PCIe-FRM16_B

User Manual

Version 1.0

DAQ SYSTEM
Measurement & Automation

Contents

1. Introduction

PCIe-FRM16_B is a board that receives DVI (Digital Visual Interface) signal and transmits it to PC using PCI Express 4x interface method. Various resolutions such as 640x480, 800x600, 1024x768, 1920x1080 and 1920x1200 are supported. It supports up to 1920x1200 per channel and can handle two DVI signals at the same time.

The operation of the board is controlled by the program API, and the figure below shows the interlocking operation of the board.
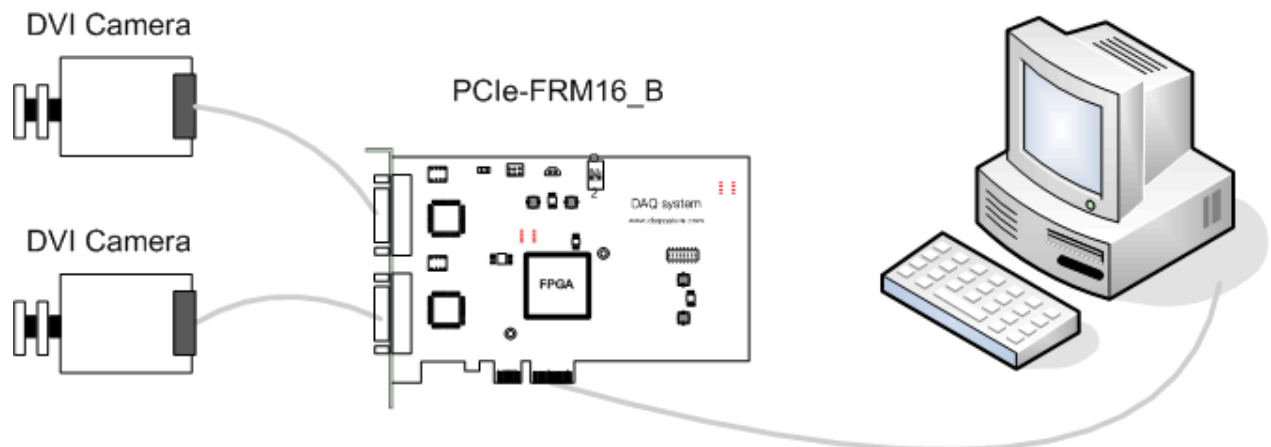
[Figure 1-1.   PCIe-FRM16_B Board Usage]

1-1 Product Features

Items	Description	Remark
Hardware		
PC Interface	PCI Express Gen2 4x	
Operation Power	PC Power	+3.3V (Max 1.1A)
		+12V (Max 1A).
Video Interface	2 Ports Single DVI	
Feature	Full HD 1080P at 12fps	MAX 1920x1200 resolution
External I/O		
On-board Memory		
Communication		
Simultaneous use of boards	Max. 4	
Software		
OS	Windows 2000/XP/7/8/10 (32/64bit)	
API	Windows Client DLL API	
Development		
Support	Sample Program	VC++
Environmental conditions		
Operating temperature range	0 ~ 60℃	
Storage temperature range	-20 ~ 80℃	
Humidity range	5 ~ 95%	Non-condensing
Board size	152mm X 106mm	PCB Board Size

1-2 Product Applications

- Image recognition (Pattern, particle, etc.)
- Inspection equipment (Sensor, Semiconductor, Device etc.)
- Security Solution
- Medical Image Capture
- BLU-RAY
- Game Consoles

2. PCIe-FRM16_B Board Function

2-1 FPGA Block Diagram

In the case of PCIe-FRM16_B, FPGA Core Logic is in charge of overall control. It receives RGB, HDMI (High-Definition Multimedia Interface), and DVI (Digital Visual Interface) signals as its main function and delivers it to the PC.

