FOculus
IEEE1394 Digital Camera

User Operation Manual

for FIREWIRE CCD Cameras FOxxxSx Models

User Manual Version 1.3 June 2011

Legal Notice.

For Customers in U.S.A.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. You are cautioned that any changes or modifications not expressly approved in this manual could void your authority to operate this equipment. The shielded interface cable recommended in this manual must be used with this equipment in order to comply with the limits for a computing device pursuant to Subpart J of Part 15 of FCC Rules.

For customers in Europe

This apparatus has been certified to meet or exceed the standards for CE compliance per the Council Directives. Pertinent testing documentation is available for verification.

For customers in Canada

This apparatus complies with the Class B limits for radio noise emissions set out in the Radio Interference Regulations.

Pour utilisateurs au Canada

Cet appareil est conforme aux normes Classe B pour bruits radioélectriques, spécifiées dans le Règlement sur le brouillage radioélectrique.

Life support applications

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. NET customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify NET for any damages resulting from such improper use or sale.

Before You Start

This manual should help you in installation and setting of the camera and we recommend you to carefully follow the instruction described.

To ensure that your warranty remains valid, read the manual carefully before using the camera.

DO NOT disassemble, modify or repair the camera since there is no user serviceable part inside and may void warranty. For prevention of fire or electric shock DO NOT remove screws or cover from the camera.

Operations in wet environments are NOT recommended and camera SHOULD NOT be exposed to rain or moisture. For prolong life and use of camera's CCD, do not point the camera directly to the sun or strong spotlight which may result CCD blooming and permanent damage.

DO NOT operate camera beyond operation temperature range stated and AVOID usage in conditions exceeding 90% humidity.

DO NOT use unregulated power supply source to prevent camera's circuit damage.

Use soft materials such as lens tissue or cotton tipped applicator with ethanol for CCD faceplate cleaning ONLY when necessary and AVOID contact with fingers or any hard object. Do not use solvent, abrasives or detergent in case of cleaning camera body.

Warranty shall be voided for improper usage or fault caused by user or damage caused by other equipments due to negligence

Warranty

NET GMBH warrants the original components free of defects for one year from purchase date. This warranty covers failures and damage due to defect which may occur during normal use. It does not cover damages or failure resulting from mishandling, abuse, misuse or modification. For every repair or replacement, RMA numbers must be obtained in advance.

Disclaimer

The information in this document has been carefully checked and is believed to be reliable. However, no responsibility is assumed for inaccuracies, nor is any responsibility assumed by NET GMBH. There is no legal obligation to documenting internal relationships in any functional module of its products, which is realized in either hardware or software.

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FOculus S Series Operation Manual

1.   Introduction

1.1.   Overview

NET GmbH's new **FOCULUS S SERIES** opens a new horizon to digital image processing providing more features in a small form factor still maintaining the cost effectiveness and high quality. **FOCULUS S SERIES** models are lined up by a wide range of resolution equipped with FIREWIRE™ interface and trigger to suit the need for every application.

The **FOCULUS S SERIES** offer the highest frame rate each in its resolution range compared with products from others. The small form factor design has expanded the usage by eliminating limits currently existing due to size and weight which has broaden the application area.

Large selection of cameras is available and scheduled to be added to the **FOCULUS S SERIES** which consist of various sensor sizes (2/3", 1/2", 1/3", 1/1.8") and resolution (VGA, SVGA, XGA, SXGA, UXGA) both in color and black and white. The **FOCULUS S SERIES** consist of the following models.

FOCULUS S SERIES	Model Name	CCD(Progressive)	Resolution	FPS at Max Resolution
Black & White	FO531SB	1/1.8"	1600 x 1200	16
	FO442SB	2/3"	1392 x 1040	20
	FO432SB	1/2"	1392 x 1040	20
	FO323SB	1/3"	1024 x 768	36
	FO234SB	1/2"	780 x 580	63
	FO134SB	1/2"	640 x 480	86
	FO124SB	1/3"	640 x 480	86
Color	FO531SC	1/1.8"	1600 x 1200	16
	FO442SC	2/3"	1392 x 1040	20
	FO432SC	1/2"	1388 x 1036	20
	FO323SC	1/3"	1024 x 768	36
	FO234SC	1/2"	780 x 580	63
	FO134SC	1/2"	640 x 480	86
	FO124SC	1/3"	640 x 480	86

FOCULUS S SERIES 's unique features are support for external trigger mode 0 ~ 5 and 14, multi camera auto-sync, one-shot and multi-shot, wide range of shutter speed (1us ~ 3600s), RS232C pass through via FIREWIRE™, fast format 7 partial scan, vertical and full binning mode (1x2, 2x2 for B&W and FO531SC) which would provide maximum flexibility in applications. From **FOCULUS S SERIES** input signals are isolated optically ensuring quality images acquiring without the risk of noise through input and industrial screw lock cable support has been added for more reliable connectivity.. **FOCULUS S SERIES** 's firmware can be upgraded via FIREWIRE™ and latest versions are available through our website together with NET GmbH's SDK and demo applications.

1.2.   Components

Components in our package

The following components are included in our package
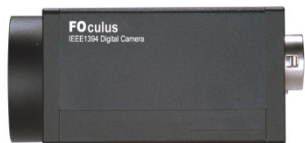
FOCULUS S SERIES

CAMERA UNIT

Optical Low Pass filter for Color Models.

FIREWIRE^{TM} Digital Imaging CD

Driver

Demo Software

FOSDK API Library

Manuals

User Manual

Downloadable Software

Latest Update of Firmware and Demo Applications are available on our website.

http://www.net-gmbh.com   http://www.net-usa-inc.com

1.3. Optional Accessories

Machine Vision CCD Lens

FIREWIRE^{TM} OHCI Adapter

FIREWIRE^{TM} PC-Card Bus Adapter

FIREWIRE^{TM} Cable

FIREWIRE^{TM} Genders

FIREWIRE^{TM} Hub Repeater

Tripod Plate

1.4.   Dimension and Description

Camera Body Size   :   44 (w) x 29 (H) x 63(D) mm (for all models except FO442SB/FO442SC)

Camera Body Weight :   approx. 110 g
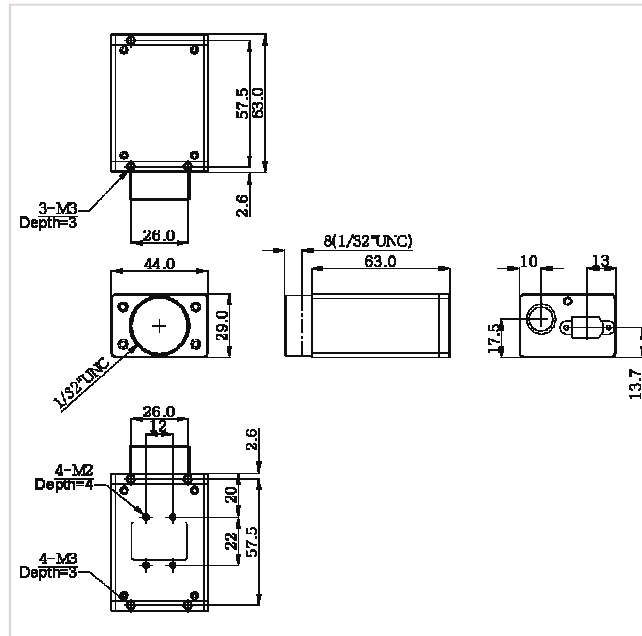
Camera Body Size   :   44 (w) x 29 (H) x 67(D) mm (for Camera model FO442SB/FO442SC)

Camera Body Weight :   approx. 119 g
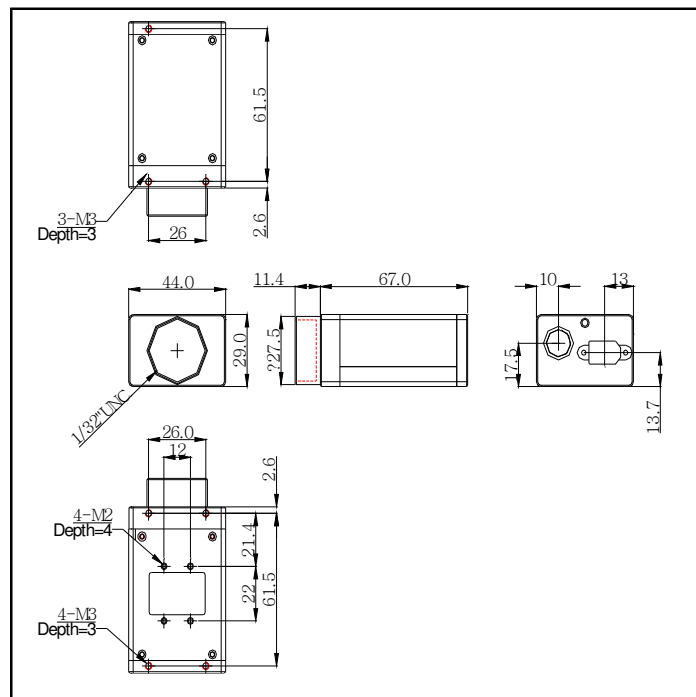
## 1.5.		Camera Interface

FOCULUS S Series - camera interfaces are located on the back side of the camera(assuming lens mount is on the front side) as the following image shows.
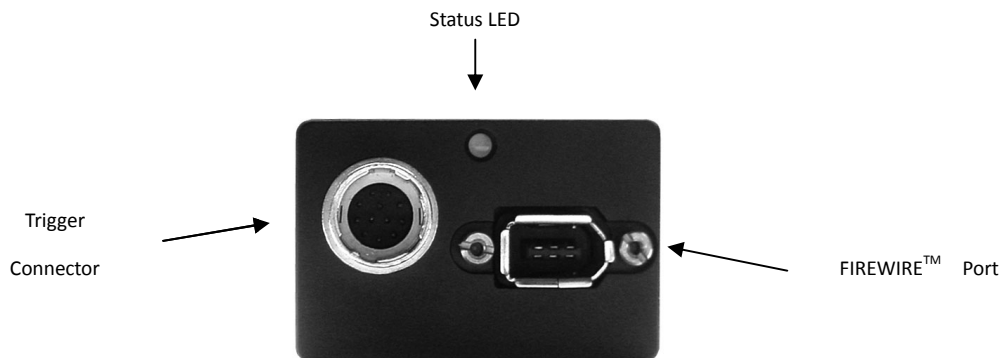
### 1.5.1.		FIREWIRE Port

The industry standard FIREWIRE™ (IEEE-1394) port has the following pin assign. Data and control on the camera is operated via FIREWIRE™ and camera power can also be supplied by FIREWIRE™.
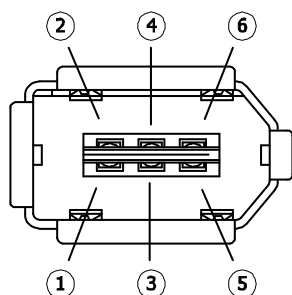
Pin	Signal
1	VP
2	VG(Ground)
3	TPB-
4	TPB+
5	TPA-
6	TPA+

CAUTION	: DO NOT reverse the polarity which may result in damage to the camera.

### 1.5.2.		Trigger Connector Port

External Trigger Connector provides the access to multiple I/O and also provides power as a secondary source.
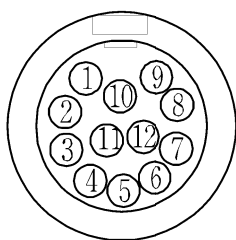
Pin	Signal	Pin	Signal
1	Ext. Power GND	7	GND
2	Ext Power(+12V)	8	RX RS232
3	GND	9	TX RS232
4	Ext. Trigger	10	+3.3VDC
5	Ext. Trigger GND	11	Strobe
6	NC	12	Strobe Power

Remark : NC pins should be not connected

1.5.3. Status LED

LED Status	Isochronous Channel	Packet Transfer
RED	Disable	NO
GREEN	Enable	YES
OFF	Enable	NO

Remark : Also when power off, LED is OFF

1.5.4. Camera Power Requirement

FOCULUS S Series utilizes a selection of power among FIREWIRE^{TM} and Trigger Connector Port where power source with higher

voltage provides the power to the camera. Input voltage range of 8V ~ 30V is accepted.

1.6. Electrical Operating Condition

Trigger
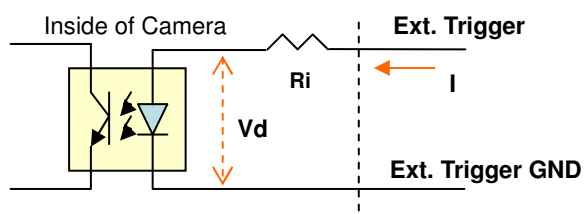
Parameter	Min	Typical	Max
I	7 mA	10 mA	20 mA
Ri	-	360 Ω	-
Vd	-	1.08 V	-
Rising trigger delay	2.24 us	3.34 us	3.36 us
Falling trigger delay	2.62 us	3.61 us	3.64 us

Strobe
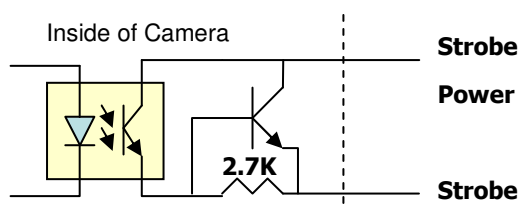
Strobe Power	Strobe falling delay	Strobe rising delay
5 V	26.8 us	2.16 us
12 V	7.6 us	2.8 us
24 V	3.6 us	3.4 us

1.7.   Pixel Data

FOCULUS S SERIES complies with the IIDC 1394-based Digital Camera Specification V1.31 where data packets are transmitted by FIREWIRE^{TM} interface as isochronous packets. Every video format, mode and frame rate has different video data format.

(Pixel data source : IIDC V1.31 Specification)

Isochronous Data Block Packet Format

0 - 7	8 - 15		16 - 23	24 - 31	
Data Length		tg	channel	tCode	Sy
Header CRC					
Video data payload					
Data CRC					

Where the following fields are defined in the IEEE 1394 standard:

data_length : number of bytes in the data field   tg : (tag field) shall be set to zero

channel : isochronous channel number, as programmed in the iso_channel field of the cam_sta_ctrl register

tCode : (transaction code) shall be set to the isochronous data block packet tCode

sy : (synchronization value) shall be set to 0001h on the first isochronous data block of a frame, and shall be set to zero on all other isochronous data blocks

Video data payload   : shall contain the digital video information, as defined in the following sections

Video data Payload Structure

           Pn   :   Pixel number / packet .

           K   :   Pn x n (n = 0.....N-1)

                                          (Pn x N = Total pixel number /frame)

<YUV (4: 2: 2) format >

U-(K+0)	Y-(K+0)	V-(K+0)	Y-(K+1)
U-(K+2)	Y-(K+2)	V-(K+2)	Y-(K+3)
U-(K+4)	Y-(K+4)	V-(K+4)	Y-(K+5)
U-(K+Pn-6)	Y-(K+Pn-6)	V-(K+Pn-6)	Y-(K+Pn-5)
U-(K+Pn-4)	Y-(K+Pn-4)	V-(K+Pn-4)	Y-(K+Pn-3)
U-(K+Pn-2)	Y-(K+Pn-2)	V-(K+Pn-2)	Y-(K+Pn-1)

<Y(Mono) Format >

Y-(K+0)	Y-(K+1)	Y-(K+2)	Y-(K+3)
Y-(K+4)	Y-(K+5)	Y-(K+6)	Y-(K+7)

Y-(K+Pn-8)	Y-(K+Pn-7)	Y-(K+Pn-6)	Y-(K+Pn-5)
Y-(K+Pn-4)	V-(K+Pn-3)	Y-(K+Pn-2)	Y-(K+Pn-1)

<Y(Mono) Format >

High Byte	Low Byte

Y-(K+0)	Y-(K+1)
Y-(K+2)	Y-(K+3)
Y-(K+Pn-4)	Y-(K+Pn-3)
V-(K+Pn-2)	Y-(K+Pn-1)

Data Structure

<Y, R, G, B >

Each component has 8 bit data. The data type is "Unsigned Char"

	Signal Level (Decimal)	Data (Hexadecimal)
Highest	255	0xFF
	254	0xFE
	.	.
	.	.
	1	0x01
Lowest	0	0x00

<U, V>

Each component has 8 bit data. The data type is "Straight Binary"

	Signal Level (Decimal)	Data (Hexadecimal)
Highest(+)	127	0xFF
	126	0xFE
	.	.
	.	.
	1	0x81
Lowest	0	0x80
	-1	0x7F
	.	.
	.	.
	-127	0x01
Lowest	-128	0x00

<Y(Mono16)>

Y component has 16 bit data. The data type is "Unsigned Short(big-endian)".

Y	Signal Level (Decimal)	Data (Hexadecimal)
Highest	65535	0xFFFF
	65534	0xFFFE
	.	.
	.	.
	1	0x0001
Lowest	0	0x0000

1.8. Environmental Requirements.

Operation Temperature : -5°C ~ 45°C   /   Storage Temperature : -20°C ~ 65°C

Avoid operation in environment of high humidity over 90% and allow sufficient airflow for prevention of heat buildup!

2.   Basic Installation

FOCULUS S Series operates in connection with PC or Mac running operation system such as MS Windows, Linux, and Mac OS (Coming Soon). Basic installation starts from driver installation to connecting the camera and loading the demo application software. Please refer to the demo application software manual for details.

2.1.   Recommended System Requirement

Requirements	Details and Description
Operating System	Windows 2000 (SP4), Windows XP (SP3), Windows Vista, Windows 7
CPU	Intel Pentium 4 1.5 GHz or equivalent AMD CPU or higher
System Memory	256 M Byte or more
Video Adapter	1280 x 1024 with 24 bit color or higher
Hard Disk Drive	40 GB or higher
Optical Drive	CDROM or DVDROM
FIREWIRE^{TM}	FIREWIRE^{TM} OHCI PCI or PC-Card Adaptor
Cable	Standard FIREWIRE^{TM} 6P-6P cable or 4P to 6P cable (for Notebooks)
Software	DirectX 9.0 or higher (9.0b or higher for Windows XP) NET GmbH Digital Imaging CD (FOControl Application and Driver) Or other Windows Application such as amcap.exe

Remark : Other software or hardware may be required for user specific applications.

2.2.   Hardware Installation

Basic camera installation is a very simple 3 STEP Process as follows. (Also check the figure below)

STEP 1.   Turn to the back of the computer and locate the FIREWIRE^{TM} port.

(Note : some might have FIREWIRE^{TM} port in the front).

STEP 2.   Plug one end of the FIREWIRE^{TM} cable to the computer's FIREWIRE^{TM} port.

STEP 3.   Plug the other end of the FIREWIRE^{TM} cable to the camera's FIREWIRE^{TM} port.

Back of the Camera

Back of the Computer

FIREWIRE (IEEE-1394) 6 PIN PORT

6PIN Connector Looks like this
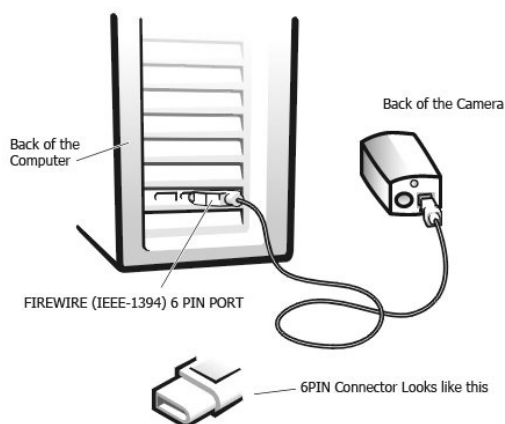
Basic

Hardware Installation

and

Camera Connection

2.3.   Software Installation

Important !!,   DO NOT CONNECT THE CAMERA before any Installation !!

Insert the NET Digital Imaging CD which would auto install the camera drivers and demo applications. (For details of the

application and driver please refer to the demo application manual.)

FIREWIRE^{TM} Digital Imaging CD

Driver

Demo Software

FOControl API Library

Manuals

2.3.1.   Application Installation.
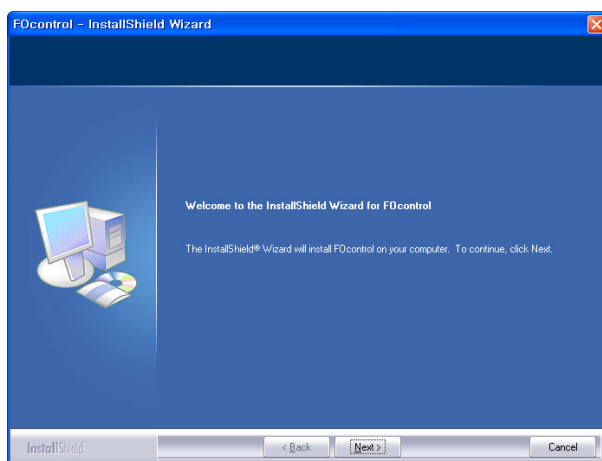
Follow the instruction as per the application install dialog by inputting "Name of User" and "Company" and select "Setup type".

A dialog would appear to disconnect the camera before driver installation.

"PLEASE DISCONNECT THE CAMERA FROM THE COMPUTER"
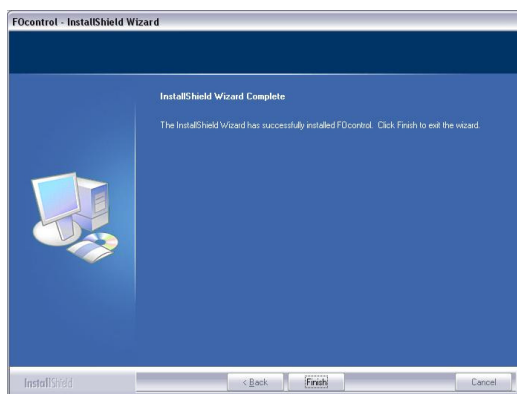
Restart the computer.

2.3.2.   Connecting the Camera for driver installation

After the computer restart, connect the camera and follow the following instruction to install the driver.

