

Digital Camera Module

Technical Manual

XCD-V60CR/SX90CR/U100CR
(Color model)

XCD-V60/SX90/U100
(Black and white model)

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Overview

The six models of the XCD-series digital camera modules (Black and white models and RAW color models) employing the IEEE1394b-2002 standard are equipped with quality digital camera features. Although it is compact, the camera allows high-speed image transfer and daisy chain connection with two IEEE1394b connectors. The camera also has versatile features such as hardware preprocessing in the camera that reduces the load of image processing in a PC, bus synchronization, and broadcast delivery of commands. The XCD-series digital output cameras conforming to the IIDC 1.31 protocol take full advantages of IEEE1394 capabilities.

Main Features

High image quality, high-speed image output

The image device, output frame rate and resolution of the cameras are as follows:
XCD-V60/V60CR: 1/3-type PS IT CCD, 90 fps, VGA
XCD-SX90/SX90CR: 1/3-type PS IT CCD, 30 fps, SXGA
XCD-U100/U100CR: 1/1.8-type PS IT CCD, 15 fps, UXGA

Daisy chain connection

The camera is equipped with two IEEE1394b connectors that support connection of multiple cameras. As the power can be supplied from a 12-pin connector, the camera achieves daisy chain connection without limitation of power supply capacity so that a simple image processing system with multiple cameras can be developed.

Hardware preprocessing

The camera is equipped with hardware LUT (Lookup Table).
The black and white models are also equipped with 3 × 3 pixel matrix operation.

Bus synchronization

The cameras connected to the same bus automatically operate in synchronization with the 1394 bus, without using an external sync signal. The exposure timing on multiple cameras is synchronized correctly via the IEEE1394b cable only.

Broadcast delivery of commands

The camera settings for all the cameras connected to the same bus can be changed at the same time. For example, the gain or shutter speed is set to the same value on all

the cameras, or exposure starts on all the cameras simultaneously using a software trigger.

Memory channel

The memory channel allows storage of up to 15 sets of camera settings such as gain and shutter.

Bulk trigger mode

The Bulk trigger mode allows output of multiple images with a shot of a trigger signal. Each image is shot with the camera settings stored in the memory channel. Up to 15 image settings are possible.

Memory Shot

The image exposed from the sensor is stored in the camera's built-in memory. The stored image can be read out using a command from the host PC when required.

		XCD-V60/ V60CR	XCD-SX90/ SX90CR	XCD-U100/ U100CR
Standard image size (H × V)		640 × 480 (VGA)	1,280 × 960 (SXGA)	1,600 × 1,200 (UXGA)
Bit length	Mono8/ Raw8	54 frames	13 frames	8 frames
	Mono16/ Raw16	27 frames	6 frames	4 frames

Partial scan

Partial scan clips a required angle of view (area) from the entire screen to be read out. As a part of the image is read out, the unit takes advantage of reduced image data and high-speed transfer. The minimum clipping unit is 32 pixels × 24 lines.

Binning

Binning increases the sensitivity and frame rate based on mixing the pixel data.

9-pin connector with fixing screws

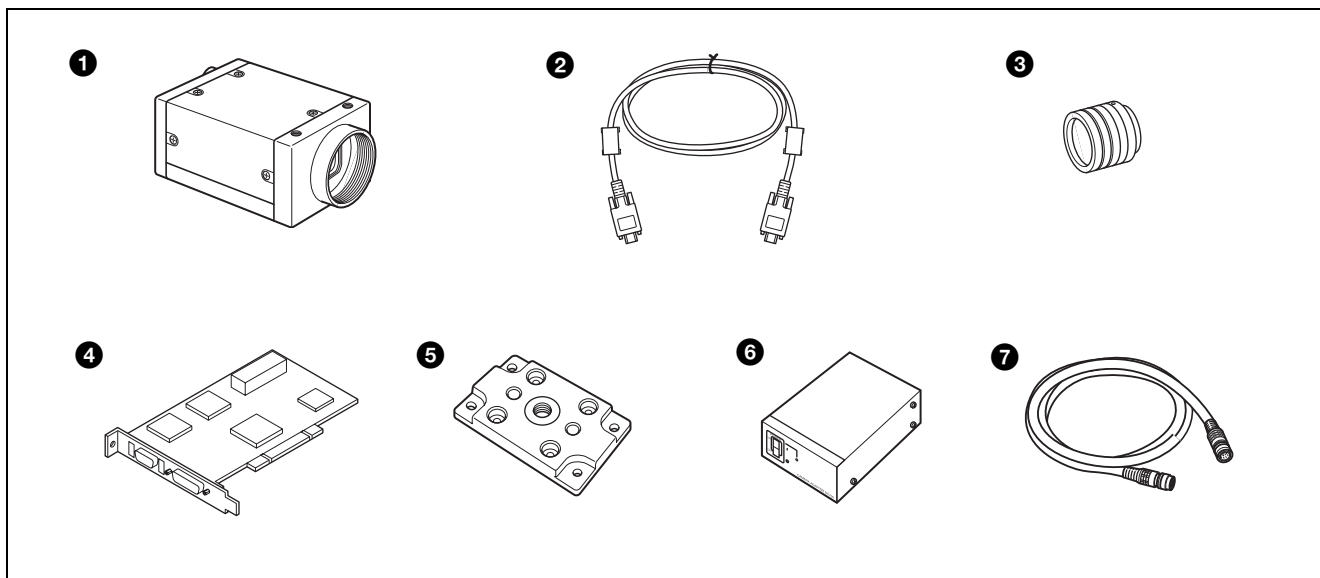
Low power consumption, vibration and shock-resistant structure, and compact size

