AMD RAID® User Guide

Publication #	**53987** Revision: **3.31**
Issue Date:	**April 2025**

Advanced Micro Devices 

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Revision History

Date	Revision	Description
March 2025	3.31	• Updated content in Section 1.3, See change bars. • Added new bullet to Section 1.3. • Updated content in Section 1.4, See change bars. • Updated Table 8. • Updated content in Section 2.9, See change bars. • Removed content in Section 3.1. • Added Section 3.1.2. • Added Section 3.1.3. • Updated content in Section 3.3.1, See change bars. • Added new caution in 3.3.2.1. • Updated content in Section 4.3.1, See change bars. • Updated content in Section 4.3.5.1, See change bars. • Updated content in Section 4.4.1, See change bars. • Updated Section 4.7, See change bars. • Updated Table 21. • Updated Table 22. • Updated content in Section 4.4.5.1, See change bars. • Updated content in Section 5.4, See change bars. • Removed content in Section 5.4.1. • Removed content in Section 5.6.1. • Updated Table 31. • Removed Section 6.3. • Updated Table 34. • Removed “RAID5 support only for AMD Family 17h Models 31h sTRX4/sWRX8 processors” throughout document. • Removed Section 6.6. • Updated content in Section 7.1 and 7.2, See change bars. • Removed Appendix A.

Date	Revision	Description
March 2024	3.30	Added "Informed Hot Swap" details: • Updated Figure 1, "Array Status Window." • Updated Table 16, "Elements of the Disk List Pane, Array Status Window." • Updated Section 4.3.5, "Options" (disk options) and added Section 4.3.5.2, "Prepare to Remove — Using Informed Hot Swap." • Updated Section 4.4.5, "Prepare to Physically Remove an Array." • Updated Table 28, "rcadm Disk List Elements." • Added options to Section 5.8.2, "rcadm -M." • Updated Section 7.2, "Array Precautions." Chapter 2, "Understanding Arrays, Disks, and RAID Levels" updates: • Updated Table 5, "RAID Levels – General Characteristics." • Updated Table 7, "Device Failure by RAID Level." • Updated title of Section 2.5, "Expanding Array Capacity Online: Using OCE." Chapter 4, "AMD RAIDXpert2 Graphical User Interface (GUI)" updates: • Minor corrections in Table 17. • Added note to Section 4.4.3, "Transform Arrays." Chapter 8, "Software License: EULA" • Removed this chapter; refer to software.
September 2023	3.20	Chapter 1, "Getting Started" updates: • Updated Section 1.3, "Supported Operating Systems." • Added Section 1.4, "Controller Count and Configuration." • Updated Table 4 features summary. • Specified SATA backplane in Table 5 fault tolerance feature description. Chapter 3, "AMD RAIDXpert2 Configuration Utility (HII)" updates: • Promoted "Chapter 4 AMD RAIDXpert2 Configuration Utility (HII)" to its own chapter. Chapter 4, "AMD RAIDXpert2 Graphical User Interface (GUI)" updates: • Added element to Table 17, "Elements of the Array List Section, Array Status Window." • In Section 4.5.4, added PCI Location info to Controller view. Chapter 5, "rcadm Command Line Interface Tool" updates: • In Table 27, added elements. • In Table 28, added Trim support. (continued)

Date	Revision	Description
September 2023	3.20	(continued) Removed sections that are in the OS-based Quick Start Guides, *AMD RAID™ Quick Start Guide for Red Hat (RHEL) Operating System* (order# 56963) and *AMD RAID™ Quick Start Guide for Ubuntu Operating Systems* (order# 56966): • Section 1.3, "System Requirements for Using RAIDXpert2" • Chapter 3, "Platform BIOS RAID Configuration" • Chapter 4, "Software Installation" • Chapter 5, "RAID Software Update"
March 2021	3.12	Throughout: • Added sWRX8 to note on support for RAID5. • Added cautionary notes about not using SMR hard drives. Chapter 1 updates: • Updated requirements, supported processors, and chipsets. • Added support for RHEL 8.3 in Section 1.3. • Added note at end of Supported Feature Set. Chapter 2 updates: • Updated Section 2.11.2. Chapter 3 updates: • Updated compatible processors. • Updated instructions in "Enable RAID for the AMD SP3-Series Chipsets." • Added section to support FP6 processors. • Added caution note to Section 3.4. (Prior) Chapter 4 updates: • Updated "System Setup Process Overview." • Added Debian to "Copying AMD RAID Drivers to Removable Storage." • Added and updated notes in "Installing AMD RAID Drivers While Installing Microsoft® Windows®." • Updated instructions in "Installing AMD RAID Drivers • While Installing Linux® Operating System." • Clarified section as instructions for Ubuntu. • Added new section, "Secure Boot Enablement." • Clarified section as instructions for RHEL. • Labeled instructions for RHEL 8.2. • Added section for RHEL 8.3. • Clarified section as instructions for Debian. (continued)

Date	Revision	Description
March 2021	3.12	(continued) Chapter 4, "RAID Software Update" updates: • Clarified Section 4.3.2.1 title to indicate Windows. Chapter 4, "AMD RAIDXpert2 Graphical User Interface (GUI)" updates: • Removed note in Section 4.3.4.1, "Change Disk Caching Properties." • Added restricted characters to array names in Sections 4.4.1 and 4.4.2. • Added step in Section 4.4.7.1. Chapter 5 updates: • Added smart-get option. Chapter 6 updates: • Added Table 39. Deleted Secondary Array Availability Using HII During Hibernation Resume. Chapter 7 updates: • Updated Section 7.2 for compatible processors and NVMe recommendation language.
May 2020	3.11	Added install instructions for the AMD RAID drivers during a RHEL Linux installation. Added install instructions for the AMD RAID BIOS drivers during an Ubuntu DT Linux installation. Added an Appendix Updated trademarks pages. Removed references to web. Added references to RAIDXpert2. Removed references to no longer supported operating systems. Added TRX40 platform chipset and RAID5 support information. Removed Chapter 5. Removed section 7.5.2.1. Added information for SATA and NVME.
June 2019	3.10	Updated and added new information to Chapters 1, 2, and 4-11. Updated Table 3. Updated the memory requirements. Updated Table 4. Updated chipset names. Updated Table 6. Removed references to licensing type. Updated Section 2.3.2. Updated the release designations. Added Section 11.6. Troubleshooting information for the Web Graphical User Interface (GUI).
February 2019	3.09	Updated Section 12.1.4, Proprietary Rights.
January 2019	3.08	Updated Table 9 and Table 33. Editorial corrections
March 2018	3.07	NVMe RAID validation update Added references to CTS – Cache Tag Size – in Array Creation, Web GUI and rcadm.
July 2017	3.06	Updated the steps to install xampp for RHEL and Ubuntu Operating systems

Date	Revision	Description
June 2017	3.05	Fourth Public Release. • Updated steps to install Ubuntu OS in RAID mode. • Removed references to RAIDXpert2 Plus. • Removed references to RAID-5 array. • Edited steps to Assign and Unassign spares. • Removed the section related to “Change the Controller Options”
December 2016	3.02	Third Public Release. • Added a new chapter for RAIDXpert2 Configuration Utility (HII). • Added a new chapter for RAID Driver Software Update. • Updated Operating System Requirements. • Updated revisions of Ubuntu Desktop Linux to 16.04 32 bit and 64 bit • Updated revisions of RedHat (RHEL) 7.3 64 bit • Updated steps for BIOS and UEFI boot platforms. • Removed support for Ubuntu 15.04, 15.10. • Removed support for RedHat 7.2 (RHEL)
June 2016	3.01	Second Public Release. Removed support for the Microsoft® Windows® 8 operating system. Removed support for Ubuntu 13.10. This included removing extra steps that concerned Ubuntu 13.10. Updated Operating System Requirements Removed references to Windows XP and Windows 8.1. Replaced SUSE (SLED) references with Red Hat (RHEL) 7.2 64 bit Updated revisions of Ubuntu Desktop Linux • 15.04 32 bit and 64 bit • 15.10 32 bit and 64 bit Removed support for SLED Removed support for Ubuntu 12.04.04 and 14.04, 32 bit and 64 bit Changed supported controllers Removed RAID5 from Table 6 and Table 8 Updated steps for BIOS and UEFI boot platforms
November 2013	3.00	Initial Public release

Preface

This user guide:

- Describes requirements on how to configure RAID mode on AMD platforms.
- Provides information about arrays, disks, and RAID levels (RAID types).
- Describes how to improve storage system performance or reliability by understanding array and disk tasks and options.
- Describes the procedures on how to acquire and load RAIDXpert2 drivers for supported Microsoft® Windows® operating systems and Linux® operating systems.
- Describes supported features and procedures for using RAIDXpert2, which is the RAIDXpert2 GUI.

Intended Audience

This user guide is intended for use by system administrators and technicians who are experienced with the following:

- Direct Attached Storage (DAS), Storage Area Network (SAN), or Network Attached Storage (NAS) operators
- Network administration
- Network installation
- Storage system installation and configuration

Prerequisites

Prerequisites for installing and configuring this product include familiarity with:

- Servers and computer networks
- RAID and input/output signal technology (such as SCSI, SATA, or NVMe)
- Fibre Channel and Ethernet protocols

Document Conventions and Symbols

Table 1. Document Convention

Convention	Element
Navy blue, underlined text (http.//www.example.com)	Web site addresses
Bold font	Key names Text typed into a GUI element, such as into a box GUI elements that are clicked or selected, such as menu and list items, buttons, and check boxes
Italics font	Text emphasis
Monospace font	File and directory names System output Code Text typed at the command line
Monospace, Italic font	Code variables Command line variables
Monospace, bold font	Emphasis of file and directory names, system output, code, and text typed at the command line

Customer Support

For customer support, contact your system supplier or motherboard vendor.

Glossary

Table 2. Glossary of Terms

Term	Definition
rcadm	A command line interface (CLI) tool for managing RAID controllers on Linux®, on Windows®, and UEFI operating systems. It is used for creating, transforming, and deleting arrays; and adding and removing disks.
disk	Legacy disks include new or unrecognized disks which may contain data or even an operating system. Legacy disks appear in the RAIDXpert2 Configuration Utility (HII) as legacy arrays. When the legacy disk is initialized, configuration data is written to the disk. The legacy array then becomes an online disk usable in arrays. ***CAUTION:*** *A legacy disk can contain valid data. When a legacy disk is initialized, all data on the disk is lost.*
Linux®	Free, open-source UNIX-based operating system.

Chapter 1 Getting Started

1.1 AMD RAIDXpert2 Technology

AMD RAIDXpert2 consists of the following:

- Storage management application
- RAID controller and port virtualization

AMD RAIDXpert2 runs on existing systems by using a motherboard's built-in SATA ports, PCIe M.2 slots, and PCIe NVMe add-in cards.

- AMD-RAID Bottom Device (rcbottom) – WDF-based bus driver
- AMD-RAID Controller (rcraid) [storport] – Virtual Storport miniport driver
- AMD-RAID Config Device (rccfg) – WDM-based config device

1.2 Who Should Use This User Guide

Only trained, experienced, and authorized personnel should install RAIDXpert2 and use its features and capabilities.

All unit operators must be familiar with system hardware, data storage, RAID technology, input/output signal technology (such as NVMe, SCSI, SAS, or SATA), and Direct Attached Storage (DAS), Network Attached Storage (NAS), and/or Storage Area Network (SAN) concepts and technology.

The intended user audience of this user guide is system administrators and experienced users.

1.3 Supported Operating Systems

RAIDXpert2 supports the following 64-bit operating systems.

Mobile, desktop, and workstation:

- Microsoft® Windows® 10 and Windows 11®

Workstation only:

- Red Hat® Enterprise Linux® (RHEL) 8.x, 9.x
- Ubuntu® Linux, 22.04.x, 24.04.x

For software installation steps, refer to the following documents:

- *AMD RAID Quick Start Guide for Windows Operating Systems*, order# 56268
- *AMD RAID Quick Start Guide for Red Hat (RHEL) Operating System*, order# 56963
- *AMD RAID Quick Start Guide for Ubuntu Operating Systems*, order# 56966

- AMD *RAID Quick Start Guide for Ubuntu Server*, order# 58503

1.4 Controller Count and Configuration

Table 3 shows allowable controller and configuration maximums, based on the installed driver.

Table 3. Maximum Controller Count and Configuration

Component	For Systems with Driver 9.3.3
Max Controller Count	18 controllers: 16 NVMe + 2 AHCI (or 15 NVMe + 3 AHCI): Two controllers with device ID 0x7917 or 0x43BD and NVMe (one per NVMe)
Maximum Configuration	• 22 arrays for deletion • 12 arrays for creation • 22 devices (16 NVMe + 6 SATA) • 8 devices per array

Note: *Desktop/Mobile/x399/Workstation systems with driver 9.3.3 support S0i3, S3, and S4.*

1.5 Features of RAIDXpert2

The features of RAIDXpert2 described in Table 4 apply to all supported operating systems.

Table 4. RAIDXpert2 Features

RAIDXpert2 Feature	Description
Arrays (general information)	RAIDXpert2 allows: • An array refers to data storage created by RAIDXpert2 from one or more disks. An array can be created from several disks, but it is seen by the operating system as a single disk. • Creating arrays of different RAID levels using the same disks. • Creating different RAID level arrays on the same disk to adapt each array to the I/O that it processes. • Dissimilar Disk Support within the Same Array • Online RAID Level Migration (ORLM)
Array Creation	Instant Create support and Create Array Functions without Rebooting: • No initialization • Foreground initialization • Background initialization
Array Deletion	Delete Array Functions without Rebooting • Single • Multiple
Array Hiding	• An array can be hidden from the operating system so that neither the software nor users can see or access it.

Table 4. RAIDXpert2 Features (Continued)

RAIDXpert2 Feature	Description	
Array Recovery	If a redundant array is accidentally deleted, it might be recovered by creating a new array with the same properties as the deleted array. (This can occur only if disk Write Access operations are not in-progress.)	
Array Transformation	Transform from one RAID level to almost any other RAID level.	
Background Array Initialization (BGI)	Background initialization allows a redundant array to be used immediately. Data is not lost if a disk goes offline prior to completion of the BGI process.	
Cache Support for Arrays	Various array-caching options are supported: • No Cache • Read Ahead Cache • Write Back Cache • Read Ahead and Write Back Cache	
Cache Support for Disks	Various disk-caching options are supported: • No Cache • Read Ahead Cache • Write Back Cache • Read Ahead and Write Back Cache ***Note:*** *By default, NVMe Physical disk Read Ahead and Write Back cache are always disabled. User cannot enable the setting because it may impact the operational performance of the NVMe disk.*	
Controller Spanning	RAIDXpert2 was architected to ensure spanning support and a common interface API to the underlying hardware. This allows creating a RAID Virtual Disk spanning across devices connected to the AMD chipset, AMD processor, and/or NVMe controllers.	
Consistency Check	A Consistency Check is a background operation that verifies and corrects the mirror or parity data for fault-tolerant disks. It is recommended that a Consistency Check be run periodically on an array. Options: • Background redundancy check • Scheduled	
Device Interfaces Supported	• SATA HDD • SATA SSD • M.2 SATA SSD • M.2 NVMe SSD	• ATAPI • PCIe NVMe SSD • U.2 device • U.3 device
Dissimilar Disk Support within the Same Array	Creating an array from a mix of different type disks is allowed but not recommended because of the performance impacts. For example, a RAID10 array can be created from a group of disks that contain two SATA HDDs and two SATA SSDs, or only one NVMe or a group of SATA and NVMe disks.	

