IBM FlashSystem 9500

Hardware guide

Note

Before using this information and the product it supports, read the information in Chapter 2, “Notices ,” on page 3.

This edition applies to version 8, release 7, modification x, and to all subsequent modifications until otherwise indicated in new editions.

Contents

Figures vii

Tables xix

Chapter 1. FlashSystem 9500 1

Chapter 2. Notices 3
- Trademarks 4
- Product support statement 5
- Homologation statement 5
- Safety and environmental notices 5
  - Safety notices and labels 5
  - Special caution and safety notices 10
  - Environmental notices 13
  - Electromagnetic compatibility Class A notices 13
  - Electromagnetic compatibility Class B notices 17

Chapter 3. System overview 21
- Node canisters 24
  - Dual-port 100 Gbps Ethernet host interface adapter 28
  - Quad-port 64 Gbps Fibre Channel adapter 29
  - Quad-port 32 Gbps Fibre Channel adapter 30
  - Dual-port 25 Gbps Ethernet (RoCE) host interface adapter 31
  - Dual-port 25 Gbps Ethernet (iWARP) host interface adapter 32
  - Dual-port 12 Gbps SAS expansion adapter 33
  - Batteries 34
- Power supply units 35
- Drives 37
- Software feature limits 38

Chapter 4. Expansion enclosures 39
- 2U Expansion enclosures 40
- 5U Expansion enclosures 41

Chapter 5. Planning for hardware 45
- Control enclosure environmental requirements 45
- SAS expansion enclosure environmental requirements 51
- Enclosure location guidelines 56
- Planning management connections 57
- Planning for I/O connections 58
- Cable reference 60
- Planning worksheets 61

Chapter 6. Installing 63
- Unpacking a 4U control enclosure 63
  - Safety notices and considerations for 4U enclosure 66
  - Weight considerations: 4U enclosure 70
- Installing support rails for the control enclosure 71
- Installing a control enclosure 74

Installing a 2U expansion enclosure 75
Unpacking a 2U expansion enclosure 75
Installing support rails for 2U expansion enclosures 76
Installing an optional 2U SAS expansion enclosure 78
Powering on the optional 2U SAS expansion enclosures 78
Installing a 5U expansion enclosure 79
Safety notices and considerations 79
Weight considerations: 5U expansion enclosure 83
Identify the hardware components 86
Unpacking an optional 5U expansion enclosure 88
Installing or replacing the support rails 91
Installing a 5U expansion enclosure in a rack 93
Powering on the optional 5U expansion enclosure 98
Powering off the 5U expansion enclosure 100
Procedure: Transporting a 5U 92-drive expansion enclosure 101
Connecting the components 101
Connecting Ethernet cables to the node canisters 101
Connecting Fibre Channel cables to the control enclosure 102
Connecting expansion enclosures to the control enclosure 104
Powering on the control enclosure 107
Initializing the system with the technician port (IBM SSR task) 108
Completing the service setup for a new system (IBM SSR task) 110
Completing the initial system setup (customer task) 111
Adding a control enclosure to an existing system 112
Installing optional features 113

Chapter 7. Hardware Servicing 115
Resolving a problem with failure to boot 115
Removing and replacing control enclosure parts 116
Procedure: Identifying which enclosure or canister to service 116
Procedure: Understanding system volume dependencies 117
Procedure: Powering off the system 117
Procedure: Powering off a node canister 118
Removing and replacing the enclosure end caps 119
Removing and replacing the control enclosure support rails 120
Removing and replacing a drive 124
Removing and replacing a drive blank 126
Removing and replacing a power supply unit 127
Removing and replacing an SFP transceiver 128
Removing and replacing a network adapter 131
Removing and replacing the cover of a node canister 134
Removing and replacing the node canister battery 135
Removing and replacing a CMOS battery 137
Removing and reseating a node canister 138
Removing and replacing a memory module 142
Removing and replacing a fan module 148
Removing and replacing a power interposer 150
Removing and replacing an adapter cage 154
Removing and replacing the Trusted Platform Module 156
Removing and replacing a boot drive 159
Removing and replacing the air baffle of a node canister 164
Removing and replacing a compression card 165
Removing and replacing an enclosure or midplane assembly 166
Removing and replacing 2U expansion enclosure parts 173
Procedure: Powering off a 2U expansion enclosure 173
Removing and replacing the 2U enclosure end caps 174
Replacing 2U expansion enclosure support rails 174

Removing and replacing a drive assembly....176
Removing and replacing a drive blank....178
Replacing a power supply unit for an expansion enclosure....179
Replacing a 2U expansion canister....180
Replacing a 2U expansion enclosure midplane assembly....181
Replacing an expansion enclosure attachment SAS cable....185
Removing and replacing 5U expansion enclosure parts....186
Removing the support rails of the 5U expansion enclosure....186
Removing a 5U expansion enclosure from a rack....187
Removing or moving the cable-management arm....192
Removing and replacing the top cover....196
Removing and replacing a drive....198
Removing and replacing a secondary expander module....202
Replacing an expansion enclosure....208
Removing and replacing the fascia....210
Removing and replacing a power supply....213
Removing and replacing a display panel assembly....218
Removing an expansion canister....220
Removing and installing a SAS cable....221
Removing and replacing a fan module....223
Removing and replacing a fan interface board....225
System indicators summary....228
Control enclosure indicators....229
Drive indicators....230
Power supply indicators....231
Node canister indicators....232
Network adapter port indicators....236
Expansion enclosure indicators....239
Replaceable units....248
Control enclosure replaceable units....248
2U expansion enclosure replaceable units....250
High density expansion enclosure replaceable units....252

Chapter 8. FlashSystem 9500R 255
Planning for a FlashSystem 9500R rack solution....255
Planning a location for the rack....255
Planning power for the rack....256
Planning for system connections within the rack....256
Planning for the IBM Enterprise Slim Rack (7965-S42) rack frame....257
IP connectivity of Fibre Channel switches and power distribution units (PDUs) worksheet....270
Installing the FlashSystem 9500R rack solution....271
Locating the FlashSystem 9500R rack solution (Customer task)....272
Installing the IBM Enterprise Slim Rack (7965-S42) (Customer task)....273

Figures

1. Front view of the control enclosure..... 21

2. Rear view of the control enclosure..... 21

3. Node canister - Rear view..... 24

4. Dual-port 100 Gbps Ethernet host interface adapter..... 28

5. 100 Gbps Ethernet card ports and indicators..... 28

6. Quad-port 64 Gbps Fibre Channel adapter..... 29

7. Fibre Channel ports and indicators..... 29

8. Quad-port 32 Gbps Fibre Channel adapter..... 30

9. Fibre Channel ports and indicators..... 30

10. Dual-port 25 Gbps Ethernet (RoCE) host interface adapter..... 31

11. Ethernet ports and indicators..... 31

12. Dual-port 25 Gb Ethernet (iWARP) host interface adapter..... 32

13. Ethernet ports and indicators..... 33

14. Dual-port 12 Gbps SAS expansion adapter..... 34

15. Dual-port 12 Gbps SAS - front view..... 34

16. Power supply details..... 36

17. IBM Storage FlashSystem 9500 preferred slot plug ordering pattern..... 38

18. Front view of an 2U12 expansion enclosure..... 40

19. Front view of an 2U24 expansion enclosure..... 40

20. Rear view of an expansion enclosure..... 41

21. Features on the front of the 5U expansion enclosure..... 41

22. Front fascia of the 5U expansion enclosure..... 42

23. Features on the rear of the 5U expansion enclosure..... 42

24. Rack space requirements for the 5U expansion enclosures..... 54
25. Tray containing rail kit..... 64
26. Folding the cardboard..... 64
27. Foam removal from enclosure..... 65
28. Moving on to lift..... 65
29. Enclosure on lift..... 66
30. Control enclosure support rails..... 72
31. Hole locations in the front of the rack..... 72
32. Opening the hinge brackets..... 73
33. Installing the side rail..... 73
34. Inserting the enclosure..... 74
35. Expansion enclosure support rails..... 76
36. Hole locations in the front of the rack..... 76
37. Opening the hinge brackets..... 77
38. Closing the hinge brackets..... 77
39. Expansion enclosure LEDs..... 79
40. Features on the front of the 5U expansion enclosure..... 86
41. Front fascia of the 5U expansion enclosure..... 86
42. Features on the rear of the 5U expansion enclosure..... 87
43. Support rails..... 87
44. CMA assemblies..... 88
45. Tray containing expansion enclosure parts..... 89
46. Packaging materials..... 90
47. Packaging for fascia..... 90
48. Support rails..... 91

49. Detaching the inner rail section..... 91
50. Screw locations to attach the inner rail to the enclosure..... 91
51. Attaching the inner rail section to the enclosure..... 92
52. Installing the rail assembly to the rack frame..... 92
53. Example of the required rack space..... 92
54. Example installation of the enclosure in the rack..... 97
55. Replacing the 5U enclosure in the rack..... 97
56. Features on the front of the 5U expansion enclosure..... 98
57. Secure power cables 99
58. Power and SAS cable connections on the back of the enclosure 99
59. Features on the rear of the 5U expansion enclosure..... 99
60. Node canisters and PSUs..... 102
61. Adapter slot locations in the control enclosure..... 103
62. SAS cable connector orientation..... 104
63. Pushing the SAS cable latch closed..... 105
64. Connecting the SAS cables to control enclosure..... 107
65. Technician port..... 108
66. Front view of the control enclosure..... 119
67. End cap touch point and LED indicators..... 119
68. End cap touch point and LED indicators..... 120
69. Example of a silver screw and M5 screw..... 121
70. Opening the rear hinge bracket of the mounting rail..... 122
71. Compressing the rail for removal from rack..... 123
72. Unlocking the drive and release latch..... 125
73. Inserting the new drive..... 125

74. Completing the drive installation..... 125

75. Correct drive blank orientation.....126

76. Locate Power Supply Units..... 127

77. Features of a power supply unit..... 128

78. Removing the power supply unit 128

79. Alignment of the network adapter..... 134

80. Removing the node canister cover..... 135

81. Replacing the node canister cover..... 135

82. Removing the battery.....136

83. Replacing the battery.....136

84. Locating a CMOS battery.....137

85. Replacing a CMOS battery..... 138

86. Removing and replacing the canister..... 139

87. Location of CPUs and DIMM slots..... 143

88. Identifying DIMM locations 1-6.....145

89. Identifying DIMM locations 7-12..... 146

90. Identifying DIMM locations 13-18..... 146

91. Identifying DIMM locations 19-24..... 147

92. Location of the fans within the node canister..... 149

93. Removing the fan module.....149

94. Removing an adapter cage..... 155

95. Removing an adapter cage..... 156

96. Location of boot drives..... 157

97. Removing the boot drive.....158

98. Released boot drive..... 158

99. Locating the TPM....158
100. Removing the TPM....159
101. Location of the boot drives....161
102. Removing the boot drive....162
103. Released boot drive....162
104. Inserting the boot drive....163
105. Removing the air baffle....164
106. Replacing the air baffle....165
107. Locating the compression card....166
108. Locating the compression card....166
109. Expansion enclosure support rails....174
110. Hole locations in the front of the rack....175
111. Opening the hinge brackets....175
112. Closing the hinge brackets....176
113. Unlocking and removing a 3.5-inch drive from its slot....177
114. Installing and locking a 3.5-inch drive into its slot....178
115. Correct drive blank orientation....179
116. Removing the power supply unit from the left side of the expansion enclosure....180
117. Removing and replacing the IBM Storage FlashSystem expansion canister....181
118. Removing a vertical style hard disk drive....182
119. Removing a horizontal style hard disk drive....183
120. Removing the screws of an expansion enclosure assembly....184
121. Proper orientation for SAS cable connector....186
122. Remove the rail assembly from the front frame bracket....186
123. Remove the rail assembly from the rear frame bracket....187

124. Removing the 5U expansion enclosure from the rack....191
125. Upper and lower cable-management arms....192
126. Connectors for the upper cable management arm....193
127. Components of the lower CMA assembly....194
128. Upper and lower CMA assemblies moved aside....195
129. Lower CMA assembly moved....195
130. Release the upper CMA assembly....196
131. Release the lower CMA assembly....196
132. Releasing the 5U expansion enclosure cover....197
133. Removing the 5U expansion enclosure cover....197
134. Aligning the top cover....197
135. Replacing the top cover....197
136. Locking the top cover....198
137. Drive assembly....198
138. Drive locations in a 5U expansion enclosure....199
139. Remove the drive assembly....200
140. Drive locations in a 5U expansion enclosure....201
141. Correct drive installation....201
142. Incorrect drive installation....201
143. Replace the drive....202
144. Location of secondary expander modules....203
145. Location of LEDs on the secondary expander module....204
146. Remove the secondary expander module....205
147. Secondary expander module connectors....205
148. Secondary expander module removed from the enclosure....206

149. LEDs on a secondary expander module....206
150. Open the secondary expander module handles....207
151. Replace the secondary expander module....207
152. Fascia components on the expansion enclosure....210
153. Remove fascia components from the expansion enclosure....211
154. Fascia removed from the PSUs....212
155. Replace fascia components on the expansion enclosure....213
156. Releasing the power supply handles....214
157. Removed power supply....215
158. Preparing to install the power supply....216
159. Install the power supply....217
160. Power supply indicators....217
161. Removing the display panel assembly....218
162. Display panel assembly....219
163. Installing the display panel assembly....220
164. Expansion canister....220
165. Removing the expansion canister....221
166. Correct orientation for SAS cable connectors....222
167. Example of SAS cables routed through the cable management arms....222
168. SAS cable correctly inserted into the SAS port....223
169. Fan module LED....223
170. Fan module release tab....224
171. Remove and replace a fan module....224
172. Fan module orientation....225
173. Fan module LED....226

174. Location of the FIB cover....226
175. Loosen the FIB screws....227
176. Remove the FIB from the chassis....227
177. FIB parts removed from the chassis....228
178. Left enclosure end cap....229
179. Drive LEDs....230
180. Power supply details....231
181. Node canister status LEDs....232
182. Node canister LEDs....232
183. Battery LEDs....234
184. Fibre Channel ports and indicators....236
185. Dual-port 25 Gbps Ethernet host interface adapter ports and LEDs (RoCE)....237
186. Dual-port 25 Gbps Ethernet host interface adapter ports and LEDs (iWARP)....237
187. Dual-port 100 Gbps Ethernet adapter host interface adapter ports and LEDs (RoCE)....238
188. Quad-port 12 Gbps SAS expansion adapter....239
189. Left enclosure end cap....240
190. LED indicators on a vertical 2.5 in. (6.35 cm) drive....241
191. Expansion canister LEDs....242
192. SAS ports and LEDs at the rear of an expansion canister....243
193. LEDs on the front of the expansion enclosure....244
194. LEDs on the front of a power supply unit....245
195. LEDs on drives and SEMs....246
196. LEDs on the back of the expansion enclosure....247
197. LEDs on the back of the expansion canister....247
198. Fibre Channel ports in the IBM SAN24B-6 switches....256

199. Fibre Channel ports in the IBM SAN32C-6 switches....257
200. Floor cutout....260
201. Caster and leveler locations....261
202. Cabling within the rack....262
203. Cabling under the floor....263
204. Cabling overhead....264
205. Graphic showing two PDUs. One PDU is on each side of the FlashSystem 9500R rack solution....265
206. Logical NVMe drive placement....272
207. NVMe drive population with numbering....272
208. Rack bolt-down hardware....277
209. Securing the rack to the concrete floor....278
210. Recommended bolt-down locations....279
211. Adjusting the leveling feet....280
212. Installing the airflow plate....281
213. Rack bolt-down hardware....282
214. Securing the rack frame to the concrete floor....284
215. Bolt-down locations....285
216. Adjusting the leveling feet....287
217. Installing the airflow plate....288
218. Adjusting the leveling feet....289
219. Installing the stabilizer bracket....290
220. Aligning the vertical-mounting brackets to the front of a PDU....291
221. Aligning the vertical-mounting brackets to the front of the PDU+....292
222. Attaching nut clips to the rack mounting flanges from the rear of the rack....293
223. Aligning the PDU+ with the opening in the side of the rack, seen from the rear of the rack....294

224. Aligning the connector on the power cord with the PDU+ 295

225. Connecting a notebook computer to a 1U PDU 296

226. Connecting a router or switch to an PDU+ 297

227. Connecting a router or switch to a PDU environment sensor 298

228. Moving the rack hinges 309

229. Installing the door hinges 310

230. Reorienting the door latch 311

231. Removing the ruggedized latch components 313

232. Assembling the ruggedized latch 314

233. Ground points on the rack frame 315

234. Grounding connection point on the door 316

235. Ground point on the door 317

236. Ring terminal and external star washer 318

237. Installing the side covers 319

238. Installing the extender 321

239. Fastening the rack braces 323

240. Removing the corner screws 324

241. Removing the remaining screws 325

242. Lifting the top cover 326

243. Removing the shipping bracket from the back of a control enclosure 328

244. Removing the rail end brackets from the shipping bracket 329

245. Installing the rail end brackets 330

246. Exploded view of duct switch assembly 332

247. Rails and locking mechanism 333

248. Components assembled on rail inner members 334

249. Incorrect screw length..... 334

250. Switch duct rails and ear location..... 335

251. Rack front detail.....335

252. Attaching a bracket to an outer rail member..... 336

253. Rack rear right-side detail..... 336

254. Rack front views.....337

255. Exploded view of duct switch assembly..... 338

256. Power cable routes for SAN32C-6 switches (includes for optional second PSU) 339

Tables

1. IBM Storage FlashSystem 9500 Models 22

2. Adapter types 23

3. Node canister ports 25

4. Adapter Cage 1 combinations 25

5. Adapter Cage 2 combinations 26

6. Adapter Cage 3 combinations 26

7. Port numberings 27

8. Memory configuration 27

9. FlashCore Modules sizes and capacities 37

10. IBM Storage FlashSystem 9500 expansion enclosure models 39

11. Valid combinations of expansion enclosures per SAS chain 39

12. Supported drives, 2U24 Expansion enclosure 39

13. Supported drives, 5U92 Expansion enclosure 39

14. Power specifications per power supply 46

15. Power consumption examples per enclosure 47

16. Temperature requirements 47

17. Airflow requirements for FlashSystem 48

18. Physical characteristics of the enclosures 48

19. Rack space requirements for the FlashSystem 9500 control enclosure 48

20. Clearances 48

21. Declared noise emission values in accordance with ISO 9296 49

22. Shock testing results 50

23. Vibration testing results 51

24. Power specifications per power supply....51
25. Power consumption examples per enclosure....52
26. Temperature requirements....52
27. Physical characteristics of the expansion enclosures....53
28. Rack space requirements for the SAS expansion enclosures....54
29. Clearances....54
30. Drive specifications....54
31. Acoustical specifications for 4666-AFF SAS expansion enclosures....55
32. Declared noise emissions for 5U SAS expansion enclosures in accordance with ISO 9296....55
33. Shock testing results....56
34. Vibration testing results....56
35. Summary of TCP/IP ports and services....57
36. Communications types....59
37. Cabling to direct-connect two control enclosures....59
38. Ethernet cable standards....60
39. Lift requirements....70
40. Enclosure weight as FRUs are installed....71
41. Selecting bracket pins for your rack....73
42. Selecting bracket pins for your rack....77
43. Weight of expansion enclosure parts....83
44. Weight of an enclosure with 92 SAS drives....84
45. Enclosure weight as FRUs are installed....84
46. Summary of internal components that can be removed and replaced....121
47. SFP transceiver example....130
48. Cable identification for adapters in the cage being serviced....131

49. Summary of network adapters and SFP devices 132

50. Temperature requirements..... 141

51. Available memory configurations for a control enclosure..... 143

52. Summary of node canister 1 PCIe slots and port connections..... 150

53. Summary of node canister 2 PCIe slots and port connections..... 152

54. Summary of adapter cage slots and port connections..... 155

55. Recording control enclosure information..... 168

56. Summary of node canister 1 PCIe slots and port connections..... 169

57. Summary of node canister 2 PCIe slots and port connections..... 170

58. Selecting bracket pins for your rack..... 175

59. LEDs on the secondary expander modules..... 204

60. Summary of LED Indicators..... 229

61. Drive LED status..... 230

62. Summary of LED indicators for the PSUs..... 231

63. Node canister status LEDs indicator..... 233

64. Battery status LED indicators..... 234

65. Adapter slot fault LED indicator..... 235

66. Boot drive fault LED indicator..... 236

67. Onboard Ethernet port LEDs 236

68. Link status values for Fibre Channel adapter LEDs..... 237

69. LED indicators for dual-port 25 Gbps Ethernet host interface adapter (RoCE)..... 237

70. Table 2. LED indicators for dual-port 25 Gbps Ethernet host interface adapter (iWARP)..... 238

71. LED indicators for dual-port 100 Gbps Ethernet host interface adapter (RoCE)..... 238

72. Summary of LED Indicators..... 240

73. Drive LED status..... 241

74. Expansion canister LED descriptions..... 242

75. SAS port LEDs on the expansion canister..... 243

76. Power supply LEDs.....244

77. Display panel LEDs.....245

78. Power supply unit LEDs..... 245

79. LEDs on drives and secondary expansion modules.....246

80. Expansion canister and SAS port LEDs 248

81. Summary of IBM Storage FlashSystem 9500 control enclosure parts.....249

82. FlashSystem expansion enclosure replaceable units.....250

83. Drive replaceable units..... 251

84. Cable and power replaceable units.....251

85. Expansion enclosure replaceable units..... 252

86. Drive replaceable units..... 253

87. Cable and power cord replaceable units.....253

88. Dimensions for rack..... 257

89. Weight capacity limits.....258

90. Dimensions for doors.....258

91. Dimensions for side covers.....258

92. Environment requirements1.....259

93. Service clearances..... 259

94. PDU specifications..... 265

95. Intelligent Switched PDU+ features.....266

96. Supported PDU power cords for the FlashSystem 9500R rack solution..... 267

97. Supported PDU power cords for PDU feature codes ECJK, ECJL, ECJP, and ECJQ with Amphenol inlet.....269

98. FlashSystem 9500R Fibre Channel switch 2 (lower) information.....270

99. FlashSystem 9500R Fibre Channel switch 1 (upper) information..... 270

100. FlashSystem 9500R PDU A management connection information..... 271

101. FlashSystem 9500R PDU B management connection information..... 271

102. Example weights of FlashSystem 9500R rack as delivered.....272

103. Power-on timing..... 302

104. Parts list..... 332

105. Parts list..... 338

Chapter 1. FlashSystem 9500

Welcome to the FlashSystem 9500 documentation, where you can find information about how to install, maintain, and use the IBM Storage FlashSystem 9500 . This product is ENERGY STAR certified. For more information, see ENERGY STAR certified storage products.

Chapter 2. Notices

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SSIC can be found at http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss.

Homologation statement

This product may not be certified in your country for connection by any means whatsoever to interfaces of public telecommunications networks. Further certification may be required by law prior to making any such connection. Contact an IBM representative or reseller for any questions.

Safety and environmental notices

Review all safety notices, environmental notices, and electronic emission notices before you install and use the product.

Suitability for telecommunication environment: This product is not intended to connect directly or indirectly by any means whatsoever to interfaces of public telecommunications networks.

To find the converted text for a caution or danger notice, complete the following steps.

1. Look for the identification number at the end of each caution notice or each danger notice. In the following examples, the numbers (C001) and (D002) are the identification numbers.

   

   CAUTION: A caution notice indicates the presence of a hazard that has the potential of causing moderate or minor personal injury. (C001)

   

   DANGER: A danger notice indicates the presence of a hazard that has the potential of causing death or serious personal injury. (D002)
2. Locate the *IBM Systems Safety Notices* document with the user publications that were provided with your system hardware.
3. Find the matching identification number in *IBM Systems Safety Notices*. Then, review the topics about the safety notices to ensure that you are in compliance.
4. (Optional) Read the multilingual safety instructions on the system website.
   a. Go to www.ibm.com/support
   b. Enter the name of your system in the Search field (for example, "IBM Storage FlashSystem 5300").
   c. Click the documentation link.

For more information on Safety and environmental notices, see Environmental and safety notices.

For more details on different notices, see the following pages:

Safety notices and labels

Review the safety notices and safety information labels before you use this product.

To view a PDF file, you need Adobe Acrobat Reader. You can download it at no charge from the Adobe website:

www.adobe.com/support/downloads/main.html

IBM Systems Safety Notices

This publication contains the safety notices for the IBM Systems products in English and other languages. Anyone who plans, installs, operates, or services the system must be familiar with and understand the safety notices. Read the related safety notices before you begin work.

Note: The *IBM System Safety Notices* document is organized into two sections. The danger and caution notices without labels are organized alphabetically by language in the "Danger and caution notices by language" section. The danger and caution notices that are accompanied with a label are organized by label reference number in the "Labels" section. You can download the most current version of *IBM System Safety Notices* at the following site: *Environmental and safety notices*.

The following notices and statements are used in IBM documents. They are listed in order of decreasing severity of potential hazards.

Danger notice definition
A special note that emphasizes a situation that is potentially lethal or extremely hazardous to people.

Caution notice definition
A special note that emphasizes a situation that is potentially hazardous to people because of some existing condition, or to a potentially dangerous situation that might develop because of some unsafe practice.

Note: In addition to these notices, labels might be attached to the product to warn of potential hazards.

Finding translated notices

Each safety notice contains an identification number. You can use this identification number to check the safety notice in each language.

To find the translated text for a caution or danger notice:

1. In the product documentation, look for the identification number at the end of each caution notice or each danger notice. In the following examples, the numbers (D002) and (C001) are the identification numbers.

   DANGER: A danger notice indicates the presence of a hazard that has the potential of causing death or serious personal injury. (D002)

   CAUTION: A caution notice indicates the presence of a hazard that has the potential of causing moderate or minor personal injury. (C001)
2. After you download the *IBM System Safety Notices* document, open it.
3. Under the language, find the matching identification number. Review the topics about the safety notices to ensure that you are in compliance.

Caution notices for the system

Ensure that you understand the caution notices for the system.

Use the reference numbers in parentheses at the end of each notice (for example, D005) to find the matching translated notice in *IBM Systems Safety Notices*.

CAUTION: The battery contains lithium. To avoid possible explosion, do not burn or charge the battery.

Do not throw or immerse into water, heat to more than 100°C (212°F), repair or disassemble. (C003)

CAUTION:

≥ 18 kg (39.7 lb) ≥ 33.6 kg (74 lb) ≥ 46.3 kg (102 lb)

The weight of this part or unit is between 32 and 55 kg (70.5 and 121.2 lb). It takes three persons to safely lift this part or unit. (C010)

CAUTION: To avoid personal injury, before lifting this unit, remove all appropriate subassemblies per instructions to reduce the system weight. (C012)

CAUTION: CAUTION regarding IBM provided VENDOR LIFT TOOL:

- Operation of LIFT TOOL by authorized personnel only
- LIFT TOOL intended for use to assist, lift, install, remove units (load) up into rack elevations. It is not to be used loaded transporting over major ramps nor as a replacement for such designated tools like pallet jacks, walkies, fork trucks and such related relocation practices. When this is not practicable, specially trained persons or services must be used (for instance, riggers or movers). Read and completely understand the contents of LIFT TOOL operator's manual before using.
- Read and completely understand the contents of LIFT TOOL operator's manual before using. Failure to read, understand, obey safety rules, and follow instructions may result in property damage and/or personal injury. If there are questions, contact the vendor's service and support. Local paper manual must remain with machine in provided storage sleeve area. Latest revision manual available on vendor's website.
- Test verify stabilizer brake function before each use. Do not over-force moving or rolling the LIFT TOOL with stabilizer brake engaged.
- Do not raise, lower or slide platform load shelf unless stabilizer (brake pedal jack) is fully engaged. Keep stabilizer brake engaged when not in use or motion.
- Do not move LIFT TOOL while platform is raised, except for minor positioning.
- Do not exceed rated load capacity. See LOAD CAPACITY CHART regarding maximum loads at center versus edge of extended platform.
- Only raise load if properly centered on platform. Do not place more than 200 lb (91 kg) on edge of sliding platform shelf also considering the load's center of mass/gravity (CoG).
- Do not corner load the platform tilt riser accessory option. Secure platform riser tilt option to main shelf in all four (4x) locations with provided hardware only, prior to use. Load objects are designed to slide on/off smooth platforms without appreciable force, so take care not to push or lean. Keep riser tilt option flat at all times except for final minor adjustment when needed.
- Do not stand under overhanging load.
- Do not use on uneven surface, incline or decline (major ramps).
- Do not stack loads.
- Do not operate while under the influence of drugs or alcohol.
- Do not support ladder against LIFT TOOL.
- Tipping hazard. Do not push or lean against load with raised platform.
- Do not use as a personnel lifting platform or step. No riders.
- Do not stand on any part of lift. Not a step.
- Do not climb on mast.
- Do not operate a damaged or malfunctioning LIFT TOOL machine.
- Crush and pinch point hazard below platform. Only lower load in areas clear of personnel and obstructions. Keep hands and feet clear during operation.
- No Forks. Never lift or move bare LIFT TOOL MACHINE with pallet truck, jack or fork lift.

- Mast extends higher than platform. Be aware of ceiling height, cable trays, sprinklers, lights, and other overhead objects.
- Do not leave LIFT TOOL machine unattended with an elevated load.
- Watch and keep hands, fingers, and clothing clear when equipment is in motion.
- Turn Winch with hand power only. If winch handle cannot be cranked easily with one hand, it is probably over-loaded. Do not continue to turn winch past top or bottom of platform travel. Excessive unwinding will detach handle and damage cable. Always hold handle when lowering, unwinding. Always assure self that winch is holding load before releasing winch handle.
- A winch accident could cause serious injury. Not for moving humans. Make certain clicking sound is heard as the equipment is being raised. Be sure winch is locked in position before releasing handle. Read instruction page before operating this winch. Never allow winch to unwind freely. Freewheeling will cause uneven cable wrapping around winch drum, damage cable, and may cause serious injury. (C048)

CAUTION: Removing components from the upper positions in the rack cabinet improves rack stability during a relocation. Follow these general guidelines whenever you relocate a populated rack cabinet within a room or building.

- Reduce the weight of the rack cabinet by removing equipment starting at the top of the rack cabinet. When possible, restore the rack cabinet to the configuration of the rack cabinet as you received it. If this configuration is not known, you must observe the following precautions.
  - Remove all devices in the 32U position and above.
  - Ensure that the heaviest devices are installed in the bottom of the rack cabinet.
  - Ensure that there are no empty U-levels between devices installed in the rack cabinet below the 32U level.
- If the rack cabinet you are relocating is part of a suite of rack cabinets, detach the rack cabinet from the suite.
- If the rack cabinet you are relocating was supplied with removable outriggers they must be reinstalled before the cabinet is relocated.
- Inspect the route that you plan to take to eliminate potential hazards.
- Verify that the route that you choose can support the weight of the loaded rack cabinet. Refer to the documentation that comes with your rack cabinet for the weight of a loaded rack cabinet.
- Verify that all door openings are at least 760 x 230 mm (30 x 80 in.).
- Ensure that all devices, shelves, drawers, doors, and cables are secure.
- Ensure that the four leveling pads are raised to their highest position.
- Ensure that there is no stabilizer bracket installed on the rack cabinet during movement.
- Do not use a ramp inclined at more than 10 degrees.
- When the rack cabinet is in the new location, complete the following steps:
  - Lower the four leveling pads.
  - Install stabilizer brackets on the rack cabinet.
  - If you removed any devices from the rack cabinet, repopulate the rack cabinet from the lowest position to the highest position.
- If a long-distance relocation is required, restore the rack cabinet to the configuration of the rack cabinet as you received it. Pack the rack cabinet in the original packaging material, or equivalent. Also lower the leveling pads to raise the casters off the pallet and bolt the rack cabinet to the pallet. (R002)

Danger notices for the system

Ensure that you are familiar with the danger notices for your system.

Use the reference numbers in parentheses at the end of each notice (for example, D005) to find the matching translated notice in *IBM Systems Safety Notices*.

DANGER: When working on or around the system, observe the following precautions:

Electrical voltage and current from power, telephone, and communication cables are hazardous. To avoid a shock hazard: If IBM supplied the power cord(s), connect power to this unit only with the IBM provided power cord. Do not use the IBM provided power cord for any other product. Do not open or service any power supply assembly. Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.

-  The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords. For AC power, disconnect all power cords from their AC power source. For racks with a DC power distribution panel (PDP), disconnect the customer's DC power source to the PDP.
- When connecting power to the product ensure all power cables are properly connected. For racks with AC power, connect all power cords to a properly wired and grounded electrical outlet. Ensure that the outlet supplies proper voltage and phase rotation according to the system rating plate. For racks with a DC power distribution panel (PDP), connect the customer's DC power source to the PDP. Ensure that the proper polarity is used when attaching the DC power and DC power return wiring.
- Connect all power cords to a properly wired and grounded electrical outlet. Ensure that the outlet supplies proper voltage and phase rotation according to the system rating plate.
- Connect any equipment that will be attached to this product to properly wired outlets.
- When possible, use one hand only to connect or disconnect signal cables.
- Never turn on any equipment when there is evidence of fire, water, or structural damage.
- Do not attempt to switch on power to the machine until all possible unsafe conditions are corrected.
- When performing a machine inspection: Assume that an electrical safety hazard is present. Perform all ontinuity, grounding, and power checks specified during the subsystem installation procedures to ensure that the machine meets safety requirements. Do not attempt to switch power to the machine until all possible unsafe conditions are corrected. Before you open the device covers, unless instructed otherwise in the installation and configuration procedures: Disconnect the attached AC power cords, turn off the applicable circuit breakers located in the rack power distribution panel (PDP), and disconnect any telecommunications systems, networks, and modems.
- Disconnect the attached power cords, telecommunications systems, networks, and modems before you open the device covers, unless instructed otherwise in the installation and configuration procedures.
- Connect and disconnect cables as described in the following procedures when installing, moving, or opening covers on this product or attached devices.

  To disconnect:

  1. Turn off everything (unless instructed otherwise).
  2. Remove the power cords from the outlets.
  3. Remove the signal cables from the connectors.
  4. Remove all cables from the devices.

  To connect:

  1. Turn off everything (unless instructed otherwise).

2. Attach all cables to the devices.
3. Attach the signal cables to the connectors.
4. Attach the power cords to the outlets.
5. Turn on the devices.

- Sharp edges, corners and joints might be present in and around the system. Use care when handling equipment to avoid cuts, scrapes and pinching. (D005)

DANGER: Heavy equipment–personal injury or equipment damage might result if mishandled. (D006)

DANGER: Serious injury or death can occur if loaded lift tool falls over or if a heavy load falls off the lift tool. Always completely lower the lift tool load plate and properly secure the load on the lift tool before moving or using the lift tool to lift or move an object. (D010)

DANGER: Racks with a total weight of > 227 kg (500 lb.), Use Only Professional Movers! (R003)

DANGER: Do not transport the rack via fork truck unless it is properly packaged, secured on top of the supplied pallet. (R004)

DANGER:

Main Protective Earth (Ground):

This symbol is marked on the frame of the rack.

The PROTECTIVE EARTHING CONDUCTORS should be terminated at that point. A recognized or certified closed loop connector (ring terminal) should be used and secured to the frame with a lock washer using a bolt or stud. The connector should be properly sized to be suitable for the bolt or stud, the locking washer, the rating for the conducting wire used, and the considered rating of the breaker. The intent is to ensure the frame is electrically bonded to the PROTECTIVE EARTHING CONDUCTORS. The hole that the bolt or stud goes into where the terminal conductor and the lock washer contact should be free of any non-conductive material to allow for metal to metal contact. All PROTECTIVE EARTHING CONDUCTORS should terminate at this main protective earthing terminal or at points marked with . (R010)

Special caution and safety notices

This information describes special safety notices that apply to the system.

These notices are in addition to the standard safety notices that are supplied; they address specific issues that are relevant to the equipment provided.

General safety

When you service the IBM Storage FlashSystem 5300, follow general safety guidelines.

CAUTION: The weight of the enclosure exceeds 18kgs, lift the enclosure after referring label

Use the following general rules to ensure safety to yourself and others.

- Observe good housekeeping in the area where the devices are kept during and after maintenance.
- Follow the guidelines when lifting any heavy object:

1. Ensure that you can stand safely without slipping.
2. Distribute the weight of the object equally between your feet.
3. Use a slow lifting force. Never move suddenly or twist when you attempt to lift.
4. Lift by standing or by pushing up with your leg muscles; this action removes the strain from the muscles in your back. *Do not attempt to lift any objects that weigh more than 18 kg (40 lb) or objects that you think are too heavy for you.*

- Do not perform any action that causes a hazard or makes the equipment unsafe.
- Before you start the device, ensure that other personnel are not in a hazardous position.
- Place removed covers and other parts in a safe place, away from all personnel, while you are servicing the unit.
- Keep your tool case away from walk areas so that other people cannot trip over it.
- Do not wear loose clothing that can be trapped in the moving parts of a device. Ensure that your sleeves are fastened or rolled up above your elbows. If your hair is long, fasten it.
- Insert the ends of your necktie or scarf inside clothing or fasten it with a nonconducting clip, approximately 8 cm (3 in.) from the end.
- Do not wear jewelry, chains, metal-frame eyeglasses, or metal fasteners for your clothing.

  Remember: Metal objects are good electrical conductors.
- Wear safety glasses when you are hammering, drilling, soldering, cutting wire, attaching springs, using solvents, or working in any other conditions that might be hazardous to your eyes.
- After service, reinstall all safety shields, guards, labels, and ground wires. Replace any safety device that is worn or defective.
- Reinstall all covers correctly after you have finished servicing the unit.

Inspecting the system for unsafe conditions

Use caution when you are working in any potential safety hazardous situation that is not covered in the safety checks. If unsafe conditions are present, determine how serious the hazards are and whether you can continue before you correct the problem.

Before you begin

Before you start the safety inspection, make sure that the power is off, and that the power cord is disconnected.

About this task

Each device has the required safety items that are installed to protect users and support personnel from injury. Only those items are addressed.

Important: Good judgment must also be used to identify potential safety hazards due to the attachment of non-IBM features or options that are not covered by this inspection guide.

If any unsafe conditions are present, you must determine how serious the apparent hazard might be and whether you can continue without first correcting the problem. For example, consider the following conditions and their potential safety hazards:

Electrical hazards (especially primary power)
Primary voltage on the frame can cause serious or lethal electrical shock.

Explosive hazards
A damaged CRT face or a bulging capacitor can cause serious injury.

Mechanical hazards
Loose or missing items (for example, nuts and screws) can cause serious injury.

To inspect each node for unsafe conditions, use the following steps. If necessary, see any suitable safety publications.

Procedure

1. Turn off the system and disconnect the power cord.
2. Check the frame for damage (loose, broken, or sharp edges).
3. Check the power cables by using the following steps:
   a) Ensure that the third-wire ground connector is in good condition. Use a meter to check that the third-wire ground continuity is 0.1 ohm or less between the external ground pin and the frame ground.
   b) Ensure that the power cord is the appropriate type, as specified in the parts listings.
   c) Ensure that the insulation is not worn or damaged.
4. Check for any obvious nonstandard changes, both inside and outside the unit. Use good judgment about the safety of any such changes.
5. Check inside the node for any obvious unsafe conditions, such as metal particles, contamination, water or other fluids, or marks of overheating, fire, or smoke damage.
6. Check for worn, damaged, or pinched cables.
7. Ensure that the voltage that is specified on the product-information label matches the specified voltage of the electrical power outlet. If necessary, verify the voltage.
8. Inspect the power-supply assemblies and check that the fasteners (screws or rivets) in the cover of the power-supply unit are not removed or disturbed.
9. Check the grounding of the network switch before you connect the system to the storage area network (SAN).

Checking external devices

Ensure that you complete an external device check before you install or service the system.

Procedure

To conduct an external device check, complete the following steps.

1. Verify that all external covers are present and are not damaged.
2. Ensure that all latches and hinges are in the correct operating condition.
3. Check the power cords for damage.
4. Check the external signal cables for damage.
5. Check the cover for sharp edges, damage, or alterations that expose the internal parts of the device.
6. Correct any problems that you find.

Checking internal devices

Ensure that you complete an internal device check before you install or service your system.

About this task

To conduct the internal device check, use the following steps.

Procedure

1. Check for any non-IBM changes that were made to the device.
2. Check the condition of the inside of the device for any metal or other contaminants, or any indications of water, other fluid, fire, or smoke damage.
3. Check for any obvious mechanical problems, such as loose components.
4. Check any exposed cables and connectors for wear, cracks, or pinching.

Handling static-sensitive devices

Ensure that you understand how to handle devices that are sensitive to static electricity.

Attention: Static electricity can damage electronic devices and your system. To avoid damage, keep static-sensitive devices in their static-protective bags until you are ready to install them.

To reduce the possibility of electrostatic discharge, observe the following precautions:

- Limit your movement. Movement can cause static electricity to build up around you.
- Handle the device carefully, holding it by its edges or frame.
- Do not touch solder joints, pins, or exposed printed circuitry.
- Do not leave the device where others can handle and possibly damage the device.
- While the device is still in its antistatic bag, touch it to an unpainted metal part of the system unit for at least 2 seconds. (This action removes static electricity from the package and from your body).
- Remove the device from its package and install it directly into your system, without putting it down. If it is necessary to put the device down, place it onto its static-protective bag. (If your device is an adapter, place it component-side up.) Do not place the device onto the cover of the system or onto a metal table.
- Take additional care when you handle devices during cold weather. Indoor humidity tends to decrease in cold weather, causing an increase in static electricity.

Sound pressure

Attention: Depending on local conditions, the sound pressure can exceed 85 dB(A) during service operations. In such cases, wear appropriate hearing protection.

Environmental notices

This information contains all the required environmental notices for IBM Systems products in English and other languages.

The *IBM Systems Environmental Notices* information includes statements on limitations, product information, product recycling and disposal, battery information, flat panel display, refrigeration and water-cooling systems, external power supplies, and safety data sheets.

Electromagnetic compatibility Class A notices

The following Class A statements apply to IBM products and their features unless designated as electromagnetic compatibility (EMC) Class B in the feature information.

When attaching a monitor to the equipment, you must use the designated monitor cable and any interference suppression devices that are supplied with the monitor.

Canada Notice

CAN ICES-3 (A)/NMB-3(A)

European Community and Morocco Notice

This product is in conformity with the protection requirements of Directive 2014/30/EU of the European Parliament and of the Council on the harmonization of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the product, including the fitting of non-IBM option cards.

This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

Warning: This equipment is compliant with Class A of CISPR 32. In a residential environment this equipment may cause radio interference.

Germany Notice

Deutschsprachiger EU Hinweis: Hinweis für Geräte der Klasse A EU-Richtlinie zur Elektromagnetischen Verträglichkeit

Dieses Produkt entspricht den Schutzanforderungen der EU-Richtlinie 2014/30/EU zur Angleichung der Rechtsvorschriften über die elektromagnetische Verträglichkeit in den EU-Mitgliedsstaatenund hält die Grenzwerte der EN 55032 Klasse A ein.

Um dieses sicherzustellen, sind die Geräte wie in den Handbüchern beschrieben zu installieren und zu betreiben. Des Weiteren dürfen auch nur von der IBM empfohlene Kabel angeschlossen werden. IBM übernimmt keine Verantwortung für die Einhaltung der Schutzanforderungen, wenn das Produkt ohne Zustimmung von IBM verändert bzw. wenn Erweiterungskomponenten von Fremdherstellern ohne Empfehlung von IBM gesteckt/eingebaut werden.

EN 55032 Klasse A Geräte müssen mit folgendem Warnhinweis versehen werden:
"Warnung: Dieses ist eine Einrichtung der Klasse A. Diese Einrichtung kann im Wohnbereich Funk-Störungen verursachen; in diesem Fall kann vom Betreiber verlangt werden, angemessene Maßnahmen zu ergreifen und dafür aufzukommen."

Deutschland: Einhaltung des Gesetzes über die elektromagnetische Verträglichkeit von Geräten
Dieses Produkt entspricht dem "Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG)." Dies ist die Umsetzung der EU-Richtlinie 2014/30/EU in der Bundesrepublik Deutschland.

Zulassungsbescheinigung laut dem Deutschen Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG) (bzw. der EMC Richtlinie 2014/30/EU) für Geräte der Klasse A

Dieses Gerät ist berechtigt, in Übereinstimmung mit dem Deutschen EMVG das EG-Konformitätszeichen - CE - zu führen.

Verantwortlich für die Einhaltung der EMV-Vorschriften ist der Hersteller:

International Business Machines Corp.
New Orchard Road
Armonk, New York 10504
Tel: 914-499-1900

Der verantwortliche Ansprechpartner des Herstellers in der EU ist:

IBM Deutschland GmbH
Technical Relations Europe, Abteilung M456
IBM-Allee 1, 71139 Ehningen, Germany
Tel: +49 800 225 5426
e-mail: Halloibm@de.ibm.com

Generelle Informationen:

Das Gerät erfüllt die Schutzanforderungen nach EN 55024 und EN 55032 Klasse A.

Japan Electronics and Information Technology Industries Association (JEITA) Notice

（一社）電子情報技術産業協会　高調波電流抑制対策実施
要領に基づく定格入力電力値：IBM Documentationの各製品の仕様ページ参照

This statement applies to products less than or equal to 20 A per phase.

高調波電流規格 JIS C 61000-3-2 適合品

This statement applies to products greater than 20 A, single phase.

高調波電流規格 JIS C 61000-3-2 準用品

本装置は、「高圧又は特別高圧で受電する需要家の高調波抑制対策ガイドライン」対象機器（高調波発生機器）です。
- 回路分類：６（単相、ＰＦＣ回路付）
- 換算係数：０

This statement applies to products greater than 20 A per phase, three-phase.

高調波電流規格 JIS C 61000-3-2 準用品

本装置は、「高圧又は特別高圧で受電する需要家の高調波抑制対策ガイドライン」対象機器（高調波発生機器）です。
- 回路分類：５（３相、ＰＦＣ回路付）
- 換算係数：０

Japan Voluntary Control Council for Interference (VCCI) Notice

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 ー A

Korea Notice

이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

People's Republic of China Notice

警告:在居住环境中,运行此设备可能会造成无线电干扰。

Russia Notice

ВНИМАНИЕ! Настоящее изделие относится к классу А.
В жилых помещениях оно может создавать
радиопомехи, для снижения которых необходимы
дополнительные меры

Saudi Arabia Notice

قد يتسبب هذا المنتج في حدوث تداخل إذا تم استخدامه في المناطق السكنية.

ويجب تجنب هذا الاستخدام ما لم يتخذ المستخدم تدابير خاصة لتقليل الانبعاثات الكهرومغناطيسية لمنع التداخل مع استقبال البث الإذاعي والتلفزيوني.

SASO CISPR 32 تحذير: هذا الجهاز متوافق مع الفئة أ من

في البيئة السكنية، قد يتسبب هذا الجهاز في حدوث تداخل لاسلكي.

Taiwan Notice

CNS 13438

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。

CNS 15936

警告：為避免電磁干擾，本產品不應安裝或使用於住宅環境。

IBM Taiwan Contact Information:

United Kingdom Notice

This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

United States Federal Communications Commission (FCC) Notice

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 not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. IBM is not responsible for any radio or television interference caused by using other than

recommended cables and connectors, or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device might not cause harmful interference, and (2) this device must accept any interference received, including interference that might cause undesired operation.

Responsible Party:
International Business Machines Corporation
New Orchard Road
Armonk, NY 10504
Contact for FCC compliance information only: fccinfo@us.ibm.com

Electromagnetic compatibility Class B notices

The following Class B statements apply to features designated as electromagnetic compatibility (EMC) Class B in the feature installation information.

When attaching a monitor to the equipment, you must use the designated monitor cable and any interference suppression devices supplied with the monitor.

Canada Notice

CAN ICES-3 (B)/NMB-3(B)

European Community and Morocco Notice

This product is in conformity with the protection requirements of Directive 2014/30/EU of the European Parliament and of the Council on the harmonization of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the product, including the fitting of non-IBM option cards.

Germany Notice

Deutschsprachiger EU Hinweis: Hinweis für Geräte der Klasse B EU-Richtlinie zur Elektromagnetischen Verträglichkeit

Dieses Produkt entspricht den Schutzanforderungen der EU-Richtlinie 2014/30/EU zur Angleichung der Rechtsvorschriften über die elektromagnetische Verträglichkeit in den EU-Mitgliedsstaatenund hält die Grenzwerte der EN 55022/ EN 55032 Klasse B ein.

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Zulassungsbescheinigung laut dem Deutschen Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG) (bzw. der EMC Richtlinie 2014/30/EU) für Geräte der Klasse B

Dieses Gerät ist berechtigt, in Übereinstimmung mit dem Deutschen EMVG das EG-Konformitätszeichen - CE - zu führen.

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Generelle Informationen:

Das Gerät erfüllt die Schutzanforderungen nach EN 55024 und EN 55032 Klasse B

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Chapter 3. System overview

IBM Storage FlashSystem 9500 combines IBM FlashCore® Modules, NVMe architecture, and AI-powered features for unrivalled performance.

Part of the FlashSystem family, the IBM Storage FlashSystem 9500 delivers extreme speed and simplicity for the most demanding enterprise workloads, packaged in a 4U enclosure. IBM Storage FlashSystem 9500 is also available as a FlashSystem 9500R.

Figure 1. Front view of the control enclosure

Figure 2. Rear view of the control enclosure

Table 1. IBM Storage FlashSystem 9500 Models		
Machine Type - Model	**Description**	**Minimum Software Level**
4983-AH8	IBM Storage FlashSystem 9500 controller with Expert Care	8.6.0
4666-AH8	IBM Storage FlashSystem 9500 controller	8.5.0
4666-UH8	IBM Storage FlashSystem 9500 controller – Utility model	8.5.0
4983-AFF	2U24 All-Flash Expansion with Expert Care	8.6.0
4666-AFF	2U24 All-Flash Expansion	8.5.0
4983-A9F	5U92 All-Flash Expansion with Expert Care	8.6.0
4666-A9F	5U92 All-Flash Expansion	8.5.0

IBM Storage Virtualize software

IBM Storage FlashSystem 9500 runs IBM Storage Virtualize which provides the following functions for the host systems that attach to the system:

- A single pool of storage
- Logical unit virtualization
- Management of logical volumes

The software also provides the following functions:

- Replication:
  - Simplify data management by automating configuration tasks.
  - Ensure seamless continuity while maintaining high throughput and low latency to applications.
- Data reduction:
  - Hardware compression with FlashCore Modules (FCM)
  - Thin-provisioned logical volumes
  - Data reduction pool with deduplication and compression
- Ransomware threat detection enhanced with FlashCore Module 4 computational storage assists.
- High-performance Distributed RAID for redundancy and fast rebuild
- Large scalable cache
- Easy to use management and automation that is consistent across the Storage Virtualize portfolio, including RestAPI, Ansible Playbooks, CSI integration, VMWare integration, and a modern Graphical User Interface (GUI).

For more information on IBM Storage Virtualize software, see the relevant IBM Documentation.

Control Enclosure

IBM Storage FlashSystem 9500 comprises a 4U Rack-Unit (4U) Control enclosure, which contains:

- 48 slots for NVMe Flash devices (front)
- Two Node Canisters
- Four Power Supplies.

The system can be expanded with the addition of SAS-based Expansion Enclosures.

NVMe Flash Devices

IBM Storage FlashSystem 9500 supports the use of IBM FlashCore Modules, with inbuilt hardware compression and computational storage assists. The system also supports the use of Industry-Standard Flash Drives.

Note: Only drives that are sold as system options are supported. For more information, see IBM Sales Manual and search for "4983-AF8 Sales Manual".

Highly Available Architecture

IBM Storage FlashSystem 9500 implements an Active-Active architecture, with the two Node Canisters forming a redundant I/O Group. Because data volumes are served by both node canisters, the volume remains available if one node canister fails or is taken offline.

Node canisters contain the systems CPUs, memory, backup batteries, and Network Attachment adapters.

Flexible Network Attachment

IBM Storage FlashSystem 9500 supports a range of Network Attachment adapter features. These adapters are housed in removable Adapter Cages, which allow removal or replacement of adapters without having to remove an entire Node Canister from the system.

The following adapter types are supported by the system:

Table 2. Adapter types

Adapter Type	Protocols supported	Minimum or maximum per node canister	Minimum software level
Quad-port 64 Gbps Fibre Channel	SCSI, FC-NVMe	0 - 3	8.6.0
Quad-port 32 Gbps Fibre Channel	SCSI, FC-NVMe	0 - 6	8.5.0
Dual-port 100 Gbps Ethernet	iSCSI, RoCE, NVMe/TCP	0 – 3 (8.5.0) 0 – 6 (8.6.0)	8.5.0
Dual-port 25 Gbps Ethernet (RoCE)	iSCSI, RoCE, NVMe/TCP	0 – 5 (8.5.0) 0 – 6 (8.6.0)	8.5.0
Dual-port 25 Gbps Ethernet (iWARP)	iSCSI, iWARP (Replication/High availability)	0 – 5 (8.5.0) 0 – 6 (8.6.0)	8.5.0
Dual-port 12 Gbps SAS Expansion	SAS (expansion)	0 - 1	8.5.0

In addition, each canister has two on-board 1 Gbps Ethernet ports that are used for system management.

Power Supplies and Battery Backup

IBM Storage FlashSystem 9500 has four redundant Power Supplies. The system can be powered by any two supplies (N+2 redundant).

Each Node Canister contains a pair of Battery backup units. The battery backup units are designed to allow a canister to destage its cache and metadata in an unscheduled power-down event.

Enterprise Warranty and Services

IBM Storage FlashSystem 9500 is available with IBM Storage Expert Care, with several levels of support to suit different deployment models. Refer to IBM Enterprise Support and Preferred Care options for more information.

System components

For more details on the different components of the system, see the following pages:

Node canisters

Canisters are replaceable hardware units that are subcomponents of enclosures.

A *node canister* provides host interfaces, management interfaces, and interfaces to the control enclosure. The node canister in the upper enclosure bay is identified as *canister 1*. The node canister in the lower bay is identified as *canister 2*. A node canister has cache memory, internal drives to store software and logs, and the processing power to run the system's virtualizing and management software. A node canister also contains batteries that help to protect the system against data loss if a power outage occurs.

The node canisters in an enclosure combine to form a cluster, presenting as a single redundant system with a single point of control for system management and service. System management and error reporting are provided through an Ethernet interface to one of the nodes in the system, which is called the *configuration node*. The configuration node runs a web server and provides a command-line interface (CLI). The configuration node is a role that any node can take. If the current configuration node fails, a new configuration node is selected from the remaining nodes. Each node also provides a command-line interface and web interface to enable some hardware service actions.

Information about the canister can be found in the management GUI.

Figure 3. Node canister - Rear view

Boot drive and TPM

Each node canister has two externally accessible boot drives, which hold the system software and associated logs and diagnostics. The boot drives are also used to save the system state and cache data if there is an unexpected power-loss to the system or canister.

The system supports hardware root of trust and secure boot operations, which protect against unauthorized physical access to the hardware and prevents malicious software from running on the system.

The system provides secure boot by pairing the boot drive with the Trusted Platform Module (TPM). The TPM provides a secure cryptographic processor that performs verification of hardware and prevents unauthorized access to hardware and the operating system. The TPM protects secure boot to ensure that the installed code images are signed, trusted, and unchanged.

As the system boots, the TPM acquires hash values from each part of the boot (software and configuration settings) in a process that is known as measuring. If a particular set of hash values reach the right values, TPM secures and locks this information into the TPM. This process is known as sealing information into the TPM. After the information is sealed within the TPM, it can only be unsealed if the boot arrives at the

correct hash values. TPM verifies each of these hash values and unlocks the operating system only during a boot operation when these values are correct.

Batteries

Each node canister contains two redundant battery, which provide power to the canister if there is an unexpected power loss. This allows the canister to safely save system state and cached data.

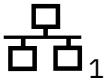
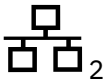
Node canister indicators

A node canister has several LED indicators, which convey information about the current state of the node.

Node canister ports

Each node canister has the following on-board ports:

Table 3. Node canister ports

Port Marking	Logical port name	Connection and Speed	Function
	Ethernet port 1	RJ45 copper, 1 Gbps	Primary Management IP Service IP
	Ethernet port 2	RJ45 copper, 1 Gbps	Secondary Management IP (optional)
	Technician port	RJ45 copper, 1 Gbps	DCHP port direct service management
	USB port	USB type A	Encryption key storage, Diagnostics collection May be disabled

Adapter cards

Each canister contains three removable adapter cages, each of which may contain up to two network adapter cards. These adapter cages connect with a single x16 PCIe connector on the main canister board, and have two connectors into which adapter cards can be inserted. If an adapter is present in the higher-numbered of the two slots in the cage, the x16 link is split into two x8 links. Otherwise, all 16 lanes are routed to the lower-numbered slot.

In the system software, adapter card slots are numbered left to right.

- Cage 1 holds adapters 1 and 2.
- Cage 2 holds adapters 5 and 6.
- Cage 3 holds adapters 7 and 8.

Adapter slots 3 and 4 are not in a removable cage, and are used for the Compression Accelerator card (fixed configuration).

Each node canister supports the following combinations of network adapters:

Table 4. Adapter Cage 1 combinations

Adapter Slot 1	Adapter Slot 2
Quad-port 64 Gbps Fibre Channel	Empty

Table 4. Adapter Cage 1 combinations (continued)	
Adapter Slot 1	**Adapter Slot 2**
Quad-port 32 Gbps Fibre Channel	Quad-port 32 Gbps Fibre Channel
Dual-port 25 Gbps Ethernet (iWARP)	Dual-port 25 Gbps Ethernet (iWARP)
Dual-port 25 Gbps Ethernet (RoCE)	Dual-port 25 Gbps Ethernet (RoCE)
Dual-port 100 Gbps Ethernet	Empty
Dual-port 100 Gbps Ethernet **Note:** This combination is supported with a minimum of 8.6.0 code.	Dual-port 100 Gbps Ethernet **Note:** This combination is supported with a minimum of 8.6.0 code.

Table 5. Adapter Cage 2 combinations	
Adapter Slot 5	**Adapter Slot 6**
Quad-port 64 Gbps Fibre Channel	Empty
Quad-port 32 Gbps Fibre Channel	Quad-port 32 Gbps Fibre Channel
Dual-port 25 Gbps Ethernet (iWARP)	Dual-port 12 Gbps SAS Expansion
Dual-port 25 Gbps Ethernet (iWARP)	Dual-port 25 Gbps Ethernet (iWARP)
Dual-port 25 Gbps Ethernet (RoCE)	Dual-port 12 Gbps SAS Expansion
Dual-port 25 Gbps Ethernet (RoCE)	Dual-port 25 Gbps Ethernet (RoCE)
Dual-port 100 Gbps Ethernet	Empty
Dual-port 100 Gbps Ethernet **Note:** This combination is supported with a minimum of 8.6.0 code.	Dual-port 100 Gbps Ethernet **Note:** This combination is supported with a minimum of 8.6.0 code.

Table 6. Adapter Cage 3 combinations	
Adapter Slot 7	**Adapter Slot 8**
Empty	Empty
Quad-port 64 Gbps Fibre Channel	Empty
Quad-port 32 Gbps Fibre Channel	Quad-port 32 Gbps Fibre Channel
Dual-port 25 Gbps Ethernet (iWARP)	Dual-port 25 Gbps Ethernet (iWARP)
Dual-port 25 Gbps Ethernet (RoCE)	Dual-port 25 Gbps Ethernet (RoCE)
Dual-port 100 Gbps Ethernet	Empty
Dual-port 100 Gbps Ethernet **Note:** This combination is supported with a minimum of 8.6.0 code.	Dual-port 100 Gbps Ethernet **Note:** This combination is supported with a minimum of 8.6.0 code.

Port Numbering

For each adapter card, ports are numbered downwards from top to bottom. Fibre Channel cards have a fixed relationship between port numbers and slot number.

Note: The cards are populated in order of slots 1, 2 followed by 7, 8 then 5, 6 to ensure best performance. The card in slots 7 and 8 will be numbered as shown even if there are not Fibre Channel adapters in slots 5 and 6.

Table 7. Port numberings

Adapter slot numbers	**1**	**2**	**5**	**6**	**7**	**8**
Fibre channel port numbers	1	5	9	13	17	21
	2	6	10	14	18	22
	3	7	11	15	19	23
	4	8	12	16	20	24

Ethernet port numbering starts with the on-board ports (1, 2) and then progresses incrementally across any installed adapter cards, starting with the leftmost slot and numbering down each adapter in turn.

Memory configurations

IBM Storage FlashSystem 9500 supports up to twenty-four 64 GB DIMMs per node, with three memory configurations supported.

Table 8. Memory configuration

Configuration	**Feature code**	**DIMMs per node**	**Memory per node**	**Best practice recommendation**
Base	ACGM	8	512 GB	Base config, ideal for < 16 drives and 1 network adapter with modest IOPS requirements
Upgrade 1	ACGN	16	1024 GB	This configuration is ideal for cache-heavy I/O Workloads and DRP or Deduplication workloads IOPs or latency and >16 drives with >1 adapter cage and/or DRP/Deduplication workloads
Upgrade 2	ACGP	24	1536 GB	This configuration is ideal for cache-heavy I/O Workloads and DRP or Deduplication workloads

For more details on the adapters, see the following pages:

Dual-port 100 Gbps Ethernet host interface adapter

The dual-port 100 Gbps Ethernet adapter provides two Ethernet port connections capable of running at 100 Gbps.

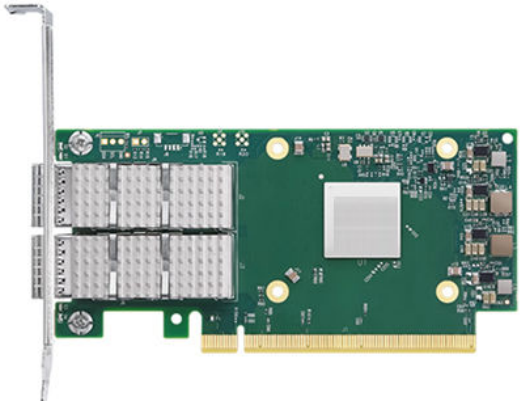


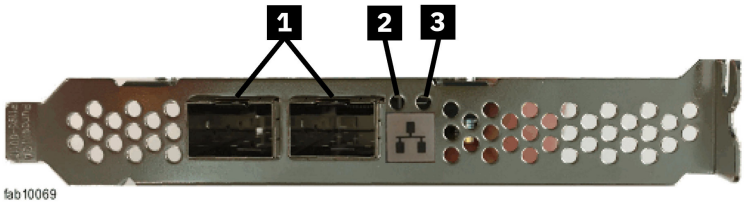
Figure 4. Dual-port 100 Gbps Ethernet host interface adapter

100 Gbps Ethernet ports can be used for:

- Host connections by using iSCSI, NVMe/TCP, or NVMe-RoCE

Connections can be made via a Ethernet switch, or as a direct connection to a host or other FlashSystem controller. Use of the NVMe-RoCE protocol requires RoCE-compatible Ethernet switches.

Ethernet ports are numbered from 1 to 2, starting from the left (horizontal placement) or top (vertical placement). Figure 2 shows ports and their indicators.



1 Ethernet port (2-port card)
2 Status LED (port 1)
3 Status LED (port 2)

Figure 5. 100 Gbps Ethernet card ports and indicators

Each port has a QSFP28 receptacle and a number of physical connection types supported:

Connection type	Supply method	Part number (examples for customer-supplied parts)
Optical Shortwave QSFP28 Module – 100 Gbps MPO (SR4)	IBM Orderable Feature	78P4988
100 Gbps DAC passive copper cable – up to 2M	Customer supplied	Mellanox MCP1600- C002E30N Cisco QSFP-100G-CU2M
Optical Shortwave QSFP28 Module – 100 Gbps LC (SRBD)	Customer supplied	Cisco SFBR-89BDDZ-CS4

Connection type	Supply method	Part number (examples for customer-supplied parts)
100 Gbps AOC active optical cable	Customer supplied	Cisco QSFP-100G-AOC5M

For more information, see “Dual-port 100 Gbps Ethernet host interface adapter ports and indicators” on page 238.

Quad-port 64 Gbps Fibre Channel adapter

The quad-port 64 Gb Fibre Channel adapter provides four Fibre Channel port connections capable of running at 64 Gbps.

The ports can also auto-negotiate to 32 Gb or 16 Gb for compatibility with slower networks.

Figure 6. Quad-port 64 Gbps Fibre Channel adapter

64 Gb Fibre Channel ports can be used for:

- Host connections by using standard Fibre Chanel (SCSI) or FC-NVMe
- Replication links
- Communications between control enclosures.

Connections can be made via a Fibre Channel switch, or as a direct connection to a host or other FlashSystem controller.

Fibre Channel ports are numbered from 1 to 4, starting from the left (horizontal placement) or top (vertical placement). Figure 2 shows ports and their indicators.

Each port has an Short-wave SFP transceiver that is installed as standard and can be connected with an LC-to-LC Fibre Channel cable. Long-wave SFP transceivers are not supported with the 64 Gbps Fibre Channel adapter.

The SFPs supported by the adapter are identified by the FRU part number that is displayed on the SFP.

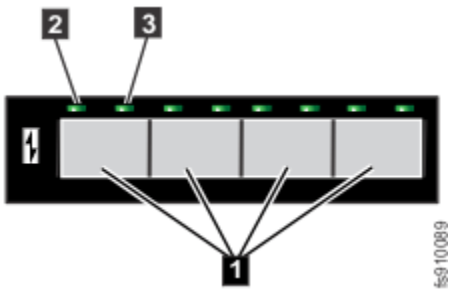


Figure 7. Fibre Channel ports and indicators

1 Fibre Channel port
2 Link-state LED (one for each port)
3 Speed-state LED (one for each port)

For more information, see “Fibre Channel port indicators” on page 236.

Quad-port 32 Gbps Fibre Channel adapter

The quad-port 32 Gbps Fibre Channel adapter provides four Fibre Channel port connections capable of running at 32 Gbps.

The ports can also auto-negotiate to 16 Gbps or 8 Gbps for compatibility with slower networks.

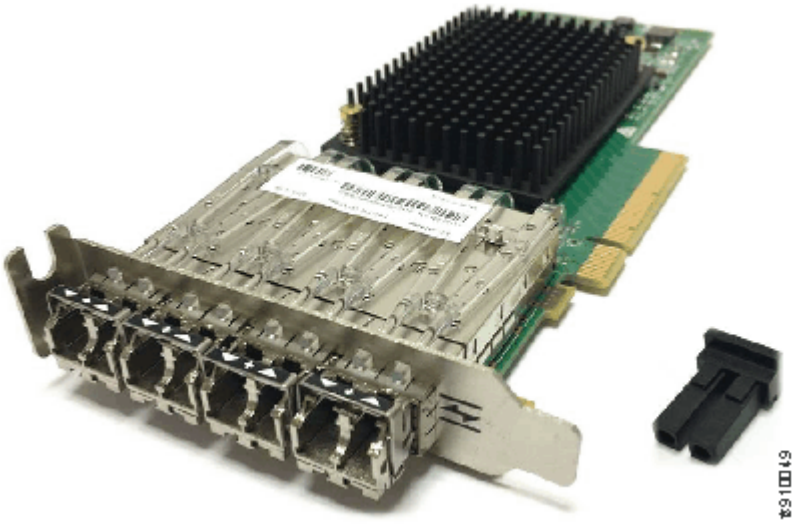


Figure 8. Quad-port 32 Gbps Fibre Channel adapter

32 Gbps Fibre Channel ports can be used for:

- Host connections by using standard Fibre Chanel (SCSI) or FC-NVMe
- Replication links
- Communications between control enclosures.

Connections can be made via a Fibre Channel switch, or as a direct connection to a host or other FlashSystem controller.

Fibre Channel ports are numbered from 1 to 4, starting from the left (horizontal placement) or top (vertical placement). Figure 2 shows ports and their indicators.

Each port has a Short-wave SFP transceiver that is installed as standard and can be connected with an LC-to-LC Fibre Channel cable. Long-wave SFP transceivers are available as an option for implementation of long-distance links.

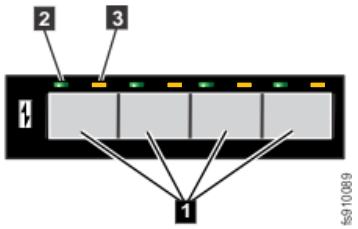


Figure 9. Fibre Channel ports and indicators

1 Fibre Channel port (4-port card)
2 Link-state LED (one for each port)
3 Speed-state LED (one for each port)

For more information, see “Fibre Channel port indicators” on page 236.

Dual-port 25 Gbps Ethernet (RoCE) host interface adapter

The dual-port 25 Gbps Ethernet (RoCE) adapter provides two Ethernet port connections capable of running at 25 Gbps.

The ports can also work at 10 Gbps when a 10 Gbps transceiver module is fitted. The ports can auto-negotiate to 10 Gbps only when non-optical transceiver modules are used.

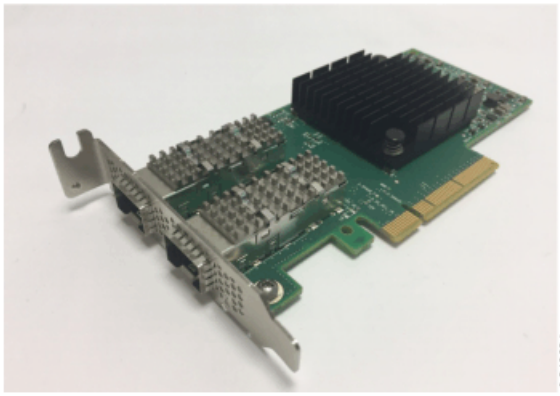


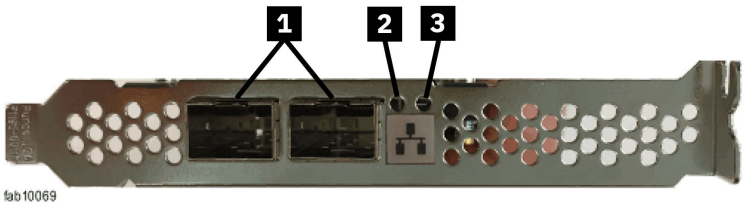
Figure 10. Dual-port 25 Gbps Ethernet (RoCE) host interface adapter

25 Gbps Ethernet ports can be used for:

- Host connections by using iSCSI, NVMe/TCP, or NVMe-RoCE
- IP Replication links

Connections can be made via a Ethernet switch, or as a direct connection to a host or other FlashSystem controller. Use of the NVMe-RoCE protocol requires RoCE-compatible Ethernet switches.

Ethernet ports are numbered from 1 to 4, starting from the left (horizontal placement) or top (vertical placement). Figure 2 shows ports and their indicators.



1 Ethernet port (2-port card)
2 Status LED (port 1)
3 Status LED (port 2)

Figure 11. Ethernet ports and indicators

Each port has an SFP+ receptacle, and a number of physical connection types supported:

Connection type	Supply method	Part number (examples for customer-supplied parts)
Optical Shortwave SFP28 Module - 25 Gb	IBM Orderable Feature	78P5153
Optical Shortwave SFP+ Module – 10 Gb	IBM Orderable Feature	78P1661
Copper 10BASE-T RJ45 Module - 10 Gb	IBM Orderable Feature	45W2412
25 Gbps DAC passive copper cable	Customer supplied	Mellanox MCP2M00-A003
QSFP28 to SFP28 passive Twinax copper cable (100 Gbps to 25 Gb)	Customer supplied	Cisco QSFP-4SFP25G-CU3MMellanox - MCP7F00-A002R
10 Gbps DAC passive copper cable	Customer supplied	Cisco SFP-H10GB-CU3m
QSFP+ to SFP+ splitter cable (40 Gbps to 10 Gb)	Customer supplied	Mellanox MC2609125-005

For more information, see “Dual-port 25 Gbps Ethernet host interface adapter ports and indicators” on page 237.

Dual-port 25 Gbps Ethernet (iWARP) host interface adapter

The dual-port 25 Gb Ethernet (iWARP) adapter provides two Ethernet port connections capable of running at 25 Gbps.

The ports can also work at 10 Gbps when a 10 Gbps transceiver module is fitted. The ports can auto-negotiate to 10 Gbps only when non-optical transceiver modules are used.

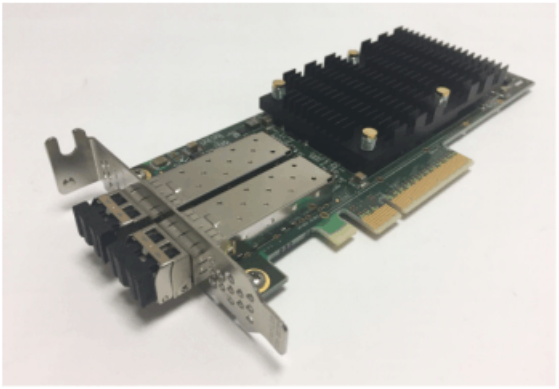


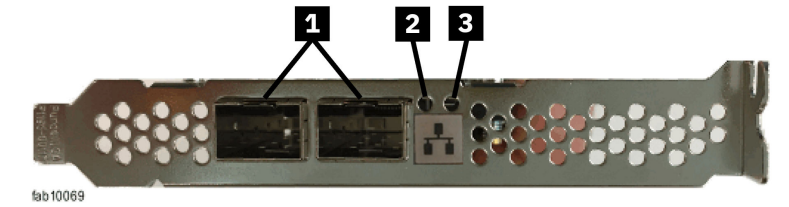
Figure 12. Dual-port 25 Gb Ethernet (iWARP) host interface adapter

25 Gb Ethernet ports can be used for:

- Host connections by using iSCSI
- IP Replication links
- Communications between control enclosures.

Connections can be made via a Ethernet switch, or as a direct connection to a host or other FlashSystem controller.

Ethernet ports are numbered from 1 to 2, starting from the left (horizontal placement) or top (vertical placement). Figure 2 shows ports and their indicators.



1 Ethernet port (2-port card)
2 Status LED (port 1)
3 Status LED (port 2)

Figure 13. Ethernet ports and indicators

Each port has an SFP+ receptacle, and a number of physical connection types supported:

Connection type	Supply method	Part number (examples for customer-supplied parts)
Optical Shortwave SFP28 Module - 25 Gb	IBM Orderable Feature	78P5153
Optical Shortwave SFP+ Module – 10 Gb	IBM Orderable Feature	78P1661
Copper 10BASE-T RJ45 Module - 10 Gb	IBM Orderable Feature	45W2412
25 Gb DAC passive copper cable	Customer supplied	Mellanox MCP2M00-A003
QSFP28 to SFP28 passive Twinax copper cable (100 Gb to 25 Gb)	Customer supplied	Cisco QSFP-4SFP25G-CU3MMellanox - MCP7F00-A002R
10 Gb DAC passive copper cable	Customer supplied	Cisco SFP-H10GB-CU3m
QSFP+ to SFP+ splitter cable (40 Gb to 10 Gb)	Customer supplied	Mellanox MC2609125-005

For more information, see “Dual-port 25 Gbps Ethernet host interface adapter ports and indicators” on page 237.

Dual-port 12 Gbps SAS expansion adapter

The 12 Gbps SAS expansion adapter allows FlashSystem NVMe controllers to connect to SAS expansion enclosures to implement a tiered storage system.

The 12 Gbps SAS expansion adapter provides two 12 Gbps SAS wide-port connections, providing a maximum bandwidth of 5 GBps per port. Each port connects to a chain of one or more expansion enclosures.

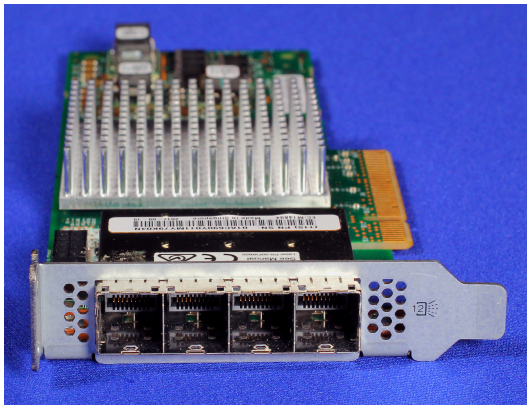


Figure 14. Dual-port 12 Gbps SAS expansion adapter

The SAS expansion adapter is implemented as a quad-port card that is numbered from 1 to 4 starting from the left (horizontal placement) or the top (vertical placement). Only ports 1 and 3 are used for expansion attach, and ports 2 and 4 are unused.

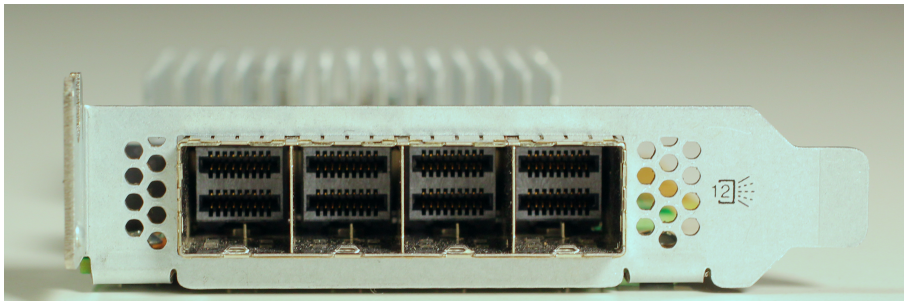


Figure 15. Dual-port 12 Gbps SAS - front view

Each port has a Mini-SAS HD connector and can be connected with a Mini-SAS HD cable of up to six meters. SAS cables are available as IBM orderable features.

Each port has indicators. For more information, see SAS expansion adapter ports and indicators page in the relevant Hardware Guide.

Batteries

Each node canister in the control enclosure caches critical data and holds state information in volatile memory.

If power to a node canister fails, the node canister uses battery power to write cache and state data to its boot drives, before performing an orderly shutdown.

Each node canister contains a redundant pair of batteries. A single battery can power the node long enough to write the configuration state and cache to the internal boot drive. Both batteries together provide enough charge capacity to handle two back-to-back power failures. This means that normally the node canister can restart I/O operations immediately after repowering without waiting to recharge the battery, or requiring any operator intervention. If several power events occur in close succession, such as battery does not have enough charge for node to save its internal state, the node remains in service until the batteries are charged sufficiently.

The battery subsystem supports a five-second ride-through capability to handle a brief AC power outage. During this time, the batteries power the node that continues to run normally servicing host I/O requests. If AC power is restored within the ride-through period, the node continues to run and does not shut down. If AC power does not return within the ride-through period, then the node stops servicing I/O and proceeds to save state data and shut down. When started, the shutdown operations run to completion even if the system power is restored during this time.

Note: Expansion canisters do not cache volume data or store state information in volatile memory. Therefore, expansion canisters do not require battery power. If AC power to both power supplies in an expansion enclosure fails, the enclosure powers off. When AC power is restored to at least one power supply, the enclosure restarts without operator intervention.

Important: Although the system is resilient to power failures and brown outs, always install the enclosures in an environment that has reliable, consistent, and required AC power. Consider uninterruptible power supply units to avoid extended interruptions to data access.

Battery management

As a battery ages, it loses capacity. The battery in the node canister lasts at least five years before it cannot hold enough charge to support a successful node shutdown.

The batteries automatically perform conditioning cycles approximately every three months to ensure accurate determination of their state of health.

When the battery capacity starts to degrade, the system posts an “EOL Warning” event for software level 8.6.3 and later. At this point, the battery subsystem still has enough capacity to be able to support an unscheduled system power-down. If a battery reports an "EOL Warning" event, replace it within approximately six months post the event.

When a battery no longer has capacity to protect against a power loss event, it reports the “EOL Fatal” event. If a battery reports an "EOL Fatal" event, the node goes offline and the battery needs replacing to allow the node to exit from Service state and come online.

If a node canister’s battery fails, that canister goes offline and reports a node error. The remaining canisterdestages its cache and runs the I/O group in “write-through” mode until its partner canister is repaired and online.

Batteries can be installed or removed from the rear of the node canister without shutting down or removing the node.

The node canister has a battery status LED, which is described in Node canister indicators.

To access information about the battery in the management GUI, select **Monitoring** > **System**. On the **System - Overview** page, click the directional arrow next to the enclosure that contains the battery module. Select **Battery Module** under **Internal Components** to display information about the battery module. To display information about the battery in the command-line interface, use the **`lsenclosurebattery`** command.

Power supply units

Power supply units (PSUs) are subcomponents of enclosures. A PSU takes electrical power from the rack Power Distribution Units (PDUs) and provides the power to the components in the enclosure.

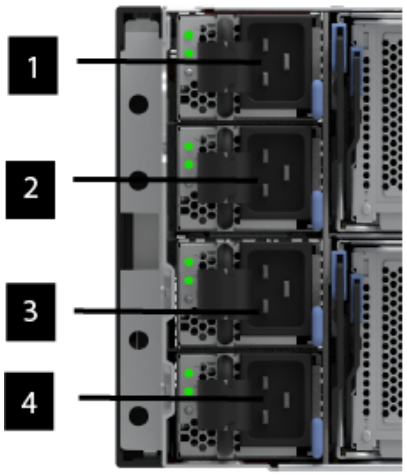
For redundancy, the IBM Storage FlashSystem control enclosure has four 2010 W PSUs that provide power to the system. If any two PSUs fail, the system can still run without any interruptions.

Power supplies in the IBM Storage FlashSystem control enclosure are 80Plus certified as “Titanium” efficiency.

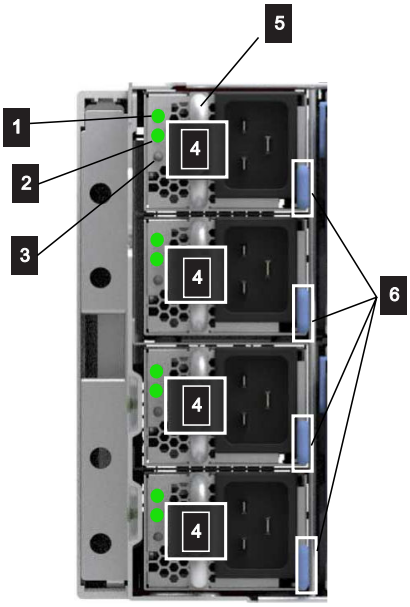
The information about the health of the PSUs can be found in the management GUI.

Figure 16 on page 36 shows the rear view of a control enclosure and identifies the location of a power supply unit and its indicators. The power supply has no power switch. A power supply is active when the power cord is connected to the power connector and power source.

When viewed from the rear, the power supplies are stacked at the left side of the control enclosure. PSU 1 is at the top continuing down to PSU 4 at the bottom.



1 Power supply 1
2 Power supply 2
3 Power supply 3
4 Power supply 4



1 AC good indicator
2 DC good indicator
3 Fault indicator
4 Hook-and-loop strap for securing the power cable
5 Power supply handle
6 Power supply release tab

Figure 16. Power supply details

Each enclosure contains fans that enable cool air inflow and outflow over each power supply unit. The warm air is ejected through the rear of each power supply. For optimal cooling, do not obstruct the warm air outflow. Ensure that all enclosure components or fillers are installed while the system is operational.

The power supply indicators provide a summary of the status of the power supply.

Drives

The IBM Storage FlashSystem 9500 system supports several drive classes and capacities.

These drives are used to create arrays that provide capacity for pools and volumes. All drives in an array are the same type and capacity.

The system supports the following drive types:

- IBM FlashCore® Modules
- Industry-standard SSD drives
- Storage-Class Memory drives

IBM Storage FlashSystem 9500 also supports SAS HDDs and SSDs in expansion enclosures.

Note: Do not replace a drive unless the drive fault LED is on or you are instructed to do so by a fix procedure.

FlashCore Modules

IBM® FlashCore Modules (FCM) are a family of high-performance flash drives in a standard 2.5-inch, 15 mm form factor.

The FlashCore Module design uses the NVMe protocol, a Gen4 U.2 interface, and high-speed NAND memory to provide high throughput and IOPS with consistent and predictable latency. The FlashCore Modules are accessible from the front of the enclosure. Hardware-based data compression, self-encryption, and T10-Diff are supported.

FlashCore Modules are available in 4.8 TB, 9.6 TB, 19.2 TB, and 38.4 TB.

Table 9. FlashCore Modules sizes and capacities

FlashCore Module	Terabytes usable	Terabytes effective
FCM 3	4.8 9.6 19.2 38.4	21.99 28.8 57.6 115.2
FCM 4	4.8 9.6 19.2 38.4	21.99 28.8 57.6 115.2

FlashCore Module 4 drives have a PCIe Gen 4 interface at all capacity points. In addition, FlashCore Module 4 drives support computational storage assists for real-time ransomware threat detection. To take advantage of this feature, RAID arrays must entirely consist of FlashCore Module 4 drives and must be created on a minimum code level of 8.6.2.

FlashCore Module 4 drives are undergoing FIPS140-3 validation.

Industry-standard NVMe SSDs

IBM Storage FlashSystem 9500 supports Industry-Standard NVMe SSDs with the following capacities: 1.92 TB, 3.84 TB, 7.68 TB, 15.36 TB, and 30.72 TB. These NVMe drives support hardware-based encryption for data at rest as well as standard T-10Diff protection.

Note: Industry-Standard SSDs do not offer the internal compression or computational storage features of FlashCore Modules.

Storage Class Memory drives

Storage Class Memory drives provide the lowest latency for high performance small capacity workloads. IBM Storage FlashSystem 9500 supports a 1.6 TB Storage Class Memory drive .

Drive plug ordering

New systems ordered from IBM with fewer than 48 drives follow a particular slot usage pattern. If more drives are installed later, continuing with the same plug ordering pattern ensures optimum system performance.

Any drive slot without a drive in it should be fitted with a Drive Blank to maintain correct airflow impedance.

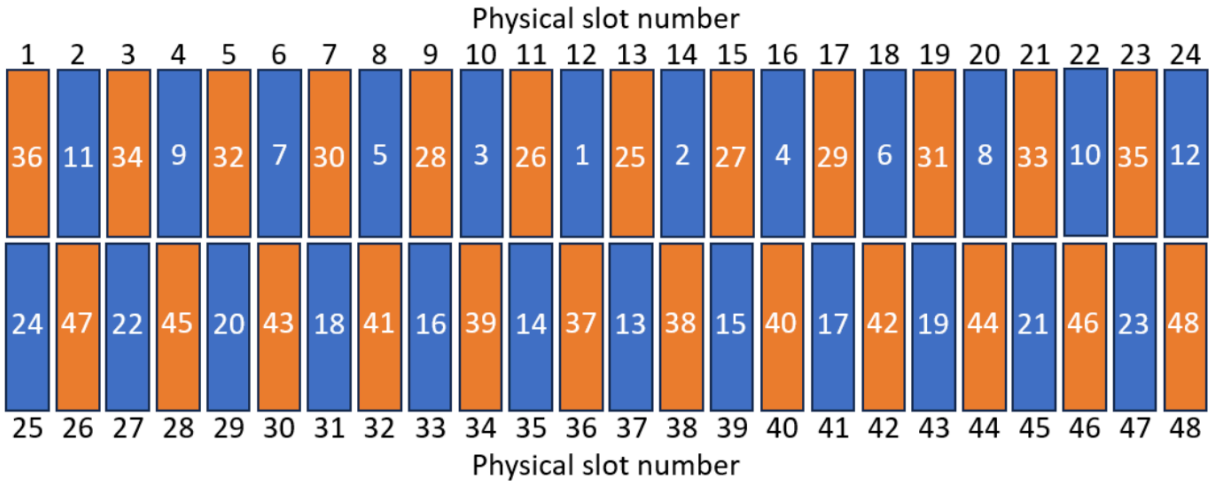


Figure 17. IBM Storage FlashSystem 9500 preferred slot plug ordering pattern

Note: In figure, the numbers inside the drive slots denote the preferred plug order, where 1 is the first drive that is plugged and 48 is the last.

Software feature limits

FlashSystem 9500 runs the IBM Storage Virtualize software stack to provide its rich storage functionality. There are no software feature limits on this product.

Chapter 4. Expansion enclosures

An IBM Storage FlashSystem 9500 can be expanded beyond the capacity in the control enclosure by using expansion enclosures. This can be used to implement a tiered storage system.

The system supports the following expansion enclosures:

Table 10. IBM Storage FlashSystem 9500 expansion enclosure models

Machine Type - Model	Description	Minimum software level
4983-AFF	2U24 All-Flash Expansion with Expert Care	8.6.0
4666-AFF	2U24 All-Flash Expansion	8.5.0
4983-A9F	5U92 All-Flash Expansion with Expert Care	8.6.0
4666-A9F	5U92 All-Flash Expansion	8.5.0

The system supports specific combinations of SAS expansion enclosures, based on the capacity of each of the enclosures.

High-density enclosures and standard-density enclosures can be supported within a chain, based on the following rules:

- A chain can have any combination of expansions up to 6 rack units (6U) of space.
- Standard-density expansion enclosure are 2U each.
- High-density expansion enclosures are 5U each.

The following table describes the valid combinations of expansion enclosures based on these rules:

Table 11. Valid combinations of expansion enclosures per SAS chain

Expansion enclosures types	Valid combinations	
5U expansion enclosures	0	1
2U expansion enclosures	0-3	0

Supported Drives for IBM Storage FlashSystem 9500 expansion enclosures

The following tables provide the list of supported drives for IBM Storage FlashSystem 9500 SAS expansion enclosures.

All drives are dual-port and hot-swappable. Drives of the same form factor and connector type can be intermixed within an enclosure, however an Array must use drives of the same type.

Table 12. Supported drives, 2U24 Expansion enclosure

Drive type	Capacities supported
2.5 inch Flash drive (SAS)	1.92 TB, 3,84 TB, 7.68 TB, 15.36 TB, 30.72 TB

Table 13. Supported drives, 5U92 Expansion enclosure

Drive type	Capacities supported
3.5 inch Flash drive (SAS)	1.92 TB, 3,84 TB, 7.68 TB, 15.36 TB, 30.72 TB

For more details on the expansion enclosures, see the following pages:

2U Expansion enclosures

Expansion enclosures provide extra drives that can be managed by the system.

The 2U SAS expansion enclosure has two versions with support for either 24 small form factor (SFF) or 12 large form factor (LFF) SAS drives in a compact 2U footprint.

Figure 18. Front view of an 2U12 expansion enclosure

Figure 19. Front view of an 2U24 expansion enclosure

Note: IBM FlashSystem 9500 only supports the 2U24 SFF variant of the 2U expansion enclosure.

The front of the enclosure provides access to the hot-pluggable drive bays (either 12 or 24), and an indicator panel that provides high-level status.

Figure 20 on page 41 shows the locations of the expansion canisters and the two power supply units in the rear of the expansion enclosure.

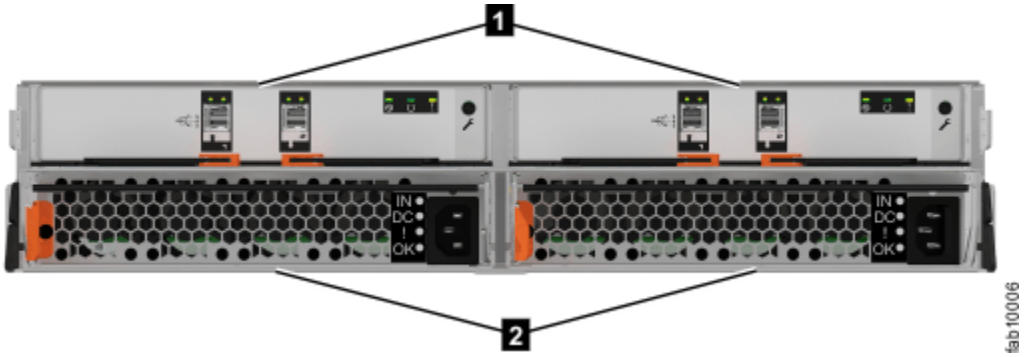


Figure 20. Rear view of an expansion enclosure

1 Expansion canisters
2 Power supply units

The rear of the enclosure provides access to two expansion canisters, and two dual-redundant power supplies.

Each expansion canister has two Wide-SAS ports: the left port is for upstream connection (toward the controller), and the right port is for downstream connection (to more expansion enclosures).

Both expansion canisters can access all the drives in the expansion enclosure, and so provide a redundant path to data.

The Power Supply Units (PSUs) in the 2U expansion enclosure are combined power and cooling units, housing the main cooling fans for the enclosure. Therefore, power supplies should only be removed from the enclosure during a Power supply replacement operation. The 800 W, multi-output PSUs can be connected to 240 VAC (high-line) or 120 VAC (low-line) AC supplies, and are 80Plus certified as "Platinum" efficiency.

The 2U expansion enclosure has several indicators to show status and aid serviceability. For more information, see 2U expansion enclosure indicators.

Drive plug ordering

New systems that are ordered from IBM follow a particular slot usage pattern. If more drives are installed later, continue adding from left to right in increasing slot order.

Any drive slot without a drive in it should be fitted with a Drive Blank to maintain correct airflow impedance.

5U Expansion enclosures

Expansion enclosures provide extra storage capacity that can be managed by the system.

The 5U SAS Expansion enclosure supports up to 92 drives in 3.5" large form factor (LFF) carriers in a 5U footprint, allowing greater rack density than 2U enclosures. The enclosure is mounted on slide rails and moves forward from the rack into a "service position" to remove or replace drives.

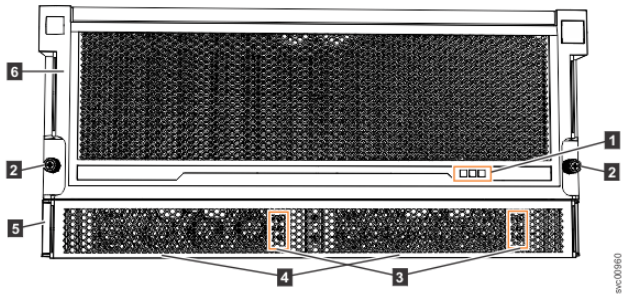


Figure 21. Features on the front of the 5U expansion enclosure

1 Display panel indicators
2 Rack retention thumb screws
3 Power® supply unit indicators
4 Power supply units (PSUs)
5 PSU fascia (1U)
6 Front fascia (4U)

The front of the enclosure provides access to the dual-redundant power supplies, and an indicator panel providing high-level status. The power supplies are housed in the bottom portion of the enclosure, behind a removeable bezel.

However, as Figure 22 on page 42 shows, the 4U and 1U fascias are packaged separately. You must attach them to the front of the 5U expansion enclosure as part of the initial installation process.

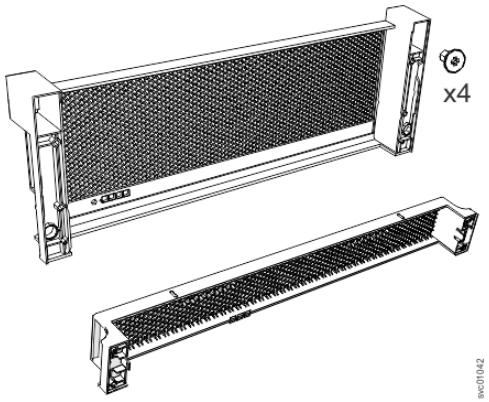


Figure 22. Front fascia of the 5U expansion enclosure

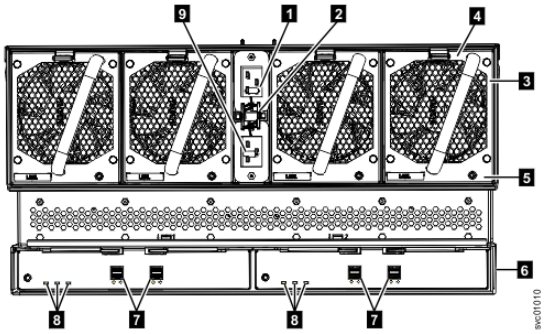


Figure 23. Features on the rear of the 5U expansion enclosure

1 Power cable connector for PSU 2
2 Power cable retention clamps
3 Fan module
4 Fan release latch
5 Fan fault indicator
6 Expansion canister
7 SAS ports and indicators
8 Expansion canister indicators
9 Power cable connector for PSU 1

The rear of the enclosure provides access to two primary expansion canisters, four redundant fan modules, and the power connectors. The 5U expansion canisters are mounted upside down into the enclosure compared to their orientation in a 2U expansion enclosure. Thus, Port 1 is to the right of Port 2.

Each primary expansion canister has two Wide-SAS ports: Port 1 (on the right) is for upstream connection (toward the controller), and Port 2 (on the left) is for downstream connection (to more expansion enclosures).

Both expansion canisters can access all the drives in the expansion enclosure, and so provide a redundant path to data.

The 92 drives are accessed by sliding the drawer forward to the Service position and removing the top lid. All the drives are then available for servicing while the drawer continues to operate.

The centre of the drawer includes two “Secondary Expansion Modules”, which provide the additional fanout that is required to connect all 92 SAS endpoints to the primary expansion canisters.

The Power Supply Units (PSUs) in the 2U Expansion Enclosure are combined power and cooling units, housing the main cooling fans for the enclosure. Therefore, power supplies should only be removed from the enclosure during a Power supply replacement operation. The 800W, multi-output PSUs can be connected to 240 VAC (high-line) or 120 VAC (low-line) AC supplies, and are 80Plus certified as “Platinum” efficiency.

A high-density expansion enclosure has sets of LEDs on the front and rear of the enclosure. Inside the expansion enclosure, LEDs also indicate the status of the drives and each secondary expander module. For more information, see 5U Expansion enclosure indicators.

Drive plug ordering

New systems ordered from IBM follow a particular slot usage pattern. If additional drives are installed later, continue adding from back to front and left to right in increasing slot order. It is important to ensure that no holes are left in the filling pattern as this adversely affects airflow and cooling.

Any drive slot without a drive in it should be fitted with a Drive Blank to maintain correct airflow impedance.

Chapter 5. Planning for hardware

This information is intended to help prepare the physical site for the installation of a FlashSystem 9500.

About this task

Certain physical site specifications must be met before the system can be set up. This activity includes verifying that adequate space is available, and that requirements for power and environmental conditions are met.

Procedure

1. Review all the guidelines in the planning topics to understand where the system can be installed and identify all prerequisites, such as building structure, equipment rack, environmental controls, power supply, and accessibility.
2. Complete the “Planning worksheets” on page 61 to record the information for the initial system creation.

What to do next

For more details on the planning for hardware, see the following pages:

Control enclosure environmental requirements

Before you install a system, your physical environment must meet certain requirements.

These requirements include verifying that adequate space is available and power and environmental conditions are met.

Safety notices

Use the following general safety information for all rack-mounted devices.

DANGER: Observe the following precautions when working on or around your IT rack system:

- Heavy equipment–personal injury or equipment damage might result if mishandled.
- Always lower the leveling pads on the rack cabinet.
- Always install stabilizer brackets on the rack cabinet.
- To avoid hazardous conditions due to uneven mechanical loading, always install the heaviest devices in the bottom of the rack cabinet. Always install servers and optional devices starting from the bottom of the rack cabinet.
- Rack-mounted devices are not to be used as shelves or work spaces. Do not place objects on top of rack-mounted devices.

- Each rack cabinet might have more than one power cord. Be sure to disconnect all power cords in the rack cabinet when directed to disconnect power during servicing.
- Connect all devices installed in a rack cabinet to power devices installed in the same rack cabinet. Do not plug a power cord from a device installed in one rack cabinet into a power device installed in a different rack cabinet.
- An electrical outlet that is not correctly wired could place hazardous voltage on the metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. (R001 part 1 of 2)

CAUTION:

- Do not install a unit in a rack where the internal rack ambient temperatures will exceed the manufacturer's recommended ambient temperature for all your rack-mounted devices.
- Do not install a unit in a rack where the air flow is compromised. Ensure that air flow is not blocked or reduced on any side, front, or back of a unit used for air flow through the unit.
- Consideration should be given to the connection of the equipment to the supply circuit so that overloading of the circuits does not compromise the supply wiring or overcurrent protection. To provide the correct power connection to a rack, refer to the rating labels located on the equipment in the rack to determine the total power requirement of the supply circuit.
- (For sliding drawers) Do not pull out or install any drawer or feature if the rack stabilizer brackets are not attached to the rack. Do not pull out more than one drawer at a time. The rack might become unstable if you pull out more than one drawer at a time.
- (For fixed drawers) This drawer is a fixed drawer and must not be moved for servicing unless specified by the manufacturer. Attempting to move the drawer partially or completely out of the rack might cause the rack to become unstable or cause the drawer to fall out of the rack. (R001 part 2 of 2)

Important: In addition, remember:

- The rack design must support the total weight of the installed enclosures and incorporate stabilizing features suitable to prevent the rack from tipping or being pushed over during installation or normal use.
- The rack must not exceed the maximum enclosure operating ambient temperature of 35-degrees C (95-degrees Fahrenheit). Air is drawn through the control enclosure by fans in each node canister and each power supply.

  In particular, the rack front and rear doors must be at least 60% perforated to enable sufficient airflow through the enclosure. If there is less airflow, additional mechanisms are required to cool the enclosure. An appropriate IBM rack configuration would be the 7014-T42 IBM Rack Model T42, with standard rear door and feature code 6069 Front Door For 2.0 Meter Rack (High Perforation).
- The rack must have a safe electrical distribution system. It must provide overcurrent protection for the enclosure and must not be overloaded by the total number of enclosures installed. The electrical power consumption rating that is shown on the nameplate should be observed.
- The electrical distribution system must provide a reliable ground for each enclosure in the rack.

Power requirements for each power supply

Ensure that your environment meets the following power requirements. To aid in power and cooling requirements planning, Table 14 on page 46 lists the rating of each power supply unit (PSU) by enclosure.

The power that is used by the system depends on various factors, including the number of enclosures and drives in the system and the ambient temperature.

Table 14. Power specifications per power supply

Model and type	Part number	Input power requirements	Maximum input current	Maximum power output
FlashSystem 9500 control enclosure	2000 W	200-240 V single phase AC At a frequency of 50 Hz or 60 Hz IEC C20 standardized	10 A	2000 W

The power and thermal measurements that are shown in Table 15 on page 47 were obtained in the specific operating environment and under the conditions described. These measurements are presented as an illustration; measurements that are obtained in other operating environments might vary. Conduct your own testing to determine specific measurements for your environment.

Table 15. Power consumption examples per enclosure

Model and type	Configuration	Total power consumption	Caloric value (BTU/hr)
IBM Storage FlashSystem 9500	1 enclosure with 40 of 4.8 TB FCM 3.0 NVMe drives, 12 of 32 Gb FC adapters, and 3 TB of memory, working at 100% throughput (16K 70/30 with 50% cache hits)	2,037.6 W	6952.5
	1 enclosure with 36 of 19.2 TB FCM 3.0 NVMe drives, 12 of 32 Gb FC adapters, and 3 TB of memory, working at 100% throughput (16K 70/30 with 50% cache hits)	2,486.8 W	8485.3

Each enclosure contains four PSUs for redundancy. The total power consumption value is the sum of the power that is drawn by each PSU.

Environmental requirements

System airflow is from the front to the rear of each enclosure:

- Airflow passes between drive carriers and through each enclosure.
- Air exhausts from the rear of each canister.

Ensure that your environment falls within the ranges that are shown in Table 16 on page 47.

Table 16. Temperature requirements

Environment	Ambient temperature	Altitude	Relative humidity	Maximum wet bulb temperature
Operating	5°C to 35°C (41°F to 95°F)	0 - 3048 m (0 - 10000 ft)	8% to 80% noncondensing	23°C (73°F)
Non-operating	1°C to 50°C (34°F to 122°F)	-305 to 12192 m (-1000 to 40000 ft)	8% to 80% noncondensing	27°C (80°F)
Storage	1°C to 60°C (34°F to 140°F)		5% to 80% noncondensing	29°C (84°F)
Shipping	-40°C to 60°C (-40°F to 140°F)		5% to 100% condensing, but not precipitating	

Note: Above 950 m altitude, de-rate maximum ambient temperature 1°C per 300 m.

