

NVMeSW IP Core Demo Instruction

Rev1.1 17-Aug-23

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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 NiosII command shell.

The sequence to run NVMeSW-IP with NVMe SSD directly (without PCIe switch) is almost same as NVMe-IP. Please see more details for running by using direct connection in "NVMe-IP demo instruction" document.

https://www.dgway.com/products/IP/NVMe-IP/dg nvmeip instruction intel en.pdf

1 **Environment Requirement**

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

- 1) Supported FPGA Development board: Arria10 GX development board
- 2) PC installing QuartusII programmer and NiosII command shell software.
- 3) The PCIe adapter board (AB18-PCIeX16 board/AB16-PCIeXOVR board) provided by **Design Gateway**

https://dgway.com/ABseries_E.html

- 4) Power adapter for FPGA board
- 5) ATX power supply for AB18
- 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 SSD(s) connecting on PCIe switch card
- 8) A micro USB cable for programming FPGA and JTAG UART, connecting between FPGA board and PC



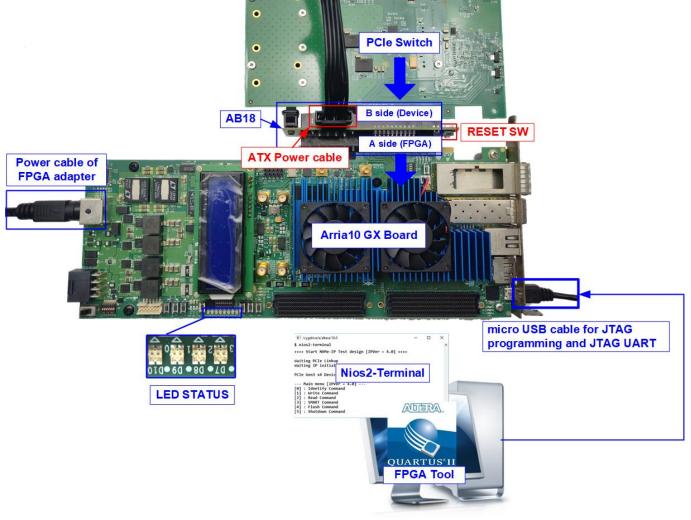


Figure 1-1 NVMeSW-IP demo environment setup on Arria10 GX



2 Demo setup

- 1) Power off system.
- 2) Connect 1-4 NVMe SSD(s) to PCIe switch card. Figure 2-1 and Figure 2-2 show the example to use four SSDs connected to PCIe switch card. The SSD channel number depends on the PCIe switch card characteristic.

