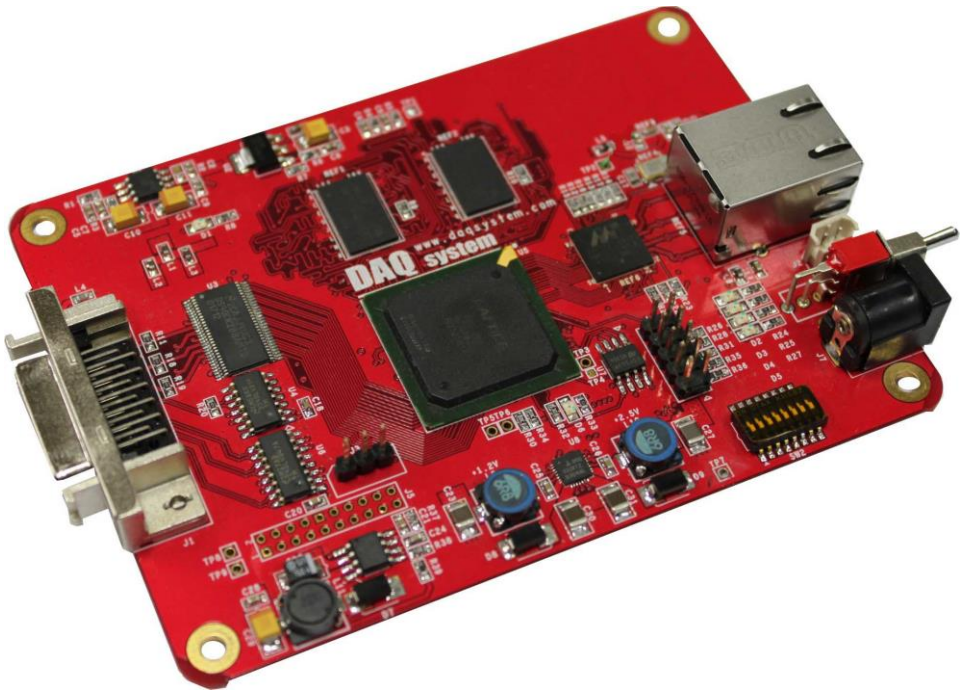
NET-FRM01

User's Manual



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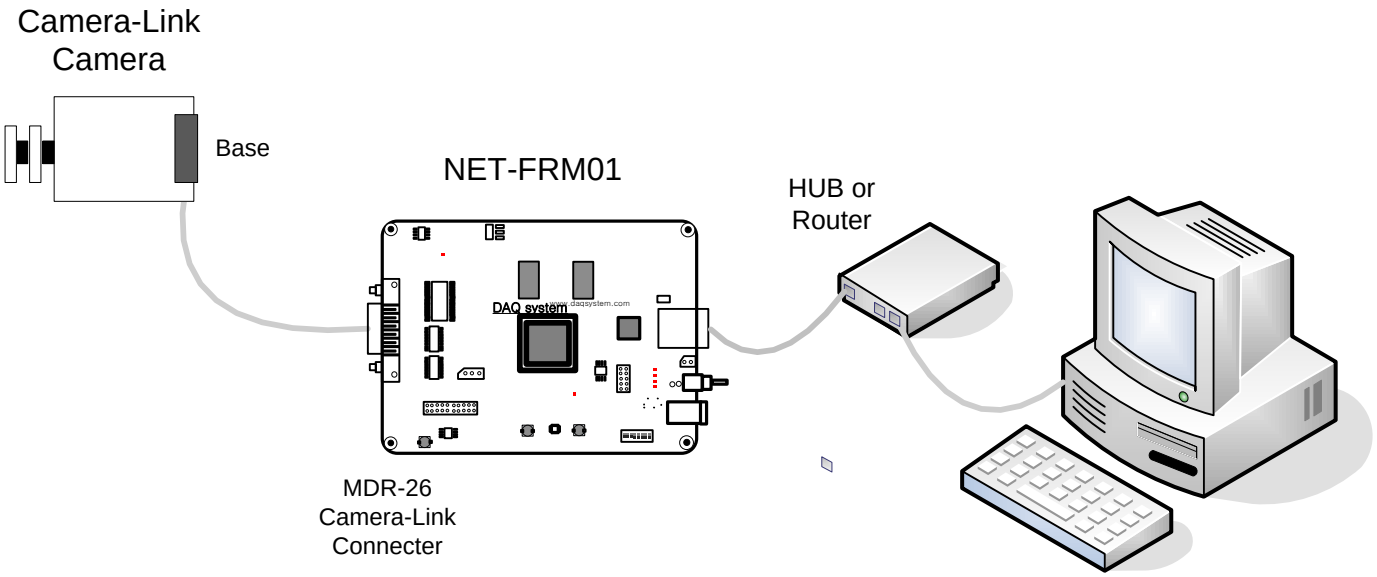
1. Introduction

The NET-FRM01 is a board having the function of processing the frame data received from Camera-link camera and transmitting the image frame data to PC through 10/100/1000Mbps Ethenrnet Network.

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

DAQ system provides a sample program to use the board briefly so you can test the API pr ovided insource form, so the user can be used to modify. Please refer to Chapter 5 for a deta iled description of this sample program.



[Figure 1-1. NET-FRM01 Board Usage]

As shown in Figure [1-1], the NET-FRM01 receives Image Frame from camera via Camera-Link Standard Interface. And, the Image Frame data transmit to the PC through the network device like as HUB or Router.

[NET-FRM01 Features]

- Supports Base Configuration Camera Link Camera
- Fully Plug-and-Play
- 24/16/8bit Frame Data Acquisition
- Supports 10/100/1000Mbps (RJ-45 Ethernet Connector)
- Selectable Board Network Information (IP, etc.)
- Supports Fixed IP
- UART(Data 8 bits, 1bit start, 1 stop, No parity, 9600/19200/38400/57600/115200bps) Rx/Tx
- O.S : Windows XP SP1over, Windows 7
- Convenient Windows Application Programming Interface(DLL)

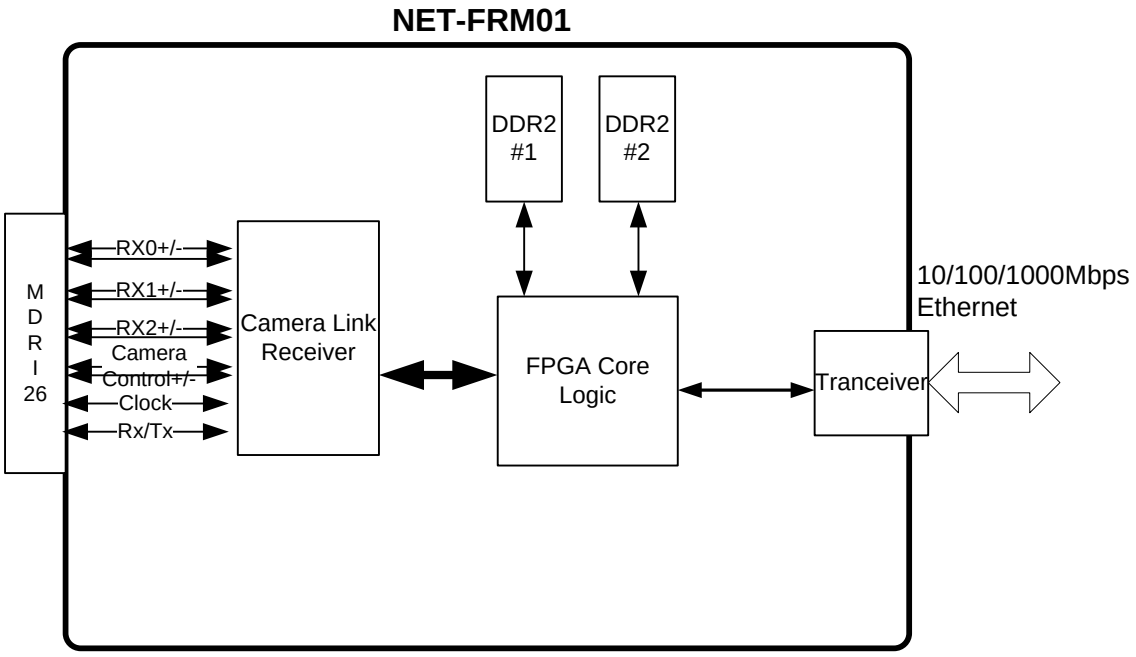
[Application]

- Image Acquisition (Pattern, Particle etc.)
- Inspection Equipment (Sensor, Semiconductor, Device etc.)
- Security Solution
- Medical Image Capture

2. NET-FRM01 Functions

2.1 Block Diagram

As shown in the following figure, main control of the board is performed in FPGA Core Logic. The primary functions are receiving the frame data and are transmitting/receiving the UART data.



[Figure 2-1. NET-FRM01 Block Diagram]

Programming FPGA Core Logic is performed via the JTAG interface. The logic program of the FPGA is saved in a flash ROM, it is located on the board and loaded at the power-up time.