Capacity of exhaust

Ensure that the installation site meets the airflow requirements that are listed as following:

Table 17. Airflow requirements for FlashSystem		
Storage configuration	**Cubic feet per minute (CFM)Nominal temperature (23°C) (73.4°F)**	**Maximum temperature (35°C) (95°F)**
1 control enclosure with 48 FCM drives	240	430

Dimensions and weight requirements for rack installation

Ensure that space is available in a standard 19" rack that is capable of supporting the enclosure. The rack rail kit supports racks with either threaded round or square rail mounting holes. The following table lists the dimensions and weights of the enclosures.

Table 18. Physical characteristics of the enclosures					
Enclosure	**Height**	**Width**	**Depth**	**Maximum weight**	
				Drive ready (without drives)	**Fully configured (with drives)**
IBM Storage FlashSystem 9500 control enclosures with 48 drive slots	174 mm (6.85 in.)	446 mm (17.56 in.)	826 mm (32.51 in.)	25.18 kg (55.51 lb)	69.32 kg (152.82 lb)

The following table shows the rack space requirements for the control enclosure in tabular form.

Table 19. Rack space requirements for the FlashSystem 9500 control enclosure	
Minimum rail length	**Maximum rail depth**
670 mm (26.38 in.)	870 mm (34.25 in.)

Additional space requirements

Ensure that these additional space requirements, as shown in Table 20 on page 48, are available around the enclosures.

Table 20. Clearances		
Location	**Additional space requirements**	**Reason**
Left and right sides	50 mm (2 in.)	Cooling air flow
Back	Minimum: 100 mm (4 in.)	Cable exit

Acoustical Declaration with Noise Hazard Notice

CAUTION:

High levels of acoustical noise are (or could be under certain circumstances) present.

Use approved hearing protection and/or provide mitigation or limit. (L018)

Table 21. Declared noise emission values in accordance with ISO 9296

Declared noise emission values in accordance with ISO 9296						
Product description 9846-AF7 9846-AF8 9848-AF7 9848-AF8	Declared A-weighted sound power level, $L_{WA,m}$ (B)		Declared A-weighted emission sound pressure level, $L_{pA,m}$(dB)[1-7]		Statistical adder for verification, K_v (B)	
	Operating	Idling	Operating	Idling	Operating	Idling
Principal configuration: Single 2U FlashSystem 9100 enclosure in a rack 25 degrees C, 500m	7.8[(6)]	7.8[(6)]	74	74	0.3	0.3
Maximum configuration: Single 2U FlashSystem 9100 enclosure in a rack 27 degrees C, 500m	8.0[(6)]	8.0[(6)]	77	77	0.3	0.3

Table 21. Declared noise emission values in accordance with ISO 9296 (continued)						
Declared noise emission values in accordance with ISO 9296						
Maximum configuration: Single 2U FlashSystem 9100 enclosure in a rack Maximum fan speeds, Worst-case ambient	8.6(6)	8.6(6)	83	83	0.3	0.3

Note:

1. Declared level $L_{WA,m}$ is the upper-limit A-weighted sound power level; Declared level $L_{PA,m}$ is the mean A-weighted sound pressure level measured at the 1-meter bystander positions.
2. The statistical adder for verification, K_v, is a quantity to be added to the declared mean A-weighted sound power level, $L_{WA,m}$ such that there will be a 95% probability of acceptance, when using the verification procedures of ISO 9626, if no more than 6.5% of the batch of new equipment has A-weighted sound power levels greater than ($L_{WA,m}$+K_v).
3. The quantity $L_{WA,c}$(formerly called $L_{WA,d}$), can be computed from the sum of $L_{WA,m}$and K_v.
4. All measurements made in conformance with ISO 7779 and declared in conformance with ISO 9296.
5. B, dB, abbreviations for bels and decibels, respectively. 1 B = 10 dB
6. **Notice:** Government regulations (such as those prescribed by OSHA or European Community Directives) might govern noise level exposure in the workplace and might apply to you and your server installation. The actual sound pressure levels in your installation depend upon various factors, including the number of racks in the installation; the size, materials, and configuration of the room where you designate the racks to be installed; the noise levels from other equipment; the room ambient temperature, and employees' location in relation to the equipment. Further, compliance with such government regulations also depends upon various extra factors, including the duration of employees' exposure and whether employees wear hearing protection. IBM recommends that you consult with qualified experts in this field to determine whether you are in compliance with the applicable regulations.

Shock and vibration specifications for enclosures

Table 22 on page 50 and Table 23 on page 51 provide the shock and vibration testing results for your system.

Table 22. Shock testing results		
Shock categories	**Test level**	**Performance**
Operational	5 g 10 ms 1/2 Sine	<= 25 g 10 ms
Non-operational	30 g 10 ms 1/2 Sine	<= 75 g 11 ms

Table 23. Vibration testing results		
Vibration categories	**Test level**	**Performance**
Operational	0.21 grms 5-500 Hz Random	Throughput loss <= 10% FCAL <= 0.68 grms
Non-operational	1.04 grms 2-200 Hz Random	<= 3.12 grms
Shipping	0.3 g 2-200 Hz Sine	<= 5 g
Rotational vibration	Normal operation performance measurements in enclosure with no external vibration.	Throughput loss for all drives of the same type within performance profile.

SAS expansion enclosure environmental requirements

Before you install any 2U or 5U SAS expansion enclosure, your physical environment must meet certain requirements.

These requirements include verifying that adequate space is available and power and environmental conditions are met.

Power requirements for each power supply (two per enclosure)

Ensure that your environment meets the following power requirements.

To aid in power and cooling requirements planning, Table 24 on page 51 lists the rating of each Power Supply Unit (PSU) by enclosure.

The power that is used by the system depends on several factors, including the number of enclosures and drives in the system and the ambient temperature.

Table 24. Power specifications per power supply					
Model and type	**PSU**	**Input power requirements**	**Maximum input current**	**Maximum power output**	**Caloric value (BTU/hr)**
4666-AFF	764 W (2)	100 V to 240 V single phase AC at a frequency of 50 Hz to 60 Hz	10A for 100 V 6A for 240 V	764 W	2607
4666-A9F	2400 W (2)	AC 200 - 240 V~ nominal; +/- 10% tolerant) 50 or 60 Hz (nominal; 47 - 63 Hz tolerant)	12 A (x2 - per inlet redundancy) Requires an IEC C20 appliance coupler (16-20A branch circuit or C19 power socket PDU)	2400 W	8189

Note: One or more C19 Power Distribution Units (PDU) are needed in the rack to connect power to the power supplies for 5U expansion enclosures.

The power and thermal measurements that are shown in Table 25 on page 52 were obtained in the specific operating environment and under the conditions described. These measurements are presented

as an illustration; measurements that are obtained in other operating environments might vary. Conduct your own testing to determine specific measurements for your environment.

Table 25. Power consumption examples per enclosure

Model and type	Configuration	Total power consumption
4666-AFF	One enclosure with 24 2.5-inch flash drives	151 W
4666-AFF	One enclosure with 24 10 K SAS drives	175 W
4666-AFF	One enclosure with 24 15 K SAS drives	234 W
4666-AFF	One enclosure with 12 7.2 K nearline SAS drives	158 W
4666-A9F	One enclosure with 92 10 TB nearline SAS drives	848 W
4666-A9F	One enclosure with 92 15 TB tier 1 flash drives	748 W

Each SAS expansion enclosure contains two PSUs for redundancy. The total power consumption value is the sum of the power that is drawn from each PSU

Environmental requirements

System airflow is from the front to the rear of each enclosure:

- Airflow passes between drive carriers and through each enclosure.
- Airflow for the upper 4U of the 5U enclosure enters the front, passes between the disk drives, and exits through the large fans in the rear of the enclosure.
- Airflow for the lower 1U of the 5U enclosure is driven through the power supplies with 40 mm X 56 mm fans. Air continues through the chassis, cools the ESMs or controllers, and exits the rear of the enclosure.
- The combined power and cooling module exhausts air from the rear of each canister.

Ensure that your environment falls within the ranges that are shown in Table 26 on page 52.

Table 26. Temperature requirements

Environment	Ambient temperature	Altitude	Relative humidity	Maximum wet bulb temperature
Operating	5°C to 35°C (5°C to 40°C for 24 drives) 41°F to 95°F (41°F to 104°F for 24 drives)	0 - 2133 m(0 - 7000 ft)	8% to 80% noncondensing	23°C (73°F)
	5°C to 30°C (41°F to 86°F)	2134 - 3048 m (7001 - 10000 ft)		

Table 26. Temperature requirements (continued)				
Environment	**Ambient temperature**	**Altitude**	**Relative humidity**	**Maximum wet bulb temperature**
Non-operating	1°C to 50°C (34°F to 122°F)	-305 to 12192 m (-1000 to 40000 ft)	8% to 80% noncondensing	27°C (80°F)
Storage	1°C to 60°C (34°F to 140°F)		5% to 80% noncondensing	29°C (84°F)
Shipping	-40°C to 60°C (-40°F to 140°F)		5% to 100% condensing, but not precipitating	

Dimensions and weight requirements for rack installation

Ensure that space is available in a standard 19" rack that can support the enclosure. The rack rail kits support racks with either threaded round or square mounting holes in the rail. The following table lists the dimensions and weights of the expansion enclosures.

Table 27. Physical characteristics of the expansion enclosures					
Enclosure	**Height**	**Width**	**Depth**	**Maximum weight**	
				Drive ready (without drive)	**Fully configured (with drives)**
4666-AFF	87 mm (3.46 in.)	483 mm (19.0 in.)	556 mm (21.9 in.)	16.7 kg (36.8 lb)	25.0 kg (55.1 lb)
4666-A9F	222.2 mm (8.75 in.)	483 mm (19.0 in.)	968 mm (38.1 in.)	67 kg (147.7 lb)	135 kg (297 lb)

Attention: To avoid potential equipment damage during transport and subsequent loss of data, see “Procedure: Transporting a 5U 92-drive expansion enclosure” on page 101. The procedure describes what to do for the following situations.

- When you power off a 92F, 92G, or an A9F 5U expansion enclosure because you intend to transport it to another location.
- When you intend to move a rack that contains a 92F, 92G, or an A9F 5U expansion enclosure.

The procedure describes how to remove each drive from the 5U enclosure and transport the enclosure. Removing the drives prevents damage to the drives and makes the enclosure lighter to move.

Warning: Some racks do not provide sufficient space to close the rear door. Expansion enclosures that are 5U need 968 mm from the rack front post to the back of the cable management arm (CMA). In addition, allow 905 mm from the front post to the back of the enclosure. To allow space for the power cables, provide 60 - 70 mm from the back of the enclosure.

Figure 24 on page 54 shows the rack space requirements for the 5U expansion enclosures.

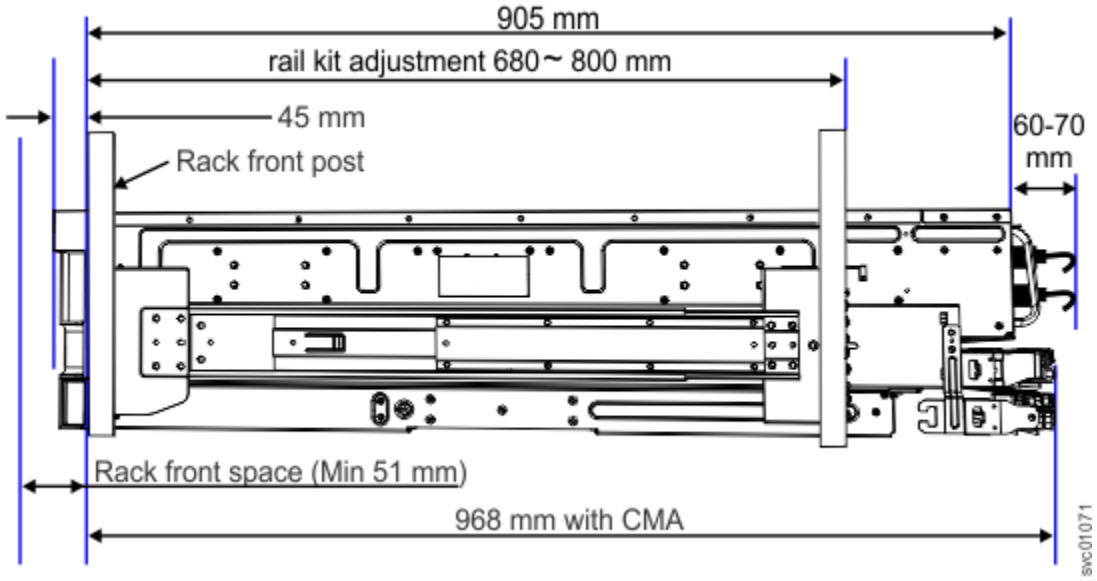


Figure 24. Rack space requirements for the 5U expansion enclosures

The following table shows the rack space requirements for the expansion enclosures in tabular form.

Table 28. Rack space requirements for the SAS expansion enclosures		
Enclosure	**Minimum rail length**	**Maximum rail depth**
4666-AFF	595 mm (23.4 in.)	795 mm (31.3 in.)
4666-A9F	680 mm (26.8 in.)	800 mm (31.5 in.)

Extra rack space requirements

Ensure that these additional space requirements, as shown in Table 29 on page 54, are available around the enclosures.

Table 29. Clearances		
Location	**Space requirements**	**Reason**
Left and right sides	50 mm (2 in.)	Cooling air flow
Back	Minimum of 100 mm (4 in.). This space is not needed for 5U expansion enclosure models.	Cable exit

Supported drives for SAS expansion enclosures

Table 30 on page 54 provides drive specifications for SAS expansion enclosures.

All drives are dual-port and hot-swappable. Drives of the same form factor and connector type can be intermixed within an enclosure.

Table 30. Drive specifications		
Model and type	**3.5-inch drive**	**2.5-inch drive**
4666-AFF	-	2.5" Flash Drives 1.92 TB, 3,84 TB, 7.68 TB, 15.36 TB, 30.72 TB

Table 30. Drive specifications (continued)		
Model and type	**3.5-inch drive**	**2.5-inch drive**
	3.5" Flash Drives 1.92 TB, 3,84 TB, 7.68 TB, 15.36 TB, 30.72 TB	

Acoustical specifications for SAS expansion enclosures

The following table provides the acoustical specifications for the 4666-AFF SAS expansion enclosures.

Table 31. Acoustical specifications for 4666-AFF SAS expansion enclosures	
Model and type	**Acoustical output per enclosure**
4666-AFF	Less than 6.3 B LwA - Operating (40% Average seek rate) @ 23°C ambient

The noise emission level that is stated is the declared (upper limit) sound power level, in decibels, for a random sample of machines. All measurements are made in accordance with ISO 7779 and reported in conformance with ISO 9296.

Table 32 on page 55 provides the acoustical specifications for the 5U SAS expansion enclosures in accordance with ISO 9296(1,2,3).

Important: Hearing conservation program (HCP) procedures are required for field service personnel who service 5U SAS expansion enclosures.

Table 32. Declared noise emissions for 5U SAS expansion enclosures in accordance with ISO 9296				
Model and type	**Declared A-Weighted Sound Power Level, L_{WAd} (B)**		**Declared A-Weighted Sound Pressure Level, L_{pAm} (dB)**	
	Operating	**Idling**	**Operating**	**Idling**
Fully configured expansion enclosure, MTM / Model 4666-A9F	8.5	8.5	85	85

Notes:

1. Declared level L_{WAd} is the upper-limit A-weighted sound power level. Declared level L_{pAm} is the mean A-weighted sound pressure level that is measured at the 1-meter bystander positions.
2. All measurements are made in conformance with ISO 7779 and declared in conformance with ISO 9296.
3. "B" and "dB" are abbreviations for bels and decibels. 1 B = 10 dB.

Important: Government regulations (such as regulations prescribed by OSHA or European Community Directives) can govern noise level exposure in the workplace and can apply to you and your server installation. This system is available with an optional acoustical door feature that can help reduce the noise that is emitted from this system. The actual sound pressure levels in your installation depend upon various factors. These factors include the number of racks in the installation. Other factors include the size, materials, and configuration of the room where you designate the racks to be installed. Other factors include the noise levels from other equipment, the room ambient temperature, and the employee's location in relation to the equipment. Further, compliance with such government regulations also depends upon various other factors, including the duration of employees' exposure and whether employees wear hearing protection. It is a good practice to seek qualified expert opinion in this field to determine whether you are in compliance with the applicable regulations.

Shock and vibration specifications for SAS expansion enclosures

Table 33 on page 56 and Table 34 on page 56 provide the shock and vibration testing results for SAS expansion enclosures.

Table 33. Shock testing results

Shock categories	Test level	Performance
Operational	5 g 10 ms 1/2 Sine	<=25 g 10 ms
Non-operational	30 g 10 ms 1/2 Sine	<=75 g 11 ms

Table 34. Vibration testing results

Vibration categories	Test level	Performance
Operational	0.21 G_{rms} 5 - 500 Hz Random	Throughput loss <=10% FCAL <= 0.68 G_{rms}
Non-operational	1.04 G_{rms} 2 - 200 Hz Random	<=3.12 G_{rms}
Shipping	0.3 G_{rms} 2 - 200 Hz Sine	<=5 G_{rms}
Rotational vibration	Normal operation performance measurements in enclosure with no external vibration.	Throughput loss for all drives of the same type within performance profile.

Enclosure location guidelines

Use these guidelines to plan the location of a control enclosure and any expansion enclosures that attach to it.

Each control enclosure contains two node canisters, forming an I/O group. The guidelines apply on an I/O group by I/O group basis.

Note: A mounting rail kit is provided with each control enclosure and expansion enclosure. Each rail can expand to accommodate a range of rack depths, which are measured between the front and rear mounting posts of the rack. However, because there are differences between some types of mounting rails, be sure to use the specific rail kit that is supplied with each control or expansion enclosure.

Note: A SAS chain is the set of enclosures connected via a single SAS ports on each node canister in the control enclosure.

Plan for one of the following types of installation.

- Control enclosure only

  The control enclosure requires four standard units of space in the rack. If you plan to add expansion enclosures in the future, follow the guidelines for a control enclosure and one or more expansion enclosures.
- Control enclosure and one or more expansion enclosures
  - Position the control enclosure in the center of the rack to have shorter cabling runs. Balance the number of expansion enclosures above and below the control enclosure.
  - Position the enclosures together. Avoid adding other equipment between enclosures.
  - Position the enclosures in the rack so that you can easily view them and access them for servicing. This action also allows the rack to remain stable and allows two or more people to install and remove the enclosures.
  - Should the configuration span multiple racks, locate the racks next to one another to have shorter cabling runs.

– Attach no more than three 2U expansion enclosures or one 5U expansion enclosure to each of the SAS ports (port 1 or port 3) of the node canister.

Planning management connections

The cable-connection tables provide an easy to read method of recording the locations of current and planned cable connections for each control enclosure in the system.

Management Ethernet connections

Each node canister in a control enclosure contains three Ethernet ports. Ports 1 and 2 are used exclusively for accessing management interfaces, (management GUI, service assistant, command-line, and REST-API interfaces) and the port marked with a gear symbol is used as the technician port. The system does not support host attachment with any on-board Ethernet ports.

Note:

- For 100 Gbps Ethernet connectivity, you may use third-party 100GBASE-BIDI QSFP optical transceiver that meets the minimum standards specifications. However, during troubleshooting, IBM support may ask customers to install IBM approved transceivers if the third-party transceivers are determined to cause the issue.

IP address allocation and usage

As you plan your installation, you must consider IP address requirements and service access for the system.

Use Table 35 on page 57 to consider the TCP/IP address requirements of the system and the requirements to access other services. You must also plan for the IP address allocation, and for the configuration of the Ethernet router, gateway and firewall.

Table 35. Summary of TCP/IP ports and services

Service	Traffic direction	Protocol	Port	Service type
Email (SMTP) notification and inventory reports	Outbound	TCP	25	Optional
SNMP event notification	Outbound	UDP	162	Optional
Syslog event notification	Outbound	TCP UDP	6514 (TCP) 514 (UDP)	Optional
IPv4 DHCP (Node service address)	Outbound	UDP	68	Optional
IPv6 DHCP (Node service address)	Outbound	UDP	547	Optional
Network time server (NTP)	Outbound	UDP	123	Optional
SSH for command line interface (CLI) access	Inbound	TCP	22	Mandatory
Remote support assistance	Outbound	TCP	22	Optional
HTTPS for GUI access	Inbound	TCP	443	Mandatory
Uploading support packages to IBM	Outbound	TCP	443	Optional
Remote support assistance for HTTPS GUI access	Outbound	TCP	443	Optional
Remote user authentication service - HTTP	Outbound	TCP	16310	Optional
Remote user authentication service - HTTPS	Outbound	TCP	16311	Optional

Table 35. Summary of TCP/IP ports and services (continued)

Service	Traffic direction	Protocol	Port	Service type
Remote user authentication service - Lightweight Directory Access Protocol (LDAP)	Outbound	TCP	389	Optional
iSCSI	Inbound	TCP	3260	Optional
iSCSI iSNS	Outbound	TCP	3260	Optional
IP-based RDMA replication/high availability	Inbound and Outbound	TCP	4791, 21451, 21452, and 21455	Optional
IP-based RDMA replication/high availability	Inbound and Outbound	UDP	4791, 21451, 21452, and 21455	Optional
IP Partnership management IP communication	Inbound and Outbound	TCP	3260	Optional
IP Partnership data path connections[1]	Inbound and Outbound	TCP	3265	Optional
REST API access and replication management	Inbound	TCP	7443	Optional
NVMe over RDMA	Inbound and Outbound	UDP over RoCEv2	4420	Optional
NVMe over TCP	Inbound and Outbound	TCP	4420	Optional
IP quorum application	Inbound and Outbound	TCP	1260	Optional

[1]Ports must be open for IP addresses that are configured for replication and not the system IP address.

For configuration and management, you must allocate an IP address to the system; this IP address is referred to as the *management IP address*. For extra fault tolerance, you can also configure a second IP address for the second Ethernet port on the node. The addresses must be fixed addresses. If IPv4 and IPv6 are operating concurrently, you must provide an address for each protocol.

Attention: The address for a management IP cannot be the same address that is used for the service IP. Using the same IP address causes communication problems.

Name servers are not used to locate other devices. You must supply the numeric IP address of the device. To locate a device, the device must have a fixed IP address.

Planning for I/O connections

Plan to install the appropriate adapters for your FlashSystem control enclosure so that it is compatible with your networking topology and provides the appropriate connection capability.

The control enclosure contains two node canisters. Each node canister has eight PCIe interface slots, where 6 are used for host adapter cards. The SAS adapters are supported in adapter slot 6. On the FlashSystem 9500 there are dedicated on-board ports and cannot be used for host I/O or replication.

Important: Both node canisters in a control enclosure (I/O group) must be configured with the same adapters.

Note: Both the node canisters are right way up and are numbered left to right and top to bottom. Refer to the support page http://ibm.com/support for "max configurations".

Table 36 on page 59 provides examples of the connection types and the alternative connection methods if alternative connection methods are available.

Table 36. Communications types

Functionality	Network speeds supported	On-board or Adapter	Host I/O	System to system	Storage virtualization
Fibre Channel SAN (SCSI)	64 Gb, 32 Gb, 16 Gb	Adapter: 4-port	yes	yes	yes
Fibre Channel SAN (FC-NVMe)	64 Gb, 32 Gb, 16 Gb	Adapter: 4-port	yes	no	no
Ethernet (iSCSI)	100 Gb	Adapter: 2-port	yes	no	no
	25 Gb or 10 Gb	Adapter: 2-port	yes	yes	yes
Ethernet (NVMe/TCP and NVMe/RDMA)	100 Gb	Adapter: 2-port	yes	no	no
	25 Gb or 10 Gb	Adapter: 2-port	yes	yes	no

Note: 2 port adapter with port speed 25 Gb or 10 Gb depends on transceiver installation. For more information on the adapter, see “Cable reference” on page 60.

Connecting two control enclosures directly with Fibre Channel cables

Two control enclosures can be directly connected to form a partnership (for Policy-based High Availability, migration or replication), or to form a clustered HyperSwap system for legacy high availability support. Creating a clustered system prevents the use of newer features such as storage partitions, policy-based High Availability and vVol replication.

It is best for reliability, availability, and serviceability for control enclosures to communicate with each other through network switches. However, they can be directly connected with Fibre Channel (FC) cables, if needed.

Each node canister must have at least two paths to each node canister in the other control enclosure. This means that at least 8 Fibre Channel cables are needed and at least four Fibre Channel ports on each node canister will be used. Table 37 on page 59 shows an example of Fibre Channel connections between the enclosures.

Table 37. Cabling to direct-connect two control enclosures

	Control enclosure 1		Control enclosure 2	
FC Cable	**Node Canister**	**FC Port**	**Node Canister**	**FC Port**
1	1	1	1	1
2	1	2	2	1
3	1	3	1	2
4	1	4	2	2
5	2	1	1	3
6	2	2	2	3
7	2	3	1	4

Table 37. Cabling to direct-connect two control enclosures (continued)				
	Control enclosure 1		**Control enclosure 2**	
8	2	4	2	4

Cable reference

The cable standard tables specify cable types and standards for customer-supplied cables for use with the system.

Table 38 on page 60 provides a list of Ethernet cable standards. Ethernet cables are not supplied as part of your order. Ensure the cables that are used meet the minimum standards for the Ethernet port type.

Table 38. Ethernet cable standards

Ethernet adapter type	**Ethernet port type**	**Connector**	**Cable type**	**Minimum standard**	**Remark**
On-board Ethernet ports	1 Gbps Ethernet port	RJ45	Unshielded twisted pair (UTP)	Cat 5e or Cat 6 (up to 100 meters)	
2 Port 25 Gbps RoCE Adapter Card or 2 Port 25 Gbps iWARP Adapter Card	25 Gbps Ethernet port	LC-SFP28 Transceiver (IBM feature)	Optical fibre	• OM3 (up to 70 m) • OM4 (up to 100 m)	
2 Port 25 Gbps RoCE Adapter Card or 2 Port 25 Gbps iWARP Adapter Card	25 Gbps Ethernet port	QSFP28 to SFP28	Passive Twinax DAC Cable (up to 2 m)	• SFF-8432 transceiver specification • IEC60825-1 product safety specification • Operational temperature should be 0 deg C - 70 deg C. However, in some cases the temperature can reach to 85 deg C.	
2 Port 25 Gbps RoCE Adapter Card or 2 Port 25 Gbps iWARP Adapter Card	10 Gbps Ethernet port	RJ45 SFP+ connector (IBM feature)	Unshielded twisted pair (UTP)	• Cat 6a or Cat 7 (up to 100 meters	The 25 Gbps Adapter card runs as a 10 Gbps port when using the RJ45 SFP+ connector.

Table 38. Ethernet cable standards (continued)

Ethernet adapter type	Ethernet port type	Connector	Cable type	Minimum standard	Remark
2 Port 25 Gbps RoCE Adapter Card or 2 Port 25 Gbps iWARP Adapter Card	10 Gbps Ethernet port	LC - SFP+ Transceiver (IBM feature)	Optical fiber	• OM2 (up to 60 meters) or OM3 (60 - 150 meters)	The 25 Gbps Adapter card runs as a 10 Gbps port when using the LC - SFP+ Transceiver connector.
2 Port 25 Gbps RoCE Adapter Card or 2 Port 25 Gbps iWARP Adapter Card	25 Gbps Ethernet port	DAC (Direct Attached Copper)	DAC: Twin-ax copper cable (up to 2 m)	• SFF-8432 transceiver specification • IEC60825-1 product safety specification • Operational temperature should be 0 deg C - 70 deg C. However, in some cases the temperature can reach 85 deg C.	The 25 Gbps adapter ports can work with 10 Gbps and 25 Gbps DAC cables.
2 Port 100 Gbps RoCEv2 Adapter Card	100 Gbps Ethernet	QSFP28 (SR4) – Transceiver (IBM feature)	MPO fabric	• OM3 (up to 70 m) • OM4 (up to 100 m)	
2 Port 100 Gbps RoCEv2 Adapter Card	100 Gbps Ethernet	QSFP28 (SRBD) – Transceiver	LC fabric Optical: OM3/OM4	• SFF-8436 transceiver specification • IEC60825-1 product safety specification • Operational temperature should be 0 deg C - 70 deg C. However, in some cases the temperature can reach to 85 deg C.	
2 Port 100 Gbps RoCEv2 Adapter Card	100 Gbps Ethernet	AOC (Active Optical Cable)	AOC: Ribbon optical fiber cable		
2 Port 100 Gbps RoCEv2 Adapter Card	100 Gbps Ethernet	DAC (Direct Attached Copper)	DAC: Twin-ax copper cable (up to 2 m)		

Planning worksheets

Planning worksheets can help identify important information that is needed when the system is installed and configured. Complete the relevant sections to help with installation planning.

The planning worksheet is available for download in the following languages:

- English
- Brazilian Portuguese
- French
- Italian
- German
- Spanish
- Simplified Chinese
- Japanese
- Korean

Chapter 6. Installing

This information covers the system hardware installation and initial setup.

After you verify that the power and environmental requirements of the system are met, and planning the location of the enclosure, you are ready to begin installing the hardware components. The installation activity follows the plan that is used in the planning section.

Note: Much of the installation information is intended only for IBM authorized service providers. Customers need to refer to the terms of their warranty to determine the extent to which they might attempt any IBM Storage FlashSystem 9500 installation or maintenance actions that are identified as IBM SSR tasks.

The installation poster provides an illustrated sequence of steps for installing the enclosure in a rack and beginning the setup process. Refer to the Installation Poster.

For more details on the installation, see the following pages:

Unpacking a 4U control enclosure

Before you unpack a 4U control enclosure, ensure that you review and follow all related instructions.

Before you begin

CAUTION:

The weight of this part or unit is more than 55 kg (121.2 lb). It takes specially trained persons, a lifting device, or both to safely lift this part or unit.

CAUTION: To avoid personal injury, before you lift this unit, remove all appropriate sub assemblies per instructions to reduce the system weight.

Important: Before you unpack, move, install, or service the enclosure and its parts, always complete the following tasks:

- Read and follow the safety notices and instructions, as described in “Safety notices and considerations for 4U enclosure” on page 66
- Read and follow the guidelines that are described in “Weight considerations: 4U enclosure” on page 70.
- Ensure that a suitably rated mechanical lift is available to support the weight of the enclosure when it is moved out of the packaging and inserted into the rack for installation.

About this task

Procedure

1. Remove the cardboard tray that contains the rails and set it aside in a safe place as shown in Figure 25 on page 64.

Figure 25. Tray containing rail kit

2. Fold down the sides of the box as shown in Figure 26 on page 64. If necessary, carefully cut along the lower fold line of the sides and remove them.

Figure 26. Folding the cardboard

3. Remove the foam pieces from front and rear sides of the enclosure. Refer in Figure 27 on page 65.

Figure 27. Foam removal from enclosure

4. Position the lift next to the enclosure, level lift with the bottom side of enclosure as shown in Figure 28 on page 65.

Figure 28. Moving on to lift

5. If you are using lift, two people need to push the enclosure sideways onto the adjacent lift bed. Enclosure needs to be placed on lift as shown in Figure 29 on page 66.

Figure 29. Enclosure on lift

6. If you do not have a lift, remove the below mentioned parts from the enclosure chassis:
   a) Node canisters
   b) Power supplies
   c) Drives

   The empty chassis can be safely lifted by two persons.
7. Unpack the support rail kit from the shipment box, which was removed earlier from the package as shown in Figure 25 on page 64.

Safety notices and considerations for 4U enclosure

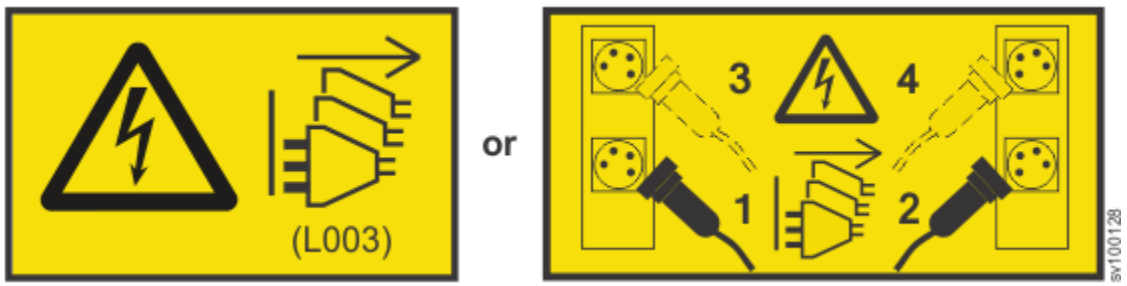
Before you install, service, or move a 4U expansion enclosure, always read and follow the safety notices and guidelines.

Safety notices

Use the reference numbers in parentheses at the end of each notice (for example, D005) to find the matching translated notice in *IBM Systems Safety Notices*.

DANGER: Serious injury or death can occur if loaded lift tool falls over or if a heavy load falls off the lift tool. Always completely lower the lift tool load plate and properly secure the load on the lift tool before moving or using the lift tool to lift or move an object. (D010)

DANGER: Multiple power cords. The product might be equipped with multiple AC power cords or multiple DC power cables. To remove all hazardous voltages, disconnect all power cords and power cables. (L003)



DANGER:

Hazardous voltage present. Voltages present constitute a shock hazard, which can cause severe injury or death. (L004)

DANGER:

Hazardous energy present. Voltages with hazardous energy might cause heating when shorted with metal, which might result in splattered metal, burns, or both. (L005)

DANGER: Observe the following precautions when working on or around your IT rack system:

- Heavy equipment–personal injury or equipment damage might result if mishandled.
- Always lower the leveling pads on the rack cabinet.
- Always install stabilizer brackets on the rack cabinet.
- To avoid hazardous conditions due to uneven mechanical loading, always install the heaviest devices in the bottom of the rack cabinet. Always install servers and optional devices starting from the bottom of the rack cabinet.
- Rack-mounted devices are not to be used as shelves or work spaces. Do not place objects on top of rack-mounted devices.

- Each rack cabinet might have more than one power cord. Be sure to disconnect all power cords in the rack cabinet when directed to disconnect power during servicing.
- Connect all devices installed in a rack cabinet to power devices installed in the same rack cabinet. Do not plug a power cord from a device installed in one rack cabinet into a power device installed in a different rack cabinet.
- An electrical outlet that is not correctly wired could place hazardous voltage on the metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. (R001 part 1 of 2)

CAUTION:

- Do not install a unit in a rack where the internal rack ambient temperatures will exceed the manufacturer's recommended ambient temperature for all your rack-mounted devices.
- Do not install a unit in a rack where the air flow is compromised. Ensure that air flow is not blocked or reduced on any side, front, or back of a unit used for air flow through the unit.
- Consideration should be given to the connection of the equipment to the supply circuit so that overloading of the circuits does not compromise the supply wiring or overcurrent protection. To provide the correct power connection to a rack, refer to the rating labels located on the equipment in the rack to determine the total power requirement of the supply circuit.
- (For sliding drawers) Do not pull out or install any drawer or feature if the rack stabilizer brackets are not attached to the rack. Do not pull out more than one drawer at a time. The rack might become unstable if you pull out more than one drawer at a time.
- (For fixed drawers) This drawer is a fixed drawer and must not be moved for servicing unless specified by the manufacturer. Attempting to move the drawer partially or completely out of the rack might cause the rack to become unstable or cause the drawer to fall out of the rack. (R001 part 2 of 2)

CAUTION: Removing components from the upper positions in the rack cabinet improves rack stability during a relocation. Follow these general guidelines whenever you relocate a populated rack cabinet within a room or building.

- Reduce the weight of the rack cabinet by removing equipment starting at the top of the rack cabinet. When possible, restore the rack cabinet to the configuration of the rack cabinet as you received it. If this configuration is not known, you must observe the following precautions.
  - Remove all devices in the 32U position and above.
  - Ensure that the heaviest devices are installed in the bottom of the rack cabinet.
  - Ensure that there are no empty U-levels between devices installed in the rack cabinet below the 32U level.
- If the rack cabinet you are relocating is part of a suite of rack cabinets, detach the rack cabinet from the suite.
- If the rack cabinet you are relocating was supplied with removable outriggers they must be reinstalled before the cabinet is relocated.
- Inspect the route that you plan to take to eliminate potential hazards.
- Verify that the route that you choose can support the weight of the loaded rack cabinet. Refer to the documentation that comes with your rack cabinet for the weight of a loaded rack cabinet.
- Verify that all door openings are at least 760 x 230 mm (30 x 80 in.).
- Ensure that all devices, shelves, drawers, doors, and cables are secure.
- Ensure that the four leveling pads are raised to their highest position.
- Ensure that there is no stabilizer bracket installed on the rack cabinet during movement.
- Do not use a ramp inclined at more than 10 degrees.
- When the rack cabinet is in the new location, complete the following steps:
  - Lower the four leveling pads.
  - Install stabilizer brackets on the rack cabinet.
  - If you removed any devices from the rack cabinet, repopulate the rack cabinet from the lowest position to the highest position.
- If a long-distance relocation is required, restore the rack cabinet to the configuration of the rack cabinet as you received it. Pack the rack cabinet in the original packaging material, or equivalent. Also lower the leveling pads to raise the casters off the pallet and bolt the rack cabinet to the pallet. (R002)

DANGER: Racks with a total weight of > 227 kg (500 lb.), Use Only Professional Movers! (R003)

DANGER: Do not transport the rack via fork truck unless it is properly packaged, secured on top of the supplied pallet. (R004)

DANGER:

Main Protective Earth (Ground):

This symbol is marked on the frame of the rack.

The PROTECTIVE EARTHING CONDUCTORS should be terminated at that point. A recognized or certified closed loop connector (ring terminal) should be used and secured to the frame with a lock washer using a bolt or stud. The connector should be properly sized to be suitable for the bolt or stud, the locking washer, the rating for the conducting wire used, and the considered rating of the breaker. The intent is to ensure the frame is electrically bonded to the PROTECTIVE EARTHING CONDUCTORS. The hole that the bolt or stud goes into where the terminal conductor and the lock washer contact should be free of any non-conductive material to allow for metal to metal contact. All PROTECTIVE EARTHING CONDUCTORS should terminate at this main protective earthing terminal or at points marked with . (R010)

CAUTION:

≥ 18 kg (39.7 lb) ≥ 33.6 kg (74 lb) ≥ 46.3 kg (102 lb)

The weight of this part or unit is more than 55 kg (121.2 lb). It takes specially trained persons, a lifting device, or both to safely lift this part or unit. (C011)

CAUTION: CAUTION regarding IBM provided VENDOR LIFT TOOL:

- Operation of LIFT TOOL by authorized personnel only
- LIFT TOOL intended for use to assist, lift, install, remove units (load) up into rack elevations. It is not to be used loaded transporting over major ramps nor as a replacement for such designated tools like pallet jacks, walkies, fork trucks and such related relocation practices. When this is not practicable, specially trained persons or services must be used (for instance, riggers or movers). Read and completely understand the contents of LIFT TOOL operator's manual before using.
- Read and completely understand the contents of LIFT TOOL operator's manual before using. Failure to read, understand, obey safety rules, and follow instructions may result in property damage and/or personal injury. If there are questions, contact the vendor's service and support. Local paper manual must remain with machine in provided storage sleeve area. Latest revision manual available on vendor's website.
- Test verify stabilizer brake function before each use. Do not over-force moving or rolling the LIFT TOOL with stabilizer brake engaged.
- Do not raise, lower or slide platform load shelf unless stabilizer (brake pedal jack) is fully engaged. Keep stabilizer brake engaged when not in use or motion.
- Do not move LIFT TOOL while platform is raised, except for minor positioning.
- Do not exceed rated load capacity. See LOAD CAPACITY CHART regarding maximum loads at center versus edge of extended platform.
- Only raise load if properly centered on platform. Do not place more than 200 lb (91 kg) on edge of sliding platform shelf also considering the load's center of mass/gravity (CoG).
- Do not corner load the platform tilt riser accessory option. Secure platform riser tilt option to main shelf in all four (4x) locations with provided hardware only, prior to use. Load objects are designed to slide on/off smooth platforms without appreciable force, so take care not to push or lean. Keep riser tilt option flat at all times except for final minor adjustment when needed.
- Do not stand under overhanging load.
- Do not use on uneven surface, incline or decline (major ramps).
- Do not stack loads.
- Do not operate while under the influence of drugs or alcohol.
- Do not support ladder against LIFT TOOL.
- Tipping hazard. Do not push or lean against load with raised platform.
- Do not use as a personnel lifting platform or step. No riders.
- Do not stand on any part of lift. Not a step.
- Do not climb on mast.
- Do not operate a damaged or malfunctioning LIFT TOOL machine.
- Crush and pinch point hazard below platform. Only lower load in areas clear of personnel and obstructions. Keep hands and feet clear during operation.
- No Forks. Never lift or move bare LIFT TOOL MACHINE with pallet truck, jack or fork lift.
- Mast extends higher than platform. Be aware of ceiling height, cable trays, sprinklers, lights, and other overhead objects.

- Do not leave LIFT TOOL machine unattended with an elevated load.
- Watch and keep hands, fingers, and clothing clear when equipment is in motion.
- Turn Winch with hand power only. If winch handle cannot be cranked easily with one hand, it is probably over-loaded. Do not continue to turn winch past top or bottom of platform travel. Excessive unwinding will detach handle and damage cable. Always hold handle when lowering, unwinding. Always assure self that winch is holding load before releasing winch handle.
- A winch accident could cause serious injury. Not for moving humans. Make certain clicking sound is heard as the equipment is being raised. Be sure winch is locked in position before releasing handle. Read instruction page before operating this winch. Never allow winch to unwind freely. Freewheeling will cause uneven cable wrapping around winch drum, damage cable, and may cause serious injury. (C048)

CAUTION: If the System slide rails are installed above EIA location 29U, the [ServerLIFT®] tool (or other qualified lift tool) must be used as a safety precaution for servicing. Position the lift tool platform slightly below the bottom of the System drawer to account for the slight downward flex when the drawer is extended out fully on its slides. Then gently raise the lift tool platform to stably contact the bottom of the drawer, minding not to over force it as it could put upward stress to the slide rails. A service-qualified ladder may have to be used to reach or properly work around the System at such heights. While using a ladder, do not lean on or against the system drawer or lift tool during service, and follow safe practices. (C051)

Weight considerations: 4U enclosure

Before you install, move, or perform service on a 4U enclosure, you must be prepared to handle the weight of the enclosure and its parts.

Safety notices and considerations

Important: Always read and follow the safety notices and instructions before you install, move, or service the enclosure and its parts. See “Safety notices and considerations for 4U enclosure” on page 66 for information.

- Do not exceed the specified maximum load of the rack where the enclosure is to be installed.
- Do not exceed any load limit of the building and flooring where the enclosure is to be installed.
- Always use a suitably rated mechanical lift or four persons when you are performing any of the following tasks:
  - Removing the enclosure from its packing material
  - Lifting and installing the enclosure in the rack for the first time
  - Reinstalling the enclosure after you complete a service task (for example, replacing the enclosure FRU).
  - You must use a server lift such as this one,https://serverlift.com/data-center-lifts/sl-1000x/ as the enclosure is very heavy and there is a chance that a component could be damaged if the enclosure is disassembled to make it light enough and then reassembled. You must always use a lift when the enclosure will rack above your chest height.
  - Lift requirements:

Table 39. Lift requirements

Description	Weight	Requirement
An enclosure with a maximum configuration	69.32 kg	Mechanical lift
Enclosure without node canisters, Power Supply Units (PSU) and NVMe drives	20.26 kg	Two-person lift up to chest height (57" or over 32U)

Table 39. Lift requirements (continued)		
Node canister with maximum configuration	18.1 kg	More than one person

- To maximize rack stability, always install the enclosure in the lowest possible position in the rack.

Weight increases as FRUs are installed

As you install or replace FRUs, the overall weight of the enclosure increases. For example, Table 40 on page 71 shows the weight progression as different combinations of FRUs are installed.

Table 40. Enclosure weight as FRUs are installed

Enclosure assembly		**Approximate weight**	
FRUs installed	**FRUs not installed**	**kg**	**lb**
• Node canister (fully configured)		18.1	39.90
• Enclosure	• PSUs • Expansion canisters • Drives	20.26	44.66
• Enclosure • PSU's	• Canisters • Drives	25.40	60
• Enclosure with maximum configuration		69.32	152.82

Conversely, the overall weight of the enclosure is reduced as you remove parts. However, even with parts removed, the 4U enclosure is heavy. Depending on the number of parts that remain, you might need four persons or a mechanical lift to support the weight of the expansion enclosure.

Installing support rails for the control enclosure

You must install the support rails before you install the enclosure in a rack.

Procedure

To install the support rails for the control enclosure, complete the following steps.

1. Locate the control enclosure rails, as shown in Figure 30 on page 72.
   The rail assembly consists of two rails that must be installed in the rack cabinet.

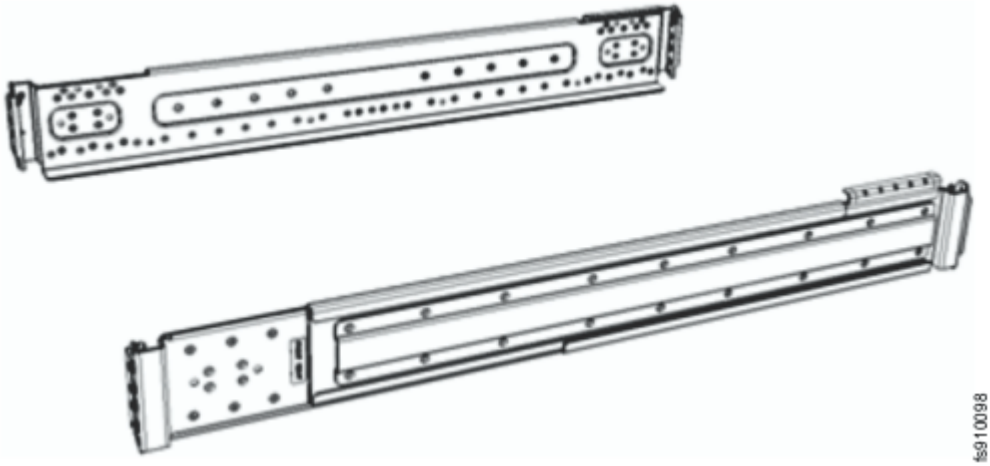


Figure 30. Control enclosure support rails

2. Working at the front of the rack cabinet, identify the two standard rack units (2U) of space in the rack into which you want to install the support rails.

   Figure 31 on page 72 shows two rack units with the front mounting holes identified.

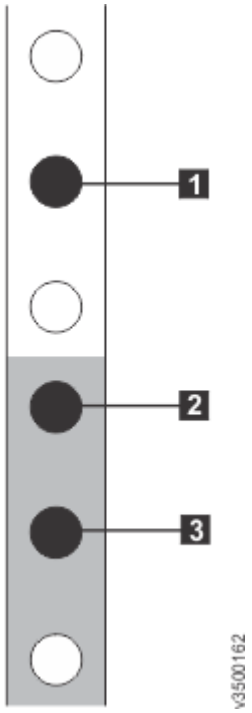


Figure 31. Hole locations in the front of the rack

- 1 Upper rail-mounting bracket pin
- 2 Lower rail-mounting bracket pin
- 3 Rack mounting screw hole

3. Ensure that the appropriate bracket pins are installed in the front and rear bracket of each rail.

   Each rail comes with four medium pins preinstalled (two in the front bracket and two in the rear bracket). Large pins are provided separately. Use the pins that are appropriate for the mounting holes in your rack, as described in Table 41 on page 73.

Table 41. Selecting bracket pins for your rack	
Mounting holes	**Bracket pins**
Round, unthreaded	Use the preinstalled medium pins.
Square	Unscrew the medium pins and replace with the large pins that are supplied with the rails.

4. At each end of the rail, grasp the tab **1** and pull *firmly* to open the hinge bracket.
   See Figure 32 on page 73.

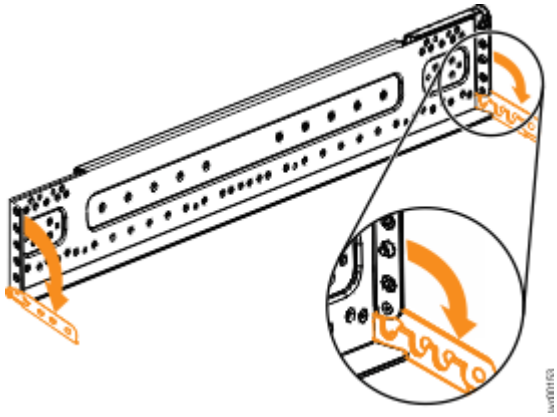


Figure 32. Opening the hinge brackets

5. Align the holes in the rail bracket with the holes on the front and rear rack cabinet flanges.
   Ensure that the rails are aligned on the inside of the rack cabinet.
6. On the rear of the rail, press the two bracket pins into the holes in the rack flanges.
7. Close the rear hinge bracket to secure the rail to the rack cabinet flange.
8. On the front of the rail, press the two bracket pins into the holes in the rack flanges.
9. Close the front hinge bracket to secure the rail to the rack cabinet flange.
10. Close the rear hinge bracket to secure the rail to the rack cabinet flange.
11. On the front of the rail, press the two bracket pins into the holes in the rack flanges.
12. Close the front hinge bracket to secure the rail to the rack cabinet flange.
13. Do not fit any screws to fasten the rail to the rack yet because this will get in the way of fitting the control enclosure and the brackets to stabilize the back of the enclosure.

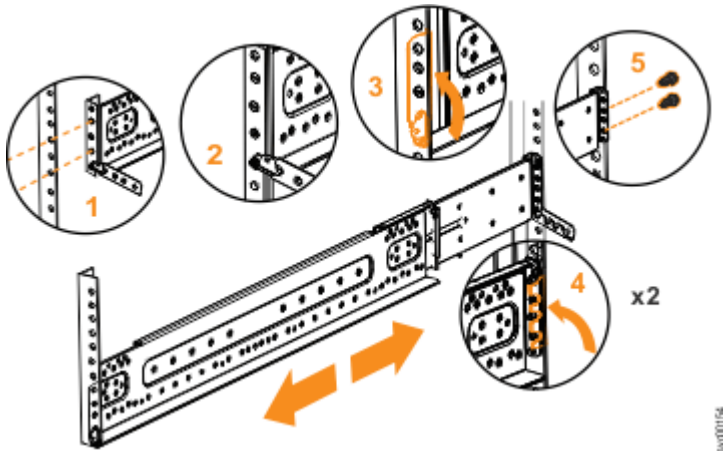


Figure 33. Installing the side rail

14. Repeat the steps to secure the opposite rail to the rack cabinet.
15. Repeat the procedure to install rails for each additional control enclosure.

Installing a control enclosure

Following your enclosure location plan, install the control enclosure.

About this task

CAUTION:

- To lift a control enclosure requires at least three people.
- Install a control enclosure only onto the control enclosure rails supplied with the enclosure.
- Load the rack from the bottom up to ensure rack stability. Empty the rack from the top down.
- If the 4U or 5U enclosure is not being supported by mechanical lifting equipment,then it must have been dissembled so that is safe for two people to lift into the rack.

Procedure

To install a control enclosure, complete the following steps.

1. On either side of the drive assemblies, remove the enclosure end caps by grasping the handle and pulling the bottom of the end cap free, then clearing the tab on the top of the enclosure.
2. Align the enclosure with the front of the rack cabinet.
3. Slide the enclosure into the rack along the rails until the enclosure is fully inserted. (See Figure 34 on page 74.

   Note: The rails are not designed to hold an enclosure that is partially inserted. The enclosure must always be in a fully inserted position.

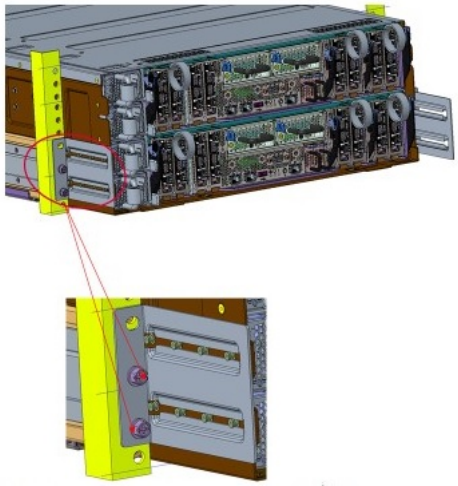


Figure 34. Inserting the enclosure

4. Fit the rear retaining brackets as shown in Figure 34 on page 74.
5. Reinstall the left and right end caps.

   The left end cap has indicator windows that align with the status LEDs (light-emitting diodes) on the edge of the enclosure.

   a) Ensure that the serial number on the left end cap matches the serial number on the left flange ("ear") on the front of the enclosure.

   b) Fit the slot on the top of the end cap over the tab on the flange.

   c) Rotate the end cap down until it snaps into place.

   d) Ensure that the inside surface of the end cap is flush with the flange.

What to do next

If you removed components from the enclosure to lift it, reinstall the components into the slots of the enclosure from which they were removed.

Installing a 2U expansion enclosure

Use the following information to install the optional 2U expansion enclosure.

Unpacking a 2U expansion enclosure

Before you unpack the optional 2U expansion enclosure, ensure that you review and follow all related instructions.

Before you begin

The expansion enclosure and related parts are included in a single box that contains the following items:

- Expansion enclosure with the following components preinstalled:
  - Two power supplies
  - Drives and drive blanks
- Rail kit, which includes left and right rails, black M5 screws, and alternative silver screw pins for other rack types
- Two power cables

Note: You will need a box knife to unpack the expansion enclosure.

About this task

CAUTION: To lift the assembled enclosure requires three persons unless suitable lifting equipment is available or the enclosure is unpacked and dismantled as described in the procedure.

Procedure

1. Cut the box tape and open the lid of the shipping carton.
2. Remove the rail kit box and set it aside in a safe location.
3. Lift the front and back foam packing pieces from the carton.
4. Remove the four corner reinforcement pieces from the carton.
5. Using the box knife, carefully cut the four corners of the carton from top to bottom.
6. Fold the sides and back of the carton down to uncover the front of the expansion enclosure.

   If necessary, carefully cut along the lower fold lines and remove each of the sides.
7. Carefully cut the foam packing away from the front of the enclosure.
8. Carefully cut open the bag that covers the front of the enclosure.
9. Remove the leftmost drive or drive filler. Note it's location (and its serial number, if it is a drive) and set it aside.
10. Repeat until all drives or drive fillers are removed from the enclosure.
11. Lift the enclosure from the shipping carton. Note that the rear half of the enclosure is heavier than the front half.

    Note: With the drives removed, the enclosure weighs approximately 17 kg (37 lb).

Installing support rails for 2U expansion enclosures

Before you install 2U expansion enclosures, you must first install support rails.

Procedure

To install the support rails, complete the following steps.

1. Locate the expansion enclosure rails (Figure 35 on page 76).
   The rail assembly consists of two rails that must be installed in the rack cabinet.

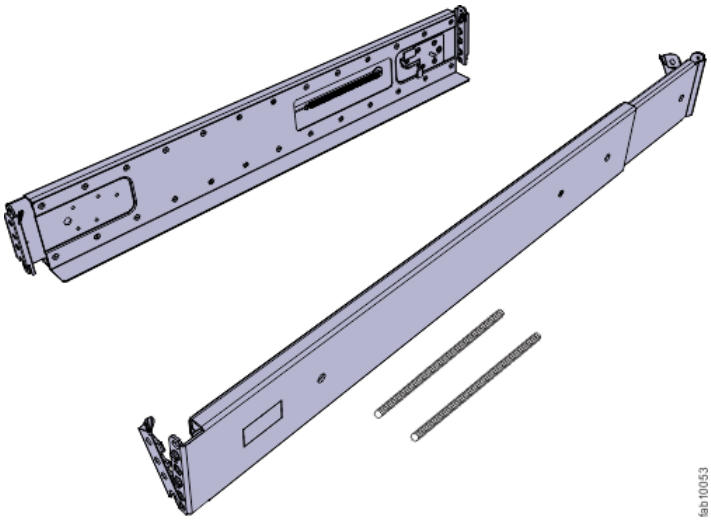


Figure 35. Expansion enclosure support rails

2. Locate the hardware that is used to install the rails, including two rail springs, two sets of eight bracket pins, and two M5 screws.
   Set the hardware aside for use later in the installation process.
3. Install a spring on each rail.
   a) Extend the rail to its full length.
   b) Push one looped end of a spring over one stud on the inside of the rail.
   c) Stretch the spring slightly and push the other looped end of the spring onto the other stud on the inside of the rail.
4. Working at the front of the rack cabinet, identify the two standard rack units (2U) of space in the rack into which you want to install the support rails.
   Figure 36 on page 76 shows two rack units with the front mounting holes identified.

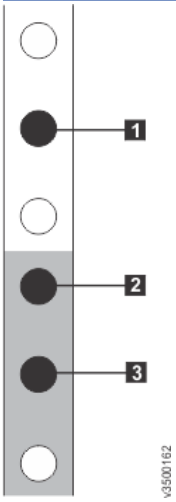


Figure 36. Hole locations in the front of the rack

- 1 Upper rail mounting bracket pin
- 2 Lower rail mounting bracket pin
- 3 Rack mounting screw hole

5. Ensure that the appropriate bracket pins are installed in the front and rear bracket of each rail.

   Each rail comes with four medium pins preinstalled (two in the front bracket and two in the rear bracket). Large and small pins are provided separately. Use the pins that are appropriate for the mounting holes in your rack. See Table 42 on page 77.

Table 42. Selecting bracket pins for your rack	
Mounting holes	**Bracket pins**
Round, unthreaded	Use the preinstalled medium pins.
Round, threaded	Unscrew the medium pins and replace with the smaller pins that are supplied with the rails.
Square	Unscrew the medium pins and replace with the large pins that are supplied with the rails.

6. At each end of the rail, grasp the tab 1 and pull *firmly* to open the hinge bracket (see Figure 37 on page 77).

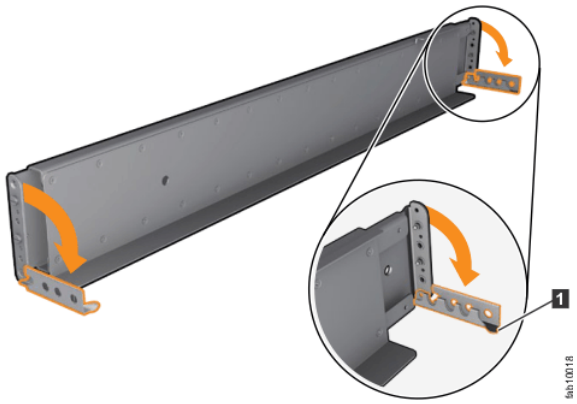


Figure 37. Opening the hinge brackets

7. Align the holes in the rail bracket with the holes on the front and rear rack cabinet flanges.

   Ensure that the rails are aligned on the inside of the rack cabinet.

8. On the rear of the rail, press the two bracket pins into the holes in the rack flanges.
9. Close the rear hinge bracket to secure the rail to the rack cabinet flange.

   (See Figure 38 on page 77.)

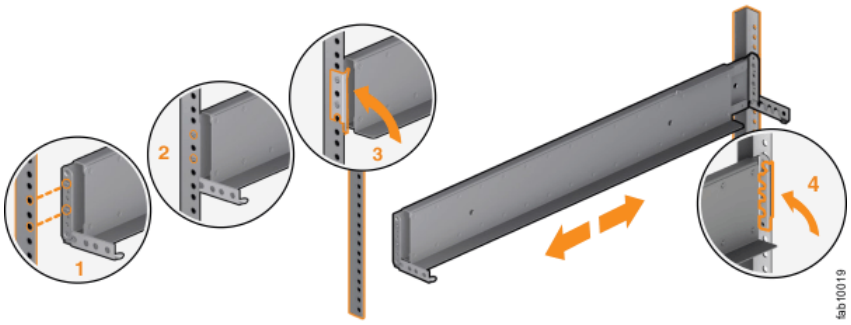


Figure 38. Closing the hinge brackets

10. On the front of the rail, press the two bracket pins into the holes in the rack flanges.
11. Close the front hinge bracket to secure the rail to the rack cabinet flange.

    See Figure 38 on page 77.

12. Secure the rear of the rail to the rear rack flange with an M5 screw that is provided with the rack kit.
13. Repeat the steps to secure the opposite rail to the rack cabinet.
14. Repeat the procedure to install rails for each additional expansion enclosure.

Installing an optional 2U SAS expansion enclosure

The 2U SAS expansion enclosures are installed in the same rack as the control enclosure.

About this task

CAUTION:

- To lift and install the 2U SAS expansion enclosure into the rack requires at least two people.
- Install a 2U SAS expansion enclosure only onto the rails that are supplied with the enclosure.
- Load the rack from the bottom up to ensure rack stability. Empty the rack from the top down.

Procedure

To install an optional 2U SAS expansion enclosure, complete the following steps.

1. Remove the two enclosure end caps by grasping the handle and pulling the bottom of the end cap free, then clearing the tab on the top of the enclosure.
2. Align the enclosure with the front of the rack cabinet.
3. Carefully slide the enclosure into the rack along the rails until the enclosure is fully inserted.
4. Secure the enclosure with screws in the rack mounting screw holes.
5. Reinstall the left and right end caps.

   The left end cap has indicator windows that align with the status LEDs (light-emitting diodes) on the edge of the enclosure.

   a) Ensure that the serial number of the end cap matches the serial number on the rear of the enclosure.

   b) Fit the slot on the top of the end cap over the tab on the chassis flange.

   c) Rotate the end cap down until it snaps into place.

   d) Ensure that the inside surface of the end cap is flush with the chassis.
6. If you are installing additional 2U SAS expansion enclosures, repeat the previous steps to complete the installation.

Powering on the optional 2U SAS expansion enclosures

After you install all the hardware components, power on the optional 2U SAS expansion enclosures and check their status.

About this task

Attention: Do not power on an expansion enclosure with any open bays or slots.

- Every unused drive bay must be occupied by a filler panel.
- Filler panels must be installed in all empty host interface adapter slots.

Open bays or slots disrupt the internal air flow, causing the drives to receive insufficient cooling.

Procedure

To power on the 2U SAS expansion enclosures, complete the following steps.

1. Use the supplied power cords to connect both power supply units of the first expansion enclosure to their power sources.

   If the power sources have circuit breakers or switches, ensure that they are turned on. The expansion enclosure does not have power switches. Repeat this step for each expansion enclosure in the system.

   Note: Each enclosure has two power supply units. To provide power failure redundancy, connect the two power cords to separate power circuits.

2. From the rear of the rack, check the LEDs on each expansion enclosure (see Figure 39 on page 79).

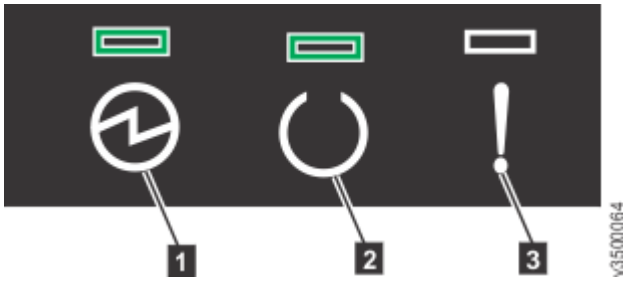


Figure 39. Expansion enclosure LEDs

1 Power
2 Status
3 Fault

The canister is ready with no critical errors when **Power** is illuminated, **Status** is on, and **Fault** is off.

3. Wait for all expansion canisters to finish powering on before you proceed with the system installation process.

Installing a 5U expansion enclosure

Use the following information to install the optional 5U expansion enclosure.

Safety notices and considerations

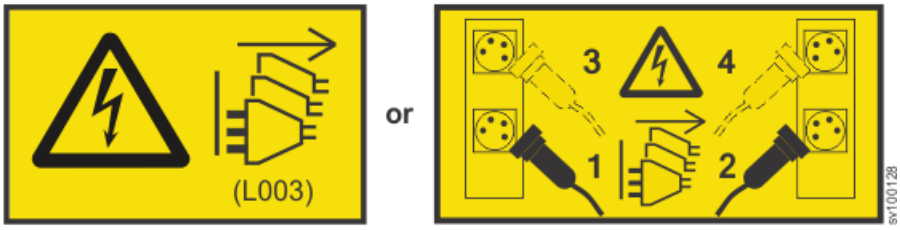
Before you install, service, or move a 5U expansion enclosure, always read and follow the safety notices and guidelines.

Safety notices

Use the reference numbers in parentheses at the end of each notice (for example, D005) to find the matching translated notice in *IBM Systems Safety Notices*.

DANGER: Serious injury or death can occur if loaded lift tool falls over or if a heavy load falls off the lift tool. Always completely lower the lift tool load plate and properly secure the load on the lift tool before moving or using the lift tool to lift or move an object. (D010)

DANGER: Multiple power cords. The product might be equipped with multiple AC power cords or multiple DC power cables. To remove all hazardous voltages, disconnect all power cords and power cables. (L003)



DANGER:

Hazardous voltage present. Voltages present constitute a shock hazard, which can cause severe injury or death. (L004)

DANGER:

Hazardous energy present. Voltages with hazardous energy might cause heating when shorted with metal, which might result in splattered metal, burns, or both. (L005)

DANGER: Observe the following precautions when working on or around your IT rack system:

- Heavy equipment–personal injury or equipment damage might result if mishandled.
- Always lower the leveling pads on the rack cabinet.
- Always install stabilizer brackets on the rack cabinet.
- To avoid hazardous conditions due to uneven mechanical loading, always install the heaviest devices in the bottom of the rack cabinet. Always install servers and optional devices starting from the bottom of the rack cabinet.
- Rack-mounted devices are not to be used as shelves or work spaces. Do not place objects on top of rack-mounted devices.

- Each rack cabinet might have more than one power cord. Be sure to disconnect all power cords in the rack cabinet when directed to disconnect power during servicing.
- Connect all devices installed in a rack cabinet to power devices installed in the same rack cabinet. Do not plug a power cord from a device installed in one rack cabinet into a power device installed in a different rack cabinet.
- An electrical outlet that is not correctly wired could place hazardous voltage on the metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. (R001 part 1 of 2)

CAUTION:

- Do not install a unit in a rack where the internal rack ambient temperatures will exceed the manufacturer's recommended ambient temperature for all your rack-mounted devices.
- Do not install a unit in a rack where the air flow is compromised. Ensure that air flow is not blocked or reduced on any side, front, or back of a unit used for air flow through the unit.
- Consideration should be given to the connection of the equipment to the supply circuit so that overloading of the circuits does not compromise the supply wiring or overcurrent protection. To provide the correct power connection to a rack, refer to the rating labels located on the equipment in the rack to determine the total power requirement of the supply circuit.
- (For sliding drawers) Do not pull out or install any drawer or feature if the rack stabilizer brackets are not attached to the rack. Do not pull out more than one drawer at a time. The rack might become unstable if you pull out more than one drawer at a time.
- (For fixed drawers) This drawer is a fixed drawer and must not be moved for servicing unless specified by the manufacturer. Attempting to move the drawer partially or completely out of the rack might cause the rack to become unstable or cause the drawer to fall out of the rack. (R001 part 2 of 2)

CAUTION: Removing components from the upper positions in the rack cabinet improves rack stability during a relocation. Follow these general guidelines whenever you relocate a populated rack cabinet within a room or building.

- Reduce the weight of the rack cabinet by removing equipment starting at the top of the rack cabinet. When possible, restore the rack cabinet to the configuration of the rack cabinet as you received it. If this configuration is not known, you must observe the following precautions.
  - Remove all devices in the 32U position and above.

  - Ensure that the heaviest devices are installed in the bottom of the rack cabinet.
  - Ensure that there are no empty U-levels between devices installed in the rack cabinet below the 32U level.
- If the rack cabinet you are relocating is part of a suite of rack cabinets, detach the rack cabinet from the suite.
- If the rack cabinet you are relocating was supplied with removable outriggers they must be reinstalled before the cabinet is relocated.
- Inspect the route that you plan to take to eliminate potential hazards.
- Verify that the route that you choose can support the weight of the loaded rack cabinet. Refer to the documentation that comes with your rack cabinet for the weight of a loaded rack cabinet.
- Verify that all door openings are at least 760 x 230 mm (30 x 80 in.).
- Ensure that all devices, shelves, drawers, doors, and cables are secure.
- Ensure that the four leveling pads are raised to their highest position.
- Ensure that there is no stabilizer bracket installed on the rack cabinet during movement.
- Do not use a ramp inclined at more than 10 degrees.
- When the rack cabinet is in the new location, complete the following steps:
  - Lower the four leveling pads.
  - Install stabilizer brackets on the rack cabinet.
  - If you removed any devices from the rack cabinet, repopulate the rack cabinet from the lowest position to the highest position.
- If a long-distance relocation is required, restore the rack cabinet to the configuration of the rack cabinet as you received it. Pack the rack cabinet in the original packaging material, or equivalent. Also lower the leveling pads to raise the casters off the pallet and bolt the rack cabinet to the pallet. (R002)

DANGER: Racks with a total weight of > 227 kg (500 lb.), Use Only Professional Movers! (R003)

DANGER: Do not transport the rack via fork truck unless it is properly packaged, secured on top of the supplied pallet. (R004)

DANGER:

Main Protective Earth (Ground):

This symbol is marked on the frame of the rack.

The PROTECTIVE EARTHING CONDUCTORS should be terminated at that point. A recognized or certified closed loop connector (ring terminal) should be used and secured to the frame with a lock washer using a bolt or stud. The connector should be properly sized to be suitable for the bolt or stud, the locking washer, the rating for the conducting wire used, and the considered rating of the breaker. The intent is to ensure the frame is electrically bonded to the PROTECTIVE EARTHING CONDUCTORS. The hole that the bolt or stud goes into where the terminal conductor and the lock washer contact should be free of any non-conductive material to allow for metal to metal contact. All PROTECTIVE EARTHING CONDUCTORS should terminate at this main protective earthing terminal or at points marked with . (R010)

CAUTION:

The weight of this part or unit is more than 55 kg (121.2 lb). It takes specially trained persons, a lifting device, or both to safely lift this part or unit. (C011)

CAUTION: To avoid personal injury, before lifting this unit, remove all appropriate subassemblies per instructions to reduce the system weight. (C012)

CAUTION: CAUTION regarding IBM provided VENDOR LIFT TOOL:

- Operation of LIFT TOOL by authorized personnel only
- LIFT TOOL intended for use to assist, lift, install, remove units (load) up into rack elevations. It is not to be used loaded transporting over major ramps nor as a replacement for such designated tools like pallet jacks, walkies, fork trucks and such related relocation practices. When this is not practicable, specially trained persons or services must be used (for instance, riggers or movers). Read and completely understand the contents of LIFT TOOL operator's manual before using.
- Read and completely understand the contents of LIFT TOOL operator's manual before using. Failure to read, understand, obey safety rules, and follow instructions may result in property damage and/or personal injury. If there are questions, contact the vendor's service and support. Local paper manual must remain with machine in provided storage sleeve area. Latest revision manual available on vendor's website.
- Test verify stabilizer brake function before each use. Do not over-force moving or rolling the LIFT TOOL with stabilizer brake engaged.
- Do not raise, lower or slide platform load shelf unless stabilizer (brake pedal jack) is fully engaged. Keep stabilizer brake engaged when not in use or motion.
- Do not move LIFT TOOL while platform is raised, except for minor positioning.
- Do not exceed rated load capacity. See LOAD CAPACITY CHART regarding maximum loads at center versus edge of extended platform.
- Only raise load if properly centered on platform. Do not place more than 200 lb (91 kg) on edge of sliding platform shelf also considering the load's center of mass/gravity (CoG).
- Do not corner load the platform tilt riser accessory option. Secure platform riser tilt option to main shelf in all four (4x) locations with provided hardware only, prior to use. Load objects are designed to slide on/off smooth platforms without appreciable force, so take care not to push or lean. Keep riser tilt option flat at all times except for final minor adjustment when needed.
- Do not stand under overhanging load.
- Do not use on uneven surface, incline or decline (major ramps).
- Do not stack loads.
- Do not operate while under the influence of drugs or alcohol.
- Do not support ladder against LIFT TOOL.
- Tipping hazard. Do not push or lean against load with raised platform.
- Do not use as a personnel lifting platform or step. No riders.
- Do not stand on any part of lift. Not a step.
- Do not climb on mast.
- Do not operate a damaged or malfunctioning LIFT TOOL machine.
- Crush and pinch point hazard below platform. Only lower load in areas clear of personnel and obstructions. Keep hands and feet clear during operation.
- No Forks. Never lift or move bare LIFT TOOL MACHINE with pallet truck, jack or fork lift.
- Mast extends higher than platform. Be aware of ceiling height, cable trays, sprinklers, lights, and other overhead objects.
- Do not leave LIFT TOOL machine unattended with an elevated load.
- Watch and keep hands, fingers, and clothing clear when equipment is in motion.
- Turn Winch with hand power only. If winch handle cannot be cranked easily with one hand, it is probably over-loaded. Do not continue to turn winch past top or bottom of platform travel. Excessive unwinding will detach handle and damage cable. Always hold handle when lowering, unwinding. Always assure self that winch is holding load before releasing winch handle.

- A winch accident could cause serious injury. Not for moving humans. Make certain clicking sound is heard as the equipment is being raised. Be sure winch is locked in position before releasing handle. Read instruction page before operating this winch. Never allow winch to unwind freely. Freewheeling will cause uneven cable wrapping around winch drum, damage cable, and may cause serious injury. (C048)

CAUTION: If the System slide rails are installed above EIA location 29U, the [ServerLIFT®] tool (or other qualified lift tool) must be used as a safety precaution for servicing. Position the lift tool platform slightly below the bottom of the System drawer to account for the slight downward flex when the drawer is extended out fully on its slides. Then gently raise the lift tool platform to stably contact the bottom of the drawer, minding not to over force it as it could put upward stress to the slide rails. A service-qualified ladder may have to be used to reach or properly work around the System at such heights. While using a ladder, do not lean on or against the system drawer or lift tool during service, and follow safe practices. (C051)

Weight considerations: 5U expansion enclosure

Before you install, move, or perform service on a 5U SAS expansion enclosure, you must be prepared to handle the weight of the enclosure and its parts.

Safety notices and considerations

Important: Always read and follow the safety notices and instructions before you install, move, or service the expansion enclosure and its parts. See “Safety notices and considerations” on page 79 for information.

- Do not exceed the specified maximum load of the rack where the enclosure is to be installed.
- Do not exceed any load limit of the building and flooring where the enclosure is to be installed.
- Always use a suitably rated mechanical lift or four persons when you are performing any of the following tasks:
  - Removing the expansion enclosure from its packing material
  - Lifting and installing the expansion enclosure in the rack for the first time
  - Reinstalling the expansion enclosure after you complete a service task (for example, replacing the enclosure FRU).
- At least three persons are required to move the enclosure while it is in the rack (if you are moving the enclosure off the rails). Even after the drives, power supply units, secondary expander modules, canisters, fans, and top cover are removed, the enclosure weighs approximately 43 kg (95 lbs).
- To maximize rack stability, always install the expansion enclosure in the lowest possible position in the rack.

Weight of expansion enclosure parts

Table 43 on page 83 summarizes the weight and quantity of the parts (FRUs) that are shipped with the 5U expansion enclosure.

Table 43. Weight of expansion enclosure parts

FRU description	Weight per unit		Quantity shipped	Total weight	
	kg	lbs		kg	lb
Enclosure FRU	42.5	93.696	1	42.500	93.696
Rail kit	9.231	20.351	1	9.231	20.351
Front fascia (4U front cover)	0.303	0.668	1	0.303	0.668
Display panel assembly	0.020	0.044	1	0.020	0.044
PSU fascia (1U cover)	0.010	0.022	1	0.010	0.022
Power supply unit (PSU)	3.335	7.352	2	6.670	14.705

Table 43. Weight of expansion enclosure parts (continued)

FRU description	Weight per unit		Quantity shipped	Total weight	
	kg	lbs		kg	lb
Secondary expansion module	0.826	1.821	2	1.652	3.642
Fan module	0.890	1.962	4	3.560	7.848
Expansion canister	1.588	3.501	2	3.176	7.002
Cable management arm (lower and upper arms)	1.373	3.027	1	1.373	3.027
Top cover	3.720	8.201	1	3.720	8.201
Fan interface board	0.118	0.260	1	0.236	0.260

Weight of expansion enclosure SAS drives

The SAS drives are shipped in a separate package from the 5U expansion enclosure. The enclosure can support up to 92 SAS drives; however, the quantity varies depending on the number of drives ordered.

Weight increases as FRUs are installed

The 5U expansion enclosure supports up to 92 SAS drives. As Table 44 on page 84 shows, substantial weight is added to the enclosure when all drives are installed.

Table 44. Weight of an enclosure with 92 SAS drives

FRU description	Approximate weigh per unit		Maximum supported	Approximate extra weight	
	kg	lb		kg	lb
2.5-inch tier 0 flash drive 2.5-inch tier 1 flash drive	0.224	0.494	92	20.608	45.433
2.5-inch hard disk drive	0.304	0.670	92	27.968	61.659
3.5-inch Near-Line SAS hard disk drive	0.876	1.931	92	80.592	177.675

As you install or replace FRUs, the overall weight of the expansion enclosure increases. For example, Table 45 on page 84 shows the weight progression as different combinations of FRUs are installed.

Table 45. Enclosure weight as FRUs are installed

Enclosure assembly		Approximate weight	
FRUs installed	FRUs not installed	kg	lb
• Enclosure	• Secondary expansion modules • Fascia (1U and 4U) • PSUs • Expansion canisters • Fan modules • Fan interface board • Display assembly • Drives • Cover	42.5	93.7
• Enclosure • Secondary expansion modules	• Fascia (1U and 4U) • PSUs • Expansion canisters • Fan modules • Fan interface board • Display assembly • Drives • Cover	44.3	97.7

Table 45. Enclosure weight as FRUs are installed (continued)

Enclosure assembly		Approximate weight	
FRUs installed	**FRUs not installed**	**kg**	**lb**
• Enclosure • Secondary expansion modules • Fascia (1U and 4U) • PSUs • Expansion canisters • Fan modules • Fan interface board • Display assembly	• Drives • Cover	58	127.9
Note: The following FRUs are installed when the enclosure is initially shipped. • Enclosure • Secondary expansion modules • PSUs • Expansion canisters • Fan modules • Fan interface board • Display assembly • Cover	• Fascia (1U and 4U) • Drives	61.5	135.4
• Enclosure • Secondary expansion modules • Fascia (1U and 4U) • PSUs • Expansion canisters • Fan modules • Fan interface boards • 92 2.5-inch tier 1 flash drives	• Cover	78.6	173.3
• Enclosure • Secondary expansion modules • Fascia • PSUs • Expansion canisters • Fan modules • Fan interface board • 92 2.5-inch hard disk drives	• Cover	86	189.6
• Enclosure • Secondary expansion modules • Fascia • PSUs • Expansion canisters • Fan modules • Fan interface board • 92 3.5-inch Near-Line SAS hard disk drives	• Cover	138.6	305.6

Conversely, the overall weight of the expansion enclosure is reduced as you remove parts. However, even with parts removed, the 5U expansion enclosure is heavy. Depending on the number of parts that remain, you might need four persons or a mechanical lift to support the weight of the expansion enclosure.

Identify the hardware components

You should become familiar with the external components of the 5U expansion enclosure.

Components on the front of the enclosure

Figure 40 on page 86 shows the front of the 5U expansion enclosure. In the figure, all parts are installed in the enclosure.

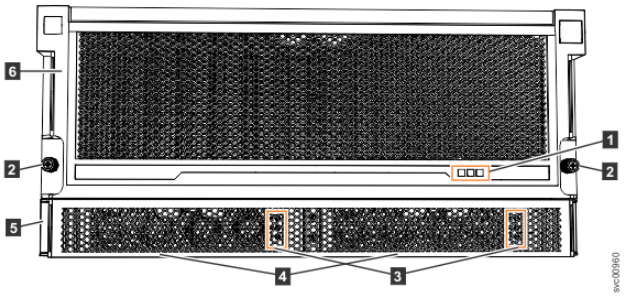


Figure 40. Features on the front of the 5U expansion enclosure

1. Display panel indicators
2. Rack retention thumb screws
3. Power supply unit indicators
4. Power supply units (PSUs)
5. PSU fascia (1U)
6. Front fascia (4U)

However, as Figure 41 on page 86 shows, the 4U and 1U fascias are packaged separately. You must attach them to the front of the 5U expansion enclosure as part of the initial installation process.

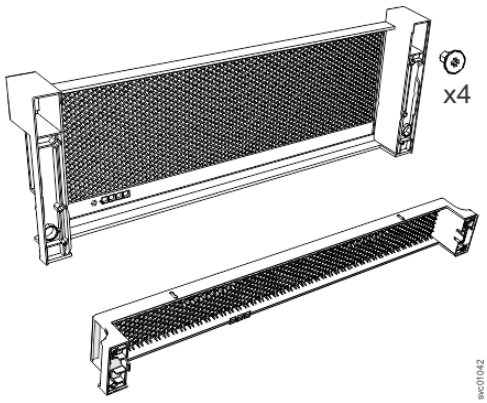


Figure 41. Front fascia of the 5U expansion enclosure

Components on the rear of the enclosure

Figure 42 on page 87 shows the components on the rear of the 5U expansion enclosure. Four fan modules and two expansion enclosures are accessible from the back of the enclosure.

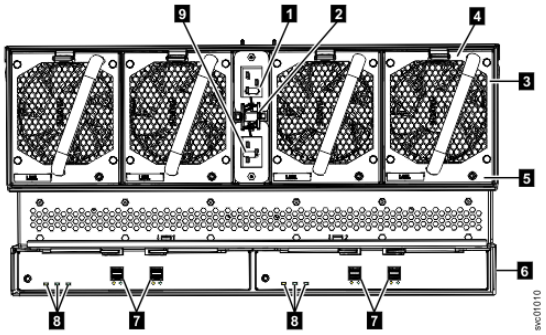


Figure 42. Features on the rear of the 5U expansion enclosure

1 Power cable connector for PSU 2
2 Power cable retention clamps
3 Fan module
4 Fan release latch
5 Fan fault indicator
6 Expansion canister
7 SAS ports and indicators
8 Expansion canister indicators
9 Power cable connector for PSU 1

Support rails

Figure 43 on page 87 shows the support rails for the expansion enclosure. The support rails are packaged separately from the expansion enclosure.

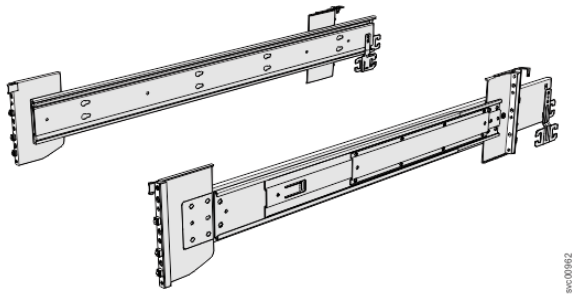


Figure 43. Support rails

Cable management arm

The cable management arm (CMA), which consists of an upper and lower assembly, are packaged separately from the expansion enclosure. As Figure 44 on page 88 shows, each CMA assembly is attached to the rear end of the support rails.

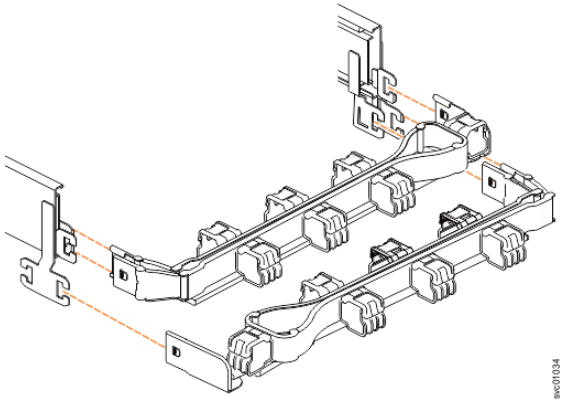


Figure 44. CMA assemblies

Unpacking an optional 5U expansion enclosure

Before you unpack an optional 5U expansion enclosure, ensure that you review and follow all related instructions and safety notices.

Before you begin

CAUTION:

The weight of this part or unit is more than 55 kg (121.2 lb). It takes specially trained persons, a lifting device, or both to safely lift this part or unit. (C011)

CAUTION: To avoid personal injury, before you lift this unit, remove all appropriate subassemblies per instructions to reduce the system weight. (C012)

Important: Before you unpack, move, install, or service the expansion enclosure and its parts, always complete the following tasks:

- Read and follow the safety notices and instructions, as described in "Safety notices and considerations" on page 79.
- Read and follow the guidelines that are described in "Weight considerations: 5U expansion enclosure" on page 83.
- Ensure that a suitably rated mechanical lift is available to support the weight of the expansion enclosure when it is inserted into the rack for installation.

About this task

The expansion enclosure and most parts are shipped together in one large box. A tray on top of the enclosure contains the front fascia (1U and 4U pieces), the cable management arm (CMA), and the slide rail kit. Figure 45 on page 89 shows how the enclosure is packaged for shipment.

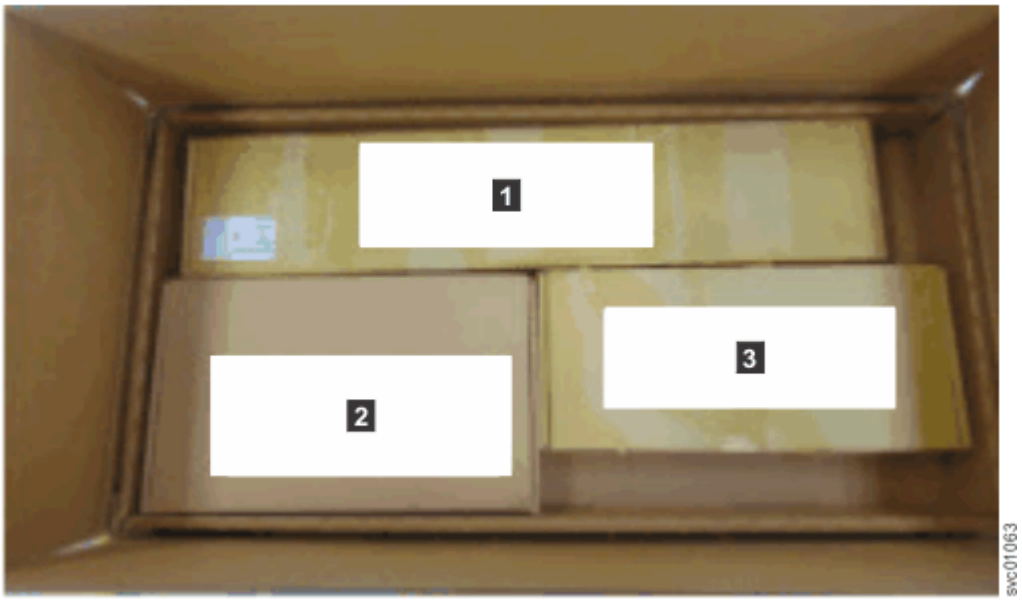


Figure 45. Tray containing expansion enclosure parts

1 Slide rail kit
2 Cable management arm
3 Fascia

Note: Drives are not included in installation package for the enclosure; they are provided in a separate package.

Procedure

1. Remove the cardboard tray that contains the slide rails, cable management arm, and fascia from cardboard box in which the expansion enclosure was shipped.
2. Remove the foam end pieces from the top of the expansion enclosure.
3. Cut the corners of the shipping box and fold them down to uncover the sides and faces of the expansion enclosure, as shown in Figure 46 on page 90.

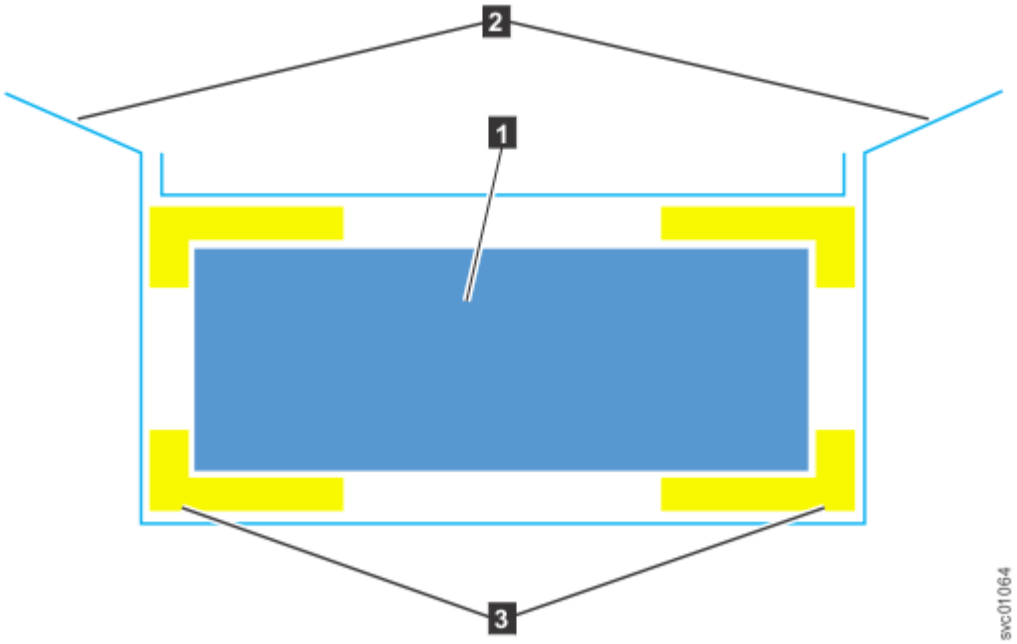


Figure 46. Packaging materials

1 Enclosure
2 Top of shipping box, folded back
3 Foam protectors

4. With four or more persons, push the expansion enclosure sideways onto an adjacent flat bed lift. Keep the remaining foam block protectors attached to the enclosure.
5. Remove the support rail kit from the box in which it was shipped (1, as shown in Figure 45 on page 89).
6. Remove the 4U and 1U fascia from the boxes in which they were shipped, as shown in Figure 47 on page 90.

Figure 47. Packaging for fascia

1 4U fascia (front)

2 1U fascia (power supply units)

7. Remove the cable management arm assembly from its packaging (2 in Figure 45 on page 89).

Installing or replacing the support rails

You must install the support rails before you can install a 5U expansion enclosure in a rack.

Procedure

1. Locate the hardware that is used to install the rails, including the M4xL6 and M5xL13 screws.
   Set the hardware, which is shown in Figure 48 on page 91, aside for use later in the installation process.

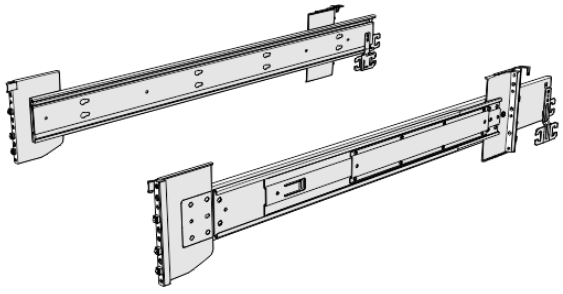


Figure 48. Support rails

2. Select an available 5U space in your rack to install the expansion enclosure.

   Important notes:

   - When you select a rack location, ensure that the enclosure and its parts are easily accessible. Allow enough space for the lid to be easily removed and for internal components, such as drives and secondary expansion modules, to be serviced.
   - When all components and drives are installed, the expansion enclosure is heavy. Install the support rails and enclosure at the lowest available position. Do not install the rails and enclosure above position U25 in the rack.

3. Remove the inner member of the rail. Push the tab (a) and slide the middle rail member back, as shown in Figure 49 on page 91.

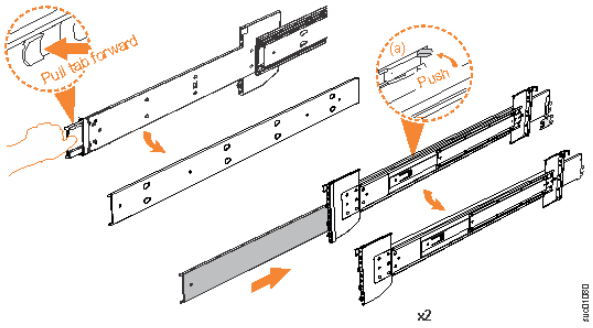


Figure 49. Detaching the inner rail section

4. Use four M4 screws to attach the inner rail to the side of the enclosure. Figure 50 on page 91 shows the screw locations.

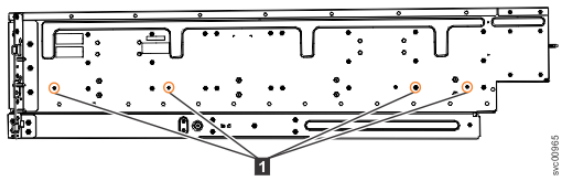


Figure 50. Screw locations to attach the inner rail to the enclosure

5. Install the inner section of the rail onto each side of the expansion enclosure, as shown in Figure 51 on page 92.

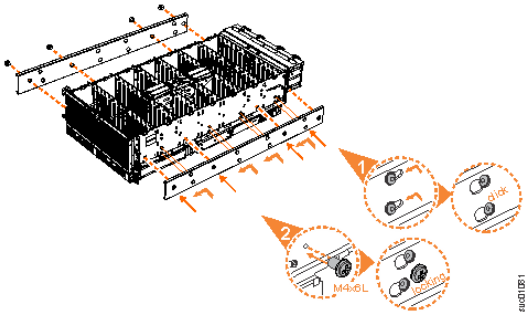


Figure 51. Attaching the inner rail section to the enclosure

6. Use the M5 screws to install the outer rail member and bracket assembly to the rack, as shown in Figure 52 on page 92.

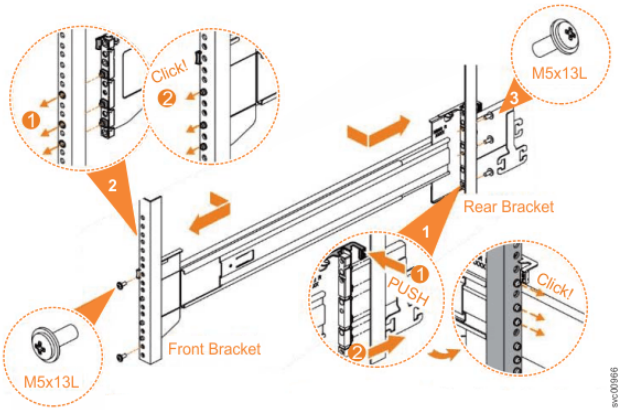


Figure 52. Installing the rail assembly to the rack frame

For example, Figure 53 on page 92 shows the front of the rail that is attached to the frame.

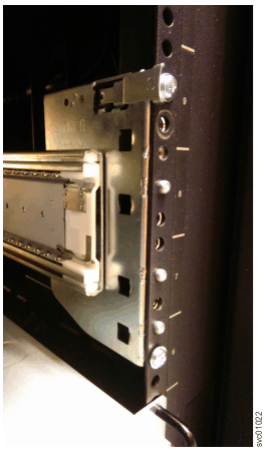


Figure 53. Example of the required rack space

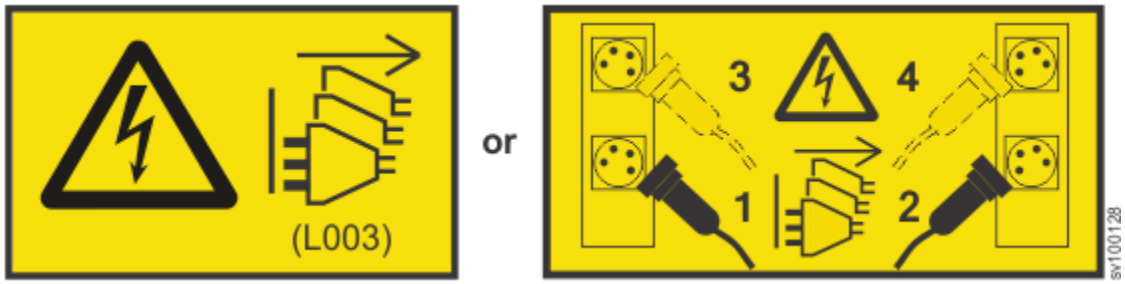
7. Repeat steps “5” on page 92 through “6” on page 92 to install the opposite rail.
8. Install the expansion enclosure in the rack, as described in “Installing a 5U expansion enclosure in a rack” on page 93.

Installing a 5U expansion enclosure in a rack

Use the following procedure to place a 5U expansion enclosure in a rack during the installation process. To complete some service tasks, you might also need to slide the enclosure back in to the rack.

Before you begin

DANGER: Multiple power cords. The product might be equipped with multiple AC power cords or multiple DC power cables. To remove all hazardous voltages, disconnect all power cords and power cables. (L003)



Use the reference numbers in parentheses at the end of each notice (for example, D005) to find the matching translated notice in *IBM Systems Safety Notices*.

DANGER: Observe the following precautions when working on or around your IT rack system:

- Heavy equipment–personal injury or equipment damage might result if mishandled.
- Always lower the leveling pads on the rack cabinet.
- Always install stabilizer brackets on the rack cabinet.
- To avoid hazardous conditions due to uneven mechanical loading, always install the heaviest devices in the bottom of the rack cabinet. Always install servers and optional devices starting from the bottom of the rack cabinet.
- Rack-mounted devices are not to be used as shelves or work spaces. Do not place objects on top of rack-mounted devices.

- Each rack cabinet might have more than one power cord. Be sure to disconnect all power cords in the rack cabinet when directed to disconnect power during servicing.
- Connect all devices installed in a rack cabinet to power devices installed in the same rack cabinet. Do not plug a power cord from a device installed in one rack cabinet into a power device installed in a different rack cabinet.
- An electrical outlet that is not correctly wired could place hazardous voltage on the metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. (R001 part 1 of 2)

CAUTION:

- Do not install a unit in a rack where the internal rack ambient temperatures will exceed the manufacturer's recommended ambient temperature for all your rack-mounted devices.
- Do not install a unit in a rack where the air flow is compromised. Ensure that air flow is not blocked or reduced on any side, front, or back of a unit used for air flow through the unit.
- Consideration should be given to the connection of the equipment to the supply circuit so that overloading of the circuits does not compromise the supply wiring or overcurrent protection. To provide the correct power connection to a rack, refer to the rating labels located on the equipment in the rack to determine the total power requirement of the supply circuit.

- (For sliding drawers) Do not pull out or install any drawer or feature if the rack stabilizer brackets are not attached to the rack. Do not pull out more than one drawer at a time. The rack might become unstable if you pull out more than one drawer at a time.
- (For fixed drawers) This drawer is a fixed drawer and must not be moved for servicing unless specified by the manufacturer. Attempting to move the drawer partially or completely out of the rack might cause the rack to become unstable or cause the drawer to fall out of the rack. (R001 part 2 of 2)

CAUTION: Removing components from the upper positions in the rack cabinet improves rack stability during a relocation. Follow these general guidelines whenever you relocate a populated rack cabinet within a room or building.

- Reduce the weight of the rack cabinet by removing equipment starting at the top of the rack cabinet. When possible, restore the rack cabinet to the configuration of the rack cabinet as you received it. If this configuration is not known, you must observe the following precautions.
  - Remove all devices in the 32U position and above.
  - Ensure that the heaviest devices are installed in the bottom of the rack cabinet.
  - Ensure that there are no empty U-levels between devices installed in the rack cabinet below the 32U level.
- If the rack cabinet you are relocating is part of a suite of rack cabinets, detach the rack cabinet from the suite.
- If the rack cabinet you are relocating was supplied with removable outriggers they must be reinstalled before the cabinet is relocated.
- Inspect the route that you plan to take to eliminate potential hazards.
- Verify that the route that you choose can support the weight of the loaded rack cabinet. Refer to the documentation that comes with your rack cabinet for the weight of a loaded rack cabinet.
- Verify that all door openings are at least 760 x 230 mm (30 x 80 in.).
- Ensure that all devices, shelves, drawers, doors, and cables are secure.
- Ensure that the four leveling pads are raised to their highest position.
- Ensure that there is no stabilizer bracket installed on the rack cabinet during movement.
- Do not use a ramp inclined at more than 10 degrees.
- When the rack cabinet is in the new location, complete the following steps:
  - Lower the four leveling pads.
  - Install stabilizer brackets on the rack cabinet.
  - If you removed any devices from the rack cabinet, repopulate the rack cabinet from the lowest position to the highest position.
- If a long-distance relocation is required, restore the rack cabinet to the configuration of the rack cabinet as you received it. Pack the rack cabinet in the original packaging material, or equivalent. Also lower the leveling pads to raise the casters off the pallet and bolt the rack cabinet to the pallet. (R002)

DANGER: Racks with a total weight of > 227 kg (500 lb.), Use Only Professional Movers! (R003)

DANGER: Do not transport the rack via fork truck unless it is properly packaged, secured on top of the supplied pallet. (R004)

DANGER:

Main Protective Earth (Ground):

This symbol is marked on the frame of the rack.

The PROTECTIVE EARTHING CONDUCTORS should be terminated at that point. A recognized or certified closed loop connector (ring terminal) should be used and secured to the frame with a lock washer using a bolt or stud. The connector should be properly sized to be suitable for the bolt or stud, the locking washer, the rating for the conducting wire used, and the considered rating of the breaker. The intent is to ensure the frame is electrically bonded to the PROTECTIVE EARTHING CONDUCTORS. The hole that the bolt or stud goes into where the terminal conductor and the lock washer contact should be free of any non-conductive material to allow for metal to metal contact. All PROTECTIVE EARTHING CONDUCTORS should terminate at this main protective earthing terminal or at points marked with ⏚. (R010)

CAUTION:

The weight of this part or unit is more than 55 kg (121.2 lb). It takes specially trained persons, a lifting device, or both to safely lift this part or unit. (C011)

CAUTION: To avoid personal injury, before lifting this unit, remove all appropriate subassemblies per instructions to reduce the system weight. (C012)

CAUTION: CAUTION regarding IBM provided VENDOR LIFT TOOL:

- Operation of LIFT TOOL by authorized personnel only
- LIFT TOOL intended for use to assist, lift, install, remove units (load) up into rack elevations. It is not to be used loaded transporting over major ramps nor as a replacement for such designated tools like pallet jacks, walkies, fork trucks and such related relocation practices. When this is not practicable, specially trained persons or services must be used (for instance, riggers or movers). Read and completely understand the contents of LIFT TOOL operator's manual before using.
- Read and completely understand the contents of LIFT TOOL operator's manual before using. Failure to read, understand, obey safety rules, and follow instructions may result in property damage and/or personal injury. If there are questions, contact the vendor's service and support. Local paper manual must remain with machine in provided storage sleeve area. Latest revision manual available on vendor's website.
- Test verify stabilizer brake function before each use. Do not over-force moving or rolling the LIFT TOOL with stabilizer brake engaged.
- Do not raise, lower or slide platform load shelf unless stabilizer (brake pedal jack) is fully engaged. Keep stabilizer brake engaged when not in use or motion.
- Do not move LIFT TOOL while platform is raised, except for minor positioning.
- Do not exceed rated load capacity. See LOAD CAPACITY CHART regarding maximum loads at center versus edge of extended platform.
- Only raise load if properly centered on platform. Do not place more than 200 lb (91 kg) on edge of sliding platform shelf also considering the load's center of mass/gravity (CoG).
- Do not corner load the platform tilt riser accessory option. Secure platform riser tilt option to main shelf in all four (4x) locations with provided hardware only, prior to use. Load objects are designed to slide on/off smooth platforms without appreciable force, so take care not to push or lean. Keep riser tilt option flat at all times except for final minor adjustment when needed.
- Do not stand under overhanging load.
- Do not use on uneven surface, incline or decline (major ramps).
- Do not stack loads.
- Do not operate while under the influence of drugs or alcohol.
- Do not support ladder against LIFT TOOL.
- Tipping hazard. Do not push or lean against load with raised platform.
- Do not use as a personnel lifting platform or step. No riders.