These functions are performed using API in PC through PCI Express 1x interface.
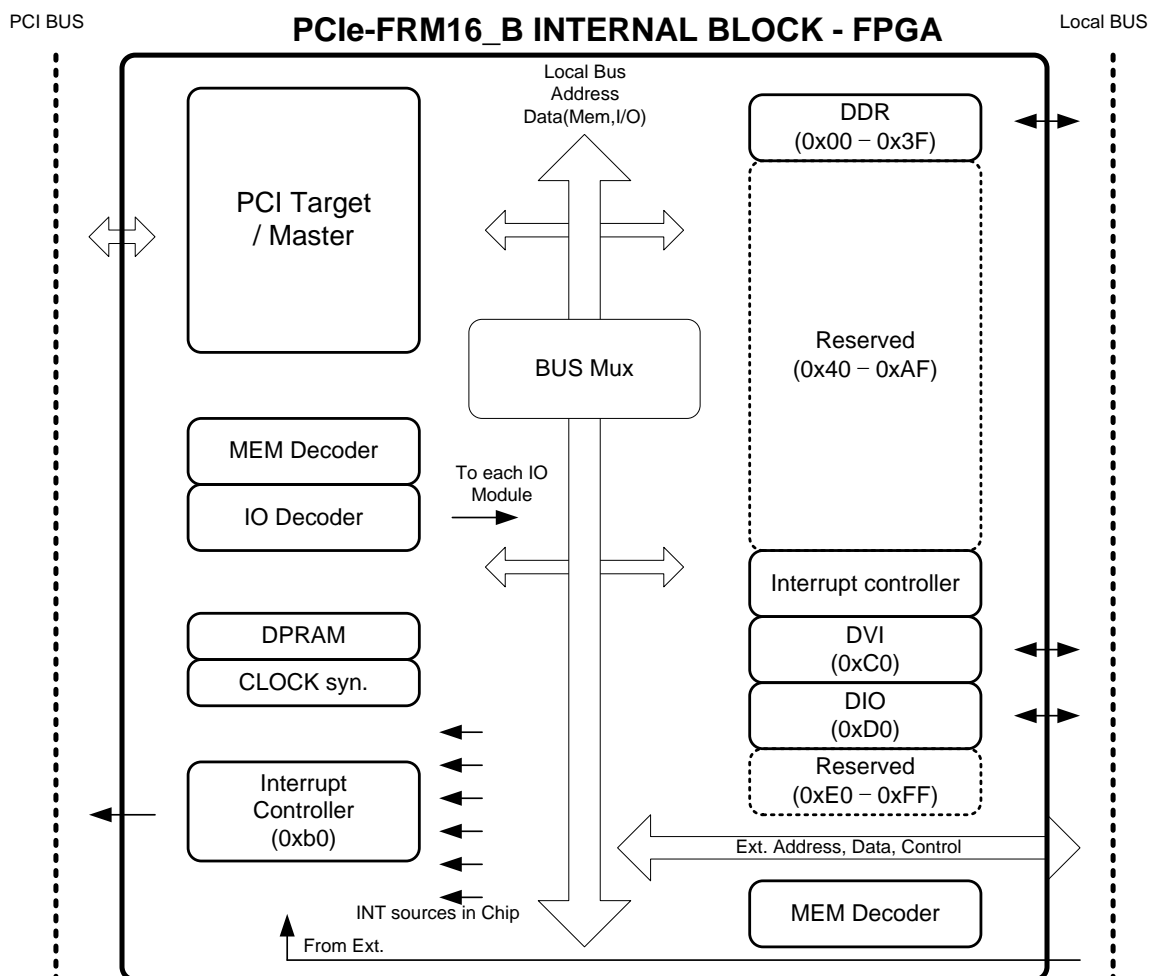
[Figure 2-1.　PCIe-FRM16_B Block Diagram]

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 DVI (Digital Visual Interface)

DVI (Digital Visual Interface) is divided into DVI-D (Digital Only), DVI-A (Analog Only), and DVI-I (Integrated Digital & Analog) methods. The PCIe-FRM14 board supports DVI-I type DVI, so it is compatible with the existing analog type methods. Also, HDMI (High Definition Multimedia Interface) that uses the same format of digital image data can be used together by using the DVI to HDMI gender. [Figure 2-2. Reference]

However, some HDMI monitors may not display images output from devices that do not comply with the encryption standard for copyright protection called HDCP (High-bandwidth Digital Control Protection) high-bandwidth digital content protection.


[Figure 2-2. DVI to HDMI Gender]

The data format of DVI is based on the Panel Link serial signal line. DVI uses a digital transmission protocol that is Transition Minimized Differential Signaling (TMDS) as shown in [Figure 2-2]. TMDS is composed of TMDS Transmitter and TMDS Receiver, and a Transmitter is mounted on the graphic card side and a Receiver is mounted on the monitor side to transmit digital data from the graphic card to the monitor.

DVI is divided into single DVI using Digital Channel 0 ~ 2 and Clock line, and Dual DVI using both signal lines of Digital Channel 3 ~ 5. For single DVI, it supports up to WUXGA (1920 x 1200 @60Hz) and has a bandwidth of 3.7Gbits/s. Dual DVI supports up to WQXGA (2560 x 1600 @60Hz) and has a bandwidth of 7.4Gbits/s. The advantage of DVI is that it can transmit longer distances than LVDS (Low Voltage Differential Signaling) and can transmit a higher band signal.

A single DVI link has a maximum resolution of 2.6M pixels at 60Hz. The single link maximum is fixed at 165 MHz, so all displays slower than this use single link mode, and faster than this will switch to dual link mode.
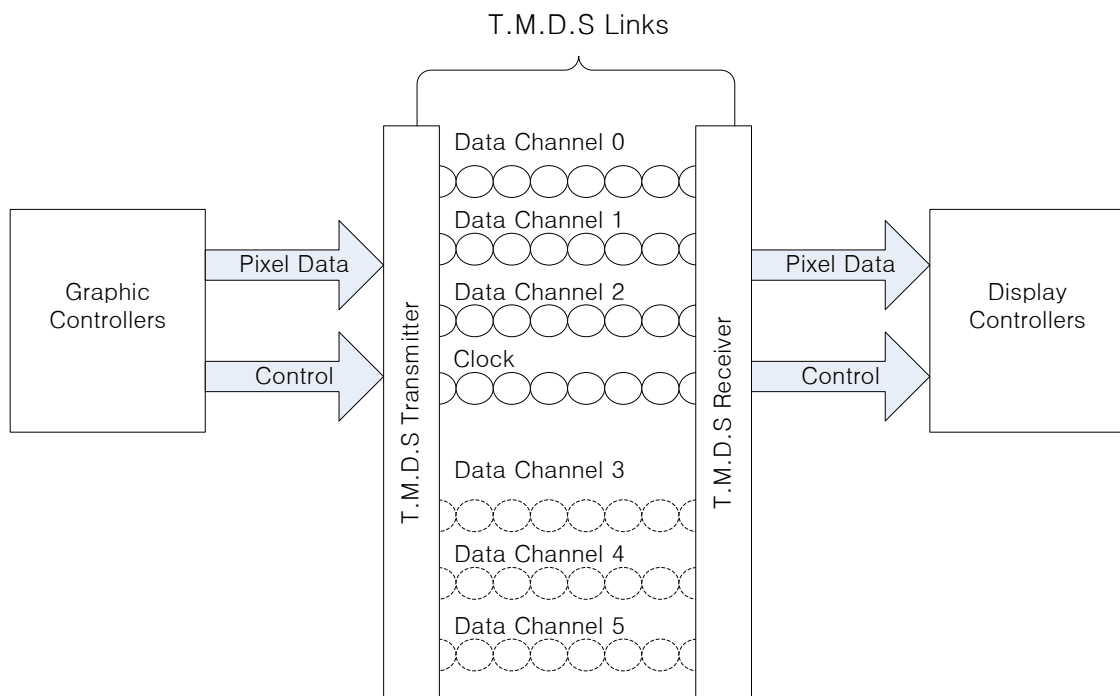
[Figure 2-3.   T.M.D.S Logical Links]

