HP StorageWorks Enterprise Virtual Array expansion cabinet reference guide

The procedures in this guide describe how to add a 0C6D expansion cabinet to an existing Enterprise Virtual Array (EVA) main cabinet containing Fibre Channel (FC) loop switches. Only an EVA5000, EVA8000, or EVA8100 have controllers that are capable of being used for cabinet expansion, with 18 drive enclosures being the maximum number that can be addressed. Only the 0C6D expansion cabinet configuration is discussed in this document because a 0C12D expansion cabinet is cabled as two 0C6D configurations in one cabinet.

A 0C6D expansion cabinet can be used to expand a 2C12D main cabinet configuration. A 0C12D cabinet can be used to expand two 2C12D main cabinets with each main cabinet only connected to half (6) the drive enclosures of the expansion cabinet. However, a 0C12D expansion cabinet should not be used to expand a 2C6D main cabinet, because of bus addressing issues occurring in expansion cabinets with more than six drives. Expansion drive enclosure numbering begins at 15 and cannot exceed 20, limiting the expansion capability to six drive enclosures.

📝 **NOTE:**

The procedure for adding an expansion cabinet is extensive and complex. Therefore, it is important you read and understand the "Summary of the expansion cabinet addition procedure" on page 5 before performing the actual connections, to ensure you understand the sequence of steps involved.

Configuration information

The following tables show the components needed to perform the expansion for these configurations.

Table 1 Example configurations for the EVA5000 or a 2 or 4 Gb EVA8000

Expansion cabinet components	Quantity per 0C6D	Quantity per 0C12D	Description
AF002A	1	1	EVA 42U HP 10000 G2 series rack
252663–xxx	2 (minimum)	2 (minimum)	Power distribution unit (country specific)
336881–B21	1	2	EAB bus expansion cable kit
AD542B	6	12	M5314B FC drive enclosure
345580–B21	6	12	Cable kit, expansion cab drive shelf

Table 2 Example configurations for the EVA8100

| Expansion cabinet components	Quantity per 0C6D	Quantity per 0C12D	Description
AF002A	1	1	EVA 42U HP 10000 G2 series rack
252663–xxx	2 (minimum)	2 (minimum)	Power distribution unit (country specific)
336881–B21	1	2	EAB bus expansion cable kit
AD542C	6	12	M5314C FC drive enclosure
345580–B21	6	12	Cable kit, expansion cab drive shelf

Expansion cabinet requirements

- At least one existing 2C12D main cabinet containing a properly wired enclosure address bus (EAB), controller pair, FC loops, drive enclosures, and FC loop switches, to which the controllers and drive enclosures are connected (see Figure 1). This main cabinet must be running properly, without any known errors.

- A new 0C6D or 0C12D expansion cabinet containing a properly wired EAB and drive enclosures (see Figure 2).

> **NOTE:**
>
> A 0C12D expansion cabinet is installed as two 0C6D configurations with two separate EABs for the upper and lower six drive enclosures. A 0C12D cabinet requires twice the amount of cabinet extension and optical cables than described for one 0C6D expansion cabinet.

- An EAB extension cable (part number 17-05108-02) for joining the EAB of the expansion cabinet to the EAB of the main cabinet.
- Twelve 5-meter Fibre Channel optical cables (part number 17-05030-02/191117-005) for joining the FC loops in the expansion cabinet to the FC loop switches in the main cabinet. Small form-factor pluggable (SFP) transceivers are required for inserting the optical cables into the I/O modules and loop switches. The SFPs and optical cables are supplied in the 345580-B21 kit.

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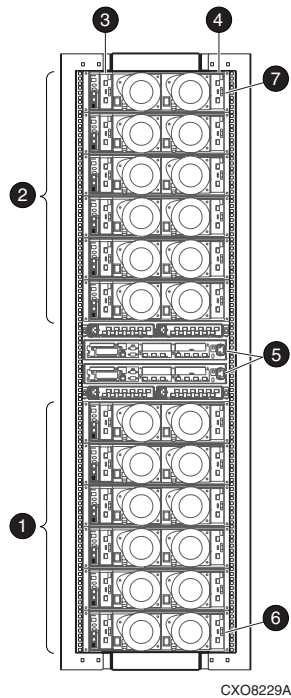
1	Section 1	5	Controller pair
2	Section 2	6	Drive enclosure 1
3	Side B	7	Drive enclosure 14
4	Side A		

