SATA-IP exFAT Demo on ArriaV GX Starter Instruction

Rev1.0 5-Sep-13

This document describes the instruction to run SATA-IP exFAT demo on ArriaV GX Starter board with SATA3 device.

1 Environment Setup

To run host demo, HSMC SATA board is required to connect ArriaV GX Starter board with SATA-III HDD/SSD, as shown in Figure 1-1.

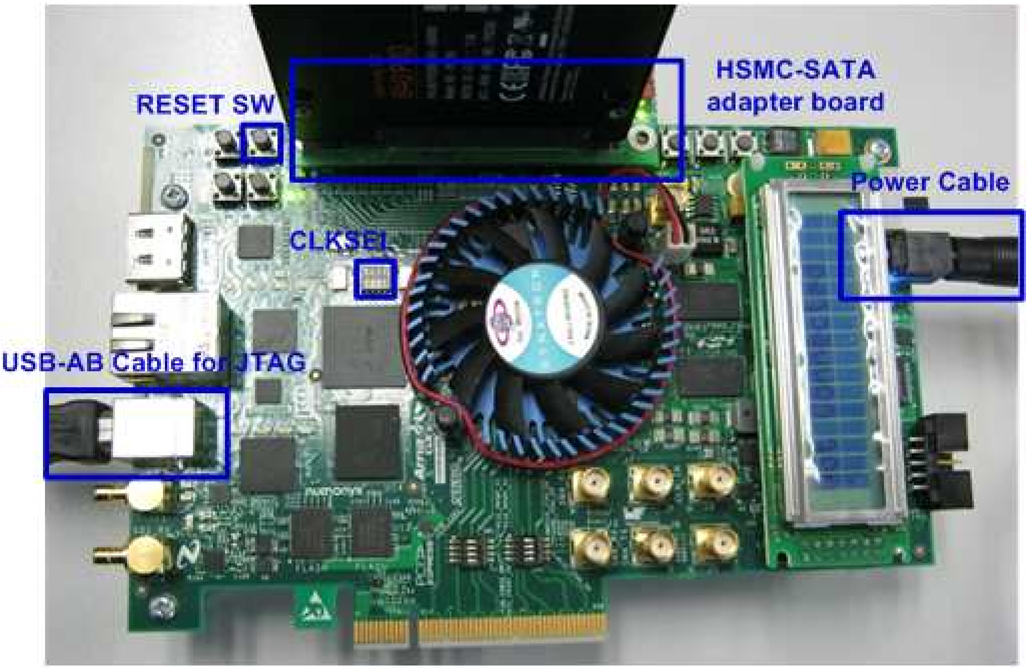

RESET SW
HSMC-SATA adapter board
Power Cable
CLKSEL
USB-AB Cable for JTAG

Figure 1-1 SATA-IP Demo Environment Setup

Following step is setup procedure for running demo.

- Insert SATA-III HDD/SSD to SATA socket on HSMC SATA board.
- Connect HSMC SATA board to HSMC connector on ArriaV GX Starter board
- Connect USB A-B cable from ArriaV GX board to PC and connect power supply to ArriaV GX board.
- Set Bit1 of SW4 = OFF to select clock input fed from programmable oscillator, as shown in Figure 1-2.

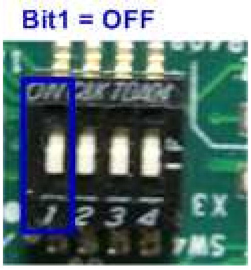


Figure 1-2 Set SW to select clock input

- Power on ArriaV GX board and power-on power switch on HSMC SATA board

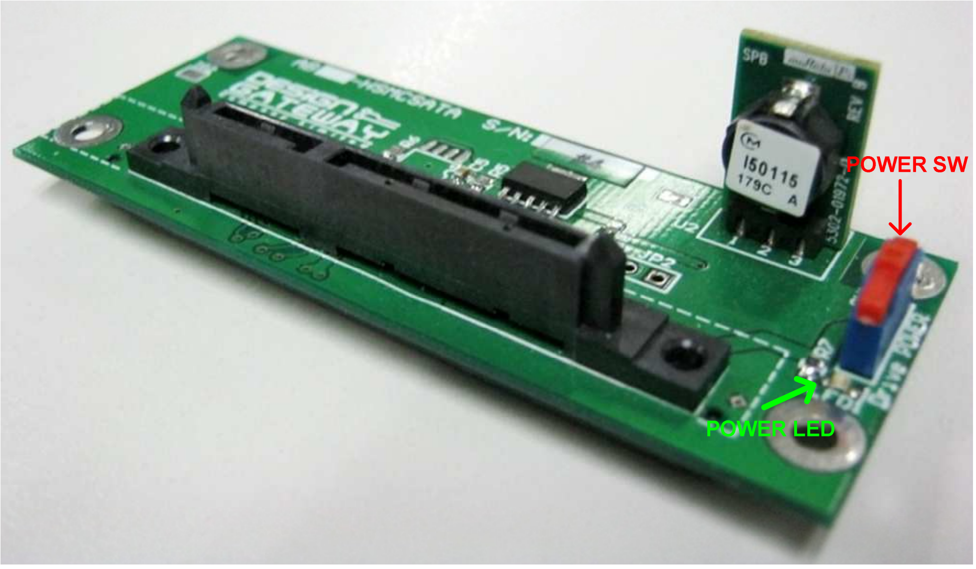
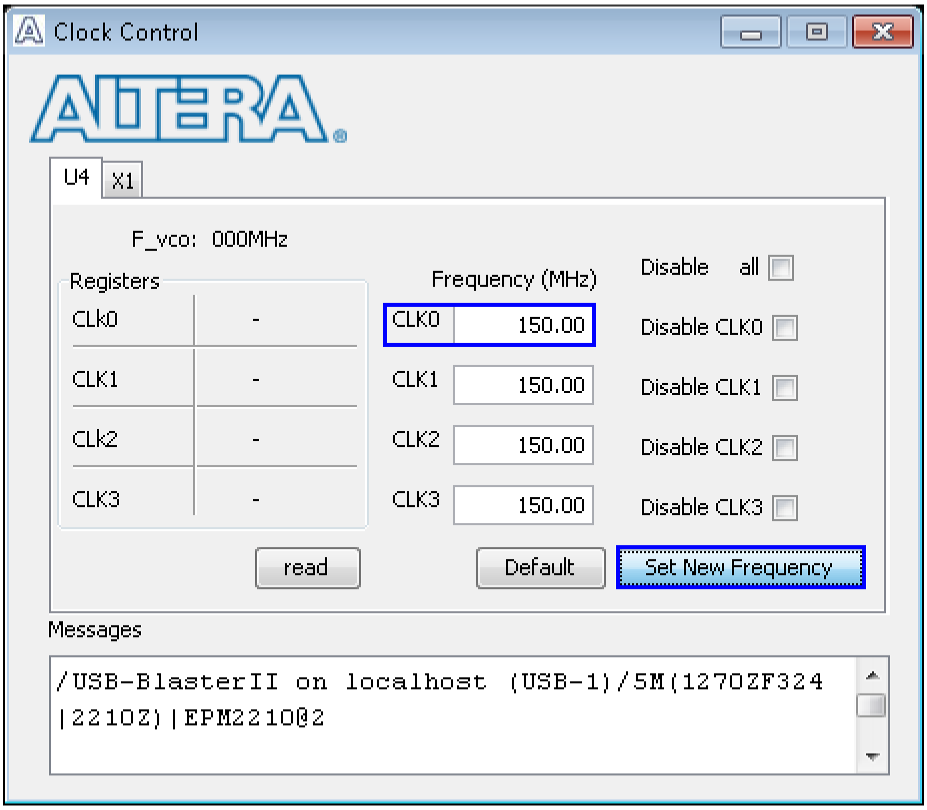


Figure 1-3 ON-Power Switch within HSMC SATA board

- Open “Clock Control” application which is provided by Altera for ArriaV GX Starter board, change CLK0 value to be 150 MHz and press “Set New Frequency” button. Then, wait until clock programmable complete. After this step, reference clock will be 150 MHz for SATA interface, as shown in Figure 1-4.


Clock Control
ALTERA
U4
X1
Registers
Frequency (MHz)
Disable all ☐
Disable CLK0 ☐
Disable CLK1 ☐
Disable CLK2 ☐
Disable CLK3 ☐
read
Default
Set New Frequency
Messages