PCIe-FRM16_B supports single DVI as shown in [Figure 2-4]. PCIe-FRM16_B board supports DVI-I type DVI, so it is compatible with existing analog type methods. can [Refer to 3-3 for DVI connector and signal line]

Control signal line consists of LVAL (Line Valid), FVAL (Frame Valid), DVAL (Data Valid) and clock, and transmits the valid horizontal and vertical resolution and data of the image to be transmitted according to the clock.

TMDS Receiver such as monitor and TMDS Transmitter such as graphic card have EDID (Extended Display Identification Data) standard for data communication between the output of the source device and the display. That is, display information is transferred from a display side such as a monitor to a host such as a frame grabber. EDID of the display is defined as a 128-byte (256-byte for EDID 2.0) data structure that contains information such as the relevant manufacturer and product identification block, display medium, color characteristics, and stable timing. EDID transmission method generally uses I2C.

3. PCIe-FRM16_B Board Description

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

3-1 PCIe-FRM16_B Board Layout
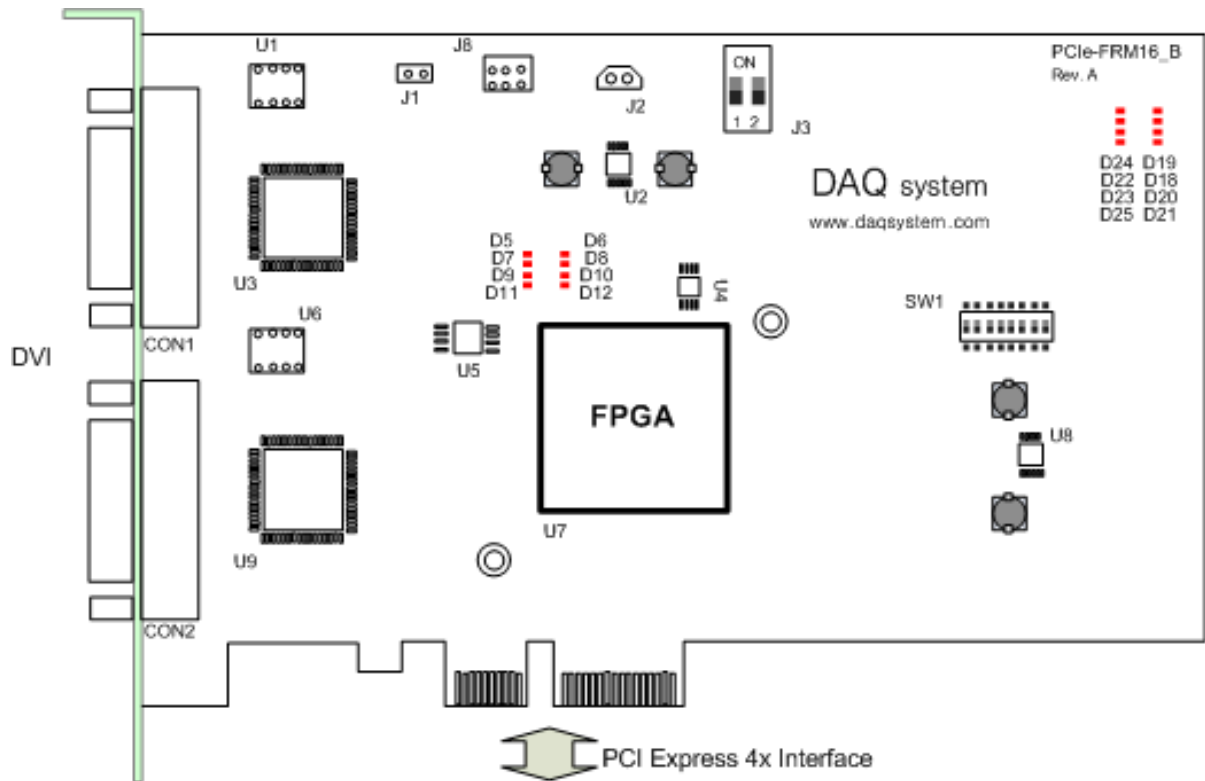
[Figure 3-1.　PCIe-FRM16_B Layout]

3-2   Device Features

(1) **FPGA : U7**

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

(2) **DVI Receiver : U3, U9**

It is receiving DVI Data and transmitting to FPGA.

