

FAT32-IP for SATA Demo Instruction

Rev1.0 4-Oct-17

This document describes the instruction to run FAT32-IP for SATA demo on FPGA development board with AB09-FMCRAID/AB12-HSMCRAID adapter board. The demo is designed to write and verify data with SATA-III device. User can control test operation through NiosII command shell.

1 Environment Requirement

To demo FAT32-IP for SATA demo on Intel board, please prepare the following hardware/software.

- 1) IntelFPGA board: Intel ArriaV GX Starter board/Intel Arria10 SoC Development board
- 2) PC with QuartusII programmer and NiosII command shell software
- 3) AB09-FMCRAID for Arria10 SoC board or AB12-HSMCRAID for ArriaV GX Starter board
- 4) SATA-III device
- 5) Intel Power adapter and ATX power supply for SSD
- 6) A cable for programming FPGA and NiosII command shell connecting between FPGA board and PC,
 - USB Type-B cable in case of ArriaV GX Starter board
 - micro USB cable in case of Arria10 SoC Development board



Figure 1-1 FAT32-IP for SATA demo environment setup on ArriaV GX starter board







2 Demo setup

- 1) Power off system.
- 2) Setup board option.
 - a) For ArriaV GX Starter board only, set bit1 of SW4 to OFF position.



Figure 2-1 Set SW to select clock input for ArriaV GX Starter board

- 3) Setup RAID adapter board.
 - i. Connect AB09-FMCRAID/AB12-HSMCRAID to FMC#A/HSMC connector on IntelFPGA board.
 - ii. Connect SATA-III device to CN0 on AB09/AB12.
 - iii. Connect power to power connector on AB09/AB12



Figure 2-2 AB12 connection to FPGA board



4) Connect USB Type B or micro USB cable from FPGA board to PC for JTAG programming and JTAG UART.



- 5) Power on FPGA development board and power supply for SATA device.
- 6) For ArriaV GX Starter board only, open "Clock Control" application, select 1st tab (U4), set CLK0 frequency = 150 MHz, and click "Set New Frequency" button to program 150 MHz clock.

\land Clock Contro	I		
04 X1			
F_vco	: 000MHz		
Registers	1	Frequency (MHz)	Disable all 📃
CLk0	-	CLK0 150.00	Disable CLK0 📃
CLK1	-	CLK1 150.00	Disable CLK1 📃
CLK2	-	CLK2 150.00	Disable CLK2 📃
СГКЗ	-	CLK3 150.00	Disable CLK3 📃
	read	Default	Set New Frequency
Messages			
/USB-Blas 22102) H	sterII on lo SPM221002	ocalhost (USB-1))/5M(1270ZF324
Figure 2	-4 Set clock	k frequency for	ArriaV GX board



7) Use QuartusII Programmer to program "FAT32SataTest.sof" file, as shown in Figure 2-5.

Ardware Setup. USB-Blasterl [USB-1] Mode: JTAG Progress: 100% (Successful) Enable real-time ISP to allow background programming when available Image: Construction of the state of)	Processing Tools Wind	low <u>H</u> elp			Search	n altera.com	
No Start File Device Checksum Usercode Program/ Verify Blank Imb Stop D/Pin/FAT32/FAT32Sat 10AS066N3F40 1D268BCA FFFFFFFF Image: Connex	Hardware Setup	USB-Blasterll [USB-1]	Mode: ,	ITAG ble	▼ Prog	ress: 1	00% (Succe	essful)
Image: Stop D/Pim/FAT32/FAT32Sat 10AS066N3F40 1D268BCA FFFFFFF Image: Stop Image: Auto Detect SOCVHPS 00000000 <none> Image: Stop Image:</none>	▶ [™] Start	File	Device	Checksum	Usercode	Program/ Configure	Verify	Blank- Check
Auto Detect Auto Detect Auto Detect Add File Change File Change File Change File Change File TDI DI DI DI DI DI DI DI DI DI	₩ ^N Stop	D:/Pin/FAT32/FAT32Sat	10AS066N3F40	1D268BCA	FFFFFFF			
X Delete <none> 5M2210Z 00000000 <none> M Add File</none></none>	Auto Detect	<none></none>	5M2210Z	00000000	<none></none>			
Add Fie Change Fie T ^N Up T ^N Up T ^N Up T ^N Down TDI TDI TDI TDI TDI TDI TDI TDI	🗙 Delete	<none></none>	5M2210Z	00000000	<none></none>			
Change File.	Add File							
Image: Save File Add Device Image: Save File Image: Save File <td>Change File</td> <td></td> <td></td> <td></td> <td>1</td> <td></td> <td></td> <td></td>	Change File				1			
Add Device TDI TDI TDI TDI TDI TDI TDI TDI	Save File							
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205001 Ended Programmer operación ac the occ 05 11.00.15 2017	Type ID	Message	operation	at Tue Oct 03	11-00-18 20	017		
4	200051	ended Frogrammer	operacion	at the occ os	11.00.10 20			
	0 209061							

