

PCIe-FRM21

User's Manual



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1. Introduction

SDI (Serial Digital Interface) is a family of video interfaces by SMPTE (Society Motion and Television Engineers). These standards are used for transmission of uncompressed, unencrypted digital video signals.

Standard	Name	Bitrates (Max)	Resolution(Max)	Transfer Length(Max)
SMPTE 259M	SD-SDI	360Mbit/s	480i ¹ , 576i	20dB : 364m
				30dB : 545m
SMPTE 344M	ED-SDI	540Mbit/s	480p², 576p	
SMPTE 292M	HD-SDI	1.485Gbit/s	720p, 1080i	20dB : 179m
				30dB : 268m
SMPTE 372M	Dual HD-SDI	2.970Gbit/s	1080p	
SMPTE 424M	3G-SDI	2.970Gbit/s	1080p	

[Table 1. Standard SMPTE]

caution) 1. i : Interlaced

2. p : Progressive

The various serial digital interface standards all use coaxial cables with BNC connecters, with a nominal impedance of 75 ohms. The data of image, sound and various digital information (Line Counter, CRC) can carry hundreds meter far using coaxial cable. Transfer is serial communication, but the final processed image data is processed the parallel RGB or YCbCr such as the [Table 2].

Standard	Name	Frequency	Data Type	Data
SMPTE 259M	SD-SDI	270Mbps	YCbCr	4:2:2
SMPTE 292M	HD-SDI	1.5Gbps	YCbCr	4:2:2
SMPTE 372M	Dual HD-SDI	2 x 1.5Gbps	YCbCr	4:2:2
			RGB	4:4:4
SMPTE 424M	3G-SDI	3Gbps	YCbCr	4:2:2
			RGB	4:4:4

Caution) PCIe-FRM21 is supported until HD-SDI.

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The PCIe-FRM21 is a board having the function of processing the frame data received from HD-SDI (High Definition Serial Digital Interface) standard camera and transfer to PC through PCI Express 1x interface. It can support a Full HD (High Definition) resolution, in addition it has the 4 digital Inputs and 4 digital outputs for external controls.

The operation of the board is controlled by program API, figure [1-1] shows connection of the system (usually PC).



[Figure 1-1. PCIe-FRM21 board Usage]

As shown in Figure [1-1], the PCIe-FRM21 is inserted into any available PCI Express slot in your PC. It receives Image Frame through HD-SDI interface and saves the received data in the system main memory via PCI Express x1 interface.

[Features of the PCIe-FRM21 board]

- 1.485Gbit/s HD-SDI (High Definition Serial Digital Interface)
- Supports to SMPTE 259M(SD-SDI), SMPTE344M(ED-SDI), SMPTE292M(HD-SDI)
- 4:2:2 YCbCr Data Format
- Serial Digital Interface uses BNC Connecter/Cable
- PCI Express 1x Interface (Can connect PCI Express 4x, 8x, 16x)
- 128MByte DDR SDRAM (64MB x 2)
- Supports to 480i, 576i, 480p, 576p, 720p, 1080i formats
- 4 Bits Digital Input/Output
- Loop through Output (Option)
- Windows 2000 SP4 or Windows XP SP1 above
- Convenient Windows Application Programming Interface(DLL)

[Application]

- Interface for CCTV & DVR
- Image Acquisition (Pattern, Particle etc)
- Inspection Equipment (Sensor, Semiconductor, Device etc)
- Security Solution (CCTV Surveillance Cameras)
- Broad-casting

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2. Hardware Reference

2.1 FPGA Block Diagram

As shown in the following figure, main control of the board is performed in FPGA Core Logic. Primary functions are receiving the image frame data, and controlling 4 bit digital inputs and 4 bit digital outputs.

You can control these functions using API provided by DAQ system.



[Figure 2-1. Functional Block Diagram]

The core logic program of the FPGA is loaded by JTAG. It saves a program at the FPGA Program Logic and loads when power-up.



2.2 PCB Layout



[Figure 2-2. PCIe-FRM21 PCB Layout]

There are 7 LED in the board, each explanation is as follows.

- **LED1** turns on when the board wake up or resets.
- LED2 turns on when power is applied to the board and the initialization ends up.
- **LED3** turns on when the board receives the image frame data
- **LED4** on when the board transmits the received data to your PC
- **LED5** turns on when the DDR memory operate to write.
- **LED6** turns on when the image request is approved.
- **LED7** turns when FPGA configuration is completed.

2.2.1 Description of the functional blocks

(1) **FPGA**

All of the board functions are controlled by the Logic program of the FPGA.

(2) SDI Receiver

Receive SDI Data.

(3) **Regulator**

This block is for supplying the power to the board.

(4) PCI Express Chipset

This block is for PCI Express Bridge.

