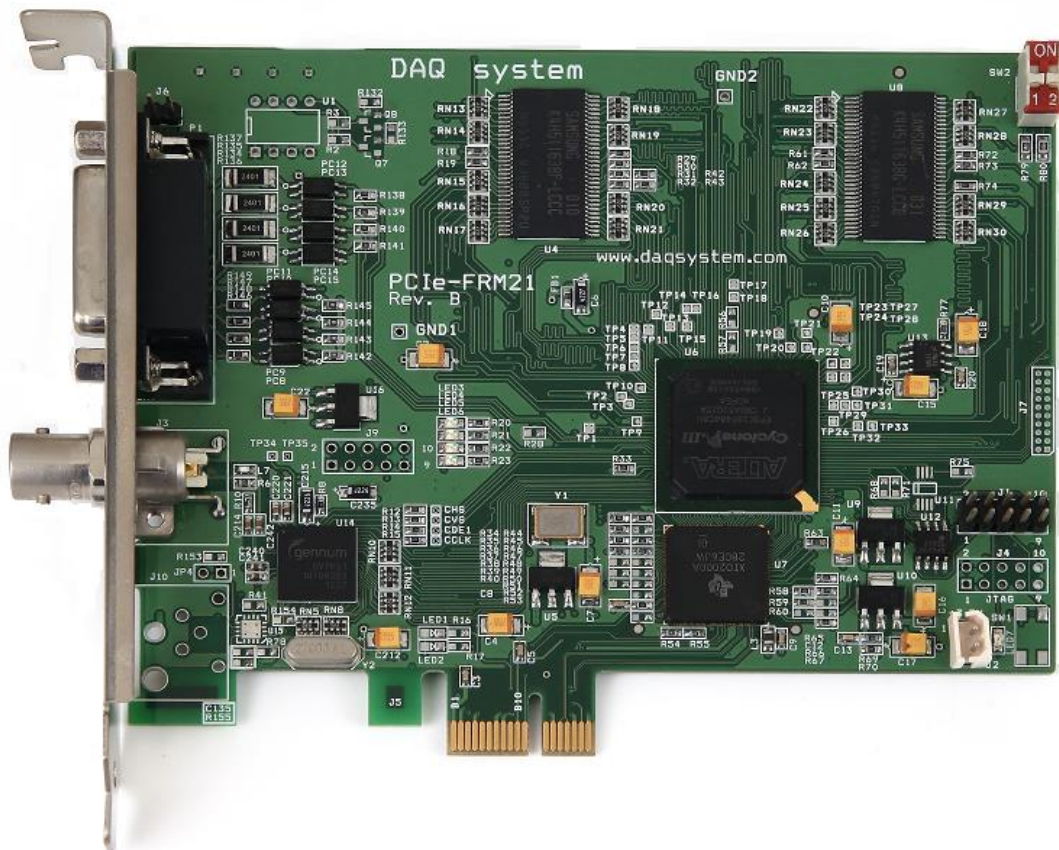


# PCIe-FRM21

## User Manual

Version 1.2



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## 1. Introduction

SDI (Serial Digital Interface) is a video interface standardized by SMPTE (Society Motion and Television Engineers). In order to realize high quality that exceeds the low resolution of CVBS, S-Video, PAL, and NTSC of analog video format methods, an uncompressed transmission method with a serial interface is adopted as a standard.

[Table 1. Standard SMPTE ]

Signal Spec.	Name	Bitrates (Max)	Resolution(Max)	Transmission (Max) <sup>3</sup>
SMPTE 259M	SD-SDI	360Mbit/s	480i <sup>1</sup> , 576i	20dB : 364m 30dB : 545m
SMPTE 344M	ED-SDI	540Mbit/s	480p <sup>2</sup> , 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	

**Note) 1. i : Interlaced                      2. p : Progressive**

**3. In the SMPTE standard, the maximum transmission distance of a coaxial cable is regarded as 30dB for video formats under SMPTE 259M (SD signal) and 20dB for HD-SDI signal of SMPTE 292M. It can be seen that there is a big difference in the transmission distance depending on the frequency of the signal even with the same coaxial cable.**

**(Note) 1. Currently, Interlaced mode is not supported.**

Using a BNC coaxial cable, video information, audio information, and various digital information (Line Counter, CRC) can be transmitted over a distance of several hundred meters through a single line. Transmission is done serially, but the final processed image data is processed as YCbCr or RGB parallel data as shown in the table below.

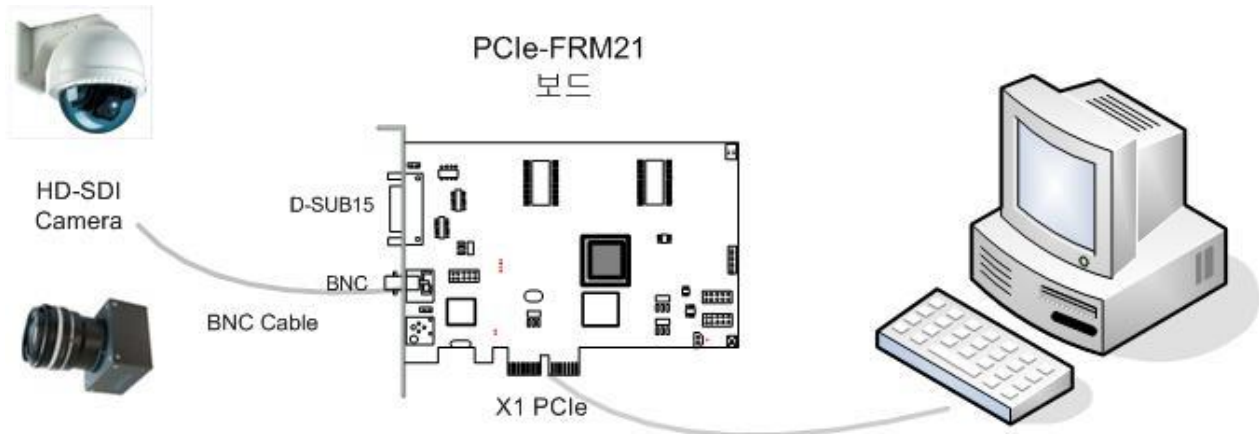
[Table 2. SDI Data Type]

Signal Spec.	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

**Note) Some high-end 3G-SDI screens may be cut off depending on system specifications.  
PCIe-FRM21 is supported until HD-SDI.**

PCle-FRM21 is linked with HD-SDI (High Definition Serial Digital Interface) camera, which is used to realize high-definition images that exceed the low resolution of analog video formats, and transmits the captured image frame to the PC using the PCI Express 1x interface method. It is a board that It can support up to Full-HD and also has the function of external control by providing 4 Digital Inputs and 4 Digital Outputs.