Figure 2-5 Programmed by QuartusII Programmer



8) Open NiosII Command Shell and run nios2-terminal command. Boot message is displayed. User can set file size by press 'y' or 'Y'. If user refuses to set file size, it will be set to default (32 MB). After that, main menu is displayed on the command shell, as shown in Figure 2-6 and Figure 2-7.

/cygdrive/e/altera/16.0	
++++ Start FAT32-IP for SATA Test design [Ver =	1.0] ++++
Waiting device ready Device is ready Wait until device is ready	
System is now operating at FileSize = 32[MB] Maximum number of file is 7629 File **********WARNING********	Green: User Input Blue: Message to User
Changing FileSize may damage the file system Are you sure you want to change FileSize [Y/N]	=>y
	rm to change file size
File size changed System is now operating at FileSize = 256[MB] Maximum number of file is 953 File	Maximum number of file is updated following new file size
Please format disk before use Press 'y' to confirm to format disk =>y 'Y' to fo .Format Disk complete	rmat disk
Main menu [Ver = 1.0] [0] : Format Disk [1] : Write File [2] : Read File [3] : Change FileSize	Main menu to select operating command
[• [₩ id ₁

Figure 2-6 Main menu when confirm to set file size





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

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

Table 1 LED Definition



Figure 2-8 4-bit LED Status for user output

After programming complete, LED[0] and LED[1] are ON during FAT32 initialization process. Then, LED[1] is OFF to show that FAT32 –IP for SATA completes initialization process and now system is ready to receive command from user.



Figure 2-9 LED status after program configuration file and FAT32-IP initialization complete



3 Test Menu

3.1 Format Disk

Select '0' to send Format disk command to the SATA device. After the operation is completed, the system shows current operation file size and maximum number of file, as shown in Figure 3-1.

/cygdrive/e/altera/16.0	
+++ Format Disk selected +++ Press 'y' to confirm to format disk => .Format Disk complete System is now operating at FileSize =	Y' to confirm format disk Current file size and
Main menu [Ver = 1.0] [0] : Format Disk	maximum number of fill
[2] : Read File [3] : Change FileSize	
٠	

Figure 3-1 Result from Format Disk menu



3.2 Write File

Select '1' to send Write command to the SATA device. After that, users are asked to set created time of file. Users can input 'y' or 'Y' to confirm to change created time or input others to refuse. If user choose to refuse, the created time will be set to default (default created time is 22 Sep 2017, 15:31:18).

The details of created time are shown as in Figure 3-2. Next, users can input created time of file. If input is invalid, invalid message will be displayed. Only parameter that is input with invalid value is not changed. Then, the new created time is displayed.

After setting created time process is done, user inputs by the following steps.

- 1) Start file No Input a number of the first written file. The input can be decimal unit or add prefix "0x" for hexadecimal unit.
- 2) NUM of file Input total transfer size in file unit. The input can be decimal unit or add prefix "0x" for hexadecimal unit.
- 3) Select pattern Select pattern of test data for writing to device. Five types can be selected, e.g. 32-bit increment, 32-bit decrement, all 0, all 1, and 32-bit LFSR counter.





dg_fat32ip_sata_instruction_intel_en.doc

/cygdrive/e/altera/16.0

Figure 3-3 Result from Write File menu when changing created time is refused

As shown in Figure 3-2 and Figure 3-3, if all inputs are valid, the operation will be started. Total data size is displayed first. Then, current transfer size is displayed out to the command shell every second during writing operation to show that system still operates. When operation is done, test performance (data written size, time usage, and transfer speed) is displayed on the command shell.