(5) Photo-coupler Isolated I/O

This block is for controlling isolated I/O circuit with external device.

2.3 Connector Pin-out

The PCIe-FRM21 board is equipped with BNC connector for HD-SDI Camera connection and D-SUB 15 Pin connector for external I/O connection.

Figure [4-2] shows the bracket of the board where P1 and J1 connector exist.



[Figure 2-3. PCIe-FRM21 Front View]

2.3.1 Dsub-15 Connecter : P1

Figure [2-4] shows the board's D-Sub15 connector pin-map.

[Figure 2-4. D-SUB 15PIN pin-out]

[Table 3.	D-Sub15	Connector	Description
[10010 5.	D Duois	connector	Desemption

Pin	Signal Name	Description	Remark
1	OUT0	Output 0	
2	OUT2	Output 2	
3	OUT_COM	Output Common	
4	IN0	Input 0	
5	IN2	Input 2	
6	IN_COM	Input Common	
7	N.C	No Connected	
8	GND	Ground	
9	OUT1	Output 1	
10	OUT3	Output 3	
11	N.C	No Connected	
12	IN1	Input 1	
13	IN3	Input 3	
14	N.C	No Connected	
15	N.C	No Connected	

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2.3.2 BNC Connecter : J3, J10

BNC(Bayonet Neil-Concelman) connecter is a miniature quick connect/disconnect RF connecter used for coaxial cable. It features three part of cable, at the center of the signal lines and coax internal signal that surround outer conductor (shield), and insulation. BNC connecters are made to match the characteristic impedance of cable at either 50 ohms or 75 ohms. The 75 ohm types can sometimes be recognized by the reduced or absent dielectric in the mating ends.

[Figure 2-5. BNC Connecter and Cable] Caution) Report : (RG-59 750hm Cable for BNC Connecter, Canare BCP-C4F)

[Figure 2-6. Cable Section]

2.3.3 J2 Connecter

J2 is a connecter for external power of 3.3V DC using to upgrade the FPGA. It is not used normal condition.

2.3.4 J4 Connecter

J4 is JTAG(Joint Test Action Group) connecter, it is used to update a FPGA program. It is not used normal condition.

2.3.5 SW1

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FPGA Reset Switch.

[Figure 2-7. SW1 Switch]

2.3.6 SW2

PCIe-FRM21 board is designed of four maximum PCIe-FRM21 boards at the same time so as usable. Distribution of each board sets it up through 4 pin switch (SW2) in a board.

[Figure 2-8. SW2 Switch]

[Table 4. SW2 Description]

1	2	Description
OFF	OFF	Board No. 0
ON	OFF	Board No. 1
OFF	On	Board No. 2
On	ON	Board No. 3

2.4 Digital I/O

PCIe-FRM21 Board has four photo-coupler isolated digital inputs and four equivalent outputs. Each is available from P1 connector. The equivalent circuit is as shown Figure [2-9].

< Photo coupler input>

<Photo coupler output>

[Figure 2-9. Photo-coupler Input/Output Circuit]

The input resistance is 2.4K ohms thus the flow current is about 5mA when 12V input is applied and about 10mA when 24V power applied. Maximum operation input voltage is from 9V to max 24V.

The output current is limited by output resistance, the output resistance is 22 ohms. Continuous output current has to be used under 10mA. The user can change the Input/Output resistance for special operation.

[Photo-coupler Digital Input]

[Figure 2-10. Photo-coupler Digital Input circuit]

Photo-coupler inputs are routed from connector P1(D-SUB 15Pin), each input are matched with DIO input bit position from 3 to 0 as shown in Figure [2-10].

[Photo-coupler Digital Output]

[Figure 2-11. Photo-coupler Digital Output Circuit]

Photo-coupler outputs are routed to connector P1(DSUB 15PIN), each output are matched with DIO output bit position from 3 to 0 as shown in Figure [2-11].

3. Installation

3.1 Package contents

In addition to the user's Manual, the package includes the following items. If any of these items is missing or damaged, contact DAQ system.

- PCIe-FRM21 board

- CDROM (drivers/manual/API/Samples etc.)

After unpacking, inspect the board carton to make sure there are no damages on the board.

3.2 Installation Sequence

To install your PCIe-FRM21 board in your PC, follow the steps described in the document "How to install PCI DAQ Board" provided by DAQ System. If the document is missing, you can get it from <u>www.daqsystem.com</u>. The PCIe-FRM21 board is completely Plug & Play. There are no switches or jumpers to set. Therefore you can install it easily.

- Your OS requirement : Windows 2000 SP4 or Windows XP SP1 above

The PCIe-FRM21 connects to Express Card Port. After that you can show the below picture of "New Hardware Search Wizard" window.

