User Guide

Ultrastar Data102
Regulatory Model H4102-J
Document D018-000226-000
Revision 03
March 2022

Western Digital.

Table of Contents

Revision History

Date	Revision	Comment
November 2017	1.0	Initial release
November 2017	1.1	• The crossbar on the CMA was changed. See CMA *(page 55)*. • Removed Lowline power specs from Power Requirements *(page 19)*. • Changed required rack depth, see Mechanical Specifications *(page 5)*. • Changed typical power consumption, see Electrical Specifications *(page 4)*. • Updated LED Flash Patterns, see LEDs *(page 10)*.
December 2017	1.2	• Added active cable support • Added firmware upgrade section. See Firmware Upgrade *(page 206)*. • Updated the Non-Op altitude specification. See Environmental Specifications *(page 4)*.
January 2018	1.2.1	Updated the product name
January 2018	1.3	• Updated information on the 2.5" drive carrier option. See 2.5in SSD Assembly *(page 64)*. • Added torque requirements for all screws used in the enclosure. • Updated the IOM replacement section to account for the possibility of a firmware mismatch. See IOM Replacement *(page 69)*. • Updated the drive assembly installation instructions to clarify the orientation of the drive assemblies. 3.5in HDD Assembly Replacement *(page 83)*.
April 2018	1.4	• Updated Compatible Drives List. See List of Compatible Drives *(page 24)*. • Updated the Rack Requirements. See Ultrastar Data102 Rack Requirements *(page 16)*. • Updated the Firmware Upgrades. See: Firmware Upgrade *(page 206)*
May 2018	1.5	Added the Part Replacement Service Window. See: Part Replacement Service Window *(page 68)*
June 2018	1.6	• Updated Compatible Drives List. See List of Compatible Drives *(page 24)* • Updated the Firmware Upgrade section. See Firmware Upgrade *(page 206)*

Date	Revision	Comment
		• Updated the Firmware Download section. See Downloading Firmware from the Support Portal *(page 208)* • Updated the System Architecture Overview section. See System Architecture Overview *(page 2)* • Updated the Daisy Chaining section. See Daisy Chaining *(page 271)* • Added the Rear Cover Alignment Bracket Description. See Top Cover Alignment Bracket *(page 54)*
November 2018	1.7	• Updated the images in the Daisy Chaining section. See Daisy Chaining *(page 271)* • Updated List of CRUs. See List of Customer Replaceable Units (CRUs) *(page 7)* • Updated Compatible Drives List. See List of Compatible Drives *(page 24)* • Updated the Host Connectivity section. See: SAS Cabling *(page 22)*
May 2019	1.8	• Changed senddiag commands from images to codeblocks. See sg_senddiag Command *(page 237)*. • Updated daisy-chaining tables to match diagrams. See Two Host Cable Configurations *(page 278)*. • Corrected OOBM zoning configuration instructions. See Predefined Zoning Configurations *(page 230)*. • Added Configuring OOBM Network Settings Using SES *(page 225)*.
May 2019	1.9	• Corrected explanation of SATA configuration in Firmware Upgrade *(page 206)* section.
June 2019	1.10	• Updated the Host Connectivity section. See: SAS Cabling *(page 22)* • Added Windows syntax examples and reorganized the Upgrading Firmware with OOBM section
June 2019	1.11	Updated the Host Connectivity section. See: SAS Cabling *(page 22)*
July 2019	1.12	Moved the following topics to the Ultrastar Data102 Description *(page 2)* section: • Ultrastar Data102 Rack Requirements *(page 16)* • Power Requirements *(page 19)* • ESD *(page 20)* • Enclosure Cooling *(page 20)* • SAS Cabling *(page 22)*

Date	Revision	Comment
		Moved the Supported Operating Systems *(page 8)* topic to the Management *(page 204)* section. Corrected LED identification tables for IOMs, PSUs, and drives in the LEDs *(page 10)* section. Updated servicing image to correct length values and rail servicing extension in Ultrastar Data102 Rack Requirements *(page 16)* section. Updated the following for CMA Lite: • Added CMA Lite Component Overview *(page 58)* section, including description, specs, and layout. • Updated CMA Replacement *(page 90)* section to combine CMA Standard and CMA Lite content where applicable. • Updated Maximum HD Mini-SAS Configuration *(page 203)* section. Added a note about OOBM ports configured for DHCP by default to the OOBM Management Overview *(page 225)* section.
September 2019	1.13	• Replaced references to He12 drives with Ultrastrar DC HC520 in List of Compatible Drives *(page 24)* • Changed device references from OS-specific (`/dev/sgX` for Linux and `SCSIX:X,X,X` for Windows) to generic (`<dev>`) throughout. • Updated table for Approved SAS Cables in SAS Cabling *(page 22)* • Added Subenclosure Nickname *(page 261)* section • Updated Supported Operating Systems *(page 8)*
November 2019	1.14	• Updated images of captive chassis-cover screws throughout • Updated table for Approved SAS Cables in SAS Cabling *(page 22)* • Updated the Daisy Chaining configurations in Daisy Chaining *(page 271)*
April 2020	1.15	• Added note about using non-automatic firmware activation for RAID adpaters in Firmware Upgrade *(page 206)* • Added note about performing zoning offline in Zoning *(page 230)* • Added note and step for configuring zoning on an IOM after replacement in IOM Replacement *(page 69)* • Added RHEL 8.0 to Supported Operating Systems *(page 8)* • Added note about LED behavior during proper drive insertion in Drive Assembly LED *(page 15)* • Added note about minimum time between removing and reapplying power in Power Connections *(page 292)*
August 2020	1.16	• Updated Supported Operating Systems *(page 8)* • Updated SAS Cabling *(page 22)*

Date	Revision	Comment
		• Updated List of Compatible Drives *(page 24)* • Added File-Based Zoning *(page 251)* section • Updated note in IOM Replacement *(page 69)* about standard vs. file-based zoning configuration after IOM replacement
October 2020	1.17	• Fixed typo in Rails Layout *(page 53)* • Updated text and color-coded images in Predefined Zoning Configurations *(page 230)* • Updated images in LEDs *(page 10)* and Components *(page 36)* • Added note about not unzipping tar.gz file prior to firmware upgrade in Downloading Firmware from the Support Portal *(page 208)*, Linux Upgrade to New Firmware *(page 212)*, Non-Automatic Firmware Activation in Linux *(page 213)*, Windows Upgrade to New Firmware *(page 217)*, and Non-Automatic Firmware Activation in Windows *(page 219)* • Added Ubuntu 20.04 to Supported Operating Systems *(page 8)* • Updated table of approved SAS cables in SAS Cabling *(page 22)* • Updated FW activation step in Upgrading Firmware with OOBM *(page 228)*
December 2020	1.18	• Added UK Import Representation Contact • Removed Formerica cables from SAS Cabling *(page 22)*
February 2021	1.19	• Added 4U46 SKU (1ES2039) to Supported SKUs and updated minimum number of HDDs in Partially Populated Enclosures *(page 263)* • Added Ultrastar DC HC650 drives to List of Compatible Drives *(page 24)* • Added content for Artesyn PSU *(page 46)* • Added Firmware Auto-Sync *(page 222)* section and updated IOM Replacement *(page 69)* to reference this feature • Updated Rails Replacement *(page 116)* to include instructions for toolless screwplate • Updated Rear Fan Replacement *(page 77)* with requirement to replace all four fans
March 2021	1.20	• Added Appendices *(page 301)* section to contain SKUs for Fully-Populated Configurations *(page 302)*, SKUs for Partially-Populated Configurations *(page 302)*, and SKUs for Scale-Up Modules *(page 303)* • Updated List of Customer Replaceable Units (CRUs) *(page 7)*
August 2021	1.21	• Removed Mexico from Country Certifications *(page 296)*

Date	Revision	Comment
		• Updated Rear Fan Replacement *(page 77)* with notes about replacing all four fans • Added Multiple CRU Replacements *(page 68)* to Part Replacement Service Window *(page 68)* • Added Verifying OOBMs before Firmware Upgrade in Linux *(page 206)* to Firmware Upgrade *(page 206)*
September 2021	01	Changed document number from 1ET1094 to D018-000226-000
January 2022	02	• Added drive model numbers to List of Compatible Drives *(page 24)* • Added footnote to Mechanical Specifications *(page 5)* and Components *(page 36)* that listed weights do not include accessories or packaging/shipping materials • Reorganized tables in SKUs for Fully-Populated Configurations *(page 302)*, SKUs for Partially-Populated Configurations *(page 302)*, and SKUs for Scale-Up Modules *(page 303)* • Added Configuring OOBM Static IP Address Using cURL *(page 227)* • Removed Top Cover Alignment Bracket content from Rails *(page 52)*; added Top Cover Alignment Bracket *(page 54)* • Updated component image in 2.5in SSD Assembly *(page 64)* • Removed Amphenol ICC (FCI) passive cables 10112041-2010LF, -2020LF, and -2030LF from SAS Cabling *(page 22)* • Added 1EX2470, 1EX2465, 1EX2490, and 1EX2485 to SKUs for Scale-Up Modules *(page 303)*
March 2022	03	• Reorganized SAS Cabling *(page 22)* section and added note about compatibility between AOCs and 9300-, 9302-, and 9305-series HBAs • Updated drive installation instructions in 3.5in HDD Assembly Replacement *(page 83)* • Updated logo for detachable power cord in Safety Warnings and Cautions *(page 291)* • Added Debian 10, 11 and RHEL 8.4 to Supported Operating Systems *(page 8)* • Updated component images and tables in Delta PSU Layout *(page 45)* and Artesyn PSU Layout *(page 47)*

Notices

Western Digital Technologies, Inc. or its affiliates' (collectively "Western Digital") general policy does not recommend the use of its products in life support applications wherein a failure or malfunction of the product may directly threaten life or injury. Per Western Digital Terms and Conditions of Sale, the user of Western Digital products in life support applications assumes all risk of such use and indemnifies Western Digital against all damages.

This document is for information use only and is subject to change without prior notice. Western Digital assumes no responsibility for any errors that may appear in this document, nor for incidental or consequential damages resulting from the furnishing, performance or use of this material.

Absent a written agreement signed by Western Digital or its authorized representative to the contrary, Western Digital explicitly disclaims any express and implied warranties and indemnities of any kind that may, or could, be associated with this document and related material, and any user of this document or related material agrees to such disclaimer as a precondition to receipt and usage hereof.

Each user of this document or any product referred to herein expressly waives all guaranties and warranties of any kind associated with this document any related materials or such product, whether expressed or implied, including without limitation, any implied warranty of merchantability or fitness for a particular purpose or non-infringement. Each user of this document or any product referred to herein also expressly agrees Western Digital shall not be liable for any incidental, punitive, indirect, special, or consequential damages, including without limitation physical injury or death, property damage, lost data, loss of profits or costs of procurement of substitute goods, technology, or services, arising out of or related to this document, any related materials or any product referred to herein, regardless of whether such damages are based on tort, warranty, contract, or any other legal theory, even if advised of the possibility of such damages.

This document and its contents, including diagrams, schematics, methodology, work product, and intellectual property rights described in, associated with, or implied by this document, are the sole and exclusive property of Western Digital. No intellectual property license, express or implied, is granted by Western Digital associated with the document recipient's receipt, access and/or use of this document or the products referred to herein; Western Digital retains all rights hereto.

Western Digital, the Western Digital logo, and Ultrastar are registered trademarks or trademarks of Western Digital Corporation or its affiliates in the US and/or other countries. Broadcom is among the trademarks of Broadcom. Intel and Xeon are trademarks of Intel Corporation or its subsidiaries. Linux® is the registered trademark of Linus Torvalds in the U.S. and other countries. Mellanox is a registered trademark of Mellanox Technologies, Ltd. All other marks are the property of their respective owners. Product specifications subject to change without notice. Pictures shown may vary from actual products. Not all products are available in all regions of the world.

Western Digital
5601 Great Oaks Parkway
San Jose, CA 95119

Points of Contact

For further assistance with a Western Digital product, contact Western Digital Datacenter Platforms technical support. Please be prepared to provide the following information, as applicable: part number (P/N), serial number (S/N), product name and/or model number, software version, and a brief description of the issue.

Email:
support@wdc.com

Website:
https://portal.wdc.com/Support/s/

UK Import Representation Contact

Western Digital UK Limited
PO Box 471
Leatherhead KT22 2LU
UK

Telephone: +44 1372 366000

EU Import Representation Contact

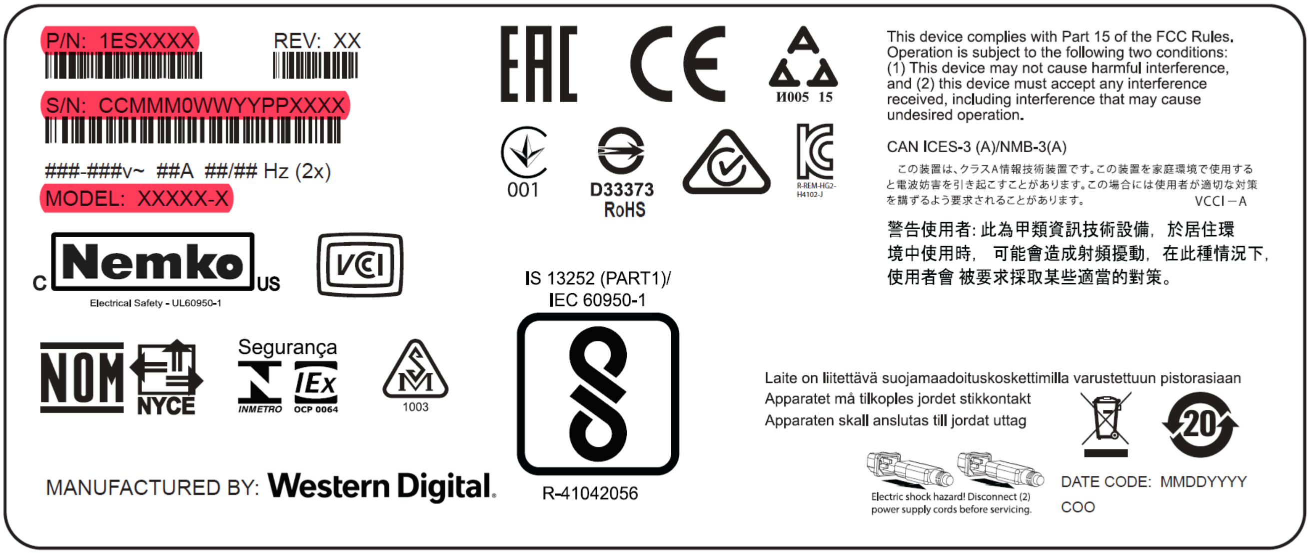
Western Digital EU Limited
PO Box 13379
Swords, Co
Dublin, Ireland

1.1 Product Label Information

The following product information is required for technical support requests:

- Part Number (P/N)
- Serial Number (S/N)
- Product Name and/or Model Number (MODEL)

This information may be found on the product label, which is affixed to an exterior, non-removable surface of the chassis. The following is an example label with the applicable information fields highlighted:


P/N: 1ESXXXX
REV: XX
S/N: CCMMM0WWYYPPXXXX
###-###v~ ##A ##/## Hz (2x)
MODEL: XXXXX-X
Nemko
Electrical Safety - UL60950-1
Segurança
INMETRO
OCP 0064
1003
NYCE
MANUFACTURED BY: Western Digital.
001
D33373
RoHS
IS 13252 (PART1)/
IEC 60950-1
R-41042056
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
CAN ICES-3 (A)/NMB-3(A)
この装置は、クラスA情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。 VCCI－A
警告使用者: 此為甲類資訊技術設備，於居住環境中使用時，可能會造成射頻擾動，在此種情況下，使用者會 被要求採取某些適當的對策。
Laite on liitettävä suojamaadoituskoskettimilla varustettuun pistorasiaan
Apparatet må tilkoples jordet stikkontakt
Apparaten skall anslutas till jordat uttag
Electric shock hazard! Disconnect (2) power supply cords before servicing.
DATE CODE: MMDDYYYY
COO

Overview

This section provides a high level overview of the features of the Ultrastar Data102 .

In This Chapter:

1.1 Ultrastar Data102 Description

Figure 2: Ultrastar Data102

The Ultrastar Data102 is a 4U form factor, high availability, high density, rack-mounted storage enclosure. It is capable of hosting up to 102 HDD drives (SAS or SATA), or hybrid support with up to 24 SSDs (SAS or SATA) for a data acceleration tier. The maximum data storage capacity of the Ultrastar Data102 is 2.0PB using 20TB Ultrastar HC650 drives . (For a full list of compatible drives and total storage capacities, see the List of Compatible Drives *(page 24)*.) The enclosure runs on an input voltage of 200-240 VAC and consumes ~1300W of power under typical conditions. It requires a maximum of ~1600W (Delta PSU) / ~1800W (Artesyn PSU) at full load.

It is designed to fit within a 4U rack space and requires 1181-1197 mm (46.5in. - 47.13in.) of usable rack space, frame to frame . A fully loaded system will add 118.8 kg / 262 lbs. of static load when fully loaded with drives.

- 4U Storage Enclosure
- Supports up to 102 Drives
- Can support 3.5" drives and 2.5" SSD drives (2.5" requires an adapter) in the 102 available drive bays.
- Up to 12W per drive slot for the 102 data storage drives (Cannot exceed 85A on the 5V rail)
- House and control four (4) N+1 redundant 80mm rear fans
- House and control a dual rotor 40mm internal IOM Fan
- Controlled by two (2) redundant I/O Modules[1]
- Powered by two (2) redundant 1600W PSUs
- Supports High Line (220-240 VAC) Input Power
- Full high availability with independent dual paths to all HDDs
- Toolless replacement of all Customer Replaceable Units (CRUs)
- Fits within a standard EIA-310 rack including all necessary cable management (see Compatible Rack Hardware Configuration *(page 18)*)
- Supports up to 3m passive SAS cables (limited to 3m or less) or active cables (any length) (see SAS Cabling *(page 22)*)

1. SATA based models will only include 1 IOM

1.2 System Architecture Overview

The Ultrastar Data102 IOM uses a cascaded expander design to allow for connection to all 102 drives. A 48-port primary expander connects with the six host ports, has a x3 link to the other IOM for IOM-IOM communication and syncing, and also has a x10 SAS link to each secondary expander. Each secondary expander then connects with fifty-one (51) drives.

The out-of-band management microprocessor provides an Ethernet connection using a Redfish/RESTful API to access the various enclosure services. All the SES enclosure information can be obtained through the out-of-band management port. Major use cases for this feature include obtaining storage subsystem health information, locating enclosure components using the IDENT LEDs, and updating firmware.

The system FPGAs control and report the states of the system fans, enclosure LEDs, connector LEDs, drive LEDs, and T10 drive power disable signals on the 102 data storage drives.

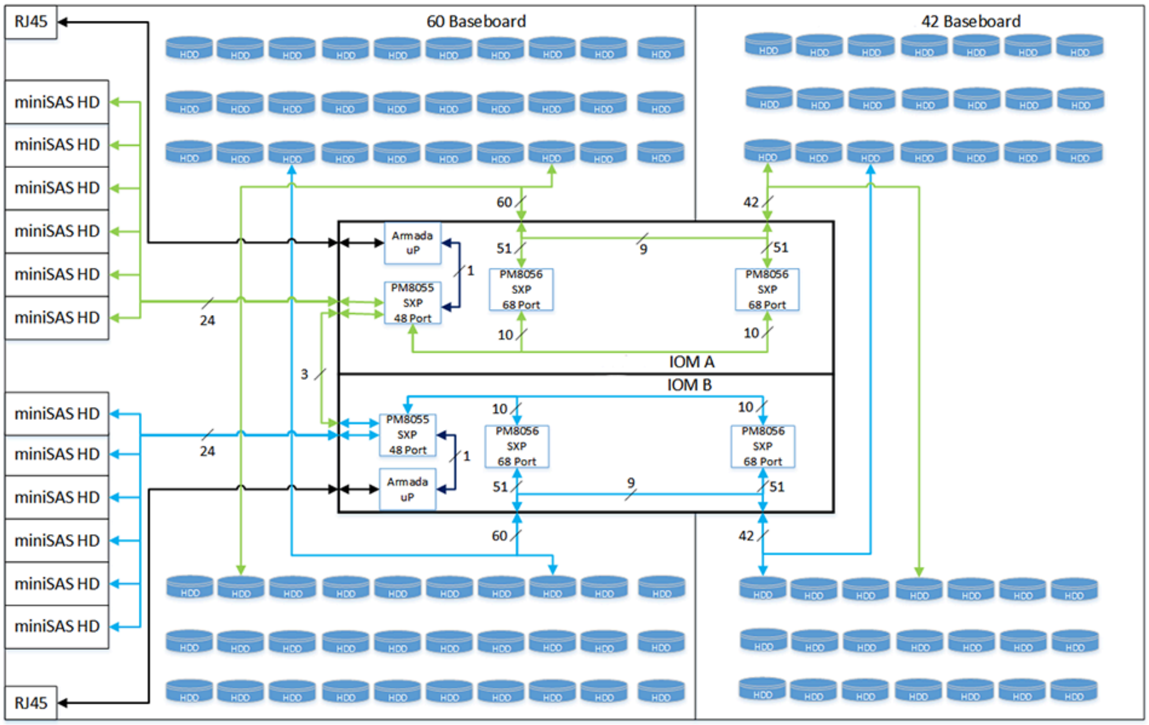
Note: To use T10 power disable, the drives installed must also support this feature.

The I^2C architecture is designed to support only one single master on any given bus. The primary expander will be the master on each I^2C bus. There are eight I^2C buses used in the Ultrastar Data102 enclosure. The number of devices on each bus are balanced to allow communication to peripheral devices and not overload any one bus. The devices connected on the I^2C buses include the enclosure VPDs, temp sensors, baseboard FPGAs, and SAS connectors among others.

1.3 System Level Block Diagram

The following image shows the system block diagram for the Ultrastar Data102 .

Figure 3: System Block Diagram



1.4 Environmental Specifications

Table 1: Environmental Specification

Specification	Non-Operational	Operational
Temperature	-40°C to 70°C	5°C to 35°C
Temperature Gradient	30°C per hour max	20°C per hour max
Temperature De-rating	1°C per 300m above 3000m	1°C per 300m above 900m
Relative Humidity	8-90% Non-Condensing	8-90% Non-Condensing
Relative Humidity Gradient	30% per hour maximum	30% per hour maximum
Altitude	-300m to 12,000m / -984 ft. to 39,370 ft	-300m to 3048m / -984 ft. to 10,000 ft.

1.5 Electrical Specifications

Table 2: Electrical Specifications

Specification	Value
Max Power Consumption	~1600W (Delta PSU) / ~1800W (Artesyn PSU)

Specification	Value
Typical Power Consumption[2]	~1300W
Input Voltage	200-240 VAC
PSU Connector Type	C14
PSU Efficiency	80 PLUS Platinum
Inrush Current Maximum (per PSU)	AC line inrush current shall not exceed 40A peak, for up to one-quarter of the AC cycle after which, the input current should be no more than the specified maximum input current.

Caution: The Ultrastar Data102 can only be plugged into high line (200-240 VAC) power. If the unit is plugged into low line (110-127 VAC), the PSU will report a "Critical" state when status pages are queried using SES. In this case, the enclosure will power up, but the drives will not. The enclosure will remain in low-power mode.

1.6 Mechanical Specifications

Table 3: Mechanical Specifications

Specification	Non-Operational	Operational
Shock	10G, 0 - peak,11ms half sine; 3 positive and 3 negative pulses in each axis Shock	5G, 0 - peak, 11ms half sine; 3 positive and 3 negative pulses in each axis-minimum 6 seconds between shocks to allow for write/read recovery
Vibration	0.75G, 0 - peak swept sine; 5 -500Hz; 1 complete sweep @ 1/2 octave per minute	0.10G, 0 - peak swept sine; 5 -500Hz; 1 complete sweep @ 1/2 octave per minute
Weight	118.8 kg / 262 lbs.[3]	
Enclosure Dimensions	W: 447 mm x L: 1048.5 mm x H: 175 mm / W: 17.67 in. x L: 41.28 in. x H: 6.89 in.	
Length of Enclosure w/ CMA	CMA Standard: 1183mm / 46.57in.	
	CMA Lite: 1148mm / 45.19in.	
Required Rack Width	450 mm (17.72 in.) minimum width, with 465 mm (18.31 in.) ± 1.5 mm nominal hole spacing. See EIA-310 Rack Standard.	
Required Rack Depth	1181-1197 mm (46.5in. - 47.13in.) of usable rack space, frame to frame	
Rack Units (U)	4U	

2. Max and typical power consumption values represent the output power to the system. Input power will vary depending on the PSU efficiency and load sharing between PSUs.

3. Listed weight is for a dual-IOM enclosure, fully populated with 102 drives. It does not include the CMA, cable tray, accessories, or packaging/shipping materials.

Specification	Non-Operational	Operational
Vertical Rack Rail Spacing	812.8 - 914.4 mm / 32 - 36 in.	

1.7 Performance Specifications

Table 4: Performance Specifications

Specification	Value
Number of Drive Slots	102
Data Transfer Rates	12Gbps SAS / 6Gbps SATA
Max Raw Data Storage Capacity	2.0PB using 20TB Ultrastar HC650 drives
SAS Ports	12 x Mini-SAS HD (6 per IOM) 2 x 10/100/1G Ethernet

1.8 Ultrastar Data102 Layout

Figure 4: Front and Rear Product Layout

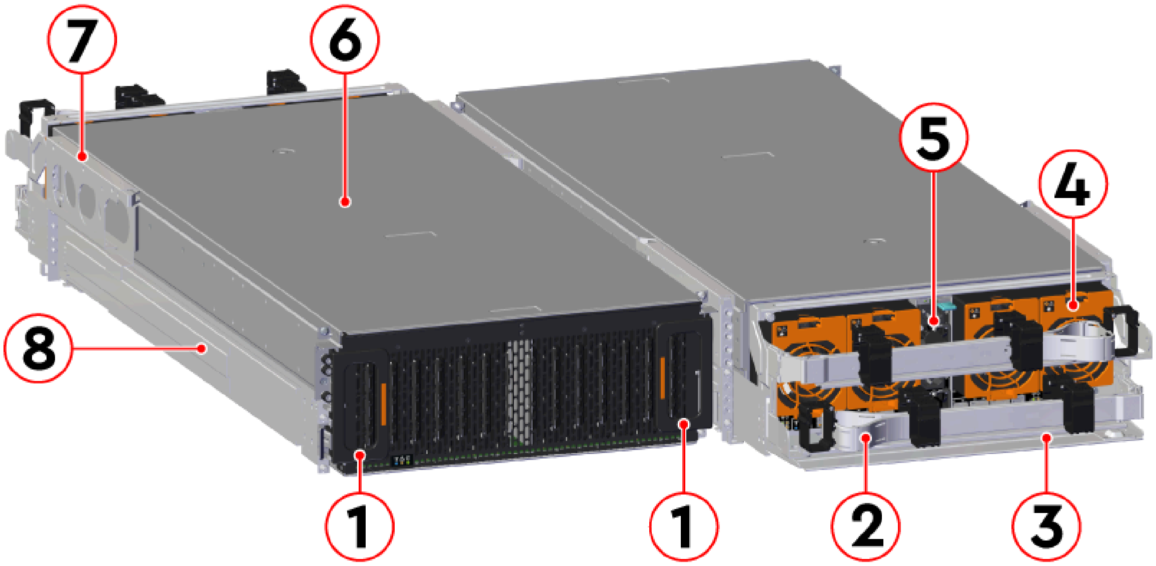


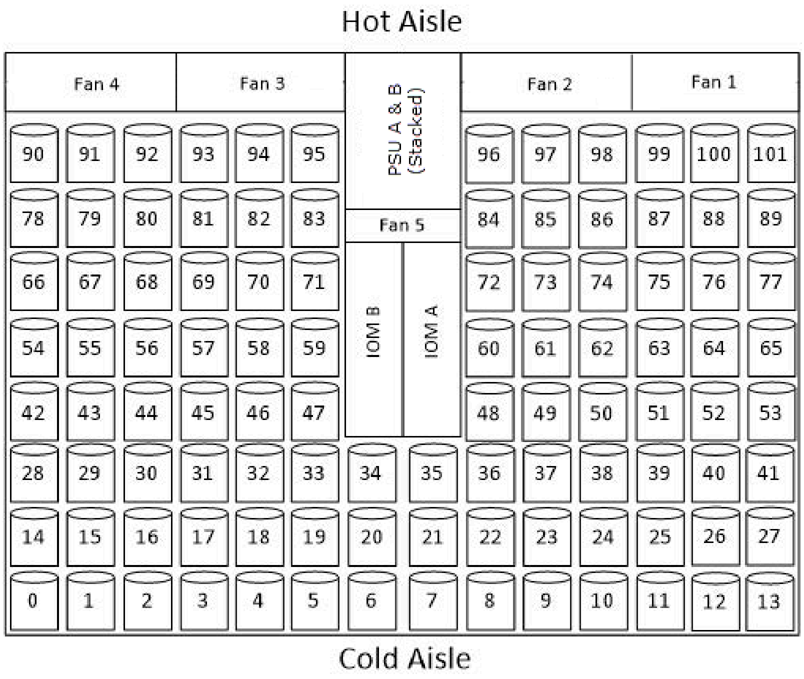
Table 5: Front and Rear Component Identification

Number	Component
1	Enclosure Handles
2	CMAs
3	CMA Tray
4	Rear Fans

Number	Component
5	PSUs (Delta PSUs shown)
6	Chassis Cover
7	Rear Cover Alignment Brackets
8	Rails

The following is an image of the layout of the major system components inside the Ultrastar Data102 .

Figure 5: Component Layout



1.9 List of Customer Replaceable Units (CRUs)

The following table lists the replaceable components and their part numbers.

Table 6: List of Replaceable Components

Component	Part Number
Ultrastar Data102 Chassis (one IOM, two PSUs)	1EX0440
Ultrastar Data102 Chassis (two IOMs, two PSUs)	1EX0441
Delta PSU 1600W	1EX0434
Artesyn PSU 1800W	1EX2801
IOM	1EX2201
IOM Blank	1EX0431
IOM Fan	1EX0432

Component	Part Number
Rear Fans	1EX2814
Top Cover Alignment Brackets	1EX2288
Rails Kit (CMA Standard)	1EX0435
Rails Kit (CMA Lite)	1EX1601
CMA Standard Arms (dual)	1EX0437
CMA Standard Arm (single)	1EX1174
CMA Lite Arm (2U baskets)	1EX1834
CMA Lite Arm (1U baskets)	1EX1602
CMA Cable Tray	1EX1119
CMA Lite Cable Tray	1EX1603
CMA Lite Kit (w/ rails, spacer brackets, and 2U-basket CMA)	1EX1825
CMA Lite Kit (w/ rails, spacer brackets, and 1U-basket CMA)	1EX1527
3.5 in. Drive Carrier	1EX0438
3.5 in. Drive Blank	1EX0429
2.5 in. to 3.5 in. Conversion Drive Carrier	1EX0439
Power Cable for PDU, C13-C14, 18AWG, 3m	1EX1158
HD Mini-SAS to HD Mini-SAS, Passive, 2m	1EX1531
HD Mini-SAS to HD Mini-SAS, Passive, 3m	1EX1533
HD Mini-SAS to HD Mini-SAS, Active Optical, 3m	1EX2316
HD Mini-SAS to HD Mini-SAS, Active Optical, 4m	1EX2315
Accessory Kit	1EX2755
Packaging Kit	1EX0581

1.10 Supported Operating Systems

Table 7: Compatible Operating Systems

OS Support	
Microsoft® Windows	**2012** R2 x64 Server
	2016 R1 x64 Server
	2019 R1 x64 Server
CentOS/RedHat® Enterprise Linux (RHEL)	**7.2** (x86_64) Kernel: 3.10.0-327
	7.3 (x86_64) Kernel: 3.10.0-514
	7.4 (x86_64) Kernel: 3.10.0-693

OS Support	
	7.6 (x86_64) Kernel: 3.10.0-957
	8.0 (x86_64) Kernel: 4.18.0-80
	8.2 (x86_64) Kernel: 4.18.0-193
	8.3 (x86_64) Kernel: 4.18.0-240
	8.4 (x86_64) Kernel: 4.18.0-305
Ubuntu® Server	**14.04** Kernel: 3.13
	16.04 Kernel: 4.4
	18.04 Kernel: 4.15
	20.04 Kernel: 5.4
Debian GNU/Linux	**8.10** Kernel: 3.16
	9.6 Kernel: 4.9
	9.8 Kernel: 4.9
	10 Kernel: 4.19
	11 Kernel: 5.10
SUSE® Linux Enterprise Server (SLES)	**12** SP3
	15 SP1

1.11 LEDs

1.11.1 Front and Rear IO LEDs

The Ultrastar Data102 has a number of LEDs on the exterior of the enclosure that display various system statuses. The three LEDs on the front mirror three on the rear, allowing the general status of the enclosure to be determined from either side of the rack.

Figure 6: Front LEDs Location

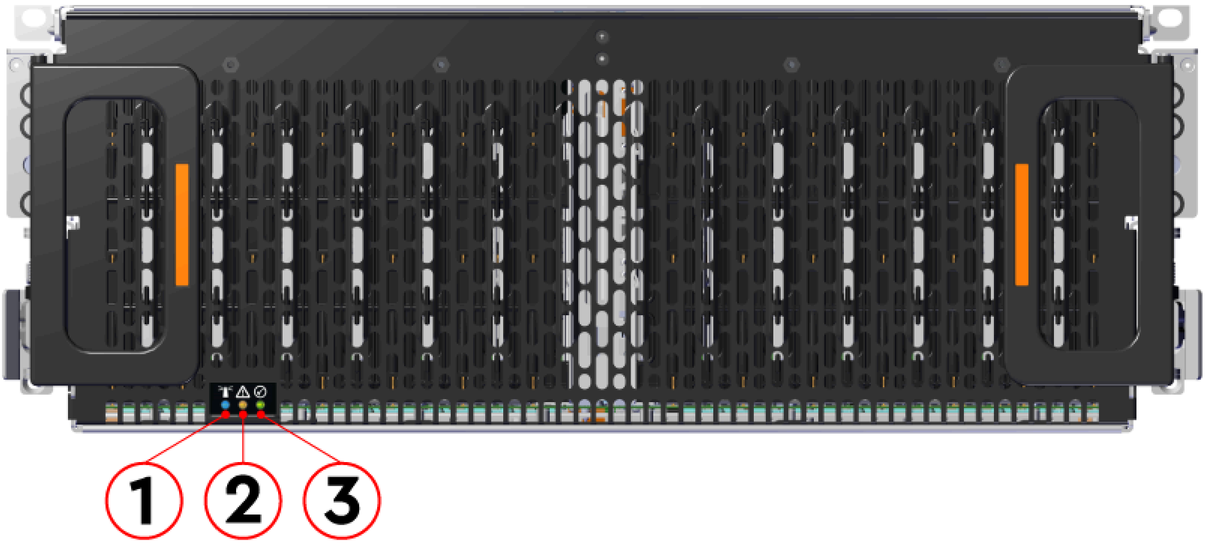


Table 8: Front LEDs Identification

Number	LED Name	Color	Behavior
1	Identify	Blue	**Blink** @ 1 Hz (50% duty cycle) – Blinks only when Identification has been activated. Will blink when **any** component is identified.
2	Fault	Amber	**Blink** @ 1 Hz (50% duty cycle) – Enclosure has a fault **Off** – Enclosure has no fault
3	Power	Green	**Solid** – Powered On

In addition to the three enclosure status LEDs, the rear provides LEDs for the Ethernet and SAS ports.

Figure 7: Rear LEDs Location

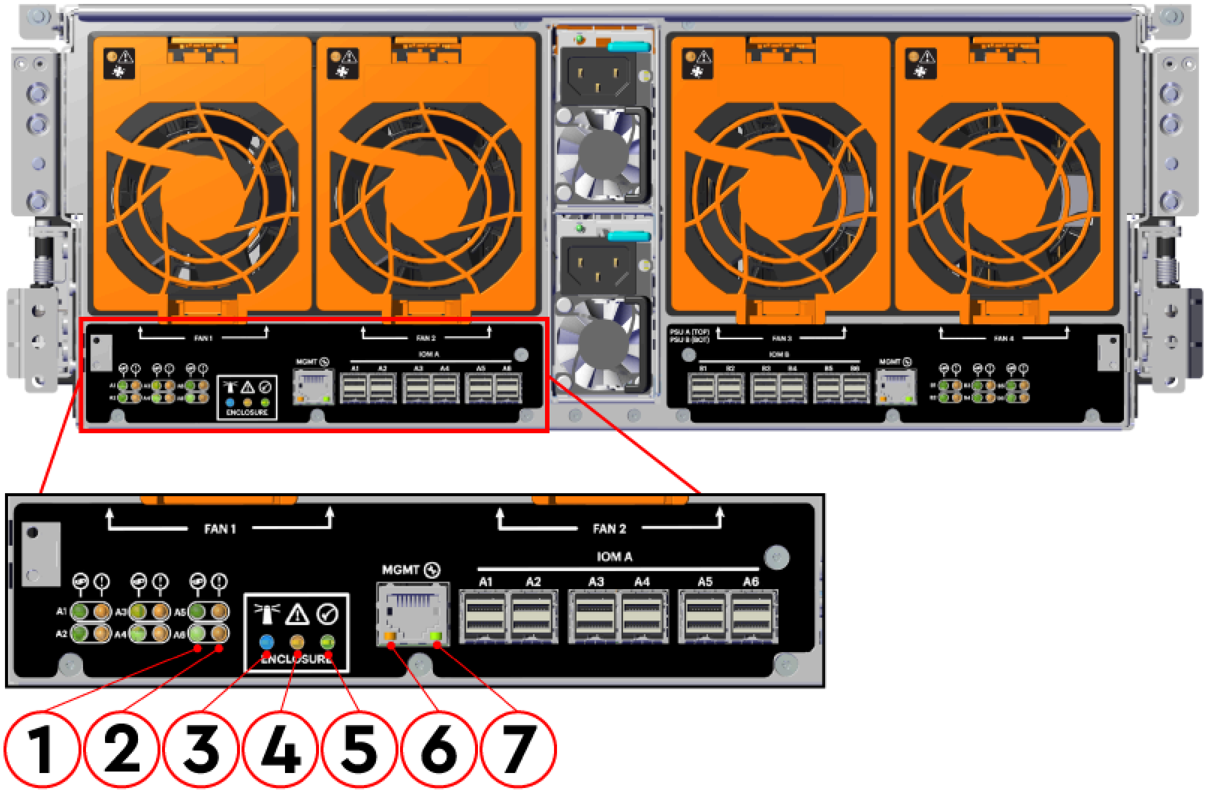


Table 9: Rear LEDs Identification

Number	LED Name	Color	Behavior
1	SAS Link Status	Green	**Solid** – SAS cable connected **Off** – SAS cable not connected
2	SAS Fault Status	Amber	**Blink** @ 1 Hz (50% duty cycle) – SAS connection fault **Off** – No SAS connection fault
3	Identification	Blue	**Blink** @ 1 Hz (50% duty cycle) – Blinks only when Identification has been activated. Will blink when **any** component is identified.
4	Fault	Amber	**Blink** @ 1 Hz (50% duty cycle) – Enclosure has a fault **Off** – Enclosure has no fault
5	Power	Green	**Solid** – Powered On
6	Ethernet Connector Speed	Green/ Amber	**Off** – Operating at 10 Mbps **Green Solid** – Operating at 100 Mbps **Amber Solid** – Operating at 1Gpbs
7	Ethernet Connectors Link/Activity	Green	**Off** – No Connection **Solid** – Connected **Blink** – Activity

1.11.2 IOM LEDs

The IOM has three LEDs, one each for power, fault, and identification.

Figure 8: IOM LEDs Location

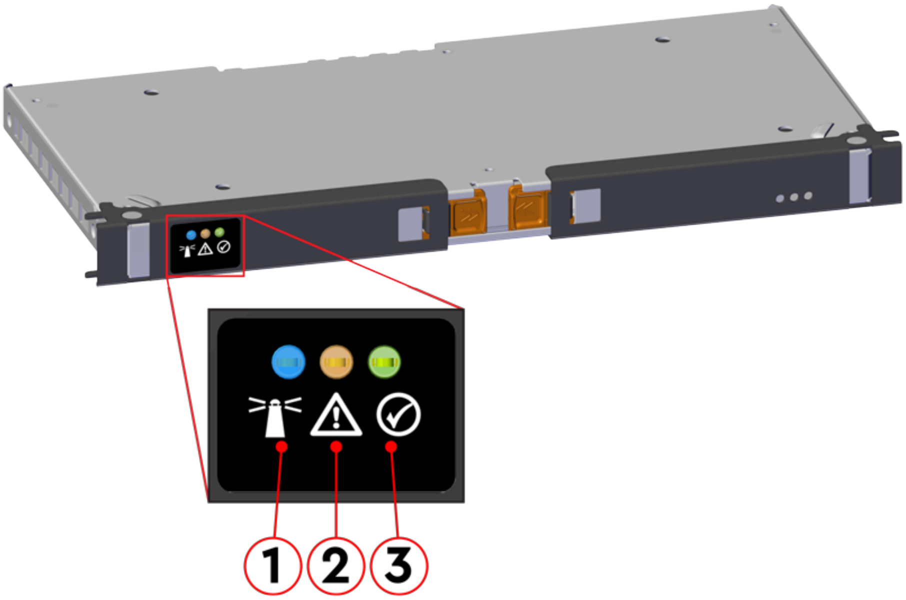


Table 10: IOM LEDs Identification

Number	LED Name	Color	Behavior
1	IOM Identification	Blue	**Blink** @ 0.5 Hz (75% duty cycle) – Blinks only when IOM Identification has been activated **Off** - Not being identified
2	IOM Fault	Amber	**Blink** @ 0.5 Hz (75% duty cycle) – IOM has Fault **Off** - IOM is functioning normally
3	IOM Power	Green	**Solid** – IOM is on **Off** – IOM is off

1.11.3 IOM Fan LED

The IOM Fan has a single LED with three distinct states for fault condition, identification, and power off.

Figure 9: IOM Fan LED Location

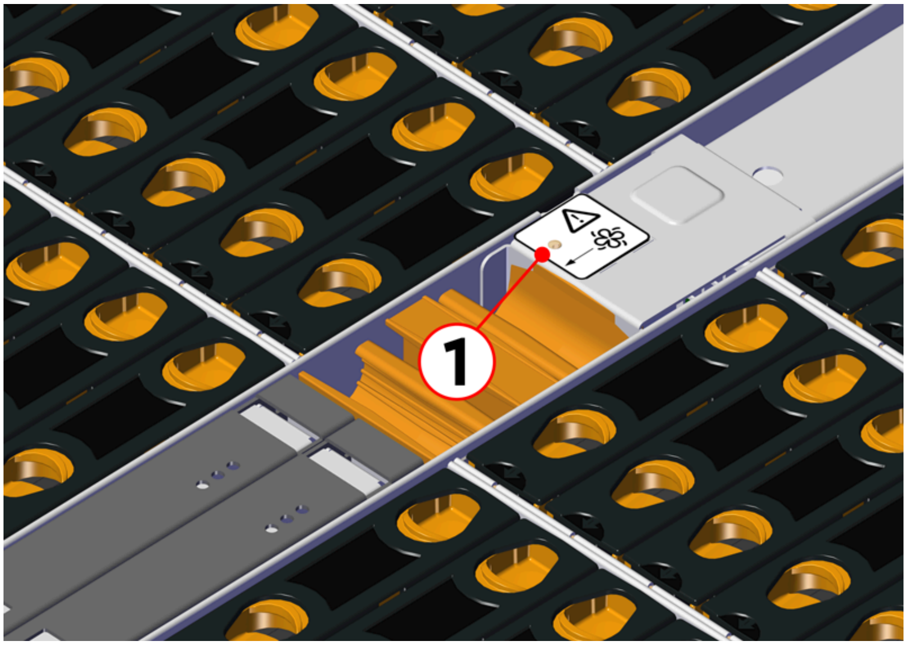


Table 11: IOM Fan LED Identification

Number	LED Name	Color	Behavior
1	IOM Fan LED	Amber	**Blink** @ 2 Hz (50% duty cycle) – IOM Fan is being identified **Blink** @ 1 Hz (50% duty cycle) – IOM Fan is reporting faults **Off** – IOM Fan is on and reporting no faults

1.11.4 PSU LED

The PSU has a single, multi-function LED. See the following tables for a detailed functional description.

Figure 10: PSU LED Location (Delta PSU shown)

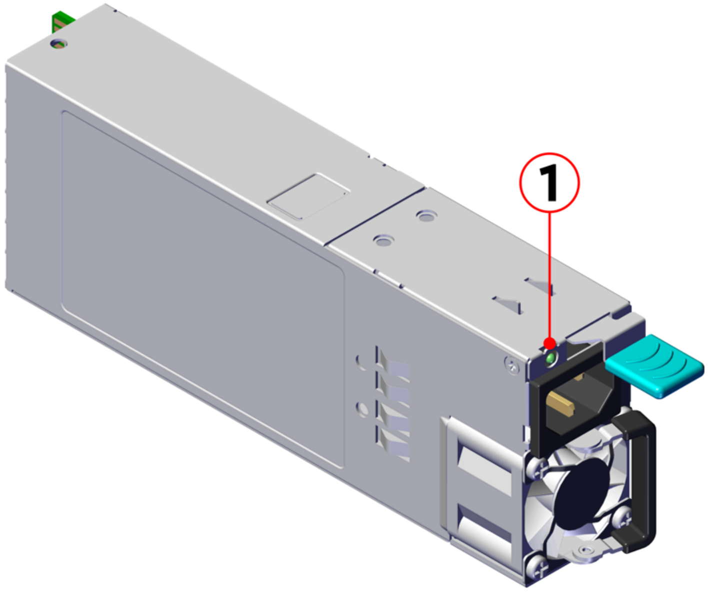


Table 12: Delta PSU LED Identification

Number	LED Name	Color	Behavior
1	PSU Multi-Function LED	Green/ Amber	**Off** – PSU disconnected from power
		Green	**Solid** – PSU on and reporting no faults **Blink** @ 0.5Hz (50% duty cycle) – AC present and 12VSB on **Blink** @ 2Hz (50% duty cycle) – PSU in firmware update mode
		Amber	**Solid** – PSU disconnected from power, or critical fault causing a shutdown failure **Blink** @ 0.5Hz (50% duty cycle) – PSU reporting warnings

Table 13: Artesyn PSU LED Identification

Number	LED Name	Color	Behavior
1	PSU Multi-Function LED	Green/ Amber	**Off** – PSU disconnected from power
		Green	**Solid** – PSU on and reporting no faults **Blink** @ 1Hz (50% duty cycle) – AC present and 12VSB on **Blink** @ 2Hz (50% duty cycle) – PSU in firmware update mode
		Amber	**Solid** – PSU disconnected from power while second PSU is connected to power, or critical fault causing a shutdown failure, or compatibility fault **Blink** @ 1Hz (50% duty cycle) – PSU reporting warnings

1.11.5 Rear Fan LED

The Rear Fan has a single LED with three distinct states for indicating a fault condition, identification, or normal operation.

Figure 11: Fan LED Location

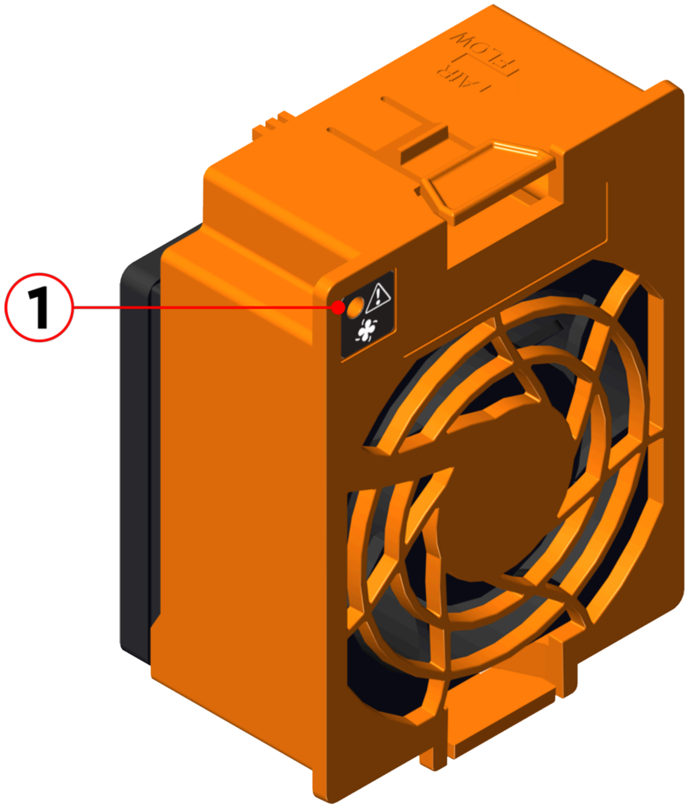


Table 14: Fan LED Identification

Number	LED Name	Color	Behavior
1	Fan LED	Amber	**Blink** @ 1 Hz (50% duty cycle) – Fan is reporting faults **Blink** @ 2 Hz (50% duty cycle) – Fan is being identified **Off** – Fan is on and reporting no faults

1.11.6 Drive Assembly LED

The HDD drive assembly itself does not contain an LED, but it contains a light-pipe that displays the multi-function LED located on the drive slot. This amber LED has three distinct states for indicating a fault condition, identification, or normal operation.

Figure 12: HDD Assembly LED Location

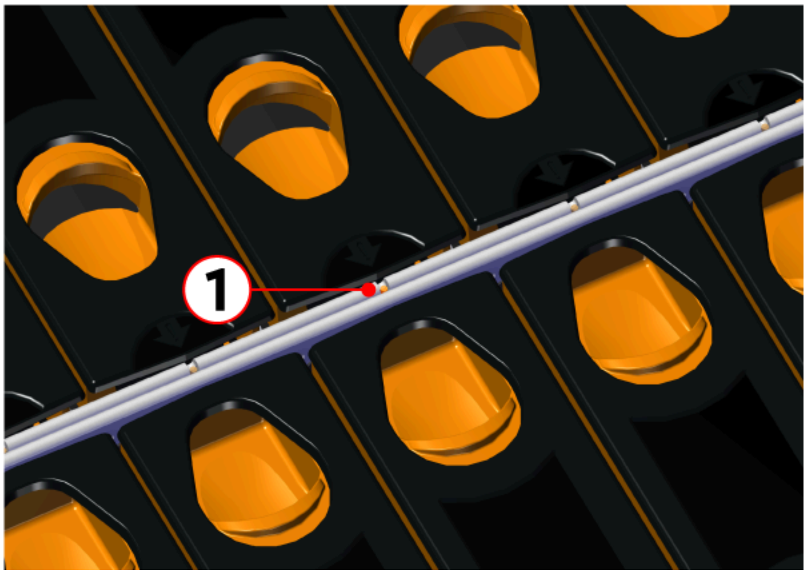


Table 15: HDD Assembly LED Identification

Number	LED Name	Color	Behavior
1	HDD Drive Multi-Function LED	Amber	**Blink** @ 2 Hz (50% duty cycle) – Drive identify **Blink** @ 1 Hz (50% duty cycle) – Drive fault **Off** – Drive has no faults

Note: During service events—when a drive is hot plugged or replaced and the drive installed properly—the LED state of that drive slot will change to solid ON. This is to provide the user with visual feedback that the drive has been successfully connected and has been discovered by the expander. Once the enclosure has been slid back into the rack and the OPEN bit on the door sensor element is 0, the LED will return to the previously set state (Ident, Fault, or Off).

For example: A drive in slot 0 needs to be replaced. The fault bit on Array Slot descriptor 0 is set to indicate to the service technician which drive slot to replace. This will cause the LED to blink at 1Hz (50% duty cycle). When the service technician pulls out the enclosure, inserts a new drive, and successfully installs the drive, the slot LED state will change to solid ON to indicate that the drive was properly installed. When the service technician pushes the enclosure back into the rack and the OPEN bit of the door sensor element changes from 1 to 0, the LED state of drive slot 0 will change back to the fault indication blink rate (1 Hz 50% duty cycle).

1.12 Ultrastar Data102 Rack Requirements

The Ultrastar Data102 is designed to be installed into a rack that meets the EIA-310 standard at a minimum 1181-1197 mm (46.5in. - 47.13in.) of usable rack space, frame to frame . The vertical rack rails must be set between 812.8 - 914.4 mm / 32 - 36 in. to support the enclosure. It requires 4U of rack space, and it should be installed into the rack at the lowest possible U height to keep the load on the rack balanced.

Table 16: Required Rack Specifications

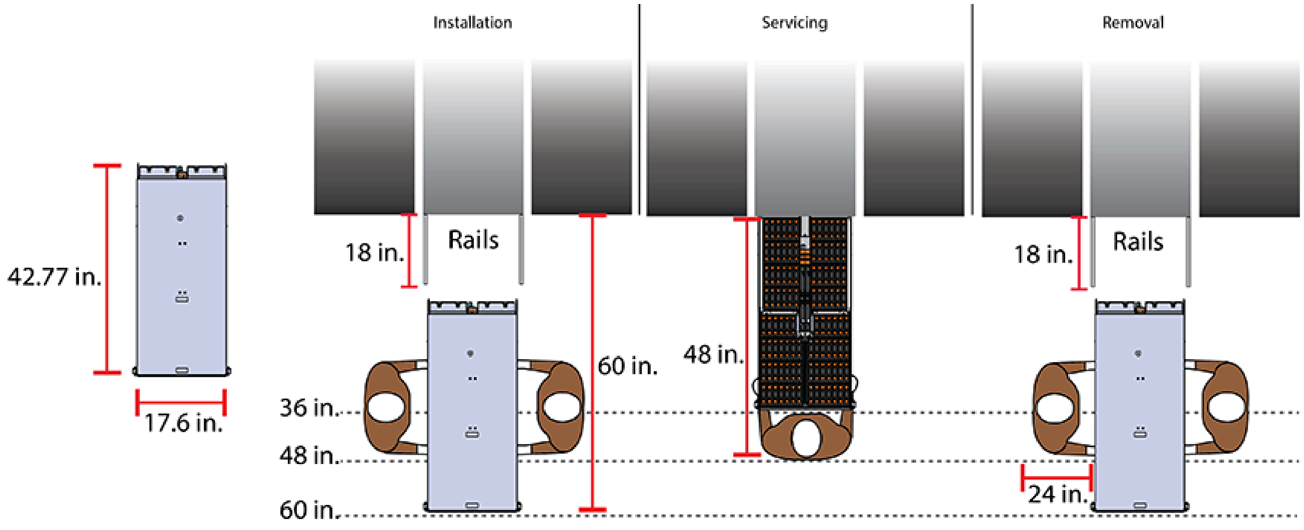
Parameter	Requirement
Rack Depth	1181-1197 mm (46.5in. - 47.13in.) of usable rack space, frame to frame
Rack Width	450 mm (17.72 in.) minimum width, with 465 mm (18.31 in.) ± 1.5 mm nominal hole spacing. See EIA-310 Rack Standard.
Rack Units (U)	4U
Vertical Rack Rail Spacing	812.8 - 914.4 mm / 32 - 36 in.
Static Load Rating	1360.7 kg. / 3000 lbs.
Dynamic Load Rating	1020.5 kg. / 2250 lbs.

Warning: When extended out of the rack on the rail system, the Ultrastar Data102 will be ~950 mm / 37.4in. extended outward. This may be a potential tipping hazard depending on the configuration of the rack. Ensure that leveling feet, anti-tilt, and any other safety features recommended by the specific rack manufacturers have been deployed before servicing.

The following section provides specific information necessary to install, service, and remove the Ultrastar Data102 . The installation of the Ultrastar Data102 requires two people and a space of 1524mm / 60in. in front of the installation space. The servicing of the enclosure requires one person and a minimum of 1219.2mm / 48in. of space in front of the installation space. The removal of the enclosure requires two people, 1371mm / 54in. of space in front of the installation space, and 24in. on either side of the enclosure for two people to remove the enclosure.

Warning: The handles on the front of the chassis are not intended to be used to support the weight of the Ultrastar Data102 . Lifting the unit by the chassis handles or trying to support the unit on the handles can cause them to fail. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

Figure 13: Installation, Servicing, and Removal



Attention: Do not install or remove the enclosure while it is populated with drives. The fully populated enclosure exceeds the amount of weight that a team of two should lift.

1.12.1 Compatible Rack Hardware Configuration

The following table(s) list the approved rack hardware configurations for the Ultrastar Data102 :

Table 17: Compatible Hardware Configuration 1

Parameter	Rack	PDU (Vertical)	PDU Mounting Bracket	Additional Mounting Bracket Hardware
Vendor	CRENLO/EMCOR	Server Technology	Server Technology	Various
Part Number	AS-160099-03 (Drawing Number EMCOR 526121 Rev 5)	412-0761-11_STV-4501 412-0761-20_STV-4502 412-0761-23_STV-4503	KIT-MBVPT-1B (one kit per PDU)	4 x M6 x 16 Hex Cap Screws 8 x M6 Fender Washers 4 x M6 Hex Nut with Nylon Lock
Quantity	1	2	2	Varies

Table 18: Compatible Hardware Configuration 2

Parameter	Rack	PDU (Vertical)	PDU Mounting Bracket	Additional Mounting Bracket Hardware
Vendor	AFCO/Legrand	Server Technology	Server Technology	Various
Part Number	**Options:** 42RU – WEDIT605 45RU – WEDIT604 48RU – WEDIT603 51RU – WEDIT606	412-0761-11_STV-4501 412-0761-20_STV-4502 412-0761-23_STV-4503	KIT-MB-40	None
Quantity	1 rack	2	1	N/A

Table 19: Compatible Hardware Configuration 3

Parameter	Rack	PDU (Vertical)	PDU Mounting Bracket	Additional Mounting Bracket Hardware
Vendor	TRIPP LITE	Server Technology	Server Technology	Various

Parameter	Rack	PDU (Vertical)	PDU Mounting Bracket	Additional Mounting Bracket Hardware
Part Number	**Options:** SR42UBDP (Rack) SREXTENDER 25U (Rack Extension) SREXTENDER 42U (Rack Extension) SREXTENDER 48U (Rack Extension)	412-0761-11_STV-4501 412-0761-20_STV-4502 412-0761-23_STV-4503	KIT-MBVPT-1B	None
Quantity	1 rack	2	1	N/A

Table 20: Compatible Hardware Configuration 4

Parameter	Rack	PDU (Vertical)	PDU Mounting Bracket	Additional Mounting Bracket Hardware
Vendor	APC/Schneider	Server Technology	Server Technology	Various
Part Number	AR3300W	412-0761-11_STV-4501 412-0761-20_STV-4502 412-0761-23_STV-4503	KIT-MBVPT-1B (one kit per PDU)	4 x M6 x 16 Hex Cap Screws 8 x M6 Fender Washers 4 x M6 Hex Nut with Nylon Lock
Quantity	1 rack	2	2	Varies

1.13 Power Requirements

The following table describes the A/C input power specification for the Ultrastar Data102 .

Table 21: AC Power Specifications

Power	
Alternating Current (AC) Power Supply (2 per enclosure)	
Wattage (per power supply)[4]	**Supply Rating:** 80 PLUS Platinum rated **Max Power Consumption:** ~1600W (Delta PSU) / ~1800W (Artesyn PSU)

4. Max and typical power consumption values represent the output power to the system. Input power will vary depending on the PSU efficiency and load sharing between PSUs.

Power	
	Typical Power Consumption: ~1300W
Voltage (per power supply)	200-240 VAC, auto-ranging, 50/60 Hz
Maximum inrush current (per power supply)	AC line inrush current shall not exceed 40A peak, for up to one-quarter of the AC cycle after which, the input current should be no more than the specified maximum input current.

Caution: The Ultrastar Data102 can only be plugged into high line (220-240 VAC). If the unit is plugged into low line (110-127 VAC), the PSU will report a "Critical" state when status pages are queried using SES. In this case, the enclosure will power up, but the drives will not. The enclosure will remain in low-power mode.

1.14 ESD

The enclosure is designed to dissipate all electrostatic discharge (ESD) to the chassis base. Ensure that there is sufficient electrical and mechanical connection from the chassis base to the rack rails, and that the rack itself is tied to earth ground. Precautions must be taken to ensure that the system is not exposed to ESD while handling components or servicing the unit.

The unit must be grounded in accordance with all local/regional and national electrical codes.

1.15 Enclosure Cooling

The Ultrastar Data102 has an advanced thermal algorithm running within the logical enclosure services process called the SEP that monitors all of the temperature sensors in the enclosure. The SEP makes adjustments to the fan speeds based upon the thermal sensors. The fan algorithm takes into account the component and the warning and critical threshold limits defaulted and managed by the SEP controller. If any temperature sensor exceeds the temperature threshold configured in the SES pages, the fan speed will increase to cool the enclosure. If the enclosure encounters low temperatures, the enclosure will reduce fan speed in an attempt to conserve power and not over-cool the enclosure. This algorithm is agnostic to effects of altitude and humidity. The algorithm works based on temperatures within the enclosure with emphasis on reducing power consumption.

The rack that the Ultrastar Data102 is installed in must not restrict airflow to the enclosure. Racks with doors should be tested to ensure they do not constrict airflow to the enclosure. If the enclosure reaches critical temperature, it will go into low-power mode to avoid damage to the enclosure.

When the Ultrastar Data102 is extended out of the rack, the cover of the enclosure remains inside the rack which exposes the drives. This feature allows for easier access to drives and simplifies maintenance tasks related to internal components. However, there is a limit to the amount of time the enclosure can be extended out of the rack before the enclosure will begin to overheat.

Attention: Limit the amount of time that the enclosure is extended out of the rack to only what is necessary to exchange a component or perform regular maintenance and should be limited to a maximum of 5 minutes total. **Never extend the enclosure out for longer than 5 minutes to prevent overheating.** Only extend the enclosure out of the rack as far as necessary to service components. The enclosure is equipped with a sensor that will be tripped when the enclosure's top cover has been opened resulting in the rear fans increasing to max speed. In the event that a fan has failed, it must be replaced before any other CRUs and should be removed from the enclosure within 30 seconds of removing the enclosure cover.

1.16 SAS Cabling

The Ultrastar Data102 can use passive cables up to 3m in length, or active cables up to 10m, for SAS connections to the host. All approved passive and active SAS cables are listed in the following tables.

Active Cabling

Active cables can be used for both direct (host-to-enclosure) and daisy-chain (enclosure-to-enclosure) connections. When daisy-chaining multiple Ultrastar Data102 enclosures together, active cables must be used between enclosures for improved signal integrity.

Important: Active Optical SAS cable support is limited to Broadcom 9300-, 9302-, and 9305-series HBAs.

Note: MegaRAID adapters do not support the use of active SAS cables. If your configuration requires the use of MegaRAID adapters, passive cables must be used.

Table 22: Approved Active Optical HD Mini-SAS to HD Mini-SAS Cables

Length	Manufacturer	Vendor Part Number
3m	Amphenol ICC (FCI)	FOHHB23P00003[5]
	Molex	106415-2103
4m	Amphenol ICC (FCI)	FOHHB23P00004
5m	Amphenol ICC (FCI)	FOHHB23P00005
	Molex	106415-2105
6m	Amphenol ICC (FCI)	FOHHB23P00006
10m	Molex	106415-2110

Passive Cabling

Passive cables should only be used for direct (host-to-enclosure) connections.

Table 23: Approved Passive HD Mini-SAS to HD Mini-SAS Cables

Length	Manufacturer	Vendor Part Number
2m	Amphenol ICC (FCI)	601760006
		10117949-2020LF
	CS Electronics	12G-HD-4444/2M
	Data Storage Cables (DSC)	C5555-2M

5. Listed FOHHB23P00xxx cables are compatible, beginning with FW 2052-003.

Length	Manufacturer	Vendor Part Number
	Molex	1110751002
	The Mate Company (TMC)	C5555-2M
3m	Amphenol ICC (FCI)	601760008
		10117949-4030LF
	CS Electronics	12G-HD-4444/3M
	Molex	1110751003

As a best practice, Western Digital requires connecting the cables to every other SAS connector port when connecting more than one host per IOM. Please refer to Table 24: Recommended IOM Port Connection Order *(page 23)* for port connection ordering required for IOMA and IOMB:

Table 24: Recommended IOM Port Connection Order

IOM	1st Host Ports	2nd Host Ports	3rd Host Ports	4th Host Ports	5th Host Ports	6th Host Ports
A	A6	A4	A2	A5	A3	A1
B	B1	B3	B5	B2	B4	B6

Edge Buffering

Edge buffering is an enclosure feature that increases the overall performance when a 6Gb/s target is connected. With edge buffering disabled, primitives that can be deleted from the initiator are added to slow the effective logical rate to the slowest target device connected between the initiator and the target device. With edge buffering enabled, the expanders buffer data from slower 6Gb/s targets to utilize the 12Gb/s link from the expander to the initiator in a more efficient manner.

1.17 List of Compatible Drives

HDD with 3.5-inch Drive Carrier

Table 25: Western Digital Ultrastar DC HC310

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number / Model Number
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SE	6TB	1EX1189 / HUS726T6TALE604
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	TCG	6TB	1EX1188 / HUS726T6TALE601
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SE	6TB	1EX1187 / HUS726T6TALN604
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	TCG	6TB	1EX1186 / HUS726T6TALN601
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	SE	6TB	1EX1185 / HUS726T6TAL5204
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG	6TB	1EX1184 / HUS726T6TAL5201
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG-FIPS	6TB	1EX1853 / HUS726T6TAL5205
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	SE	6TB	1EX1183 / HUS726T6TAL4204
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG	6TB	1EX1182 / HUS726T6TAL4201
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG-FIPS	6TB	1EX1852 / HUS726T6TAL4205

Table 26: Western Digital Ultrastar DC HC320

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number / Model Number
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SE	8TB	1EX1227 / HUS728T8TALE604
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SED	8TB	1EX1226 / HUS728T8TALE601
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SE	8TB	1EX1225 / HUS728T8TALN604
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	TCG	8TB	1EX1224/ HUS728T8TALN601
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	SE	8TB	1EX1223 / HUS728T8TAL5204

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number / Model Number
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG	8TB	1EX1222 / HUS728T8TAL5201
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG-FIPS	8TB	1EX1343 / HUS728T8TAL5205
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	SE	8TB	1EX1221 / HUS728T8TAL4204
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG	8TB	1EX1220 / HUS728T8TAL4201
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG-FIPS	8TB	1EX1342 / HUS728T8TAL4205

Table 27: Western Digital Ultrastar DC HC330

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number / Model Number
Ultrastar DC HC330 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SE	10TB	1EX2440 / WUS721010ALE604
Ultrastar DC HC330 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SED	10TB	1EX2441 / WUS721010ALE601
Ultrastar DC HC330 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SE	10TB	1EX2438 / WUS721010ALN604
Ultrastar DC HC330 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SED	10TB	1EX2439 / WUS721010ALN601
Ultrastar DC HC330 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	SE	10TB	1EX2435 / WUS721010AL5204
Ultrastar DC HC330 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG	10TB	1EX2436 / WUS721010AL5201
Ultrastar DC HC330 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG-FIPS	10TB	1EX2437 / WUS721010AL5205
Ultrastar DC HC330 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG	10TB	1EX2433 / WUS721010AL4201
Ultrastar DC HC330 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG-FIPS	10TB	1EX2434 / WUS721010AL4205

Table 28: Western Digital Ultrastar DC HC510

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number / Model Number
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SE	10TB	1EX0499 / HUH721010ALE604
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	ISE	10TB	1EX0497 / HUH721010ALE600
Ultrastar DC HC510	HDD	SATA 6Gb/s	512e	SED	10TB	1EX0498 /

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number / Model Number
w/ 3.5 in. drive carrier						HUH721010ALE601
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SE	10TB	1EX0496 / HUH721010ALN604
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	ISE	10TB	1EX0494 / HUH721010ALN600
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SED	10TB	1EX0495 / HUH721010ALN601
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	SE	10TB	1EX0487 / HUH721010AL5204
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	ISE	10TB	1EX0485 / HUH721010AL5200
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG	10TB	1EX0486 / HUH721010AL5201
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG-FIPS	10TB	1EX1341 / HUH721010AL5205
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	SE	10TB	1EX0484 / HUH721010AL4204
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	ISE	10TB	1EX0482 / HUH721010AL4200
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG	10TB	1EX0483 / HUH721010AL4201
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG-FIPS	10TB	1EX1340 / HUH721010AL4205

Table 29: Western Digital Ultrastar DC HC520

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number / Model Number
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SE	12TB	1EX1015 / HUH721212ALE604
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	ISE	12TB	1EX1013 / HUH721212ALE600
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SED	12TB	1EX1014 / HUH721212ALE601
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SE	12TB	1EX1012 / HUH721212ALN604
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	ISE	12TB	1EX1010 / HUH721212ALN600
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SED	12TB	1EX1011 / HUH721212ALN601
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	SE	12TB	1EX1009 / HUH721212AL5204

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number / Model Number
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	ISE	12TB	1EX1007 / HUH721212AL5200
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG	12TB	1EX1008 / HUH721212AL5201
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG-FIPS	12TB	1EX1338 / HUH721212AL5205
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	SE	12TB	1EX1006 / HUH721212AL4204
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	ISE	12TB	1EX1004 / HUH721212AL4200
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG	12TB	1EX1005 / HUH721212AL4201
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG-FIPS	12TB	1EX1339 / HUH721212AL4205

Table 30: Western Digital Ultrastar DC HC530

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number / Model Number
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SE	14TB	1EX1793 / WUH721414ALE604
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SED	14TB	1EX1794 / WUH721414ALE6L1
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SE	14TB	1EX1790 / WUH721414ALN604
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	SE	14TB	1EX1791 / WUH721414AL5204
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	ISE	14TB	1EX1583 / WUH721414AL5200
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG	14TB	1EX1792 / WUH721414AL5201
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG-FIPS	14TB	1EX1855 / WUH721414AL5205
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	SE	14TB	1EX1788 / WUH721414AL4204
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG	14TB	1EX1789 / WUH721414AL4201
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG-FIPS	14TB	1EX1854 / WUH721414AL4205

Table 31: Western Digital Ultrastar DC HC550

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number / Model Number
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SE	16TB	1EX2476 / WUH721816ALE604
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SED	16TB	1EX2477 / WUH721816ALE601
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	SE	16TB	1EX2473 / WUH721816AL5204
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG	16TB	1EX2474 / WUH721816AL5201
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG-FIPS	16TB	1EX2475 / WUH721816AL5205
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SE	18TB	1EX2481 / WUH721818ALE604
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SED	18TB	1EX2482 / WUH721818ALE601
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	SE	18TB	1EX2478 / WUH721818AL5204
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG	18TB	1EX2479 / WUH721818AL5201
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG-FIPS	18TB	1EX2480 / WUH721818AL5205

Table 32: Western Digital Ultrastar DC HC650

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number / Model Number
Ultrastar DC HC650 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SE	20TB	1EX2719 / WSH722020ALN604
Ultrastar DC HC650 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SED	20TB	1EX2720 / WSH722020ALN601
Ultrastar DC HC650 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	SE	20TB	1EX2716 / WSH722020AL4204
Ultrastar DC HC650 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG	20TB	1EX2717 / WSH722020AL4201

Caution: Ultrastar DC HC650 drives are only compatible with the OSs and HBAs listed in the following table:

OS	Kernel	HBA	HBA FW	HBA Driver
Ubuntu 18.04	4.15.0-76-generic	9400-8e	15.00.01.00	34.00.00.00
		9405-16e		

OS	Kernel	HBA	HBA FW	HBA Driver
Ubuntu 20.04	5.4.0-47-generic	9400-8e		
		9405-16e		

SSD with 2.5-inch Drive Carrier

Table 33: Western Digital Ultrastar SS300

Drive	Type	Interface	Drive Writes	Encryption	Volume	Part Number / Model Number
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	400GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	400GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	400GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG-FIPS	400GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	SE	400GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	ISE	400GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG	400GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG-FIPS	400GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	800GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	800GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	800GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG-FIPS	800GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	SE	800GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	ISE	800GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG	800GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG-FIPS	800GB	No longer available

Drive	Type	Interface	Drive Writes	Encryption	Volume	Part Number / Model Number
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	1.6TB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG-FIPS	1.6TB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG-FIPS	1.6TB	No longer available

SSD with 3.5-inch to 2.5-inch Drive Carrier

Table 34: Western Digital Ultrastar SS200

Drive	Type	Interface	Drive Writes	Encryption	Volume	Part / Model
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	400GB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	400GB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	400GB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG-FIPS	400GB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	TCG	480GB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	800GB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	800GB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	800GB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	TCG	960GB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	1.6TB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	1.6TB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	1.6TB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	TCG	1.92TB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	3.2TB	No longer available

Drive	Type	Interface	Drive Writes	Encryption	Volume	Part / Model
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	ISE	3.84TB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	SE	7.68TB	No longer available

Table 35: Western Digital Ultrastar SS300

Drive	Type	Interface	Drive Writes	Encryption	Volume	Part / Model
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	400GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	400GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	400GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	SE	400GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	ISE	400GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG	400GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG-FIPS	400GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	800GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	800GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	800GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG-FIPS	800GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	SE	800GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	ISE	800GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG	800GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG-FIPS	800GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	1.6TB	No longer available

Drive	Type	Interface	Drive Writes	Encryption	Volume	Part / Model
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	1.6TB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	1.6TB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG-FIPS	1.6TB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-10DW/D	SE	1.6TB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-10DW/D	ISE	1.6TB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-10DW/D	TCG	1.6TB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG-FIPS	1.6TB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	3.2TB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	3.2TB	No longer available

Table 36: Western Digital Ultrastar SS530

Drive	Type	Interface	Drive Writes	Encryptic	Volume	Part Number / Model Number
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	400GB	1EX2020 / WUSTR6440ASS204
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	400GB	1EX2021 / WUSTR6440ASS200
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	400GB	1EX2087 / WUSTR6440ASS201
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	SE	400GB	1EX2012 / WUSTM3240ASS204
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	ISE	400GB	1EX2013 / WUSTM3240ASS200
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG	400GB	1EX2083 / WUSTM3240ASS201
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	SE	480GB	1EX2030 / WUSTR1548ASS204
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	ISE	480GB	1EX2031 / WUSTR1548ASS200
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	TCG	480GB	1EX2092 / WUSTR1548ASS201

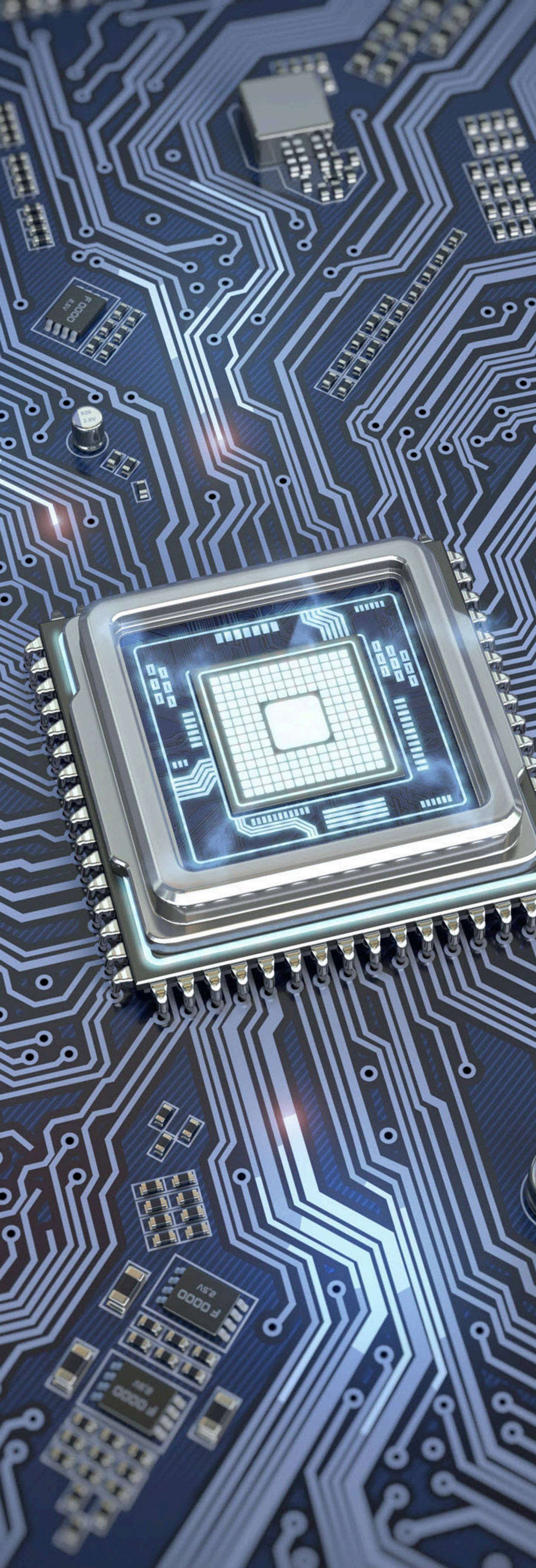
Drive	Type	Interface	Drive Writes	Encryptic	Volume	Part Number / Model Number
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	800GB	1EX2022 / WUSTR6480ASS204
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	800GB	1EX2023 / WUSTR6480ASS200
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	800GB	1EX2088 / WUSTR6480ASS201
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	SE	800GB	1EX2014 / WUSTM3280ASS204
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	ISE	800GB	1EX2015 / WUSTM3280ASS200
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG	800GB	1EX2084 / WUSTM3280ASS201
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	SE	960GB	1EX2032 / WUSTR1596ASS204
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	ISE	960GB	1EX2033 / WUSTR1596ASS200
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	TCG	960GB	1EX2093 / WUSTR1596ASS201
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	1.6TB	1EX2024 / WUSTR6416ASS204
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	1.6TB	1EX2025 / WUSTR6416ASS200
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	1.6TB	1EX2089 / WUSTR6416ASS201
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	SE	1.6TB	1EX2016 / WUSTM3216ASS204
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	ISE	1.6TB	1EX2017 / WUSTM3216ASS200
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG	1.6TB	1EX2085 / WUSTM3216ASS201
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	SE	1.92TB	1EX2034 / WUSTR1519ASS204
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	ISE	1.92TB	1EX2035 / WUSTR1519ASS200
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	TCG	1.92TB	1EX2094 / WUSTR1519ASS201
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	3.2TB	1EX2026 / WUSTR6432ASS204
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	3.2TB	1EX2027 / WUSTR6432ASS200

Drive	Type	Interface	Drive Writes	Encryptic	Volume	Part Number / Model Number
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	3.2TB	1EX2090 / WUSTR6432ASS201
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	SE	3.2TB	1EX2018 / WUSTM3232ASS204
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	ISE	3.2TB	1EX2019 / WUSTM3232ASS200
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG	3.2TB	1EX2086 / WUSTM3232ASS201
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	SE	3.84TB	1EX2036 / WUSTR1538ASS204
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	ISE	3.84TB	1EX2037 / WUSTR1538ASS200
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	TCG	3.84TB	1EX2095 / WUSTR1538ASS201
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	6.4TB	1EX2028 / WUSTR6464ASS204
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	6.4TB	1EX2029 / WUSTR6464ASS200
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	6.4TB	1EX2091 / WUSTR6464ASS201
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	SE	7.68TB	1EX2038 / WUSTR1576ASS204
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	ISE	7.68TB	1EX2039 / WUSTR1576ASS200
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	TCG	7.68TB	1EX2096 / WUSTR1576ASS201
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	SE	15.36TB	1EX2040 / WUSTR1515ASS204
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	ISE	15.36TB	1EX2041 / WUSTR1515ASS200
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	TCG	15.36TB	1EX2097 / WUSTR1515ASS201

Table 37: Western Digital Ultrastar SA620

Drive	Type	Interface	Drive Writes	Encryption	Volume	Part / Model
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-1.8DW/D	SE	400GB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-1.8DW/D	ISE	400GB	No longer available

Drive	Type	Interface	Drive Writes	Encryption	Volume	Part / Model
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-0.6DW/D	SE	480GB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-0.6DW/D	ISE	480GB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-1.8DW/D	SE	800GB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-1.8DW/D	ISE	800GB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-0.6DW/D	SE	960GB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-0.6DW/D	ISE	960GB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-1.8DW/D	SE	1.6TB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-1.8DW/D	ISE	1.6TB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-0.6DW/D	SE	1.92TB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-0.6DW/D	ISE	1.92TB	No longer available



Components

This section is intended to give an overview of all of the major components contained within the Ultrastar Data102 . Each section includes specifications, descriptions, and images that explain the features of each component.

In This Chapter:

2.1 Chassis

Figure 14: Ultrastar Data102 Chassis

The chassis is the primary housing that contains and connects all of the system components of the Ultrastar Data102 . The chassis is comprised of the drive bays that contains all of the system data storage drives and a number of other bays that contain the major system components, such as the PSUs and IOMs. Other system components are attached to the exterior of the chassis, such as the rear fans and rails, to provide system cooling and rackmounting capability. The chassis also houses the baseboard, which is mounted inside the bottom of the chassis and is the primary data pathway that connects all of the enclosure's system components. The chassis has internal backflow preventers to prevent hot air from re-entering the enclosure.

2.1.1 Chassis Specifications

Specification	Value
Dimensions	W: 447 mm x L: 1048.5 mm x H: 175 mm / W: 17.67 in. x L: 41.28 in. x H: 6.89 in.
Part Number	1EX0440 (single IOM) / 1EX0441 (dual IOMs)
Hot Swappable?	No
Weight	32.34 kg / 71.3 lbs [6]

6. Listed weight does not include packaging/shipping materials.

2.1.2 Chassis Layout

Figure 15: Chassis Component Locations

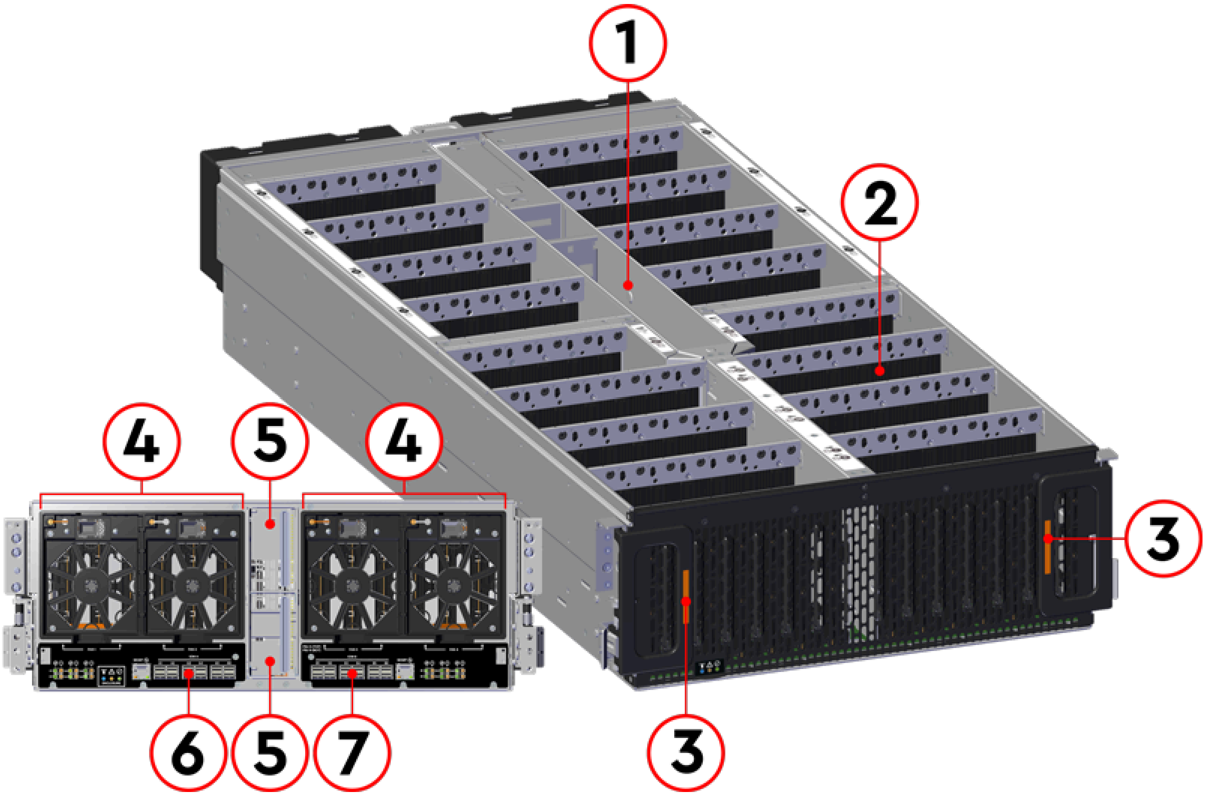


Table 38: Chassis Component Descriptions

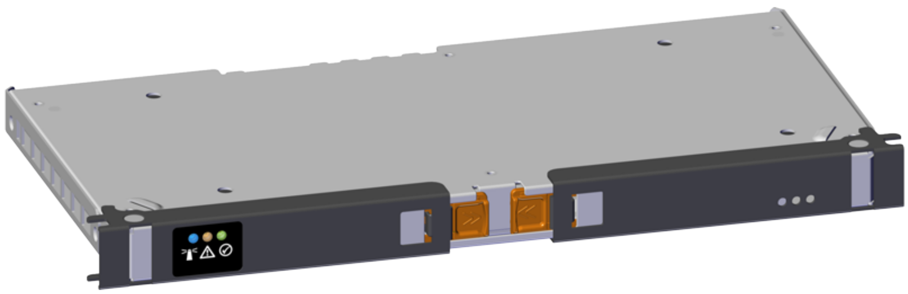
Number	Feature
1	IOM and IOM Fan Bay
2	Drive Bays
3	Chassis Handles
4	Rear Fans Bays
5	PSU Bays
6	IOM A Dual HD-Mini SAS Ports (x6) 1GB Ethernet Port (x1)
7	IOM B Dual HD-Mini SAS Ports (x6) 1GB Ethernet Port (x1)

The Chassis has a removable lid that encloses the internal system components and ensures proper airflow. The drive bays are comprised of 16 sections that isolate the data storage drives from transmitting vibration to one another. A long central bay contains the enclosure's IOMs and the IOM Fan. The front of the Chassis has a metal mesh cover and two handles that swing out from the chassis, which are used to pull the enclosure out of the rack. Two rack ears at the front of the enclosure are used to secure the enclosure to the rack for shipping purposes. The rear of the Chassis has two housings to shroud and connect the four Rear Fans to the enclosure, and a center bay that houses the PSU modules.

Warning: The handles on the front of the chassis are not intended to be used to support the weight of the Ultrastar Data102 . Lifting the unit by the chassis handles or trying to support the unit on the handles can cause them to fail. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

2.2 IOM

Figure 16: Ultrastar Data102 IOM



Each IOM provides system data connectivity through 6 Mini-SAS HD ports, capable of four 12Gbps SAS connections each. The IOMs are N+1 redundant, hot-swappable components. The IOMs are installed into the central bay from the top of the Chassis and connect to the drive board. The baseboard completes the connection to the Mini-SAS HD ports, which extend out the rear of the enclosure. Each IOM contains a primary and two SAS expander chips, and an out-of-band management (OOBM) chip that connects to the management port on the rear of the enclosure.

2.2.1 IOM Specifications

Specification	Value
Connector Type	x6 HD Mini-SAS (connected externally at the rear of the enclosure)
Number per Enclosure	2
Part Number	1EX2201
Hot Swappable?	Yes
FRU or CRU?	CRU
Weight	1.27 kg / 2.8 lbs [7]

7. Listed weight does not include packaging/shipping materials.

2.2.2 IOM Layout

Figure 17: IOM Component Locations

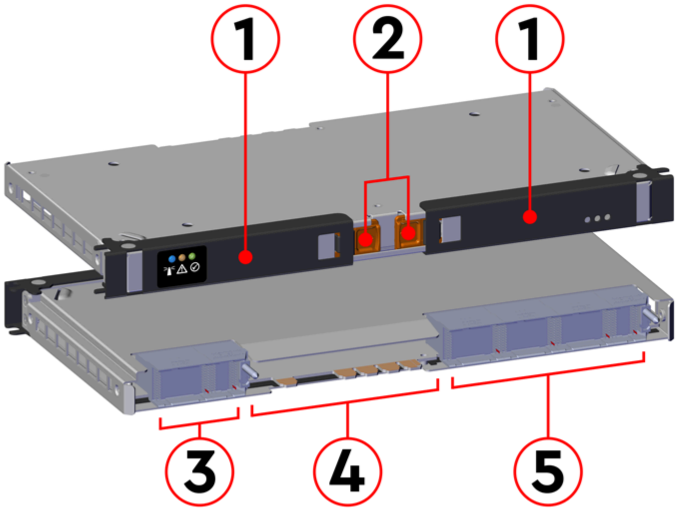
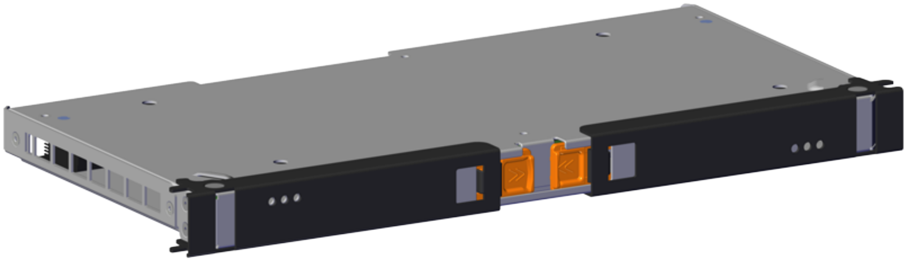


Table 39: IOM Component Descriptions

Number	Feature
1	IOM Handles
2	Latch Release
3	Internal IO Connector
4	Card Edge Power Receptacle
5	Internal IO Connector

2.2.3 IOM Blank

Figure 18: Ultrastar Data102 IOM Blank



The IOM Blank is a placeholder component for filling the unused IOM slot in versions of the Ultrastar Data102 that do not leverage redundant IOMs. The IOM Blank may only be installed into IOM slot B under all circumstances. From the front of the enclosure, slot B is the left-hand slot. It is necessary to have a blank installed in this unused slot in order to ensure the airflow remains within the operational parameters designed for the enclosure; the IOM Blank has no function beyond this.

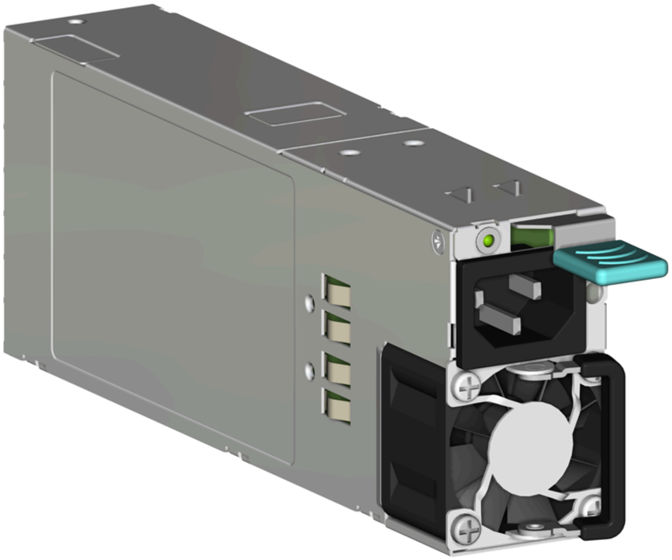
2.3 PSU

Your system may contain PSUs from one of two models. Please see the following sections for details on each model:

- Delta PSU *(page 44)*
- Artesyn PSU *(page 46)*

2.3.1 Delta PSU

Figure 19: Ultrastar Data102 Delta PSU



The Ultrastar Data102 contains redundant 1600W power supply units (PSUs). Each PSU requires an input voltage between 200 - 240 VAC, is 80 PLUS Platinum certified, and utilizes a C14 power cable receptacle.