Figure 1 Rear view of a 2C12D main cabinet

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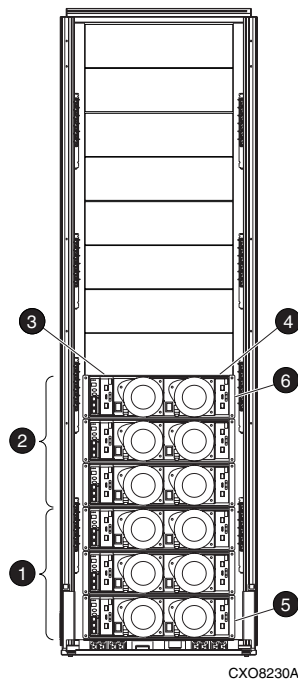
1	Section 1	4	Side A
2	Section 2	5	Drive enclosure 15
3	Side B	6	Drive enclosure 20

Figure 2 Rear view of a 0C6D expansion cabinet

Summary of the expansion cabinet addition procedure

The goal of the detailed upgrade procedure is to complete the following steps:

1. Make sure the expansion cabinet you are connecting to the main cabinet is working properly. See "Preparing the expansion rack for connection to the main rack" on page 6.

2. Stop host I/O to the main EVA cabinet, and then power down the main cabinet. See "Shutting down the main cabinet controllers" on page 8.

3. Extend the EAB in the main cabinet to the expansion cabinet by adding an extension cable between the two cabinets. See "Connecting the EAB extension cable to the main rack" on page 11.

   • The EAB enables the six new enclosures in the expansion cabinet to be numbered from 15 through 20, starting with the bottom enclosure (see Figure 2). To extend the bus, an EAB extension cable is connected to the bottom EAB connection in the expansion cabinet in place of a bottom terminator.

   • The EAB extension cable is run from the expansion cabinet to the main cabinet. In the main cabinet, the cable is connected in place of the terminator currently connected to the bottom EAB connector box.

4. Connect the controller pair to the six drive enclosures in the expansion cabinet through FC expansion cables connected to the FC loop switches in the main cabinet. See "Connecting the drive enclosures in the expansion rack to the FC loop switches" on page 11.

   • Both the main cabinet and the expansion cabinet are divided into two sections labeled sections 1 and 2. The design goal is to have an equal number of drive enclosures in each section in each cabinet. See Figure 1 and Figure 2.

     • The main cabinet has six drive enclosures in each of the two sections.

     • The expansion cabinet has three drive enclosures in each of the two sections.

- The upgrade process connects the two cabinets as follows:
  - The section 1 enclosures in the expansion cabinet are connected to the section 1 enclosures in the main cabinet.
  - Likewise, the section 2 enclosures in the expansion cabinet are connected to the section 2 enclosures in the main cabinet.
  - Once completed, the configuration has nine drive enclosures in section 1 and nine in section 2.

> **NOTE:**
>
> The design goal is to split the six expansion enclosures into two separate sections of three drive enclosures each and to connect each section to its corresponding section in the main cabinet. This design achieves balanced controller loading.

- The FC loops in both the expansion and main cabinets are divided into four main loops. Viewed from the rear of the cabinet as shown in Figure 1 and Figure 2, they are:
  - Loop 1A—Section 1, side A: Lower section, right side.
  - Loop 1B—Section 1, side B: Lower section, left side.
  - Loop 2A—Section 2, side A: Upper section, right side.
  - Loop 2B—Section 2, side B: Upper section, left side.

These four loops correspond to the four ports on the rear of each controller of a controller pair. The FC loop connections between both cabinets are made using twelve 5-meter FC extension cables. These cables are connected between the drive enclosures in the expansion cabinet and the FC loop switches in the main cabinet (see Figure 5 and Figure 6).

5. Power up the main cabinet. See "Powering up the controllers" on page 16.

Preparing the expansion cabinet for connection to the main cabinet

This section contains the preparation steps that must be performed before connecting the expansion cabinet and the main cabinet.

> **IMPORTANT:**
>
> During this procedure, many conditions require inspection within a short time after powering on the expansion cabinet. Therefore, please read and understand this entire section before applying power.

Physically inspect the expansion cabinet

Physically inspect the expansion cabinet and the EAB cabling. Verify each of the following conditions:

- All enclosures and enclosure modules are properly installed and seated.
- Each power supply is connected to one of the electrical outlets in the cabinet.
- The end connector of each cable is plugged into a drive enclosure I/O module.
- All I/O modules have one cable connected to an SFP transceiver in the upper port.
- All EAB components are cabled together serially.
- The top of the EAB cabling has an EAB terminator in its topmost connector.
- Each drive enclosure is connected to an EAB connector.