Table 4. RAIDXpert2 Features (Continued)

RAIDXpert2 Feature	Description
Drive/Disk Roaming	With disk roaming, SATA cables can be disconnected from their disks and shuffled without confusing RAIDXpert2. ***Note:*** *Disconnect SATA cables from disks only when system is shutdown.* Disk roaming allows: • Same system: Devices can be moved to different locations; RAIDXpert2 detects which devices belong to which arrays, regardless of device location. • Between systems: Device(s) to be moved between systems. ***Note:*** *It might not be possible to move disks between systems if they contain the AMD RAID boot array.*
Fault Tolerance	The following fault tolerance features are available with RAIDXpert2 to prevent data loss in case of a failed disk. • Disk failure detection (automatic). • Array rebuild using hot spares (automatic if the hot spare is configured for this functionality). • Hot swap — the manual replacement of a SATA device without rebooting the system (only available in systems with backplanes that support hot swap) ***Note:*** *Hot swapping is not recommend for disks that are part of the Boot Virtual Disk or are connected to the AMD RAID supported chipsets. This applies to all chipsets.*
Hot-Swap Support	Hot-swapping is not recommended for disks that are part of AMD RAID boot array.
Mirror Rebuilding	A broken mirrored array can be rebuilt after a new disk is inserted and the disk is designated as a spare. The system does not require rebooting.
Native Command Queuing (NCQ)	Native Command Queuing is a command protocol of SATA disks that are supported by RAIDXpert2. NCQ enables individual disks to internally optimize the order in which Read and Write commands are executed. RAIDXpert2 permits a maximum queue depth of up to 32 read/write commands per disk.
Online Capacity Expansion (OCE)	OCE is a process that allows the user to add storage capacity to an existing array without taking the system offline. It enables the user to increase total storage capacity of an array by integrating unused storage into the array. Data can be accessed while the disks are added and while data on the array is being redistributed.

Table 4. RAIDXpert2 Features (Continued)

RAIDXpert2 Feature	Description
Online RAID Level Migration (ORLM)	• Users can easily move an array from one RAID level to another. This can be useful if the array type used is not the optimal type for the application. • This function depends on array capacity, redundancy level, and capacity of the drive or free space available. • While the migration is taking place, data is accessible and protected to the lowest protection of either the source RAID level or the destination RAID level.
RAID Level Support	RAIDXpert2 supports: • RAID levels 0, 1, 5, 10, Volume, and RAIDABLE • Multiple RAID Levels per Disk: Support for multiple array levels per disk allows the administrator to create arrays of different RAID levels using the same disks.
Restore (Rebuild) Priority	RAIDXpert2 has the ability to set the Priority of the restore task.
Secure Erase	All data on an array can be erased and ensured it is unrecoverable, even with advanced data recovery techniques.
Self-Monitoring Analysis and Reporting Technology (SMART)	SMART is a hard-disk-drive (HDD) capability that allows reliability information reporting. If a drive anticipates a high likelihood of future failure, it triggers a SMART error condition. RAIDXpert2 presents this error condition so the drive can be replaced before the predicted failure.
Sparing	Global — Spare disk that is shared by multiple arrays Dedicated — Spare disk assigned to a specific redundant array
Trim Support	Allows the OS to inform the SSD about deleted data so it can optimize performance. Simple and Advanced Trim types are supported. ***Note:*** *RAID5 does not support Trim.*
UEFI Driver (BIOS) Support	• Create array • Delete array • RAIDXpert2 Configuration Utility (HII) • EFI shell utility (rcadm)

Chapter 2 Understanding Arrays, Disks, and RAID Levels

2.1 Understanding Arrays

Arrays are several disks that are grouped together to improve either the performance or reliability of a storage system. Because some RAID levels enhance performance while others improve reliability, it is important to consider the user's needs when planning an array configuration.

Note: *It is highly recommended that this user manual be reviewed in its entirety before configuring arrays. Some of the advanced features of RAIDXpert2 (such as sparing options) must be understood by the user before creating arrays.*

2.2 RAID Levels

RAIDXpert2 supports the RAID levels indicated in Table 5.

Table 5. RAID Levels – General Characteristics

RAID Level	Main Characteristic	Use/Usefulness
RAID0 (Striping)	• Provides the highest performance but no data redundancy. Data in the array is striped (distributed) across several disks. • Supports 2-8 disks.	• RAID0 arrays are useful for holding information, such as the operating system paging file, where performance is extremely important, but redundancy is not.
RAID1 (Mirroring)	• Mirrors data on a partition of one disk to another. • Supports 2 disks.	• Useful when there are only two disks available and data integrity is more important than storage capacity.
RAID10 (Striped RAID1 Sets)	• Combines mirrors and stripe sets. RAID10 allows multiple disk failures, up to 1 failure in each mirror that has been striped. • Supports 4, 6, or 8 disks.	• Offers better performance than a simple mirror because of the extra disks. • Requires twice the disk space of RAID1 to offer redundancy.

Table 5. RAID Levels – General Characteristics (Continued)

RAID Level	Main Characteristic	Use/Usefulness
RAID5	• Stripes data as well as parity, across all disks in the array. • In the event of a failure, RAIDXpert2 can restore the lost data of the failed disk from the other surviving disks. • Supports 3-8 disks.	• Offers exceptional read performance and redundancy. • Write performance is not an issue due to the tendency of the operating system to perform many more reads than writes. • Requires only one extra disk to offer redundancy. • For most systems with three or more disks this is the correct choice for a RAID level.
Volume (JBOD)	• RAIDXpert2 treats one or more disks or the unused space on a disk as a single array. • Supports 1 to 8 disks	Provides the ability to link-together storage from one or several disks, regardless of the size of the space on those disks. Useful in scavenging space on disks unused by other disks in the array. Does not provide performance benefits or data redundancy. Disk failure will result in data loss.
RAIDABLE (also known as RAID Ready)	• Allows a RAIDABLE disk to be transformed later to RAID0 or RAID1. • Supports one disk.	See RAID0 (Striping), on page 23 or RAID1 (Mirroring) on page 23 for post-transformation usefulness.

2.3 Array States

Within the management applications, an array is a logical device that can exist in one of four states: Normal, Ready, Critical, or Offline.

- In RAIDXpert2, these states display in the Array List section in a column named State.
- Within the **rcadm** Command Line interface, these states also display in a column named State.

The array states are defined in Table 6, on page 25.

Table 6. Array States

State	Description
Normal	The Normal state is displayed when everything is functioning correctly.
Ready	The Ready state is displayed while an array is being created.
Critical	The Critical state is displayed when the array is no longer redundant (fault tolerant) because of one or more disk failures. Arrays can still be read and written to, but the data is no longer protected should another disk fail.
Offline	The Offline state is displayed when arrays cannot be read or written to because of one or more disk failures.

Whether an array is marked as Critical or Offline depends upon what RAID level it is and how many disks within the array have failed. Note the changes in state in Table 7.

Table 7. Device Failure by RAID Level

RAID Level	Failure State	Is Displayed Whenever
RAID1 (Redundant Arrays)	Critical	A single disk fails.
	Offline	Two disks fail.
RAID10 (RAID Levels with Multiple Redundancies)	Critical	A single disk fails in any one of the sets.
	Offline	All the disks in a set fail.
Volume, RAIDABLE and RAID0	Offline	A single disk fails.
RAID5 (Redundant Array)	Critical	A single disk fails.
	Offline	Two disks fail.

More than one array can be created using the same set of disks. If a disk is disconnected that belongs to more than one array, only the arrays that try to access the disk and receive I/O errors report the failure. For example: there are two arrays, both of which are RAID1 sets and both use

disk 4. If a system that is being used by array 1 receives an I/O error when trying to communicate with disk 4, the state of array 1 changes to Critical. However, the state of array 2 using disk 4 does not change to Critical until an I/O error is reported. If systems using array 1 are not communicating with failed disk 4, the state of array 1 still displays as Normal.

If a rescan of all channels is performed after disconnecting a disk, the state of every array using the missing disk changes from Normal to either Critical or Offline, depending on the RAID level.

See Section 2.9, Rescanning Disks for Changes in State, on page 30 for a discussion of when to rescan disks and the outcomes when doing so.

2.4 Creating Arrays: Future Expansion

When creating arrays, consider whether disk capacity needs to expand in the future. If the file system must be expanded, perform the tasks indicated in Table 6

Table 8. Array Expansion Considerations

Operating System	Do This...	And Consider This...
Microsoft® Windows®	Format the arrays with NTFS. Microsoft Corporation provides a utility (Diskpart.exe) that can dynamically extend an NTFS file system onto any unused adjacent space. Note also that using a single partition per array makes expansion much easier.	1. The Diskpart.exe utility version depends on which version of the Windows operating system is running. 2. The Diskpart.exe utility can be found on the CD for some versions of Windows operating systems, or on the Microsoft Corporation website *(http://www.microsoft.com)* for other versions. Use the correct version for the operating system.
Linux®	Use an expandable file system.	Because RAIDXpert2 software is limited to twelve arrays, if a large number of logical volumes are needed, use a logical volume manager (LVM).

2.5 Expanding Array Capacity Online: Using OCE

Online Capacity Expansion (OCE) allows:

- Adding disks to an array at any time to increase an array's capacity.
- Accessing the array data while it is being redistributed.

To increase the size and organization of an array, transform the array. For more information about transforming arrays, see Section 4.4.3, Transform Arrays on page 57.

2.6 Migrating RAID Levels Online: Using ORLM

Online RAID Level Migration (ORLM) allows an array to move from one RAID level to almost any other RAID level. This task includes migrating the array from a non-redundant RAID level to a redundant RAID level.

Prior to starting a RAID level migration/transformation, make sure that the disks selected for the destination array have sufficient capacity. RAID level migration/transformation can occur only when the destination array has the same or larger capacity as the source array.

While the migration/transformation is taking place, data is accessible and protected to the lowest protection of either the source RAID level or the destination RAID level.

The Transform task can also be used to expand the capacity of an array, by using OCE. It can also be used as part of the system backup and recovery strategy using the RAID1 and RAID10 levels.

To perform this process, see Section 4.4.3, Transform Arrays on page 57.

2.7 Array Tasks: Starting and Stopping Tasks

Tasks are started when one of the following actions are performed:

- Create a redundant array.
- Transform an array.
- Restore an array.
- Securely erase an array.
- Check for consistency on redundant arrays.
- Verify that data was not corrupted after a system crash (Check Bitmap performed automatically).

Full task control can be used on Create, Consistency Check, and Bitmap Check tasks. On a Transform or Restore task for dedicated and global spares, task control can only pause/resume, but it cannot remove the task. To remove these types of tasks, pause and then remove them.

The tasks indicated in Table 9 on page 28, can be displayed for each array.

Table 9. Types of Tasks per Array

Task	When Displayed
Transform	While an array is being transformed.
Create	While an array is being created.
Consistency Check	While verifying the mirror disk (RAID1 or RAID10) consistency is correct. (For redundant type arrays only.)
Restore	While an array is being restored.
Secure Erase	While an array secure erase is being performed.
Check_Bitmap	While verifying that the mirror halves on a RAID1 or RAID10 set, are consistent. This action is performed automatically to ensure that data is not corrupted whenever a system crashes.
Not_Active	When no other tasks are being performed.

2.8 Understanding Disks

2.8.1 Disks States

Within the management applications, a disk can be part of one or more arrays and can exist in one of five states: Online, Offline, New, Legacy, or SMART Error.

- In RAIDXpert2, these states are displayed in the Disk List section in a column named State. See Table 16, on page 48, for additional information.
- Within the **rcadm** command line interface, these states are also displayed in a column named State. See Table 28, on page 72, and Table 29, on page 74, for additional information.

The disk states are defined in Table 10.

Table 10. Disk States

Disk State	When Displayed
Online	Whenever the disk is connected, functioning correctly, and RAIDXpert2 can communicate with it.

Table 10. Disk States (Continued)

Disk State	When Displayed
New	Whenever an uninitialized, new disk is connected.
Legacy	Whenever a disk containing non-RAIDXpert2 configuration data is connected.
Offline	Whenever the disk fails and RAIDXpert2 detects an error condition on the disk.
SMART Error	Whenever the disk reports a SMART error(s) to RAIDXpert2.

A disk can be a member of multiple arrays. A disk failure in one array doesn't necessarily mean it has failed in other arrays.

After a rescan is performed the following can occur:

- A disconnected disk no longer appears in the Disk List (although the disk appears as Missing in the Array View for the arrays to which it belonged).
- A disk that experiences a catastrophic failure appears in the Disk List as Offline and is highlighted in red. The disk appears as Failed for the arrays to which it belonged.
- A disk that has a SMART error appears in the Disk List as SMART Error. (A disk with a SMART error cannot be used to create an array)
- A disk that experiences a software-related failure appears in the Disk List as Online and is highlighted in red. New arrays can be created with the disk.

Arrays that exist on a failed or disconnected disk might not be designated as Failed or Missing until the system attempts to communicate with the failed or disconnected disk.

2.8.2 Disks

A legacy disk is a disk that contains valid data from a Non-AMD RAID controller.

A legacy disk appears in RAIDXpert2 GUI and RAIDXpert2 Configuration Utility (HII) with a corresponding legacy array. When the legacy disk is initialized in RAIDXpert2 GUI and RAIDXpert2 Configuration Utility (HII) the legacy array disappears.

CAUTION: *A legacy disk can contain valid data. When a legacy array is deleted the data is lost.*

2.8.2.1 Legacy Disk and New Disk

Table 11 provides information on how disks appear in RAIDXpert2 GUI and RAIDXpert2 Configuration Utility (HII).

Table 11. New and Legacy Disks, as They Appear in the RAIDXpert2 Configuration Utility (HII) and RAIDXpert2

Status of the Disk	RAIDXpert2 Utility	In the BIOS Configuration Utility/RAIDXpert2 Configuration Utility (HII)
New, un-initialized disk.	The disk appears as a new disk with a legacy array. When the new disk is initialized, its state changes to Online (or similar).	The disk appears as a new disk (the disk can appear with a legacy array). When the new disk is initialized, RAIDXpert2 configuration data is written to the disk. The disk state changes to Online.
A disk containing non-RAIDXpert2 configuration data. ***CAUTION:*** *A legacy disk can contain valid data. When a legacy array is deleted, or when its corresponding legacy disk is initialized, the data is lost.*	The disk appears as a legacy disk with a legacy array. When the legacy array is deleted, the legacy array disappears and the legacy disk type changes to Disk. The disk can now be used in RAIDXpert2 arrays.	The disk appears as a legacy disk with a legacy array. When the legacy array is deleted the state of the legacy disk changes to Empty. The disk can now be used in RAIDXpert2 arrays.

Note: *A Native AHCI installation will not boot into the OS, after changing the BIOS settings to RAID mode.*

See Chapter 4, AMD RAIDXpert2 Graphical User Interface (GUI), on page 46, for the disk initialization procedure and the appearance of legacy disks in the BIOS Configuration Utility.

2.9 Rescanning Disks for Changes in State

The information displayed in the Disk List section is the state of the disks when they were last scanned. If a rescan has not been performed, the information displayed is the state of the disks at boot time.

Every time a disk is connected or disconnected while online, a message asks if the user wants to perform a rescan (of all devices/controllers). If Rescan is selected, the information in both the Array List and the Disk List is updated. This view might show arrays as being in a Critical or Offline state if all disks have not been installed or removed.

Although it is highly recommended that the system be shut down before adding or removing disks, disks can be added or removed while the system is online (“hot-swapping”), if the system supports

the hot-swapping function. This is not recommended for disks that are part of the Boot Virtual Array or those that are connected to the AMD RAID supported chipsets.

Because of this function, RAIDXpert2 does not automatically perform a rescan when it detects that a disk has been added or removed. For example, to hot-swap a RAID1 set with two disks into a new system, do not perform a rescan until both disks have been connected.

Arrays associated with the disks that are not yet connected change state to either Critical or Offline. In the example above, if the state of the RAID1 set changes to Offline, data is unavailable.

Rescanning can also result in the state of a disk being reported differently in the Array View and the Disk List. A disk within an array can have a state of Failed in the Array View field, while at the same time it can show a state of Online in the Disk List.

2.10 Sparing Options: Disks and Arrays

RAIDXpert2 supports multiple sparing options. Spares are restored in the order indicated in Table 12.

Table 12. Sparing Options

Option	Description
Dedicated	A spare disk assigned to a specific redundant array.
Global	A spare disk that is shared by multiple arrays.

Note: *An array is marked Critical or Offline if a disk reports a Failed state to an I/O, or if the Disk, SATA cable, or power cable is disconnected.*

Note: *One or more spares can be assigned to a redundant RAID level.*

Note: *Spare assignments do not apply to non-redundant RAID levels. To protect data, transform the array to a redundant RAID level. Spares can then be assigned.*

2.10.1 Dedicated Sparing

A dedicated spare is a disk that is assigned as an alternate disk for a specific array. Should a disk fail in that array, the alternate disk is used to replace the failed disk and the array is rebuilt.

A dedicated spare can be assigned to any redundant array type, and up to four spares can be assigned to an array.