- Do not stand on any part of lift. Not a step.
- Do not climb on mast.
- Do not operate a damaged or malfunctioning LIFT TOOL machine.
- Crush and pinch point hazard below platform. Only lower load in areas clear of personnel and obstructions. Keep hands and feet clear during operation.
- No Forks. Never lift or move bare LIFT TOOL MACHINE with pallet truck, jack or fork lift.
- Mast extends higher than platform. Be aware of ceiling height, cable trays, sprinklers, lights, and other overhead objects.
- Do not leave LIFT TOOL machine unattended with an elevated load.
- Watch and keep hands, fingers, and clothing clear when equipment is in motion.
- Turn Winch with hand power only. If winch handle cannot be cranked easily with one hand, it is probably over-loaded. Do not continue to turn winch past top or bottom of platform travel. Excessive unwinding will detach handle and damage cable. Always hold handle when lowering, unwinding. Always assure self that winch is holding load before releasing winch handle.
- A winch accident could cause serious injury. Not for moving humans. Make certain clicking sound is heard as the equipment is being raised. Be sure winch is locked in position before releasing handle. Read instruction page before operating this winch. Never allow winch to unwind freely. Freewheeling will cause uneven cable wrapping around winch drum, damage cable, and may cause serious injury. (C048)

CAUTION: If the System slide rails are installed above EIA location 29U, the [ServerLIFT®] tool (or other qualified lift tool) must be used as a safety precaution for servicing. Position the lift tool platform slightly below the bottom of the System drawer to account for the slight downward flex when the drawer is extended out fully on its slides. Then gently raise the lift tool platform to stably contact the bottom of the drawer, minding not to over force it as it could put upward stress to the slide rails. A service-qualified ladder may have to be used to reach or properly work around the System at such heights. While using a ladder, do not lean on or against the system drawer or lift tool during service, and follow safe practices. (C051)

DANGER: Serious injury or death can occur if loaded lift tool falls over or if a heavy load falls off the lift tool. Always completely lower the lift tool load plate and properly secure the load on the lift tool before moving or using the lift tool to lift or move an object. (D010)

About this task

Important: The 5U expansion enclosure is heavy. Before you install the expansion enclosure in the rack for the first time or replace it in the rack to complete a service task, review and implement the following tasks:

- Always use a suitably rated mechanical lift or four persons to raise the enclosure to install it in the rack. Even after the drives, power supply units, secondary expander modules, canisters, fans, and top cover are removed, the enclosure weighs 43 kg (95 lbs).
- Install the expansion enclosure in the lowest position in the rack. Figure 54 on page 97 shows an example.

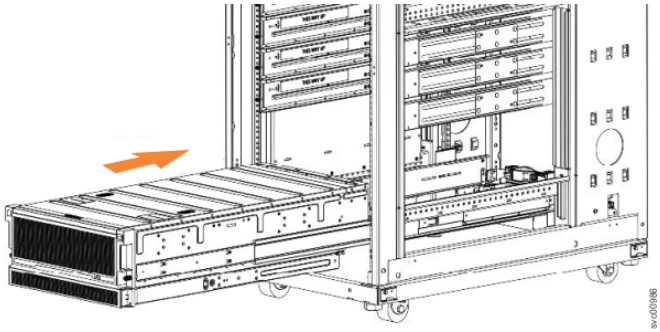


Figure 54. Example installation of the enclosure in the rack

- Ensure that the drives are easily accessible. Avoid installing the 5U expansion enclosure above position 22U in the rack.

If you are reinstalling the expansion enclosure in the rack after you performed a service task (for example, replacing the enclosure), you must also perform the following tasks:

- Reinstall all of the following parts:
  - Cover
  - Drives
  - Fan modules
  - Power supply units and 1U fascia
  - Secondary expander modules
  - Expansion canisters (and SAS cables)
- Reconnect both power cables to the expansion enclosure.

Procedure

1. Fully extend the left and right drawer sections from the rack to lock the rails in the extended position (**1** in Figure 55 on page 97).

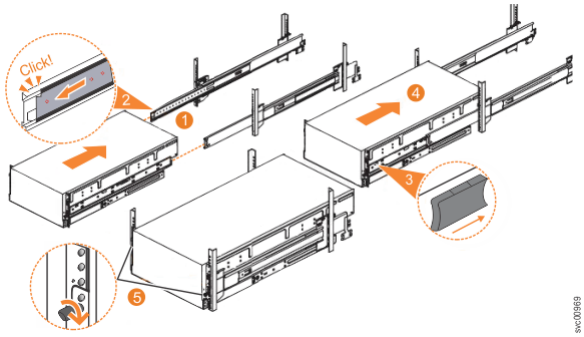


Figure 55. Replacing the 5U enclosure in the rack

2. Ensure that the ball bearing retainer clicks into place inside the front of the left and right drawer sections (**2** in Figure 55 on page 97).

Reinstalling parts into the enclosure

3. If you took the enclosure out of the rack, reinstall the following parts inside of the enclosure, as described in the following procedures. You can reinstall the parts in any order.
   - "Removing and replacing a drive" on page 198
   - "Removing and replacing a secondary expander module" on page 202

   Remember: The weight of the enclosure increases as more drives are installed.
4. Replace the top cover, as described in "Removing and replacing the top cover" on page 196.

5. Reinstall the remaining enclosure parts, as described in the following topics. You can reinstall the parts in any order.
   - “Removing and replacing a power supply” on page 213
   - “Removing and replacing the fascia” on page 210
   - “Removing an expansion canister” on page 220
   - “Removing and installing a SAS cable” on page 221
   - “Removing and replacing a fan module” on page 223

Sliding the enclosure into the rack

6. Locate the left and right blue release tabs near the front of the enclosure. Press both release tabs forward to unlock the drawer mechanism (3 in Figure 55 on page 97).
7. Push the enclosure firmly into the rack (4 in Figure 55 on page 97).
8. Tighten the locking thumb screws (5 in Figure 55 on page 97) to secure the enclosure in the rack.
9. Reconnect power to the expansion enclosure.

Powering on the optional 5U expansion enclosure

Use the following procedure to provide power to the 5U expansion enclosure as part of the initial installation process or after a service procedure.

Before you begin

Important: Before you connect the power cables to the rear of the enclosure, always check that the expansion enclosure is secured in the rack. If needed, tighten the thumbscrews on the front of the enclosure (2 in Figure 56 on page 98) to ensure that the enclosure drawer does not roll open.

About this task

The 5U expansion enclosure has two power supply units (PSUs) that are accessible from the front of the enclosure (4 in Figure 56 on page 98). As the figure also shows, the PSUs are covered by the 1U fascia (5).

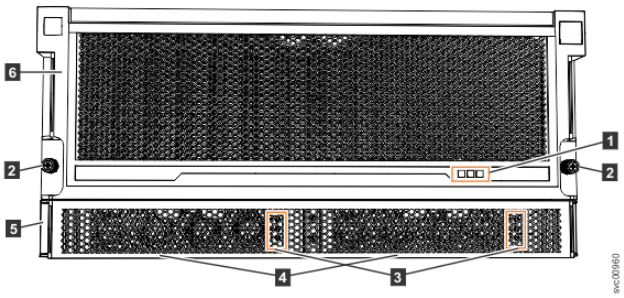


Figure 56. Features on the front of the 5U expansion enclosure

1 Display panel LEDs
2 Rack retention thumb screws
3 Power supply unit LEDs
4 Power supply units (PSUs)
5 PSU fascia (1U)
6 Front fascia (4U)

Each PSU has a power supply connector and power cable, which are accessible from the back of the enclosure. Power is provided by plugging a C19-C20 power cable into each power supply unit and, if necessary, turning on the power source. The expansion enclosure does not have a power button.

Procedure

1. Connect the C19-C20 power cables to the power connectors on the rear of the expansion enclosure.

   The enclosure automatically powers on and begins its Power On Self-Tests (POST).
2. Secure the power cables in the cable retainer at each power connector on the rear of the enclosure, as shown in Figure 57 on page 99. Also, ensure that each cable is installed along one of the cable management arms. The cable management arms also support the SAS cables.

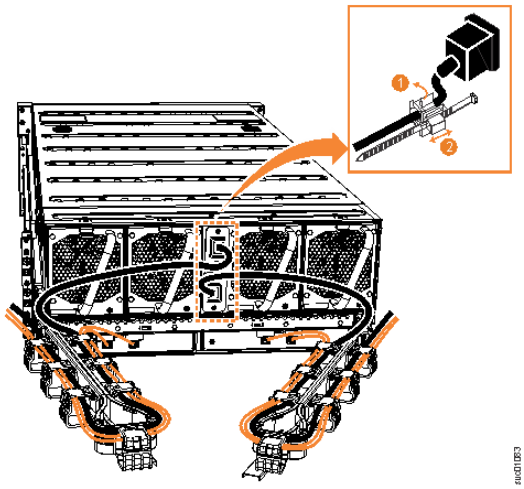


Figure 57. Secure power cables

Important: Always secure each power cable with a cable retainer and ensure that the cable is installed along one of the cable management arms. When secured, the power and SAS cables stay connected when you slide the expansion enclosure out of the rack to perform service tasks.\

Figure 58. Power and SAS cable connections on the back of the enclosure

3. Verify that the expansion enclosure and its components are operating as expected.

   On the back of the expansion enclosure, all four fans and the expansion canister indicators (3 and 8 in Figure 59 on page 99) become active when the power is connected.

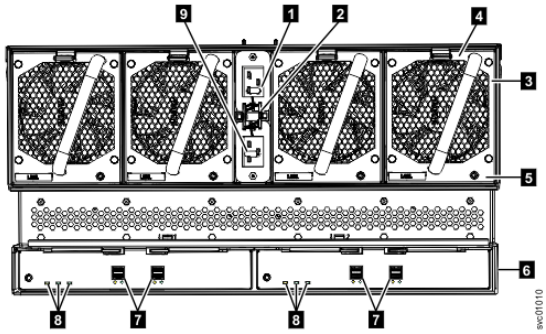


Figure 59. Features on the rear of the 5U expansion enclosure

1 Power cable connector for PSU 2
2 Power cable retention clamps
3 Fan module
4 Fan release latch
5 Fan fault indicator
6 Expansion canister
7 SAS ports and indicators
8 Expansion canister indicators
9 Power cable connector for PSU 1

On the front of the enclosure, the indicators on the front display panel and each PSU (1 and 3 in Figure 56 on page 98) are also lit when the power is connected. See "High density expansion enclosure LEDs and indicators" on page 244 for information about the status that is provided by the indicators.

4. Verify that the system recognizes the expansion enclosure.

   In the management GUI, view information about the system status and the expansion enclosure.

   - If a new expansion enclosure was installed, make sure that the enclosure was discovered by the system. A newly recognized expansion enclosure is visible in the management GUI.
   - If the expansion enclosure was powered off as part of a service procedure, view the information in the management GUI to confirm that the enclosure is operating as expected. You can also access the Event Log to view enclosure and component events and complete any remaining fix procedures.

Powering off the 5U expansion enclosure

Before you power down a 5U expansion enclosure, review the following procedure.

Before you begin

Attention: To avoid potential equipment damage during transport and subsequent loss of data, see "Procedure: Transporting a 5U 92-drive expansion enclosure" on page 101. The procedure describes what to do for the following situations.

- When you are powering off a 92F, 92G, or A9F 5U expansion enclosure because you intend to transport it to another location
- When you intend to move a rack that contains a 92F, 92G, or A9F 5U expansion enclosure

The procedure describes how to remove each drive from the 5U enclosure and transport the enclosure. Removing the drives prevents damage to the drives and makes the lighter enclosure easier to move.

When you power off an expansion enclosure, the drives in that enclosure are no longer available to the control enclosure. The SAS chain also breaks. Any expansion enclosures that are beyond the enclosure that is powered down are also disconnected from the control enclosure.

Before you power off an enclosure, use the management GUI to show the volumes that depend on that enclosure. In the system view, select the expansion enclosure to be powered off. Then, select **Dependent Volumes**. If no configuration changes are made, other volumes remain available to the system.

Procedure

1. Stop all I/O to the system from hosts that access the expansion enclosure.
2. Unmount any associated file systems.
3. Wait 5 minutes for all write data to be flushed to the drives.
4. Unplug both of the power cords from the rear of the expansion enclosure to remove all power from the enclosure.

Procedure: Transporting a 5U 92-drive expansion enclosure

Safely transport a 5U expansion enclosure by following this procedure.

Procedure

To transport a model 92F, 92G, or A9F expansion enclosure between locations, or to transport an entire rack that contains one or more of these 5U enclosures, follow these steps to protect against drive damage.

1. Safely power down the 5U enclosure by referring to “Powering off the 5U expansion enclosure” on page 100. Do not remove rack power until systems are safely powered down.
2. Transfer all of the drives in the 5U enclosure into their original packaging or equivalent packaging for safe transportation.

   The original packaging consists of an anti-static bag for each drive, an inner carton with slots for 20 drives, and an outer carton to hold three inner cartons of drives.
3. Disconnect only the cables necessary for the equipment move.
4. To remove the 5U enclosure from the rack, see “Removing a 5U expansion enclosure from a rack” on page 187.
5. Return all components, **but not the drives**, to the 5U enclosure for shipping.

   Do not return the drives to the 5U enclosure until the enclosure is at its new location and is not to be moved again.

Connecting the components

After installing the rails and enclosures in the rack, the storage enclosure and control enclosures are connected to power, the network, and any optional expansion enclosures.

After all cabling connections are completed, the system components are powered on.

Connecting Ethernet cables to the node canisters

To provide system management connectivity for your system, you must connect Ethernet cables to at least Ethernet port 1 of each node canister in the control enclosure.

Procedure

To install the Ethernet cables, complete the following steps.

1. Locate the onboard Ethernet ports of each node canister in the control enclosure. Figure 1 shows the location of the onboard Ethernet ports.

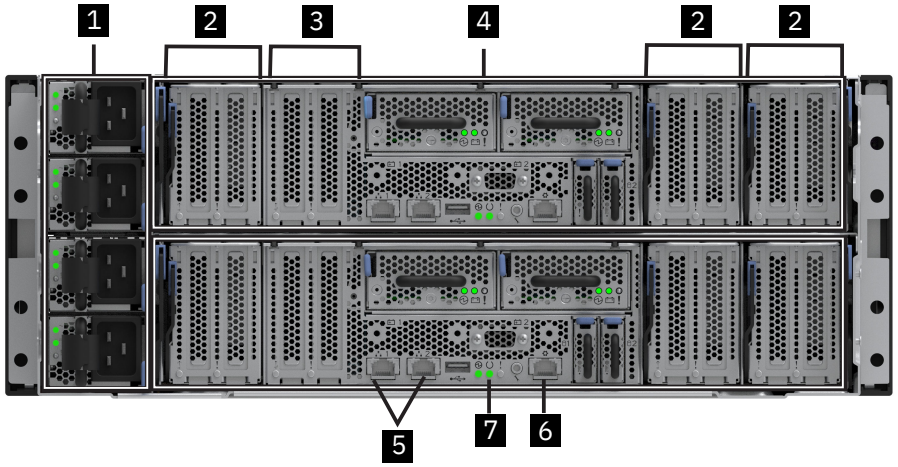


Figure 60. Node canisters and PSUs

1 Power supply units
2 Adapter cages
3 Fixed use (compression cards)
4 Node canisters
5 1 GbE management ports
6 Technician port

Connect Ethernet port 1 of each node canister in the control enclosure to the IP network that provides connection to the system management interfaces, as shown in the Table 2 that a customer fills and provide to the IBM SSR. Where more than one control enclosure is present in the system, ensure that the port 1 of every node canister is connected to the same network to provide management access if the configuration node fails.

2. Optionally, connect Ethernet port 2 of each node canister in the system to a second IP network that will provide redundant connection to the system management interfaces, if the customer indicates this connection on the onboard Ethernet connections planning worksheets.

   It is possible that the Ethernet adapters in the adapter cages of each node canister. In that case, look at the Ethernet adapter port connections table of the planning worksheets that the customer fills and provide to the IBM SSR to see whether the customer wants the SSR to make any such connections. The SSR needs to make any connection from Ethernet adapter ports that might be used for node-to-node communications.
3. Connect the Ethernet cables to any Ethernet adapter ports that the customer documented on the network connections worksheet, if the customer indicated on the worksheet that they wanted the IBM SSR to connect those cables.

Connecting Fibre Channel cables to the control enclosure

If your system has 4-port 32 Gbps Fibre Channel adapters, or 4-port 64 Gbps Fibre Channel adapters installed, use Fibre Channel cables to connect the two node canisters in the enclosure to the switches in the Fibre Channel SAN.

Before you begin

Obtain the network cable connections worksheet that you completed during your planning to determine the number of required cables and their intended port locations.

Procedure

Referring to the “Planning worksheets” on page 61, connect the required number of Fibre Channel cables to the node canisters in the control enclosure.

Note: Both node canisters must have the same number of cables connected.

The figure shows the location of the adapter cages and adapter slots, for up to 24 Fibre Channel ports per node canister.

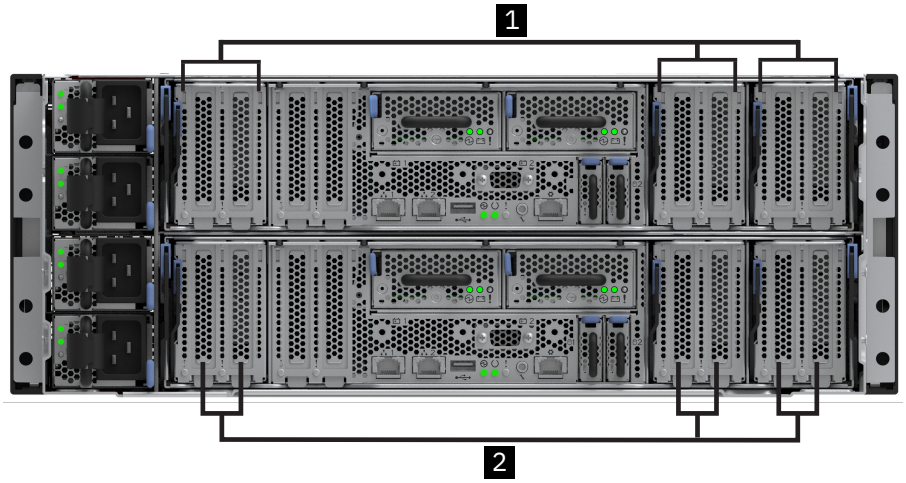


Figure 61. Adapter slot locations in the control enclosure

1 Adapter cages 1 to 3 (of node canister 1)
2 Adapter slots 1, 2, 5, 6, 7 and 8 (of node canister 2)

At the rear of each node canister, adapters are numbered sequentially according to the slot they occupy: adapter 1 is in the leftmost slot and adapter 8 is in the rightmost slot.

On each adapter, ports are numbered sequentially. Port 1 of an adapter is at the top of the adapter.

There are three adapter cages in each node canister, each holding two adapter cards. In the system software, these are numbered left to right:

- Cage 1 holds adapters 1 and 2.
- Cage 2 holds adapters 5 and 6.
- Cage 3 holds adapters 7 and 8.

Adapter slots 3 and 4 are not in a removable cage, and are not used for Fibre Channel adapters.

Ports that can be used for I/O are also enumerated with an ID number. I/O ports that are built into a node canister are enumerated first, followed by any ports of that type in each occupied adapter slot. Each type of port is enumerated separately. The **`lsportethernet`**, **`lsportfc`** and **`lsportsas`** commands show the ID and location of each port.

Connecting expansion enclosures to the control enclosure

This is a guide to using SAS cables to connect 2U and 5U expansion enclosures in a rack to the control enclosure in the rack.

About this task

This task applies if you are installing one or more expansion enclosures.

Note: It is recommended that you read the following "SAS Cabling Guidelines" before you connect any SAS cables between the control enclosure and any expansion enclosures in the rack.

SAS cabling guidelines

Orienting the connector

When you insert SAS cables, make sure the connector (Figure 62 on page 104) is oriented correctly.

- The orientation of the connector must match the orientation of the port before you push the connector into the port. The cable connector and socket are keyed, and it is important that you have proper alignment of the keys when the cable is inserted.
- Insert the connector **gently** until it clicks into place. If you feel resistance, the connector is probably oriented the wrong way. Do **not** force it.
- When inserted correctly, the connector can be removed only by pulling the tab.
- When both ends of a SAS cable are inserted correctly, the green link LEDs next to the connected SAS ports are lit.
- For FlashSystem control enclosure node canisters and 2U expansion enclosures, the blue pull tab must be below the cable (1 in Figure 62 on page 104).

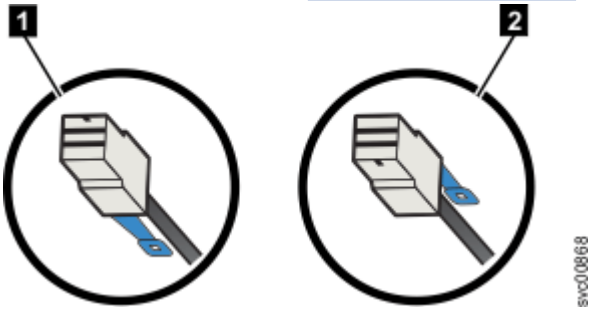


Figure 62. SAS cable connector orientation

- For 5U expansion enclosure canisters, the blue pull tab must be above the connector (2 in Figure 62 on page 104).
- Insert the connector gently until it clicks into place. If you feel resistance, the connector is probably oriented the wrong way. Do not force it. See Figure 63 on page 105.

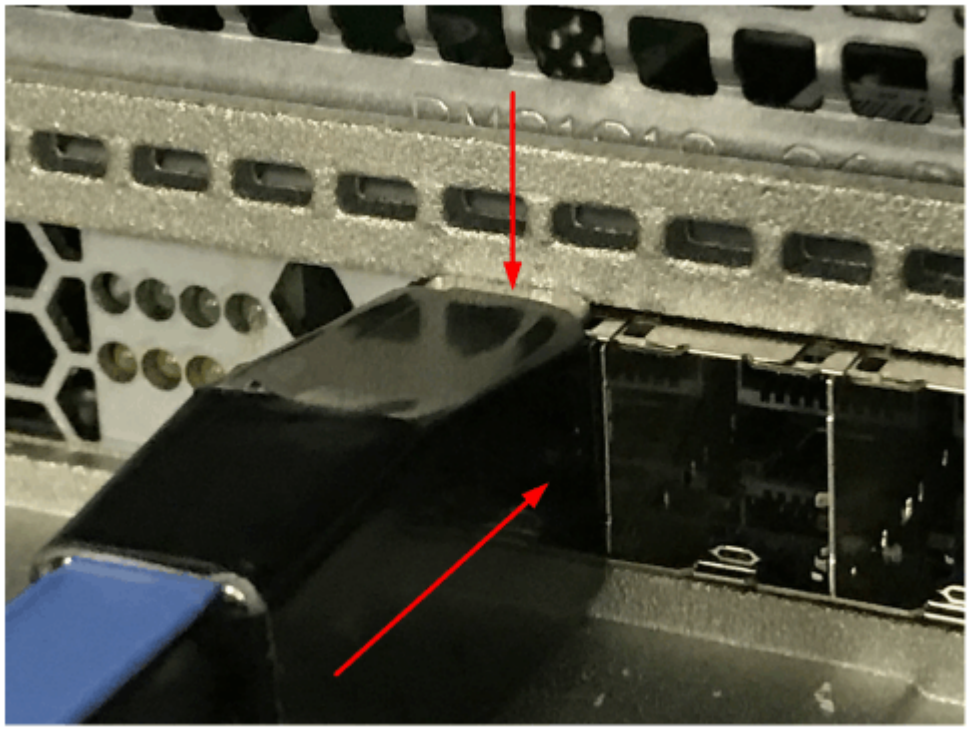


Figure 63. Pushing the SAS cable latch closed

- When inserted correctly, the connector can be removed only by pulling the tab.

Guidelines

Be aware of the following guidelines when you connect the SAS ports of a control enclosure canister to the SAS ports of a 2U and 5U expansion enclosure canister.

- The FlashSystem models support 4-port SAS interface adapters. However, only ports 1 and 3 are used for SAS connections, as Figure 64 on page 107 shows.
- See “Enclosure location guidelines” on page 56 for the number and type of expansion enclosures that can be chained to SAS port 1 and SAS port 3 of a node canister. The expansion enclosures in this chain must be installed below the control enclosure (as shown in Figure 64 on page 107).
- Do not connect a cable between a SAS port on a left canister and a SAS port on a right canister.
- Do not connect a cable between SAS ports in the same enclosure.
- Do not connect a SAS port on a control canister to more than one SAS port on an expansion canister. Cables that split the SAS connection out into separate physical connections are not supported.
- Attach cables serially between enclosures; do not skip an enclosure.
- It is recommended that SAS cables be routed through the cable management arms to reduce the risk of disconnecting the nodes from their storage arrays. This step also helps to protect the SAS cables from getting damaged if you slide the node or enclosure out of the rack while they are attached. Arrange your cables to provide access to the following components:
  - Ethernet ports, including the technician port. The technician port is used for initial setup of the system by directly attaching to a personal computer. It can also be used to complete service actions for the system.
  - USB ports.
  - The nodes and the enclosures themselves. Access is required to the hardware for servicing and for safely removing and replacing components by using two or more people.
- Do not place any cables in SAS port 2 of canister 1 or SAS port 2 of canister 2, of the last expansion enclosure in a chain.

- Ensure that cables are installed in an orderly way to reduce the risk of cable damage when replaceable units are removed or inserted.

Note:

- Figure 64 on page 107 shows an example configuration of a control enclosure that is connected to two SAS chains.
- Each chain consists of a 2U expansion enclosure and a 5U high-density expansion enclosure.
- Figure 64 on page 107 is a generic cabling diagram intended to illustrate how to cable the different types of expansion enclosure. Some systems do not allow for a mixture of expansion enclosure types in the same chain. See Chapter 4, "Expansion enclosures," on page 39 for details on the supported expansion enclosures for your specific system model.

The order of the SAS ports on the 5U high-density expansion enclosure differs from the order of the SAS ports of a 2U expansion enclosure because the canisters in the 5U expansion enclosure are rotated.

Procedure

Using the supplied SAS cables, connect the control enclosure to the expansion enclosure at rack position 1, as shown in Figure 64 on page 107.

1. Connect SAS port 1 of the uppermost or leftmost node canister in the control enclosure to SAS port 1 of the left expansion canister in the first expansion enclosure.
2. Connect SAS port 1 of the lowermost or rightmost node canister in the control enclosure to SAS port 1 of the right expansion canister in the first expansion enclosure.

To add further expansion enclosures, continue to connect the expansion canisters as shown in Figure 64 on page 107.

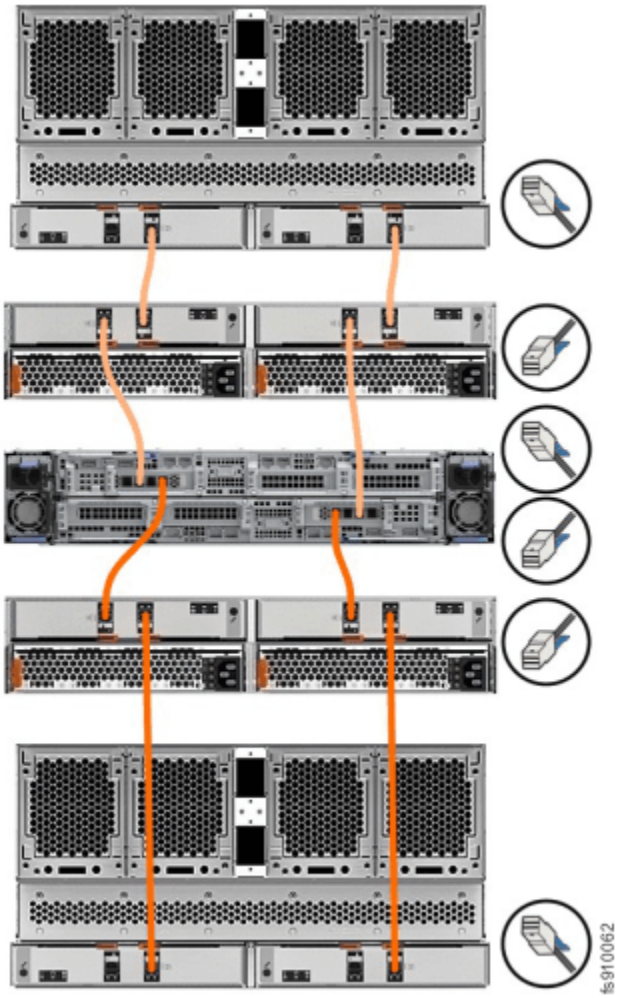


Figure 64. Connecting the SAS cables to control enclosure

Powering on the control enclosure

After you install all hardware components, you must power on the system and check its status.

About this task

Attention: Do not power on the system with any open bays or slots. Open bays or slots disrupt the internal air flow, causing the drives to receive insufficient cooling.

- Every unused drive bay must be occupied by a filler panel.
- Filler panels must be installed in all empty host interface adapter slots.

Procedure

To power on the system, complete the following steps.

1. Wait for all expansion enclosures to finish powering on.
2. Power on the control enclosure. Use the supplied power cords to connect all of the power supply units of the enclosure to their power sources.

   If the power sources have circuit breakers or switches, ensure that they are turned on. The enclosure does not have power switches.

   Notes:

- Each enclosure has four power supply units. To provide power failure redundancy, connect the four power cords to separate power circuits.
- Ensure that each power cable is secured to each PSU on the back of the enclosure.

What to do next

Next, you will connect an Ethernet cable to the technician port on the control enclosure, and initialize the system.

Initializing the system with the technician port (IBM SSR task)

To initialize the system, connect a computer to a technician port of the node canister by using an Ethernet cable, and then open a wizard in a supported web browser.

Before you begin

View the “Planning worksheets” on page 61.

Procedure

1. Ensure the system is powered on.
2. Configure an Ethernet port on the personal computer to enable Dynamic Host Configuration Protocol (DHCP) configuration of its IP address and DNS settings.

   If you do not have DHCP, you must manually configure the personal computer. Specify the static IPv4 address `192.168.0.2`, subnet mask `255.255.255.0`, gateway `192.168.0.1`, and DNS `192.168.0.1`.
3. Locate the technician port on each node canister, as shown in the following figure:

   The technician port is labeled with the "gear" icon.

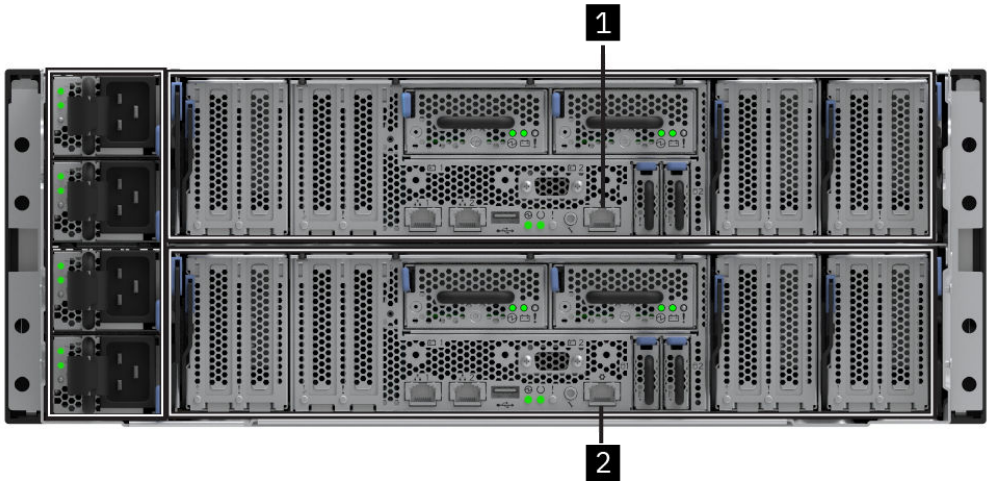


Figure 65. Technician port

1 Node canister 1 technician port
2 Node canister 2 technician port

4. Disconnect the personal computer from all networks. Connect an Ethernet cable between the port of the personal computer that is configured in step “2” on page 108 and the technician port in the left canister (1) that is shown in Figure 65 on page 108.
5. After the Ethernet port of the personal computer is connected, open a supported browser and browse to address `https://install`. (If you do not have DCHP, open a supported browser and go to the following static IP address `192.168.0.1`.)

   The browser is automatically directed to the initialization tool.

6. Follow the instructions that are presented by the initialization wizard to configure the system with a management IP address.
7. After you complete the initialization process, disconnect the cable between the personal computer and the technician port. Continue to initial system setup, see “Completing the initial system setup (customer task)” on page 111.
8. For newly installed nodes, set IP address for each node. Configure the service IP address for each node by using the values provided by the customer on the planning worksheets. To configure service IP address in the management GUI, navigate to **Settings** > **Network** > **Service IPs**

   Repeat the step for each node in the system.
9. Using the initialization GUI, enter the requested information by using the worksheets that you created during the planning phase, including the management IP address, subnet mask, and gateway.
10. Add any additional control enclosures to the system created for the first enclosure in the order.
    a) If the customer ordered feature code 9152, or otherwise has multiple control enclosures in the order, find the "Management address and service address information worksheet" that the customer filled out.
    b) Determine whether you should add the additional control enclosures to the system that you created for the first control enclosure for which you just completed the service setup. (The customer might prefer to add more candidate enclosures to existing systems on their own.)
    c) To add a new candidate enclosure to an existing system, log on to the management GUI by using the same username and password that you used to complete the service setup for the first control enclosure.

What to do next

Important:

- Connect to the system CLI using SSH and use **`sainfo lsrootcertificate`** and **`satask exportrootcertificate`** to export the system's root certificate and add it to the browser's trust store. The root certificate must be exported from the node that will be used to initialize the system.
- Browser security features might alert the user that the system certificate does not contain a valid subject alternative name. It is safe to accept the risk and continue. A new certificate that contains a valid subject alternative name can be created after completing system initialization. See System Certificates for instructions to create a new certificate.
- It might be necessary to remove old certificates that are stored in the browser before the browser accepts the request.
- The web browser might display a warning about a potential security risk if the root certificate is not added to the browser truststore. It is safe to accept the risk and continue.
- After the technician port physical connection is completed (that is, connected both ends), it can take up to 45 seconds before the port is fully up and able to process requests. Submitting requests before this interval might result in 404 error responses.
- If the `https://service` request in the browser causes a 404 error, or fails to produce a response, it might be necessary to use the url `https://192.168.0.1` in the browser request to connect to the system.

After you initialize all control enclosures in the order, complete the service setup for the first control enclosure in a multi-control enclosure order or for the only control enclosure in the order.

Completing the service setup for a new system (IBM SSR task)

Use the service setup wizard to input initial setup information for a new system.

Before you begin

- Begin this procedure after the physical installation of a new system is finished and the management IP address is established.
- Have on hand the completed Call Home information worksheet that is provided by the customer.

Procedure

To complete the service setup of the system and create MDisks on the storage array, complete the following steps.

1. After the system initialization finishes successfully, the system management GUI login screen is displayed. Log in with user name **superuser** and password **passw0rd**.

   Note: The **0** character in the password is a zero, not the letter O.

   The service setup wizard starts up.
2. To enter contact information and set up the Call Home function, complete the following steps:
   a) Enter the physical location of the enclosure to facilitate service or parts deliveries if needed, and then click **Next**.
   b) Enter a contact name, email address, phone number, and location, and then click **Next**.
   c) Enter the IP address and server port of the email server. (The server port number defaults to 25.)
   d) If the email server requires authentication, enter the username and password, then click **Next**.
   e) The standard IBM Call Home email address is preconfigured.
   f) Select event notifications for any additional email addresses if necessary, then click **Next**.

      The Test Call Home function automatically runs. Correct any errors if instructed to do so.
3. To facilitate access to IBM Storage Insights by the customer, enter the customer's **IBMid** from the customer worksheet.
   - If the customer is already using IBM Storage Insights, the wizard will display an IP address that you should provide to the customer for their use when they perform their initial system configuration.
   - If the customer has not used IBM Storage Insights, they will automatically be registered and will receive an email notification when it is ready for use.
4. Review the summary screens and make any necessary changes, then click **Finish**.

   The wizard completes the service setup process and then displays a window that indicates that the service installation is complete.

   Note: You must wait until the server has completely rebooted before proceeding to the next step.
5. Confirm that the customer can access the management GUI using the management IP address.
6. Add any additional control enclosures to the system created for the first enclosure.
   a) If the customer ordered feature code 9152, or otherwise has multiple control enclosures in the order, have on hand the completed "Management address and service address information worksheet" that is provided by the customer.

      Determine if you should add the additional control enclosures that you have initialized to the system that you just created for the first control enclosure. (The customer might prefer to add additional candidate enclosures to existing systems on their own.)
   b) To add a new candidate enclosure to an existing system, log onto the management GUI using the same user name and password that you used in step “1” on page 110.
   c) To add a candidate enclosure in the management GUI, select **Monitoring** > **System** > **System -- Overview** > **Add Enclosure** to start the wizard.

Tip: If **Add Enclosure** is not displayed on the **System – Overview** page, a potential cabling issue might exist. Check the installation information to ensure that you cabled the enclosure correctly.

Complete the wizard and verify the new enclosure.

After adding a control enclosure to the system, the node status LEDs on the new node canisters should come on solid within 15 minutes, as described in "Node canister indicators" on page 232.

Results

The customer can now complete the setup by using the management GUI.

Completing the initial system setup (customer task)

After the service setup of the new system is complete, use the management GUI to do the initial system setup.

Before you begin

Have the following information on hand:

- The management IP address of the system
- Licensed key information
- The worksheets that were completed during the system planning process.

Procedure

To complete the initial setup of your system, use the management GUI to complete the following high-level tasks.

1. Use a web browser to open: `https://your_management_IP`
2. Log in to the management GUI for the first time by using ID `superuser` and password `passw0rd`.

   After you log in, the initial setup wizard helps you get started.

   Use the information on your worksheets to inform your inputs.

   a) Choose and create a new password.

   b) Configure licensed functions.

   - If encryption was purchased, you can activate it now or later by opening the management GUI and selecting **Settings** > **Security** > **Encryption**.
   - The base license entitles the system to all licensed functions such as Virtualization, FlashCopy®, Global Mirroring, and Metro Mirroring for expansion enclosures.

     The system supports an optional External Storage Virtualization license to include external storage controllers to your configuration. The license is based on the total amount of capacity that you plan to virtualize from these external storage systems. If you plan to use Remote copy or FlashCopy functions with external storage, you must purchase the optional External Storage Virtualization license.

   c) If you already use IBM Storage Insights, log in to Storage Insights, select **Add Storage System** and register the new system by using the IP address.

   Important: If you do not use IBM Storage Insights, you were registered during the initial system setup. When your Storage Insights interface is ready to use, you receive an email notification. IBM® Storage Insights is an *IBM Cloud®™ software as a service* offering that can help you monitor and optimize the storage resources in the system and across your data center.

   d) If errors exist, you are prompted to resolve them.

   e) Review the system summary page, then click **Finish**.

   The Initial Setup Wizard closes.

3. If there is more than one control enclosure for your system, go to **Monitoring** > **System** > **System--Overview** and click **Add Enclosure**.

   Add Enclosure is shown only when a candidate control enclosure exists.
4. Use the **System update** page of the management GUI to check whether software updates are available for this system. Use the management GUI to help you install any updates.

   During the automatic update process, each node canister in the system is updated one at a time. After all the nodes in the system are successfully restarted with the new code level, the new level is automatically committed.
5. After you complete system set up and add any additional enclosures, create pools and add storage before creating volumes.

   Note: If there are more than 24 of the 38.4 TB FlashCore Modules in a control enclosure, you must upgrade the system software to 8.5.2 or a later release.

   To create pools and add storage, complete these steps:

   a. In the management GUI, select **Pools** > **Pools** > **Create**.
   b. Right-click the new pool on **Pools** page and select **Add Storage**. The management GUI displays storage configuration for the drives based on the recommended configuration for the drives within the storage array.
6. Referring to the Call Home and Storage Insights configuration worksheet, use the following URL to register the new system:

   `https://call-home.w3ibm.mybluemix.net/activate`
7. If you activated an encryption license, click **Enable Encryption** to complete the encryption setup wizard.
8. If exactly two control enclosures are in the system (release 8.7.0 or earlier), you must set up a quorum disk or application outside of the system. If the two control enclosures lose communication with each other, the quorum disk prevents both I/O groups from going offline. For more information, see Quorum.

Results

You completed the initial setup of your system as the final part of installation.

What to do next

Consider updating the system software to the latest available level.

You are ready to migrate data from another system and configure your system.

After the installation and initial configuration of the hardware is complete, IBM strongly suggests that the customer checks to see whether a later level of system software is available, and update to that level. After completing the software update, if necessary, you may also need to update the firmware on the drives in the system.

Adding a control enclosure to an existing system

To add a control enclosure to an existing system (release 8.7.0 and earlier), you must first install it in the rack.

About this task

Note: Enclosures with different machine types (for example, 4666-AH8 and 4983-AH8) cannot be mixed in the same system.

When SAN is being used, connect the new control enclosure to the system through a zone that you configure in the SAN. When you are using RDMA over Ethernet, you must assign IP addresses. When you are connecting the Fibre Channel adapters directly, you can bypass network setup.

Procedure

To add a control enclosure to an existing system, complete the following steps.

1. The SSR installs the FlashSystem 9500 control enclosure and completes cabling.
2. Connect the canisters directly, connects them to the storage area network, or connects them to a 25 Gbps or faster Ethernet network.
   a) To directly connect the new control enclosure to a control enclosure with an existing system, see .
   b) To connect the new control enclosure that uses the SAN, see “Connecting Ethernet cables to the node canisters” on page 101 and “Connecting Fibre Channel cables to the control enclosure” on page 102.
   c) To connect the new control enclosure by using RDMA-capable Ethernet, see Configuration details for using RDMA-capable Ethernet ports for node-to-node communications.
3. For SAN connections, complete all SAN configuration before installation and see “Cable reference” on page 60 about the cabling requirements.

   The correct zoning provides a way for the Fibre Channel ports to connect to each other.
4. For RDMA connections, ensure that the new control enclosure is connected to the same Ethernet subnet as the existing system.

   For the new node canisters to use RDMA over Ethernet, use the service assistant tool or the **satask chnodeip** command to set the node IP of each new node in the system.
5. In the management GUI, select **Monitoring** > **System**. On the **System -- Overview** page, select **Add Enclosure**. When a new enclosure is cabled correctly to the system, the **Add Enclosure** action automatically displays on the **System -- Overview** page. If this action does not appear, review the installation instructions to ensure that the new enclosure is cabled correctly. You can also add an enclosure by selecting **Add Enclosure** from the **System Actions** menu.
6. Complete the instructions in the **Add Enclosures** wizard until the control enclosure is added to the system.
7. If exactly two control enclosures are in the system, you must set up a quorum disk or application outside of the system. If the two control enclosures lose communication with each other, the quorum disk prevents both I/O groups from going offline. For more information, see Quorum.

Installing optional features

Optional hardware features can be installed in an enclosure. For example, drives, network adapters, and more memory modules.

The optional features that an enclosure supports are shown in the sales manual within the IBM Documentation. To find the relevant IBM Sales Manual, search “in all of IBM Sales manuals” for the machine type or the product name of the enclosure.

If an optional feature was ordered with the enclosure order, it is fitted at IBM manufacturing.

Drives can be added to a control enclosure or an expansion enclosure without powering off the enclosure. The IBM Storage Virtualize software discovers the drives. Use the management GUI to add the drives to an existing array or use them to make a new array.

Pluggable network port modules (for example SFP) can be added or changed without powering off the node canister.

A node canister must be logically removed from the system (by using the **rmnode** command) and power off before adding memory modules to it. When putting the node canister back in to the enclosure, it is automatically added back into the system if there are no unrecoverable node errors. Ensure that hosts can access volumes via this node canister before logically removing the other node canister from the system (by using the **rmnode** command) and power it off to add memory modules to it.

A node canister must be logically removed from the system (by using the **rmnode** command) and powered off before adding or changing any network adapter to it.

When a node canister comes online with new adapters in it, the addresses of the ports might move. Some reconfiguration might be needed to restore all communication links before proceeding to update the next node canister. If portmasks or portsets are being used, they might need to be changed.

Always check that hosts, other Storage Virtualize nodes, and any back-end storage controllers can access the partner node canister before powering off a node canister.

Note: Wait for the power LED to start flashing (standby mode) before removing the node canister from the enclosure.

Use the management GUI to check that access to volumes is not lost if a node is offline. Host administrators can check that there are still paths to volumes if a node is offline.

If there are partnerships with other IBM Storage Virtualize systems, use the management GUI to check that communication with the partner system is not lost when a node is offline.

Use the management GUI to power off or remove a node canister from the system. However, if the node is logically removed from the system, use the service assistant tool or CLI to power it off.

Use the management GUI to make any port configuration changes that might be needed to a node with new or different network adapters.

See the Removing and replacing a drive page appropriate to the product for the specific information about how and where to fit drives in the node canister type.

See the “Removing and replacing a network adapter” on page 131 page appropriate to the product for the specific information about how and where to fit adapters in the node canister type.

Related concepts

“Removing and replacing control enclosure parts” on page 116
Parts can be removed and replaced in the control enclosures to perform service procedures or during the initial installation process.

Related information

Troubleshooting

Chapter 7. Hardware Servicing

The following topics contain information about service procedures for control and expansion enclosures.

This section describes removing and replacing field-replaceable units (FRUs) from the nodes and expansion enclosures.

Each part has its own removal procedure. Sometimes a step within a procedure refers you to a different remove or replace procedure. Complete the new procedure before you continue with the first procedure that you started.

Note: Do not use FRUs from containers with broken seals or try to transfer FRUs between systems. If you open a FRU container but do not use the part, do not re-seal the container; instead, send the FRU back for reconditioning per the Certified Service Parts (CSP) process.

For more details on the service procedures, see the following pages:

Resolving a problem with failure to boot

An IBM Service Support Representative (SSR) can use this procedure to do a minimum configuration on a node canister if it fails to boot when powered on.

Before you begin

If the Storage Virtualize software is not running, then the node canister status and battery status LEDs are off. The service interfaces such as the service IP, technician port, and satask.txt on a USB flash drive do not work.

Note: If the canister services software on the PCIe switch chip finds that the microprocessors might not start, the node canister fault LED might be on with the node canister status LED off.

If the Storage Virtualize software is running, then the node canister fault LED might be on, and the node canister status LED might blink. The node canister error code and error data can be seen in the Service Assistant GUI, by connecting to the technician port, or by using the other service interfaces. Look up the error code in the FlashSystem 9500 IBM Documentation to find out what the error data means and what to do about it.

About this task

Complete the following steps if the Storage Virtualize software is not running on a node canister.

Procedure

1. Use the management GUI or **`lseventlog`** CLI to look for any error events for the missing node canister.
2. If secure boot has failed, then run the fix procedure for assistance with recovery. You might be directed to replace the boot drive with the fault LED on or to replace the node canister with the node fault LED on.
3. If the microprocessors might not be started, run the fix procedure for assistance with recovery. You might be directed to try removing all adapter cages and DIMMs except for the DIMM in slot 2 and slot 14.
4. If the Power On Self-Test (POST) on the microprocessor has failed, then run the fix procedure for assistance with recovery. You might be directed to try removing all adapter cages and DIMMs except for the DIMM in slot 2 and slot 14.
5. If there is no error event about the missing node, complete the following steps:
   a) Power off the node canister by pulling out the node canister from the enclosure.
   b) Wait for 1 minute.

c) Push the node canister back in to the enclosure and close the release latches.

The node canister attempts to power on.

d) If the power LED comes on green, then watch the node canister status indicator.

e) If the node canister status LED remains off and there are no error events for the missing node, replace the node canister.

Removing and replacing control enclosure parts

Parts can be removed and replaced in the control enclosures to perform service procedures or during the initial installation process.

Important: Read the safety precautions in the IBM Systems Safety Notices. These guidelines help you safely work with the system.

Procedure: Identifying which enclosure or canister to service

Use this procedure to identify which enclosure or canister must be serviced.

About this task

To prevent data access loss or data loss when servicing the system, identify the correct enclosure or canister when you complete a service action.

- Labels on the enclosure front and rear indicate the enclosure model and serial number.
- The node canister can be identified by the enclosure it is in, and the serial number of the node canister. The label on the release handles of the canister displays the serial number.

Depending on the system model, the rear of the enclosure might have different features. But, in general, looking at the rear of a rack:

- Control enclosures contain node canisters that have slots for networking adapters, Ethernet ports, SAS ports, and USB ports. LED indicators are also visible.
- Expansion enclosures have SAS ports and LED indicators and a service port. The model type is shown on a label.

A canister can also be located by the enclosure that contains it and its slot location. This ID is shown as *E*-*C* or *E*|*C*, where *E* is the enclosure ID and *C* is the canister slot location. On the service assistant, the ID is known as the Panel.

Note: When a node canister is added to a system as a node, it is given a node name and a node ID. The default node name is *nodeN*, where *N* is the node ID. The node ID does not represent the slot location of the node.

To display the node name and canister location in the management GUI, complete the following steps:

1. Select **Monitoring** > **System Hardware**.
2. On the **System Hardware - Overview** page, select the directional arrow next to the enclosure that contains the node canister that you want to display.
3. On the **Enclosure Details** page, click **Node Canister** to highlight the node canister in the graphic and display details for the node canister.

The service assistant home-page also shows both the node name and the canister location. If you have only the node name, use these panels to determine the node canister location. Use this procedure to identify which enclosure or canister must be serviced, as completing a service action on the wrong canister can lead to data access loss or data loss.

To control the identify LED of an enclosure or online canister, use the management GUI:

1. Select **Monitoring** > **System Hardware** .
2. On the **System Hardware - Overview** page, select the directional arrow next to the enclosure that contains the node canister that you want to identify.

3. On the **Enclosure Details** page, right-click the node canister in the graphic and select **Identify** from the **Actions** menu.

Alternatively, if a node canister is not online to the system, use the service assistant to control the identified LED.

1. Log in to the service assistant of the node canister to be identified.
2. Click **Identify** at the upper left of the page to control the identified LEDs.

Procedure: Understanding system volume dependencies

If one component in a redundant pair is offline or powered off, host access to volumes can be disrupted. Before you remove or power off a node canister or enclosure, verify whether any volumes depend on those components.

The following examples describe scenarios where the system or node status can impact if a volume is available to a host.

- If a control enclosure has only one node canister online, access to a volume depends on the online node canister. For example, a host might lose access to a volume that is stored partially or wholly on an array that uses drives in the offline node or its expansion enclosures.
- If one expansion canister in an expansion enclosure is powered off, further expansion canisters to that down side chain get isolated from the control canister of the side chain. In this case, host access to volumes depends on the online canister if the volume uses drives in an isolated enclosure or the enclosure with the offline canister.
- If an entire expansion enclosure is powered off, both sides of the SAS chain are broken. In this case, host access to some volumes can be considered to depend on the entire expansion enclosure.

The impact that a service procedure might have on host access to data can be understood by using the management GUI. To do so, use the following procedure:

1. In the management GUI, select **Monitoring** > **System** .
2. On the **System -- Overview** page, use the directional arrow near the enclosure that contains the node canister to open the **Enclosure Details** page.
3. Under **Rear View** of the system, right-click the canister and select **Dependent Volumes** from the **Actions** menu to display all volumes that become disabled to hosts if the canister is powered off.

During a maintenance procedure, if the **Dependent Volumes** action identifies dependent volumes, you may choose to stop the procedure. Then, investigate whether it is possible to reinstate the redundancy in the system to carry out the procedure without loss of access to data. For example, first complete procedures to ensure that both canisters in the enclosure are online. Then, complete any procedure that powers off the only online canister in the enclosure.

Procedure: Powering off the system

Sometimes, it is necessary to power down all node canisters in a system. For example, you might need to shut down the system before you do the maintenance actions in your data center.

Before you begin

Notes:

- It is not necessary to shut down the entire system (all node canisters) when you complete service actions.
- Service actions upon a node canister require only one node canister in the control enclosure to be shut down. If one node canister of an I/O group is online and communicating with hosts and other nodes, volumes that depend on resources of the I/O group can remain online.
- Service actions upon a control enclosure might require the control enclosure to be shut down. In this case, the I/O group that is provided by the control enclosure goes offline. All volumes that depend on that I/O group become disabled. However, other I/O groups in the system can continue to operate.

Procedure

1. Stop all host I/O to volumes on the system.
2. Shut down the system by using the management GUI. Click **Monitoring** > **System**. From the **System Actions** menu, select **Power Off System**.
3. Disconnect the power cords.
   a) If you are servicing the control enclosure only, disconnect the power cords from both power supply units (PSUs) in the control enclosure.

      Note: You do not need to power off the expansion enclosures.

   b) If you are preparing for site maintenance, disconnect the power cords from both power supplies in each expansion enclosure in the control enclosure's SAS chains.

      Note: The 2U and 5U expansion enclosures do not have a power button. Each expansion enclosure has two PSUs.
4. When you are ready to restore power to the control enclosure and any expansion enclosures, follow the appropriate procedures for your system configuration.
   a) Powering on the optional 2U SAS expansion enclosures
   b) Powering on the optional 5U expansion enclosures
   c) Powering on the control enclosures

Procedure: Powering off a node canister

To complete some service tasks, you must ensure that the node canister is powered off safely.

About this task

Attention: If your system is powered on and doing I/O operations, the system must power off correctly to ensure that no data is lost. If possible, always use the fix procedures that are presented by the management GUI to manage and maintain your system. The fix procedures ensure that the canister is powered off safely.

After powering off a node canister by using this procedure, a physical reset of the canister will be required to power it back on. The reset procedure requires physical access to the enclosure.

While a node canister is powered off, some volumes can become inaccessible. Refer to “Procedure: Understanding system volume dependencies” on page 117 to determine whether it is appropriate to continue this procedure.

Procedure

To power off a node canister, complete the following steps:

1. If you are powering off the node canister to add memory or changing an adapter that is used to communicate with another control enclosure in the system, select **Monitoring** > **System Hardware**. Right-click the node canister from the rear view of the enclosure and select **Remove**. This action uses the **rmnode** command to logically remove the node canister from the system, so it can be updated without causing problems.
2. Go to the service assistant for the node with the canister to shut down.
3. On the home page, select the node canister to shut down.
4. If you intend to do maintenance of the node canister, click **Identify** to light the Identify LED on the canister. Confirm that you know the location of the node canister.
5. Use the **Power off** action to power off the canister.
6. After the node is powered off, the service assistant shows that the node status is offline. The status LED indicators on the canister show that the node is powered off.

Removing and replacing the enclosure end caps

You can remove and replace the enclosure end caps during some service procedures.

About this task

Figure 66 on page 119 shows the end caps on the front of the control enclosure. Each end cap provides information to identify the enclosure (machine type and model and serial number). LED indicators also provide information about the status of the enclosure.

Figure 66. Front view of the control enclosure

Notes:

- The information on the end cap must always match the information that is printed on the rear of the enclosure. It must also match the information that is stored on the enclosure midplane.
- No tools are required to complete this task. Do not remove or loosen any screws.

Procedure

1. If the enclosure is on a table or other flat surface, elevate the enclosure front slightly or carefully extend the front over the table edge.
2. Grasp the end cap by the blue touch point and pull it until the bottom edge of the end cap is clear of the bottom tab on the chassis flange.

   Figure 67 on page 119 shows an example of the left end cap. The touch point is located below the LED indicators.

   Figure 67. End cap touch point and LED indicators.
3. Lift the end cap off the chassis flange.

   Figure 68 on page 120 shows how to lift the end cap of chassis flange.

Figure 68. End cap touch point and LED indicators

4. Fit the slot on the top of the new end cap over the tab on the top of the chassis flange.
5. Rotate the end cap down until it snaps into place.

Removing and replacing the control enclosure support rails

You can replace faulty support rails with new rails that are received from stock.

About this task

As part of this procedure, the control enclosure must be removed from the rack. If all of the components are installed in the enclosure, four persons are required to remove the enclosure from the rack. Follow all safety precautions when you complete this procedure.

CAUTION:

The weight of this part or unit is more than 55 kg (121.2 lb). It takes specially trained persons, a lifting device, or both to safely lift this part or unit. (C011)

CAUTION: To avoid personal injury, before lifting this unit, remove all appropriate subassemblies per instructions to reduce the system weight. (C012)

Ensure that a suitably rated mechanical lift is available to support the weight of the enclosure when it is inserted into the rack for installation. If you do not have mechanical lifting equipment then you will need to dis-assemble the removable components from the enclosure so that it becomes safe for 2 people to lift the empty chassis from the pallet and into the rack.

To enable two people to lift the enclosure to and from the rack, you can remove the components from the control enclosure before you remove it from the rack. Record the serial number of the component in each location so that the components can be returned to the same location at the end of the procedure. Then, remove the components and place them in a safe location. As well all of the cables will need to be labeled.

Procedure

1. Identify the enclosure that is mounted on the rails that are being replaced.

   Follow the steps in “Procedure: Identifying which enclosure or canister to service” on page 116 to ensure that you identify the correct enclosure.
2. Shut down the control enclosure by following the steps in “Procedure: Powering off the system ” on page 117.
3. Remove power from the enclosure by unplugging both power cables from the electrical outlets.
4. Remove all cables from the back of the enclosure that has faulty support rails; ensure that you identify the port to which each cable connects.

5. Remove the end caps from the front flanges of the enclosure, as described in topic “Removing and replacing the enclosure end caps” on page 119.
6. Unscrew the four M5 screws that secure the left and right end caps of the control enclosure to the rack

   Some installations might have two black, removable M5 screws and two silver screws that remain attached to the control enclosure after they are loosened. Figure 69 on page 121 shows an example of an silver alternative rail pin for square holes and an M5 screw.

Figure 69. Example of a silver screw and M5 screw

7. Slide the enclosure from the rack.
   - If components were not removed from the control enclosure, ensure that a lift is used to support the weight of the enclosure when it is removed from the rack.
   - You can remove several internal components to decrease the weight of the control enclosure. Be sure to note the serial numbers and slots (for drives) for each component and follow the procedures that are listed in Table 46 on page 121.

Table 46. Summary of internal components that can be removed and replaced

Component	**Procedure**
Node canister 1	“Removing and reseating a node canister” on page 138
Node canister 2	
Power supply unit 1	“Removing and replacing a power supply unit” on page 127
Power supply unit 2	
Power supply unit 3	
Power supply unit 4	
Power interposer 1	“Removing and replacing a power interposer” on page 150
Drives (1 - 24 drives). Record the slot from which each drive was removed.	“Removing and replacing a drive” on page 124
Drives (1 - 48 drives). Record the slot from which each drive was removed.	“Removing and replacing a drive” on page 124

8. Locate the left support rail.

   Record the shelf number of the support rail so that the replacement rails can be installed into the same position.
9. At the rear of the rack, remove the black M5 screws from the rear bracket of the rail. Two screws are attached to each bracket. Then, open the rear hinge bracket, as show in Figure 70 on page 122.

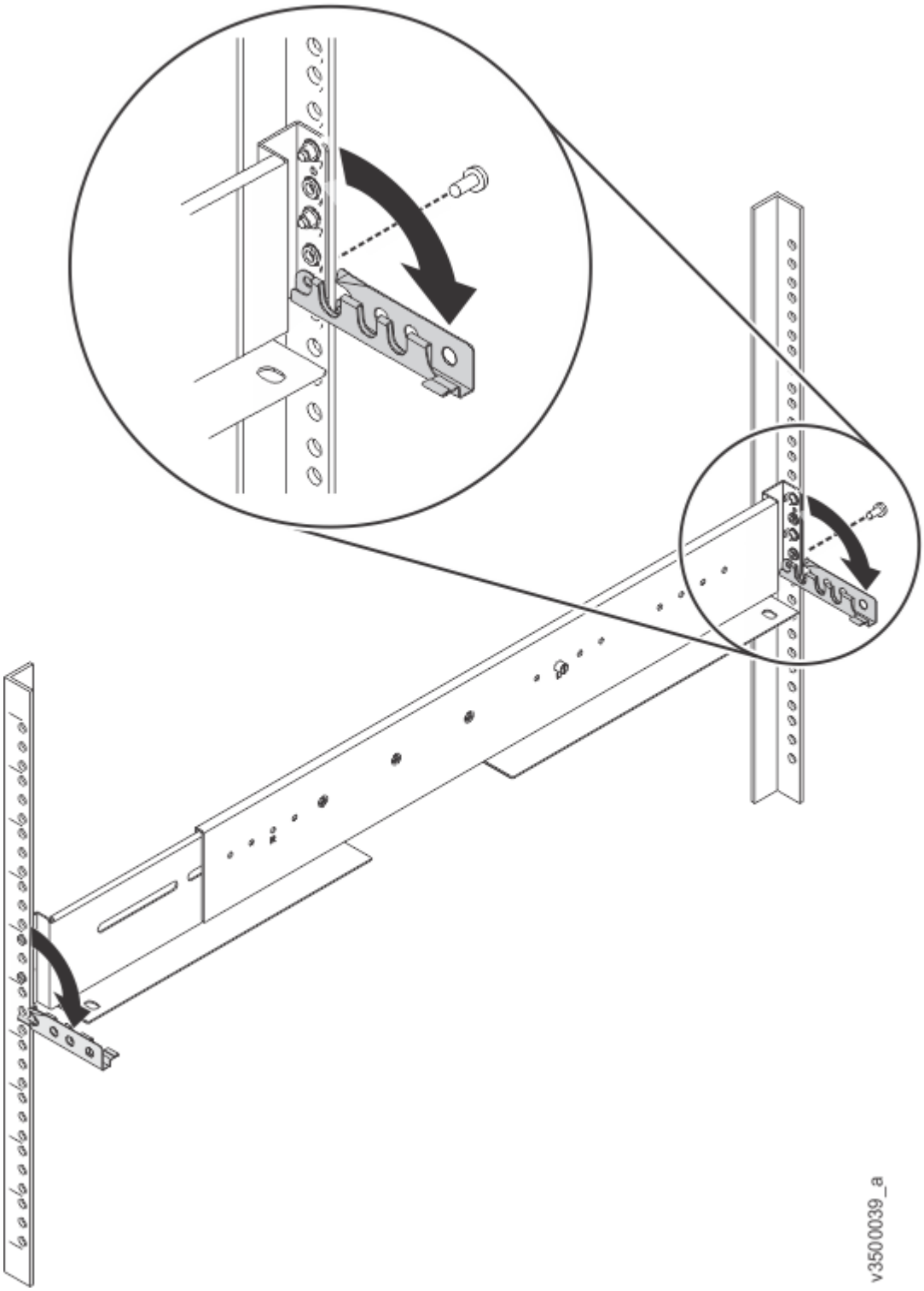


Figure 70. Opening the rear hinge bracket of the mounting rail

10. At the front of the rack, hold on to the rail and open the front hinge bracket.
11. Compress the rail to shorten it, then, remove it from inside the rack, as Figure 71 on page 123 shows.

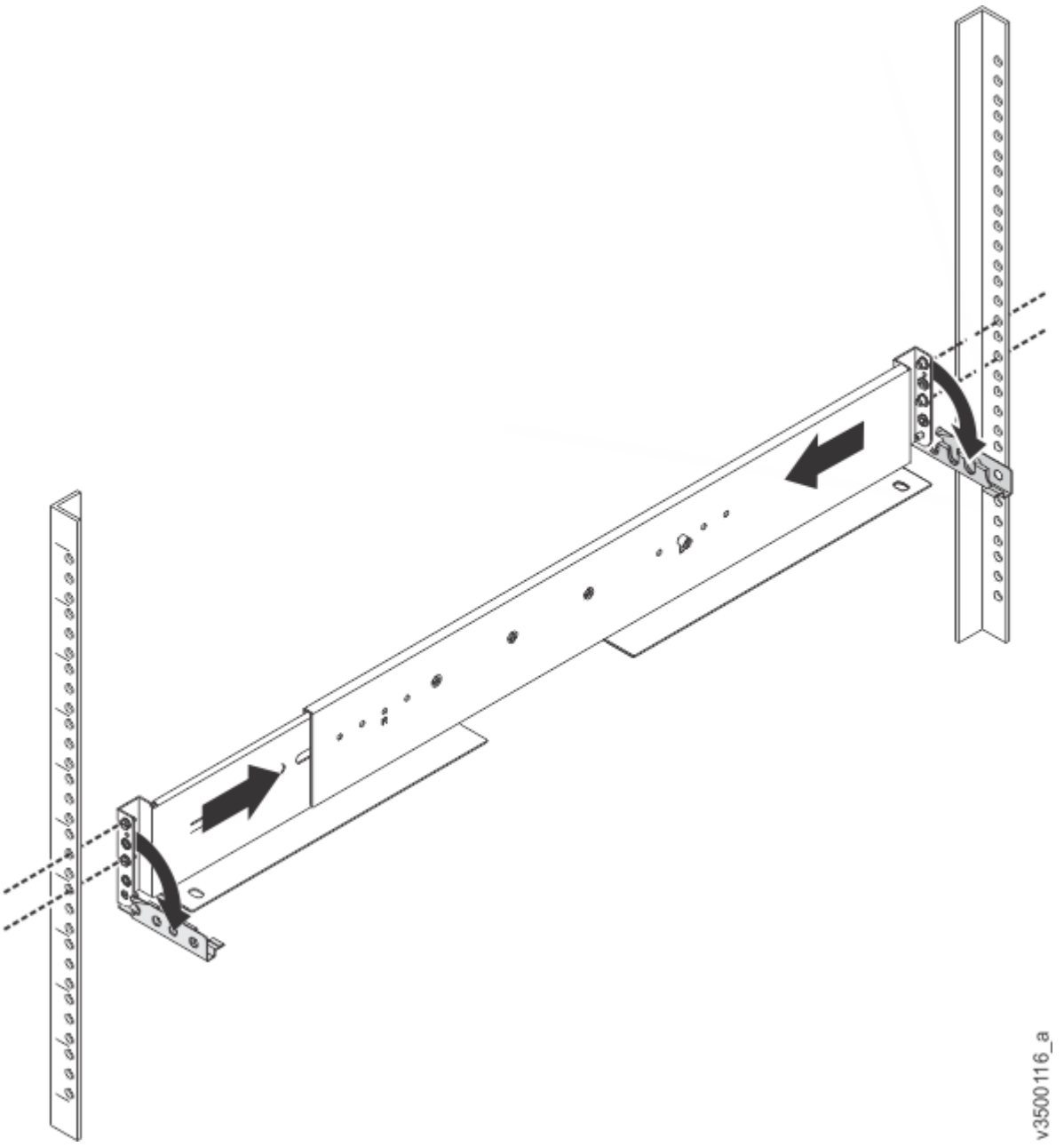


Figure 71. Compressing the rail for removal from rack

12. Repeat steps “9” on page 121 to “11” on page 122 on the right support rail.
13. Install the new support rails at the rack position that is recorded at step “8” on page 121. Follow the procedure, as described in “Installing support rails for the control enclosure ” on page 71.
14. Return the control enclosure that was removed at step “7” on page 121 to the rack.
    - If no components were removed from the control enclosure, ensure that three persons are available to support the weight.
    - If components were removed, return the control enclosure to the rack position from which it was removed. Then, follow the procedures that are listed in Table 46 on page 121 to reinstall each component into the control enclosure.
15. Secure the control enclosure to the rail with the four black M5 screws that were removed at step “6” on page 121.

Note: Some installations might have two black, removable M5 screws and two silver screws that are built into the control enclosure. In this case, first secure the silver screws and then secure the M5 screws.

16. Reinstall the end caps (removed at step “5” on page 121) by following the instructions in “Removing and replacing the enclosure end caps” on page 119.
17. Reconnect the cables, ensuring that they are connected to their original ports.
18. Reconnect the power supply cables to their original power supply and electrical outlet.

    The system starts.
19. After the system is online, use the management GUI to verify that the system is functioning correctly.

Removing and replacing a drive

Use the following procedures to remove a faulty drive from the enclosure and replace it with a new one from stock. The procedures are also applicable when you are removing or replacing an IBM FlashCore Module.

Before you begin

Attention:

- 
  When you replace this part, you must follow recommended procedures for handling electrostatic discharge (ESD)-sensitive devices.
- No tools are required to complete this task. Do not remove or loosen any screws.
- You can identify the failed drive by the flashing amber fault LED on the drive carrier. If the fault LED is lit on a drive, it is safe to replace the drive.

  If you are not sure which drive is faulty, go to the management GUI and follow the fix procedures to prevent loss of data or access to data. If an incorrect part is removed, it is possible to lose access to data.
- Every drive slot of an operational control enclosure must contain either a drive or a blank filler, and must not be left empty for more than 10 minutes during servicing. Ensure that you read and understand the instructions. Also, ensure that the replacement drive is available and unpacked before you remove the existing drive.
- IBM FlashCore Modules are not interchangeable with the flash modules that are used in IBM Storage FlashSystem 900 storage enclosures.
- The version of firmware on the replacement drive might not be the latest drive firmware available, and might not match the firmware version of other drives in the system. If necessary, firmware on the replacement drive can be updated after this procedure is complete.

Each drive slot of an operational control enclosure must contain a drive or a blank filler. The drives must be installed in specific locations, depending on the drive type and capacity. NVMe drives can be installed in slots 1 - 48. The highest capacity drive must be installed in the lowest available drive slot. Storage Class Memory (SCM) drives can be installed only in drives slots 40 - 48. The highest capacity drive must be installed in the highest available drive slot.

For more information about the supported drives, see “Control enclosure replaceable units” on page 248.

Procedure

1. Read the safety precautions in the *IBM Systems Safety Notices*. These guidelines help you safely work with the system.

Removing the drive

2. Press the blue touchpoint to unlock the latching handle, as shown in this figure.

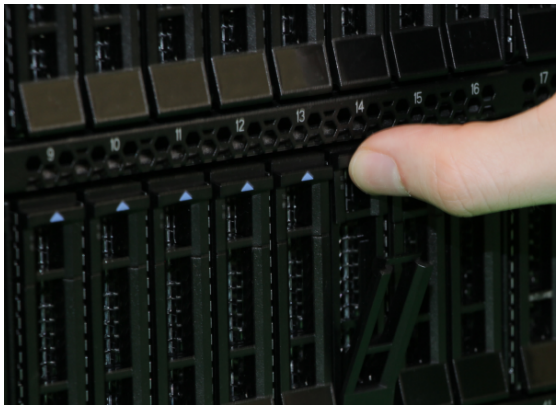


Figure 72. Unlocking the drive and release latch

3. Lower the handle and slide the drive out of the enclosure, as shown in this figure.

Replacing the drive

4. Ensure that the LED indicators are at the top of the drive.
5. Press the blue touchpoint to unlock the latching handle on the new drive.
6. Slide the new drive into the node canister, as shown in this figure. Press on the drive label near the bottom of the drive to ensure that the drive is fully inserted into the slot.

Figure 73. Inserting the new drive

7. Finish inserting the new drive by closing the handle until the latch clicks into place.

Figure 74. Completing the drive installation

Results

If the failed drive was a member of an array and sufficient members of the array are online, the system automatically updates array membership. The system rebuilds the array to include the replacement drive.

If necessary, you can update the drive firmware of the replacement drive. For more information, see Drive update.

Removing and replacing a drive blank

Use the following procedures to remove a faulty drive slot filler (blank) and replace it with a new one from stock. Drive slot fillers are passive components that regulate airflow through the control enclosure.

About this task

Notes:

- Every drive slot of an operational control enclosure must contain either a drive or a drive slot filler. A drive slot must not be left empty for more than **10 minutes** during servicing. Ensure that you read and understand the removal and replacement instructions, and the unpacked replacement part is available, before you remove the existing drive slot filler.
- No tools are required to complete this task. Do not remove or loosen any screws.

Procedure

1. Unpack the replacement drive-slot filler from its packaging.

Removing the drive-slot filler

2. Use your thumb and forefinger to pinch the latch of the faulty drive blank.

Removing a drive blank assembly

3. Gently slide the release latch up to unlock the handle.
4. Pull the faulty drive slot filler from the drive slot.

Replacing a drive blank assembly

5. Hold the drive blank the correct way up, as shown in Figure 75 on page 126.

Figure 75. Correct drive blank orientation

6. Slide the replacement drive slot filler (blank) into the empty drive slot until the latches engage.

Removing and replacing a power supply unit

You can remove and replace either of the four hot-swap redundant power supply units (PSUs) in a control enclosure. These redundant power supplies operate in parallel, a minimum of two of them are needed to power the enclosure.

About this task

Notes:

- Do not insert a PSU if the PSU slot does not contain a power interposer.
- Do not operate an enclosure without a power interposer and PSU in a PSU slot for longer than **5 minutes**. Operating for longer than this period might cause the enclosure to shut down due to overheating.
- Remove the replacement PSU from its packaging and have it available before carrying out this procedure.
- No tools are required to complete this task. Do not remove or loosen any screws.
- Although many components are hot-swappable, their intended use is only when your system is not active (no I/O operations). If your system is powered on and processing I/O operations, go to the management GUI and follow the fix procedures. Initiating the replacement actions without the assistance of the fix procedures can result in loss of data or loss of access to data.
- Be careful when you are replacing the hardware components that are located in the back of the system. Do not inadvertently disturb or remove any cables that you are not instructed to remove.
- 

When you replace this part, you must follow recommended procedures for handling electrostatic discharge (ESD)-sensitive devices.

Procedure

1. Identify the location of the control enclosure that requires service. The Event Log contains the enclosure MTM and serial number. The power supplies are shown in Locate Power Supply Units.

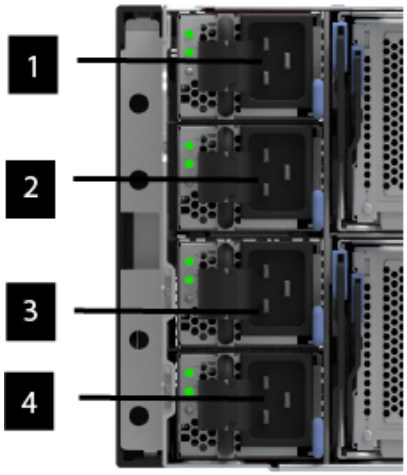


Figure 76. Locate Power Supply Units

2. Identify the PSU that requires service; the Event Log contains the ID of the PSU that failed.

Removing the PSU

3. Release the cable hook-and-loop strap and disconnect the power cord from the power supply unit that you are replacing.

This figure shows the location of the PSU LED indicator 1, hook-and-loop strap 2, PSU release tab 3, and the PSU handle 4.

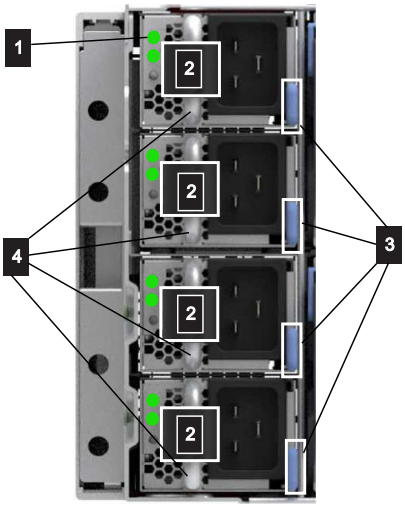


Figure 77. Features of a power supply unit

4. Hold the PSU handle, and press and hold the PSU release tab. Then, steadily pull the handle horizontally to slide the PSU from the enclosure, as shown in this figure.

   Support the PSU with your other hand as it is released from the enclosure.

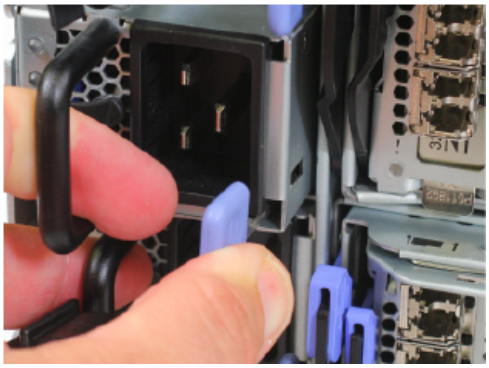


Figure 78. Removing the power supply unit

Important: Insert the replacement PSU within 5 minutes; otherwise, the system may overheat and shut down.

Replacing the PSU

5. While supporting the PSU, slide the power supply into the enclosure until the release tab engages with a "click".
6. Connect the power cord to the power supply and to a properly grounded electrical outlet. Secure the cable with the cable hook-and-loop strap on the rear of the power supply unit.

   Note: After the power cord is connected to the electrical outlet, make sure that the PSU LED indicator 1 shown in Figure 77 on page 128, is lit.

Removing and replacing an SFP transceiver

When a failure occurs on an optical link in a control enclosure, the SFP transceiver in the port that provides the link might need to be removed and replaced.

About this task

No tools are required to complete this task. Do not remove or loosen any screws.

Although many components are hot-swappable, their intended use is only when your system is not active (no I/O operations). If your system is powered on and processing I/O operations, go to the management GUI and follow the fix procedures. Initiating the replacement actions without the assistance of the fix procedures can result in loss of data or loss of access to data.

Be careful when you are replacing the hardware components that are located in the back of the system. Do not inadvertently disturb or remove any cables that you are not instructed to remove.

CAUTION: Some laser products contain an embedded Class 3A or Class 3B laser diode. Note the following information: laser radiation when open. Do not stare into the beam, do not view directly with optical instruments, and avoid direct exposure to the beam. (C030)

When you replace this part, you must follow recommended procedures for handling electrostatic discharge (ESD)-sensitive devices

Procedure

1. Carefully determine the failing physical port connection. In the Event Log, its location is identified by the following information:
   - Enclosure (MTM and serial number)
   - Canister (serial number)
   - Adapter (slot number) - if applicable
   - Port (port number).

   Important:
   - For correct operation, use the correct replacement SFP transceivers with each adapter. See Replaceable units for the applicable information for your system.
     - Use only the appropriate 25 Gbps SFP transceiver in the 25 Gbps Ethernet adapters.
     - Use only the appropriate 64 Gbps SFP transceiver in the 64 Gbps Fibre Channel adapters.
   - Removing the wrong SFP transceiver might result in loss of data access.

Replacing the SFP

2. Locate the faulty SFP device. The enclosure MTM and serial number are at the rear of the enclosure. The canister serial number is at the rear of the canister. Adapter slots and canister Ethernet ports are numbered on the canister, from left to right. Ports on each adapter are numbered from left to right.
3. Record or mark the cable that is to be removed.
4. Unlatch and remove the cable from the faulty SFP device.

   As Table 47 on page 130 shows, the SFP transceiver and latching mechanism can vary per each type of host interface adapter.

Table 47. SFP transceiver example

Host interface adapter	SFP transceiver example
Quad-port 64 Gbps Fibre Channel	
Quad-port 32 Gbps Fibre Channel	
Dual-port 25 Gbps Ethernet (iWARP)	
Dual-port 100 Gbps Ethernet	

5. Remove the faulty SFP transceiver from its aperture.
   a) Unclip the handle of the SFP transceiver.

b) Pull on the handle of the SFP transceiver to slide it out of the slot.

Replacing the SFP

6. Install the replacement SFP transceiver into the aperture that is vacated in step "5" on page 130.
   a) Open the latch on the replacement SFP transceiver.
   b) Push the new SFP transceiver into the aperture until it stops.
   c) Close the release latch.
   d) Gently pull the SFP transceiver. If it is installed correctly, it does not move from its aperture.
7. Reconnect the optical cable.
8. Check the Event Log to confirm that the error is cleared. Mark the error as fixed or restart the node, depending on the failure indication originally noted.

Removing and replacing a network adapter

Use this procedure to remove and replace a network adapter, such as a host interface adapter or SAS adapter, in a FlashSystem 9500 system with a new one received from stock.

About this task

Notes: No tools are required to complete this task. Do not remove or loosen any screws when you remove or replace an adapter.

Procedure

1. Identify the node with the faulty adapter.
   a) Identify any dependencies on the node canister by using the management GUI. Understand the impact of any dependencies and resolve them if necessary.
   b) Locate the control enclosure that requires servicing by its MTM and serial number (S/N), which are labeled on the enclosure front left cover and also on the enclosure rear. At the rear of the enclosure, locate the node canister by finding its serial number on the bottom lip of the canister.
   c) Use the Event Log to identify the location of the adapter that requires replacement. Location information includes the enclosure MTM and S/N, node canister (slot number/serial number), and the adapter slot number.
2. At the rear of the enclosure, the adapter is located in a cage. There may be another adapter in the same cage. Label each network cable connection or record all cables that are connected to each adapter in the cage, using a table such as shown in Table 48 on page 131

Table 48. Cable identification for adapters in the cage being serviced

Slot numbers contained in cage	
Adapter in slot 1 of the cage	**Adapter in slot 2 of the cage**
Port 1 cable:	Port 1 cable:
Port 2 cable:	Port 2 cable:
Port 3 cable:	Port 3 cable:
Port 4 cable:	Port 4 cable:

3. Use the management GUI to shut down the node canister containing the adapter that requires replacement.
4. Wait for the node to shut down. Refer to the status LEDs to determine that the node has shut down before proceeding to replace the adapter.

Note: If you are using NVMe over RDMA for host attachment with 100 Gbps adapters in the node canister, ensure that 100 Gbps adapter ports must be set with 1500 MTU value. If the MTU value for 100 Gbps

adapter changes to a value other than 1500 on adding or removing any adapter in the system, use the chportethernet command to change MTU value.

Removing the host interface adapter

5. If applicable, remove each SFP from each port of the failed adapter , as described in “Removing and replacing an SFP transceiver” on page 128. Record the serial number of each SFP device as you remove them from the adapter ports, to ensure they can be returned to the same port in the replacement adapter.
6. Locate the eject handle on the left side of the cage containing the failed adapter. Release the cage from the canister by pulling the blue end of the cage release lever downwards.
7. Slide the adapter cage from the canister. Ensure other cables allow for removal of the adapter cage containing the adapter.
8. Press the adapter out of the PCIe socket of the adapter cage.

   Important: Adapters with a large SFP cage, such as the 4-port Fibre Channel adapter, might have limited clearance between the external edge of the SFP cage and the slot of the PCIe riser. When you remove or insert an adapter, you might need to start the removal at the bracket end of the adapter, so that the adapter is removed at a slight angle.

Replacing the host interface adapter

9. Review Table 49 on page 132 to ensure that you are using the correct replacement adapter.

Table 49. Summary of network adapters and SFP devices

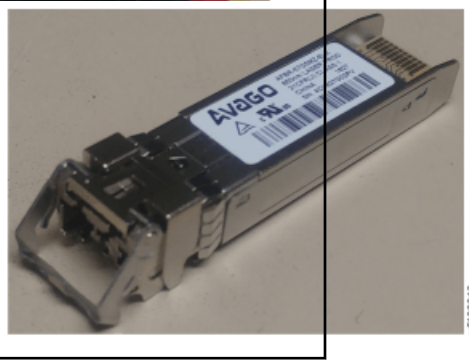
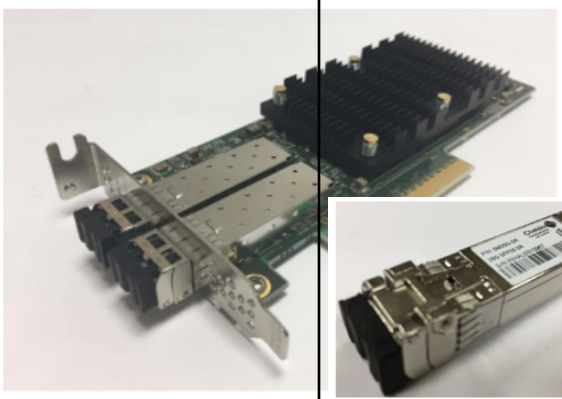
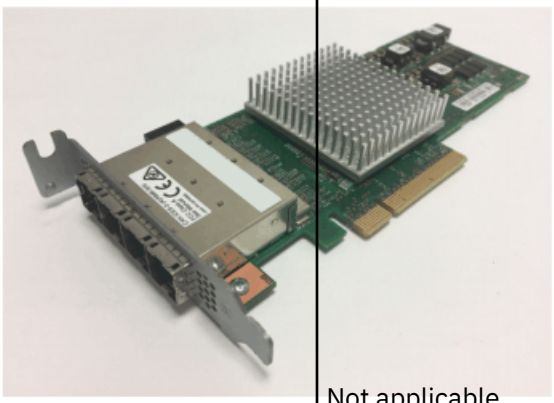
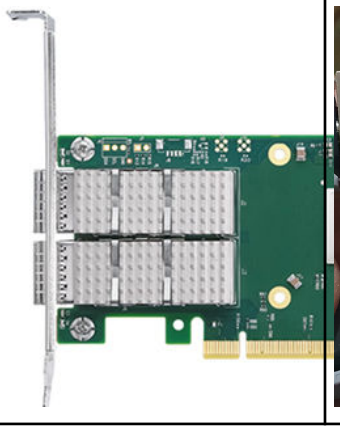
Type	Adapter	SFP device
Quad-port 64 Gbps Fibre Channel		
Quad-port 32 Gbps Fibre Channel		

Table 49. Summary of network adapters and SFP devices (continued)

Type	Adapter	SFP device
Dual-port 25 Gbps Ethernet (iWARP)		
Quad-port 12 Gbps SAS		Not applicable
Dual-port 100 Gbps Ethernet		

10. Align the replacement adapter with the PCIe socket of the adapter cage and press the adapter into place. Ensure that the adapter is fully seated in the riser, as shown in Figure 79 on page 134.

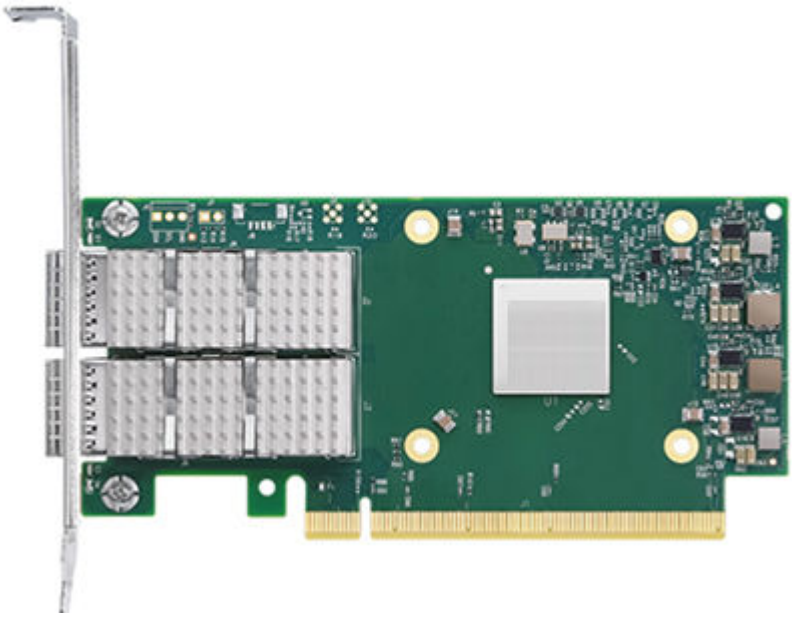


Figure 79. Alignment of the network adapter

11. Ensure the both adapters or PCIe card filler are well seated.
12. Insert any SFP devices that were removed into the adapter.
13. Align the adapter cage so that the adapter SFPs face out of the canister and the adapter cage lever is fully open.
14. Push the adapter cage into the proper slot until the lever begins to move, the press the handle up and in until it clicks into place.
15. Reconnect the network cables to the rear of the canister, by using the information that you collected at step “2” on page 131.
16. Log in to the Service assistant GUI of the node canister in service state.
17. Wait for the node canister to restart, it should automatically leave service, if it does not log into the service GUI or CLI.
18. Verify that the error is cleared from the Event Log.

Removing and replacing the cover of a node canister

To complete a service procedure, you may need to remove and replace the cover of a node canister.

About this task

- A Philips screwdriver is required to complete this task.
- The cover of a node canister can be removed only after the canister is removed from the control enclosure.
- Allow the fans to quit running before removing the cover. If the canister is not properly shutdown, the system will still have power.
- Use an ESD wrist strap.

Procedure

1. Remove the node canister from the control enclosure, as described in “Removing and reseating a node canister” on page 138.

Removing the cover

2. Place the node canister on a flat, level work surface, with the cover facing upwards. Unscrew the captive screw in the top middle of the canister.

Note: If the node canister was not powered off properly there may still be power running in the system running on the batteries. In case of this, you should wait until all the LEDs have turned off before opening the node canister.

3. Slide the cover of the node canister towards the handles and then lift the cover off of the node canister, see Figure 80 on page 135.

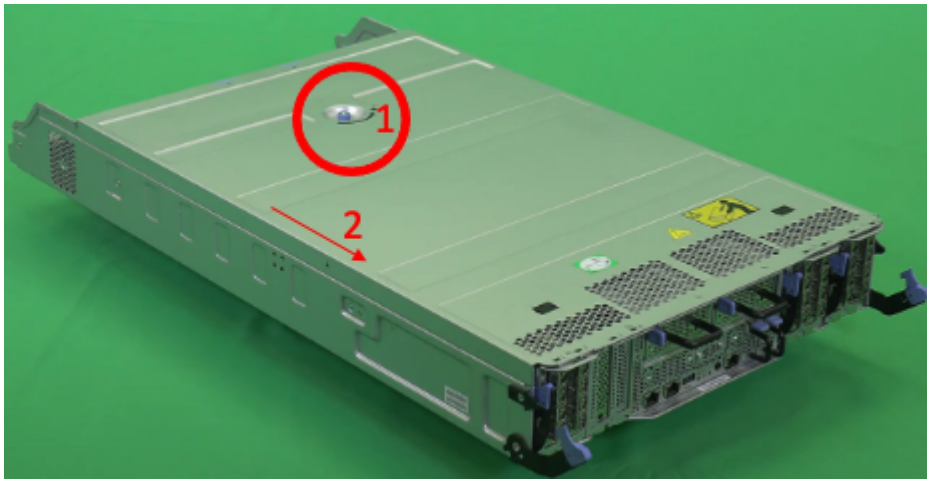


Figure 80. Removing the node canister cover

Replacing the cover

4. Align the cover to the groves on the canister sides, and lower the cover onto the canister until it is level and flush.
5. Slide the cover in the groves until the catch clicks and the lid edges are flush with the canister.
6. Fasten the captive screw on the top of the cover.

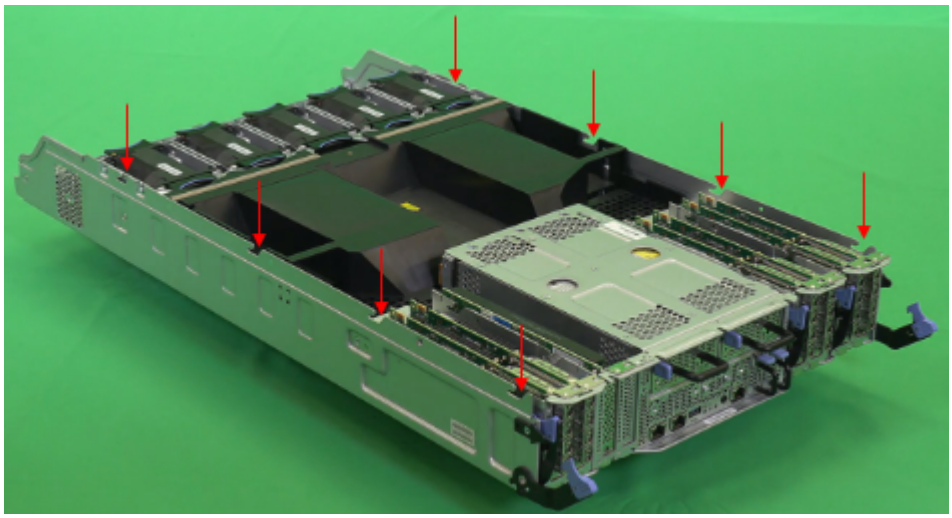


Figure 81. Replacing the node canister cover

Removing and replacing the node canister battery

To remove and replace a faulty battery with a new one received from stock, use this procedure.

About this task

No tools are required to complete this task. Do not remove or loosen any screws.

There are redundant batteries in each canister. The batteries can be hot swapped without removing the canister or powering the canister down.

CAUTION: The battery is a lithium ion battery. To avoid possible explosions, do not burn. Exchange only with the approved part. Recycle or discard the battery as instructed by local regulations. (C007a)

Procedure

1. Refer to the Event Log to identify the enclosure and node canister where battery replacement is required. Alternately, follow the procedure “System indicators summary” on page 228.

Removing the battery

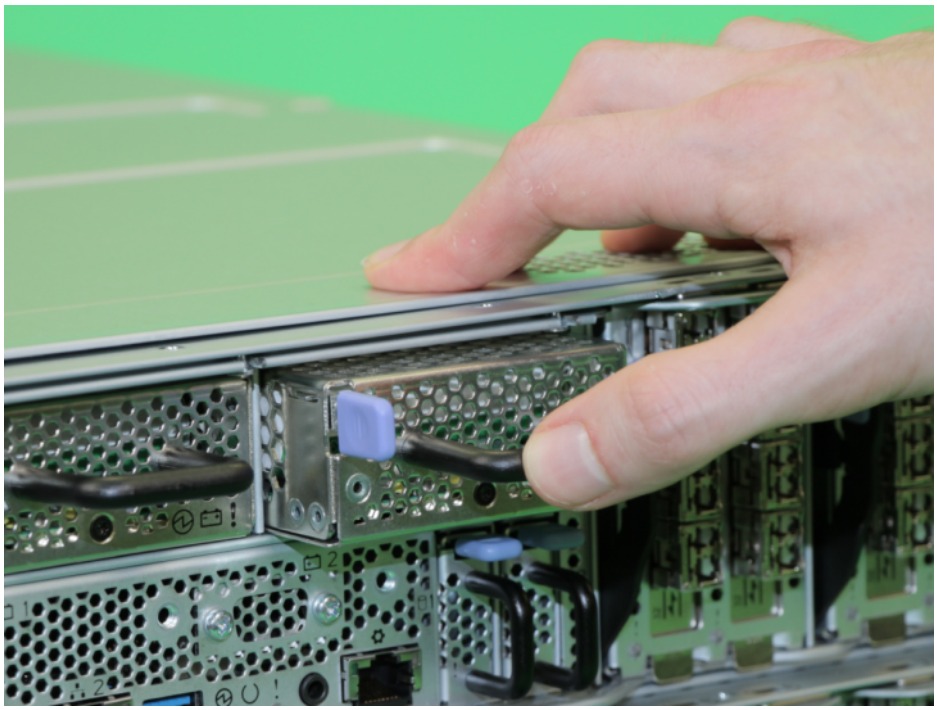
2. Identify the canister and battery to be removed. The battery fault LED will usually be on or flashing.
3. Hold the battery handle (3) and press the battery latch (1) towards the handle and slide the battery out as shown in Figure 1. The battery LEDs (2) are displayed in Figure 1.

Figure 82. Removing the battery

Replacing the battery

4. Align the battery so that the blue latch is on the left side of the battery.
5. Place the replacement battery in the battery slot.
6. Push the battery until the latch clicks.

Figure 83. Replacing the battery



Removing and replacing a CMOS battery

The complementary metal-oxide semiconductor (CMOS) battery is a coin-shaped power cell that is mounted inside the node canister. It is used to keep the system time when there is no power to the node canister.

About this task

- Use this procedure to remove and replace a CMOS battery in a node canister.
- The node canister must be shutdown and removed to perform this task.
- A Philips screw driver is needed to remove the canister cover.
- Recycle or discard the battery as instructed by local regulations.

Procedure

1. Remove the node canister, as described in “Removing and reseating a node canister” on page 138.
2. Remove the node canister cover, as described in “Removing and replacing the cover of a node canister” on page 134.

Removing the CMOS battery

3. Locate the CMOS battery inside the node canister.

Figure 84. Locating a CMOS battery

4. Gently pop the CMOS battery out of the battery holder, as shown in Figure 85 on page 138.

Figure 85. Replacing a CMOS battery

Replacing the CMOS battery

5. Orient the replacement coin cell with positive toward the right (away from adapter cage 1).
6. Gently push the new coin cell down into the battery holder.
7. Install the node canister cover, as described in "Removing and replacing the cover of a node canister" on page 134.
8. Reinsert the node canister, as described in "Removing and reseating a node canister" on page 138.
   If the canister does not begin to power-up, check that it is fully inserted into the enclosure.
9. Reconnect all cables.
10. Use the management GUI to check that the time and date settings of the system are correct.
    a) If a CMOS battery error is present in the Event Log, run the fix procedure.

Removing and reseating a node canister

To access or replace some components during service procedures, a canister might need to be temporarily removed from, and reinserted into, the enclosure.

Before you begin

Note: This topic provides instructions for temporarily removing and replacing a canister and should be used only when instructed to do so by other service procedures. To replace a faulty node canister with one from FRU stock, follow the procedure that is described in "Removing and replacing a faulty node canister" on page 140.

Make a note of the following points before replacing a canister:

- No tools are required to complete this task. Do not remove or loosen any screws.
- Before removing a canister, it must be powered off or be in service state. Otherwise, it can result in loss of data or loss of access to data.
- If a canister was recently removed from the system, and then added again, ensure that the canister is online for at least 25 minutes before you remove its partner canister. This delay allows multipath drivers to fail over to the online canister when the partner canister is removed.
- Use care when you remove a canister from the enclosure. Have a flat surface ready to receive the canister after removal.

- Use care when you lift and insert the canister.

Before you start the removal procedure, make sure to transfer the following components from the faulty canister to the replacement canister:

- DIMMs
- PCIe adapters
- Backup battery

To remove and reinsert a canister in the enclosure, complete the following steps.

Procedure

1. Shut down the canister by using the service assistant. Follow the steps in "Procedure: Powering off a node canister" on page 118.
2. Use the LED indicators on the canister to confirm that it is safe to remove it from the enclosure, as described in "Node canister indicators" on page 232.
3. Record which data cables are plugged into the specific ports on the rear of the canister. The cables must be inserted back into the same ports after the replacement is complete; otherwise, the system cannot function properly.
4. Disconnect the data cables that are connected to the canister.
5. If you are reinserting the canister while the enclosure is installed in the rack, disconnect the CMA arm from the adjacent side of the enclosure to allow room to slide the canister out of the enclosure.
6. Locate the left and right release levers for the canister, marked by blue touchpoints on the ends of the levers.
7. Holding the canister release levers by the blue touch points, open the two levers horizontally 90 degrees, then slide the canister out of the enclosure and place it onto an antistatic mat.

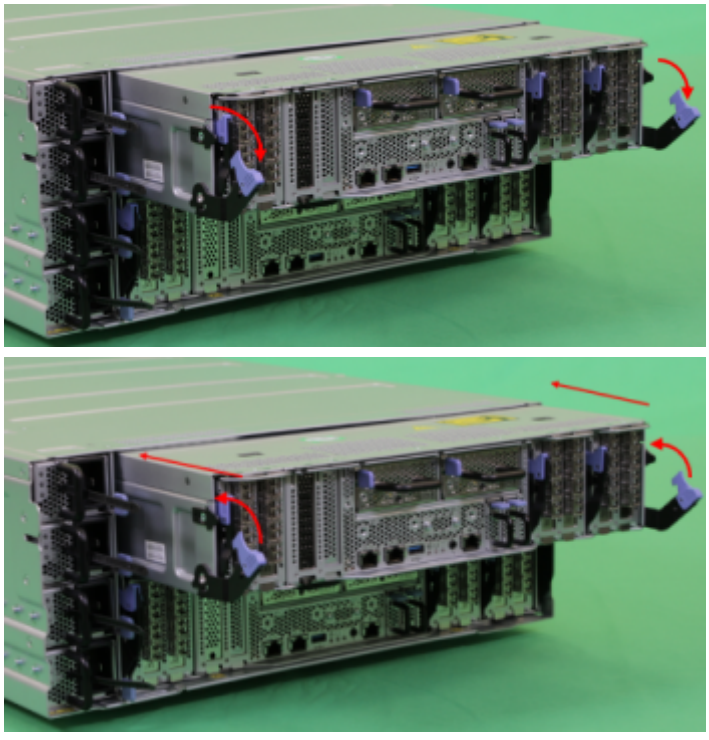


Figure 86. Removing and replacing the canister

8. To reinstall the canister, ensure that both of the canister release levers are fully open (90 degrees relative to the canister), and then slide the canister into the enclosure, ensuring that both release levers engage with the canister and begin to close.

9. Press the release levers closed to lock the canister into the enclosure. Press the latch ends to ensure that the latches are engaged with the canister.
10. Reconnect the CMA to the enclosure and rack.
11. Reconnect all cables that were removed from the back of the canister.
12. If the canister does not begin to power up, check that it is fully inserted into the enclosure. If necessary, remove the power and cables; then, repeat steps “8” on page 139 through “12” on page 140.
13. Connect directly with the replaced canister CLI. Using the following methods:
    a. Via technician port (DHCP) at 192.168.0.1
    b. Via service IP on ethernet port1, if known (blank USB key to retrieve if needed).

    If unable to connect, refer to “Resolving a problem with failure to boot” on page 115.

    Once connected issue **sainfo lsservicenodes** command to verify the node status.

    Note: Node error code 545 is expected. For more information, see 545.

    If error 545 is present, issue command **satask chbootdrive -replacecanister** to update the drives to match the serial number of the new node canister. The node will automatically reboot and join cluster.

    To help identify the node canister, the inside of the release levers is labeled with the serial number.
14. Use the management GUI or service assistant GUI to check that the node canister is online (or is Active) in the system.
15. Review the management GUI to determine that all errors are resolved.

Removing and replacing a faulty node canister

You can use this procedure to remove a faulty node canister and replace it with a new node canister. You can remove the parts from the faulty node canister and reinstall them into the new node canister. You can also use this procedure to allow for replacement of parts inside the node canister.

About this task

Notes:

- Ensure the FRU part number (P/N) of the replacement part matches that of the failed node canister, or is an approved substitute. The FRU P/N is identified on the label of the canister and on the FRU packaging.
- A Phillips screw driver is required to remove the node canister cover. Do not remove or loosen any other screws.
- Use care when you remove a node canister from the control enclosure. The node canister is long and its center of gravity is far forward. It can be helpful to have a lift or other sturdy, flat surface ready to receive the node canister during removal.
- If a node canister is being replaced because of a failure to boot, refer to “Resolving a problem with failure to boot” on page 115.

CAUTION:

- Under the worst case conditions there might be limited time for an IBM SSR to have a IBM Storage FlashSystem 9500 node canister out of a IBM Storage FlashSystem 9500 control enclosure. The worst case conditions are:
  - 950-meter elevation.
  - 48 FCM drives that are all working at maximum throughput.
- Following is a table of ambient temperature vs the maximum time that a node canister can be out of the IBM Storage FlashSystem 9500enclosure under the above worst case conditions:

Table 50. Temperature requirements	
Ambient temperature	**Maximum time**
35°C	0 minutes
30°C	2 minutes
25°C	5 minutes
21°C	10 minutes
20°C	15 minutes
19°C	indefinite minutes

Tip: You do not need to investigate this if there are less than 48 FCM drives in the enclosure. You can use the management GUI to see if all 48 FCM drives are hard-lined at maximum throughput.

