

NVMeSW IP Core Demo Instruction

Rev1.2 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 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
 <u>https://www.aplicata.com/quattro-400/</u>
 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)



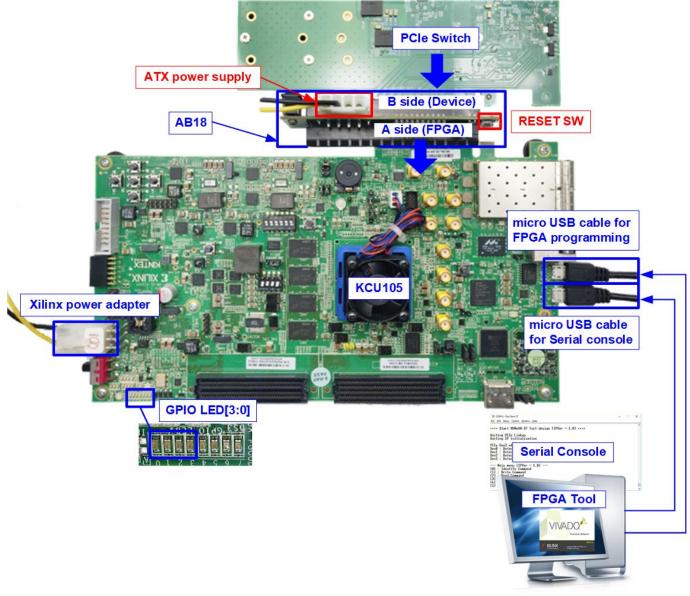


Figure 1-1 NVMeSW-IP demo environment setup on KCU105



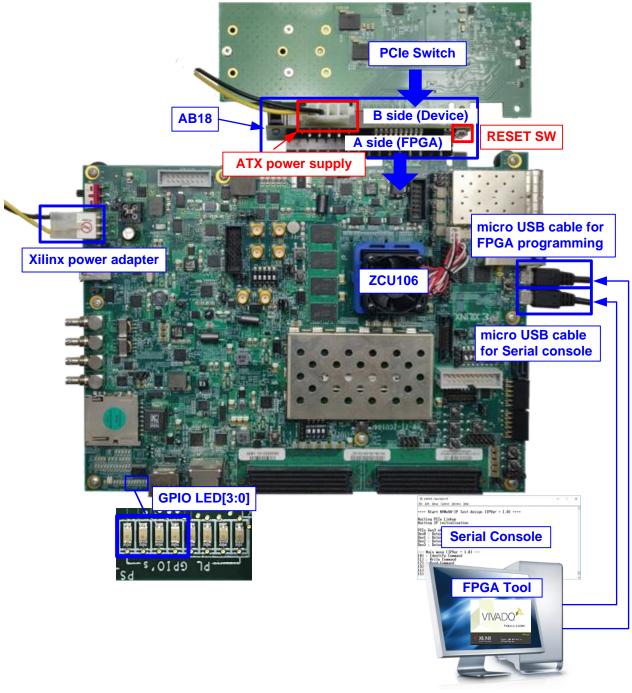


Figure 1-2 NVMeSW-IP demo environment setup on ZCU106



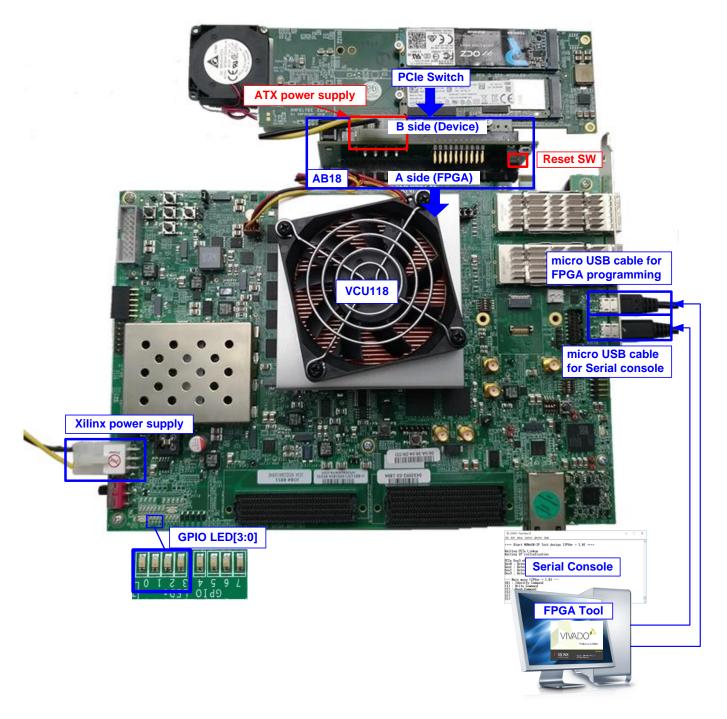


Figure 1-3 NVMeSW-IP demo environment setup on VCU118



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.

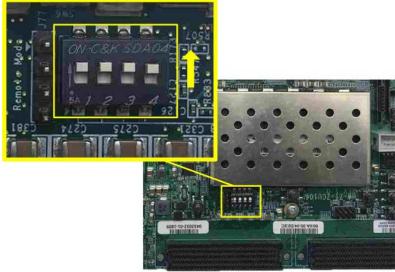