Note: *Disk capacity of the Dedicated Spare must be greater or equal to the capacity of the smallest disk in the array.*

CAUTION: *Assigning a dedicated spare does not reserve space on the disk. Therefore, an automatic restore is not guaranteed if a disk fails. If a disk fails, make space on the disk for the fail-over to complete, or assign a different disk with enough space. If a dedicated spare is assigned and a disk fails, the restore process starts automatically, if there is enough space available on the dedicated spare.*

For additional information, see Section 4.4.12, Add or Remove Dedicated Spares, on page 65.

2.10.2 Global Sparing

A global spare is a disk that is assigned as an alternate disk for multiple arrays, instead of associating it with only one array.

Many arrays can be restored using the global spare disk, if it is not already part of the array and it has enough space available. Unlike a dedicated spare, this type of spare can be assigned at any time, even while tasks are running on arrays.

Assigning a disk for use as a global spare does not reserve space on that disk. An automatic restore is not guaranteed if a disk fails.

If there is not enough disk space on the global spare, make room for the fail-over to complete, or assign a different disk with enough capacity as the spare. If there is enough space available on the global spare and a disk failure occurs, the restore process starts automatically.

For additional information, see Section 4.4.13, Add or Remove Global Spares, on page 65.

2.11 RAID Performance Considerations

With RAID technology, performance is based on the following considerations:

- The number and organization of disks in an array.
- Caching attributes used for the array.
- Application workload.
- Array level verifies that the array creation completes before running performance testing.

Note: *AMD recommends not using SMR hard drives with AMD RAID systems because it can cause poor performance or failures. SMR drives are not suitable for workloads that require many random writes (such as boot drive). If used with RAID, the multiple SMR drives and background RAID tasks (such as creates and rebuilds) compound any issues or problems.*

Note: *– In certain situations, RAID scaling may not meet expectations. A future release is planned to address this issue.*

2.11.1 Number and Organization of Disks

RAID functions increase performance by putting more disks to work and by buffering data for the host.

Many disks can transfer data at greater than 100 MB per second. RAIDXpert2 can aggregate this bandwidth in an almost linear fashion, as more of the same disks are included in an array.

2.11.2 Caching Attributes

Arrays can also be configured to provide Read and Write Back cache, Write Back, Read Ahead cache, and No cache option with RAIDXpert2 configuration utility and GUI utility, if desired. Write Back caching has a large effect on most workloads but should be used with caution.

2.11.3 Application Workload

When configuring an array, workload is probably the most important performance variable. Most applications do many more reads than writes. The best performance is obtained with array types like RAID0 or RAID10.

2.12 RAID Reliability Considerations

RAID reliability is enhanced through data redundancy and backup.

2.12.1 Data Redundancy

RAID1, RAID5, or RAID10 are necessary for redundancy. With redundancy, both capacity and performance are sacrificed for reliability. With RAIDXpert2, extremely high performance is obtained even with redundant-type arrays.

2.12.2 Backup

It is good practice to back up your data periodically in case of a catastrophic failure. Tape backup or other media can be used to secure your data.

2.13 Multiple RAID Levels

With RAIDXpert2, different RAID levels can be created on the same disk, to adapt each array to the I/O that it processes. Also, more than one array can be created per disk.

Depending on the array capacity and redundancy level, an existing array can be transformed to another RAID level, if the level of the array being used is not the optimal RAID level for the application. Also, different arrays with different characteristics can be built for different applications.

Chapter 3 AMD RAIDXpert2 Configuration Utility (HII)

The RAIDXpert2 Configuration Utility is also known as the HII. Use the utility to accomplish the procedures indicated in Table 13.

Table 13. When to use the AMD RAID RAIDXpert2 Configuration Utility (HII)

Procedure	Description	Find Information At
Initialize a new disk	To initialize a new disk drive for data storage.	Section 3.2, Initialize Disks, on page 35
Create Arrays	Create arrays at different RAID levels	Section 3.3, Create Arrays, on page 36
Delete Arrays	Delete an array	Section 3.4, Delete Arrays, on page 41
Manage hot spares	Allows selection of global and dedicated hot spares.	Section 3.5, Manage Spares, on page 41
View Controller details	View information about each controller.	Section 3.6, View Controller Details, on page 43 Section 3.7, View Disk Details, on page 44
View Disk details	View information about each disk.	Section 3.6, View Controller Details, on page 43
View Array details	View information about each array.	Section 3.7, View Disk Details, on page 44
Rescan all channels	Rescan all channels to detect new or removed disks and arrays.	Section 3.9, Rescan All Channels, on page 45

3.1.1 Access the AMD RAIDXpert2 Configuration Utility (HII) AMI BIOS

To enter the RAIDXpert2 Configuration Utility (HII) based on AMI BIOS, complete the following:

1. Power **ON** the system.
2. Press **DEL**.
3. In the **Menu Bar**, select **Advanced**.
4. Select **RAIDXpert2 Configuration Utility**, then press **Enter.**

3.1.2 Access the AMD RAIDXpert2 Configuration Utility (HII) Insyde BIOS

To enter the RAIDXpert2 Configuration Utility (HII) for Insyde BIOS, complete the following:

1. Power **ON** the system.
2. Press **ESC**.
3. Select **Device Management**, then press **Enter**.
4. Select **RAIDXpert2 Configuration Utility**, then press **Enter**.

Note: *If the BIOS Configuration Utility does not display, contact your system or motherboard supplier.*

3.1.3 Access the AMD RAIDXpert2 Configuration Utility (HII) AMD NDA BIOS

To enter the RAIDXpert2 Configuration Utility (HII) based on AMD NDA BIOS, complete the following:

1. Press DEL.
2. In the BIOS home page, select **Device Manage**.
3. Select **RAIDXpert2 Configuration Utility**, then press **Enter.**

3.2 Initialize Disks

New disks and legacy disks must be initialized before they can be used to create an AMD RAID array.

Initialization writes AMD RAID configuration information (metadata) to a disk.

CAUTION: *If a disk is part of an AMD RAID array, the disk cannot be selected for initialization. To initialize the disk anyway, delete the AMD RAID array. Data on the disk is deleted during initialization so ensure the correct disks are chosen to initialize.*

CAUTION: *A legacy disk can contain valid data. When a legacy array is deleted, all data on the disk is lost.*

1. From the RAIDXpert2 Configuration Utility's Main Menu, use the arrow keys to select **Physical Disk Management**, then press **Enter**.

2. Select **Select Physical Disk Operations** using the arrow keys, then press **Enter**.
3. Highlight **Initialize Disk** using the arrow keys, then press **Enter**
4. Select the disk(s) to initialize:
   a. To select individual disks, highlight a disk with the arrow keys and press the space bar or **Enter**. Multiple disks may be selected using this method.
   b. When the desired number are selected, use arrow keys to select **OK**, then press **Enter**.
   c. Review the warning message, if you want to proceed, use the arrow keys to select **YES**, then press the **Enter** key, or press **ESC** to cancel the initialization.

Initialization takes 10 to 15 seconds per disk. During initialization, a complete rescan of all channels is done automatically.

3.3 Create Arrays

Arrays can be created after the disks are initialized. See Section 2.2, RAID Levels, on page 23, for deciding what type of RAID levels to use for the array.

TIP: *See also Section 4.4.1, Create and Format Arrays on page 54, and Section 5.4, Create New Arrays: rcadm --create, on page 76.*

3.3.1 Before You Begin

- For redundant arrays the Create process starts after the operating system and AMD RAID OS drivers are installed and the system is booted to the operating system. However, the arrays are immediately available to use for either a bootable array or a data array.
- Array numbers are valid only for a given boot and might be different in the RAIDXpert2 Configuration Utility (HII) and RAIDXpert2 GUI. If a permanent label is required, use the RAIDXpert2 GUI Array Naming feature.
- At any point in the procedure return to a prior window by pressing **ESC**.
- If the system is booted from an AMD RAID bootable array the first array in the **Arrays** section must be the bootable array. The system boots only from the first array in the **Arrays** section.
- AMD recommends not using SMR hard drives with AMD RAID systems because it can cause poor performance or failures. SMR drives are not suitable for workloads that require many random writes (such as boot drive). If used with RAID, multiple SMR drives and background RAID tasks (such as creates and rebuilds) compound any issues or problems.

3.3.2 Create an Array

Before proceeding with array create and manage, System BIOS configuration should be setup as mentioned in the Quick Start Guide section “Platform BIOS RAID Configuration Prerequisites” for system RAID mode to be enabled.

The **RAIDXpert2 Configuration Utility** can be used to create a bootable array with levels Volume, Raidable, RAID0, RAID1, RAID5 and RAID10. Configure array cache and Cache tag size settings by following the steps mentioned in the following sections.

Table 14. Default Cache Tag Size

Array Type	Default CTS
HDD Array SSD Array Mix of HDD/SSD Array	64 K
All NVMe Array	256 K
Mix of NVMe with HDD/SSD Array	256 K

Caution: *Cache Tag Size for an array cannot be changed after creation.*

To install the operating system and RAIDXpert2 files see instructions for software installation in the Quick Start Guide.

3.3.2.1 Create an AMD RAID Bootable Array

To install the operating system, AMD RAID Device driver and RAIDXpert2 GUI utility see instructions for software installation in the Quick Start Guide.

CAUTION: *Do not use eSATA devices or Devices located in Hot Swap bays, for your boot array, as they can be removed.*

CAUTION: *It is recommended to create only one array for the OS installation. If more arrays are needed, they can be created in the OS GUI/cli or HII, after the OS installation completes.*

3.3.2.2 Create a RAIDABLE Array

Note: *Refer to Table 5 for RAIDABLE array characteristics.*

1. From the RAIDXpert2 Configuration Utility's Main Menu, use the arrow keys to select **Array Management**, then press **Enter**.
2. Select **Create Array** using the arrow keys, then press **Enter**.
3. Select **Select RAID Level** using the arrow keys, then press **Enter**.
4. From the **Select RAID Level Drop** down menu, use the arrow keys to select **RAIDABLE**, then press **Enter**.
5. Select the disk with which to create the array:
6. Select **Physical Disks** using the arrow keys, then press **Enter**.
7. Select an individual disk, highlight a disk using the arrow keys and press the space bar or **Enter**.
    - Select **Apply Changes** using the arrow keys, then press **Enter**.

Note: *Refer to Table 14 on page 37 for Default Cache Tag Size.*

8. Select **Read Cache Policy** using the arrow keys, then press **Enter**.
   - Select the desired **Read Cache Policy**, then press **Enter**.
9. Select **Write Cache Policy** using the arrow keys, then press **Enter**.
   - Select the desired **Write Cache Policy**, then press **Enter**.
10. Select **Create Array** using the arrow keys, then press **Enter**.

3.3.2.3 Create a VOLUME Array

Note: *Refer to Table 5 for VOLUME array characteristics*

1. From the RAIDXpert2 Configuration Utility's Main Menu, use the arrow keys to select **Array Management**, then press **Enter**.
2. Select **Create Array** using the arrow keys, then press **Enter**.
3. Select **Select RAID Level** using the arrow keys, then press **Enter**.
   - From the **Select RAID Level** drop-down menu, use the arrow keys to select **VOLUME**, then press **Enter**.
4. Select the disks with which to create the array:
   a. Select **Physical Disks** using the arrow keys, then press **Enter**.
   b. Select desired disks, highlight a disk (arrow keys), and press the space bar or **Enter**.
   c. Select **Apply Changes** using the arrow keys, then press **Enter**.

Note: *Refer to Table 14 on page 37 for Default Cache Tag Size.*

5. Select **Read Cache Policy** using the arrow keys, then press **Enter**.
   - Select the desired **Read Cache Policy**, then press **Enter**.
6. Select **Write Cache Policy** using the arrow keys, then press **Enter**.
   - Select the desired **Write Cache Policy**, then press **Enter**.
7. Select **Create Array** using the arrow keys, then press **Enter**.

3.3.2.4 Create a RAID0 Array

Note: *Refer to Table 5 for RAID0 array characteristics*

1. From the RAIDXpert2 Configuration Utility's Main Menu, use the arrow keys to select **Array Management**, then press **Enter**.
2. Select **Create Array** using the arrow keys, then press **Enter**.
3. Select **Select RAID Level** using the arrow keys, then press **Enter**.
   - From the **Select RAID Level** drop-down menu, use the arrow keys to select **RAID0**, then press **Enter**.
4. Select the disks to create the array:

a. Select **Physical Disks** using the arrow keys, then press **Enter**.
b. Select desired disks, highlight a disk with the arrow keys and press the space bar or **Enter**.
c. Select **Apply Changes** using the arrow keys, then press **Enter**.

Note: *Refer to Table 14 on page 37 for Default Cache Tag Size.*

5. Select **Read Cache Policy** using the arrow keys, then press **Enter**.
   - Select the desired **Read Cache Policy**, then press **Enter**.
6. Select **Write Cache Policy** using the arrow keys, then press **Enter**.
   - Select the desired **Write Cache Policy**, then press **Enter**.
7. Select **Create Array** using the arrow keys, then press **Enter**.

3.3.2.5 Create a RAID1 Array

Note: *Refer to Table 5 for RAID1 array characteristics*

1. From the RAIDXpert2 Configuration Utility's Main Menu, select **Array Management** using the arrow keys, then press **Enter**.
2. Select **Create Array** using the arrow keys, then press **Enter**.
3. Select **Select RAID Level** using the arrow keys, then press **Enter**.
   - From the **Select RAID Level** drop-down menu, use the arrow keys to select **RAID1**, then press **Enter**.
4. Select the disks to create the array:
   a. Select **Physical Disks** using the arrow keys, then press **Enter**.
   b. Select desired disks, highlight a disk with the arrow keys and press the space bar or **Enter**.
   c. Select **Apply Changes** using the arrow keys, then press **Enter**.

Note: *Refer to Table 14 on page 37 for Default Cache Tag Size.*

5. Select **Read Cache Policy** using the arrow keys, then press **Enter**.
   - Select the desired **Read Cache Policy**, then press **Enter**.
6. Select **Write Cache Policy** using the arrow keys, then press **Enter**.
   - Select the desired **Write Cache Policy**, then press **Enter**.
7. Select **Create Array** using the arrow keys, then press **Enter**.

3.3.2.6 Create a RAID10 Array

Note: *Refer to Table 5 for RAID10 array characteristics*

1. From the RAIDXpert2 Configuration Utility's Main Menu, use the arrow keys to select **Array Management**, then press **Enter**.

2. Select **Create Array** using the arrow keys, then press **Enter**.
3. Select **Select RAID Level** using the arrow keys, then press **Enter**.
   - From the **Select RAID Level** drop-down menu, use the arrow keys to select **RAID10**, then press **Enter**.
4. Select the disks with which to create the array:
   a. Select **Physical Disks** using the arrow keys, then press **Enter**.
   b. Select desired disks, highlight a disk with the arrow keys and press the space bar or **Enter**.
   c. Select **Apply Changes** using the arrow keys, then press **Enter**.

Note: *Refer to Table 14 on page 37 for Default Cache Tag Size.*

5. Select **Read Cache Policy** using the arrow keys, then press **Enter**.
   - Select the desired **Read Cache** Policy, then press **Enter**.
6. Select **Write Cache Policy** using the arrow keys, then press **Enter**.
   - Select the desired **Write Cache Policy**, then press **Enter**.
7. Select **Create Array** using the arrow keys, then press **Enter**.

3.3.2.7 Create a RAID5 Array

Note: *Refer to Table 5 for RAID5 array characteristics.*

1. From the RAIDXpert2 Configuration Utility's Main Menu, use the arrow keys to select **Array Management**, then press **Enter**.
2. Select **Create Array** using the arrow keys, then press **Enter**.
3. Select **Select RAID Level** using the arrow keys, then press **Enter**.
   - From the **Select RAID Level** drop-down menu, use the arrow keys to select **RAID5**, then press **Enter**.
4. Select the disks to create the array:
   a. Select **Physical Disks** using the arrow keys, then press **Enter**.
   b. Select desired disks, highlight a disk with the arrow keys and press the space bar or **Enter**. Select a minimum of three (3) devices for RAID5.
   c. Select **Apply Changes** using the arrow keys, then press **Enter**.