> **NOTE:**
>
> Do not power up the expansion cabinet or proceed until all these conditions are met.

Ensure correct operation of the drive enclosure EMUs in the expansion cabinet

Before the expansion cabinet is powered on, be sure you understand the following environmental monitor unit (EMU) inspection steps:

- The faceplate of each drive enclosure EMU contains three LEDs positioned horizontally at the top. Below the three LEDs is a dual seven-segment display. Below the display are two large pushbuttons.
- When the enclosure is powered on later in this section, none of the EMUs should audibly alarm. Even if the alarm comes on for only a few seconds and clears, a problem exists. An alarm condition is indicated when an EMU gives an audible beep and the rightmost LED of the three horizontal LEDs at the top of the EMU is flashing amber.
- To determine that an EMU is working properly:
  - Observe that the *leftmost* of the three horizontal LEDs at the top of the EMU is FLASHING green.
  - Observe that the *center* horizontal LED at the top of the EMU is ON and green.
  - If the EMU is not detecting any errors in its enclosure, the *rightmost* of the three horizontal LEDs at the top of the associated EMU is OFF.

At this time, power on the expansion cabinet and observe the EMUs. If any EMU alarms, or its horizontal top LEDs are not as described above, an error is present. Diagnose and correct all problems indicated by the drive enclosure EMU before proceeding to the next section.

Inspect the drive enclosure power supplies

From the rear of the expansion cabinet, observe each power supply. Each drive enclosure has two power supplies. Each power supply has one green LED on its fan casing. Make sure the green light on each power supply is ON and not FLASHING. If not, diagnose and correct the problem before proceeding with the next step.

Inspect the I/O modules

Observe each I/O module. Each I/O module has three green LEDs on the faceplate.

- Within the first five seconds after the expansion cabinet is powered on, the middle light on each I/O module should be ON (not FLASHING).
- The other two lights on each I/O module should be OFF until the cabling is completed later in this procedure.

> 📝 **NOTE:**
>
> If the EMU on the same enclosure is not working properly, the middle light of the I/O module may flash for about one and a half minutes, then go ON rather than FLASHING.

If any of these required conditions is not met, the problem in the expansion cabinet must be diagnosed and corrected before proceeding to the next section. Once all problems are corrected, repeat these preparation procedures to ensure that all elements are working properly.

Engage all expansion cabinet drives

After the expansion cabinet is powered up, make sure all disk drives are fully engaged and seated into their associated enclosures. Observe the drive lights to ensure that the disks are working properly. Each disk has three lights on its faceplate as follows:

- Bottom light: A red light that looks like a cylinder with an "X" across it.
  - When ON, this light indicates either that the drive is defective or that the drive enclosure is not connected to a controller pair. Because the expansion cabinet has not yet been joined to the main cabinet, the first engaged drive in each drive enclosure, starting on the left of the enclosure, has this red light ON.

- During spin-up, this light on other drives may also be ON. After spin-up is completed, no other drive in the enclosure except the first engaged disk should have this light ON.
- Middle light: A green light that looks like a cylinder turned sideways.
- Top light: A green light that looks like an arrow. This light has three states:
  - ON (lit solid)
  - FLASHING at a rate of about two flashes every second
  - FLASHING at a much slower rate of about one flash every two seconds

Drive indicator conditions during spin-up

- Bottom red light: When power is first applied and for up to five minutes afterwards, any or all of the bottom red lights on the disks in the expansion cabinet can be ON or FLASHING.
- Middle green light: May be ON or FLASHING during spin up.
- Top green light: Flashes at the rate of two flashes per second until the disk is spun up.

Drive indicator conditions after spin-up

After all disk drives in the expansion cabinet are fully engaged and seated into their associated drive enclosures, allow up to five minutes for the drives to spin up and to settle.

- Bottom red light: After the drives are spun up, observe the lights on each drive from the front of the expansion cabinet. The first engaged drive of each enclosure (at the left) has its bottom red light ON. This is normal when an enclosure is powered up but not connected to a controller pair over its FC loops. No other drive should have its red light ON or FLASHING.
- Middle green light: Should be ON.
- Top green light: Must be either ON or FLASHING at the slower rate of about one flash every two seconds.

