

FASTCAM-ultima APX-i2 Hardware Manual

Rev. 1.04

Photron

PHOTRON LIMITED

SEP, 2007

Table of contents

Chapter 1. Introduction	5
1.1. Preface	6
1.2. Warranty	7
1.3. How to Use This Manual	8
1.4. Precautions	9
 Chapter 2. Set Up	 12
2.1. To Start	13
2.1.1. Unpacking	13
2.1.2. Optional Accessories	13
2.2. Names of Components	14
2.2.1. Processor	14
2.2.2. Camera Head	15
2.2.3. Remote Control Keypad	16
2.2.4. AC `Power Adapter for APX-i2 Camera	17
2.2.5. GENERAL IN Cable	18
2.2.6. GENERAL OUT Cable	19
2.2.7. MCDL / RS422 Cable	20
2.2.8. DC Power-IN Cable	22
2.3. System Connection	23
2.3.1. Connecting Camera Head	23
2.3.2. Connecting Remote Control Keypad	24
2.3.3. Connecting Video Monitor	25
2.3.4. Power Connection	26
2.4. Switching Power on	27
2.5. Basics of Remote Control Keypad Operation	28
2.5.1. Details of Controls on Keypad	28
2.5.2. Menu Display	29
2.5.3. Menu Selection	29
2.5.4. Canceling Menu Selection	29
2.6. System Setup (Date, Time and Revision)	30
2.6.1. Setting Date and Time	30
2.6.2. Switching Date / Time	31
2.6.3. Displaying System Revision	32
 Chapter 3. Before Recording	 34
3.1. Operation of Image Intensifier	35
3.1.1. I.I. Protection Circuit	35
3.1.2. I.I. (Image Intensifier) menu operation	36
3.1.3. Storing settings	41

3.1.4. Operation before Recording.....	42
3.1.5. Switching intensifier off	46
Chapter 4. Recording	48
4.1. Initialization (Calibration)	49
4.1.1. Start Calibration.....	49
4.1.2. Saving Calibrated Setting	50
4.1.3. Loading Calibrated Settings.....	50
4.2. Selecting Frame Rate.....	51
4.3. Selecting Resolution.....	52
4.4. Selecting Shutter Speed	53
4.4.1. Switching Shutter Speed Steps.....	54
4.4.2. Switching SHUTTER MODE	55
4.5. Selecting Trigger Mode.....	56
4.5.1. START Mode.....	57
4.5.2. CENTER Mode	58
4.5.3. END Mode.....	59
4.5.4. MANUAL Mode	60
4.5.5. RANDOM Mode	63
4.5.6. RANDOM RESET Mode	66
4.5.7. RANDOM CENTER Mode	68
4.5.8. RANDOM MANUAL Mode	71
4.5.9. DUAL FRAMING RATE Mode.....	75
4.6. Partitioning Memory.....	78
4.6.1. Prepare for Memory Partitioning (Set Number of Sections)	78
4.6.2. Recording into Divided Sections	79
4.6.3. Playback of Recorded Sections	79
4.6.4. PARTITION MODE.....	79
4.7. Look-Up Table (LUT) Operation	80
4.7.1. Operating Preset LUT	80
4.7.2. Customizing LUT Patterns	83
4.8. Extended Dynamic Range Mode.....	84
4.9. External Trigger Input	85
4.9.1. Input of External Trigger Signals.....	85
4.9.4. Output of Trigger Signals to External Equipment.....	87
4.10. Input of External Sync Signals.....	88
4.10.1. Input of External Sync Signals	88
4.10.2. Output of External Sync Signals	89
4.10.3. Sync Operation of Multiple APX-i2 Systems.....	90
4.10.4. Sync Operation with External Equipment	92
4.10.5. Sync Operation of APX-i2 and Other Models of Cameras.....	94
4.11. Setting GENERAL IN / OUT Signals	96
4.11.1. Setting GENERAL IN Signals.....	96
4.11.2. Setting GENERAL OUT Signals.....	97
4.12. Event Marker Function.....	98

4.13. MCDL - Multi-Channel Data Link (Data acquisition)	99
4.14. IRIG Time Code	100
Chapter 5. Playback	101
5.1. Playing Recorded Images	102
5.2. Searching Images of Interest (Fast Forward/Rewind Play)	103
5.3. Slow Playback (Jog)	104
5.4. Zooming (Zoom/Fit/Scroll)	105
5.4.1. Fitting Image Frame to Video Screen	106
5.4.2. Zooming Playback Image Frame	107
5.4.3. Scrolling Playback Image Frame	108
5.5. Block Playback (Playback of Clips of Interesting Scenes)	109
5.6. Text Display – Hide / Unhide	110
5.7. Displaying Crosshair Cursor	111
5.8. Switching NTSC / PAL Video Output	112
5.9. Automatic Playback	113
5.10. Playback Event Markers	114
Chapter 6. Connecting APX-i2 to a PC	115
6.1. Connecting APX-i2 to a PC	116
6.1.1. APX-i2 with IEEE1394 Interface	117
6.1.2. APX-i2 with Ether Interface	117
6.1.3. Connection with Optical Interface	118
6.2. Connecting Multiple APX-i2's to a PC	124
Chapter 7 Specifications	126
7.1. Specifications	127
7.1.1. Product Specifications	127
7.1.2. Image Intensifier (I I) Specification	127
7.1.3. Miscellaneous	128
7.1.4 Accessories	129
7.1.5. Optional Items	129
7.1.6. Frame Rates and Resolutions	130
7.1.7. Number of Recorded Images vs. Resolution	132
7.1.8. RS422 Serial Control Commands	133
7.1.9. STATUS OUT	139
7.1.10. Shutter Speed Table (COARSE Steps)	140
7.2. Mechanical Data	141
7.2.1. Camera Head (millimeters)	141
7.2.2. Processor (millimeters)	142
7.2.3. Keypad (millimeters)	143
7.3. Care of Lenses	144

Memo

Chapter 1. Introduction

1.1. Preface

1.2. Warranty

1.3. How to Use This Manual

1.4. Precautions

1.1. Preface

The FASTCAM-ultima APX I.I. (Image-Intensified model, referred to as “APX-i2” hereinafter) High-Speed Video Camera System will prove itself a truly powerful visualization tool giving solution to engineers and scientists in such fields as general research and development, designing, manufacturing, quality assurance, scientific researches, medical and biological researches, space and aeronautics engineering. With its mega-pixel, ultra-high sensitivity imaging sensor that enables framing under extremely low level of light, the APX-i2 offers a great basic feature of extremely high-speed recording. Another outstanding feature is that it promises an excellent user-friendliness of intuitive recording of subjects moving at a very high speed thanks to its real-time video output and easy-to-operate keypad-type remote control unit. Also, the hybrid-design scheme of the APX-i2 makes it possible to seamlessly connect with a PC via a high-speed digital interface, combined with easy-to-use control software, to form an image recording and processing system that offers a much easier means for analyzing captured events immediately, which has been very difficult with conventional systems.

You will find this new recording technology most useful to capture the image of high-speed moving subjects for subsequent slow-motion observation and motion analysis, and image processing applications. This manual presents the technical details of the APX-i2 system and how to operate it.

Remarks:

1. For the best use of the system, please read through this manual.
2. The content of this manual is based on the best knowledge of the manufacturer. However, in case any error or missed information is found in this manual, please inform the manufacturer of such shortcomings. Notwithstanding the above, the manufacturer is not responsible for any results of the use of this equipment.
3. Copying all or any part of this manual without permission is prohibited.
4. The content of this manual may be changed any time without prior notice.
5. The manufacturer assumes no responsibility for any direct or indirect damages or loss of profit resulting from the use of this equipment
6. The manufacturer assumes no responsibility for any result of the use of this equipment.
7. Copying all or any part of the software included in this system without prior written permission by the author is an infringement of copyright.

1.2. Warranty

New Equipment Warranty PHOTRON FASTCAM-ultima APX-i2

PHOTRON LIMITED warrants this PHOTRON FASTCAM-ultima APX-i2 ("APX-i2") and accessories manufactured by PHOTRON LIMITED to function properly for one year from the date of shipment, provided the warranty registration card was filled out and returned to PHOTRON USA, INC. or PHOTRON EUROPE LIMITED within thirty days of shipment. PHOTRON LIMITED, in conjunction with PHOTRON USA, INC. or PHOTRON EUROPE LIMITED, agrees to perform the following equipment warranty services:

1. Repair service: If shipped to PHOTRON at any of the addresses shown below, repairs will be made at no charge.
2. Parts replacement: Replacement parts installed under warranty will be provided at no charge.

Special remarks:

The image intensifier ("II") tube used in the FASTACAM APX-i2 carries a life warranty of a period of 12 months after shipment by Photron for defects in material and workmanship.

Because the II tube is subject to deterioration by use, this warranty is not applied to the deterioration caused by use even if the tube is within the warranty period.

The warranty expires twelve (12) months after the date of shipment by Photron.

THIS WARRANTY DOES NOT APPLY UNDER THE FOLLOWING CONDITIONS:

Failure to operate the APX-i2 in accordance with Photon's written instructions, including environmental specifications listed in the User's Manual.

If there is evidence of the APX-i2 being subjected to accidental damage, misuse or abuse.

If the APX-i2 has been repaired or tampered with by persons other than PHOTRON personnel, customer personnel trained by PHOTRON or without permission of PHOTRON.

Shipping damage is not covered by this warranty. The purchaser has the responsibility to place a claim of damage in shipment with the carrier.

PHOTRON LIMITED makes no other warranties, express or implied, including the implied warranties of merchantability and fitness for a particular purpose. If this APX-i2 does not function properly during the warranty period, PHOTRON LIMITED will repair it without charge according to the terms stated above. Repair without charge is PHOTRON LIMITED's only obligation under this warranty. PHOTRON LIMITED, PHOTRON USA, INC. or PHOTRON EUROPE LIMITED will not be responsible for any consequential or incidental damages resulting from the sale, use or improper functioning of this equipment even if loss or damage is caused by the negligence or other fault of PHOTRON LIMITED, PHOTRON USA, INC. or PHOTRON EUROPE LIMITED.

Return the equipment that needs warranty service to:

In Americas & Antipodes
PHOTRON USA, INC.
9520 Padgett Street
Suite 110
San Diego, CA 92126-4446
USA
Phone: 858-684-3555
Fax: 858-684-3558
E-mail: image@photron.com
www.photron.com

In Europe:
PHOTRON EUROPE LTD.
Willowbank House
84 Station Road
Marlow, Bucks SL7 1NX
U. K.
Phone: +44(0) 1628 89 4353
Fax: +44(0) 1628 89 4354
E-mail: image@photron.com
www.photron.com

In other areas:
PHOTRON LIMITED
Fujimi 1-1-8, Chiyoda-Ku
Tokyo 102-0071
Japan
Phone: +81 3 3238 2170
Fax: +81 3 3238 2171
E-mail: image@photron.com
www.photron.co.jp

1.3. How to Use This Manual

DEFINITION OF TERMS

You will notice that some of the information in this manual is presented as a NOTE, CAUTION or WARNING. It is important that you understand the significance of these three terms. For safe operation of the system, please follow the safety instructions below:

“Note” includes information that should be emphasized regarding the operation of the APX-i2.

“Caution” includes important information regarding operation. If it is neglected and the equipment is used in the wrong manner, damage may be caused to the content of recording, the equipment and related peripheral devices.

“Warning” presents very important information regarding safety of the operators. If it is neglected and the equipment is used in the wrong manner, a serious hazardous sequence involving human injury or death may result. It must not be disregarded.

Chapters

This manual is divided into six chapters each discussing subject matters related to its chapter title.

Chapter 1. Introduction

Contains Warranty, precautions, introduction and how to use this manual.

Chapter 2. Set Up

Introduces you to the components of the APX-i2 and explains the use of each connector, keypad operation and parameter settings to make ready for recording.

Chapter 3. Recording

Explains the operation of the APX-i2 for recording.

Chapter 4. Playback

Discusses playback of recorded images and filing image data.

Chapter 5. Connection to a PC

Shows how to connect and operate the APX-i2 to a PC (Operation of the APX-i2 from PC is discussed in the PFV Software Manual).

Chapter 6. Specifications

Provides detailed specifications of the APX-i2 system.

1.4. Precautions

Ambient Temperature

Photron FASTCAM-ultima APX-i2 has been designed to work properly in an ambient temperature range of 0 to 35 degrees Celsius (32 to 95 degrees Fahrenheit), no condensation.

Storage Temperature

The APX-i2 must be stored in a place with an ambient temperature range of -20 to +70 degrees Celsius (-4 to +158 degrees Fahrenheit), no condensation.

Transportation

Save the original carton the unit came in for future transportation.

Do not apply excessive shocks or vibration during transportation, storage or operation. The image intensifier has a glass tube that is fragile and operates at a high degree of vacuum. Excessive shocks or vibration may cause failures or malfunctions.

Do not transport the unit under ambient temperature of below -20 degrees Celsius (-4 degrees Fahrenheit) or above 70 degrees Celsius (+158 degrees Fahrenheit).

No condensation should be allowed during transportation, storage or operation.

FEDERAL COMMUNICATIONS COMMISSION STATEMENTS

WARNING: This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class computing device pursuant to Subpart A of Part 15 of the FCC Rules and VDE 0871 Class B which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

This device complies with Part 15 of the FCC Rules and VDE 0871. Operation is subject to the following two conditions: (1) this equipment may cause harmful interference, and (2) this equipment must accept any interference received including interference that may cause undesired operation.

WARNING

This product is grounded through the power cord. This protective ground connection is essential for safe operation of the equipment. Avoid electrical shock by plugging the power cord into a properly wired power outlet. A loss of the protective grounding, for any reason, could result in electrical shock. Use the proper power cord and insure that it is in good condition.

Do not touch or allow any object to come in contact with the input window of the image intensifier at any time. The input window can be easily damaged and electrical shocks (static discharge) or failures may result. Never attempt to touch an internal part of image intensifier while it is in operation.

CAUTIONS

The Image intensifiers is an extremely sensitive optical device. When operating the system, exercise caution to gradually increase light falling on the light-entrance window

of the intensifier surface by slowly opening the lens iris starting at the largest f-stop (f32 or f16) of the lens. Slowly open the lens iris and watch the image brightness, while viewing live image on the monitor, until an optimum level of brightness is reached.

Do not expose the light-entrance window (the intensifier's front surface) to strong light, such as sun light, while operating or storing the intensifier. Bright light falling on the light-entrance window of the image intensifier surface, even when the device is not operating, can damage the image intensifier. Always store the camera head with an appropriate body cap or lens and lens cap in place when not in use.

Operating the image intensifier while it is exposed to bright light (e.g. ambient room illumination) will cause serious damage to the intensifier's photocathode.

Always adjust the intensifier (and camera) while watching live image on the monitor.

Switch the intensifier off when done with a recording or test. Avoid exposing the light-entrance window of the intensifier to bright light while changing lenses regardless of whether the intensifier is powered. The intensifier tube can be damaged by excessive light with or without power on.

If a lens whose iris does not completely close is used, install a lens cap to avoid exposing the intensifier to excessive light while not in use.

When installing the image-intensified camera on a microscope, make sure there is no leakage of light from other than the microscope's light source.

Memo

Chapter 2. Set Up

2.1. To Start

2.2. Names of Components

2.3. System Connection

2.4. Switching power on

2.5. Basics of Remote Control Keypad Operation

2.5. System Setup

2.1. To Start

2.1.1. Unpacking

The APX system consists of the following items. Make sure if all the components are found in the package.

1. Camera Head	1 ea.
2. Processor	1 ea.
3. Remote Control Keypad	1 ea.
4. AC Power Adapter (attached to processor unit)/AC Cable	1 ea.
5. AC Power Adapter for II Camera	1 ea.
6. Camera Cable (5 meters long)	1 ea.
7. C-Mount Lens Adapter	1 ea.
8. Allen Wrench for Changing Lens Mount	1 ea.
9. Lens Mount Cap	1 ea.
10. GENERAL IN Cable	1 ea.
11. GENERAL OUT Cable	1 ea.
12. MCDL/IRIG Compound Cable	1 ea.
13. Ferrite Core for Cable	1 ea.
14. CD-ROM for Driver/Application Setup	1 ea.
15. FASTCAM-ultima APX-i2 Hardware Manual	1 ea.
16. FASTCAM Control Software Operation Manual	1 ea.
17. Warranty Registration Card	1 ea.
18. CD-ROM for I.I. Data Storage	1 ea.
19. Optical PCI Interface Board	1 ea.
20. Optical Cables (5 meters long)	2 units

Note: Items 19 and 20 are for APX-i2 with optical interface only.

Note: Item 19, the optical cable is a single mode fiber cable 9/125 micrometers SMF (5 meters long).

2.1.2. Optional Accessories

The following optional items are available for the APX-i2:

1. Additional Memory Unit (to be installed at factory only)
2. IEEE1394 Optical Link (IEEE1394 Optical fiber extension unit)

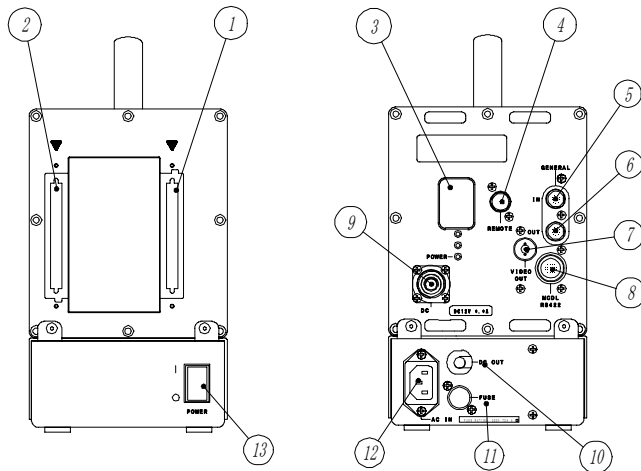
2.2. Names of Components

The APX system consists of a processor, camera head, remote-control keypad and control software.

2.2.1. Processor

The APX processor is designed to have a set of IC memory with a capacity of 2.6GB, standard, and a maximum of 8GB, to store non-compressed digital data of high-speed recorded images. The processor has a video output connector to display the recorded images on the video monitor, an IEEE1394 digital interface to control the camera from a PC and download recorded image data, input and output connectors for external sync and trigger signals, and a port to accept IRIG time code and MCDL analog waveform signals.

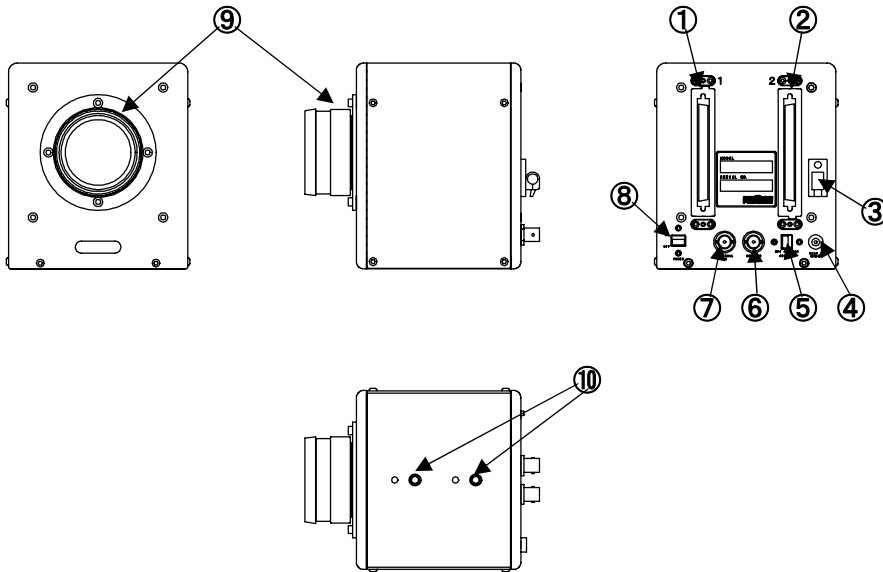
Names of Components



No.	Name	No.	Name
1	Camera Cable Connector 1	8	MCDL/RS422 Connector
2	Camera Cable Connector 2	9	DC Power IN Connector
3	IEEE1394 Interface Connector	10	DC Power OUT Cable
4	Remote Control Keypad Connector	11	Fuse Box
5	GENERAL IN Connector	12	AC Power IN Connector
6	GENERAL OUT Connector	13	AC Power Switch
7	VIDEO OUT Connector		

2.2.2. Camera Head

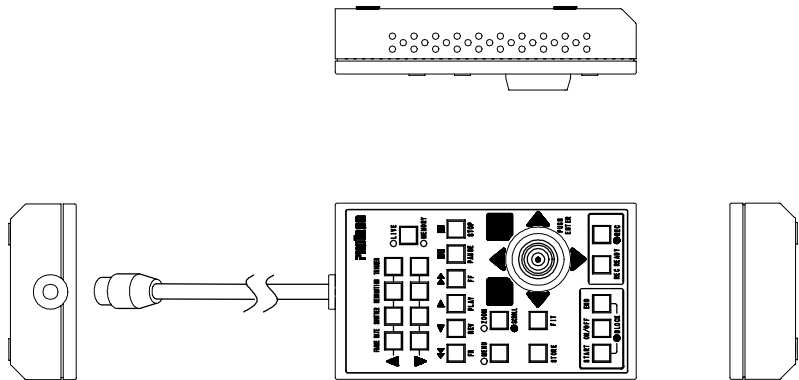
The light-weight and compact-sized APX camera head has been designed for ease of handling under various recording conditions and environments. The lens mount can be selected from C-type or F-type to the user's application. The camera head has tripod-mounting screw holes on its base plate.



No.	Description
1	Camera cable connector 1 (connects to processor)
2	Camera cable connector 2 (connects to processor)
3	Cable clamp (clamps AC adapter cable)
4	DC-IN connector (from AC power adapter)
5	Protection mode SW (with yellow LED)
6	MONITOR OUT (Gate pulse, BNC connector)
7	EXTERNAL IN (Gate pulse, BNC connector)
8	Power ON/OFF switch (with green LED)
9	Lens mount
10	Tripod mounting screw holes

2.2.3. Remote Control Keypad

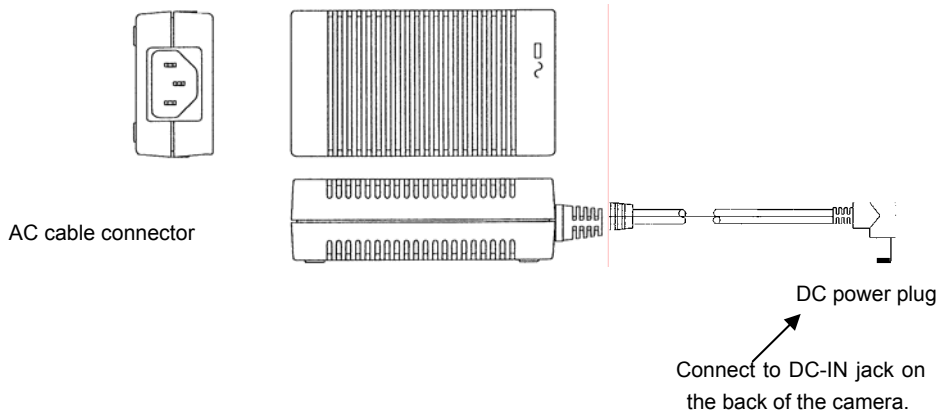
The APX Remote Control Keypad connects to the processor and controls all the functions of the camera system. The keypad is of “hot-plug” type and can be connected or disconnected with power on.



Connector on Processor	Signal	Connector Model (On Processor)	Connector Model (On Keypad)
REMOTE	Remote Keypad Signal	HR10A-10R-12SC (Hirose)	HR10A-10P-12P (Hirose)

2.2.4. AC Power Adapter for APX-i2 Camera

Connect the DC power supply plug from the AC power supply adapter to the DC-IN jack on the back of the camera. Use the cable clamp mounted on the side of the camera to hold the cable securely.



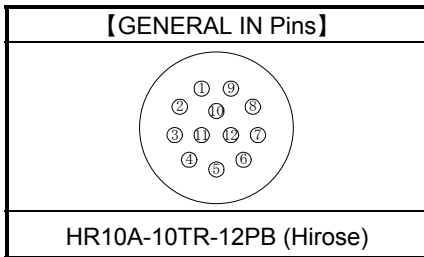
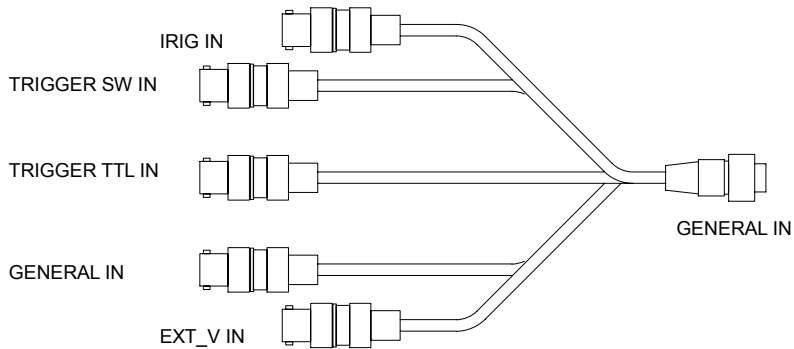
Plug: RC6705 (center positive)



Use this cable clamp to hold the DC power cable securely.

2.2.5. GENERAL IN Cable

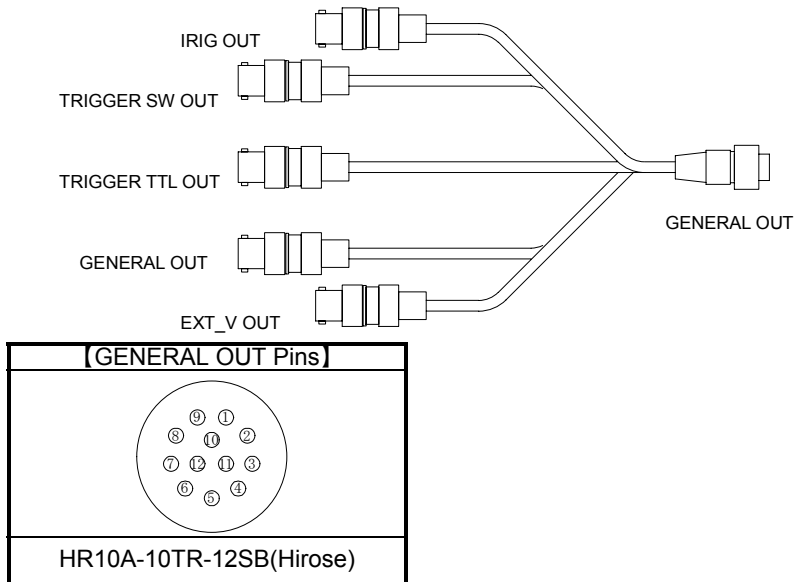
The APX can be used as an integral part of a testing system by its capability to work in sync with external trigger and sync signals from other devices and equipment within the system. The processor has a GENERAL IN connector on its rear panel, which combines relevant input signal lines into one connector.



