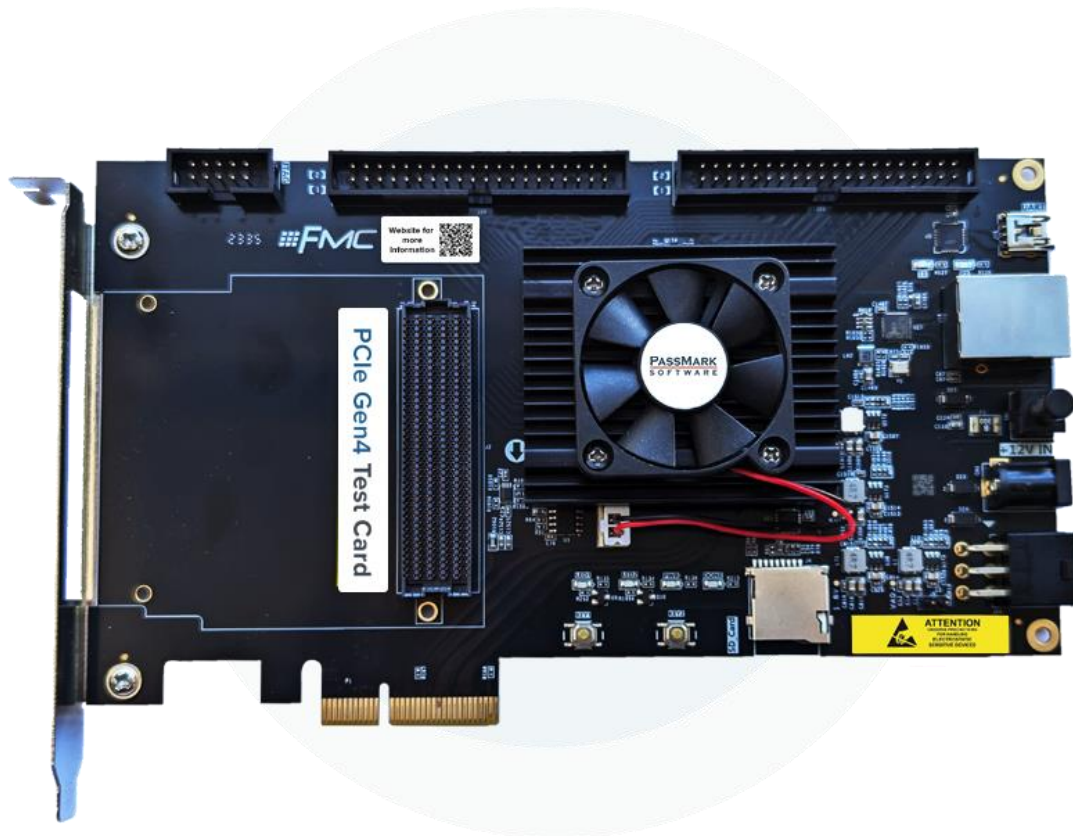


# PCIe Gen4 Test Card

## Users Guide

Model PM146



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## Introduction

The PCIe Gen 4 Tester can be used to diagnose and troubleshoot PCIe slots. With the PCIe Gen 4 Tester, you can test that PCI-Express slots function correctly and provide the expected speed. It is possible to verify that:

- The PCIe slot is powered.
- That a port is capable of Gen4.0 (16Gb/s per lane) or Gen3.0 (8Gb/s per lane) or Gen2.0 (5Gb/s per lane) or GEN1.0 (2.5Gb/s per lane). The maximum speed of the slot can be benchmarked.
- That data can be sent and received from the PCIe host slot.
- That data can be transferred without error.
- The system remains stable under long periods of load.
- Concurrently check multiple PCIe slots at the same time
- Ensure no low-level errors are occurring on the bus that might be hidden from the user

The PCIe Test Card is software upgradable via the included JTAG programmer.

## What's Inside

- 1- The PCIe Gen4 Test card
- 2- The JTAG Programmer for firmware updates



- 3- USB cable for JTAG Programmer



## General Notes

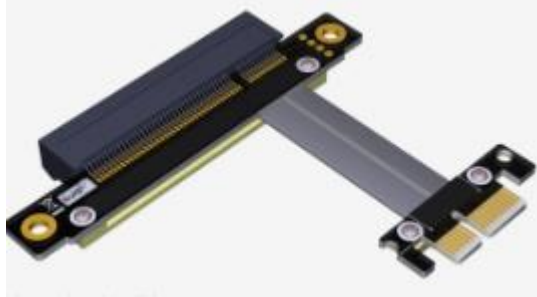
### Compatibility

Windows 7, 8, 10 and 11 supported.

PCIeGen4Test software is required for Windows. Only 64bit Windows driver is available.