Note: Above 950 m altitude, de-rate maximum ambient temperature 1°C per 300 m.

Procedure

1. Review the Event Log to identify the faulty node canister.
2. Review “Procedure: Understanding system volume dependencies” on page 117 to identify any volume dependencies on the node canister.
3. Follow Procedure: Powering off a node canister to verify that the hosts do not lose access to data in volumes.
4. From the rear of the control enclosure, label each cable and remove it from the node canister.

Removing the faulty node canister

5. Remove the node canister, as described in “Removing and reseating a node canister” on page 138, and place it on a flat, level surface.
6. Remove the new node canister from its packaging.

   Ensure that the FRU P/N of the replacement node canister matches that of the failed node canister or that the new P/N is an approved substitute. See “Replaceable units” on page 248 for more information.
7. Remove the covers from the faulty and replacement node canisters and set them aside, as described in “Removing and replacing the cover of a node canister” on page 134.
8. Remove the air baffles from the faulty and replacement node canisters and set them aside, as described in “Removing and replacing the air baffle of a node canister” on page 164.
9. Complete the following procedures to remove parts from the faulty node canister and install them in the replacement node canister.
   - “Removing and replacing a memory module” on page 142
   - “Removing and replacing the Trusted Platform Module” on page 156
   - “Removing and replacing the node canister battery” on page 135
   - “Removing and replacing an adapter cage” on page 154

     Notes:

     – You do not need to remove each adapter from its adapter cage. Each assembled riser and adapter are transferred to the replacement node canister.

     – When you install each PCIe risers and adapter assembly into the replacement node canister, use the same numbered slot that was used in the faulty node canister.
   - “Removing and replacing a boot drive” on page 159

     Note: Transfer each boot drive one at a time. Ensure that you install the drive into the same slot in the replacement node canister.

- “Removing and replacing a compression card” on page 165

Replacing the new node canister

10. Replace the air baffle in the new node canister, as described in “Removing and replacing the air baffle of a node canister” on page 164.
11. Replace the cover on the new node canister, as described in, as described in “Removing and replacing the cover of a node canister” on page 134.
12. Install the new node canister into the control enclosure, as described in “Removing and reseating a node canister” on page 138.
13. Reconnect the cables that were removed in step “4” on page 141 to the appropriate ports in the replacement node canister.
14. If the node canister was communicating with other node canisters using RDMA over Ethernet, then use the Service Assistant Tool or the **sainfo lsnodeip** command to check if the node IP configuration has been lost. Use the Service Assistant Tool or the **satask chnodeip** command to set the node IP if needed.

    Note: Step “14” on page 142 and “15” on page 142 are only needed for a new node canister.
15. Connect directly with the replaced canister CLI. Using the following methods:

    a. Via technician port (DHCP) at 192.168.0.1

    b. Via service IP on Ethernet port1, if known (blank USB key to retrieve if needed)

    If unable to connect, refer to “Resolving a problem with failure to boot” on page 115.

    Once connected issue **sainfo lsservicenodes** command to verify the node status.

    Note: Node error code 545 is expected. For more information, see 545.

    If error 545 is present, issue command **satask chbootdrive -replacecanister** to update the drives to match the serial number of the new node canister. The node will automatically reboot and join cluster.

    To help identify the node canister, the inside of the release levers is labeled with the serial number.
16. Use the management GUI or service assistant GUI to check that the node canister is online (or is Active) in the system.
17. Review the management GUI to determine that all errors are resolved.

Removing and replacing a memory module

You can remove and replace a faulty dual inline memory module (DIMM) from a control enclosure. You can also use this procedure to add DIMMs to increase the memory capacity of the node canister.

About this task

Notes:

- 

The memory modules are sensitive to electrostatic-discharge (ESD). Take precautions to avoid damage from static electricity. When you remove or replace this part, you must follow recommended procedures for handling ESD-sensitive devices.
- A screwdriver is required to open the node canister cover.
- The hardware (for example labels on the printed circuit board) identifies the processors as CPU0 and CPU1, but the Storage Virtualize error messages identify them as CPU1 and CPU2.
- All DIMMs are 64 GB, and supported configurations can have 8, 16 or 24 installed DIMMs in specific slots.

As Figure 87 on page 143 shows, each node canister contains:

- Five fans across the top
- Two processors, which are identified as CPU 1 and CPU 2
- 24 DIMM slots numbered 1 through 24.

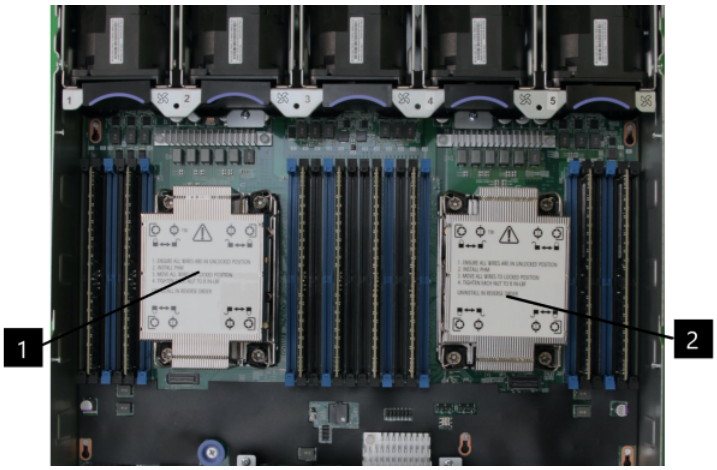


Figure 87. Location of CPUs and DIMM slots

1 CPU1 to the Storage Virtualize Software and CPU 0 to the hardware. 2 CPU 2 to the Storage Virtualize Software and CPU 1 to the hardware.

- A CPU processor can have 4, 8 or 12 DIMMs installed.
- On the system board, the DIMM slots are labeled according to their memory channel and slot. They are associated with the CPU nearest to their DIMM slots.
- You do not have to replace all memory modules at the same time. However, when you install memory modules, be sure that you follow the configurations that are described in the following table:

Table 51. Available memory configurations for a control enclosure

Total Memory per Control Enclosure	**512 GB**	**1024 GB**	**1536 GB**	**Slot label**
Features	**ACGM**	**ACGM + ACGN**	**ACGM + ACGN + ACGP**	
CH1-DIMM0	Blank	64 GB	64 GB	**1**
CH0-DIMM0	64 GB	64 GB	64 GB	**2**
CH0-DIMM1	Blank	Blank	64 GB	**3**
CH3-DIMM0	Blank	64 GB	64 GB	**4**
CH2-DIMM0	64 GB	64 GB	64 GB	**5**
CH3-DIMM1	Blank	Blank	64 GB	**6**
CPU 1				
CH6-DIMM1	Blank	Blank	64 GB	**7**
CH6-DIMM0	64 GB	64 GB	64 GB	**8**
CH7-DIMM0	Blank	64 GB	64 GB	**9**
CH4-DIMM1	Blank	Blank	64 GB	**10**
CH4-DIMM0	64 GB	64 GB	64 GB	**11**
CH5-DIMM0	Blank	64 GB	64 GB	**12**

Table 51. Available memory configurations for a control enclosure (continued)				
Total Memory per Control Enclosure	**512 GB**	**1024 GB**	**1536 GB**	**Slot label**
CH1-DIMM0	Blank	64 GB	64 GB	**13**
CH0-DIMM0	64 GB	64 GB	64 GB	**14**
CH0-DIMM1	Blank	Blank	64 GB	**15**
CH3-DIMM0	Blank	64 GB	64 GB	**16**
CH2-DIMM0	64 GB	64 GB	64 GB	**17**
CH3-DIMM1	Blank	Blank	64 GB	**18**
CPU 2				
CH6-DIMM1	Blank	Blank	64 GB	**19**
CH6-DIMM0	64 GB	64 GB	64 GB	**20**
CH7-DIMM0	Blank	64 GB	64 GB	**21**
CH4-DIMM1	Blank	Blank	64 GB	**22**
CH4-DIMM0	64 GB	64 GB	64 GB	**23**
CH5-DIMM0	Blank	64 GB	64 GB	**24**

If a node error 510 is logged (error code 1022 in the system log), the sense data includes the following information, that you can use to determine which DIMMs need to be replaced.

- Detected memory size in MB.
- Expected memory size in MB.
- A list with one entry per DIMM slot, show the size of the DIMM in GB for each slot.

Procedure

Identifying failed DIMMs

1. If you are replacing failed DIMMs, use the service assistant or the **System Event Log** in the management GUI to obtain the sense data. This data shows the detected and expected memory sizes and the size of the DIMM in each slot.
2. Identify the column in the memory configuration table that contains the expected configuration. To do so, match the expected memory size from the error sense data to the column that has the same node canister total memory.
3. Compare the size of DIMM reported in each slot in the error data with the expected DIMM size for the slot index and node canister total memory size that is shown in the memory configuration table. For each mismatch, the DIMM must be replaced with the size of DIMM that is indicated in the table. See the Replaceable units topic for the correct FRU part number for each size of DIMM.

Removing the node canister

4. Follow “Procedure: Powering off a node canister” on page 118 to verify that the hosts do not lose access to data in volumes.
5. Remove the node canister, as described in “Removing and reseating a node canister” on page 138, and place it on a flat, level surface.
6. Remove the cover, as described in “Removing and replacing the cover of a node canister” on page 134.

Removing the DIMM

Important: Do not start service status on the node. Power off the node to replace a DIMM or run the rmnode command to add DIMMs.

If you are upgrading memory of a node canister as a part of an enclosure upgrade, you must remove that node from the system configuration before you start the following procedure. To do so, you can use the management GUI or the CLI.

- To use the management GUI, right-click the node canister and select **Remove**.
- To use the CLI, enter the following command, where *object_id | object_name* identifies the node canister that receives the additional memory:

```
rmnodecanister object_id | object_name
```

If you are replacing a faulty DIMM with a new one from FRU stock, you do not need to remove the node canister from the system configuration.

7. Remove the air baffle. For details, see “Removing and replacing the air baffle of a node canister” on page 164.
8. Locate the appropriate DIMM slot.

   As Figure 88 on page 145, Figure 89 on page 146, Figure 90 on page 146, and Figure 91 on page 147 shows that the DIMM locations are identified on the system board.

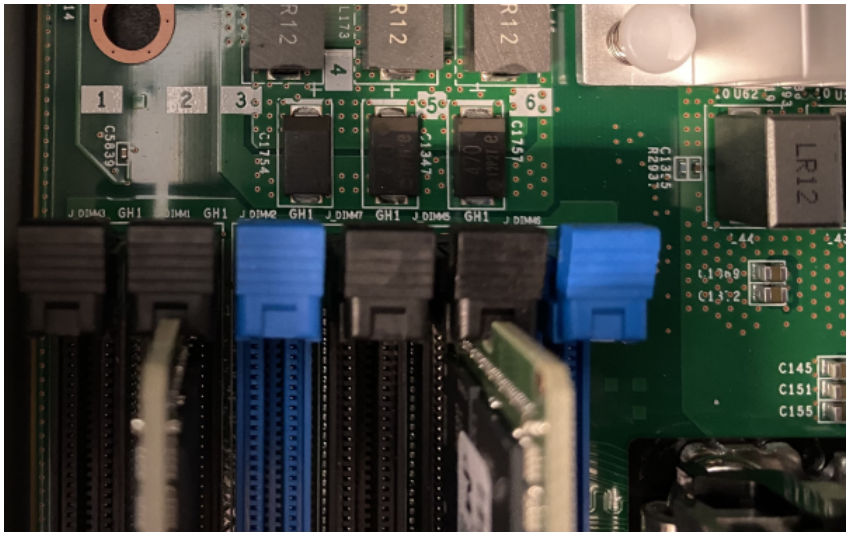


Figure 88. Identifying DIMM locations 1-6

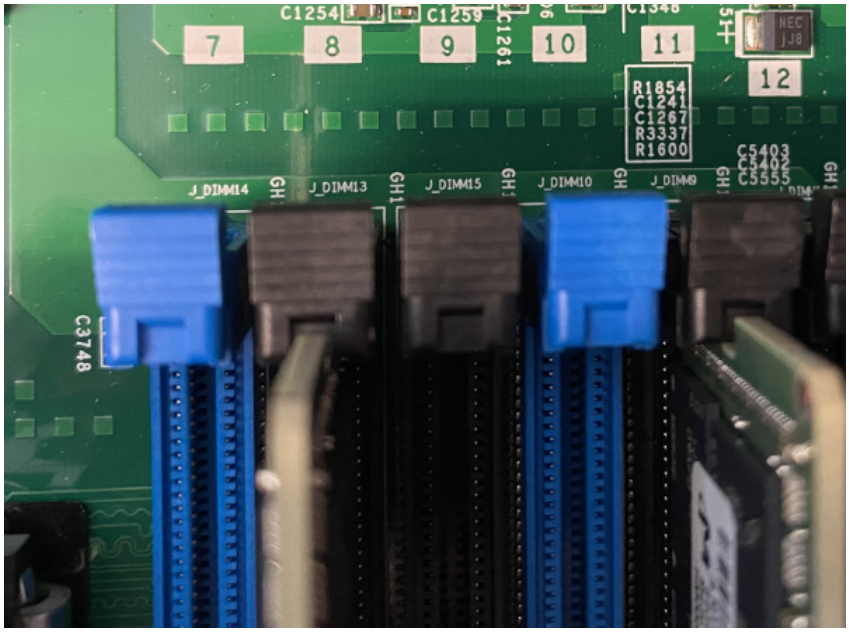


Figure 89. Identifying DIMM locations 7-12

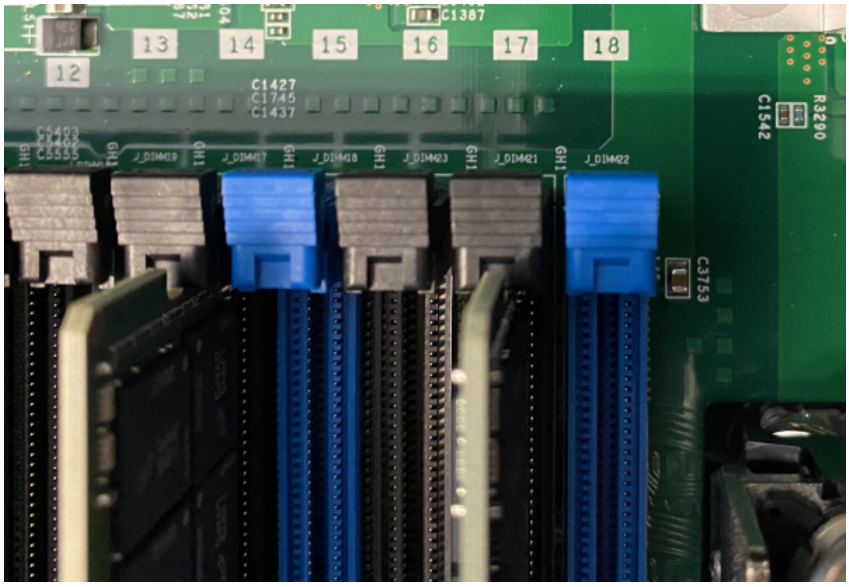


Figure 90. Identifying DIMM locations 13-18

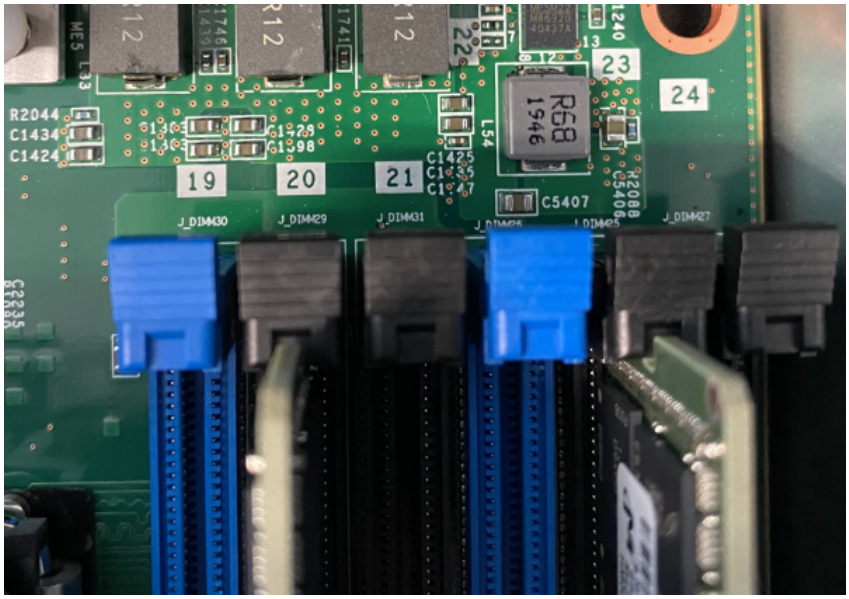


Figure 91. Identifying DIMM locations 19-24

9. Press the locking tabs on the side of the DIMM to eject it.
10. Lift the DIMM up and out of the slot.
11. If you have other tasks to complete inside the control enclosure, do those tasks now.

Replacing or adding the DIMM

Important: If you are adding memory to a node canister, you must remove that node from the system configuration before you start the following procedure. To do so, you can use the management GUI or the CLI.

- To use the management GUI, right-click the node canister and select **Remove**.
- To use the CLI, enter the following command, where *object_id | object_name* identifies the node canister that receives the additional memory:

```
rmnodecanister object_id | object_name
```

If you are replacing a faulty DIMM with a new one from FRU stock, you do not need to remove the node canister from the system configuration.

12. Touch the static-protective package that contains the new DIMM to any unpainted metal surface on the node canister. Remove the DIMM from the package.
13. Turn the DIMM so that the DIMM keys align correctly with the connector on the main board.
14. Insert the DIMM into the connector by aligning the edges of the DIMM with the slots at the ends of the DIMM connector.

    Attention: If there is a gap between the DIMM and the retaining clips, the DIMM is not correctly inserted; open the retaining clips, remove the DIMM, and then reinsert it.
15. Apply pressure on both ends of the DIMM simultaneously and firmly press the DIMM straight down into the connector. The retaining clips snap into the locked position when the DIMM is firmly seated in the connector.
16. Repeat steps “12” on page 147 through “15” on page 147 until all the new or replacement DIMMs are installed.
17. Replace the air baffle. For details, see “Removing and replacing the air baffle of a node canister” on page 164.
18. Install the cover, as described in “Removing and replacing the cover of a node canister” on page 134.
19. Reinsert the node canister, as described in “Removing and reseating a node canister” on page 138.

    If the canister does not begin to power-up, check that the canister is fully inserted into the enclosure.

20. When the node is active again, go to the management GUI and look for any unfixed events that are related to the DIMMs.

Removing and replacing a fan module

Use this procedure to replace a faulty fan module in an FlashSystem 9500 node canister with a new one received from stock.

About this task

Each node canister contains five fan modules, which are accessible when the node canister is removed from the control enclosure.

Attention:

- Do not remove the node canister and faulty fan module before the replacement fan is available. After a fan module is removed, this replacement procedure must be completed within **16 minutes** to ensure that the components do not shut down due to excessive temperatures.
- 

When you replace this part, you must follow recommended procedures for handling electrostatic discharge (ESD)-sensitive devices.
- A Phillips screw driver is required to remove the canister cover.

Procedure

1. Follow “Procedure: Powering off a node canister” on page 118 to verify that the hosts will not lose access to data in volumes.
2. Remove the node canister, as described in “Removing and reseating a node canister” on page 138.
3. Remove the cover, as described in “Removing and replacing the cover of a node canister” on page 134.

Removing the fan module

4. Remove the replacement fan module from its packaging.
5. Identify the faulty fan module.

   The Event Log indicates the fan and node that are causing the error. The fix procedure in the management GUI provides the location of the node canister. As Figure 92 on page 149 shows, the fan modules are numbered 1 to 5 within the node canister. Note that Figure 92 on page 149 shows the fans with the air baffle removed. The air baffle does not need to be removed to remove or replace a fan

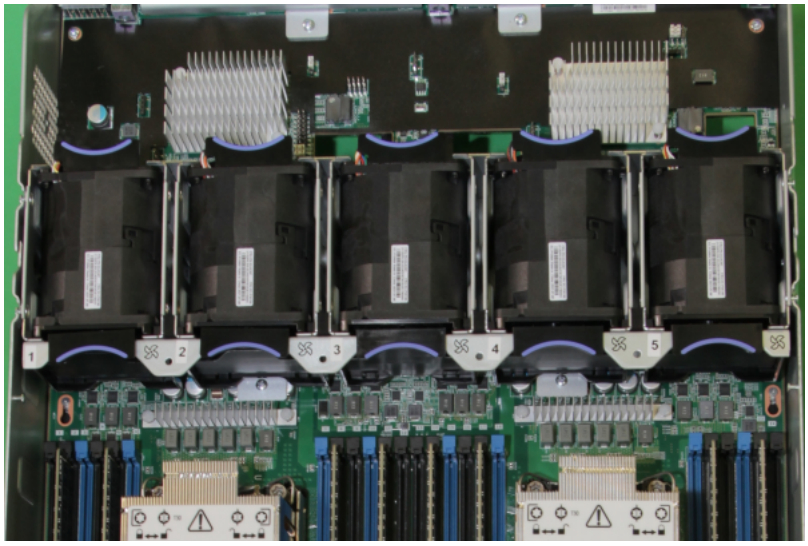


Figure 92. Location of the fans within the node canister

6. Hold the fan module between your finger and thumb at the blue touch points. Squeeze gently and lift the fan module out of the node canister, as Figure 93 on page 149 shows.

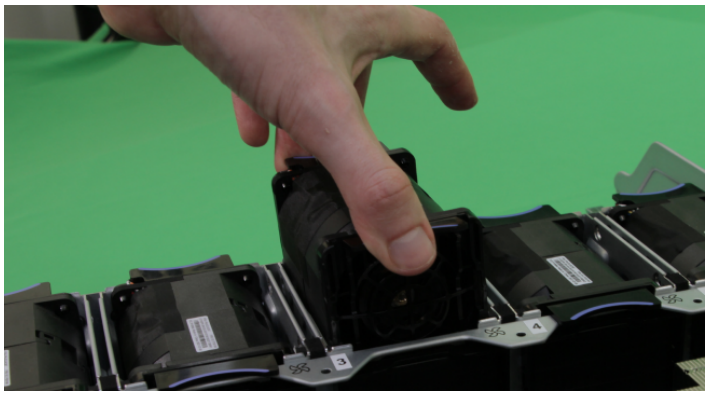


Figure 93. Removing the fan module

Replacing the fan module

7. Install the replacement fan module into the vacant fan slot. . Ensure that the cable is not caught under the fan module.
8. Install the canister cover, as described in "Removing and replacing the cover of a node canister" on page 134.
9. Reinsert the node canister, as described in "Removing and reseating a node canister" on page 138.
10. Reconnect the power and data cables into the ports from which they were removed.
11. If the control enclosure is powered and the node canister is correctly installed, the node canister starts automatically.
    a) If the node canister is not correctly installed, remove it and repeat the installation procedure.
12. When the node canister is back online, check the Event Log for any new events that might indicate a problem with the reassembly.

Removing and replacing a power interposer

A faulty power interposer can be removed and replaced with an identical or equivalent replacement part from stock.

About this task

A power interposer fills the space between the PSU and the midplane. This is a disruptive procedure, and the enclosure must be shutdown and removed from the rack to service the power interposer. The PSUs must be removed from the rear of the enclosure before the power interposer can be removed. Before you remove or replace a power interposer, review the following guidelines for this procedure:

- Ensure that you identify the correct PSUs and power interposer for removal.
- Do not insert a PSU into the slot while the power interposer is removed.
- A screwdriver is required to remove the power interposer.

DANGER: When working on or around the system, observe the following precautions:

Electrical voltage and current from power, telephone, and communication cables are hazardous. To avoid a shock hazard: If IBM supplied the power cord(s), connect power to this unit only with the IBM provided power cord. Do not use the IBM provided power cord for any other product. Do not open or service any power supply assembly. Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.

- The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords. For AC power, disconnect all power cords from their AC power source. For racks with a DC power distribution panel (PDP), disconnect the customer's DC power source to the PDP.
- Sharp edges, corners and joints might be present in and around the system. Use care when handling equipment to avoid cuts, scrapes and pinching. (D005)

Procedure

1. Before you start identify which power interposer assembly will be replaced. The 4U enclosure contains 2 power interposer assemblies. The upper power inteposer connects to PSU 1 and PSU 2, while the lower connects to PSU3 and PSU4.
2. Complete "Procedure: Powering off a node canister" on page 118 for both node canisters in the enclosure.

Disconnecting cables from the enclosure

3. Label and disconnect the four (4) power cables from the rear of the control enclosure.
4. Write down the port and cable connections before you disconnect all cables from the ports rear of the control enclosure. Use the following tables to record the information for each node canister. Depending on your system configuration, some PCIe adapter ports and Ethernet ports might not be connected.

   Possible connections on Node Canister 1 summarizes the possible PCIe slot and port configuration of node canister 1.

Table 52. Summary of node canister 1 PCIe slots and port connections

Location	Port	Label or empty
Adapter Cage 1 - PCIe Card 1 (left) - Slot 1	1	
Adapter Cage 1 - PCIe Card 1 (left) - Slot 1	2	

Table 52. Summary of node canister 1 PCIe slots and port connections (continued)

Location	Port	Label or empty
Adapter Cage 1 - PCIe Card 1 (left) - Slot 1	3	
Adapter Cage 1 - PCIe Card 1 (left) - Slot 1	4	
Adapter Cage 1 - PCIe Card 2 (right) - Slot 2	1	
Adapter Cage 1 - PCIe Card 2 (right) - Slot 2	2	
Adapter Cage 1 - PCIe Card 2 (right) - Slot 2	3	
Adapter Cage 1 - PCIe Card 2 (right) - Slot 2	4	
Adapter Cage 2 - PCIe Card 1 (left) - Slot 5	1	
Adapter Cage 2 - PCIe Card 1 (left) - Slot 5	2	
Adapter Cage 2 - PCIe Card 1 (left) - Slot 5	3	
Adapter Cage 2 - PCIe Card 1 (left) - Slot 5	4	
Adapter Cage 2 - PCIe Card 2 (right) - Slot 6	1	
Adapter Cage 2 - PCIe Card 2 (right) - Slot 6	2	
Adapter Cage 2 - PCIe Card 2 (right) - Slot 6	3	
Adapter Cage 2 - PCIe Card 2 (right) - Slot 6	4	
Adapter Cage 3 - PCIe Card 1 (left) - Slot 7	1	
Adapter Cage 3 - PCIe Card 1 (left) - Slot 7	2	
Adapter Cage 3 - PCIe Card 1 (left) - Slot 7	3	
Adapter Cage 3 - PCIe Card 1 (left) - Slot 7	4	
Adapter Cage 3 - PCIe Card 2 (right) - Slot 8	1	
Adapter Cage 3 - PCIe Card 2 (right) - Slot 8	2	
Adapter Cage 3 - PCIe Card 2 (right) - Slot 8	3	

Table 52. Summary of node canister 1 PCIe slots and port connections (continued)		
Location	**Port**	**Label or empty**
Adapter Cage 3 - PCIe Card 2 (right) - Slot 8	4	
Management Ethernet port	1	
Management Ethernet port	2	
Technician Port	T	
USB Port		

Possible connections on Node Canister 2 summarizes the possible PCIe slot and port configuration of node canister 2.

Table 53. Summary of node canister 2 PCIe slots and port connections		
Location	**Port**	**Label or empty**
Adapter Cage 1 - PCIe Card 1 (left) - Slot 1	1	
Adapter Cage 1 - PCIe Card 1 (left) - Slot 1	2	
Adapter Cage 1 - PCIe Card 1 (left) - Slot 1	3	
Adapter Cage 1 - PCIe Card 1 (left) - Slot 1	4	
Adapter Cage 1 - PCIe Card 2 (right) - Slot 2	1	
Adapter Cage 1 - PCIe Card 2 (right) - Slot 2	2	
Adapter Cage 1 - PCIe Card 2 (right) - Slot 2	3	
Adapter Cage 1 - PCIe Card 2 (right) - Slot 2	4	
Adapter Cage 2 - PCIe Card 1 (left) - Slot 5	1	
Adapter Cage 2 - PCIe Card 1 (left) - Slot 5	2	
Adapter Cage 2 - PCIe Card 1 (left) - Slot 5	3	
Adapter Cage 2 - PCIe Card 1 (left) - Slot 5	4	
Adapter Cage 2 - PCIe Card 2 (right) - Slot 6	1	
Adapter Cage 2 - PCIe Card 2 (right) - Slot 6	2	
Adapter Cage 2 - PCIe Card 2 (right) - Slot 6	3	

Table 53. Summary of node canister 2 PCIe slots and port connections (continued)		
Location	**Port**	**Label or empty**
Adapter Cage 2 - PCIe Card 2 (right) - Slot 6	4	
Adapter Cage 3 - PCIe Card 1 (left) - Slot 7	1	
Adapter Cage 3 - PCIe Card 1 (left) - Slot 7	2	
Adapter Cage 3 - PCIe Card 1 (left) - Slot 7	3	
Adapter Cage 3 - PCIe Card 1 (left) - Slot 7	4	
Adapter Cage 3 - PCIe Card 2 (right) - Slot 8	1	
Adapter Cage 3 - PCIe Card 2 (right) - Slot 8	2	
Adapter Cage 3 - PCIe Card 2 (right) - Slot 8	3	
Adapter Cage 3 - PCIe Card 2 (right) - Slot 8	4	
Management Ethernet port	1	
Management Ethernet port	2	
Technician Port	T	
USB Port		

5. Remove the cables from the rear of the enclosure.

Removing the enclosure

6. Remove the end caps from the front flanges of the enclosure, as described in topic “Removing and replacing the enclosure end caps” on page 119
   a) Unscrew the four M5 screws that secure the left and right end caps of the control enclosure to the rack. Eight screws at the front of the enclosure
7. Remove the enclosure from the rack.
   a) Slide the enclosure from the rack. If components were not removed from the control enclosure. Ensure that four persons are available to support the weight of the enclosure when it is removed from the rack.
   b) If fewer people are available, you can remove several internal components to decrease the weight of the control enclosure. Be sure to note the serial numbers and slots for each component (drives and canisters).
8. Remove the power supply unit, as described in “Removing and replacing a power supply unit” on page 127.
9. Place the enclosure on a flat surface.

Removing the power interposer

10. Facing the front of the enclosure the power interposer cover is on the right side of the top of the enclosure. Remove the three screws, and slide forward then lift the cover off of the top of the enclosure. Under the cover there are two power interposer assemblies.
11. Remove the screw holding the power interposer board latch in place.

12. Remove the upper power interposer by pressing down and away from the midplane on the top power interposer latch to disengage it from the backplane power connector, and lift the upper power interposer from the enclosure.
13. The lower power interposer is removed the same way. Remove the screw retaining the latch. Press down and away from the midplane on the bottom power interposer to disengage it from the backplane power connectors and lift the lower power interposer from the enclosure.

Replacing the power interposer

14. Lower the power interposer into the enclosure from the top.
15. Move the latch up and towards the midplane to secure it to the power connector backplane.
16. Fasten the latch in place using a screw.
17. Repeat these steps for the upper PIB.
18. Lower the power interposer into the enclosure from the top.
19. Move the latch up and towards the midplane to secure it to the power connector backplane.
20. Fasten the latch in place using a screw.
21. Replace the PIB cover using 3 screws.
22. Replace the enclosure in the rack per "Removing and replacing an enclosure or midplane assembly" on page 166
23. Secure the ears to the rack and install left and right ear covers per "Removing and replacing the enclosure end caps" on page 119.
24. Replace the drive if they were removed.
25. Replace the canisters if they were removed, per "Removing and reseating a node canister" on page 138.
26. Replace the cables to the canister per the above Table 1 and Table 2.
27. Replace the PSUs.
28. Plug in the line cords per their labeling, per "Removing and replacing a power supply unit" on page 127.
29. Reconnect all cables.

Removing and replacing an adapter cage

Use this procedure to remove and replace a network adapter in a node canister with a new one received from stock. The adapter cage is replaced when replacing a single adapter does not work or both adapters in the cage are having problems.

About this task

Note:

- No tools are required to complete this task. Do not remove or loosen any screws.
- This procedure requires that the node canister is powered down. The adapter cages are not hot swappable.

Procedure

1. Identify the node canister with the faulty adapter. Identify any dependencies on the node canister by using the management GUI. Understand the impact of any dependencies and resolve them, if necessary.
2. Before you can remove the faulty adapter, power down the node canister, as described in "Procedure: Powering off a node canister" on page 118.
3. Identify the location of the network adapter cage that requires replacement. The Event Log contains the enclosure MTM and serial number, node canister (slot number and serial number), and adapter slot number. Note that release lever for adapter cage 1 is to the right of the left canister release lever.

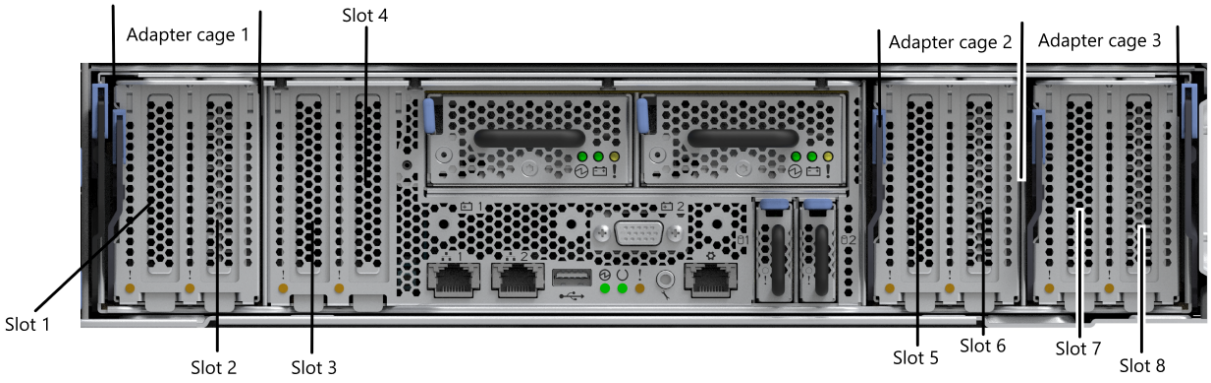


Figure 94. Removing an adapter cage

4. Locate the enclosure that requires servicing by its MTM and S/N, which are labeled on the enclosure front left cover and the enclosure rear. At the rear of the enclosure, locate the node canister by finding its serial number on the bottom lip of the canister.
5. Label each cable connection or record all cables that are connected to the node canister adapter cage. This information is used to reconnect the cables later. If adjacent cables are preventing the removal of the adapter cage, they may need to be labeled and removed.

   Possible connections on an adapter cage summarizes the network adapter slot and port configuration of node canister.

Table 54. Summary of adapter cage slots and port connections

Location	Port	Label or empty	SFP Serial
Adapter slot 1 (left)	1		
Adapter slot 1 (left)	2		
Adapter slot 1 (left)	3		
Adapter slot 1 (left)	4		
Adapter slot 2 (right)	1		
Adapter slot 2 (right)	2		
Adapter slot 2 (right)	3		
Adapter slot 2 (right)	4		

6. Remove the cables from the node canister adapter cage.
7. Record the serial of each SFP device as you remove them from the adapter ports. You need to put them back in the same ports later.

Removing the network adapter cage

8. Remove the node canister adapter cage, by lowering the pressing down on the lever on the upper left side of the adapter cage. Use the lever to pull the adapter cage out of the enclosure.

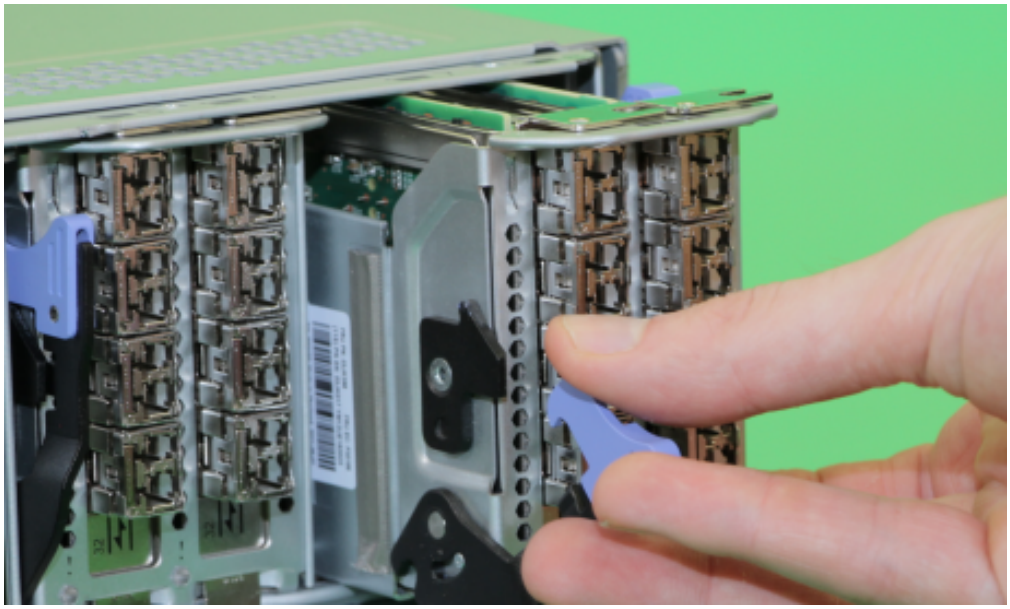


Figure 95. Removing an adapter cage

9. Migrate the network adapter cards to the replacement adapter cage using “Removing and replacing a network adapter” on page 131.
10. Remove the network adapter cards from the adapter cage. With the adapter cage on a static-protective flat surface lift each adapter from the cage. The Adapter slots are not screwed in. Move the cards one at a time to keep them in the same slot order.

    Important: Adapters with a large SFP cage, such as the 4-port Fibre Channel adapter, have limited clearance between the external edge of the SFP cage and the slot of the network adapter riser. When you remove or insert an adapter, it may be necessary to start the removal at the bracket end of the adapter, so that the adapter is removed at a slight angle, rather than square to the adapter slot.

Replacing the network adapter cage

11. Ensure that the adapter is fully seated in the riser; the bracket of the adapter must be aligned correctly with the tab on the adapter cage.
12. Orient the adapter cage so that the lever is fully extended on the left side of the cage. Press the adapter cage into the proper adapter cage slot until the lever moves up.
13. Press the lever until a click to seat the cage. Note if both adapter cage slots 2 and 3 are empty use the adjacent wall for alignment.
14. Insert any SFP devices that were removed into one or more adapters as per “Removing and replacing an SFP transceiver” on page 128.
15. Reconnect the cables to the rear of the node canister. Use the information that you collected to identify the correct ports.
16. If a fix procedure is being run in the management GUI to direct this procedure, then it powers the node canister back on. Otherwise, you can reseat the node canister to make it power back on.
17. Verify that the error is cleared from the Event Log.

Removing and replacing the Trusted Platform Module

Use this procedure to remove and replace a faulty Trusted Platform Module (TPM) with a new one received from stock.

About this task

Do not remove or loosen any screws.

When you replace this part, you must follow recommended procedures for handling electrostatic discharge (ESD)-sensitive devices.

Important: If the node canister is part of a system and is the last online node, do not proceed to change the TPM in the node. Doing so prevents the node from accessing encryption keys that are stored on the node canister boot drive. Instead, complete repairs to bring another node (ideally the partner node) online in the system. The node with the replacement TPM can then obtain required encryption keys from the online node.

Note: You will need two FRU kits. One FRU kit has the TPM with a matched boot drive, the other FRU kit is a blank boot drive. It does not matter which of the two boot drive slots the blank drive is put in.

Procedure

1. Identify the node canister that contains the faulty TPM. Use the management GUI to identify any dependencies on the node canister. Understand the impact of any dependencies and resolve them, if necessary.

   The Event Log contains the TPM failure error. You can also locate the enclosure MTM and serial number, and the node canister serial number.
2. Label each power and cable connection or record all cables that are connected to the node canister. This information is used to reconnect the canister later.
3. Remove the cables from the node canister.
4. Follow “Removing and reseating a node canister” on page 138 to disconnect and remove the node canister with the faulty TPM.
5. Remove the cover of the node canister, as described in “Removing and replacing the cover of a node canister” on page 134.

Removing the boot drives

6. Locate the boot drives on the rear of the node canister.

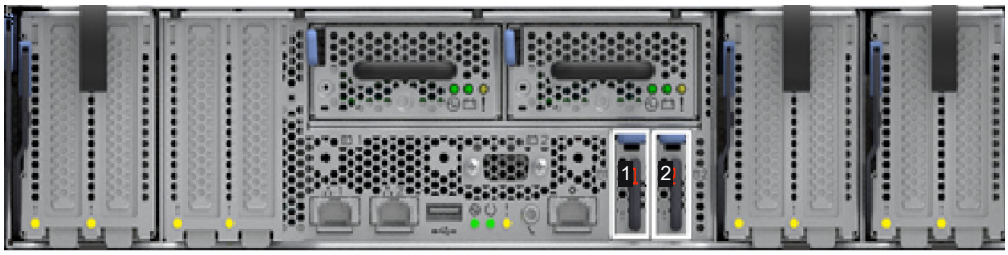


Figure 96. Location of boot drives

7. Hold the boot drive handle (3) and press down on the release latch (1) towards the handle and pull to remove the boot drive. In Figure 97 on page 158, the faulty LED (2) location on the boot drive is shown.

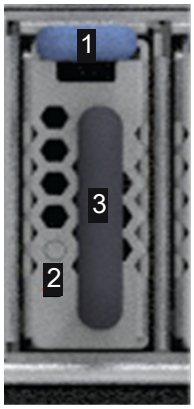


Figure 97. Removing the boot drive

8. When the latch is released, the boot drive can be slide out of slot.

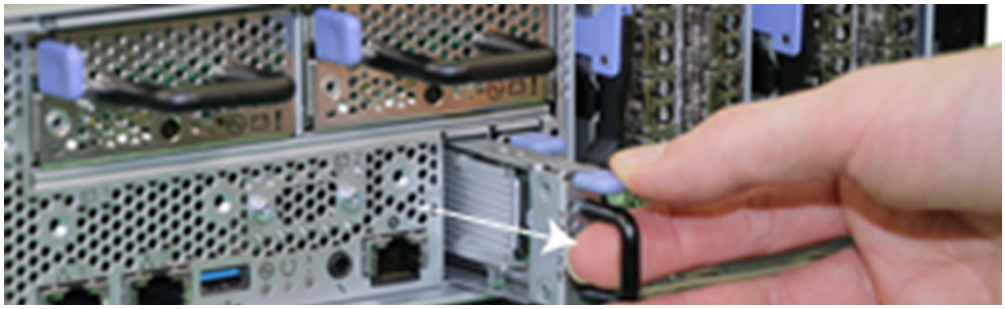


Figure 98. Released boot drive

Removing the TPM

9. Locate the TPM, which is between the boot drive and CMOS battery, as shown in Figure 99 on page 158.

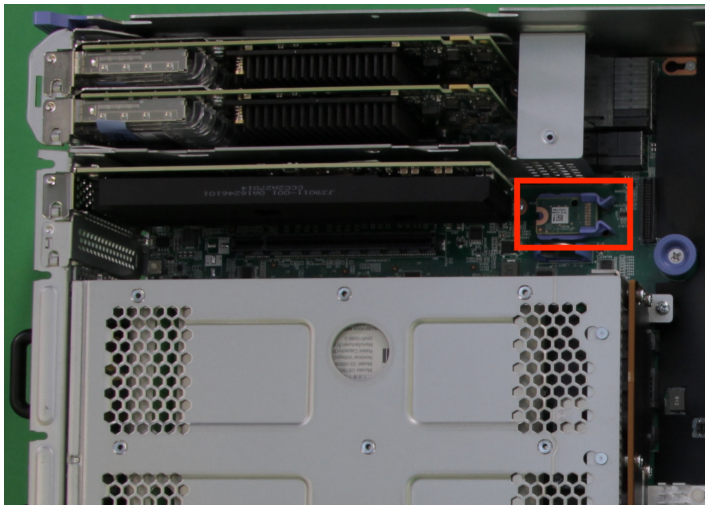


Figure 99. Locating the TPM

10. Insert your finger tip between the latches and hold the TPM between your thumb and finger, as shown in Figure 100 on page 159.

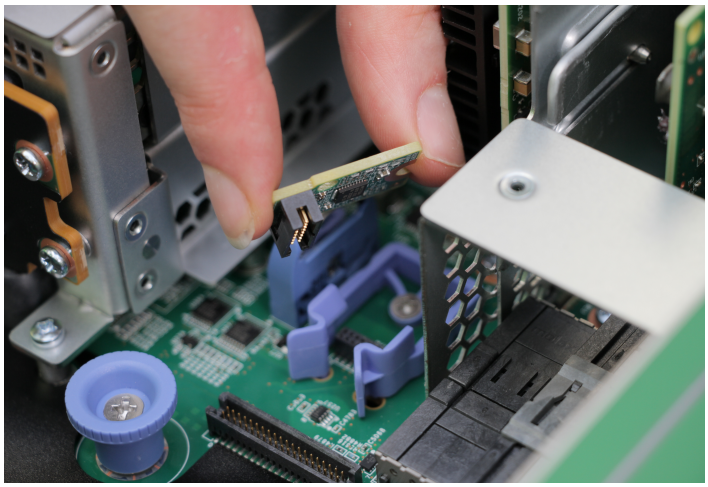


Figure 100. Removing the TPM

11. Remove the TPM by pulling it upwards from its socket.

Replacing the TPM and boot drives

12. Touch the replacement TPM packaging onto a metal area of the case; then, remove the replacement TPM from its package.
13. Align the replacement TPM over the socket and firmly press it straight down into the socket.
14. Replace the paired boot drive that came with the TPM.
15. Replace the blank boot drive.
16. Install the node canister lid, as described in “Removing and replacing the cover of a node canister” on page 134.
17. Reinstall the node canister, as described in “Removing and reseating a node canister” on page 138.
18. Reconnect the power and networking cables to the node canister, ensuring the cables go into the same ports from which they were removed in step “4” on page 157.
19. When the node canister is back online, check the Event Log for new events, particularly events that relate to TPM and encryption failures.

Removing and replacing a boot drive

Use this procedure to remove and replace a faulty boot drive from a node canister.

About this task

IBM Storage FlashSystem node canisters have dual boot drives. The canister can run if one boot drive failed. See “Procedure: Understanding system volume dependencies” on page 117 to check for dependencies before you put the node in service state.

Notes:

- Install the boot drive in drive bay 1 or 2 in the rear of the enclosure.
- Do not change both boot drives at the same time. You can only replace a single boot drive. If you replace the TPM then you will be required to replace both boot drives.
- Do not use a drive that was already used in another node.
- Do not swap the two boot drives between slots or canisters.

- Do not replace both boot drives and the node canister all at the same time. If you do, then all Vital Product Data on the node is lost and the whole node needs to be replaced.
- If all boot drives in a node canister are replaced with new drives, then some Ethernet configuration of the node will be lost, such as the service IP and node IP. Use the Service Assistant Tool to reset the service IP and node IP if needed. (A node IP is only needed if the node must communicate with other nodes by using RDMA over Ethernet). If the boot drives are replaced at the same time, then replace the Trusted Platform Module (TPM) too. See "Removing and replacing the Trusted Platform Module" on page 156 for more information.
- No tools are required to complete this task. Do not remove or loosen any screws while you are completing this procedure.
- The boot drives are hot swappable and require a command to sync the new drive. Until drives comes online, sync command will take the node offline.

Procedure

1. Read the safety information.
2. Review the Event Log to identify the faulty boot drive and the node canister in which it resides.
3. Log in to the management GUI to check for dependent volumes.
4. Log in to the service GUI or CLI for the impacted node.
5. Check the hardware panel or command **lsbootdrive** to ensure the drive that failed in the Active column, if it says active, the node should be rebooted to prevent removing an active drive and causing the node OS to crash.

Removing the boot drive

6. Locate the boot drive on the rear of the canister.

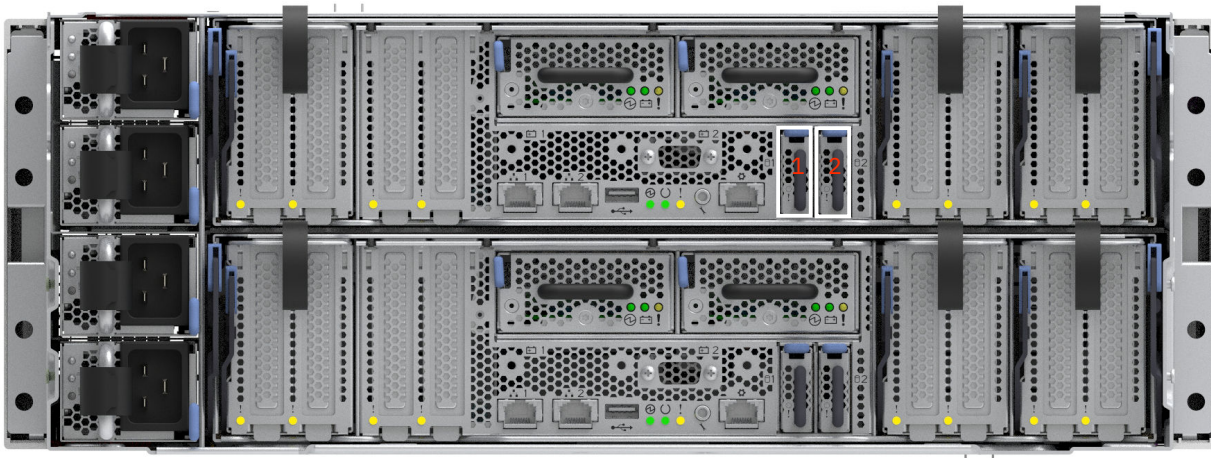


Figure 101. Location of the boot drives

7. Hold the boot drive handle (3) and press down on the release latch (1) towards the handle and pull to remove the boot drive. In Figure 102 on page 162, the faulty LED (2) location on the boot drive is shown.

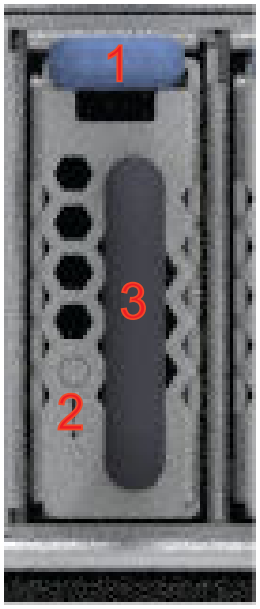


Figure 102. Removing the boot drive

8. When the latch is released, the boot drive can be slide out of slot.

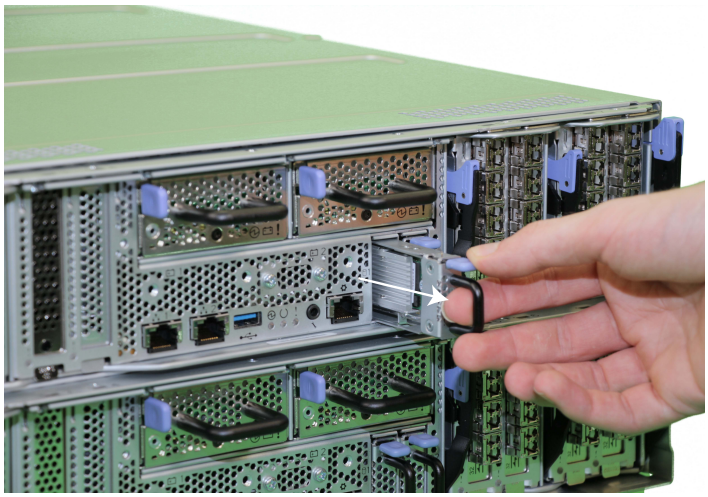


Figure 103. Released boot drive

Replacing the boot drive

9. Touch the static-protective package that contains the drive to any unpainted metal surface on the node; then, remove the drive from the package and place it on a static-protective surface. Orient the boot drive so that the latch is on the up.
10. Physically replace the boot drive that is broken (the fault LED will indicate the specific drive).
11. Slide the boot drive into the boot drive slot, and press in until the latch clicks in Figure 104 on page 163

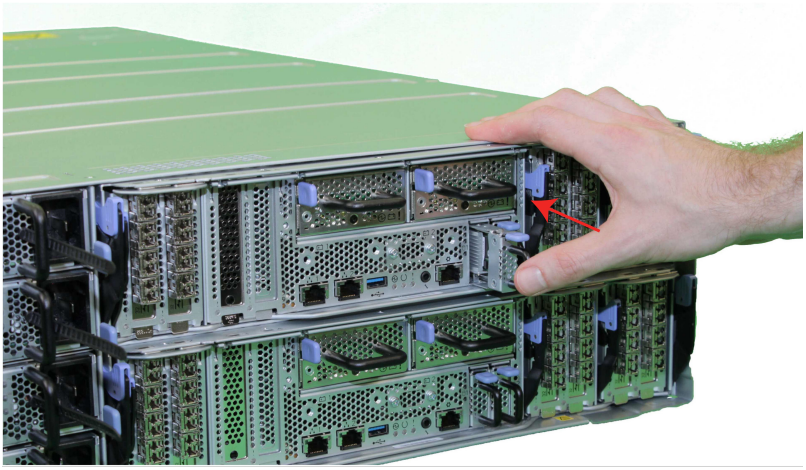


Figure 104. Inserting the boot drive

12. Log into the service assistant GUI or use management GUI or service CLI to place the node in service state.
13. From the service GUI, issue the boot drive sync operation or log into the CLI to run the sync command. Then, issue the following command:

```
satask chbootdrive -sync panel_name
```

14. Wait for the node to restart. It should leave the service mode automatically if it does not log into the service GUI or CLI.
15. The node canister should automatically rejoin the cluster. Wait for the node to complete sync. After the completion of sync, the status of the node changes from out_of _sync to online.

    The following example displays the status of the node before completing sync.

```
sainfo lsbootdrive
```

    The resulting output:

```
panel_name node_id node_name can_sync slot_id booted status      actual_drive_sn
configured_drive_sn actual_node_sn identify  FRU_part_number FRU_identity
bfbfbf1    1       bfn1      yes      1       no     out_of_sync
1234567         1234567             bfbfbf1        off       90Y8879
11S49Y7427YXXX6XK
bfbfbf2    1       bfn2      no       2       yes    online
1234568                                           off
```

    The following example displays the status of the node after completing sync.

```
sainfo lsbootdrive
```

    The resulting output:

```
panel_name node_id node_name can_sync slot_id booted status      actual_drive_sn
configured_drive_sn actual_node_sn identify  FRU_part_number FRU_identity
bfbfbf1    1       bfn1      no       1       no     online
1234567         1234567             bfbfbf1        off       90Y8879
```

```
11S49Y7427YXXX6XK
bfbfbf2    1       bfn2      no       2       yes    online
1234568                                             off
```

Removing and replacing the air baffle of a node canister

To service parts under the air baffle such as memory, you may need to remove and replace the air baffle of a node canister.

About this task

- A Phillips screwdriver required to complete this task to remove the canister cover. No other tools are needed.
- The air baffle can be removed after the node canister is removed from the control enclosure and the canister cover is removed.

Procedure

1. Remove the node canister from the control enclosure, as described in “Removing and reseating a node canister” on page 138.
2. Remove the cover from the node canister, as described in “Removing and replacing the cover of a node canister” on page 134.

Removing the air baffle

Note: If the node canister was not powered off properly there may still be power running in the system running on the batteries.

3. With the node canister on a level surface, lift the air baffle out of the inner section of the node canister. There are no latches or screws holding it in place.

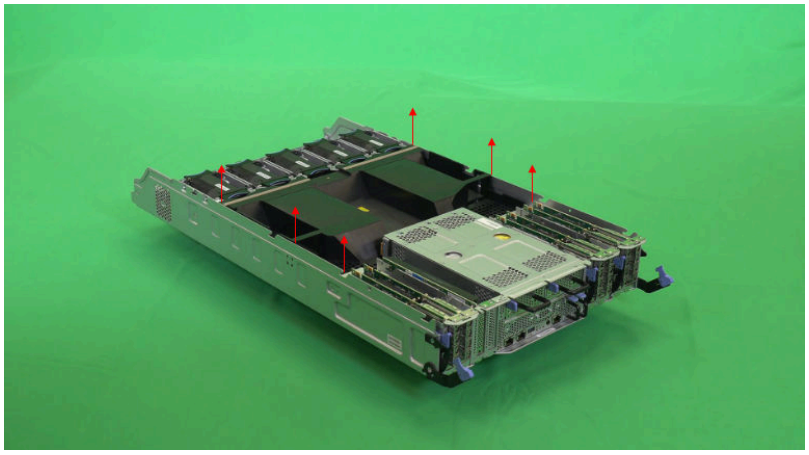


Figure 105. Removing the air baffle

Replacing the air baffle

4. Align the baffle to the edges of node canister, fan edge and adapter cages, then lower the air baffle into the node canister until it is level and flush.

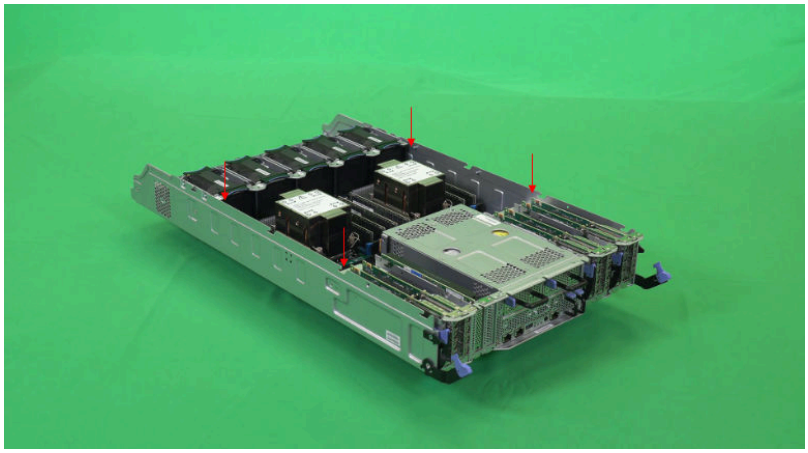


Figure 106. Replacing the air baffle

5. Install the cover on the node canister, as described in “Removing and replacing the cover of a node canister” on page 134.
6. Install the node canister on the control enclosure, as described in “Removing and reseating a node canister” on page 138.

Removing and replacing a compression card

Use this procedure to remove and replace a compression card in an IBM Storage FlashSystem system with a new one received from stock.

About this task

Note: When a node canister is removed, see Removing and replacing a node canister for information about how long a node canister can be out of a powered control enclosure. Operating the system for longer than this period might cause the control enclosure to shut down due to overheating.

- A screw driver is required to remove the node canister cover.
- The adapter is not attached to the node canister by screws.
- ESD wrist strap is required.

Procedure

1. Label each network cable connection or record all cables that are connected to the node canister. This information is used to reconnect the cables to the node canister.
2. The compression card is not contained in an adapter cage. Shut down and remove the canister to replace the card.

Removing the compression card

3. Remove the node canister, as described in Removing and replacing a node canister.
4. Remove the cover and set it aside, as described in “Removing and replacing the cover of a node canister” on page 134.
5. The compression card is located in adapter slot 3 located closest to adapter cage 1, as shown in Figure 107 on page 166

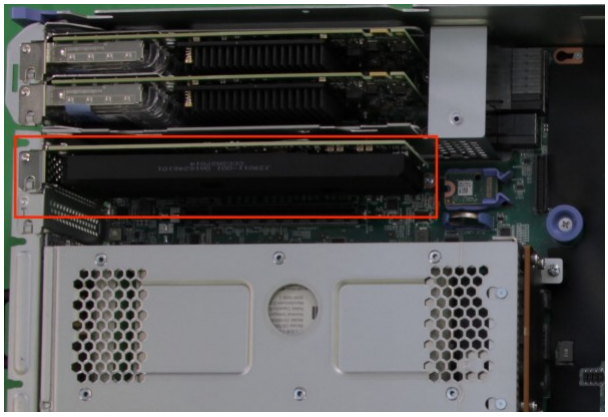


Figure 107. Locating the compression card

6. Lift the PCIe adapter from the canister, similar to standard PCIe cards.

Replacing the host interface adapter

7. Align the replacement card with the PCIe socket and press the adapter into place. Ensure that the adapter is fully seated in the connector.
8. Ensure that the bracket of the compression card is aligned with the metal tab of the enclosure.

Figure 108. Locating the compression card

9. Install the canister lid, as described in “Removing and replacing the cover of a node canister” on page 134.
10. Insert the node canister, as described in Removing and replacing a node canister.
11. If the node canister does not start, check that the canister is fully inserted into the enclosure.
12. Reconnect the network cables to the rear of the canister, by using the information that you collected at the start.

Removing and replacing an enclosure or midplane assembly

A trained service provider does not replace a midplane. Instead, they replace the enclosure with a new enclosure, which contains the midplane assembly and PIBs. The midplane includes a VPD chip that contains the Machine Type, Model, and Serial number of the enclosure. These need to be recorded along with worldwide node names.

About this task

Attention: This procedure causes a loss of excess data, as the enclosure is removed from the rack.

CAUTION:

The weight of this part or unit is more than 55 kg (121.2 lb). It takes specially trained persons, a lifting device, or both to safely lift this part or unit. (C011)

CAUTION: To avoid personal injury, before lifting this unit, remove all appropriate subassemblies per instructions to reduce the system weight. (C012)

Ensure that a suitably rated mechanical lift is available to support the weight of the enclosure when it is inserted into the rack for installation. If you do not have mechanical lifting equipment, then dis-assemble the removable components from the enclosure so that it becomes safe for 2 persons to lift the empty chassis from the pallet and into the rack.

To enable two people to lift the enclosure to and from the rack, you can remove the components from the control enclosure before you remove it from the rack. Record the serial number of the component in each location so that the components can be returned to the same location at the end of the procedure. Then, remove the components and place them in a safe location. Also, all cables need to be labeled.

Refer to the Environmental requirements and Weight considerations before you install the enclosure.

DANGER: When working on or around the system, observe the following precautions:

Electrical voltage and current from power, telephone, and communication cables are hazardous. To avoid a shock hazard: If IBM supplied the power cord(s), connect power to this unit only with the IBM provided power cord. Do not use the IBM provided power cord for any other product. Do not open or service any power supply assembly. Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.

-  The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords. For AC power, disconnect all power cords from their AC power source. For racks with a DC power distribution panel (PDP), disconnect the customer's DC power source to the PDP.
- When connecting power to the product ensure all power cables are properly connected. For racks with AC power, connect all power cords to a properly wired and grounded electrical outlet. Ensure that the outlet supplies proper voltage and phase rotation according to the system rating plate. For racks with a DC power distribution panel (PDP), connect the customer's DC power source to the PDP. Ensure that the proper polarity is used when attaching the DC power and DC power return wiring.
- Connect all power cords to a properly wired and grounded electrical outlet. Ensure that the outlet supplies proper voltage and phase rotation according to the system rating plate.
- Connect any equipment that will be attached to this product to properly wired outlets.
- When possible, use one hand only to connect or disconnect signal cables.
- Never turn on any equipment when there is evidence of fire, water, or structural damage.
- Do not attempt to switch on power to the machine until all possible unsafe conditions are corrected.
- When performing a machine inspection: Assume that an electrical safety hazard is present. Perform all ontinuity, grounding, and power checks specified during the subsystem installation procedures to ensure that the machine meets safety requirements. Do not attempt to switch power to the machine until all possible unsafe conditions are corrected. Before you open the device covers, unless instructed otherwise in the installation and configuration procedures: Disconnect the attached AC power cords, turn off the applicable circuit breakers located in the rack power distribution panel (PDP), and disconnect any telecommunications systems, networks, and modems.
- Disconnect the attached power cords, telecommunications systems, networks, and modems before you open the device covers, unless instructed otherwise in the installation and configuration procedures.

- Connect and disconnect cables as described in the following procedures when installing, moving, or opening covers on this product or attached devices.

  To disconnect:

  1. Turn off everything (unless instructed otherwise).
  2. Remove the power cords from the outlets.
  3. Remove the signal cables from the connectors.
  4. Remove all cables from the devices.

  To connect:

  1. Turn off everything (unless instructed otherwise).
  2. Attach all cables to the devices.
  3. Attach the signal cables to the connectors.
  4. Attach the power cords to the outlets.
  5. Turn on the devices.

-  Sharp edges, corners and joints might be present in and around the system. Use care when handling equipment to avoid cuts, scrapes and pinching. (D005)

Attention:

- The control enclosure midplane assembly must be replaced only by a trained service provider. Complete this procedure only if instructed to do so by a service action or the IBM Support center.
- If you have a single control enclosure, this procedure requires that you shut down your system to replace the control enclosure midplane assembly. If you have more than one control enclosure, part of the system can continue to run. However, you lose access to the volumes that are on the affected I/O group. You also lose access to any volumes that are in other I/O groups that depend on the drives that are in the affected I/O group. If the system is still doing I/O requests in all the I/O groups, schedule the replacement during a maintenance period or other time when the I/O can be stopped.
- When you replace hardware components in the back of the enclosure, ensure that you do not inadvertently disturb or remove cables that you are not instructed to remove.
- Ensure that you are aware of procedures for handling static-sensitive devices before you remove the enclosure.

Procedure

1. Log in to the service assistant on one of the node canisters in the control enclosure. In the **Node Details** panel, select the **Location** tab. Note the following values for the enclosure in Table 55 on page 168. This information might be needed later.

Table 55. Recording control enclosure information

Item	Value
WWNN 1	
WWNN 2	
Machine type and model	
Serial number	

2. If the control enclosure is still active, stop host I/O or FlashCopy, FlashCopy, Global Mirror, or Metro Mirror activities on all the volumes that depend on the control enclosure.

   This step applies to all I/O group volumes that are managed by this control enclosure. It also applies to any volumes in other I/O groups that depend on the drives in the affected I/O group.

3. Complete “Procedure: Powering off a node canister” on page 118 for the node canister that requires the midplane assembly replacement.

Removing the enclosure

4. Disconnect label and remove the four power cables from the rear of the control enclosure.
5. Write down the port and cable connections before you disconnect all cables from the ports rear of the control enclosure. Use the following tables to record the information for each node canister. Depending on your system configuration, some PCIe adapter ports and Ethernet ports might not be connected. Ports are numbered top to bottom, and left to right.

   Possible connections on Node Canister 1 summarizes the possible PCIe slot and port configuration of node canister 1.

Table 56. Summary of node canister 1 PCIe slots and port connections

Location	Port	Label or empty
Adapter Cage 1 - PCIe Card 1 (left) - Slot 1	1	
Adapter Cage 1 - PCIe Card 1 (left) - Slot 1	2	
Adapter Cage 1 - PCIe Card 1 (left) - Slot 1	3	
Adapter Cage 1 - PCIe Card 1 (left) - Slot 1	4	
Adapter Cage 1 - PCIe Card 2 (right) - Slot 2	1	
Adapter Cage 1 - PCIe Card 2 (right) - Slot 2	2	
Adapter Cage 1 - PCIe Card 2 (right) - Slot 2	3	
Adapter Cage 1 - PCIe Card 2 (right) - Slot 2	4	
Adapter Cage 2 - PCIe Card 1 (left) - Slot 5	1	
Adapter Cage 2 - PCIe Card 1 (left) - Slot 5	2	
Adapter Cage 2 - PCIe Card 1 (left) - Slot 5	3	
Adapter Cage 2 - PCIe Card 1 (left) - Slot 5	4	
Adapter Cage 2 - PCIe Card 2 (right) - Slot 6	1	
Adapter Cage 2 - PCIe Card 2 (right) - Slot 6	2	
Adapter Cage 2 - PCIe Card 2 (right) - Slot 6	3	
Adapter Cage 2 - PCIe Card 2 (right) - Slot 6	4	

Table 56. Summary of node canister 1 PCIe slots and port connections (continued)		
Location	**Port**	**Label or empty**
Adapter Cage 3 - PCIe Card 1 (left) - Slot 7	1	
Adapter Cage 3 - PCIe Card 1 (left) - Slot 7	2	
Adapter Cage 3 - PCIe Card 1 (left) - Slot 7	3	
Adapter Cage 3 - PCIe Card 1 (left) - Slot 7	4	
Adapter Cage 3 - PCIe Card 2 (right) - Slot 8	1	
Adapter Cage 3 - PCIe Card 2 (right) - Slot 8	2	
Adapter Cage 3 - PCIe Card 2 (right) - Slot 8	3	
Adapter Cage 3 - PCIe Card 2 (right) - Slot 8	4	
Management Ethernet port	1	
Management Ethernet port	2	
Technician Port	T	
USB Port		

Possible connections on Node Canister 2 summarizes the possible PCIe slot and port configuration of node canister 2.

Table 57. Summary of node canister 2 PCIe slots and port connections		
Location	**Port**	**Label or empty**
Adapter Cage 1 - PCIe Card 1 (left) - Slot 1	1	
Adapter Cage 1 - PCIe Card 1 (left) - Slot 1	2	
Adapter Cage 1 - PCIe Card 1 (left) - Slot 1	3	
Adapter Cage 1 - PCIe Card 1 (left) - Slot 1	4	
Adapter Cage 1 - PCIe Card 2 (right) - Slot 2	1	
Adapter Cage 1 - PCIe Card 2 (right) - Slot 2	2	
Adapter Cage 1 - PCIe Card 2 (right) - Slot 2	3	
Adapter Cage 1 - PCIe Card 2 (right) - Slot 2	4	

Table 57. Summary of node canister 2 PCIe slots and port connections (continued)

Location	Port	Label or empty
Adapter Cage 2 - PCIe Card 1 (left) - Slot 5	1	
Adapter Cage 2 - PCIe Card 1 (left) - Slot 5	2	
Adapter Cage 2 - PCIe Card 1 (left) - Slot 5	3	
Adapter Cage 2 - PCIe Card 1 (left) - Slot 5	4	
Adapter Cage 2 - PCIe Card 2 (right) - Slot 6	1	
Adapter Cage 2 - PCIe Card 2 (right) - Slot 6	2	
Adapter Cage 2 - PCIe Card 2 (right) - Slot 6	3	
Adapter Cage 2 - PCIe Card 2 (right) - Slot 6	4	
Adapter Cage 3 - PCIe Card 1 (left) - Slot 7	1	
Adapter Cage 3 - PCIe Card 1 (left) - Slot 7	2	
Adapter Cage 3 - PCIe Card 1 (left) - Slot 7	3	
Adapter Cage 3 - PCIe Card 1 (left) - Slot 7	4	
Adapter Cage 3 - PCIe Card 2 (right) - Slot 8	1	
Adapter Cage 3 - PCIe Card 2 (right) - Slot 8	2	
Adapter Cage 3 - PCIe Card 2 (right) - Slot 8	3	
Adapter Cage 3 - PCIe Card 2 (right) - Slot 8	4	
Management Ethernet port	1	
Management Ethernet port	2	
Technician Port	T	
USB Port		

6. Carefully remove each drive or drive blank and label it with the drive slot from which it was removed, as described in “Removing and replacing a drive” on page 124 or “Removing and replacing a drive blank” on page 126.
7. Remove the four power supplies from the control enclosure, as described in “Removing and replacing a power supply unit” on page 127.

8. Remove the node canisters from the control enclosure, as described in “Removing and reseating a node canister” on page 138. Label them to indicate what canister came from each canister slot. The top canister is in slot 1, and the bottom canister is in slot 2.
9. Remove the end caps from the control enclosure, as described in “Removing and replacing the enclosure end caps” on page 119.
10. Remove the screws from the front of the control enclosure to free the enclosure from the rack.
11. Carefully slide the control enclosure from the rack.

Replacing the enclosure

12. Unpack the replacement enclosure.
13. Visually inspect the enclosure to ensure the power inter-poser boards are installed in the replacement enclosure. If not move the old power inter-poser boards from the old enclosure using the “Removing and replacing a power interposer” on page 150.
14. Record the machine type and model serial number of the enclosure on the blank agency sticker at the top of the enclosure.
15. Reinstall the control enclosure in the rack cabinet, securing it with the screws that were removed.
16. Reinstall the end caps at the front of the enclosure, as described in “Removing and replacing the enclosure end caps” on page 119.
17. Reinstall the drives or drive blanks that were removed. Ensure that each drive is inserted into the same slot from which it was removed, as described in “Removing and replacing a drive” on page 124 or “Removing and replacing a drive blank” on page 126.
18. Reinstall the node canisters into the same canister slots from which they were removed, as described in “Removing and reseating a node canister” on page 138.
19. Reinstall the power interposers, as described in “Removing and replacing a power interposer” on page 150.
20. Reinstall the four power supplies, as described in “Removing and replacing a power supply unit” on page 127.
21. Reconnect the data cables to the same connectors at the rear of the control enclosure. Use the data that you collected in step “5” on page 169.
22. Reconnect power to the control enclosure.

    The node canisters restart. The yellow fault LED indicators are on because the new enclosure was not set with the identity of the old enclosure. The node canisters log node error 504 to report that they are in the wrong location. In the system Event log, the error code is 1192. It is good to verify that the line cords are connected to at least two different power distribution units.
23. Use an **ssh** client to log in as the superuser to the service IP address of either node canister. Then, access the service assistant CLI.

    Important:

    - Do not reset the system ID.
    - After the replacement midplane is modified, it cannot be used as a replacement part for a different enclosure. Do **not** return a modified midplane assembly to FRU stock.

    Note: If you replaced a node canister, log in to the node canister that was not replaced. Enter the **satask chvpd -replacemidplane** command. If the command is successful, the node canister modifies the VPD data. You are disconnected from the CLI as both node canisters reboot.
24. If the **satask chvpd -replacemidplane** command fails, complete the following steps:
    a) Connect to the Service Assistant Tool of the node canister. Go to `http://service_ip/service` or connect to the technician port of the node canister.

       If you replaced a node canister at the same time as the midplane assembly, connect to the node canister that was not replaced.

    b) If you cannot access the service assistant, see Problem: Cannot connect to the service assistant.

    c) In the Service Assistant tool, use the **Configure Enclosure** panel.

d) Select to use the node copy of the data that you recorded in step “1” on page 168 (WWNN 1, WWNN 2, machine type and model, and serial number).

   If the node copy for any of the values is not available, select the **Specify** option for each missing value. Then, enter the value that you recorded at step “1” on page 168.

e) After you specify all values in the **Enclosure Information** panel, click **Modify**.

   The node canisters restart. When the restart finishes, the system comes online with both node canisters online.

25. Wait for the green status LED of both node canisters to light and indicate that the node canisters are active in the system.

Note: Customers can complete the following tasks after the new enclosure is installed and the control enclosure is operating again.

26. Use the management GUI to check the status of all volumes and physical storage to ensure that the system is operating normally.
27. Go to **Monitoring** > **Events** to check the Event Log for other events or errors.
28. Restart the host application and any FlashCopy, Global Mirror, or Metro Mirror activities that were stopped.

Removing and replacing 2U expansion enclosure parts

You can remove and replace parts from the 2U expansion enclosure to perform service or during the initial installation process.

About this task

Attention: Even though many of these components are hot-swappable, they are intended to be used only when your system is not active (no I/O operations). If your system is powered on and processing I/O operations, go to the management GUI and follow the fix procedures. Initiating the replacement actions without the assistance of the fix procedures can result in loss of data or loss of access to data.

Each replaceable unit has its own removal procedure. Sometimes you can find that a step within a procedure might refer you to a different remove and replace procedure. You might want to complete the new procedure before you continue with the first procedure that you started.

Remove or replace parts only when you are directed to do so.

Procedure: Powering off a 2U expansion enclosure

Follow the procedure to power off a 2U expansion enclosure. For example, it might be required to power off a 2U expansion enclosure when maintenance is planned.

About this task

To power off the 2U expansion enclosure, complete the following steps.

Procedure

1. Read the safety precautions in the IBM Systems Safety Notices. These guidelines help you safely work with the system.
2. Read Procedure: Understanding system volume dependencies to determine whether to continue this procedure.
3. Disconnect the power cords from both power supplies in the expansion enclosure so that the expansion enclosure is powered off.
4. Confirm that all the LEDs on the rear of the enclosure are off.

Removing and replacing the 2U enclosure end caps

You can remove and replace enclosure end caps.

About this task

Attention: The left end cap is printed with information that helps identify the enclosure.

- Machine type and model
- Enclosure serial number

The information on the end cap should always match the information that is printed on the rear of the enclosure. It should also match the information that is stored on the enclosure midplane.

Procedure

To remove and replace either the left or right end cap, complete the following steps.

1. If the enclosure is on a table or other flat surface, elevate the enclosure front slightly or carefully extend the front over the table edge.
2. Grasp the end cap by the blue touch point and pull it until the bottom edge of the end cap is clear of the bottom tab on the chassis flange.
3. Lift the end cap off the chassis flange.
4. Fit the slot on the top of the new end cap over the tab on the top of the chassis flange.
5. Rotate the end cap down until it snaps into place.

Replacing 2U expansion enclosure support rails

.Before you install 2U expansion enclosures, you must first install support rails.

Procedure

To replace the support rails, complete the following steps.

1. Locate the expansion enclosure rails (Figure 109 on page 174).

   The rail assembly consists of two rails that must be installed in the rack cabinet.

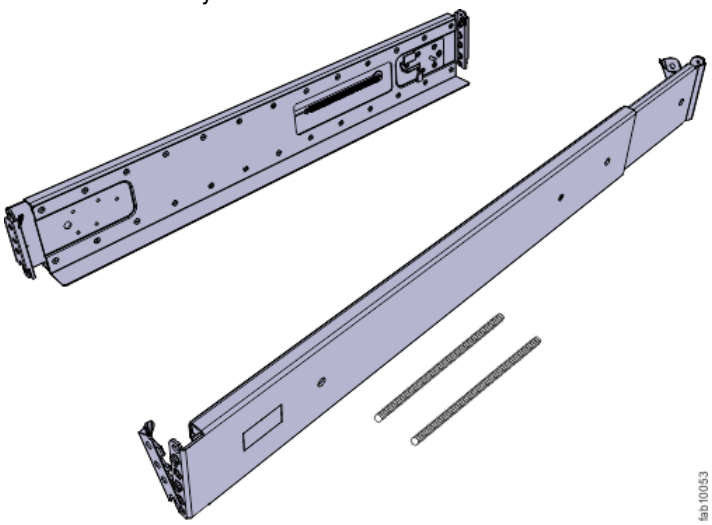


Figure 109. Expansion enclosure support rails

2. Locate the hardware that is used to install the rails, including two rail springs, two sets of eight bracket pins, and two M5 screws.

   Set the hardware aside for use later in the installation process.
3. Install a spring on each rail.

a) Extend the rail to its full length.

b) Push one looped end of a spring over one stud on the inside of the rail.

c) Stretch the spring slightly and push the other looped end of the spring onto the other stud on the inside of the rail.

4. Working at the front of the rack cabinet, identify the two standard rack units (2U) of space in the rack into which you want to install the support rails.

   Figure 110 on page 175 shows two rack units with the front mounting holes identified.

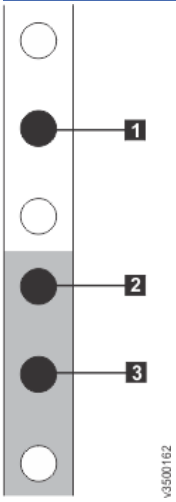


Figure 110. Hole locations in the front of the rack

- 1 Upper rail mounting bracket pin
- 2 Lower rail mounting bracket pin
- 3 Rack mounting screw hole

5. Ensure that the appropriate bracket pins are installed in the front and rear bracket of each rail.

   Each rail comes with four medium pins preinstalled (two in the front bracket and two in the rear bracket). Large and small pins are provided separately. Use the pins that are appropriate for the mounting holes in your rack. See Table 58 on page 175.

Table 58. Selecting bracket pins for your rack

Mounting holes	Bracket pins
Round, unthreaded	Use the preinstalled medium pins.
Round, threaded	Unscrew the medium pins and replace with the smaller pins that are supplied with the rails.
Square	Unscrew the medium pins and replace with the large pins that are supplied with the rails.

6. At each end of the rail, grasp the tab 1 and pull *firmly* to open the hinge bracket (see Figure 111 on page 175).

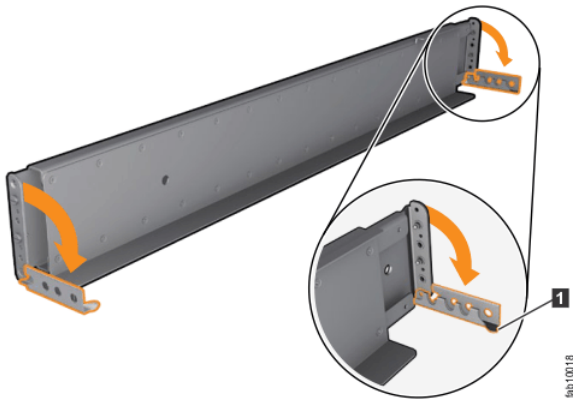


Figure 111. Opening the hinge brackets

7. Align the holes in the rail bracket with the holes on the front and rear rack cabinet flanges.
   Ensure that the rails are aligned on the inside of the rack cabinet.
8. On the rear of the rail, press the two bracket pins into the holes in the rack flanges.
9. Close the rear hinge bracket to secure the rail to the rack cabinet flange.
   (See Figure 112 on page 176.)

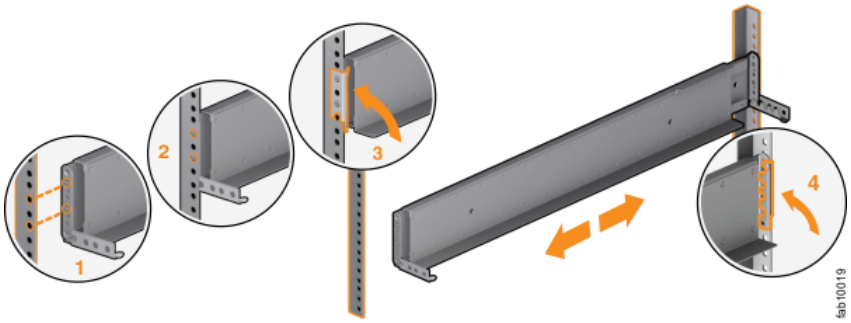


Figure 112. Closing the hinge brackets

10. On the front of the rail, press the two bracket pins into the holes in the rack flanges.
11. Close the front hinge bracket to secure the rail to the rack cabinet flange.
    See Figure 112 on page 176.
12. Secure the rear of the rail to the rear rack flange with an M5 screw that is provided with the rack kit.
13. Repeat the steps to secure the opposite rail to the rack cabinet.
14. Repeat the procedure to install rails for each additional expansion enclosure.

Removing and replacing a drive assembly

You can replace a faulty 3.5-inch drive in the 2U expansion controller with a new one received from stock.

Before you begin

Ensure that the drive is not a spare or a member of an array. The drive status is shown in **Pools** > **Internal Storage** in the management GUI.

Attention:

- Do not replace a drive unless the drive fault LED is on or you are instructed to do so by a fix procedure.
- If the drive is a member of an array, go to the management GUI and follow the fix procedures. The fix procedures mitigate loss of data and loss of access to data and manage use of the drive by the system.
- Do not leave a drive slot empty for extended periods. Do not remove a drive assembly or a blank filler without having a replacement drive or a blank filler with which to replace it.

Procedure

To prepare to replace a drive assembly, complete the following steps.

1. Read the safety information in the IBM Systems Safety Notices publication that was provided with your system hardware.
2. Locate the slot that contains the drive assembly that you want to replace.
   a) Refer to Procedure: Identifying which enclosure or canister to service to ensure correct identification of the correct system or enclosure.
   b) The drive slots on the front are numbered 1 - 12.
   For example, the numbering is from left to right and top to bottom:

```
1  2  3  4
5  6  7  8
9 10 11 12
```

c) If the drive in the slot is faulty, the lit, amber fault LED on the drive helps to identify it.

3. To further help identify the drive assembly, go to the management GUI to **Pools** > **Internal Storage**, select the drive to replace, and click **Actions** > **Identify**. Verify that the correct drive fault LED flashes.

Attention: Never hot-swap a disk drive when its green activity LED is flashing. Hot-swap a drive only when its amber fault LED is lit (not flashing) or when the drive activity LED is off.

Remove a drive assembly

4. Gently slide the orange release latch up to unlock the handle.
5. Pull out the tray handle to the open position (see Figure 113 on page 177).

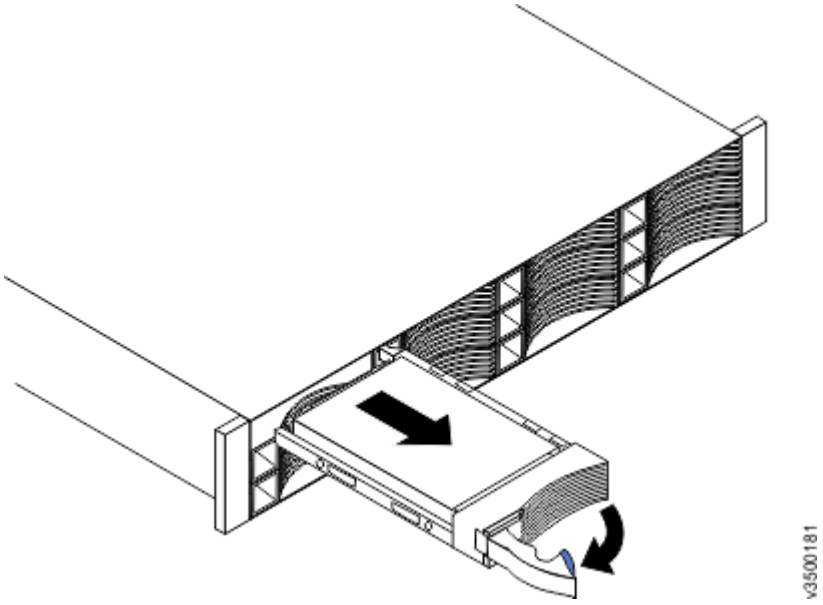


Figure 113. Unlocking and removing a 3.5-inch drive from its slot

6. Grasp the handle and pull the drive partially out of the bay.
7. To avoid possible damage to the drive, wait at least 20 seconds before you remove the drive assembly from the enclosure.
8. Gently slide the drive assembly out of the enclosure.
9. Make sure the drive assembly has proper identification, such as a label on the hard disk drive.

   If the drive fails, record that information on the label.

Replace a drive assembly

10. Touch the static-protective package that contains the drive assembly to any unpainted surface on the outside of the enclosure.
11. Remove the drive assembly from its package.
12. Make sure that its drive-tray handle is in the open (unlocked) position.
13. Align the drive assembly with the guide rails in the bay (see Figure 114 on page 178).

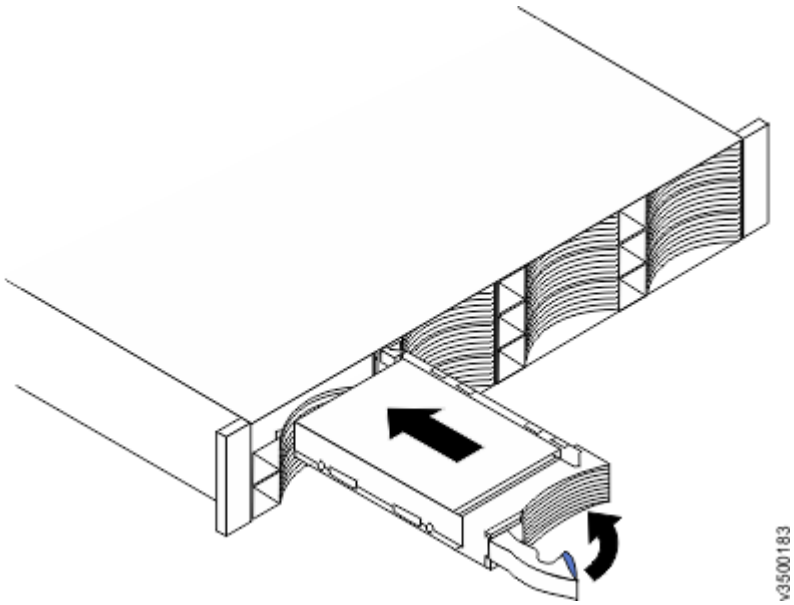


Figure 114. Installing and locking a 3.5-inch drive into its slot

14. Gently push the drive assembly into the bay until the drive stops.
15. Rotate the drive handle to the closed (locked) position.

Results

If the replaced drive was a failed drive, the system automatically reconfigures the replacement drive as a spare and the replaced drive is removed from the configuration. The process can take a few minutes.

Removing and replacing a drive blank

Use the following procedures to remove a faulty drive slot filler and replace it with a new one from stock. Drive slot fillers are passive components that regulate airflow through the control enclosure.

About this task

Notes:

- Every drive slot of an operational control enclosure must contain either a drive or a drive slot filler. A drive slot must not be left empty for more than **10 minutes** during servicing. Ensure that you have read and understood the removal and replacement instructions, and have the replacement part unpacked before you remove the existing drive slot filler.
- No tools are required to complete this task. Do not remove or loosen any screws.

Procedure

1. Unpack the replacement drive slot filler from its packaging.

Removing the drive slot filler

2. Use your thumb and fore finger to pinch the latch of the faulty drive blank.

Removing a drive blank assembly

3. Gently slide the release latch up to unlock the handle.
4. Pull the faulty drive slot filler from the drive slot.

Replacing a drive blank assembly

5. Hold the drive blank the correct way up, as shown in Figure 115 on page 179.

   Figure 115 on page 179 relates to the 2.5" slots in the 2U24 expansion enclosure. Note that the drive blanks are also available in 3.5" form factor for the 2U12 expansion enclosure.

Figure 115. Correct drive blank orientation

6. Slide the replacement drive blank into the empty drive slot.

Replacing a power supply unit for an expansion enclosure

You can replace either of the two hot-swap redundant power supplies in an enclosure. These redundant power supplies operate in parallel, one continuing to power the canister if the other fails.

Before you begin

Attention:

- Although many components are hot-swappable, their intended use is only when your system is not active (no I/O operations). If your system is powered on and processing I/O operations, go to the management GUI and follow the fix procedures. Initiating the replacement actions without the assistance of the fix procedures can result in loss of data or loss of access to data.
- Be careful when you are replacing the hardware components that are located in the back of the system. Do not inadvertently disturb or remove any cables that you are not instructed to remove.
- Ensure that you are aware of the procedures for handling static-sensitive devices before you replace the power supply.

Procedure

1. Before you remove and replace parts, you must be aware of all safety issues. First, read the safety precautions in the IBM Systems Safety Notices. These guidelines help you work safely with the system.
2. Confirm that you know which power supply must be replaced. Go to “Procedure: Identifying which enclosure or canister to service” on page 116.
3. Disconnect the power cord from the electrical outlet. Release the cable retention clip and disconnect the power cord from the power supply that you are replacing.
4. On the left side of the power supply, press the orange release tab to the right slightly to release the handle (no more than 6 mm [0.25 in.]) as you rotate the handle downward.
5. Using the handle, gently slide the power supply out of the enclosure, as shown in Figure 116 on page 180.

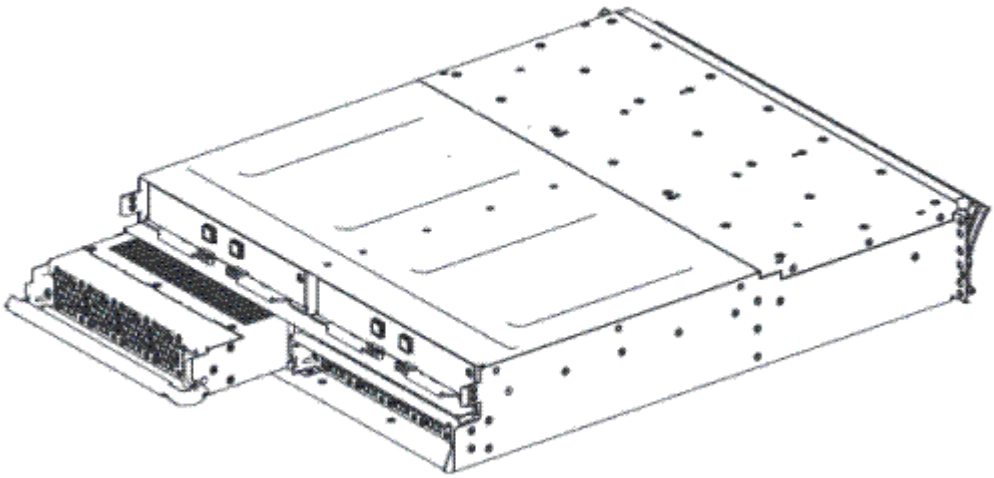


Figure 116. Removing the power supply unit from the left side of the expansion enclosure

6. Hold the new power supply so that the handle is fully extended.
7. Slide the power supply into the enclosure until it stops. Rotate the handle upward into the closed position until it clicks.
8. Hold the new power supply so that the handle is fully extended.
9. Connect the power cord to the power supply and to a properly grounded electrical outlet.

   Note: After the power cord is connected to the electrical outlet, make sure that the AC and DC power (green) LEDs are lit and the fault (amber) LED is off.

Installing or replacing a 2U expansion canister

To replace a faulty expansion canister with a new one received from CRU / FRU stock, use this procedure.

About this task

Attention: Although many components are hot-swappable, they are intended to be used only when your system is not active (no I/O operations). If your system is powered on and processing I/O operations, go to the management GUI and follow the fix procedures. Initiating the replacement actions without the assistance of the fix procedures can result in loss of data or loss of access to data.

Be careful when you are replacing the hardware components that are located in the back of the system. Do not inadvertently disturb or remove any cables that you are not instructed to remove.

Do not remove an expansion canister unless directed to do so by a service procedure.

To replace an expansion canister, do the following steps:

Procedure

1. Read the safety information in IBM Systems Safety Notices.
2. Refer to “Procedure: Understanding system volume dependencies” on page 117 to determine whether to do this procedure.
3. Carefully identify the expansion canister that you are replacing. If possible, go to **Monitoring** > **System** in the management GUI. On the **System -- Overview** page, select the directional arrow near the expansion enclosure that you are replacing. On the **Enclosure Details** page, select **Enclosure Actions** > **Turn Identify On** to set the canister fault LED blinking.
4. Record which SAS cables are plugged into the specific ports of the expansion canister. Select **SAS Chain View** to display the SAS ports that are currently used by the system.

The cables must be inserted back into the same ports after the replacement is complete; otherwise, the system cannot function properly.

5. Disconnect the SAS cables from the canister.
6. Open the two release levers as shown in Figure 117 on page 181.

   The canister moves out of the slot approximately 0.6 cm (0.25 inch).
7. Slide the canister out of the slot.
8. Open the release levers of the replacement canister.
9. Push the replacement canister into the slot until it stops.
10. Finish inserting the canister by closing both release levers so that both orange latches click into place.
11. The canister is correctly installed when the rear face of the canister is flush with the rear edge of the enclosure.

    If the enclosure is powered on and the canister is correctly installed, the canister starts automatically.
12. Reattach each SAS cable into the port from which it was removed in step "5" on page 181.
    a) Ensuring the SAS cable connectors are inserted with the pull tab to the bottom of the connector, gently push the connector in until a slight click is felt or heard.
    b) Verify that the connector is fully inserted by gently pulling on it (not on the tab).

       You should not be able to remove it.

       If the enclosure is powered on and the SAS connector is correctly inserted into the port, the green SAS link LED above the port lights up.

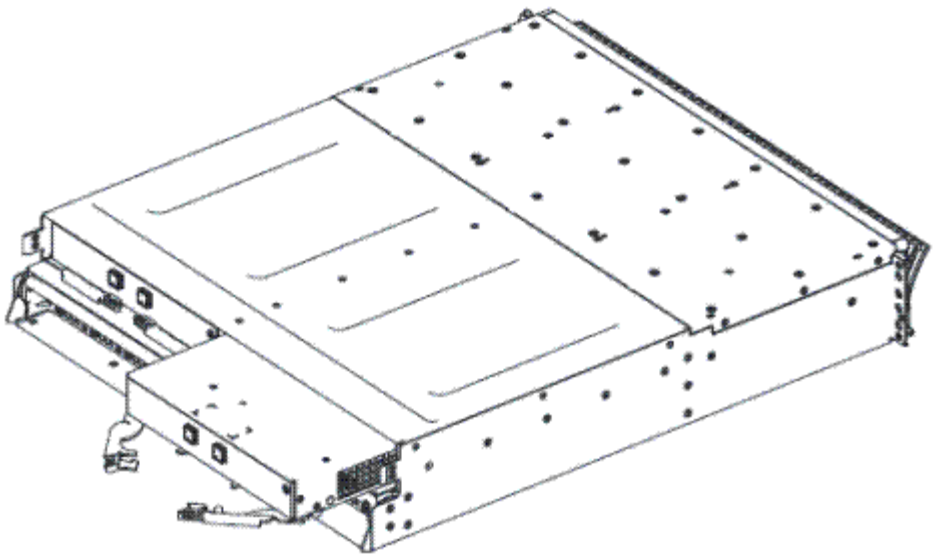


Figure 117. Removing and replacing the IBM Storage FlashSystem expansion canister

Replacing a 2U expansion enclosure midplane assembly

A trained service provider can use this procedure to replace a faulty 2U expansion enclosure midplane assembly with a new one received from CRU / FRU stock.

Before you begin

Three persons are required at step "11" on page 183.

About this task

Attention: To prevent data loss, you must shut down the system before you begin the procedure to replace an expansion enclosure midplane assembly.

The expansion enclosure midplane assembly must be replaced only by a trained service provider.

There are two models of expansion enclosure. Before you replace an expansion enclosure midplane assembly, ensure the FRU part number of the replacement part matches that of the enclosure that is being repaired.

Procedure

To replace the expansion enclosure midplane, complete the following steps.

1. Before you remove and replace parts, you must be aware of all safety issues. First, read the safety precautions in the IBM Systems Safety Notices. These guidelines help you work safely with the system.
2. Read “Procedure: Understanding system volume dependencies” on page 117 to determine whether to continue this procedure.
3. Disconnect each power supply unit in the expansion enclosure from its power outlet so that the expansion enclosure is powered off.
4. Confirm that all the LEDs on the rear of the enclosure are off.
5. Disconnect all cables, labeling each cable to record exactly which port it was attached to (so that the cables can be inserted back into the same ports).
6. Carefully remove each hard disk drive and label it with the drive slot from which it was removed (so that the drives can be inserted back into the same slots). Refer to Figure 118 on page 182 or Figure 119 on page 183.

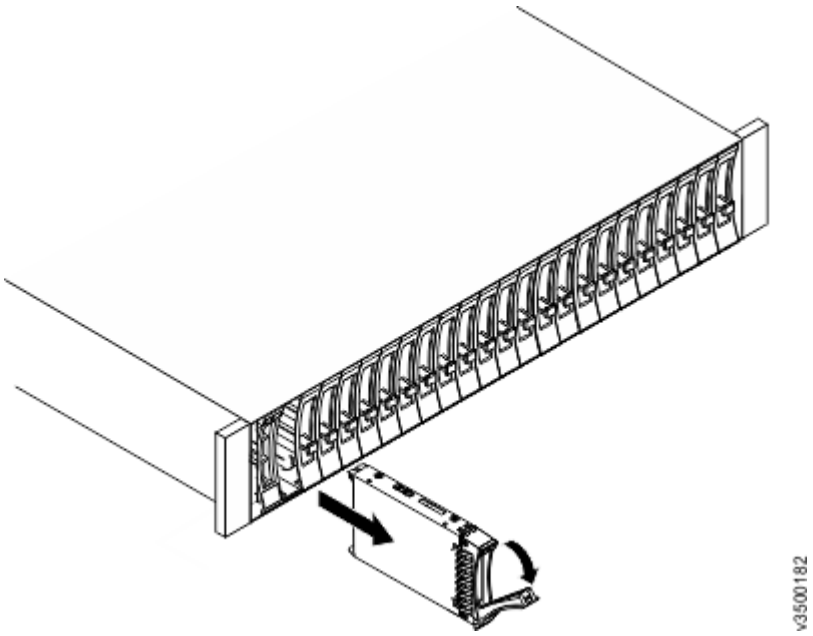


Figure 118. Removing a vertical style hard disk drive

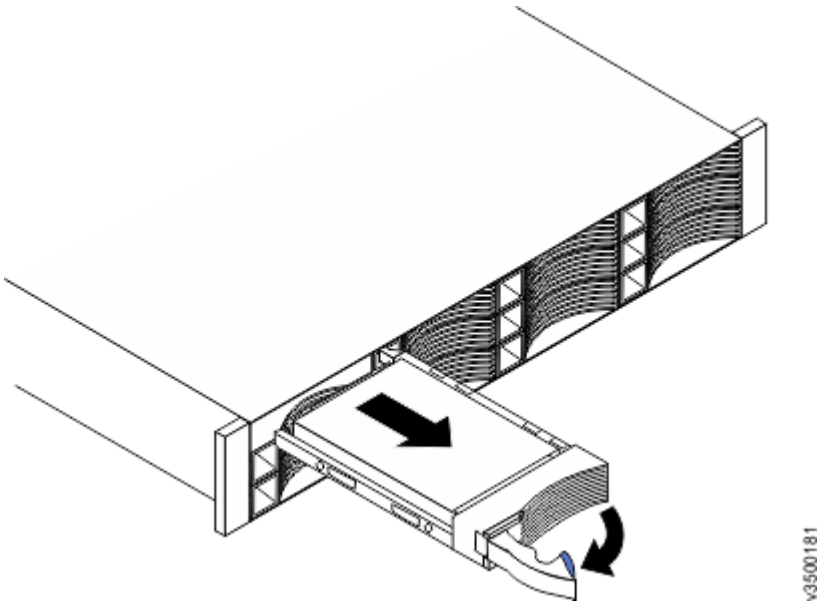


Figure 119. Removing a horizontal style hard disk drive

7. Remove the two power supplies from the enclosure. Refer to "Replacing a power supply unit for an expansion enclosure" on page 179 for guidance.
8. Remove the expansion canisters from the enclosure. Label them to indicate which canister came from which slot.
9. Remove the end caps from the enclosure, as described in "Removing and replacing the enclosure end caps" on page 119.
10. Remove the two screws that secure the front of the enclosure into the rack. Label these screws to indicate the location from which they are removed and place them aside.
11. Slide the enclosure from the rack cabinet, turn it onto its back so that the bottom of the enclosure is facing upwards, and place the enclosure on a flat surface.

CAUTION:

The weight of this part or unit is between 32 and 55 kg (70.5 and 121.2 lb). It takes three persons to safely lift this part or unit. (C010)

12. Remove the four screws from the bottom of the enclosure (see Figure 120 on page 184). Remove the three screws that are near the front and the screw that is near the middle. Label these screws to indicate the location from which they are removed and place them aside.