Note: *Refer to Table 14 on page 37 for the Default Cache Tag Size.*

5. Select **Read Cache Policy** using the arrow keys, then press **Enter**.
   - Select the desired **Read Cache** Policy, then press **Enter**.
6. Select **Write Cache Policy** using the arrow keys, then press **Enter**.
   - Select the desired **Write Cache Policy**, then press **Enter**.
7. Select **Create Array** using the arrow keys, then press **Enter**.

3.4 Delete Arrays

CAUTION: *Deleting an array permanently destroys all the data on the array. This action cannot be undone, and it is very unlikely the data can be recovered.*

CAUTION: *Do not delete the first array listed in the Arrays section if it is the AMD RAID bootable array. Doing this deletes the operating system and AMD RAID files.*

CAUTION: *Deleting secondary arrays in the RAIDXpert2 Configuration Utility (HII) after the system resumes from a hibernation results in the arrays not being deleted. The system boots from the previous hibernation configuration. If you want to delete secondary arrays in RAIDXpert2 Configuration Utility (HII), reset the system, then enter RAIDXpert2 Configuration Utility (HII) and perform the delete.*

3.4.1 Delete an Array

1. From the RAIDXpert2 Configuration Utility's Main Menu, use the arrow keys to select **Array Management**, then press **Enter**.
2. Select **Delete Arrays** using the arrow keys, then press **Enter**.
3. Select the array(s) to delete:
   a. Select the desired array or multiple arrays using the arrow keys, then press the space bar or **Enter** to change option to **Enabled** for deletion.
   b. If you want to select all the arrays, use the arrow keys to select **Check all**, then press **Enter**.
   c. Select **Delete Array** using the arrow keys, then press the space bar or **Enter**.
   d. To select all the arrays for deletion: use the arrow keys to select **Check all**, then press the space bar or **Enter**.
   e. Review the warning message, if you want to proceed, press the space bar or **Enter**.
   f. Select **Yes** using the arrow keys to delete arrays or press the **ESC** key to exit.

3.5 Manage Spares

This option allows the user to assign or unassign global or dedicated spares.
Note: *To assign a physical disk as a Global Spare, it must not be part of any Array.*

3.5.1 Assign Global Spares

1. From the RaidXpert2 Configuration Utility's Main Menu, use the arrow keys to select **Physical Disk Management**, then press **Enter**.
2. Select **Physical Disk Operations** using the arrow keys, then press **Enter**.
3. Select **Select Physical Disk** using the arrow keys, then press **Enter**.
4. Select **Assign Global Hot Spare** using the arrow keys, then press **Enter**.

5. Review the warning message, if you want to proceed, use the arrow keys to select **Yes**, or press **ESC** or **No**, to exit.

3.5.2 Assign Dedicated Spares

Note: *Dedicated spares can only be assigned to redundant arrays and must the same size or larger than the other members of the redundant array.*

1. From the RAIDXpert2 Configuration Utility's Main Menu, use the arrow keys to select **Array Management**, then press **Enter**.
2. Select **Manage Array Properties** using the arrow keys, then press **Enter**.
3. Select **Select Array** using the arrow keys.
   - Select the desired array (must be a redundant array) from the drop-down menu, then press **Enter**.
4. Select **Manage Dedicated Hot Spares** using the arrow keys, then press **Enter**.
5. Select the disks to assign as dedicated spares.
   a. Select the disk using the arrow keys to highlight the disk and press the space bar or **Enter** to select it.
   b. Select **Add Hot Spare Physical Disk** using the arrow keys, then press **Enter**.
   c. At the warning message, press the space bar or **Enter** to **Confirm**.
   d. Select **Yes** using the arrow keys, then press **Enter** or press the **ESC** key to exit adding the Dedicated Spare.

3.5.3 Unassign Spares

1. From the RAIDXpert2 Configuration Utility's Main Menu, use the arrow keys to select **Physical Disk Management**, then press **Enter**.
2. Select **Select Physical Disk Operations** using the arrow keys, then press **Enter**.
3. Select **Select Physical Disk** using the arrow keys, then press **Enter**.
4. From the drop-down menu, use the arrow keys to select the **Global / Dedicated Spare**, then press **Enter**.
5. Select **Unassign Hot Spare** using the arrow keys, then press **Enter**.
6. Review the warning message, if you want to proceed select **Yes**, then press **Enter** or press the **ESC** key to exit.

3.6 View Controller Details

This option will display the details about of the controllers. Nothing can be changed using this menu option; it is for informational purposes only.

1. From the RAIDXpert2 Configuration Utility's Main Menu, use the arrow keys to select **Controller Management**, then press **Enter**.
2. Select Select View Controller Information using the arrow keys, then press Enter.
3. Select **Select Controller** using the arrow keys, then press **Enter.**
4. From the drop-down menu, select the desired controller, then press **Enter**. Information about the controller is displayed below the **Select Controller** header:
   - PCI ID
   - Controller Physical Disk Count
   - Total Physical Disk Count
   - Total Array Count
   - UEFI Driver Version
   - Firmware Properties/Firmware Build Time
5. To view another controller, press **Enter** and from the drop-down menu, select a different controller, then press **Enter**.
6. Press **ESC** to exit to the **Main Menu**.

3.7 View Disk Details

This option allows the user to view details about the physical disk(s). Nothing can be changed using this menu option; it is for informational purposes only.

1. From the RAIDXpert2 Configuration Utility's Main Menu, use the arrow keys to highlight **Physical Disk Management**, then press **Enter**.
2. Select **View Physical Disk Properties** using the arrow keys, then press **Enter**.
3. Select **Select Physical Disk** using the arrow keys, then press **Enter**.
4. From the drop-down menu, select the physical disk you want more information about, then press **Enter**.
5. Information about the physical disk is displayed below the **Select Physical Disk** header:
   - Unique Disk ID
   - State
   - Size
   - Smart Status
   - Revision
   - Drive Type
   - Maximum Free Space
   - Used Space
   - Disk Protocol
   - Disk Speed
   - Associated Array, if part of one
   - Serial Number
   - Model Number
6. To view another physical disk, press **Enter** and from the drop-down menu, select a different physical disk, then press **Enter**.
7. Press **ESC** to exit to the **Main Menu**.

3.8 View Array Details

This option will display the details of an array. Nothing can be changed using this menu option; it is for informational purposes only.

1. From the RAIDXpert2 Configuration Utility's Main Menu, use the arrow keys to select **Array Management**, then press **Enter**.
2. Select **Select Manage Array Properties** using the arrow keys, then press **Enter**.
3. Select **Select Array** using the arrow keys, then press **Enter**.
4. From the drop-down menu, select the desired array, then press **Enter**.
5. Select **View Associated Physical Disks** using the arrow keys, then press **Enter**
6. Press the space bar to select one of the members of the Array
7. Select **View Physical Disk Properties** using the arrow keys, then press **Enter**
8. Information about the array is displayed below the **Select Array header**:
   - Array number
   - RAID level
   - State (see Table 6)
   - Size
   - Cache Tag Size
   - Cache settings
   - Associated physical disks
9. To view another array, press **ESC** twice and perform steps 2 through 8 again.
10. Press **ESC** to exit to the **Main Menu.**

3.9 Rescan All Channels

This option allows the user to rescan all channels to detect new or removed disks and arrays. It rereads the configuration information from each disk.

Sometimes when a disk is offline, it can be brought online through a rescan.

1. From the RAIDXpert2 Configuration Utility's Main Menu, use the arrow keys to select **Controller Management**, then press **Enter**.
2. Select **Rescan Disks** using the arrow keys, then press **Enter**.
   - After a rescan completes, all of the physical disks are displayed.
3. Select **OK** using the arrow keys, then press **Enter**.

Chapter 4 AMD RAIDXpert2 Graphical User Interface (GUI)

4.1 Start RAIDXpert2

The RAIDXpert2 graphical user interface (GUI) is a Desktop Application tool designed and packaged to be a UWP compliant package, available from the Microsoft Store. It reads and writes to the internal RAID drivers, which communicate with the AMD RAID arrays and physical devices. Also available, is a version that is based off the Desktop application but is not UWP compliant.

Open the Windows menu and search for **AMD RAIDXpert2** or the desktop shortcut.

4.1.1 Desktop Shortcut Access

4.1.1.1 Signing in Using the RAIDXpert2 Desktop Shortcut

Open the Windows menu and search for **AMD RAIDXpert2**, click to open or make a desktop shortcut, or pin to the taskbar.

4.1.1.2 Help and About Windows

To view the software version and build number for the GUI, select About at the Help menu. The AMD RAIDXpert2 Driver Version and GUI Version are displayed.

For reference help, select **Help > User Guide**. A PDF version of this document is displayed. A PDF reader program is needed to view it.

For further customer support, click **Help > Support** for the AMD Drivers and Support page, or contact your system supplier or motherboard vendor.

4.2 Reviewing the RAIDXpert2 GUI

4.2.1 The Array View Section of the Array Status Window

4.2.1.1 Elements of the Array View Section

The **Array View** section presents a graphical view of array properties. Table 15 provides information about the elements of the **Array View** section (see Figure 1 on 47).

Table 15. Elements of the Array View Section, Array Status Window

Element	Description
Controller Name	The RAIDXpert2 controller for the arrays displayed below it.
Array	The number assigned to an array.
Array name	The name assigned to an array.
RAID Level	The RAID level of the array.
Disk Number	The number assigned to disks in an array.
Disk Manufacturer	The manufacturer of disks in an array.
Disk Model Number	The model number of the disks in an array.

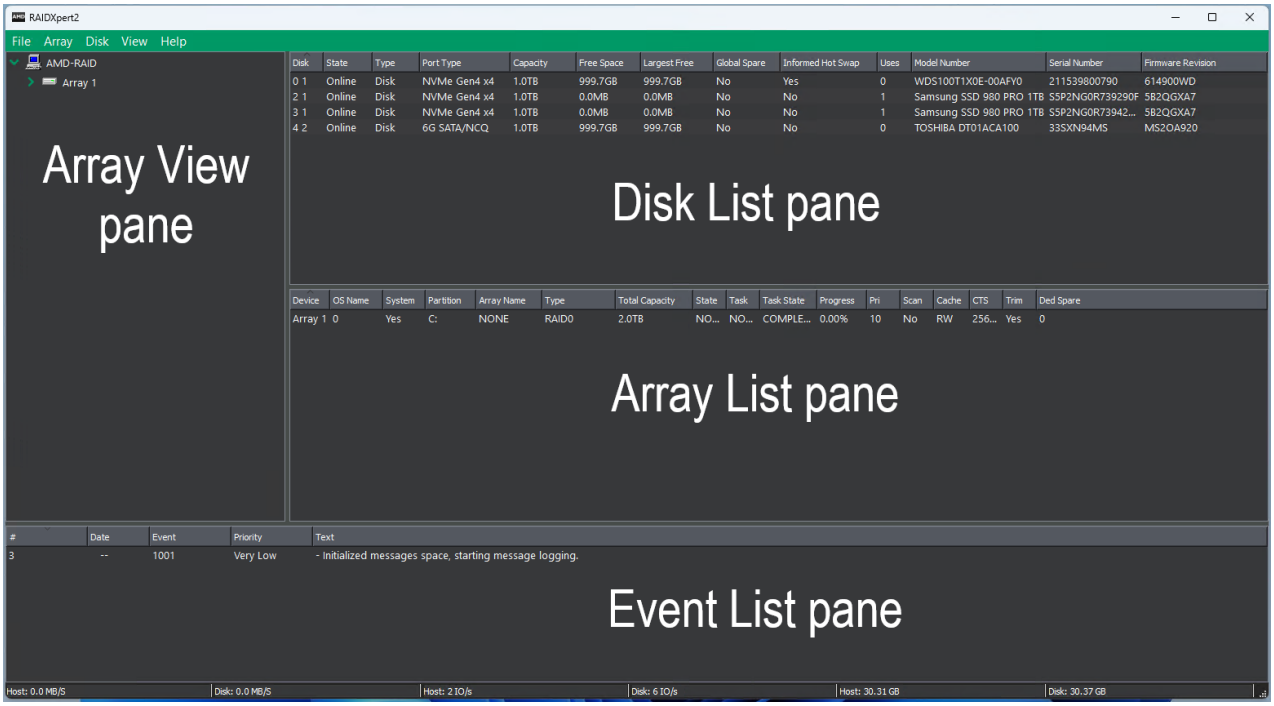

Figure 1. Array Status Window

4.2.2 The Disk List Section of the Array Status Window

4.2.2.1 Elements of the Disk List Section

The Disk List section provides information about all disks assigned or available to arrays. Table 16 provides information about the elements of the Disk List section.

Table 16. Elements of the Disk List Pane, Array Status Window

Element	Description
Disk	Controller and disk number.
State	State of the disk (Online, Offline, SMART Error).
Type	Disk type (Disk, Legacy, New).
Port Type	Negotiated Speed (not the speed of the port type and SATA NCQ or NVMe
Capacity	Disk capacity: 1 MB = 1,000,000 bytes 1 GB = 1,000,000,000 bytes ***Note:*** *Because the ATA storage industry has standardized the meanings of MB as 1,000,000 bytes and GB as 1,000,000,000 bytes, RAIDXpert2 reports the same units*
Space Available	Total amount of space unused on the disk.
Largest Available	Largest contiguous unused space on the disk.
Global Spare (GS)	Indicates if the disk is assigned as a global spare.
Informed Hot Swap	Indicates whether a disk is enabled for live disconnect and removal.
Users	Number of arrays that this disk is a member of.
Model	Disk manufacturer’s model number.
Serial No.	Disk manufacturer’s serial number.
Firmware	Disk manufacturer’s firmware version.

If a disk is missing from the Disk List, the most likely causes are:

- A loose cable. Make sure that all disk cables are connected, then perform a rescan.
- A disk that is not fully seated in its bay or slot. Make sure that the disk is inserted completely in its bay or slot, then perform a rescan.

4.2.3 The Array List Section of the Array Status Window

4.2.3.1 Elements of the Array List Section

The Array List section provides information about the arrays. Table 17 provides information about the elements of the Array List section.

Table 17. Elements of the Array List Section, Array Status Window

Element	Description
Device	The array number.
OS Name	Corresponds to the Disk number in Windows Disk Management.
System	If yes, it is your boot array, otherwise it is not a boot critical array.
Partition	Drive letter that was assigned to this array during the partition process. (A blank space appears if the array has not been partitioned.) ***Note:*** *If a dynamic volume is created on an array, RAIDXpert2 cannot retrieve the volume's drive letter.*
Array Name	User-created name for the array.
Type	The RAID level (RAID type) or LEGACY.
Total Capacity	Total capacity: 1 MB = 1,000,000 bytes 1 GB = 1,000,000,000 bytes ***Note***: The ATA storage industry standardizes MB as 1,000,000 bytes and GB as 1,000,000,000 bytes, so RAIDXpert2 reports the same units.
State	State of the array (NORMAL, CRITICAL, OFFLINE).
Task	Task type, if in progress (TRANSFORM, CHECK, CHECK_BITMAP, CREATE, RESTORE, ZERO, SECURE_ERASE).
Task State	The state of the task (STARTED, PAUSED, COMPLETED); the progress of the task is given in the Array View section.
Progress	Percent given of a given task.
Pri	Task priority if a task is in progress.

Table 17. Elements of the Array List Section, Array Status Window (continued)

Element	Description
Scan	Background Array Scan enabled? (Yes/No).
Cache	Current cache setting (NC = No Cache, R = Read Ahead Cache, W = Write Back Cache, RW = Read/Write Cache).
Cache Tag size	Any Array with only HDD/SSD will have default CTS of 64k Any Array with NVMe/HDD/SSD will have default CTS of 256k
Trim	No: Array does not support Trim. Yes: Array supports Trim.
Dedicated Spare	If assigned, the number of dedicated spares assigned to array.

4.2.4 The Event View Section of the Array Status Window

4.2.4.1 Elements of the Event View Section

The **Event View** section is an optional-view section. It can be displayed or hidden by selecting **View > Event View**.

The information in the **Event View** is linked to the **View Log**. The **View Log** displays user-initiated tasks or actions, and system-generated notifications and events. The **View Log** can be accesses by selecting **View > Log**.

The **Event View** provides information about the events. Table 18, on page 50, provides information about the elements of the **Event View** section.