Organize 👻 📃 Open			UEE .	- 🔟 🌘
ጵ Favorites	Name	Date modified	Туре	Size
Nesktop	FILE0000.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
Downloads	FILE000A.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
🔛 Recent Places	FILE000B.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
	FILE000C.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
🗃 Libraries	FILE000D.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
Documents	FILE000E.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
J Music	FILE000F.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
E Pictures	FILE0001.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
Videos	FILE001A.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
	FILE001B.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
🖳 Computer	FILE001C.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
🏭 Local Disk (C:)	FILE001D.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
💼 Local Disk (D:)	FILE001E.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
😏 CD Drive (F:)	FILE001F.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
🕞 DG_FAT32 (G:)	FILE0002.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
	FILE002A.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
🙀 Network	FILE002B.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
	FILE002C.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
	FILE002D.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
	FILE002E.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
	FILE002F.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
	FILE0003.BIN	9/22/2017 3:31 PM	BIN File	32,768 K
	•	m		,

Figure 3-4 Example test files that written by Write File command

Test data is written to the SATA device as a file with constant file size. The File is named FILExxxx.BIN, when xxxx is a file number in hexadecimal unit, as shown in Figure 3-4.



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		4 −6 4	4-bit 8-bit	t hea uniq	der ue v	of ea	ach s	secto	or->									+- 6	4-bi 48-b	t hea it un	ique	of ea	ich s	sect	or->								
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044		110	SB		Jise		0	1000	2		0		D	0	An				12		315						94	DILL		pan		Jata	
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00000	010	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
00000	020	00	00	00	00	09	00	00	00	OF	00	00	00	OF	00	00	00	49	00	00	00	92	00	00	00	24	01	00	00	49	02	00	00
00000	0.40	10	00	00	00	11	00	00	00	10E	00	00	00	10	00	00	00	92	04	00	00	24	09	00	00	49	12	00	00	92	24	00	00
00000	040	10	00	00	00	11	00	00	00	14	00	00	00	17	00	00	00	24	49	00	00	49	92	00	00	92	24	01	00	24	49	02	00
00000	0000	10	00	00	00	10	00	00	00	10	00	00	00	10	00	00	00	49	92	04	00	92	24	09	00	24	49	12	00	49	92	24	00
00000	0000	10	00	00	00	10	00	00	00	15	00	00	00	10	00	00	00	93	24	49	00	27	49	92	00	41	92	24	10	9E	24	49	02
00000	0070	20	00	00	00	21	00	00	00	22	00	00	00	22	00	00	00	SUCE	49	92	40	19	32	24	09	F3	24	49	12	上/	49	92	24
00000	0000	20	00	00	00	21	00	00	00	26	00	00	00	23	00	00	00	CF	93	24	49	9E	2/	49	92	30	41	92	24	/A	9E	24	49
00000	0.00	29	00	00	00	20	00	00	00	20	00	00	00	20	00	00	00	FS	SU	49	92	EB	19	32	24	25	F3	24	49	AE	E/	49	92
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00000	0000	20	00	00	00	21	00	00	00	20	00	00	00	22	00	00	00	20	FD	SU	49	AL	EB	19	92	SU	25	F3	24	88	AL	E/	49
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00000	100	40	00	00	00	41	00	00	00	12	00	00	00	12	00	00	00	/0	22	20	FD	EU	UE	AL	EB	10	1D	SU	25	83	38	88	AL
00000	1110	40	00	00	00	45	00	00	00	46	00	00	00	47	00	00	00	22	20	07	50	DE	EE	EU OF	DA	CD	CI	1D	15	37	00	20	ED