2.2 Camera Link

Camera Link is a communication interface for use in a vision application development. In the past, the camera manufacturer and Frame Grabber manufacturers use their own standard connectors and cables. This has caused a lot of confusion and increased costs to users. In order to eliminate this confusion and increase the data rate and data transmission trouble, the specifications of Camera Link interface have been made to the regulations of cable or connector assembly specifications, transfer speed, transfer method at the meeting of camera makers and Frame grabber manufacturers.

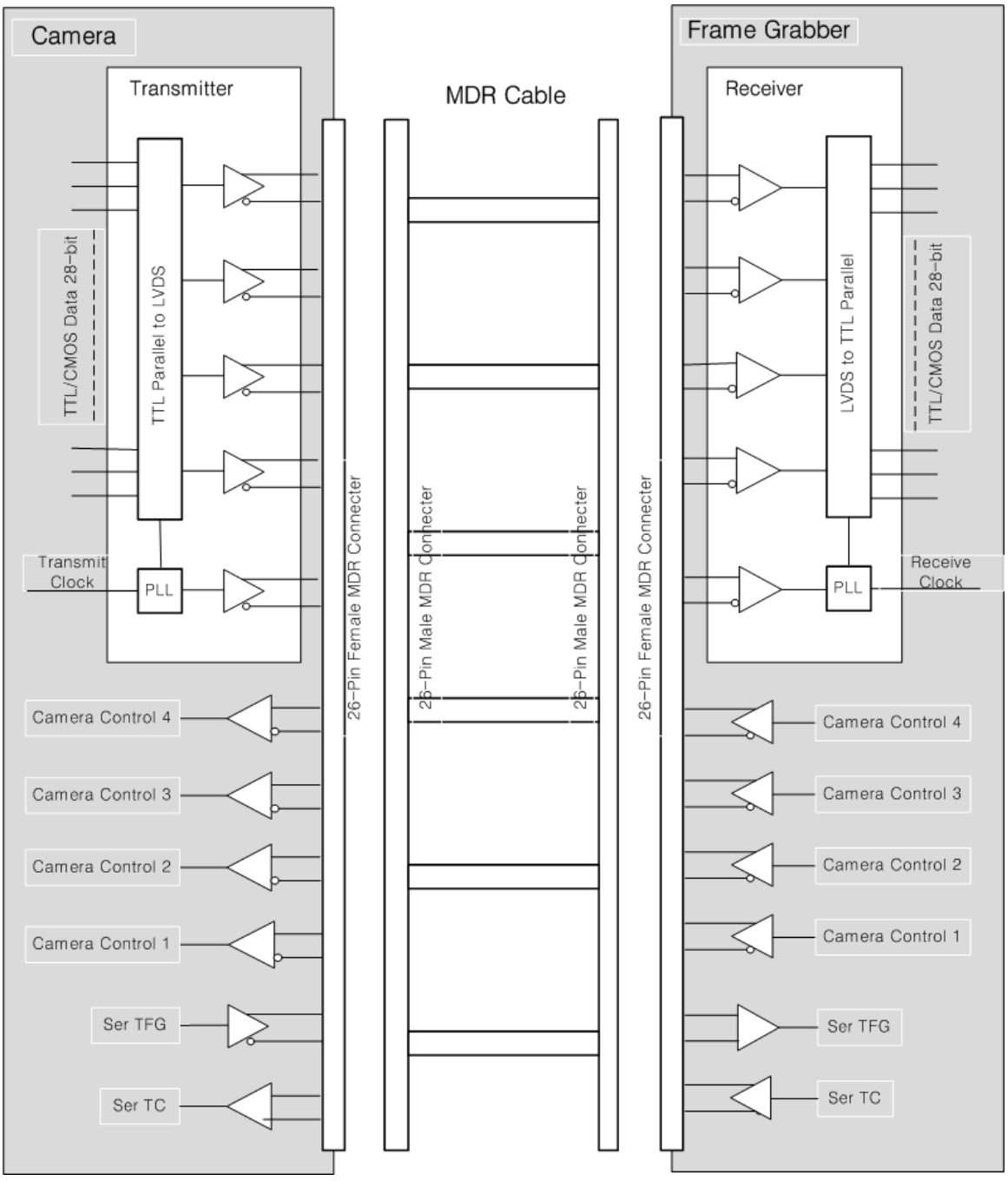
Currently, many digital video solution use the LVDS (Low Voltage Differential Signal) communication as defined RS-644. LVDS is a way to improve the existing RS-422 that had intractable cable and transmission speed limit. RS-644 LVDS was the Camera Link standard. The LVDS can be transferred the data at high speed using low voltage swing differential signal Differential Signal. This is compared with the existing single-ended signal (Single-ended Signal) using one of the lines, the differential signal transmits the signal using two complementary lines. Such a transfer is characterized by excellent noise immunity, low power consumption, large in-phase voltage transmission to refer only to the data transfer on the ground, however Single-ended system is impossible.

Camera Link has multiple configuration with depending on the amount of data to be transferred. Base Configuration consists of 28 bits, including a 24-bit pixel data and 3-bit video sync signal lines of the Data Valid, Frame Line Valid, Line Valid, one reserved signal line, and can transmit 2.04Gbit / s (256MB / s). Medium Configuration can be transmitted the 48bit video signal to 4.08Gbit/s(510Mb/s), Full Configuration can be transmitted the 64bit video signal to 5.44Gbit/s(680MB/s). Camera Link requires two cables to transfer more than Medium Specifications.

Transmitter part is converted to LVDS data stem's 4/8/12 from 28/48/64 bit CMOS / TTL data only. Converted signal is transmitted to MDR Cable in accordance with the Transmit Clock signal, the opposite Receiver will be converted into parallel LVDS data of 28/48/64 bits of CMOS / TTL according to the Receive Clock signal from 4/8/12 LVDS data. This Channel Link technology can immediately take advantage of the low cost chip-set because easy to learn and easy to transplant.

Camera Link Interface includes Base Configuration, Medium Configuration, Full Configuration. Base Configuration is used 4 RS-644 LVDS pairs for controlling the Transmitter/Receiver and Camera like Figure 2-2, is used for communication between the camera and the frame grabber. Transferred the data from serial 26-Pin MDR Cable, is used to change 28-bit parallel image data at

the Receiver part of Frame Grabber.

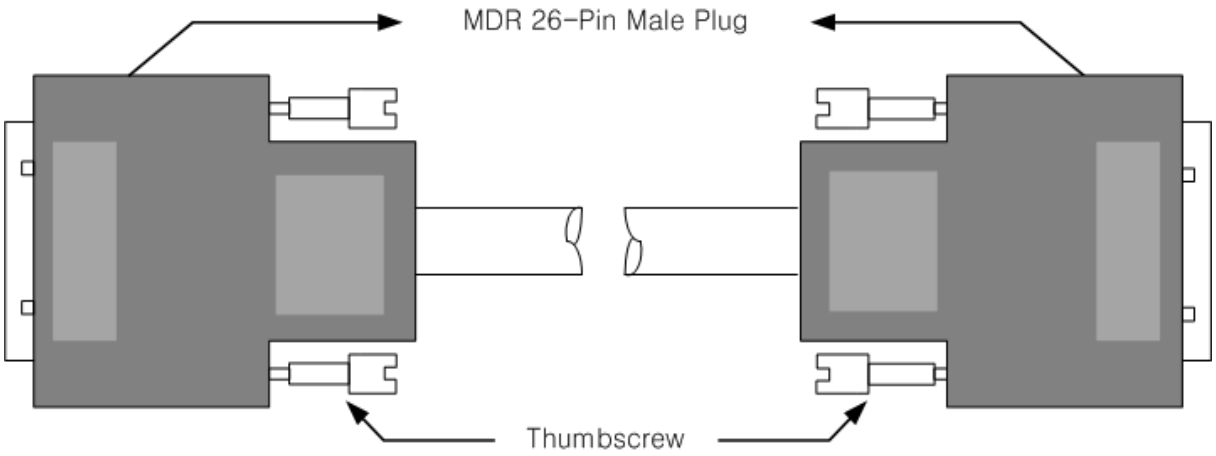


[Figure 2-2. Base Camera Link Block Diagram]

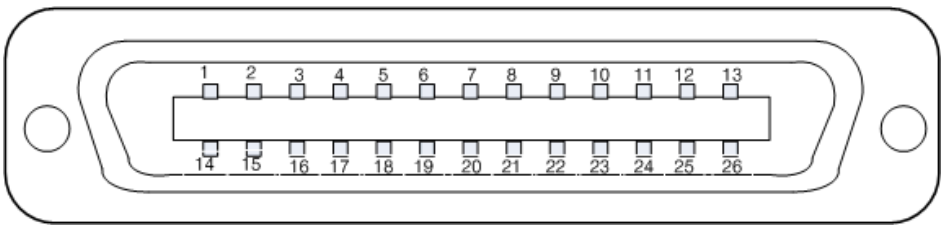
2.3 Camera Link Cable & Connecter

The connection between the camera link cameras and NET-FRM01 board uses the 26 Pin Mini MDR (Mini D Ribbon) cable. Camera Link cable consists of twin-axial shielded cable and 2 Mini MDR 26-male plug. The bottom of Figure 2-4 Camera Link cable is typically used.

