



HPE MSA 2062 Storage Array QuickSpecs

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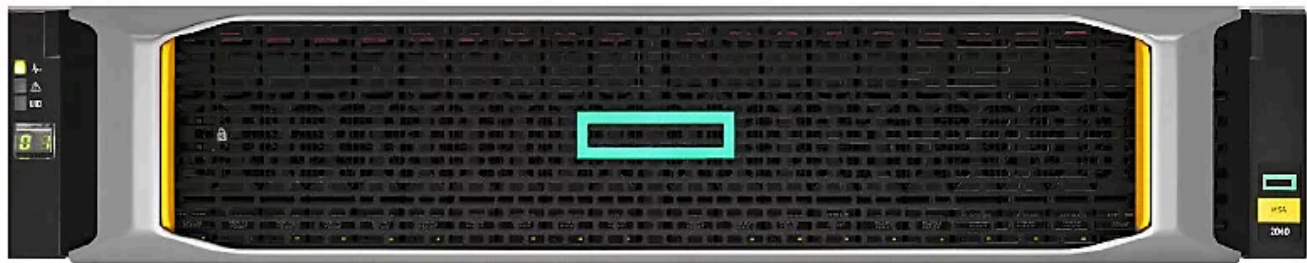
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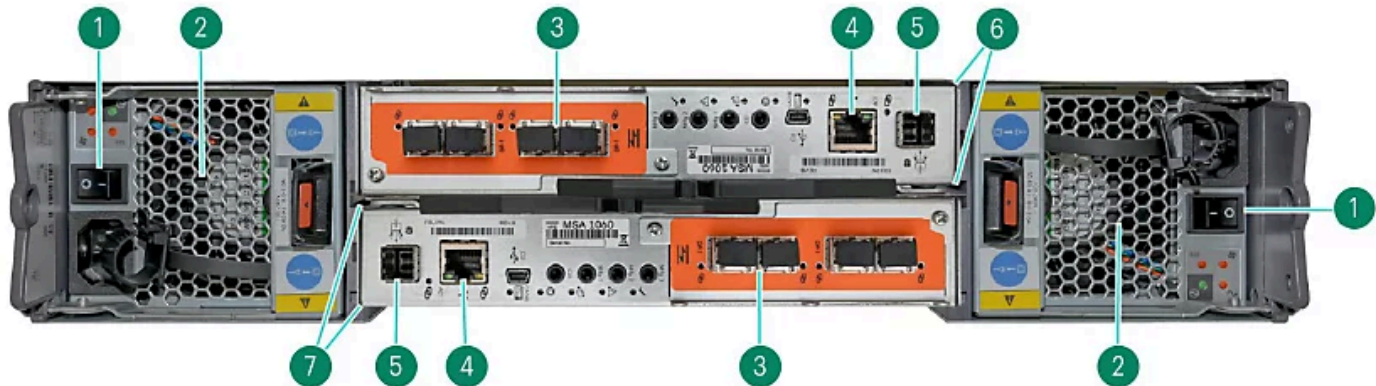
Looking for seriously simple and affordable flash storage? The HPE MSA 2062 Storage is a flash-enabled system designed for affordable application acceleration for small and remote office deployments. Do not let the low cost mislead you.

The MSA 2062 gives you the combination of simplicity, flexibility, and advanced features you may not expect in an entry-priced storage array. Starting with 3.84 TB of embedded flash capacity, you can scale the system from there with any combination of Solid-State Disks (SSD), high-performance Enterprise SAS HDDs, or lower-cost Midline SAS HDDs. Capable of delivering up to 395,000 IOPS, the MSA 2062 also provides great value with an all-inclusive software suite and 3.84 TB of flash capacity included. It's seriously simple and affordable flash storage to help you achieve high performance yet meet challenging budgets.

Overview



HPE MSA 2062 Storage



HPE MSA 2062 Storage

Item	Description	Item	Description
1.	Power Switch	5.	12 Gb SAS expansion port
2.	Redundant Power and Cooling Module (AC or DC)	6.	Controller A (Inverted)
3.	Host connection ports (8/16 Gb FC, 10/25GbE iSCSI, 1/10GBase-T iSCSI, or 12 Gb SAS depending on model)	7.	Controller B
4.	Ethernet management port		

What's New

- HPE MSA Smart Choice Options delivering flexibility in scaling HPE MSA Smart Choice array configurations.
- HPE Smart Choice MSA Gen6 hybrid-flash storage array bundles with 32TB of raw storage capacity included, supporting 16Gb Fibre Channel, 10GbE iSCSI, and 12Gb SAS host connectivity.
- HPE MSA 24 TB SAS 7.2K LFF HDD option available as a single drive or 6-pack HDD bundle. Increases MSA 2062 array maximum raw capacity to 2.76 PB with up to nine additional MSA 2060 LFF Drive Enclosures added.
- HPE MSA Storage certification as a Backup Repository to provide seamless protection and Instant VM Recovery with Veeam Backup and Replication.
- NEBS certification for HPE MSA Gen6 16 Gb FC and 12 Gb SAS SFF storage arrays and the MSA 2060 SFF Drive Enclosure.

MSA 2062 Storage Models

Description	SKU
HPE MSA 2062 16Gb Fibre Channel SFF Storage	ROQ80B
HPE MSA 2062 10GbE iSCSI SFF Storage	ROQ82B
HPE MSA 2062 12Gb SAS SFF Storage	ROQ84B
HPE MSA 2062 10GBASE-T iSCSI SFF Storage	R7J71B

Notes:

- Includes an MSA 2060-branded SFF array chassis, two MSA 2060 controllers, two 1.92 TB Read Intensive SSDs, one Advanced Data Services LTU (preinstalled on the array), two AC power supplies, two 1.5m PDU cords (IEC C13/C14), one rack-mount kit.
- SFPs are not included in the base Storage Systems.
- All MSA 2062 Fibre Channel and 10GbE iSCSI array models must use the appropriate Gen6 SFP option – please review “Configuration Information” section for further details.
- All SKUs ending in “B” include the new 94% efficient power supply that meets EU Lot9 power efficiency requirements.

MSA 2062 Smart Choice Array Models

Description	SKU
HPE MSA 2062 SFF 2x16Gb FC 4-port Controller 12x2.4TB HDD 4x16Gb SFP FC XCVR 32TB Storage Array	P84170-B25
HPE MSA 2062 SFF 2x10GbE iSCSI 4-port Controller 12x2.4TB HDD 4x10Gb iSCSI XCVR 32TB Storage Array	P84171-B25
HPE MSA 2062 SFF 2x12Gb SAS 4-port Controller 12x2.4TB HDD 32TB Storage Array	P84172-B25

Notes:

- Includes an MSA 2060 SFF Array Chassis, two MSA 2060 controllers, two AC power supplies, two 1.5m PDU cords (IEC C14), and one rack-mount kit.
- Each model includes two 1.92TB Read Intensive (RI) SFF SSDs, twelve 2.4TB 10K SFF HDDs, and one 4-pack of supported SFP transceivers (excluding 12Gb SAS models)
- All models include 94% efficient power supplies that meet EU Lot9 power efficiency requirements.

Standard Features

HPE MSA 2062 Storage

Array

Access Type	Block
Form Factor	2U, SFF or LFF
Number of controllers per array	2
Number of host ports per array	8
FC host connectivity	8/16 Gb
iSCSI host connectivity (IPv4 and IPv6)	10/25 GbE (SFP) 1/10GBase-T (RJ-45)
SAS host connectivity	12 Gb

Cache, per array

Max Read cache per array	8 TB
Data (read/write) cache + system memory per array	24 GB
Pool Capacity	Two (2) Pools 4 PiB addressable capacity per pool 1,708 TiB* Useable capacity per system Notes: *Using 24x 1.92 TB SSDs (Pool A) and 108x 24 TB HDDs (Pool B), in RAID MSA-DP+ with recommended sparing
RAID Levels supported:	RAID 0*,1, 5, 6, 10, MSA-DP+ Notes: *Read Cache Only

Enclosures

Expansion Drive Enclosures	0-9 enclosures
LFF/SFF array/enclosure mixing	Supported
Maximum number of drives per array enclosure	24 SFF or 12 LFF
Maximum number of drives per drive enclosure	24 SFF or 12 LFF

HPE MSA 2062 Storage

Drive enclosure interface type	12 Gb SAS
Drives	
Maximum total HDDs per array	238 SFF / 108 LFF (All models ship standard with 2 factory integrated SFF SSDs; LFF media added via MSA 2060 LFF Drive Enclosure)
Maximum total SSDs per array	240 SFF / 108 LFF
Max raw capacity per array enclosure	172.8 TB SFF
Max raw capacity per drive enclosure	184.32 TB SFF / 288 TB LFF
Max raw capacity per array	1,831.68 TB (All SFF) / 2,764.8 TB (SFF array + All LFF drive enclosures)
Drive Capacities	
SFF SSDs	960 GB, 1.92 TB, 3.84 TB, 7.68 TB
LFF SSD	1.92 TB
SFF HDDs	10 K: 600 GB, 1.2 TB, 1.8 TB, 2.4 TB
LFF HDDs	7.2 K: 6 TB, 8 TB, 12 TB, 16 TB, 20 TB, 24 TB
Software Features	
Thin Technologies	Thin Provisioning, Space Reclamation, Thin Rebuild
Tiering	Performance Tier, Standard Tier, Archive Tier
Replication	Snapshots (512), Volume Copy, Remote Snaps
Quality of Service	Virtual Tier Affinity
Bundled/Integrated Licenses	Advanced Data Services LTU standard on MSA 2062 (preinstalled on the array)
Additional Features	
Maximum number of volumes per pool	512
Maximum number of volumes per array	1024

HPE MSA 2062 Storage

Maximum number of snapshots (included with array)	64
Maximum number of snapshots (with Advanced Data Services License)	512
Maximum number of hosts	512
Maximum number of initiators	1024
Customer self-installable	Yes
Customer self-repairable	Yes
Customer self-upgradeable	Yes
Health Check analytics	Yes
Energy Star Certified	Yes
USGv6 Certified	Yes