If any drive does not spin up, or the lights on any drive are not as described above, the drive can be defective and should be replaced with a known good drive as soon as possible.

Shutting down the main cabinet controllers

△ CAUTION:

The process of adding an expansion cabinet disturbs the EAB within the storage system. This disruption can compromise data availability and integrity. Therefore, the controllers must be shut down during this procedure.

✎ NOTE:

The steps in this section shut down the controllers using the HP Command View EVA. If you prefer, you may use other methods to perform a clean shutdown of the controller.

1. Using HP Command View EVA, navigate to the Initialized Storage System Properties window.
2. Click **Shut Down**.
3. Use the System Shutdown option to power off both controllers and the disk enclosures.
4. Manually power down the main cabinet by toggling the two switches on the PDU.
5. Toggle the switch on the back of each controller so that it is in the OFF position. This prevents the controllers from powering on again when the main cabinet is powered on in a later section.

Connecting the expansion cabinet to the main cabinet

There are two styles of EAB cables you may encounter. The older style (see Figure 3) uses junction boxes with each box connecting to two drive enclosures. The newer molded EAB expander cables (see Figure 4) have one cable between a drive enclosure and the shelf connector on the EAB expander cable.

To simplify the illustrations, only the two top and two bottom connections are shown. The top EAB connector requires an EAB top terminator. Underneath the lowest EAB connector in the main cabinet is where the bottom terminator is located, prior to its removal for the extension cable that connects at this location.

> **NOTE:**
>
> The top and bottom terminators are not identical or interchangeable. The top terminator is part number 12-56288-01 or 12-56288-03 depending on the EAB cabling (EAB junction boxes or shelf expander cables). The bottom terminator is part number 12-56288-02 and is the same for either EAB cable type. If the wrong terminator is installed, incorrect enclosure addressing occurs.
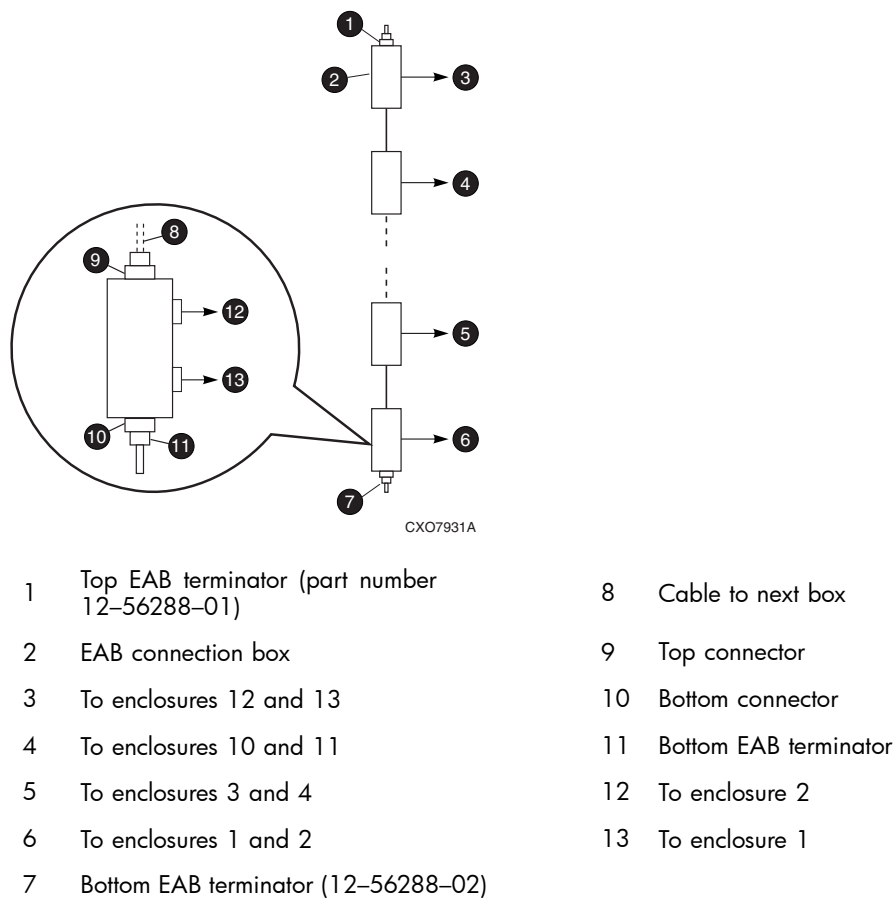

