

Unibrain Fire-i compact industrial cameras

Models: 520/ 521 / 620 / 720 / 820

User Operation Manual

Version 1.0

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unibrain
The 1394 Innovators

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. 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. Allied customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify allied 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.

Operation in wet area is 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

Unibrain warrants the original components free of defects for one (1) 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 Unibrain. 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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1. Introduction

1.1. Overview

Unibrain's new **Fire-i compact size IIDC 1394a camera 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. All models are lined up by a wide range of resolution equipped with Firewire interface and trigger to suit the need for every application.

The cameras 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 **Fire-i camera series** which consist of various sensor sizes (1/2", 2/3" 1/3", 1/1.8") and resolution (VGA, SVGA, XGA, SXGA, UXGA) both in color and black and white. This new Unibrain camera series consist of the following models.

Compact Series	Model Name	CCD(Progressive)	Resolution	FPS at Max Resolution
Black & White	Fire-i 820b	1/1.8"	1600 x 1200	16
	Fire-i 720b	2/3"	1392 x 1040	20
	Fire-i 620b	1/3"	1024 x 768	36
	Fire-i 521b	1/2"	640 x 480	86
	Fire-i 520b	1/3"	640 x 480	86
Color	Fire-i 820c	1/1.8"	1600 x 1200	16
	Fire-i 720c	2/3"	1388 x 1036	20
	Fire-i 620c	1/3"	1024 x 768	36
	Fire-i 521c	1/2"	640 x 480	86
	Fire-i 520c	1/3"	640 x 480	86

The cameras 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 ~ 65s), RS232C pass through via 1394, Fast format 7 partial scan, horizontal and vertical binning mode(1x2, 2x2 for B&W and Fire-i 820c) which would provide maximum flexibility in applications. The 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.

Downloadable Software

Latest Update of camera control drivers & software are available on our website. (Fire-i application):

<http://www.unibrain.com/downloads/>

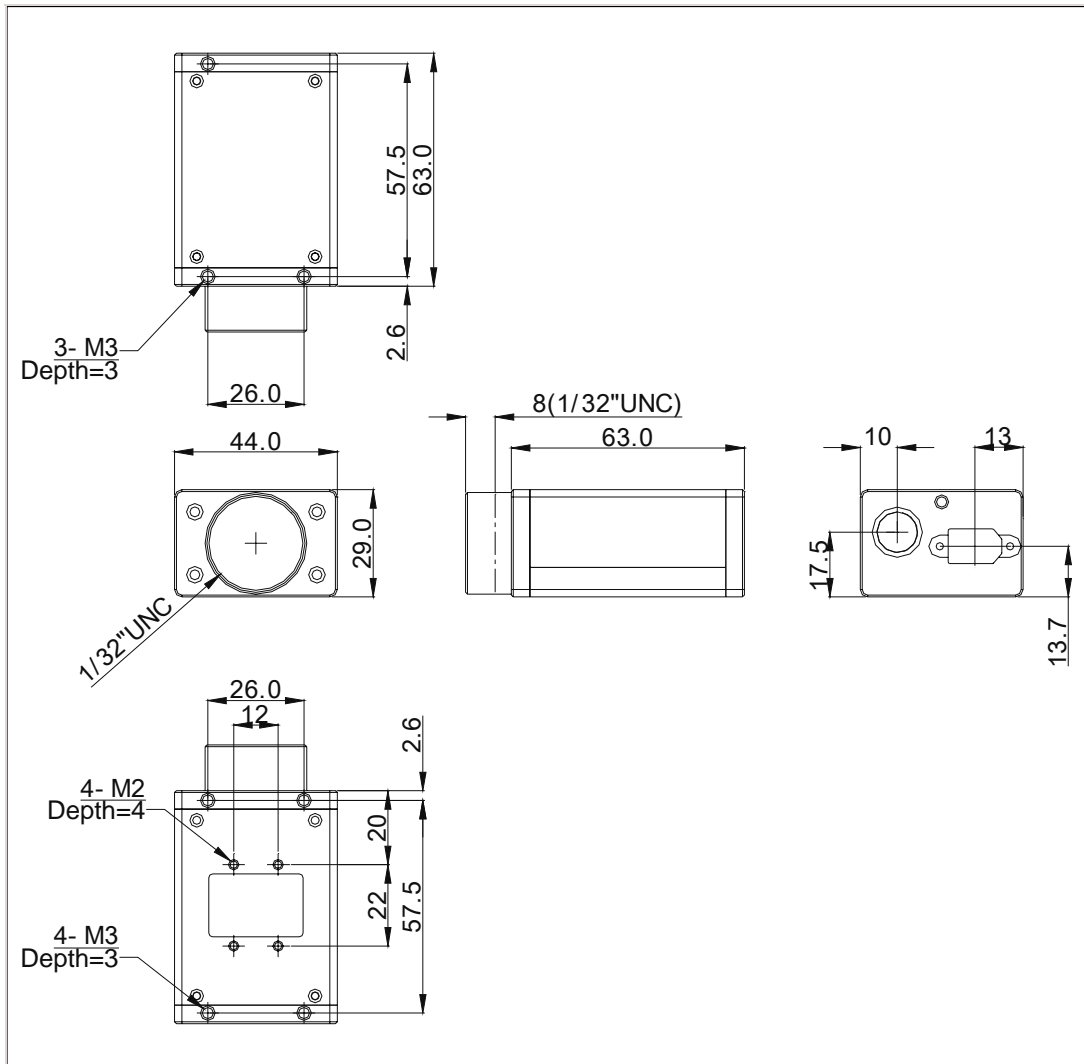
1.2. Dimensions and Description

Camera Body Size : 44 (w) x 29 (H) x 63(D) mm

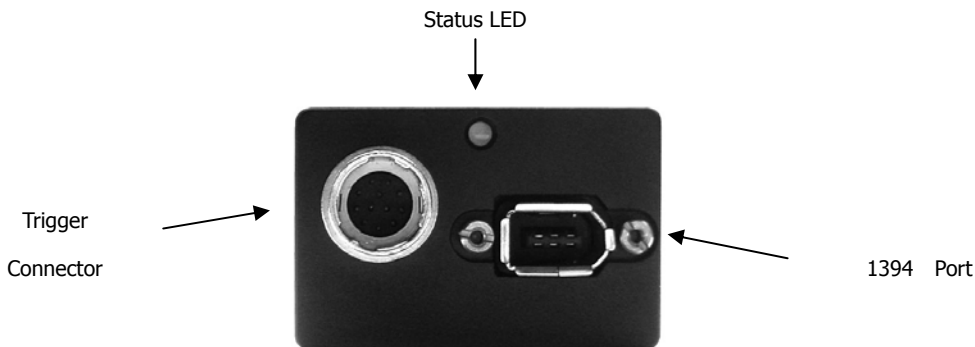
Camera Body Weight: approx. 110 gram

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.

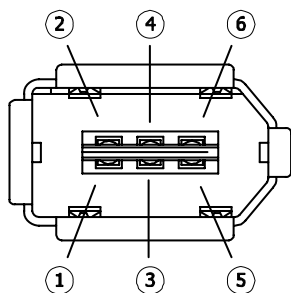


1.3. Camera Interface



1.3.1. Firewire port

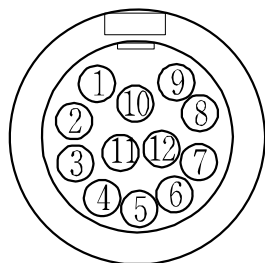
The industry standard firewire (IEEE-1394) port has the following pin assign. Data and control on the camera is operated via 1394 and camera power can also be supplied by 1394



Pin	Signal
1	VP
2	VG(Ground)
3	TPB-
4	TPB+
5	TPA
6	TPA-

1.3.2. 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	POWER GND	7	GND
2	Ext Power(+12V)	8	RX RS232
3	GND	9	TX RS232
4	Ext. Trigger	10	NC
5	Ext. Trigger GND	11	Strobe
6	NC	12	Strobe Power

Remark: NC pins must have no connection

1.3.3. Status LED

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

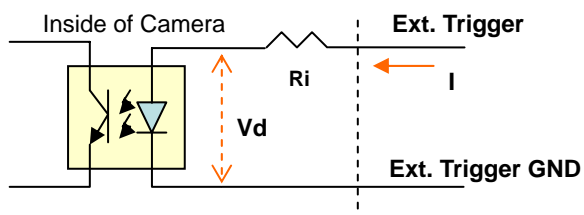
Remark: Also when power off, LED is OFF

1.3.4. Camera Power Requirement

The cameras utilize a selection of power among 1394 and Trigger Connector Port where power source with higher voltage provides the power to the camera. Input voltage range or 8V ~ 30V is accepted.