00000	1120	10	00	00	00	40	00	00	00	40	00	00	00	10	00	00	00	13	07	22	20	ED	EU	UE	AL	DI	10	1D	SU	AC	03	38	88
00000	120	40	00	00	00	40	00	00	00	AF	00	00	00	40	00	00	00	34	20	20	07	00	DE	EE	EU OF	DI 1D	CD	DC	ID	A3	37	50	03
00000	140	50	00	00	00	51	00	00	00	52	00	00	00	45	00	00	00	4/	13	20	22	DE	ED	EU	UE	1D	DI	10	1D	SA	JA	83	38
00000	150	50	00	00	00	51	00	00	00	52	00	00	00	53	00	00	00	14	34	07	77	E9	68	UE	EE	03	DI	CD	DC	Ab	AJ	39	88
00000	1160	54	00	00	00	50	00	00	00	50	00	00	00	ED.	00	00	00	40	4/	13	/0	98	DE FO	ED	EU	31	TD DD	DI	10	03	JA	34	03
00000	170	50	00	00	00	57	00	00	00	DA	00	00	00	5D	00	00	00	CB	14	34	07	80	E9	68	DE	IB	03	DI	CD	3/	Ab	AJ	39
00000	1100	60	00	00	00	61	00	00	00	62	00	00	00	6.2	00	00	00	DE TI	40	4/	13	DC	98	DE EO	ED	88	10	10	DI	00	03	SA	3A
00000	1190	64	00	00	00	601	00	00	00	66	00	00	00	67	00	00	00	EI	CD	14	34	24	DD DC	E.7	00	00	1D	21	1DI	DD	37	AD	23
00000	1140	60	00	00	00	69	00	00	00	63	00	00	00	6P	00	00	00	10	DE	40	4/	34	CO	20	FO	00	00	10	1D	00	00	22	SA
00000	1120	60	00	00	00	60	00	00	00	6F	00	00	00	6F	00	00	00	AU AC	11	CD	14	41	24	DC	E.7	20	60	DO	21	60	DO	3/	40 60
00000	100	70	00	00	00	71	00	00	00	72	00	00	00	72	00	00	00	CO	10	DE EI	40	10	34	DC CO	20	30	00	00	10	07	00	00	03
00000	1100	74	00	00	00	75	00	00	00	76	00	00	00	77	00	00	00	OF	AU AC	12	CO	15	10	24	DC	25	20	20	DO	25	60	DO	20
00000	1150	70	00	00	00	79	00	00	00	73	00	00	00	78	00	00	00	DF	CO	10	DE.	TE	10	34	CO	SF FF	00	00	00	TD.	07	00	00
00000	1150	70	00	00	00	70	00	00	00	75	00	00	00	75	00	00	00	E E A	OF	AU	13	FF	15	10	24	FD	03	20	60	FD DO	25	60	DO
00000	200	01	00	00	00	00	00	00	001	82	00	00	00	83	00	00	00	DA DA	00	00	18	0.0	11	10	00	02	00	00	00	04	00	00	00
00000	1210	84	00	00	00	85	00	00	00	86	00	00	00	87	00	00	00	01	00	00	00	10	00	00	00	24	00	00	00	40	00	00	00
00000	1220	88	00	00	0.0	199	00	00	00	84	00	00	00	SP	00	00	00	03	00	00	00	24	01	00	00	10	00	00	00	97	00	00	00
00000	1220	00	00	60	Lhit	hear	lor	00	00	OA	00	00	00	0.0	00	00	00	22	00	00	1-bit	hear	OI	00	00	47	02	00	00	22	04	00	00
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Data in the test file inserts 64-bit header every 512-byte. The header is unique value in one SATA device. The first 32-bit header is calculated by (file name x file size) + sector offset in the file. The remaining 32-bit data is 0. After that, the test pattern is filled following user selection such as 32-bit increment pattern (left window of Figure 3-5) and 32-bit LFSR pattern (right window of Figure 3-5).



Figure 3-6 – Figure 3-8 show error messages when user's input is invalid. "Invalid input" message is displayed on the command shell, and then returns to main menu to receive new command.

/cygdrive/e/altera/16.0

1
+++ Write File selected +++
Press 'y' to set created time (Current = 22/09/2017, 15:31:18) => n
Input Start file No. (0x0000 - 0x1DCC) => 0xFFFF Out-of-range start file number
++++ INUALID INPUT ++++ Error message
----- Main menu [Ver = 1.0] ----[0] : Format Disk
[1] : Write File
[2] : Read File
[3] : Change FileSize







/cygdrive/e/altera/16.0
1
++++ Write File selected +++
Press 'y' to set created time (Current = 22/09/2017, 15:31:18) => n
Input Start file No. (0×0000 - 0×1DCC) => 0
Input NUM of file (0×0001 - 0×1DCD) => 1
File size = 32[MB],NUM of file = 1[File],Total = 32 MB
Select Pattern [0]Inc32 [1]Dec32 [2]All_0 [3]All_1 [4]LFSR => 9 Invalid pattern
++++ INVALID INPUT ++++ Error message
[0] : Format Disk
[1] : Write File
[2] : Read File
[3] : Change FileSize





3.3 Read File

Select '2' to read file to the SATA device. Three inputs are required for this menu.

