

NVMeSW IP Core Demo Instruction

Rev1.2 20-Apr-20

This document describes the instruction to run NVMeSW-IP demo on FPGA development board by using the PCIe adapter board (AB18-PCIeX16 board or AB16-PCIeXOVR board). The demo is designed to write/verify data by connecting NVMe SSD through PCIe switch. User controls the test operation through Serial console.

The sequence to run NVMeSW-IP with NVMe SSD directly without PCIe switch is mostly similar to NVMe-IP. So, please see more details of direct connection from “NVMe-IP demo Instruction” document.

https://dgway.com/products/IP/NVMe-IP/dg_nvmeip_instruction_v4_en.pdf

1 Environment Requirement

To run the demo on FPGA development board, please prepare following environment.

- 1) Supported FPGA Development board: KCU105/ZCU106/VCU118
- 2) PC installing Xilinx programmer software (Vivado) and Serial console software such as HyperTerminal and TeraTerm
- 3) The PCIe adapter board (AB18-PCIeX16 board/AB16-PCIeXOVR board) provided by Design Gateway
https://dgway.com/ABseries_E.html
- 4) Xilinx power adapter for FPGA board
- 5) ATX power supply for PCIe adapter board
- 6) PCIe switch card with M.2 connector such as
 - a) Quattro 400 M.2 NVMe SSD adapter
<https://www.aplicata.com/quattro-400/>
 - b) Squid SKU-086-34 NVMe SSD Adapter
<https://amfeltec.com/products/pci-express-gen-3-carrier-board-for-m-2-ssd/>
- 7) 1-4 NVMe SSDs connecting on PCIe switch card
- 8) Two micro USB cables connecting between FPGA board and PC (one for programming FPGA and another for Serial console)

