

**IEEE1394  
Digital CCD Camera  
C4742-95-12ERG  
Instruction Manual**

Thank you for your purchase.



**CAUTION**

Follow the safety precautions in Chapter 1 in order to avoid personal injury and damage to property when using this camera.

Be sure to read this Instruction manual beforehand in order to use C4742-95-12ERG digital CCD camera correctly. The manual describes the correct method of handling the camera and provides cautions in order to avoid accidents. After reading, keep the manual where it can be referred to at any time.

**Ver.1.1  
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**HAMAMATSU PHOTONICS K.K.**

55110-530-01

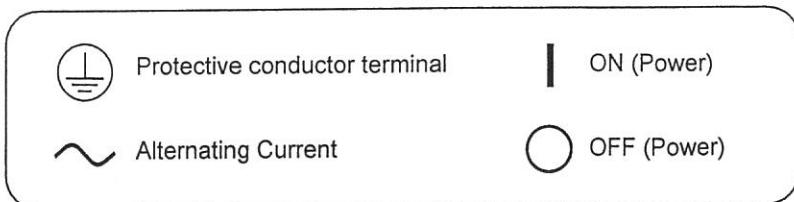
7263171-01

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# 1. SAFETY PRECAUTIONS

The following symbols can be found on this product:



## 1-1 CLASSIFICATION OF WARNING

We have classified the warnings symbols that appear in this instruction manual and on the camera as follows for your convenience. Make sure that you fully understand them and obey the instructions they contain.

	<b>WARNING</b>	Improper handling of the camera without observing these warnings could lead to serious injury to the user and even death.
	<b>CAUTION</b>	Improper handling of the camera without observing these cautions could lead to personal injury to the user or damage to property.
	<b>Note</b>	This symbol indicates a note to help you get the best performance from the camera. Read the contents of the note carefully to ensure correct and safe use. Failure to observe one of these notes might impair the performance of the camera.
		This symbol indicates a cautionary item that should be obeyed when handling the camera. Read the contents carefully to ensure correct and safe use.
		This symbol indicates an action that is forbidden. Read the contents carefully and be sure to obey them.
		This symbol indicates a compulsory action or instruction. Read the contents carefully and be sure to obey them.



## WARNING

### Power Supply



Use the camera with the voltage indicated on the rating sticker. Using a different voltage can damage the camera and lead to fire or electric shock.



Be careful not to place heavy objects on the power supply cord or bend it excessively. Doing so can damage the cable and lead to fire or electric shock.



**Do not attempt to dismantle or modify the camera.**

Doing so can also lead to damage and even injury, as some internal components become very hot. Only touch parts as indicated in this manual.



**Do not allow foreign objects such as combustible substances, metal objects or water to get inside the camera. They can damage the camera and lead to fire or electric shock.**



**If an abnormality occurs,** such as the image suddenly disappearing or a strange noise, smell or smoke coming from the camera, turn the power off immediately and contact your local dealer.



## CAUTION



When unplugging the power supply cord, always pull by the plug, not the cord. Doing so can damage the cable and lead to fire or electric shock.



Remove the power supply cord from the outlet when not using the camera for long periods of time. Doing so can damage the cable and lead to fire or electric shock.



### Connecting and disconnecting cables

Always turn off the power before connecting and disconnecting cables.



### Fixing the camera head

When fitting the camera head to a tripod, for example, use the screw (1/4-20UNC) in the center of a camera mount. Be careful that the fitting screw does not enter more than 8 mm from the surface of the mount. Screwing it in excessively can impair normal operation.



### Lenses

Be careful not to screw the lens more than 6.5 mm onto the C-mount of the camera head. Doing so can scratch the protective glass. (Some wide-angle lenses in particular can have a thread of 6.5 mm or more.)



### Shipping precautions

When transporting the camera by truck, ship, airplane, etc., wrap it securely in packaging material or something similar.



### Avoid Strong Impact

Do not subject the camera to strong shocks by dropping it, for example. Doing so can damage the camera.

## 2. CHECK THE CONTENTS OF THE PACKAGE

When you open the package, check that the following items are included before use. If the contents are incorrect, insufficient or damaged in any way, contact your local dealer without attempting to operate the camera.

(1)	Camera head	1
(2)	Camera control unit	1
(3)	Cables	
(3) - 1	Camera cable (5 m)	1
(3) - 2	Power supply code	1
(4)	Spare fuse (installed inside AC inlet)	1
(5)	Instruction Manual (This booklet)	1

## 3. INSTALLATION



### Don't Use or Store the Unit in These Locations:

- Where the ambient temperature may fall below 0 °C or rise above 40 °C
- Where the temperature fluctuates sharply
- In direct sunlight, or near a source of heat
- Where the humidity exceeds 70 %, or where it is exposed to water
- Near sources generating strong magnetic or electrical fields
- Where there is vibration
- Where it comes in contact with corrosive gases (chlorine, fluorine, etc.)
- Dusty locations



### Don't Block Ventilation Openings

To prevent the internal temperature from rising excessively, don't wrap cloth around the equipment while it is operating, and make sure the fan on the back panel of the CCD and the slits on the sides are not blocked. Both the air blown for air outlet and the air inlet must be at least 10 cm from the wall.

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## **4. OVERVIEW**

C4742-95-12ERG is a high-performance, 12 bit digital output CCD camera with an IEEE 1394 interface. C4742-95-12ERG was developed to meet the demands for high-precision, high-quality imaging of an industrial/scientific image capture device. This camera is capable of sending images directly to a PC using the IEEE 1394 interface.

## **5. FEATURES**

**(1) High Resolution**

Equipped with a high-resolution solid-state imaging device having 1344(horizontal) × 1024(vertical) pixels. Pixels are square, facilitating image processing for measurement purposes.

**(2) No Need for Mechanical Shutter**

The use of a progressive-scan interline CCD image sensor (below, give a brief "CCD" in some part) obviates the need for a mechanical shutter.

**(3) Use of IEEE 1394 Interface**

Image signals undergo A/D conversion inside the camera controller, and are transmitted externally via the IEEE 1394 bus interface as 12 bit digital data. The camera can also be controlled via this bus.

**(4) Employment of Common Camera Control Standard**

Uses the industry-standard "IIDC 1394-based Digital Camera Control Specification Ver.1.30" for this control. This ensures compatibility with other cameras and controls, which support this standard.

**(6) Low Distortion**

The CCD's pixels are laid out geometrically, ensuring nearly zero distortion.

**(7) No Burn-in**

**(8) C-Lens Mount**

**(9) Small Head**

Small, lightweight camera head allows for a construction that is extremely easy to use in such applications as microscopic measurement and spectrometry.