(3) **Power Regulator : U2, U8**

This block is for supplying the power to the board.
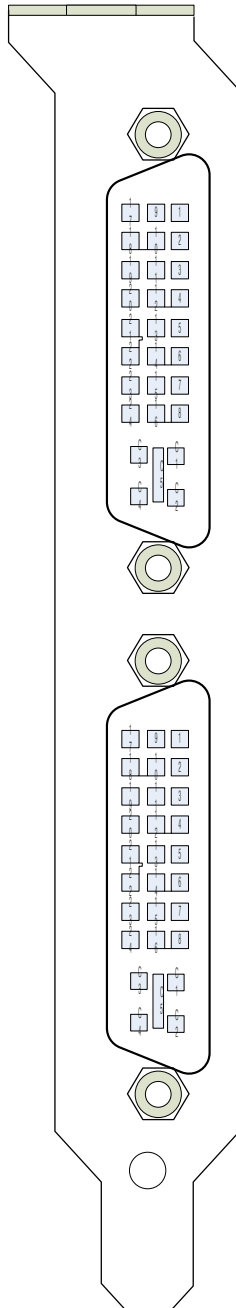
(4) **J3**

This is a board selection switch (#0 ~ 3).

3-3   Connector Pin-out

The connectors and jumpers used in PCIe-FRM16_B will be described. The main connectors are DVI connectors CON1 and CON2 connectors for DVI connection.
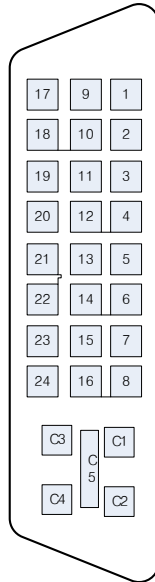
[Figure 3-2] shows the bracket that interfaces with the board and the connection connector.

[Figure 3-2.   PCIe-FRM16_B Front View]

3-3-1 DVI Connector

[Figure 3-3] below shows the pin map of the CON1 and CON2 connectors on the board. All pin specifications are input/output based on the DVI standard, so please refer to the DVI standard document for details.

[Figure 3-3. PCIe-FRM16_B CON1, CON2 Connector Pin-out]

[Table 1. CON1, CON2 DVI Connector]

Pin #	Signal	Description
1	**TMDS Data2-**	Digital Red- (Link 1)
2	**TMDS Data2+**	Digital Red+ (Link 1)
3	**TMDS Data2/4 Shield-**	
4	**TMDS Data4-**	Digital Green- (Link 2)
5	**TMDS Data4+**	Digital Green+ (Link 2)
6	**DDC Clock**	Display Data Sync Clock
7	**DDC Data**	Display data channel (Display Information – Vendor/Product Identification EDID structure version Display media/features color, timing standard timing identification)
8	**Analog V sync**	Analog Vertical Sync
9	**TMDS Data1-**	Digital Green- (Link 1)
10	**TMDS Data1+**	Digital Green+ (Link 1)
11	**TMDS Data1/3 Shield**	

12	TMDS Data3-	Digital Blue- (Link 2)
13	TMDS Data3+	Digital Blue+ (Link 2)
14	+5V Power	Power for monitor standby
15	GND	Pin 14 and regression for synchronization
16	Hot Plug Detect	
17	TMDS Data0-	Digital Blue- (Link 1)
18	TMDS Data0+	Digital Blue+ (Link 1)
19	TMDS Data0/5 Shield	
20	TMDS Data5-	Digital Red- (Link 2)
21	TMDS Data5+	Digital Red+ (Link 2)
22	TMDS Clock Shield	
23	TMDS Clock+	Digital Clock+ (Link 1 & 2)
24	TMDS Clock-	Digital Clock- (Link 1 & 2)
C1	Analog Red	Analog Red (Disabled)
C2	Analog Green	Analog Green (Disabled)
C3	Analog Blue	Analog Blue (Disabled)
C4	Analog H sync	Analog Horizontal Sync (Disabled)
C5	Analog Ground	R, G, B signal regression (Disabled)

3-3-2 J3 Switch

The PCIe-FRM16_B board is designed so that up to four PCIe-FRM16_B 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.
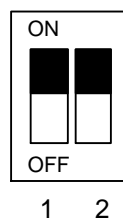
[Figure 3-7. J3 Switch (Top View)]

[Table 2. J3 Switch PIN-OUT]

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

4. Installation

4-1 Product Contents

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

1. PCIe-FRM16_B Board
2. CD (Drivers/Manual/API/Sample source etc.)
   - Document Folder :   Manual and Catalog
   - Driver Folder   :   pcie_frm16.sys pcie-frm16.inf
   - Readme Folder   :
   - Sample Folder   :   Sample Application and DLL
   - TestApp Folder   :   FrmTest.exe, FrmView.exe

