X1001

Overview

The X1001 V1.1 shield is an NVME M2 SSD PIP (PCIe Peripheral Board) for the Raspberry Pi 5 that uses the new PCIE interface of the Raspberry Pi 5 to utilise the NVME M2 SSDs for fast data transfers and ultra-fast booting.

This shield follows the new "PIP" design guideline (https://datasheets.raspberrypi.com/pcie/pcie-connector-standard.pdf) from Raspberry Pi fundation ensuring that it will be easy to use and be supported long term by updates to Raspberry Pi OS - though it is very early days and things are improving rapidly there!

Geekworm PCIe to NVME Sets:

After the release of the Raspberry Pi AI Kit (https://www.raspberrypi.com/products/ai-kit/), we tested four PIPs: X1001, X1004, X1011, and M901. X1001, X1004, and M901 all support the hailo-8 ai accelerator, but X1011 does not.

X1001 V1.1 NVME M2 SSD Shield for Raspberry Pi 5

It should be noted that X1004 uses ASMedia ASM1182e (https://www.asmedia.com.tw/product/213yQcasx8gNAzS4/b7FyQBCxz2URbzg0) PCIe switch, it can't support PCIe Gen 3 speed, so even though we forced to enable PCIe Gen 3.0 setting in Raspberry Pi 5, it is limited by ASMedia ASM1182e PCIe switch, and speed is still PCIe Gen 2.0 5Gbps speed. when you use an hailo-8 ai accelerator, Raspberry Pi Fundation highly recommends using PCIe 3.0 to achieve best performance with your AI Kit.

Our tentative conclusions are as follows:

- If you need to use hailo-8 ai accelerator with high performance, it is recommended to use X1015/X1002/X1003/M901/ the official M.2 HAT+ (https://www.raspberrypi.com/products/m2-hat-plus/) etc. When choosing these PIP boards, **you should focus on whether there is a conflict between the camera cable and the PIP board installation**, and enable PCIe3.0 to use hailo-8 ai accelerator. At the same time, you need to prepare an SD card as the system disk.
- If you don't care about the high performance brought by PCIe 3.0, then you can consider using X1004, so that you can use any socket of X1004 to install NVME SSD as the system disk, and another socket to install hailo-8 ai accelerator, so as to have both.

Model	Compatible with	Position	NVMe M2 SSD Length Support	Matching Case	Matching Cooler	Support NVMe Boot	Support PCIe 3.0	Support Hailo-8 AI Accelerator
X1000	Raspberry Pi 5	Top	2230/2242	P579	Official Cooler / Argon THRML Cooler / H505/ H501	Yes	-	Not tested
X1001	Raspberry Pi 5	Top	2230/2242/2260/2280	P579	Official Cooler / Argon THRML Cooler / H505/ H501	Yes	-	Yes
X1002	Raspberry Pi 5	Bottom	2230/2242/2260/2280	P580 / P580-V2	Official Cooler / Argon THRML Cooler / H505/ H501	Yes	-	Not tested
X1003	Raspberry Pi 5	Top	2230/2242	P579 / P425	Official Cooler / H501 Only	Yes	-	Not tested
X1004	Raspberry Pi 5	Top	Dual ssd: 2280	P579-V2	Official Cooler / Argon THRML Cooler / H505/ H501	Yes (Requires EEPROM 2024/05/17 and later version)	NO	Yes
X1015	Raspberry Pi 5	Top	2230/2242/2260/2280	P579	Official Cooler / Argon THRML Cooler / H505/ H501	Yes	-	Yes
X1005	Raspberry Pi 5	Bottom	Dual ssd: 2230/2242/2260/2280	P580-V2	Official Cooler / Argon THRML Cooler / H505/ H501	Yes (Requires EEPROM 2024/05/17 and later version)	NO	Yes
X1011	Raspberry Pi 5	Bottom	4 ssds: 2230/2242/2260/2280	X1011-C1	Official Cooler / Argon THRML Cooler / H505/ H501	Yes (eeprom 2024/05/17 and later version)	NO	NO
M901	Raspberry Pi 5	Top	2230/2242/2260/2280	P579	Official Cooler / Argon THRML Cooler / H505/ H501	Yes	-	Yes
Q100	Raspberry Pi 5	Top	2242	P579	Official Cooler / Argon THRML	Yes	-	Not tested