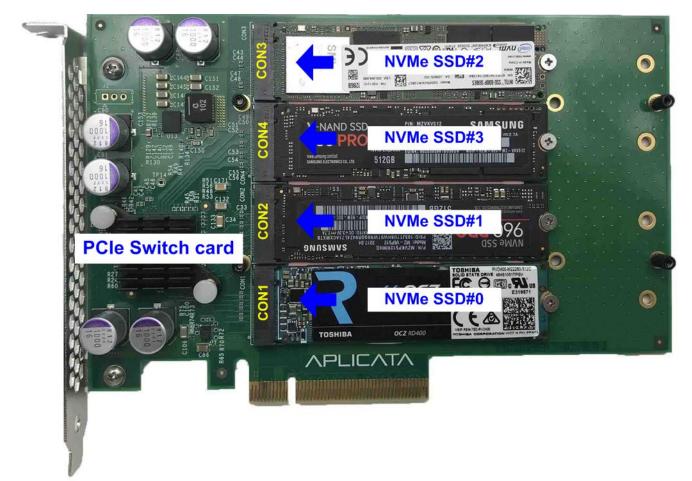


Figure 2-1 Connect NVMe SSD to PCIe Swtich#1

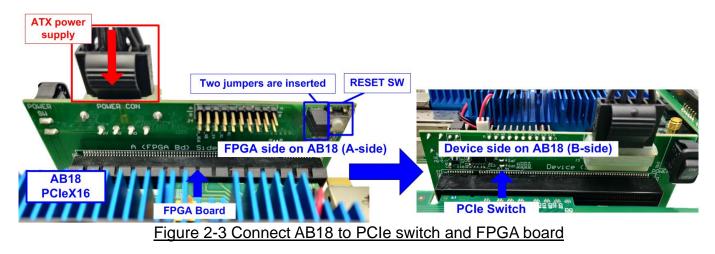


NVMe SSD#2 SNMSUVS SULD CARTER BOARD FAMILY AMFELTEC OF SNMSUND	
AFFEITE COORD AFFEITE COORD AFFEIT	

Figure 2-2 Connect NVMe SSD to PCIe Swtich#2

- 3) As shown in Figure 2-3, setup AB18 board by following step.
 - a) Confirm that two mini jumpers are inserted at J5 connector on AB18.
 - b) Connect ATX power supply to AB18.
 - c) Connect FPGA Side (A-side) on AB18 to PCIe connector on FPGA board
 - d) Connect PCIe switch to device side (B-Side) on AB18.

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





e) Connect a micro USB cable for JTAG programming/UART.



f) Power on FPGA development board, ATX supply for AB18 board, and AB18 board, as shown in Figure 2-5.

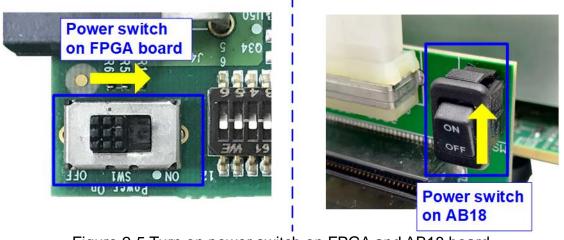


Figure 2-5 Turn on power switch on FPGA and AB18 board



g) Use QuartusII Programmer to program "NVMeIPTest.sof" file, as shown in Figure 2-6

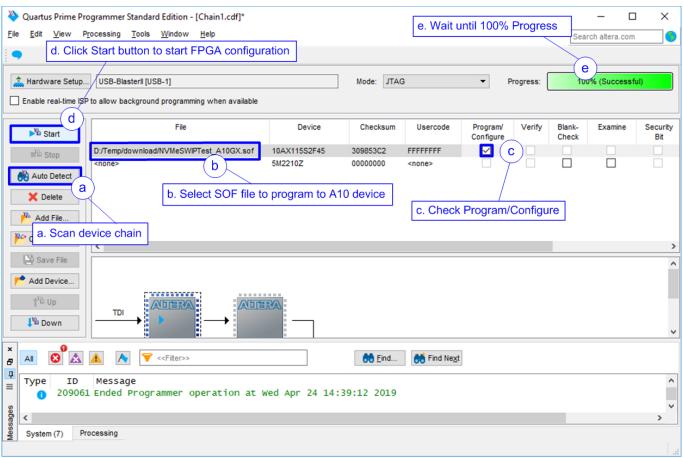


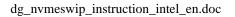
Figure 2-6 Programmed by QuartusII Programmer

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



Figure 2-7 Four LEDs to show the current status

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							





- i) 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.
- j) Open NiosII Command Shell and run "nios2-terminal". 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 is shown in Figure 2-8.

<pre> /cygdrive/c/WINDOWS/system32 Command script // Command</pre>	Green: User input Blue: Output to user
nios2-terminal: connected to hardware target usi nios2-terminal: "USB-BlasterII [USB-1]", device nios2-terminal: (Use the IDE stop button or Ctrl	1, instance 0
++++ Start NVMeSW-IP Test design [IPVer = 1.0] + Wait PCle Linkup Waiting PCIe Linkup Waiting IP initialization	***
PCIe speed = Gen3 and PCIe Gen3 x4 Device Detect PCIe lane = 4 lanes	
Dev0 : Detected Dev1 : Detected Dev2 : Detected Dev3 : Detected	
Main menu [IPVer = 1.0] [0] : Identify Command [1] : Write Command [2] : Read Command [3] : SMART Command [4] : Flush Command [5] : Shutdown Command	