By Camera plug in, windows would recognize the driver automatically and install the driver.
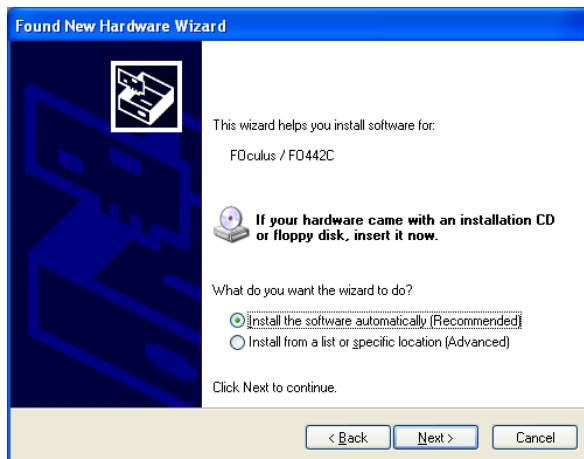
Please select
"Install the software automatically".
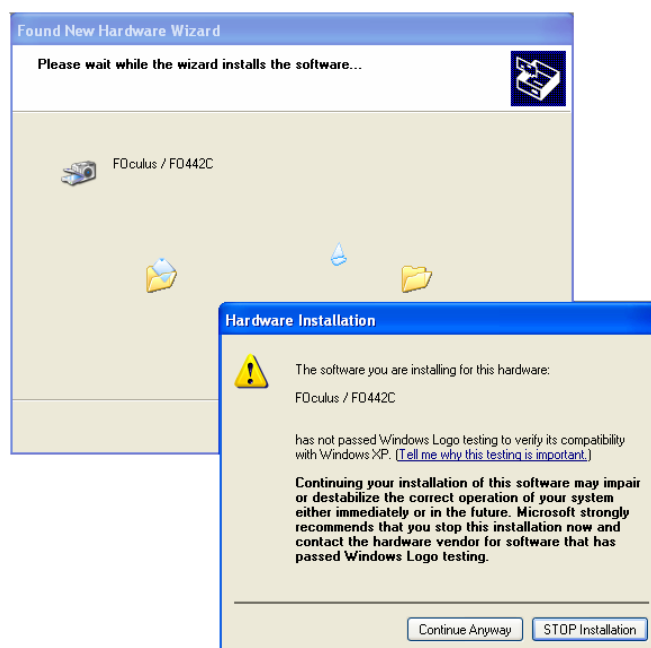
Device Driver installation dialog would appear and please click "Continue Anyway" for driver installation.
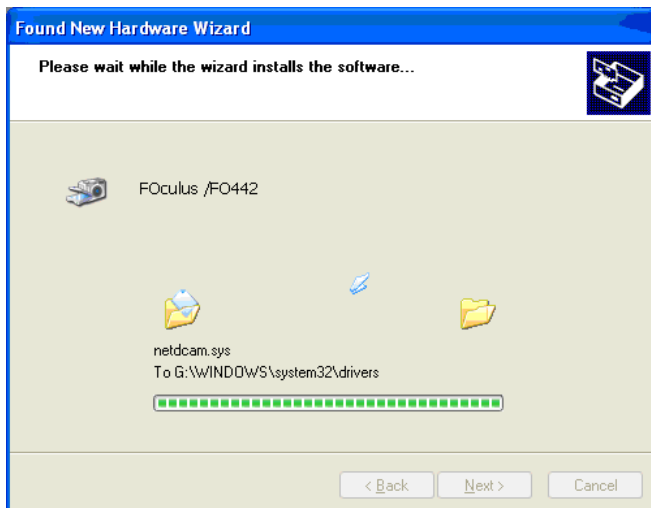
Device driver being installed.
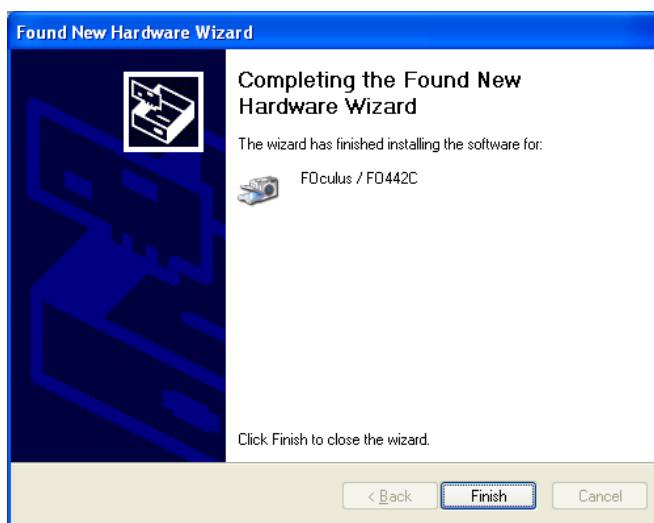
Now the camera is connected and Camera Driver is installed.

From now on without installing the application again, the camera would be detected automatically.

2.3.3.   Checking Windows Device Manager for Driver Verification.
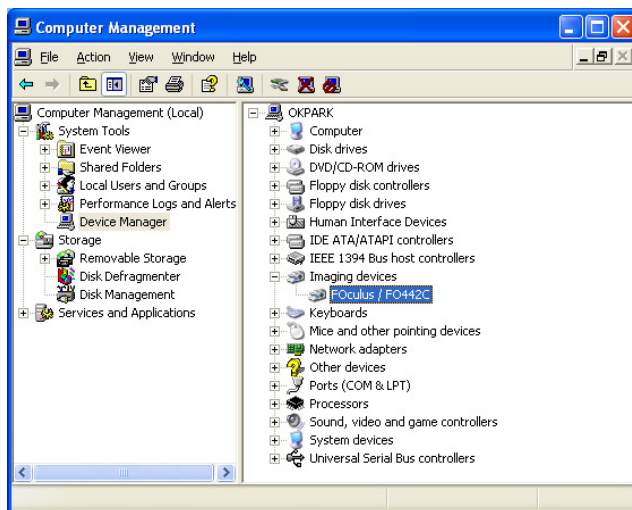
Go to "Imaging Device"

in Windows Device Manager

to check driver install.

Once the driver installation is verified, you are all set to start camera operation

2.3.4.   FOControl Application
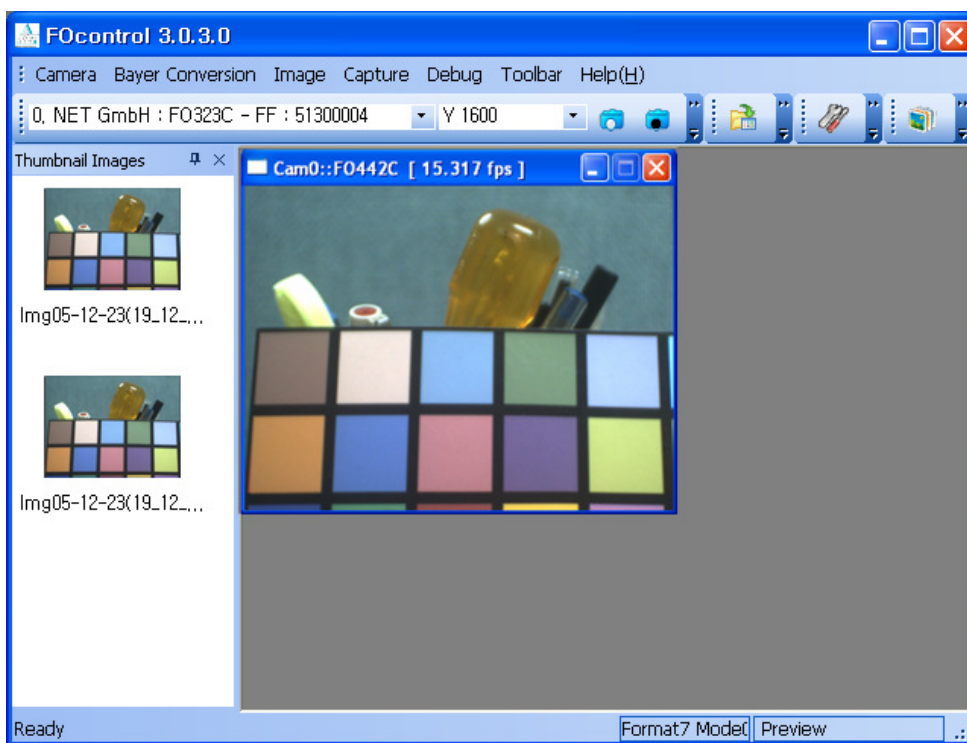
Once the driver is installed you can start the FOControl Demo Application to check the various feature of the camera.

Please refer to the demo application manual for further features of the demo application and its usage.

3.   FOCULUS S Series Camera Specifications.

3.1.   Black and White Camera

3.1.1. FO531SB Specification

Features (FO531SB)	
Image Sensor	1/1.8" Interline CCD(ICX274AL)
Effective Pixels	2,010,000 pixels 1628(H) x 1236(V)
Picture Size	1600x1200, 1280x960, 1024x768, 800x600, 640x480, 320x240
Cell Size	4.40 um x 4.40 um
Real Frame Rate	15, 7.5, 3.75, 1.875 16 (1600x1200, Format 7 mode 0) 32 (640x480, Format 7 mode 0) 29 (800x600, Format7 mode 1, 2x2 binning) 29 (1600x600, Format7 mode 2, 1x2 binning)
Lens Mount	C-mount
Scanning System	Progressive System
Binning	2x2, 1x2
Format 7	Partial Scan (Unit: 4x4)
Trigger	Edge	Rising Edge or Falling Edge
	Mode	0, 1, 2, 3, 4, 5, 14
	Source	External Trigger or Software Trigger
Strobe	Active High, Support Normal Mode or Trigger Mode
Multi-camera auto sync	-144 us ~ +144 us at 15, 7.5 frame rate
Memory Save/Load	16 Channels(0:factory, 1~4:feature, 5~15:mode/feature)
One-shot/Multi-shot	65535 Shots
Control Functions	Brightness, Sharpness, Gamma, Auto-Exposure, Auto-Shutter, Pan/Tilt
SIO(RS-232)	IIDC v1.31 version : Pass through or NET GmbH Command
Frame Delay from Read-out	Min. 106us
Digital Interface / Transfer Rate	IEEE 1394 1 port(6pin) / 400Mbps
Gain	0 ~ 25 dB
Shutter Speed	1 usec ~ 3600 sec
Data Depth	8 bit or 12 bit B/W
S/N Ratio	56dB or better
Supply Voltage/power consumption	8 VDC ~ 30 VDC / Max. 260mA @ +12VDC
External Dimension / Weight	44(W) x 29(H) x 63(D) mm / Approx 110g
Operation Temp. / Storage Temp.	-5°C to 45°C / -30°C to 60°C
Camera Specification	IIDC 1394-based Digital Camera Specification v1.31

3.1.2. FO442SB Specification

Features (FO442SB)	
Image Sensor	2/3" Interline CCD(ICX285AL)
Effective Pixels	1,450,000 pixels 1392(H) x 1040(V)
Picture Size	1392x1040, 1280x960, 1024x768, 800x600, 640x480, 320x240
Cell Size	6.45 um x 6.45 um
Real Frame Rate	15, 7.5, 3.75, 1.875 20 (1392x1040, Format 7 mode 0) 35 (1392x520, Format 7 mode 0) 37 (688x516 Format 7 mode 1　2x2 binning) 37 (1388x516 Format 7 mode 1　1x2 binning)
Lens Mount	C-mount
Scanning System	Progressive System
Binning	2x2, 1x2
Format 7	Partial Scan (Unit: 4x4)
Trigger — Edge	Rising Edge or Falling Edge
Trigger — Mode	0, 1, 2, 3, 4, 5, 14, 15,
Trigger — Source	External Trigger or Software Trigger
Strobe	Active High, Support Normal Mode or Trigger Mode
Multi-camera auto sync	-144 us ~ +144 us at 15,7.5 frame rate
Memory Save/Load	16 Channels(0:factory, 1~4:feature, 5~15:mode/feature)
One-shot/Multi-shot	65535 Shots
Control Functions	Brightness, Sharpness, Gamma, Auto-Exposure, Auto-Shutter, Pan/Tilt Frame Save Function, LUT, GPIO, No Trigger Delay
SIO(RS-232)	IIDC v1.31 version : Path through or　NET GmbH Command
Frame Delay from Read-out	Min. 106us
Digital Interface / Transfer Rate	IEEE 1394 1 port(6pin)　/ 400Mbps
Gain	0 ~ 27 dB
Shutter Speed	1 usec ~ 3600 sec
Data Depth	8 bit or 12 bit B/W
S/N Ratio	56dB or better
Supply Voltage & Power	8 VDC ~ 30 VDC　260mA at 12V DC
External Dimension / Weight	44(W) x 29(H) x 67(D) mm　/ Approx 112g
Operation Temp. / Storage Temp.	-5°C to 45°C　/ -30°C to 60°C
Camera Specification	IIDC 1394-based Digital Camera Specification v1.31

3.1.3. **FO432SB   Specification**

Features (FO432SB)		
Image Sensor Type		1/2-inch Interline CCD (ICX205AL)
Effective pixels		1,450,000 pixels 1392(H) x 1040(V)
Picture Size		1392x1040,1280x960,1024x768, 800x600, 640x480, 320x240
Cell Size(um)		4.65x4.65
Real Frame Rate		15, 7.5, 3.75, 1.875 20 (1392x1040, Format 7 mode 0) 35 (1392x520, Format 7 mode 0) 37(688x516 Format 7 mode 1 2x2 binning) 37(1388x516 Format 7 mode 2 1x2 binning)
Lens Mount		C Mount
Scanning System		Progressive System
Binning		2x2, 1x2
Trigger	Edge	Rising Edge or Falling Edge
	Mode	0, 1, 2, 3, 4, 5, 14
	Source	External Trigger or Software Trigger
Strobe		Active High, Support Normal Mode or Trigger Mode
Multi-camera auto sync		-144 us ~ +144 us at 15,7.5 frame rate
Memory Save/Load		16 Channels(0:factory, 1~4:feature, 5~15:mode/feature)
One-shot/Multi-shot		65535 Shots
Control Functions		Brightness, Sharpness, Gamma, Auto-Exposure, Auto-Shutter, Pan/Tilt
SIO(RS-232)		IIDC v1.31 version : Pass through or NET GmbH Command
Frame Delay from Read-out		Min. 106us
Digital Interface / Transfer Rate		IEEE 1394 1 port(6pin) / 400Mbps
Gain		0 ~ 25 dB
Shutter Speed		1 usec ~ 3600 sec
Data Depth		8 bit or 12 bit B/W
S/N Ratio		56dB or better
Supply Voltage/power consumption		8 VDC ~ 30 VDC / Max. 260mA @ +12VDC
External Dimension / Weight		44(W) x 29(H) x 63(D) mm / Approx 110g
Operation Temp./ Storage Temp		-5°C to 45°C / -30°C to 60°C
Camera Specification		IIDC 1394-based Digital Camera Specification v1.31

Remark : Camera Specification described above may change without notice

3.1.4. FO323SB   Specification

Features(FO323SB)		
Image Sensor Type		1/3-inch Interline CCD (ICX204AL)
Effective pixels		800,000 pixels 1034(H) x 779(V)
Picture Size		1024x768, 800x600, 640x480, 320x240
Cell Size(um)		4.65x4.65
Real Frame Rate		30, 15, 7.5, 3.75, 1.875 36 (1024x768, Format 7 mode 0) 63 (1024x384, Format 7 mode 0) 70 (512x384, Format7 mode 1, 2x2 binning) 70 (1024x384, Format7 mode 2, 1x2 binning)
Lens Mount		C Mount
Scanning System		Progressive System
Binning		2x2, 1x2
Format7		Partial Scan (Unit: 4x4)
Trigger	Edge	Rising Edge or Falling Edge
	Mode	0, 1, 2, 3, 4, 5, 14
	Source	External Trigger or Software Trigger
Strobe		Active High, Support Normal Mode or Trigger Mode
Multi-camera auto sync		-144 us ~ +144 us at 30,15,7.5 frame rate
Memory Save/Load		16 Channels(0:factory, 1~4:feature, 5~15:mode/feature)
One-shot/Multi-shot		65535 Shots
Control Functions		Brightness, Sharpness, Gamma, Auto-Exposure, Auto-Shutter, Pan/Tilt
SIO(RS-232)		IIDC v1.31 version : Pass through or NET GmbH Command
Frame Delay from Read-out		Min. 70us
Digital Interface		IEEE 1394 1 port(6pin)
Transfer Rate		400Mbps
Gain		0 ~ 25 dB
Shutter Speed		1 usec ~ 3600 sec
Data Depth		8 bit or 12 bit B/W
S/N Ratio		56dB or better
Supply Voltage/power consumption		8 VDC ~ 30 VDC / Max. 260mA @ +12VDC
External Dimension / Weight		44(W) x 29(H) x 63(D) mm / Approx 110g
Operation Temp. / Storage Temp		-5°C to 45°C / -30°C to 60°C
Camera Specification		IIDC 1394-based Digital Camera Specification v1.31

Remark : Camera Specification described above may change without notice

3.1.5. FO234SB   Specification

Features(FO234SB)		
Image Sensor Type		1/2-inch Interline CCD (ICX415AL)
Effective pixels		455,124 pixels 782(H) x 582(V)
Picture Size		780x580, 640x480, 320x240
Cell Size(um)		8.3x8.3
Real Frame Rate		60, 30, 15, 7.5, 3.75, 1.875 61 (780x580, Format 7 mode 0) 104 (780x288, Format 7 mode 0) 116 (388x288, Format7 mode 1, 2x2 binning) 114 (780x288, Format7 mode 2, 1x2 binning)
Lens Mount		C Mount
Scanning System		Progressive System
Binning		2x2, 1x2
Format7		Partial Scan (Unit: 4x4)
Trigger	Edge	Rising Edge or Falling Edge
	Mode	0, 1, 2, 3, 4, 5, 14
	Source	External Trigger or Software Trigger
Strobe		Active High, Support Normal Mode or Trigger Mode
Multi-camera auto sync		-144 us ~ +144 us at 60,30,15,7.5 frame rate
Memory Save/Load		16 Channels(0:factory, 1~4:feature, 5~15:mode/feature)
One-shot/Multi-shot		65535 Shots
Control Functions		Brightness, Sharpness, Gamma, Auto-Exposure, Auto-Shutter, Pan/Tilt
SIO(RS-232)		IIDC v1.31 version : Pass through or NET GmbH Command
Frame Delay from Read-out		Min. 43us
Digital Interface		IEEE 1394 1 port(6pin)
Transfer Rate		400Mbps
Gain		0 ~ 25 dB
Shutter Speed		1 usec ~ 3600 sec
Data Depth		8 bit or 12 bit B/W
S/N Ratio		56dB or better
Supply Voltage/power consumption		8 VDC ~ 30 VDC / Max. 260mA @ +12VDC
External Dimension / Weight		44(W) x 29(H) x 63(D) mm / Approx 110g
Operation Temp. / Storage Temp		-5°C to 45°C / -30°C to 60°C
Camera Specification		IIDC 1394-based Digital Camera Specification v1.31

Remark : Camera Specification described above may change without notice

3.1.6. FO134SB   Specification

Features(FO134SB)		
Image Sensor Type		1/2-inch Interline CCD (ICX414AL)
Effective pixels		330,000 pixels 659(H) x 494(V)
Picture Size		640 x 480, 320 x 240
Cell Size(um)		9.9x9.9
Real Frame Rate		60, 30, 15, 7.5, 3.75, 1.875 88 (640x480, Format 7 mode 0) 150 (640x240, Format 7 mode 0) 156 (320x240, Format7 mode 1,2x2 binning) 156 (640x240, Format7 mode 2,1x2 binning)
Lens Mount		C Mount
Scanning System		Progressive System
Binning		2x2, 1x2
Format7		Partial Scan (Unit: 4x4)
Trigger	Edge	Rising Edge or Falling Edge
	Mode	0, 1, 2, 3, 4, 5, 14
	Source	External Trigger or Software Trigger
Strobe		Active High, Support Normal Mode or Trigger Mode
Multi-camera auto sync		-144 us ~ +144 us at 60,30,15,7.5 frame rate
Memory Save/Load		16 Channels(0:factory, 1~4:feature, 5~15:mode/feature)
One-shot/Multi-shot		65535 Shots
Control Functions		Brightness, Sharpness, Gamma, Auto-Exposure, Auto-Shutter, Pan/Tilt
SIO(RS-232)		IIDC v1.31 version : Pass through or NET GmbH Command
Frame Delay from Read-out		Min. 43us
Digital Interface		IEEE 1394 1 port(6pin)
Transfer Rate		400Mbps
Gain		0 ~ 25 dB
Shutter Speed		1 usec ~ 3600 sec
Data Depth		8 bit or 12 bit B/W
S/N Ratio		56dB or better
Supply Voltage/power consumption		8 VDC ~ 30 VDC / Max. 260mA @ +12VDC
External Dimension / Weight		44(W) x 29(H) x 63(D) mm / Approx 110g
Operation Temp. / Storage Temp		-5°C to 45°C / -30°C to 60°C
Camera Specification		IIDC 1394-based Digital Camera Specification v1.31

Remark : Camera Specification described above may change without notice

3.1.7. FO124SB　Specification

Features (FO134SB)		
Image Sensor		1/3-inch Interline CCD (ICX424AL)
Effective Pixels		330,000 pixels　659(H) x 494(V)
Picture Size		640 x 480, 320 x 240
Cell Size		7.40 x 7.40
Real Frame Rate		60, 30, 15, 7.5, 3.75, 1.875 86 (640x480, Format 7 mode 0) 147 (640x240, Format 7 mode 0) 156 (320x240, Format7 mode 1,2x2 binning) 156 (640x240, Format7 mode 2,1x2 binning)
Lens Mount		C-mount
Scanning System		Progressive System
Binning		2x2, 1x2
Format 7		Partial Scan (Unit: 4x4)
Trigger	Edge	Rising Edge or Falling Edge
	Mode	0, 1, 2, 3, 4, 5, 14
	Source	External Trigger or Software Trigger
Strobe		Active High, Support Normal Mode or Trigger Mode
Multi-camera auto sync		-144 us ~ +144 us at 15,7.5 frame rate
Memory Save/Load		16 Channels(0:factory, 1~4:feature, 5~15:mode/feature)
One-shot/Multi-shot		65535 Shots
Control Functions		Brightness, Sharpness, Gamma, Auto-Exposure, Auto-Shutter, Pan/Tilt
SIO(RS-232)		IIDC v1.31 version : Pass through or NET GmbH Command
Frame Delay from Read-out		Min. 43us
Digital Interface / Transfer Rate		IEEE 1394 1 port(6pin)　/ 400Mbps
Gain		0 ~ 25 dB
Shutter Speed		1 usec ~ 3600 sec
Data Depth		8 bit or 12 bit B/W
S/N Ratio		56dB or better
Supply Voltage/power consumption		8 VDC ~ 30 VDC / Max.　260mA　@　+12VDC
External Dimension / Weight		44(W) x 29(H) x 63(D) mm　/ Approx 110g
Operation Temp. / Storage Temp		-5°C to 45°C　/ -30°C to 60°C
Camera Specification		IIDC 1394-based Digital Camera Specification v1.31