					Cooler / H505/ H501			
Q200	Raspberry Pi 5	Top	Dual ssd: 2280	P579	Official Cooler / Argon THRML Cooler / H505/ H501	NO	-	Not tested
M300	Raspberry Pi 5	Top	2230/2242	P579	Official Cooler / Argon THRML Cooler / H505/ H501	Yes	-	Not tested
M400	Raspberry Pi 5	Top	2230/2242/2280	P579	Official Cooler/ Argon THRML Cooler / H505/ H501	Yes	-	Not tested

Important Notes

NVMe SSD Incompatibility List

We recommend avoiding the following NVMe SSD drives which is equipped with a **Phison controller** due to their proven incompatibility:

- WD Blue SN550 series (Solved! Refer to New rpi-eeprom-update 2024-01-24 WD Blue SN550 nvme works now. (https://forums.raspberrypi.com/viewtopic.php?t=364327))
- WD Green SN580 series (Solved! Refer to NVMe_SSD_boot_with_the_Raspberry_Pi_5#comment-4708)
- WD Green SN350 series (Solved! Refer to NVMe_SSD_boot_with_the_Raspberry_Pi_5#comment-4602)
- WD Black SN850 series
- WD Black SN770
- Inland tn446 nvme drive
- Corsair MP600 SSD
- Micron 2450 SSD (Can be recognised but not support boot from NVME)
- Other NVMe SSD drivers equipped with the same **Phison controller**

These specific models have demonstrated compatibility issues, and it is advisable to avoid them when considering NVMe SSD options for the X10xx series NVMe shield. You can run "**lspci**" command to check the controller brand of the SSD.

Also note:

- Compatible with M.2 **NVMe** SSDs only, **Not** compatible with M.2 SATA SSDs, M.2 PCIe AHCI SSDs, or other M.2 non-NVMe devices
- Older NVMe drives with less efficient flash media may not perform as well as newer drives

- New NVMe SSDs are not partitioned and will need to be both partitioned and formatted when first connected to the Raspberry Pi before they will be accessed in the Explorer.
- We get feedback from customers that **Polaris Controller** will also have compatibility problems. Please replace the other SSD test if it not work, whether it is compatible with the Raspberry Pi 5 does not depend on the X100X series boards
- NVMEs using the **MAP1202** controller may not support PCIe Gen 2, and must be forced to enable PCIe Gen 3 in order to be recognised. This is due to the fact that the controller is not backward compatible with PCIe Gen 2, and NVMEs using this controller will have compatibility issues, and are not recommended for use. Can refer to https://zhuanlan.zhihu.com/p/644984347

PS: There is also feedback from buyers that even NVME SSDs with *Phison controller* are supported after updating the latest firmware. Please refer to go to: X1001#comment-4638

Features

- Minimalist design, easy to install
- Compatible with other HAT shield;
- FFC is only 30mm length.
- Supports installation of official active coolers;
- PCIE LED Indicators: PCie - The LED will be on if the SSD is recognised;

    According the Raspberry Pi Foundation's specification for PCIE (https://datasheets.raspberrypi.com/pcie/pcie-connector-standard.pdf), we have redesigned and retained only the ACT LED indicator in the next production batch (starting December 20, 2023).**On: Power OK/Standby,Flashing: Reading/Writing**

- Supports 2230/2242/2260/2280 NVME M2 SSD.
- Can power the X1001 shield directly from the FFC PCIe ribbon (providing maximum 5W of continuous power)
- Integrated with XH2.54 5V power connector, just use it if you are using a ultra large capacity SSD if the current is not enough;

PS:

- Maximum current for pcie connector is 1A, and voltage is 5V
- If you find that the SSD is not working properly, it is possible that the power supply of SSD is not enough, then you need to check the current requirement of your SSD to decide whether power the SSD separately.
- The X1001 hardware has no limit on NVME SSD capacity, which is dependent on the Raspberry Pi OS.

How to Power

Can power the X1001 shield directly from the FFC PCIe ribbon (providing maximum 5W of continuous power)

SSD Required Current Tips

DC +3.3V **2.5A**   PCIe Gen4 **x 4**

Although the maximum current required by this SSD is **2.5A**, it is actually the current requirement when it works on **PCIe x4**; Raspberry Pi 5 only supports **PCIe x1**, so the required current is only **2.5A/4=0.625A**; Currently the NVMe M.2 SSDs sold on on the market are PCIe x4 or PCIe x3. The FFC cable power supply we provide is sufficient!