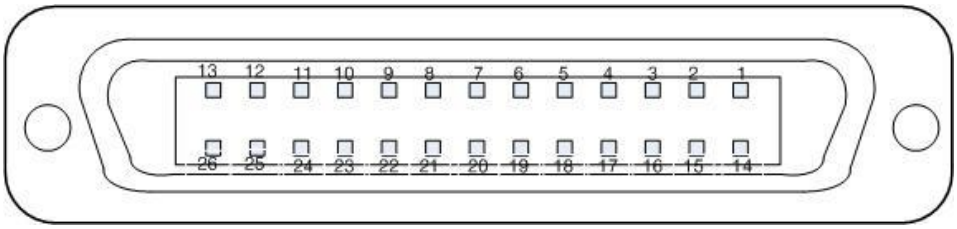
26-Pin Mini MDR Connecter is located at the end of the cable as like Figure 2-5, Figure 2-6 is 26-Pin Mini MDR Connecter, placed at the Camera or Frame Grabber. As shown in the figure, Pin numbers are cross-linked to each other, Transmitter and Receiver of Camera and Frame Grabber signals are connected cross each other.



[Figure 2-3. MDR-26 Camera Link Straight Cable]



[Figure 2-4. MDR-26 Cable (Male) Pin Map]

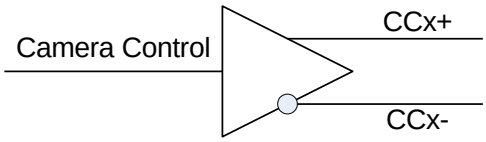


[Figure 2-5. MDR-26 Connecter (Female) Pin Map]

2.4 Camera Link and NET-FRM01

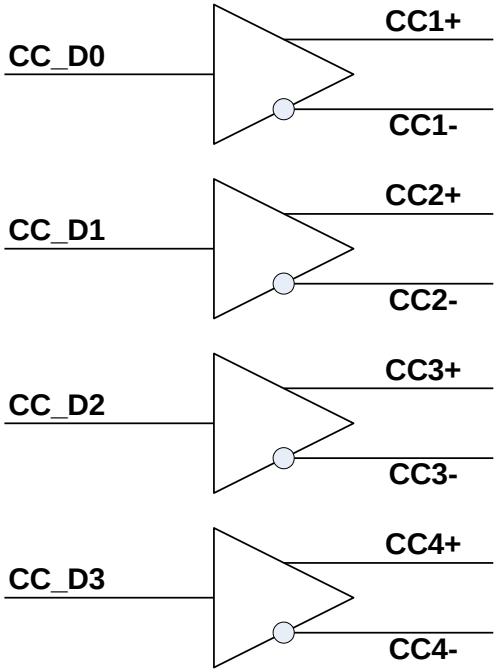
NET-FRM01 supports Camera Link Base/Medium/Full Configuration. Base Configuration, 24 data bits and four enable signals Frame Valid, Line Valid, Data Valid and a spare, including 28-bit parallel signals serialized four LVDS signal lines and one LVDS signal line to fit the camera and synchronous LVDS signal lines including four CC (Camera Control) signal and full 11 includes two asynchronous serial communication to communicate with the camera LVDS lines, is transmitted through one MDR cable. In order to use the MDR Medium / Full Configuration is used other cable and has a total 64bit wide video path.

The transmitted signal is parallelized to 64-bit parallel image signal and Frame Valid, Line Valid, Data Valid, and a spare for each specification from 12 image LVDS serial signal through channel link chip of NET-FRM01.



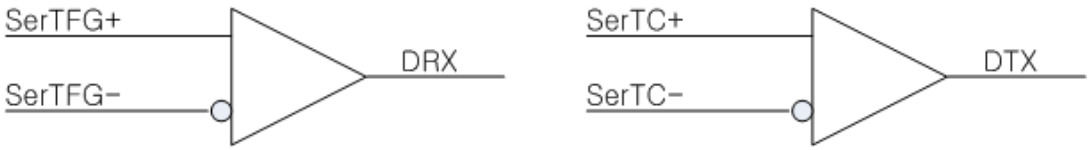
Above picture is a Camera Control output circuit from USB3-FRM13 board to Camera for the specific control of the Camera-link Cable.

The NET-FRM01 board has four differential digital outputs. Each output is mapped by Digital output. Below picture[Figure 2-6] display that each bit position set.



[Figure 2-6. Camera Control LVDS Digital Output Circuit]

The serial input signal through the Camera-link cable is used for general input circuit from NET-FRM01 board.

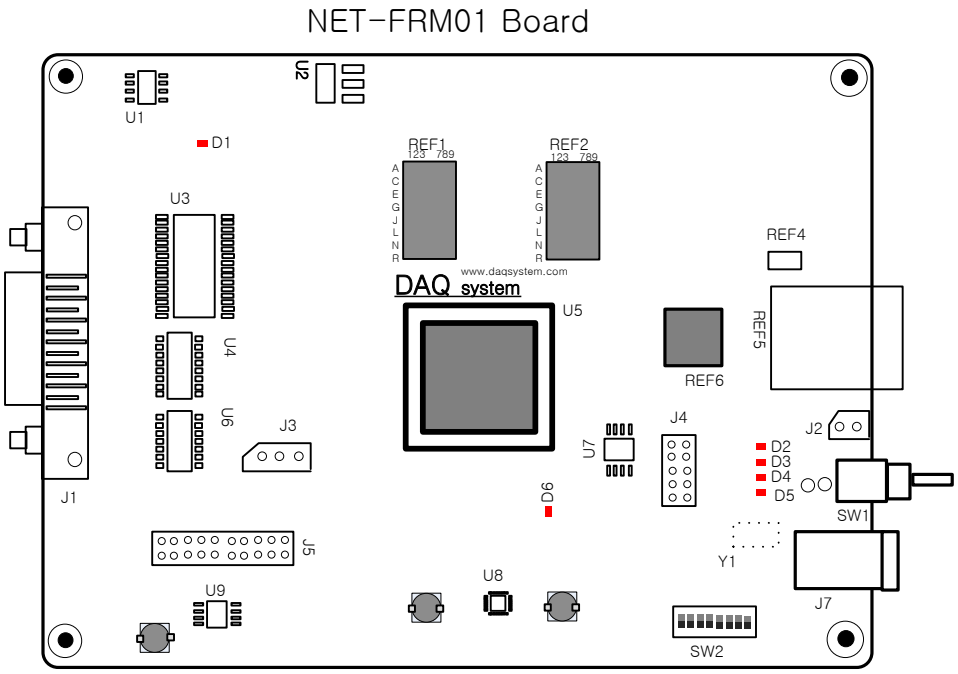


[Figure 2-7. Serial Communication LVDS Digital Output Circuit]

3. NET-FRM01 Board Description

In this chapter, the primary functions of the board are described briefly. For more information, refer to the device specification.

3.1 NET-FRM01 Layout



[Figure 3-1. NET-FRM01 Layout]

The board has 6 LEDs to indicate the operation status.

D1 : turns on when power(3.3V) is applied to the board..

D2 ~ D5 : turns on and off when the network configuration is complete.

D6 : turns on when power is applied to the board and the initialization ends up.

3.2 Functional Blocks

(1) **FPGA : U5**

All of the functions are controlled by the logic program of the FPGA.

(2) **DDR Memory : REF1, REF2**

After save the data in a frame unit, transfer to PC through FPGA.

(3) **Oscillator : REF4, Y1**

10/100/1000Mbps Ethernet Transceiver provides a 25MHz clock.

50MHz is supplied to the FPGA.

(4) **Ethernet Module : REF5**

10/100/1000Mbps Ethernet Module (RJ-45 Connector)

(5) **10/100/1000Mbps Ethernet Transceiver : REF6**

The Ethernet Physical Layer of 1000BASE-T is executed.

(6) **Regulator : U1, U2,**

The Regulator is for supplying the power (3.3V) to the board.

(7) **LVDS Channel : U3**

It is protected a circuit that the interface of high voltage higher than 3.3V CMOS Logic is exchanged to normal 3.3V Logic Level.

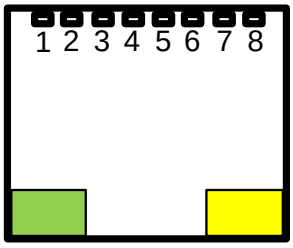
3.3 Connector Pin-out

This chapter will be described about the connector and Jumper that NET-FRM01 used.

The NET-FRM01 board is equipped with RJ-45 connector REF1 for Network connection and J1 connector for external Image Frame connection(Camera Link Signals).

3.3.1 REF1(RJ-45) Connector

When viewed from the front of the cable is connected to PIN of RJ-45 connectors, it is as [Figure 3-2].