IIDC Ver.1.31 protocol compliant

System Components

The camera module imaging system comprises the following products.

Products ❶ to ❷ are used for the basic configuration, and ❶ to ❷ for the optional configuration. (All the products except the camera module are available separately.)



❶ Camera module

This is a small-size, high-resolution, camera module using a CCD image sensor.

❷ IEEE1394b camera cable (commercially available)

Connect this cable to the IEEE1394b connector on the rear panel of the camera module. The power and image/control signals are transmitted through this cable. To prevent a poor connection or damage to the camera or cable, use the cable equipped with fixing screws.

❸ C-mount lens (commercially available)

Use an appropriate lens for the camera module and usage.

❹ Camera module interface board (commercially available)

Install the board in a PCI bus slot of a host device such as a PC.

Select an IEEE1394 interface board to match your system.

Select an IEEE1394b interface board if you use the transfer speed of 800 Mbps.

❺ VCT-ST70I tripod adaptor (Sony)

Attach this adaptor to the bottom of the camera module to fix the camera module to a tripod.

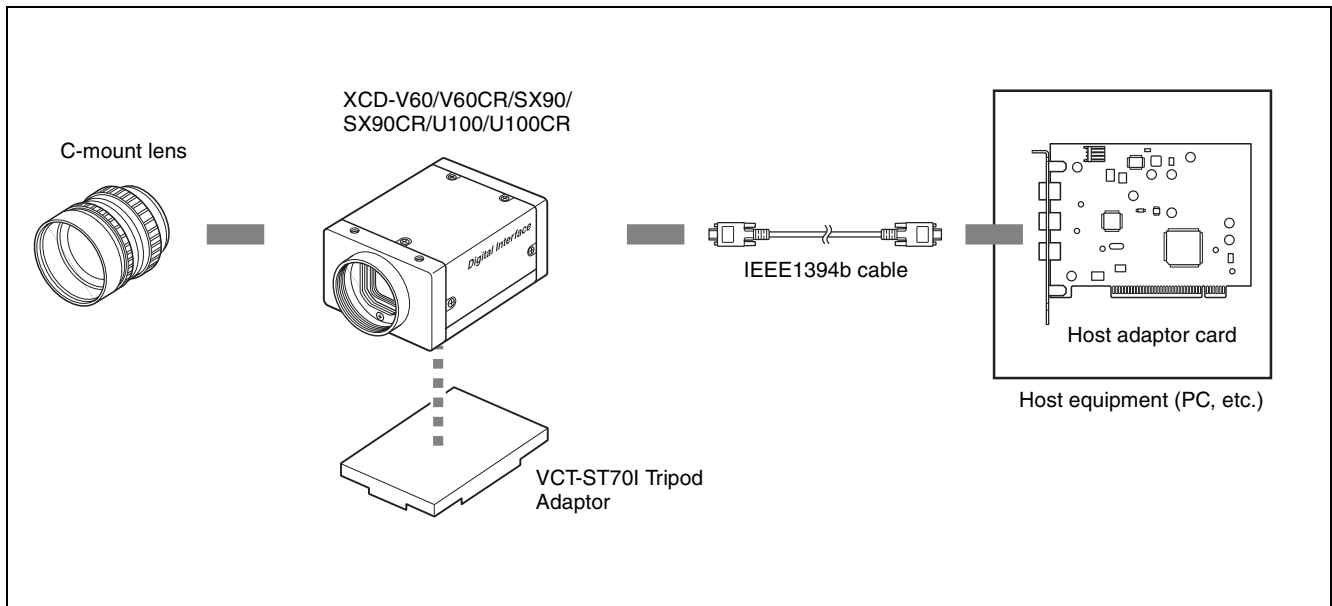
❻ DC-700/700CE camera adaptor (Sony)

Connect this adaptor to the camera module to enable power supply from an ordinary AC power source.