## 6. NAMES AND FUNCTIONS OF THE PARTS

### 6-1 CAMERA HEAD

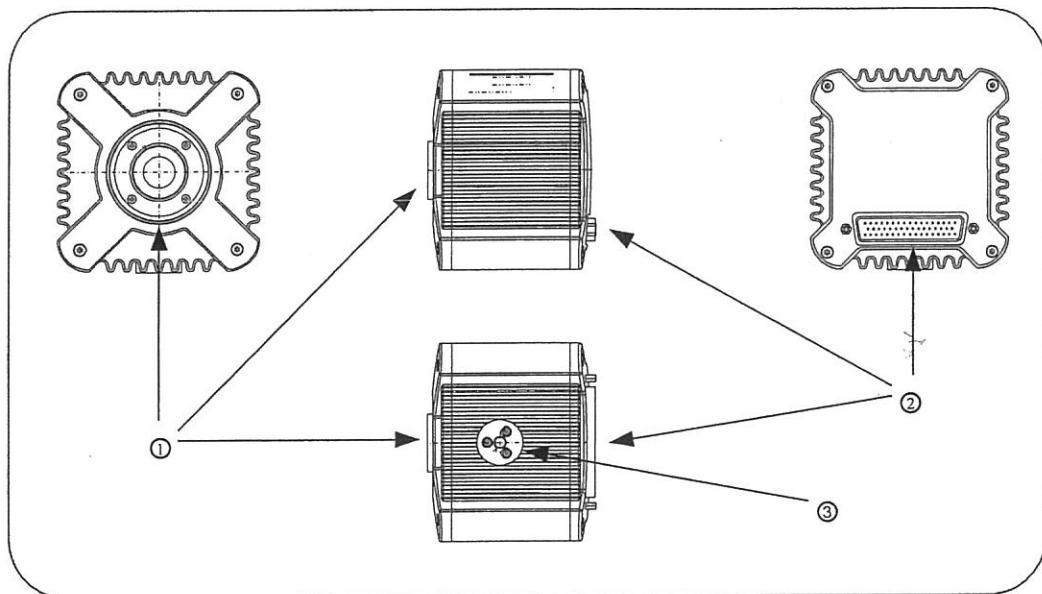


Fig.6-1

#### ① Lens mount

A C-mount lens or an optics system with a C-mount can be attached. Thus, by using an F/C mount, K/C mount, or P/C mount adaptor, various lenses can be attached.

**Note**

- The depth of the C-mount is 6.5 mm. Screwing in the mount too far can scratch the glass surface.

#### ② Camera connector

This is used to connect the camera head and camera control unit.

#### ③ Camera attachment stand

This is used to secure the camera and head in place when using a tripod.

## 6-2 CAMERA CONTROL UNIT (FRONT PANEL)

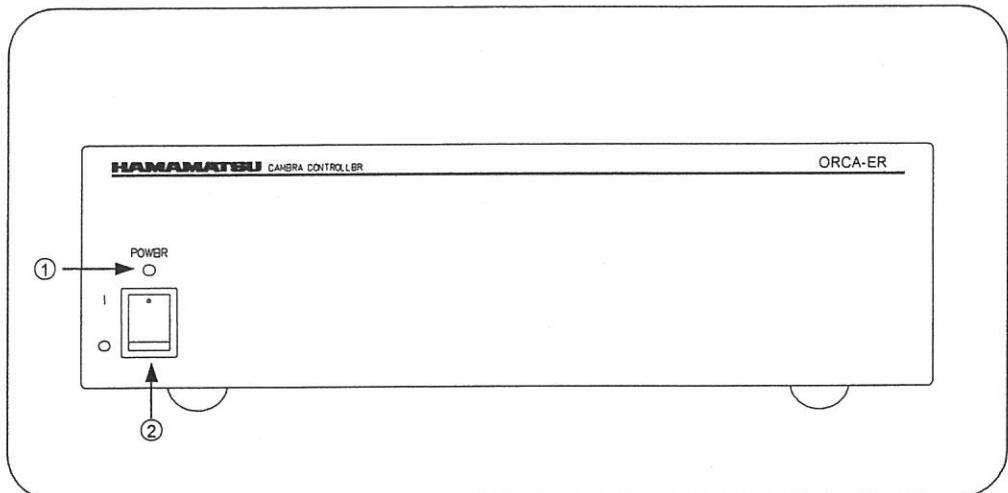


Fig.6-2

### ① Power switch

This is the power switch. Pressing the switch once turns on the power supply to the CCD and camera head, and lights the power LED.



- If the power supply has been turned off, wait at least 5 seconds before turning it on again.

### ② POWER LED

This green LED lights to indicate that the power is on.

## 6-3 CAMERA CONTROL UNIT (REAR PANEL)

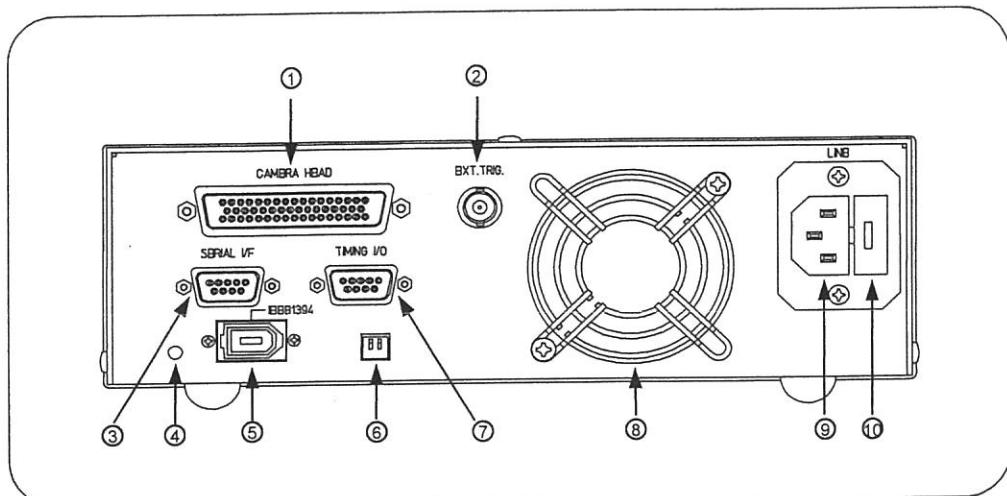


Fig.6-3

① Camera connector (CAMERA HEAD)

This is used to connect the camera head and camera control unit. Use the special cable provided for that purpose.