F_vco: 000MHz

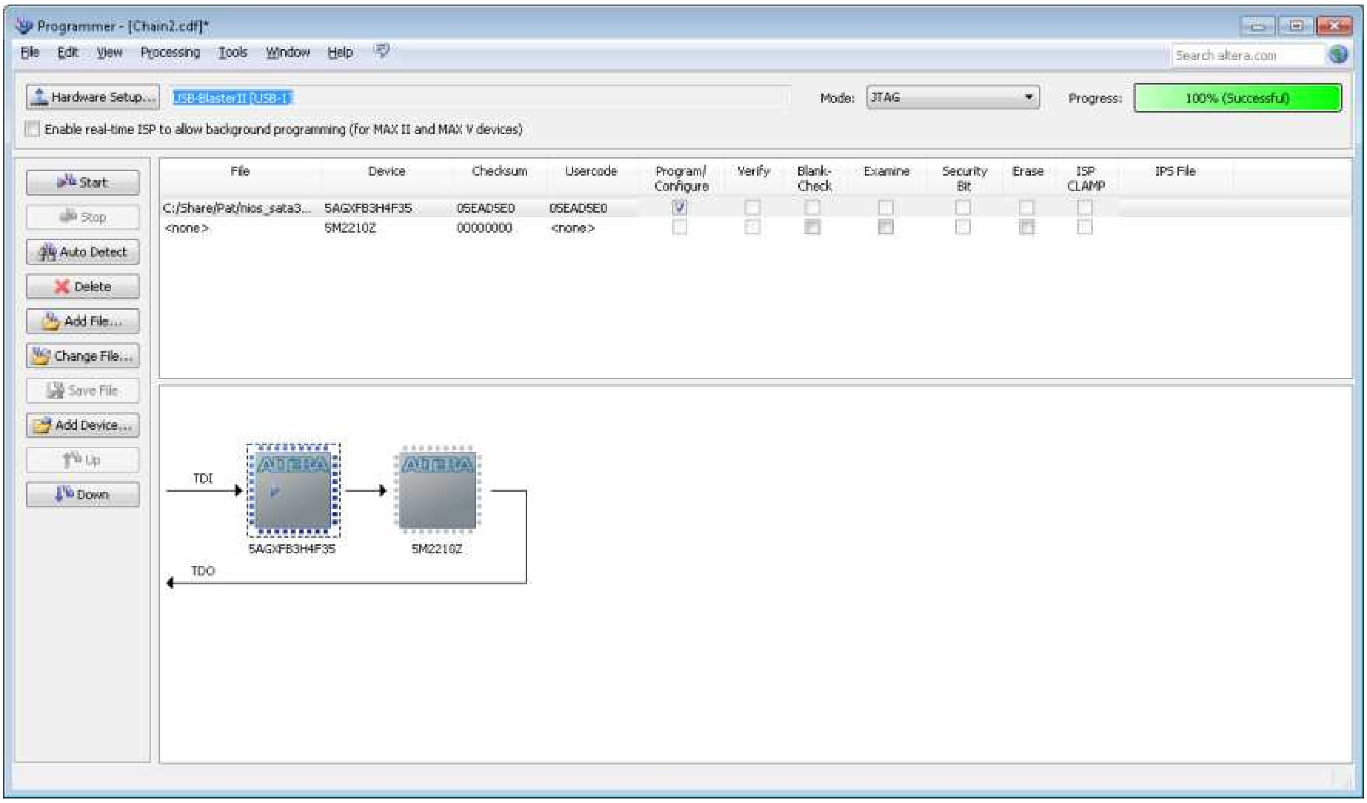
Registers	
CLk0	-
CLK1	-
CLk2	-
CLK3	-

CLK0 150.00
CLK1 150.00
CLK2 150.00
CLK3 150.00

```
/USB-BlasterII on localhost (USB-1)/5M(1270ZF324
|2210Z)|EPM2210@2
```

Figure 1-4 Set programmable clock = 150 MHz by Clock Control Application

- Open Quartus Programmer and download “nios_sata3_timeout_exfat.sof” to ArriaV GX board, as shown in Figure 1-5.


Programmer - [Chain2.cdf]*
File
Edit
View
Processing
Tools
Window
Help
Search altera.com
Hardware Setup...
Start
Stop
Auto Detect
Delete
Add File...
Change File...
Save File
Add Device...
Up
Down
TDI
TDO
5AGXFB3H4F35
5M2210Z

USB-BlasterII [USB-1]

Mode: JTAG

Progress: 100% (Successful)

☐ Enable real-time ISP to allow background programming (for MAX II and MAX V devices)

File	Device	Checksum	Usercode	Program/ Configure	Verify	Blank-Check	Examine	Security Bit	Erase	ISP CLAMP	IPS File
C:/Share/Pat/nios_sata3...	5AGXFB3H4F35	05EAD5E0	05EAD5E0	☑	☐	☐	☐	☐	☐	☐	
<none>	5M2210Z	00000000	<none>	☐	☐	▨	▨	☐	▨	☐	

Figure 1-5 Programmer Environment

- Check LED status on ArriaV GX board now and LED0-1 should be turn-on, as shown in Figure 1-6.

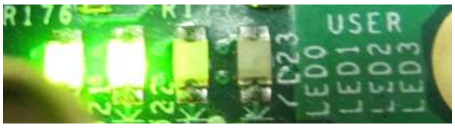


Figure 1-6 LED Status after setup complete

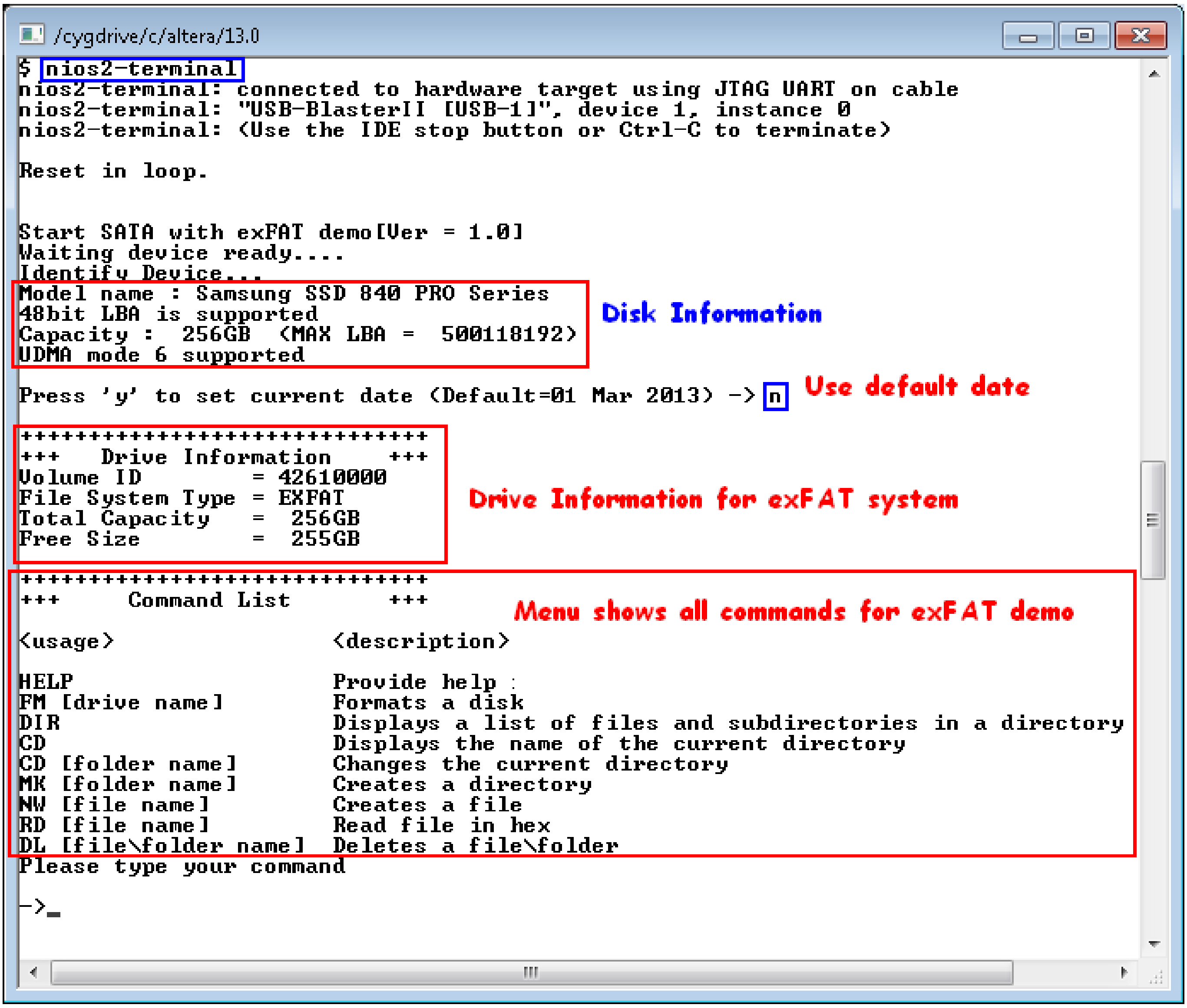
LED	ON	OFF	BLINK
LED0	OK	SATA-IP cannot detect SATA device. Please check SATA-cable connection or reference clock frequency setting that should be 150 MHz.	1-hour timeout or SATA error detect
LED1	OK	Internal PLL is not LOCK.	
LED2	In process of write SATA HDD/SSD	Idle Status	N/A
LED3	In process of read SATA HDD/SSD	Idle Status	N/A