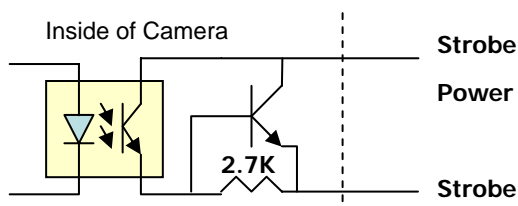
1.4. Electrical Operating Condition

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

1.5. Pixel Data

The cameras comply with the IIDC 1394-Based Digital Camera Specification V1.31 where data packets are transmitted by 1394 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)

<YUV (4: 1: 1) format >

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

U-(K+Pn-8)	Y-(K+Pn-8)	Y-(K+Pn-7)	V-(K+Pn-8)
Y-(K+Pn-6)	Y-(K+Pn-5)	U-(K+Pn-4)	Y-(K+Pn-4)
Y-(K+Pn-3)	V-(K+Pn-4)	Y-(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
	.	.
Lowest	.	.
	1	0x81
	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
	.	.
Lowest	.	.
	1	0x0001
	0	0x0000

2. Unibrain compact series camera specifications

2.1. Black and White Cameras

2.1.1. Fire-i 820b specification

Features		
Image Sensor	1/1.8" Interline CCD (Sony ICX-274AL)	
Effective Pixels	2,010,000 pixels, 1628(H) x 1236(V)	
Picture Size	1600x1200, 1280x960, 1024x768, 800x600, 640x480, 320x240	
Cell Size (um)	4.60 x 4.60	
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 custom 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 ~ 65 sec	
Data Depth	8 bit or 12 bit B/W	
S/N Ratio	56dB or better	
Supply Voltage	8 VDC ~ 30 VDC	
External Dimension / Weight	44(W) x 29(H) x 63(D) mm / Approx 110g	
Operation Temp.	-5°C to 45°C	

2.1.2. Fire-i 720b specification

Features		
Image Sensor Type	2/3 inch Interline CCD (Sony ICX-285AL)	
Effective pixels	1,450,000 pixels 1392(H) x 1040(V)	
Picture Size	1392x1036,1280x960,1024x768, 800x600, 640x480, 320x240	
Cell Size (um)	6.45 x 6.45	
Real Frame Rate	15, 7.5, 3.75, 1.875 20 (1392x1040, Format 7 mode 0) 35 (1392x520, Format 7 mode 0) 37(692x516 Format 7 mode 1 2x2 binning) 37(1388x516 Format 7 mod3 1 1x2 binning)	
Lens Mount	C Mount	
Scanning System	Progressive System	
Binning	N/A	
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 custom 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 ~ 65 sec	
Data Depth	8 bit or 12 bit B/W	
S/N Ratio	56dB or better	
Supply Voltage	8 VDC ~ 30 VDC	
External Dimension / Weight	44(W) x 29(H) x 63(D) mm / Approx 110g	
Operation Temp.	-5°C to 45°C	

2.1.3. Fire-i 620b Specification

Features		
Image Sensor Type	1/3-inch Interline CCD (Sony ICX-204AL)	
Effective pixels	800,000 pixels 1034(H) x 779(V)	
Picture Size	1024x768, 800x600, 640x480, 320x240	
Cell Size(um)	4.65 x 4.65	
Real Frame Rate	30, 15, 7.5, 3.75, 1.875 36 (1024x768, Format 7 mode 0) 63 (1024x384, Format 7 mode 0) 72 (512x384, Format7 mode 1, 2x2 binning) 72 (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 custom 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 ~ 65 sec	
Data Depth	8 bit or 12 bit B/W	
S/N Ratio	56dB or better	
Supply Voltage	8 VDC ~ 30 VDC	
External Dimension / Weight	44(W) x 29(H) x 63(D) mm / Approx 110g	
Operation Temp.	-5°C to 45°C	

2.1.4. Fire-i 521b specification

Features		
Image Sensor Type	1/2-inch Interline CCD (Sony ICX-414AL)	
Effective pixels	330,000 pixels 659(H) x 494(V)	
Picture Size	640 x 480, 320 x 240	
Cell Size(um)	9.9 x 9.9	
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	
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 custom 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 ~ 65 sec	
Data Depth	8 bit or 12 bit B/W	
S/N Ratio	56dB or better	
Supply Voltage	8 VDC ~ 30 VDC	
External Dimension / Weight	44(W) x 29(H) x 63(D) mm / Approx 110g	
Operation Temp.	-5°C to 45°C	

2.1.5. Fire-i 520b specification

Features		
Image Sensor	1/3-inch Interline CCD (Sony ICX-424AL)	
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 custom 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 ~ 65 sec	
Data Depth	8 bit or 12 bit B/W	
S/N Ratio	56dB or better	
Supply Voltage	8 VDC ~ 30 VDC	
External Dimension / Weight	44(W) x 29(H) x 63(D) mm / Approx 110g	
Operation Temp.	-5°C to 45°C	

2.2. Color Cameras

2.2.1. Fire-i 820c specification

Features		
Image Sensor Type	1/1.8-inch Interline CCD (Sony ICX-274AQ)	
Effective pixels	2,010,000 pixels 1628(H) x 1236(V)	
Picture Size	1600x1200, 1280x960, 1024x768, 800x600, 640x480, 320x240	
Cell Size(um)	4.6 x 4.6	
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 custom command	
Frame Delay from Read-out	Min. 106us	
Digital Interface	IEEE 1394 1 port(6pin)	
Transfer Rate	400 Mbps	
Gain	0 ~ 25 dB	
Shutter Speed	1 usec ~ 65 sec	
Data Depth	8 bit or 12 bit Raw RGB	
S/N Ratio	56dB or better	
Supply Voltage	8 VDC ~ 30 VDC	
External Dimension / Weight	44(W) x 29(H) x 63(D) mm / Approx 110g	
Operation Temp.	-5°C to 45°C	

2.2.2. Fire-i 720c specification

Features		
Image Sensor Type	2/3-inch Interline CCD (Sony - ICX285AQ)	
Effective pixels	1,450,000 pixels 1392(H) x 1040(V)	
Picture Size	1388x1036,1280x960,1024x768, 800x600, 640x480, 320x240	
Cell Size(um)	6.45 x 6.45	
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	N/A	
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 custom 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 ~ 65 sec	
Data Depth	8 bit or 12 bit Raw RGB	
S/N Ratio	56dB or better	
Supply Voltage	8 VDC ~ 30 VDC	
External Dimension / Weight	44(W) x 29(H) x 63(D) mm / Approx 110g	
Operation Temp.	-5°C to 45°C	

2.2.3. Fire-i 620c specification

Features		
Image Sensor Type	1/3-inch Interline CCD (Sony ICX-204AK)	
Effective pixels	800,000 pixels 1034(H) x 779(V)	
Picture Size	1024x768, 800x600, 640x480, 320x240	
Cell Size(um)	4.65 x 4.65	
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	N/A	
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 custom 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 ~ 65 sec	
Data Depth	8 bit or 12 bit Raw RGB	
S/N Ratio	56dB or better	
Supply Voltage	8 VDC ~ 30 VDC	
External Dimension / Weight	44(W) x 29(H) x 63(D) mm / Approx 110g	
Operation Temp.	-5°C to 45°C	

2.2.4. Fire-i 521c specification

Features		
Image Sensor Type	1/2-inch Interline CCD (Sony ICX-414AQ)	
Effective pixels	330,000 pixels 659(H) x 494(V)	
Picture Size	640 x 480, 320 x 240	
Cell Size(um)	9.9 x 9.9	
Real Frame Rate	60, 30, 15, 7.5, 3.75, 1.875 86 (640x480, Format 7 mode 0) 147 (640x240, Format 7 mode 0)	
Lens Mount	C Mount	
Scanning System	Progressive System	
Binning	N/A	
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 : Path through or custom 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 ~ 65 sec	
Data Depth	8 bit or 12 bit Raw RGB	
S/N Ratio	56dB or better	
Supply Voltage	8 VDC ~ 30 VDC	
External Dimension / Weight	44(W) x 29(H) x 63(D) mm / Approx 110g	
Operation Temp.	-5°C to 45°C	

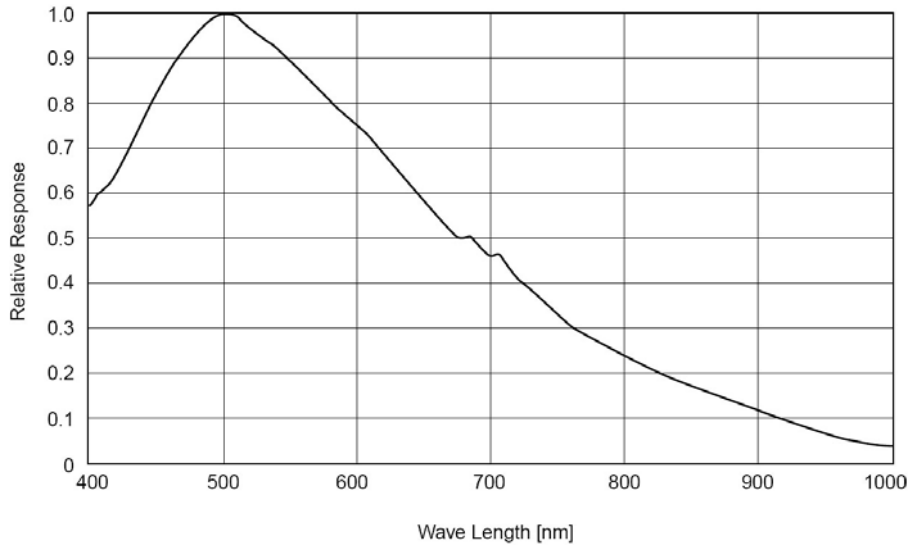
2.2.5. Fire-i 520c specification

Features		
Image Sensor Type	1/3-inch Interline CCD (Sony ICX-424AQ)	
Effective pixels	330,000 pixels 659(H) x 494(V)	
Picture Size	640 x 480, 320 x 240	
Cell Size(um)	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)	
Lens Mount	C Mount	
Scanning System	Progressive System	
Binning	N/A	
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 : Path through or custom 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 ~ 65 sec	
Data Depth	8 bit or 12 bit Raw RGB	
S/N Ratio	56dB or better	
Supply Voltage	8 VDC ~ 30 VDC	
External Dimension / Weight	44(W) x 29(H) x 63(D) mm / Approx 110g	
Operation Temp.	-5°C to 45°C	