② Trigger In connector (EXT.TRIG.)

This is used when C4742-95-12ERG is being operated using external synchronization. Input is TTL level (EXT.TRIG circuit is terminated by  $680\ \Omega$ .). When an external trigger is input, the trigger is activated at the falling or rising edge of the signal. (You can choose external trigger polarity between Negative and Positive.)

③ Serial interface connector (SERIAL I/F)

Used for camera maintenance. Please do not connect anything to this.

④ Status LED

Lit when sending image data over the IEEE 1394 bus.

⑤ IEEE 1394 Connector (IEEE1394)

This connector is used to connect the camera controller to a host computer. Connect to the host computer's IEEE 1394 connector using the supplied cable.

⑥ Change Mode Switch

This switch is used for maintenance. Please do not activate it. (Leave off at all times)

⑦ Timing I/O (TIMING I/O)

This connector is used to for input and output of timing signals when synchronizing with external equipment.  
But, this connector isn't used with this camera. Don't connect it.

---

⑧ Air outlet

This is the outlet for the heat ventilation blower.



- Make sure a space of at least 10 cm is available at the back of the unit for ventilation.

⑨ AC inlet (LINE)

This is the power supply terminal. Using the accessory power supply cord.

⑩ Fuse holder

This is the holder for the power supply fuse.

**Note**

- Refer to Chapter 10 when you replace a fuse.

## 7. CONNECTING CABLES

Refer to the figure when connecting the various cables.

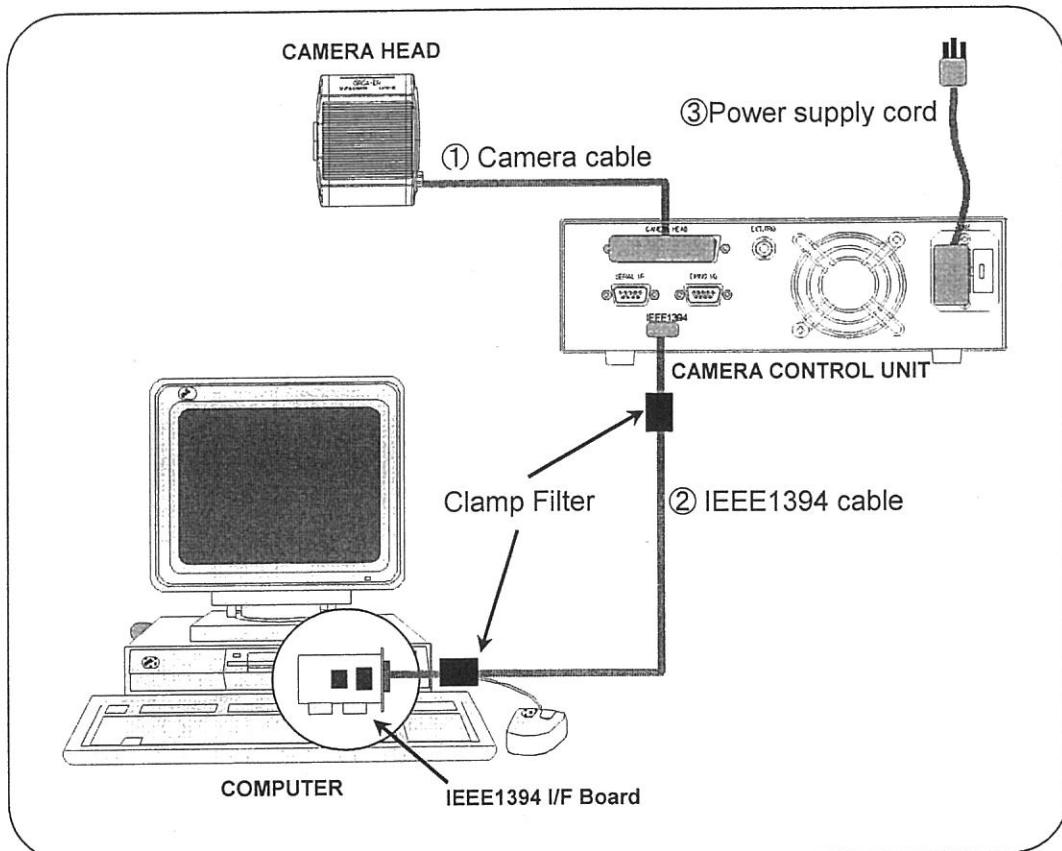


Fig. 7-1

### ① Camera cable

This connects the camera control unit (CCU) to the camera head using the dedicated camera connector (CAMERA HEAD). The cable has no particular polarity.

### ② IEEE1394 cable

The IEEE 1394 cable for connecting to a host computer is an option. Please supply the necessary cable. While it is also possible to use a standard 6-pin cable, it is recommended that you utilize a genuine industrial-type connector provided as an option.

Connect the camera's IEEE 1394 socket to the host computer's IEEE 1394 socket using the IEEE 1394 interface cable. When using an industrial type connector, press it in firmly while pressing the button on the side of the cable connector. To release the cable, also press it to unlock then pull to remove.

**Note**

- When the recommended cable is not used for, the camera performance and safety cannot be guaranteed.

---

③ Power supply cord

Check first to make sure the AC line voltage is within the usable range indicated in the table below, and that the power switch of the CCU has been turned off. Then connect the power supply cord provided as an accessory.

## 7-1 ATTACHING THE CLAMP FILTER

When using a genuine cable, attach the two supplied clamp filters to either end of the IEEE 1394 camera cables.

**Note**

- Take care not to pinch the cable when closing the clamp filter.

**Note**

- Attaching the clamp filter too far from the base of the connector will prevent it from functioning effectively.

## **8. OPERATION**

### **8-1 PRECAUTIONS**

When cables are connected, confirming the power switch is in the OFF position.

#### **(1) Ambient temperature**

Cooling of this equipment is done using a Peltier element. With a Peltier element, when current is supplied, one surface is cooled, and the other surface is heated. The CCD chip is positioned on the cooling side, and cooling is done by discharging the heat from the heated surface. Thus, the maximum temperature to which the CCD can be cooled, and the stability of the cooled temperature, are affected by the ambient temperature. The ambient temperature should be maintained at a constant temperature in order for cooling to be effective.

The recommended ambient temperature for camera operation is 20 °C. At this temperature, the CCD will be cooled to approximately -20 °C.

#### **(2) Control Specifications**

This camera conforms to the "I IDC 1394-based Digital Camera Specification, Ver.1.30" control specifications (below, "controller specification"). It is possible to modify camera operation from a host computer by configuring each of the camera parameters, via the IEEE 1394 interface. See the "I IDC 1394-based Digital Camera Specification, Ver. 1.30," and the supplementary section of this User's guide for camera parameter definitions and configuration.

