PCIe Gen 5 NVMe Storage

ThinkStation P5, P7, P8, and PX

Table of Contents

Section 1 - Overview

The leading-edge technology for PCIe Gen 5 NVMe storage has been gaining popularity in the enterprise workstation market. In order to take full advantage of PCIe Gen 5 NVMe storage, users will need a Gen 5 compatible motherboard, processor, and supporting thermal hardware. The Lenovo ThinkStations P5, P7, P8, and PX platforms have been carefully designed from the ground up to support PCIe Gen 5 NVMe storage. However, like many other leading-edge technologies, there are a few caveats and considerations users will need to be aware of to achieve PCIe Gen 5 performance. Each of the sections below will highlight important PCIe Gen 5 storage considerations for each of Lenovo's performance workstations.

Section 2 - ThinkStation PCIe Gen 5 Storage Support

The latest Lenovo workstation platforms, ThinkStation P5, P7, P8, and PX, all have the ability to take full advantage of PCIe Gen 5 storage potential. However, there are a few caveats and considerations users will need to know.

For each of the platforms, our current support for PCIe Gen 5 storage is either utilizing the onboard M.2 slots or the ThinkStation PCIe Gen 5 Quad M.2 SSD Adapter.

ThinkStation PX

The ThinkStation PX offers three (3) Gen 5 capable onboard M.2 slots. However, there are a couple of caveats with utilizing these slots with PCIe Gen 5 drives.

- Installing up to two onboard M.2 PCIe Gen 5 drives will allow both drives to operate at full PCIe Gen 5 bandwidth potential.

- Installing three onboard M.2 PCIe Gen 5 drives will result in all three drives operating at slightly reduced bandwidth.

Table 1 - PX Onboard M.2 Slot Power Delivery for M.2 Gen 5 NVMe Drives

# of M.2 Gen 5 Drives Onboard	Onboard M.2 Slot 1	Onboard M.2 Slot 2	Onboard M.2 Slot 3
1	10W	10W	8W
2	10W	10W	8W
3	8W	8W	8W
*For maximum bandwidth, Gen 5 drives require 10W of power.			

Gen 5 drives operating at 8W of power will see a performance degradation compared to Gen 5 drives operating at 10W of power.

The onboard M.2 slots one and two will use a newer, longer 10W heatsink to support PCIe Gen 5 drives, while the third onboard M.2 slot will still use the original 8W heatsink as shown below. See appendix section below for part number information regarding the new 10W M.2 heatsink.

M.2 Slot 1 – 10W Heatsink

M.2 Slot 2 – 10W Heatsink

M.2 Slot 3 – 8W Heatsink
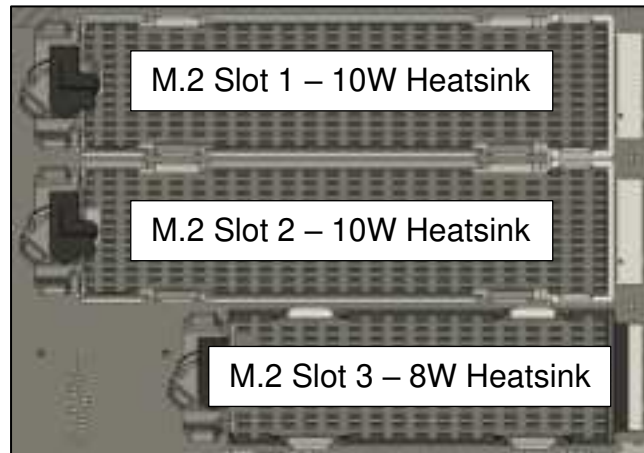
Note: PCIe Gen 5 M.2 drives are not currently supported in the front access storage bays.

ThinkStation P5, P7

The ThinkStation P5 and P7 both offer two (2) Gen 5 capable onboard M.2 slots using a newer, longer 10W heatsink to support PCIe Gen 5 drives. In these platforms, there are no Gen 5 limitations utilizing these two onboard M.2 slots simultaneously. However, the optional third M.2 slot via a vertical riser card in the ThinkStation P7 is limited to PCIe Gen 4 only.
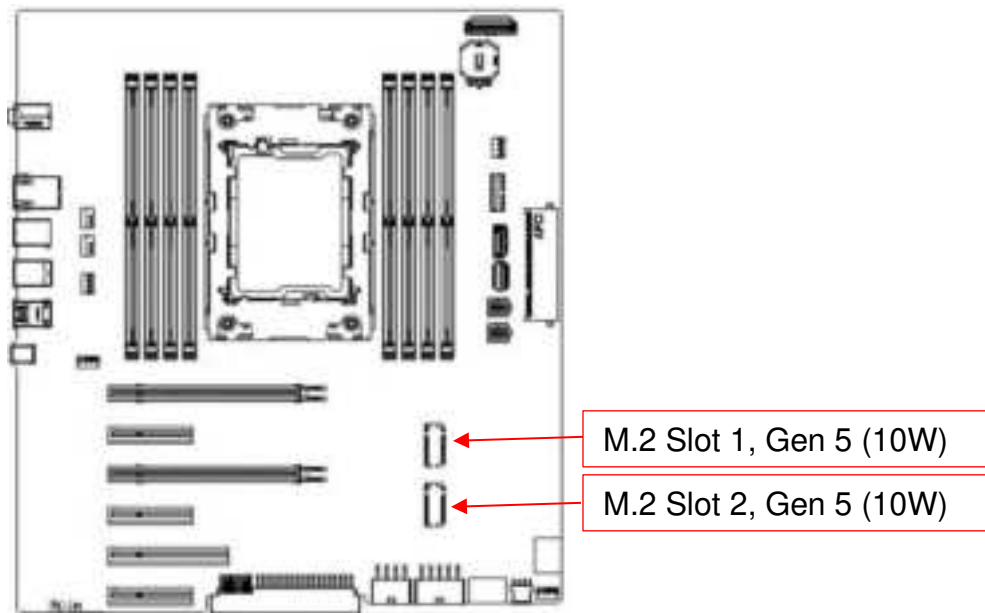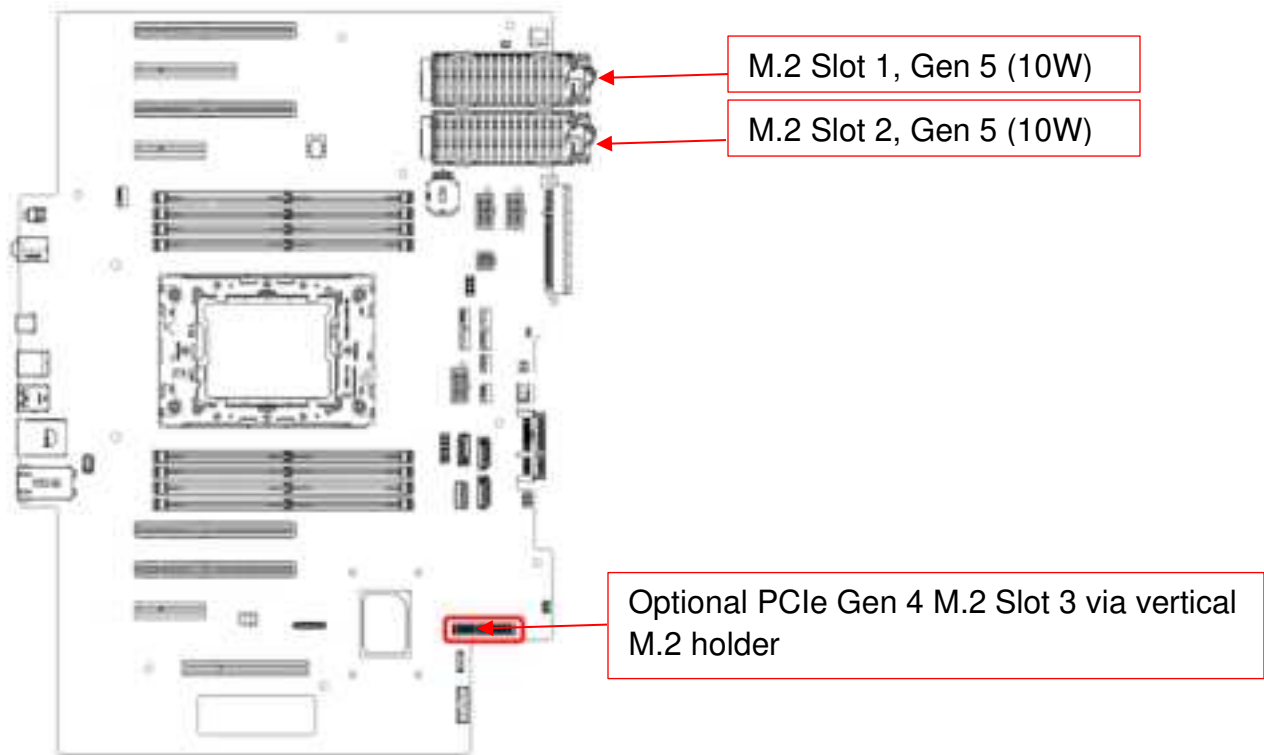
Figure 1 - ThinkStation P5 Motherboard

M.2 Slot 1, Gen 5 (10W)

M.2 Slot 2, Gen 5 (10W)

Figure 2 - ThinkStation P7 Motherboard

M.2 Slot 1, Gen 5 (10W)

M.2 Slot 2, Gen 5 (10W)

Optional PCIe Gen 4 M.2 Slot 3 via vertical M.2 holder

Note 1: PCIe Gen 5 M.2 drives are not currently supported in the front access storage bays in the P5 platform.

