

FASTCAM-X 1280PCI Hardware Manual

Rev.1.0

PHOTRON

PHOTRON LIMITED

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Chapter 1 Introduction

1.1. Introduction

1.2. Warranty

1.3. How To Use This Manual

1.4. Precautions



1.1. Introduction

The FASTCAM-X1280PCI High-Speed Video Camera System has been developed to offer a powerful engineering solution in R and D, engineering, manufacturing, quality control in general industries and special applications in scientific, medical, biological, aerospace studies. Its extra-high-speed recording capability and easy-to-use remote control software provide a motion analysis environment that has been hard to obtain so far.

The live image setup function ensures that the image of the object on the screen is captured and recorded in the memory at a simple click on the recording button with your mouse. The image can also be recorded in the HDD of your PC.

Use this cutting-edge recording technology to observe your fast moving object as a slow-motion playback image or to input the moving image data into your motion analysis system for processing.

This manual has been prepared for you to use the FASTCAM-X1280PCI system in the most effective way for slow-motion observation and motion analysis of fast moving objects.

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 damage 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-X1280PCI

PHOTRON LIMITED warrants this PHOTRON FASTCAM-X1280PCI system and its accessories manufactured by PHOTRON LIMITED, to function properly for one year from the date of shipment, if 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.

THIS WARRANTY DOES NOT APPLY UNDER THE FOLLOWING CONDITIONS:

Failure to operate the PHOTRON FASTCAM-X1280PCI series in accordance with Photon's written instructions, including environmental specifications listed in the User's Manual.

If there is evidence of the PHOTRON FASTCAM-X1280PCI system being subjected to accidental damage, misuse or abuse.

If the PHOTRON FASTCAM-X1280PCI system 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 PHOTRON FASTCAM-X1280PCI system 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
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

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

In other areas:
PHOTRON LIMITED
Shibuya 1-9-8, Shibuya-ku
Tokyo 150-0002
Japan
Phone: +81 3 3486 3471
Fax: +81 3 3486 8760
E-mail: image@photron.com

1.3. How to Use This Manual

DEFINITION OF TERMS

You will notice as you read this manual that some of the information is presented as a NOTE, CAUTION or WARNING. It is important that you understand the significance of these three terms.

NOTE

A note contains information that we wish to emphasize regarding the operation of your FASTCAM-PCI series.

CAUTION

A caution is intended to warn you that a certain operation or condition may cause harm to your FASTCAM-PCI series.

WARNING

A warning is important to the safety of everyone operating the FASTCAM-X1280PCI system and should not be disregarded under any circumstances.

Chapter 1. Introduction

Contains Warranty, Precautions, Introduction and how to use this manual.

Chapter 2. Visual Introduction

Visual introduction to the components of your FASTCAM-X1280PCI system. Explains the use of each of connectors and controls on the Camera and the Processor.

Chapter 3. Appendix

Contains specifications and special remarks on the system.

If you require additional information not included in this manual regarding the care, technical service and operation of your FASTCAM-X1280PCI system please contact the service department in San Diego by calling:

800 - 585 - 2129

1.4. Precautions

AMBIENT Temperature

Photron FASTCAM-X1280PCI has been designed to work properly in an ambient temperature range of 0 to 35 degrees Celsius (32 to 95 degrees Fahrenheit), no condensation. For the ambient temperature of the PC to be used with FASTCAM-X1280PCI, see the PC manual. If it has a different working temperature range, the lower of the two different ranges should be observed.

STORAGE Temperature

FASTCAM-X1280PCI 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. Or, if you transport the unit frequently, the use of a special carrying case is recommended. Please check with your dealer, Photron USA or Photron Europe. Do not send the unit to a place where the temperature can go below -20 degrees Celsius (-4 degrees Fahrenheit) or above 70 degrees Celsius (+158 degrees Fahrenheit).

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 B 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 device may not cause harmful interference, and (2) this device 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 receptacle. A loss of the protective ground, for any reason, could result in electrical shock. Use the proper power cord and insure that it is in good condition.

Memo

Chapter 2

Visual Introduction

2.1. Products

2.2. FASTCAM-X1280PCI System

2.3. Hardware Installation

2.4. Multi-Camera Sync Operation

2.5. High Gain Operation

2.1. Visual Introduction

2.1.1. Unpacking

When unpacking, please see if the following items are included in the package:

- | | |
|--|-------|
| 1. Camera head | 1 ea. |
| 2. Grabber board (PCI board) | 1 ea. |
| 3. Camera cable (5m) | 1 ea. |
| 3. Lens mount cap | 1 ea. |
| 5. Driver/application setup CD-ROM | 1 ea. |
| 6. Sensor information file FDD(3.5"1.44M) | 1 ea. |
| 7. FASTCAM-X1280PCI Hardware manual | 1 ea. |
| 8. FASTCAM Control Software operation manual | 1 ea. |
| 9. Warranty registration card | 1 ea. |
| 10. Internal sync cable (for 2 units) | 1 ea. |
| 11. Internal sync cable (for 3/4 units) | 1 ea. |

2.1.2. Accessories and Optional Items

The following optional item is offered for the FASTCAM-X1280PCI:

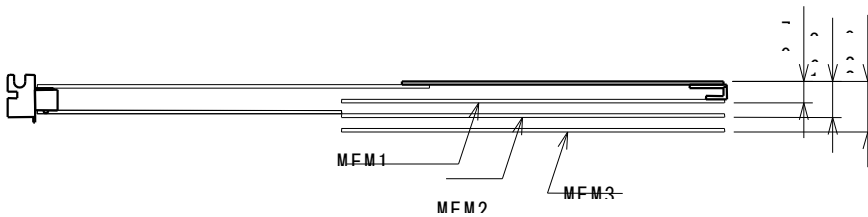
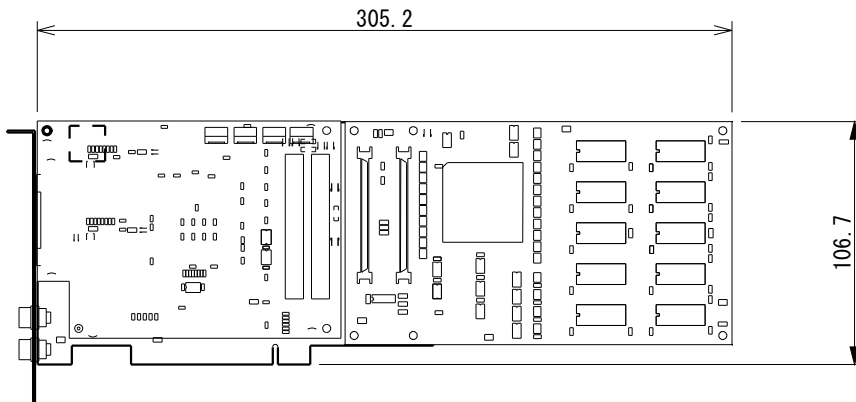
1. **Additional memory board (up to 2 boards can be added)**

2.2. FASTCAM-X 1280PCI System

The FASTCAM-X1280PCI system consists of such components as a grabber board, camera head, control software and so forth.

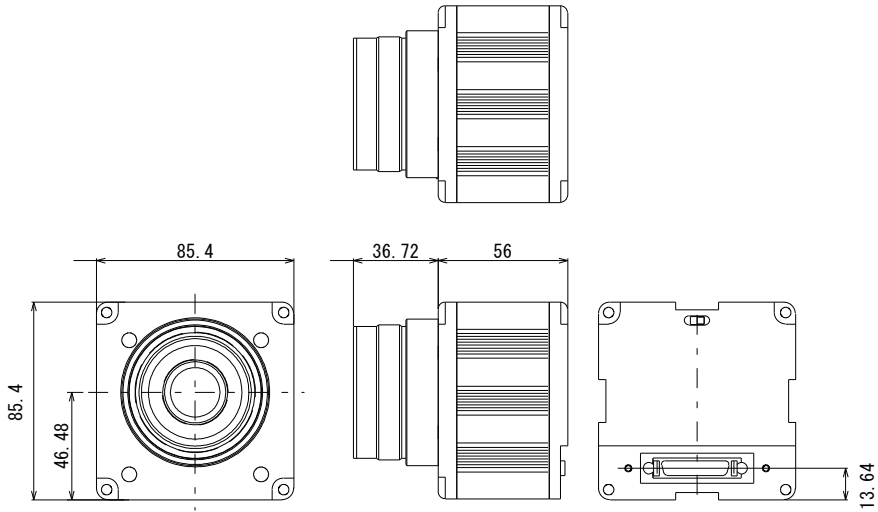
2.2.1. Grabber board

The FASTCAM- X1280PCI grabber board has been so designed that a maximum of four boards can be loaded in PCI slots of the PC of ATX standard.



2.2.2. Camera Head

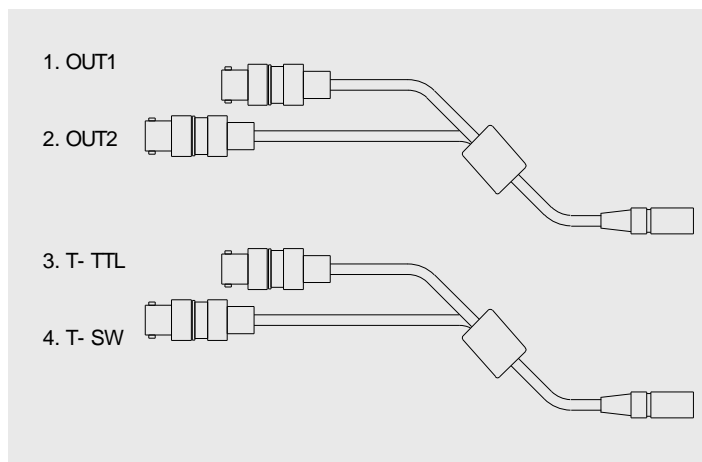
The FASTCAM-X1280PCI camera head, designed with compactness and light weight, ensures ease of handling and operation in almost any shooting situation with its compactness and light weight. It uses the F mount for the taking lens. A tripod mounting hole is provided on the camera base.



2.2.3. Accessories

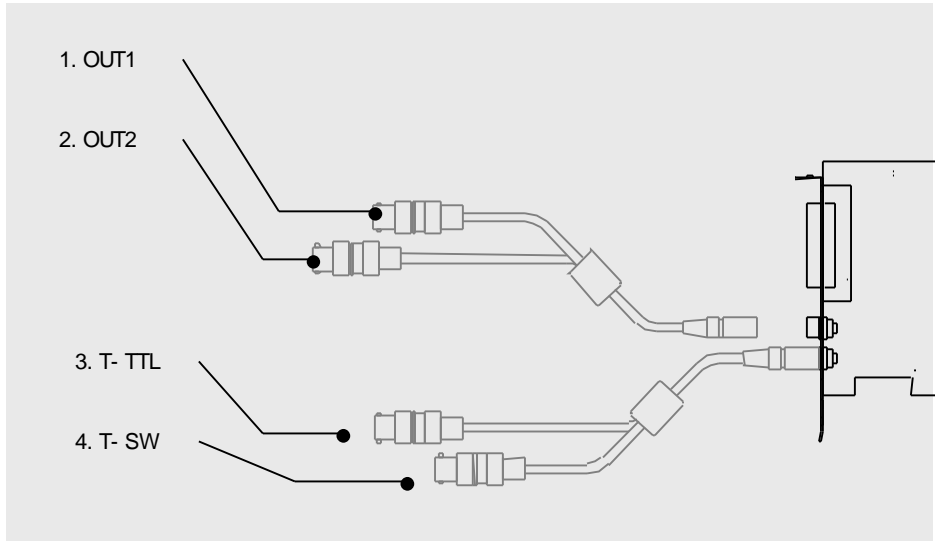
EXT OUT and Trigger IN cables

The FASTCAM-X 1280PCI grabber board has two compound connectors that provide trigger and sync signals in and out between the grabber board and external devices using dedicated cables. Two external connection cables come with the system as standard accessories.