❼ CCXC-12P02N (2 m, 6.6 ft)/05N (5 m, 16.4 ft)/10N (10 m, 32.8 ft)/25N (25 m, 82 ft) camera cable (Sony)

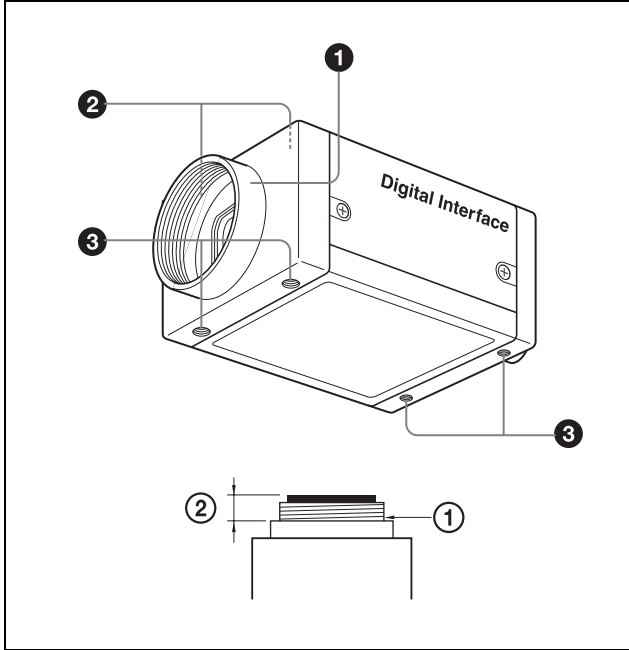
Connect this cable to the 12-pin I/O connector on the rear panel of the camera module. The cable is used for power supply and exchange of trigger signals.

Connection Diagram



Location and Function of Parts and Operation

Front/Top/Bottom



- 1 Lens mount (C-mount)**
Attach any C-mount lens or other optical equipment.

Note

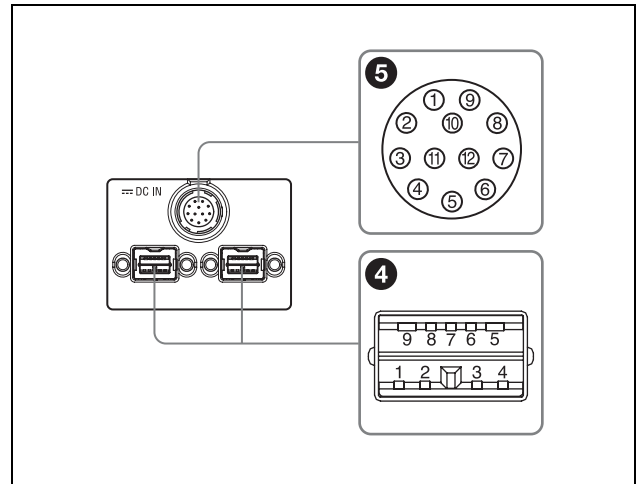
The lens must not project more than 10 mm (13/32 inch) from the lens mount.

- ① Lens mount face ② 10 mm (13/32 inch) or less

- 2 Auxiliary holes (top)**
- 3 Reference holes (bottom)**
These precision screw holes are for locking the camera module. Locking the camera module into these holes secures the optical axis alignment.
For details, see “Dimensions” on page 38.

Four screw reference holes **3** can be used as the tripod adaptor screw holes, too. Screw the VCT-ST70I tripod adaptor into the four screw holes when you use a tripod.

Rear



- 4 IEEE1394b connectors**
Connect an IEEE1394b camera cable (not supplied) to this connector.

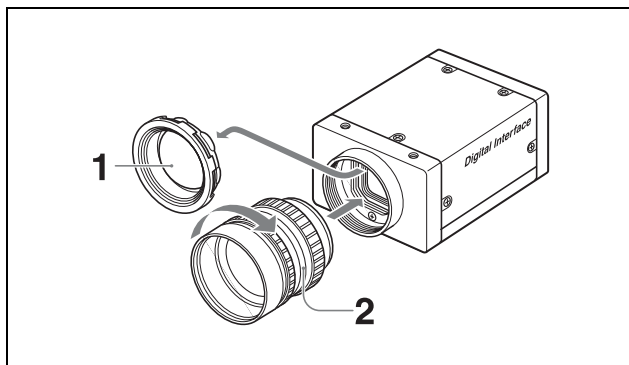
Pin No.	Signal	Pin No.	Signal
1	TPB-	6	VG
2	TPB+	7	NC
3	TPA-	8	VP
4	TPA+	9	TPBG
5	TPAG		

- 5 12-pin I/O connector**
When power from the IEEE1394b connector is insufficient, power is supplied through this connector.
Connect a camera cable such as the CCXC-12P05N to this connector.