All MSA 2062 models offer a common set of valuable features

MSA 2062 Solution

- MSA 2060-branded SFF array chassis
- Two AC power supplies with 1 black 1.5m C13/C14 PDU style jumper cord each
- Two MSA 2060 Storage Controllers (FC, iSCSI, or SAS)
- Two 1.92 TB Read Intensive SSDs
- One Advanced Data Services LTU (preinstalled on the array)

Chassis

- 24 drive bay SFF 2U base arrays
- 12 drive bay LFF or 24 drive bay SFF 2U expansion enclosures, depending on the model
- 12 Gb SAS disk expansion protocol
- New next-generation drive carriers
- Front-side bezel with support for optional bezel lock

Storage Controllers

- Dual hot-swappable active/active controllers
- 4 host ports per controller, 8 host ports per array
- 8/16 Gb Fibre Channel, 10/25GbE iSCSI, 1/10GBase-T iSCSI, and 12 Gb SAS protocol support
- Auto negotiation supported on Fibre Channel (down to 8 Gb) and 10GBase-T iSCSI (down to 1 Gb)
- New next-generation RAID offload ASIC and Processor
- 24 GB system cache
- 12 Gb SAS expansion ports
- Battery-free cache backup with super capacitors and MMC

Expansion Capacity

- Maximum expansion of 9 drive enclosures (either LFF and/or SFF)
- Maximum of 240 SFF or 24 SFF + 108 LFF drives
- Maximum of 1,831.68 TB (All SFF) / 2,764.8 TB (SFF array + LFF drive enclosures) raw capacity

Storage Services

- Virtual Storage
 - Up to two (2) pools (4 PiB each addressable capacity per pool)
 - Automated tiering v2.0
 - SSD read cache extension
 - Thin Provisioning
 - Volume Copy
 - Snapshot capability (64 snapshots per array, standard; 512 snapshots with Advanced Data Services License)
- Virtual Storage Disk Groups can be spanned across multiple enclosures.
- Virtual Storage RAID levels supported: 0, 1, 5, 6, 10, MSA-DP+ (RAID 0 supported for Read Cache only).

- New disk group type (MSA-DP+):
 - Integrated sparing
 - Fast rebuilds
 - Improved sequential performance
 - Incremental disk group expansion

Management

- New web-based interface (SMU v4)
- HPE MSA Health Check
- New RESTful interface
- CLI
- Non-disruptive on-line controller code upgrade. Requires multi-pathing software
- Arxscan Arxview remote monitoring via HPE Complete

Data Protection

- Remote Snapshot (Array-based asynchronous replication, standard)
- VMware Site Recovery Manager
- HPE Zerto Virtual Replication
- Optional bezel locking kit

Product Technology

Storage Controllers

- The MSA 2062 FC controllers with 8/16 Gb FC host connectivity.
- The MSA 2062 iSCSI controllers with 10/25GbE iSCSI host connectivity.
- The MSA 2062 iSCSI controllers with 1/10GBase-T iSCSI host connectivity.
- The MSA 2062 SAS controllers with 12 Gb SAS host connectivity.
- No converged SAN controllers with MSA 2062 models.
- Dual controller active/active (dual pool) design. System can be configured as active/passive (single pool).
- Controllers contain next generation RAID offload ASIC and CPU.
- 24 GB System cache

- 12 Gb SAS expansion ports.

Notes: The MSA 2062 does not support single controller configurations. Single-controller support is provided only when a controller fails over to its partner controller.

Modular Chassis

- New chassis design with the MSA array and drive enclosures.
- 2U rack height 24 SFF drive bays.
- 12G SAS Midplane.
- Next generation drive carriers.

Available Drives

The MSA 2062 Storage Systems and MSA 2060 Drive Enclosures support a wide variety of 3.5-inch LFF drives and 2.5-inch SFF drives.

- Solid-State Drives (SSDs) deliver the highest levels of performance and reliability.
- Enterprise-class SAS hard disk drives (10K RPM) offer a balance of performance, capacity, and cost while delivering enterprise grade reliability.
- Midline SAS hard disk drives (7.2K RPM) are optimized to provide the best ratio of capacity to cost.

Optional Drive Enclosures

MSA 2060 LFF Drive Enclosure

This 2U enclosure is designed to support twelve (12) HPE Storage LFF drives and accepts MSA dual-ported 12 Gb SSD and/or SAS Midline hard drives. The pre-configured MSA 2060 LFF Drive enclosure has two I/O modules and supports MSA 2062 Storage systems.

- The MSA 2060 LFF Drive Enclosure can be attached to the MSA 2062 SFF Storage systems.
- Each MSA 2060 LFF Drive Enclosure ships standard with two 0.5m mini-SAS HD to mini-SAS HD cables for connection to the MSA 2060 array expansion port or existing drive enclosure cascade port.
- LFF and/or SFF drive enclosures can be mixed up to a maximum of nine (9) drive enclosures

HPE MSA 2060 SFF Drive Enclosure

This 2U enclosure is designed to support twenty-four (24) HPE Storage SFF drives and accepts MSA dual ported 12 Gb SSD and/or Enterprise SAS hard drives. The pre-configured MSA 2060 SFF Drive Enclosure has two I/O modules and supports MSA 2062 Storage systems.

- The MSA 2060 SFF Drive Enclosure can be attached to the MSA 2062 SFF Storage systems.
- Each MSA 2060 SFF Drive Enclosure ships standard with two 0.5m mini-SAS HD to mini-SAS HD cables for connection to the MSA 2062 array expansion port or existing drive enclosure cascade port.
- LFF and/or SFF Drive Enclosures can be mixed up to a maximum of nine (9) drive enclosures.

Scalability

- SFF array + LFF drive enclosure configurations can scale up to 288 TB per drive enclosure, expandable to 2,764.8 TB with the addition of up to nine (9) MSA 2060 LFF Drive Enclosures.
- SFF array + SFF drive enclosure configurations can scale up to 184.32 TB per drive enclosure, expandable to 1,831.68 TB with the addition of up to nine (9) MSA 2060 SFF Drive Enclosures.

Disk Group

A Disk Group is a collection of disks in a given redundancy mode (RAID 1, 5, 6, 10, MSA-DP+). Disk Group RAID level and size can be created based on performance and/or capacity requirements. Multiple Disk Groups can be allocated into a Storage Pool for use with Virtual Storage features.

LUNs

The MSA 2062 arrays support 512 volumes and up to 512 snapshots in a system. All volumes can be mapped to LUNs. Maximum LUN sizes up to 140 TB. Thin Provisioning allows the user to create LUNs independent of physical storage.

Storage Pools

Storage Pools are comprised of one or more Disk Groups. A volume's data on a given LUN can now span all disk drives in a pool. When capacity is added to a system, users will benefit from the performance of all spindles in that pool. The MSA 2062 supports large, flexible Volumes with sizes up to 128TiB and facilitates seamless capacity expansion. As pools are expanded data automatically reflows to balance capacity utilization on all drives.

RAID 0, 1, 5, 6, 10, MSA-DP+

The MSA 2062 features several important additional RAID levels. MSA-DP+ offers improved performance, availability, and very fast rebuild times compared to traditional parity RAID by utilizing erasure coding technology. MSA-DP+ includes distributed spare capacity (default is equal to 2x the largest drive) and does not use traditional spare drives. RAID 6 allocates two sets of parity data across drives and allows simultaneous write operations. It can withstand two simultaneous drive failures without downtime or data loss. RAID 10 is mirroring and striping

without parity and allows large Drive Groups to be created with high performance and mirroring for fault tolerance. RAID 5 combines block striping and parity. Because data and parity are striped across all drives, no single drive is a bottleneck. RAID 0 (Striping) is supported for Read Cache only.

MSA-DP+

MSA-DP+ is a new RAID-based data protection level introduced with the 6th Generation MSA Storage Systems that:

- Maximizes flexibility
- Provides built-in spare capacity
- Optimizes performance due to elimination of idle spares
- Allows for very fast rebuilds, large storage pools, and simplified expansion

If a disk fails in an MSA-DP+ disk group, and the failed disk is replaced with a new disk in the same slot, the replacement disk will be added to the disk group automatically. All disks in an MSA-DP+ disk group must be the same type (enterprise SAS, for example), but can have different capacities, provided the range of difference does not exceed a factor of two. For example, mixing a 1.2 TB disk and a 2.4 TB disk is acceptable; but mixing an 8 TB disk and an 24 TB disk is not recommended. It is conceivable that a sizeable difference between mixed disk capacities (ratio greater than two) could prevent consuming space on disks due to insufficient distributed space required to support striping.

All disks in an MSA-DP+ disk group are used to hold user data, but not all disks will be used by each page of data. To increase fault tolerance, any available capacity on disks can be allocated as spare for reconstruction purposes. When new data is added, new disks are added, or the system recognizes that data is not distributed across disks in a balanced way, the system moves the data to maintain balance across the disk group. Spare drives are not used by MSA-DP+ disk groups since the RAID design provides built-in spare capacity that is spread across all disks in the disk group. In the case of a disk failure, data will be redistributed to many disks in the disk group, allowing for quick rebuilds and minimal disruption to I/O. The system will automatically default to a target spare capacity that is the sum of the largest two disks in the MSA-DP+ disk group, which is large enough to fully recover fault tolerance after loss of any two disks in the disk group. The actual spare capacity value can change depending on the current available spare capacity in the disk group. Spare capacity is determined by the system as disks are added to a disk group, or when disk groups are created, expanded, or rebalanced.

Notes:

- HPE recommends not mixing disks if the ratio of the largest disk to the smallest disk is greater than two.
- For more information on MSA-DP+, refer to the HPE MSA 1060/2060/2062 Storage Management Guide.

Configuration and Management Tools

Management access: out-of-band, Storage Management Utility (SMU) V4, CLI.

Interface Types: USB, 100/1000 Ethernet.

Protocols Supported: SNMP, SSH, SMTP, FTP, SFTP, HTTP, HTTPS, Telnet

Web Browser Support

The MSA 2062 arrays come integrated with web-based management (SMU v4) and CLI based software for storage and RAID management, setup, configuration, and troubleshooting. The MSA 2062 management supports Microsoft Edge, Mozilla Firefox, and Google Chrome.