The operation of the board is controlled by the program API, and the figure below shows the interlocking operation of the board.



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

As shown in [Figure 1-1], PCIe-FRM21 is installed in the PCI Express slot in the PC and receives the image frame from the HD-SDI Camera through the HD-SDI interface. It is responsible for transmitting the received data to the application program through the PCI Express 1x interface.

## 1-1 Product Features

Items	Description	Remark
<b>Hardware</b>		
PC Interface	PCI Express 1x	
Operation Power	+12VDC/650mA	External 12V DC Power (A6-Type : 5.5x2.1mm)
Video Interface	SMBTE 259M(SD-SDI) SMBTE 344M(ED-SDI) SMBTE 292M(HD-SDI)	480i, 576i, 480p, 576p, 720p, 1080i formats지원
Feature	8-bit, 10-bit Component Digital Video RGB or YCbCr 4:4:4 / YCbCr 4:2:2 or 4:2:0 4 Bits Digital Input/Output Loop through Output (Option)	
Interface	Serial Digital Interface uses BNMC connector / Cable (75 Ohm Coaxial)	
On-board Memory	1286MB DDR SDRAM	
Communication		
Simultaneous use of boards	Max. 4	
<b>Software</b>		
OS	Windows 2000/XP/7/8/10 (32/64bit)	
API	Windows Client DLL API	
Development		
Support	Sample Program	VC++
<b>Environmental conditions</b>		
Operating temperature range	0 ~ 60°C	
Storage temperature range	-20 ~ 80°C	
Humidity range	5 ~ 95%	Non-condensing
Board size	130mm X 106mm	PCB Board size

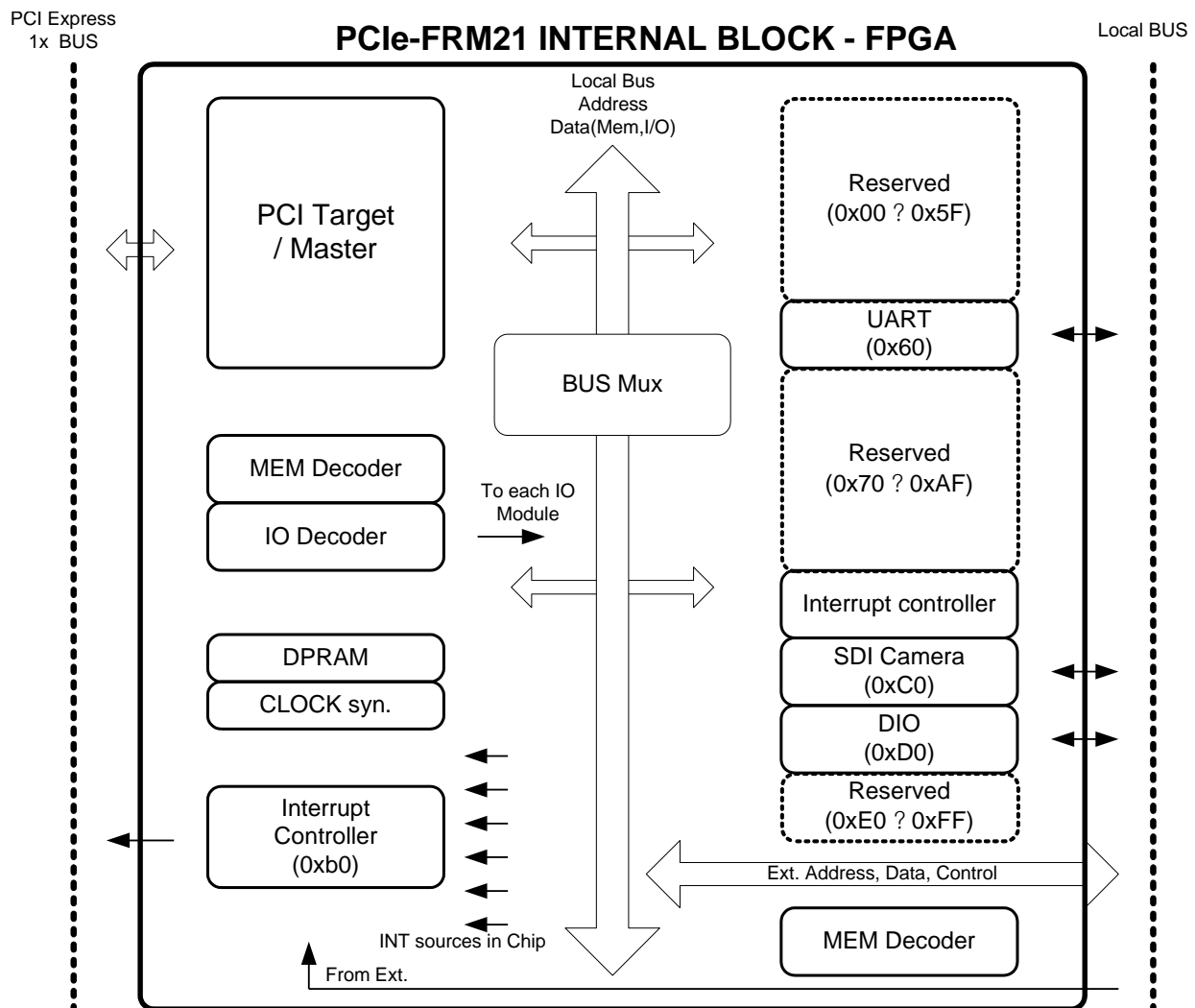
## 1-2 Product Applications

- Interface for CCTV & DVR (Digital Video Recorder)
- Surveillance Security Solution (CCTV)
- Image recognition (Pattern, particle, etc.)
- Inspection equipment (Sensor, Semiconductor, Device, etc.)
- Broadcast equipment

## 2. PCIe-FRM21 Board Function

### 2-1 Block Diagram

As shown in the figure below, in the case of PCIe-FRM21, FPGA Core Logic is in charge of overall control. Its main function is to receive Image Frame Data through two BNC connectors, write it to DDR#1 and DDR#2 first, and transmit it to the PC upon request. These functions are performed using API in PC through USB 3.0 interface.