#### **(3) Control software**

The control software should be run several seconds after the power supply to the camera has been turned on. If commands are received through the serial interface when the power supply to the camera is turned on, the camera may not start up properly. If this happens, immediately stop the camera and the control software, and restart both, waiting the appropriate interval before running the software.

### **8-2 SETUP FOR IMAGING**

Use the following procedure when starting operating of the camera.

- (1) Connect the equipment as shown in Fig.7-1.
- (2) Switch the camera's power switch to ON.

### **8-3 WHEN IMAGING IS FINISHED**

Carry out the procedure below when imaging is finished.

- (1) End imaging or transmission of image data and the control software.
- (2) Turn off the power to the camera and peripheral equipment.

## 9. IMAGE ACQUISITION

### 9-1 THEORY OF CCD

C4742-95-12ERG CCD camera uses the new progressive scan inter-line CCD whose structure is as shown in Fig.9-1-1. Incident photon generates an electron on the photo-diode and generated electrons are transferred from photo-diode to on-chip amplifier, which converts the electron to voltage, by using the vertical CCD and horizontal CCD. By supplying the readout signal to the sensor gate, all generated charges are transferred to vertical CCD and, next, stored charges are transferred line by line in the vertical CCD and finally charges are shifted pixel by pixel in the horizontal CCD. Finally all charges reach to the on-chip amplifier.

This CCD has also a function of electrical shutter. By using this function, all charges integrated in the photo-diode are dumped to the silicon base instantaneously.

#### Binning:

Accumulated charges for a specified number of pixels in the vertical and horizontal directions on the CCD are calculated and combined (binned), then read out from the CCD. With this camera, binning can be set to  $2\times 2$ , where two pixels in the vertical and horizontal directions are combined,  $4\times 4$ , where four vertical and horizontal pixels are combined, or  $8\times 8$ , where eight vertical and horizontal pixels are combined.

#### Exposure Time:

When set to the normal CCD scanning mode, this is as shown in Fig.9-1-2. Exposure time is the elapsed time between one readout signal and the next; this interval is at least as long as the time necessary for all of the charges from the CCD to be read out.

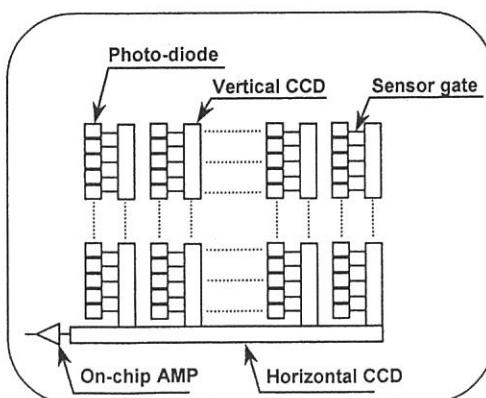


Fig.9-1-1

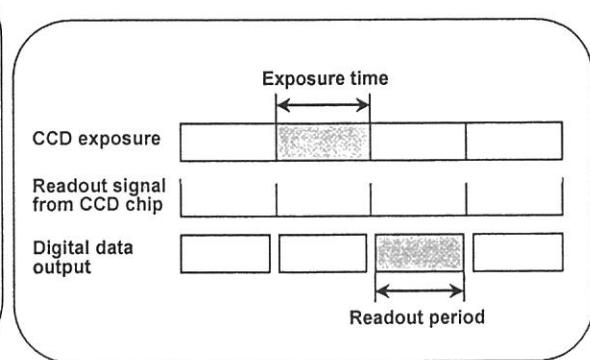


Fig.9-1-2

## 9-2 CAMERA CONTROL SPECIFICATION

This is a digital camera employing an IEEE 1394-compliant interface. It operates under Format 7 of the "1394-based Digital Camera specification, Ver 1.30." See the specification sheets below for details about camera control:

- IEEE Std 1394-1995, Standard for High Performance Serial Bus
- ANSI/IEEE Std 1212-1994, Command and Status Register Architecture
- 1394-TA 1999023, IIDC 1394-based Digital Camera Specification Version 1.30

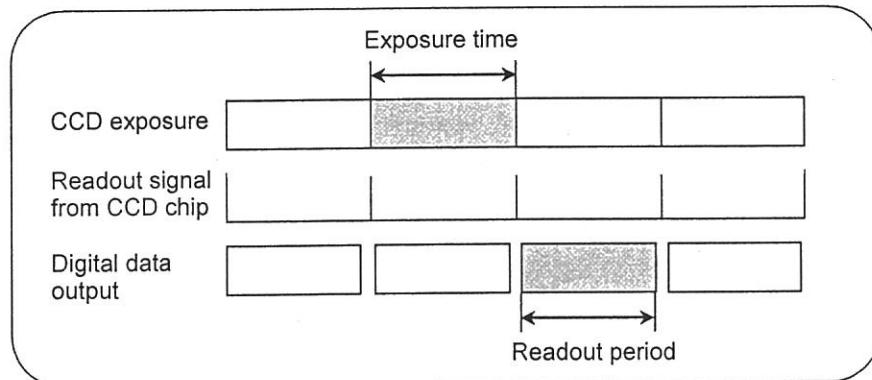
Supplemental information about camera operation can be found below:  
This camera's Format 7 operation modes are as follows:

Format 7:	Mode 0	Normal Mode
	Mode 1	2×2 binning mode
	Mode 2	4×4 binning mode
	Mode 3	8×8 binning mode

### 9-2-1 DETAILS ON CCD SCANNING (SCAN MODE)

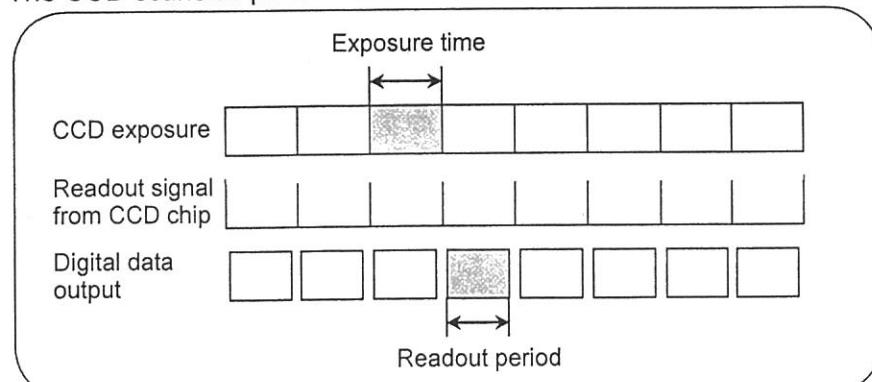
#### 9-2-1-1 Normal Mode

Reads out the load from the CCD using standard scanning.  
The CCD scans all pixels at a rate of 8.9 Hz.