Figure 2-1 SW6 setting to configure PS from JTAG on ZCU106

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

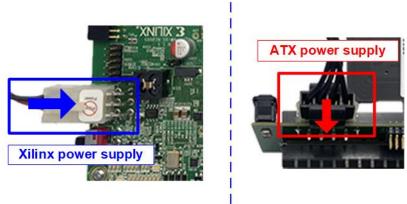


Figure 2-2 Power connection



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.

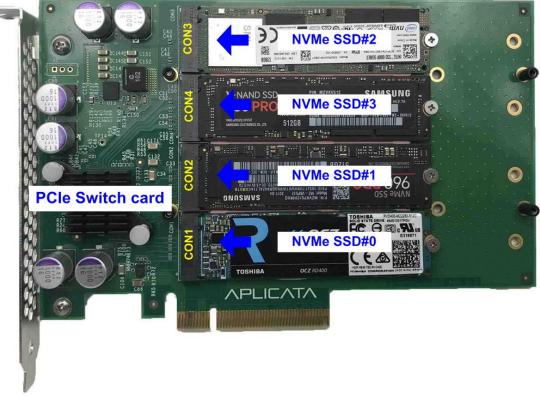


Figure 2-3 Connect NVMe SSD to PCIe Swtich#1

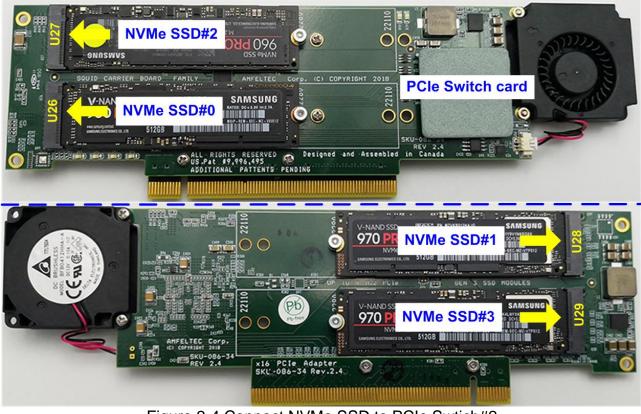
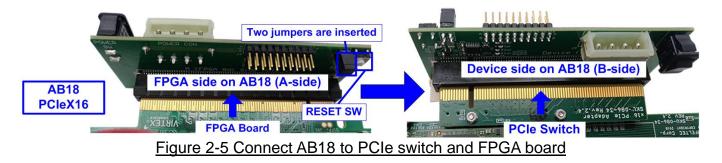


Figure 2-4 Connect NVMe SSD to PCIe Swtich#2

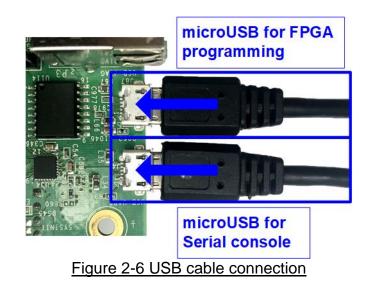


5) a. Confirm that two mini jumpers are inserted at J5 connector on AB18.

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. <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.



