exFAT IP for SATA Demo Instruction

Rev1.2 15-May-19

This document describes the instruction to run exFAT IP for SATA demo on FPGA development board by using AB09-FMCRAID adapter board. The demo is designed to write and verify data with SATA-III device. User controls the test operation through NiosII command shell.

1 Environment Requirement

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

1) IntelFPGA board: Intel Cyclone10 GX development board or Intel Arria10 SoC Development board
2) PC installing QuartusII programmer and NiosII command shell software
3) AB09-FMCRAID provided by Design Gateway
4) SATA-III device connecting to AB09 board
5) Intel power adapter for FPGA board
6) ATX power supply for SATA device
7) micro USB cable for programming FPGA and NiosII command shell, connecting between FPGA board and PC

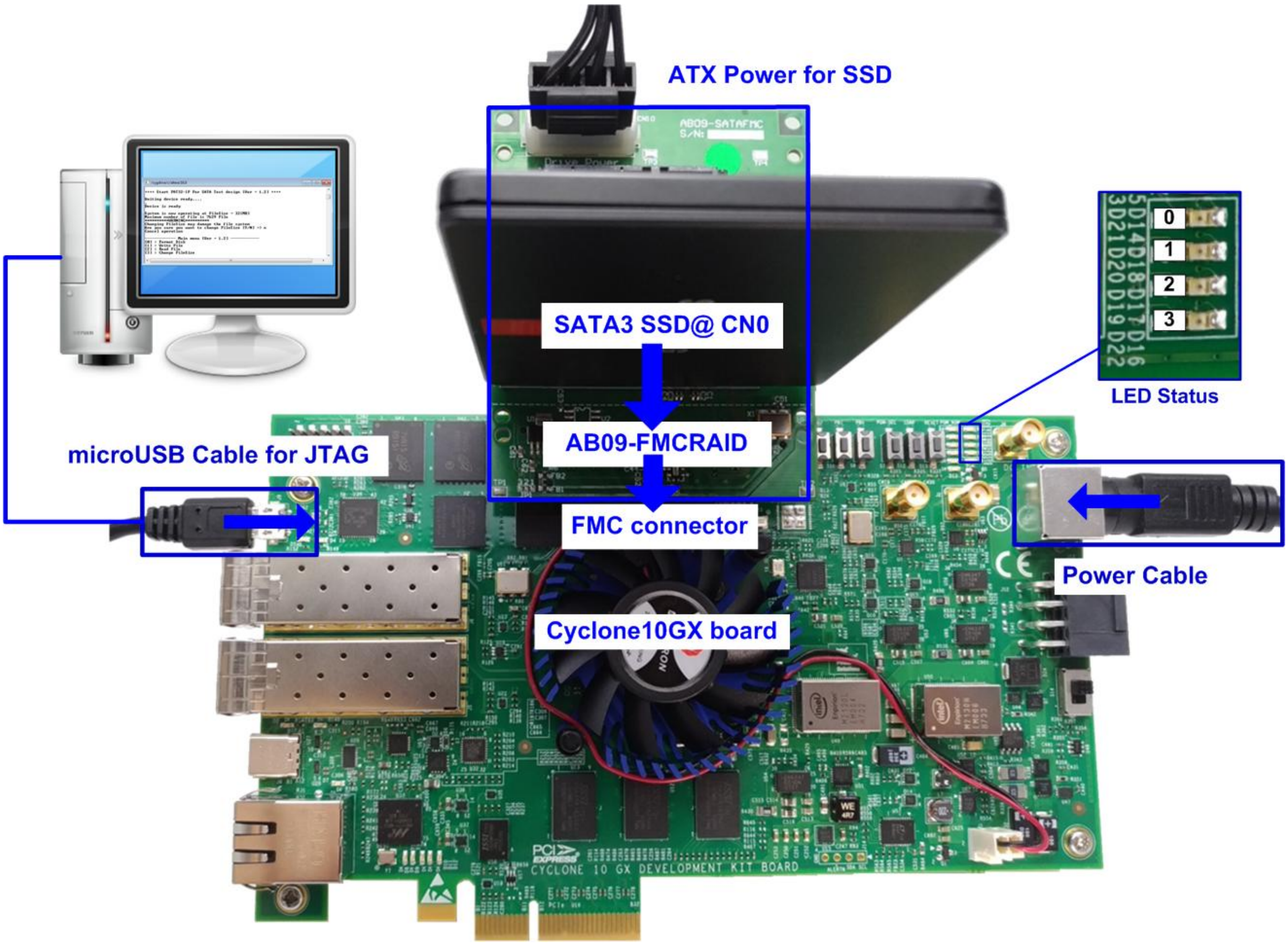


Figure 1-1 exFAT-IP for SATA demo environment setup on Cyclone10 GX board

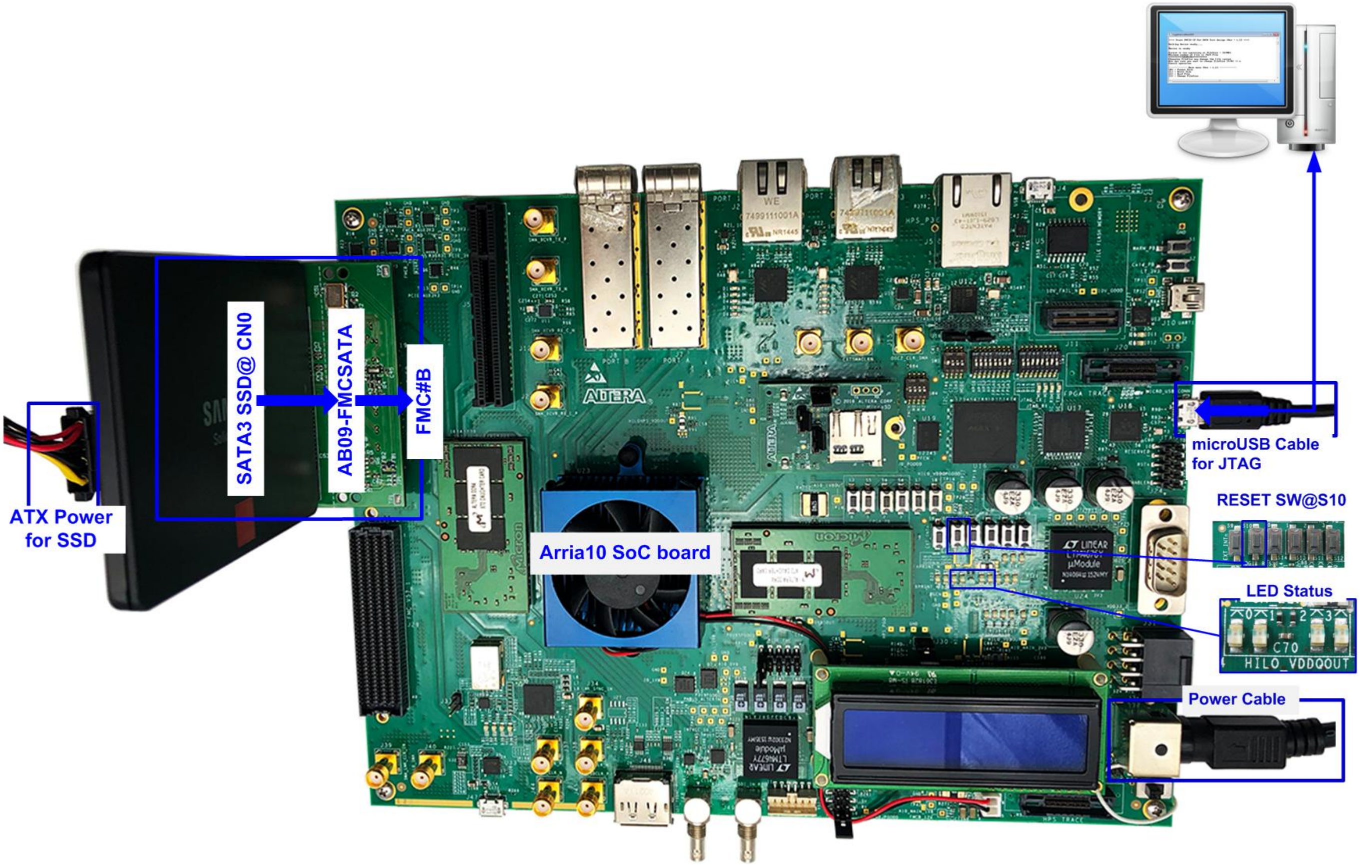


Figure 1-2 exFAT-IP for SATA demo environment setup on Arria10 SoC development board

2 Demo setup

1) Power off system.
2) Setup AB09 adapter board as shown in Figure 2-1.
   i. Connect AB09-FMCRAID to FMC#B/FMC connector on FPGA development board.
   ii. Connect SATA-III device to CN0 on AB09-FMCRAID board.
   iii. Connect ATX power to power connector on AB09.

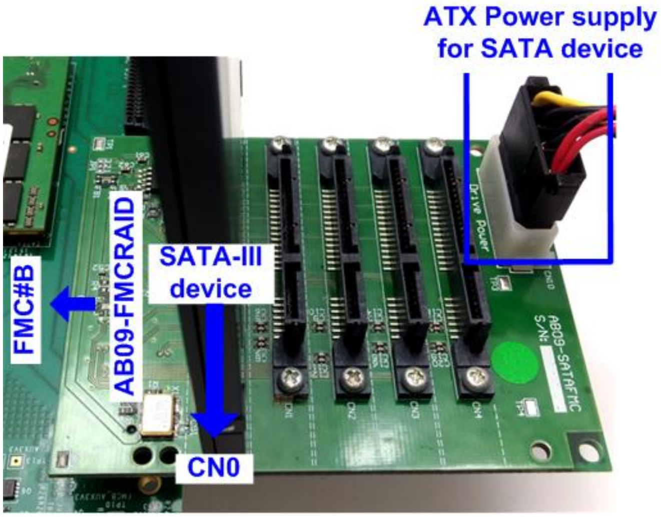


Figure 2-1 AB09 connection to FPGA board

3) Connect micro USB cable from FPGA board to PC for JTAG programming and JTAG UART.