### Testing PCIe x1 slot:

The card has a x4 edge which means it can't be inserted into a x1 slot. For testing a x1 slot, you need a PCIe Gen 4 (or higher) riser card extension adapter (x1 to x4 or x1 to x8 or x1 to x16). Please note this extension adapter is not included.



### Multiple PCIe Test Cards

Multiple PCIe Test Cards can be connected, and simultaneous loopback and benchmark testing carried out.

Each PCIe Test Card is unique and has its own serial number, which is displayed by PCIeGen4Test.exe. This can be used to distinguish between multiple cards plugged into your system.

### Speed

PCIe Gen4.0 is normally quoted as 16GBps per lane; however, data rates will never reach these speeds on a real device due to several factors. These include overhead from bit encoding, Transaction Layer Packet (TLP) and Data Link Layer Packet (DLLP) communications, and Physical Layer Packet (PLP) management. These protocols and encoding mechanisms consume signalling bandwidth, reducing the effective throughput available for data transfer. Moreover, practical throughput is further influenced by additional system-level latencies. These can include operating system overhead, interrupt processing delays, and other software-related factors that impact the overall data transfer efficiency beyond the hardware-level protocol overheads. On a correctly functioning PC with a single PCIe device connected, you should typically see measured maximum speed results shown in the below table:

PCIe Gen4 Lane width	Expected speed
X1	1900MB/s
X4	7600MB/s

The PCIe Test Card has a maximum bandwidth of 7000 MBps, so the card cannot benchmark up to the PCIe gen 4.0 maximum x4 bandwidth of ~7600 MBps).

### **LEDs Indicators:**

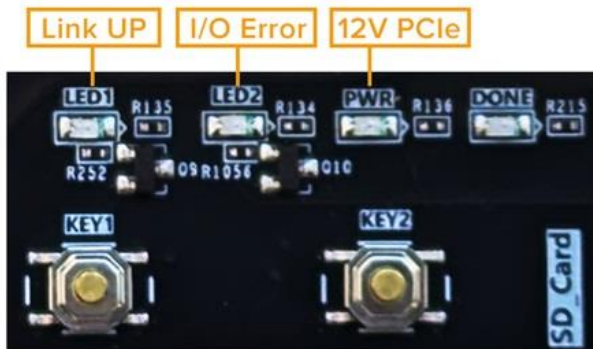
There are 4 LEDs on the card, each serving a specific purpose:

LED1: Link UP = PCIe link has been successfully established and is fully operational

LED2: I/O Error = This LED illuminates when an error occurs on the PCIe link

PWR:12V PCIe = This LED lights up to indicate that 12V power is present on the PCIe slot

DONE = This LED is used for debugging purposes and remains off during testing



### **Electrostatic Discharge Caution**

**CAUTION!** ESD can damage electronic components when they are improperly handled and can result in total or intermittent failures. Always follow ESD-prevention procedures when installing or removing the PCIe test card.

To prevent ESD damage:

- Use an ESD wrist or ankle strap and ensure that it makes skin contact.
- Connect the equipment end of the strap to an unpainted metal surface on the chassis.
- Avoid touching the adapter against your clothing. The wrist strap protects components from ESD on the body only.
- Handle the adapter by its bracket or edges only.
- Avoid touching the printed circuit board or the connectors.
- Put the adapter down only on an antistatic surface such as the bag supplied in your kit.

## **Windows Installation:**

### **Step 1 – Installing the PCIe Test card in a PC Chassis**

Make sure the computer is completely off. Insert the PCIe card into a vacant PCIe slot.

Please note no external adapter or ATX connection is required for testing. However, if you suspect a failure is due to improper power from the 12V PCIe slot, you can use an external adapter or connect the ATX 6-pin connector from the PSU. Please note that the adapter is not included, so if you opt for an external adapter, ensure it is of good quality with the correct polarity (ground on the outside and +12V inside).