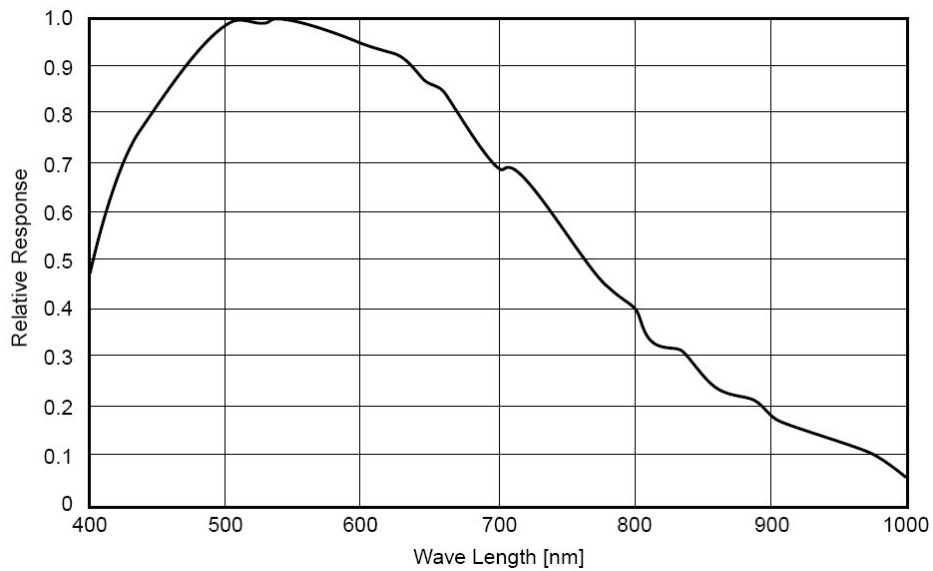
2.3. Spectral Sensitivity

Excludes lens and light source characteristic

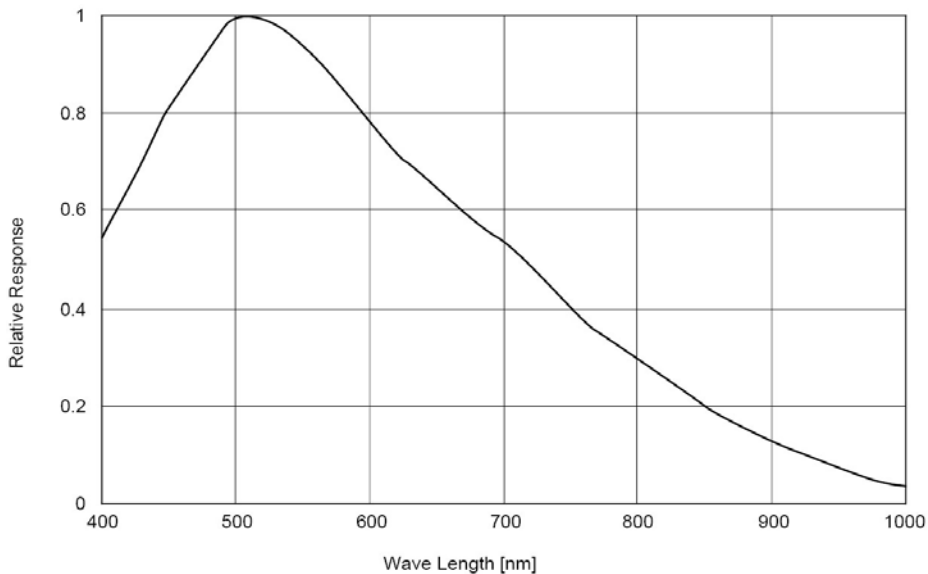
2.3.1. B&W Cameras



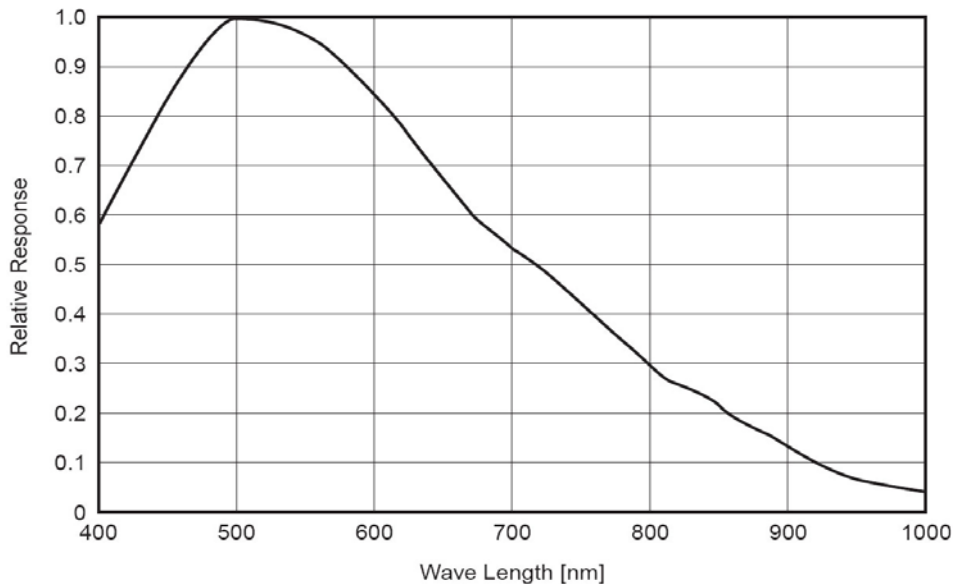
Spectral Sensitivity for Fire-i 820b



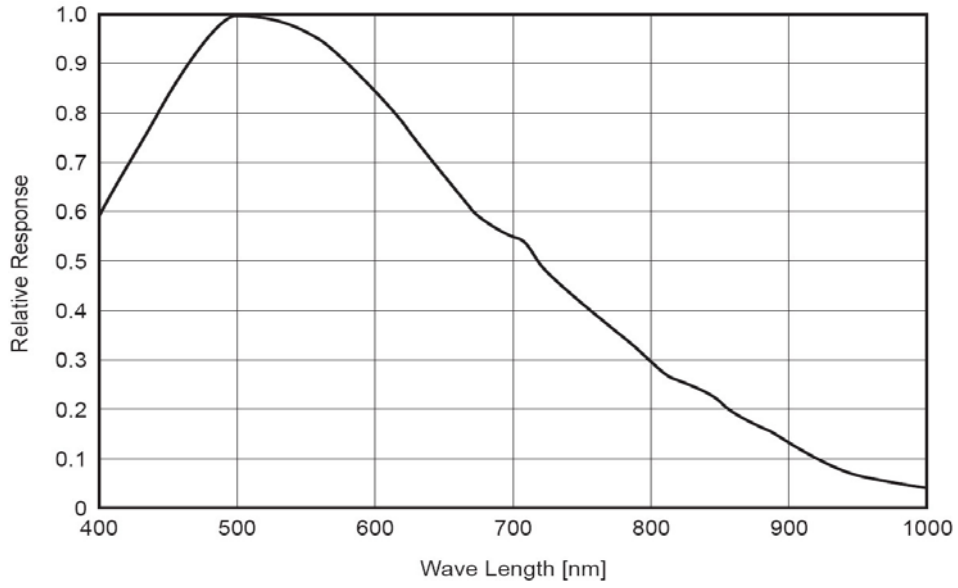
Spectral Sensitivity for Fire-i 720b



Spectral Sensitivity for Fire-i 620b

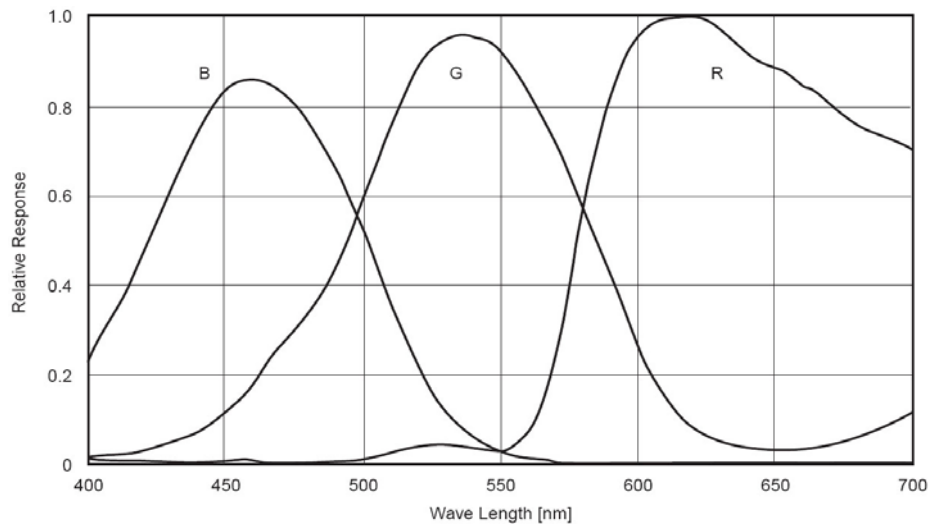


Spectral Sensitivity for Fire-i 521b

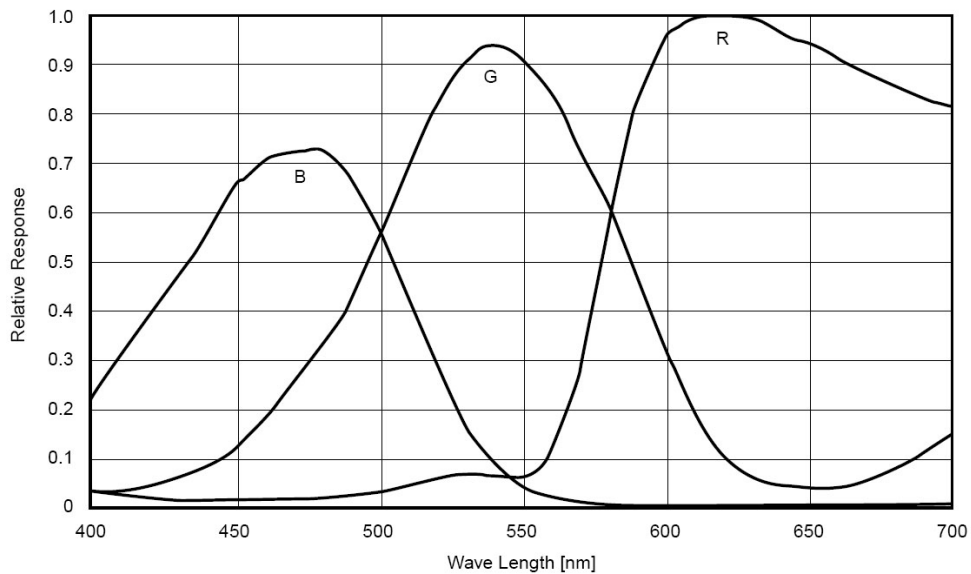


Spectral Sensitivity for Fire-i 520b

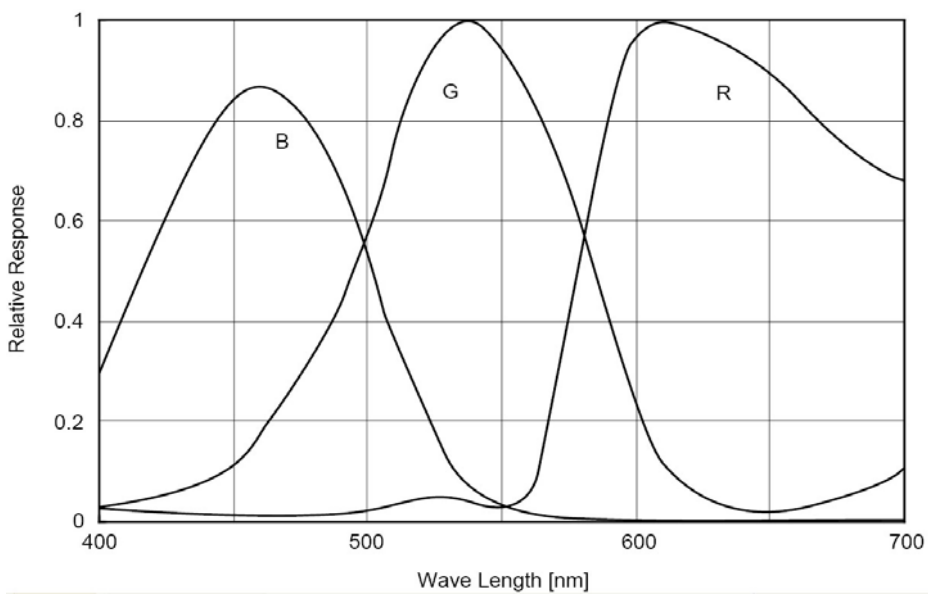
2.3.2. Color Cameras



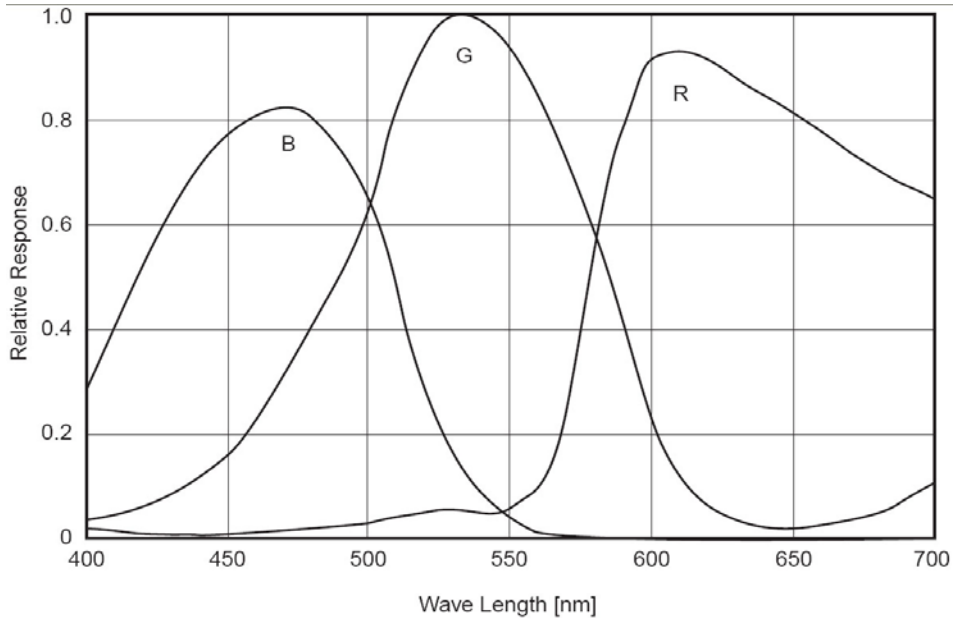
Spectral Sensitivity for Fire-i 820c



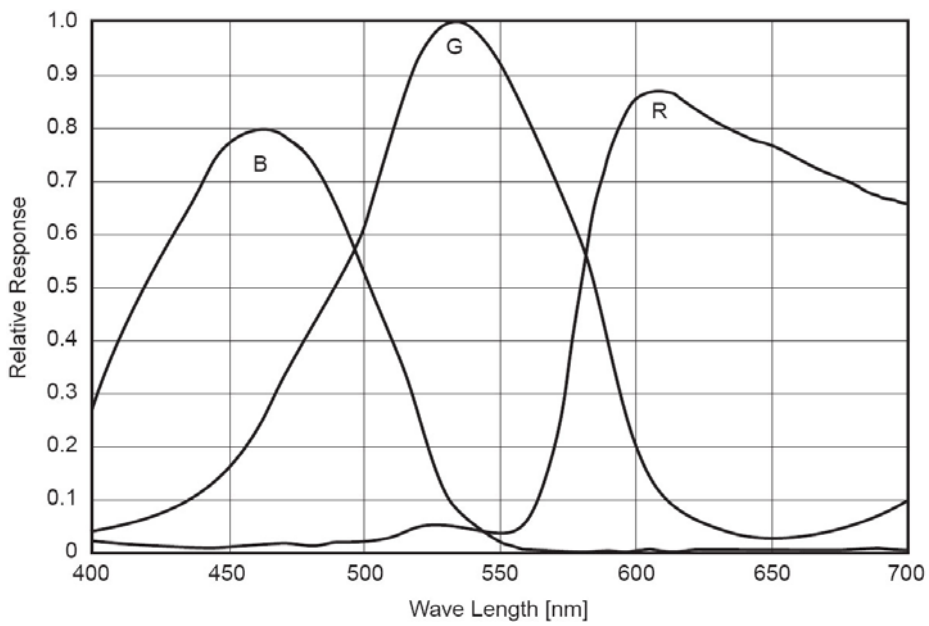
Spectral Sensitivity for Fire-i 720c



Spectral Sensitivity for Fire-i 620c



Spectral Sensitivity for Fire-i 521c



Spectral Sensitivity for Fire-i 520c

3. Basic Operation and Features

Unibrain Firewire cameras employ progressive scan CCD sensor which provides features according to each model. Basic functions and features are similar while each camera of its range would have their specific function support. The cameras fully support the IIDC V1.31 specification such as registers, video format, mode of operation and control.

3.1. 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 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]	Minimum value for this feature control

3.2. 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_EXP OSURE_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_EXP OSURE	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

3.3. 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".

3.4. 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. Currently automatic white balance features are not supported.