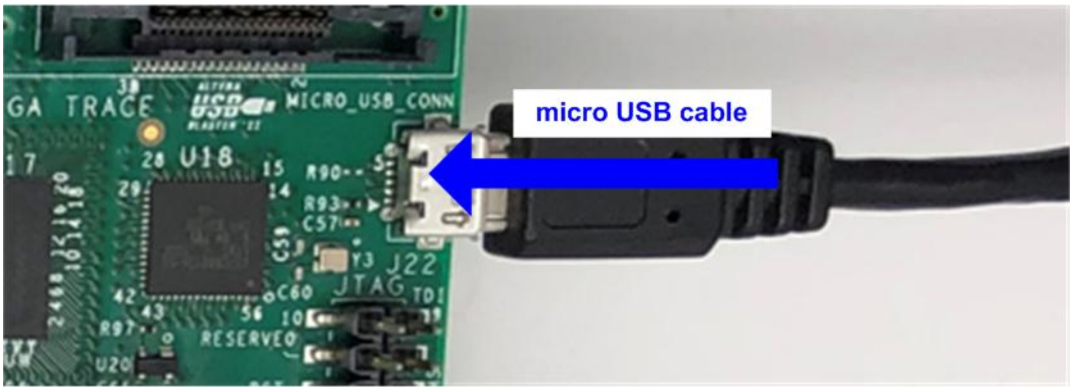
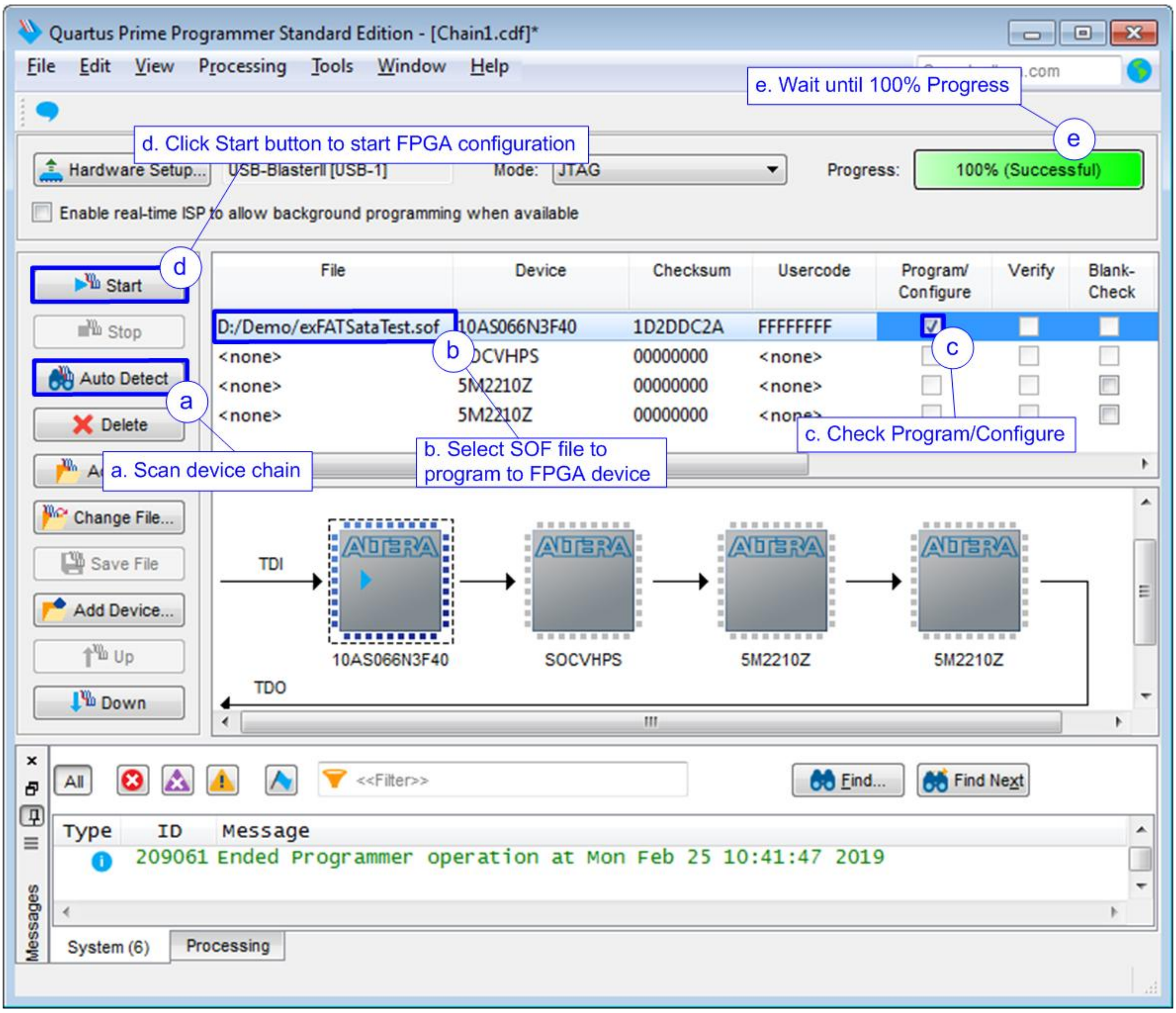


Figure 2-2 micro USB cable for JTAG

4) Power on FPGA development board and ATX power supply for SATA device.

5) Use QuartusII Programmer to program “exFATSataTest.sof” file, as shown in Figure 2-3.



USB-BlasterII [USB-1] Mode: JTAG

Progress: 100% (Successful)

□ Enable real-time ISP to allow background programming when available

File	Device	Checksum	Usercode	Program/ Configure	Verify	Blank-Check
D:/Demo/exFATSataTest.sof	10AS066N3F40	1D2DDC2A	FFFFFFFF	☑	□	□
<none>	SOCVHPS	00000000	<none>	□	□	□
<none>	5M2210Z	00000000	<none>	□	□	□
<none>	5M2210Z	00000000	<none>	□	□	□

```
Type  ID     Message
      209061 Ended Programmer operation at Mon Feb 25 10:41:47 2019
```

a. Scan device chain

b. Select SOF file to program to FPGA device

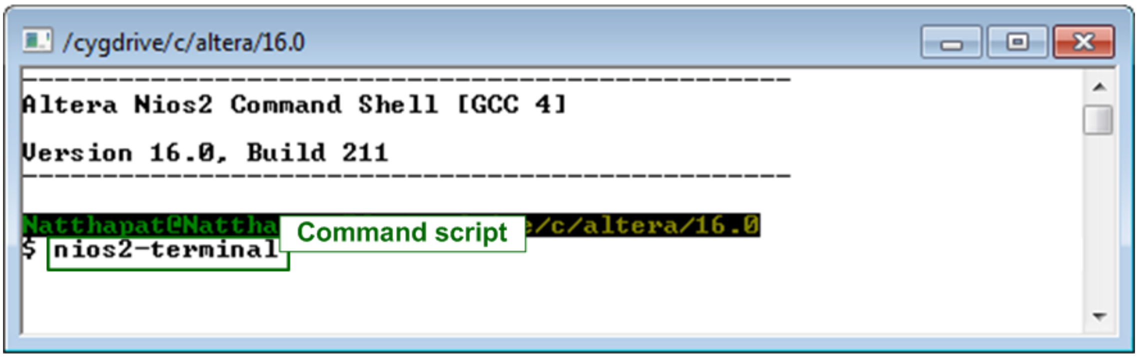
c. Check Program/Configure

d. Click Start button to start FPGA configuration

e. Wait until 100% Progress

Figure 2-3 Programmed by QuartusII Programmer

6) Open NiosII Command Shell and run nios2-terminal command. After that, boot message is displayed as shown in Figure 2-6.



```
-------------------------------------------------
Altera Nios2 Command Shell [GCC 4]

Version 16.0, Build 211
-------------------------------------------------

Natthapat@Nattha e/c/altera/16.0
$ nios2-terminal
```

Figure 2-4 NiosII Command Shell

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

Table 1 LED Definition

GPIO LED	ON	OFF
0	Normal operation	System is in reset condition
1	System is busy	Idle status
2	Error detect	Normal operation
3	Data verification fail	Normal operation

8) After programming complete, LED[0] and LED[1] are ON during running initialization process. LED[1] changes to OFF after finishing exFAT IP initialization.

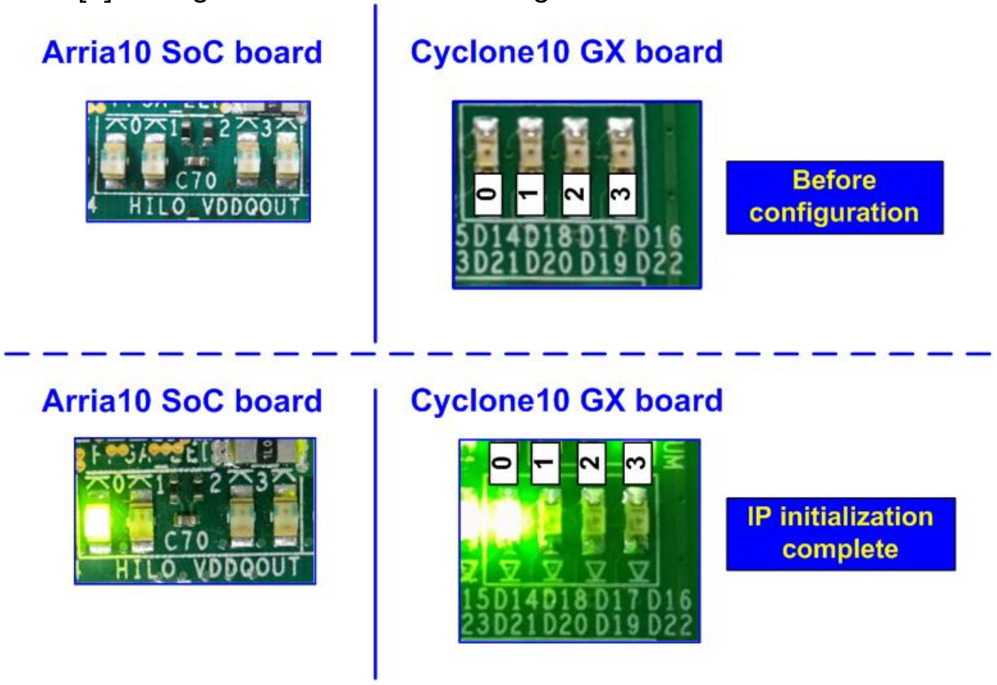
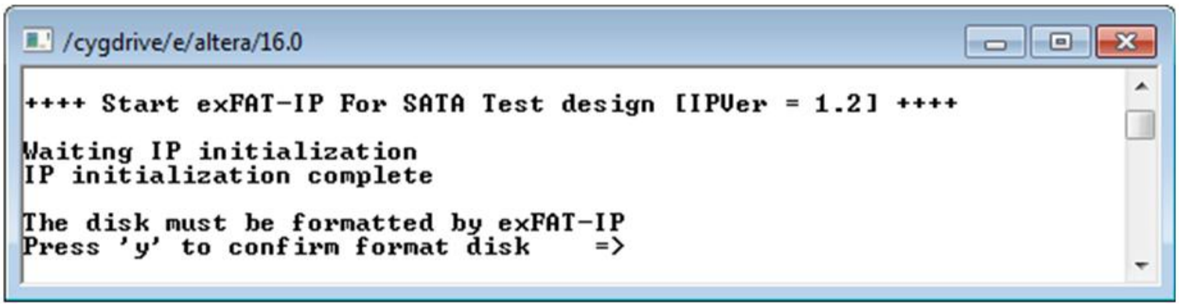


Figure 2-5 LED Status

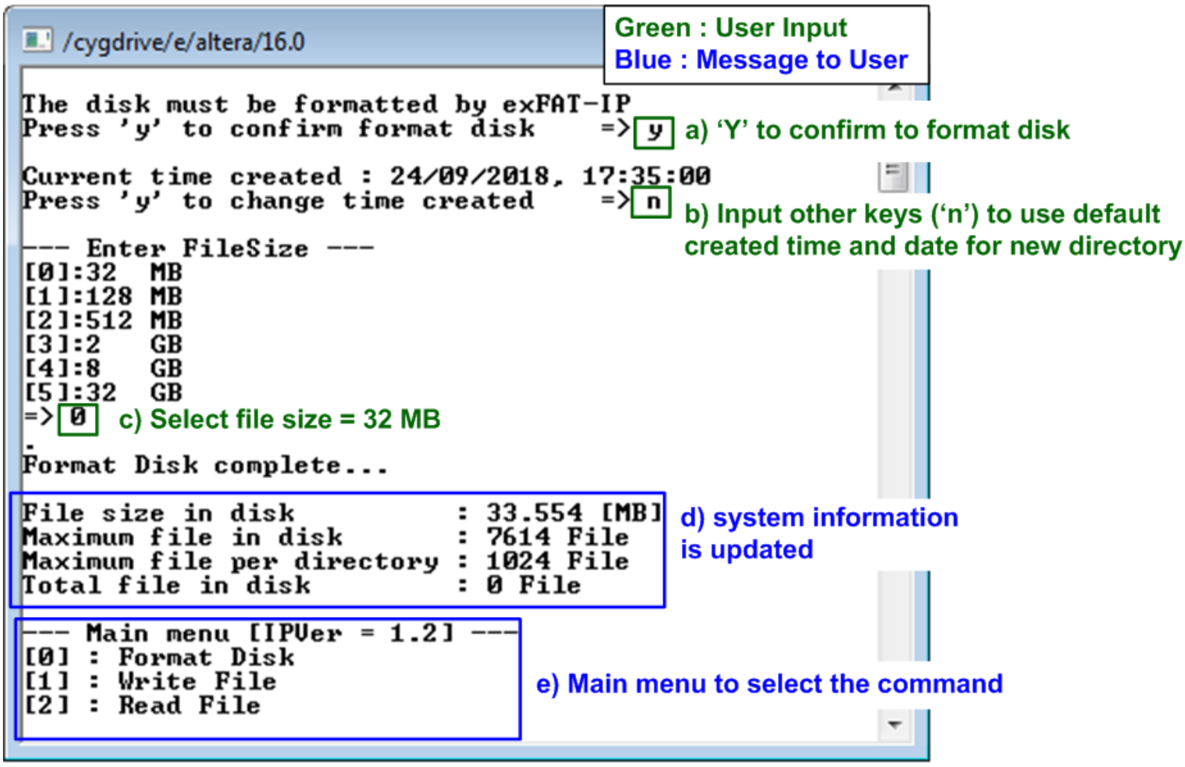
9) On NiosII command shell, the message is displayed to show current status as follows
   - "Waiting IP initialization" is displayed during initialization sequence.
   - "IP initialization complete" is displayed when IP is idle.
   - Before running the test, "The disk must be formatted by exFAT-IP" is displayed. User input 'y' to format the disk when the disk is the new disk which has never been formatted by exFAT-IP. After running Format command, all data in the disk are deleted. The example to run Format command is shown in Figure 2-7 while the example to skip Format command is shown in Figure 2-8.



```
++++ Start exFAT-IP For SATA Test design [IPVer = 1.2] ++++

Waiting IP initialization
IP initialization complete

The disk must be formatted by exFAT-IP
Press 'y' to confirm format disk     =>
```