Pin No.	Signal	Pin No.	Signal
1	Power GND	7	GPIO IN 2
2	Power IN	8	GPIO OUT 2-
3	ISO GND	9	GPIO OUT 2+
4	Strobe OUT	10	GPIO IN 1
5	GPIO OUT 1-	11	Trigger IN
6	GPIO OUT 1+	12	ISO GND

Installation

Fitting the lens



- 1** Remove the lens mount cap.
- 2** Screw in the lens (not supplied), and turn it until it is secured.

Note

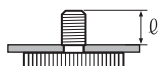
Clean the optical filter with a commercially available blower brush to remove dust.

Using a tripod

To use the tripod, install the VCT-ST70I tripod adaptor (not supplied) on the camera module.

Use a tripod screw with a protrusion (ℓ) extending from the installation surface, as follows, and tighten the screw using a hand screwdriver.

ℓ : 4.5 to 5.5 mm (0.18 to 0.22 inches)

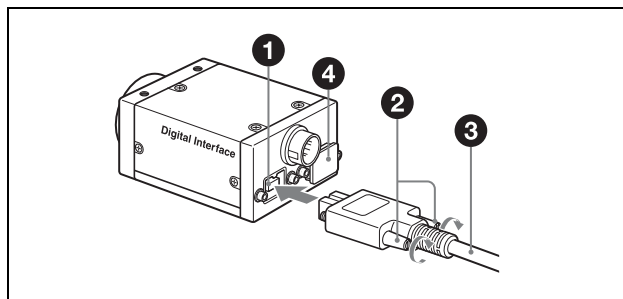


Note

When you install the tripod adaptor, use the screws supplied with the tripod adaptor.

Connecting the camera cable

Connect a commercially available IEEE1394b camera cable to the IEEE1394b connector and the 1394b interface connector of your PC. When you connect the cable, insert the cable connector into the IEEE1394b connector until it snaps into place, holding it. Then, tighten the fixing screws placed on both sides of the cable connector.



- 1** IEEE1394b connector
- 2** Fixing screws
- 3** IEEE1394b camera cable (not supplied)
- 4** IEEE1394b connector cap

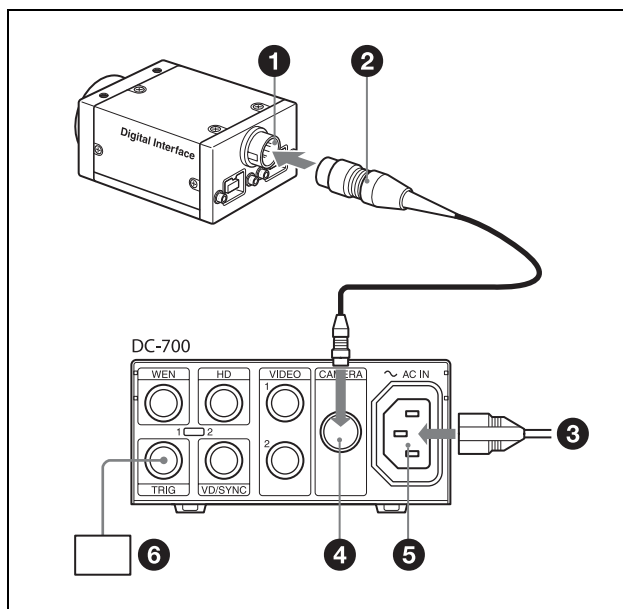
The IEEE1394b connector on the right has a cover cap exclusively for this camera. If you use this connector, remove the cap. The unused connector shall be covered with the cap.

Note

Loose fixing screws may cause a poor connection or damage to the camera or cable. Be sure to tighten the fixing screws.

When power supply from the IEEE1394b connector is insufficient

Power can be supplied to the camera module via the DC-700/700CE camera adaptor (optional) and a camera cable such as CCXC-12P05N (optional) if power supply from the IEEE1394b connector is insufficient.



- 1** 12-pin I/O connector
- 2** Camera cable (e.g. CCXC-12P05N)
- 3** to AC power source
- 4** CAMERA connector
- 5** AC IN connector
- 6** Trigger generator

Notes on Operation

Power supply

Power is supplied to the camera module via the IEEE1394b cable connected to a PC. If the power supply is insufficient, use the DC-700/700CE that supplies stable power with less ripple or noise.

Foreign bodies

Be careful not to spill liquids, or drop any flammable or metal objects in the camera body.

Locations for operation and storage

Avoid operation or storage in the following places.

- Extremely hot or cold locations. Recommended temperature range is 0°C to 40°C (32°F to 104°F)
- Locations subject to strong vibration or shock
- Near generators of strong electromagnetic radiation such as TV or radio transmitters

Care

Use a blower to remove dust from the surface of the lens or optical filter. Clean the exterior with a soft, dry cloth. If the camera is very grimy, apply a cloth soaked in a mild detergent then wipe with a dry cloth. Do not apply organic solvents such as alcohol which may damage the finish.