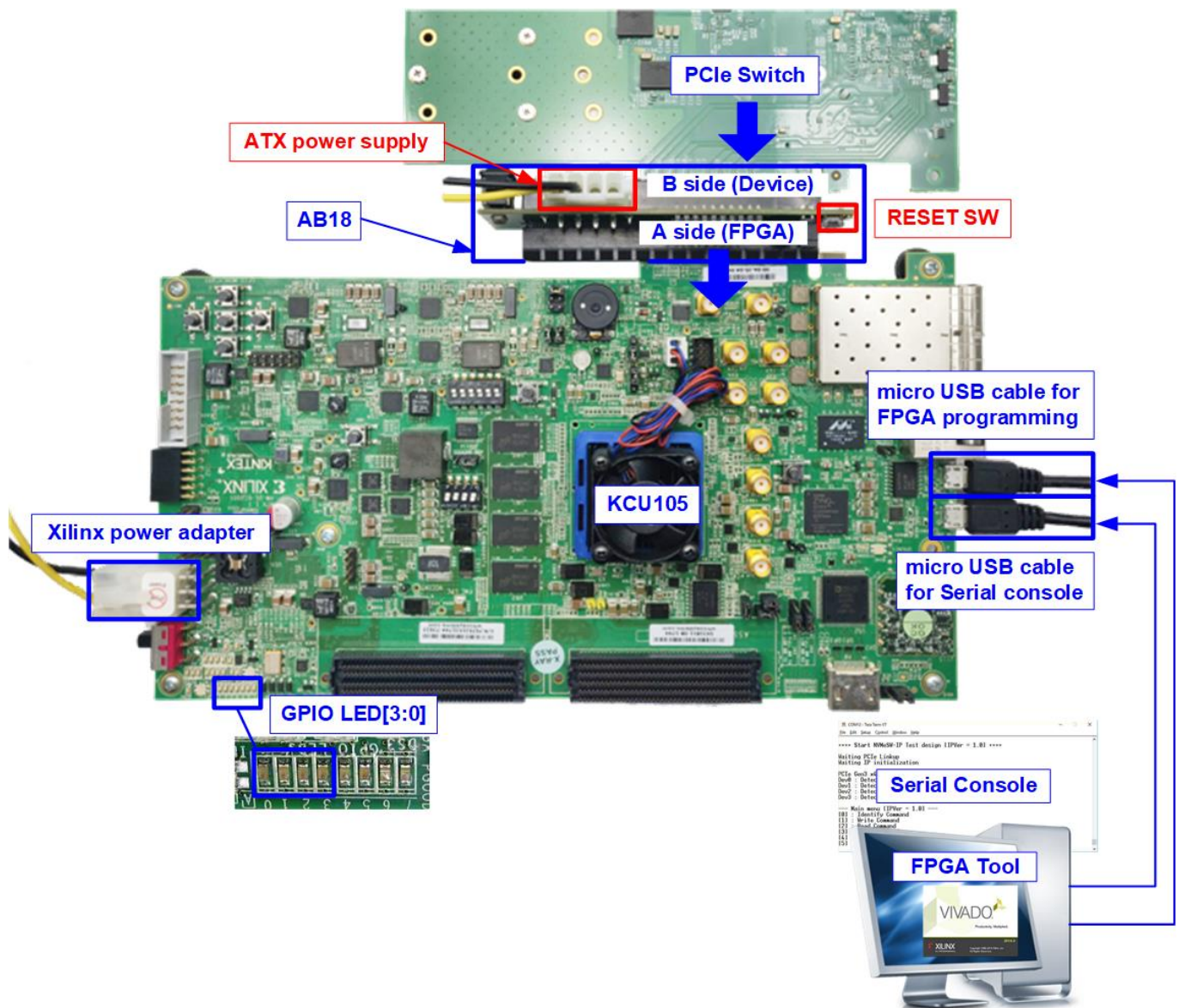


Figure 1-1 NVMeSW-IP demo environment setup on KCU105

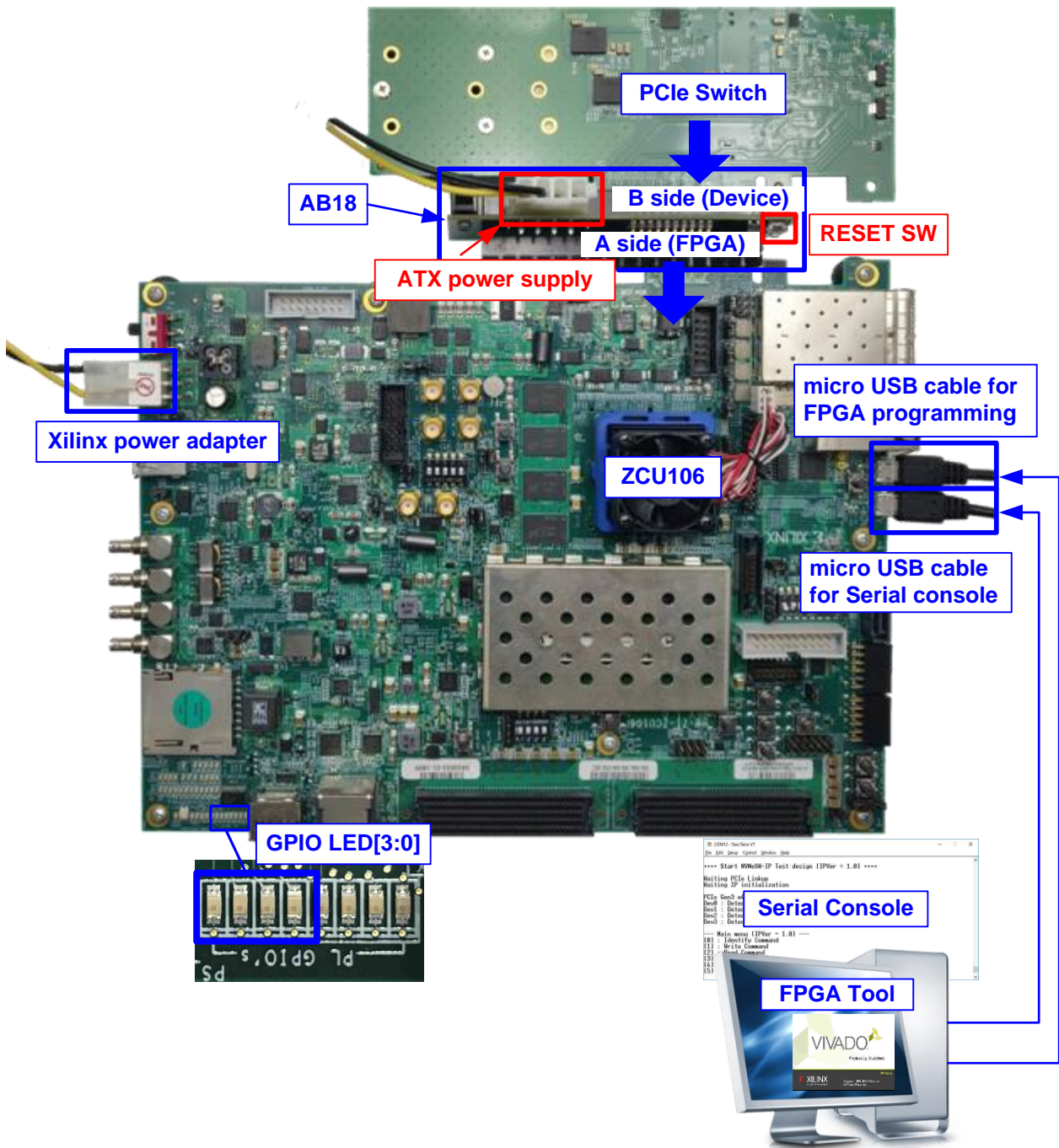


Figure 1-2 NVMeSW-IP demo environment setup on ZCU106

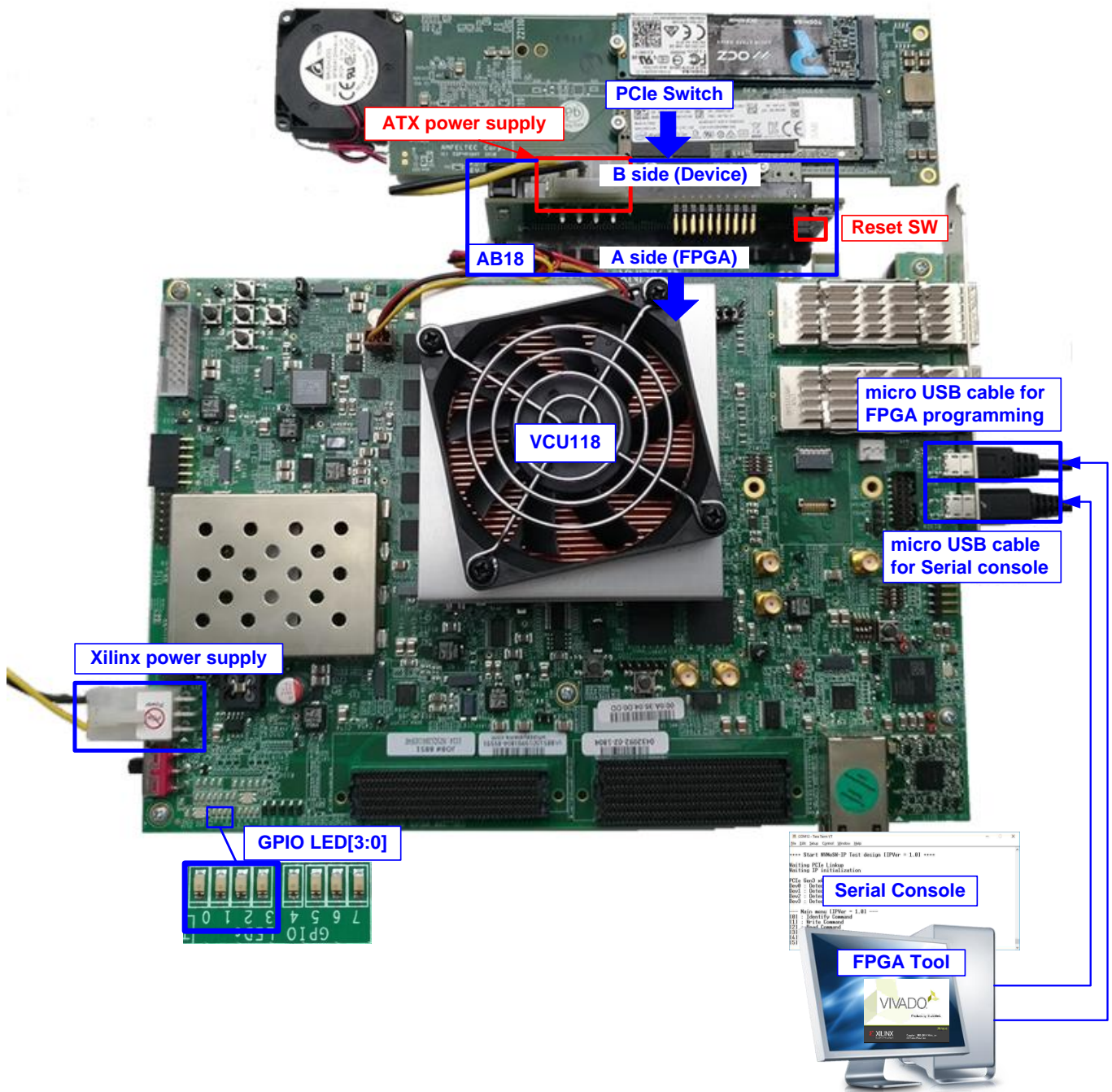


Figure 1-3 NVMeSW-IP demo environment setup on VCU118

2 Demo setup

- 1) Power off system.
- 2) For ZCU106 board, set SW6[4:1] = all ON to configure PS from JTAG, as shown in Figure 2-1.

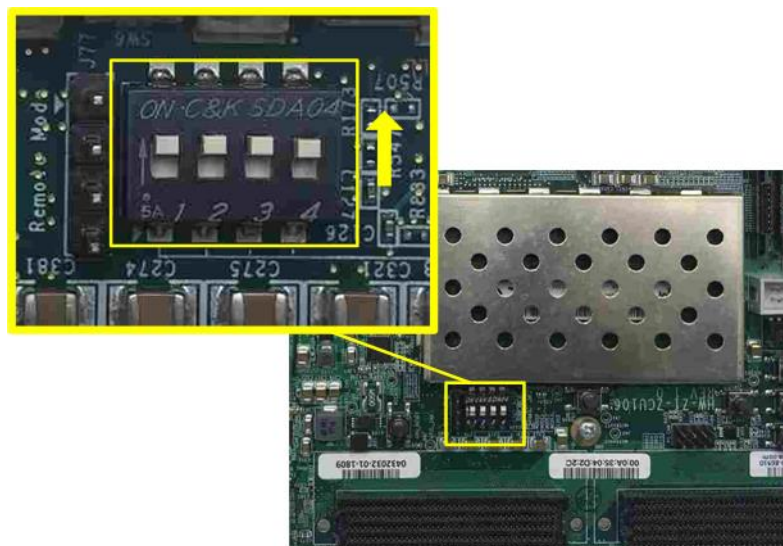


Figure 2-1 SW6 setting to configure PS from JTAG on ZCU106

- 3) Connect ATX power supply to AB18-PCIeX16 board and Xilinx power adapter to FPGA development board.

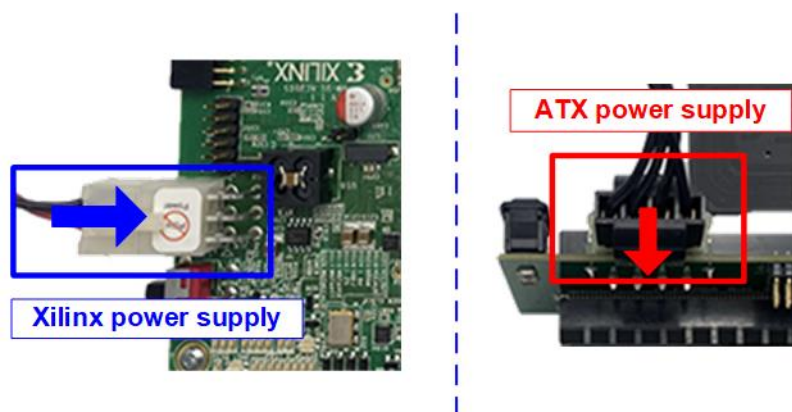


Figure 2-2 Power connection

- 4) Connect 1-4 NVMe SSDs to PCIe switch card. Figure 2-3 and Figure 2-4 show the example of using four SSDs connected to PCIe switch card.

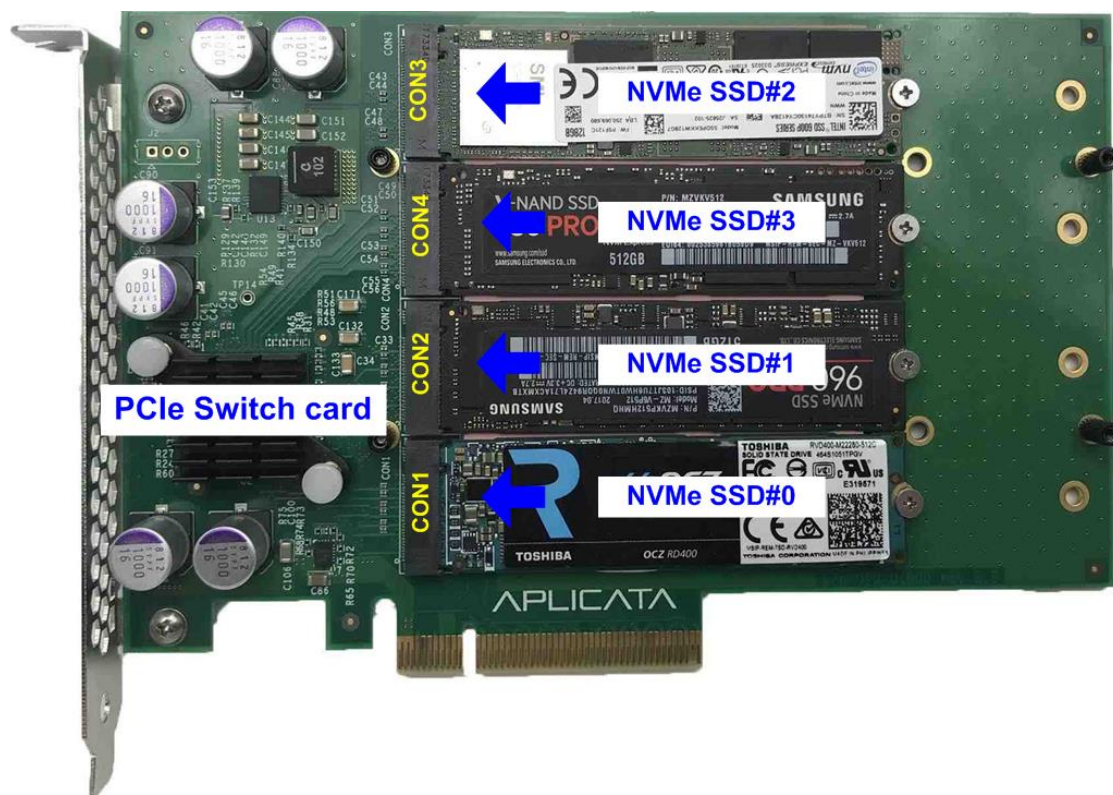


Figure 2-3 Connect NVMe SSD to PCIe Switch#1

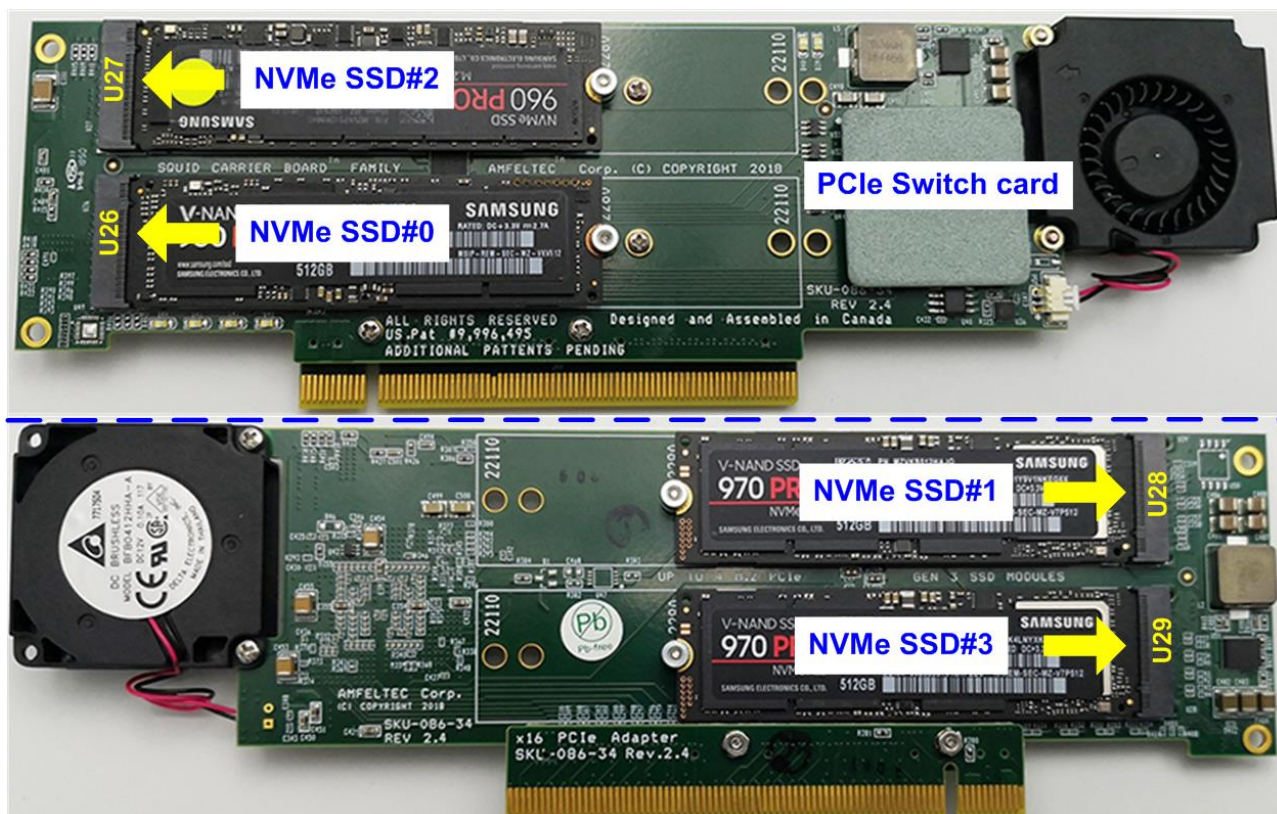


Figure 2-4 Connect NVMe SSD to PCIe Switch#2

- 5) a. Confirm that two mini jumpers are inserted at J5 connector on AB18.
 b. Connect FPGA Side (A-side) on AB18 to PCIe connector on FPGA board
 c. Connect PCIe switch to device side (B-Side) on AB18, as shown in Figure 2-5.