Connector Name	Signal Name	Pin No.	Connector on Processor Model (Manufacturer)	Connector on Cable Model (Manufacturer)	Input Connect ors
GENERAL IN	Trigger SW IN	1	HR10A-10TR-12 PB (Hirose)	HR10A-10TPA-12S (Hirose)	BNC
	GND	2			
	Trigger TTL IN	3			BNC
	GND	4			
	EXT_V IN	5			BNC
	GND	6			
	General IN	7			BNC
	GND	8			
	IRIG IN	9			BNC
	GND	10			

2.2.6. GENERAL OUT Cable

The APX can be used as an integral part of a testing system by its capability to make other devices and equipment in the system work in sync with the APX's exposure timing and sync signals. The processor has a GENERAL OUT connector on its rear panel, which distributes APX's output signals to relevant devices and equipment.



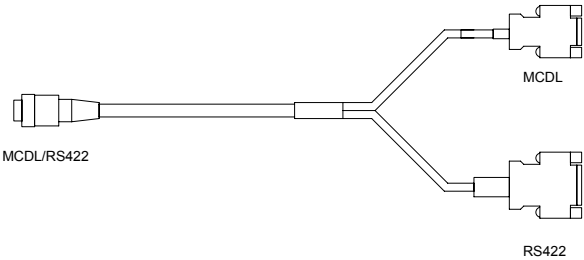
Connector Name	Signal Name	Pin No.	Connector on Processor Model (Manufacturer)	Connector on Cable Model (Manufacturer)	Output Connectors
GENERAL OUT	Trigger SW OUT	1	HR10A-10TR-12 SB (Hirose)	HR10A-10TP-1 2P (Hirose)	BNC
	GND	2			
	Trigger TTL OUT	9			BNC
	GND	10			
	EXT_V OUT	5			BNC
	GND	6			
	General OUT	7			BNC
	GND	8			
	IRIG OUT	3			BNC
	GND	4			

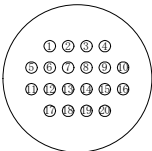
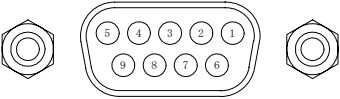
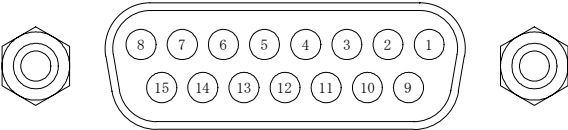
2.2.7. MCDL / RS422 Cable

The APX has connectivity with Photron MCDL (Multi-Channel Data Link) unit (optional). The waveform data output (up to 4 channels of analog data and up to 6 channels of digital data) from MCDL is sampled and recorded together with image data.

The RS422 port is an interface to control the APX using RS422 communication protocol.

The MCDL and RS422 signal lines are combined into one composite cable, whose details are shown below:



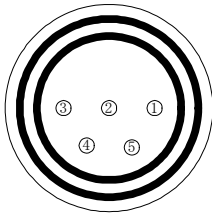
【MCDL/RS422 Connector Pins on Processor】	【MCDL Connector Pins】
 <p>HR10A-13TR-20SB (Hirose)</p>	 <p>9-pin D-sub Connector (Female)</p>
【RS422 Connector Pins】	
 <p>15-pin D-sub Connector (Female)</p>	

Connector Name	Connector on Processor Model (Manufacturer)	Connector on Cable Model (Manufacturer)	Signal Name / Pin No.		Input Connector / Pin No.
MCDL RS422	HR10A-13TR-20SB (Hirose)	HR10A-13TPD-20P (Hirose)	MCDL		9-pin D-sub Connector (Female)
			SYNC-	13	1
			SYNC+	12	2
			CLK+	14	4
			CLK-	15	5
			DATA_B-	9	6
			DATA_A-	8	7
			DATA_A+	7	8
			DATA_B+	10	9
			N.C.	--	3
			RS422		15-pin D-sub Connector (Female)
			N.C.	--	1
			TXD+	18	2
			TXD-	17	3
			RXD+	19	4
			RXD-	20	5
			II_CAM_V/ (N.S.)	5	6
			GND	6	7
			GND	4	8
			II_GATE (N.S.)	3	9
			GND	2	10
			II_RESET/ (N.S.)	1	11
			N.C.	--	12
			N.C.	--	13
			GND	11	14
			GND	16	15

N.C.: Not Connected

N.S.: Not Supported

2.2.8. DC Power-IN Cable



【DC IN Pins】

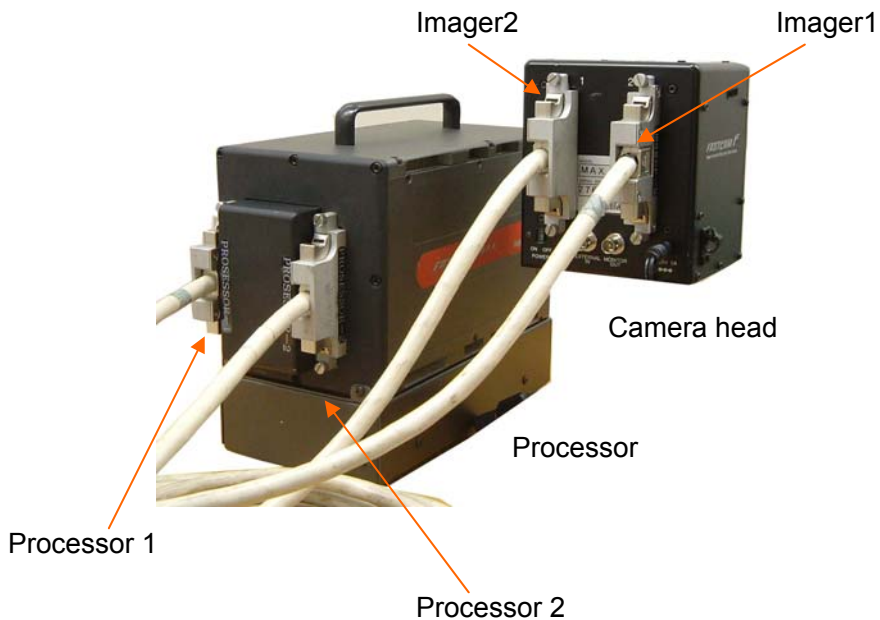
Connector Name	Signal Name	Pin No.	Connector on Processor Model (Manufacturer)	Connector on Cable Model (Manufacturer)
DC-IN	+12VDC	1	TRC01-A13R5FA (Tajimi)	TRC01-A13P5MA (Tajimi)
	+12VDC	2		
	N.C.	3		
	GND	4		
	GND	5		

2.3. System Connection

2.3.1. Connecting Camera Head

Follow the below procedure to connect between the camera head and processor.

1. Be sure to turn the main power off on the processor.
2. Connect between the camera head and processor using the cables. Make sure the numbers on mating connectors match.

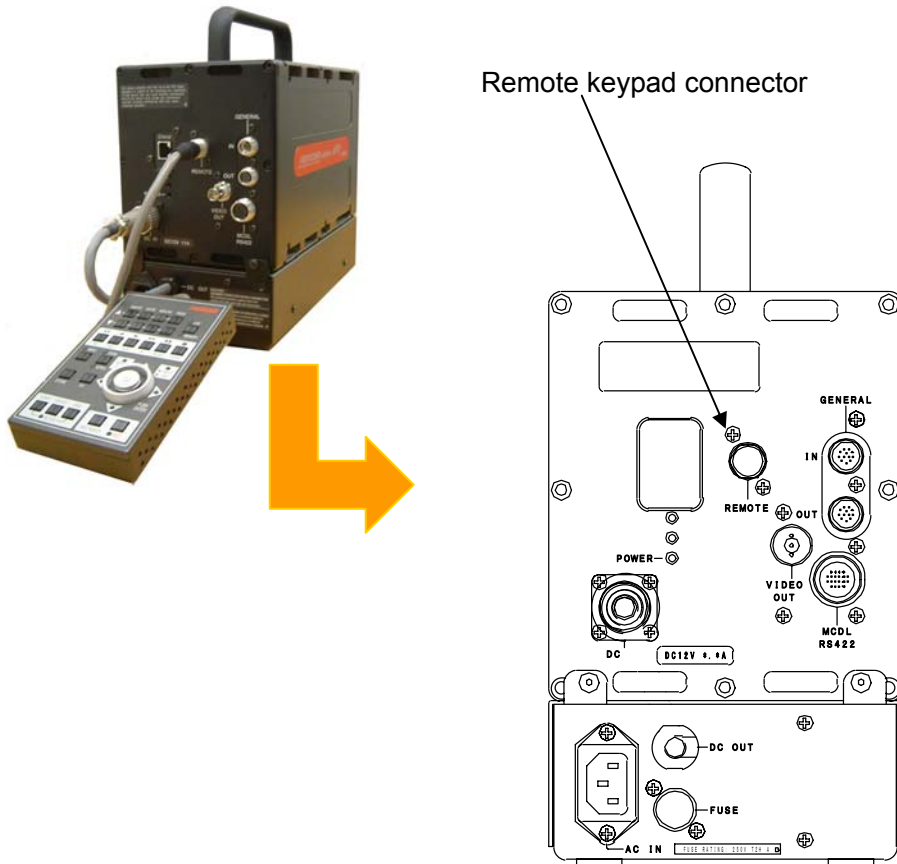


3. Fasten the retaining screws in the circles, below, tightly on all connectors in order to avoid any loose contact which will result in abnormal images displayed on the monitor.



2.3.2. Connecting Remote Control Keypad

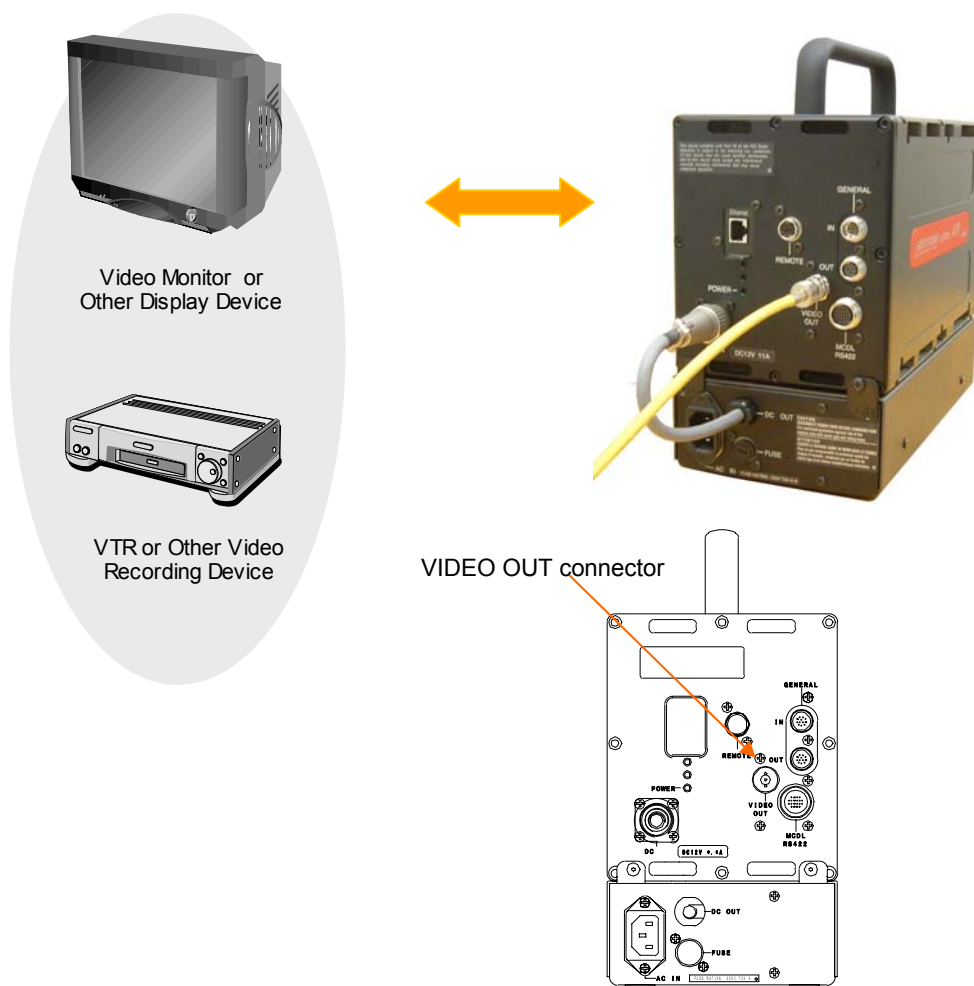
1. Connect the keypad cable connector to the REMOTE connector on the processor rear panel.



Note: The keypad is “hot-pluggable” and allows for connecting and disconnecting while power is on.

2.3.3. Connecting Video Monitor

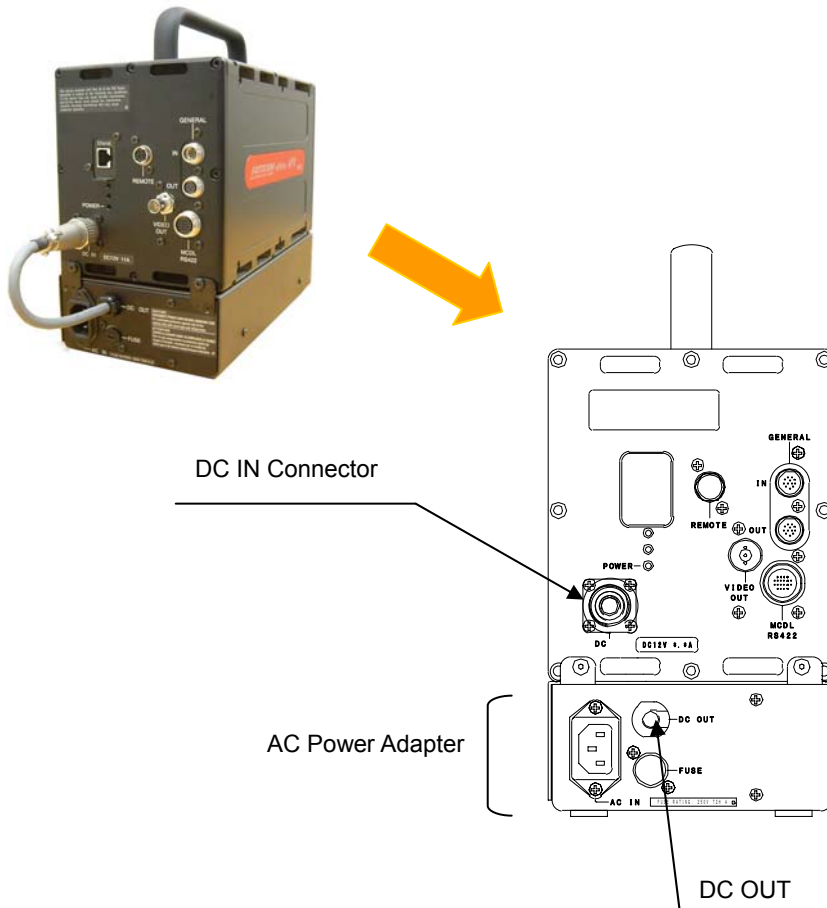
Connect a video monitor to the processor to monitor live images from the APX-i2 camera. Connect between the VIDEO OUT connector on the processor and the VIDEO-IN connector of a video monitor with a coax cable.



2.3.4. Power Connection

The APX is powered by DC power fed from the attached AC power adapter that connects to a power line of 100 to 240 VAC.

1. Connect the DC output cable from the AC power adapter unit to the DC IN connector on the APX rear panel.



2. Connect the AC power cord to the AC IN connector on the AC power adapter unit.
3. Plug the power cord into an AC outlet.

2.4. Switching Power on

When system connection is done, the system is ready to switch power on. Before turning power on, be careful about the following points.

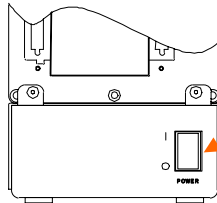
(1) Set the lens iris to the highest number (F/32 or F/16) and cover the lens with a lens cap.



(2) Keep the POWER switch on the rear panel of the camera in the OFF position.

(3) Switch the video monitor on.

(4) Switch the processor on (press the "I" part on the switch).

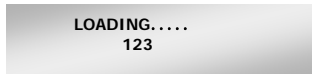


Processor power SW

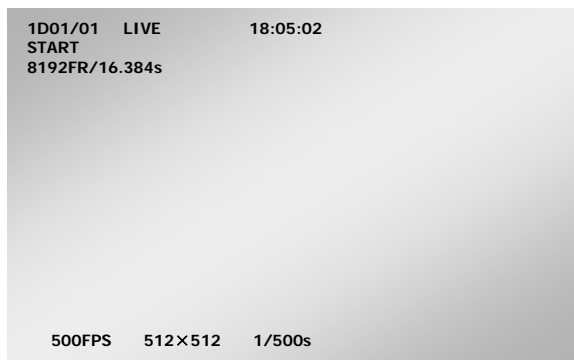
I : Power on

O : Power off

(5) The video monitor displays "LOADING" as shown below:



(6) When counting is done, the display changes as follows:



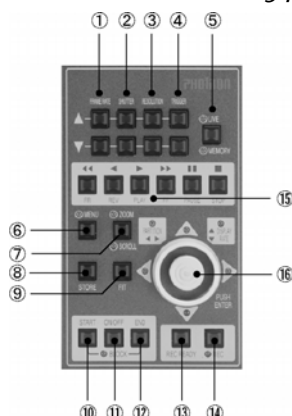
(7) Now you are ready to begin setting up the camera using the remote keypad.

2.5. Basics of Remote Control Keypad Operation

The APX remote control keypad has been so designed that most of “frequently-used” functions are operated by one touch on the keypad as much as possible. Also, the menu has been so organized that parameter settings can be effectively carried out from the joystick.

This section discusses the basics of joystick operation that is necessary to use the menu in the most effective manner.

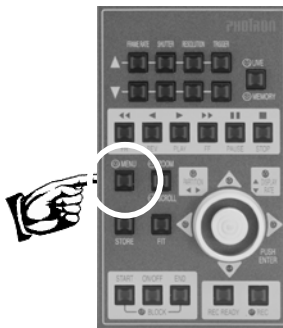
2.5.1. Details of Controls on Keypad



No.	Name	Function	No.	Name	Function
①	FRAME RATE	Sets frame rate.	⑨	FIT	Fits video image to frame size.
②	SHUTTER	Sets shutter speed.	⑩	START/BLOCK	Sets start frame of block playback.
③	RESOLUTION	Sets resolution.	⑪	BLOCK ON/OFF	Switches ON / OFF of block playback.
④	TRIGGER	Sets trigger mode.	⑫	END/BLOCK	Sets end frame of block playback.
⑤	LIVE / MEMORY	Switches LIVE / Playback from memory.	⑬	REC READY	Make ready for recording.
⑥	MENU	Displays menu.	⑭	REC	Starts recording.
⑦	ZOOM / SCROLL	Switches Zoom / Scroll	⑮	PLAYBACK	Playback buttons.
⑧	STORE	Stores setting and markers.	⑯	JOYSTICK	Steers selection.

2.5.2. Menu Display

Press the MENU button on the keypad to display the menu on the video monitor.



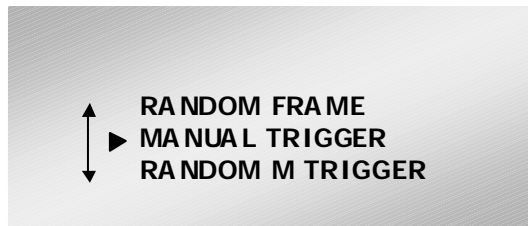
ID01/01LIVE 13:07:41
 START
 2048FR/1.024S

RANDOM FRAME	RESERVED
MANUAL TRIGGER	LUT SELECT
RANDOM M TRIGGER	CALIBRATE
RANDOM E TIMES	DS SHUTTER
TWO STAGES	DIGITAL I/F SET
PARTITION	TIME SET
OSD SELECT	DATA/TIME
CURSOR	SHUTTER STEP
RESERVED	SYSTEM REV
NTSC/PAL	SHUTTER MODE
EXT-SYNC IN	STATUS OUT
EXT-SYNC OUT	RESERVED
GENERAL IN	HEAD EXCHANGE
GENERAL OUT	II POWER
AUTO PLAY	II GAIN GATE
MCDL/IRIG	II GATE SELECT
IRIG OFFSET	II PROTECTION
PARTITION MODE	RESERVED

2.5.3. Menu Select

2000FPS 1024X1024 1/2000S

Move the joystick up, down, left or right to steer the cursor [>]. Bring the cursor to the top of a menu item that you wish to pick and press the joystick handle down firmly, and the menu item is selected.



2.5.4. Canceling Menu Selection

To cancel a selection of any menu item, press the MENU button while the menu is displayed.

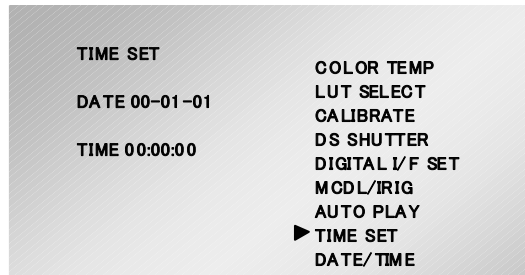
2.6. System Setup (Date, Time and Revision)

This section discusses how to set up the internal clock of the APX system. Date and time are correctly set up and are stored as a part of recorded image data. Once the clock is set up, it is supported by an internal battery and the date and time are retained correctly even when the system is switched off.

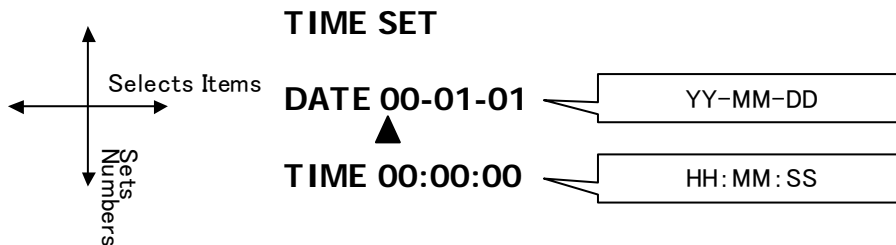
2.6.1. Setting Date and Time

Follow the below procedure to set up date and time of the clock.

1. Press the MENU button to display the menu. 「MENU」
2. Select [TIME SET] menu using the joystick on the keypad.
3. The TIME SET menu is shown as follows:



4. Left-Right movement of the joystick selects menu items, and up-down movement sets numbers.

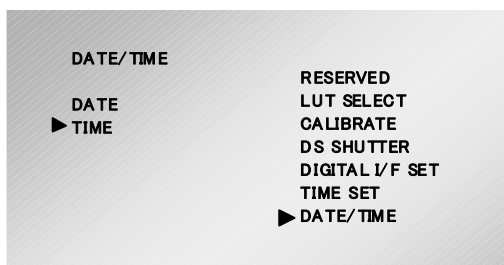


5. When all is done, press the joystick down firmly to enter the setting.

2.6.2. Switching Date / Time

For display in the image frame, either date or time can be chosen. Follow the below procedure to make a selection:

1. Press the MENU button to display the menu.
2. Select the [DATE/TIME] menu by the joystick.
3. The DATE/TIME menu is displayed as follows:

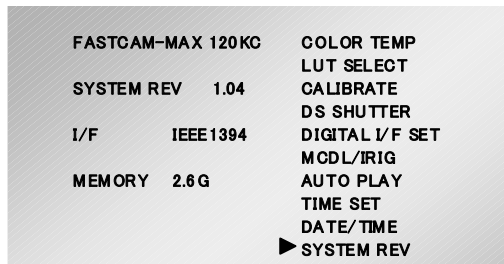


4. Move the cursor up or down to select either DATE or TIME. The selected item, DATE or TIME is now displayed.
5. When selection is done, press the joystick down firmly to set the selection as default.
6. Check to see if the time indication is shown as it was intended.

2.6.3. Displaying System Revision

The current system version number is shown on the display.

1. Press the MENU button to display the menu.
2. Select [SYSTEM REV] by the joystick on the keypad.



3. The current system revision number is displayed.

Memo

Chapter 3. Before Recording **(Image Intensifier Operation)**

3.1. Operation of Image Intensifier

Caution:

To prevent the intensifier from burning and to make its useful life as long as possible, you are strongly urged to use the system following, as closely as possible, the setups and procedures instructed and suggested in this manual.

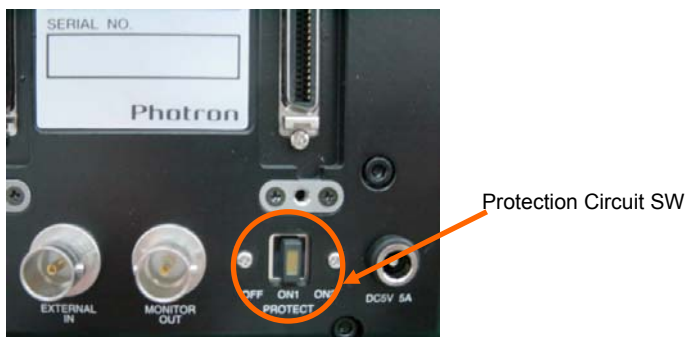
3.1. Operation of Image Intensifier

3.1.1. I.I. Protection Circuit

The function of the Image Intensifier Protection Circuit is discussed as follows:

3.1.1.1. Turning on the protection circuit

The protection circuit is switched ON or OFF by the Protection Circuit Switch located on the camera's rear panel.



OFF: Turns the protection circuit off. When this switch is in the OFF position, the protection circuit is disabled. Avoid any excessive light falling on the light-entrance window of the intensifier.

ON1 (MODE1): The protection circuit is active. In this mode, the actuating point of the protection circuit is adjustable. Select II PROTECTION in the main menu and you can set the actuating point to one of the five steps 1 to 5 (see "I.I. menu operation", Subsection 3.1.2. for details). The protection circuit is set to NO1 (MODE1), and II PROTECTION to 1 at factory before shipping.

ON2 (MODE2): The protection circuit is active. In this mode, the actuating point of the protection circuit is NOT adjustable. It is fixed to a value that is equivalent to PROTECTION 5 of MODE1.

Note: The use of the protection circuit is always recommended any time the II is operated.

3.1.1.2. Operation of protection circuit

Turn on the protection circuit switch and the yellow indication LED lights. When active, the protection circuit trips and automatically shuts off the operation of the intensifier as soon as excessive light is detected on the entrance window. At this time, the green LED on the POWER SW blinks to indicate the shutoff status of the intensifier. Blinking green LED, with the yellow LED on, indicates that the protection circuit has tripped, holding temporarily the operation of the intensifier.