Table 1-1 LED Status of SATA-IP demo on ArriaV GX board

2 System boot up

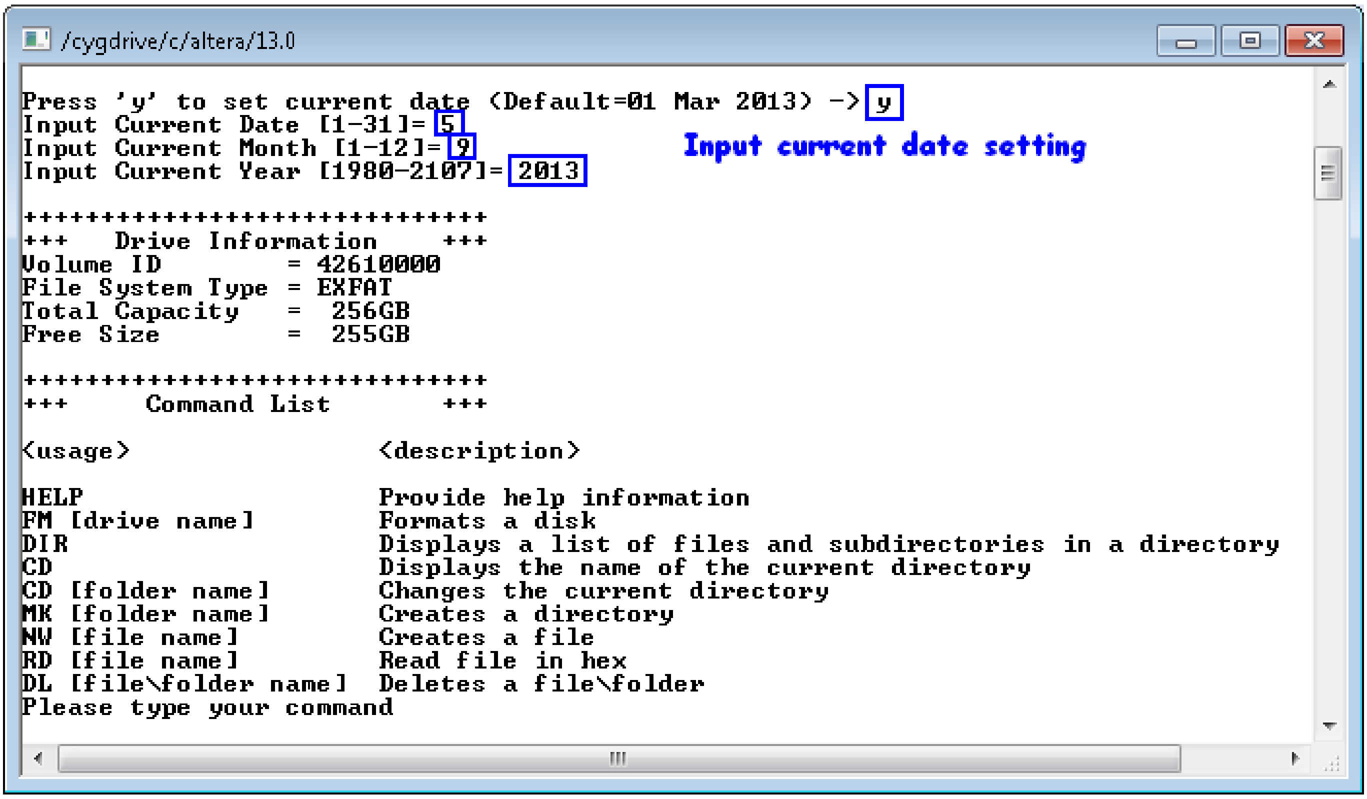
- Open NiosII Command shell by typing “nios2-terminal”, main menu will be displayed as shown in Figure 2-1. The step on boot screen is follows.

  (1) Disk information is displayed to show name and size.
  (2) Ask user to set date which is the created date when creating file/directory. Press ‘y’ to set date, or press other keys to skip setting and use default value instead (Default is 1 Mar 2013). Default mode is shown in Figure 2-1 and date setting mode is shown in Figure 2-2.
  (3) a. Show File system information if exFAT file system has already detected on this disk.
  b. If no exFAT file system on disk, user needs to press ‘y’ to confirm and start format process, as shown in Figure 2-3.
  (4) Information about exFAT file system on disk is shown in next line.
  (5) Main Menu to show all supported command in this demo is displayed on last line.


/cygdrive/c/altera/13.0
Disk Information
Use default date
Drive Information for exFAT system
Menu shows all commands for exFAT demo

```
$ nios2-terminal
nios2-terminal: connected to hardware target using JTAG UART on cable
nios2-terminal: "USB-BlasterII [USB-1]", device 1, instance 0
nios2-terminal: (Use the IDE stop button or Ctrl-C to terminate)

Reset in loop.


Start SATA with exFAT demo[Ver = 1.0]
Waiting device ready....
Identify Device...
Model name : Samsung SSD 840 PRO Series
48bit LBA is supported
Capacity :  256GB  (MAX LBA =  500118192)
UDMA mode 6 supported

Press 'y' to set current date (Default=01 Mar 2013) ->n

++++++++++++++++++++++++++++++
+++    Drive Information    +++
Volume ID          = 42610000
File System Type   = EXFAT
Total Capacity     =  256GB
Free Size          =  255GB

++++++++++++++++++++++++++++++
+++      Command List       +++

<usage>                  <description>

HELP                     Provide help :
FM [drive name]          Formats a disk
DIR                      Displays a list of files and subdirectories in a directory
CD                       Displays the name of the current directory
CD [folder name]         Changes the current directory
MK [folder name]         Creates a directory
NW [file name]           Creates a file
RD [file name]           Read file in hex
DL [file\folder name]    Deletes a file\folder
Please type your command

->_
```

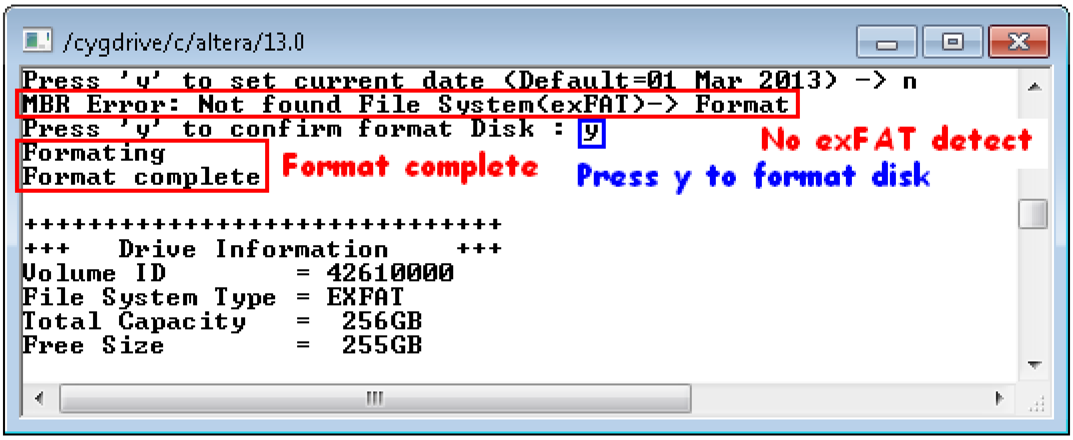
Figure 2-1 Main menu when exFAT detect and use default date



```
Press 'y' to set current date (Default=01 Mar 2013) -> y
Input Current Date [1-31]= 5
Input Current Month [1-12]= 9
Input Current Year [1980-2107]= 2013

++++++++++++++++++++++++++++++
+++   Drive Information    +++
Volume ID        = 42610000
File System Type = EXFAT
Total Capacity   =  256GB
Free Size        =  255GB

++++++++++++++++++++++++++++++
+++     Command List       +++

<usage>                    <description>

HELP                       Provide help information
FM [drive name]            Formats a disk
DIR                        Displays a list of files and subdirectories in a directory
CD                         Displays the name of the current directory
CD [folder name]           Changes the current directory
MK [folder name]           Creates a directory
NW [file name]             Creates a file
RD [file name]             Read file in hex
DL [file\folder name]      Deletes a file\folder
Please type your command
```

Input current date setting

Figure 2-2 Main menu when select to set current date



```
Press 'y' to set current date (Default=01 Mar 2013) -> n
MBR Error: Not found File System(exFAT)-> Format
Press 'y' to confirm format Disk : y
Formating
Format complete

++++++++++++++++++++++++++++++
+++   Drive Information    +++
Volume ID        = 42610000
File System Type = EXFAT
Total Capacity   =  256GB
Free Size        =  255GB
```

No exFAT detect

Format complete

Press y to format disk

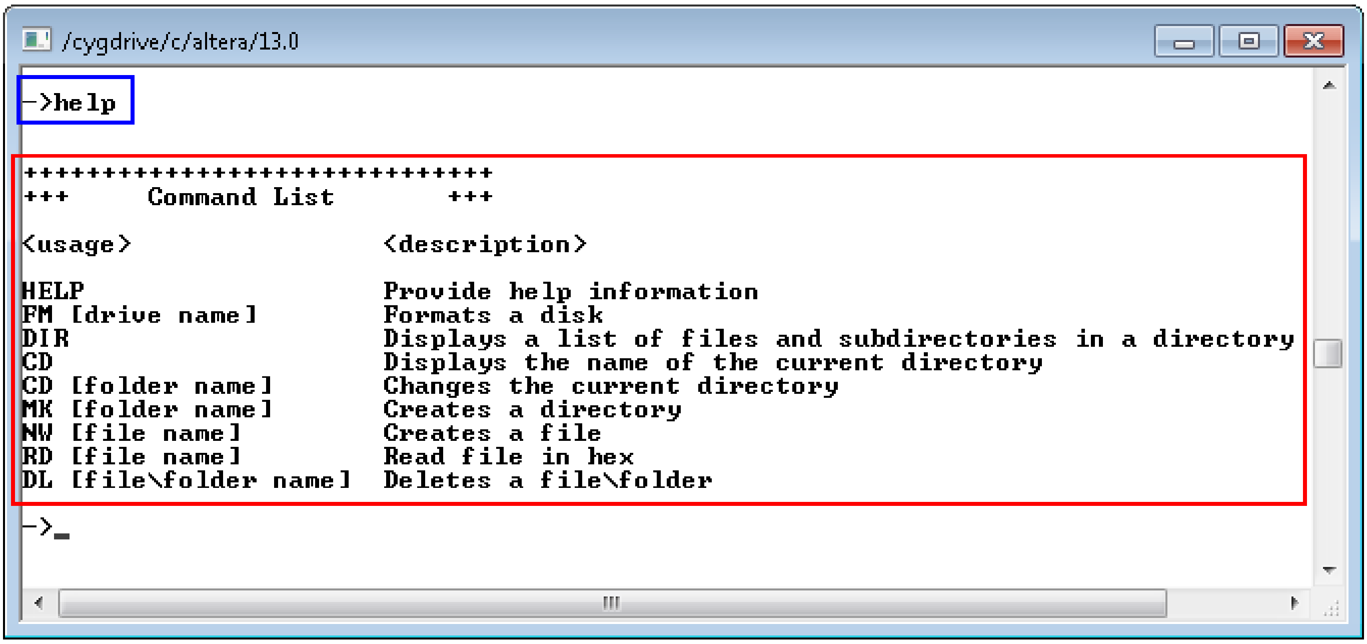
Figure 2-3 Format menu when exFAT not detect in disk