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_BAL ANCE	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

3.5. Hue

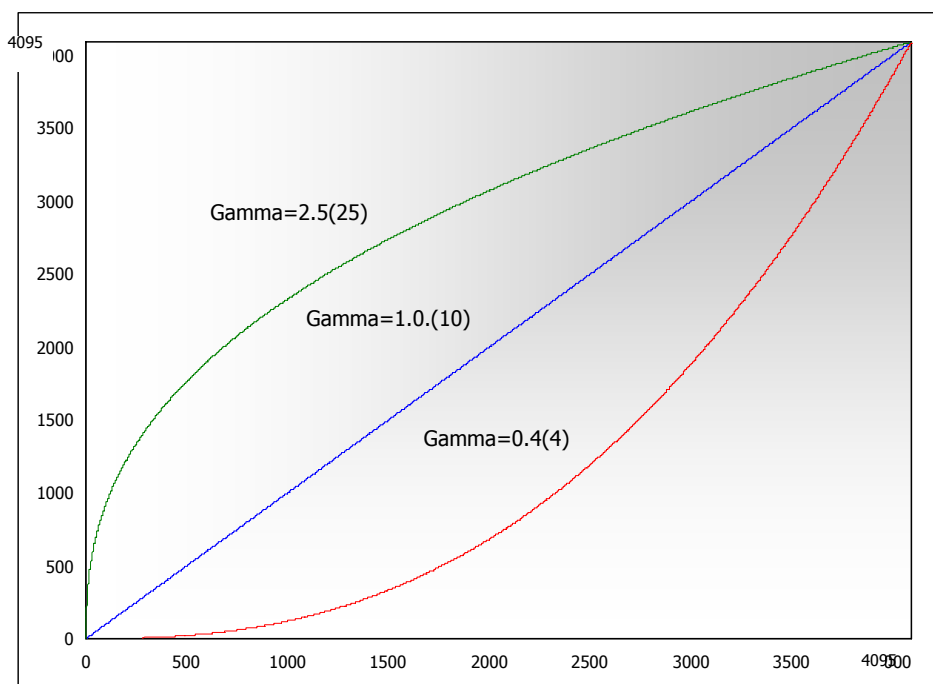
Color models support Hue control which changes the color phase of the picture by adjusting the Green gain. You may use this feature when white balance correction adjusting Red and Blue value does give satisfying result.

3.6. 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".

3.7. 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

3.8. 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 ~ 3223	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

3.9. 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

3.10. Trigger & Strobe

The cameras 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. A software trigger can also be used which issues trigger signal via software command.

3.10.1. Supported Trigger

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

Inquiry Register

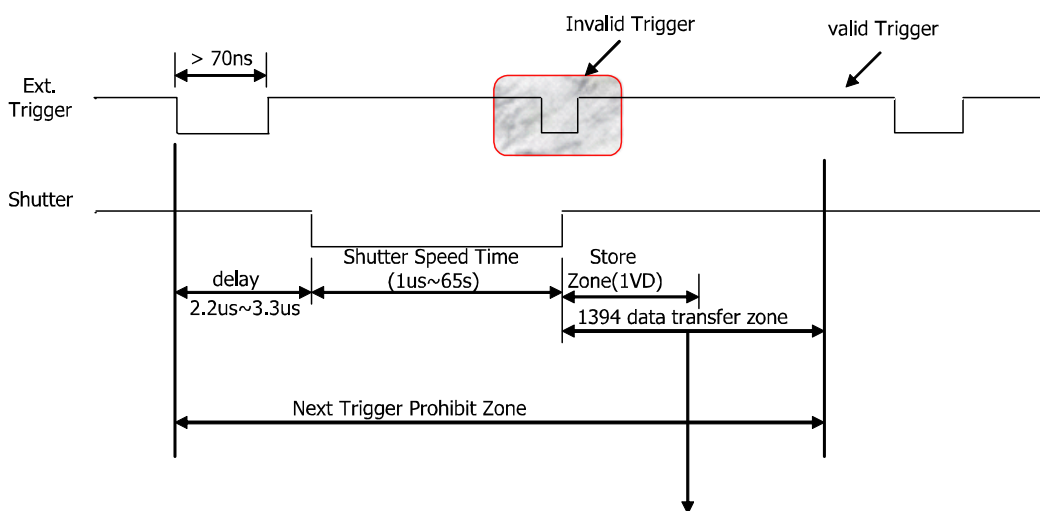
Address	Name	Field	Bit	Description
530h	TRIGGER_I NQ	Presence_Inq	[0]	Presence of this feature
		Abs_Control_Inq	[1]	Capability of control with absolute value
		-	[2..3]	Reserved
		ReadOut_Inq	[4]	Capability of reading the value of this feature
		On/Off_Inq	[5]	Capability of switching this feature On 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)
		[8..11]	Reserved
	Trigger_Mode	[12..15]	Trigger mode.(Trigger_Mode_0-15)
		[16..19]	Reserved
	Parameter	[20..31]	Parameter for trigger function, if required.

3.10.2. Trigger Timing Diagram

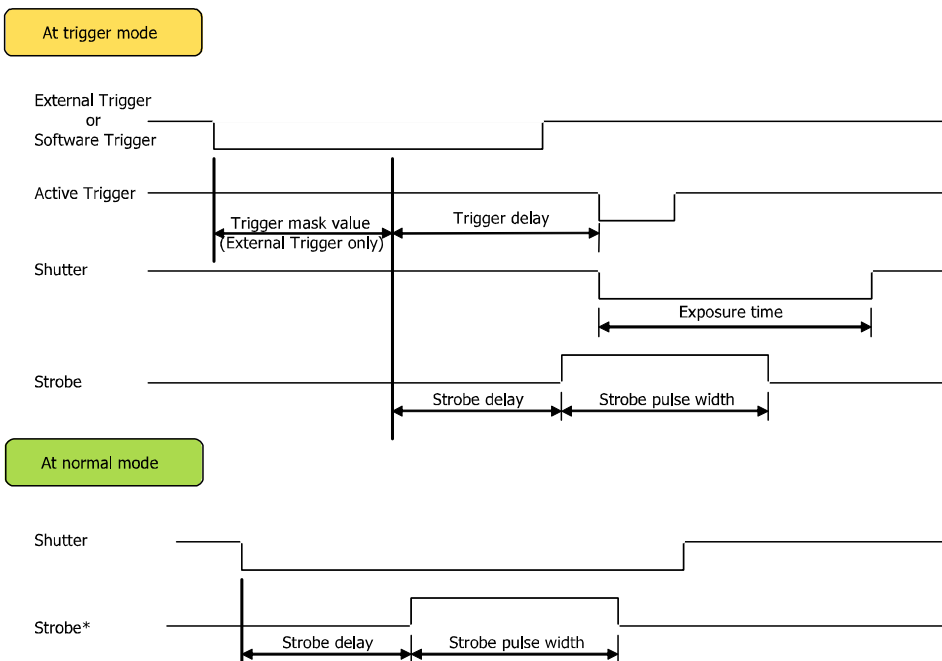


Correlation of VD and fps

Cameras	60 fps	30 fps	15 fps	7.5 fps	3.75 fps	1.875 fps
IMx-1200	-	-	1 VD	2 VD	4 VD	8 VD
IMx-1140	-	-	1 VD	2 VD	4 VD	8 VD
IMx-1080	-	1 VD	2 VD	4 VD	8 VD	16 VD
IMx-1050	1 VD	2 VD	4 VD	8 VD	16 VD	32 VD
IMx-1040	1 VD	2 VD	4 VD	8 VD	16 VD	32 VD

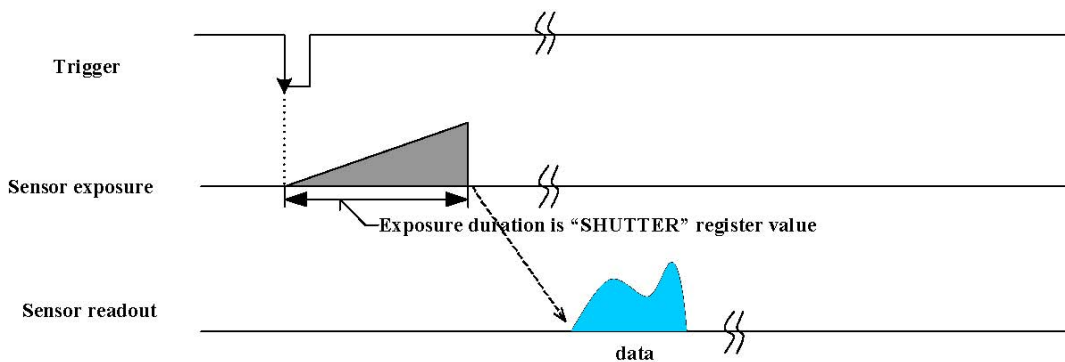
Cameras	50 fps	25 fps	12.5 fps	6.25 fps	3.125 fps	1.5625 fps
IMx-1070	1 VD	2 VD	4 VD	8 VD	16 VD	32 VD