Note 2: The internal M.2 SSD enclosure bays and front access storage bay in P7 are limited to PCIe Gen 4 speeds only. Any Gen 5 drives installed in Gen 4 slots will be limited to Gen 4 speeds.

ThinkStation P8

The ThinkStation P8 offers three (3) Gen 5 capable onboard M.2 slots using a newer, longer 10W heatsink to support PCIe Gen 5 drives. In this platform, there are no Gen 5 limitations utilizing all three of these onboard M.2 slots simultaneously.

Figure 3 - ThinkStation P8 Motherboard
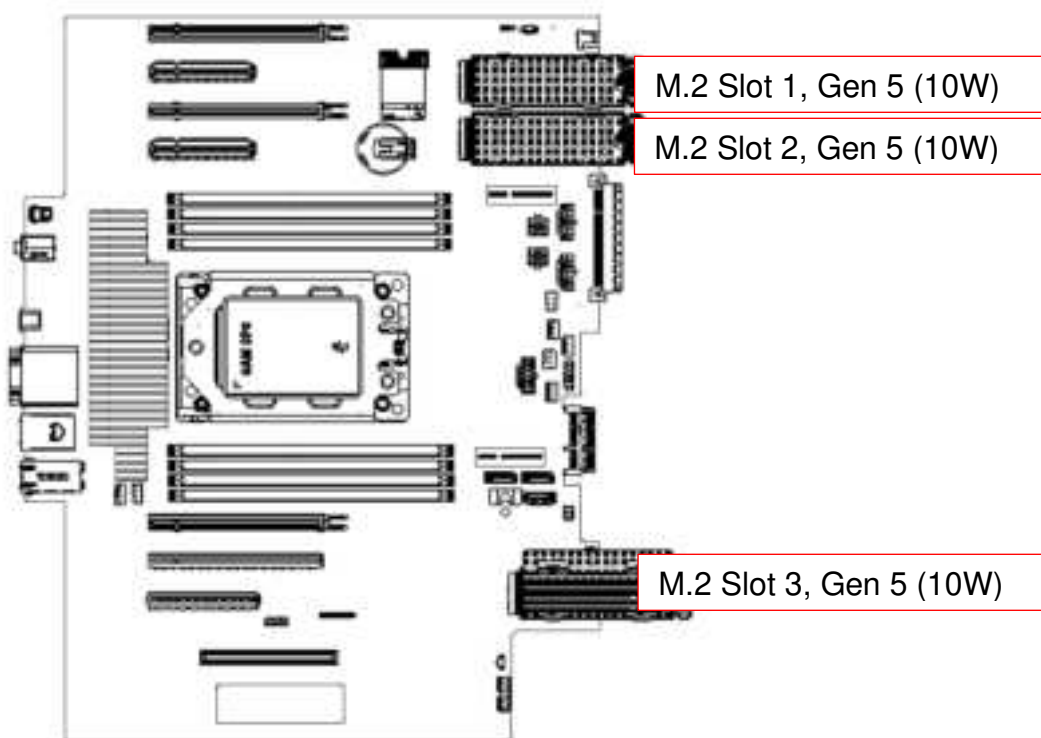
Note: PCIe Gen 5 M.2 drives are not currently supported in the front access storage bay or the internal M.2 SSD enclosure bays.

In order to utilize the new 10W heatsinks, there is a latching mechanism on both M.2 Slot 1 and Slot 2 in each platform that may need to be altered from supporting the original 8W heatsinks to the new 10W heatsinks. To move these latching mechanisms, see section below for additional information. See appendix for available option kit.

Here is a picture showing the size difference between the 8W and 10W M.2 drive heatsinks used across the P5, P7, P8, and PX platforms to support 2280 M.2 drives. See detailed drawings in the next section.

2280 M.2 drive

8W M.2 Heatsink
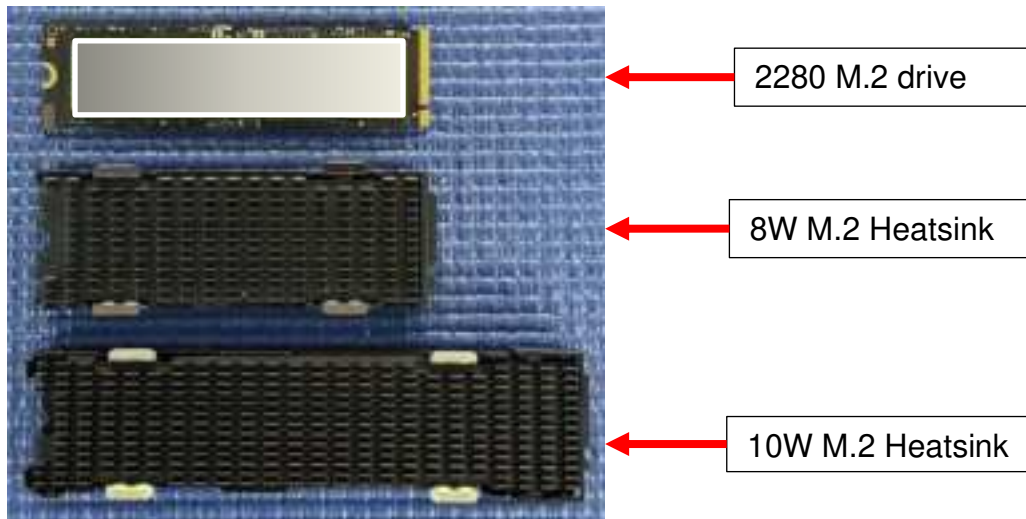
10W M.2 Heatsink

# Section 3 - Gen 5 M.2 Heatsink Design for 2280 Drives

Here are some diagram images that show the internal design of the new Gen 5 heatsink kit used on the P5, P7, P8, and PX workstation platforms.

To remove the heatsink, carefully push out on the tabs to release the heatsink from the carrier.

Once you remove the heatsink from the M.2 carrier, there is a latch mechanism that holds the 2280 M.2 drive in place as shown here. Make sure to remove the plastic liner from the thermal pads before installing the M.2 drive.

Press here!

Press here!
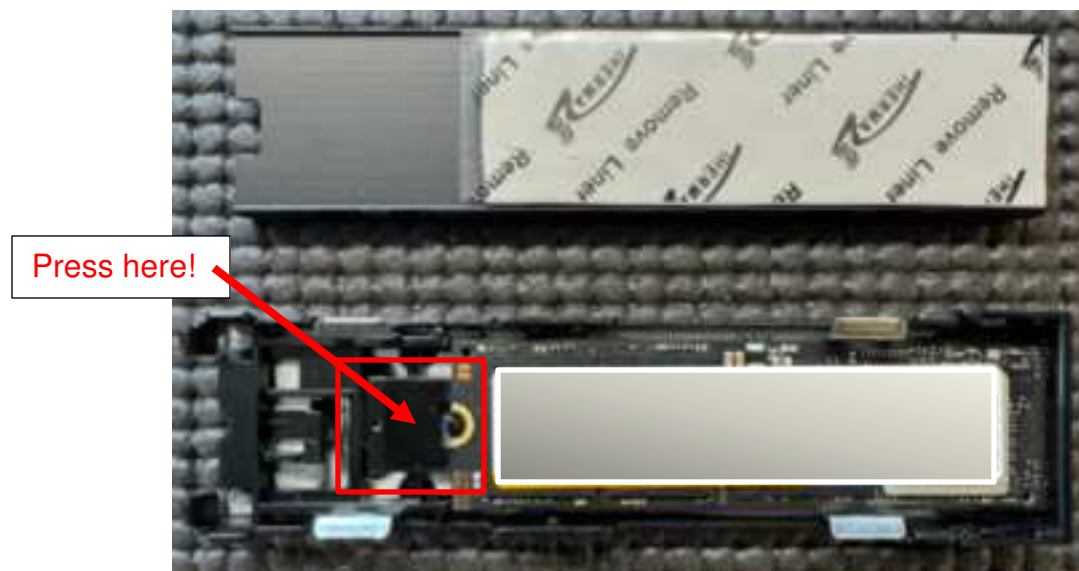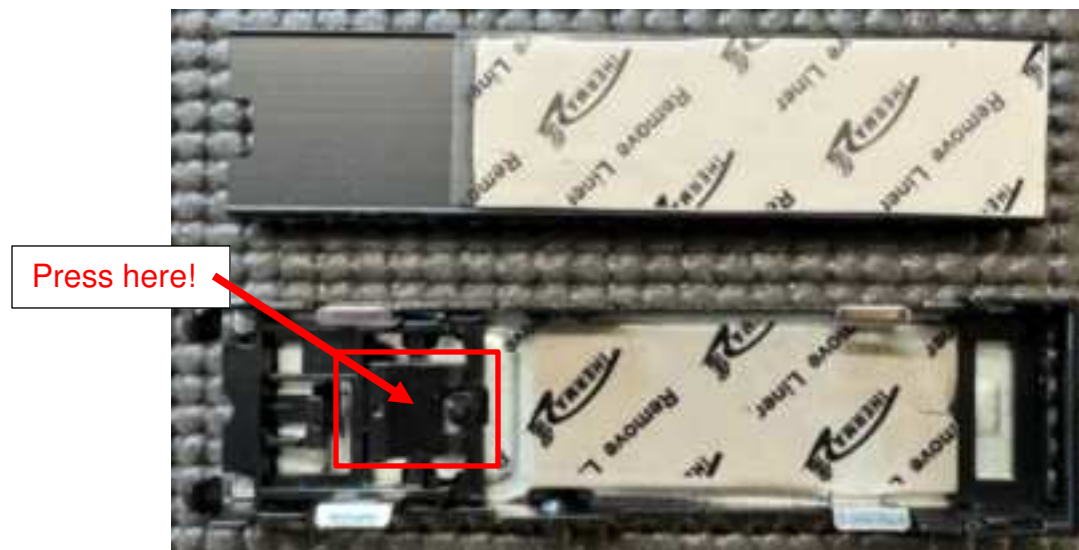
Section 4 - Installing Gen 5 M.2 Drives

In order to utilize the new 10W style Gen 5 M.2 heatsinks, there is a latching mechanism inside the chassis that may need to be altered from supporting the original 8W M.2 heatsinks. Both single-sided and double-sided Gen 4 and Gen 5 drives are compatible with the new 10W heatsinks. Here is some guidance on how to install these heatsinks properly.

