ThinkStation P500/P510, P700/P710, and P900/P910 RAID Hardware Configuration

Version 1.1

1. Introduction

The introduction of the new ThinkStation P500/P510, P700/P710 and P900/P910 platforms brings with it several new storage options that are designed to increase the storage capacity and performance of the system. As with previous ThinkStation platforms, P500/P510/700/P9710/P900/P910 will continue to support the standard SATA and SAS storage technologies to provide users with a wide variety of data storage solutions. This document will highlight the available SATA, SAS, and RAID storage solutions offered on this latest generation of ThinkStations as well as provide valuable information about how users can configure these solutions to provide the best performance possible.

2. Hard Drive Controllers used on ThinkStation P500/P510, P700/P710, P900/P910

ThinkStation P500/P510, P700/P710 and P900/P910, have several hard drive controller options that can be used to support a wide variety of drive configurations. Selecting the correct controller will directly depend on the number and type of drives a user wants to support in their specific configuration. RAID requirements also play a big part in determining which controller to choose when configuring your ThinkStation.

Onboard Intel SATA Controller

The "default" controller on P500/P510, P700/P710, and P900/P910 is the onboard Intel SATA controller, sometimes called S-SATA. This controller is capable of supporting up to four SATA HDDs/SSDs at Gen3 (6Gb/s) max theoretical bandwidth. It's important to note that only SATA devices are supported with the onboard Intel controller. RAID modes 0/1/5/10 are supported as well. *Refer to "P500-P510-P700-P710-P900-P910 How to Create and Configure RAID Arrays" for more info about how to configure RAID arrays.*

Unlike previous ThinkStation systems that used onboard Intel SATA controllers, all three platforms have support for the same number of drives with this controller. Connection methods do vary by platform.

P900/P910 SATA Support via Intel Onboard S-SATA Controller

Maximum Number of Drives	4 (2 drives per BCA)
Connection Method	Tool-less via BCA
Drive Locations	Drives install into FLEX Bays via FLEX Tray. One drive per FLEX bay. Drives install in **upper** (▲) position labelled P1 & P2.
Hardware Required	BCA-S* or BCA-P
Drives Types Supported (6Gb/s)	3.5" SATA HDD (7200rpm) 3.5" SSHD (Hybrid) 2.5" SATA SSD
RAID Level Support	RAID 0 RAID 1 RAID 5 RAID 10
Drive Speed	Maximum speed is 6Gb/s.

*BCA-S comes standard in P900/P910.

P500/P510/P700/P710 SATA Support via Intel Onboard S-SATA Controller using Manual HDD Connect

Maximum Number of Drives	4
Connection Method	Manual plug for data and power using standard cabling methods
Drive Locations	Drives install into FLEX Bays via FLEX Tray. One drive per FLEX bay.
Hardware Required	SATA HDD cable(s), HDD Power cable
Drives Types Supported (6Gb/s)	3.5" SATA HDD (7200rpm) 3.5" SSHD (Hybrid) 2.5" SATA SSD
RAID Level Support	RAID 0 RAID 1 RAID 5 RAID 10
Drive Speed	Maximum speed is 6Gb/s.

P500/P510/P700/P710 SATA Support via Intel Onboard S-SATA Controller using Blind Connect Assembly (BCA)

Maximum Number of Drives	4 (2 drives per BCA)
Connection Method	Blind Connect Assembly (BCA)
Drive Locations	Drives install into FLEX Bays via FLEX Tray. One drive per FLEX bay. Drives install in **upper** (▲) position labelled P1 & P2.
Hardware Required	Up to two BCA-S or BCA-P.
Drives Types Supported (6Gb/s)	3.5" SATA HDD (7200rpm) 3.5" SSHD (Hybrid) 2.5" SATA SSD
RAID Level Support	RAID 0 RAID 1 RAID 5 RAID 10
Drive Speed	Maximum speed is 6Gb/s

Optional LSI SATA/SAS RAID controllers

ThinkStation P500/P510, P700/P710, and P900/P910 platforms utilize discrete controllers in order to add support for SAS drives. These controllers offer support for both SATA and SAS drives, support more drives than the standard onboard controller and in some cases offer increased performance and reliability capabilities.

LSI SATA/SAS RAID FLEX Adapter

- Specialized FLEX adapter that only installs to Lenovo FLEX Connectors
- Capable of supporting up to 8 SATA or SAS drives using Blind Connect Assemblies
- Uses LSI SAS3008 IOC controller
- Support for RAID 0/1/5/10 for both SATA and SAS formats
- Support for up to 12Gb/s
- Does not occupy a traditional PCIe slot, allowing for additional system expansion
- Utilizes mini-SAS HD connectors to connect the adapter to BCA
- For the P500/P510 and P700/P710, the FLEX Adapter may utilize a manual connect option by using the LSI to HDD Manual Tray Cable to avoid using Blind Connect Assemblies. If the LSI to HDD Manual Tray Cable is used, then the FLEX Adapter can only support up to 4 SATA, SAS or SATA and SAS drives.

LSI 9364-8i PCIe SATA/SAS ROC Adapter

- Standard PCIe x8 card
- Capable of supporting up to 8 SATA or SAS drives using Blind Connect Assemblies
- Uses LSI SAS3108 ROC controller
- Support for RAID 0/1/5/10 for both SATA and SAS formats
- Support for up to 12Gb/s
- Utilizes mini-SAS HD connectors to connect the adapter to BCA
- Increased performance as all RAID workload is handled on card, instead of being offloaded to system (CPU)
- Includes support for optional SuperCap for added reliability in case of power outages.
- For the P500/P510 and P700/P710, the FLEX Adapter may utilize a manual connect option by using the LSI to HDD Manual Tray Cable to avoid using Blind Connect Assemblies. If the LSI to HDD Manual Tray Cable is used, then the FLEX Adapter can only support up to 4 SATA, SAS, or SATA and SAS drives.

P500/P510/P700/P710/P900/P910 SATA and SAS Support via LSI Controllers Using Blind Connect Assembly

Maximum Number of Drives	8 (4 drives per BCA)
Connection Method	BCA
Drive Locations	Drives install into FLEX Bays via FLEX Tray. Up to two drives per FLEX Tray*
Hardware Required	LSI SATA/SAS RAID FLEX Adapter or LSI 9364-8i ROC Up to two BCA-S or BCA-P
Drives Types Supported	3.5" SATA HDD (7200rpm) 3.5" SSHD (Hybrid) 2.5" SATA SSD 2.5" SAS HDD (15000rpm, 12Gb/s) 2.5" SAS SSD (12Gb/s)
RAID Level Support	RAID 0 RAID 1 RAID 5 RAID 10
Drive Speed	Maximum speed is 12Gb/s

*Some physical limitations apply

P500/P510/P700/P710 SATA and SAS Support via LSI Controllers using Manual HDD Connect

Maximum Number of Drives	4
Connection Method	LSI to HDD Manual Connect Cable
Drive Locations	Drives install into FLEX Bays via FLEX Tray. One drive per FLEX tray.
Hardware Required	LSI SATA/SAS RAID FLEX Adapter or LSI 9364-8i ROC LSI to HDD Manual Connect Cable*
Drives Types Supported (6Gb/s)	3.5" SATA HDD (7200rpm) 3.5" SSHD (Hybrid, 7200rpm) 2.5" SATA SSD 2.5" SAS HDD (15000rpm, 12Gb/s) 2.5" SAS SSD (12Gb/s)
RAID Level Support	RAID 0 RAID 1 RAID 5 RAID 10
Drive Speed	Maximum speed is 12Gb/s.

*The LSI to HDD Manual Tray Cable is only supported on P500/P510 and P700/P710

3. How to Utilize the Onboard Intel S-SATA Controller

P900/P910

In the P900 system, drives are always connected through the use of Blind Connect Assemblies (BCA). When using the onboard Intel S-SATA controller, up to two drives can be connected per BCA. This gives P900 support for up to 4 drives with the onboard Intel S-SATA controller via two BCA. When the BCA is connected to the controller, LEDs will illuminate on the BCA to show which port(s) are active, and the drive type supported by that port (see 'Technical Glossary' for diagram).