Warning: Please confirm that the PCIe switch is inserted in the correct side of AB18 (B-side, not A-side) before power on system.

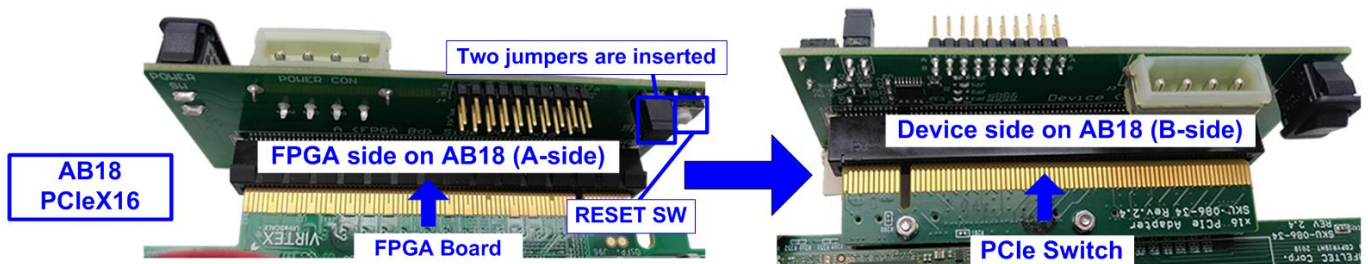


Figure 2-5 Connect AB18 to PCIe switch and FPGA board

- 6) Connect two micro USB cables for JTAG programming and Serial console.

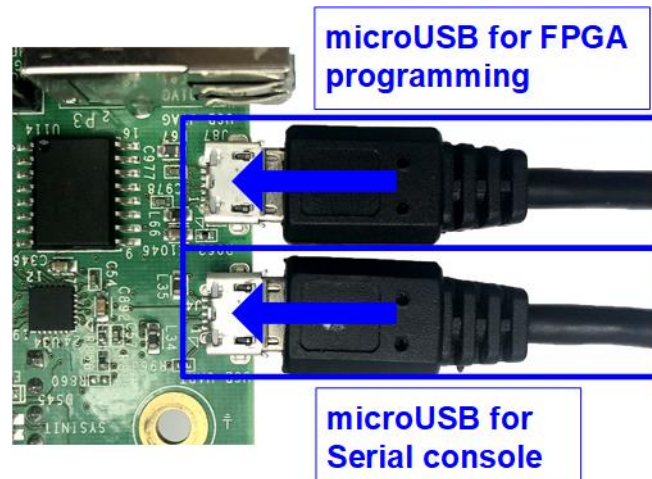


Figure 2-6 USB cable connection

- 7) Power on FPGA development board, ATX power supply, and AB18 board, as shown in Figure 2-7.

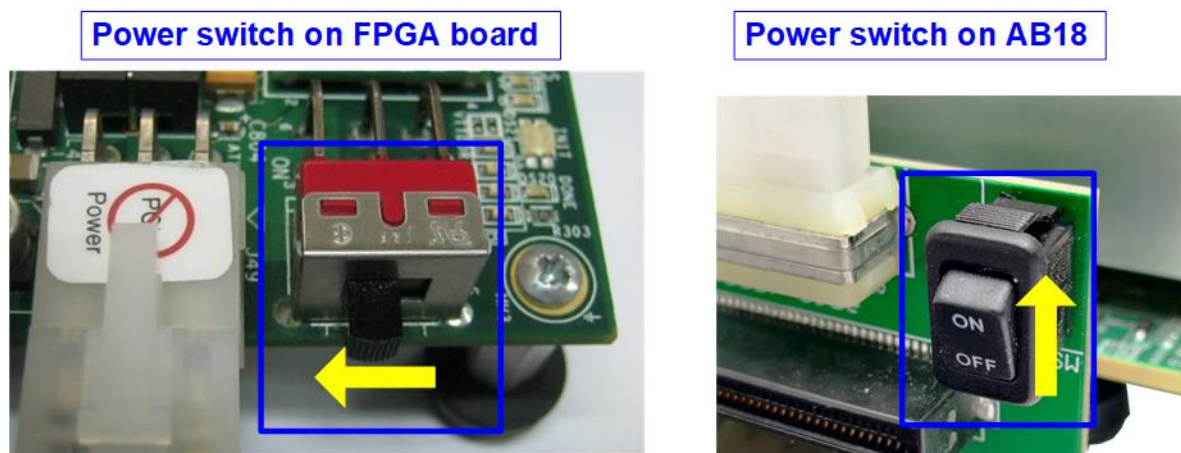


Figure 2-7 Turn on power switch on FPGA and AB18 board

- 8) On PC, additional COM port is detected after connecting USB cables to FPGA board. On Ultrascale/Ultrascale+ board, more than one COM ports are detected.

In case of KCU105 and VCU118, select Standard COM port.

In case of ZCU106, select the lowest number for ZCU106 board, as shown in Figure 2-8.

On Serial console, the setting is as follows. Baud rate=115,200, Data=8-bit, Non-Parity, and Stop = 1.

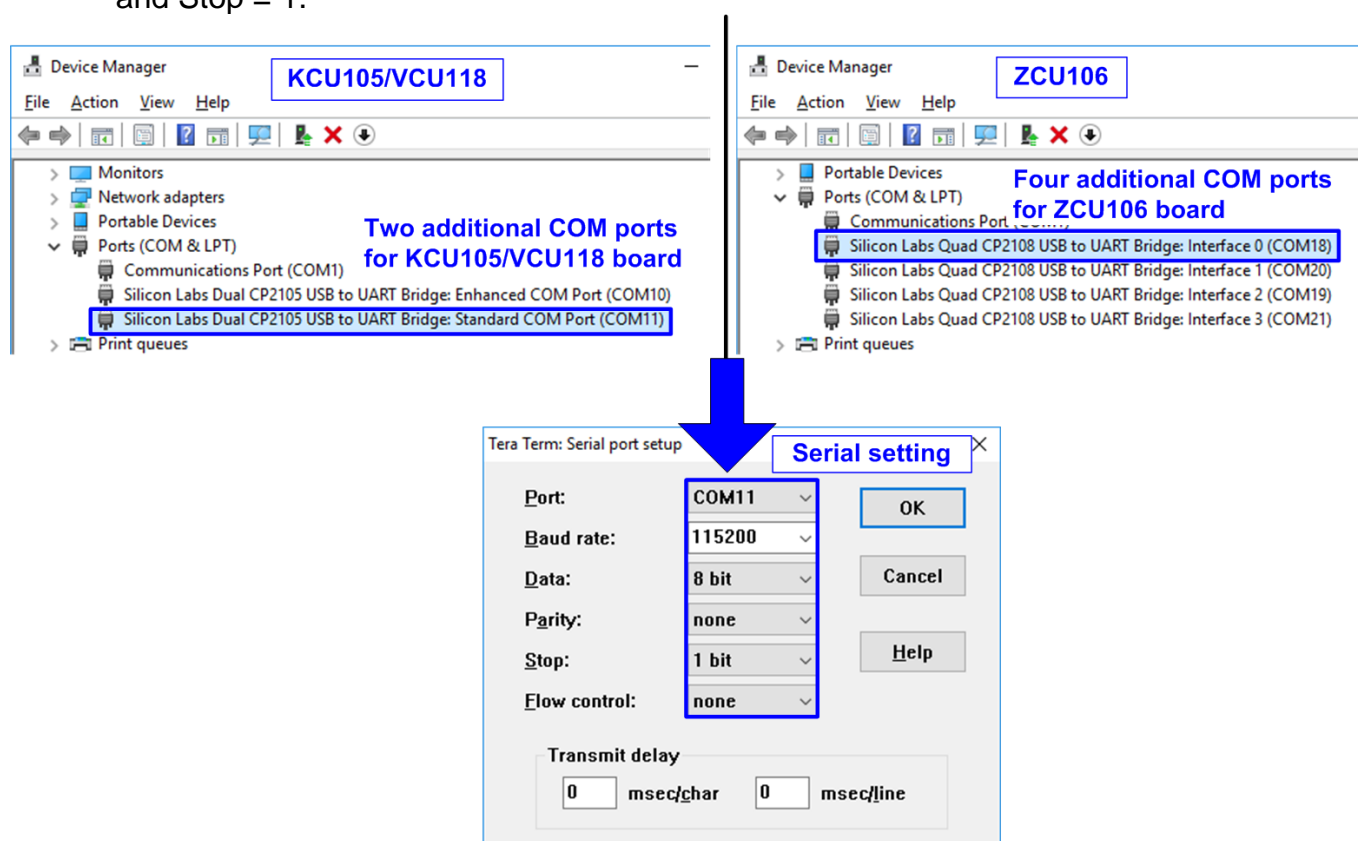


Figure 2-8 Select and set COM port

- 9) Download and program configuration file and firmware to FPGA board.
 - a) For KCU105/VCU118, configure FPGA by using Vivado as shown in Figure 2-9.