3 Main Menu

3.1 HELP

Command -> help

Select this command to display all support commands on console with its description. The example result is shown in Figure 3-1.



```
->help

++++++++++++++++++++++++++++++
+++     Command List        +++

<usage>                  <description>

HELP                     Provide help information
FM [drive name]          Formats a disk
DIR                      Displays a list of files and subdirectories in a directory
CD                       Displays the name of the current directory
CD [folder name]         Changes the current directory
MK [folder name]         Creates a directory
NW [file name]           Creates a file
RD [file name]           Read file in hex
DL [file\folder name]    Deletes a file\folder

->_
```

Figure 3-1 HELP command

3.2 FORMAT

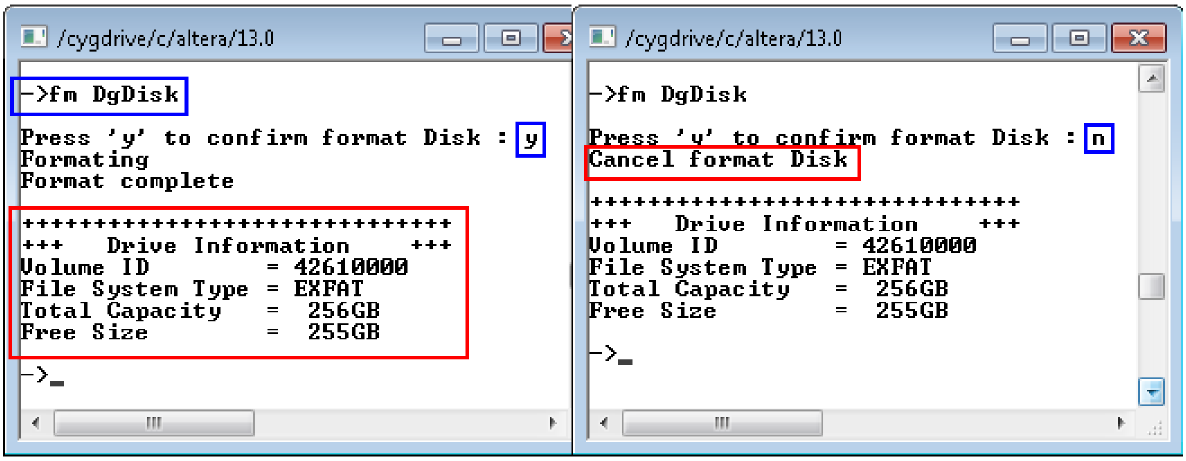
Command -> fm [drive name]

Select this command to format disk to exFAT file system. User needs to input

(1) Drive Name: This input can receive up to 11 Characters. Only 1st – 11th Character will be used if too long character length is received.

(2) Press ‘y’ to confirm operation and start format. Then, wait until “Format complete” and drive information are displayed after operation end. If press other inputs, operation will be cancelled.

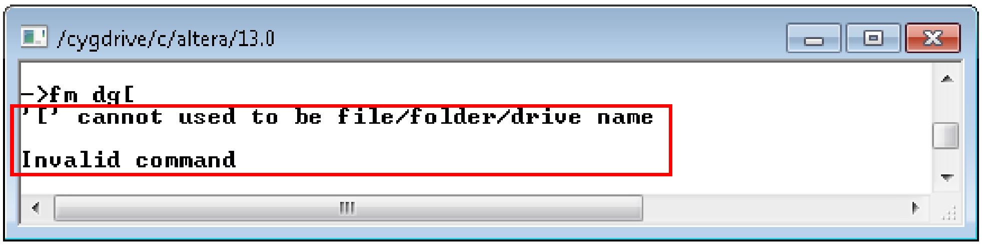
Figure 3-3 and Figure 3-4 shows the error when Drive name includes invalid Characters and too long file name length sequentially.



```
->fm DgDisk

Press 'y' to confirm format Disk : y
Formating
Format complete

+++++++++++++++++++++++++++++++
+++    Drive Information    +++
Volume ID          = 42610000
File System Type  = EXFAT
Total Capacity    =  256GB
Free Size         =  255GB

->_
```

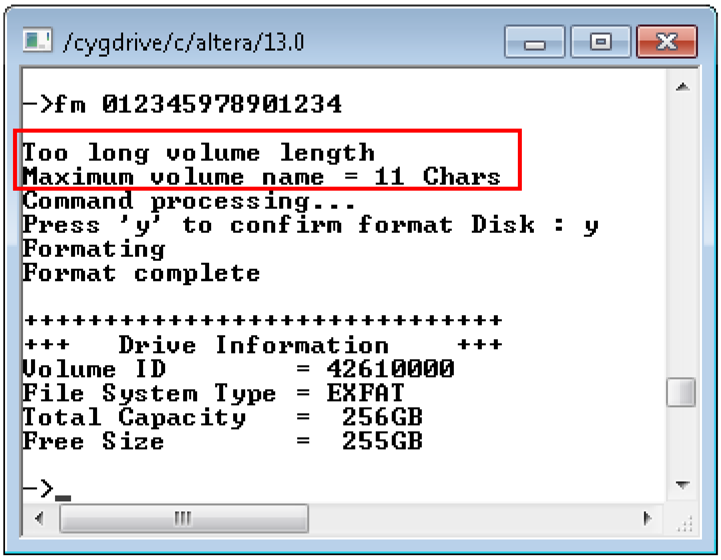
```
->fm DgDisk

Press 'y' to confirm format Disk : n
Cancel format Disk

+++++++++++++++++++++++++++++++
+++    Drive Information    +++
Volume ID          = 42610000
File System Type  = EXFAT
Total Capacity    =  256GB
Free Size         =  255GB

->_
```

Figure 3-2 FORMAT command



```
->fm dg[
'[' cannot used to be file/folder/drive name

Invalid command
```

Figure 3-3 Error from invalid character



```
->fm 012345978901234

Too long volume length
Maximum volume name = 11 Chars
Command processing...
Press 'y' to confirm format Disk : y
Formating
Format complete

+++++++++++++++++++++++++++++++
+++    Drive Information    +++
Volume ID          = 42610000
File System Type  = EXFAT
Total Capacity    =  256GB
Free Size         =  255GB

->_
```

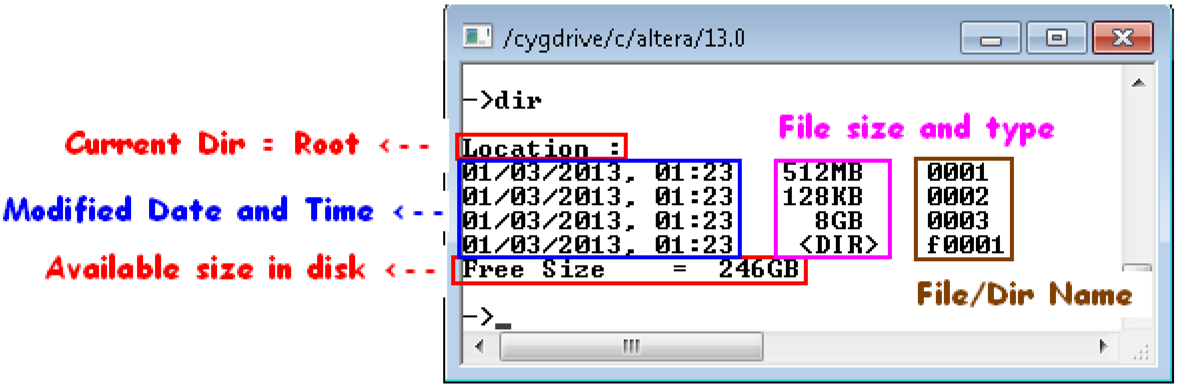
Figure 3-4 Error from too long name

3.3 DIR

Command -> dir

Select this command to display list of all files and sub-directories within current directory. The output of this command is

(1) Path of current directory. If space is found, it means current directory is root directory.
(2) Modified date and time of each file and sub-directory.
(3) File size in case of file type or <DIR> in case of directory type.
(4) File/Directory Name
(5) Free Space size in disk


/cygdrive/c/altera/13.0
Current Dir : Root <- -
Modified Date and Time <- -
Available size in disk <- -
File size and type
File/Dir Name

```
->dir
Location :
01/03/2013, 01:23  512MB   0001
01/03/2013, 01:23  128KB   0002
01/03/2013, 01:23    8GB   0003
01/03/2013, 01:23   <DIR>  f0001
Free Size     =   246GB

->_
```

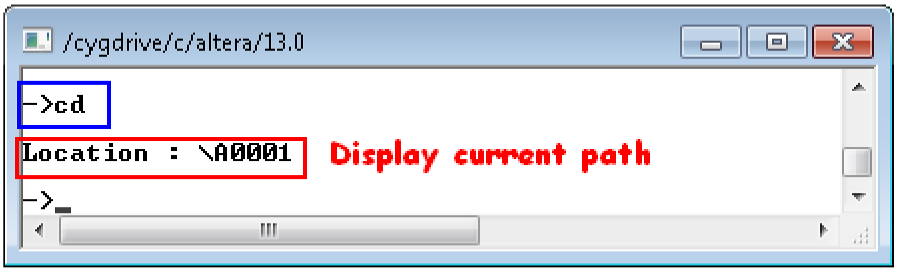
Figure 3-5 DIR command

3.4 CD

Command -> cd, cd .., or cd [sub-directory name]

Select this command to change current directory to parent by “cd ..” or to sub-directory by “cd [sub-directory name]. In case of only “cd” input, path of current directory will be displayed. The examples of the three commands are displayed in Figure 3-6 to Figure 3-8.