Figure 2-6 Message when IP runs initialization process

The operation after selecting format disk is same as topic 3.1. Please see more details in that topic. After finishing Format operation or Format is skipped, the system information in the disk are displayed, i.e. current file size, maximum file in the disk, maximum file per directory, and total file in the disk. If the disk is not empty, total file in the disk will not be equal to 0. User can continue to write new file by using same file size. Also, Read file command could be used to verify the data in the disk.



```
The disk must be formatted by exFAT-IP
Press 'y' to confirm format disk     =>y

Current time created : 24/09/2018, 17:35:00
Press 'y' to change time created     =>n

--- Enter FileSize ---
[0]:32   MB
[1]:128  MB
[2]:512  MB
[3]:2    GB
[4]:8    GB
[5]:32   GB
=>0
.
Format Disk complete...

File size in disk             : 33.554 [MB]
Maximum file in disk          : 7614 File
Maximum file per directory    : 1024 File
Total file in disk            : 0 File

--- Main menu [IPVer = 1.2] ---
[0] : Format Disk
[1] : Write File
[2] : Read File
```

a) 'Y' to confirm to format disk

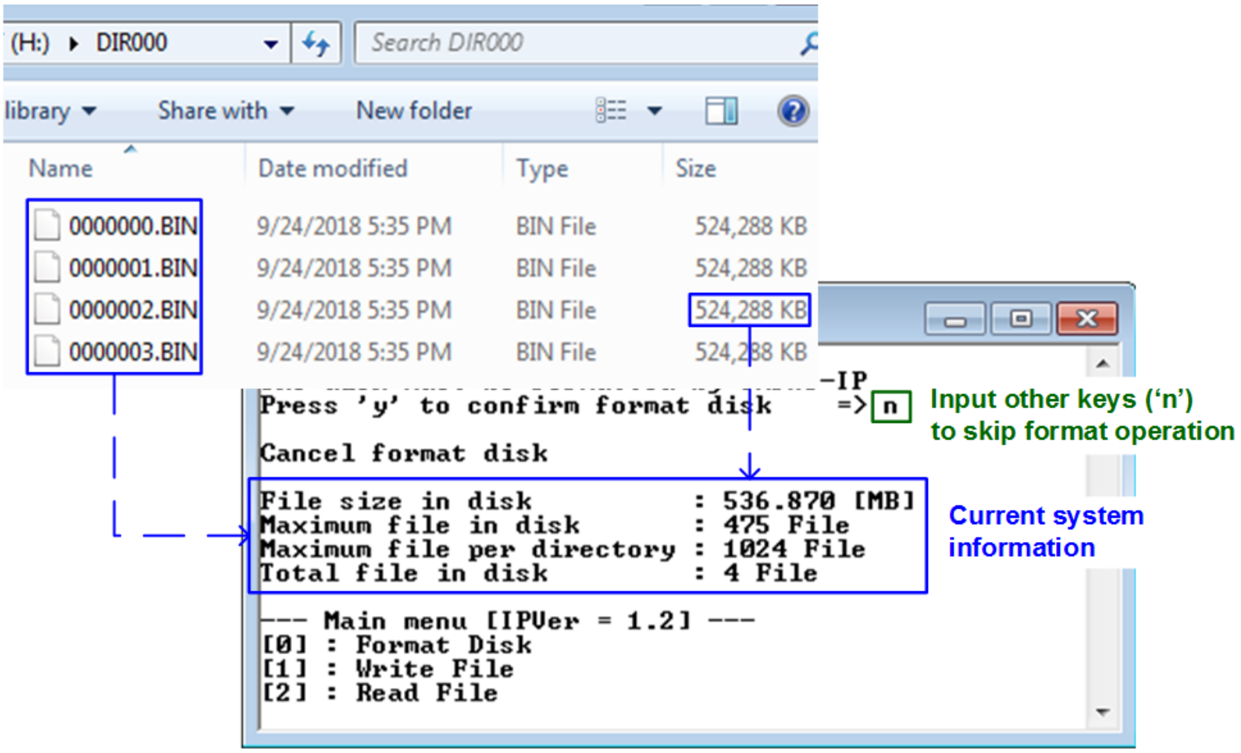
b) Input other keys ('n') to use default created time and date for new directory

c) Select file size = 32 MB

d) system information is updated

e) Main menu to select the command

Figure 2-7 Initialization with format operation



Name	Date modified	Type	Size
0000000.BIN	9/24/2018 5:35 PM	BIN File	524,288 KB
0000001.BIN	9/24/2018 5:35 PM	BIN File	524,288 KB
0000002.BIN	9/24/2018 5:35 PM	BIN File	524,288 KB
0000003.BIN	9/24/2018 5:35 PM	BIN File	524,288 KB

```
                                          -IP
Press 'y' to confirm format disk          => n

Cancel format disk

File size in disk             : 536.870 [MB]
Maximum file in disk          : 475 File
Maximum file per directory    : 1024 File
Total file in disk            : 4 File

--- Main menu [IPVer = 1.2] ---
[0] : Format Disk
[1] : Write File
[2] : Read File
```

Input other keys ('n') to skip format operation

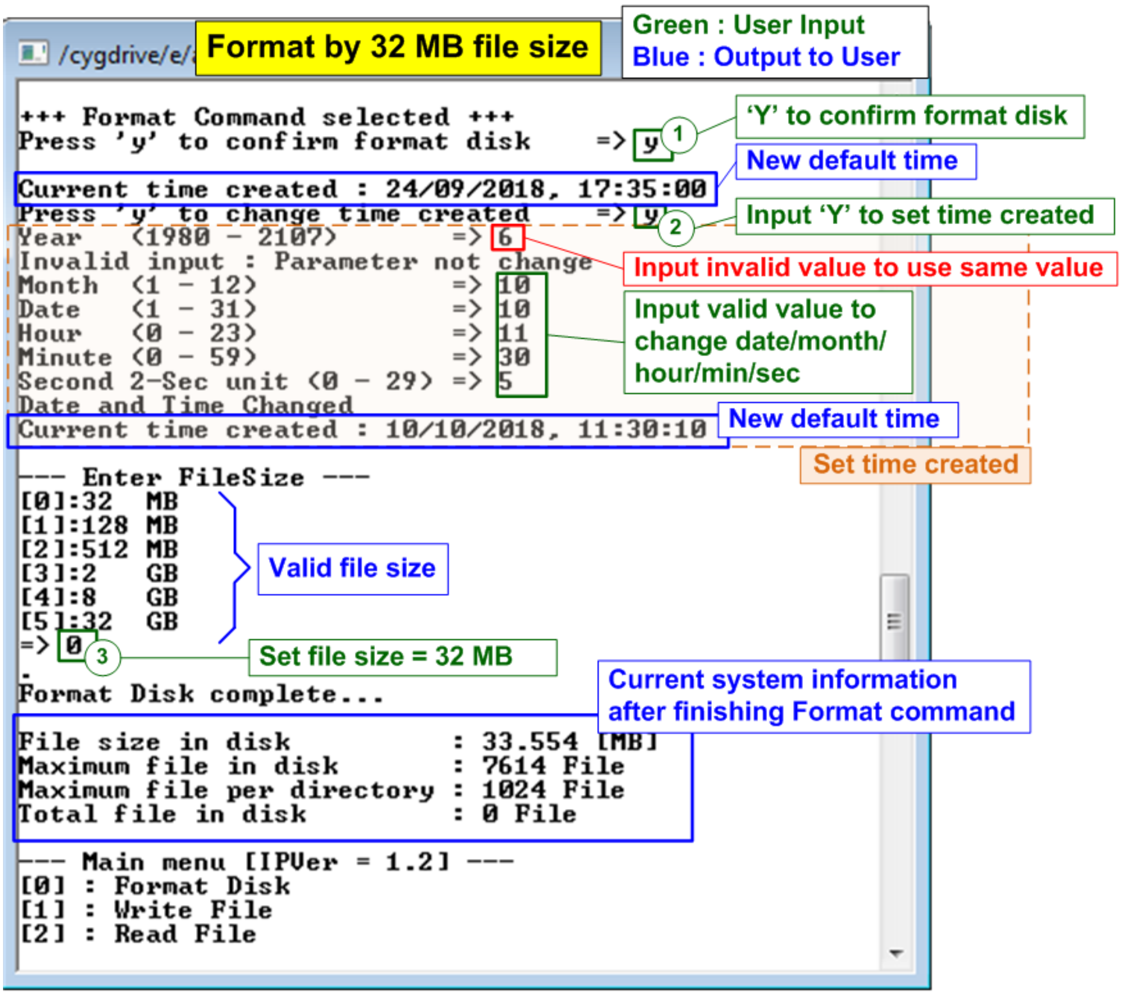
Current system information

Figure 2-8 Initialization without format operation

3 Test Menu

3.1 Format Disk

Select ‘0’ to send Format disk command to exFAT IP. The step to run Format command is as follows.