   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.
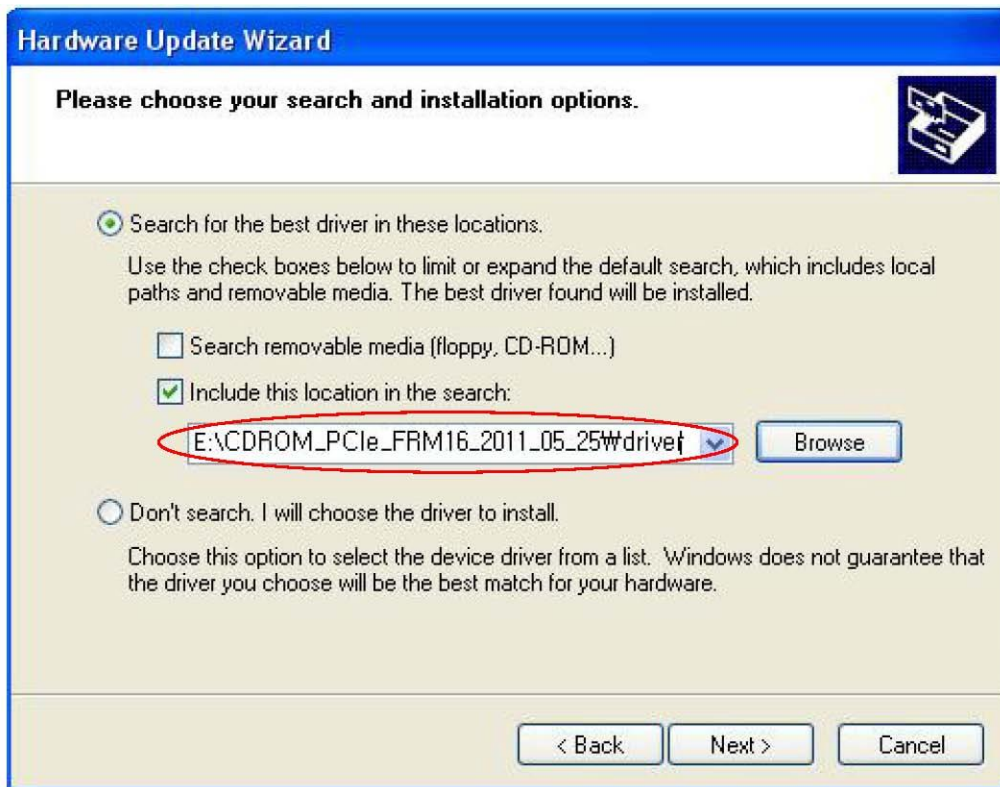
4-2 Installation Process

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-FRM16_B 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.
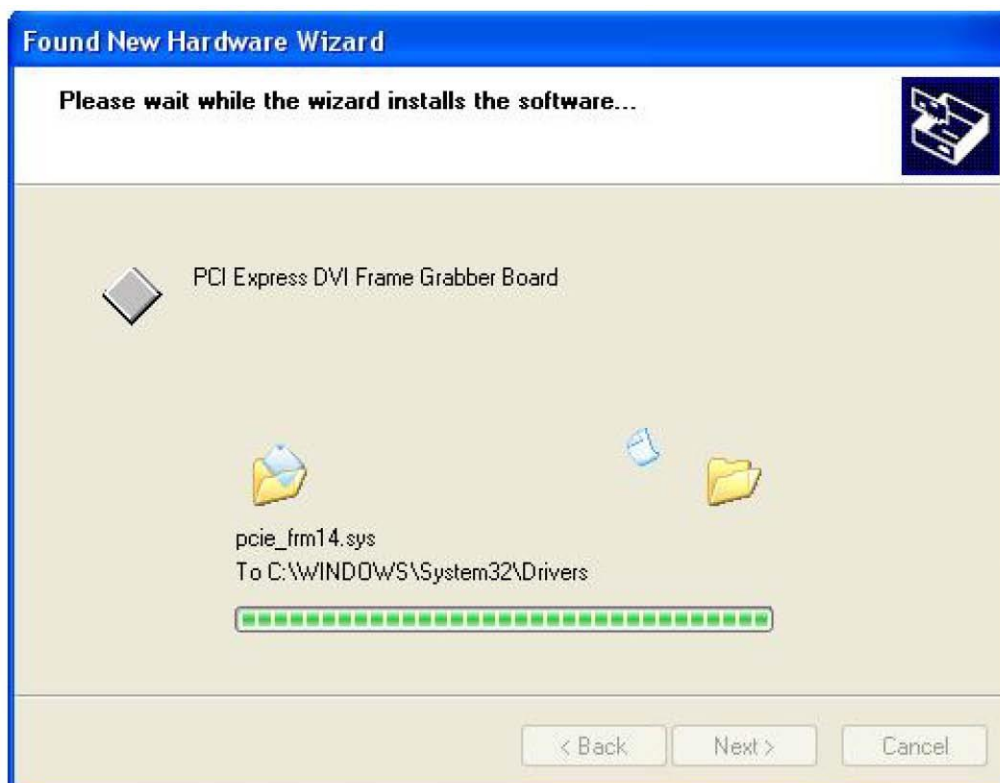
1. Select as below and click the Next button

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_frm16.inf"** and **"pcie_frm16.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. PCIe-FRM16_B has two DVI devices, so the above is done twice.

6. When the installation is complete, check whether the driver is installed normally in the following way.

7. In My Computer -> Properties -> Hardware -> Device Manager, check if the **Multifunction Adapter -> "PCIe-FRM16"** is installed.