- 1) Start file No Input a number of the first read file. The input can be decimal unit or add prefix "0x" for hexadecimal unit.
- 2) NUM of file Input total transfer size in file unit. The input can be decimal unit or add prefix "0x" for hexadecimal unit.
 Select pattern – Select pattern to varify data from daviag. Test pattern must be matched

Select pattern – Select pattern to verify data from device. Test pattern must be matched with written data. Five types can be selected, e.g. 32-bit increment, 32-bit decrement, all 0, all 1, and 32-bit LFSR counter



Figure 3-9 Result and input from Read File menu with successful verification

Similar to write test, if all inputs are valid, the operation will be started. Total data size is displayed first. Then, current transfer size is displayed out to the console every second during reading operation to show that system still operates. Final stage, test performance is displayed when the transfer is done. "Invalid input" will be displayed if any inputs are invalid.

Figure 3-10 and Figure 3-11 show the error message when data verification is failed. "Verify fail" message is displayed with name of the first file that error occurs, error address, expected data, and read data. User can press some keys to cancel the operation or wait until all read process complete.



/cygdrive/e/altera/16.0

2 * +++ Read File selected +++ Input Start file No. (0x0000 - 0x1DCC) => 0 Input NUM of file (0x0001 - 0x1DCD) => 0x60 File size = 32[MB],NUM of file = 96[File],Total = 3 GB Select Pattern [0]Inc32 [1]Dec32 [2]All_0 [3]All_1 [4]LFSR => 4 561.960 MB 1.125 GB 1.688 GB 2.251 GB *********Verify fail******* File name : FILE0045.bin Verify fail without cancel operation Byte Address : 0x0000008 Expect data : 0x008A0001 Read data : 0x0000000 Press any key to cancel operation 2.814 GB Done Total = 3[GB] , Time = 5723[ms] , Transfer speed = 562[MB/s] - Main menu [Ver = 1.0] -------[0] : Format Disk [1] : Write File [2] : Read File [3] : Change FileSize •

Figure 3-10 Data verification is failed and user does not cancel operation

/cygdrive/e/altera/16.0	
2	*
+++ Read File selected +++ Input Start file No. (0x0000 - 0x1DCC) => 0 Input NUM of file (0x0001 - 0x1DCD) => 0x80 File size = 32[MB],NUM of file = 128[File],Total = 4 GB	
Select Pattern [0]Inc32 [1]Dec32 [2]All_0 [3]All_1 [4]LFSR => 4 561.944 MB 1.124 GB 1.688 GB 2.251 GB	
Verify fail with	
Byte Address : 0x0000008 cancel operation	
Expect data : 0x008A0001 Read data : 0x0000000	
Press any key to cancel operation	
2.814 GB 3.377 GB	
Please reset system before start new test Operation is cancelled	
Main menu [Ver = 1.0]	
[1] : Write File	
[2] : Read File	
L3J : Change FileSize	-

Figure 3-11 Data verification is failed and user cancels operation



3.4 Change File Size

Select '3' to change file size. After selecting menu, current file size and warning message are displayed on the console. Then, user can input 'y' or 'Y' to confirm to change file size or input others to cancel the operation.

After confirming to change file size, the selecting file size menu is displayed. User can select the new file size here. When changing file size is completed, the system updates current operating file size and maximum file number.

When file size is changed, a request to format disk message is asked. Then, user can input 'y' or 'Y' to accept format disk operation or input others to refuse.

<u>Note</u>: Changing file size may damage to the file system. Therefore, user should format disk after the operation to delete files in the device.



Figure 3-12 Result from Change FileSize command





Figure 3-13 Cancel Change FileSize command



4 Revision History

Revision	Date	Description						
1.0	4-Oct-17	Initial version release						