Hot Plug Expansion and Replacement Support

All MSA 2062 models support hot plug expansion and replacement of redundant controllers, drives, fans, power supplies, and I/O modules for simple, fast installation and maintenance. Hot add expansion of drive enclosures is also supported.

HPE Server Compatibility

The MSA 2062 supports most HPE ProLiant, BladeSystems and Integrity servers including:

- HPE ProLiant DL, ML Servers
- HPE c-Class Blade Servers
- Integrity servers, IA64
- Compatibility must be confirmed at: <http://www.hpe.com/storage/spock>

Notes: Depends on protocol.

3rd Party Server Support

The MSA 2062 supports most multi-vendor industry standard Intel and AMD based (x86) servers. Hewlett Packard Enterprise requires the Third-Party Server to be logged and listed on the Microsoft Windows Server Catalog.

- Hewlett Packard Enterprise recommends that the Third-Party Server Vendor is an active member of TSANet. Refer to the TSANet website for details: <http://www.tsanet.com> 
- Non-HPE servers will generally be supported if the HPE storage stack is used. This includes supported HPE branded HBAs, drivers, and supported FC switches.

OS Support

Refer to the Hewlett Packard Enterprise support statements for complete current OS version support:

<http://www.hpe.com/storage/spock>

- Microsoft Windows Server 2022
- Microsoft Windows Server 2019
- Microsoft Windows Server 2016
- VMware vSphere
- Red Hat Enterprise Linux
- SuSE SLES Linux
- Oracle Linux
- Citrix Hypervisor
- HP-UX

Notes: depends on protocol.

Advanced Data Services Suite

The HPE MSA Advanced Data Services Suite is included and preinstalled as a standard feature on the MSA 2062 at no extra charge.

The standard Advanced Data Services Suite includes the following functionality:

- Performance Tiering
- 512 Snapshots and Volume Copy
- Remote Snap functionality

Performance Tiering and Archive Tiering

Disk tiers are comprised of aggregating one or more Disk Groups of similar physical disks. The MSA 2062 supports 3 distinct tiers:

- A Performance tier with SSDs
- A Standard SAS tier with Enterprise SAS HDDs
- An Archive tier utilizing Midline SAS HDDs.

The MSA 2062 supports sub-LUN tiering and automated data movement between tiers. The MSA 2062 automated tiering engine moves data between available tiers based on the access characteristics of that data. Frequently accessed “pages” will migrate to the highest available tier delivering maximum I/O’s to the application.

Snapshot and Volume Copy

- All MSA 2062 arrays come standard with 64 snapshots and can be expanded to 512 snapshots with the HPE Advanced Data Services License.
- Snapshots create up to 512 point-in-time copies of data.
- Volume Copies create up to 128 point-in-time copies of data.
- Volume copies become standard volumes when they are complete.
- Recovery is instant - revert data from any previous Snapshot or Volume Copy.
- Backup 'snapped' data to disk, virtual tape, or physical tape without a backup window.
- If telephone support and software updates are desired for bundled software functionalities like 512 snapshots and volume copy software, a combination HW + SW support care pack must be purchased.
- Hewlett Packard Enterprise does not provide warranty assistance for software products included with our base hardware products. Support is available with either SupportPlus or SupportPlus24 Service options. The hardware warranty component of these services is accounted for in the pricing of the SP and SP24 HPE Services.

Remote Snap

All MSA 2062 arrays come standard with Remote Snaps. HPE MSA Remote Snap Software is an array-based feature that provides remote replication for HPE MSA 2062 array products. MSA Remote Snap is a form of asynchronous replication which consists of replication of block-level data from a volume on a local system to a volume on a second independent system. This second system may be co-located with the first system or may be located at a remote site.

- MSA Remote Snaps are used to determine the data to be replicated using the differences in snapshots on the primary volume, minimizing the amount of data to be transferred.
- MSA Remote Snap replication technology provides the ability to accomplish key data management and protection capabilities. First, because Remote Snap uses snapshots as the underlying technology can create multiple local recovery points which can be used for such tasks as to complement daily backups; second, replication provides the ability to access data in a remote site which could be used for dispersed operations; and third but definitely not least important replication allows for business continuance in the event of a failure on the primary site.
- To perform a replication, a snapshot of the volume to be replicated is taken, creating a point-in-time image of the data. This point-in-time image is compared to the point-in-time image taken during the previous replication and the changes are then replicated to the destination volume by copying the data represented by the snapshot via a transport medium such as TCP/IP (iSCSI) or Fibre Channel. The amount of data transferred is minimized though the use of snapshots whenever possible.
- Support of both Ethernet and Fibre Channel interconnects provides flexible options to the application environments.

- Snapshot based replication technology means only changed data will be replicated to target sites.
- Many to 1 replication (up to 4 nodes) - primary use case is to replicate from "many" branch offices to the home office for the purpose of backing up data from the branches.
- Advanced scheduler provides several options for IT administrators for business continuance.
- Flexible architecture allows remote replication between MSA 2062 and MSA 2060 or MSA 1060 arrays using the virtual storage architecture licensed with Remote Snap with the Advanced Data Services LTU.
- Snapshot based replication enables both local and remote recovery depending on the need. Snapshot replication isolates problems to a specific point in time which can be selected by the administrator. Additionally snapshot replication supports longer distance replication.
- Multiple relationships provide greater storage flexibility and utilization.
- Fast application recovery with minimal or no transaction loss.
- Creation of disaster tolerant copies of your critical business data.
- No single-point-of-failure solution to increase the availability of your data.
- With the improved disaster recovery features of the MSA 1060, MSA 2060 and MSA 2062, you can failover to the secondary / remote volume or volume group, map the secondary volume or volume group for access, then, when the primary array has recovered, failback to the primary volume or volume group, with the option to incorporate changes made to the secondary volume or volume group back to the primary volume or volume group.
- Another improvement in Remote Snap with the MSA 1060, MSA 2060 and MSA 2062 is the ability to reverse the direction of the replication set.

Notes: One Advanced Data Services Suite License per array is required for replication. For example, if you have two MSA arrays performing replication (from Primary system to Remote System), you will need a total of 2 licenses.

HPE Storage Integration Pack for VMware vCenter

HPE Storage Integration Pack for VMware vCenter is the redesigned version of the HPE OneView for VMware vCenter plug-in. With the new name, it features a new user interface that seamlessly integrates with the vCenter and centralizes all HPE Storage functionality on one page. Starting with the 10.0 release, the server and storage plug-ins are separated. The HPE Storage Integration Pack for VMware Center is a standalone product for managing only HPE Storage systems with no dependencies on HPE OneView. The server plug-in component is no longer bundled with the storage plug-in and is available as a separate download.

The HPE Storage Integration Pack for VMware vCenter enables vSphere administrators to quickly obtain context-aware information and manage supported HPE storage devices like the MSA in their VMware vSphere environment directly from within vCenter. This plug-in operates independently of the core HPE OneView product and does not require a license to use. By providing a clear relationship between VM's, datastores and storage, the VMware administrator's productivity increases, as does the ability to ensure quality of service. Roles for administrators can be defined on an individual basis, providing the ability to apply specific permissions for both view and control functions.

HPE Storage Integration Pack for VMware vCenter supports mixed array environments including MSA Storage, and other HPE Storage systems including Primera Storage, 3PAR Storage, Nimble Storage, and StoreOnce.

When deployed with MSA Storage, this plug-in provides the following:

- Active Management functionality for the MSA Storage:
 - Create/Expand/Delete a Datastore
 - Create a Virtual Machine from a template
- Monitors the health and status of the MSA Storage.
- Displays LUN / volume connections from VMs and ESX servers to the arrays and provides the location and attributes of the MSA array within the SAN.
- Identifies what storage features are available to allow administrators to match the features available on the MSA array to their requirements.
- Provide a cluster-level view of the storage.
- HPE Storage Integration Pack for VMware vCenter is downloadable from [MSC](#) (My Software Center).

vStorage API for Array Integration (VAAI)

The vStorage API for Array Integration (VAAI) is one of the storage application programming interfaces (API) in vSphere. VAAI is an API storage partners can leverage to enhance performance of virtual machine (VM) management operations by delegating these operations to the storage array. With hardware offload, ESX/ESXi hosts perform certain operations faster and consume less server CPU and memory resources as well as storage port and storage fabric bandwidth. VAAI includes high performance and scalable VM data path primitives.

Storage Hardware Primitives for VAAI

- Full Copy or Hardware Assisted Move
- Block Zeroing or Hardware Assisted Zeroing
- Hardware Assisted Locking or Atomic Test and Set (ATS)
- UNMAP reclaims space that is no longer on a thinly provisioned VMFS volume

HPE Morpheus VM Essentials Software

HPE Morpheus VM Essentials Software is a virtualization software solution that allows customers to provision and manage KVM and VMware-based VMs from a single intuitive interface. The solution comes with the KVM-based HVM hypervisor that is enhanced to include enterprise-grade cluster management with capabilities such as high availability, live compute and storage migration, distributed workload placement, integrated data protection, secure hardening, and external storage support. To enable flexibility for those continuing to host VMware-based applications, VM Essentials can also be used to connect to and manage existing VMware clusters. This means unified management and simple VM provisioning across both the HVM hypervisor and VMware ESXi™ so you can provision workloads on demand to the right environment, on your terms, with zero lock-in. When you're ready, you can use the included toolset to convert existing VMware images to VM Essentials.

Please review the [HPE Morpheus VM Essentials Software QuickSpecs](#) for further details.

HPE MSA Gen6 Storage is now fully qualified for use with HPE Morpheus VM Essential Software.

Please visit the [HPE Morpheus VM Essentials Software Compatibility Matrix](#) for further details on supported server, storage, and software platforms.

LDAP Support

LDAP (Lightweight Directory Access Protocol) is an industry standard application protocol for accessing and maintaining distributed directory information services over an IP network. LDAP provides the ability to authenticate MSA users with a central directory.