Figure 2-8 Main menu after IP finishes initialization



3 Test Menu

3.1 Identify Command

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

```
🚾 /cygdrive/c/WINDOWS/
                                                   /cygdrive/c/WINDOWS
                     All SSDs
                                                                      SSD#0
                                                  +++ Identify Command selected +++
+++ Identify Command selected +++
                                                                            Green: User input
Select device number
                                                  Select device number
                                                                            Blue: Output to user
                                                  0 : Dev 0
0 : Dev 0
                                                  1 : Dev 1
1 : Dev 1
2 : Dev 2
                                                  2 : Dev 2
                                                  3 : Dev 3
3 : Dev 3
                                                  9 : All Devs
9 : All Devs
                                                                Select device 0
                                                  -> 0
->9-
         Select all devices
                                                  DevØ selected
All devs selected
                                                  Model Number
                                                                    : Samsung SSD 970 PRO 512GB
                                                  SSD Capacity
                                                                    = 512[GB]
DevØ selected
                                                  Data size per LBA = 512[Byte]
Model Number
                  : Samsung SSD 970 PRO 512GB
SSD Capacity
                  = 512[GB]
                                                  --- Main me Model name, SSD Capacity, and
Data size per LBA = 512[Byte]
                                                  [0] : Ident LBA unit of selected device
                                                  [1] : Write 👡
Dev1 selected
                                                  [2] : Read Command
Model Number
                  : INTEL SSDPEKKW128G7
                                                  [3] : SMART Command
SSD Capacity
                  = 128[GB]
                                                  [4] : Flush Command
Data size per LBA = 512[Byte]
                                                  [5] : Shutdown Command
Dev2 selected
Model Number
                  : TOSHIBA-RD400
SSD Capacity
                  = 512[GB]
Data size per LBA = 4096[Byte]
Dev3 selected
Model Number
                  : PLEXTOR PX-512M8PeG
SSD Capacity
                  = 512[GB]
Data size per LBA = 512[Byte]
                               Model name, SSD capacity,
--- Main menu [IPVer = 1.0] -
                               and LBA unit of all devices
[0] : Identify Command
[1] : Write Command
[2] : Read Command
[3] : SMART Command
[4] : Flush Command
[5] : Shutdown Command
```

```
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.