1. Ensure that the S/X cable of the BCA is connected to the mini-SAS HD connector on the motherboard. For the lower BCA (bays 1 and 2), the S/X cable of the BCA attaches to the SATA 1-2 port on the motherboard. For the upper BCA (bays 3 and 4), the S/X cable of the BCA attaches to the SATA 3-4 port on the motherboard.
2. With AC power connected and the system off, the BCA will illuminate to show which ports are active and the drive types supported by each port.
3. Install the SATA drive into the FLEX Tray in a manner such that the drive connectors for power and data align correctly with the port on the BCA. Note that the FLEX Tray can be rotated 180 degrees to allow for the correct connection.
4. Align the FLEX Tray with the SATA drive and insert it into the bay making sure that the drive is connecting to an active port. Insert the FLEX Tray fully, and push the pull-bar feature so that it is flush with the bay.
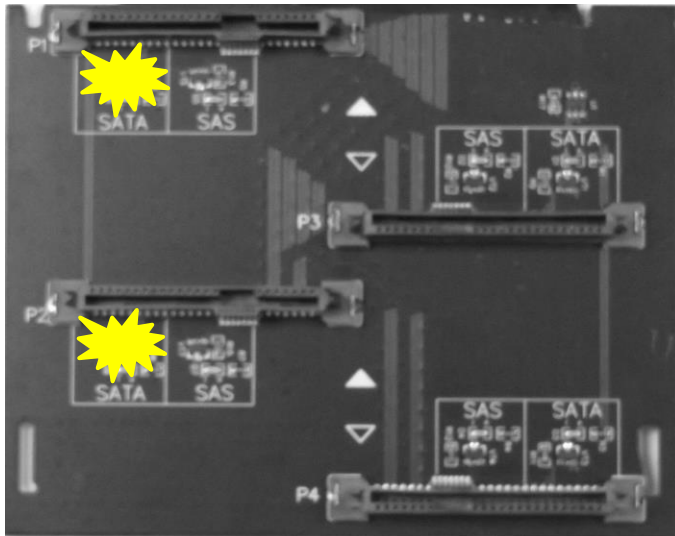
P900/P910 – Blind Connect Assembly
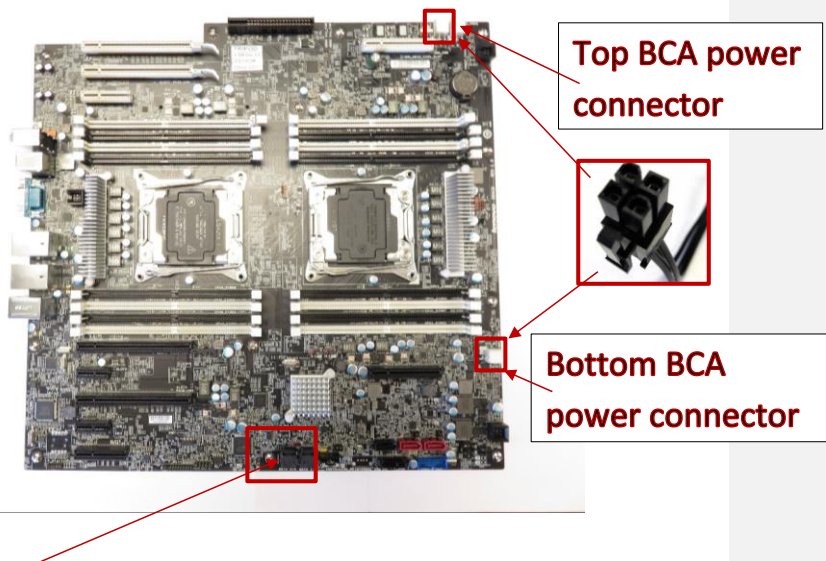
Top BCA power connector

Bottom BCA power connector
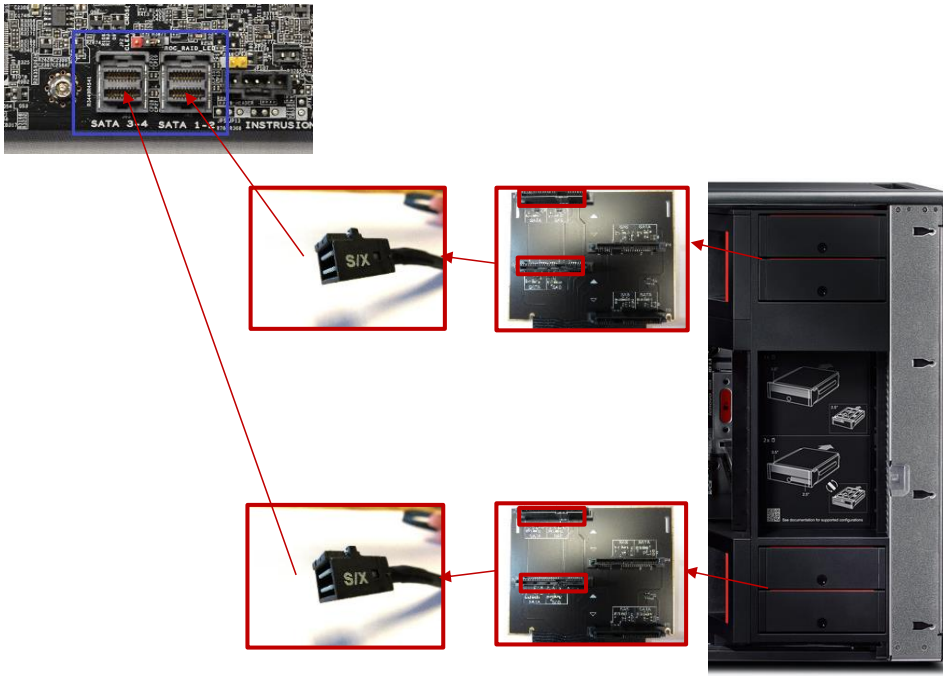
P500/P510/P700/P710 via Manual HDD Connect Option

For P500/P510 and P700/P710, SATA drives are connected to the onboard Intel S-SATA controller via a manual plug method. This consists of manually cabling both power and data to each drive individually. Total drive support is the same as P900/P910, with the onboard Intel S-SATA controller supporting up to 4 drives.

1. Install the SATA drive into the FLEX Tray. Note that FLEX Trays can be rotated 180 degrees as needed for ease of connection.
2. Insert the FLEX Tray with drive into the bay.
3. Connect SATA power to the drive using one of the SATA power connectors on the included cable. The other end of the SATA power cable should already be connected to the motherboard.
4. Connect the SATA data cable to the drive.
5. Connect the SATA data cable to one of the onboard SATA ports (refer to the system label on the system cover for the SATA port location).

P500/P510 – Manual Connect

SATA4 SATA1
SATA3 SATA2
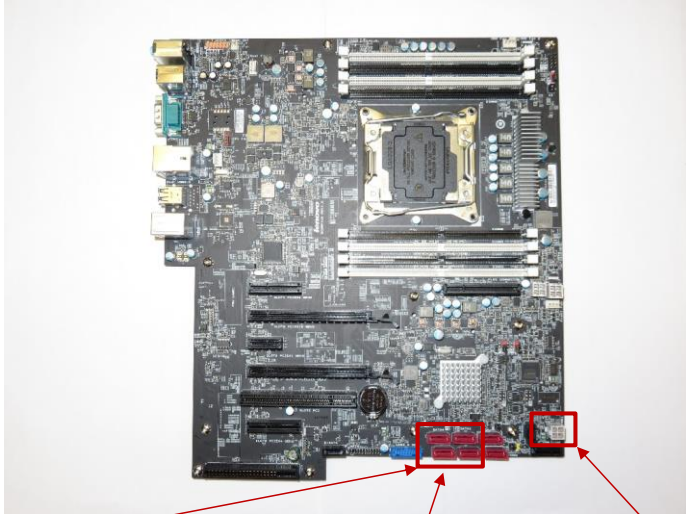
Data cable

Power cable

***One data cable per HDD/SSD. One power cable connects to four HDD/SSD.

P700/P710 – Manual Connect Option

Data cable	**Power cable**

SATA1 SATA2 SATA3 SATA4
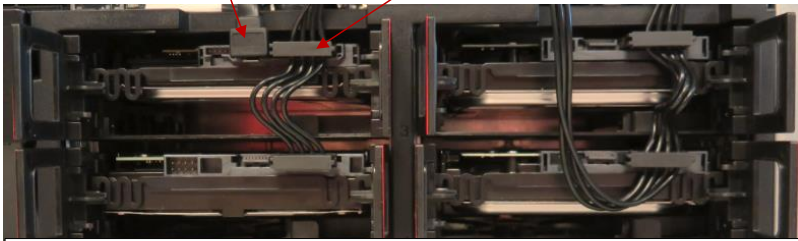
***One data cable per HDD/SSD. One power cable connects to four HDD/SSD.