- Domain or Directory Credentials are not stored on the MSA for authentication – avoids a security issue.
- Once user groups are configured on all MSAs in your organization, users can be authenticated on any MSA through the Active Directory.
- Uses an LDAP implementation to authenticate users with a Windows Active Directory.
- The MSA CLI and SMU will allow the configuration of new LDAP users groups into the MSA security scheme (manage vs monitor users, interface restrictions Web/CLI/FTP).
- Ability to authenticate Local or LDAP users.

I/O Workload Functionality

A beneficial user interface element called "I/O Workload" is included in the MSA web browser (SMU v4). The MSA array controllers keep track of a substantial amount of data pertaining to the I/O dynamics at a logical page level (4MB chunks). From this data, it is possible to provide some visibility to what percentage of I/Os are being processed by what percentage of the overall

array's capacity across a 7-day timeline. While some workloads have "transient" data access patterns, many workloads have steady access patterns on small portions of the array's capacity. This produces "hot" pages in the array which remain hot a large amount of the array's uptime. Users would see substantial benefits if these pages could be served from the fastest media in the array (ideally SSDs). As has been described in the MSA's tiering functionality, the MSA array's tiering engine will work to position the hottest pages on the fastest media at any given time.

The new I/O Workload graph will show a line labeled Capacity and a line plot for each selected workload percentage (100%, 80%, or Other% value). Below are two examples of user scenarios where the I/O Workload Graph might be useful and how to utilize the data the graph provides.

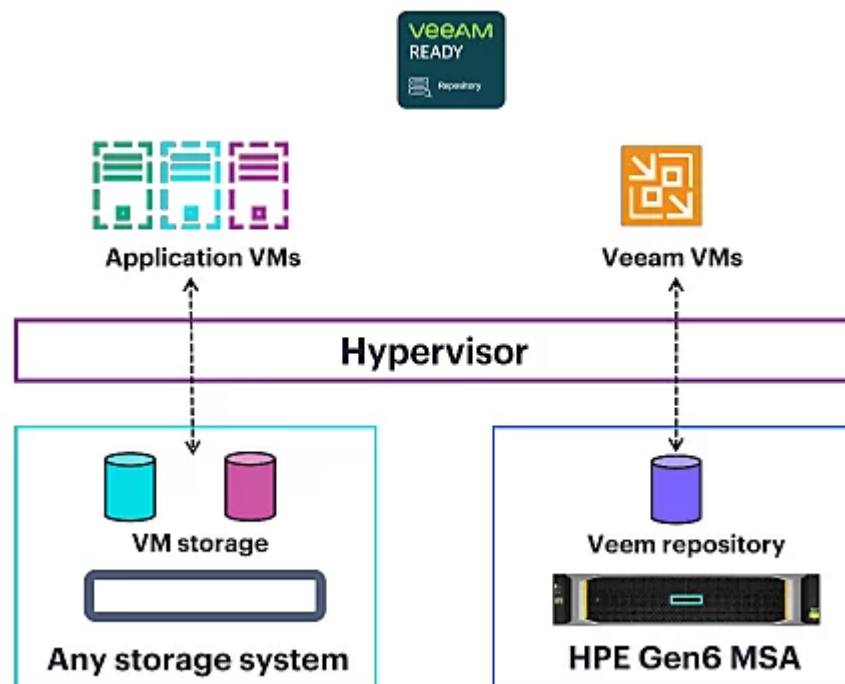
- New User or SSD Installation.
- Once the MSA array is installed and has had workloads running against it for a week's time, the I/O Workload data will give a representation of what Capacity is servicing 100% of I/O and 80% of I/O. Users may select a custom % value if desired. In a new installation or in an installation with no SSD tier installed, the 80% line is a reasonable starting point for an SSD tier. Based on SSD RAID settings, customers can then calculate a good starting point regarding SSD tier sizing based on that week's workload. While not a hard fast rule, it is a good starting point. These values should also be compared to the Best Practices "rule of thumb" which suggests that 5-15% of the array's capacity should be SSDs for tiered solutions.
- Users with existing SSD tiering or read caching installed and running.
- For arrays running with SSDs installed (tiered or read cache), the I/O Workload graph will have a dotted line which shows the installed SSD capacity. The I/O Workload graphs can be checked periodically to see where the 80% I/O line is regarding the SSD capacity line. While there are no hard and fast rules which indicate good/bad situations, users can use the graph with other system performance tools to better understand specific dynamics of their installation and the normal dynamics of a system in the day-to-day activities for a specific environment.

Interpreting the I/O Workload graphs allows users to strike a balance between the SSD costs versus performance benefits. For example, some customers may be willing to have a couple of days where peak usage is far above the SSD capacity line as it may be acceptable to have slower performance as the system uses HDDs for a larger percentage of the workload I/O. This may be perfectly acceptable for systems sized to optimize \$/TB due to budget constraints. Other users may want to optimize the system such that a sizeable percentage of daily I/O can reside on SSD media (sized to 80% or 90%). When combined with other performance monitoring tools, the new I/O Workload function gives users some representation as to how the workloads and the MSA are working together in a user's real-world environment.

Protect your data with HPE MSA Storage and Veeam Backup & Replication

Together, HPE and Veeam help you safeguard your data to ensure it's always on, always protected and that your enterprise can rapidly and easily recover should a situation arise - from human error to a malicious attack. And now, HPE MSA Storage is certified as a Backup Repository to provide seamless protection and Instant VM Recovery. Veeam Backup & Replication provides a single

management console to orchestrate the protection of virtual servers, physical machines, and cloud-based workloads. Due to the extraordinary ratio of cost to capacity and performance offered by HPE MSA Storage, Veeam Back & Replication with HPE MSA Storage makes the perfect solution to modernize your backup strategy and protect your data from disaster.



Key features of Veeam Backup and Replication:

- Image-level VM backups: Create application-consistent backups with advanced application-aware processing.
- Higher data availability with efficient movement of backup copies offsite for disaster recovery
- Unify management of protection of physical and cloud environments
- Scale-out Backup Repository: Create a single virtual pool of backup storage to which backups can be assigned, offering the freedom to easily extend backup storage capacity.
- SureBackup: Automatically tests and verifies every backup and every VM for recoverability.
- Image-based VM replication with WAN acceleration: Get backups off site up to 50x faster than non-accelerated traffic and save bandwidth for offsite for disaster recovery (DR).
- Direct Storage Access: Perform vSphere backups faster and with reduced impact by backing up via Direct SAN Access and Direct NFS Access.
- Instant VM Recovery: Restore access to a failed VM in less than two minutes while the full restore is executed in parallel.
- Native tape support: Store entire VM backups or individual files on HPE StoreEver with direct restore from tape.
- SureReplica: Automatically test and verify every VM replica for recoverability.

For more details on Veeam Backup & Replication see the [Veeam Backup & Replication](#) web pages.

HPE Zerto

HPE MSA Storage users can leverage Zerto Virtual Replication to replicate applications and data from one MSA array to another MSA array. Popular use cases include departmental MSA storage replicated to an enterprise storage array, enterprise storage replicated to an MSA array for backup or replicating MSA workloads into the cloud for data protection.

Zerto operates on the hypervisor level and includes orchestration and automation built-in to enable faster recovery of workloads (RTO in minutes) at much lower Recovery Point Objective (RPO of seconds) available through other data protection tools like backup. Zerto is also a workload mobility tool and allows IT to confidently move workloads and data across heterogeneous storage or cloud.

Ordering, configuring, and installing Zerto is simple. Zerto is licensed by the number of Virtual Machines that are being protected or moved. For mobility use cases, order the appropriate number of migration licenses needed. For replication use cases, order the appropriate quantity of Zerto Virtual Replication licenses using a combination of the tiered licenses plus the corresponding maintenance part numbers. The license is independent of source and target array size, type or capacity being replicated. See the HPE Complete/Zerto QuickSpecs for a complete list of part numbers. A corresponding MSA Advanced Data Services LTU is not required for data replication when using Zerto Virtual Replication. An MSA Advanced Data Services LTU would be required if deploying MSA array-based replication.

Zerto installs as a virtual machine under VMware or Hyper-V or in the Cloud as a VM in AWS and Azure in minutes. Zerto does not install any components in the guest operating system and does not depend on any specific configuration of the storage or use MSA array or VMware snapshots to replicate and recover applications.

Review the [HPE Zerto QuickSpecs](#) for more information.

HPE Insight Remote Support

HPE Insight Remote Support (Insight RS) is a software solution that enables reactive and proactive remote support to improve the availability of supported servers, storage and networking. Insight RS enables enhanced delivery of your warranty or support services contract. Insight RS supplements your monitoring continuously to ensure maximum system availability by providing intelligent event diagnosis and automatic, secure submission of hardware event notifications to HPE, initiating a fast and accurate resolution, based on your product's service level. Notifications may be sent to your HPE Authorized Channel Partner for on-site service, if configured and available in your country. For more information about Insight Remote Support see: <http://www.hpe.com/services/getconnected>.

HPE Insight Remote Support is fully supported on all HPE MSA Gen6 and Gen7 array models. Its use requires the purchase of an HPE Tech Care Service agreement: Basic, Essential, or Critical.

HPE MSA Health Check Tool

MSA Health Check is a cloud-based tool that provides users insight into the general health of their MSA array. The tool uses a powerful rules-based analytics engine which can predict failures before they happen. The MSA Health Check tool performs a full sweep of analytics, checking thousands of data points from sensors inside the MSA array. The analytics engine will pick up common failure signatures and check against MSA best practices producing a simple, easy to digest PDF report with status and suggested courses of action to correct anything found in the scan. The tool is free of charge to HPE MSA customers. The MSA Health Check tool is supported across all current MSA 1060/2060/2062 arrays as well as the prior three generations of arrays (MSA P2000 G3, MSA 1040/2040/2042 and MSA 1050/2050/2052).

The tool is available immediately at: <http://www.hpe.com/storage/MSAHealthCheck>.

For more information on how to use HPE MSA Health Check, please review the [HPE MSA Health Check User Guide](#).