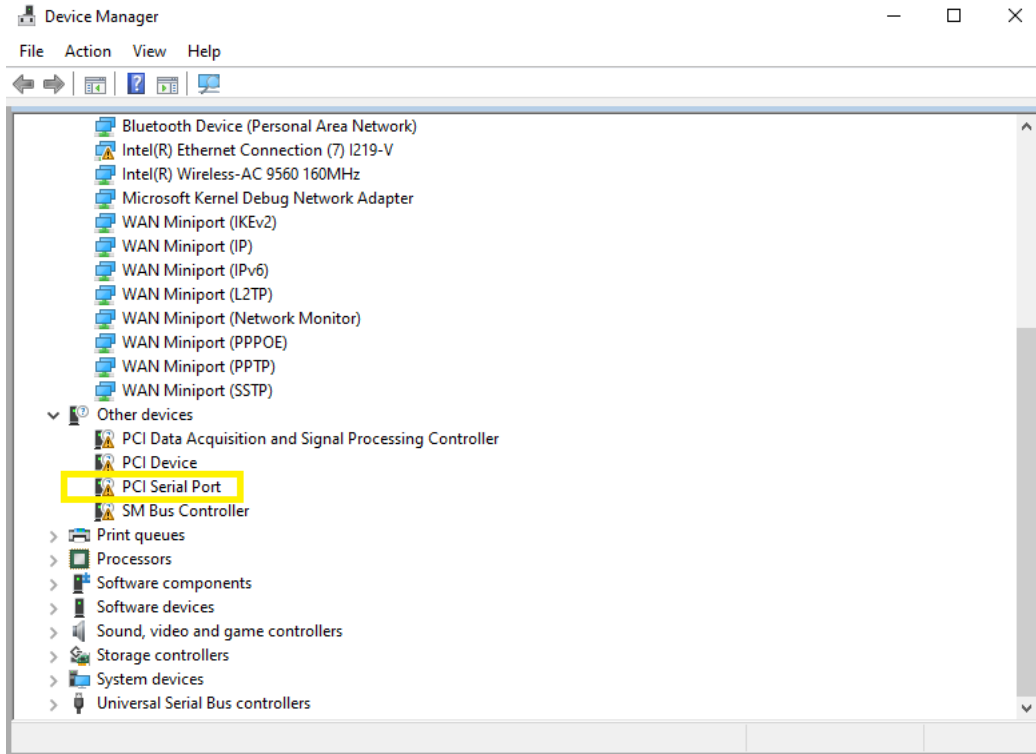
### **Step 2 – Install the device driver**

If a PassMark PCIe Test Card has been installed on the system previously, the device drivers will be automatically installed, and the installation is complete.

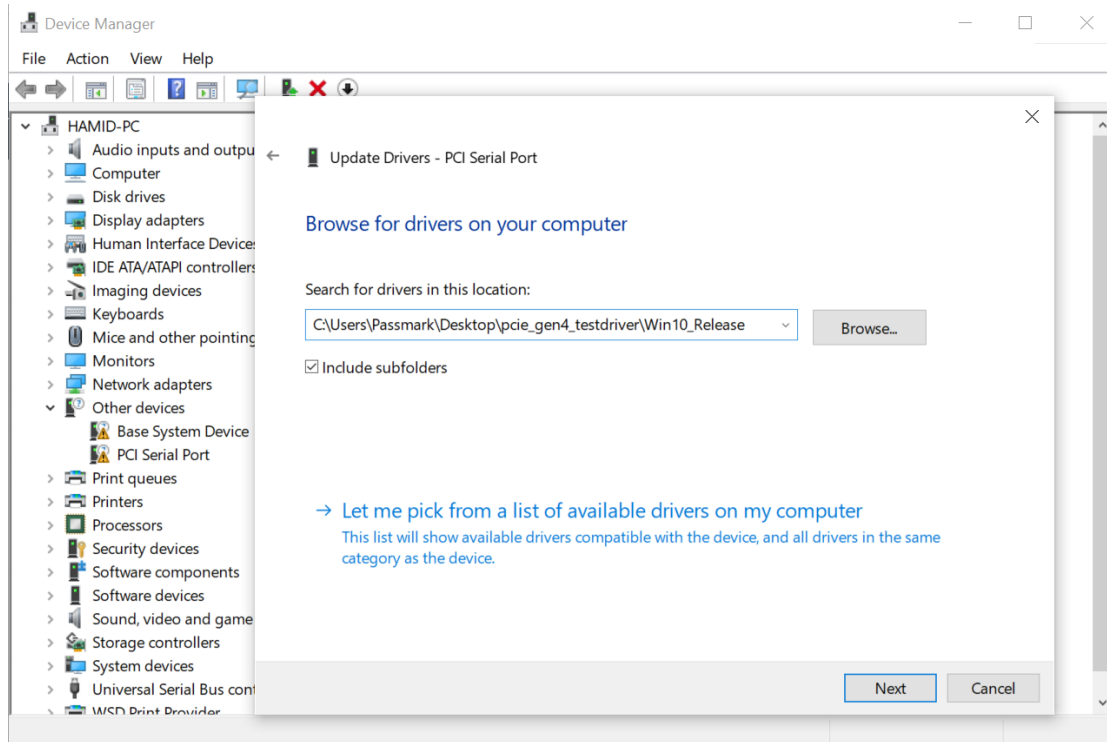
If the driver is not installed, download the latest device driver from the below link and follow the below steps to install the driver.