2.3.1.1 Delta PSU Specifications

Specification	Value
Power Output	1600W
80 PLUS Standard	Platinum
Input Voltage	200 - 240 VAC
Connector Type	C14
Number per Enclosure	2
Part Number	1EX0434
Hot Swappable?	Yes
FRU or CRU?	CRU
Weight	1 kg / 2.2 lbs. [8]

8. Listed weight does not include packaging/shipping materials.

2.3.1.2 Delta PSU Layout

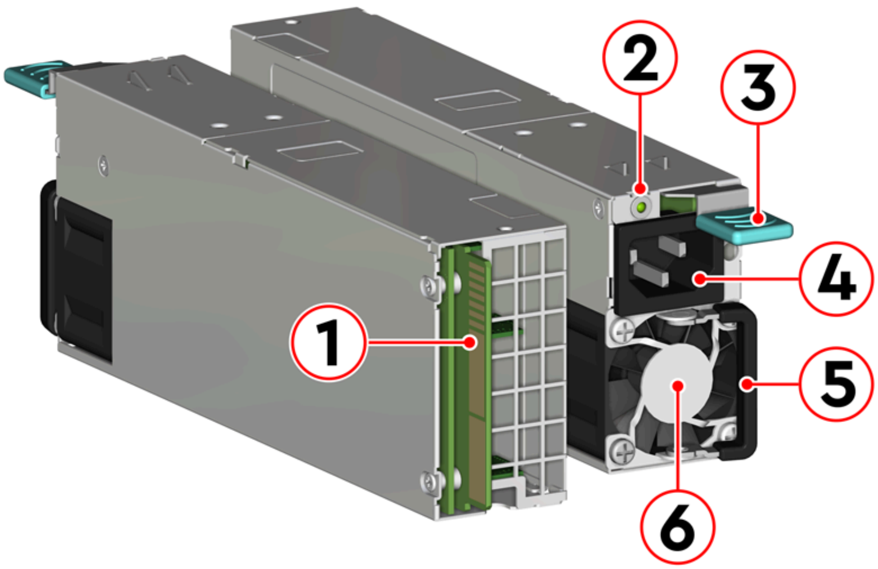


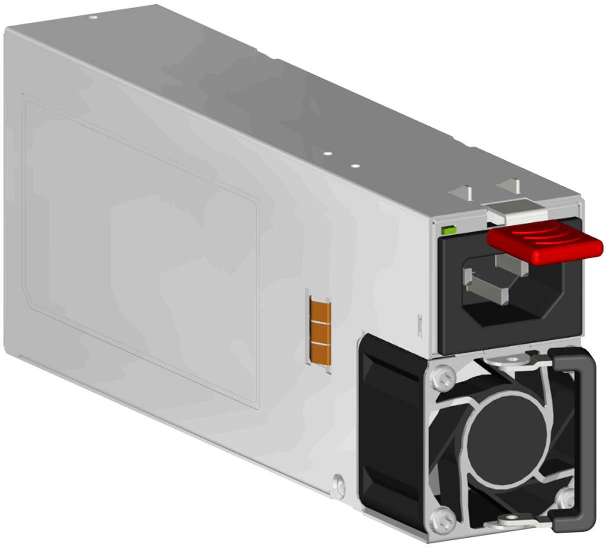
Figure 20: PSU Component Locations

Table 40: PSU Component Descriptions

Number	Feature
1	Internal Connector
2	LED
3	Latch Release Lever
4	C14 Power Receptacle
5	Handle
6	Fan

2.3.2 Artesyn PSU

Figure 21: Ultrastar Data102 Artesyn PSU



The Ultrastar Data102 contains redundant 1800W power supply units (PSUs). Each PSU requires an input voltage between 200 - 240 VAC, is 80 PLUS Platinum certified, and utilizes a C14 power cable receptacle.

Note: The Artesyn PSU requires 3000 series firmware or later.

2.3.2.1 Artesyn PSU Specifications

Specification	Value
Power Output	1800W
80 PLUS Standard	Platinum
Input Voltage	200 - 240 VAC
Connector Type	C14
Number per Enclosure	2
Part Number	1EX2801
Hot Swappable?	Yes
FRU or CRU?	CRU
Weight	1 kg / 2.2 lbs. [9]

9. Listed weight does not include packaging/shipping materials.

2.3.2.2 Artesyn PSU Layout

Figure 22: Artesyn PSU Component Locations

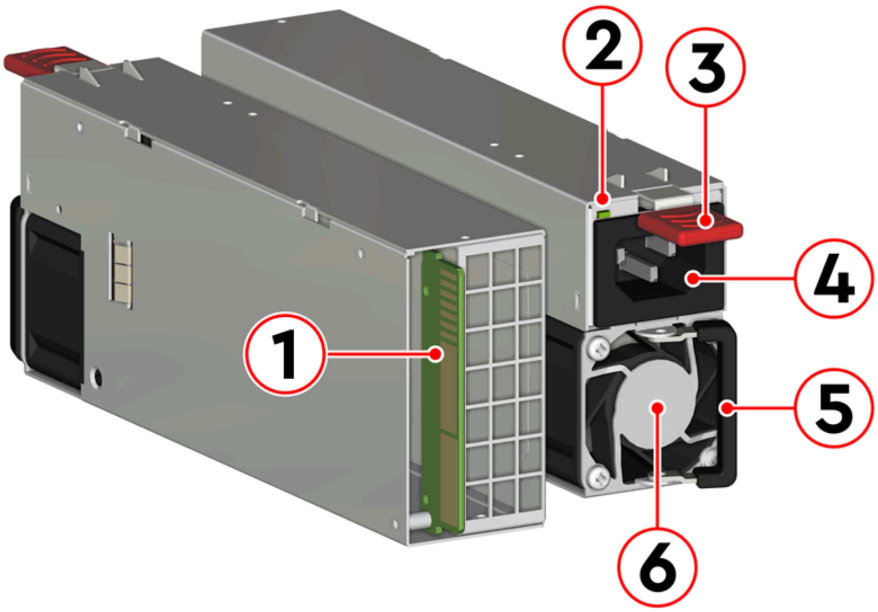


Table 41: Artesyn PSU Component Descriptions

Number	Feature
1	Internal Connector
2	LED
3	Latch Release Lever
4	C14 Power Receptacle
5	Handle
6	Fan

2.4 Rear Fan

Figure 23: Ultrastar Data102 Rear Fan

The Rear Fans are toolless modules that provide the primary system cooling for the Ultrastar Data102 . They are attached inside the fan housing at the rear of the chassis by two latches and a 6-pin connector, which also provides power and control signals to the modules.

2.4.1 Rear Fan Specifications

Specification	Value
Number per Enclosure	4
Part Number	1EX2814
Hot Swappable?	Yes
FRU or CRU?	CRU
Weight	318 g / .7 lbs [10]

10. Listed weight does not include packaging/shipping materials.

2.4.2 Rear Fan Layout

Figure 24: Rear Fan Component Locations

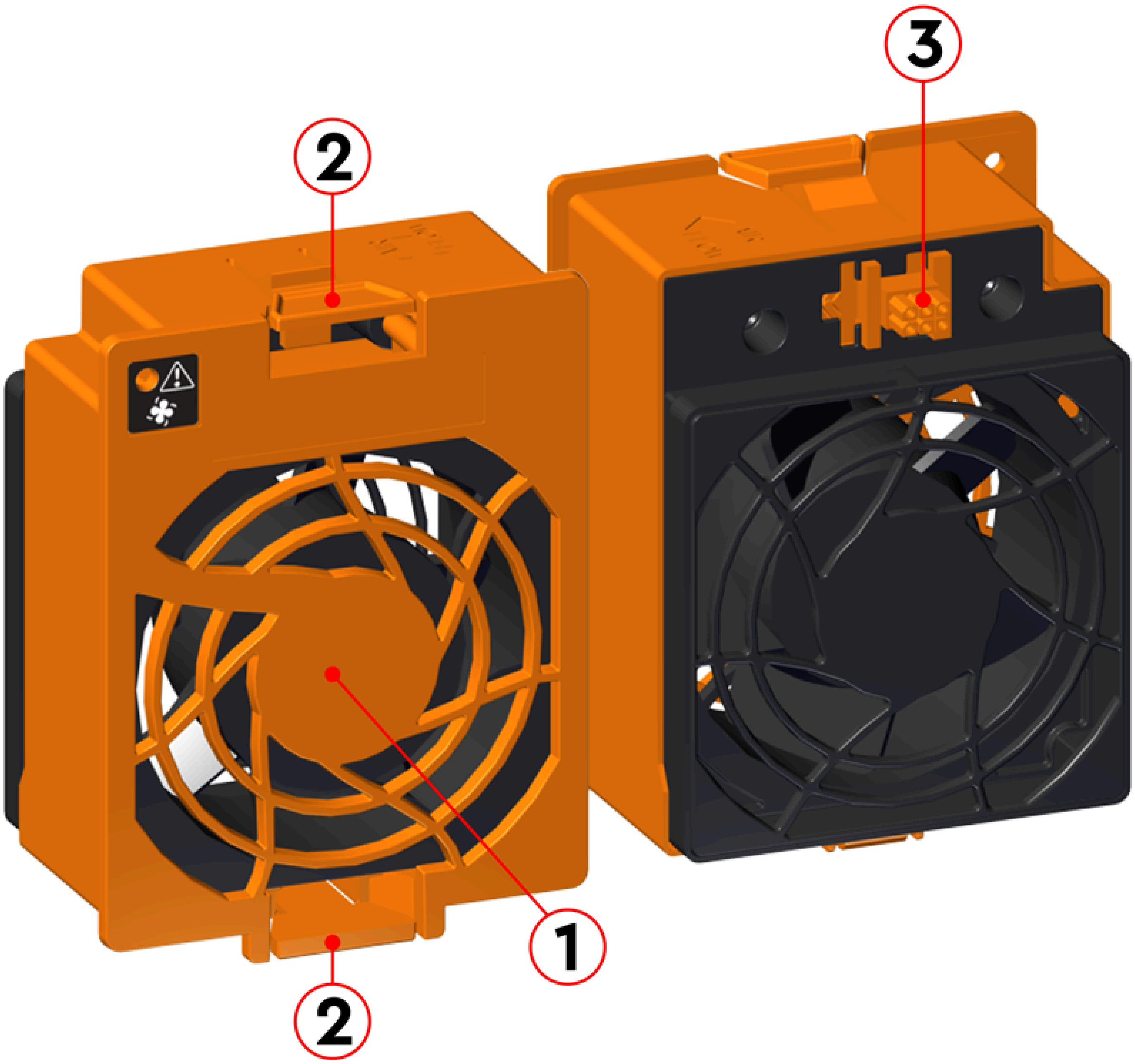
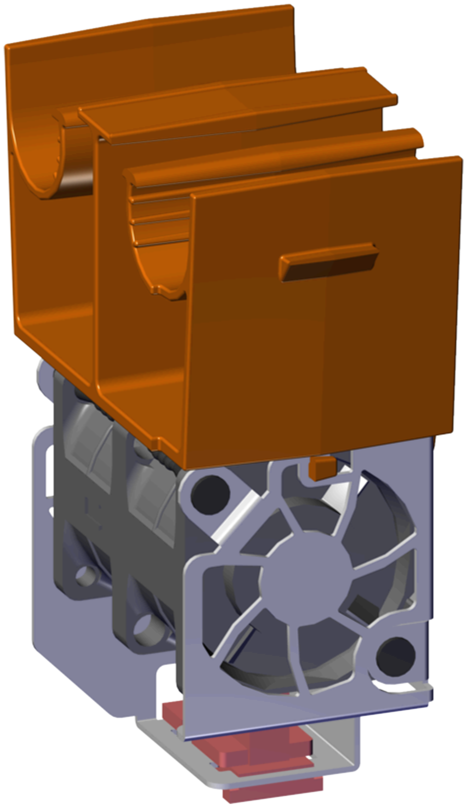


Table 42: Rear Fan Component Descriptions

Number	Feature
1	Fan
2	Latch Releases
3	Internal Power and IO Connector

2.5 IOM Fan

Figure 25: Ultrastar Data102 IOM Fan



The IOM Fan is designed to focus cooling on the enclosure's IOMs. It is installed into the central bay of the chassis and is accessed from the top of the enclosure through the removable cover. It is attached to the chassis via a toolless release mechanism that allows for easy replacement.

2.5.1 IOM Fan Specifications

Specification	Value
Number per Enclosure	1
Part Number	1EX0432
Hot Swappable?	Yes
FRU or CRU?	CRU
Weight	181.4 g / .4 lbs [11]

11. Listed weight does not include packaging/shipping materials.

2.5.2 IOM Fan Layout

Figure 26: IOM Fan Component Locations

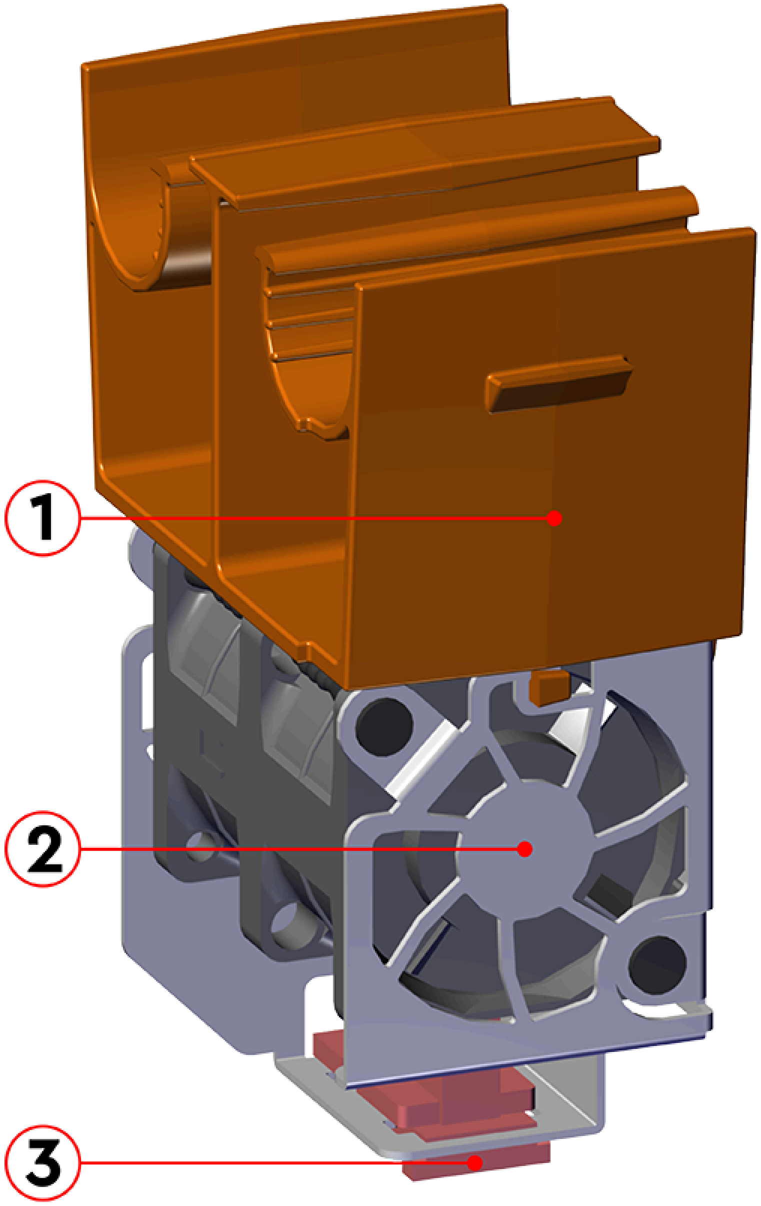


Table 43: IOM Fan Component Descriptions

Number	Feature
1	Latch Mechanism
2	Fan Module
3	Internal Connector

2.6 Rails

Figure 27: Ultrastar Data102 Rails

The Ultrastar Data102 is installed into a rack using a toolless-attach rail system. Each rail is a two-piece assembly, with one rail that attaches directly to the chassis (*inner rail*) and another (*outer rail*) that attaches to the rack. The inner rail comes nested inside the outer rail and can be accessed by sliding it out of the outer rail. The outer rails attach to the rack and receive the chassis to support it inside the rack. The outer rails attach to vertical rack rails, which should be set between 32 in.-36 in . The toolless design allows an installer to attach the rails to a rack without any tools, which simplifies installation. Once they are attached, they can be secured with the included M5 screws and washers.

2.6.1 Rails Specifications

Specification	Value
Length	1028.7 mm / 40.5 in.
Rails Kit (CMA Standard) Part Number	1EX0435
Rails Kit (CMA Lite) Part Number	1EX1601
Hot Swappable?	No
FRU or CRU?	CRU
Weight	7.89 kg total (3.95 kg per rail) / 17.4 lbs total (8.7 per rail) [12]

12. Listed weight does not include packaging/shipping materials.

2.6.2 Rails Layout

Figure 28: Rails Component Locations

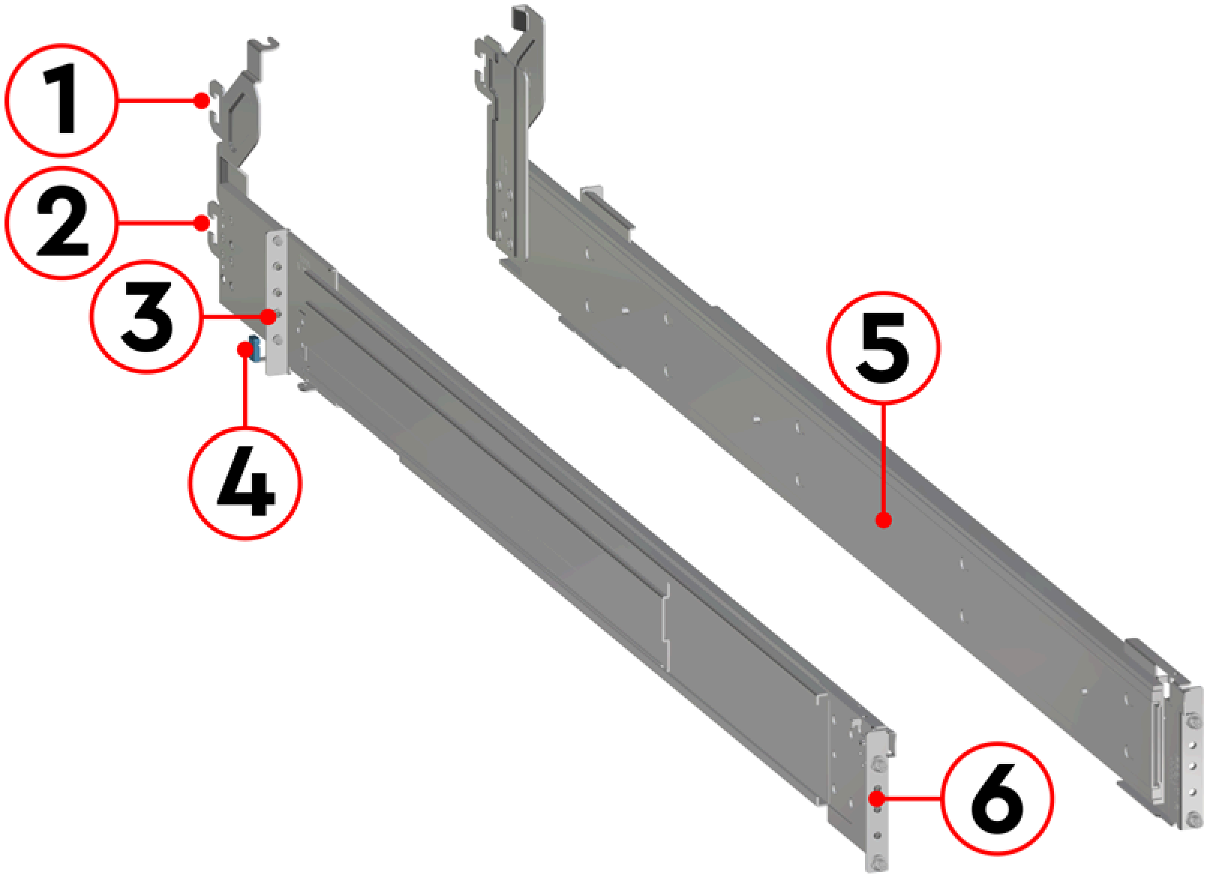


Table 44: Rails Component Descriptions

Number	Features
1	Upper CMA Connector
2	Lower CMA Connector
3	Rear Rack Mounting Bracket
4	Rear Latch Release
5	Inner Rail
6	Front Rack Mounting Bracket and Latch Release

2.7 Top Cover Alignment Bracket

Figure 29: Ultrastar Data102 Top Cover Alignment Brackets

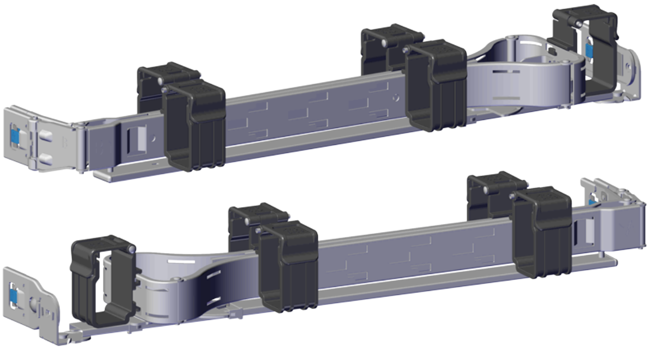
The Top Cover Alignment Brackets are designed to keep the top cover of the Chassis in the rack while extending the Ultrastar Data102 out of the rack for servicing. The Top Cover Alignment Brackets attach to the rear vertical rack rails and rest on top of the toolless rail system.

2.7.1 Top Cover Alignment Bracket Specifications

Specification	Value
Bracket Dimensions	W: 19.8 mm x L: 282.4 mm x H: 109.1 mm / W: 0.8 in. x L: 11.1 in. x H: 4.3 in.
Part Number	1EX2288
Hot Swappable?	Yes
FRU or CRU?	CRU

2.8 CMA

Figure 30: Ultrastar Data102 CMA



The cable management assembly (CMA) protects and manages the cables connected to the PSU ports, SAS ports, and Ethernet ports. It prevents damage to the port connectors and the cables throughout the full travel of the enclosure as it is pulled out of the rack for servicing. This motion ensures that the cables contained by the CMA arm do not snag or get pulled out of the ports as the enclosure moves.

The Ultrastar Data102 CMA is a two-arm design that separates the connections to the two sides of the enclosure. The lower arm supports the cables that connect to the dual SAS ports and Ethernet on the right hand side of the unit as viewed from the rear, as well as the lower PSU power cord. The upper arm supports the left hand ports and the upper PSU power cord. Each arm is attached to the Ultrastar Data102 by one clip at the elbow and two at the other end. The cables are secured to the arms by plastic clips called baskets that can be opened at the top to adjust, add, or remove cables. The arms can also be moved into a service position by unclipping them from the elbow end of the arm and swinging them away from the enclosure when the enclosure is fully inserted in a rack. This provides access to connections and components at the rear of the system without having to remove the CMA or disconnect any of the cabling.

2.8.1 CMA Specifications

Specification	Value
Extension Range	0 - 36 in.
Number per Enclosure	1 assembly (2 arms)
CMA Arms (Dual) Part Number	1EX0437
CMA Arm (Single) Part Number	1EX1174
Cable Tray Part Number	1EX1119
Hot Swappable?	No
Maximum Number of Cables (with dual arms)	12 SAS Cables
	2 Power Cords
	2 Ethernet Cables
FRU or CRU?	CRU

Specification	Value
Weight	1.54 kg (0.77 per arm) / 3.4 lbs. (1.7 per arm) [13]

2.8.2 CMA Layout

Figure 31: CMA Component Locations

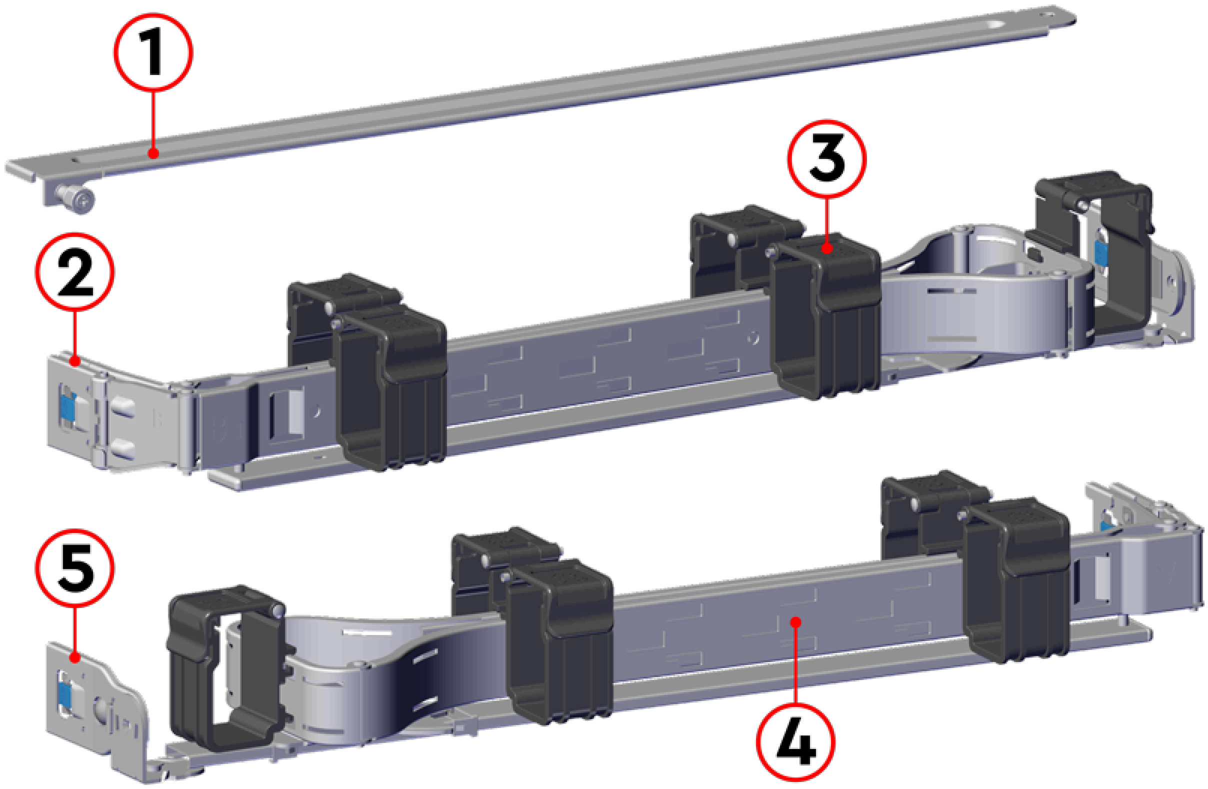


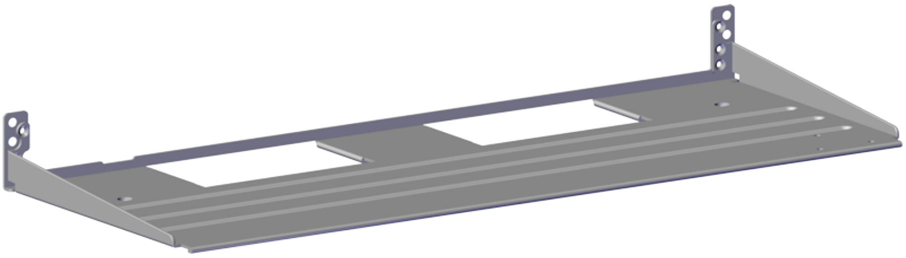
Table 45: CMA Component Descriptions

Number	Feature
1	Crossbar
2	Rail and Rack Connectors
3	Baskets (retain cables)
4	Arm
5	Elbow Connector

13. Listed weight does not include cable tray or packaging/shipping materials.

2.8.3 CMA Cable Tray

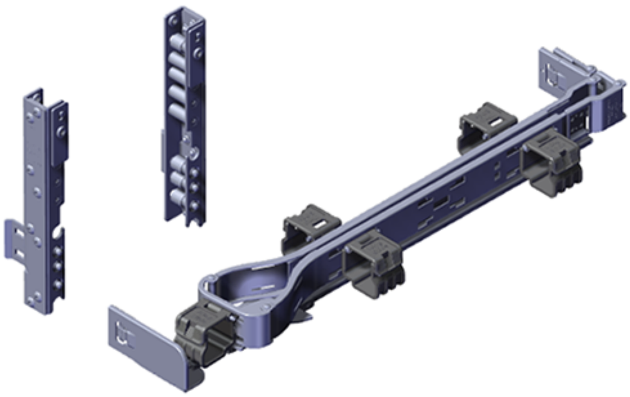
Figure 32: Overview Image



The cable management assembly (CMA) comes with an **optional** tray that is used to support cable loads greater than ten (five per arm). The CMA Cable Tray is mounted at the bottom-rear of the chassis using four M3 x 8mm T10 Torx screws (two per side). It is useful in situations where cables might interfere with the lower U space beneath the chassis.

2.9 CMA Lite

Figure 33: Ultrastar Data102 CMA Lite



The lite version of cable management assembly (CMA Lite) provides the same cable management and protection benefits as the standard CMA for a lighter cable load (2 SAS, 2 power, 2 Ethernet). It features modified cable and enclosure positioning to allow the enclosure to fit within racks that utilize front and rear doors.

CMA Lite manages the cables connected to the PSU ports, SAS ports, and Ethernet ports by securing them to an extendable arm with basket clips that can be opened at the top to adjust, add, or remove cables. The extension of the arm prevents damage or unplugging of the port connectors and cables throughout the full travel of the enclosure as it is pulled out of the rack for servicing. The arm can also be moved into a service position by unclipping it at the elbow end and swinging it away from the enclosure when the enclosure is fully inserted in a rack. This provides access to connections and components at the rear of the system without having to remove the assembly or disconnect any of the cabling.

2.9.1 CMA Lite Specifications

Specification	Value
Extension Range	0 - 39.5 in.
Number per Enclosure	1 arm
CMA Lite Arm (2U Baskets), Part Number	1EX1834
CMA Lite Arm (1U Baskets), Part Number	1EX1602
CMA Lite Cable Tray, Part Number	1EX1603
CMA Lite Kit (w/ rails, spacer brackets, 2U-basket arm), Part Number	1EX1825
CMA Lite Kit (w/ rails, spacer brackets, 1U-basket arm), Part Number	1EX1527
Maximum Number of Cables	2 SAS Cables
	2 Power Cords

Specification	Value
	2 Ethernet Cables
Hot Swappable?	No
FRU or CRU?	CRU
Weight	0.9 kg / 1.9 lbs [14]

14. Listed weight is for arm with 2U baskets and does not include packaging/shipping materials.

2.9.2 CMA Lite Layout

Figure 34: CMA Lite Component Locations

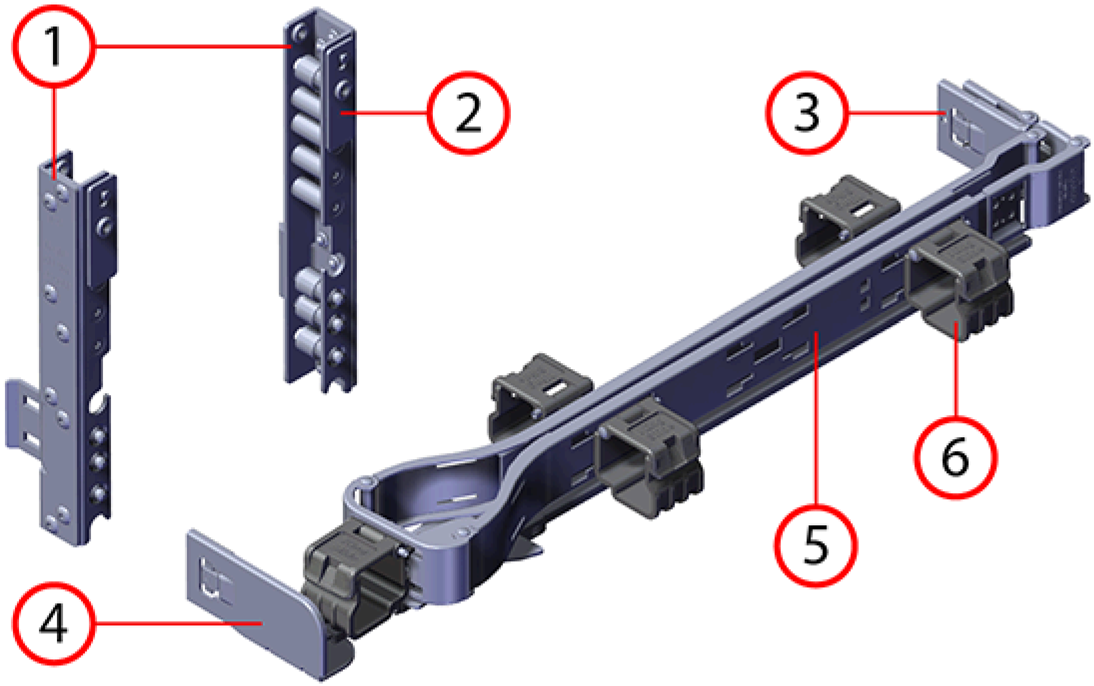
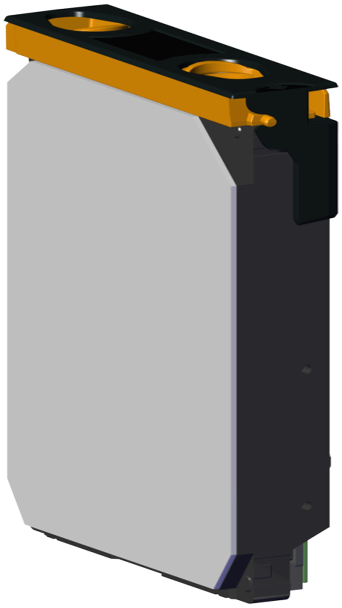


Table 46: CMA Lite Component Descriptions

Number	Feature
1	Spacer Brackets
2	Nut Plate
3	Rail and Rack Connectors
4	Elbow connector
5	Arm
6	Basket Clips (retain cables)

2.10 3.5in HDD Assembly

Figure 35: Ultrastar Data102 3.5in HDD Assembly



The 3.5in HDD Assembly is comprised of two parts: the storage drive and the drive carrier. The carrier attaches to the exterior of the data storage drive and caddies the drive into the enclosure. It stabilizes the motion of the drive into the drive bay so that the drive properly mounts onto the drive board.

2.10.1 3.5in HDD Assembly Specifications

Specification	Value
Number per Enclosure	Up to 102 drives
Part Number	See the List of Compatible Drives *(page 24)* to find the specific part number required.
Hot Swappable?	Yes
Weight	0.68 kg / 1.5 lbs. [15] [16]

15. Listed weight does not include packaging/shipping materials.
16. Actual weight may vary by drive model

2.10.2 3.5in HDD Assembly Layout

Figure 36: 3.5in HDD Assembly Component Locations

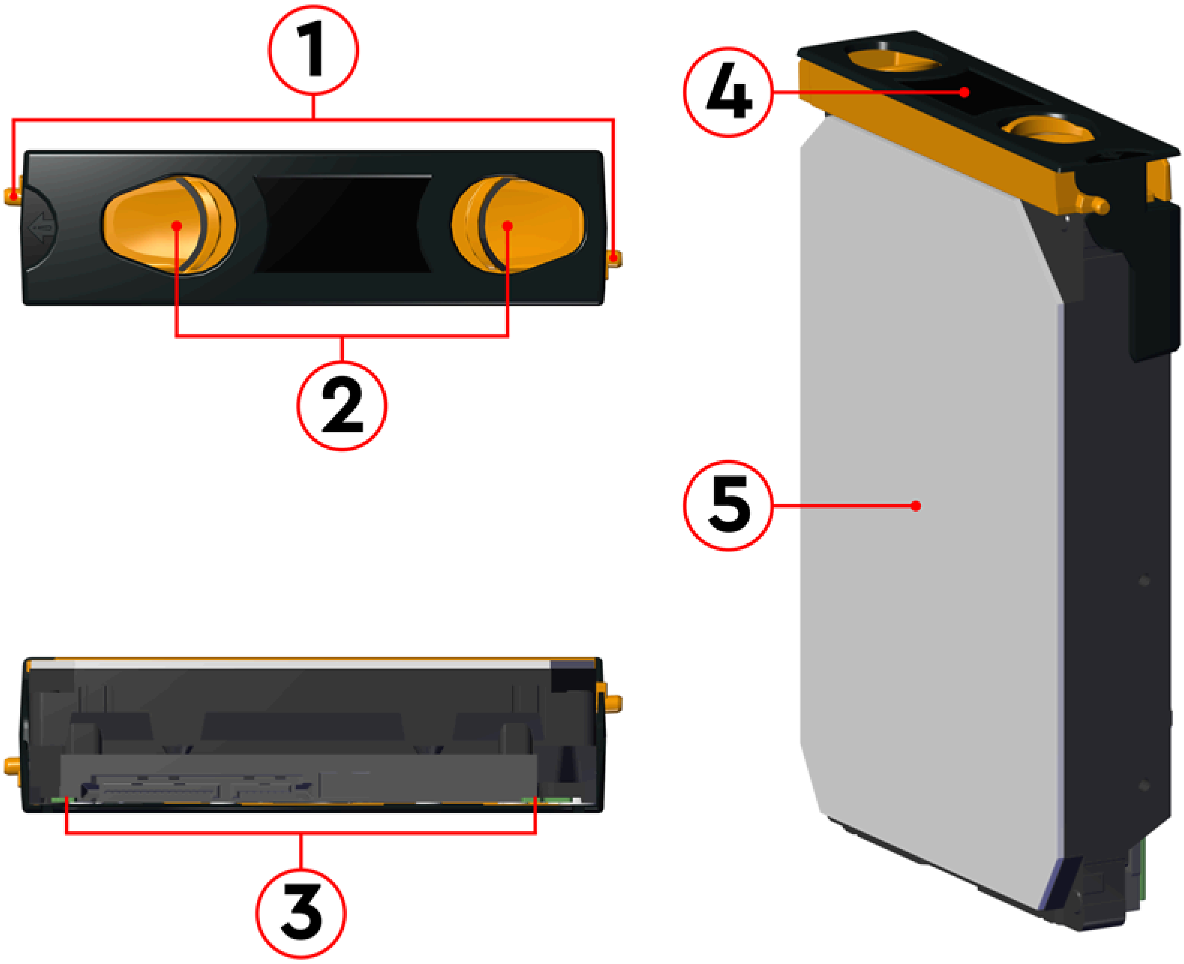
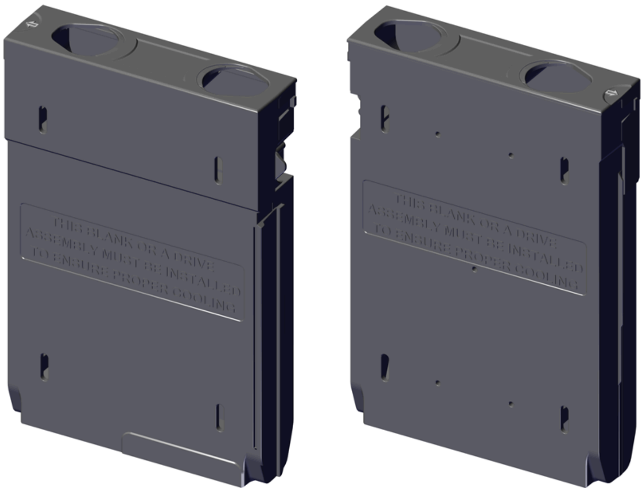


Table 47: 3.5in HDD Assembly Component Descriptions

Number	Feature
1	Latches
2	Latch Release
3	IO and Power Connectors
4	Drive Carrier
5	Disk Drive

2.10.3 3.5in Drive Blank

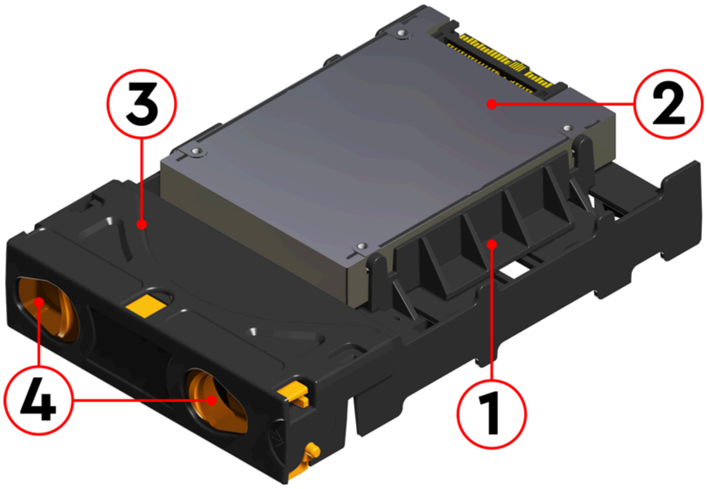
Figure 37: Ultrastar Data102 3.5in Drive Blank



The 3.5in Drive Blank is a placeholder component used to fill empty drive slots in the chassis when an Ultrastar Data102 enclosure is partially populated with drives. When the number of drives in a row is less than the total necessary to fill that row, the 3.5in Drive Blank is used to fill out the row in place of actual drives. The purpose of the 3.5in Drive Blank is to maintain proper airflow and cooling of the enclosure and the components within the enclosure. For more information on requirements for a partially populated enclosure, see Partial Population Configurations *(page 263)*.

2.11 2.5in SSD Assembly

Figure 38: 2.5in SSD Assembly Component Locations



The 2.5in SSD Assembly is used to adapt a 2.5in form factor SSD to the 3.5in drive slots in the Ultrastar Data102 drive bays. This allows the enclosure to accommodate high speed SSD drives as its primary data storage medium. The carrier operates by utilizing an innovative clamping mechanism. The 2.5" drive is seated in the orientation shown the overview image. Then the clamp is inserted to apply pressure to the SSD and secure it in place.

Table 48: 2.5in SSD Assembly Component Descriptions

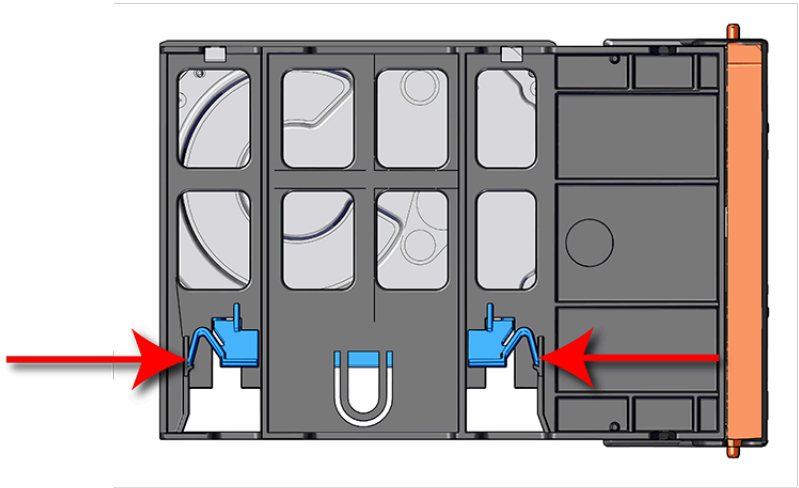
Number	Feature
1	Drive Holder Clamp
2	SSD
3	Carrier Shell
4	Drive Latch Release

2.11.1 Operating the 2.5" Drive Carrier

Follow these steps to operate the clamping mechanism and install a 2.5" drive in the carrier.

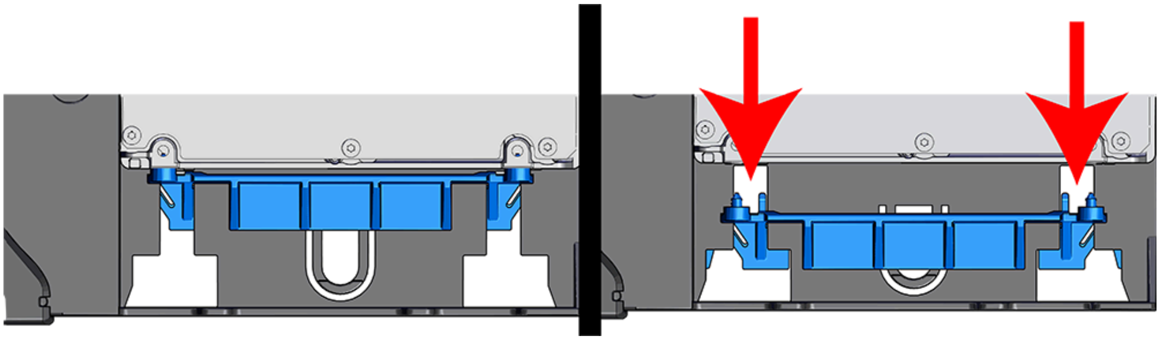
Step 1: Locate the release clips on the rear and press them inward to release the clamp.

Figure 39: Clamp Release (clamp shown in blue for visual clarity)



Step 2: Slide the clamp in the direction shown in the following image to loosen it from the drive. Be sure not to slide too far as this will allow the clamp to fall from the carrier body and it will have to be reinstalled.

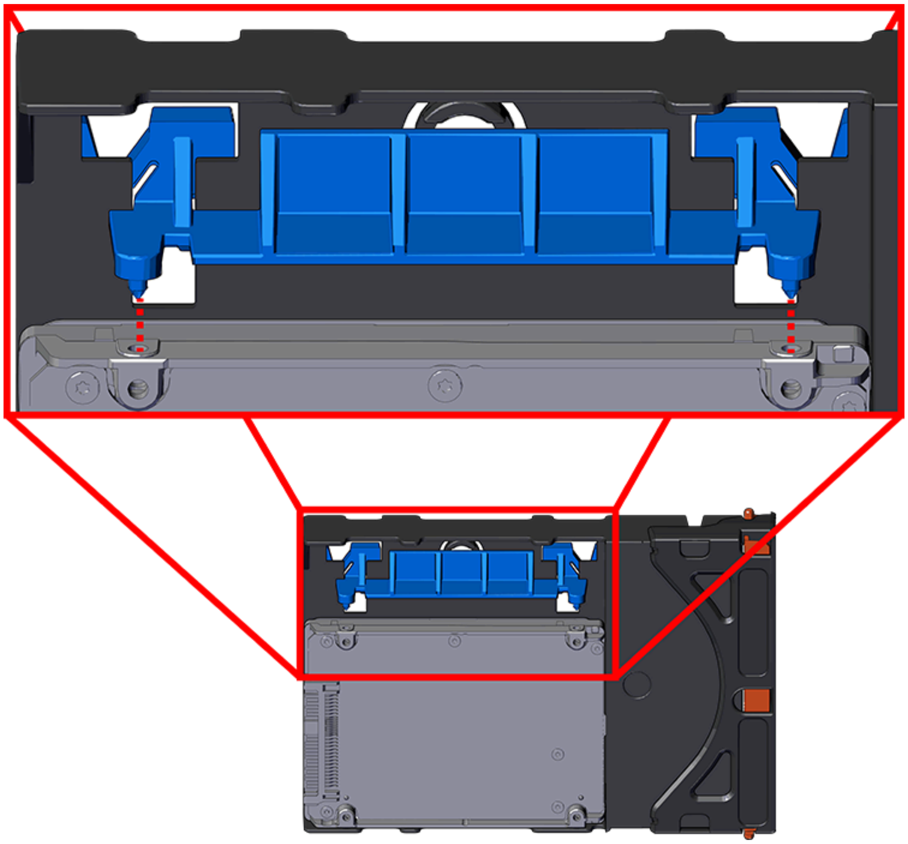
Figure 40: Clamp Slide (clamp shown in blue for visual clarity)

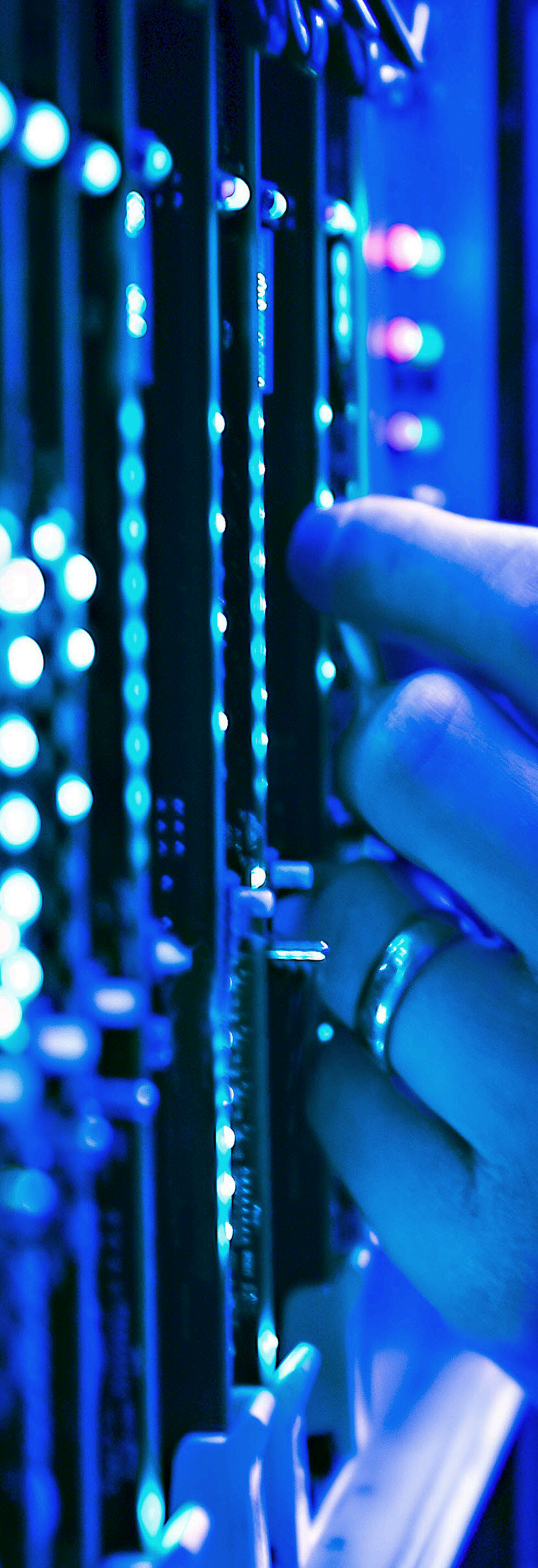


Step 3: Insert the 2.5" drive into the drive slot so that it is snug into the corner.

Step 4: Slide the clamp back toward the drive making sure that the two plastic pins on the side of the drive properly install into the drive screwholes. If these pins are not seated properly, unlatch the clamp and retry.

Figure 41: Clamp Pins (clamp shown in blue for visual clarity)





Support

In This Chapter:

3.1 Part Replacement Service Window

The following table contains a time required and a replacement window for each hot-swappable replacement part within the enclosure. The *Time Required* is the expected amount of time to replace the part. The *Replacement Window* is the amount of time that the enclosure can be open for servicing. If the enclosure cover is open for a period lasting longer than the replacement window, the enclosure may reduce access to drives and other components to reduce the occurrence of thermal issues.

Table 49: Replacement Service Window

Part	Time Required	Replacement Window
IOM	1 min	5 min
PSU	1 min	5 min
Rear Fan	1 min	5 min
IOM Fan	1 min	5 min
Drive Assembly	1 min	5 min

Attention: In the case of multiple CRU failures, a failed fan should **always** be replaced before any other part. Once the enclosure cover is open, the failed fan **must** be removed within a minute. The remainder of the fan replacement should be completed within the 5 minute window.

3.1.1 Multiple CRU Replacements

This procedure provides information and instructions for replacing multiple CRUs in a single servicing window.

In order to maintain proper airflow for enclosure cooling, the Ultrastar Data102 can be opened for servicing of hot-swap components for a maximum of 5 minutes. If multiple CRUs must be replaced within that servicing window, it is critical to optimize servicing actions to make the best use of that time. The following procedure describes a scenario where an IOM Fan, an IOM , and a Drive Assembly (3.5in HDD Assembly or 2.5in SSD Assembly) must be replaced. These instructions provide a strategy for optimizing the servicing window, the order in which CRUs should be replaced, and how to respond if the replacement time will exceed the overall enclosure servicing window.

Step 1: Remotely determine which CRUs have faulted.

Step 2: Review the appropriate CRU replacement procedures in Support *(page 67)* to familiarize yourself with the steps involved, the required parts and tools, and any safety precautions.

Step 3: Gather all the replacement CRUs and required tools.

Note: These preparation activities should be accomplished before servicing, to minimize the number of activities that must be performed while the enclosure is open. Staying within the enclosure servicing window is critical to maintaining its thermal operating requirements.

Step 4: If the Rear Fans or PSUs require replacement, start with these CRUs as they are external and do not require opening the enclosure. Access the rear of the enclosure and follow the appropriate procedure for replacing these CRUs.

Step 5: For replacement of internal CRUs, pull the enclosure out of the rack to allow access to the inside of the enclosure. The enclosure can stay in this position for a maximum of 5 minutes in an ambient temperature of 5°C to 35°C (de-rated for elevation).

Step 6: If an IOM Fan has faulted, replace this CRU first. Remove the IOM Fan and install the replacement in **30 seconds** or less.

Step 7: If an IOM has faulted, replace this CRU next. Remove the IOM and install the replacement in **1 minute** or less.

Step 8: If any Drive Assemblies have faulted, replace each device in a sequential fashion. Pay close attention to proper orientation of the device within the enclosure. Replace each device in **1 minute** or less.

Step 9: Perform a visual inspection of the enclousre to ensure that all CRUs are seated properly.

Step 10: Before the 5-minute servicing window expires, push the enclosure back into the rack. If there are additional internal CRUs that require replacement, wait **10 minutes** before repeating this procedure, beginning with step 5 *(page 69)*.

Step 11: After all CRUs have been replaced, verify remotely that the CRU replacements were successful and that enclosure function has returned to 100%.

3.2 IOM Replacement

Before you begin:

Important: Standard zoning methods (i.e. WDDCS Tool, OOBM, sg_senddiag, or SMP zoning commands) require each IOM to be configured individually. After replacing an IOM, zoning should be configured on it before the system is put back into production, otherwise, any host that is booted and has access to that IOM will see all drives. File-based zoning does not require individual IOM zoning configuration after replacement, as the zoning configuration is stored on the baseboard.

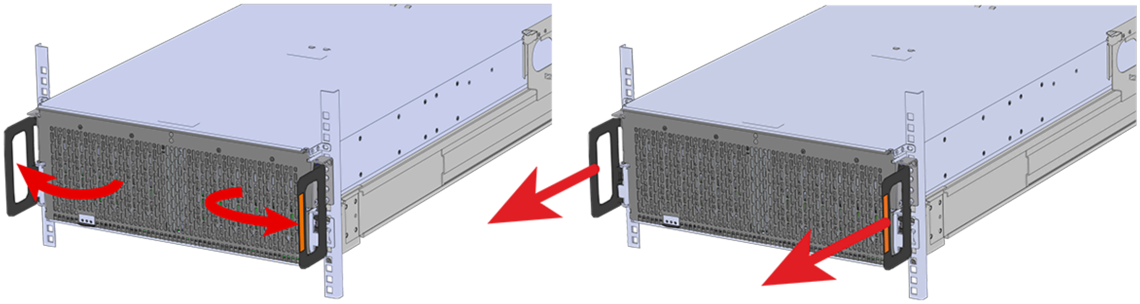
Note: Enclosures running firmware version 3000-058 or later are equipped with Auto-Sync, a feature that automatically detects a mismatch of SEP and OOBM firmware between an enclosure's two IOMs and synchronizes the firmware versions. See Firmware Auto-Sync *(page 222)* for more details and instructions for enabling this feature.

Replacement Requirements	
Personnel Required	1
Avg. Replacement Time	1 min
Max Replacement Time	5 min

Tool	# Needed	Required vs. Recommended
None	N/A	N/A

Step 1: Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. The safety latches will prevent the enclosure from coming out of the rack completely and the cover will remain in the rack attached to the rear alignment brackets.

Figure 42: Chassis Handle Operation

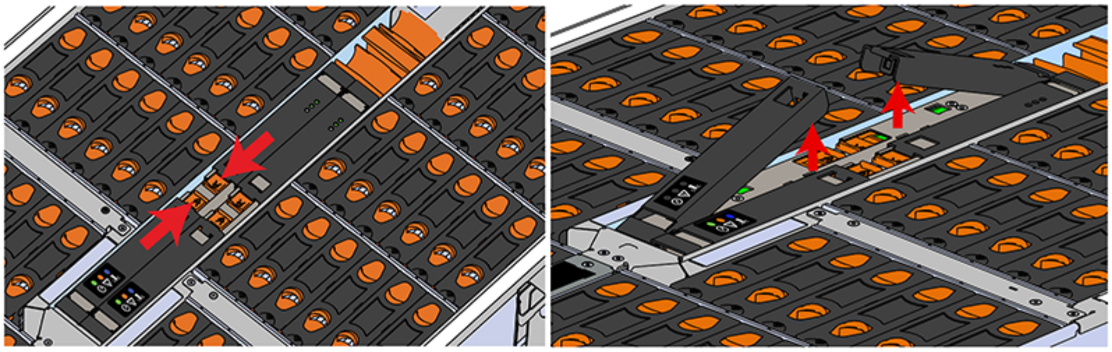


Step 2: Locate the faulty IOM by the amber LED that will be lit on top if there is a fault or by activating the identify LED on the IOM being replaced.

Step 3: Uninstall the IOM(s).

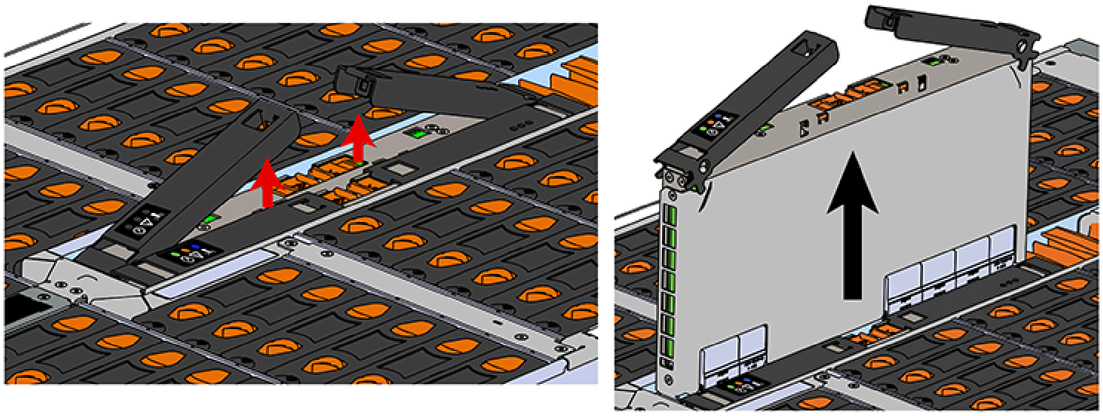
a. Locate the latch release on the IOM and press it in the direction shown in the following image.

Figure 43: Unlatching the IOM



b. Grasp both handles, one handle in each hand, and lift evenly with both hands to ensure the IOM comes out straight. This will prevent any damage to the pins on the internal connectors.

Figure 44: Removing IOM



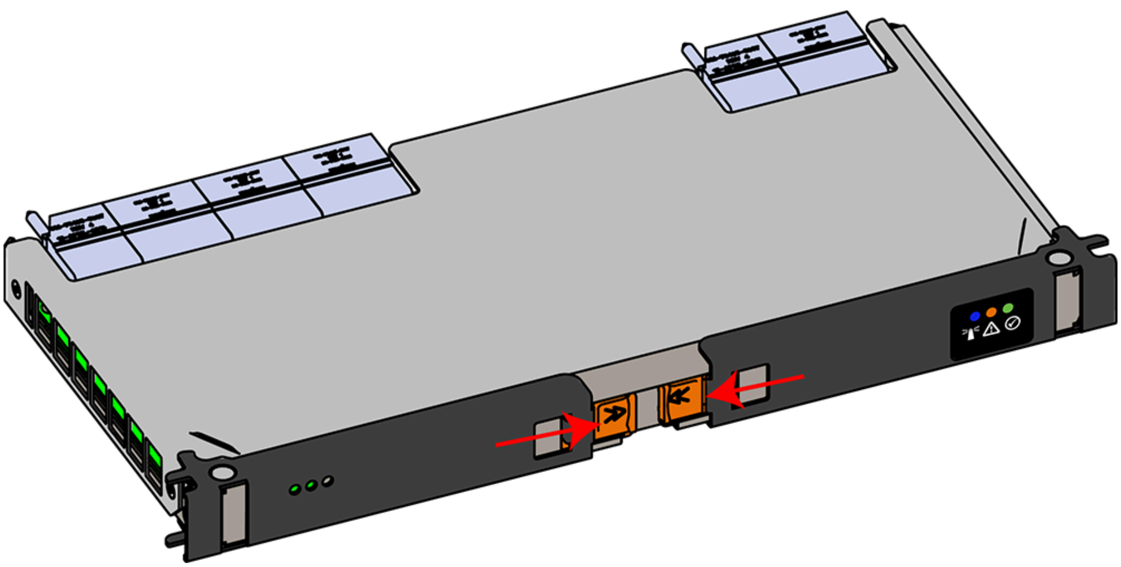
Step 4: Remove the new IOM from its packaging.

Step 5: Install the IOM.

> **Caution:** If a pin on the IOM's internal connectors is bent or damaged, the IOM will have to be replaced. For this reason it is imperative that the IOM is not forced into position, that it is inserted straight, and that the directions for installing the IOM are followed exactly.

a. Ensure that the handles on the IOM are not latched. To unlatch them, press the latch release in the direction shown in the following image.

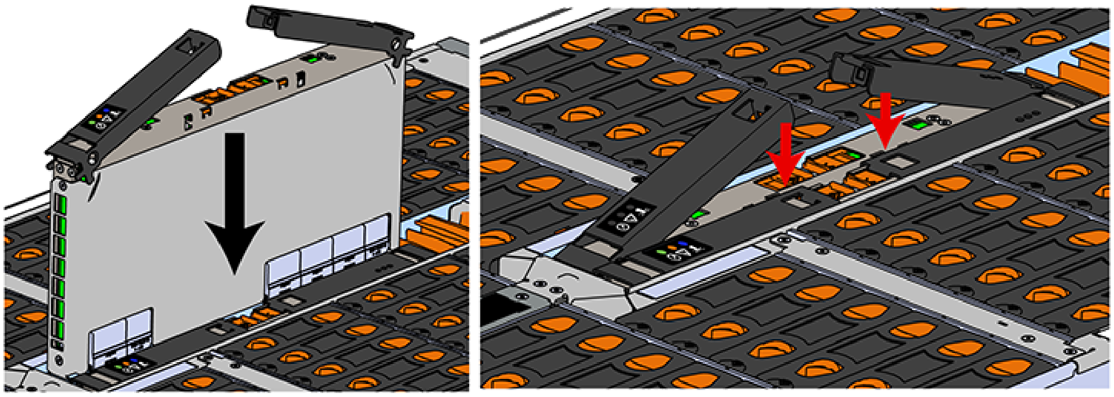
Figure 45: Unlatching IOM Handles



b. Align the IOM with the empty slot on the top of the chassis so that the arrow on the IOM latch release is facing toward the side shown in the following image.

c. Slowly lower the IOM into the empty slot while being careful to keep it level. Do not to force it.

Figure 46: Installing the IOM



d. When the IOM is lowered fully, apply light pressure with both hands evenly on the IOM body, not the handles, to seat the IOM in the connector. If the IOM won't seat correctly, **DO NOT FORCE IT**. Instead, back the IOM out, check the pins to make sure none are damaged, and try again.

e. Once the IOM is seated properly in the slot, close the handles until they latch closed.

Step 6: Push the chassis back into the rack. Verify that the fans have slowed to their regular RPM. This ensures that the enclosure is back to its proper cooling settings.

Step 7: Enclosures running firmware version 3000-058 or later are equipped with Auto-Sync, a feature that automatically detects a mismatch of SEP and OOBM firmware between an enclosure's two IOMs and synchronizes the firmware versions. See Firmware Auto-Sync *(page 222)* for more details.

a. For enclosures running earlier firmware versions, check the fault LEDs on the IOM or on the enclosure's front and rear LED panels to determine if there is a firmware mismatch between the replacement IOM and the IOM that was not replaced.

b. If the fault LED is illuminated, open a command prompt on the host server and issue the following command using SG3_utils.

```
sg_ses <dev> -p 3
```

Remember to replace the <dev> field with the appropriate value related to the IOM in slot A.

c. Scan the output for the ESCE element status descriptor. If it is critical, then there is a firmware mismatch.

d. To fix the firmware mismatch, perform an upgrade to the current firmware revision by following the upgrade instructions here: Firmware Upgrade *(page 206)*

Step 8: If zoning was configured via the WDDCS Tool, OOBM, sg_senddiag, or SMP zoning commands, these methods require each IOM to be configured individually. Configure zoning on the new IOM before the system is put back into production. For instructions on zoning, please see Zoning *(page 230)*.

3.3 PSU Replacement

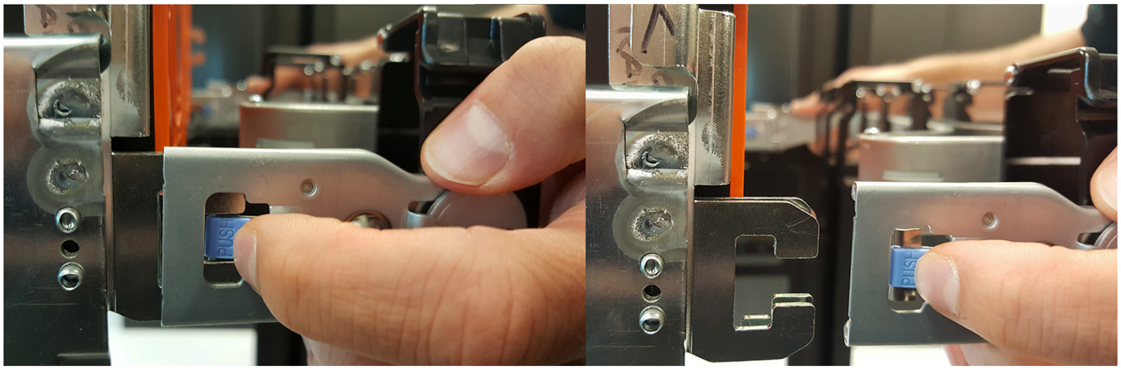
This procedure provides instructions for replacing a PSU.

Replacement Requirements		
Personnel Required		1
Avg. Replacement Time		1 min
Max Replacement Time		5 min
Tool	**# Needed**	**Required vs. Recommended**
None	N/A	N/A

Step 1: Place the CMA(s) into service position.

a. Unlatch the CMA(s) from the rail at the elbow connector by pressing the blue release button.

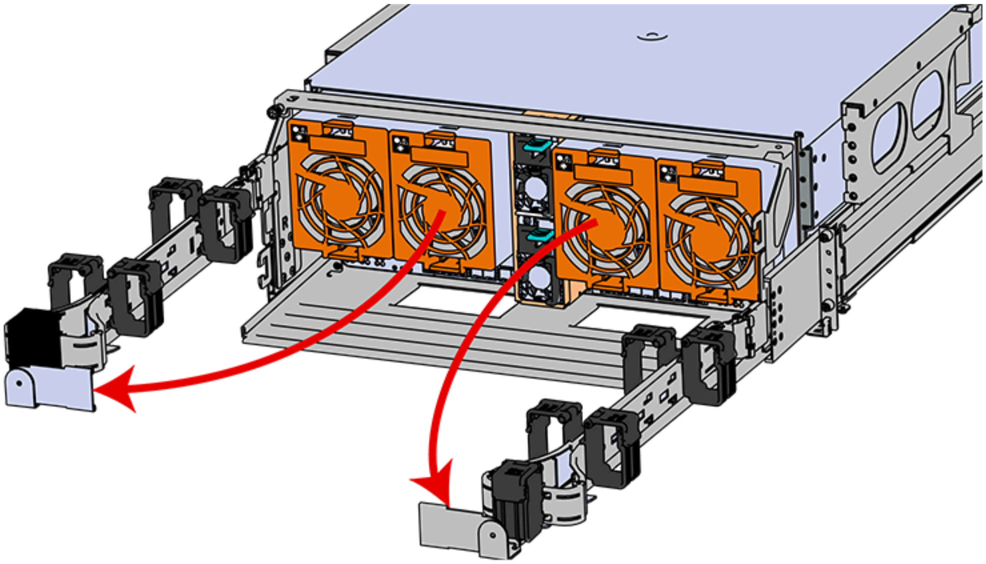
Figure 47: Unlatching a CMA Connector



b. Swing the CMA(s) away from the enclosure.

c. The arm(s) should be extended away from the enclosure as shown in the following example.

Figure 48: CMA(s) in service position (Cables not shown)



Step 2: Locate the faulty PSU by finding the amber LED lit at the rear of the enclosure.

Step 3: Detach the cable retention mechanism.

Figure 49: Delta PSU Cable Retention Clip

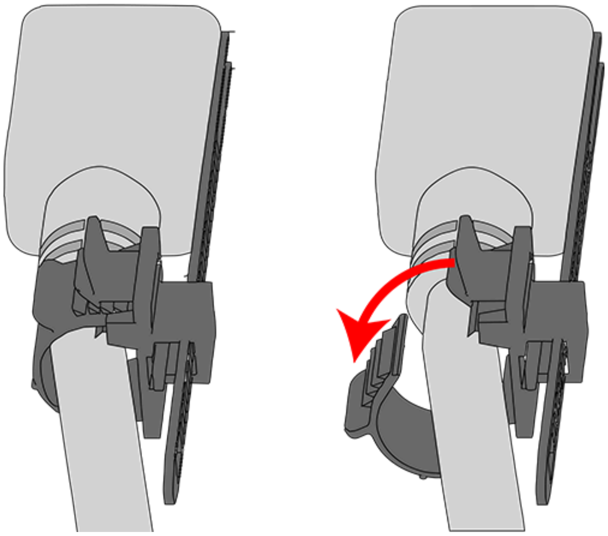
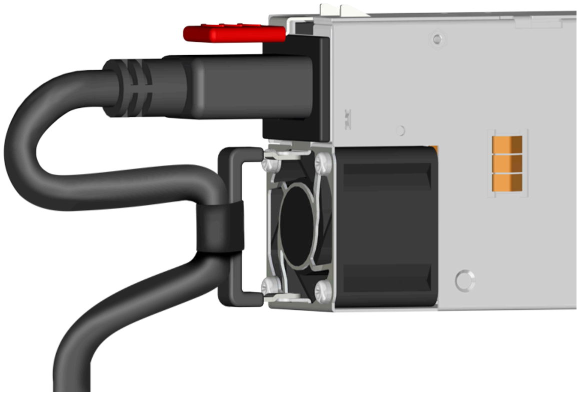


Figure 50: Artesyn PSU Cable Retention Strap

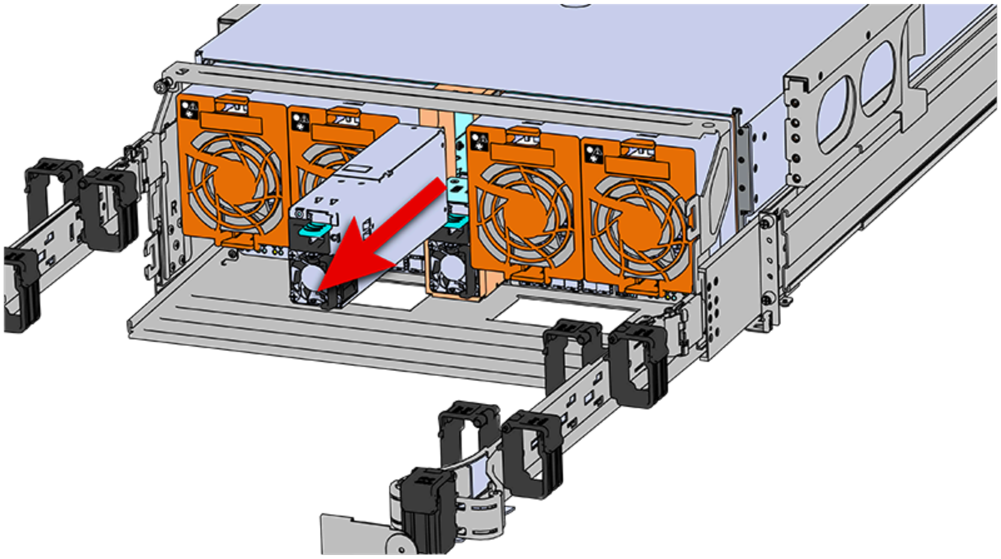


Step 4: Remove the power cable from the faulty PSU.

Step 5: Uninstall the PSU.

a. Grasp the release lever and the metal handle in a downward pinching motion to release the latching mechanism.

Figure 51: Uninstalling the PSU (Delta PSU shown)



b. Pull the PSU straight out with even pressure.

Step 6: Remove the new PSU from its packaging.

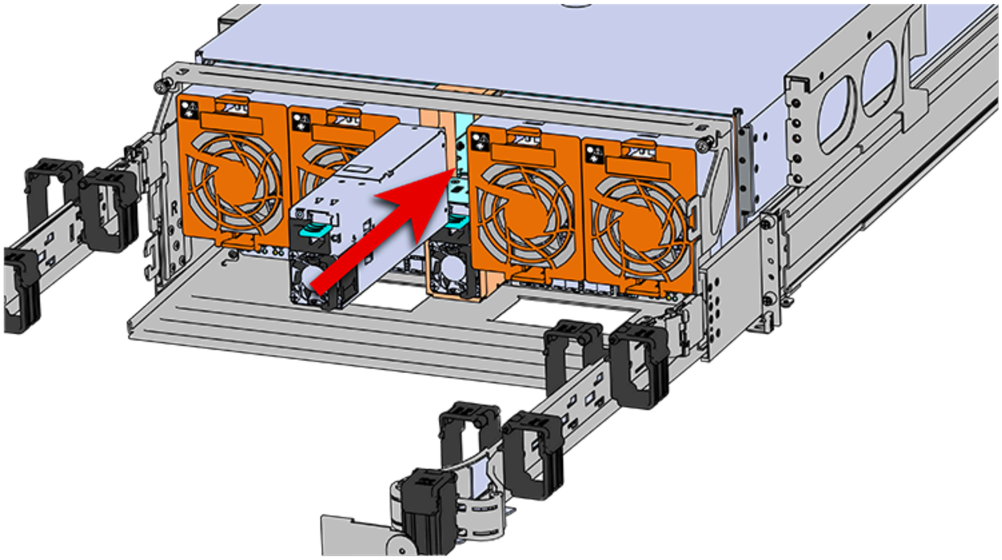
Step 7: Install the PSU.

Note: The Artesyn PSU requires 3000 series firmware or later.

a. Align the PSU in the orientation shown in the following image.

b. Slide the PSU into the slot until it seats fully into the chassis.

Figure 52: Installing the PSU (Delta PSU shown)



c. Plug the power cable into the receptacle at the back of the PSU.

d. Attach the cable retention mechanism.

For the Delta PSU, loop the retention clip around the power cable and pinch it until the clip catches and locks in place. Then slide the retention clip forward until it stops near the cable connector. Doing this will ensure that the retention clip functions properly in the event the cable is pulled on for some reason.

Figure 53: Delta PSU Cable Retention Clip

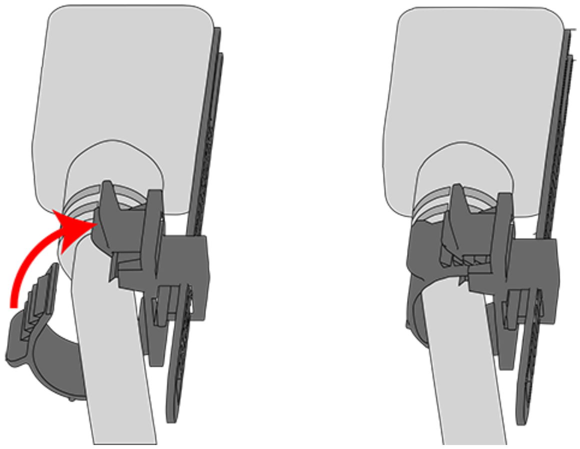
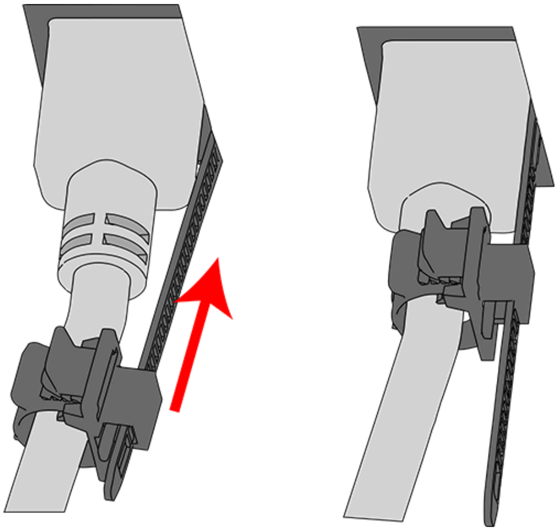
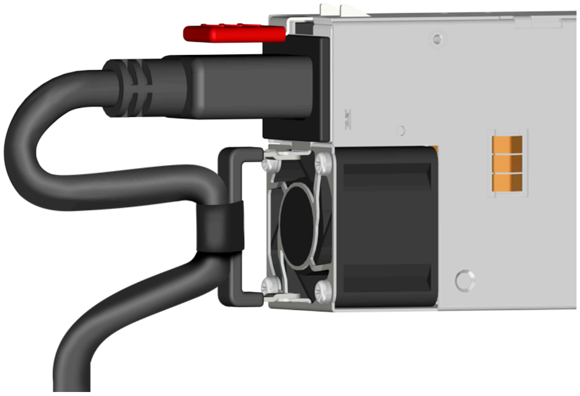


Figure 54: Cinching Cable Retention Clip



For the Artesyn PSU, secure the power cable to the PSU handle with the velcro retention strap as shown in the following image.

Figure 55: Artesyn PSU Cable Retention Strap



Step 8: Make sure the CMA(s) is in operational position by folding the arm(s) in toward the enclosure and attaching the elbow end(s) to the connector(s) attached to the rail. Verify that all of the cabling is in functional order and does not bind or catch.

3.4 Rear Fan Replacement

Before you begin:

Caution: All four enclosure fans must be replaced with the fans included in the CRU replacement package. Failure to replace all 4 may result in false error messages.

Note: Mark or label the old fans prior to removing them, to ensure that all 4 are replaced.

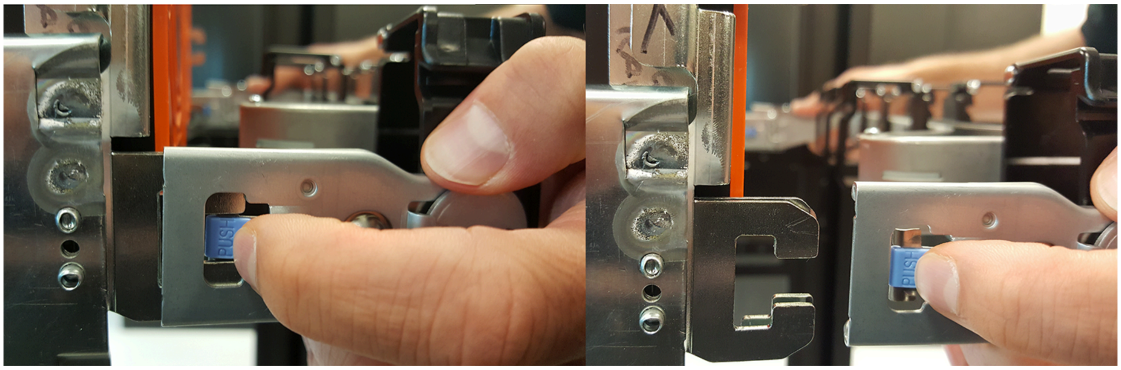
Warning: For hot-plug replacement, the fans must be replaced one at a time and all four completed in a timely manner (5 minutes max.), to prevent exceeding thermal thresholds. An alternative is to replace the fans when the enclosure is offline.

Replacement Requirements		
Personnel Required		1
Avg. Replacement Time		1 min
Max Replacement Time		5 min
Tool	**# Needed**	**Required vs. Recommended**
None	N/A	N/A

Step 1: Place the CMA(s) into service position.

a. Unlatch the CMA(s) from the rail at the elbow connector by pressing the blue release button.

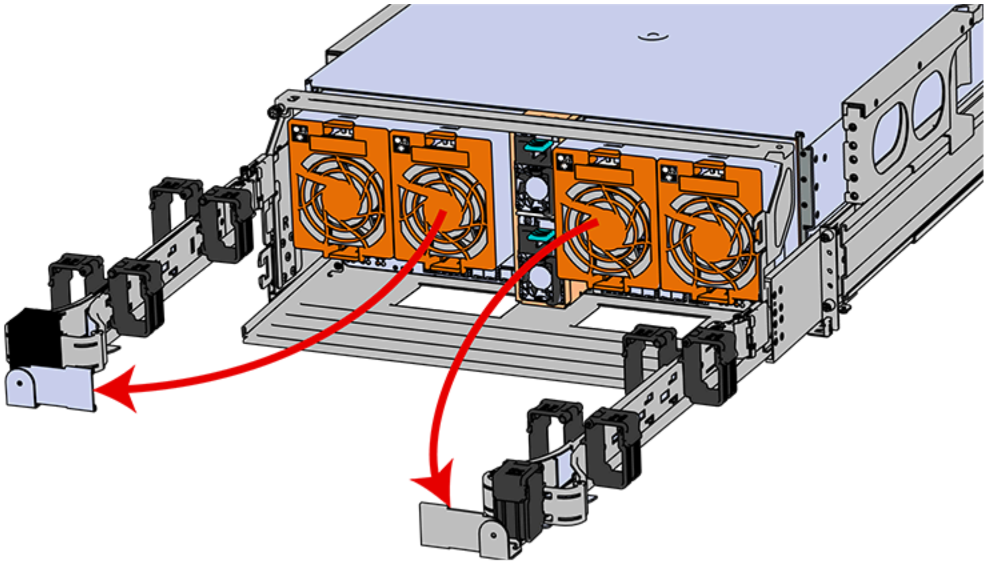
Figure 56: Unlatching a CMA Connector



b. Swing the CMA(s) away from the enclosure.

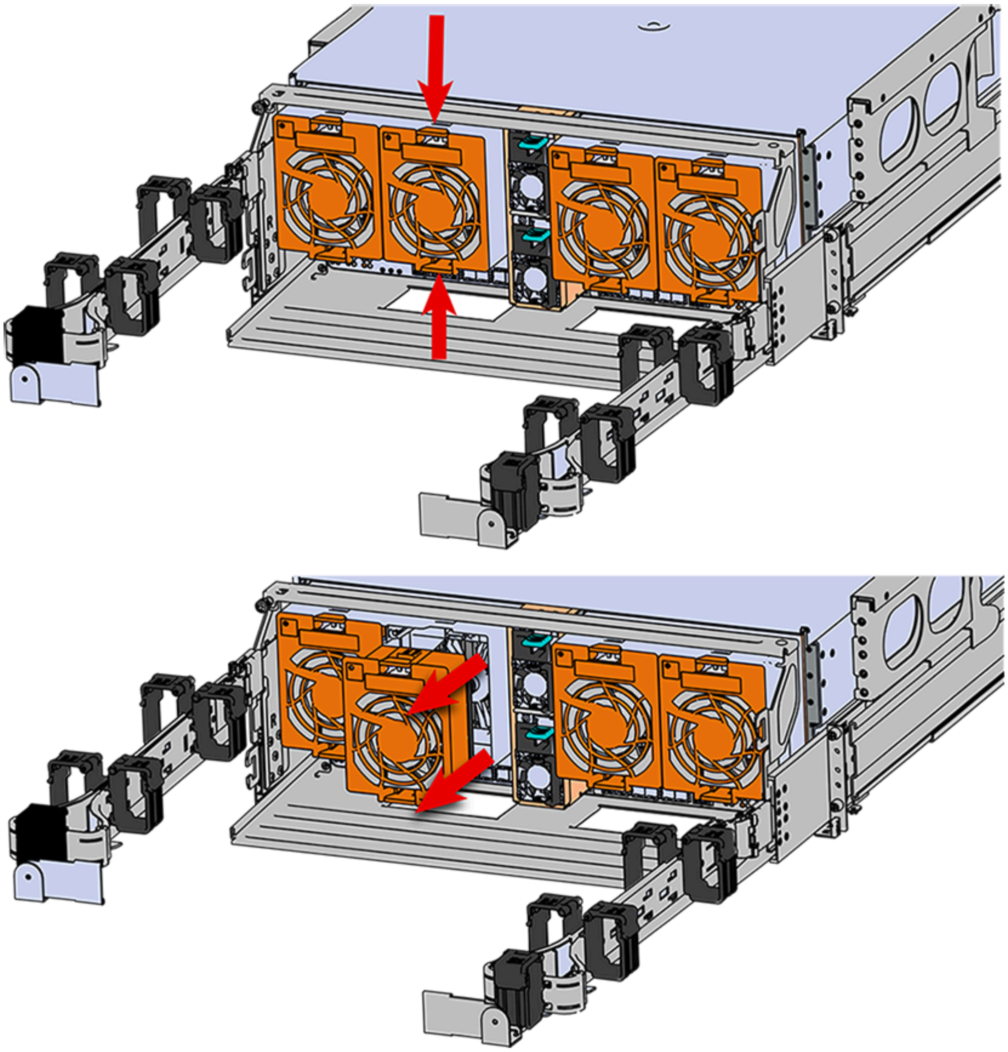
c. The arm(s) should be extended away from the enclosure as shown in the following example.

Figure 57: CMA(s) in service position (Cables not shown)



Step 2: To unlatch the rear fan from the fan housing, use one hand to press the clip at the top and bottom of the fan and pull to free it from the chassis and remove it.

Figure 58: Uninstalling the Rear Fan



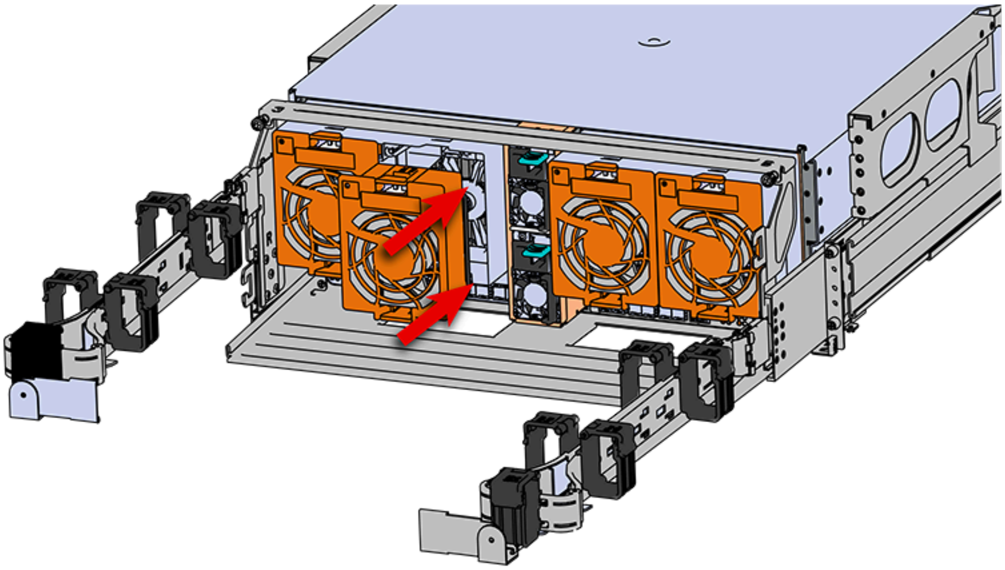
Step 3: Uninstall the remaining fans.

Step 4: Install Rear Fan

a. Orient the rear fan as shown in the following image.

b. Insert the rear fan into the housing as shown in the following image.

Figure 59: Installing the Rear Fan



Step 5: Install the remaining fans.

Step 6: Make sure the CMA(s) is in operational position by folding the arm(s) in toward the enclosure and attaching the elbow end(s) to the connector(s) attached to the rail. Verify that all of the cabling is in functional order and does not bind or catch.

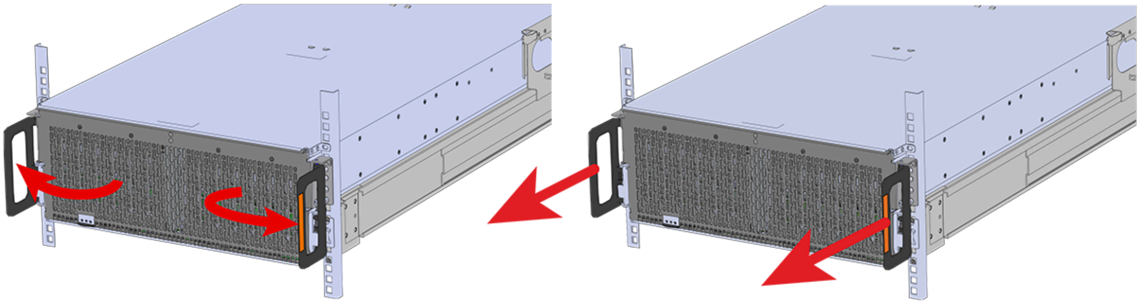
3.5 IOM Fan Replacement

Replacement Requirements	
Personnel Required	1
Avg. Replacement Time	1 min
Max Replacement Time	5 min

Tool	# Needed	Required vs. Recommended
None	N/A	N/A

Step 1: Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. The safety latches will prevent the enclosure from coming out of the rack completely and the cover will remain in the rack attached to the rear alignment brackets.

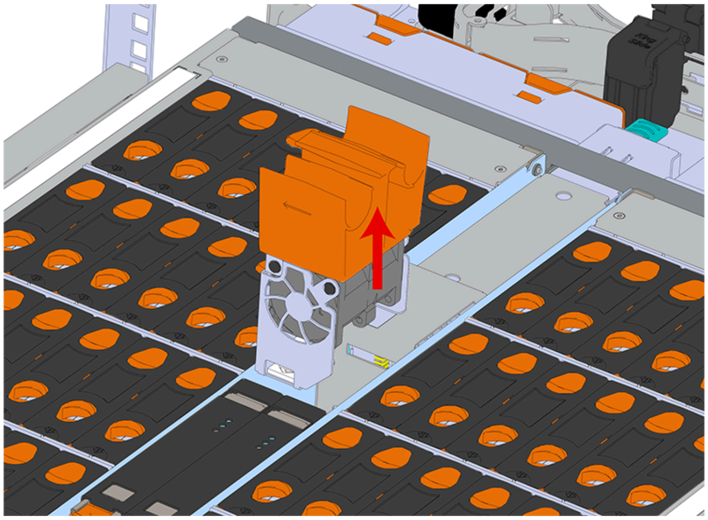
Figure 60: Chassis Handle Operation



Step 2: Remove the IOM Fan.

a. With one hand, grasp around the center square of the fan housing as shown in the following image.
b. Pinch the IOM fan housing to release the latching mechanism and pull it straight out from the chassis.

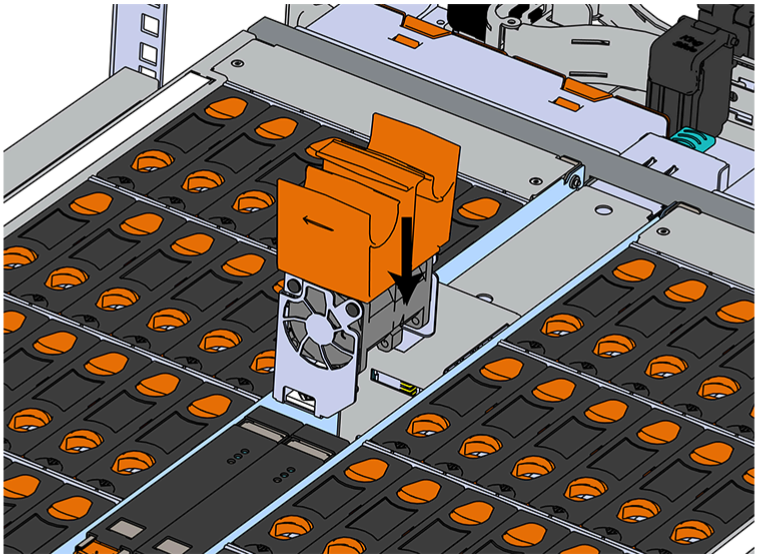
Figure 61: Removing IOM Fan



Step 3: Install the IOM Fan.

a. Align the IOM Fan as shown in the following image.

Figure 62: Installing the IOM Fan



b. Pinch the latch release mechanism slightly and carefully lower the IOM Fan into the slot.