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



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

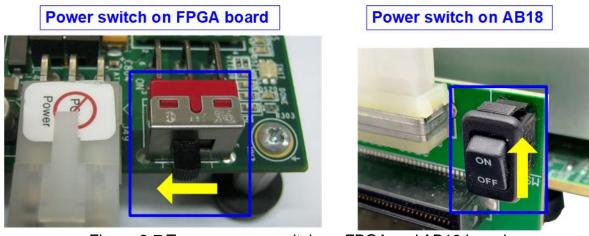


Figure 2-7 Turn on power switch on FPGA and AB18 board



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.

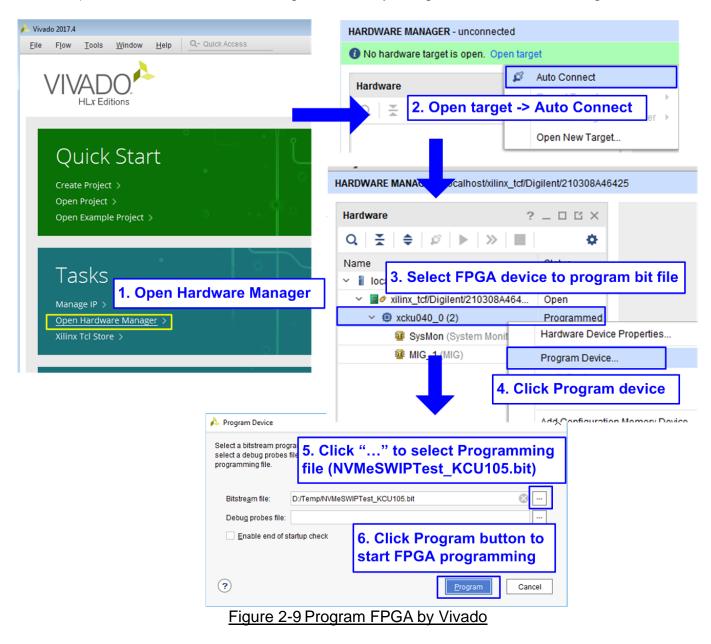
In case of KCU105 and VCU118, select Standard COM port. In case of ZCU106, select the lowest number for ZCU106 board, as shown in Figure 2-8.

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

Source (COM & DT)	tional COM ports 05/VCU118 board nanced COM Port (COM10) ndard COM Port (COM11)	Image: Silicon Labs Quad CP2108 USB to UART Bridge: Interface 0 (COM18) Image: Silicon Labs Quad CP2108 USB to UART Bridge: Interface 1 (COM20) Image: Silicon Labs Quad CP2108 USB to UART Bridge: Interface 2 (COM19) Image: Silicon Labs Quad CP2108 USB to UART Bridge: Interface 3 (COM21) Image: Silicon Labs Quad CP2108 USB to UART Bridge: Interface 3 (COM21) Image: Silicon Labs Quad CP2108 USB to UART Bridge: Interface 3 (COM21) Image: Silicon Labs Quad CP2108 USB to UART Bridge: Interface 3 (COM21) Image: Silicon Labs Quad CP2108 USB to UART Bridge: Interface 3 (COM21) Image: Silicon Labs Quad CP2108 USB to UART Bridge: Interface 3 (COM21) Image: Silicon Labs Quad CP2108 USB to UART Bridge: Interface 3 (COM21) Image: Silicon Labs Quad CP2108 USB to UART Bridge: Interface 3 (COM21) Image: Silicon Labs Quad CP2108 USB to UART Bridge: Interface 3 (COM21) Image: Silicon Labs Quad CP2108 USB to UART Bridge: Interface 3 (COM21) Image: Silicon Labs Quad CP2108 USB to UART Bridge: Interface 3 (COM21) Image: Silicon Labs Quad CP2108 USB to UART Bridge: Interface 3 (COM21) Image: Silicon Labs Quad CP2108 USB to UART Bridge: Interface 3 (COM21)
	Tera Term: Serial port setup	Serial setting ×
	Port:	СОМ11 ~ ОК
	<u>B</u> aud rate:	115200 ~
	<u>D</u> ata:	8 bit v Cancel
	P <u>a</u> rity:	none v
	<u>S</u> top:	1 bit v Help
	Elow control:	none v
Fic	Transmit delay	char I msec/line 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.



 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.

