

# **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 inphase 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]

# **DAQ** SYSTEM

### 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)]

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

#### [Table 1. RJ-45 Connector]

### 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.



# **Frame Grabber**

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



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	Х3-	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		

### [Table 2. J1 Connector Description]

(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  $\rightarrow$  local area connection  $\rightarrow$  properties" is selected, this comes under the network properties.

🕹 Local Area Connection Properties 🛛 🔹 🏹 🗙
General Advanced
Connect using:
Realtek PCIe GBE Family Controller      Configure
This connection uses the following items:
<ul> <li>Client for Microsoft Networks</li> <li>File and Printer Sharing for Microsoft Networks</li> <li>QoS Packet Scheduler</li> <li>Transmit Protocol (TCP/IP)</li> </ul>
Install Uninstall Properties
Description Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.
<ul> <li>Show icon in notification area when connected</li> <li>Notify me when this connection has limited or no connectivity</li> </ul>
OK Cancel

[Figure 4-1. Network Connection Property]

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

🕹 Local Area Connection Properties 🛛 🔹 🏹
Select Network Component Type 🛛 💽 🔀
Click the type of network component you want to install: Client Service Protocol
Description         Services provide additional features such as file and printer sharing.         es         Add       Cancel
<ul> <li>Show icon in notification area when connected</li> <li>Notify me when this connection has limited or no connectivity</li> </ul>
OK Cancel

[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 Component Type 🛛 🔋 🗙	
Click the type of network component you want to install	2 🗙
an installation disk for this component, click Have Disk.	ICK UK. If you have
D'	
Network Service:	
This driver is digitally signed. <u>Tell me why driver signing is important</u>	Have Disk
ОК	Cancel
OK Cancel	
	Sec
👍 Local Area Connection Properties 💦 🏾 🤶 🗙	
Select Network Component Type ? 🗙	
Click the type of network component you want to install:	
Select Network Service	? 🗙
Select Network Service	? 🗙 lick OK. If you have
Select Network Service Click the Network Service that you want to install, then of an installation disk for this component, click Have Disk, Install From Disk	ick OK. If you have
Select Network Service Click the Network Service that you want to install, then c an installation disk for this component. click Have Disk. Install From Disk	ick OK. If you have
Select Network Service Click the Network Service that you want to install, then c an installation disk for this component, click Have Disk. Install From Disk Insert the manufacturer's installation disk, and then make sure that the correct drive is selected below.	Iick OK. If you have       Ick OK. If you have
Select Network Service Click the Network Service that you want to install, then of an installation disk for this component. click Have Disk. Install From Disk Insert the manufacturer's installation disk, and then make sure that the correct drive is selected below.	Iick OK. If you have
Select Network Service Click the Network Service that you want to install, then of an installation disk for this component. click Have Disk. Install From Disk Insert the manufacturer's installation disk, and then make sure that the correct drive is selected below.	ick OK. If you have
Select Network Service Click the Network Service that you want to install, then of an installation disk for this component, click Have Disk. Install From Disk Insert the manufacturer's installation disk, and then make sure that the correct drive is selected below.	ick OK. If you have
Select Network Service Click the Network Service that you want to install, then of an installation disk for this component, click Have Disk. Install From Disk Insert the manufacturer's installation disk, and then make sure that the correct drive is selected below. Copy manufacturer's files from:	? X lick OK. If you have   OK   OK   Cancel
Select Network Service Click the Network Service that you want to install, then c an installation disk for this component. click Have Disk. Install From Disk Insert the manufacturer's installation disk, and then make sure that the correct drive is selected below. Copy manufacturer's files from: ROM_NET-FRM01-2014-03-13\Driver\WinXP\x88	Cancel
Select Network Service Click the Network Service that you want to install, then c an installation disk for this component. click Have Disk. Install From Disk Insert the manufacturer's installation disk, and then make sure that the correct drive is selected below. Copy manufacturer's files from: ROM_NET-FRM01-2014-03-13\Driver\WinXP\x88	Rowse
Select Network Service Click the Network Service that you want to install, then of an installation disk for this component. click Have Disk. Install From Disk Install From Disk Insert the manufacturer's installation disk, and then make sure that the correct drive is selected below. Copy manufacturer's files from: ROM_NET-FRM01-2014-03-13\Driver\WinXP\x8\$	? × lick OK. If you have OK OK Cancel Browse Cancel

🕹 Local Area Connection Properties 🛛 🛛 🔀
Select Network Component Type ? 🗙
Click the type of network component you want to install:
📱 Select Network Service 🛛 🔹 🤶 🔀
Click the Network Service that you want to install, then click OK.
Network Service:
DAQ System Filter Driver
This driver is not digitally signed! <u>Tell me why driver signing is important</u>
OK Cancel
OK Cancel

"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.