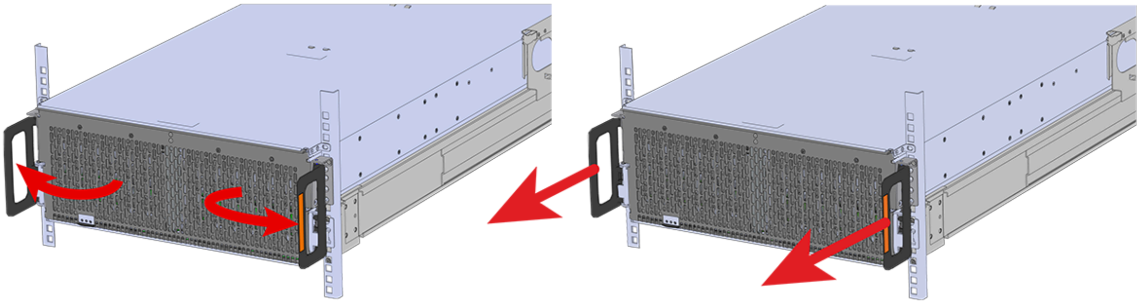
Step 4: Push the enclosure back into the rack to ensure proper cooling.

3.6 3.5in HDD Assembly Replacement

Replacement Requirements		
Personnel Required		1
Avg. Replacement Time		1 min
Max Replacement Time		5 min
Tool	**# Needed**	**Required vs. Recommended**
None	N/A	N/A

Step 1: Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. The safety latches will prevent the enclosure from coming out of the rack completely and the cover will remain in the rack attached to the rear alignment brackets.

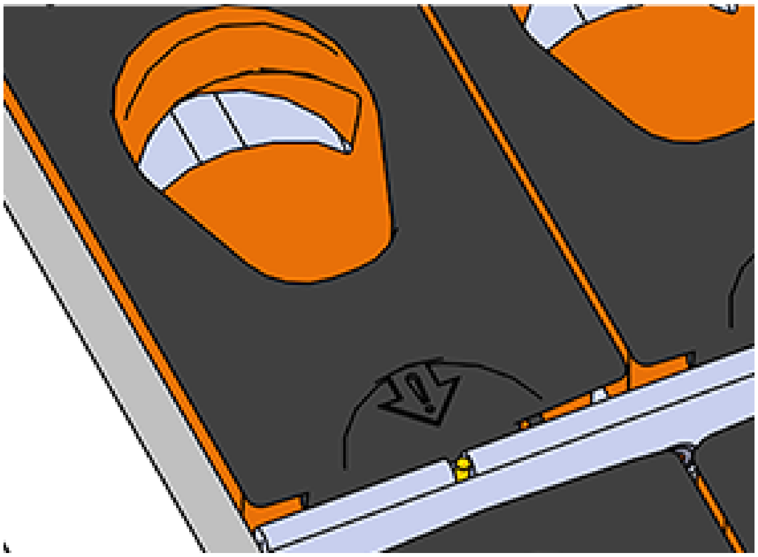
Figure 63: Chassis Handle Operation



Only extend the enclosure out of the rack as far as is needed to reach the drive being replaced.

Step 2: Locate the faulty 3.5in HDD Assembly by finding the illuminated amber LED or by activating the identification LED for the drive to be replaced.

Figure 64: HDD Assembly LED

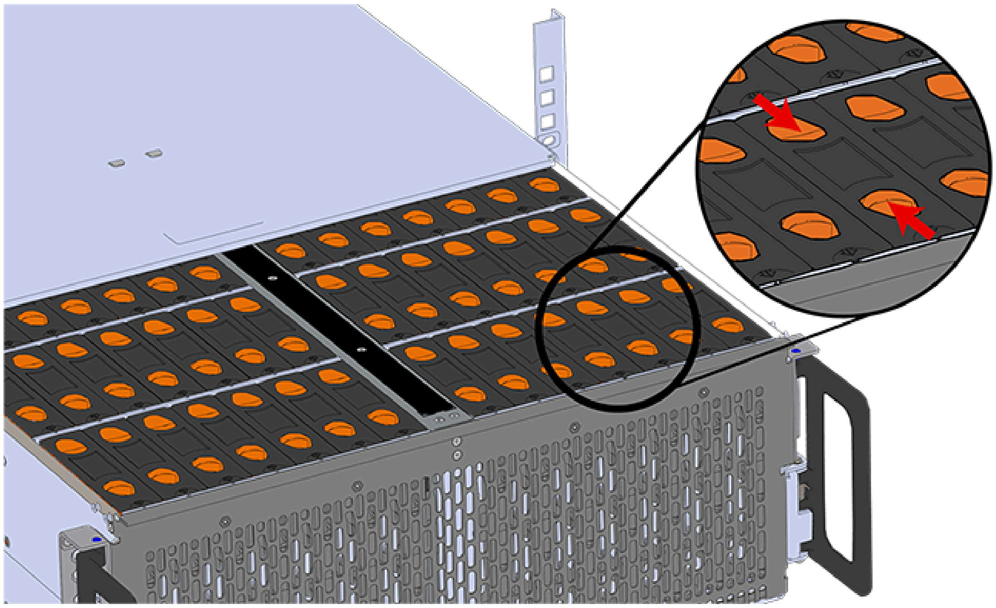


Step 3: Follow these steps to remove a 3.5in HDD Assembly.

a. Find the latch release mechanism on the 3.5in HDD Assembly being removed.

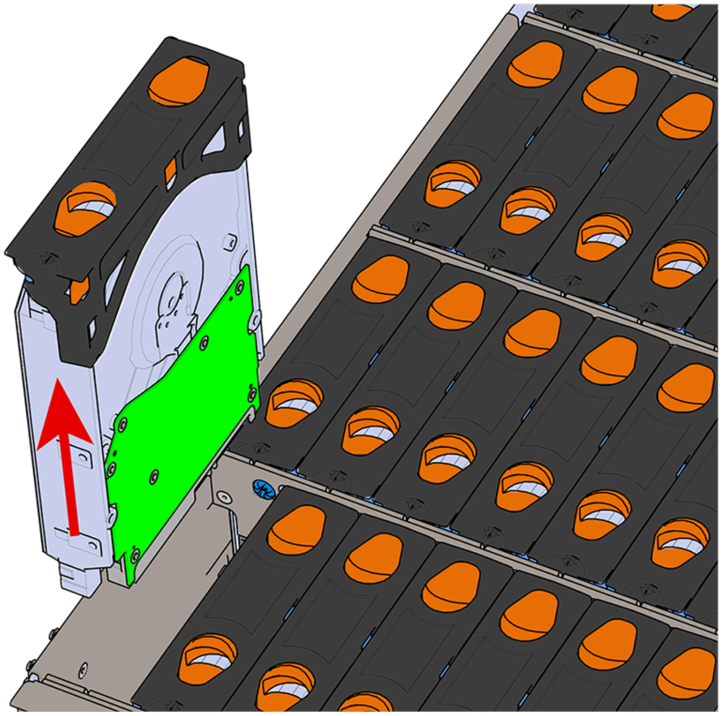
b. Insert a finger and a thumb into the latch release and pinch to unlatch the 3.5in HDD Assembly.

Figure 65: Unlatch Drive Carrier (IOM Not Shown)



c. Lift the 3.5in HDD Assembly free from the enclosure.

Figure 66: Removing 3.5in HDD Assembly

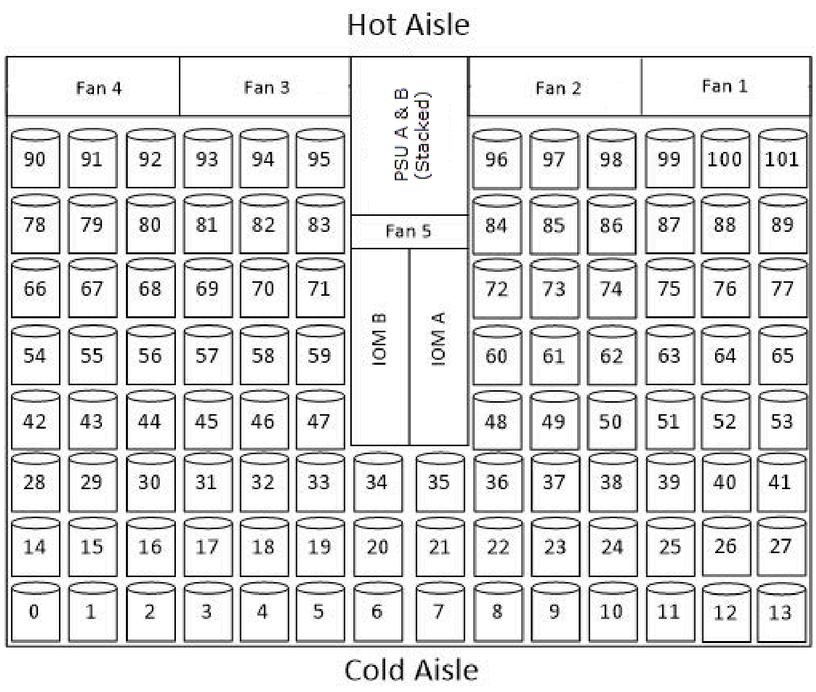


Step 4: Remove the new 3.5in HDD Assembly from its packaging.

Installing the 3.5in HDD Assembly

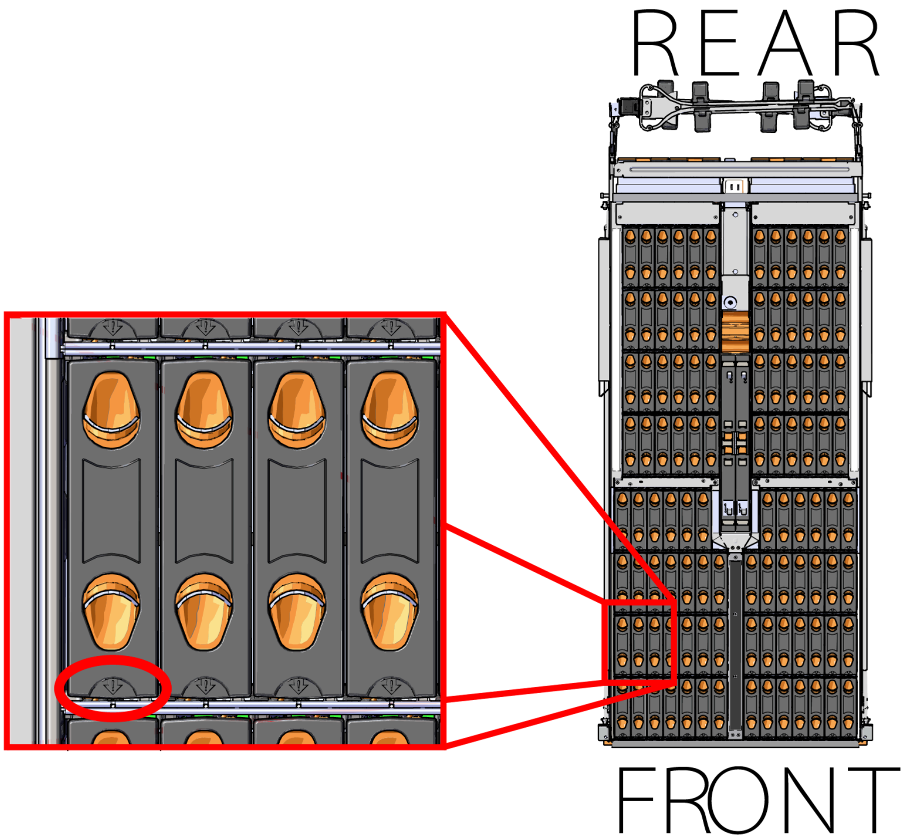
Note: When installing drives, populate the enclosure from left-to-right, rear-to-front. For example, begin with slot 90 (as shown in the following diagram), continue through 101, then proceed with 78 through 89, and so on:

Figure 67: Drive Layout



Note: When installing drives, ensure that the LED pointer on the top of the drive carrier points toward the front of the enclosure, as shown in the following image:

Figure 68: LED Pointer Orientation



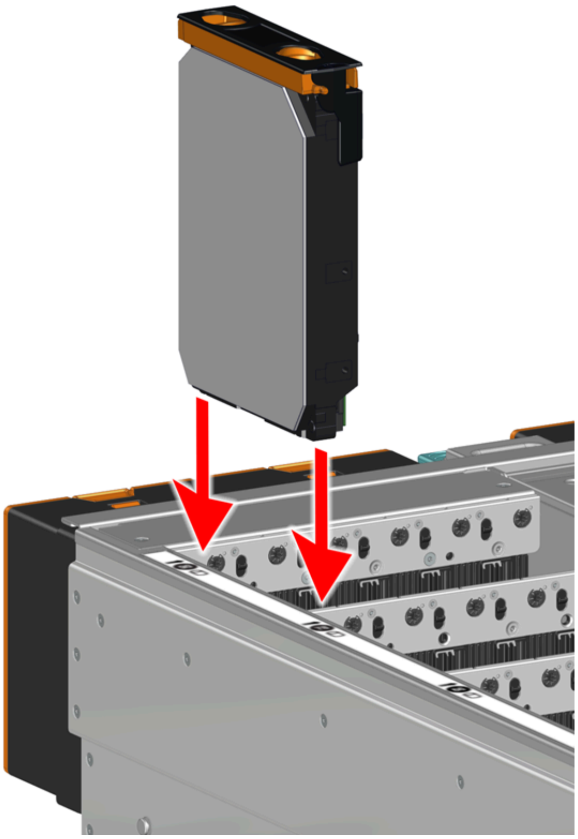
Caution: To ensure proper airflow for enclosure cooling, all drive slots must be populated with either drives or drive blanks.

Step 5: Ensure that the enclosure has been pulled out of the rack until the rail latches engage.

Step 6: Install each drive in the place it was removed from by following the labels or marks that were added earlier.

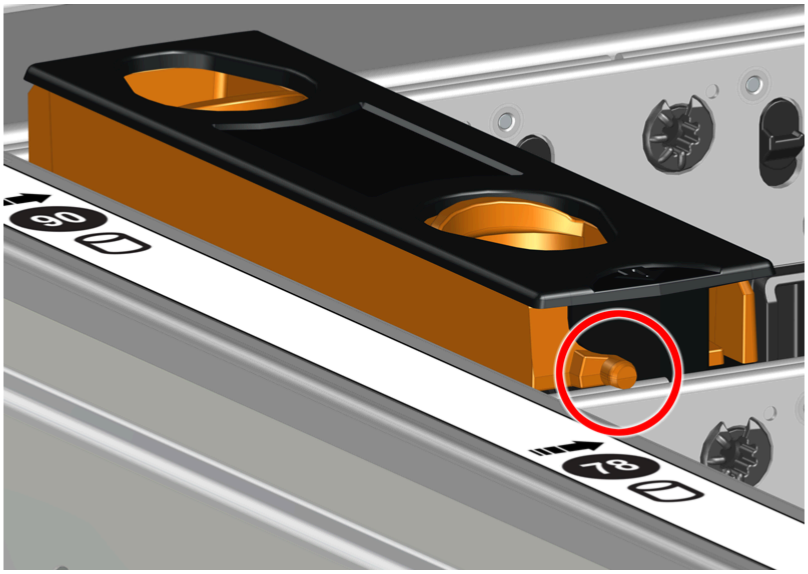
Step 7: Align the drive with the empty slot that will receive it. Lower it into the slot, ensuring that it stays level and does not bind.

Figure 69: Inserting a 3.5in HDD Assembly



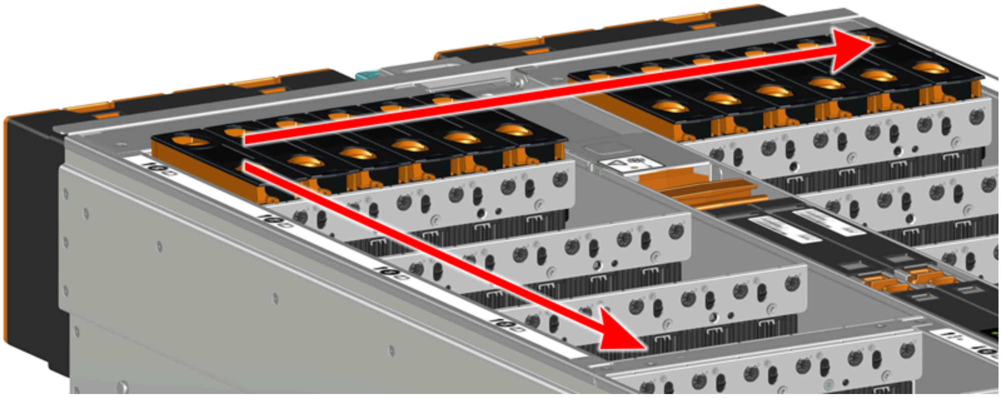
Step 8: Lower the drive until the spring-loaded posts on the carrier contact the top edges of the drive slot. This is an intermediate position; the drive assembly will be fully seated later on.

Figure 70: Intermediate Install Position



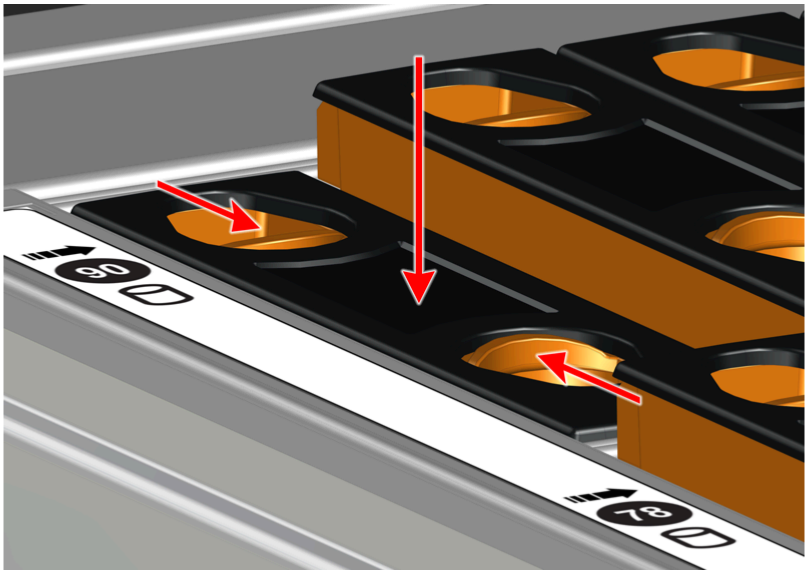
Step 9: Repeat this intermediate installation for the remaining drive assemblies, populating the enclosure from left-to-right, rear-to-front.

Figure 71: Populating the Enclosure



Step 10: Returning to the first drive assembly, pinch the latch release and carefully press downward to fully seat the 3.5in HDD Assembly into the drive slot.

Figure 72: Seating the 3.5in HDD Assembly



Step 11: Repeat this action to fully install the remaining drive assemblies in the same order, from left-to-right, rear-to-front.

Step 12: Push the enclosure back into the rack to ensure proper cooling.

3.7 CMA Replacement

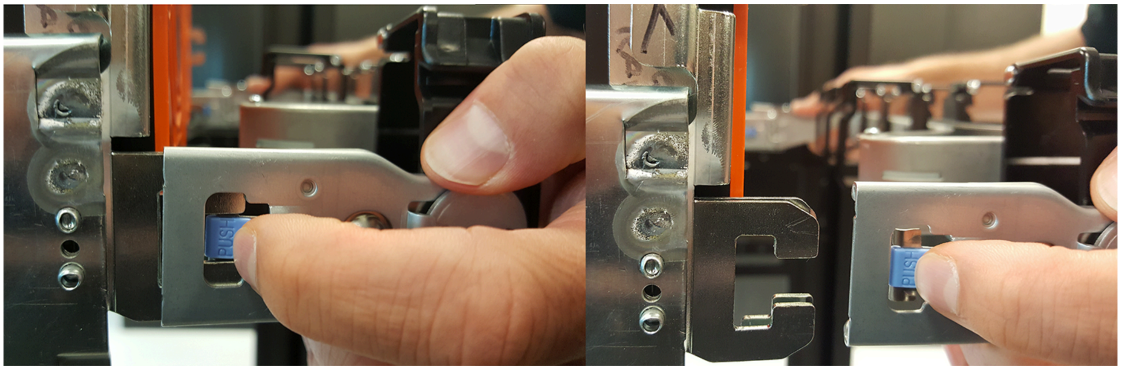
Attention: The CMA Lite replacement package includes a CMA arm and spacer brackets. Replacing the CMA arm can be done with the enclosure in place in the rack. To replace the spacer brackets, the enclosure must be removed from the rack. For the replacement of a CMA arm alone, anything pertaining to the spacer brackets may be skipped.

Replacement Requirements	
Personnel Required	**CMA Standard:** 1 **CMA Lite:** 2
Avg. Replacement Time	**CMA Standard:** 15m **CMA Lite:** 45m
Max Replacement Time	
Tool	**Required vs. Recommended**
# 2 Philips Screwdriver	Required
Cable Ties (for configurations with greater than 10 total cables)	Recommended
Tape Measure	Recommended
Low-Profile M4 x 3.2mm Philips screws	Recommended

Step 1: Place the CMA(s) into the service position.

a. Unlatch the CMA(s) at the elbow connector by pressing the blue release button to unlatch the connector from the rail.

Figure 73: Unlatching a CMA Connector



b. Swing the CMA(s) away from the enclosure.

c. The CMA arm(s) should be extended away from the enclosure.

Step 2: Disconnect the Enclosure from power.

a. Locate the redundant PSUs at the rear of the enclosure.

b. Detach the cable retention mechanism from both power cords.

Figure 74: Delta PSU Cable Retention Clip

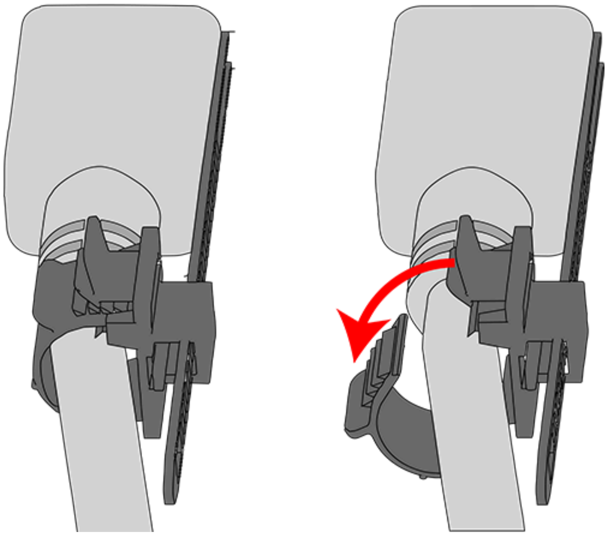
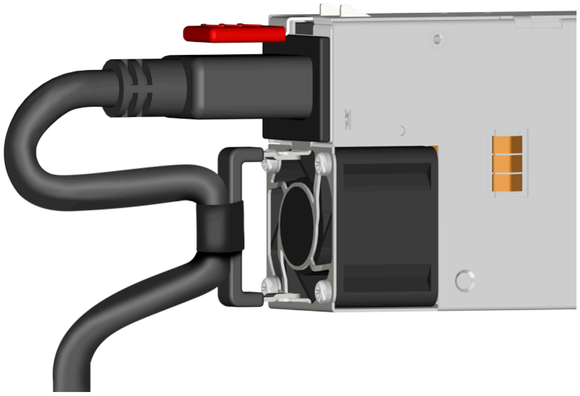


Figure 75: Artesyn PSU Cable Retention Strap



c. Power down the enclosure by disconnecting both power cables, one from each PSU.

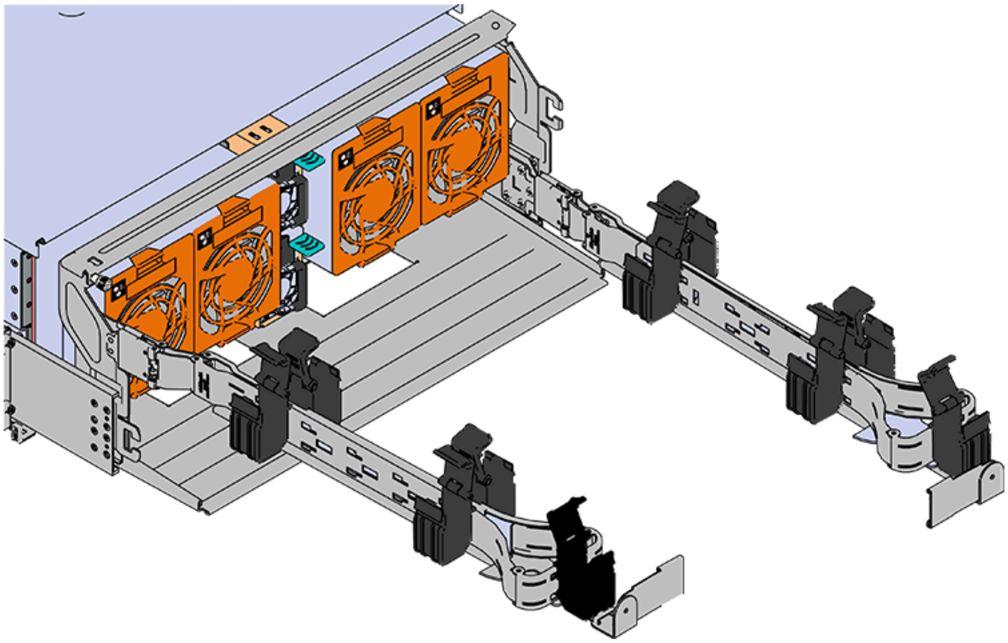
Step 3: Disconnect the remaining cables from the enclosure.

Step 4: Uncable the CMA(s).

CMA Standard:

a. Open all of the baskets on the CMA.

Figure 76: Open Baskets



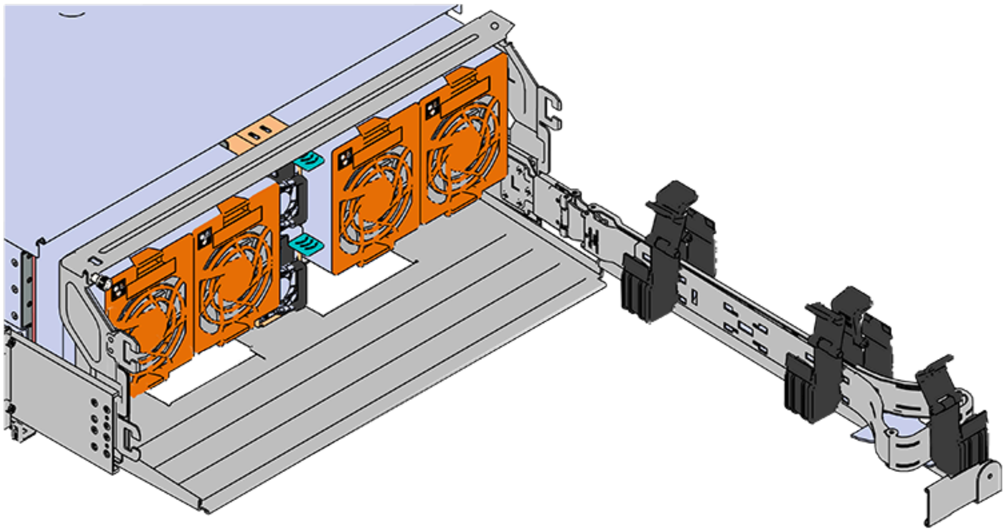
b. Remove one cable from the CMA at a time making sure not to put too much strain on the arm.

c. Repeat these steps to remove the cables from the second arm.

CMA Lite:

a. Open all of the baskets on the CMA.

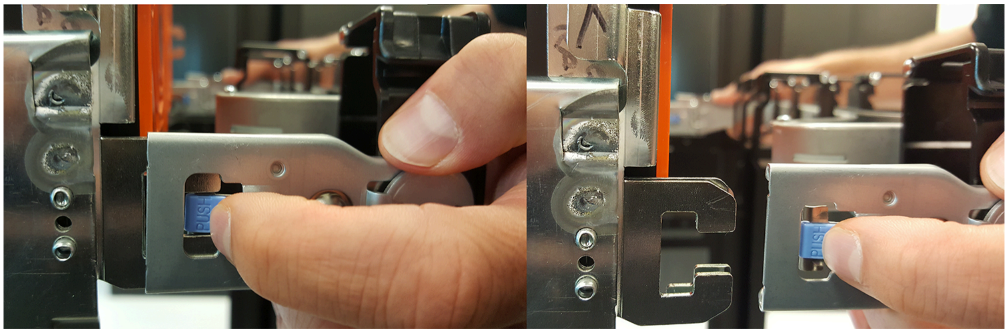
Figure 77: Open Baskets



b. Remove one cable from the CMA at a time making sure not to put too much strain on the arm.

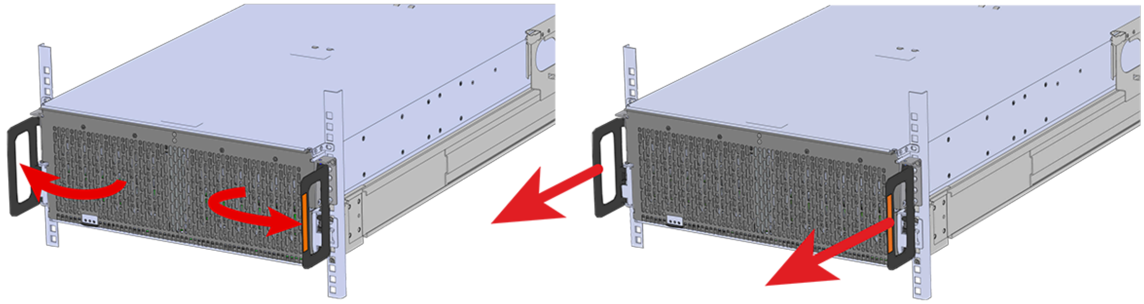
Step 5: Unlatch all of the connectors that attach the CMA(s) to the enclosure and the rail by locating the latch release button and pressing it from either side of the latch. There are three total connections that need to be removed, one at the elbow and two at the opposite end.

Figure 78: Unlatching a CMA Connector



Step 6: Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. The safety latches will prevent the enclosure from coming out of the rack completely and the cover will remain in the rack attached to the rear alignment brackets.

Figure 79: Chassis Handle Operation

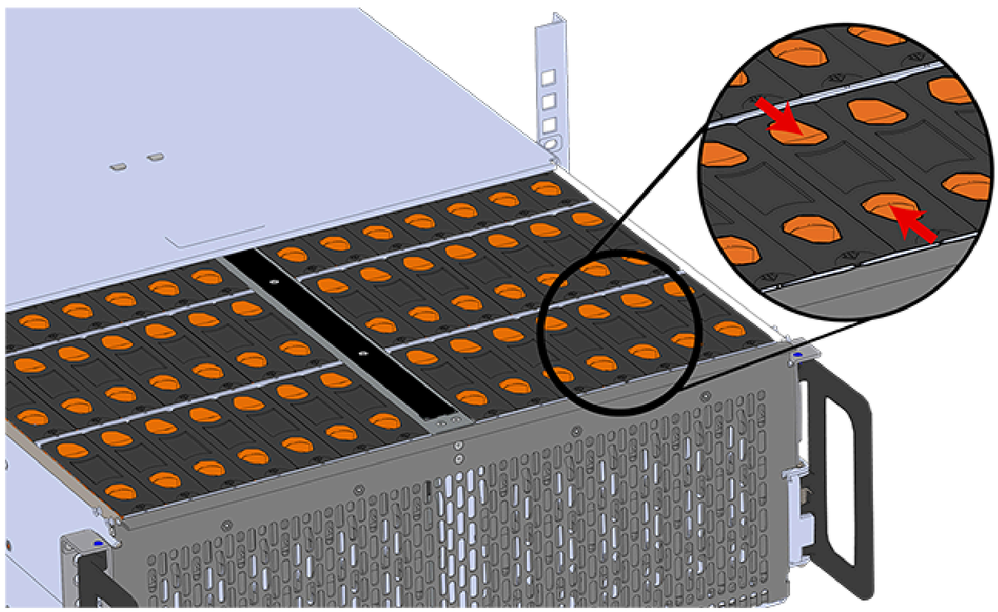


Step 7: Follow these steps to remove a 3.5in HDD Assembly.

a. Find the latch release mechanism on the 3.5in HDD Assembly being removed.

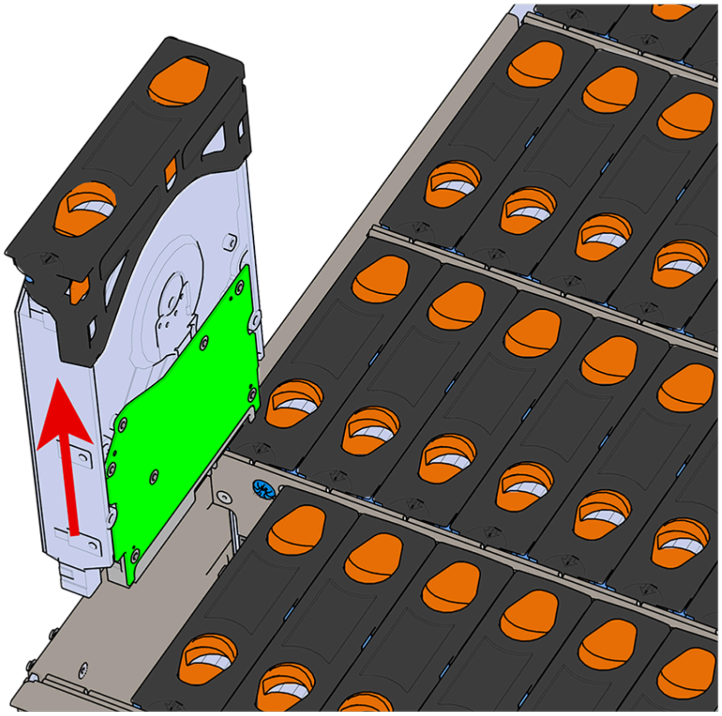
b. Insert a finger and a thumb into the latch release and pinch to unlatch the 3.5in HDD Assembly.

Figure 80: Unlatch Drive Carrier (IOM Not Shown)



c. Lift the 3.5in HDD Assembly free from the enclosure.

Figure 81: Removing 3.5in HDD Assembly



Step 8: Follow the previous step for each drive in the enclosure. Attach a label or mark the drives with the drive slot they were removed from in order to add them to the same slot in the future. Store the drives in an ESD safe location until the drives are ready to be installed back into an enclosure.

Step 9: Release the safety latch on the inner rails on each side of the chassis as shown in the following image.

Figure 82: Inner Rail Safety Latch Release

Step 10: Remove the chassis from the rack.

a. Be prepared to support the enclosure once it is free of the rails by having a second person or a lift to support the enclosure

b. Grasp both handles at the front of the enclosure and pull with even pressure until the enclosure will not extend further.

> **Warning:** The handles on the front of the chassis are not intended to be used to support the weight of the Ultrastar Data102 . Lifting the unit by the chassis handles or trying to support the unit on the handles can cause them to fail. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

c. Locate the safety catches on the inner rails attached to the enclosure.

Figure 83: Safety Latch Release

d. Depress the latch release lever for the safety latches on the rail and push the chassis very slightly forward. The chassis is now unsecured from the rack.

e. Ensure that you have the proper support mechanism to hold the chassis in position, whether that be a team lifting partner or an appropriate lift.

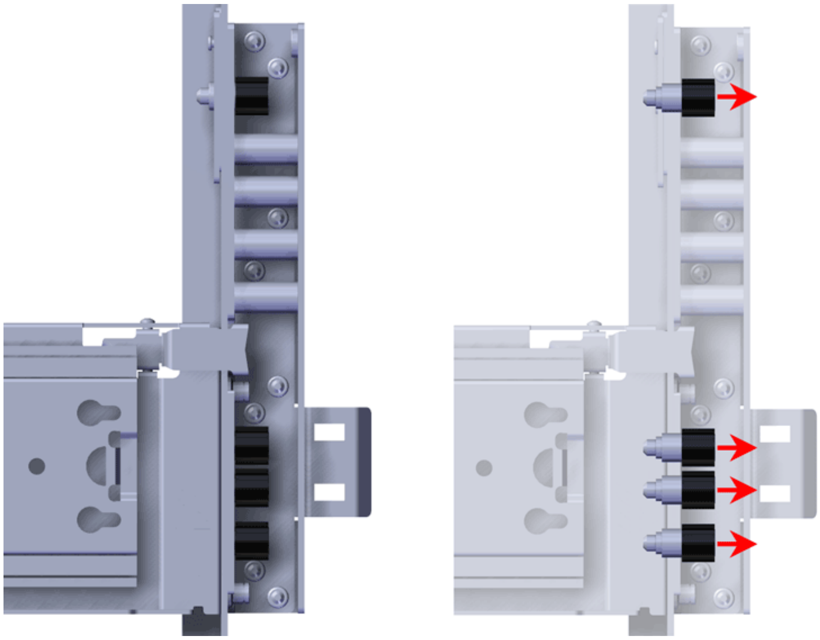
> **Warning:** Do not lift the chassis by the Cable Tray while removing the chassis from the rack OR while installing it into a rack. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

f. Slide the chassis forward to free it from the rails. Place the chassis in a safe location to avoid damage.

Step 11: **CMA Lite:** Uninstall the spacer brackets.

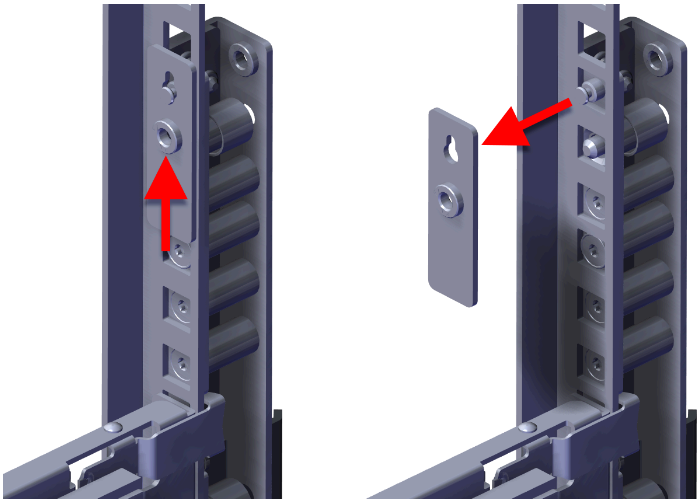
a. Using a screwdriver, remove all four of the captive screws from the spacer bracket.

Figure 84: Captive Screws Removal



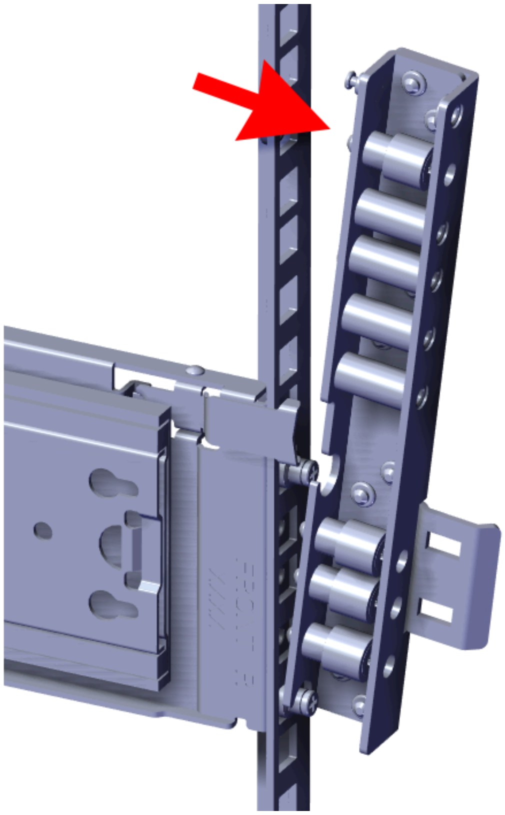
b. Remove the nut plate from the mounting pin on the back of the spacer bracket.

Figure 85: Rack Spacer Nut Plate Removal



c. Remove the spacer brackets from the rack.

Figure 86: Spacer Bracket Removal



Step 12: **CMA Lite:** Install the new spacer brackets.

a. Line the spacer bracket up with the bottom of rack unit location of the installed outer rails. The bottom of the spacer bracket will rest on top of the bottom outer rail pin.

Figure 87: Spacer Bracket Orientation

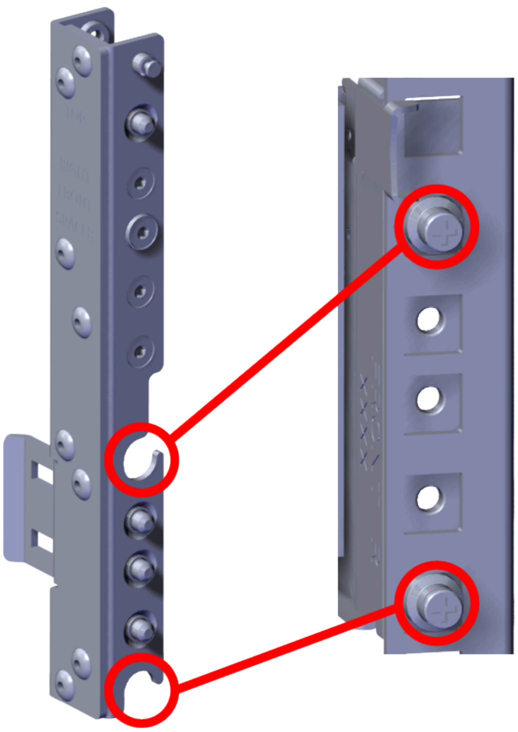
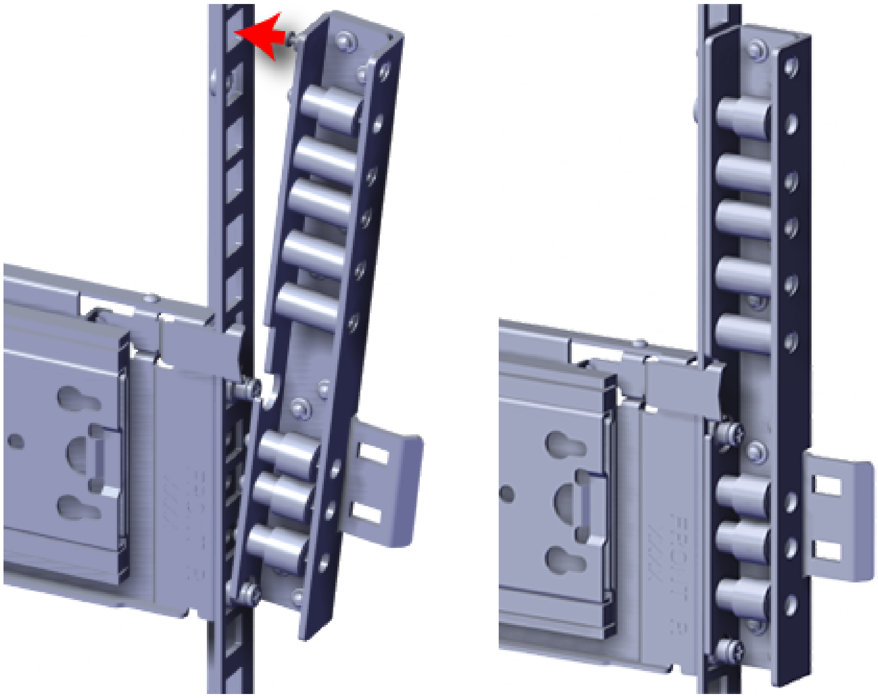
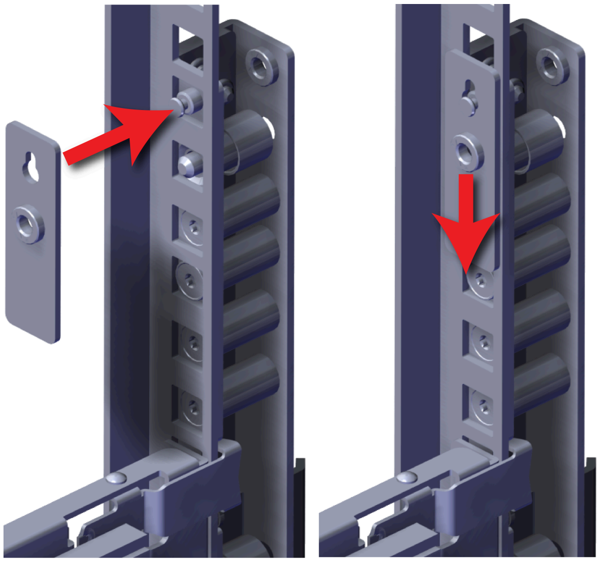


Figure 88: Spacer Bracket Placement



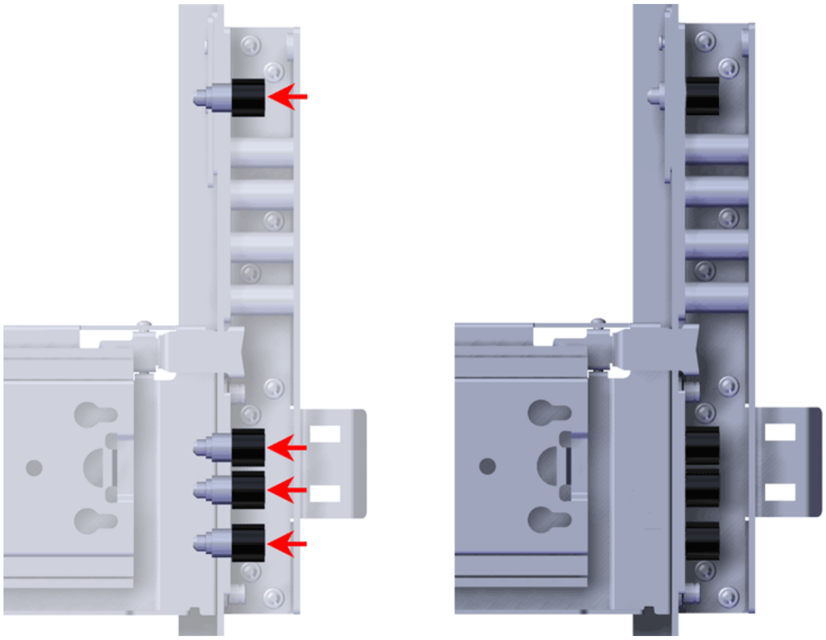
b. Slide the nut plate down over the mounting pin on the back of the spacer bracket.

Figure 89: Rack Spacer Nut Plate Installation



c. Using a T15 Torx screwdriver, tighten the top captive screw to secure the mounting plate in place. Tighten the remaining captive screws at the bottom of the spacer bracket, and torque all four of the captive screws to 3.38-3.61 Nm / 30-32 in-lbf.

Figure 90: Captive Screws

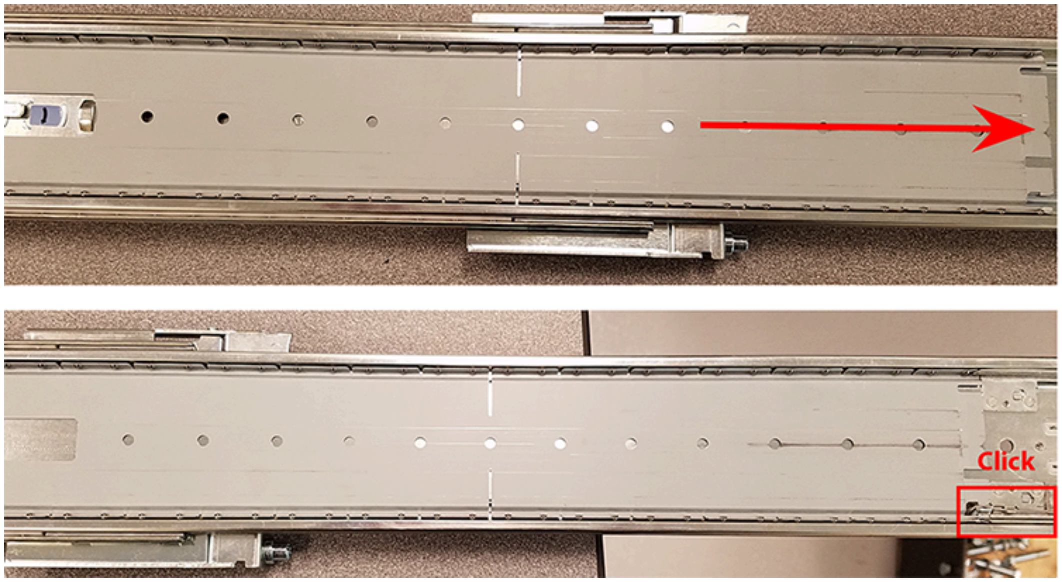


d. Repeat these steps to install the remaining rack spacer.

Step 13: Install the chassis into the rails.

a. Extend the bearing plates on the inside of the mid-rails until they are fully forward (detent has engaged). This prevents potential damage due to improper mating of the rails.

Figure 91: Bearing Plate



b. **Caution:** This step in the installation requires a minimum of 3 individuals to install safely, two to lift and one to guide the others who may have difficulty seeing because the enclosure is in the way. Ensure that the appropriate measures are taken to safely support the enclosure during installation. The enclosure MUST have no drives installed and requires a two person team lift to install. **Do not attempt to lift the system if it is fully populated with drives.** The only case in which the system may be installed or removed with the drives populated is if the facility has a lift that is rated to handle the maximum weight of the fully loaded system.

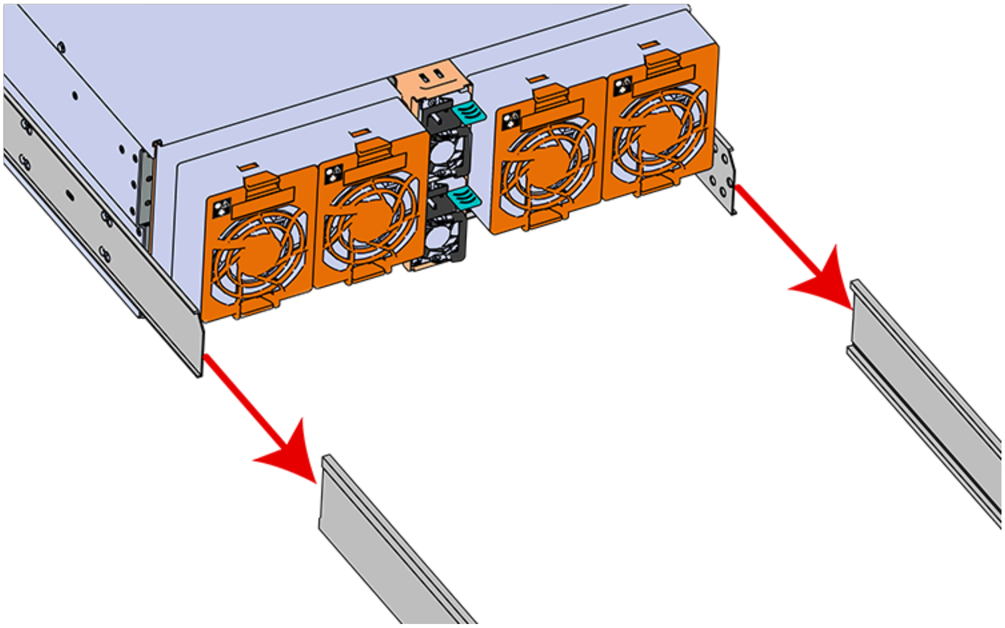
Warning: The handles on the front of the chassis are not intended to be used to support the weight of the Ultrastar Data102 . Lifting the unit by the chassis handles or trying to support the unit on the handles can cause them to fail. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

Warning: Do not lift the chassis by the Cable Tray while removing the chassis from the rack OR while installing it into a rack. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

In preparation to perform a team lift, position one individual on each side of the enclosure (to lift) and a third individual standing at the protruding rack rails (to guide the chassis to mate with rack rails).

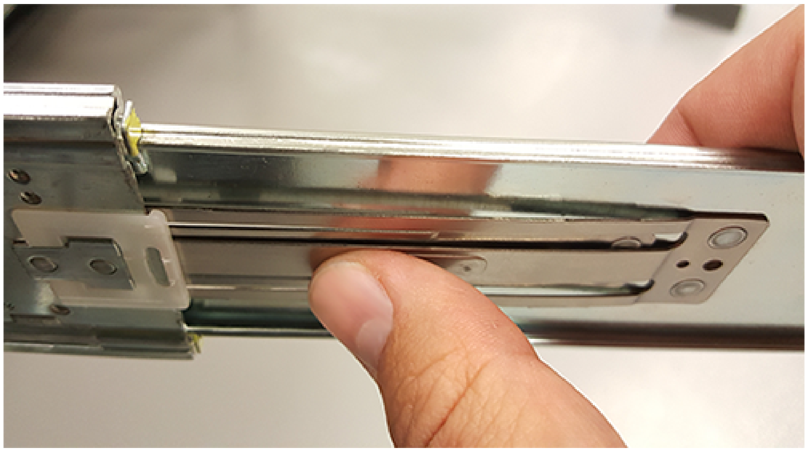
c. Team-lift the enclosure until the inner rails (which are attached to the chassis) align with the extended mid-rails (which are attached to the rack), and guide the inner rails on the chassis to mate with the rack rails.

Figure 92: Installing the Chassis



d. Once the rails are mated properly, slide the enclosure into the rack until it is stopped by the safety catch on the rails. Push the release lever on the safety latch (located on the side of each of the rails), and push the enclosure the rest of the way into the rack.

Figure 93: Safety Latch Release



e. As the chassis is slid into the rack, position one installer at the rear of the rack to ensure that the pegs on the sides of the cover will slide correctly into the rear cover alignment brackets on both sides of the rack. If the chassis does not install smoothly or snags, check that the rear cover alignment brackets are not interfering with the chassis sidewalls, and try again.

Step 14: Install the CMA(s).

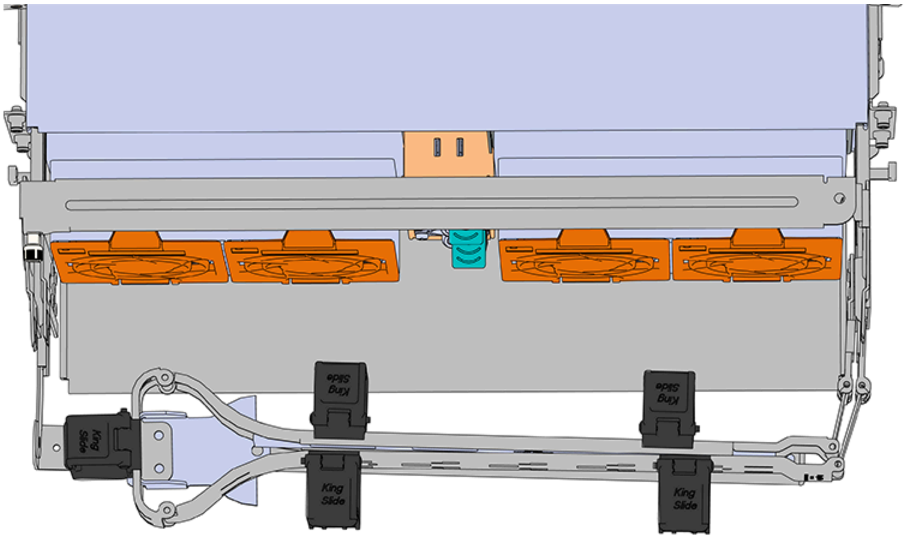
Note: The standard CMA has two arms, labeled "upper" and "lower." The lower arm should have the elbow on the left side and be installed first; the upper arm should have the elbow on the right side and be installed last.

Note: CMA Lite has one arm, to be installed at the lower position. This arm should have the elbow on the left side.

a. Orient the CMA so that the elbow is on the left hand side.

b. Attach all three of the connectors to the brackets on the rails. There should be one at the elbow side and two at the other end.

Figure 94: Lower CMA Orientation



c. Slowly slide the enclosure forward to ensure the arm is operating properly, then slide it back into the rack.

d. **CMA Standard:** Repeat these steps to install the upper arm with the elbow facing to the right.

Step 15: Cable the CMA(s).

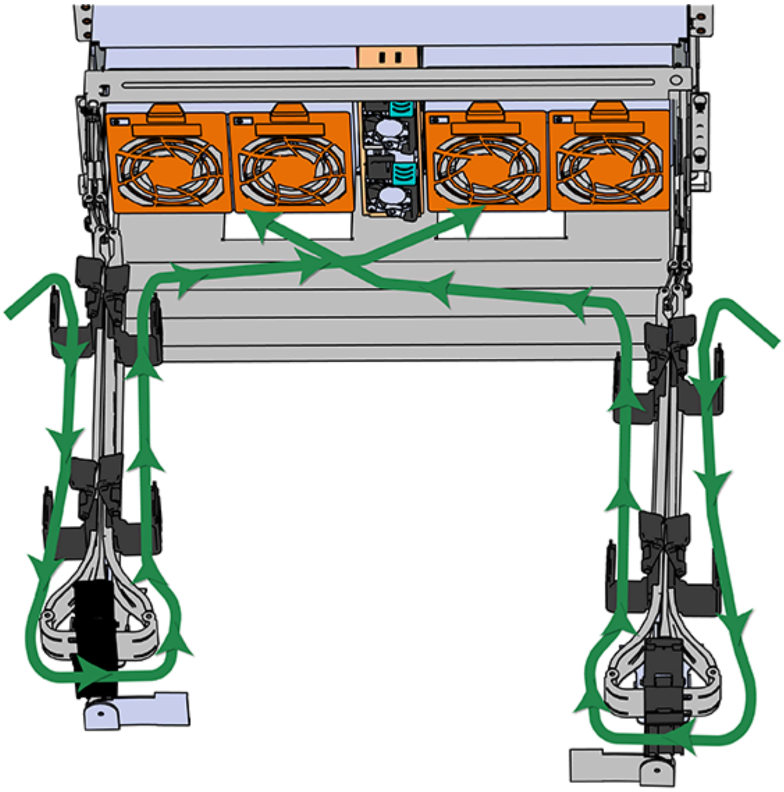
CMA Standard:

a. Unlatch the elbow side of the arm(s) by pressing the blue button labeled "push," and then swing the arm(s) open.

b. Gather the SAS, power, and Ethernet cables for installation. Before cabling, note the following routing patterns for best results:

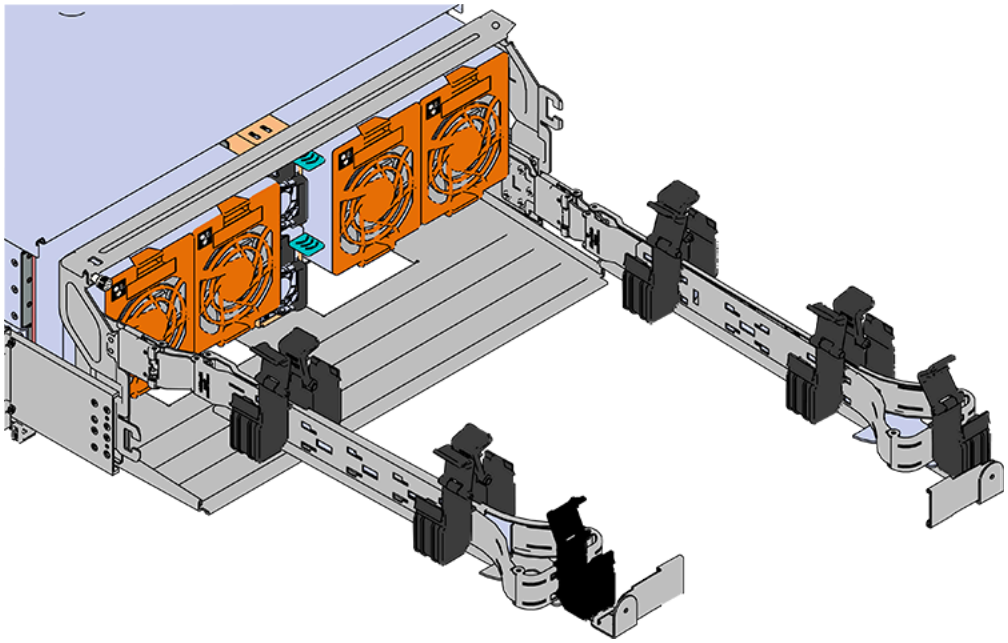
Note: Route the cables supported by the lower arm to IOM A (left hand side looking at the rear). Second, route the cables supported by the upper arm to IOM B (right hand side looking at the rear) in a "criss-cross" pattern. See the Special Considerations for Cable Routing *(page 199)* for more information.

Figure 95: CMA Cable Routing



c. Open all of the baskets.

Figure 96: Open Baskets



d. Connect the Ethernet cable to the Ethernet port, and route the cable through each of the baskets on the arm.

e. Connect the SAS cables to the SAS ports, and route them through the baskets one at a time. Make sure to follow the labels to ensure they are connected to the proper ports.

f. Connect the power cable to the PSU.

> **Attention: Make sure the power cable is not connected to a PDU.** If it is, the system will power up when the cable is connected to a PSU. This is not intended at this stage of installation.

g. Attach the cable retention mechanism.

For the Delta PSU, loop the retention clip around the power cable and pinch it until the clip catches and locks in place. Then slide the retention clip forward until it stops near the cable connector. Doing this will ensure that the retention clip functions properly in the event the cable is pulled on for some reason.

Figure 97: Delta PSU Cable Retention Clip

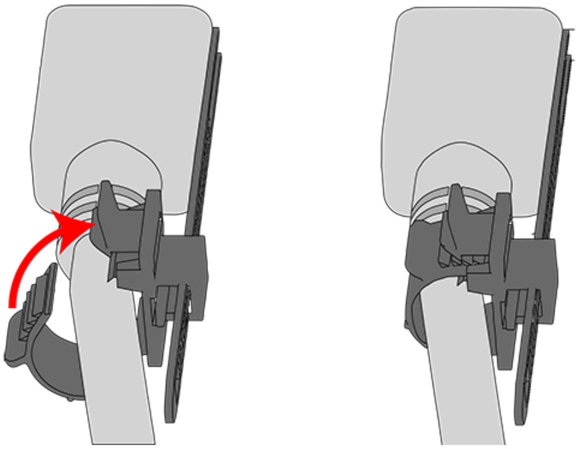
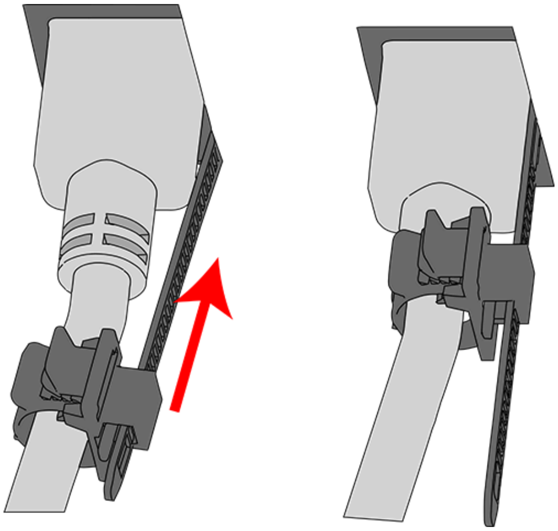
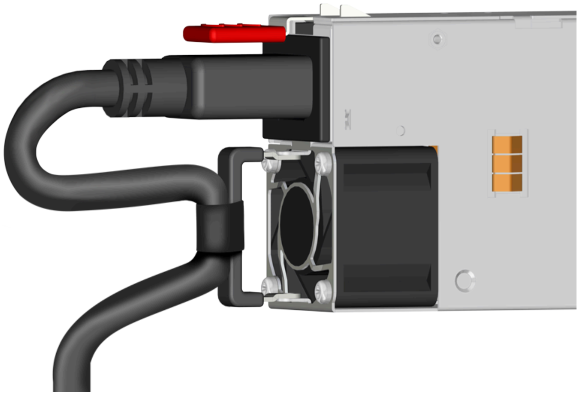


Figure 98: Cinching Cable Retention Clip



For the Artesyn PSU, secure the power cable to the PSU handle with the velcro retention strap as shown in the following image.

Figure 99: Artesyn PSU Cable Retention Strap

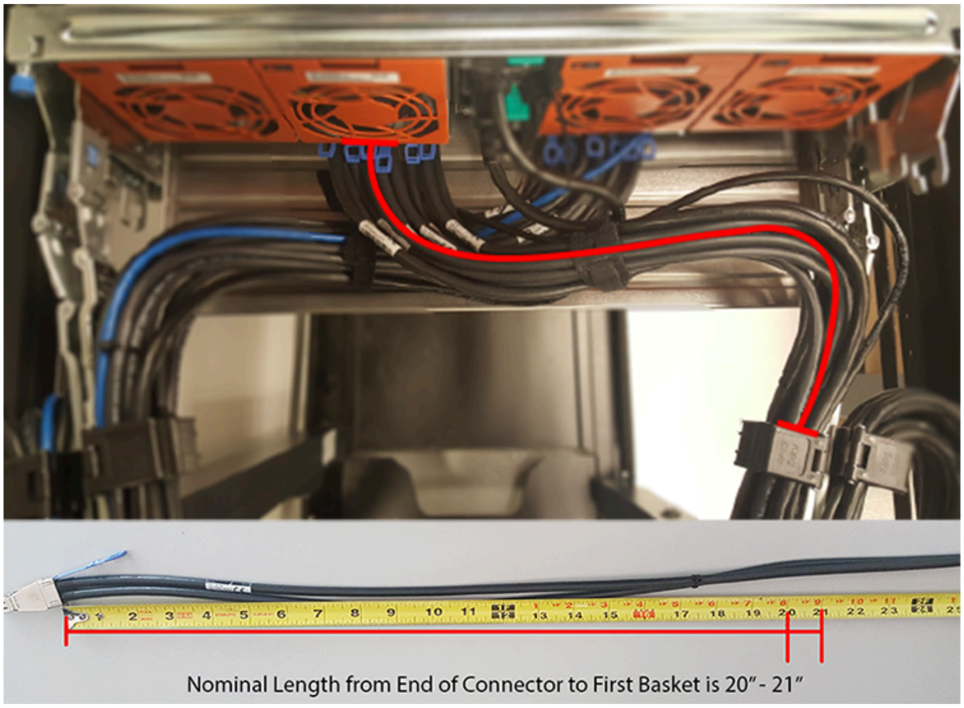


h. Route the power cable through each basket.

i. If the installation includes more than 10 total cables, follow the recommendations in Special Considerations for Cable Routing *(page 199)*, before proceeding.

> **Note:** Each cable must be given enough slack at the connector end to operate smoothly. Allow 20 - 21 in. (508 – 533.4 mm) between the connector and the first basket.

Figure 100: Nominal Cable Length at Connectors



j. Close all of the baskets.

k. If the Ultrastar Data102 is being installed in a rack and will subsequently be transported inside that rack, it is important to use the included cable tie to wrap the CMA bundle to ensure it does not get damaged during transport. If the Ultrastar Data102 is instead being installed where it will be operated, skip this step. Remember to remove the cable ties after the enclosure has reached its final operational location.

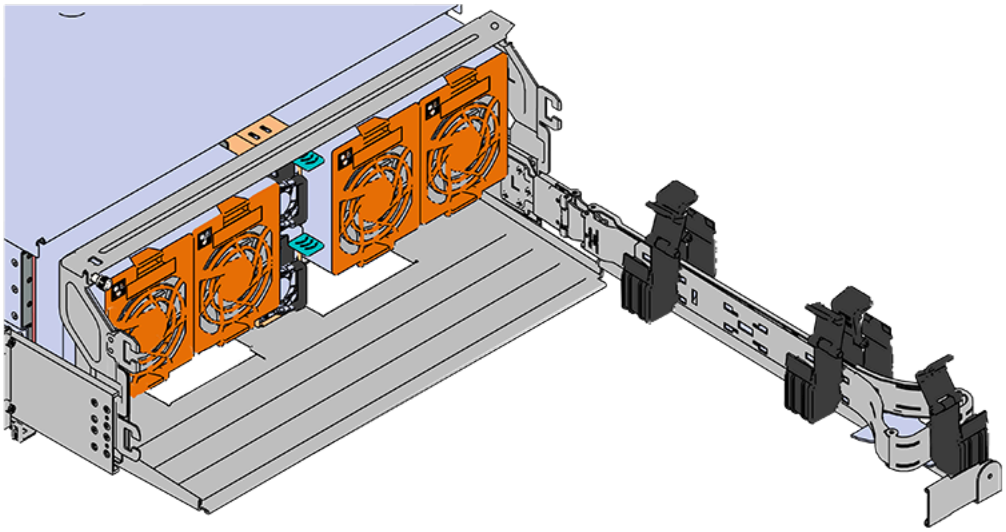
l. Reconnect the arm at the elbow to the connectors on the rail.

CMA Lite:

a. Press the blue latch button labeled "push" to unlatch the elbow side of the CMA arm, and then swing the arm open.

b. Open all of the baskets.

Figure 101: Open Baskets

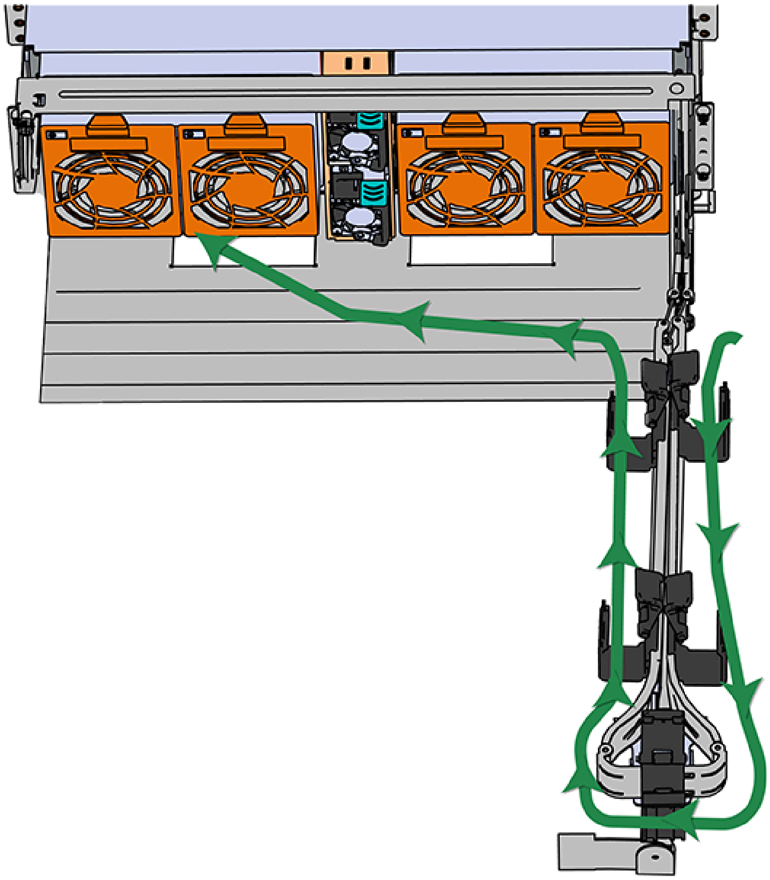


c. Gather the SAS, power, and Ethernet cables for installation.

> **Note:** Route all cables to IOM A (left hand side looking at the rear).

d. Connect the Ethernet cables to the Ethernet ports on the left hand side of the Ultrastar Data102 , and then route the cables through each of the baskets on the arm.

Figure 102: Connected Cable Routing



e. Connect the SAS cables and route them through the baskets one at a time. Follow the labels to ensure they are connected to the proper ports.

f. **Important: Make sure the power cable is not connected to a PDU**. If it is, the system will power up when the cable is plugged into the PSU. This is not intended at this stage of installation.

Connect the power cable to the lower PSU and route it through each basket.

g. Close all of the baskets.

h. If the Ultrastar Data102 is being installed in a rack and will subsequently be transported inside that rack, it is important to use the included cable tie to wrap the CMA bundle to ensure it does not get damaged during transport. If the Ultrastar Data102 is instead being installed where it will operated, skip this step. Remember to remove the cable ties after the enclosure has reached its final operational location.

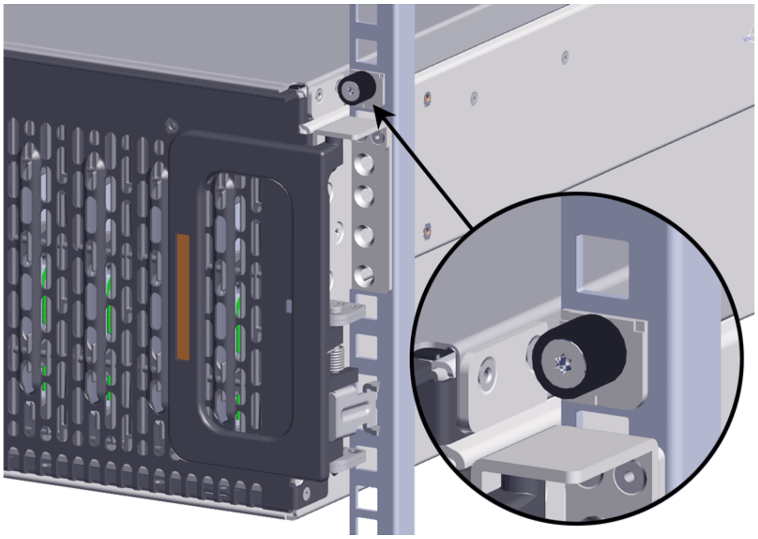
i. Reconnect the arm to the rail by the connector at the elbow.

Step 16: Make sure the CMA(s) is in operational position by folding the arm(s) in toward the enclosure and attaching the elbow end(s) to the connector(s) attached to the rail. Verify that all of the cabling is in functional order and does not bind or catch.

Step 17: Test for binding in the extension of the arm by gently pulling the enclosure out of the rack, ensuring the cables extend properly and that the system doesn't bind at all. If it does, examine the point at which the binding occurred and adjust the seating of cables in the baskets, check the connections to the rails, and examine the joints of the arm to ensure that they are all functioning properly.

Step 18: Secure the chassis top cover to the rack using the captive M5 thumb-screws as shown in the following image. Use a T15 Torx screwdriver, and tighten the screws to 3.38-3.61 Nm / 30-32 in-lbf.

Figure 103: Cover Retention Screws

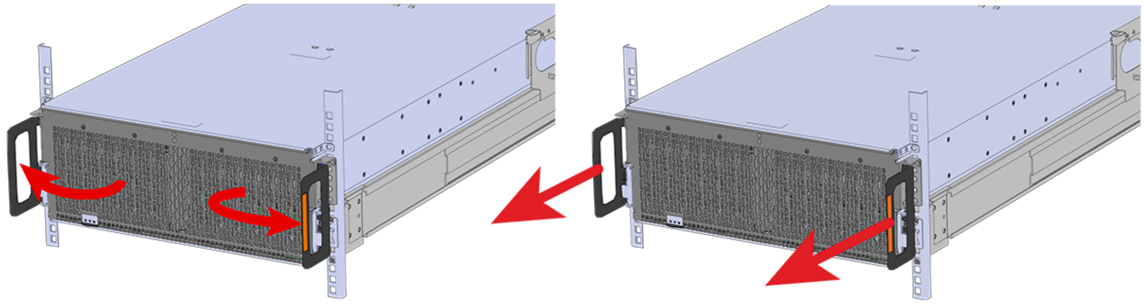


Step 19: Now that the chassis is installed, test the installation by sliding the enclosure in and out of the rack a minimum of three times. If the enclosure binds, catches, or displays any incorrect motion or behavior repeat the installation.

> **Note:** Adjustments of the vertical rack rails may be required to fix any issues that may occur.

Step 20: Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. The safety latches will prevent the enclosure from coming out of the rack completely and the cover will remain in the rack attached to the rear alignment brackets.

Figure 104: Chassis Handle Operation

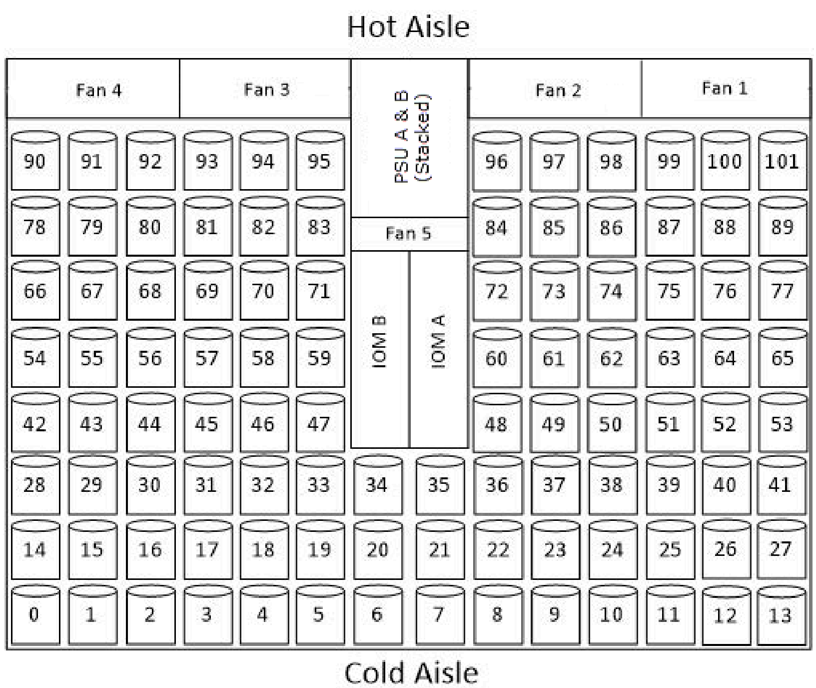


Step 21: Perform this same action two more times without the drives loaded to make sure the rail kits are installed properly.

Installing the 3.5in HDD Assembly

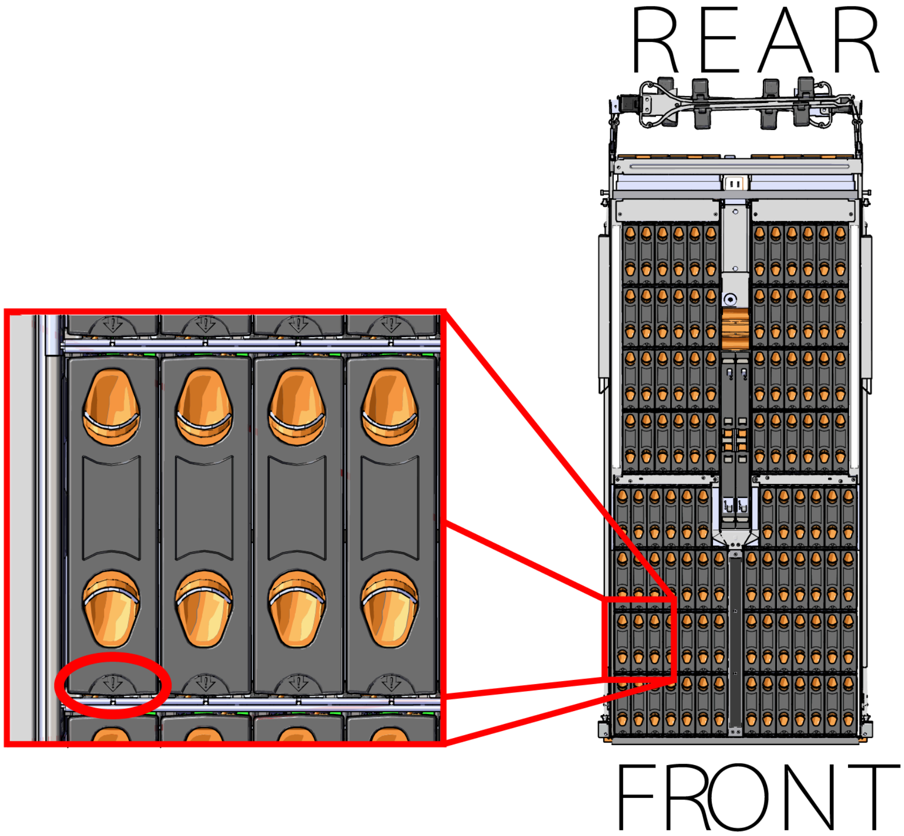
Note: When installing drives, populate the enclosure from left-to-right, rear-to-front. For example, begin with slot 90 (as shown in the following diagram), continue through 101, then proceed with 78 through 89, and so on:

Figure 105: Drive Layout



Note: When installing drives, ensure that the LED pointer on the top of the drive carrier points toward the front of the enclosure, as shown in the following image:

Figure 106: LED Pointer Orientation



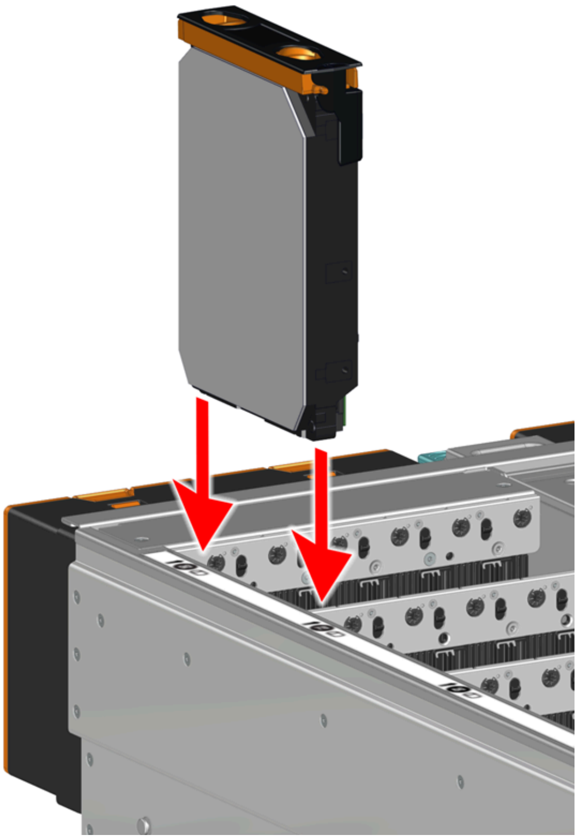
Caution: To ensure proper airflow for enclosure cooling, all drive slots must be populated with either drives or drive blanks.

Step 22: Ensure that the enclosure has been pulled out of the rack until the rail latches engage.

Step 23: Install each drive in the place it was removed from by following the labels or marks that were added earlier.

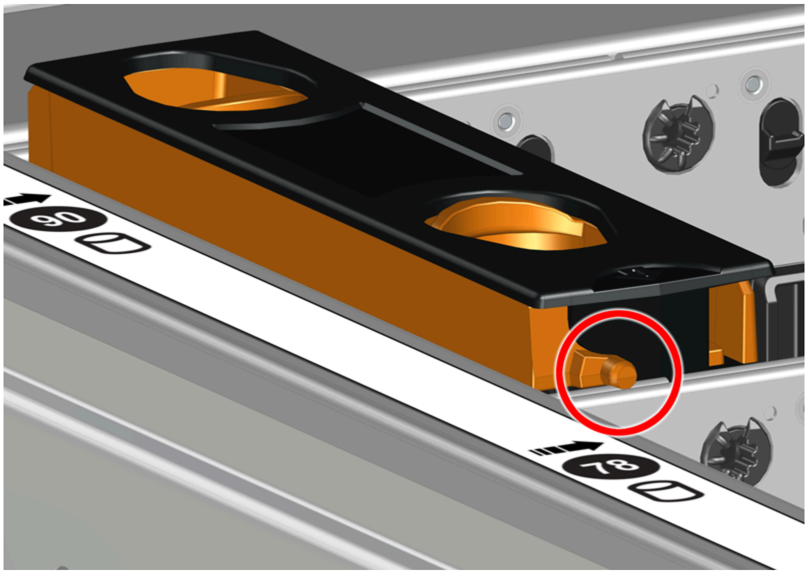
Step 24: Align the drive with the empty slot that will receive it. Lower it into the slot, ensuring that it stays level and does not bind.

Figure 107: Inserting a 3.5in HDD Assembly



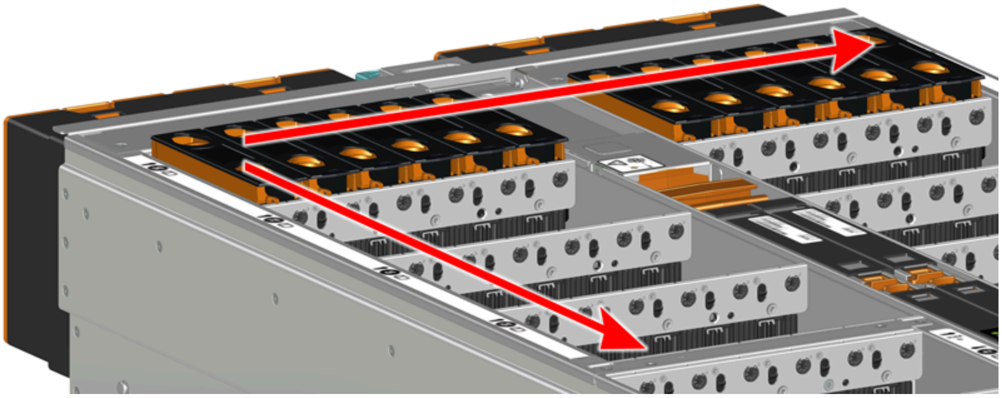
Step 25: Lower the drive until the spring-loaded posts on the carrier contact the top edges of the drive slot. This is an intermediate position; the drive assembly will be fully seated later on.

Figure 108: Intermediate Install Position



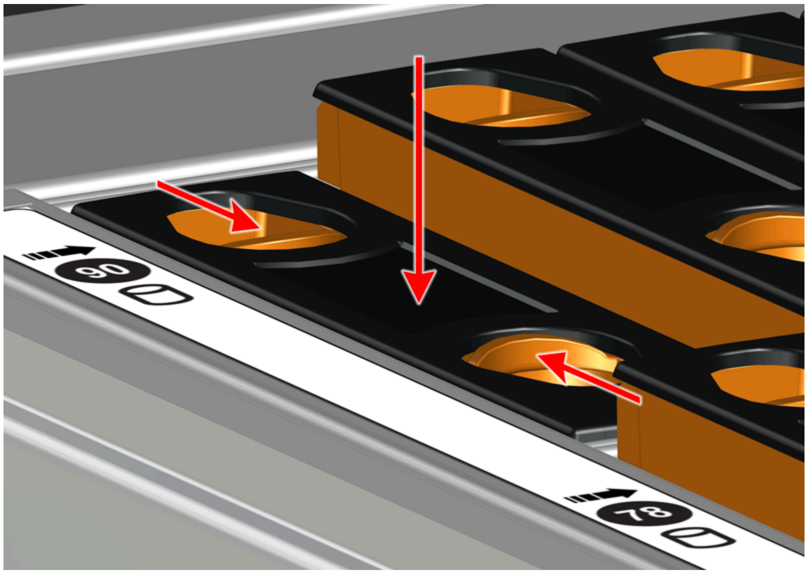
Step 26: Repeat this intermediate installation for the remaining drive assemblies, populating the enclosure from left-to-right, rear-to-front.

Figure 109: Populating the Enclosure



Step 27: Returning to the first drive assembly, pinch the latch release and carefully press downward to fully seat the 3.5in HDD Assembly into the drive slot.

Figure 110: Seating the 3.5in HDD Assembly



Step 28: Repeat this action to fully install the remaining drive assemblies in the same order, from left-to-right, rear-to-front.

Step 29: Now that the drives are installed into the chassis, test the installation by sliding the enclosure in and out of the rack a minimum of three times. If the enclosure binds, catches, or displays any incorrect motion or behavior retry the installation of the drives and chassis.

Step 30: If the chassis is being installed into a rack that will be shipped fully assembled, you **must** install eight (four per side) of the included M5 x 12mm T15 Flat Head Torx screws into the two brackets at the front of the chassis in the following locations. These screws should be tightened to 3.38-3.61 Nm / 30-32 in-lbf using a Long T15 Torx Screwdriver. If this chassis will not be installed into a rack for shipping purposes, skip this step and move on to the next one.

Figure 111: Shipping Bracket Screw Locations (CMA Standard)

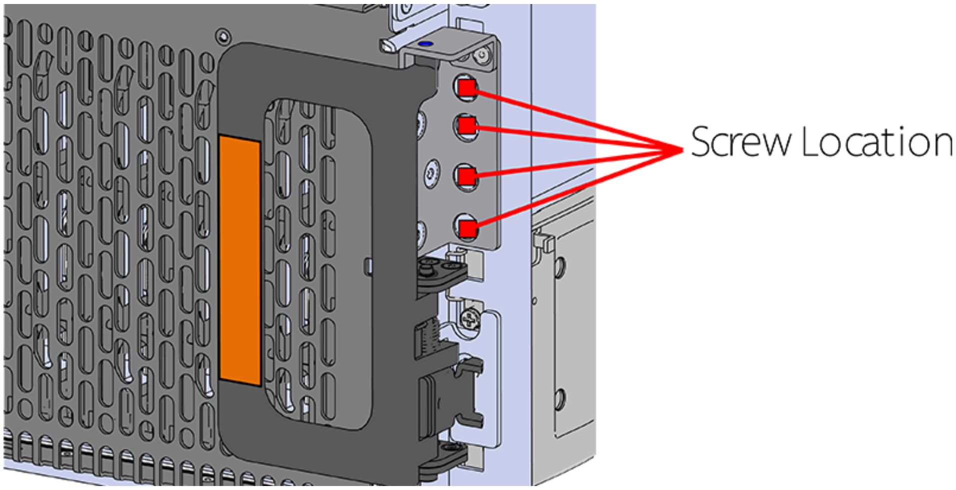


Figure 112: Shipping Bracket Screw Locations (CMA Lite)

Step 31: Plug the enclosure power cords into a PDU to power the enclosure.

Step 32: Double check the power indicators and other LEDs to ensure that the system is booting.

3.8 Rails Replacement

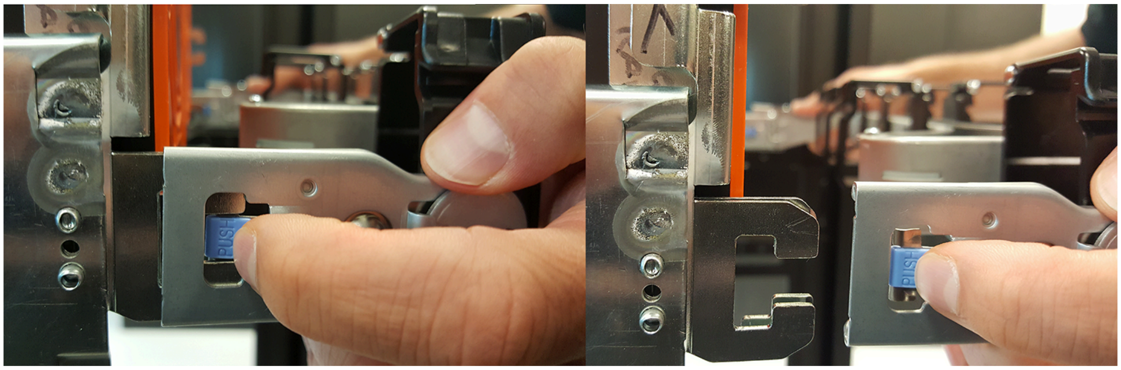
Replacement Requirements	
Personnel Required	3 Total (2 for Team Lifting Purposes and 1 to Guide and Spot)
Avg. Replacement Time	~1 hr
Max Replacement Time	N/A
Tool	**Required vs. Recommended**
Long T15 Torx Screwdriver	Required
# 2 Philips Screwdriver	Required
Long T10 Torx Screwdriver	Recommended
Cable Ties (for configurations with greater than 10 total cables)	Recommended
Tape measure	Recommeded
Level	Recommeded
Option 1: M5 x 12mm T15 Flat Head Torx screws with washers **Option 2**: Toolless screwplate	Required
Low-Profile M4 x 3.2mm Philips screws (included with rail assembly)	Required

Tool	Required vs. Recommended
Optional (if using CMA Tray): M3 x 8mm T10 Torx screws	Recommeded

Step 1: Place the CMA(s) into service position.

a. Unlatch the CMA(s) from the rail at the elbow connector by pressing the blue release button.