Remark : Camera Specification described above may change without notice

3.2.   Color Cameras

3.2.1. FO531SC   Specification

Features(FO531SC)		
Image Sensor Type		1/1.8-inch Interline CCD (ICX274AQ)
Effective pixels		2,010,000 pixels 1628(H) x 1236(V)
Picture Size		1600x1200, 1280x960, 1024x768, 800x600, 640x480, 320x240
Cell Size(um)		4.40 x 4.40
Real Frame Rate		15, 7.5, 3.75, 1.875 16 (1600x1200, Format 7 mode 0) 32 (640x480, Format 7 mode 0) 29 (800x600, Format7 mode 1, 2x2 binning) 29 (1600x600, Format7 mode 2, 1x2 binning)
Lens Mount		C Mount
Scanning System		Progressive System
Binning		2x2, 1x2
Format7		Partial Scan (Unit: 4x4)
Trigger	Edge	Rising Edge or Falling Edge
	Mode	0, 1, 2, 3, 4, 5, 14
	Source	External Trigger or Software Trigger
Strobe		Active High, Support Normal Mode or Trigger Mode
Multi-camera auto sync		-144 us ~ +144 us at 15,7.5 frame rate
Memory Save/Load		16 Channels(0:factory, 1~4:feature, 5~15:mode/feature)
One-shot/Multi-shot		65535 Shots
Control Functions		Brightness, Sharpness, Gamma, Auto-Exposure, Auto-Shutter, Pan/Tilt U/B V/R, Hue/G
SIO(RS-232)		IIDC v1.31 version : Pass through or NET GmbH Command
Frame Delay from Read-out		Min. 106us
Digital Interface		IEEE 1394 1 port(6pin)
Transfer Rate		400Mbps
Gain		0 ~ 25 dB
Shutter Speed		1 usec ~ 3600 sec
Data Depth		8 bit or 12 bit Raw RGB, YUV422
S/N Ratio		56dB or better
Supply Voltage/power consumption		8 VDC ~ 30 VDC / Max. 260mA @ +12VDC
External Dimension / Weight		44(W) x 29(H) x 63(D) mm / Approx 110g
Operation Temp. / Storage Temp		-5°C to 45°C / -30°C to 60°C
Camera Specification		IIDC 1394-based Digital Camera Specification v1.31

3.2.2. FO442SC Specification

Features (FO442SC)		
Image Sensor		2/3" Interline CCD(ICX285AQ)
Effective Pixels		1,450,000 pixels 1392(H) x 1040(V)
Picture Size		1388x1036, 1280x960, 1024x768, 800x600, 640x480, 320x240
Cell Size		6.45 um x 6.45 um
Real Frame Rate		15, 7.5, 3.75, 1.875 20 (1388x1040, Format 7 mode 0) 35 (1388x520, Format 7 mode 0)
Lens Mount		C-mount
Scanning System		Progressive System
Binning		Not supported
Format 7		Partial Scan (Unit: 4x4)
Trigger	Edge	Rising Edge or Falling Edge
	Mode	0, 1, 2, 3, 4, 5, 14, 15,
	Source	External Trigger or Software Trigger
Strobe		Active High, Support Normal Mode or Trigger Mode.
Multi-camera auto sync		-144 us ~ +144 us at 15, 7.5 frame rate
Memory Save/Load		16 Channels (0:factory, 1~4:feature, 5~15:mode/feature)
One-shot/Multi-shot		65535 Shots
Control Functions		Brightness, Sharpness, Gamma, Auto-Exposure, Auto-Shutter, Pan/Tilt Frame Save Function, LUT, GPIO, No Trigger Delay
SIO(RS-232)		IIDC v1.31 version : Path through or NET GmbH Command
Frame Delay from Read-out		Min. 106us
Digital Interface / Transfer Rate		IEEE 1394 1 port(6pin) / 400Mbps
Gain		0 ~ 25 dB
Shutter Speed		1 usec ~ 3600 sec
Data Depth		8 bit or 12 bit B/W, YUV422
S/N Ratio		56dB or better
Supply Voltage & Power		8 VDC ~ 30 VDC 260mA at 12V DC
External Dimension / Weight		44(W) x 29(H) x 67(D) mm / Approx 112g
Operation Temp. / Storage Temp.		-5℃ to 45℃ / -30℃ to 60℃
Camera Specification		IIDC 1394-based Digital Camera Specification v1.31

3.2.3. FO432SC   Specification

Features(FO432SC)		
Image Sensor Type		1/2-inch Interline CCD (ICX205AK)
Effective pixels		1,450,000 pixels 1392(H) x 1040(V)
Picture Size		1388x1036, 1280x960, 1024x768, 800x600, 640x480, 320x240
Cell Size(um)		4.65x4.65
Real Frame Rate		15, 7.5, 3.75, 1.875 20 (1388x1036, Format 7 mode 0) 35 (1388x520, Format 7 mode 0)
Lens Mount		C Mount
Scanning System		Progressive System
Binning		Not supported
Format7		Partial Scan (Unit: 4x4)
Trigger	Edge	Rising Edge or Falling Edge
	Mode	0, 1, 2, 3, 4, 5, 14
	Source	External Trigger or Software Trigger
Strobe		Active High, Support Normal Mode or Trigger Mode
Multi-camera auto sync		-144 us ~ +144 us at 15,7.5 frame rate
Memory Save/Load		16 Channels(0:factory, 1~4:feature, 5~15:mode/feature)
One-shot/Multi-shot		65535 Shots
Control Functions		Brightness, Sharpness, Gamma, Auto-Exposure, Auto-Shutter, Pan/Tilt
		U/B V/R, Hue/G
SIO(RS-232)		IIDC v1.31 version : Pass through or NET GmbH Command
Frame Delay from Read-out		Min. 97us
Digital Interface		IEEE 1394 1 port(6pin)
Transfer Rate		400Mbps
Gain		0 ~ 25 dB
Shutter Speed		1 usec ~ 3600 sec
Data Depth		8 bit or 12 bit Raw RGB, YUV422
S/N Ratio		56dB or better
Supply Voltage/power consumption		8 VDC ~ 30 VDC / Max. 260mA @ +12VDC
External Dimension / Weight		44(W) x 29(H) x 63(D) mm / Approx 110g
Operation Temp. / Storage Temp		-5℃ to 45℃ / -30℃ to 60℃
Camera Specification		IIDC 1394-based Digital Camera Specification v1.31

Remark : Camera Specification described above may change without notice

3.2.4. FO323SC   Specification

Features(FO323SC)		
Image Sensor Type		1/3-inch Interline CCD (ICX204AK)
Effective pixels		800,000 pixels 1034(H) x 779(V)
Picture Size		1024x768, 800x600, 640x480, 320x240
Cell Size(um)		4.65x4.65
Real Frame Rate		30, 15, 7.5, 3.75, 1.875 36 (1024x768, Format 7 mode 0) 63 (1024x384, Format 7 mode 0)
Lens Mount		C Mount
Scanning System		Progressive System
Binning		Not supported
Format7		Partial Scan (Unit: 4x4)
Trigger	Edge	Rising Edge or Falling Edge
	Mode	0, 1, 2, 3, 4, 5, 14
	Source	External Trigger or Software Trigger
Strobe		Active High, Support Normal Mode or Trigger Mode
Multi-camera auto sync		-144 us ~ +144 us at 30,15,7.5 frame rate
Memory Save/Load		16 Channels(0:factory, 1~4:feature, 5~15:mode/feature)
One-shot/Multi-shot		65535 Shots
Control Functions		Brightness, Sharpness, Gamma, Auto-Exposure, Auto-Shutter, Pan/Tilt
		U/B V/R, Hue/G
SIO(RS-232)		IIDC v1.31 version : Pass through or NET GmbH Command
Frame Delay from Read-out		Min. 70us
Digital Interface		IEEE 1394 1 port(6pin)
Transfer Rate		400Mbps
Gain		0 ~ 25 dB
Shutter Speed		1 usec ~ 3600 sec
Data Depth		8 bit or 12 bit Raw RGB, YUV422
S/N Ratio		56dB or better
Supply Voltage/power consumption		8 VDC ~ 30 VDC / Max. 260mA @ +12VDC
External Dimension / Weight		44(W) x 29(H) x 63(D) mm / Approx 110g
Operation Temp. / Storage Temp		-5°C to 45°C / -30°C to 60°C
Camera Specification		IIDC 1394-based Digital Camera Specification v1.31

Remark : Camera Specification described above may change without notice

3.2.5. FO234SC   Specification

Features(FO234SC)		
Image Sensor Type		1/2-inch Interline CCD (ICX415AQ)
Effective pixels		455,124 pixels 782(H) x 582(V)
Picture Size		780x580, 640x480, 320x240
Cell Size(um)		8.3x8.3
Real Frame Rate		60, 30, 15, 7.5, 3.75, 1.875 61 (780x580, Format 7 mode 0) 103 (780x288, Format 7 mode 0)
Lens Mount		C Mount
Scanning System		Progressive System
Binning		Not supported
Format7		Partial Scan (Unit: 4x4)
Trigger	Edge	Rising Edge or Falling Edge
	Mode	0, 1, 2, 3, 4, 5, 14
	Source	External Trigger or Software Trigger
Strobe		Active High, Support Normal Mode or Trigger Mode
Multi-camera auto sync		-144 us ~ +144 us at 60,30,15,7.5 frame rate
Memory Save/Load		16 Channels(0:factory, 1~4:feature, 5~15:mode/feature)
One-shot/Multi-shot		65535 Shots
Control Functions		Brightness, Sharpness, Gamma, Auto-Exposure, Auto-Shutter, Pan/Tilt
		U/B V/R, Hue/G
SIO(RS-232)		IIDC v1.31 version : Pass through or NET GmbH Command
Frame Delay from Read-out		Min. 43us
Digital Interface		IEEE 1394 1 port(6pin)
Transfer Rate		400Mbps
Gain		0 ~ 25 dB
Shutter Speed		1 usec ~ 3600 sec
Data Depth		8 bit or 12 bit Raw RGB, YUV422
S/N Ratio		56dB or better
Supply Voltage/power consumption		8 VDC ~ 30 VDC / Max. 260mA @ +12VDC
External Dimension / Weight		44(W) x 29(H) x 63(D) mm / Approx 110g
Operation Temp. / Storage Temp		-5℃ to 45℃ / -30℃ to 60℃
Camera Specification		IIDC 1394-based Digital Camera Specification v1.31

Remark : Camera Specification described above may change without notice

3.2.6. FO134SC   Specification

Features(FO134SC)		
Image Sensor Type		1/2-inch Interline CCD (ICX414AQ)
Effective pixels		330,000 pixels 659(H) x 494(V)
Picture Size		640 x 480, 320 x 240
Cell Size(um)		9.9x9.9
Real Frame Rate		60, 30, 15, 7.5, 3.75, 1.875 88 (640x480, Format 7 mode 0) 150 (640x240, Format 7 mode 0)
Lens Mount		C Mount
Scanning System		Progressive System
Binning		Not supported
Format7		Partial Scan (Unit: 4x4)
Trigger	Edge	Rising Edge or Falling Edge
	Mode	0, 1, 2, 3, 4, 5, 14
	Source	External Trigger or Software Trigger
Strobe		Active High, Support Normal Mode or Trigger Mode
Multi-camera auto sync		-144 us ~ +144 us at 60,30,15,7.5 frame rate
Memory Save/Load		16 Channels(0:factory, 1~4:feature, 5~15:mode/feature)
One-shot/Multi-shot		65535 Shots
Control Functions		Brightness, Sharpness, Gamma, Auto-Exposure, Auto-Shutter, Pan/Tilt
		U/B V/R, Hue/G
SIO(RS-232)		IIDC v1.31 version : Pass through or NET GmbH Command
Frame Delay from Read-out		Min. 43us
Digital Interface		IEEE 1394 1 port(6pin)
Transfer Rate		400Mbps
Gain		0 ~ 25 dB
Shutter Speed		1 usec ~ 3600 sec
Data Depth		8 bit or 12 bit Raw RGB, YUV422
S/N Ratio		56dB or better
Supply Voltage/power consumption		8 VDC ~ 30 VDC / Max. 260mA @ +12VDC
External Dimension / Weight		44(W) x 29(H) x 63(D) mm / Approx 110g
Operation Temp. / Storage Temp		-5°C to 45°C / -30°C to 60°C
Camera Specification		IIDC 1394-based Digital Camera Specification v1.31

Remark : Camera Specification described above may change without notice

3.2.7. **FO124SC   Specification**

Features(FO124SC)		
Image Sensor Type		1/3-inch Interline CCD (ICX424AQ)
Effective pixels		330,000 pixels 659(H) x 494(V)
Picture Size		640 x 480, 320 x 240
Cell Size(um)		7.40x7.40
Real Frame Rate		60, 30, 15, 7.5, 3.75, 1.875 88 (640x480, Format 7 mode 0) 150 (640x240, Format 7 mode 0)
Lens Mount		C Mount
Scanning System		Progressive System
Binning		Not supported
Format7		Partial Scan (Unit: 4x4)
Trigger	Edge	Rising Edge or Falling Edge
	Mode	0, 1, 2, 3, 4, 5, 14
	Source	External Trigger or Software Trigger
Strobe		Active High, Support Normal Mode or Trigger Mode
Multi-camera auto sync		-144 us ~ +144 us at 60,30,15,7.5 frame rate
Memory Save/Load		16 Channels(0:factory, 1~4:feature, 5~15:mode/feature)
One-shot/Multi-shot		65535 Shots
Control Functions		Brightness, Sharpness, Gamma, Auto-Exposure, Auto-Shutter, Pan/Tilt
		U/B V/R, Hue/G
SIO(RS-232)		IIDC v1.31 version : Pass through or NET GmbH Command
Frame Delay from Read-out		Min. 43us
Digital Interface		IEEE 1394 1 port(6pin)
Transfer Rate		400Mbps
Gain		0 ~ 25 dB
Shutter Speed		1 usec ~ 3600 sec
Data Depth		8 bit or 12 bit Raw RGB, YUV422
S/N Ratio		56dB or better
Supply Voltage/power consumption		8 VDC ~ 30 VDC / Max. 260mA @ +12VDC
External Dimension / Weight		44(W) x 29(H) x 63(D) mm / Approx 110g
Operation Temp. / Storage Temp		-5°C to 45°C / -30°C to 60°C
Camera Specification		IIDC 1394-based Digital Camera Specification v1.31

Remark : Camera Specification described above may change without notice

3.3.   Spectral Sensitivity

Excludes lens and light source characteristic

3.3.1. FOCULUS S Series B&W Cameras
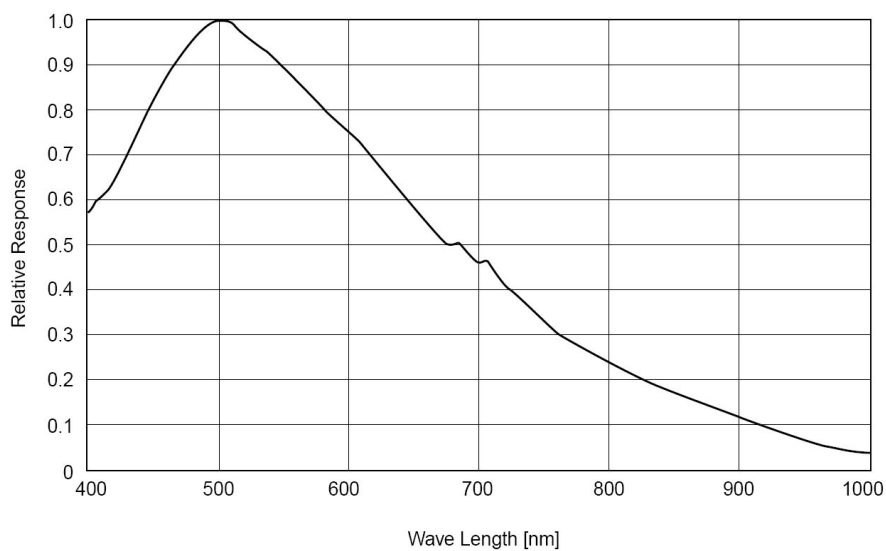
Spectral Sensitivity for   FO531SB
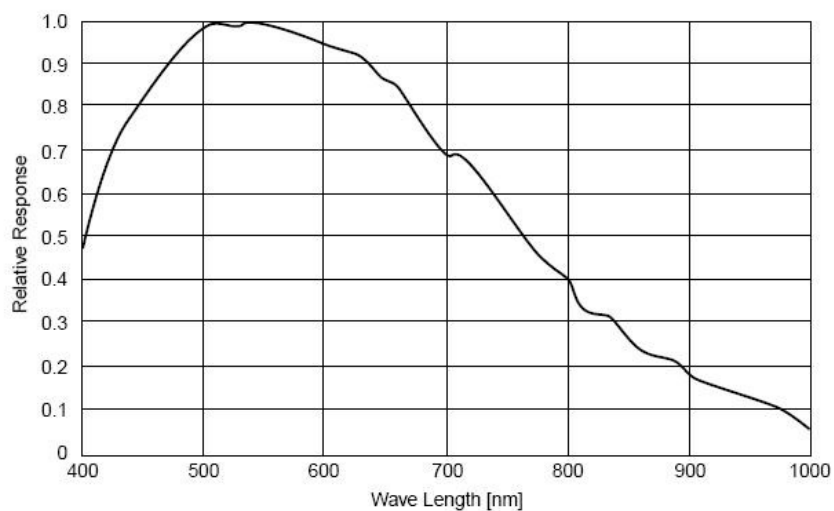
Spectral Sensitivity for   FO442SB
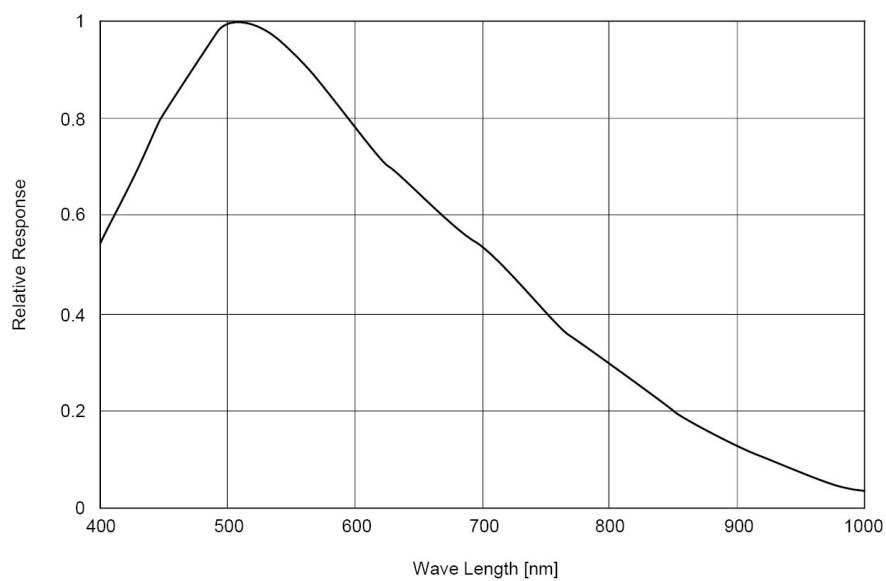
Spectral Sensitivity for   FO432SB
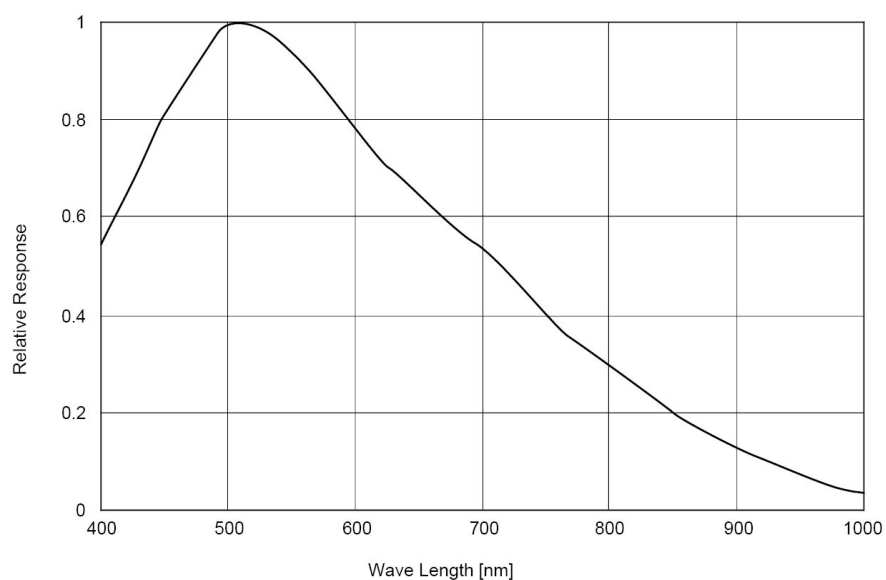
Spectral Sensitivity for   FO323SB
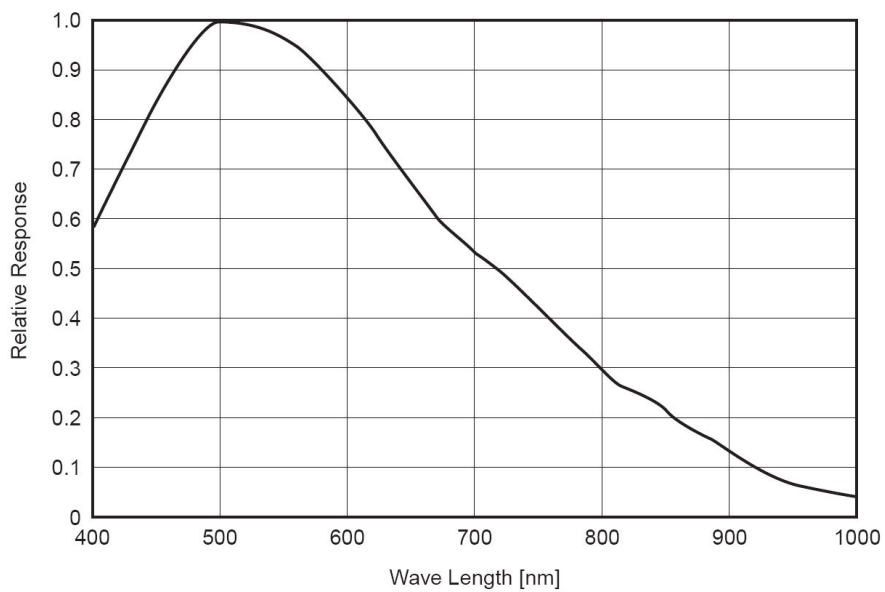
Spectral Sensitivity for   FO234SB
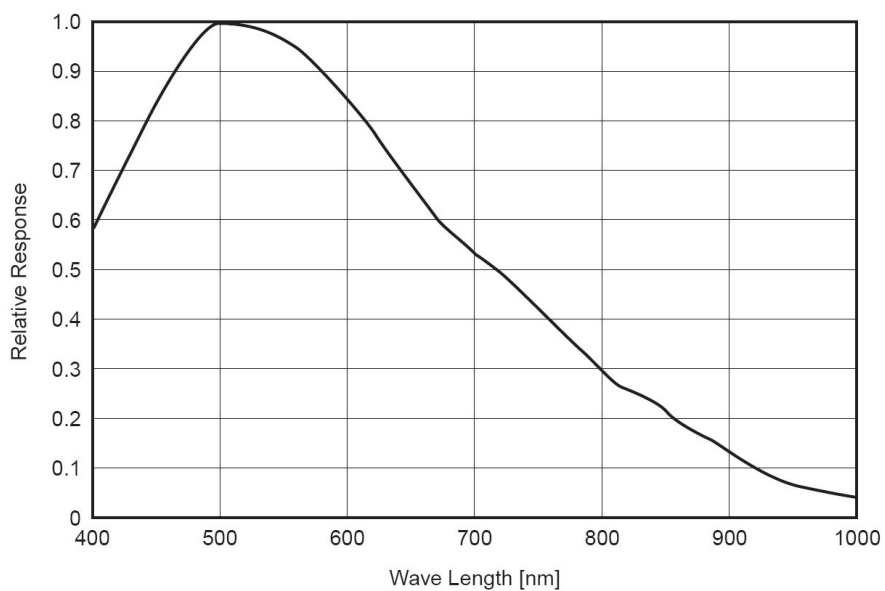
Spectral Sensitivity for   FO134SB
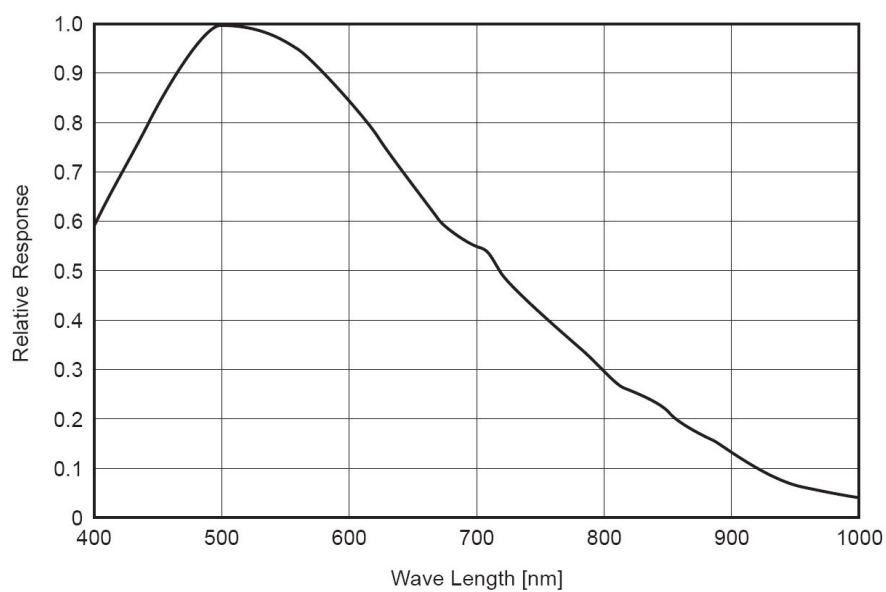
Spectral Sensitivity for   FO124SB