ThinkStation PX

For the ThinkStation PX, the onboard M.2 retaining clips are installed directly on the motherboard as shown here. Depending on the motherboard revision will depend on where the M.2 retaining clips are installed.

Motherboard Part Numbers	Onboard M.2 Heatsinks
P/N: SB20T22679 P/N: SB20T22728	
P/N: SB21Q37995	

In order to install the new 10W M.2 heatsinks on earlier motherboard revisions, the user will need to manually move the red M.2 retaining clips. Follow these instructions for guidance on moving the red M.2 retaining clips.

1. Remove the M.2 heatsinks from the system. Refer to the ThinkStation PX Storage Configurator whitepaper for detailed instructions or the diagram below from the hardware maintenance manual (HMM) on removing the onboard M.2 heatsinks.
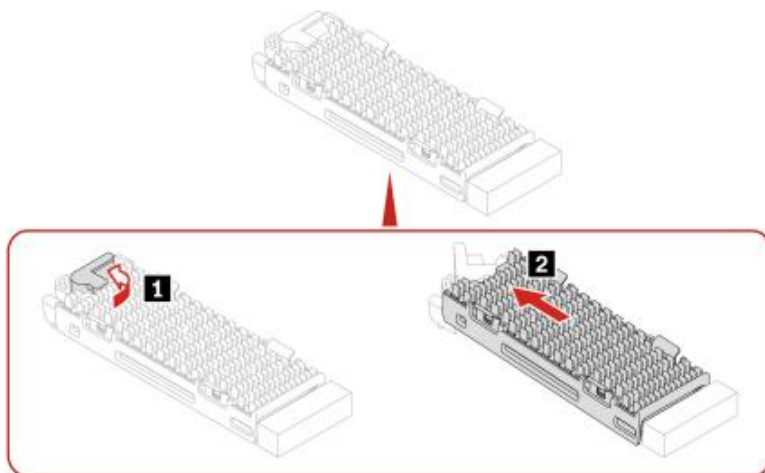

2. **<u>Caution</u>**! Since the tabs on the M.2 latch are very fragile, very gently press in on the tabs shown (1) and slide the latch (2) toward the front of the system.
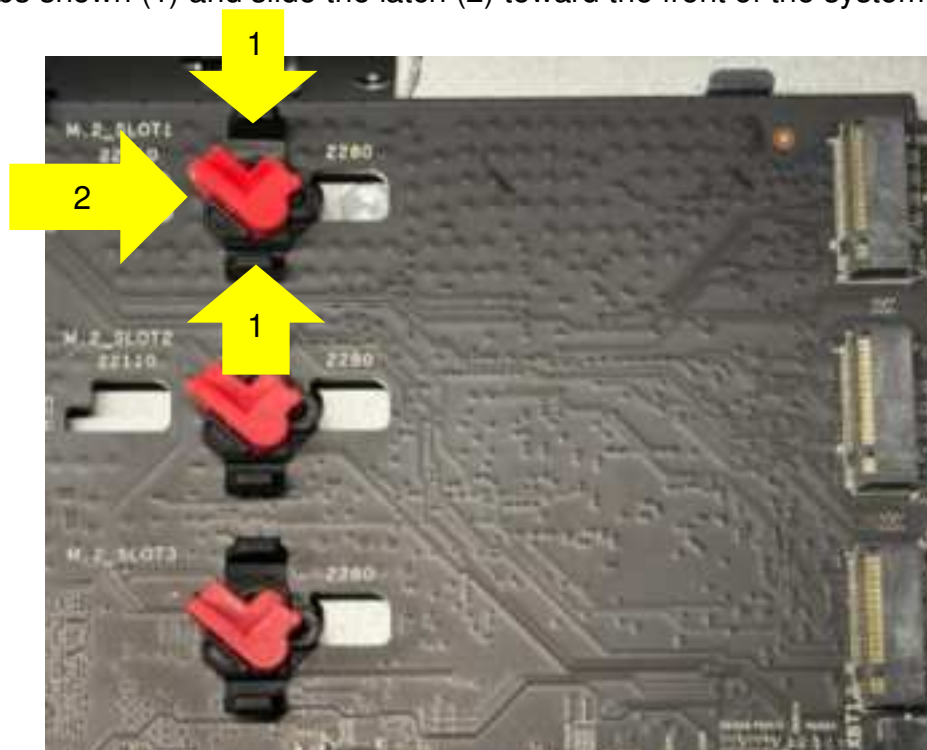
3. Once the latch slides all the way forward as shown (left), pull the latch straight out as shown (right).
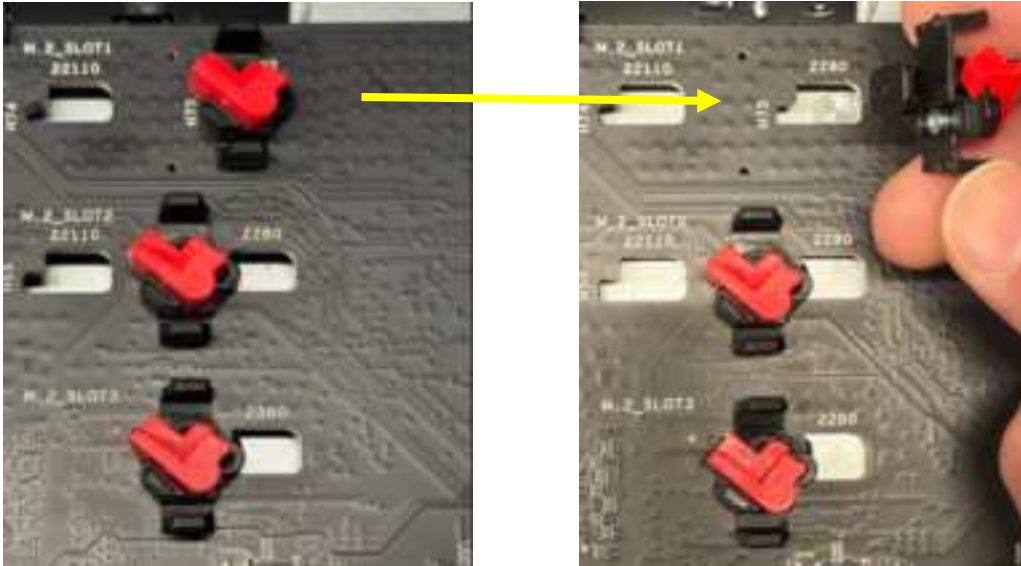