2.2.4. Specifications of Connectors

The specifications of the FASTCAM-X 1280PCI external connectors are shown here. The connectors support the following signals:



1 EXTOUT1 Output connector

A BNC-type connector. It outputs a signal that indicates the first frame when an asynchronous reset trigger is input.

2 EXTOUT2 Output connector

A BNC-type connector. It outputs the camera's vertical sync signal for external strobe and pulse laser units to synchronize with.

3 TRIGGER TTL IN Input connector

A BNC-type connector. It accepts external TTL-compatible signal to control the start and end of recording in a selected recording mode. The input pulse must be of +5V, positive and 50usec wide. The operational current is 10mA recommended and 20mA maximum.

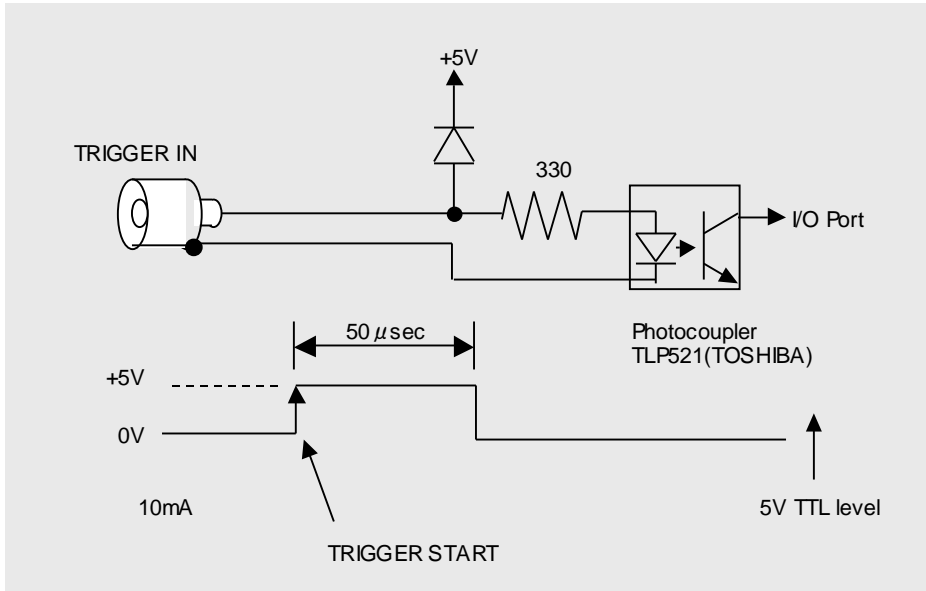
4 TRIGGER SW IN Input connector

A BNC-type connector. A contact switch between the center and the shield conductors of the BNC connector controls the start and end of recording in a selected recording mode.

Caution: Input of trigger signals other than switch contact into TRIGGER SW IN connector will severely damage the system.

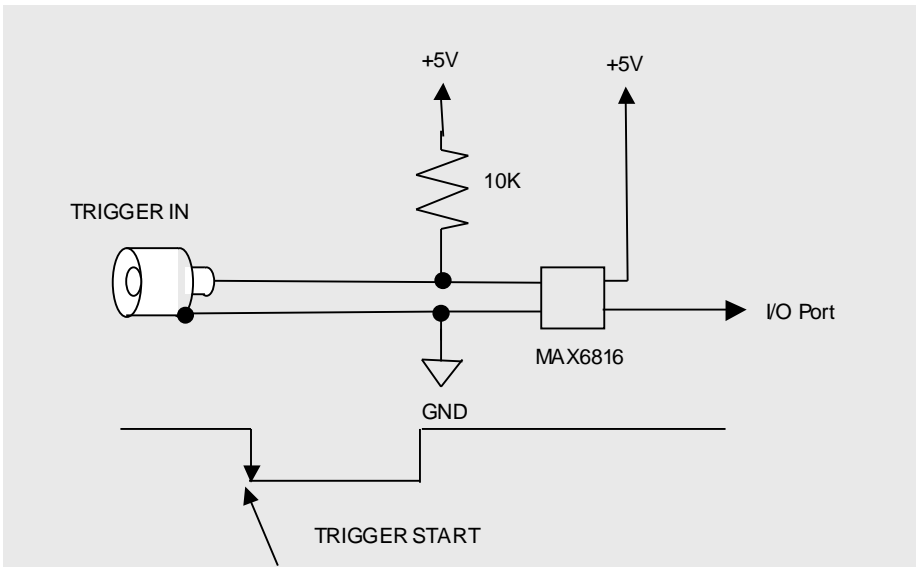
TRIGGER TTL IN Input connector

Circuit diagram



TRIGGER SW IN Input connector

Circuit diagram



5. V SYNC / INTERNAL TRIGGER INPUT connector (BD_IN connector)

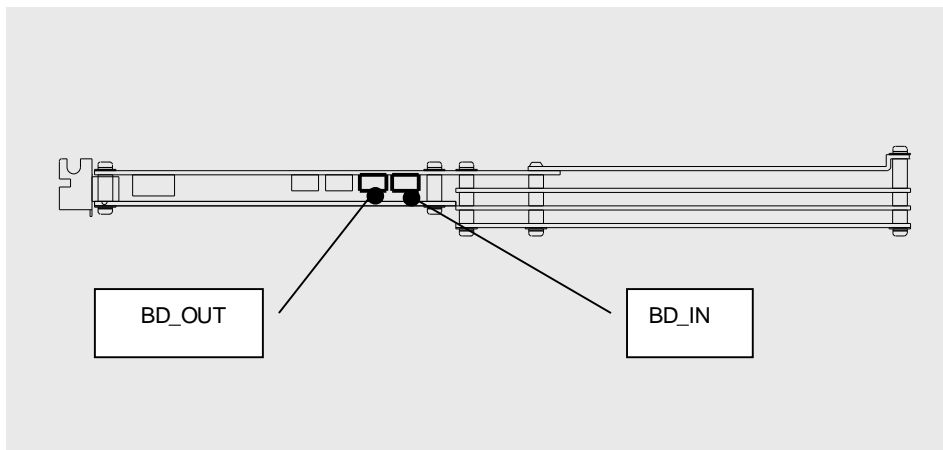
This a connector provided specifically to synchronize all the units involved in a multi-camera operation where two or more FASTCAM-X1280PCI grabber boards are installed in one PC. It does not support connection or synchronization with external devices or equipment.