Matching Case

Refer to <u>P579/P579-V2</u>

P579-V2 Case Dimensions

90.8mm/
3.57inch

64.0mm/
2.52inch

40.8mm/
1.41inch

69.0mm/2.72inch
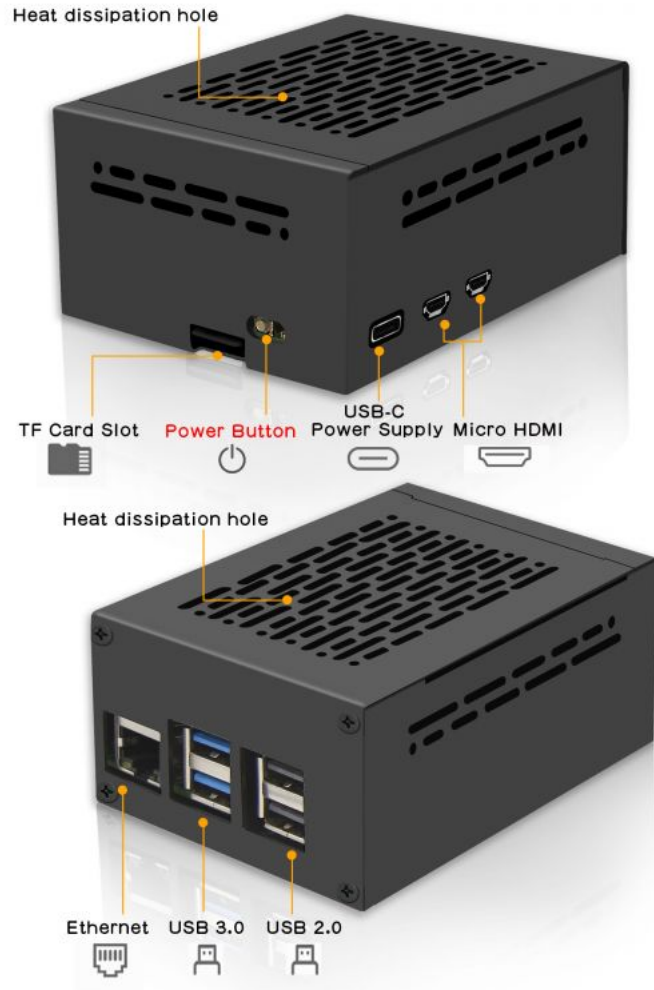
Installation Guide

① Fix Pi 5 & NVMe M.2 SSD Shield. As shown in picture.

② Push the whole assembly into P579 case,use KM2.5x4 screws to fix it.

③ ④ Fix top cover using 4pcs KM2.5x4 screws.

Pasting 4pcs rubber pads on the bottom.

Test Reviews

By default the PCIe connector is not enabled. To enable it you should add the following option into /boot/firmware/config.txt and reboot:

```
sudo nano /boot/config.txt
```

Then add the following comment;

```
# Enable the PCIe External connector.
dtparam=pciex1
```

```
# This line is an alias for above (you can use either/or to enable the port).
dtparam=nvme
```

Press **Ctrl-O**, then enter, to write the change to the file.

Press **Ctrl-X** to exit nano (the editor).

And the connection is certified for Gen 2.0 speed (5 GT/sec), but you can force it to Gen 3.0 (10 GT/sec) if you add the following line after:

```
dtparam=pciex1_gen=3
```

You also can refer to official documentatio:Enabling PCIe (https://www.raspberrypi.com/documentation/computers/raspberry-pi-5.html#enabling-pcie)

After I forced Gen 3.0 speeds, in my many tests I found that some NVMEs were able to run stably, but some NVMEs caused some problems: such as slow startup and running laggy, really really laggy. As the official statement says:

The Raspberry Pi 5 is not certified for Gen 3.0 speeds, and connections to PCIe devices at these speeds may be unstable.