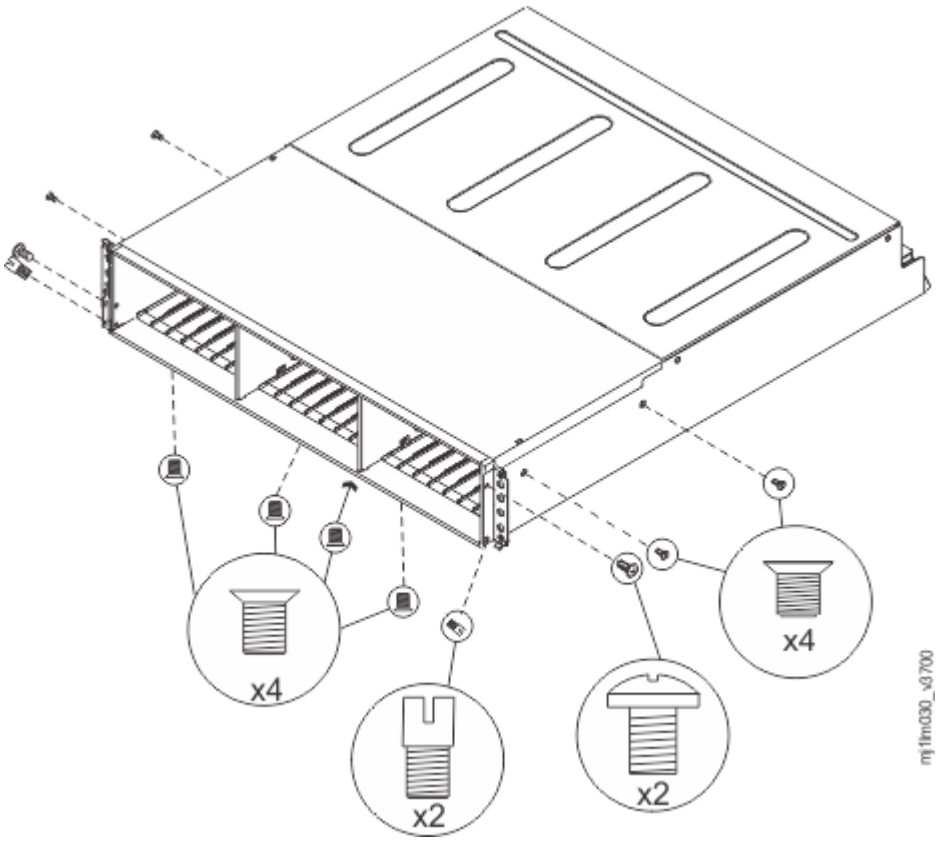


Figure 120. Removing the screws of an expansion enclosure assembly

13. Turn the enclosure top side up and place it on a flat surface.
14. Remove the three screws and one screw-pin on the right side that secure the midplane assembly to the enclosure (see Figure 120 on page 184). Label the screws to indicate the location from which they are removed and place them aside.
15. Remove the three screws and one screw-pin on the left side that secure the midplane assembly to the enclosure (see Figure 120 on page 184). Label the screws to indicate the location from which they are removed and place them aside. See Figure 4.
16. Remove the midplane assembly from the chassis by rotating the midplane assembly up about 45° and then lifting it out. Set the midplane assembly on a flat surface.
17. Unpack the replacement midplane assembly. Grasp the midplane assembly with two hands and hold it at a 45° angle.
18. Insert the tabs on the midplane assembly into the tab holes in the enclosure and rotate the front of the assembly down.
19. Secure the midplane assembly to the chassis on both the right and left sides of the enclosure by using the six screws and two screw-pins that you removed in steps "14" on page 184 and "15" on page 184.
20. Turn the enclosure over so the bottom faces upwards and insert the four screws on the bottom of the enclosure that you removed in step "12" on page 183.
21. Reinstall the enclosure in the rack cabinet, securing it with the two screws that are removed at step "10" on page 183.
22. Reinstall the end caps at the front of the enclosure, as described in "Removing and replacing the enclosure end caps" on page 119.
23. Reinstall the hard disk drives at the front of the enclosure. Ensure that each drive is inserted back in the same slot from which it was removed.
24. Reinstall the canisters into the same slots they were removed from.
25. Reinstall the two power supplies.

26. Reconnect the data cables at the rear of the enclosure.
27. Reconnect the power to the expansion enclosure. The expansion canisters restart and the system logs an error in the event log alerting you to the unrecognized enclosure.

    Important: Step "28" on page 185 writes the enclosure identity into the replacement midplane. The replacement midplane cannot be used as a replacement part for a different enclosure after step "28" on page 185 is completed.
28. Go to **Monitoring** > **Events** in the management GUI. Find the error that relates to the enclosure ID of the replaced enclosure and run the fix procedure for the error.

Replacing an expansion enclosure attachment SAS cable

To replace a faulty expansion enclosure attachment SAS cable with a new one received from CRU or FRU stock, use this procedure.

About this task

Be careful when you are replacing the hardware components that are located in the back of the system. Do not inadvertently disturb or remove any cables that you are not instructed to remove.

Attention:

If you need to replace more than one cable, record which two ports, canisters, and enclosures each cable connects. By doing so, you can match the connections with the replacement cables. The system cannot operate if the expansion enclosure attachment SAS cabling is incorrect.

Expansion enclosure attachment SAS cables are connected only between SAS port 3 or 4 of a node canister and SAS port 1 of an expansion canister, or between SAS ports 1 and 2 of different expansion canisters.

More information about correct expansion enclosure attachment SAS cabling can be found in the troubleshooting description of a problem with IBM Storage FlashSystem SAS cabling.

Procedure

To replace a SAS cable, complete the following steps.

1. Locate the connector at one end of the SAS cable that is to be removed.
2. Grasp the connector by its blue tag. Pull the tag.

   The connector is released and slides out of the port.
3. Repeat steps 2 and 3 on the other end of the SAS cable.
4. To connect the replacement expansion-enclosure attachment SAS cable, connect each end to the vacated ports.

   Attention: When you insert a SAS connector into a SAS port, ensure that the orientation of the connector matches the orientation of the port before you push the connector into the port.

   - The cable connector and socket are keyed and it is important that you have proper alignment of the keys when the cable is inserted.
   - Before you insert the connector into the port, ensure that the connector is rotated such that the blue tag is the lowest part.
   - Figure 121 on page 186 shows the correct orientation. The blue tab is always below the port for expansion enclosure attachment SAS cables.

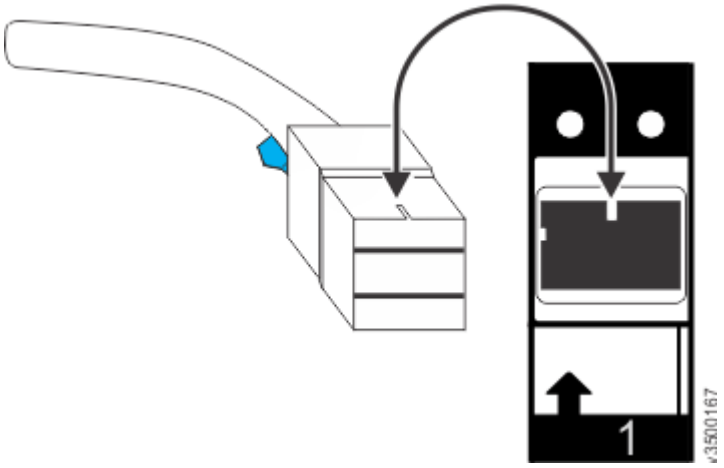


Figure 121. Proper orientation for SAS cable connector

- A click is heard or felt when the cable is successfully inserted and you should not be able to disconnect the cable without pulling on the blue tag.
- When both ends of a SAS cable are correctly connected, the green link LED next to the connected SAS ports are lit.

  For more information, see the troubleshooting procedure for finding the status of SAS connections.

Removing and replacing 5U expansion enclosure parts

You can remove parts from the 5U expansion enclosure to perform service or during the initial installation process.

Removing the support rails of the 5U expansion enclosure

You can remove the support rails for the 5U expansion enclosure.

About this task

This task assumes the following conditions:

- The cable management arm is removed, as described in Removing the cable-management arm.
- The expansion enclosure is removed from the rack, as described in Removing a 5U expansion enclosure from a rack .

Procedure

1. Remove the two screws that attach the outer rail section to the front bracket assembly, as shown in Figure 122 on page 186.

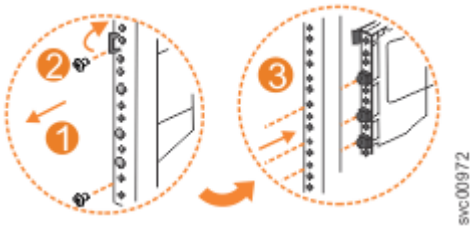


Figure 122. Remove the rail assembly from the front frame bracket

2. Remove the rail section by pulling it away from the front bracket, as shown in Figure 122 on page 186.
3. Remove the two screws that attach the inner rail section to the rear bracket, as shown in Figure 123 on page 187.

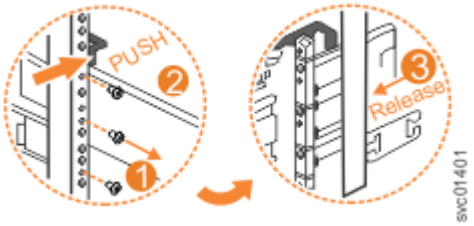


Figure 123. Remove the rail assembly from the rear frame bracket

4. Pull the rail forward away from the rear bracket, as shown in Figure 123 on page 187.
5. Repeat step "1" on page 186 through step "4" on page 187 for the other side of the rail assembly.

Replace the support rails

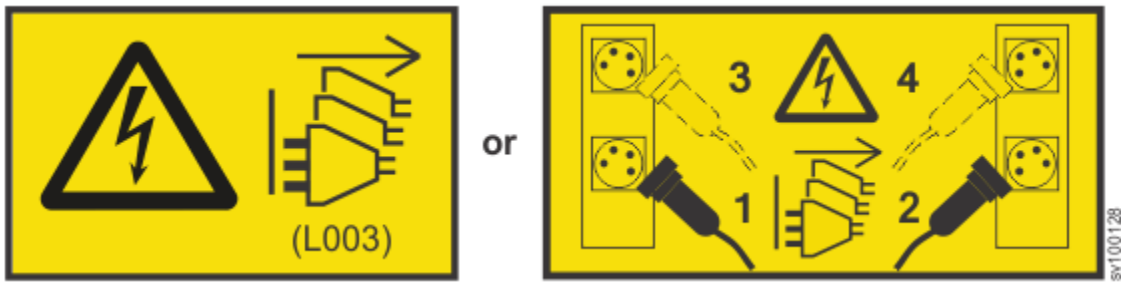
6. To reinstall the support rails, or replace them with support rails from FRU stock, follow the procedure in "Installing or replacing the support rails" on page 91.

Removing a 5U expansion enclosure from a rack

You might need to slide the 5U expansion enclosure out of the rack to apply service. For some tasks, you might need to completely remove the expansion enclosure from the rack.

Before you begin

DANGER: Multiple power cords. The product might be equipped with multiple AC power cords or multiple DC power cables. To remove all hazardous voltages, disconnect all power cords and power cables. (L003)



Use the reference numbers in parentheses at the end of each notice (for example, D005) to find the matching translated notice in *IBM Systems Safety Notices*.

DANGER: Observe the following precautions when working on or around your IT rack system:

- Heavy equipment–personal injury or equipment damage might result if mishandled.
- Always lower the leveling pads on the rack cabinet.
- Always install stabilizer brackets on the rack cabinet.
- To avoid hazardous conditions due to uneven mechanical loading, always install the heaviest devices in the bottom of the rack cabinet. Always install servers and optional devices starting from the bottom of the rack cabinet.
- Rack-mounted devices are not to be used as shelves or work spaces. Do not place objects on top of rack-mounted devices.

- Each rack cabinet might have more than one power cord. Be sure to disconnect all power cords in the rack cabinet when directed to disconnect power during servicing.

- Connect all devices installed in a rack cabinet to power devices installed in the same rack cabinet. Do not plug a power cord from a device installed in one rack cabinet into a power device installed in a different rack cabinet.
- An electrical outlet that is not correctly wired could place hazardous voltage on the metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. (R001 part 1 of 2)

CAUTION:

- Do not install a unit in a rack where the internal rack ambient temperatures will exceed the manufacturer's recommended ambient temperature for all your rack-mounted devices.
- Do not install a unit in a rack where the air flow is compromised. Ensure that air flow is not blocked or reduced on any side, front, or back of a unit used for air flow through the unit.
- Consideration should be given to the connection of the equipment to the supply circuit so that overloading of the circuits does not compromise the supply wiring or overcurrent protection. To provide the correct power connection to a rack, refer to the rating labels located on the equipment in the rack to determine the total power requirement of the supply circuit.
- (For sliding drawers) Do not pull out or install any drawer or feature if the rack stabilizer brackets are not attached to the rack. Do not pull out more than one drawer at a time. The rack might become unstable if you pull out more than one drawer at a time.
- (For fixed drawers) This drawer is a fixed drawer and must not be moved for servicing unless specified by the manufacturer. Attempting to move the drawer partially or completely out of the rack might cause the rack to become unstable or cause the drawer to fall out of the rack. (R001 part 2 of 2)

CAUTION: Removing components from the upper positions in the rack cabinet improves rack stability during a relocation. Follow these general guidelines whenever you relocate a populated rack cabinet within a room or building.

- Reduce the weight of the rack cabinet by removing equipment starting at the top of the rack cabinet. When possible, restore the rack cabinet to the configuration of the rack cabinet as you received it. If this configuration is not known, you must observe the following precautions.
  - Remove all devices in the 32U position and above.
  - Ensure that the heaviest devices are installed in the bottom of the rack cabinet.
  - Ensure that there are no empty U-levels between devices installed in the rack cabinet below the 32U level.
- If the rack cabinet you are relocating is part of a suite of rack cabinets, detach the rack cabinet from the suite.
- If the rack cabinet you are relocating was supplied with removable outriggers they must be reinstalled before the cabinet is relocated.
- Inspect the route that you plan to take to eliminate potential hazards.
- Verify that the route that you choose can support the weight of the loaded rack cabinet. Refer to the documentation that comes with your rack cabinet for the weight of a loaded rack cabinet.
- Verify that all door openings are at least 760 x 230 mm (30 x 80 in.).
- Ensure that all devices, shelves, drawers, doors, and cables are secure.
- Ensure that the four leveling pads are raised to their highest position.
- Ensure that there is no stabilizer bracket installed on the rack cabinet during movement.
- Do not use a ramp inclined at more than 10 degrees.
- When the rack cabinet is in the new location, complete the following steps:
  - Lower the four leveling pads.
  - Install stabilizer brackets on the rack cabinet.

- If you removed any devices from the rack cabinet, repopulate the rack cabinet from the lowest position to the highest position.

- If a long-distance relocation is required, restore the rack cabinet to the configuration of the rack cabinet as you received it. Pack the rack cabinet in the original packaging material, or equivalent. Also lower the leveling pads to raise the casters off the pallet and bolt the rack cabinet to the pallet. (R002)

DANGER: Racks with a total weight of > 227 kg (500 lb.), Use Only Professional Movers! (R003)

DANGER: Do not transport the rack via fork truck unless it is properly packaged, secured on top of the supplied pallet. (R004)

DANGER:

Main Protective Earth (Ground):

This symbol is marked on the frame of the rack.

The PROTECTIVE EARTHING CONDUCTORS should be terminated at that point. A recognized or certified closed loop connector (ring terminal) should be used and secured to the frame with a lock washer using a bolt or stud. The connector should be properly sized to be suitable for the bolt or stud, the locking washer, the rating for the conducting wire used, and the considered rating of the breaker. The intent is to ensure the frame is electrically bonded to the PROTECTIVE EARTHING CONDUCTORS. The hole that the bolt or stud goes into where the terminal conductor and the lock washer contact should be free of any non-conductive material to allow for metal to metal contact. All PROTECTIVE EARTHING CONDUCTORS should terminate at this main protective earthing terminal or at points marked with . (R010)

DANGER: Serious injury or death can occur if loaded lift tool falls over or if a heavy load falls off the lift tool. Always completely lower the lift tool load plate and properly secure the load on the lift tool before moving or using the lift tool to lift or move an object. (D010)

CAUTION:

The weight of this part or unit is more than 55 kg (121.2 lb). It takes specially trained persons, a lifting device, or both to safely lift this part or unit. (C011)

CAUTION: To avoid personal injury, before lifting this unit, remove all appropriate subassemblies per instructions to reduce the system weight. (C012)

CAUTION: CAUTION regarding IBM provided VENDOR LIFT TOOL:

- Operation of LIFT TOOL by authorized personnel only
- LIFT TOOL intended for use to assist, lift, install, remove units (load) up into rack elevations. It is not to be used loaded transporting over major ramps nor as a replacement for such designated tools like pallet jacks, walkies, fork trucks and such related relocation practices. When this is not practicable, specially trained persons or services must be used (for instance, riggers or movers). Read and completely understand the contents of LIFT TOOL operator's manual before using.
- Read and completely understand the contents of LIFT TOOL operator's manual before using. Failure to read, understand, obey safety rules, and follow instructions may result in property damage and/or personal injury. If there are questions, contact the vendor's service and support. Local paper manual must remain with machine in provided storage sleeve area. Latest revision manual available on vendor's website.
- Test verify stabilizer brake function before each use. Do not over-force moving or rolling the LIFT TOOL with stabilizer brake engaged.
- Do not raise, lower or slide platform load shelf unless stabilizer (brake pedal jack) is fully engaged. Keep stabilizer brake engaged when not in use or motion.

- Do not move LIFT TOOL while platform is raised, except for minor positioning.
- Do not exceed rated load capacity. See LOAD CAPACITY CHART regarding maximum loads at center versus edge of extended platform.
- Only raise load if properly centered on platform. Do not place more than 200 lb (91 kg) on edge of sliding platform shelf also considering the load's center of mass/gravity (CoG).
- Do not corner load the platform tilt riser accessory option. Secure platform riser tilt option to main shelf in all four (4x) locations with provided hardware only, prior to use. Load objects are designed to slide on/off smooth platforms without appreciable force, so take care not to push or lean. Keep riser tilt option flat at all times except for final minor adjustment when needed.
- Do not stand under overhanging load.
- Do not use on uneven surface, incline or decline (major ramps).
- Do not stack loads.
- Do not operate while under the influence of drugs or alcohol.
- Do not support ladder against LIFT TOOL.
- Tipping hazard. Do not push or lean against load with raised platform.
- Do not use as a personnel lifting platform or step. No riders.
- Do not stand on any part of lift. Not a step.
- Do not climb on mast.
- Do not operate a damaged or malfunctioning LIFT TOOL machine.
- Crush and pinch point hazard below platform. Only lower load in areas clear of personnel and obstructions. Keep hands and feet clear during operation.
- No Forks. Never lift or move bare LIFT TOOL MACHINE with pallet truck, jack or fork lift.
- Mast extends higher than platform. Be aware of ceiling height, cable trays, sprinklers, lights, and other overhead objects.
- Do not leave LIFT TOOL machine unattended with an elevated load.
- Watch and keep hands, fingers, and clothing clear when equipment is in motion.
- Turn Winch with hand power only. If winch handle cannot be cranked easily with one hand, it is probably over-loaded. Do not continue to turn winch past top or bottom of platform travel. Excessive unwinding will detach handle and damage cable. Always hold handle when lowering, unwinding. Always assure self that winch is holding load before releasing winch handle.
- A winch accident could cause serious injury. Not for moving humans. Make certain clicking sound is heard as the equipment is being raised. Be sure winch is locked in position before releasing handle. Read instruction page before operating this winch. Never allow winch to unwind freely. Freewheeling will cause uneven cable wrapping around winch drum, damage cable, and may cause serious injury. (C048)

About this task

Attention: To avoid potential equipment damage during transport and subsequent loss of data, see Procedure: Transporting a 5U 92-drive expansion enclosure . The procedure describes what to do for the following situations.

- When you are powering off a 92F, 92G, or an A9F 5U expansion enclosure because you intend to transport it to another location.
- When you intend to move a rack that contains a 92F, 92G, or an A9F 5U expansion enclosure.

The procedure describes how to remove each drive from the 5U enclosure and transport the enclosure. Removing the drives prevents damage to the drives and makes the lighter enclosure easier to move.

To complete some service tasks, you might need to slide the enclosure out of the rack to gain access to parts. For these tasks, you do not have to completely remove the enclosure from the rack. However, in limited circumstances, you must remove the enclosure completely from the rack.

Important:

The 5U expansion enclosure is heavy. Always use a suitably rated mechanical lift or four persons to support the weight of the enclosure whenever you slide the enclosure out from the rack or remove it completely.

In addition to using a mechanical lift, always complete the following tasks before you attempt to remove the expansion enclosure from the rack.

- Remove both power cables from the expansion enclosure.
- Remove all the following parts:
  - Cover
  - Drives
  - Fan modules
  - Power supply units and 1U fascia
  - Secondary expansion modules
  - Expansion canisters and SAS cables

  When the enclosure is not secured to the rails in a rack, you can minimize the risk of injury and make maneuvering the enclosure on a lift easier. However, even after you remove the drives, power supply units, secondary expander modules, canisters, fans, and cover, the enclosure weighs 43 kg (95 lbs).

Procedure

Sliding the expansion enclosure out of the rack

Note: You can accomplish most service actions when the expansion enclosure is fully extended from the rack on its slide rails.

1. Loosen the locking thumb screws (1) on the front of the enclosure, as shown in Figure 124 on page 191.

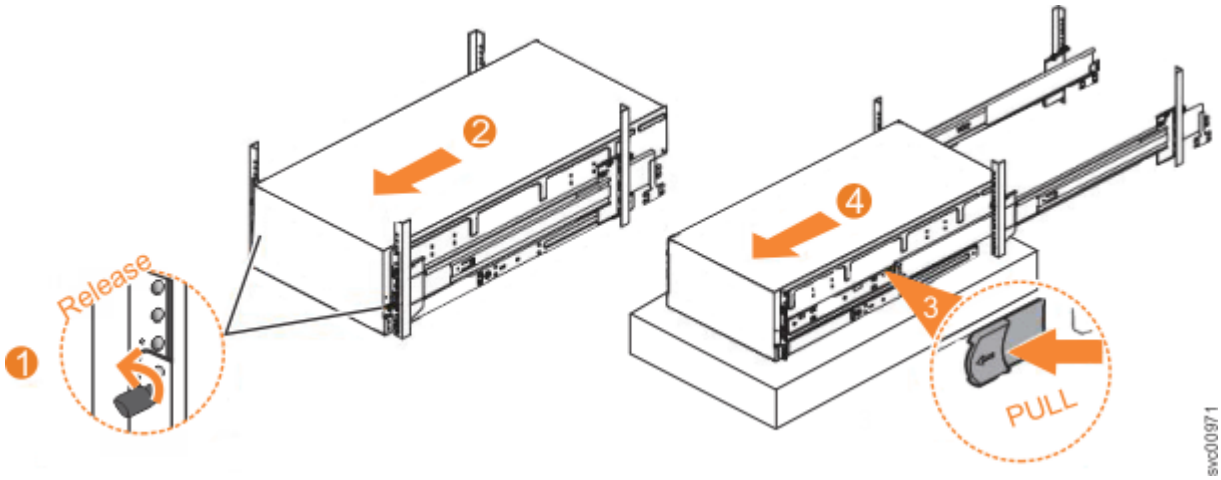


Figure 124. Removing the 5U expansion enclosure from the rack

2. Carefully slide the enclosure forward out of the rack (2), as shown in Figure 124 on page 191.
3. Locate the left and right blue release tabs near the front of the enclosure. Pull both release tabs forward to unlock the drawer mechanism (3 in Figure 124 on page 191).
4. Slide the enclosure and inner rail member out of the rack (4 in Figure 124 on page 191).

   For safety, ensure that a mechanical lift or other mechanism is available to support the weight of the enclosure.

Removing the expansion enclosure from the rack

Note: Continue the procedure (step "5" on page 192 through step "7" on page 192) only if you must completely remove the expansion enclosure from the rack to complete a service procedure.

5. Power down the expansion enclosure and disconnect all power cords.
6. Remove all the following parts from the enclosure, as described in the following procedures:
   - "Removing and replacing the top cover" on page 196
   - "Removing and replacing the fascia" on page 210 (for the PSU fascia) and "Removing and replacing a power supply" on page 213
   - "Removing and replacing a drive" on page 198
   - "Removing and replacing a secondary expander module" on page 202
   - "Removing an expansion canister" on page 220 and "Removing and installing a SAS cable" on page 221
   - "Removing and replacing a fan module" on page 223
7. With the help of multiple persons or a mechanical lift, lift and remove the enclosure from the rack.

Replace the enclosure in the rack

8. To reinstall or return the expansion enclosure in the rack, follow the procedure in "Installing a 5U expansion enclosure in a rack" on page 93.

Removing or moving the cable-management arm

You might need to move the cable-management arm (CMA) aside to complete service tasks. If needed, you can also remove the CMA from the 5U expansion enclosure.

About this task

The Cable Management Arm (CMA) consists of an upper and lower arm assembly, as the figure Figure 125 on page 192 shows. The upper and lower are independent of each other. They can be installed, moved, or removed from the enclosure individually.

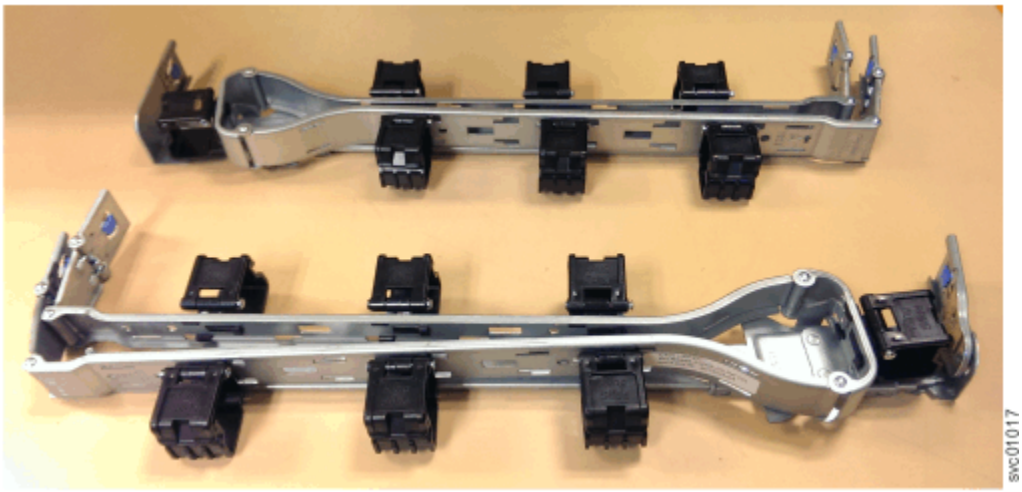


Figure 125. Upper and lower cable-management arms

To complete many service tasks, you can swing the CMA assemblies away from the expansion enclosure. You do not have to completely remove the CMA assemblies from the enclosure. For these service tasks, complete step "1" on page 195 through step "4" on page 196 in "Moving the cable management arms" on page 194.

However, you might need to remove a CMA assembly from the 5U expansion enclosures. To do so, complete step "1" on page 193 through step "8" on page 194 in following procedure.

Procedure

Remove the upper CMA assembly

The connectors of the CMA are installed on the rail hooks at the end of the support rails. Figure 126 on page 193 shows the connectors on the upper CMA assembly.

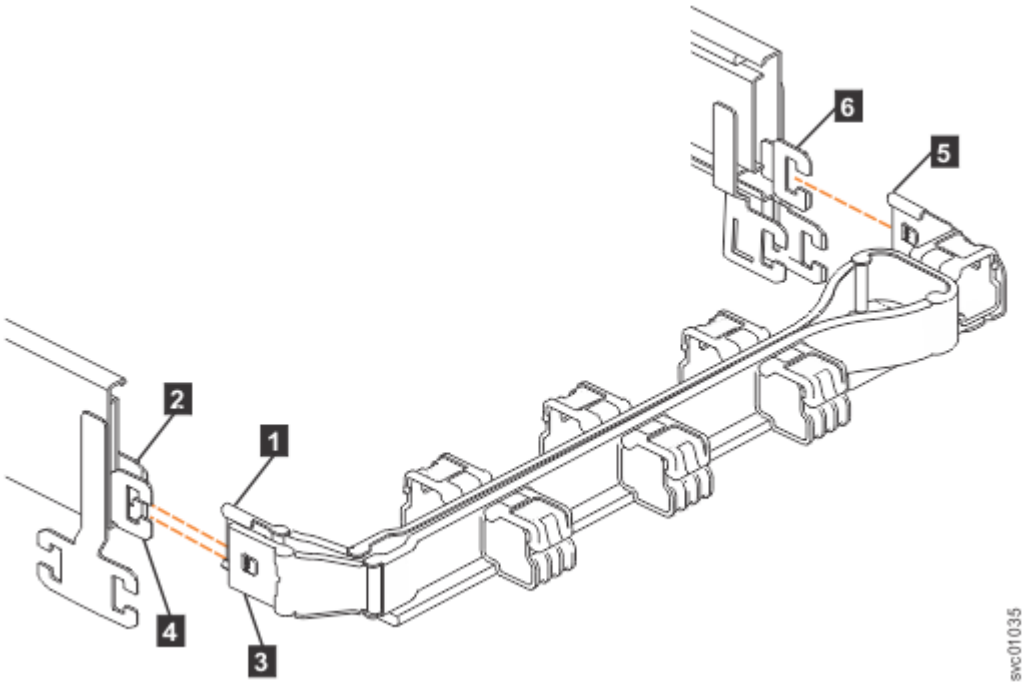


Figure 126. Connectors for the upper cable management arm

1. Inner connector on the upper CMA
2. Connector base on inner rail member
3. Outer connector on the upper CMA
4. Connector base on outer rail member
5. Support rail connector on the upper CMA
6. Connector base on outer rail member

1. Press the latch on the connector base on the upper CMA assembly (5 in Figure 126 on page 193).
2. Pull the connector to remove it from the connector base on the right support rail (6 in Figure 126 on page 193).
3. Press the latch on the outer connector of the upper CMA assembly (3 in Figure 126 on page 193).
4. Remove the outer connector from the inner member of the left support rail (4 in Figure 126 on page 193).
5. Remove the inner connector of the upper CMA assembly (1) from the inner member of the left support rail (2), as shown in Figure 126 on page 193.

Remove the lower CMA assembly

Note: The procedure for removing the lower CMA assembly is the same as the procedure to remove the upper CMA assembly. However, the connector locations are reversed. For example, the connector base of the upper CMA (5 in Figure 126 on page 193) connects to the right rail. The connector base of the lower CMA (11 in Figure 127 on page 194) attaches to the left rail.

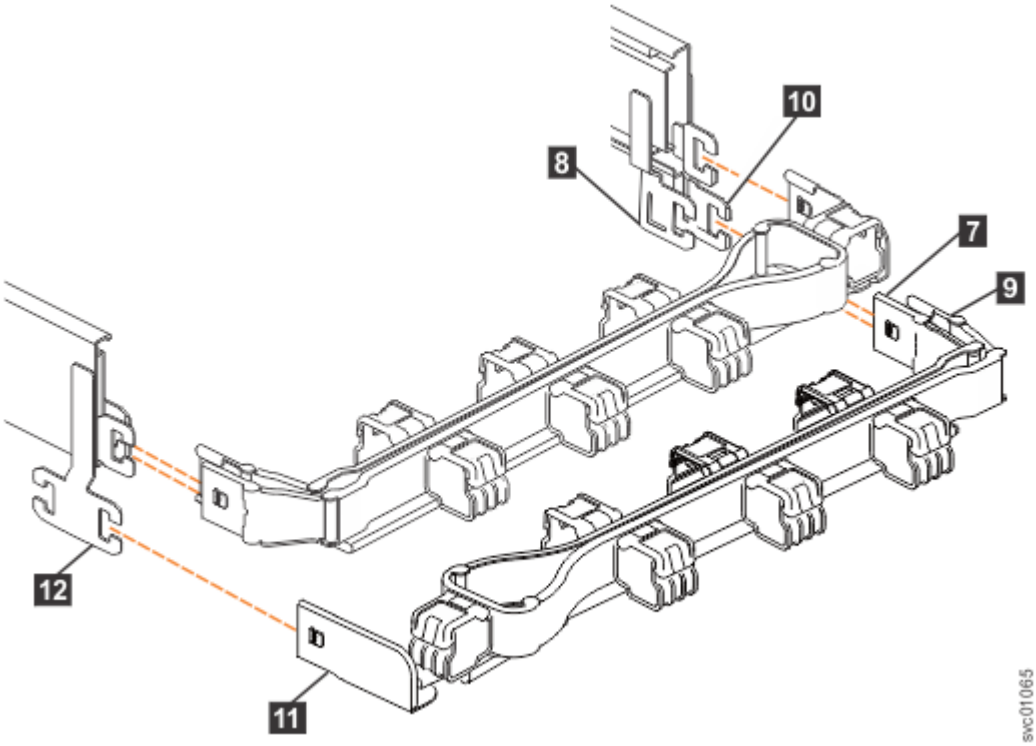


Figure 127. Components of the lower CMA assembly

6. Remove the connector base on the lower CMA assembly (11) from the connector on the left support rail (12), as Figure 127 on page 194.
7. Remove the inner connector of the lower CMA assembly (9) from the outer member of the right support rail (10), as shown in Figure 127 on page 194.
8. Remove the outer connector of the lower CMA assembly (7) from the inner member of the right support rail (8), as shown in Figure 127 on page 194.

Moving the cable management arms

About this task

To complete most service tasks, you can swing the CMA assemblies out of the way. You can move each arm independently or you can move both arms. For example, Figure 128 on page 195 shows that both of the CMA assemblies are swung away from the rear of the enclosure.

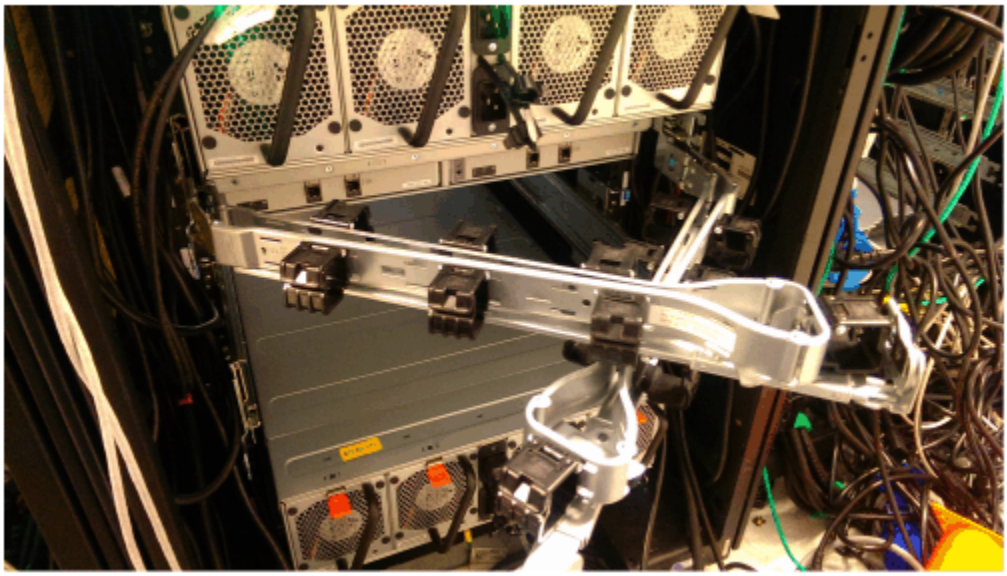


Figure 128. Upper and lower CMA assemblies moved aside

Figure 129 on page 195 shows that the lower CMA assembly is swung away from the rear of the enclosure so that the expansion canister is accessible.

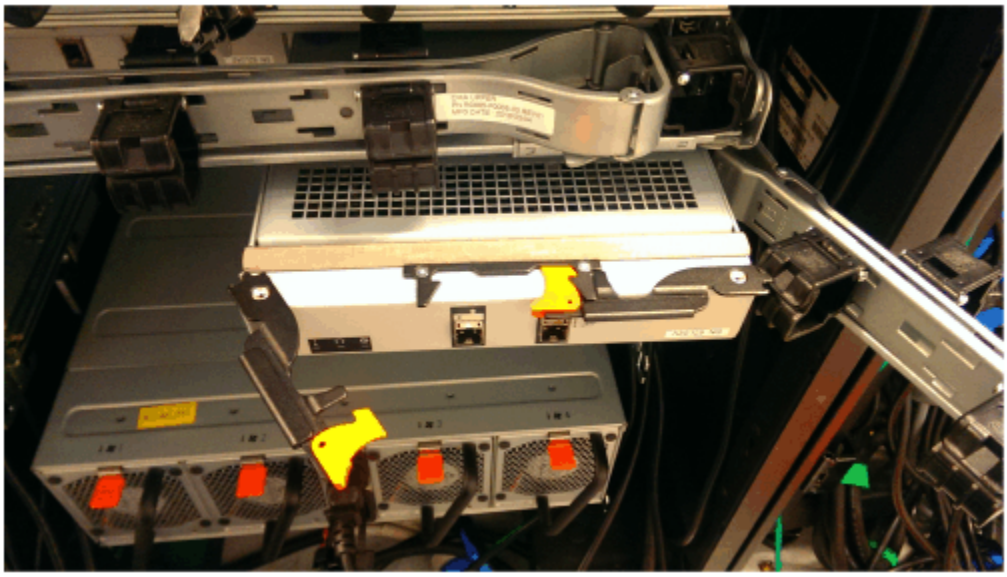


Figure 129. Lower CMA assembly moved

Procedure

1. To release the upper CMA, push the latch on the support rail connector 5 to release it from the connector base 6 on the right rail.

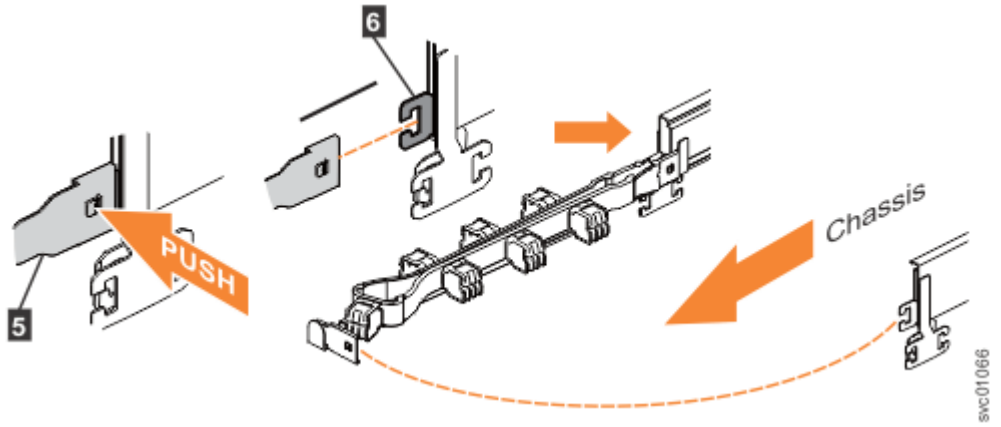


Figure 130. Release the upper CMA assembly

2. Move the upper CMA to the left to swing it out of the way.
   a) To reattach the upper CMA to the rail, reverse the procedure.
3. To release the lower CMA, push the latch on the support rail connector 11 to release it from the connector base 12 on the left rail.

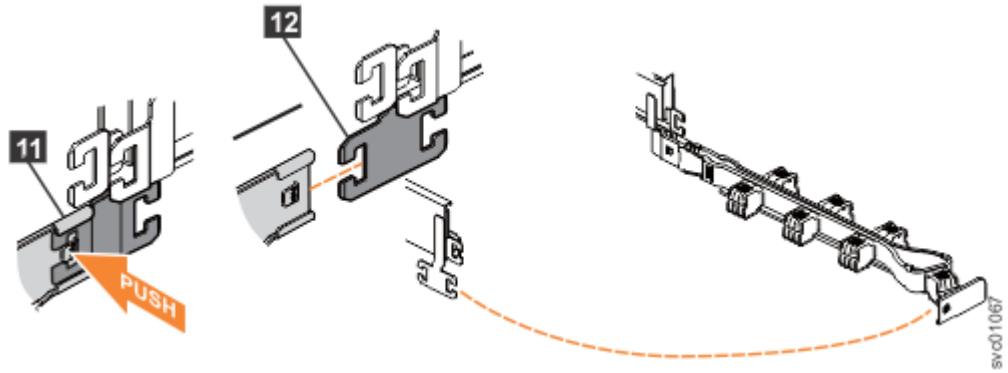


Figure 131. Release the lower CMA assembly

4. Move the lower CMA to the right to swing it out of the way.
   a) To reattach the lower CMA to the rail, reverse the procedure.

Removing and replacing the top cover

To complete some service tasks, you might need to remove the top cover from a 5U expansion enclosure.

Before you begin

Important: You can remove the cover without powering off the expansion enclosure. However, to maintain operating temperature, replace the cover within 15 minutes of its removal. When the cover is removed, the reduction in airflow through the enclosure might cause the enclosure or its components to shut down to protect from overheating.

Procedure

1. Use the slide rails to pull the enclosure out from the rack.
2. Slide the release latch (1) in the direction that is shown in Figure 132 on page 197.

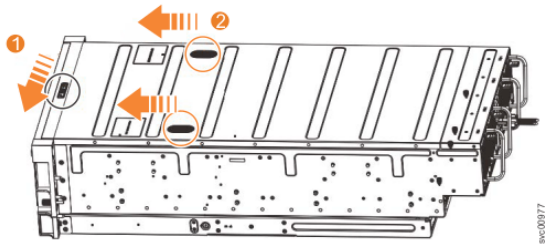


Figure 132. Releasing the 5U expansion enclosure cover

3. Slide the cover toward the front of the expansion enclosure (2), as shown in Figure 132 on page 197.
4. Carefully lift the cover up, as shown in Figure 133 on page 197.

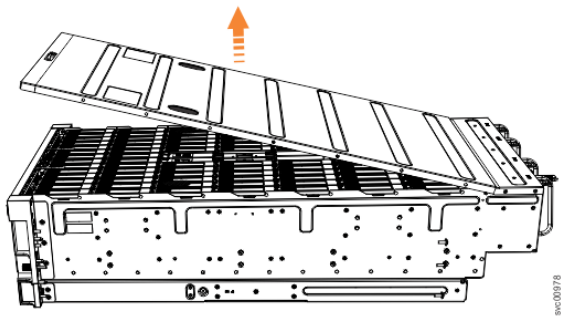


Figure 133. Removing the 5U expansion enclosure cover

5. Place the cover in a safe location.

Replace the cover

6. Carefully lower the cover and ensure that it is aligned correctly with the back of the enclosure, as shown in Figure 134 on page 197.

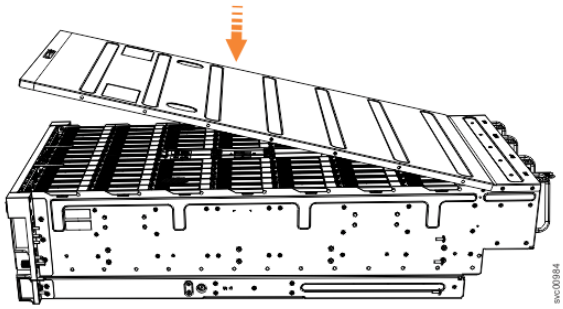


Figure 134. Aligning the top cover

7. Push the cover release lever to the side (2) as shown in Figure 135 on page 197.
8. Slide the cover towards the back of the enclosure (3) back until it stops, as shown in Figure 135 on page 197.

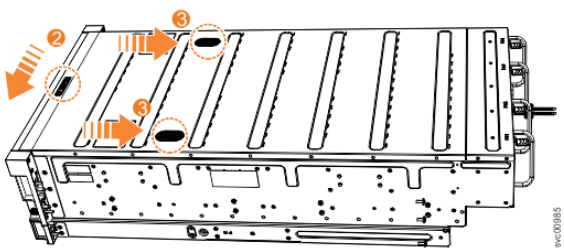


Figure 135. Replacing the top cover

9. Verify that the cover correctly engages the cover release latch and all of the inset tabs on the expansion enclosure.
10. Lock the cover into position by sliding the release lever 4, as shown in Figure 136 on page 198

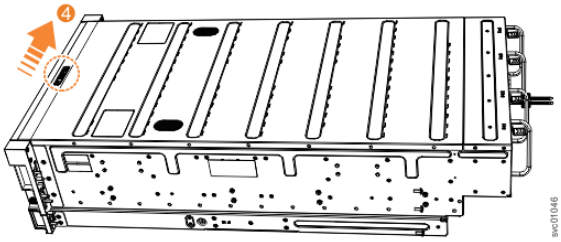


Figure 136. Locking the top cover

Removing and replacing a drive

You can remove a faulty drive from a 5U expansion enclosure to replace it with a new one received from FRU stock.

Before you begin

Ensure that the drive is not a spare or a member of an array. The drive status is shown in **Pools** > **Internal Storage** in the IBM Storage FlashSystem. If the drive is a member of an array, follow the fix procedures in the IBM Storage FlashSystem. The fix procedures minimize the risk of losing data or access to data. The procedures also manage the system's use of the drive.

Important: You can remove a drive assembly without powering off the expansion enclosure. However, to maintain operating temperature, complete the following tasks.

- Do not remove a faulty drive assembly until its replacement is ready to be installed.
- Do not keep the cover off an operational enclosure for more than 15 minutes. The reduction in airflow through the enclosure might cause the enclosure or its components to shut down to protect from overheating.

About this task

The 5U expansion enclosure supports 92 drives. Figure 137 on page 198 shows an example of a drive assembly.

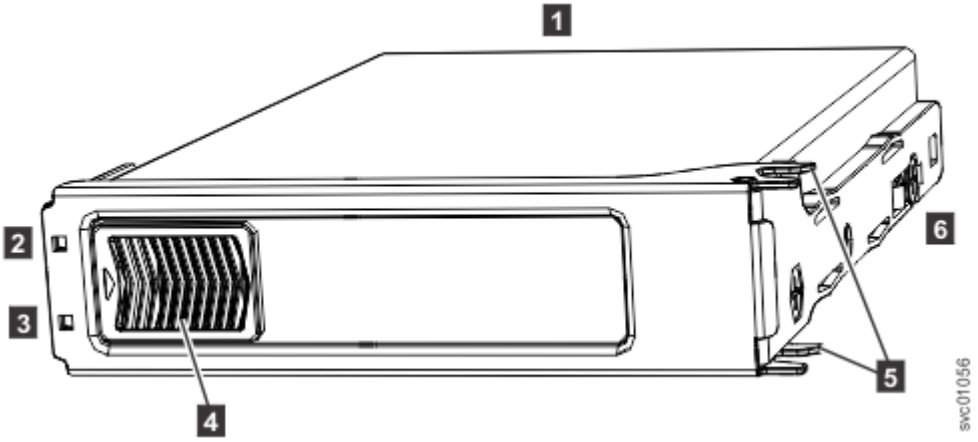


Figure 137. Drive assembly

1 Disk drive
2 Online indicator
3 Fault indicator
4 Release latch
5 Drive latch toes
6 Drive carrier

Procedure

1. Read all available safety information.
2. Use the slide rails to pull the enclosure out from the rack, as described in “Removing a 5U expansion enclosure from a rack” on page 187.
3. Remove the top cover, as described in “Removing and replacing the top cover” on page 196.
4. Locate the slot that contains the drive assembly that you want to remove.

   Note: When a drive is faulty, the amber fault indicator is lit (3 in Figure 137 on page 198). Do not replace a drive unless the drive fault indicator is on or you are instructed to do so by a fix procedure. When lit, the green indicator shows that activity is occurring on the drive.

   A label on the enclosure cover (Figure 138 on page 199) shows the location of the drive slots. The drive slots are numbered 1-14 from left to right and A-G from the back to the front of the enclosure.

   The drive locations are also marked on the enclosure itself. The rows (A-G) are marked on the left and right edges of the enclosure. The columns (1-14) are marked on the front edge of the enclosure. The row and column marks are visible when the top cover is removed.

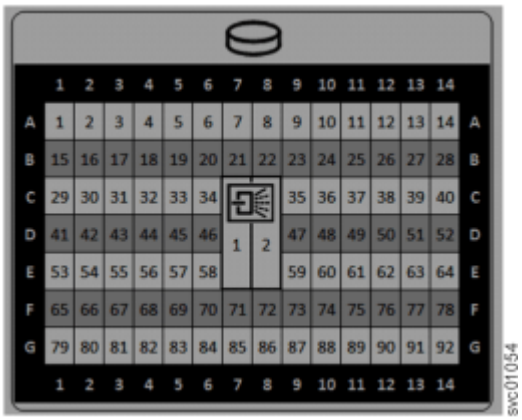


Figure 138. Drive locations in a 5U expansion enclosure

5. Slide the release latch forward (1), as shown in Figure 139 on page 200.

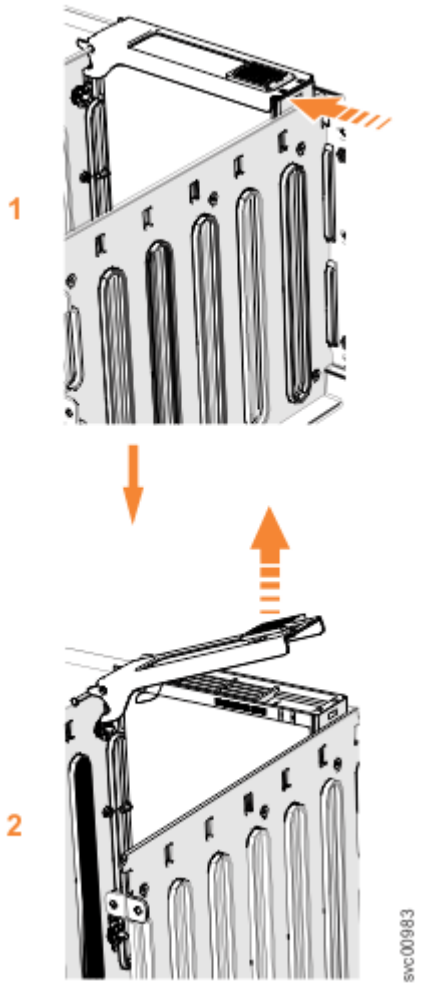


Figure 139. Remove the drive assembly

6. Lift the handle (2) to unlock the drive carrier from the partition, as shown in Figure 139 on page 200. Ensure the toe on the bottom of the latch is fully disengaged.
7. Carefully lift the drive carrier up to remove it from the expansion enclosure.
8. Repeat step "4" on page 199 through step "7" on page 200 for each drive you need to remove.

Replace the drive

9. Read all of the available safety information.
10. Carefully slide the expansion enclosure out of the rack.
11. Remove the cover, as described in "Removing and replacing the top cover" on page 196.
12. Locate the empty drive slot to receive the new drive or that contains the faulty drive that you want to replace.

    Note: When a drive is faulty, the amber fault indicator is lit (3 in Figure 137 on page 198). Do not replace a drive unless the drive fault indicator is on or you are instructed to do so by a fix procedure.

    A label on the enclosure cover (Figure 140 on page 201) shows the drive locations in the enclosure. The drive slots are numbered 1-14 from left to right and A-G from the back to the front of the enclosure.

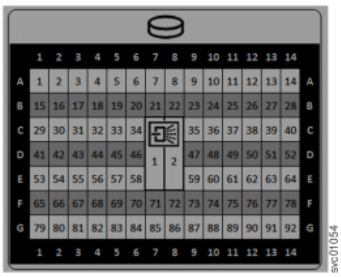


Figure 140. Drive locations in a 5U expansion enclosure

The drive slots must be populated sequentially, starting from the back-left corner position (slot 1, grid A1). Sequentially install the drive in the slots from left to right and back row to front. Always complete a full row before you install drives in the next row.

For example, in Figure 141 on page 201, the drives are installed correctly. Drives are installed in slots 1 -14 of row A and the installation continues in slot 15 in row B.

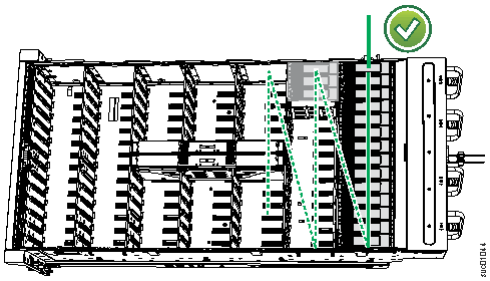


Figure 141. Correct drive installation

In Figure 142 on page 201, the drives are not installed correctly. Slot 1 (A1) does not contain a drive. In addition, drives are installed in row B even though row A contains empty drive slots.

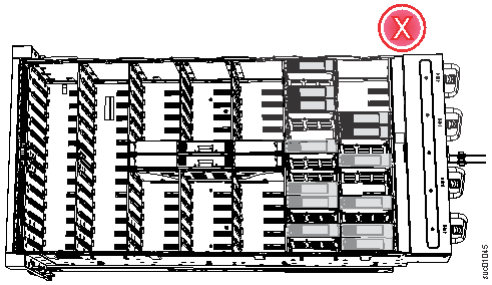


Figure 142. Incorrect drive installation

13. Touch the static-protective package that contains the drive to any unpainted metal surface on the enclosure. Wear an anti-static wrist strap to remove the drive from the package.
14. Ensure that the drive handle (**1** in Figure 143 on page 202) of the drive assembly is in the open (unlocked) position.
15. Hold the drive by two top corners so that it hangs squarely over the appropriate drive slot.

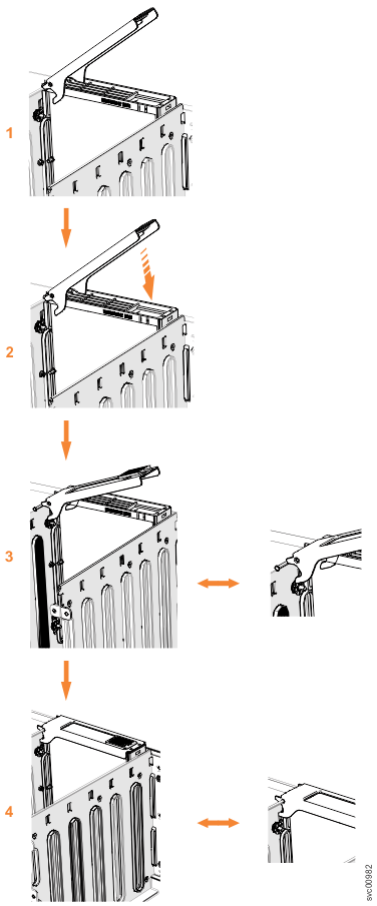


Figure 143. Replace the drive

16. Lower the drive down, without pushing, until it stops and the bottom of the latch is aligned with the top of the partition. Ensure that the handle is not open more than 45 degrees from the drive carrier. (2 in Figure 143 on page 202). If the drive does not slide down easily then inform IBM remote technical support.
17. Rotate the handle down to lock the drive assembly into the chassis (3 in Figure 143 on page 202).
18. Ensure the toe on the bottom of the latch is fully engaged with the partition in the chassis.
19. Ensure that the top toe of the latch is also fully engaged (4 in Figure 143 on page 202).
20. Repeat steps "13" on page 201 through "19" on page 202 for each drive you are replacing.
21. Replace the cover, as described in "Removing and replacing the top cover" on page 196.
22. Slide the expansion enclosure back into the rack, as described in "Installing a 5U expansion enclosure in a rack" on page 93.

Removing and replacing a secondary expander module

You can remove a secondary expander module from a 5U expansion enclosure if it is faulty or to perform other service tasks.

Before you begin

DANGER:

Hazardous voltage present. Voltages present constitute a shock hazard, which can cause severe injury or death. (L004)

DANGER:

Hazardous energy present. Voltages with hazardous energy might cause heating when shorted with metal, which might result in splattered metal, burns, or both. (L005)

CAUTION:

- Only an IBM Service Support Representative (SSR) can remove or replace the secondary expander module from an enclosure (FRU P/N 01LJ112) that is powered on. If the 01LJ112 enclosure is powered on, use caution and avoid contact with the connectors on the main board.
- If the FRU part number of the enclosure is 01LJ607, you can remove or replace the secondary expander module while the enclosure is powered on.

Important: You can remove a secondary expander module without powering off the expansion enclosure. However, to maintain operating temperature, perform the following tasks.

- Do not remove a faulty secondary expander module until its replacement is ready to be installed.
- Do not keep the cover off an operational enclosure for more than 15 minutes. The reduction in airflow through the enclosure might cause the enclosure or its components to shut down to protect from overheating.

About this task

The secondary expander modules provide SAS connectivity between the expansion canisters and the drives. Each drive has 2 SAS ports. SAS port 1 of each drive is connected to secondary expander module 1. SAS port 2 of each drive is connected to secondary expander module 2. Each expansion canister is connected to both secondary expander module 1 and secondary expander module 2. If secondary expander module 2 is missing or is faulty, the expansion canisters can communicate only with SAS port 1 on each drive. Similarly, if secondary expander module 1 is missing or is faulty, the expansion canisters can communicate only with SAS port 2 on each drive.

The two secondary expansion modules are already installed when the 5U expansion enclosure is shipped, as Figure 144 on page 203 shows.

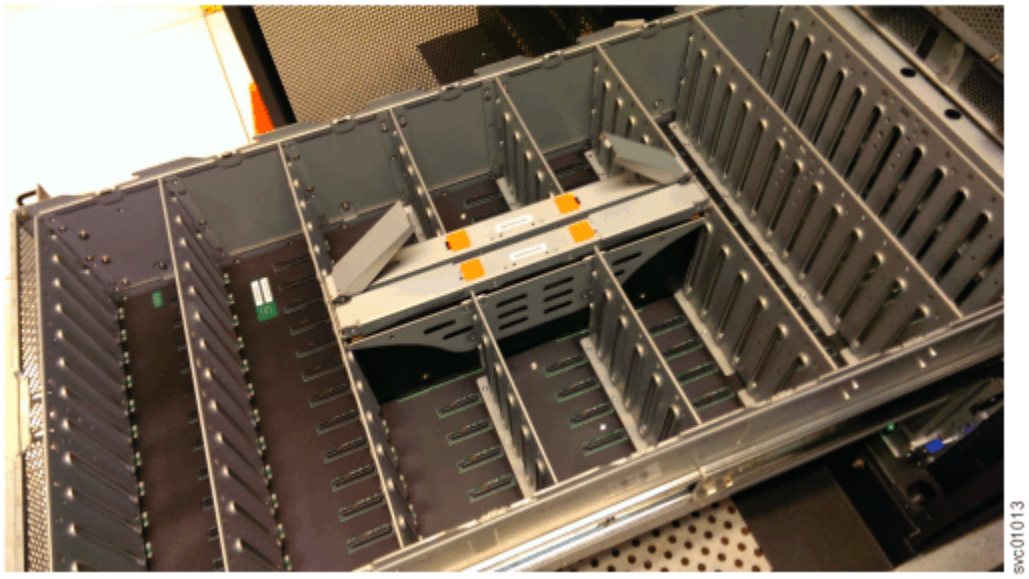


Figure 144. Location of secondary expander modules

Figure 145 on page 204 shows the location of the LED indicators on the top of the secondary expander module. Each secondary expander module has its own set of LEDs. When power is connected to the expansion enclosure, the LEDs identify the operational status of the secondary expander modules.

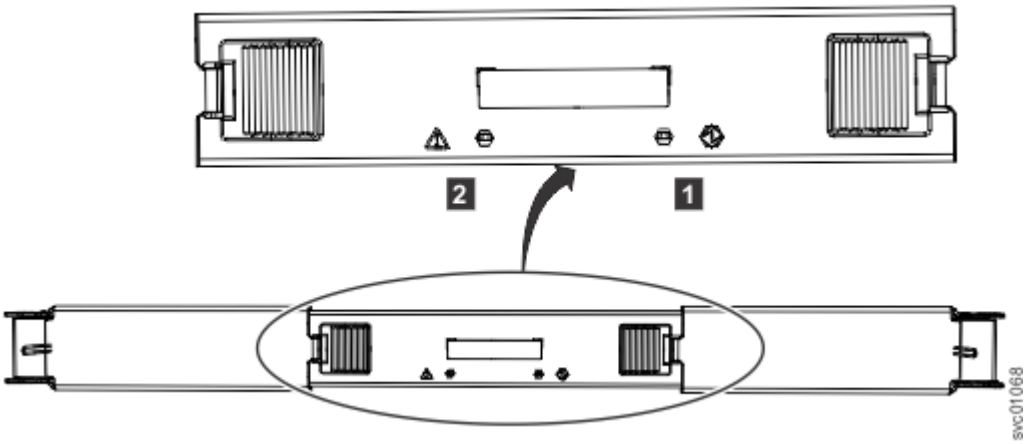


Figure 145. Location of LEDs on the secondary expander module

Table 59 on page 204 describes the function and status values of each LED indicator.

Table 59. LEDs on the secondary expander modules

LED	Color	Status	Description
Power 1	Green	On	The secondary expander module is receiving power.
		Off	The secondary expander module is not receiving power.
Fault 2	Amber	On	Not used.
		Blink	The secondary expander module is being identified.
		Off	Normal operation.

This task assumes that the following conditions were met:

- The expansion enclosure is slid out from the rack, as described in "Removing a 5U expansion enclosure from a rack" on page 187.
- The top cover was removed, as described in "Removing and replacing the top cover" on page 196.

Procedure

1. Identify the secondary expander module to be replaced; refer to Table 59 on page 204.
2. Press the release buttons on top of the secondary expander module to release the handles.
3. Rotate the handles outward to the unlocked position.
4. Lift the secondary expander module carefully out of the enclosure, as shown in Figure 146 on page 205.

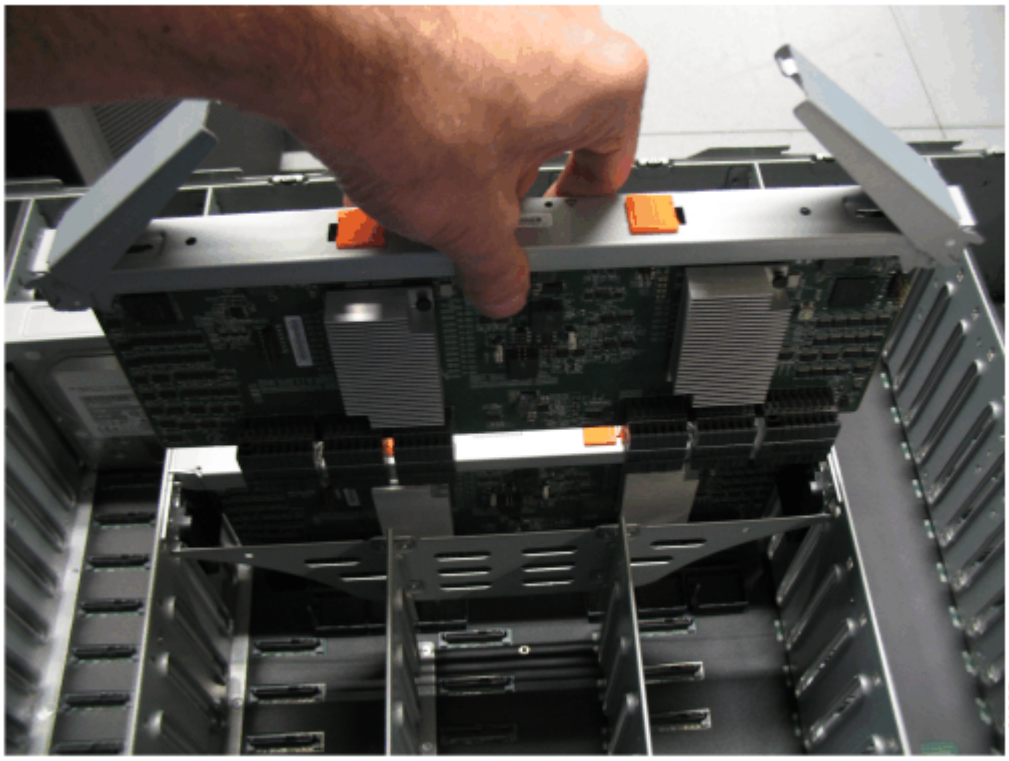


Figure 146. Remove the secondary expander module

Important: To avoid electric shock after you remove the secondary expander module, do not touch the connectors inside the enclosure (FRU P/N 01LJ112), which are shown in Figure 147 on page 205.

Figure 147. Secondary expander module connectors

5. Place the secondary expander module in a safe location, as shown in Figure 148 on page 206.

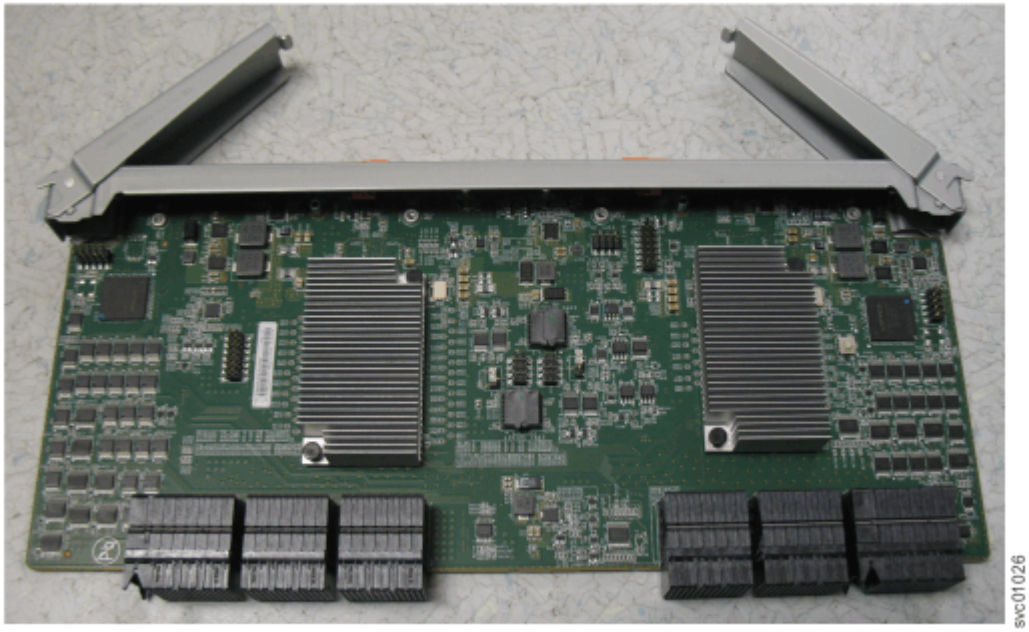


Figure 148. Secondary expander module removed from the enclosure

6. If needed, repeat step “2” on page 204 through step “5” on page 205 to remove the other secondary expander module.

Replace the secondary expansion module

7. Slide the expansion enclosure out from the rack, as described in Removing a 5U expansion enclosure from the rack.
8. Identify the secondary expander module to be replaced; LEDs on a secondary expander module shows the LEDs on top of a secondary expander module.

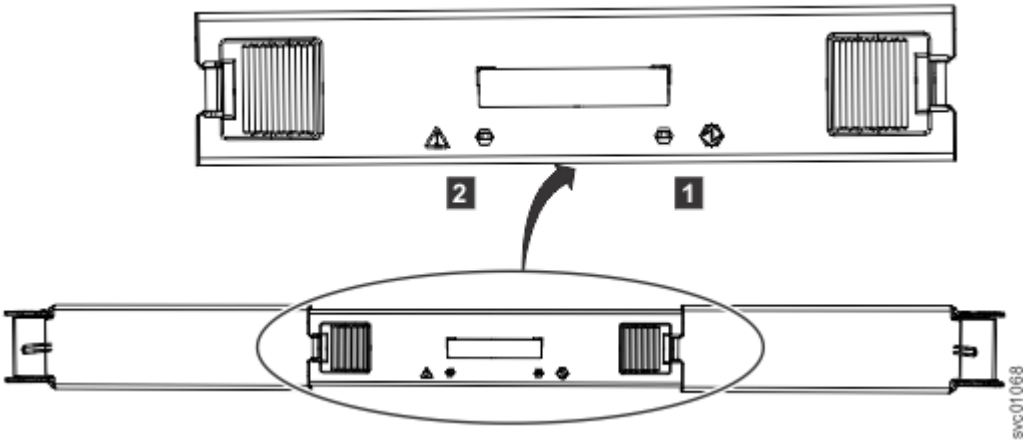


Figure 149. LEDs on a secondary expander module

1 Online indicator
2 Fault indicator

9. Rotate both handles on the new secondary expander module to an open position, as shown in Open the secondary expander module handles.

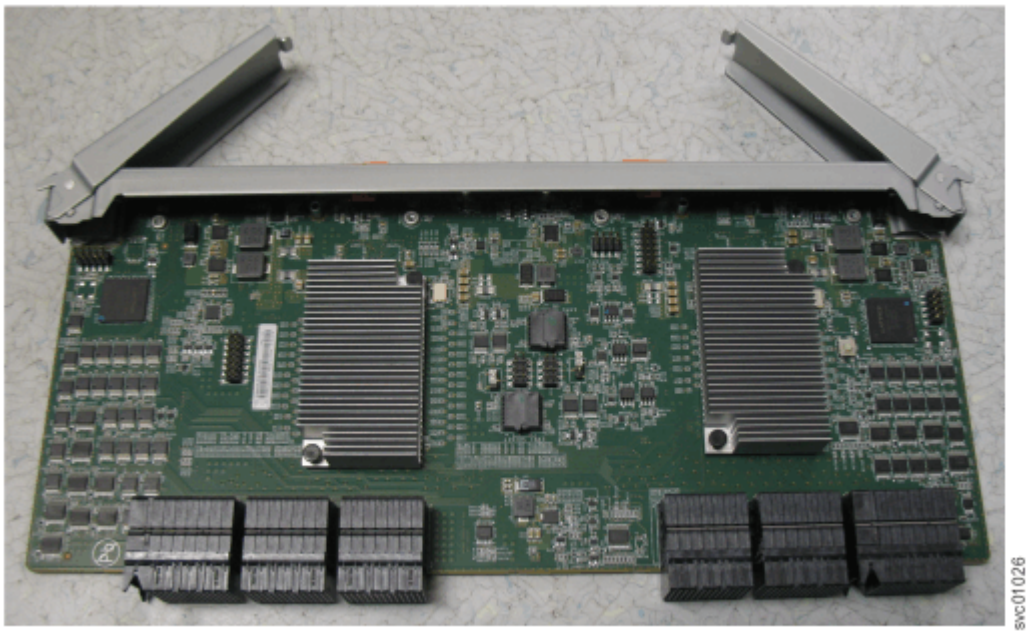


Figure 150. Open the secondary expander module handles

10. Align the edges of the secondary expander module carefully in the guide slot in the enclosure, as shown in Replace the secondary expander module.

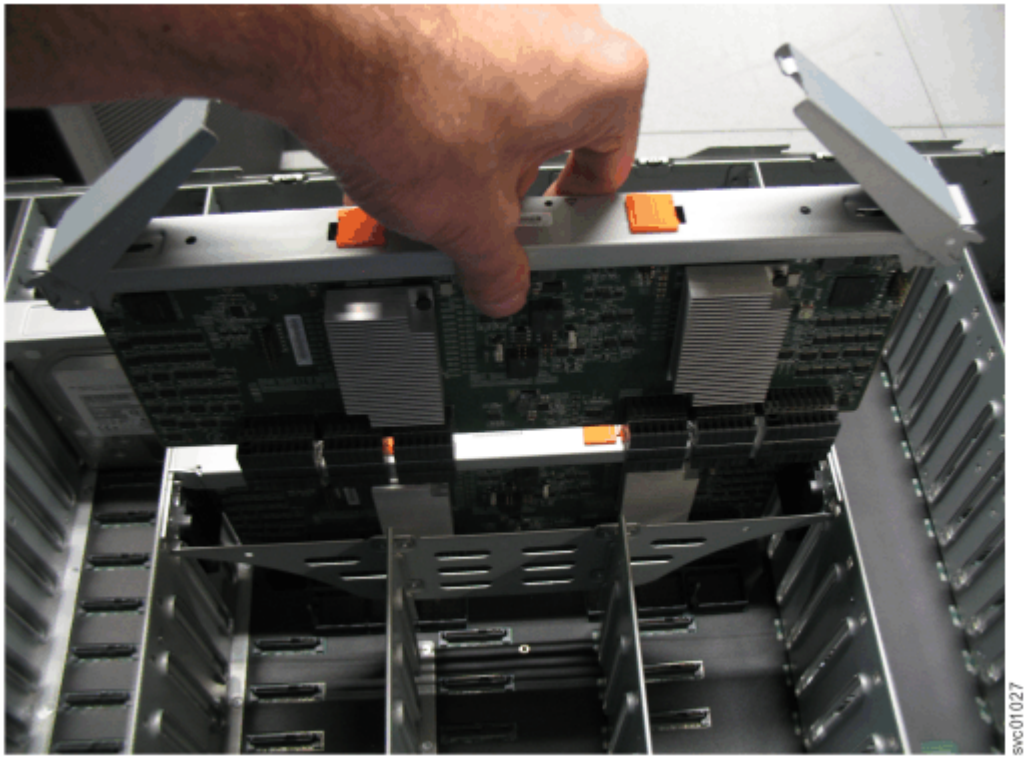


Figure 151. Replace the secondary expander module

11. Press the secondary expander module down into position in the enclosure.
12. Rotate the handles on the secondary expander module to the closed position to lock it in the enclosure.
13. If needed, repeat step 9 through step 12 to replace the other secondary expander module.
14. Replace the top cover, as described in Removing and replacing a top cover.

15. If needed, reconnect the power cables to the expansion enclosure, as described in Powering on the optional 5U expansion enclosure.
16. Check the LEDs on the top of the secondary expander module to verify that it is receiving power.

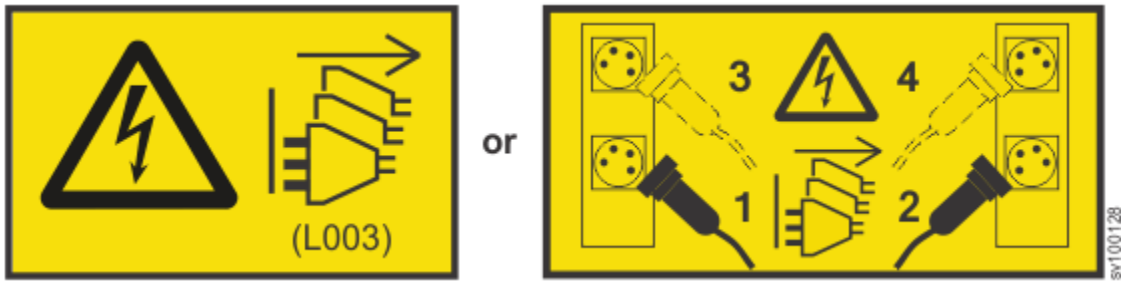
    High density expansion enclosure LEDs and indicators describes the status indicated by the LEDs.

Replacing an expansion enclosure

You can replace a faulty enclosure of a 5U expansion enclosure with a new one from FRU stock.

Before you begin

DANGER: Multiple power cords. The product might be equipped with multiple AC power cords or multiple DC power cables. To remove all hazardous voltages, disconnect all power cords and power cables. (L003)



CAUTION:

The weight of this part or unit is more than 55 kg (121.2 lb). It takes specially trained persons, a lifting device, or both to safely lift this part or unit. (C011)

CAUTION: To avoid personal injury, before lifting this unit, remove all appropriate subassemblies per instructions to reduce the system weight. (C012)

Notes:

- Perform the following procedure only if directed to do so by IBM Remote Technical support or by a fix procedure in the management GUI.
- An enclosure can have FRU P/N 01LJ112 or FRU P/N 01LJ607. When needed, an enclosure with FRU P/N 01LJ607 is used to replace FRU P/N 01LJ112.

This task assumes that the following conditions are met:

- All power cables were removed from the enclosure, as described in Powering off the 5U expansion enclosure.
- All SAS cables were removed, as described in Removing and installing a SAS cable .
- The following FRUs were removed from the enclosure, as described in the applicable tasks:
  - Top cover (“Removing and replacing the top cover” on page 196)
  - Drives (Removing and replacing a drive)
  - PSU (1U) fascia (Removing and replacing a fascia)
  - Power supply units (Removing and replacing a power supply)
  - Secondary expander modules (Removing and replacing a secondary expander module)
  - Expansion canisters (Removing an expansion canister)
  - Fan modules (Removing and replacing a fan module)

- The expansion enclosure was removed from the rack, as described in “Removing a 5U expansion enclosure from a rack” on page 187.
- A suitably rated mechanical lift is available to support the weight of the enclosure.

About this task

The expansion enclosure contains the drive board, signal interconnect board, and internal power cables. If a fault with the drive board or the intercanister link is suspected, you can replace the enclosure. However, you can remove the parts from the old expansion enclosure and reinstall them in the replacement enclosure.

Procedure

1. Remove the front display (4U) and PSU (1U) fascia from the old enclosure, as described in Removing or replacing the fascia.
   a) Install the front display (4U) and PSU (1U) fascia on the new enclosure, as described in Removing or replacing the fascia.
2. Remove the display panel assembly from the old enclosure, as described in Removing and replacing a display panel assembly.
   a) Install the display panel assembly into on the new enclosure, as described in Removing or replacing the display panel assembly.
3. Remove the fan interface boards from the old enclosure, as described in Removing and replacing a fan interface board.
   a) Install the fan interface boards into on the new enclosure, as described in Removing and replacing a fan interface board.
4. Remove the inner section of the slide rail from the old enclosure, as described in “Removing the support rails of the 5U expansion enclosure” on page 186.
5. Attach the inner rail section to the new enclosure, as described in Installing or replacing the support rails.
6. Replace the new enclosure in rack, as described in Installing the 5U expansion enclosure in the rack.
7. Reinstall the remaining parts into the enclosure, as described in the following topics. You can install the parts in any order.

   Important: Ensure that a mechanical lift is available and in place to support the additional weight as the FRUs are reinstalled in the enclosure.

   - Removing and replacing a power supply.
   - Removing and replacing a drive.
   - “Removing and replacing a secondary expander module” on page 202.
   - “Installing or replacing a 2U expansion canister” on page 180.
   - “Removing and replacing a fan module” on page 223.
   - “Removing and replacing the top cover” on page 196.
8. Reconnect the SAS cables, as described in Removing and installing a SAS cable .
9. Reconnect the power cables, as described in “Powering on the optional 5U expansion enclosure” on page 98.
10. Run the next recommended fix procedure in the management GUI to set the serial number of the 5U expansion enclosure.

Removing and replacing the fascia

To complete some service tasks, you can remove each component of the fascia from the front of a 5U expansion enclosure.

About this task

The 5U expansion enclosure has a 4U front fascia that covers the display panel and a 1U fascia that covers the power supply units (PSUs). As Figure 152 on page 210 shows, the fascias are independent; you can remove or replace one without having to remove or replace the other.

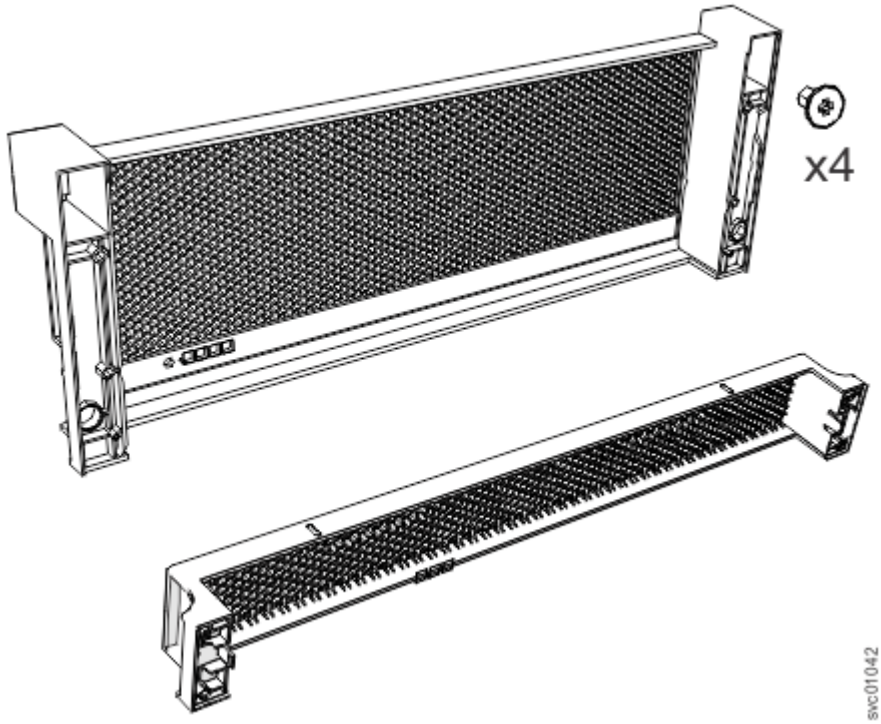


Figure 152. Fascia components on the expansion enclosure

Note: When the expansion enclosure is shipped, the 4U and 1U fascia are not installed. You must install them as part of the initial installation process.

Procedure

1. Use the slide rails to pull the enclosure out of the rack, as described in “Removing a 5U expansion enclosure from a rack” on page 187.

   Ensure that a mechanical lift is available to support the weight of the enclosure.

Remove the front (4U) fascia

2. Remove the front fascia by removing the two screws that attach the fascia to the flange on each side of the chassis, as shown in Figure 153 on page 211.

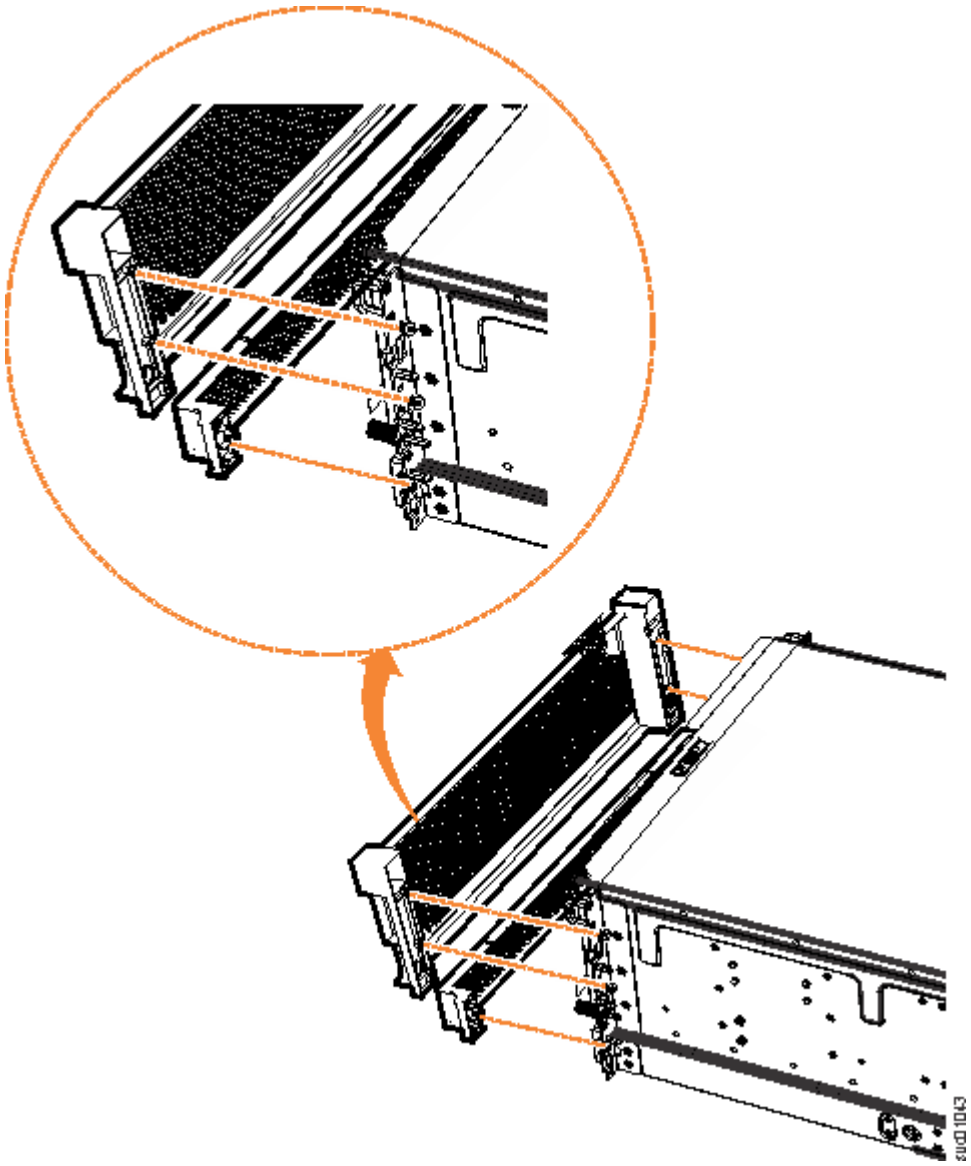


Figure 153. Remove fascia components from the expansion enclosure

Remove the bottom (1U) fascia

3. Gently pull on each side of the PSU fascia to remove it from the chassis, as shown in Figure 153 on page 211. The PSU fascia disengages from the slot and pin that connect it to each side of the chassis.

   You must remove the bottom fascia to access and service either PSU. However, as Figure 154 on page 212 shows, you do not have to remove the front fascia.

Figure 154. Fascia removed from the PSUs

Replace the fascia

4. Use the slide rails to pull the enclosure out of the rack.

Attach the front (4U) fascia

5. Align the front 4U fascia with the enclosure so that the thumbscrews go through the holes on each side. As Figure 4 shows, this action aligns the screw holes on the back of the fascia with the screw holes on the front flange of the enclosure.
6. Replace the four screws to reattach the 4U fascia. Secure the screws from the back of the flange and into the rear of the fascia. Each side of the 4U fascia contains two screws.

Attach the bottom (1U) fascia

7. Reattach the bottom 1U fascia that covers the power supply units (PSUs). Align the fascia with the enclosure and gently push it until it clicks into place on the chassis, as shown in Figure 4.

   Align the tab on each side of the 1U fascia with the corresponding slots on the enclosure flange. Pins on each flange must also align with a hole in each side of the 1U fascia.

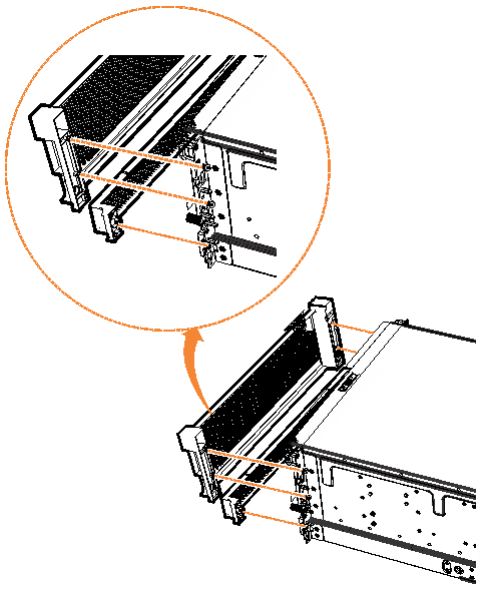


Figure 155. Replace fascia components on the expansion enclosure

Removing and replacing a power supply

You can remove either of the redundant power supply units in a 5U expansion enclosure. Redundant power supplies operate in parallel; one continues to provide power to the enclosure if the other fails.

Before you begin

Important: You can remove a PSU without powering off the expansion enclosure. However, to maintain operating temperature, ensure that you perform the following tasks.

- Do not remove a faulty PSU until its replacement is ready to be installed.
- Do not remove a PSU from an operational enclosure for more than approximately 10 minutes. The reduction in airflow through the enclosure might cause the enclosure or its components to shut down to protect from overheating.

About this task

Each PSU provides cooling to the lower part of the enclosure. Ensure that the second PSU in the enclosure is powered on and operating correctly. For example, in Figure 156 on page 214, PSU 1 is operating while PSU 2 is being removed.

Review and follow the procedures for handling static-sensitive devices before you remove the power supply unit (PSU).

Procedure

1. Read all safety information.
2. Remove the 1U fascia that covers the PSUs on the front of the expansion enclosure, as described in “Removing and replacing the fascia” on page 210.
3. Press on the handle lock to release the handles on the PSU.
4. Rotate the handles outward, as shown in Figure 156 on page 214.

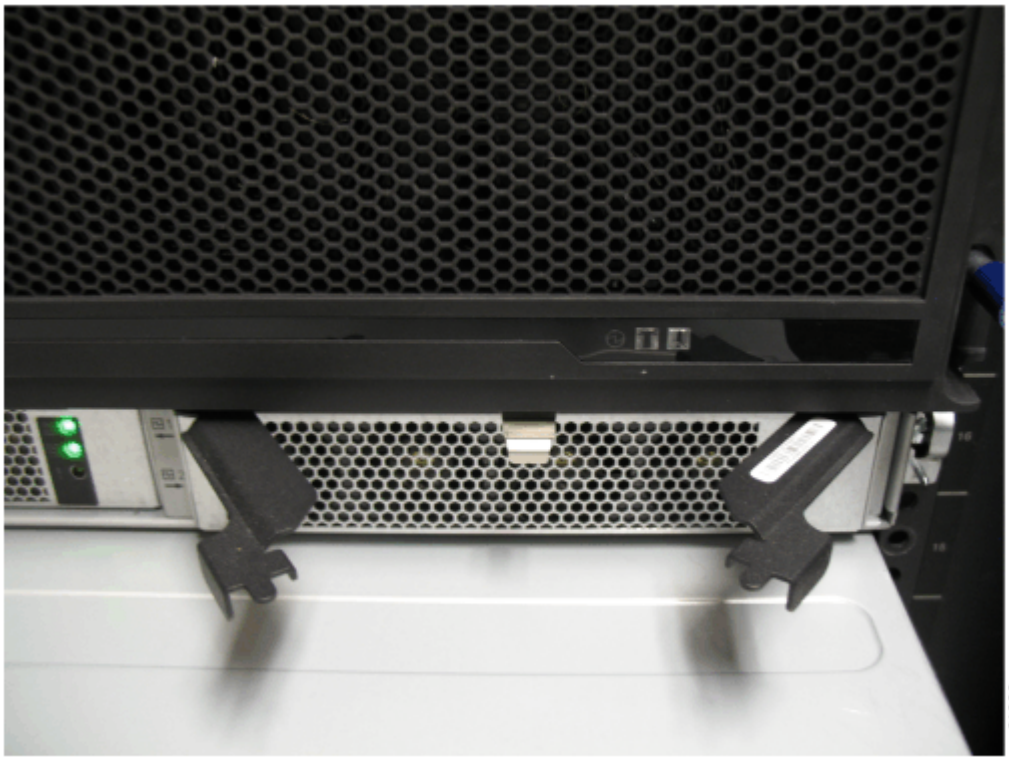


Figure 156. Releasing the power supply handles

5. Carefully pull the PSU out of the expansion enclosure chassis and place it in a safe location, as shown in Figure 157 on page 215.

Figure 157. Removed power supply

6. If you are instructed to return the power supply, follow all packaging instructions. Use any packaging materials for shipping that are supplied to you.

Replace the power supply

7. Read all safety information.
8. Rotate the handles on the PSU outward, as shown in Figure 3.

Figure 158. Preparing to install the power supply

9. Slide the PSU forward into the chassis until it clicks in to place, as shown in Figure 4.

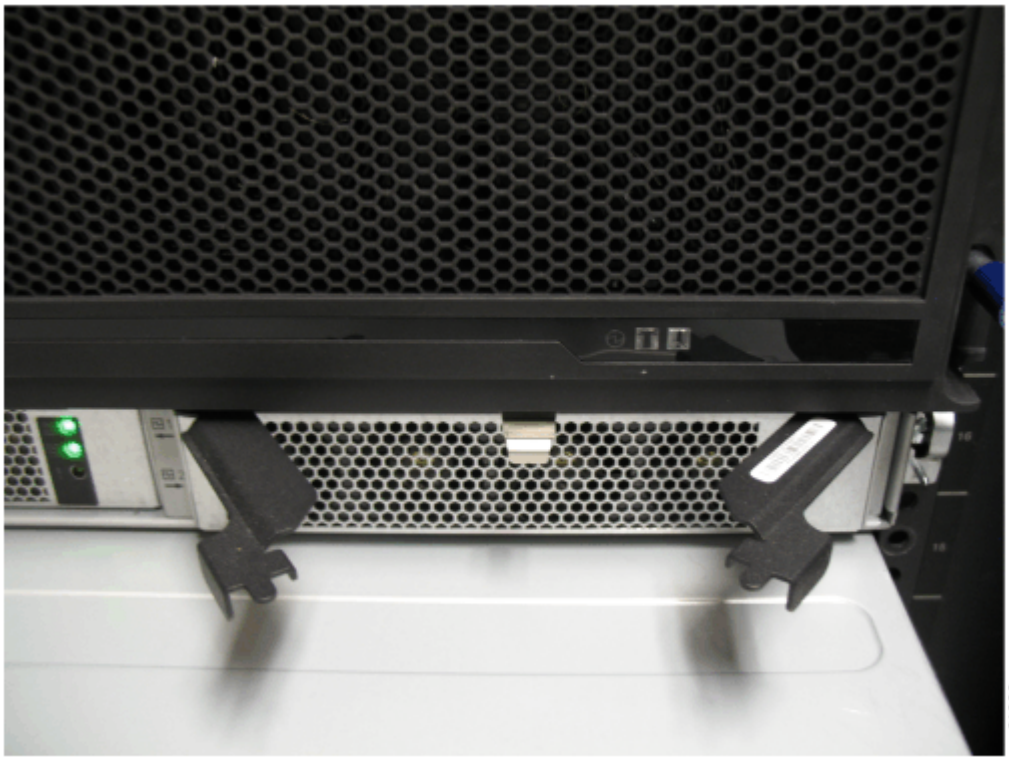


Figure 159. Install the power supply

10. Close the handles on the PSU and ensure the handle lock clicks in to place.
11. Verify that the AC input and the DC power indicators are lit on the front of the PSU, as shown in Figure 5.

Figure 160. Power supply indicators

For more information about the power supply indicators, see High density expansion enclosure LEDs and indicators.

Removing and replacing a display panel assembly

You can remove the display panel assembly from a 5U expansion enclosure.

Procedure

1. Slide the expansion enclosure out of the rack, as described in “Removing a 5U expansion enclosure from a rack” on page 187.
2. Remove the top cover, as described in “Removing and replacing the top cover” on page 196.
3. Press the release tab at the top of the display panel assembly, as shown in Figure 161 on page 218.

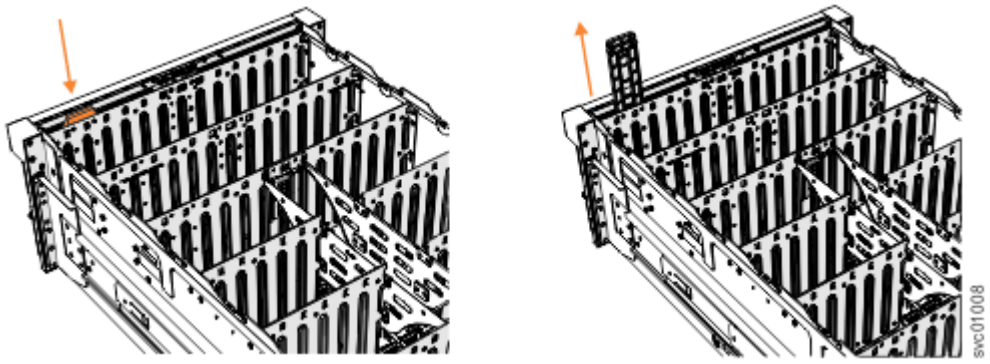


Figure 161. Removing the display panel assembly

4. Carefully pull the display panel assembly, which is shown in the Figure 162 on page 219, out of the chassis.

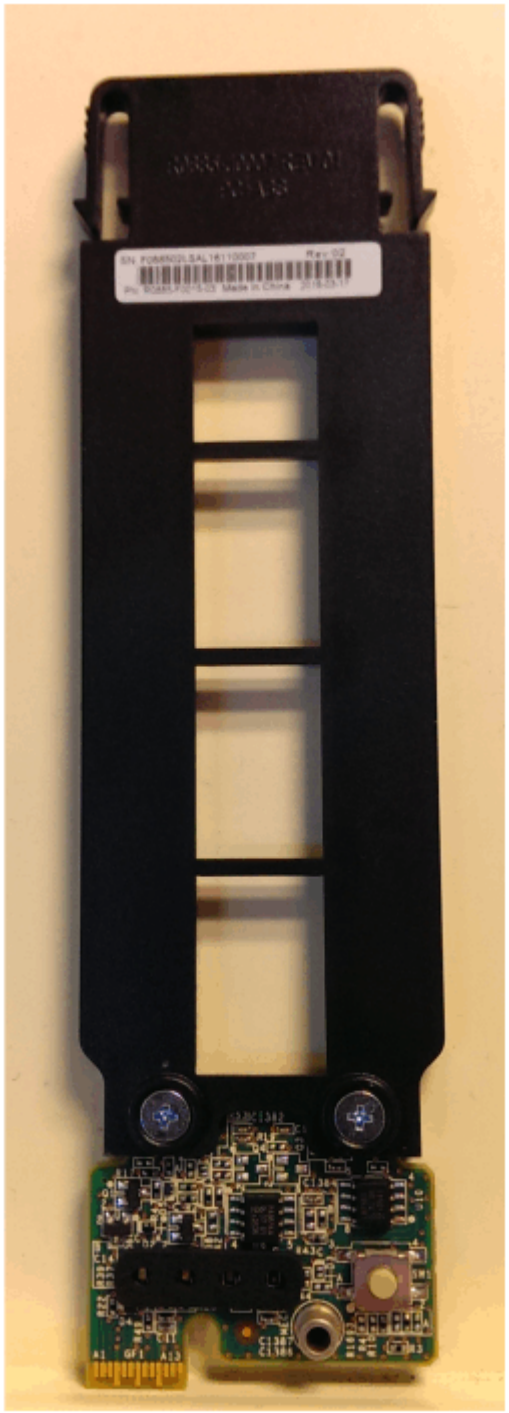


Figure 162. Display panel assembly

Replace the display panel assembly

5. Remove the display panel assembly, which is shown in Figure 162 on page 219, from its packaging.
6. Carefully align the display panel assembly in the slot at the front of the expansion enclosure, as shown in Figure 163 on page 220.

   Ensure the display panel assembly, which is shown in Figure 162 on page 219, faces toward the outside of the chassis.

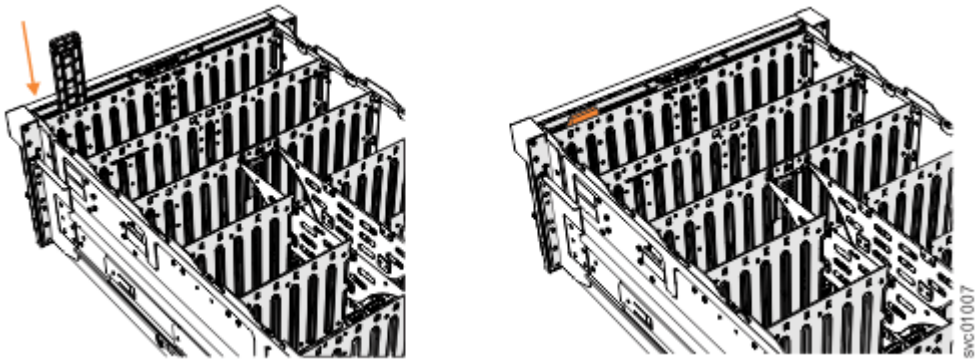


Figure 163. Installing the display panel assembly

7. Insert the display panel assembly until it clicks into position.
8. Replace the top cover, as described in “Removing and replacing the top cover” on page 196.
9. Ensure the LEDs on the display panel are lit correctly. See “High density expansion enclosure LEDs and indicators” on page 244 for details.

Removing an expansion canister

You can remove the expansion canisters in a 5U expansion enclosure.

Before you begin

Important: You can remove an expansion canister without powering off the expansion enclosure. However, to maintain operating temperature, perform the following tasks.

- Do not remove a faulty expansion canister until its replacement is ready to be installed.
- Do not remove an expansion canister from an operational enclosure for more than approximately 10 minutes. The reduction in airflow through the enclosure might cause the enclosure or its components to shut down to protect from overheating.

About this task

An expansion canister provides SAS connectivity between the 5U expansion enclosure and control enclosure system. If either of the two expansion canisters has a failure, the other expansion canister assumes the full I/O load. Figure 164 on page 220 shows the features of an expansion enclosure.

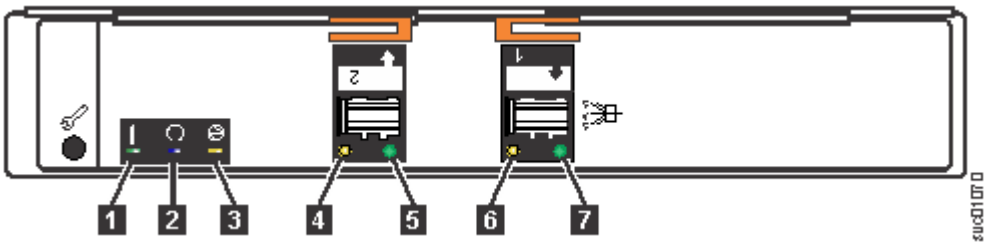


Figure 164. Expansion canister

1 Canister fault indicator
2 Canister status
3 Canister power indicator
4 and 6 SAS link fault indicators
5 and 7 SAS link operational indicators
8 Canister release handles

Procedure

1. Read all safety information.
2. Locate the expansion canister to be removed.
3. Release the lower cable management arm to swing it out of the way, as described in Figure 164 on page 220.
4. Remove the SAS cables from the expansion canister, as described in “Removing and installing a SAS cable” on page 221.
5. Rotate the handles on the expansion canister outward, as shown in Figure 165 on page 221.

Figure 165. Removing the expansion canister

6. Carefully pull the expansion canister out of the chassis and place it on a safe, level surface.

Replace the expansion canister

7. To reinstall an expansion canister, or replace it with one from FRU stock, follow the procedure in Installing or replacing an expansion canister.

Removing and installing a SAS cable

Use the following procedures to attach SAS cables to the 5U enclosure during the initial installation process. You can also remove a faulty SAS cable and replace it with a new one received from FRU stock.

About this task

Be careful when you are replacing the hardware components that are located in the back of the system. Do not inadvertently disturb or remove any cables that you are not instructed to remove.

If you replace more than one cable, record which two ports, canisters, and enclosures each cable connects, so you can match the connections with the replacement cables. The system cannot operate if the SAS cabling to the expansion enclosure is incorrect.

When the 5U expansion enclosure is installed in the rack, the expansion canisters are upside down. The input cable connects to the right port (port 1) on the expansion canister. The output cable connects to the left port (port 2) on the canister.

Procedure

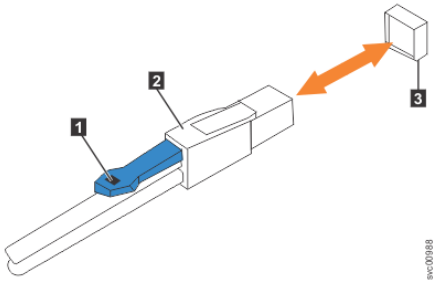
Removing a SAS cable

1. Locate the connector at the end of the SAS cable that is to be removed from the expansion enclosure.

2. Grasp the connector by its blue tag. Pull the tag.
3. Release the connector and slide it out of the SAS port.
4. Repeat steps “2” on page 222 and “3” on page 222 on the other end of the SAS cable.

Replacing a SAS cable

5. Ensure that the SAS connector is oriented correctly, as shown in Figure 166 on page 222. The blue tab must face toward the top of the enclosure canister.



1 Blue pull tab
2 SAS cable
3 SAS port

Figure 166. Correct orientation for SAS cable connectors

6. Insert the SAS cable into the SAS port until you hear or feel a click. When the cable is successfully inserted, you cannot disconnect the cable without pulling on the blue tag.

Connecting to a system node

7. Connect the SAS cable to the SAS port with blue tab **above** the connector (that is, facing toward the top of the node).

   You hear or feel a click when the cable is successfully inserted. You cannot disconnect the cable without pulling on the blue tag.