To resume the operation of the intensifier from the dormant status, turn off the power from the keypad or the software, and then reactivate the system by switching power on by the keypad or the software. However, before reactivating the system, be sure to remove the cause of the excessive light that fell on the entrance window of the intensifier.

3.1.2. 1.1. (Image Intensifier) menu operation

There are three menus that are used to set up the II (image intensifier) for operation. Details of them are described below:

① **II POWER Menu** ····· switches power to the II (image intensifier) on and off.

Press the MENU button on the keypad to have the main menu displayed. Select "II POWER" in the menu. The II POWER menu is displayed in the window as shown below:

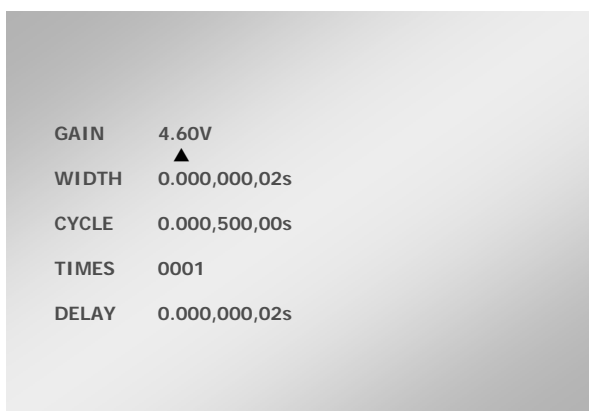


II POWER		OFF	Switches power off.
		ON	Switches power on.
		ON LOAD	Switched-on status stored in memory. Switches power on.

The above setup starts up the intensifier, but the II is not ready to work. The monitor screen remains dark unless II's gating is set up as shown in ③ below.

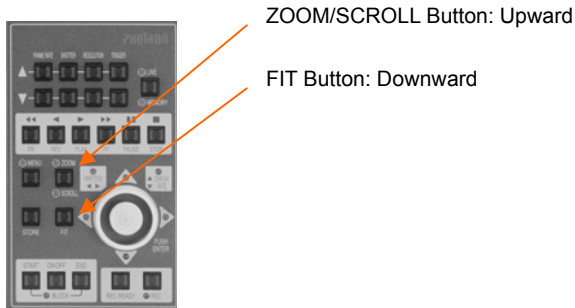
When you press the STORE button while the II is active, the status of the II is stored in memory. At this time, the gate setting is still off; it must be set up.

② **II GAIN GATE** ····· sets the gain and gate of the II.



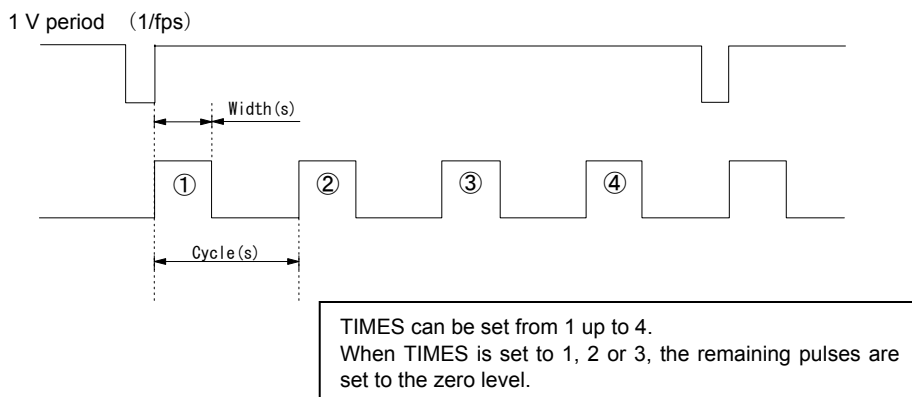
Note: When you move the cursor between the setup items, press the ZOOM/SCROLL button for upward movement and the FIT button downward. The up-down movement of the joystick changes the setup values only. Its left-right movement does not move the cursor between menu items.

For multiple exposures, you need to set up CYCLE and TIMES. CYCLE shows the time interval between gates for multiple gating operation. TIMES sets the number of multiple exposures that are possible.



- **GAIN** Sets to a voltage from 4.60 V down to 2.00 V. The lowest voltage varies by the II being used. Default value is 4.6 0V (maximum).
- **WIDTH** Sets the gate width. It is changeable by 20 ns increment. The maximum gate width is (CYCLE – 20) ns. Default value is 20 ns. It works in the gate mode “GATING/DELAY”.
- **CYCLE** Setup item for multiple exposure operation. Default is 1/fps. It works in the gate mode “GATING”.
- **TIMES** Sets the number of multiple exposures to be made. The number can only be set if it matches the setting of CYCLE. It works in the gate mode “GATING”.
- **DELEY** Sets the amount of delay when the gate mode is “DELAY”. It is changeable by 20 ns increment. It works in the gate mode “DELAY”.

Setup of multiple exposures (Example)



③ **GATE SELECT** Selects a gate mode out of the following five.

▶ OFF	When gate is OFF, II does not work even if the II unit is powered on.
CONTINUOUS	Gate operates in synchronization with the camera shutter.
GATING	Gate operates according to the value set up in ② (except DELAY).
EXTERNAL	Gate operates in sync with the gate signal input to EXTERNAL IN on the camera head.
DELAY	Gate operates according to the value (WIDTH/DELAY only) set up in ② above.

Explanation of each gate mode is given below:

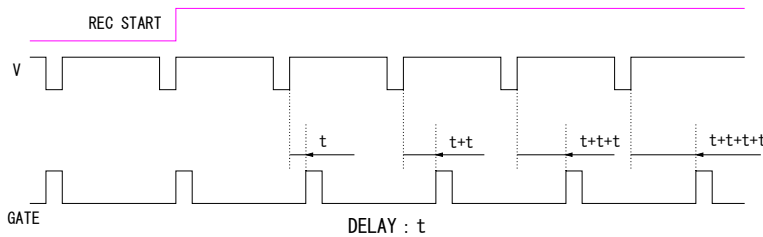
- **OFF** No gating operation can be made when OFF is selected. When power is switched on (either by ON or ON LOAD in the II POWER menu), the intensifier gets in this OFF status by default. The intensifier will not be in operation unless the gate setting is made as shown in ③ GATE SELECT.
- **CONTINUOUS** The intensifier operates in synchronization with the camera shutter. Select a shutter speed on the keypad and the intensifier gate is automatically set accordingly. Note that the item set in ② II GAIN GATE only is reflected; other items (those set in CYCLE, WIDTH, TIMES and DELAY) are not.
- **GATING** Items set in ② CYCLE, WIDTH and TIMES are reflected. The intensifier performs gating operation in accordance with these settings. In internal operating mode, use this GATING to set the above items when gating of higher rate than the shutter speed. The camera shutter MUST be set to 1/ (frame rate).
- **EXTERNAL** The intensifier performs gating operation with the signal that is input to the [EXTERNAL IN] BNC connector on the camera head. Because no processing is done to the incoming signal, the signal needs to be correctly synchronized with the camera shutter in advance.

Note: The intensifier does not support DC operation. If a HIGH signal is input continuously over 2 seconds, the protection circuit automatically shuts down the intensifier.

* How to recover from a shut down status: When the protection circuit is active, the indication LED on the camera head blinks. Switch the II power off from the menu, and switch power on again.

Note: Only the item set under GAIN in ② is reflected; all others (CYCLE, WIDTH, TIMES and DELAY) are not.

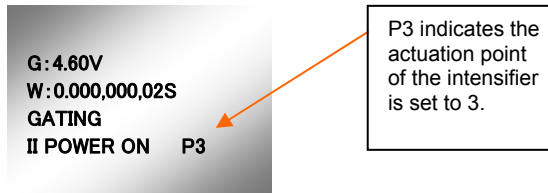
- **DELAY** Gating of the intensifier is delayed by the delay value set in ② DELAY at each occurrence of a gate pulse as shown below. In this mode, get [REC POS] signal from [GENERAL OUT] of the camera processor and feed it to [EXTERNAL IN] on the camera head. The camera trigger modes that support this DELAY mode are START and RANDOM only. Any trigger mode where an endless recording of captured image data is involved does not support this DELAY mode. The camera shutter must be set to 1/ (frame rate).

DELAY MODE

④ **II PROTECTION:** This allows adjusting the actuation point of the protection circuit. You can select any actuation point, 1 to 5, of the protection circuit when the Protection SW on the camera head is placed in the ON1 (MODE1) position.



The actuation point of the protection circuit can be set to any of the five steps, 1 to 5, when Protection SW is in the ON1 (MODE1) position. Setting the maximum allowable amount of light falling on the entrance window of the intensifier to 100 %, the PROTECTION step 1 denotes 20 % of the maximum light amount; 2 40 %; 3 60 %; 4 80 % and 5 100 %. The actuation point that is currently selected is displayed on the monitor for confirmation as is the case with other II settings.



P3 indicates the actuation point of the intensifier is set to 3.

Note: When you are going to set gating and delay in the GATE or DELAY mode, first set the camera shutter back to 1/ (frame rate). Otherwise, image is not captured, displayed or recorded because, if the intensifier is gated at the timing preset in the GATING/DELAY mode, the gate is opened at the moment the image sensor is not in exposure period because the shutter function is out of synchronization with gating.

Note: When you turn on the intensifier into operational status, in order to protect the intensifier from being burnt, follow the below procedure:

1. Connect the AC power adapter.
2. Switch the camera on.

3. Select ON from the II POWER menu on the keypad.
 4. Select a gate mode in the GATE SELECT mode.
- The intensifier is operational only after the above procedure has been completed.

Note: Protection SW and the actuation point are factory-set to ON1 (MODE1) and 1, respectively.

Note: It is strongly recommended that the protection circuit is activated whenever the intensifier is operated. The provided software also has a protection feature incorporated. The combined use of both protection features are recommended.

3.1.3. Storing settings

Settings of the intensifier can be stored in the camera memory.

<How to store>

- ① After completion of the intensifier setting, while the intensifier is still powered on, press the MENU button on the keypad to exit the menu.
- ② Press the STORE button on the keypad, and the settings have been stored in the camera.

<How to use the stored settings>

- ① Press the MENU button on the keypad and select <II POWER>. The ON/ON/ON-LOAD menu is displayed.
- ② Select <ON LOAD> by the cursor and press the <Enter> button on the keypad. Power to the intensifier is switched on by the stored setting. Note that the <GATE MODE> setting is still off, as is the case with power-on by the POWER switch.
- ③ Select a gate mode. Press the MENU button and select <II GATE MODE> and press the <Enter> button on the keypad. OFF / CONTINUOUS / GATING / EXTERNAL / DELAY are displayed. Select one of them and press the <Enter> button to confirm the selection.

Note: The setting data that is stored in the camera includes the camera data such as the frame rate and shutter speed. To store the II setup data, make settings of the camera correlated with those of the intensifier.

3.1.4. Operation before Recording

① Intensifier Power ON-OFF

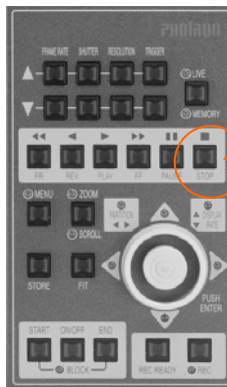
The intensifier has a protection circuit incorporated. However, it does not mean that the intensifier is completely protected against damage. You must be very careful not to expose the intensifier to excessive light input. In order to avoid any unexpected exposure of the intensifier to light, place a lens cap on the objective lens while you set up the intensifier and the camera, and keep the lens iris to the largest f-stop (f16 or f32). If you are using lighting equipment, switch it off or swing it away from the object, or adjust the light amount to the minimum setting if it is adjustable.

In case of an emergency, shut the camera processor power off, or, when the intensifier is in the PLAY mode, press the STOP button on the keypad, which is the shortcut key for shutting the intensifier off.

Intensifier power
ON-OFF switch
(on the camera rear)

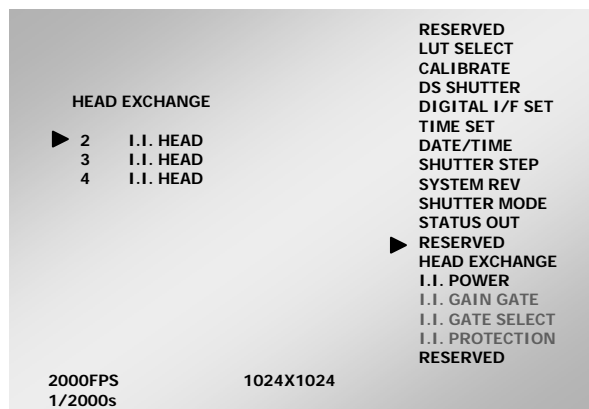


STOP button on keypad



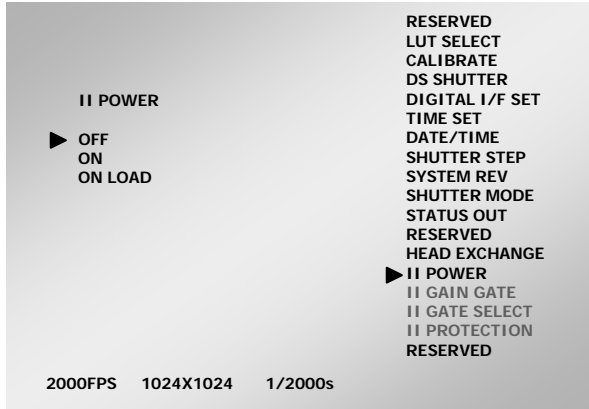
② Initializing Intensifier

Press the MENU button on the keypad and go to <HEAD EXCHANGE>, and then select [II HEAD]. Loading starts and the camera is initialized. If the camera had already been selected prior to the use at this time, this procedure is not necessary because the camera should have been initialized during the previous use.



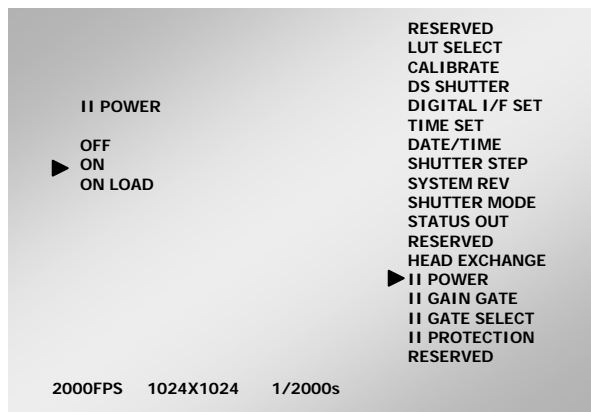
③ Confirming settings of camera

When the camera has been set up, II POWER OFF is displayed on the video monitor. If it is not displayed, the camera head has not been correctly set up. Reset the camera carefully.



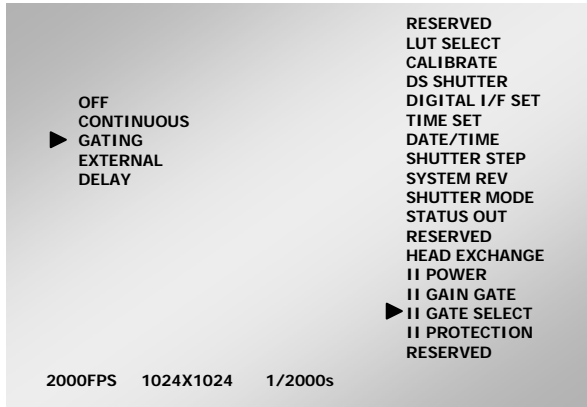
④ Switching intensifier power on

After the camera has started up, reconfirm the II switch on the back of the camera head is off. Turn on the power SW on the back of the camera processor. The SW LED does not light at this time. Press the MENU button on the keypad to open the menu. In the <II POWER> part, select ON with the enter key of the keypad. When the selection is confirmed, the SW LED (green) on the camera head lights indicating the intensifier has been powered. With the LED on, operation of the intensifier is reflected in the image on the monitor.



⑤ Setting gate

When you switch the intensifier on in the menu, all the menu items shown below are activated. Make selection in [II GATE SELECT] and the intensifier starts working. Note that the intensifier does not work if it is switched on. This is because its gate has not yet been activated.



Monitor display when II GATE SELECT is selected.

⑥ Setting gain

Open the menu on the keypad and select [II GAIN GATE]. Set GAIN to 4.60V, the maximum value.

⑦ Adjusting lens aperture

After the above settings are done, double-check that the lens aperture is set to the highest f stop (see ①). Remove the lens cap. Gradually open the lens aperture from the highest f-stop (f16 or f32). As you increase the lens opening (smaller f-stop numbers), you will begin to see an image on the monitor.

⑧ Adjusting light source

If a light source is used in your application, adjust the light level to a minimum value (assuming the light can be adjusted). If the light source is not adjustable, turn the light away from the scene that the intensifier will view to reduce the initial light level.

Before opening the lens completely (smallest f-stop possible), try adding light in small increments. If the image on the monitor appears very bright, move the lens f-stop to a larger f-stop number (close the lens down). Do not increase the amount of light rapidly. Avoid exposing the intensifier to excessive light levels where the image on a monitor would be very saturated or bright.

⑨ Adjusting gain

If there is a level of noise in the image, try setting the gain to a lower number (see ⑥ Setting gain) and increase the input light amount in small increments. Note the increase of light directly affects the useful life of the intensifier.

⑩ Important tips for longer useful life of intensifier

- Reduce the input light amount as much as possible.
- Operate the gain setting to a level where it is sufficient to produce an image, but within the range where the image does not saturate. Using high gain settings will consume the intensifier's useful life faster.
- Operate at as low a frame rate as possible to reduce the amount of light amplification. If you are using a shutter speed faster than 1/ (frame rate), lowering the frame rate will not matter.
- Try increasing the camera gain before increasing the intensifier gain. This will reduce the amount of light amplification required by the intensifier. The camera gain can be found in the PFV LUT settings under MORE.
- When the image on the monitor screen is too dark, first try a higher gain setting.

- If the subject is stationary for long periods and you take image with the intensifier, this has a tendency to burn the image into the intensifier. Do not shoot stationary scenes with the intensifier over long periods of time (minutes) to avoid burning the intensifier screen.
- Do your setup on the camera & intensifier at lower frame rates for focusing and Field-Of-View adjustments. This will reduce the time that the intensifier is on at higher gain levels.
- When the intensifier is not operating, shut the power off and place a cap on the lens.

⑪ Useful life of the intensifier

1. For a given period of operation time, the more input light exposed on the intensifier, the shorter will be its useful life.
2. Allowing the intensifier to be exposed to high light intensities (high light input) over time will deteriorate the intensifier gain.
3. For a given amount of input light, the higher gain setting that you use will produce a higher light amplification with the intensifier but it will result in a shorter useful life.
4. The amount of input light and the accumulated length of time of exposure to input light adversely affect the useful life of the intensifier.

⑫ Image quality

An image intensifier's image quality is determined by many factors including the previous history of use for the intensifier as well as the light amplification requirement, resolution of the intensifier, wavelength of incoming light, coupling methods to an electronic sensor and other factors. The image quality is affected the most by the intensifier's previous use as well as the amount of light amplification required to produce an image. Therefore, if more light can be used to illuminate a scene, the better the image quality will be with the intensifier. The reason is due to the fact that both noise and light are amplified with the intensifier. At higher gains, more noise is amplified as well as the image signal, which heavily affects the useful life of the intensifier. It is a trade-off between the useful life and image quality.

⑬ High-Speed Framing

An image intensifier has a finite life of use. The longevity of useful life is determined entirely by use and environment. A high-speed camera takes images very fast. There is a direct relationship between the number of exposures, the intensity of exposure and the frequency between exposures that relates to the rate at which an intensifier is consumed. As the intensifier is consumed, it will become less sensitive at a given gain (amplified) level. Therefore, more gain will be required for the same application over time. In this case, time may mean months or it may mean hours depending on how the intensifier is used and protected by the user.

For example, when the frame rate is doubled, the output of the intensifier must be doubled as well. In this case, if the amount of input light is not increased, the intensifier gain will need to be increased and the intensifier sensitivity deterioration is accelerated. Also, the same situation can occur where excessive light is required in order to make image with low noise.

When the frame rate is set to higher than 2,000 fps (frame rate will be at a resolution smaller than the full resolution), only a portion of the full frame can be displayed on the monitor. If there is a strong light falling on a portion of the intensifier surface that is not displayed on the screen, damage can occur without the user knowing the intensifier is being overexposed.

⑭ Use of electronic shutter of the imaging sensor

When the electronic shutter is used, the exposure time on the sensor is shortened. As a result, the useful life of the intensifier is adversely affected because the intensifier has to operate at higher gain levels since the imaging sensor needs more light output from the intensifier. As an example, if the shutter speed of 1/1000 sec is used for 250 fps framing, the imaging sensor needs light input amount equal to that needed for 1,000 fps. Therefore, whenever possible, set the shutter rate of the camera at 1/frame rate.

3.1.5. Switching intensifier off

Press the MENU button on the keypad to open the menu. Select <II POWER> and then select <OFF> and press the Enter key. The LED indicator in the II power switch on the camera head goes out. Move the II power switch to the OFF position and the shutdown of the intensifier is completed. Be sure to use this II power switch whenever you shut down the intensifier.

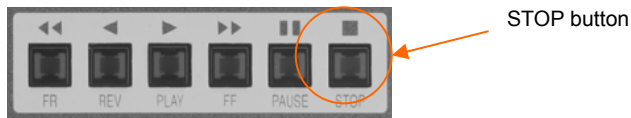
To switch the camera processor off, be sure to do so only after you have first shut down the intensifier.

If the power to the intensifier is shut off using the II power SW on the camera head in an emergency, the menu display remains as it was before the shutoff, which erroneously indicates as if the intensifier is still working. To return the intensifier from this status to active status, you need to press the MENU button to have the menu displayed and select <II POWER OFF> and enter it, and then select <II POWER ON> and enter it. Make sure the green LED indicator in the II power SW on the camera head has lighted, which indicates the intensifier is back in the active mode.

Shutdown of intensifier from keypad

In an emergency, the power to the intensifier can be shut off from the keypad. Simply press the STOP button on the keypad to shut down the intensifier. With this switch, there is no need to use the menu to switch the intensifier power off in an emergency.

Note, however, this STOP switch is for shutdown of the intensifier only. To switch the intensifier on, you must use the menu to select II POWER ON (see ④ Switching intensifier power on).



Memo

Chapter 4. Recording

- 4.1. Initialization (Shading Correction)*
- 4.2. Selecting Frame Rate*
- 4.3. Selecting Resolution*
- 4.4. Selecting Shutter Speed*
- 4.5. Selecting Trigger Mode*
- 4.6. Partitioning Memory*
- 4.7. Look-Up Table Operation*
- 4.8. Extended Dynamic Range Mode*
- 4.9. External Trigger Input*
- 4.10. External Sync Input*
- 4.11. Setting Input and Output Signals*
- 4.12. Event Marker Function*
- 4.13. MCDL - Multi Channel Data Link*
- 4.14. IRIG Time Code*

4.1. Initialization (Calibration)

To take advantage of maximum performance of the APX-i2 system high image quality, it is necessary to correct the non-uniformity in sensitivity of each pixel of the imaging sensor. The APX has a calibration (shading correction) function that corrects the non-uniformity in output of each pixel based on black level. This function uses a uniform black image as reference to null the output of each pixel against black, making it possible to obtain uniform output from each of pixels in proportion to the level of incoming light.

Calibration is carried out automatically when the system is switched on. For the best result of recording, however, **it is strongly recommended that whenever you change framing parameters such as resolution, gain, frame rate, shutter speed, etc., you carry out calibration of the camera before starting a recording.**

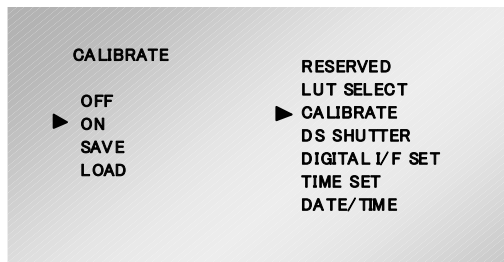
It may happen that as follows, but it will be resolved if you carry out calibration.

- ◆ Horizontality fixed noise appears.
- ◆ Partial area is clear but other area has noise.

The following procedure shows how to initialize the system.

4.1.1. Start Calibration

1. Turn off power to the intensifier.
2. Set up framing parameters such as frame rate and shutter speed.
3. Place a cap on the lens to completely cover it. The black image at this time is used as reference black. Make sure the lens is covered and there is no light falling on the imaging sensor.
4. Press the MENU button on the keypad to display the menu.
5. Use the joystick on the menu to go to [CALIBRATE] and press the joystick down to select.

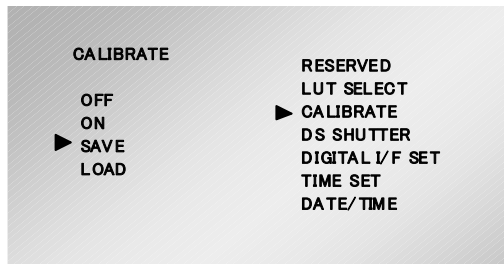


6. Use the joystick to go to [ON]. Double check if the lens is completely covered and press the joystick down at [CALIBRATE] to execute calibration.
7. Remove the lens cap and make sure corrected image is displayed.

4.1.2. Saving Calibrated Setting

The APX-i2 can save one pattern of black image data obtained through the execution of calibration. Follow the below procedure to save a correction pattern.

1. Press the MENU button on the keypad to display the menu.
2. Use the joystick to go to [CALIBRATE] and press the joystick down to select.
3. Use again the joystick to go to [SAVE] and press the joystick down to execute [SELECT].

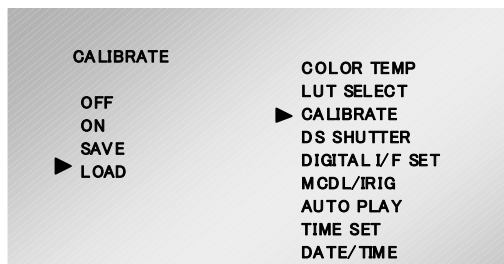


Note: It may take tens of seconds to several minutes to save data of a black image.

4.1.3. Loading Calibrated Settings

The black image data saved in the APX-i2 system may be loaded for subsequent use in the following manner.

1. Press the MENU button on the keypad to display the menu.
2. Use the joystick to go to [CALIBRATE] and press the joystick down to select.
3. Use the joystick to go to [LOAD] and press the joystick down to execute [LOAD].
4. The recorded black image data for calibration is read out from the processor memory and the calibration is reflected on the output image.