Format by 32 MB file size

Green : User Input
Blue : Output to User

```
+++ Format Command selected +++
Press 'y' to confirm format disk      => y
Current time created : 24/09/2018, 17:35:00
Press 'y' to change time created      => y
Year     (1980 - 2107)             => 6
Invalid input : Parameter not change
Month    (1 - 12)                  => 10
Date     (1 - 31)                  => 10
Hour     (0 - 23)                  => 11
Minute   (0 - 59)                  => 30
Second 2-Sec unit (0 - 29)         => 5
Date and Time Changed
Current time created : 10/10/2018, 11:30:10

--- Enter FileSize ---
[0]:32  MB
[1]:128 MB
[2]:512 MB
[3]:2   GB
[4]:8   GB
[5]:32  GB
=> 0
.
Format Disk complete...

File size in disk            : 33.554 [MB]
Maximum file in disk         : 7614 File
Maximum file per directory   : 1024 File
Total file in disk           : 0 File

--- Main menu [IPVer = 1.2] ---
[0] : Format Disk
[1] : Write File
[2] : Read File
```

1 ‘Y’ to confirm format disk

New default time

2 Input ‘Y’ to set time created

Input invalid value to use same value

Input valid value to change date/month/ hour/min/sec

New default time

Set time created

Valid file size

3 Set file size = 32 MB

Current system information after finishing Format command

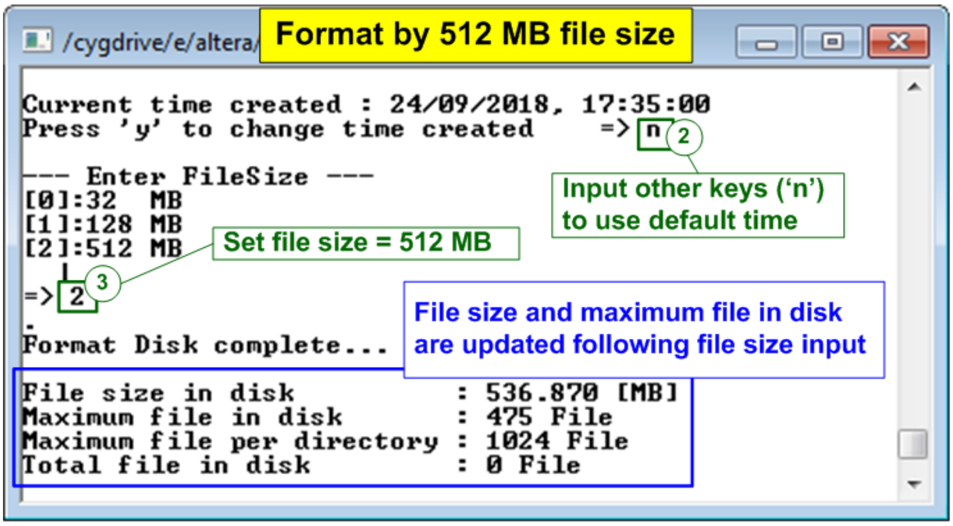
Figure 3-1 Format Disk menu when updating the created time

1) Input ‘y’ to confirm Format operation or input other keys to cancel the operation. When Format is run, the default value of created date and time will be displayed. This value is applied to be created date and time of empty directories.

2) Input ‘y’ to change created date and time or input other keys to use the default value. There are six parameters to set created date and time for empty directories, i.e.
   a) Year –Year of created date. Valid range is 1980 – 2107.
   b) Month – Month of created date. Valid range is 1 – 12.
   c) Date – Date of created date. Valid range is 1 – 31.
   d) Hour –Hour of created time. Valid range is 0 – 23.
   e) Minute – Minute of created time. Valid range is 0 – 59.
   f) Second – x2 second of created time. Valid range is 0 – 29.

The input is received as decimal unit. User adds “0x” to be a prefix when the input is hexadecimal unit. If the input is invalid, the parameter will not change by using old value. Only the parameter which is in the valid range is updated. Otherwise, the old value is applied.

As shown in Figure 3-1, year parameter is invalid, so the old value (2018) is applied. Month, date, hour, minute, and second are valid, so these parameters are applied to be the new default value. After that, “Date and Time changed” and the new created time and date are displayed on the console.



Format by 512 MB file size

```
Current time created : 24/09/2018, 17:35:00
Press 'y' to change time created     => n

--- Enter FileSize ---
[0]:32  MB
[1]:128 MB
[2]:512 MB

=> 2
.
Format Disk complete...

File size in disk          : 536.870 [MB]
Maximum file in disk       : 475 File
Maximum file per directory : 1024 File
Total file in disk         : 0 File
```

Input other keys (‘n’) to use default time

Set file size = 512 MB

File size and maximum file in disk are updated following file size input

Figure 3-2 Format Disk menu when using the default created time

Figure 3-2 shows the example when running Format command without updating created time.

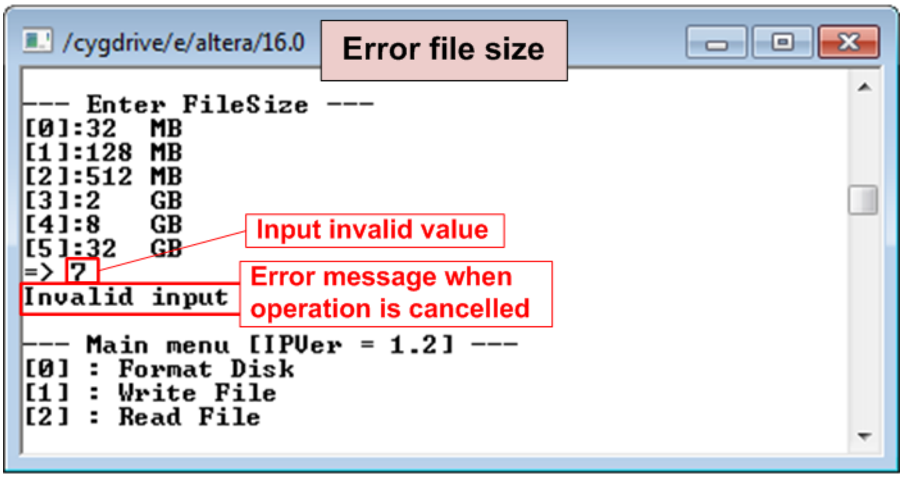
3) Input file size of the disk. The console lists the valid file size of the disk. After receiving file size from user, the IP starts Format operation.

“Format Disk complete” and the updated system information are displayed after finishing Format command.

Figure 3-1 and Figure 3-2 sets the different file size based on the same disk capacity. Maximum file in the disk is reduced when file size is increased.

If file size is invalid, the operation will be cancelled, as shown in Figure 3-3

Note: Default created time after system boot up is 24 Sep 2018, 17:35:00. When user sets the new created time in Format menu or Write file menu, the new value is applied to be the new default value.

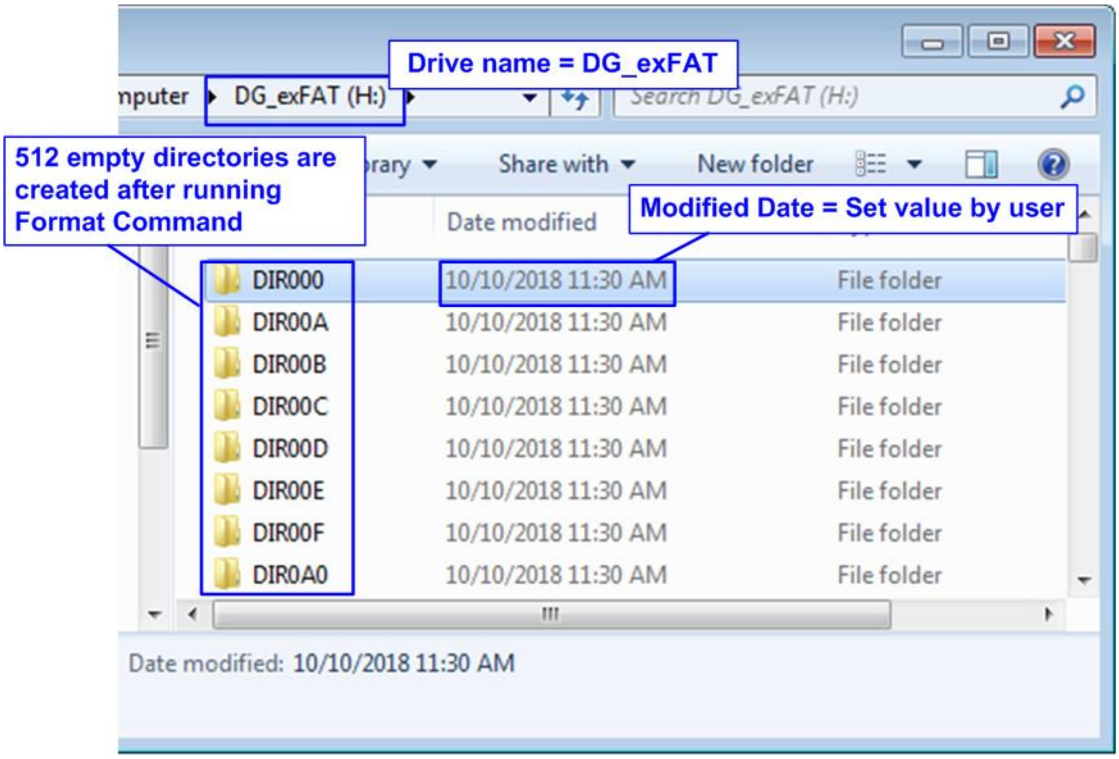


```
--- Enter FileSize ---
[0]:32  MB
[1]:128 MB
[2]:512 MB
[3]:2   GB
[4]:8   GB
[5]:32  GB
=> 7
Invalid input

--- Main menu [IPVer = 1.2] ---
[0] : Format Disk
[1] : Write File
[2] : Read File
```

Figure 3-3 Result from Format Disk menu when file size is invalid

When the disk formatted by exFAT IP is connected to PC, DG_exFAT drive is detected with 512 empty directories (DIR000<1st directory> - DIR1FF<512th directory>). Modified date of the empty directories is equal to the created date setting in the test.

Note: When connecting disk to PC, please do not create, write, or modify data in the disk. If the disk has some modification, the disk must be formatted by exFAT IP.



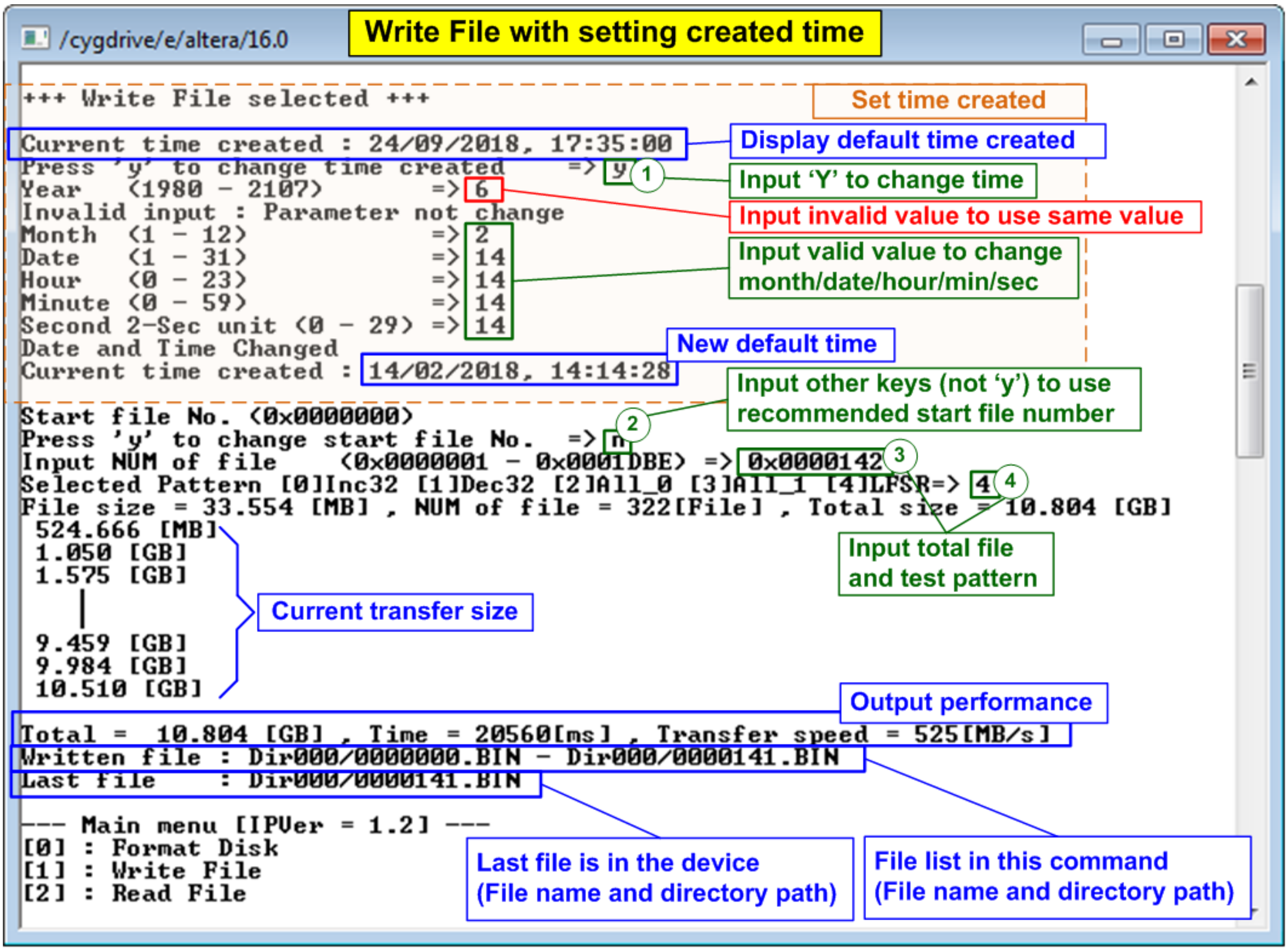
DIR000	10/10/2018 11:30 AM	File folder
DIR00A	10/10/2018 11:30 AM	File folder
DIR00B	10/10/2018 11:30 AM	File folder
DIR00C	10/10/2018 11:30 AM	File folder
DIR00D	10/10/2018 11:30 AM	File folder
DIR00E	10/10/2018 11:30 AM	File folder
DIR00F	10/10/2018 11:30 AM	File folder
DIR0A0	10/10/2018 11:30 AM	File folder

Date modified: 10/10/2018 11:30 AM

Figure 3-4 512 Empty directories after Format Disk command completes

3.2 Write File

Select ‘1’ to send Write file command to exFAT IP. The step to run Write file command is as follows.