4. One thing to notice here is the round bumps underneath the latch as shown. When this is properly installed these round bumps will engage with the small round holes on the motherboard as shown.
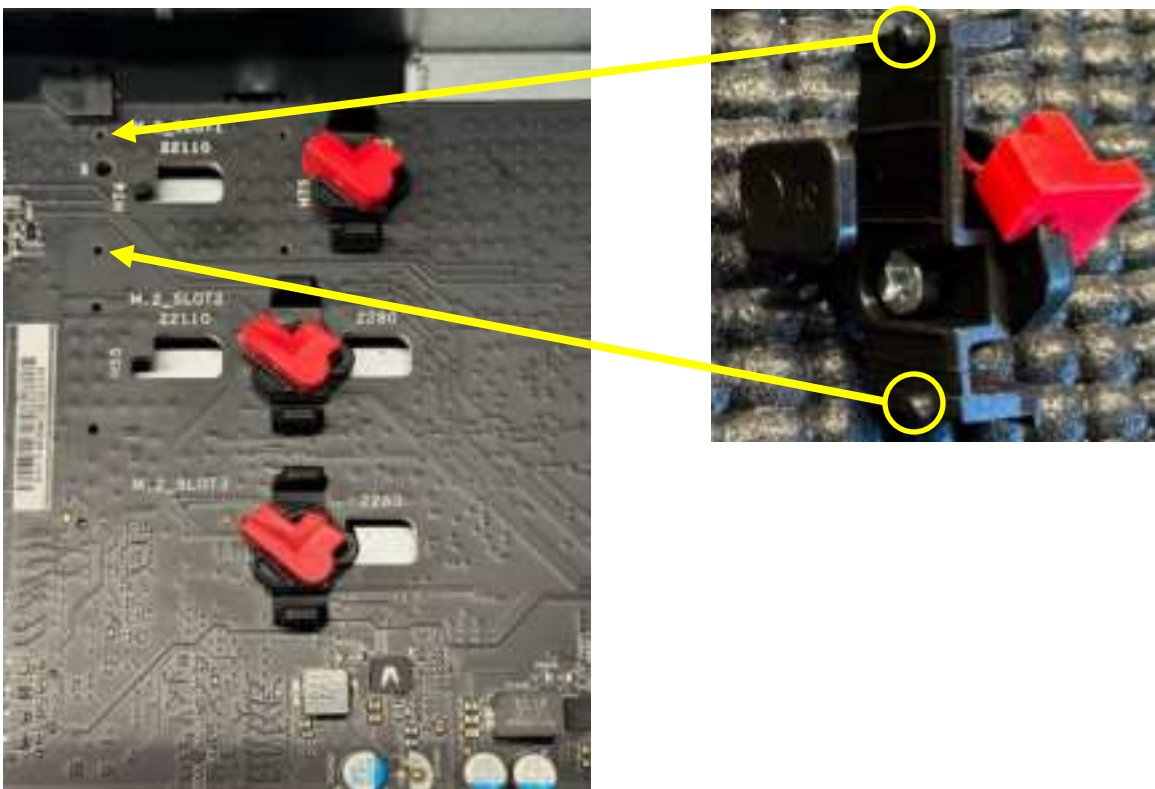
5. Once the latch has been removed cleanly, reinstall the latch into the next slot over toward the rear of the system in reverse order.
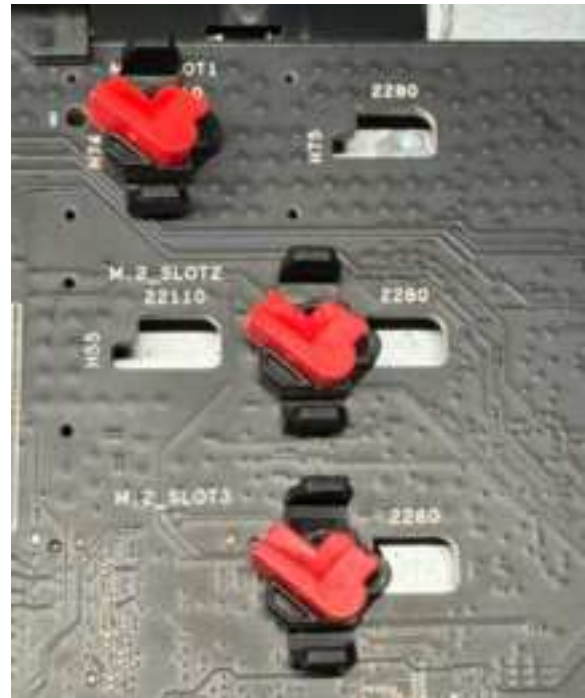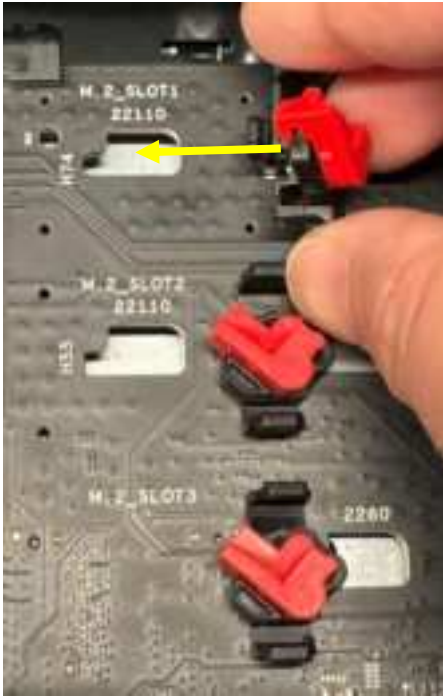

6. While gently holding the side of the tabs inward (1), slide the latch toward the rear of the system (2) as shown until the alignment tabs latch into place.
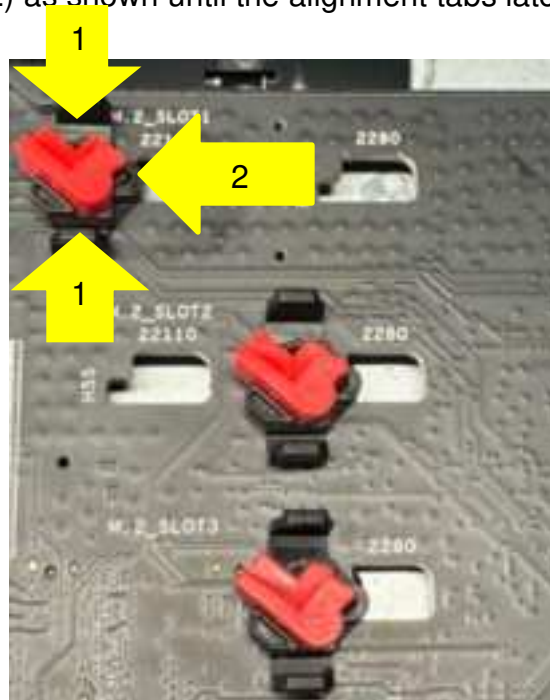
7. Repeat the steps above for the second M.2 slot latching mechanism.

8. When finished, the M.2 latching mechanisms should look like this.

10W M.2 Heatsink Position

10W M.2 Heatsink Position

8W M.2 Heatsink Position
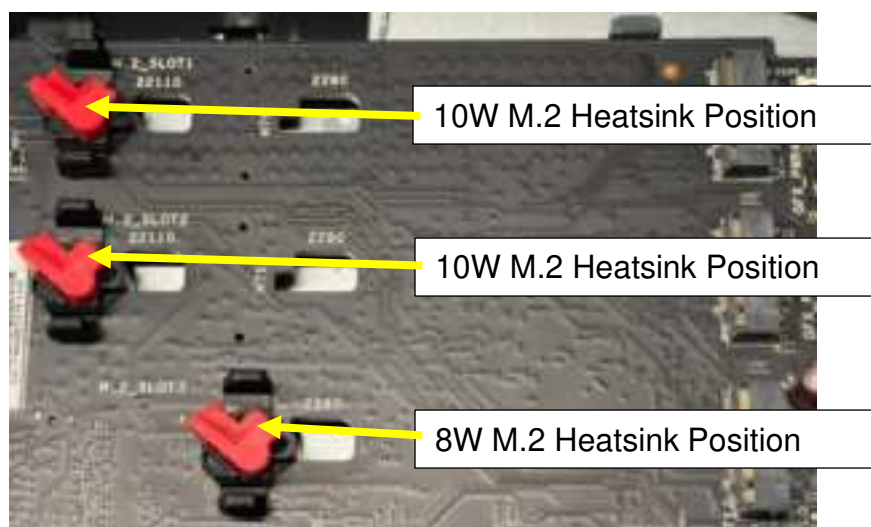
9. Install the M.2 heatsinks into the system after the M.2 drives have been properly installed inside the heatsink per previous section.

10W M.2 Heatsink

10W M.2 Heatsink

8W M.2 Heatsink
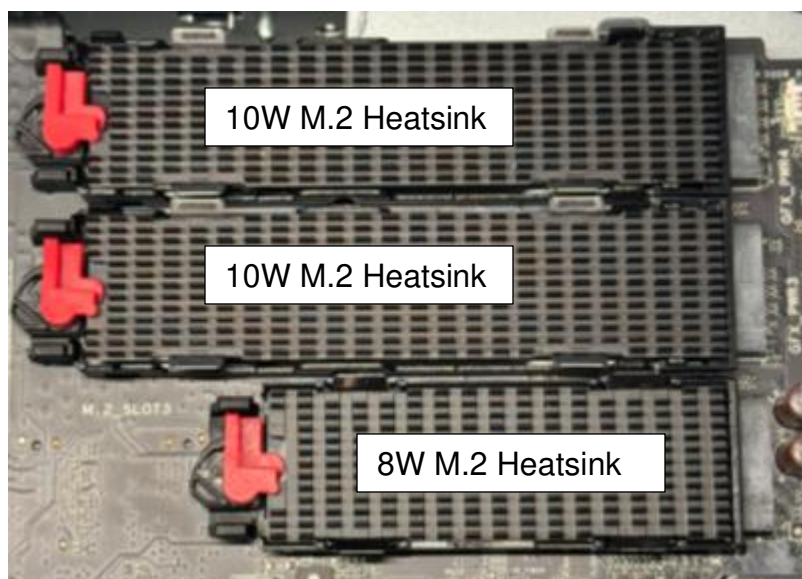
ThinkStation P5, P7, P8

For the ThinkStation P5, P7, and P8 platforms, the onboard M.2 retaining clips are installed directly on an M.2 SSD holder latched onto the inside of the chassis. Final assembly of the M.2 retaining clips will vary depending on the base system chassis shell being used. The easiest way to determine this is to physically look at the inside of the system to view which M.2 heatsinks are installed.