<https://www.passmark.com.au/products/pcie-gen4-test-card/download.php>

Start Device Manager by selecting Windows Start and typing “Device Manager” or through the Control Panel. If the PCIe Test Card has never been installed before, it should appear as “PCI Serial Port” under Device Manager>>Other devices



If the PCIe Test Card already has drivers installed and you wish to update the driver then it should appear as “Passmark PCIe Gen4 Test Card” under Device Manager >> “Passmark PCIe Gen4 Driver”



Right-click the device and select “Update Driver Software...” from the drop-down menu.  
Select “Browse my computer for driver software” and enter the location of the device drivers. Click Install.

After successful installation, a Window will be displayed indicating that “Windows has successfully updated your driver software”.  
If the PCIe Test Card already has drivers installed and you wish to update the driver then it should appear as “Passmark PCIe Gen4 Test Card” under Device Manager >> “Passmark PCIe Gen4 Driver”

### **Step 3 – Starting the Test Software**

The PCIe Test Card can be used to test PCIe slots with PCIeGen4Test software. The latest version of PCIeGen4Test software can be downloaded from the below link.  
<https://www.passmark.com.au/products/pcie-gen4-test-card/download.php>

To run PCIeGen4Test, download the standalone test application from Passmark website and click on “PCIeGen4Test.exe”.

## **Loopback Test**

In Loopback test, the software sends 256KB of data to the plug and reads back the data from the card. Then, data is verified, and low-level errors occurred during communication will be reported.

**PassMark(R) PCIeGen4Test**

Select PCIe test

Device: PCIe-0, Windows ID: {74c7e4a9-6d5d-4a70-bc0d-20691dff9e9d}

Duration: 0 Minutes

Mode:  Loopback  Benchmark

**Results** *Status: LOOPBACK test - Complete*

Duration: 000h 00m 07s Operations: 525 Errors: 0

Loopback blocks 401–410: Min 1644.0 MB/s, Max 1908.0 MB/s (Round)
Loopback blocks 411–420: Min 1748.0 MB/s, Max 1908.0 MB/s (Round)
Loopback blocks 421–430: Min 1772.0 MB/s, Max 1893.0 MB/s (Round)
Loopback blocks 431–440: Min 1772.0 MB/s, Max 1908.0 MB/s (Round)
Loopback blocks 441–450: Min 1748.0 MB/s, Max 1922.0 MB/s (Round)
Loopback blocks 451–460: Min 1748.0 MB/s, Max 1922.0 MB/s (Round)
Loopback blocks 461–470: Min 1824.0 MB/s, Max 1922.0 MB/s (Round)
Loopback blocks 471–480: Min 1811.0 MB/s, Max 1922.0 MB/s (Round)
Loopback blocks 481–490: Min 1748.0 MB/s, Max 1922.0 MB/s (Round)
Loopback blocks 491–500: Min 1811.0 MB/s, Max 1922.0 MB/s (Round)
Loopback blocks 501–510: Min 1785.0 MB/s, Max 1922.0 MB/s (Round)
Loopback blocks 511–520: Min 1797.0 MB/s, Max 1908.0 MB/s (Round)

Test Start time: Mon Jul 8 13:07:24 2024  
Duration: 000h 00m 07s  
525 Operations.  
0 Read error(s). 0 Write error(s). 0 Verification error(s).  
Test passed: PCIe-0, Windows ID: {74c7e4a9-6d5d-4a70-bc0d-20691d}

Max. Rate NA

8000  
6000  
4000  
2000  
0 (MB/s) R/W

Start Configure  
Save Log About  
Exit

## Benchmark Test

In the Benchmark test, the Test application initiates 16MB transfers and measures the time each transfer takes to calculate the throughput. The transfer size can be changed via the Configuration window.

**PassMark(R) PCIeGen4Test**

Select PCIe test

Device: PCIe-0, Windows ID: {74c7e4a9-6d5d-4a70-bc0d-20691dff9e9d}

Duration: 0 Minutes

Mode:  Loopback  Benchmark

**Results** *Status: BENCHMARK test*

Duration: 000h 00m 17s Operations: 7080

Read blocks 261–270: Min 6809.0 MB/s, Max 6831.4 MB/s
Write blocks 261–270: Min 6602.3 MB/s, Max 6612.2 MB/s
Read blocks 271–280: Min 6816.2 MB/s, Max 6825.8 MB/s
Write blocks 271–280: Min 6601.1 MB/s, Max 6610.6 MB/s
Read blocks 281–290: Min 6804.8 MB/s, Max 6818.9 MB/s
Write blocks 281–290: Min 6601.2 MB/s, Max 6611.0 MB/s
Read blocks 291–300: Min 6811.3 MB/s, Max 6820.3 MB/s
Write blocks 291–300: Min 6599.1 MB/s, Max 6607.3 MB/s