Run the following command on Teminal window to test:

```
dd if=/dev/zero of=./Testingfile bs=100M count=10 oflag=direct
dd if=./Testingfile of=/dev/zero bs=100M count=10 oflag=dsync
```

Nomral PCIE 2.0 test data with *dd* command;

```
pi@raspberrypi:~ $ dd if=/dev/zero of=./Testingfile bs=100M count=50 oflag=direct
50+0 records in
50+0 records out
5242880000 bytes (5.2 GB, 4.9 GiB) copied, 25.7478 s, 204 MB/s
pi@raspberrypi:~ $ dd if=./Testingfile of=/dev/zero bs=100M count=50 oflag=dsync
50+0 records in
50+0 records out
5242880000 bytes (5.2 GB, 4.9 GiB) copied, 11.564 s, 453 MB/s
pi@raspberrypi:~ $
```

**Forced Gen 3.0 speeds test data with** dd **command:**

```
pi@raspberrypi:~ $ dd if=/dev/zero of=./Testingfile bs=100M count=50 oflag=direct
50+0 records in
50+0 records out
5242880000 bytes (5.2 GB, 4.9 GiB) copied, 7.50982 s, 698 MB/s
pi@raspberrypi:~ $ dd if=./Testingfile of=/dev/zero bs=100M count=50 oflag=dsync
50+0 records in
50+0 records out
5242880000 bytes (5.2 GB, 4.9 GiB) copied, 6.96089 s, 753 MB/s
pi@raspberrypi:~ $
```

Packing List

- 1 x X1001 V1.1 NVMe SSD Shield
- 1 x PCIe FFC Cable(30mm length)
- 3 x M2.5x17mm F/F Spacers
- 6 x M2.5x5mm Screws
- 1 x M2x4mm Screws (to fix M2 SSD)
- 1 x Copper pillar (Used to fix 2242/2230 SSDs, not to be added until April 2024)