3.10.3. Trigger and Strobe Signal Relation



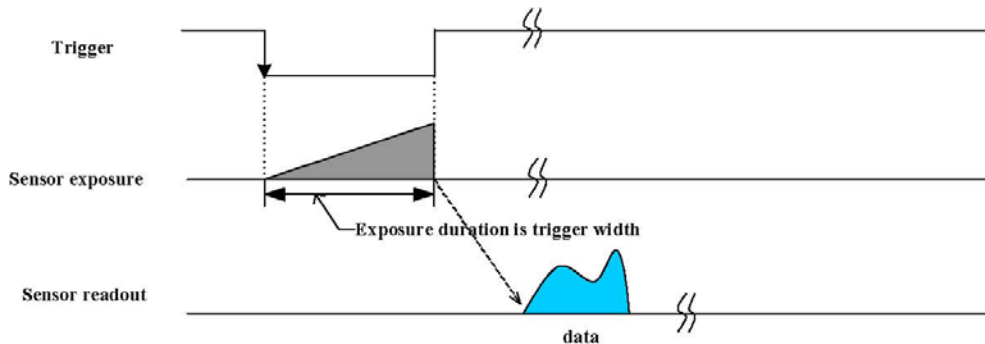
3.10.4. Trigger Mode 0

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



3.10.5. Trigger Mode 1

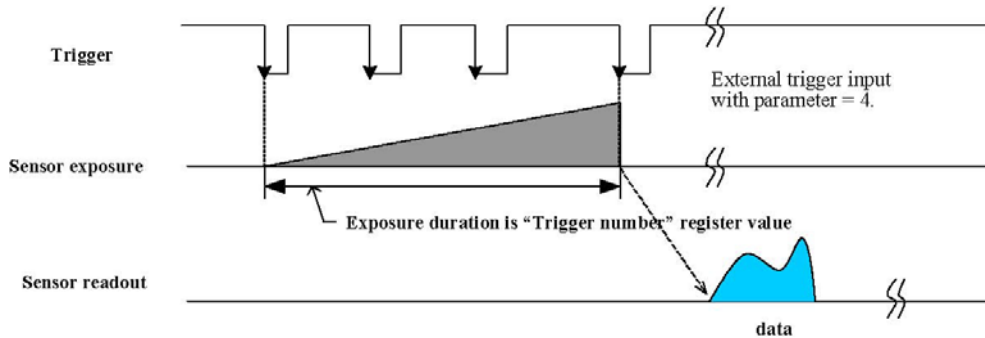
Camera starts integration of the incoming light from external trigger input falling edge. Integration time is equal to low state time of the external trigger input. No parameter is needed.



3.10.6. 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.

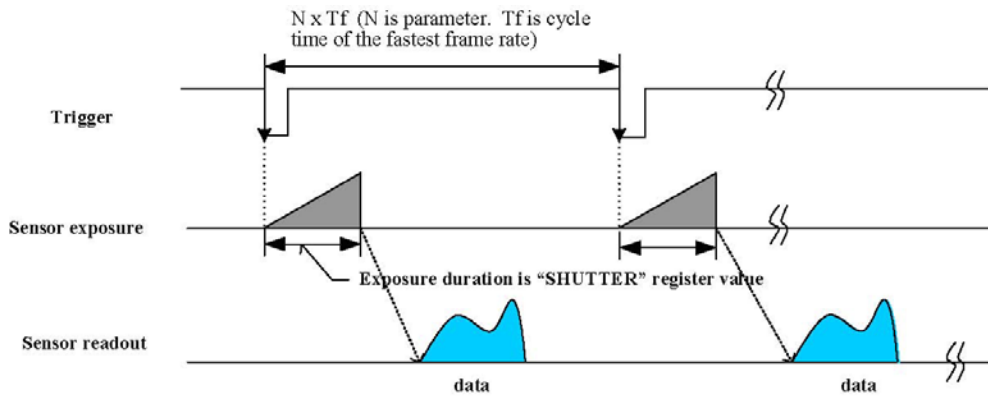
Parameter is required and shall be two or more. ($N \geq 2$)



3.10.7. Trigger Mode 3

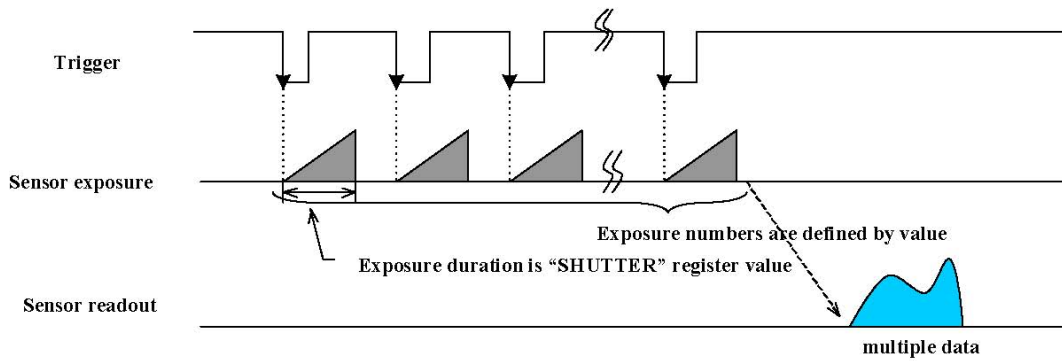
Not supported at Format-7 mode

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 ($N \geq 1$)



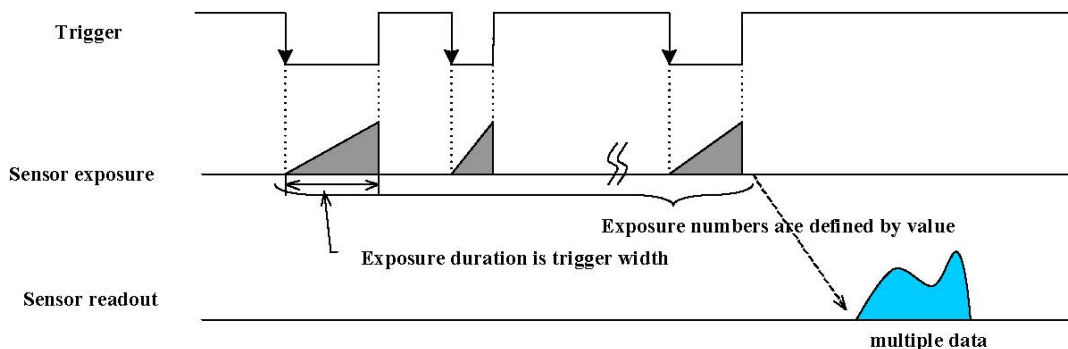
3.10.8. Trigger Mode 4

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. ($N \geq 1$)



3.10.9. Trigger Mode 5

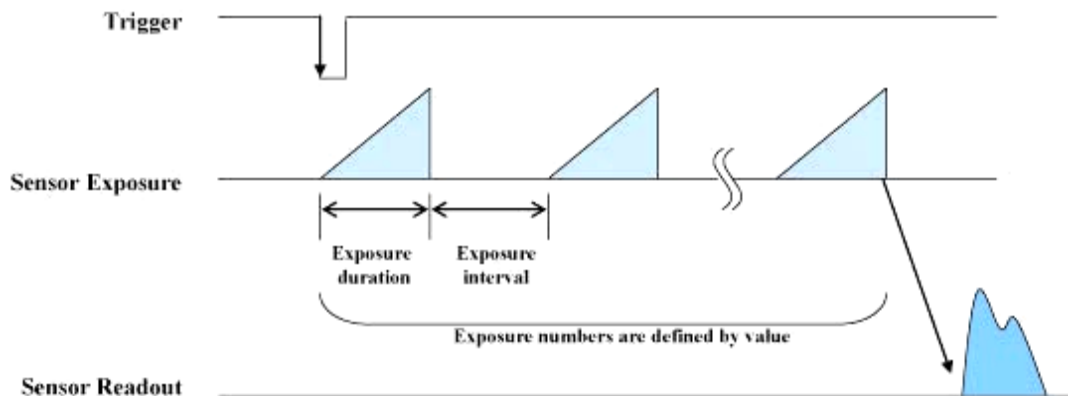
This mode is "multiple shutter pulse width mode". Camera starts integration of incoming light from first external trigger input falling edge and exposes incoming light until trigger is inactive. Repeat this sequence the N-th (parameter) external trigger input falling edge then finish integration. Parameter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



3.10.10. Trigger Mode 14

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).



3.11. 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	

3.12. Trigger Delay Control

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

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

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

3.12.1. Strobe Delay and Duration Table

Strobe Index (Y)	Incremental Step	Trigger Delay Time : T		
		Delay Time	Duration Time	Range
0		0 us	1 us	
1		1 us	1us	
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

Strobe Delay / Duration Index

Index	0	1	10	100	250	253	257	269	289	329	449	489
Delay Time	0us	1us	10us	100us	250us	1ms	2ms	5ms	10ms	20ms	50ms	60ms
Duration Time	2us	1 us	10 us	100 us	250 us	1ms	2ms	5ms	10ms	20ms	50ms	60ms

3.13. 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_I NQ	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

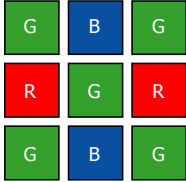
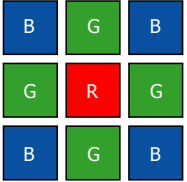
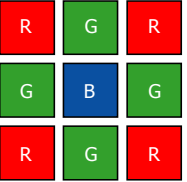
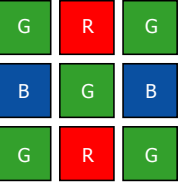
Status Control Register

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

3.14. 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				

4. Advanced Features

4.1. Binning Mode

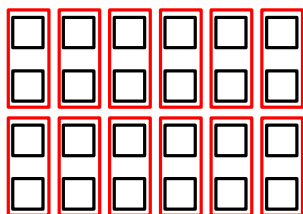
(B/W models and Fire-i 820c model)

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.