Overall benchmark result:  
Duration: 000h 00m 17s  
Maximum read data rate: 6832.4 MB/s (54.66 Gb/s)  
Average read data rate: 6817.7 MB/s (54.54 Gb/s)  
Minimum read data rate: 6804.8 MB/s (54.44 Gb/s)  
Maximum write data rate: 6616.3 MB/s (52.93 Gb/s)  
Average write data rate: 6604.0 MB/s (52.83 Gb/s)  
Minimum Write data rate: 6555.7 MB/s (52.45 Gb/s)  
Average combined R/W data rate: 6710.8 MB/s (53.69 Gb/s)

Max. Rate 6832

8000  
6000  
4000  
2000  
0 (MB/s) R/W

Start Configure  
Save Log About  
Exit



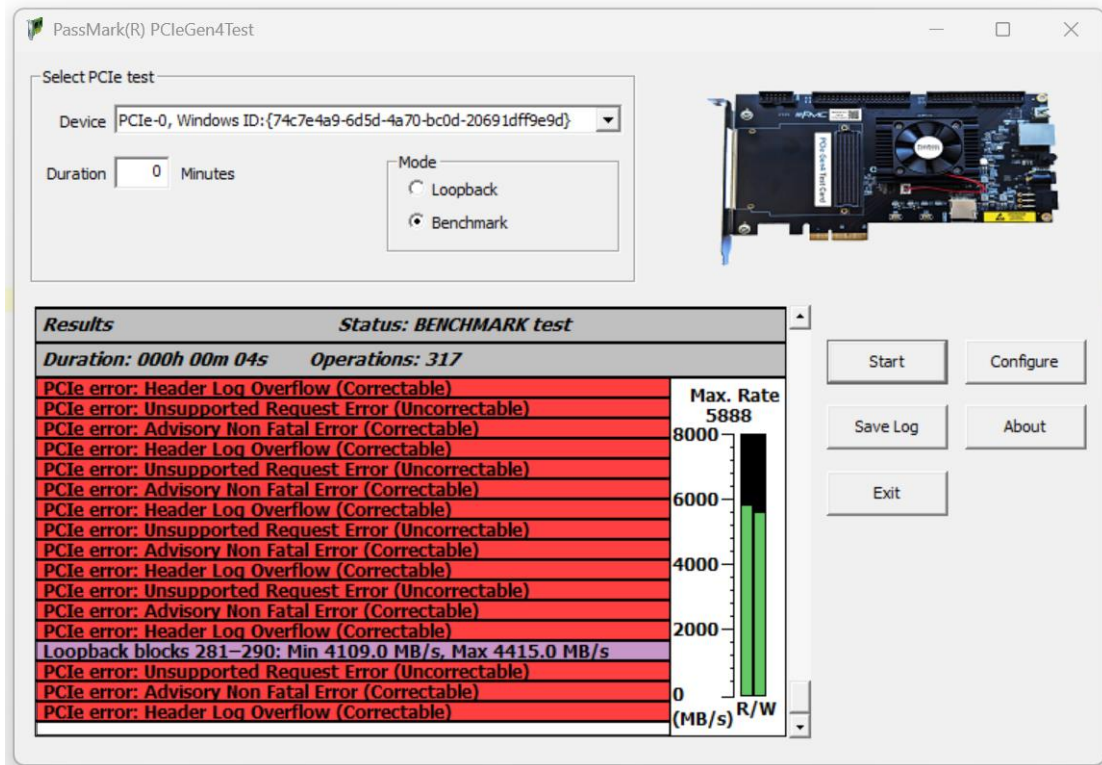
## Advanced Error Reporting

AER (Advanced Error Reporting) is a PCI Express feature that allows for more enhanced reporting and control of errors than the basic error reporting scheme. AER errors are categorized as either correctable or uncorrectable and can be detected by the test software.

Correctable errors include those error conditions where hardware can recover without any loss of information. Hardware corrects these errors and software intervention is not required.

Uncorrectable errors are those error conditions that impact functionality of the interface. There is no mechanism defined by PCIe specification to correct these errors. The below table summarize the list of errors that can be detected by the PCIe Gen4 Test card.