[Figure 3-2. RJ-45 Connector(Front View)]

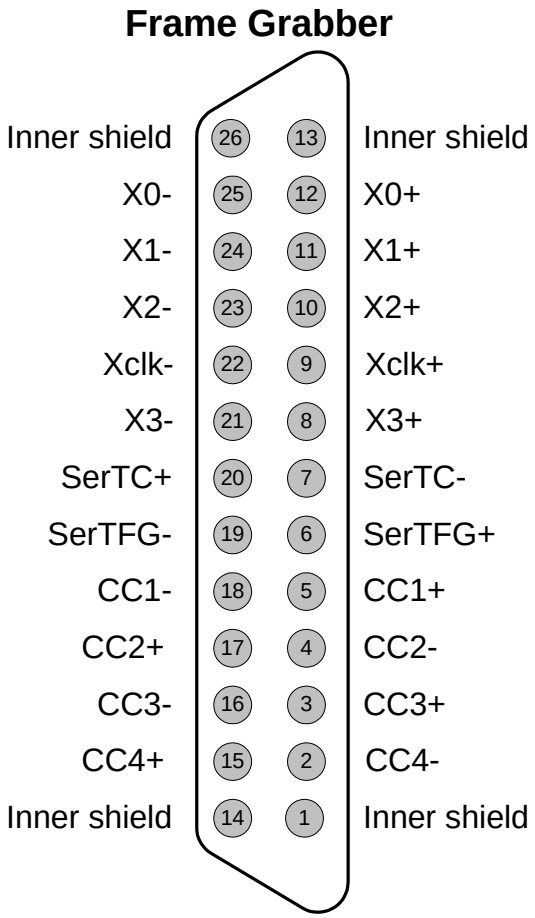
[Table 1. RJ-45 Connector]

Pin	1000BASE-T Signal ID	Remark
1	DA+	
2	DA-	
3	DB+	
4	DC+	
5	DC-	
6	DB-	
7	DD+	
8	DD-	

3.3.2 J1(MDR26) Connector

Figure [3-3] shows the board's J4 connector pin-map.

All of the pin functions are based on the Camera link standard, so please refer to the Camera link standard document for more description and information.



[Figure 3-3. NET-FRM01 J1 Connector Pin-out]

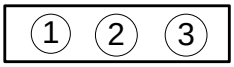
[Table 2. J1 Connector Description]

Pin	Signal Name	Description	Remark
1	**Inner Shield**	Cable shield	
2	**CC4-**	Camera Control output 4-	
3	**CC3+**	Camera Control output 3+	
4	**CC2--**	Camera Control output 2-	
5	**CC1+**	Camera Control output 1+	
6	**SerTFG+**	Serial to Frame grabber +	
7	**SerTC-**	Serial to Camera-	
8	**X3+**	Camera link LVDS receive data3 +	
9	**Xclk+**	Camera link LVDS receive clock +	
10	**X2+**	Camera link LVDS receive data2 +	
11	**X1+**	Camera link LVDS receive data1 +	
12	**X0+**	Camera link LVDS receive data0 +	
13	**Inner Shield**		
14	**Inner Shield**		
15	**CC4+**	Camera Control output 4+	
16	**CC3-**	Camera Control output 3-	
17	**CC2+**	Camera Control output 2+	
18	**CC1-**	Camera Control output 1-	
19	**SerTFG-**	Serial to Frame grabber-	
20	**SerTC+**	Serial to Camera+	
21	**X3-**	Camera link LVDS receive data3-	
22	**Xclk-**	Camera link LVDS receive clock-	
23	**X2-**	Camera link LVDS receive data2-	
24	**X1-**	Camera link LVDS receive data1-	
25	**X0-**	Camera link LVDS receive data0-	
26	**Inner Shield**		

(Note) For more information, refer to Camera Link Standard Specification.

3.3.3 J3 Connector (3Pin Header, 2.54mm)

It is an external RS-232 Debug Port.



[Figure 2-4. J3 Connector (Top View)]

[Table 3. J3 PIN-OUT Description]

No.	Name	Description
1	**U_SPI_MISO**	Tx (Transceiver Data)
2	**U_SPI_MOSI**	Rx (Receiver Data)
3	**GND**	Ground

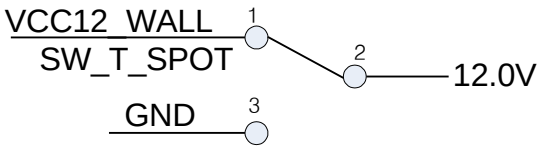
3.3.4 J7 Connector

It is an external 12V DC Jack Power Connector of DC-005 (2.0) standard.

[Figure 2-5. Rated Output]

3.3.5 SW1 Switch

Board On/Off Switch.



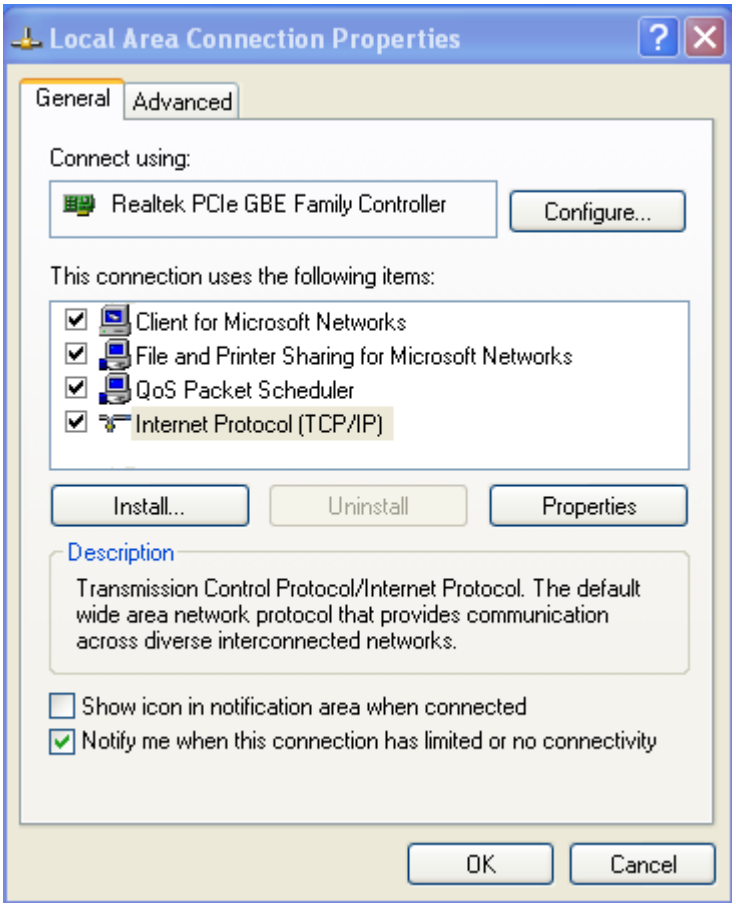
[Figure 2-6. SW1 Switch]

4. Network Setup

The NET-FRM01 don't need a separate device driver because it uses for network. However, it is used by specifying IP(Internet Protocol) address identifier. It is possible to install and use the service on the network Filter Driver.

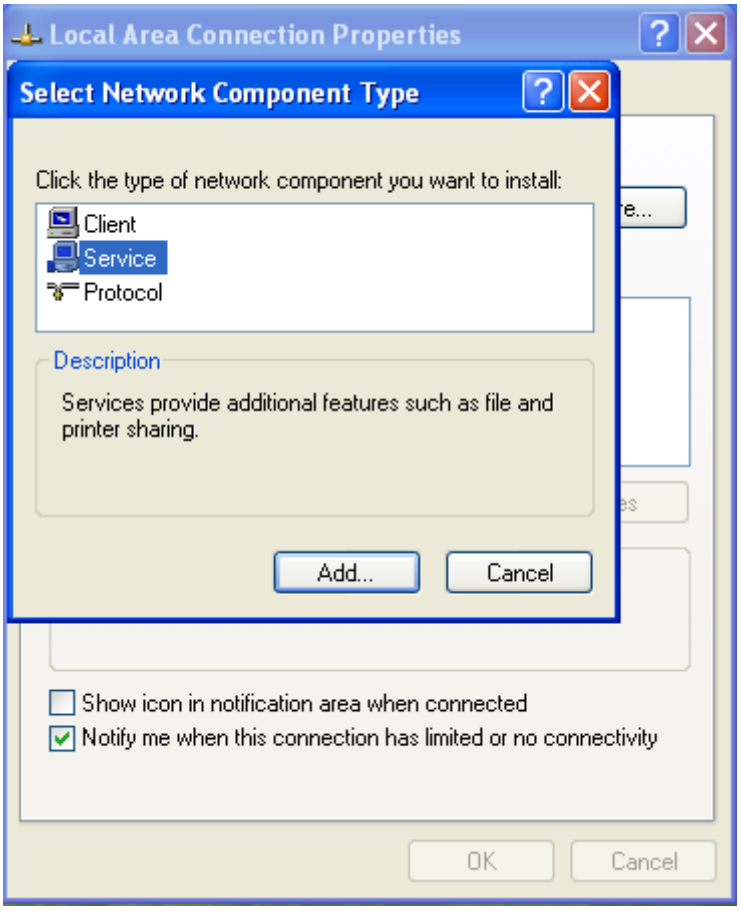
4.1 Filter Driver Installation for Win XP

Installed a filter driver can reduce the PC resources. The procedure is as follows. "My Network Places ➔ local area connection ➔ properties" is selected, this comes under the network properties.