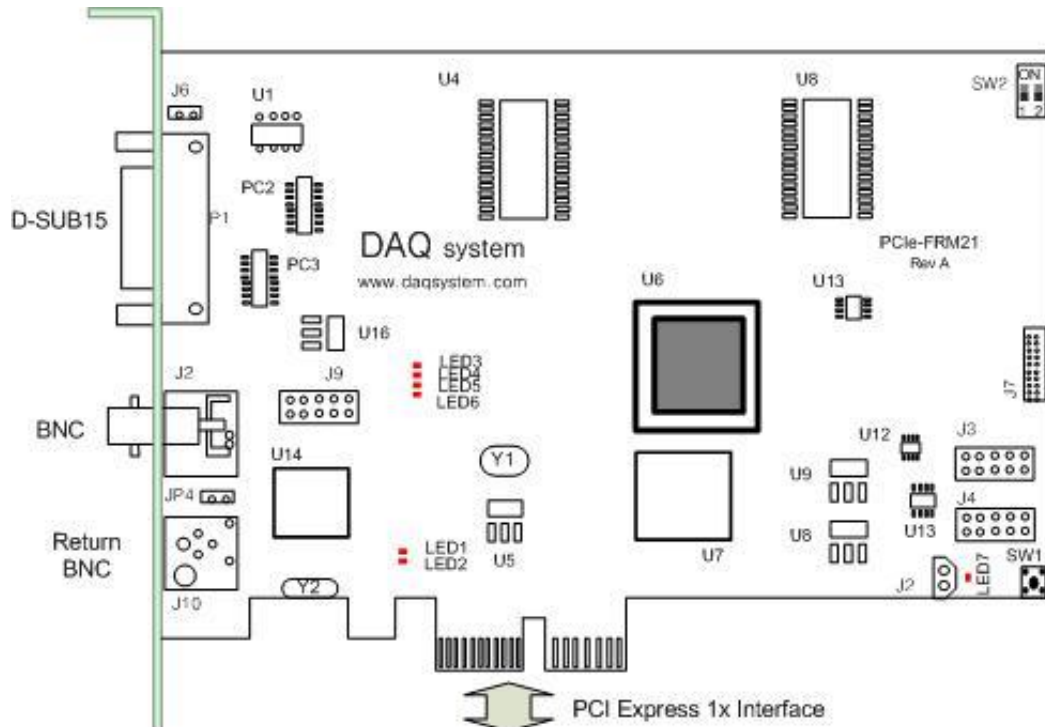


[Figure 2-1. PCIe-FRM21 Block Diagram]

The FPGA core logic is programmed using JTAG, and the logic program is saved in FPGA Program Logic and loaded when power is applied.

## 2-2 PCIe-FRM21 Board Layout

Each important board function is briefly described. For detailed function information, please refer to the parts specification.



[Figure 2-2. PCIe-FRM21 Layout]

There are a total of seven LEDs on the board, and the description of each is as follows.

**LED1** : Lights up when the board is booted or reset.

**LED2** : Lights up when the board finishes configuration and ready for operation.

**LED3** : Lights up when there is a video request.

**LED4** : Lights up when video is transmitted.

**LED5** : Lights up during write operation of DDR memory.

**LED6** : Lights up when the video request is approved.

**LED7** : Lights up when FPGA configuration is completed.



## 2-2-1 Device Features

(1) **FPGA : U6**

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

(2) **SDI Receiver : U14**

Receive SDI data.

(3) **Regulator : U5, U8, U9, U13, U16**

This block is for supplying the power to the board.

(4) **PCI Express Chipset : U7**

PCI Express Bridge.

(5) **DDR Mempy : U4,U8**

128Mbyte (64MB x2) DDR SDRAM.

(6) **Oscillator : Y1, Y2**

It supplies the necessary clock to FPGA and SDI Receiver.

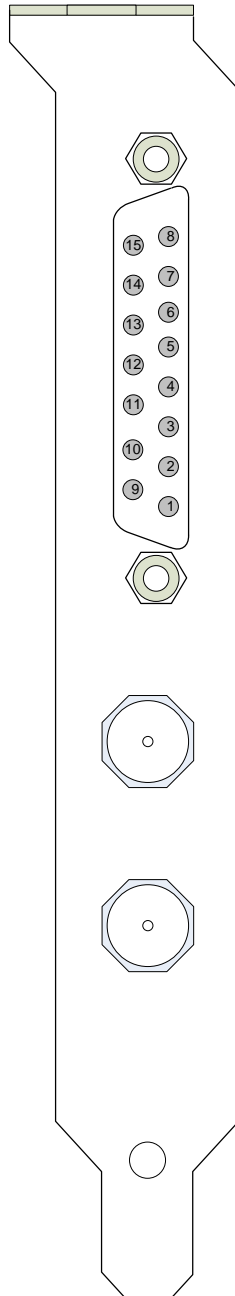
(7) **Photo-coupler Isolated I/O : P1**

Configure an isolated input/output circuit for connection with an external device.

## 2-3 Connector Pin-out

The connectors and jumpers used in PCIe-FRM21 will be described. As for main connectors, there are BNC connector for HD-SDI Camera connection and D-SUB 15pin connector for external I/O connection.

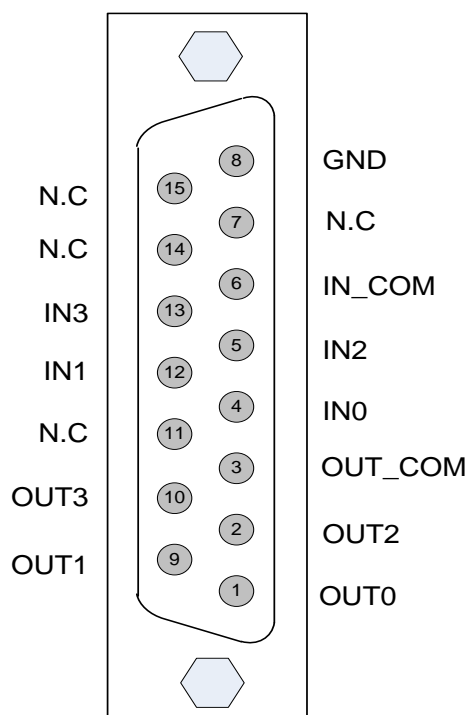
[Figure 2-3] shows the bracket that interfaces with the board and the connection connector.



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

### 2-3-1 P1(DSub-15) Connector

The pin map of the connector is shown in the figure below.



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

[Table 1. D-Sub 15 Connector]

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

### 2-3-2 J3, J8(BNC) Connector

BNC (Bayonet Neil-Concelman) connector is a fast connection/disconnection RF connector and is a model used for coaxial cables. If you look inside the coaxial cable, you can see the signal line in the center, the insulator surrounding the signal line, and the outer conductor (shield). There are 50 ohm impedance and 75 ohm impedance for coaxial cable. Video signals including HD-SDI are weak signals of less than 1Vp-p and use 75 ohm coaxial cable with the least signal attenuation.



[Figure 2-5. BNC Connector and Cable]

**Note) Source: (RG-59 75 ohm coaxial cable only BNC connector, Canare BCP-C4F)**



[Figure 2-6. Cable Cross Section]

### 2-3-3 J2 Connector

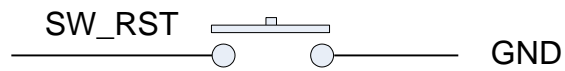
It is a 3.3V external DC power connector. This is the power used when installing the FPGA and is not normally used.