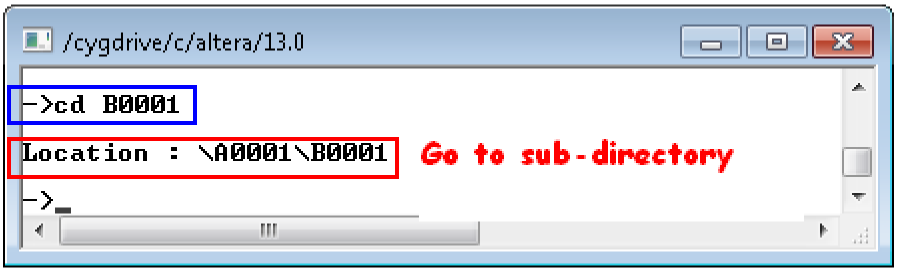
“[sub-directory name] Not Found” message will be displayed if name input is not matched with any directory within current directory, as shown in Figure 3-9.



```
->cd
Location : \A0001
->_
```

Display current path

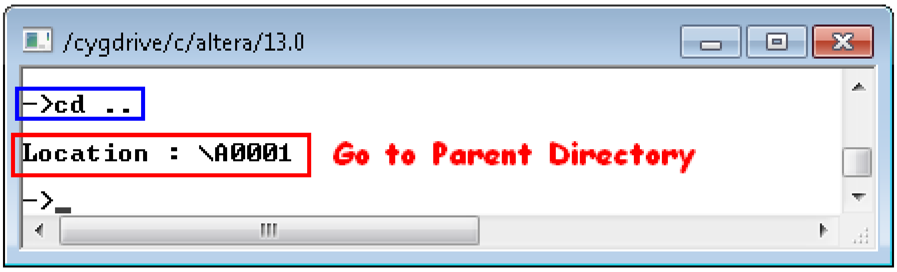
Figure 3-6 CD command



```
->cd B0001
Location : \A0001\B0001
->_
```

Go to sub-directory

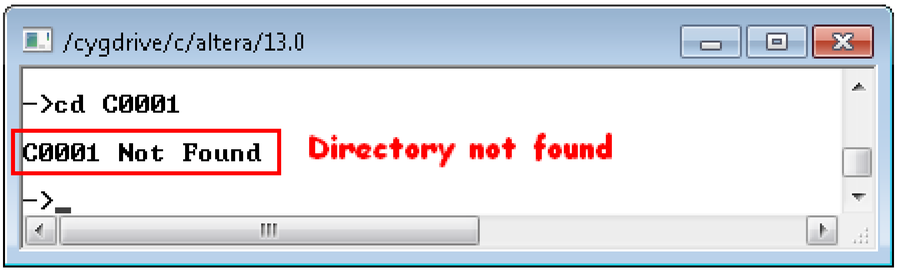
Figure 3-7 Go to sub-directory



```
->cd ..
Location : \A0001
->_
```

Go to Parent Directory

Figure 3-8 Go to parent directory



```
->cd C0001
C0001 Not Found
->_
```

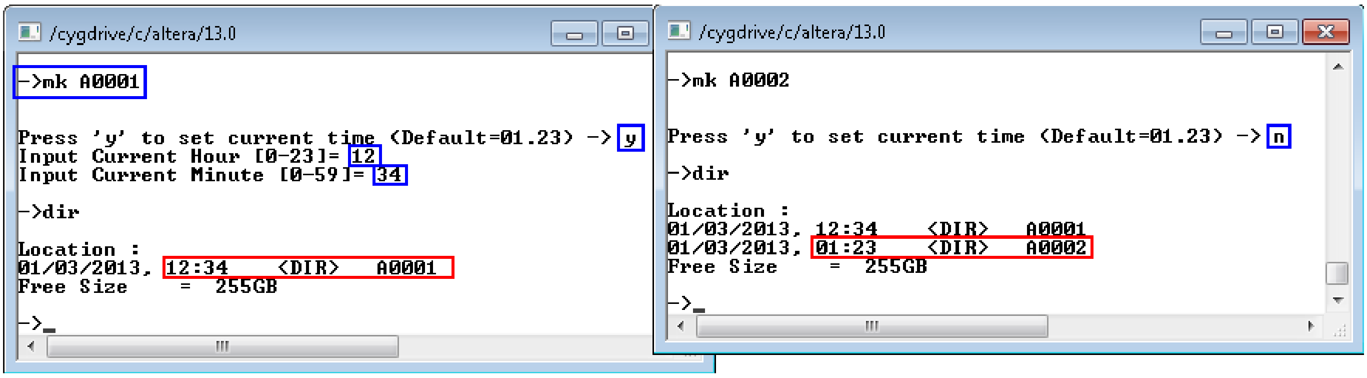
Directory not found

Figure 3-9 Directory Not Found

3.5 MAKE

Command -> mk [folder name]

Select this command to create new directory within current directory.
- Name input can support up to 255 Characters, following exFAT specification.
- User can select to set time of new file by press ‘y’. If press other inputs, it will use default time (01.23), as shown in Figure 3-10.

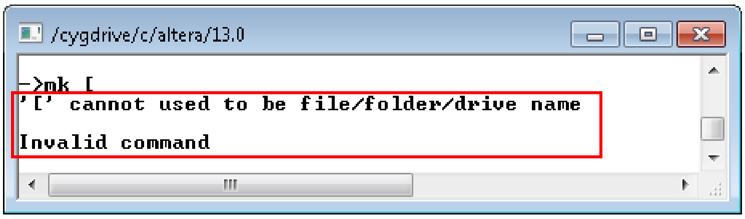


```
->mk A0001

Press 'y' to set current time (Default=01.23) -> y
Input Current Hour [0-23]= 12
Input Current Minute [0-59]= 34

->dir

Location :
01/03/2013, 12:34     <DIR>    A0001
Free Size      =  255GB

->_
```

```
->mk A0002

Press 'y' to set current time (Default=01.23) -> n

->dir

Location :
01/03/2013, 12:34     <DIR>    A0001
01/03/2013, 01:23     <DIR>    A0002
Free Size      =  255GB

->_
```

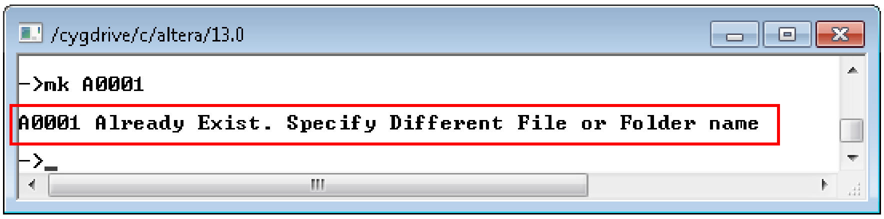
Figure 3-10 MAKE command

Three errors are shown in the example, i.e.
(1) Error from invalid character to be directory name, as shown in Figure 3-11
(2) Error from directory name already exist in current directory, as shown in Figure 3-12
(3) Auto-running when directory name input is equal to 255 Character (maximum length), as shown in Figure 3-13.



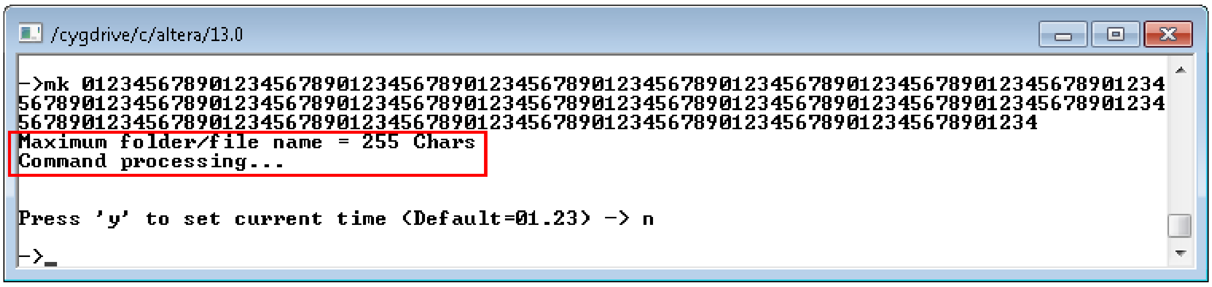
```
->mk [
'[' cannot used to be file/folder/drive name

Invalid command
```

Figure 3-11 Error from invalid character



```
->mk A0001

A0001 Already Exist. Specify Different File or Folder name

->_
```

Figure 3-12 Error from exist name in directory



```
->mk 012345678901234567890123456789012345678901234567890123456789012345678901234
56789012345678901234567890123456789012345678901234567890123456789012345678901234
5678901234567890123456789012345678901234567890123456789012345678901234
Maximum folder/file name = 255 Chars
Command processing...


Press 'y' to set current time (Default=01.23) -> n

->_
```

Figure 3-13 Maximum character received

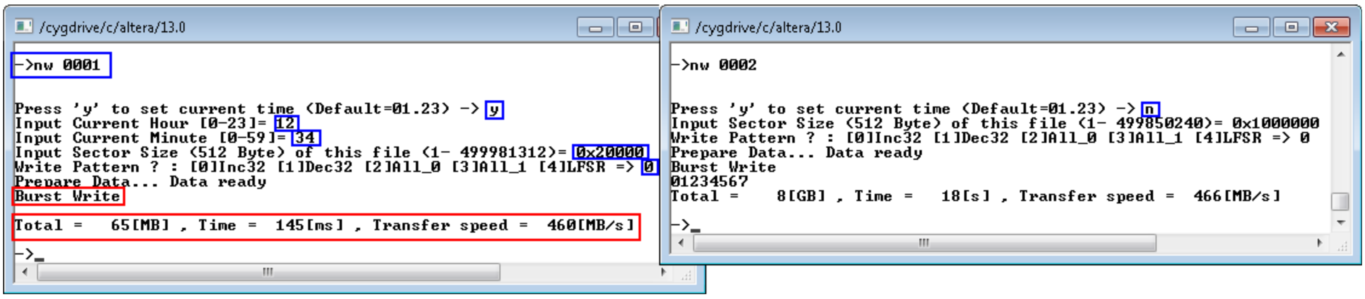
3.6 NEW

Command -> nw [file name]

Select this command to create new file within current directory. The input of this command is follows.