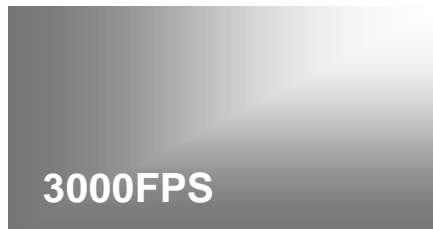
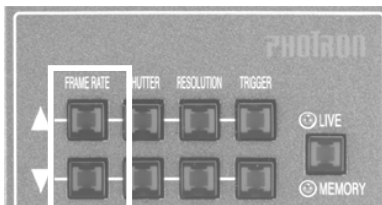
4.2. Selecting Frame Rate

The APX-i2 can set a frame rate of from 60 frames per second (FPS) upward depending on the particular need of a recording. With the APX-i2, frame rates from 60 FPS to 2,000 FPS allow for recording of image using the full resolution of 1024 x 1024 pixels. Recording at frame rates higher than 2,000 FPS, the resolution is limited by the read-out area (resolution) of the sensor.

The frame rate (FPS):

1.  mode.

2. Press the FRAME RATE up or down button on the keypad. The frame rate increases as the up button is pressed and decreases as the down button is pressed.



3. Make sure the frame rate indication in the lower left corner of the video image changes as either button is pressed.

Note: At a frame rate higher than 2,000 FPS, the maximum resolution of those allowable under the currently selected frame rate is automatically selected. Please see the Frame Rate / Resolution reference table in section 7.1.6.

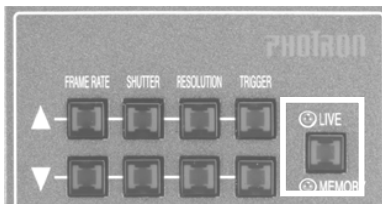
Note: The lowest frame rate for the PAL mode is 50 fps.

4.3. Selecting Resolution

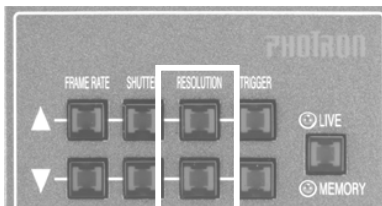
The APX-i2 has a high-speed mega-pixel imaging sensor with a full resolution of 1024 x 1024 pixels in its imager. It can produce a high-density image of 1,000,000 pixels in full resolution operation. Also, depending on the needs from each recording application, it can record at higher speeds by limiting the image resolution, or can record for a longer duration by reducing the amount of data of each of captured frames.

This section discusses how to select a resolution as follows:

1. Make sure the camera system is in the LIVE mode.

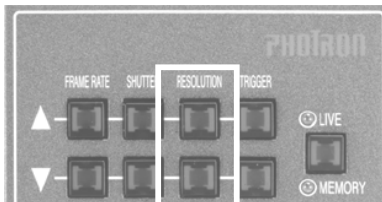


2. Use the RESOLUTION buttons on the keypad to select a desired resolution. Press the UP[△] button to make resolution increased, and the DOWN [▽] button decreased.



II POWER OFF
500FPS 1024X512 1/500S

3. Make sure the resolution indication in the lower left corner of the video frame changes as either of the RESOLUTION buttons is pressed.
4. The maximum available record duration is also updated together with resolution.



ID01/01 LIVE 12:29:59
START
4096FR / 8.192s

Note: See the Frame Rate/Resolution Reference Table (Section 7.1.6.)

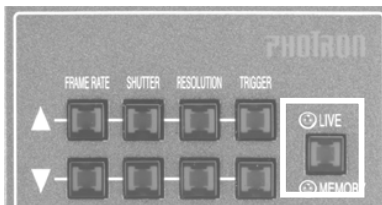
4.4. Selecting Shutter Speed

The APX-i2's electronic shuttering system makes it possible to control the exposure time within a frame regardless of the current frame rate. By using an exposure time that is shorter than the frame time determined by the frame rate (i.e. 1/frame rate sec.), you can capture events taking place at an extremely high speed as a still image without blurring effect.

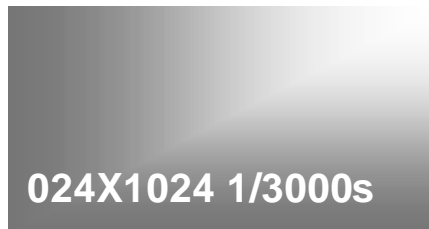
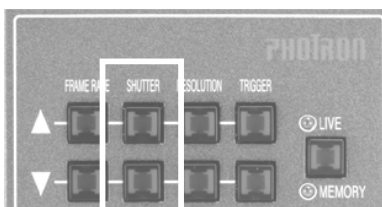
The shutter speed can be changed from the basic speed of 1/frame rate sec. up to 1/250,000 sec. (4 micro seconds) at an increment of 1/1,000 sec.

This section discusses how to select a shutter speed from the keypad.

1. Make sure the camera is in the LIVE mode.



2. Use the SHUTTER buttons on the keypad to select a shutter speed. Press the UP [Δ] button to have the shutter speed made higher, the DOWN [∇] button lower.



3. Make sure the shutter speed indication in the lower left corner of the video frame changes as either of the SHUTTER buttons is pressed.

Note: See the Shutter Speed Table, Section 7.1.6.

4.4.1. Switching Shutter Speed Steps

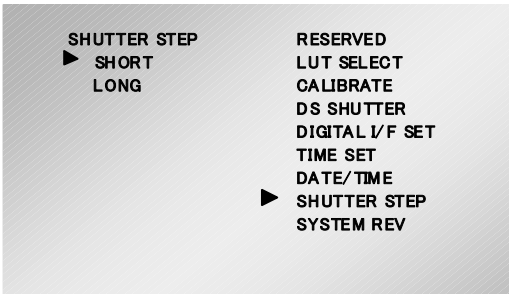
The APX-i2 system offers two choice of shutter speed increments, or steps, – FINE and COARSE – to choose from. With both sets of steps, the lowest shutter speed is 1/60 second with the speed doubling at each increment for the next five steps, up to 1/2000 regardless of which step mode is selected. After that, the COARSE step option causes the speed to double for the next several steps, and then offers users the more frequently-used shutter speeds.

With FINE steps, the shutter speed gradually increases after the 1/2,000 second threshold, in much finer increments of 1/1,000 seconds. With both options the highest shutter speed is 1/250,000 seconds.

Note: See the Shutter Speed Table, Section 6.1.6. for details of COARSE steps.

You can choose one of the two sets of shutter speed steps by the following operation:

1. Press the MENU button on the keypad to display the menu list.
2. Move the cursor to [SHUTTER STEP] and press the joystick down to select the menu.
3. The SHUTTER STEP menu is displayed as follows:



FINE	Shutter speed can be increased with 1/1,000 second step after 1/2,000.
COARSE	27 frequently-used shutter speeds are available to choose from

4. Move the cursor to [FINE] or [COARSE].
5. Press the joystick down to set the selection.

Note: See the COARSE Shutter Speed Table, Section 7.1.6.

4.4.2. Switching SHUTTER MODE

By switching between MODE 1 and MODE 2 on [SHUTTER MODE] in the menu, the setting mode of shutter speed is changed.

MODE 1: When the frame rate is changed, the shutter speed is automatically set to $1/(\text{frame rate})$.

MODE 2: If the frame rate is changed, the current setting is retained. When the retained shutter speed is larger than $1/(\text{frame rate})$, the shutter speed is automatically reset and retained to $1/(\text{frame rate})$.

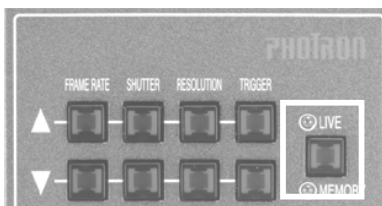
4.5. Selecting Trigger Mode

The APX-i2 has several different modes of triggering to meet the particular needs of capturing varied, instantaneous events.

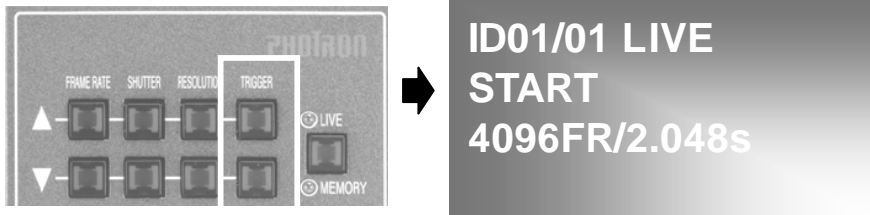
This section discusses how each of the trigger modes works.

First, the procedure to select a trigger mode is shown, and then how each trigger mode works is discussed.

1. Make sure that the camera is in the LIVE mode.



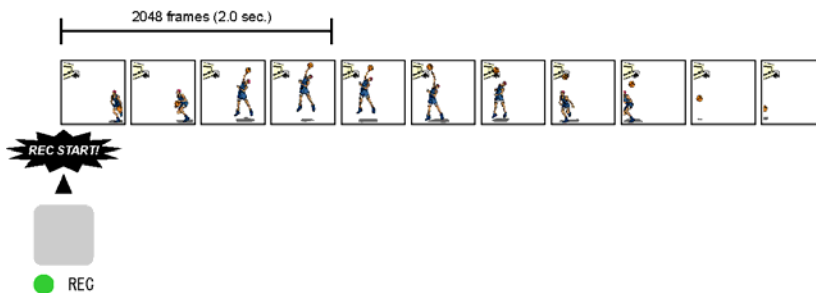
2. Press the TRIGGER \triangle or ∇ button on the keypad to select a trigger mode.



3. The selected trigger mode is displayed on the screen immediately. Make sure that the trigger mode indication changes as you press the \triangle or ∇ button.

4.5.1. START Mode

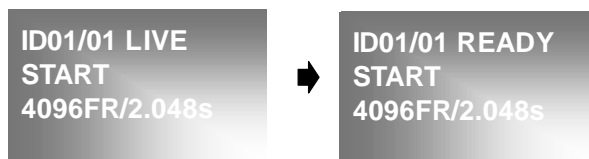
In the START trigger mode, the camera starts recording at the moment the REC button is pressed and continues recording until the memory is full, and automatically stops recording. This mode is useful when you know for sure when the anticipated event will occur. If your camera has a recording capacity of 2 seconds, for example, the camera records the high-speed event for two seconds after the REC button is pressed, as shown below.



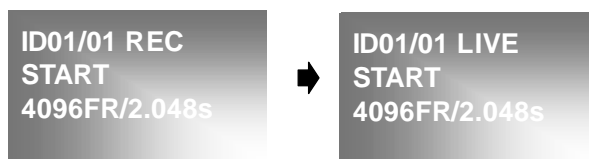
Recording in START Mode

Here is how to record in the START mode:

1. As discussed in Section 3.5, make sure that the camera is in the LIVE mode, and select the START trigger mode.
2. Press the REC READY button on the keypad. The camera is now in the READY mode. Make sure that the [LIVE] indication on the screen has changed to [READY].

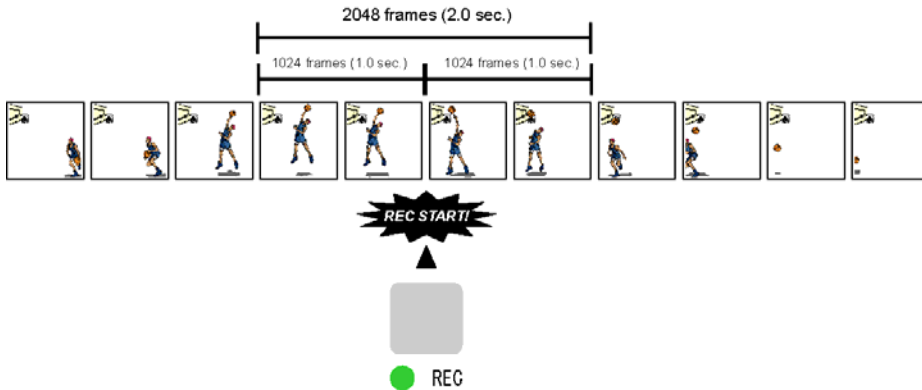


3. At the moment your interested event is coming up, press the REC button on the keypad. Note that the [READY] indication changes to [REC], indicating the camera is recording, and then it turns to [LIVE] when recording ends.



4.5.2. CENTER Mode

In the CENTER trigger mode, the camera records the target event in the same number of frames before and after the trigger. It is useful when you are interested in the scenes of before and after a particular event. If your camera has a recording capacity of two seconds, the camera records the scenes in the same number of frames (1024 frames – one second each) before and after the trigger as shown below.



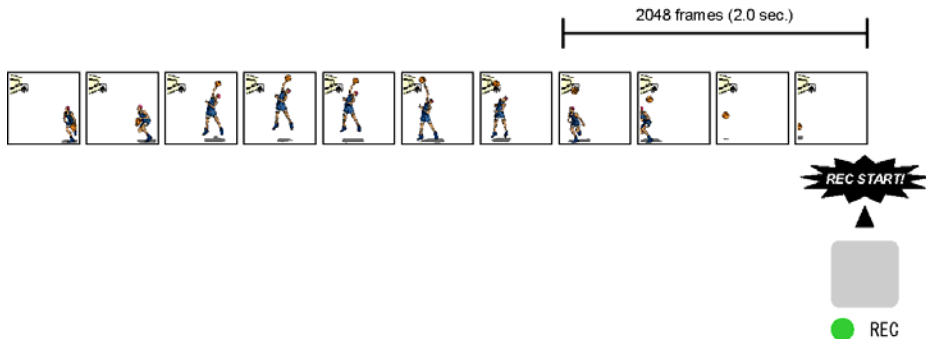
Recording in CENTER Mode

Follow the below procedure to record in the CENTER mode.

1. Following Section 3.5, make sure that the camera is in the LIVE mode, and select the CENTER trigger mode.
2. Press the REC READY button on the keypad. The camera is now in the READY mode. Make sure that the [LIVE] indication on the screen has changed to [READY].
3. Press the REC button on the keypad when your target event is expected to take place very soon. Note the indication on the screen has turned to [ENDLESS] showing that the camera is now recording the image of the target subject in the memory going around from end to end repeatedly.
4. At the moment you have seen your interested event has taken place, press the REC button again. The camera stops, having recorded the scenes before and after the event in the same number of frames. Note that the indication on the screen has turned from [ENDLESS] to [REC] to [LIVE].

4.5.3. END Mode

The END trigger mode records the images of a target event right before the REC button is pressed. This mode is useful when it is hard to know when your target event will take place. For example, if your camera has a recording capacity of two seconds, it records images of the event in the memory for two seconds before the REC button is pressed as shown below.



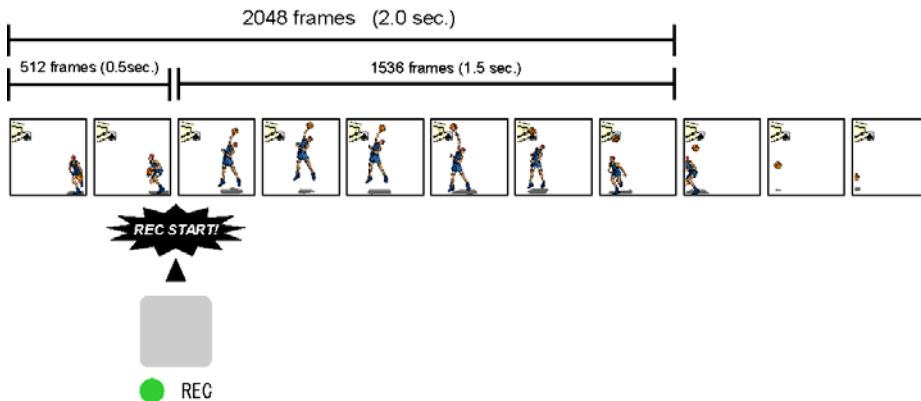
Recording in END Mode

Follow the below procedure to record in the END trigger mode:

1. As discussed in Section 3.5, make sure that the camera is in the LIVE mode, and select the END trigger mode.
2. Press the REC READY button on the keypad. The camera is now in the READY mode. Note that the indication on the screen has turned from [LIVE] to [READY].
3. Press the REC button on the keypad, and the indication on the screen turns to [ENDLESS]. The camera is now recording the image of the target subject in the memory going around from end to end repeatedly.
4. At the moment the event of your interest has taken place, press the REC button on the keypad again. The camera stops recording. The camera has recorded the event together with the scene right before it. Note the indication on the screen has turned from [ENDLESS] to [LIVE].

4.5.4. MANUAL Mode

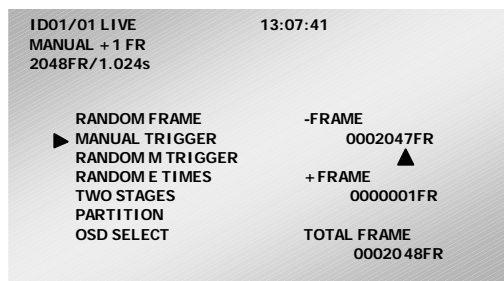
In the MANUAL trigger mode, the camera records scenes before and after the REC button is pressed. Unlike the CENTER mode, however, the numbers of frames to record before and after a trigger can be preset differently. For a camera with a recording capacity of two seconds, for example, record durations of 0.5 seconds before and 1.5 seconds after the trigger can be set as shown in the below figure.



Setting MANUAL Mode

To use your camera in the MANUAL mode, you need to divide the memory into two parts – one part for scenes before and another for scenes after – a trigger. Here is how to divide the memory

1. Press the MENU button on the keypad to display the menu list.
2. Move the cursor to MANUAL TRIGGER and press the joystick down to select it.
3. The MANUAL TRIGGER menu comes up as shown below. The right hand portion of the menu is for presetting the numbers of frames before and after a trigger.

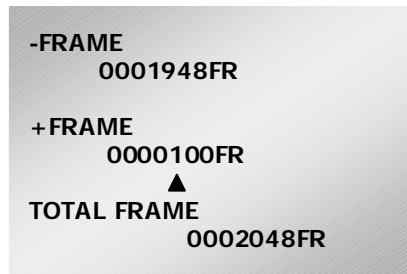
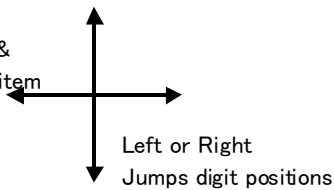


4. The meaning of each item is as follows:

-FRAME	Number of frames to record BEFORE a trigger.
+FRAME	Number of frames to record AFTER a trigger.
TOTAL FRAME	Total number of frames available in memory.

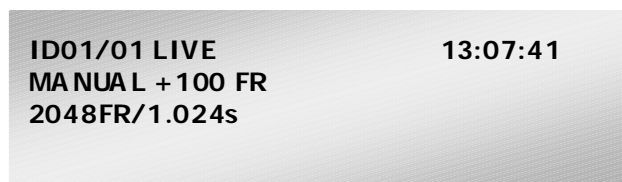
5. Now set the numbers of frames before and after a trigger. Using the joystick, up or down for increase or decrease the number, and left or right to jump the digit position, set a number. If you set the number for [-FRAME] as shown below, for example, the number for [+FRAME] is automatically set depending on the total number of frames available for recording.

Up or Down
Changes
number &
Selects item



6. When you are done, press the joystick down to enter the settings. Now you should see the trigger mode setup indication of [MANUAL +100 FR] in the upper left corner of the screen as shown below, where the number of frames to record after a trigger is 100.

7. Now the camera is ready to record 1948 frames before and 100 frames after a trigger.



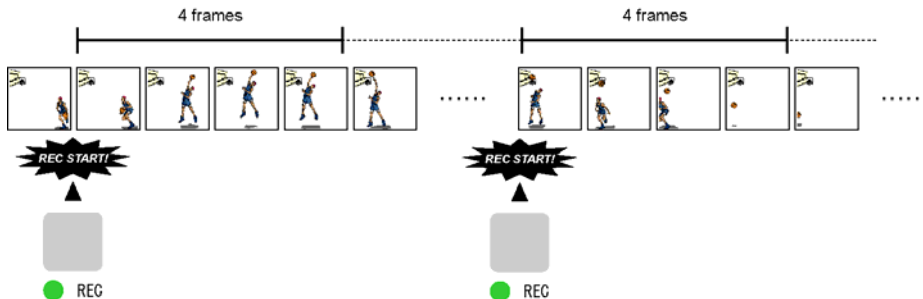
Recording in MANUAL Mode

After presetting the numbers of frames to record before and after a trigger as shown in the above example, follow the below procedure to record in the MANUAL trigger mode:

1. Following Section 3.5, make sure the camera is in the LIVE mode, and select the MANUAL trigger mode.
2. Press the REC READY button on the keypad. The camera is now in the READY mode. Make sure that the [LIVE] indication has turned to [READY].
3. Press the REC button on the keypad when your target event is expected to take place very soon. Note the indication on the screen has turned to [ENDLESS] showing that the camera is now recording the images of the subject in the memory going around from end to end repeatedly.
4. At the moment you have seen the event of your interest taking place, press the REC button again. The camera stops. It has recorded in its memory 1948 frames before and 100 frames after the trigger, respectively, as preset in the above example. Make sure that the indication on the screen has turned from [REC] to [LIVE].

4.5.5. RANDOM Mode

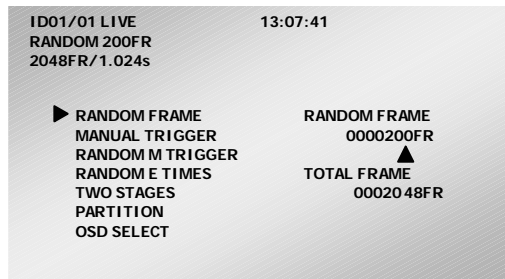
In the RANDOM trigger mode, the camera records in its memory a preset number of frames of images every time a trigger is given. This mode is useful to record images of events that take place at an unpredictable timing with output of a trigger signal. The number of frames to record at each trigger can be set any number from 1 (one) up to the total number of available frames in the memory.



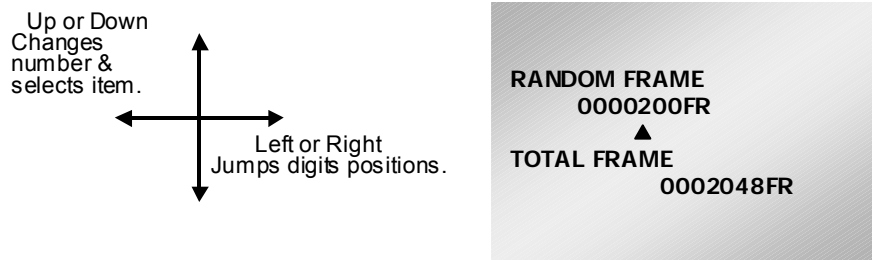
Setting Number of Frames for RANDOM Mode Recording

To operate the camera in the RANDOM trigger mode, you need to preset the number of frames to record at each trigger. Follow the procedure below:

1. Press the MENU button on the keypad to display the menu list.
2. Use the joystick on the keypad to move the cursor to [RANDOM TRIGGER]. Press the joystick down to select the menu.
3. The RANDOM TRIGGER menu appears as shown below. The number of frames to record at each trigger is shown in the lower right area.



- Now you can set the number of frames to record at each trigger by moving the cursor with the joystick as shown in the following figure on the next page. Move the joystick, left or right, to select a digit, and, up or down, to increase or decrease the number in each digit as necessary.



- When you are done, press the joystick down to enter the settings. Now you should see the number of frames to record at each trigger as [RANDOM 20 FR] in the upper left area of the screen as shown below, where the number of frames to record at each trigger is 20.



Recording in RANDOM Mode

Follow the below procedure to record in the RANDOM mode.

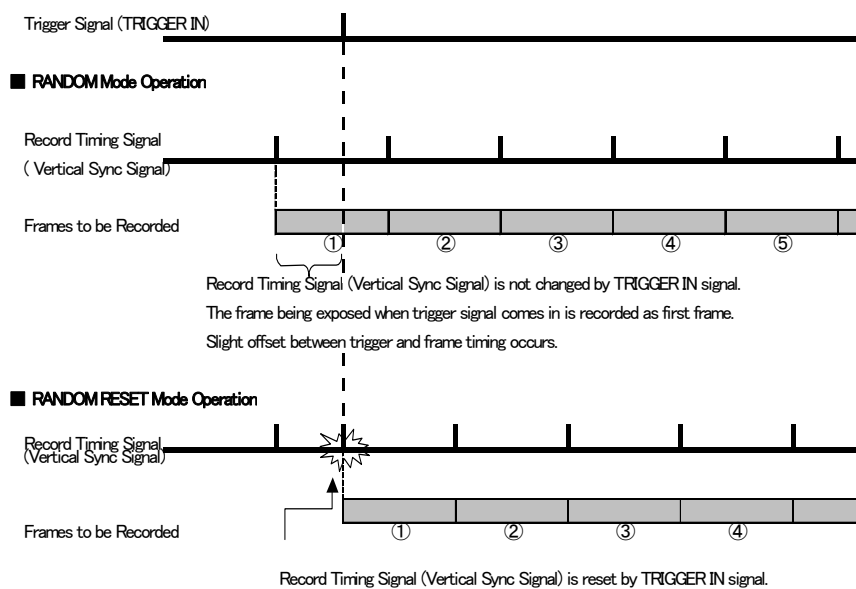
1. Following Section 3.5, make sure the camera is in the LIVE mode and the RANDOM trigger mode has been selected.
2. Press the REC READY button on the keypad. The camera is now in the READY mode. Make sure that the indication on the screen has turned from [LIVE] to [READY].
3. Press the REC button on the keypad for the first time. Note the indication on the screen has turned from [READY] to [REC]. The camera is now recording images in the memory going around from end to end repeatedly.
4. Press the REC button again when you know events of your interest are coming up very soon. The camera records in the memory the preset number of frames of images and stands by for a next trigger. In addition to the REC button on the keypad, contact or TTL signals from external trigger input terminals can be used to trigger the camera in the RANDOM mode (see Section 3.10 External Trigger Input).
5. The camera automatically stops recording when the memory is full (*). Make sure the indication on the screen has turned from [REC] to [LIVE].

*Note: You can stop recording by pressing the REC READY button at any time during recording.

4.5.6. RANDOM RESET Mode

This section describes the principle of operation of the RANDOM RESET mode in comparison with the RANDOM and START mode. To simply put it, the RANDOM RESET mode is a mode of recording operation that has been devised to improve the accuracy of temporal relationship between the timing of trigger input and that of start of recording by resetting the recording timing, i.e. vertical sync, at the input of a trigger.

The following figure is a visual presentation of the basic idea of the RANDOM RESET mode.



The above figure shows the difference in timing of trigger input and start of recording between the RANDOM (or START) mode and RANDOM RESET mode.