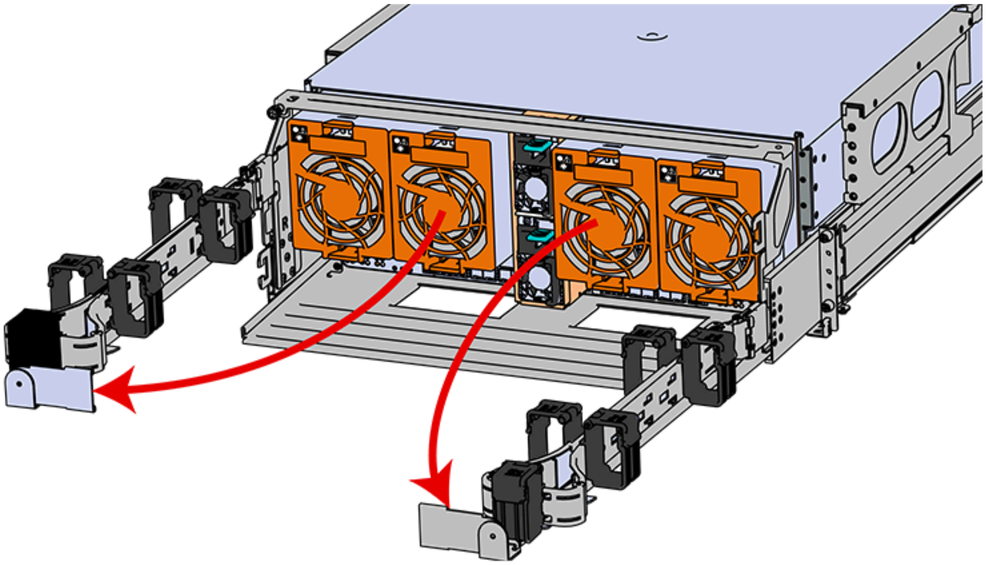
Figure 113: Unlatching a CMA Connector



b. Swing the CMA(s) away from the enclosure.

c. The arm(s) should be extended away from the enclosure as shown in the following example.

Figure 114: CMA(s) in service position (Cables not shown)



Step 2: Disconnect the Enclosure from power.

a. Locate the redundant PSUs at the rear of the enclosure.

b. Detach the cable retention mechanism from both power cords.

Figure 115: Delta PSU Cable Retention Clip

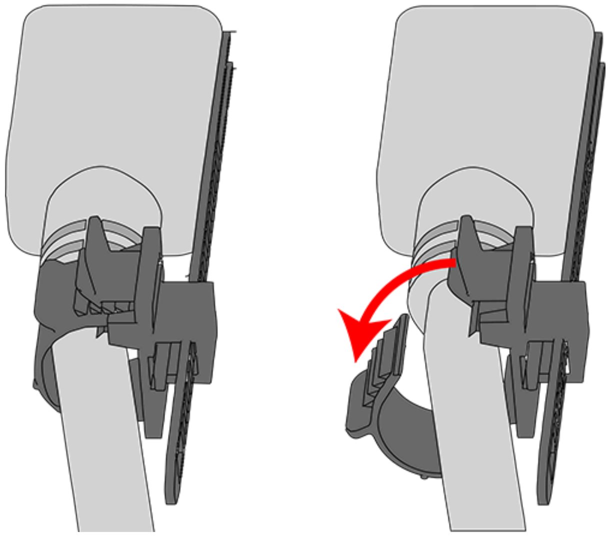
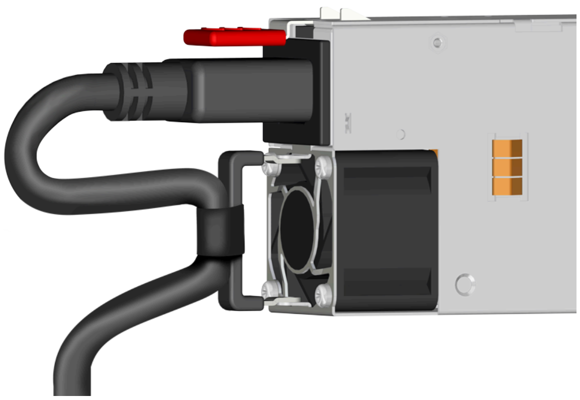


Figure 116: Artesyn PSU Cable Retention Strap



c. Power down the enclosure by disconnecting both power cables, one from each PSU.

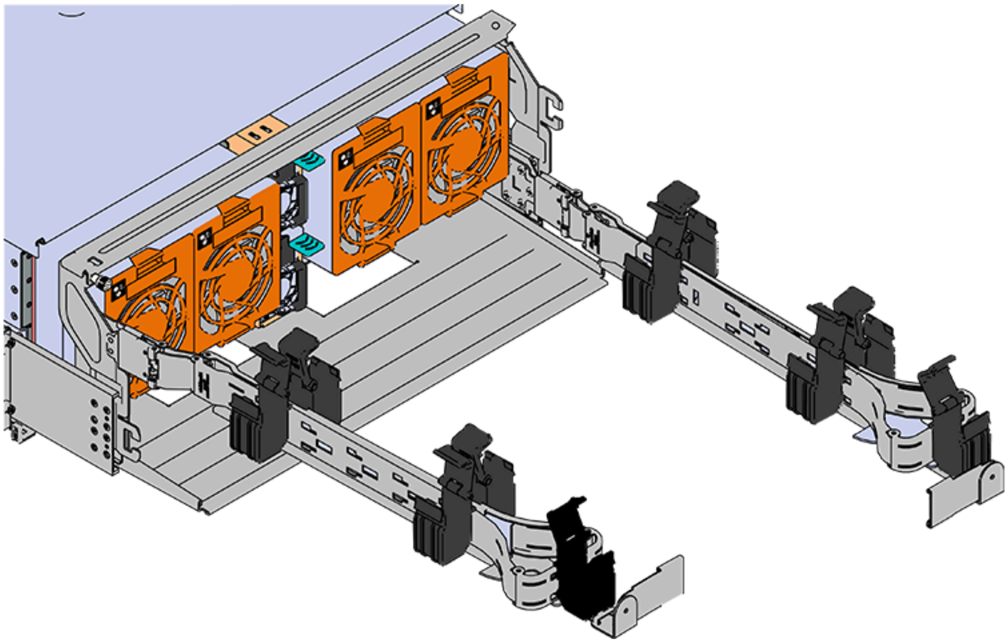
Step 3: Disconnect the HD Mini-SAS cables from the rear of the enclosure by pulling (don't jerk) on the blue tab that is extending outward from the connector. This will free the cable from the port. Make sure each cable is labeled or label them yourself to ensure that they will be plugged back into the same location.

Step 4: Unplug the Ethernet cables from the out-of-band management ports.

Step 5: Uncable the CMA(s).

a. Open all of the basket clips on the CMA(s).

Figure 117: Open Baskets



b. Remove one cable at a time from the arm, making sure not to put too much strain on the arm.

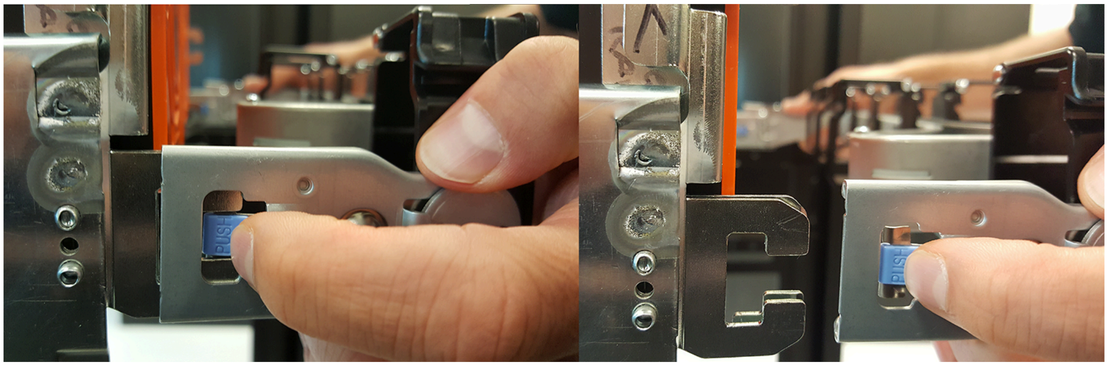
Step 6: Remove the CMA(s).

a. Release all of the connectors that attach the CMA(s) to the enclosure and the rail.

There are three total connections that need to be released, one at the elbow and two at the opposite end.

b. To release a connector, press the blue latch release button and pull the connector free.

Figure 118: Unlatching a CMA Connector

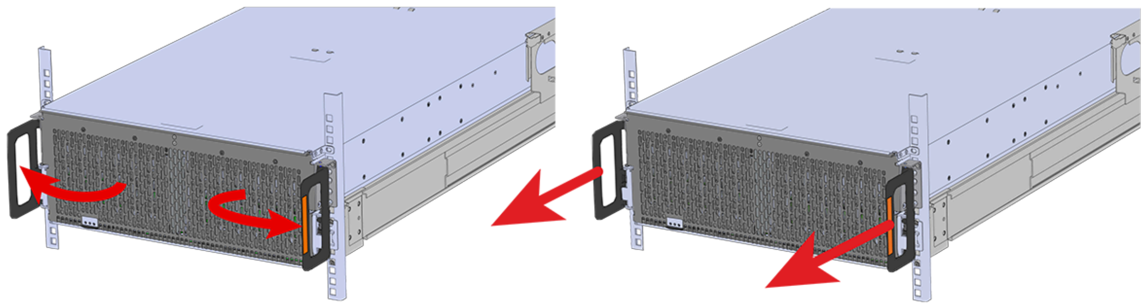


Step 7: Complete the previous step for the second CMA.

Warning: The following steps regarding uninstalling drives from the enclosure should be followed in order to reduce the weight enough to remove the chassis during the rails replacement process. However, if there is proper lift/support equipment rated to support the full weight of the enclosure, 118.8 kg / 262 lbs. , these steps can be skipped. If not, please follow these drive removal instructions to remove all of the drives and reduce the weight. **Never try to support the weight of the full system by hand.** Doing so could cause damage to the system or serious bodily harm.

Step 8: Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. The safety latches will prevent the enclosure from coming out of the rack completely and the cover will remain in the rack attached to the rear alignment brackets.

Figure 119: Chassis Handle Operation

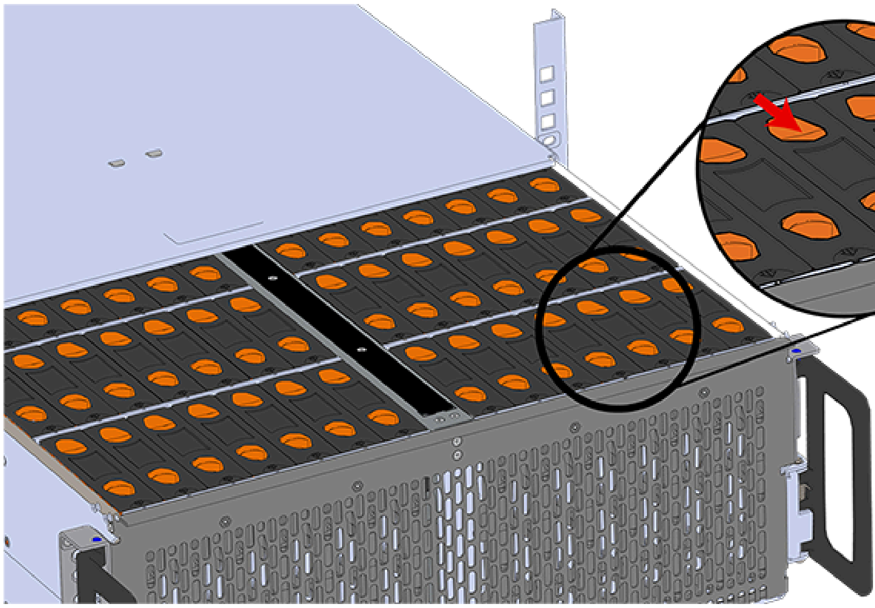


Step 9: Follow these steps to remove a 3.5in HDD Assembly.

a. Find the latch release mechanism on the 3.5in HDD Assembly being removed.

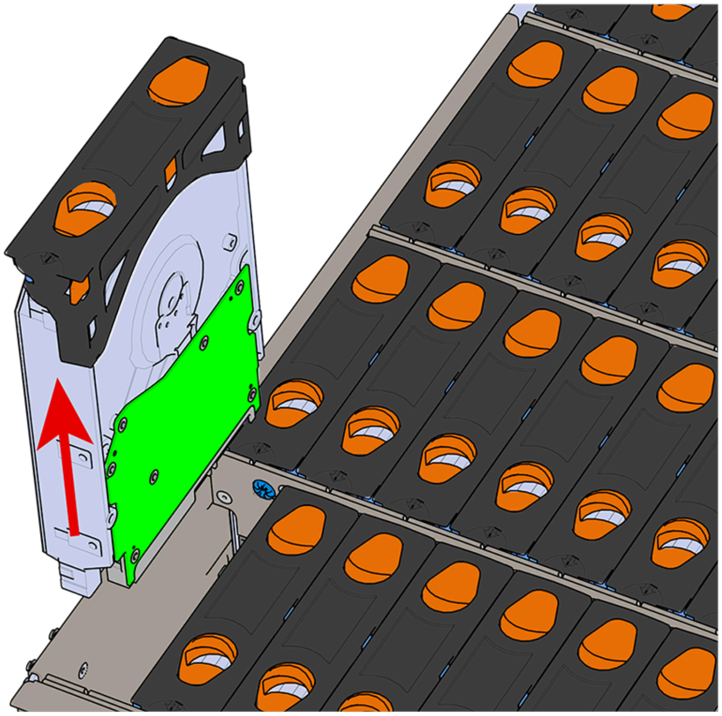
b. Insert a finger and a thumb into the latch release and pinch to unlatch the 3.5in HDD Assembly.

Figure 120: Unlatch Drive Carrier (IOM Not Shown)



c. Lift the 3.5in HDD Assembly free from the enclosure.

Figure 121: Removing 3.5in HDD Assembly



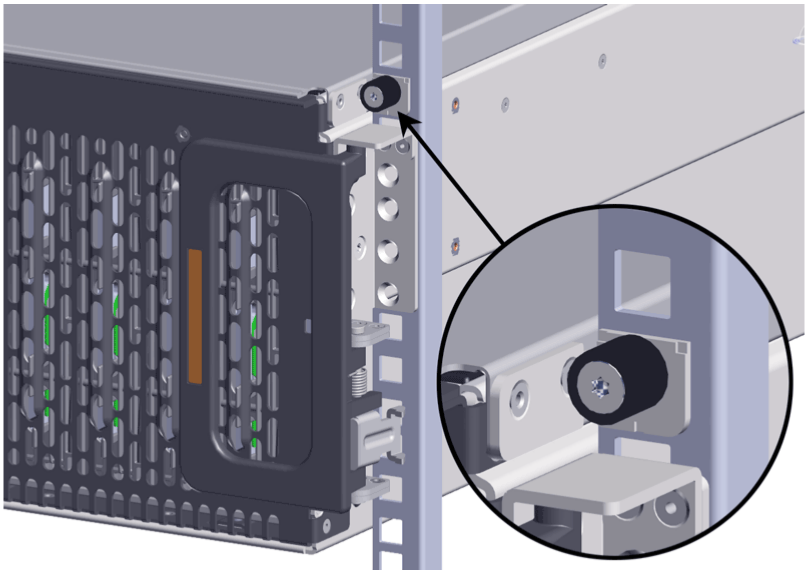
Step 10: Follow the previous step for each drive in the enclosure. Attach a label or mark the drives with the drive slot they were removed from in order to add them to the same slot in the future. Store the drives in an ESD safe location until the drives are ready to be installed back into an enclosure.

Step 11: Release the safety latch on the inner rails on each side of the chassis as shown in the following image.

Figure 122: Inner Rail Safety Latch Release

Step 12: Push the chassis back into the rack.

Step 13: Locate the M5 thumb-screws on the top cover of the enclosure that keep it in place when the drawer is extended, and unscrew them using a T15 Torx screwdriver. This will allow the top cover to move freely with the enclosure when the enclosure is removed.



Step 14: Remove the chassis from the rack.

a. Be prepared to support the enclosure once it is free of the rails by having a second person or a lift to support the enclosure

b. Grasp both handles at the front of the enclosure and pull with even pressure until the enclosure will not extend further.

Warning: The handles on the front of the chassis are not intended to be used to support the weight of the Ultrastar Data102 . Lifting the unit by the chassis handles or trying to support the unit on the handles can cause them to fail. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

c. Locate the safety catches on the inner rails attached to the enclosure.

Figure 124: Safety Latch Release

d. Depress the latch release lever for the safety latches on the rail and push the chassis very slightly forward. The chassis is now unsecured from the rack.

e. Ensure that you have the proper support mechanism to hold the chassis in position, whether that be a team lifting partner or an appropriate lift.

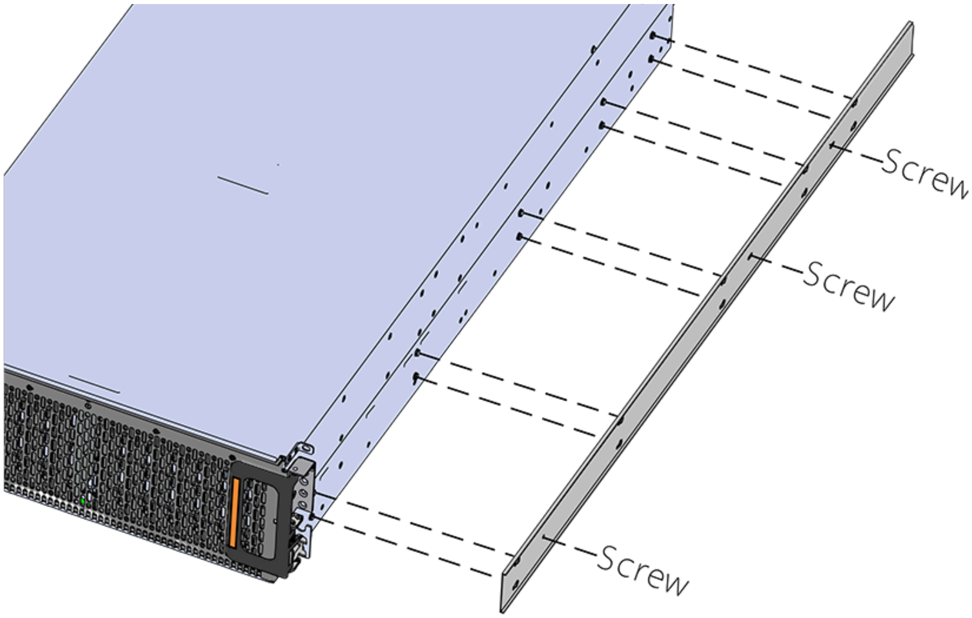
Warning: Do not lift the chassis by the Cable Tray while removing the chassis from the rack OR while installing it into a rack. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

f. Slide the chassis forward to free it from the rails. Place the chassis in a safe location to avoid damage.

Step 15: Uninstall the inner rails from the sides of the chassis.

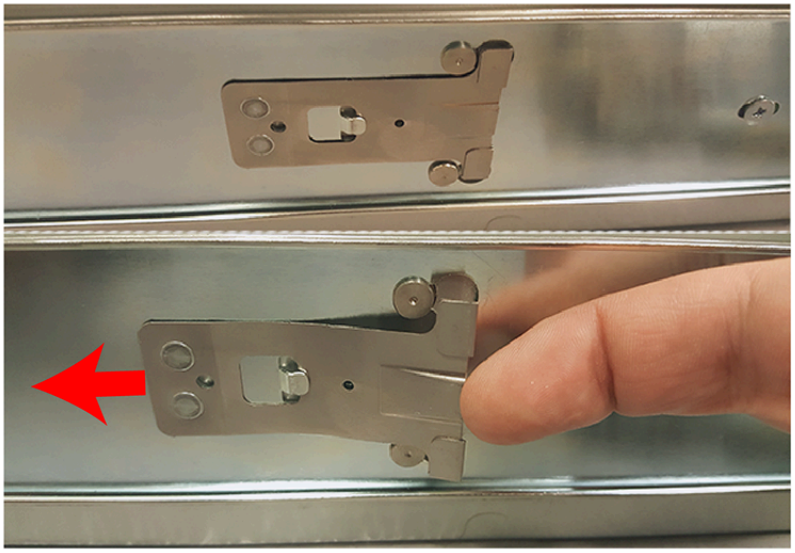
a. Unscrew the three Low-Profile M4 x 3.2mm Philips screws that attach the inner rails to the chassis using a #2 Philips head screwdriver.

Figure 125: Remove Inner Rail



b. Locate and unlatch the springlock on the side of the inner rail.

Figure 126: Inner Rail Spring Latch



c. Slide the inner rail toward the front of the enclosure to unlock it from the pegs that secure it to the sidewall and pull it free.

Step 16: Remove the screws that secure the alignment brackets and rails to the rack.

a. Remove the screws that secure the alignment bracket and rail to the rack. Be careful, the alignment bracket will be free once the screws are removed. Make sure you have a solid grip on it before removing the final screw. The following images show two methods by which these components could be secured to the rack: individual screws (with washers) or a toolless screwplate.

Figure 127: Rear Screws Removal

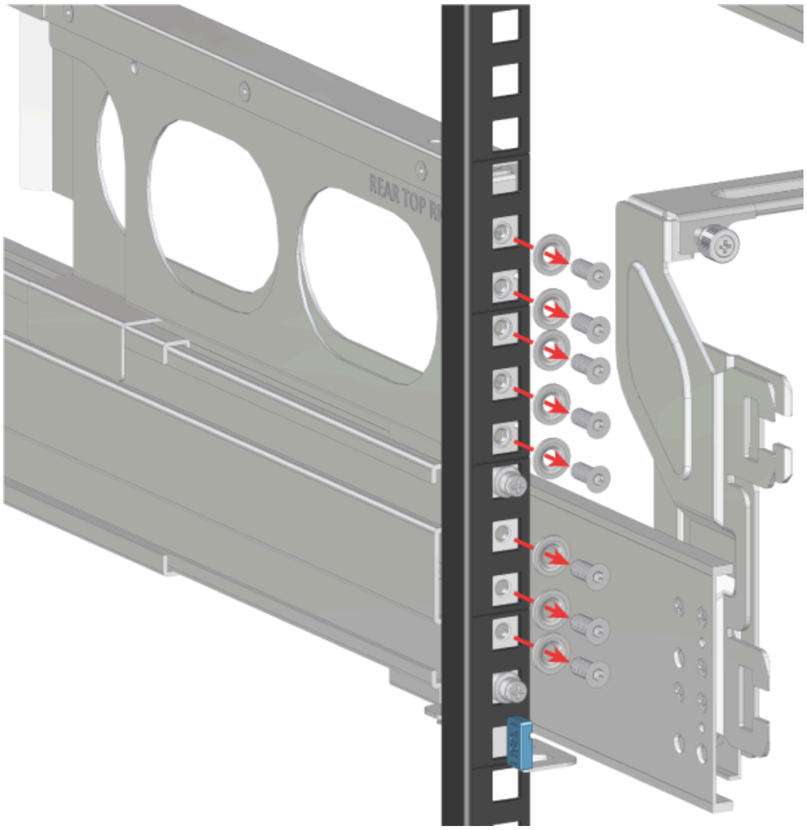
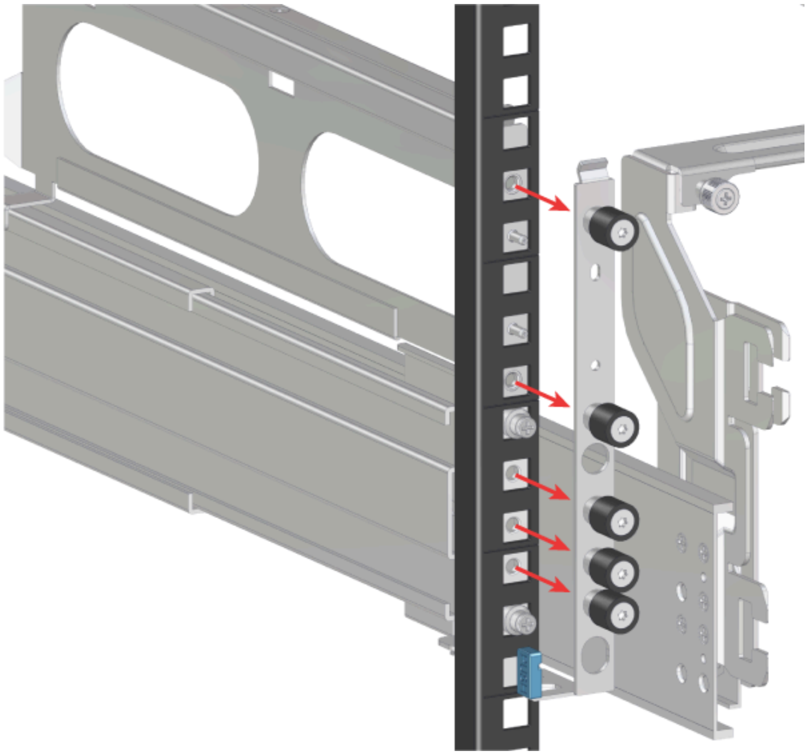


Figure 128: Rear Screwplate Removal



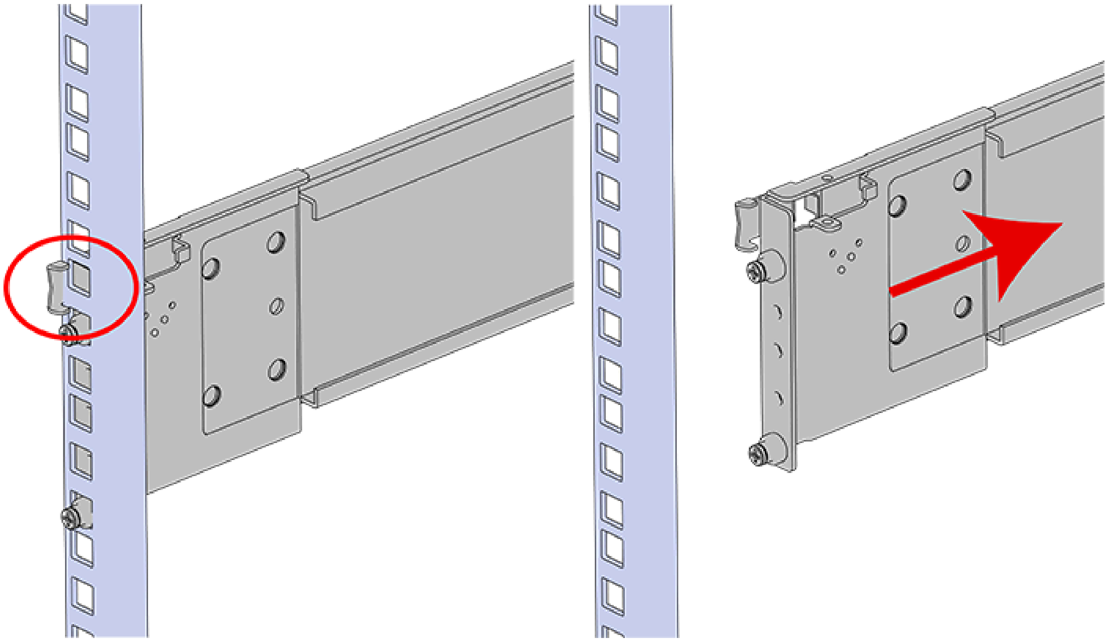
b. Move to the front of the rack and remove the three screws that hold the latch bracket to the front of the rack using a T15 Torx screwdriver. Be careful, the rack latch bracket will be free once the screws are removed. Make sure you have a solid grip on it before removing the final screw.

Figure 129: Rack Latch Bracket Installed

Step 17: Uninstall the rack rails from the rack.

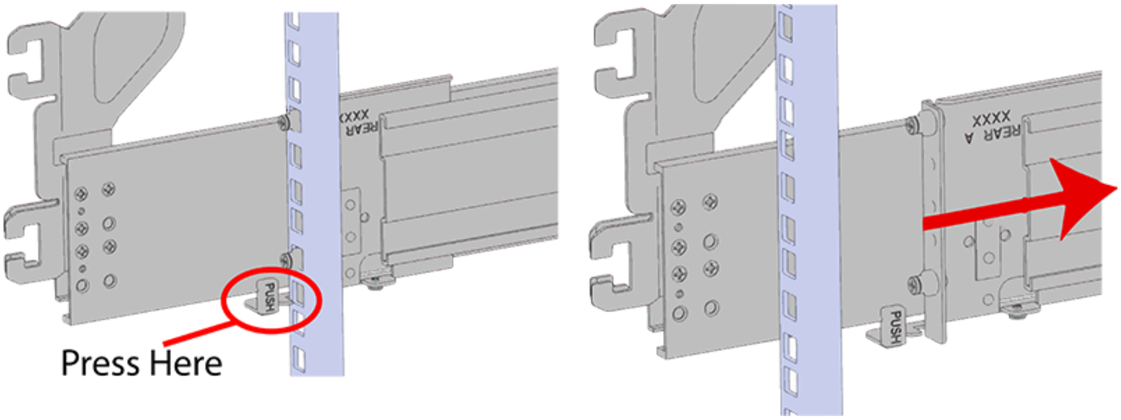
a. From the front of the rack, locate the release clip as shown in the following image.

Figure 130: Front Rail Release Clip Operation



b. Press the release clip and press lightly toward the rear of the rack to compress the rail clear of the rack post.
c. Let go of the rail and move to the rear of the rack.
d. Support the rail with one hand and press the release button with the other to free the rail from the rack and remove it.

Figure 131: Rear Rail Latch Release Button



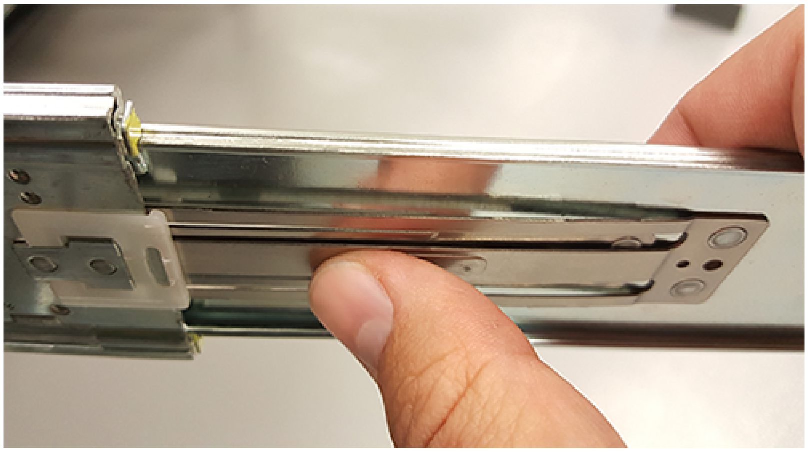
Step 18: Gather the replacement rails and prepare to install them.

Step 19: Remove the inner rail that is nested inside the rack rails.

> **Note:** There are Right and Left rails and they must be installed as a set. Each inner rail will read "R" for the right or "L" for the left embossed on the inside. Each outer rail will read "R-Front" for the right or "L-Front" for the left. Right and Left refer to when you are facing the front of the rack.

a. Start by sliding the inner rail out of the outer/rack rail until the safety latch engages and the inner rail will not extend further. It will only slide one way.
b. Press on the safety latch release spring located on the side of the rail and slide the inner rail out the rest of the way.

Figure 132: Rail Safety Latch

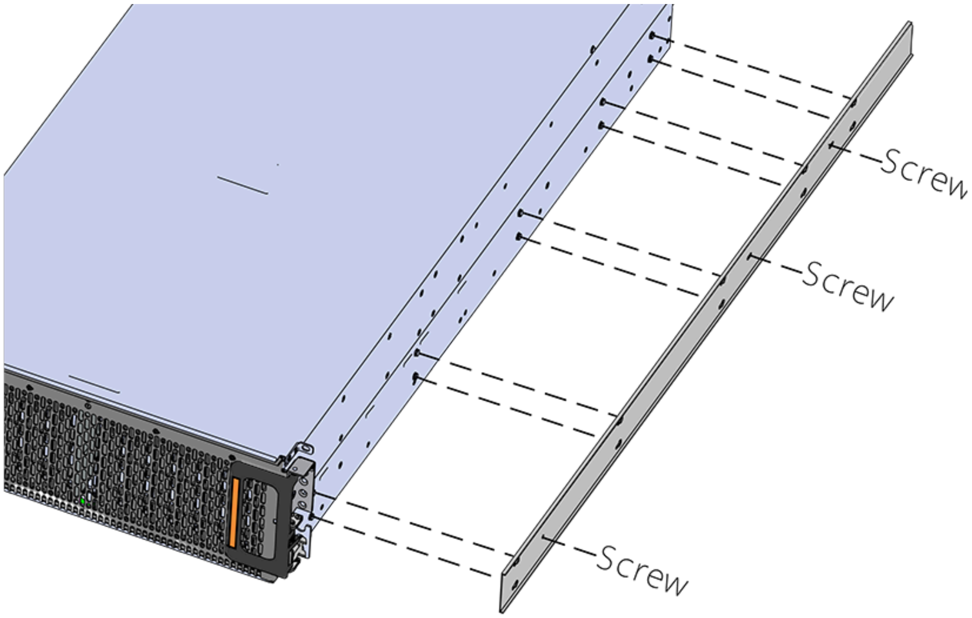


Step 20: Install the inner rail onto the chassis making sure they are installed on the correct side. Each inner rail will read "R" for the right or "L" for the left embossed on the side that faces away from the chassis. Right and Left are with reference to looking at the front of the enclosure.

a. Orient the inner rails so that the flat side is facing the enclosure and the side with the grooves is facing away from the enclosure.

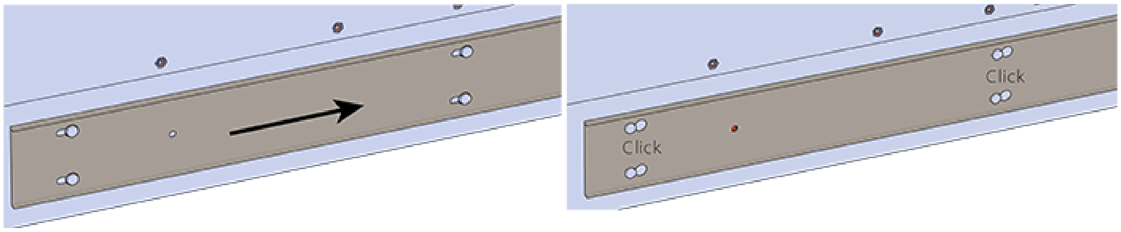
b. Align the keyholes on the inner rail to the mounting pegs on the side of the enclosure and press the inner rail flush against the chassis. If the keyholes don't line up with the pegs, flip the rail length-wise to see if this will align them.

Figure 133: Inner Rail Attachment



c. Slide the inner rail toward the rear of the chassis to lock it in place. There will be an audible click and the mounting pegs will cover the front part of the keyhole.

Figure 134: Slide Inner Rail



d. **Caution:** When installing the inner rail onto the chassis, make sure to only use the special Low-Profile M4 x 3.2mm Philips screws provided in the accessory kit with the CMA. These screws should be tightened to .90-1.12 Nm / 8-10 in-lbf using a # 2 Philips Screwdriver. These screws are specially designed for this purpose. Using unapproved screws could cause damage to the slides inside the rail.

Install the three special low-profile M4 x 3.2mm Philips screws provided to secure the inner rail to the chassis.

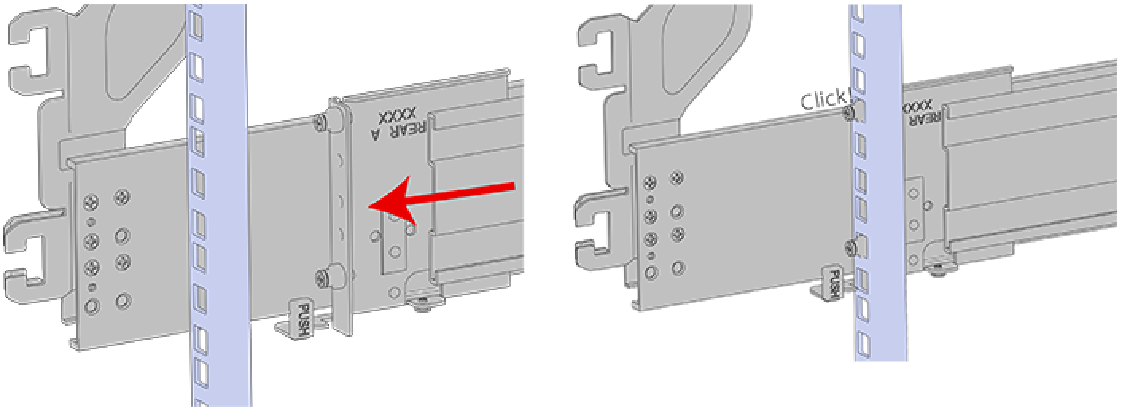
e. Follow these steps for the second inner rail on the opposite side of the enclosure.

Step 21: Install the outer rails into the rack. Pay special attention to which side is being installed. The embossed R is for the right side and L is for the left side. Right and Left refer to when you are facing the front of the rack.

a. Move to the rear of the rack.

b. Orient the rail so that the word "REAR" that is embossed into the metal of the rail is at the rear end of the rack, and the release latch is facing the inside of the rack posts as shown in the following image.

Figure 135: Rear Rail Latch Release Latch



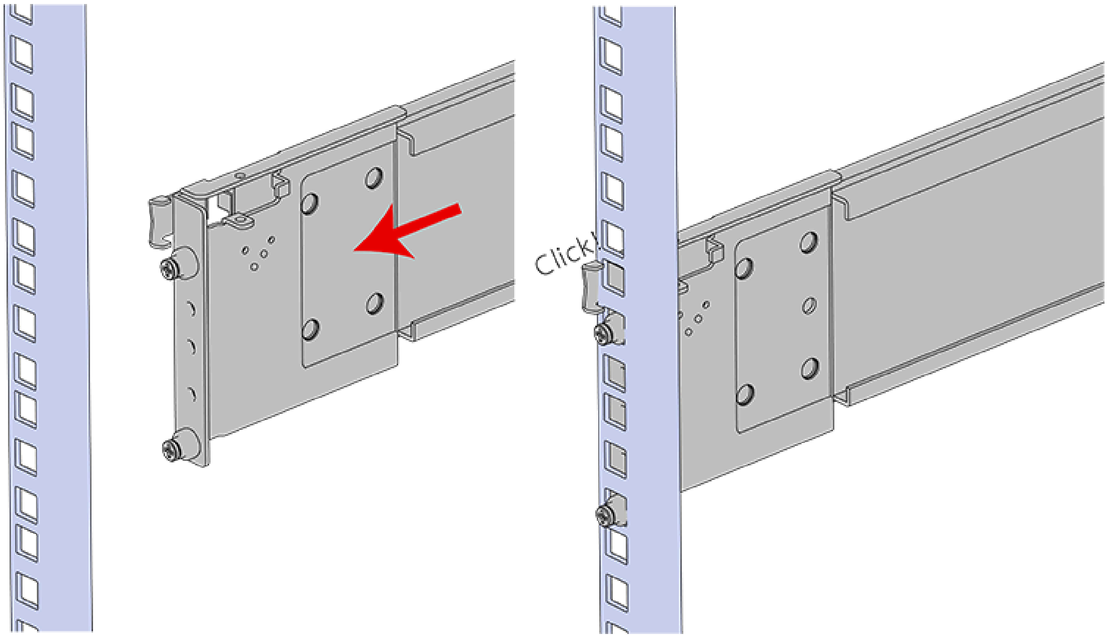
c. Align the rail on the rack posts at the U-height desired for installation. The bottom of the rail will be the lower most U of the total 4U height.

d. Pull the rail toward the rack post until the toolless latching mechanism engages the rack. The latching mechanism may need to be pulled open to get around the rack post.

e. Move to the front of the rack.

f. Align the front of the rail with the holes on the rack posts that will receive the rails and pull the rail toward the holes until the toolless latching mechanism engages the rack.

Figure 136: Front Rail Release Clip Operation



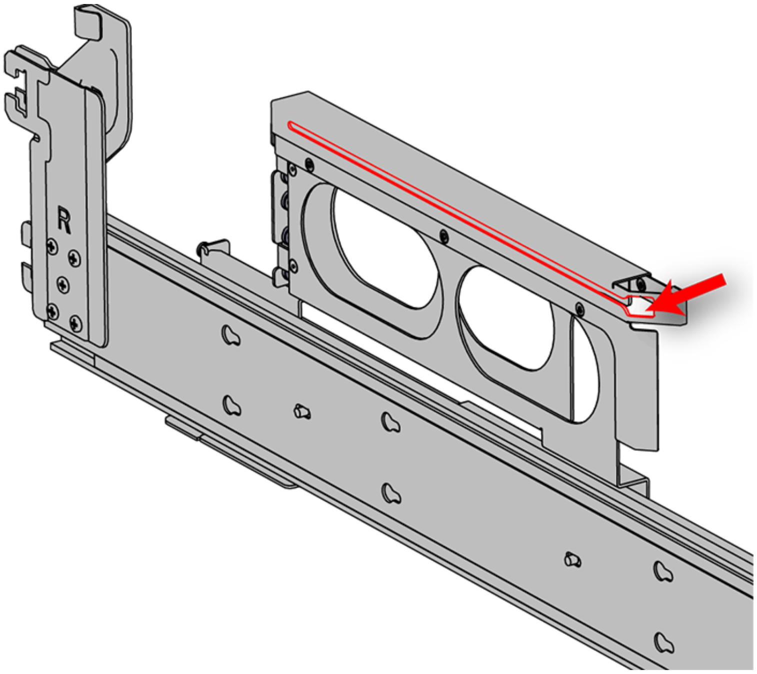
g. Use a level to make sure that the rails are aligned properly.

h. Follow these steps for the other outer rail.

Step 22: Install the rear cover alignment brackets and secure the rear rails.

a. From the rear of the rack, orient the alignment brackets so that the groove that will catch the cover is facing the inside of the rack.

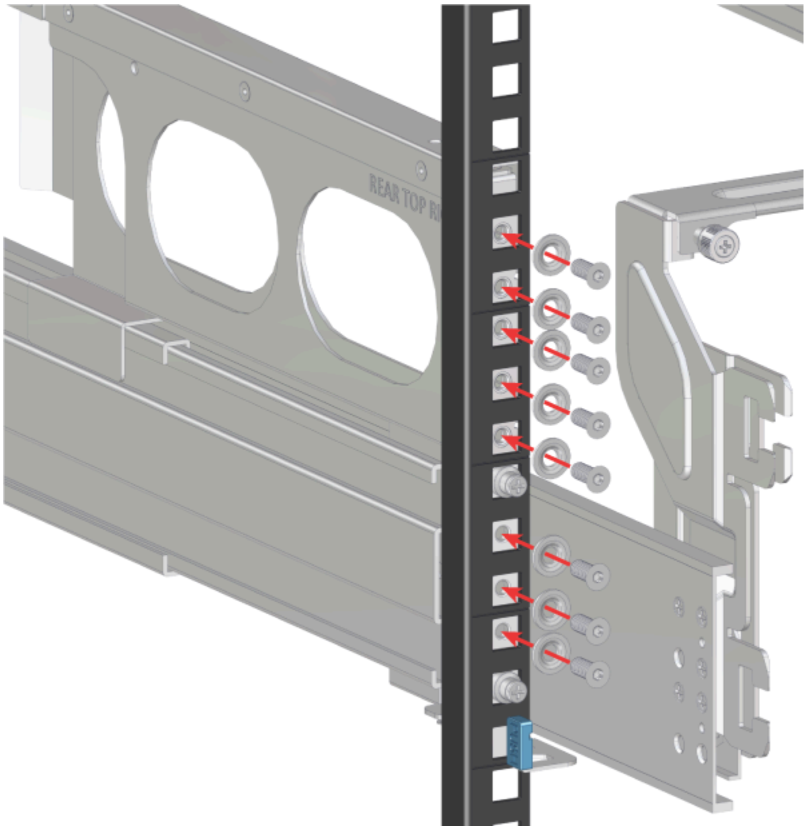
Figure 137: Alignment Bracket Groove (highlighted in red)



b. Attach the rear cover alignment bracket and rear rail to the vertical rack rail. The following examples show two methods for securing the bracket and rail to the rack: individual screws (with washers) or a screw plate.

Option 1: Using a Long T15 Torx Screwdriver, install M5 x 12mm T15 Flat Head Torx screws (with washers) to attach the rear cover alignment bracket. The number of required screws will vary depending on the bracket type. Install additional M5 x 12mm T15 Flat Head Torx screws (with washers) to attach the rear rail to the rack posts. Screw locations are shown in the following image. Tighten the rails screws to 3.38-3.61 Nm / 30-32 in-lbf.

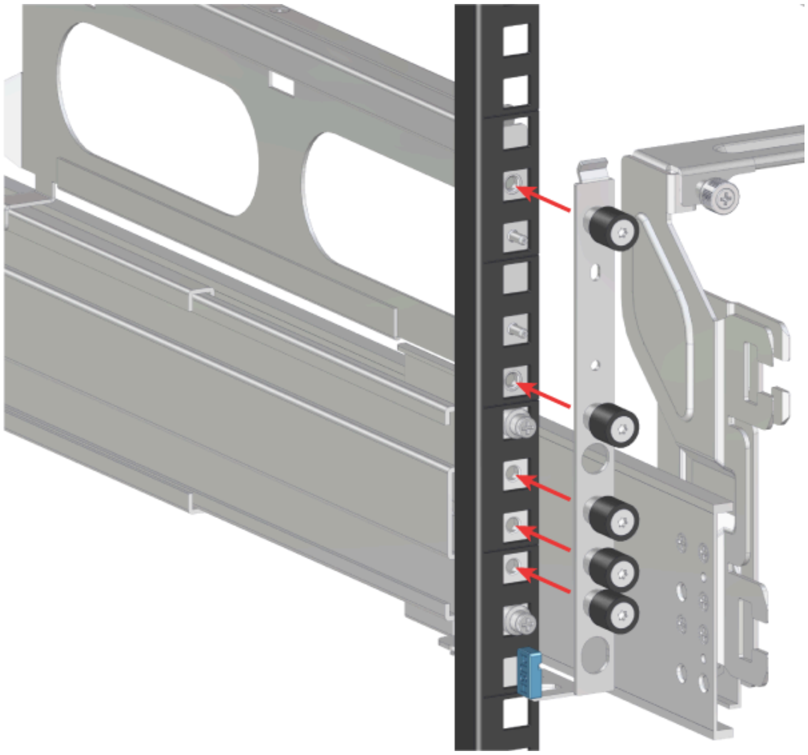
Figure 138: Rear Screws Installation



Caution: Be careful to set the screws properly in the cover alignment bracket and rail to prevent crossthreading.

Option2: Using a Long T15 Torx Screwdriver, install the screw plate to attach the rear cover alignment bracket and the rear rail to the rack posts. The screw locations are shown in the following image. Tighten the rail screws to 3.38-3.61 Nm / 30-32 in-lbf.

Figure 139: Screw Plate Installation



Step 23: **CMA Standard:** Install the two rack latch brackets at the front of the rack.

a. Orient the brackets so that the screw holes are between the two pins supporting the outer rails as shown in the following image. There is a left and a right. Use the image below as a guide for how to orient this bracket and mirror it for the other side. Notice the increased distance between the top two screw holes and the lower screwholes and the flange being oriented on the outside.

Figure 140: Rack Latch Bracket Installed

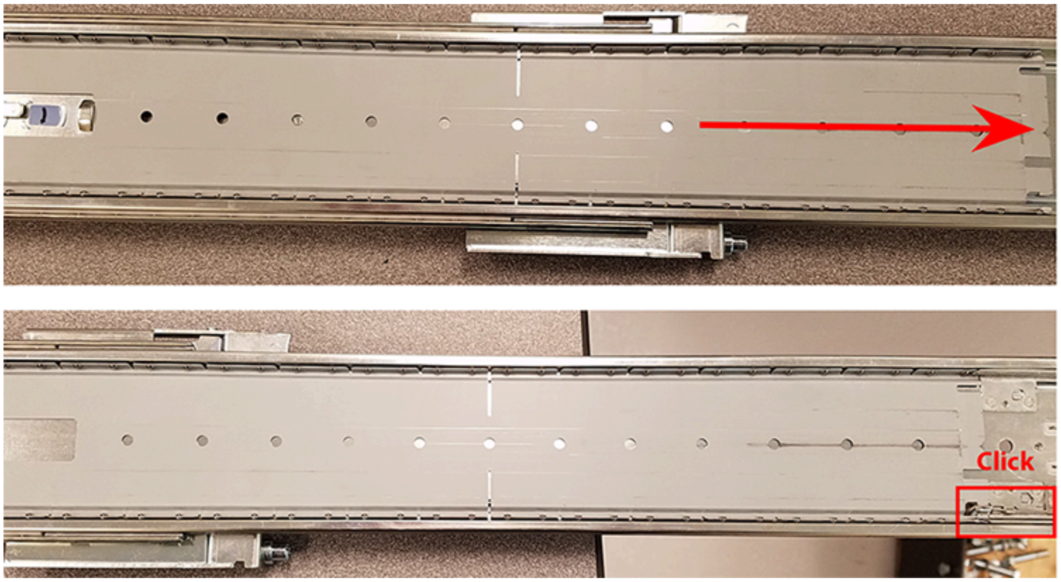
b. Use 6 of the included M5 x 12mm screws and the T15 Torx screwdriver to install each bracket, 3 screws per bracket.

Caution: Always install the top cover onto the enclosure before installing the chassis into a rack. Not having the top cover installed may damage the alignment brackets.

Step 24: Install the chassis into the rails.

a. Extend the bearing plates on the inside of the mid-rails until they are fully forward (detent has engaged). This prevents potential damage due to improper mating of the rails.

Figure 141: Bearing Plate



b. **Caution:** This step in the installation requires a minimum of 3 individuals to install safely, two to lift and one to guide the others who may have difficulty seeing because the enclosure is in the way. Ensure that the appropriate measures are taken to safely support the enclosure during installation. The enclosure MUST have no drives installed and requires a two person team lift to install. **Do not attempt to lift the system if it is fully populated with drives.** The only case in which the system may be installed or removed with the drives populated is if the facility has a lift that is rated to handle the maximum weight of the fully loaded system.

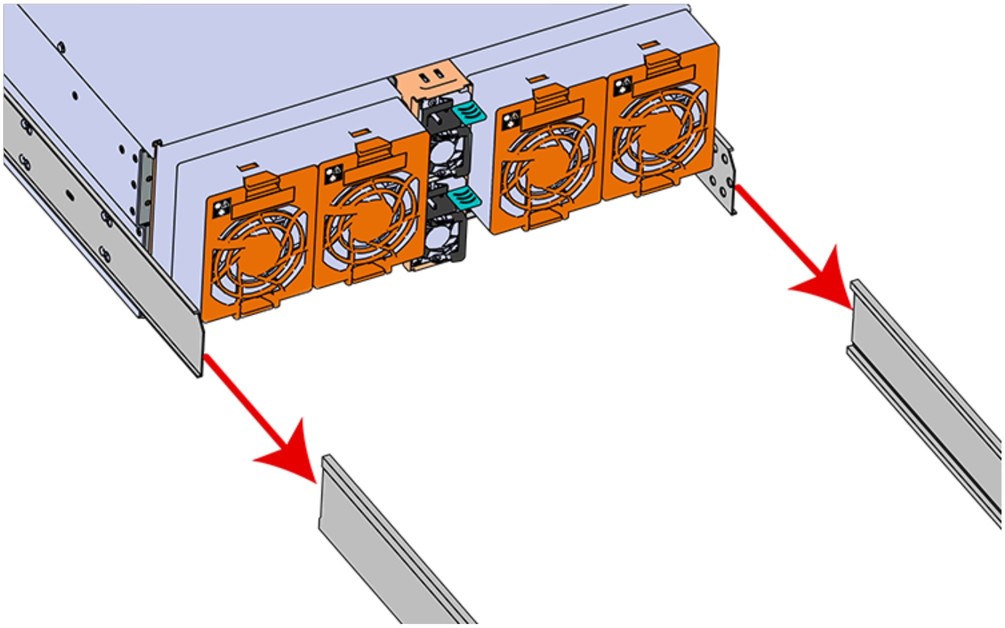
Warning: The handles on the front of the chassis are not intended to be used to support the weight of the Ultrastar Data102 . Lifting the unit by the chassis handles or trying to support the unit on the handles can cause them to fail. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

Warning: Do not lift the chassis by the Cable Tray while removing the chassis from the rack OR while installing it into a rack. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

In preparation to perform a team lift, position one individual on each side of the enclosure (to lift) and a third individual standing at the protruding rack rails (to guide the chassis to mate with rack rails).

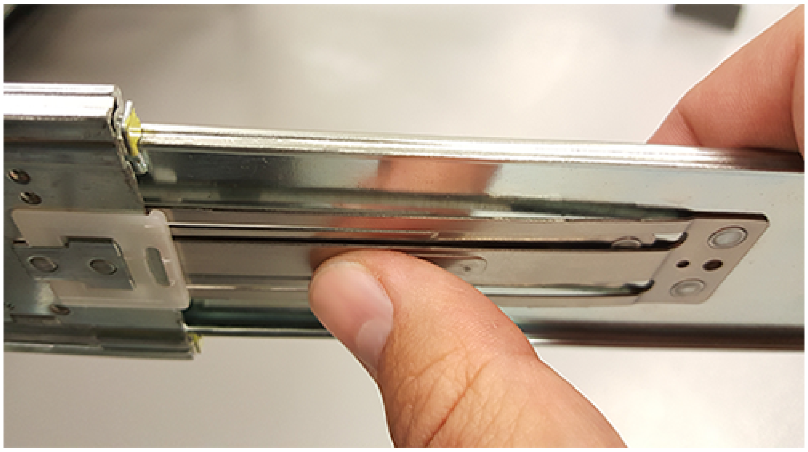
c. Team-lift the enclosure until the inner rails (which are attached to the chassis) align with the extended mid-rails (which are attached to the rack), and guide the inner rails on the chassis to mate with the rack rails.

Figure 142: Installing the Chassis



d. Once the rails are mated properly, slide the enclosure into the rack until it is stopped by the safety catch on the rails. Push the release lever on the safety latch (located on the side of each of the rails), and push the enclosure the rest of the way into the rack.

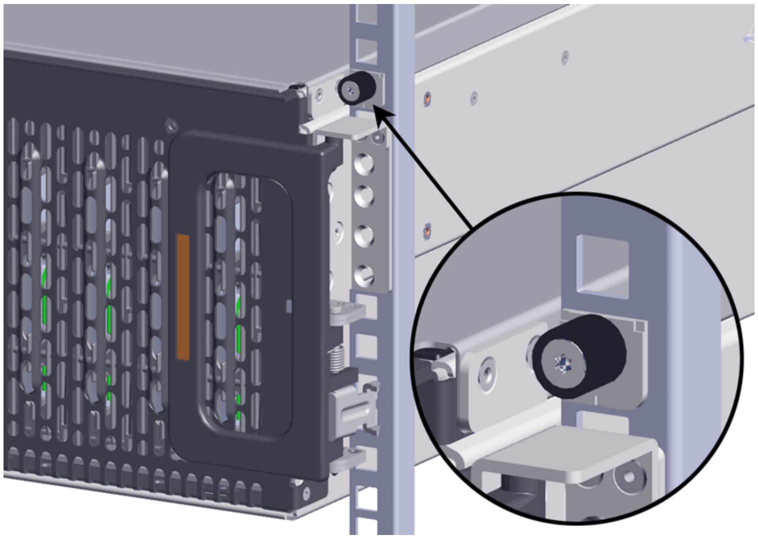
Figure 143: Safety Latch Release



e. As the chassis is slid into the rack, position one installer at the rear of the rack to ensure that the pegs on the sides of the cover will slide correctly into the rear cover alignment brackets on both sides of the rack. If the chassis does not install smoothly or snags, check that the rear cover alignment brackets are not interfering with the chassis sidewalls, and try again.

Step 25: Secure the chassis top cover to the rack using the captive M5 thumb-screws as shown in the following image. Use a T15 Torx screwdriver, and tighten the screws to 3.38-3.61 Nm / 30-32 in-lbf.

Figure 144: Cover Retention Screws



Note: If any drives were removed earlier to facilitate the removal of the chassis, follow the rest of the steps to reinstall the drives by following the labeling scheme noted earlier. If not, proceed to the cabling section.

Step 26: If the chassis is being installed into a rack that will be shipped fully assembled, you **must** install eight (four per side) of the included M5 x 12mm T15 Flat Head Torx screws into the two brackets at the front of the chassis in the following locations. These screws should be tightened to 3.38-3.61 Nm / 30-32 in-lbf using a Long T15 Torx Screwdriver. If this chassis will not be installed into a rack for shipping purposes, skip this step and move on to the next one.

Figure 145: Shipping Bracket Screw Locations (CMA Standard)

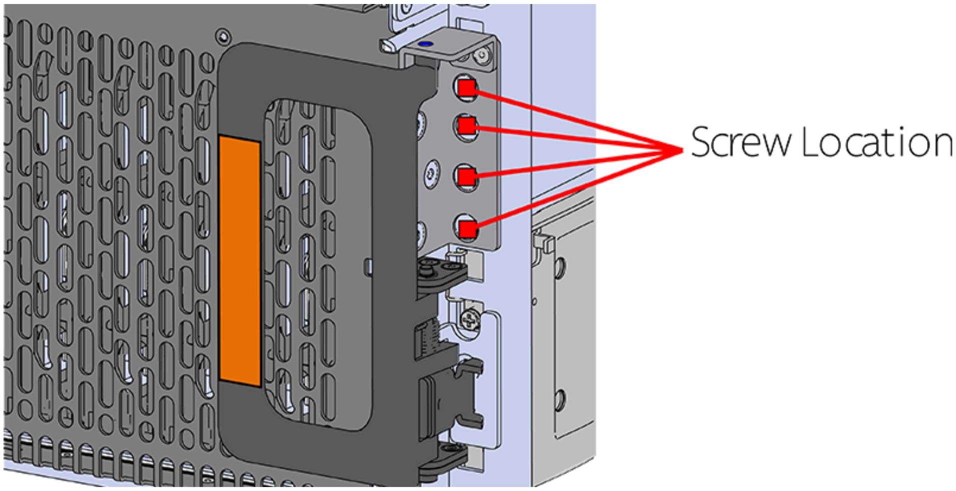
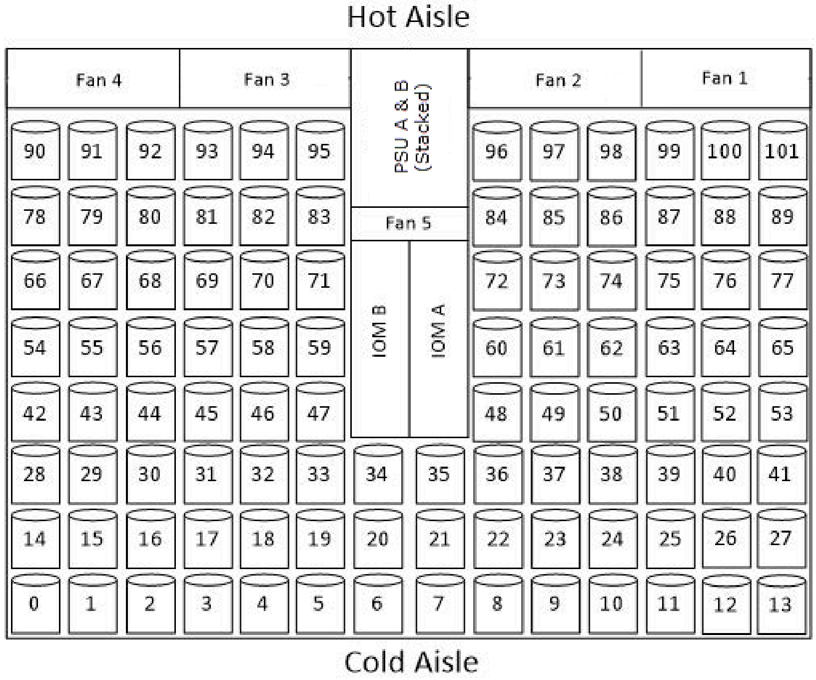


Figure 146: Shipping Bracket Screw Locations (CMA Lite)

Installing the 3.5in HDD Assembly

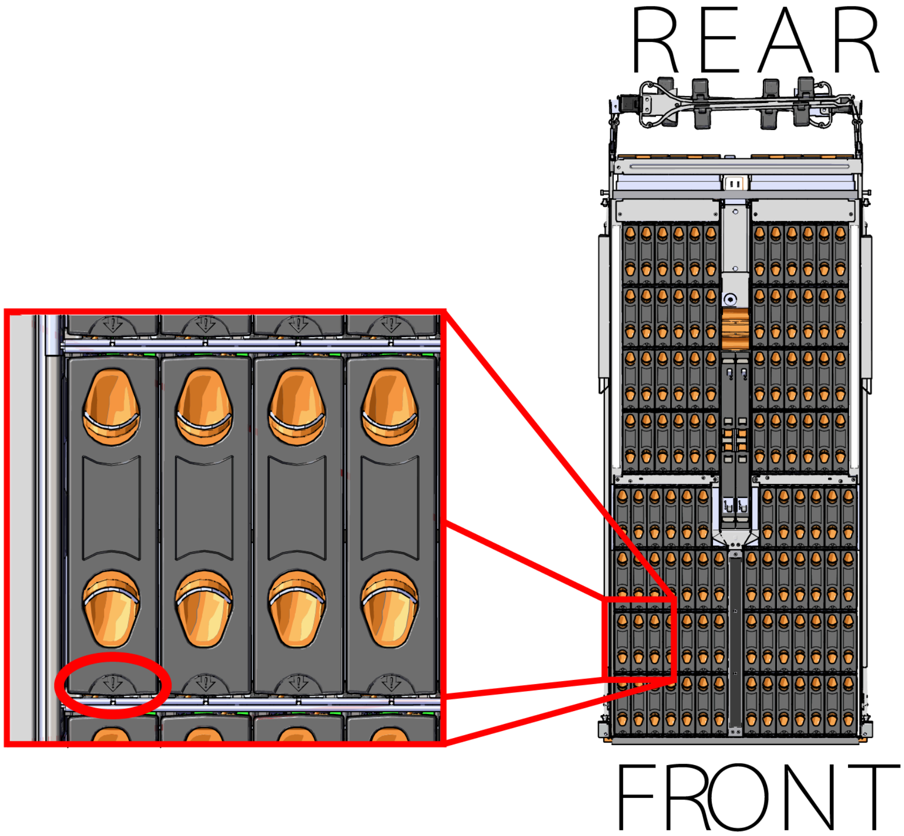
Note: When installing drives, populate the enclosure from left-to-right, rear-to-front. For example, begin with slot 90 (as shown in the following diagram), continue through 101, then proceed with 78 through 89, and so on:

Figure 147: Drive Layout



Note: When installing drives, ensure that the LED pointer on the top of the drive carrier points toward the front of the enclosure, as shown in the following image:

Figure 148: LED Pointer Orientation



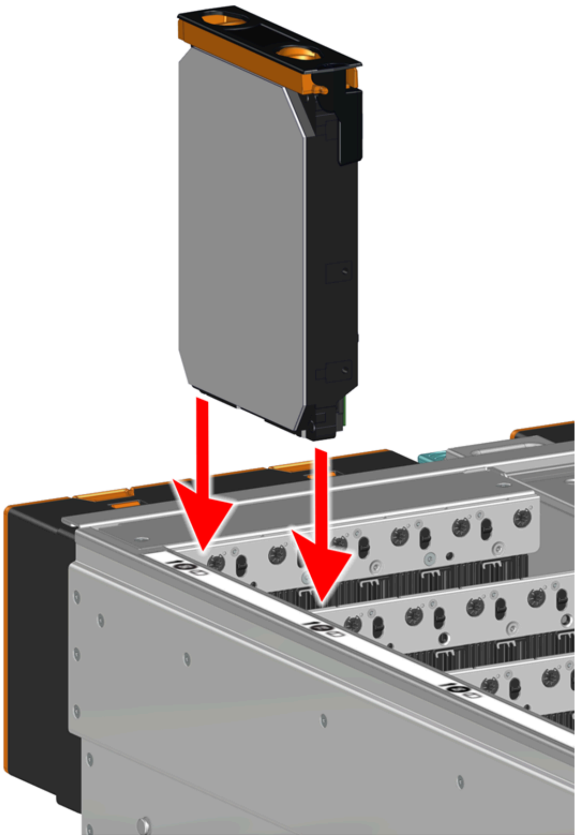
Caution: To ensure proper airflow for enclosure cooling, all drive slots must be populated with either drives or drive blanks.

Step 27: Ensure that the enclosure has been pulled out of the rack until the rail latches engage.

Step 28: Install each drive in the place it was removed from by following the labels or marks that were added earlier.

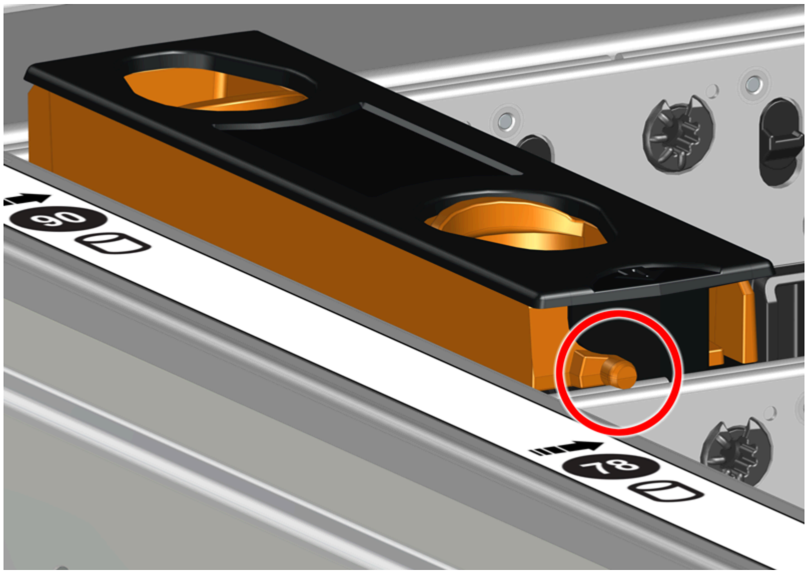
Step 29: Align the drive with the empty slot that will receive it. Lower it into the slot, ensuring that it stays level and does not bind.

Figure 149: Inserting a 3.5in HDD Assembly



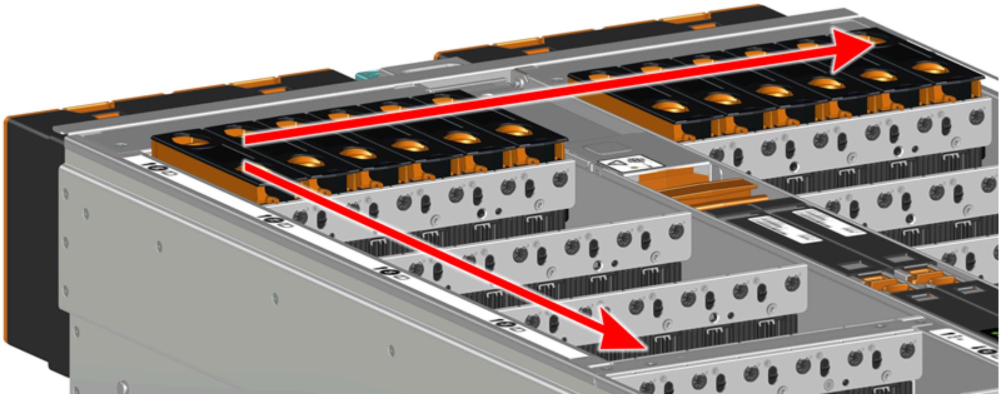
Step 30: Lower the drive until the spring-loaded posts on the carrier contact the top edges of the drive slot. This is an intermediate position; the drive assembly will be fully seated later on.

Figure 150: Intermediate Install Position



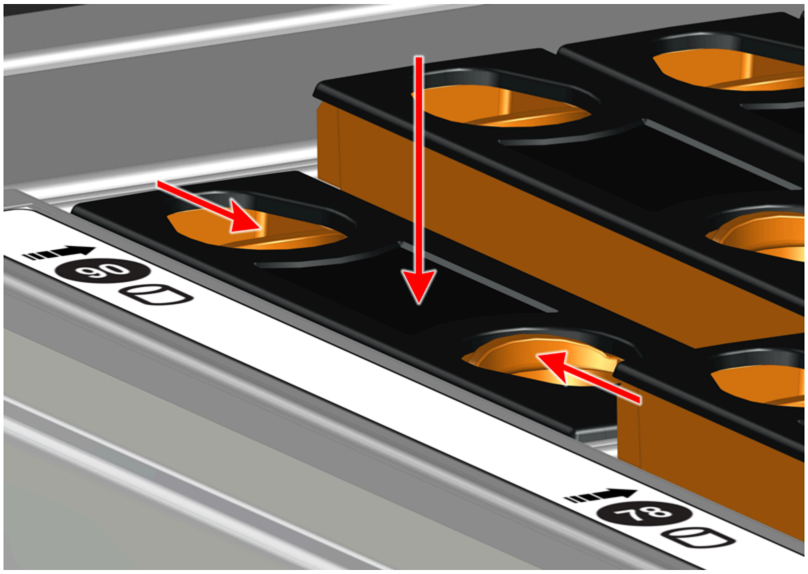
Step 31: Repeat this intermediate installation for the remaining drive assemblies, populating the enclosure from left-to-right, rear-to-front.

Figure 151: Populating the Enclosure



Step 32: Returning to the first drive assembly, pinch the latch release and carefully press downward to fully seat the 3.5in HDD Assembly into the drive slot.

Figure 152: Seating the 3.5in HDD Assembly



Step 33: Repeat this action to fully install the remaining drive assemblies in the same order, from left-to-right, rear-to-front.

Step 34: Install the CMA(s).

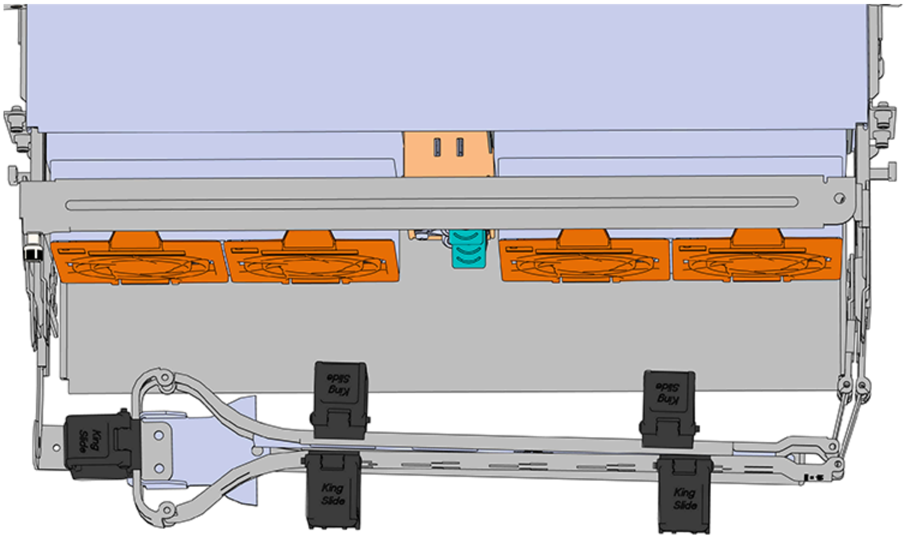
> **Note:** The standard CMA has two arms, labeled "upper" and "lower." The lower arm should have the elbow on the left side and be installed first; the upper arm should have the elbow on the right side and be installed last.

> **Note:** CMA Lite has one arm, to be installed at the lower position. This arm should have the elbow on the left side.

a. Orient the CMA so that the elbow is on the left hand side.

b. Attach all three of the connectors to the brackets on the rails. There should be one at the elbow side and two at the other end.

Figure 153: Lower CMA Orientation



c. Slowly slide the enclosure forward to ensure the arm is operating properly, then slide it back into the rack.

d. **CMA Standard:** Repeat these steps to install the upper arm with the elbow facing to the right.

Step 35: Cable the CMA(s).

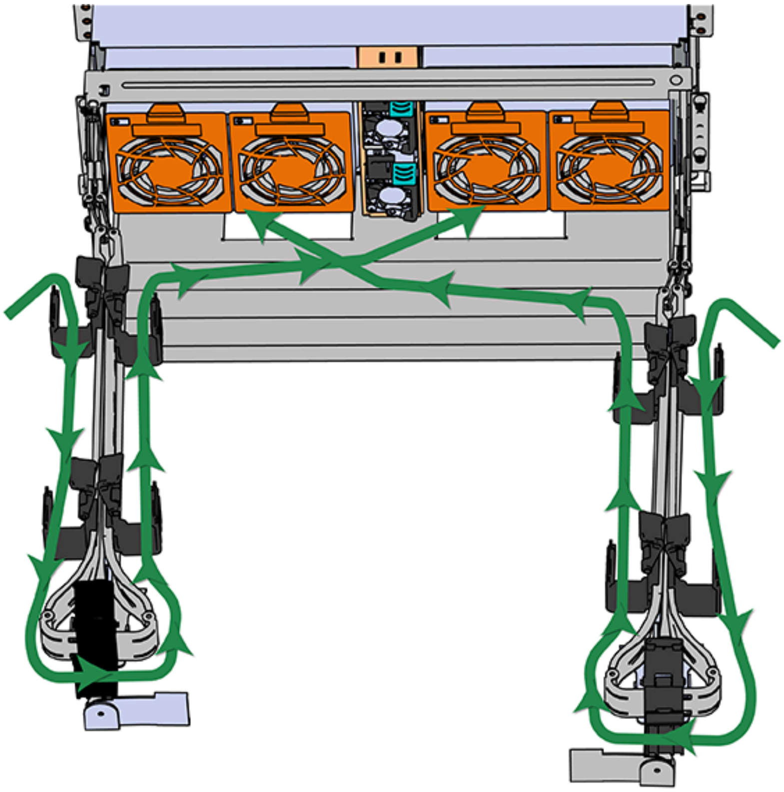
CMA Standard:

a. Unlatch the elbow side of the arm(s) by pressing the blue button labeled "push," and then swing the arm(s) open.

b. Gather the SAS, power, and Ethernet cables for installation. Before cabling, note the following routing patterns for best results:

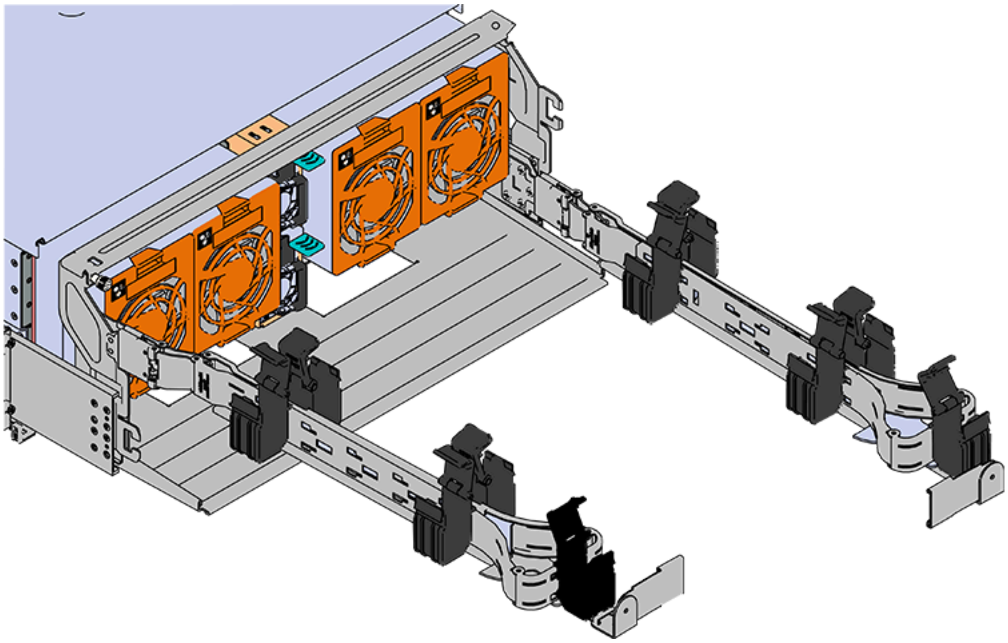
> **Note:** Route the cables supported by the lower arm to IOM A (left hand side looking at the rear). Second, route the cables supported by the upper arm to IOM B (right hand side looking at the rear) in a "criss-cross" pattern. See the Special Considerations for Cable Routing *(page 199)* for more information.

Figure 154: CMA Cable Routing



c. Open all of the baskets.

Figure 155: Open Baskets



d. Connect the Ethernet cable to the Ethernet port, and route the cable through each of the baskets on the arm.

e. Connect the SAS cables to the SAS ports, and route them through the baskets one at a time. Make sure to follow the labels to ensure they are connected to the proper ports.

f. Connect the power cable to the PSU.

> **Attention: Make sure the power cable is not connected to a PDU.** If it is, the system will power up when the cable is connected to a PSU. This is not intended at this stage of installation.

g. Attach the cable retention mechanism.

For the Delta PSU, loop the retention clip around the power cable and pinch it until the clip catches and locks in place. Then slide the retention clip forward until it stops near the cable connector. Doing this will ensure that the retention clip functions properly in the event the cable is pulled on for some reason.

Figure 156: Delta PSU Cable Retention Clip

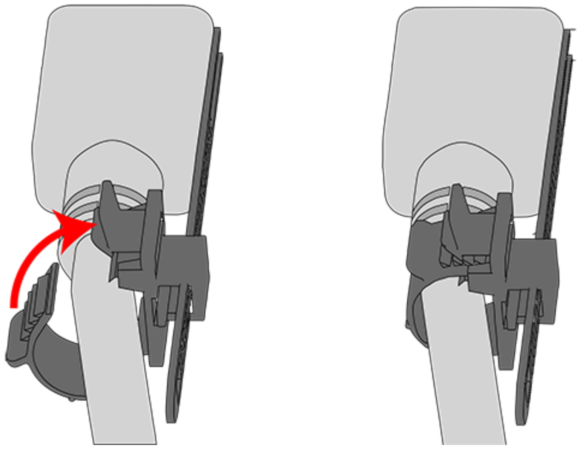
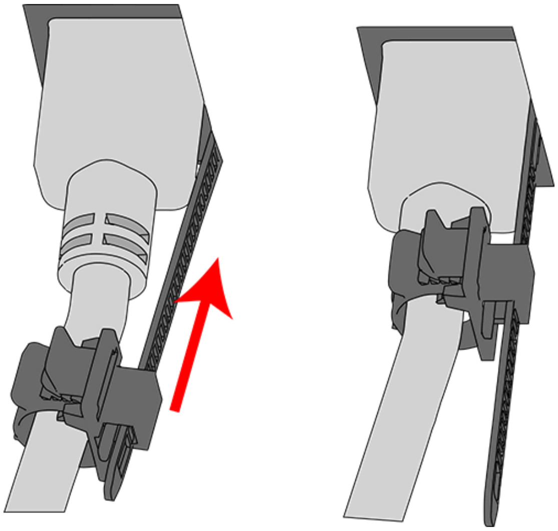
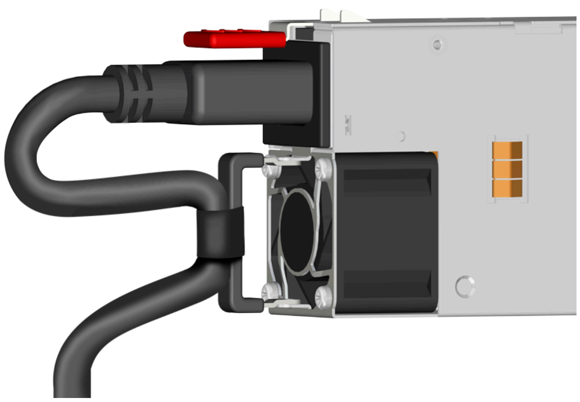


Figure 157: Cinching Cable Retention Clip



For the Artesyn PSU, secure the power cable to the PSU handle with the velcro retention strap as shown in the following image.

Figure 158: Artesyn PSU Cable Retention Strap

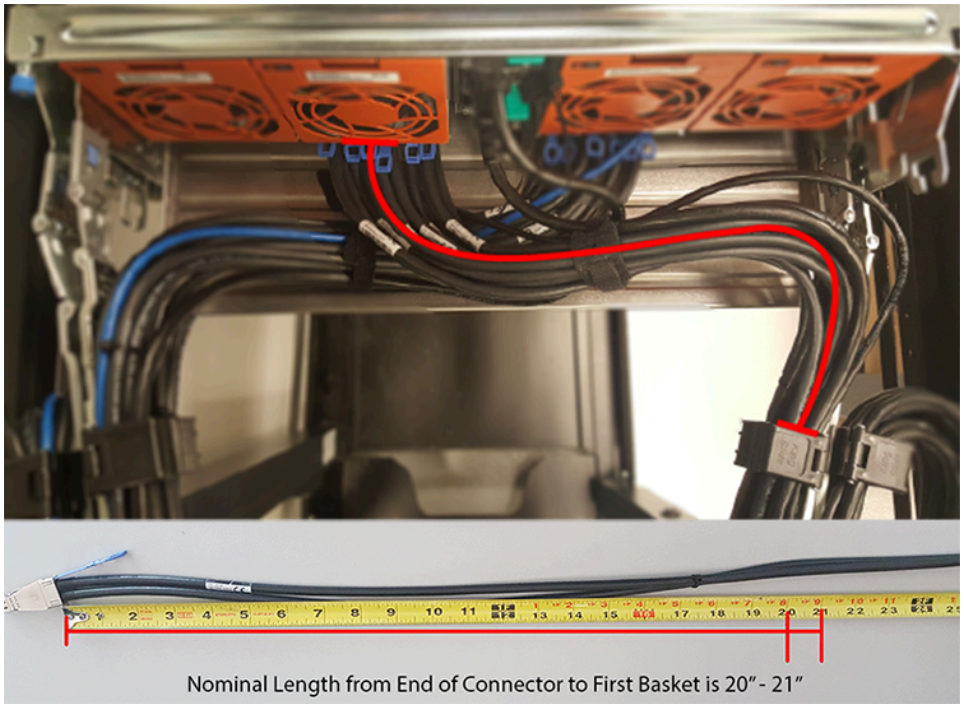


h. Route the power cable through each basket.

i. If the installation includes more than 10 total cables, follow the recommendations in Special Considerations for Cable Routing *(page 199)*, before proceeding.

> **Note:** Each cable must be given enough slack at the connector end to operate smoothly. Allow 20 - 21 in. (508 – 533.4 mm) between the connector and the first basket.

Figure 159: Nominal Cable Length at Connectors



j. Close all of the baskets.

k. If the Ultrastar Data102 is being installed in a rack and will subsequently be transported inside that rack, it is important to use the included cable tie to wrap the CMA bundle to ensure it does not get damaged during transport. If the Ultrastar Data102 is instead being installed where it will be operated, skip this step. Remember to remove the cable ties after the enclosure has reached its final operational location.

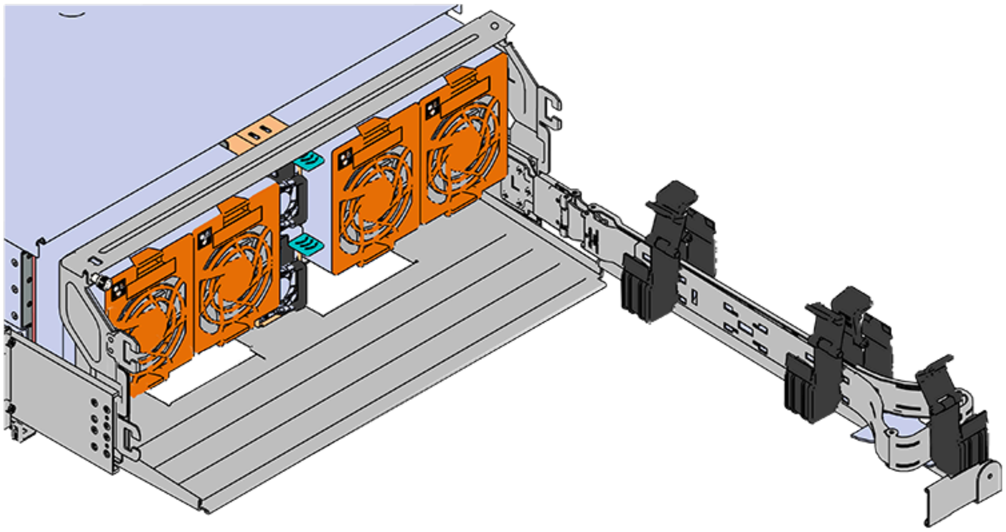
l. Reconnect the arm at the elbow to the connectors on the rail.

CMA Lite:

a. Press the blue latch button labeled "push" to unlatch the elbow side of the CMA arm, and then swing the arm open.

b. Open all of the baskets.

Figure 160: Open Baskets

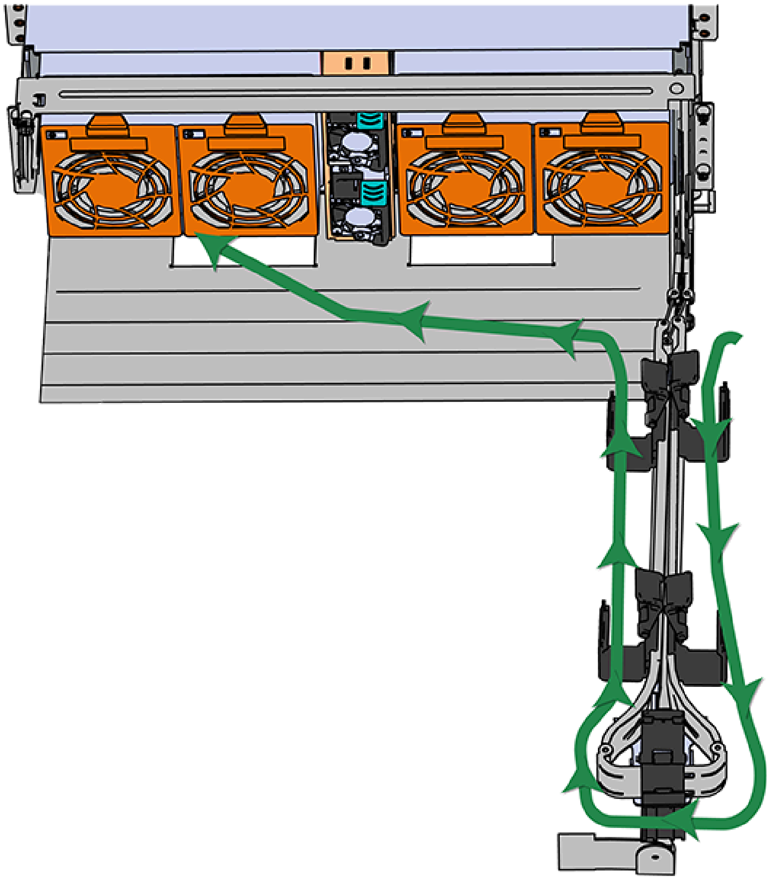


c. Gather the SAS, power, and Ethernet cables for installation.

> **Note:** Route all cables to IOM A (left hand side looking at the rear).

d. Connect the Ethernet cables to the Ethernet ports on the left hand side of the Ultrastar Data102 , and then route the cables through each of the baskets on the arm.

Figure 161: Connected Cable Routing



e. Connect the SAS cables and route them through the baskets one at a time. Follow the labels to ensure they are connected to the proper ports.

f. **Important: Make sure the power cable is not connected to a PDU**. If it is, the system will power up when the cable is plugged into the PSU. This is not intended at this stage of installation.

Connect the power cable to the lower PSU and route it through each basket.

g. Close all of the baskets.

h. If the Ultrastar Data102 is being installed in a rack and will subsequently be transported inside that rack, it is important to use the included cable tie to wrap the CMA bundle to ensure it does not get damaged during transport. If the Ultrastar Data102 is instead being installed where it will operated, skip this step. Remember to remove the cable ties after the enclosure has reached its final operational location.

i. Reconnect the arm to the rail by the connector at the elbow.

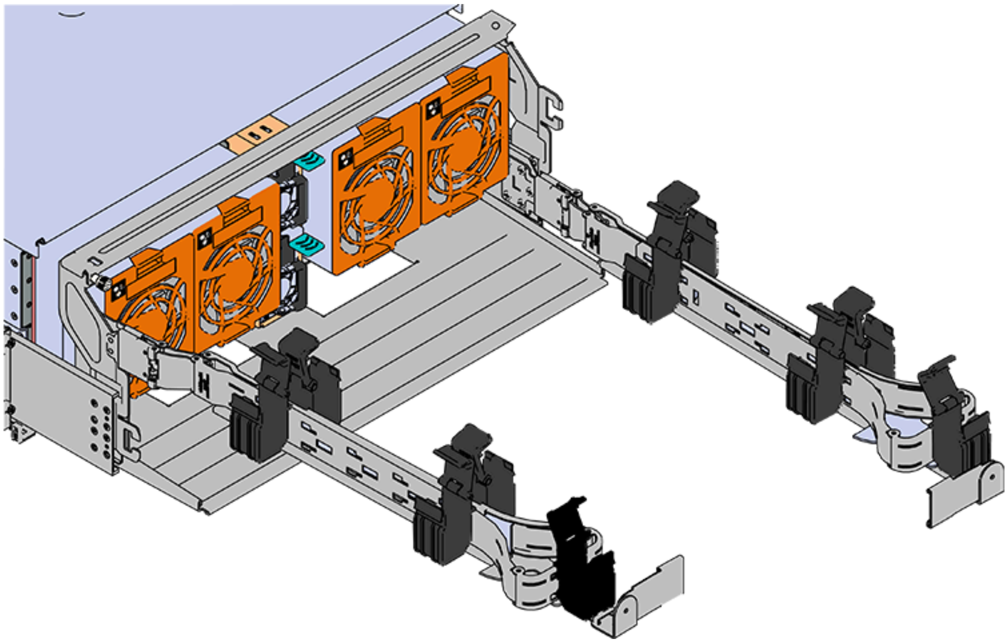
Step 36: Cable the upper CMA.

a. Unlatch the elbow side of the CMA arm and swing it forward by pressing the blue button that says "push" to unlatch it.

b. Gather the SAS cables, one power cable, and one Ethernet cable to install in the left hand side.

c. Open all of the baskets

Figure 162: Open Baskets

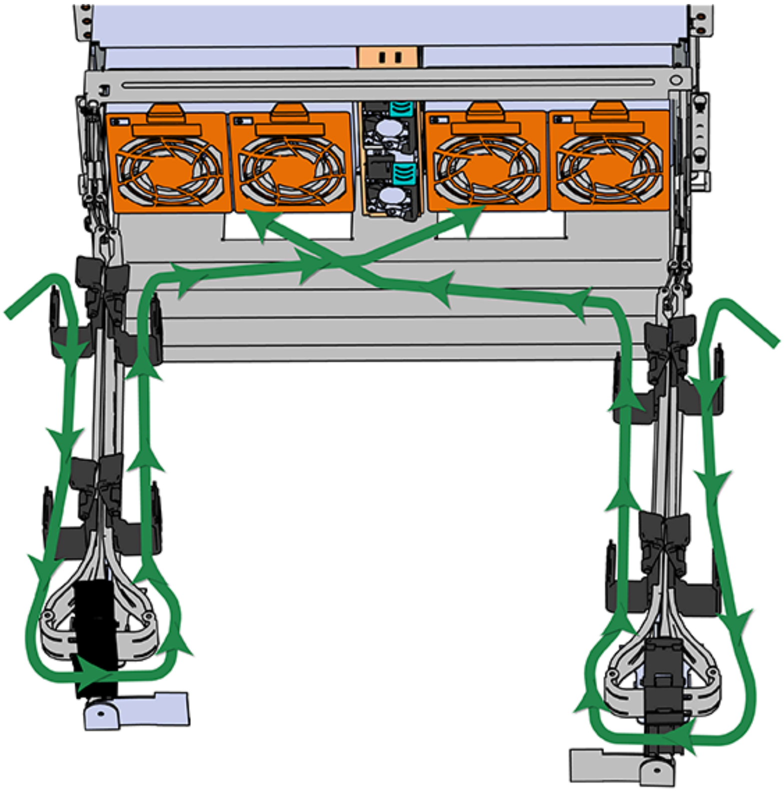


a. Connect the Ethernet cable to the Ethernet port on the right hand side of the Ultrastar Data102 and route the cable through each of the baskets on the CMA.

b. Connect the SAS cables and route them through the baskets one at a time. Make sure to follow the labels to make sure they are connected to the proper port.

c. Connect the power cable to the upper PSU and route it through each basket. The following image shows the appropriate cable "criss-cross" pattern they should be installed in.