8. Route the SAS cables through the cable management arms, as shown in Figure 167 on page 222.

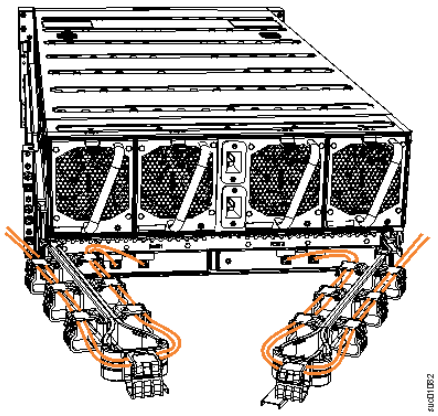


Figure 167. Example of SAS cables routed through the cable management arms

9. When both ends of a SAS cable are correctly connected, the green link-LED next to the connected SAS ports are lit.

   For example, Figure 168 on page 223 shows the LEDs of expansion canister 1 on a 5U expansion enclosure. The SAS cable is successfully inserted in to port 1 (input); port 2 (output) does not contain a SAS cable.

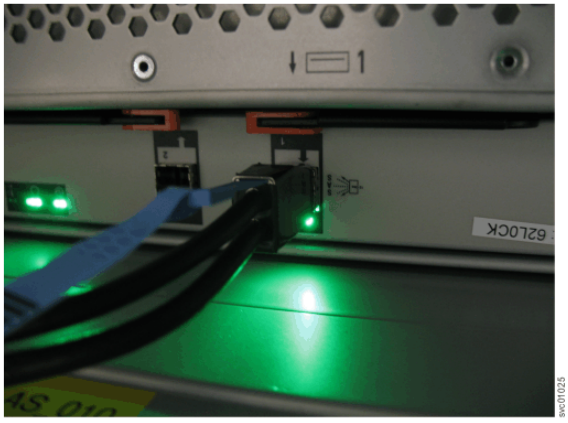


Figure 168. SAS cable correctly inserted into the SAS port

Removing and replacing a fan module

You can remove a fan module from a 5U expansion enclosure.

Before you begin

Important: You can remove a fan module without powering off the expansion enclosure. However, to maintain operating temperature, do not remove more than one fan module at a time.

- Remove a faulty fan module only when its replacement is ready to be installed.
- Do not remove a fan module from an operational enclosure for more than approximately 10 minutes. The reduction in airflow through the enclosure might cause the enclosure or its components to shut down to protect from overheating.

About this task

Note: If you plan to remove the expansion enclosure from the rack, you must remove all of the fan modules.

Procedure

1. Identify the fan module to be replaced. When lit, the amber LED on the front of the fan module (1 in Figure 169 on page 223) identifies a fault.

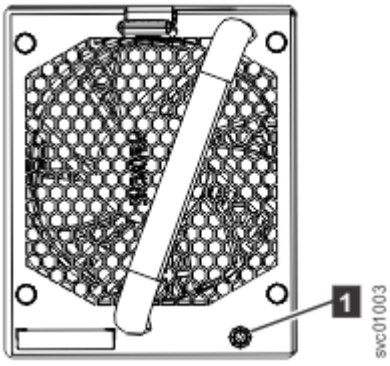


Figure 169. Fan module LED

   You can also issue the **lsenclosurefanmodule** command to display the status of the fan modules.
2. Press the release tab on the fan module, as Figure 170 on page 224 shows.

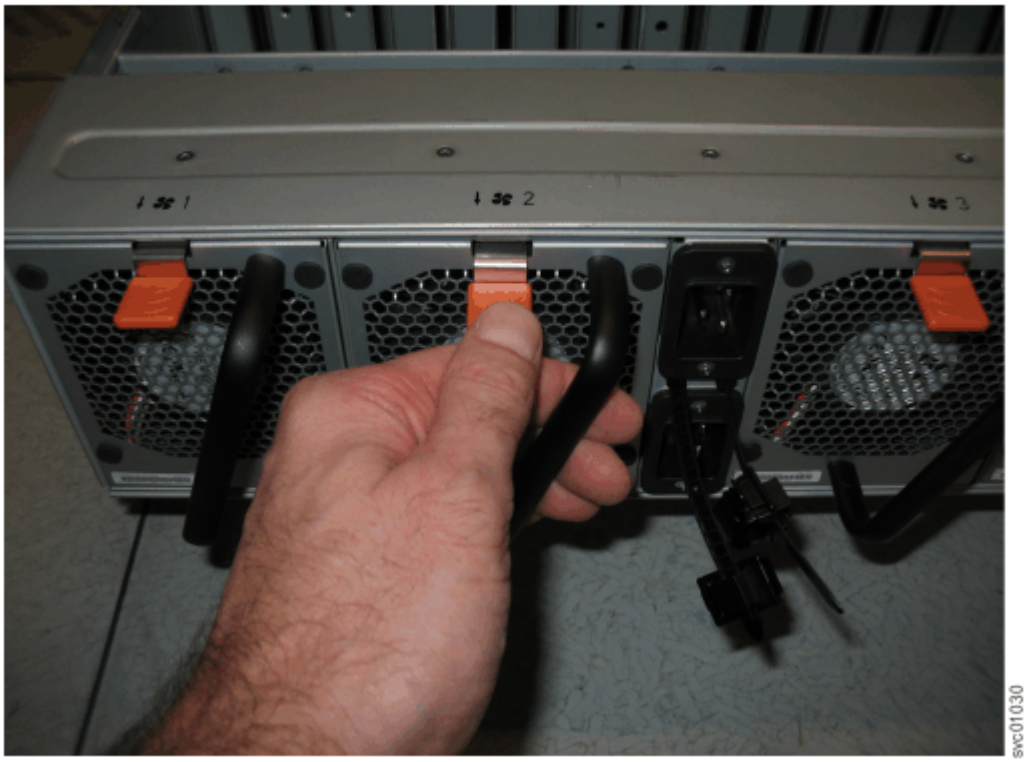


Figure 170. Fan module release tab

3. Use the handle to pull the fan module out of the expansion enclosure chassis, as shown in Figure 171 on page 224.

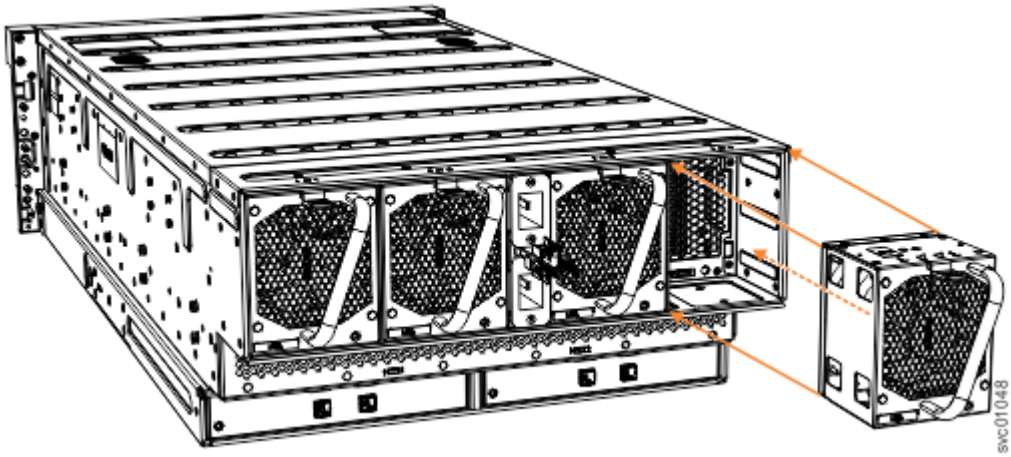


Figure 171. Remove and replace a fan module

4. Repeat steps “2” on page 223 and “3” on page 224 for each additional fan module you need to remove.

Replace a fan module

5. Hold the fan module with the release tab on top and the connector pin on the bottom, as shown in Figure 172 on page 225.

Figure 172. Fan module orientation

6. Carefully insert the fan module into the chassis until it clicks in place, as shown in Figure 171 on page 224.
7. Repeat the steps “5” on page 224 and “6” on page 225 for each fan module to be replaced.

Removing and replacing a fan interface board

You can remove a fan interface board (FIB) from a 5U expansion enclosure.

Before you begin

This task assumes that the following conditions were met:

- All power cables were removed from the enclosure, as described in “Powering off the 5U expansion enclosure” on page 100.
- The top cover, fan modules, and the other heavy FRUs (drives, secondary expander modules) were removed before the enclosure was removed from the rack.
- The expansion enclosure was removed from the rack, as described in “Removing a 5U expansion enclosure from a rack” on page 187.

  Ensure that you use a lift to support the weight of the enclosure.

About this task

The 5U expansion enclosure contains two fan interface boards (FIBs). The FIBs act as the interface between the fans and the system drive board. FIB 1 connects fan modules 1 and 2 to the drive board; FIB 2 connects fan modules 3 and 4. If both fan modules controlled by a FIB fail, it is possible that the FIB needs to be replaced.

Important: Because this task is disruptive to the storage system, always attempt fan replacement first. See “Removing and replacing a fan module” on page 223 for information about the removal and replacement procedures. Ensure that both fans are installed correctly. Perform the following procedure only if the amber fault LED on each fan remains lit (1 in Figure 173 on page 226).

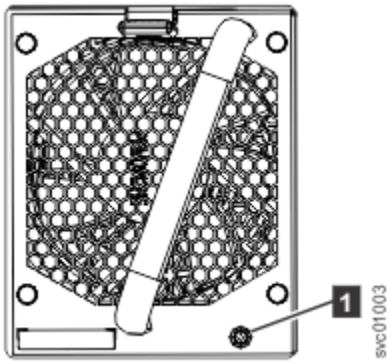


Figure 173. Fan module LED

Procedure

1. Using a cross head screwdriver, remove the narrow metal cover that is over the FIBs, as shown in Figure 174 on page 226. The screws are on each side of the chassis. Place the cover and cover screws in a safe location.

Figure 174. Location of the FIB cover

2. Use a cross head screwdriver to loosen the retaining screws on the FIB, as shown in Figure 175 on page 227.

Figure 175. Loosen the FIB screws

3. Use the handle to pull the FIB out of the expansion enclosure chassis, as shown in Figure 176 on page 227.

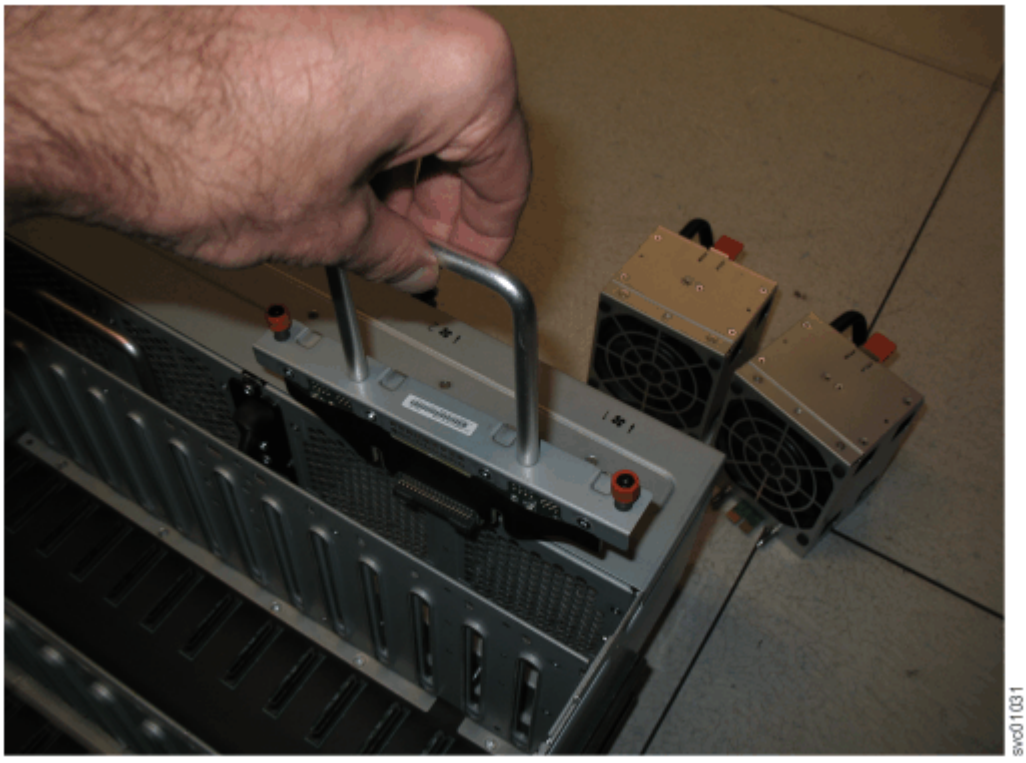


Figure 176. Remove the FIB from the chassis

4. Place the FIB (shown in Figure 177 on page 228) in a safe location.

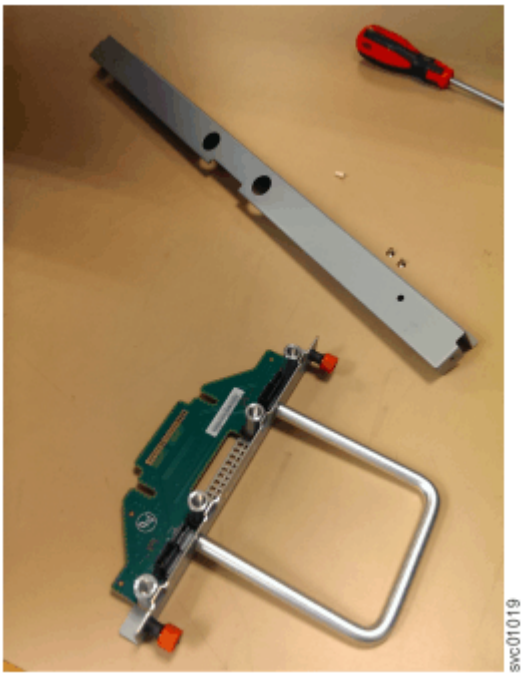


Figure 177. FIB parts removed from the chassis

5. If needed, repeat the steps “2” on page 226 through “3” on page 227 to remove the other FIB.

Replace the fan interface board

6. Assemble the new FIB, cover, and the cover screws in a safe location as shown in Figure 177 on page 228.
7. Carefully insert the new FIB into the expansion enclosure chassis, as shown in Figure 176 on page 227.
8. Use a cross head screwdriver to tighten the retaining screws that secure the FIB to the drive board, as shown in Figure 175 on page 227.
9. If needed, repeat steps “7” on page 228 and “8” on page 228 to replace the other FIB.
10. Replace the narrow metal cover, which is shown in Figure 174 on page 226, over the FIB assemblies. The attachment screws are on each side of the chassis.
11. Place the enclosure back in the rack, as described in “Installing a 5U expansion enclosure in a rack” on page 93.
12. Replace each of the fan modules. Follow the procedure that is described in “Removing and replacing a fan module” on page 223.
13. Replace the drives, secondary expander modules, and other heavy FRUs that were removed before the enclosure was removed from the rack.
14. Replace the top cover, as described in “Removing and replacing the top cover” on page 196.
15. Reconnect power to the enclosure, as described in “Powering on the optional 5U expansion enclosure” on page 98.

System indicators summary

An IBM Storage FlashSystem 9500 system contains several control and expansion enclosures, each of which has LED indicators for identification and fault diagnosis. The details of these indicators are covered in the following topics.

Note: For optimal usage, configure call home and event notifications rather than using the LED indicators as the primary means of fault diagnosis. As a best practice, configure call home and event notifications to precisely detect the fault and failure of the system.

Control enclosure indicators

The front panel of the enclosure has four light-emitting diodes (LEDs) that display the overall health of the enclosure.

Labels and indicators on the left end cap of the control enclosure provide information about the enclosure status. When multiple enclosures are in a rack, the serial number is used to identify the enclosure that is being referenced.

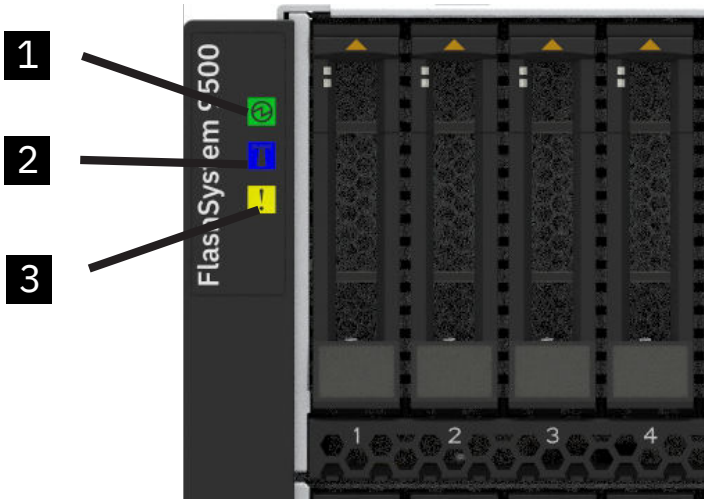


Figure 178. Left enclosure end cap

Table 60 on page 229 summarizes the possible meanings of each indicator.

Table 60. Summary of LED Indicators

Indicator Name	Color	Symbol	Meaning
Control enclosure operational	Green		• Off - There is no external power to the enclosure. • Slow flash - The enclosure is in a stand by state. • On - There is AC power to the enclosure and at least one canister is not in standby mode.
Identify enclosure.	Blue		• Off - The enclosure is not being identified. • On - The enclosure is set to be identified.

Table 60. Summary of LED Indicators (continued)			
Indicator Name	**Color**	**Symbol**	**Meaning**
Enclosure fault	Amber		• Off - There are no isolated FRU failures in the enclosure. • On - There are one or more isolated FRU failures in the enclosure requiring service or replacement.

Drive indicators

Drives are accessible from the front of the control enclosure. Each drive has two light-emitting diode (LED) indicators.

The following figure shows the location of the LEDs on a small form factor (SFF) 2.5-inch drive.

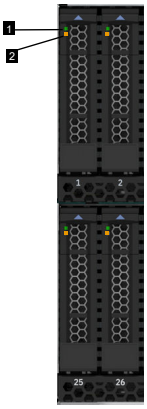


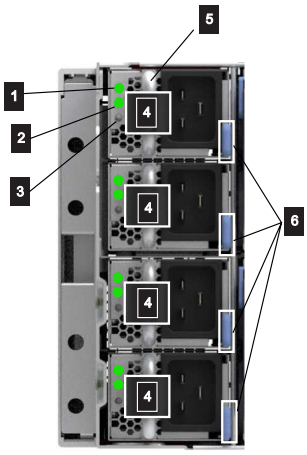
Figure 179. Drive LEDs

Table 61 on page 230 lists the status descriptions for the two LED indicators.

Table 61. Drive LED status				
LED name	**Callout**	**Color**	**State**	**Meaning**
Activity	1	Green	Off	The drive is not ready for use.
			Flashing	The drive is ready. Activity is in progress.
			On	The drive is ready. No activity is in progress.
Fault	2	Amber	Off	No known fault exists.
			Flash	The drive is identified.
			On	A fault exists on the drive.

Power supply indicators

IBM Storage FlashSystem power supplies have three LED indicators to convey information about the state of the supply.



1 AC good indicator
2 DC good indicator
3 Fault indicator
4 Hook-and-loop strap for securing the power cable
5 Power supply handle
6 Power supply release tab

Figure 180. Power supply details

Table 62 on page 231 describes the meaning of each indicator.

Table 62. Summary of LED indicators for the PSUs

Indicator	Color	Meaning
AC Good	Green	• Off - There is no AC input to the PSU, or the PSU is in a fault state that does not allow AC input. • On - The power supply is receiving AC line cord power and is operating normally.
DC Good	Green	• Off - There is no DC output from the PSU to the enclosure. • On - The power supply is providing DC power; no action is required.
FAULT	Amber	A fault needs to be resolved. • On - The associated PSU is isolated and require service or replacement. • Off - There are no isolated FRU failures on the PSU. • Flash - The PSU is being identified by using an identify command.

Node canister indicators

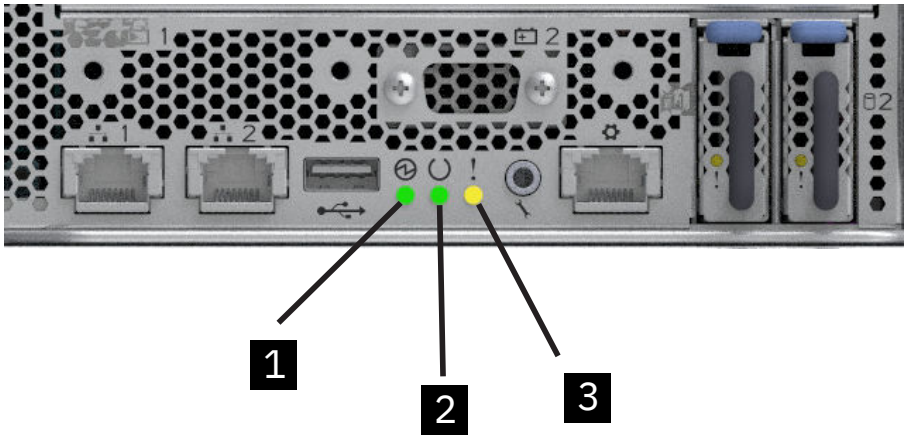
Each node canister has five Light-Emitting Diode (LED) indicators that display the state of the individual canister and the node.

Figure 181 on page 232 shows the indicators a control enclosure. Each node canister has its own set of indicators that identify the status of the node canister.

Figure 181. Node canister status LEDs

Node canister status LED indicators

Figure 182 on page 232 shows the location of the LED indicators:



1 Node canister power LED
2 Node canister status LED
3 Node canister fault LED

Figure 182. Node canister LEDs

Table 63 on page 233 summarizes the meaning and values of each indicator.

Table 63. Node canister status LEDs indicator

LED Name	Color	State	Meaning
Power	Green	Off	There is no external power to the node canister.
		Slow flash	The node canister is in a stand by state.
		Fast flash	During POST, the Power LED on the node canister will fast blink to indicate the BIOS is in POST.
		On	The node canister is in a power on state. **Note:** During ride through and FHD, the LED remains in Solid.
Status	Green	Off	The controller RAID stack is not operational.
		Slow flash	The node canister is in candidate or service state. For example, if it is not able to perform I/O in a cluster, it is safe to remove the node.
		Fast flash	Node canister is performing destage activity or running on battery.
		On	The controller is active and joined a cluster. The node canister has state data that must be preserved on shutdown. This normally means it is active in the cluster, handling I/O, but there is a transient starting state that is also covered (it is possible to get held in starting state if a quorum cannot be established, the alert then lights).

Table 63. Node canister status LEDs indicator (continued)			
LED Name	**Color**	**State**	**Meaning**
Fault	Amber	Off	There are no isolated FRU failures on the node canister.
		Flash	The node canister is being identified using an **identify** command.
		On	There are one or more isolated FRU failures in the node canister requiring service or replacement.

Battery status LED indicators

Each node canister also has a battery and three LED indicators for the battery status. If an AC power failure occurs, the battery provides power to the node canister as it stores cache and system data to an internal drive. This process is known as a *fire hose dump*. The following image shows the location of the battery indicators and Table 64 on page 234 describes the function and possible values for each indicator.

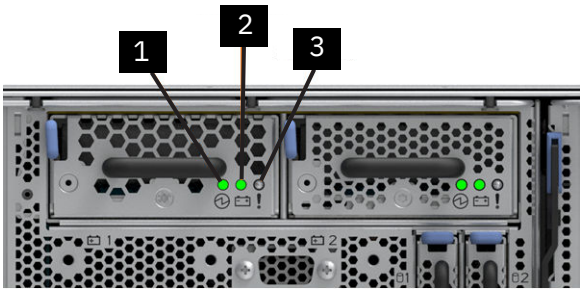


Figure 183. Battery LEDs

1 Battery power LED
2 Battery status LED
3 Battery fault LED

Table 64. Battery status LED indicators			
LED Name	**Color**	**State**	**Meaning**
Power	Green	Off	The battery power protection is not being provided. This LED is per battery. If both batteries are failing to indicate battery power, the node does not have AC Loss protection. Replace the batteries or canister.
		On	The Battery Module has DC input power or is providing power to the system.

Table 64. Battery status LED indicators (continued)			
LED Name	**Color**	**State**	**Meaning**
Status	Green	Off	Output is off or out of tolerance, unable to supply power to volatile cache memory, and potentially de-staging function.
		Flash	Battery is charging.
		On	The battery is fully charged. No action necessary.
Fault	Amber	Off	There have been NO isolated faults or conditions detected by the battery module that can be serviced using service indicators.
		Flash	The APD has been identified and the battery is charging. **Note:** It is possible the battery might also have a fault.
		On	There has been a fault condition detected with the battery that can be serviced using service indicators. The battery is in a condition that permits repair or replacement activity if removable.

Adapter slot fault LED indicators

Fault LEDs on the adapter is used to identify the adapters with any faults which might require any replacement or servicing. Table 65 on page 235 describes the function and possible values for each indicator.

Table 65. Adapter slot fault LED indicator		
Fault	Off	There are no isolated FRU failures on this adapter.
	Flash	The adapter is being identified using an identify command .
	On	There is an isolated FRU failures in the adapter that requires service or replacement.

Boot drive fault LED indicators

Boot drive LEDs are used to identify any failed or missing boot drive. Table 66 on page 236 describes the function and possible values for each indicator.

Table 66. Boot drive fault LED indicator		
Fault	Off	There are no isolated FRU failures on this boot drive.
	Flash	This boot drive is being identified using an identify command.
	On	There is an isolated FRU failure in this boot drive that requires service or replacement.

Node port indicators

Each Node canister Ethernet port has a pair of green LEDs with the following meanings. Table 67 on page 236 describes the LED indicators.

Table 67. Onboard Ethernet port LEDs				
Name	**Symbol**	**Color**	**State**	**Meaning**
Link speed	None	Green	OFF	No link connection or the link is connected at less than 1 Gbps.
			ON	There is a 1 Gbps link connection to a remote device.
Activity	None	Green	OFF	No activity.
			FLASHING	Activity on link.

Network adapter port indicators

A control enclosure can support several types of optional host interface adapters. Each host interface adapter has its own Light-Emitting Diode (LED) indicators to help with status and fault diagnosis, as documented in the following sections:

Fibre Channel port indicators

The system supports dual-port and quad-port fibre channel adapters and the status is shown by the indicators.

Each Fibre Channel port has two green Light-Emitting Diode (LED) indicators. Consider the LEDs as a pair to determine the overall link state.

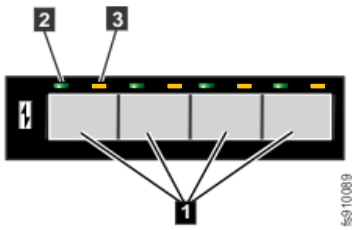


Figure 184. Fibre Channel ports and indicators

1 Fibre Channel port (4-port card)
2 Link-state LED (one for each port)
3 Speed-state LED (one for each port)

The following table lists the possible link status values for the Fibre Channel LEDs.

Table 68. Link status values for Fibre Channel adapter LEDs

Green LED	Amber LED	Meaning
Off	Off	One of the following situations is in effect: • The port is not configured. • The port is not active.
Off	On	The port is configured, but the link is not detected at the transport layer. This situation is the result of the port not being connected or of a failed link negotiation with the switch.
On	Off	The link is up and running at the expected port speed. This display does not imply logical connectivity, that is completion of FLOGI or FIP.
On	On	The link is up but running at a degraded speed.

Dual-port 25 Gbps Ethernet host interface adapter ports and indicators

Each port on the dual-port 25 Gbps Ethernet host interface adapter has one bi-color LED that indicates the status of the link and port. The location of the LEDs varies depending on the type of adapter.

Figure 185 on page 237 shows the front of a dual-port 25 Gbps Ethernet (RoCE) host interface adapter.

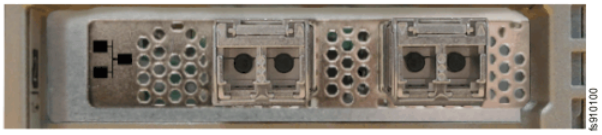


Figure 185. Dual-port 25 Gbps Ethernet host interface adapter ports and LEDs (RoCE)

The LED states and their descriptions are explained in Table 69 on page 237.

Table 69. LED indicators for dual-port 25 Gbps Ethernet host interface adapter (RoCE)

Color	State	Description
None	Off	The port is not active.
Green	Solid	The port has a valid link with no active traffic.
Green	Blinking	The port has a valid link with active traffic.
Yellow	Blinking	The link has a problem.

Figure 186 on page 237 shows the 25 Gbps Ethernet (iWARP) host interface adapter. Each port has a single LED that indicates the status of the port and link.

Figure 186. Dual-port 25 Gbps Ethernet host interface adapter ports and LEDs (iWARP)

Table 70 on page 238 summarizes the possible values of the LEDs on the 25 Gbps Ethernet host interface adapter (iWARP).

Table 70. Table 2. LED indicators for dual-port 25 Gbps Ethernet host interface adapter (iWARP)		
Color	**State**	**Description**
Off	Off	The ports and links are not active.
Green	Solid	The ports have a valid link.

Dual-port 100 Gbps Ethernet host interface adapter ports and indicators

Each port on the dual-port 100 Gbps Ethernet host interface adapter has one bi-color LED that indicates the status of the link and port. The location of the LEDs varies depending on the type of adapter.

Figure 187 on page 238 shows the dual-port 100 Gbps Ethernet (RoCE) network adapter.

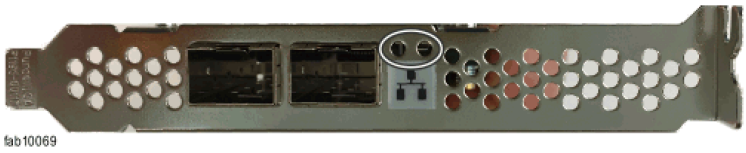


Figure 187. Dual-port 100 Gbps Ethernet adapter host interface adapter ports and LEDs (RoCE)

Table 71 on page 238 shows LED states and their descriptions. The Dual-port 100 Gbps Ethernet (RoCE) network adapter has a single bi-colour LED per port.

Table 71. LED indicators for dual-port 100 Gbps Ethernet host interface adapter (RoCE)		
Color	**State**	**Description**
None	Off	The port is not active.
Green	Solid	The port has a valid link with no active traffic.
Green	Blinking	The port has a valid link with active traffic.
Yellow	Blinking	The link has a problem.

Quad-port 12 Gbps SAS expansion-adapter port indicators

Quad-port 12 Gbps SAS expansion adapters are used to connect to SAS expansion enclosures.

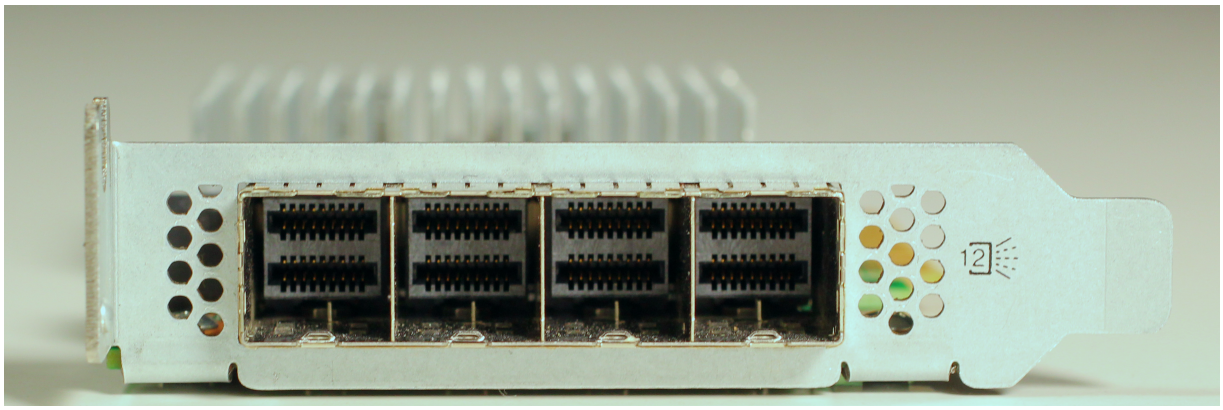


Figure 188. Quad-port 12 Gbps SAS expansion adapter

Status indicators

If a SAS port or cable is not functioning correctly, the system writes an entry to the system Error Log. To find the entry in the management GUI, select **Monitoring** > **Events**.

You can also use the management GUI to display status information about the SAS ports. To do so, select **Monitoring** > **System - Overview**; then, select the control enclosure that contains the SAS ports. Select **System - Enclosure Details** for the control enclosure. Then, select **SAS Ports** to see the status of the SAS ports.

You can also use the lsportsas command to display the status and configuration of the SAS ports within the entire system. Use the *node_id*, *node_name*, *port_id*, and *status* fields of the command output to locate information about the node and SAS ports of interest.

Expansion enclosure indicators

The expansion enclosure has several sets of Light-Emitting Diodes (LEDs) that provide information about the overall status of the enclosure, power, drives, canisters, and SAS connections.

2U expansion enclosure indicators

The 2U expansion enclosure has several sets of Light-Emitting Diodes (LEDs) that provide information about the overall status of the enclosure, power, drives, canisters, and SAS connections.

LEDs on the front of the expansion enclosure

System Status LEDs

Labels and indicators on the left end cap of the expansion enclosure provide information about the enclosure status. When multiple enclosures are in a rack, the serial number is used to identify the enclosure that is being referenced.

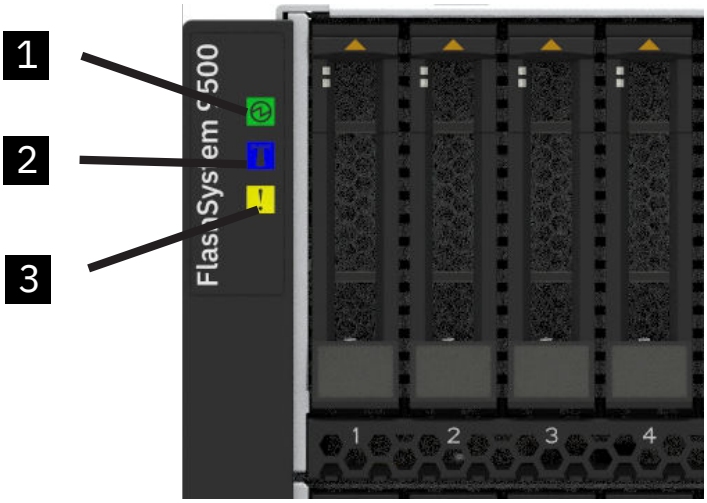


Figure 189. Left enclosure end cap

Table 72 on page 240 summarizes the possible meanings of each indicator.

Table 72. Summary of LED Indicators

Indicator Name	Callout	Color	Symbol	Meaning
Control enclosure operational	1	Green		• Off - There is no external power to the enclosure. • Slow flash - The enclosure is in a stand by state. • On - There is AC power to the enclosure and at least one canister is not in standby mode.
Identify enclosure	2	Blue		• Off - The enclosure is not being identified. • On - The enclosure is set to be identified.

Table 72. Summary of LED Indicators (continued)				
Indicator Name	**Callout**	**Color**	**Symbol**	**Meaning**
Enclosure fault	3	Amber		• Off - There are no isolated FRU failures in the enclosure. • On - There are one or more isolated FRU failures in the enclosure requiring service or replacement.
Check Log	4	Amber		Not used in Storage Virtualize implementation

Drive Status LEDs

Each drive on the expansion enclosure has two light-emitting diode (LED) indicators; they have no controls or connectors. Figure 190 on page 241 shows the location of the LEDs on a SFF 2.5-inch drive.

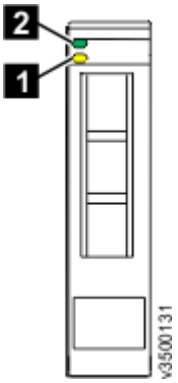


Figure 190. LED indicators on a vertical 2.5 in. (6.35 cm) drive

Table 73 on page 241 describes the LED status values for the two LEDs on each drive.

Table 73. Drive LED status				
LED name	**Callout**	**Color**	**State**	**Meaning**
Fault	1	Amber	OFF	No known fault exists.
			FLASHING	The drive is being identified; a fault might or might not exist.
			ON	A fault exists on the drive.

Table 73. Drive LED status (continued)				
LED name	**Callout**	**Color**	**State**	**Meaning**
Activity	2	Green	OFF	The drive is not ready for use.
			FLASHING	The drive is ready. Activity is in progress.
			ON	The drive is ready. No activity is in progress.

LEDs on the rear of the expansion enclosure

Canister indicators

Each expansion canister has three LED indicators that provide status and identification for the expansion canister.

Three LEDs are located in a horizontal row on the right side (when viewed from the rear) of the expansion canister. Figure 191 on page 242 shows the expansion canister indicators.

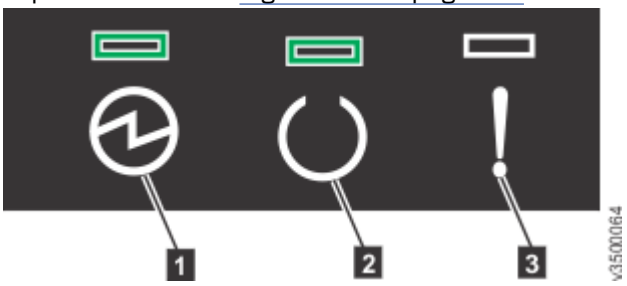


Figure 191. Expansion canister LEDs

Table 74 on page 242 describes the function and meaning of each indicator.

Table 74. Expansion canister LED descriptions			
Name	**Description**	**Color**	**Symbol**
1 Power	Indicates whether the expansion canister has power. • If the LED is on, the canister has power. • If the LED is off, the canister does not have power.	Green	
2 Status	Indicates whether the expansion canister is active. • If the LED is on, the canister is active. • If the LED is off, the canister is not active. • If the LED is flashing, there is a vital product data (VPD) error.	Green	
3 Fault	Indicates whether a fault is present and identifies the expansion canister. • If the LED is on, a fault exists. • If the LED is off, no fault exists. • If the LED is flashing, the expansion canister is being identified. This status might or might not be a fault.	Amber	

SAS port indicators

Each of the two SAS ports on the expansion canister has two status LEDs above the port: Link (left-hand indicator) and Fault (right-hand indicator), as shown in Figure 192 on page 243.

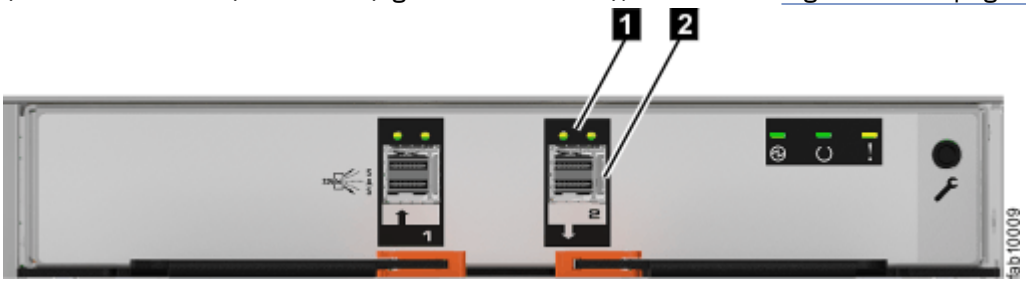


Figure 192. SAS ports and LEDs at the rear of an expansion canister

Figure 191 on page 242 describes the LED states for each of the two LEDs per SAS port. The link LED is on the left of each set of ports.

Table 75. SAS port LEDs on the expansion canister

Name	Color	State	Meaning
SAS Port 1 Link	Green	OFF	No physical link connection on any phys. The connection is down.
		ON	There is a connection on at least one physical lane. At least one of the lanes to that connector is up.
SAS Port 1 Fault	Amber	OFF	No fault. All four physical lanes have a link connection.
		ON	This value indicates a number of different error conditions: • One or more, but not all, of the four physical lanes are connected. • Not all four physical lanes are at the same speed. • One or more of the connected physical lanes are attached to an address different from the others.
SAS Port 2 Link	Green	OFF	No link connection on any physical lanes. The connection is down.
		ON	There is a connection on at least one physical lane. At least one of the lanes to that connector is up.
SAS Port 2 Fault	Amber	OFF	No fault. All four physical lanes have a link connection.
		ON	This value indicates a number of different error conditions: • One or more, but not all, of the four physical lanes are connected. • Not all four physical links are at the same speed. • One or more of the connected physical links are attached to an address different from the others

Power supply indicators

Each power supply unit has four LED indicators that are described in Table 76 on page 244.

Table 76. Power supply LEDs			
Name	**Label**	**Color**	**Description**
Input status	IN ⁓	Green	**Off** No input power detected **On** Direct current input power detected
Output status	DC ⎓	Green	**Off** PSU is not providing DC output power **On** PSU is providing DC output power
Fault	!	Amber	**Off** No fault detected **On** PSU fault detected **Flash** PSU is being identified. A fault might have been detected.
(None)	OK	Blue	Not used

High density expansion enclosure LEDs and indicators

The high density expansion enclosure has several sets of LEDs that provide information about the overall status of the enclosure, power, drives, fans, canisters, and SAS connections.

A high density expansion enclosure has sets of LEDs on the front and rear of the enclosure. Inside of the expansion enclosure, LEDs also indicate the status of the drives and each secondary expander module.

LEDs on the front of the expansion enclosure

As Figure 193 on page 244 shows, the front of the 5U expansion enclosure contains LEDs for the display panel (1) and for each of the power supply units (3).

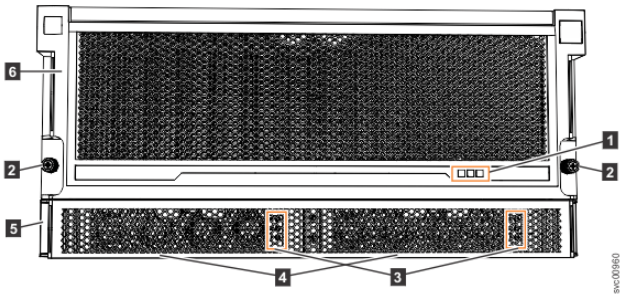


Figure 193. LEDs on the front of the expansion enclosure

1 Display panel LEDs
2 Rack retention thumb screws
3 Power supply unit LEDs
4 Power supply units (PSUs)
5 PSU fascia (1U)
6 Front fascia (4U)

The display panel (1) contains three LEDs that describe the operational status of the expansion enclosure. Table 77 on page 245 describes the function and meaning of the LEDs on the front display panel.

Table 77. Display panel LEDs

Function	Color	Status	Description
Power	Green	On	The expansion enclosure power is on; this LED is controlled by the expansion enclosure.
		Off	The expansion enclosure power is off.
Identify	Blue	On	Identifies the expansion enclosure; this LED is controlled by the system. Use the management GUI or service interface to identify an enclosure.
		Off	The expansion enclosure is operating normally.
Enclosure fault	Amber	On	The expansion enclosure is coming up or a fault is detected against a component within the enclosure.
		Off	No faults are detected.

The 5U expansion enclosure contains two PSUs (4 in Figure 193 on page 244) that are accessible from the front of the enclosure. Each PSU has its own a set of LEDs, as shown in Figure 194 on page 245.

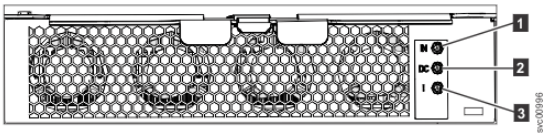


Figure 194. LEDs on the front of a power supply unit

1 Input power
2 DC power
3 Fault indicator

Table 78 on page 245 explains the function and status that is indicated by each of the LEDs. The power cords for each PSU are accessible from the rear of the expansion enclosure (1), as shown in Figure 196 on page 247.

Table 78. Power supply unit LEDs

Function	Color	Status	Description
1 Input power	Green	On	The input voltage is within specification.
		Off	No power input detected.
2 DC power	Green	On	DC power outputs are within specification.
		Off	DC power is not available.
3 Fault	Amber	On	A fault is detected in the PSU.
		Off	No faults are detected.

LEDs inside of the expansion enclosure

As Figure 195 on page 246 shows, each of the drives and secondary expansion modules within the expansion enclosure has two LEDs.

Figure 195. LEDs on drives and SEMs

Table 79 on page 246 describes the meaning of the LEDs. The function and description might vary depending on whether the LED is on a drive or a secondary expansion module.

Table 79. LEDs on drives and secondary expansion modules

Function	Color	Status	Description
• Activity (for drives) • Power (for secondary expansion modules)	Green	On	• The drive is ready to be used. • The secondary expansion module is receiving power.
		Flashing	• The drive is operating and I/O is occurring. • Not used for secondary expansion modules.
		Off	• The drive is not installed or an installed drive is not ready to be used. • The secondary expansion module is not receiving power.

Table 79. LEDs on drives and secondary expansion modules (continued)			
Function	**Color**	**Status**	**Description**
Fault	Amber	On	• A fault occurred on the drive. The LED is turned off when the drive is removed and replaced. • Not used for secondary expansion modules.
		Flash	• The drive is being identified; a fault might or might not be detected. • The secondary expansion module is being identified.
		Off	The installed drive or secondary expansion module is operating normally; no faults are detected.

LEDs on the rear of the expansion enclosure

Figure 196 on page 247 shows the rear view of a expansion enclosure. LEDs on the rear of the enclosure provide information about each fan module, each expansion canister, and SAS links.

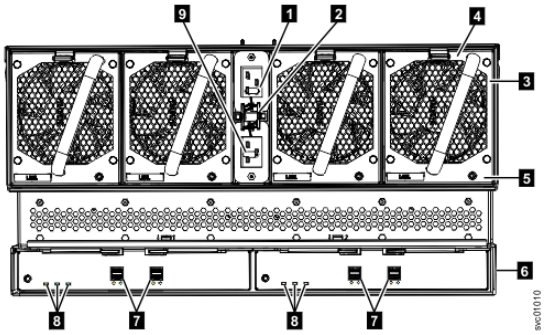


Figure 196. LEDs on the back of the expansion enclosure

The expansion enclosure has four fans. Each fan has one LED; for example, Figure 196 on page 247 shows the location of the LED (5) for fan number four. When a fan is operating normally, the LED is not lit. If a fault is detected, the amber LED is lit.

As Figure 196 on page 247 also shows, the expansion enclosure contains two expansion canisters. Each expansion canister contains its own set of LEDs, as shown in Figure 197 on page 247. The LEDs provide status information about the expansion canister itself and the SAS connections.

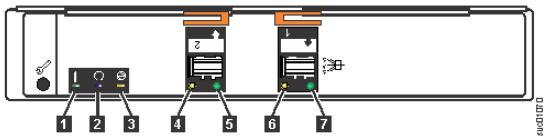


Figure 197. LEDs on the back of the expansion canister

1 Canister fault
2 Canister status
3 Canister power
4 and 6 SAS link fault
5 and 7 SAS link operational

Table 80 on page 248 describes the values and meaning of each LED.

Table 80. Expansion canister and SAS port LEDs

Name	Color	State	Meaning
1 Canister fault	Amber	Off	Normal operation.
		On	A fault was detected.
		Flashing	The expansion canister is being identified. A fault might or might not be detected.
2 Canister status	Green	Off	Canister is off.
		On	Normal operation.
		Flashing	A vital product data (VPD) error occurred.
3 Canister power	Green	Off	Canister is off.
		On	Canister is receiving power.
4 and 6 SAS link fault	Amber	Off	No faults are detected. All four phys have a link connection.
		On	Several error conditions are possible: • Only 1, 2, or 3 phys are connected, but not all 4. • The phys are not operating at the same speed. • All phys are not connected to the same remote port. One or more of the connected lanes are attached to a different address.
5 and 7 SAS link operational	Green	Off	No link connection on any lane. The connection is down.
		On	The SAS link is active. At least one of the four lanes is connected.

Note:

To monitor your system, configure call home and event notifications rather than checking the LED indicators. It is highly recommended to configure call home and event notifications to precisely detect the fault and failure of the system

Replaceable units

Each system consists of several replaceable units, such as cables, SFP transceivers, canisters, power supply units, batteries, drives, and enclosure chassis. The part numbers vary depending on the model of the control enclosure or expansion enclosure.

Control enclosure replaceable units

System parts for the IBM Storage FlashSystem 9500 control enclosures are field-replaceable units (FRUs). They must be replaced by IBM trained service technicians.

Table 81 on page 249 lists the supported quantity of the component in the control enclosure.

Note: The following quantities in the table is per control enclosure and is not the quantity for a FRU carton.

Table 81. Summary of IBM Storage FlashSystem 9500 control enclosure parts

Part Number	Description
00RY543	CMOS coin battery
03GH960	Compression adapter
03JK080	9500 Node Canister
03JK029	AC Power Supply
03JK399	Power Supply inter-poser
03GU966	Boot drive with TPM
03JK978	Boot drive
03JK125	Battery
03JK539	9500 Enclosure
03JK398	Adapter cage
03JK397	Fan
03JK031	9500 Rail kit
01LL634	Dual-port 100 Gbps RoCEv2 adapter
03JK535	64 GB Memory module
01YM705	Drive blank
03JK076	4.8 terabytes usable (TBu) IBM FlashCore Module 3.0
03JK077	9.6 TBu IBM FlashCore Module 3.0
03JK078	19.2 TBu IBM FlashCore Module 3.0
03JK079	38.4 TBu IBM FlashCore Module 3.0
03JK372	1.92 TB NVMe drive
03JK374	3.84 TB NVMe drive
03JK376	7.68 TB NVMe drive
03JK378	15.36 TB NVMe drive
03JK380	30.72 TB NVMe drive
03JK382	1.6 TB SCM
03JK659	Left enclosure end cap
03JK660	Right enclosure end cap
03JK915	Quad-port 32 Gbps and 64 Gbps FC adapter
03JK911	Quad-port 64 Gbps FC-NVMe adapter
03JK177	Quad-port 32 Gbps FC-NVMe adapter
03GH231	Quad-port 16 or 32 Gbps FC-NVMe adapter
01YM283	25 Gbps dual-port Ethernet (RoCE) adapter

Table 81. Summary of IBM Storage FlashSystem 9500 control enclosure parts (continued)	
Part Number	**Description**
01YM285	Dual-port 25 GbE (iWARP) adapter
03GH999	12 Gbps SAS adapter
78P7742	64 Gbps short-wave (SW) SFP
78P7709	64 Gbps FC SW SFP
78P5240	32 Gbps FC SW SFP Transceiver
78P5241	32 Gbps FC long-wave (LW) SFP Transceiver
03GH278	25 Gbps Ethernet SFP28 Transceiver
03GH316	25 Gbps Ethernet SFP Transceiver
03JK732	10 Gbps RJ45 Transceiver
03GU827	10 Gbps SFP

Note: The IBM Storage Virtualize software calls out the FRU part number of the type of 32 Gbps or 64 Gbps FC adapter that is fitted. It is best to replace it with the same type of adapter but it can also be replaced with the other type of 32 Gbps or 64 Gbps adapter.

2U expansion enclosure replaceable units

System parts for the FlashSystem 9500 expansion enclosures are field-replaceable units (FRUs). They must be replaced by IBM trained service technicians.

Table 82 on page 250 summarizes the replaceable units for the control enclosures and node canisters.

Table 82. FlashSystem expansion enclosure replaceable units	
Part number	**Description**
00MJ291	OEM branded expansion enclosure packaging
00MJ339	IBM branded expansion enclosure packaging
00RY543	IBM Right bezel (SFF or LFF)
00WY892	RFID tag AG/AP: 902-928 MHz
00WY894	RFID tag EMEA: 865.6-867.8 MHz
00Y2512	IBM Right bezel (SFF or LFF)
00Y5808	Model 24F expansion bezel set - OEM
01NN187	Argentina import label for placement on enclosure
01YM272	Regular TAA for shipments for WW except for USA and China
01YM307	BBU
01YM308	Canister / canister SSD
01YM310	PSU
01YM311	IBM left bezel (Control or exp)
01YM312	Chassis
01YM313	Fan/Fan Tray

Table 82. FlashSystem expansion enclosure replaceable units (continued)	
Part number	**Description**
01YM314	Power Interposer board
01YM315	TPM
01YM317	Rail kit
01YM549	Shipping and handling AFF
01YM557	IBM model AFF expansion publications
01YM629	IBM model AFF Expansion Enclosure rework BoM
01YM706	PCIe Riser card with bracket ASM
01YM708	Canister /canister SSD
01YM789	Dummy DIMM
85Y6061	JEMT indicator
	Pass through CAN card
01YM311	Left IBM branded bezel

Table 83 on page 251 summarizes the replaceable units for the 2.5-inch form factor (SFF) drives.

Table 83. Drive replaceable units	
Part number	**Description**
00AK290	SFF dummy carrier for SFF 2U enclosures
01EJ803	1.92 TB 2.5" RI Flash drive
01EJ808	1.92 TB 2.5" RI Flash drive
01EJ961	3.84 TB 2.5" RI Flash drive
01EJ966	3.84 TB 2.5" RI Flash drive
01LJ382	7.68 TB 2.5" RI Flash drive
01LJ385	15.36 TB 2.5" RI Flash drive
01LJ391	7.68 TB 2.5" RI Flash drive
01LJ393	15.36 TB 2.5" RI Flash drive
02PX474	30.72 TB 2.5" RI Flash drive
45W8680	SFF drive blank
01YM705	Drive Blank (SFF or LFF)

Table 84 on page 251 describes the replaceable units for cable and power units.

Table 84. Cable and power replaceable units	
Part number	**Description**
01LJ901	AC Power Supply
39M5068	Power cord - Argentina
39M5080	Power cord - Chicago

Table 84. Cable and power replaceable units (continued)	
Part number	**Description**
39M5081	Power cord - US/Group
39M5102	Power cord - Australia/NZ
39M5123	Power cord - Europe/Africa
39M5130	Power cord - Denmark
39M5144	Power cord - South Africa
39M5151	Power cord - UK/EMEA
39M5158	Power cord - Switzerland
39M5165	Power cord - Chile/Italy
39M5172	Power cord - Israel
39M5199	Power cord - Japan
39M5206	Power cord - China
39M5219	Power cord - Korea
39M5226	Power cord - India
39M5240	Power cord - Brazil
39M5247	Power cord - Taiwan
39M5392	Power cord - PDU J/C20
39M5508	Power cord - PDU F/C14

High density expansion enclosure replaceable units

Parts for the 4662-92G or 4662-F92 expansion enclosures are all field-replaceable units (FRUs). They must be replaced by IBM trained service technicians.

Replacement parts listed here are for a 4666-A9F expansion enclosure.

Table 85 on page 252 summarizes the replaceable units for the A9F model.

Table 85. Expansion enclosure replaceable units	
Part number	**Description**
01LJ114	Rack rail kit
01LJ116	Front fascia (4U front cover)
01LJ118	Display panel assembly
01LJ120	PSU 1U fascia (cover)
01LJ950	PSU
01LJ126	Fan module
01LJ128	Expansion canister
01LJ132	Chassis top lid
01LJ134	Fan interface board
01LJ607	Enclosure

Table 85. Expansion enclosure replaceable units (continued)	
Part number	**Description**
01LJ860	SAS Expander Module

Table 86 on page 253 summarizes the replaceable units for the 3.5-inch form factor (SFF) drives.

Table 86. Drive replaceable units	
Part number	**Description**
01LJ075	1.92 TB 3.5" RI Flash Drive 12G
01LJ076	3.84 TB 3.5" RI Flash Drive 12G
01LJ077	7.68 TB 3.5" RI Flash Drive 12G
01LJ078	15.36 TB 3.5" RI Flash Drive 12G

Table 87 on page 253 describes the part numbers for power cord and cable replaceable units.

Table 87. Cable and power cord replaceable units	
Part number	**Description**
00AR317	3.0 m 12 Gb SAS Cable
00AR439	6.0 m 12 Gb SAS Cable
39M5388	Power cord - PDU HD Exp.

Chapter 8. FlashSystem 9500R

The 9500R rack solution is a complete storage system delivered and assembled, with installation and configuration. Read the following sections to learn more about planning and installation the rack solution.

Planning for a FlashSystem 9500R rack solution

Plan to order FlashSystem 9500R control enclosures and optional 2U or 5U expansion enclosures that are preinstalled with two SAN switches in an FlashSystem 9500R rack solution.

Read through all of the planning and installation topics to understand your options when you order the rack solution.

Use “IP connectivity of Fibre Channel switches and power distribution units (PDUs) worksheet” on page 270 to specify IP configuration details for SAN switches and PDUs. IBM Lab Services uses the worksheet to connect the Fibre Channel switches to your Ethernet management network. To monitor power usage, the IBM Intelligent Switched Power Distribution Unit Plus (PDU+) PDUs also require connection to your Ethernet network.

Complete other customer worksheets, such as the “Planning worksheets” on page 61. The worksheets provide information that is needed by the IBM SSR and by IBM Lab Services. The IBM SSR and IBM Lab Services use the information to connect each control enclosure to the management network and to initially configure the clustered system.

You can order a pre-configured rack with FlashSystem 9500 control enclosures with one of the following E-config FlashSystem options.

- 4983-AH8 with two control enclosures
- 4666-AH8 with two control enclosures

Components that include the control enclosures, two Fibre Channel switches, two PDUs, and optional 2U or 5U expansion enclosures are preinstalled in the rack. When you order 5U expansion enclosures, the drives to populate the 5U expansion enclosures are in separate packaging and require IBM SSR installation into the expansion enclosures.

Planning a location for the rack

Plan to take delivery of the racked system. The delivery consists of 2 - 3 pallets of equipment.

One pallet carries the rack, preinstalled with the following components.

- FlashSystem 9500R model 4666-AH8 or 4666-UH8 control enclosures
- Any optional model 4666-AFF or 4666-A9F expansion enclosures
- Two IBM power distribution units
- Two IBM Fibre Channel switches
- Power cables

A second pallet carries a package that contains more accessories and cables.

If the FlashSystem 9500R is configured with one or two IBM 4666-AFF or 4666-A9F expansion enclosures, the second pallet also contains 1 - 2 packages of drives for those 5U enclosures. If the configuration contains more than 60 drives per 5U expansion enclosure, a third pallet carries more drives. Drives are packed in cartons within packages. Each drive carton is labeled with the machine type-model (MT-M) and the serial number of the 5U expansion enclosure where the IBM System Services Representative (SSR) is to install the drives.

Drives for control enclosures and drives for 2U expansion enclosures are preinstalled in the enclosures that are already installed in the rack.

Plan to move the FlashSystem 9500R rack off its delivery pallet and into its operating location, as described in “Locating the FlashSystem 9500R rack solution (Customer task)” on page 272. Ensure that the additional packages are located nearby for installation.

When the FlashSystem 9500R racked system is in its operating location, an IBM SSR can complete the installation as described in Installing.

After the hardware is installed, IBM Lab Services works with you to configure the FlashSystem 9500R system and to connect the system to your SAN, hosts, and storage.

Planning power for the rack

Plan to provide two separate site power source connections to power the FlashSystem 9500R rack solution.

- The included cables that connect each PDU to site power are 4.2 meters long.
- Ensure that each site power supply is compatible with the supplied PDUs and connection cables.
- Ensure that each of the two site power supplies can provide enough power for all components in the FlashSystem 9500R rack.
- Refer to “Control enclosure environmental requirements” on page 45, which has links related to physical installation planning for control enclosures and expansion enclosures.
- Refer to Fibre Channel switch power requirements in Product specifications.
- Refer to PDU specifications in “Intelligent Switched Power Distribution Unit Plus (PDU+) and power cord options for the IBM Storage FlashSystem rack solution” on page 264.

Planning for system connections within the rack

The two Fibre Channel switches that are preinstalled in the FlashSystem 9500R rack provide a dedicated, dual-redundant fabric for the preinstalled control enclosures.

Each node canister is connected to four (eight per enclosure) of the available switch ports, which are shown in Figure 198 on page 256 and Figure 199 on page 257 for different switch options.

Figure 198. Fibre Channel ports in the IBM SAN24B-6 switches

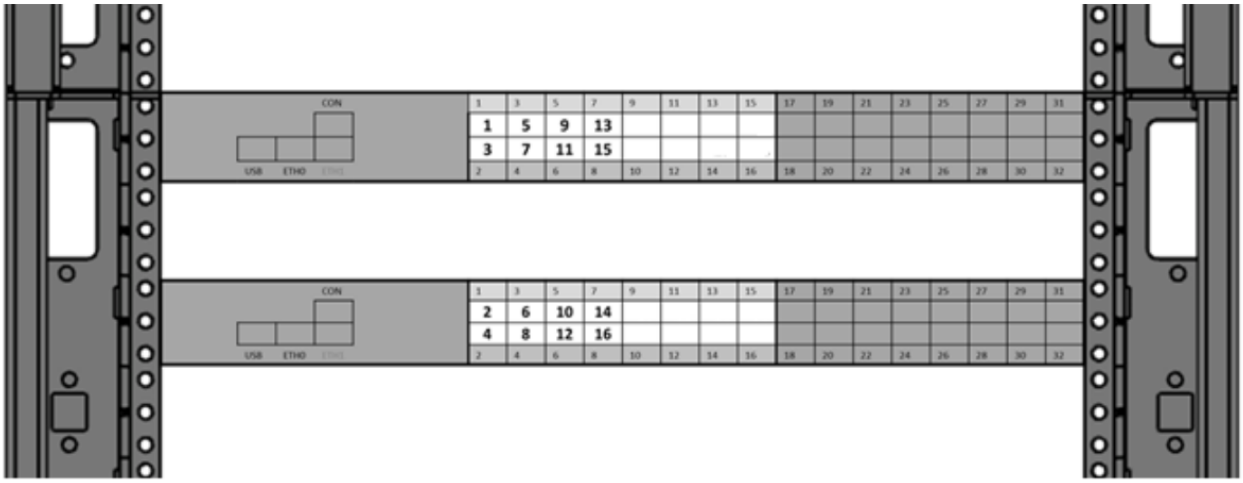


Figure 199. Fibre Channel ports in the IBM SAN32C-6 switches

Any unused ports of the switches are reserved for control enclosures that you might add later.

For connections to hosts and other storage, plan to use the second adapter slot of each node canister to connect each control enclosure to an external SAN or directly to hosts. Ensure that you have the correct number and length of cables for connecting control enclosure ports to the external SAN or directly to hosts.

Plan for connections to an IP network that is used to manage the storage devices on your SAN.

- Provide Ethernet port 1 of each IBM FlashSystem 9500 node canister with a Service IP configuration and record the IP addresses in the “Planning worksheets” on page 61.
- Provide 1 or 2 system IP addresses through which the system is managed. Refer to the “Planning management connections” on page 57 topic to plan these connections, then record the connections in the .
- Provide each Fibre Channel switch with an IP configuration to connect it to the management network. Record the IP configuration in the .
- You have the option of providing each PDU with an IP configuration for remote power management and monitoring, as described in “Setting up power monitoring using the PDU+ (Customer task)” on page 298. Record the IP configuration in the .

Planning for the IBM Enterprise Slim Rack (7965-S42) rack frame

The FlashSystem 9500R racked system uses the IBM Enterprise Slim Rack (7965-S42) rack frame. Rack specifications provide detailed information for your rack, including dimensions, electrical, power, temperature, environment, and service clearances.

Model 7965-S42 rack specifications

Hardware specifications provide detailed information for your rack, including dimensions, electrical, power, temperature, environment, and service clearances.

Table 88. Dimensions for rack

	Width	Depth	Height	Weight (Empty)	EIA unit capacity
Rack only	600 mm (23.6 in.)	1070 mm (42.1 in.)	2020 mm (79.5 in.)	166 kg (365 lb)	42 EIA units
Rack with two standard doors	600 mm (23.6 in.)	1132 mm (44.6 in.)	2020 mm (79.5 in.)	177 kg (391 lb)	42 EIA units

Table 88. Dimensions for rack (continued)

	Width	Depth	Height	Weight (Empty)	EIA unit capacity
Rack with rear door heat exchanger (dry) and standard doors	600 mm (23.6 in.)	1231 mm (48.5 in.)	2020 mm (79.5 in.)	210 kg (463 lb)	42 EIA units
Rack with high-end appearance front door and rear door	600 mm (23.6 in.)	1201 mm (47.3 in.)	2020 mm (79.5 in.)	181 kg (398 lb)	42 EIA units

Table 89. Weight capacity limits

Characteristics	Maximum weight	EIA unit capacity
Dynamic (rolling)	1134 kg (2500 lb)	18 kg (40 lb) / EIA average
Static	1678 kg (3700 lb)	32 kg (70 lb) / EIA average
Seismic certified	1170 (2580 lb)	20 kg (45 lb) / EIA maximum

Table 90. Dimensions for doors

Door model	Width	Height	Depth	Weight
Standard front door and standard back door	590 mm (23.2 in.)	1942 mm (76.5 in.)	31 mm (1.2 in.)	5.9 kg (13 lb)
Rear door heat exchanger door	600 mm (23.6 in.)	1950 mm (76.8 in.)	129 mm (5.0 in.)	39 kg (85 lb) - empty
				48 kg (105 lb) - filled
High-end appearance front door	590 mm (23.2 in.)	1942 mm (76.5 in.)	100 mm (3.9 in.)	9.1 kg (20 lb)
FC ECRC and ECRD acoustic front and rear doors, black IBM	590 mm (23.2 in.)	1942 mm (76.5 in.)	115.5 mm (4.6 in)	17.7 kg (39 lb)
FC ECRC and ECRD acoustic front and rear doors, black OEM	590 mm (23.2 in.)	1942 mm (76.5 in.)	110 mm (4.3 in)	17.7 kg (39 lb)

Table 91. Dimensions for side covers

Width[1]	Depth	Height	Weight[2]
12 mm (0.5 in.)	1070 mm (42.1 in.)	1942 mm (76.5 in.)	20 kg (44 lb)

Table 91. Dimensions for side covers (continued)			
Width[1]	**Depth**	**Height**	**Weight[2]**
[1] Side covers increase the overall width of the rack by 12 mm (0.5 in.) per side, but are only used on the ends of the rows. [2] Weight is for each side cover.			

Table 92. Environment requirements[1]			
Environment	**Recommended operating**	**Allowable operating**	**Nonoperating**
ASHRAE class		A3	
Airflow direction		Front-to-back	
Temperature[2]	18°C - 27°C (64°F - 80°F)	5°C - 40°C (41°F - 104°F)	1°C - 60°C (34°F - 140°F)
Humidity range	5.5°C (42°F) dew point (DP) to 60% relative humidity (RH) and 15°C (59°F) dew point	-12.0°C (10.4°F) DP and 8% - 80% RH	8% - 80% RH
Maximum dew point		24°C (75°F)	27°C (80°F)
Maximum operating altitude		3050 m (10000 ft)	
Shipping temperature			-40°C to 60°C (-40°F to 140°F)
Shipping relative humidity			5% - 100%
1. The final ASHRAE class is determined by the hardware that is installed in the rack. Individual specifications for each piece of hardware must be reviewed. 2. Derate maximum allowable dry-bulb temperature 1°C per 175 m above 950 m. IBM recommends a temperature range of 18°C - 27°C (64°F - 80.6°F).			

Table 93. Service clearances	
Front[1]	**Back**
915 mm (36 in.)	915 mm (36 in.)
[1] Storage racks require larger service clearances in the front of the rack.	

Electrical

For electrical requirements, see “Intelligent Switched Power Distribution Unit Plus (PDU+) and power cord options for the IBM Storage FlashSystem rack solution” on page 264.

Floor cutout

Racks with water hoses and power cords that exit from the bottom of the rack require a floor tile cutout of at least 30.48 cm (12 in.) long by 22.86 cm (9 in.) wide. Due to the hose bend radii, the hole must be positioned towards the side of the rack without the manifold (the left side of the rack when looking at the rear of the rack). The left edge of the hole must be at least 11.43 cm (4.5 in.) from the side and 3.81 cm (1.5 in.) from the back edge of the rack (not including doors). Hole placement on the tile depends on the location of the rack, tile size, and tile load limitations.

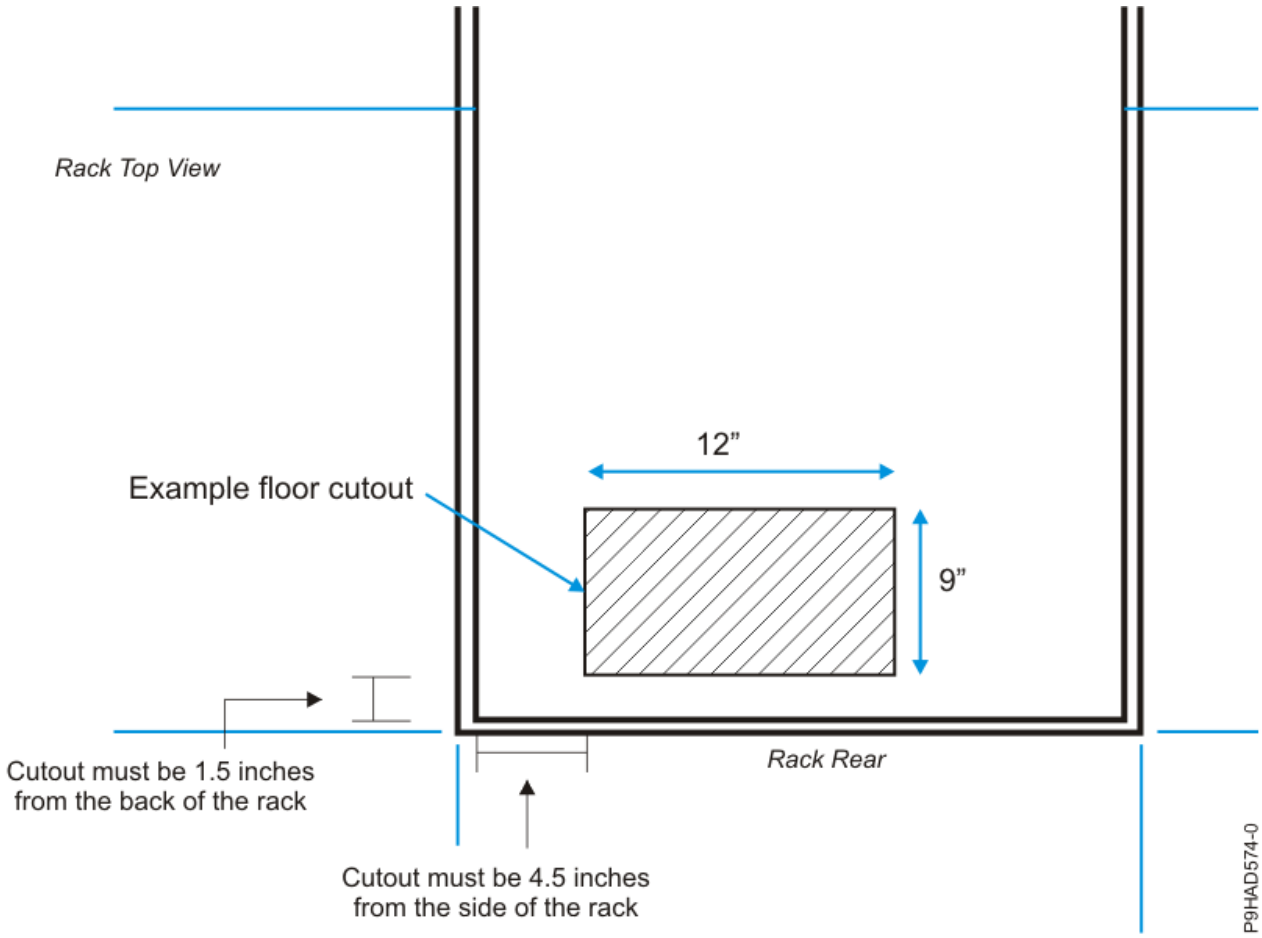


Figure 200. Floor cutout

Caster and leveler locations

The following diagram provides the caster and leveler locations for the 7965-S42 rack.

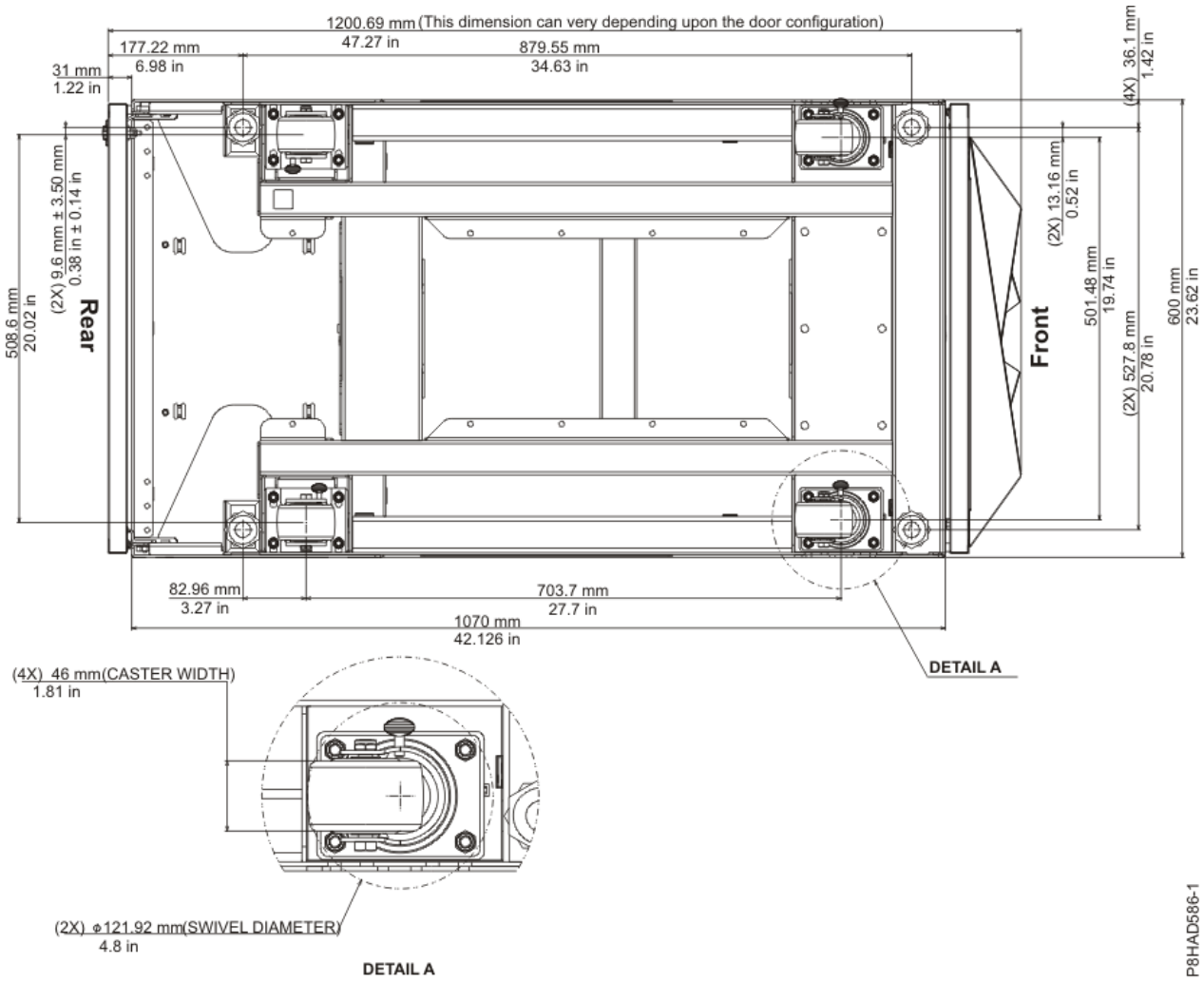


Figure 201. Caster and leveler locations

Planning for rack location

Learn about the different cable routing options available for the 7965-S42 rack.

Cabling within the rack

When the 9500R racked system is in its operating location, an IBM System Service Representative (SSR) can complete installation of the 9500R racked system as described in the *Installing* topic. After the hardware is installed, IBM Lab Services works with you to configure the FlashSystem 9200 system and connect to your SAN, hosts and storage.

Side cable channels are available in the rack to route cables. Three cable channels are on each side of the rack.

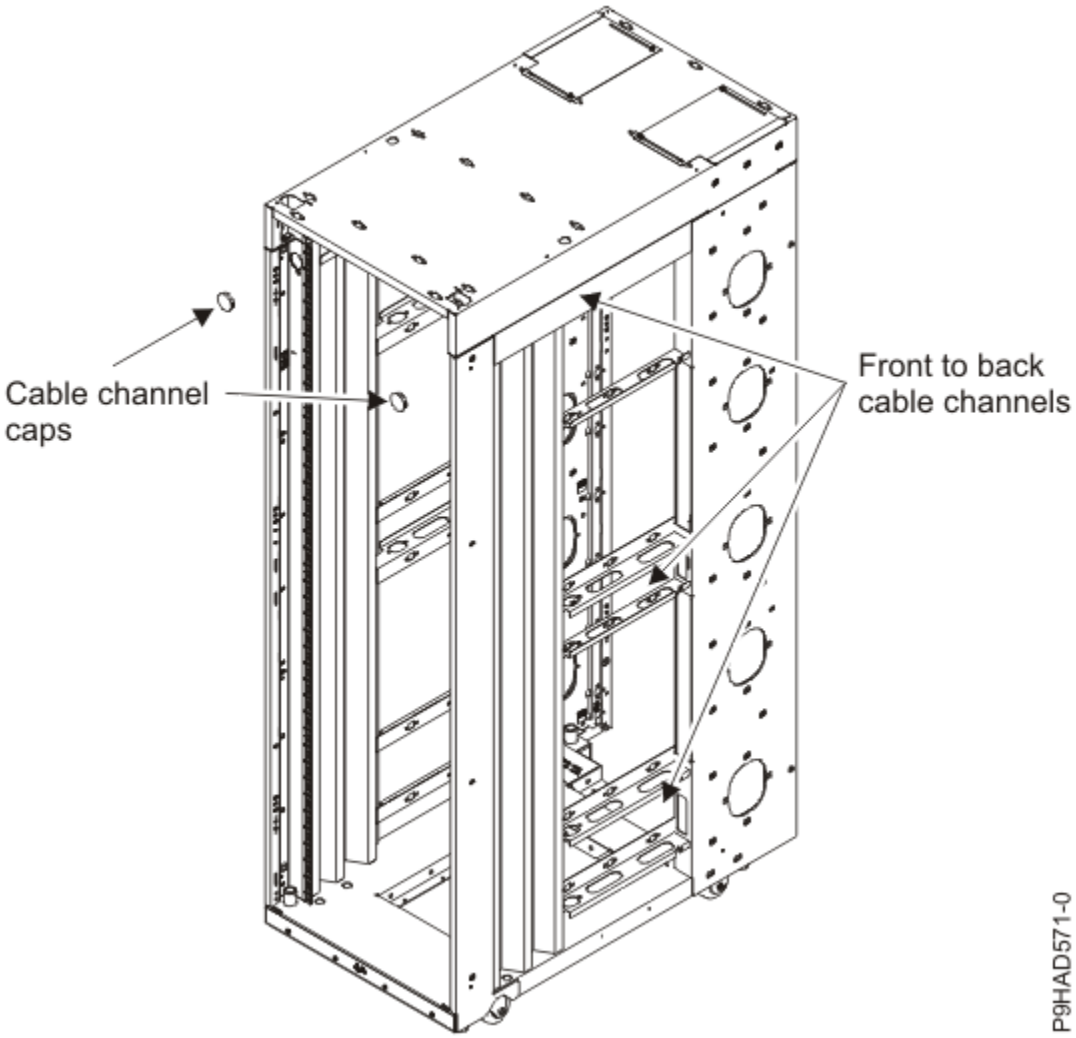


Figure 202. Cabling within the rack

Cabling under the floor

Cables can be routed straight down through the side channels of the rack or routed towards the center of the opening.

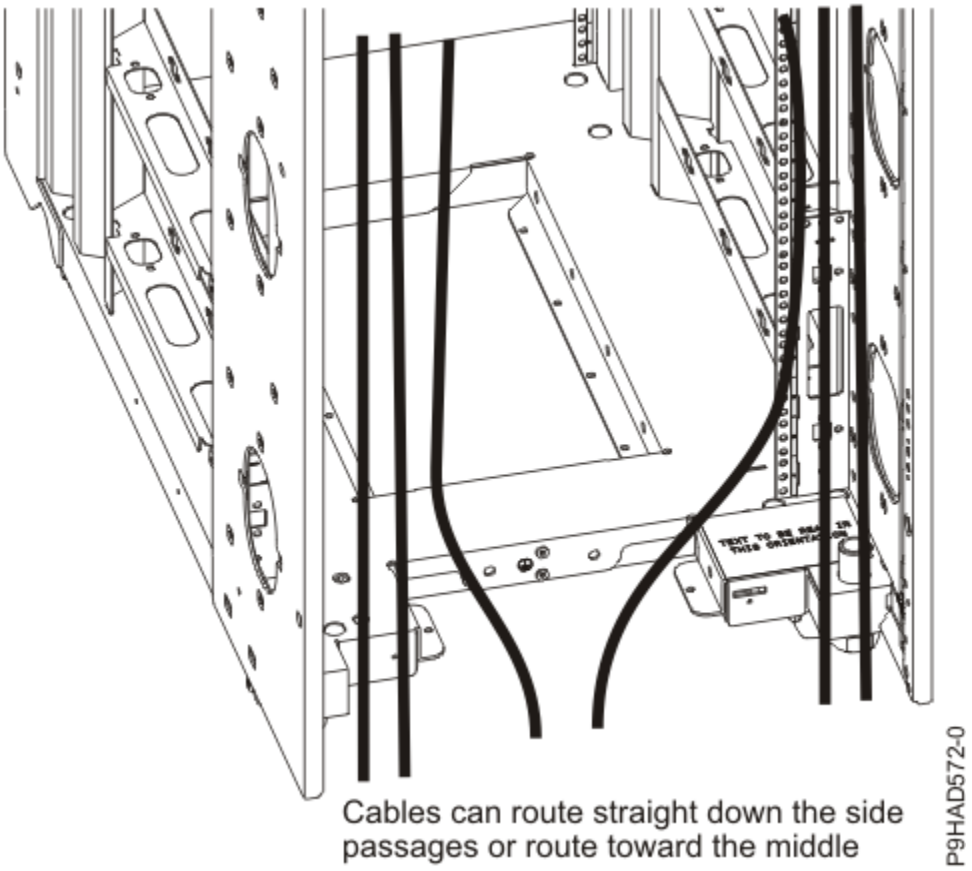


Figure 203. Cabling under the floor

Cabling overhead

Front and rear cable access openings that are on the top of the rack cabinet allow cables to be routed up and out of the rack. Cable access covers on the rear are adjustable by loosening the side screws and sliding the covers forward or backward. Because of the smaller size of the cable openings in front, cables that pass through this area must be minimized.

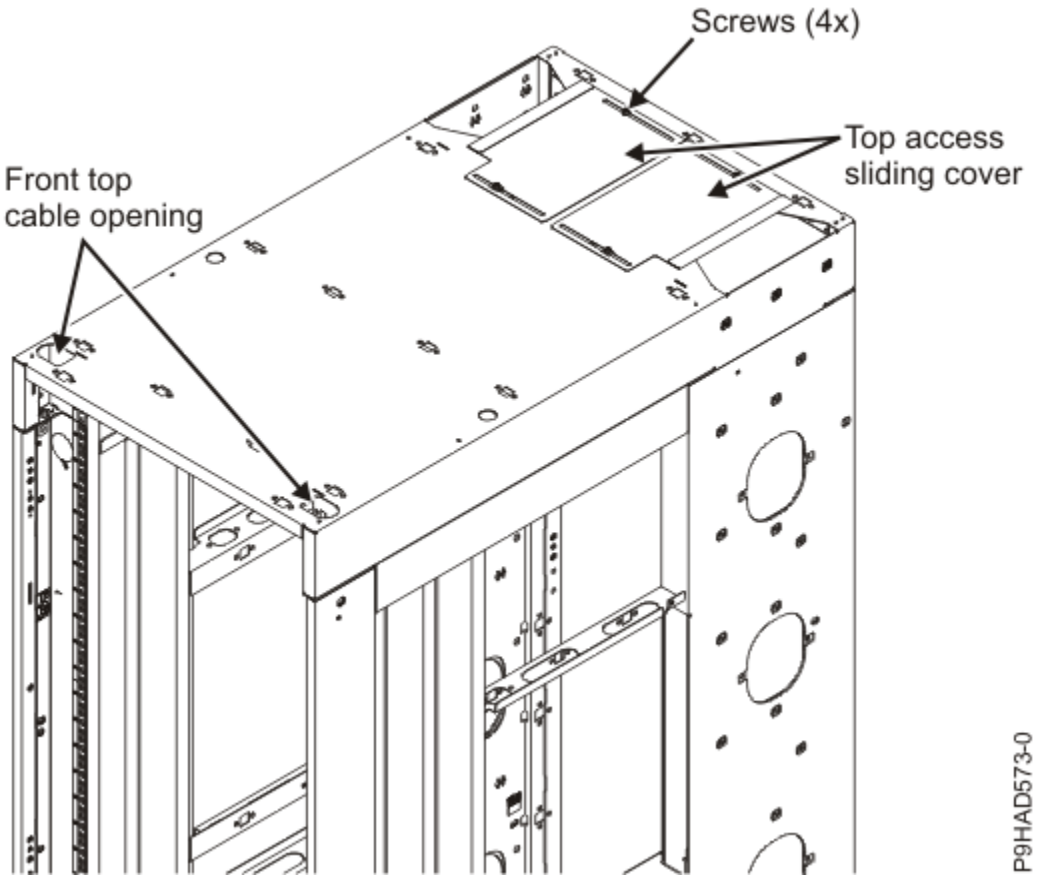


Figure 204. Cabling overhead

Intelligent Switched Power Distribution Unit Plus (PDU+) and power cord options for the IBM Storage FlashSystem rack solution

Two Intelligent Switched Power Distribution Unit Plus (PDU+) PDUs are used with the FlashSystem 9500R rack solution. The FlashSystem 9500R racked system uses the IBM Enterprise Slim Rack (7965-S42) rack frame. PDU features and specifications are described.

Intelligent Switched Power Distribution Unit Plus (PDU+) locations

Figure 205 on page 265 shows the two vertical PDU locations in the FlashSystem 9500R (7965-S42) rack solution.

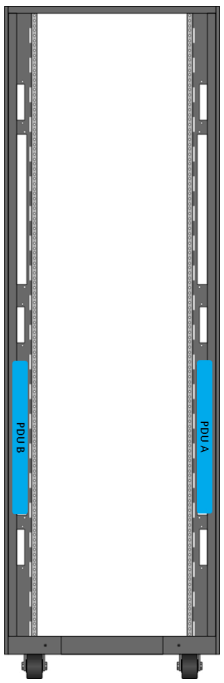


Figure 205. Graphic showing two PDUs. One PDU is on each side of the FlashSystem 9500R rack solution.

The PDU A label shows the PDU+ on the right side when viewed from the front of the rack.
The PDU B label shows the PDU+ on the left side when viewed from the front of the rack.

The PDUs are preinstalled in the FlashSystem 9500R rack solution.

PDU+ specifications

The Intelligent PDU+ has power-monitoring capabilities. The PDU+ is an intelligent AC PDU that monitors the amount of power that is being used by the devices that are plugged into it. The default PDU+ provides twelve C13 power outlets and receives power through a Souriau UTG connector. It can be used in many locations worldwide and for many applications with the PDU-to-wall power cord, which is automatically configured for the rack according to the destination country. Each PDU+ requires one PDU-to-wall power cord. When the PDU+ is connected to a dedicated power source, it conforms to UL60950, CSA C22.2-60950, EN-60950, and IEC-60950 standards.

Table 94. PDU specifications

Characteristics	**Properties**
Height	42.5 mm (1.67 in.)
Width	447.5 mm (17.6 in.)
Depth	351 mm (13.82 in.)
Extra clearance	25 mm (0.98 in.) for circuit breakers
	3 mm (0.12 in.) for outlets
Weight	C19 PDU models: 5.25 kg (11.6 lb) C13 PDU models: 4.3 kg (9.5 lb)
Operating temperature at 0 - 914 m (0 - 3000 ft) (room ambient)	10°C - 60°C (50°F - 140°F)
Operating temperature at 914 - 2133 m (3000 - 7000 ft) (room ambient)	10°C - 60°C (50°F - 140°F)

Table 94. PDU specifications (continued)	
Characteristics	**Properties**
Operating humidity	8 - 80% (noncondensing)
Localized air temperature in PDU	60 °C (140 °F) maximum
Rated frequency (all feature codes)	50 - 60 Hz
Circuit breakers	Nine double-pole branch rated circuit breakers that are rated at 20 amps for 1U C19 PDU models. Six double-pole branch rated circuit breakers that are rated at 20 amps for 1U C13 PDU models.

Intelligent Switched Power Distribution Unit Plus (PDU+) features

One of two PDU features are automatically installed depending on whether your FlashSystem 9500R order includes a 5U expansion enclosure option.

Table 95. Intelligent Switched PDU+ features			
Feature code (FC)	**Description** • **Voltage** • **Amperage** • **Phase**	**Provided power receptacles**	**Supported power cords (PDU to wall)**
ECJJ	• 200 - 240 V ac • Single phase or three phase[1] • 16 A, 24 A, 32 A, 48 A, or 63 A[1]	9 IEC 320-C19 and 3 IEC 320-C13 receptacles	“Supported power distribution unit (PDU) power cords ” on page 266
ECJN	• 200 - 240 V ac • Single phase or three phase [1] • 16 A, 24 A, 32 A, 48 A, or 63 A[1]	Twelve IEC 320-C13 receptacles	“Supported power distribution unit (PDU) power cords ” on page 266
Notes: 1. Amperage and phase depend on the power cord that is used. Three phase is wye wired. The voltage is 380 - 415 V ac at the PDU input and 220 - 240 V ac at the PDU output.			

The intelligent switched AC power distribution unit (PDU+) provides the capability to monitor the amount of electrical power that is being used by devices that are plugged into the PDU. The PDU can also cycle power to individual receptacles by using the switched function.

Supported power distribution unit (PDU) power cords

Power cords for the PDUs in your FlashSystem 9500R rack solution are automatically configured for your country.

When you order your FlashSystem 9500R racked system, e-config automatically orders power cords for your country or region. You can use the following table to select a PDU power cord that overrides the default power cord selected for your country or region when there are multiple choices.

Table 96. Supported PDU power cords for the FlashSystem 9500R rack solution

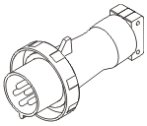
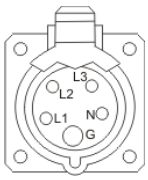
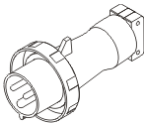
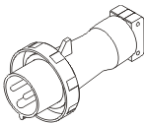
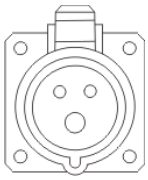
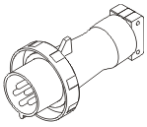
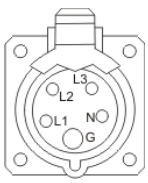
Feature code (FC)	Description • **Voltage** • **Amperage** • **Phase** • **Length** • **Wall plug**	IBM plug that is included	View of plug	Matched female connector (on cord)	Matched female wall receptacle (on wall)	IBM part number	Countries
6489	Power cord, PDU to wall • 230 V ac output • 32 A • 3-phase wye • 4.3 m (14 ft) • IEC 309, 3P+N+G	Plug type 532P6W 		Connector type 532C6W	Receptacle type 532R6W 	39M5413	Europe, Middle East, Africa (EMEA)
6491	Power cord, PDU to wall • 230 V ac • 63 A • Single phase • 4.3 m (14 ft) • IEC 309, P+N+G	Plug type 363P6W 		Connector type 363C6W	Receptacle type 363P6W	39M5415	Europe, Middle East, Africa (EMEA)
6492	Power cord, PDU to wall • 200 - 208 V ac or 240 V ac • 60 A plug (48 A derated) • Single phase • 4.3 m (14 ft) • IEC 309, 2P+G	Plug type 360P6W 		Connector type 360C6W	Receptacle type 360P6W 	39M5417	United States, Canada, Latin America, Japan, and Taiwan
6653	Power cord, PDU to wall • 230 V ac output • 16 A • 3-phase wye • 4.3 m (14 ft) • IEC 309, 3P+N+G	Plug type 516P6W 		Connector type 516C6W	Receptacle type 516R6W 	39M5412	Switzerland

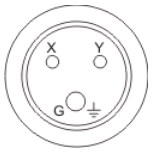
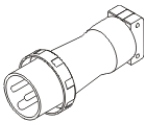
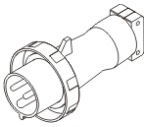
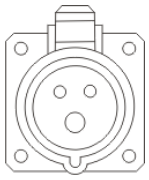
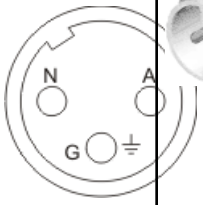
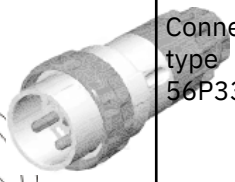
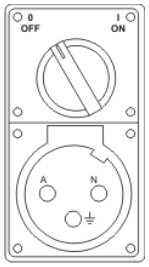
Table 96. Supported PDU power cords for the FlashSystem 9500R rack solution (continued)							
Feature code (FC)	**Description** • **Voltage** • **Amperage** • **Phase** • **Length** • **Wall plug**	**IBM plug that is included**	**View of plug**	**Matched female connector (on cord)**	**Matched female wall receptacle (on wall)**	**IBM part number**	**Countries**
6654	Power cord, PDU to wall • 200 - 208 V ac or 240 V ac • 30 A plug (24 A derated) • Single phase • 4.3 m (14 ft) • NEMA L6-30	Plug type NEMA L6-30P 			Receptacle type NEMA L6-30R 	39M5416	United States, Canada, Latin America, Japan, and Taiwan
6655	Power cord, PDU to wall • 200 - 208 V ac or 240 V ac • 30 A plug (24 A derated) • Single phase • 4.3 m (14 ft) • RS 3750DP (Watertight)					39M5418	United States, Canada, Latin America, Japan, and Taiwan
6656	Power cord, PDU to wall • 230 V ac • 32 A • Single phase • 4.3 m (14 ft) • IEC 309, P+N+G	Plug type 60309 		Connector type 60309	Receptacle type 60309 	39M5414	Europe, Middle East, Africa (EMEA)
6657	Power cord, PDU to wall • 230 - 240 V ac • 32 A • Single phase • 4.3 m (14 ft) • PDL	Plug type 56P332 		Connector type 56P332	Receptacle type 56CV332 	39M5419	Australia and New Zealand

Table 96. Supported PDU power cords for the FlashSystem 9500R rack solution (continued)

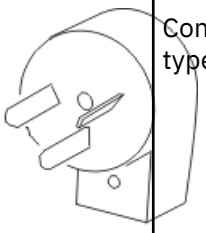
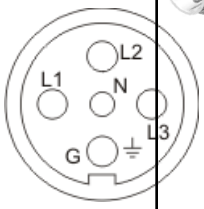
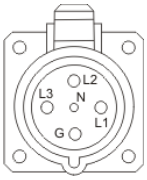
Feature code (FC)	Description • **Voltage** • **Amperage** • **Phase** • **Length** • **Wall plug**	IBM plug that is included	View of plug	Matched female connector (on cord)	Matched female wall receptacle (on wall)	IBM part number	Countries
6658	Power cord, PDU to wall • 220 V ac • 30 A plug (24 A derated) • Single phase • 4.3 m (14 ft) • Korean plug SJ-P3302	Plug type KP 32A 		Connector type KP	Receptacle type KP 	39M5420	South Korea
6667	Power cord, PDU to wall • 230 - 240 V ac output • 32 A • 3-phase wye • 4.3 m (14 ft) • PDL 56P532	Plug type 56P532 		Connector type 56P532	Receptacle type 56P532 	69Y1619	Australia and New Zealand

Table 97. Supported PDU power cords for PDU feature codes ECJK, ECJL, ECJP, and ECJQ with Amphenol inlet

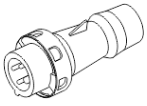
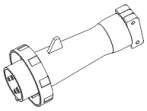
Feature code (FC)	Description • **Voltage** • **Amperage** • **Phase** • **Length** • **Wall plug**	IBM plug that is included	View of plug	Matched female connector (on cord)	Matched female wall receptacle (on wall)	IBM part number	Countries
ECJ5	• 200 - 240 V ac • 24 A • 3 phase delta • 4.3 m (14 ft) • IEC 309, 3P+N+G	Plug type 430P9W 		Connector type 430C9W	Receptacle type 430R9W	02WN660	United States, Canada, Latin America, Japan, and Taiwan

Table 97. Supported PDU power cords for PDU feature codes ECJK, ECJL, ECJP, and ECJQ with Amphenol inlet (continued)

Feature code (FC)	Description • **Voltage** • **Amperage** • **Phase** • **Length** • **Wall plug**	IBM plug that is included	View of plug	Matched female connector (on cord)	Matched female wall receptacle (on wall)	IBM part number	Countries
ECJ7	• 200 - 240 V ac • 48 A • Three phase delta • 4.3 m (14 ft) • IEC 309, 3P+G	Plug type 460P9W 		Connector type 460C9W	Receptacle type 460R9W	02WN658	United States, Canada, Latin America, Japan, and Taiwan

IP connectivity of Fibre Channel switches and power distribution units (PDUs) worksheet

The FlashSystem 9500R rack solution has two SAN switches preinstalled. To connect them to your Ethernet management network, provide IP configuration information. Also provide IP information for the PDUs to enable monitoring power usage over your Ethernet management network.

Two identical Fibre Channel SAN fabric switches are dedicated to the system in your FlashSystem 9500R rack solution. Provide the information in Table 98 on page 270 and Table 99 on page 270.

Fibre Channel switch 2 (lower)

Table 98. FlashSystem 9500R Fibre Channel switch 2 (lower) information

Serial number (when known, for reference)	
Static IPv4 or IPv6 address	
Subnet mask value	
Default gateway value	
Location of Ethernet port for connection to SAN switch	
Administrator password to set	

Fibre Channel switch 1 (upper)

Table 99. FlashSystem 9500R Fibre Channel switch 1 (upper) information

Serial number (when known, for reference)	
Static IPv4 or IPv6 address	
Subnet mask value	
Default gateway value	
Location of Ethernet port for connection to SAN switch	

Table 99. FlashSystem 9500R Fibre Channel switch 1 (upper) information (continued)	
Administrator password to set	

Two identical IBM Intelligent Switched Power Distribution Unit Plus (PDU+) PDUs are in your FlashSystem 9500R rack solution.

To give IBM Lab Services the information that they need to configure the PDUs, provide your values in Table 100 on page 271 and Table 101 on page 271.

PDU A management connection

Table 100. FlashSystem 9500R PDU A management connection information	
Serial number (when known, for reference)	
Static IPv4 or IPv6 address	
Subnet mask value	
Default gateway value	
Location of Ethernet port for connection	
Administrator password to set	
Identity of the site power supply outlet, for connection	

PDU A is on the right when you are viewing the front of the PDU.

PDU B management connection

Table 101. FlashSystem 9500R PDU B management connection information	
Serial number (when known, for reference)	
Static IPv4 or IPv6 address	
Subnet mask value	
Default gateway value	
Location of Ethernet port for connection	
Administrator password to set	
Identity of the site power supply outlet, for connection	

Installing the FlashSystem 9500R rack solution

Customers, an IBM System Services Representative (SSR), and (optionally) IBM Lab Services locate, install, and initially configure the FlashSystem 9500R rack solution.

About this task

With partially populated control enclosures, we have some drive slot plugging rules that must be adhered to, ensuring the best possible operating conditions for the drives.

Figure 1 shows the logical NVMe drive placement, starting from the center of the enclosure (slot 12) on the upper 24 slots. Any slots that do not have an NVMe drive present must have a blank filler installed.

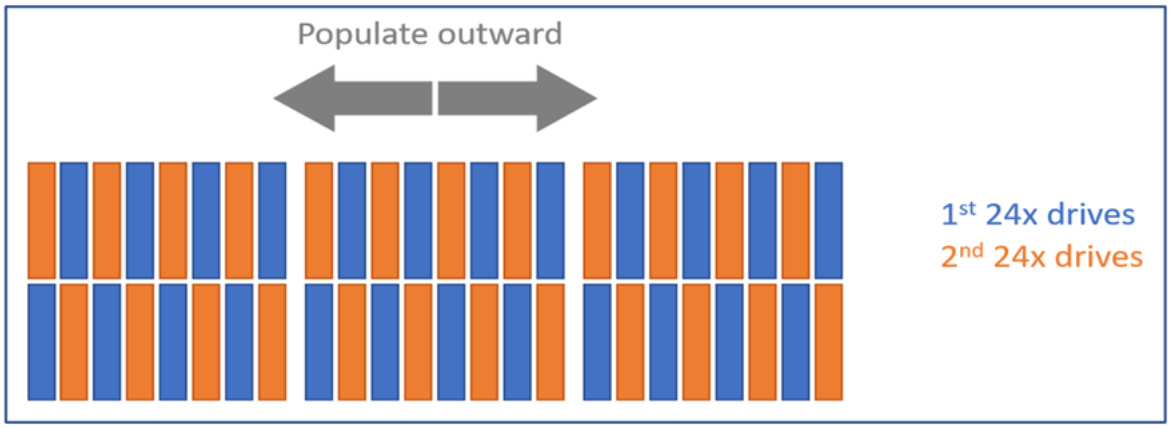


Figure 206. Logical NVMe drive placement

Figure 2 shows the actual drive population with numbering. This shows how the drives are populated from center out, and then distributing them from top and bottom, as the number of drives increase over time.

Note: The layout in Figure 16 has been split at slots 12 and 13 for better clarity on this page, but in reality slots 1 to 24 and slots 25 to 48 are contiguous.

Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7	Slot 8	Slot 9	Slot 10	Slot 11	Slot 12
36	11	34	9	32	7	30	5	28	3	26	1
Slot 25	Slot 26	Slot 27	Slot 28	Slot 29	Slot 30	Slot 31	Slot 32	Slot 33	Slot 34	Slot 35	Slot 36
24	47	22	45	20	43	18	41	16	39	14	37
Slot 13	Slot 14	Slot 15	Slot 16	Slot 17	Slot 18	Slot 19	Slot 20	Slot 21	Slot 22	Slot 23	Slot 24
25	2	27	4	29	6	31	8	33	10	35	12
Slot 37	Slot 38	Slot 39	Slot 40	Slot 41	Slot 42	Slot 43	Slot 44	Slot 45	Slot 46	Slot 47	Slot 48
13	38	15	40	17	42	19	44	21	46	23	48

Figure 207. NVMe drive population with numbering

Locating the FlashSystem 9500R rack solution (Customer task)

You must move the FlashSystem 9500R rack into its operational position before the IBM System Services Representative (SSR) can initialize the racked system.

About this task

Important: When you are moving equipment, refer to the marked shipping weights and observe all safety information. Table 102 on page 272 provides the weights of some example rack configurations.

Table 102. Example weights of FlashSystem 9500R rack as delivered. Example weights of FlashSystem 9500R rack as delivered.

Rack contents	Weight (kg)	Weight (lb)

Table 102. Example weights of FlashSystem 9500R rack as delivered. Example weights of FlashSystem 9500R rack as delivered. *(continued)*		
The **FlashSystem 9500R** rack solution that contains a pair of IBM SAN24B-6 (8960-F24) or IBM SAN32C-6 (8977-T32) Fibre Channel switches, a pair of IBM Storage FlashSystem4666-AH8 control enclosures, PDUs and power cables, and blanking panels.	412 kg	908 lb

Notes:

- Packaging weight is not included in the table.