```
Image: Cygdrive/c/
Image: Error device number
Image: Error device number
Image: Error device number
Image: Error device number
Select device number
Image: Error device 0 and 1 are available
Image: Error number
Image: Error device 0 and 1 are available
Image: Error number
Image: Error device 0 and 1 are available
Image: Error number
Image: Error device 0 and 1 are available
Image: Error number
Image: Error device number
Error device number
Image: Error device number
Image: Error device number
Image: Error device number
Image: Error device number
Error device number
Image: Error device number
Image: Error device number
Error device number
Error device number
Image: Error device number
Error device number
Image: Error device number
Error device number
Error device number
Image: Error device number
Error device number
Image: Error device number
Error device number
Error device number
Image: Error device number
Error device
```

Figure 3-2 Error message when selecting the unavailable device

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3.2 Write Command

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

/cygdrive/c/WINDOWS/system32	
+++ Write Command selected +++	
Select device number	
0 : Dev 0	
1 : Dev 1	
2 : Dev 2	
3 : Dev 3	
->0 Select device	
Dev0 selected Input to	est parameters
Enter Start Address (512 Byte): 0 - 0x3B9E12AF = Enter Length (512 Byte) : 1 - 0x3B9E12B0 = Selected Pattern [0]Inc32 [1]Dec32 [2]All_0 [3]A 2.357 [GB] 4.688 [GB] 7.031 [GB] 30.436 [GB] 32.778 [GB]	>0x4000000 3 111_1 [4]LFSR=>4
	Output performance
Total = 34.359 [GB] , Time = 14671[ms] , Transf	er speed = 2341[MB/s]
Main menu [IPVer = 1.0] [0] : Identify Command [1] : Write Command [2] : Read Command	
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 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 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 as test result.



•		-Tes	t da	ata d	of 32	2-bit	t inc	reme	ent p	atte	rn—					•	-				Test	dat	a of	32-k	oit LF	FSR	pat	tern				-
	4- 64-I	bit h	ead	er of	feac	h 51	2- by	∕te→									4-6 4	-bit	head	der o	of eac	ch 51	12-b	yte-								
		bit a 2 by					0x0(000					data crem	ent)				48	bit ad	ddres	SS		0x0(000			(st da it LF			
Offset	0	1	2		4	5	6	7	8	9	`	в	c	↓ D	Е	F	0	1	2	3	4	5	6	7	8	9	A	в	с	↓ _D	Е	F
00000000	-	00	-								00		03	-			00	00		-	00	00	-		_	-	00		_	00		-
00000010							00			00						00	04	00		00										00		
00000020	08	00	00	00	09	00	00	00	0A	00	00	00	0B	00	00	00	49	00		00					24	01				02		
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	00			00	00		1B	00	00		93	24								92				24		
The 1 st 51	12-byte	e da	ta		1D		00			00	00	00	1F	00	00		3C	49	92	04	79		24		F3	24	49		E7	49		
				00		00		00		00	00	00	23	00		00	CF	93	24	49		27			3D	4F	92		7A		24	
00000090	24						00			00	00	00	27	00	00		F5		49			79				F3				E7		
000000A0				00	29	00	00	00		00	00	00	2B	00	00			CF	93				27		75	3D				7A		
000000B0	2C			00		00 00	00 00	00		00	00	00	2F	00	00			F5												AE		
000000C0 000000D0				00 00		00		00		00 00	00 00	00 00	33 37	00 00	00 00	00	70 07	5D D7	CF F5			BA AE			1D	75 5C	3D			EB	/A AE	
000000E0						00	00		38 38		00	00	3B	00	00		77	70		CF										Бо 83		
000000F0				00		00	00	00		00	00	00		00	00		70	07				0E				1D				оз 3В		
00000100						00	00		42		00	00	43	00	00		07			5D										B8		
00000110				00		00	00	00		00	00	00	47	00		00	73	70		D7		EO				C1				83		
00000120				00		00	00	00		00	00	00	4B	00	00		34	07	77	70		0E								39		
00000130	4C	00	00	00	4D	00	00	00	4E	00	00	00		00	00	00		73		07										9A		
00000140	50	00	00	00	51	00	00	00	52	00	00	00	53	00	00	00	74	34	07	77	E9	68	0E	EE	D3	D1	1C	DC	A6	ÀЗ	39	B8
00000150	54	00	00	00	55	00	00	00	56	00	00	00	57	00	00	00	4C	47	73	70	98	8E	E6	E0	31	1D	CD	C1	63	ЗA	9A	83
00000160	58	00	00	00	59	00	00	00	5A	00	00	00	5B	00	00	00	C6	74	34	07	8D	E9	68	0E	1B	D3	D1	1C	37	Α6	AЗ	39
00000170	5C	00	00	00	5D	00	00	00	5E	00	00	00	5F	00	00	00	6E	4C	47	73	DC	98	8E	E6	B8	31	1D	CD	70	63	ЗÀ	9A
00000180						00		00	62		00	00		00	00			C6	74	34		8D								37		
00000190						00		00		00	00	00	67	00	00		1Å	6E	4C	47			98			B8				70		
000001A0						00	00			00	00	00	6B	00	00		AO	E1				C3				86			06			
000001B0						00	00	00		00	00	00	6F	00	00			1Å				34				68	B8			DO		
000001C0				00		00	00	00	72	00	00	00	73	00	00		CO			C6					03	83		1B		06	OD	
000001D0	74						00			00	00		77				OF			6E						30				60		
000001E0 000001F0		00					00		7A 7E			00 00			00 00					E1						03				07		
00000190	01	00						_		00	00	00	_	00	00		FA 01	0F 00		1Å 00					E9	3F 00	30		D3	00	60	
00000000	.	~~	~ ~		85		00	_		00	00	00	83 87	00				00		00	_			_	24	00	00		04 49		00	
The 2 nd 5	12-byt	e da	4		89		00						8B							00										04		
					nead		00	50	OH	50	00	00	00	50	50	50	12	00		4-bit	•		00	50	4)	02	00	00	12	04	50	50
Figuro	21	Γ,					ot i	date		F + 6	~ ·	1 st	n	4	nd	51	2 h	.					inc	ron	n	\ ∔ /I		D	no	tto	rn	
Figure	<u> </u>		\al	пρ	ie	16	510	uali	a U	l ll	ie	1.,	an	u 2		51	∠- 0	yte	5 D	уu	1911	ıg I	III C	1 EU	ner	IU/L	- F C	אכ	μa	iiie	111	

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.

LBA alignment error
+++ Write Command selected +++
Select device number 0 : Dev 0
1 : Dev 1
2 : Dev 2
3 : Dev 3
-> 2