### 2-3-4 J4 Connector

J4 is a JTAG (Joint Test Action Group) connector and is used to update the FPGA program on the board. Do not use when operating the board normally.

### 2-3-5 SW1 Switch

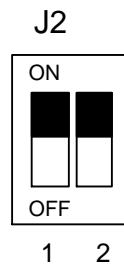
It's a switch of FPGA Reset.



[Figure 2-7. SW1 Switch]

### 2-3-6 SW2 Switch

The PCIe-FRM21 board is designed so that up to four PCIe-FRM21 boards can be used simultaneously in one system (PC). Each board classification can be set through the 4-pin DIP switch (SW1) in the board.



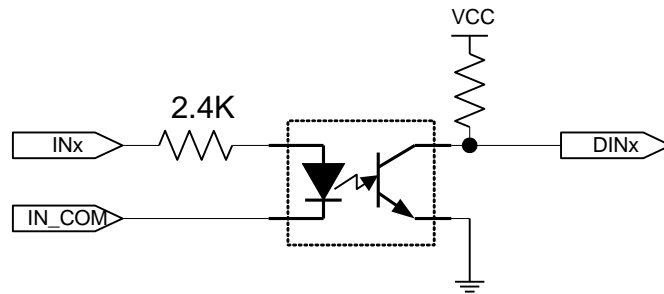
[Figure 2-8. J2 Switch]

[Table 2. J2 Switch]

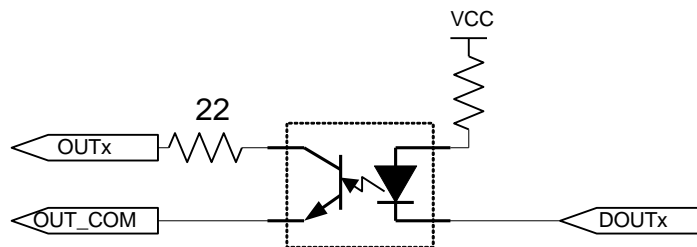
1	2	Description
OFF	OFF	Board No. 0
ON	OFF	Board No. 1
OFF	ON	Board No. 2
ON	ON	Board No. 3

## 2-4 Digital I/O

On the PCIe-FRM21 board, 4 digital inputs and 4 digital outputs isolated by photo-couplers can be used through the P1 connector. The circuit is as follows.



< Photo coupler input >



<Photo coupler output>

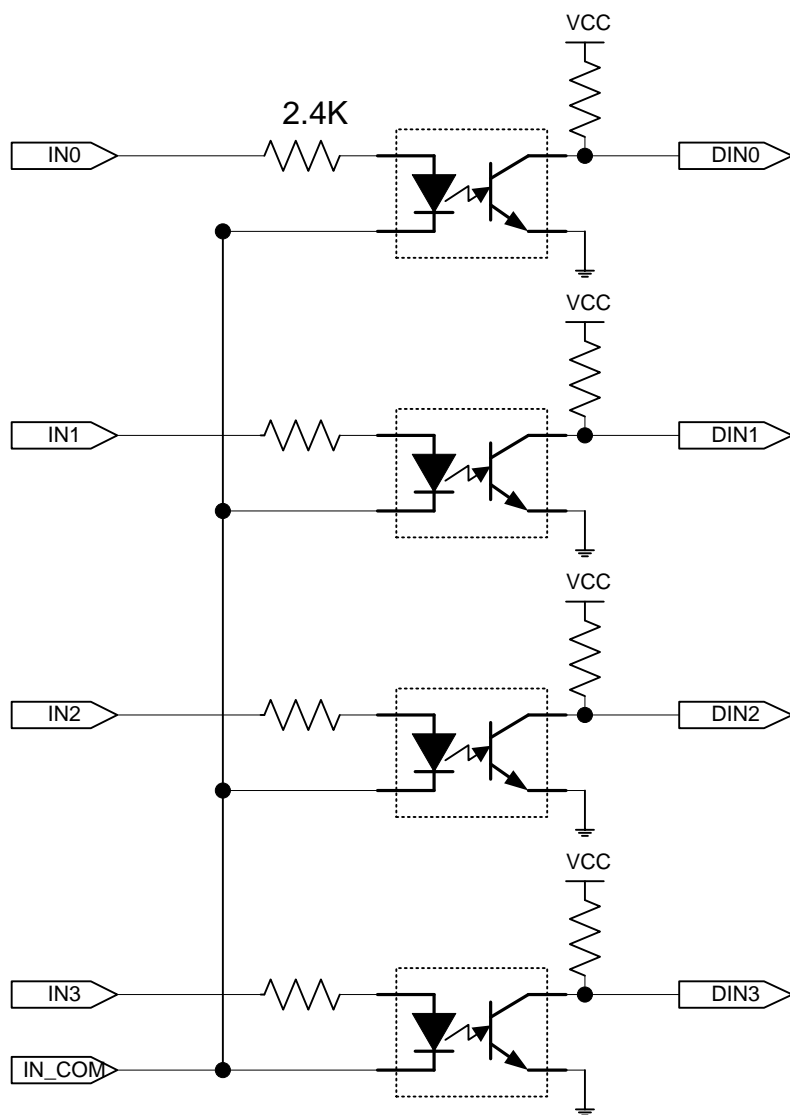
[Figure 2-9. Photo-coupler In/Out Circuit]

For input, using a resistance of 2.4K ohm, about 5mA for 12V input and about 10mA for 24V input will flow. Available input voltage is within 9V to 24V.

The output uses a 22 ohm resistor to limit the maximum output current. Output current should be used within 10mA.

In special circumstances, the R value is adjusted and used to operate according to the above description.