3.3.2.   FOCULUS S Series Color Cameras
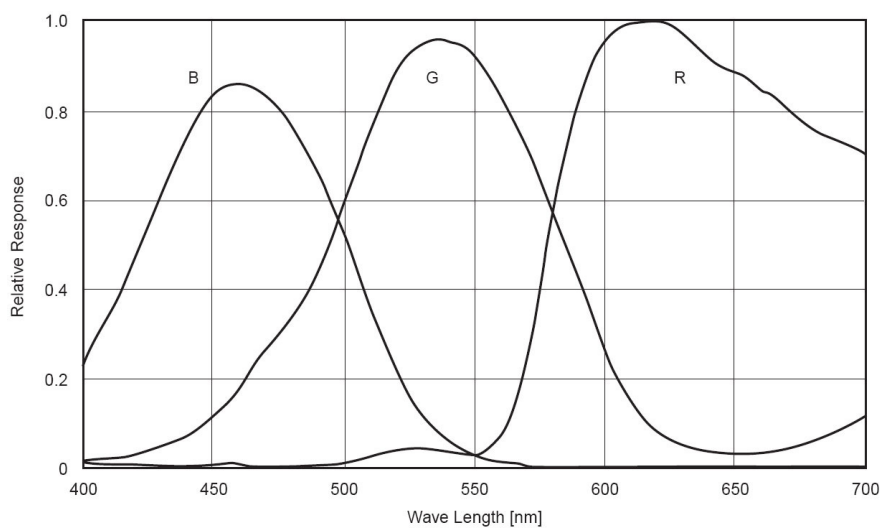
Spectral Sensitivity for   FO531SC
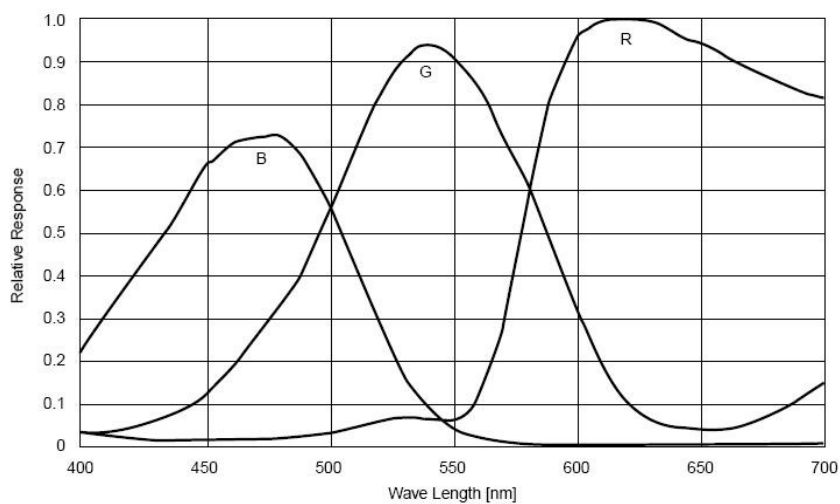
Spectral Sensitivity for   FO442SC
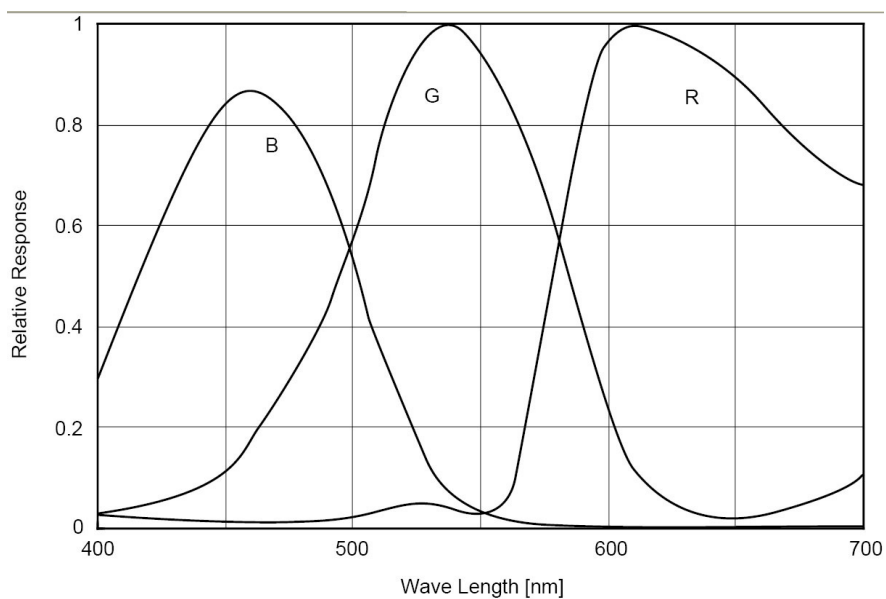
Spectral Sensitivity for   FO432SC
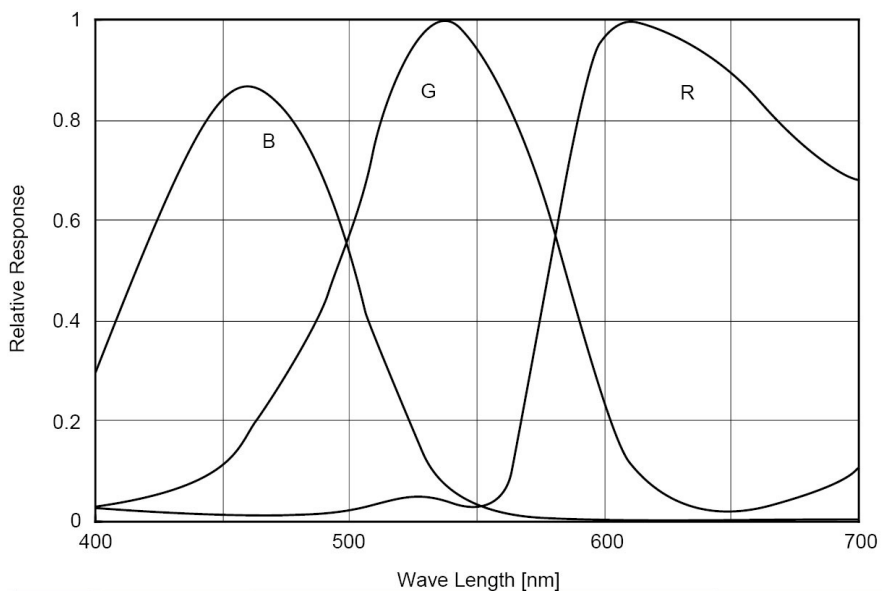
Spectral Sensitivity for   FO323SC
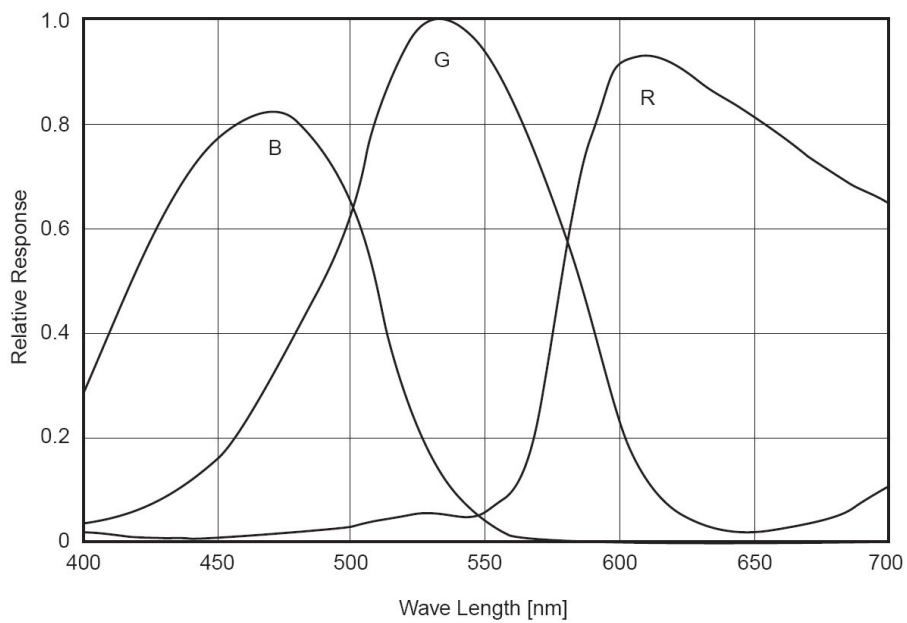
Spectral Sensitivity for   FO234SC
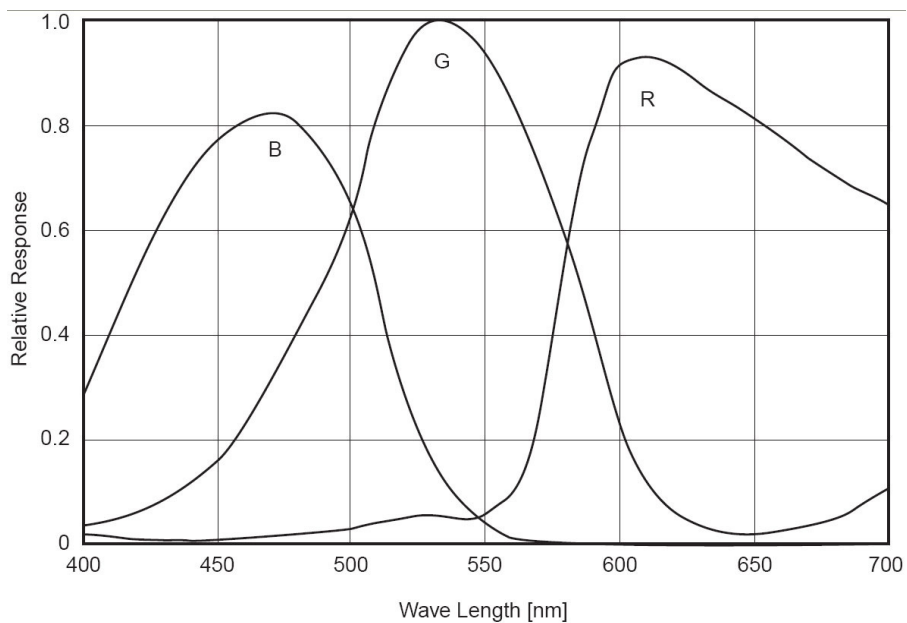
Spectral Sensitivity for   FO124SC
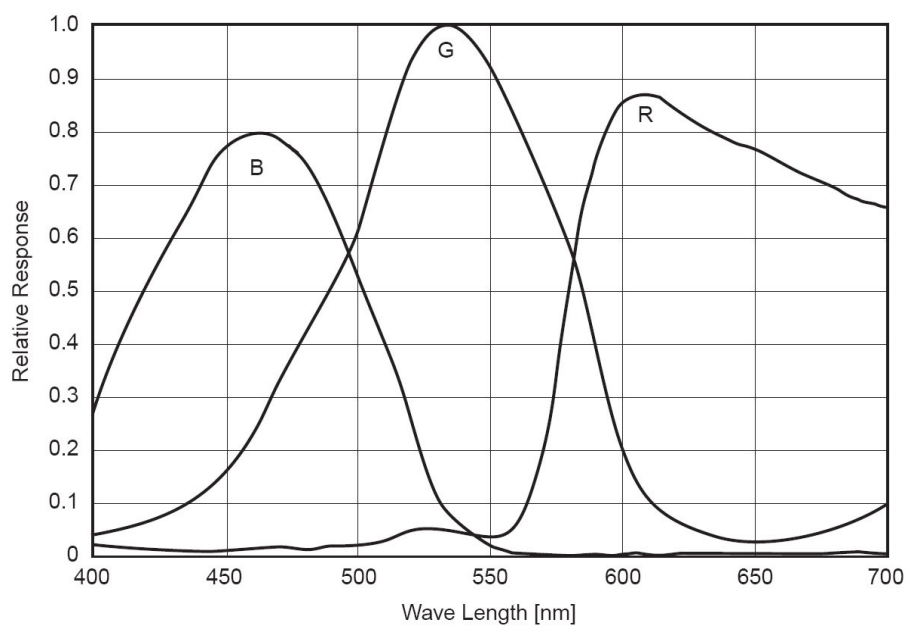
Spectral Sensitivity for   FO124SC

4.   Basic Operation and Features

FOCULUS S Series employ progressive scan CCD sensor which provides features according to each model. Basic functions and features are similar while each camera of it's range would have their specific function support. FOCULUS S Series fully support the IIDC V1.31 specification such as registers, video format, mode of operation and control.

4.1.   Brightness

Brightness of the camera can be controlled by changing the black level in the camera user can inquire the setting of the camera and control using the status control register. Adjust the brightness if the appropriate gradation cannot be obtained due to blurring of black portion of the image.

Inquiry Register

Address	Name	Field	Bit	Description
500h	BRIGHTN ESS_INQ	Presence_Inq	[0]	Presence of this feature
		Abs_Control_Inq	[1]	Capability of control with absolute value
		-	[2]	Reserved
		One_Push_Inq	[3]	One push auto mode (Controlled automatically by camera only once)
		ReadOut_Inq	[4]	Capability of reading the value of this feature
		On/OFF_Inq	[5]	Capability of switching this feature ON and OFF
		Auto_Inq	[6]	Auto Mode (Controlled automatically by camera)
		Manual_Inq	[7]	Manual Mode (Controlled by user)
		Min_Value	[8..19]	Minimum value for this feature control
		Max_Value	[20..31]	Maximum value for this feature control

Status Control Register

Address	Name	Field	Bit	Description
800h	BRIGHTNESS	Presence_Inq	[0]	Presence of this feature 0:N/A 1:Available
		Abs_Control	[1]	Absolute value control 0: Control with value in Value field 1: Control with value in Absolute value CSR if this bit =1, value in Value filed is ignored
		-	[2..4]	Reserved
		One_Push	[5]	Write '1': begin to work(Self cleared after operation) Read : Value='1' in operation Value ='0' not in operation If A_M_Mode=1, this bit is ignored
		On/OFF	[6]	Write : ON or OFF this feature Read : read a status 0: OFF, 1:ON If this bit=0, other fields will be read only.
		A_M_Mode	[7]	Write : Set the mode Read : Read a current mode 0: Manual, 1:Auto
		-	[8..19]	Reserved
		Value	[20..31]	Minimum value for this feature control

4.2.   Auto Exposure Control

The automatic shutter/gain mode is based on a feedback loop which calculates the average pixel luminance. Then the average is compared with the exposure reference value, adjusting shutter and gain accordingly. This feature is similar to "Contrast Control"

Inquiry Register

Address	Name	Field	Bit	Description
504h	AUTO_EXPO SURE_INQ	Presence_Inq	[0]	Presence of this feature
		Abs_Control_Inq	[1]	Capability of control with absolute value
		-	[2]	Reserved
		One_Push_Inq	[3]	One push auto mode(Controlled automatically by camera only once)
		ReadOut_Inq	[4]	Capability of reading the value of this feature
		On/Off_Inq	[5]	Capability of switching this feature On and OFF
		Auto_Inq	[6]	Auto mode (Controlled automatically by camera)
		Manual_Inq	[7]	Manual mode(Controlled by user)
		Min_Value	[8..19]	Minimum value for this feature control
		Max_Value	[20..31]	Maximum value for this feature control

Status Control Register

Address	Name	Field	Bit	Description
804h	AUTO_EXPO SURE	Presence_Inq	[0]	Presence of this feature 0:N/A 1:Available
		Abs_Control	[1]	Absolute value control 0: Control with value in the Value field 1: Control with value in the Absolute value CSR If this bit = 1, value in the Value field is ignored.
		-	[2..4]	Reserved
		One_Push	[5]	Write '1' :begin to work (Self cleared after operation) Read: Value='1' in operation Value='0' not in operation If A_M_Mode =1, this bit is ignored
		ON_OFF	[6]	Write: ON or OFF this feature, Read: read a status 0:OFF, 1:ON If this bit=0, other fields will be read only.
		A_M_Mode	[7]	Write: set the mode, Read: read a current mode 0: Manual, 1:Auto
		-	[8..19]	Reserved
		Value	[20..31]	Value : Write the value in Auto mode, this filed is ignored. If "ReadOut" capability is not available, read value Has no meaning

4.3.   Sharpness

The sharpness control feature may be used to compensate low-pass effects caused for instance by the special color interpolation. If you do not prefer such signal manipulation, you may switch it OFF.

For sharpness control inquiry and status register, follow the same definition as "BRIGHTNESS"

4.4.   White Balance

Color models have the white balance feature which can be controlled automatically or manually. U/R(Red/Green) and V/B(Green/Blue) alter the degree to which Red and Blue CCD component pixels are weighed to form composite pixels. In manual mode you can adjust the white balance by altering the Blue and Red Value. One push white balance option can be used for a non-interactive calibration in addition. Automatic white balance features are supported for models with MICOM 2.03 or higher.

Inquiry Register

Address	Name	Field	Bit	Description
50Ch	WHITE_BAL_ INQ	Presence_Inq	[0]	Presence of this feature
		Abs_Control_Inq	[1]	Capability of control with absolute value
		-	[2]	Reserved
		One_Push_Inq	[3]	One push auto mode(Controlled automatically by camera only once)
		ReadOut_Inq	[4]	Capability of reading the value of this feature
		On/Off_Inq	[5]	Capability of switching this feature On and OFF
		Auto_Inq	[6]	Auto mode(Controlled automatically by camera)
		Manual_Inq	[7]	Manual mode(Controlled by user)
		Min_Value	[8..19]	Minimum value for this feature control
		Max_Value	[20..31]	Maximum value for this feature control

Status Control Register

Address	Name	Field	Bit	Description
80Ch	WHITE_BALA NCE	Presence_Inq	[0]	Presence of this feature. 0:N/A 1:Available
		Abs_Control	[1]	Absolute value control 0: Control with value in the Value field 1: Control with value in the Absolute value CSR If this bit = 1, value in the Value field is ignored.
		-	[2..4]	Reserved
		One_Push	[5]	Write '1' :begin to work(Self cleared after operation) Read: Value='1' in operation Value='0' not in operation If A_M_Mode =1, this bit is ignored
		ON_OFF	[6]	Write: ON or OFF this feature, Read: read a status 0:OFF, 1:ON If this bit=0, other fields will be read only.
		A_M_Mode	[7]	Write: set the mode, Read: read a current mode 0: Manual, 1:Auto
		-	[8..19]	U Value / B_Value. Write the value in AUTO mode, this field is ignored. If "ReadOut" capability is not available,, read value has no mean

		Value	[20..31]	V Value / R_Value Write the value in AUTO mode, this field is ignored. If "ReadOut" capability is not available, read value has no meaning

4.5. Hue

Color models support hue control which changes the color phase of the picture by adjusting the green gain. You may use this feature when white balance correction adjusting red and blue value does give satisfying result.

4.6. Saturation

The saturation controls the color saturation in color models by manually adjusting the level of color from zero level (monochrome). For saturation control inquiry and status register, follow the same definition as "BRIGHTNESS".

4.7. Gamma

Gamma control defines the function between incoming light level and output picture level. Factory default setting for gamma is set to 1.0. gamma value is adjustable in the range of 0.4 ~ 2.5 as per the table below.   For gamma control inquiry and status register, follow the same definition as "BRIGHTNESS"
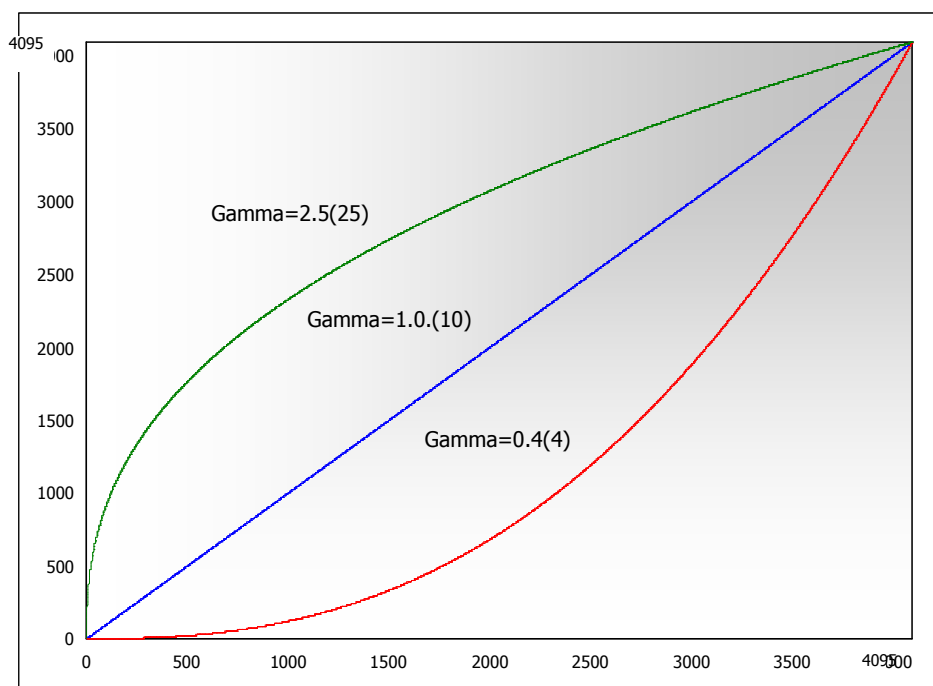
Gamma Range Table

Gamma Value	4	5	6	7	8	9	10	11	12	13	14
Gamma	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4

Gamma Value	15	16	17	18	19	20	21	22	23	24	25
Gamma	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5

4.8.   Shutter

Shutter is defined as integration time of the incoming light where both manual and auto shutter is supported. The shutter range varies from 1us ~ 65s. For shutter control inquiry and status register, follow the same definition as "BRIGHTNESS".