When a slave mode is set for multi-camera operation, this connector provides trigger signals from the master unit to slave(s) for synchronized recording.

6. V SYNC / INTERNAL TRIGGER OUTPUT connector (BD_OUT connector)

This a connector provided specifically to synchronize all the units involved in a multi-camera operation where two or more FASTCAM-X1280PCI grabber boards are installed in one PC. It does not support connection or synchronization with external devices or equipment.

Locations of BD_IN and BD_OUT connectors



2.3. Hardware Installation

Caution

Before you connect between the camera head and grabber board, and install the grabber board into the PC, please be sure to switch off the PC and unplug the power cord from the mains outlet. Otherwise, major damages may be caused on your camera head, grabber board and/or PC. Also, please make sure that there is no twist on the cables.

2.3.1. Grabber board installation

Follow the below procedure to install the grabber (PCI) board into the PC.

1. Switch off the PC and unplug the power cord.
2. Open up the housing of the PC following the instructions given in the PC user's manual.
3. Make sure there is an empty PCI slot(s).
4. Remove the metal cover plate over the empty PCI slot.
5. Plug the grabber board in the empty PCI slot. Be sure to press the board firmly so that the board connector is completely seated in the slot. Fasten the board onto the PC chassis with the retaining screw.
6. Connect the camera cable from the camera head to the PCI board. Make sure if the orientation of the connector is correct and fasten it with the retaining screw. Pull the cable lightly to see if the connector does not come off.
7. Replace the housing cover. Follow the instructions given in the PC manual.

2.3.2. Camera head installation

8. Connect the camera cable between the connector on the camera head and the camera connector on the grabber board.

Note:

Fasten the connector to the camera head using the retaining screws on the connector shell.

Caution:

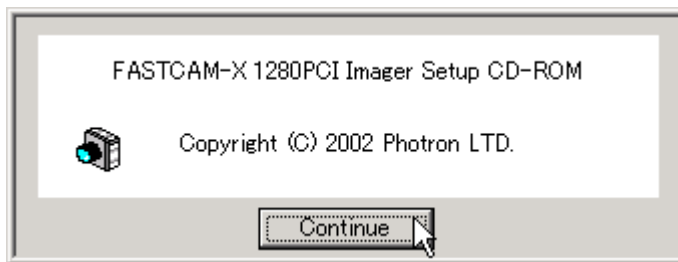
Be sure to switch off the PC and unplug the power cord before installing the grabber board in the PC.

2.3.3. Imager SETUP CD-ROM installation

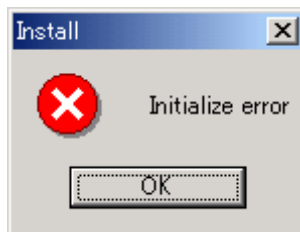
The mega-pixel C-MOS sensor used in the FASTCAM-X 1280PCI system has been checked under Photron's own quality assurance criteria that sets the pixel defect allowance in each of the geometric areas of the sensor surface. Data from each of the defective pixels on the sensor surface is replaced with data obtained by calculating data from adjacent pixels. The defect correction function is programmed in the attached PFV control software. Because the distribution of defective pixels is unique to each C-MOS sensor, each of the FASTCAM-X 1280PCI must be installed with the correction data specifically prepared for and attached to it. Use the attached FASTCAM-X 1280PCI Imager SETUP CD-ROM for installation following the procedure below:

First, make sure the grabber board, driver and PFV have been installed.

Insert the Imager SETUP CD-ROM into the CD drive and set up automatically starts by Auto RUN.



If there is no driver or grabber board installed, the following Initialize Error message is displayed:



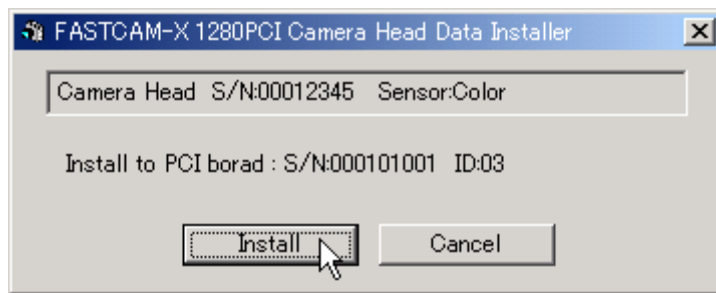
If PFV is not installed, you will see the following message:



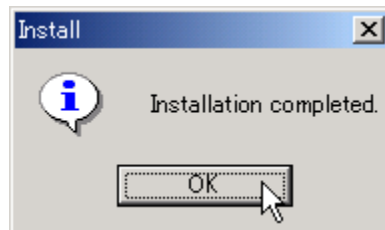
If the sensor serial number of the correction data to be installed and the sensor serial number imbedded in the grabber board disagree, the following error message appears:



When the preparation is done, execution window is displayed as shown below:



Press the Install button and installation starts. The completion window show up when all is done.



2.4. Multi-Camera Sync Operation

The FASTCAM-X1280PCI system offers synchronized multi-camera operation involving up to four cameras. In the multi-camera sync operation, all the cameras shoot one single fast-moving event from different viewing angles along the same timeline and record in their respective memory. This is useful for simultaneously recording a fast-moving object and other related events from different viewpoints.