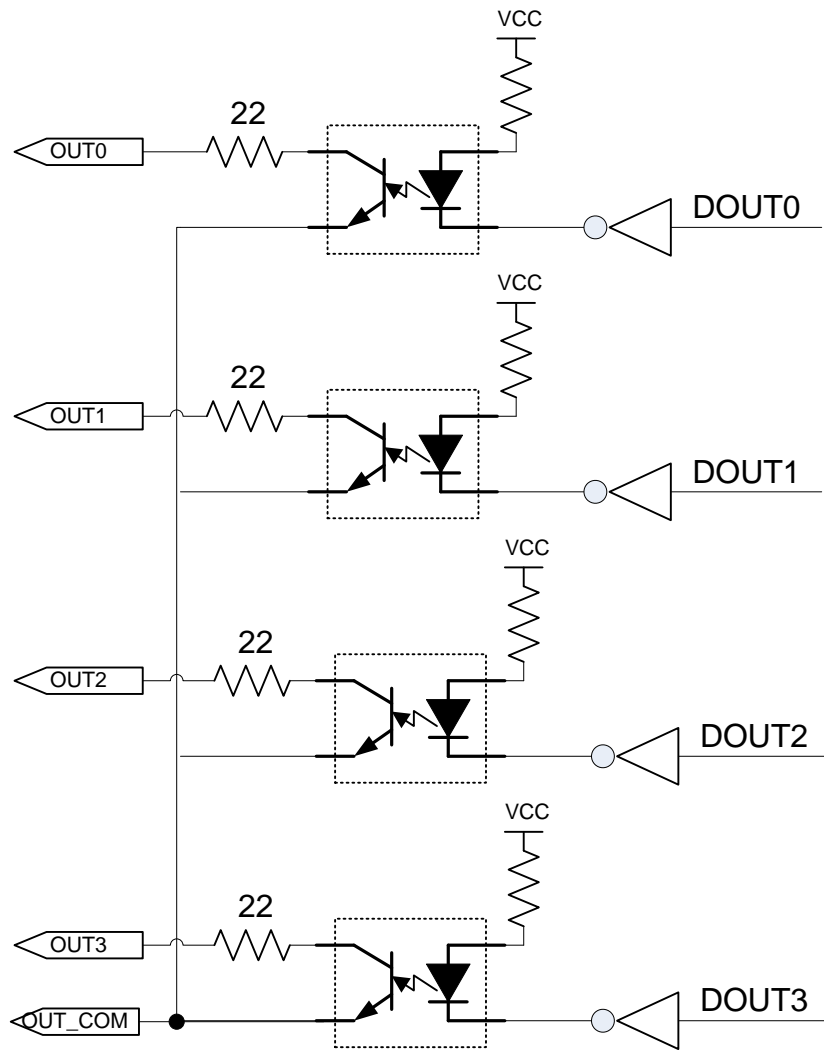
### 2-4-1 Photo-coupler Digital Input



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

The photo-coupler input is input to the D-SUB 15-pin connector of the board, and in the program, DIO input bits 3 to 0 are connected as shown in the figure above.

## 2-4-2 Photo-coupler Digital Output



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

The photo-coupler output is output to the DSUB 15-pin connector of the board, and in the program, bits 3 to 0 of the DIO output are connected as shown in the figure above.



## 3. Installation

### 3-1 Product Contents

Before installing the board, check that the contents of the package are intact.

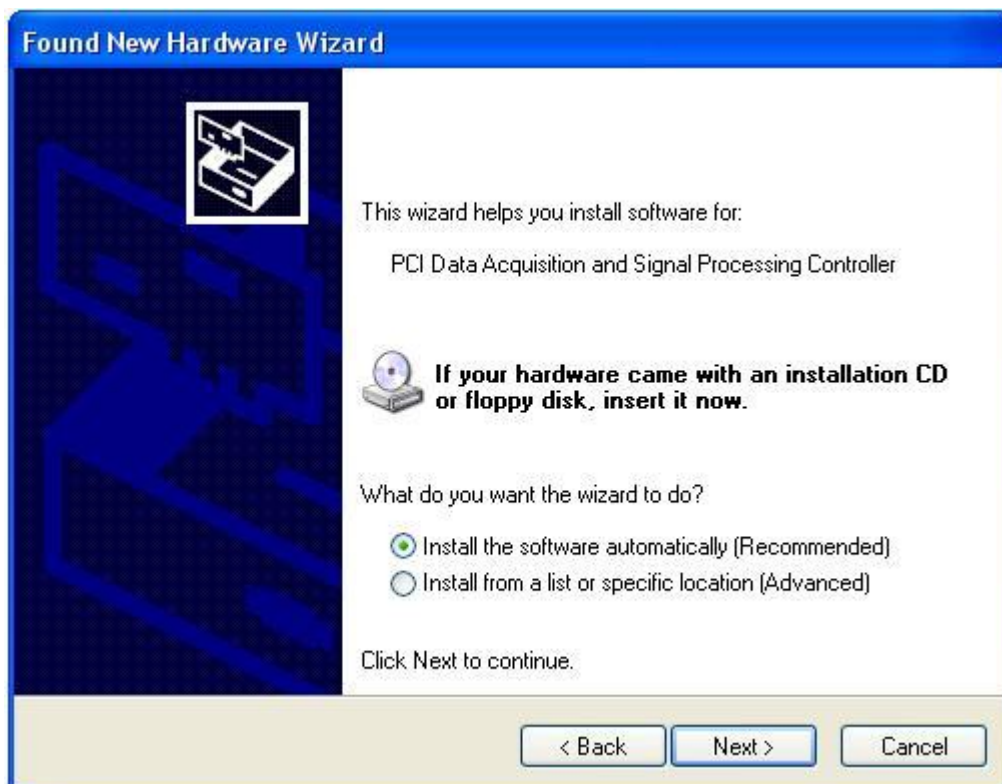
1. PCIe-FRM21 Board
2. CD (Drivers/Manual/API/Sample source etc.)
  - Document Folder : Manual and Catalog
  - Driver Folder : pcie\_frm21.sys pcie-frm21.inf
  - Readme Folder :
  - Sample Folder : Sample Application and DLL
  - TestApp Folder : FrmTest.exe, FrmView.exe