Shutter Speed Value & Range

FIREWIRE Shutter Value(Y)	Increment Step	Shutter Speed Time : T	
		Exposure Time	Range
1 ~ 500	1 us	T= Y us	1us ~ 500us
501 ~ 1000	10 us	T= (Y-500)*10+500 us	510us ~ 5500us
1001 ~ 1705	100 us	T= (Y-1000)*100+5500 us	5.6ms ~ 76ms
1706 ~ 2399	1 ms	T= (Y-1705)+76 ms	77ms ~ 770ms
2400 ~ 2902	10 ms	T= (Y-2399)*10+770 ms	780ms ~ 5800ms
2903 ~ 3304	100 ms	T= (Y-2902)*100+5800 ms	5.9s ~ 46s
3305 ~ 3323	1s	T= (Y-3304)*1000+46000 ms	47s ~ 65s

Shutter Speed Example

Shutter Speed Example Table			
1394 Shutter	Exposure Time	1394 Shutter	Exposure Time
1	1us	1729	100ms
10	10us	1829	200ms
100	100us	2129	500ms
500	500us	2422	1s
550	1ms	2522	2s
650	2ms	2822	5s
950	5ms	2944	10s
1045	10ms	3044	20s
1145	20ms	3318	60s
1445	50ms	3323	65s

4.9.   Gain

Gain refers to the amount of the CCD output signal amplification where gain and shutter have similar effect to the image.

Manual and automatic gain mode are supported and manual adjustment is possible for the following range.

For gain control inquiry and status register, follow the same definition as "BRIGHTNESS".

Camera Type	Step Range	Range in dB	Increment Length
Monochrome Camera	0 ~ 723	0 ~ 25	approx. 0.0345 dB/step
Color Camera	0 ~ 723	0 ~ 25	approx. 0.0319 dB/step

4.10. Trigger & Strobe

FOCULUS S Series support external trigger by receiving input through the external trigger port. The falling edge and rising edge can be detected as trigger according to the modes it supports as per the following table. Strobe timing is user controllable while signal output is TTL. FOCULUS S Series can also be used with a software trigger that issues trigger signal via software command.

4.10.1. Supported Trigger

Trigger	Edge	Rising Edge or Falling Edge
	Mode	0, 1, 2, 3, 4, 5, 14
	Source	External or Software Trigger

Inquiry Register

Address	Name	Field	Bit	Description
530h	TRIGGER_INQ	Presence_Inq	[0]	Presence of this feature
		Abs_Control_Inq	[1]	Capability of control with absolute value
		-	[2..3]	Reserved
		ReadOut_Inq	[4]	Capability of reading the value of this feature
		On/Off_Inq	[5]	Capability of switching this feature On and OFF
		Polarity_Inq	[6]	Capability of changing polarity of trigger input
			[7..15]	Reserved
		Trigger_Mode0_Inq	[16]	Presence of Trigger Mode0
		Trigger_Mode1_Inq	[17]	Presence of Trigger Mode1
		Trigger_Mode2_Inq	[18]	Presence of Trigger Mode2
		Trigger_Mode3_Inq	[19]	Presence of Trigger Mode3
			[20..31]	Reserved

Status Control Register

Address	Name	Field	Bit	Description
830h	TRIGGER_MODE	Presence_Inq	0	Presence of this feature 0:N/A 1:Available
		Abs_Control	[1]	Absolute value control 0: Control with value in the Value field 1: Control with value in the Absolute value CSR If this bit = 1, value in the Value field is ignored.
		-	[2..5]	Reserved
		ON_OFF	[6]	Write: ON or OFF this feature Read: read a status 0: OFF, 1: ON If this bit=0, other fields will be read only.
		Trigger_Polarity	[7]	If Polarity_Inq is "1", Write to change polarity of the trigger input Read to get polarity of trigger input If Polarity_Inq is "0", Read only. (0: Low active input, 1: High active input)
		Trigger_Mode	[12..15]	Trigger mode.(Trigger_Mode_0-15)
			[16..19]	Reserved
		Parameter	[20..31]	Parameter for trigger function, if required.

4.10.2. High Speed Up Trigger Frame Rate

4.10.2.1 Trigger Timing Diagram

FOculus S series cameras with MICOM version up to 2.03 have the store zone called VD and 1394 data transfer zone, which is compromised of minimum time for the valid external trigger called 'Next Trigger Prohibit zone'. The next prohibit zones are different depending on models and frame per rate. Please see the below.
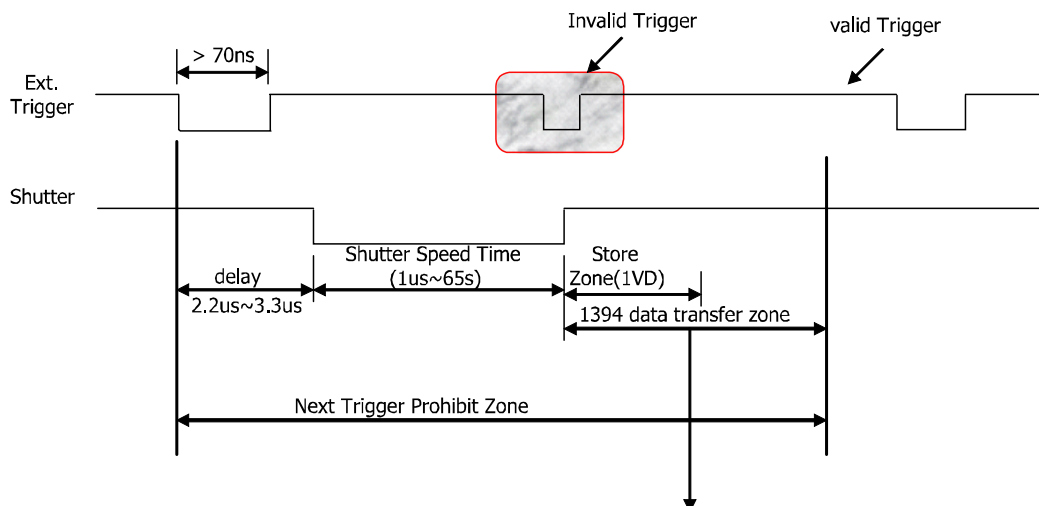
Correlation of VD and fps

Cameras	60 fps	30 fps	15 fps	7.5 fps	3.75 fps	1.875 fps
FO531Sx FO432Sx	-	-	1 VD	2 VD	4 VD	8 VD
FO323Sx		1 VD	2 VD	4 VD	8 VD	16 VD
FO234Sx FO134Sx FO124Sx	1 VD	2 VD	4 VD	8 VD	16 VD	32 VD

(1VD = 33.3msec : VD is frame interval)

4.10.2.2 High Speed Up Trigger Frame Rate   (MICOM 3.0 or higher)

The previous version (upto micom 2.03) had the time limitation for trigger max frame rate as below

---

Previous version

Trigger max frame rate =

$$\frac{1}{1/fps + shutter\_time(0xf0f0081c) + trigger\_delay(0xf0f00834) + trigger\_noise\_filter(0xf2f10110)}$$

However, from micom version 3.0, if trigger delay is zero(0) and trigger noise is disabled, trigger max frame rate speeds up to

frame at normal mode at trigger mode 0.

Version 3.00

At trigger mode 0 :

Trigger max frame rate   =

$$\frac{1}{1/fps + trigger\_delay(0xf0f00834) + trigger\_noise\_filter(0xf2f10110) + 200 \ usec}$$

Caution:

If the next trigger pulse interval is less than (1/fps + trigger_delay(0xf0f00834)+trigger_noise_filter(0xf2f10110)

+ 200 usec), this trigger pulse may be lost.

And, for the trigger max frame rates at the other trigger modes, the shutter time also should be considered.

At other trigger mode : equal to the previous frame

Trigger max frame rate =

$$\frac{1}{1/fps + shutter\_time(0xf0f0081c) + trigger\_delay(0xf0f00834) + trigger\_noise\_filter(0xf2f10110)}$$

If trigger interval is less than (1/fps + shutter_time), bar noise may be detected.

4.10.3. Trigger and Strobe Signal Relation
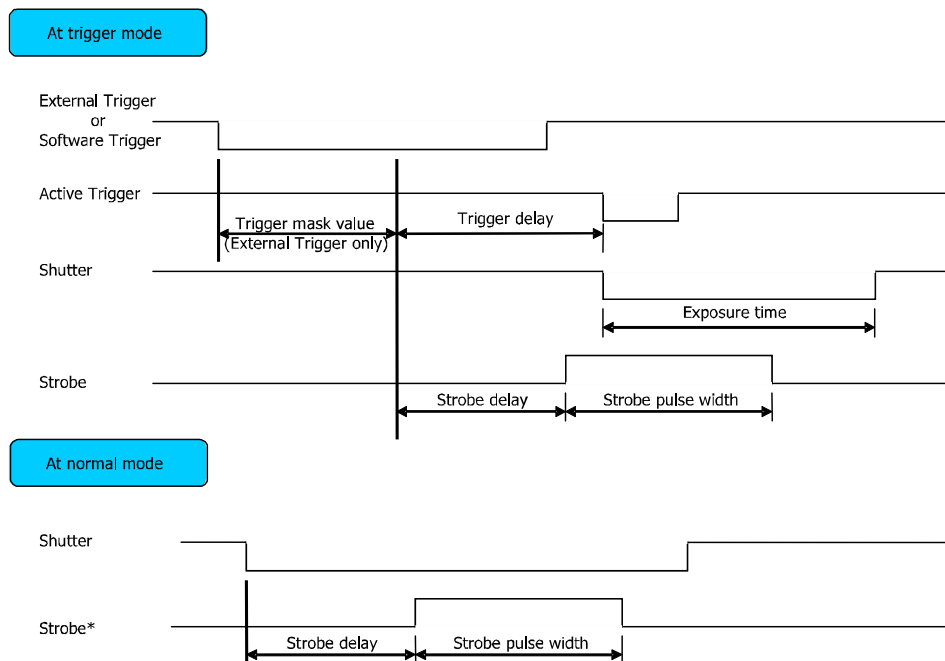
4.10.4. Trigger Mode 0

Camera starts integration of the incoming light from external trigger input falling edge. Integration time is described in "Shutter" register. No parameter is needed.
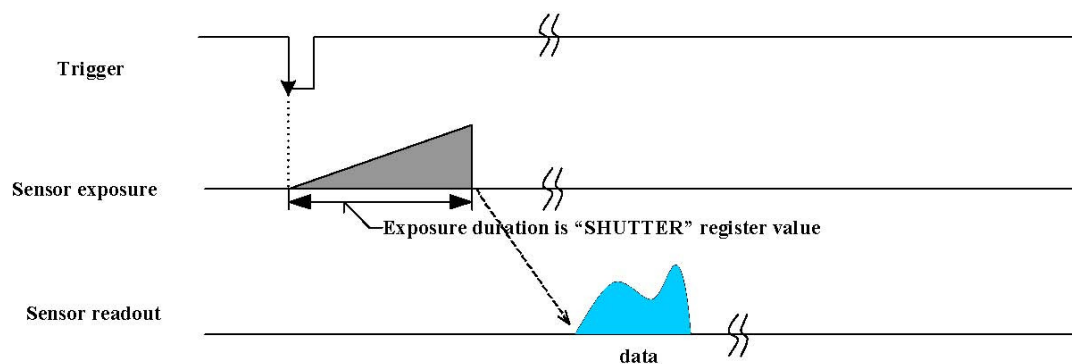
4.10.5. Trigger Mode 1

Camera starts integration of the incoming light from external trigger input falling edge. Integration time is equal to low state time of the external trigger input. No parameter is needed.

Exposure duration is trigger width

data
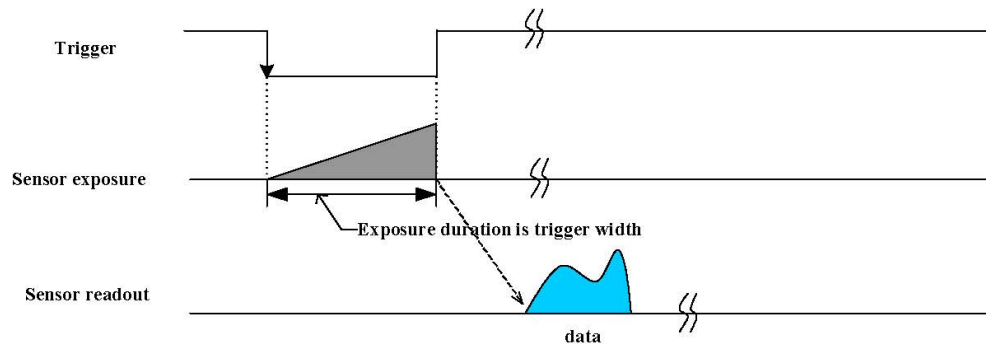
4.10.6. Trigger Mode 2

Camera starts integration of incoming light from first external trigger input falling edge. At the N-th (parameter) external trigger input falling edge, integration will be stopped. Parameter is required and shall be two or more.

(N >= 2)

External trigger input with parameter = 4.

Exposure duration is "Trigger number" register value

data
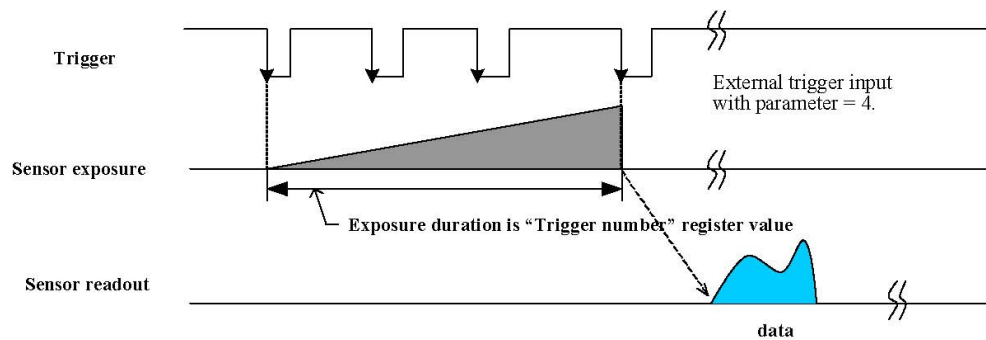
4.10.7. Trigger Mode 3

Not supported at Format 7 Mode

This is an internal trigger mode. Camera will issue trigger internally and cycle time is N times (parameter) of the cycle time of fastest frame rate. Integration time of incoming light is described in "Shutter" register. Parameter is required and shall be one or more (N>=1)

N x Tf (N is parameter. Tf is cycle time of the fastest frame rate)

Exposure duration is "SHUTTER" register value

data   data
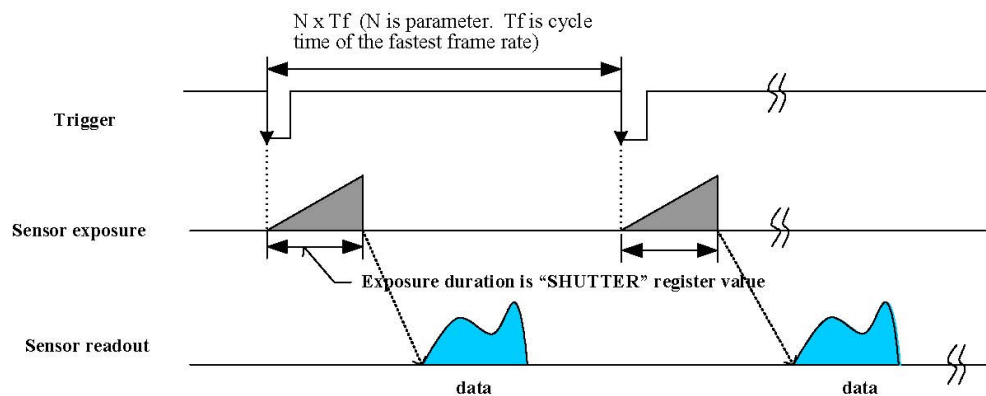
4.10.8.   Trigger Mode 4

This mode is "multiple shutter preset mode". Camera starts integration of incoming light from first external trigger input falling edge and exposes incoming light at shutter time. Repeat this sequence the N-th (parameter) external trigger input falling edge then finish integration. Parameter is required and shall be one or more. (N >= 1)
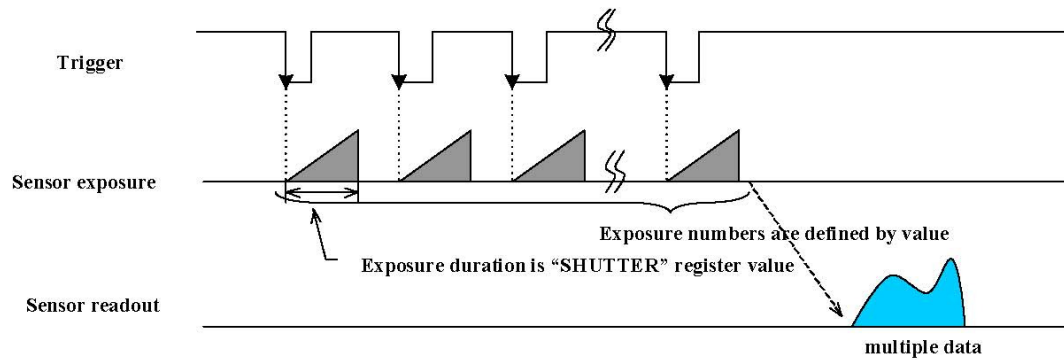
4.10.9.   Trigger Mode 5

This mode is "multiple shutter pulse width mode". Camera starts integration of incoming light from first external trigger input falling edge and exposes incoming light until trigger is inactive. Repeat this sequence the N-th (parameter) external trigger input falling edge then finish integration. Parameter is required and shall be one or more.   (N >= 1)
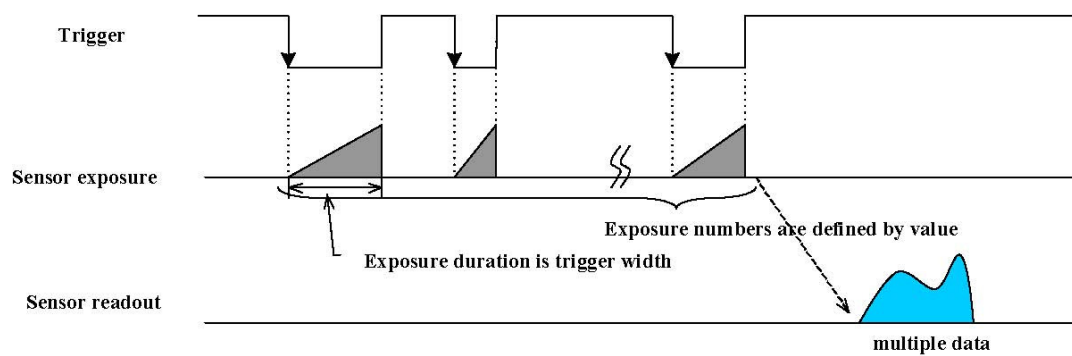
4.10.10. Trigger Mode 14

NET GmbH's Vender Unique Mode

This mode is "preset multiple shutter mode with a single trigger" . This mode is Similar to "trigger mode 4" but the difference is that all the parameter is preset by the users using only a single trigger. "Exposure Number", "Exposure Duration", and "Exposure Interval" are the parameters required for this mode however the exposure duration and interval in each multiple shutter is equal and cannot be different.

Exposure duration & interval is defined by user defined 1394 address(0xF2F10114)
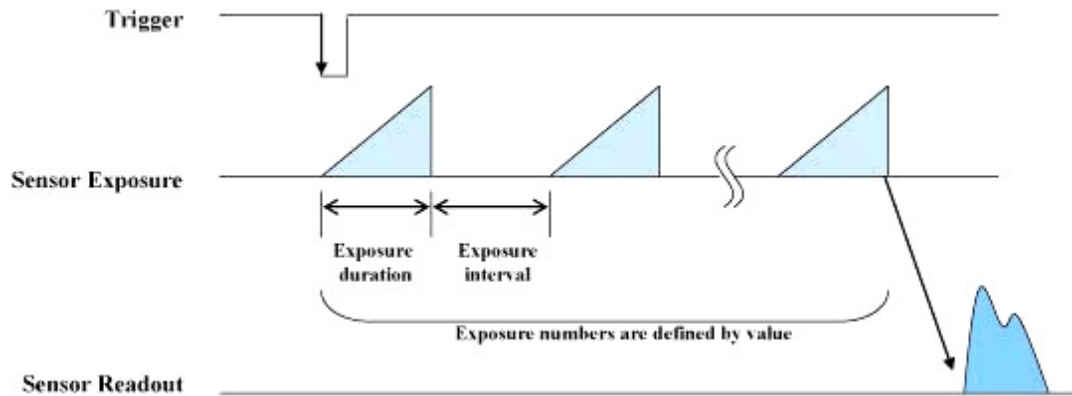
4.10.11. Trigger Mode 15 (MICOM 3.10 or higher)

Tigger mode 15 is the new function which is upgraded for micom version 3.0. User can capture the images as many as they want with one external trigger signal. This mode can be called 'One-trigger Multi-frames'. For this mode 15, the value of shutter time should be fixed.