For systems with the 8W heatsinks on the onboard M.2 slots one and two, here are some instructions on how to move the red latching mechanism to account for the larger 10W heatsinks.

1. Remove the M.2 heatsinks from the system. Refer to the ThinkStation Storage Configurator whitepapers for each platform for detailed instructions or the diagram below from the hardware maintenance manual (HMM) on removing the onboard M.2 heatsinks.
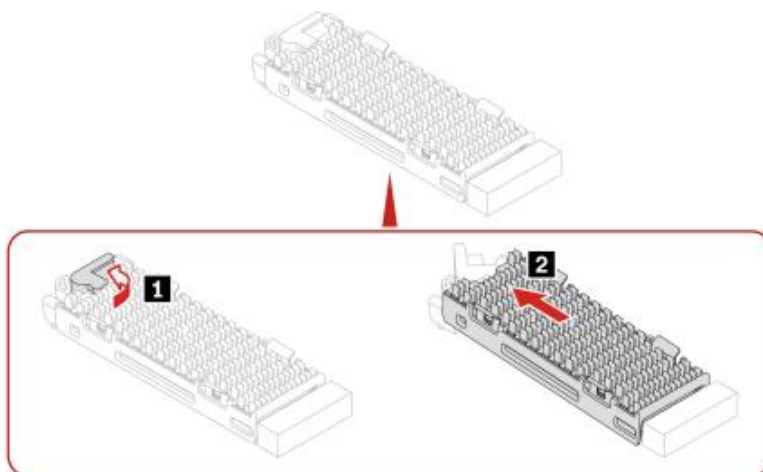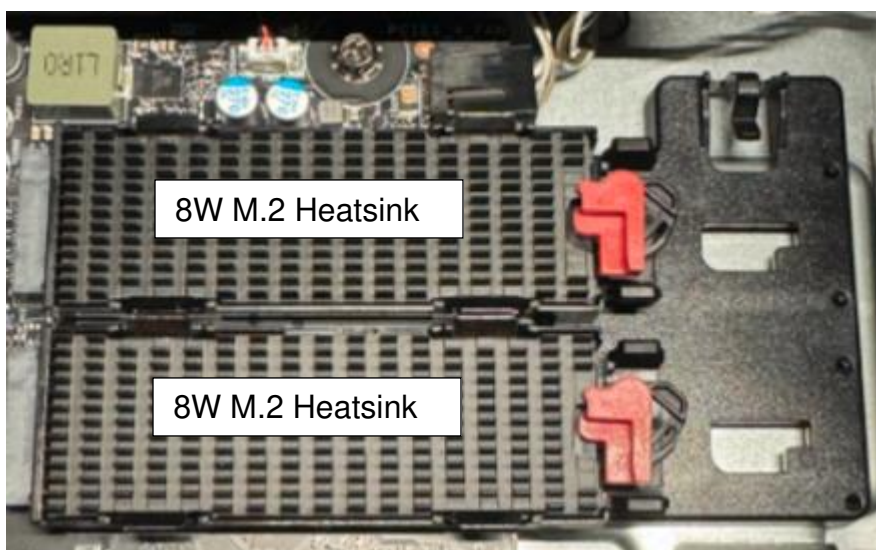
2. It may be easier to move the red latching mechanisms by removing the onboard M.2 SSD holder. To remove this onboard M.2 SSD holder, here's a diagram from the hardware maintenance manual (HMM).
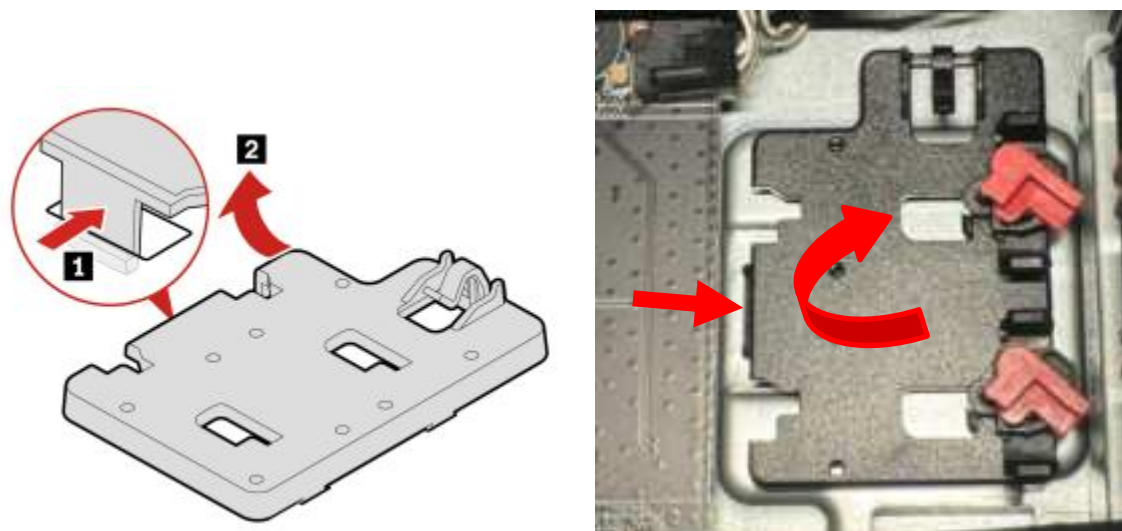

3. **Caution**! Since the tabs on the M.2 latch are very fragile, very gently press in on the tabs shown (1) and slide the latch (2) toward the rear of the system.

8W M.2 Heatsink Position

8W M.2 Heatsink Position
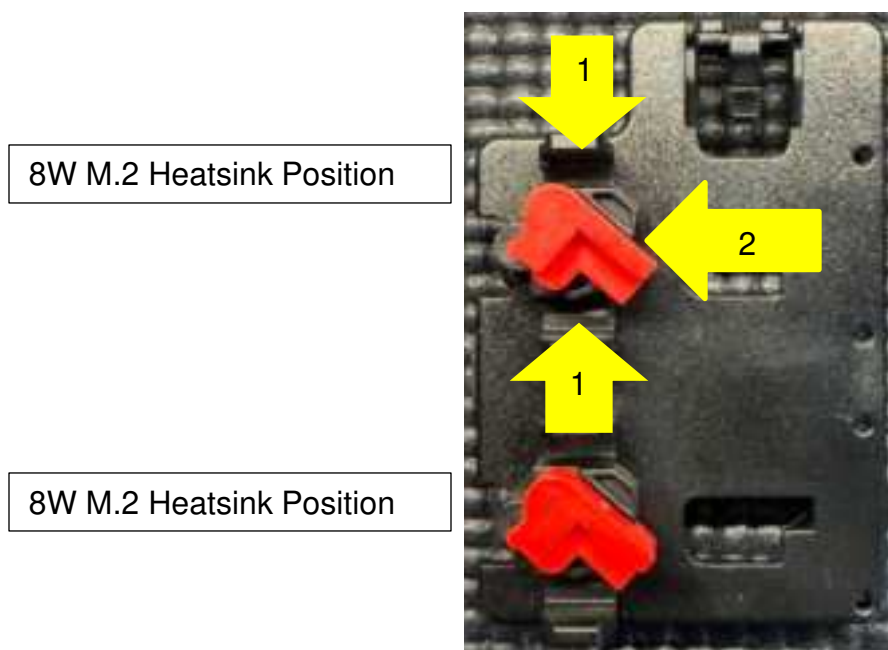
4. Once the M.2 latch slides cleanly toward the rear of the system, remove the M.2 latch straight out of the M.2 SSD holder.


5. Once the latch has been removed cleanly, reinstall the latch into the next slot over toward the front of the system in reverse order.
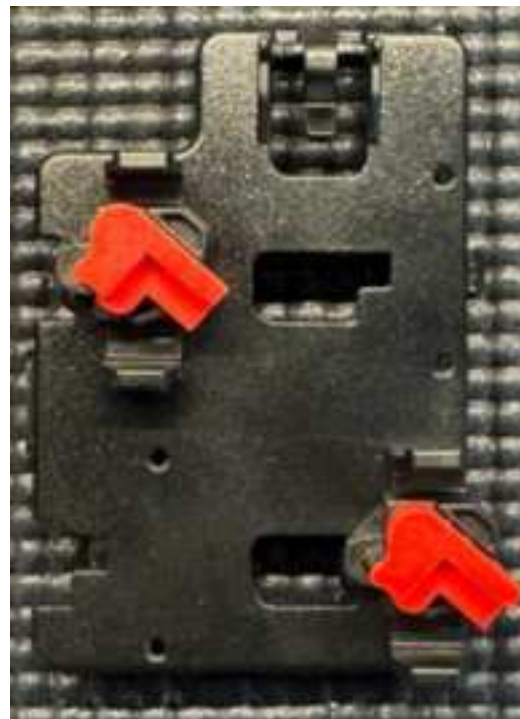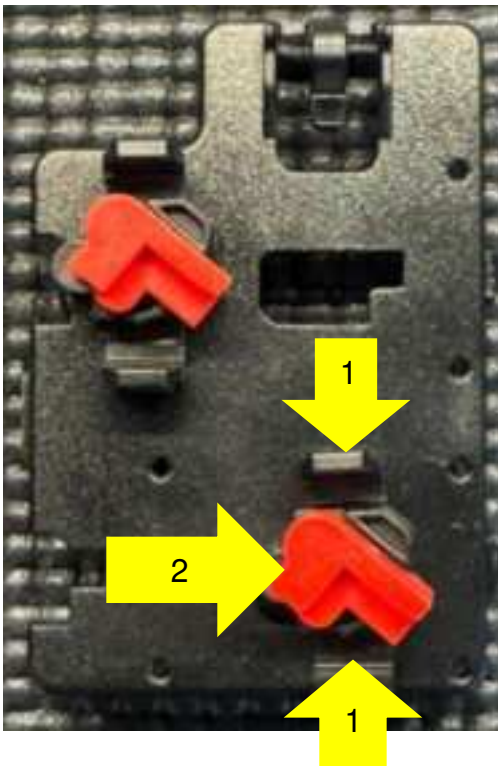
6. Repeat the steps above for the second M.2 slot latching mechanism.