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1	Top EAB terminator (part number 12–56288–01)	8	Cable to next box
2	EAB connection box	9	Top connector
3	To enclosures 12 and 13	10	Bottom connector
4	To enclosures 10 and 11	11	Bottom EAB terminator
5	To enclosures 3 and 4	12	To enclosure 2
6	To enclosures 1 and 2	13	To enclosure 1
7	Bottom EAB terminator (12–56288–02)		

Figure 3 Older style junction box EAB cabling and terminators in the main cabinet

16000
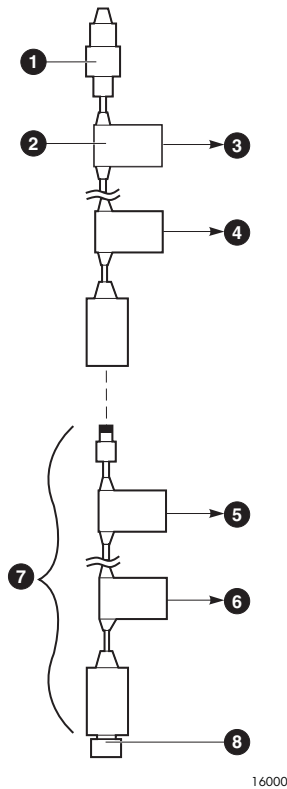
1	Top EAB terminator (part number 12–56288–03)	5	To enclosure 2
2	Shelf connector	6	To enclosure 1
3	To enclosure 13	7	Shelf ID expander cable
4	To enclosures 12	8	Bottom EAB terminator (12–56288–02)

Figure 4 Newer style expander EAB cabling and terminators in the main cabinet

Termination in the expansion cabinet is designed as follows:

- The expansion cabinet does not have a bottom terminator connected to the bottom EAB connection. The EAB extension cable in the expansion cabinet connects where the bottom terminator would otherwise go.
- The connection box to which the sixth enclosure attaches is terminated at the top. Make sure that this connection box already has a top terminator installed.

Connecting the EAB extension cable to the expansion cabinet

NOTE:

Although the connectors on each end of the EAB extension cable look similar, they are wired differently internally. The cable end marked P2 connects to the expansion cabinet and the end marked P1 connects to the main cabinet.

1. In the expansion cabinet, connect the P2 end of the EAB extension cable to the underneath side of the bottom EAB connector (where the bottom terminator would otherwise go).

2. With one end of the EAB extension cable connected to the expansion cabinet, observe the EMU display on each of the six drive enclosures in the expansion cabinet. If the display on the bottom enclosure of the expansion cabinet does not show `15`, try reversing the cable ends.

> **NOTE:**
> If reversing the cable ends does not fix the problem, the cable is defective. Do not continue with the next step until the bottom enclosure in the expansion cabinet displays 15 and each successive enclosure is numbered 16 through 20. If reversing the cable effectively changes the enclosure number, it will be necessary to power off the expansion cabinet, wait two minutes, and then power back on the cabinet to address any potential enclosure addressing issues.

Connecting the EAB extension cable to the main cabinet

1. Route the EAB extension cable over to the bottom EAB connector in the main cabinet, but do not connect it. Typically, the EAB extension cable should be run underneath both cabinets.

> **NOTE:**
> To connect to the bottom of the older style EAB junction box, it is sometimes necessary to remove the two screws holding the box to the frame of the main cabinet. Take care to run the EAB extension cable so that it does not interfere when reconnecting the bottom junction box to the cabinet frame.

2. In the main cabinet, disconnect the bottom terminator.

3. Connect the P1 end of the extension cable in the terminator's place.

4. Apply power to the main cabinet by toggling the PDU switches.

5. Observe the EMUs in the main cabinet and ensure that the 2-character display on each EMU again displays the correct number for its respective enclosure. The bottom EMU in the main cabinet should display 01.

6. Move to the rear of the expansion cabinet and observe the displays on each EMU. When the EAB extension cable is connected properly, each EMU displays the enclosure number of its respective enclosure. The bottom drive enclosure should be enclosure 15. From bottom to top, each successive drive enclosure EMU should display 16, 17, 18, 19, and 20.

Should any expansion cabinet or main cabinet EMU display be incorrect, one of the following problems exists:

- The EAB extension cable is defective or improperly connected to the EAB cabling.
- The six expansion drive enclosures are not properly connected to the EAB in the expansion cabinet.
- An EMU is defective.