Note on laser beams

Laser beams may damage a CCD. You are cautioned that the surface of a CCD should not be exposed to laser beam radiation in an environment where a laser beam device is used.

Phenomena Specific to CCD Image Sensors

The following phenomena that may appear in images are specific to CCD (Charge Coupled Device) image sensors. They do not indicate malfunctions.

White flecks

Although the CCD image sensors are produced with high-precision technologies, fine white flecks may be generated on the screen in rare cases, caused by cosmic rays, etc.

This is related to the principle of CCD image sensors and is not a malfunction.

The white flecks especially tend to be seen in the following cases:

- when operating at a high environmental temperature
- when you have raised the gain (sensitivity)
- when using the slow shutter

Vertical smear

When an extremely bright object, such as a strong spotlight or flashlight, is being shot, vertical tails may be produced on the screen, or the image may be distorted.

Aliasing

When fine patterns, stripes, or lines are shot, they may appear jagged or flicker.

Gain

Both Manual and Auto Gain settings are available with this camera.

The variable range extends from 0 to 24 dB for the black and white models or from 0 to 18 dB for the color models. The camera is designed so that the gain can be subdivided and set by 0.0359 dB.

At the factory default setting, the gain is set to 0 dB. When Auto Gain is selected, the gain is adjusted automatically, based on the brightness of the subject. At this time, the reference level (target point) is set in the AutoExposure register.

For details on AutoExposure, see “Auto Exposure” on page 10.

Shutter

This camera allows both Manual and Auto Shutter settings.

The variable range extends from 10 microseconds to 16.0 seconds; relative values are indicated by a 12-bit integer, and absolute values are indicated using a 32-bit floating point value.

The relationship between the parameter and the exposure time is given by the following formulas, where:

P = Parameter (003h to 47Eh)

E = Exposure time (s)

If P= 3

$$E = 0.00001$$

If 4 <= P <= 1000

$$E = \frac{P^2}{1000000} \text{ ————— ①}$$

If 1000 <= P <= 1150

$$E = (P - 1000) \times 0.1 + 1 \text{ — ②}$$

Setting examples

3 (003h) : 10 μs (1/100000)

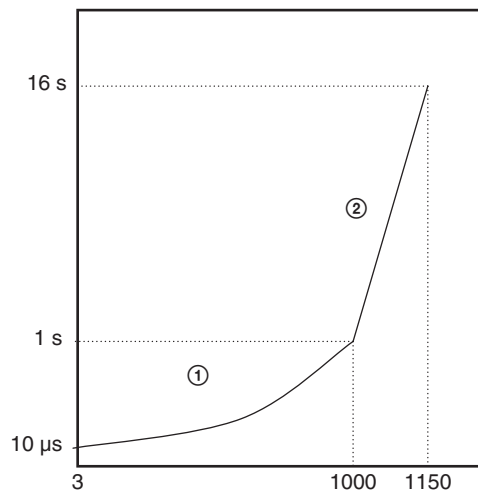
32 (020h) : 1 ms (1/1000)

100 (064h) : 10 ms (1/100)

1000 (3E8h) : 1 s

1010 (3F2h) : 2 s

1150 (47Eh) : 16 s



When Auto Shutter is selected, the exposure time is adjusted automatically, based on the brightness of the subject. At this time, the reference level (target point) is set in the AutoExposure register.

For details on AutoExposure, see “Auto Exposure” on page 10.

For long exposure times

When the exposure time is longer than the frame period, the camera enters the long exposure time mode, and the actual frame rate is reduced in accordance with the exposure time.

Absolute Value Control for the Shutter

This camera allows control of exposure time using absolute values. The values are indicated using a 32-bit floating point value. (Unit: sec.)

The variable range of absolute values extends from 10 microseconds to 16.0 seconds.

Programming example

```
union
{
    DWORD dwValue; // 1394 is expressed in quadlets,
    float fValue; // exposure time is indicated in seconds.
} AbsoluteShutterValue;
```

```
AbsoluteShutterValue.fValue = Exposure time;
WriteQuad(AbsoluteShutterOffsetAddress,
AbsoluteShutterValue.dwValue);
```

WriteQuad is a virtual function used to write in the 1394 register.

AbsoluteShutterOffsetAddress is an offset address for the absolute value control.

See “ConfigurationROM” on page 18 for the formula for the offset address.

Auto Exposure

AutoExposure is a function that automatically adjusts the gain and shutter settings, based on the brightness of the subject. When the gain or shutter is set to Auto, the brightness is adjusted automatically to the value specified with AutoExposure.

Gamma

This camera uses the gamma function to select the lookup table.

- 0: Linear
- 1: Reverse
- 2: Equivalent of Gamma = 0.70
- 3: User setting

To set an arbitrary gamma curve, prestore the setting values in the lookup table (EEPROM) of the camera.

