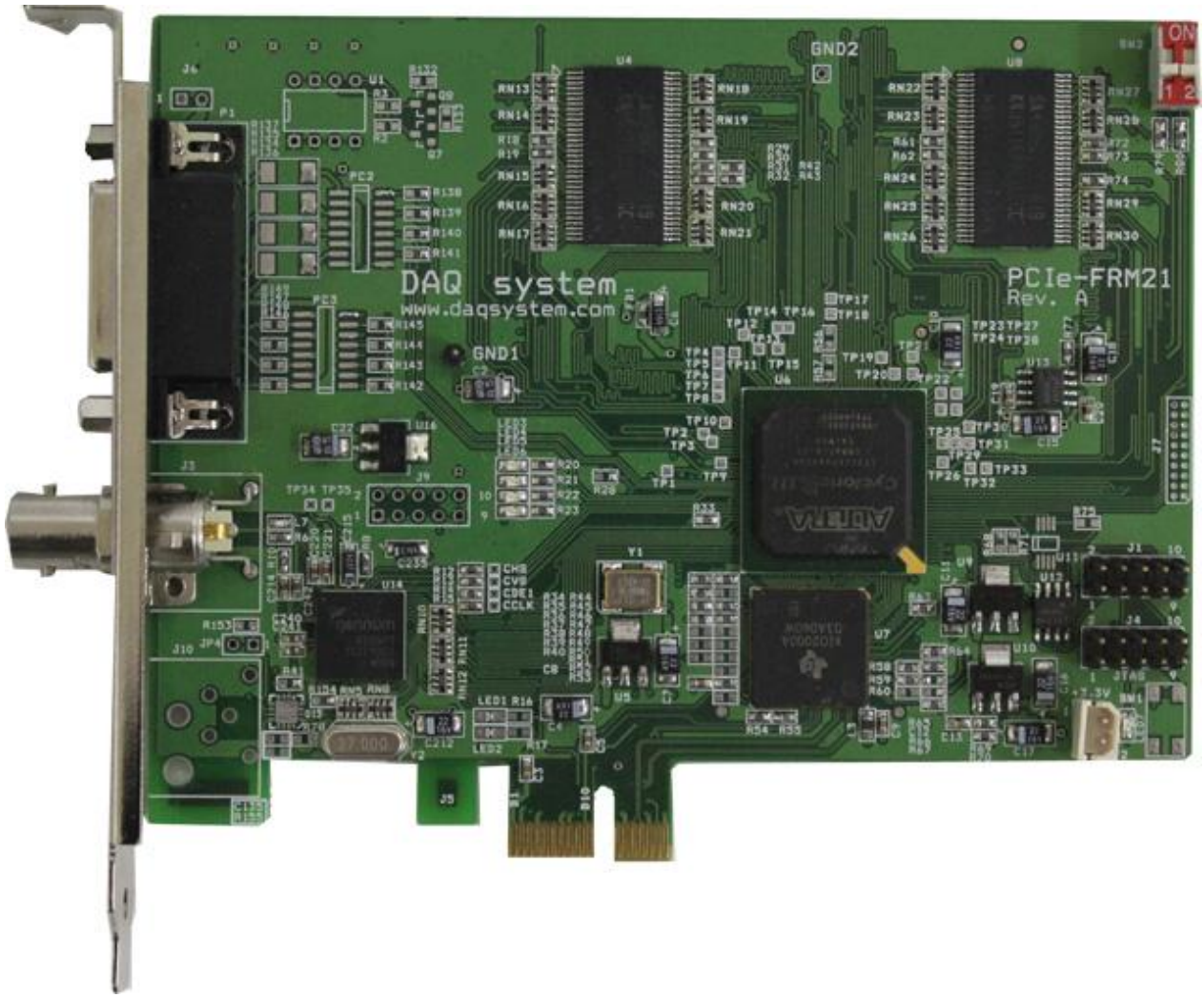
PCIe-FRM21

User's Manual



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-- Contents –

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.

[Table 1. Standard SMPTE]

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	480p[2], 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	

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].

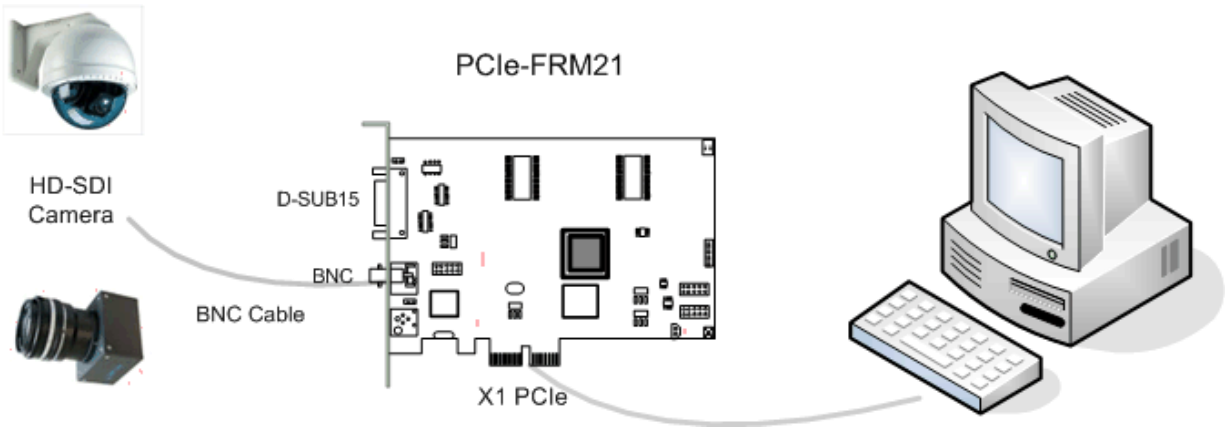
[Table 2. SDI Data Type]

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 RGB	4 : 2 : 2 4 : 4 : 4
SMPTE 424M	3G-SDI	3Gbps	YCbCr RGB	4 : 2 : 2 4 : 4 : 4

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

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]