Procedure

Install the FlashSystem 9500R rack, which uses the IBM Enterprise Slim Rack (7965-S42) rack frame, into its location by following the installation instructions provided in "Installing the IBM Enterprise Slim Rack (7965-S42) (Customer task)" on page 273.

Some parts of the FlashSystem 9500R rack solution are preinstalled. You can add one or two Ethernet Switches to the top of the rack for the management links to the control enclosures, SAN switches and PDUs. Make the Ethernet connections that you filled in on the "IP connectivity of Fibre Channel switches and power distribution units (PDUs) worksheet" on page 270.

After the FlashSystem 9500R rack solution is in its operating location, an IBM SSR completes the installation and the initial system setup using the information provided in the customer worksheets.

Installing the IBM Enterprise Slim Rack (7965-S42) (Customer task)

You are required to complete some tasks when installing the FlashSystem 9500R rack solution, which uses the IBM Enterprise Slim Rack (7965-S42) rack frame. Other tasks are carried out by an IBM System Services Representative (SSR) or an IBM Lab Services engineer. Use this information to locate, level, and install the IBM Enterprise Slim Rack (7965-S42) rack frame.

Before installing the rack, read the "Rack safety notices" on page 274.

Completing a parts inventory (Customer task)

Before beginning locating, leveling, and installing the FlashSystem 9500R rack frame, complete a parts inventory.

Procedure

1. Locate the kitting report in an accessory box.
2. Ensure that you received all of the features that you ordered and all of the parts in the kitting report.

Results

If there are incorrect, missing, or damaged parts, contact a source for IBM help.

- Your IBM reseller.
- IBM support. (See the Directory of worldwide contacts website (http://www.ibm.com/planetwide) at IBM Directory of worldwide contacts - Country/region for contact information for your country.)
- IBM Rochester Manufacturing Automated Information Line at 1–800–300–8751 (United States only)

Rack safety notices

You need to read the rack safety notices before installing equipment.

About this task

Before locating, leveling, and installing the FlashSystem 9500R rack frame and its features, or before installing a control enclosure or expansion enclosure into the rack, read the following safety information.

(R001 part 1 of 2):

DANGER: Observe the following precautions when working on or around your IT rack system:

- Heavy equipment–personal injury or equipment damage might result if mishandled.
- Always lower the leveling pads on the rack cabinet.
- Always install stabilizer brackets on the rack cabinet unless the earthquake option is to be installed.
- To avoid hazardous conditions due to uneven mechanical loading, always install the heaviest devices in the bottom of the rack cabinet. Always install servers and optional devices starting from the bottom of the rack cabinet.
- Rack-mounted devices are not to be used as shelves or work spaces. Do not place objects on top of rack-mounted devices. In addition, do not lean on rack mounted devices and do not use them to stabilize your body position (for example, when working from a ladder).

- Stability hazard:
  - The rack may tip over causing serious personal injury.
  - Before extending the rack to the installation position, read the installation instructions.
  - Do not put any load on the slide-rail mounted equipment mounted in the installation position.
  - Do not leave the slide-rail mounted equipment in the installation position.
- Each rack cabinet might have more than one power cord.
  - For AC powered racks, be sure to disconnect all power cords in the rack cabinet when directed to disconnect power during servicing.
  - For racks with a DC power distribution panel (PDP), turn off the circuit breaker that controls the power to the system unit(s), or disconnect the customer's DC power source, when directed to disconnect power during servicing.
- Connect all devices installed in a rack cabinet to power devices installed in the same rack cabinet. Do not plug a power cord from a device installed in one rack cabinet into a power device installed in a different rack cabinet.
- An electrical outlet that is not correctly wired could place hazardous voltage on the metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. (R001 part 1 of 2)

(R001 part 2 of 2):

CAUTION:

- Do not install a unit in a rack where the internal rack ambient temperatures will exceed the manufacturer's recommended ambient temperature for all your rack-mounted devices.
- Do not install a unit in a rack where the air flow is compromised. Ensure that air flow is not blocked or reduced on any side, front, or back of a unit used for air flow through the unit.
- Consideration should be given to the connection of the equipment to the supply circuit so that overloading of the circuits does not compromise the supply wiring or overcurrent protection.

To provide the correct power connection to a rack, refer to the rating labels located on the equipment in the rack to determine the total power requirement of the supply circuit.

- *(For sliding drawers.)* Do not pull out or install any drawer or feature if the rack stabilizer brackets are not attached to the rack or if the rack is not bolted to the floor. Do not pull out more than one drawer at a time. The rack might become unstable if you pull out more than one drawer at a time.

- *(For fixed drawers.)* This drawer is a fixed drawer and must not be moved for servicing unless specified by the manufacturer. Attempting to move the drawer partially or completely out of the rack might cause the rack to become unstable or cause the drawer to fall out of the rack. (R001 part 2 of 2)

Lift precautions:

Positioning and leveling the FlashSystem 9500R rack frame (Customer task)

Proper rack positioning and leveling is needed to comply with safety and regulatory requirements. Use this procedure to complete this task.

About this task

Use the following information to determine the next step.

- To bolt the FlashSystem 9500R rack frame to a concrete floor, see “Attaching the rack frame to a concrete floor (Customer task)” on page 276.
- To bolt the FlashSystem 9500R rack frame to a concrete floor beneath a raised floor, see “Attaching the rack frame to a concrete floor (Customer task)” on page 276.
- If you must level the FlashSystem 9500R rack, continue with the next step.

To position and level the FlashSystem 9500R rack frame, complete the following steps.

1. Remove all the packing materials from the FlashSystem 9500R rack, such as tape, plastic sheets, cardboard, or other packing materials.
2. Position the rack at your planned location.
3. Loosen the jam nut on each leveling foot.

4. Rotate each leveling foot downward until it contacts the surface on which the FlashSystem 9500R rack is placed.
5. Adjust the leveling feet downward as needed until the FlashSystem 9500R rack is level. When the FlashSystem 9500R rack is level, tighten the jam nuts against the base.
6. See “Attaching the rack frame to a concrete floor (Customer task)” on page 276.

Attaching the rack frame to a concrete floor (Customer task)

Attach the FlashSystem 9500R rack frame to a concrete floor.

About this task

Obtain the services of a Professional Engineer and/or mechanical contractor to attach the FlashSystem 9500R rack frame to the concrete floor. The Professional Engineer and/or mechanical contractor must determine that the hardware being used to secure the FlashSystem 9500R rack frame to the concrete floor is sufficient to meet the requirements for the installation. IBM provides rack-mounting plates that may be used for installation of the FlashSystem 9500R rack frame to the concrete floor. If the IBM rack-mounting plates are used, refer to the following installation procedure to plan how you might complete your installation.

Procedure

To attach the FlashSystem 9500R rack frame to a concrete floor, complete the following steps.

1. Put the FlashSystem 9500R rack frame in its predetermined location.
2. Remove the front and rear doors if they are installed. To remove a FlashSystem 9500R rack door, complete the following steps.
   a. Unlock and open the door.
   b. Grasp the door firmly with both hands and lift it up away from the hinges.
3. Locate the hardware mounting kit and the two mounting plates. Refer to the following figure when reviewing the contents of the hardware mounting kit. The hardware mounting kit contains the following items.
   - 4 rack-mounting bolts
   - 4 thick washers [12.7 mm (½”)]
   - 4 thick washers [6.4 mm (¼”)]
   - 4 spacers

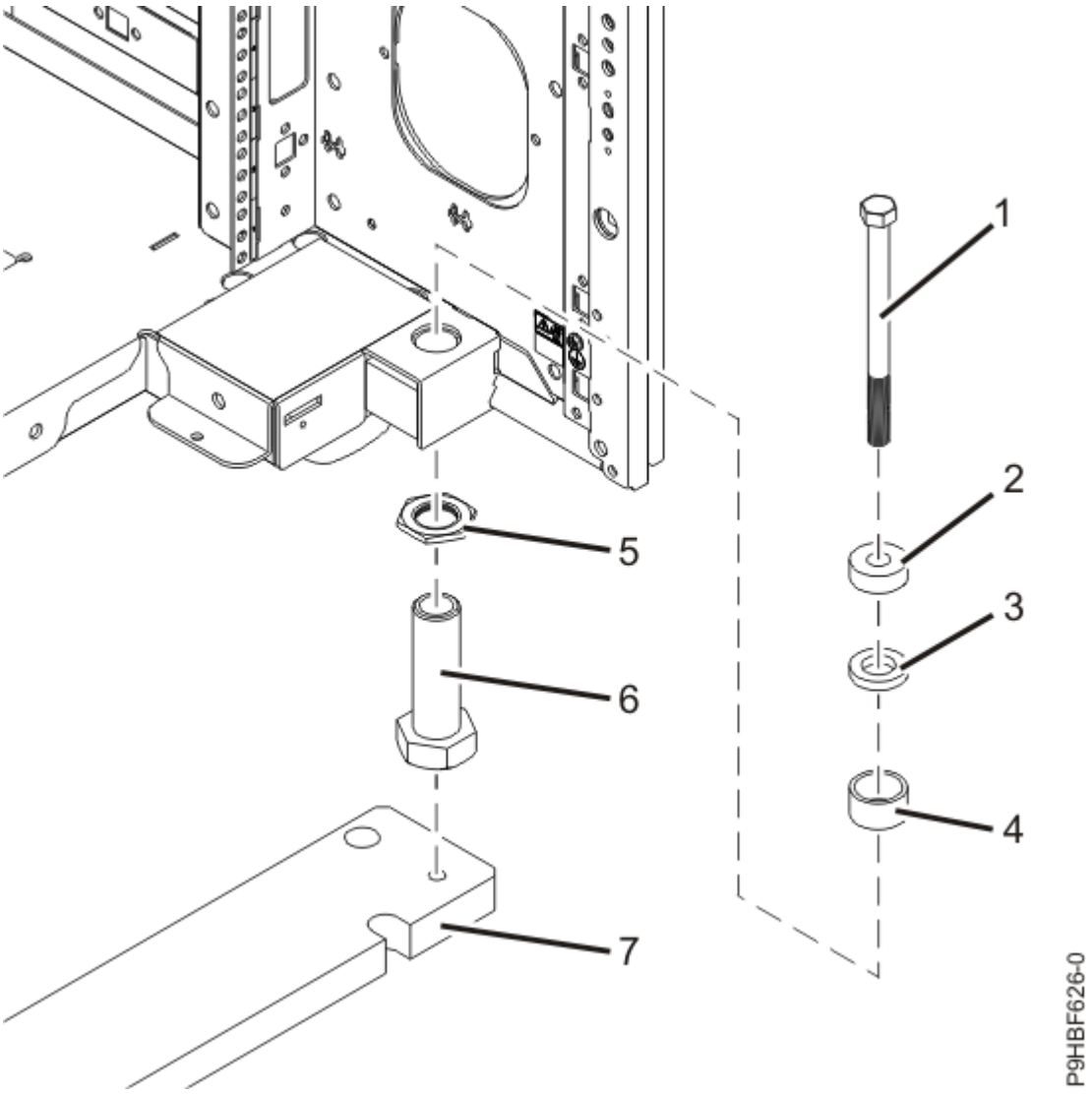


Figure 208. Rack bolt-down hardware

1
Rack-mounting bolt

2
Thick washer (12.7 mm)

3
Thick washer (6.4 mm)

4
Spacer

5
Jam nut

6
Leveling foot

7
Mounting plate

4. Position the two mounting plates in the approximate mounting location under the rack.
5. Create a rack-mounting bolt assembly by adding the following items, in the order listed, to each rack-mounting bolt.
   a. Thick washer (12.7 mm)

b. Thick washer (6.4 mm)

c. Spacer

6. Insert a rack-mounting bolt assembly through each of the leveling feet.
7. Reposition the rack-mounting plates under the four rack-mounting bolts so that the mounting bolts are centered directly over the threaded bolt holes.
8. Turn the rack-mounting bolts four complete turns into the mounting plate's threaded bolt holes.

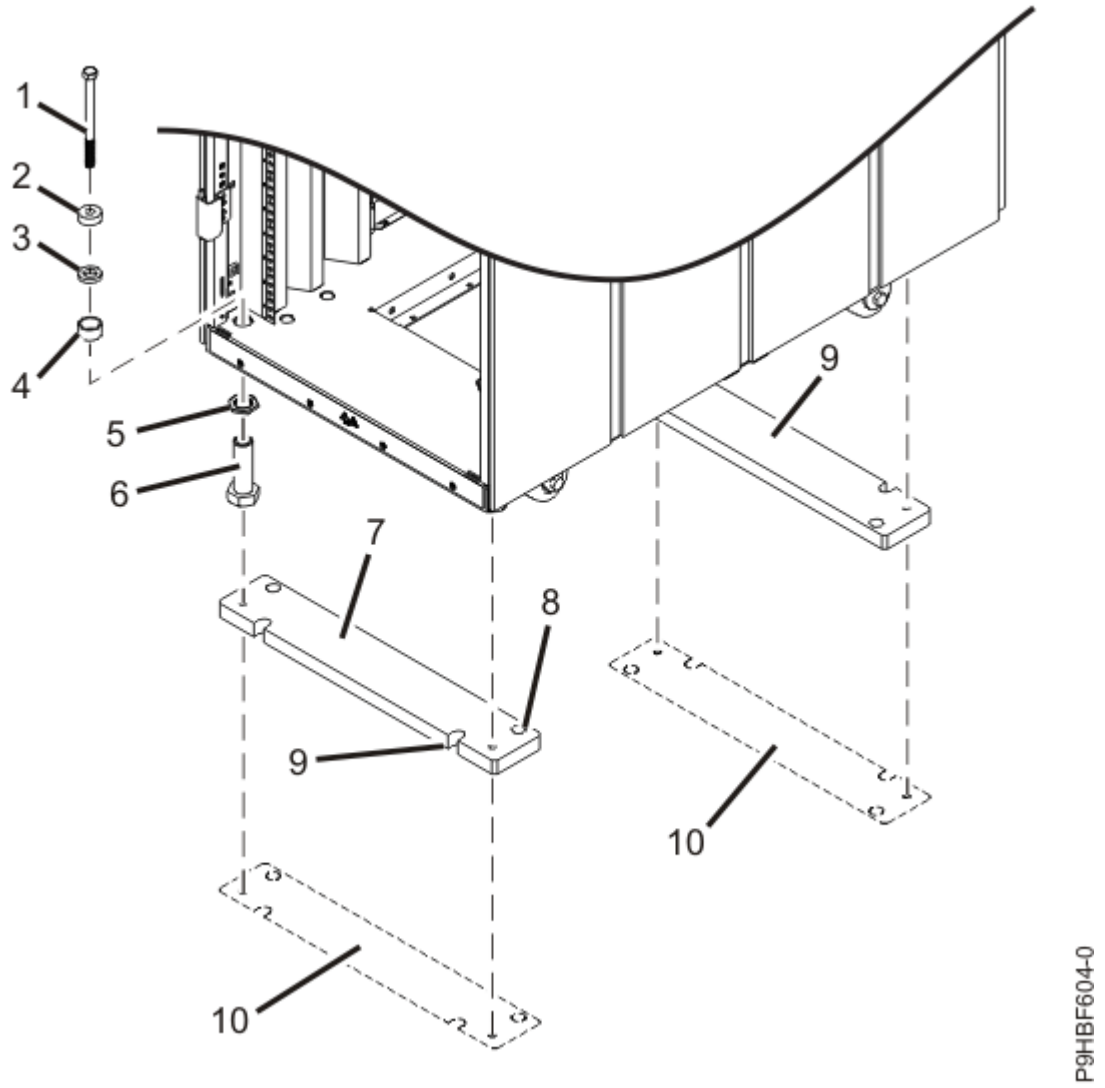


Figure 209. Securing the rack to the concrete floor

1
Rack-mounting bolt

2
Thick washer (12.7 mm)

3
Thick washer (6.4 mm)

4
Spacer

5
Jam nut

6
Leveling foot

7
Mounting plate

8
Threaded hole (Used to secure the rack to the mounting plate.)

9
Anchor bolt hole

10
Traced pattern (Pattern to be traced onto the floor using the mounting plate as a template)

9. Mark the floor around the edges of both mounting plates.
10. Mark the plate bolt-down holes.
11. Remove the rack-mounting bolt assemblies.
12. Remove the mounting plates from the marked locations.
13. Move the rack so that it is clear of both areas that were marked on the floor for the mounting plate locations
14. Reposition the mounting plates within the marked areas.
15. Mark the floor at the center of all holes in both mounting plates, including the threaded holes.
16. Remove the two rack-mounting plates from the marked areas.
17. At the marked location of the threaded rack-mounting bolt holes, drill four clearance holes into the concrete floor. Each clearance hole should be approximately 1-inch deep. This depth allows the rack-mounting bolts enough room to protrude past the thickness of the mounting plates.

    Note: If the hole locations selected at the rear of the FlashSystem 9500R rack frame are not accessible, riggers are required to install bolts in the non-accessible hole locations as the rack frame has to be lifted to install them.
18. Drill holes into the concrete floor at the hole locations (**A**), for each mounting plate bolt.

    Note: The quantity, location, size and/or type of anchor bolts and concrete anchors must be determined by the Professional Engineer and/or the mechanical contractor doing the rack mounting plate installation.

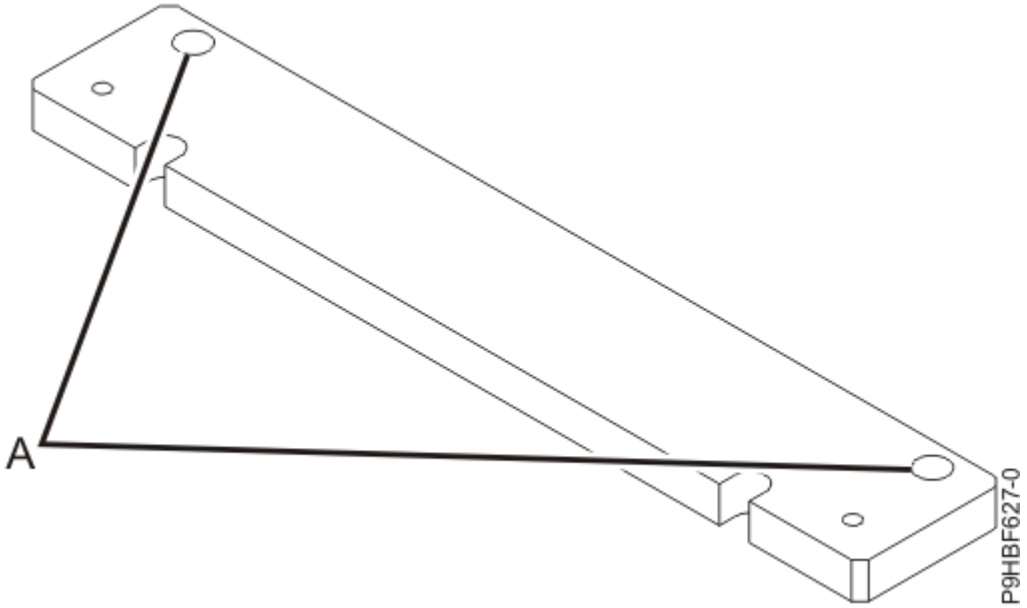


Figure 210. Recommended bolt-down locations

19. Install the concrete anchors.
20. Position the rack-mounting plate over the concrete anchors.

21. Install the anchoring bolts in the front rack-mounting plate but do not tighten.
22. Position the FlashSystem 9200R rack frame over the front rack-mounting plate.
23. Insert two of the rack-mounting bolts through the 12.7 mm thick washer, 6.4 mm thick washer, spacer and through each of the front leveling feet.
24. Align the two rack-mounting bolts with the two tapped holes in the front mounting plate and turn three to four rotations.
25. Position the rear-mounting plate over the concrete anchors.
26. Install the anchoring bolts in the rear rack-mounting plate but do not tighten.
27. Insert two of the rack-mounting bolts through the 12.7 mm thick washer, 6.4 mm thick washer, spacer and through each of the rear leveling feet.
28. Align the two rack-mounting bolts with the two tapped holes in the rear mounting plate and turn three to four rotations.
29. Torque the bolts securing the front rack-mounting plate to the concrete floor. Torque requirements are provided by the professional engineer or the mechanical contractor.
30. Torque the bolts securing the rear rack-mounting plate to the concrete floor. Torque requirements are provided by the professional engineer or the mechanical contractor.
31. Adjust the leveling feet downward as needed to take the load off the castors (should spin freely) and until the rack is level. When the FlashSystem 9200R rack frame is level, tighten the jam nuts against the base of the rack.

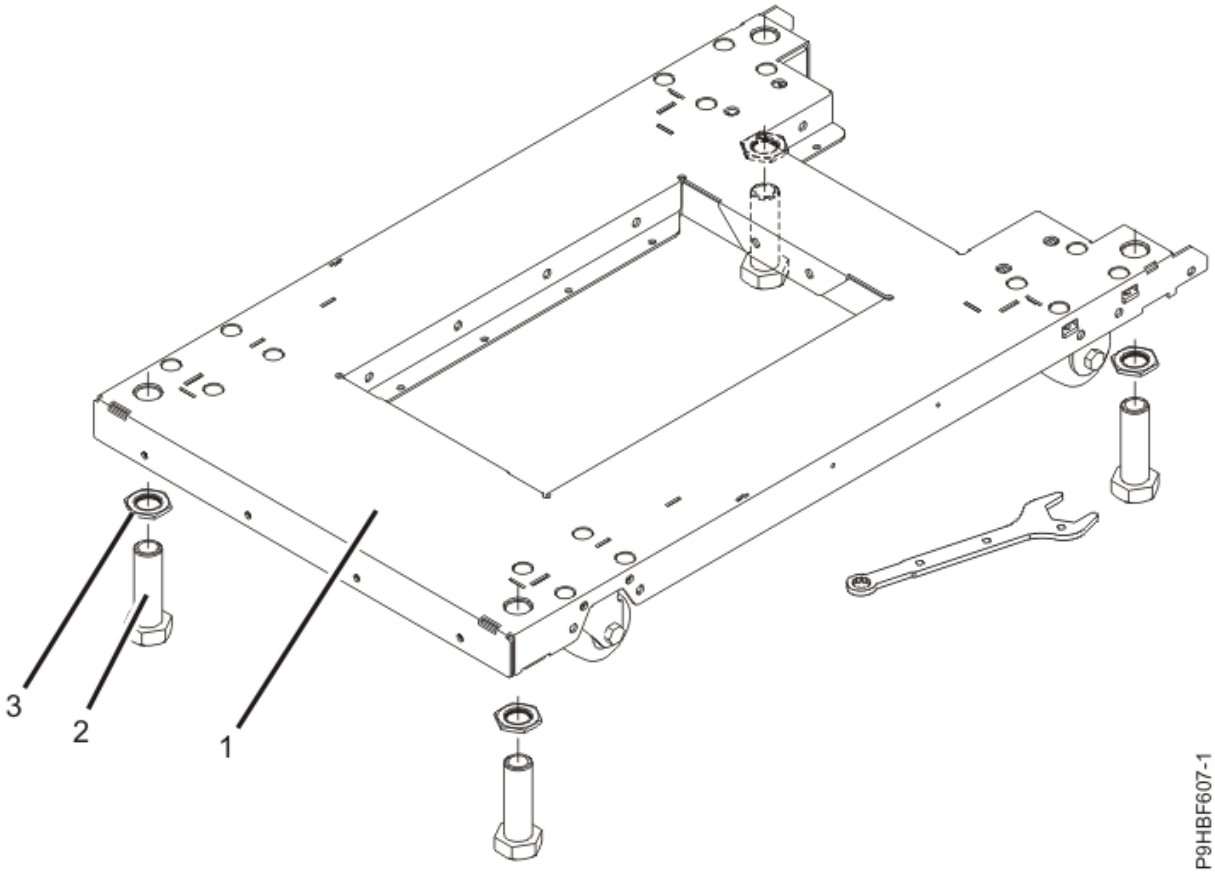


Figure 211. Adjusting the leveling feet

1
Rack front (base)

2
Leveling foot (quantity 4)

3
Jam nut (quantity 4)

32. Torque the four bolts to 54 - 67 newton-meters (Nm) [40 - 50 foot-pounds (ft lb)].
33. After the FlashSystem 9500R rack is bolted down, install the airflow plate to the front of the rack. To install the airflow plate, complete the following steps.
    a. Position the airflow plate (**1**) so that it rests on the rack-mounting plate.
    b. Install two M6 x 10 flathead screws (**2**).
    c. Use a torque screwdriver to tighten each screw to 2.5 Nm ± 0.2 Nm [22.1 inch-pounds (in lb) ± 1.8 in lb].

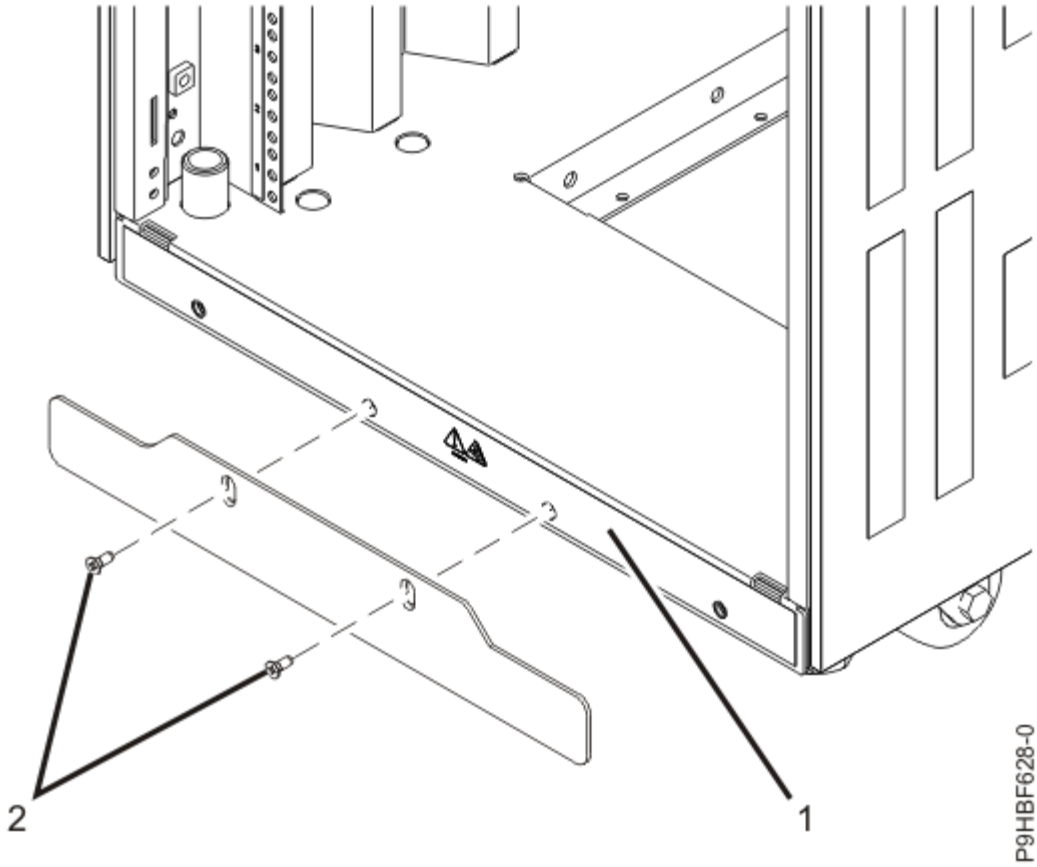


Figure 212. Installing the airflow plate

Attaching the rack frame to a concrete floor beneath a raised floor (Customer task)

Attach the FlashSystem 9500R rack frame to a concrete floor, which lays beneath a raised floor.

About this task

Obtain the services of a Professional Engineer or mechanical contractor to attach a rack frame in a raised floor environment. The Professional Engineer or mechanical contractor must determine that the hardware used to secure the rack frame to the concrete floor is sufficient to meet the requirements for the raised floor installation. IBM provides rack-mounting plates that are used for installation of the rack frame.

Procedure

To attach the rack frame to a concrete floor beneath a raised floor, complete the following steps.

1. Put your rack frame in its predetermined location.

2. Remove the front and rear doors.

   To remove a rack door, complete the following steps.

   a. Unlock and open the door.

   b. Grasp the door firmly with both hands and lift it up away from the hinges.

   After the rack doors are removed, go to the next step.

3. Locate the hardware-mounting kit and the two mounting plates. Refer to the following illustration when you review the contents of the hardware-mounting kit.

   The hardware-mounting kit contains the following items.

   - 4 Rack-mounting bolts
   - 4 Thick washers [12.7 mm (½")]
   - 4 Thick washers [6.4 mm (¼")]
   - 4 Spacers

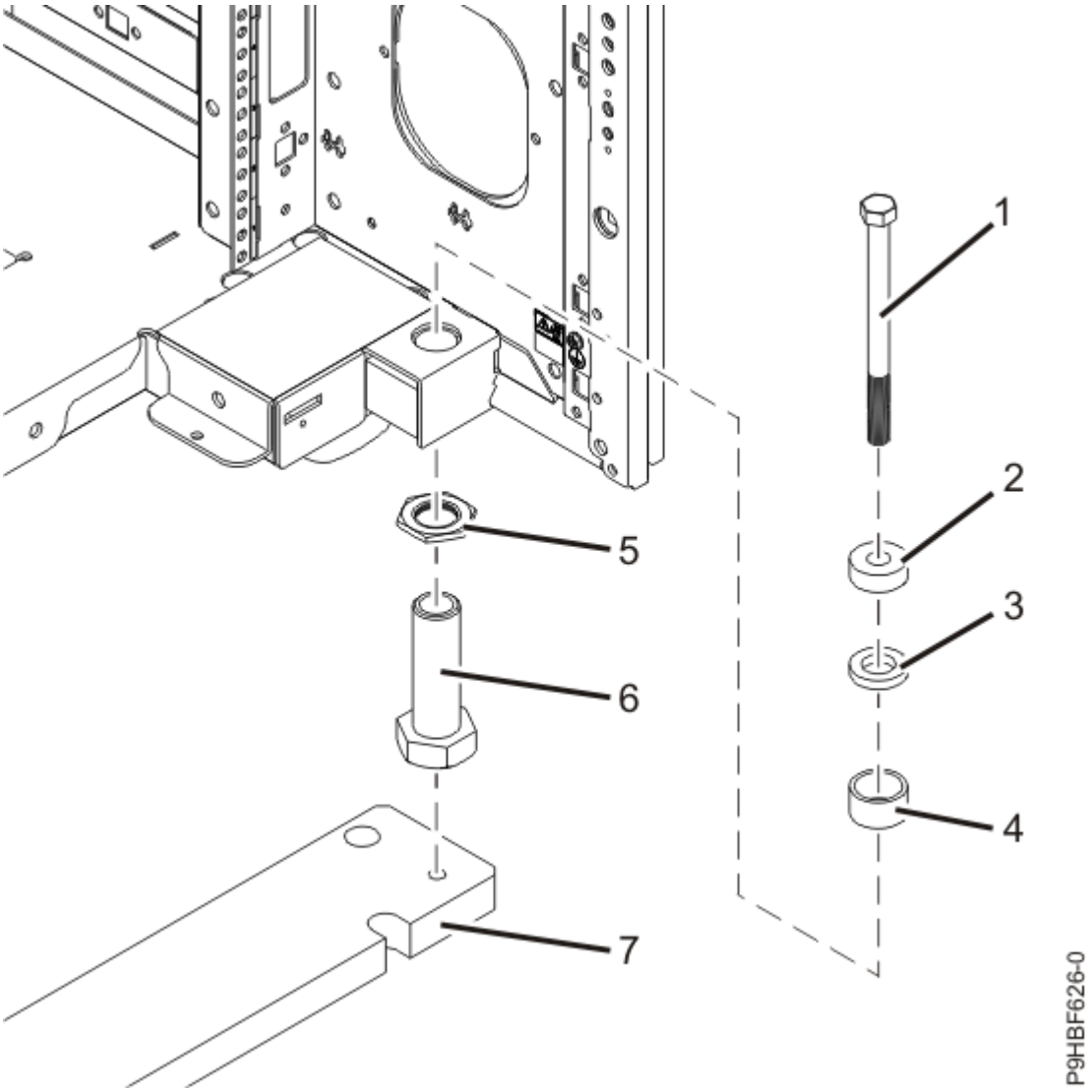


Figure 213. Rack bolt-down hardware

1
Rack-mounting bolt

2
Thick washer (12.7 mm)

3
Thick washer (6.4 mm)

4
Spacer

5
Jam nut

6
Leveling foot

7
Mounting plate

4. Position the two mounting plates in the approximate mounting location under the rack frame.
5. Create a rack-mounting bolt assembly by adding the following items, in the order listed, to each rack-mounting bolt.
   a. Thick washer (12.7 mm)
   b. Thick washer (6.4 mm)
   c. Spacer
6. Insert a rack-mounting bolt assembly through each of the leveling feet.
7. Reposition the rack-mounting plates under the four rack-mounting bolts so that the mounting bolts are centered directly over the threaded bolt holes.
8. Turn the rack-mounting bolts four complete turns into the mounting plate's threaded bolt holes.

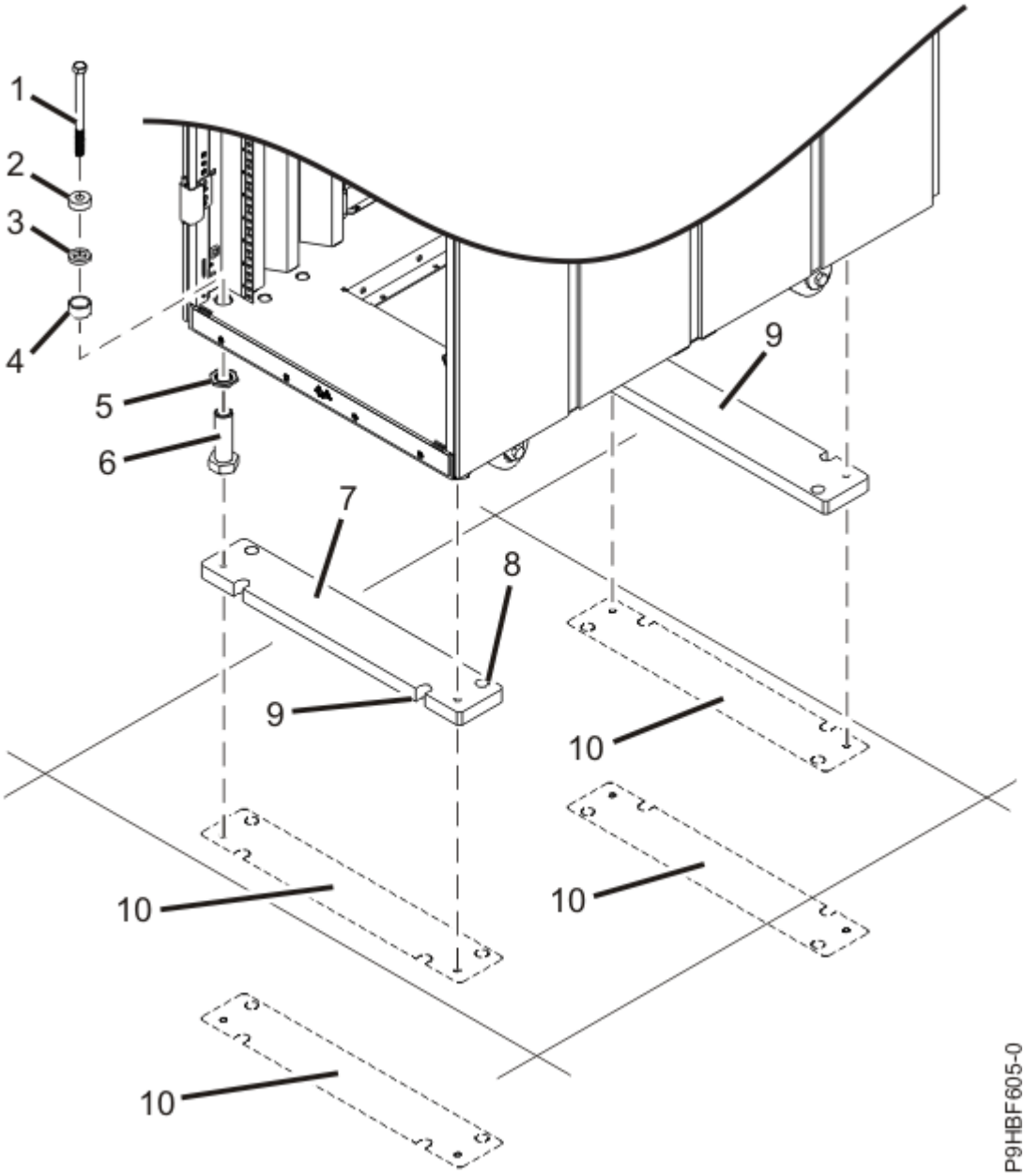


Figure 214. Securing the rack frame to the concrete floor

1
Rack-mounting bolt

2
Thick washer (12.7 mm)

3
Thick washer (6.4 mm)

4
Spacer

5
Jam nut

6
Leveling foot

7
Mounting plate

8
Threaded hole (Used to secure the rack to the mounting plate.)

9
Anchor bolt hole

10
Traced pattern (Pattern to be traced onto the floor by using the mounting plate as a template)

9. 9. Mark the raised-floor panel around the edges of the front and rear rack-mounting plates.
10. Mark the plate bolt-down holes.
11. Remove the rack-mounting bolt assemblies.
12. Remove the mounting plates from the marked locations.
13. Move the rack frame so that it is clear of both areas that were marked on the floor for the mounting plate locations.
14. Reposition the mounting plates within the marked areas.
15. Mark the floor at the center of all holes in both mounting plates, including the threaded holes.
16. Remove the two rack-mounting plates from the marked areas.
17. At the marked location of the threaded rack-mounting bolt holes, drill four clearance holes into and through the raised floor. The holes allow the rack-mounting bolts enough room to protrude past the thickness of the rack-mounting plates.

    Note: The quantity, location, size, and type of concrete anchors *must* be determined by the Professional Engineer or the mechanical contractor who is completing the rack-mounting plate installation.

    Note: If the hole locations at the rear of the rack frame are not accessible, riggers are required to install the mounting hardware in the non-accessible hole locations. You must lift the rack frame to install the hardware.
18. Drill pass-through holes at the selected hole locations (**A**) into the raised floor panels. The pass-through holes allow the mounting hardware to be inserted into the rack-mounting plate and pass through the raised floor panel to the concrete floor.

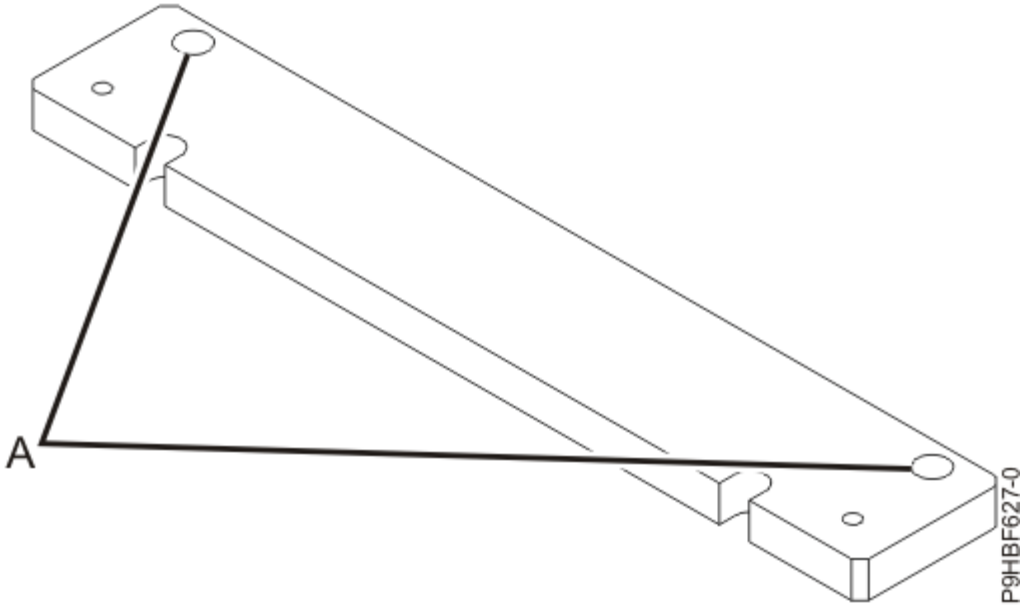


Figure 215. Bolt-down locations

Note: The quantity, location, size, and type of concrete anchors *must* be determined by the Professional Engineer or the mechanical contractor who is completing the rack-mounting plate installation.

19. Transfer the locations of the anchor bolt holes (exclude the clearance holes drilled for the rack-mounting bolts) from the raised-floor panel to the concrete floor directly beneath. Mark the hole locations on the concrete floor.
20. Drill holes in the concrete floor to secure the anchor bolts.
21. If the raised-floor panels were removed, position the raised-floor panels back into position over the anchor bolt holes.
22. Position the front rack-mounting plate within the marked area on the raised-floor panel.
23. Using your anchoring method, secure the front rack-mounting plate on top of the raised floor and through to the concrete floor, but do not tighten.
24. Replace all raised panels that are required to position the rack frame over the front mounting plate.
25. Position the rack frame over the front rack-mounting plate.
26. Insert two of the rack-mounting bolts through the 12.7 mm thick washer, 6.4 mm thick washer, spacer and through each of the front leveling feet.
27. Align the two rack-mounting bolts with the two tapped holes in the front mounting plate and turn 3 - 4 rotations.
28. Position the rear-mounting plate over the holes in the raised floor.
29. Using your anchoring method, secure the rear rack-mounting plate on top of the raised floor and through to the concrete floor, but do not tighten.
30. Insert two of the rack-mounting bolts through the 12.7 mm thick washer, 6.4 mm thick washer, spacer and through each of the front leveling feet.
31. Align the two rack-mounting bolts with the two tapped holes in the rear mounting plate and turn 3 - 4 rotations.
32. Using torque requirements that are provided by the Professional Engineer or the mechanical contractor, torque the hardware that secures the front rack-mounting plate to the concrete floor.
33. Using torque requirements that are provided by the Professional Engineer or the mechanical contractor, torque the hardware that secures the rear rack-mounting plate to the concrete floor.
34. Replace all raised panels that you removed when you are aligning and securing the mounting plate hardware to the concrete floor.
35. Adjust the leveling feet downward as needed to take the load off the castors (ensure that they spin freely) and until the rack frame is level. When the rack frame is level, tighten the jam nuts against the base of the rack frame.

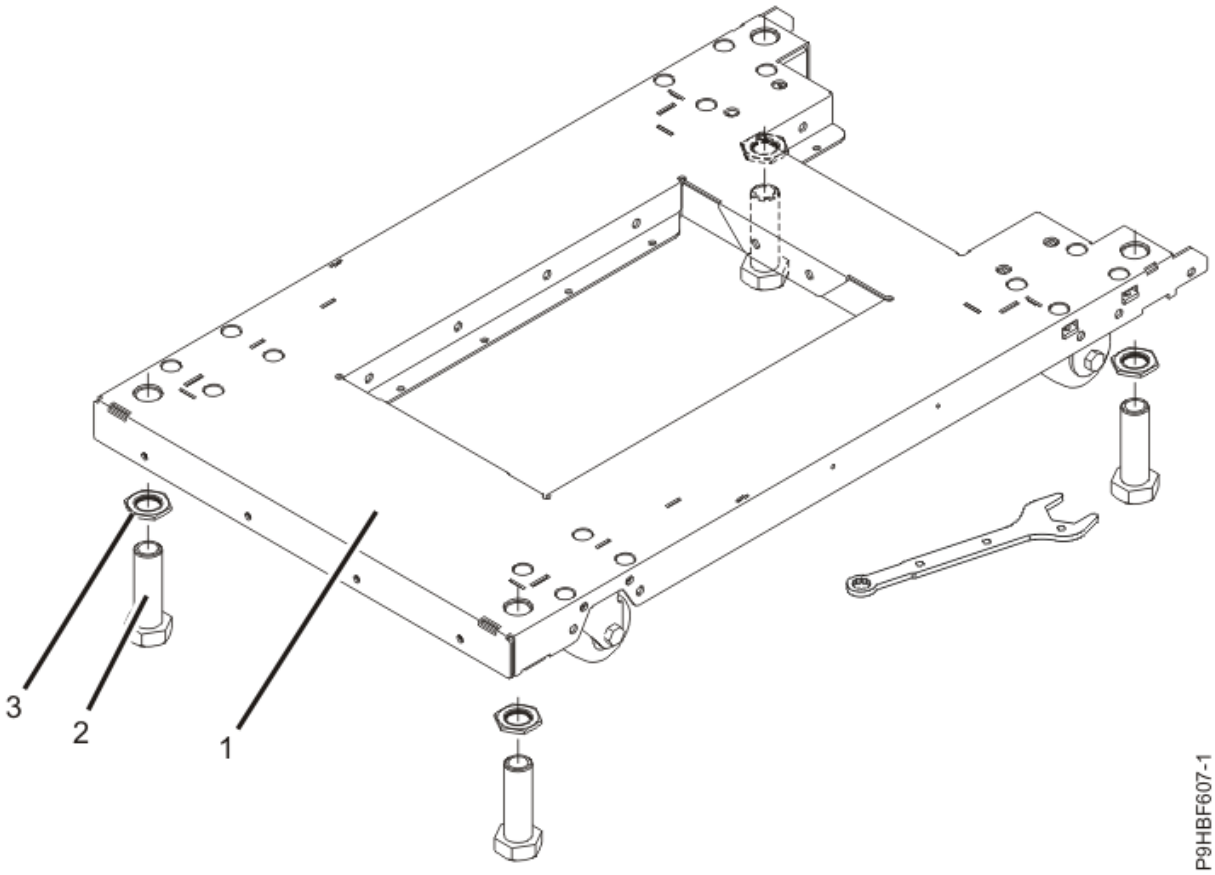


Figure 216. Adjusting the leveling feet

1
Rack front (base)

2
Leveling foot (quantity 4)

3
Jam nut (quantity 4)

36. Torque the four bolts to 54 - 67 newton-meters (Nm) [40 - 50 foot-pounds (ft lb)].
37. After the rack frame is bolted down, install the airflow plate to the front of the rack. To install the airflow plate, complete the following tasks.
    a. Position the airflow plate (**1**) so that it rests on the rack-mounting plate.
    b. Install two M6 x 10 flathead screws (**2**).
    c. Use a torque screwdriver to tighten each screw to 2.5 Nm ± 0.2 Nm [22.1 inch-pounds (in lb) ± 1.8 in lb].

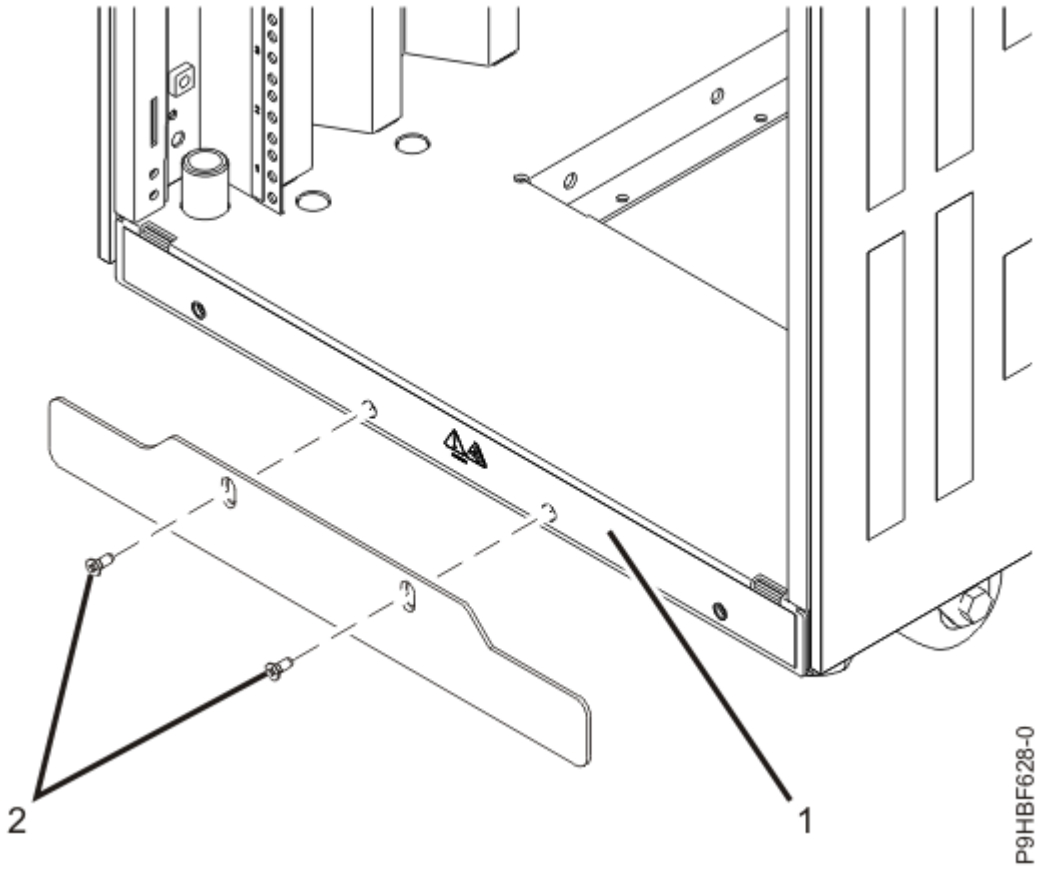


Figure 217. Installing the airflow plate

Attaching the stabilizer brackets (Customer task)

If the rack frame is not bolted to the floor, install the stabilizer bracket.

Procedure

To attach the stabilizer bracket to the bottom of the rack, complete the following steps.

1. Loosen the jam nut on each leveling foot **(3)** on each leveling foot, as shown in Figure 218 on page 289.
2. Rotate each leveling foot **(3)** downward until it contacts the surface on which the rack is placed, as shown in Figure 218 on page 289.
3. Install the two mounting screws.
4. Adjust the leveling feet downward as needed until the rack is level. When the rack is level, tighten the jam nuts against the base.

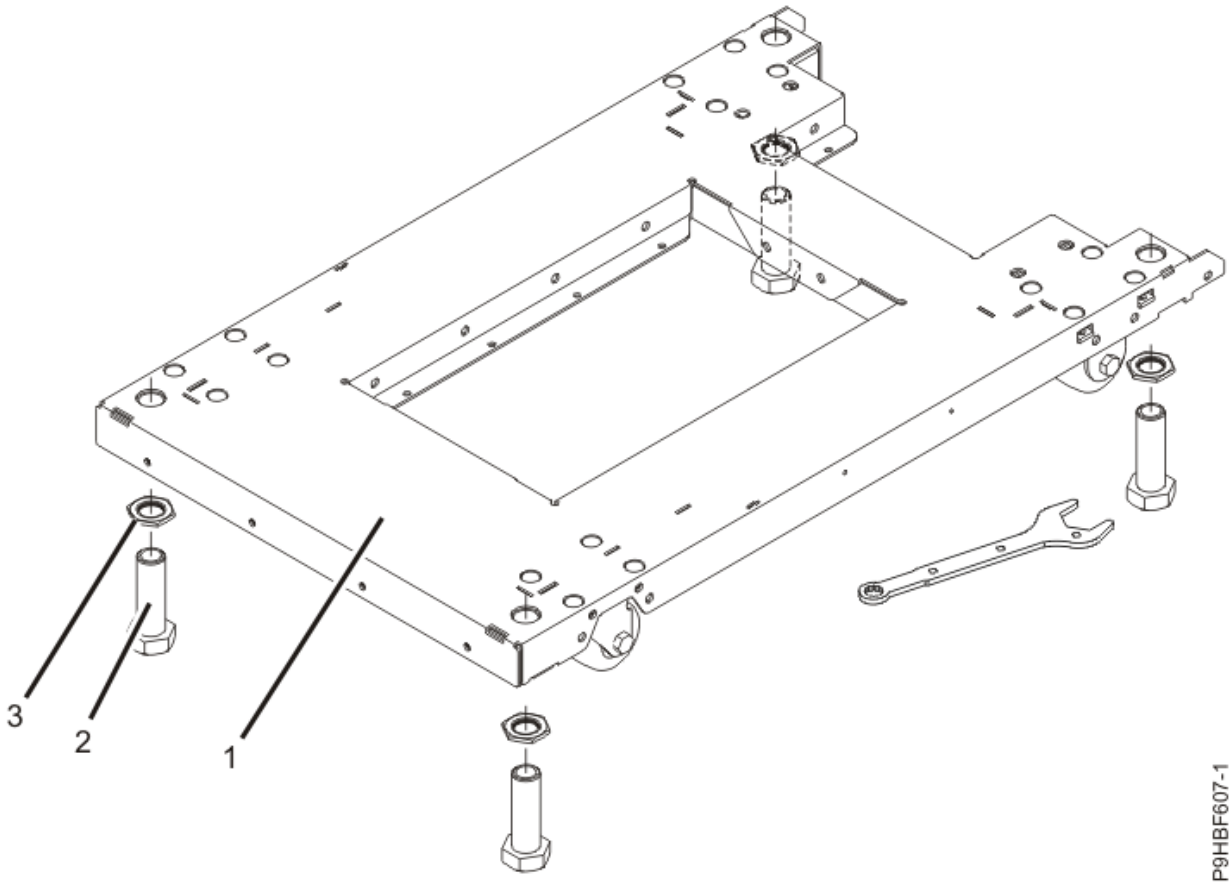


Figure 218. Adjusting the leveling feet

Item	Description
1	Rack front (base)
2	Leveling foot (quantity 4)
3	Jam nut (quantity 4)

5. Align the slots of one of the stabilizer brackets **(3)** with the mounting holes **(2)** at the bottom front of the rack, as shown in Figure 219 on page 290.
6. Install the four mounting screws **(2)** loosely into the holes **(2)** on the stabilizer bracket **(3)**, and ensure that the base of the stabilizer (3) rests firmly on the floor, as shown in Figure 219 on page 290.

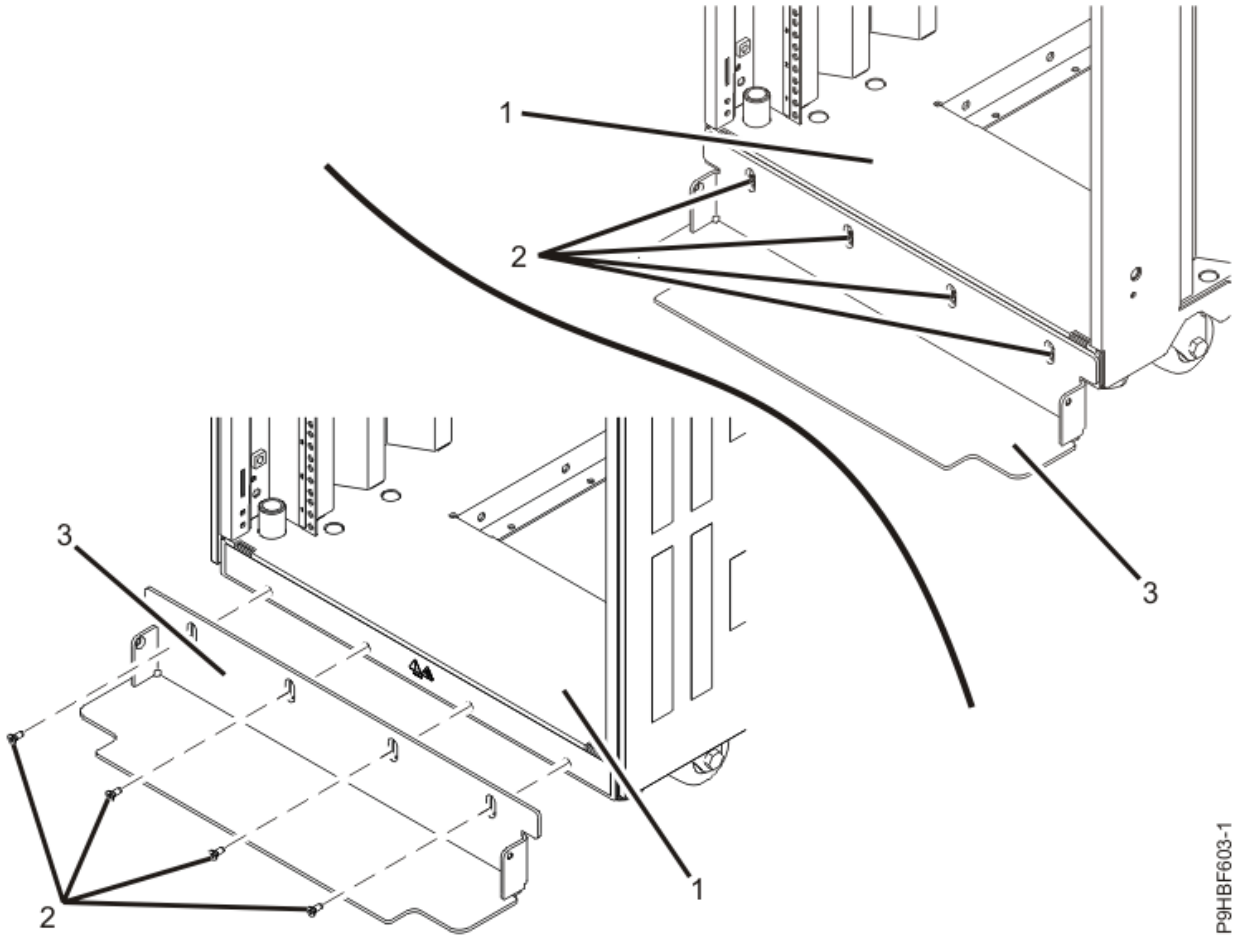


Figure 219. Installing the stabilizer bracket

7. Use a #2 Phillips screwdriver to torque the screws to 2.5 newton meters (Nm) [22.13 inch pounds (in lb) or 1.84 foot pounds (ft lb)].

Intelligent Switched Power Distribution Unit Plus (PDU+)

The Intelligent Switched Power Distribution Unit Plus (PDU+) PDUs are already installed in the FlashSystem 9500R rack solutions. You can monitor the PDU+ PDUs to observe the individual power loads of the devices that are plugged into it.

Installing the PDU+ in the side of a rack

Learn how to install the Intelligent Switched Power Distribution Unit Plus (PDU+) vertically in the side of the rack.

Before you begin

Figure 220 on page 291 shows a generic PDU. The PDU+ has 12 power connectors. Regardless, these steps are the same for both types of PDUs.

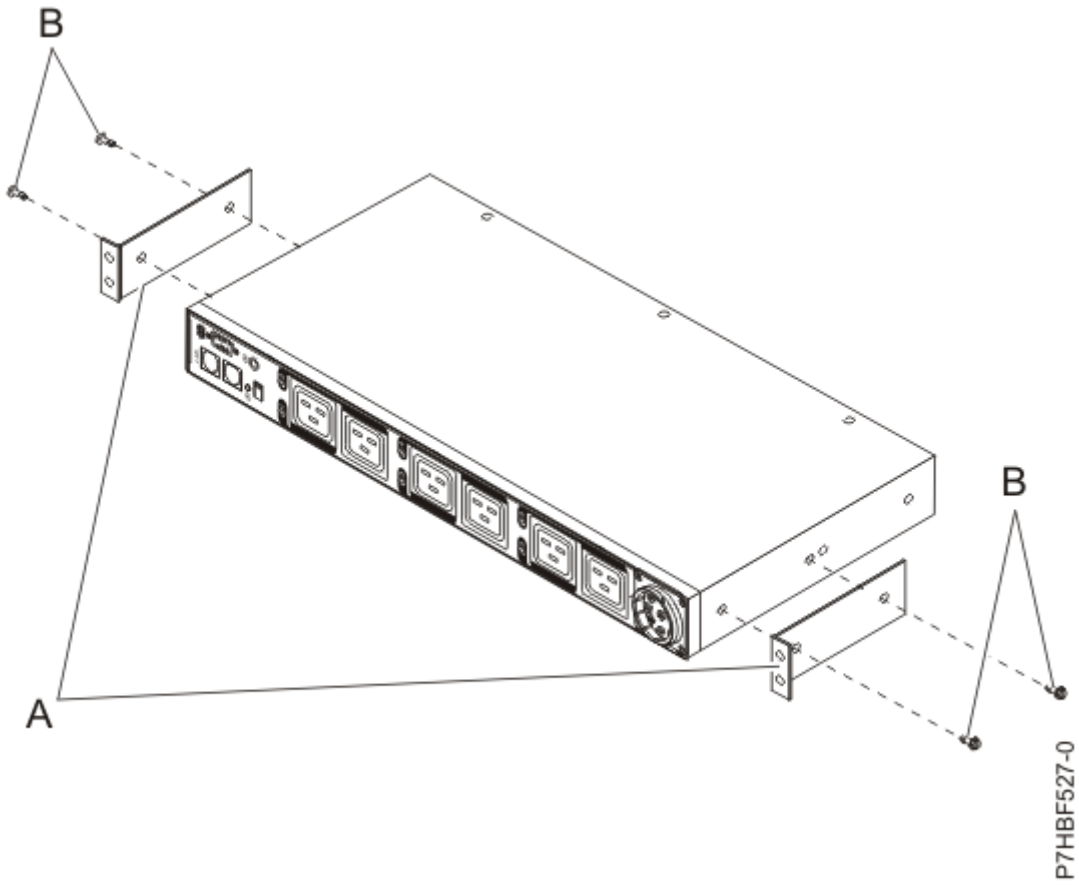


Figure 220. Aligning the vertical-mounting brackets to the front of a PDU

Tip: Removing the rack doors and side panels makes installing or removing the PDU+ easier.

Procedure

To install the PDU+ in a single EIA vertical mounting space in the side of the rack, complete the following steps.

1. Read the “Rack safety notices” on page 274.
2. Align the vertical-mounting brackets **(A)** to the front of the PDU+.
   Make sure that you attach the brackets so that the power outlets face the rear of the rack.

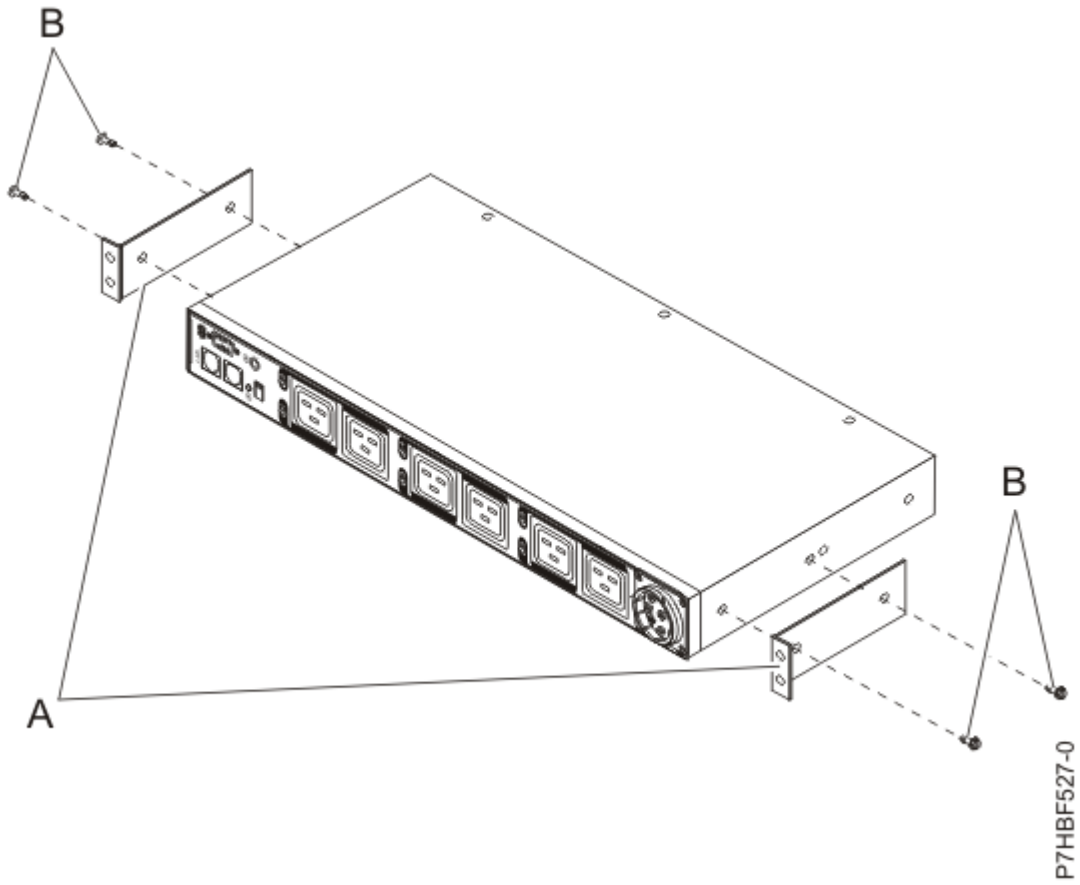


Figure 221. Aligning the vertical-mounting brackets to the front of the PDU+

3. Attach the brackets **(A)** to the PDU+ with two M3x5 screws **(B)** per bracket. Use screws that were provided with the rack mounting kit.
4. Attach nut clips **(A)** to the four locations on the rack mounting flanges where you want to attach the PDU+.

   Use nut clips that were provided with the rack mounting kit. See the following figure.

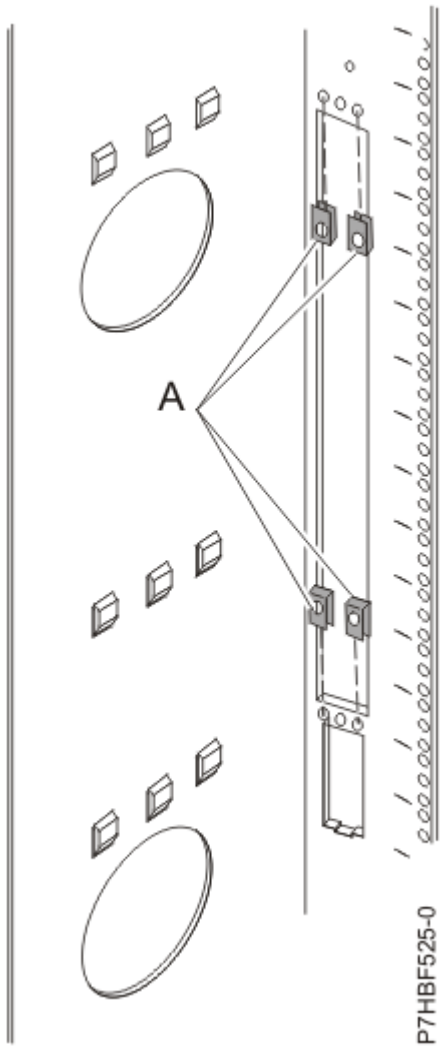


Figure 222. Attaching nut clips to the rack mounting flanges from the rear of the rack

5. Align the PDU+ with the opening in the side of the rack.

   Then, while you hold the PDU+ in place, attach the brackets to the nut clips in the rack mounting flanges with four M5 screws **(A)** as shown in the following figure. Use screws that were provided with the rack mounting kit.

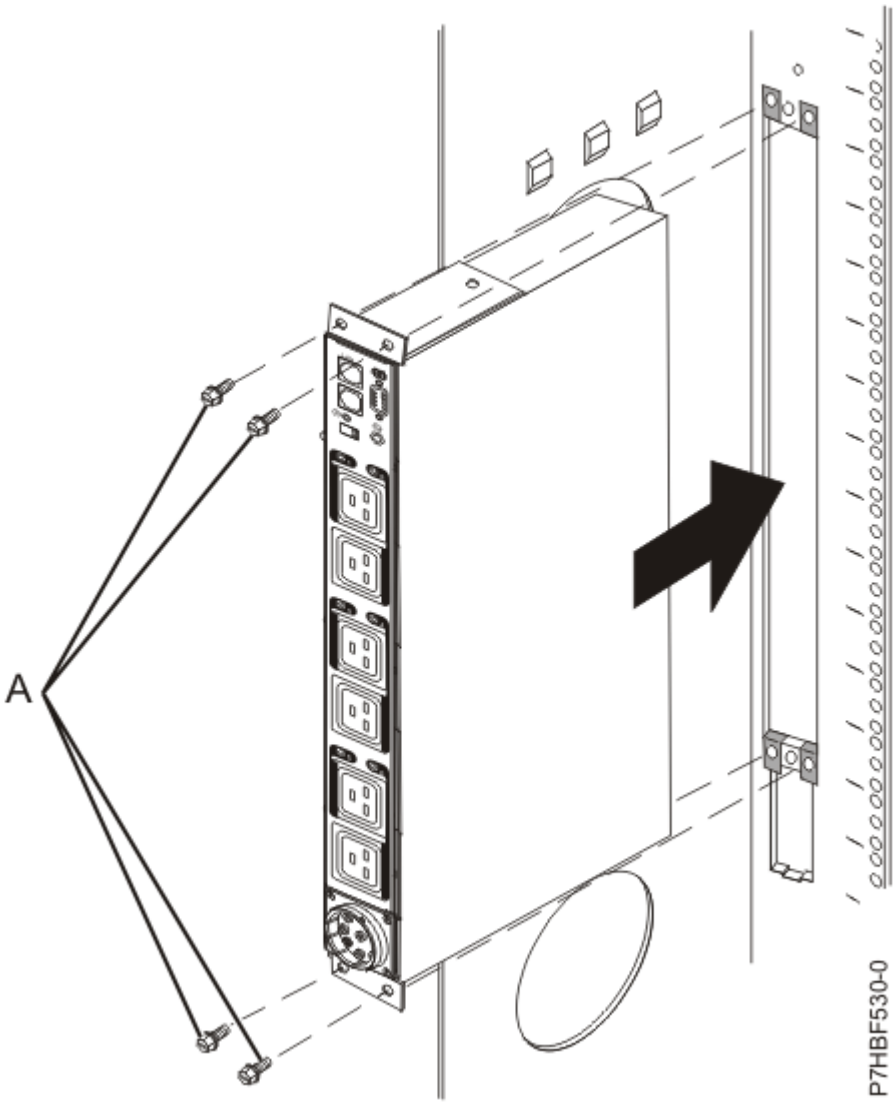


Figure 223. Aligning the PDU+ with the opening in the side of the rack, seen from the rear of the rack

Attention: You must ensure that the main input power is disconnected from the power source before you connect or disconnect the input power cord from the PDU+.

6. If it was included in your order, connect the PDU Access Cord 0.38m to the PDU before you install it into the side of the rack.
7. If the PDU+ was provided with a detached power cord, connect the power cord now.

   Align the connector on the power cord **(A)** that was provided with the PDU+ with the connector on the front of the unit **(A)**, turning as necessary for key alignment. Then, turn the connector twist-lock **(B)** clockwise until it locks into place.

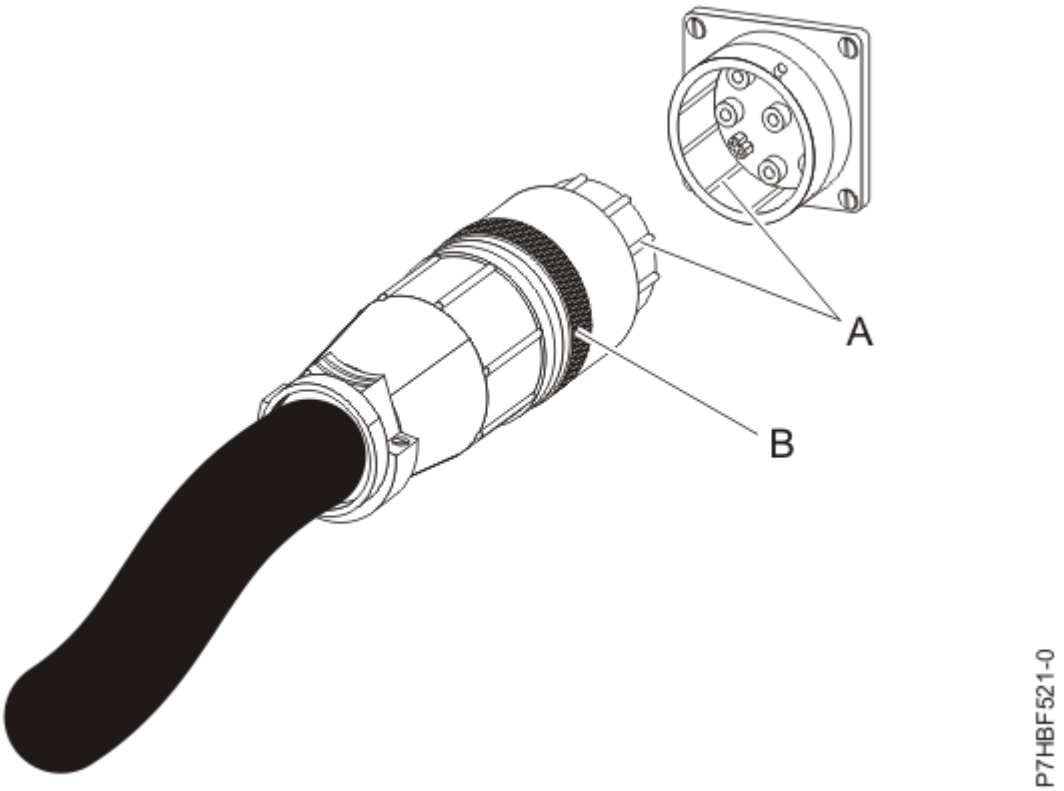


Figure 224. Aligning the connector on the power cord with the PDU+

8. Route the power cord from the PDU+ toward the rack side braces.

   Then, route the power cord along a side brace toward the rear of the rack and secure the power cord with the cable straps that are provided with the PDU+.
9. Route the power cord toward a dedicated power source.

   Use the provided cable straps to secure the power cord along the way. Use the openings in the rack, if the power cord must exit the rack to connect to a power source.

   Attention: To prevent damage to a power device and other connected devices, always connect the power device to an authorized power source for that device.
10. To connect the expansion enclosures and control enclosures and the Fibre Channel switches in the rack to the power outlets on the PDU+, see “Powering on the FlashSystem 9500R rack solution (IBM SSR task)” on page 331.
11. Connect the power cord of the PDU+ to a properly wired and grounded and dedicated power source,
12. Route all of the other power cables neatly, and secure the power cables with cable straps.
13. If you removed the side covers or doors, reinstall them.

What to do next

To remove the PDU+, reverse the procedure.

Cabling the PDU+ to a console (IBM Lab Services or Customer task)

Cable the Intelligent Switched Power Distribution Unit Plus (PDU+) to a console, LAN, and PDU environment sensor.

About this task

To cable the PDU+ to a console, use a DB9-to-RJ-45 cable to connect the serial (COM) connector on a workstation or notebook computer to the RS-232 connector on the PDU. The following illustration shows how to connect a notebook computer to a 1U PDU.

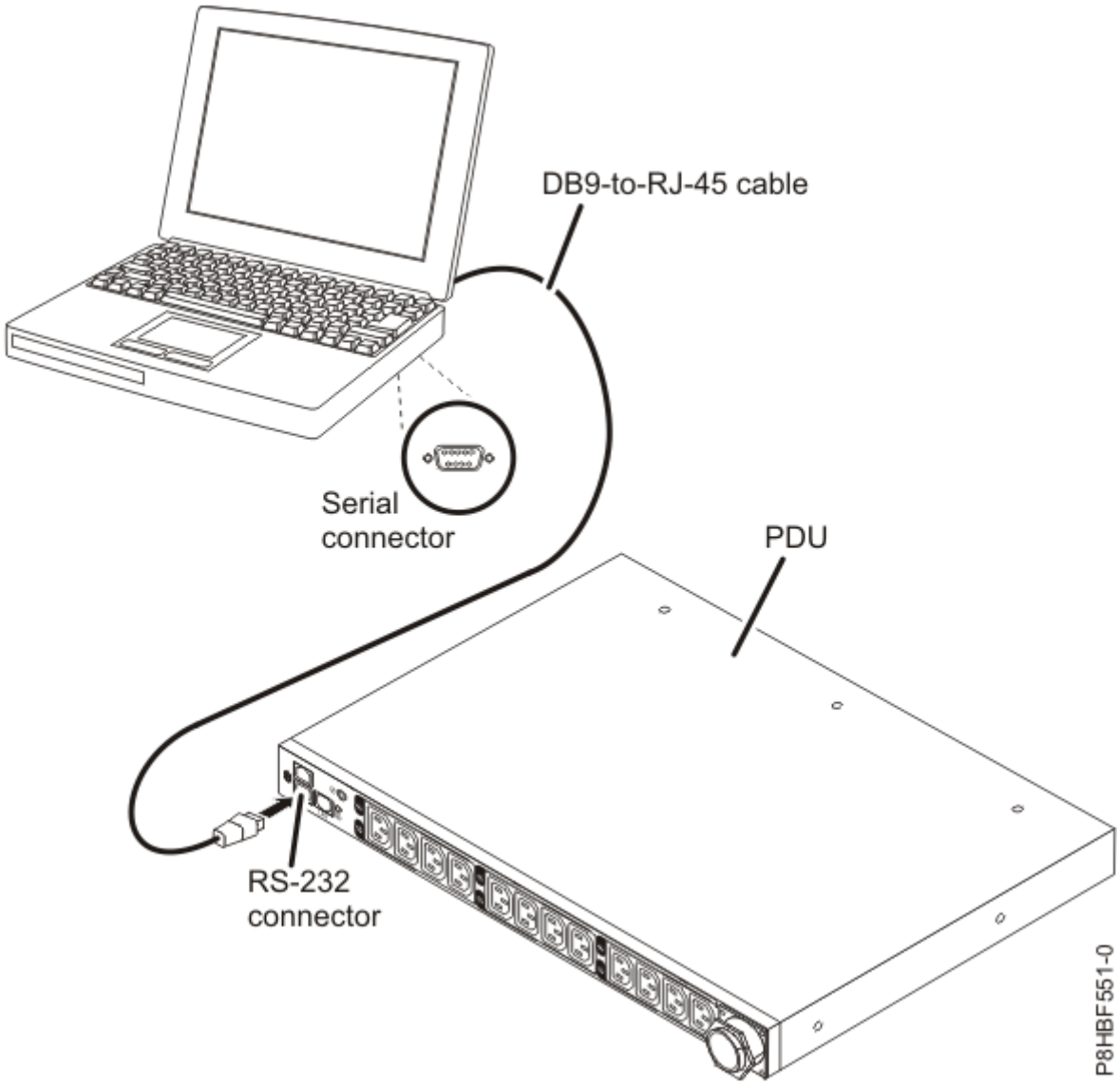


Figure 225. Connecting a notebook computer to a 1U PDU.

If your workstation or notebook computer does not have a DB9 serial connector, you can use a DB9-to-USB converter cable to connect the PDU to a workstation or notebook computer.

Procedure

To connect the PDU to a workstation or notebook computer by using a DB9-to-USB converter cable, complete the following steps.

1. Obtain a DB-9-to-USB converter cable (must be purchased separately).

2. On the workstation or notebook computer that you are connecting to the PDU, install the device drivers for the DB-9-to-USB converter cable, by using the instructions that come with the converter cable.
3. Connect the DB9-to-RJ-45 cable that comes with the PDU to the RJ-45 console connector on the PDU, as shown in the previous illustration.
4. Connect the DB9 connector end of the converter cable to the cable that you connected to the PDU in step 3.
5. Connect the USB connector end of the converter cable to the workstation or notebook computer.

   Communication is now established with the PDU through the COM port that is created by the converter cable.

Connecting the PDU+ to a LAN

You can monitor the PDU power outlets and digital outputs over a network through the web interface, using a LAN connection.

About this task

Connect a router or switch to the Ethernet connector on the PDU, using an Ethernet cable. You can then monitor the PDU from a workstation or notebook computer that is connected to the same network.

The following illustration shows how to connect a router or switch to an PDU+.

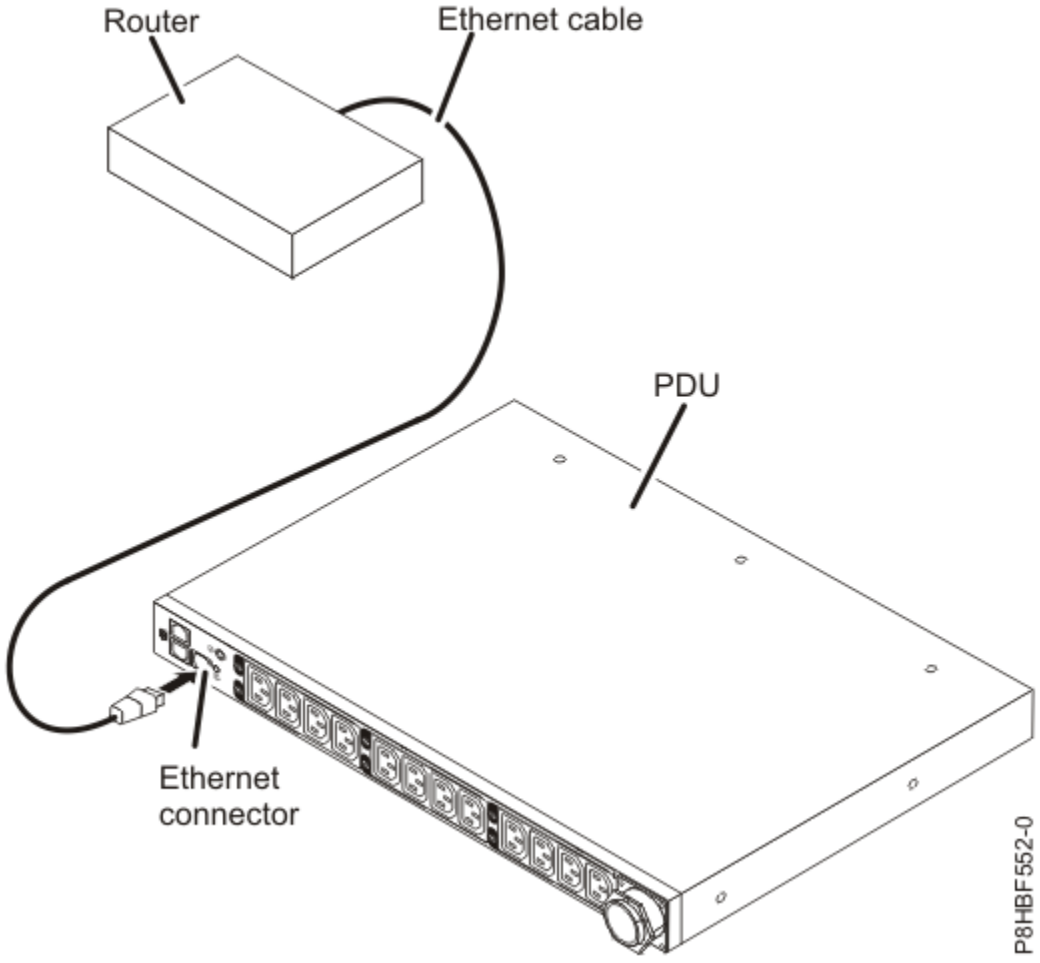


Figure 226. Connecting a router or switch to an PDU+

Connecting PDU+ to a PDU environment sensor
The PDU environment sensor that comes with the PDU has a built-in temperature and humidity sensor and enables you to remotely monitor the temperature and humidity of the environment in which the PDU is operating. Connect the PDU environment sensor to the environment sensor connector on the PDU.

About this task

The following illustration shows how to connect a PDU environment sensor to an PDU+.

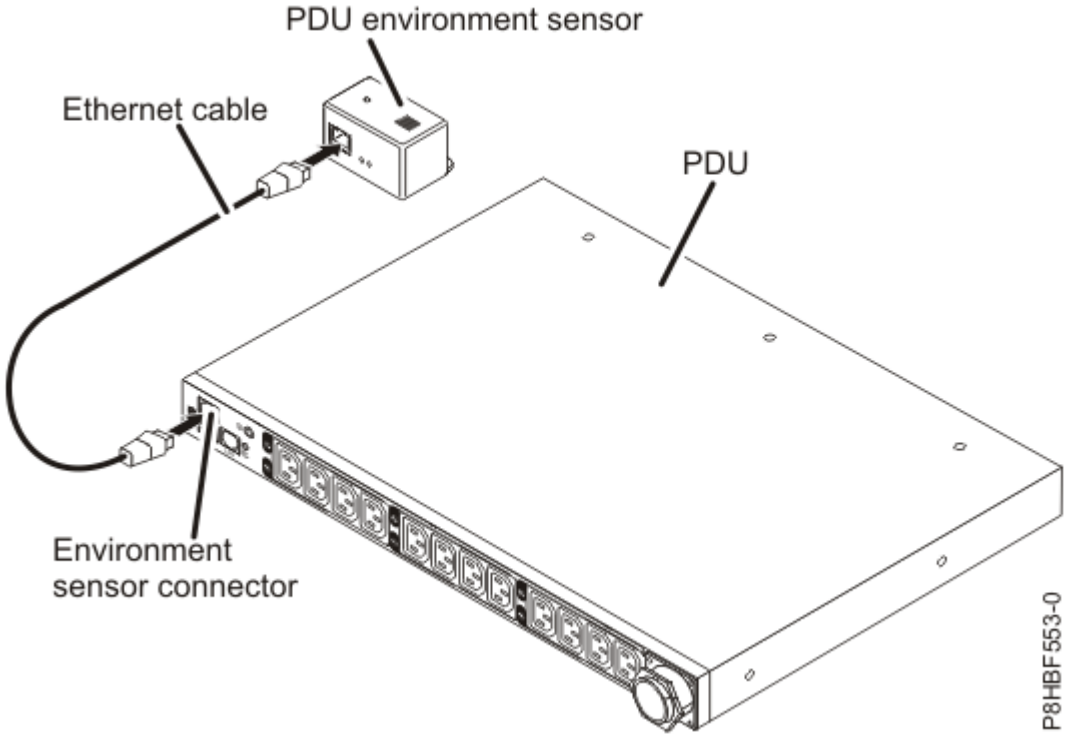


Figure 227. Connecting a router or switch to a PDU environment sensor

Connecting output devices
The PDU power outlets are used to connect devices such as workstations, servers, and printers.

About this task

You can monitor the power status of a connected device either manually or remotely through the RS-232 and Ethernet connectors. Connect a device that you want to monitor to a power outlet on the PDU with the power cord that comes with the device.

Setting up power monitoring using the PDU+ (Customer task)

You can monitor the power status for any device that is connected to the Intelligent Switched Power Distribution Unit Plus (PDU+), either manually or remotely, through the PDU+ web interface.

Note: All of the Configuration Utility configuration options are available through the web interface after the PDU+ is set up on the local network.

Enabling the IBM DPI Configuration Utility (Customer task or IBM Lab Services task)
Learn to use the IBM Distributed power interconnect (DPI) Configuration Utility. IBM DPI configures Intelligent Switched Power Distribution Unit Plus (PDU+) settings, such as the IP address, network parameters, access control table, and trap receivers table.

Connecting the console
You can configure the PDU+ by using a workstation or notebook computer that is connected to the PDU+. Connect the DB9-to-RJ-45 cable that is shipped with the PDU+ to the RJ-45 console connector on the PDU+, and to a RS-232 serial (COM) connector on a workstation or notebook computer.

Configuration Utility menu options

About this task

The following options are shown on the Configuration Utility main menu. To find information about how the customer wants to configure these settings, see "Planning worksheets" on page 61.

IBM DPI Settings
When you select IBM DPI Settings, the IBM DPI Configuration Utility window is displayed with the following options.

Set the IP Address, Gateway Address and MIB System Group
View and change the IP address, date, time, and MIB system information.

Set IBM DPI Control Group
Set the administrator user name, password, and access protocols.

Set Write Access Managers
Set up a list of users who can access and control the PDU+.

Set Trap Receivers
Configure remote network management system (NMS) servers to receive traps.

Set Date and Time
Adjust the date and time information for the PDU+.

Set Superuser Name and Password
Set the user name and password of the administrator who will use a web browser to configure the PDU+.

E-mail Notification
Set up a list of users who will be alerted with event messages if an unusual event is triggered on the PDU+ system.

Set Multi-Users
Configure other user and password logins and the read and write access levels.

Set IBM DPI Information
Configure the PDU+ logging interval, refresh rate, and custom name fields for the load groups.

Settings and Event Log Summary
View all PDU+ configuration settings.

Reset Configuration to Default
Reset all system settings to their factory default values.

Restart HD-PDU
Restart the PDU+.

Setting the IP address
You must set the IP address before you can use the web interface or access the PDU+ in an IP network (LAN/WAN). To find information about how the customer wants to configure the IP address, see "Planning worksheets" on page 61.

Procedure

To set the IP address, complete the following steps.

1. In the Configuration Utility main menu, enter the menu option for **IBM DPI Settings**.
2. Enter the menu option for **Set the IP Address, Gateway Address and MIB System Group**.

Using the web interface
Use the web interface to configure and monitor the Intelligent Switched Power Distribution Unit Plus (PDU+) remotely. The PDU+ provides a graphical user interface that you can view from a web browser. Using a web browser, you can access and monitor the PDU+ power outlets and output devices remotely from a workstation or notebook computer.

Monitoring the power status using the PDU+

You can monitor the power status of any device that is connected to the Intelligent Switched Power Distribution Unit Plus (PDU+), either locally or remotely, by using the PDU+ web interface or the IBM PDU Configuration Utility. You can also use IBM Systems Director Active Energy Manager to monitor power usage of the PDU+ and its load groups. All of the PDU Configuration Utility configuration menu choices are available through the web interface after the PDU+ is set up on the local network. You can use Telnet or any other terminal program to configure the PDU+ after the IP address is set.

Using the IBM PDU Configuration Utility to set up the PDU+
The IBM PDU Configuration Utility is integrated in the Intelligent Switched Power Distribution Unit Plus (PDU+). It is used to configure PDU+ settings, such as the IP address, network parameters, and trap receivers table. Before you can use the web interface to monitor the PDU+ power status, you must use the PDU Configuration Utility to set up the PDU+.

Procedure

To configure the PDU+ by using the IBM PDU Configuration Utility, complete the following steps.

1. Connect a workstation or notebook computer to the PDU+. Connect one end of a DB9-to-RJ-45 cable to the RS-232 connector on the PDU+ and the other end to an RS-232 serial (COM) connector on a workstation or notebook computer.
2. To start HyperTerminal and set up a connection between the workstation or notebook computer and the IBM PDU Configuration Utility on the PDU, click **Start → Programs → Accessories → Communications → HyperTerminal**. The Connection Description window opens. In the **Name** field, type the name for the connection and select an icon for the connection. Click **OK**. The Connect To window opens.
3. From the **Connect using** list, select the COM port that is connected to the PDU+. Click **OK**. The Properties window opens.
4. Select **115200** from the **Bits per second** list and select **None** from the **Flow control** list. Click **OK**.
5. When a blank window opens, press Enter. The IBM PDU Configuration Utility login window opens.
6. Type the default login ID `ADMIN` and the password `1001`. Press Enter. The IBM PDU Configuration Utility main menu window opens.
7. On the main menu window, press 2 to set up the network parameters. The Setup Network Information window opens.
8. To enable or disable DHCP, press either 1 or 2 as applicable. The default is **Disable**. Then, type the IP address, gateway IP address, and subnet mask. Press Enter.
9. Press 1 to view the PDU+ default configuration information. A window similar to the one in the following illustration is displayed.
10. Press any key to return to the main menu. You can continue to use the PDU Configuration Utility, or you can use the web interface to configure and monitor the PDU+ remotely.

Power-on sequencing (some models)
You can use the power-on sequence function to define a sequence for powering on the Intelligent Switched Power Distribution Unit Plus (PDU+) outlets. You can use Telnet and SNMP through the Ethernet port or HyperTerminal through the serial port to configure the power-on sequence function.

About this task

Use the power-on sequence function for the following two scenarios.

- Device dependency There are applications that required the power-on sequence function. For example, a system includes device A, device B, and device C and requires that device A is powered on first, then device B, and then device C. If the devices do not follow the required sequence when powered on, the system will not run correctly.
- Power-on in-rush current In-rush current might be a problem in some applications if you are powering on multiple devices at the same time. In such applications, the power-on sequence function is required to power on devices in user-definable sequences to limit in-rush current.

To use the power-on sequence function, you must set the following parameters by using either a serial or Ethernet interface:

- GlobalDelayTimer (range: from 0 - 3600 seconds; data type: integer). All PDU+ outlets are controlled by this global timer.

  If GlobalDelayTimer is not set (equal to 0), the global delay function for all outlets is not enabled.
- IndividualDelayTimer (range: from 0 - 3600 seconds; data type: integer). Each outlet also has its own individual delay variable (IndividualDelayTimer) that is accessible through either a serial (HyperTerminal) or Ethernet (Telnet and SNMP) interface.

  If IndividualDelayTimer is not set (equal to 0), the individual outlet delay function is not enabled.

If both the GlobalDelayTimer and IndividualDelayTimer parameters are not set, the power-on sequence function is off automatically.

When a PDU+ is powered on for the first time, all the relays are off, and the power-on sequencing is not used. You must turn on the relays by using the web interface or SNMP. You must also set the values for the GlobalDelayTimer and IndividualDelayTimer, if they are used. After that, when the PDU+ is turned on (or power is restored), the outlet power-on sequence and behavior are controlled by the following settings:

- Previous state of the outlets (on or off)
- GlobalDelayTimer value
- IndividualDelayTimer value

The outlets that were off before the PDU+ was turned off (or lost power) will stay off after power is restored.

The outlets that were on before the PDU+ was turned off (or lost power) will be tuned back on in a sequence that is determined by the timers. If the timer values are zero, the only delay is the PDU+ boot-up time, which is 10 seconds. If there are values in the delay timers, the turn on time is the sum of following three values:

- PDU+ boot-up time (10 seconds)
- GlobalDelayTimer value
- IndividualDelayTimer value

The following example shows what you can expect to see if power to the PDU+ is restored after a power outage.

- PDU+ boot-up time = 10 seconds
- GlobalDelayTimer = 5 seconds
- The previous outlet state for the PDU+ is:

Outlet 1 On
Outlet 2 On
Outlet 3 On
Outlet 4 Off
Outlet 5 On
Outlet 6 On
Outlet 7 On
Outlet 8 On
Outlet 9 On
Outlet 10 Off
Outlet 11 On
Outlet 12 Off

- The IndividualDelayTimer for each outlet has the following settings:

Outlet 1 1 Sec
Outlet 2 2 Sec
Outlet 3 3 Sec
Outlet 4 5 Sec
Outlet 5 2 Sec
Outlet 6 2 Sec
Outlet 7 4 Sec
Outlet 8 1 Sec
Outlet 9 2 Sec
Outlet 10 2 Sec
Outlet 11 5 Sec
Outlet 12 3 Sec

The following table shows the PDU+ outlet power-on timing when power is restored after a power outage.

Table 103. Power-on timing

Outlet number	**Outlet power-on timing**	**Comment**
1	16th second	Total Delay time = bootup time + GlobalDelayTimer + IndividualDelayTimer
2	17th second	Total Delay time = bootup time + GlobalDelayTimer + IndividualDelayTimer
3	18th second	Total Delay time = bootup time + GlobalDelayTimer + IndividualDelayTimer
4	Off	Previous state is Off
5	17th second	Total Delay time = bootup time + GlobalDelayTimer + IndividualDelayTimer
6	17th second	Total Delay time = bootup time + GlobalDelayTimer + IndividualDelayTimer
7	19th second	Total Delay time = bootup time + GlobalDelayTimer + IndividualDelayTimer
8	16th second	Total Delay time = bootup time + GlobalDelayTimer + IndividualDelayTimer

Table 103. Power-on timing (continued)		
Outlet number	**Outlet power-on timing**	**Comment**
9	17th second	Total Delay time = bootup time + GlobalDelayTimer + IndividualDelayTimer
10	Off	Previous state is Off
11	20th second	Total Delay time = bootup time + GlobalDelayTimer + IndividualDelayTimer
12	Off	Previous state is Off

The following sections explain how to configure the GlobalDelayTimer and IndividualDelayTimer parameters through the serial port (by using HyperTerminal or similar applications) or through the Ethernet port (by using Telnet and SNMP).

Using SNMP through the Ethernet port
Set the parameters for the power-on sequence function by using an Ethernet port and the SNMP interface.

Procedure

To set the parameters for the power-on sequence function by using an Ethernet port and the SNMP interface, complete the following steps.

1. Open your MIB browser (for example, iReasoning).
2. Set the GlobalDelayTimer parameter with the object identifier (OID) as shown in the following illustration.
3. Set the IndividualDelayTimer parameter with the OID.

Using Telnet through the Ethernet port
Set the parameters for the power-on sequence function by using an Ethernet port and the Telnet interface.

Procedure

To set the parameters for the power-on sequence function by using an Ethernet port and the Telnet interface, complete the following steps.

1. Log in as ADMIN/1001.
2. Type 1 for System Configuration.
3. Type 3 for Outlet Global Delay Timer and PDU Location.
4. Type 15 to define the Outlet Global Delay Timer.
5. Type the value for the New Outlet Global Delay Timer.
6. Type 0 to return to the previous menu.
7. Type 4 for the Outlet Name and Individual Delay Timer.
8. Type the outlet number and enter the outlet name and its IndividualDelayTimer value.

Using HyperTerminal through the serial port
Set the parameters for the power-on sequence function by using a serial port (HyperTerminal interface).

Procedure

To set the parameters for the power-on sequence function by using a serial port (HyperTerminal interface), complete the following steps.

1. Make sure that the serial port configuration is 115200, 8-N-1-None.

2. Log-in as ADMIN/1001.
3. On the IBM PDU Configuration Utility main menu, type 8 to select Set PDU Location and Outlet Information.
4. Type the GlobalDelayTimer value.
5. On the main menu, type the IndividualDelayTimer values for each outlet.

Enabling the web interface to configure the PDU+
Learn how to use the web interface to configure and monitor the Intelligent Switched Power Distribution Unit Plus (PDU+) remotely. The PDU+ provides a graphical user interface that you can view from a web browser. Using a web browser, you can access and monitor the PDU+ power outlets and output devices remotely from a workstation or notebook computer.

Starting the web interface

Procedure

To start the web interface, complete the following steps.

1. Start a web browser from a workstation or notebook computer, and enter the IP address of the PDU+ in the **address** field.

   The **Connect to** window is displayed.

   Note: For more information about setting the IP address of the system, see "Setting the IP address" on page 299.
2. In the **User name** field, type `USERID` (all uppercase letters).
3. In the **Password** field, type `passw0rd` (all lowercase letters with a zero, not O).
4. Click **OK**.

   The main status page is displayed.

Results

The main status page displays a graphical representation of the PDU+ power outlets and input status:

- The left pane displays the menus and submenus for the PDU+. Click a menu to display the menu options, expand the menu items, and modify the menu options as required.
- The graphic displayed in the right pane shows the status of the outlets, input voltage, output voltage, frequency, current and power, watt-hour consumption, and cumulative kilowatt hour power consumption. If you connect an optional environmental monitored probe, the temperature and humidity environment conditions are displayed.

Each menu page provides online help to assist you with configuring the PDU+. Click the **Help** icon at the top of each page to view the help.

Changing basic settings
Use the System menu to configure the PDU+ system parameters such as the superuser name, password, IP address, date, and time.

Changing the superuser name and password
You can set the user name and password of the administrator who will use a web browser to configure the PDU+ on the Configuration Utility page.

Procedure

To change the superuser name and password, complete the following steps.

1. From the main status page, in the left navigation pane, click **System**.
2. Click **Configuration** to view and modify the system configuration and superuser user name and password.

Identifying the PDU+ and Web/SNMP card
You can view the PDU+ and Web/SNMP card information on the Identification of Power Management page.

Procedure

To view the power management information of the PDU+ and Web/SNMP card, complete the following steps.

1. From the main status page, in the left navigation pane, click **System**.
2. Click **Identification** to view the PDU+ and Web/SNMP card information.

Adding users
You can add users who can access and control the PDU+ on the Multi-User Configuration page.

Procedure

To create a list of users who can access and control the PDU+, complete the following steps.

1. From the main status page, in the left navigation pane, click **System**.
2. Click **Multi-User** to add users who can only view the PDU+ status or users who can change the PDU+ settings.

Changing the date and time
You can change the date and time of the PDU+ on the Date and Time page.

About this task

Important: Changing the PDU+ date and time affects other system settings such as e-mail, traps, and logs.

Procedure

To change the date and time, complete the following steps.

1. From the main status page, in the left navigation pane, click **System**.
2. Click **Date and Time** to view and modify the system date and time.

   You can set the date and time manually, synchronize it with the computer time, or synchronize it with an NTP server.

Changing event alerts
You can change event alerts on the SNMP Trap Receivers page.

Procedure

To configure the PDU+ to send e-mail or SNMP trap alerts to specified users when specific events occur, complete the following steps.

1. From the main status page, in the left navigation pane, click **System**.
2. Click **Trap Receivers** to create a list of users or workstations who will be alerted with an SNMP trap message.

   You can specify the IP addresses of up to eight trap receivers, the community information, type of trap, severity of trap, and description of the events that cause the traps.
3. Click **Email Notification** under **System** to create a list of up to four users who will be alerted with an e-mail.

   Use this menu to specify the mail server, user account, DNS, and other information necessary to set up a mail server for sending mail alerts. Use the Email Receivers Table to add the e-mail addresses.

Changing the network information
Use the Network menu to change the network information for the PDU+, for example, the IP address.

Changing the network configuration
You can view or change the network configuration on the Network Configuration page.

Procedure

To view or change the network configuration of the PDU+, complete the following steps.

1. From the main status page, in the left navigation pane, click **Network**.
2. Click **Configuration** to set the PDU+ IP address, gateway address, subnet mask, and Domain Name System (DNS) address.
3. Click **Control** to configure TCP/IP settings.
4. Click **Access Control** to set access control to prevent unauthorized users from accessing the PDU+.

History and event log summaries
The Logs menu provides a detailed description of all events and a record of the PDU+ status. System administrators can analyze problems with network equipment.

Viewing the history log
You can view the complete history of the PDU+ inputs and outputs on the History Log page.

Procedure

To view the history of the PDU+, complete the following steps.

1. From the main status page, in the left navigation pane, click **Logs**.
2. Click **History**.

   Each event log file shows the time, date, and description of all the events occurring on the PDU+.

Viewing the event log
You can view the complete record of the PDU+ events on the Event Log page.

Procedure

To view the complete record of the PDU+ events, complete the following steps.

1. From the main status page, in the left navigation pane, click **Logs**.
2. Click **Events**.

   Each log file shows a record of the input power and output power of each outlet.

Starting the web interface
You can start the web interface for monitoring the Intelligent Switched Power Distribution Unit Plus (PDU+).

Procedure

To start the web interface, complete the following steps.

1. Start a web browser from a workstation or notebook computer and enter the IP address of the PDU+ in the address field. The Login window opens.
2. In the **User Name** field, type `ADMIN` (all uppercase letters). In the Password field, type `1001`.
3. Click Login. The main status page opens.

   The main status page shows the PDU+ power outlets and input status per load segment.

   - The left pane shows the menus and submenus for the PDU+. Click a menu to display the menu choices, expand the menu items, and modify the menu choices as required.

- The information in the right pane shows the status of the voltage, real power, amperes, apparent power, power factor, and energy.

Each menu page provides online help to assist you with configuring the PDU+. Click the question mark (?) icon at the top of each page to view the help.

Power management relay setting
You can use the power management relay setting to turn each power outlet on or off by using the software.

On the Setting of Relay page, you can change the relay setting. For the load segment and relay of the power outlet for which you want to turn on or off, click Set to turn off the outlet or click Set again to turn on the outlet.

Environment status and configuration
If a PDU+ environment sensor is connected to the Intelligent Switched Power Distribution Unit Plus (PDU+), you can view the temperature and humidity information.