(1) File name: The input can receive up to 255 Characters.
(2) Time setting: Press ‘y’ to set up created time for new file, or press other inputs to use default time.
(3) File size: The input unit is sector size (512 byte size).
(4) Test pattern format: 5 patterns can be selected, i.e. [0] 32-bit Increment, [1] 32-bit Decrement, [2] All Zero, [3] All One, and [4] LFSR counter. Test pattern is filled in buffer up to 64 MB as maximum size. If file size is more than 64 MB, the next 64 MB will be similar to the first 64 MB.

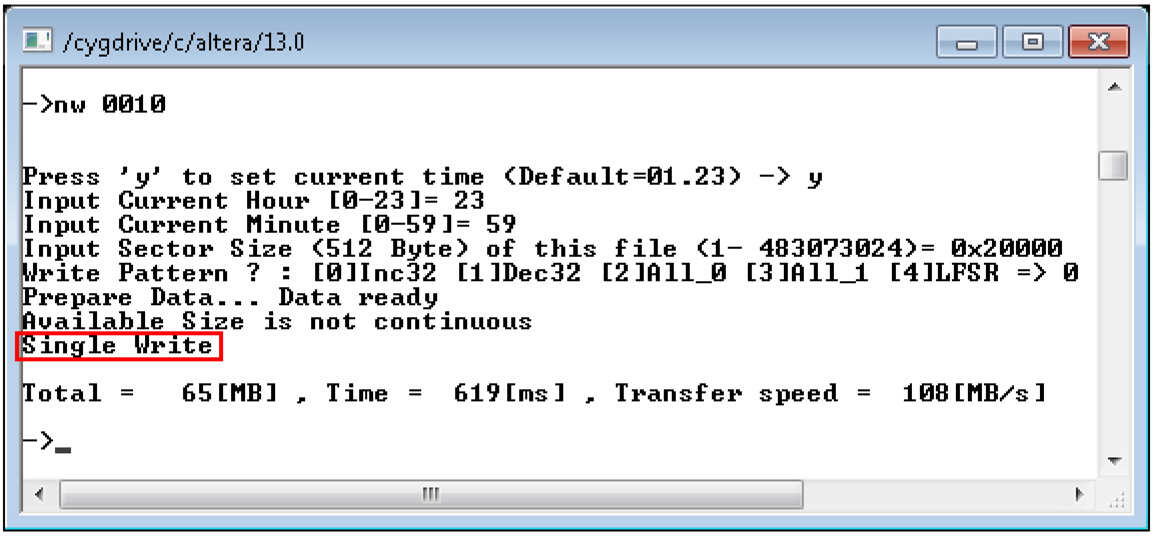
There are two modes for writing data to disk, i.e. Burst and Single. If free cluster to store data is contiguous, it will run in Burst mode which will achieve good performance. On the contrary, it will run on Single mode with transfer size = 1 cluster when free cluster is not contiguous. Smaller transfer size in Single mode makes performance worse than Burst mode which transfer size in each transaction is bigger, as shown in Figure 3-15.



```
->nw 0001


Press 'y' to set current time (Default=01.23) -> y
Input Current Hour [0-23]= 12
Input Current Minute [0-59]= 34
Input Sector Size (512 Byte) of this file (1- 499981312)= 0x20000
Write Pattern ? : [0]Inc32 [1]Dec32 [2]All_0 [3]All_1 [4]LFSR => 0
Prepare Data... Data ready
Burst Write

Total =   65[MB] , Time =  145[ms] , Transfer speed =  460[MB/s]

->_
```

```
->nw 0002


Press 'y' to set current time (Default=01.23) -> n
Input Sector Size (512 Byte) of this file (1- 499850240)= 0x1000000
Write Pattern ? : [0]Inc32 [1]Dec32 [2]All_0 [3]All_1 [4]LFSR => 0
Prepare Data... Data ready
Burst Write
01234567
Total =    8[GB] , Time =   18[s] , Transfer speed =  466[MB/s]

->_
```

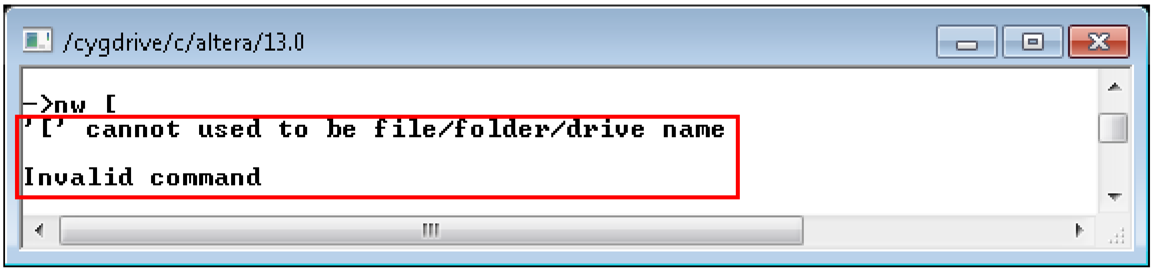
Figure 3-14 NEW command



```
->nw 0010


Press 'y' to set current time (Default=01.23) -> y
Input Current Hour [0-23]= 23
Input Current Minute [0-59]= 59
Input Sector Size (512 Byte) of this file (1- 483073024)= 0x20000
Write Pattern ? : [0]Inc32 [1]Dec32 [2]All_0 [3]All_1 [4]LFSR => 0
Prepare Data... Data ready
Available Size is not continuous
Single Write

Total =   65[MB] , Time =  619[ms] , Transfer speed =  108[MB/s]

->_
```

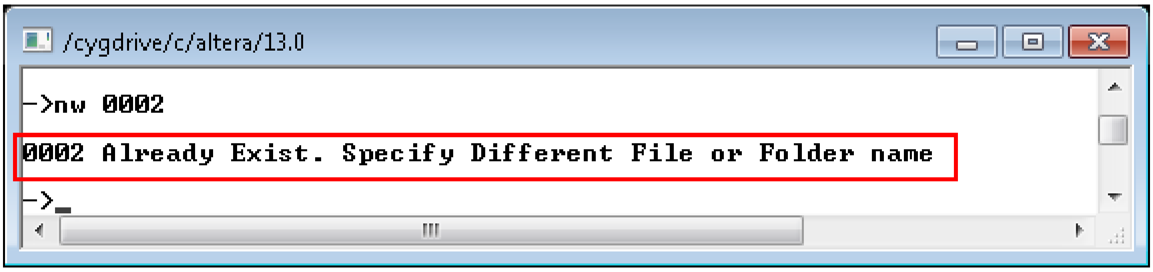
Figure 3-15 NEW command with Single mode

Similar to make command, three errors are shown to be example, as shown in Figure 3-16 to Figure 3-18.



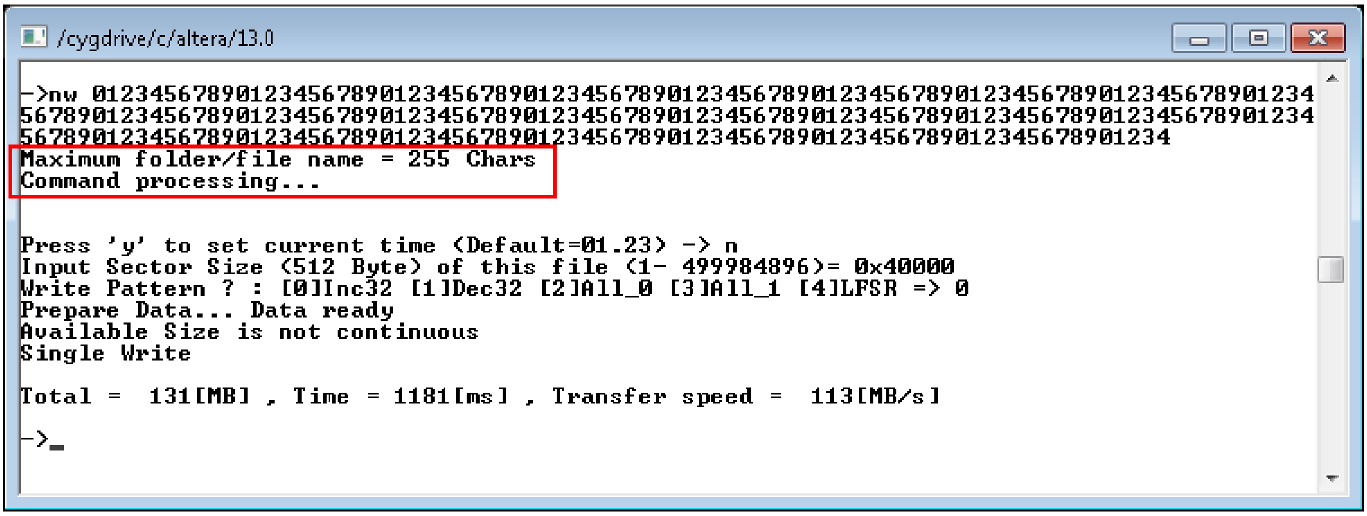
```
->nw [
'[' cannot used to be file/folder/drive name

Invalid command
```