The following subsections discuss the procedures for setting up a multi-camera sync operation system.

The following four steps are needed to set up a multi-camera sync operation:

- 2.4.1. Setting up Master/Slave modes on cameras**
- 2.4.2. Connecting cables for internal sync signals**
- 2.4.3. Setting up unique camera ID's**
- 2.4.4. Setting up PFV software**

2.4.1. Setting up Master/Slave modes

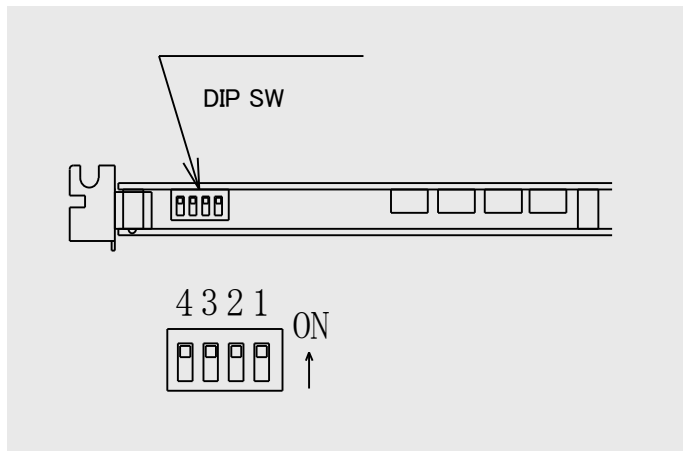
For multi-camera sync operation, one of the cameras must be set to be the Master and others Slave(s). By this, the slave cameras operated in accordance with the sync signal generated by and fed from the master camera, thus all the cameras operate in a perfect synchronization along one timeline.

For this setting up, the mode setup switch on the grabber board is used in the following manner:

Caution: Before start working, be sure to switch off the PC and unplug the power cord.

1) Position of mode setup switches

The mode setup switches are located on the upper surface of the grabber board. See the below figure to confirm their positions. This figure shows the switches as seen from the top of the board.



2) Setting the switches to sync mode

Set the respective dip switches for the master board and slaves as shown in the below chart.

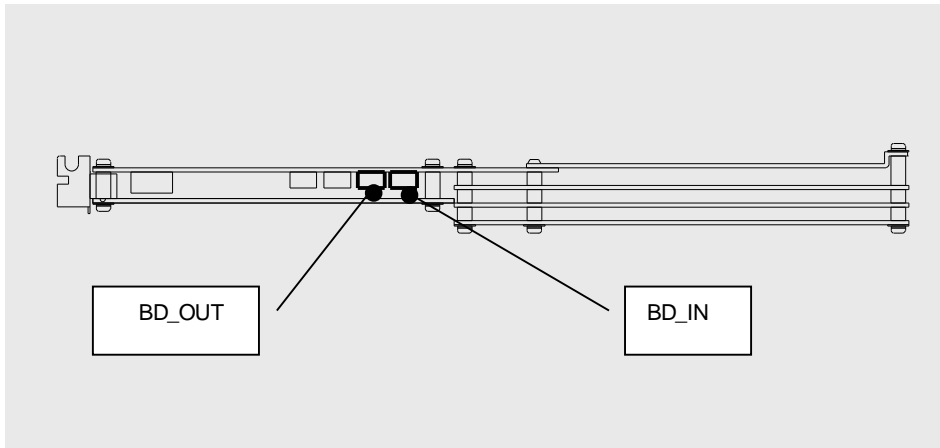
	Switch setting	Functions
Master Mode	4 3 2 1 Switch 3 is OFF	Generates sync and trigger signals and output them from BD_OUT connector.
Slave Mode	4 3 2 1 Switch 3 is ON	Follow the master in accordance with the sync signal fed from the master via BD_IN connector. Starts and ends recording by the trigger signals fed from master via BD_IN connector.

2.4.2. Installing internal sync cables

After Master/Slave set up of the grabber boards, install the sync cables between the boards

1) Position of internal sync connectors

Connectors for internal sync signal input/output are located at the position on the board as shown below. For multi-camera sync operation, connect between these connectors on respective boards using the attached cables.



- **BD_IN Connector**

Receives internal sync and trigger signals from BD_OUT connector of another board.

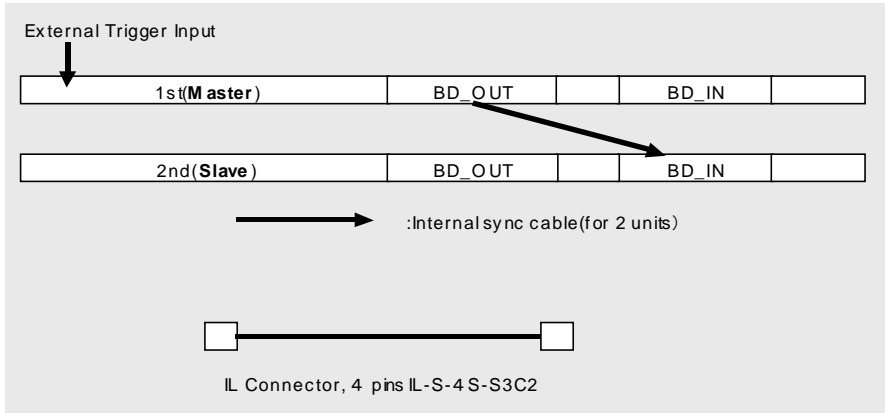
- **BD_OUT Connector**

Outputs internal sync and trigger signals.