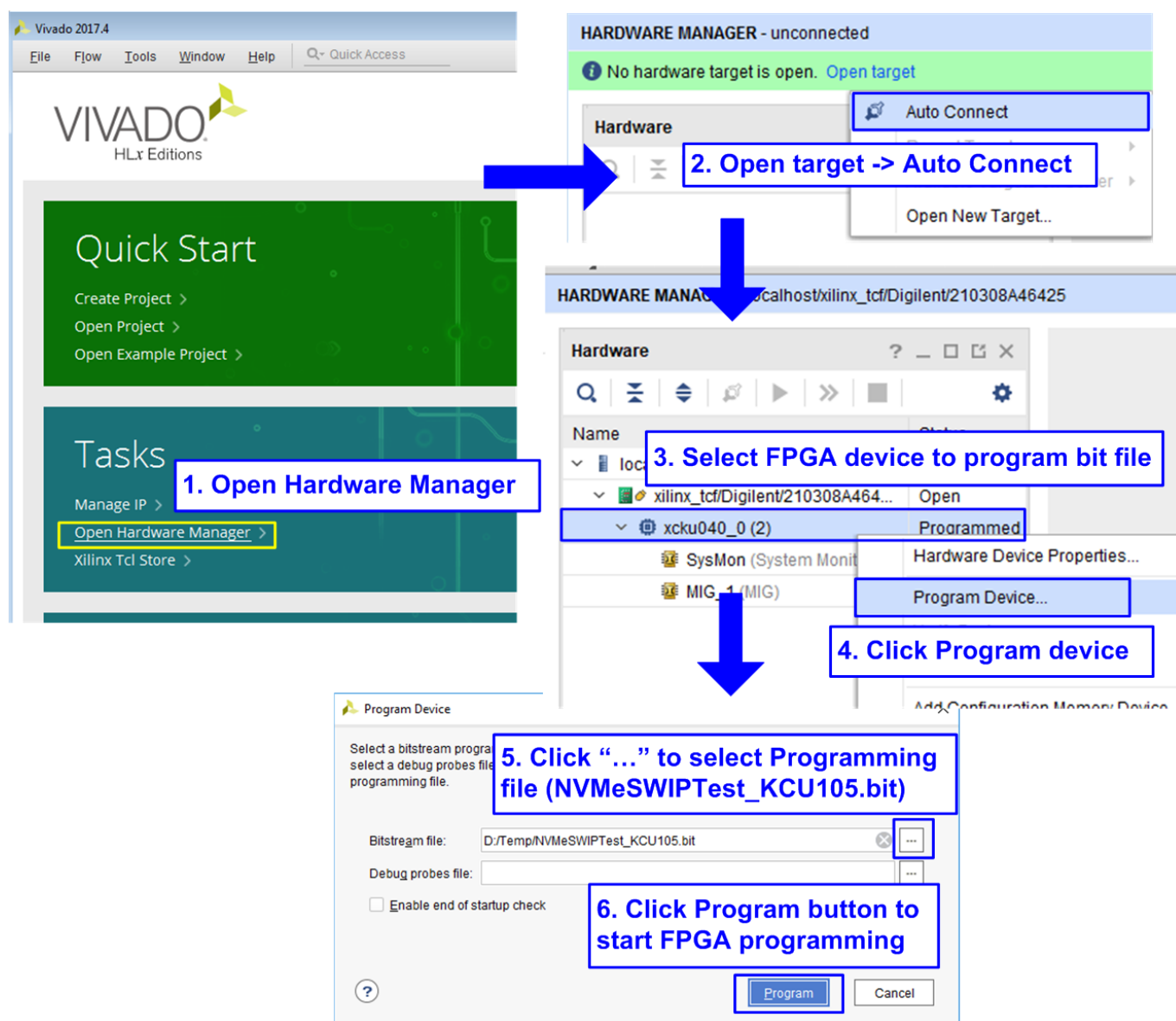


Figure 2-9 Program FPGA by Vivado

- b) For ZCU106 board, open Vivado TCL shell, change directory to ready_for_download or directory that batch file is located. Next, type NVMeSWIPTest_ZCU106.bat, as shown in Figure 2-10.

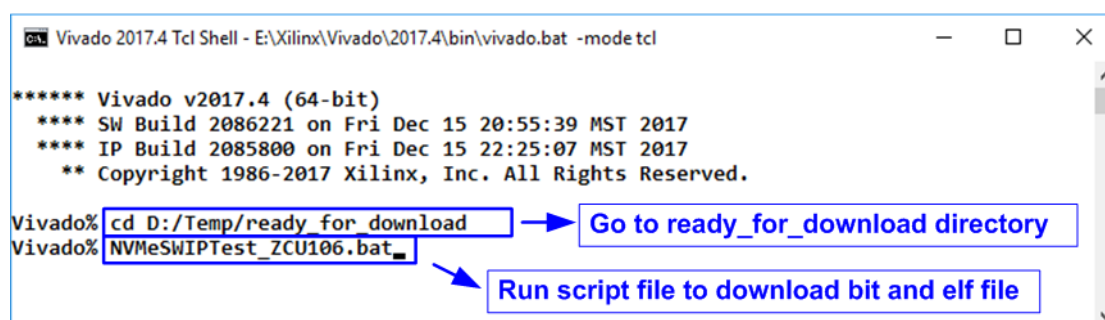


Figure 2-10 Command script to download demo file on Vivado TCL shell

10) Check LED status on FPGA board. The description of LED is as follows.

Table 2-1 LED Definition

GPIO LED	ON	OFF
0	Normal operation	Clock is not locked or reset button is pressed
1	System is busy	Idle status
2	IP Error detect	Normal operation
3	Data verification fail	Normal operation

11) After finishing FPGA programming, LED[0] and LED[1] are ON during PCIe initialization process. LED[1] changes to OFF after PCIe initialization process is finished as shown in Figure 2-11.

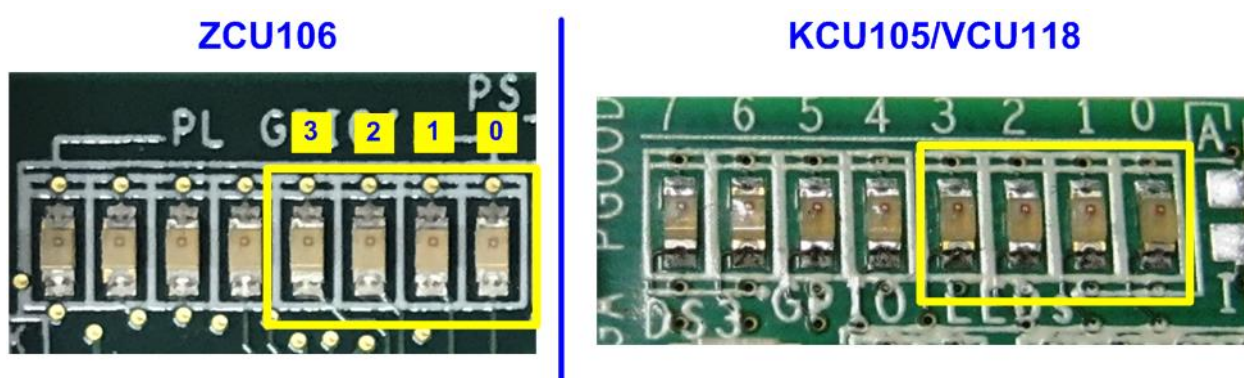


Figure 2-11 Four LEDs to show the current status

12) On the console, the message is displayed to show current status as follows.

- “Waiting PCIe Linkup” is displayed after finishing configuration.
- After PCIe is linkup, “Waiting IP initialization” is displayed.
- After finishing NVMeSW-IP initialization, PCIe speed, number of PCIe lanes, and total detected devices are displayed. Finally, main menu to run six commands is shown on the console. The example message when connecting to four SSDs and one SSD is shown in Figure 2-12.

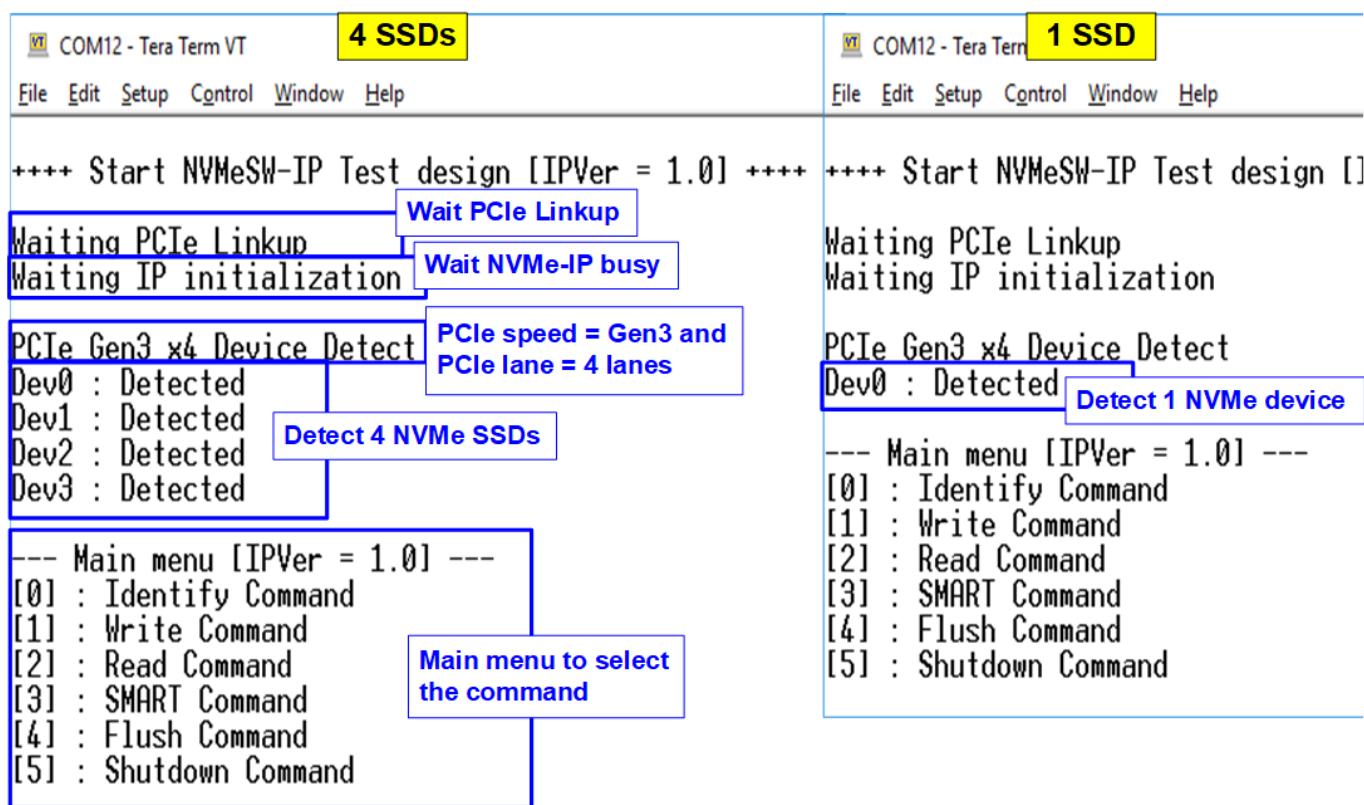


Figure 2-12 Main menu after IP finishes initialization

3 Test Menu

3.1 Identify Command

Select '0' to send Identify command to NVMe SSD.

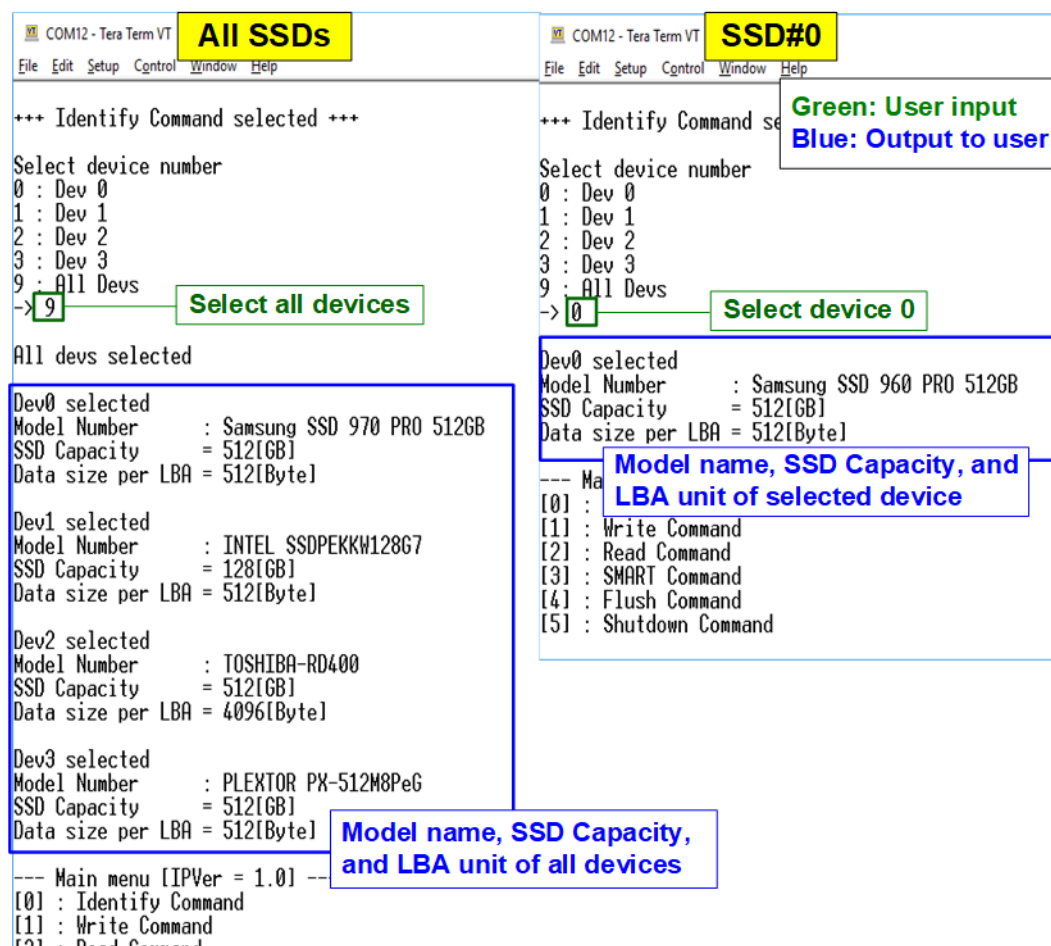


Figure 3-1 Test result when running Identify command

After that, user inputs to select the active device.