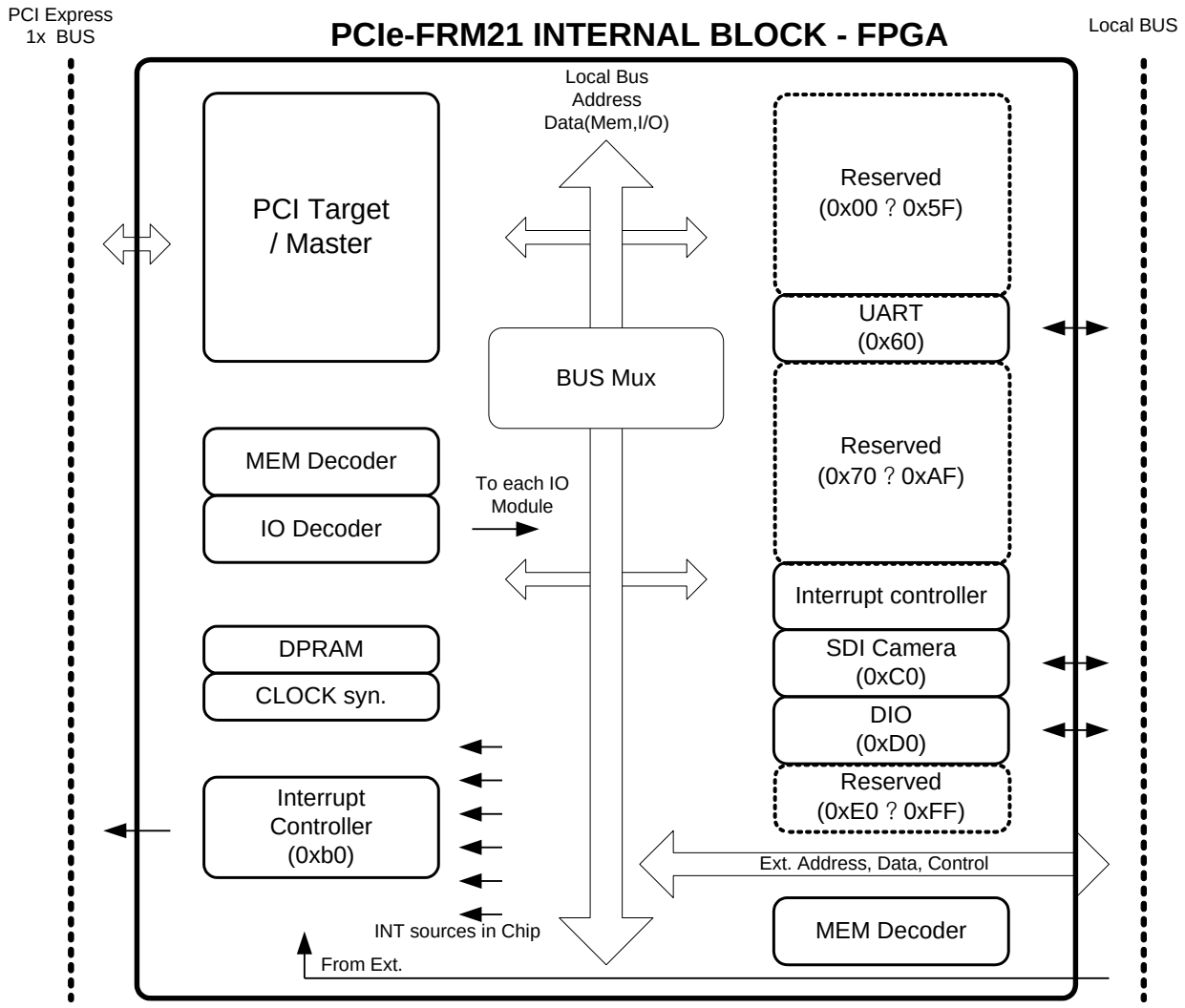
- Interface for CCTV & DVR
- Image Acquisition (Pattern, Particle etc)
- Inspection Equipment (Sensor, Semiconductor, Device etc)
- Security Solution (CCTV Surveillance Cameras)
- Broad-casting

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.

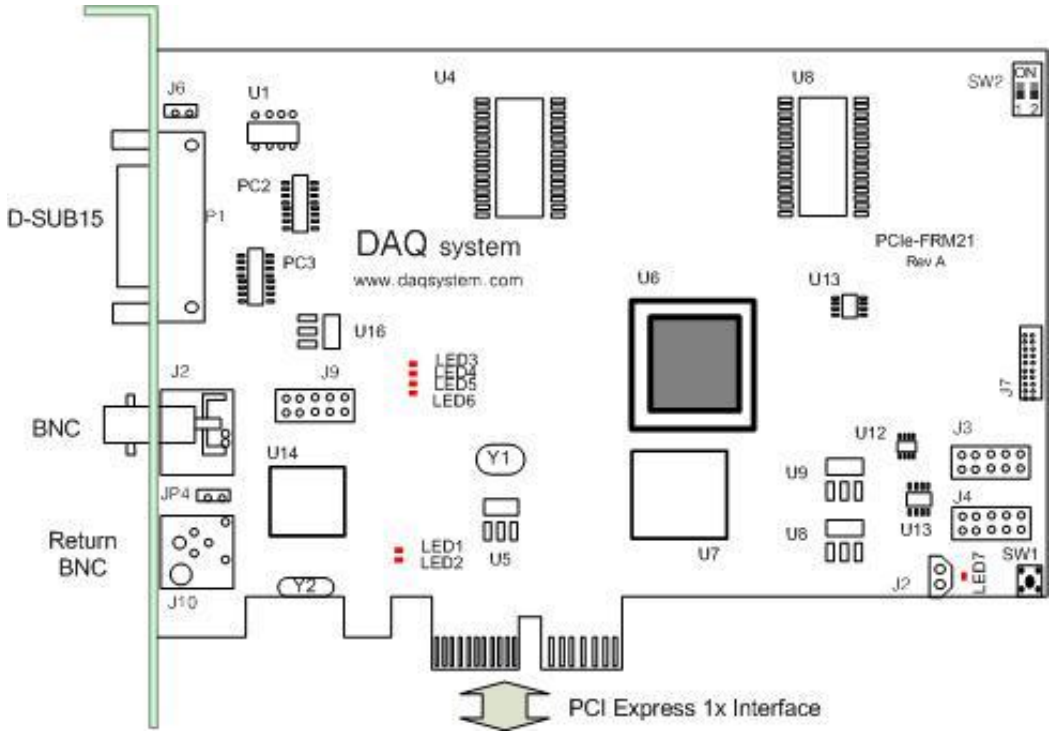
You can control these functions using API provided by DAQ system.



[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.