Trigger mode 15 : One-trigger Multi-frames

External

Frame

1/fps + 200us

Shutter
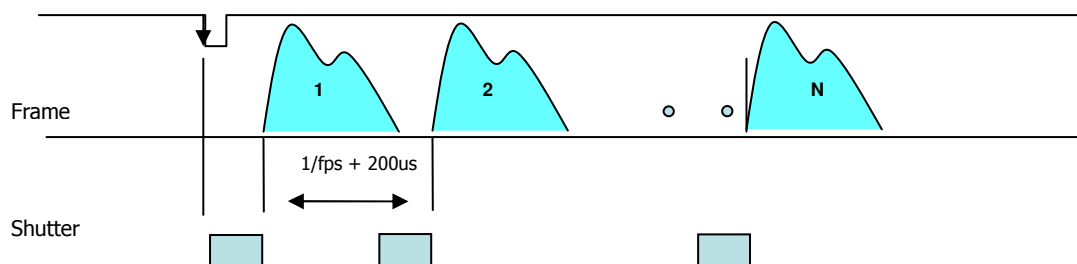
N : 1 ~ 255

Control Address : 0xF0F00830

Number of frame : N

830h	TRIGGER_MODE	Presence_Inq	[0]	Presence of this feature. 0:N/A 1:Available
		Abs_Control	[1]	Absolute value control 0: Control with value in the Value field 1: Control with value in the Absolute value CSR If this bit = 1, value in the Value field is ignored.
		-	[2..5]	Reserved.
		ON_OFF	[6]	Write: ON or OFF this feature, Read: read a status 0: OFF, 1: ON If this bit =0, other fields will be read only.
		Trigger_Polarity	[7]	Select trigger polarity (Except for software trigger) If Polarity_Inq is "1", Write to change polarity of the trigger input Read to get polarity of the trigger input. If Polarity_Inq is "0", Read only. (0: Low active input, 1: High active input)
		Trigger_Source	[8..10]	Select trigger source Set trigger source ID from trigger source ID_Inq
		Trigger_Value	[11]	Trigger Input raw signal value Read only 0:Low, 1:High
		Trigger_Mode	[12..15]	Trigger mode. (Trigger_Mode_0..15)
		-	[16..19]	Reserved
		Parameter	[20..31]	Parameter for trigger function, if required. (Optional)

Caution:

At trigger mode 15, Shutter value may be not changed. This operation may loss the frames and the next trigger.

Therefore, the shutter value must be changed before trigger generation or trigger enable command.

Strobe Control Register

Base Address : 0xF2F23000h

Address	Name	Field	Bit	Description
000h	Strobe_CTRL_Inq	Strobe_0_Inq	[0]	Presence of strobe 0 signal
		Strobe_1_Inq	[1]	Presence of strobe 1 signal
		Strobe_2_Inq	[2]	Presence of strobe 2 signal
		Strobe_3_Inq	[3]	Presence of strobe 3 signal
		-	[4..31]	Reserved
004h . . 0FCh				Reserved
100h	Strobe_0_Inq	Presence_Inq	[0]	Presence of this function
		-	[1..3]	Reserved
		ReadOut_Inq	[4]	Capability of reading the value of this feature
		On/Off_Inq	[5]	Capability of switching this function ON and OFF
		Polarity_Inq	[6]	Capability of changing polarity of the signal
		-	[7]	Reserved
		Min_Value	[8..19]	Minimum value of this function control
		Max_Value	[20..31]	Maximum value of this function control
104h	Strobe_1_Inq		Same definition to Strobe_0_Inq	
	Strobe_2_Inq		Same definition to Strobe_1_Inq	
	Strobe_3_Inq		Same definition to Strobe_2_Inq	
110h . . 1FCh				Reserved
200h	Strobe_0_Cnt	Presence_Inq	[0]	Presence of this function 0:N/A 1: Available
		-	[1..5]	Reserved
		ON_OFF	[6]	Write : ON or OFF this function Read: read a status 0: OFF, 1: ON if this bit=0, other fields will be read only
		Signal Polarity	[7]	Select signal polarity If Polarity_Inq is "1" Write to change polarity of the strobe output Read to get polarity of the strobe output If Polarity_Inq is "0" Read only (0: lowa active output, 1: High active output)

		Delay_Value	[8..19]	Delay after start of exposure until the strobe signal asserts
		Duration_Value	[20..31]	Duration of the strobe signal A value 0 means dessert at the end of exposure function if required.
204h	Strobe_1_Cnt	Same definition to Strobe_0_Inq		
208h	Strobe_2_Cnt	Same definition to Strobe_1_Inq		
20Ch	Strobe_3_Cnt	Same definition to Strobe_2_Inq		
210h . . 2FFh	Reserved			

4.11. Trigger Delay Control

Based on external triggers users can delay image acquisition by the trigger delay control feature. FOCULUS S Series support the IIDC V1.31 specification for trigger delay control as per the following tables.

Table valid for camera models with MICOM version below 3.10

Trigger Delay Table

Trigger Delay Index (Y)	Incremental Step	Trigger Delay Time : T	
		Delay Time	Range
1 ~ 500	1 us	T = Y us	1us ~ 500 us
501 ~ 1000	10 us	T = (Y - 500) * 10 + 500	510 us ~ 5500 us
1001 ~ 1445	100 us	T = (Y - 1000) * 100 + 5500 us	5.6 ms ~ 50 ms

Trigger Delay Example Table

Index	1	10	100	500	550	650	950	1045	1145	1445
Time	1 us	10 us	100 us	500 us	1 ms	2 ms	5 ms	10 ms	20 ms	50ms

Table valid for camera models with MICOM version 3.10 or higher

Trigger Delay Table

Trigger Delay Index (Y)	Incremental Step	Trigger Delay Time : T	
		Delay Time	Range
1 ~ 4000	1 us	T = Y us	1us ~ 4000 us

Inquiry Register

Address	Name	Field	Bit	Description
534h	TRIGGER_DLY_INQ	Presence_Inq	[0]	Presence of this feature
		Abs_Control_Inq	[1]	Capability of control with absolute value
		-	[2]	Reserved
		One_Push_Inq	[3]	One push auto mode (Controlled automatically by camera only once)
		ReadOut_Inq	[4]	Capability of reading the value of this feature

		On/OFF_Inq	[5]	Capability of switching this feature ON and OFF
		Auto_Inq	[6]	Auto Mode (Controlled automatically by camera)
		Manual_Inq	[7]	Manual Mode (Controlled by user)
		Min_Value	[8..19]	Minimum value for this feature control
		Max_Value	[20..31]	Maximum value for this feature control

Status Control Register

Address	Name	Field	Bit	Description
834h	TRIGGER_DELAY	Presence_Inq	[0]	Presence of this feature 0:N/A 1:Available
		Abs_Control	[1]	Absolute value control 0: Control with value in Value field 1: Control with value in Absolute value CSR if this bit =1, value in Value filed is ignored
		-	[2..5]	Reserved
		On/OFF	[6]	Write : ON or OFF this feature Read : read a status 0: OFF, 1:ON If this bit=0, other fields will be read only.
		-	[7..19]	Reserved
		Value	[20..31]	Minimum value for this feature control

4.11.1. Strobe Delay and Duration Table

Strobe	Incremental	Strobe Delay Time : T		
Index (Y)	Step	Delay Time		Range
0 ~ 3900	1 us	T = Y us		0 us ~ 3900 us

Strobe	Incremental	Strobe Duration : T

Index (Y)	Step	Delay Time	Duration Time	Range
0		0 us	N/A	
1		1 us	N/A	
2		2 us	2 us	
3 ~ 250	1 us	T = Y us	T = Y us	3 us ~ 250 us
251 ~ 489	250 us	T=(Y-250)*250us+250us	T=(Y-250)*250us+250us	500 us ~ 60ms

Delay Index(Y)	Strobe Delay Time	Duration Index (Y)	Strobe Duration Time
0	0us	0	N.A
1	1us	1	N.A
2	2us	2	2us
10	10us	10	10us
100	100us	100	100us
200	200us	250	250us
300	300us	253	1ms
500	500us	257	2ms
800	800us	269	5ms
1000	1000us	289	10ms
2000	2000us	329	20ms
3000	3000us	449	50ms
3900	3900us	489	60ms

4.12. Optical Filter Control

Optical Filter control allow user to change the optical filter of the camera lens function. You can change the Bayer patterns by moving the starting position which to output pixel data by one position up, down, right or left. (Only for color models)

Inquiry Register

Address	Name	Field	Bit	Description
58Ch	OPTICAL_FILTER_INQ	Presence_Inq	[0]	Presence of this feature
		Abs_Control_Inq	[1]	Capability of control with absolute value
		-	[2]	Reserved
		One_Push_Inq	[3]	One push auto mode (Controlled automatically by camera only once)

		ReadOut_Inq	[4]	Capability of reading the value of this feature
		On/OFF_Inq	[5]	Capability of switching this feature ON and OFF
		Auto_Inq	[6]	Auto Mode (Controlled automatically by camera)
		Manual_Inq	[7]	Manual Mode (Controlled by user)
		Min_Value	[8..19]	Minimum value for this feature control
		Max_Value	[20..31]	Maximum value for this feature control

Status Control Register

Address	Name	Field	Bit	Description
88Ch	OPTICAL_FILTER	Presence_Inq	[0]	Presence of this feature 0:N/A 1:Available
		Abs_Control	[1]	Absolute value control 0: Control with value in Value field 1: Control with value in Absolute value CSR if this bit =1, value in Value filed is ignored
		-	[2..5]	Reserved
		On/OFF	[6]	Write : ON or OFF this feature Read : read a status 0: OFF, 1:ON If this bit=0, other fields will be read only.
		-	[7..19]	Reserved
		Value	[20..31]	Minimum value for this feature control

4.13. Color (Bayer) Patterns Conversion

Color sensors capture images through a optical low pass filter placed over the individual pixel in Bayer Mosaic layout. Imaged data are transferred by passing color processing which can save bandwidth gaining higher frame rate and flexibility of applying different Bayer Pattern on the PC side.

Obtained images can be processed in either of the following 4 different conversion algorithm can on the PC side.

Modes	Mode 0 GB/RG	Mode 1 BG/GR	Mode 2 RG/GB	Mode 3 GR/BG
Color(Bayer) Pattern	G B G / R G R / G B G	B G B / G R G / B G B	R G R / G B G / R G R	G R G / B G B / G R G

5.   Advanced Features

5.1.   Binning Mode

(B/W models and FO531SC Model)

Binning is defined as reading neighboring pixel and combining directly from the CCD of the camera. Binning is has an advantage in the following situation and may further be used in various applications. Relative binning mode per camera model is described in each camera specification.

- Low Light Operation   : Combining neighboring pixel increases the area of the CCD receiving light thus may obtain brighter picture in low light condition with possible noise reduction.

- High Frame Rate Operation   : Vertical Binning accelerates the speed of CCD data transfer rate by combining multiple vertical line per single horizontal line of the CCD resulting a significant gain in frame rate.

5.1.1.   Vertical Binning

Vertical binning combines CCD pixels neighboring vertically to a single pixel increasing light sensitivity of the camera. Since CCD acquire data horizontally, multiple lines are acquired in case of vertical binning which results significant speed gain. Thus the vertical resolution is reduced and due to the increased CCD area over exposure may occur which may require adjustment.
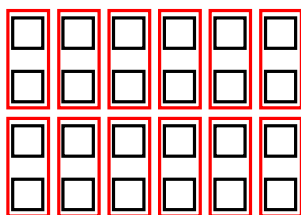
1x2 Vertical Binning

Example

5.1.2.   Full Binning

Full binning mode can be obtained by combining vertical and horizontal binning. First horizontal pixels are combined followed by a vertical conjunction of these pixels. This would increase light sensitivity by a factor of 4 in case of 2 x 2 (Horizontal x Vertical) binning. However as described above, only vertical binning would result speed gain while horizontal binning gives no speed gain thus speed gain results as similar to vertical binning. Resolution in this mode would be reduced both horizontally and vertically.
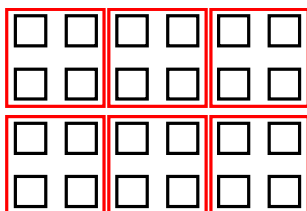
2x2 Full Binning

Example

5.2.   Partial Scan

Cameras are defined of a certain resolution according to the image sensor while often a certain region maybe of an interest to

the user. The partial scan mode provides the function to provide output of a certain region of interest (ROI) which may have advantage in data transfer speed resulting faster operation. As described in binning mode speed gain would occur only in vertical resolution decrease. Partial Scan is supported only in Format 7 by setting the following registers described in the IIDC1.31 specification. Unit size of the partial scan is described in the camera specification which user must consider in increment configuration.

IMAGE_POSITION & IMAGE_SIZE register

Left = Hposunit * n1

Top = Vposunit * m1

Width = Hunit * n2

Height = Vunit * m2

Left + Width < = Hmax

Top + Height < = Vmax

(n1,n2, m1, m2 are integer)

0 - 7	8 – 15	16 – 23	24 - 31
Left		Top	
0 - 7	8 – 15	16 – 23	24 - 31
Width		Height	

Initial Values	System Dependant
Read Values	Last Update Value
Write Effect	Stored

Partial Scan Image
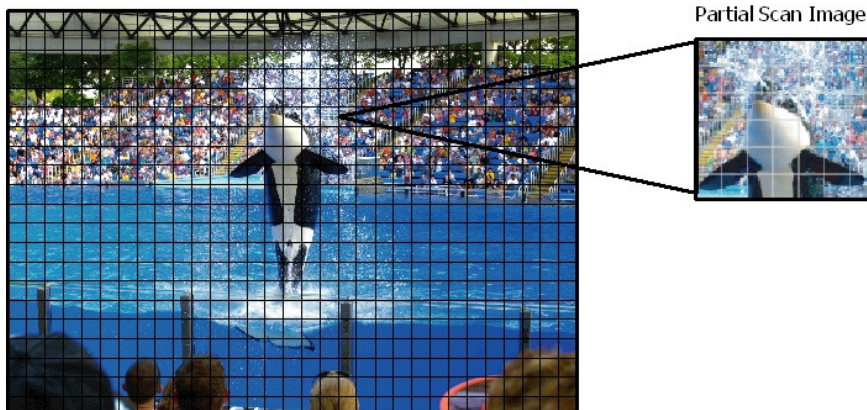
5.2.1.   Pan/Tilt

Pan/Tilt is a function used to move a camera up and down or left and right. However unlike the mechanical Pan /Tilt which is carried out by physically moving the camera up and down, this functions by using smaller video mode than the CCD's effective pixel and moving the image up and down. This results of a cut off pixel from the whole image which user can specify by the Pan/Tilt command. Pan/Tilt range and values depend on the characteristic of each CCD used in the camera respectively as per the following tables. Note that at Format 7 mode, the pan/tilt value must be set at non-format 7 mode before operation.

Kh = Kh$_1$ + Kh$_2$ Kv = Kv$_1$ + Kv$_2$
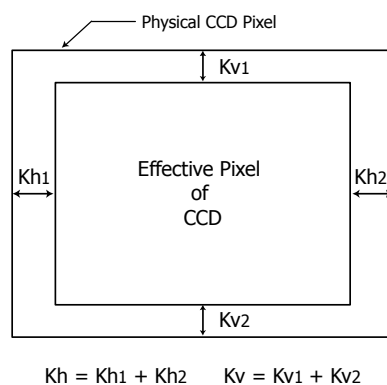
Pan/Tilt Details for FO124SB/FO134SB and FO124SC/FO134SC

Image Size	Movement	FO124SB / FO134SB Kh =12, Kv=12		FO124SC / FO134SC Kh=8, Kv=10	
		Range(Incr.=1)	Default	Range(Incr.=2)	Default
320 x 240	Pan	160 ~ 492	326	160 ~ 488	324
	Tilt	120 ~ 372	246	120 ~ 370	242
640 x 480	Pan	320 ~ 332	326	320 ~ 328	324
	Tilt	240 ~ 252	246	240 ~ 250	242
640 x 480 Format 7 Mode 0	Pan	320 ~ 332	326	320 ~ 328	324
	Tilt	240 ~ 252	246	240 ~ 250	242
320 x 240 Format 7 Mode 1	Pan	320 ~ 332	326	-	-
	Tilt	240 ~ 252	246	-	-
640 x 240 Format 7 Mode 2	Pan	320 ~ 332	326	-	-
	Tilt	240 ~ 252	246	-	-

*At format7 mode, PAN/TITL value must be set at non-format7 mode.

Pan/Tilt Details for FO234SB and FO234SC

Image Size	Movement	FO234SB Kh=0, Kv=0		FO234SC Kh=0, Kv=0	
		Range(Incr.=1)	Default	Range(Incr.=2)	Default
320 x 240	Pan	160 ~ 620	390	160 ~ 620	390
	Tilt	120 ~ 460	290	120 ~ 460	290
640 x 480	Pan	320 ~ 460	390	320 ~ 460	390
	Tilt	240 ~ 340	290	240 ~ 340	290
780 x 580 Format 7 Mode 0	Pan	-	390	-	390
	Tilt	-	290	-	290
388 x 288 Format 7 Mode 1	Pan	-	390	-	-
	Tilt	-	290	-	-
780 x 288 Format 7 Mode 2	Pan	-	390	-	-
	Tilt	-	290	-	-

Pan/Tilt Details for FO323SB and FO323SC

Image Size	Movement	FO323SB Kh=0, Kv=0		FO323SB Kh=0, Kv=0	
		Range(Incr.=1)	Default	Range(Incr.=2)	Default
320 x 240	Pan	160 ~ 872	516	160 ~ 872	516
	Tilt	120 ~ 656	388	120 ~ 656	388
640 x 480	Pan	320 ~ 712	516	320 ~ 712	516
	Tilt	240 ~ 536	388	240 ~ 536	388
800 x 600	Pan	400~632	516	400~632	516
	Tilt	300~476	388	300~476	388

1024 x 768	Pan	400 ~ 632	516	400 ~ 632	516
	Tilt	300 ~ 476	388	300 ~ 476	388
1024 x 768	Pan	512 ~ 520	516	512 ~ 520	516
Format 7 Mode 0	Tilt	384 ~ 392	388	384 ~ 392	388
512 x 384	Pan	512 ~ 520	516	-	-
Format 7 Mode 1	Tilt	384 ~ 392	388	-	-
1024 x 384	Pan	512 ~ 520	516	-	-
Format 7 Mode 2	Tilt	384 ~ 392	388	-	-

Pan/Tilt Details for FO432SB/FO432SC and FO442SB/FO442SC

Image Size	Movement	FO432SB/FO442SB Kh=0, Kv=0		FO432SC/FO442SC Kh=0, Kv=0	
		Range(Incr.=1)	Default	Range(Incr.=2)	Default
320 x 240	Pan	160 ~ 1232	694	160 ~ 1232	694
	Tilt	120 ~ 920	518	120 ~ 920	518
640 x 480	Pan	320 ~ 1072	694	320 ~ 1072	694
	Tilt	240 ~ 800	518	240 ~ 800	518
800 x 600	Pan	400 ~ 992	694	400 ~ 992	694
	Tilt	300 ~ 740	518	300 ~ 740	518
1024 x 768	Pan	512 ~880	694	512 ~880	694
	Tilt	384 ~ 656	518	384 ~ 656	518
1280 x 960	Pan	640 ~ 752	694	640 ~ 752	694
	Tilt	480 ~ 560	518	480 ~ 560	518
1392 x 1040	Pan	-	694	-	694
Format 7 Mode 0	Tilt	-	518	-	518
692 x 516	Pan	-	694	-	-
Format 7 Mode 1	Tilt	-	518	-	-
1388 x 516	Pan	-	694	-	-
Format 7 Mode 2	Tilt	-	518	-	-

Pan/Tilt Details for FO531SB and FO531SC

Image Size	Movement	FO531SB Kh=22, Kv=34		FO531SC Kh=20, Kv=34	
		Range(Incr.=1)	Default	Range(Incr.=2)	Default
320 x 240	Pan	160 ~ 1462	810	160 ~ 1460	810
	Tilt	120 ~ 1114	616	120 ~ 1114	616
640 x 480	Pan	320 ~ 1302	810	320 ~ 3000	810
	Tilt	240 ~ 994	616	240 ~ 994	616
800 x 600	Pan	400 ~ 1222	810	400 ~ 1220	810
	Tilt	300 ~ 934	616	300 ~ 934	616
1024 x 768	Pan	512 ~ 1110	810	512 ~ 1108	810
	Tilt	384 ~ 850	616	384 ~ 850	616
1280 x 960	Pan	640 ~ 982	810	640 ~ 980	810
	Tilt	480 ~ 754	616	480 ~ 754	616
1600 x 1200	Pan	800 ~ 822	810	800 ~ 820	810
	Tilt	600 ~ 634	616	600 ~ 634	616
1600 x 1200	Pan	800 ~ 822	810	800 ~ 820	810
Format 7 Mode 0	Tilt	600 ~ 634	616	600 ~ 634	616
800 x 600	Pan	800 ~ 822	810	800 ~ 820	810
Format 7 Mode 1	Tilt	600 ~ 632	616	600 ~ 632	616
1600 x 600	Pan	800 ~ 822	810	800 ~ 820	810
Format 7 Mode 2	Tilt	600 ~ 632	616	600 ~ 632	616

*At format7 mode, PAN/TITL value must be set at non-format7 mode

5.3.   One-Shot and Multi-Shot   (Not supported at MICOM 3.0 and 3.11)

This camera supports One-Shot and Multi-Shot features. The camera should be in a Iso_disabled mode before the execution of these command and if the camera is Iso_enabled mode these commands are ignored. One-Shot and Multi-Shot can be used combined with a hardware trigger which grabs either one frame or multi frame according to the command respectively. The command can be executed configuring the following registers.

One-Shot		Multi-Shot	
Address	F0F0061CH	Address	F0F0061CH
Data	80000000h	Data	4000nnnh

nnnn is the number of frames output which can be from any number between 0001h ~ FFFFh.(1~ 65,535)

Priority of the command execution is as follows.   Continuous > One-shot > Multi-shot.

When a command with higher priority is being executed the command with lower priority shall be ignored.

5.4.   Multi-Camera Auto-sync.

Not supported at 3.75fps – may implemented in the future

In application incorporating multi camera, there is often a need to synchronize the cameras. Multi-Camera Auto Synchronization is supported utilizing the FIREWIRE bus time cycle register which are connected on the same FIREWIRE bus. However the video mode of the camera must be set within the limit a single FIREWIRE bus bandwidth of 400Mbps. Also maximum shutter value be set as per the table below not exceeding the FIREWIRE bus cycle time. Jitter may occur due to CPU operation timing.

FPS	FO124Sx FO134Sx		FO234Sx		FO323Sx		FO432Sx/FO442Sx		FO531Sx	
	Max Shutter		Max Shutter		Max Shutter		Max Shutter		Max Shutter	
	Value	Time	Value	Time	Value	Time	Value	Time	Value	Time
60	1110	16.5ms	1108	16.3ms	-	-	-	-	-	
30	1276	33.1ms	1272	32.7ms	1270	32.5ms	-	-	-	-
15	1608	66.3ms	1601	65.6ms	1598	65.3ms	1612	66.7ms	1606	66.1ms
7.5	1760	131ms	1759	130ms	1758	129ms	1761	132ms	1760	131ms
3.75	1893	264ms	1891	262ms	1889	260ms	1895	266ms	1893	264ms

To utilize Auto-sync, please set Bit 31 to Auto-sync Enable, then check the Bit 27 to verify whether it is ready. Please refer the details as the following table.