ENERGY STAR Certification

The HPE MSA 2062 SAN Storage systems are ENERGY STAR certified. ENERGY STAR certified products are energy efficient resulting in cost savings via reduced energy consumption and regulatory rebates. Please refer to the US EPA website for details on ENERGY STAR certification criteria and process. MSA 2062 ENERGY STAR Certification is listed on the EPA website.

NEBS Certification

When used in conjunction with specific Storage SFF SAS drives and the MSA 2060 764W -48VDC Hot Plug Power Supply Kit (ROQ90A), the HPE MSA 2062 16 Gb FC SFF Storage (ROQ80A/ROQ80B) and MSA 2060 12 Gb SAS SFF Storage (ROQ84A/ROQ84B) arrays are certified compliant with GR-63-Core (Issue 5) and GR-1089-Core (Issue 7) NEBS criteria. NEBS Certified DC-Power Storage systems are designed for network equipment providers (NEPs) and communication service providers. All NEBS compliant MSA 2062 Storage systems support configurations with up to 9 compliant 2060 SFF Drive Enclosures (ROQ40A/ROQ40B) for a maximum of 240 SFF HDDs or SSDs.

Service and Support

For the most up-to-date information on HPE Services, please refer to the [HPE Services – Supplemental QuickSpecs](#), which provides a comprehensive and regularly updated overview of available services.

Configuration Information

Pre-Configured MSA Models - HPE Smart Choice purchase program

The HPE Smart Choice purchase program features popular fully configured HPE MSA 2062 arrays that can be quoted in minutes and shipped quickly through HPE Authorized Partners. Products are configured and tested in an HPE factory and stocked at HPE Authorized Distributors and Partners. The products arrive in a single box, making onsite integration easier and more efficient for partners and customers. Additionally, there are aggressively priced HPE Services available only through the HPE Smart Choice program when you purchase an HPE Smart Choice product.

For additional information on the HPE Smart Choice purchase program, please visit:
<https://www.hpe.com/psnow/doc/a50009219enw>

HPE MSA 2062 Smart Choice Arrays

HPE MSA Gen6 2062 Storage models currently available through the HPE Smart Choice program include:

Description	SKU
HPE MSA 2062 SFF 2x16Gb FC 4-port Controller 12x2.4TB HDD 4x16Gb SFP FC XCVR 32TB Storage Array	P84170-B25
HPE MSA 2062 SFF 2x10GbE iSCSI 4-port Controller 12x2.4TB HDD 4x10Gb iSCSI XCVR 32TB Storage Array	P84171-B25
HPE MSA 2062 SFF 2x12Gb SAS 4-port Controller 12x2.4TB HDD 32TB Storage Array	P84172-B25

Notes:

– Each of the Smart Choice models listed above includes -

- Includes an MSA 2060 SFF Array Chassis, two 4-port MSA 2060 controllers, two AC power supplies, two 1.5m PDU cords (IEC C14), and one rack-mount kit.
- Each model includes two 1.92TB Read Intensive (RI) SFF SSDs, twelve 2.4TB 10K SFF HDDs, and one 4-pack of supported SFP transceivers (excluding 12Gb SAS models)
- All models include 94% efficient power supplies that meet EU Lot9 power efficiency requirements.
- Included drives factory configured into a single pool

HPE MSA Smart Choice Options

HPE MSA Smart Choice Arrays can be configured with either standard MSA Options or with options from the MSA Smart Choice Options menu below:

Description	SKU
HPE MSA 11.5TB SAS 12G Read Intensive SFF (2.5in) M2 3-year Warranty 6-pack (6x1.92TB) SSD Bundle	P88911-B25
HPE MSA 23TB SAS 12G Read Intensive SFF (2.5in) M2 3-year Warranty 6-pack (6x3.84TB) SSD Bundle	P88912-B25
HPE MSA 46TB SAS 12G Read Intensive SFF (2.5in) M2 3-year Warranty 6-pack (6x7.68TB) SSD Bundle	P88913-B25
HPE MSA 7.2TB SAS 12G Enterprise 10K SFF (2.5in) M2 3-year Warranty 6-pack (6x1.2TB) HDD Bundle	P88914-B25
HPE MSA 14.4TB SAS 12G Enterprise 10K SFF (2.5in) M2 3-year Warranty 6-pack (6x2.4TB) HDD Bundle	P88915-B25
HPE MSA 16Gb SFP+ Short Wave Fibre Channel 4-pack Transceiver Bundle	P88918-B25
HPE MSA 10Gb SFP+ Short Range 4-pack iSCSI Transceiver Bundle	P88920-B25
HPE MSA 25Gb SFP28 Short Range 4-pack iSCSI Transceiver Bundle	P88921-B25

Step 1: MSA 2062 Base Configurations / Pre-Configured Systems

MSA 2062 Storage Systems

Description	SKU
HPE MSA 2062 16Gb Fibre Channel SFF Storage	ROQ80B
HPE MSA 2062 10GbE iSCSI SFF Storage	ROQ82B
HPE MSA 2062 12Gb SAS SFF Storage	ROQ84B
HPE MSA 2062 10GBASE-T iSCSI SFF Storage	R7J71B

Notes:

- Includes an SFF array, two MSA 2060 controllers, two 1.92TB Read Intensive SSDs, one Advanced Data Services LTU (preinstalled on the array), two AC power supplies, two 1.5m PDU cords (IEC C13/C14), one rack-mount kit.
 - SFPs are not included in the base MSA 2062 Storage Systems.
 - There are no converged protocol models with the MSA 2062 Storage Systems– you must select the appropriate Fibre Channel, iSCSI, or SAS array model.
 - All SKUs ending in “B” include the new 94% efficient power supply that meets EU Lot9 power efficiency requirements.
 - HPE MSA 2062 models ROQ80B and ROQ84B are compliant with NEBS criteria for GR-63-Core (Issue 5) and GR-1089-Core (Issue 7). See “Step 3” and “Step 4” for NEBS supported drive and power supply options or refer to “NEBS Certification” section for further details.
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Step 2: Select Your SFP+ Module

Description	SKU
HPE MSA 16Gb Short Wave Fibre Channel SFP+ 4-pack Transceiver	C8R24B
HPE MSA 10Gb Short Range iSCSI SFP+ 4-pack Transceiver	C8R25B
HPE MSA 25Gb SFP28 Short Range 4-pack iSCSI Transceiver	S0K91A

Notes:

- MSA 2062 Storage Systems do not ship with SFPs.
- Each MSA 2062 16G b FC or 10GbE iSCSI Storage Systems can be configured with either four or eight SFPs.
- MSA SFPs are for use with MSA 2062 16 Gb FC or 10GbE iSCSI Storage Systems only.
- MSA 2062 SAS and 10GBase-T iSCSI Storage Systems do not require SFP modules.
- Minimum of one SFP transceiver 4 pack is required for Fibre Channel models
- MSA 2062 10GbE iSCSI configurations can use Direct Attach Copper (DAC) cables instead of SFPs.
- Both MSA 2060 10GbE iSCSI array models (LFF and SFF) can support both 10 Gb or 25 Gb transceivers in the same array.
- iSCSI models require either an SFP 4 pack of transceivers (C8R25B or S0K91A) or a DAC cable option.
- Controller host ports are recommended to be configured identically.
- Cannot mix FC transceivers with iSCSI transceivers in the same storage system.

Step 3: Select your Drives

- The following HDD and SSD options are for use with MSA Gen 6 and Gen7 Storage Systems only.
- The following HDD and SSD options are not compatible with prior generation MSA Storage Systems.
- Prior generations of MSA HDDs and SSDs are not compatible with MSA Gen 6 Storage Systems.
- Customers can mix SSD, Enterprise SAS, and SAS Midline (MDL) drives in the same array configuration.
- Adding LFF HDD or SSD options to an MSA 2062 storage array requires the addition of an MSA 2060 LFF Drive Enclosure (ROQ39B).

SFF HDD 6-Pack Bundles

Select MSA SFF HDD options are available to purchase in bundles that include 6 drives. Purchasing MSA drives in bundles typically provides a lower purchase price than purchasing them individually. Check with your HPE sales representative or channel partner for further details.

Description	SKU
HPE MSA 7.2TB SAS 12G Enterprise 10K SFF (2.5in) M2 3yr Wty 6-pack HDD Bundle	ROQ65A
Notes: Contains 6 x MSA 1.2TB 12G SAS 10K SFF Enterprise HDDs (ROQ55A). Certified for use in NEBS certified MSA Gen6 configurations.	
HPE MSA 10.8TB SAS 12G Enterprise 10K SFF (2.5in) M2 3yr Wty 6-pack HDD Bundle	ROQ66A
Notes: Contains 6 x MSA 1.8TB 12G SAS 10K SFF Enterprise HDDs (ROQ56A). Certified for use in NEBS certified MSA Gen6 configurations.	
HPE MSA 14.4TB SAS 12G Enterprise 10K SFF (2.5in) M2 3yr Wty 6-pack HDD Bundle	ROQ67A
Notes: Contains 6 x MSA 2.4TB 12G SAS 10K SFF Enterprise HDDs (ROQ57A). Certified for use in NEBS certified MSA Gen6 configurations.	

LFF HDD 6-Pack Bundles

Select MSA LFF HDD options are available to purchase in bundles that include 6 drives. Purchasing MSA drives in bundles typically provides a lower purchase price than purchasing them individually. Check with your HPE sales representative or channel partner for further details.