P500/P510/P700/P710 via BCA

For P500/P510 and P700/P710, SATA drives can be connected to the onboard Intel S-SATA controller via a BCA. This consists of the Blind Connect to SATA Cable and dual BCA-S. Total drive support is the same as above, with the onboard Intel S-SATA controller supporting up to 4 drives.

1. Install dual BCA-S into the HDD bays.
2. Connect the Blind Connect to SATA Cable to SATA ports 1, 2, 3, and 4 on the motherboard.
3. Connect the other end of the Blind Connect to SATA Cable to both of the BCA-S.
4. Connect the BCA-S power connector to the motherboard.
5. Remove the red marked handles to the FLEX Tray, rotate the FLEX Tray 180 degrees vertically and install the handles back on the opposite end of the FLEX Tray.
6. Install the SATA drive into the FLEX Tray.
7. Insert the FLEX Tray with drive into the bay so the drive attaches to the left-most slots of the BCA-S.
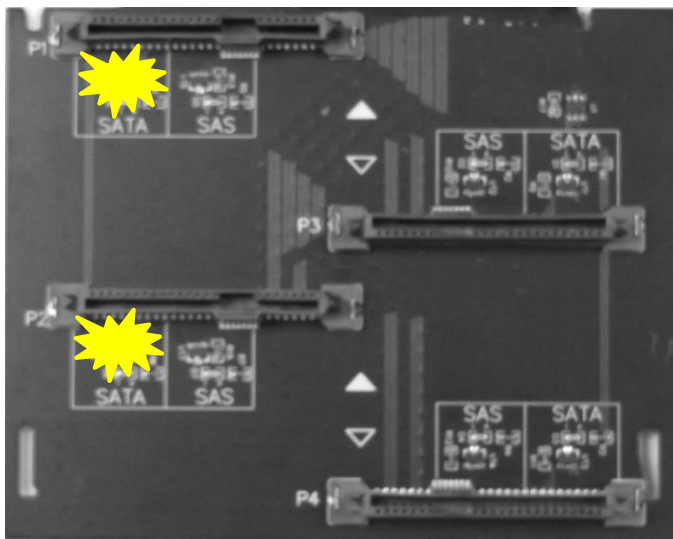
***Active ports are indicated by LED Lights shown above in yellow.

P500/P510 - Onboard Intel sSATA w/ BCA's
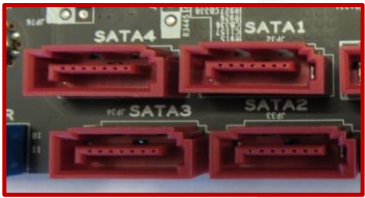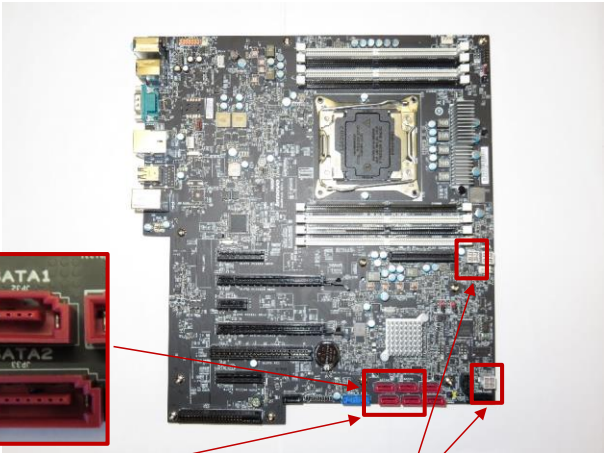
1 per BCA. Connects to motherboard.

1 per BCA. Connects to Blind Connect SATA cable.
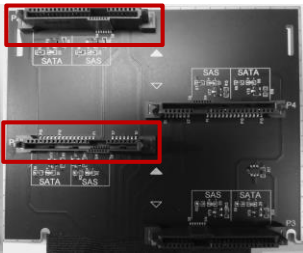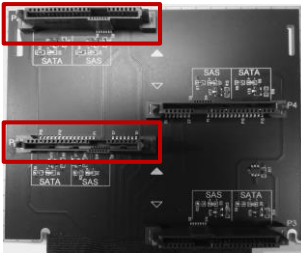
These ports will be active as indicated by an LED.

FLEX trays.

1 HDD/SSD per FLEX tray.

P700/P710 – Onboard Intel sSATA w/ BCA's
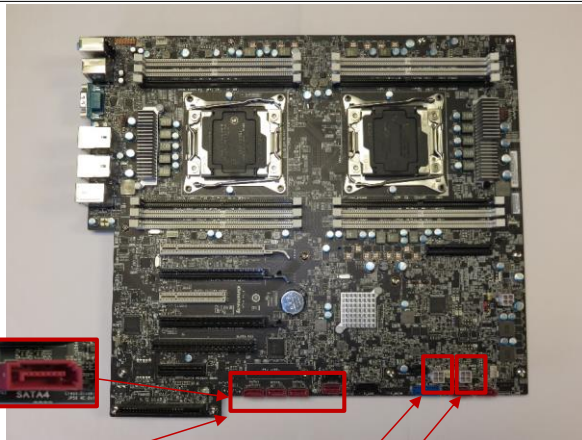
1 per BCA. Connects to motherboard.

1 per BCA. Connects to Blind Connect SATA cable.
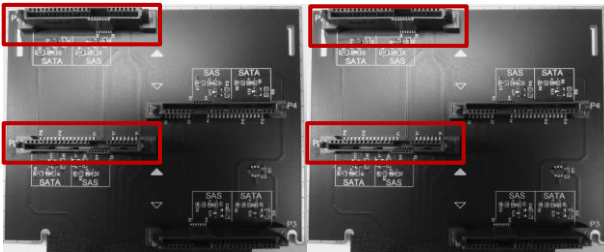
These ports will be active as indicated by an LED.
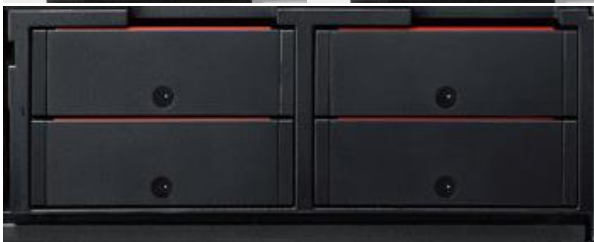
FLEX trays.

1 HDD/SSD per FLEX tray.

4. How to Utilize LSI Controllers

When configuring any of the new P500/P510, P700/P710, or P900/P910 platforms with one of the optional LSI controllers, there are some considerations to be made in order to ensure all the necessary hardware is installed to support these controllers. Both the LSI SAS/SATA FLEX RAID Adapter and the LSI 9364-8i ROC controller can utilize BCA's or manual cable connections. Note that if manual connections are used, a maximum of 4 drives can be supported in the system.

For P900/P910, two BCA-S assemblies are standard to the system, so no additional hardware is required other than the optional LSI controller (FLEX RAID Adapter or 9364-8i). Alternatively, BCA-P can also be used in place of BCA-S with the same functionality.

For P500/P510 and P700/P710, the normal method supporting drives with the LSI controllers is by BCA. Manual cable connections can be used, but this also limits the maximum number of drives supported to 4 total drives.

With either of the LSI controllers installed, each platform can support a maximum of 8 drives when BCA's are utilized. Once the BCA is connected properly to the controller and AC power is applied, the BCA will illuminate LEDs near each port to show that it is active and the drive types that can be supported (SATA and SAS). With the use of manual cable connections, the maximum number of drives is limited to 4 per system.