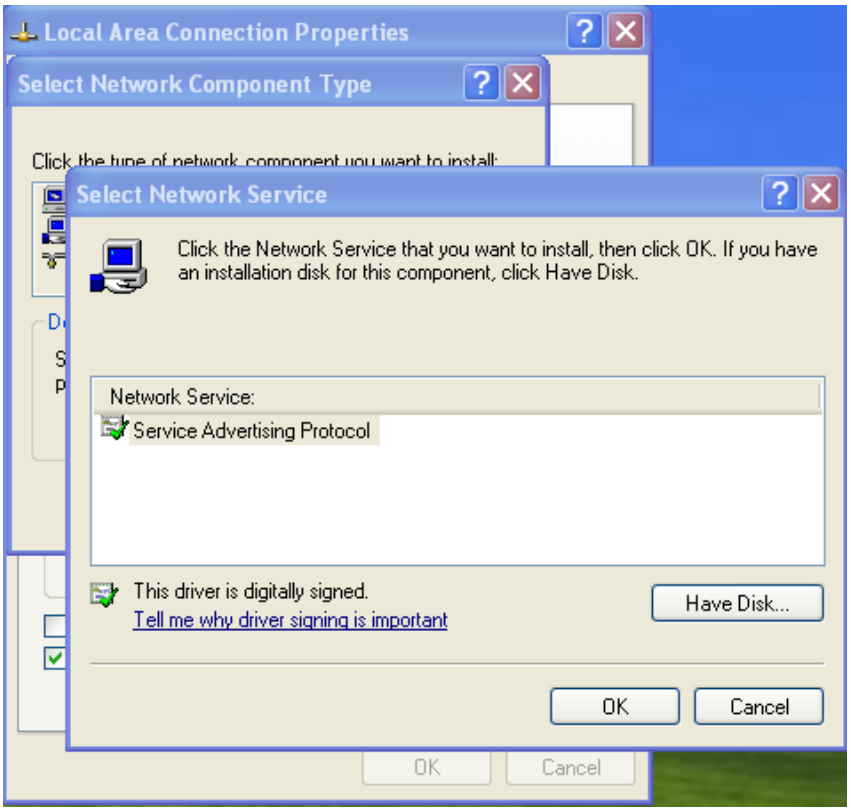
[Figure 4-1. Network Connection Property]

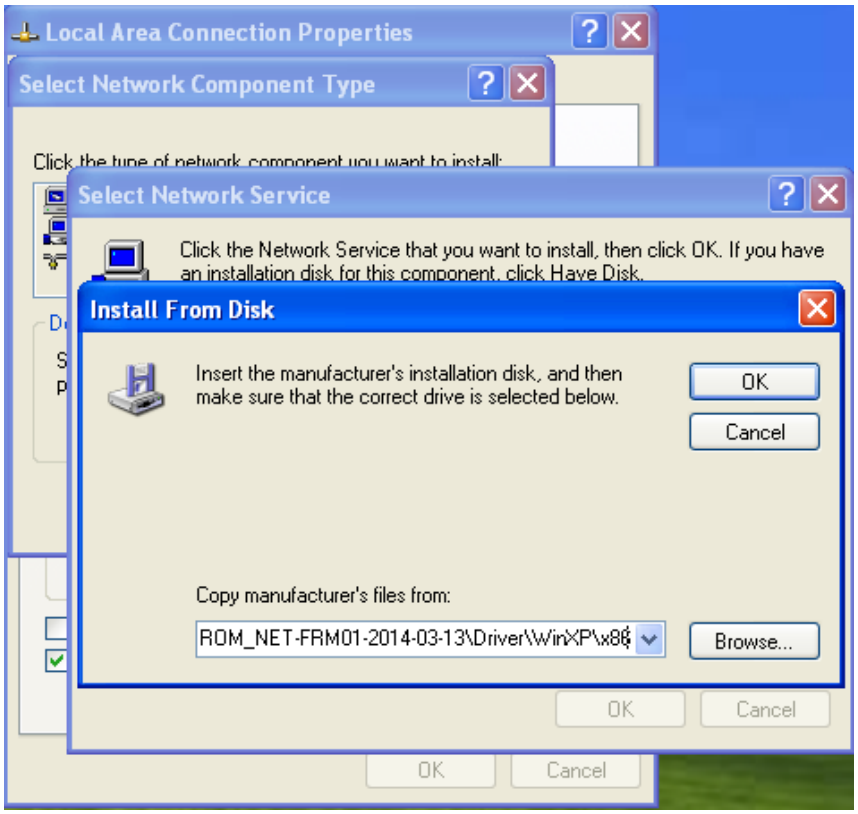
In the “Internet Protocol (TCP / IP)” window, the "install ..." is selected and then selects a service.

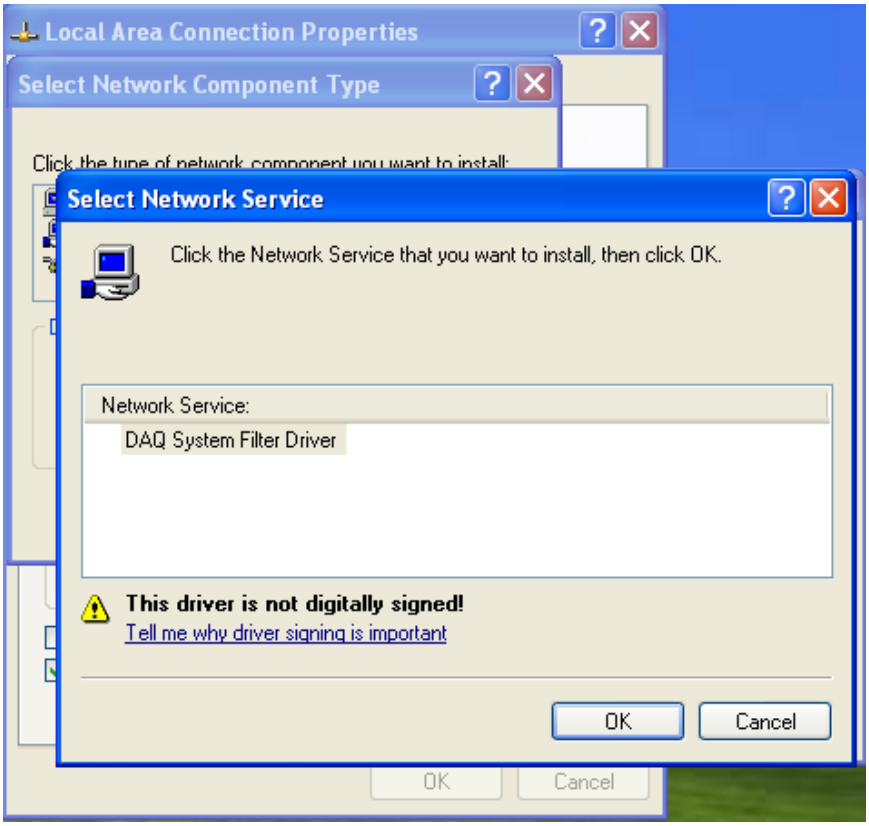


[Figure 4-2. Network Component Type Selection]

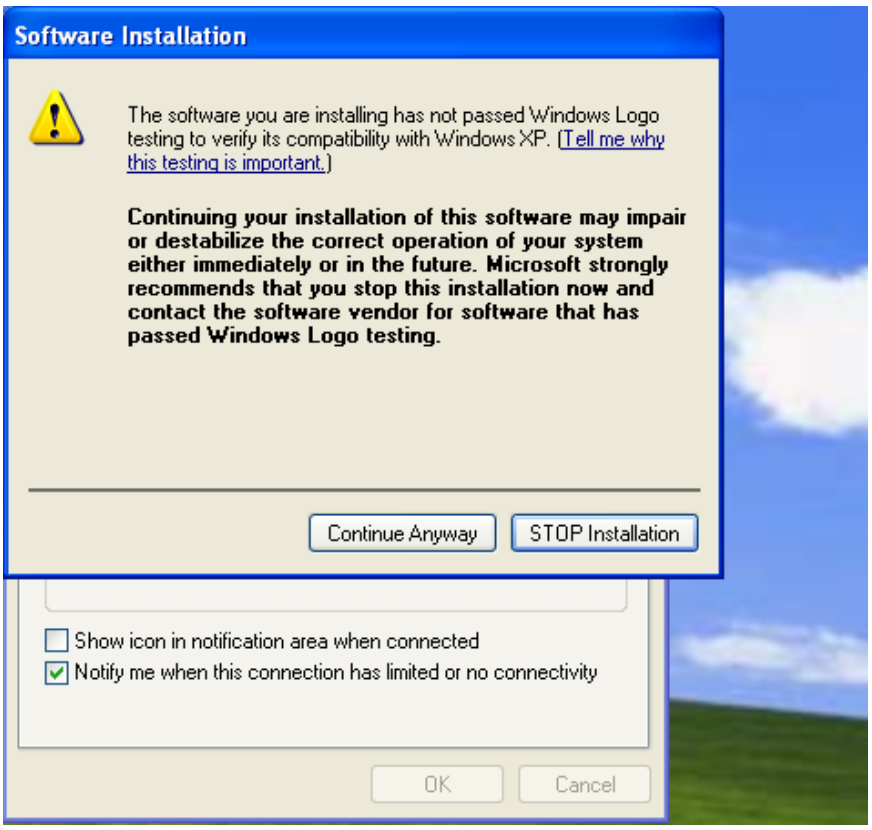
Select a "Have Disk…" in the "Select Network Service" and click "Browse (B) ...". You can find a “netsf.ini” file from the provided CD-ROM, and then click OK.