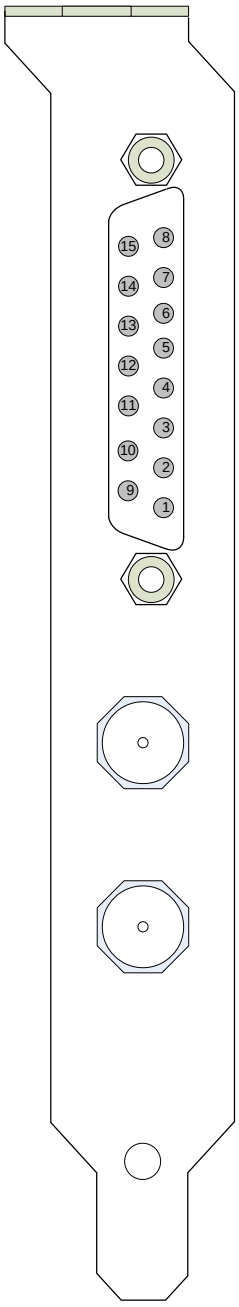
(5) **Photo-coupler Isolated I/O**

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.

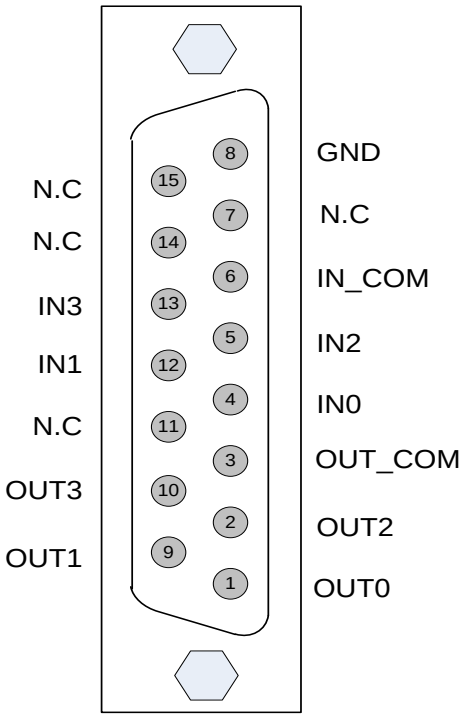
Figure [4-2] shows the bracket of the board where P1 and J1 connector exist.



[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]

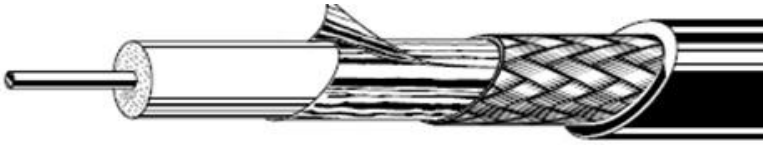
Pin	Signal Name	Description	Remark
1	OUT0	Output 0	
2	OUT2	Output 2	
3	OUT_COM	Output Common	
4	IN0	Input 0	
5	IN2	Input 2	
6	IN_COM	Input Common	
7	N.C	No Connected	
8	GND	Ground	
9	OUT1	Output 1	
10	OUT3	Output 3	
11	N.C	No Connected	
12	IN1	Input 1	
13	IN3	Input 3	
14	N.C	No Connected	
15	N.C	No Connected	

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 75Ohm Cable for BNC Connecter, Canare BCP-C4F)



[Figure 2-6. Cable Section]

2.3.3 J2 Connecter

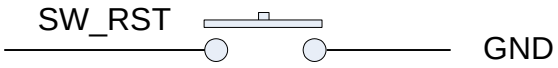
J2 is a connecter for external power of 3.3V DC using to upgrade the FPGA. It is not used normal condition.

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

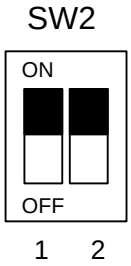
FPGA Reset Switch.



[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.



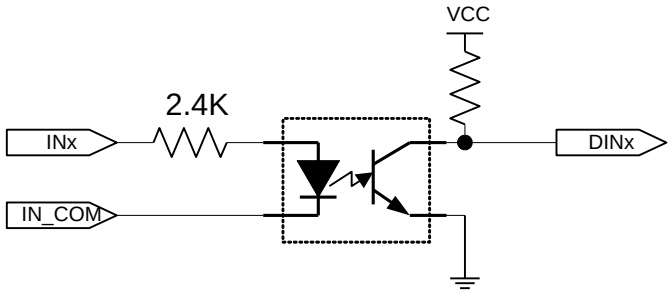
[Figure 2-8. SW2 Switch]

[Table 4. SW2 Description]

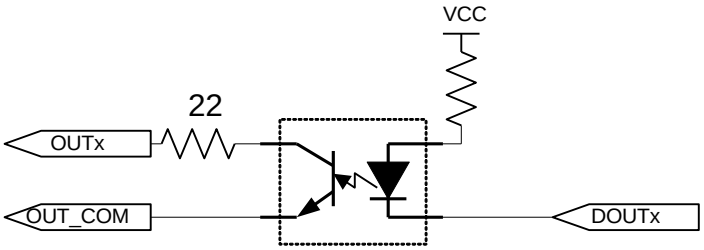
1	2	Description
OFF	OFF	Board No. 0
ON	OFF	Board No. 1
OFF	On	Board No. 2
On	ON	Board No. 3