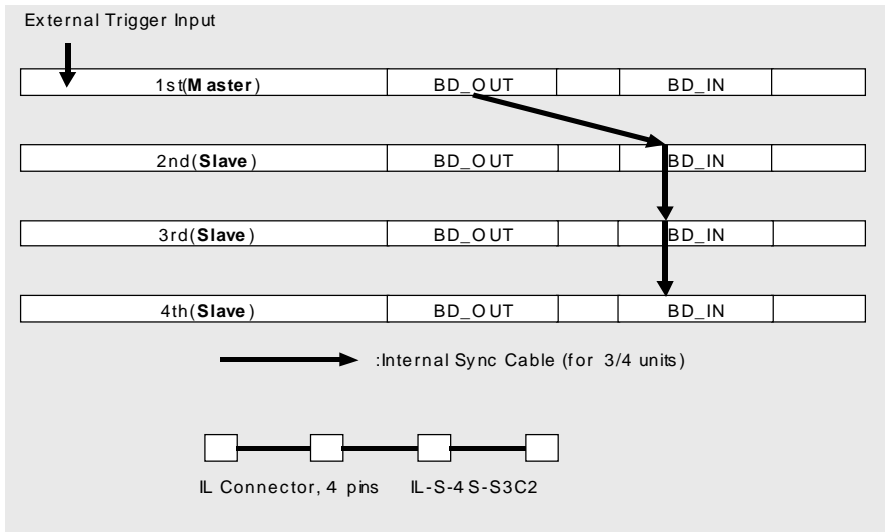
2) Internal sync cable connection

The following figures show how to connect between the master and slave boards for two- and four-camera sync operations. Connect the cables so that the sync output (BD_OUT) from the master board is fed to the sync input (BD_IN) of a slave board.

*Cable connections (2-camera sync operation)



*Cable connections (4-camera sync operation)



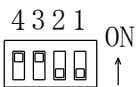
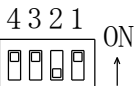
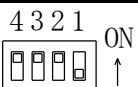
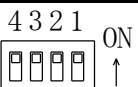
2.4.3. Setting camera ID numbers

For the software to recognize each camera correctly in multi-camera sync operation, the FASTCAM-X 1280PCI can be assigned an ID number from 0 to 3. By this feature, each of the cameras is correctly recognized even if the order of camera recognition by the OS changes.

Assign ID numbers in the following manner.

1) Dip switch setting for camera ID

Camera ID number are assigned by setting the dip switches No. 1 and No. 2 as shown in the table below:

ID Number		Switch No. 1	Switch No. 2
0		OFF	OFF
1		ON	OFF
2		OFF	ON
3		ON	ON

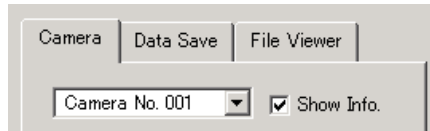
Note: Factory-set ID number is "0".

Caution: Do not duplicate ID numbers on multiple boards.

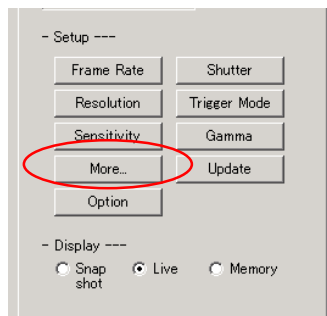
2.4.4. Software setting

Hardware setting for multi-camera sync operation has completed in the previous subsections. In this subsection, how to initialize the internal connections by the control software is discussed. For the basic operation of the software, please see the Software Operation Manual.

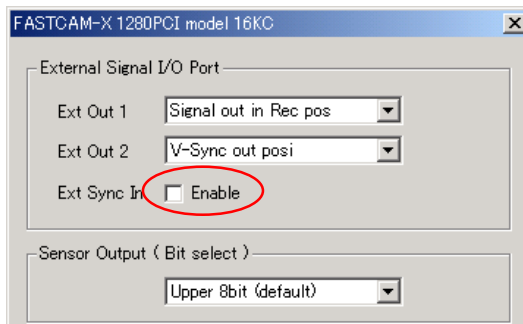
- 1) Select a slave camera in the camera selection pull-down box.



- 2) Press the More button to start setting details.



- 3) Check "Ext Sync In" to enable the external sync mode. Now the slave camera will operate synchronized to sync and trigger signals from the master.



Note: "Ext Sync In" for master camera is gray out and is not selectable.

- 4) Repeat the above steps 1) through 3) with all the slave cameras.
This concludes the software setting procedure.

2.4.5. Tips for multi-camera sync operation

Triggering from software

With the internal sync cables connected (see subsection 2.4.2), software triggering can be done to all the boards without any delay between them.

Using external trigger

You can use external triggers for multi-camera sync operation. Input a trigger to the master board from an external source. The trigger is then transferred to slave boards for sync operation.

Note: Input of an external trigger to a slave is invalid: it will not be recognized as a trigger.

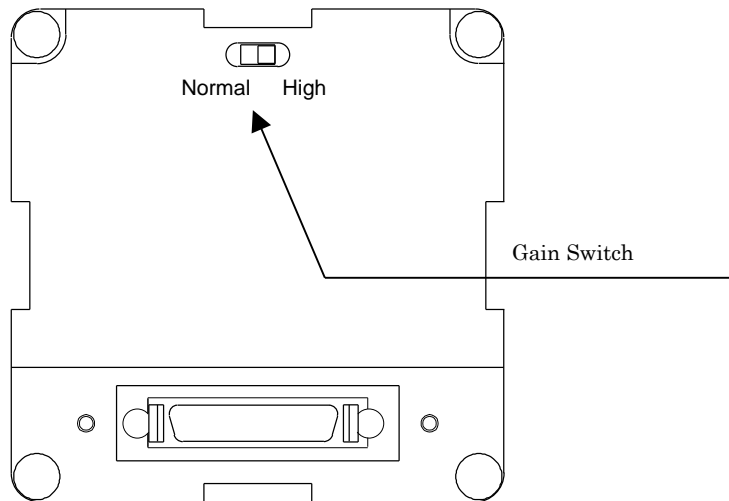
Note: Triggering takes place in all the boards, the master and slave(s), set up for sync operation all at one time in synchronization. In the multi-camera sync operation system, no individual board can be triggered independently from others.