X1001 Packing List

2R2

ACT

5V IN

+ −

M.2 KEY-M
NVMe

2280   2260   2242   2230

SSD copper pillar
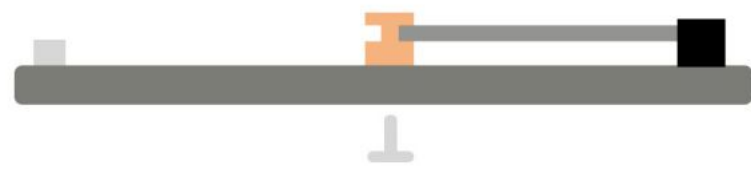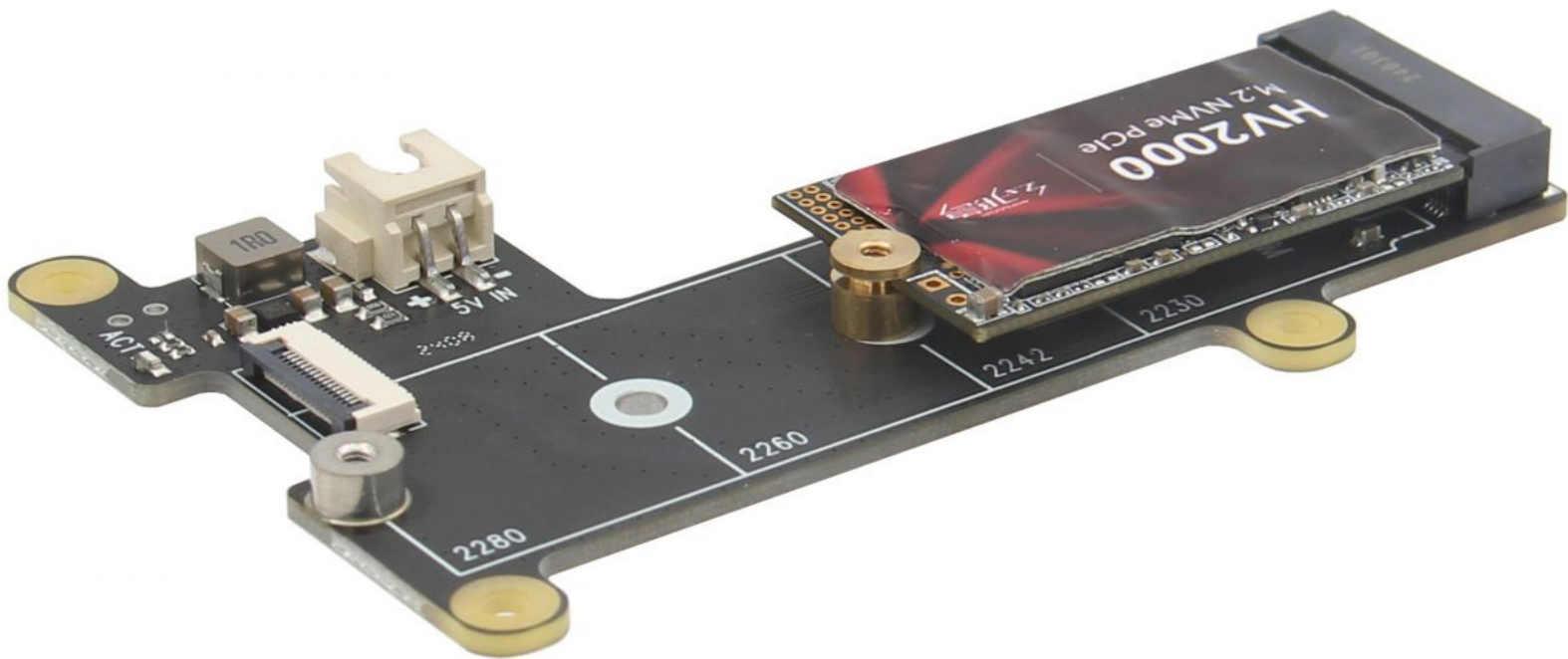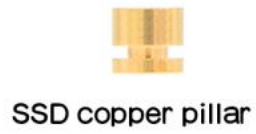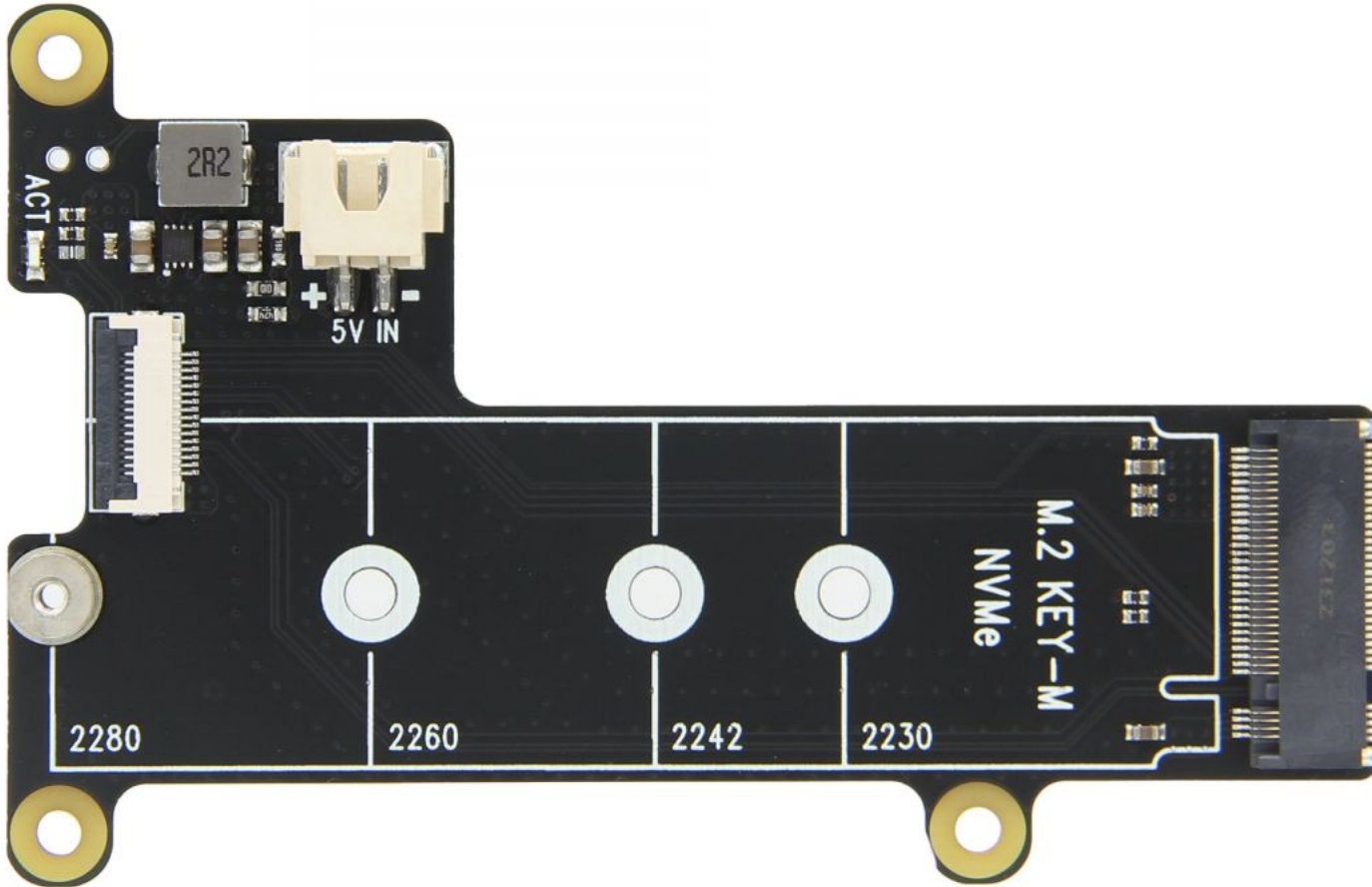
NOTE:

The M2*4 screw is to fix M2 SSD;

User Manual

- X1001 hardware description: X1001 Hardware
- X1001 software tutorials: NVMe SSD boot with the Raspberry Pi 5
- Raspberry pi 5 pcie connector pin out (https://datasheets.raspberrypi.com/pcie/pcie-connector-standard.pdf)
- Dimensions source file (DXF): File:X1001-V1.0.dxf - You can view it with Autodesk Viewer (https://viewer.autodesk.com/) online

Video Guide

Installation Video of X1001: https://youtu.be/X1GxqLKpPfg

X1001/X1001/X1002 Test Video by leepsvideo https://youtu.be/XMA8e4r1AUQ

Which NVMe drives work with a Raspberry Pi 5? https://youtu.be/3mUgVTBmKi0

Thanks for the test video by Computadoras y Sensores! https://youtu.be/DgIAfzBMTA0

Thanks for the video by Code Fallacy! https://youtu.be/IUxP31rNRY4

Thanks for the test video by Andy Yong! https://youtu.be/nq90S1vxfUU

FAQ

Overview

In fact, some PIPs such as X1001 / X1002 / X1003 / X1000 etc are just an extension of the Raspberry Pi 5 PCIe, and their own hardware functions are limited. If the **OS configuration** and **PCIe FFC cable faults** can be ruled out, the normal operation of PCIe (recognizing and booting) depends more on the **firmware** and **SSD compatibility**. Since October 2023, the Raspberry Pi Foundation has been updating the bootloader version to solve similar problems.

You can learn more from the link below.

Raspberry Pi5 bootloader EEPROM release notes (https://github.com/raspberrypi/rpi-eeprom/blob/master/firmware-2712/release-notes.md)
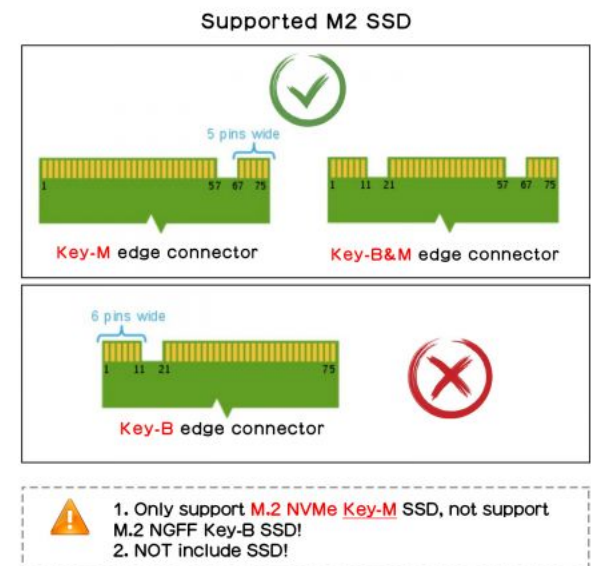
But in fact, after several major version updates, the bootloader has basically solved the firmware issue, so the remaining is the **OS configuration** and **SSD compatibility** issues.

If you are using a very old SSD, if you are experiencing issues with it being recognised and not being able to boot, the first thing you should consider is replacing the NVME SSD.

Q1: Can't boot/recognize from NVMe SSD?