Description	SKU
HPE MSA 48TB SAS 12G Midline 7.2K LFF (3.5in) M2 1yr Wty 6-pack HDD Bundle	ROQ69A
Notes: Contains 6 x MSA 8TB 12G SAS 7.2K LFF Midline HDDs (ROQ59A)	
HPE MSA 72TB SAS 12G Midline 7.2K LFF (3.5in) M2 1yr Wty 6-pack HDD Bundle	ROQ71A
Notes: Contains 6 x MSA 12TB 12G SAS 7.2K LFF Midline HDDs (ROQ61A)	
HPE MSA 96TB SAS 12G Midline 7.2K LFF (3.5in) M2 1yr Wty 6-pack HDD Bundle	R3U73A

Notes: Contains 6 x MSA 16TB 12G SAS 7.2K LFF Midline HDDs (R3U72A)

HPE MSA 120TB SAS 12G Midline 7.2K LFF M2 1-year Warranty 6-pack HDD Bundle	S0F33A
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Notes: Contains 6 x MSA 20TB 12G SAS 7.2K LFF Midline HDDs (S0F32A)

HPE MSA 144TB SAS 12G Midline 7.2K LFF M2 1-year Warranty 6-pack HDD Bundle	S3P39A
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Notes: Contains 6 x MSA 24TB 12G SAS 7.2K LFF Midline HDDs (S3P38A)

SFF HDDs

Description	SKU
HPE MSA 600GB SAS 12G Enterprise 10K SFF (2.5in) M2 3yr Wty HDD	ROQ54A
HPE MSA 1.2TB SAS 12G Enterprise 10K SFF (2.5in) M2 3yr Wty HDD	ROQ55A
HPE MSA 1.8TB SAS 12G Enterprise 10K SFF (2.5in) M2 3yr Wty HDD	ROQ56A
HPE MSA 2.4TB SAS 12G Enterprise 10K SFF (2.5in) M2 3yr Wty HDD	ROQ57A

Notes: MSA 1.2 TB, 1.8 TB, and 2.4 TB 10K SFF HDD options are certified for use in NEBS certified MSA Gen6 configurations.

LFF HDDs

Description	SKU
HPE MSA 8TB SAS 12G Midline 7.2K LFF (3.5in) M2 1yr Wty HDD	ROQ59A
HPE MSA 12TB SAS 12G Midline 7.2K LFF (3.5in) M2 1yr Wty HDD	ROQ61A
HPE MSA 16TB SAS 12G Midline 7.2K LFF (3.5in) M2 1yr Wty HDD	R3U72A
HPE MSA 20TB SAS 12G Midline 7.2K LFF M2 1-year Warranty HDD	S0F32A
HPE MSA 24TB SAS 12G Midline 7.2K LFF M2 1-year Warranty HDD	S3P38A

SFF SSDs

Description	SKU
HPE MSA 960GB SAS 12G Read Intensive SFF (2.5in) M2 3yr Wty SSD	ROQ46A
HPE MSA 1.92TB SAS 12G Read Intensive SFF (2.5in) M2 3yr Wty SSD	ROQ47A
HPE MSA 3.84TB SAS 12G Read Intensive SFF (2.5in) M2 3yr Wty SSD	R3R30A

HPE MSA 7.68TB SAS 12G Read Intensive SFF (2.5in) M2 3-year Warranty SSD	SOF31A
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Notes: MSA 960 GB, 1.92 TB, and 3.84 TB SSD options are certified for use in NEBS certified MSA Gen6 configurations.

LFF SSDs	
Description	SKU
HPE MSA 1.92TB SAS 12G Read Intensive LFF (3.5in) M2 3yr Wty SSD	ROQ49A

Step 4: Options

Drive Enclosures

Description	SKU
HPE MSA 2060 SAS 12G 2U 12-disk LFF Drive Enclosure	ROQ39B
HPE MSA 2060 SAS 12G 2U 24-disk SFF Drive Enclosure	ROQ40B

Notes:

- Each drive enclosure includes a single rack-mount kit and two 0.5m MiniSAS HD to MiniSAS HD cables.
- Add up to nine additional drive enclosures.
- Both MSA 2060 LFF Drive Enclosures and MSA 2060 SFF Drive Enclosures can be connected to MSA 2062 SFF Storage systems.
- All SKUs ending in “B” include the new 94% efficient power supply that meets EU Lot9 power efficiency requirements.
- The HPE MSA 2060 SFF Drive Enclosure, ROQ40B, is compliant with NEBS criteria for GR-63-Core (Issue 5) and GR-1089-Core (Issue 7). See “Step 3” and “Step 4” for NEBS supported drive and power supply options or refer to “NEBS Certification” section for further details.

Drive Enclosure Cables

Description	SKU
HPE External 1.0m (3ft) Mini-SAS HD 4x to Mini-SAS HD 4x Cable	716195-B21
HPE External 2.0m (6ft) Mini-SAS HD 4x to Mini-SAS HD 4x Cable	716197-B21

Notes: For use when connecting an MSA 2062 controller to a drive enclosure and a longer cable is required.

Security Option

Description	SKU
HPE Bezel Lock Kit	875519-B21

Notes: Each array and drive enclosure chassis includes a bezel. This option includes a lock for securing the bezel.

DC Power Option

Description	SKU
HPE MSA 764W -48VDC Hot Plug Power Supply Kit	ROQ90A

Notes:

- All MSA 2062 array enclosures and drive enclosures come standard with 2 AC power supplies.
 - If DC power is desired, then two DC power supplies must be selected on the array enclosure and all drive enclosures.
 - DC Power Supplies can be ordered with factory integration or with field integration. With factory integrated orders, the AC power supplies will not be shipped.
 - One (1) 48VDC 2.3M power cord is included with each ROQ90A kit.
 - Required for use in NEBS compliant MSA Gen6 configuration.
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Power Cords

Description	SKU
HPE C13 - C14 WW 250V 10Amp 2.0m Jumper Cord	AOK02A
HPE C13-NEMA 6-15P 10A/250V 3.6m Black Power Cord	AON33A
HPE C13 - Nema 5-15P US/CA 110V 10Amp 1.83m Power Cord	AF556A
HPE C13 - GB-1002 CN 250V 10Amp 1.83m Power Cord	AF557A
HPE C13 - IRAM -2073 AR 250V 10A 2.5m Power Cord	AF558A
HPE C13 - KSC- 8305 KR 250V 10Amp 1.83m Power Cord	AF560A
HPE C13 - CNS-690 TW 110V 13Amp 1.83m Power Cord	AF561A
HPE C13 - IS-1293 IN 240V 6Amp LV 2.0m Power Cord	AF562A
HPE C13 - SI-32 IL 250V 10Amp 1.83m Power Cord	AF564A
HPE C13 - SEV 1011 CH 250V 10Amp 1.83m Power Cord	AF565A
HPE C13 - DK-2.5A DK 250V 10Amp 1.83m Power Cord	AF566A
HPE C13 - SABS-164 ZA 250V 10Amp 2.5m Power Cord	AF567A
HPE C13 - CEE-VII EU 250V 10Amp 1.83m Power Cord	AF568A
HPE C13 - AS3112-3 AU 250V 10Amp 2.5m Power Cord	AF569A
HPE C13 - BS-1363A UK/HK/SG 250V 10Amp 1.83m Power Cord	AF570A
HPE C13 - JIS C8303 JP 100V 12Amp 2.0m Power Cord	AF572A
HPE C13 - C14 WW 250V 10Amp Flint Gray 2.0m Jumper Cord	AF573A

HPE C13 - NBR-14136 BR 250V 10Amp 1.83m Power Cord
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AF591A

HPE C13-C14 IN 250V 10Amp 2m Black Jumper Cord
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R1C65A

Notes:

- Two PDU cables, 1.5m black C13/C14, ship standard with all AC-powered enclosures
 - These power cord options may be used by customers that desire to plug their base array and/or drive enclosures into a wall outlet or require a different length PDU Jumper Cord.
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Step 5: Choose cables for Host Connection

Fibre Channel Infrastructure

PremierFLEX OM4 type cables

Description	SKU
HPE Premier Flex LC/LC Multi-mode OM4 2 Fiber 1m Cable	QK732A
HPE Premier Flex LC/LC Multi-mode OM4 2 Fiber 2m Cable	QK733A
HPE Premier Flex LC/LC Multi-mode OM4 2 Fiber 5m Cable	QK734A
HPE Premier Flex LC/LC Multi-mode OM4 2 Fiber 15m Cable	QK735A
HPE Premier Flex LC/LC Multi-mode OM4 2 Fiber 30m Cable	QK736A
HPE Premier Flex LC/LC Multi-mode OM4 2 Fiber 50m Cable	QK737A

OM3 Fibre FC to LC cables

Description	SKU
HPE LC to LC Multi-mode OM3 2-Fiber 0.5m 1-Pack Fiber Optic Cable	AJ833A
HPE LC to LC Multi-mode OM3 2-Fiber 1.0m 1-Pack Fiber Optic Cable	AJ834A
HPE LC to LC Multi-mode OM3 2-Fiber 2.0m 1-Pack Fiber Optic Cable	AJ835A
HPE LC to LC Multi-mode OM3 2-Fiber 5.0m 1-Pack Fiber Optic Cable	AJ836A
HPE LC to LC Multi-mode OM3 2-Fiber 15.0m 1-Pack Fiber Optic Cable	AJ837A
HPE LC to LC Multi-mode OM3 2-Fiber 30.0m 1-Pack Fiber Optic Cable	AJ838A
HPE LC to LC Multi-mode OM3 2-Fiber 50.0m 1-Pack Fiber Optic Cable	AJ839A

10GbE Infrastructure

Direct Attach Copper Cables

Description	SKU
HPE Aruba Networking 10G SFP+ to SFP+ 1m Direct Attach Copper Cable	J9281D
HPE Aruba Networking 10G SFP+ to SFP+ 3m Direct Attach Copper Cable	J9283D

HPE Aruba Networking 10G SFP+ to SFP+ 7m Direct Attach Copper Cable	J9285D
HPE BladeSystem c-Class 10GbE SFP+ to SFP+ 3m Direct Attach Copper Cable	487655-B21
HPE BladeSystem c-Class 10GbE SFP+ to SFP+ 5m Direct Attach Copper Cable	537963-B21
HPE Networking X240 10G SFP+ SFP+ 0.65m DAC Cable	JD095C
HPE Networking X240 10G SFP+ SFP+ 1.2m DAC Cable	JD096C
HPE Networking X240 10G SFP+ SFP+ 3m DAC Cable	JD097C
HPE Networking X240 10G SFP+ SFP+ 5m DAC Cable	JG081C
HPE Networking X240 10G SFP+ 7m DAC Cable	JC784C
HPE Networking Comware X240 40G QSFP+ to 4x10G SFP+ 1m Direct Attach Copper Splitter Cable	JG329A
HPE Networking Comware X240 40G QSFP+ to 4x10G SFP+ 3m Direct Attach Copper Splitter Cable	JG330A
HPE Networking Comware X240 40G QSFP+ to 4x10G SFP+ 5m Direct Attach Copper Splitter Cable	JG331A