Input '9' to run the command to all devices in the system or 0-3 to run only one device.

If the input is valid, the SSD information output from Identify command is displayed as shown in Figure 3-1. The console shows three values for each SSD.

- 1) SSD model number: This value is decoded from Identify controller data.
- 2) SSD capacity: This value is signal output from IP.
- 3) Data size per LBA: This value is signal output from IP. Two values are supported, i.e. 512 byte and 4 Kbyte.

If user selects the unavailable device, error message is displayed as shown in Figure 3-2.

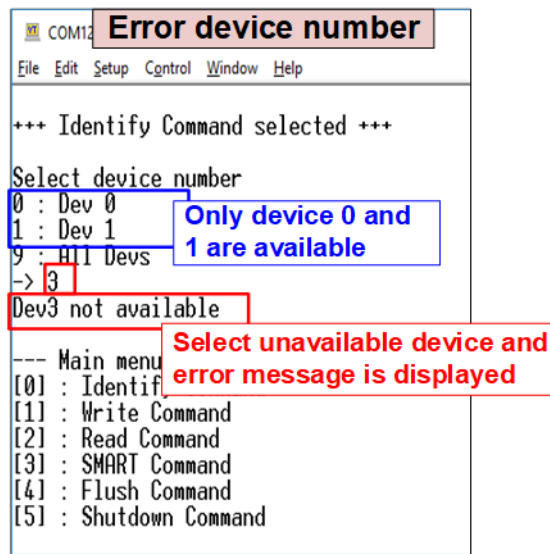
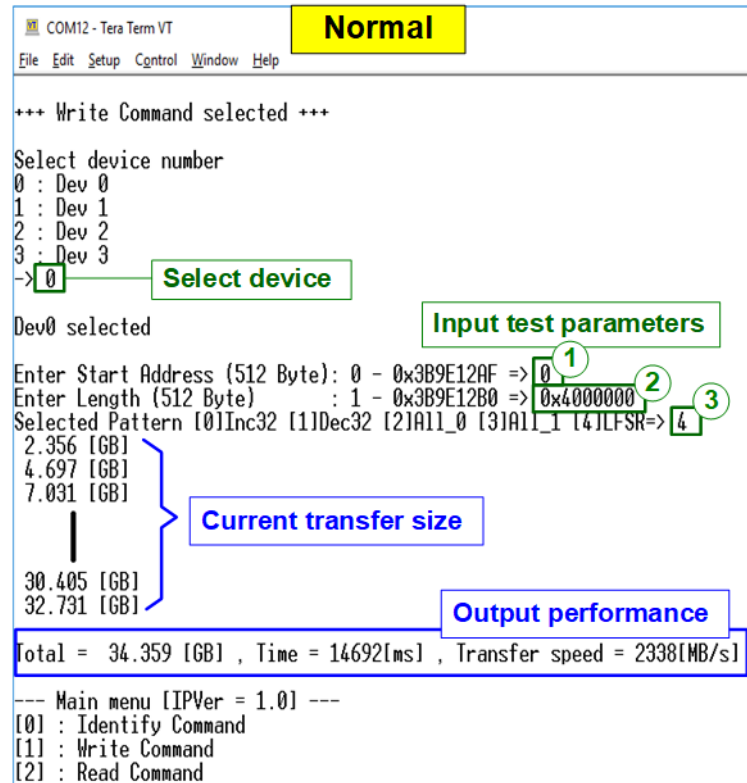


Figure 3-2 Error message when selecting the unavailable device

3.2 Write Command

Select '1' to send Write command to NVMe SSD.



```

COM12 - Tera Term VT
Normal

+++ Write Command selected +++

Select device number
0 : Dev 0
1 : Dev 1
2 : Dev 2
3 : Dev 3
-> 0

Dev0 selected

Enter Start Address (512 Byte): 0 - 0x3B9E12AF => 0
Enter Length (512 Byte) : 1 - 0x3B9E12B0 => 0x4000000
Selected Pattern [0]Inc32 [1]Dec32 [2]All_0 [3]All_1 [4]LFSR=> 4

2.356 [GB]
4.697 [GB]
7.031 [GB]
30.405 [GB]
32.731 [GB]

Total = 34.359 [GB] , Time = 14692[ms] , Transfer speed = 2338[MB/s]

--- Main menu [IPVer = 1.0] ---
[0] : Identify Command
[1] : Write Command
[2] : Read Command
  
```

Select device: Points to the input '0' for device selection.

Input test parameters: Points to the inputs '0', '0x4000000', and '4' for start address, length, and pattern respectively.

Current transfer size: Points to the progress bar showing transfer size in GB.

Output performance: Points to the final summary line: "Total = 34.359 [GB] , Time = 14692[ms] , Transfer speed = 2338[MB/s]"

Figure 3-3 Test result when running Write command

The first input from user is the device selection. User must input the device number for running Write command. If the input is valid, the selected device number is displayed on the console.

Next, user inputs three parameters as follows.

- 1) Start Address: Input start address to write SSD as 512-byte unit. The input is decimal unit when user enters only digit number. User can add "0x" to be a prefix for hexadecimal unit. When LBA unit of SSD is 4 Kbyte, this input must be aligned to 8.
- 2) Transfer Length: Input total transfer size as 512-byte unit. The input is decimal unit when user enters only digit number. User can add "0x" to be a prefix for hexadecimal unit. When LBA unit of SSD is 4 Kbyte, this input must be aligned to 8.
- 3) Test pattern: Select test data pattern for writing to SSD. There are five patterns, i.e. 32-bit incremental, 32-bit decremental, all-0, all-1, and 32-bit LFSR counter.

When all inputs are valid, the operation begins. During writing data, current transfer size is displayed on the console every second to show that system is still alive. Finally, total size, total time usage, and test speed are displayed on the console to be a test result.

Test data of 32-bit increment pattern																Test data of 32-bit LFSR pattern																			
←64-bit header of each 512-byte→																←64-bit header of each 512-byte→																			
		48-bit address (512 byte unit)								Test data (32-bit increment)										48 bit address								Test data (32-bit LFSR)							
Offset		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F		
00000000		00	00	00	00	00	00	00	00	02	00	00	00	03	00	00	00	00	00	00	00	00	00	00	00	01	00	00	00	02	00	00	00		
00000010		04	00	00	00	05	00	00	00	06	00	00	00	07	00	00	00	04	00	00	00	09	00	00	00	12	00	00	00	24	00	00	00		
00000020		08	00	00	00	09	00	00	00	0A	00	00	00	0B	00	00	00	49	00	00	00	92	00	00	00	24	01	00	00	49	02	00	00		
00000030		0C	00	00	00	0D	00	00	00	0E	00	00	00	0F	00	00	00	92	04	00	00	24	09	00	00	49	12	00	00	92	24	00	00		
00000040		10	00	00	00	11	00	00	00	12	00	00	00	13	00	00	00	24	49	00	00	49	92	00	00	92	24	01	00	24	49	02	00		
00000050		14	00	00	00	15	00	00	00	16	00	00	00	17	00	00	00	49	92	04	00	92	24	09	00	24	49	12	00	49	92	24	00		
00000060		18	00	00	00	19	00	00	00	1A	00	00	00	1B	00	00	00	93	24	49	00	27	49	92	00	4F	92	24	01	9E	24	49	02		
The 1 st 512-byte data										1E	00	00	00	1F	00	00	00	3C	49	92	04	79	92	24	09	F3	24	49	12	E7	49	92	24		
00000090		24	00	00	00	25	00	00	00	26	00	00	00	27	00	00	00	CF	93	24	49	9E	27	49	92	3D	4F	92	24	7A	9E	24	00		
000000A0		28	00	00	00	29	00	00	00	2A	00	00	00	2B	00	00	00	F5	3C	49	92	EB	79	92	24	D7	F3	24	49	AE	E7	49	92		
000000B0		2C	00	00	00	2D	00	00	00	2E	00	00	00	2F	00	00	00	5D	CF	93	24	BA	9E	27	49	75	3D	4F	92	EB	7A	9E	24		
000000C0		30	00	00	00	31	00	00	00	32	00	00	00	33	00	00	00	D7	F5	3C	49	AE	EB	79	92	5C	D7	F3	24	B8	AE	E7	49		
000000D0		34	00	00	00	35	00	00	00	36	00	00	00	37	00	00	00	70	5D	CF	93	E0	BA	9E	27	C1	75	3D	4F	83	EB	7A	9E		
000000E0		38	00	00	00	39	00	00	00	3A	00	00	00	3B	00	00	00	07	D7	F5	3C	0E	AE	EB	79	1D	5C	D7	F3	3B	B8	AE	E7		
000000F0		3C	00	00	00	3D	00	00	00	3E	00	00	00	3F	00	00	00	77	70	5D	CF	EE	E0	BA	9E	DC	C1	75	3D	B8	83	EB	7A		
00000100		40	00	00	00	41	00	00	00	42	00	00	00	43	00	00	00	70	07	D7	F5	E0	0E	AE	EB	C1	1D	5C	D7	83	3B	B8	AE		
00000110		44	00	00	00	45	00	00	00	46	00	00	00	47	00	00	00	07	77	70	5D	0E	EE	E0	BA	1C	DC	C1	75	39	B8	83	EB		
00000120		48	00	00	00	49	00	00	00	4A	00	00	00	4B	00	00	00	73	70	07	D7	E6	E0	0E	AE	CD	C1	1D	5C	9A	83	3B	B8		
00000130		4C	00	00	00	4D	00	00	00	4E	00	00	00	4F	00	00	00	34	07	77	70	68	0E	EE	E0	D1	1C	DC	C1	A3	39	B8	83		
00000140		50	00	00	00	51	00	00	00	52	00	00	00	53	00	00	00	47	73	70	07	8E	E6	E0	0E	1D	CD	C1	1D	3A	9A	83	3B		
00000150		54	00	00	00	55	00	00	00	56	00	00	00	57	00	00	00	74	34	07	77	E9	68	0E	EE	D3	D1	1C	DC	A6	A3	39	B8		
00000160		58	00	00	00	59	00	00	00	5A	00	00	00	5B	00	00	00	4C	47	73	70	98	8E	E6	E0	31	1D	CD	C1	63	3A	9A	83		
00000170		5C	00	00	00	5D	00	00	00	5E	00	00	00	5F	00	00	00	C6	74	34	07	8D	E9	68	0E	1B	D3	D1	1C	37	A6	A3	39		
00000180		60	00	00	00	61	00	00	00	62	00	00	00	63	00	00	00	6E	4C	47	73	DC	98	8E	E6	B8	31	1D	CD	70	63	3A	9A		
00000190		64	00	00	00	65	00	00	00	66	00	00	00	67	00	00	00	E1	C6	74	34	C3	8D	E9	68	86	1B	D3	D1	0D	37	A6	A3		
000001A0		68	00	00	00	69	00	00	00	6A	00	00	00	6B	00	00	00	1A	6E	4C	47	34	DC	98	8E	68	B8	31	1D	D0	70	63	3A		
000001B0		6C	00	00	00	6D	00	00	00	6E	00	00	00	6F	00	00	00	A0	E1	C6	74	41	C3	8D	E9	83	86	1B	D3	06	0D	37	A6		
000001C0		70	00	00	00	71	00	00	00	72	00	00	00	73	00	00	00	0C	1A	6E	4C	18	34	DC	98	30	68	B8	31	60	D0	70	63		
000001D0		74	00	00	00	75	00	00	00	76	00	00	00	77	00	00	00	C0	A0	E1	C6	81	41	C3	8D	03	83	86	1B	07	06	0D	37		
000001E0		78	00	00	00	79	00	00	00	7A	00	00	00	7B	00	00	00	0F	0C	1A	6E	1F	18	34	DC	3F	30	68	B8	7F	60	D0	70		
000001F0		7C	00	00	00	7D	00	00	00	7E	00	00	00	7F	00	00	00	FF	C0	A0	E1	FF	81	41	C3	FE	03	83	86	FD	07	06	0D		
		7C	00	00	00	7D	00	00	00	7E	00	00	00	7F	00	00	00	FA	0F	0C	1A	F4	1F	18	34	E9	3F	30	68	D3	7F	60	D0		
00002000		01	00	00	00	00	00	00	00	82	00	00	00	83	00	00	00	01	00	00	00	00	00	00	00	02	00	00	00	04	00	00	00		
The 2 nd 512-byte data										86	00	00	00	87	00	00	00	09	00	00	00	12	00	00	00	24	00	00	00	49	00	00	00		
		00	89	00	00	00	00	00	00	8A	00	00	00	8B	00	00	00	92	00	00	00	24	01	00	00	49	02	00	00	92	04	00	00		
64-bit header																		64-bit header																	