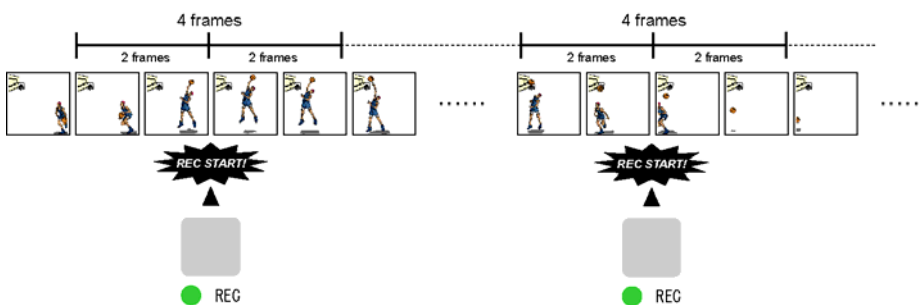
In the RANDOM or START mode, the record timing signal (vertical sync) advances regardless of the timing of trigger input as shown in the above. Because of this fact, the recording start time of the first frame may be slightly brought forward, up to about 3/4 of a framing cycle, depending on when the trigger is given, and there is no knowing how much the offset may be.

In the RANDOM RESET mode, on the other hand, the record timing signal (vertical sync) is reset by the trigger input and restarts working from that point. By resetting the vertical sync at the trigger, we now know exactly the temporal relationship between the trigger input and start of recording of the first frame. It is a known fact that it takes 100 ns from the input of a trigger signal to reset of the vertical sync signal, i.e. start of recording.

Note: Technically, there is a slight time lag between the record timing (vertical sync) and start of exposure, which is dependant on the framing rate being used (7.4 us at 2,000 fps).

4.5.7. RANDOM CENTER Mode

In the RANDOM CENTER trigger mode, the camera records in the memory a preset number of frames of images at each trigger, as in the case with the RANDOM mode. The difference is that the RANDOM CENTER mode records the preset number of frames before and after a trigger, while the RANDOM mode only records after a trigger. This mode is useful to record images of events that take place at an unpredictable timing with output of a trigger signal and that you wish to observe together with scenes preceding the it. The number of frames to record at each trigger can be set any number from 1 (one) up to the total number of available frames in the memory.



Setting Number of Frames and Triggers for RANDOM CENTER Mode Recording

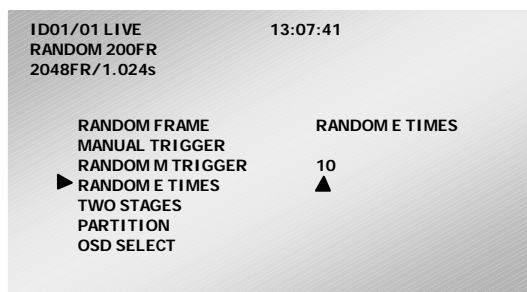
The procedures for presetting the number of frames to record at each trigger and the number of triggers to be given during a recording session are the same as the ones used in the RANDOM trigger mode. See the previous Section 3.5.5 RANDOM Mode.

Setting Number of Recordings for RANDOM CENTER Mode Recording

The maximum number of trigger accepted in RANDOM CENTER mode operation is ten (10) times. It is possible to end a series of recordings when a preset number of input triggers finished. This subsection describes how to preset a number of trigger inputs.

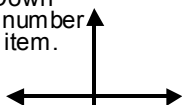
1. Press the MENU button on the keypad to display the menu list.
2. Move the cursor to [RANDOM E TIMES] and press the joystick down to set the selection.

3. The RANDOM E TIMES menu is displayed as shown below. The number of trigger acceptance is preset in the right-hand side area of the screen



4. Set a number of trigger acceptance using the joystick on the keypad.

Up or Down
Changes number
& selects item.



Left or Right
Jumps digit position.



Recording in RANDOM CENTER Mode

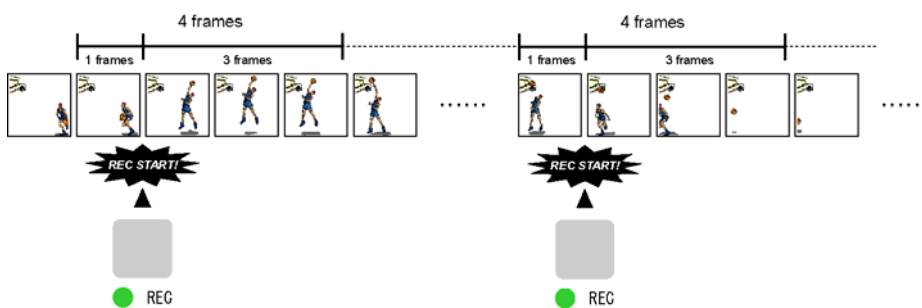
Here is how to record in the RANDOM CENTER mode:

1. Following Section 3.5, make sure that the camera is in the LIVE mode, and select the RANDOM CENTER mode.
2. Press the REC READY button on the keypad. The camera is now ready to record. Make sure that the indication [LIVE] has turned [READY].
3. Press the REC button on the keypad for the first time, which will turn the camera into ENDLESS recording mode. Note the indication on the screen has turned from [READY] to [ENDLESS]. The camera is now recording images in the memory going around from end to end repeatedly.
4. Press the REC button again when you know events of your interest are coming very soon. The camera records in the memory the preset number of frames of images before and after the event, and stands by for a next trigger. In addition to the REC button on the keypad, contact or TTL signals from external trigger input terminals can be used to trigger the camera in the RANDOM mode (see Section 3.10 External Trigger Input).
5. The camera automatically stops recording when the memory is full (*). Make sure the indication on the screen has turned from [ENDLESS] to [LIVE].

*Note: You can stop recording by pressing the REC READY button at any time during a recording session.

4.5.8. RANDOM MANUAL Mode

In the RANDOM MANUAL trigger mode, the camera records in the memory a preset number of frames of images at each trigger, as in the case with the RANDOM CENTER mode. The difference is that the RANDOM MANUAL allows for any number of frames to be recorded before and after a trigger, while the RANDOM SENTER mode records the same number of frames before and after a trigger. This mode is useful to record images of events that take place at an unpredictable timing with output of a trigger signal and that you wish to observe together with scenes preceding the it. The number of frames to record at each trigger can be set any number from 1 (one) up to the total number of available frames in the memory.



Setting Number of Frames and Triggers for RANDOM MANUAL Mode

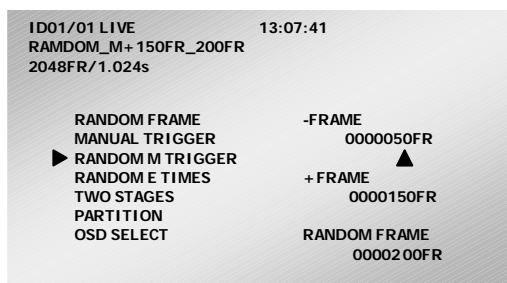
The procedures for presetting the number of frames to record at each trigger and the number of triggers to be given during a recording session are the same as the ones used in the RANDOM CENTER trigger mode. See the previous Section 3.5.5 RANDOM CENTER Mode. After presetting these numbers, go to the following procedure for RANDOM MANUAL mode setting.

Setting RANDOM MANUAL Mode Recording

To use your camera in the RANDOM MANUAL mode, you need to preset numbers of frames to record before and after each trigger. Here is how to preset these numbers:

1. Press the MENU button on the keypad to display the menu list.
2. Move the cursor by the joystick to [RANDOM TRIGGER] and press the joystick down to select the menu.

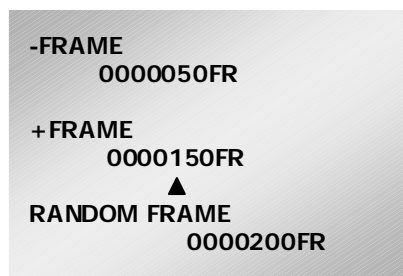
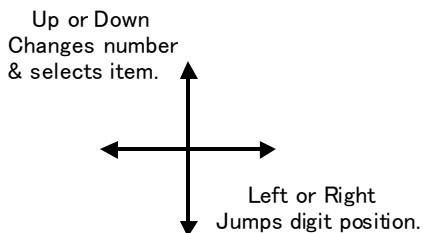
3. The RANDOM M TRIGGER menu is displayed as shown below. The numbers of frames to record before and after a trigger are shown in the right hand area.



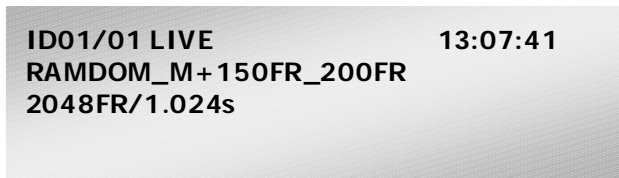
- 4 The meaning of each item is as follows:

-FRAME	Number of frames to record BEFORE a trigger.
+FRAME	Number of frames to record AFTER a trigger.
TOTAL FRAME	Total number of frames to record at a trigger.

5. Now set the numbers of frames to record before and after a trigger. Using the joystick, up or down to increase or decrease the number, and left or right to jump the digit position, set a number. If you set the number for [-FRAME] as shown below, for example, the number for [+FRAME] is automatically set depending on the total number of frames to record at each trigger.



6. When you are done with setting, press the joystick down to enter the settings. Now you should see the trigger mode setup indication of [RANDOM_M+150FR_200FR] in the upper left corner of the screen as shown below, where the number of frames to record after a trigger is 150 and the total number of frames to record at each trigger 200. Now the camera is ready to record 50 frames before and 150 frames after each trigger.



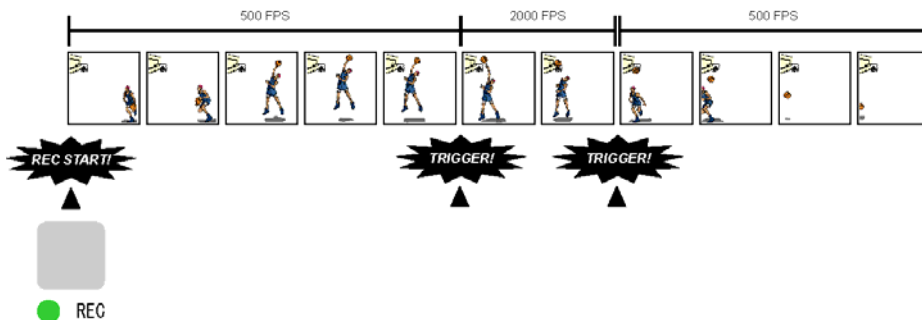
Recording in RANDOM MANUAL Mode

Follow the below procedure to make a recording in the RANDOM MANUAL mode:

1. Following Section 3.5, make sure the camera is in the LIVE mode, and select the RANDOM MANUAL mode.
2. Press the REC READY button on the keypad. The camera is now in the READY mode. Make sure the indication [LIVE] on the screen has turned to [READY].
3. Press the REC button on the keypad for the first time, which will turn the camera into ENDLESS recording mode. Note the indication on the screen has turned from [READY] to [ENDLESS]. The camera is now recording images in the memory going around from end to end repeatedly.
4. Press the REC button again when you know events of your interest are coming up very soon. The camera records in the memory the preset number of frames of images before and after the event, and stands by for a next trigger. In addition to the REC button on the keypad, contact or TTL signals from external trigger input terminals can be used to trigger the camera in the RANDOM MANUAL mode (see Section 3.10 External Trigger Input).
5. The camera automatically stops recording when the memory is full (*). Make sure the indication on the screen has turned from [ENDLESS] to [LIVE].

*Note: You can stop recording by pressing the REC READY button at any time during a recording.

4.5.9. DUAL FRAMING RATE Mode



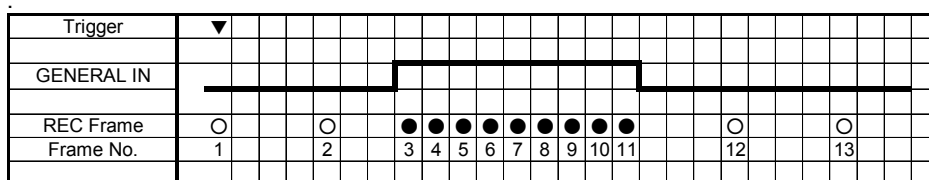
The DUAL FRAMING RATE Mode has been devised to use two preset framing rates alternately. It allows for changing the framing rate during a recording to capture faster or more interesting events for slower playback. For example, while shooting, at a slower framing rate, a basketball player nearing the goal, you can record the instance the basketball player stuffing the ball into the basket in a higher temporal resolution for subsequent motion analysis. This section describes how the Dual Framing Rate Mode works.

Concept of Dual Framing Rate Mode and External Control Signal Input

To use the Dual Frame Rate mode, you first set a higher framing rate with which you wish to capture the instance of important event. Then, you set a slower framing rate as 1/2, 1/4 or 1/8 of the higher framing rate.

The change of the frame rate during recording is effected by an external TTL signal input using the GENERAL IN cable connector.

The following figure is a visual presentation of the temporal relationship between the trigger signals and corresponding recorded to be recorded in an example of 1:4 rate setting.



Where the white circle denotes frames recorded at the lower rate and the black at higher rate.

The START mode is the mode of recording used in the Dual Framing Rate mode.

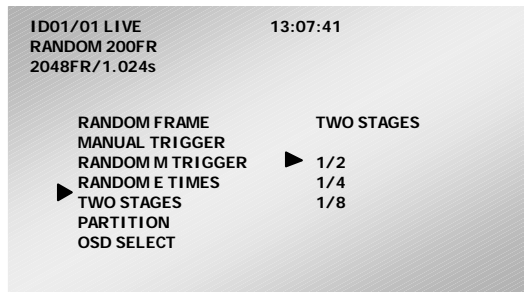
TTL change over signals to be fed to the GENERAL IN connector are defined as follows (e.g. for positive signal setting):

GENERAL_IN Input "H"	Change to higher rate from the next frame
GENERAL_IN Input "L"	Change to lower rate from the next frame

Parameter Setting for Dual Framing Rate Mode Operation

The following shows how to set parameters for a higher and lower framing rates.

1. Referring to Section 3.2. [Selecting Frame Rate], select a framing rate for the higher rate, for example 2000 fps.
2. Press the MENU button on the keyboard to display the menu list.
3. Move the cursor by the joystick to [TWO STAGES] and press the joystick down to select the item.
4. The TWO STAGE menu appears on the screen. In the right-hand area, framing rate ratios of 1/2, 1/4 and 1/8 are shown to choose from.



5. Move the cursor to one of the ratios, for example 1/4, and press the joystick down to select it.
6. Now the system has been set to record at 2,000 fps for the higher rate and 500 fps for the lower rate.
7. Press the MENU button to exit and go back to the LIVE screen.

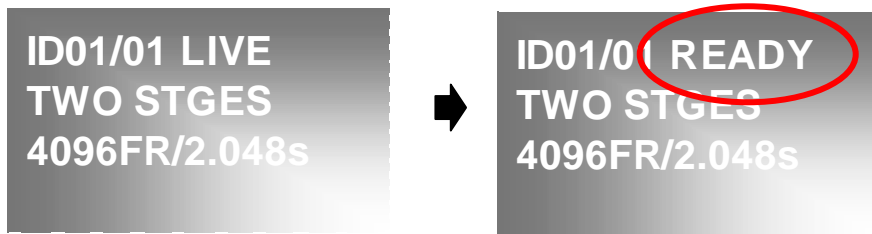
Recording in Dual Framing Rate Mode

Follow the below procedure to record in the Dual Framing Rate mode.

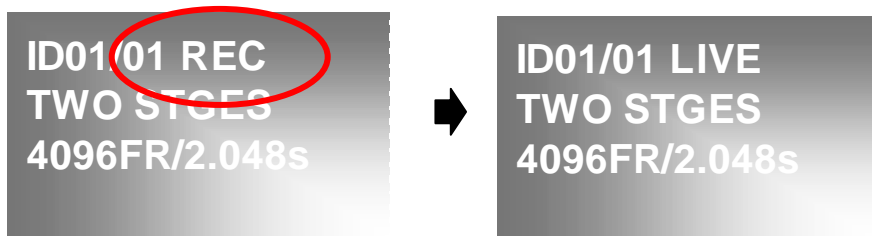
1. Referring to Section 3.5. Selecting Trigger Mode, make sure the camera is in the LIVE mode and the trigger mode is TWO STAGES.
2. Connect a TTL trigger input to the GENERAL IN connector. See the table below for TTL signal and recording frame rate (e.g. for positive signal setting):

GENERAL_IN Input "H"	Change to higher rate from the next frame
GENERAL_IN Input "L"	Change to lower rate from the next frame

3. Press the REC READY button on the keypad to turn the system into the READY mode. Make sure the indication on the screen has turned from [LIVE] to [READY].



4. At the moment you wish to start recording, press the REC button. The system starts recording and the indication turns to [REC]. When the recording is done, i.e. the memory is full, the system automatically stops recording. The indication turns to [LIVE].



4.6. Partitioning Memory

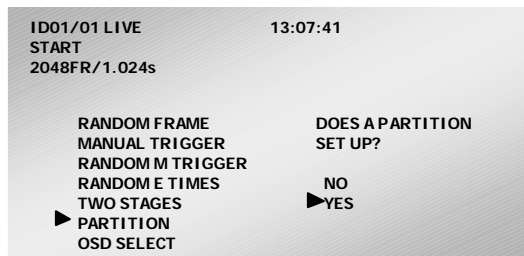
The APX-i2 has a large capacity memory of 2.6GB, standard, or up to 8GB with optional additional memory units. The memory can be partitioned into several sections and each section is used for a recording session. The memory can be divided into up to 64 sections of equal capacity. Each section is given its own ID number for recording management purposes. Each of the divided sections can have its own recording parameter settings, which is a useful feature when an event is recorded repeatedly under several different shooting conditions.

4.6.1. Prepare for Memory Partitioning (Set Number of Sections)

To take advantage of the memory partitioning feature, it is necessary to decide on how to divide the memory and set it up accordingly. This section discusses how to set up memory partitioning.

1. Press the MENU button on the keypad to display the MENU.
2. Select [PARTITION] with the joystick.
3. The PARTITION menu is now displayed on the screen.
4. A dialog window is displayed asking if you wish to set up partitions.

Note: If you partition the memory or change the current partitions, all the image data currently stored in the memory is erased.



5. Select YES to have partitioning executed and a setup menu displayed.
6. Move the joystick up or down to select the desired number or divided sections.
7. Once the selection is done, press the joystick down to enter the setting.
8. Make sure the ID indication is in fractional number mode now as shown in the above.



FA ID01/04 LIVE
START
512FR/00.256s

This section describes how to record in the PARTITION mode.

Note: The following instruction is good only when the camera is in the PARTITION mode.

1. Make sure that the camera is in the LIVE mode.
2. Move the joystick left or right to select the ID number. Make sure if the ID number displayed in the screen is correct.
3. Once the ID number has been selected, start a recording in the usual manner.

4.6.3. Playback of Recorded Sections

Recorded image in any of the sections can be played by selecting the ID of the particular section of interest as follows:

1. Make sure that the camera is in the MEMORY mode.
2. Move the joystick on the keypad, left or right, to select a section that you wish to play. Make sure if the displayed ID number is correct.
3. Once the section that you wish to play back has been selected, play it in the usual manner following the instructions in Chapter 5.

4.6.4. PARTITION MODE

The explanation in the previous section 4.6.2. (Recording into Divided Sections) is only applicable when MODE 1 is selected in PARTITION MODE.

When MODE 2 is selected, manual ID selection is not necessary: it is automatically updated. The following is an explanation for recording in divided sections in MODE 2 when the number of partitions is 10, for example (see 4.6.2.).

1. Set the camera in READY status with ID01.
2. Give a trigger to start a recording.
3. Recording ends.
4. ID is automatically updated to 02 and the camera gets in the "REC-trigger waiting" status. The REC-trigger waiting status means the READY status for the START mode, and the ENDLESS status for CENTER, END and MANUAL modes.
5. Press the REC button to give a trigger to start a recording.
6. Recording end.
7. ID is automatically updated to 03 and the camera gets in the "REC-trigger waiting" status.
8. Repeat 2, 3, and 4 above again and again until you have completed recording in ID 10 when the camera returns to LIVE mode.

As seen in the above, because ID is updated automatically and REC-trigger waiting status is automatically set up, MODE 2 operation is useful for consecutive recordings of events.

Note: MODE 2 is good with START, CENTER, END and MANUAL modes only.

4.7. Look-Up Table (LUT) Operation

The look-up table is a reference table that defines the mutual relationship between the grayscale values of the recorded image data and that of the displayed image on the computer monitor or video display screen.

The APX-i2 has a built-in hardware LUT that offers a means to enhance the contrast of image to make the subject look more clearly, or to enhance a particular range of gray level within a frame to make the subject outstand in the scene. This gray level manipulation is effective only on the displayed image and the original recorded image data is not altered in any way.

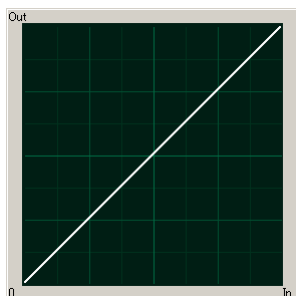
This section discusses the relationship between the LUT, video output and PC software of the APX-i2 system.

4.7.1. Operating Preset LUT

The APX-i2 has five (5) preset LUT patterns. All the five patterns are shown here:

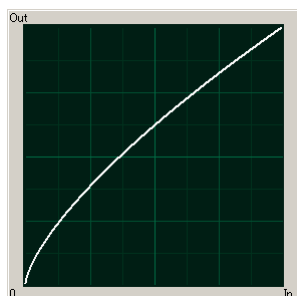
D1

This is a LUT pattern whose output is always linear to the input. It is the standard LUT that is used in usual applications.



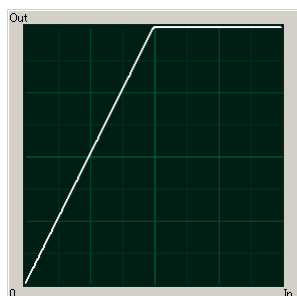
D2

This is an LUT pattern with a 0.6 gamma.



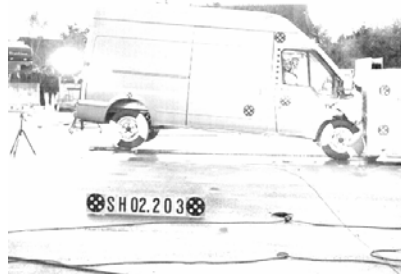
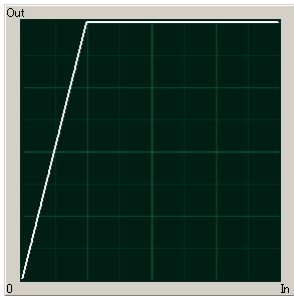
D3

This is a LUT pattern that allocates the lower 512 of the 1024 total steps to output. It expands the darker portion of an original recorded image.



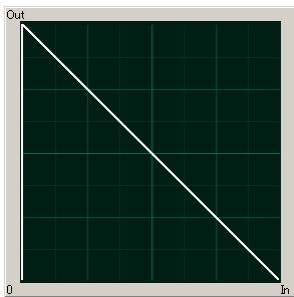
D4

This is an LUT pattern that allocates the lower 256 of the 1024 total steps to output. It expands the darker portion of an image, more than D3 LUT.



D5

This is a LUT pattern that inverts the input image data.



4.7.2. Customizing LUT Patterns

LUT patterns can be created from the PFV (Photron FASTCAM Viewer) Control Software. See the PFV Software Manual for details of LUT pattern creation.

USER

This mode uses a custom LUT created from the PFV Control Software.

4.8. Extended Dynamic Range Mode

The Extended Dynamic Range Mode has been developed to record highlight and lowlight portions together in one image frame by readjusting the exposure in the imaging sensor. With this feature, the sensor automatically makes a necessary adjustment so that both highlight and lowlight areas within one frame can be recorded with appropriate exposure when the target event has an extremely wide range of brightness.

This exposure adjustment function has three different levels, each assignable to a different magnitude of brightness variation of the subject.

How to Set Extended Dynamic Range Mode

1. Press the MENU button on the keypad to display the menu.
2. Move the cursor by joystick to select the DS SHUTTER menu.
3. The menu shows the following items:

Menu Items	Description
OFF	Switches Extended Dynamic Mode off.
ON MODE 1	Sets magnitude of exposure adjustment low.
ON MODE 2	Sets magnitude of exposure adjustment medium.
ON MODE 3	Sets magnitude of exposure adjustment high.

4. Move the cursor by joystick to select a mode. Once the desired mode is selected, press the joystick down to set it.

4.9. External Trigger Input

The APX-i2 can operate in response to external triggers that are provided depending on the needs of each application.

This section discusses the different kinds of external triggers and how to set up the system for each of them.

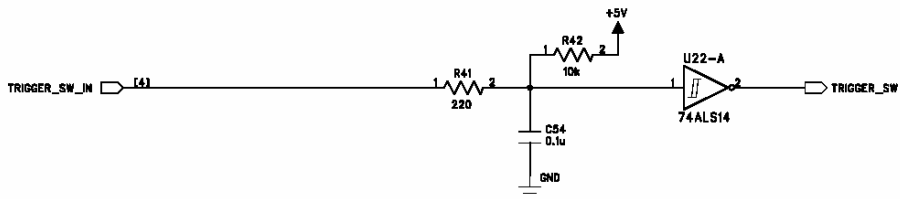
4.9.1. Input of External Trigger Signals

The trigger signals that are used on the APX-i2 and the corresponding input connectors are shown below.

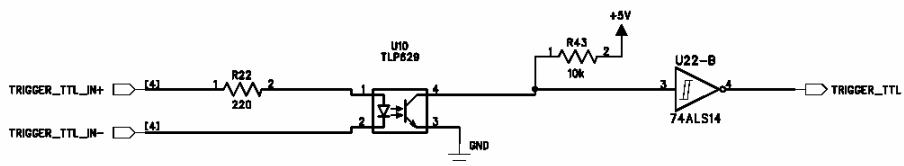
Connectors (Input)	Menu Setting	Signals
TRIGGER SW IN	None	Contact signal Trigger on CLOSURE
TRIGGER TTL IN	None	Optical isolator input Positive logic, 5V, 10mA
GENERAL IN	TRIGGER POS	TTL level, Positive logic
	TRIGGER NEG	TTL level, Negative logic Contact signal, Trigger on CLOSURE

Note: For input trigger signals for GENERAL IN, the GENERAL IN circuit must be set up for the type of the input signal from the menu in advance. Please see the GENERAL IN section elsewhere in this manual for details.

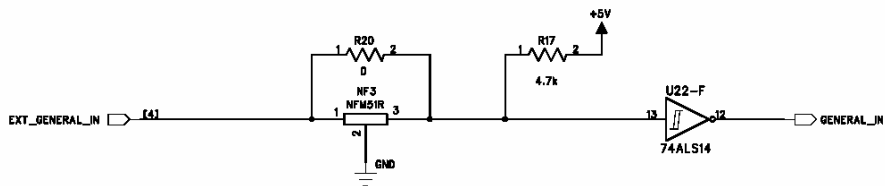
TRIGGER SW IN Circuit



TRIGGER TTL IN Circuit



GENERAL IN Circuit



4.9.4. Output of Trigger Signals to External Equipment

The APX-i2 can output trigger signals to external equipment and devices. The output signals are provided from the TRIGGER SW OUT and TRIGGER TTL OUT connectors. In addition, other trigger output are available from the GENERAL OUT connector by setting up the circuit as necessary.