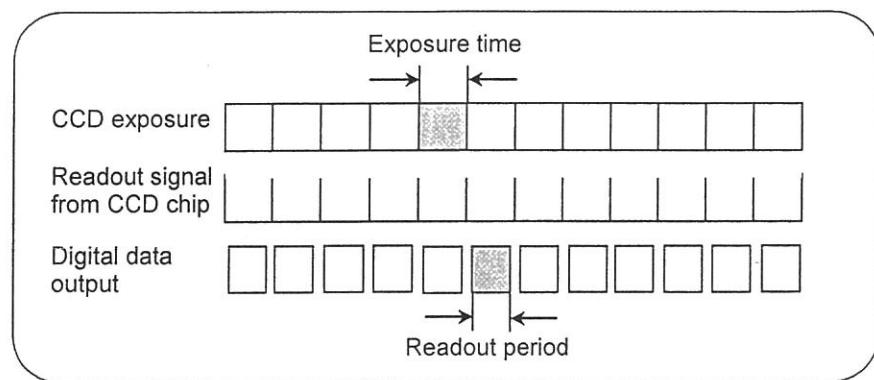
#### 9-2-1-2 2x2 Binning Mode

Reads out the load from the CCD in 2×2 binning mode.  
The CCD scans all pixels at a rate of 16.3 Hz.



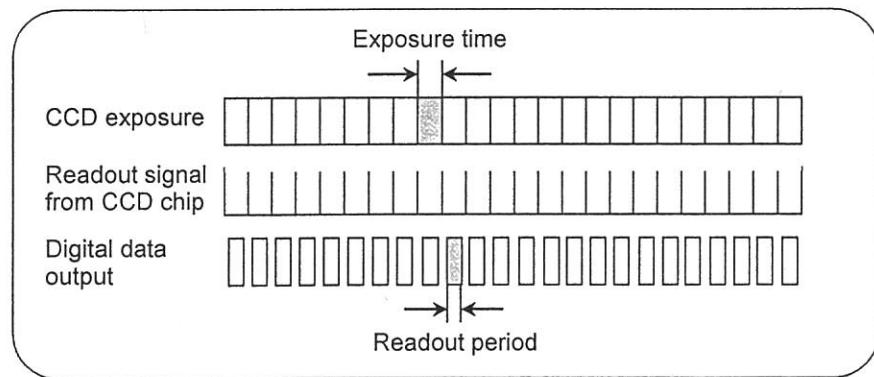
### 9-2-1-3 4x4 Binning Mode

Reads out the load from the CCD in  $4 \times 4$  binning mode.  
The CCD scans all pixels at a rate of 27.8 Hz.



### 9-2-1-4 8x8 Binning Mode

Reads out the load from the CCD in  $8 \times 8$  binning mode.  
The CCD scans all pixels at a rate of 43.0 Hz.



### 9-2-1-5 Partial Scan (Sub array Scan)

This camera supports partial-scanning operation in each mode. Partial scanning is a procedure in which only a portion of the image is scanned. See the IIDC camera control specification for instructions on configuring partial scanning. It is possible to increase the frame rate by reducing the number of vertical lines scanned. To get the maximum frame rate for partial scanning, see the section on configuring exposure time.

---

### 9-2-1-6 Configuring Exposure Time

Exposure time is configured in the shutter feature control register. The shutter can be configured in either relative or absolute settings. Note, however, that there are limitations on the range of relative register settings. The setting range for the relative value register is 10 ms to 3 s. The setting range for the absolute value register is 10 ms to 10 s.

When the setting time is longer than a single frame, the camera operates in long-term exposure mode; when it is shorter, it operates in electronic shutter mode. Turning this feature off fixes the exposure time to the time of a single frame.

The time of a single frame ( $T_f$ ) is calculated using the following formula:

$$T_f(s) = (V_n + 26) * H_l + (1033 - V_n) * H_s$$

$$H_l = 106.337 \times 10^{-6} \text{ (s)}$$

$$H_s = 7.595 \times 10^{-6} \text{ (s)}$$

$V_n$  = Number of vertical read-out lines

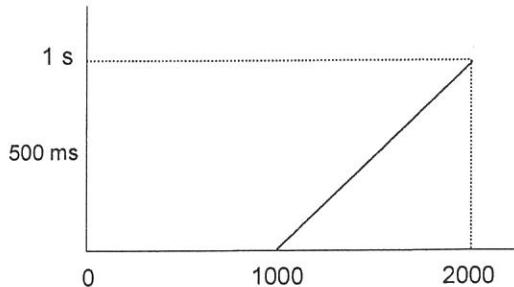
#### 9-2-1-6-1 Relative Shutter Value Configuration

Relative CSR's use 12 bit values. Shutter feature control is configured at IIDC command register offset 0x81C.

See Fig.9-2 for the relationship between setting values and actual exposure times.

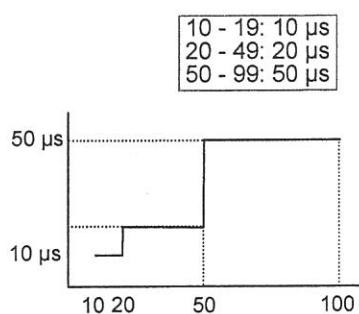
### Relative Setting Conversion Table

[  $1000 < \text{Value} \leq 2000$  ]



$Te \doteq \text{Setting value} - 1000 \text{ ms}$   
 $1000 < \text{Input} \leq 4000$   
(Exact value is closest larger value calculated by following formula)  
 $Ts = 0.106337 \times n^* + 0.035129 \times n$ : integer

[  $10 \leq \text{Value} < 100$  ]



[  $100 \leq \text{Value} \leq 1000$  ]

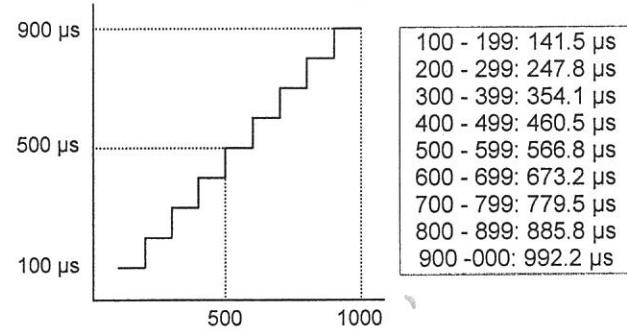


Fig. 9-2

#### 9-2-1-6-2 Absolute Shutter Value Configuration

To configure an absolute value, set an absolute value in the shutter's absolute value register in seconds; then set bit 1 (Abs\_Control) in the Shutter feature control register.