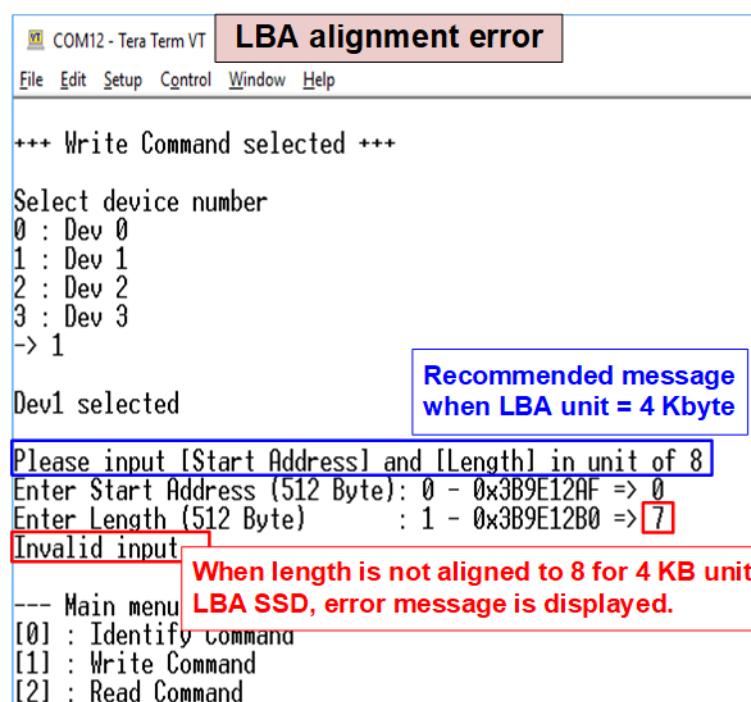
Figure 3-4 Example Test data of the 1st and 2nd 512-byte by using increment/LFSR pattern

Test data in SSD is split into 512-byte unit. For incremental, decremental, or LFSR pattern, each 512-byte data has unique 64-bit header consisting of 48-bit address (in 512-byte unit) and 16-bit zero value. The data after 64-bit header is the test pattern which is selected by user.

The left window of Figure 3-4 shows the example when using 32-bit incremental pattern while the right window shows the example when using 32-bit LFSR pattern. The unique header is not included when running all-0 or all-1 pattern.

When user runs Write or Read command with 4-Kbyte LBA SSD, there is the message displaying on the console to show the input limitation which must be aligned to 8, as shown in Figure 3-5. When the input does not align to 8, “Invalid input” is displayed and the operation is cancelled.

Also, Figure 3-6 shows the example when the input is out of the recommended range for each parameter. The console displays “Invalid input” and then the operation is cancelled.



```

COM12 - Tera Term VT  LBA alignment error
File Edit Setup Control Window Help

+++ Write Command selected +++

Select device number
0 : Dev 0
1 : Dev 1
2 : Dev 2
3 : Dev 3
-> 1

Dev1 selected

Please input [Start Address] and [Length] in unit of 8
Enter Start Address (512 Byte): 0 - 0x3B9E12AF => 0
Enter Length (512 Byte) : 1 - 0x3B9E12B0 => 7
Invalid input

--- Main menu
[0] : Identify Command
[1] : Write Command
[2] : Read Command
  
```

Figure 3-5 Error message when the input is unaligned for SSD with 4KB LBA unit

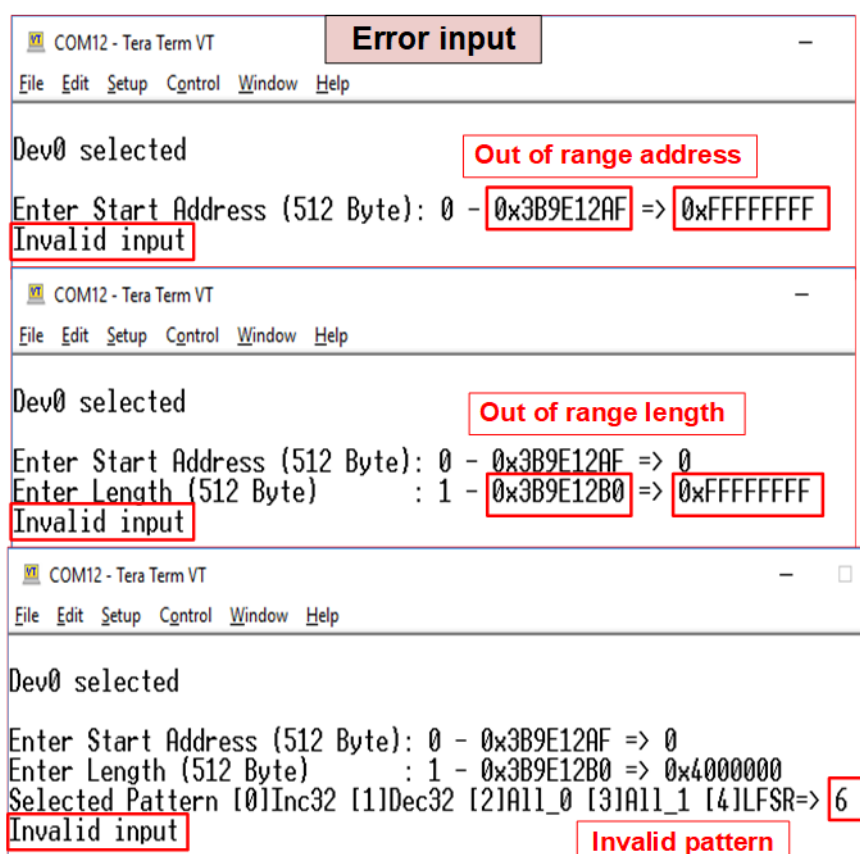
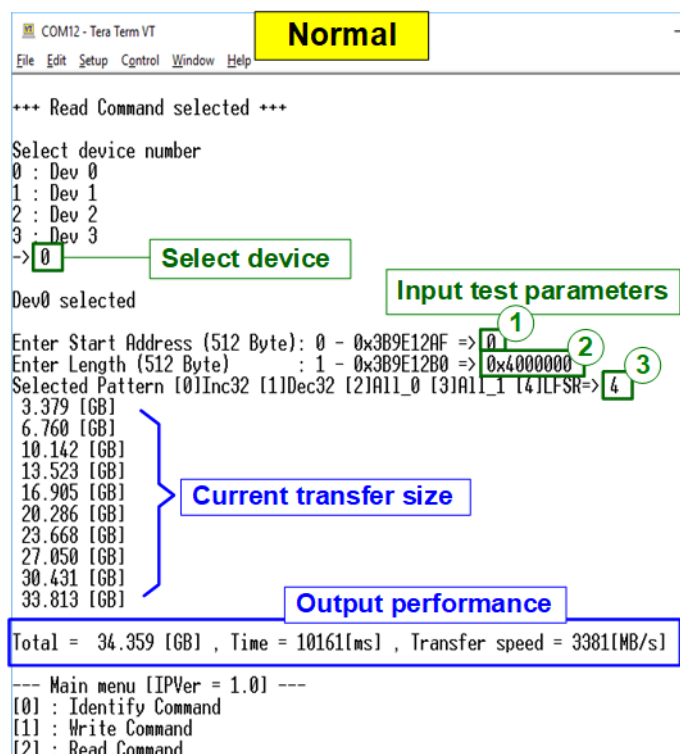


Figure 3-6 Error message from the invalid input

3.3 Read Command

Select '2' to send Read command to NVMe SSD.



```

COM12 - Tera Term VT
File Edit Setup Control Window Help

Normal

+++ Read Command selected +++

Select device number
0 : Dev 0
1 : Dev 1
2 : Dev 2
3 : Dev 3
-> 0
Dev0 selected

Enter Start Address (512 Byte): 0 - 0x3B9E12AF => 0
Enter Length (512 Byte) : 1 - 0x3B9E12B0 => 0x4000000
Selected Pattern [0]Inc32 [1]Dec32 [2]A11_0 [3]A11_1 [4]LFSR=> 4

3.379 [GB]
6.760 [GB]
10.142 [GB]
13.523 [GB]
16.905 [GB]
20.286 [GB]
23.668 [GB]
27.050 [GB]
30.431 [GB]
33.813 [GB]

Total = 34.359 [GB] , Time = 10161[ms] , Transfer speed = 3381[MB/s]

--- Main menu [IPVer = 1.0] ---
[0] : Identify Command
[1] : Write Command
[2] : Read Command
  
```

Figure 3-7 Test result when running Read command

The first input from user is the device selection. User must input the device number for running Read command. If the input is valid, the selected device number is displayed on the console.