## 3-2 Installation Process

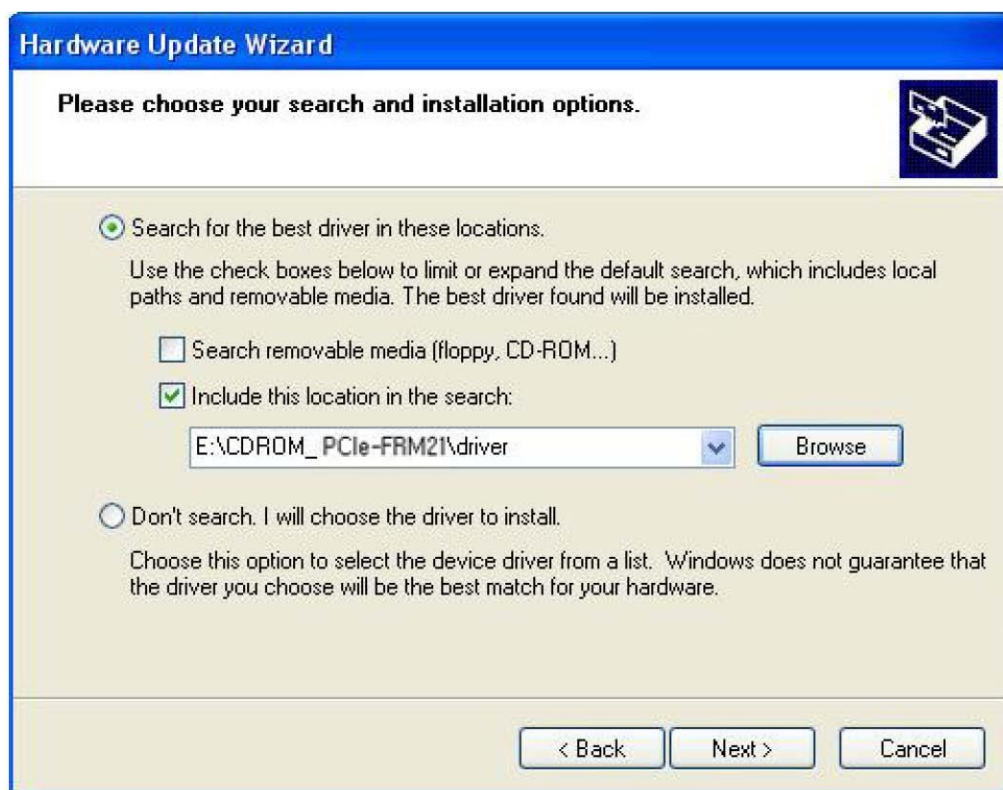
- ① Turn off the computer.
- ② Remove the computer cover according to the computer manual.
- ③ Insert the product into an empty PCI Express slot. If possible, insert the boards in the order closest to the CPU.
- ④ After removing the blocked part at the back of the computer case in the slot where the board is inserted, tightly fasten the screws between the bracket of the board and the connection part of the case.
- ⑤ In case of multi-board, repeat from step 3.

The board environment must be Windows 2000 SP4 or higher and Windows XP SP1 or higher. First, turn off the PC's power, plug the PCIe-FRM21 board into the PCI Express Slot, and turn on the PC's power. When the "Start New Hardware Wizard" window opens as shown below, select as shown below and click the Next button.

1. Select as below and click the Next button



2. Select Driver from the enclosed CD and click the Next button.



3. Click the Next button. It indicates that the installation process is proceeding as shown below. The driver folder contains "**pcie\_frm21.inf**" and "**pcie\_frm21.sys**" files required for driver installation. Click Next to install the driver files.

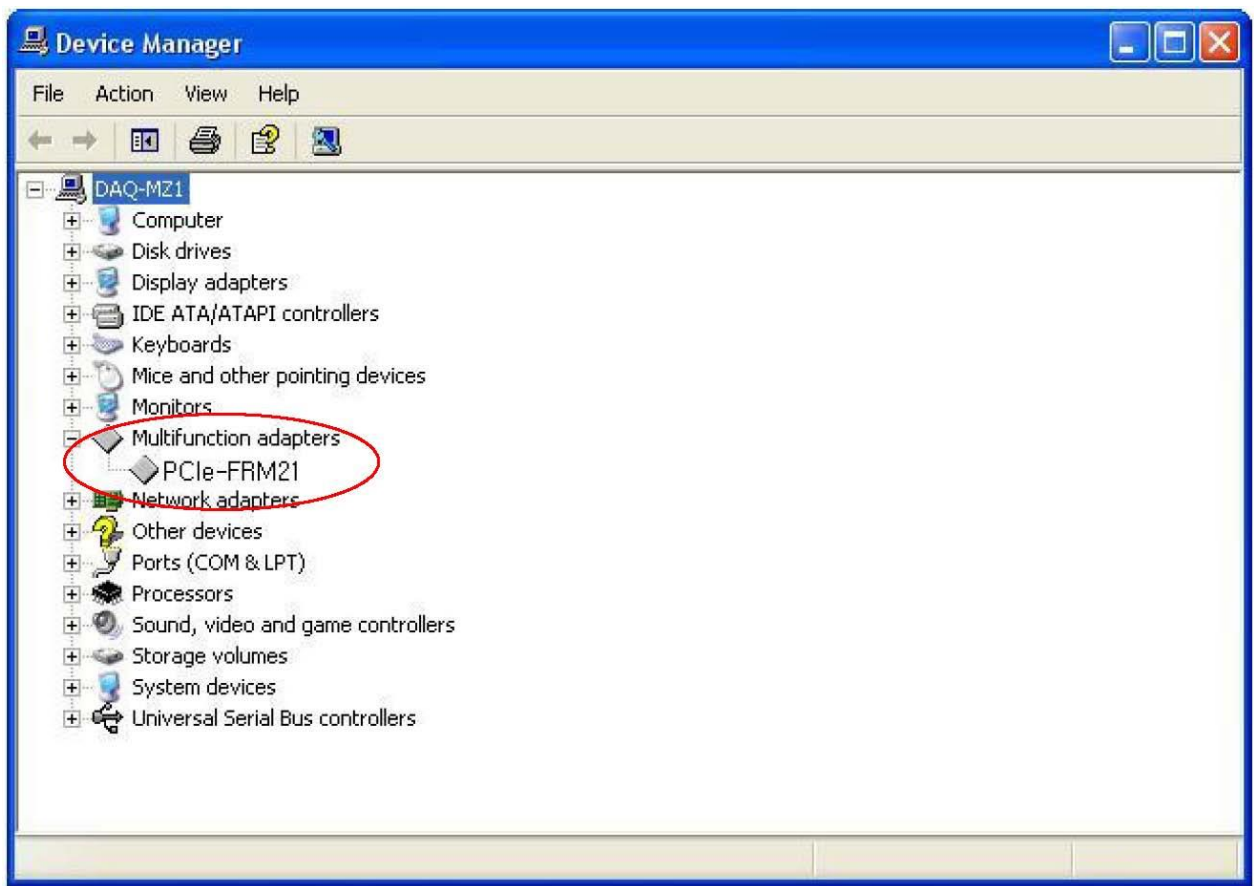


4. When the installation is completed normally, it is shown in the figure below.



5. When the installation is complete, check whether the driver is installed normally in the following way.
6. In My Computer -> Properties -> Hardware -> Device Manager, check if the **Multifunction Adapter** -> "PCIe-FRM21" is installed.