P900/P910

1. Install the desired LSI controller to the appropriate slot in the system
    a. For the LSI 9364-8i, the adapter must install to an available PCIe slot. Note that CPU2 must be populated for slot 6, slot 7, or slot 8 to be used. Refer to the system label for slot locations.
        -   Lift the card retention handle and remove the PCI blank for the slot to be used.
        -   Install the LSI 9364-8i into the PCIe slot.
        -   Install the LSI ROC card air baffle on top of the LSI 9364-8i card.
        -   Close the card retention handle.

    b. For the LSI SAS/SATA FLEX RAID Adapter, the card must install to one of the FLEX Connectors on the motherboard. Note that CPU2 must be populated for the (white) FLEX Connector #2 to be used. Refer to the system label for FLEX Connector locations.
        -   Lift the card guide tab near the FLEX Connector
        -   Install the FLEX Adapter into the slot making sure the card guide is engaged on the right side of the card.
        -   Close the card guide tab to secure the adapter.
2. Locate the mini-SAS HD cable (labeled S/X) from the lower BCA-S (bays 1 and 2) and attach it to the connector on the LSI controller. For LSI 9364-8i, connect the S/X cable to Port 0 (right) on the card. For the LSI SAS/SATA FLEX RAID Adapter, connect the S/X cable to P1 on the FLEX Adapter.
3. Locate the mini-SAS HD cable (labeled S/X) from the upper BCA-S (bays 3 and 4) and attach it to the connector on the LSI controller. For LSI 9364-8i, connect the S/X cable to Port 1 (left) on the card. For the LSI SAS/SATA FLEX RAID Adapter, connect the S/X cable to P2 on the FLEX Adapter.
4. Once AC power is applied to the system, the BCA(s) should now illuminate LEDs to indicate which ports are active as well as which drive types (SATA and SAS) are supported.
5. Install all drives to the FLEX Trays. Note that with LSI controllers, each FLEX Tray can support up to two drives (one 3.5" drive and one 2.5" drive per tray; certain physical limitations apply).
6. Insert the populated FLEX Tray(s) fully into the bay, and push the pull-bar feature such that it is flush with the bay.
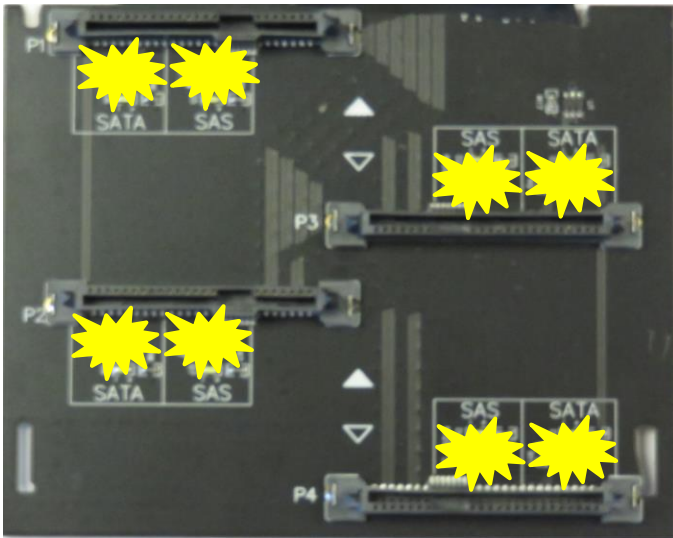
***Active ports are indicated by LED Lights shown above in yellow.

P900/P910 with LSI SATA/SAS RAID FLEX Adapter
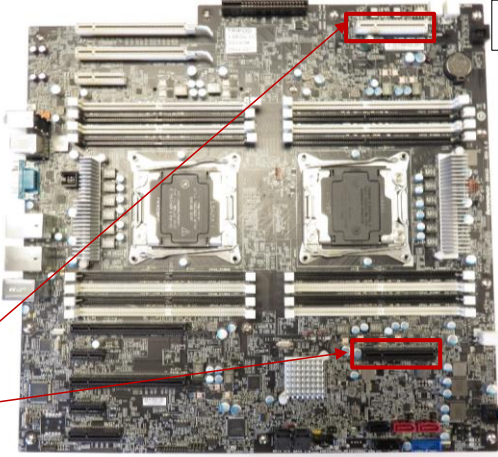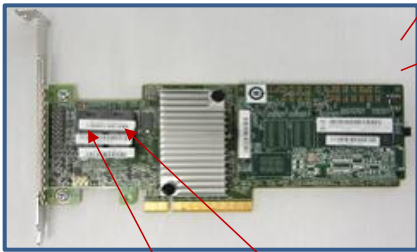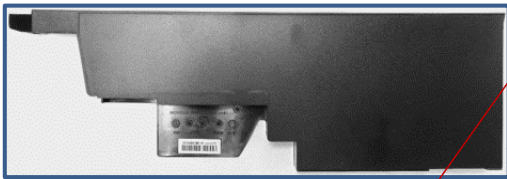
Routed to CPU 2.

Routed to CPU 1.

Primary install slot is the bottom (black) FLEX connector routed to CPU 1.
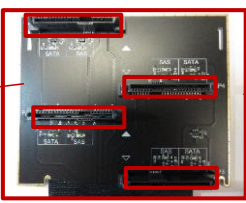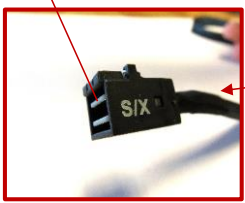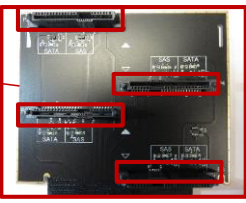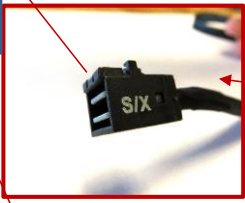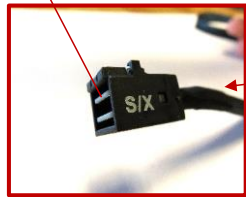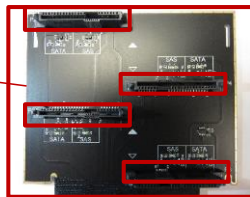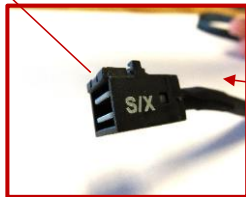
P900/P910 with LSI 9364-8i ROC Adapter

Routed to CPU 2.

LSI ROC RAID card air baffle
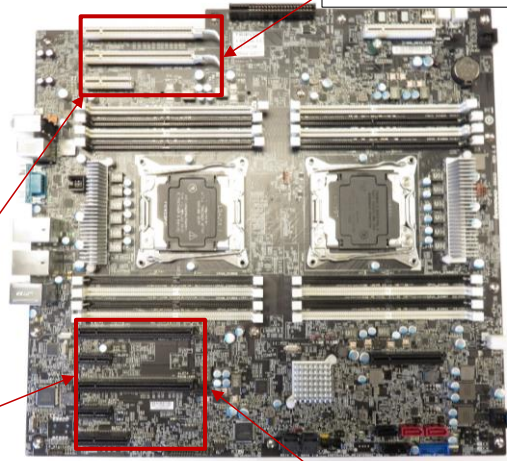
Routed to CPU 1.

Primary install slot are the bottom (black) PCIe slots routed to CPU 1.

P500/P510/P700/P710

Instructions for using the LSI controllers with P500/P510 and P700/P710 are essentially the same as the instructions for P900/P910 listed above. There are a few hardware requirements to consider prior to following those instructions.

- Ensure the system is equipped with BCA's.
- Ensure the system is equipped with "pull-bar" style FLEX Trays instead of the "barn-door" style FLEX Trays that are used by default for manual connections.

Once these requirements are met, users can follow the P900 instructions to configure the system for use with the LSI 9364-8i ROC or LSI SAS/SATA RAID FLEX Adapter.

Note: For P500/P510 and P700/P710, bays 1 and 2 are the left-most bays. Bays 3 and 4 are the right most bays.