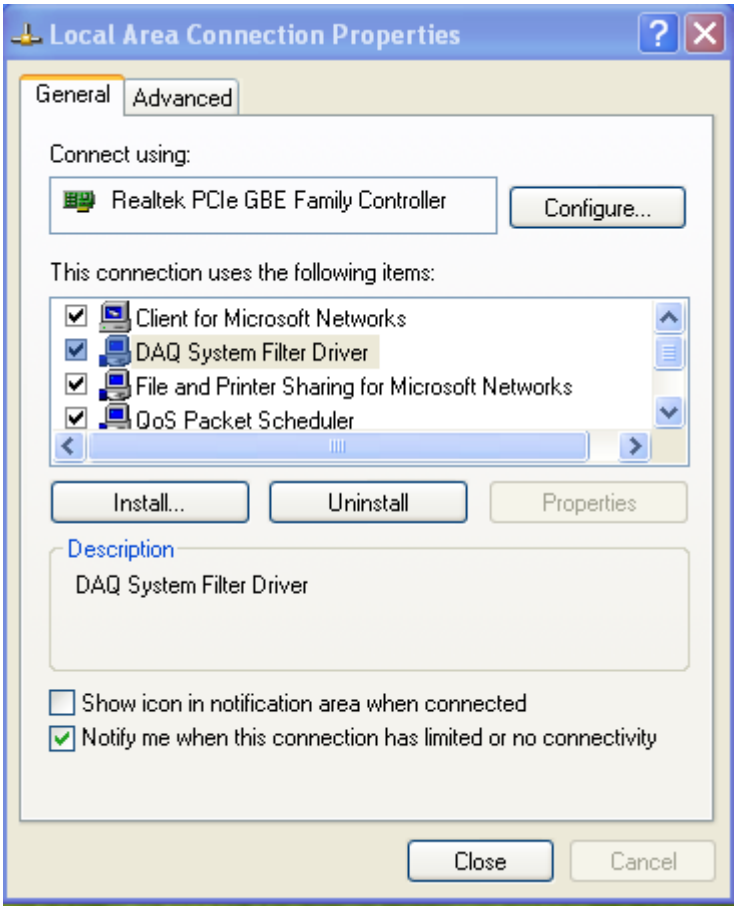




"Select Network Service", and then click the [OK], and requires a check of compatibility.



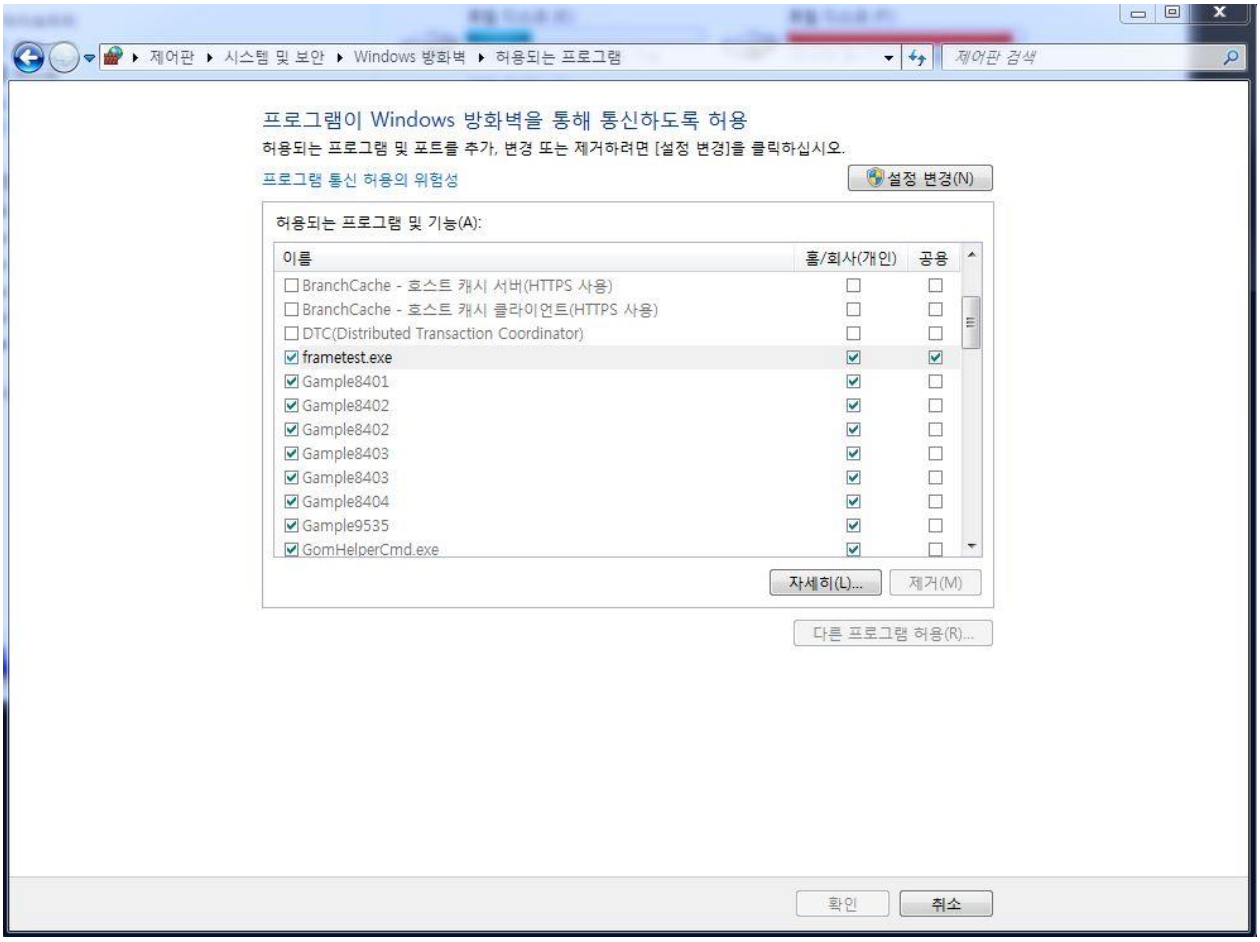
When the driver installation is complete, you can see **"DAQ System Filter Driver"** as shown below.



4.2 Filter Driver Installation for Win 7

In the case of Win7, you run the program with administrator privileges to depending on the setting of the operating system. You can prevent the execution of the block of DAQ system against firewall program. If you cannot share a computer, and can use a computer in the office, please ask them to contact the administrator user of your PC, you are given administrator rights to your user account. The rest of the process is the same as Win XP.

If FrameTest.exe executable file doesn't not perform as firewall, Press the **"Control Panel ➔ System and Security ➔ Windows Firewall ➔ Allows the Program through Window Firewall".** You have to permit as shown below **"frametest.exe ➔ Home/Company(Private)"**.