Dev2 selected Recommended message when LBA unit = 4 Kbyte
Please input [Start Address] and [Length] in unit of 8
Enter Start Address (512 Byte): 0 - 0x3B9E12AF => <u>0</u>
Enter Length (512 Byte) : 1 - 0x3B9E12B0 => 7
Invalid input
When ength is not aligned to 8 for 4 KB unit, Main menu LBA SSD, error message will be displayed.
[0] : Identify Command
[1] : Write Command
[2] : Read Command
[3] : SMART Command
[4] : Flush Command
[5] : Shutdown Command

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



Cygdrive/c/WINDOWS/syste	
/cygdrive/c/wiNDOws/syste	
Dev O and a stad	
Dev0 selected	Out of range address
Enter Start Address (512 Byte): 0 - 0	0x3B9E12AF => 0xFFFFFFFF
Invalid input	
/cygdrive/c/WINDOWS/system32	
Dev0 selected	Out of range length
Enton Stout Adduces (E42 Duts), O	
Enter Start Address (512 Byte): 0 - <u>Enter Length (</u> 512 Byte) : 1 -	
Invalid input	
/cygdrive/c/WINDOWS/system32	
Dev0 selected	
Enter Start Address (512 Byte): 0 - 6	
Enter Length (512 Byte) : 1 - 0 <u>Selected Patte</u> rn [0]Inc32 [1]Dec32 [2	
Invalid input	
	Invalid pattern
Figure 3-6 Error message f	<u>rom the invalid input</u>

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3.3 Read Command

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

/cygdrive/c/WINDOWS/system32	Normal
+++ Read Command selected +++	
Select device number	
0 : Dev 0	
1 : Dev 1	
2 : Dev 2	
3 : Dev 3	
->0 Select device	
Dev0 selected	Input test parameters
Enter Start Address (512 Byte):	A - AY380512AE -> A
Enter Length (512 Byte) :	
Selected Pattern [0]Inc32 [1]Dec	2C32 [2]A11_0 [3]A11_1 [4]LFSR=>[4]
3.379 [GB]	telenie felenie felene
6.760 [GB]	
10.142 [GB]	
Current transfer	rsize
30.431 [GB]	
33.812 [GB]	
	Output performance
Total = 34.359 [GB] , Time = 10	.0161[ms] , Transfer speed = 3381[MB/s]
Main menu [IPVer = 1.0]	
[0] : Identify Command	
[1] : Write Command	
	when running Read command
	when running iteau commanu

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.

- 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 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 prefix for hexadecimal unit. If LBA unit of SSD is 4 Kbyte, this input must be aligned to 8.
- 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).

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.

/cygdrive/d	Verification erro	r without ca	ncellation	
+++ Read Co	mmand selected +++			
Enter Lengt	Address (512 Byte): h (512 Byte) :	1 - 0x3B9E12B0	=> 0x400000	Wrong pattern
Verify fail 1st Error a Expect Data Read Data	t Byte Addr = 0x00000 = 0x00000 = 0x00000 ey to cancel operatio	000 003_00000002_00 002_00000001_00 n Mess	000000_000000	000
] 30.432 [GB 33.813 [GB Total = 34]] .359 [GB] , Time = 10	Output per 161[ms] , Trans		3381[MB/s]
	nu [IPVer = 1.0] ify Command			
🕵 Select /cyg	drive Verification er	ror with can	cellation	
Enter Start Enter Lengt	mmand selected +++ Address (512 Byte): (h (512 Byte) : 1 ttern [0]Inc32 [1]Deci	L - 0x3B9E12B0	=> 0x4000000	=> 0
Expect Data Read Data Press any k	t Byte Addr = 0x00000 = 0x00000 = 0x000000 ey to cancel operation	003_00000002_00 002_00000001_00	000000_000000	00
3.380 [GB] 6.761 [GB]		cancel the ope	-	
	s cancelled t system before start:	ing a new test		
Main me		peration is can	celled	
[0] : Ident	Figure 3-8 Dat	a verificatio	on is failed	d

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3.4 SMART Command

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

/cygdrive/c/WINDOWS/system All S	505		/cygdrive/c/WINDOWS/system32	SSD#(J				
+++ SMART Command selected +++			+++ SMART Command selected +++						
Select device number			Select device number						
0 : Dev 0			0 : Dev 0						
1 : Dev 1			1 : Dev 1						
9 : All Devs			2 : Dev 2						
->9 Select all devices			3 : Dev 3						
			9 : All Devs						
All devs selected		Data output from SMART	->0 Select device 0		Data output from SMART command of selected device				
DevØ selected		command of all devices	DevØ selected						
<pre><< SMART Log Information >></pre>			<pre><< SMART Log Information >></pre>						
	: 31 Degre	e Celsius		· 31 De	gree Celsius				
	: 1006 GB	e cersius	Temperature : 31 Degree Celsius Total Data Read : 1006 GB						
		000 00000000 00000000 001DFB02	Total Data Read (Raw data) : 0000000 00000000 00000000 001DFB02						
	: 694 GB		Total Data Written : 694 GB						
Total Data Written (Raw data)		000 0000000 0000000 001/0/2	Total Data Written (Raw data) : 0x00000000 00000000 00000000 0014B425						
	: 23 Times		Power On Cycles : 23 Times						
	: 1 Hours	•	Power On Hours : 1 Hours						
	: 12 Times		Unsafe Shutdowns : 12 Times						
Silver Si	. 12 11005	•							
SMART Command complete			SMART Command complete						
Dev1 selected			Main menu [IPVer = 1.0]						
<pre><< SMART Log Information >></pre>			[0] : Identify Command						
	: 32 Degre	a Calcius	[1] : Write Command						
•	: 7376 GB	CC (CI3103	[2] : Read Command						
		000 00000000 00000000 00DBD405	[3] : SMART Command						
	: 7552 GB	00_0000000_0000000000000000000000000000	[4] : Flush Command						
Total Data Written (Raw data)		000 0000000 0000000 0051115							
	: 563 Time								
	: 76 Hours	-							
Power On Hours									