25GbE Infrastructure

Direct Attach Copper Cables

Description	SKU
HPE Aruba Networking 25G SFP28 to SFP28 3m Direct Attach Copper Cable	JL488A
HPE Aruba Networking 25G SFP28 to SFP28 5m Direct Attach Copper Cable	JL489A
HPE 100Gb QSFP28 to 4x25Gb SFP28 3m Direct Attach Copper Cable	845416-B21
HPE Networking X240 QSFP28 4xSFP28 3m Direct Attach Copper Cable	JL283A

Active Optical Cables

Description	SKU
HPE Aruba Networking 25G SFP28 to SFP28 3m Active Optical Cable	ROM44A
HPE Aruba Networking 25G SFP28 to SFP28 7m Active Optical Cable	ROM45A
HPE Aruba Networking 25G SFP28 to SFP28 15m Active Optical Cable	ROZ21A

HPE QSFP28 to 4x25Gb SFP28 7m Active Optical Cable	845420-B21
HPE QSFP28 to 4x25Gb SFP28 15m Active Optical Cable	845424-B21

SAS Infrastructure

Mini SAS HD to Mini SAS Cables

Description	SKU
HPE 1.0m External Mini SAS High Density to Mini SAS Cable	716189-B21
HPE 2.0m External Mini SAS High Density to Mini SAS Cable	716191-B21
HPE 4.0m External Mini SAS High Density to Mini SAS Cable	716193-B21

Notes:

- These cables are used to connect the c-Class 6 Gb BladeSystem SAS switch to MSA 2060 SAS Storage system.
- These are not used for connecting the MSA 1060 to a drive enclosure.

Mini SAS HD to Mini SAS HD Cables

Description	SKU
HPE External 1.0m (3ft) Mini-SAS HD 4x to Mini-SAS HD 4x Cable	716195-B21
HPE External 2.0m (6ft) Mini-SAS HD 4x to Mini-SAS HD 4x Cable	716197-B21
HPE External 4.0m (13ft) Mini-SAS HD 4x to Mini-SAS HD 4x Cable	716199-B21

Notes:

- Each kit includes a single cable that can support up to 4 lanes.
- These cables are used to connect the DL and ML ProLiant 12 Gb SAS Servers to MSA 2060 SAS Storage system.
- The 1.0m and 2.0m Mini-SAS HD to Mini-SAS HD cables can also be used for connecting a MSA 2060 SAS controller to a SFF or LFF drive enclosure.

Step 6: Software

- The MSA Advanced Data Services LTU comes standard on the MSA 2062 models.
- Visit HPE Complete on HPE.com for information on Zerto Virtual Replication and Arxscan Arxview software that is supported on the MSA 1060/2060/2062 Storage.

Technical Specifications

MSA 2062

Power requirements

Input Power Requirements (typical-running I/O)	120VAC 3.07A, 293-361 W; 220VAC 1.58A,289-352W
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SFF/LFF arrays

Max Input Power	100-240 VAC, 50/60 Hz., 4.38-2.17A; 48-60 VDC 10.4A/8.3A
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Heat Dissipation	1766 BTU/hr
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Temperature and Humidity Ranges

Operating Temperature	ASHRAE A3 5°C to 40°C, -12°C DP & 8 to 24°C DP (Derated maximum allowable dry-bulb temperature 1°C/175m above 900m)
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Shipping Temperature	-40°F to 158°F (-40°C to 70°C)
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Operating Humidity	Up to 85% RH
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Non-Operating Humidity	Up to 90% RH @ 30°C
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Physical

Height	3.5 in (8.9 cm)
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Depth (Back of chassis ear to controller latch)	20.0 in (50.8 cm)
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Depth (Front of chassis ear to back of cable bend)	26.4 in (66.9 cm)
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Width (Chassis only)	17.5 in (44.5 cm)
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Width (Chassis with bezel ear caps)	19.0 in (48.3 cm)
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Weight LFF Enclosure

Chassis empty	11 lb (5 kg)
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Controller enclosure (fully populated with FRUs and disks)	71 lb (32 kg)
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Expansion enclosure (fully populated with FRUs and disks)	62 lb (28 kg)
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MSA 2062

Weight SFF Enclosure

Chassis empty	11 lb (5 kg)
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Controller enclosure (fully populated with FRUs and disks)	66 lb (30 kg)
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Expansion enclosure (fully populated with FRUs and disks)	55 lb (25 kg)
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Acoustic Ratings

Sound Power	A weighted sound power LWAd - 8.3 B
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Sound Pressure	A weighted sound pressure LpAm - 74dBA
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Shock and Vibration

Shock, Operational	5G, 11 ms
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Shock, Non-Operational	15G, 10ms
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Vibration, Operational	5-500Hz, 0.18 Grms
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Vibration, Non-Operational	x-axis (5-300Hz) 0.8 Grms z-axis (5-300Hz) 1.2 Grms
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Altitude

Altitude, operating	3000m (10,000 feet)
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Altitude, non-operating	12,192m (40,000 feet)
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Power Supply Details

2U Flex 580W PSU 80+ Gold

Input Voltage Range (V rms)	100-240		
Frequency Range (Hz)	50-60		
Nominal Input Voltage	115	208	230
Maximum Output Wattage Rating (W)	584	584	584
Nominal Input Current (Arms)	5.7	3.2	2.8
Maximum Input Wattage Rating (W)	652	645	644
Maximum Rated VA (VA)	653	661	650
Efficiency (%/100)	0.896	0.905	0.907
Power Factor	0.999	0.976	0.991
Leakage Current (mA)	<0.8		
Maximum Inrush Current (A peak)	45		
Maximum Inrush Current Duration (ms)	40		
Maximum British Thermal Unit Rating (BTU-hr)	2224.233	2201.382	2196.286

2U Flex 580W PSU 80+ Platinum

Input Voltage Range (V rms)	100-240		
Frequency Range (Hz)	50-60		
Nominal Input Voltage	115	208	230
Maximum Output Wattage Rating (W)	584	584	584
Nominal Input Current (Arms)	5.56	3.06	2.77
Maximum Input Wattage Rating (W)	639.4	635.5	630
Maximum Rated VA (VA)	640.3	636.1	625.2
Efficiency (%/100)	0.913	0.919	0.935

Power Supply Details

Power Factor	0.999	0.999	0.999
Leakage Current (mA)	<0.8		
Maximum Inrush Current (A peak)	45		
Maximum Inrush Current Duration (ms)	40		
Maximum British Thermal Unit Rating (BTU-hr)	2180.4	2167.0	2148.3

MSA 2062 Regulatory Information

Safety	– UL/CSA 62368-1 (USA/Canada)
	– EN 62368-1 (European Union)
	– IEC 60950-1 (International)
Power	– EU Regulation 2019/424 (Lot 9)
Electromagnetic Compatibility	– VCCI Class A (Japan)
	– FCC Class A (USA)
	– ICES-003 Class A (Canada)
	– EN55032: (European Union Class A); CISPR 32 (International Class A)
	– EN61000-3-2: (Harmonics) (European Union)
	– EN61000-3-3: (Flicker) (European Union)
	– EN 55035 (European Union, Immunity, Class A); CISPR 24 (International Immunity, Class A)
	– AS/NZS CISPR 32, Class A (Australia, New Zealand)
	– CNS 13438 Taiwan, Class A (Taiwan)
RoHS and WEEE	– RoHS-6/6
	– China RoHS
	– WEEE
Country Approvals	United States, Australia/New Zealand, Canada, European Union, Japan, South Korea, Taiwan

MSA 2062 Benchmark Performance Results

The performance figures provided here are for reference as many variables exist between array configurations, workloads, drive types, disk group setup parameters and host system setup.

Hewlett Packard Enterprise has traditionally published a set of end-to-end MSA performance specifications that are fed into HPE Sizer tools which are based on conservative real-world configurations. For consistency, the MSA performance numbers have been documented in both

Benchmark and End-to-End Performance tables. These numbers are subject to change without notice.

HPE MSA 2062 Benchmark Performance Results

Benchmark Performance Results ¹	HPE MSA 2062 (with SSDs)
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IOPS	
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Random Reads ²	395,000
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Random Writes ³	161,500
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Sequential ⁴	
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Segmented Sequential Reads ⁵	13.1 GB/s
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Segmented Sequential Writes ⁶	7.3 GB/s
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Notes:

- ¹Performance results were generated using internal HPE test tools. Number and type of applications, drive type and number of drives, operating system used, and the number of hosts will affect overall performance. This table is provided strictly as a test-lab comparison.
- ²Dual controller configuration, four SSDs, RAID 1, two SSDs per disk group; one disk group per pool, four volumes per pool, block size: 8k, 16 Gb FC direct connect to array.
- ³Dual controller configuration, 20 SSDs, RAID 10, ten SSDs per disk group; one disk group per pool, four volumes per pool, block size: 8k, 16 Gb FC direct connect to array.
- ⁴Sequential performance numbers were generated using segmented sequential workloads. For segmented sequential workloads with a queue depth greater than 1, each sequential stream is targeted to operate on a separate LBA range. Other types of sequential workloads that target specific LBA ranges may achieve higher results.
- ⁵Dual controller configuration, 20 SSDs, RAID 10, ten SSDs per disk group, one disk group per pool, four volumes per pool, 256k block size, 16 Gb FC direct connect to array.
- ⁶Dual controller configuration, 18 SSDs, RAID 5, nine SSDs per disk group, one disk group per pool, four volumes per pool, 256k block size, 16 Gb FC direct connect to array.