If the bit 1 (Abs\_Control) is already set in the shutter register, it is sufficient to only write an absolute value to the shutter absolute value register.

The quadlet offset of the shutter's absolute value register address from the base address (0xF000\_0000) is stored in the I2C ABS\_CSR\_HI\_INQ at offset 0x71C. The register address can be calculated from this information.

When using absolute value, actual setting value is returned to this value register.

You can know this by reading the register.

---

### **9-2-1-7 Gain Configuration**

Camera gain is configured in the Gain feature control register. The gain can be configured in the relative settings. The setting range for the relative value register is 0 to 255. Set 0 means 0 db, set 255 means 20 db.

### **9-2-1-8 Offset Level Configuration**

Camera offset is configured in the Brightness feature control register. Brightness can be configured in the relative settings. The setting range for the relative value register is 0 to 255. Set 0 means -100 %, set 255 means 0 %.

### **9-2-1-9 External Trigger Configuration**

External trigger operation is configured using the Trigger feature control register. This camera supports trigger mode in Mode 0 (edge trigger) and Mode 1 (level trigger). In Mode 0, exposure time is configured by setting the shutter value; in Mode 1, it is set by specifying the pulse width. Trigger polarity is set in Trigger Polarity.

### **9-2-1-10 Camera Operation Mode Specifications**

Switch the camera between low-light mode and highlight mode in Camera Feature, in Gamma. Set this value to 0 for low-light mode, and 1 for highlight mode in the relative settings register. Low-light mode deactivates the CCD's anti-blooming feature, and sets it to high-sensitivity mode. Highlight mode activates the CCD's anti-blooming feature, and lowers sensitivity slightly.

## 10. FUSE REPLACEMENT

Replacement a fuse with the following process.

- (1) Turn off the power switch.
- (2) Unplug the power supply cord from the AC inlet.
- (3) Remove the fuse holder with something like a screwdriver. (Fig.10-1)
- (4) Before replacement, you must check that the new fuse has the same rating as the previous fuse. (Fig.10-2)



**CAUTION**

- Always replace with the spare fuse, or a fuse of the same type as indicated on the ratings sticker. The standard of the fuse is "T2.5A 250V".

- (5) After replacement, return the fuse holder to its original location in the AC inlet.



**CAUTION**

- Be careful not to use excessive force when fitting the fuse holder. You might damage the fuse.

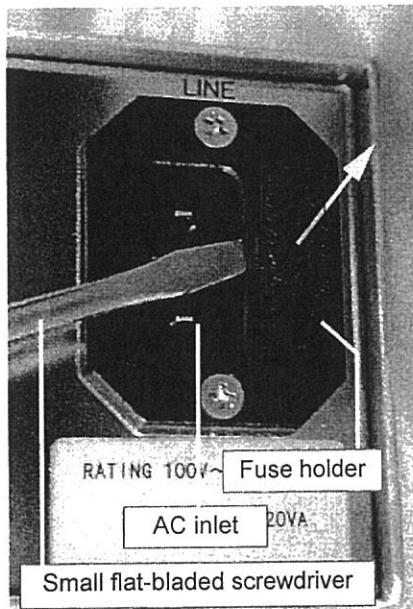


Fig.10-1

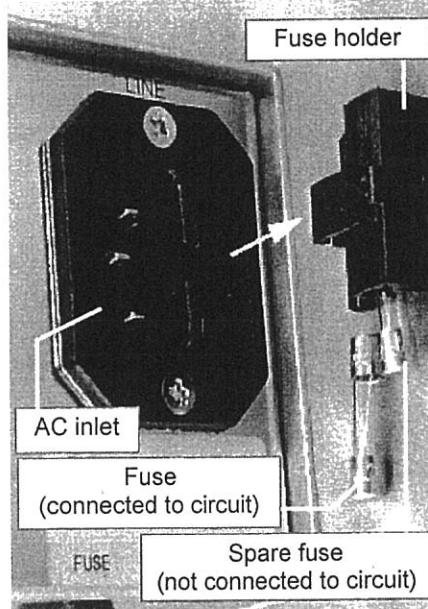


Fig.10-2

## 11. CARE

Clean the exterior with a soft, dry cloth.



**CAUTION**

- Do not use a wet cloth.

## 12. TROUBLESHOOTING CHECKLIST

If an abnormality occurs, look up the possible causes in the following tables and, if necessary, report the details to Hamamatsu subsidiary or local distributor.

### 12-1 TURNING ON THE POWER

#### 12-1-1 The power LED does not light.

Cause	Measures	Chapter
1. A fuse is blown.	Replace the fuse.	10
2. The AC inlet is loose.	Tighten the connection.	
3. The power supply cord is cut or damaged.		
4. The LED circuit is broken down.	Contact Hamamatsu subsidiary or distributor	16
5. The power switch is broken.		

### 12-2 IMAGES NOT TRANSFERRED

Cause	Measures	Chapter
1. The camera cable is not tightly connected.		
2. The digital I/F cable is not tightly connected.	Tighten the connection.	
3. The serial I/F cable is not tightly connected.		
4. The monitor I/F cable is not tightly connected.		
5. The correct command has not been sent to the camera side.	Check the command.	
6. The camera cable is cut or disconnected.	Contact Hamamatsu subsidiary or distributor	16
7. The digital I/F cable is cut or disconnected.		
8. The serial I/F cable is cut or disconnected.		
9. The monitor I/F cable is cut or disconnected.	Change the cable.	

### 12-3 ALTHOUGH IMAGES ARE TRANSFERRED (Other problems)

#### 12-3-1 Scratches or discoloration visible on the screen.

Cause	Measures	Chapter
1. The lens is dirty.	Wipe the lens clean.	
2. The glass on the front of the camera head is dirty.	Wipe the glass with a piece of gauze dipped lightly in alcohol.	

#### 12-3-2 Image is blurred.

Cause	Measures	Chapter
1. The lens is not focused.	Focus the lens.	
2. The monitor contrast is too high.	Reduce the contrast.	
3. The background focus is not adjusted correctly.	Contact Hamamatsu subsidiary or distributor	16
4. The CCD chip is dirty.		