8. If it appears as shown in the figure below, the installation has been completed normally.
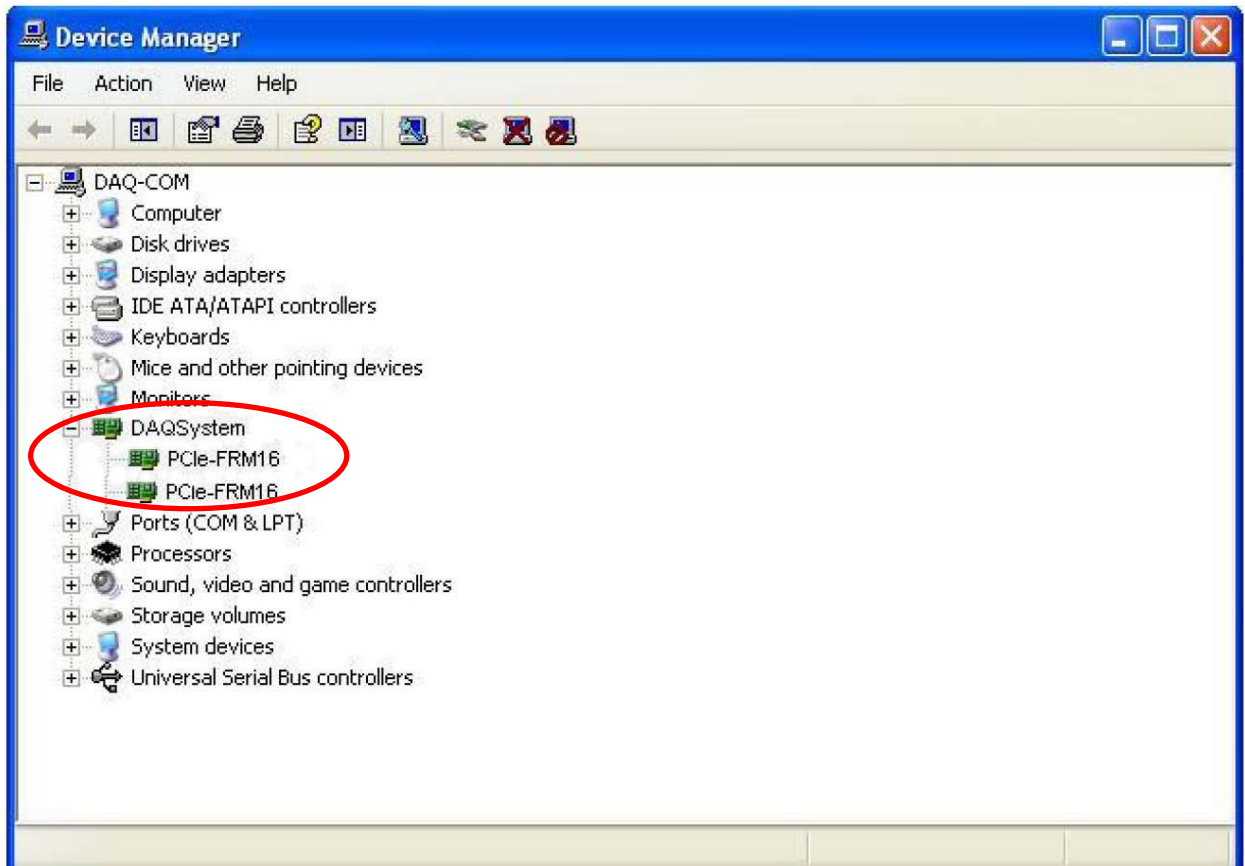
If you can see the "PCIe-FRM16" at Multifunction Adaptors, the driver installation is to have been over. (Check the red circle. And it must be displayed two drivers of PCIe-FRM16_B.)

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

5. Sample Program

Sample programs "FrmTest" and "FrameView" are provided in the TestApp folder of the CDROM provided with the board for easy use of the board. First, **"FrmTest.exe"**, one of the executable files, displays Frame Data as a hexadecimal value and stores it in memory or hard disk so that developers can utilize the necessary frame data, and **"FrameView.exe"** It is an executable file that shows the screen as an image for easy understanding of the frame data by the user. In order to test the sample program, the driver of the board must be installed first.

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

5-1 FrmTest Program
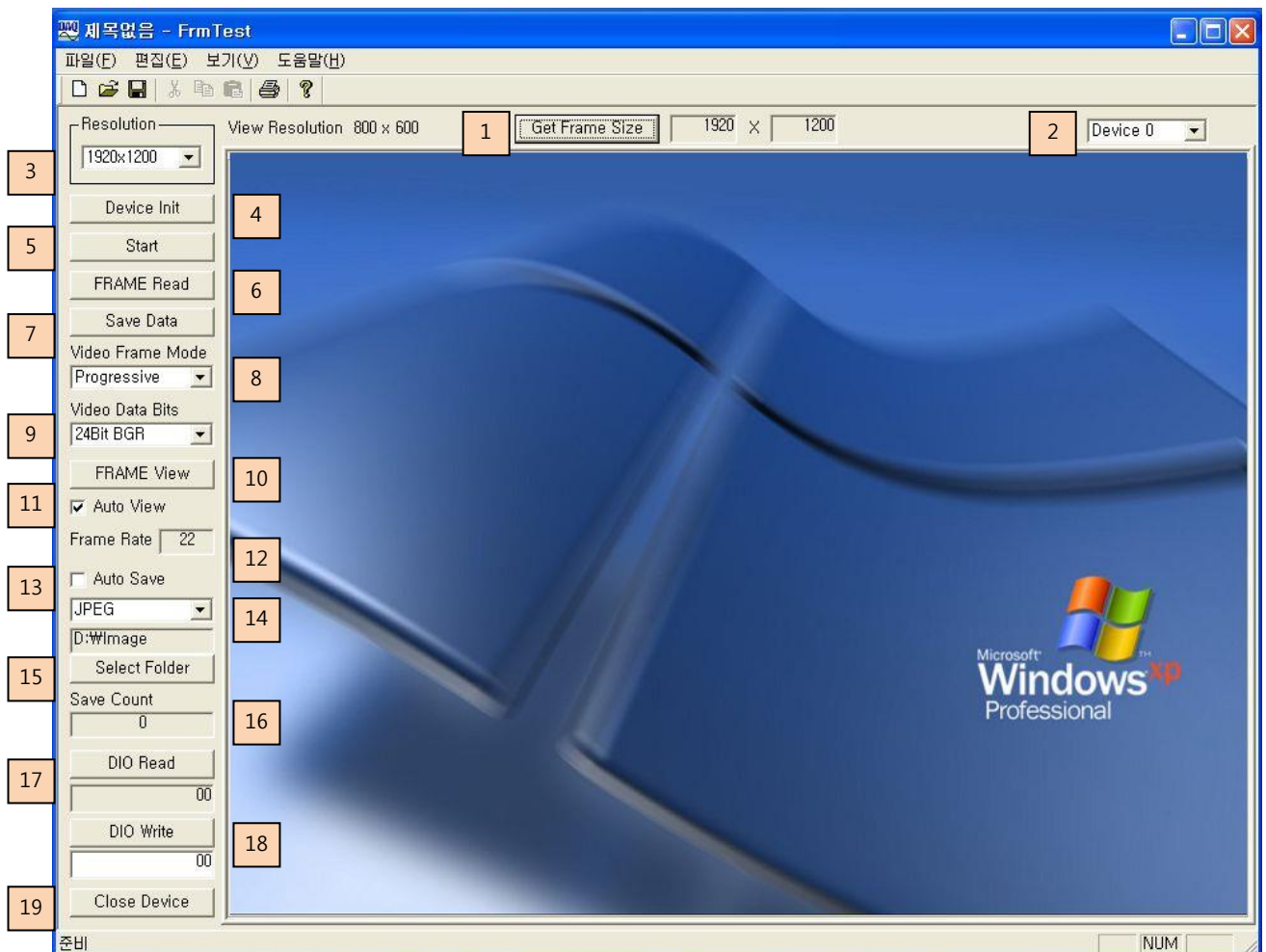
[Figure 5-1. Sample Program "FrmTest.exe"]