	Vivado 2017.4 Tcl Shell - E:\Xilinx\Vivado\2017.4\bin\vivado.bat -mode tcl	-		Х	
,	***** Vivado v2017.4 (64-bit)				^
	<pre>**** SW Build 2086221 on Fri Dec 15 20:55:39 MST 2017 **** IP Build 2085800 on Fri Dec 15 22:25:07 MST 2017 ** Copyright 1986-2017 Xilinx, Inc. All Rights Reserved.</pre>				
	Vivado% cd D:/Temp/ready_for_download Go to ready_for_download Vivado% NVMeSWIPTest_ZCU106.bat	ad dire	ctory		
	Run script file to download bit a	ind elf	file		~
1	Figure 2-10 Command script to download demo file on Viva	do TC	L she	ell	



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

	10010	
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

Table 2-1 LED Definition

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.

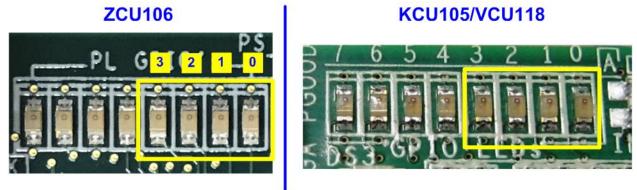


Figure 2-11 Four LEDs to show the current status



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.

COM12 - Tera Term VT	COM12 - Tera Tern 1 SSD
<u>File Edit Setup Control Window H</u> elp	<u>File Edit Setup Control Window H</u> elp
++++ Start NVMeSW-IP Test design [IPVer = 1.0] ++++ Wait PCle Linkup Waiting PCIe Linkup Waiting IP initialization	++++ Start NVMeSW-IP Test design [] Waiting PCIe Linkup Waiting IP initialization
PCIe Gen3 x4 Device Detect PCle speed = Gen3 and Dev0 : Detected PCle lane = 4 lanes Dev1 : Detected Detect 4 NVMe SSDs Dev3 : Detected Pcle speed = Gen3 and PCle lane = 4 lanes Detect 4 NVMe SSDs Image: Detected Image: Detected Image: Detected Ima	PCIe Gen3 x4 Device Detect Dev0 : Detected Detect 1 NVMe device Main menu [IPVer = 1.0] [0] : Identify Command [1] : Write Command [2] : Read Command [3] : SMART Command [4] : Flush Command
[2] : Read CommandMain menu to select[3] : SMART Commandthe command	[5] : Shutdown Command
[4] : Flush Command [5] : Shutdown Command	

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.

COM12 - Tera Term VT All SSDs	COM12 - Tera Term VT SSD#0
<u>File Edit Setup Control Window Help</u>	<u>File Edit Setup Control Window Help</u>
+++ Identify Command selected +++	+++ Identify Command se Blue: Output to user
Select device number Ø : Dev Ø 1 : Dev 1 2 : Dev 2 3 : Dev 3 9 : All Devs ->9 ->9 ->9 ->9	Select device number 0 : Dev 0 1 : Dev 1 2 : Dev 2 3 : Dev 3 9 : All Devs -> 0 Select device 0
All devs selected	Dev0 selected Model Number : Samsung SSD 960 PRO 512GB
Dev0 selected Model Number : Samsung SSD 970 PRO 512GB SSD Capacity = 512[GB] Data size per LBA = 512[Byte]	SSD Capacity = 512[GB] Data size per LBA = 512[Byte] Ma LDA emits for shorted planing
Dev1 selected Model Number : INTEL SSDPEKKW12867 SSD Capacity = 128[GB] Data size per LBA = 512[Byte]	[1] : Write Command [2] : Read Command [3] : SMART Command [4] : Flush Command
Dev2 selected Model Number : TOSHIBA-RD400 SSD Capacity = 512[GB] Data size per LBA = 4096[Byte]	[5] : Shutdown Command
Dev3 selected Model Number : PLEXTOR PX-512M8PeG SSD Capacity = 512[GB] Data size per LBA = 512[Byte] Model name, S	SD Capacity,
Main menu [IPVer = 1.0] and LBA unit o [0] : Identify Command [1] : Write Command	of all devices
Figure 3-1 Test result when	n 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