<b>Name of Error</b>	<b>Classification &amp; severity</b>
Data Link Protocol Error	Uncorrectable
Poisoned TLP	Uncorrectable
Flow Control Protocol Error	Uncorrectable
Completion Timeout	Uncorrectable
Completer Abort	Uncorrectable
Unexpected Completion	Uncorrectable
Receiver Overflow	Uncorrectable
Malformed TLP	Uncorrectable
Unsupported Request Error	Uncorrectable
Uncorrectable Internal Error	Uncorrectable
Receiver Error	Correctable
Bad TLP	Correctable
Bad DLLP	Correctable
Replay Num Rollover	Correctable
Replay Timer Timeout	Correctable
Advisory Non Fatal Error	Correctable
Corrected Internal Error	Correctable
Header Log Overflow	Correctable



## Uninstalling in Windows

From the Windows "Start" option, select "Control Panel", "System", "Hardware", "Device Manager", from the " Passmark PCIe Gen4 Drivers " branch of the device tree, select the " Passmark PCIe Gen4 Test Card" device and from the menu select "Action", "Uninstall".

## Trouble shooting

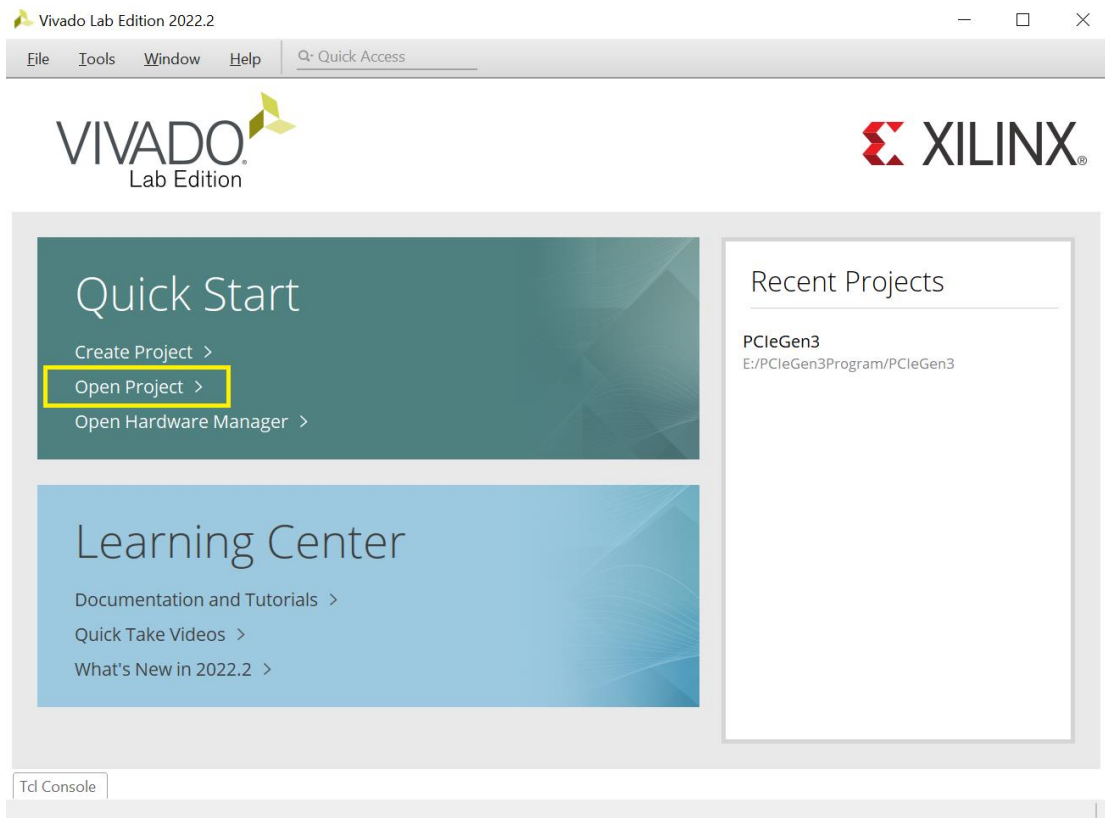
Symptom: Power, but no appearance of a PCI Device under Device Manager  
The basic PCIe device enumeration process could not be completed. This could be a fault in the Windows O/S installation or with the PCIe hardware in the computer.