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>



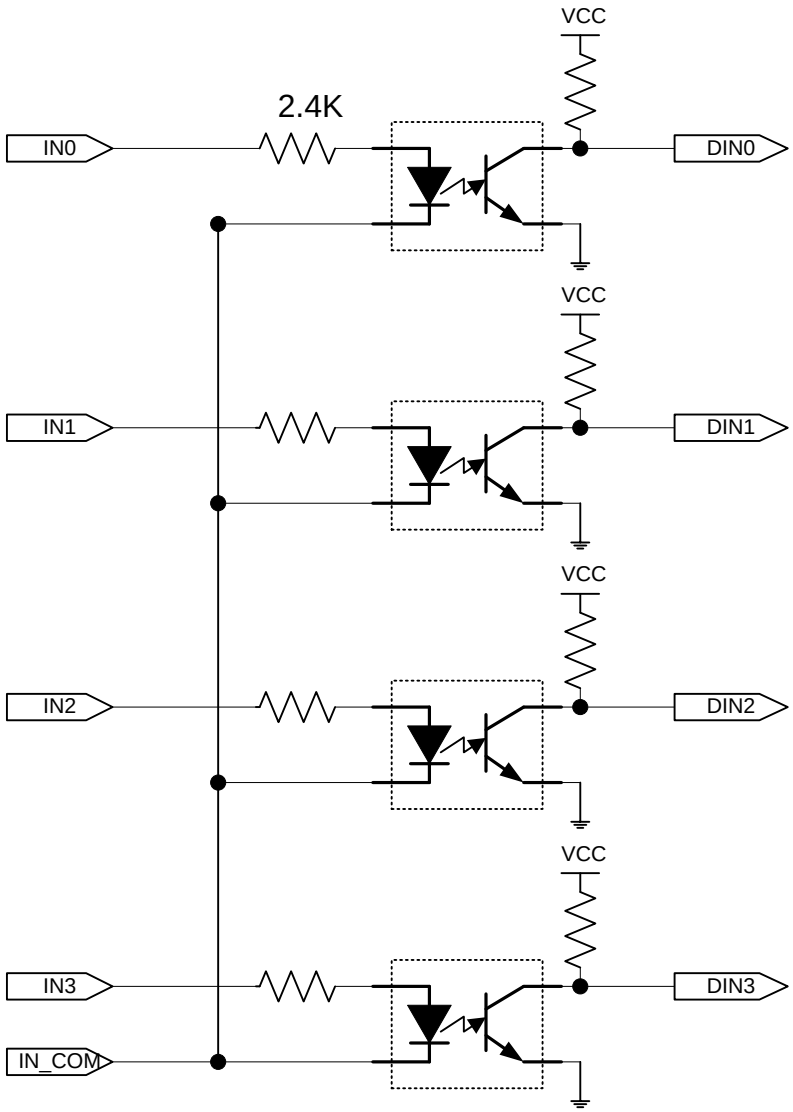
<Photo coupler output>

[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.

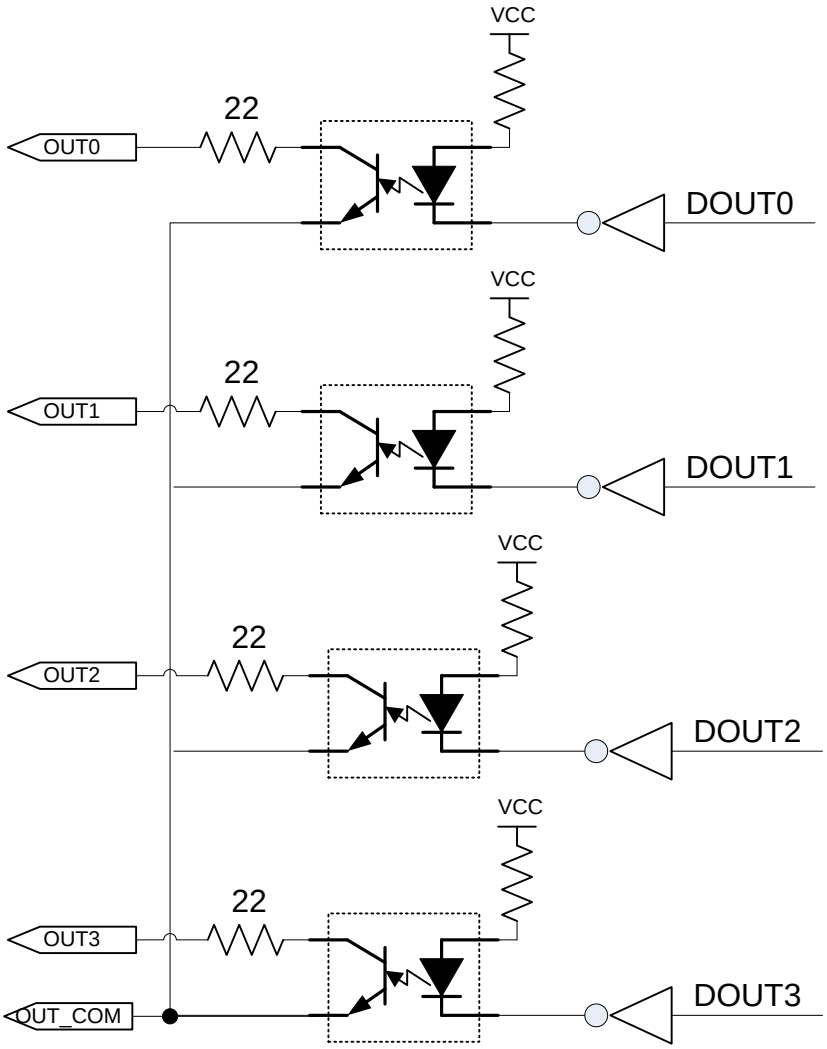
[Photo-coupler Digital Input]



[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.)

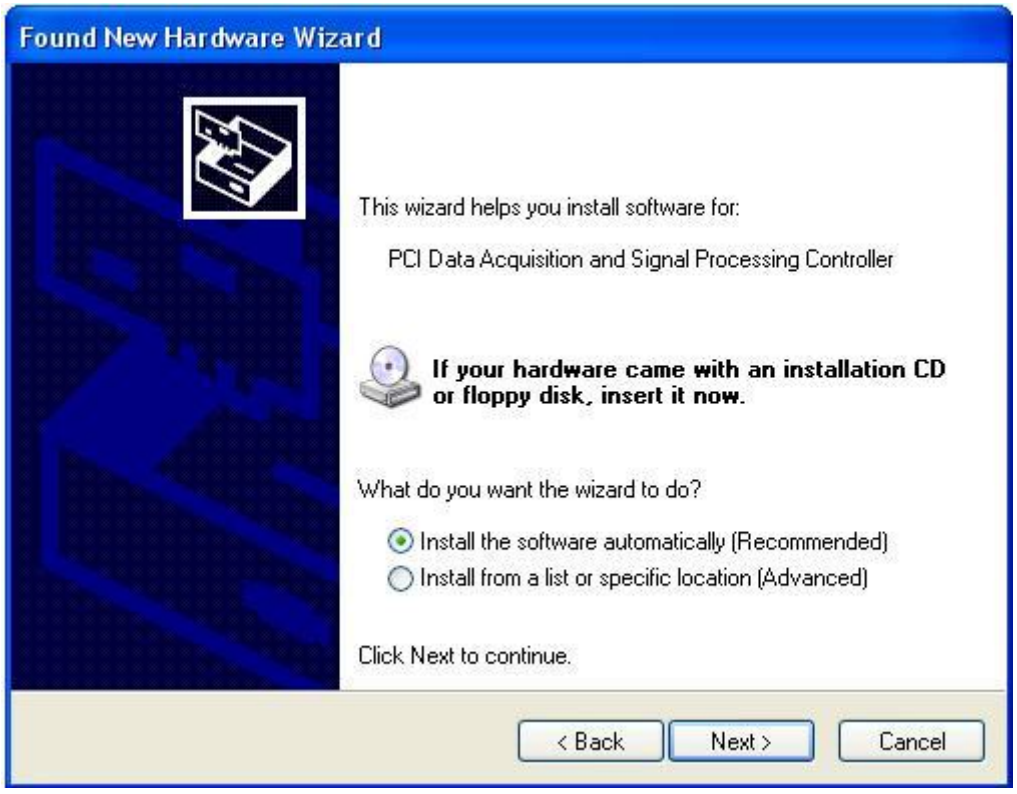
After unpacking, inspect the board carton to make sure there are no damages on the board.