Write File with setting created time

```
+++ Write File selected +++

Current time created : 24/09/2018, 17:35:00
Press 'y' to change time created        => y
Year    (1980 - 2107)                   => 6
Invalid input : Parameter not change
Month   (1 - 12)                        => 2
Date    (1 - 31)                        => 14
Hour    (0 - 23)                        => 14
Minute  (0 - 59)                        => 14
Second 2-Sec unit (0 - 29)              => 14
Date and Time Changed
Current time created : 14/02/2018, 14:14:28

Start file No. (0x0000000)
Press 'y' to change start file No.      => n
Input NUM of file     (0x0000001 - 0x0001DBE) => 0x0000142
Selected Pattern [0]Inc32 [1]Dec32 [2]All_0 [3]All_1 [4]LFSR=> 4
File size = 33.554 [MB] , NUM of file = 322[File] , Total size = 10.804 [GB]
 524.666 [MB]
 1.050 [GB]
 1.575 [GB]
   |
 9.459 [GB]
 9.984 [GB]
 10.510 [GB]

Total =  10.804 [GB] , Time = 20560[ms] , Transfer speed = 525[MB/s]
Written file : Dir000/0000000.BIN - Dir000/0000141.BIN
Last file    : Dir000/0000141.BIN

--- Main menu [IPVer = 1.2] ---
[0] : Format Disk
[1] : Write File
[2] : Read File
```

Set time created

Display default time created

Input ‘Y’ to change time

Input invalid value to use same value

Input valid value to change month/date/hour/min/sec

New default time

Input other keys (not ‘y’) to use recommended start file number

Input total file and test pattern

Current transfer size

Output performance

Last file is in the device (File name and directory path)

File list in this command (File name and directory path)

Figure 3-5 Result from Write File menu with setting time created

1) Similar to Format command, input 'y' to change created date and time or input other keys to use the default value. There are six parameters to set created date and time for the new file, i.e.
   a) Year –Year of created date. Valid range is 1980 – 2107.
   b) Month – Month of created date. Valid range is 1 – 12.
   c) Date – Date of created date. Valid range is 1 – 31.
   d) Hour –Hour of created time. Valid range is 0 – 23.
   e) Minute – Minute of created time. Valid range is 0 – 59.
   f) Second – x2 Second of created time. Valid range is 0 – 29.

   The input is received as decimal unit. User adds "0x" to be a prefix when the input is hexadecimal unit. If the input is invalid, the parameter will not change by using old value. Only the parameter which is in the valid range is updated. Otherwise, the old value is applied.

   As shown in Figure 3-5, year parameter is invalid, so the old value (2018) is applied. Month, date, hour, minute, and second are valid, so these parameters are applied to be the new default value. After that, "Date and Time changed" and the new created time and date are displayed on the console.

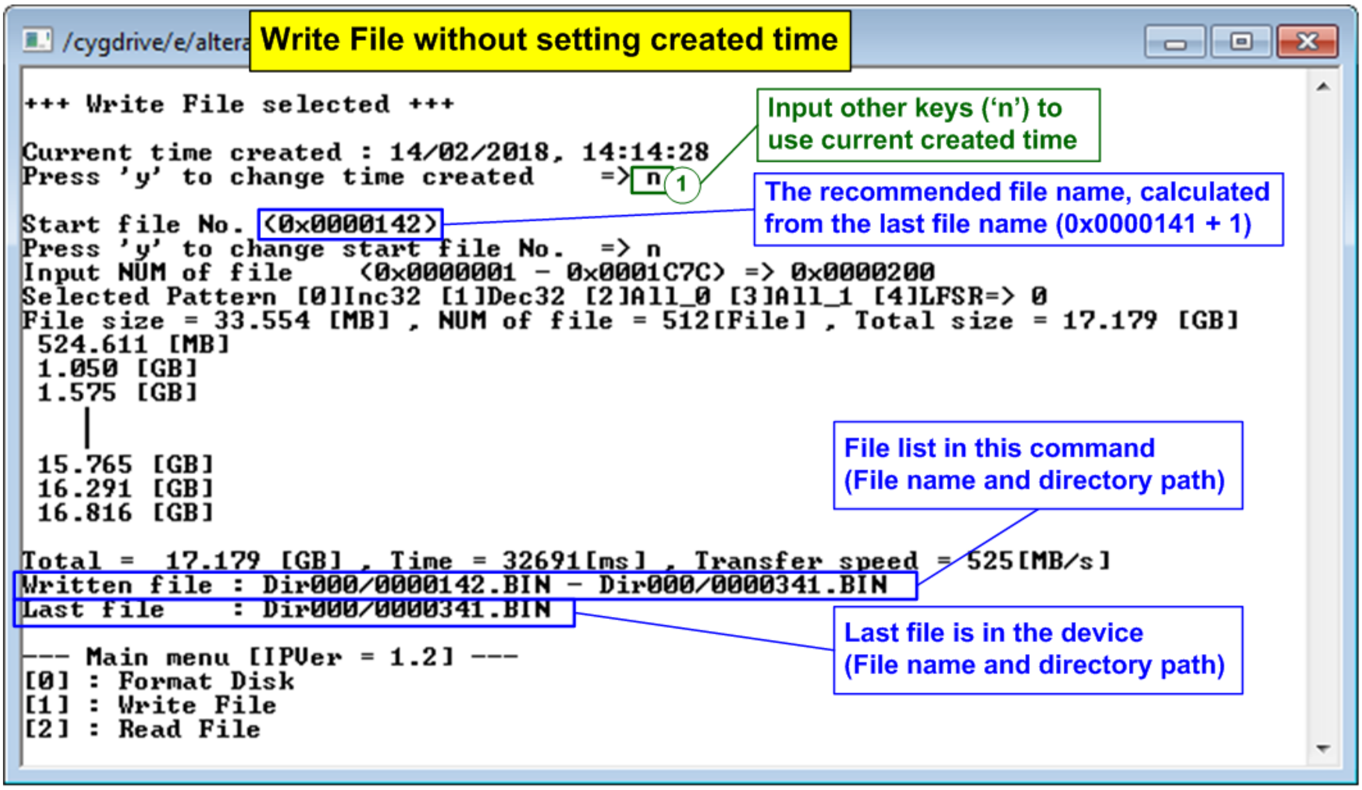
2) Input other keys (not 'y') to use the recommended start file no. The console displays the recommended value which is the next value from the latest write file.
   Note: Input 'y' to change start file no. is applied to replace the old file. After running, the data in the old file is replaced by the new write file command.

3) Input NUM of file – Input total files to transfer in this command. After complete write file operation, Filename <Start file No>.BIN - Filename <Start file No + NUM of file - 1>.BIN are stored in the device. The input is decimal unit when input only digit number. User can add "0x" to be prefix when the input is hexadecimal unit.

4) Input test pattern – Select pattern of test data in the file. Five patterns can be set, i.e. 32 bit increment, 32 bit decrement, all 0, all 1, and 32 bit LFSR counter.

If all inputs are valid, total data size (calculated by file size x Num of file) will be displayed on the console. Next, Write file command is operated. During writing file, 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.

One directory limits the number of files to store, so the new files may store in the different directory. After finishing Write file command, the console lists the file which has just written on the console with the directory path (calculated by <file name>/<maximum files per directory>). Finally, the console displays the last available file in the disk.



Write File without setting created time

```
+++ Write File selected +++

Current time created : 14/02/2018, 14:14:28
Press 'y' to change time created     => n

Start file No. (0x0000142)
Press 'y' to change start file No.   => n
Input NUM of file    (0x0000001 - 0x0001C7C) => 0x0000200
Selected Pattern [0]Inc32 [1]Dec32 [2]All_0 [3]All_1 [4]LFSR=> 0
File size = 33.554 [MB] , NUM of file = 512[File] , Total size = 17.179 [GB]
 524.611 [MB]
 1.050 [GB]
 1.575 [GB]

 15.765 [GB]
 16.291 [GB]
 16.816 [GB]

Total =  17.179 [GB] , Time = 32691[ms] , Transfer speed = 525[MB/s]
Written file : Dir000/0000142.BIN - Dir000/0000341.BIN
Last file    : Dir000/0000341.BIN

--- Main menu [IPVer = 1.2] ---
[0] : Format Disk
[1] : Write File
[2] : Read File
```

Input other keys ('n') to use current created time

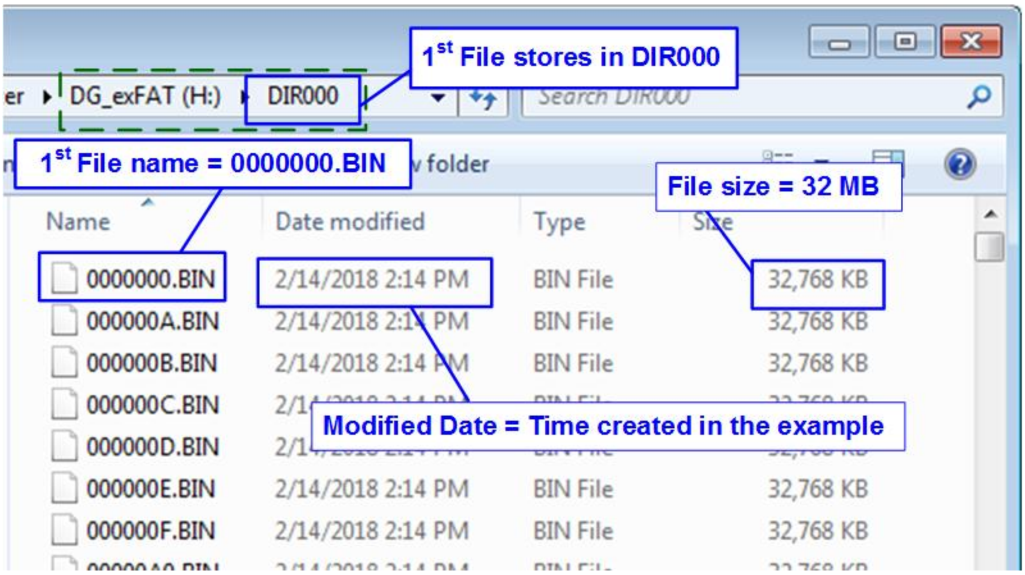
The recommended file name, calculated from the last file name (0x0000141 + 1)

File list in this command (File name and directory path)

Last file is in the device (File name and directory path)

Figure 3-6 Result from Write File by using current created time

Figure 3-6 shows the example to Write File by using current created time. "Start file No" of this test is updated from the previous write test. The previous write test in Figure 3-5 writes file "0000000.BIN" – "0000141.BIN", so the recommended "Start file No" is 0x0000142 (0x0000141 + 1). After finishing the operation, 512 new files (0x0000142.BIN – 0x0000341.BIN) are created. Now the last file in the disk is updated to be 0x0000341.BIN.