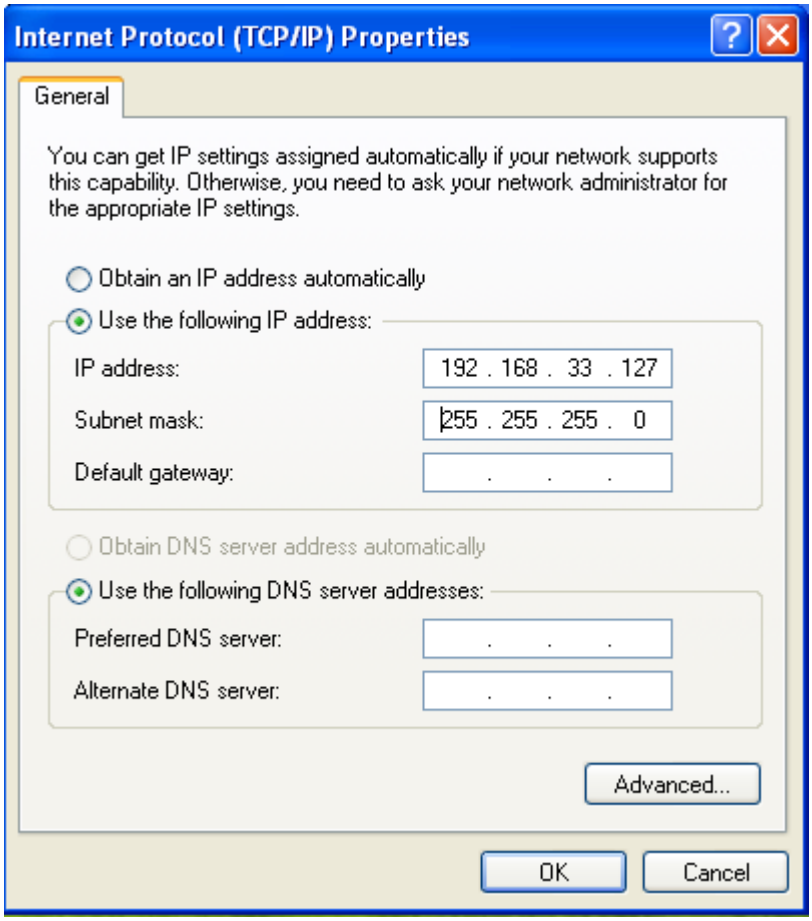


[Figure 4-3. Allows program when shut off the firewall]

4.3 Network IP Setup

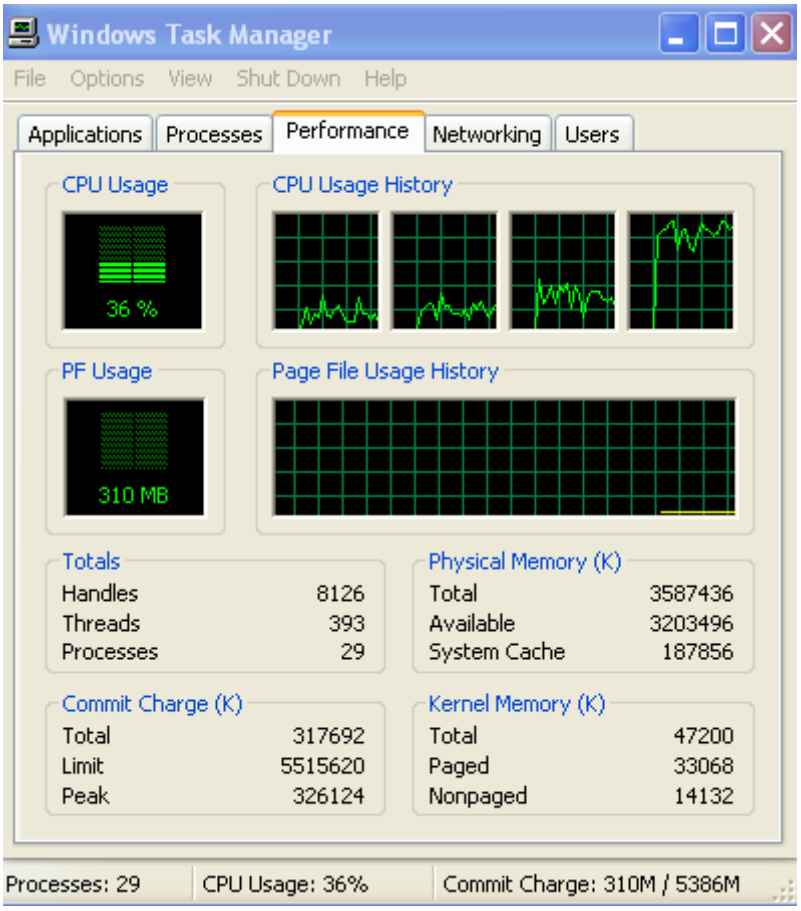
Before using the board, it uses after specifying the IP address in the “Internet Protocol (TCP/IP)” as shown [Figure 4-1].

The NET-FRM01 board 192.168.33.129 IP is used as the fixed identifier. This identifier does not overlap with the appropriate choice of IP, 255.255.255.0 as the subnet mask set used. The remaining portion of the selection may be omitted.

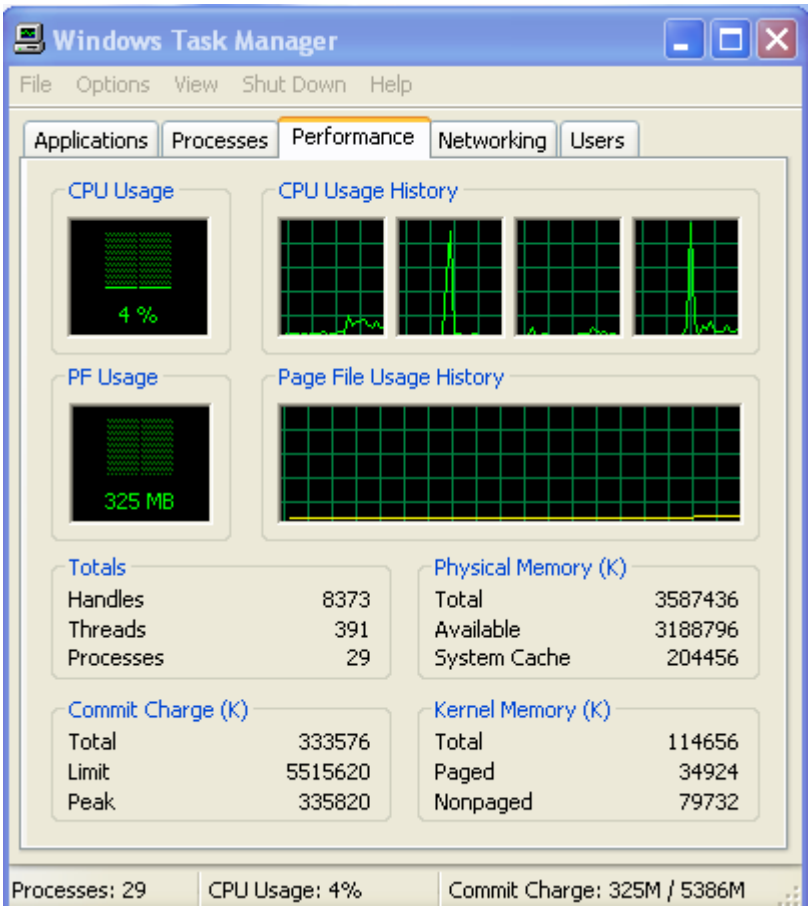


[FIgure 4-4. Internet Protocol(TCP/IP) Property]

When you use the NET-FRM01, it is possible not to install the filter driver as section 4.1. However, using the filter driver can be reduced the PC's resources.



[Figure 4-5. PC CPU Usage - when did not install the filter driver]

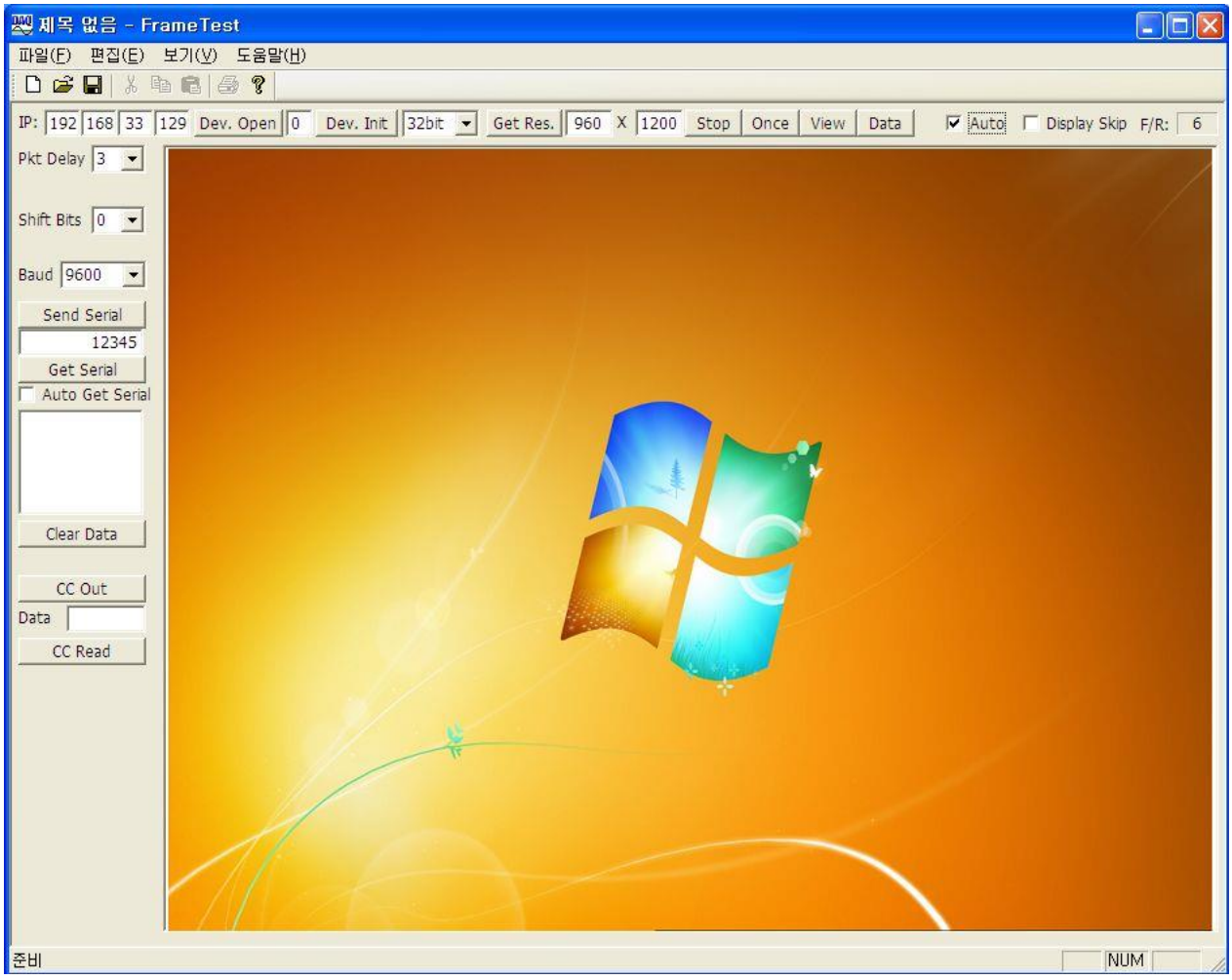


[Figure 4-6. PC CPU Usage - When install the filter driver]