7. If it appears as shown in the figure below, the installation has been completed normally.



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

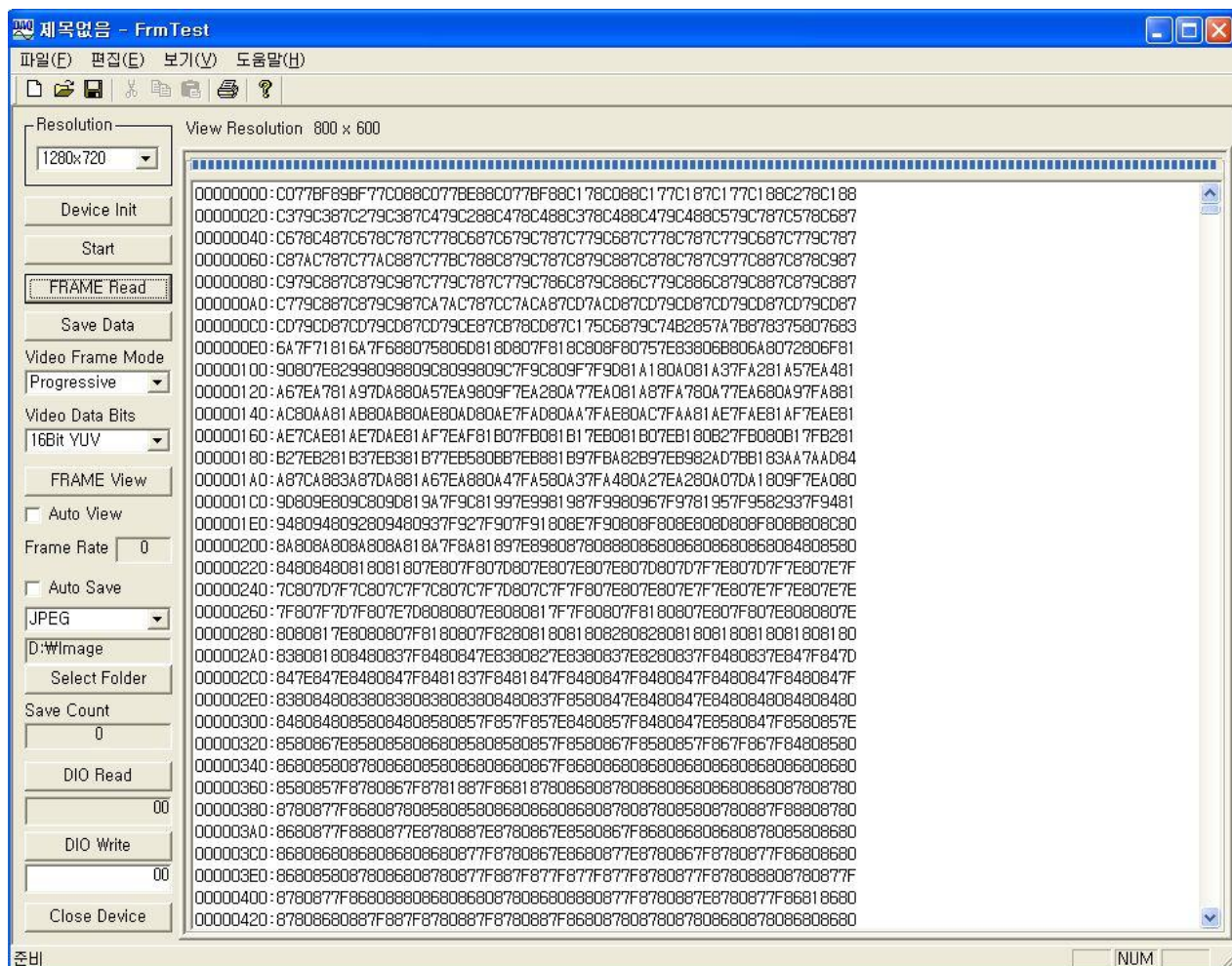
**Notice : After installation, you should re-boot the system for the proper operation.**

## 4. Sample Program

In the Exe folder of the CDROM provided with the board, a sample program "FrmTest.exe" is provided for easy use of the board. By displaying Frame Data as a hexadecimal value, it is stored in memory or hard disk so that developers can utilize the frame data needed. In order to test the sample program, the driver of the board must be installed first.

The sample program is provided in source form so that the API provided to use the board can be tested briefly, so the user can modify it and use it.

### 4-1 FrmTest Program



[Figure 4-1. Sample Program "FrmTest.exe"]

API (Application Programming Interface) is required to use the above sample program. API is provided in the form of "DLL", and import library and header file are required for compilation.

All files specified above are included on the supplied CDROM. In order to run the sample program normally, the API DLL (**PCI-FRM21.DLL**) must be located in the folder of the executable file or in the Windows system folder or the folder specified by the Path environment variable.

#### 4-1-1 Image Function

(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 DIO Function

(1) **DIO Read**

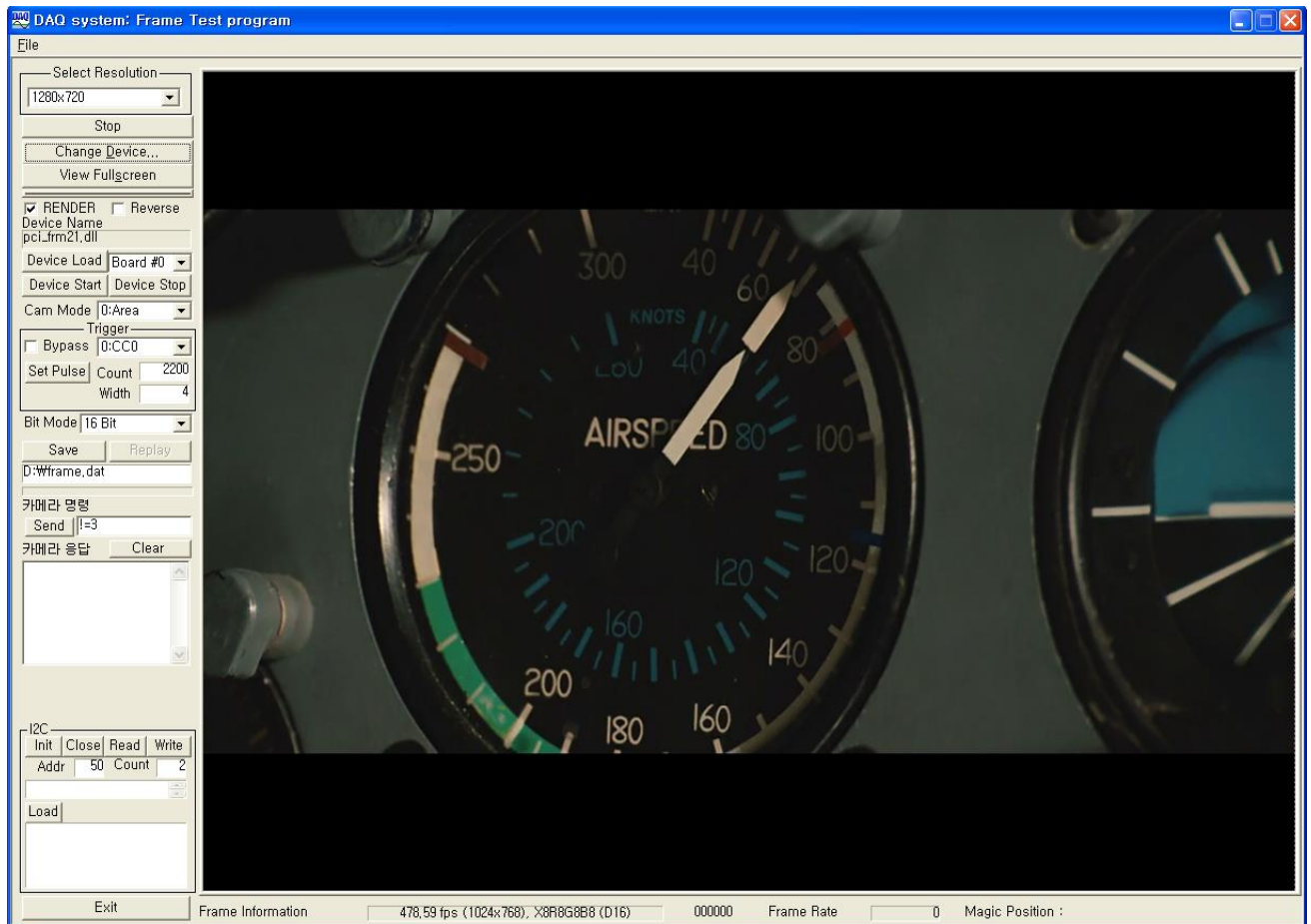
Press this button to read the data on General Purpose I/O port. Reading Data are recorded the editor box beside the button