A: Here are a few steps to help you troubleshoot some issues：

1. **Only** Raspberry Pi OS (**Bookworm**) supports PCIe, Raspberry Pi OS bullseye is NOT supported, refer to https://www.raspberrypi.com/software/operating-systems/
2. Make sure that your OS configuration (`/boot/firmware/config.txt`) is completely correct: refer to the tutorial:NVMe SSD boot with the Raspberry Pi 5 (will Continuously updating)
3. Update the bootloader firmware to the last verson, refer to How to update eeprom firmware, this is very important!!! Make sure your upgrade is successful by running command **vcgencmd bootloader_version**
4. Add **PCIE_PROBE=1** to the eeprom, (Run **sudo rpi-eeprom-config --edit** command, then add this line, then press CTRL+O to write change to file, press CTRL+X to exit, then **reboot**)
5. Make sure the SSD type you use is correct, only support M.2 NVME (Sata) Key-M SSD **NOT support** M.2 NGFF Key-B SSD. Refer to the right diagram:
6. Make sure the FPC cable is **firmly and fully inserted** into the PI 5, this is **very important**. For X1003 shield, make sure the FPC cable **direction** is correct also.
7. For some small brand SSD, consider forcing open **PCIe Gen3** to test (add dtparam=pciex1_gen=3 line in **config.txt** then **reboot**), because some small brand SSDs are **NOT backward compatible with PCIe Gen 2** for cost reasons.
8. **For X1003 shield, make sure the FPC cable direction is correct also. If an error still occurs, replace the FFC cable to test or purchase other PFC from here[1]to troubleshoot the issue.**
9. Read this post (https://geekworm.com/community/forum/topic/120764/geekworm-x1001-for-raspberry-pi-5) to get some help;
10. Although you can also boot from a SD card, Pi OS is required for the NVMe SSD to boot, DON'T forget Flash OS into NVMe SSD.
11. If you're flashing a fresh Pi OS into NVME SSD , DON'T forget to **ENABLE PCIe** to NVMe SSD.
12. Run the **lspci** and**lsblk** command to check the NVMe SSD is recognized. (NOTE: Make sure your **NVMe SSD is plugged into the PCIe PIP**, not just connecting PCIe PIP to the Pi5, otherwise the lspci will not be able to display any PCIe device.)
13. Start thinking about SSD compatibility issues and try to switch to other brands of NVME SSDs. Some customers have reported that they have successfully solved their problems by replacing their SSDs.

Supported M2 SSD

5 pins wide

57 67 75   1 11 21   57 67 75

Key-M edge connector   Key-B&M edge connector

6 pins wide

1 11 21   75

Key-B edge connector

1. Only support M.2 NVMe Key-M SSD, not support M.2 NGFF Key-B SSD!
2. NOT include SSD!

click it to zoom out

14. Contact us at email: support@geekworm.com, and attached your product model, OS version (run **uname -a** to get), bootloader version (run **vcgencmd bootloader_version** to get) and order number

  - **How to get FPC Wires:**

  1.
     Amazon US: https://www.amazon.com/dp/B0CXCTPQ2N
     Amazon DE: https://www.amazon.de/dp/B0CX4T993J
     Amazon UK: https://www.amazon.co.uk/dp/B0CX4T993J
   Amazon JP: https://www.amazon.co.jp/dp/B0CYGKN7G1

     - PS: The shortest length of the FPC cable here is **30mm**, but the length of the FPC cable used by X1003 is only **22mm**. For X1003, this may not be perfect, but you can use these FPC cables to troubleshoot the issue. DON'T buy it if you mind.
     - If the issue is confirmed to be a FFC cable, we will reimburse you the cost of purchasing the FFC cable.

Q2: Don't recognize / boot from NVME SSD?