Alternatively, the P500/P510/P700/P710 may utilize the manual connect option instead of the blind connect option. To do so, the LSI to HDD Manual Tray Cable must be used. This is done by simply connecting one end of the LSI to HDD Manual Tray Cable to each of the drives installed and the other end to the LSI controller.
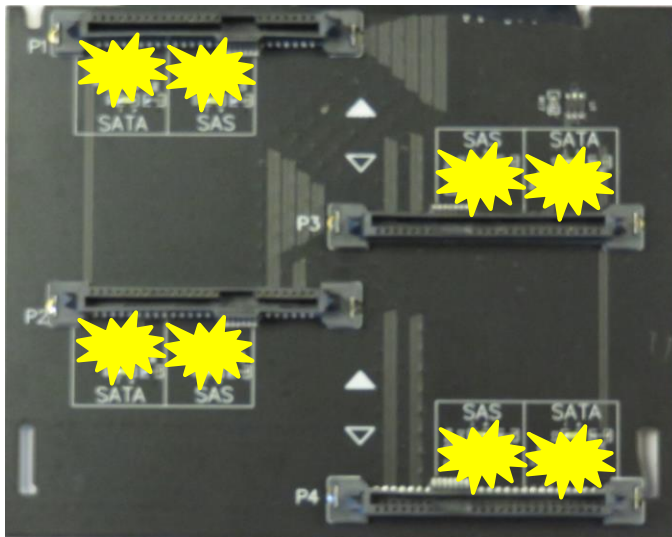
***Active ports are indicated by LED Lights shown above in yellow.

P500/P510 with LSI SATA/SAS RAID FLEX Adapter
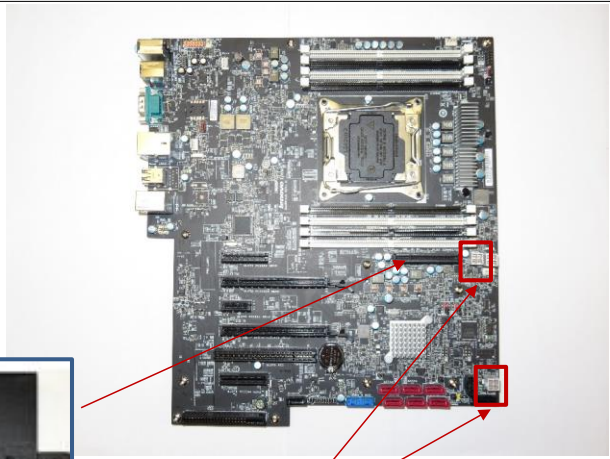
1 per BCA. Connects to motherboard.

1 per BCA. Connects to LSI adapter.
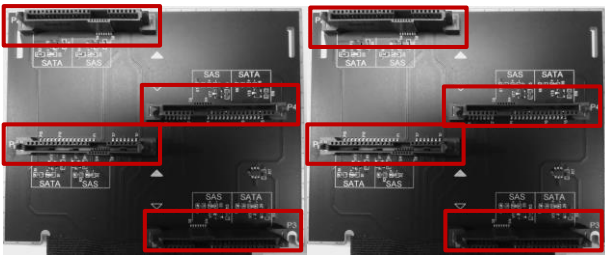
These ports will be active as indicated by an LED.

FLEX trays.

1 HDD/SSD per FLEX tray.

P500/P510 with LSI 9364-8i ROC Adapter
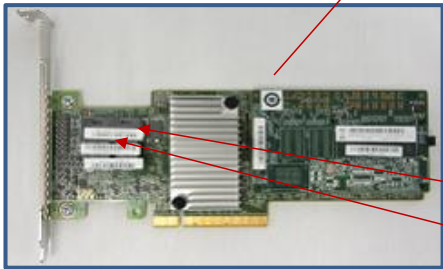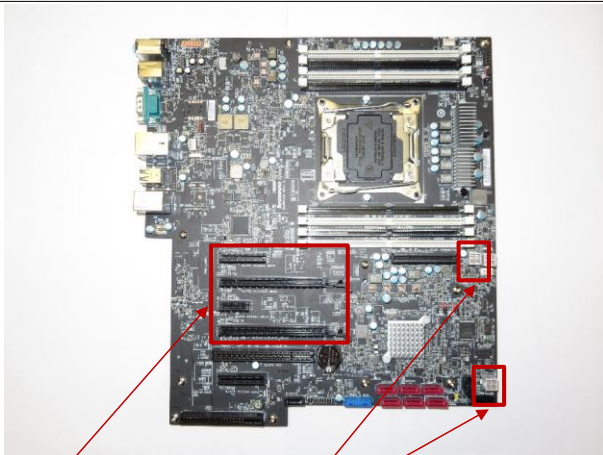
1 per BCA. Connects to motherboard.
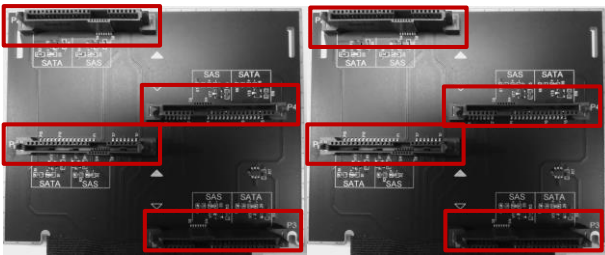
1 per BCA. Connects to LSI adapter.

These ports will be active as indicated by an LED.
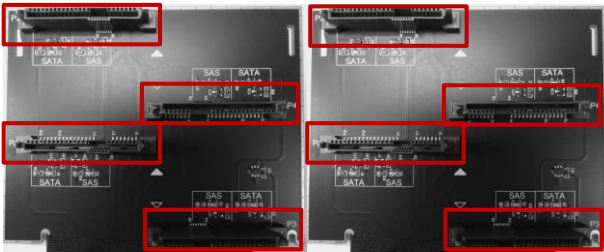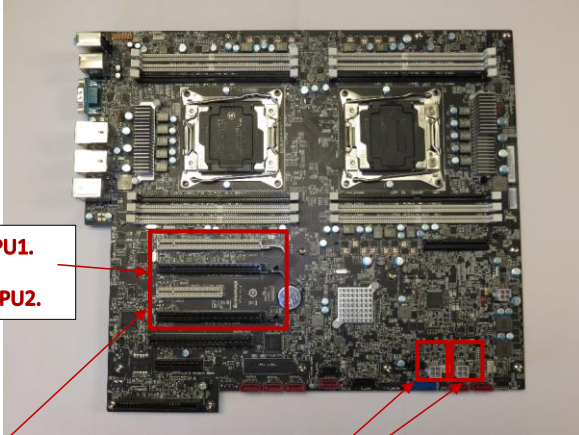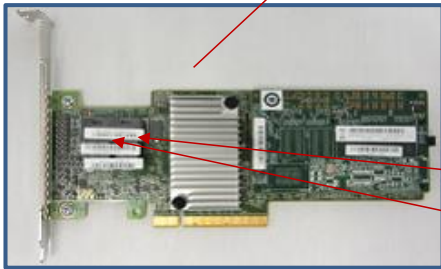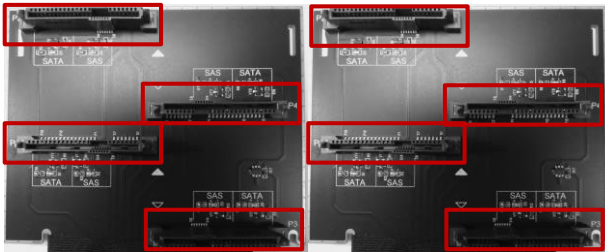
FLEX trays.

1 HDD/SSD per FLEX tray.

P700/P710 with LSI SATA/SAS RAID FLEX Adapter
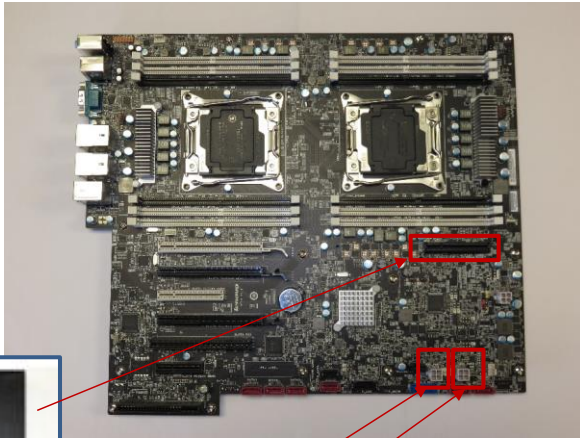
1 per BCA. Connects to motherboard.