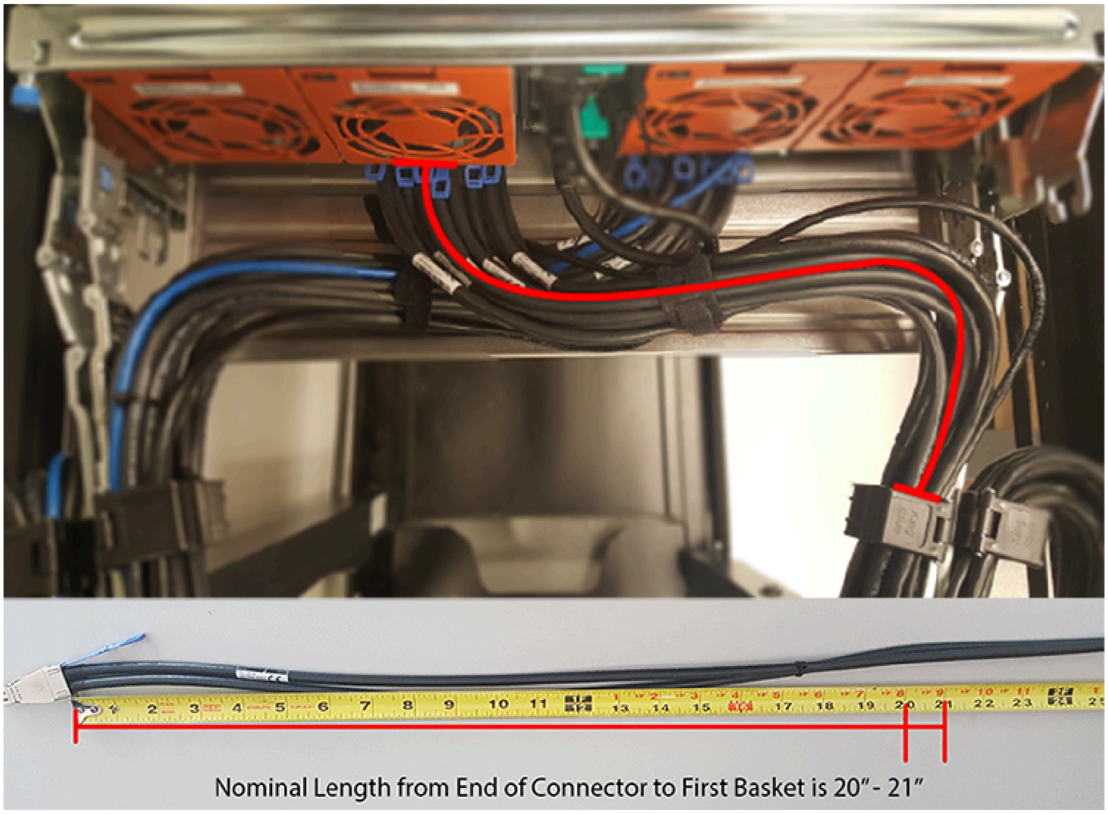
Figure 163: Connected Cable Routing



d. Wrap cable tie around the installed cable bundle between the ports and the first basket of the CMA

Note: Each cable must be given enough slack at the connector end to operate smoothly. For the upper CMA allow 20" - 21" (508 – 533.4mm) between the end of the connector and the first basket. Make sure to route all of the upper CMA cables **under** the lower CMA cables.

Figure 164: Nominal Cable Length at Connectors



e. Attach the cable retention mechanism.

For the Delta PSU, loop the retention clip around the power cable and pinch it until the clip catches and locks in place. Then slide the retention clip forward until it stops near the cable connector. Doing this will ensure that the retention clip functions properly in the event the cable is pulled on for some reason.

Figure 165: Delta PSU Cable Retention Clip

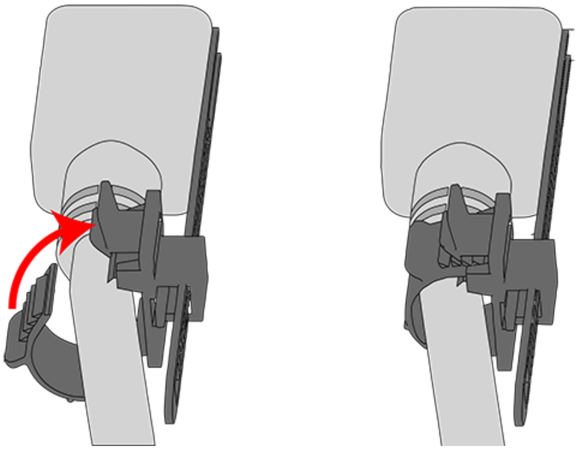
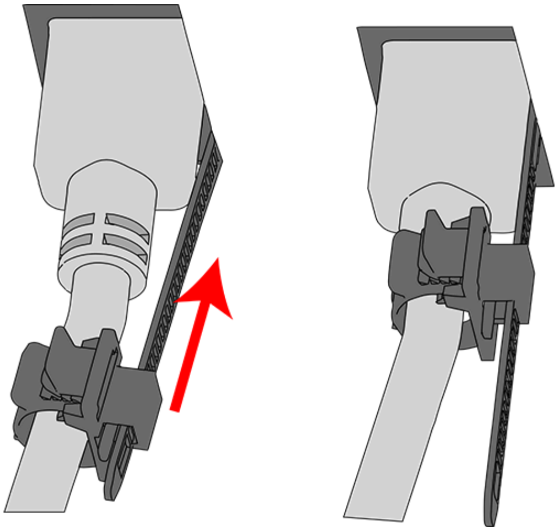
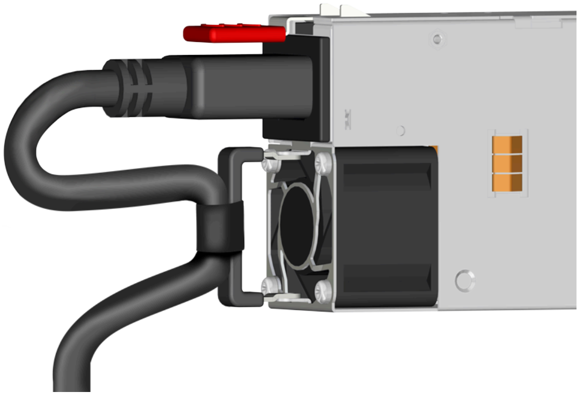


Figure 166: Cinching Cable Retention Clip



For the Artesyn PSU, secure the power cable to the PSU handle with the velcro retention strap as shown in the following image.

Figure 167: Artesyn PSU Cable Retention Strap



f. If the Ultrastar Data102 is being installed in a rack and will subsequently be transported inside that rack, it is important to use the included cable tie to wrap the CMA bundle to ensure it does not get damaged during transport. If the Ultrastar Data102 is instead being installed where it will operated, skip this step.

g. Close all of the baskets.

h. Reconnect the CMA at the elbow to connector A.

Step 37: Test for binding in the extension of the arm by gently pulling the enclosure out of the rack, ensuring the cables extend properly and that the system doesn't bind at all. If it does, examine the point at which the binding occurred and adjust the seating of cables in the baskets, check the connections to the rails, and examine the joints of the arm to ensure that they are all functioning properly.

Step 38: Make sure the CMA(s) is in operational position by folding the arm(s) in toward the enclosure and attaching the elbow end(s) to the connector(s) attached to the rail. Verify that all of the cabling is in functional order and does not bind or catch.

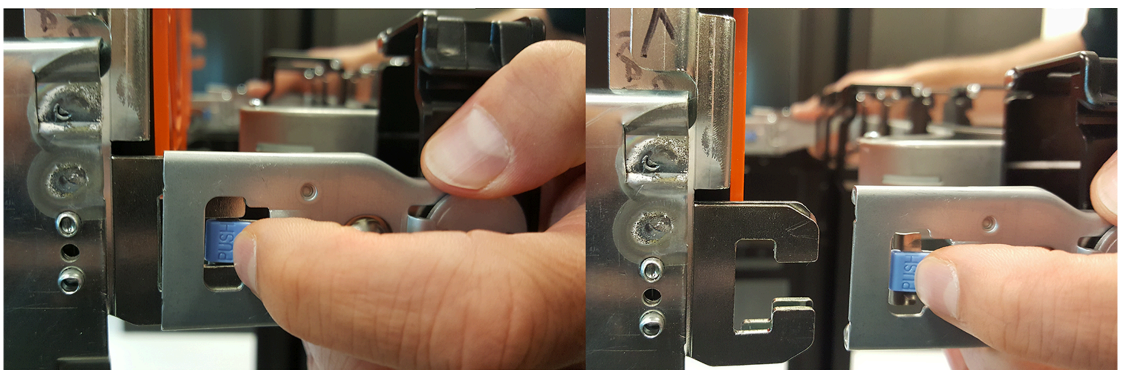
3.9 Chassis Replacement

Replacement Requirements	
Personnel Required	3
Avg. Replacement Time	2 hr.
Max Replacement Time	2 hr.
Tool	**Required vs. Recommended**
Long T15 Torx Screwdriver	Required
# 2 Philips Screwdriver	Required
T30 Torx Screwdriver	Required
Long T10 Torx Screwdriver	Required
Cable Ties (for configurations with greater than 10 total cables)	Recommended
Tape Measure	Recommended
Level	Recommended
Option 1: M5 x 12mm T15 Flat Head Torx screws with washers **Option 2**: Toolless screwplate	Required
Included Washers	Required
Low-Profile M4 x 3.2mm Philips screws (included with rail assembly)	Required
Optional (if using CMA Tray): M3 x 8mm T10 Torx screws	Required

Step 1: Place the CMA(s) into service position.

a. Unlatch the CMA(s) from the rail at the elbow connector by pressing the blue release button.

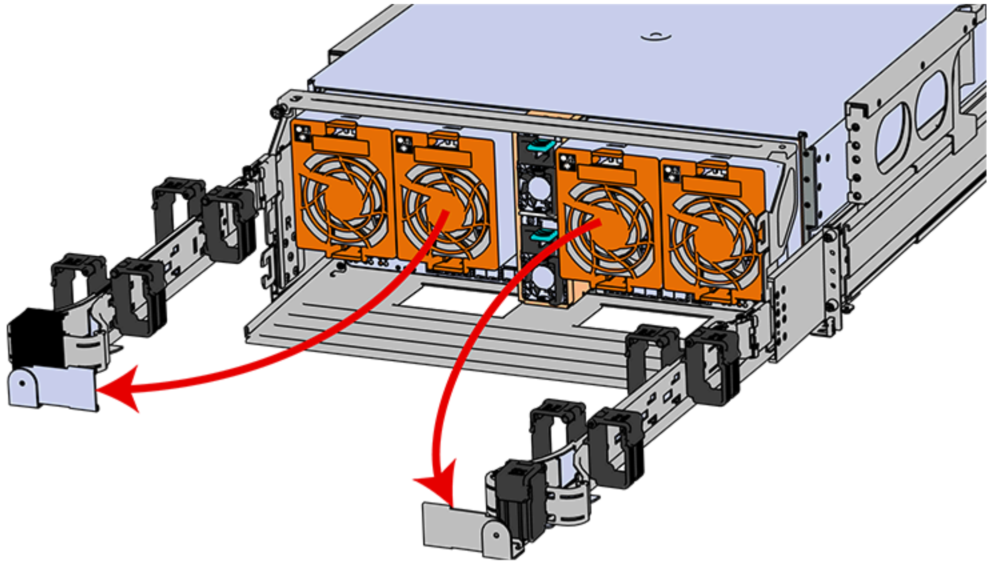
Figure 168: Unlatching a CMA Connector



b. Swing the CMA(s) away from the enclosure.

c. The arm(s) should be extended away from the enclosure as shown in the following example.

Figure 169: CMA(s) in service position (Cables not shown)



Step 2: Disconnect the Enclosure from power.

a. Locate the redundant PSUs at the rear of the enclosure.
b. Detach the cable retention mechanism from both power cords.

Figure 170: Delta PSU Cable Retention Clip

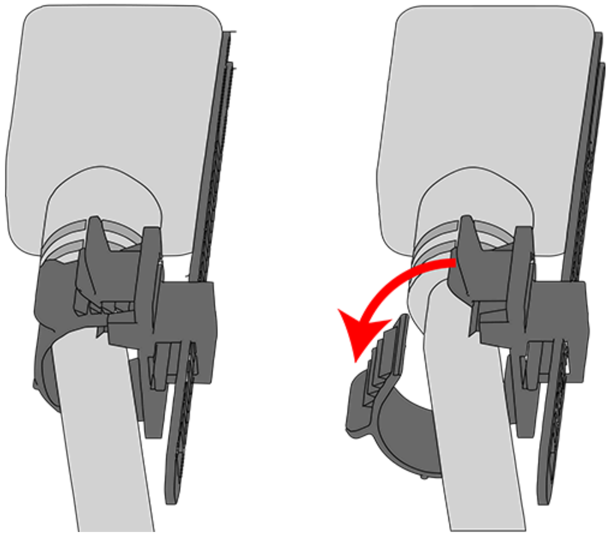
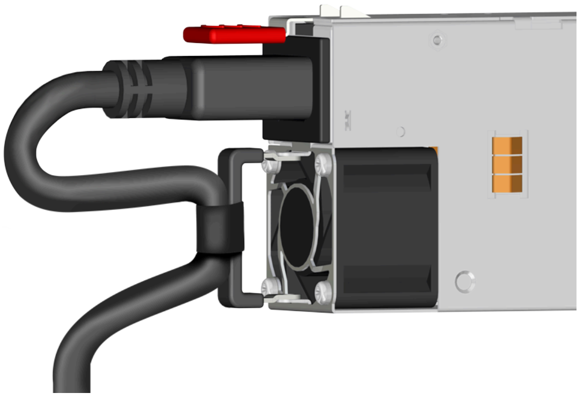


Figure 171: Artesyn PSU Cable Retention Strap



c. Power down the enclosure by disconnecting both power cables, one from each PSU.

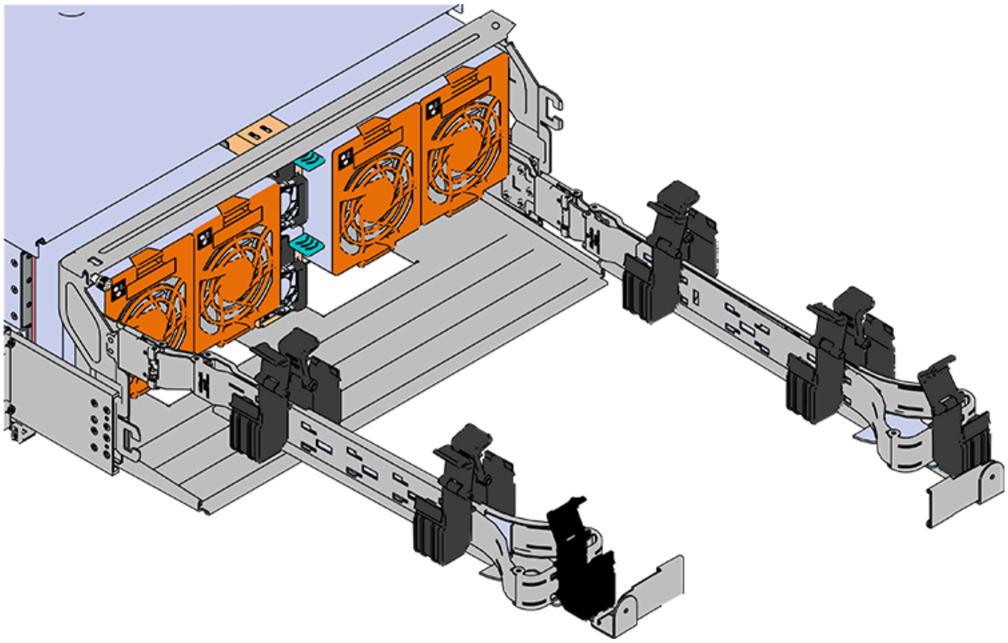
Step 3: Disconnect the HD Mini-SAS cables from the rear of the enclosure by pulling (don't jerk) on the blue tab that is extending outward from the connector. This will free the cable from the port. Make sure each cable is labeled or label them yourself to ensure that they will be plugged back into the same location.

Step 4: Unplug the Ethernet cables from the out-of-band management ports.

Step 5: Uncable the CMA(s).

a. Open all of the basket clips on the CMA(s).

Figure 172: Open Baskets



b. Remove one cable at a time from the arm, making sure not to put too much strain on the arm.

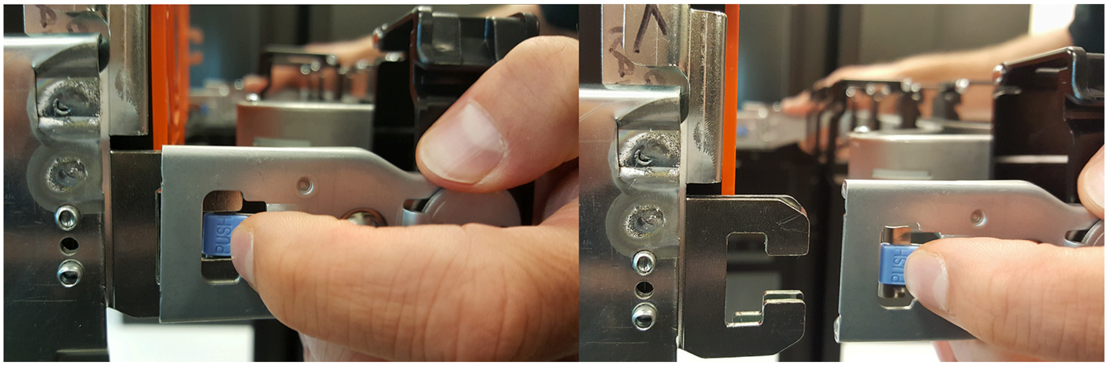
Step 6: Remove the CMA(s).

a. Release all of the connectors that attach the CMA(s) to the enclosure and the rail.

There are three total connections that need to be released, one at the elbow and two at the opposite end.

b. To release a connector, press the blue latch release button and pull the connector free.

Figure 173: Unlatching a CMA Connector

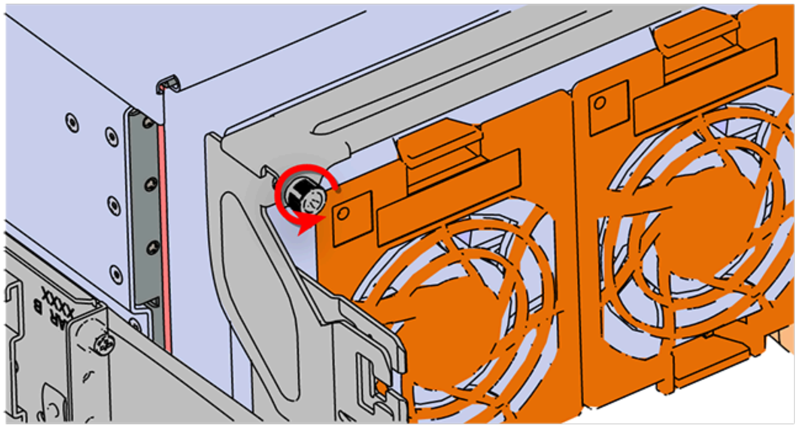


Step 7: Complete the previous step for the second CMA.

Step 8: Uninstall the crossbar from the CMA mounting bracket.

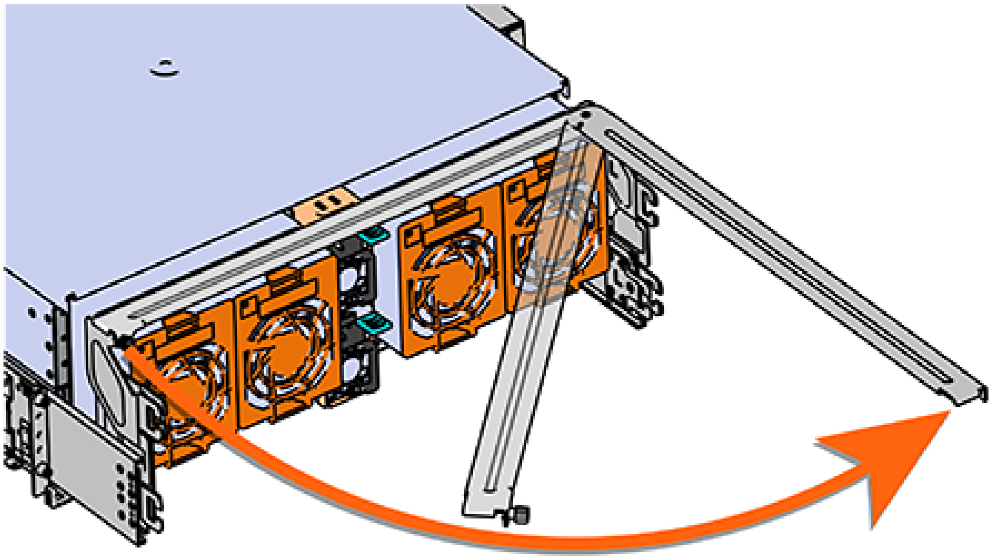
a. Locate the crossbar thumbscrew that secures the crossbar to the CMA mounting brackets and unscrew it.

Figure 174: Unscrew Thumbscrew



b. Swing the crossbar away from the enclosure.

Figure 175: Crossbar Swinging Out

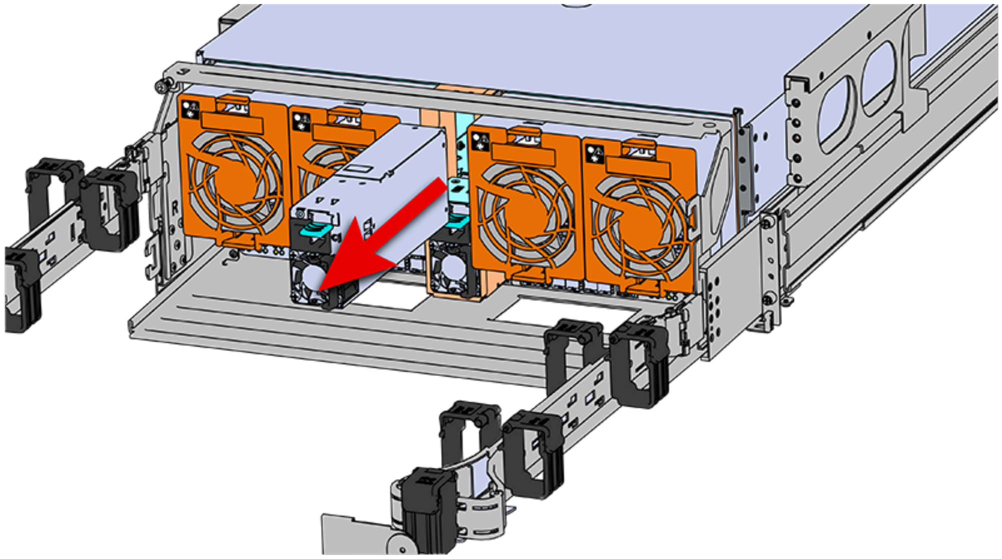


c. Once the crossbar is straight it should easily come free from the mounting bracket.

Step 9: Uninstall the PSU.

a. Grasp the release lever and the metal handle in a downward pinching motion to release the latching mechanism.

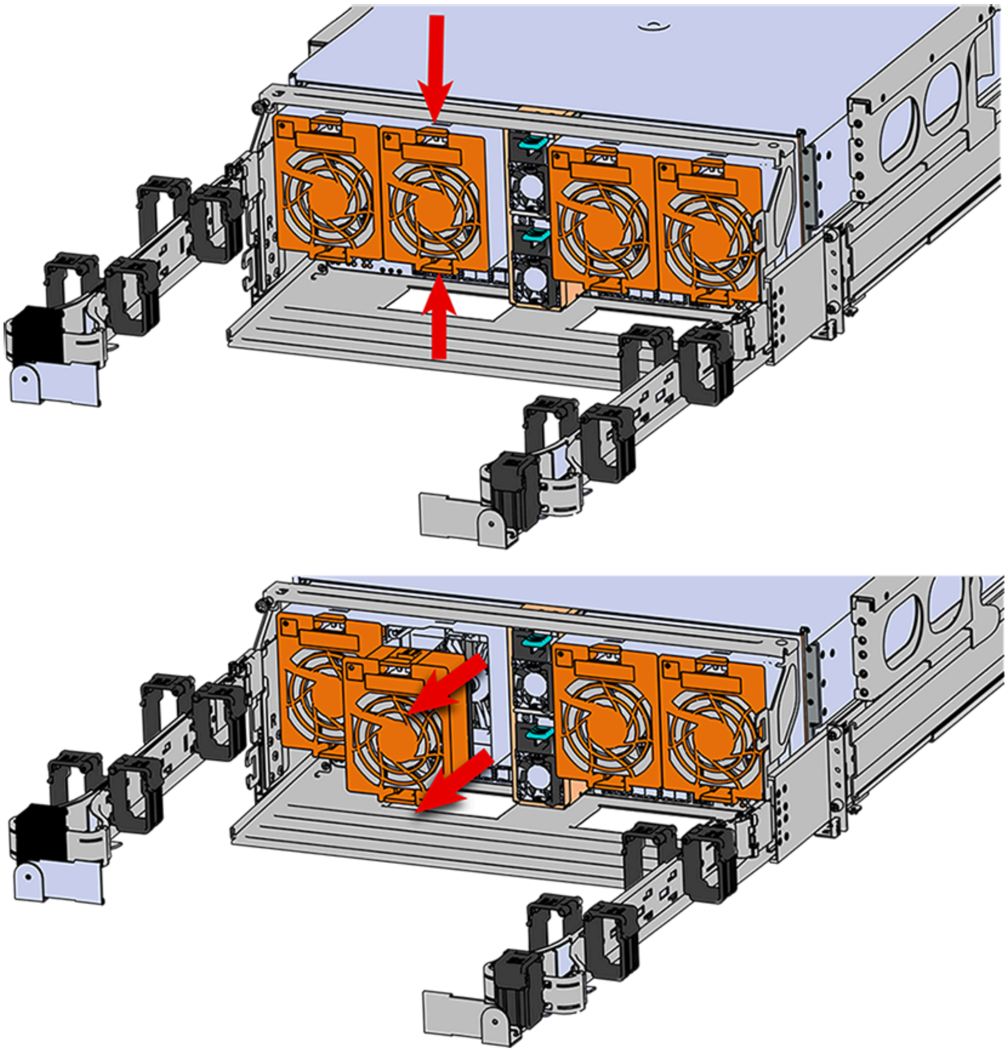
Figure 176: Uninstalling the PSU (Delta PSU shown)



b. Pull the PSU straight out with even pressure.

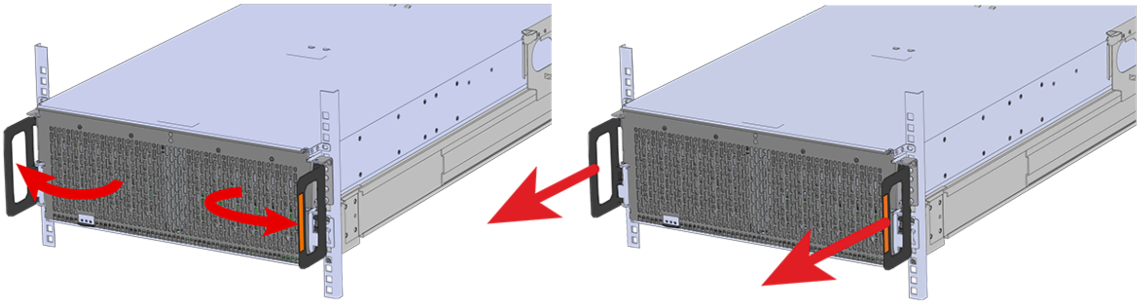
Step 10: To unlatch the rear fan from the fan housing, use one hand to press the clip at the top and bottom of the fan and pull to free it from the chassis and remove it.

Figure 177: Uninstalling the Rear Fan



Step 11: Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. The safety latches will prevent the enclosure from coming out of the rack completely and the cover will remain in the rack attached to the rear alignment brackets.

Figure 178: Chassis Handle Operation



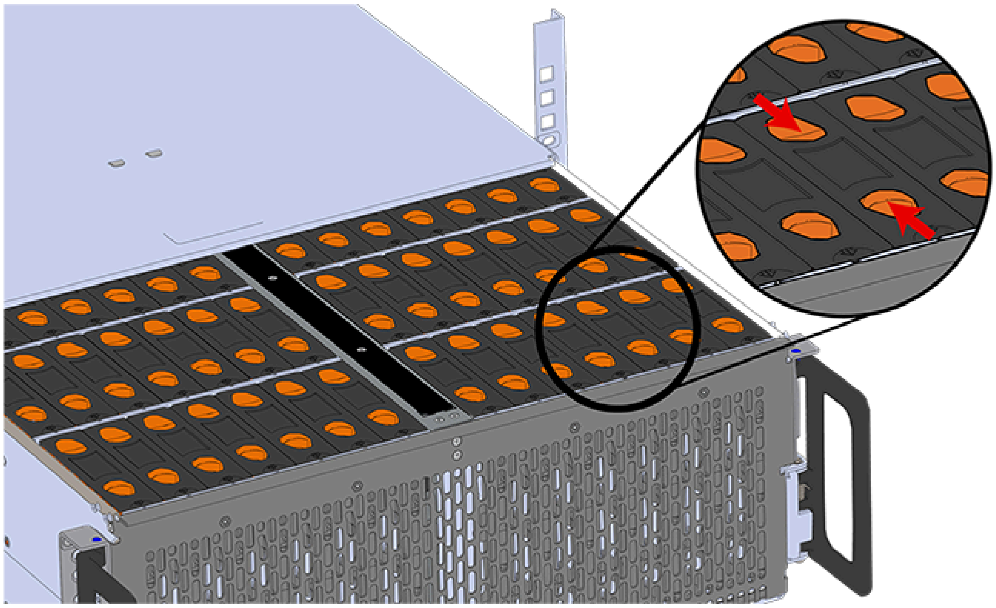
Step 12: Remove all of the drives from the chassis before uninstalling the chassis. Be prepared to label the drives as they are removed so they can be reinstalled in the same location in the new chassis.

Step 13: Follow these steps to remove a 3.5in HDD Assembly.

a. Find the latch release mechanism on the 3.5in HDD Assembly being removed.

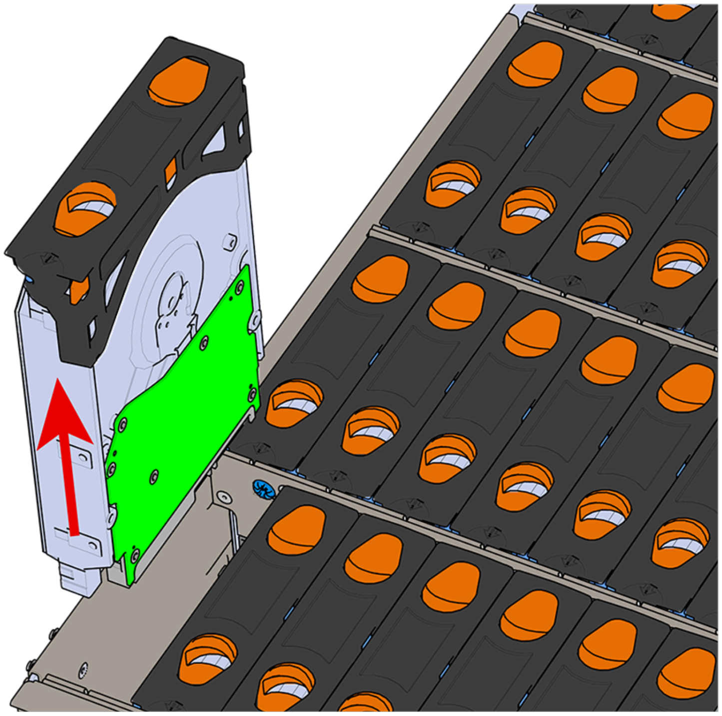
b. Insert a finger and a thumb into the latch release and pinch to unlatch the 3.5in HDD Assembly.

Figure 179: Unlatch Drive Carrier (IOM Not Shown)



c. Lift the 3.5in HDD Assembly free from the enclosure.

Figure 180: Removing 3.5in HDD Assembly

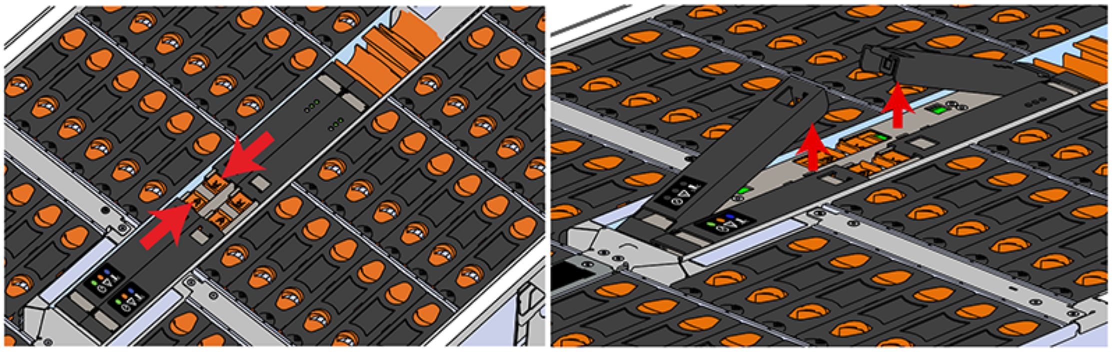


Step 14: Follow the previous step for each drive in the enclosure. Attach a label or mark the drives with the drive slot they were removed from in order to add them to the same slot in the future. Store the drives in an ESD safe location until the drives are ready to be installed back into an enclosure.

Step 15: Uninstall the IOM(s).

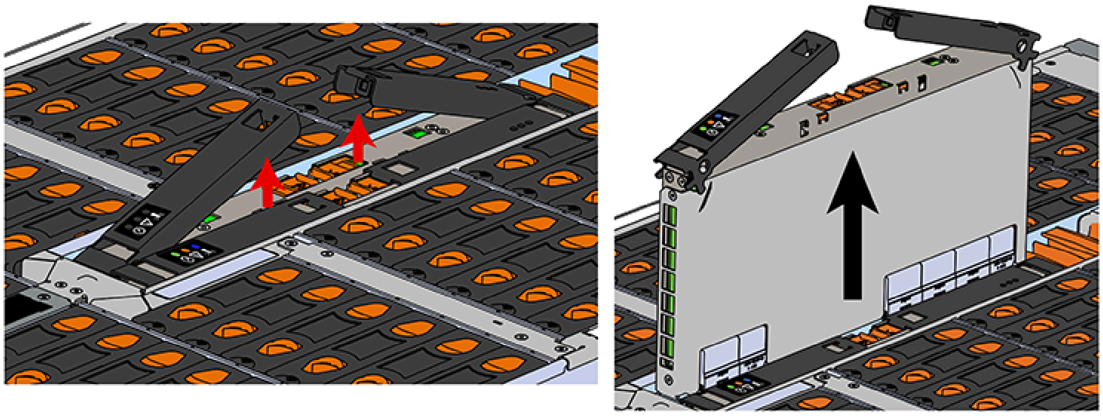
a. Locate the latch release on the IOM and press it in the direction shown in the following image.

Figure 181: Unlatching the IOM



b. Grasp both handles, one handle in each hand, and lift evenly with both hands to ensure the IOM comes out straight. This will prevent any damage to the pins on the internal connectors.

Figure 182: Removing IOM

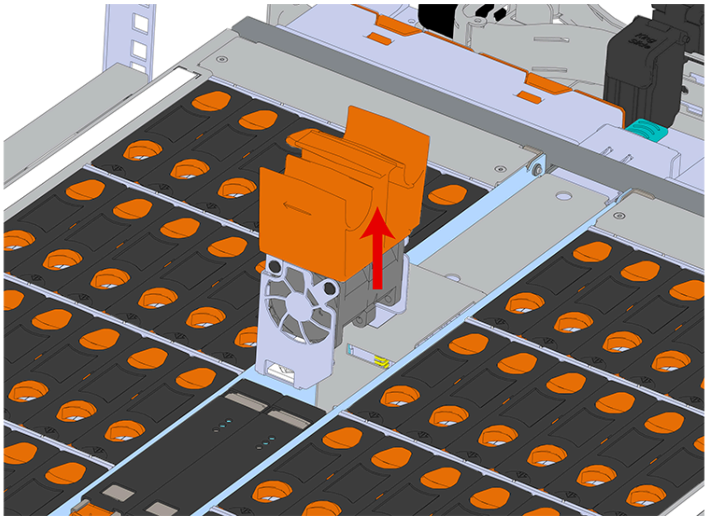


Step 16: Remove the second IOM.

Step 17: Remove the IOM Fan.

a. With one hand, grasp around the center square of the fan housing as shown in the following image.
b. Pinch the IOM fan housing to release the latching mechanism and pull it straight out from the chassis.

Figure 183: Removing IOM Fan

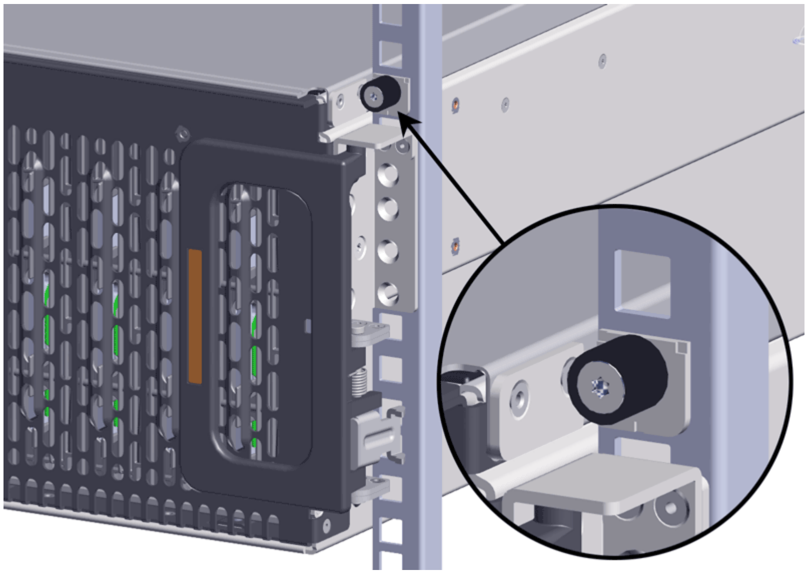


Step 18: Release the safety latch on the inner rails on each side of the chassis as shown in the following image.

Figure 184: Inner Rail Safety Latch Release

Step 19: Push the chassis back into the rack.

Step 20: Locate the M5 thumb-screws on the top cover of the enclosure that keep it in place when the drawer is extended, and unscrew them using a T15 Torx screwdriver. This will allow the top cover to move freely with the enclosure when the enclosure is removed.



Step 21: Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. Make sure that the top cover comes with the chassis as it is extended out of the rack. The safety latches will prevent the enclosure from coming out of the rack completely.

Step 22: Remove the chassis from the rack.

a. Be prepared to support the enclosure once it is free of the rails by having a second person or a lift to support the enclosure

b. Grasp both handles at the front of the enclosure and pull with even pressure until the enclosure will not extend further.

Warning: The handles on the front of the chassis are not intended to be used to support the weight of the Ultrastar Data102 . Lifting the unit by the chassis handles or trying to support the unit on the handles can cause them to fail. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

c. Locate the safety catches on the inner rails attached to the enclosure.

Figure 186: Safety Latch Release

d. Depress the latch release lever for the safety latches on the rail and push the chassis very slightly forward. The chassis is now unsecured from the rack.

e. Ensure that you have the proper support mechanism to hold the chassis in position, whether that be a team lifting partner or an appropriate lift.

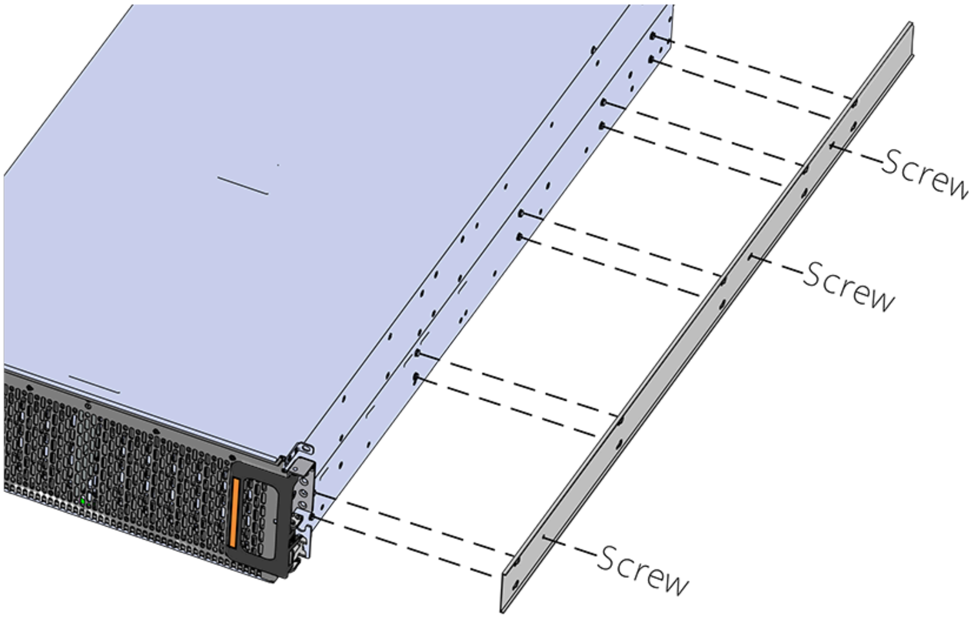
Warning: Do not lift the chassis by the Cable Tray while removing the chassis from the rack OR while installing it into a rack. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

f. Slide the chassis forward to free it from the rails. Place the chassis in a safe location to avoid damage.

Step 23: Uninstall the inner rails from the sides of the chassis.

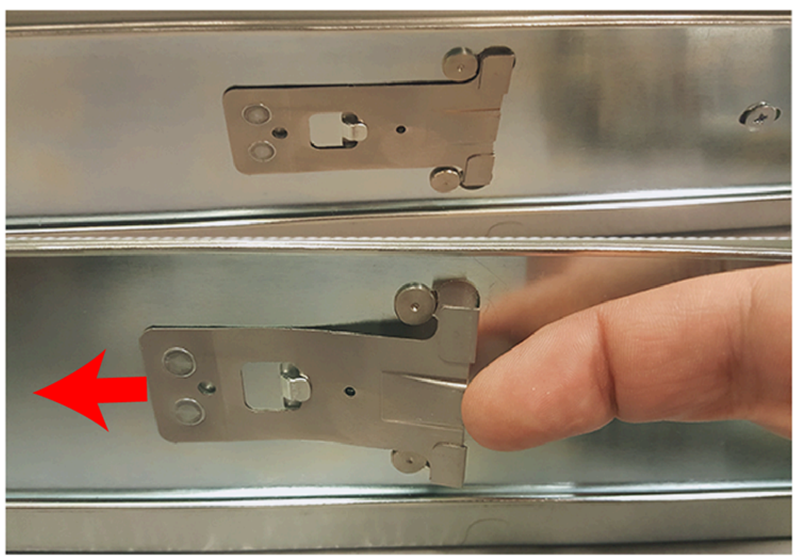
a. Unscrew the three Low-Profile M4 x 3.2mm Philips screws that attach the inner rails to the chassis using a #2 Philips head screwdriver.

Figure 187: Remove Inner Rail



b. Locate and unlatch the springlock on the side of the inner rail.

Figure 188: Inner Rail Spring Latch

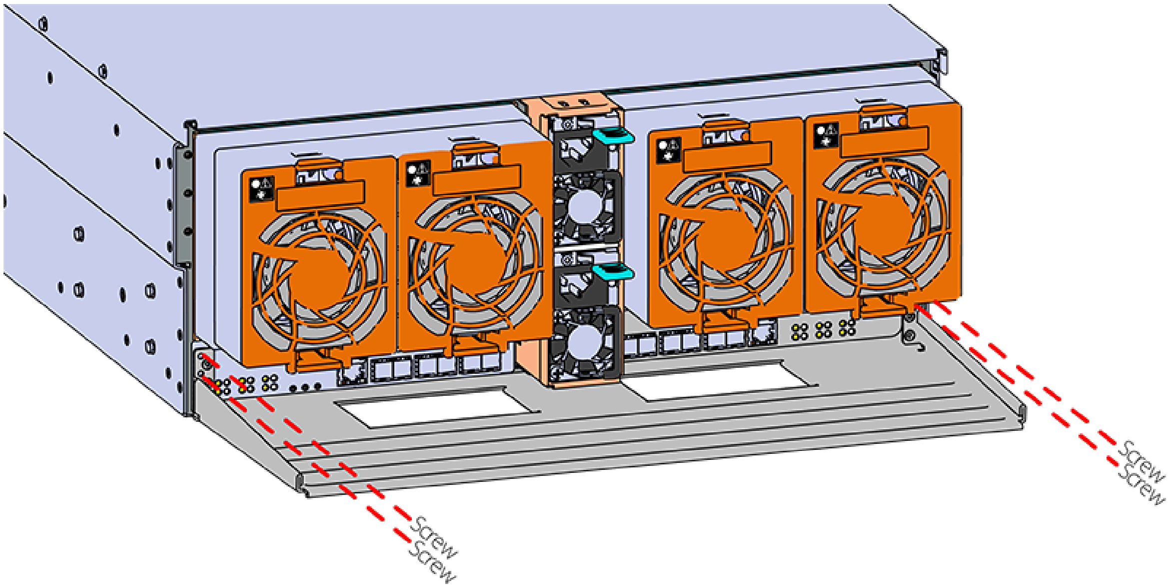


c. Slide the inner rail toward the front of the enclosure to unlock it from the pegs that secure it to the sidewall and pull it free.

Note: Follow the next step if the cable tray was installed.

Step 24: Uninstall the Cable Tray by removing the M3 x 8mm screws using the long T10 Torx head screwdriver.

Figure 189: Uninstalling the Cable Tray



Caution: Always install the top cover onto the enclosure before installing the chassis into a rack. Not having the top cover installed may damage the alignment brackets.

Step 25: Ensure the top cover is installed.

a. From the rear of the enclosure, align the top cover with the grooves on the top of the chassis.

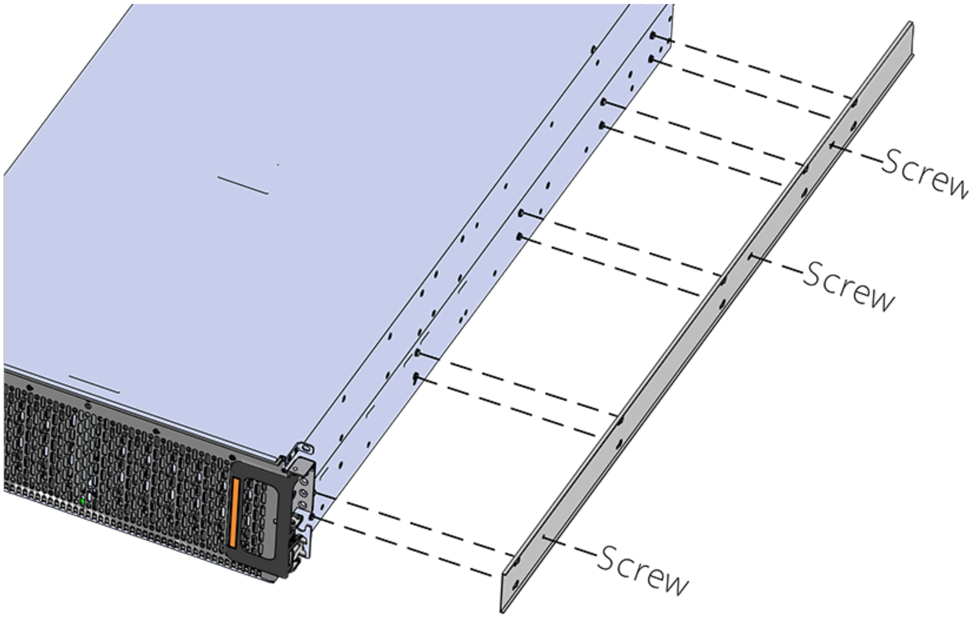
b. Ensure that there is a good catch of the top cover by the chassis and slide it in all the way.

Step 26: Install the inner rail onto the chassis making sure they are installed on the correct side. Each inner rail will read "R" for the right or "L" for the left embossed on the side that faces away from the chassis. Right and Left are with reference to looking at the front of the enclosure.

a. Orient the inner rails so that the flat side is facing the enclosure and the side with the grooves is facing away from the enclosure.

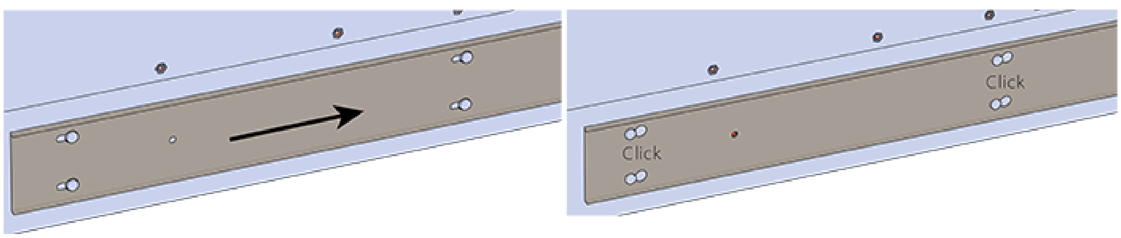
b. Align the keyholes on the inner rail to the mounting pegs on the side of the enclosure and press the inner rail flush against the chassis. If the keyholes don't line up with the pegs, flip the rail length-wise to see if this will align them.

Figure 190: Inner Rail Attachment



c. Slide the inner rail toward the rear of the chassis to lock it in place. There will be an audible click and the mounting pegs will cover the front part of the keyhole.

Figure 191: Slide Inner Rail



d. **Caution:** When installing the inner rail onto the chassis, make sure to only use the special Low-Profile M4 x 3.2mm Philips screws provided in the accessory kit with the CMA. These screws should be tightened to .90-1.12 Nm / 8-10 in-lbf using a # 2 Philips Screwdriver. These screws are specially designed for this purpose. Using unapproved screws could cause damage to the slides inside the rail.

Install the three special low-profile M4 x 3.2mm Philips screws provided to secure the inner rail to the chassis.

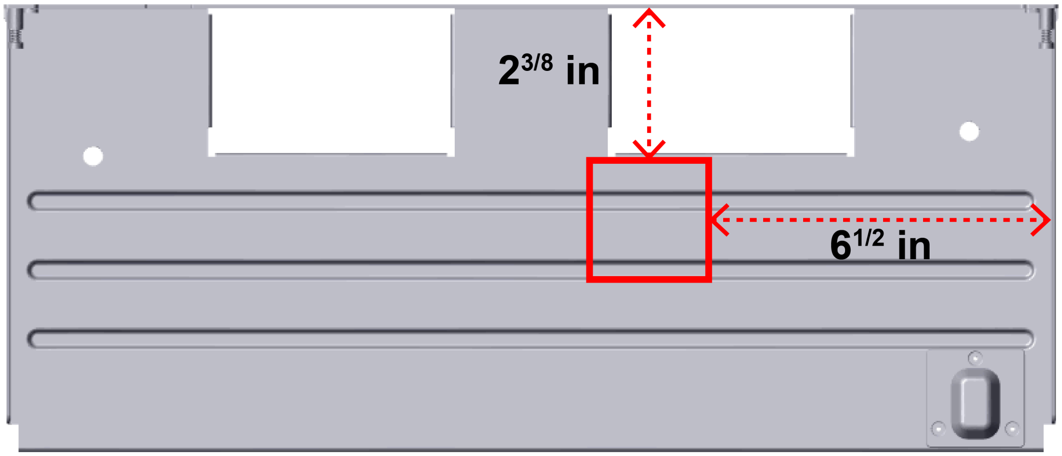
e. Follow these steps for the second inner rail on the opposite side of the enclosure.

Step 27: Attach a cable tie mount to the cable tray.

a. Clean the surface of the cable tray, under the mounting area, with isopropyl alcohol and allow to dry.

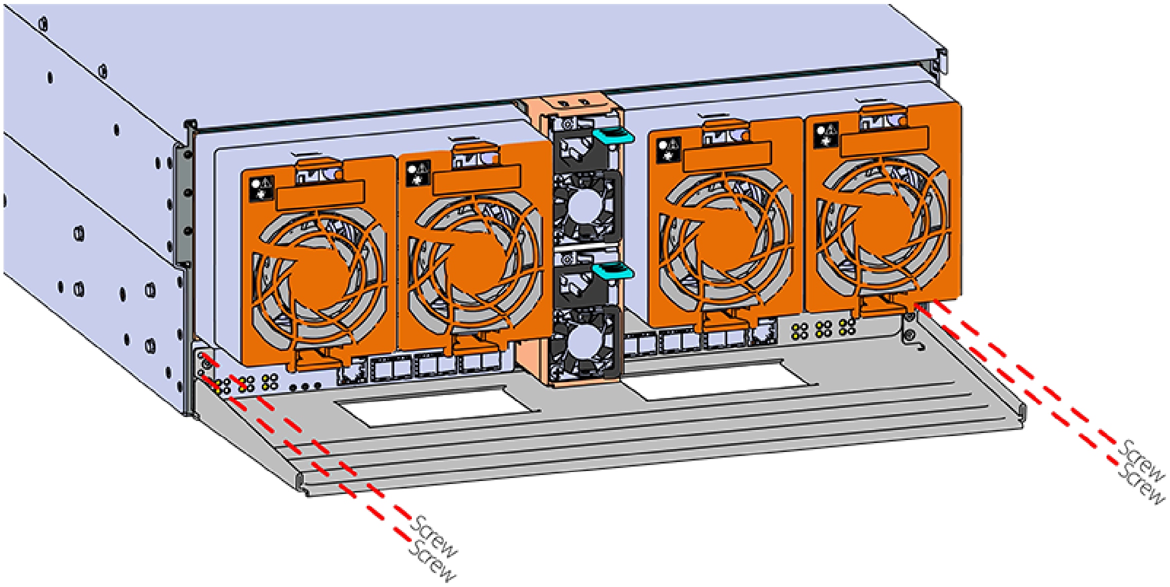
b. Adhere a cable tie mount in the approximate location shown in the following diagram:

Figure 192: Cable Tie Mount Location



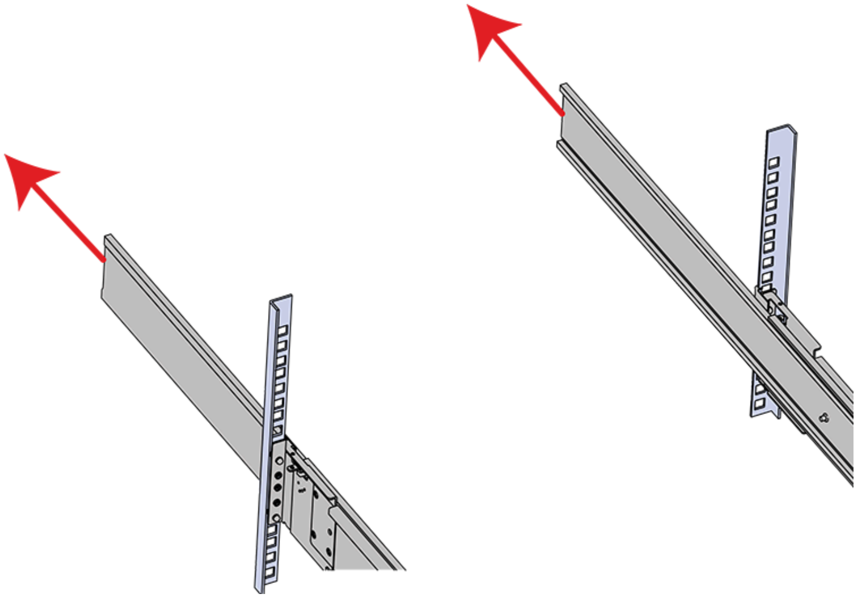
Step 28: Secure the cable tray onto the enclosure using the included M3 x 8mm T10 Torx screws and the Long T10 Torx Screwdriver. These screws should be tightened to .33-.56 Nm / 3-5 in-lbf.

Figure 193: Installing the Cable Tray



Step 29: Extend the mid-rails out of the rack so that they are protruding from the front of the rack and the safety latches engage.

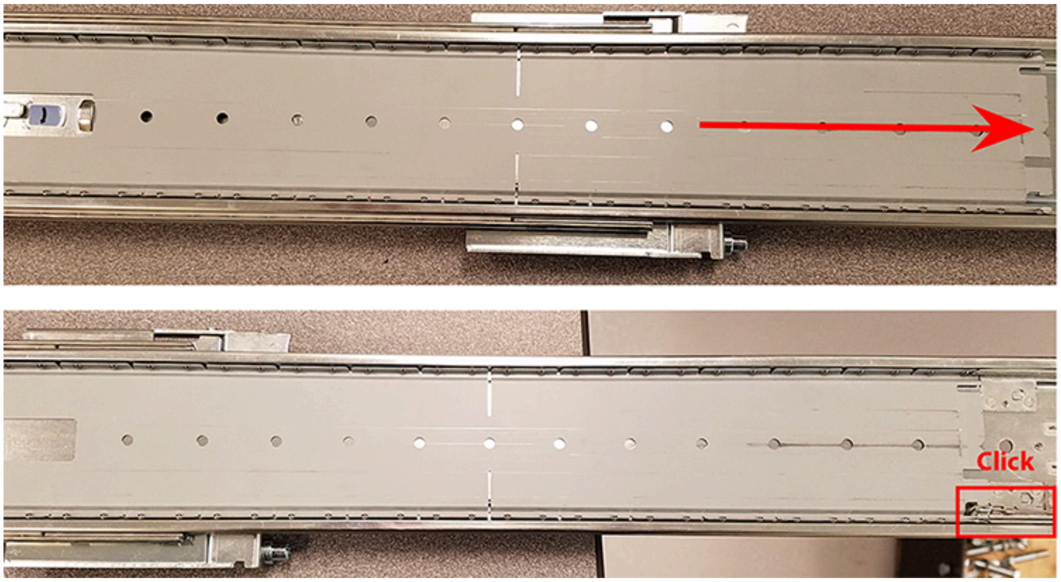
Figure 194: Extend Mid-Rails



Step 30: Install the chassis into the rails.

a. Extend the bearing plates on the inside of the mid-rails until they are fully forward (detent has engaged). This prevents potential damage due to improper mating of the rails.

Figure 195: Bearing Plate



b. **Caution:** This step in the installation requires a minimum of 3 individuals to install safely, two to lift and one to guide the others who may have difficulty seeing because the enclosure is in the way. Ensure that the appropriate measures are taken to safely support the enclosure during installation. The enclosure MUST have no drives installed and requires a two person team lift to install. **Do not attempt to lift the system if it is fully populated with drives.** The only case in which the system may be installed or removed with the drives populated is if the facility has a lift that is rated to handle the maximum weight of the fully loaded system.

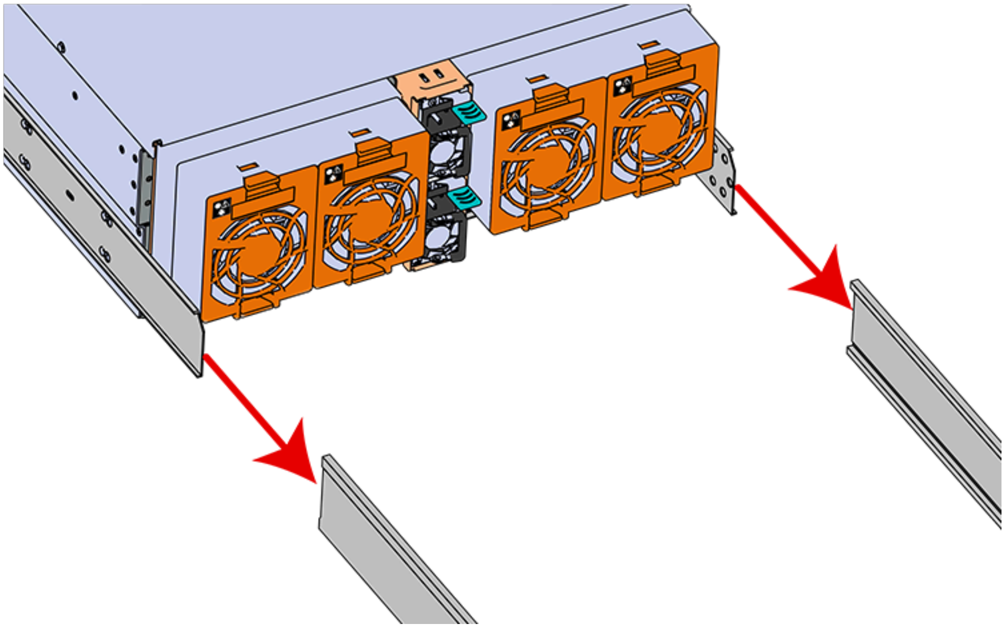
Warning: The handles on the front of the chassis are not intended to be used to support the weight of the Ultrastar Data102 . Lifting the unit by the chassis handles or trying to support the unit on the handles can cause them to fail. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

Warning: Do not lift the chassis by the Cable Tray while removing the chassis from the rack OR while installing it into a rack. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

In preparation to perform a team lift, position one individual on each side of the enclosure (to lift) and a third individual standing at the protruding rack rails (to guide the chassis to mate with rack rails).

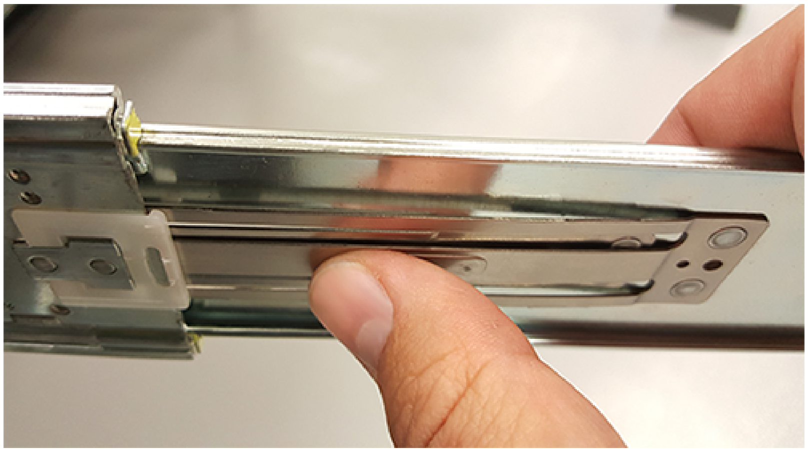
c. Team-lift the enclosure until the inner rails (which are attached to the chassis) align with the extended mid-rails (which are attached to the rack), and guide the inner rails on the chassis to mate with the rack rails.

Figure 196: Installing the Chassis



d. Once the rails are mated properly, slide the enclosure into the rack until it is stopped by the safety catch on the rails. Push the release lever on the safety latch (located on the side of each of the rails), and push the enclosure the rest of the way into the rack.

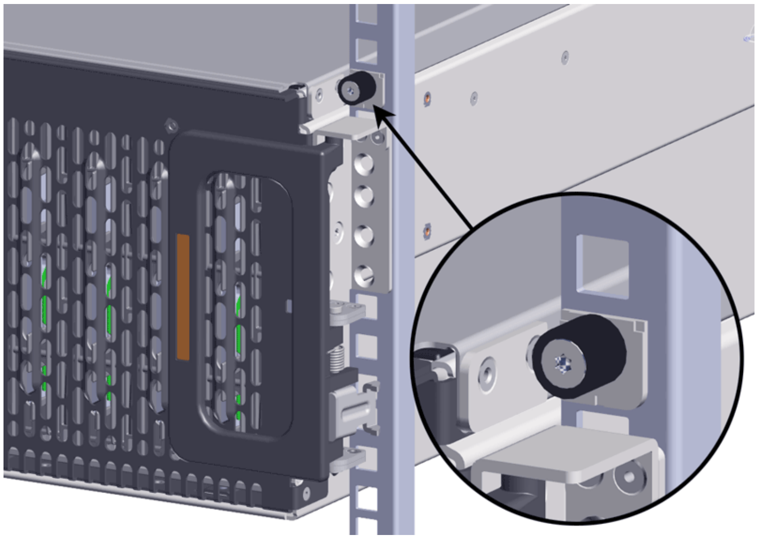
Figure 197: Safety Latch Release



e. As the chassis is slid into the rack, position one installer at the rear of the rack to ensure that the pegs on the sides of the cover will slide correctly into the rear cover alignment brackets on both sides of the rack. If the chassis does not install smoothly or snags, check that the rear cover alignment brackets are not interfering with the chassis sidewalls, and try again.

Step 31: Secure the chassis top cover to the rack using the captive M5 thumb-screws as shown in the following image. Use a T15 Torx screwdriver, and tighten the screws to 3.38-3.61 Nm / 30-32 in-lbf.

Figure 198: Cover Retention Screws



Step 32: Now that the chassis is installed, test the installation by sliding the enclosure in and out of the rack a minimum of three times. If the enclosure binds, catches, or displays any incorrect motion or behavior repeat the installation.

> **Note:** Adjustments of the vertical rack rails may be required to fix any issues that may occur.

Step 33: Install the CMA(s).

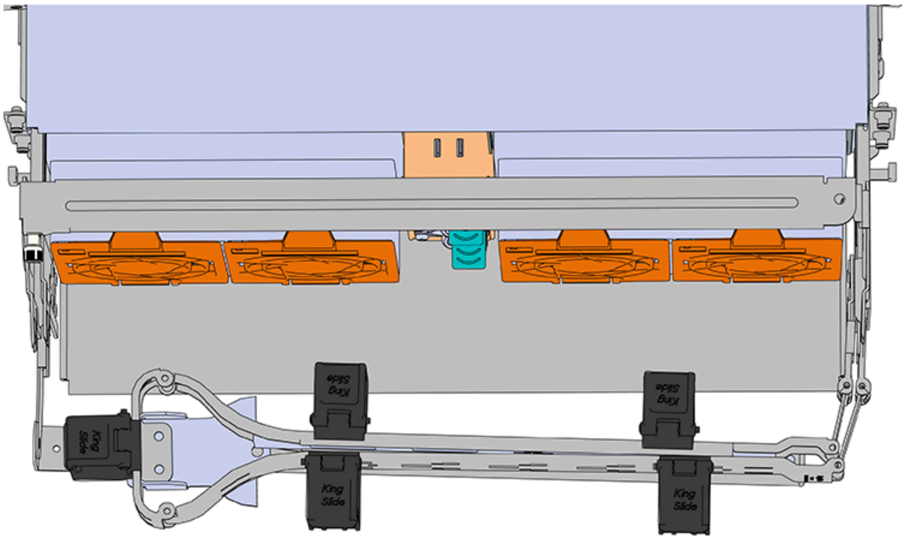
> **Note:** The standard CMA has two arms, labeled "upper" and "lower." The lower arm should have the elbow on the left side and be installed first; the upper arm should have the elbow on the right side and be installed last.

> **Note:** CMA Lite has one arm, to be installed at the lower position. This arm should have the elbow on the left side.

a. Orient the CMA so that the elbow is on the left hand side.

b. Attach all three of the connectors to the brackets on the rails. There should be one at the elbow side and two at the other end.

Figure 199: Lower CMA Orientation

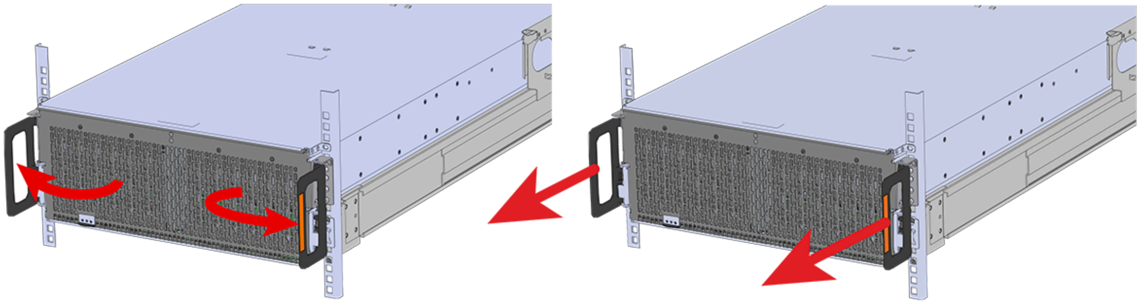


c. Slowly slide the enclosure forward to ensure the arm is operating properly, then slide it back into the rack.

d. **CMA Standard:** Repeat these steps to install the upper arm with the elbow facing to the right.

Step 34: Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. The safety latches will prevent the enclosure from coming out of the rack completely and the cover will remain in the rack attached to the rear alignment brackets.

Figure 200: Chassis Handle Operation

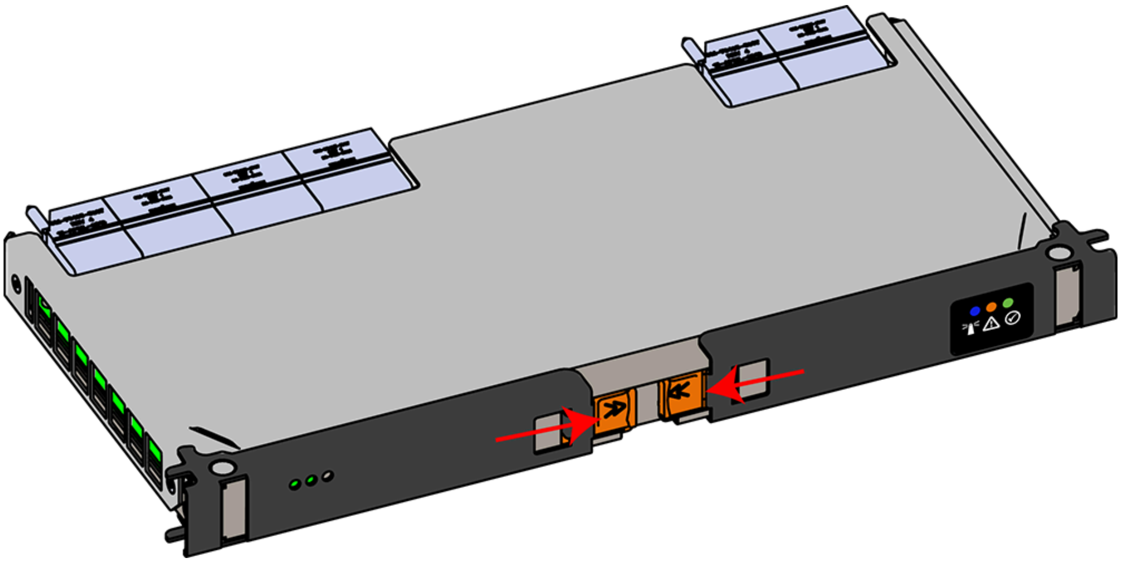


Step 35: Install the IOM.

Caution: If a pin on the IOM's internal connectors is bent or damaged, the IOM will have to be replaced. For this reason it is imperative that the IOM is not forced into position, that it is inserted straight, and that the directions for installing the IOM are followed exactly.

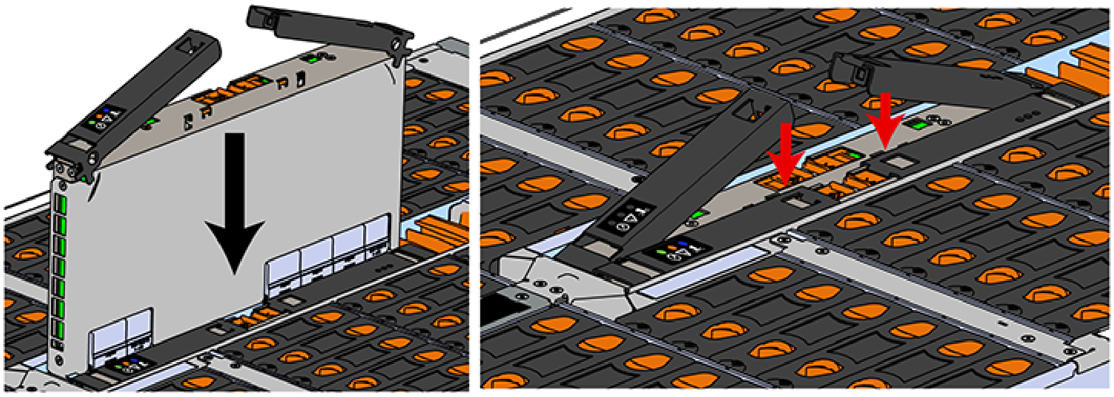
a. Ensure that the handles on the IOM are not latched. To unlatch them, press the latch release in the direction shown in the following image.

Figure 201: Unlatching IOM Handles



b. Align the IOM with the empty slot on the top of the chassis so that the arrow on the IOM latch release is facing toward the side shown in the following image.
c. Slowly lower the IOM into the empty slot while being careful to keep it level. Do not to force it.

Figure 202: Installing the IOM



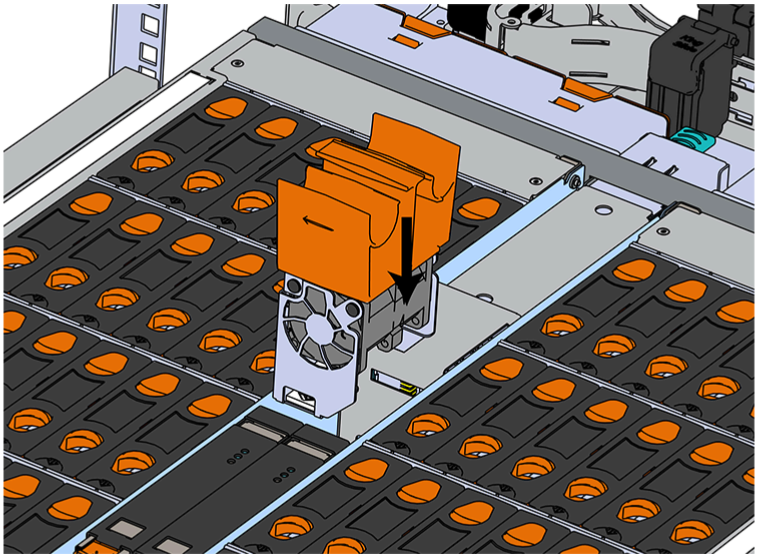
d. When the IOM is lowered fully, apply light pressure with both hands evenly on the IOM body, not the handles, to seat the IOM in the connector. If the IOM won't seat correctly, **DO NOT FORCE IT**. Instead, back the IOM out, check the pins to make sure none are damaged, and try again.
e. Once the IOM is seated properly in the slot, close the handles until they latch closed.

Step 36: Install the second IOM using the same method as the first.

Step 37: Install the IOM Fan.

a. Align the IOM Fan as shown in the following image.

Figure 203: Installing the IOM Fan



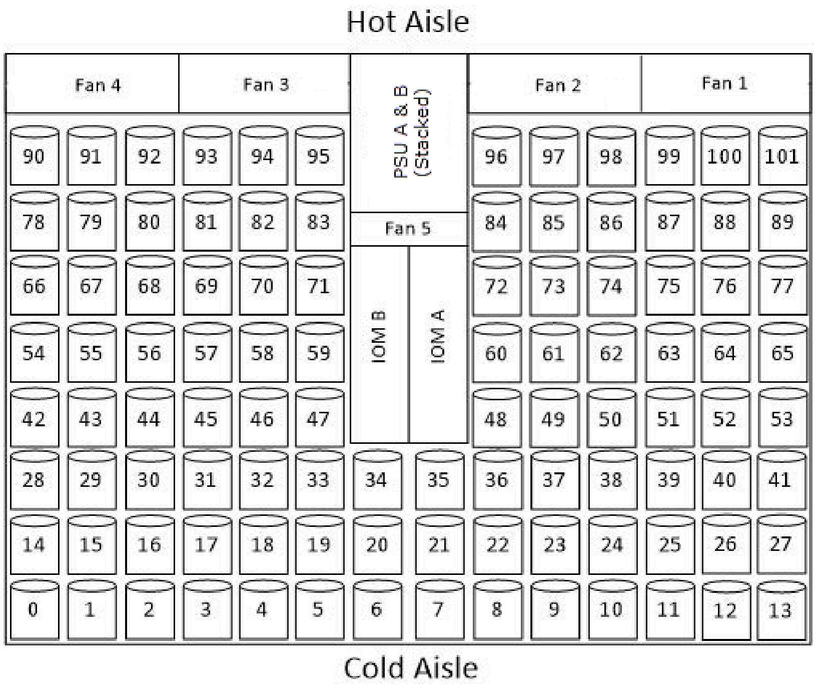
b. Pinch the latch release mechanism slightly and carefully lower the IOM Fan into the slot.

Installing the 3.5in HDD Assembly

Note: The 2.5in SSD Assembly is installed in the same manner as the 3.5in HDD Assembly. For instructions on assembling the 2.5in SSD Assembly, see Operating the 2.5" Drive Carrier *(page 65)*.

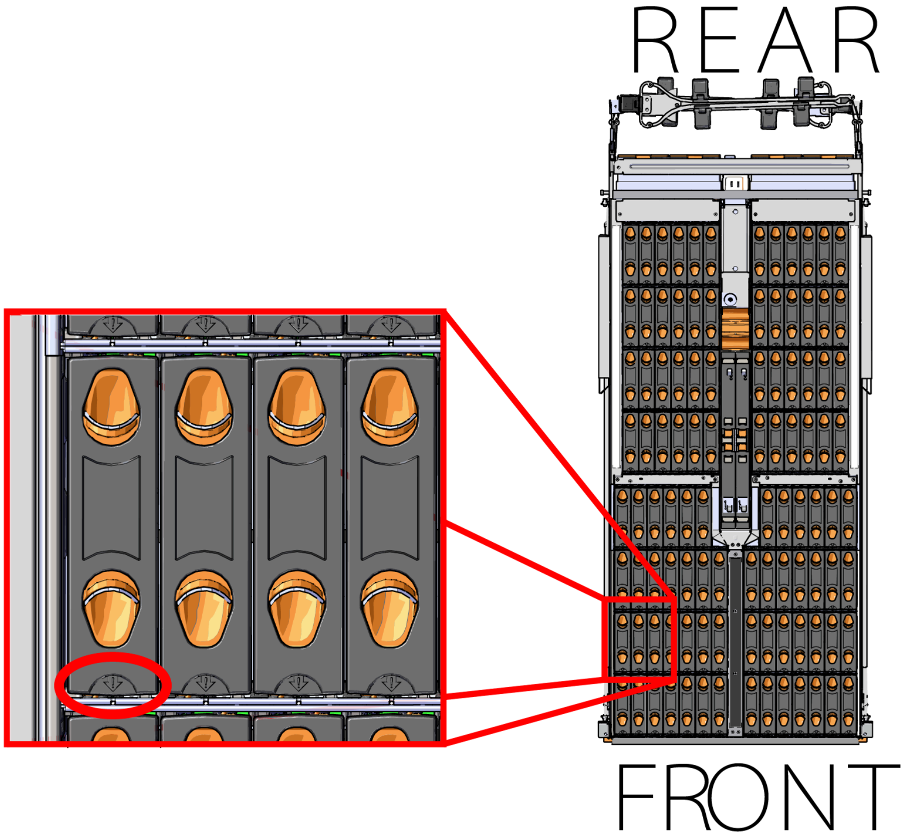
Note: When installing drives, populate the enclosure from left-to-right, rear-to-front. For example, begin with slot 90 (as shown in the following diagram), continue through 101, then proceed with 78 through 89, and so on:

Figure 204: Drive Layout



Note: When installing drives, ensure that the LED pointer on the top of the drive carrier points toward the front of the enclosure, as shown in the following image:

Figure 205: LED Pointer Orientation



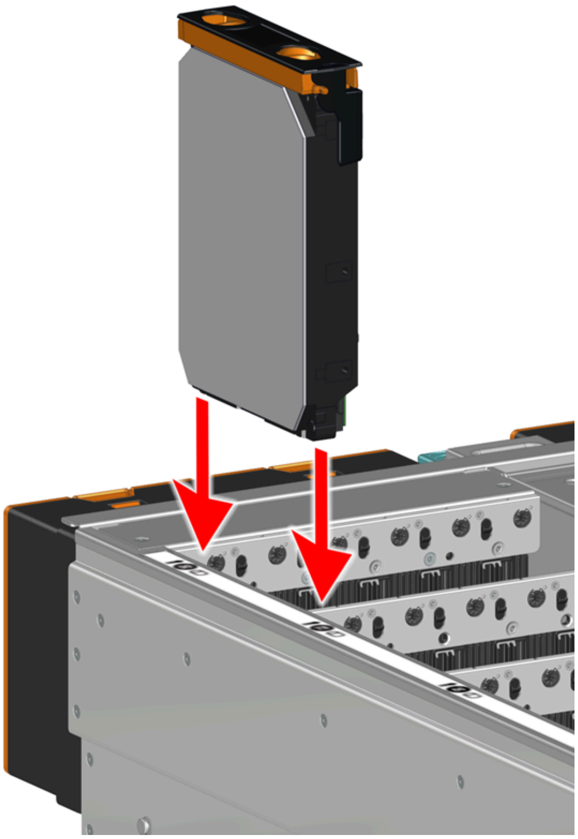
Caution: To ensure proper airflow for enclosure cooling, all drive slots must be populated with either drives or drive blanks.

Step 38: Ensure that the enclosure has been pulled out of the rack until the rail latches engage.

Step 39: Install each drive in the place it was removed from by following the labels or marks that were added earlier.

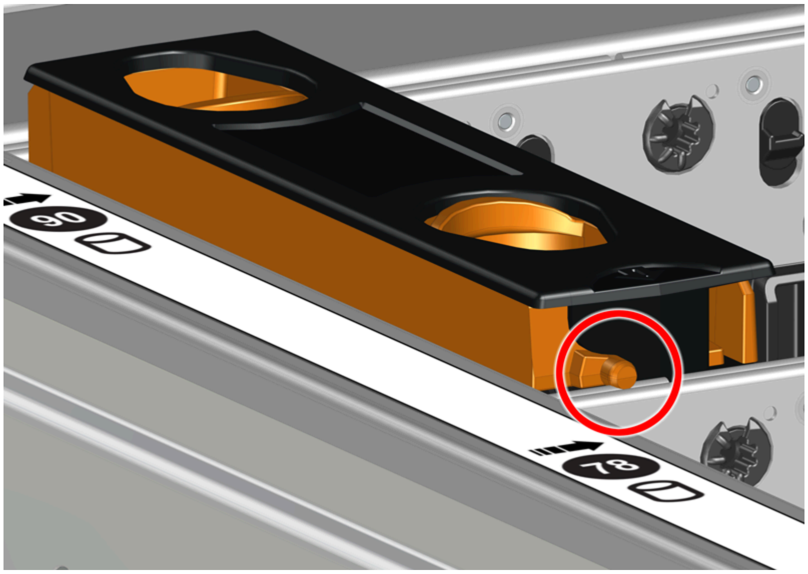
Step 40: Align the drive with the empty slot that will receive it. Lower it into the slot, ensuring that it stays level and does not bind.

Figure 206: Inserting a 3.5in HDD Assembly



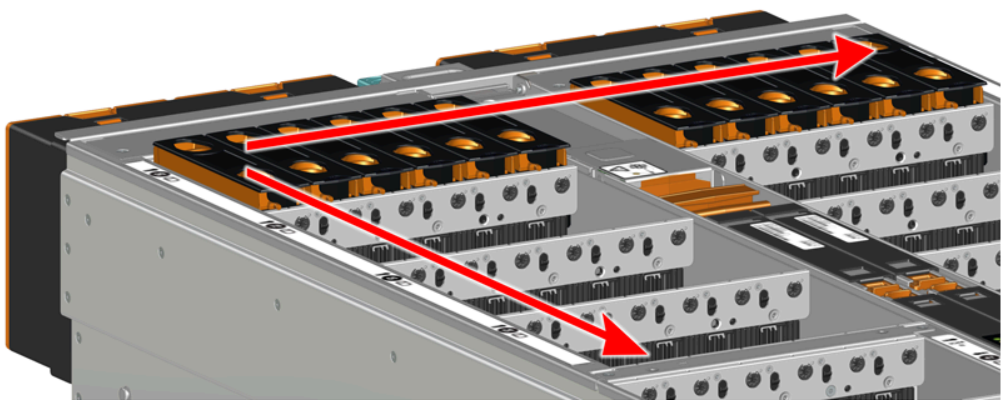
Step 41: Lower the drive until the spring-loaded posts on the carrier contact the top edges of the drive slot. This is an intermediate position; the drive assembly will be fully seated later on.

Figure 207: Intermediate Install Position



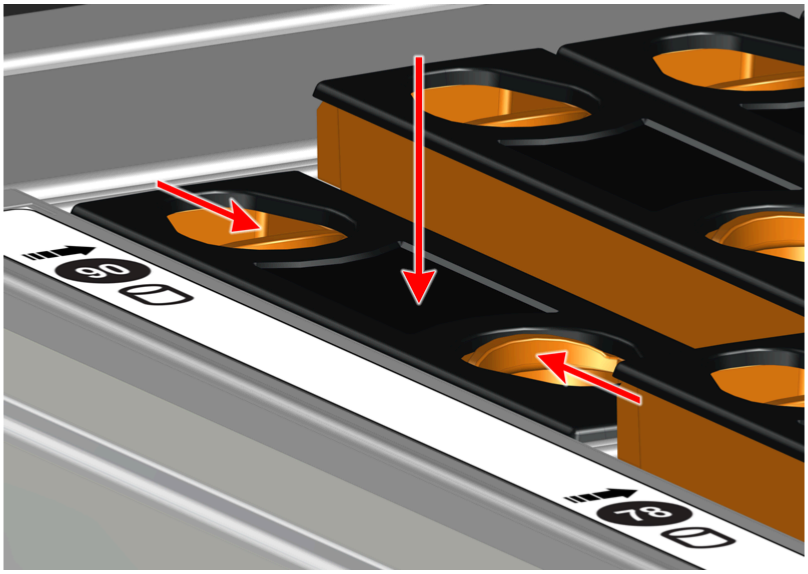
Step 42: Repeat this intermediate installation for the remaining drive assemblies, populating the enclosure from left-to-right, rear-to-front.

Figure 208: Populating the Enclosure



Step 43: Returning to the first drive assembly, pinch the latch release and carefully press downward to fully seat the 3.5in HDD Assembly into the drive slot.

Figure 209: Seating the 3.5in HDD Assembly



Step 44: Repeat this action to fully install the remaining drive assemblies in the same order, from left-to-right, rear-to-front.

Step 45: If the chassis is being installed into a rack that will be shipped fully assembled, you **must** install eight (four per side) of the included M5 x 12mm T15 Flat Head Torx screws into the two brackets at the front of the chassis in the following locations. These screws should be tightened to 3.38-3.61 Nm / 30-32 in-lbf using a Long T15 Torx Screwdriver. If this chassis will not be installed into a rack for shipping purposes, skip this step and move on to the next one.

Figure 210: Shipping Bracket Screw Locations (CMA Standard)

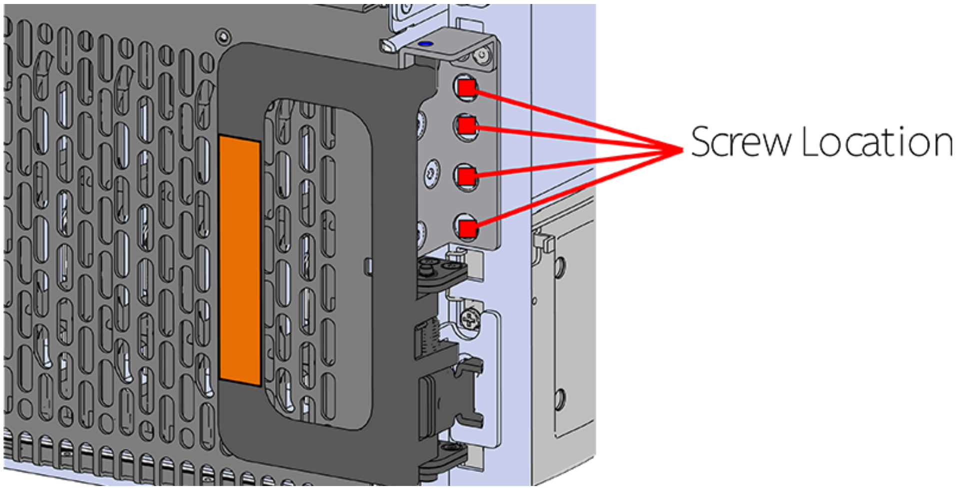


Figure 211: Shipping Bracket Screw Locations (CMA Lite)

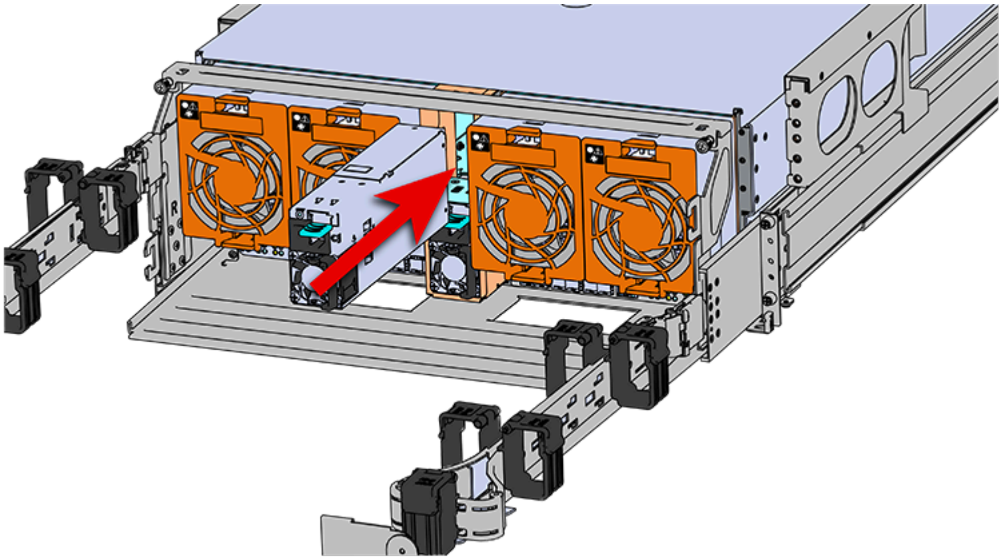
Step 46: Install the PSU.

Note: The Artesyn PSU requires 3000 series firmware or later.

a. Align the PSU in the orientation shown in the following image.

b. Slide the PSU into the slot until it seats fully into the chassis.

Figure 212: Installing the PSU (Delta PSU shown)



c. Plug the power cable into the receptacle at the back of the PSU.

d. Attach the cable retention mechanism.

For the Delta PSU, loop the retention clip around the power cable and pinch it until the clip catches and locks in place. Then slide the retention clip forward until it stops near the cable connector. Doing this will ensure that the retention clip functions properly in the event the cable is pulled on for some reason.