Diagnose the problem before repeating the EAB connection steps again. Do not proceed to the next section until the EAB cabling is correct and all EMUs in both cabinets are displaying their correct enclosure number.

Connecting the drive enclosures in the expansion cabinet to the FC loop switches

This section explains how the drive enclosures in the expansion cabinet are connected to the FC loop switches in the main cabinet. You can connect all cables to the expansion cabinet at the same time and route all the cables as a bundle. After each drive enclosure is connected to the FC loop switch, check the loop for proper operation before connecting the next drive enclosure to the FC loop switch.

Labeling the FC expansion cables

The 0C6D configuration contains twelve FC expansion cables. Each 5–meter cable connects an I/O module in a drive enclosure in the expansion cabinet to an FC loop switch in the main cabinet.

To help trace and manage the cabling scheme, label both ends of each cable with the drive enclosure number (15 through 20) and the section/side designation (1A, 1B, 2A, or 2B) of the I/O module into which the cable will be plugged. See the connection locations described in "Connecting the FC expansion cables to the main cabinet" on page 12.

Installing SFP transceivers in the FC loop switches in the main cabinet

The drive enclosures in the expansion cabinet connect to previously unused ports in the FC loop switch in the main cabinet. Install an SFP transceiver in each port to be used.

> **NOTE:**
> Some revisions of the I/O module require an SFP transceiver in the lower I/O port even in switched configurations where this port is not used. The I/O modules in the drive enclosures in the expansion cabinet should be shipped with the I/O ports correctly populated with SFP transceivers for the revision of the I/O module. However, HP recommends that you determine the revision level of the I/O modules and check their ports to ensure that they have SFP transceivers where needed.

Connecting the FC expansion cables to the expansion cabinet

The main cabinet should still be powered on, with the controllers off. Connect the FC expansion cables to the drive enclosures in the expansion cabinet:

1. Following the labels you placed on each cable, connect one end of each cable to the upper port of the corresponding I/O module.

2. Route the FC expansion cables from the expansion cabinet to the main cabinet:
   - Route the cables along the side of each cabinet so they can be secured and out of the way.
   - Route all the FC expansion cables as a single bundle out the bottom of the expansion cabinet.
   - Route the cables underneath the suspended flooring if present.
   - Bring the cables into the bottom of the main cabinet and separate them into two bundles, one for the switches on the right side (A-side) of the cabinet and one for the switches on the left side (B-side) of the cabinet. See the connection locations described in "Connecting the FC expansion cables to the main cabinet" on page 12 to determine which cables go to the A-side switches and which cables go to the B-side switches.
   - Bring the cables up to the FC loop switches in such a manner that they can be connected without damage to the FC loop switch ports.

   > **△ CAUTION:**
   > Do not allow fiber cables to bend with a radius smaller than 30 mm (1.2 in). Overbending compromises the integrity of the glass fiber transmission. To avoid deforming or possibly breaking copper cables, do not allow them to bend with a radius smaller than 60 mm (2.4 in).

Connecting the FC expansion cables to the main cabinet

The twelve FC expansion cables are now available in the main cabinet. In this section, each pair of FC expansion cables is connected from the I/O modules in each drive enclosure to A- and B-side FC loop switches. Two connection schemes are illustrated, depending on the style of loop switches available in the main rack. Figure 5 and Table 3 show the cable connections for model 310 or 352 2–Gbps loop switches with staggered top and bottom ports. Figure 6 and Table 4 show the cable connections for model 852 4–Gbps loop switches with aligned top and bottom ports.

For example, cables 20/2B and 20/2A form a pair to connect drive enclosure 20 in the expansion cabinet to the upper left and right FC loop switches in the main cabinet.

1. Connect one pair of FC expansion cables to the FC loop switches. For simplicity of illustration, the pre-exisiting connections from the FC loop switches to the controllers and to the drive enclosures in the main cabinet are not shown.

NOTE:

For a 0C12D expansion cabinet, the lower six enclosures connect to the first main cabinet and the upper six enclosures connect to the second main cabinet in exactly the same manner (that is, callout 1 drive enclosure I/O port to callout 1 FC loop switch port in the second main cabinet and so forth as shown in Figure 5 and Figure 6).