Table 18. Elements of the Event View Section, Array Status Window

Element	Description
#	The number of the event.
Date	The date and time at which the event occurred.
Event	The RAIDXpert2 Asynchronous Event Notification (AEN) number of the event.
Priority	The notification priority of the event: Low, Informational, Warning, Critical, or Fatal.
Text	A brief description of the event.

4.2.5 Array and Disk Commands

The Array and Disk menus of the Array Status window contain lists of commands. The commands allow the system user to initiate or modify array- and disk-related tasks.

Not all commands are available for an array or for the system. Availability depends on:

- The tasks that can be performed with the system's license level.
- The RAID level of an array. For example, a Consistency Check can be performed only on arrays at a redundant RAID level.
- The remaining capacity of the disk drives. For example, if a system has three disk drives and large arrays have used all of the capacity on two of the disks, only non-redundant Volume arrays can be created on the remaining disk. Certain commands are not available with a non-redundant array.

Table 19 provides page numbers for each command.

Table 19. Disk Menu Commands

Disk Commands	See Detailed Information on this Page
Rescan	page 51
Initialize	page 51
Clear Metadata	Page 52
Properties	page 53
Options	page 53

4.3 Working with Disks

4.3.1 Rescan Disks

The Rescan Command Performs the Following Actions:

- Rescans the devices/controllers and searchs for new, legacy, or removed disks.
- Rereads the configuration information from each disk.

When a disk is offline, it might be brought online by using a rescan. A rescan also stops and then automatically resumes all tasks.

To rescan disks, select **Rescan** at the **Disk** menu.

4.3.2 Initialize Disks

When a disk is initialized, RAIDXpert2 configuration information (metadata) is written to the disks. If a disk is new and has not been used before, or if it is a legacy disk, it must be initialized

before it can be used in a RAIDXpert2 array. After a disk is initialized, it appears as Disk in the Disk List.

If all the disks contain metadata, the **Initialized** button is deactivated (greyed out).

Note: *All new disks and legacy disks will have an associated array. You must delete the array in order to initialize the disk.*

4.3.2.1 To Initialize Disks

1. At the **Disk** menu, select **Initialize**. The Initialize Disk window displays.
2. Select the disk(s) to be initialized, by selecting the box next to the disk(s).
3. Click Initialize Selected.

4.3.3 Clear Metadata Description

When a device has Clear Metadata applied to it, the RAIDXpert2 metadata is removed and the device becomes a New/Legacy device.

If the device is part of an Array or is a New/Legacy device, it will not be available to be selected. Also, if there aren't any devices that are empty, the Clear Metadata button is deactivated (greyed out). The device will no longer be useable in AMD RAIDXpert2 until it is initialized.

4.3.3.1 To Clear Metadata Steps

1. At the **Disk** Menu, select **Clear Metadata**. The Clear Metadata window displays.
2. Select the device(s) to be initialized, by selecting the box next to the device(s).
3. Click Clear Metadata.

4.3.4 Change Cache Properties for Disks

The Read Ahead and Write Back Cache properties can be changed if the disks support this option. The default settings are:

- Read Ahead: enabled.
- Write Back Cache: enabled.

CAUTION: *Leaving Write Back Cache enabled can increase the likelihood of data being corrupted if the system experiences a power interruption or unexpected shutdown.*

Note: *A disk's cache setting cannot be changed if a task is active for the array. The cache settings are enabled when the task is finished.*

Note: *As default setting NVMe Physical disk Read ahead and Write Back cache is always disabled. User cannot enable the setting as it may impact the operational performance of the NVMe disk.*

4.3.4.1 Change Disk Caching Properties

1. At the Disk menu, select **Properties**.
2. The **Properties** window opens.
3. Select the disks you want to change the properties of.
4. Click **Enable** or **Disable** for the desired settings.

4.3.5 Options

Disk options include the following:

- Assign as Dedicated Spare
- Assign as Global Spare
- Identify Disk Using LEDs
- Prepare to Remove

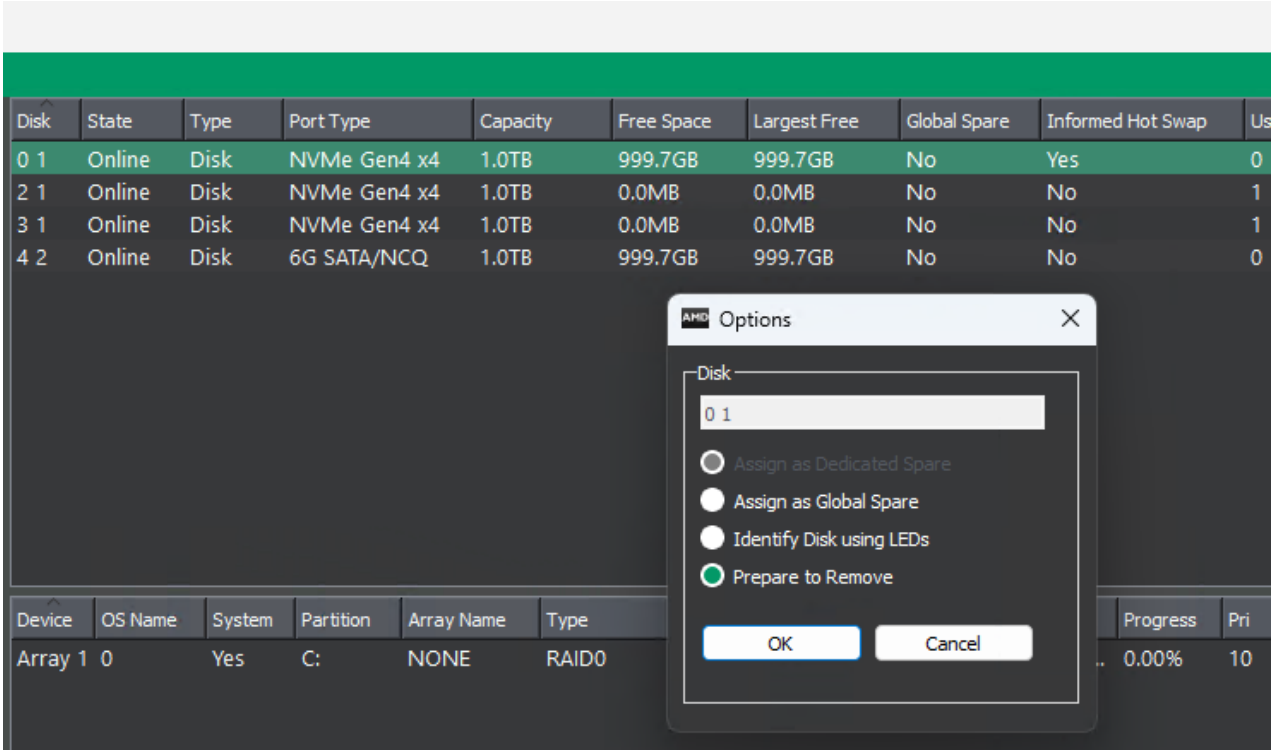

Figure 2. Disk Options

4.3.5.1 Assign a Disk as a Dedicated or Global Spare

Spare disks allow an array to be rebuilt when a disk fails. Global spares can be assigned and if a redundant arrays fails, they will be automatically assigned, while dedicated spares are assigned to a specific array.

1. Select a disk in the **Disk List** section.
2. Select **Options** on the Disk menu.
   A pop-up dialog lists options for **Disk Device** options.
3. Select one of the following:
   - Select **Assign as Dedicated Spare** to use the disk as a dedicated spare.
     Note: *The capacity of a dedicated spare must be equal to or larger than the capacity of the smallest disk in the array.*
   - Select **Assign as Global Spare** to use the disk as a global spare.
4. Click **OK**.

4.3.5.2 Prepare to Remove — Using Informed Hot Swap

Note: *Only use this feature if there are no arrays on the device. Otherwise, see Section 4.4.5, "Prepare to Physically Remove an Array."*

For systems that support Informed Hot Swap, a drive can be disconnected in software to prepare for safe removal. This can be used when replacing a drive with a new larger drive or replacing a failed drive.

To remove a device, select **Disk Options** > **Prepare to Remove**.

4.4 Working with Arrays

4.4.1 Create and Format Arrays

RAIDXpert2 allows the partitioning and creation of as many as twelve arrays across the system's disks. Portions of disks can be used to create arrays, while other arrays use different portions of the same disks.

Table 20. Array Menu Commands

Array Commands	Details		
Create	page 56	**Hide**	page 66
Transform	page 57	**Identify Array**	page 49
Check Consistency	page 63	**Prepare to Remove**	page 60
Background Array Scan	page 64	**Remove Spares**	page 65
Modify Cache Settings	page 62	**Delete**	page 61
Task	page 63	**Delete Multiple Arrays**	page 61
Name	page 57	**Secure Erase**	page 66

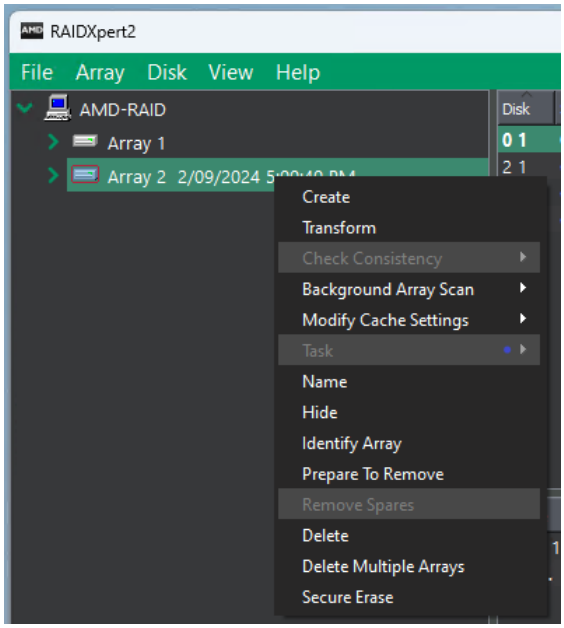

Figure 3. Array Options

4.4.1.1 Before You Begin

Review the issues and recommendations indicated in Table 21.

Table 21. Creating Arrays: Issues and Recommendations

Issues	Recommendations
Access to arrays	Creation of arrays, even redundant arrays, allows users immediate access to the arrays (unless the Zero Create option is used during the Create process).
Array numbers	Array numbers are valid only for a given boot and can be different in the BIOS Configuration Utility and RAIDXpert2. If a permanent label is required, use the Array Naming feature, Name Arrays (Section 4.4.2, page 57).
Array size	Refer to the operating system documentation for details on maximum array sizes.
Number of arrays	In some circumstances, more than twelve arrays are possible. They might appear to function properly but are not supported by AMD RAID.
System reboot	When the system reboots, the creation process continues where it left off.

4.4.1.2 Create an Array

4.4.1.2.1 Select an Array and Cache

1. Select **Create** at the **Array** menu.
2. Select the disk(s) to include in the array by checking the box next to the desired disk(s) in the **Select Active Disks**: field.

Note: *Click **All** to select all disks, or click **Unused** to select disks that are not currently used in an array. Maximum of 8 NVMe/HDD/SSD disks can be part of array. if more than 8 disks, the Create button will be grayed out or unselectable.*

3. Enter a name for the array in the **Array Name**: field.

Note: *The following characters are not allowed in an array name.*

( ) ^ , | = “ ” . [ ]

4. Select an array type at the **Array Type**: drop-down menu.
5. Select an option at the **Organized As**: drop-down menu.

Note: *The Organized As: drop-down menu only displays options for advanced management of a RAID10 configuration if you selected RAID10.*

6. Enter the capacity in the **Capacity**: field. The maximum available capacity changes with:
   - The disks that are selected.
   - The RAID level of the array.
7. Select a cache option at the **Cache Options**: drop-down menu. (The default is Read and Write Back Cache.)
8. Cache Tag Size will default to a setting based off of the disks that are selected. All HDD/SSD, default will be 64k. All NVMe or a mix of NVMe/HDD/SSD will default to 256k. The user should not change from the default settings.
9. Check **Background Array Scan** to enable background array scanning. (A background array scan checks sectors of the disks in an array for potential problems. A background array scan runs continuously, until the user stops it by accessing Array > Background Array Scan > Stop.)

Note: *Refer to Table 14 on page 37 for Default Cache Tag Size.*

Note: *Refer to Section 4.4.11, Scan an Array in the Background, on page 64, for details.*

10. Check **Skip Initialize** to skip initialization.

CAUTION: *Creating a redundant array with Skip Initialization selected can result in data corruption.*

11. **Check Leave Existing Data Intact** if an array is lost or deleted, and the user immediately creates a replacement array of the same characteristics. This leaves the data on the disks of

the lost or deleted array untouched when the replacement array is created. See Table 38, on page 92, for additional information.

12. Check **Zero Create** to write zeros on the created array. If Zero Create is used, the array is not immediately available. (The array is hidden from the operating system during the Create process.)
13. Click **Create** to create the array.

4.4.1.3 Partition and Format an Array

Each operating system has different names and paths for partitioning and formatting arrays and are outside the scope of this document. For information, see operating system's user documentation.

4.4.2 Name Arrays

Naming an array can be useful when creating backups. It makes an array easy to identify in a list.

1. In the **Array View** section, select the array to name.
2. At the **Array** menu, select **Name**. The **Array Name** window displays.
3. Type the desired name in the blank field.

Note: *The following characters are not allowed in an array name.*

( ) ^ , | = “ ” . [ ]

4. Click **OK**. The array name appears in the Array List and in the BIOS Configuration Utility (only 17 characters of the name are displayed in the BIOS Configuration Utility).

4.4.3 Transform Arrays

With the Transform task, an array can be:

- Transformed from one RAID level to almost any other RAID level. This function is also referred to as Online RAID Level Migration (ORLM).
- Expanded dynamically, even under I/O load, by adding disks to the array to increase array capacity. This function is also referred to as Online Capacity Expansion (OCE).

Note: *If you transform an array by adding or removing a device located in the front panel(s), a reboot is required to notify the Windows configuration of the underlying array/device change.*

4.4.3.1 Before You Begin

Review the issues and recommendations indicated in Table 22.

Table 22. Transforming Arrays: Issues and Recommendations

Issues	Recommendations
Array size	An array cannot be transformed to a smaller-sized array. The transformed array must be the same size as or larger than the original array.
Array size limits	Refer to the operating system documentation for details on maximum array sizes.
Disk failure during a Transform	If a disk fails while the Transform task is in progress, no data is lost if the source and destination RAID levels are redundant. If a spare has been assigned to the destination array, a fail-over task starts as soon as the Transform completes (if the spare is available after the Transform).
Multiple arrays	If there are multiple arrays, it might not be possible to transform some of the arrays to a larger size. If, in the future, an array needs to be expanded in size, it is best to configure the available space as a single array.
Task control commands	When using task control commands, a Transform task can only be paused or resumed but not removed. To end a Transform task, pause and delete it. **Note:** If a task is paused, then deleted, the array is deleted. Deleting a task is the same as deleting an array. Data loss occurs when a task is deleted. Back up data before deleting a task involving Transform or Restore.
System reboot during a Transform	If the system reboots during a Transform, the Transform continues where it left off.

4.4.3.2 Transform an Array

1. In the **Array View** section, select the array to transform.
2. At the **Array** menu, select **Transform**.

Note: *If the system window is not wide enough, only the Destination View is displayed.*

3. Select all the desired disks for the array (including disks that might be already in the array) by selecting the box next to the drive in the Disk List section.

Note: *Click **Same** to select all disks currently used in the array, **All** to select all disks, or **Unused** to select disks that are not currently used in an array.*

4. Select the RAID level to be transformed at the **Array Type**: drop-down menu.
5. Select an option at the **Organized As:** drop-down menu.

Note: *The **Organized As:** drop-down menu only displays options for advanced management of a RAID10 configuration if you selected RAID10.*

6. Expand the array by entering the size of the new array in the **Capacity**: field. The maximum available capacity changes with:
   - The disks that are selected.
   - The RAID level of the array.

   Note: *If a Transform is not possible, the Commit option is not enabled. A typical reason preventing a Transform is insufficient available space on the disks.*

7. Click **Commit**.

Note: *Unless the transformation is instantaneous, the Array Status window updates to show the source and destination arrays, along with the progress of the transformation.*

4.4.3.3 Access Additional Space

After an array has been transformed to a larger size, use the operating system tools to access the additional space.