Lookup Table

The lookup table of this camera consists of 1,024 tables with 10-bit input and 10-bit output.

The lookup table allows setting of an arbitrary gamma curve or binary segmentation.

3 × 3 Image Filter

For black and white models only, simple image processing using the 3 × 3 image filter is possible on hardware.

- 0: Filter OFF
- 1: Sharpness enabled
- 2: Horizontal edge detection (Type 1)
- 3: Vertical edge detection (Type 1)
- 4: Horizontal edge detection (Type 2)
- 5: Vertical edge detection (Type 2)
- 6: Edge emphasis (Type 1)
- 7: Edge emphasis (Type 2)
- 8: User setting

Note

Sharpness is disabled when the 3 × 3 image filter is set to 0, or 2 to 8.

Trigger

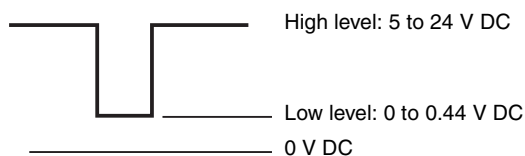
Trigger shutter is useful for capturing images in response to a trigger that starts the exposure to match a preset timing. It can also be used to capture an image using multiple cameras with the same timing.

When a trigger shutter is used, the required trigger is input via the 12-pin connector on the rear panel. The input signal is a 5 to 24 V negative pulse. As the input connector is pulled inside of the camera, the camera can receive a trigger only by short-circuiting the input pin and ISO (GND) pin.

Note

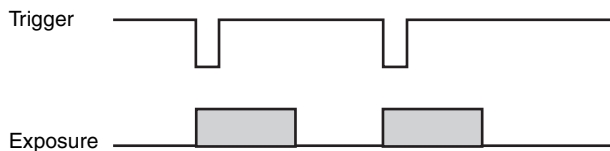
To connect to ground, use a device having a minimum pulse width of 10 microseconds and an input current of 0.5 mA or more.

This camera supports four trigger modes: 0, 1, 14 and 15.



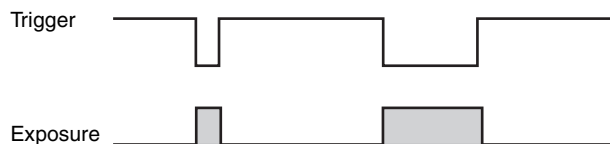
Trigger mode 0

Trigger mode 0 starts exposure by detecting the falling edge of a trigger signal. The exposure time is determined by the shutter parameter.



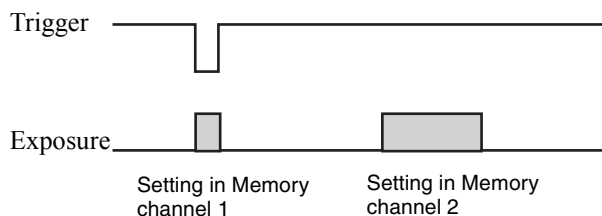
Trigger mode 1

Trigger mode 1 controls the exposure time using the width of the trigger signal pulse. When trigger mode 1 is used, there is actually no limit to the exposure time.



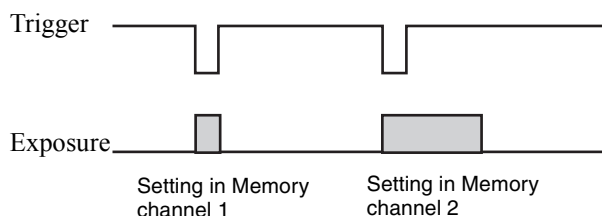
Trigger mode 14 (Bulk trigger mode)

Trigger mode 14 allows shooting of multiple images with different camera settings using only one trigger signal. The camera settings should be prestored in memory channels.



Trigger mode 15 (Sequential trigger mode)

Trigger mode 15 allows shooting of images by loading the camera settings prestored in memory channels in sequence each time a trigger is input.



As this camera is equipped with 15 memory channels, a repeat pattern of up to 15 image shootings can be set for trigger mode 14 or 15.

The number of the repeat patterns to be set in one cycle can be determined by the parameter of the trigger mode. Memory channel 0 is not used for the Bulk trigger mode and the Sequential trigger mode.

The following features are loaded from the memory to be set for shooting:

- Brightness
- Sharpness
- Saturation
- White balance
- Hue
- Gamma
- Shutter
- Gain
- Pan/Tilt
- Optical Filter

Note that the Auto mode of White Balance, Shutter and Gain cannot be set.

Also note that Pan/Tilt is set only when the current video mode is the same as the video mode selected when the setting has been stored in the memory channel.

This camera can also be used with a software trigger that issues the trigger signal via software command. Trigger modes 0, 1, 14 and 15 can be used with software triggers.