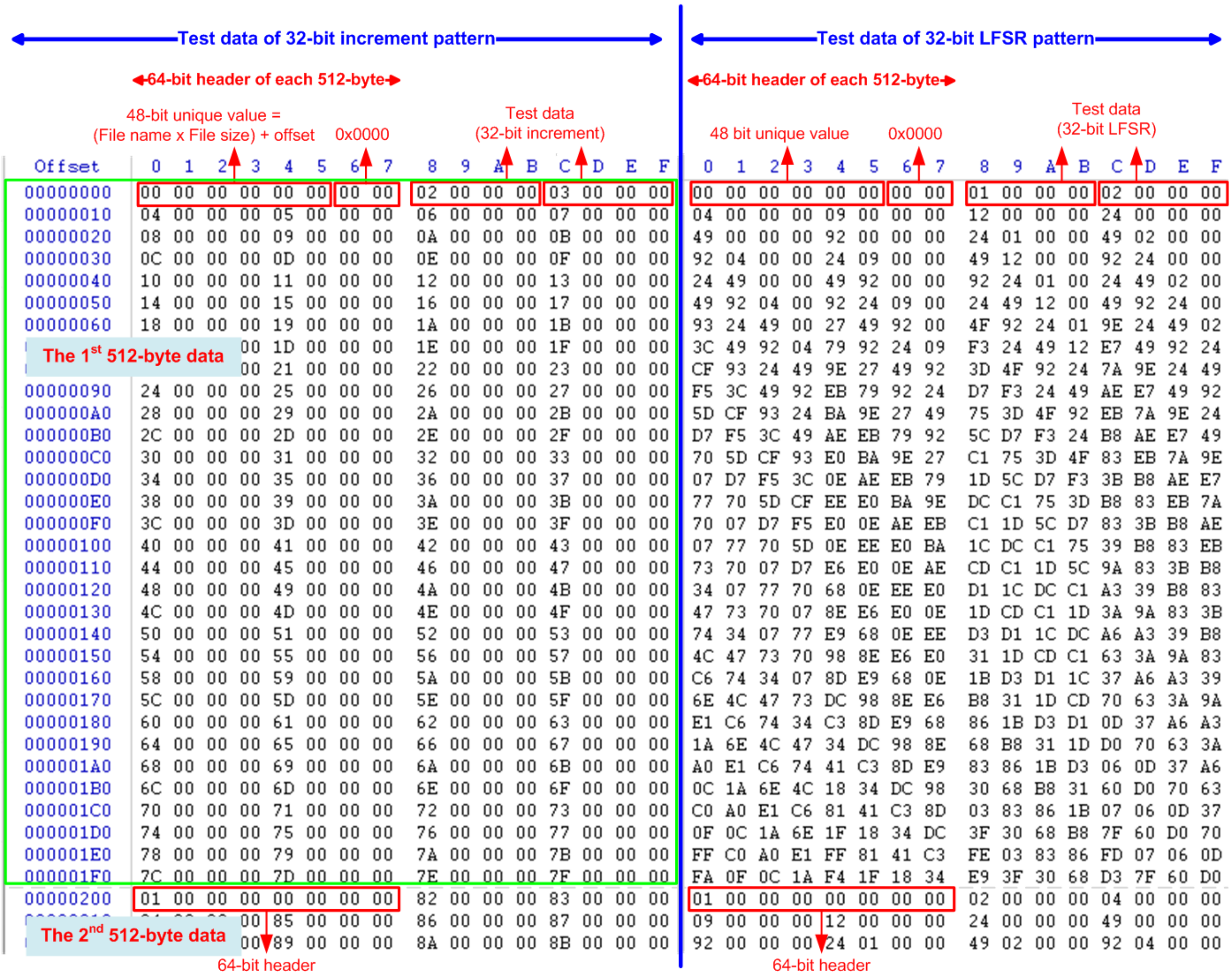

er ▸ DG_exFAT (H:) ▸ DIR000
Search DIR000
folder
1st File stores in DIR000
1st File name = 0000000.BIN
File size = 32 MB
Modified Date = Time created in the example

Name	Date modified	Type	Size
0000000.BIN	2/14/2018 2:14 PM	BIN File	32,768 KB
000000A.BIN	2/14/2018 2:14 PM	BIN File	32,768 KB
000000B.BIN	2/14/2018 2:14 PM	BIN File	32,768 KB
000000C.BIN	[illegible]	[illegible]	[illegible]
000000D.BIN	[illegible]	[illegible]	[illegible]
000000E.BIN	2/14/2018 2:14 PM	BIN File	32,768 KB
000000F.BIN	2/14/2018 2:14 PM	BIN File	32,768 KB

Figure 3-7 Example test files written by Write File command

When plug the device to PC, the new files are found in the directory. The 1st file in the disk is 0000000.BIN (stored in DIR000). File size and modified date of the new file are equal to the created date and created time setting in Write File test.

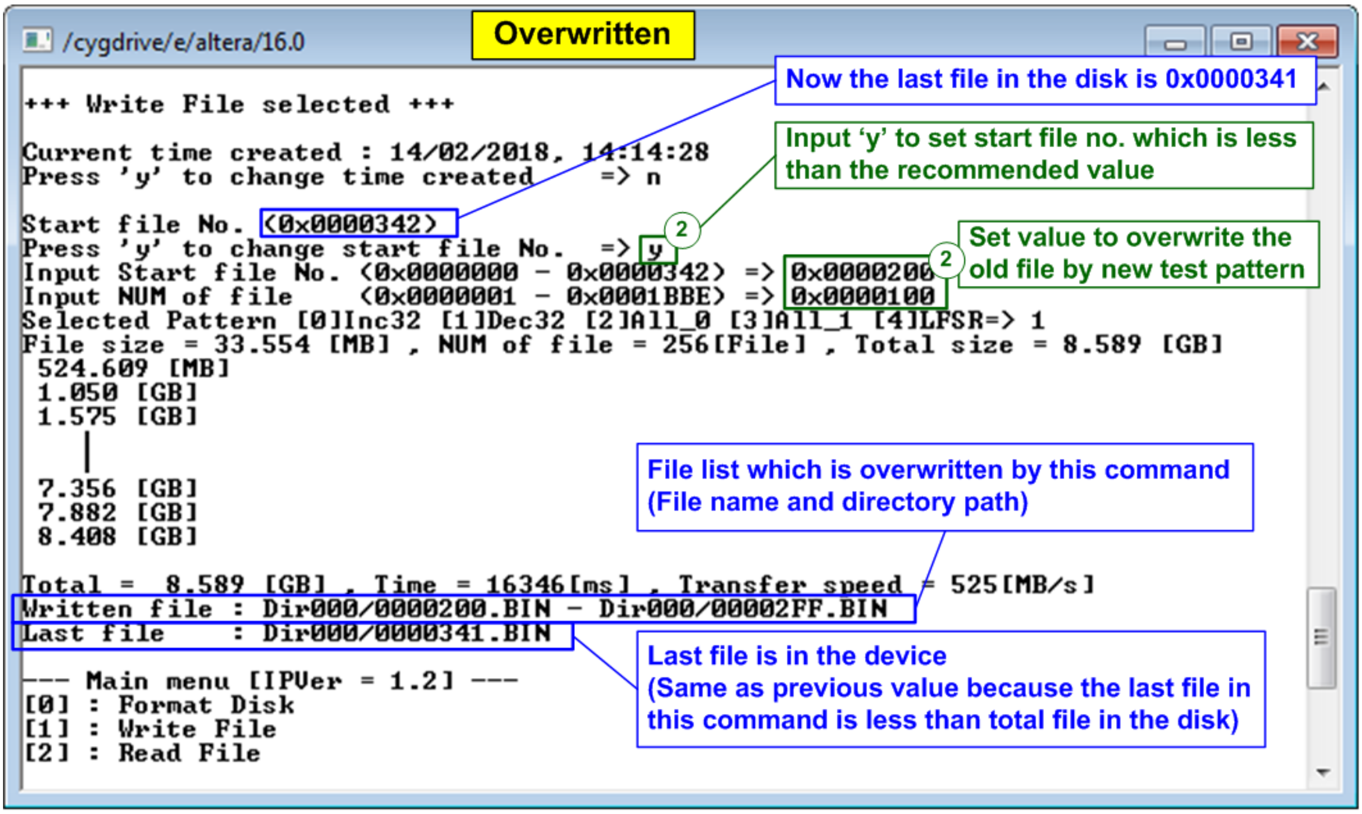
Note: When connecting disk to PC, please do not create, write, or modify data in the disk. If the disk has some modification, the disk must be formatted by exFAT IP.



```
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
                     00 1D 00 00 00  1E 00 00 00 1F 00 00 00   3C 49 92 04 79 92 24 09  F3 24 49 12 E7 49 92 24
                     00 21 00 00 00  22 00 00 00 23 00 00 00   CF 93 24 49 9E 27 49 92  3D 4F 92 24 7A 9E 24 49
00000090  24 00 00 00 25 00 00 00  26 00 00 00 27 00 00 00   F5 3C 49 92 EB 79 92 24  D7 F3 24 49 AE E7 49 92
000000A0  28 00 00 00 29 00 00 00  2A 00 00 00 2B 00 00 00   5D CF 93 24 BA 9E 27 49  75 3D 4F 92 EB 7A 9E 24
000000B0  2C 00 00 00 2D 00 00 00  2E 00 00 00 2F 00 00 00   D7 F5 3C 49 AE EB 79 92  5C D7 F3 24 B8 AE E7 49
000000C0  30 00 00 00 31 00 00 00  32 00 00 00 33 00 00 00   70 5D CF 93 E0 BA 9E 27  C1 75 3D 4F 83 EB 7A 9E
000000D0  34 00 00 00 35 00 00 00  36 00 00 00 37 00 00 00   07 D7 F5 3C 0E AE EB 79  1D 5C D7 F3 3B B8 AE E7
000000E0  38 00 00 00 39 00 00 00  3A 00 00 00 3B 00 00 00   77 70 5D CF EE E0 BA 9E  DC C1 75 3D B8 83 EB 7A
000000F0  3C 00 00 00 3D 00 00 00  3E 00 00 00 3F 00 00 00   70 07 D7 F5 E0 0E AE EB  C1 1D 5C D7 83 3B B8 AE
00000100  40 00 00 00 41 00 00 00  42 00 00 00 43 00 00 00   07 77 70 5D 0E EE E0 BA  1C DC C1 75 39 B8 83 EB
00000110  44 00 00 00 45 00 00 00  46 00 00 00 47 00 00 00   73 70 07 D7 E6 E0 0E AE  CD C1 1D 5C 9A 83 3B B8
00000120  48 00 00 00 49 00 00 00  4A 00 00 00 4B 00 00 00   34 07 77 70 68 0E EE E0  D1 1C DC C1 A3 39 B8 83
00000130  4C 00 00 00 4D 00 00 00  4E 00 00 00 4F 00 00 00   47 73 70 07 8E E6 E0 0E  1D CD C1 1D 3A 9A 83 3B
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 A3 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 3A 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 A6 A3 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 3A 9A
00000180  60 00 00 00 61 00 00 00  62 00 00 00 63 00 00 00   E1 C6 74 34 C3 8D E9 68  86 1B D3 D1 0D 37 A6 A3
00000190  64 00 00 00 65 00 00 00  66 00 00 00 67 00 00 00   1A 6E 4C 47 34 DC 98 8E  68 B8 31 1D D0 70 63 3A
000001A0  68 00 00 00 69 00 00 00  6A 00 00 00 6B 00 00 00   A0 E1 C6 74 41 C3 8D E9  83 86 1B D3 06 0D 37 A6
000001B0  6C 00 00 00 6D 00 00 00  6E 00 00 00 6F 00 00 00   0C 1A 6E 4C 18 34 DC 98  30 68 B8 31 60 D0 70 63
000001C0  70 00 00 00 71 00 00 00  72 00 00 00 73 00 00 00   C0 A0 E1 C6 81 41 C3 8D  03 83 86 1B 07 06 0D 37
000001D0  74 00 00 00 75 00 00 00  76 00 00 00 77 00 00 00   0F 0C 1A 6E 1F 18 34 DC  3F 30 68 B8 7F 60 D0 70
000001E0  78 00 00 00 79 00 00 00  7A 00 00 00 7B 00 00 00   FF C0 A0 E1 FF 81 41 C3  FE 03 83 86 FD 07 06 0D
000001F0  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
00000200  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
                     00 85 00 00 00  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  8A 00 00 00 8B 00 00 00   92 00 00 00 24 01 00 00  49 02 00 00 92 04 00 00
```