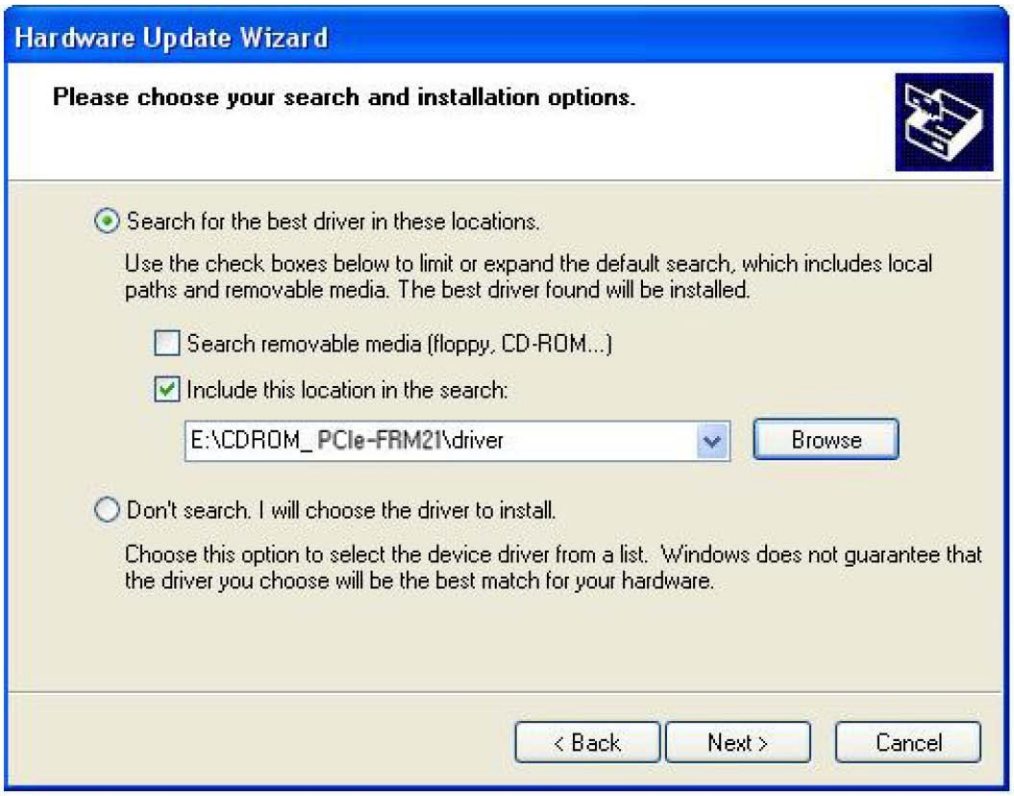
3.2 Installation Sequence

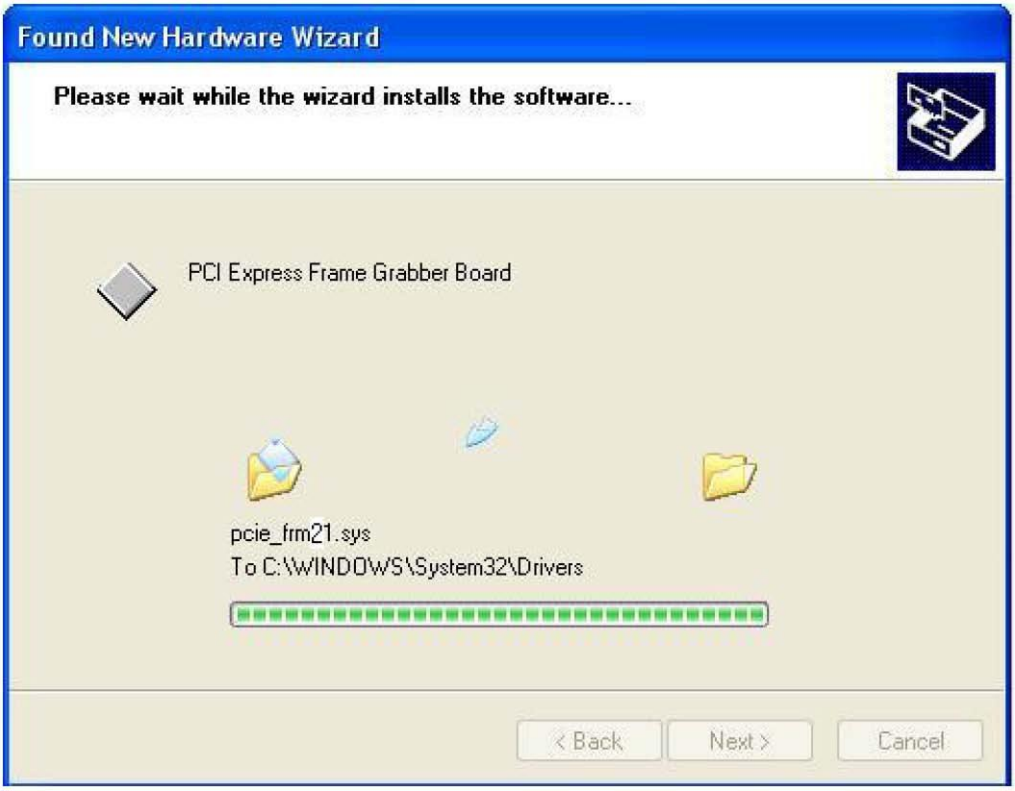
To install your PCIe-FRM21 board in your PC, follow the steps described in the document "How to install PCI DAQ Board" provided by DAQ System. If the document is missing, you can get it from www.daqsystem.com. The PCIe-FRM21 board is completely Plug & Play. There are no switches or jumpers to set. Therefore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