Found New Hardware Wiza	rd
	This wizard helps you install software for: PCI Data Acquisition and Signal Processing Controller If your hardware came with an installation CD or floppy disk, insert it now.
	What do you want the wizard to do? Install the software automatically (Recommended) Install from a list or specific location (Advanced) Click Next to continue.
	< Back Next > Cancel

Please cho	ose your search and installation options.
💿 Seard	h for the best driver in these locations.
Use t paths	ne check boxes below to limit or expand the default search, which includes local and removable media. The best driver found will be installed.
	Search removable media (floppy, CD-ROM)
	Include this location in the search:
	E:\CDROM_PCIe-FRM21\driver Srowse
O Don't	search L will choose the driver to install
Choo the di	se this option to select the device driver from a list. Windows does not guarantee the iver you choose will be the best match for your hardware.
	<pre></pre>

If the installation is completely finished, you confirm it in the following ways.

Do the following steps to show up the "Device Manager" window.

[My Computer -> properties -> Hardware -> Device Manager -> Multifunction Adaptors -> PCIe-FRM21]

[Figure 3-1. Select "My computer"->"Properties"]

Syster	n Restore	Automa	atic Updates	Remote
General	Comp	uter Name	Hardware	Advanced
Device I	Manager			
Ż	The Device M on your compo properties of a	anager lists all uter. Use the D ny device.	the hardware devic evice Manager to c	es installed hange the
			Device M	anager
Drivers-				
	Driver Signing compatible wit how Windows	lets you make h Windows, W connects to V	sure that installed d indows Update lets /indows Update for	rivers are you set up drivers.
	Driver	Signing	Windows I	Jpdate
Hardwai	e Profiles			
Ð	Hardware prof different hardv	iles provide a v vare configurat	vay for you to set up ions.) and store
			Hardware	Profiles

[Figure 3-2. "System Properties" window-"Hardware" Tab]

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[Figure 3-3. "Device Manager" window]

If you can see the "PCIe-FRM21" at Multifunction Adaptors, the driver installation is to have been over. (Check the red circle)

Important Notice : After installation, you should re-boot the system for the proper operation.

4. Sample Program

DAQ system provides a sample program to make the user be familiar with the board operation and to make the program development easier. You can find the sample program **"FrmTest.exe"** in the CDROM accompanying with the board. Before using it, you have to install the PCIe-FRM21 board and its drivers in your computer.

Sample program is provided in source form in order to show the usage of API (Application Programming Interface) of the board and may be modified for customer's own usage.

4.1 FrmTest Program

💐 제국없음 - Frm I	est
파일(<u>F</u>) 편집(<u>E</u>) 보	기(文) 도움말(H)
0 🖨 🔚 🕺 🖻	
- Resolution	View Resolution 800 × 600
1900790	
1200x 720 I	
Device July	00000000: C0778F898F77C088C0778F88C0778F88C178C088C177C187C177C188C278C188
Device init	00000020:C379C387C279C387C479C288C478C488C378C488C479C488C579C787C578C687
Start	00000041:057804870678078707780587057907870778058707780587077905870779058707790587
	100000061:C87AC78/C7AC88/C7ABC78628/9C787C87C87C87C87C87C87C87C87C87C87C87C87
FRAME Read	1000000-03-9300 (Co. 9300 (C. 130 (C.
Save Data	0000004-01130010013050104 mto 10 foc Make 10 mooth 10 moo
	00000000: 647771816476880758060818080778180880777838068807878380688078
Video Frame Mode	00000100:90807E82998098809C8099809C7F9C809F7F9D81A180A081A37FA281A57EA481
Progressive 💌	00000120: A67EA781A97DA880A57EA9809F7EA280A77EA081A87FA780A77EA680A97FA881
Video Data Bits	00000140:AC80AA81AB80AB80AE80AD80AE7FAD80AA7FAE80AC7FAA81AE7FAE81AF7EAE81
16Bit YUV 👻	00000160: AE7CAE81AE7DAE81AF7EAF81B07FB081B17EB081B07EB180B27FB080B17FB281
	00000180-B27EB281B37EB381B77EB580BB7EB881B97FBA82B97EB982AD7BB183AA7AAD84
FRAME View	0000011A0: A87CA883A87DA881A67EA880A47FA580A37FA480A27EA280A07DA1809F7EA080
T Auto View	1000011C0:90809E805C80908194/H-9C8199/E998194/H-998095/H-9/3195/H-982293/H-9481
	100001 E0: 948094809280948093 /r 92 /r 90 /r 91 808 /r 90805 80680808087 808808080
Frame Hate U	
T Auto Save	000022-0-04004001-01-001001-001-001001-0010001-00010001-00010-0000-0000-0000-0000-0000-0000-0000-0000
	0000260 : 758075707580757080808075808081757580807581808075807580758075807580758075
	00000280 : 808081 755080807F81 80807F828081 8081 808280628061 8081 8081 8081 8081 80
D:\Image	000002A0:838081808480837F8480847E8380827E8380837E8280837F8480837E847F847D
Select Folder	000002C0 : 847E847E8480847F8481837F8481847F8480847F8480847F8480847F8480847F
Save Count	000002E0:8380848083808380838083808480837F8580847E8480847E84808480848084808480
	00000300:84808480858084808580857F857F857F857E8480857F8480847E8580847F8580857E
-	00000320: 9550867/855806580858085808577 85608677 85808577 8677 8677 8677 8678 8678 8678 8678
DIO Read	
00	UUUUUUU-0 -0 rouo // rooouo rouo souo souo rouo rouo rouo ro
DIO Write	0000030-368086906806806808680729790987265868097769209872678680977886908880
00	000003E0: 86808580878066808780877F877F877F877F877F877F8780877F8780880878087
	00000400:878087758650888086808680880880887758780887E8780877586818680
Close Device	00000420:87808680887F887F8780887F8780887F868087808780878087808680878086808680
· 준비	NUM