0xF2F10018	**Auto-Sync Mode control register** Bit 31 : auto sync enable Bit 30 : SIO enable mode (0 : NET GMBH mode, 1 : IIDC v1.31) Bit 27 : auto sync complete (read only. 1: ready, 0: not yet auto-sync)	Read/Write

5.5.   Asynchronous Broadcasting

Asynchronous broadcasting is supported where using node 63 of the FIREWIRE bus is used as a target node for asynchronous write request. This enables all the camera to be triggered by software simultaneously. By utilizing Asynchronous Broadcasting

user can execute and control all the camera on the same FIREWIRE bus at the same time with a single command.

5.6.   Memory Save / Load

The setting of the camera features and video mode can be stored in a non-volatile memory. Our camera supports 16 memory

channels as per the table below for user to conveniently save and load different features as well as video modes.

Address	Name	Bit	Description
618h	Memory_Save	[0]	Saves the current setting
		[1..31]	Reserved

Address	Name	Bit	Description
620h	Mem_Save_Ch	[0]	Factory Default Setting Cannot overwrite
		[1..4]	Write Channel for Memory Save for Channel 1 ~ 4 (Only for Features)
		[5..15]	Write Channel for Memory Save for Channel 5 ~ 15 (For Features, Format and Mode Save)

Address	Name	Bit	Description
624h	Cur_Save_Ch	[0]	Read and Load Factory Default Setting
		[1..4]	Read and Load Memory Channel 1 ~ 4
		[5..15]	Read and Load Load Memory Channel 5 ~ 15

User Defined FireWire Register Control

Address	Description(bit : msb*)	Read/Write
0xF2F1011C	**Power on default memory channel** Bit 0 ~ Bit 3 : power on initial memory channel	Read/Write

5.7.   Time Stamp Register

Time stamp register may be inquired from the Native FireWire Bus (IEEE-1394.a) CYCLE_TIME registers as follows.

You may also get the same value from user defined registers (See Chap. 6.1) but we recommend using this.

Address	Description(bit : msb*)	Read/Write
0xF0000200	**CYCLE_TIME** 0 1 2 3 4 5 6 | 7 8 9 10 11 12 13 14 15 16 17 18 19 | 20 21 22 23 24 25 26 27 28 29 30 31 SECONDS COUNT | CYCLE COUNT | CYCLE OFFSET <table><tr><td>Bit Number</td><td>Bit Name</td><td>Function</td><td>DIR</td><td>Description</td></tr><tr><td>0 - 6</td><td>SECONDS COUNT</td><td>Seconds Count</td><td>R/W</td><td>1 Hz cycle timer counter</td></tr><tr><td>7 - 19</td><td>CYCLE COUNT</td><td>Cycle Count</td><td>R/W</td><td>8,000 Hz cycle timer counter</td></tr><tr><td>20 - 31</td><td>CYCLE OFFSET</td><td>Cycle Offset</td><td>R/W</td><td>24.576 MHz cycle timer counter</td></tr></table>	Read

5.8.   Serial Interface

FOCULUS S Series are equipped with SIO(Serial input/output) feature described in the IIDC 1.31 specification. By using the

serial interface, users can execute commands by writing data in a specific address in the FIREWIRE address range. SIO can be

further used as a RS232 interface which supports pass through and NET GmbH command..

5.8.1. SIO Pass Through Scheme
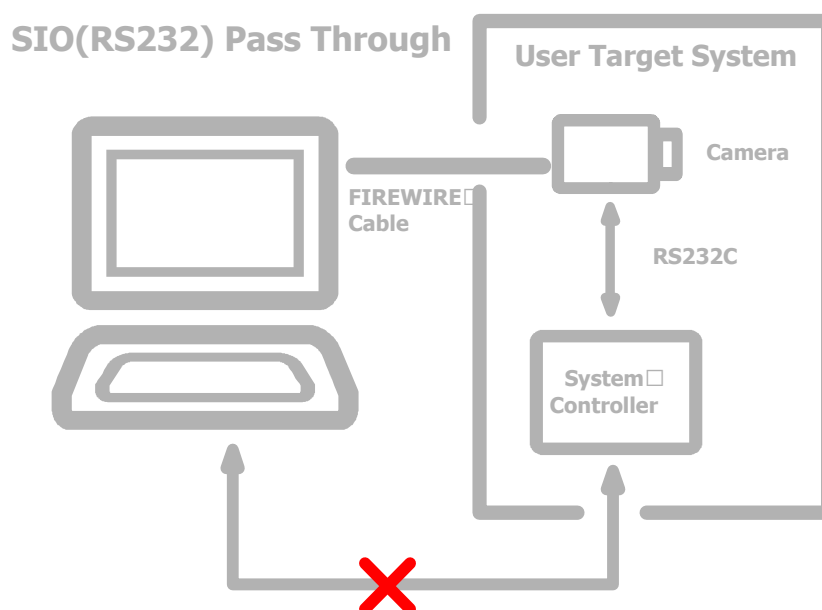
5.8.2. SIO (RS232) Control Setting Procedure

STEP 1. Configuration of Registers   Address : F2F22000h

Baud Rate : 9600, No Parity, 1 bit Stop, 8 bit data length

Write : F2F22000h, Data = 050800000h

Value read after write = 050800020h   20 is the buffer of TX and RX

STEP 2. Enable RS232 TX / RX   Address : F2F22004h

Write Data : C00000000   : Now RS232 TX / RX port is enabled

5.8.3. SIO (RS232) RX Control Procedure

STEP 1   Read RBUF_ST of the Receive Buffer Status Control Register (address : F2F22008h) and check number of RX data

buffered in the camera.

If (RBUF_ST !=0) the RX is Ready else RX is NOT Ready

RBUF_ST : The number of current data buffered in the camera (Unit : byte)

RBUF_CNT : READ : Remaining RX buffer size

STEP 2   Write number of RX data intended to read from RBUF_CNT of the Receive Buffer Status Control Register (address :

F2F22008h)

RBUF_CNT can be configured by unit of byte.

The value of RBUF_CNT must be smaller than RBUF_ST.

STEP 3   Read RS232 RX data from SIO_Data_Register (addr. : F2F22100)

STEP 4   If data is further required repeat from STEP1

Note that 1394 data consist of 32 bit data the data read should

Bit 0 ~ Bit 7   : 1st Data   Bit 8 ~ Bit 15   : 2nd Data

Bit 16 ~ Bit 23   : 3rd Data   Bit 24 ~ Bit 31   : 4th Data

Bit 0 : Msb   Bit 31 : Lsb

5.8.4.   SIO (RS232) TX Control Procedure Method I

STEP 1   Check TX buffer size   by reading TBUF_ST of the Transmit_Buffer_Status_Control register(Addr. : F2F220Ch)

If ((TBUF_ST == Buffer_Size_Inq) or (TBUF_TDRD ==1)) then TX is COMPLETE else TX is INCOMPLETE

TBUF_ST : Current TX Data buffer(Unit:byte) of the camera

TBUF_CNT : Read : Number of data transmitted by RS232 TX

Buffer_Size_Inq : Defined in Serial_Mode_Reg(Addr. : F2F22000h)

Ex) 20050000h : valid data buffer size = 20   number of data sent : 05

STEP 2   Write number of RS232 TX data to be set for TBUF_CNT at SIO_Data_Register(Addr: F2F22100h)

STEP 3   Write number of TX data to be transferred to TBUF_CNT of Transmit_Buffer_Status_Control Register(Addr:F2F2200Ch)

TBUF_CNT can be configured by unit of byte.

The value of TBUF_CNT must be smaller than data written at SIO_Data_Register.

If (write data number > = TBUF_CNT)

{

   RS232TX Start

   Write Data number larger that TBUF_CNT is discarded.

   For example if TBUF_CNT = 5 , in IEEE-1394 write is done by a unit of 4 bytes where 8 bytes shall be written at

   SIO_Data_Register but only 5 bytes are transmitted and the 3 bytes remaining shall be discarded.

}

STEP4   If there is data to be transmitted repeat from Step 1 .

Bit 0 ~ Bit 7   : 1st Data   Bit 8 ~ Bit 15   : 2nd Data

Bit 16 ~ Bit 23   : 3rd Data   Bit 24 ~ Bit 31   : 4th Data

Bit 0 : Msb   Bit 31 : Lsb

5.8.5.   SIO (RS232) TX Control Procedure Method II

STEP 1   Check TX buffer size   by reading TBUF_ST of the Transmit_Buffer_Status_Control register(Addr. : F2F220Ch)

If ((TBUF_ST == Buffer_Size_Inq) or (TBUF_TDRD ==1)) then TX is COMPLETE else TX is INCOMPLETE

TBUF_ST : Current TX Data buffer(Unit:byte) of the camera

TBUF_CNT : Read : Number of data transmitted by RS232 TX

Buffer_Size_Inq : Defined in Serial_Mode_Reg(Addr. : F2F22000h)

Ex) 20050000h : valid data buffer size = 20   number of data sent : 05

STEP 2   Write number of RS232 TX data to be set for TBUF_CNT at Transmit_Buffer_Status_Control Register(Addr:F2F2200Ch)

TBUF_CNT can be configured by unit of byte.

The value of TBUF_CNT must be smaller than data written at SIO_Data_Register.

STEP 3   Write RS232 TX data set at TBUF_CNT to SIO_Data Register(Addr. : F2F22100h)

If (write data number > = TBUF_CNT)

{

RS232TX Start

Write Data number larger that TBUF_CNT is discarded.

For example if TBUF_CNT = 5 , in IEEE-1394 write is done by a unit of 4 bytes where 8 bytes shall be written at

SIO_Data_Register but only 5 bytes are transmitted and the 3 bytes remaining shall be discarded.

}

STEP4   If there is data to be transmitted repeat from Step 1 .

Bit 0 ~ Bit 7   : 1st Data   Bit 8 ~ Bit 15   : 2nd Data

Bit 16 ~ Bit 23   : 3rd Data   Bit 24 ~ Bit 31   : 4th Data

Bit 0 : MSB   Bit 31 : LSB

5.8.6.   SIO(RS232) Registers

Base address: F2F22000h, default baud rate is 57600

Address	Name	Field	Bit	Description
000h	Serial_Mode_Reg	Baud Rate	[0..7]	Baud Rate Setting
				Write : Set baud rate
				Read : Get current baud rate
				0: 300 bps 1: 600 bps
				2: 1200 bps 3: 2400 bps
				4: 4800 bps 5: 9600 bps
				6: 19200 bps 7: 38400 bps
				8: 57600 bps 9: 115200bps
				10: 230400bps Other value reserved.
		Char_Length	[8..15]	Character length setting
				Write: Set data length(must not be 0)
				Read : Get data length
				7: 7 bits
				8: 8 bits
				Other values reserved.
		Parity-	[16..17]	Parity setting
				Write : Set Parity
				Read : Get current parity
				0: None 1 : Odd 2 : Even

		Stop_bit	[18..19]	Stop bits Write : Set stop bit Read : Get current stop bit 0: 1 1: 1.5 2: 2.
		-	[20..23]	Reserved
		Buffer_Size_Inq	[24..31]	Buffer Size (Read Only) This field indicates the maximum size of receive/transmit data buffer. If this value=1, Buffer_Status_Control, SIO_Data_Register Char1-3 should be ignored
004h	Serial_Control_Reg	RE	[0]	Receive enable Read : Current status Write : 0 : Disable 1: Enable
		TE	[1]	Transmit enable Read : Current status Write : 0 : Disable 1: Enable
		-	[2..7]	Reserved
	Serial_Status_Reg	TDRD	[8]	Transmit data buffer ready Read only 0 : Not ready 1: Ready
		-	[9]	Reserved
		RDRD	[10]	Receive data buffer ready Read only 0 : Not ready 1: Ready
		-	[11]	Reserved
		ORER	[12]	Receive buffer over run error Read : Current status Write : 0: Clear flag 1: Ignored
		FER	[13]	Receive data framing error Read : Current status Write : 0: Clear flag 1: Ignored
		PER	[14]	Receive data parity error Read : Current status Write : 0: Clear flag 1: Ignored
		-	[15]	Reserved
008h	Receive_Buffer_Status_Control	RBUF_ST	[0..8]	SIO receive buffer status Read : Valid data size of current receive buffer Write : Ignored
		RBUF_CNT	[8..15]	SIO receive buffer control Read : Remain data size for read Write : Set input data size
		-	[16..31]	Reserved
00Ch	Transmit_Buffer_Status_Control	TBUF_ST	[0..7]	SIO ouput buffer status Read : Available data space of transmit buffer Write : Ignored
		TBUF_CNT	[8..15]	SIO output buffer control Read : Written data size to buffer Write : Set output data size for transmit
		-	[16..31]	Reserved
010h				Reserved

.. 0FFh				
100h	SIO_Data_Register	Char_0	[0..7]	Chracter_0 Read : Read character from receive buffer Padding data, if data is not available Write : Character to transmit buffer padding data if data is invalid
		Char_1	[8..15]	Chracter_1 Read : Read character from receive buffer +1 Padding data, if data is not available Write : Character to transmit buffer +1 padding data if data is invalid
		Char_2	[8..15]	Chracter_2 Read : Read character from receive buffer +2 Padding data, if data is not available Write : Character to transmit buffer +2 padding data if data is invalid
		Char_3	[16..31]	Chracter_3 Read : Read character from receive buffer +3 Padding data, if data is not available Write : Character to transmit buffer +3 padding data if data is invalid
104h .. 1FFh	SIO_Data_Register_Alias		[0..31]	Alias SIO_Data_Register area for block transfer

5.8.7. SIO(RS232)   NET GMBH Commands

SIO(RS232) NET GmbH commands are non IIDC compliant which is a specific mode for NET cameras.

Before using these commands serial communication parameters must be set at **Serial_Mode_Reg(F2F22000h)**

Baud Rate	Stop Bit	Parity	Flow Control
57600 bps(Default)	1 bit	None	Non

● **Command format :   [STX] [Command] [Data] [ETX]**

    [STX]   :   Command start character : 'S'

    Command] :   Command length is 2byte. See next page command table.

    [Data]   :   Data length is varied with each command. Data format is hexadecimal: '0'~'9', 'A'~'F'.

    [ETX]   :   Command end character : 'Z'

● **Return value**

    'G'   :   Command complete acknowledge.

    "Gdd..d"   :   "dd..d" is return data and hexadecimal character.

    'U'   :   Undefined command.

● Valid Character : '0'~'9', 'A'~'F', 'S','Z'   Invalid character is received is discarded.

● **example)   Gain setting command with 0x200 value.**

    All of "SA0200Z", "S A0 200 Z", "SA0 200Z",   "S A0200 Z", and "SKA0V200Z" are parsed to "SA0200Z".

- **SIO(RS232) Commands**

STX	Command	Data Length	ETX	Return Value	Function
S	A0	3Bytes	Z	G	**Gain control** (0x000 ~ 0x30F(BW Model) or 2D3(Color Model)) (see gain mapping graph) Ex) SA0200Z : Gain index value 512 (18dB)
S	A1	3Bytes	Z	G	**Shutter speed control** (0x001 ~ 0xCFB) (see shutter speed table)
S	A2	1Bytes	Z	G	**Set/Clear auto shutter speed and auto gain** Bit 0 : Auto gain Bit 1 : Auto shutter speed Ex) SA21Z : set auto gain and clear auto shutter speed SA23Z : set auto gain and auto shutter speed SA20Z : clear auto gain and auto shutter speed
S	A3	2Bytes	Z	G	**Auto exposure control** (0x00~0x64)
S	A4	1Bytes	Z	G	**Gamma control** (0x0~0x19) (see gamma table)
S	A5	3Bytes	Z	G	**Brightness control** (0x000~0x800)
S	A6	3Bytes	Z	G	**Sharpness control** (0x000~0x3F8)
S	A7	1Bytes	Z	G	**ISO control** 1: ISO enable, 0 : disable
S	A8	1Bytes	Z	G	**Trigger control** 1: trigger enable, 0 : trigger disable
S	AF	0Bytes	Z	'G'+18 Byte	**Read feature control value** Return value order 'G'[Gain] [Shutter] [Set/Clear auto gain and shutter] [Auto Exposure] [Gamma] [Brightness] [Sharpness] [ISO] [Trigger] Ex) At Command SAFZ, if return value is G001200132F20020101, Gain : 0x001 Shutter speed : 0x200 Set auto gain/Clear auto shutter speed : 0x1 Auto exposure : 0x32 Gamma : 0xF Brightness : 0x200 Sharpness : 0x201 ISO : 0x0 Trigger : 0x1
S	B0	16Bytes	Z	G	**RS232 synchronization** : RS232 buffer cleared in camera.
S	B1	8Bytes	Z	G	**Write access of 1394 address** Format : SB1 [address(8 byte)] [data(8byte)] Z Ex) SB1F2F10100 12345678Z : write 0x12345678 data at 0xF2F10100 address
S	B2	0Bytes	Z	'G'+8 Byte	**Read access of 1394 address** Format : SB2 [address(8byte)] Z Ex) If command is SB2F2F10100Z and return value is G12345678, Read value of address 0xF2F10100 is 0x12345678.
S	B3	3Bytes	Z	G	**Return to default feature value** Return control feature : gain, shutter speed, auto exposure, brightness, sharpness, gamma, auto shutter speed, auto gain
S	Undefined Command	Any Byte	Z	U	**Undefined command** Return Value is 'U' character.

6.   User Defined FIREWIRE Registers

User defined registers are features undefined in the IIDC specification which NET cameras are capable of. User can utilize extended features of these NET specific FIREWIRE register for application.

Note that for users who had previous versions of NET Camera, several User Defined Registers have been incorporated in the IIDC V1.31 specification.

6.1.   User Defined FIREWIRE Address

Address	Description(bit : msb*)	Read/Write
0xF2F10000	**A/D bit resolution** Bit 28~Bit31 : A/D bit resolution Please refer to IIDC v1.31 data depth register (address: 0xF0F00630) Mono 8 /Raw RGB 8bit — Discard — **12 Bit A/D, Resolution** 11 10 9 8 7 6 5 4 3 2 1 0 15 ... 8 7 ... 0 11 10 9 8 7 6 5 4 11 10 9 8 7 6 5 4 Mono 16 /Raw RGB 16bit 15 ... 8 7 ... 0 Null data 11 10 9 8 7 6 5 4 3 2 1 0	Read only
0xF2F10004	**Auto shutter-speed maximum/minimum value register.(32bit)** At auto shutter mode, shutter speed value is checked between auto shutter-speed maximum value and minimum value 0 .... 15 16 .... 31 Auto Shutter-Speed Maximum Value	Auto Shutter-Speed Minimum Value	Read/Write
0xF2F10008	**Auto gain maximum/minimum value register.*(32bit)** At auto gain mode, gain value is checked between auto gain maximum value and minimum value. 0 .... 15 16 .... 31 Auto Gain Maximum Value	Auto Gain Minimum Value	Read/Write

0xF2F10018	**Mode control register** Bit 31 : auto sync enable Bit 30 : SIO enable mode (0 : NET GmbH mode, 1 : IIDC v1.31) Bit 27 : auto sync complete (read only. 1: ready, 0: not yet auto-sync)	Read/Write
0xF2F1001C	**1394 time stamp register(msb:bit0)** See bit layout and table below. **We recommend using native CYCLE_TIME register in Chap. 5.7.**	Read only
0xF2F10100	**Power on reset condition control register** Not Recommended Please refer to IIDC v1.31 memory save/load channel.	Read/Write (Self Cleared)
0xF2F10104	**Trigger control register** Not Recommended Please refer to IIDC v1.31 trigger control register (address: 0xF0F00830)	Read/Write
0xF2F10108	**Software trigger** Not Recommended Please refer to IIDC v1.31 software trigger register (address: 0xF0F0062C)	Read only
0xF2F1010C	**Strobe control register.** Only supports active high polarity. Not Recommended Please refer to IIDC v1.31strobe control register (address: 0xF0F0048C -> 0xF2F23200)	Read/Write
0xF2F10110	**Trigger noise filter register (External trigger only)** Bit 22~Bit 31 : trigger masking range (M, unit : usec, range:0~999)	Read/Write
0xF2F10114	**Multi-cut exposure & interval time control (for Mode 14)** Bit 16 ~ 31 : exposure time (E) Bit 0 ~ 15 : exposure time interval (P)	Read/Write
0xF2F10118	**Local ISO_EN control register for one-shot/multi-shot** Bit 31 : iso_enable (1: enable. 0: disable)	
0xF2F1011C	**Power on default memory channel** Bit 0 ~ Bit 3 : power on initial memory channel	Read/Write
0xF2F10200	**Camera version register** Bit 16~Bit 31 : camera version (ex: If reading value: 0x00003000, camera version is 3.000)	Read only
0xF2F10120	**Bright Level for Iris Control Application** Bit 24 ~ Bit 31 : Bright Level for Image Capture	Read only
0xF2F10124	**Test Pattern** Bit 0 : Vertical Grey Bar Bit 1: Bias Grey Bar	Read/Write

Bit layout for 0xF2F1001C:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
SECONDS COUNT							CYCLE COUNT													CYCLE OFFSET											

Bit Number	Bit Name	Function	DIR	Description
0 - 6	SECONDS COUNT	Seconds Count	R/W	1 Hz cycle timer counter
7 - 19	CYCLE COUNT	Cycle Count	R/W	8,000 Hz cycle timer counter
20 - 31	CYCLE OFFSET	Cycle Offset	R/W	24.576 MHz cycle timer counter

*msb: most significant bit

6.2.   **Frame Save Function** (MICOM 3.10 or higher)

Users can get the images as many as they want at the time they want and while the cameras save them. With this function, users can overcome the limitation of bandwidth and decrease CPU overload. Frame is saved where we called it user's defined mode as below.

Address	Description (bit 0 : MSB)	Read/Write

0xF2F10128	Defer Image control
	
	Bit 0 : presence inquiry (read only
	
	Bit 6 : defer image On/Off control
	
	     (1: image hold mode, 0 : normal real time mode)
	
	Bit 7 : send image command ;
	
	     If bit 6 is on status, this bit is send image command from camera to PC.
	
	Bit 16 ~ Bit 23 : Queue size inquiry :
	
	     Must check whenever format or mode is changed (read only)
	
	Bit 24 ~ Bit 31 :
	
	  At read operation, this value is the number of remained image at queue.
	
	  At write operation, this value is the number of sending images by bit 7
	
	  send image command
		Read/Write

As you can see the address(0xF2F10128) at the table, the frames are saved at that address and read value bit is from bit 16 to bit 23. All models except FO442SB and FO442SC has the max frames as below

	Mode 800	**Mode 1600/Y422**
320 x 240	31 frames	31 frames
640 x 480	15 frames	7 frames
800 x 600	15 frames	7 frames
1024 x 768	7 frames	3 frames
1280 x 960	3 frames	1 frames
1600 x 1200	3 frames	1frames

FO442SB and FO442SC has the max frames as below

	Mode 800	**Mode 1600/Y422**
320 x 240	127 frames	127 frames
640 x 480	63 frames	31 frames
800 x 600	63 frames	31 frames
1024 x 768	31 frames	15 frames
1280 x 960	15 frames	7 frames

6.3.   Lookup Table (LUT)   (MICOM 3.10 or higher)

FOculus cameras support the function of LUT called Lookup table, which is providing users with Output image to AD (12bit) output. FOculus cameras have two types of 4 step knee lookup table and 16 user defined lookup table, both of which have the functions of the loading and the saving. The images which have the pixels with the values of output at real time also can be applied with the function of pass through having affect on the images with the values of brightness and sharpness and gamma.