Figure 3-8 Test data in sector#0 - #1 of file “0000000.BIN” by increment/LFSR pattern

Test data is split into 512 byte unit. Each 512 byte data has the different 64 bit header which consists of 48 bit address (calculated by <file name x file size> + offset in the file) and 16 bit zero value. 48 bit address is the unique value for each 512 byte data. The data after 64 bit header is the test pattern which is selected by user. The example data in file “0000000.BIN” when writing data by increment pattern is in the left window of Figure 3-8. The right window of Figure 3-8 shows the example when test pattern is LFSR pattern. The header is same for every test pattern, but the test data (starting from byte#8) depends on the test pattern.



```
+++ Write File selected +++

Current time created : 14/02/2018, 14:14:28
Press 'y' to change time created      => n

Start file No. (0x0000342)
Press 'y' to change start file No.    => y
Input Start file No. (0x0000000 - 0x0000342) => 0x0000200
Input NUM of file    (0x0000001 - 0x0001BBE) => 0x0000100
Selected Pattern [0]Inc32 [1]Dec32 [2]All_0 [3]All_1 [4]LFSR=> 1
File size = 33.554 [MB] , NUM of file = 256[File] , Total size = 8.589 [GB]
 524.609 [MB]
 1.050 [GB]
 1.575 [GB]
   |
 7.356 [GB]
 7.882 [GB]
 8.408 [GB]

Total =  8.589 [GB] , Time = 16346[ms] , Transfer speed = 525[MB/s]
Written file : Dir000/0000200.BIN - Dir000/00002FF.BIN
Last file    : Dir000/0000341.BIN

--- Main menu [IPVer = 1.2] ---
[0] : Format Disk
[1] : Write File
[2] : Read File
```

Now the last file in the disk is 0x0000341

Input 'y' to set start file no. which is less than the recommended value

Set value to overwrite the old file by new test pattern

File list which is overwritten by this command (File name and directory path)

Last file is in the device (Same as previous value because the last file in this command is less than total file in the disk)

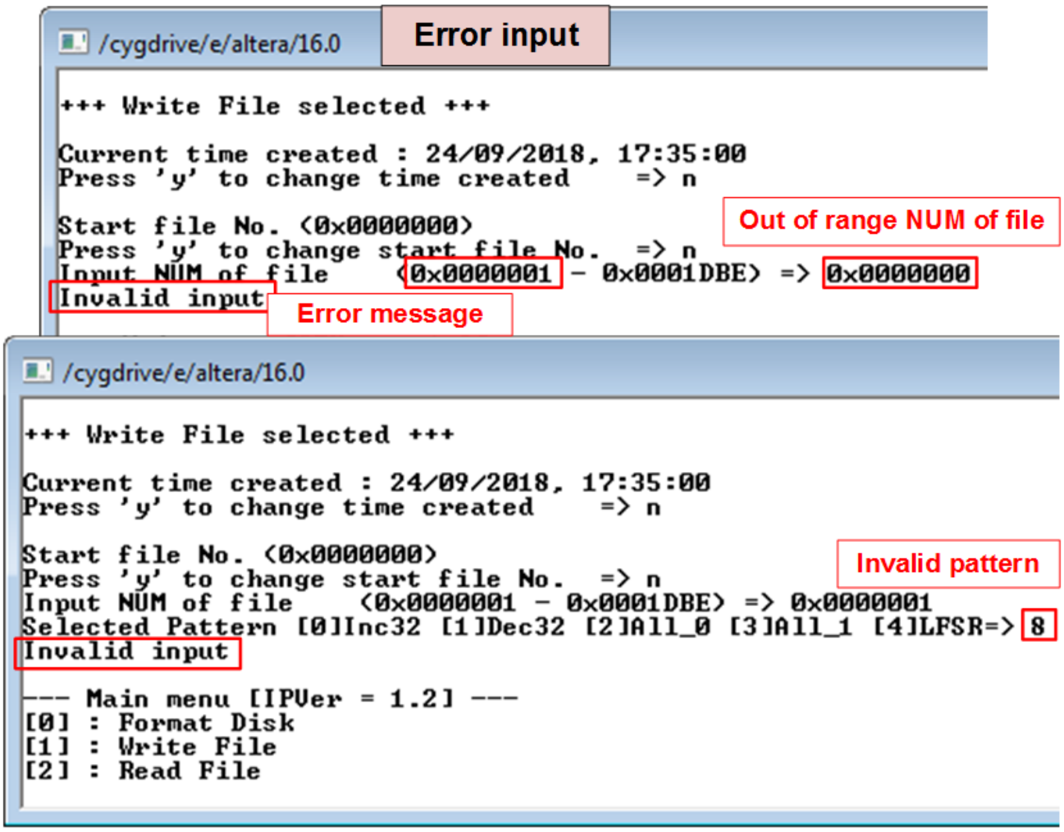
Figure 3-9 Set new start file no.

Figure 3-9 shows the example of the overwritten case by setting Start file No. to be less than the default value. The last file in the disk is 0x0000341, but the new command is sent to write 0x0000200.BIN – 0x00002FF.BIN by using decrement pattern (In Figure 3-6, 0x0000142.BIN – 0x0000341.BIN are created by using increment pattern).

After finishing the operation, the data in 0x0000200.BIN – 0x00002FF.BIN is replaced by the decrement pattern. Because the last file in the new command (0x00002FF.BIN) is less than the last file which is available in the device (0x0000341.BIN), the last file is not updated.

When the last file in the new write file command is more than the previous value, the last file will be updated by the new value.

Figure 3-10 shows the example of error messages when the input is less than or more than the recommended range for each parameter. “Invalid input” message is displayed on the console and then returns to main menu.



Error input

```
+++ Write File selected +++

Current time created : 24/09/2018, 17:35:00
Press 'y' to change time created    => n

Start file No. (0x0000000)
Press 'y' to change start file No.  => n
Input NUM of file     (0x0000001 - 0x0001DBE) => 0x0000000
Invalid input
```

Out of range NUM of file

Error message

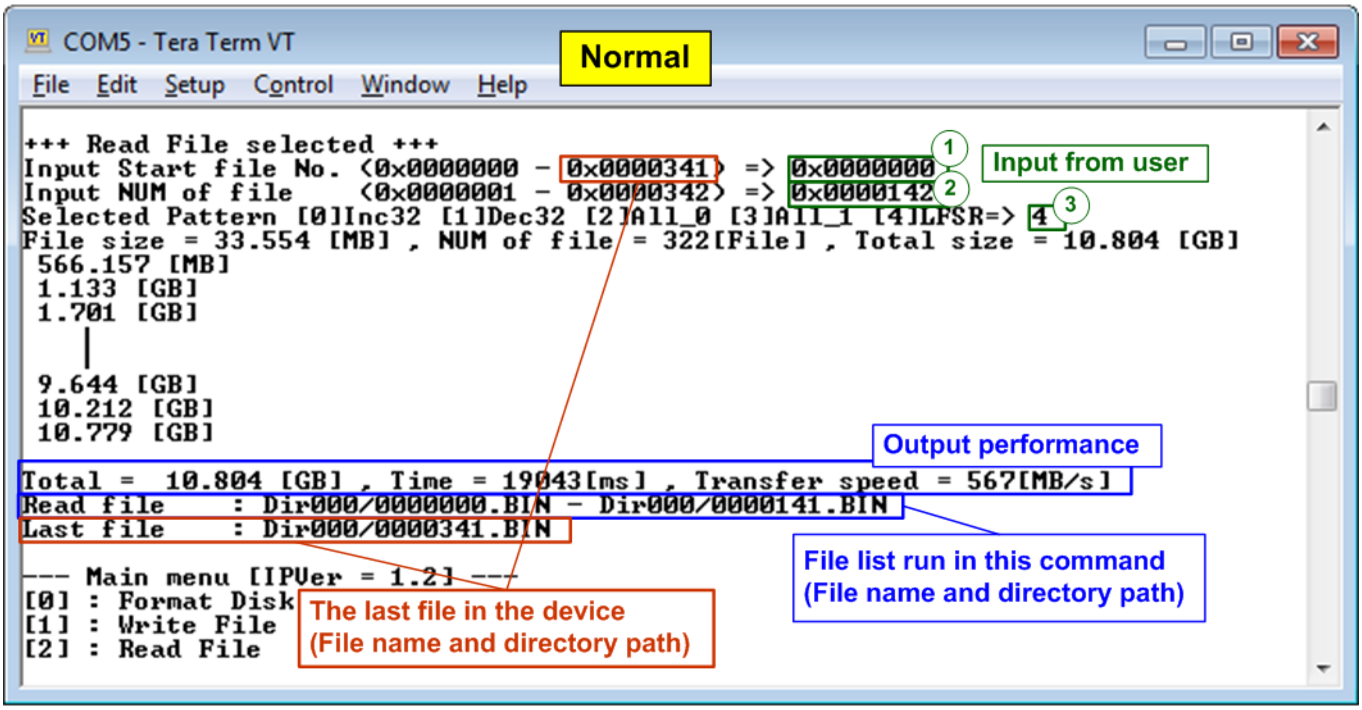
```
+++ Write File selected +++

Current time created : 24/09/2018, 17:35:00
Press 'y' to change time created    => n

Start file No. (0x0000000)
Press 'y' to change start file No.  => n
Input NUM of file     (0x0000001 - 0x0001DBE) => 0x0000001
Selected Pattern [0]Inc32 [1]Dec32 [2]All_0 [3]All_1 [4]LFSR=> 8
Invalid input

--- Main menu [IPVer = 1.2] ---
[0] : Format Disk
[1] : Write File
[2] : Read File
```

Invalid pattern

Figure 3-10 Error message from the invalid input

3.3 Read File

Select ‘2’ to send Read file command to exFAT IP. The step to run Read File command is as follows.



COM5 - Tera Term VT
File Edit Setup Control Window Help
Normal
1
2
3
Input from user
Output performance
File list run in this command
(File name and directory path)
The last file in the device
(File name and directory path)

```
+++ Read File selected +++
Input Start file No. <0x0000000 - 0x0000341> => 0x0000000
Input NUM of file    <0x0000001 - 0x0000342> => 0x0000142
Selected Pattern [0]Inc32 [1]Dec32 [2]All_0 [3]All_1 [4]LFSR=> 4
File size = 33.554 [MB] , NUM of file = 322[File] , Total size = 10.804 [GB]
 566.157 [MB]
 1.133 [GB]
 1.701 [GB]
   |

 9.644 [GB]
 10.212 [GB]
 10.779 [GB]

Total =  10.804 [GB] , Time = 19043[ms] , Transfer speed = 567[MB/s]
Read file     : Dir000/0000000.BIN - Dir000/0000141.BIN
Last file     : Dir000/0000341.BIN

--- Main menu [IPVer = 1.2] ---
[0] : Format Disk
[1] : Write File
[2] : Read File
```

Figure 3-11 Read File menu when verification is successful

1) Input Start file No – Input the 1st file name to read. The input is decimal unit when input only digit number. User can add “0x” to be prefix when the input is hexadecimal unit. The maximum value is equal to <total file in the disk – 1>.