7. When finished, the M.2 latching mechanisms should look like this.

10W M.2 Heatsink Position

10W M.2 Heatsink Position
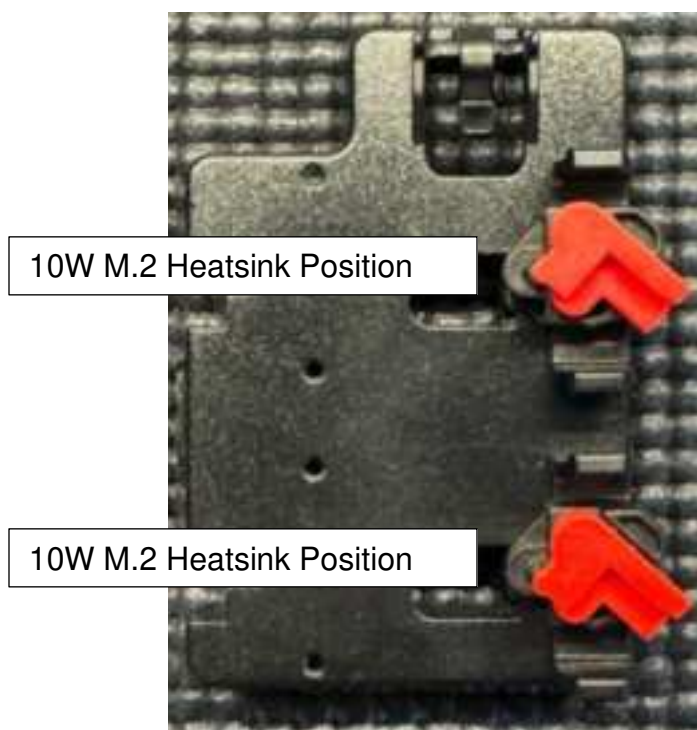
8. Reinstall the onboard M.2 SSD holder back into the chassis. Here's a diagram from the hardware maintenance manual (HMM).
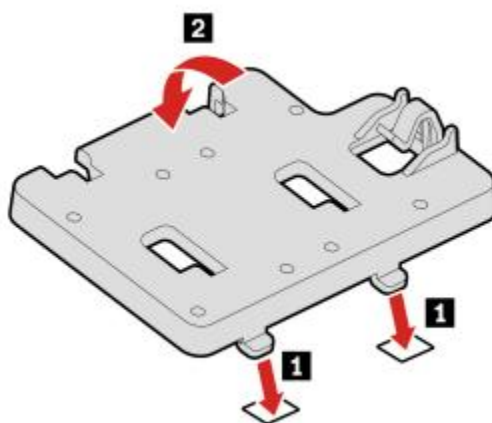
9. Here is the onboard M.2 SSD holder with the retaining clips moved for Gen 5 heatsinks installed back into the chassis.

10W M.2 Heatsink Position

10W M.2 Heatsink Position
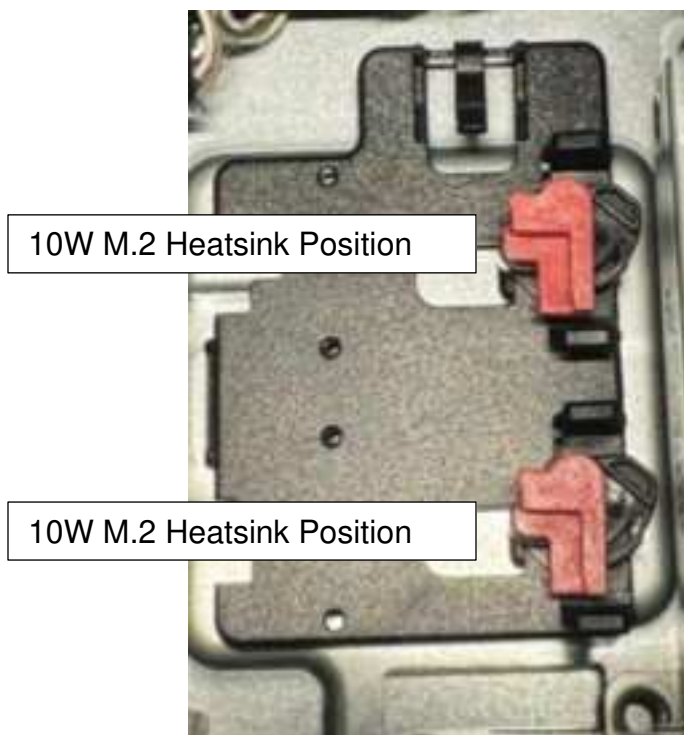
10. Install the new 10W heatsinks in the system after the M.2 drives have been installed properly inside the heatsink as per the previous section.

10W M.2 Heatsink

10W M.2 Heatsink
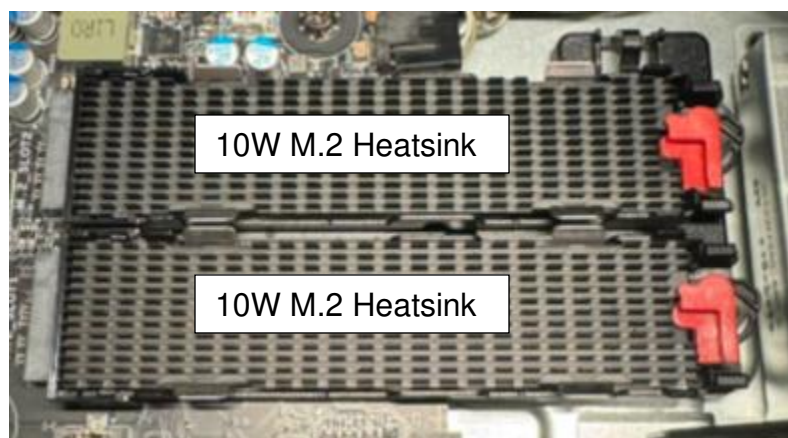
11. In the ThinkStation P8, there is a third onboard M.2 slot that can utilize a PCIe Gen 5 M.2 drive using these same 10W heatsinks. The process is the same as the above steps on moving the latching mechanism, but on a different style onboard M.2 SSD holder.
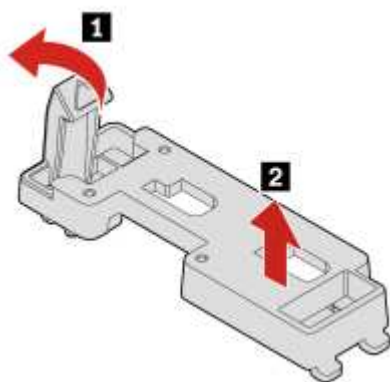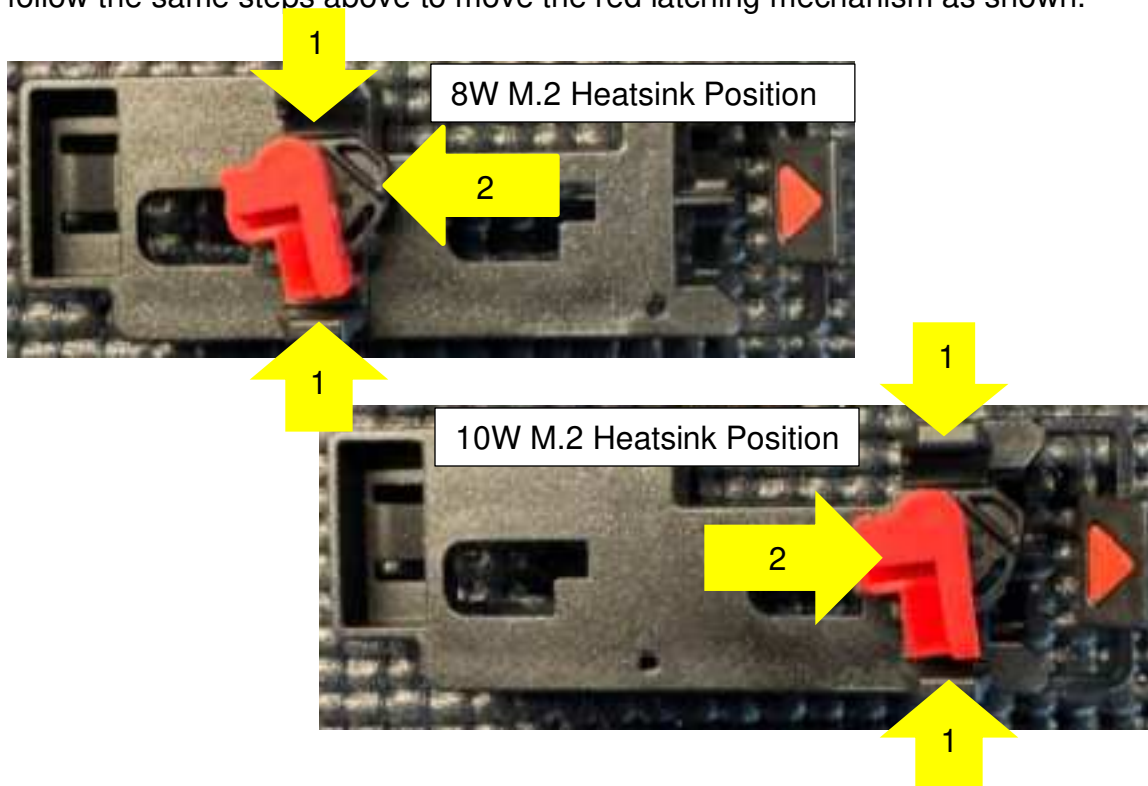
Here is a diagram from the hardware maintenance manual (HMM) that shows how to remove the third onboard M.2 SSD holder.