DG

dg_nvmeswip_instruction_en.doc

3.2 Write Command

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

COM12 - Tera Term VT Normal
File Edit Setup Control Window Help
Select device number 0 : Dev 0 1 : Dev 1 2 : Dev 2 3 : Dev 3 ->0 Select device
DevØ selected Input test parameters
Enter Start Address (512 Byte): 0 - 0x3B9E12AF => 0 1 Enter Length (512 Byte) : 1 - 0x3B9E12B0 => 0x4000000 2 Selected Pattern [0]Inc32 [1]Dec32 [2]Al1_0 [3]Al1_1 [4]LFSR=> 4 2.356 [GB] 4.697 [GB] 7.031 [GB] Current transfer size
30.405 [GB] 32.731 [GB]
<pre>Fotal = 34.359 [GB] , Time = 14692[ms] , Transfer speed = 2338[MB/s</pre>
Main menu [IPVer = 1.0] [0] : Identify Command [1] : Write Command [2] : Read Command Figure 3-3 Test result when running Write comman

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	dat	a o	of 32	2-bit	t inc	reme	ent p	atte	rn–					•	-				Test	t dat	a of	f 32-k	oit LF	FSR	pat	tern				-
	4- 64-k	oit he	ade	r of	eac	h 51	1 2- by	yte-									4-6 4	-bit	head	der o	of eac	ch 5 [.]	12-b	yte-								
		bit ad 2 byte					0x0(000					data crem	ent)				48	bit a	ddres	SS		0x0(000			(Tes 32-b	st da it LF			
Offset		1	2▲	3	4	5	6	7	8	9	A	в	c	↓ D	E	F	0	1	2	3	4	5	6	7	8	9	A	в	с	↓ _D	Е	F
00000000	-	-)0 0	-		-			00		00	00		03	-			00	00		-	00	00	-		_	-	00		_	00		-
00000010							00			00	00					00	04			00										00		
00000020	08 0	0 0	0 0	0	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 (0 0	0 0	0	OD	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 0	0 0	0 0	0	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						00	00		16	00	00	00	17	00	00		49	92	04	00	92		09		24	49	12		49		24	
00000060	18 (0 0				00	00			00	00		1B	00	00		93	24								92				24		
The 1 st 51	12-byte	dat	a		1D		00			00	00	00	1F	00	00		3C		92		79		24		F3	24	49		E7		92	
						00			22	00	00	00	23	00		00	CF	93	24	49	9E	27			3D	4F	92		74		24	
00000090	24 (00 00	00 00	00 00		00	00	00	27	00	00		F5					79				F3				E7		
000000A0 000000B0	28 0 2C 0					00	00			00 00	00 00	00 00	2B 2F	00 00	00 00			CF F5	93 3C		BA	9E	27		75	3D				7 A A E	9E	
0000000000						00	00			00	00	00	2r 33	00	00		70	r5 5D	CF							75	r S 3D			EB		
0000000000						00			36	00	00	00	37	00		00	07					ΔE			1D	5C	D7				ΑE	
000000E0						00	00		3A		00	00	3B	00	00		77			CF										83		
000000F0						00	00	00		00	00	00	3F	00	00		70	07				0E				1D		D7				
00000100	40 (0 0	0 0	0	41	00	00	00	42	00	00	00	43	00	00	00	07	77		5D					1C	DC				B8		
00000110	44 (0 0	0 0	0	45	00	00	00	46	00	00	00	47	00	00	00	73	70	07	D7	E6	E0	0E	ΑE	CD	C1	1D	5C	9A	83	3B	B8
00000120	48 (0 0	0 0	0	49	00	00	00	4A	00	00	00	4B	00	00	00	34	07	77	70	68	0E	EE	E0	D1	1C	DC	C1	АЗ	39	B8	83
00000130	4C (0 0	0 0	0	4D	00	00	00	4E	00	00	00	4F	00	00	00	47	73	70	07	8E	E6	ΕO	0E	1D	CD	C1	1D	ЗÀ	9A	83	3B
00000140	50 0	0 0	0 0	0	51	00	00	00	52	00	00	00	53	00	00	00	74	34	07	77	E9	68	0E	EE	D3	D1	1C	DC	A 6	АЗ	39	B8
00000150	54 (00	00			00	00	00	57	00	00		4C	47	73			8E								ЗA		
00000160						00	00	00		00	00	00	5B	00		00	C6	74	34			E9								A6		
00000170						00	00		5E	00	00	00	5F	00	00		6E	4C	47		DC		8E		B8	31		CD			3A	
00000180						00		00	62		00	00		00	00			C6	74			8D								37		
00000190						00				00	00	00	67 (D	00	00		14	6E	4C				98			B8				70		
000001A0 000001B0						00 00	00 00		6A 6E	00 00	00 00	00 00	6B 6F	00 00	00 00			E1 1Å	C6			C3 34				86 68	B8	D3 21		OD DO		
000001C0				_		00	00		72	00	00	00	73	00	00		CO			C6					03	83		1B		06	0D	
000001D0	74 (00			00	00		77				OF			6E						30				60		
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00000200	01 (_		00	00	00	_	00	00		01	00		00						00				00		
00000000			- n		85			00	86	00	00	00	87	00				00		00	_			_	24	00	00		49		00	
The 2 nd 5	12-byte	e dat	a	00	89	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-ł	oit h	ead	er													6	4-bit	head	der										
Figure	3-4	Ex	an	gr	le [·]	Te	st (data	a o	f th	ne	1 st	an	d 2	2nd	51	2-b	vte	e b	v u	ısir	na	inc	ren	ner	nt/L	_FS	SR	pa	itte	rn	
			J									-	<u>_</u>		_		~ ~	,		, .												