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 (**PCIe-FRM16_B.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.

(1) **"Get Frame Size" button**
   Displays the resolution of the input DVI.

(2) **Device Selection**
   Select DVI input number. (0: lower DVI(CON1), 1: upper DVI(CON2))

(3) **Resolution Selection**
   Select according to the input resolution. The user-settable resolution is 640 x 480, 800 x 600,
   1024 x 768, 1280 x 720, 1280x1024, 1600 x 1200, 1920 x 1080, 1920 x 1200,
   2048 x 1536 (not currently supported), 2560 x 2048 (not currently supported).

(4) **"Device Init" button**
   Initialize the image frame function. It is performed only once when the first power is applied.

(5) **"Start" button**
   Press this button to begin to save image data.

(6) **"FRAME Read" button**
   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.

(7) **"Save Data" button**
   Press this button to save the image frame data of PC to a file.
   (Not currently supported)

(8) **Video Frame Mode**
   It selects a Progressive or Interlace Mode according camera image.
   (Not currently supported)

(9) **Video Data Bits**
   Select the 8bit, 16bit YUV, 24bit BGR.

(10) **"Frame View" button**
   Shows one screen at a time when clicked.

(11) **"Auto View" click**

　　　When checked, the video is displayed.

(12) **Frame Rate**

　　　It shows the frame/sec of the video.

(13) **"Auto Save" button**

　　　When checked, it is saved as a file in BMP or JPEG format in the box below.

　　　(Not currently supported)

(14) **Image Mode Selection**

　　　Choose Save as BMP or JPEG Image. (Not currently supported)

(15) **"Select Folder" button**

　　　Select the folder to save. By default, it is set to the D:\Image folder.

　　　(Not currently supported)

(16) **Save Count**

　　　Indicates the number of images to be saved. (Not currently supported)

(17) **"DIO Read" button**

　　　Reads digital data. (Not currently supported)

(18) **"DIO Write" button**

　　　Writes digital data (Not currently supported)

(19) **"Close Device" button**

　　　Close any open devices.

5-2 FrameView Program

[Figure 5-2. 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_FRM16.DLL)** must be in the executable folder or in the Windows system folder or the folder specified by the Path environment variable.

[Figure 5-2] is a screen captured by connecting PCIe-FRM16_B to the DVI connector of the graphic card of another system and executing "FrameView.exe" to capture the image displayed on the monitor.

The description of each menu bar is as follows.