2. After connecting one cable pair, verify every aspect of the connection before proceeding to the next cable pair.

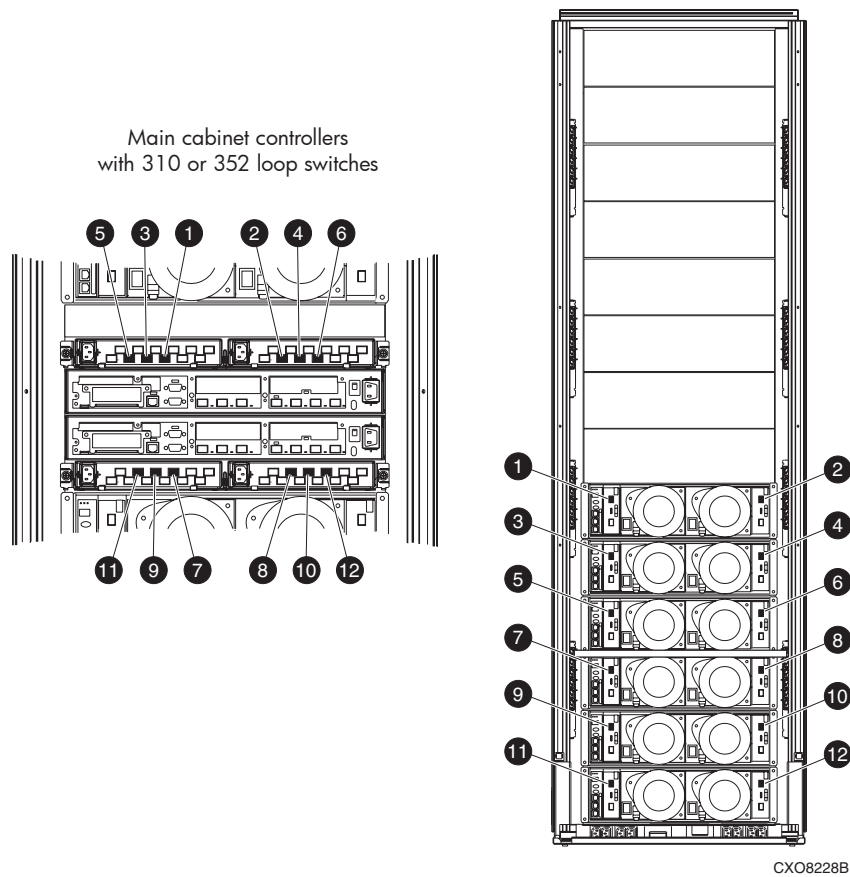3. Secure the FC expansion cables neatly to the cable management arms.

Main cabinet controllers with 310 or 352 loop switches

CXO8228B

Figure 5 Expansion cabinet enclosure connections to 310 or 352 loop switches

Table 3 Expansion cabinet drive enclosure connection to 310 or 352 FC loop switches

FC loop switch location	FC loop switch port	Drive enclosure/ loop designation	Identifying bullet[1]
Upper left	6	20 / 2B	1
Upper right	10	20 / 2A	2
Upper left	8	19 / 2B	3
Upper right	8	19 / 2A	4
Upper left	10	18 / 2B	5
Upper right	6	18 / 2A	6
Lower left	5	17 / 1B	7
Lower right	9	17 / 1A	8
Lower left	7	16 / 1B	9
Lower right	7	16 / 1A	10
Lower left	9	15 / 1B	11
Lower right	5	15 / 1A	12

[1]See Figure 5

Main cabinet controllers with
852 loop switches
(30-10022-01)