2) Input NUM of file – Input total files to transfer in this command. The input is decimal unit when input only digit number. User can add “0x” to be prefix when the input is hexadecimal unit. The maximum value is equal to <total file in the disk – Start file No. input>.

3) Input test pattern – Select pattern to verify data in the file. Test pattern must be matched with the test pattern using in Write File menu. Five patterns can be set, i.e. 32 bit increment, 32 bit decrement, all 0, all 1, and 32 bit LFSR counter.

If “Start file No.”, “NUM of file”, and “Select pattern” are valid, total data size (calculated by File size x NUM of file) will be displayed on the console. Read file command is run.

During reading file, 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.

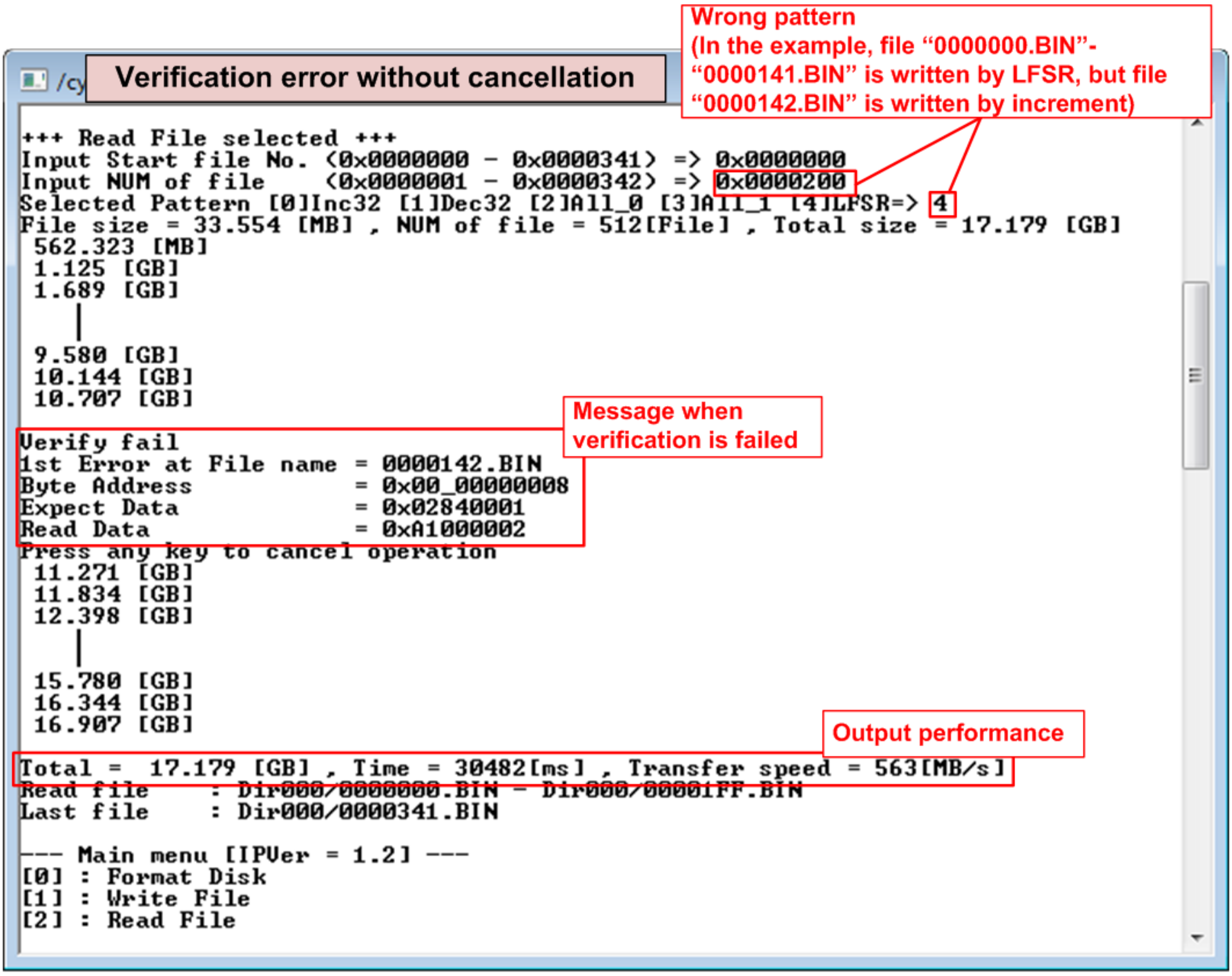
When input is out-of-range, “Invalid input” is displayed with operation cancelled.

Similar to write file menu, the console lists all read files of the latest command and shows the last available file in the disk. The last file in the disk is not updated by Read file menu. The value is still same as the upper range to input Start File No. of Read file command.

Figure 3-12 and Figure 3-13 show the example of error message when data verification is failed. “Verify fail” is displayed with the first file name which has error, the error address of a file, the expected data, and the read data. User presses any key to cancel read operation or waits until the read process is completed.

If the user waits until read command completing, the output performance from the read process will be displayed. The user can continue to run the system test if the error is caused from wrong test pattern input.

If the user cancels the read operation, the command will not complete in the good sequence. It is recommended to power-off/on SATA device and press “RESET” button to restart system.



Verification error without cancellation

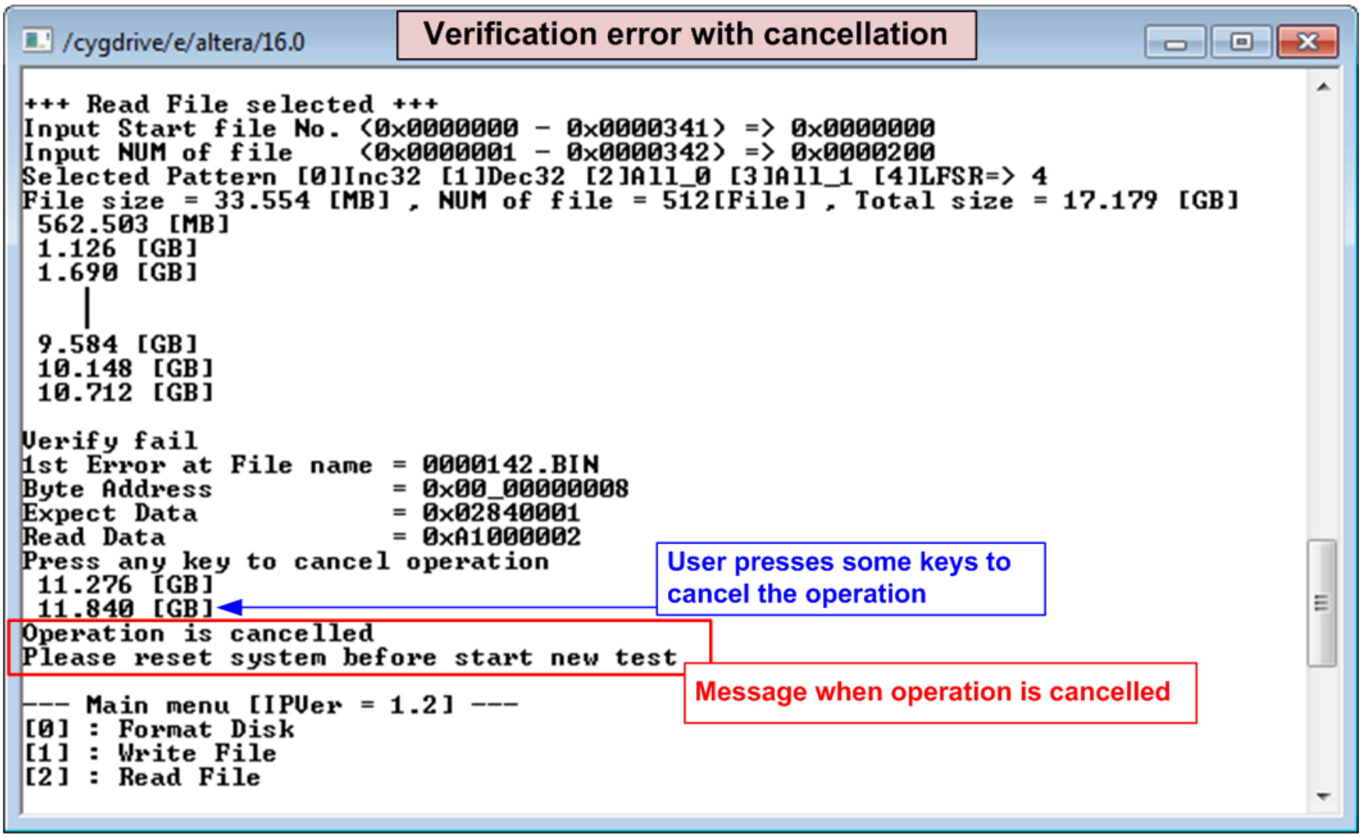
Wrong pattern
(In the example, file “0000000.BIN”-“0000141.BIN” is written by LFSR, but file “0000142.BIN” is written by increment)

```
+++ Read File selected +++
Input Start file No. (0x0000000 - 0x0000341) => 0x0000000
Input NUM of file     (0x0000001 - 0x0000342) => 0x0000200
Selected Pattern [0]Inc32 [1]Dec32 [2]All_0 [3]All_1 [4]LFSR=> 4
File size = 33.554 [MB] , NUM of file = 512[File] , Total size = 17.179 [GB]
 562.323 [MB]
 1.125 [GB]
 1.689 [GB]
   |
 9.580 [GB]
 10.144 [GB]
 10.707 [GB]

Verify fail
1st Error at File name  = 0000142.BIN
Byte Address            = 0x00_00000008
Expect Data             = 0x02840001
Read Data               = 0xA1000002
Press any key to cancel operation
 11.271 [GB]
 11.834 [GB]
 12.398 [GB]
   |
 15.780 [GB]
 16.344 [GB]
 16.907 [GB]

Total =  17.179 [GB] , Time = 30482[ms] , Transfer speed = 563[MB/s]
Read file      : Dir000/0000000.BIN - Dir000/000001FF.BIN
Last file      : Dir000/0000341.BIN

--- Main menu [IPVer = 1.2] ---
[0] : Format Disk
[1] : Write File
[2] : Read File
```

Message when verification is failed

Output performance

Figure 3-12 Data verification is failed but wait until read complete



Verification error with cancellation

```
+++ Read File selected +++
Input Start file No. (0x0000000 - 0x0000341) => 0x0000000
Input NUM of file     (0x0000001 - 0x0000342) => 0x0000200
Selected Pattern [0]Inc32 [1]Dec32 [2]All_0 [3]All_1 [4]LFSR=> 4
File size = 33.554 [MB] , NUM of file = 512[File] , Total size = 17.179 [GB]
 562.503 [MB]
 1.126 [GB]
 1.690 [GB]
    |

 9.584 [GB]
 10.148 [GB]
 10.712 [GB]

Verify fail
1st Error at File name = 0000142.BIN
Byte Address           = 0x00_00000008
Expect Data            = 0x02840001
Read Data              = 0xA1000002
Press any key to cancel operation
 11.276 [GB]
 11.840 [GB]
Operation is cancelled
Please reset system before start new test

--- Main menu [IPVer = 1.2] ---
[0] : Format Disk
[1] : Write File
[2] : Read File
```

User presses some keys to cancel the operation

Message when operation is cancelled

Figure 3-13 Data verification is failed and press any key to cancel operation

4 Revision History

Revision	Date	Description
1.0	29-Nov-18	Initial version release
1.1	20-Mar-19	Add file size and total file information
1.2	15-May-19	Correct directory name and update overwritten feature