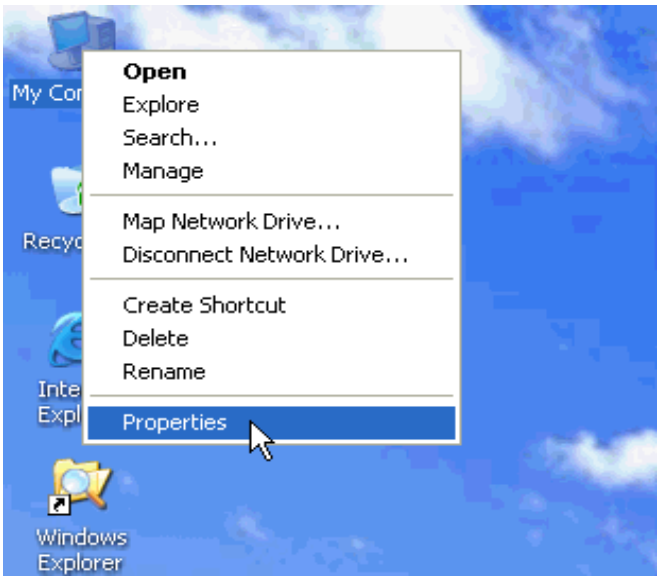

Hardware Update Wizard
Please choose your search and installation options.
Search for the best driver in these locations.
Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.
Search removable media (floppy, CD-ROM...)
Include this location in the search:
E:\CDROM_ PCIe-FRM21\driver
Browse
Don't search. I will choose the driver to install.
Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.
< Back
Next >
Cancel


Found New Hardware Wizard
Please wait while the wizard installs the software...
PCI Express Frame Grabber Board
pcie_frm21.sys
To C:\WINDOWS\System32\Drivers
< Back
Next >
Cancel

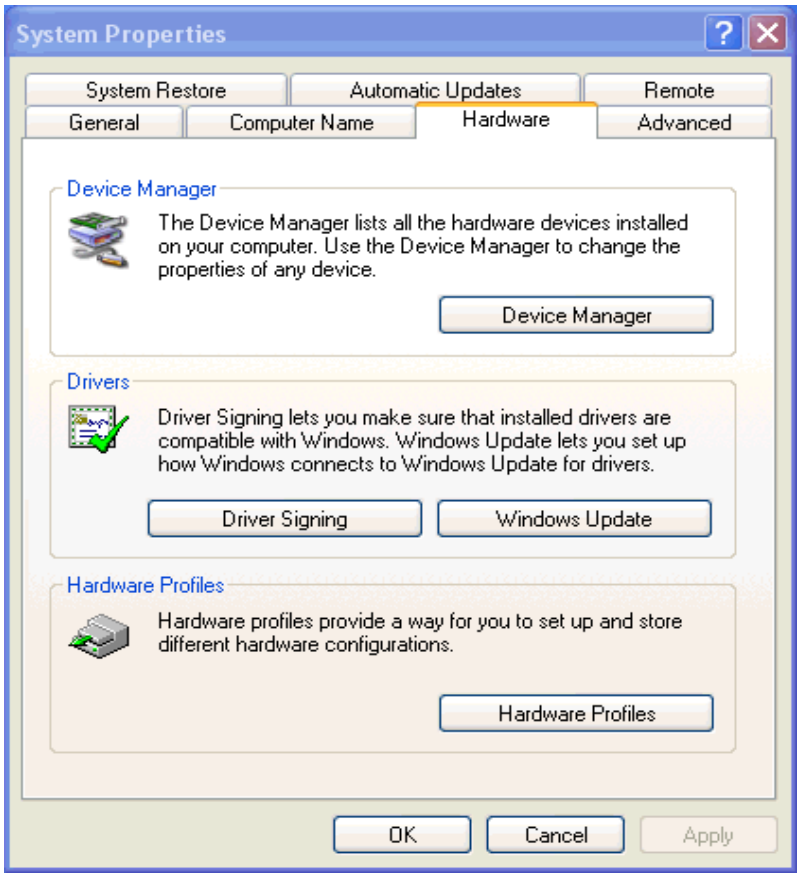
If the installation is completely finished, you confirm it in the following ways.