---

### **12-3-3 Only dark shaded Image output.**

Cause	Measures	Chapter
1. The lens cap has been left in place.	Take off the cap.	

### **12-3-4 All Image overflowing.**

Cause	Measures	Chapter
1. The volume of light is too high.	Tighten the lens aperture.	
2. The amp gain is too high.	Reduce the amp gain.	

### **12-3-5 Noise in Image.**

Cause	Measures	Chapter
1. Contact between the lens and the camera head is not tight.	Tighten the contact.	
2. The monitor cable and connector are not in complete contact.	Re-connect them.	
3. There is external noise coming in.	Find the source and eliminate it.	
4. Internal connectors are loose.	Contact Hamamatsu subsidiary or distributor	16
5. Circuitry is defective.		

# 13. SPECIFICATIONS

## 13-1 CAMERA SPECIFICATIONS

### (1) Electrical specifications

Image element	Progressive-scan interline CCD fixed imaging element	
Effective no. of pixels	1344 × 1024 (Horizontal×Vertical)	
Pixel size	6.45 µm × 6.45 µm square pixels	
Sensitive area	8.66 mm × 6.60 mm (2/3 in)	
Frame rate	Normal mode	8.9 Hz
	2×2 Binning mode	16.3 Hz
	4×4 Binning mode	27.8 Hz
	8×8 Binning mode	43.0 Hz
Mean readout noise (r.m.s)	8 e⁻ *Note 1)	
A/D converter resolution	12 bit	
Cooling method	Electronic cooling + Air cooling	
Lens mount	C-mount	
Amp gain conversion coefficient *Note 2)	4.6 e⁻/ADcounts (18 000 e⁻)	
Contrast enhancement gain	1 to 10	
Exposure time config. range	10 µs to 10 s	
Partial scan setting	Arbitrary area of 64×64 pixel units (Mode 0) Arbitrary area of 84×64 pixel units (Modes 1 to 3)	
External trigger feature	Yes (edge trigger, level trigger)	
Image data format	Uncompressed B&W (Mono 8, Mono 16)	
Host interface standard	IEEE 1394-1995	
Connector specification	6-pin IEEE 1394 Connector (industrial)	
Camera control specification	1394-based Digital Camera specification, Ver 1.30	

\*Note 1) This value is the measured value in normal readout mode. To find this value, the CCD was placed in darkened conditions and the exposure time set to the minimum level. Two images were then read under these conditions and subtraction carried out between the images. The standard deviation of the results was measured and that value was multiplied by the conversion coefficient divided by the square root.

\*Note 2) The amp gain conversion coefficient is the coefficient used to convert the count value for the measured image to electrons. When the conversion is carried out, dark subtraction must always be done first. The value noted in parentheses below the conversion coefficient indicates the amount of load placed on the CCD if the A/D converter overflows.

### (2) Power supply specifications

Input power supply	100 V AC 117 V AC 220 V to 230 V AC 230 V to 240 V AC
Power consumption	90 V·A

**Note**

- Fluctuations of Input power supply voltages are not to exceed ±10 % of the nominal voltage.

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(3) Ambient operating conditions

Ambient storage temperature	- 10 °C to + 50 °C
Ambient operating temperature	0 °C to + 40 °C
Ambient operating humidity	70 % max. (with no condensation)
Ambient use place	Indoors, maximum elevation 2000 m

(4) Dimensional outlines and weight

Camera head	Approx. 1.2 kg
Camera control unit	Approx. 6.6 kg

**Note**

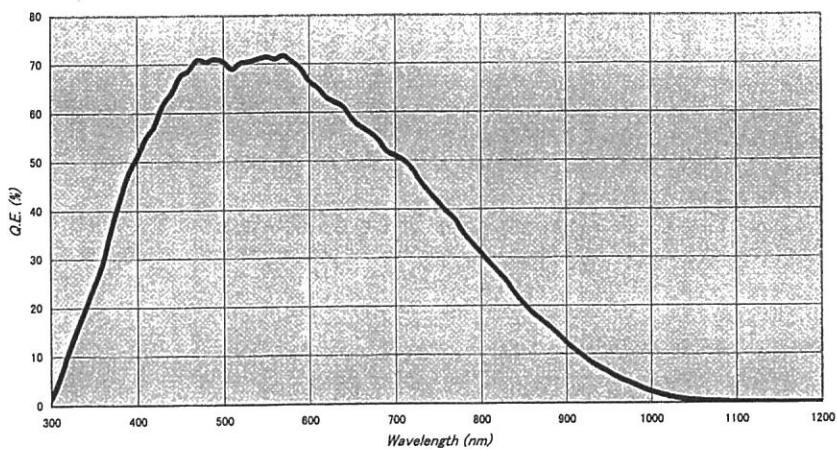
- For dimensional outlines, please see Chapter 14.

(5) Applicable standards

Safety	EN61010-1: 1993 + A2: 1995
	Overvoltage category: II
	Pollution degree: 2
	Degrees of protection provided by enclosures: IP20
EMC	EN61326: 1997 + A1: 1998

## 13-2 SPECTRAL CHARACTERISTICS

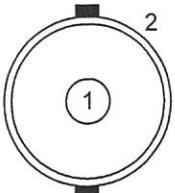
Following is the typical spectral characteristics of the CCD.



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### 13-3 INTERFACE SPECIFICATIONS