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 alignm	ent error		
	<u>F</u> ile <u>E</u> dit <u>S</u> etup C <u>o</u> ntrol	<u>W</u> indow <u>H</u> elp			
	+++ Write Comman	d selected +++			
	Select device nu	mber			
	0 : Dev 0				
	1 : Dev 1 2 : Dev 2				
	3 : Dev 3				
	-> 1	ſ			
				nded message	
	Dev1 selected		when LBA	unit = 4 Kbyte	
	Please input [St	art Address] and	d [Length] i	n unit of 8	
	Enter Start Addr	ess (512 Byte):	0 - 0x3B9E1	2AF => <u>0</u>	
	Enter Length (51	2 Byte) :	1 - 0x3B9E1	2B0 => 7	
	Invalid input	hen lenath is na	ot aligned to	8 for 4 KB unit]
		BA SSD, error m	-		
	[0] : Identify u	ommana			1
	[1] : Write Comm				
	[2] : Read Comma				
Figure 3-5 Eri	ror message w	nen the input i	s unaligne	d for SSD with	<u>n 4KB LBA unit</u>



COM12 - Tera Term VT	or input –
<u>File Edit Setup Control Window H</u> elp	
Dev0 selected	Out of range address
Enter Start Address (512 Byte) Invalid input	: 0 - 0x3B9E12AF => 0xFFFFFFFF
💆 COM12 - Tera Term VT	-
<u>File Edit Setup Control Window H</u> elp	
Dev0 selected	Out of range length
Enter Start Address (512 Byte) Enter Length (512 Byte) Invalid input	: 0 - 0x3B9E12AF => 0 : 1 - 0x3B9E12B0 => 0xFFFFFFFF
🔟 COM12 - Tera Term VT	
<u>File E</u> dit <u>S</u> etup C <u>o</u> ntrol <u>W</u> indow <u>H</u> elp	
Dev0 selected	
Enter Start Address (512 Byte): Enter Length (512 Byte) <u>Selected Patte</u> rn [0]Inc32 [1]De Invalid input	: 0 - 0x3B9E12AF => 0 : 1 - 0x3B9E12B0 => 0x4000000 ec32 [2]All_0 [3]All_1 [4]LFSR=> 6 Invalid pattern
Figure 3-6 Error mess	age from the invalid input



3.3 Read Command

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

	112 - Tera T : <u>S</u> etup		<u>W</u> indow	_	<mark>lorm</mark> a	I		-
Select Ø : De 1 : De 2 : De		ce nu		ed +++ t devi	се			
Dev0 s	elect	ed				Inp	out test par	ameters
Enter Select 3.379 6.760 10.10 13.52 16.90 20.28 23.60 27.05 30.43	Lengtl ed Pa [GB] [GB] [GB] [CB] [CB] [CB] [CB] [CB] [CB] [CB] [C	h (51 ttern]]]]]	2 Byte) [0]Inc	32 [1]De	ransfe	89E12 11_0 r siz	B0 => <u> 0x4000000</u> [3]A11 <u>_1 [4]LF</u> S	2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
Total	= 34	. 359	[GB] ,	Time = 1	0161[ms]	, Tr	ansfer speed =	3381[MB/s]
[0] : [1] : [2] :	Ident Write Read I	ify C Comm Comma	ommand and nd	1.0]			ning Read	Loommo