Pan/Tilt

Pan/Tilt is a function used to move a camera up and down or left and right. However this camera supports a video mode much smaller than the CCD's effective pixels by cutting out images from the whole screen. You can specify the portion to be cut out using Pan/Tilt commands.

The variable range differs according to the selected video mode.

When a video mode is changed, the pan/tilt values are set to the default setting.

Brightness

This feature controls the black level of a video image.

Sharpness (Black and white models only)

This feature controls the image quality.

A smaller value makes the image softer, and a larger value makes it sharper.

The Sharpness feature cannot be used together with the 3×3 filter.

Saturation (Color models only)

This feature controls the color density.

White Balance (Color models only)

This feature controls the white balance by setting the R and B levels relative to the G level.

The camera also supports the Auto white balance by which the camera automatically adjusts the white balance.

Hue (Color models only)

When the white balance cannot be obtained with the R and B level adjustment, you can change the G level by hue adjustment. Normally use the default hue setting.

Trigger Delay

Issue of a trigger signal can be delayed from the external trigger inside the camera.

This delay adjustment is useful to get an appropriate shooting timing when the position of the subject is not good at a regular trigger timing.

GPIO

A general-purpose I/O port with a 2-bit output and 2-bit input is assigned in the 12-pin connector.

This port is used for reading information of external switches and sensors from the camera and controlling external devices.

The output terminal is of the open-collector type and should be pulled outside of the camera (5 to 24 V).

Note on input

Connect to ISO (GND) using an input device with a minimum signal width of 0.5 msec and an input current of 0.5 mA or more.

Note on output

Use the following conditions:

Recommended pull-up resistor: 4.7 k Ω

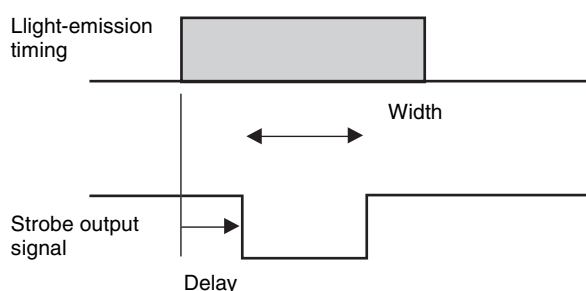
Recommended pull-up voltage: 5 V

Minimum signal width: 0.5 msec

The camera is equipped with a protective resistor of 220 Ω . If the above conditions prove difficult in use, check the output voltage and determine the external pull-up resistor.

Strobe Control

A strobe control signal is assigned in the 12-pin connector. This allows direct command of light-emission from the strobe connected to the camera and controls the light-emission timing and the signal width. The output terminal is of the open-collector type and should be pulled at the strobe side. A strobe that emits light by short-circuiting the input to ground can be connected to the camera directly.



Note

Use the following conditions:
 Recommended pull-up resistor: 4.7 kΩ
 Recommended pull-up voltage: 5 V

The camera is equipped with a protective resistor of 220 Ω. If the above conditions prove difficult in use, check the output voltage and determine the external pull-up resistor. The camera is capable of outputting a signal of about 10 microsecond width, although the rise time depends on the pull-up resistor.

Setting AE/AWB Control Frame and Parameters

The detection frame for Auto Exposure and Auto White Balance can be set.

Determine the detection frame in percentage units taking the width and height of the output image as 100 %.

The control speeds for Auto Exposure and Auto White Balance can also be set. Raise or lower the response speed for each application respectively. For Auto Exposure, the restart conditions can also be set, that is the conditions once Auto Exposure adjustment has concluded and after the gain and shutter changes have been restored to a stable state, and a new change in video image becomes visible. In the Auto Exposure or Auto White Balance parameter setting mode, the set frame is highlighted on the video image.

Test Charts

A color bar chart (for color models only) and a gray scale chart can be output.

Changing Bayer Patterns (Color models only)

The color models of this camera series output raw data. For these models, the correct color reproduction is not obtained if the Bayer pattern in the application software does not match that in the camera. The output pattern can be set at the camera if the application is not equipped with the pattern setting.

Trigger Inhibition

At the factory default setting, this camera accepts trigger input quickly and no triggers are inhibited.

If the camera is used under noisy conditions with this setting, noise may enter before a trigger input is accepted, causing image disturbance.

If the trigger inhibition is enabled in such a condition, the camera does not accept a new trigger until the image output is completed and achieves stable operation.

With the trigger inhibition enabled, however, exposure cannot be performed during image output.

Consequently, an acceptable trigger cycle becomes longer according to the exposure time.

For example, when exposure is set to 1/30 s in 30 fps mode, the trigger cycle becomes almost double, that is, equivalent to 15 fps.

User Free Memory

This camera is equipped with a 256-byte memory space so the user can write and read data freely.