## Updating the firmware

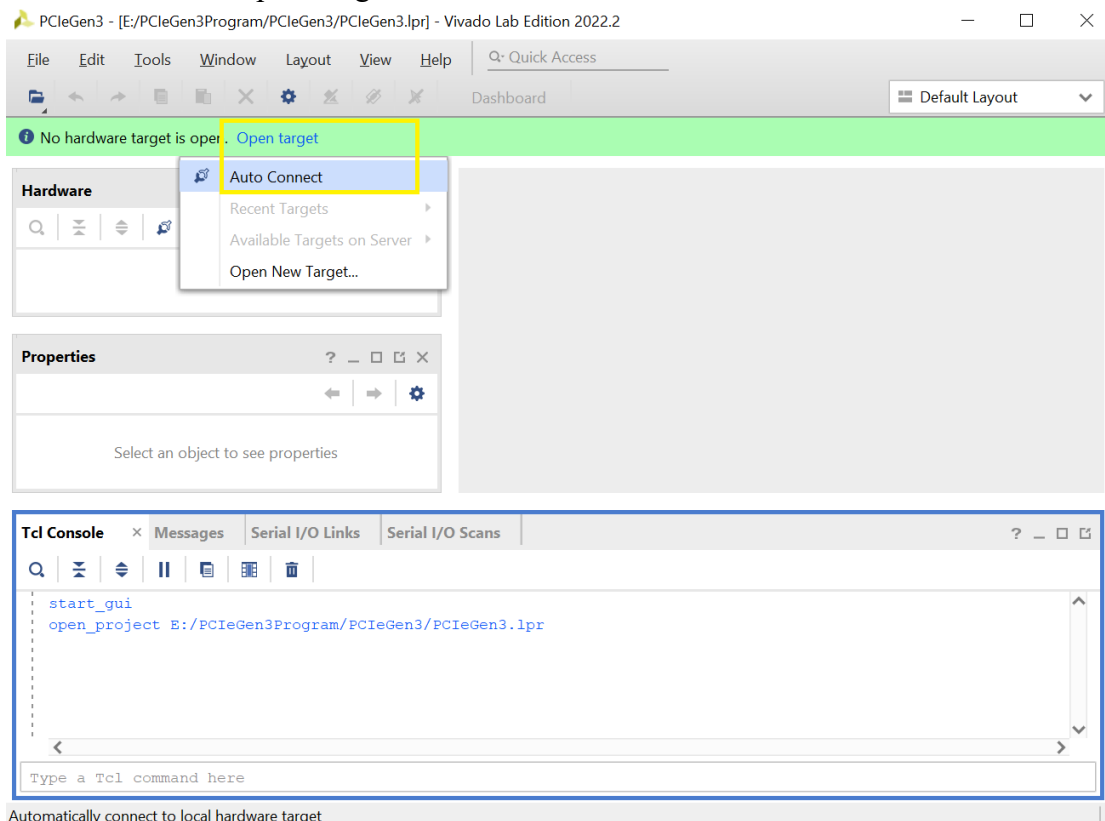
You need Vivado Lab Edition to update the firmware on the card.  
<https://www.xilinx.com/support/download.html>

The firmware file is available from PassMark upon request.

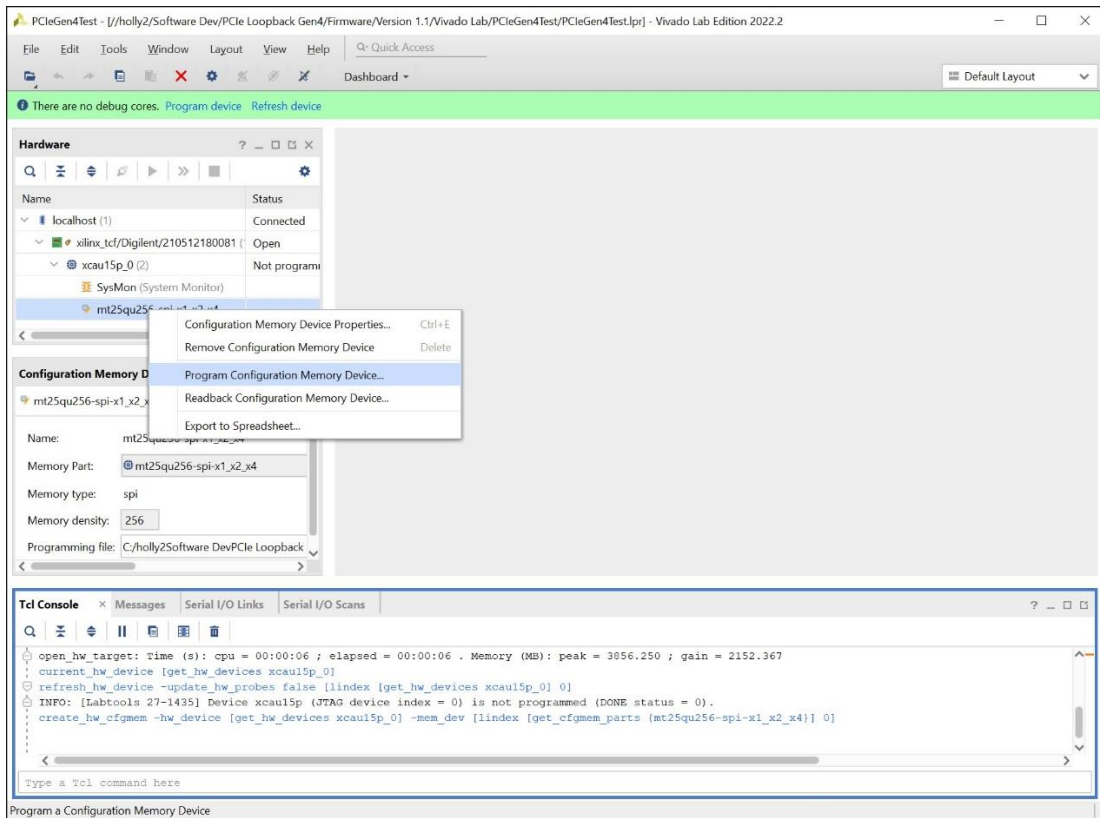
- 1- Turn off the PC
- 2- Insert the PCIe card into a vacant PCIe slot
- 3- Turn on the PC
- 4- Open Vivado Lab Edition and select "Open Project". Select the Vivado Lab Project file inside the firmware directory.