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 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.
- 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 Te Verification error without cancellation	
Eile 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]All_0 [3]All_1 [4]LFSR=> 0	attei
Verify fail 1st Error at Byte Addr = 0x00000000 Expect Data = 0x00000003_00000000_00000000_00000000 Read Data = 0x00000002_00000000_00000000_00000000 Press any key to cancel operation Message when 3.380 [GB] verification is failed	
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-TeraTerr Elle Edit Setup Common with cancellation	
+++ 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]All_0 [3]All_1 [4]LFSR=> 0	
Verify fail 1st Error at Byte Addr = 0x00000000 Expect Data = 0x00000002_000000001 User presses some keys Press any key to cancel operation to cancel the operation 3.238 [GB]	
Operation is cancelled Please reset system before starting a new test Main menu [IPVer = Message when operation is cancelled [0] : Identify Command [1] : Write Command	
Figure 3-8 Data verification is failed	J



3.4 SMART Command

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

COM12 - Tera Term VT Eile Edit Setup Control Window Help	COM12 - Tera Term VT Eile Edit Setup Control Window Help
+++ SMART Command selected +++ Select device number 0 0 : Dev 0 1 1 : Dev 1 9 9 : All Devs -> >> 9 Select all devices All devs selected Data output from SMART Dev0 selected command of all devices <	<pre>+++ SMART Command selected +++ Select device number 0 : Dev 0 1 : Dev 1 2 : Dev 2 3 : Dev 3 9 : All Devs ->0 Select device 0 Data output from SMART command of selected device << SMART Log Information >> Iemperature : 31 Degree Celsius Total Data Read : 96796 GB Total Data Read (Raw data) : 0x00000000_00000000_0000000_0000000_000000</pre>
SMART Command complete Dev1 selected <	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

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 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 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 All SSDs <u>F</u> ile <u>E</u> dit <u>S</u> etup Co	COM12 - Tera Terr SSD#0 <u>File E</u> dit <u>S</u> etup Common <u>H</u> elp
+++ Flush Command selected +++	+++ Flush Command selected +++
Select device number Ø : Dev Ø 1 : Dev 1 2 : Dev 2 3 : Dev 3 9 : All Devs -> 9 Select all devices	Select device number 0 : Dev 0 1 : Dev 1 2 : Dev 2 3 : Dev 3 9 : All Devs ->0 Select device 0
All devs selected	Dev0 selected Flush Command complete
DevØ selected Flush Command complete	Message after finishing the
Dev1 selected Flush Command complete Dev2 selected Flush Command complete	[0 operation of selected device [1] : Write Command [2] : Read Command [3] : SMART Command [4] : Flush Command [5] : Shutdown Command
Dev3 selected Flush Command complete	
Message after finishing the	•
[0] operation of each device [1] : Write Command	
	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.

Image: COM12 - Tera Term VT All SSDs File Edit Setup Control Window Help	Image: Communication Image: Communication Eile Edit Setup Control Window
+++ 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	Select device number Ø : Dev 0 1 : Dev 1 2 : Dev 2 3 : Dev 3 9 : All Devs ->2 Select device 2
All devs selected	Are you sure you want to shutdown the device now ? Press 'y' to confirm : y
Are you sure you want to shutdown the device now ? Press 'y' to confirm : y Press 'y' to confirm	Dev2 selected Shutdown Command complete Shutdown Command complete
Dev0 selected Shutdown Command complete Dev1 selected	Dev0 : Detected Dev1 : Detected Dev3 : Detected Device 2 is unavaliable
Shutdown Command complete	Main menu [IPVer = 1.0]
Dev2 selected Shutdown Command complete	<pre>[0] : Identify Command [1] : Write Command [2] : Read_Command</pre>
Dev3 selected Shutdown Command complete Shutdown operation of all devices	[3] : SMART Command [4] : Flush Command [5] : Shutdown Command
All devices were shutdown 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 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