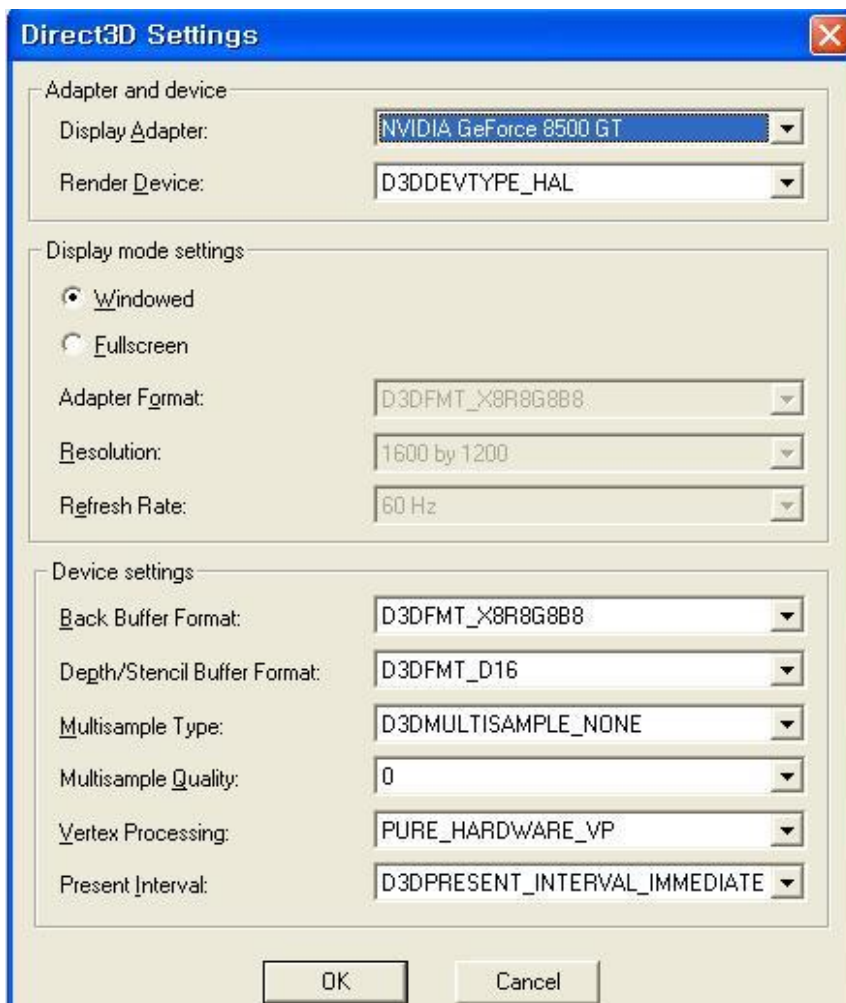**(1) Select resolution**

Display   resolution – Select according to the input resolution

Reverse --- Reverse On/Off   (Not currently supported)

(2) **Save** --- Saved in D:₩frame.dat (fixed).

(3) **Stop** --- Stop saving.

(4) **Change Device** --- If multiple devices are attached, select the desired device.

(5) **View Fullscreen** --- A screen shows all over an image.

(6) **Board # selection** --- Select a DVI Input number (0 : Bottom DVI, 1 : Upper DVI)

(7) **Device Start** --- Start device which you selected.

(8) **Device Stop** --- Stop device which you selected.

(9) **Clear Frame** --- When press this button, it will be clear current frame.

(10) **Get Frame** --- Get a just one frame.

(11) **Frame Auto Read ---** When check this box, it get a frame continuously until re-check.

(12) **Exit** --- Exit a program.

Appendix

A-1 Board Size

The external sizes of the board are as follows.

For detailed dimensions, please contact the person in charge.
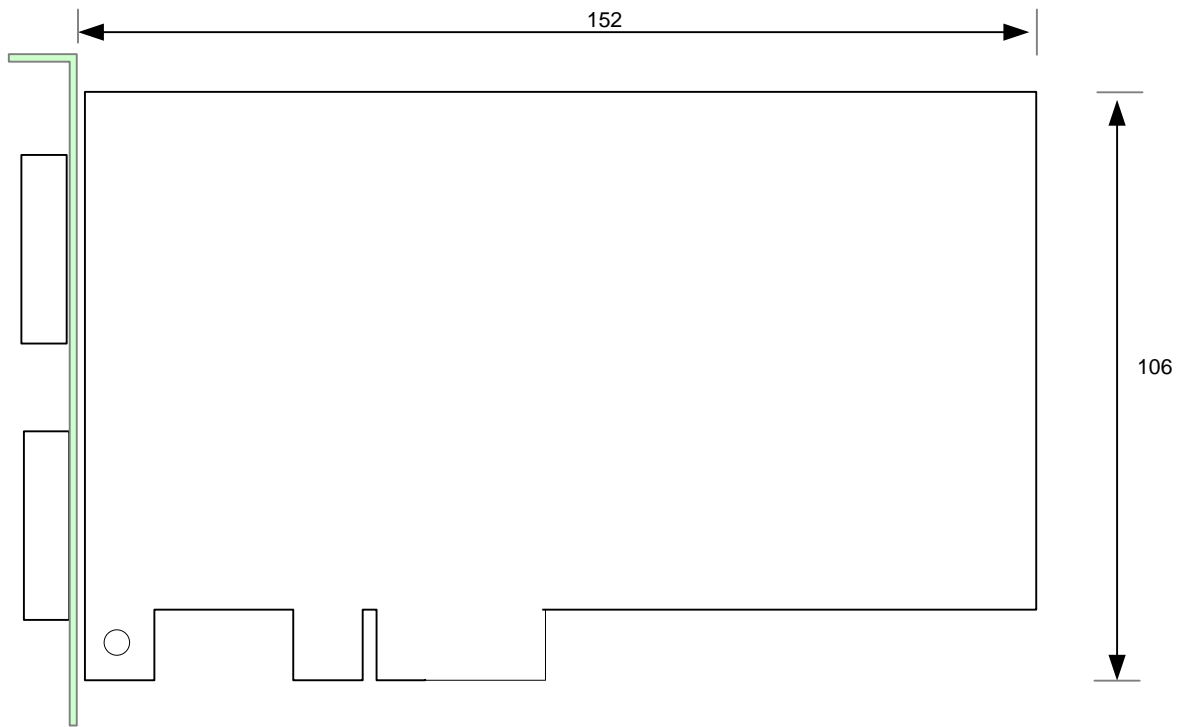
A-2 Repair Regulations

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-FRM16_B API Programming

-- DAQ system

MEMO

Contact Point

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