5. Sample Program

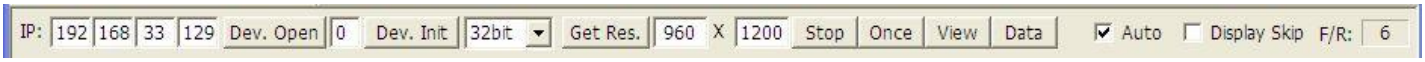
DAQ system provides a sample program to make the user be familiar with the board operation and to make the program development easier. You can find the sample program in the CDROM accompanying with the board.

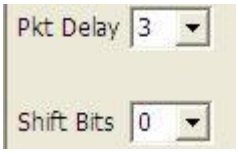
Before using the program, as part of Network Configuration chapter 4 PC Internet TCP / IP address must be set first.



[Figure 5-1. When Sample program "FrmTest.exe' is executed]

5.1 Image Frame Function





(1) **"Dev. Open" button**

It starts a selected board device.

If it is "0", it is the normal state. If it is "-1", the device is not recognized.

(2) **"Dev. Init" button**

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

(3) **Mode Selection**

It selects a Video Data Mode of 8bit, 16bit, 24bit, 32bit.

(4) **"Get Res." button**

It shows the image resolution.

(5) **"Start" button**

It starts the image transfer. It is a Toggle button, press again stop the image transferring.

(6) **"Once" button**

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

(7) **"View" button**

Start the image transmission.

(8) **"Data" button**

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

(9) **"Auto" toggle**

When check this box, it displays a video

(10) **"Display Skip" toggle**

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

(11) **"F/R"**

Frame rates/sec

(12) **"Pkt Delay" Selection**

You can select a next Package Delay 0 ~ 15 after transfer Package. The unit is 5us.

(13) **"Shift Bits"**

It is an option for Black/White Camera test, the bits 0-8 of the input frames can be moved to the right. For example, you can view the images(8bit) after shifting 4bit in case of 12bit Black/White camera.

5.2 UART/Status Function

(1) **"Baud" Selection**

Select the Baud Rate (9600, 19200, 38400, 57600, 115200 Baud Rate).

(2) **"Send Serial" button**

Send the UART data.

(3) "**Get Serial" button**

Get the data from UART buffer.

(4) **"Auto Get Signal" toggle**

When check this box, the serial data from Frame Grabber will be displayed in the below box.

(5) **"Clear Data" button**

Clear the UART Receiver buffer.

(6) **"CC Out" button**

Write CC(Camera Control) Data.

(7) **"CC Read" button**

Read CC(Camera Control) Data.

.

Appendix

A.1 General Specification

Image Input

- One Base Camera Link

Output

- 10/100/1000 Mbps Ethernet Interface

Serial Interface (Option)

- 8bit Data, 1 Stop bit, No parity
- Baud Rates --- 9600, 19200, 38400, 57600, 115200

Power Requirement

- Voltage : +12V (Max. 1A)

Environment

Caution) When using internal,

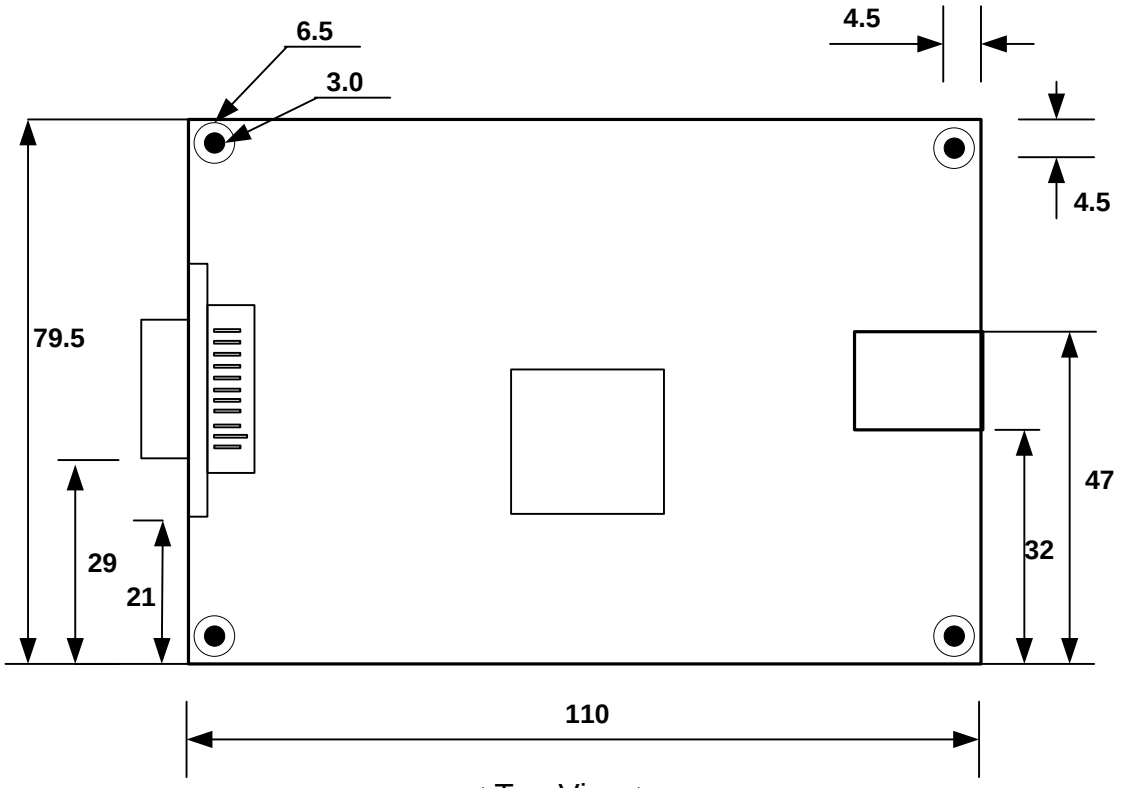
- Operating Temperature : 0 ℃ ~ 60 ℃
- Storage Temperature : -20 ℃ ~ 70 ℃
- Relative Humidity : 5% ~ 90%, non-condensing

Software

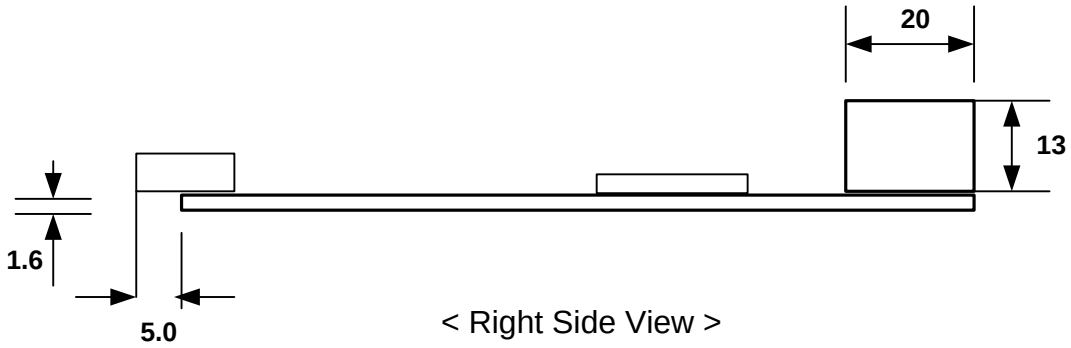
- OS : 32/64bit Windows XP SP1/Windows 7 SP1
- API : Interface with Application through client DLL
- Sample Software : Test Sample software for evaluation

A.2 Physical Dimension

Dimensions of the board are as follows:



< Top View >



< Right Side View >

References

1. AN201 How to build application using API

-- DAQ system

2. AN342 NET-FRM01 API ver1.0

-- DAQ system