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

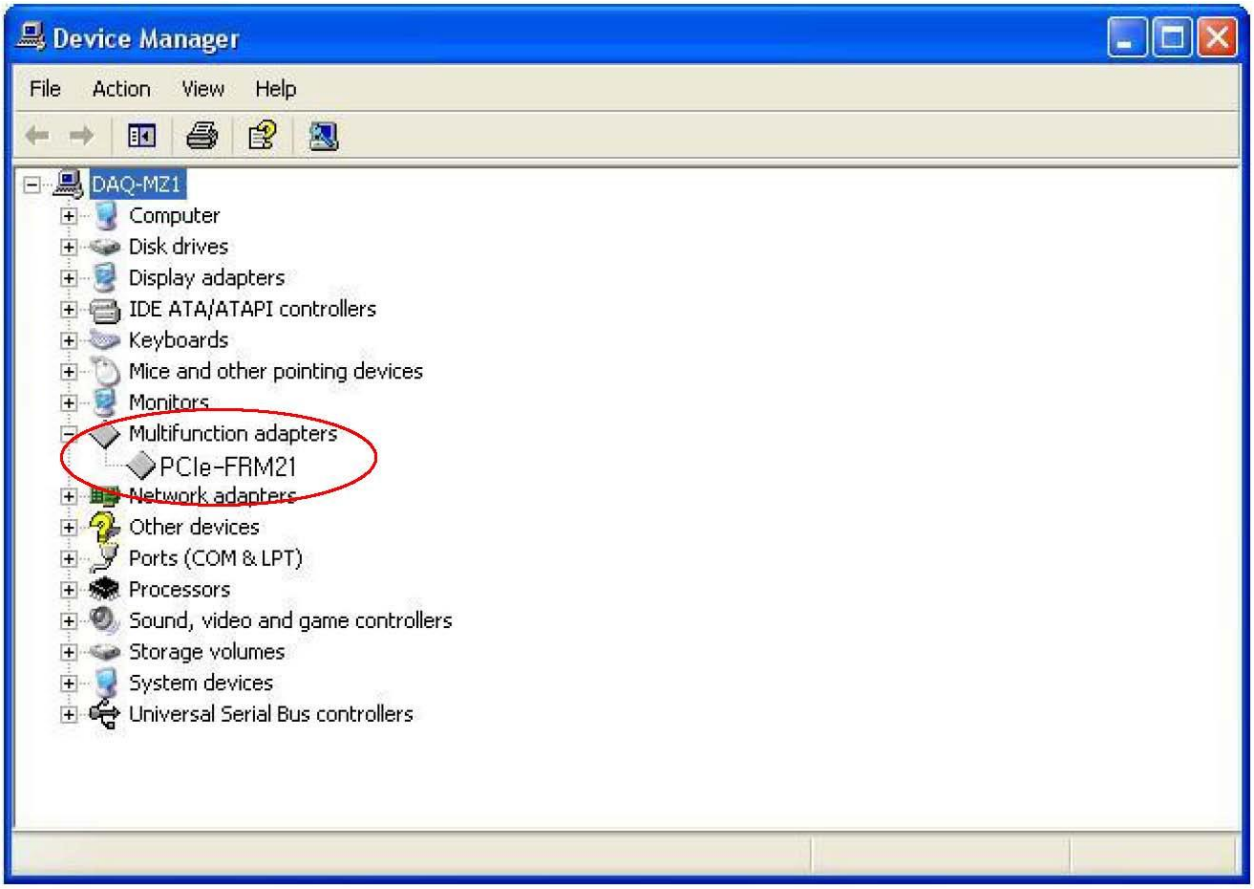
[My Computer -> properties -> Hardware -> Device Manager -> **Multifunction Adaptors** -> **PCIe-FRM21**]



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



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



[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)

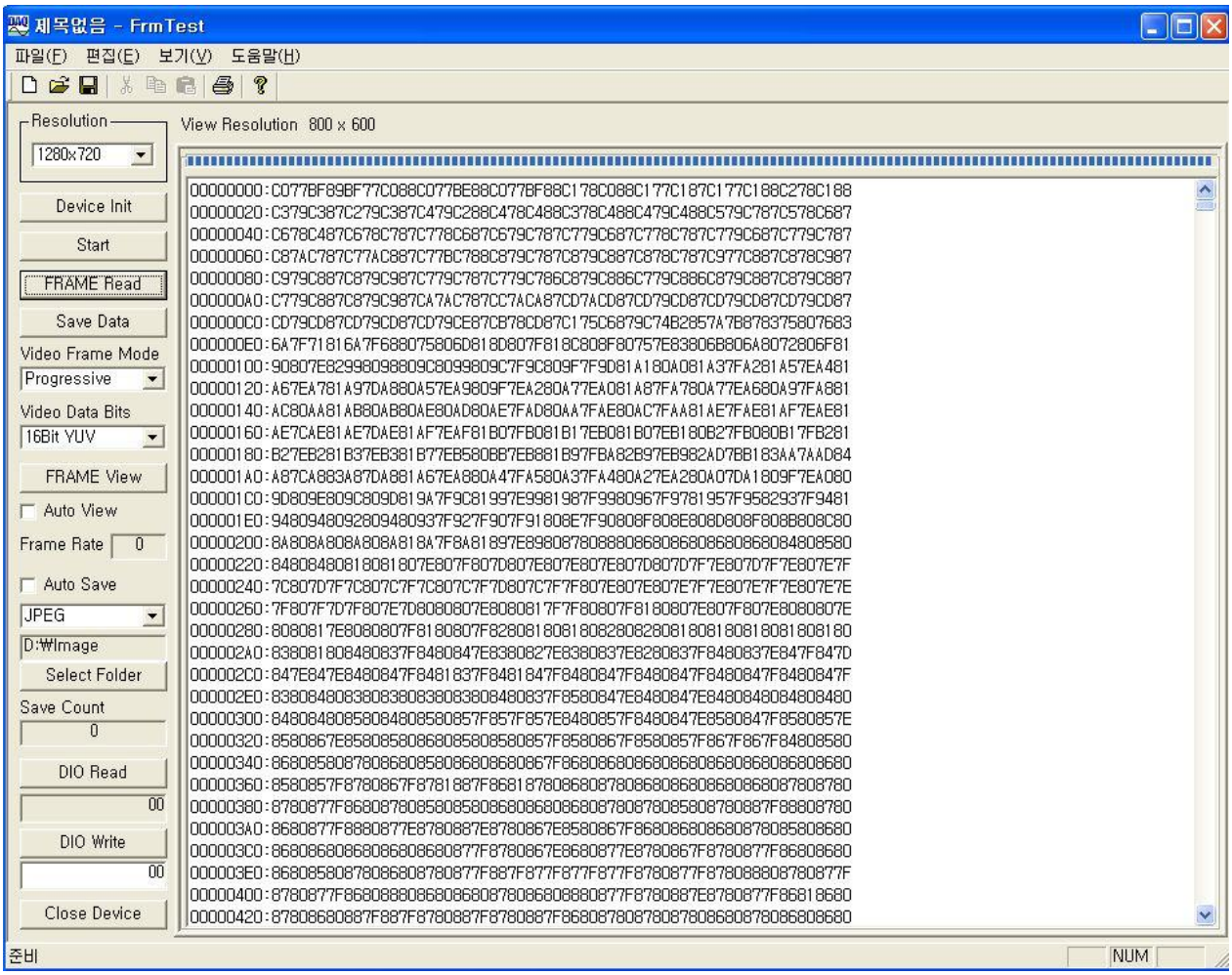
Important Notice : After installation, you should re-boot the system for the proper operation.