6.3.1.   4 Step Knee Lookup Table

Users can set the values of 4x and 4y as below

* Control Registers

Address	Description(bit 0: msb*)	Read/Write
0xF2F1012C	LUT knee 1st point register Bit 0 : presence inquiry (read only) Bit 1 : LUT regeneration command (self cleared) Bit 2~Bit4 : reserved Bit 5 : enable brightness, sharpness, gamma feature with knee function Bit 6 : On/Off Bit 7 : reserved Bit 8~Bit 19 : X coordination of 1st knee point Bit 20~Bit31 : Y coordination of 1st knee point	Read only
0xF2F10130	LUT knee 2nd point register Bit 0 : presence inquiry (read only) Bit 1 : LUT regeneration command (self cleared) Bit 2~Bit5 : reserved Bit 6 : reserved Bit 7 : reserved Bit 8~Bit 19 : X coordination of 2nd knee point Bit 20~Bit31 : Y coordination of 2nd knee point	Read/Write
0xF2F10134	LUT knee 3rd point register Bit 0 : presence inquiry (read only) Bit 1 : LUT regeneration command (self cleared) Bit 2~Bit5 : reserved Bit 6 : reserved Bit 7 : reserved Bit 8~Bit 19 : X coordination of 3rd knee point Bit 20~Bit31 : Y coordination of 3rd knee point	Read/Write
0xF2F10138	LUT knee 4th point register Bit 0 : presence inquiry (read only) Bit 1 : LUT regeneration command (self cleared) Bit 2~Bit5 : reserved Bit 6 : reserved Bit 7 : reserved Bit 8~Bit 19 : X coordination of 4th knee point Bit 20~Bit31 : Y coordination of 4th knee point	Read/Write

6.3.2.   User Defined Lookup Table

Users can save and load up to 16 modes as they want. Users make up the spreadsheet for data (data resolution ; 12 bit) they want and apply it to the cameras with FOculus API through block-read, which it is needed just first one time. And then, the applied image is displayed with the data whenever users load it. The number of user defined LUT is 16 but only the one user defined LUT is applied at run time.

Caution:
If both knee LUT and user defined LUT are enable, only user defined LUT is operated.

Control Registers

Address	Description (bit 0: msb*)	Read/Write
0xF2F1013C	User defined LUT run control register Bit 0 : presence inquiry (read only) Bit 1 ~ Bit 4 : reserved Bit 5 : enable brightness, sharpness, gamma feature with user defined LUT function Bit 6 : On/Off Bit 7 ~ Bit 11 : reserved Bit 12 ~ Bit 15 : run LUT index Bit 16 ~ Bit 31 : reserved	Read/Write
0xF2F10140	LUT save control register Bit 0 : save command Bit 1 : save ready status(read only) Bit 2 ~ Bit 6 : reserved Bit 7 : set LUT write buffer address to 0 Bit 8 ~ Bit 11 : save LUT index Bit 12 ~ Bit 31 : reserved	Read/Write
0xF2F10144	LUT data register (block write command) Save the first data at low word, then second data at high word Bit 0 ~ Bit 3 : reserved Bit 4 ~ Bit 15 : the second data Bit 16 ~ Bit 19 : reserved Bit 20 ~ Bit 31 : the first data	Write Only

- User defined LUT save procedure

    1. Check save ready bit (bit1) status of LUT save control register (0xF2F10140). If bit 1 is 0, wait.

    2. Write 1 at LUT buffer address init bit (bit7) of LUT save control register (0xF2F10140)

        : 0xF2F10140 <= 0x01000000

    3. Write 4096 LUT data at LUT data register (0xF2F10144)

    4. Write save command (bit0), LUT index (N: bit8-bit11) at LUT save control register (0xF2F10140)

        :0xF2F10140 <= 0x80N00000

- User defined LUT run procedure

    LUT index: N

            0xF2F1013C <= 0x820N0000 : brightness, sharpness, gamma disable mode

            0xF2F1013C <= 0x860N0000 : brightness, sharpness, gamma enable mode

- The number of user defined LUT is 16, but only one user defined LUT is used.

6.4.　One Pixel Snow Noise Remove (MICOM 3.10 or higher)

This is to average the value of snow noise pixel by using the neighboring pixels values and Operation scheme is as follows.　If ((Pi-Pi-1) > Threshold*16) and ((Pi-Pi+1) > (Threshold*16)), Pi is bad pixel. This function is to increase the average pixels values for the whole image and be automatically be displayed and the images can be compensated by over up to 50%. The address for this function is as below.

Address	Description (bit 0: msb*)	Read/Write
0xF2F10150	Bad pixel remove threshold register Bit 0 : presence inquiry (read only) Bit 1 ~ Bit 5 : reserved Bit 6 : on/off Bit 7~Bit23 : reserved Bit 24~Bit31 : Threshold Value (T) : If　Pixel difference value > Threshold Value, then replace near pixel average Value **0**　　　　　　　　　　　**7　8**　　　**11** **(MSB)**　　　　　　　　　　　　　　**(LSB)** | **Threshold Value (T)** | **0** | **Pixel compared threshold value bit map**	Read/Write

6.5.　PIO Control Register (GPIO) (MICOM 3.10 or higher)

FOculus cameras support the PIO control register by 1394 address for strobe and trigger signal.

Address	Description (bit 0: msb)	Read/Write
0xF2F21000	PIO output register Bit 30 :　Strobe GPIO output	Write only
0xF2F21004	PIO input register Bit 31 : trigger GPIO input	Read only
0xF2F21008	PIO GPIO enable register. Bit 30 : Strobe pin GPIO selector (1: GPIO, 0: strobe)	Read/Write

7.   Video Formats and Modes

IIDC 1.31 defines several video format which determines the video data output from the camera. Overview of these formats is as follows.

- Format 0 : Video formats up to VGA(640 x 480) resolution.

- Format 1 : Video formats for SVGA(800 x 600) and XGA(1024x768) resolution.

- Format 2 : Video Formats for SXGA or higher resolutions (1280 x 960 and 1600 x 1200)

- Format 6 : Still Images

- Format 7 : Scalable images sized (User defined size and position)

Format 0 / Format 1 / Format 2

In these formats frame rates are also pre-defined for each video mode as per the IIDC specification.

There are several defined modes for each format where a mode specifies the size and color information of the pixels. By reading the inquiry register of the camera user may determine which frame rates are supported by the camera. Please refer to the IIDC specification for the details.

Format 7

Format 0, 1, & 2 were defined at the early stage of the digital industrial camera where cameras supported these common VESA compliant resolutions. While user required a flexible and definable format camera manufacturers utilized the user definable Format 7 to meet this demand.

Format 7 is extremely flexible which allows user to define the width, height, position and pixel format of the video data where separate sets of control register exists for each Format 7 mode.

FOCULUS S Series supports Format 7 Mode 0, 1, 2 with the following base address.

Format 7 Mode 0 : F1F00000h   Format 7 Mode 1 : F1F00100h   Format 7 Mode 2 : F1F00200h

Offset	Name	Description
000h	MAX_IMAGE_SIZE_INQ	Maximum Horizontal / Vertical pixel number
004h	UNIT_SIZE_INQ	Horizontal and Vertical unit pixel number
008h	IMAGE_POSITION	Left / Top position of requested image region (pixel)
00Ch	IMAGE_SIZE	Width / Height of the requested image region (pixel)
010h	COLOR_CODING_ID	Color coding ID from COLOR_CODING_INQ register
014h	COLOR_CODEING_INQ	Inquiry register for color information setting
034h	PIXEL_NUMBER_INQ	Pixel number per frame
038h	TOTAL_BYTE_HI_INQ	Higher quadlet of total bytes of image data per frame
03Ch	TOTAL_BYTE_LO_INQ	Lower quadlet of total bytes of image data per frame
040h	PACKET_PARA_INQ	Unit (Minimum) bytes per packet Multiple by 4 Maximum bytes per packet Multiple by UnitBytePerPacket
044h	BYTE_PER_PACKET	Packet size, Recommended bytes per packet. If this value is zero, shall ignore this field.

Please refer to the IIDC specification for the details.

NOTE : In Format 7 Mode, frames rates may vary which may depend on Size, Color, Maximum byte per packet, shutter and system performances.

7.1.   FO531SB / FO531SC

Format	Mode	Resolution		60fps	30fps	15fps	7.5fps	3.75fps	1.875fps
0	0	160 x 120	YUV 444						
	1	320 x 240	YUV 422						
	2	640 x 480	YUV 411						
	3	640 x 480	YUV 422			O	O	O	
	4	640 x 480	RGB						
	5	640 x 480	Mono 8			O	O	O	
	6	640 x 480	Mono 16			O	O	O	
1	0	800 x 600	YUV 422			O	O	O	
	1	800 x 600	RGB 8						
	2	800 x 600	Mono 8			O	O		
	3	1024 x 768	YUV 422			O	O	O	O
	4	1024 x 768	RGB 8						
	5	1024 x 768	Mono 8			O	O	O	O
	6	800 x 600	Mono 16			O	O	O	
	7	1024 x 768	Mono 16			O	O	O	O
2	0	1280 x 960	YUV 422				O	O	O
	1	1280 x 960	RGB 8						
	2	1280 x 960	Mono 8			O	O	O	O
	3	1600 x 1200	YUV 422				O	O	O
	4	1600 x 1200	RGB 8						
	5	1600 x 1200	Mono 8			O	O	O	O
	6	1280 x 960	Mono 16				O	O	O
	7	1600 x 1200	Mono 16				O	O	O
7	0	1600 x 1200	16 fps at Mono8 (Frame rate may differ in YUV and Mono 16)						
	1	800 x 600	29 fps at Mono8 (2x2 Binning)						
	2	1600 x 600	29 fps at Mono8 (1x2 Binning)						

Remark : Color Models supports YUV converted by hardware and Raw Bayer Pattern converted by software .

▮▮▮▮   : Unsupported Mode as per IIDC 1.31 Specification

7.2.   FO442SB / FO442SC

Format	Mode	Resolution		60fps	30fps	15fps	7.5fps	3.75fps	1.875fps
0	0	160 x 120	YUV 444						
	1	320 x 240	YUV 422						
	2	640 x 480	YUV 411						
	3	640 x 480	YUV 422			O	O	O	
	4	640 x 480	RGB						
	5	640 x 480	Mono 8			O	O	O	
	6	640 x 480	Mono 16			O	O	O	
1	0	800 x 600	YUV 422			O	O	O	
	1	800 x 600	RGB 8						-
	2	800 x 600	Mono 8			O	O		
	3	1024 x 768	YUV 422			O	O	O	O
	4	1024 x 768	RGB 8						
	5	1024 x 768	Mono 8			O	O	O	O
	6	800 x 600	Mono 16			O	O	O	
	7	1024 x 768	Mono 16			O	O	O	O
2	0	1280 x 960	YUV 422				O	O	O
	1	1280 x 960	RGB 8						
	2	1280 x 960	Mono 8			O	O	O	O
	3	1600 x 1200	YUV 422						
	4	1600 x 1200	RGB 8						
	5	1600 x 1200	Mono 8						
	6	1280 x 960	Mono 16				O	O	O
	7	1600 x 1200	Mono 16						
7	0	1392 x 1040	20 fps at Mono 8 (Color model) (Frame rate may differ in YUV and Mono16)						
		1388 x 1040	20 fps at Mono 8 (B/W model) (Frame rate may differ in Mono16)						
	1	688 x 516	37 fps at Mono8 (2x2 Binning, B/W model)						
	2	1384 x 516	37 fps at Mono8 (1x2 Binning, B/W model)						

Remark : Color Models outputs Raw Bayer Pattern which is converted by software.

	: Unsupported Mode as per IIDC 1.31 Specification

7.3.   FO432SB / FO432SC

Format	Mode	Resolution		60fps	30fps	15fps	7.5fps	3.75fps	1.875fps
0	0	160 x 120	YUV 444						
	1	320 x 240	YUV 422						
	2	640 x 480	YUV 411						
	3	640 x 480	YUV 422			O	O	O	
	4	640 x 480	RGB						
	5	640 x 480	Mono 8			O	O	O	
	6	640 x 480	Mono 16			O	O	O	
1	0	800 x 600	YUV 422			O	O	O	
	1	800 x 600	RGB 8						-
	2	800 x 600	Mono 8			O	O		
	3	1024 x 768	YUV 422			O	O	O	O
	4	1024 x 768	RGB 8						
	5	1024 x 768	Mono 8			O	O	O	O
	6	800 x 600	Mono 16			O	O	O	
	7	1024 x 768	Mono 16			O	O	O	O
2	0	1280 x 960	YUV 422				O	O	O
	1	1280 x 960	RGB 8						
	2	1280 x 960	Mono 8			O	O	O	O
	3	1600 x 1200	YUV 422						
	4	1600 x 1200	RGB 8						
	5	1600 x 1200	Mono 8						
	6	1280 x 960	Mono 16				O	O	O
	7	1600 x 1200	Mono 16						
7	0	1392 x 1040	20 fps at Mono8 (Color model) (Frame rate may differ in YUV and Mono16)						
		1388 x 1040	20 fps at Mono8 (B/W model) (Frame rate may differ in Mono16)						
	1	688 x 516	37 fps at Mono8 (2x2 binning, B/W Model)						
	2	1384 x 516	37 fps at Mono8 (1x2 binning, (B/W Model)						

Remark : Color Models outputs Raw Bayer Pattern which is converted by software.

: Unsupported Mode as per IIDC 1.31 Specification

7.4.   FO323SB / FO323SC

Format	Mode	Resolution		60fps	30fps	15fps	7.5fps	3.75fps	1.875fps
0	0	160 x 120	YUV 444						
	1	320 x 240	YUV 422						
	2	640 x 480	YUV 411						
	3	640 x 480	YUV 422		O	O	O	O	
	4	640 x 480	RGB						
	5	640 x 480	Mono 8		O	O	O	O	
	6	640 x 480	Mono 16	O	O	O	O		
1	0	800 x 600	YUV 422		O	O	O		
	1	800 x 600	RGB 8						-
	2	800 x 600	Mono 8		O	O	O		
	3	1024 x 768	YUV 422			O	O	O	O
	4	1024 x 768	RGB 8						
	5	1024 x 768	Mono 8		O	O	O	O	O
	6	800 x 600	Mono 16		O	O	O	O	
	7	1024 x 768	Mono 16			O	O	O	O
7	0	1024 x 768	36 fps at Mono 8 (Frame rate may differ in YUV and Mono16)						
	1	512 x 384	70 fps at Mono8 (2x2 binning) for B&W Models Only						
	2	1024 x 384	70 fps at Mono8 (1x2 binning) for B&W Models Only						

Remark : Color Models outputs Raw Bayer Pattern which is converted by software.

          : Unsupported Mode as per IIDC 1.31 Specification

7.5.   FO234SB / FO234SC

Format	Mode	Resolution		60fps	30fps	15fps	7.5fps	3.75fps	1.875fps
0	0	160 x 120	YUV 444						
	1	320 x 240	YUV 422						
	2	640 x 480	YUV 411						
	3	640 x 480	YUV 422		O	O	O	O	
	4	640 x 480	RGB						
	5	640 x 480	Mono 8	O	O	O	O	O	
	6	640 x 480	Mono 16		O	O	O	O	
7	0	780 x 580	61 fps at Mono8 (Frame rate may differ in YUV and Mono16)						
	1	388 x 288	116 fps at Mono8 (2x2 binning) for B&W Models Only						
	2	780 x 288	116 fps at Mono8 (1x2 binning) for B&W Models Only						

Remark : Color Models outputs Raw Bayer Pattern which is converted by software.

          : Unsupported Mode as per IIDC 1.31 Specification

7.6.   FO134SB / FO134SC

Format	Mode	Resolution		60fps	30fps	15fps	7.5fps	3.75fps	1.875fps
0	0	160 x 120	YUV 444						
	1	320 x 240	YUV 422						
	2	640 x 480	YUV 411						
	3	640 x 480	YUV 422		O	O	O	O	
	4	640 x 480	RGB						
	5	640 x 480	Mono 8	O	O	O	O	O	
	6	640 x 480	Mono 16		O	O	O	O	
7	0	640 x 480	88 fps at Mono8 (Frame rate may differ in YUV and Mono16)						
	1	320 x 240	157 fps at Mono8 (2x2 binning) for B&W Models Only						
	2	640 x 240	157 fps at Mono8 (1x2 binning) for B&W Models Only						

Remark : Color Models outputs Raw Bayer Pattern which is converted by software.

[grey box]   : Unsupported Mode as per IIDC 1.31 Specification

7.7.   FO124SB / FO124SC

Format	Mode	Resolution		60fps	30fps	15fps	7.5fps	3.75fps	1.875fps
0	0	160 x 120	YUV 444						
	1	320 x 240	YUV 422						
	2	640 x 480	YUV 411						
	3	640 x 480	YUV 422		O	O	O	O	
	4	640 x 480	RGB						
	5	640 x 480	Mono 8	O	O	O	O	O	
	6	640 x 480	Mono 16		O	O	O	O	
7	0	640 x 480	86 fps at Mono8 (Frame rate may differ in YUV and Mono16)						
	1	320 x 240	157 fps at Mono8 (2x2 binning) for B&W Models Only						
	2	640 x 240	157 fps at Mono8 (1x2 binning) for B&W Models Only						

Remark : Color Models outputs Raw Bayer Pattern which is converted by software.

[grey box]   : Unsupported Mode as per IIDC 1.31 Specification

8.   Trouble Shooting

FireWire based camera are operated in connection with system where user may encounter problems as they operate. These problems may orient either from the camera side or the system side that the camera is being used. We recommend reading the manual carefully beginning from the installation to features in concern. Also some system may not have enough power to operate these cameras especially for high resolution and frame rate we recommend the system should be Pentium 4 or higher with 256MB of System memory and Graphic Accelerator with 32MB or more of video memory. When using Windows, due to high graphic requirement and DirectX support we recommend using at least MX400(Nvidia) or Radeon(ATI) or higher.

Frequently asked question in installation is described as follows. (Please carefully check each case.)

8.1.   Hardware Related Issues

8.1.1. Camera is not recognized in the device manager

- Please check whether the LED in the back of the camera is ON. If LED is tuned OFF, please check camera connection. Please check the cable connection on both the camera and the PC.
- If you haven't installed the camera driver yet, please refer to the software installation and install the drivers and software provided.
- Please reconnect the camera by plugging out the FireWire cable and plugging in the cable connected on the camera.

8.1.2. LED is OFF while power is provided either by FireWire or external power.

- Please check the supplied voltage and ensure the supplied power is compliant to the operation manual.

8.1.3. Camera Power

As described in this manual the power of the camera is provided either by the FireWire cable or the external power through 12 Pin Trigger Port.

Please be careful when using external power input through the trigger port and refrain from using power over +30V DC. In normal condition we recommend using +12V DC. Also please check the operation manual for the power connection pin assign for external power input to avoid damaging the camera.

8.1.4. No Image or Black Image Displayed

Check the "Status LED" if it appears Green. If Not, camera is not Isochronous enabled which means not transmitting any image and is in a idle stage.

Check whether the lens is properly mounted and open the iris it to the maximum level.

Check feature values such as shutter speed, gain and exposure. Also check whether the camera is in trigger mode.

8.2. Software Related Issues

8.2.1. System Environment

NET Cameras are IIDC compliant camera which may be used in various application such as amcap, DirectX SDK, Windows XP capture utility,, Application supporting Twain interface or WDM. It may also be used with image processing library such as IMAQ(labview) or MIL 8.0(Matrox). Please check each application before using the camera and refer to the relative software function for proper operation.

8.2.2. Appears in Device Manager as unknown device

- Please check the camera driver and update to the latest driver.

8.2.3. Multiple Camera Connection

NET cameras are compliant with the multi-camera support in the IIDC 1.31 specification. For two or more camera connection, please carefully consider that the FireWire's bandwidth is limited to 400Mbps in a single FireWire bus. This means that if you are planning to run multiple cameras at the same time on higher resolution, you may be required to install more than 1 FireWire adapter to expand the band with by providing more bus. Note that 1 FireWire card is equivalent to 1 FireWire bus as long as they are not interconnected.

The bandwidth of a camera can be calculated as simply applying the following formula.

Data Bit of the Format * Resolution * Desired Frame Rate = Bandwidth(bit/sec)

Ex) Running a 16 bit Image at 800 x 600   would be 16 bit x 800 x 600 x 15fps = 115Mbps

8.2.4. NET's Driver Support

NET's driver and applications are solely designed to work with NET's camera. We cannot guarantee or support other vender's camera to work with the driver and software we provide.

8.2.5. Camera Supported Frame Rate cannot be achieved

Check the shutter speed. If the shutter speed is too slow, you may not reach your desired level of frame rate.

Check the bandwidth and ensure you are not exceeding the bandwidth limit.

Check CPU load and ensure the computer's CPU is not overloaded. Quit other application and try again.

8.2.6. How to read the serial number

1	2	3	4	5	6	7	8	9	10
FF		Model ID			Serial Number				

9.   Revision History

9.1.   Changes Since V 1.0

● Section 5.2.1 Pan / Tilt Range change

● Section 7.1 ~ 7.6   Format, Mode and Frame Rate changed due to newly implemented YUV support

9.2.   Added Since V 1.0

● Section 5.8.1 ~ 5.8.5 added for SIO(RS232) Pass through Control

● Section 7 Video Format and Modes with detailed explanation.

9.3.   Micom Version 3.0 upgrade function

● High Speed up Trigger Frame Rate

● Frame Save Function

● 16 User Defined Lookup Table

● New Trigger Mode 15 (one-trigger multi-frames)

● Pixel Snow Noise Rejection

● GPIO Control Register : GPIO

10.   Firmware Update

FireWire camera's Firmware can be updated via the FireWire cable. You my download the latest firmware from our website as follows.

http://www.net-gmbh.com

http://www.net-usa-inc.com

http://www.net-japan.com

When updating the firmware, please carefully follow the instruction provided on our website for firmware update. Also ensure the FireWire connection and DO NOT disconnect the cable in any case during the update.

11.   Technical Support

We ensure the conformity of our product to be reliable and free from defects during manufacturing by testing all the cameras before release. However unexpected problems and technical issues may come up due to the complexity of the product. In case you require technical support contact the agent near you or you may contact us directly with the following information.

Web Support by Bulletin Board :

Europe	http://www.net-gmbh.com
USA	http://www.net-usa-inc.com
Asia	http://www.net-japan.com

Support Team Email :

Europe	info@net-gmbh.com
USA	info@net-usa-inc.com
Asia	info@net-japan.com

Support Team Phone :

Europe	+49 8806 92 34-0
USA	+1 219 934 9042
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Support Team Fax :

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