2.5. Gain Selector Switch

The gain switch on the back of the camera lets you select the camera gain (analog) setting from the following two modes:

- Standard gain mode
- High gain mode (+6dB)

In a lower-light level situation, the high gain mode may be helpful. Note, however, you need to be careful when using it because it will raise the overall noise level to a certain degree.



Note: Factory setting is "Standard".

Note: High gain will raise the overall noise level to a certain degree.

Memo

Memo

Chapter 3 Appendix

3.1. Specifications

3.2. Dimensions

3.3. Remarks

3.4. Care of Lenses

3.1. Specifications

3.1.1. PHOTRON FASTCAM-X 1280PCI

Recording method		Digital recording in memory board (SD-RAM)
	START	Records frames to the maximum of the recording memory, and stops.
	END	Stops recording at a trigger.
	CENTER	Records the same number of frames before and after a trigger.
	MANUAL	Records preset number of frames before and after a trigger.
	RANDOM	Records from 1 up to 256 frames, as preset, at each trigger. The number is set by control software.
		START and RANDOM modes support Random reset trigger that is on/off switchable by control software.
Framing rate	Full frame	60; 125; 250; 500 FPS
	Partial frame	1000; 2000; 4000; 8000; 16000 FPS
Models		500, 1k, 4k and 16k

3.1.2. Framing rate vs. Model

Framing rate (FPS)	Model			
	500	1k	4k	16k
60	○	○	○	○
125	○	○	○	○
250	○	○	○	○
500	○	○	○	○
1000	-	○	○	○
2000	-	-	○	○
4000	-	-	○	○
8000	-	-	-	○
16000	-	-	-	○

3.1.3. Framing rate vs. Image resolution

Resolution (pixels)	Framing rate (FPS)								
	60	125	250	500	1000	2000	4000	8000	16000
1280x1024	○	○	○	○	-	-	-	-	-
1280x512	○	○	○	○	○	-	-	-	-
640x512	○	○	○	○	○	-	-	-	-
1280x256	○	○	○	○	○	○	-	-	-
640x256	○	○	○	○	○	○	-	-	-
320x256	○	○	○	○	○	○	-	-	-
640x128	○	○	○	○	○	○	○	-	-
320x128	○	○	○	○	○	○	○	-	-
160x128	○	○	○	○	○	○	○	-	-
640x64	○	○	○	○	○	○	○	○	-
320x64	○	○	○	○	○	○	○	○	-
160x64	○	○	○	○	○	○	○	○	-
80x64	○	○	○	○	○	○	○	○	-
320x32	○	○	○	○	○	○	○	○	○
160x32	○	○	○	○	○	○	○	○	○

3.1.4. Shutter speed vs. Framing rate

Shutter speed	Framing rate (FPS)								
	60	125	250	500	1000	2000	4000	8000	16000
1/60s	○	-	-	-	-	-	-	-	-
1/125s	○	○	-	-	-	-	-	-	-
1/250s	○	○	○	-	-	-	-	-	-
1/500s	○	○	○	○	-	-	-	-	-
1/1000s	○	○	○	○	○	-	-	-	-
1/2000s	○	○	○	○	○	○	-	-	-
1/4000s	○	○	○	○	○	○	○	-	-
1/8000s	○	○	○	○	○	○	○	○	-
1/16000s	○	○	○	○	○	○	○	○	○
1/32000s	○	○	○	○	○	○	○	○	○
1/64000s	○	○	○	○	○	○	○	○	○
1/128000s	○	○	○	○	○	○	○	○	○

3.1.5. Recording capacity (number of images)

The following three models are available of FASTCAM-X 1280PCI:

- 1 Model (1.28GB Memory)
- 2 Model (2.56GB Memory)
- 3 Model (3.84GB Memory)

Resolution (pixels)	Memory capacity		
	1.28GB	2.56GB	3.84GB
	No. of frames	No. of frames	No. of frames
1280x1024	1024	2048	3072
1280x512	2048	4096	6144
640x512	4096	8192	12288
1280x256	4096	8192	12288
640x256	8192	16384	24576
320x256	16384	32768	49152
640x128	16384	32768	49152
320x128	32768	65536	98304
160x128	65536	131072	196608
640x64	32768	65536	98304
320x64	65536	131072	196608
160x64	131072	262144	393216
80x64	262144	524288	786432
320x32	131072	262144	393216
160x32	262144	524288	786432

Note: The recording time is calculate as follows:
 Recording time = No. frames x (1/frame rate)

3.1.6. PHOTRON FASTCAM-X 1280PCI Camera Head

Sensor resolution	1280 x 1024 pixels	
Grayscale	Mono	8 bits
	Color	8 bits each RGB (Bayer color filter)
Lens mount	F mount (Nikon)	
Dimensions	85.4 (W) x 85.4 (H) x 56.0 (L) mm (Excl. lens mount, camera mount plate)	
Camera cable	5 meters (not expandable)	
Data bus I/F	PanelLink Standard (Photron-modified)	
Power	5VDC power fed by grabber board via camera cable NEVER remove camera cable while PC is powered on.	
High gain feature 1 (Analog gain selection)	Gain selectable between Standard and High Gain Switch on camera back plate	
Sensor output range selection	Selectable by control software from Upper 8 bits(default) / Middle 8 bits / Lower 8 bits	

Caution:

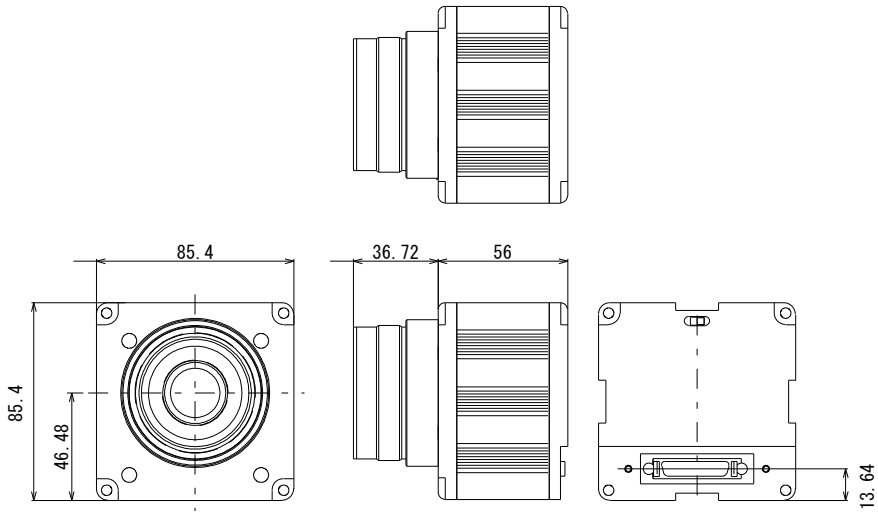
NEVER remove the camera cable while the PC is powered on. Be sure to shut down the PC before removing the camera cable.

3.1.7. PHOTRON FASTCAM-X 1280PCI Grabber Board

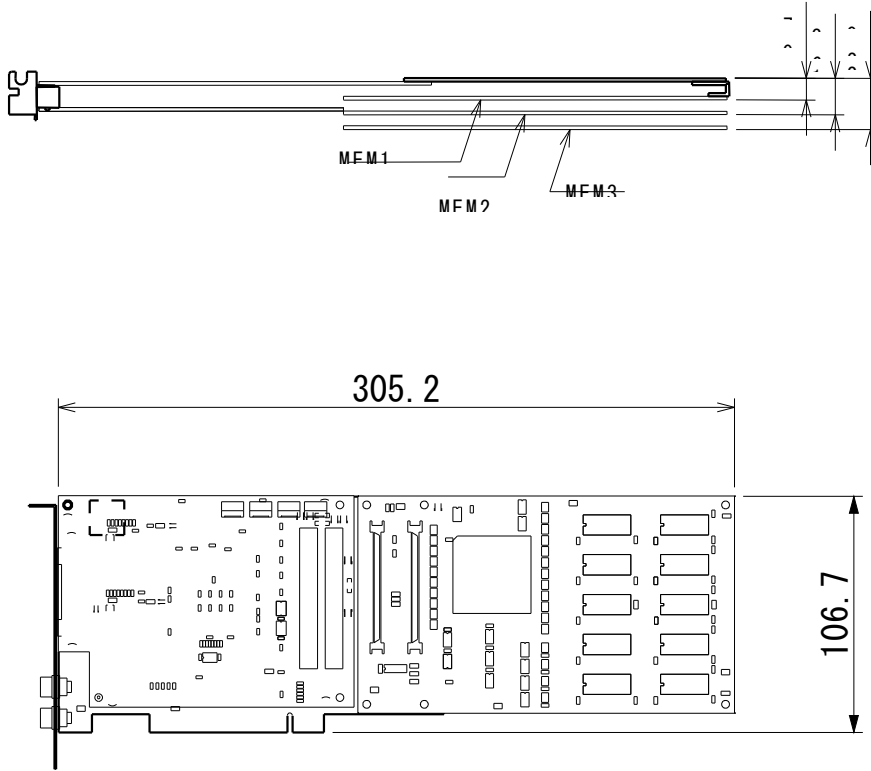
PCI Standard	PCI Rev2.1 Specificaiotn	
Board size	PCI full size standard (with memory board installed) Uses one PCI slot when one memory board is installed Uses two PCI slots when two or more memory boards installed	
LIVE display	Displays LIVE image while recording in memory	
High gain feature 2	Gain factors x 1(default), x 2(+0.7F), x 4(+1.0F), and x 8(+1.3F) selectable by control software "Sensitivity"	
External trigger input	TTL input	+5V/10mA, Positive going
	Contact input	
BD_IN/BD_OUT connectors	Used for sync between FASTCAM-X1280PCI cameras	
Sync signal input	Vertical sync signal 3.3Vp-p, Negative going	
External output signal 1 (EXT OUT1)	Random reset trigger timing signal (+5V TTL) Memory recording indication signal (+5V TTL) Selected from above two by control software	
External output signal 2 (EXT OUT2)	Vertical sync signal +5V TTL	
Power consumption	25W max. (+5VDC, 2.5A; +3.3VDC, 2.5A) (incl. Camera head power consumption)	

3.2. Dimensions

3.2.1. Camera head (in millimeters)



3.2.2. Grabber board (in millimeters)



3.3. Remarks

1. Each individual system has its own characteristics and may differ from others in the following aspects:

- It may display a slight lack of brightness uniformity across the entire screen.
- It may have an exceptionally bright horizontal line in the lower end of the image (monochrome model).
- It may display a slight lack of color uniformity on one or two horizontal lines in the upper, leftmost or rightmost portion(s) of the screen.

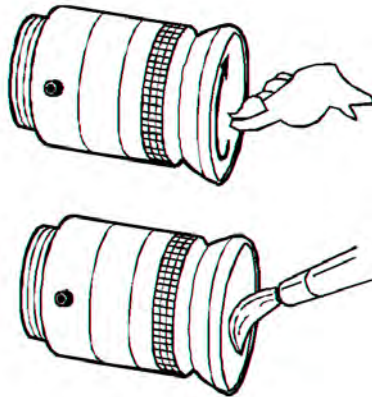
2. When using the higher-gain features (Gain Switch on the camera head, Sensor output range and/or Sensitivity setting), please note the following inevitable drawbacks:

- Noise level gets higher.
- Color balance needs readjustment.
- Color uniformity is lowered across the entire screen.
- The sensitivity gets less linear (lower grayscale).

Please note all the above are due entirely to the basic characteristics and specifications of the C-MOS sensors used in the system and should not be interpreted as defects.

3.4. Care of Lenses

The surface of photographic lenses has thin coatings that reduce chromatic aberration, unwanted reflections, and other distortions. Extra care should be taken to protect this fragile coating. 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.



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