Once the third onboard M.2 SSD holder has been removed from the system, follow the same steps above to move the red latching mechanism as shown.

8W M.2 Heatsink Position

10W M.2 Heatsink Position

Here is a diagram from the hardware maintenance manual (HMM) that shows how to install the third onboard M.2 SSD holder.
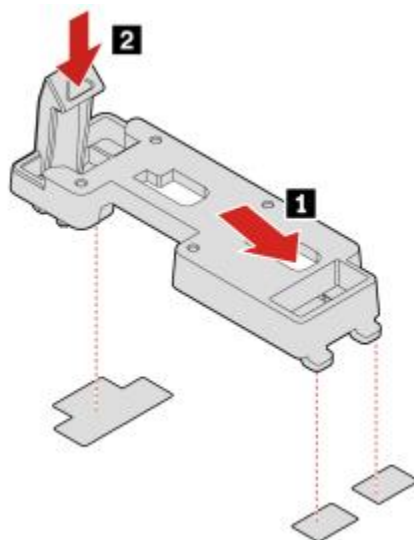
Note: The PCIe cables for the 3.5" bays pass under this bracket and through the indent provided. It is important not to crush or pinch these cables when reinstalling the retainer.

12. Once the third onboard M.2 SSD holder gets reinstalled into the system, install the new 10W heatsinks in the system after the M.2 drives have been installed properly inside the heatsink per previous section.

10W M.2 Heatsink

# Section 5 - ThinkStation PCIe Gen 5 Quad M.2 SSD Adapter

Lenovo offers a "ThinkStation PCIe Gen 5 Quad M.2 SSD Adapter" option for users needing additional PCIe Gen 5 storage. These adapters can hold up to four M.2 NVMe drives and will physically install into an available Gen 5 PCIe x16 slot. When the PCIe adapter is installed into a PCIe Gen 5 capable slot, all drives will perform at their full PCIe Gen 5 bandwidth potential.

Note: If the adapter is installed into a Gen 4 PCIe x16 slot, the drives in the adapter will be limited to Gen 4 speeds.

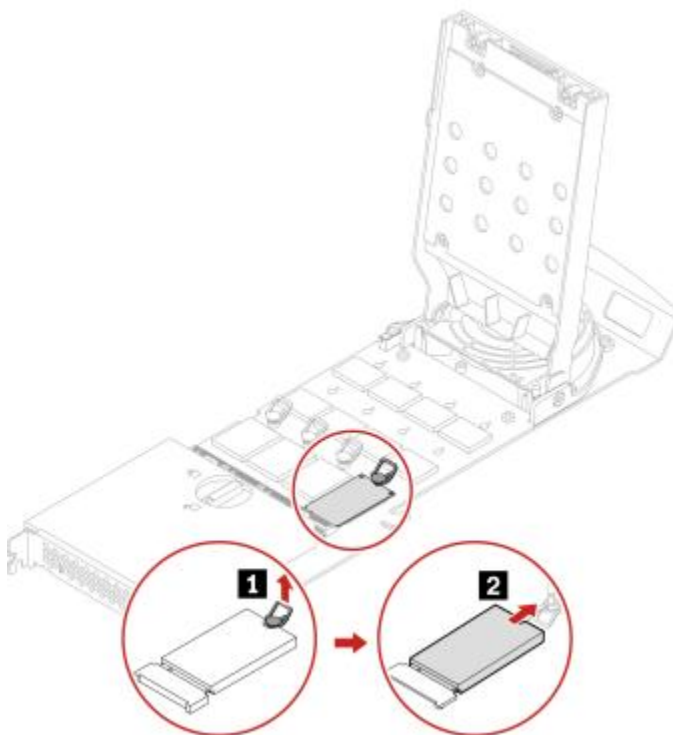| Lenovo Part Numbers	ThinkStation PCIe Gen 5 Quad M.2 SSD Adapter
Lenovo Option Kit: 4XH1S82999	
Lenovo FRU: 5C51M21362	

Please refer to the instructions below from the hardware maintenance manual (HMM) for detailed instructions on how to install M.2 drives in the ThinkStation PCIe Gen 5 Quad M.2 SSD Adapter.
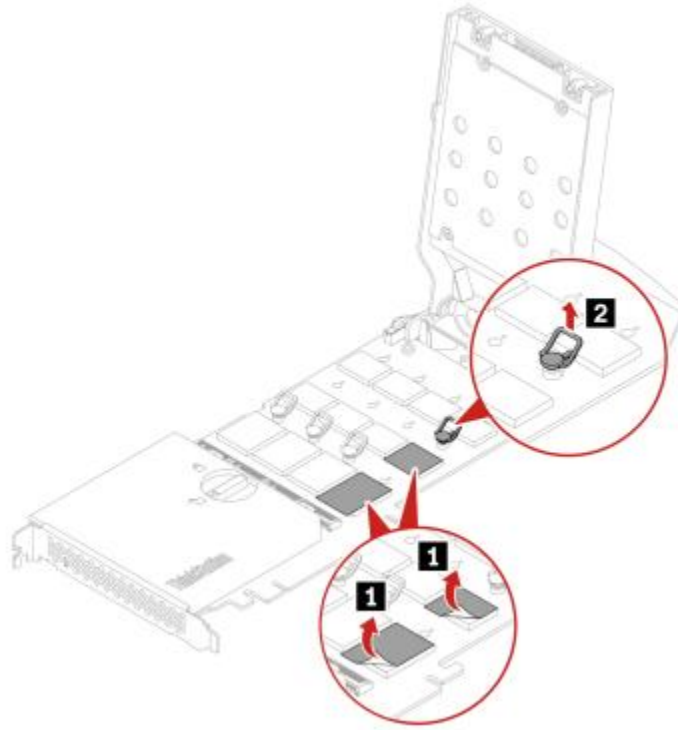
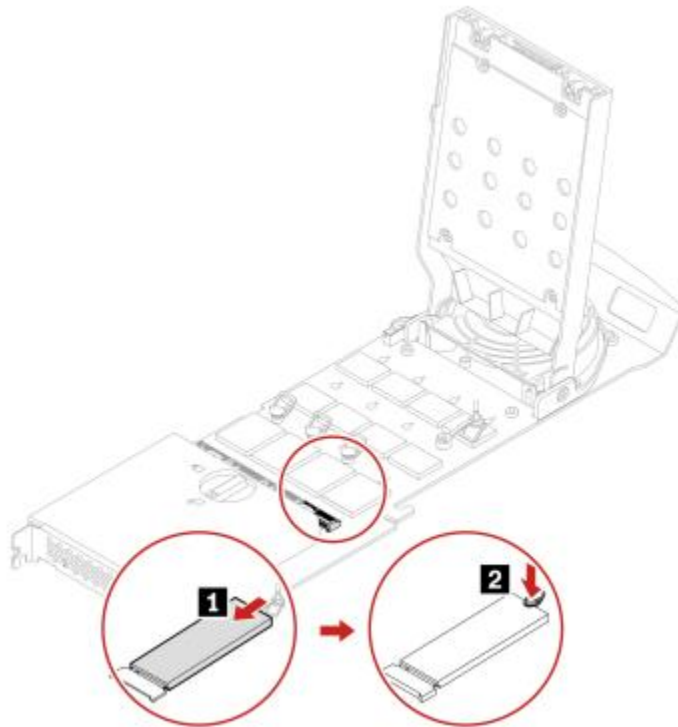1. Open the cover to the ThinkStation PCIe Gen 5 Quad M.2 SSD Adapter as shown.
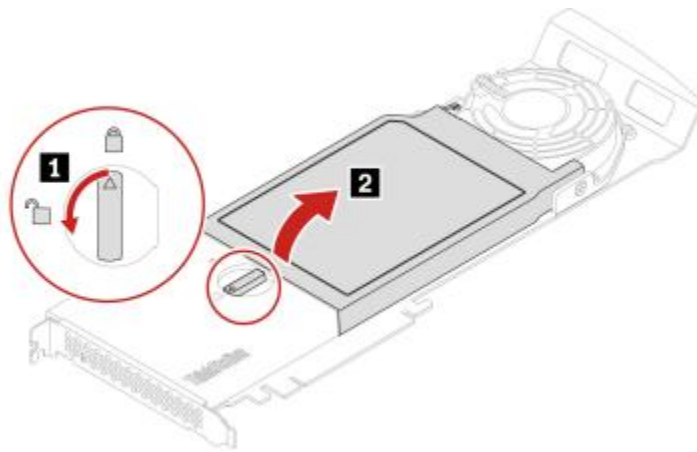
2. If necessary, move the retention latch to an appropriate location to suit the length of the M.2 SSD.