Figure 213: Delta PSU Cable Retention Clip

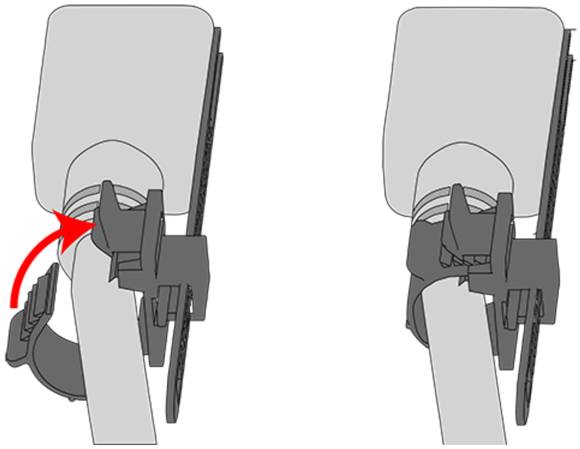
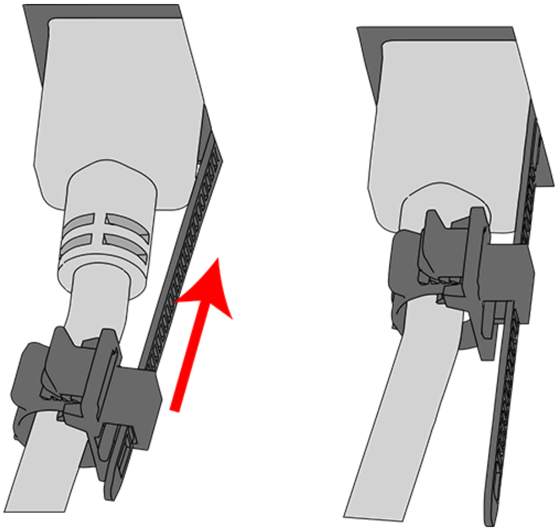
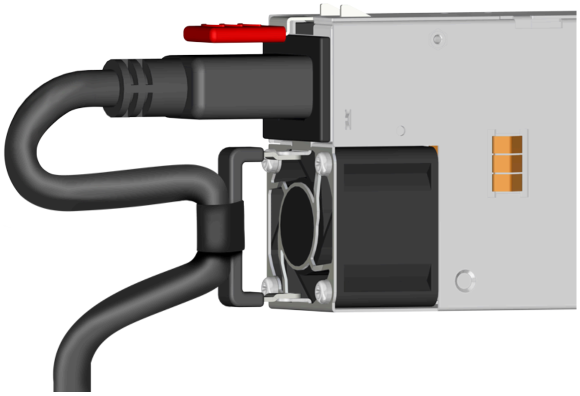


Figure 214: Cinching Cable Retention Clip



For the Artesyn PSU, secure the power cable to the PSU handle with the velcro retention strap as shown in the following image.

Figure 215: Artesyn PSU Cable Retention Strap

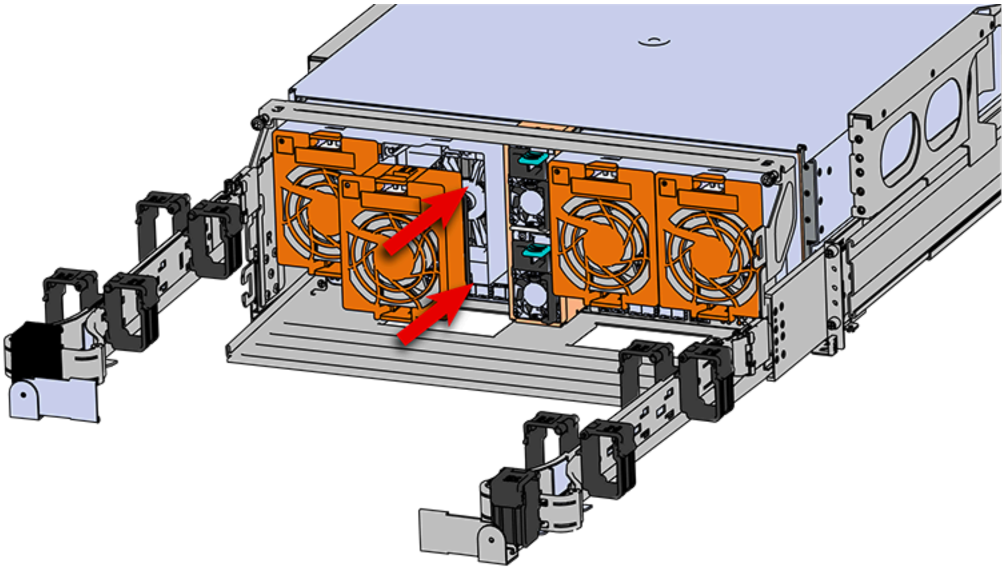


Step 47: Install the second PSU.

Step 48: Install Rear Fan

a. Orient the rear fan as shown in the following image.
b. Insert the rear fan into the housing as shown in the following image.

Figure 216: Installing the Rear Fan



Step 49: Install the rest of the rear fans into the rear of the enclosure.

Step 50: Install the CMA(s).

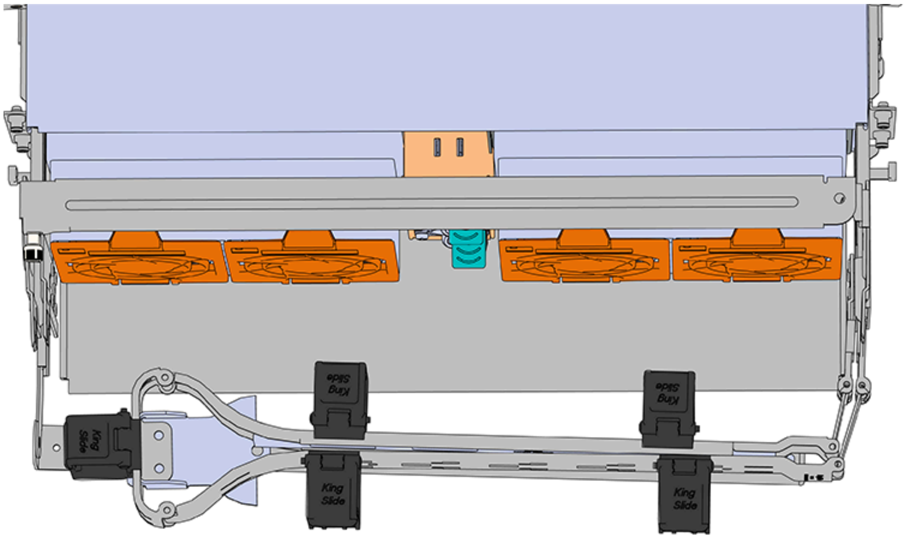
Note: The standard CMA has two arms, labeled "upper" and "lower." The lower arm should have the elbow on the left side and be installed first; the upper arm should have the elbow on the right side and be installed last.

Note: CMA Lite has one arm, to be installed at the lower position. This arm should have the elbow on the left side.

a. Orient the CMA so that the elbow is on the left hand side.

b. Attach all three of the connectors to the brackets on the rails. There should be one at the elbow side and two at the other end.

Figure 217: Lower CMA Orientation



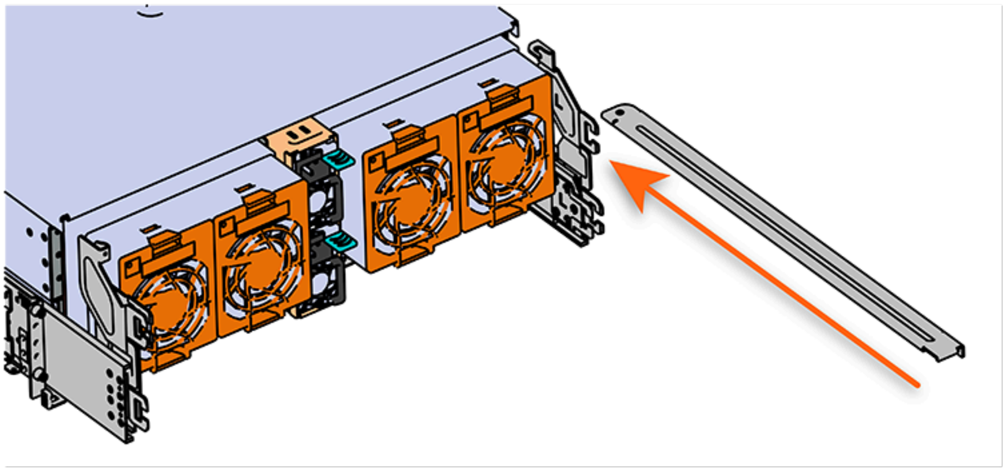
c. Slowly slide the enclosure forward to ensure the arm is operating properly, then slide it back into the rack.

d. **CMA Standard:** Repeat these steps to install the upper arm with the elbow facing to the right.

Step 51: Install the crossbar onto the CMA mounting bracket.

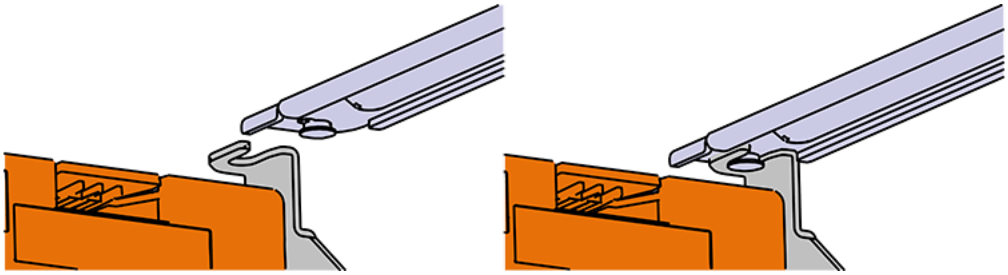
a. Align the crossbar with the mounting peg facing down and pointing toward the CMA mounting bracket.

Figure 218: Initial Alignment



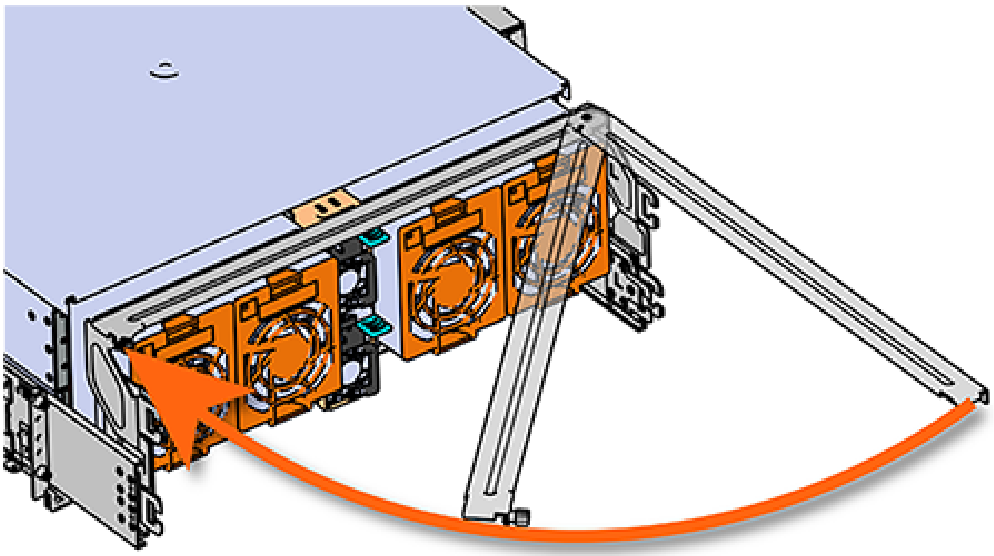
b. Insert the peg on the underside of the crossbar into the slot on the CMA mounting bracket.

Figure 219: Crossbar Underside Peg



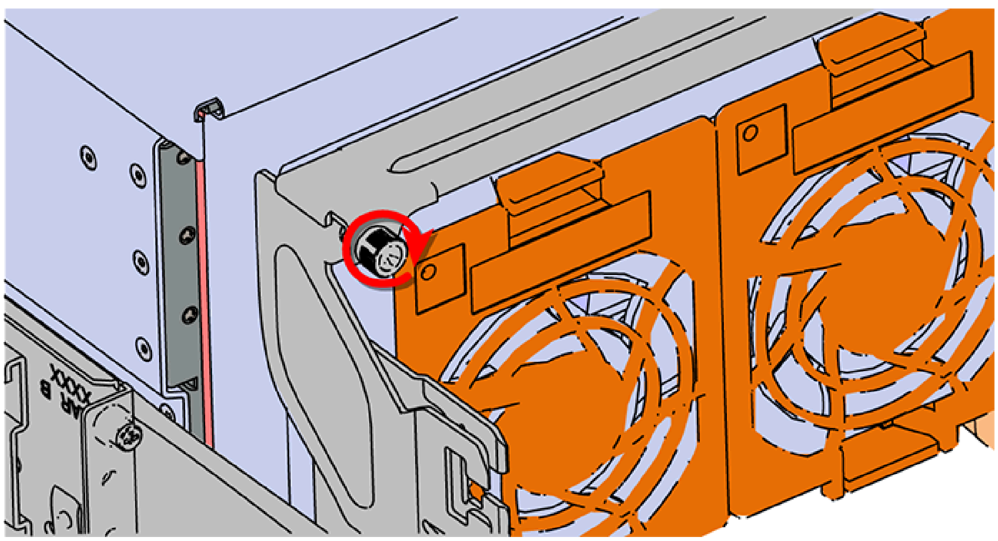
c. Swing the crossbar so that the thumbscrew lines up with the mounting hole on the opposite side of the enclosure.

Figure 220: Swinging Motion of Crossbar to Locking Position



d. Press the crossbar against the CMA mounting bracket and secure the crossbar in place by pressing and turning the thumbscrew clockwise until snug.

Figure 221: Tightening the Thumbscrew



a. Check that the crossbar is fully secured to the CMA mounting bracket by pulling on the bar to ensure it does not move.

Step 52 : Cable the CMA(s).

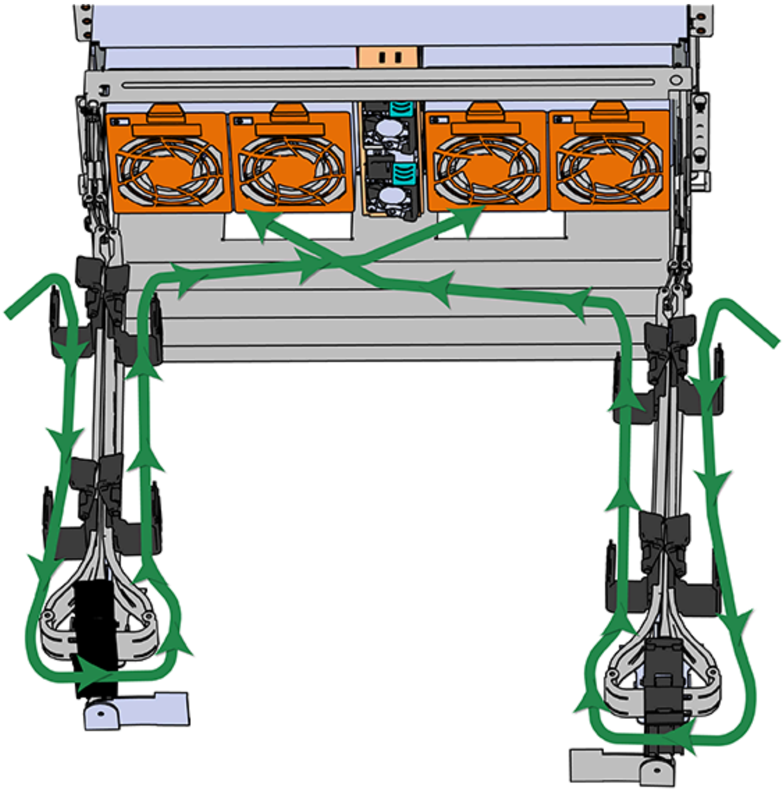
CMA Standard:

a. Unlatch the elbow side of the arm(s) by pressing the blue button labeled "push," and then swing the arm(s) open.

b. Gather the SAS, power, and Ethernet cables for installation. Before cabling, note the following routing patterns for best results:

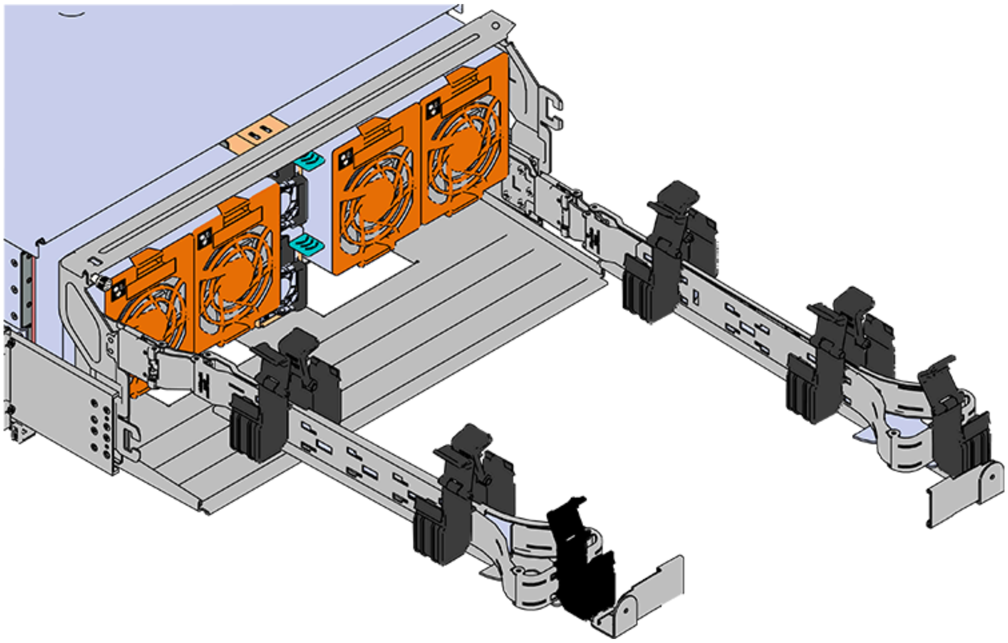
> **Note:** Route the cables supported by the lower arm to IOM A (left hand side looking at the rear). Second, route the cables supported by the upper arm to IOM B (right hand side looking at the rear) in a "criss-cross" pattern. See the Special Considerations for Cable Routing *(page 199)* for more information.

Figure 222: CMA Cable Routing



c. Open all of the baskets.

Figure 223: Open Baskets



d. Connect the Ethernet cable to the Ethernet port, and route the cable through each of the baskets on the arm.

e. Connect the SAS cables to the SAS ports, and route them through the baskets one at a time. Make sure to follow the labels to ensure they are connected to the proper ports.

f. Connect the power cable to the PSU.

> **Attention: Make sure the power cable is not connected to a PDU.** If it is, the system will power up when the cable is connected to a PSU. This is not intended at this stage of installation.

g. Attach the cable retention mechanism.

For the Delta PSU, loop the retention clip around the power cable and pinch it until the clip catches and locks in place. Then slide the retention clip forward until it stops near the cable connector. Doing this will ensure that the retention clip functions properly in the event the cable is pulled on for some reason.

Figure 224: Delta PSU Cable Retention Clip

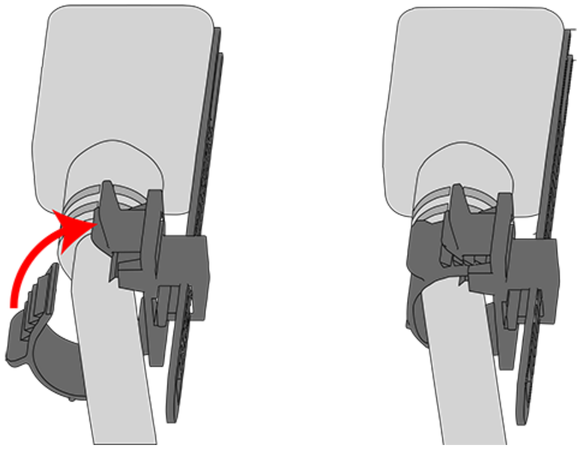
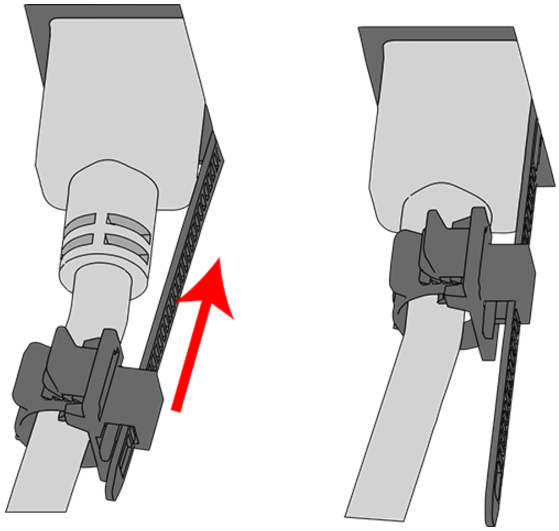
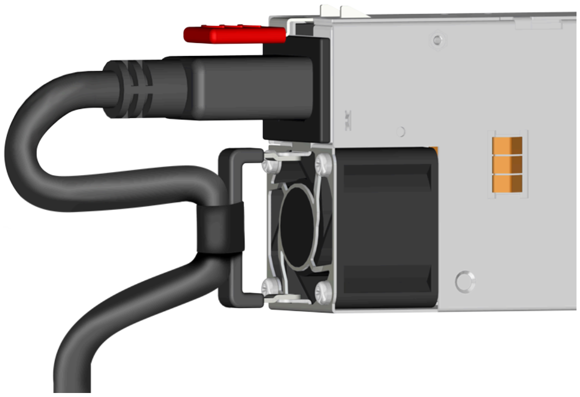


Figure 225: Cinching Cable Retention Clip



For the Artesyn PSU, secure the power cable to the PSU handle with the velcro retention strap as shown in the following image.

Figure 226: Artesyn PSU Cable Retention Strap

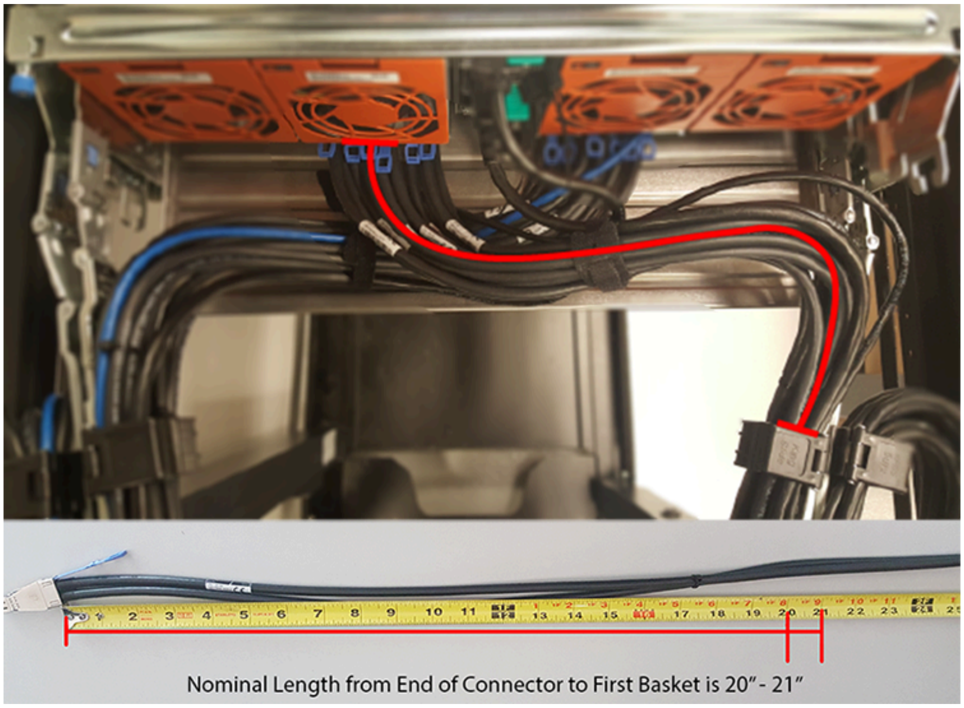


h. Route the power cable through each basket.

i. If the installation includes more than 10 total cables, follow the recommendations in Special Considerations for Cable Routing *(page 199)*, before proceeding.

> **Note:** Each cable must be given enough slack at the connector end to operate smoothly. Allow 20 - 21 in. (508 – 533.4 mm) between the connector and the first basket.

Figure 227: Nominal Cable Length at Connectors



j. Close all of the baskets.

k. If the Ultrastar Data102 is being installed in a rack and will subsequently be transported inside that rack, it is important to use the included cable tie to wrap the CMA bundle to ensure it does not get damaged during transport. If the Ultrastar Data102 is instead being installed where it will be operated, skip this step. Remember to remove the cable ties after the enclosure has reached its final operational location.

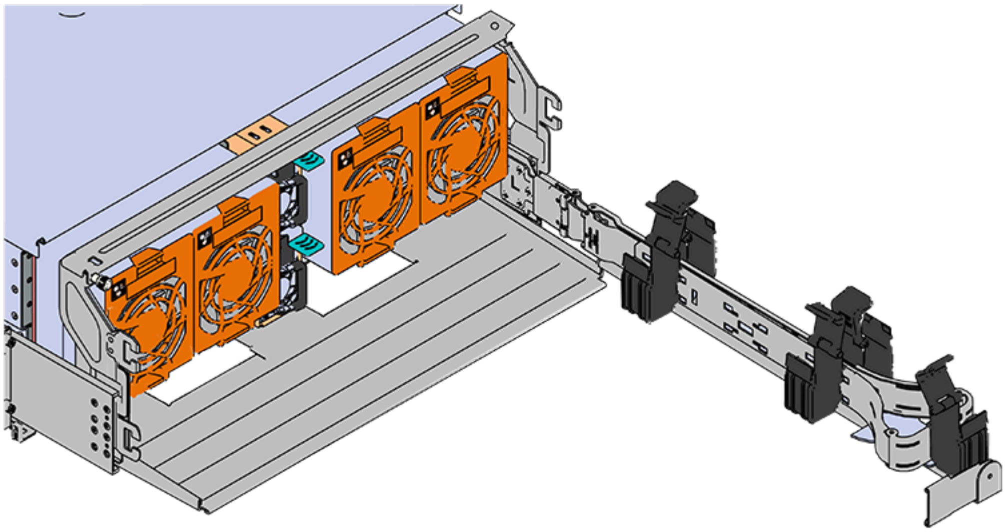
l. Reconnect the arm at the elbow to the connectors on the rail.

CMA Lite:

a. Press the blue latch button labeled "push" to unlatch the elbow side of the CMA arm, and then swing the arm open.

b. Open all of the baskets.

Figure 228: Open Baskets

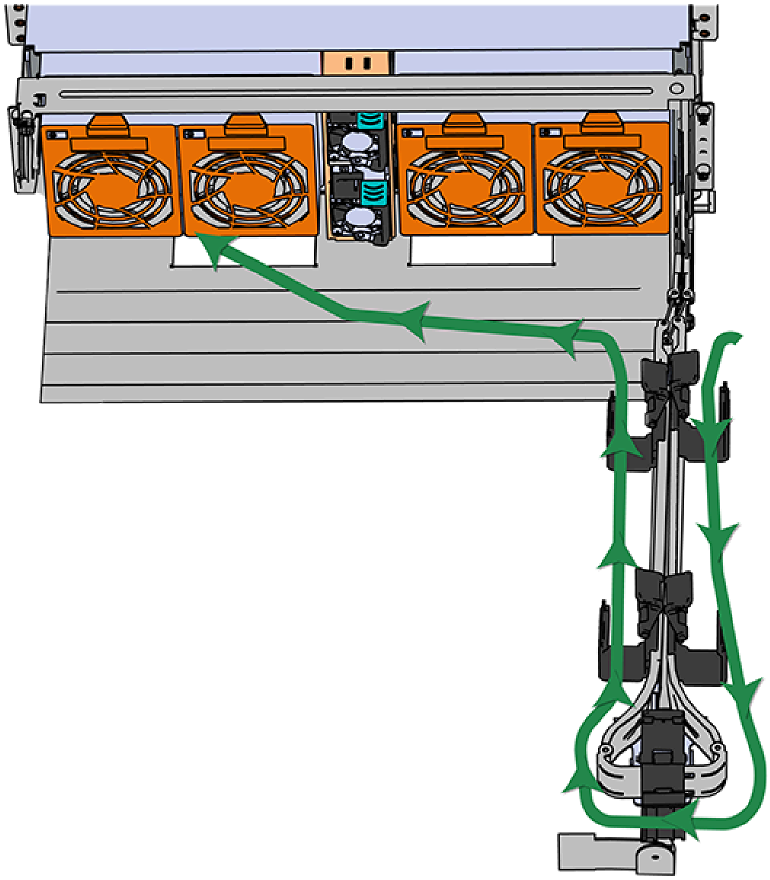


c. Gather the SAS, power, and Ethernet cables for installation.

Note: Route all cables to IOM A (left hand side looking at the rear).

d. Connect the Ethernet cables to the Ethernet ports on the left hand side of the Ultrastar Data102 , and then route the cables through each of the baskets on the arm.

Figure 229: Connected Cable Routing



e. Connect the SAS cables and route them through the baskets one at a time. Follow the labels to ensure they are connected to the proper ports.

f. **Important: Make sure the power cable is not connected to a PDU**. If it is, the system will power up when the cable is plugged into the PSU. This is not intended at this stage of installation.

   Connect the power cable to the lower PSU and route it through each basket.

g. Close all of the baskets.

h. If the Ultrastar Data102 is being installed in a rack and will subsequently be transported inside that rack, it is important to use the included cable tie to wrap the CMA bundle to ensure it does not get damaged during transport. If the Ultrastar Data102 is instead being installed where it will operated, skip this step. Remember to remove the cable ties after the enclosure has reached its final operational location.

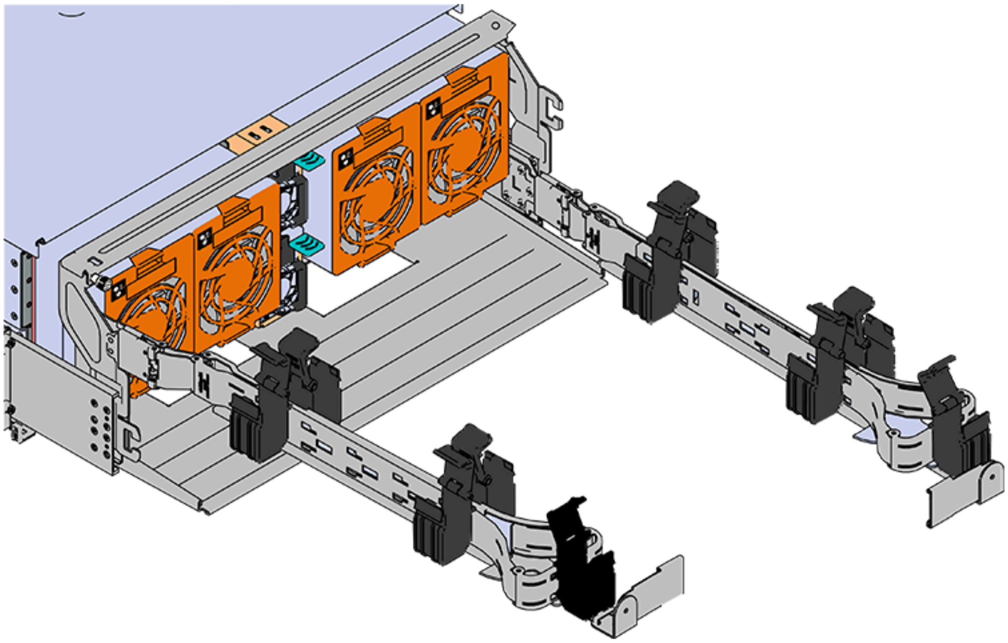
i. Reconnect the arm to the rail by the connector at the elbow.

Step 53: Cable the upper CMA.

a. Unlatch the elbow side of the CMA arm and swing it forward by pressing the blue button that says "push" to unlatch it.

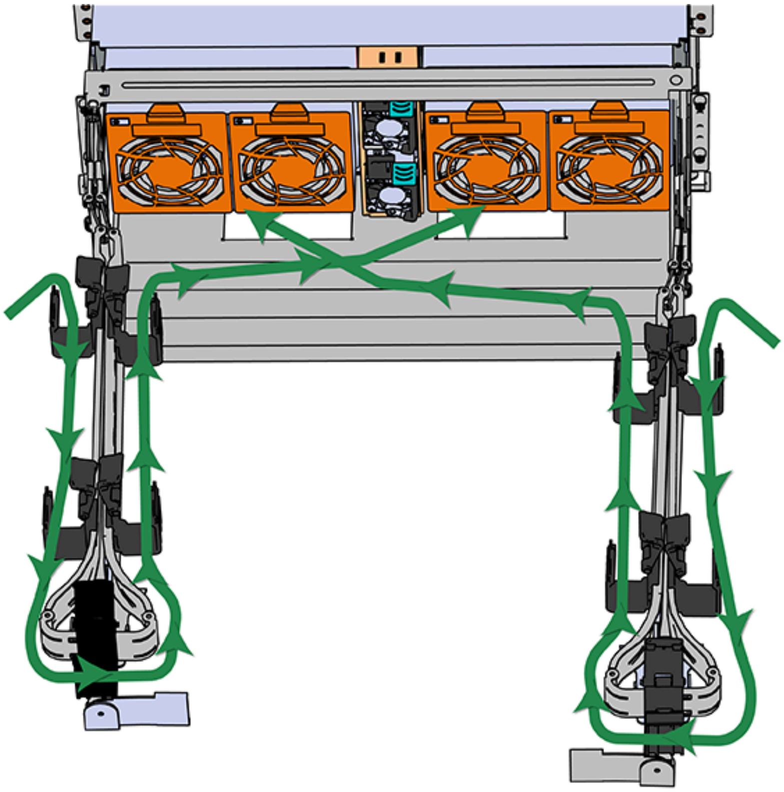
b. Gather the SAS cables, one power cable, and one Ethernet cable to install in the left hand side.
c. Open all of the baskets

Figure 230: Open Baskets



a. Connect the Ethernet cable to the Ethernet port on the right hand side of the Ultrastar Data102 and route the cable through each of the baskets on the CMA.
b. Connect the SAS cables and route them through the baskets one at a time. Make sure to follow the labels to make sure they are connected to the proper port.
c. Connect the power cable to the upper PSU and route it through each basket. The following image shows the appropriate cable "criss-cross" pattern they should be installed in.

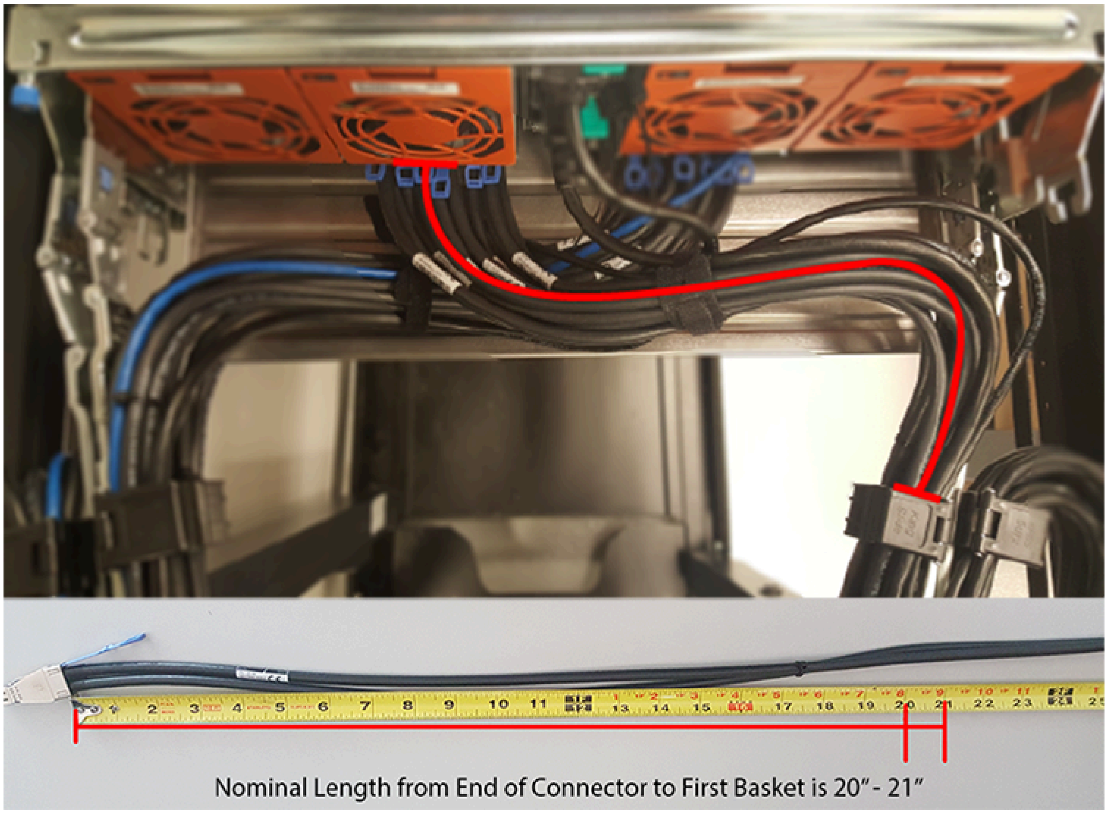
Figure 231: Connected Cable Routing



d. Wrap cable tie around the installed cable bundle between the ports and the first basket of the CMA

> **Note:** Each cable must be given enough slack at the connector end to operate smoothly. For the upper CMA allow 20" - 21" (508 – 533.4mm) between the end of the connector and the first basket. Make sure to route all of the upper CMA cables **under** the lower CMA cables.

Figure 232: Nominal Cable Length at Connectors



e. Attach the cable retention mechanism.

For the Delta PSU, loop the retention clip around the power cable and pinch it until the clip catches and locks in place. Then slide the retention clip forward until it stops near the cable connector. Doing this will ensure that the retention clip functions properly in the event the cable is pulled on for some reason.

Figure 233: Delta PSU Cable Retention Clip

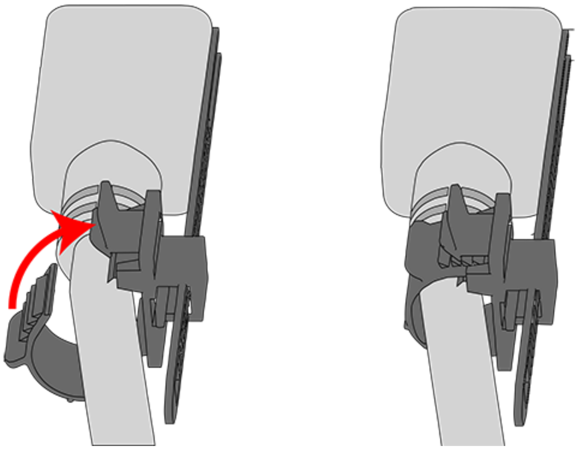
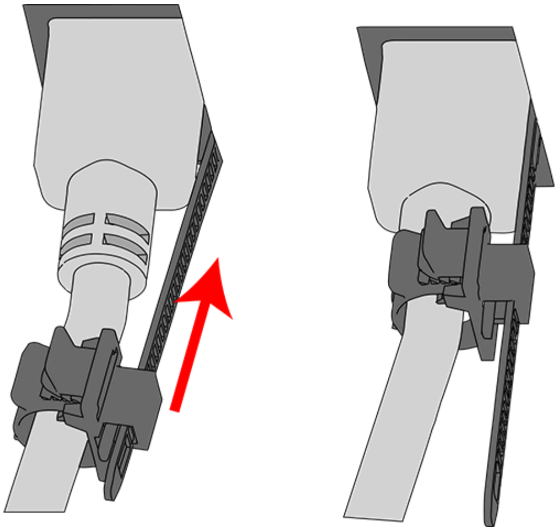
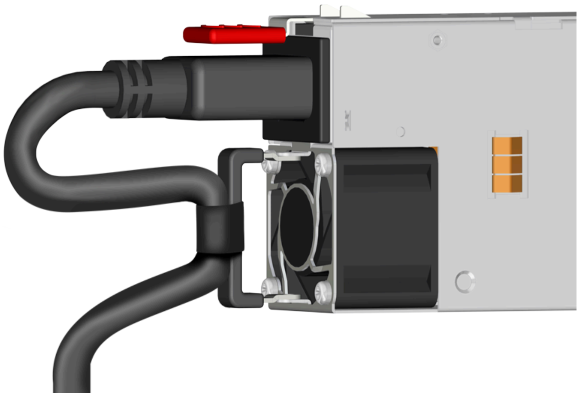


Figure 234: Cinching Cable Retention Clip



For the Artesyn PSU, secure the power cable to the PSU handle with the velcro retention strap as shown in the following image.

Figure 235: Artesyn PSU Cable Retention Strap



f. If the Ultrastar Data102 is being installed in a rack and will subsequently be transported inside that rack, it is important to use the included cable tie to wrap the CMA bundle to ensure it does not get damaged during transport. If the Ultrastar Data102 is instead being installed where it will operated, skip this step.
g. Close all of the baskets.
h. Reconnect the CMA at the elbow to connector A.

Step 54: Test for binding in the extension of the arm by gently pulling the enclosure out of the rack, ensuring the cables extend properly and that the system doesn't bind at all. If it does, examine the point at which the binding occurred and adjust the seating of cables in the baskets, check the connections to the rails, and examine the joints of the arm to ensure that they are all functioning properly.

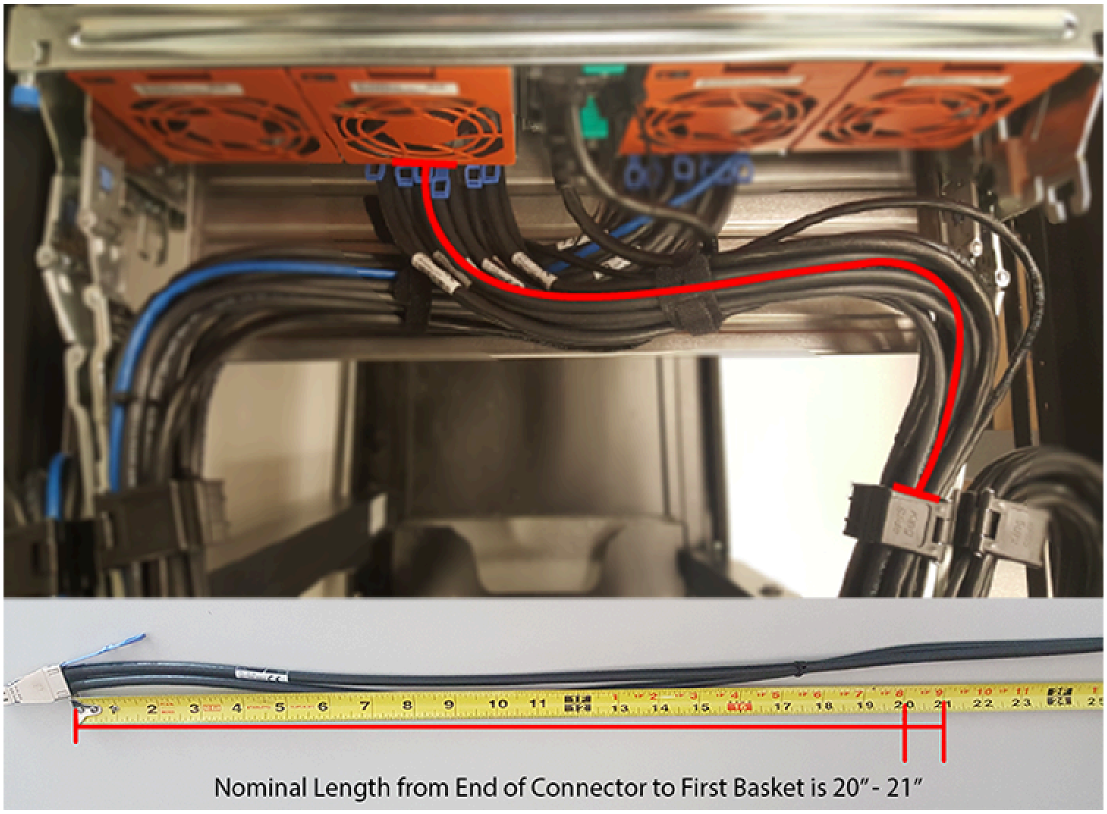
Step 55: Make sure the CMA(s) is in operational position by folding the arm(s) in toward the enclosure and attaching the elbow end(s) to the connector(s) attached to the rail. Verify that all of the cabling is in functional order and does not bind or catch.

3.10 Special Considerations for Cable Routing

There are a number of special considerations installers should take when routing cables through the CMA. This section outlines those considerations.

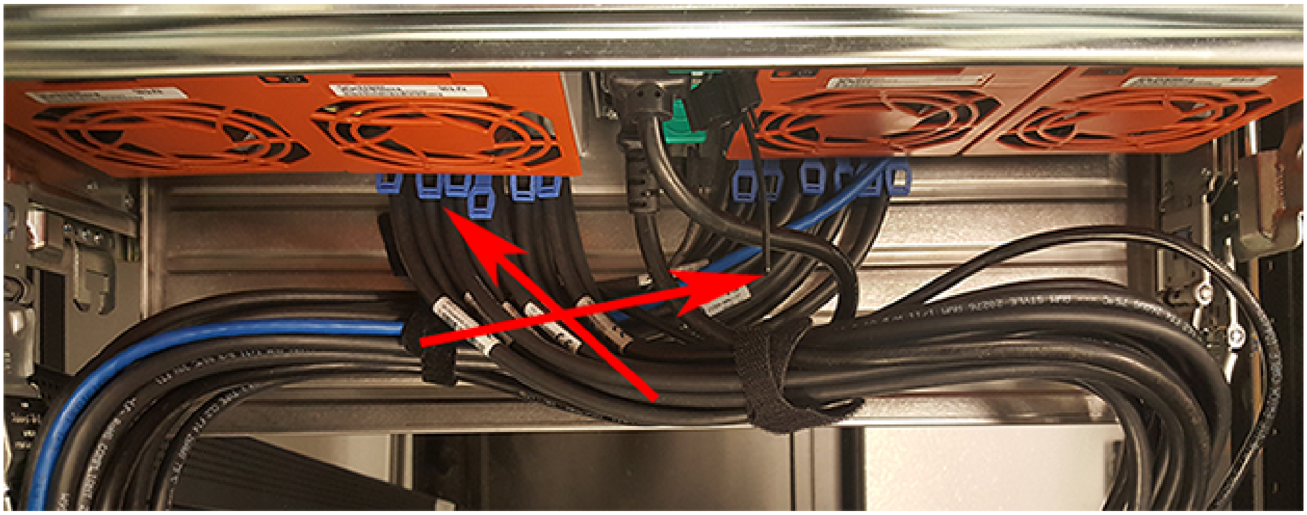
The distance from the end of the connector at the port to the first basket on the CMA should be 20" – 21" long. This will give the cables enough slack at this end to prevent stress on the port and binding during operation cycles.

Figure 236: Nominal Cable Length at Connectors



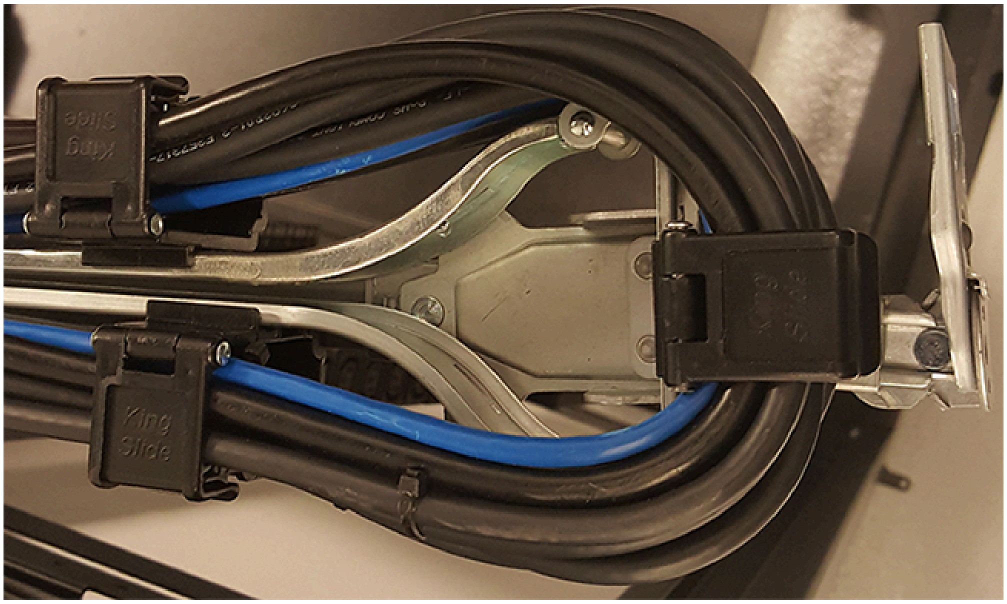
The cables at the port side of the CMA should crisscross in front of the IOMs. To accomplish this, the cables connected to the ports for IOM B (right hand side when facing the rear) should be connected to the upper CMA, and the cables connected to the ports for IOM A (left hand side when facing the rear) should be connected to the lower CMA.

Figure 237: Crisscross Cables



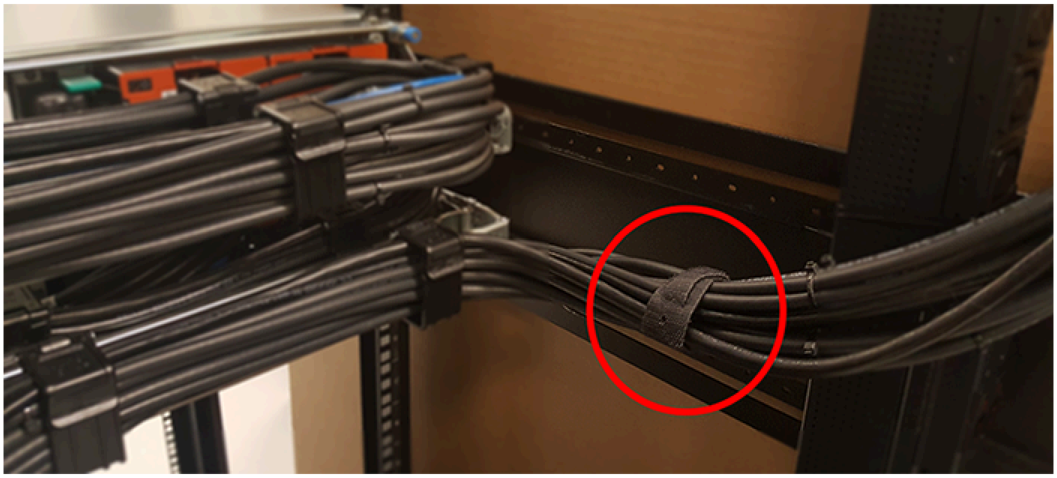
When the cables are routed into the CMA, make sure there is some slack given to the elbow joint of the CMA. It is recommended not to wrap the cables tightly around this joint because this can cause binding and prevent smooth operation. To ensure there is enough slack at the elbow, pull the enclosure in and out of the rack and have another installer check for binding in the elbow joint. Make sure the cables are bending and not twisting.

Figure 238: CMA Elbow with Full Cable Bundle



At the end of the CMA where the cables exit, use a cable tie to bundle the cables together. Make sure the cables are bending and not twisting.

Figure 239: Cable Tie at Exit of CMA



3.11 Cabling for CMA Standard and CMA Lite

3.11.1 Before You Begin

The cable configurations detailed in this section are intended to provide the optimal setup for your specific configuration. During the cabling of the CMA, the HD Mini-SAS and SFP+ cables should be installed into the CMA first, followed by Ethernet cables, and finally the power cables on top.

How to Use the Service Loop Dimension Figure and Table

This section uses the concept of service loops to inform the user on how to prepare HD mini-SAS cables for installation into either the CMA Standard or CMA Lite. The power and Ethernet cables do not need to be added to the Service Loop bundle. This concept utilizes measurements that begin at the connector end of the cable and along the cable itself. The Service Loop Dimensions figure and the Service Loop Dimensions table are paired together to communicate the length in which connectors, velcro, and the CMA cage must be set at to avoid binding or snagging.

Note: The measurement provided in this section are only suggested values based on product testing. Your specific situation may vary. Adjust the measurement as necessary to avoid cable binding or sagging below the rear of the enclosure.

1. Identify the configuration that is needed for the particular setup and locate the Service Loop Dimension table related to that configuration.
2. Take the first measurement (letter A) and measure that length from the connector on the cable to the edge of where the first verco strip will go. Apply the velco strip.
3. Repeat this action for the B and C values until the table has been completed.

Here is an example of the Service Loop Dimension Figure and Table:

Figure 240: Service Loop Dimension Figure

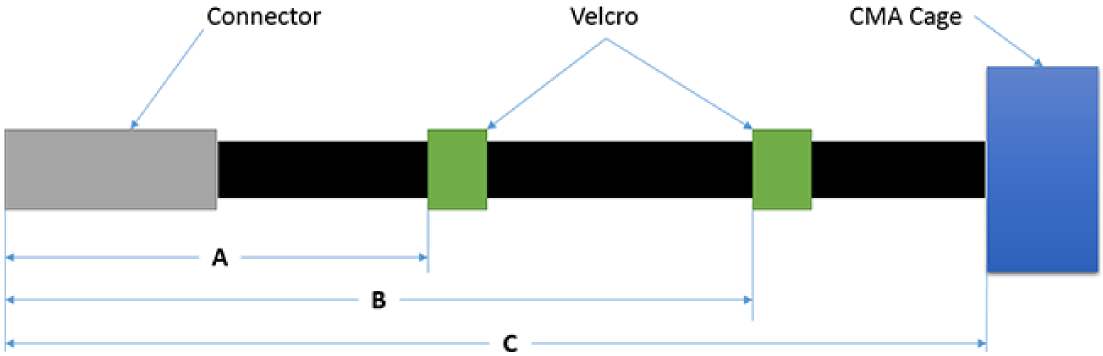


Table 50: Example Service Loop Dimension Table

A	B	C
6in.	N/A	12in.

In this case, the first measurement from the tip of the cable to the first velco strip is 6in. Followed by a 12in. measurement to the CMA cage. There is no need for a B value due how short this configuration is.

3.11.2 Cabling CMA Standard

3.11.2.1 SFP+ and HD Mini-SAS Cable Configuration

This configuration includes the use of up to **four** SFP+ and **two** HD Mini-SAS cables installed into a CMA arm.

Figure 241: Service Loop Dimension Figure

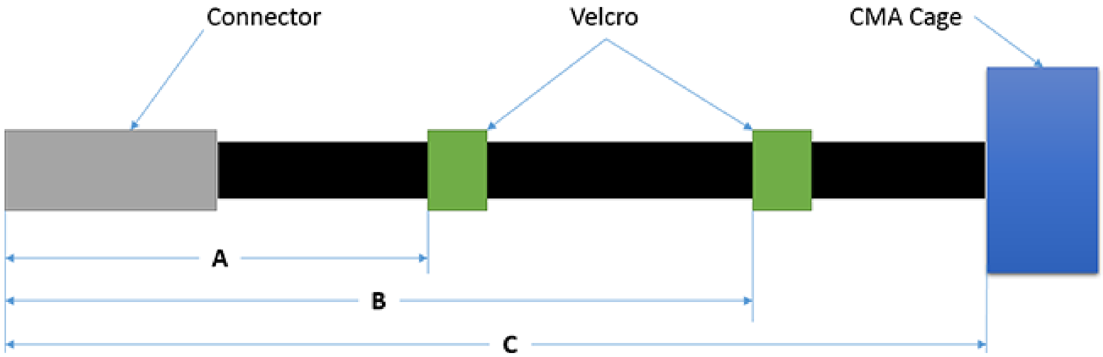


Table 51: Service Loop Dimension Table

A	B	C
6in.	12in.	16in.

3.11.3 Cable Configuration for CMA Lite

3.11.3.1 Maximum HD Mini-SAS Configuration

This configuration includes the use of up to **two** HD Mini-SAS cables, **two** Ethernet cables, and **two** power cables installed into a CMA Lite arm.

Figure 242: Service Loop Diagram

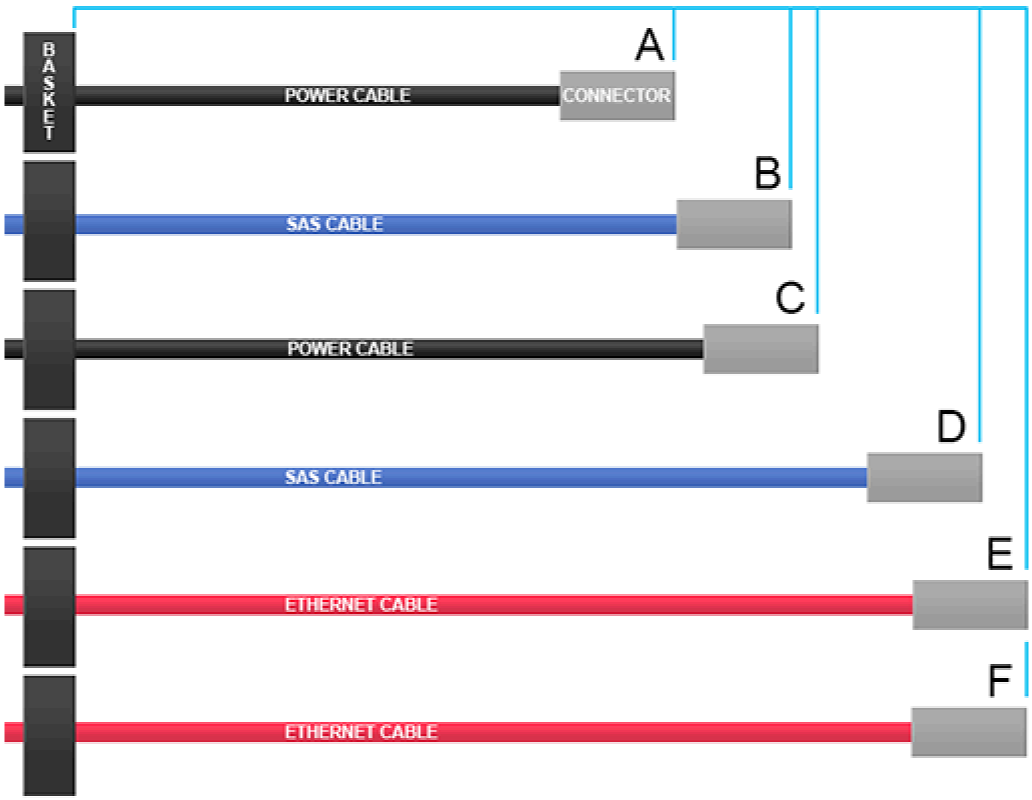


Table 52: Service Loop Lengths

Cable Identifier	Length to First Basket Clip
A	16 in / 406 mm
B	18 in / 457 mm
C	19 in / 483 mm
D	22 in / 559 mm
E	23 in / 584 mm
F	23 in / 584 mm

Management

In This Chapter:

4.1 Management Overview

This section provides an overview of the system management features available in the Ultrastar Data102 through the in-band SAS connections using SG3_utils software, and out-of-band using a REST interface over HTTPS to access Western Digital's implementation of the DMTF Redfish API.

4.2 Firmware Features Overview

The enclosure services functionality is compatible with the SES-3 (SES3r14) standard. The enclosure implements the Standalone Enclosure Services Process model described in the SES standard. The logical enclosure services process is called the SEP. The SEP operates in a dual IOM environment. To a host server, the SEP exists as a dual ported SAS device, one port on each IOM. The firmware on the Ultrastar Data102 provides an Active/Active architecture for IOM redundancy. This allows each IOM to independently report the enclosure status information such as drive power, fan speed, and LED states. This allows the Ultrastar Data102 to maintain high availability and hot-swappability. Due to the active/active architecture, commands only need to be executed to one IOM because either IOM is fully capable of performing all enclosure management tasks. The information and enclosure status will be synchronized between the two IOMs via the internal SAS links.

The primary expander in each IOM is the only expander that presents a SCSI target, and it is the main device for gathering information from the system for presentation to hosts. The SEP services SES control page operations. All control operations follow a synchronous completion model, i.e. the SEP will send SCSI status only when the requested operation has completed, or to notify the host that the requested operation cannot be performed. Typical SES control operations include:

- Requesting LED flash patterns
- Recording predicted or known component failures
- Requesting power cycle of one or more drives
- Perform a code download. All firmware in programmable components in the storage subsystem may be updated via SES.

SES Status

The SEP services SES status pages. All status operations follow a non-blocking completion model, i.e. the SEP returns the last known status, rather than blocking the completion of the SCSI operation while doing an immediate polling operation. The SES status is updated every 0.5s. Typical SES status operations include:

- FRU and drive presence, health information, and entity names
- SAS topology maps
- Report sensor readings: temperatures, fan speeds, voltages, currents, etc.

Autonomous Behavior

The SEP autonomously manages enclosure power and thermal characteristics. This is done dynamically as needed to stay within the allowed operational envelope of power consumption, thermal heating, and ambient temperature in the data center. This management can include the use of one or more mitigating actions:

- Raise and lower the cooling fans.
- Enable or disable activity safeguards which limit enclosure activity to reduce power consumption or heat generation.
- Enter a self-healing thermal offline state in which some or all enclosure components are powered off.

- Power off the enclosure (not self-healing).

The enclosure operates visual indicators. These indicators can be set or cleared via host request, or autonomously by the enclosure if it detects fault conditions. The enclosure provides non-volatile memory that records enclosure serialization and branding information. The SEP records event log entries to non-volatile memory. The SEP implements T10 defined SMP controlled "zoning on the fly", and has the capability to save the host defined zoning parameters in non-volatile memory. The SEP also implements several predefined zoning configurations. These predefined configurations are selectable via SES control operations.

4.3 Firmware Upgrade

This section provides information on actions that should be taken before starting a firmware upgrade on the Ultrastar Data102 .

The storage administrator should determine if the applications on the enclosure should be quiesced before the online upgrade is completed. Before upgrading enclosure firmware, review the following section to determine whether or not the enclosure should be taken offline before upgrading. As an alternative to the automatic firmware upgrade activation process, the storage administrator may opt to use a more controlled process by using the non-automatic firmware activation process detailed in Linux Upgrade to New Firmware *(page 212)* and Windows Upgrade to New Firmware *(page 217)*.

Attention: It is strongly recommended that the non-automatic firmware activation process be used for either Linux or Windows. And if using a RAID adapter, **only** the non-automatic firmware activation process should be used. The non-automatic update allows for control of the process during an online upgrade. With larger enclosures, the automatic firmware upgrade could potentially be too fast for Operating Systems to recover paths to drives before the redundant paths go down, resulting in a loss of access to drive paths. The non-automatic process allows the end-user to control when an IOM is activated. This allows for all paths to be optimal at the time firmware is activated on an IOM.

SAS Configuration: If the enclosure contains SAS drives and redundant IOMs, the enclosure firmware may be upgraded while online. This is due to the SAS configuration and host being able to manage the firmware upgrade using host multi-pathing software. The storage administrator should ensure that there are always redundant paths to each drive before starting an upgrade on either IOM. This will ensure that at least one path to each drive is available during the reset of the IOM that is being upgraded.

SATA Configuration: If the enclosure contains SATA drives, the enclosure firmware should not be upgraded while online. This is due to the SATA configuration having no redundancy with only a single IOM (the second slot contains an IOM blank). When the IOM is rebooted, the single path to the drives to service I/O will be taken down.

Devices (<dev>)

In order to initiate a firmware upgrade on the enclosure, a target must be identified. Linux targets are referred to as sg (SCSI Generic) devices and appear as <dev> in the Linux Firmware Upgrade procedure. Windows targets are referred to as SCSI devices and appear as <dev> in the Windows Firmware Upgrade.

Users should install all of the required downloads before beginning the firmware upgrade process.

Required Downloads:

- **SG3 Utils**: download version 1.42 from the SG3 Utils website at: http://sg.danny.cz/sg/sg3_utils.html

4.3.1 Verifying OOBMs before Firmware Upgrade in Linux

This procedure provides instructions for verifying that the OOBM processors are running prior to initiating a firmware download. If the OOBM processors are not running, a firmware download will immediately fail.

Before you begin: This procedure is written for a dual-IOM configuration. For a single-IOM configuration, ignore any steps related to a second IOM.

Step 1: Use the `sg_scan` utility to identify the SEP device handles of the IOMs.

```
# sg_scan -i | grep -i 4102 -B 1
<dev>: scsi8 channel=0 id=50 lun=0
    HGST  H4102-J  2051 [rmb=0 cmdq=1 pqual=0 pdev=0xd]
<dev>: scsi8 channel=0 id=204 lun=0
    HGST  H4102-J  2051 [rmb=0 cmdq=1 pqual=0 pdev=0xd]
```

Step 2: If needed, use the `sg_ses` utitliy to query page 4h and determine which SEP handle refers to which IOM. In the following examples, bytes 36 and 37 contain either `aa aa` (for IOM A) or `bb bb` (for IOM B).

```
# sg_ses <dev> -p4 --hex
  HGST  H4102-J  2051
Response in hex from diagnostic page: String In (SES)
 00     04 00 00 7c 00 0a 5c fc  00 11 ef ca 00 00 00 40    ...|..\........@
 10     00 00 05 8a 00 00 00 00  00 00 00 03 00 00 0c cf    ................
 20     00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00    ................
 30     00 00 00 00 01 01 aa aa  00 00 00 00 00 00 00 00    ................
 40     39 39 39 39 46 46 46 46  00 00 00 00 00 00 00 00    9999FFFF........
 50     0d 01 00 00 00 00 00 00  00 10 00 00 00 00 00 00    ................
 60     00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00    ................
 70     00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00    ................
```

```
# sg_ses <dev> -p4 --hex
  HGST  H4102-J  2051
Response in hex from diagnostic page: String In (SES)
 00     04 00 00 7c 00 10 ed 45  00 1d 63 30 00 00 00 48    ...|...E..c0...H
 10     00 00 12 fa 00 00 00 00  00 00 00 03 00 00 0c d5    ................
 20     00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00    ................
 30     00 00 00 00 01 01 bb bb  00 00 00 00 00 00 00 00    ................
 40     38 38 38 38 45 45 46 46  00 00 00 00 00 00 00 00    8888EEFF........
 50     0d 01 00 00 00 00 00 00  00 10 00 00 00 00 00 00    ................
 60     00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00    ................
 70     00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00    ................
```

Step 3: Use the `sg_ses` utility to query page 7h from the first IOM. Note the OOBM firmware versions, indicating that the OOBM processors are running.

```
# sg_ses <dev> -p7 | grep -i esce
      Element 0 descriptor: ESCE IOMA,1EB1026-30          ,THCLS01018EL002C
  ,5000CCAB04010E3C,10.202.237.77,00:0C:CA:08:05:08,2.4.18

      Element 1 descriptor: ESCE IOMB,1EB1026-30          ,THCLS01018EL002E
  ,5000CCAB04010E7C,10.202.237.103,00:0C:CA:08:05:0D,2.4.18
```

Step 4: Use the `sg_ses` utility to query page 7h from the second IOM. Note the OOBM firmware versions, indicating that the OOBM processors are running.

```
# sg_ses <dev> -p7 | grep -i esce
      Element 0 descriptor: ESCE IOMA,1EB1026-30          ,THCLS01018EL002C
  ,5000CCAB04010E3C,10.202.237.77,00:0C:CA:08:05:08,2.4.18

      Element 1 descriptor: ESCE IOMB,1EB1026-30          ,THCLS01018EL002E
  ,5000CCAB04010E7C,10.202.237.103,00:0C:CA:08:05:0D,2.4.18
```

Step 5: Alternatively, use the WDDCS Tool to display the current OOBM values for each IOM.

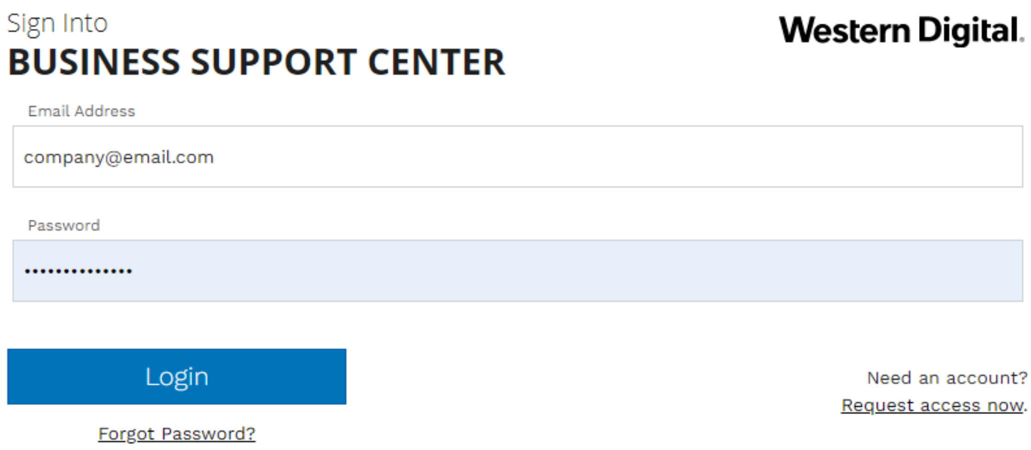
```
# wddcs iom oobm
wddcs v2.0.6.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: <dev>
    IOM B   : DHCP (1)
    IP      : 10.202.237.103
    Netmask : 255.255.252.0
    Gateway : 10.202.236.1
    OOBM FW : 2.4.18
    MAC     : 00:0C:CA:08:05:0D

Device: <dev>
    IOM A   : DHCP (1)
    IP      : 10.202.237.77
    Netmask : 255.255.252.0
    Gateway : 10.202.236.1
    OOBM FW : 2.4.18
    MAC     : 00:0C:CA:08:05:08
```

Result: If the OOBM firmware versions for both IOMs can be read from both IOMs, the OOBM processors are running and will prevent an immediate firmware download failure.

4.3.2 Downloading Firmware from the Support Portal

Note: The product must be registered in order to download firmware updates.

Step 1: Log in to the **Western Digital Enterprise Support Center** using a valid email address and password:

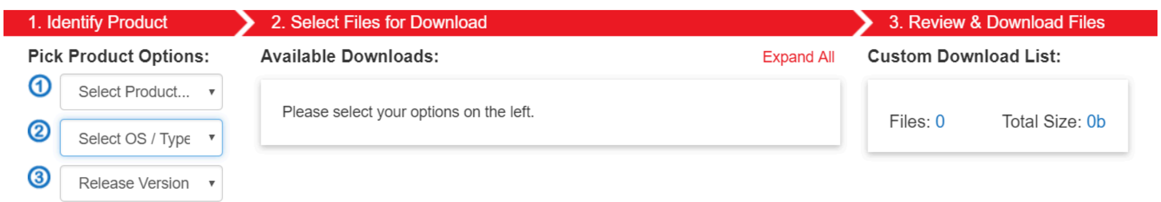


Several support options will appear on the page.

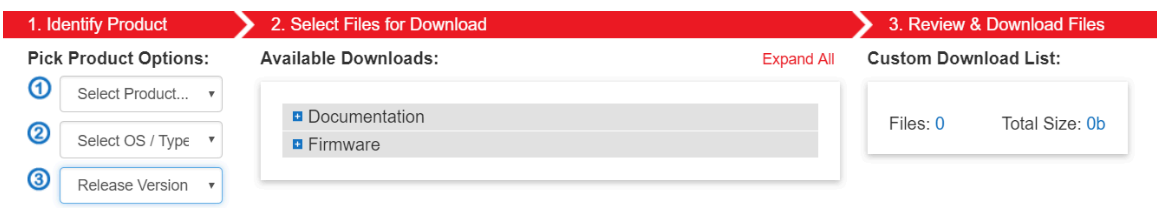
Step 2: Click the **Downloads** option in the top banner:

The Western Digital downloads page will appear.

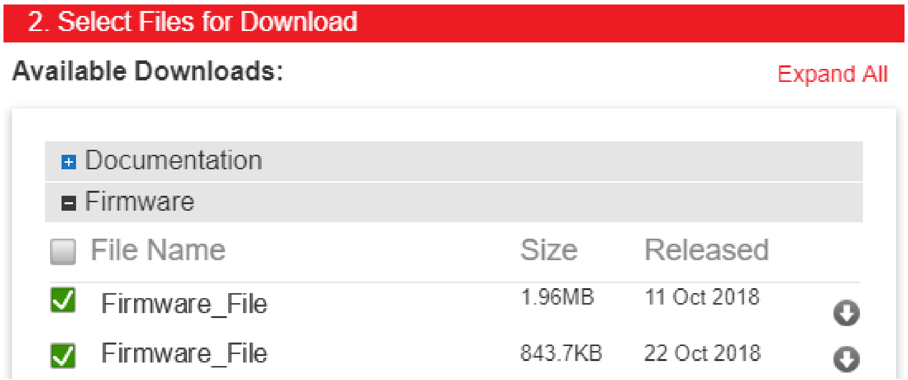
Step 3: From the **Identify Product** section, select the **Product**, **OS / Type**, and **Release Version**:



The **Select Files for Download** section updates with the applicable options:

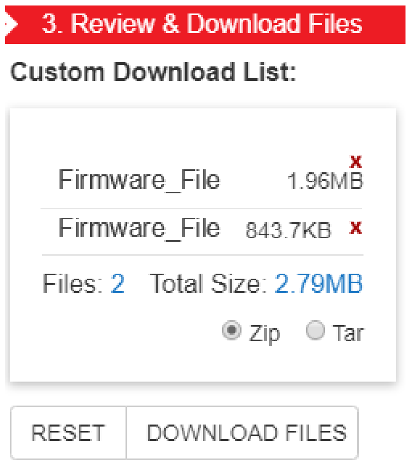


Step 4: From the **Select Files for Download** section, expand the **Firmware** option and select the checkbox for the appropriate firmware file(s):



Note: Filenames will vary, depending on the options chosen in the **Identify Product** section.

Step 5: In the **Review & Download Files** section, review the selected files to ensure that all intended files are included in the list.



Step 6: If needed, remove an unwanted file by clicking its red *X*.

Step 7: Select the appropriate archive file format by clicking either **Zip** or **Tar**.

Step 8: Click the **Download Files** button to download the selected files.

Important: Do not unzip/extract the tar.gz file. Doing so will result in errors during the firmware upgrade process.

4.3.3 Linux Upgrade Preparation

To prepare the firmware package for download, do the following:

Step 1: Connect the Ultrastar Data102 to a standard SAS HBA or a RAID SAS HBA hosted on the Linux Server that presents the Enclosure Services Processor to the Linux operating system. The Enclosure Services Processor in the Ultrastar Data102 will be referred to as an IOM.

Note: To perform an online firmware upgrade, the Ultrastar Data102 must be configured with redundant data paths, meaning both IOMs must have a SAS Port populated and connected to the host server.

SAS Configurations: The server host must be configured with multi-pathing software that can handle the nature of the firmware upgrade. i.e. Once firmware is downloaded to the IOMs, each IOM will reset and boot the new code in a staggered fashion such that the host always has at least one path to the drives to service I/O.

SATA Configurations: A SATA configuration should not be considered for an online upgrade due to the single path nature of the topology.

Step 2: Type the **sg_scan -i** command to verify that the enclosure has been found by the server.

```
# sg_scan -i | grep -i 4102 -B 1
<dev>: scsi8 channel=0 id=50 lun=0
    HGST  H4102-J  2020 [rmb=0 cmdq=1 pqual=0 pdev=0xd]
<dev>: scsi8 channel=0 id=204 lun=0
    HGST  H4102-J  2020 [rmb=0 cmdq=1 pqual=0 pdev=0xd]
```

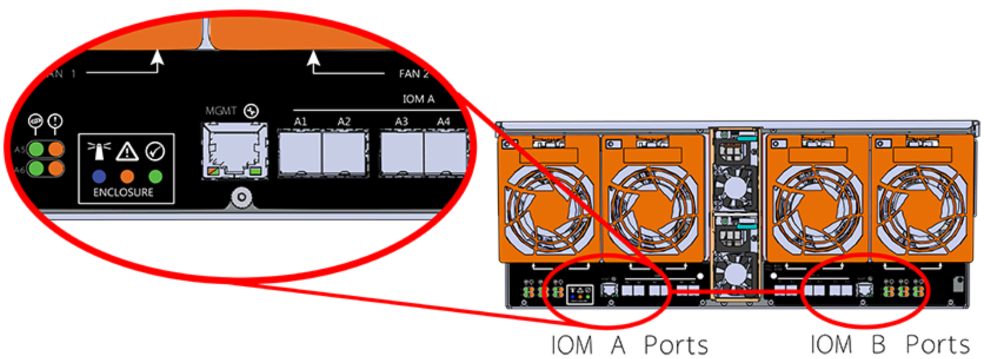
Note: If the Ultrastar Data102 is connected to an HBA that does not present the Enclosure Services Processor to the host for management purposes, HGST recommends attaching the Ultrastar Data102 to a host that does expose the Enclosure Services Processor so that the upgrade may be performed.

Attention: Beginning with firmware version 2000-073, the user may upgrade in-band via sg_ses_microcode without the requirement of having Ethernet interfaces actively configured with DHCP. Please proceed to the upgrade procedure.

Step 3: **The following upgrade preparation steps apply only to firmware versions 01XX-XXX or if the user is upgrading via OOBM.** If this does not apply, please proceed to the upgrade procedure.

a. **IMPORTANT:** There is a firmware upgrade requirement which requires both Ethernet interfaces to be connected to obtain the IP addresses via DHCP prior to starting the upgrade process. The Ethernet ports are shown in the following image:

Figure 249: Ethernet Ports (IOM A port magnified)



b. After connecting the Ethernet interfaces and obtaining the IP addresses via DHCP, locate the `<dev>` device name from the `sg_scan -i` output from step 2 (page 211).

c. Verify that both OOBMs have IP addresses by issuing the command `sg_ses <dev> -p0x7`.

d. Locate the IP addresses in the Enclosure Services Controller Electronics (ESCE) elements, indicated by the `XXX.XXX.XXX.XXX` in the results, as shown in the following example:

```
Element type: Enclosure services controller electronics, subenclosure id:
 0 [ti=5]
Overall descriptor: <empty>
Element 0 descriptor: ESCE IOMA,IOM PART NUM ,IOM SERIAL
 NUM,5000CCAB0500003C,XXX.XXX.XXX.XXX
Element 1 descriptor: ESCE IOMB,IOM PART NUM ,IOM SERIAL
 NUM,5000CCAB0500007C,XXX.XXX.XXX.XXX
```

4.3.4 Linux Upgrade to New Firmware

To download the new firmware package, do the following:

Step 1: Ensure multi-pathing can see all of the expected drives.

a. Execute the following command to verify that there are two paths to each drive:

```
multipath -ll | grep -i “active ready running” -c
```

Step 2: Locate the <dev> device name from the sg_scan -i.

Step 3: In the terminal, type:

```
sg_ses_microcode <dev> -m 0xe -N -b 4096 -I <filename> -vv
```

Important: Do not unzip/extract the tar.gz file. Doing so will result in errors during the firmware upgrade process.

Step 4: Press **Enter**.

The firmware begins loading onto the IOMs. The upgrade can take up to 20 minutes to complete.

Important:

Due to the firmware image being a .tar.gz file, the enclosure has to unpack and load the firmware onto the respective ICs which may take up to 15 minutes. Once the sg_ses_microcode command is issued wait 20 minutes to ensure the enclosure has time to perform this process. To check the status of this process, use the Redfish out-of-band management to make a GET request to the following target:

```
curl -G  -k -u admin:admin -H "Content-type: application/
json" https://<ip address>/redfish/v1/UpdateService/Actions/
UpdateService.SimpleUpdate/Status
```

Note:

Execute the command until you see the following result:

```
{"ErrorCode":0,"StatusCode":2,"Description":"FW update completed.
 Waiting for activation.","EstimatedRemainingMinutes":0}
```

Attention: If the OOBM is not being used, query Page Eh by executing the following command **sg_ses <dev> -p 0xe**. The first time this command is issued, the output may be inaccurate, please ignore and issue the command again. The string to observe for download microcode status is "Complete, no error, start after hard reset or power cycle [0x11]" before proceeding to the activate step.
Example output:

```
sg_ses <dev> -p 0xe

  HGST  H4102-J  2040
Download microcode status diagnostic page:
  number of secondary subenclosures: 0
  generation code: 0x0
   subenclosure identifier: 0 [primary]
     download microcode status: Complete, no error, start after
 hard reset or power cycle [0x11]
     download microcode additional status: 0x0
     download microcode maximum size: 1703914 bytes
     download microcode expected buffer id: 0x0
     download microcode expected buffer id offset: 0
```

Step 5: Once the download is complete, type:

```
sg_ses_microcode <dev> -m 0xf
```

Step 6: Press **Enter**.

The IOMs will reset. This process can take up to 5 minutes to activate.

Attention: The system will lose communication with the drives during this part of the upgrade. To avoid data loss, ensure that no data is being transferred during this process.

Step 7: Verify the installation is correct by repeating the **sg_scan -i** again.

Note: The firmware update is downloaded to both IOMs at the same time.

Step 8: Ensure multi-pathing can see all of the expected drives.

a. Execute the following command to verify that there are two paths to each drive:

```
multipath -ll | grep -i “active ready running” -c
```

4.3.5 Non-Automatic Firmware Activation in Linux

Step 1: Ensure multi-pathing can see all of the expected drives.

a. Execute the following command to verify that there are two paths to each drive:

```
multipath -ll | grep -i “active ready running” -c
```

Step 2: Locate the <dev> device name from the sg_scan -i.

Step 3: Execute the following command to upgrade the enclosure firmware using sg_ses_microcode.

a. Issue the following command:

```
sg_ses_microcode <dev> -m 0xe -N -b 4096 -I <filename> -vv
```

Important: Do not unzip/extract the tar.gz file. Doing so will result in errors during the firmware upgrade process.

Step 4: Press **Enter**.

The firmware begins loading onto the IOMs. The upgrade can take up to 20 minutes to complete.

Important: Due to the firmware image being a .tar.gz file, the enclosure has to unpack and load the firmware onto the respective ICs which may take up to 15 minutes. Once the sg_ses_microcode command is issued wait 20 minutes to ensure the enclosure has time to perform this process. To check the status of this process, use the Redfish out-of-band management to make a GET request to the following target:

```
curl -G  -k -u admin:admin -H "Content-type: application/
json" https://<ip address>/redfish/v1/UpdateService/Actions/
UpdateService.SimpleUpdate/Status
```

Note: Execute the command until you see the following result:

```
{"ErrorCode":0,"StatusCode":2,"Description":"FW update completed.
 Waiting for activation.","EstimatedRemainingMinutes":0}
```

Attention: If the OOBM is not being used, query Page Eh by executing the following command `sg_ses <dev> -p 0xe`. The first time this command is issued, the output may be inaccurate, please ignore and issue the command again. The string to observe for download microcode status is "Complete, no error, start after hard reset or power cycle [0x11]" before proceeding to the activate step.
Example output:

```
sg_ses <dev> -p 0xe

  HGST  H4102-J  <FW Version>
Download microcode status diagnostic page:
  number of secondary subenclosures: 0
  generation code: 0x0
   subenclosure identifier: 0 [primary]
```

```
    download microcode status: Complete, no error, start after
hard reset or power cycle [0x11]
    download microcode additional status: 0x0
    download microcode maximum size: 1703914 bytes
    download microcode expected buffer id: 0x0
    download microcode expected buffer id offset: 0
```

Step 5: Issue the following command to activate IOM A:

```
sg_ses <dev> -p4 -c -d 02,00,01,00
```

Note: Activate only one IOM at a time to ensure there is always at least one path to the drives. The user will need to issue a reset to each IOM to activate the firmware using an sg_ses command to ensure this occurs properly.

Step 6: Ensure multi-pathing can see all of the expected drives after activating IOM A.

a. Execute the following command to verify that there are two paths to each drive:

```
multipath -ll | grep -i “active ready running” -c
```

Step 7: Issue the following command to activate IOM B:

```
sg_ses <dev> -p4 -c -d 02,00,01,01
```

Step 8: Ensure multi-pathing can see all of the expected drives after activating IOM B.

a. Execute the following command to verify that there are two paths to each drive:

```
multipath -ll | grep -i “active ready running” -c
```

b. Verify that there are two paths to each drive.

Note: It could take the OS several minutes to rebuild all the paths to the drives depending on the workload on the drives and how busy the host is. Multipathing may have to be verified several times to ensure that all paths are in an optimal state following the reset of IOM B.

4.3.6 Windows Firmware Upgrade Preparation

To upgrade firmware using a windows server, do the following:

Step 1: Make sure that **sg3_utils** is installed on the system and that the **MPIO** software is configured and enabled on the host to be able to handle an online upgrade.

Step 2: Connect the Ultrastar Data102 to a standard SAS HBA or a RAID SAS HBA hosted on the Windows Server that presents the Enclosure Services Processor to the operating system. The Enclosure Services Processor in the Ultrastar Data102 will be referred to as an IOM.

Note: To perform an online firmware upgrade, the Ultrastar Data102 must be configured with redundant data paths, meaning both IOMs must have a SAS Port populated and connected to the host server.

SAS Configurations: The server host must be configured with multi-pathing software that can handle the nature of the firmware upgrade. i.e. Once firmware is downloaded to the IOMs, each IOM will reset and boot the new code in a staggered fashion such that the host always has at least one path to the drives to service I/O.

SATA Configurations: A SATA configuration should not be considered for an online upgrade due to the single path nature of the topology.

Step 3: Log on to the Windows server and launch a command prompt.

Step 4: Input the **sg_scan -s** command to find the IOM devices to ensure that they can be accessed.

Note: If the Ultrastar Data102 is connected to an HBA that does not present the Enclosure Services Processor to the host for management purposes, Western Digital recommends attaching the Ultrastar Data102 to a host that does expose the Enclosure Services Processor so that the upgrade may be performed.

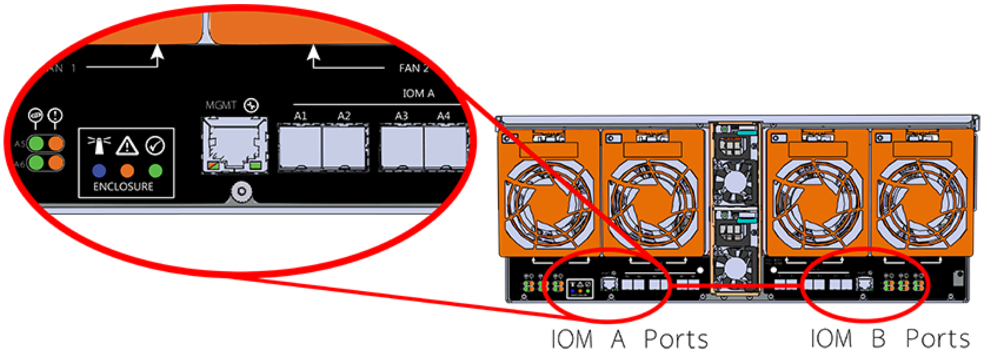
Attention: Beginning with firmware version 2000-073, the user may upgrade in-band via sg_ses_microcode without the requirement of having Ethernet interfaces actively configured with DHCP. Please proceed to the upgrade procedure.

Step 5: To determine which IOM is which, use the **<dev>** string with the sg_ses command.

Step 6: **The following upgrade preparation steps apply only to firmware versions 01XX-XXX or if the user is upgrading via OOBM.** If this does not apply, please proceed to the upgrade procedure.

a. **IMPORTANT:** There is a firmware upgrade requirement which requires both Ethernet interfaces be connected to obtain the IP addresses via DHCP prior to starting the upgrade process. The Ethernet ports are shown in the following image:

Figure 250: Ethernet Ports (IOM A port magnified)



b. After connecting both Ethernet interfaces and obtaining the IP addresses via DHCP, locate the `<dev>` device name from the `sg_scan -s` output from step 4 *(page 216)*.

c. Verify that both OOBMs have IP addresses by issuing the command `sg_ses <dev> -p0x7`.

d. Locate the IP addresses in the Enclosure Services Controller Electronics (ESCE) elements, indicated by the `XXX.XXX.XXX.XXX` in the results, as shown in the following example:

```
Element type: Enclosure services controller electronics, subenclosure id:
 0 [ti=5]
Overall descriptor: <empty>
Element 0 descriptor: ESCE IOMA,IOM PART NUM ,IOM SERIAL
 NUM,5000CCAB0500003C,XXX.XXX.XXX.XXX
Element 1 descriptor: ESCE IOMB,IOM PART NUM ,IOM SERIAL
 NUM,5000CCAB0500007C,XXX.XXX.XXX.XXX
```

4.3.7 Windows Upgrade to New Firmware

To download the new firmware package, do the following:

Step 1: Ensure Windows MPIO can see all paths to the drives.

a. Execute the following command:

```
C:\mpclaim -v C:\Users\Administrator\Desktop\mpclaim_output.txt
```

b. Verify that there are two paths to each drive by executing the following command:

```
C:\more C:\Users\Administrator\Desktop\mpclaim_output.txt
```

Step 2: Input the **sg_scan -s** command to find the IOM devices to ensure that they can be accessed.

Note: If the Ultrastar Data102 is connected to an HBA that does not present the Enclosure Services Processor to the host for management purposes, Western Digital recommends attaching the Ultrastar Data102 to a host that does expose the Enclosure Services Processor so that the upgrade may be performed.

Step 3: In the terminal, type:

```
sg_ses_microcode <dev> -m 0xe -N -b 4096 -I <filename> -vv
```

Important: Do not unzip/extract the tar.gz file. Doing so will result in errors during the firmware upgrade process.

Step 4: Press **Enter**.

The firmware begins loading onto the IOMs. The upgrade can take up to **20 minutes** to complete.

Important: Due to the firmware image being a .tar.gz file, the enclosure has to unpack and load the firmware onto the respective ICs which may take up to 15 minutes. Once the sg_ses_microcode command is issued wait 20 minutes to ensure the enclosure has time to perform this process. To check the status of this process, use the Redfish out-of-band management to make a GET request to the following target:

```
curl -G  -k -u admin:admin -H "Content-type: application/
json" https://<ip address>/redfish/v1/UpdateService/Actions/
UpdateService.SimpleUpdate/Status
```

Note: Execute the command until you see the following result:

```
{"ErrorCode":0,"StatusCode":2,"Description":"FW update completed.
 Waiting for activation.","EstimatedRemainingMinutes":0}
```

Attention: If the OOBM is not being used, query Page Eh by executing the following command `sg_ses <dev> -p 0xe`. The first time this command is issued, the output may be inaccurate, please ignore and issue the command again. The string to observe for download microcode status is "Complete, no error, start after hard reset or power cycle [0x11]" before proceeding to the activate step.
Example output:

```
sg_ses 0 -p 0xe

  HGST  H4102-J  2040
Download microcode status diagnostic page:
  number of secondary subenclosures: 0
  generation code: 0x0
   subenclosure identifier: 0 [primary]
     download microcode status: Complete, no error, start after
 hard reset or power cycle [0x11]
     download microcode additional status: 0x0
     download microcode maximum size: 1703914 bytes
     download microcode expected buffer id: 0x0
     download microcode expected buffer id offset: 0
```

Step 5: Once the download is complete, type:

```
sg_ses_microcode <dev> -m 0xf
```

Step 6: Press **Enter**.

The IOMs will reset in a staggered manner. This process can take up to 5 minutes to activate.

Step 7: Ensure multi-pathing can see all of the expected drives.

a. Execute the following command to verify that there are two paths to each drive:

```
multipath -ll | findstr -i “active ready running” -c
```

Step 8: Ensure Windows MPIO can see all paths to the drives after activating IOM A.

a. Execute the following command:

```
C:\mpclaim.exe –v C:\Users\Administrator\Desktop\mpclaim_output.txt
```

b. Verify there are two paths to each drive by issuing the following command:

```
C:\more C:\Users\Administrator\Desktop\mpclaim_output.txt
```

Note: It could take the OS several minutes to rebuild all the paths to the drives depending on the workload on the drives and how busy the host is. Multipathing may have to be verified several times to ensure that all paths are in an optimal state following the reset of IOM A.

c. Verify that the output from the mpclaim_output.txt output appears similar to the following example.

```
0000000077010524 Active/Optimized 001|005|036|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
134|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
0000000077000431 Active/Optimized 000|004|049|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
132|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
MPIO Disk98: 02 Paths, Least Blocks, ALUA Not Supported SN:
5000CCA2532558CC
Supported Load Balance Policies: FOO RR RRWS LQD WP LB Path ID
State SCSI
Address Weight
-----------------------------------------------------------
0000000077010523 Active/Optimized 001|005|035|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
134|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
0000000077000430 Active/Optimized 000|004|048|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
132|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
MPIO Disk97: 02 Paths, Least Blocks, ALUA Not Supported SN:
5000CCA253255E9C
Supported Load Balance Policies: FOO RR RRWS LQD WP LB Path ID
State SCSI
Address Weight
-----------------------------------------------------------
...
```

4.3.8 Non-Automatic Firmware Activation in Windows

Step 1: Ensure Windows MPIO can see all paths to the drives.

Note: This should be completed before beginning the firmware upgrade procedure.

a. Execute the following command:

```
C:\mpclaim –v C:\Users\Administrator\Desktop\mpclaim_output.txt
```

b. Verify that there are two paths to each drive by executing the following command:

```
C:\more C:\Users\Administrator\Desktop\mpclaim_output.txt
```

Step 2: Upgrade the enclosure firmware using sg_ses_microcode by executing the following command:

```
sg_ses_microcode <dev> -m 0xe -N -b 4096 -I <filename> -vv
```

Important: Do not unzip/extract the tar.gz file. Doing so will result in errors during the firmware upgrade process.