#### (1) Trigger input connector pin assignments (TRIGGER IN)

No.	Signal	Pin connection
1	TRIG IN	
2	GND	

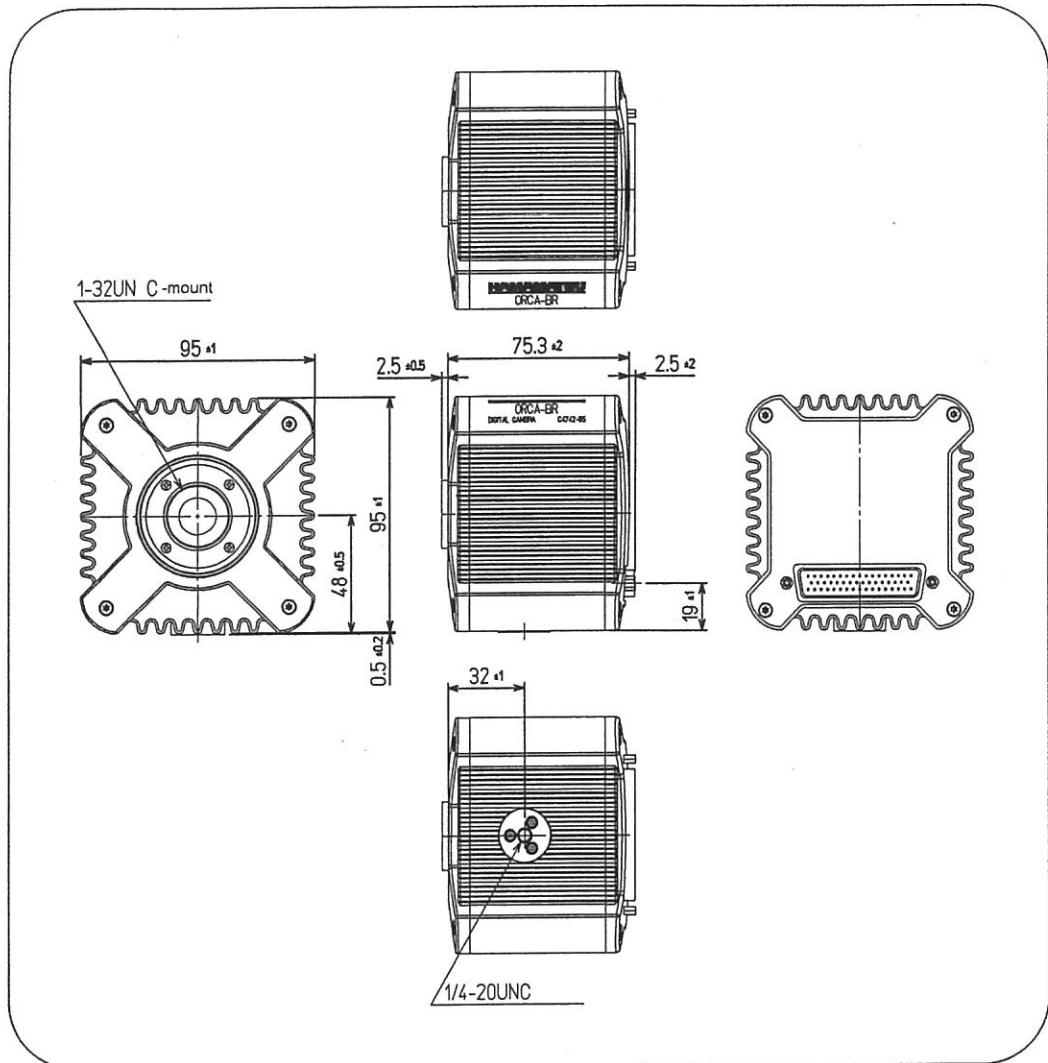
This is the external trigger input terminal used when the camera is being operated externally, in External Trigger Mode.

The input level is TTL level (EXT.TRIG circuit is terminated by  $680\ \Omega$ .), and the trigger polarity is programmable.

## 14. DIMENSIONAL OUTLINES

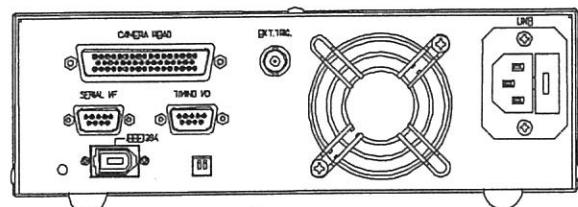
### 14-1 CAMERA HEAD

(Unit: mm)

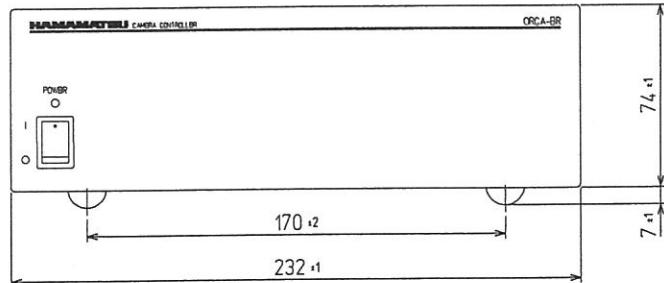


## 14-2 CAMERA CONTROL UNIT

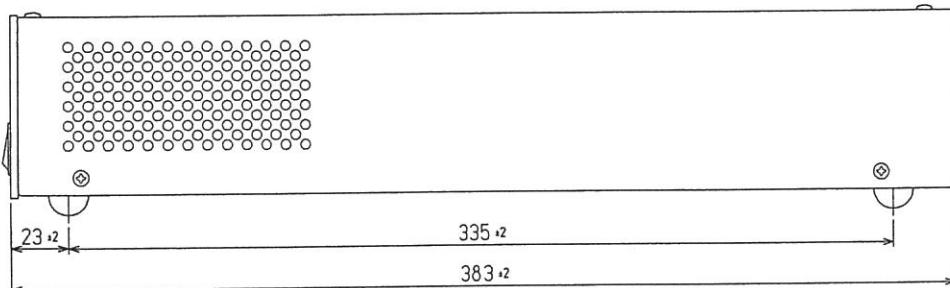
(Unit: mm)



[REAR view]



[FRONT view]



[SIDE view]

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## **15. WARRANTY**

Hamamatsu Photonics have fully inspected this camera and checked that its performance conforms to specifications. In the unlikely event of breakdown or other malfunction, contact Hamamatsu subsidiary or local distributor.

- (1) Unless otherwise stated by Hamamatsu subsidiary or local distributor, this camera is under warranty for twelve months from the delivery date.
- (2) The warranty only covers defects in the materials and manufacturing of the camera. You may be liable for repairs during the warranty period in the event of a natural disaster or if you handle the camera contrary to the instructions in this manual, use it without due caution, or try to modify it.
- (3) We will repair the camera or replace it, subject to availability, free of charge within the terms of the warranty.

### **Repairs**

- (1) If you notice anything wrong with the camera, confirm whether or not it is malfunctioning by referring to the TROUBLESHOOTING CHECKLIST in this instruction manual. You must first clarify the symptoms in order to avoid any misunderstanding or error.
- (2) If you have any trouble or are unclear about anything, contact Hamamatsu subsidiary or local distributor giving the product name, serial number and details of the problem. If Hamamatsu Photonics consider the problem to be a malfunction, we will decide whether dispatch an engineer or have the camera returned to us for repairs.

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## 16. CONTACT INFORMATION

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- The contents of this manual are subject to change without notice.
- The unauthorized reproduction or distribution of parts or all of this manual is prohibited.
- If one of the following problems occurs, please contact Hamamatsu Photonics. (See the CONTACT INFORMATION.) We will deal with the problem immediately.
  - Some contents of the manual are dubious, incorrect or missing.
  - Some pages of the manual are missing or in the wrong order.
  - The manual is missing or dirty.