Figure 3-16 Error from invalid character



```
->nw 0002

0002 Already Exist. Specify Different File or Folder name

->_
```

Figure 3-17 Error from exist name in directory



```
->nw 012345678901234567890123456789012345678901234567890123456789012345678901234
56789012345678901234567890123456789012345678901234567890123456789012345678901234
5678901234567890123456789012345678901234567890123456789012345678901234
Maximum folder/file name = 255 Chars
Command processing...


Press 'y' to set current time (Default=01.23) -> n
Input Sector Size (512 Byte) of this file (1- 499984896)= 0x40000
Write Pattern ? : [0]Inc32 [1]Dec32 [2]All_0 [3]All_1 [4]LFSR => 0
Prepare Data... Data ready
Available Size is not continuous
Single Write

Total =  131[MB] , Time = 1181[ms] , Transfer speed =  113[MB/s]

->_
```

Figure 3-18 Maximum character received

3.7 READ

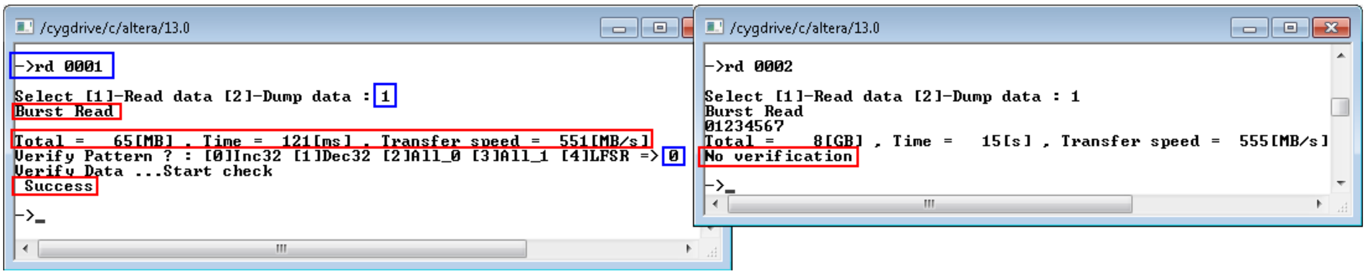
Command -> rd [file name]

Select this command to read/verify or dump data in request file. The input of this command is follows.

(1) File name: Input request file name in current directory

(2) Mode: Select operation by [1]-Read/Verify data [2]-Dump data to console.

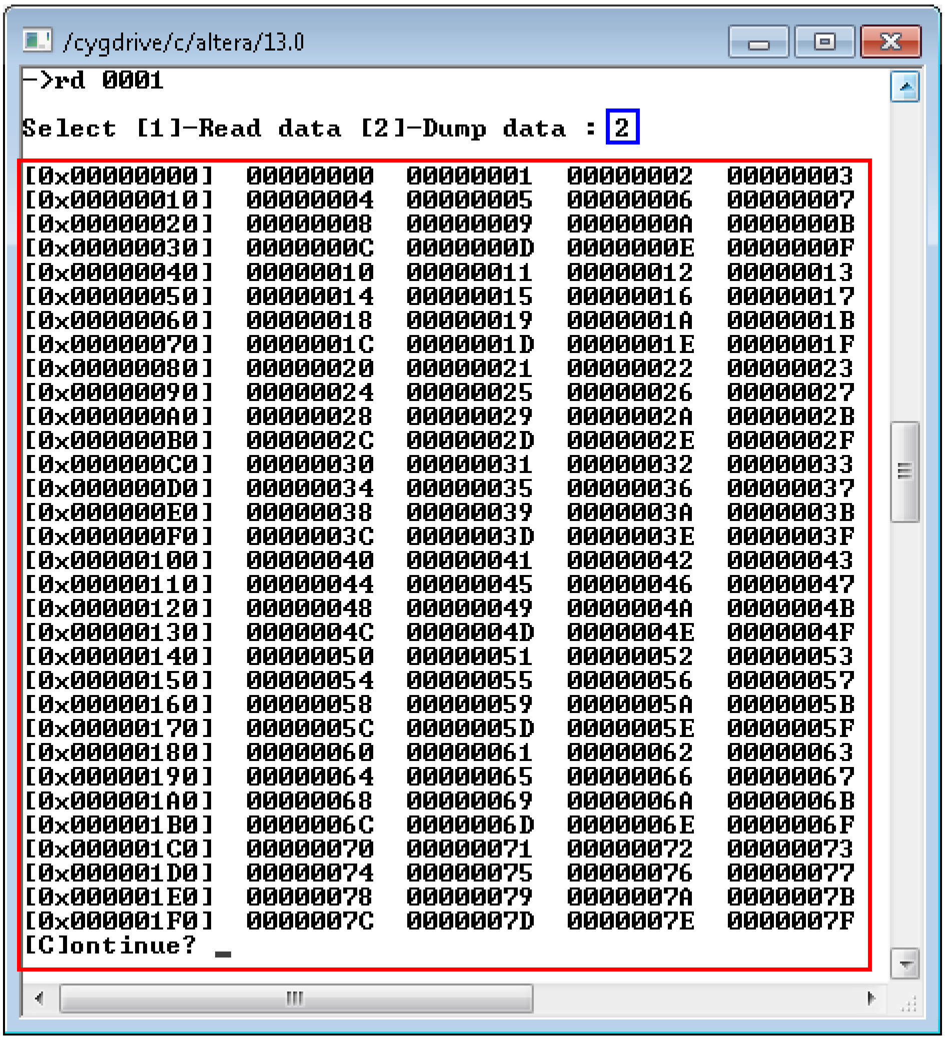
In Read/Verify mode, data will be verified by user selected test pattern when data size in file is 64 MB at most, as shown in the left window of Figure 3-19, while “No verification” will be displayed for file size more than 64 MB.



```
->rd 0001

Select [1]-Read data [2]-Dump data : 1
Burst Read

Total =    65[MB] , Time =  121[ms] , Transfer speed =  551[MB/s]
Verify Pattern ? : [0]Inc32 [1]Dec32 [2]All_0 [3]All_1 [4]LFSR => 0
Verify Data ...Start check
 Success

->_
```

```
->rd 0002

Select [1]-Read data [2]-Dump data : 1
Burst Read
01234567
Total =    8[GB] , Time =   15[s] , Transfer speed =  555[MB/s]
No verification

->_
```

Figure 3-19 READ command

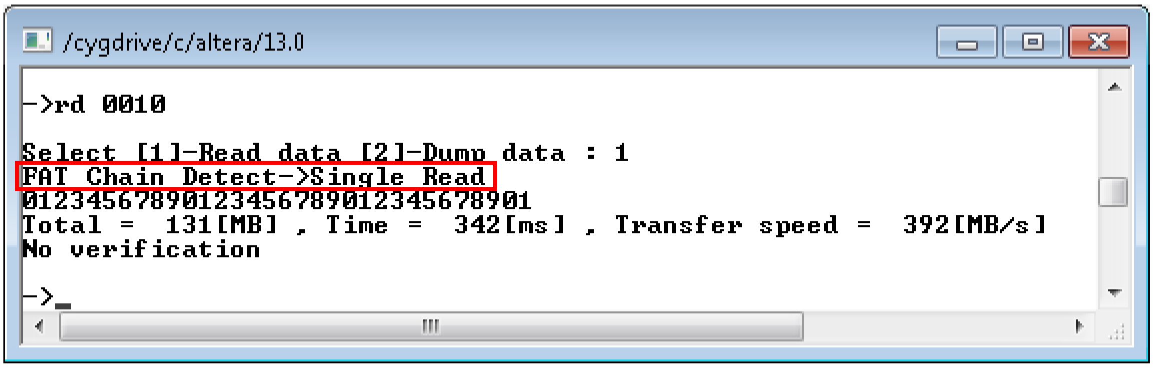


```
->rd 0001

Select [1]-Read data [2]-Dump data : 2
[0x00000000]  00000000  00000001  00000002  00000003
[0x00000010]  00000004  00000005  00000006  00000007
[0x00000020]  00000008  00000009  0000000A  0000000B
[0x00000030]  0000000C  0000000D  0000000E  0000000F
[0x00000040]  00000010  00000011  00000012  00000013
[0x00000050]  00000014  00000015  00000016  00000017
[0x00000060]  00000018  00000019  0000001A  0000001B
[0x00000070]  0000001C  0000001D  0000001E  0000001F
[0x00000080]  00000020  00000021  00000022  00000023
[0x00000090]  00000024  00000025  00000026  00000027
[0x000000A0]  00000028  00000029  0000002A  0000002B
[0x000000B0]  0000002C  0000002D  0000002E  0000002F
[0x000000C0]  00000030  00000031  00000032  00000033
[0x000000D0]  00000034  00000035  00000036  00000037
[0x000000E0]  00000038  00000039  0000003A  0000003B
[0x000000F0]  0000003C  0000003D  0000003E  0000003F
[0x00000100]  00000040  00000041  00000042  00000043
[0x00000110]  00000044  00000045  00000046  00000047
[0x00000120]  00000048  00000049  0000004A  0000004B
[0x00000130]  0000004C  0000004D  0000004E  0000004F
[0x00000140]  00000050  00000051  00000052  00000053
[0x00000150]  00000054  00000055  00000056  00000057
[0x00000160]  00000058  00000059  0000005A  0000005B
[0x00000170]  0000005C  0000005D  0000005E  0000005F
[0x00000180]  00000060  00000061  00000062  00000063
[0x00000190]  00000064  00000065  00000066  00000067
[0x000001A0]  00000068  00000069  0000006A  0000006B
[0x000001B0]  0000006C  0000006D  0000006E  0000006F
[0x000001C0]  00000070  00000071  00000072  00000073
[0x000001D0]  00000074  00000075  00000076  00000077
[0x000001E0]  00000078  00000079  0000007A  0000007B
[0x000001F0]  0000007C  0000007D  0000007E  0000007F
[C]ontinue? _
```

Figure 3-20 Dump mode

As shown in Figure 3-20, 512-byte data within file will be displayed on Serial console when selecting dump mode. Press 'C' to continue dumping in next sector, or press other inputs to exit operation.