(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.



## 4-2 FrameView Program



[Figure 4-2. Sample Program "FrameView.exe"]

API (Application Programming Interface) is required to use the above sample program.

API is provided in the form of "DLL", and import library and header file are required for compilation. All files specified above are included on the supplied CDROM. In order to run the sample program normally, the API DLL (PCI\_FRM21.DLL) must be in the folder of the executable file or in the Windows system folder or the folder specified by the Path environment variable.

The description of each menu bar is as follows. The menu bar not described here is an unused function.

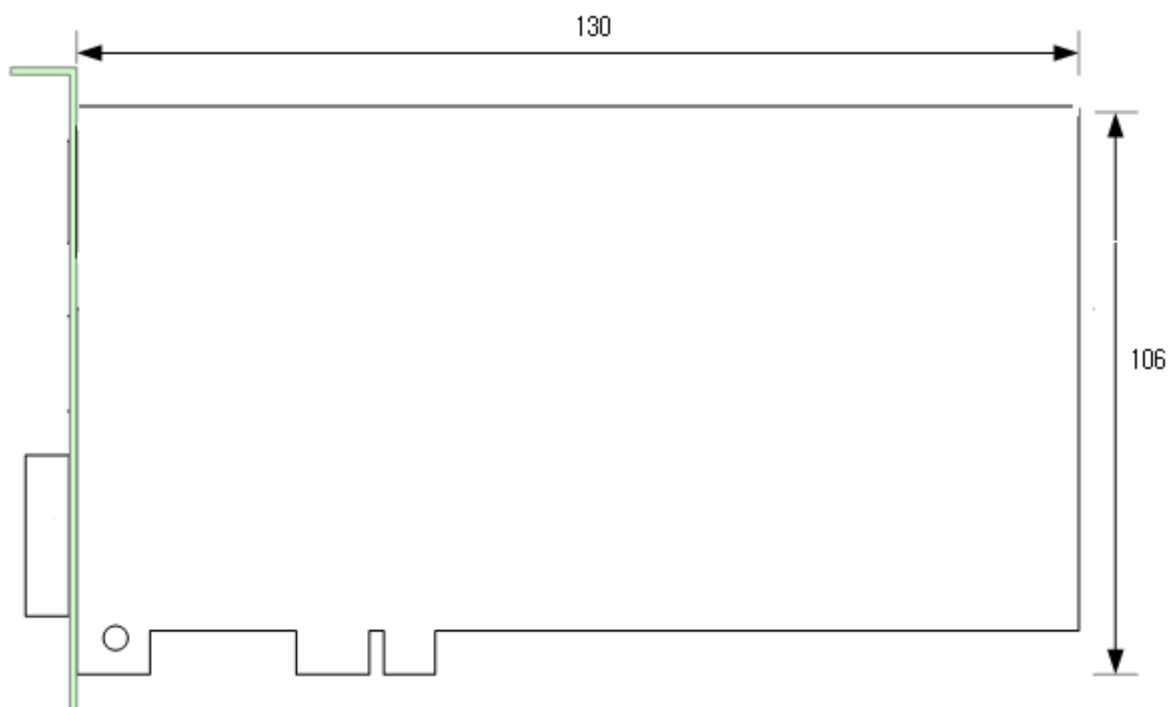
- (1) Select Resolution --- It selects resolution to adjust a Camera output resolution.
- (2) Device Load --- Recall .dll file.
- (3) Board # selection --- Select a PCIe-FRM21 board number 0 ~ 3.
- (4) Device Start --- Start device which you selected.
- (5) Device Stop --- Stop device which you selected.

## Appendix

### A-1 Board Size

The external sizes of the board are as follows.

For detailed dimensions, please contact the person in charge.



## A-2 Repair Regulations

Thank you for purchasing a DAQ SYSTEM product. Please refer to the following regarding Customer Service regulated by DAQ SYSTEM.

- (1) Read the user manual and follow the instructions before using the DAQ SYSTEM product.
- (2) When returning the product to be repaired, please write down the symptoms of the failure and send it to the head office.
- (3) All DAQ SYSTEM products have a 1-year warranty.
  - . Warranty period counts from the date the product is shipped from DAQ SYSTEM.
  - . Peripherals and third-party products not manufactured by DAQ SYSTEM are covered by the manufacturer's warranty.
  - . If you need repairs, please contact the Contact Point below..
- (4) Even during the warranty period, repairs are charged in the following cases..
  - ① Failure or damage caused by use without following the user's manual
  - ② Failure or damage caused by customer's negligence during product transportation after purchase
  - ③ Failure or damage caused by natural phenomena such as fire, earthquake, flood, lightning, pollution, or power supply exceeding the recommended range
  - ④ Failure or damage caused by inappropriate storage environment (e.g. high temperature, high humidity, volatile chemicals, etc.)
  - ⑤ Breakdown or damage due to unreasonable repair or modification
  - ⑥ Products whose serial number has been changed or removed intentionally
  - ⑦ If DAQ SYSTEM determines that it is the customer's fault for other reasons
- (5) Shipping costs for returning the repaired product to DAQ SYSTEM are the responsibility of the customer.
- (6) The manufacturer is not responsible for any problems caused by misuse, regardless of our warranty terms.

## References

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

# MEMO

## Contact Point

Web sit : <https://www.daqsystem.com>

Email : [postmaster@daqsystem.com](mailto:postmaster@daqsystem.com)