The following table shows the output connectors and the relevant output signals.

Connector (Output)	Menu Setting	Signals	Delay (Approx.)
TRIGGER SW OUT	None	Contact signal	5 nsec
TRIGGER TTL OUT	None	CMOS (74ACT541 buffered) Output, Positive logic	2.7 μ sec
GENERAL OUT	TRIGGER POS	CMOS (74ACT541 buffered) Output, Positive logic	55 nsec
	TRIGGER NEG	CMOS (74ACT541 buffered) Output, Negative logic	70 nsec

Note: For output trigger signals from GENERAL IN, the GENERAL IN circuit must be set up for the type of the input signal from the menu in advance. See Section 3.12.2. GENERAL OUT for details.

4.10. Input of External Sync Signals

The APX-i2 has an operation mode for recording in sync with external sync signal. By using sync signals fed from outside, synchronized multiple-camera recording or single- or multiple-camera recording in sync with external instrumentation and lighting equipment is possible.

This section describes how to set up the APX-i2 system in external sync environment giving some tips and precautions.

4.10.1. Input of External Sync Signals

The table below shows external signals that can be input to the APX-i2 system. Follow the below procedure to set up the system.

1. Connect an external sync signal to the processor.
2. The green LED (POWER LED) on the rear panel blinks.
3. Press the MENU button to display the menu list.
4. Use the joystick on the keypad to select [EXT-SYNC IN] menu.
5. The menu is shown. Details of the menu is as follows:

Menu Display	Description	Signal
OFF	Switches External Sync off.	None
ON POS CAM	Operates in sync with APX-i2.	TTL level, Pos. logic
ON NEG CAM	Operates in sync with APX-i2.	TTL level, Neg. logic
ON POS OTHERS	Operates in sync with external equipment.	TTL level, Pos. logic
ON NEG OTHERS	Operates in sync with external equipment.	TTL level, Neg. logic

6. Move the joystick up or down to select a menu item.
7. Once the selection is done, press the joystick down to set.

Note: Some external sync signal may introduce disturbance in the system synchronization depending on the environment causing malfunctioning of the camera. To avoid any trouble, the use of a termination resistor at [EXT-SYNC IN] is recommended.

4.10.2. Output of External Sync Signals

The APX-i2 can output sync signals to outside equipment and devices. The following table shows the output signals from the APX-i2. Set up sync signal output in the following procedure.

1. Press the MENU button on the keypad to display the menu list.
2. Move the joystick on the keypad to select the [EXT-SYNC OUT] menu.
3. The menu is displayed. Details are shown below:

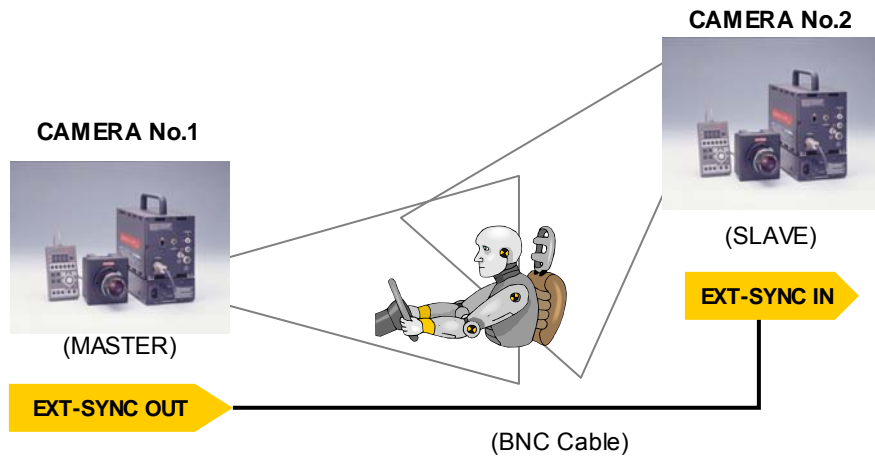
Menu Display	Description	Signal	Remarks (Input delay, approx.)	
VSYNC POS	Outputs positive logic VSYNC signal.	CMOS(74ACT541 buffered) output, Positive logic	EXT-V IN is set in positive logic.	50 nsec
			EXT-V IN is set in negative logic	80 nsec
VSYNC NEG	Outputs negative logic SYNC signal.	CMOS(74ACT541 buffered) output, Negative logic	EXT-V IN is set in positive logic.	50 nsec
			EXT-V IN is set in negative logic.	80 nsec

4. Move the joystick up or down to select an output signal.
5. Once selection is done, press the joystick down to complete the setting.

4.10.3. Sync Operation of Multiple APX-i2 Systems

Multiple APX-i2 systems can be synchronized, using the external input and output features of the system, for synchronized recording.

Concept of Sync Operation



This section describes how to set up external sync signals necessary for sync operation of two APX-i2 cameras.

Setting up Master Camera (that outputs sync signal)

First decide the master camera that provides sync signal to the other camera, and make necessary setting on it in the following manner:

1. Press the MENU button on the keypad to display the menu list.
2. Move the cursor by the joystick to [EXT-SYNC OUT] menu and press the joystick down to enter the selection.
3. Move the joystick up or down to select an output signal, **VSYNC POS** in this example, and press the joystick down.
4. Now the system has been set in a way that a sync signal (positive going) is output from EXT-SYNC OUT connector.

Setting up Slave Camera (That Receives Sync Signal)

Next, set up input sync signal on the slave camera.

1. Connect between the EXT-SYNC OUT of the master camera and the EXT-SYNC IN of the slave camera with a BNC cable to feed the sync signal from the master camera to the slave.
2. Make sure that the green LED (POWER LED) on the rear panel of the slave camera blinks.
3. To set up the type of sync signal that the slave receives, press the MENU button on the keypad to display the menu list.
4. Move the cursor by the joystick to select the [EXT-SYNC IN] menu.
5. Move the cursor by the joystick to select the type of output signal. Because the master camera has been set to positive (VSYNC POS), **ON POS CAM** should be selected here.
6. Once the selection is done, press the joystick down to set it.

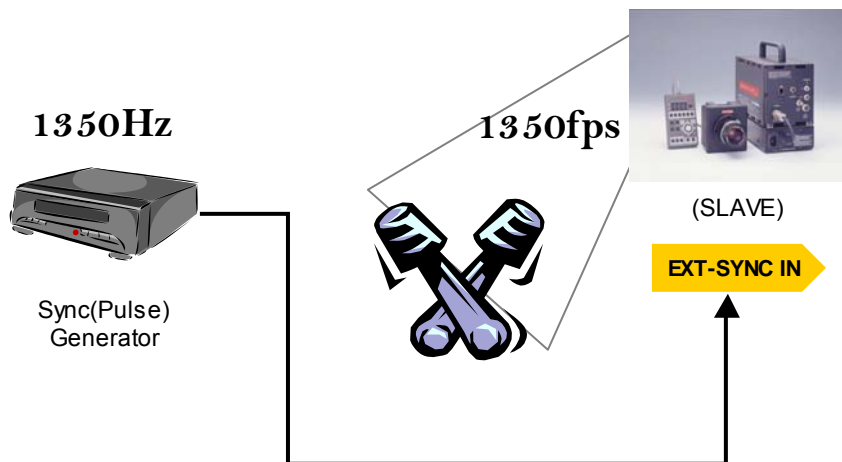
Note: If the steps 3 to 6 are done without input sync signal from the master, the slave camera operates at 60 fps.

Note: Blinking of green LED indicates that input sync signal is present. If the sync signal stops or is lost, the LED stops blinking.

4.10.4. Sync Operation with External Equipment

In addition to its original framing rates, the APX-i2 has a feature of setting up a frame rate locked to the frequency of a sync signal from external source. With this feature, it has considerably expanded its range of application. For example, it can work in sync with a manufacturing machine running at 1350 rpm, to record the machine's behavior at 1350 FPS.

Concept of External Sync Recording



This section describes the function that makes the APX-i2 work in sync with external equipment.

Requirement on Input Signals

For the APX-i2 to work in sync with external equipment, the basic requirement on the input signal is as follows:

- ◆ TTL level, Positive or Negative logic
- ◆ 60 Hz to 120,000 Hz

Camera Setup

1. Feed a sync signal to the APX-i2 processor. Connect between the sync signal generator and the EXT-SYNC IN on the APX-i2 rear panel with a BNC cable.
2. Make sure that the green LED (POWER LED) on the APX-i2 processor rear panel blinks when a sync signal from the generator is present.
3. Press the MENU button to display the menu list.
4. Move the cursor by the joystick to the [EXT-SYNC IN] and press the joystick down to select it.
5. Move the cursor by the joystick, up or down, to select a type of sync signal, **ON POS OTHERS** (positive) or **ON NEG OTHERS** (negative).
6. Once the selection is done, press the joystick down to set it.
7. Start the external signal source sending sync signal to the camera. Make sure that the camera recognizes the signal frequency and the frame rate is in sync with the input signal. The current frame rate recognized by the APX-i2 system is displayed in the lower left corner of the screen.

Note: The frequency of the sync signal from the external source should not be changed when the camera is in the LIVE mode or recording (malfunctioning may result).

Note: Every time the frequency of the external sync source is changed for any reason, do the steps 1 through 7 again to set up the system to the new frequency.

Note: If steps 3 to 7 are done without input sync signal, the camera operates at 60 FPS. In this case, the camera indicates 1 FPS in text, which means there is no sync signal input.

Note: Blinking of the green LED on the rear panel indicates the presence of a sync signal. It stops blinking when the input sync signal is lost.

Note: Frame rate sync operation with external equipment cannot be carried out in the RANDOM RESET mode.

Note: Due to the particular internal circuit configuration, this function inevitably has a slight error against the input sync signal. In the APX-i2, the error is within a magnitude of ± 22.83 n sec.

Example) For external sync signal operation with 10,000 Hz input sync signal, the actual operating sync signal in the system is:

$$100 \text{ u sec} \pm 22.83 \text{ n sec} = 9998 \text{ fps} - 10002 \text{ fps}$$

4.10.5. Sync Operation of APX-i2 and Other Models of Cameras

(Sync Operation of Mixed Models of Cameras)

Using the APX-i2 camera's feature of setting up a frame rate locked to the frequency of a sync signal from external sources described in the previous Section 3.11.4., the model allows for sync operation with other models of FASTCAM cameras, such as the Ultima 512 and 1024R2 models.

Synchronizing the APX-i2 to 512

To make the APX-i2 camera synchronized to the 512, the 512 is the master camera and the APX-i2 slave.

Setting up the 512 (Master camera that feeds sync signal to the slave)

The 512 has rear panel connectors of the same specifications as the APX-i2. Also, its control software GUI and remote keypad menu are of the same specifications as the APX-i2. Because of these common specifications, setting up the 512 camera is carried out as if both cameras are of one same model, the 512 or the APX-i2.

1. Press the MENU button on the keypad to display the menu list.
2. Move the cursor by the joystick to [EXT-SYNC OUT] menu and press the joystick down to enter the selection.
3. Move the joystick up or down to select an output signal, **VSYNC POS** in this example, and press the joystick down.
4. Now the system has been set in a way that a sync signal (positive going) is output from EXT-SYNC OUT connector.

Setting up the APX-i2 (Slave camera that receives sync signal from the master)

Next, set up input sync signal on the slave camera.

1. Connect between the EXT-SYNC OUT of the master camera and the EXT-SYNC IN of the slave camera with a BNC cable to feed the sync signal from the master camera to the slave.
2. Make sure that the green LED (POWER LED) on the rear panel of the slave camera blinks.
3. To set up the type of sync signal that the slave receives, press the MENU button on the keypad to display the menu list.
4. Move the cursor by the joystick to select the [EXT-SYNC IN] menu.
5. Move the cursor by the joystick to select the type of output signal. Because the master camera has been set to positive (VSYNC POS), **ON POS CAM** should be selected here.
6. Once the selection is done, press the joystick down to set it.

Note: When you wish to make the 512 camera synchronized to the APX-i2, the APX-i2 is the master camera and the 512 slave, follow the above procedure swapping the places of the two cameras.

Synchronizing the APX-i2 to FASTCAM-Ultima 1024R2

To make the APX-i2 camera synchronized to an Ultima 1024R2, the 1024R2 is the master camera and the APX-i2 slave.

Setting up the 1024R2 (Master Camera Feeding Sync Signal to the Slave)

1. Press the MENU button on the keypad to display the menu list.
2. Move the cursor by the joystick to [EXT OUT] menu and press the ENTER key to enter the selection.
3. Move the joystick up or down to select an output signal from the EXT OUT connector. Select **[VSYNC POS]** in this example, and press the ENTER key.
4. Now the system has been set in a way that a sync signal (positive going) is output from EXT OUT connector.

Setting up the APX-i2 (Slave Camera Receiving Sync Signal from the Master)

Next, set up input sync signal on the slave camera.

1. Connect between the EXT OUT of the master camera and the EXT-SYNC IN of the slave camera with a BNC cable to feed the sync signal from the master camera to the slave.
2. Make sure that the green LED (POWER LED) on the rear panel of the slave camera blinks.
3. To set up the type of sync signal that the slave receives, press the MENU button on the keypad to display the menu list.
4. Move the cursor by the joystick to select the [EXT-SYNC IN] menu.
5. Move the cursor by the joystick to select the type of output signal. Because the master camera has been set to positive (VSYNC POS), **ON POS CAM** should be selected here.
6. Once the selection is done, press the joystick down to set it.

Note: It is not possible to make the 1024R2 synchronized to the APX-i2 because the 1024R2 does not have the function to follow sync signal from an external source.

4.11. Setting GENERAL IN / OUT Signals

4.11.1. Setting GENERAL IN Signals

This section describes how to set up input signals connected to the GENERAL IN connector.

1. Press the MENU button on the keypad to display the menu list.
2. Move the joystick to select the [GENERAL IN] menu.
3. The GENERAL IN menu is now displayed. The items are as follows:

Menu Display	Description	Signal Condition
EVENT POS	Inputs event signals (Positive logic)	TTL level, Positive logic
EVENT NEG	Inputs event signals (Negative logic)	TTL level, Negative logic
TRIGGER POS	Inputs trigger signals (Positive logic)	TTL level, Positive logic
TRIGGER NEG	Inputs trigger signals (Negative logic)	TTL level, Negative logic Contact signals, Trigger on CLOSURE
READY POS	Inputs READY signal (Positive logic)	TTL level, Positive logic
READY NEG	Inputs READY signal (Negative logic)	TTL level, Negative logic Contact signals, Trigger on CLOSURE

READY POS/NEG

By setting to POS/NEG, the camera can be set to READY status by an input of a pulse. Also, when the [PARTITION MODE] is set to [MODE 2], an input of a pulse turns the camera into REC-trigger waiting status (READY status for the START trigger mode, and ENDLESS status for CENTER, END or MANUAL mode).

Note: When you use external signals to drive the whole system, be sure to check the nature of the incoming signals.

Note: See Section 4.12. (Event Marker Function) for detailed tips on how to set up EVENT POS or NEG.

4.11.2. Setting GENERAL OUT Signals

This section describes how to set up signals output from the GENERAL OUT connector.

1. Press the MENU button on the keypad to display the menu list.
2. Move the joystick to select the [GENERAL OUT] menu.
3. The GENERAL OUT menu is now displayed. The items are as follows:

Menu Display	Description	Signal
EXPOSE POS	Outputs sensor's exposure duration in HIGH level.	TTL level, Positive logic
EXPOSE NEG	Outputs sensor's exposure duration in LOW level.	TTL level, Negative logic
REC POS	Outputs recording duration in HIGH level.	TTL level, Positive logic
REC NEG	Outputs recording duration in LOW level.	TTL level, Negative logic
TRIGGER POS	Transfers received external trigger signal in HIGH level.	TTL level, Positive logic
TRIGGER NEG	Transfers received external trigger signal in LOW level.	TTL level, Negative logic
READY POS	Outputs signal in HIGH level when in REC-trigger wait	TTL level, Positive logic
READY NEG	Outputs signal in LOW level when in REC-trigger wait	TTL level, Negative logic

READY POS/NEG

By setting to POS/NEG, a signal of the specified level is output when the camera is in REC-trigger waiting status (READY status for the START trigger mode, and ENDLESS status for CENTER, END or MANUAL mode). This function is only effective in the START, CENTER, END or MANUAL mode.

Note: When you use these signals to drive the whole system, be sure to check the nature of the signals.

4.12. Event Marker Function

The APX-i2's Event Marker function makes it possible to record a frame number, on the fly, at each external marking signal so that you can jump to the marked frame (event frame) when playing recorded images. In addition to triggering points, these event marks given at any moments of interesting event will let you play back such interesting events quickly. Up to ten event frames can be marked in each partitioned section.

Marking is done at an edge of the incoming marker pulse. The immediately subsequent frame after receipt of a marker pulse is recorded as an event frame. The following describes how to place event marks:

1. Press the MENU button on the keypad to display the menu list. Move the joystick to select the GENERAL IN menu. Using the joystick in the GENERAL IN menu, select [EVENT POS] or [EVENT NEG]. EVENT POS marks an event at the rising edge of the marking signal and EVENT NEG at the falling edge.
2. Send pulses into the GENERAL IN connector each moment you see an interesting event during a recording session.
3. Up to ten marking pulses are accepted in a session.
4. Recording comes to an end.
5. Press the LIVE/MEMORY button to switch to the MEMORY mode.
6. Press the \triangle or ∇ FRAME RATE button to jump to the first marked event. At each press on either button, playback jumps to previous or subsequent event frames.
7. While an event frame is displayed on the screen, the text shows [EVENT FRAME x] where the x is a number between 1 and 10 each representing the serial number of an event frame.

Note: This function is not available in the DUAL FRAME RATE operation mode.

4.13. MCDL - Multi-Channel Data Link (Data acquisition)

The APX-i2 has connectivity with the Photron MCDL (Multi-Channel Data Link – optional), which makes it possible for the APX-i2 to record sampled waveform data (up to 4 channels of analog and 6 channels of digital signals) along with image data. The original waveform data from the MCDL is sampled at the frequency of ten times the current frame rate and the sampling takes place at a timing of every tenth of each frame period.

The recorded data is played as a waveform on the PFV. Also, it is added to the header when the image data is stored in the TIFF format. It may also be viewed on video monitor.

The following describes how to operate the APX-i2 together with an MCDL unit.

1. Connect the MCDL output cable to the MCDL connector (9-pin D-sub) on the APX-i2 rear panel.
2. Press the MENU button on the keypad to display the menu list. Move the joystick to select the [MCDL/IRIG] menu. Further select the [MCDL ON] and press the joystick down to set it on.
3. The waveform of the input signal is displayed in the text portion of the screen.
4. The waveform is now recorded superimposed on and in sync with the image.
5. To play a recorded waveform, press the LIVE/MEMORY button to get in the MEMORY mode. Press the PLAY button and the recorded waveform is shown superimposed on each corresponding image.

Note: This feature cannot be used at 128 x 16 resolution.

Note: When you use both MCDL and IRIG, select [MCDL IRIG ON].

4.14. IRIG Time Code

The APX-i2 is compatible with the IRIG-B signal input and can add an IRIG code to each recorded frame. The sampling of IRIG code is once every frame.

The IRIG code recorded on each frame is displayed on video screen or PFV screen. It is added to the header when the recorded image data is stored in the TIFF format.

The required specification of IRIG code is as follows:

- Connector: BNC
- Code Format: IRIG—B (122), Analog
- Amplitude: 1.2 Vp-p Minimum; 8.0 Vp-p Maximum
- Modulation Ratio: 2:1 to 4:1

The following describes how to use the MCDL:

1. Connect the IRIG generator output cable to the IRIG IN connector (BNC) on the APX-i2 rear panel.
2. Press the MENU button on the keypad to display the menu list. Move the joystick to select the [MCDL/IRIG] menu. Further select the [IRIG ON] and press the joystick down to set it on.
3. IRIG code is displayed in the text portion of the screen.
4. The IRIG code is now recorded on the image.
5. To play a recorded IRIG code, press the LIVE/MEMORY button to get in the MEMORY mode. Press the PLAY button and the recorded IRIG code is shown superimposed on each corresponding image.

Note: This feature cannot be used at 128 x 16 resolution.

Note: When you use both MCDL and IRIG, select [MCDL IRIG ON].

Adding offset to sampled IRIG time code

To add an offset to sampled IRIG time code, follow the below procedure:

1. Go to the IRIG OFFSET menu
2. Specify a value for offset between +0.999999 and -0.999999 sec.
3. An offset is added to each of the sampled IRIG codes.

Chapter 5. Playback

- 5.1. Playing Recorded Images*
- 5.2. Search Images of Interest*
(Fast Forward/Rewind Play)
- 5.3. Slow Playback (Jog)*
- 5.4. Zooming (Zoom / Fit / Scroll)*
- 5.5. Block Playback*
(Playback of Clips of Interesting Scene)
- 5.6. Text Display – Hide / Unhide*
- 5.7. Displaying Crosshair Cursor*
- 5.8. Switching NTSC / PAL Video Output*
- 5.9. Automatic Playback*
- 5.10. Playback Event Markers*

5.1. Playing Recorded Images

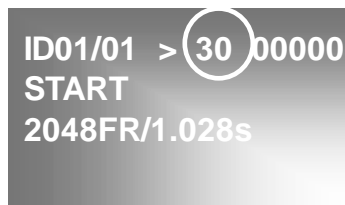
The APX-i2 can play back images recorded in the memory on the video monitor instantly. The following describes how to play recorded images.

1. If the camera is in the LIVE mode, press the LIVE/MEMORY button on the keypad to change to the MEMORY mode. Make sure the LED right next to the mode indication [MEMORY] is on now and that the video screen shows an image frame from memory.
2. Press the PLAY button on the keypad to play back the recorded images. The functions of playback buttons are shown in the below table.



Name	Function	Description
FR	Rewind and Play	Rewinds and plays recorded images at x10, x100 or x1000 the currently set playback speed. Each press on FR button changes playback speed.
REV	Reverse Play	Plays recorded images in reverse direction at 2 to 30 FPS in NTSC or 2 to 25 FPS in PAL
PLAY	Play	Plays recorded images in normal direction at 2 to 30 FPS in NTSC and 2 to 25 FPS in PAL.
FF	Fast Forward	Plays recorded images at x10, x100 or x1000 the currently set playback speed. Each press on the FF button changes speed.
PAUSE	Temporary Stop	Stops playback temporarily. A [] mark is displayed on video screen. With this mark in the screen, you can jog frames by pressing the PLAY/REV button.
STOP	Stop	Stops playback and returns to the trigger frame.

3. Move the joystick up or down on the keypad to change playback speed. The current playback speed is displayed in the upper portion of the video screen.



PAL Playback Rates	2; 5; 8; 12; 25 FPS
NTSC Playback Rates	2; 5; 10; 15; 30 FPS

5.2. Searching Images of Interest (Fast Forward/Rewind Play)

Make sure that the system is in the MEMORY mode.

1. Press the [\triangleright] (PLAY) button to start a playback.



2. Press the [$\triangleright \triangleright$] (FF) and/or [$\triangleleft \triangleleft$] (FR) button to search your desired images on the fly.

Note: At each press on the button, speed changes to x10 to x100 to x1000.

3. As soon as you see your desired or interesting image, press the [\triangleright] (PLAY) button to go back to normal playback, or the [||] (PAUSE) button to stop playback temporarily.

5.3. Slow Playback (Jog)

Make sure the system is in the MEMORY mode.

1. Press the [>] (PLAY) button to start playback.



2. Press the [> >] (FF) or [< <] (FR) button to search your desired image.



3. When your desired image is coming up, press the [||] (PAUSE) button to stop playback temporarily.

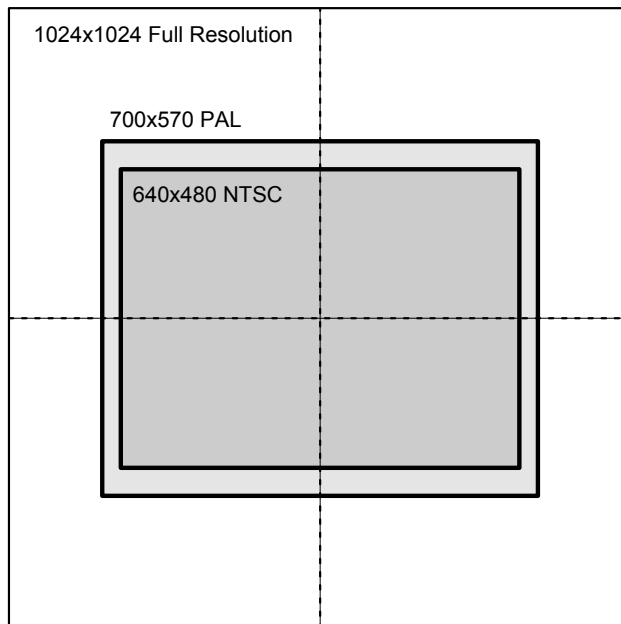


4. Make sure a [II] mark is displayed in the video screen.
5. Press the [>] (PLAY) button to play in the single-frame jog mode, or the FF or FR button to play in the ten-frame jog mode.

5.4. Zooming (Zoom/Fit/Scroll)

In high-resolution mode (1025 x 1025 pixels or 1025 x 512 pixels) recording, the APX-i2 system records images in a higher resolution than standard NTSC or PAL video resolution. In order to view the full image frame of recording on a video monitor, such high-resolution images from the APX-i2 system must be reduced to fit the NTSC or PAL video format. The Fit function of the APX-i2 performs this size reduction.

Relationship Between Video Formats and Resolution



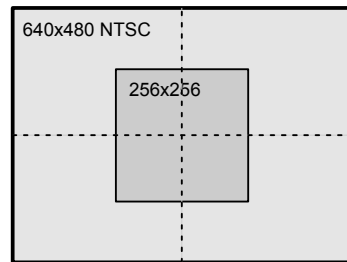
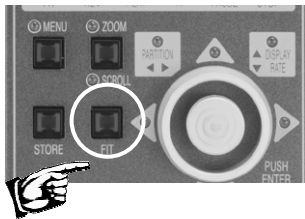
When the APX-i2 records at a higher frame rate than 2,000 FPS (e.g. 10,000 FP), the frame resolution of 512 x 256 pixels is much smaller than the standard video format. If the recorded image is displayed on the video monitor, it looks as a small frame taking only a portion of the full video screen. In this case, the playback image must be expanded to fill the video screen. The APX-i2's Zoom/Fit function performs this expansion/fitting to display the playback image filling the full screen of the standard video format.

The following pages discuss the function of digital video signal zooming and how to use it.