Viewing the status
On the Status of Environment Sensor page, you can view the temperature and humidity status from the PDU+ environment sensor.

Changing the environment configuration settings
On the Configuration of Environment Sensor page, you can configure the temperature and humidity threshold values for the PDU+ environment sensor that is connected to the PDU+.

Modifying the basic settings
Use the System menu to configure the PDU+ system parameters such as the system name, password, IP address, date, and time. Some of these settings are described in the following sections.

Changing the system information
On the Configuration of IBM PDU+ page, you can change the system name and location, SNMP community, and history log interval, and you can restart the PDU+.

Displaying SNMPv3 information
On the IBM SNMPv3 USM Setup page, you can set up the configuration for user profiles of SNMPv3 USM related parameters. You can set up the user, authentication method, and privacy method.

Identifying the PDU
On the Identification of Power Management page, you can view the PDU+ information such as the part number, serial number, and MAC address.

Note: You cannot modify the information on the Identification of Power Management page.

Changing the date and time
On the Date and Time page, you can change the date and time of the PDU+. You can set the date and time manually or synchronize it with the computer time.

Note: Changing the PDU+ date and time affects other PDU+ settings such as e-mail, traps, and logs.

Changing event alerts
If an event occurs within the PDU+ that triggers a trap, the trap information can be sent to a monitoring application through SNMP. On the SNMP Trap Receivers page, you can specify the IP address of a server on which a monitoring application is running.

Upgrading firmware
You can upgrade the PDU+ firmware on the Upgrade Firmware page. To update the firmware, type the TFTP server IP address and the firmware image file name and click Upgrade.

Import configuration
You can import the configuration settings for the PDU+ on the Import Configuration page. The import function updates the EEPROM of the PDU+.

Export configuration

On the Export Configuration page, you can export the configuration settings of the PDU+ to a file. Then, you can import the exported file to other like PDUs in the network to provide consistent and similar configuration settings.

Changing the network configuration

You can view or change the network configuration of the PDU+ on the Network Configuration page. You can set the PDU+ IP address, gateway address, subnet mask, TFTP server address, mail server address, and SMTP port number. You can also set up the e-mail receivers table to list two users who are alerted with an e-mail.

Event and history log summaries

The Logs menu provides a detailed description of all events and a record of the PDU+ status. System administrators can use this page to analyze problems with network equipment.

Viewing the event log

On the Event Log page, you can view the complete record of the PDU+ events. Each event log file shows the date, time, and description of each event that has occurred on the PDU+. The index shows the order in which the events are logged.

Viewing the history log

On the History Log page, you can access the complete history of the PDU+ inputs, outputs, and PDU+ environment sensor. On the page, you can clear the history log or export the history log to a comma-separated values (CSV) file.

Connecting the power distribution system

You can use a Intelligent Switched Power Distribution Unit Plus (PDU+) to monitor the individual power loads of the devices that are plugged into it.

About this task

To connect a PDU+, see “Connecting the power distribution system” on page 308.

Changing the side on which your rear door opens (Customer task)

You might want to change the way that the door opens on the rear of the rack.

Procedure

To change the way that the door opens on the rear of the rack, complete the following steps.

1. If the door is already installed, remove it from the rack.
2. Determine whether you want the door to open to the right or left.

   If you want to change the way that the door opens, move the rack hinges **(A)** to the other side of the rack. If you move the rack hinges, remove the latch bracket **(B)** and install it on the other side of the rack.

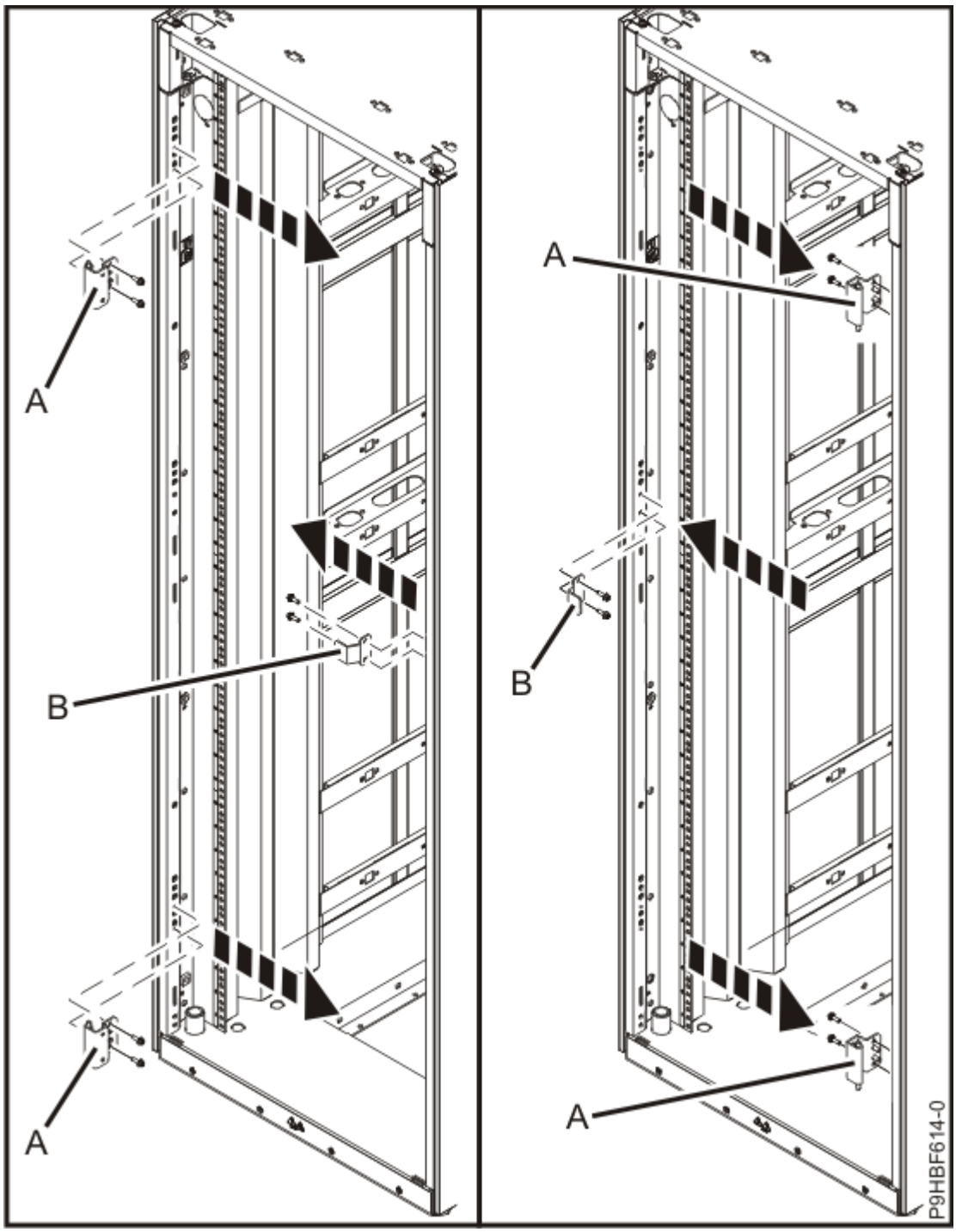


Figure 228. Moving the rack hinges

3. On the rack door, remove the two screws **(A)** that keep the door hinge bracket in place. Move the door hinge bracket **(B)** down on both the top and bottom of the door.
4. Install the door hinge bracket by tightening the screws **(A)**.

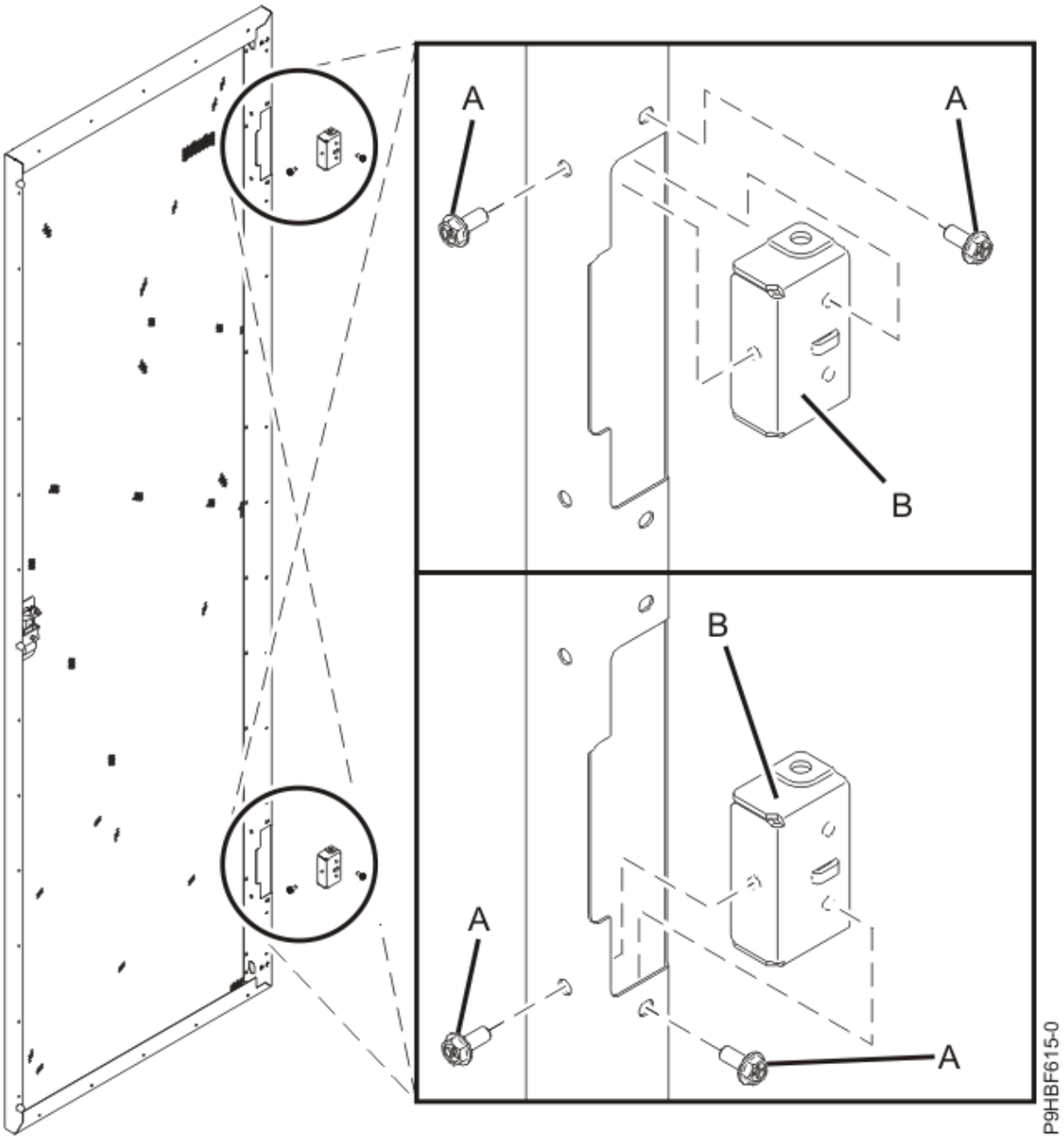


Figure 229. Installing the door hinges

5. Loosen the bolt that secures the latch to the door **(A)** and release the latch retention bracket **(B)**. Rotate the latch 180 degrees **(C)**. Tighten the bolt and latch retention bracket.

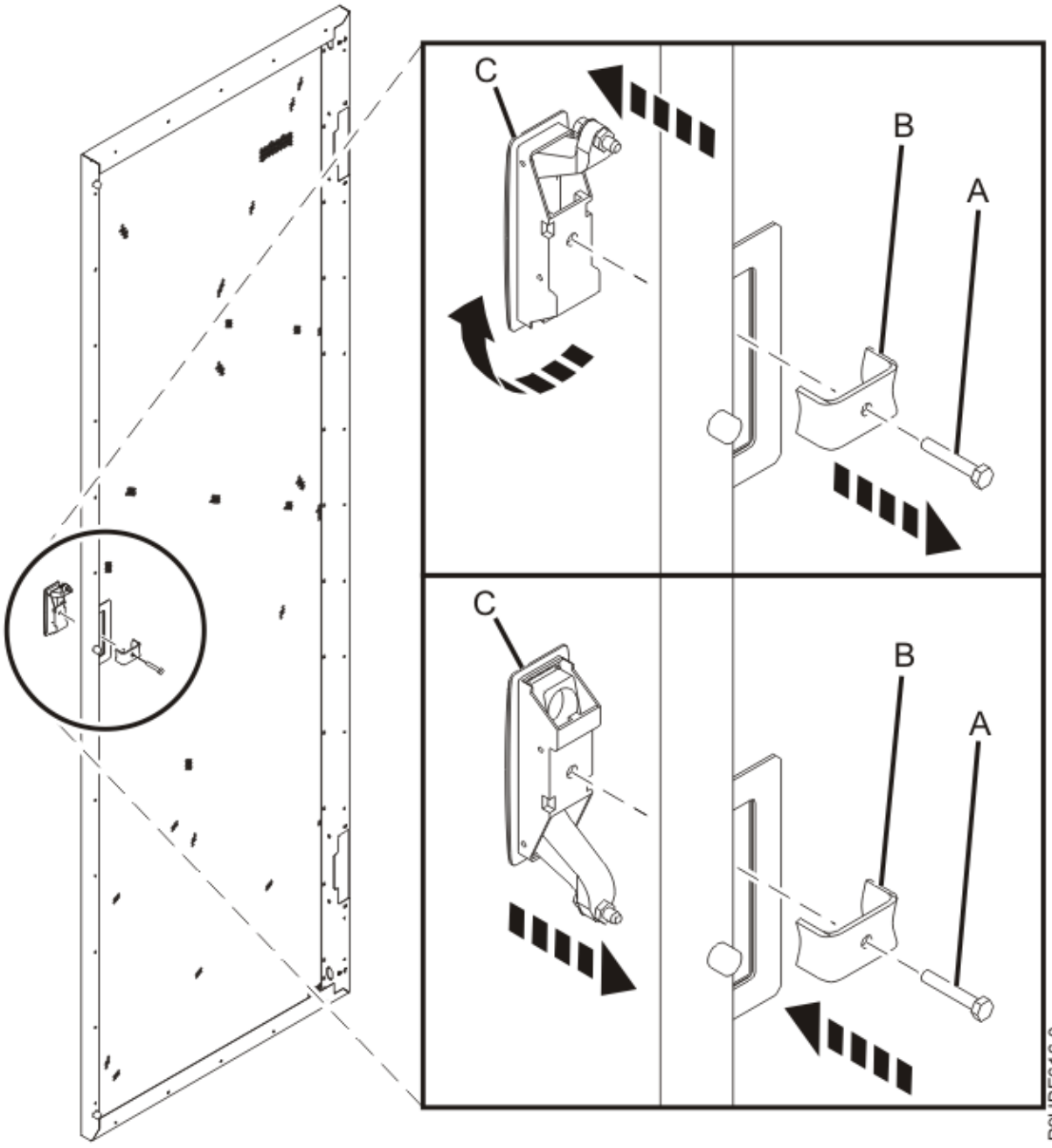


Figure 230. Reorienting the door latch

6. Install the door back onto the hinge.
7. Adjust the latch such that the door latches securely.

Installing the rack security kit (Customer task)

You might need to install the rack security kit.

Procedure

To install a rack security kit that consists of the security lock, complete the following steps.

1. Read the “Rack safety notices” on page 274.
2. Verify the inventory in the rack security kit.

   Ensure that you have the following parts.

   - Two lock hardware kits. Each kit contains the following parts.

- Rack lock
- Bracket
- Screw
- Two keys

- Two security slide bars
- Two locked or unlocked stickers

3. Remove the existing door latch.

   To remove the existing door latch, perform the following tasks.

   a. Open the front rack door.
   b. On the inside of the door, remove the screw that secures the latch to the rack door.
   c. Remove the latch bracket.
   d. From the outside of the door, remove the door latch.

4. If the door latch has the ruggedized latch, continue with the next step. If the standard latch is not yet installed, see step “6” on page 314.
5. Assemble the ruggedized latch.

   To assemble the ruggedized latch, perform the following tasks.

   a. Remove the end cap **(A)** from the new latch and discard.

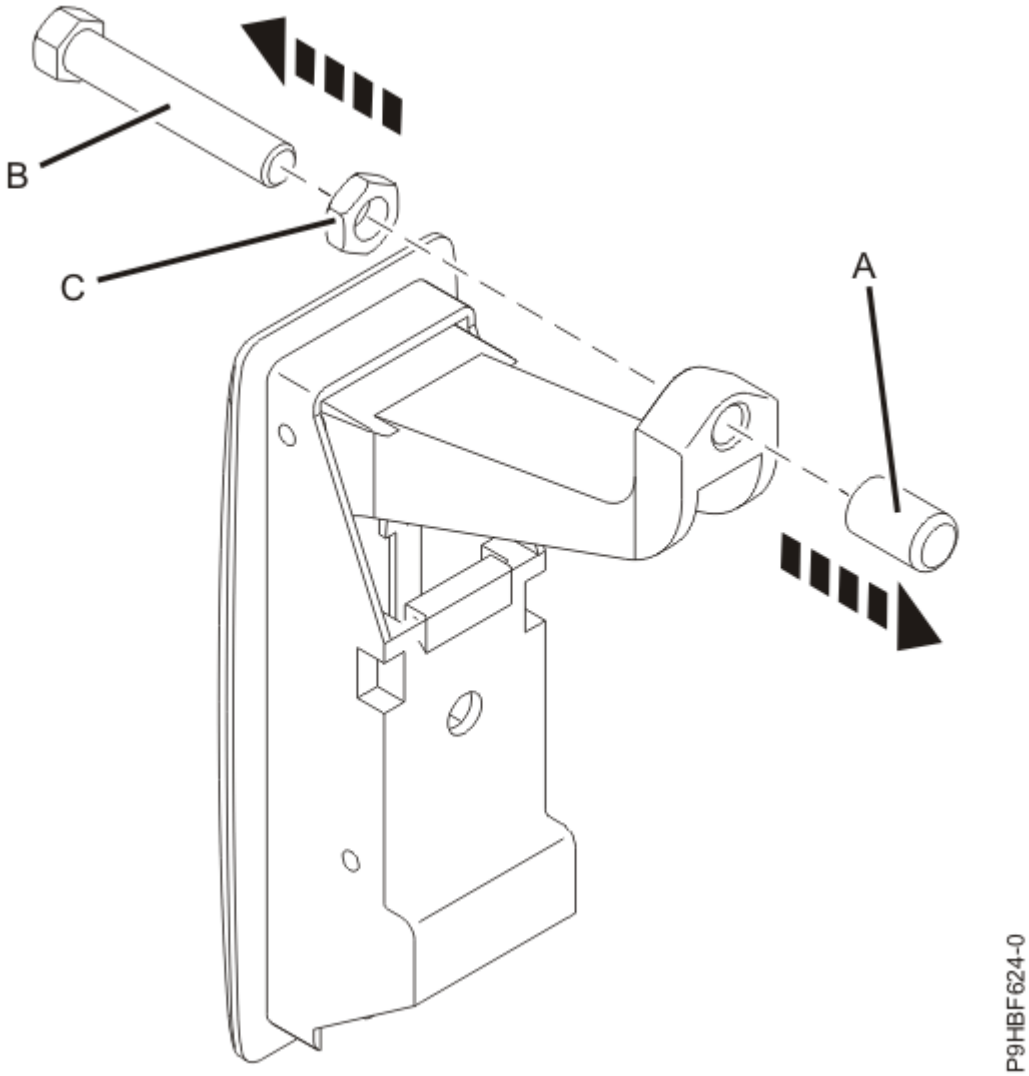


Figure 231. Removing the ruggedized latch components

b. Loosen the hex nut **(C)**.

c. Remove the screw **(B)** from the new latch.

d. Remove the nut **(C)** from the screw.

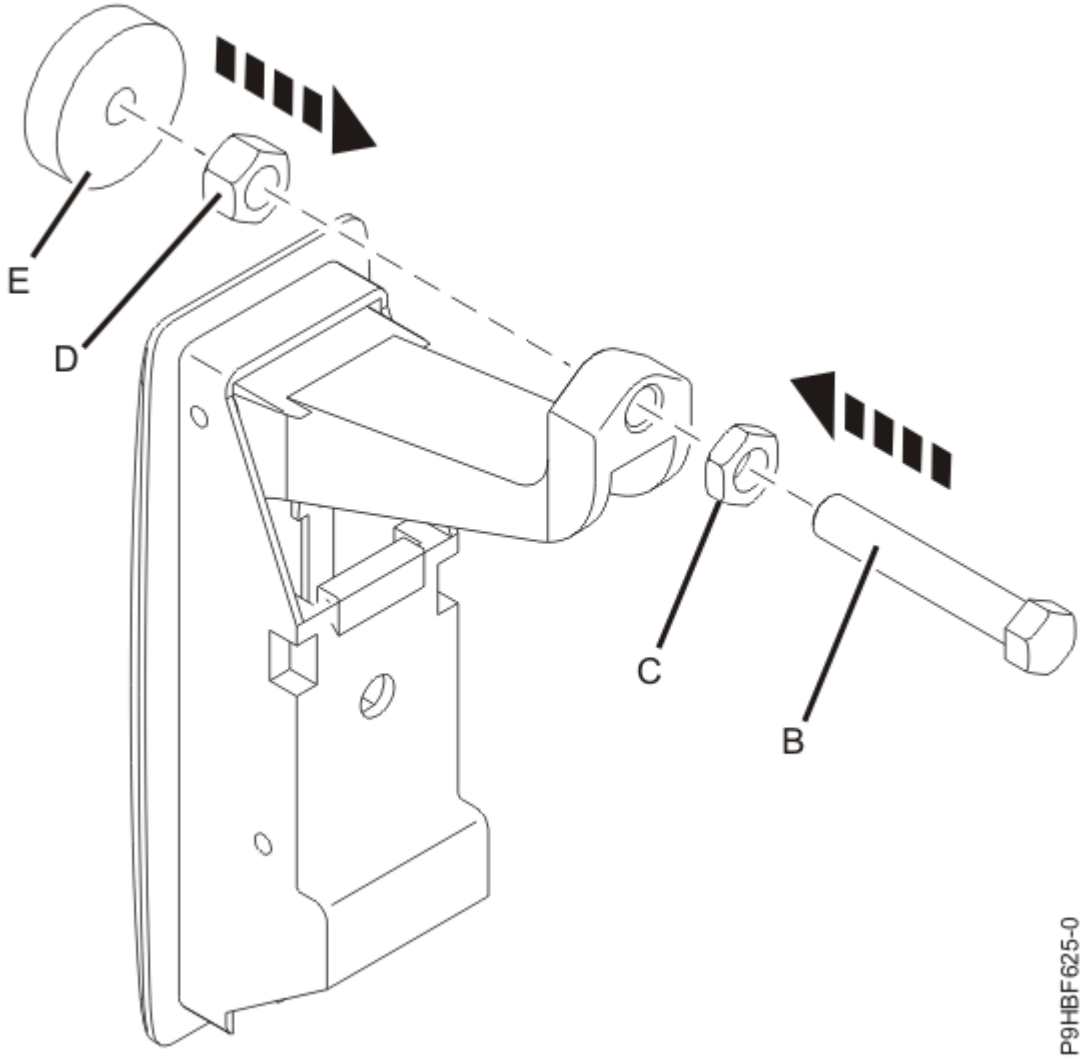


Figure 232. Assembling the ruggedized latch

e. Insert the screw **(B)** through the nut **(C)** and into the new latch, in the reverse orientation.
f. Screw the hex nut **(D)** onto the screw **(B)**.
g. Insert the screw through the jam nut **(E)**. The jam nut must be flush with the end of the screw.
h. Tighten the hex nut **(D)** against the jam nut **(E)**.

6. Install the locking latch.
   a. Insert the keyed rack lock into the latch slot on the front of the door.
   b. Secure the lock by attaching the lock bracket with the screw on the inside of the door.
7. Repeat steps "3" on page 312 and "6" on page 314 to install the second lock on the rear rack door.
8. Adjust the screw **(B)** to secure the door. The door rubber bumpers must be snug against the frame when the door is latched.
9. Tighten the hex nut **(C)** against the latch to prevent the screw from loosening.

Earth (ground) bonding the rack (Customer task)

Electrical bonding is the practice of intentionally electrically connecting all exposed metallic non-current-carrying items in a room or building as protection from electric shock. The following topics provide

instructions for earth (ground) bonding the rack side covers and the front and rear doors to the rack frame.

Rack frame connection points
Two connection points are available on the rack frame.

About this task

These connection points are identified by the international earth (ground) symbol.

The following figure shows the ground points on the rack frame.

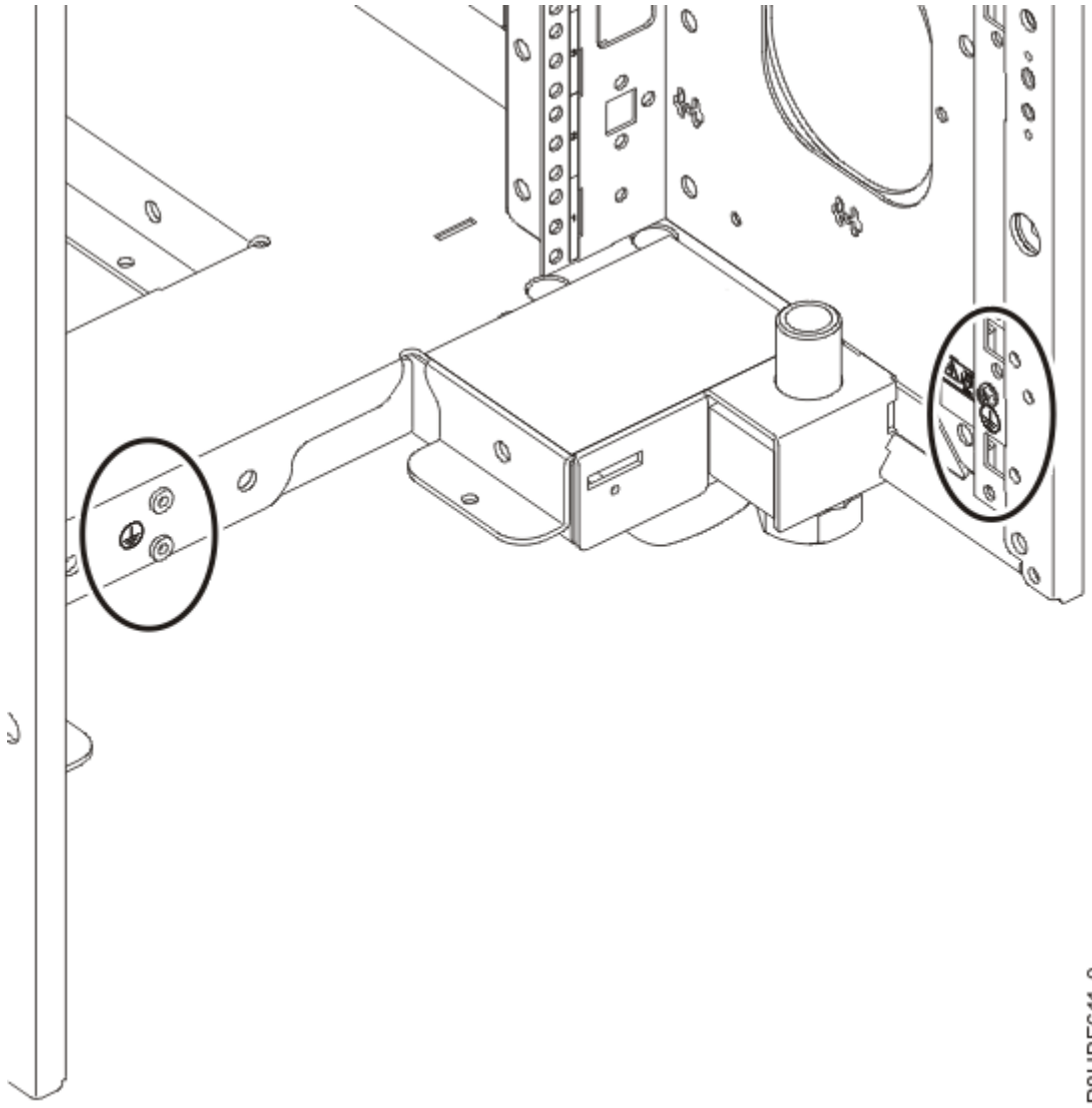


Figure 233. Ground points on the rack frame

Earth (ground) bonding the side covers to the rack frame
The rack side covers shipped from IBM are already grounded. If you remove and replace the side covers, ground the covers again by installing the bolts.

Door ground connection points
The earth (ground) connection points on the front and rear doors are located in each of the hinge side corners.

About this task

The connection points are identified by the international earth (ground) symbol.

The following figure shows a ground connection point on the door.

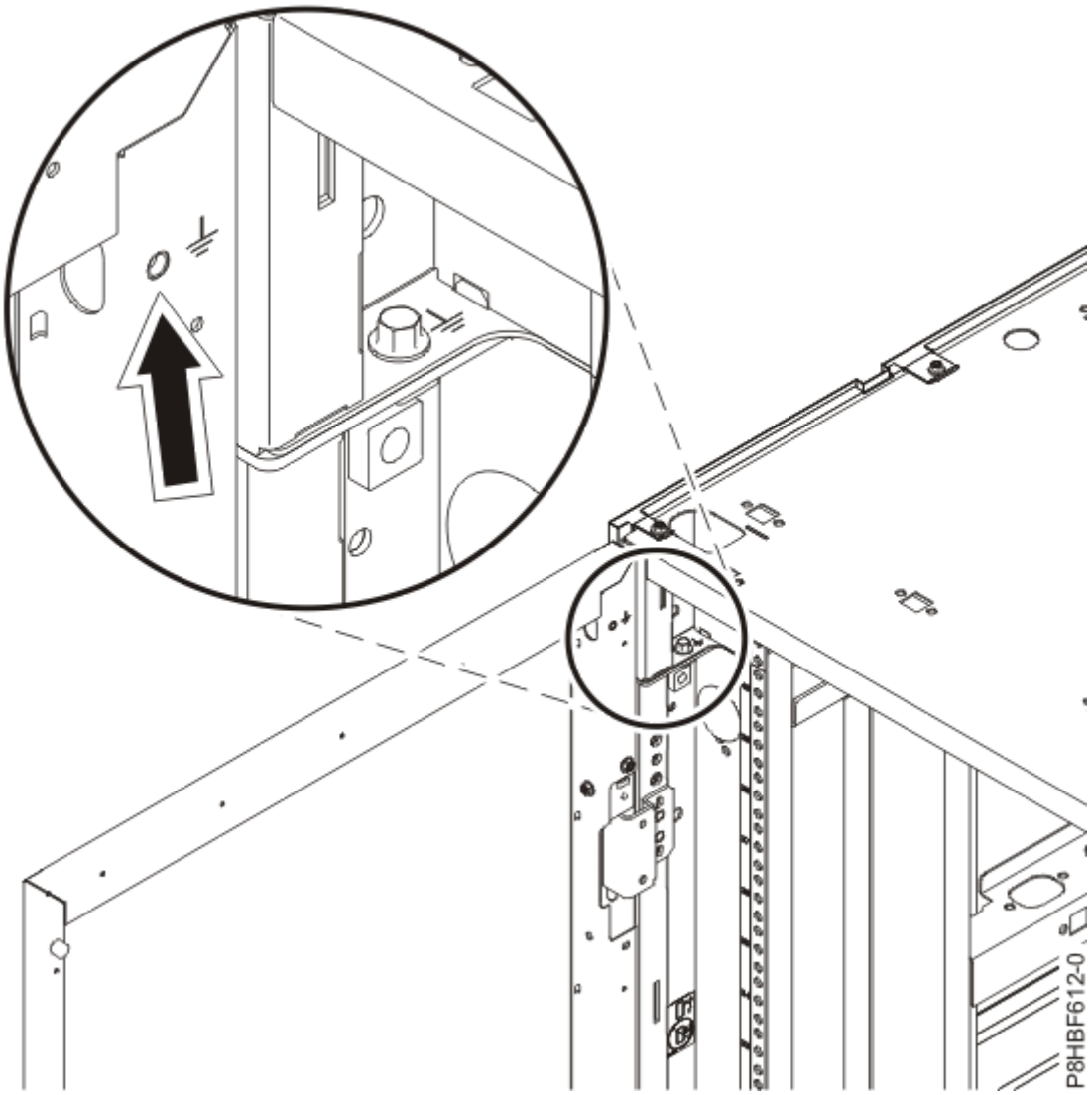


Figure 234. Grounding connection point on the door

Earth bonding the front and rear doors to the rack frame
You might need to earth (ground) bond the front and rear doors to the frame.

About this task

Before you begin, ensure that you have the following items.

- 8 AWG copper wire with either solid green or green-yellow insulation
- Wire with approximately 0.5 inches (1.25 cm) of insulation that is stripped from each end of the wire.

- A ring-type connector that is secured to each end of the wire, according to the instructions that come with the connectors.
- M5 bolt and external star washers
- M6 external star washers

Note: You must use a 6-point (pt) socket with an extension bar to remove the bolts from the top cover. Other tools might cause the bolt heads to become rounded and difficult to remove.

Procedure

To earth (ground) bond the rack front and rear doors to the rack frame, complete the following steps.

1. On the rack door, locate the earth (ground) connection point.

   The following figure shows a ground connection point on the door.

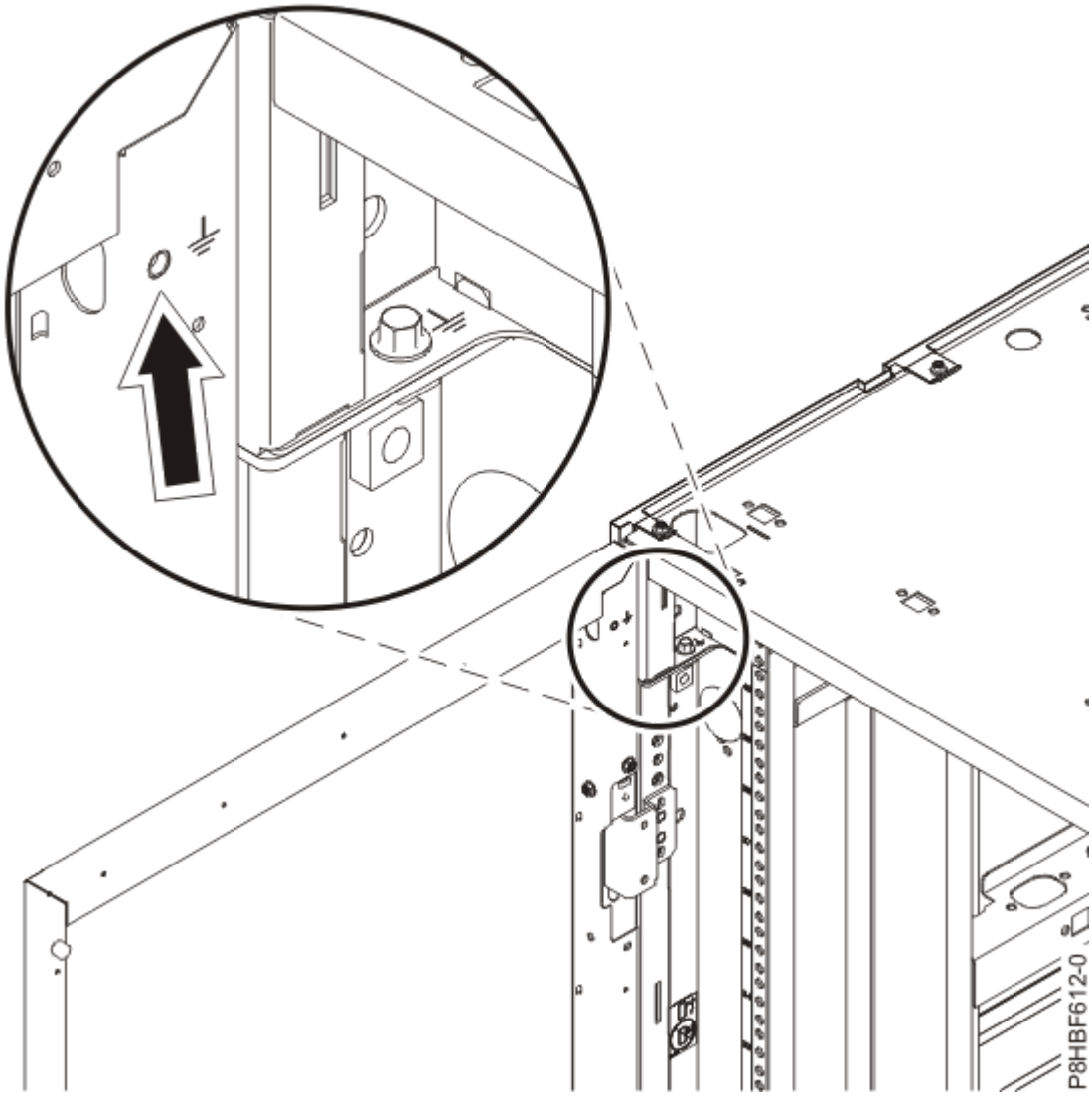


Figure 235. Ground point on the door

2. Using an 8 mm 6-point socket, remove an M6 bolt on the rack. Use the connection point screw that is closest to the door hinge.

   Note: The ground points are at each corner of the rack. The ground point for the acoustic door is near the upper hinge side.

3. Place one ring terminal and then one external star washer on the bolt.

The following figure shows the order in which the screw, ring terminal, and external star washer are installed.

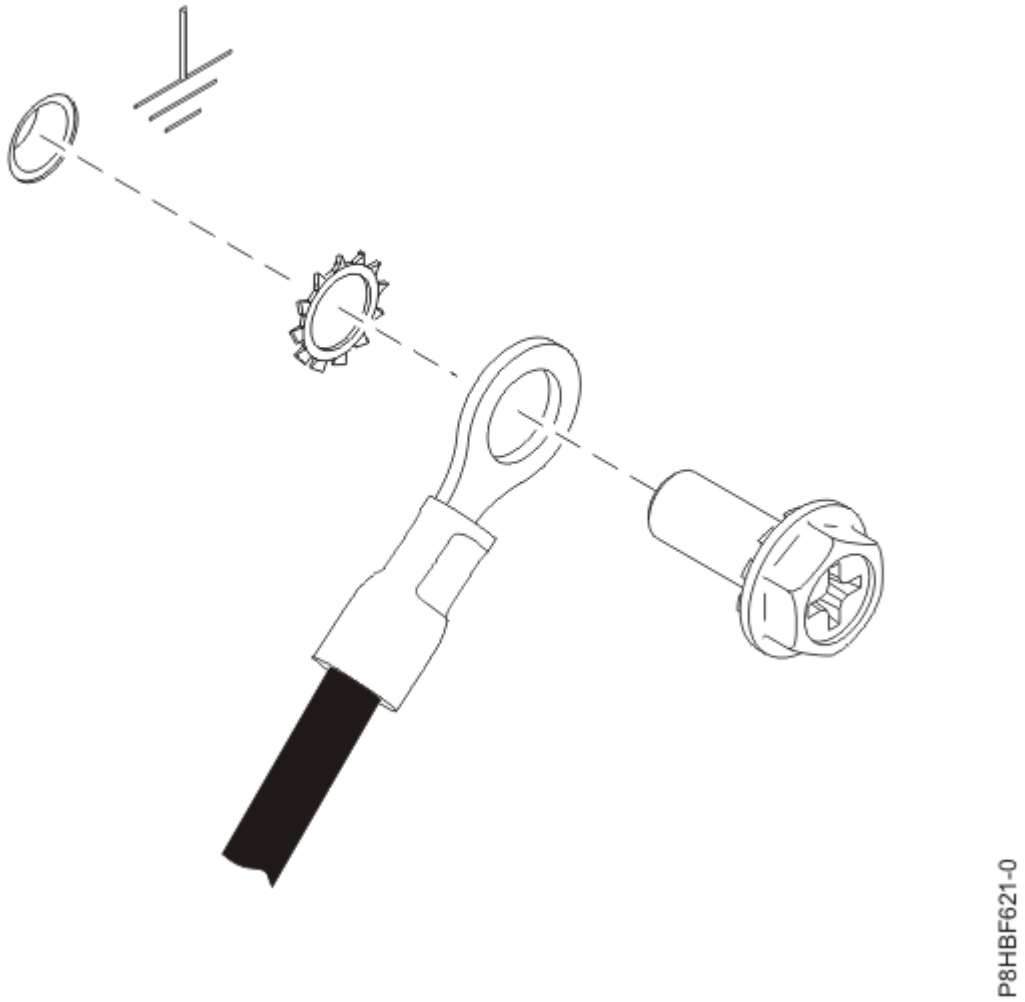


Figure 236. Ring terminal and external star washer

4. Use the external star washer and m5 bolt to secure the wire to the door ground point.
5. Place the other wire connector ring on the screw and add the M6 external star washer, as shown in Figure 236 on page 318.
6. Use a hex socket to tighten the screw into the connection point on the rack frame.
7. Repeat steps "1" on page 317 - "6" on page 318 to earth (ground) bond the other door.

Installing the side cover

You might need to install a side cover on your rack.

Procedure

To install a side cover, complete the following tasks.

1. Ensure that the J-bracket on the bottom of the rack is in place. If a J-bracket is not installed on the bottom of the rack, install it now.
2. Tilt the side cover so that the bottom tab of the cover aligns with the J-bracket in the rack.

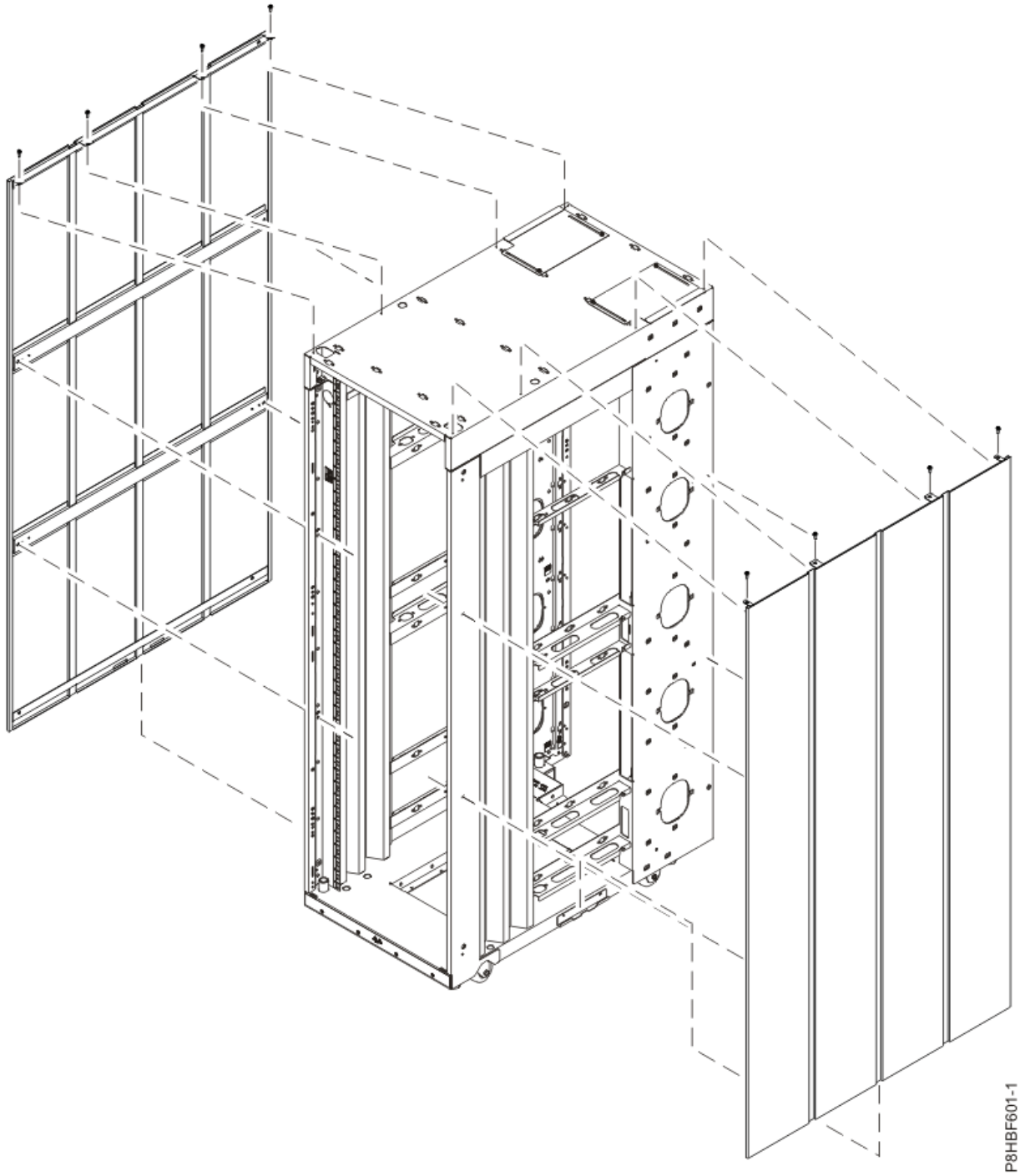


Figure 237. Installing the side covers

3. Raise the cover until it is flush with the rack, and the four holes in the top of the cover align with the four holes in the top of the rack.
4. Install eight screws into each of the holes (four on the top and four on the inside) to secure the cover to the rack.

Installing an extender to the rack (Customer task)

The components of the FlashSystem 9500R rack solution all fit within the rack. However, there is an extender available for your rack, if you ever need it.

Procedure

To install an extender to the rack, complete the following tasks.

1. Prepare the rack for the extension kit installation.

   To prepare the rack for the extension kit installation, complete the following steps.

   a. Allow for enough space, at the rear of the rack, for component installation.

   b. Lift the rear door off the hinges, and then remove the door from the rack.

   c. Using a #2 Phillips head screwdriver or an 8 mm socket, remove the screws that secure the top and bottom hinges to the rack.

   d. Using a #2 Phillips head screwdriver or an 8 mm socket, remove the screws that secure the rear latch plate.

2. Install the left extension panel.

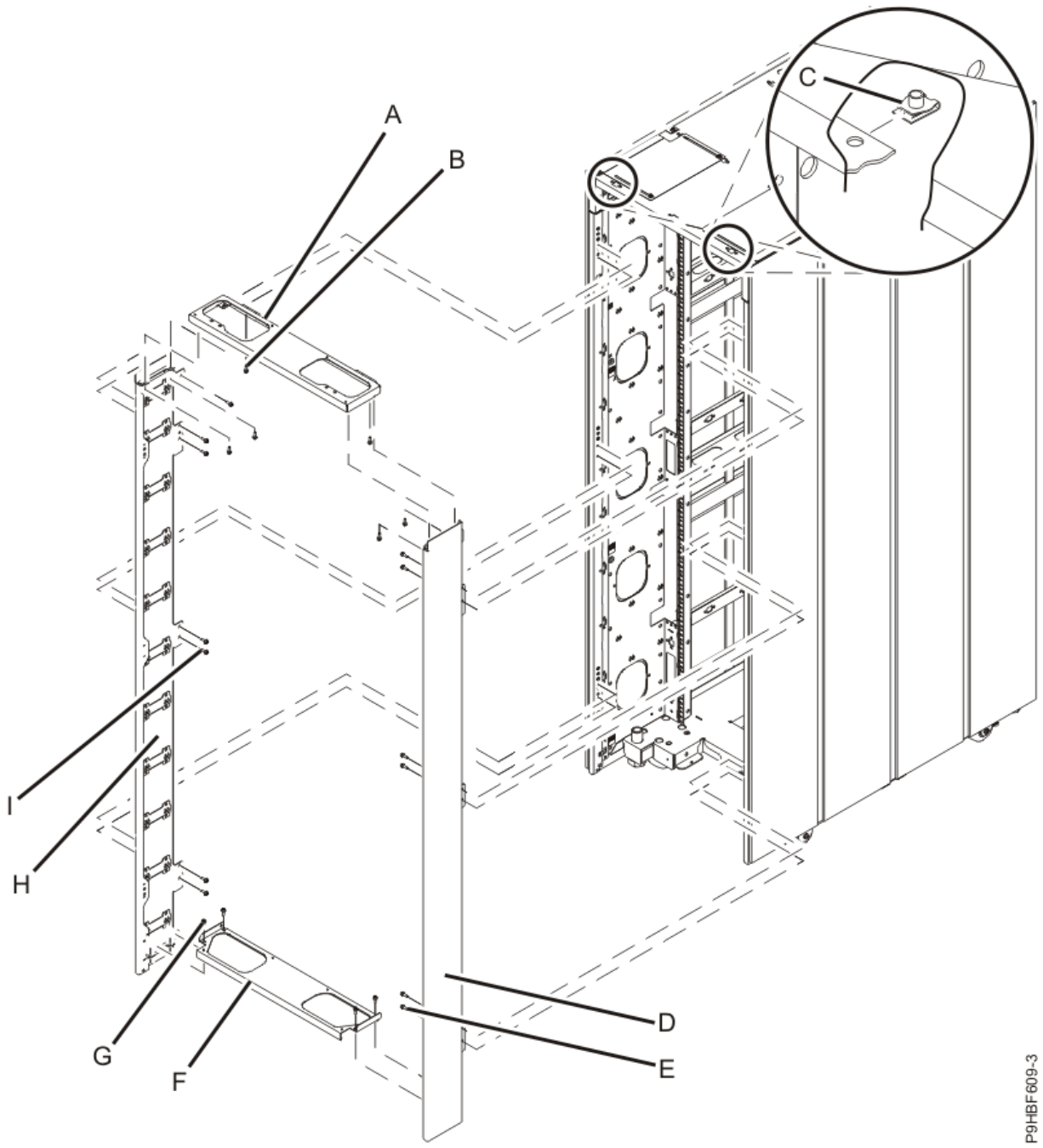


Figure 238. Installing the extender

To install the left extension page, complete the following steps.

a. Align the left extension panel **(H)** with the rack corner post.

b. Using a #2 Phillips head screwdriver, tighten the seven M5 screws with captive star washer **(I)** into the rack. Use a torque screwdriver to tighten the screws to 2.5 newton meters (Nm) [22.1 inch-pounds (in-lbs)].

3. Install the right extension panel.

   To install the right extension panel, complete the following steps.

   a. Align the right extension panel **(D)** with the right side covers.

   b. Using a #2 Phillips head screwdriver, tighten the seven M5 screws with captive star washer **(E)** into the rack. Use a torque screwdriver to tighten the screws to 2.5 Nm (22.1 in-lbs).

4. Install the top cap.

To install the top cap, complete the following steps.

a. Align the top cap **(A)** with the installed extension panels.

b. Using a #2 Phillips head screwdriver, insert and tighten the M5 screws with captive star washers **(B)** into each of the screw holes. Use a torque screwdriver to tighten the screws to 2.5 Nm (22.1 in-lbs).

c. Install the nut clips **(C)**.

5. Install the bottom cap.

   To place the bottom cap, complete the following steps.

   a. Align the bottom cap **(F)** with the installed extension panels.

   b. Using a #2 Phillips head screwdriver, insert and tighten the M5 screws **(G)** with captive star washers into each of the screw holes. Use a torque screwdriver to tighten the screws to 2.5 Nm (22.1 in-lbs).

6. Install the rear hinge assemblies (top and bottom) and the latch plate that you previously removed from the frame onto the extension panel.

Removing the rack top cover (Customer task)

The top 2U of the FlashSystem 9500R rack can be temporarily detached to make it easier to move through doors or into elevators.

About this task

You can reattach the top 2U to the rack frame to provide the full 42U rack capacity. The rack is approximately 4.25" shorter with the top removed.

Note: You must use a 6-point (pt) box socket with an extension bar to remove the screws from the top cover. Other tools might cause the screw heads to become rounded and difficult to remove.

Procedure

To remove the rack top cover, complete the following steps.

1. Remove the front door.
2. Remove the rear door.
3. Remove the side panels.
4. Locate the front and rear rack braces, M6 nut clips, and M6 screws. Fasten each rack brace at the top of the front and rear of the rack, just below the top cover.

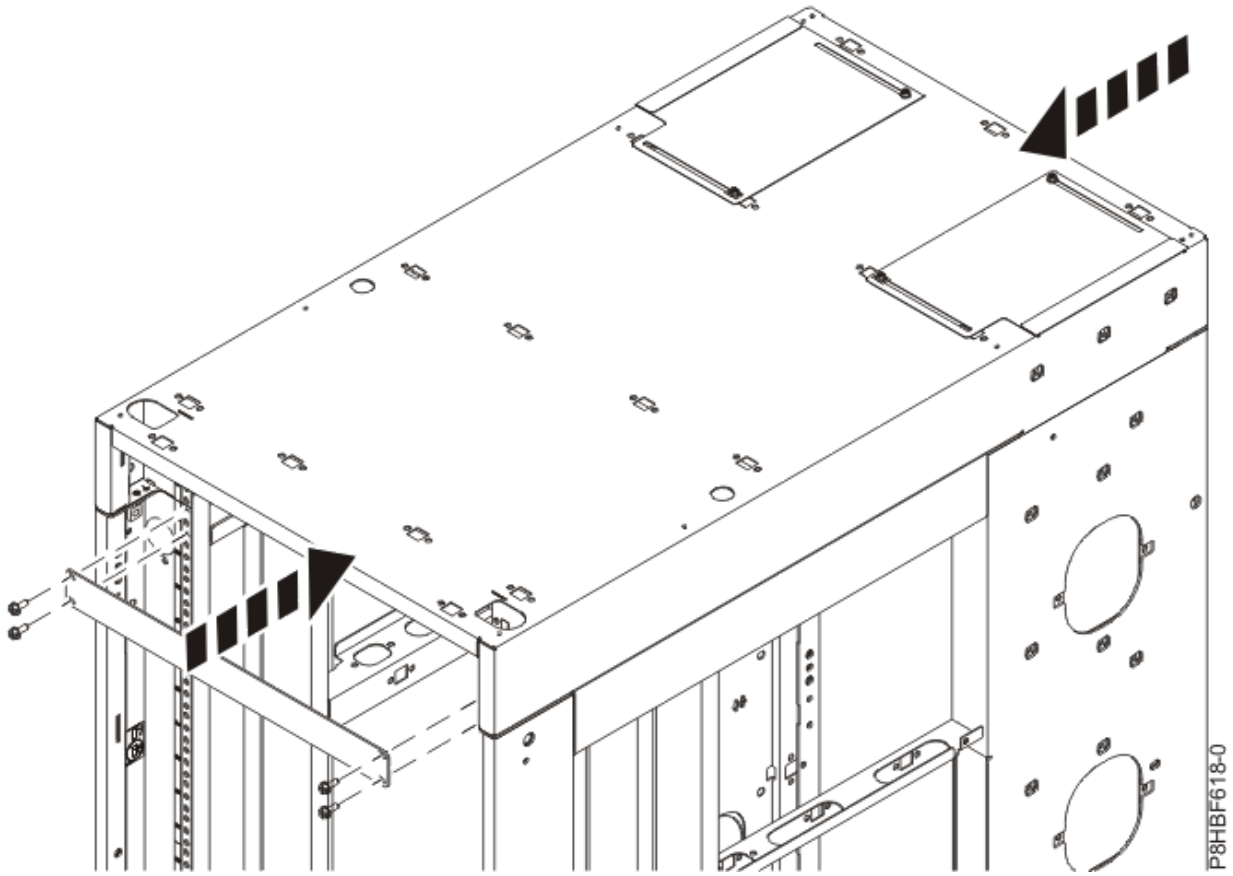


Figure 239. Fastening the rack braces

5. Remove the four corner screws from the top cover.

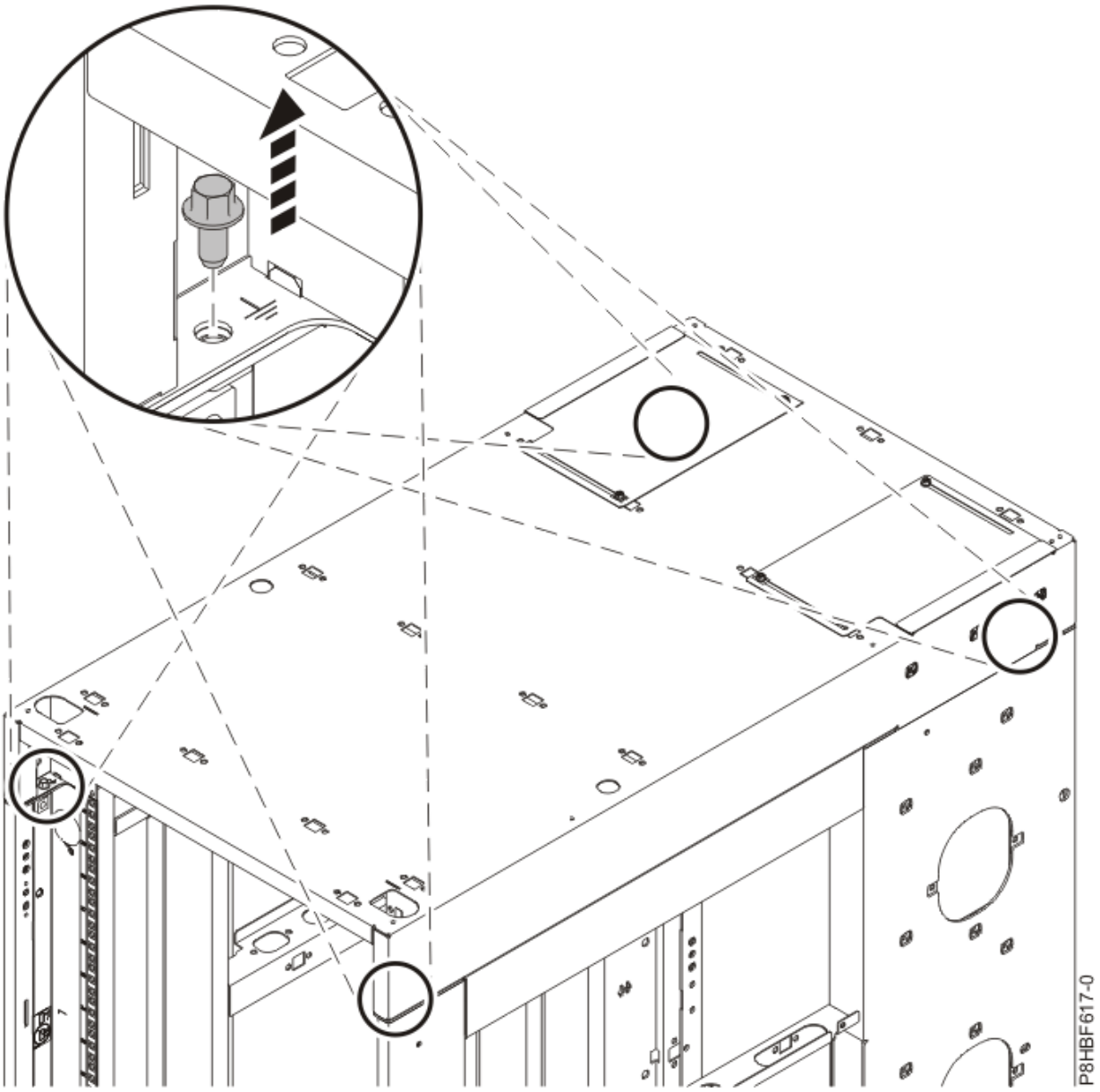


Figure 240. Removing the corner screws

6. Remove the remaining screws from the top cover.

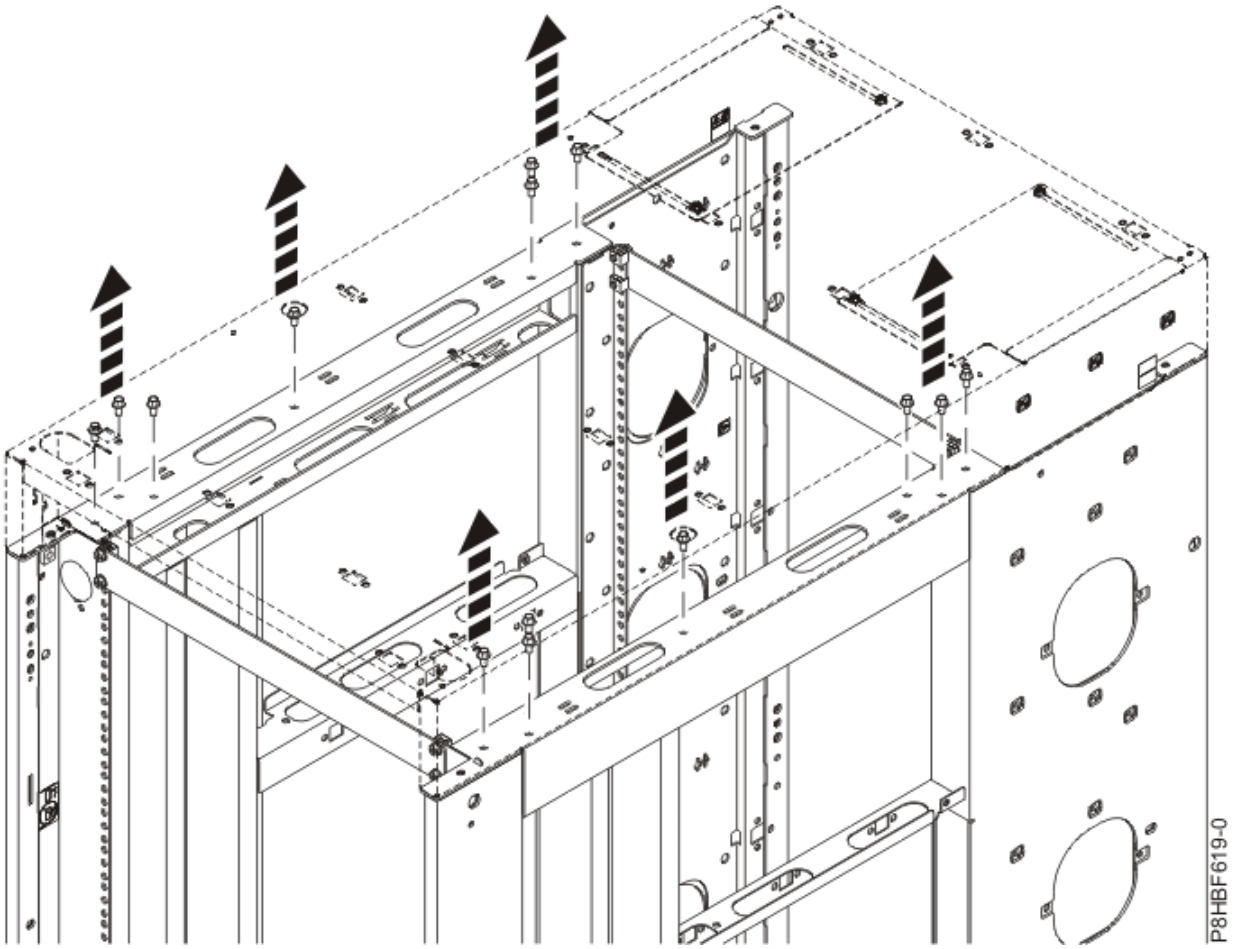


Figure 241. Removing the remaining screws

7. Lift off the top cover.

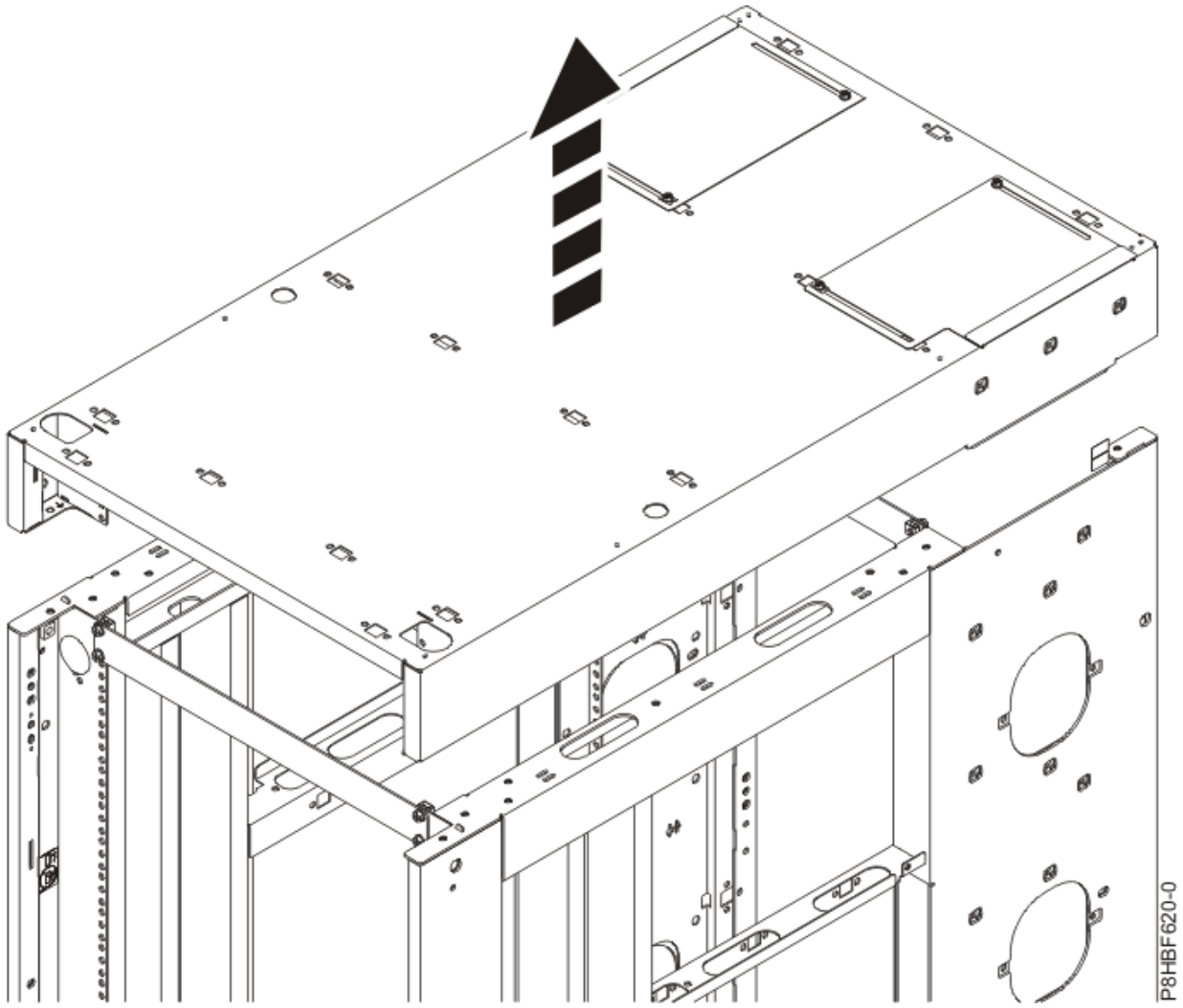


Figure 242. Lifting the top cover

Replacing the top cover (Customer task)

You might need to replace the FlashSystem 9500R rack top cover.

About this task

Note: You must use a 6-point (pt) socket with an extension bar to install the bolts for the top cover. Other tools might cause the bolt heads to become rounded and difficult to remove.

Procedure

To replace the rack top cover onto the rack, complete the following steps.

1. Position the rack top cover on the rack.
2. Install the screws.
3. Torque the screws to 5.6 N-m (4.13 ft lb).
4. Remove the rack braces by unfastening them at the top of the rack, just below the top cover. Remove the braces at the front and rear of the rack.
5. Install rack filler panels to cover open areas at the front of the rack. Seal all gaps in the front of the rack, including the gaps between pieces of equipment. Rack airflow is maintained when the gaps are sealed.

Removing the shipping brackets from FlashSystem 9500R (IBM SSR task)

An IBM® System Services Representative (SSR) uses this procedure to remove shipping brackets from the FlashSystem 9500R racked system.

Procedure

For each control enclosure in the FlashSystem 9500R rack:

1. Remove the 3 screws shown as A in Figure 243 on page 328 on each side of the shipping bracket
2. Remove the 6 screws shown as B in Figure 243 on page 328 holding the middle of the shipping bracket to the back of the control enclosure.

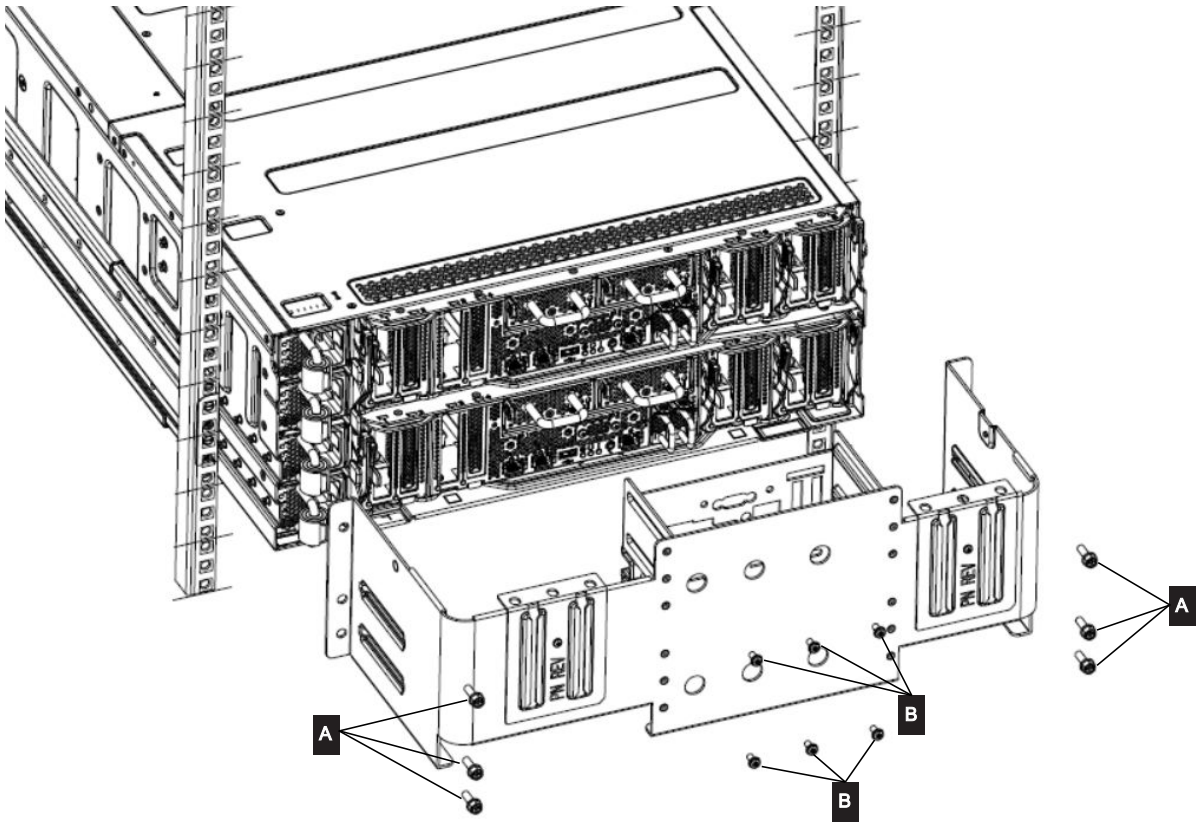


Figure 243. Removing the shipping bracket from the back of a control enclosure.

3. Pull the shipping bracket out of the rack.

4. Remove the screws holding the rail end brackets to the shipping bracket as shown in Figure 244 on page 329

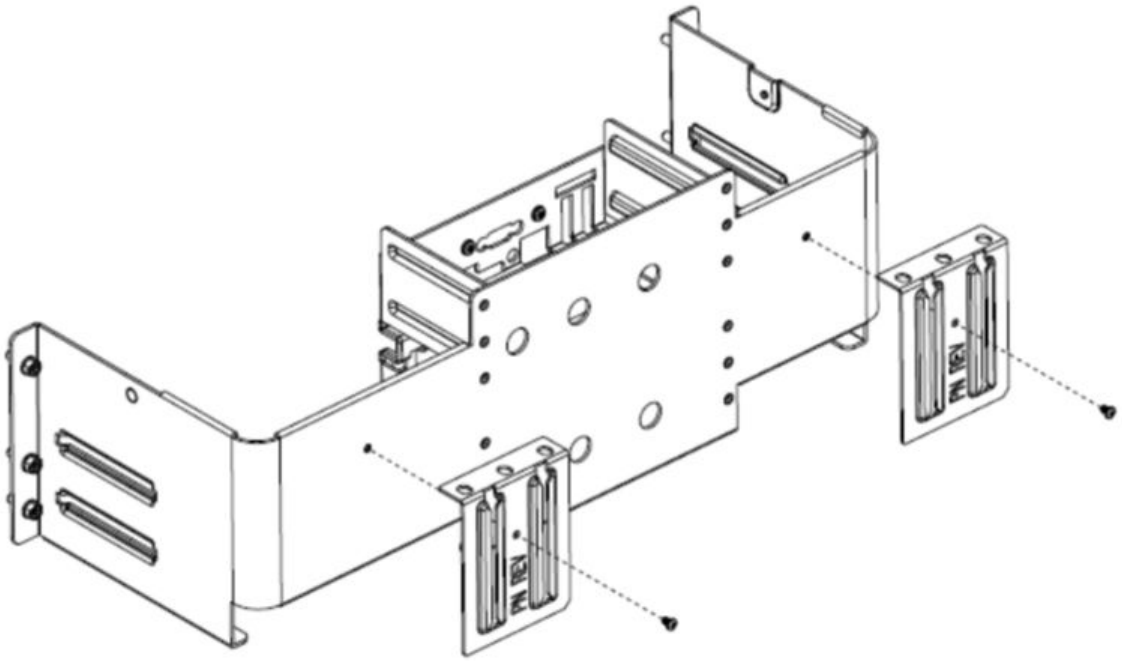


Figure 244. Removing the rail end brackets from the shipping bracket.

5. Fit the rail end brackets to the back of the control enclosure rails as shown in Figure 245 on page 330

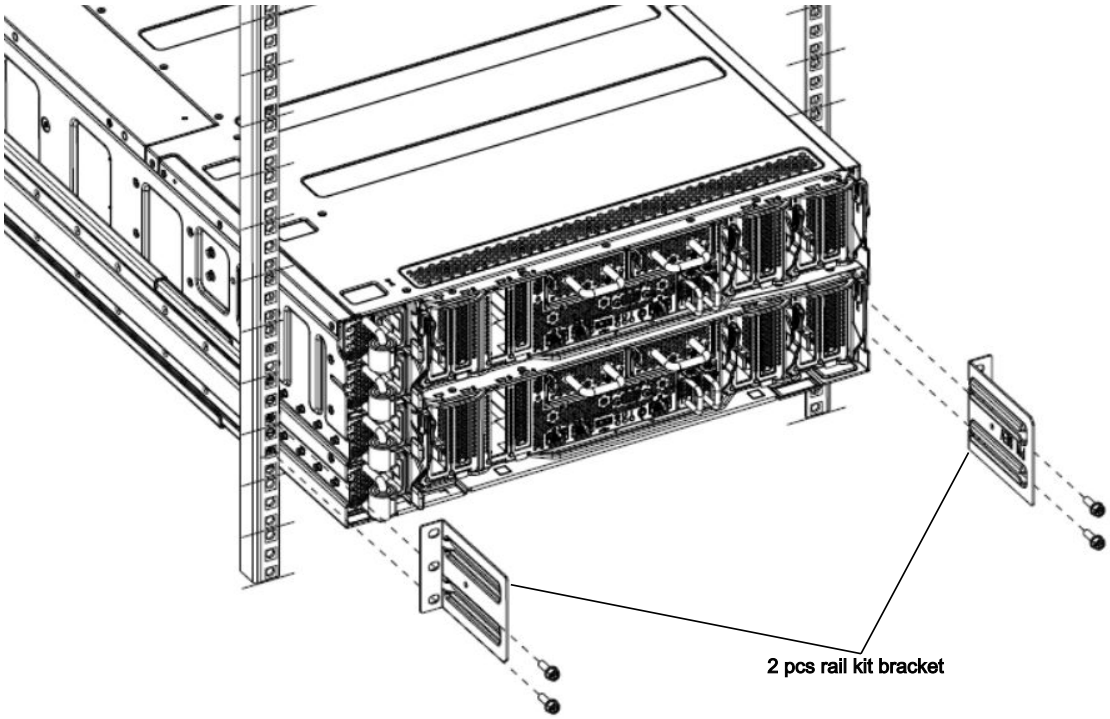


Figure 245. Installing the rail end brackets.

Powering on the FlashSystem 9500R rack solution (IBM SSR task)

An IBM System Services Representative (SSR) uses this procedure to power on the FlashSystem 9500R racked system.

Procedure

1. To power on all components in the rack, connect each PDU to the power source that the customer specified and power on the power sources.
2. Refer to “Intelligent Switched Power Distribution Unit Plus (PDU+) ” on page 290 to ensure that the PDUs power on correctly.
3. Refer to “Powering on the control enclosure” on page 107 to ensure that the enclosures power on correctly.
4. To ensure that the Fibre Channel switches power on correctly, refer to the IBM System Networking SAN24B-6 switch documentation.

   For more information, see “IBM System Networking SAN switch documentation” on page 331.

Initializing the FlashSystem 9500R rack solution (IBM SSR task)

The IBM System Services Representative (SSR) can use the technician port to initially configure each control enclosure before referring to a procedure that completes the service setup.

Procedure

1. Use “Initializing the system with the technician port (IBM SSR task)” on page 108 to connect to the technician port of the upper node of the lower control enclosure and initialize the Storage Virtualize system
2. Use “Completing the service setup for a new system (IBM SSR task)” on page 110 to setup essential support features.
3. After the FlashSystem 9500R racked system installation is complete, The customer completes the following tasks.
   a. Work through the initial setup wizard in the management GUI.
   b. Add the second control enclosure to the system using the Management GUI
   c. Connects control enclosure ports to other SAN switches in the customer's fabric, for connection to hosts and other storage controllers.
   d. Make volumes and map them to hosts.

IBM System Networking SAN switch documentation

Refer to this information from IBM Documentation about the two IBM SAN24B-6 or IBM® SAN32C-6 switches that are used in the FlashSystem 9500R rack solution.

IBM System Networking SAN24B-6 documentation
IBM System Networking SAN32C-6 documentation

Note: Note that the switches can be added to the same IBM storage Insights instance as 4666-AH8 control enclosures. See https://www.ibm.com/support/pages/ibm-storage-insights-switch-support

Installing and removing the 8960-F24 switch cooling duct assembly

Use this procedure if you need to install or remove the switch cooling duct for the 8960-F24 in the FlashSystem 9500R racked system. This ducting system is supplied free of charge on the initial order of

the 8960-F24 only as part of an FlashSystem 9500R, there is no mechanism to order it independently outside of an FlashSystem 9500R.

Before you begin

The switches in the FlashSystem 9500R racked system provide a dual-redundant Fibre Channel fabric to the control enclosures in the rack. If the system is to remain online, power down or service one switch at a time. Ensure that the other switch remains connected to control enclosures and power supplies. Before you remove a switch, power it down and disconnect the fiber cables from the rear of the switch.

Refer to Figure 246 on page 332 and Table 104 on page 332 to ensure you have all the parts of this assembly.

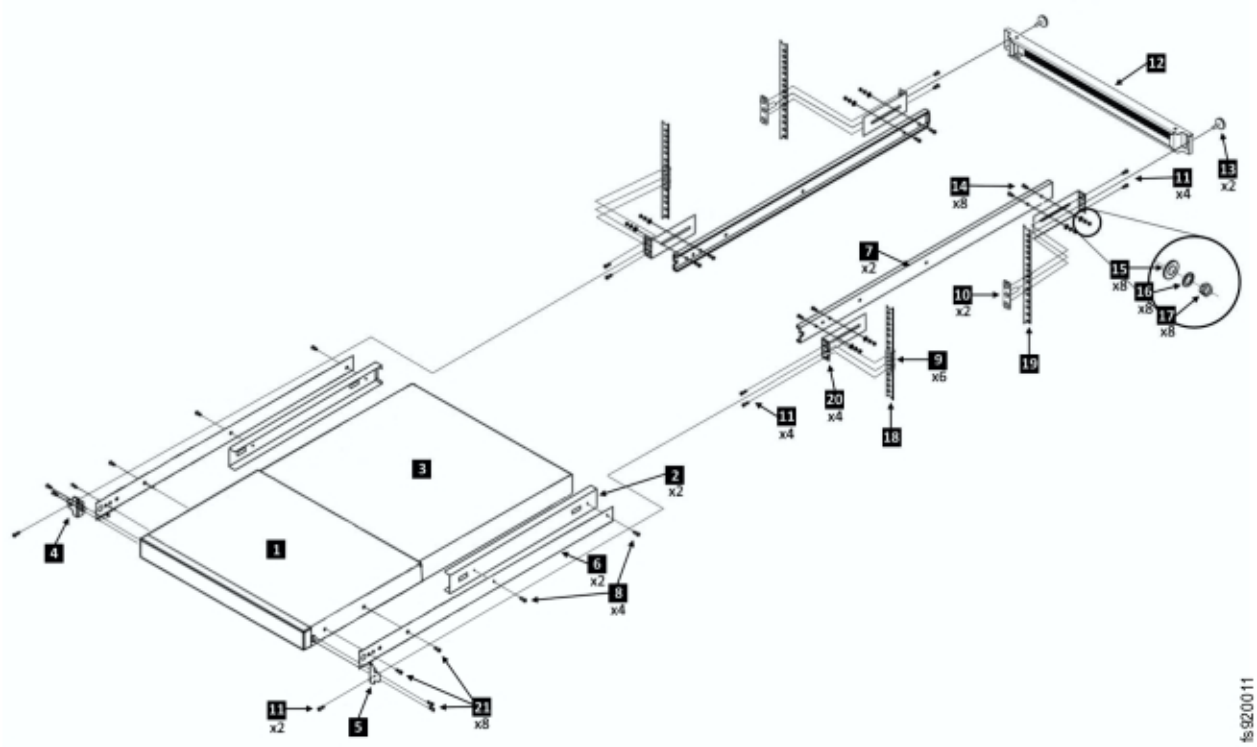


Figure 246. Exploded view of duct switch assembly

Table 104. Parts list

Item	Description	Quantity
1	SAN24B-6 switch	1
2	Duct rail (P/N 00E6894)	2
3	Duct tube (P/N 00E6796)	1
4	Left mounting bracket (included in switch mounting kit P/N 18P3562)	1
5	Right mounting bracket (included in switch mounting kit P/N 18P3562)	1
6	Inner rail member (from rail P/N 95P1855)	2
7	Outer rail member with glide bearing (from rail P/N 95P1855)	2
8	8-32 9.5 mm screw (from mounting kit P/N 18P3562)	4
9	M5 caged nut (P/N 74F1823)	6

Table 104. Parts list (continued)		
Item	**Description**	**Quantity**
10	Nut plate (P/N 00E6806)	2
11	M5x16 screw (P/N 46C6380)	10
12	Duct bezel (P/N 00E6797)	1
13	Duct bezel thumbscrew (P/N 28L0657)	2
14	Bolt	8
15	Washer	8
16	Split washer	8
17	Nut	8
18	Rear mounting rails of the rack	2
19	Rear mounting rails of the rack	2
20	Rack mounting bracket	4
21	8-32 19 mm screw (from mounting kit P/N 18P3562)	8

About this task

Installing the switch cooling duct assembly

Procedure

1. Separate the inner members of the rail from the outer members.
   a) Extend the inner member until the lock engages.
   b) Press the lock release lever (1) and remove the inner member from the outer member.

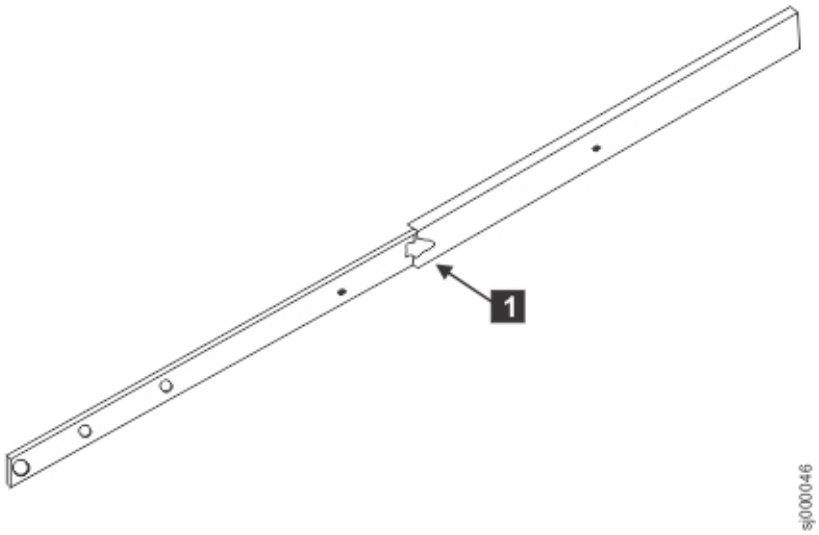


Figure 247. Rails and locking mechanism

   c) Repeat these steps for the other rail.
2. Assemble the components.

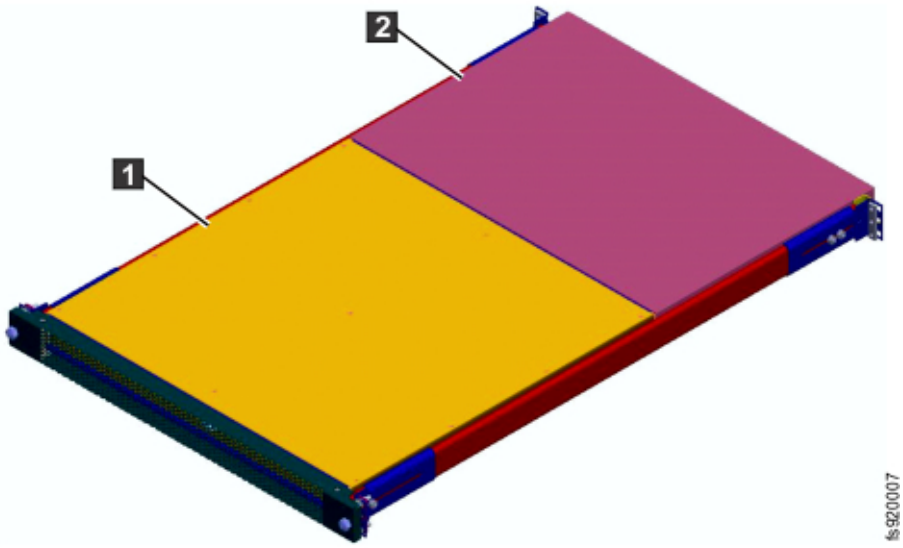


Figure 248. Components assembled on rail inner members

1 Duct
2 Switch

a) Attach the two duct rails (P/N 00E6894) to the inner rail members by using the supplied 8-32 screws, as shown in Figure 249 on page 334.

Figure 249. Incorrect screw length

1 The correct screw does not protrude out from the nut.

Torque the screws to 15in-lb (1.7N·m).

b) Attach the inner member rails to the switch by using the short 8-32 (9 mm) screws and make sure the duct tubing (P/N 00E6796) is in between.

Torque the screws to 15in-lb (1.7N·m).

Figure 250. Switch duct rails and ear location

1 Ear location
2 Duct rails (P/N 00E6894)
3 Duct tube (P/N 00E6796)

c) Install the ears to the switch by using the short (9 mm) 8-32 screws.

3. Assemble the rail outer members into the rack.

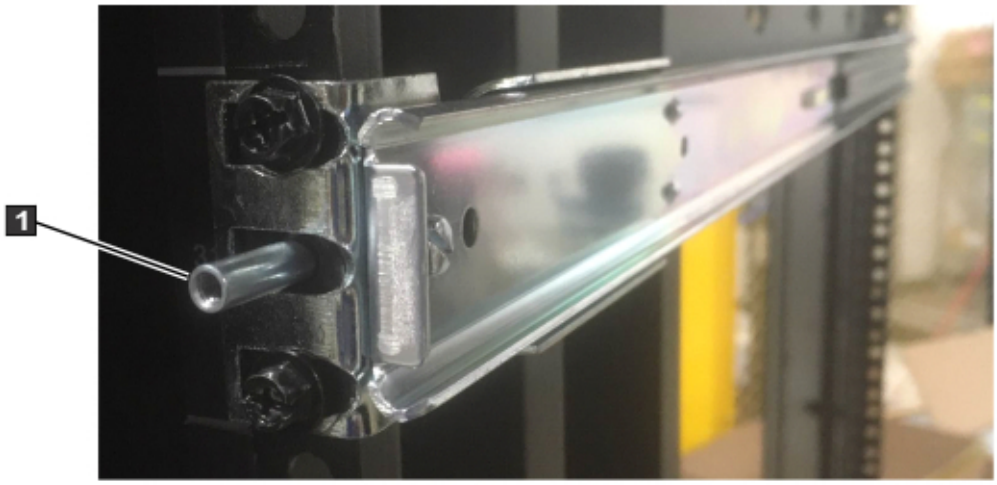


Figure 251. Rack front detail

1 Front bezel thumbscrew location.

a) Attach a mounting bracket to each end of the outer rail members by using two of the supplied bolts, nuts, split washers, and washer sets per bracket, as shown in Figure 251 on page 335.

Leave the nuts slightly loose to assist installing to the correct length.

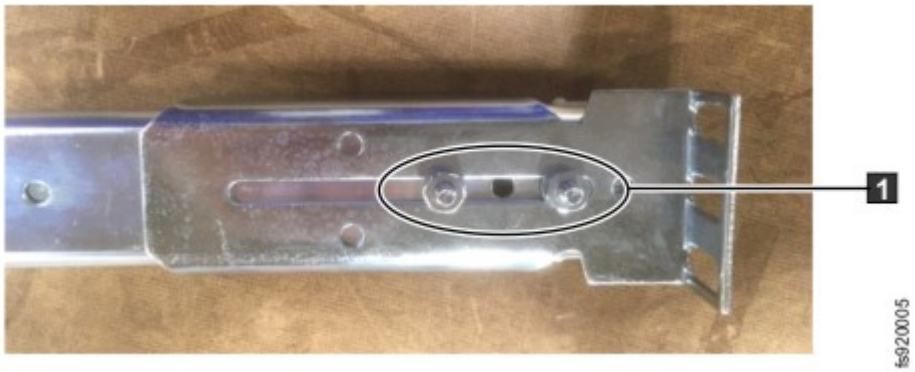


Figure 252. Attaching a bracket to an outer rail member

1 Leave the rails a bit loose to make the next step more manageable.

b) Place the six nut clips (P/N 74F1823) into the three mounting holes of the rack uprights at the rear of the rack where you are installing the switch.

Use the upper and lower nut clips to mount the open end of the rail outer member, as shown in Figure 253 on page 336.

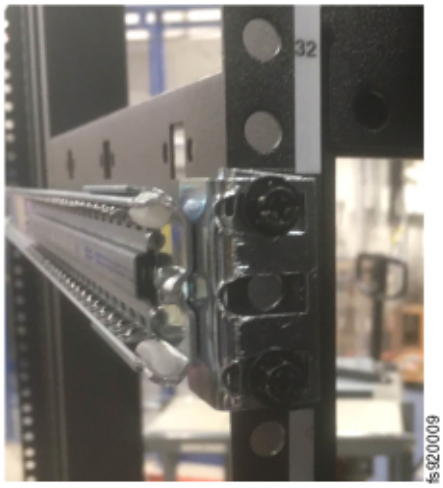


Figure 253. Rack rear right-side detail

c) Attach the rail outer members into the front of the rack by inserting the nut plate (P/N 00E6806) behind the front rack upright and securing it with two screws (P/N 46C6380) per side, as shown in Figure 251 on page 335.

d) Tighten the nuts and bolts on the mounting bracket of the outer rails, as shown in Figure 252 on page 336.

4. Insert the switch into rack.

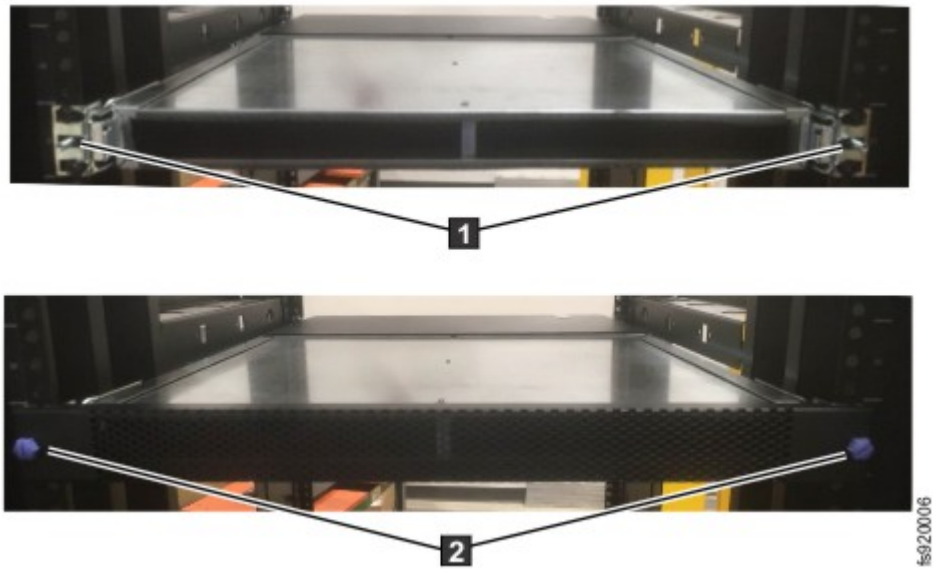


Figure 254. Rack front views

1 Front view of the assembly in the rack without the bezel.
2 Bezel thumbscrews (P/N 28L0657)

a) Slide the switch into the rack from the rear and secure it with one screw (P/N 46C6380) per side (use the middle hole) into the nut clip you attached in Step 3(b).
b) Attach the duct bezel (P/N 00E6797) by using two thumbscrews (P/N 28L0657) at the front of the rack.

   If the thumbscrews do not align with holes, the M5 bolts of the rails need to be loosened and the rails slightly adjusted.

What to do next

- Connect the switch to its power supply by using the supplied cable.
- Connect the control enclosures to the correct switch ports (see "Planning for system connections within the rack" on page 256).

Note: Conduct these steps in reverse order to remove the switch cooling duct assembly.

Installing and removing the SAN32C-6 switch cooling duct assembly

Use this procedure if you need to install or remove the switch cooling duct of the FlashSystem 9500R racked system. This ducting system is supplied free of charge on the initial order of the 8977-T32 only as part of an FlashSystem 9500R, there is no mechanism to order it independently outside of an FlashSystem 9500R.

Before you begin

The Fibre Channel switches in the FlashSystem 9500R racked system provide a dual-redundant Fibre Channel fabric to the control enclosures in the rack. If the system is to remain online, power down or service one switch at a time. Ensure that the other switch remains connected to control enclosures and power supplies.

FlashSystem 9500R racked system contains two rear mounted switches. Each switch is installed in position 38 of the rack, and the second is installed in position 40.

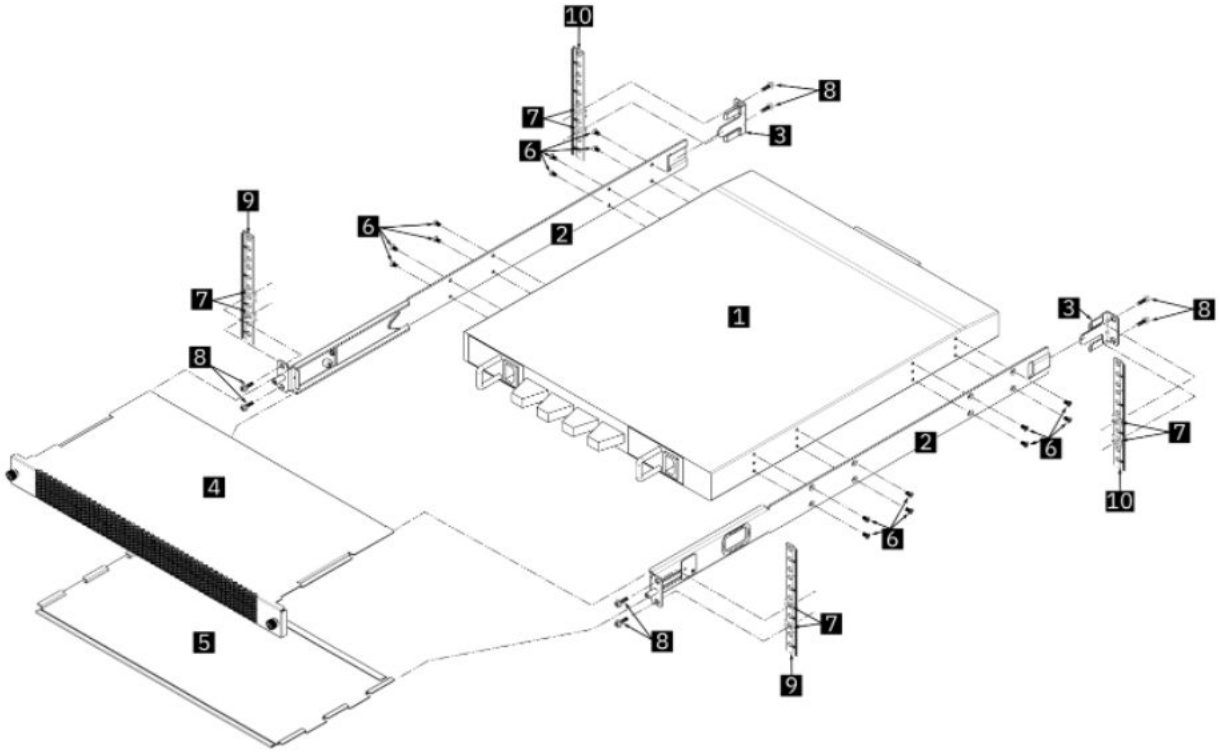


Figure 255. Exploded view of duct switch assembly

Table 105. Parts list		
Item	**Description**	**Quantity**
1	SAN32C-6 switch (MT 8977-T32)	1
2	Air Duct rail Assembly (P/N 03GU941)	2
3	Rear Bracket (P/N 03GU989)	2
4	Top Cover Bezel Assembly (P/N 03GU939)	1
5	Bottom Cover (P/N 03GU940)	1
6	M4 x 0.7 Flat Head Machine Screw (P/N 03JK123)	16
7	M5 caged nut (P/N 74F1823)	8
8	M5x16 screw (P/N 46C6380)	8
9	Front mounting rails of rack	2
10	Rear mounting rails of rack	2

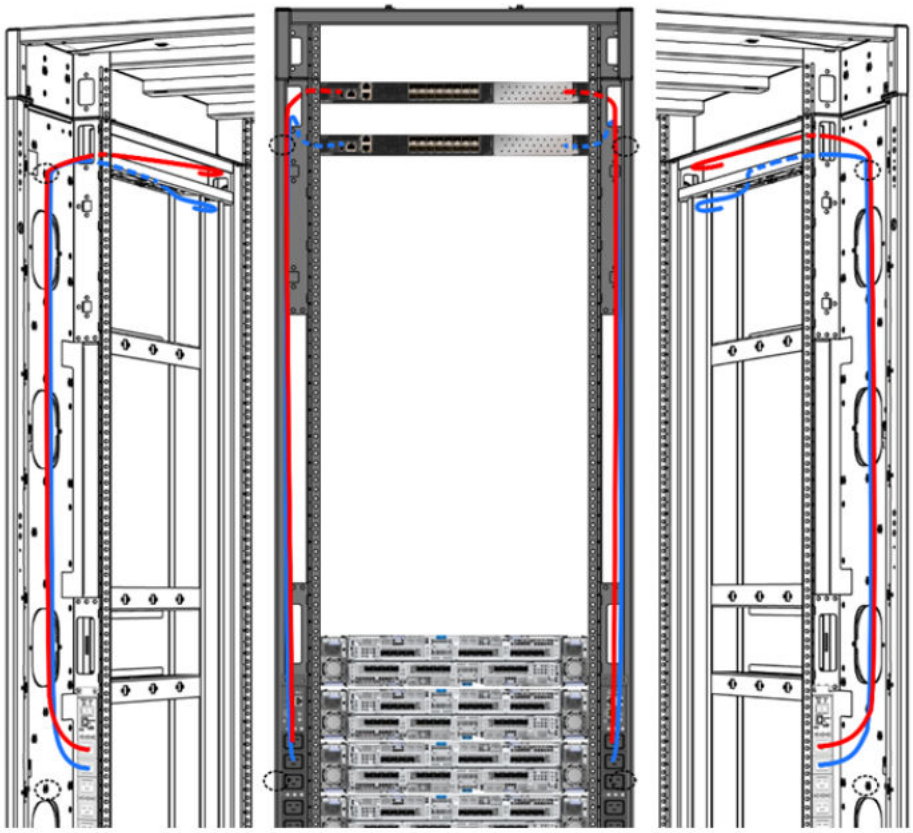


Figure 256. Power cable routes for SAN32C-6 switches (includes for optional second PSU)

About this task

Installing the switch cooling duct assembly.

Follow below procedure to remove or install the switch and duct, while referring to Figure 255 on page 338 and Table 105 on page 338.

Procedure

1. At the rear of the rack, route a power cable from the upper outlet of the left PDU, up the rack, through the upper left cableway of the rack, to the front of the rack where the switches will be installed. If a second power supply is installed in the switch, also, route a second power cable from the upper outlet of the right PDU, through the upper right cableway of the rack, to the front of the rack where the switches will be installed. Figure 256 on page 339 shows suitable routes. Do not plug the connectors into the outlets yet.

   Tip: If you are installing a pair of switches, also install one or two power cables for the second switch.
2. Install caged nuts [7] behind the upper and lower screw holes of the 1U rack position where the switch is to be mounted.
3. Install two rear brackets [3] onto the outside of the rack, pointing inwards, and secure each with two M5 screws [8] into the caged nuts [7] at the rear of the rack.
4. Attach one air duct rail assembly onto each side of the switch using the 16 provided M4 screws [6].
5. Insert the switch and rail assembly into the front of the rack, locating the rear end of the rail into the rear brackets [3].
6. Secure the front of the rails to the rack with a pair of M5 screws [8].
7. At the front of the rack, locate the sliding cable door inside the front of the right rail and install the right power cable:

a) Loosen the thumbnut then slide the door open by pulling the end of the door outward from the rack.

b) Feed the power cable through the cable doorway and connect to the right power supply of the switch.

c) Press the door closed so that the cable is snug in the doorway, then tighten the thumbnut - do not overtighten.

8. If a second PSU is installed in the switch, install the left power cable through the left rail and connect to the left power supply inlet of the switch.

   Tip: If you are installing a pair of switches, repeat the above steps to also assemble and install the second switch.

9. Slide the bottom cover [5] onto the lower ledge of the air duct rail [2]. When fitted correctly, the raised edge tabs of the bottom cover are above the ledge and the flat tabs are below the ledge.
10. Slide the top cover bezel assembly [4] onto the upper ledge of the air duct rail [2]. When fitted correctly, the flat edge tabs of the top cover are above the ledge and the middle tabs are below the ledge.
11. Secure the top cover using the two thumbnuts on the front of the top cover [4] - turn them clockwise to screw them into the front of the rail. Do not overtighten them.

What to do next

- Plug the power cables into the PDU outlets. If the PDU is powered, the switch will power on.
- Repeat the procedure on the second switch.
- Connect the control enclosures to the correct switch ports (see “Planning for system connections within the rack” on page 256).

Note: Conduct these steps in reverse order to remove the switch cooling duct assembly.