3. Remove the film and release the latch.

4. Install the M.2 SSD.

5. Close the cover.

Section 6 - PCIe Gen 5 Detection

Once the user installs PCIe Gen 5 M.2 drives in their system, it will be beneficial to make sure BIOS is detecting and training the PCIe drives properly. Boot into BIOS setup and browse to the following menu option in BIOS:

BIOS F1 setup → "Devices" menu → "PCI Express Setup" menu

Select the appropriate slot configuration from the list.
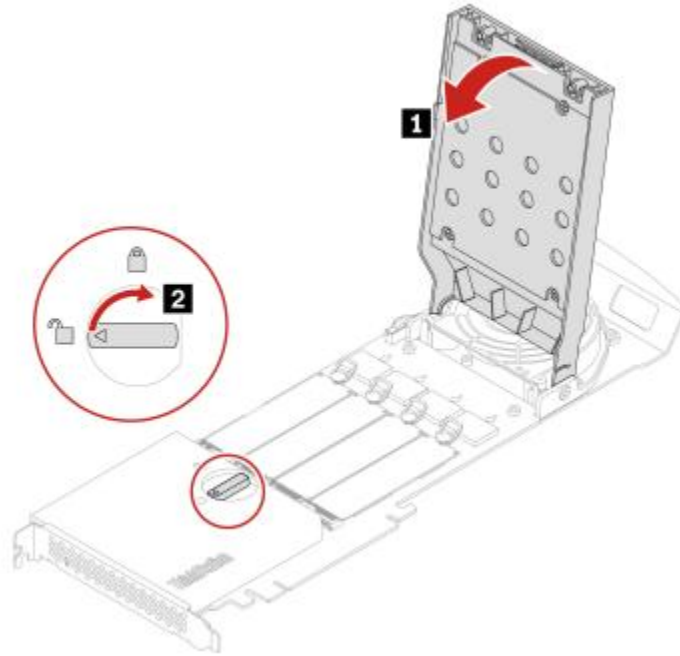
Under each slot configuration where a PCIe Gen 5 drive is installed, the PCIe Port Link Speed will be displayed as seen below.

Additionally, there is a reporting structure in the BIOS setup menu that will depict whether the drives are running at their full bandwidth potential versus limited bandwidth potential. The user needs to ensure they are using the latest BIOS revision from the Lenovo Support Site. To determine this, boot the system into BIOS F1 setup, browse to the "System Summary" menu, and search for the installed M.2 drives from the list.

Gen 5 M.2 drives running at their full bandwidth will be indicated by the "_H" appended to the end of the drive names as shown below.
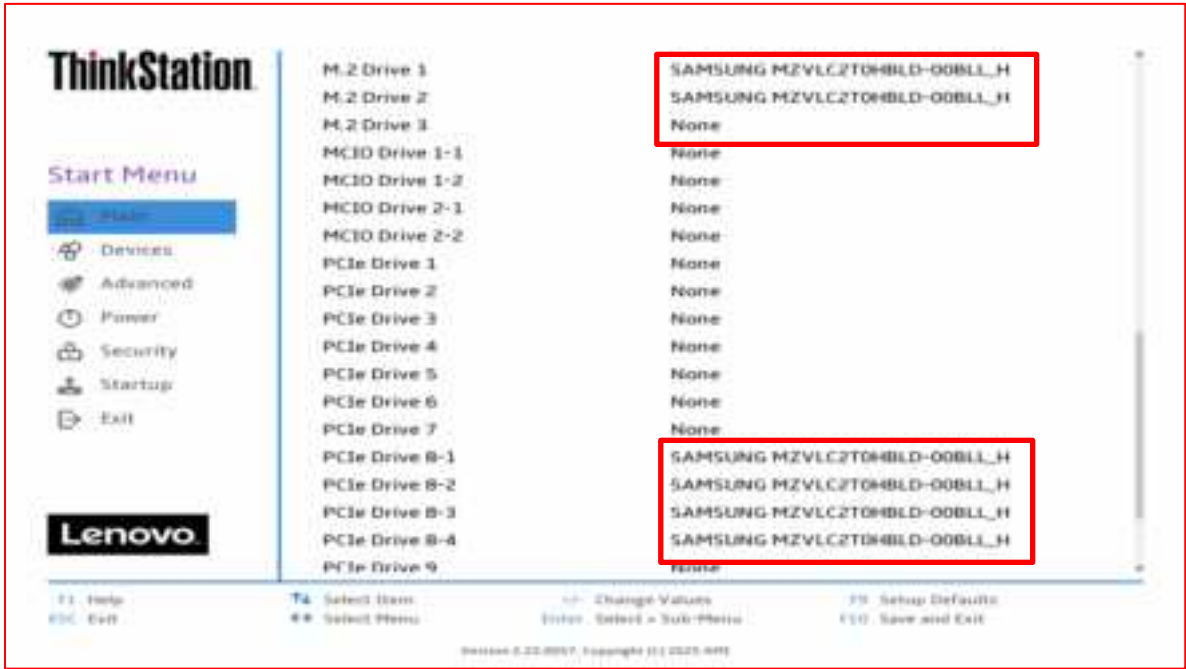
Gen 5 M.2 drives running at a reduced bandwidth will be indicated by the "_L" appended to the end of the drive names as shown below.
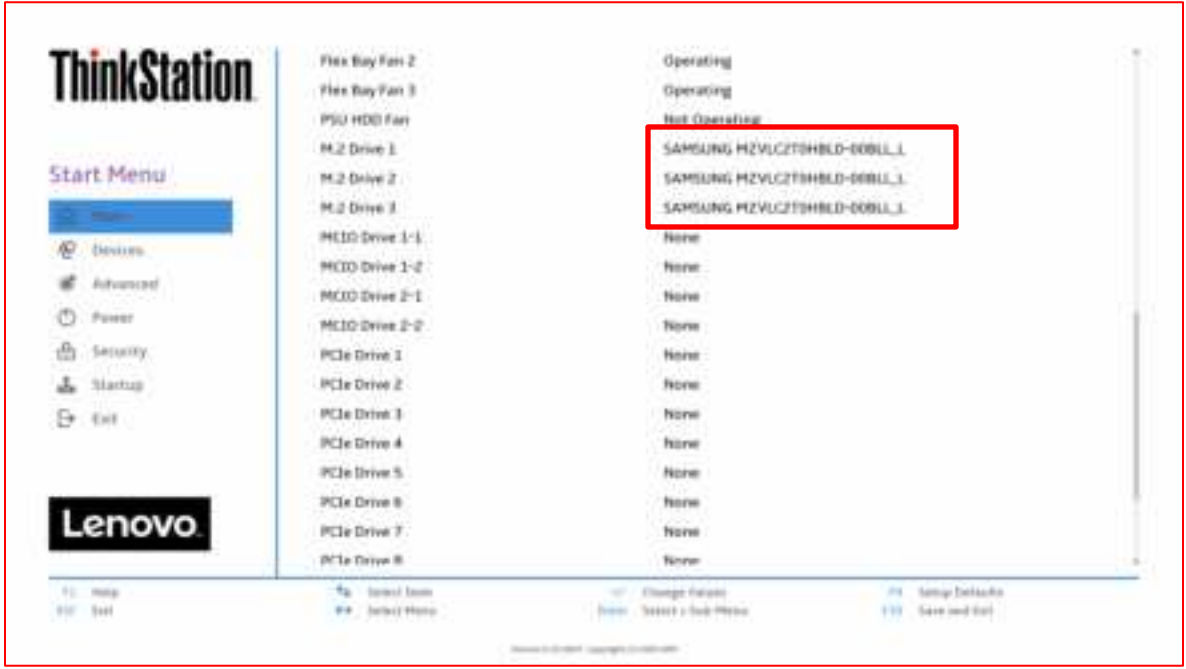
Section 7 - Considerations

- Microsoft Windows Bitlocker may have a negative performance impact on Gen 5 NVMe drives. Please reference the following Lenovo Tip:

  https://support.lenovo.com/us/en/solutions/ht517544-software-encryption-such-as-microsoft-bitlocker-may-negatively-impact-ssd-or-raid-performance

- Intel VROC Gen 5 RAID performance may not scale appropriately, and performance may be degraded due to Intel's public limitation.

  https://www.intel.com/content/www/us/en/content-details/854266/intel-vroc-performance-with-gen5-nvme-ssd-customer-communication.html?wapkw=854266

Section 8 - Appendix

Refer to the table below for new mechanical parts for Gen 5 NVMe drives.

Option Kits
4XH1S76260 – ThinkStation Heatsink Kit for PCIe Gen 5 (10W) M.2 SSD
4XH1S82999 – ThinkStation PCIe Gen 5 (10W) Quad M.2 SSD Adapter

Revision History

Version	Date	Author	Changes/Updates
1.0	7/14/2025	Jason M	Initial Release.