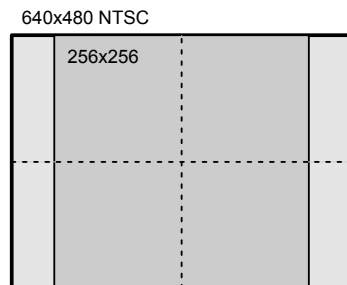
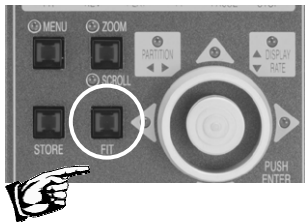
5.4.1. Fitting Image Frame to Video Screen

The Fit function of the APX-i2 system readjusts the size of each framing resolution to maximize the playback image fitting the video screen format. This section describes how a recorded image of 256 x 256 pixel resolution is readjusted to fit the video format screen by the Fit function.

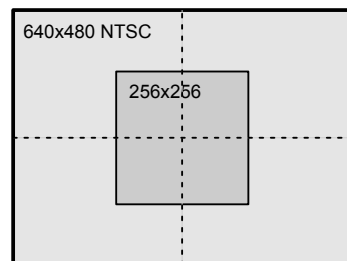
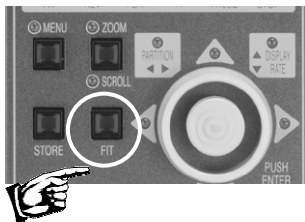
1. Press the FIT button on the keypad once.



2. The displayed image size has changed so that the recorded image area has been maximized within the video monitor screen.



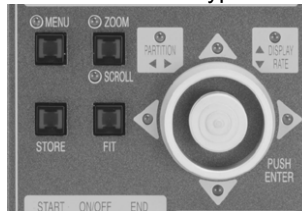
3. Give another press to the FIT button to revert to the original size of the recorded image.



5.4.2. Zooming Playback Image Frame

The APX-i2's Zoom function magnifies the original recorded image at steps of x1, x2, x5 and x8 to display on the video screen. The following describes how to zoom the recorded image.

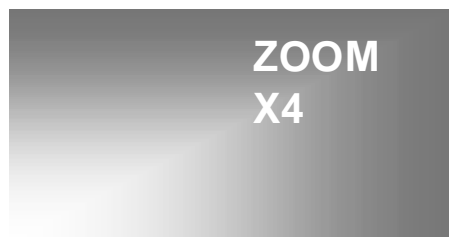
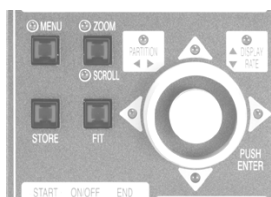
1. Press the ZOOM/SCROLL button on the keypad.



2. The ZOOM indication LED lights up. At the same time, the indication of ZOOM and the current magnification appear on the video monitor screen.



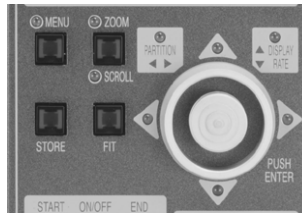
3. Move the joystick up or down to attain a desired magnification, x1, x2, x5 or x8. The image is zoomed with its center retained in the center of the video display.



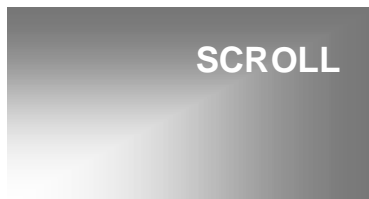
5.4.3. Scrolling Playback Image Frame

The APX-i2's Scroll function moves a magnified, oversized image over the video monitor screen to display any portion of the bigger-than-the-screen image.

1. Press the ZOOM/SCROLL button on the keypad. This button switches the mode between ZOOM and SCROLL. Press it twice if necessary. Make sure the SCROLL indication LED lights up.



2. An indication of SCROLL has appeared on the video screen.



3. Move the joystick up or down, left or right to scroll the magnified image until your interested portion comes up in the screen. When the entire image is already displayed in the screen, the image does not scroll.

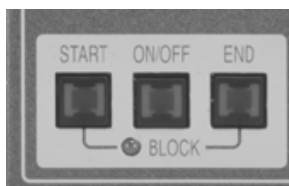
5.5. Block Playback (Playback of Clips of Interesting Scenes)

Playing a high-speed recording footage is time-consuming. For example, a footage recorded at 2,000 FPS for one second takes 66 seconds to play back at 30 FPS: it takes over one minute to see a strip of recorded 2,000 frames from end to end. In many cases, however, the frames of real interest to you are only a few or several tens of the entire footage.

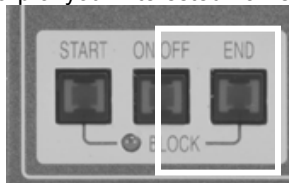
The APX-i2's Block Play function lets you see only a portion of special interest to you out of the entire recorded frames. All you have to do is pick first and last frames of a clip you want to play.

The following describes how to use this function.

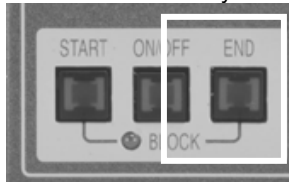
1. Press the LIVE/MEMORY button on the keypad to turn the system into the MEMORY (Playback) mode.
2. Press the PLAY button to play the footage in the usual manner.
3. Press the START button on the keypad at a frame that you wish to make the first frame of a clip.



4. Press the END button on the keypad at a frame that you wish to make the last frame of a clip. Now the clip of your interested frames has been defined.



5. Press the BLOCK ON/OFF button on the keypad and make sure the LED has lighted up. Now the system is in the Block Play mode.

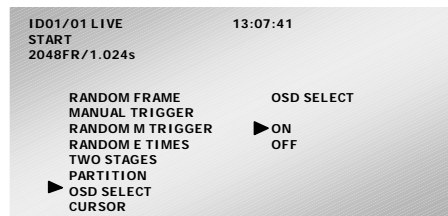


6. Now the system plays back the defined clip only. Start playing the clip in the Block Play mode as many times as necessary. You can use all playback buttons - FR, REV, PLAY, FF, PAUSE and STOP.
7. When you are done, press the BLOCK ON/OFF button to exit the Block Play mode. The clip setting is cancelled.

5.6. Text Display – Hide / Unhide

The text display on the screen can be hidden or unhidden as necessary. Here is how to handle it.

1. Press the MENU button on the keypad to display the menu.
2. Move the joystick up or down, left or right, to select the OSD SELECT menu.
3. The OSD SLELCT menu is displayed as shown below.

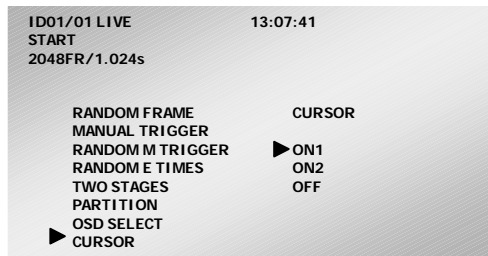


4. Move the joystick again up or down to select the OFF indication.
5. Press the joystick down to set the selection.
6. Make sure the text display has been hidden.
7. Press the MENU button on the keypad to exit the menu.
8. To have the text displayed on the screen again, select ON in step 5 above.

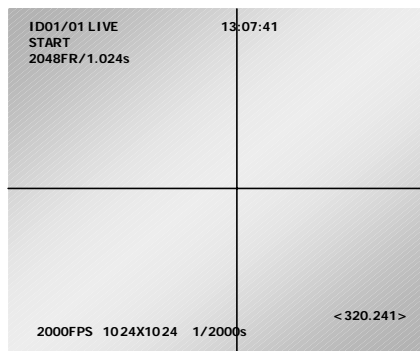
5.7. Displaying Crosshair Cursor

The APX-i2 has a crosshair cursor display function. This function is useful to pinpoint certain points of interest within the image displayed on the video screen at recording and playback. The following shows how to use the crosshair function.

1. Press the MENU button on the keypad to display the menu list.
2. Move the joystick to select the [CURSOR] menu.
3. Now the CURSOR menu is displayed on the screen as shown below.



4. Two types of cursor lines are available – White (ON 1) and Black (ON 2) to choose from depending on the brightness of the image.
5. Move the joystick up or down to select ON 1, ON 2 or OFF. Press the joystick down to set the selection.
6. Press the MENU button to exit the menu.
7. If you have selected ON 1 or ON 2 in step 5 above, you will see a crosshair displayed in the video screen and the corresponding coordinates of the cross are shown in the lower right corner of the screen.
8. Move the joystick up or down and left or right to steer the crosshair over the screen.



9. When you are done and you no longer need the crosshair cursor, repeat steps 1 to 6 selecting OFF in step 5 to make the cursor disappear.

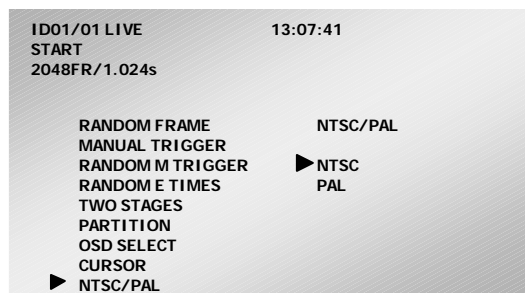
5.8. Switching NTSC / PAL Video Output

The APX-i2 has a function that lets you switch the video display format between NTSC and PAL to display images on the video screen.

Caution: You must have appropriate NTSC and PAL video monitors properly connected in the system to change the video format from NTSC to PAL, or other way around, using this function. When you are currently operating in an NTSC setup, for example, and if you inadvertently switch from NTSC to PAL without an appropriate PAL video monitor connected in the system, you will not only lose image display on the current NTSC video monitor, but also you will lose the ability to revert to NTSC operation by simple keypad operation. In such a case, you must reset the whole system from the PC control software.

The following describes how to switch the video format between NTSC and PAL.

1. Press the MENU button on the keypad to display the menu list.
2. Move the joystick to select the NTSC/PAL menu.
3. The NTSC/PAL menu is now displayed on the video monitor screen.



4. Move the joystick up or down to select the NTSC or PAL menu. Press the joystick down to set the selection.
5. Press the MENU button to exit the menu.
6. Turn the APX-i2 system off, and then turn the system on again.
7. Make sure that the video format has been changed on the relevant monitor screen.

5.9. Automatic Playback

The APX-i2 has a function that makes the system automatically change from the LIVE mode to MEMORY mode as soon as a recording is done. The trigger frame of the recorded images is displayed on the monitor screen and the system is just ready to play back. This feature is useful when you wish to view the recorded images right after recording an event.

The following describes how to use this feature.

1. Press the MENU button on the keypad to display the menu list.
2. Move the joystick to select the AUTO PLAY menu.
3. The AUTO PLAY menu is displayed on the screen.
4. Move the joystick again to select ON or OFF. Press the joystick down to set the selection.
5. Press the MENU button to exit the menu.
6. Perform a test recording and make sure if the system automatically turns into the MEMORY mode when a recording finishes.

5.10. Playback Event Markers

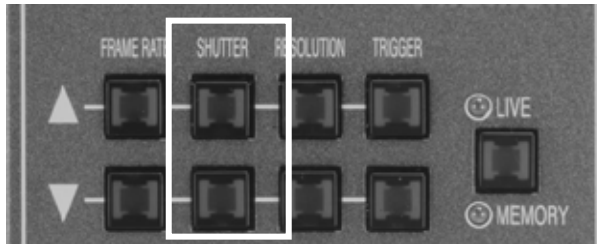
The APX-i2 has a function to set event markers, on the fly, to any frame of interest during playback. Up to ten event marks can be set within each partitioned recording. Once event markers are set, you can jump to any of the marked frames in subsequent playbacks.

The following shows how to set event markers.

1. Press the LIVE/MEMORY button on the keypad to turn the system into the MEMOEY mode.
2. Play a recorded footage in the usual manner.
3. When an interesting frame is being displayed on the screen, press the STORE button on the keypad.



4. Repeat steps 2 and 3 as necessary and until ten event marks have been set.
Note: If the number of event marks exceeds ten, the eleventh and subsequent marks overwrite previous marks starting from the first mark.
5. Press the SHUTTER \triangle or ∇ button on the keypad to jump to previous or subsequent marked frames.



6. When a marked frame is being displayed on the screen, a text of [MARKER FRAME x] is shown, x being a number 1 to 10 representing the serial number of each marked frame within the currently played recording.

Note: If you try to set more than ten marker frames, the eleventh frame and thereafter will overwrite the first frame and thereafter in the order they have been set.

Chapter 6. Connecting APX-i2 to a PC

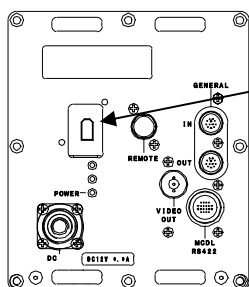
6.1. Connecting APX-i2 to a PC

6.2. Connecting Multiple APX-i2's to a PC

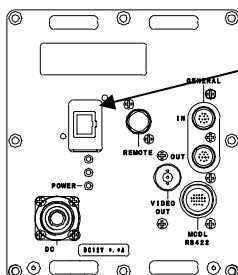
6.1. Connecting APX-i2 to a PC

This section discusses the interfacing features of the APX-i2. All functions of the APX-i2 camera can be controlled from a PC using a digital interface. An interface of your choice will be factory-installed at the time of shipping from Photron.

See the PFV (Photron FASTCAM Viewer) manual for operation of the APX-i2 software.

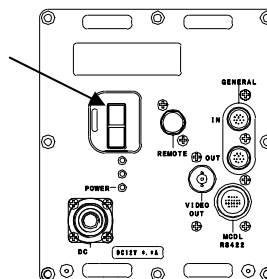


IEEE1394 interface installed
FASTCAM APX-i2



Ether interface installed
FASTCAM APX-i2

Optical interface installed
FASTCAM APX-i2



6.1.1. APX-i2 with IEEE1394 Interface

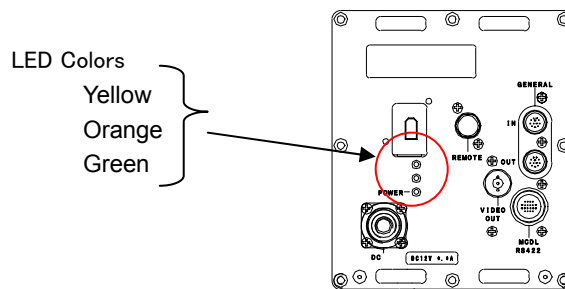
To connect the APX-i2 to a PC by the IEEE1394 interface, use a commercially available IEEE1394 standard cable. The connector on the camera processor is 6-pin type. The connector on the PC side may be 4-pin or 6-pin type depending on the PC model and/or the interface being used. Use an appropriate cable (not included in the APX-i2 set).

The IEEE1394 interface cable for the APX-i2 is hot-pluggable as is the case with other PC peripheral cables.

The APX-i2, after being connected to a PC by an IEEE1394 cable, can be controlled from the PC by installing driver software in the PC.

For installation of the driver software, see the attached FASTCAM Control Software Operation Manual, section 2.3.1 (Installation of hardware driver for IEEE1394 interface).

Confirmation of connection
by LED indicators



Indication by LED's

- Green: Power on/Sync in: Lights when power is on. Blinks when external sync input is present.
- Orange: Link: Lights when linkage is complete and blinks during command/data transfer.
- Yellow: Trigger: Lights when a REC trigger is given.

6.1.2. APX-i2 with Ether Interface

To connect an APX-i2 camera to a PC by the Ether network, use a commercially available 100BASE-TX cable. Use a UTP cable of CAT5 or higher for network connection.

The maximum allowable length of the connection cable between a PC and an APX-i2 is 100 meters. Up to 64 units of APX-i2's can be connected to a PC using a hub. Use a switching hub that accepts 100BASE-TX connection. For directly connecting an APX-i2 camera to a PC, a cross cable is necessary.

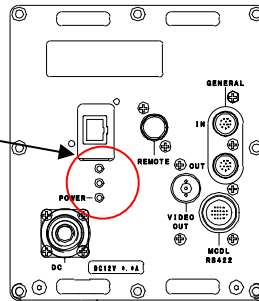
Maximum length of cable allowed between a camera (and PC) and a switching hub is 100 meters.

After connecting an APX-i2 camera to a PC with a network cable, no installation of driver software in the PC is necessary. All you have to do is to register the camera's IP address with the FASTCAM Control Software being used. See the FASTCAM Control Software Operation Manual, section 3.13.5 Registration of IP address (Ether Network) for information and instructions.

Confirmation of connection
by LED indicators

LED colors

Yellow
Orange
Green



Indication by LED's

- Green: Power on/Sync in: Lights when power is on. Blinks when external sync input is present.
- Orange: Link: Lights when linkage is complete. Blinks during command/data transfer.
- Yellow: Trigger: Lights when a REC trigger is given.

6.1.3. Connection with Optical Interface

Installing a Photron optical interface board in a PC and connecting an APX-i2 camera processor to the PC using an optical cable, the camera can be controlled by the attached FASTCAM Control Software.

6.1.3.1. Specification

- Supported OS: Windows2000/XP
- Plug & Play: Supported
- PCI bus: 32 bits (33 MHz)
- Size: 174.0 mm × 106.5 mm
- Standard: Photron's proprietary protocol
- Driver software: Photron driver
- Maximum number of cameras connected: 64
- Supported application: PFV (Photron FASTCAM Viewer)
- Operation environment: +5~+40 °C, no condensation
- Interface connector: SC connector
- Connecting cable: Special optical fiber cable
- Others: Power consumption 4 W

Note: Data transfer speed depends on the specification of the PC being used.

(1) Optical fiber cable specification

Single-mode fiber (SMF), 9/125 μ m SMF

Maximum transmission distance: 10 km (theoretical value derived from optical module)

Multiple-mode fiber (MMF), 62.5/125 μ m MMF, 50/125 μ mMMF

Maximum transmission distance: 550 meters (theoretical value derived from optical module)

Connector shape: SC terminal attached on both ends

Note: Attached standard optical cable is a single mode fiber cable of 9/125 μ m SMF, 5 meter long.

(2) Bit rate: 1 GHz (125 Mbytes/s) on optical cable

6.1.3.2. Installing IF Board in PC

Before installing an IF board in PC, be sure to switch the PC off and unplug the power cord. Open the PC housing and install the IF board in an empty PCI slot.

Make sure that the IF board has been installed firmly and squarely in the PCI slot. Loose installation may result in failure of either or both the PC and the board.

6.1.3.3. Connection between PC and Camera Processor

Use a specified optical fiber cable to connect between the PC and APX-i2.

The optical interface for the APX-i2 is hot-pluggable. You can connect and disconnect it while power is on. Refer to the below figure for connection

The optical interface has two terminals: TX (transmit) and RX (receive). When connecting one or more APX-i2's by optical interface, opposing terminals must be connected as if forming a loop as shown in the below figures.

Optical cables do not have polarity and can be connected in any direction.

Figure 1: Connecting one APX-i2 camera to a PC

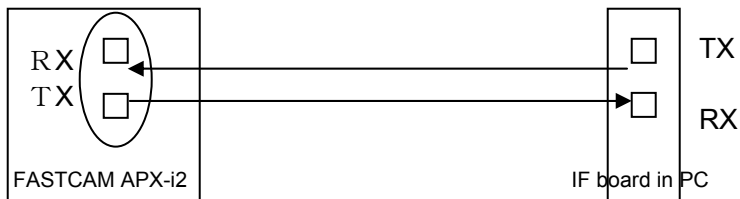
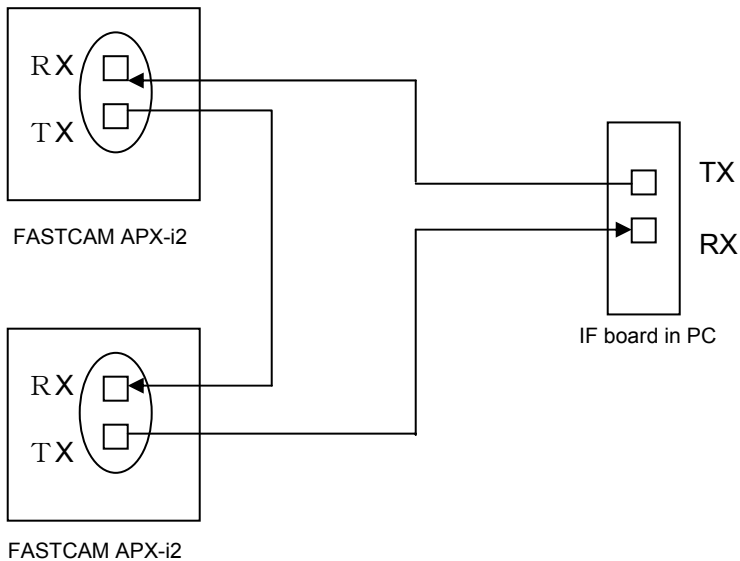
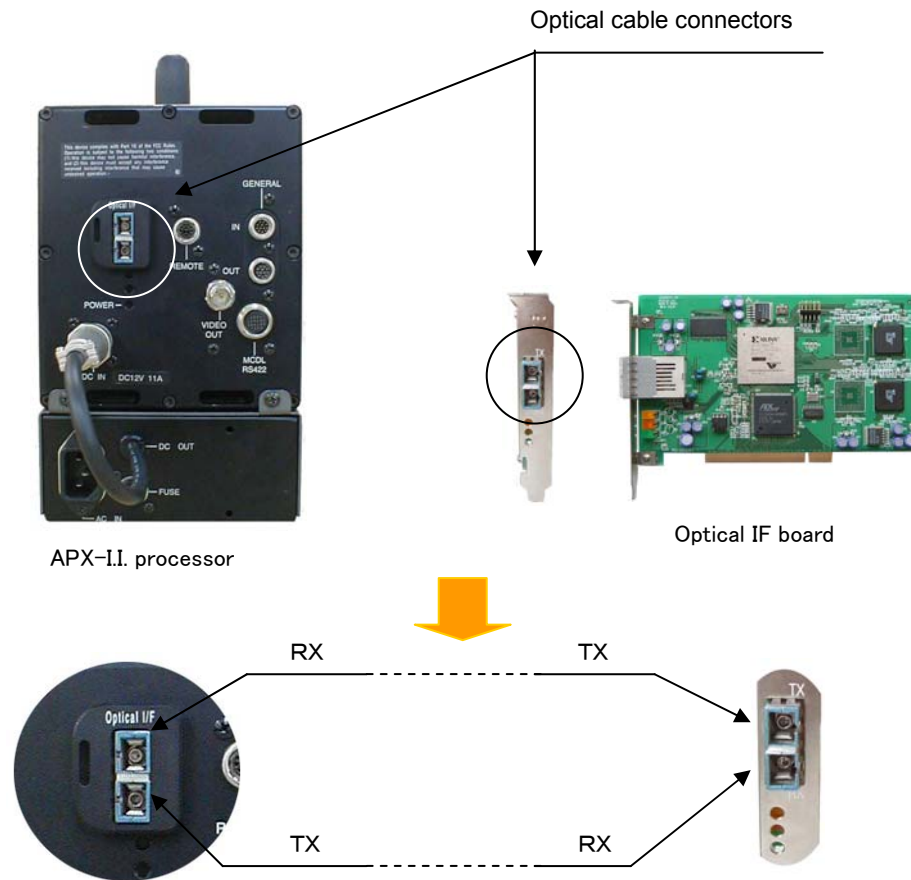


Figure 2: Connecting multiple APX-i2 cameras to a PC

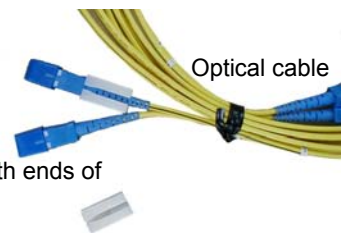


6.1.3.4. Connecting APX-i2 to a PC by Optical Cable

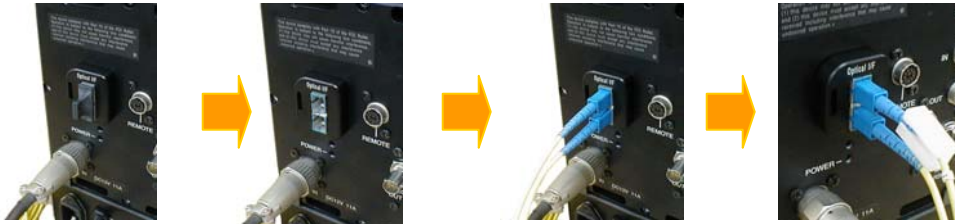
Connection between APX-i2 processor and optical IF board



- ① Get the attached 5-meter optical cable.
- ② Remove the protection cover on SC connector on both end of the cable.
- ③ Make sure that a tag, indicating RX or TX, is provided to both ends of each of the paired cables. the Both cable showing RX or TX.
- ④ The cable itself is a straight cable without polarity.



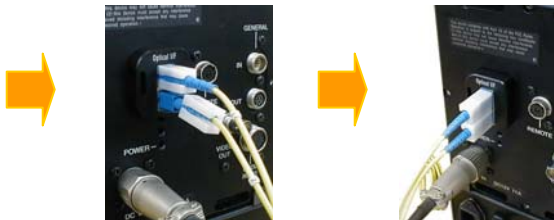
⑤ Connecting optical cable to APX-i2 processor



Remove protection cover
from connector.

Plug cable
connector.

Install clamping
covers.



Install clamping
covers.

Connection
completed.

⑥ Connecting optical cable to PC



⑦ Confirmation of connection by LED indicators

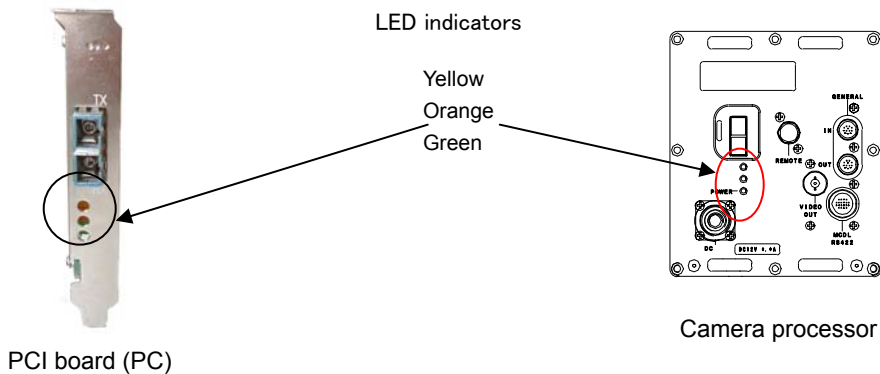
When the system is operated by the optical IF connection, the LED indicators on the APX-i2 light or blink. The LED indications are as follows:

1. PCI board (PC) side

- Green: Power on: Lights when power is on.
- Orange: Link: Lights when linkage is complete and blinks during command/data transfer.
- Yellow: Data reception: Lights when no data is being received and blinks when data is being received..