There are several possible methods for expanding the existing file system on an array that has been transformed to a larger size:

- Microsoft provides a command prompt utility called Diskpart.exe that can expand any NTFS file system without requiring a reboot. The Diskpart.exe utility version to use depends on the version of Windows being run. The Diskpart.exe utility can be found on the CD that comes with some versions of Windows, or at the Microsoft website (*http://www.microsoft.com*) for others. Use the correct version for the operating system.
- For arrays formatted with FAT32, use a third-party application, such as PartitionMagic from PowerQuest Corporation.

4.4.4 Restore (Rebuild) Arrays

With the Restore task, a redundant-type array whose state has changed to Critical can be restored (rebuilt) in one of two ways:

- By assigning a dedicated spare to the array.
- By creating a global spare or by using an existing global spare. (An existing global spare automatically starts restoring a redundant-type array after the array's state changes to Critical.)

An array in an Offline state cannot be restored. This means that non-redundant arrays (Volume, RAID0) cannot be restored: when a single disk in a non-redundant array fails, the array state changes to Offline.

Note: *If a Critical redundant array that is being restored loses a second disk (RAID1), or loses a second disk in the same mirror set (RAID10), the Restore task fails. The array must be re-created from backup storage data.*

4.4.4.1 Before You Begin

- Make sure that the disk chosen as the dedicated spare or global spare has sufficient available capacity to restore the array. The capacity of the spare disk must be equal to or larger than the capacity of the smallest disk in the critical array.
- Know how to create a global or dedicated spare. See Section 4.4.12, Add or Remove Dedicated Spares, on page 65 or Section 4.4.13, Add or Remove Global Spares, on page 65.

4.4.4.2 Restore a Critical Array

1. In the Array View section, select the critical array.
2. At the **Disk List** section, **double click on** a disk.
3. At the **Disk** menu, select **Options**. Options for **Disk Device** displays in the **Disk List** panel.
4. Perform one of the following actions:
   - To use the disk as a dedicated spare, select **Assign as Dedicated Spare**.
   - To use the disk as a global spare, select **Assign as Global Spare**.
5. Click **Confirm**.

4.4.5 Prepare to Physically Remove an Array

4.4.5.1 Physically Remove an Array

Informed Host Swap is available on workstations and only for systems that have front panels.

1. Select the array to remove in the **Array View** section.
2. Select **Prepare to Remove** at the **Array** menu.
3. Click **Yes** at the **Prepare to Remove** confirmation window.
   The array is hidden from the OS, and the drives are disconnected from the OS.
4. Physically remove the disks from the system.
5. When all disks in the array are removed from the system, select **Rescan** from the **Drive Removed** pop-up.
   The array and all associated disks are removed from the Array and Disk Status windows.

4.4.5.2 Array Migration

The disks in an array, after being removed from one system with a RAIDXpert2 controller, can be migrated to another system with a RAIDXpert2 controller. The disks and array(s) appear in the second system, in Disk Management, the BIOS Configuration Utility, and RAIDXpert2, as normal RAIDXpert2 disks and array(s).

After all drives from the array are inserted, a rescan is required. The array will be hidden from the OS.

To unhide the array:

1. Select the array, and then select **Un-Hide** from the array pull-down menu.
2. Select **Array** > **Un-Hide** to display it.

If the disks from a RAIDXpert2 system are migrated to a non-RAIDXpert2 Windows-based system, the disks appear in Disk Management of the second system as healthy, unknown partitions. To use the disks, use Disk Management to delete the RAIDXpert2-created partitions and to create Windows partitions on the disks.

CAUTION: *All data contained in a RAIDXpert2 array are lost if the RAIDXpert2 disks of the array are migrated to a non-RAIDXpert2 system.*

4.4.6 Delete Arrays

CAUTION: *Deleting an array permanently destroys all data that is on the array. This action cannot be undone, and it is very unlikely the data can be recovered.*

4.4.6.1 Before You Begin

Review the issues and recommendations indicated in Table 23.

Table 23. Deleting Arrays: Issues and Recommendations

Issue	Recommendation
Drive letters or partitions	Remove drive letters or partitions from the array using procedures in your operating system. Each operating system has different names and paths for removing drive letters or partitions and as such are outside the scope of this document. For more information, see your operating system's user documentation.
Operating system impact on arrays	If the array is not being used by the operating system, the array can be deleted at any time, even while tasks are running on the array. If the array is being used by the operating system, the array cannot be deleted. Therefore, a RAIDXpert2 bootable array cannot be deleted in RAIDXpert2. A RAIDXpert2 bootable array can only be deleted in the BIOS Configuration Utility.

4.4.6.2 Delete an Array

1. In the **Array Status** window, select the array to delete.
2. At the **Array** menu, select **Delete**. A window opens, warning about deleting the array.
3. Click **Yes**. The array disappears from the **Array View** section.

Note: *Also see Section 5.5, Delete Arrays: rcadm --delete, on page 76.*

4.4.6.3 Delete Multiple Arrays

1. Select **Delete Multiple Arrays** at the Array menu.
2. Select (check mark) the arrays you want to delete. The **Select All** button can also be used.
3. Click the **Delete** Button. A window opens, warning about deleting the array(s).
4. Click **Yes**. The array(s) will disappear from the **Array View** Section.

4.4.6.4 Recreate a Deleted Array

If an array is deleted, it might be possible to recreate the array. See Table 38. Recreate a Deleted Array, on page 92.

4.4.7 Cache Settings for Arrays

Table 24 provides information about the four array-caching options available.

Table 24. Cache Array Options

Option	Description
No Cache	I/O requests are translated and passed to the disks without keeping a cached copy of the data available for future requests
Read Cache	Data reads are cached, if appropriate. This option performs sequential Read Ahead, when necessary
Write Back Cache	Data writes are cached. This setting is intended for advanced users who understand the implications of Write Back caching
Read + Write Back Cache (default setting)	Both Read and Write Back Cache options can be selected

Note: *Cache options cannot be changed while a task is active on the array. They can be changed at any other time, including while I/O is running.*

4.4.7.1 Change Cache Settings

1. Select the array on which to change caching options in the **Array View** section.
2. Select **Modify Cache Settings** at the Array menu.

3. Choose **No Cache, Read Cache, Write Back Cache, or Read + Write Back Cache**. The new cache setting displays in the Array List Cache information.
4. Select **Rescan** at the Disk Menu.

4.4.8 Change the Priority Level of a Task

The task priority command allows the user to speed up or slow down tasks performed on arrays.

To decrease the amount of time for a task to complete, set the task priority higher (10 is highest).

Note: *A task priority can only be changed after a task is running on the array.*

4.4.8.1 Change a Task Priority

1. Select the array on which tasks are being performed in the **Array View** section.
2. Select **Task** and select **Priority** at the **Array** menu.
3. At the **Task Priority** window, change the task priority by moving the slide.
4. Click **OK**.

4.4.9 Interrupt, Cancel, or Resume a Task

Task control commands allow users to pause, resume, or cancel (remove) tasks being performed on arrays. Full task control can be used on Create, Consistency Check, and Check Bitmap tasks. On Restores with dedicated or global spares, the task can be removed, but the array returns to the Critical state.

Note: *Task control can be used only when a task is running on an array.*

4.4.9.1 Interrupt, Cancel, or Resume a Task

1. In the **Array View** section, select the array on which a task is being performed.
2. At the **Array** menu, click **Task** and select one of the following:
   - Pause to interrupt the task.
   - Remove to cancel the task.
   - Resume to interrupt the task.

4.4.10 Check for Consistency

For redundant-type arrays only, the Consistency Check task is available at the Array menu. When this task is selected it starts the process of verifying that the mirror drive consistency for fault-tolerant disks is correct. If inconsistent areas are found, they are corrected during this process.

Having consistent arrays is very important. If an array is inconsistent and a drive fails, data is lost. RAIDXpert2 is designed to maintain consistent arrays, but it is good practice to run frequent consistency checks.

When a redundant array is created using Create, and Skip Initialize is not checked (default), a Consistency Check is performed automatically. Consistency Checks that run during a Create task can be removed (by highlighting the array and selecting **Task > Remove**), but the array created is not redundant. Arrays are not protected unless a Consistency Check runs end-to-end.

After a Consistency Check is started, adjust the priority of its task relative to user I/O activity. Use the Task Priority option (see Section 4.4.8, Change the Priority Level of a Task, on page 63).

4.4.10.1 Before you Begin

- The Consistency Check command can be started at any time on a redundant-type array, as long as another task is not running on the array.
- The Consistency Check command can be started while under I/O load.
- If the array state is Critical, the Consistency Check fails.
- To estimate remaining time for a Consistency Check, note the percentage of the task that is completed (hours:minutes:seconds). Details are displayed by the array in the Array View section of the Array Status window.

4.4.10.2 Manually start a Consistency Check

1. Select the array on which to run the Consistency Check in the **Array View** section.
2. Select Check Consistency at the Array menu.
3. Click **Start**.

4.4.10.3 Manually stop a Consistency Check

1. Select the array on which to stop the Consistency Check in the **Array View** section.
2. Select Check Consistency at the Array menu.
3. Click **Stop**.

4.4.11 Scan an Array in the Background

A Background Array Scan task performs a continuous background read operation of an array, accessing at least one copy of every block of the array from beginning to end.

The user manually starts a Background Array Scan. It runs continuously until the user stops it.

Although a Background Array Scan can run while an array is engaged in other tasks, it is recommended that it runs while the array is idle (that is, when there is no I/O to or from the array).

4.4.11.1 Enable or Disable a Background Array Scan

1. Select the array on which to run the **Background Array Scan** in the **Array View** section.
2. Select Background Array Scan at the Array menu.
3. Enable or disable the **Background Array Scan**.
   - Select **Start** to enable a **Background Array Scan**.
   - Select **Stop** to disable a **Background Array Scan**.

Note: *A Background Array Scan can also be enabled for an array when it is created.*

4.4.12 Add or Remove Dedicated Spares

If a dedicated spare is added, make sure there is adequate space on the dedicated spare.

4.4.12.1 Add a Dedicated Spare

1. Select the array on which to assign a dedicated spare in the **Array View** section.
2. Double-click on the disk chosen as the dedicated spare in the **Disk List** section.
3. Select **Options** at the **Disk** menu.
4. Select Assign as Dedicated Spare, then click Confirm.

4.4.12.2 Remove a Dedicated Spare Assignment

1. Select the array from which to remove a dedicated spare in the **Array View** section.
2. Select **Options** at the **Disk** menu.
3. Select Remove as Dedicated Spare, then click Confirm.

TIP: *For additional information see Section 2.10, Sparing Options: Disks and Arrays, on page 31.*

4.4.13 Add or Remove Global Spares

If a global spare is being added, make sure there is adequate space on the global spare.

4.4.13.1 Add a Global Spare

1. Select the disk chosen as the global spare in the **Disk List** section.
2. Select **Options** at the **Disk** menu.
3. Select Assign as Global Spare, then click Confirm.

4.4.13.2 Remove a Global Spare

1. Select the disk to be removed as the global spare in the **Disk List** section.
2. Select **Options** at the **Disk** menu.
3. Select Remove as Global Spare, then click Confirm.

4.4.14 Hide an Array

Hide allows the user to hide the array from the operating system.

4.4.14.1 Hide an Array

1. Select the array to hide in the **Array View** section.
2. Select **Hide** at the **Array** menu. The array will disappear from the Array View.

Note: *If the array is currently hidden, select Array > Un-hide to display it.*

4.4.15 Secure Erase

Secure Erase is used for erasing all data on an array and ensuring that it will be unrecoverable, even with advanced data recovery techniques.

Data is Securely Erased By:

- Hiding the array from the OS
- Writing over each region of the disk with 3 patterns (0xAA, 0x55, and random)
- Using a 4th pass with all zeros to ensure that a RAID1 will be consistent

After secure erase is complete, a user can manually delete the array or reuse it. If the user chooses to reuse it, it must be unhidden using the procedure in Section 4.4.14, Hide an Array, on page 66.

CAUTION: *When an array is securely erased, the data on the array is lost.*

4.4.15.1 Securely Erasing an Array

1. Select the array to erase in the **Array View** section.
2. Select **Secure Erase** at the **Array** menu, then click **OK**.

4.5 Working with Views

The View menu allows the user to:

- Refresh the display
- Display the event view
- Display the Application log
- View Controllers
- Theme – Dark, light
- Icon Size – Small, Large
- Font Size – Small, Normal, Large

4.5.1 Display or Hide Controller Event Log Panel

To display or hide the **Controller Event Log**, select **Event View** at the **View** menu. When the **Controller Event Log** panel displays, a checkmark is displayed by the **Event View** option at the **View** menu.

4.5.2 Log Window

The [system name]: **View Log** window displays all the messages generated by RAIDXpert2. All messages are logged, not just the ones enabled at **Options > Notification**.

All messages received from the RAIDXpert2 driver are sent to a message log file. If desired, change the name of this file in the Notification window.

By default, notification events in Windows-based systems are saved to:
`%Program Files%\RAIDXpert2\rc_service.log`

Notification events in Linux-based systems are saved to: `/var/log/rc_service.log`

Select **Log** to view the RAIDXpert2 messages at the **View** menu.

4.5.3 Refresh the Display

Select **Refresh** at the **View** menu to refresh the display.

4.5.4 View Controllers

1. Select **View Controllers** in the **View** menu**.** A window lists the system **Controller List**.
   Note: *The list includes Controller Number, Type, Serial Number, Port Count, PCI Vendor ID, PCI Device ID, PCI SubVendor ID, PCI SubDevice ID, Bus, Slot, Function.*
2. Click **OK** to close the window.

4.6 Working with Options

4.6.1 Event Notifications

The **Event View** section of the **Array Status** window displays the priority listing. The event log priority levels, in ascending order, are indicated in Table 25.

Table 25. Event Log Priority Levels

Event Priority	Description
Low	Displays messages for normal system operations. (This event is not displayed unless requested by the user.)
Informational	Displays information that might be useful to know.
Warning	System user should be informed about this event, but probably does not need to take action.
Critical	The system user must be informed about this event and should take action.
Fatal	The RAIDXpert2 driver is fatally damaged and the RAID subsystem has shut down.

4.7 Transforming a RAIDAble Array

1. In the Array List, select the RAIDAble array
2. Right Click and select Transform
3. Click Same, select (check mark) the selected device(s), set the RAID level, Capacity, then click Commit

Note: *RAIDABLE array is formerly known as RAID Ready array.*

Note: *To create a redundant RAID1 array, the new disk must be the same size or greater than the RAIDABLE disk.*

Chapter 5 rcadm Command Line Interface Tool

5.1 What is rcadm?

The `rcadm` program is a command line interface (CLI) tool for managing RAIDXpert2 in the Windows, Linux, or EFI operating system. See Section 5.8, on page 77, for rcadm.efi Information.

The rcadm program initiates RAIDXpert2 operations, such as:

- Manage RAIDXpert2, arrays and disks (see Section 5.2, Manage Arrays and Disks: rcadm --manage, on page 71).
- Create new arrays (see Section 5.4, Create New Arrays: rcadm --create, on page 76).
- Delete arrays (see Section 5.5, Delete Arrays: rcadm --delete, on page 76).
- Transform arrays (see Section 5.6, Transform Arrays: rcadm --transform , on page 77).
- Follow or monitor arrays and disks (see Section 5.7, Follow or Monitor Arrays and Disks: rcadm --follow, on page 77).
- Information on drive and array states.

The rcadm program has five primary modes, with most primary modes having additional optional arguments. The five modes of operation are indicated in Table 39.

Table 26. Modes for the rcadm Program

Mode	Usage
Manage	Uses the `rcadm --manage` command to manage and query RAIDXpert2, arrays, and disks.
Create	Uses the `rcadm --create` command to create a new array.
Delete	Uses the `rcadm --delete` command to delete arrays.
Transform	Uses the `rcadm --transform` command to transform an array.
Follow	Uses the `rcadm --follow` command to follow or monitor arrays and disks.

Follow these instructions to issue the command on the operating system. Also, see Section 5.3, View Help from the Command Line, on page 75.

5.1.1 To Use rcadm with a Linux® Operating System

By default, rcadm is installed in `/usr/bin`.

5.1.2 To Use rcadm with a Windows® Operating System

- Change directories to `C:\Program Files (x86)\RAIDXpert2`.
- Run the `rcadm.exe` command from there.

  or
- Add `C:\Program Files (x86)\RAIDXpert2` to the system or user path environment variables.