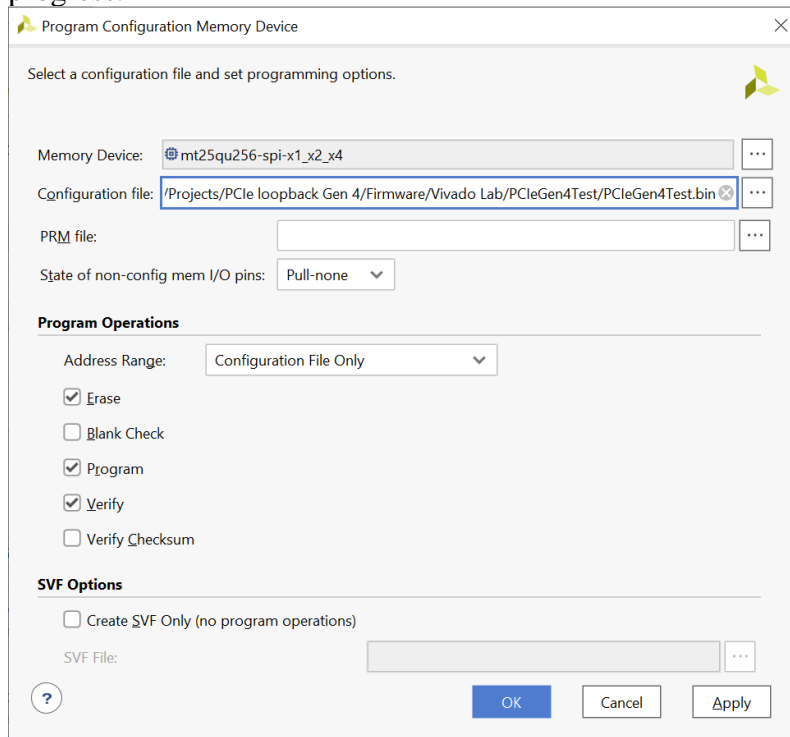
5- Click on “Open Target” and click “Auto Connect”



6- From with “Hardware Window”, right click on “mt25qu256-spi-x1\_x2\_x4” and click “Program Configuration Memory Device...”



7- Click “OK”. Do not unplug or remove power while firmware update is in progress.



8- Turn off the PC. Wait a few seconds and then turn on the PC. The card is now ready for testing.

## Technical Specifications

Product Code	PM146
PCIe Standard	Gen 4, Gen3, Gen2 and Gen 1 (also compatible with Gen 5, running at Gen4 speeds)
Physical Connector	x4 PCIe edge connector (can be used on x1 using a x4 to x1 adapter)
Max Speed	16 Gbits/sec per lane (raw bit rate)
Max Throughput	7000 MB/s (effective data rate) when inserted into a x4 PCIe slot; speed reduces to 1750 MB/s when connected via a x4 to x1 adapter for testing x1 PCIe slots.
Test Modes	Loopback: Data packets will be looped for reliability testing. Benchmark: 3x DMA engines will send/receive data to the card to measure maximum achievable speed.
PCIe Transfer Mode	DMA - Direct Memory Access
Indicators	LED1: Link UP, LED2: I/O Error, PWR: 12V PCIe
Advanced Error Reporting and Data Integrity	The card features Advanced Error Reporting (AER), including detailed logging of read/write failures and low-level PCIe bus errors. In loopback mode, it verifies data integrity and alerts users to any discrepancies between write and read operations.
Dimensions	Height: 8.38 inch (21.3 cm) Thickness (±5%): 1.062 inch (2.7 cm) Length: 14.8 inch (37.6 cm)
Weight	190g
Storage Temperature	-25°C to +60°C
Usage Temperature	0°C to +45°C
Humidity	10% to 90% non-condensing
RoHS (Lead Free)	Yes

## Disclaimer

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