2. APX-i2 camera side

- Green: Power on/Sync in: Lights when power is on. Blinks when external sync input is present.
- Orange: Link: Lights when linkage is complete and blinks during command/data transfer.
- Yellow: Trigger: Lights when a REC trigger is given.



6.1.3.5. Installing Photron Optical Interface Driver

After connection between the APX-i2 camera and PC has been completed, the driver software must be installed in the PC to make the whole system operational. For instructions for hardware driver installation, refer to the attached FASTCAM Control Software Operation Manual, section 2.3.4 Installation of driver software for Photron optical interface.



Laser safety

The optical module of this APX-i2 system uses a laser product of IEC 60825-1 Class 1.

Class 1 Laser Product



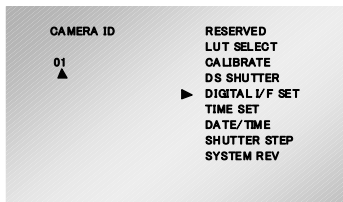
Warning: Danger

While the system is activated, do NOT look into the optical receptacle from which a laser beam is radiated, or incurable damage may be caused in your eye.

6.2. Connecting Multiple APX-i2's to a PC

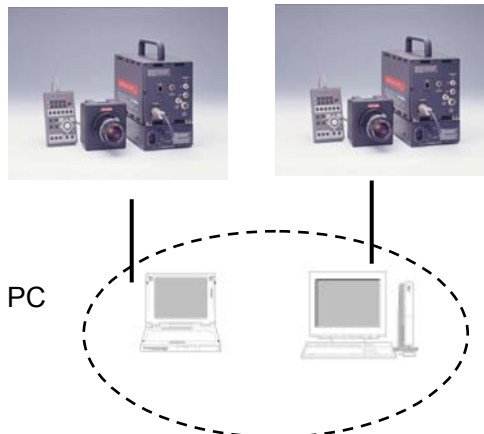
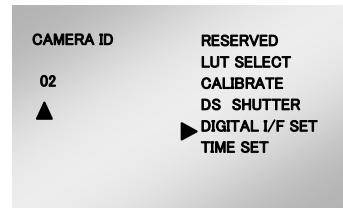
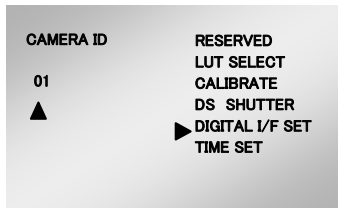
Multiple APX-i2 cameras can be connected to a PC for integrated, synchronized control. When hooking up cameras to a PC, be sure not to duplicate ID numbers: each camera must have a unique ID.

1. Press the MENU button on the keypad to display the menu.
2. Move the cursor to [DIGITAL I/F SET] and press the joystick down to set the selection.
3. The camera ID setting menu is displayed as shown below.



4. Move the joystick up or down to select an ID number and press the joystick down to set the selection.
5. Press the MENU button to exit the menu. Setting has been completed.
6. When the camera is connected to a PC, the above ID setting is reflected as shown below.

Example



Memo

Chapter 7 Specifications

7.1. Specifications

7.2. Mechanical Data

7.3. How to Care Lenses

7.1. Specifications

7.1.1. Product Specifications

Imaging Sensor	C-MOS Imaging Sensor
Sensor Resolution	1024 x 1024 Pixels
Frame Rates	Up to 2,000 FPS, full resolution
Frame Rates	2,000 FPS at 1024 × 1024 pixels full resolution 120,000 FPS, maximum, at 128 x 16 pixels
Lens Mount	F Mount (Nikon); C Mount; Hi-G Mount (optional) Changeable
Recording Grayscale	10 bits
Shutter	Electronic Shutter
Recording Media	IC Memory
Memory Capacity	2.6GB Standard, 8GB Maximum
Recording Duration	2.6GB standard, 1.0 sec (2,048 frames) at 2,000 fps, full resolution (1024 x 1024 pixels) 8.0GB extended, 3.1 sec (6,144 frames) at 2,000 fps, full resolution (1024 x 1024 pixels)
Partitioned Recording	Partitioning of up to 64 sections
Gain Control	LUT loaded in camera. Controllable from keypad or PC.
Extended Dynamic Range	3 Steps
Image Output Customization	Built-in Customizable LUT for Grayscale customization
Random Frame Rate Setting	Any frame rate can be set at 1-frame increment synchronized with external signal between 60 and 120,000 Hz.
Trigger Modes	START; CENTER; MANUAL; END; RANDOM; RANDOM CENTER; RANDOM MANUAL; RANDOM RESET; DUAL FRAME RATE
External Sync Input	5Vp-p, Pos/Neg Switchable; Synchronized with other systems sync
External Sync Output	5Vp-p, Pos/Neg Switchable
Trigger Signal Input	TTL, Contact
Other Input Signals	IRIG/MCDL (4ch analog waveform recording); Timing signal output; Event marker input
Other Output Signals	Trigger, Exposure timing, In-Recording signals
External Controls	Remote keypad, RS422 external I/F, Digital interface (PC)
Image Output Signal	RS170(NTSC/PAL); Real-time digital zoom/pan/fit function
Digital Interface	Photron gigabit optical I/F, IEEE1394 I/F (1 port), or 100BASE-TX
Other	Camera head switching function

7.1.2. Image Intensifier (I I) Specification

II Module	Gen II 25mm diameter
Input Window	Fused silica
Photocathode	S20
Phosphor Screen	FS
Sensitivity (Min.)	10mA/watt at 214 nm; 40mA/watt at 450 nm; 2mA/watt at 800 nm
Gain	Radiant gain: 10,000W/W (500nm)

Min. Gate Width	20 ns
Control	Keypad attached to camera; Software control
Gate Modes	Camera shutter sync mode; Random gate setting mode; External input signal delay mode (TTL Positive)
Gate Setting Restrictions	Min. 20ns up to max. 1/fps can be set at 20ns increment. Repetitive gating up to 150 kHz can be set. Gate setting while monitoring waveform is possible.
Protection against Excessive Light	Excessive light protection circuit works under provided software (system must be connected to a PC).

7.1.3. Miscellaneous

Operating Conditions	
Ambient Temperature	0 to 40 degrees Celsius (32 to 104 degrees Fahrenheit)
Mechanical Data	
Camera Head	120(H) x 110(W) x 99(D) mm; 4.7(H) x 4.3(W) x 3.9(D) inches
Processor	213(H) x 140(W) x 307(D) mm; 8.4(H) x 5.5(W) x 12.1(D) inches
AC Power Supply Unit	66(H) x 140(W) x 277(D) mm; 2.6(H) x 5.5(W) x 10.9(D) inches
Remote Keypad	38(H) x 82(W) x 139(D) mm; 1.5(H) x 3.2(W) x 5.5(D) inches
Camera Cable	5 meters long
Power	
Voltage	100/220 VAC
Frequency	50-60 Hz
Power Consumption	Approx. 130 VA
Weight	
Camera Head	1.0 kg; approx. 2.2 lbs.
Processor	5.5 kg; approx. 12.2 lbs.
AC Power Supply Unit	3.0 kg; approx. 6.7 lbs.
Remote Keypad	0.9 kg; approx. 1.9 lbs.

7.1.4 Accessories

Accessories	Quantity
C-mount adapter	1
Hex wrench for changing lens mounts	1
Lens mount cap	1
GENERAL IN compound cable	1
GENERAL OUT compound cable	1
MCDL/IRIG compound cable	1
Ferrite core for power cable	3
Driver/Application setup CD-ROM	1
FASTCAM-APX-i2 Hardware Manual	1
FASTCAM Control Software operation manual	1
Warranty registration card	1

7.1.5. Optional Items

Optional Items – User-set
IEEE1394 optical extension unit (OpticalLink TE/RE)
4ch MCDL Waveform data input box
4ch Trigger box
Optional Item – Factory-set
4096 Full-frame memory module (additional memory board)

7.1.6. Frame Rates and Resolutions

Table 1 (60 FPS to 8,000 FPS)

Pixels		Frame Rates (FPS)									
		60	125	250	500	1000	2000	3000	4000	6000	8000
Resolution	1024X1024	✓	✓	✓	✓	✓	✓				
	1024x512	✓	✓	✓	✓	✓	✓		✓		
	1024x256	✓	✓	✓	✓	✓	✓		✓		✓
	1024x128	✓	✓	✓	✓	✓	✓		✓		✓
	512x1024	✓	✓	✓	✓	✓	✓	✓			
	512x512	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	512x256	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	512x128	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	512x64	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	256x512	✓	✓	✓	✓	✓	✓	✓	✓		✓
	256x256	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	256x128	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	256x64	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	256x32	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	128x256	✓	✓	✓	✓	✓	✓	✓	✓		✓
	128X32	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	128X16	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 2 (10,000 FPS to 120,000 FPS)

Pixels		Frame Rates (FPS)										
		10000	12500	15000	20000	24000	30000	40000	50000	87600	100000	120000
Resolution	1024X1024											
	1024X768											
	1024x512											
	1024x256											
	1024x128			✓								
	512x1024											
	512x512											
	512x256	✓	✓									
	512x128	✓	✓	✓		✓						
	512x64	✓	✓	✓		✓		✓				
	256x512											
	256x256	✓	✓	✓								
	256x128	✓	✓	✓		✓	✓					
	256x64	✓	✓	✓		✓	✓	✓	✓			
	256x32	✓	✓	✓		✓	✓	✓	✓	✓		
	128x256				✓							
	128X32	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	128X16	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

7.1.7. Number of Recorded Images vs. Resolution

-1 Model: 2.6 GB Memory

-2 Model: 8 GB Memory

Display size	No. of Recorded Images 2.6GB Memory	No. of Recorded Images 8GB Memory
1024x1024	2048	6144
1024 x 512	4096	12288
1024 x 256	8192	24576
1024 x 128	16384	49152
512 x 1024	4096	12288
512 x 512	8192	24576
512 x 256	16384	49152
512 x 128	32768	98304
512 x 64	65536	196608
256 x 512	16384	49152
256 x 256	32768	98304
256 x 128	65536	196608
256 x 64	131072	393216
256 x 32	262144	786432
128 x 256	65536	196608
128 x 32	524288	1572864
128 x 16	1048576	3145728

Record duration = Number of Images x (1/frame rate (FPS))

7.1.8. RS422 Serial Control Commands

RS422 Protocol and Commands

RS422 Communication Protocol

The APX-i2 processor has a UART-type asynchronous system with its NRZ (Nonreturn-To-Zero) format comprising 8 data bits, 2 stop bits, non-parity. The baud rate is 4800.

Camera Setup Command

All camera parameters are set up by the camera setup commands. Each command works in the manner corresponding to the indication of the keypad button.

Camera Setup Commands	
FRAME RATE ↑	0x60
FRAME RATE ↓	0x61
RESOLUTION ↑	0x62
RESOLUTION ↓	0x63
SHUTTER ↑	0x64
SHUTTER ↓	0x65
TRIGGER ↑	0x66
TRIGGER ↓	0x67
LIVE/MEMO	0x68
PLAY <<	0x69
PLAY <	0x6A
PLAY >	0x6B
PLAY >>	0x6C
PLAY	0x6D
PLAY STOP	0x6E
BLOCK S	0x6F
BLOCK E	0x70
BLOCK ON/OFF	0x71
REC READY	0x72
REC	0x73
STORE	0x74
MENU ON/OFF	0x75
ENTER	0x76
ZOOM	0x77
FIT	0x78
CROSSHAIR KEY ↑	0x79
CROSSHAIR KEY ↓	0x7A
CROSSHAIR KEY ←	0x7B
CROSSHAIR KEY →	0x7C

Camera Information Requirement Command

Camera setup information can be obtained. Camera information corresponding to each command can be obtained.

Camera Information Requirement Commands	
FRAME RATE	0xA0
RESOLUTION	0xA1
SHUTTER	0xA2
TRIGGER	0xA3
LIVE/MEMO	0xA4
ID	0xA5
RANDOM FRAME	0xB0
MANUAL TRIGGER	0xB1
RANDOM M TRIGGER	0xB2
RANDOM E TIMES	0xB3
TWO STAGES	0xB4
OSD SELECT	0xB5
R/G/B	0xB6
EXT-SYNC IN	0xB7
EXT-SYNC OUT	0xB8
GENERAL IN	0xB9
GENERAL OUT	0xBA
COLOR TEMP	0xBB
LUT SELECT	0xBC
DS SHUTTER	0xBD
MCDL/IRIG	0xBE
AUTO PLAY	0xBF
DATE/TIME	0xC0
MAX ID	0xC1

Camera Information Response Commands

The APX-i2 camera system returns the camera information to the requiring command. The returned information includes a camera information command indicating the kind of camera information followed by setup response command that shows the setup details. The setup response command has numeric meaning in it and has 8 bytes or 16 bytes (when the data bit portion only is converted) of information sent back in a row.

Note: A 16-byte transfer of data is available only when returning setup details on resolution information.

Example: Request frame rate information when the camera is set 2,000 FPS.

1. Send a camera information request command [0xA0].
2. An information response command [0xD0] is returned by the camera.
3. Then, a setup response command consisting of 8 bytes of is returned in a row like [0x30], [0x30], [0x30], [0x30], [0x30], [0x30], [0x30], [0x30] is returned.

Camera Information Commands		Setup Response Commands (8 or 16bytes)
FRAME RATE	0xD0	00000060
		~
		00120000
RESOLUTION	0xD1	00000128 00000016
		~
		00001024 00001024
SHUTTER	0xD2	00000060
		~
		00250000
TRIGGER	0xD3	00000000 : START
		00000001 : CENTER
		00000002 : END
		00000003 : MANUAL
		00000004 : RANDOM
		00000005 : RANDOM RESET
		00000006 : RANDOM CENTER
		00000007 : RANDOM MANUAL
		00000008 : TWO STAGES
LIVE/MEMO	0xD4	00000000 : LIVE
		00000001 : MEMO

ID	0xD5	00000001
		~
		00000064
RANDOM FRAME	0xE0	00000001
		~
		0xxxxxxx
MANUAL TRIGGRE	0xE1	00000001
		~
		0xxxxxxx
RAMNDOM M TRIGGER	0xE2	00000001
		~
		0xxxxxxx
RANDOM E TIMES	0xE3	00000001
		~
		00000010
TWO STAGES	0xE4	00000002 : 1/2
		00000003 : 1/4
		00000004 : 1/8
OSD SELECT	0xE5	00000001 : ON
		00000002 : OFF
R/G/B	0xE6	00000001 : ALL
		00000002 : R
		00000003 : G
		00000004 : B
EXT-SYNC IN	0xE7	00000001 : OFF
		00000002 : ON POS CAM
		00000003 : ON NEG CAM
		00000004 : ON POS OHTERS
		00000005 : ON NEG OHTERS
EXT-SYNC OUT	0xE8	00000001 : VSYNC POS
		00000002 : VSYNC NEG
GENERAL IN	0xE9	00000001 : EVENT POS
		00000002 : EVENT NEG
		00000003 : TRIGGER POS
		00000004 : TRIGGER NEG
GENERAL OUT	0xEA	00000001 : EXPOSE POS
		00000002 : EXPOSE NEG

		00000003 : REC POS
		00000004 : REC NEG
		00000005 : TRIGGER POS
		00000006 : TRIGGER NEG
COLOR TEMP	0xEB	00000001 : 5100K
		00000002 : 3100K
		00000003 : USER 1
		00000004 : USER2
LUT SELECT	0xEC	00000001 : D1
		00000002 : D2
		00000003 : D3
		00000004 : D4
		00000005 : D5
		00000006 : USER
DS SHUTTER	0xED	00000001 : OFF
		00000002 : ON MODE 1
		00000003 : ON MODE2
		00000004 : ON MODE3
MCDL/IRIG	0xEE	00000001 : OFF
		00000002 : MCDL ON
		00000003 : IRIG ON
		00000004 : MCDL IRIG ON
AUTO PLAY	0xEF	00000001 : OFF
		00000002 : ON
DATE/TIME	0xF0	00000001 : DATE
		00000002 : TIME
TOTAL ID	0xF1	00000001
		~
		00000064

Digits of Setup Response Commands	
0	0x30
1	0x31
2	0x32
3	0x33
4	0x34
5	0x35
6	0x36
7	0x37
8	0x38
9	0x39

7.1.9. STATUS OUT

The camera status can be so set that the camera always outputs data of its status in the serial format by setting the [STATUS OUT] to ON from the menu in the following procedure:

Press the MENU button on the keypad and use the joystick to select [STATUS OUT] and press the joystick down.

Then select ON for [STATUS OUT]. The camera has been set to camera status data output in the serial format via the RS422 interface.

The camera statuses where serial data can be output are LIVE, MEMORY, READY, REC and ENDLESS. When the camera turns into one of these statuses, the camera status data is output in the serial format.

With this feature, you can know the camera status without sending a camera information acquisition request command.

The serial commands used to specify the camera status are as follows:

LIVE:	0x53, 0x30
MEMORY:	0x53, 0x31
READY:	0x53, 0x32
REC:	0x54, 0x33
ENDLESS:	0x53, 0x34

Example:

When the camera status is changed from MEMORY to LIVE, the camera automatically issues 0x53, then 0x30, which means that the camera is in the LIVE mode.

7.1.10. Shutter Speed Table (COARSE Steps)

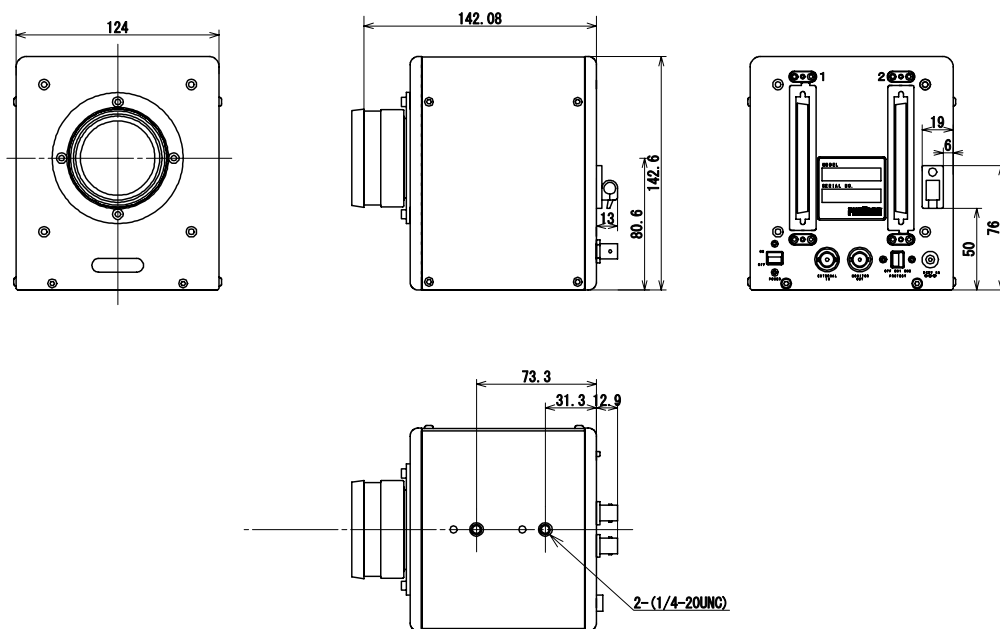
The following table shows the 27 available steps for the COARSE set of shutter speeds. Note the lowest speed is 1/60 seconds. The speed doubles up to 1/2,000 seconds and then offers the most frequently-used speeds as shown in the table.

For FINE steps, the shutter speed doubles from 1/60 to 1/2,000 seconds (as is the case with the COARSE steps - see the below table). After 1/2,000 seconds, however, the speed increases at a fine step of 1/1,000 seconds up to the highest speed of 1/250,000 seconds.

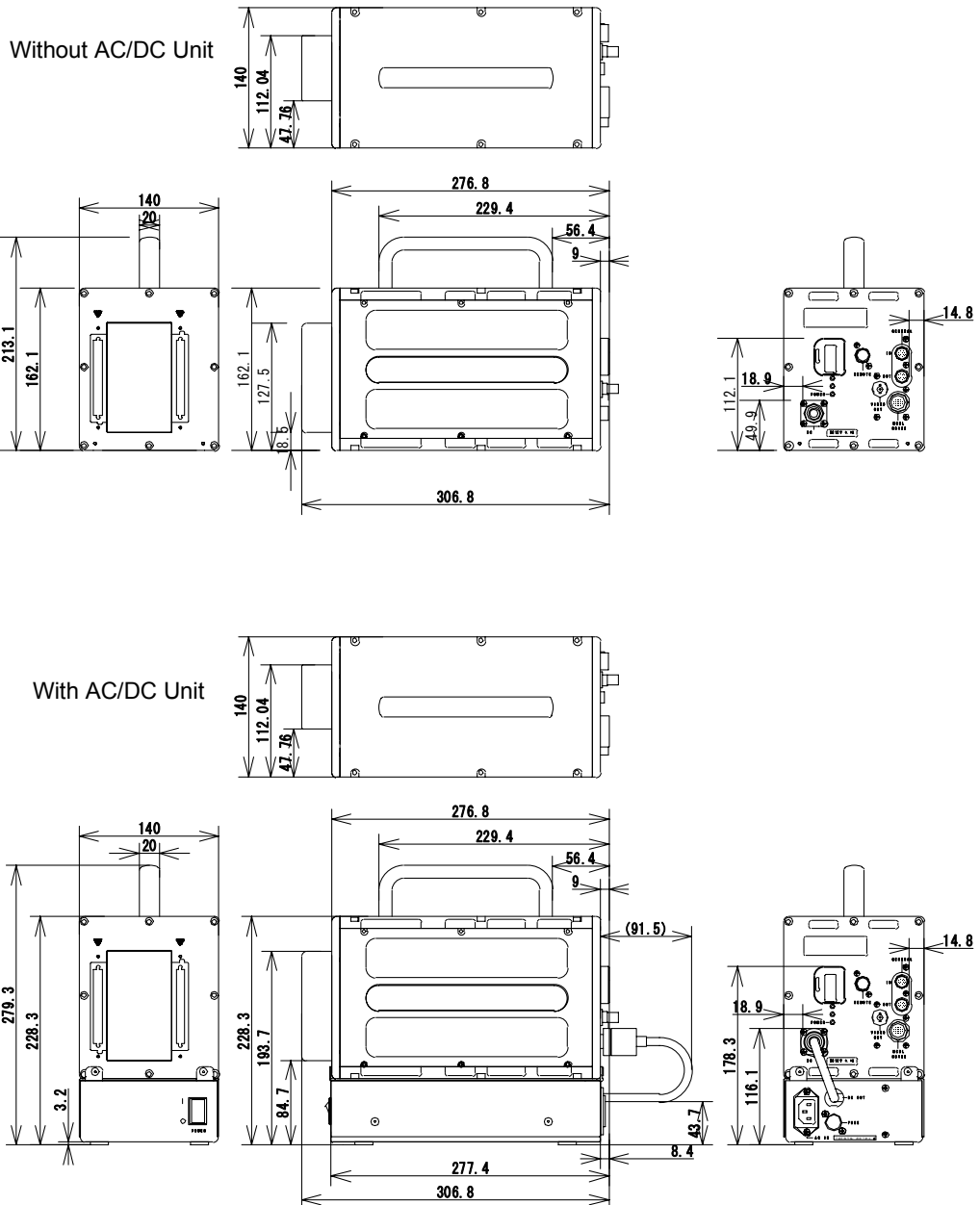
COARSE Shutter Speed Steps (seconds)
1/60
1/125
1/250
1/500
1/1000
1/2000
1/3000
1/4000
1/6000
1/8000
1/10000
1/15000
1/20000
1/24000
1/30000
1/40000
1/50000
1/87600
1/100000
1/120000
1/140000
1/160000
1/180000
1/200000
1/220000
1/240000
1/250000

7.2. Mechanical Data

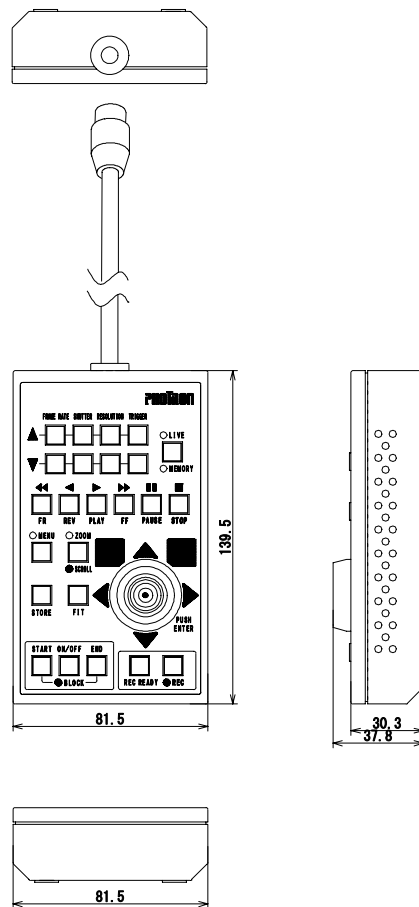
7.2.1. Camera Head (millimeters)



7.2.2. Processor (millimeters)



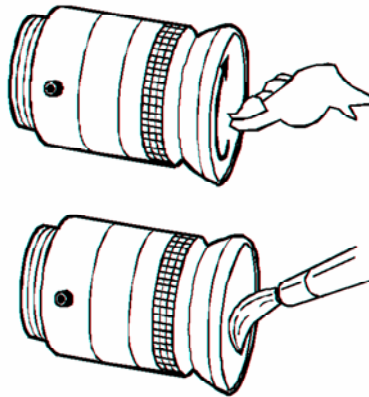
7.2.3. Keypad (millimeters)



7.3. Care of Lenses

The surface of photographic lenses has thin coatings that reduce unwanted reflections. Extra care must be taken to protect these fragile coatings.

Protect the lens by installing a lens cap when you are not using the camera. Brush the lens gently with a camel hairbrush or loosely folded piece of lens paper to remove dust particles. For stubborn dirt use photographic lens cleaning solution and lens wipes. Never rub the lens with direct pressure or drop cleaning solution directly on the lens surface.



In Americas and Antipodes:

PHOTRON USA, INC.

9520 Padgett Street, Suite 110
San Diego, CA 92126-4446, USA
Phone: 858-684-3555
Fax: 858-684-3558
E-mail: image@photron.com
www.photron.com

In Europe, Africa and India:

PHOTRON EUROPE LIMITED

Willowbank House
84 Station Road
Marlow, Bucks SL7 1NK, U.K.
Phone: +44(0) 1628 89 4353
Fax: +44(0) 1628 89 4354
E-mail: image@photron.com
www.photron.com

In other areas:

PHOTRON LIMITED

Fujimi 1-1-8, Chiyoda-Ku
Tokyo 102-0071, Japan
Phone: +81 3 3238 2107
Fax: +81 3 3238 2109
E-mail: image@photron.com
www.photron.co.jp

**FASTCAM-ultima APX-i2
User's Manual**

English Version
Sep, 2007
Rev.1.04