1 per BCA. Connects to LSI adapter.

These ports will be active as indicated by an LED.

FLEX trays.

1 HDD/SSD per FLEX tray.

P700/P710 with LSI 9364-8i ROC Adapter

Black PCIe slots routed to CPU1.

White PCIe slots routed to CPU2.

1 per BCA. Connects to motherboard.

1 per BCA. Connects to LSI adapter.

These ports will be active as indicated by an LED.

FLEX trays.

1 HDD/SSD per FLEX tray.
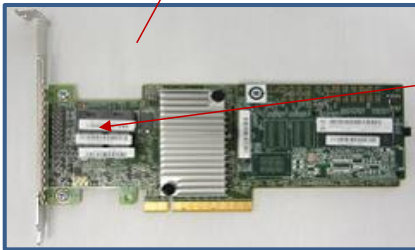
P500/P510 Manual HDD Connect using LSI Adapter
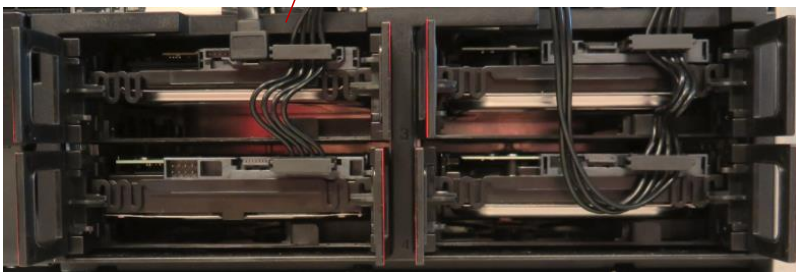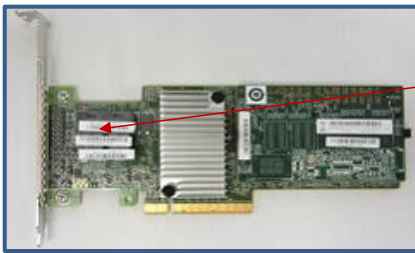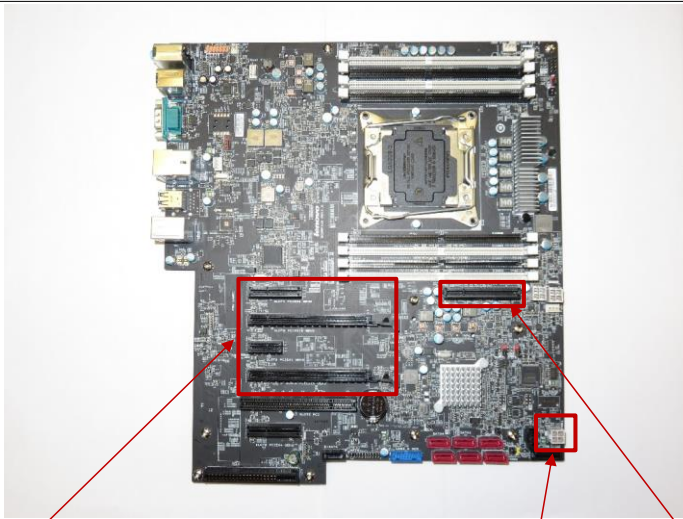
P700/P710 Manual HDD Connect using LSI Adapter
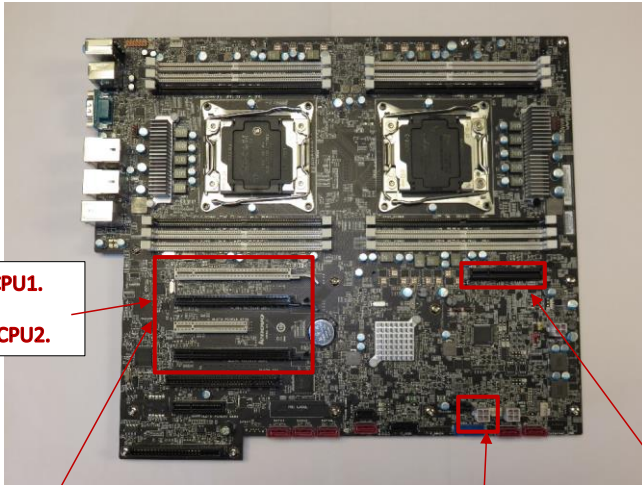
Black PCIe slots routed to CPU1.
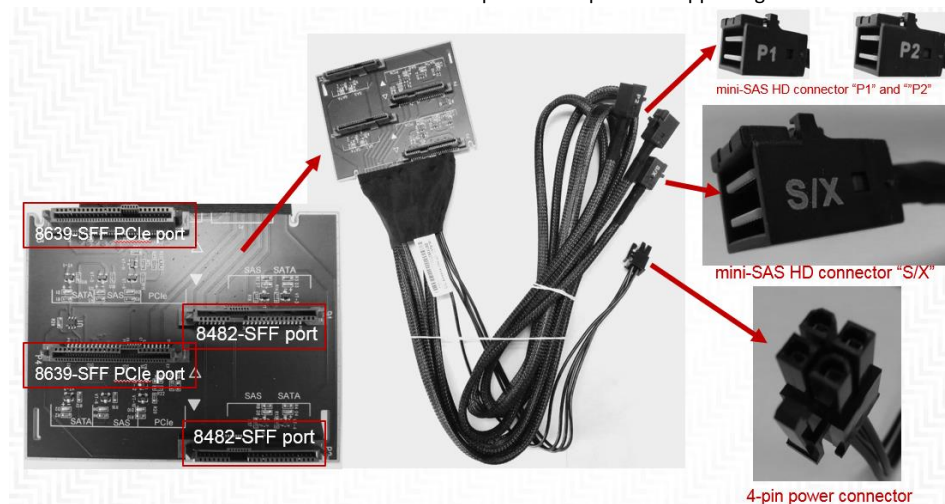
White PCIe slots routed to CPU2.
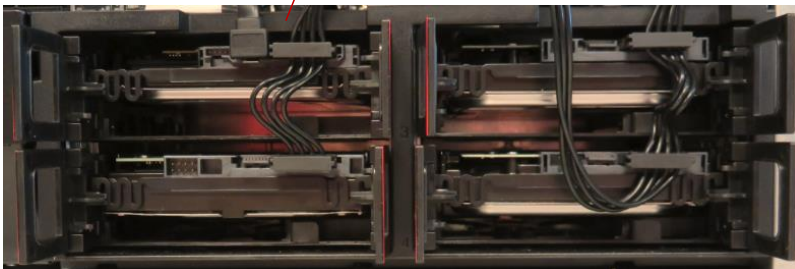
Description of Commonly Used Storage Hardware in P-Series ThinkStations

Blind Connect Assembly (BCA)

BCA-P : Blind Connect Assembly consisting of two 8639-SFF (U.2) ports (supporting PCIe, SAS, or SATA drives) and two 8482-SFF ports (supporting SAS or SATA drives). The assembly also consists of the following cable connections:

- One 4-pin power connector that connect to the motherboard
- Two mini-SAS HD connectors that connect to the Multi-IO FLEX adapter (for PCIe connections) labeled "P1" and "P2"
- One mini-SAS HD connector labeled "S/X" that connect to either the onboard controller or Avago controller
- LEDs light up next to each port to show which ports on the BCA are functional and which drive types each port can support based on the controller(s) the BCA is connected to.
- When the "S/X" cable is connected to an Avago controller, all 4 ports on the BCA are active and show as supporting SAS and SATA via the LEDs.
- When the "S/X" cable is connected to the onboard Intel controller, only two of the ports on the BCA are active and show as supporting SATA via the LEDs.
- When the "P1" and "P2" cables are connected to the Multi IO FLEX Adapter, the PCIe LEDs will illuminate to show which ports are capable of supporting 2.5" PCIe drives.

mini-SAS HD connector "P1" and ""P2"

mini-SAS HD connector "S/X"

8639-SFF PCIe port

8482-SFF port

8639-SFF PCIe port

8482-SFF port

4-pin power connector

BCA-S : Blind Connect Assembly consisting of four 8482-SFF ports (supporting SAS or SATA drives). The assembly also contains the following cable connections:

- One 4-pin power connector that connect to the motherboard
- One mini-SAS HD connector labeled "S/X" that connect to either the onboard Intel controller or Avago controller
- LEDs light up next to each port to show which ports on the BCA are functional and which drive types each port can support based on the controller(s) the BCA is connected to.
- When the "S/X" cable is connected to an Avago controller, all 4 ports on the BCA are active and show as supporting SAS and SATA via the LEDs.
- When the "S/X" cable is connected to the onboard Intel controller, only two of the ports on the BCA are active and show as supporting SATA via the LEDs.
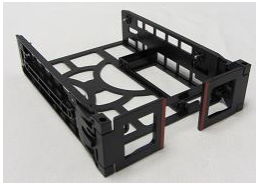

4-pin power connector

mini-SAS HD connector "S/X"
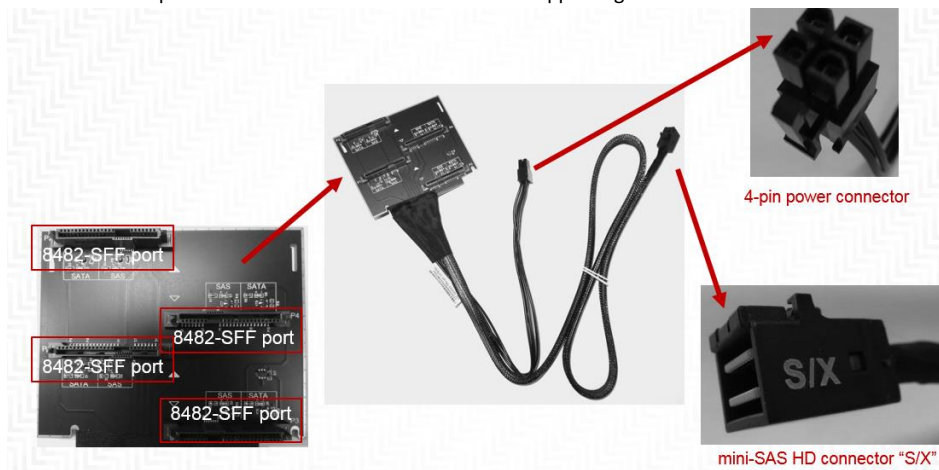
Connector Type	Drives Supported
8639-SFF (U.2) PCIe port	SATA
	SAS (only with Avago controller)
	SSD
	2.5" PCIe SSDs
8482-SFF port	SATA
	SAS (only with Avago controller)
	SSD

FLEX Tray
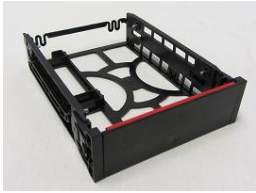
Blind Connect FLEX Tray : Tool-less tray that can hold up to two drives and utilizes a "pull-bar" style handle to connect drive(s) to the BCA


Manual Connect FLEX Tray : Tool-less tray that can hold up to two drives. These trays utilize hinged pulls that open and allow for cable access and manual cable connections.
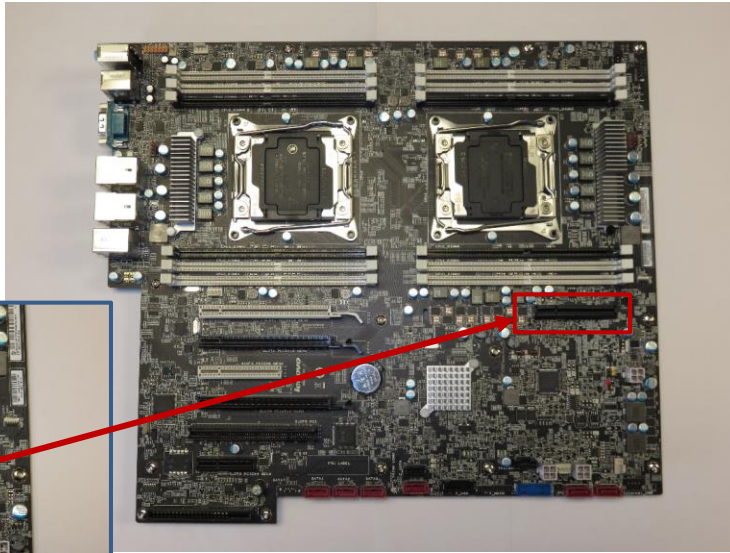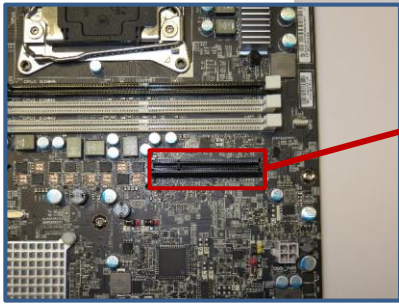
FLEX Connector

Specialized connector used to support FLEX Adapters. These connectors cannot support traditional PCIe devices. Note that the images for P500, P700, and P900 also apply to P510, P710, and P910, respectively.
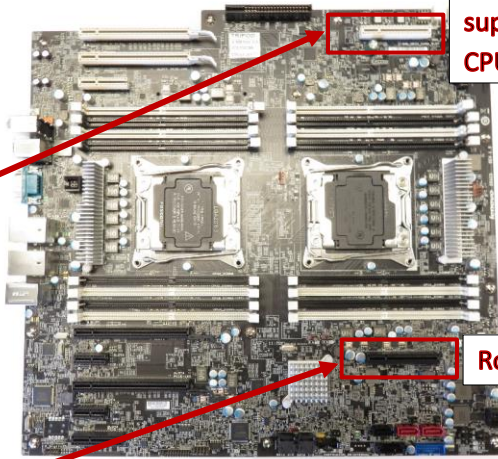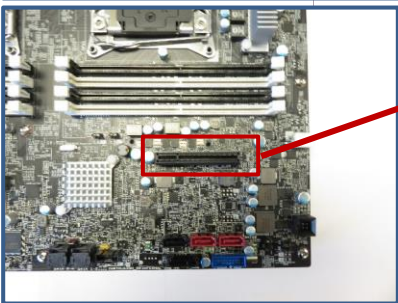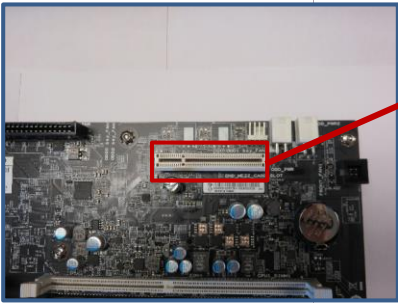
P500
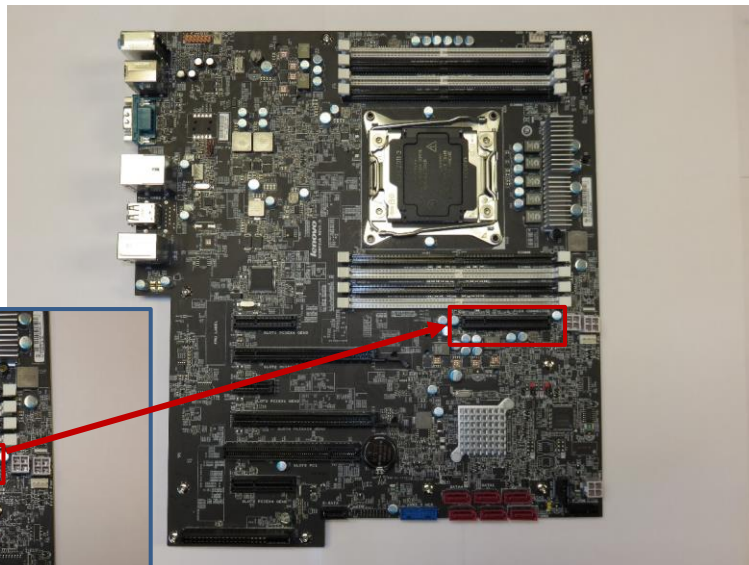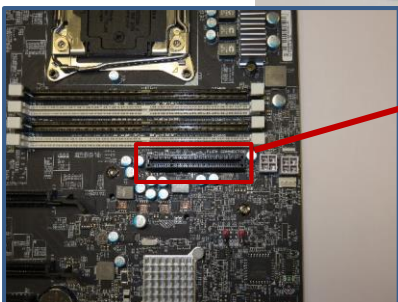
P700

P900

Routed to CPU 2. O
supported with du
CPUs.