Attention: If the OOBM is not being used, query Page Eh by executing the following command `sg_ses <device> -p0xe`.

Step 3: Press **Enter**.

The firmware begins loading onto the IOMs. The upgrade can take up to **20 minutes** to complete.

Important: Due to the firmware image being a .tar.gz file, the enclosure has to unpack and load the firmware onto the respective ICs which may take up to 15 minutes. Once the sg_ses_microcode command is issued wait 20 minutes to ensure the enclosure has time to perform this process. To check the status of this process, use the Redfish out-of-band management to make a GET request to the following target:

```
curl -G  -k -u admin:admin -H "Content-type: application/
json" https://<ip address>/redfish/v1/UpdateService/Actions/
UpdateService.SimpleUpdate/Status
```

Note: Execute the command until you see the following result:

```
{"ErrorCode":0,"StatusCode":2,"Description":"FW update completed.
 Waiting for activation.","EstimatedRemainingMinutes":0}
```

Attention: If the OOBM is not being used, query Page Eh by executing the following command `sg_ses <dev> -p 0xe`. The first time this command is issued, the output may be inaccurate, please ignore and issue the command again. The string to observe for download microcode status is "Complete, no error, start after hard reset or power cycle [0x11]" before proceeding to the activate step.
Example output:

```
sg_ses <dev> -p 0xe

  HGST  H4102-J  <FW Version>
Download microcode status diagnostic page:
  number of secondary subenclosures: 0
  generation code: 0x0
   subenclosure identifier: 0 [primary]
     download microcode status: Complete, no error, start after
 hard reset or power cycle [0x11]
     download microcode additional status: 0x0
     download microcode maximum size: 1703914 bytes
     download microcode expected buffer id: 0x0
```

```
    download microcode expected buffer id offset: 0
```

Step 4: Issue the following command to activate IOM A:

```
sg_ses <dev> -p4 -c -d 02,00,01,00
```

Note: Only activate one IOM at a time to ensure there is always at least one path to the drives to service I/O while an IOM is being reset. The user will need to issue a reset command to each IOM to activate the firmware using an sg_ses command to ensure this occurs properly.

Step 5: Ensure Windows MPIO can see all paths to the drives after activating IOM A.

a. Execute the following command:

```
C:\mpclaim.exe –v C:\Users\Administrator\Desktop\mpclaim_output.txt
```

b. Verify there are two paths to each drive by issuing the following command:

```
C:\more C:\Users\Administrator\Desktop\mpclaim_output.txt
```

Note: It could take the OS several minutes to rebuild all the paths to the drives depending on the workload on the drives and how busy the host is. Multipathing may have to be verified several times to ensure that all paths are in an optimal state following the reset of IOM A.

c. Verify that the output from the mpclaim_output.txt output appears similar to the following example.

```
0000000077010524 Active/Optimized 001|005|036|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
134|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
0000000077000431 Active/Optimized 000|004|049|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
132|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
MPIO Disk98: 02 Paths, Least Blocks, ALUA Not Supported SN:
5000CCA2532558CC
Supported Load Balance Policies: FOO RR RRWS LQD WP LB Path ID
State SCSI
Address Weight
-------------------------------------------------------------------
0000000077010523 Active/Optimized 001|005|035|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
134|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
0000000077000430 Active/Optimized 000|004|048|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
132|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
MPIO Disk97: 02 Paths, Least Blocks, ALUA Not Supported SN:
5000CCA253255E9C
Supported Load Balance Policies: FOO RR RRWS LQD WP LB Path ID
State SCSI
Address Weight
-------------------------------------------------------------------
```

```
...
```

Step 6: Issue the following command to activate IOM B:

```
sg_ses <dev> -p4 -c -d 02,00,01,01
```

Step 7: Ensure Windows MPIO can see all paths to the drives after activating IOM B.

a. Execute the following command:

```
C:\mpclaim.exe –v C:\Desktop\mpclaim_output.txt
```

b. Verify there are two paths to each drive by issuing the following command:

```
C:\more C:\Users\Administrator\Desktop\mpclaim_output.txt
```

Note: It could take the OS several minutes to rebuild all the paths to the drives depending on the workload on the drives and how busy the host is. Multipathing may have to be verified several times to ensure that all paths are in an optimal state following the reset of IOM B.

c. Verify that the output from the mpclaim_output.txt output appears similar to the following example.

```
0000000077010524 Active/Optimized 001|005|036|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
134|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
0000000077000431 Active/Optimized 000|004|049|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
132|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
MPIO Disk98: 02 Paths, Least Blocks, ALUA Not Supported SN:
5000CCA2532558CC
Supported Load Balance Policies: FOO RR RRWS LQD WP LB Path ID
State SCSI
Address Weight
-----------------------------------------------------------
0000000077010523 Active/Optimized 001|005|035|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
134|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
0000000077000430 Active/Optimized 000|004|048|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
132|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
MPIO Disk97: 02 Paths, Least Blocks, ALUA Not Supported SN:
5000CCA253255E9C
Supported Load Balance Policies: FOO RR RRWS LQD WP LB Path ID
State SCSI
Address Weight
-----------------------------------------------------------
...
```

4.4 Firmware Auto-Sync

Introduced with firmware version 3000-058, Auto-Sync is a feature that automatically detects a mismatch of SEP and OOBM firmware between an enclosure's two IOMs and initiates an upgrade or downgrade to synchronize the firmware versions. This feature is designed to reduce the time required to update firmware after replacing one or both IOMs and can be utilized to achieve different outcomes depending on the user's needs. The following sections define use cases of this feature, requirements for its operation, and procedures for enabling and disabling it.

Single IOM Replacement

After removing one IOM from a powered-up enclosure, or booting an enclosure with only a single IOM, the firmware on the installed IOM (if v3 or higher) will become dominant. If a second IOM with different firmware is then installed, the enclosure will detect the mismatch and either upgrade or downgrade the firmware on the second IOM to match the first.

Dual IOM Replacement

After booting an enclosure with two installed IOMs, the highest version of IOM firmware will become dominant. The firmware on the other IOM will be upgraded to match.

Feature Requirements

- The dominant IOM must be running SEP firmware version 3xxx or higher and OOBM firmware 3.x.x or higher. This firmware bundle is collectively referred to as "v3".
- The non-dominant IOM must be running SEP firmware version 2020 or higher.
- The enclosure must have the Auto-Sync VPD bit enabled.
- To enable and disable the Auto-Sync VPD bit, the host must have the sg3_utils package installed: http://sg.danny.cz/sg/sg3_utils.html.

4.4.1 Enabling Auto-Sync

Step 1: Follow the instructions in the Firmware Upgrade *(page 206)* section to download the v3 firmware bundle to the dominant IOM and activate it.

Step 2: From a host command line, use the `sg_modes` utility to verify that the enclosure's Auto-Sync VPD bit is currently **disabled** (00, bold in the following example):

```
sg_modes <dev> --page=0x20 --llbaa
    HGST  H4102-J  3010   peripheral_type: enclosure services device [0xd]
Mode parameter header from MODE SENSE(10):
  Mode data length=24, medium type=0x00, specific param=0x00, longlba=0
  Block descriptor length=0
>> page_code: 0x20, page_control: current
 00     a0 0e 01 00 00 00 00 00  00 00 00 00 00 00 00 00
```

Step 3: Use the `sg_wr_mode` utility to **enable** the enclosure's Auto-Sync VPD bit:

```
sg_wr_mode <dev> --dbd -s --page=0x20 --
contents=a0,0e,01,00,00,00,00,00,00,00,00,00,00,00,08,00 --
mask=00,00,00,00,00,00,00,00,00,00,00,00,00,00,08,00
```

Step 4: Use the `sg_modes` utility to verify that the enclosure's Auto-Sync VPD bit is now **enabled** (08, bold in the following example):

```
sg_modes <dev> --page=0x20 --llbaa
    HGST  H4102-J  3010   peripheral_type: enclosure services device [0xd]
```

```
Mode parameter header from MODE SENSE(10):
  Mode data length=24, medium type=0x00, specific param=0x00, longlba=0
  Block descriptor length=0
>> page_code: 0x20, page_control: current
 00     a0 0e 01 00 00 00 00 00  00 00 00 00 00 00 08 00
```

4.4.2 Checking Auto-Sync Status

Note: Depending on the user's system and configuration, it may take several minutes for the enclosure to detect a mismatch in firmware between its two IOMs, and several additional minutes for the synchronization to complete, before the upgraded/downgraded IOM reboots.

Step 1: To check the status of the Auto-Sync process, use the `sg_ses` utility to query the Download Microcode Status Diagnostic page for the IOM being upgraded/downgraded:

```
sg_ses <dev> --page=0xe
```

If the enclosure hasn't yet detected the mismatch, the `status` will indicate the following:

```
HGST  H4102-J  <FW Version>
Download microcode status diagnostic page:
  number of secondary subenclosures: 0
  generation code: 0x0
   subenclosure identifier: 0 [primary]
     download microcode status: No download microcode operation in progress
 [0x0]
     download microcode additional status: 0x0
     download microcode maximum size: 1703914 bytes
     download microcode expected buffer id: 0x0
     download microcode expected buffer id offset: 0
```

When the mismatch is detected and the syncing has begun, the `expected buffer id offset` value will grow, and the `status` will alternate between the following:

```
download microcode status: Updating storage with deferred microcode [0x3]
```

```
download microcode status: Download in progress, awaiting more [0x1]
```

When the sync is complete, the status will indicate:

```
download microcode status: Complete, no error, start after hard reset or
 power cycle [0x11]
```

Step 2: After the firmware has been syncronized, the upgraded/downgraded IOM will reboot.

4.4.3 Disabling Auto-Sync

Step 1: From a host command line, use the `sg_modes` utility to verify that the enclosure's Auto-Sync VPD bit is currently **enabled** (08, bold in the following example):

```
sg_modes <dev> --page=0x20 --llbaa
    HGST  H4102-J  3010   peripheral_type: enclosure services device [0xd]
Mode parameter header from MODE SENSE(10):
```

```
  Mode data length=24, medium type=0x00, specific param=0x00, longlba=0
  Block descriptor length=0
>> page_code: 0x20, page_control: current
 00     a0 0e 01 00 00 00 00 00  00 00 00 00 00 00 08 00
```

Step 2: Use the `sg_wr_mode` utility to **disable** the enclosure's Auto-Sync VPD bit:

```
sg_wr_mode <dev> --dbd -s --page=0x20 --
contents=a0,0e,01,00,00,00,00,00,00,00,00,00,00,00,00,00 --
mask=00,00,00,00,00,00,00,00,00,00,00,00,00,00,08,00
```

Step 3: Use the `sg_modes` utility to verify that the enclosure's Auto-Sync VPD bit is now **disabled** (00, bold in the following example):

```
sg_modes <dev> --page=0x20 --llbaa
    HGST  H4102-J  3010   peripheral_type: enclosure services device [0xd]
Mode parameter header from MODE SENSE(10):
  Mode data length=24, medium type=0x00, specific param=0x00, longlba=0
  Block descriptor length=0
>> page_code: 0x20, page_control: current
 00     a0 0e 01 00 00 00 00 00  00 00 00 00 00 00 00 00
```

4.5 OOBM Management Overview

The Ultrastar Data102 uses an implementation of DMTF Redfish for out-of-band system management. All the SES enclosure information can be obtained through the out-of-band management port using RESTful API calls to the management port over HTTPS. The OOBM ports are configured for DHCP by default.

4.5.1 Configuring OOBM Network Settings Using SES

Changing the OOBM Network Configuration

Step 1: To change the OOBM network configuration, enter the following:

```
sg_wr_mode <dev> --dbd --page=0x23,0x01 --
contents=e3,01,00,1A,<IOM>,00,00,00,<setting>,00,00,00,<IPaddr>,
<netmask>,<gateway>,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
```

Where:

- <dev> = the device SEP sg handle
- <IOM> = 01 (IOMA) or 02 (IOMB)
- <setting> = 00 (static) or 01 (DHCP)
- <IPaddr> = The IP address in four pairs of two-digit hex codes
- <netmask> = The netmask, in four pairs of two-digit hex codes
- <gateway> = The gateway, in four pairs of two-digit hex codes

For example, to change the OOBM network configuration on IOM A to **static**:

```
sg_wr_mode /dev/sg3 --dbd --page=0x23,0x01 --
contents=e3,01,00,1A,01,00,00,00,00,00,00,00,C0,A8,00,0A,
FF,FF,FF,00,C0,A8,00,01,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
```

- Device = /dev/sg3
- IOM = 01 (IOM A)
- Setting = 00 (static)
- IP Address = 192.168.0.10
- Netmask = 255.255.255.0
- Gateway = 192.168.0.1

To change the OOBM network configuration on IOM B to **static**:

```
sg_wr_mode /dev/sg3 --dbd --page=0x23,0x01 --
contents=e3,01,00,1A,02,00,00,00,00,00,00,00,C0,A8,00,0B,
FF,FF,FF,00,C0,A8,00,01,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
```

- Device = /dev/sg3
- IOM = 02 (IOM B)
- Setting = static
- IP Address = 192.168.0.11
- Netmask = 255.255.255.0
- Gateway = 192.168.0.1

To change the OOBM network configuration on IOM A to **DHCP**:

```
sg_wr_mode /dev/sg3 --dbd --page=0x23,0x01 --
contents=e3,01,00,1A,01,00,00,00,01,00,00,00,00,00,00,00,
00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
```

- Device = /dev/sg3
- IOM = 01 (IOM A)
- Setting = 01 (DHCP)
- IP Address = 0.0.0.0
- Netmask = 0.0.0.0
- Gateway = 0.0.0.0

To change the OOBM network configuration on IOM B to **DHCP**:

```
sg_wr_mode /dev/sg3 --dbd --page=0x23,0x01 --
contents=e3,01,00,1A,02,00,00,00,01,00,00,00,00,00,00,00,
00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
```

- Device = /dev/sg3
- IOM = 02 (IOM B)
- Setting = 01 (DHCP)
- IP Address = 0.0.0.0
- Netmask = 0.0.0.0
- Gateway = 0.0.0.0

Viewing the OOBM Network Configuration

Step 2: To view the OOBM network configuration, enter the following:

```
sg_wr_mode <dev> --dbd --page=0x23,0x01
```

This returns:

```
e3,01,00,30,03,00,00,00,<IOM A Setting>,00,00,00,<IOM A IPaddr>,<IOM
 A Netmask>,<IOM A Gateway>,00,00,00,<IOM B Setting>,00,00,00,<IOM B
 IPaddr>,<IOM B Netmask>,<IOM B Gateway>
```

- <IOM> = 03 (IOMA & IOMB)
- <IOM A Setting> = 00 (static) or 01 (DHCP)
- <IOM A IPaddr> = The IP address in four pairs of two-digit hex codes
- <IOM A Netmask> = The netmask, in four pairs of two-digit hex codes
- <IOM A Gateway> = The gateway, in four pairs of two-digit hex codes
- <IOM B Setting> = 00 (static) or 01 (DHCP)
- <IOM B IPaddr> = The IP address in four pairs of two-digit hex codes
- <IOM B Netmask> = The netmask, in four pairs of two-digit hex codes
- <IOM B Gateway> = The gateway, in four pairs of two-digit hex codes

The result, after setting the two static addresses in Changing the OOBM Network Configuration *(page 225)*:

```
e3,01,00,30,03,00,00,00,00,00,00,00,C0,A8,00,0A,FF,FF,FF,00,C0,A8,00,01,
00,00,00,00,C0,A8,00,0A,FF,FF,FF,00,C0,A8,00,01 <dev>
```

The result, when IOM B is not booting (no IP):

```
e3,01,00,30,03,00,00,00,00,00,00,00,C0,A8,00,0A,FF,FF,FF,00,C0,A8,00,01,
00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00 <dev>
```

Note: Setting an invalid gateway will result in that field being zeroed-out.

4.5.2 Configuring OOBM Static IP Address Using cURL

This procedure provides instructions for assiging a static IP address to the OOBM network interface using a cURL command.

Note: This procedure uses angle brackets "`<example>`" to indicate text that should be modified for your specific needs.

Step 1: Issue a PATCH request to the applicable I/O module resource, using the data option to set the `AddressOrigin` to `Static` and provide the IP address, subnet mask, and gateway:

```
curl
-X PATCH
-sku <username>:<password>
https://<oobm_ip>/redfish/v1/Systems/Self/EthernetInterfaces/IOModule<A/B>FRU
-H 'Content-Type: application/json'
-d '
    {
        "IPv4Addresses": [
            {
                "Address": "<ip_address>",
                "SubnetMask": "<subnet_mask>",
                "AddressOrigin": "Static",
```

```
                "Gateway": "<gateway_ip>"
            }
        ]
    }
'
```

For example:

```
curl -X PATCH -sku admin:admin https://10.206.144.81/redfish/v1/Systems/
Self/EthernetInterfaces/IOModuleAFRU -H 'Content-Type: application/
json' -d '{"IPv4Addresses": [{"Address": "10.206.144.82", "SubnetMask":
 "255.255.248.0", "AddressOrigin": "Static", "Gateway": "10.206.144.1"}]}'
```

Step 2: Issue a GET request to the same resource, and review the response to confirm that the IP address details were set properly:

```
curl -X GET -u admin:admin https://10.206.144.81/redfish/v1/Systems/Self/
EthernetInterfaces/IOModuleAFRU
```


```
{
    "@odata.context": "/redfish/v1/
$metadata#EthernetInterface.EthernetInterface",
    "@odata.id": "/redfish/v1/Systems/Self/EthernetInterfaces/IOModuleA",
    "@odata.type": "#EthernetInterface.v1_2_0.EthernetInterface",
    "Name": "IOM A Ethernet Interface",
    "Id": "IOModuleA",
    "LinkStatus": "LinkUp",
    "PermanentMACAddress": "00:0C:CA:08:38:88",
    "SpeedMbps": 1000,
    "HostName": "oobm-00:0C:CA:08:38:88",
    "FQDN": "oobm-00:0C:CA:08:38:88.\n",
    "FullDuplex": "true",
    "IPv4Addresses": [
        {
            "Address": "10.206.144.81",
            "SubnetMask": "255.255.248.0",
            "AddressOrigin": "Static",
            "Gateway": "10.206.144.1"
        }
    ],
    "NameServers": [],
    "Oem": {
        "WDC": {
            "Copyright": "Copyright © 2017-2021 Western Digital Corporation"
        }
    }
}
```


Note: IOMA cannot be used to modify IOMB's OOBM IP address, and vice versa.

Step 3: If applicable, repeat these steps to set the OOBM IP address for the second I/O module.

4.5.3 Upgrading Firmware with OOBM

The following procedure should be followed to upgrade the firmware of the Ultrastar Data102 using the OOBM API.

Step 1: Open a web browser, go to: https://portal.wdc.com/Support/s/, and download the firmware package for the Ultrastar Data102 .

Step 2: Extract the downloaded zip file and place file in a location that is accessible to the Ultrastar Data102 .

Step 3: Make a POST call to the UpdateService object using the `SimpleUpdate` action.

```
POST /redfish/v1/UpdateService/Actions/UpdateService.SimpleUpdate HTTP/1.1
Content-Type: application/json;charset=utf-8
Content-Length: <computed length>
OData-Version: 4.0
Authorization: Basic userid:password
```

a. In the body of the POST, list the `ImageURI` as the data parameter, and set the value of this parameter to the file location of the bin file.

Note: TFTP and HTTPS are supported.

Linux Example:

```
{"ImageURI": "tftp://<tftp IP address>/HGST_Ultrastar-DATA60-DATA102-
Server60-8_SEP_bundle_3010-007_3.1.11.tar.gz"}
```

Windows Example:

```
{\"ImageURI\":\"https://<https IP address>/HGST_Ultrastar-DATA60-DATA102-
Server60-8_SEP_bundle_3010-007_3.1.11.tar.gz\"}
```

Step 4: To check the status of this process, make a GET request to the following target:

Note: This command may need to be issued multiple times until it reports a completed status. This should be done before completing the remainder of the procedure.

```
curl -G -k -u admin:admin -H "Content-type: application/json" https://<IP
 address>/redfish/v1/UpdateService/Actions/UpdateService.SimpleUpdate/Status
```

a. Execute the command until you see the following result:

```
{
    "ErrorCode":0,
    "StatusCode":2,
    "Description":"FW update completed. Waiting for activation.",
    "EstimatedRemainingMinutes":0
}
```

Step 5: To activate the firmware, send a POST request:

- For an **automatic** activation, send the POST request to the `UpdateService` object using the `UpdateService.FWActivate` command:

```
curl -X POST -k -u admin:admin -H "Content-type: application/
json" https://<IP address>/redfish/v1/UpdateService/Actions/
UpdateService.FWActivate
```

Note: This command will perform a rolling reset of the IOMs.

- For a **non-automatic** activation, reset the IOMs manually by sending sequential POST requests to the `Chassis` object using the `Chassis.Reset` command:

```
curl -X POST -k -u admin:admin -H "Content-type: application/json"
 https://<OOBM IOMA-IP Address>/redfish/v1/Chassis/IOModuleAFRU/Actions/
Chassis.Reset
```

```
curl -X POST -k -u admin:admin -H "Content-type: application/json"
 https://<OOBM IOMB-IP Address>/redfish/v1/Chassis/IOModuleBFRU/Actions/
Chassis.Reset
```

4.6 SES Page 02

The SCSI `Send Diagnostic` and `Receive Diagnostic Results` commands can be addressed to a specific SES element in the enclosure. There are many different element codes, such as Page 02, defined to cover a wide range of devices. Page 02 refers to the control and status of the enclosure's PSUs, HDDs, ESMs, and sensors.

Note: Refer to the SES Firmware Management Interface Specification for more information on SES Page 02.

4.7 Zoning

Caution: Zone configuration should only be performed during a maintenance window, when the system is offline (not in production).

4.7.1 Before Zoning

This section provides information on actions that should be taken before starting zoning on the Ultrastar Data102 .

Users should install all of the required downloads before beginning the zoning process.

Required Downloads:

- SMP Tools 0.98 for Linux: http://sg.danny.cz/sg/smp_utils.html
- SG3 Utils: http://sg.danny.cz/sg/sg3_utils.html
- CLI Tools: to download the latest version of CLI tools, see: Downloading Firmware from the Support Portal *(page 208)*

4.7.2 Predefined Zoning Configurations

There are four predefined zoning configurations for the Ultrastar Data102 . Each configuration connects a different number of host ports to a set number of drives, called a zone group. This section provides information about each of the predefined zoning configurations.

Configuration 0

Configuration 0 is the default configuration of the enclosure when zoning is disabled; it allows all hosts to view all drive slots and the devices populating those drive slots. In this configuration, all of the drives belong to the same zone group as shown in the image below (represented by one color). Each of the SAS ports on the rear IO of the enclosure are also represented by the same color to display their connection to all of the drives within the enclosure.

- **In-band management**: Configuration 0 (default configuration) can be initiated in-band with the `sg_senddiag` command by passing `00` as the zoning configuration option. See: sg_senddiag Command *(page 237)* for the actual senddiag command.
- **Out-of-band management**: Configuration 0 (default configuration) can be initiated out-of-band to disable zoning by passing `0` as the `ZoningConfig` option for each IOM. The following are example Redfish and cURL POST commands:

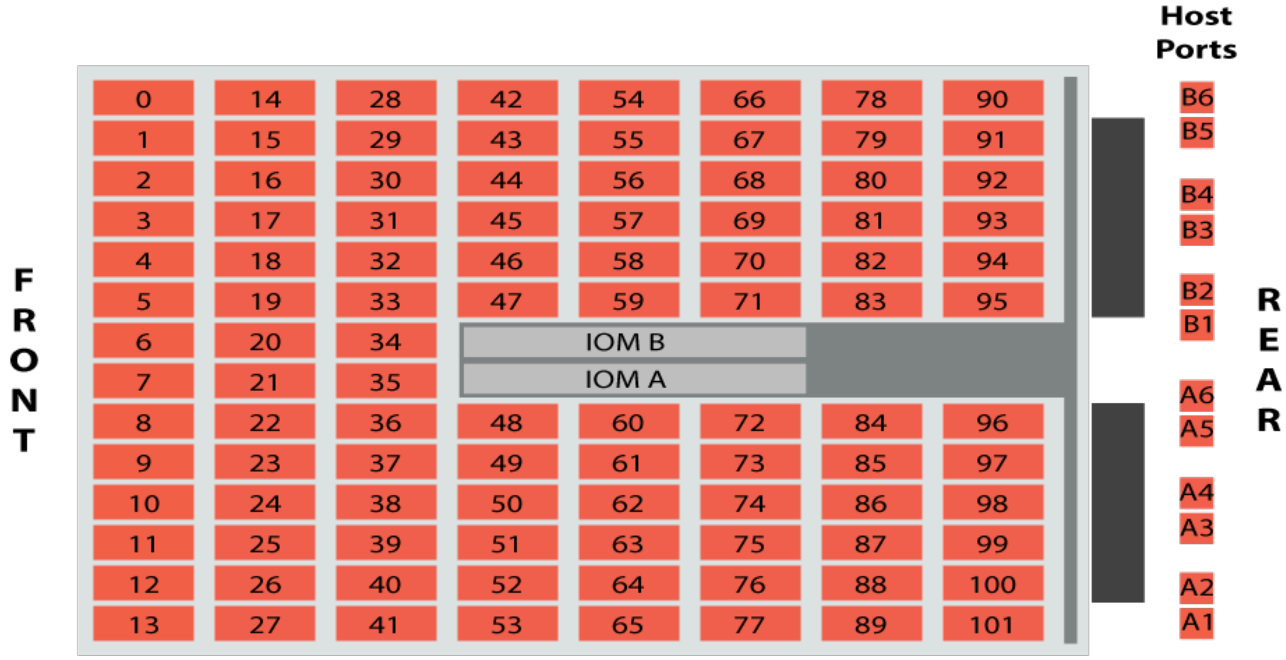
  Redfish POST:

  ```
  /redfish/v1/Systems/Self/Storage/<Enclosure Logical ID>/Actions/Storage.Zoning
  { "ZoningConfig": "0" }
  ```

  cURL POST:

  ```
  curl -X POST -k -u admin:admin -H "Content-type: application/json"
  https://<IP Address>/redfish/v1/Systems/Self/Storage/<Enclosure Logical ID>/Actions/
  Storage.Zoning -d
  '{"ZoningConfig" : "0"}'
  ```

Figure 251: Configuration 0



There is no SAS cable connection table for this configuration, because the host servers do not rely on specific ports to see specific drives and drive slots.

Configuration 1

Configuration 1 allows up to six redundantly configured hosts to view a specific zone group of drives. Each host will be able to view up to 17 drives that are mapped to both IOMs. Each zone group will display all of the devices that are contained within that zone. If a drive slot is not populated, it will still be part of that zone group, but it will not display any results in enclosure management until the drive slot has been populated. In this configuration, the enclosure is divided into six zone groups as shown in the folloing image (represented by six different colors). Each zone group matches to a single SAS port on each IOM (represented by a matching color) to allow for the connections to six different hosts.

- **In-band management**: Configuration 1 can be initiated in-band with the `sg_senddiag` command by passing `01` as the zoning configuration option. See: sg_senddiag Command *(page 237)* for the actual senddiag command.
- **Out-of-band management**: Configuration 1 can be initiated out-of-band by passing `1` as the `ZoningConfig` option for each IOM. The following are example Redfish and cURL POST commands:

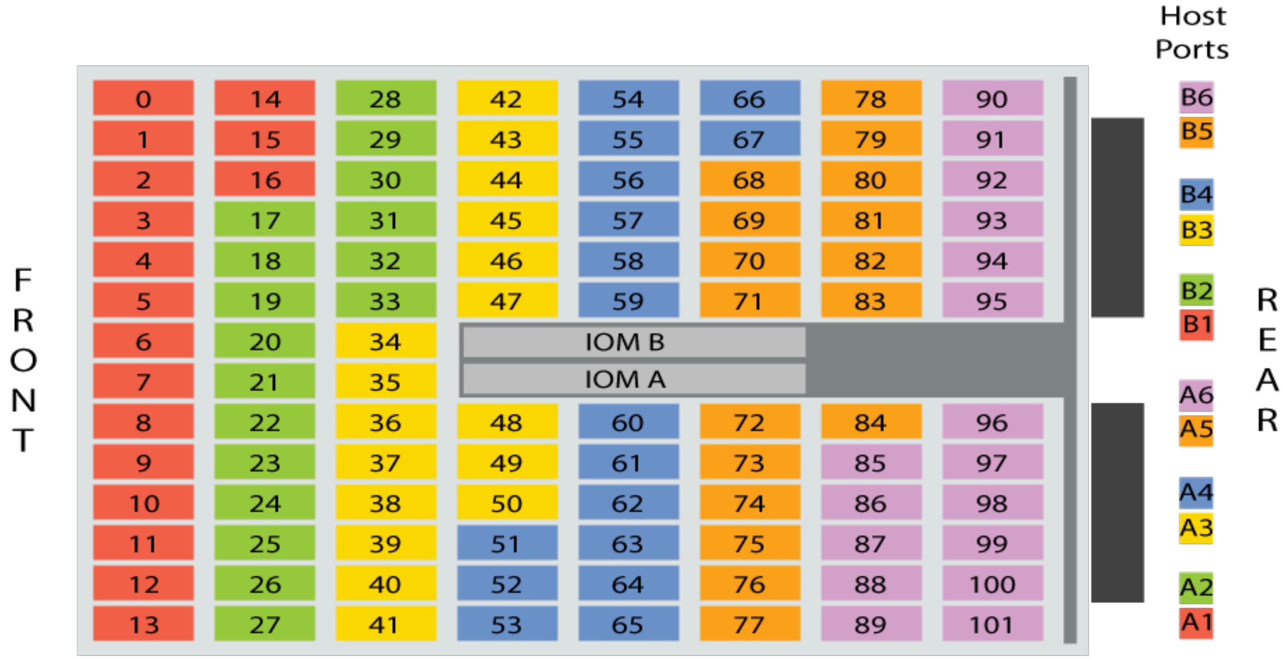
  Redfish POST:

  ```
  /redfish/v1/Systems/Self/Storage/<Enclosure Logical ID>/Actions/Storage.Zoning
  { "ZoningConfig": "1" }
  ```

  cURL POST:

  ```
  curl -X POST -k -u admin:admin -H "Content-type: application/json"
  https://<IP Address>/redfish/v1/Systems/Self/Storage/<Enclosure Logical ID>/Actions/
  Storage.Zoning -d
  '{"ZoningConfig" : "1"}'
  ```

Figure 252: Configuration 1



Connect the host servers to the enclosure using SAS cables in the configuration listed in the table below. The left side of the table displays the host number, and the right side displays the appropriate IOM SAS ports on the enclosure for that host.

Table 53: SAS Cable Connections for Configuration 1

Host	Enclosure IOM SAS Port
Host 1	A1
	B1
Host 2	A2
	B2
Host 3	A3
	B3
Host 4	A4
	B4
Host 5	A5
	B5
Host 6	A6
	B6

Configuration 2

Configuration 2 allows up to three redundantly configured hosts to view a specific zone group of drives. Each host will be able to view up to 34drives that are mapped to both IOMs. Each zone group will display all of the devices that are contained within that zone. If a drive slot is not populated, it will still be part of that zone group, but it will not display any results in enclosure management until the drive slot has been populated. In this configuration, the enclosure is divided into three zone groups as shown in the image below (represented by three different colors). Each zone group matches to a pair of SAS ports on each IOM (represented by a matching color) to allow for the connections to three different hosts.

- **In-band management**: Configuration 2 can be initiated in-band with the `sg_senddiag` command by passing `02` as the zoning configuration option. See: sg_senddiag Command *(page 237)* for the actual senddiag command.
- **Out-of-band management**: Configuration 2 can be initiated out-of-band by passing `2` as the `ZoningConfig` option for each IOM. The following are example Redfish and cURL POST commands:

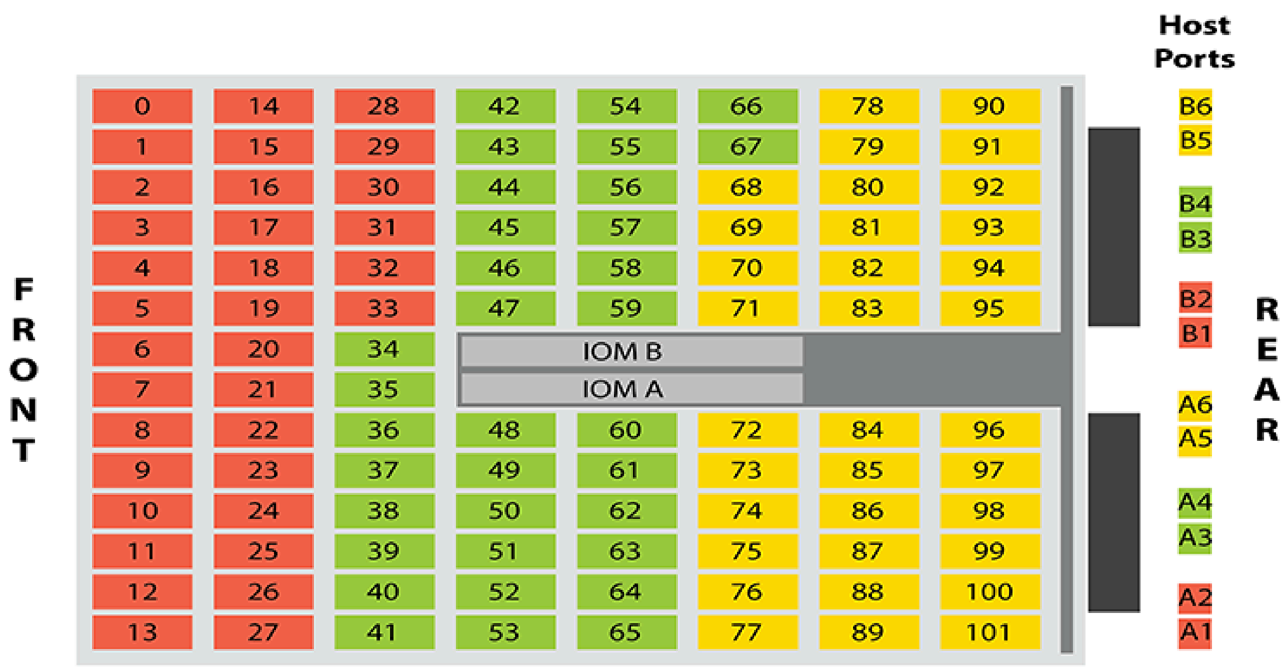
  Redfish POST:

  ```
  /redfish/v1/Systems/Self/ Storage/<Enclosure Logical ID>/Actions/Storage.Zoning
  { "ZoningConfig": "2" }
  ```

  cURL POST:

  ```
  curl -X POST -k -u admin:admin -H "Content-type: application/json"
  https://<IP Address>/redfish/v1/Systems/Self/Storage/<Enclosure Logical ID>/Actions/
  Storage.Zoning -d
  '{"ZoningConfig" : "2"}'
  ```

Figure 253: Configuration 2



Connect the host servers to the enclosure using SAS cables in the configuration listed in the table below. The left side of the table displays the host number, and the right side displays the appropriate IOM SAS ports on the enclosure for that host.

Table 54: SAS Cable connections for Configuration 2

Host	Enclosure IOM SAS Port
Host 1	A1
	A2
	B1
	B2
Host 2	A3
	A4
	B3
	B4
Host 3	A5
	A6
	B5
	B6

Configuration 3

Configuration 3 allows up to two redundantly configured hosts to view a specific zone group of drives. Each host will be able to view up to 51 drives that are mapped to both IOMs. Each zone group will display all of the devices that are contained within that zone. If a drive slot is not populated, it will still be part of that zone group, but it will not display any results in enclosure management until the drive slot has been populated. In this configuration, the enclosure is divided into two zone groups as shown in the image below (represented by two different colors). Each zone group matches to three SAS ports on each IOM (represented by a matching color) to allow for the connections to two different hosts.

- **In-band management**: Configuration 3 can be initiated in-band with the `sg_senddiag` command by passing `03` as the zoning configuration option. See: sg_senddiag Command *(page 237)* for the actual senddiag command.
- **Out-of-band management**: Configuration 3 can be initiated out-of-band by passing `3` as the `ZoningConfig` option for each IOM. The following are example Redfish and cURL POSTcommands:

  Redfish POST:

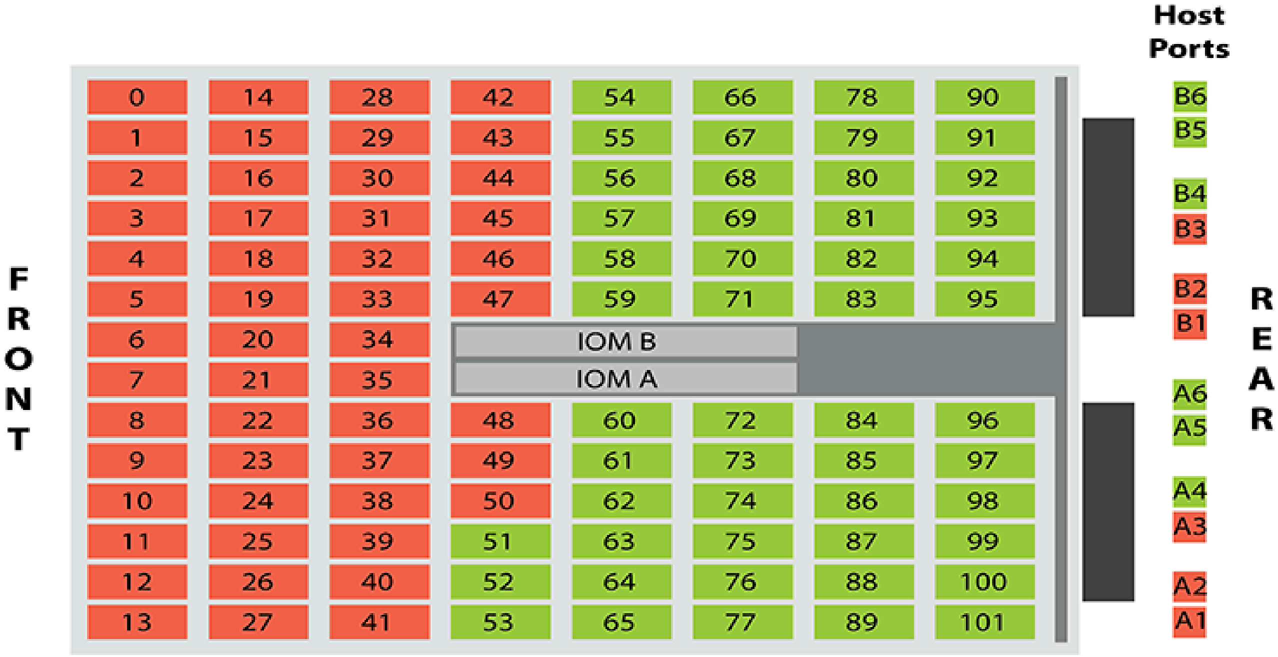
  ```
  /redfish/v1/Systems/Self/Storage/<Enclosure Logical ID>/Actions/Storage.Zoning
  { "ZoningConfig": "3" }
  ```

  cURL POST:

  ```
  curl -X POST -k -u admin:admin -H "Content-type: application/json"
  https://<IP Address>/redfish/v1/Systems/Self/Storage/<Enclosure Logical ID>/Actions/
  Storage.Zoning -d
  ```

```
'{"ZoningConfig" : "3"}'
```

Figure 254: Configuration 3



Connect the host servers to the enclosure using SAS cables in the configuration listed in the table below. The left side of the table displays the host number, and the right side displays the appropriate IOM SAS ports on the enclosure for that host.

Table 55: SAS Cable connections for Configuration 3

Host	Enclosure IOM SAS Port
Host 1	A1
	A2
	A3
	B1
	B2
	B3
Host 2	A4
	A5
	A6
	B4

Host	Enclosure IOM SAS Port
	B5
	B6

4.7.3 sg_senddiag Command

The `sg_senddiag` command is used to configure zoning on the Ultrastar Data102 . This command contains several values that are important for enabling and disabling zoning through the use of the IOMs and expanders. The following section breaks down how to understand the necessary information to properly enable or disable zoning on the enclosure. Each important part of the command matches an explanation of that part's function. Understanding the parts of the command will ensure that the proper information is collected to build the commands in the following sections.

sg_senddiag Command

```
sg_senddiag <a> --pf --raw=04,00,00,90,<b>,<c>,00,00,<d>
```

Command Breakdown

- **`sg_senddiag`** – a utility that performs a SCSI send diagnostic command
- **`<a>`** – the sg device (Linux) or SCSI device (Windows) that is assigned by the SEP. The information collected for the device will be input in any location that requests **<dev>**. There will be one sg or SCSI device handle for each of the two IOMs.
- **`--pf`** – Page Format is a bit, and in this case is clear due to the lack of a `–list` option.
- **`--raw`** – Raw reads the sequence of bytes from the standard input.
- **`<b>`** – the value that enables or disables the zone configuration. Input one of the following values:
  - **`60`** – disables zoning configurations on the enclosure
  - **`61`** – enables zoning configurations on the enclosure
- **`<c>`** – the value that chooses the zoning configuration that will be applied to the enclosure. Input one of the following values:
  - **`00`** – disables zoning in the enclosure
  - **`01`** – configures the zone groups into six sections containing 17 drives each
  - **`02`** – configures the zone groups into three sections containing 34 drives each
  - **`03`** – configures the zone groups into two sections containing 51 drives each

  Note: For more information on zoning configurations, see: Partial Population Configurations *(page 263)*.
- **`<d>`** – the value obtained from getting the SAS Address of each IOM. There will be one for each of the two IOMs on the enclosure. When the IOM SAS Address is applied to the string, each pair of characters should be offset by a comma.

4.7.4 Enabling Zoning using Linux

Step 1: From the host server, identify the sg devices that are associated with the Ultrastar Data102 IOMs.

a. Issue the following command:

```
sg_scan -i | grep -i H4102-J -B 1
```

b. Identify the sg devices from the output. The devices can be identified by the **<dev>**. The devices appear as **/dev/sg3** and **/dev/sg106** bolded in the example below.

```
/dev/sg3: scsi9 channel=0 id=43 lun=0
    HGST  H4102-J  0101 [rmb=0 cmdq=1 pqual=0 pdev=0xd]
'--
/dev/sg106: scsi9 channel=0 id=196 lun=0
    HGST  H4102-J  0101 [rmb=0 cmdq=1 pqual=0 pdev=0xd]
```

c. Record the sg device numbers for use in a later step.

Step 2: Identify the IOM SAS Address for both IOMs sg_ses page 7h.

a. Issue the following command:

```
sg_ses <dev> -p7 | grep -i esce
```

b. Identify the IOM SAS address for both IOMs from the output. Each address appears before the IP Address as bolded in the example below.

```
Element 0 descriptor: ESCE IOMA,1EB0246-B2          ,THCLS03517EL0091
  ,5000CCAB0300003C,10.202.238.225
Element 1 descriptor: ESCE IOMB,1EB0246             ,THCLS03517EL0052
  ,5000CCAB0300007C,10.202.239.201
```

c. Record the IOM SAS Addresses for use in a later step.

Step 3: Verify the IOM SAS Address that matches each sg_device that is linked to each IOM using sg_vpd page 83h.

a. Issue the following command:

```
sg_vpd <dev> -p0x83
```

b. Identify and match the IOM SAS address and sg device for both IOMs from the output. Each address appears bolded in the example below.

```
Addressed logical unit:
    designator type: NAA,  code set: Binary
      0x5000ccab0300003c
  Target port:
    designator type: NAA,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      0x5000ccab0300003c
    designator type: Relative target port,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      Relative target port: 0x1
  Target device that contains addressed lu:
    designator type: NAA,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      0x5000ccab0300003c
```

Step 4: Build the `sg_senddiag` command using the information recorded in earlier steps.

a. Use the example of the command described in sg_senddiag Command (page 237) to complete the specific command for IOM A. Replace letters **a** through **d** with the information recorded in previous steps.

sg_senddiag Command

```
sg_senddiag <a> --pf --raw=04,00,00,90,<b>,<c>,00,00,<d>
```

a. **sg device (<dev>)**: device associated with IOM A
b. **Enable Zoning**: 61
c. **Zoning Configuration**: configuration 01, 02, or 03

> **Note:** For information on preconfigured zoning configurations, see: Predefined Zoning Configurations (page 230).

d. **IOM SAS Address**: SAS Address associated with IOM A

> **Note:** A comma should be placed after each bit of data in the IOM SAS Address that was recorded. For example, if the IOM SAS Address output was **5000CCAB0300003C**, the address that should be added to the sg_senddiag command should be **50,00,CC,AB,03,00,00,3C**.

b. Use the example of the command described in sg_senddiag Command (page 237) to complete the specific command for IOM B. Replace letters **a** through **d** with the information recorded in previous steps.

sg_senddiag Command

```
sg_senddiag <a> --pf --raw=04,00,00,90,<b>,<c>,00,00,<d>
```

a. **sg device (<dev>)**: device associated with IOM B
b. **Enable Zoning**: 61
c. **Zoning Configuration**: configuration 01, 02, or 03

> **Note:** For information on preconfigured zoning configurations, see: Predefined Zoning Configurations (page 230).

d. **IOM SAS Address**: SAS Address associated with IOM B

> **Note:** A comma should be placed after each bit of data in the IOM SAS Address that was recorded. For example, if the IOM SAS Address output was **5000CCAB0300007C**, the address that should be added to the sg_senddiag command should be **50,00,CC,AB,03,00,00,7C**.

c. The following are examples of completed sg_senddiag commands for IOM A and B.

- **IOM A**: sg_senddiag <dev> --pf --raw=04,00,00,90,61,01,00,00,50,00,CC,AB,03,00,00,3C
- **IOM B**: sg_senddiag <dev> --pf --raw=04,00,00,90,61,01,00,00,50,00,CC,AB,03,00,00,7C

Step 5: Enable zoning on IOM A using the sg_senddiag command.

a. Issue the command for IOM A that was built in the previous step.

b. Enabling a predefined zoning configuration will reset the SAS connector ports which may cause the sg_senddiag command to return a status of DID_TIME_OUT or DID_SOFT_ERROR. Despite the error, the zoning configuration will be enabled. The zoning configuration can be verified after both IOMs have been zoned.

```
send diagnostic: transport: Host_status=0x03 [DID_TIME_OUT]
Driver_status=0x00 [DRIVER_OK]
```

Step 6: Enable zoning on IOM B using the sg_senddiag command.

a. Issue the command for IOM B that was built in the previous step.

b. Enabling a predefined zoning configuration will reset the SAS connector ports which may cause the sg_senddiag command to return a status of DID_TIME_OUT or DID_SOFT_ERROR. Despite the error, the zoning configuration will be enabled. The zoning configuration can be verified after both IOMs have been zoned.

```
send diagnostic: transport: Host_status=0x03 [DID_TIME_OUT]
Driver_status=0x00 [DRIVER_OK]
```

Step 7: Verify the zone groups for each of the host using the smp_discover_list command.

a. Issue the following command to locate the expander handles:

```
ls /dev/bsg
```

Example of the Expander Handles

```
0:2:0:0     9:0:1297:0  9:0:1378:0  9:0:1390:0
 end_device-9:41:26  end_device-9:44:12  end_device-9:44:9
10:0:0:0    9:0:1298:0  9:0:1379:0  9:0:1391:0
 end_device-9:41:27  end_device-9:44:13  expander-9:39
7:0:0:0     9:0:1299:0  9:0:1380:0  end_device-9:39:2
 end_device-9:41:28  end_device-9:44:14  expander-9:40
9:0:1220:0  9:0:1300:0  9:0:1381:0  end_device-9:41:17
 end_device-9:41:29  end_device-9:44:15  expander-9:41
9:0:1289:0  9:0:1301:0  9:0:1382:0  end_device-9:41:18
 end_device-9:41:30  end_device-9:44:16  expander-9:42
9:0:1290:0  9:0:1302:0  9:0:1383:0  end_device-9:41:19
 end_device-9:41:31  end_device-9:44:2   expander-9:43
9:0:1291:0  9:0:1303:0  9:0:1384:0  end_device-9:41:20
 end_device-9:41:32  end_device-9:44:3   expander-9:44
9:0:1292:0  9:0:1304:0  9:0:1385:0  end_device-9:41:21  end_device-9:42:2
   end_device-9:44:4   sas_host9
9:0:1293:0  9:0:1323:0  9:0:1386:0  end_device-9:41:22  end_device-9:44:0
   end_device-9:44:5
9:0:1294:0  9:0:1375:0  9:0:1387:0  end_device-9:41:23  end_device-9:44:1
   end_device-9:44:6
9:0:1295:0  9:0:1376:0  9:0:1388:0  end_device-9:41:24
 end_device-9:44:10  end_device-9:44:7
9:0:1296:0  9:0:1377:0  9:0:1389:0  end_device-9:41:25
 end_device-9:44:11  end_device-9:44:8
```

b. Issue the following command to access a single host's SMP Discover output:

```
smp_discover_list /dev/bsg/expander-9:39
```

c. Zone group 9 can be identified by the **`ZG:9`** located at the end of each line in zone 9. The above example displays PHYs 0-13 as being in zone group 9. All other devices are labeled as **`inaccessible`** because the host is displaying the only devices it has access to. The step can be repeated on other hosts to see what zone group each host has access to.

d. Issue the following command to access all hosts smp_discover_list:

```
smp_discover_list --ignore /dev/bsg/expander-9:39
```

e. Zone group 9, 10, 11, 12, 13, and 14 can be identified by the **`ZG`** located at the end of each group in each of their respective zones. The above example displays PHYs 0-13 as being in zone group 9, PHYs 14-27 as being in zone group 10, and so on.

4.7.5 Disabling Zoning using Linux

Step 1: From the host server, identify the sg devices that are associated with the Ultrastar Data102 IOMs.

a. Issue the following command:

```
sg_scan -i | grep -i H4102-J -B 1
```

b. Identify the sg devices from the output. The devices can be identified by the **<dev>**. The devices appear as ***/dev/sg3*** and ***/dev/sg106*** bolded in the example below.

```
/dev/sg3: scsi9 channel=0 id=43 lun=0
    HGST  H4102-J  0101 [rmb=0 cmdq=1 pqual=0 pdev=0xd]
'--
/dev/sg106: scsi9 channel=0 id=196 lun=0
    HGST  H4102-J  0101 [rmb=0 cmdq=1 pqual=0 pdev=0xd]
```

c. Record the sg device numbers for use in a later step.

Step 2: Identify the IOM SAS Address for both IOMs sg_ses page 7h.

a. Issue the following command:

```
sg_ses <dev> -p7 | grep -i esce
```

b. Identify the IOM SAS address for both IOMs from the output. Each address appears before the IP Address as bolded in the example below.

```
Element 0 descriptor: ESCE IOMA,1EB0246-B2          ,THCLS03517EL0091
  ,5000CCAB0300003C,10.202.238.225
Element 1 descriptor: ESCE IOMB,1EB0246             ,THCLS03517EL0052
  ,5000CCAB0300007C,10.202.239.201
```

c. Record the IOM SAS Addresses for use in a later step.

Step 3: Verify the IOM SAS Address that matches each sg_device that is linked to each IOM using sg_vpd page 83h.

a. Issue the following command:

```
sg_vpd <dev> -p0x83
```

b. Identify and match the IOM SAS address and sg device for both IOMs from the output. Each address appears bolded in the example below.

```
Addressed logical unit:
    designator type: NAA,  code set: Binary
      0x5000ccab0300003c
  Target port:
    designator type: NAA,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      0x5000ccab0300003c
    designator type: Relative target port,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      Relative target port: 0x1
  Target device that contains addressed lu:
    designator type: NAA,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      0x5000ccab0300003c
```

Step 4: Build the sg_senddiag command using the information recorded in earlier steps.

a. Use the example of the sg_senddiag command shown in the image above to complete the specific sg_senddiag command for IOM A. Replace letters **a** through **d** with the information recorded in previous steps.

sg_senddiag Command

```
sg_senddiag <a> --pf --raw=04,00,00,90,<b>,<c>,00,00,<d>
```

a. **sg device (<dev>)**: device associated with IOM A
b. **Disable Zoning**: 60
c. **Zoning Configuration**: configuration 00

Note: For information on preconfigured zoning configurations, see: Predefined Zoning Configurations (page 230).

d. **IOM SAS Address**: SAS Address associated with IOM A

Note: A comma should be placed after each bit of data in the IOM SAS Address that was recorded. For example, if the IOM SAS Address output was **5000CCAB0300003C**, the address that should be added to the sg_senddiag command should be **50,00,CC,AB,03,00,00,3C**.

b. Use the example of the sg_senddiag command shown in the image above to complete the specific sg_senddiag command for IOM B. Replace letters **a** through **d** with the information recorded in previous steps.

sg_senddiag Command

```
sg_senddiag <a> --pf --raw=04,00,00,90,<b>,<c>,00,00,<d>
```

a. **sg device (<dev>)**: device associated with IOM B
b. **Disable Zoning**: 60

c. **Zoning Configuration**: configuration 00

> **Note:** For information on preconfigured zoning configurations, see: Predefined Zoning Configurations (page 230).

d. **IOM SAS Address**: SAS Address associated with IOM B

> **Note:** A comma should be placed after each bit of data in the IOM SAS Address that was recorded. For example, if the IOM SAS Address output was **5000CCAB0300007C**, the address that should be added to the sg_senddiag command should be **50,00,CC,AB,03,00,00,7C**.

c. The following are examples of completed sg_senddiag commands for IOM A and B.

- **IOM A**: sg_senddiag <dev> --pf --raw=04,00,00,90,60,00,00,00,50,00,CC,AB,03,00,00,3C
- **IOM B**: sg_senddiag <dev> --pf --raw=04,00,00,90,60,00,00,00,50,00,CC,AB,03,00,00,7C

Step 5: Disable zoning on IOM A using the sg_senddiag command.

a. Issue the command for IOM A that was built in the previous step.

Step 6: Disable zoning on IOM B using the sg_senddiag command.

a. Issue the command for IOM B that was built in the previous step.

Step 7: Verify the zone groups for each of the host's has been disabled using the smp_discover_list command.

a. Issue the following command to locate the expander handles:

```
ls /dev/bsg
```

Example of the Expander Handles

```
0:2:0:0     9:0:1297:0  9:0:1378:0  9:0:1390:0
 end_device-9:41:26  end_device-9:44:12  end_device-9:44:9
10:0:0:0    9:0:1298:0  9:0:1379:0  9:0:1391:0
 end_device-9:41:27  end_device-9:44:13  expander-9:39
7:0:0:0     9:0:1299:0  9:0:1380:0  end_device-9:39:2
 end_device-9:41:28  end_device-9:44:14  expander-9:40
9:0:1220:0  9:0:1300:0  9:0:1381:0  end_device-9:41:17
 end_device-9:41:29  end_device-9:44:15  expander-9:41
9:0:1289:0  9:0:1301:0  9:0:1382:0  end_device-9:41:18
 end_device-9:41:30  end_device-9:44:16  expander-9:42
9:0:1290:0  9:0:1302:0  9:0:1383:0  end_device-9:41:19
 end_device-9:41:31  end_device-9:44:2   expander-9:43
9:0:1291:0  9:0:1303:0  9:0:1384:0  end_device-9:41:20
 end_device-9:41:32  end_device-9:44:3   expander-9:44
9:0:1292:0  9:0:1304:0  9:0:1385:0  end_device-9:41:21  end_device-9:42:2
   end_device-9:44:4   sas_host9
9:0:1293:0  9:0:1323:0  9:0:1386:0  end_device-9:41:22  end_device-9:44:0
   end_device-9:44:5
9:0:1294:0  9:0:1375:0  9:0:1387:0  end_device-9:41:23  end_device-9:44:1
   end_device-9:44:6
```

```
9:0:1295:0  9:0:1376:0  9:0:1388:0  end_device-9:41:24
 end_device-9:44:10  end_device-9:44:7
9:0:1296:0  9:0:1377:0  9:0:1389:0  end_device-9:41:25
 end_device-9:44:11  end_device-9:44:8
```

b. Issue the following command to access a single host's SMP Discover output:

```
smp_discover_list /dev/bsg/expander-9:39
```

Note: Repeat this substep for all expanders.

c. Zone groups will not be visible due to zoning being disabled. All hosts will have access to all drives.

d. Issue the following command to access all hosts smp_discover_list:

```
smp_discover_list --ignore /dev/bsg/expander-9:39
```

Note: Repeat this substep for all hosts.

4.7.6 Enabling Zoning using Windows

Step 1: From the host server, identify the SCSI devices that are associated with the Ultrastar Data102 IOMs.

Note: The operating system associates each SEP device as a SCSI device. The SCSI device of the SEP can be used to get status from or control elements within the enclosure.

a. Issue the following command:

```
sg_scan -s | findstr /i H4102-J
```

b. Identify the SCSI devices from the output. The device information follows **SCSI0**. The devices appear as **SCSI0:1,62,0** and **SCSI0:1,124,0** bolded in the example below.

```
SCSI0:1,62,0   claimed=0 pdt=dh          HGST       H4102-J       0101
      0428
SCSI0:1,124,0   claimed=0 pdt=dh          HGST       H4102-J       0101

      0428
```

Step 2: Locate the IP Address for each IOM using sg_ses page 7.

a. Issue the following command:

```
sg_ses <dev> -p7 | finstr /i esce
```

Note: For scsi**<dev>**, type the number of the SCSI device recorded in the previous step.

b. The IP Address for each IOM will appear at the end of each resulting line. Each IP Address is labeled for either IOM A or IOM B and occurs after the last comma as seen bolded in the following example.

Step 3: Verify the IOM SAS Address that matches each SCSI device that is linked to each IOM using sg_vpd page 83h.

a. Issue the following command:

```
sg_vpd <dev> -p0x83
```

b. Identify and match the IOM SAS address and sg device for both IOMs from the output. Each address appears bolded in the example below.

```
Addressed logical unit:
    designator type: NAA,  code set: Binary
      0x5000ccab0300003c
  Target port:
    designator type: NAA,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      0x5000ccab0300003c
    designator type: Relative target port,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      Relative target port: 0x1
  Target device that contains addressed lu:
    designator type: NAA,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      0x5000ccab0300003c
```

Step 4: Build the sg_senddiag command using the information recorded in earlier steps.

a. Use the example of the sg_senddiag command shown in the image above to complete the specific sg_senddiag command for IOM A. Replace letters **a** through **d** with the information recorded in previous steps.

sg_senddiag Command

```
sg_senddiag <a> --pf --raw=04,00,00,90,<b>,<c>,00,00,<d>
```

a. **SCSI device (<dev>)**: device associated with IOM A
b. **Enable Zoning**: 61
c. **Zoning Configuration**: configuration 01, 02, or 03

Note: For information on preconfigured zoning configurations, see: Predefined Zoning Configurations *(page 230)*.

d. **IOM SAS Address**: SAS Address associated with IOM A

Note: A comma should be placed after each bit of data in the IOM SAS Address that was recorded. For example, if the IOM SAS Address output was **5000CCAB0300003C**, the address that should be added to the sg_senddiag command should be **50,00,CC,AB,03,00,00,3C**.

b. Use the example of the sg_senddiag command shown in the image above to complete the specific sg_senddiag command for IOM B. Replace letters **a** through **d** with the information recorded in previous steps.

sg_senddiag Command

```
sg_senddiag <a> --pf --raw=04,00,00,90,<b>,<c>,00,00,<d>
```

a. **SCSI device (<dev>)**: device associated with IOM B
b. **Enable Zoning**: 61
c. **Zoning Configuration**: configuration 01, 02, or 03

Note: For information on preconfigured zoning configurations, see: Predefined Zoning Configurations *(page 230)*.

d. **IOM SAS Address**: SAS Address associated with IOM B

Note: A comma should be placed after each bit of data in the IOM SAS Address that was recorded. For example, if the IOM SAS Address output was **5000CCAB0300007C**, the address that should be added to the sg_senddiag command should be **50,00,CC,AB,03,00,00,7C**.

c. The following are examples of completed sg_senddiag commands for IOM A and B.

- **IOM A**: sg_senddiag 3 --pf --raw=04,00,00,90,61,01,00,00,50,00,CC,AB,03,00,00,3C
- **IOM B**: sg_senddiag 106 --pf --raw=04,00,00,90,61,01,00,00,50,00,CC,AB,03,00,00,7C

Step 5: Enable zoning on IOM A using the sg_senddiag command.

a. Issue the command for IOM A that was built in the previous step.
b. Enabling a predefined zoning configuration will reset the SAS connector ports which may cause the sg_senddiag command to return a status of DID_TIME_OUT or DID_SOFT_ERROR. Despite the error, the zoning configuration will be enabled. The zoning configuration can be verified after both IOMs have been zoned.

```
send diagnostic: transport: Host_status=0x03 [DID_TIME_OUT]
Driver_status=0x00 [DRIVER_OK]
```

Step 6: Enable zoning on IOM B using the sg_senddiag command.

a. Issue the command for IOM B that was built in the previous step.
b. Enabling a predefined zoning configuration will reset the SAS connector ports which may cause the sg_senddiag command to return a status of DID_TIME_OUT or DID_SOFT_ERROR. Despite the error, the zoning configuration will be enabled. The zoning configuration can be verified after both IOMs have been zoned.

```
send diagnostic: transport: Host_status=0x03 [DID_TIME_OUT]
Driver_status=0x00 [DRIVER_OK]
```

Step 7: Verify the zone groups for each of the host using the smp_discover_list command.

a. Issue the following command to locate the expander handles:

```
ls /dev/bsg
```

Example of the Expander Handles

```
0:2:0:0     9:0:1297:0  9:0:1378:0  9:0:1390:0
 end_device-9:41:26  end_device-9:44:12  end_device-9:44:9
10:0:0:0    9:0:1298:0  9:0:1379:0  9:0:1391:0
 end_device-9:41:27  end_device-9:44:13  expander-9:39
7:0:0:0     9:0:1299:0  9:0:1380:0  end_device-9:39:2
 end_device-9:41:28  end_device-9:44:14  expander-9:40
9:0:1220:0  9:0:1300:0  9:0:1381:0  end_device-9:41:17
 end_device-9:41:29  end_device-9:44:15  expander-9:41
9:0:1289:0  9:0:1301:0  9:0:1382:0  end_device-9:41:18
 end_device-9:41:30  end_device-9:44:16  expander-9:42
9:0:1290:0  9:0:1302:0  9:0:1383:0  end_device-9:41:19
 end_device-9:41:31  end_device-9:44:2   expander-9:43
9:0:1291:0  9:0:1303:0  9:0:1384:0  end_device-9:41:20
 end_device-9:41:32  end_device-9:44:3   expander-9:44
9:0:1292:0  9:0:1304:0  9:0:1385:0  end_device-9:41:21  end_device-9:42:2
   end_device-9:44:4   sas_host9
9:0:1293:0  9:0:1323:0  9:0:1386:0  end_device-9:41:22  end_device-9:44:0
   end_device-9:44:5
9:0:1294:0  9:0:1375:0  9:0:1387:0  end_device-9:41:23  end_device-9:44:1
   end_device-9:44:6
9:0:1295:0  9:0:1376:0  9:0:1388:0  end_device-9:41:24
 end_device-9:44:10  end_device-9:44:7
9:0:1296:0  9:0:1377:0  9:0:1389:0  end_device-9:41:25
 end_device-9:44:11  end_device-9:44:8
```

b. Issue the following command to access a single host's SMP Discover output:

```
smp_discover_list /dev/bsg/expander-9:39
```

c. Zone group 9 can be identified by the `ZG:9` located at the end of each line in zone 9. The above example displays PHYs 0-13 as being in zone group 9. All other devices are labeled as `inaccessible` because the host is displaying the only devices it has access to. The step can be repeated on other hosts to see what zone group each host has access to.

d. Issue the following command to access all hosts smp_discover_list:

```
smp_discover_list --ignore /dev/bsg/expander-9:39
```

e. Zone group 9, 10, 11, 12, 13, and 14 can be identified by the `ZG` located at the end of each group in each of their respective zones. The above example displays PHYs 0-13 as being in zone group 9, PHYs 14-27 as being in zone group 10, and so on.

4.7.7 Disabling Zoning using Windows

Step 1: From the host server, identify the SCSI devices that are associated with the Ultrastar Data102 IOMs.

> **Note:** The operating system associates each SEP device as a SCSI device. The SCSI device of the SEP can be used to get status from or control elements within the enclosure.

a. Issue the following command:

```
sg_scan -s | findstr /i H4102-J
```

b. Identify the SCSI devices from the output. The device information follows **SCSI0**. The devices appear as **SCSI0:1,62,0** and **SCSI0:1,124,0** bolded in the example below.

```
SCSI0:1,62,0   claimed=0 pdt=dh          HGST       H4102-J       0101
      0428
SCSI0:1,124,0   claimed=0 pdt=dh          HGST       H4102-J       0101

      0428
```

Step 2: Locate the IP Address for each IOM using sg_ses page 7.

a. Issue the following command:

```
sg_ses <dev> -p7 | finstr /i esce
```

> **Note:** For scsi**<dev>**, type the number of the SCSI device recorded in the previous step.

b. The IP Address for each IOM will appear at the end of each resulting line. Each IP Address is labeled for either IOM A or IOM B and occurs after the last comma as seen bolded in the following example.

Step 3: Verify the IOM SAS Address that matches each SCSI device that is linked to each IOM using sg_vpd page 83h.

a. Issue the following command:

```
sg_vpd <dev> -p0x83
```

b. Identify and match the IOM SAS address and sg device for both IOMs from the output. Each address appears bolded in the example below.

```
Addressed logical unit:
    designator type: NAA,  code set: Binary
      0x5000ccab0300003c
  Target port:
    designator type: NAA,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      0x5000ccab0300003c
    designator type: Relative target port,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      Relative target port: 0x1
  Target device that contains addressed lu:
    designator type: NAA,  code set: Binary
```

```
      transport: Serial Attached SCSI Protocol (SPL-4)
       0x5000ccab0300003c
```

Step 4: Build the sg_senddiag command using the information recorded in earlier steps.

a. Use the example of the sg_senddiag command shown in the image above to complete the specific sg_senddiag command for IOM A. Replace letters **a** through **d** with the information recorded in previous steps.

sg_senddiag Command

```
sg_senddiag <a> --pf --raw=04,00,00,90,<b>,<c>,00,00,<d>
```

a. SCSI device (<dev>): device associated with IOM A

b. Disable Zoning: 60

c. Zoning Configuration: configuration 00

> **Note:** For information on preconfigured zoning configurations, see: Predefined Zoning Configurations *(page 230)*.

d. IOM SAS Address: SAS Address associated with IOM A

> **Note:** A comma should be placed after each bit of data in the IOM SAS Address that was recorded. For example, if the IOM SAS Address output was **5000CCAB0300003C**, the address that should be added to the sg_senddiag command should be **50,00,CC,AB,03,00,00,3C**.

b. Use the example of the sg_senddiag command shown in the image above to complete the specific sg_senddiag command for IOM B. Replace letters **a** through **d** with the information recorded in previous steps.

sg_senddiag Command

```
sg_senddiag <a> --pf --raw=04,00,00,90,<b>,<c>,00,00,<d>
```

a. SCSI device (<dev>): device associated with IOM B

b. Disable Zoning: 60

c. Zoning Configuration: configuration 00

> **Note:** For information on preconfigured zoning configurations, see: Predefined Zoning Configurations *(page 230)*.

d. IOM SAS Address: SAS Address associated with IOM B

> **Note:** A comma should be placed after each bit of data in the IOM SAS Address that was recorded. For example, if the IOM SAS Address output was **5000CCAB0300007C**, the address that should be added to the sg_senddiag command should be **50,00,CC,AB,03,00,00,7C**.

c. The following are examples of completed sg_senddiag commands for IOM A and B.

- **IOM A**: sg_senddiag 3 --pf --raw=04,00,00,90,60,00,00,00,50,00,CC,AB,03,00,00,3C

- **IOM B**: sg_senddiag 106 --pf –raw=04,00,00,90,60,00,00,00,50,00,CC,AB,03,00,00,7C

Step 5: Disable zoning on IOM A using the sg_senddiag command.

a. Issue the command for IOM A that was built in the previous step.

b. Disabling a predefined zoning configuration will reset the SAS connector ports which may cause the sg_senddiag command to return a status of DID_TIME_OUT or DID_SOFT_ERROR. Despite the error, the zoning configuration will be enabled. The zoning configuration can be verified after both IOMs have been zoned.

```
send diagnostic: transport: Host_status=0x03 [DID_TIME_OUT]
Driver_status=0x00 [DRIVER_OK]
```

Step 6: Disable zoning on IOM B using the sg_senddiag command.

a. Issue the command for IOM B that was built in the previous step.

b. Disabling a predefined zoning configuration will reset the SAS connector ports which may cause the sg_senddiag command to return a status of DID_TIME_OUT or DID_SOFT_ERROR. Despite the error, the zoning configuration will be enabled. The zoning configuration can be verified after both IOMs have been zoned.

```
send diagnostic: transport: Host_status=0x03 [DID_TIME_OUT]
Driver_status=0x00 [DRIVER_OK]
```

Step 7: Reset the both IOMs by issuing the following command:

```
sg_ses <dev> -p4 -c -d 02,00,00,00
```

Step 8: Verify the zone groups for each of the host's has been disabled using the smp_discover_list command.

a. Issue the following command to locate the expander handles:

```
ls /dev/bsg
```

Example of the Expander Handles

```
0:2:0:0     9:0:1297:0  9:0:1378:0  9:0:1390:0
 end_device-9:41:26  end_device-9:44:12  end_device-9:44:9
10:0:0:0    9:0:1298:0  9:0:1379:0  9:0:1391:0
 end_device-9:41:27  end_device-9:44:13  expander-9:39
7:0:0:0     9:0:1299:0  9:0:1380:0  end_device-9:39:2
 end_device-9:41:28  end_device-9:44:14  expander-9:40
9:0:1220:0  9:0:1300:0  9:0:1381:0  end_device-9:41:17
 end_device-9:41:29  end_device-9:44:15  expander-9:41
9:0:1289:0  9:0:1301:0  9:0:1382:0  end_device-9:41:18
 end_device-9:41:30  end_device-9:44:16  expander-9:42
9:0:1290:0  9:0:1302:0  9:0:1383:0  end_device-9:41:19
 end_device-9:41:31  end_device-9:44:2   expander-9:43
9:0:1291:0  9:0:1303:0  9:0:1384:0  end_device-9:41:20
 end_device-9:41:32  end_device-9:44:3   expander-9:44
9:0:1292:0  9:0:1304:0  9:0:1385:0  end_device-9:41:21  end_device-9:42:2
   end_device-9:44:4   sas_host9
9:0:1293:0  9:0:1323:0  9:0:1386:0  end_device-9:41:22  end_device-9:44:0
   end_device-9:44:5
9:0:1294:0  9:0:1375:0  9:0:1387:0  end_device-9:41:23  end_device-9:44:1
   end_device-9:44:6
```

```
9:0:1295:0  9:0:1376:0  9:0:1388:0  end_device-9:41:24
 end_device-9:44:10  end_device-9:44:7
9:0:1296:0  9:0:1377:0  9:0:1389:0  end_device-9:41:25
 end_device-9:44:11  end_device-9:44:8
```

b. Issue the following command to access a single host's SMP Discover output:

```
smp_discover_list /dev/bsg/expander-9:39
```

Note: Repeat this substep for all expanders.

c. Zone groups will not be visible due to zoning being disabled. All hosts will have access to all drives.

d. Issue the following command to access all hosts smp_discover_list:

```
smp_discover_list --ignore /dev/bsg/expander-9:39
```

4.7.8 File-Based Zoning

File-based zoning—introduced with firmware 2030—is a method of configuring zoning on an enclosure using a binary configuration file provided by Western Digital Engineering. The file is downloaded to the enclosure, and the zoning configuration is stored on the baseboard, where it both enables the file-based zoning feature and configures the default zoning of the enclousre. Any newly installed IOM will then automatically use the zoning configuration stored on the baseboard.

Caution: If zoning is later reconfigured using another standard method (i.e. OOBM, sg_senddiag, SMP, WDDCS Tool), that configuration will only last until the enclousre is power-cycled or reset. Once rebooted, the enclosure will read and enable the default configuration from its baseboard. This behavior will continue as long as the file-based zoning feature is enabled.

Zoning Files

Zoning files are available through the Western Digital Enterprise Support Center (https://portal.wdc.com/Support/s/) for each of the predefined zoning configurations described in Predefined Zoning Configurations *(page 230)* as well as the disabling options described in Disabling File-Based Zoning *(page 251)* below. To request a custom zoning configuration file, please open a support case through the Western Digital Enterprise Support Center.

Disabling File-Based Zoning

File-based zoning can be disabled at any time by following the instructions in Disabling File-Based Zoning Using Linux *(page 254)* or Disabling File-Based Zoning Using Windows *(page 260)*. "Disabling file-based zoning" may mean one of two distinct options, both of which are available to the user and described in the disabling procedures:

- **Disabling zoning using the file-based feature** – This involves downloading and activating a binary file (`Disable_Config.bin`) that sets the enclosure zoning to configuration 0, thereby "disabling" zoning while keeping the file-based zoning feature enabled.

- **Disabling the file-based zoning feature itself** – This involves downloading and activating a binary file (`Clear_Config.bin`) that disables the file-based zoning feature and any file-based zoning configuration, allowing zoning via other standard methods to persist through enclosure power cycles.

4.7.8.1 Enabling File-Based Zoning Using Linux

This task provides instructions for enabling the file-based zoning feature and configuring zoning using the file-based method in a Linux operating system environment.

Step 1: From a command line, use the `lsscsi` and `grep` commands to list all enclosure devices connected to the host:

```
# lsscsi -g | grep -i enc
```

From the output, note the device names for the IOMs (i.e. `/dev/sgX`):

```
[1:0:3051:0] enclosu  HGST  H4102-J  2050  -  /dev/sg1
[1:0:3154:0] enclosu  HGST  H4102-J  2050  -  /dev/sg2
```

Note: Depending on the user's setup, the devices listed in the output may represent multiple HBAs, connected to multiple IOMs, within multiple enclosures. Further investigation may be required to determine the correct enclosure for zoning. If further investigation is not required, proceed to step 3 *(page 253)*.

Step 2: To determine the correct enclosure:

a. Use the `sg_inq` utility for each device to determine the serial number of its enclosure:

```
# sg_inq /dev/sg1
standard INQUIRY:
  PQual=0  Device_type=13  RMB=0  LU_CONG=0  version=0x06  [SPC-4]
  [AERC=0]  [TrmTsk=0]  NormACA=0  HiSUP=0  Resp_data_format=2
  SCCS=0  ACC=0  TPGS=0  3PC=0  Protect=0  [BQue=0]
  EncServ=1  MultiP=0  [MChngr=0]  [ACKREQQ=0]  Addr16=0
  [RelAdr=0]  WBus16=0  Sync=0  [Linked=0]  [TranDis=0]  CmdQue=1
  [SPI: Clocking=0x0  QAS=0  IUS=0]
    length=96 (0x60)   Peripheral device type: enclosure services device
 Vendor identification: HGST
 Product identification: H4102-J
 Product revision level: 2050
 Unit serial number: USCSJ03717EB0001
```

```
# sg_inq /dev/sg2
standard INQUIRY:
  PQual=0  Device_type=13  RMB=0  LU_CONG=0  version=0x06  [SPC-4]
  [AERC=0]  [TrmTsk=0]  NormACA=0  HiSUP=0  Resp_data_format=2
  SCCS=0  ACC=0  TPGS=0  3PC=0  Protect=0  [BQue=0]
  EncServ=1  MultiP=0  [MChngr=0]  [ACKREQQ=0]  Addr16=0
  [RelAdr=0]  WBus16=0  Sync=0  [Linked=0]  [TranDis=0]  CmdQue=1
  [SPI: Clocking=0x0  QAS=0  IUS=0]
    length=96 (0x60)   Peripheral device type: enclosure services device
 Vendor identification: HGST
 Product identification: H4102-J
 Product revision level: 2050
 Unit serial number: USCSJ03717EB0001
```

If multiple serial numbers are identified, the numbers can then be matched to their corresponding physical enclosures to determine which is the correct one for zoning.

Note: If multiple devices share a serial number, the devices represent either multiple HBAs within the host or multiple IOMs within the enclosure. In either situation, any of the listed device paths can be used to send the binary zoning configuration file to the enclosure.

Step 3: Use the `sg_ses_microcode` utility to send the binary zoning configuration file to the enclosure using any of the IOM SEP handles:

```
# sg_ses_microcode /dev/sg1 -m0xe -b 4096 -N -I H4102-
J_Zoning_17x1_Config.bin
```

Note: In this example, the binary file for configuration 1 is being used. For more information about this and other predefined zoning configurations, see Predefined Zoning Configurations *(page 230)*.

Step 4: Use the `sg_ses_microcode` utility to activate the zoning configuration file:

```
# sg_ses_microcode /dev/sg1 -m0xf
```

After the file is activated, the SAS connectors will be cycled off and on, triggering the host to perform discovery.

Step 5: The enclosure SEP handles may have changed as a result of the activation. Repeat the `lsscsi` command to view the SEP handles again:

```
# lsscsi -g | grep -i enc
[1:0:3257:0] enclosu  HGST  H4102-J  2050  -  /dev/sg1
[1:0:3275:0] enclosu  HGST  H4102-J  2050  -  /dev/sg2
```

Note: The file-based zoning feature and the specified zoning configuration are now enabled. The remaining steps in this task are for verification purposes and require the WDDCS Tool. For instructions on enabling file-based zoning using **only** the WDDCS Tool, please see the *WDDCS Tool User Guide*.

Step 6: Use the WDDCS Tool's `show` command to view the SEP device handles:

```
# wddcs show
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: /dev/sg1
    product : H4102-J
    serial  : USCSJ03717EB0001
    firmware: 2050-028
    name    : Ultrastar Data102

Device: /dev/sg2
    product : H4102-J
    serial  : USCSJ03717EB0001
    firmware: 2050-028
```

```
    name    : Ultrastar Data102
```

Step 7: Use the WDDCS Tool's `iom` command to determine which IOM each handle is assigned to:

```
# wddcs iom
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: /dev/sg1
Dual IOM operation
IOM A

Device: /dev/sg2
Dual IOM operation
IOM B
```

Step 8: Use the WDDCS Tool's `zone status` command along with the appropriate SEP handle to verify the zoning configuration of each IOM:

```
# wddcs /dev/sg1 zone status
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: /dev/sg1
Zoning (Enabled)
 Host    : Slots
------------------------
  Host 0 : 0-16
  Host 1 : 17-33
  Host 2 : 34-50
  Host 3 : 51-67
  Host 4 : 68-84
  Host 5 : 85-101
```

```
# wddcs /dev/sg2 zone status
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: /dev/sg2
Zoning (Enabled)
 Host    : Slots
------------------------
  Host 0 : 0-16
  Host 1 : 17-33
  Host 2 : 34-50
  Host 3 : 51-67
  Host 4 : 68-84
  Host 5 : 85-101
```

Result: The zoning status for each IOM should match the configuration from the file sent to the enclosure in step 3 *(page 253)*.

4.7.8.2 Disabling File-Based Zoning Using Linux

This task provides instructions for disabling zoning and/or disabling the file-based zoning feature in a Linux operating system environment.

Step 1: From a command line, use the `lsscsi` and `grep` commands to list all enclosure devices attached to the host:

```
# lsscsi -g | grep -i enc
```

From the output, note the device names for the IOMs (i.e. `/dev/sgX`):

```
[1:0:3257:0] enclosu  HGST  H4102-J  2050  -  /dev/sg1
[1:0:3275:0] enclosu  HGST  H4102-J  2050  -  /dev/sg2
```

Note: Depending on the user's setup, the devices listed in the output may represent multiple HBAs, connected to multiple IOMs, within multiple enclosures. Further investigation may be required to determine the correct enclosure for disabling file-based zoning. If further investigation is not required, proceed to step 3 *(page 256)*.

Step 2: To determine the correct enclosure:

a. Use the `sg_inq` utility for each device to determine the serial number of its enclosure:

```
# sg_inq /dev/sg1
standard INQUIRY:
  PQual=0  Device_type=13  RMB=0  LU_CONG=0  version=0x06  [SPC-4]
  [AERC=0]  [TrmTsk=0]  NormACA=0  HiSUP=0  Resp_data_format=2
  SCCS=0  ACC=0  TPGS=0  3PC=0  Protect=0  [BQue=0]
  EncServ=1  MultiP=0  [MChngr=0]  [ACKREQQ=0]  Addr16=0
  [RelAdr=0]  WBus16=0  Sync=0  [Linked=0]  [TranDis=0]  CmdQue=1
  [SPI: Clocking=0x0  QAS=0  IUS=0]
    length=96 (0x60)   Peripheral device type: enclosure services device
 Vendor identification: HGST
 Product identification: H4102-J
 Product revision level: 2050
 Unit serial number: USCSJ03717EB0001
```

```
# sg_inq /dev/sg2
standard INQUIRY:
  PQual=0  Device_type=13  RMB=0  LU_CONG=0  version=0x06  [SPC-4]
  [AERC=0]  [TrmTsk=0]  NormACA=0  HiSUP=0  Resp_data_format=2
  SCCS=0  ACC=0  TPGS=0  3PC=0  Protect=0  [BQue=0]
  EncServ=1  MultiP=0  [MChngr=0]  [ACKREQQ=0]  Addr16=0
  [RelAdr=0]  WBus16=0  Sync=0  [Linked=0]  [TranDis=0]  CmdQue=1
  [SPI: Clocking=0x0  QAS=0  IUS=0]
    length=96 (0x60)   Peripheral device type: enclosure services device
 Vendor identification: HGST
 Product identification: H4102-J
 Product revision level: 2050
 Unit serial number: USCSJ03717EB0001
```

If multiple serial numbers are identified, the numbers can then be matched to their corresponding physical enclosures to determine which is the correct one for disabling file-based zoning.

Note: If multiple devices share a serial number, the devices represent either multiple HBAs within the host or multiple IOMs within the enclosure. In either situation, any of the listed device paths can be used to send the binary file to the enclosure.

Step 3: Use the `sg_ses_microcode` utility to send the binary file (either `Disable_Config.bin` or `Clear_Config.bin`) to the enclosure through any of the IOM SEP handles:

```
# sg_ses_microcode /dev/sg1 -m0xe -b 4096 -N -I H4102-
J_Zoning_Clear_Config.bin
```

Note: In this example, the `Clear_Config.bin` file is being used.

Step 4: Use the `sg_ses_microcode` utility to activate the file:

```
# sg_ses_microcode /dev/sg1 -m0xf
```

After the file is activated, the SAS connectors will be cycled off and on, triggering the host to perform discovery.

Note: Depending on which binary file was used, either zoning is now disabled or the file-based zoning feature itself is now disabled. The remaining steps in this task are for verification purposes and require the WDDCS Tool. For instructions on disabling file-based zoning using **only** the WDDCS Tool, please see the *WDDCS Tool User Guide*.

Step 5: Use the WDDCS Tool's `show` command to view the SEP device handles:

```
# wddcs show
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: /dev/sg1
    product : H4102-J
    serial  : USCSJ03717EB0001
    firmware: 2050-028
    name    : Ultrastar Data102

Device: /dev/sg2
    product : H4102-J
    serial  : USCSJ03717EB0001
    firmware: 2050-028
    name    : Ultrastar Data102
```

Step 6: Use the WDDCS Tool's `iom` command to determine which IOM each handle is assigned to:

```
# wddcs iom
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: /dev/sg1
Dual IOM operation
IOM A
```

```
Device: /dev/sg2
Dual IOM operation
IOM B
```

Step 7: Use the WDDCS Tool's `zone status` command along with the appropriate SEP handle to verify the zoning configuration of each IOM:

```
# wddcs /dev/sg1 zone status
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: /dev/sg1
Zoning (Disabled)
```

```
# wddcs /dev/sg2 zone status
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: /dev/sg2
Zoning (Disabled)
```

Result: The zone status of both IOMs should now be `Disabled`.

4.7.8.3 Enabling File-Based Zoning Using Windows

This task provides instructions for enabling the file-based zoning feature and configuring zoning using the file-based method in a Windows operating system environment.

Step 1: From a command line, use the `sg_scan` and `findstr` commands to list the enclosure devices connected to the host:

```
C:\> sg_scan -s | findstr -i H4102
```

From the output, note the device names for the IOMs (i.e. `SCSIX:X:X:X`):

```
SCSI3:0,84,0    claimed=0 pdt=dh    HGST  H4102-J  2050
SCSI3:1,29,0    claimed=0 pdt=dh    HGST  H4102-J  2050
```

Note: Depending on the user's setup, the devices listed in the output may represent multiple HBAs, connected to multiple IOMs, within multiple enclosures. Further investigation may be required to determine the correct enclosure for zoning. If further investigation is not required, proceed to step 3 *(page 258)*.

Step 2: To determine the correct enclosure:

a. Use the `sg_inq` utility for each device to determine the serial number of its enclosure:

```
C:\> sg_inq SCSI3:0,84,0
standard INQUIRY:
  PQual=0  Device_type=13  RMB=0  LU_CONG=0  version=0x06  [SPC-4]
  [AERC=0]  [TrmTsk=0]  NormACA=0  HiSUP=0  Resp_data_format=2
  SCCS=0  ACC=0  TPGS=0  3PC=0  Protect=0  [BQue=0]
  EncServ=1  MultiP=0  [MChngr=0]  [ACKREQQ=0]  Addr16=0
  [RelAdr=0]  WBus16=0  Sync=0  [Linked=0]  [TranDis=0]  CmdQue=1
  [SPI: Clocking=0x0  QAS=0  IUS=0]
```

```
    length=96 (0x60)   Peripheral device type: enclosure services device
 Vendor identification: HGST
 Product identification: H4102-J
 Product revision level: 2050
 Unit serial number: USWSJ02819EZ0012
```

```
C:\> sg_inq SCSI3:1,29,0
standard INQUIRY:
  PQual=0  Device_type=13  RMB=0  LU_CONG=0  version=0x06  [SPC-4]
  [AERC=0]  [TrmTsk=0]  NormACA=0  HiSUP=0  Resp_data_format=2
  SCCS=0  ACC=0  TPGS=0  3PC=0  Protect=0  [BQue=0]
  EncServ=1  MultiP=0  [MChngr=0]  [ACKREQQ=0]  Addr16=0
  [RelAdr=0]  WBus16=0  Sync=0  [Linked=0]  [TranDis=0]  CmdQue=1
  [SPI: Clocking=0x0  QAS=0  IUS=0]
    length=96 (0x60)   Peripheral device type: enclosure services device
 Vendor identification: HGST
 Product identification: H4102-J
 Product revision level: 2050
 Unit serial number: USWSJ02819EZ0012
```

If multiple serial numbers are identified, the numbers can then be matched to their corresponding physical enclosures to determine which is the correct one for zoning.

Note: If multiple devices share a serial number, the devices represent either multiple HBAs within the host or multiple IOMs within the enclosure. In either situation, any of the listed device paths can be used to send the binary zoning configuration file to the enclosure.

Step 3: Use the `sg_ses_microcode` utility to send the binary zoning configuration file to the enclosure using any of the IOM SEP handles:

```
C:\> sg_ses_microcode SCSI3:0,84,0 -m0xe -N -b 4096 -I H4102-
J_Zoning_17x1_Config.bin
```

Note: In this example, the binary file for configuration 1 is being used. For more information about this and other predefined zoning configurations, see Predefined Zoning Configurations *(page 230)*.

Step 4: Use the `sg_ses_microcode` utility to activate the zoning configuration file:

```
C:\> sg_ses_microcode SCSI3:0,84,0 -m0xf
```

After the file is activated, the SAS connectors will be cycled off and on, triggering the host to perform discovery.

Note: The file-based zoning feature and the specified zoning configuration are now enabled. The remaining steps in this task are for verification purposes and require the WDDCS Tool. For instructions on enabling file-based zoning using **only** the WDDCS Tool, please see the *WDDCS Tool User Guide*.

Step 5: Use the WDDCS Tool's `show` command to view the SEP device handles:

```
C:\> wddcs show
```

```
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: SCSI3:0,84,0
    product : H4102-J
    serial  : USWSJ02819EZ0012
    firmware: 2050-028
    name    : Ultrastar Data102
Device: SCSI3:1,29,0
    product : H4102-J
    serial  : USWSJ02819EZ0012
    firmware: 2050-028
    name    : Ultrastar Data102
```

Step 6: Use the WDDCS Tool's `iom` command to determine which IOM each handle is assigned to:

```
C:\> wddcs iom
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: SCSI3:0,84,0
Dual IOM operation
IOM A

Device: SCSI3:1,29,0
Dual IOM operation
IOM B
```

Step 7: Use the WDDCS Tool's `zone status` command along with the appropriate SEP handle to verify the zoning configuration of each IOM:

```
C:\> wddcs SCSI3:0,84,0 zone status
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: SCSI3:0,84,0
Zoning (Enabled)
 Host    : Slots
------------------------
  Host 0 : 0-16
  Host 1 : 17-33
  Host 2 : 34-50
  Host 3 : 51-67
  Host 4 : 68-84
  Host 5 : 85-101
```

```
C:\> wddcs SCSI3:1,29,0 zone status
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: SCSI3:1,29,0
Zoning (Enabled)
 Host    : Slots
------------------------
  Host 0 : 0-16
  Host 1 : 17-33
  Host 2 : 34-50
  Host 3 : 51-67
```

```
   Host 4 : 68-84
   Host 5 : 85-101
```

Result: The zoning status for each IOM should match the configuration from the file sent to the enclosure in step 3 (page 258).

4.7.8.4 Disabling File-Based Zoning Using Windows

This task provides instructions for disabling zoning and/or disabling the file-based zoning feature in a Windows operating system environment.

Step 1: From a command line, use the `sg_scan` and `findstr` commands to list the enclosure devices connected to the host:

```
C:\> sg_scan -s | findstr -i H4102
```

From the output,note the device names for the IOMs (i.e. `SCSIX:X:X:X`):

```
SCSI3:0,84,0    claimed=0 pdt=dh    HGST  H4102-J  2050
SCSI3:1,29,0    claimed=0 pdt=dh    HGST  H4102-J  2050
```

Step 2: Use the `sg_ses_microcode` utility to send the binary file (either `Disable_Config.bin` or `Clear_Config.bin`) to the enclosure through any of the IOM SEP handles:

```
C:\> sg_ses_microcode SCSI3:0,84,0 -m0xe -b 4096 -N -I H4102-
J_Zoning_Clear_Config.bin
```

Note: In this example, the `Clear_Config.bin` file is being used.

Step 3: Use the `sg_ses_microcode` utility to activate the file:

```
C:\> sg_ses_microcode SCSI3:0,84,0 -m0xf
```

After the file is activated, the SAS connectors will be cycled off and on, triggering the host to perform discovery.

Note: Depending on which binary file was used, either zoning is now disabled or the file-based zoning feature itself is now disabled. The remaining steps in this task are for verification purposes and require the WDDCS Tool. For instructions on disabling file-based zoning using **only** the WDDCS Tool, please see the *WDDCS Tool User Guide*.

Step 4: Use the WDDCS Tool's `show` command to view the SEP device handles:

```
C:\> wddcs show
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: SCSI3:0,84,0
    product : H4102-J
    serial  : USWSJ02819EZ0012
    firmware: 2050-028
    name    : Ultrastar Data102
Device: SCSI3:1,29,0
    product : H4102-J
```

```
    serial  : USWSJ02819EZ0012
    firmware: 2050-028
    name    : Ultrastar Data102
```

Step 5: Use the WDDCS Tool's `iom` command to determine which IOM each handle is assigned to:

```
C:\> wddcs iom
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: SCSI3:0,84,0
Dual IOM operation
IOM A

Device: SCSI3:1,29,0
Dual IOM operation
IOM B
```

Step 6: Use the WDDCS Tool's `zone status` command along with the appropriate SEP handle to verify the zoning configuration of each IOM:

```
C:\> wddcs SCSI3:0,84,0 zone status
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: SCSI3:0,84,0
Zoning (Disabled)
```

```
C:\> wddcs SCSI3:1,29,0 zone status
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: SCSI3:1,29,0
Zoning (Disabled)
```

Result: The zone status of both IOMs should now be `Disabled`.