Next, user inputs three parameters as follows.

- 1) Start Address: Input start address to read SSD as 512-byte unit. The input is decimal unit when user enters only digit number. User can add "0x" to be a prefix for hexadecimal unit. When LBA unit of SSD is 4 Kbyte, this input must be aligned to 8.
- 2) Transfer Length: Input total transfer size as 512-byte unit. The input is decimal unit when user enters only digit number. User can add "0x" to be a prefix for hexadecimal unit. If LBA unit of SSD is 4 Kbyte, this input must be aligned to 8.
- 3) Test pattern: Select test data pattern to verify data from SSD. Test pattern must be matched with the pattern using in Write Command menu. There are five patterns, i.e. 32-bit incremental, 32-bit decremental, all-0, all-1, and 32-bit LFSR counter.

Similar to Write command menu, test system reads data from SSD when all inputs are valid. During reading data, current transfer size is displayed on the console every second to show that system is still alive. Total size, total time usage, and test speed are displayed after finishing the operation.

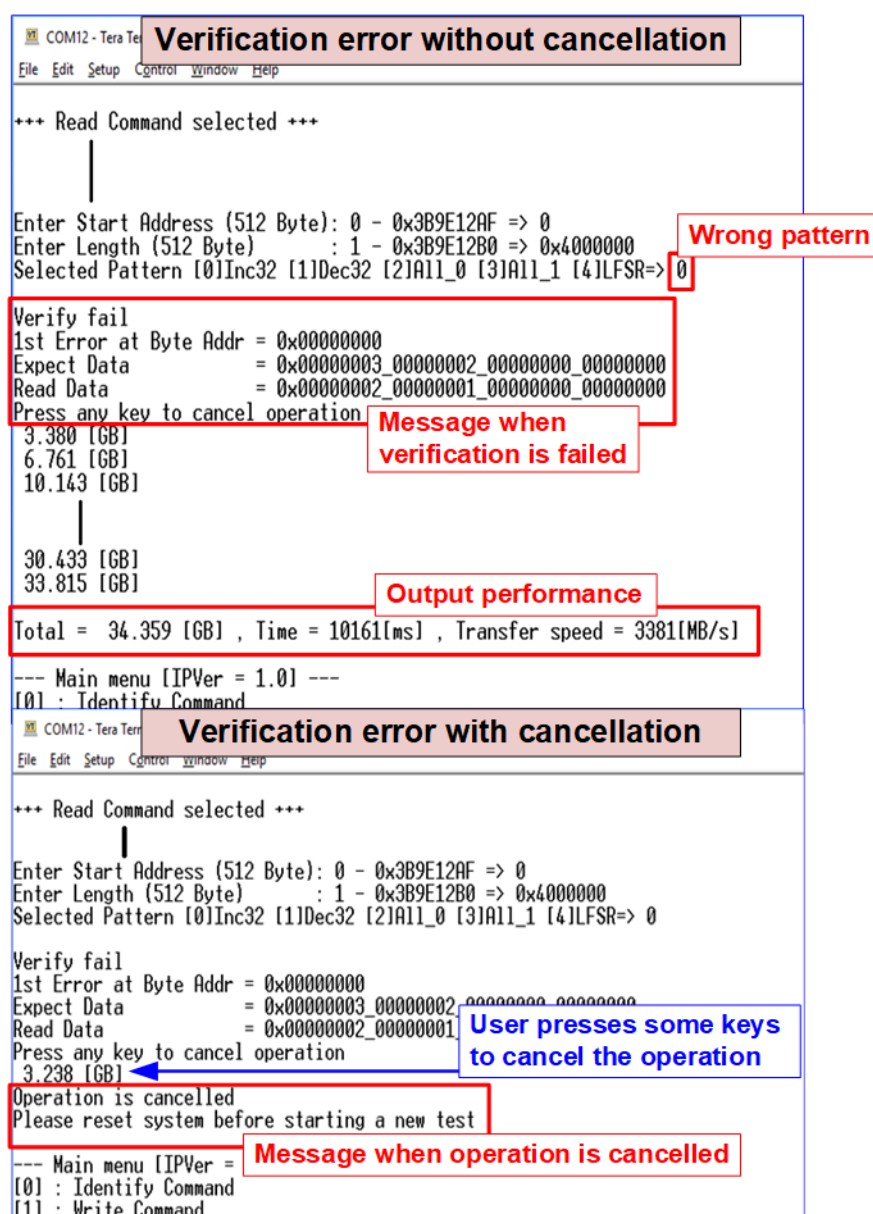
"Invalid input" is displayed when some inputs are invalid or unaligned to 8 (when connecting to 4-KB LBA SSD).

“Invalid input” is displayed when some inputs are invalid or unaligned to 8 (when connecting to 4-KB LBA SSD).

Figure 3-8 shows error message when data verification is failed. “Verify fail” is displayed with the information of the 1st failure data, i.e. the error byte address, the expected value, and the read value.

User can press any key(s) to cancel read operation or wait until finishing Read command. Similar to the normal condition, the output performance is displayed on the console when the user does not enter any key(s) to stop the operation.

When cancelling the operation, the read command still runs as the background process. It is recommended to power-off/on AB18/AB16, and then press “RESET” button to restart system.



```

COM12 - Tera Test
File Edit Setup Control Window Help

+++ Read Command selected +++

Enter Start Address (512 Byte): 0 - 0x3B9E12AF => 0
Enter Length (512 Byte) : 1 - 0x3B9E12B0 => 0x4000000
Selected Pattern [0]Inc32 [1]Dec32 [2]A11_0 [3]A11_1 [4]LFSR=> 0

Verify fail
1st Error at Byte Addr = 0x00000000
Expect Data = 0x00000003_00000002_00000000_00000000
Read Data = 0x00000002_00000001_00000000_00000000
Press any key to cancel operation

3.380 [GB]
6.761 [GB]
10.143 [GB]

30.433 [GB]
33.815 [GB]

Total = 34.359 [GB] , Time = 10161[ms] , Transfer speed = 3381[MB/s]

--- Main menu [IPVer = 1.0] ---
[0] : Identify Command

COM12 - Tera Test
File Edit Setup Control Window Help

+++ Read Command selected +++

Enter Start Address (512 Byte): 0 - 0x3B9E12AF => 0
Enter Length (512 Byte) : 1 - 0x3B9E12B0 => 0x4000000
Selected Pattern [0]Inc32 [1]Dec32 [2]A11_0 [3]A11_1 [4]LFSR=> 0

Verify fail
1st Error at Byte Addr = 0x00000000
Expect Data = 0x00000003_00000002_00000000_00000000
Read Data = 0x00000002_00000001_00000000_00000000
Press any key to cancel operation

3.238 [GB]

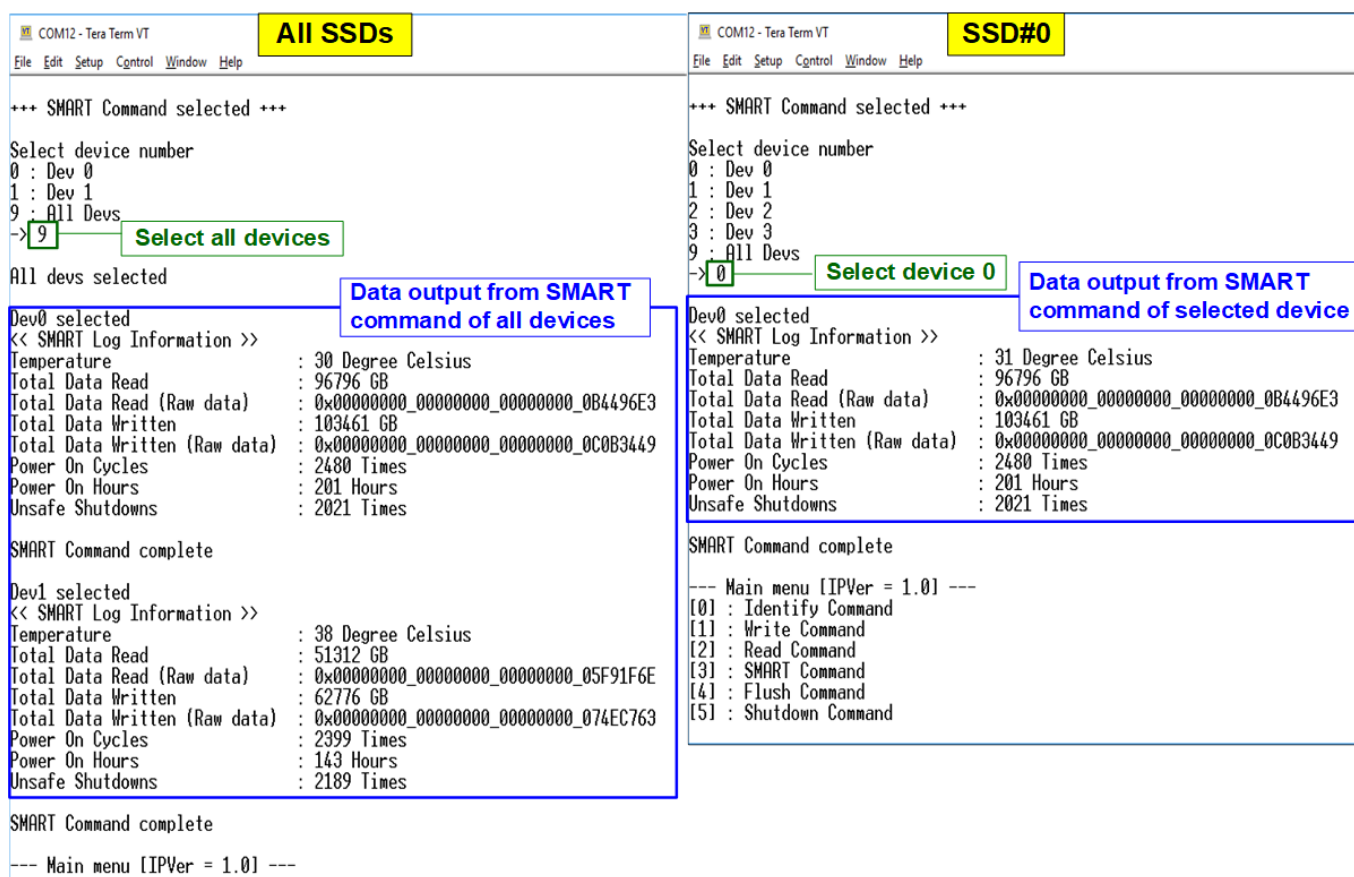
Operation is cancelled
Please reset system before starting a new test

--- Main menu [IPVer = 1.0] ---
[0] : Identify Command
[1] : Write Command
  
```

Figure 3-8 Data verification is failed

3.4 SMART Command

Select '3' to send SMART command to NVMe SSD.