Main cabinet
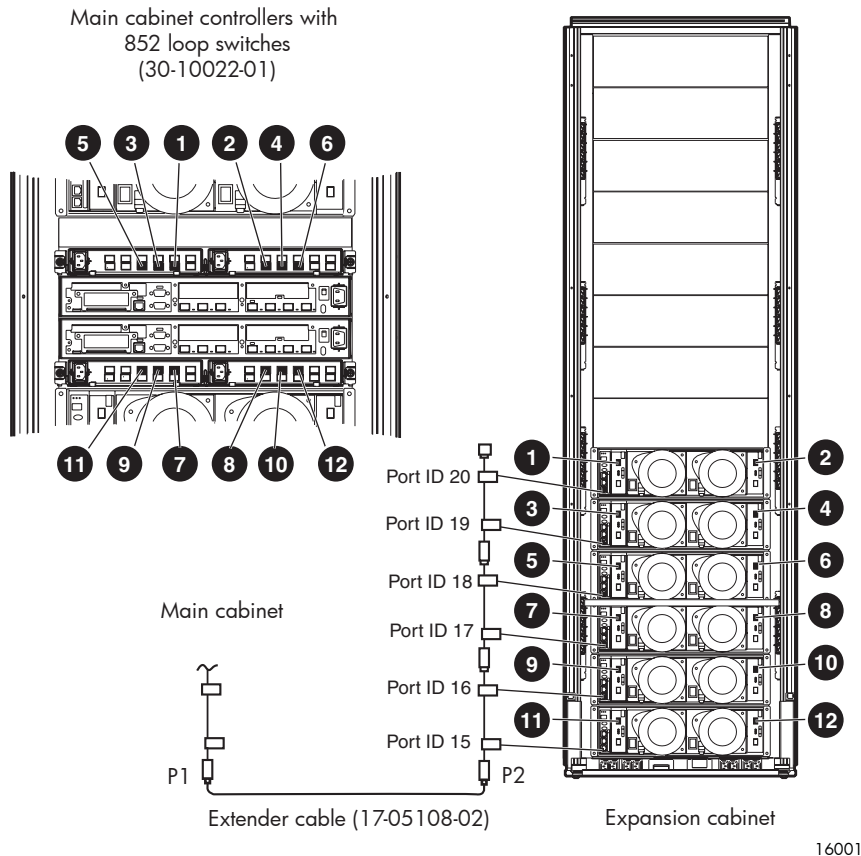
Extender cable (17-05108-02)

Expansion cabinet

16001

Figure 6 Expansion cabinet enclosure connections to 852 loop switches

Table 4 Expansion cabinet drive enclosure connection to 852 FC loop switch

FC loop switch location	FC loop switch port	Drive enclosure/ loop designation	Identifying bullet[1]
Upper left	11	20 / 2B	1
Upper right	8	20 / 2A	2
Upper left	10	19 / 2B	3
Upper right	9	19 / 2A	4
Upper left	9	18 / 2B	5
Upper right	10	18 / 2A	6
Lower left	5	17 / 1B	7
Lower right	2	17 / 1A	8
Lower left	4	16 / 1B	9
Lower right	3	16 / 1A	10
Lower left	3	15 / 1B	11
Lower right	4	15 / 1A	12

[1]See Figure 6

Powering up the controllers

The EAB and FC loops in the expansion cabinet should be displaying the proper enclosure location on the EMU. When the main cabinet controllers are powered on again, they recognize the additional enclosures and drives.

To power on the controllers:

1. Power on the cabinet by toggling the power switches on the PDUs.

2. Toggle the power switch on the back of each controller. If an EMU firmware update occurs, wait for the update to complete.

If the controllers indicate a misconfiguration error in the operator control panel display at any time during or immediately following the power-up sequence, diagnose and fix the problem:

- Pay particular attention to cabling from the expansion cabinet to the main cabinet to ensure that cables are connected to the proper loop switch.
- Review EAB cabling connections to the drive enclosures.
- Check that drives have spun up and are stabilized.
- Make sure each enclosure is functioning properly as indicated by the following LED conditions on each enclosure EMU:
  - The middle green LED on each drive in the enclosure is green and ON (not FLASHING).
  - The bottom red LED on each drive in the enclosure is OFF.
  - No other errors are present in the EMU for the enclosure or in the controller pair.

Checking for an EMU firmware update

When controllers running XCS software versions V5.020 or later, or VCS 2.0 or later, recognize the enclosure, they can initiate a firmware update of the EMUs in the expansion cabinet. The update occurs if the revision level of EMU firmware in the expansion cabinet does not match the revision level of EMU firmware in the firmware image.

△ **CAUTION:**

If a firmware update starts, be sure to let it complete on all EMUs in the section. If the power to the EMU is interrupted during the update, the EMU will become nonfunctional and requires a replacement. Power interruption includes hot swapping the EMU, powering down the enclosure, resetting or powering down the controller while it is performing firmware update, or powering down the cabinet by cycling the PDU.

To determine if an EMU firmware update is occurring, observe the 2-character display on the faceplate of each EMU in the newly connected section. EMUs undergoing a firmware update change from displaying the drive enclosure number to displaying the letters Ld.

After the Ld indicators count to 100, the EMU displays pf while the flash memory of the EMU is loaded. Do not interrupt this process or the EMU will need to be loaded via the serial upload process.

📝 **NOTE:**

Firmware update starts within one minute of controller awareness of an additional EMU in the FC loop. Upon completion of the update (typically two to three minutes per EMU), the display returns to showing the drive enclosure number.