Similar to new command, if FAT chain is detected in request file, it will run in Single mode which performance will be less than burst mode from slower transfer size in each transaction, as shown in Figure 3-21.



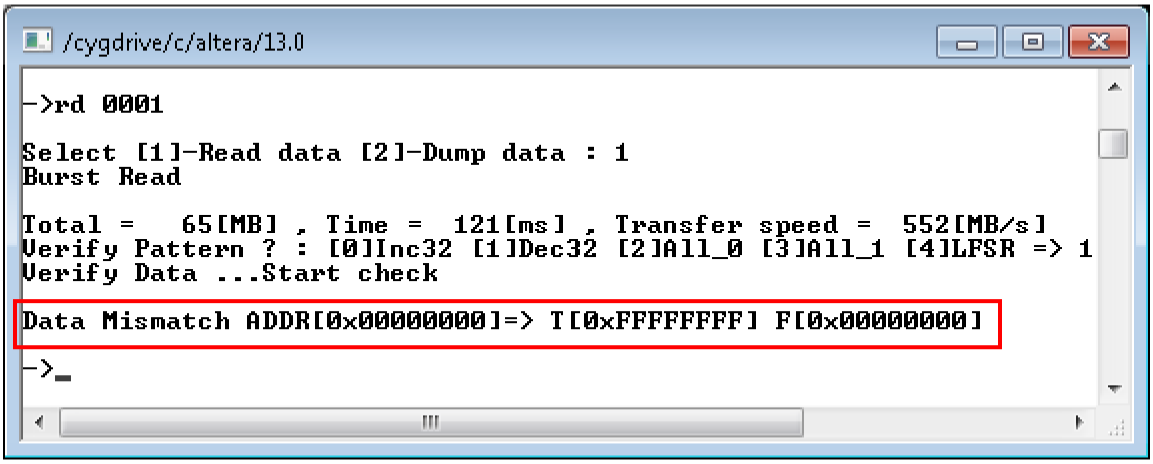
```
->rd 0010

Select [1]-Read data [2]-Dump data : 1
FAT Chain Detect->Single Read
01234567890123456789012345678901
Total =  131[MB] , Time =  342[ms] , Transfer speed =  392[MB/s]
No verification

->_
```

Figure 3-21 READ command with Single mode

Two errors are shown in the example, i.e.

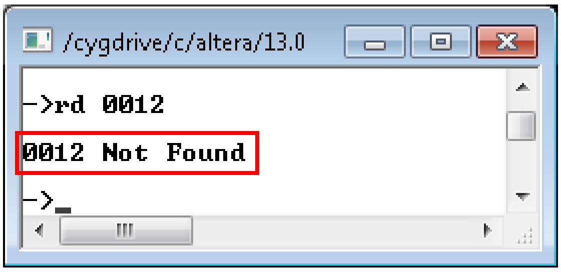
(1) Verify Error when data in file is different from expect pattern during verification, as shown in Figure 3-22.

(2) Error when request file name is not found within current directory, as shown in Figure 3-23.



```
->rd 0001

Select [1]-Read data [2]-Dump data : 1
Burst Read

Total =   65[MB] , Time =  121[ms] , Transfer speed =  552[MB/s]
Verify Pattern ? : [0]Inc32 [1]Dec32 [2]All_0 [3]All_1 [4]LFSR => 1
Verify Data ...Start check

Data Mismatch ADDR[0x00000000]=> T[0xFFFFFFFF] F[0x00000000]

->_
```

Figure 3-22 Verify Error



```
->rd 0012

0012 Not Found

->_
```

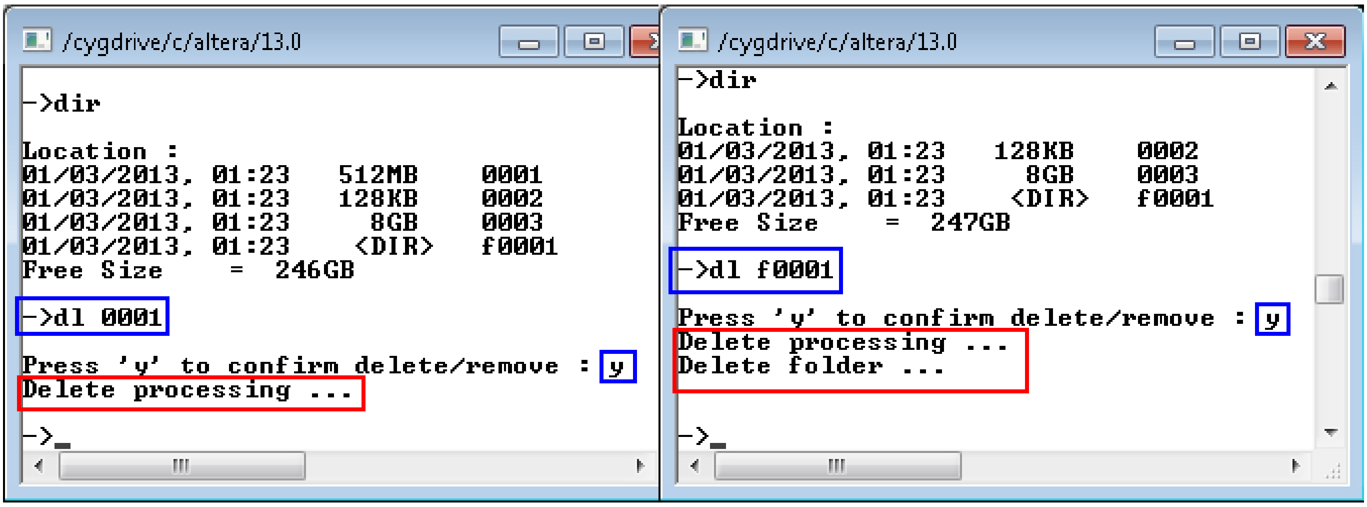
Figure 3-23 File Not Found

3.8 DELETE

Command -> dl [file name or folder name]

Select this command to delete request file or folder within current directory. User input
(1) File/Folder name to delete
(2) Press ‘y’ to confirm deleting command.

If deleted name is directory name, all internal files and sub-directories will be also deleted.

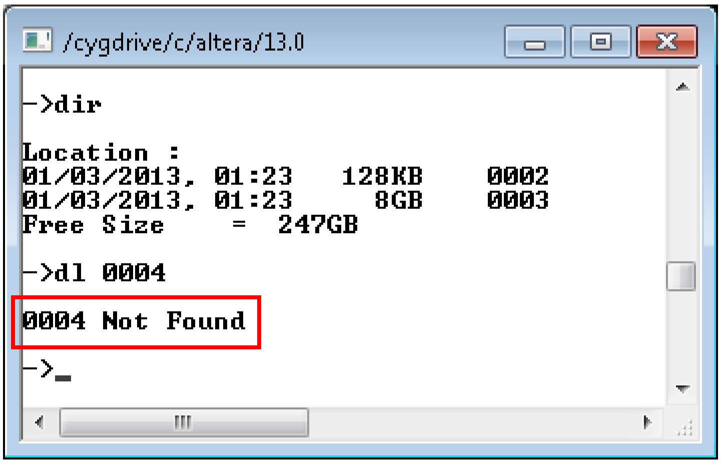


```
->dir

Location :
01/03/2013, 01:23   512MB    0001
01/03/2013, 01:23   128KB    0002
01/03/2013, 01:23     8GB    0003
01/03/2013, 01:23    <DIR>   f0001
Free Size    =  246GB

->dl 0001

Press 'y' to confirm delete/remove : y
Delete processing ...

->_
```

```
->dir

Location :
01/03/2013, 01:23   128KB    0002
01/03/2013, 01:23     8GB    0003
01/03/2013, 01:23    <DIR>   f0001
Free Size    =  247GB

->dl f0001

Press 'y' to confirm delete/remove : y
Delete processing ...
Delete folder ...

->_
```

Figure 3-24 DELETE command

Error message is displayed when request directory/file name is not found in current directory, as shown in Figure 3-25.



```
->dir

Location :
01/03/2013, 01:23   128KB    0002
01/03/2013, 01:23     8GB    0003
Free Size    =  247GB

->dl 0004

0004 Not Found

->_
```

Figure 3-25 Not Found Request File/Directory

4 Revision History

Revision	Date	Description
1.0	5-Sep-13	Initial version release