4.1.1. Vertical Binning

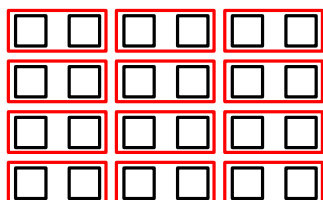
Vertical binning combines CCD pixels neighboring vertically to a single pixel increasing light sensitivity of the camera. Since CCD acquire data horizontally, multiple lines are acquired in case of vertical binning which results significant speed gain. Thus the vertical resolution is reduced and due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



1x2 Vertical Binning
Example

4.1.2. Horizontal Binning

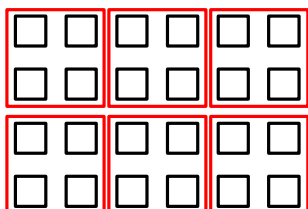
Horizontal binning combines CCD pixel neighboring horizontally to a single pixel increasing light sensitivity of the camera. However due to the nature of CCD transferring each horizontal line at a time there is no speed gain in horizontal binning. However light sensitivity increase may occur, due to the increased CCD area similar to vertical binning and horizontal resolution is reduced.



2x1 Horizontal Binning
Example

4.1.3. 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

4.2. 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

$$\text{Left} = \text{Hposunit} * n1$$

$$\text{Top} = \text{Vposunit} * m1$$

$$\text{Width} = \text{Hunit} * n2$$

$$\text{Height} = \text{Vunit} * m2$$

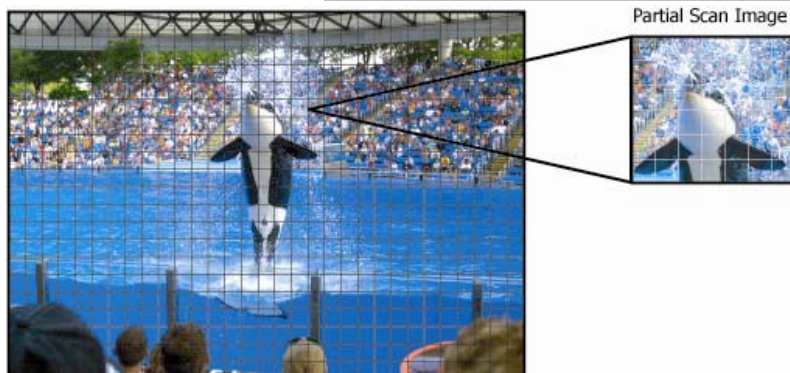
$$\text{Left} + \text{Width} <= \text{Hmax}$$

$$\text{Top} + \text{Height} <= \text{Vmax}$$

(n1,n2, m1, m2 are integer)

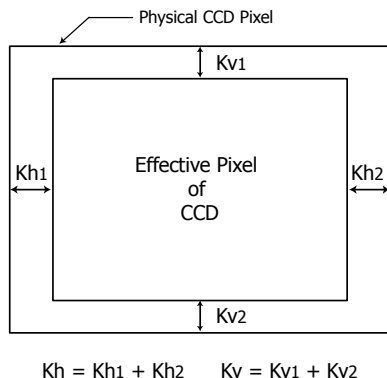
0 - 7	8 - 15	16 - 23	24 - 31
Left		Top	
0 - 7	8 - 15	16 - 23	24 - 31
Width		Height	

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



4.2.1. 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.



Pan/Tilt Details for Fire-i 520b/521b and Fire-i 520c/521c

Image Size	Movement	Fire-i 520b/521b Kh =12, Kv=12		Fire-i 520c/521c 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	-	-

Pan/Tilt Details for Fire-i 620b and Fire-i 620c

Image Size	Movement	Fire-i 620b Kh=8, Kv=8		Fire-i 620c Kh=8, Kv=8	
		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
1024 x 768	Pan	400 ~ 632	516	400 ~ 632	516
	Tilt	300 ~ 476	388	300 ~ 476	388
1024 x 768 Format 7 Mode 0	Pan	512 ~ 520	516	512 ~ 520	516
	Tilt	384 ~ 392	388	384 ~ 392	388
512 x 384 Format 7 Mode 1	Pan	512 ~ 520	516	-	-
	Tilt	384 ~ 392	388	-	-
1024 x 384 Format 7 Mode 2	Pan	512 ~ 520	516	-	-
	Tilt	384 ~ 392	388	-	-

Pan/Tilt Details for Fire-i 720b and Fire-i 720c

Image Size	Movement	Fire-i 720b Kh=0, Kv=0		Fire-i 720c 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 Format 7 Mode 0	Pan	-	694	-	694
	Tilt	-	518	-	518
692 x 516 Format 7 Mode 1	Pan	-	694	-	-
	Tilt	-	518	-	-
1388 x 516 Format 7 Mode 2	Pan	-	694	-	-
	Tilt	-	518	-	-

Pan/Tilt Details for Fire-i 820b and Fire-i 820c

Image Size	Movement	Fire-i 820b Kh=22, Kv=34		Fire-i 820c 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 Format 7 Mode 0	Pan	800 ~ 822	810	800 ~ 820	810
	Tilt	600 ~ 634	616	600 ~ 634	616
800 x 600 Format 7 Mode 1	Pan	800 ~ 822	810	800 ~ 820	810
	Tilt	600 ~ 634	616	600 ~ 634	616
1600 x 600 Format 7 Mode 2	Pan	800 ~ 822	810	800 ~ 820	810
	Tilt	600 ~ 634	616	600 ~ 634	616

4.3. One-Shot and Multi-Shot

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.

4.4. 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	Fire-i 520/521		Fire-i 620		Fire-i 720		Fire-i 820	
	Max Shutter		Max Shutter		Max Shutter		Max Shutter	
	Value	Time	Value	Time	Value	Time	Value	Time
60	1110	16.5ms	-	-	-	-	-	-
30	1276	33.1ms	1270	32.5ms	-	-	-	-
15	1608	66.3ms	1598	65.3ms	1612	66.7ms	1606	66.1ms
7.5	1760	131ms	1758	129ms	1761	132ms	1760	131ms
3.75	1893	264ms	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 : Unibrain mode, 1 : IIDC v1.31) Bit 27 : auto sync complete (read only. 1: ready, 0: not yet auto-sync)	Read/Write
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4.5. 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 the camera to be triggered by software simultaneously. By utilizing Asynchronous Broadcasting user can execute and control the camera on the same Firewire bus at the same time with a single command.

4.6. 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

4.7. Time Stamp Register

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

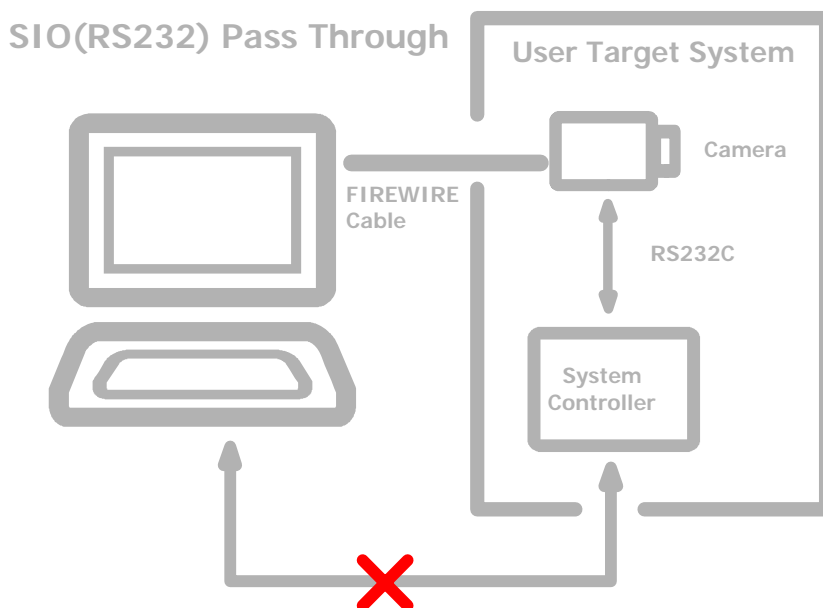
You may also get the same value from user defined registers (See Chap. 6.1) but we recommend using this.