MSA 2062 End-to-End Performance Figures

Storage Model	MSA 2062 FC		MSA 2062 iSCSI		MSA 2062 SAS	
Host Protocol	16Gb FC ²		10GbE iSCSI ²		12Gb SAS ²	
Drive Technology	HDD	SSD	HDD	SSD	HDD	SSD
MSA 2062 RAID1 / RAID 10 Performance Results ^{3,4,5,6,7}						
Random Reads IOPs	49,900	366,000	43,400	303,400	49,900	375,300
Random Writes IOPs	31,600	149,000	31,600	138,600	31,700	150,500
Random Mix 60/40 IOPs	40,100	245,800	39,800	220,600	40,100	249,800
Sequential Reads MB/s ¹	8,400	12,100	5,500	8,700	8,400	12,100
Sequential Writes MB/s ¹	4,000	5,300	3,700	4,400	4,000	5,300
MSA 2062 RAID 5 Performance Results ^{8,9,10,11}						
Random Reads IOPs	48,100	354,800	41,300	284,100	48,000	364,800
Random Writes IOPs	15,500	69,300	15,600	66,300	15,600	69,800
Random Mix 60/40 IOPs	27,300	128,600	27,200	121,500	27,100	130,300
Sequential Reads MB/s ¹	8,000	11,800	5,400	8,700	8,000	11,800
Sequential Writes MB/s ¹	5,800	6,700	4,500	4,500	5,800	6,700
MSA 2062 RAID 6 Performance Results ^{12,13,14,15}						
Random Reads IOPs	48,900	350,300	42,000	284,000	48,800	358,900
Random Writes IOPs	12,000	59,300	12,000	57,000	12,000	59,600
Random Mix 60/40 IOPs	20300	113,800	20,300	107,800	20,300	115,300

MSA 2062 End-to-End Performance Figures

Sequential Reads MB/s¹	8,000	12,100	5,500	8,700	8,000	12,100
Sequential Writes MB/s¹	5,700	6,300	4,300	4,400	5,700	6,300
MSA 2062 MSA-DP+ Performance Results^{16,17,18}						
Random Reads IOPs	48,600	338,300	41,800	281,900	48,600	347,700
Random Writes IOPs	11,700	59,200	11,800	56,900	11,800	59,600
Random Mix 60/40 IOPs¹	20,300	113,200	20,300	107,500	20,300	114,400
Sequential Reads MB/s¹	8,000	12,100	5,400	8,700	8,000	12,100
Sequential Writes MB/s¹	5,400	6,300	4,300	4,400	5,400	6,300

Notes:

– Number and type of applications, drive type and number of drives, operating system used, and the number of hosts will affect overall performance. This table is provided strictly as a test-lab comparison. These numbers reflect a full array configuration with the maximum number of front-end ports and controllers. The test results shown for the HPE MSA 2062 are designed to give a conservative reference point for comparisons.

– All performance numbers were captured using dual controller configurations.

– All performance numbers were captured using four volumes per pool.

- ¹Sequential tests (MB/s) are based on 256K block sizes and random tests (IOPS) are based on 8K block sizes. For sequential workloads with a queue depth greater than 1, each sequential stream is targeted to operate on a separate LBA range. Other types of sequential workloads that target specific LBA ranges may achieve higher results. Results cannot be expected with a single host.
- ²Fibre Channel results were measured using 16 Gb FC Host Bus Adapters. SAS results were measured using 12 Gb SAS Host Bus Adapters. 10GbE iSCSI results were measured using 10GbE iSCSI Host Bus Adapters. Hosts were directly attached to the HPE MSA 2060 array. MSA 2060 iSCSI performance numbers represent both SFP and BASE-T based controllers.
- ³RAID 1 Solid State Drive random read and mixed results: 4 SSDs, 2 SSDs per disk group, 1 disk group per pool.

- ⁴RAID 10 Solid State Drive random write results: 8 SSDs, 4 SSDs per disk group, 1 disk group per pool.
- ⁵RAID 10 Solid State Drive sequential results: 20 SSDs, 10 SSDs per disk group, 1 disk group per pool.
- ⁶RAID 10 Hard Disk Drive sequential results: 96 10K HDDs, 12 drives per disk group, 4 disk groups per pool.
- ⁷RAID 10 Hard Disk Drive random results: 240 10K HDD, 10 drives per disk group, 12 disk groups per pool.
- ⁸RAID 5 Solid State Drive random results: 6 SSDs, 3 SSDs per disk group, 1 disk group per pool.
- ⁹RAID 5 Solid State Drive sequential results: 18 SSDs, 9 SSDs per disk group, 1 disk group per pool.
- ¹⁰RAID 5 Hard Disk Drive sequential results: 90 10K HDD, 9 drives per disk group, 5 disk groups per pool.
- ¹¹RAID 5 Hard Disk Drive random results: 234 10K HDD, 9 drives per disk group, 13 disk groups per pool.
- ¹²RAID 6 Solid State Drive random results: 8 SSDs, 4 SSDs per disk group, 1 disk group per pool.
- ¹³RAID 6 Solid State Drive sequential results: 20 SSDs, 10 SSDs per disk group, 1 disk group per pool.
- ¹⁴RAID 6 Hard Disk Drive sequential results: 80 10K HDD, 10 drives per disk group, 4 disk groups per pool.
- ¹⁵RAID 6 Hard Disk Drive random results: 240 10K HDD, 10 drives per disk group, 12 disk groups per pool.
- ¹⁶MSA-DP+ Solid State Drive results: 24 SSDs, 12 SSDs per disk group, 1 disk group per pool.
- ¹⁷MSA-DP+ Hard Disk Drive sequential results: 96 10K HDD, 12 drives per disk group, 4 disk groups per pool.
- ¹⁸MSA-DP+ Hard Disk Drive random results: 240 10K HDD, 30 drives per disk group, 4 disk groups per pool.

Environment-friendly Products and Approach End-of-life Management and Recycling

Hewlett Packard Enterprise offers end-of-life product return, trade-in, and recycling programs in many geographic areas for our products. Products returned to Hewlett Packard Enterprise will be recycled, recovered, or disposed of in a responsible manner.

The EU WEEE directive (2002/95/EC) requires manufacturers to provide treatment information for each product type for use by treatment facilities. This information (product disassembly instructions) is posted on the Hewlett Packard Enterprise web site. These instructions may be used by recyclers and other WEEE treatment facilities as well as Hewlett Packard Enterprise OEM customers who integrate and re-sell Hewlett Packard Enterprise equipment.

Summary of Changes

Date	Version History	Action	Description of Change
20-Jul-2026	Version 22	Changed	QuickSpecs maintenance updates have been applied.
		Removed	Obsolete or not supported SKU removed - R0Q58A
02-Mar-2026	Version 21	Changed	Overview, Standard Features, and Configuration Information sections were updated This release primarily focuses on expanding configuration options, updating core descriptive sections, and adding new Smart Choice and option SKUs, while maintaining continuity with the HPE rebranding Main changes: – Refined positioning of the HPE MSA 2062 as an affordable, flash-enabled, Gen6 storage array – Reinforced messaging around simplicity, scalability, and performance – Current drive capacities – Tiering, caching, and RAID (including MSA-DP+) capabilities – Integrated Advanced Data Services functionality – Newly added SKUs – Updated Smart Choice models – Clarified bundle contents and ordering notes
		Added	P88911-B25, P88912-B25, P88913-B25, P88914-B25, P88915-B25, P88918-B25, P88920-B25, P88921-B25, P88922-B25
19-Jan-2026	Version 20	Changed	HPE Rebranding applied
02-Sep-2025	Version 19	Changed	Overview and Standard Feature sections were updated - HPE Smart Choice MSA models and HPE Morpheus VM Essentials Software details added Configuration Information - New SKUs were added
		Added	P84170-B25, P84171-B25, P84172-B25
03-Mar-2025	Version 18	Changed	Overview, Standard Features and Configuration Information sections were updated.
02-Dec-2024	Version 17	Changed	Overview, Standard Features and Configuration Information sections were updated. Updates to drive options.

Date	Version History	Action	Description of Change
05-Aug-2024	Version 16	Changed	Overview, Standard Features, Service and Support, Configuration information and Technical Specifications sections were updated. Added 24 TB HDD options.
19-Feb-2024	Version 15	Changed	Networking product names were updated.
04-Dec-2023	Version 14	Changed	HPE Services Rebranding. Obsolete SKUs removed.
07-Aug-2023	Version 13	Changed	Overview, Configuration information and Technical Specifications sections were updated. Updated array models, technical specifications, and certifications.
19-Jun-2023	Version 12	Changed	Overview, Standard Features, Service and Support and Configuration Information sections were updated. Added NEBS certification details, support for Veeam, and other general updates.
06-Feb-2023	Version 11	Changed	Overview and Standard Features sections were updated. GreenLake for Backup and Recovery content added.
05-Dec-2022	Version 10	Changed	Overview, Standard Features, Configuration information and Technical Specifications sections were updated. Added 20 TB HDD, 20 TB HDD six-pack, and 7.68 TB SSD drive options; Added HPE MSA 25 Gb SFP28 SR 4-pack iSCSI Transceivers.
06-Sep-2022	Version 9	Changed	Overview, Standard Features, Configuration information and Technical Specifications sections were updated. Added MSA 2062 Storage Array and MSA 2060 Drive Enclosure SKU additions for Lot9 2023 compliance.
13-Jun-2022	Version 8	Changed	Overview, Standard Features, Service and Support, and Configuration Information sections were updated.
04-Oct-2021	Version 7	Changed	Service and Support section was updated
02-Aug-2021	Version 6	Changed	Updated array performance data.
06-Jul-2021	Version 5	Changed	Added 10GBase-T models and other updates.

Date	Version History	Action	Description of Change
06-Apr-2021	Version 4	Changed	Added 18 TB HDD option, updated OS support, updated temperature, and humidity specifications.
18-Jan-2021	Version 3	Changed	Added power supply details, temperature and humidity ranges, system certifications, and other textual updates.
16-Nov-2020	Version 2	Changed	Updated content on SFPs, added Acoustic/Shock/Vibe specifications, and updated HDD and SSD content.
08-Sep-2020	Version 1	New	New QuickSpecs.

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For hard drives, 1GB = 1 billion bytes. Actual formatted capacity is less.

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