A: If you have **enabled pcie** and find that you still cannot boot from NVME SSD, please perform the following actions

1. Follow the picture below to check the version of X1001 or X1000

X1001 PCIe to M.2 NVME

Old version (2 Leds)   New version (Only 1 Led)
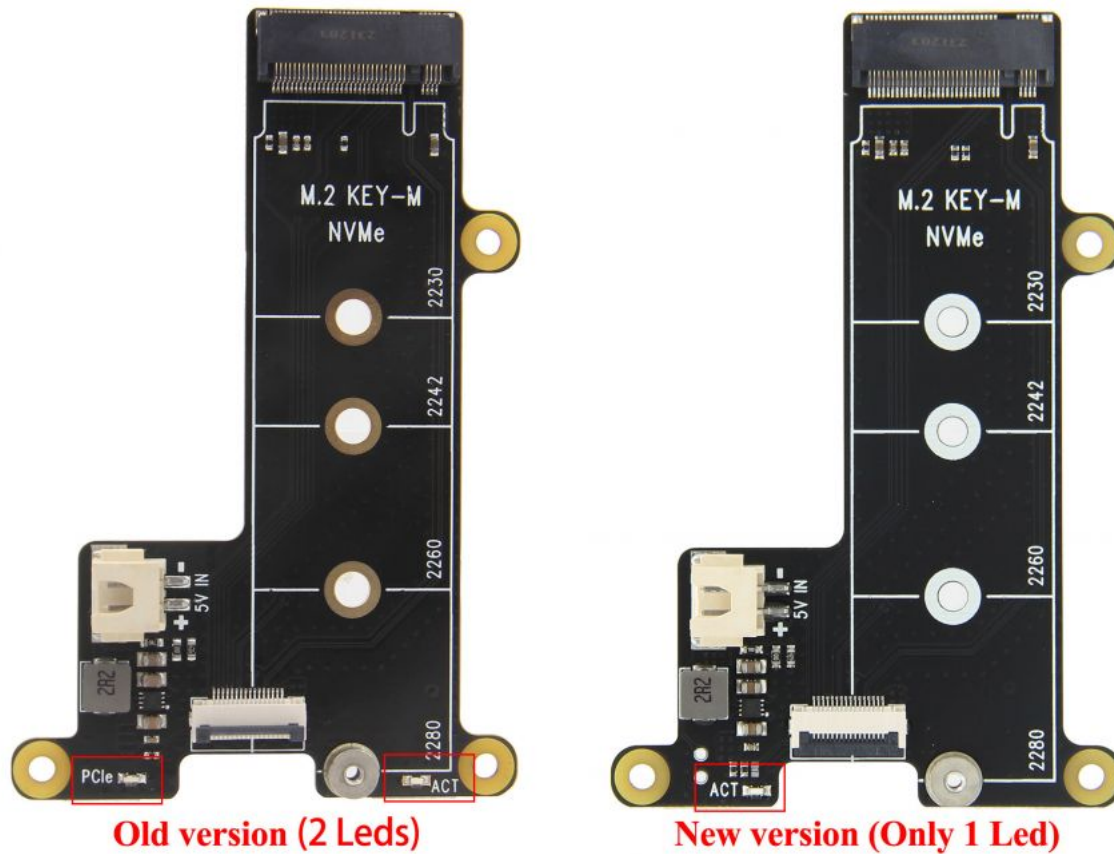
2. If it is an **Old Version**, refer to <u>How to update eeprom firmware</u> to update the firmware with **pieeprom-2023-10-30.bin file**.

3. If it is an **New Version**, refer to <u>How to update eeprom firmware</u> to update the firmware to **lasted version**.

4. **If you still have not solved the problem, please refer to the next FAQ:Q1**

Q3: How to fix the 2230/2242/2260 SSD on X1001 or other PIP?

A: The X1001 and other pips does not reserve the nut column to fix the 2230/2242/2260 SSD. Based on our test, you can secure the 2230/2242/2260 SSD using an M2*6mm screw and 2pcs M2 nuts. Place one M2 nut under the SSD, then use the M2*6mm screw and the other M2 nut to fasten the SSD.

Q4. X1002 can't boot when install into the P580 case?

A: Please check if the FPC cable touch the metal case make shorting when install X1002 into the metal case, you can stick the electrical tape on the case to prevent the ribbon FPC cable from contacting the case to test.

Q5: Which NVMe drives work with a Raspberry Pi 5?

A: You can refer to the video: https://youtu.be/3mUgVTBmKio.

Q6: Can they support gen3 PCIe speeds or only gen2?

A:

- All PIPs (such X1001, X1002, X1003 etc) are just an extension of the Raspberry Pi 5 PCIe interface. Apart from whether the chip on the PIP board supports PCIe 3.0 or not, the more main focus is on the Raspberry Pi 5.
- X1004, X1011, X1005 PIP boards do not support PCIe Gen 3 speed.