[Figure 4-1. When Sample program "FrmTest.exe' is executed]

To run the sample application program, you need to use API, it is a form of client DLL. To compile the sample source to make its executable file, you have to use Import Library files and header files. You can find them in the CDROM. To run the .exe file, the API DLL file (**ijl15.DLL**) must be in the same directory with the .exe file or Windows system folder. Another method is to add

the directory of API DLL file to PATH environmental variable.

4.1.1 Functions related to image Frame

(1) Resolution

User can set up the resolution. If you select other resolution, you re-press this button.

(2) Device Init

Press this button to initialize the image frame function. It is performed only once after power is applied to the board.

(3) Start

Press this button to begin to save image data.

(4) FRAME Read

Press this button to read the image frame data of the board to your PC. If image frame data is not saved on the board, you must wait until the end of data collection.

(5) Save Data

Press this button to begin to save image data.

(6) Video Frame Mode

It selects a Progressive or Interlace Mode according camera image.

(7) Video Data Bits

It selects 16Bit YUV.

(8) Frame View

When press this button, it displays a freeze-frame.

(9) Auto View

When check this box, it displays a video as below Figure [5-2].

(10) Frame Rate

Frame rate per second

(11) Auto Save

When check this box, it save a file by BMP or JPEG format each 30 frames per 1 second until un-check this box.

(12) Select Folder

It selects a folder for saving. It set "D:\Image" folder basically.

(13) Close Device

Press this button to finish usage of the board and terminate the program.

4.1.2 Functions related to DIO

(1) **DIO Read**

Press this button to read the data on General Purpose I/O port. Reading Data are recorded the editor box beside the button

(2) DIO Write

Press this button to write the data on General Purpose I/O port. You can directly write the data in the editor box beside the button.

5.2 FrameView

[Figure 5-2. When Sample program "FrameView.exe" is executed]

To run the sample application program, you need to use API, it is a form of client DLL. To compile the sample source to make its executable file, you have to use Import Library files and header files. You can find them in the CDROM. To run the .exe file, the API DLL file (**PCI_FRM21.DLL**) must be in the same directory with the .exe file or Windows system folder. Another method is to add the directory of API DLL file to PATH environmental variable.

- (1) Select Resolution --- It selects resolution to adjust a Camera output resolution.
- (2) Device Load --- Recall .dll file.
- (3) Board # selection --- Select a PCIe-FRM21 board number $0 \sim 3$.
- (4) Device Start --- Start device which you selected.
- (5) Device Stop --- Stop device which you selected.

Appendix

A.1 Specification

General

- 1.485Gbit/s HD-SDI (High Definition Serial Digital Interface)
- PCI Express Specification Revision 1.0
- PCI Express 1x interface
- Support HDMI 1.3, DVI 1.0
- High-bandwidth digital content protection (HDCP 1.3)
- Supports to High quality multi-format video mode

Memory

• 128Mbyte DDR SDRAM

Interface

Supports to SMPTE 259M(SD-SDI), SMPTE344M(ED-SDI), SMPTE292M(HD-SDI)

Function

- Transfer image frame data to PC
- Supports to 480i, 576i, 480p, 576p, 720p, 1080i formats
- 4 Bits Digital Input/Output

Operating System

• Windows 2000 SP4 / Windows XP SP1 / Windows 7

API

• Interface with Application through client DLL

Form Factor

• PCI Express x1 interface

Operating Environment

- Temperature : 0 to 50
- Humidity : 0 to 90% RHNC

A.2 Physical Dimension

References

	Camera Link committee
2. PCI Local Bus Specification Revision2.1	
	PCI Special Interest Group
3. How to install PCI DAQ Board	
	DAQ system
4. AN201 How to build application using API	
	DAQ system
5.AN312 PCIe-FRM21 API Programming	
	DAQ system