Address	Description(bit : msb*)	Read/Write																																																		
0xF0000200	CYCLE_TIME	Read																																																		
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">0</td><td style="text-align: center;">1</td><td style="text-align: center;">2</td><td style="text-align: center;">3</td><td style="text-align: center;">4</td><td style="text-align: center;">5</td><td style="text-align: center;">6</td><td style="text-align: center;">7</td><td style="text-align: center;">8</td><td style="text-align: center;">9</td><td style="text-align: center;">10</td><td style="text-align: center;">11</td><td style="text-align: center;">12</td><td style="text-align: center;">13</td><td style="text-align: center;">14</td><td style="text-align: center;">15</td><td style="text-align: center;">16</td><td style="text-align: center;">17</td><td style="text-align: center;">18</td><td style="text-align: center;">19</td><td style="text-align: center;">20</td><td style="text-align: center;">21</td><td style="text-align: center;">22</td><td style="text-align: center;">23</td><td style="text-align: center;">24</td><td style="text-align: center;">25</td><td style="text-align: center;">26</td><td style="text-align: center;">27</td><td style="text-align: center;">28</td><td style="text-align: center;">29</td><td style="text-align: center;">30</td><td style="text-align: center;">31</td> </tr> <tr> <td colspan="6" style="text-align: center;">SECONDS COUNT</td> <td colspan="6" style="text-align: center;">CYCLE COUNT</td> <td colspan="6" style="text-align: center;">CYCLE OFFSET</td> </tr> </table>		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					
	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																			
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4.8. Serial Interface

Unibrain Compact 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.

4.8.1. SIO Pass Through Scheme



4.8.2. SIO 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 .. 0FFh				Reserved
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

4.8.3. SIO(RS232) Custom Commands

SIO(RS232) custom commands are **non** IIDC compliant which is a specific mode for Unibrain 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) SB1F2F1010012345678Z : 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.

5. User Defined FIREWIRE Registers

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

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

5.1. User Defined FIREWIRE Address

Address	Description(bit : msb*)	Read/Write		
0xF2F10000	<p>A/D bit resolution Bit 28~Bit31 : A/D bit resolution Please refer to IIDC v1.31 data depth register (address: 0xF0F00630)</p> <p>Mono 8 /Raw RGB 8bit</p> <p>Discard</p> <p>12 Bit A/D Resolution</p> <p>Mono 16 /Raw RGB 16bit</p> <p>Null data</p>	Read only		
0xF2F10004	<p>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</p> <p>0 15 16 31</p> <table border="1" style="width: 100%; text-align: center;"> <tr> <td style="width: 50%;">Auto Shutter-Speed Maximum Value</td> <td style="width: 50%;">Auto Shutter-Speed Minimum Value</td> </tr> </table>	Auto Shutter-Speed Maximum Value	Auto Shutter-Speed Minimum Value	Read/Write
Auto Shutter-Speed Maximum Value	Auto Shutter-Speed Minimum Value			
0xF2F10008	<p>Auto gain maximum/minimum value register.*(32bit) At auto gain mode, gain value is checked between auto gain maximum value and minimum value.</p> <p>0 15 16 31</p> <table border="1" style="width: 100%; text-align: center;"> <tr> <td style="width: 50%;">Auto Gain Maximum Value</td> <td style="width: 50%;">Auto Gain Minimum Value</td> </tr> </table>	Auto Gain Maximum Value	Auto Gain Minimum Value	Read/Write
Auto Gain Maximum Value	Auto Gain Minimum Value			

0xF2F10018	Mode control register Bit 31 : auto sync enable Bit 30 : SIO enable mode (0 : Unibrain 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) <table border="1" style="width:100%; border-collapse: collapse; text-align: center;"> <tr> <td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td> </tr> <tr> <td colspan="6">SECONDS COUNT</td> <td colspan="12">CYCLE COUNT</td> <td colspan="6">CYCLE OFFSET</td> </tr> </table> <table border="1" style="width:100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Bit Number</th> <th>Bit Name</th> <th>Function</th> <th>DIR</th> <th>Description</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>We recommend using native CYCLE_TIME register in Chap. 5.7.</p>	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	Read only
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																																															
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20 - 31	CYCLE OFFSET	Cycle Offset	R/W	24.576 MHz cycle timer counter																																																																										
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:0~1023)	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																																																																												
0xF2F10184	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																																																																												









*msb: most significant bit

6. Video Formats and Modes

Video format and modes are supported as per the IIDC 1.31 specification. However user should note that Format 7 is a mode definable by the camera manufacturer to provide more features and function which are not defined in the standard Format 0 and Format 1 and its various modes.

 : Unsupported Mode as per IIDC 1.31 Specification

6.1. Fire-i 820b / Fire-i 820c

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	YUV422						
	4	640 x 480	RGB						
	5	640 x 480	Mono 8			0	0	0	
	6	640 x 480	Mono 16			0	0	0	
1	0	800 x 600	YUV 422						
	1	800 x 600	RGB 8						
	2	800 x 600	Mono 8			0	0		
	3	1024 x 768	YUV 422						
	4	1024 x 768	RGB 8						
	5	1024 x 768	Mono 8			0	0	0	0
	6	800 x 600	Mono 16			0	0	0	
	7	1024 x 768	Mono 16			0	0	0	0
2	0	1280 x 960	YUV 422						
	1	1280 x 960	RGB 8						
	2	1280 x 960	Mono 8			0	0	0	0
	3	1600 x 1200	YUV 422						
	4	1600 x 1200	RGB 8						
	5	1600 x 1200	Mono 8			0	0	0	0
	6	1280 x 960	Mono 16			0	0	0	0
	7	1600 x 1200	Mono 16				0	0	0
7	0	1600 x 1200	16 fps						
	1	800 x 600	29 fps 2x2 binning (H&V Binning)						
	2	1600 x 600	29 fps 1x2 binning (V Binning)						

Note: Color Models output Raw Bayer Pattern which is converted by software.

6.2. Fire-i 720b / Fire-i 720c

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 YUV422						
	4	640 x 480 RGB						
	5	640 x 480 Mono 8			0	0	0	
	6	640 x 480 Mono 16			0	0	0	
1	0	800 x 600 YUV 422						
	1	800 x 600 RGB 8						-
	2	800 x 600 Mono 8			0	0		
	3	1024 x 768 YUV 422						
	4	1024 x 768 RGB 8						
	5	1024 x 768 Mono 8			0	0	0	0
	6	800 x 600 Mono 16			0	0	0	
	7	1024 x 768 Mono 16			0	0	0	0
2	0	1280 x 960 YUV 422						
	1	1280 x 960 RGB 8						
	2	1280 x 960 Mono 8			0	0	0	0
	3	1600 x 1200 YUV 422						
	4	1600 x 1200 RGB 8						
	5	1600 x 1200 Mono 8						
	6	1280 x 960 Mono 16				0	0	0
	7	1600 x 1200 Mono 16						
7	0	1392 x 1040	20 fps / 35fps (1392 x 520 Format 7, Mode 0) for B&W Models					
		1388 x 1036	20 fps / 35fps (1388 x 520 Format 7, Mode 0) for Color Models					
	1	692 x 516	38 fps 2x2 binning (H&V Binning) for B&W Models Only					
	2	1388 x 516	38 fps 1x2 binning (V Binning) for B&W Models Only					

Note: Color Models output Raw Bayer Pattern which is converted by software.

6.3. Fire-i 620b / Fire-i 620c

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 YUV422							
	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							
	1	800 x 600 RGB 8						-	
	2	800 x 600 Mono 8		O	O	O			
	3	1024 x 768 YUV 422							
	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 / 63 fps (1024 x 384, Format 7 Mode 0)						
	1	512 x 384	72 fps 2x2 binning (H&V Binning) for B&W Models Only						
	2	1024 x 384	72 fps 1x2 binning (V Binning) for B&W Models Only						

Note: Color Models output Raw Bayer Pattern which is converted by software.

6.4. Fire-i 521b / Fire-i 521c

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 YUV422						
	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 90 fps / 154 fps (640 x 240, Format 7 Mode 0)						
	1	320 x 240 157 fps 2x2 binning (H&V Binning) for B&W Models Only						
	2	640 x 240 157 fps 1x2 binning (V Binning) for B&W Models Only						

Note: Color Models output Raw Bayer Pattern which is converted by software.

6.5. Fire- 520b / Fire-i 520c

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 YUV422						
	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 90 fps / 154 fps (640 x 240, Format 7 Mode 0)						
	1	320 x 240 157 fps 2x2 binning (H&V Binning) for B&W Models Only						
	2	640 x 240 157 fps 1x2 binning (V Binning) for B&W Models Only						

Note: Color Models output Raw Bayer Pattern which is converted by software.

7. Trouble Shooting

FireWire based cameras 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 512 MB of system memory and Graphic Accelerator with 64 MB or more of video memory. When using Windows, due to high graphic requirements and DirectX support, we recommend using at least a modern Nvidia or ATI graphics adapter.

7.1. Hardware Related Issues

7.1.1. Camera is not recognized in in the device manager

- Please check whether the LED in the back of the camera is ON. If LED is turned 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.

7.1.2. 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. .

7.1.3. 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.

7.1.4. 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.

7.2. Software Related Issues

7.2.1. System Environment

Unibrain Cameras are IIDC compliant camera which may be used in various applications 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.

7.2.2. Multiple Camera Connection

Unibrain 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 FireWires'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)

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

7.2.3. 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. 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 information, specifications, FAQs: <http://www.unibrain.com/>

Technical support email: support@unibrain.com

Sales inquiries: sales@unibrain.com

Telephone Numbers:

Europe/Asia: +30210-6640600

USA/Canada/South America: +1-925-866-3000

In case of RMA, you must first contact us or your local reseller in order to obtain the RMA Number before sending the product to us. The returns contact email address is: rma@unibrain.com