The figure consists of two side-by-side terminal window screenshots from 'COM12 - Tera Term VT'. The left window, titled 'All SSDs', shows the SMART command being executed for all devices. The user selects '9' for 'All Devs'. The output displays SMART Log Information for Dev0 and Dev1, including Temperature, Total Data Read/Written, Power On Cycles/Hours, and Unsafe Shutdowns. The right window, titled 'SSD#0', shows the SMART command being executed for device 0. The user selects '0' for 'Dev 0'. The output displays SMART Log Information for Dev0, including the same parameters as the left window. Both windows show a 'Main menu [IPVer = 1.0]' at the bottom.

```

COM12 - Tera Term VT
File Edit Setup Control Window Help

+++ SMART Command selected +++

Select device number
0 : Dev 0
1 : Dev 1
9 : All Devs
-> 9

All devs selected

Dev0 selected
<< SMART Log Information >>
Temperature : 30 Degree Celsius
Total Data Read : 96796 GB
Total Data Read (Raw data) : 0x00000000_00000000_0B4496E3
Total Data Written : 103461 GB
Total Data Written (Raw data) : 0x00000000_00000000_0C0B3449
Power On Cycles : 2480 Times
Power On Hours : 201 Hours
Unsafe Shutdowns : 2021 Times

SMART Command complete

Dev1 selected
<< SMART Log Information >>
Temperature : 38 Degree Celsius
Total Data Read : 51312 GB
Total Data Read (Raw data) : 0x00000000_00000000_05F91F6E
Total Data Written : 62776 GB
Total Data Written (Raw data) : 0x00000000_00000000_074EC763
Power On Cycles : 2399 Times
Power On Hours : 143 Hours
Unsafe Shutdowns : 2189 Times

SMART Command complete

--- Main menu [IPVer = 1.0] ---

COM12 - Tera Term VT
File Edit Setup Control Window Help

+++ SMART Command selected +++

Select device number
0 : Dev 0
1 : Dev 1
2 : Dev 2
3 : Dev 3
9 : All Devs
-> 0

Dev0 selected
<< SMART Log Information >>
Temperature : 31 Degree Celsius
Total Data Read : 96796 GB
Total Data Read (Raw data) : 0x00000000_00000000_0B4496E3
Total Data Written : 103461 GB
Total Data Written (Raw data) : 0x00000000_00000000_0C0B3449
Power On Cycles : 2480 Times
Power On Hours : 201 Hours
Unsafe Shutdowns : 2021 Times

SMART Command complete

--- Main menu [IPVer = 1.0] ---
[0] : Identify Command
[1] : Write Command
[2] : Read Command
[3] : SMART Command
[4] : Flush Command
[5] : Shutdown Command
  
```

Figure 3-9 Test result when running SMART command

After that, user inputs to select the active device.

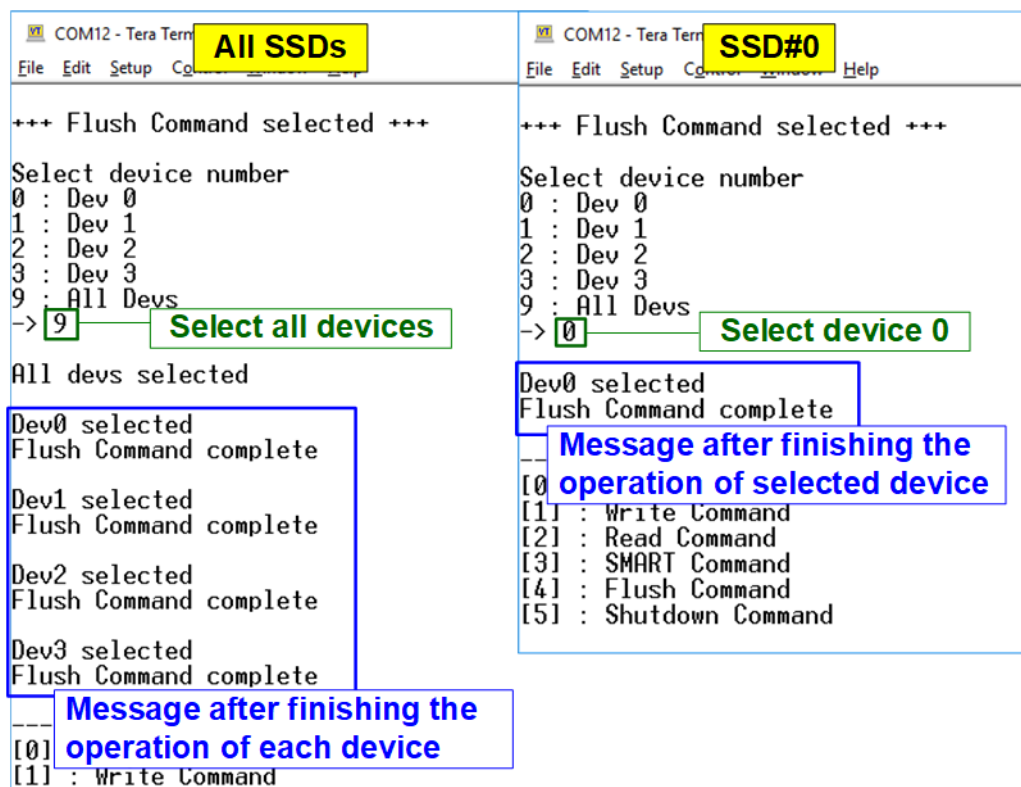
Input '9' to run the command to all devices in the system or 0-3 to run only one device.

If the input is valid, the SSD SMART/health information (output from SMART command) is displayed as shown in Figure 3-9. The console shows six parameters, described as follows.

- 1) Temperature in °C unit.
- 2) Total Data Read decoded as GB/TB unit. Additionally, raw data without decoding is displayed in 128-bit hexadecimal unit. The unit size of raw data is 512,000 byte.
- 3) Total Data Written decoded as GB/TB unit. Additionally, raw data without decoding is displayed in 128-bit hexadecimal unit. The unit size of raw data is 512,000 byte.
- 4) Power On Cycles: Display the number of power cycles.
- 5) Power On Hours: Display period of time in hours to show how long the SSD has been powered on.
- 6) Unsafe Shutdowns: Display the number of unsafe shutdowns of SSD

3.5 Flush Command

Select '4' to send Flush command to NVMe SSD.



```

COM12 - Tera Term
File Edit Setup Command History Help

+++ Flush Command selected +++
Select device number
0 : Dev 0
1 : Dev 1
2 : Dev 2
3 : Dev 3
9 : All Devs
-> 9
All devs selected
Dev0 selected
Flush Command complete
Dev1 selected
Flush Command complete
Dev2 selected
Flush Command complete
Dev3 selected
Flush Command complete
[0] : Write Command
[1] : Read Command
[2] : SMART Command
[3] : Flush Command
[4] : Shutdown Command

```

Figure 3-10 Test result when running Flush command

After that, user inputs to select the active device.

Input '9' to run the command to all devices in the system or 0-3 to run only one device.

When the input is valid, Flush command operation begins.

"Flush Command Complete" is displayed after finishing Flush operation.

3.6 Shutdown Command

Select '5' to send Shutdown command to NVMe SSD.

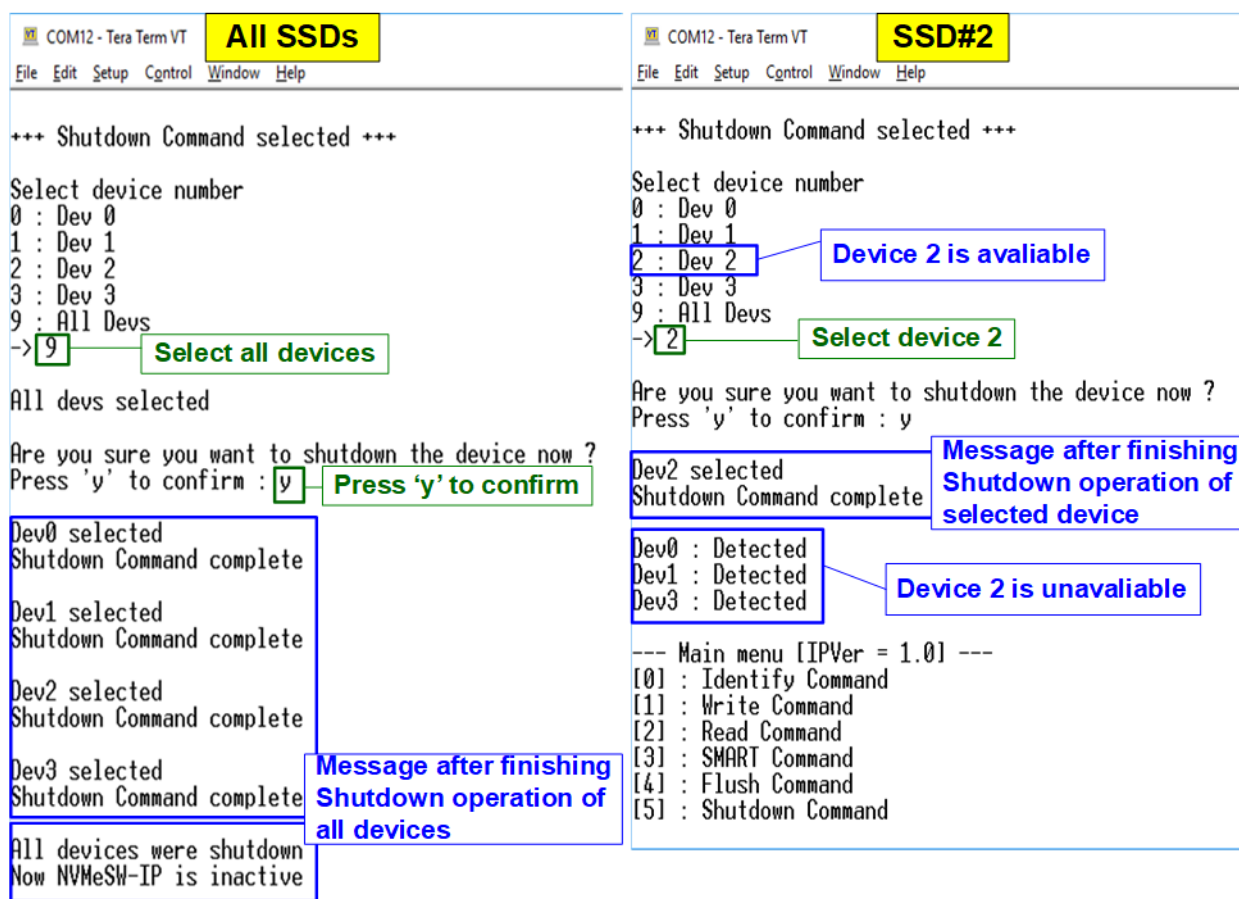


Figure 3-11 Test result when running Shutdown Command

After that, user inputs to select the active device.

Input '9' to run the command to all devices in the system or 0-3 to run only one device.

Next, the confirmation message is displayed on the console. User inputs 'y' or 'Y' to start Shutdown operation or inputs other keys to cancel the operation.

After finishing Shutdown operation, "Shutdown Command Complete" is displayed on the console. As shown in the left side of Figure 3-11, if all devices are selected, the last message is "Now NVMeSW-IP is inactive". No main menu is displayed after finishing the operation. The user needs to shut down the system.

As shown in the right side of Figure 3-11, if one device is selected, the updated device list is displayed. The device which has just finished Shutdown command is not available in the list. User needs to re-power the system to wake up the SSD.

4 Revision History

Revision	Date	Description
1.0	26-Apr-19	Initial version release
1.1	14-Feb-20	Support AB18
1.2	20-Apr-20	Remove power adapter cable from AB18