4.8 Subenclosure Nickname

4.8.1 Setting the Subenclosure Nickname

This task describes instructions for viewing and setting a subenclosure's nickname using `sg_ses` commands.

Before you begin: In the following `sg_ses` examples, angle brackets surrounding a term (i.e. `<device>`) either indicate a generic reference to an expected output or a command phrase that should be replaced with the user's specific instance of that phrase (i.e. `/dev/sg2`).

Verify Support for the Nickname Feature

Step 1: Verify the subenclosure's support for the nickname feature by using the `sg_ses <device> -p0x0` command to view the subenclosure's **Supported Diagnostic Pages**:

```
# sg_ses <device> -p0x0
```

```
  <manufacturer>  <regulatorymodel>  <firmwareversion>
Supported diagnostic pages:
  Supported Diagnostic Pages [sdp] [0x0]
  Configuration (SES) [cf] [0x1]
  Enclosure Status/Control (SES) [ec,es] [0x2]
  Help Text (SES) [ht] [0x3]
  String In/Out (SES) [str] [0x4]
  Threshold In/Out (SES) [th] [0x5]
  Element Descriptor (SES) [ed] [0x7]
  Additional Element Status (SES-2) [aes] [0xa]
  Download Microcode (SES-2) [dm] [0xe]
  Subenclosure Nickname (SES-2) [snic] [0xf]
  <unknown> [0x10]
  <unknown> [0x17]
```

If supported, the **Subenclosure Nickname** page will be included as one of the **Supported Diagnostic Pages**.

View the Nickname

Step 2: Use the `sg_ses <device> -p0xf` command to view the **Subenclosure Nickname** page:

```
# sg_ses <device> -p0xf
  <manufacturer>  <regulatorymodel>  <firmwareversion>
Subenclosure nickname status diagnostic page:
  number of secondary subenclosures: 0
  generation code: 0x0
   subenclosure identifier: 0
   nickname status: 0x0
   nickname additional status: 0x0
   nickname language code:
   nickname:
```

Note: In the example above, the subenclosure's nickname is set to an empty string ("").

Set the Nickname

Step 3: Use the `sg_ses <device> -p0xf -c --nickname=<nickname>` command to set the subenclosure's nickname:

```
# sg_ses <device> -p0xf -c --nickname=<nickname>
  <manufacturer>  <regulatorymodel>  <firmwareversion>
    No errors
```

Note: If the nickname contains one or more spaces, enclose the name in either single quotes (i.e. 'device nickname') or double quotes (i.e. "device nickname").

If the command was successful, `No errors` will be returned.

Step 4: Repeat the `sg_ses <device> -p0xf` command to view the **Subenclosure Nickname** page and verify that the nickname was set as intended:

```
# sg_ses <device> -p0xf
  <manufacturer>  <regulatorymodel>  <firmwareversion>
Subenclosure nickname status diagnostic page:
```

```
  number of secondary subenclosures: 0
  generation code: 0x0
   subenclosure identifier: 0
   nickname status: 0x0
   nickname additional status: 0x0
   nickname language code:
   nickname: <nickname>
```

Clear the Nickname

Step 5: If needed, use the `sg_ses <device> -p0xf -c --nickname=` command to clear the subenclosure's nickname (set it to an empty string):

```
# sg_ses <device> -p0xf -c --nickname=
  <manufacturer>  <regulatorymodel>  <firmwareversion>
    No errors
```

If the command was successful, `No errors` will be returned.

Step 6: Repeat the `sg_ses <device> -p0xf` command to view the **Subenclosure Nickname** page and verify that the nickname was cleared:

```
# sg_ses <device> -p0xf
  <manufacturer>  <regulatorymodel>  <firmwareversion>
Subenclosure nickname status diagnostic page:
  number of secondary subenclosures: 0
  generation code: 0x0
   subenclosure identifier: 0
   nickname status: 0x0
   nickname additional status: 0x0
   nickname language code:
   nickname:
```

4.9 Partially Populated Enclosures

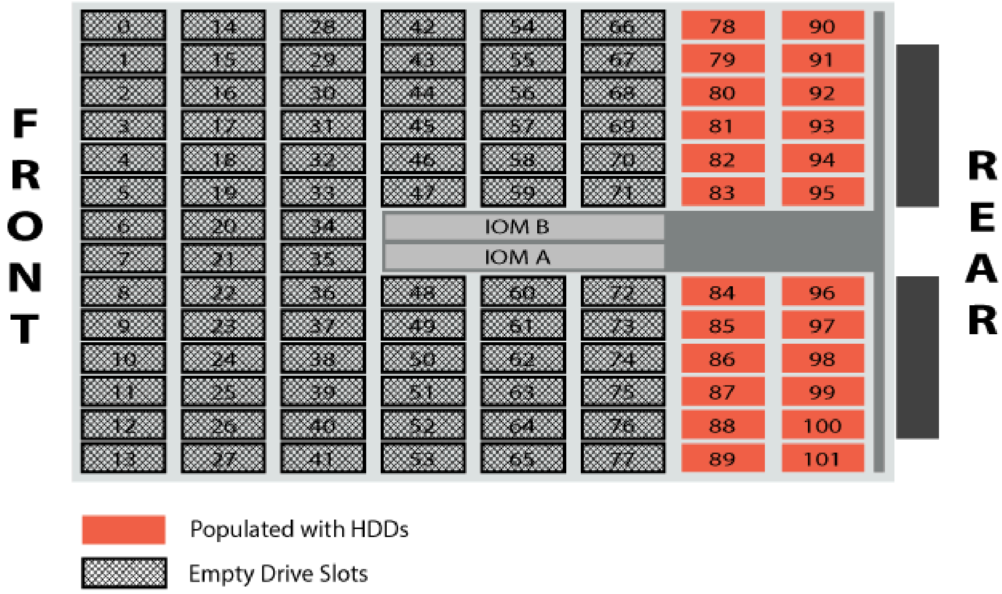
4.9.1 Partial Population Configurations

The Ultrastar Data102 supports partially-populated configurations that allow a user to increase the size of storage based on their needs. There are specific requirements that must be followed to ensure that the enclosure functions properly during operation. Partial population configurations that do not comply with the requirements listed in this section may result in enclosure performance issues. The following section details the requirements for HDD and HDD/SSD based configurations.

Minimum HDD Partial Population

The enclosure supports a minimum of 24 SAS or SATA HDDs for a partially-populated enclosure. The enclosure does not support a mix of SAS and SATA drives. The enclosure must be populated starting with the drives closest to the rear of the enclosure and work towards the front of the enclosure. If more drives are installed into the enclosure, any unfinished rows must be completed with drive blanks. The image below details the minimum required configuration for an HDD only configuration.

Figure 255: Minimum HDD Partial Population

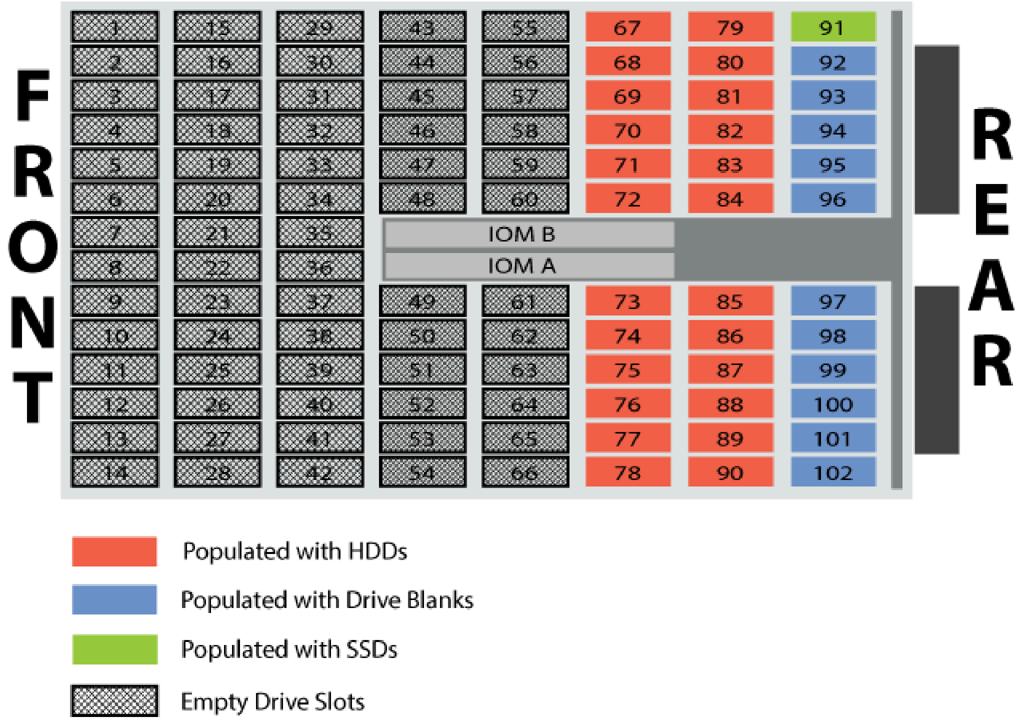


Minimum HDD and Minimum SSD Partial Population:

The enclosure supports a minimum of 24 HDDs and one SSD for a partially populated enclosure. The enclosure can support a minimum of one SSD with the remaining drive slots within that row being completed with drive blanks. The enclosure does not support a mix of SAS and SATA drives. The image below details the minimum required configuration for an HDD and SSD configuration.

Note: When installing SSDs for this configuration, the preinstalled HDDs will have to be moved one entire row to the next vacant row near the front of the enclosure.

Figure 256: Minimum HDD and Minimum SSD Partial Population



Minimum HDD and Maximum SSD Partial Population:

The enclosure supports a minimum of 24 HDDs and one SSD for a partially populated enclosure. The enclosure can support a maximum of up to 24 total SSDs in this configuration. The enclosure does not support a mix of SAS and SATA drives. The image below details the required configuration for minimum HDD and maximum SSD configuration.

Note: When installing SSDs for this configuration, the preinstalled HDDs will have to be moved two entire rows to the next vacant pair of rows near the front of the enclosure.

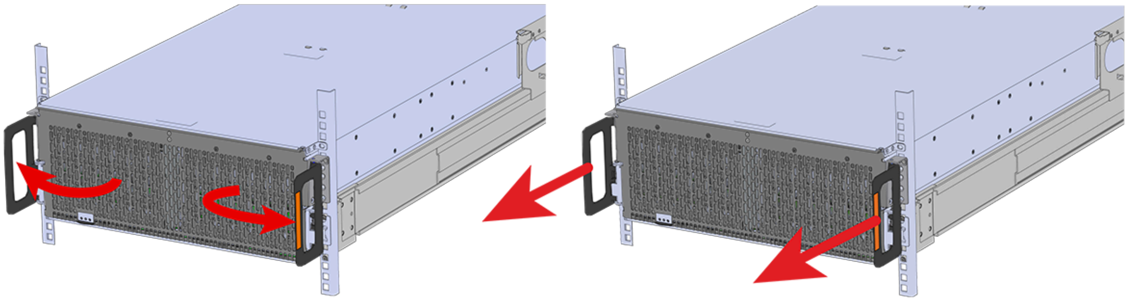
Figure 257: Minimum HDD and Maximum SSD Partial Population

4.9.2 Installing Drives

This section provides steps on how to install drives into the enclosure. The enclosure is shipped with a minimum of 60 HDDs and may require HDDs to be moved to other drives slots if SSDs are being installed. Before beginning the process of adding drives, refer to the Partial Population Configurations *(page 263)* section to determine what configuration will be used and what is required of that configuration.

Step 1: Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. The safety latches will prevent the enclosure from coming out of the rack completely and the cover will remain in the rack attached to the rear alignment brackets.

Figure 258: Chassis Handle Operation



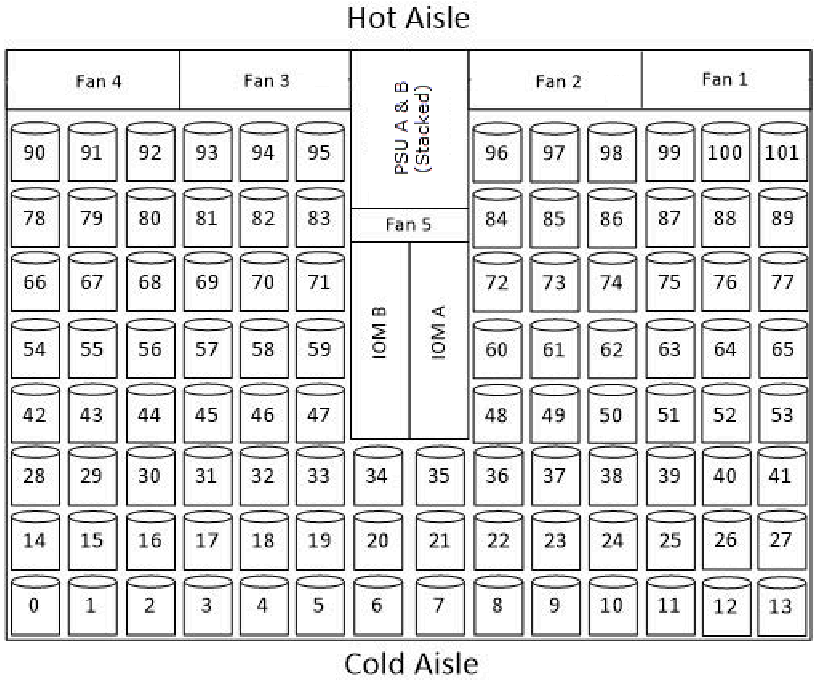
Step 2: Locate the area that the new drives will be installed into. When adding SSDs, the drives slots may already contain a drive. The drive will have to be removed and relocated before installing the HDD.

Step 3: Follow the requirements for partial populations listed in Partial Population Configurations *(page 263)*.

Installing the 3.5in HDD Assembly

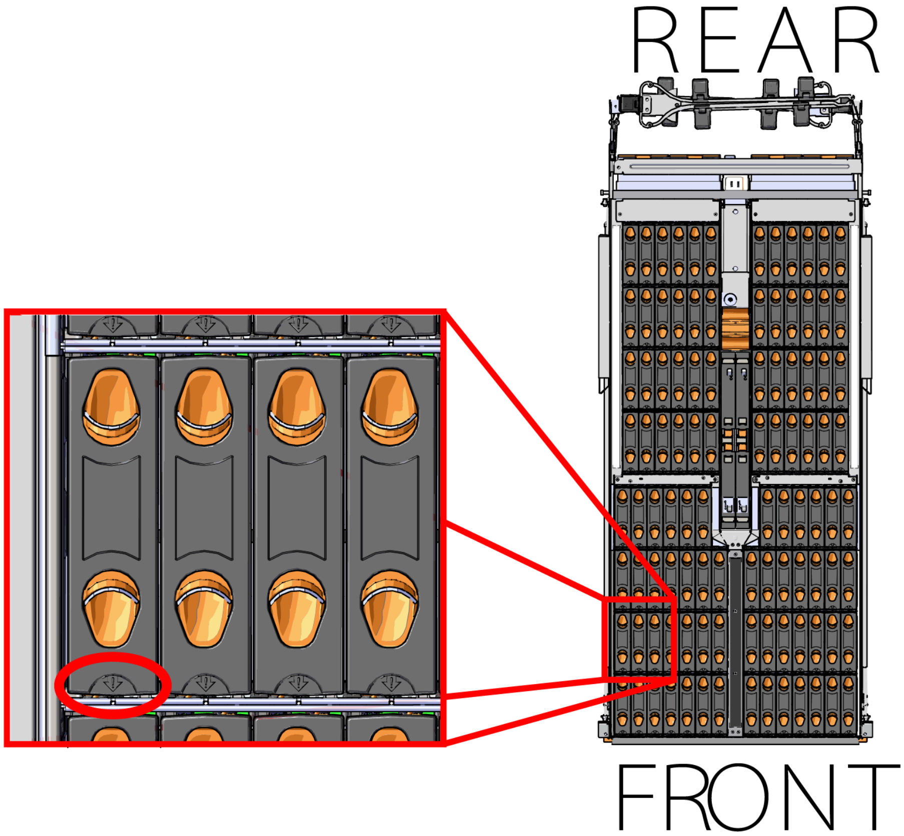
Note: When installing drives, populate the enclosure from left-to-right, rear-to-front. For example, begin with slot 90 (as shown in the following diagram), continue through 101, then proceed with 78 through 89, and so on:

Figure 259: Drive Layout



Note: When installing drives, ensure that the LED pointer on the top of the drive carrier points toward the front of the enclosure, as shown in the following image:

Figure 260: LED Pointer Orientation

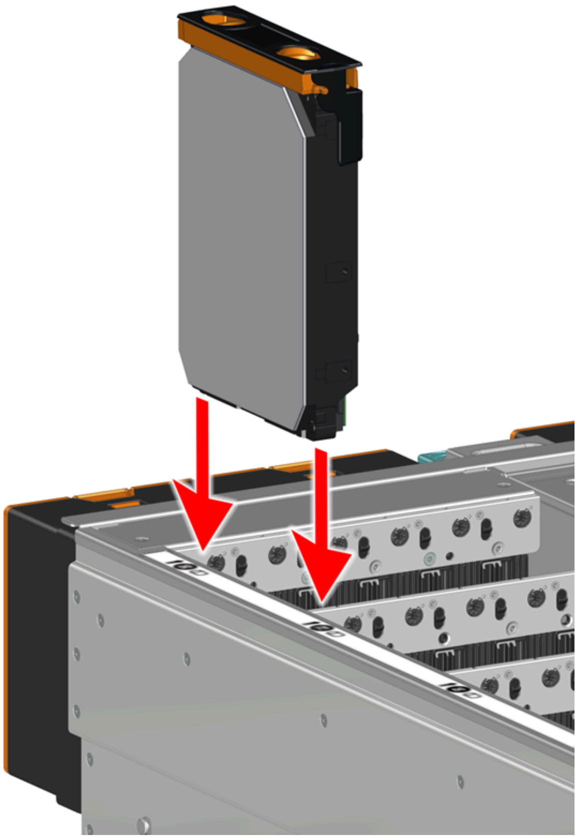


Caution: To ensure proper airflow for enclosure cooling, all drive slots must be populated with either drives or drive blanks.

Step 4: Ensure that the enclosure has been pulled out of the rack until the rail latches engage.

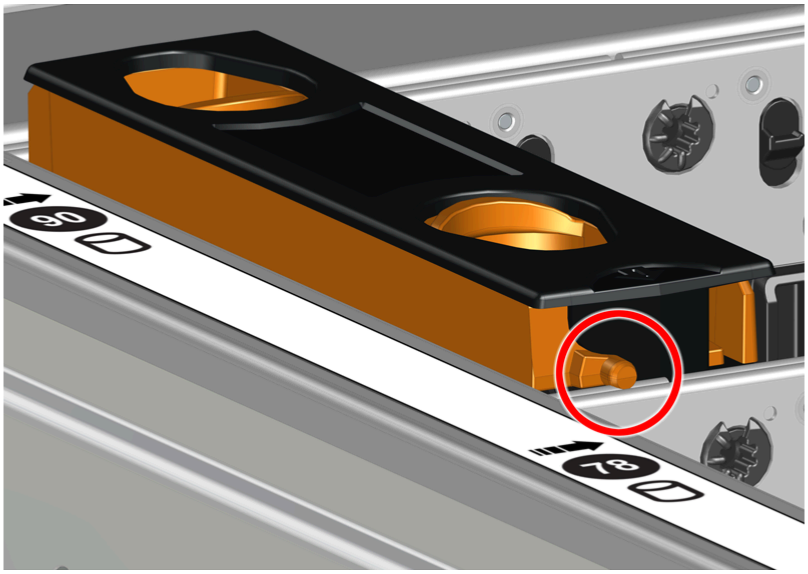
Step 5: Align the drive with the empty slot that will receive it. Lower it into the slot, ensuring that it stays level and does not bind.

Figure 261: Inserting a 3.5in HDD Assembly



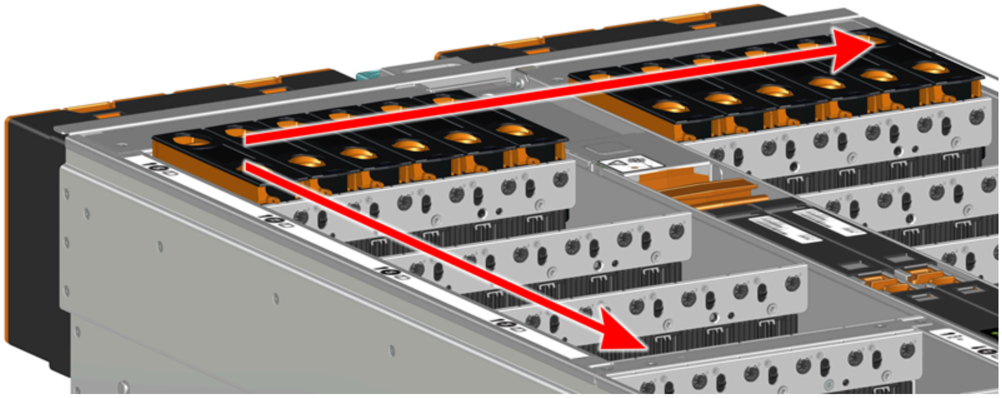
Step 6: Lower the drive until the spring-loaded posts on the carrier contact the top edges of the drive slot. This is an intermediate position; the drive assembly will be fully seated later on.

Figure 262: Intermediate Install Position



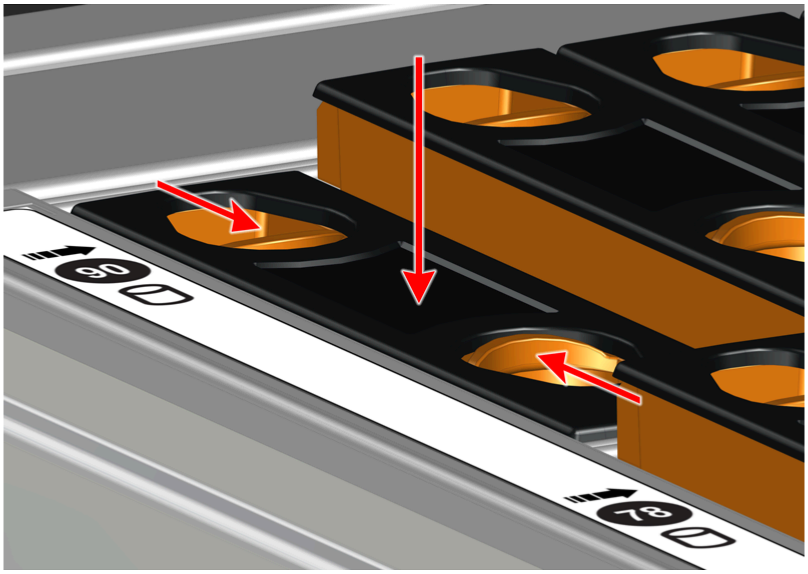
Step 7: Repeat this intermediate installation for the remaining drive assemblies, populating the enclosure from left-to-right, rear-to-front.

Figure 263: Populating the Enclosure



Step 8: Returning to the first drive assembly, pinch the latch release and carefully press downward to fully seat the 3.5in HDD Assembly into the drive slot.

Figure 264: Seating the 3.5in HDD Assembly



Step 9: Repeat this action to fully install the remaining drive assemblies in the same order, from left-to-right, rear-to-front.

Step 10: Push the enclosure back into the rack to ensure proper cooling.

4.10 Daisy Chaining

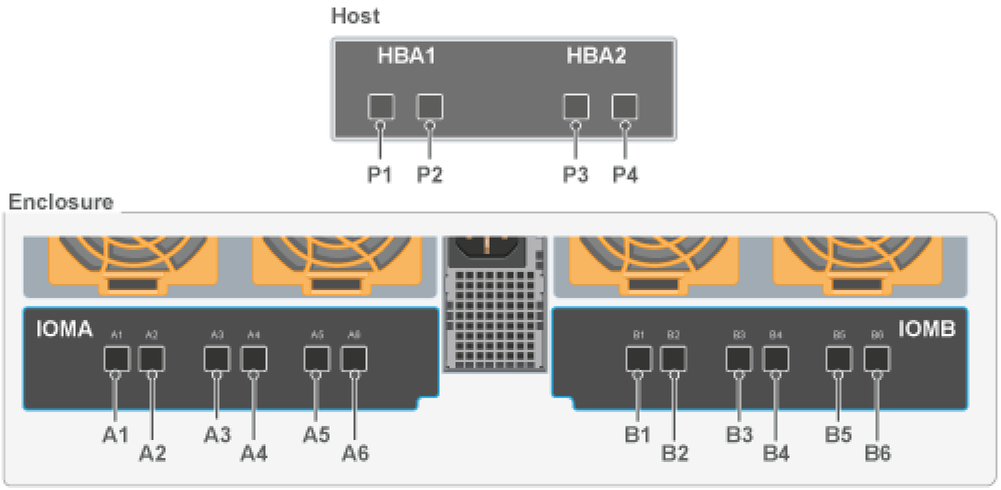
This chapter provides information related to predefined daisy chaining configurations and specific requirements.

4.10.1 Daisy Chaining Configurations

The Ultrastar Data102 supports configurations up to four enclosures daisy chained together using active cables. The Daisy Chaining Key identifies the specific information needed to use the cable maps in the following sections. The daisy chaining configurations are broken into two sections: one host configurations and two host configurations. Each of the sections provide a list of the configurations and an example diagram of how the enclosures can be connected using SAS cables.

The following diagram identifies the host, host ports, IOM configuration, and IO SAS connections.

Figure 265: Daisy Chaining Key



The following section identifies the different host configurations for daisy chaining multiple enclosures with either one or two hosts.

One Host Configurations: The following diagram is an example of how the enclosures will be connected via the IO SAS ports and what number each enclosure is. This information can be utilized with this cable map: One Host Cable Configurations (page 272).

Two Host Configurations: The following diagram is an example of how the enclosures will be connected via the IO SAS ports and what number each enclosure is. This information can be utilized with this cable map: Two Host Cable Configurations (page 278).

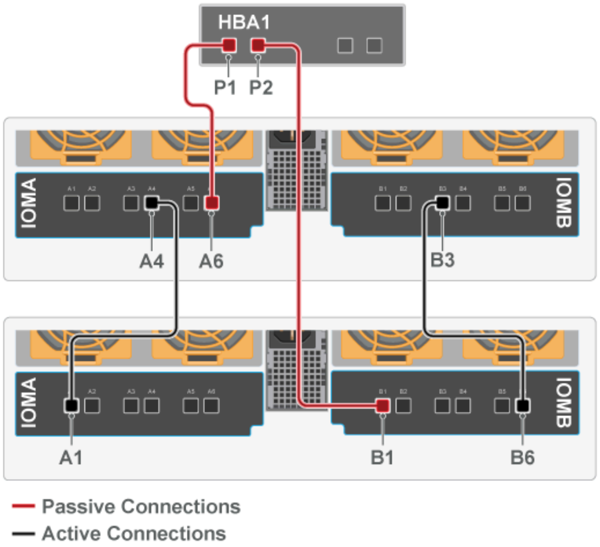
Table 56: Daisy Chaining Configurations

Type of Enclosure	Number of Hosts	Number of HBAs per Host	Number of Enclosures
SAS	1	1 HBA	2-4
	2		
	1	2 HBAs	2-4
	2		
SATA	1	1 HBA	4

4.10.2 One Host Cable Configurations

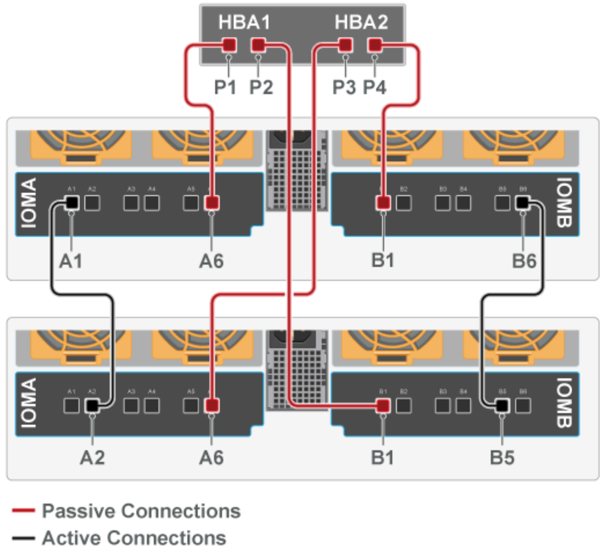
This section provides the information required to connect two or more enclosures to a single host via SAS connections. Choose the cable map that fits the preferred daisy chaining requirement.

Two Enclosures: One Host with a Single HBA



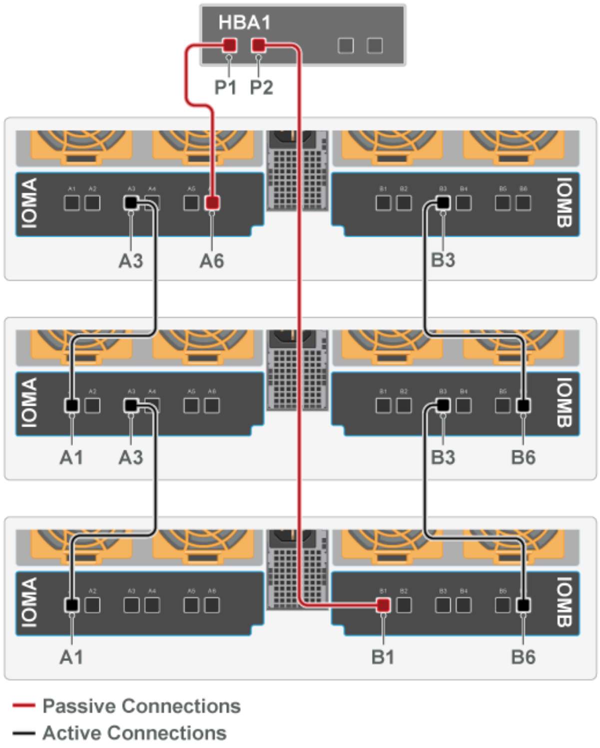
Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure2: IOMB, B1
Enclosure1: IOMA, A4	Enclosure2: IOMA, A1
Enclosure1: IOMB, B3	Enclosure2: IOMB, B6

Two Enclosures: One Host with a Two HBAs



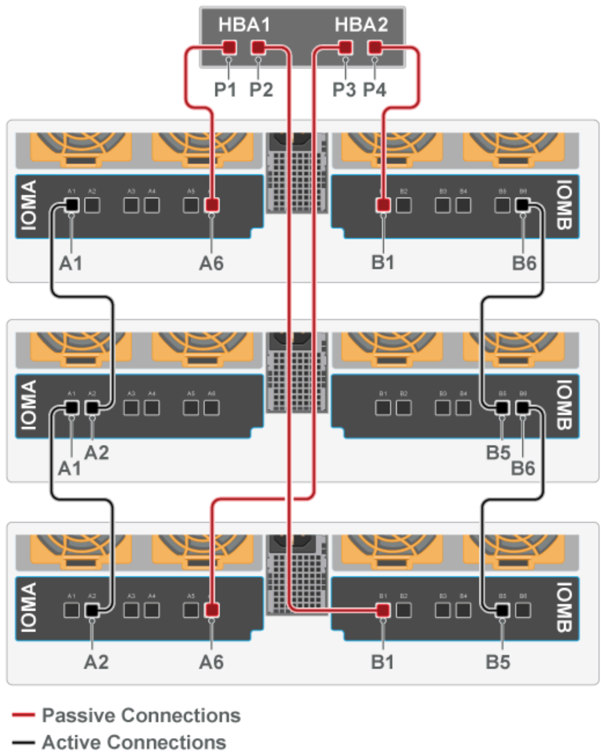
Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure2: IOMB, B1
Host1: P3	Enclosure2: IOMA, A6
Host1: P4	Enclosure1: IOMB, B1
Enclosure1: IOMA, A1	Enclosure2: IOMA, A2
Enclosure1: IOMB, B6	Enclosure2: IOMB, B5

Three Enclosures: One Host with a Single HBA



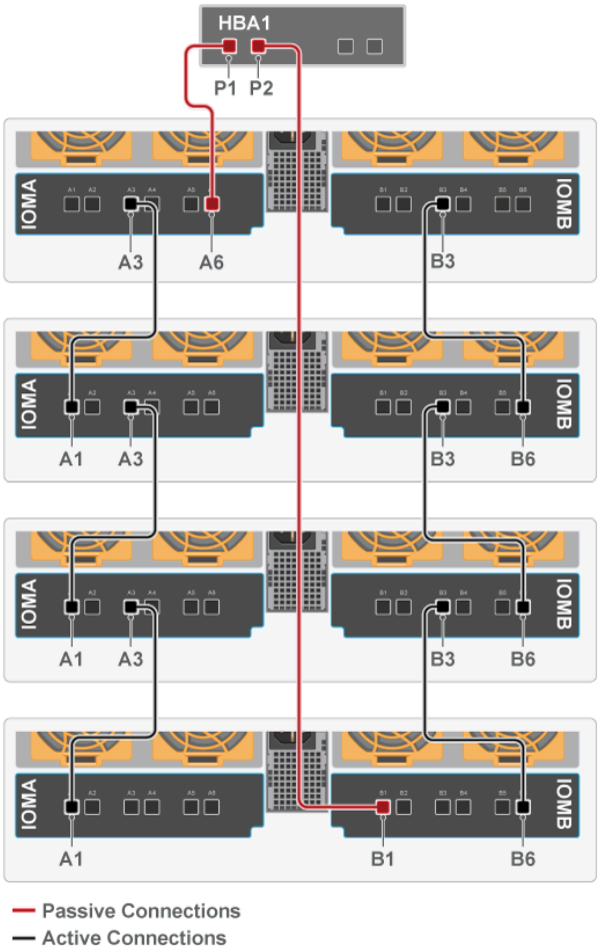
Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure3: IOMB, B1
Enclosure1: IOMA, A3	Enclosure2: IOMA, A1
Enclosure1: IOMB, B3	Enclosure2: IOMB, B6
Enclosure2: IOMA, A3	Enclosure3: IOMA, A1
Enclosure2: IOMB, B3	Enclosure3: IOMB, B6

Three Enclosures: One Host with a Two HBAs



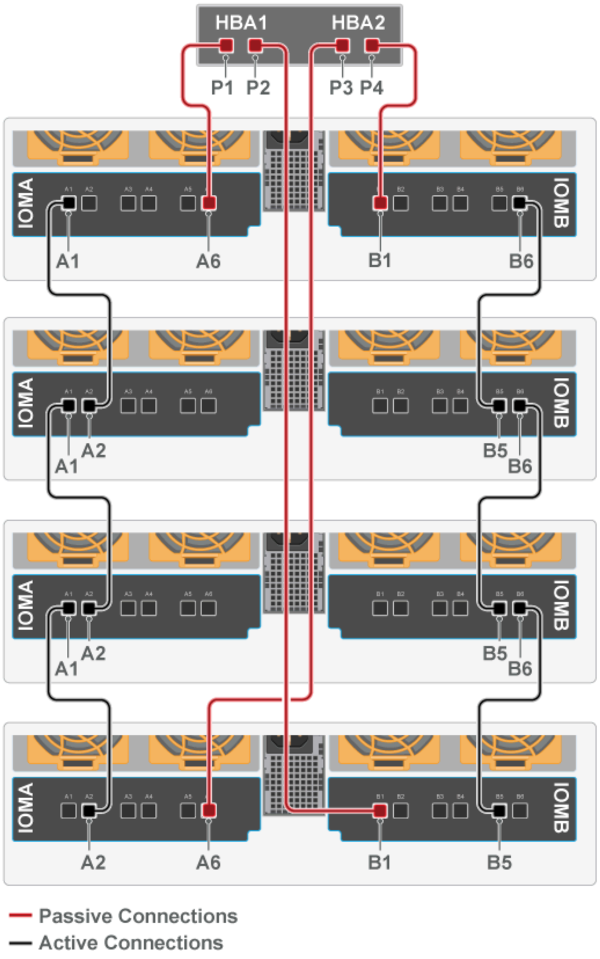
Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure3: IOMB, B1
Host1: P3	Enclosure3: IOMA, A6
Host1: P4	Enclosure1: IOMB, B1
Enclosure1: IOMA, A1	Enclosure2: IOMA, A2
Enclosure1: IOMB, B6	Enclosure2: IOMB, B5
Enclosure2: IOMA, A1	Enclosure3: IOMA, A2
Enclosure2: IOMB, B6	Enclosure3: IOMB, B5

Four Enclosures: One Host with a Single HBA



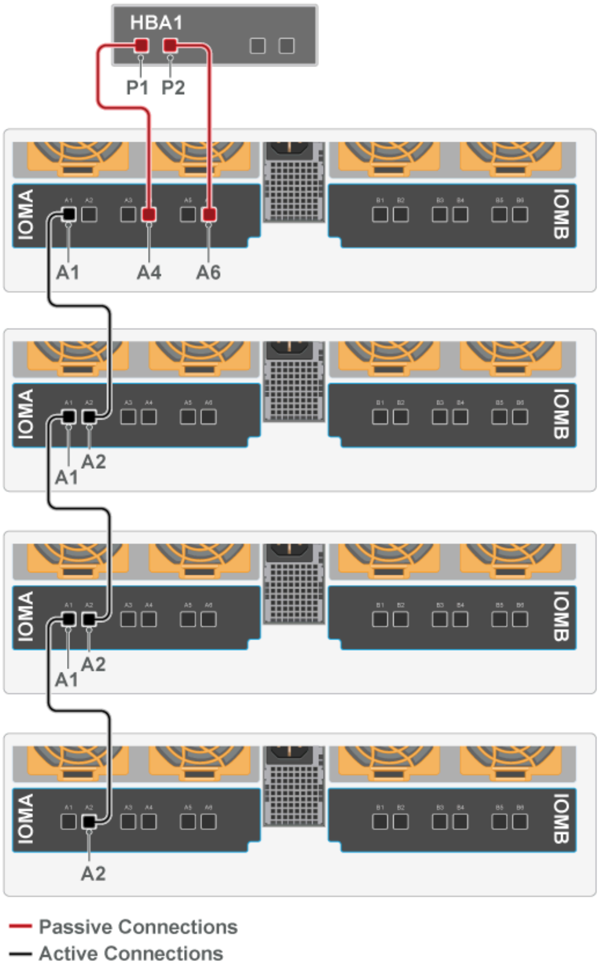
Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure4: IOMB, B1
Enclosure1: IOMA, A3	Enclosure2: IOMA, A1
Enclosure1: IOMB, B3	Enclosure2: IOMB, B6
Enclosure2: IOMA, A3	Enclosure3: IOMA, A1
Enclosure2: IOMB, B3	Enclosure3: IOMB, B6
Enclosure3: IOMA, A3	Enclosure4: IOMA, A1
Enclosure3: IOMB, B3	Enclosure4: IOMB, B6

Four Enclosures: One Host with a Two HBAs



Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure4: IOMB, B1
Host1: P3	Enclosure4: IOMA, A6
Host1: P4	Enclosure1: IOMB, B1
Enclosure1: IOMA, A1	Enclosure2: IOMA, A2
Enclosure1: IOMB, B6	Enclosure2: IOMB, B5
Enclosure2: IOMA, A1	Enclosure3: IOMA, A2
Enclosure2: IOMB, B6	Enclosure3: IOMB, B5
Enclosure3: IOMA, A1	Enclosure4: IOMA, A2
Enclosure3: IOMB, B6	Enclosure4: IOMB, B5

Four SATA Enclosure: One Host with a Single HBA

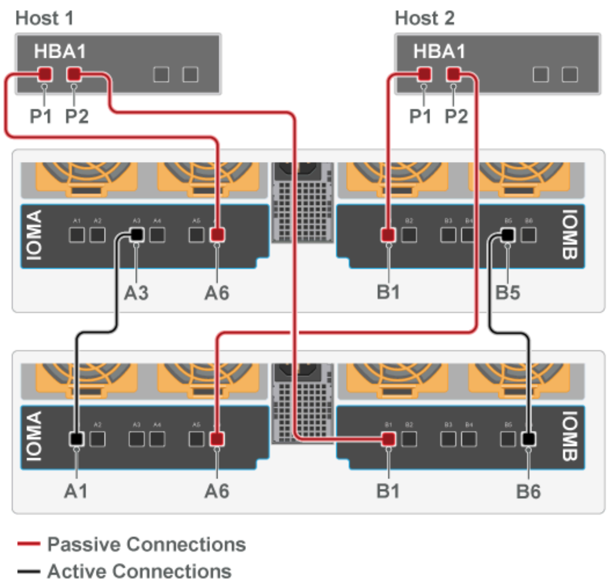


Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A4
Host1: P2	Enclosure1: IOMA, A6
Enclosure1: IOMA, A1	Enclosure2: IOMA, A2
Enclosure2: IOMA, A1	Enclosure3: IOMA, A2
Enclosure3: IOMA, A1	Enclosure4: IOMA, A2

4.10.3 Two Host Cable Configurations

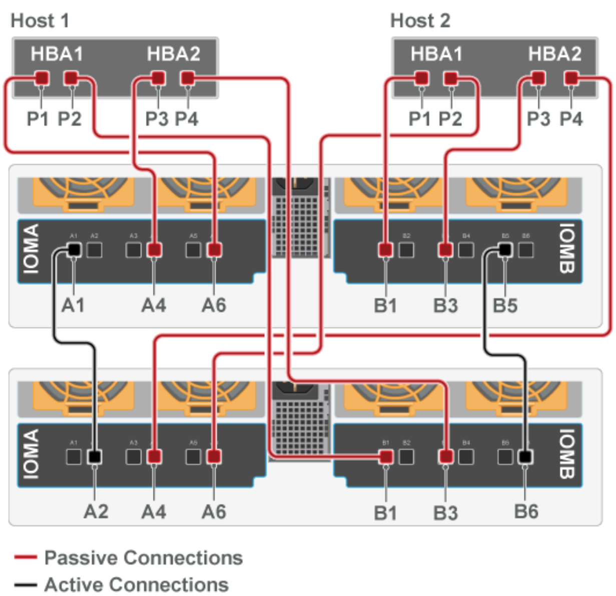
This section provides the information required to connect two or more enclosures to two hosts via SAS connections. Choose the cable map that fits the preferred daisy chaining requirement.

Two Enclosures: Two Hosts with One HBA



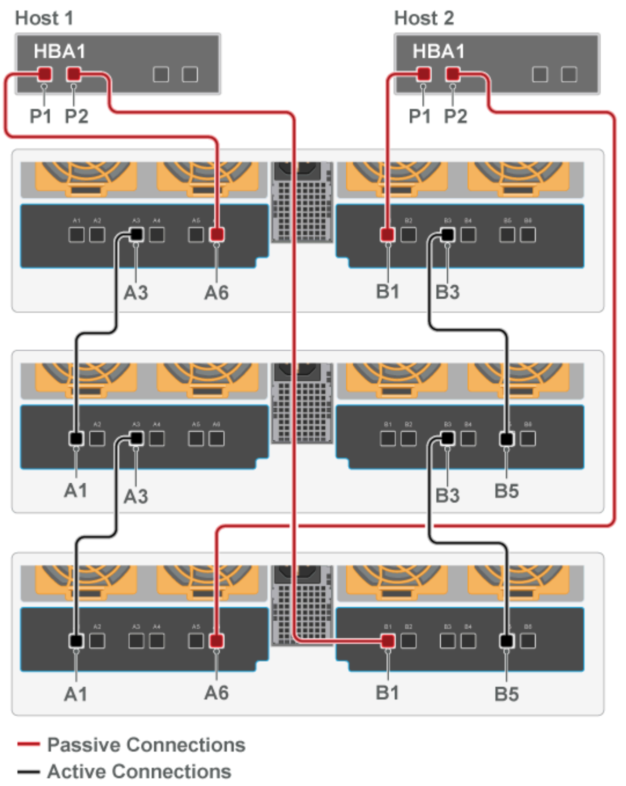
Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure2: IOMB, B1
Host2: P1	Enclosure1: IOMB, B1
Host2: P2	Enclosure2: IOMA, A6
Enclosure1: IOMA, A3	Enclosure2: IOMA, A1
Enclosure1: IOMB, B5	Enclosure2: IOMB, B6

Two Enclosures: Two Hosts with Two HBAs



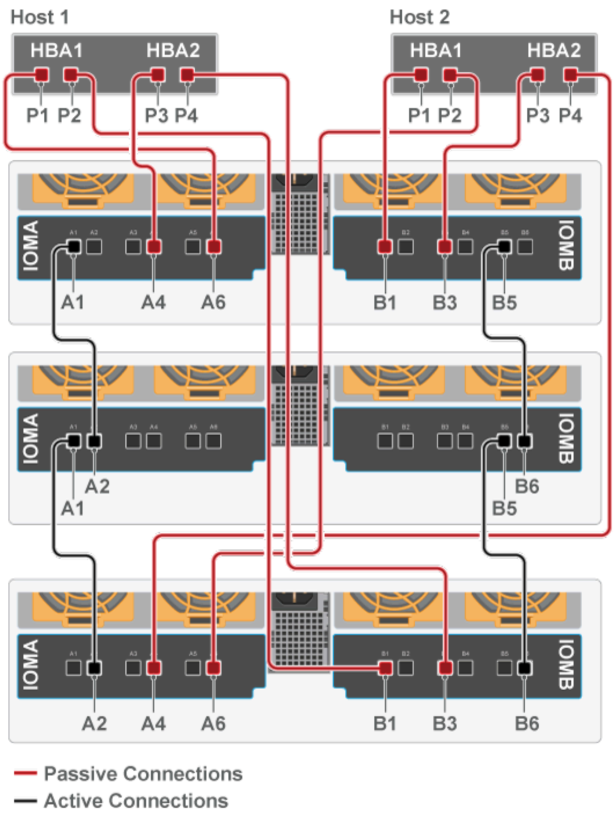
Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure2: IOMB, B1
Host1: P3	Enclosure1: IOMA, A4
Host1: P4	Enclosure2: IOMB, B3
Host2: P1	Enclosure1: IOMB, B1
Host2: P2	Enclosure2: IOMA, A6
Host2: P3	Enclosure1: IOMB, B3
Host2: P4	Enclosure2: IOMA, A4
Enclosure1: IOMA, A1	Enclosure2: IOMA, A2
Enclosure1: IOMB, B5	Enclosure2: IOMB, B6

Three Enclosures: Two Hosts with One HBA



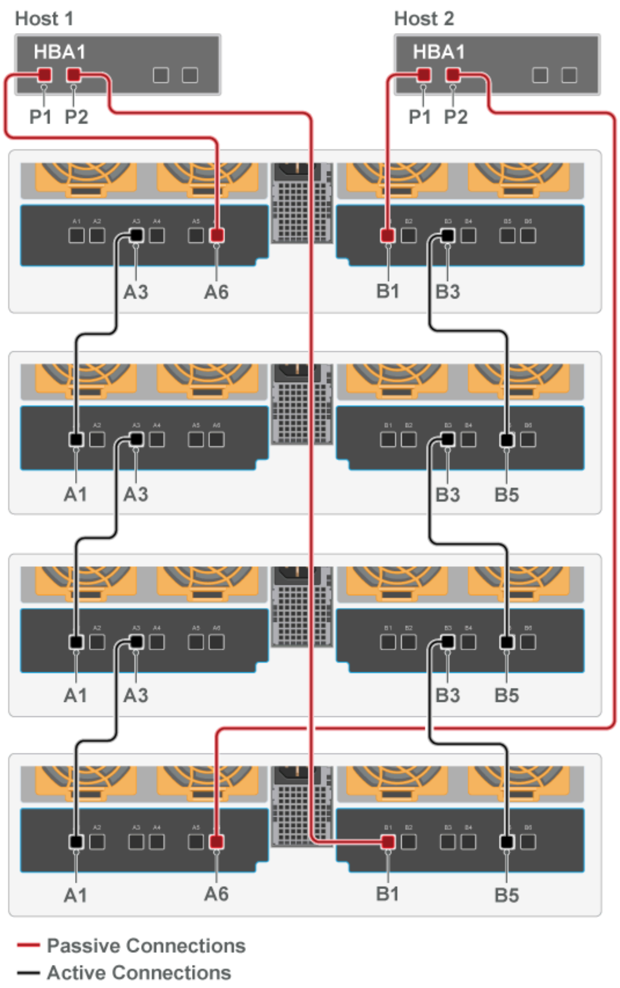
Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure3: IOMB, B1
Host2: P1	Enclosure1: IOMB, B1
Host2: P2	Enclosure3: IOMA, A6
Enclosure1: IOMA, A3	Enclosure2: IOMA, A1
Enclosure2: IOMA, A3	Enclosure3: IOMA, A1
Enclosure1: IOMB, B3	Enclosure2: IOMB, B5
Enclosure2: IOMB, B3	Enclosure3: IOMB, B5

Three Enclosures: Two Hosts with Two HBAs



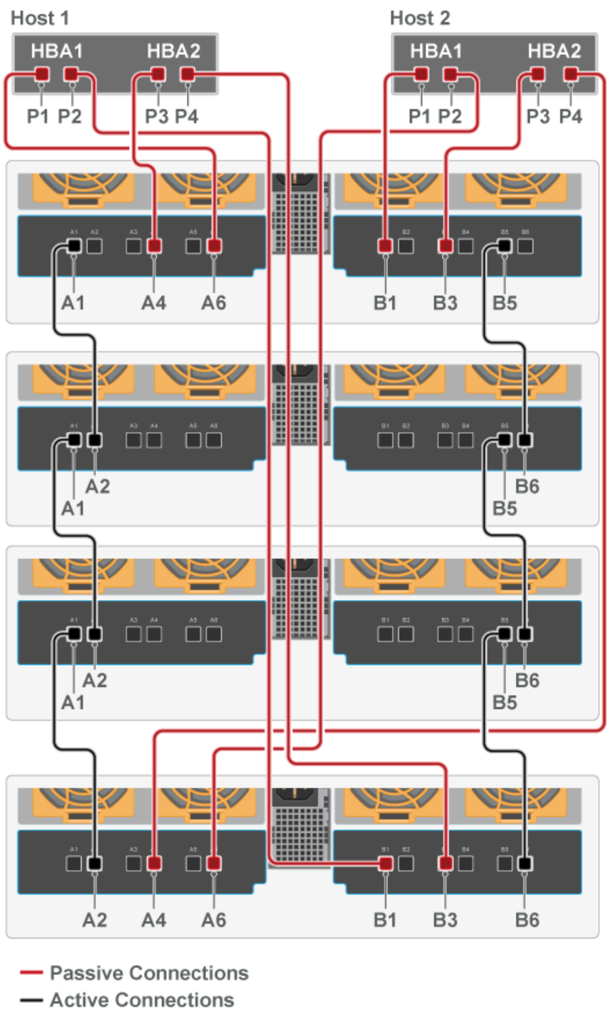
Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure3: IOMB, B1
Host1: P3	Enclosure1: IOMA, A4
Host1: P4	Enclosure3: IOMB, B3
Host2: P1	Enclosure1: IOMB, B1
Host2: P2	Enclosure3: IOMA, A6
Host2: P3	Enclosure1: IOMB, B3
Host2: P4	Enclosure3: IOMA, A4
Enclosure1: IOMA, A1	Enclosure2: IOMA, A2
Enclosure2: IOMA, A1	Enclosure3: IOMA, A2
Enclosure1: IOMB, B5	Enclosure2: IOMB, B6
Enclosure2: IOMB, B5	Enclosure3: IOMB, B6

Four Enclosures: Two Hosts with One HBA



Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure4: IOMB, B1
Host2: P1	Enclosure1: IOMB, B1
Host2: P2	Enclosure4: IOMA, A6
Enclosure1: IOMA, A3	Enclosure2: IOMA, A1
Enclosure2: IOMA, A3	Enclosure3: IOMA, A1
Enclosure3: IOMA, A3	Enclosure4: IOMA, A1
Enclosure1: IOMB, B3	Enclosure2: IOMB, B5
Enclosure2: IOMB, B3	Enclosure3: IOMB, B5
Enclosure3: IOMB, B3	Enclosure4: IOMB, B5

Four Enclosures: Two Hosts with Two HBAs



Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure4: IOMB, B1
Host1: P3	Enclosure1: IOMA, A4
Host1: P4	Enclosure4: IOMB, B3
Host2: P1	Enclosure1: IOMB, B1
Host2: P2	Enclosure4: IOMA, A6
Host2: P3	Enclosure1: IOMB, B3
Host2: P4	Enclosure4: IOMA, A4
Enclosure1: IOMA, A1	Enclosure2: IOMA, A2
Enclosure2: IOMA, A1	Enclosure3: IOMA, A2
Enclosure3: IOMA, A1	Enclosure4: IOMA, A2
Enclosure1: IOMB, B5	Enclosure2: IOMB, B6
Enclosure2: IOMB, B5	Enclosure3: IOMB, B6
Enclosure3: IOMB, B5	Enclosure4: IOMB, B6

4.10.4 Cabling for Daisy Chaining

Note: The CMA should be installed before installing cabling.

Step 1: Choose a configuration from the One Host Cable Configurations *(page 272)* section or Two Host Cable Configurations *(page 278)* sections. The configuration choice should be made based on the number of hosts being connected to the enclosure, the number of HBAs in each host, and how many enclosures will be daisy chained together.

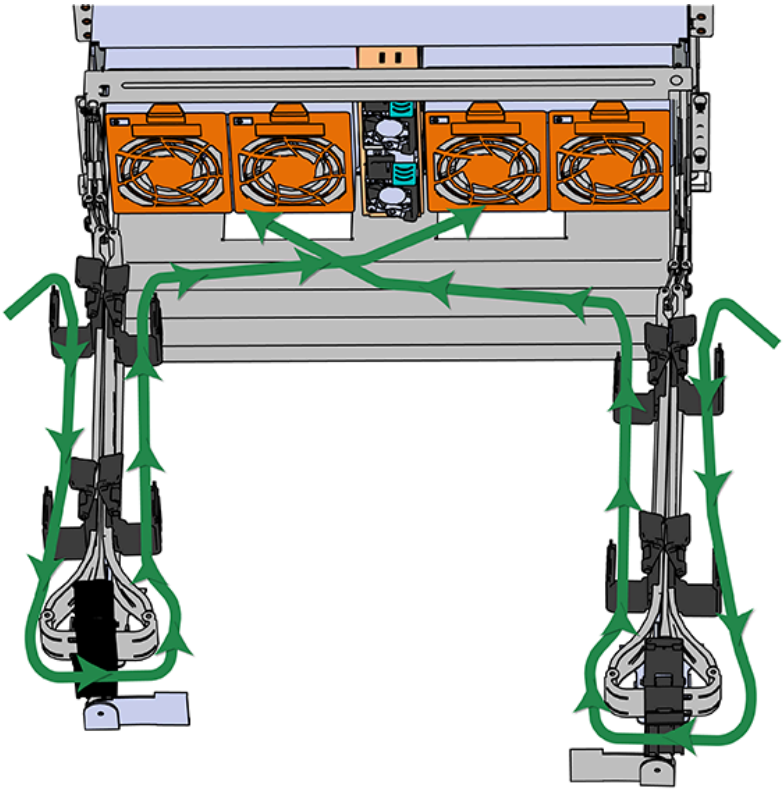
Step 2: Cable the lower CMA.

a. Unlatch the elbow side of the CMA arm and swing it forward by pressing the blue button that says "push" to unlatch it.

b. Gather the SAS cables, one power cable, and one Ethernet cable to install in the left hand side.

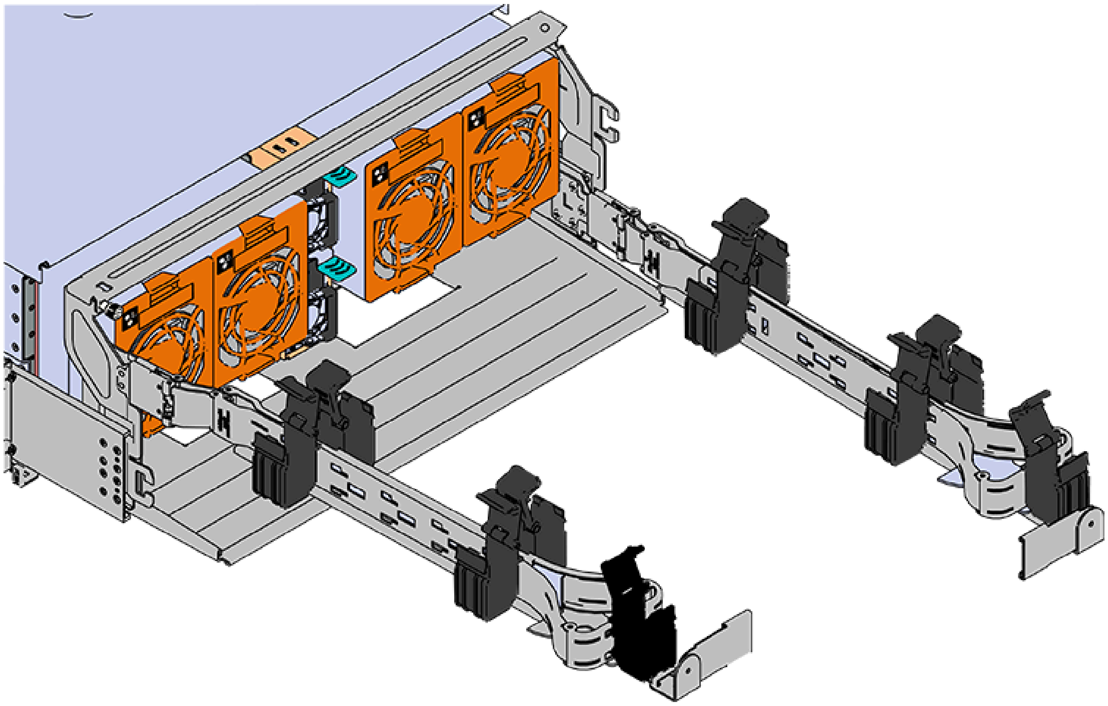
Note: Before cabling the lower CMA, note the following routing of the cables. For best results, the cables that are supported by the upper CMA are inserted into IOM B (right hand side looking at the rear) and the lower CMA cables are routed to IOM A (left hand side looking at the rear) in a "criss-cross" pattern. See the Special Considerations for Cable Routing *(page 199)* for more information.

Figure 279: Connected Cable Routing



c. Open all of the baskets

Figure 280: Open Baskets

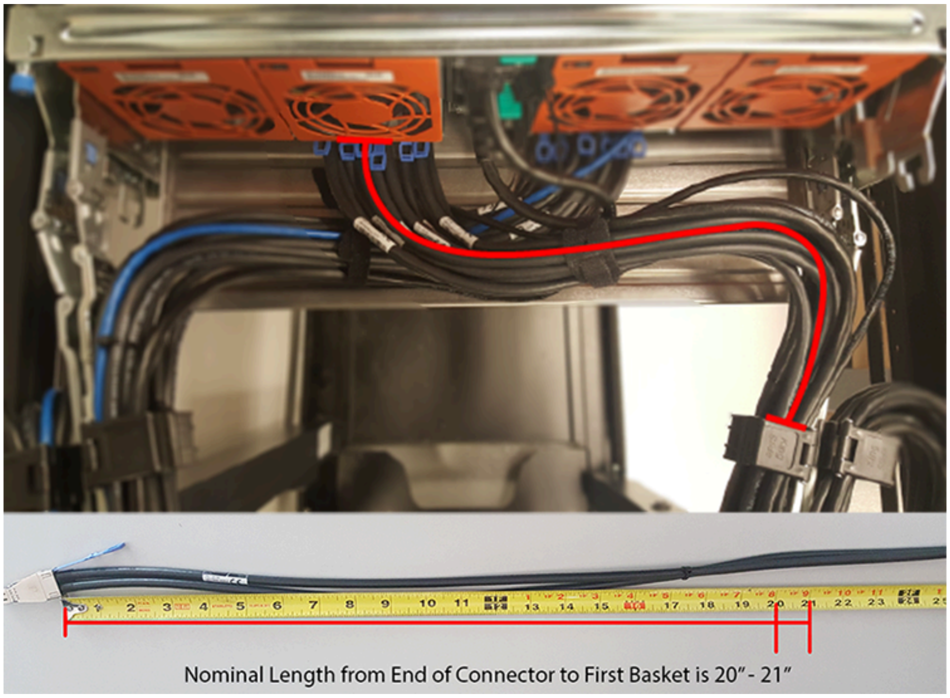


d. Connect all of the SAS cables that will be used and route them through the baskets one at a time. Make sure to follow the labels to make sure they are connected to the proper port.

e. If the installation includes more than 10 total cables, follow the recommendations in Special Considerations for Cable Routing *(page 199)*. Read this section before proceeding.

> **Note:** Each cable must be given enough slack at the connector end to operate smoothly. For the lower CMA allow 20" - 21" (508 – 533.4mm) between the connector and the first basket.

Figure 281: Nominal Cable Length at Connectors

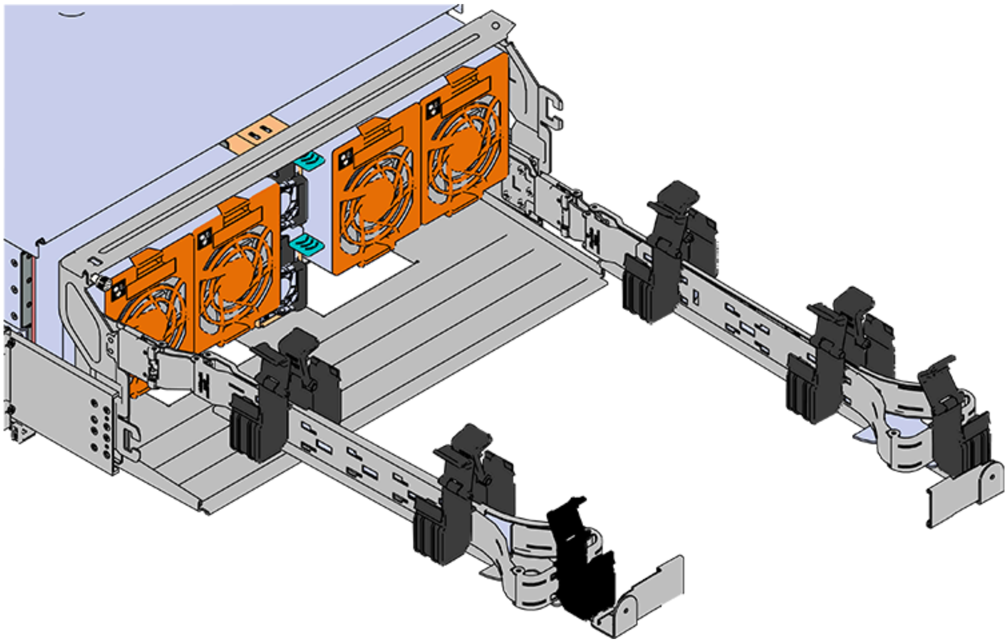


f. Close all of the baskets.
g. Reconnect the CMA at the elbow to the connectors on the rail.

Step 3: Cable the upper CMA.

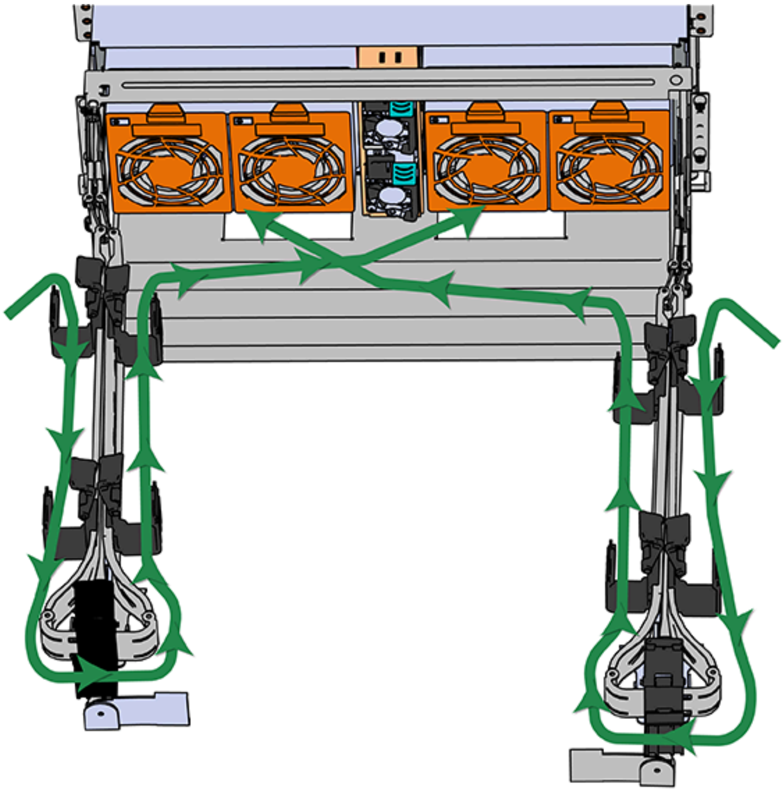
a. Unlatch the elbow side of the CMA arm and swing it forward by pressing the blue button that says "push" to unlatch it.
b. Gather the SAS cables, one power cable, and one Ethernet cable to install in the left hand side.
c. Open all of the baskets

Figure 282: Open Baskets



a. Connect the SAS cables and route them through the baskets one at a time. Make sure to follow the labels to make sure they are connected to the proper port.
b. Connect the power cable to the lower PSU and route it through each basket. The following image shows the appropriate cable "criss-cross" pattern they should be installed in.

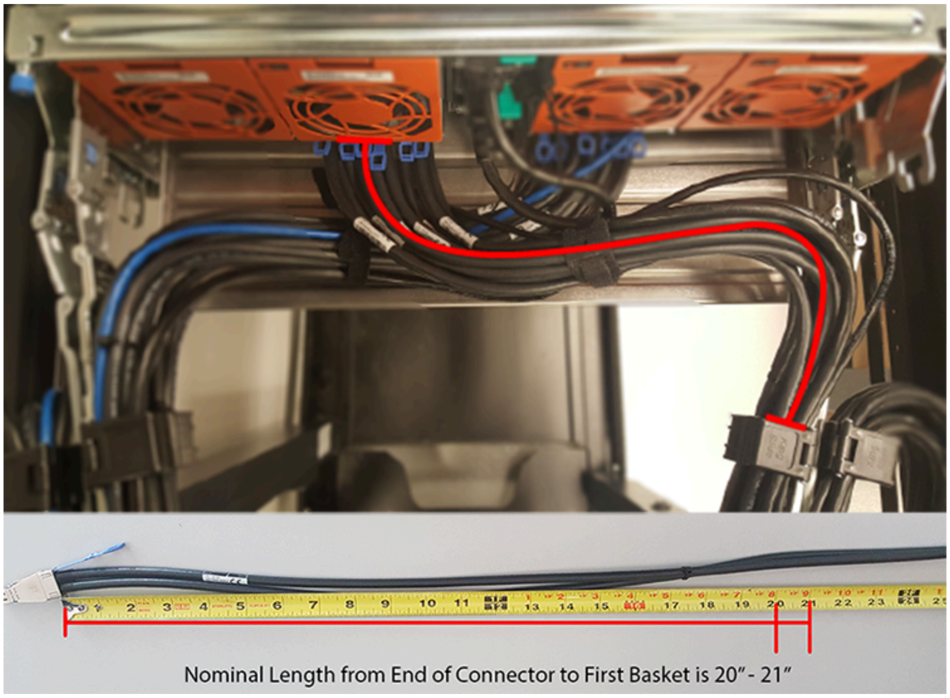
Figure 283: Connected Cable Routing



c. Wrap cable tie around the installed cable bundle between the ports and the first basket of the CMA

> **Note:** Each cable must be given enough slack at the connector end to operate smoothly. For the upper CMA allow 20" - 21" (508 – 533.4mm) between the end of the connector and the first basket. Make sure to route all of the upper CMA cables **under** the lower CMA cables.

Figure 284: Nominal Cable Length at Connectors



d. Close all of the baskets.

e. Reconnect the CMA at the elbow to connector A.

Step 4: Connect the SAS cables to the host server(s) according to the One Host Cable Configurations *(page 272)* and Two Host Cable Configurations *(page 278)*.

Safety

The following chapter provides safety information for the Ultrastar Data102 .

In This Chapter:

5.1 Safety Warnings and Cautions

To avoid personal injury or property damage, before you begin installing the product, read, observe, and adhere to all of the following safety instructions and information. The following safety symbols may be used throughout the documentation and may be marked on the product and/or the product packaging.

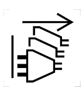
CAUTION Indicates the presence of a hazard that may cause minor personal injury or property damage if the CAUTION is ignored.

WARNING Indicates the presence of a hazard that may result in serious personal injury if the WARNING is ignored.

 Indicates potential hazard if indicated information is ignored.

 Indicates shock hazards that result in serious injury or death if safety instructions are not followed.

 Indicates do not touch fan blades, may result in injury.

 Indicates disconnect all power sources before servicing.

5.2 Electrostatic Discharge

 **CAUTION**

Electrostatic discharge can harm delicate components inside Western Digital products.

Electrostatic discharge (ESD) is a discharge of stored static electricity that can damage equipment and impair electrical circuitry. It occurs when electronic components are improperly handled and can result in complete or intermittent failures.

Wear an ESD wrist strap for installation, service and maintenance to prevent damage to components in the product. Ensure the antistatic wrist strap is attached to a chassis ground (any unpainted metal surface). If possible, keep one hand on the frame when you install or remove an ESD-sensitive part.

Before moving ESD-sensitive parts, place them in ESD static-protective bags until you are ready to install the part.

5.3 Optimizing Location

- Failure to recognize the importance of optimally locating your product and failure to protect against electrostatic discharge (ESD) when handling your product can result in lowered system performance or system failure.
- Do not position the unit in an environment that has extreme high temperatures or extreme low temperatures. Be aware of the proximity of the unit to heaters, radiators, and air conditioners.
- Position the unit so that there is adequate space around it for proper cooling and ventilation.

- Keep the unit away from direct strong magnetic fields, excessive dust, and electronic/electrical equipment that generate electrical noise.
- Do not place this product on an unstable surface. The product may fall, causing damage to the product.
- Set up the unit on a stable surface, resting in the horizontal position, with the top or bottom side facing up.
- Do not set up or use the Ultrastar Data102 in the upright position. This may cause the unit to tip over and result in personal injury or damage to the unit.

5.4 Power Connections

Be aware of the ampere limit on any power supply or extension cables being used. The total ampere rating being pulled on a circuit by all devices combined should not exceed 80% of the maximum limit for the circuit.

CAUTION The power outlet must be easily accessible close to the unit.

Always use properly grounded, unmodified electrical outlets and cables. Ensure all outlets and cables are rated to supply the proper voltage and current.

This unit has more than one power supply connection; both power cords must be removed from the power supplies to completely remove power from the unit. There is no switch or other disconnect device.

When power cycling the unit, wait 10 seconds before re-applying power. Failure to do so may cause the enclosure to boot up in an inaccessible state. If this is encountered, remove power, wait 10 seconds, and then reapply power.

5.5 Power Cords

Use only tested and approved power cords to connect to properly grounded power outlets or insulated sockets of the rack's internal power supply.

If an AC power cord was not provided with your product, purchase one that is approved for use in your country or region.

CAUTION To avoid electrical shock or fire, check the power cord(s) that will be used with the product as follows:

- The power cord must have an electrical rating that is greater than that of the electrical current rating marked on the product.
- Do not attempt to modify or use the AC power cord(s) if they are not the exact type required to fit into the grounded electrical outlets.
- The power supply cord(s) must be plugged into socket-outlet(s) that is / are provided with a suitable earth ground.
- The power supply cord(s) is / are the main disconnect device to AC power. The socket outlet(s) must be near the equipment and readily accessible for disconnection.

5.6 Rackmountable Systems

CAUTION: **Always install rack rails and storage enclosure according to Ultrastar Data102 product documentation. Follow all cautions, warnings, labels, and instructions provided within the rackmount instructions.**

Reliable grounding of rack-mounted equipment should be maintained.

If installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may be greater than room ambient. Therefore, consideration should be given to installing the equipment in an environment compatible with the maximum ambient temperature (Tma) specified by the manufacturer.

Observe the maximum rated ambient temperature, which is specified in the product documentation.

For safe operation of the equipment, installation of the equipment in a rack should be such that the amount of air flow is not impeded so that the safe operation of the equipment is not compromised.

5.7 Safety and Service

All maintenance and service actions appropriate to the end-users are described in the product documentation. All other servicing should be referred to a Western Digital-authorized service technician.

To avoid shock hazard, turn off power to the unit by unplugging both power cords before servicing the unit. Use extreme caution around the chassis because potentially harmful voltages are present.

When replacing a hot-plug power supply, unplug the power cord to the power supply being replaced before removing it from the Ultrastar Data102 .

The power supply in this product contains no user-serviceable parts. Do not open the power supply. Hazardous voltage, current and energy levels are present inside the power supply. Return to manufacturer for servicing.

Use caution when accessing part of the product that are labeled as potential shock hazards, hazardous access to moving parts such as fan blades.

Disclaimers

The following chapter describes the Regulatory Statement of Compliance, Safety Compliance, Electromagnetic Compatibility Agency Requirements, and country certifications for the Ultrastar Data102 .

In This Chapter:

6.1 Restricted Access Location

The Ultrastar Data102 is intended for installation in a server room or computer room where at least one of the following conditions apply:

- access can only be gained by **service persons** or by **users** who have been instructed about the restrictions applied to the location and about any precautions that shall be taken and/or
- access is through the use of a **tool** or lock and key, or other means of security, and is controlled by the authority responsible for the location.

6.2 Safety Compliance

Product Name: **Ultrastar Data102**
System Regulatory Model: **H4102-J**

Electromagnetic Compatibility Emissions: **Class A**

This product has been tested and evaluated as Information Technology Equipment (ITE) at accredited third-party laboratories for all safety, emissions and immunity testing required for the countries and regions where the product is marketed and sold. The product has been verified as compliant with the latest applicable standards, regulations and directives for those regions/countries. The suitability of this product for other product categories other than ITE may require further evaluation.

The product is labeled with a unique regulatory model that is printed on the label and affixed to every unit. The label will provide traceability to the regulatory approvals listed in this document. The document applies to any product that bears the regulatory model and type names including marketing names other than those listed in this document.

6.3 Electromagnetic Compatibility (EMC) Class A Compliance

The **H4102-J** complies with and conforms to the latest international standards as applicable:

Emissions

- AS/NZS CISPR 32
- BSMI CNS14338
- CE – EMC Directive 2014/30/EU
- CISPR 32
- EN 55032
- FCC CFR 47 Part 15, Subpart B
- ICES-003
- KN32
- TR CU 020/2011
- VCCI V-3

Immunity

- EN 55024
- EN 61000-3-2 Harmonic Current Emissions
- EN 61000-3-3 Voltage Fluctuations and Flicker
- EN 61000-4-2 ESD

- EN 61000-4-3 Radiated Immunity
- EN 61000-4-4 EFT
- EN 61000-4-5 Surge
- EN 61000-4-6 RF Common Mode
- EN 61000-4-8 Power Frequency Magnetic Field
- EN 61000-4-11 Voltage Dips and Interruptions
- KN35

6.4 Country Certifications

Table 57: Country Certifications

Country/Region	Authority or Mark
North America (Canada, USA)	Nemko
European Union	CE
Japan	VCCI
Korea	MSIP
Taiwan	BSMI
Australia/New Zealand	RCM
Russia, Kazakhstan, Belarus, Armenia	CU EAC
Ukraine	Ukrsepro
Israel	SII
South Africa	SABS
India	BIS

Regulatory Statements

The following chapter provides regulatory statements for the Ultrastar Data102 , **H4102-J** .

Western Digital storage enclosures are marked to indicate compliance to various country and regional standards.

Note: *Potential equipment damage:* Operation of this equipment with cables that are not properly shielded and not correctly grounded may cause interference to other electronic equipment and result in violation of Class A legal requirements. Changes or modifications to this equipment that are not expressly approved in advance by Western Digital will void the warranty. In addition, changes or modifications to this equipment might cause it to create harmful interference.

In This Chapter:

7.1 Europe (CE Declaration of Conformity)

Marking by the symbol indicates compliance of this system to the applicable Council Directives of the European Union, including the Electromagnetic Compatibility Directive (2014/30/EU) and the Low Voltage Directive (2014/30/EU). A "Declaration of Conformity" in accordance with the applicable directives has been made and is on file at Western Digital Europe.

UK Import Representation Contact

Western Digital UK Limited
PO Box 471
Leatherhead KT22 2LU
UK

Telephone: +44 1372 366000

EU Import Representation Contact

Western Digital EU Limited
PO Box 13379
Swords, Co
Dublin, Ireland

7.2 FCC Class A Notice

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy, and if it is not installed and used in accordance with the instruction manual, it may cause harmful interference to radio communications. Any modifications made to this device that are not approved by Western Digital may void the authority granted to the user by the FCC to operate equipment.

7.3 ICES-003 Class A Notice—Avis NMB-003, Classe A

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numerique de la classe A est conforme à la norme NMB-003 du Canada.

7.4 Japanese Compliance Statement, Class A ITE

The following Japanese compliance statement pertains to VCCI EMI regulations:

この装置は、クラスＡ機器です。この装置を住宅環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

VCCI－A

English translation:

This is a Class A product based on the Technical Requirement of the Voluntary Control Council for Interference by Information Technology (VCCI). In a domestic environment, this product may cause radio interference, in which case the user may be required to take corrective actions.

7.5 Taiwan Warning Label Statement, Class A ITE

警告使用者:

此為甲類資訊技術設備，於居住環境中使用時，

可能會造成射頻擾動，在此種情況下，使用者會

被要求採取某些適當的對策。

English translation:

This is a Class A product. In a domestic environment, this product may cause radio interference, in which case, the user may be required to take adequate measures.

Safety warnings:

請仔細閱讀以下說明

1. 本設備勿置于潮濕處。
2. 連接至電源前，請先檢查電壓。
3. 當設備不用時，請將電源綫拔除避免電壓不穩而造成傷害。
4. 勿將任何液體濺入設備中，避免綫路短路。
5. 基于安全理由，只有受到專業訓練的從業人員，才可以打開本設備。
6. 請勿自行調整或修理已通電的設備，以確保您的安全。
7. 如不小心受傷，請立刻找急救人員給予您適當的救護，千萬別因傷勢輕微而忽略自己的傷勢。

English translation:

Please read the following instructions carefully

1. Do not place the device in a humid place.
2. Check the voltage before connecting to the power source.
3. When the device is not in use, please unplug the power cord to avoid injury due to unstable voltage.
4. Do not spill any liquid into the equipment to avoid short circuits.
5. For safety reasons, only practitioners who have received professional training can open the device.
6. Please do not adjust or repair the powered equipment by yourself to ensure your safety.

7. If you are accidentally injured, please find emergency personnel to give you proper first aid immediately. Don't ignore your injury because of the minor injury.

Appendices

In This Chapter:

8.1 SKUs for Fully-Populated Configurations

The following table lists SKUs for fully-populated configurations of the Ultrastar Data102 .

Table 58: Fully-Populated Configurations

Description	Part Number (Encryption)
SE4U102-102 HC550 1836TB nTAA He SATA 512e	1ES1852 (SED), 1ES1851 (SE)
SE4U102-102 HC550 1836TB nTAA He SAS 512e	1ES1846 (TCG), 1ES1885 (SE)
SE4U102-102 HC550 1632TB nTAA He SATA 512e	1ES1862 (SED), 1ES1861 (SE)
SE4U102-102 HC550 1632TB nTAA He SAS 512e	1ES1856 (TCG), 1ES1855 (SE)
SE4U102-102 1428TB nTAA He SNGL SATA 512e	1ES1453 (SED), 1ES1452 (SE)
SE4U102-102 1428TB nTAA He SNGL SATA 4Kn	1ES1449 (SE)
SE4U102-102 1428TB nTAA He SAS 512e	1ES1999 (TCG-FIPS), 1ES1451 (TCG), 1ES1450 (SE)
SE4U102-102 1428TB nTAA He SAS 4Kn	1ES1448 (TCG), 1ES1447 (SE)
SE4U102-102 1224TB nTAA He SNGL SATA 512e	1ES0316 (SED), 1ES0317 (SE), 1ES0315 (ISE)
SE4U102-102 1224TB nTAA He SNGL SATA 4Kn	1ES0313 (SED), 1ES0314 (SE), 1ES0312 (ISE)
SE4U102-102 1224TB nTAA He SAS 512e	1ES0310 (TCG), 1ES0311 (SE), 1ES0309 (ISE)
SE4U102-102 1224TB nTAA He SAS 4Kn	1ES0307 (TCG), 1ES0308 (SE), 1ES0306 (ISE)
SE4U102-102 HC330 1020TB nTAA SATA 512e	1ES1814 (SED), 1ES1815 (SE)
SE4U102-102 HC330 1020TB nTAA SATA 4Kn	1ES1817 (SED), 1ES1816 (SE)
SE4U102-102 HC330 1020TB nTAA SAS 512e	1ES1802 (TCG), 1ES1807 (SE)
SE4U102-102 HC330 1020TB nTAA SAS 4Kn	1ES1805 (TCG), 1ES1804 (SE)
SE4U102-102 816TB nTAA SNGL SATA 512e	1ES1224 (SED), 1ES1225 (SE)
SE4U102-102 816TB nTAA SNGL SATA 4Kn	1ES1222 (SED), 1ES1223 (SE)
SE4U102-102 816TB nTAA SAS 512e	1ES1220 (TCG), 1ES1221 (SE)
SE4U102-102 816TB nTAA SAS 4KN TCG	1ES1218 (TCG), 1ES1219 (SE)
SE4U102-102 612TB nTAA SNGL SATA 512e	1ES1145 (SED), 1ES1146 (SE)
SE4U102-102 612TB nTAA SNGL SATA 4Kn	1ES1143 (SED), 1ES1144 (SE)
SE4U102-102 612TB nTAA SAS 512e	1ES1141 (TCG), 1ES1142 (SE)
SE4U102-102 612TB nTAA SAS 4Kn	1ES1134 (TCG), 1ES1135 (SE)

8.2 SKUs for Partially-Populated Configurations

The following table lists SKUs for partially-populated configurations of the Ultrastar Data102 .

Table 59: Partially-Populated Configurations

Description	Part Number (Encryption)
SE4U102-60 HC550 1080TB nTAA He SATA 512e	1ES1854 (SED), 1ES1853 (SE)
SE4U102-60 HC550 1080TB nTAA He SAS 512e	1ES1849 (TCG), 1ES1848 (SE)
SE4U102-60 HC550 960TB nTAA He SATA 512e	1ES1864 (SED), 1ES1863 (SE)
SE4U102-60 HC550 960TB nTAA He SAS 512e	1ES1859 (TCG), 1ES1858 (SE)
SE4U102-60 840TB nTAA He SNGL SATA 512e	1ES1460 (SED), 1ES1459 (SE)
SE4U102-60 840TB nTAA He SNGL SATA 4Kn	1ES1456 (SE)
SE4U102-60 840TB nTAA He SAS 512e	1ES1458 (TCG), 1ES1457 (SE), 1ES1494 (ISE)
SE4U102-60 840TB nTAA He SAS 4Kn	1ES1455 (TCG), 1ES1454 (SE)
SE4U102-60 720TB nTAA He SNGL SATA 512e	1ES0340 (SED), 1ES0341 (SE), 1ES0339 (ISE)
SE4U102-60 720TB nTAA He SNGL SATA 4Kn	1ES0337 (SED), 1ES0338 (SE), 1ES0336 (ISE)
SE4U102-60 720TB nTAA He SAS 512e	1ES0334 (TCG), 1ES0335 (SE), 1ES0333 (ISE)
SE4U102-60 720TB nTAA He SAS 4Kn	1ES0331 (TCG), 1ES0332 (SE), 1ES0330 (ISE)
SE4U102-60 HC330 600TB nTAA SATA 512e	1ES1819 (SED), 1ES1818 (SE)
SE4U102-60 HC330 600TB nTAA SATA 4Kn	1ES1821 (SED), 1ES1820 (SE)
SE4U102-60 HC330 600TB nTAA SAS 512e	1ES1809 (TCG), 1ES1808 (SE)
SE4U102-60 HC330 600TB nTAA SAS 4Kn	1ES1812 (TCG), 1ES1811 (SE)
SE4U102-60 480TB nTAA SNGL SATA 512e	1ES1232 (SED), 1ES1233 (SE)
SE4U102-60 480TB nTAA SNGL SATA 4Kn	1ES1230 (SED), 1ES1231 (SE)
SE4U102-60 480TB nTAA SAS 512e	1ES1228 (TCG), 1ES1229 (SE)
SE4U102-60 480TB nTAA SAS 4Kn	1ES1226 (TCG), 1ES1227 (SE)
SE4U102-60 360TB nTAA SNGL SATA 512e	1ES1153 (SED), 1ES1154 (SE)
SE4U102-60 360TB nTAA SNGL SATA 4Kn	1ES1151 (SED), 1ES1152 (SE)
SE4U102-60 360TB nTAA SAS 512e	1ES1149 (TCG), 1ES1150 (SE)
SE4U102-60 360TB nTAA SAS 4Kn	1ES1147 (TCG), 1ES1148 (SE)

8.3 SKUs for Scale-Up Modules

The following table lists SKUs for scale-up modules for the Ultrastar Data102 .

Table 60: SKUs for 14-Pack Scale-Up Modules

Description	Part Number (Encryption)
SE4U102 ScaleUp Module HC550 252TB nTAA He SATA 512e	1EX2472 (SED), 1EX2471 (SE)
SE4U102 ScaleUp Module HC550 252TB nTAA He SAS 512e	1EX2469 (TCG), 1EX2468 (SE), 1EX2470 (TCG-FIPS)
SE4U102 ScaleUp Module HC550 224TB nTAA He SATA 512e	1EX2467 (SED), 1EX2466 (SE)

Description	Part Number (Encryption)
SE4U102 ScaleUp Module HC550 224TB nTAA He SAS 512e	1EX2464 (TCG), 1EX2463 (SE), 1EX2465 (TCG-FIPS)
SE4U102 ScaleUp Module 196TB nTAA He SNGL SATA 512e	1EX1841 (SED), 1EX1840 (SE)
SE4U102 ScaleUp Module 196TB nTAA He SNGL SATA 4Kn	1EX1837 (SE)
SE4U102 ScaleUp Module 196TB nTAA He SAS 512e	1EX1839 (TCG), 1EX1838 (SE)
SE4U102 ScaleUp Module 196TB nTAA He SAS 4Kn	1EX1836 (TCG), 1EX1835 (SE)
SE4U102 ScaleUp Module 168TB nTAA He SATA 512e	1EX0535 (SE), 1EX0533 (ISE)
SE4U102 ScaleUp Module 168TB nTAA He SATA 4Kn	1EX0532 (SE), 1EX0530 (ISE)
SE4U102 ScaleUp Module 168TB nTAA He SAS 512e	1EX0528 (TCG), 1EX0529 (SE), 1EX0527 (ISE)
SE4U102 ScaleUp Module 168TB nTAA He SAS 4Kn	1EX0525 (TCG), 1EX0526 (SE), 1EX0524 (ISE)
SE4U102 ScaleUp Module HC330 140TB nTAA SATA 512e	1EX2451 (SED), 1EX2450 (SE)
SE4U102 ScaleUp Module HC330 140TB nTAA SATA 4Kn	1EX2449 (SED), 1EX2448 (SE)
SE4U102 ScaleUp Module HC330 140TB nTAA SAS 512e	1EX2446 (TCG), 1EX2445 (SE)
SE4U102 ScaleUp Module HC330 140TB nTAA SAS 4Kn	1EX2443 (TCG), 1EX2442 (SE)
SE4U102 ScaleUp Module 112TB nTAA SATA 512e	1EX1234 (SED), 1EX1235 (SE)
SE4U102 ScaleUp Module 112TB nTAA SATA 4Kn	1EX1232 (SED), 1EX1233 (SE)
SE4U102 ScaleUp Module 112TB nTAA SAS 512e	1EX1230 (TCG), 1EX1231 (SE)
SE4U102 ScaleUp Module 112TB nTAA SAS 4Kn	1EX1228 (TCG), 1EX1229 (SE)
SE4U102 ScaleUp Module 84TB nTAA SATA 512e	1EX1196 (SED), 1EX1197 (SE)
SE4U102 ScaleUp Module 84TB nTAA SATA 4Kn	1EX1194 (SED), 1EX1195 (SE)
SE4U102 ScaleUp Module 84TB nTAA SAS 512e	1EX1192 (TCG), 1EX1193 (SE)
SE4U102 ScaleUp Module 84TB nTAA SAS 4Kn	1EX1190 (TCG), 1EX1191 (SE)

Table 61: Ultrastar Data102 SKUs for 12-Pack ScaleUp Modules

Description	Part Number
SE MM ScaleUp Module HC550 216TB nTAA He SATA 512e	1EX2492 (SED), 1EX2491 (SE)
SE MM ScaleUp Module HC550 216TB nTAA He SAS 512e	1EX2489 (TCG), 1EX2488 (SE), 1EX2490 (TCG-FIPS)

Description	Part Number
SE MM ScaleUp Module HC550 216TB nTAA He SAS 4Kn	1EX2785 (SE)
SE MM ScaleUp Module HC550 192TB nTAA He SATA 512e	1EX2487 (SED), 1EX2486 (SE)
SE MM ScaleUp Module HC550 192TB nTAA He SAS 512e	1EX2484 (TCG), 1EX2483 (SE), 1EX2485 (TCG-FIPS)
SE MM ScaleUp Module 168TB nTAA He SNGL SATA 512e	1EX1848 (SED), 1EX1847 (SE)
SE MM ScaleUp Module 168TB nTAA He SNGL SATA 4Kn	1EX1844 (SE)
SE MM ScaleUp Module 168TB nTAA He SAS 512e	1EX1846 (TCG), 1EX1845 (SE)
SE MM ScaleUp Module 168TB nTAA He SAS 4Kn	1EX1843 (TCG), 1EX1842 (SE)
SE MM ScaleUp Module 144TB nTAA He SATA 512e	1EX0553 (SE), 1EX0551 (ISE)
SE MM ScaleUp Module 144TB nTAA He SATA 4Kn	1EX0550 (SE), 1EX0548 (ISE)
SE MM ScaleUp Module 144TB nTAA He SAS 512e	1EX0546 (TCG), 1EX0547 (SE), 1EX0545 (ISE)
SE MM ScaleUp Module 144TB nTAA He SAS 4Kn	1EX0543 (TCG), 1EX0544 (SE), 1EX0542 (ISE)
SE MM ScaleUp Module HC330 120TB nTAA SATA 512e	1EX2461 (SED), 1EX2460 (SE)
SE MM ScaleUp Module HC330 120TB nTAA SATA 4Kn	1EX2459 (SED), 1EX2458 (SE)
SE MM ScaleUp Module HC330 120TB nTAA SAS 512e	1EX2456 (TCG), 1EX2455 (SE)
SE MM ScaleUp Module HC330 120TB nTAA SAS 4Kn	1EX2453 (TCG), 1EX2452 (SE)
SE MM ScaleUp Module 96TB nTAA SATA 512e	1EX1242 (SED), 1EX1243 (SE)
SE MM ScaleUp Module 96TB nTAA SATA 4Kn	1EX1240 (SED), 1EX1241 (SE)
SE MM ScaleUp Module 96TB nTAA SAS 512e	1EX1238 (TCG), 1EX1239 (SE)
SE MM ScaleUp Module 96TB nTAA SAS 4Kn	1EX1236 (TCG), 1EX1237 (SE)
SE MM ScaleUp Module 72TB nTAA SATA 512e	1EX1212 (SED), 1EX1213 (SE)
SE MM ScaleUp Module 72TB nTAA SATA 4Kn	1EX1210 (SED), 1EX1211 (SE)
SE MM ScaleUp Module 72TB nTAA SAS 512e	1EX1208 (TCG), 1EX1209 (SE)
SE MM ScaleUp Module 72TB nTAA SAS 4Kn	1EX1206 (TCG), 1EX1207 (SE)
SE MM ScaleUp Module 48TB nTAA SAS 512e	1EX2252 (TCG-FIPS), 1EX2251 (TCG), 1EX2250 (SE)
SE MM ScaleUp Module 48TB nTAA SAS 4Kn	1EX2249 (TCG-FIPS), 1EX2248 (TCG), 1EX2247 (SE)