5.2 Manage Arrays and Disks: rcadm --manage

The `rcadm --manage` or `rcadm -M` command allows the user to view information about RAIDXpert2 and manage the arrays and disks.

For example, the user can:

- Set cache attributes for arrays.
- Set priority levels for tasks on an array.
- Hide and unhide arrays.
- List arrays.
- Initialize disks.
- Query information about disks.
- Add and remove spares from an array.
- Set cache attributes for disks.

5.2.1 Understand Query Output

When the `rcadm --manage --query-all or rcadm -M -qa` command is used, information about the disks and arrays for the system is displayed.

To see information about a specific controller, disk, or array use the `rcadm --manage --query` command, in conjunction with the appropriate options.

5.2.2 rcadm Controller List Elements

Table 27. rcadm Controller List Elements

Element	Description
Number	Controller number assigned by RAIDXpert2
Type	Model number of the controller
Serial Number	Serial number of the controller
Port Count	The number of ports supported by RAIDXpert2
PCIe® Vendor ID	The PCIe vendor identification number
PCIe Device ID	The PCIe device identification number
PCIe SubVendor ID	The PCIe sub-vendor identification number
PCIe SubDevice ID	The PCIe sub-device identification number
Bus	PCI bus number, assigned to the controller
Slt	Slot: Position of controller/device on assigned bus, normally 0
Fun	Function: Programming interface presented by controller/device
SAS Address (WWID)	The SAS Address (world-wide identification number)
BIOS Version	The version of the AMD RAID Configuration BIOS

5.2.3 rcadm Disk List Elements

Table 28. rcadm Disk List Elements

Element	Description
Disk	Disk number assigned by RAIDXpert2, corresponding to SATA channel ID.
State	State of the disk (Online, Failed, Unknown)
Disk Type	Disk type (Disk, Legacy, New, ATAPI)

Table 28. rcadm Disk List Elements (continued)

Element	Description
Port Type	Port type (SATA, SATA II, SATA III, SSD, NVMe)
Port Speed	The negotiated speed of the port **Note:** For NVMe the port type is always N/A.
Size	Total size of the disk: • 1 MB = 1,000,000 bytes • 1 GB = 1,000,000,000 bytes **Note:** Because the ATA storage industry has standardized the meanings of MB as 1,000,000 bytes and GB as 1,000,000,000 bytes, RAIDXpert2 reports the same units.
Free Space	Total amount of space unused on the disk
Largest Free Space	Largest contiguous unused space on the disk
GS	Indicates if the disk is assigned as a global spare
Trim	None, Simple, Advanced
Informed Hot Swap	Indicates whether a disk supports live disconnect and removal.
Ca	Current disk cache setting (NC = No Cache, R = Read Cache, W = Write Back Cache, RW = Read + Write Back Cache). **Note:** For NVMe the CA is always NC.
Ctrl Chan	Disk controller and channel number.
Vendor	Disk vendor
Model Number	Disk model number
Firmware Version	Disk firmware version
Serial Number	Disk serial number

5.2.4 rcadm Array List Elements

Table 29. rcadm Array List Elements

Element	Description
A	Array number assigned by RAIDXpert2.
Type	RAID type.
O.S. Name	Name assigned by the operating system to the array. The name shows as "Hidden" if the array is hidden from the operating system. The name shows "??" if the array is Offline.
Sys or System Device	Indicates whether or not the array is being used as a system disk under Windows.
State	State of the array (Normal, Critical, Offline).
Size or Capacity	Total size of the disk: • 1 MB = 1,000,000 bytes • 1 GB = 1,000,000,000 bytes **Note:** Because the ATA storage industry has standardized the meanings of MB as 1,000,000 bytes and GB as 1,000,000,000 bytes, RAIDXpert2 reports the same units.
Hide	Whether the array is hidden from the operating system.
Id	Globally unique identifier for the array assigned by RAIDXpert2.
Task	Task type (Transform, Check, Check_Bitmap, Not_Active, Create, Restore) **Note:** See Section 2.7, Array Tasks: Starting and Stopping Tasks, on page 27 for detailed definitions.
Task State	The state of the task (Started, Paused, Completed)
%	The progress of a current array task, such as a Create or Transform, shown as percent complete
CA	Current array cache setting (`NC`=No Cache, `R`=Read Cache, `W`=Write Back Cache, `RW`=Read + Write Back Cache).

Table 29. rcadm Array List Elements (continued)

Element	Description
CTS	Cache tag size specifies the amount of data per disk in a stripe. Supported sizes are 64kB, 128kB or 256kB Any Array with only HDD/SSD will have default CTS of 64k Any Array with NVMe/HDD/SSD will have default CTS of 256k
Scan	Background scan enabled (Yes/No)
Name	User-supplied name for the array
Dedicated Spare	Indicates the number of dedicated spares assigned to the array (`--verbose` mode only)
Disk	Listing of disks that are part of the array
Used	Capacity used of a specific disk
Offset	Location on the disk where the array begins

5.3 View Help from the Command Line

5.3.1 To view a List of the Major Modes of Operation

Type: `rcadm --help` or `rcadm -?`

5.3.1.1 To View Help for a Specific Mode and its Options

Type: `rcadm <mode> --help` or `rcadm < mode> -?`

For example, typing `rcadm --manage --help` or `rcadm -M -?` displays help and examples regarding that specific mode and its options.

5.3.1.2 To view the rcadm Man Page on a Linux® System

Type: `man rcadm`

5.4 Create New Arrays: rcadm --create

The `rcadm --create` or `rcadm -C` command allows new arrays to be created. As many as twelve arrays can be partitioned and created across all disks.

Portions of disks can be used to create arrays, while other arrays are using different portions of the same disks. A maximum of twelve arrays can be created.

5.4.1 Before You Begin

Creation of arrays, even redundant arrays, allows users immediate access to the arrays. If the system reboots, the creation process continues where it left off.

CAUTION: *In some circumstances, more than twelve arrays are possible. They might appear to function properly but are not supported.*

Note: *The ability to create RAID10 or RAIDABLE arrays may not be available on your system.*

5.4.2 Example

To create a 1 GB RAID1 array using disk members 1, 2, and 3, type:
`rcadm -C -r1 -d 1 2 -s 1000`

To see more examples, type: `rcadm -C -?`

5.5 Delete Arrays: rcadm --delete

The `rcadm --delete` or `rcadm -D` command allows the user to delete one or more arrays.

CAUTION: *Deleting an array permanently destroys all data that is on the array. This action cannot be undone and it is very unlikely the data can be recovered.*

5.5.1 Before You Begin

- If the operating system is using an array it cannot be deleted.
- If an array is accidentally deleted, and the user wants to try and recover the data, create an array using the same disks, same size, and same cache, and use the --leave-existing-data option. This option writes new configuration information to the array while trying to use the exact same disk space as before.

5.5.2 Example

To delete array 1, type: `rcadm -D -a 1`

To see more examples, type `rcadm -D -?`

5.6 Transform Arrays: rcadm --transform

The `rcadm --transform` or `rcadm -T` command allows the user to transform (migrate) an array from one RAID level to almost any other RAID level, and to expand the array dynamically, even under I/O load.

5.6.1 Before You Begin

- An array cannot be transformed to a smaller-sized array. New arrays must be either the same capacity or larger.
- When using the task control option, a Transform can only be paused or resumed but not removed.
- If a spare has been assigned to the destination array, a fail-over task starts as soon as the Transform completes, provided the spare is available after the Transform.
- If there are multiple arrays on a single controller, it might not be possible to transform some of the arrays to a larger size. If the size of an array might be expanded in the future, it is best to configure the available space as a single array.

5.7 Follow or Monitor Arrays and Disks: rcadm --follow

The `rcadm --follow` or `rcadm -F` command allows the user to follow or monitor arrays and disks. It polls the RAID subsystem for any status changes and logs them in the **Windows System Event Log**.

5.7.1 Before You Begin

It is recommended that the user not run more than one instance of rcadm --follow at the same time. If the user runs more than one instance of the command, each instance captures some of the events, but no single instance captures all events.

5.8 rcadm.efi Information

The following list of commands is a partial reference; it is not complete. Use the command prompt query for the complete list of commands.

5.8.1 rcadm -?

`-?, --help`

Displays all primary rcadm commands, or if used after an option, displays help for that specific option.

`-log, --log-file`

Print output to a log file as well as standard output. Requires a log file name argument. Overwrites existing file. Only one occurrence of this option on the command line is allowed.

Example: rcadm -M -qa -v -log status.txt

`-C, --create`

Command for creating arrays. Array types include linear (JBOD), volume (JBOD), RAID0, RAID1, RAID10, RAID10n, and RAIDABLE. Some of the major functions include assigning spare disks; setting array size; and setting cache attributes.

`-D, --delete`

Command for deleting arrays. This mode does not have any optional arguments.

`-M, --manage`

Commands for managing and querying controllers, arrays, and disks. Some of the major functions include querying for information, adding and removing dedicated and global spare disks, setting cache attributes for arrays and disks, performing consistency checks on redundant array types, initializing disks, prioritizing tasks for arrays, scanning arrays and disks for changes in status, and hiding or unhiding arrays.

5.8.2 rcadm -M

MANAGE

`-a, --array`

Used with certain options to specify arrays.

`-as, --add-spare`

Adds a dedicated spare disk to an array. No space is reserved on the disk selected.

`-rs, --remove-spare`

Removes a dedicated spare disk from an array.

`-ras, --remove-all-spares`

Removes any spares from an array.

`-ags, --add-global-spare`

Adds a disk as a global spare. No space is reserved on the disk selected.

`-rgs, --remove-global-spare`

Removes a global spare disk.

`-ca, --cache-array`

Sets the cache attributes for an array. Cache attributes include read cache (r), read and write-back cache (rw), write-back cache (w), and no cache (nc).

`-cd, --cache-disk`

Sets the cache attributes for a disk. Cache attributes include read cache (r), read and writeback cache (rw), write-back cache (w), and no cache (nc).

`-d, --disk`

A required qualifier used with certain options to specify disks.

`-h, --hide`

Hides an array from the operating system.

`-uh, --unhide`

Unhides an array, making it visible to the operating system.

`-id, --initialize-disk`

Initializes a disk. If the disk is new and has not been used, you must initialize it before you can create arrays.

`-cm, --clear metadata`

Clears metadata from a disk. Disk is no longer usable in RAID arrays until it is initialized.

`-n, --name`

Identifies an array with a user-supplied name. The name can be up to 30 characters, but only 17 of those characters display in the BIOS.

`-p, --priority`

Sets an array's task priority from 1-10, with 10 being the highest priority.

`-ptr, --prepare-to-remove`

Prepares an array and its devices to be physically removed from the system. This action hides the array operating system.

`-q, --query`

Lists information about specific controllers, arrays, and disks.

`-qa, --query-all`

Lists information about controllers, arrays, and disks.

`-v, --verbose`

Modifier of the --query and --query-all option. Specifies more detail for arrays and disks.

`-rsc, --rescan`

Rescans the serial ATA (SATA) channels for new or removed disks.

`-ej, --eject`

Ejects (prepares for removal) a specified disk.

`-sg, -- smart-get`

Reads SMART attribute and log information for the specified drive(s).

`-sa, --scan-array <on|off>`

Specifies if background array scan scanning is on or off.

`-sp, --smart-poll`

Turns SMART polling on or off for the specified drive(s).

`-t, --task`

Used to pause, resume, and remove tasks.

`-ul, --unlink`

Unlinks two arrays linked through a create copy operation.

SYNTAX and EXAMPLES

ADD SPARE

```
--add-spare –array <list> --disk <list>
-as –a <list> -d <list>
```

Examples: `rcadm –manage –add-spare –array * --disk 1`

`rcadm -M -as -a 1 2 -d 5 6`

REMOVE SPARE

```
--remove-spare –array <list> --disk <list>
-rs -a <list> -d <list>
```

Examples: `rcadm –manage –remove-spare –array 5 –disk *`

`rcadm -M -rs -a * -d 5`

REMOVE ALL SPARES

```
--remove-all-spares –array <list>
```

```
-ras -a <list>
```

Examples: `rcadm –manage –remove-all-spares –array 5`

```
rcadm -M -ras -a *
```

ADD GLOBAL SPARE

```
--add-global-spare –disk <list>
-ags -d <list>
```

Examples: rcadm –manage –add-global-spare –disk 1 2 3

```
rcadm -M -ags -d *
```

REMOVE GLOBAL SPARE

```
--remove-global-spare –disk <list>
-rgs -d <list>
```

Examples: rcadm –manage –remove-global-spare –disk *

```
rcadm -M -rgs -d 5
```

CACHE SETTINGS FOR ARRAYS

```
--cache-array <cache_attribute> --array <list>
-ca <cache_attribute> -a <list>
```

Cache attributes: `<r>` for read cache

`<rw>` for read and write-back cache

`<w>` for write-back cache

`<nc>` for no cache

Examples: `rcadm –manage –cache-array rw –array *`

```
rcadm -M -ca nc -a 1
```

Note: `rcadm -M -rsc` *is required for the change to be presented to the OS.*

DISK SETTINGS (Advanced)

Disk cache:

```
--cache-disk <cache_attribute> --disk <list>
-cd <cache_attribute> -d <list>
```

Cache attributes: `<r>` for read cache

`<rw> for read and write-back cache`

`<w> for write-back cache`

```
      <nc> for no cache
```

Examples: `rcadm –manage –cache-disk r –disk 1 2 3`

```
  rcadm -M -cd w -d *
```

HIDE ARRAY

```
--hide –array <list>
-h -a <list>
```

Examples: rcadm –manage –hide –array 5 6

```
  rcadm -M -h -a 4
```

UNHIDE ARRAY

```
--unhide –array <list>
-uh -a <list>
```

Examples: `rcadm –manage –unhide –array *`

```
  rcadm -M -uh -a 5
```

INITIALIZE DISK

```
--initialize-disk –disk <list>
-id -d <list>
```

Examples: `rcadm –manage –initialize-disk –disk *`

```
  rcadm -M -id -d 1 2 3
```

NAME ARRAY

```
--name “name” –array <list>
-n “name” -a <list>
```

Examples: `rcadm –manage –name “System Disk” –array 5`

```
  Rcadm -M -n “Backup Disk” -a 4
```

PREPARE TO REMOVE ARRAY

```
--prepare-to-remove --array <list>

-ptr -a <list>
```

Examples: `rcadm --manage --prepare-to-remove --array 2`

```
  rcadm -M -ptr -a 4
```

QUERY

```
--query [--array <list>] [--disk <list>]
  [--verbose]
-q [-a <list>] [-ct <list>] [-d <list>] [-v]
```

Examples: `rcadm --manage --query --array 1 --disk --verbose`

`rcadm -M -q -a 1 2 3 -d -v`

QUERY ALL

```
--query-all
-qa
```

Example: `rcadm --manage --query-all`

EJECT DEVICE

```
--disk <list>
```

Example: `rcadm -M --eject --disk *`

`rcadm -M -ej -d 1 2`

RESCAN DISKS

```
--rescan
-rsc
```

Example: `rcadm --manage --rescan`

SMART GET

```
--smart-get --disk <list> {--log-number <log_number=0..5> | --
attributes}
-sg -d <list> {-l <log_number=0..5> | -at}
```

Example: `rcadm --manage --smart-get --overview --log-number * --disk *`

`rcadm --manage --smart-get --attributes --disk 1 2`

SCAN ARRAY

```
--scan-array <on|off> --array <array_number>
-sa <on|off> -a <array_number>
```

Example: `rcadm -M --array 1 --scan-array on`

`rcadm -M -a 1 -sa off`

SMART POLL

```
--smart-poll <on|off> --disk <list>
-sp <on|off> -d <list>
```

Example: `rcadm --manage --smart-poll on --disk`

`rcadm -M -sp off -d 1 2 3`

TASK CONTROL

```
--task <task_operation> --array <array_number>
-t <task_operation> -a <array_number>
```

Task Operation

<pause> to temporarily pause a task

<resume> to continue running a task

<remove> to permanently remove a task

Examples: `rcadm --manage --task pause --array 5`

`rcadm -M -t remove -a 4`

TASK PRIORITY

```
--priority <1..10> --array <list>
-p <1..10> -a <list>
```

Examples: `rcadm --manage --priority 5 --array 6`

`rcadm -M -p 1 -a`

UNLINK ARRAY

```
--unlink --array <array_number>
-ul -a <array_number>
```

Examples: rcadm --manage --unlink --array 2

`rcadm -M -ul -a 5`

5.8.3 rcadm -C

CREATE

Long form:

```
rcadm --create <raid_type> --disk <list> [--size <size_mb>]
      [--sub-member <num>] [--spare-disk <list>]
      [--no-sync] [--d-spare] [--cache <r,rw,w,nc>]
      [--max-size] [--name "name"] [--priority <1..10>]
      [--zero][--scan-array]
```

Short form:

```
rcadm -C <raid_type> -d <list> [-s <size_mb>] [-sub <num>]
      [-sp <list>] [-ns] [-ds] [-ca <r, rw, w, nc>] [-ms]
      [-n "name"] [-p <1..10>] [-z] [-sa] }
```

RAID Types:

`--volume, -v` Single disk or concatenation of disks (JBOD)
`--raidable, -ra` Single disk, RAIDABLE
`--raid0, -r0` Stripe of two or more disks

`--raid1, -r1` Mirror of two disks
`--raid5, -r5` Stripes data as well as parity, across all disks in the array
`--raid10, -r10` Stripe set of mirror sets

OPTIONS

`-sp, --spare-disk`
Specifies the dedicated spare disk or disks to assign, with a maximum of four. No space is reserved on the selected disks.