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



[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

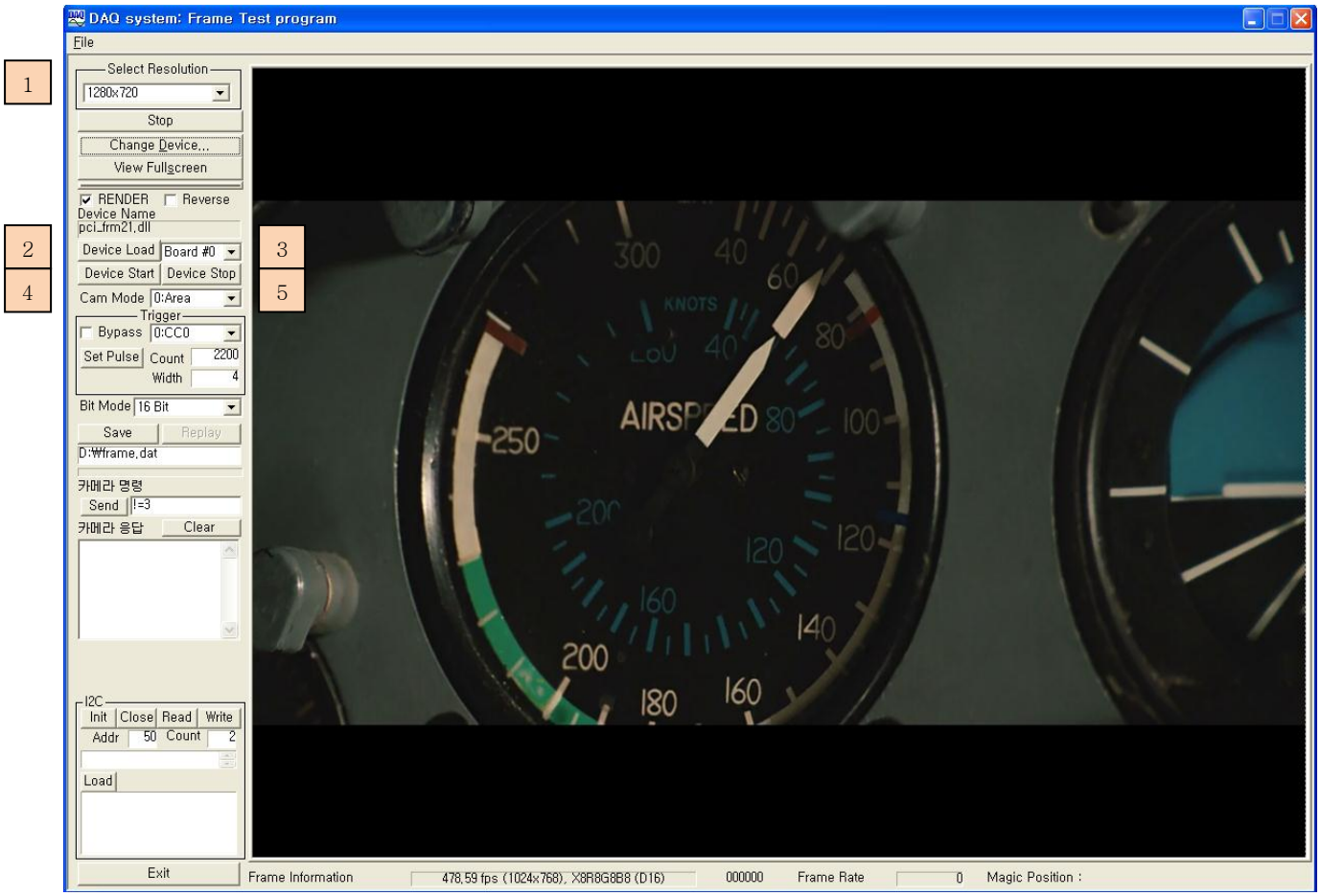
(1) **DIO Read**

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 ~ 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

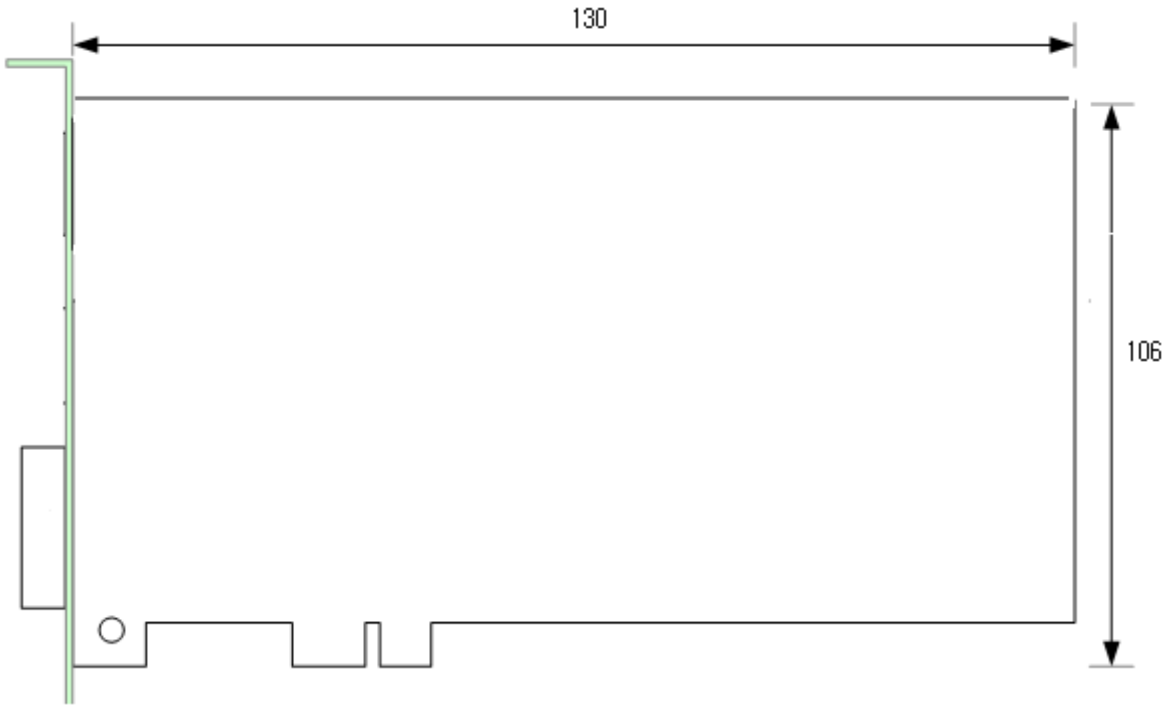
Form Factor

- PCI Express x1 interface

Operating Environment

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

A.2 Physical Dimension



References

1. Specification of Camera Link Interface Standard for Digital Cameras and Frame Grabbers

-- 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