```
SMART Command complete
```

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

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 input 0-3 to run only one device.

If the input is valid, the SSD SMART/health information (output from SMART command) us 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 as 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 as 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.

	/cygdrive/c/Wlf SSD#0 m32
+++ Flush Command selected +++	+++ Flush Command selected +++
Select device number	Select device number
0 : Dev 0	
l : Dev 1	0 : Dev 0 1 : Dev 1 2 : Dev 2 3 : Dev 3
2 : Dev 2	
3 : Dev 3	
9 : All Devs	
->9 Select all devices	9 : All Devs
All devs selected	-> 0 Select device 0
Dev0 selected	DevØ selected
lush Command complete	Flush Command complete Message after finishing the
Dev1 selected	operation of selected device
lush Command complete	[0] . idencity command
	<pre>[1] : Write Command</pre>
Dev2 selected	[2] : Read Command
Flush Command complete	[3] : SMART Command
	<pre>[4] : Flush Command</pre>
Dev3 selected	[5] : Shutdown Command
Flush Command complete	
Message after finishing the	
operation of all devices	
[1] : Write Command	
[2] : Read Command	
[3] : SMART Command	
[4] : Flush Command	
[5] : 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.

/cygdrive/c/WINDOW All SSDs	/cygdrive/c/WINDOWS/sy SSD#2
+++ Shutdown Command selected +++	+++ Shutdown Command selected +++
Select device number Ø : Dev Ø 1 : Dev 1 2 : Dev 2 3 : Dev 3 9 : All Devs -> ⑨ Select all devices All devs selected Are you sure you want to shutdown the device now ? Press 'y' to confirm : y Press 'y' to confirm	Select device number 0 : Dev 0 1 : Dev 1 2 : Dev 2 3 : Dev 3 9 : All Devs -> 2 Select device 2 Are you sure you want to shutdown the device now ? Press 'y' to confirm : y Dev2 selected Shutdown Command complete Shutdown operation of selected device
DevØ selected Shutdown Command complete	Dev0 : Detected Dev1 : Detected Dev3 : Detected
Dev1 selected Shutdown Command complete Dev2 selected Shutdown Command complete	Main menu [IPVer = 1.0] [0] : Identify Command [1] : Write Command [2] : Read Command [3] : SMART Command [4] : Flush Command
Dev3 selected Shutdown Command complete All devices were shutdown all devices	[5] : Shutdown Command
Now NVMeSW-IP is inactive	

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 should 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	30-Apr-19	Initial version release
1.1	13-Feb-20	Support AB18