Routed to CPU 1.

Specialized adapter cards used to support a variety of different functions

Multi IO FLEX Adapter: FLEX adapter primarily used to support 2.5" PCIe SSD drives via BCA-P. Also consists of a SATA (AHCI) port and USB2.0 port for additional connectivity.


M.2 SSD FLEX Adapter: FLEX adapter used to support M.2 PCIe drives and/or M.2 SATA drives.

LSI SAS/SATA RAID FLEX Adapter (IOC): FLEX adapter consisting of an LSI SAS/SATA RAID controller to support drives via BCA.
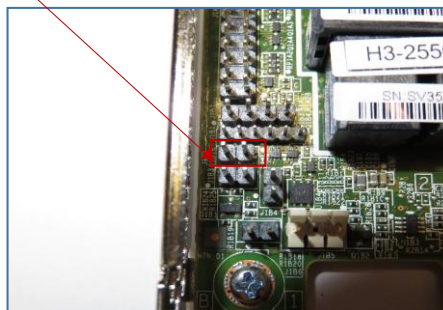
Avago 9364-8i 8-port SATA/SAS ROC Adapter (Protected Mode) w/ 1GB Flash Memory Module+SuperCap

PCIe based RAID-on-Card (ROC) adapter used to support SATA and SAS drives via BCA.
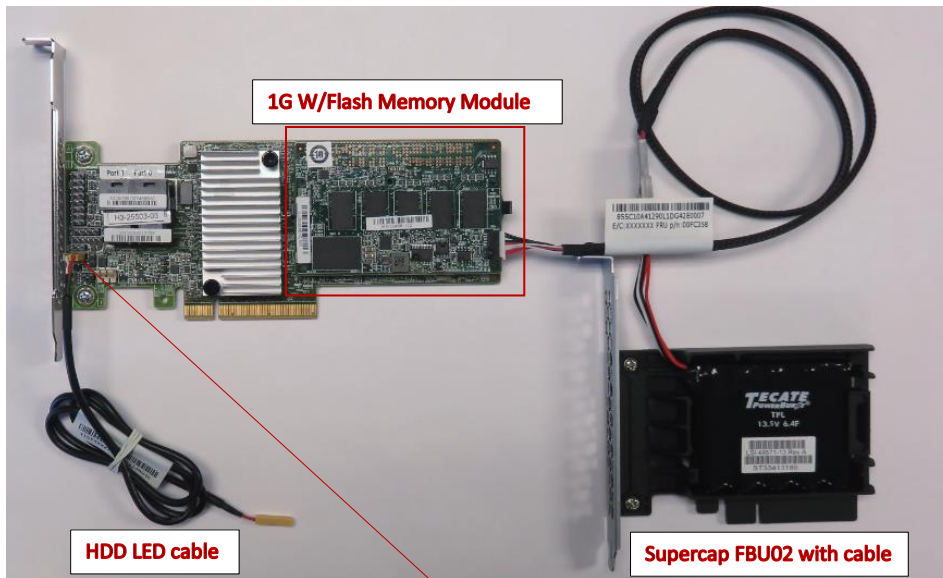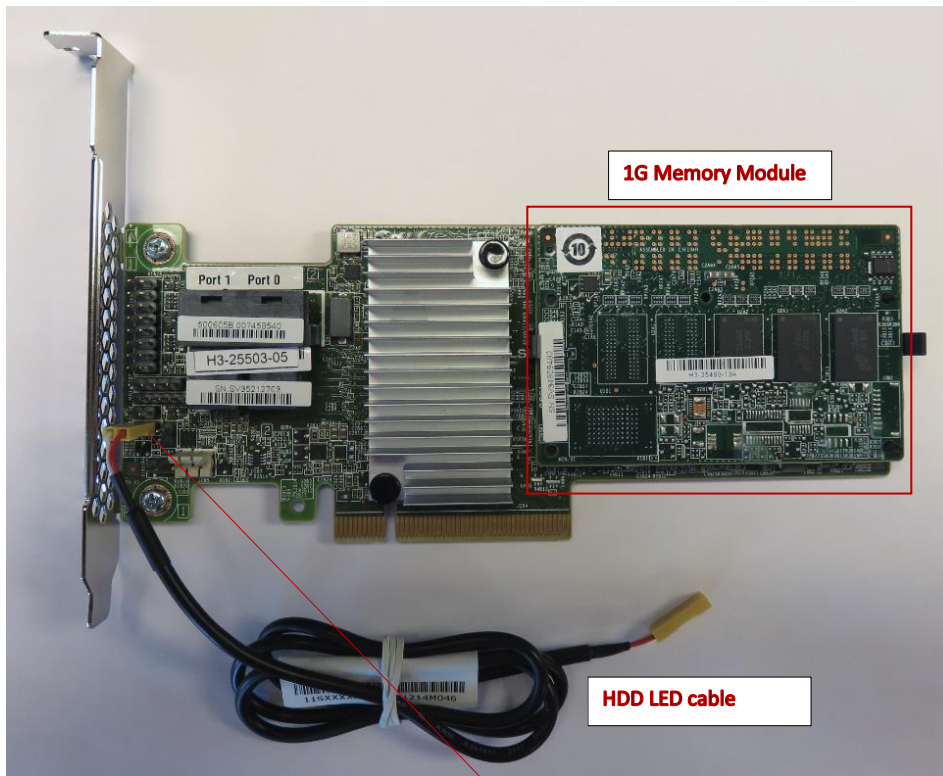

* The Supercap cable plugs directly into the 1G W/Flash Memory Module attached to the LSI adapter.

** The HDD LED cable plugs directly into the 2-pin yellow header on the motherboard.
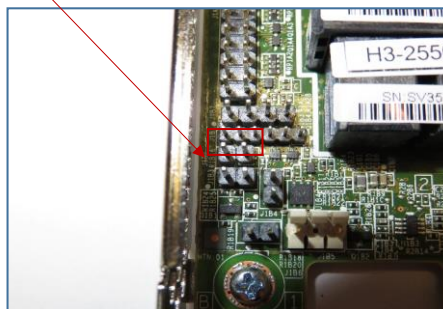
Avago 9364-8i 8-port SATA/SAS ROC Adapter (Base Mode) w/ 1GB DDR Memory Module

PCIe based RAID-on-Card (ROC) adapter used to support SATA and SAS drives via BCA.

1G Memory Module

HDD LED cable

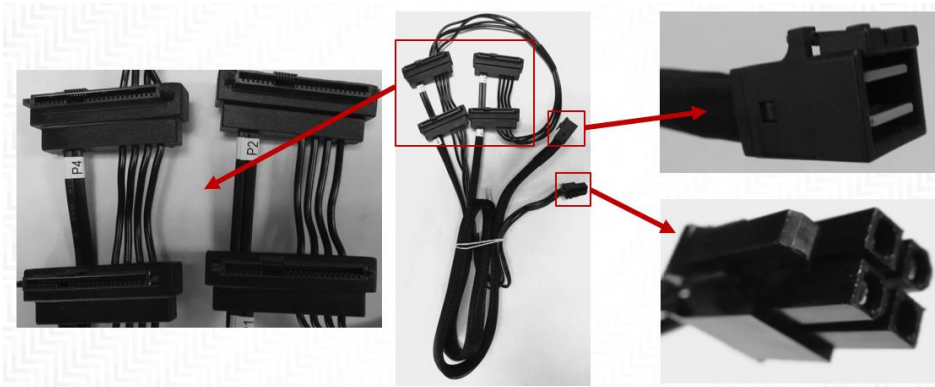** The HDD LED cable plugs directly into the 2-pin yellow header on the motherboard.*

Blind Connect to SATA cable

Blind Connect to SATA cable used to support SATA drives on Intel Onboard Controller via BCA-S for P500/P510/P700/P710.

Avago to HDD manual tray cable

Avago to HDD manual tray cable used to support SATA and SAS drives using Avago controller without BCA's.

Manual HDD Connect Cables

Manual HDD connect cables are used to support SATA drives using Intel onboard SATA controller.

SATA data cable   SATA power cable