🕹 Local Area Connection Properties 🛛 🔹 🏹
General Advanced
Connect using:
Bealtek PCIe GBE Family Controller
This connection uses the following items:
Client for Microsoft Networks
B DAQ System Filter Driver      DAQ File and Printer Sharing for Microsoft Networks
✓ ■ QoS Packet Scheduler
Install Uninstall Properties
Description
DAQ System Filter Driver
<ul> <li>Show icon in notification area when connected</li> <li>Notify me when this connection has limited or no connectivity</li> </ul>
Close Cancel

### 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)".

	## 1148.01	RE LOD PL	
중 ♥ ♥ ♥ 제어판 ▶ 시스	템 및 보안 🕨 Windows 방화벽 🕨 허용되는 프로그램	★ 4 제어판 검색	Q
	프로그램이 Windows 방화벽을 통해 통신하도록 허 허용되는 프로그램 및 포트를 추가, 변경 또는 제거하려면 [설정 변경] 프로그램 통신 허용의 위험성	용 을 클릭하십시오. 왕설정 변경(N)	
	허용되는 프로그램 및 기능(A):		
	이름 BranchCache - 호스트 캐시 서버(HTTPS 사용) BranchCache - 호스트 캐시 클라이언트(HTTPS 사용) DTC(Distributed Transaction Coordinator) frametest.exe Gample8401 Gample8402 Gample8402 Gample8403	홍/회사(개인)     공용     ^       ····································	
	Gample8403     Gample8404     Gample9535     GomHelperCmd.exe	♥ □ ♥ □ ♥ □ ▼ ₩ □ ♥ □ ▼ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩ ₩	
		확인 취소	

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

# DAQSYSTEM

### 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.

Internet Protocol (TCP/IP) Prope	rties 🛛 🖓 🔀
General	
You can get IP settings assigned auton this capability. Otherwise, you need to a the appropriate IP settings.	natically if your network supports ask your network administrator for
🔿 Obtain an IP address automaticall	y
Ose the following IP address: —	
IP address:	192 . 168 . 33 . 127
Subnet mask:	255.255.255.0
Default gateway:	· · ·
Obtain DNS server address autom	natically
─⊙ Use the following DNS server add	resses:
Preferred DNS server:	
Alternate DNS server:	· · ·
	Advanced
	OK Cancel

[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.

📕 Windows Ta	ask Manager		
File Options Vie	ew Shut Down He	lp	
Applications Pro	ocesses Performan	ce Networking User:	s
CPU Usage -	CPU Usage I	History	
36 %			
PF Usage	Page File Us	age History	
310 MB			
- Totals		Physical Memory (K	)
Handles	8126	Total	3587436
Threads	393	Available Suctors Control	3203496
Processes	29	System Cache	187856
Commit Charg	ge (K)	-Kernel Memory (K)	
Total	317692	Total	47200
Limit	5515620	Paged	33068
Peak	326124	Nonpaged	14132
Processes: 29	CPU Usage: 36%	Commit Charge: 3	310M / 5386M

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



e Options View Shu	it Down Help		
pplications Processes	Performance	Networking Users	
CPU Usage	CPU Usage His	tory	
4 %			
PF Usage	Page File Usag	e History	
325 MB			
Totals		- Physical Memory (K)	
Handles	8373	Total	3587436
Threads	391	Available	3188796
Processes	29	System Cache	204456
Commit Charge (K) —		Kernel Memory (K) —	
Total	333576	Total	114656
Limit	5515620	Paged	34924
Deals	335820	Nonnaged	79732

[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

			-		1.0000		-		Manager and Man	-		-	novi osti i i i i i	1.000		distant sectors and	 	240 2.80	and the second		
IP:	192 1	68 33	129	Dev. Open	0	Dev. Init	32bit	-	Get Res.	960	Х	1200	Stop	Once	View	Data	Auto	EI	Display Skip	F/R:	6



#### (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  $^{\circ}$ C ~ 60  $^{\circ}$ C
- Storage Temperature : -20  $^{\circ}$ C ~ 70  $^{\circ}$ C
- 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:





# References

1. AN201 How to build application using API

2. AN342 NET-FRM01 API ver1.0

-- DAQ system

-- DAQ system