`-s, --size`
Specifies the size of the array in MBs. If you do not use this option, the largest possible size is used by default.

`-ns, --no-sync`
Disables background synchronization of redundant types when creating the array.

`-ca, --cache`
Specifies a cache setting for the array(s): read cache <r>, read and write-back cache <rw>, write-back cache <w>, or no cache <nc>. The default is read and write-back cache <rw>.

`-cts, --cachetagsize`
Specifies the Cache Tag Size. This is the amount of data per disk in a stripe. Supported sizes are 64, 128, or 256; sizes in kB.

Please refer to Table 14, Default Cache Tag Size, on page 37.

`-ms, --max-size`
Prints the maximum possible size for an array without actually creating an array.

`-n, --name`
Identifies an array with a user-supplied name. The name can be up to 30 characters, but only 17 of those characters display in the BIOS.

`-p, --priority`
Sets the background initialization task priority from 1 to 10, with 10 being the highest priority. For redundant array types only.

`-led, --leave-existing-data`
Leaves the existing data on the disks untouched after the array is created. This option can be used to try to recover user data when an array has been accidentally deleted or the configuration information is lost but the data is still intact. Unless you immediately recreate the array after deleting it and no other tasks have been performed, the likelihood of recovering data with this method is very low.

`-d, --disk`

A required qualifier used with the --create option to specify the disk or disks to be included in the array.

`-sa, --scan-array`
Specifies that a background array scan should be continuously run whenever the array is idle (Default is off).

`-z, --zero`
Zero the array in the foreground. This method is faster than doing a background consistency verifies if the array is a redundant type. For non-redundant types, the zero option can be used to verify all blocks in the array can be accessed.

EXAMPLES

Example: Create a RAID1 set of the maximum possible size using all disks.

```
rcadm -C –raid1 --disk *
```

Example: Create a RAID1 set of the maximum possible size, with a spare disk and without a background initialization task.

```
rcadm -C --raid1 --spare-disk 3 --disk 1 2 --no-sync
```

5.8.4 rcadm -D

DELETE

Long form:

```
--delete --array <list> [--no-ask]
```

Short form:

```
-D -a <list> [-na] [-cg <group number>]
```

OPTIONS

```
-na, --no-ask
```

If the no ask option is specified the array is deleted without confirmation.

EXAMPLES:

Example: Delete arrays 1 and 2.

```
rcadm -D --array 1 2
```

Example: Delete all arrays.

```
rcadm -D --array
```

Chapter 6 Troubleshooting

6.1 Troubleshooting

The chapter discusses major categories of troubleshooting:

- Problems with system startup.
- Warning messages that might appear at the Power-On Self-Test (POST) screen.
- Problems with arrays.
- Problems with disks.
- Template for adding the warning message when someone tries to create a RAID5 on a system that is not supported.

Note: *When booting from an AMD RAID boot array, it takes about 4 seconds longer than a native installation to boot.*

6.2 System Startup Problems

This section correlates possible startup issues and corrective actions for system boot.

Table 30. System Does Not Boot

Possible Causes	Corrective Actions
Controller mode is set incorrectly during system startup	In the system's BIOS screen, ensure SATA is set to RAID and NVMe RAID is set to Enabled.
A bootable array is in an Offline state	Restart the system. Enter the system's BIOS screen. Check the state of the bootable array. Check for missing or offline disks.

Table 31. System No Longer Boots in Linux

Possible Causes	Corrective Actions
AMD RAID Drivers are not synchronized with the Linux Kernel.	Synchronize the drivers with kernel: 1. Click the Terminal icon. a. Enter: `yum update` b. Enter: `yum groupinstall "Development Tools"` ***Warning:*** *If the system kernel version is updated, perform step 2 before the system is rebooted. Failing to do so may result in the system failing to boot.* 2. Change to the RAIDXpert2 `driver_sdk` directory, and enter: a. Enter: `cd /opt/raidxpert2/driver_sdk` b. Enter: `sudo ./install` 3. Wait for the command to complete, then reboot the system. *For more information see the below Linux Quick Start Guides:* • AMD RAID™ Quick Start Guide for Red Hat® (RHEL) Operating System, order #56963 • AMD RAID Quick Start Guide for Ubuntu Desktop Operating System, order #56966

Table 32. BIOS Configuration Utility Does Not Display

Possible Causes	Corrective Actions
The controller mode is set incorrectly in the system BIOS	In the system's BIOS screen, ensure SATA is set to RAID and NVMe RAID is set to Enabled.
Possible Causes	Native AHCI installation.
Corrective Actions	A Native AHCI installation will not boot into the OS, after changing the BIOS settings to RAID mode.

6.3 Array-Related Errors

Table 33. Cannot Create an Array

Possible Causes	Additional Information	Corrective Actions
The disk is not displayed.	The controller cannot communicate with the disks.	See Section 6.4.1, Troubleshooting Disks, on page 93.
Insufficient free space available on the selected disks		Select a different combination of disks.
Incorrect number of disks selected for the desired RAID level	See 2.2**,** RAID Levels**,** on page 23, for a description of RAID levels and the allowable number of disks used with each RAID level.	Select the correct number of disks.

Table 33. Cannot Create an Array (continued)

Possible Causes	Additional Information	Corrective Actions
The desired disk is unavailable.	The disk is a dedicated spare for a different array. The disk is full. The disk's available capacity is insufficient.	Select a different disk.
The disk has SMART errors.	An array can contain a SMART error device, that has started to report SMART errors after the Array was created. RAIDXpert2 cannot be used to create an array with a disk that has SMART errors.	Replace the SMART error device
The system already has a maximum of twelve arrays		Delete unused arrays. ***CAUTION:*** *Deleting an array permanently destroys all data on the array. This action cannot be undone. It is unlikely data can be recovered.*

Table 34. An Array is in a Critical State

Possible Causes	Additional Information	Corrective Actions
One or more disks in the array have failed or been removed.	Due to the failed disk or disks, the array no longer maintains redundant (mirrored or parity) data. The failure of an additional disk results in an Offline state and lost data.	See Section 6.4.1, Troubleshooting Disks, on page 93.

Table 35. An Array is in an Offline State

Possible Causes	Additional Information	Corrective Actions
The array has lost the maximum allowable disks per RAID level.	One or more disks have failed. • If the array is non-redundant, the failure of a single disk causes the array to fail. • If the array is redundant, the failure of two or more disks causes the array to fail. The array cannot be restored (rebuilt).	See Section 6.4.1, Troubleshooting Disks, on page 93.

Table 36. Cannot Assign a Dedicated Spare to an Array

Possible Causes	Additional Information	Corrective Actions
The RAID level does not allow dedicated spares.	Dedicated spares cannot be created for Volume or RAID0 arrays.	• Create an array with a different RAID level and assign a dedicated spare. • Create a global spare.
The designated disk does not have sufficient capacity to be a dedicated spare	The capacity of the disk selected to be a dedicated spare must be equal to or larger than the capacity of the smallest disk in the array.	Select a different disk.

Table 37. Cannot Create a Global Spare

Possible Causes	Additional Information	Corrective Actions
The disk is already part of an array	A global spare cannot be selected if it is already part of an existing array.	Select a different disk.
There are no empty disks available or the disks have not been initialized	A disk with a legacy state can be initialized, if desired, but it is no longer legacy (initialization adds RAIDXpert2 configuration information to the disk).	Install additional disks. Initialize the disks. ***CAUTION:*** *When a disk is initialized, all data on the disk is lost.*
The disk assigned as the global spare has failed or is missing.		See Section 6.4.1, Troubleshooting Disks, on page 93.

Table 38. Recreate a Deleted Array

Possible Causes	Additional Information	Corrective Actions
An array(s) was accidentally deleted, or the wrong array was deleted	This procedure might recreate a deleted array and with its data intact. However, this is not guaranteed to occur. If I/O was running to the deleted array(s) just prior to it being deleted, there might be some data loss in the recreated array(s). If multiple arrays were deleted, all of the deleted arrays must be recreated in order to recover the desired array.	1. At the Array pop-up menu, select **Create**. 2. Create a new array using the same settings as the deleted array. • The same disks. • The same RAID type (RAID level). • The same capacity. • The same cache options. 3. Check Leave Existing Data Intact. 4. Click **Create**. 5. Ensure the settings are the same as the deleted array: • The same drive letter. • The same RAID type (RAID level). • The same disks. • The same capacity. • The same cache option 6. Check the data files of the array for corrupted or missing files, incorrect file extensions, and so on.

Table 39. Deleted Secondary Array Availability Using HII During Hibernation Resume

Possible Causes	Corrective Actions
Array(s) are seen online in Operating system after array deletion in RAIDXpert2 Configuration Utility (HII) during hibernation resume.	After array deletion in RAIDXpert2 Configuration Utility (HII) during hibernation resume, system needs to be reset for the changes to take effect.

6.4 Disk Related Errors

Table 40. Disk Errors

Possible Causes	Additional Information	Corrective Actions
A disk has been removed from an array		See Section 6.4.1, Troubleshooting Disks.
A disk is not visible in the BIOS Configuration Utility or is offline		
RAIDXpert2 cannot communicate with the spare	The dedicated spare is not visible in the BIOS Configuration Utility or is offline.	
The disk cannot be initialized	Only disks that are Ready can be initialized. ***CAUTION:*** *When a disk is initialized, all data on the disk is lost.*	• Ensure disk is not already a member of an array. • Ensure disk is still assigned as a global or dedicated spare. • Ensure disk is reporting a Ready state.

6.4.1 Troubleshooting Disks

Perform the following actions when there may be a problem with a disk.

- Ensure there is no damage to the system's backplane.
- Ensure all cables are installed correctly.
- Ensure the disk is seated correctly in the backplane or bay and the latch is secured.
- Reinsert the disk.
- Replace the disk.
- After reconnecting, reseating, reinserting, or replacing a disk, perform a re-scan and initialize the disk.

CAUTION: *When a disk is initialized, all data on the disk is lost.*

If problems with a disk caused an array to go Critical, it may be necessary to also assign a dedicated or global spare for the array.

If problems with a disk caused an array to go Offline, data may have been lost. Recover lost data from a backup storage source.

Chapter 7 Safety Precautions

This section includes general safety precautions and specific RAIDXpert2 precautions. Many are shown in context throughout this guide. Read and keep this guide for future reference.

In this section, *CAUTION* indicates that a failure to follow directions could result in damage to equipment or data.

7.1 Storage Device Precautions

CAUTION: *Assigning a dedicated spare does not reserve space on the disk. Therefore, an automatic restore is not guaranteed if a disk fails. If a disk fails, create space on the disk for the fail-over to complete, or assign a different disk with enough space. If a dedicated spare is assigned and a disk fails, the restore process starts automatically if there is enough space available on the dedicated spare.*

CAUTION: *It is recommended to create only one array for the OS installation. If more arrays are needed, they can be created in the OS GUI/CLI or HII, after the OS installation completes.*

CAUTION: *If a disk is part of an AMD RAID array, the disk cannot be selected for initialization. To initialize the disk anyway, delete the AMD RAID array. Data on the disk is deleted during initialization, so ensure the correct disks are chosen to initialize.*

CAUTION: *A legacy disk can contain valid data. When a legacy array is deleted, or when its corresponding legacy disk is initialized, the data is lost.*

CAUTION: *When a disk is initialized, all data on the disk is lost.*

CAUTION: *AMD recommends not using SMR hard drives with AMD RAID systems because it can cause poor performance or failures. SMR drives are not suitable for workloads that require many random writes (such as boot drive). If used with RAID, the multiple SMR drives and background RAID tasks (such as creates and rebuilds) compound any issues or problems.*

General notes and guidelines:

- *Volume, RAID0, RAID5, or RAID10 arrays can be created or transformed by a maximum of eight (8) NVMe and/or SATA disks.*
- *RAID1 can be created or transformed by a maximum of two (2) NVMe and/or SATA disks.*
- RAID on AMD platforms supports M.2 ports, both AMD SATA controller and PCIe M.2 NVMe. At any time, each M.2 port can support either M.2 SATA or M.2 NVMe, but not both.

- Individual disks that are not part of a RAID array are not listed in Device Manager under the Disk Drive section. Individual Disks can be managed through the RAIDXpert2 UWP-based interface (Windows only), RAIDXpert2 utility (HII), and the EFI shell.
- Instead of a shutdown, AMD recommends performing a reset/reboot of the system whenever the user is adding or moving a SATA M.2 SSD or NVMe device(s).
  - In the OS, issue a reset/reboot.
  - Wait for the AMD BIOS screen to display, press `ESC` to enter the BIOS.
  - Power off the system.
  - Install or remove the necessary device(s).
  - Power on the system and allow the OS to boot properly.
- When "NVMe RAID" = enabled, all NVMe devices connected to the system are controlled by the AMD RAID driver (includes all U.2 NVMe drives, M.2 NVMe drives, and PCIe NVMe add-in cards).
- When SATA = RAID, all SATA devices connected to the system are controlled by the AMD RAID driver (includes all HDD, SSD, ATAPI devices).

7.2 Array Precautions

CAUTION: *Windows can only be installed to the first AMD RAID array.*

CAUTION: *Deleting an array permanently destroys all data that is on the array. This action cannot be undone, and it is very unlikely the data can be recovered.*

CAUTION: *Do not delete the first array listed in the Arrays section if it is the AMD RAID bootable array. Doing this deletes the operating system and AMD RAID files.*

CAUTION: *Do not initialize a disk that is part of an array. Initializing a disk in a non-redundant array deletes the array and its data. The array no longer appears in Array View. This is especially true for a non-redundant bootable array. Initializing a disk in a non-redundant bootable array causes the array to fail and deletes the operating system, AMD RAID files, and device drivers.*

CAUTION: *Leaving Write Back Cache enabled can increase the likelihood of data being corrupted if the system experiences a power interruption or unexpected shutdown.*

CAUTION: *In Windows®, prior to removing an array, remove its drive letter.*

CAUTION: *In Linux®, prior to removing an array, unmount the array.*

CAUTION: *All data contained in an AMD RAID array are lost if any member of the array is migrated to a non-AMD RAID system.*

CAUTION: *When an array is securely erased, the data on the array is lost. The array remains hidden after the secure erase completes. The user must unhide the array for it to be available for data operations.*

CAUTION: *In some circumstances, more than twelve arrays are possible. They might appear to function properly but are not supported.*

CAUTION: *If the user creates an array using Skip Initialization, any new data written is redundant. But if a Consistency Check is performed, errors may be reported because the unwritten areas of the array have not been made consistent.*

CAUTION*: AMD RAID does not support Thunderbolt (TBT) devices.*

CAUTION*: It is recommended that NVMe hotswap actions are performed via RAIDXpert2, not systray.*

7.3 Controller Precautions

CAUTION: *Hot-swapping is not recommended for disks that are part of AMD RAID boot array.*

CAUTION*: A Native AHCI installation does not boot into the OS after changing BIOS settings to RAID mode.*