The written data is retained after the power is turned off. For example, the user can name the camera and note the installation conditions using this memory space.

The memory content is retained even if the camera initialization is performed.

Memory Shot

The camera is equipped with Memory Shot that temporarily stores an image in the frame memory inside the camera and transfers it later.

When multiple cameras are connected in the same bus, all the cameras may not output images at the same time due to the restriction of 800 Mbps band. Memory Shot may resolve this inconvenience.

When exposure starts, each camera stores an image in the frame memory without allocating the isochronous resource.

When outputting, each PC outputs the image from the camera allocating the isochronous resource.

The number of images to be stored depends on the video mode.

Broadcast Command

The normal 1394 communication method specifies the node number at the host side so that only a specified camera responds to the command.

If the node number is set to 63, all the cameras connected to the same bus can receive the command simultaneously, i.e., only one command issued from the host can control multiple cameras at the same time.

Example: To broadcast a software trigger

1. Connect multiple cameras to the same bus.
2. Set the video mode and frame rate appropriately on each camera and prepare the cameras for sending images at the same time.
3. Set each camera to the software trigger mode.
4. Issue a software command for node number 63.

Now all the cameras start exposure and output images simultaneously.

All the commands including the video mode setting and the feature control are capable of broadcasting except the block writing command.

When setting different types of cameras using a broadcast command, be careful not to issue a command that the cameras do not support.

1394 Bus Synchronization

Timing used to start exposure is synchronized with the 1394 bus time cycle register.

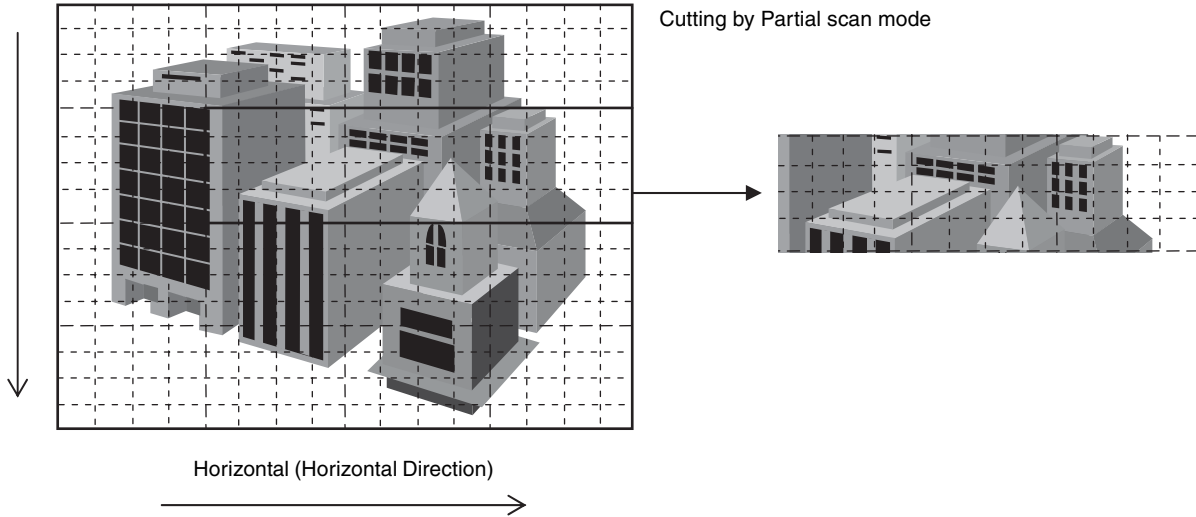
If cameras are connected to the same bus, they are automatically synchronized in a 1394 bus operation. As 800 Mbps band restriction can affect the synchronization, you must set the video mode in which the cameras can transmit a video signal at the same time. 1394 synchronization does not work in long exposure mode and Partial scan mode. In a long exposure, the exposure time is set longer than the image transmission cycle.

1394 bus synchronization includes up to 1H cycle jitter. Hardware external synchronization will ensure greater accuracy.

Partial Scan

The partial scan is a function for outputting part of a whole image as a region of interest on the whole image. Based on the unit cell as the unit, continuous parts can be selected. Only rectangles can be selected. The screen cannot be cut in convex and L shapes.

Vertical (Vertical Direction)



The minimum unit size for partial scan is 32 pixels × 24 lines. The cut-out position can be set in unit of 4 pixels × 4 lines. For high-speed scanning, set the maximum packet size.

When using multiple cameras at the same time, set a small packet size that falls within the 800 Mbps band.

When using Partial scan mode, set Format7, Mode0.

Binning Mode

The mode used when the sensitivity is increased and the frame rate is multiplied based on mixing the CCD pixel data, is called the Binning mode.

There are two types of binning: 1×2 binning when the output image is compressed in the vertical direction only, and 2×2 binning when the image is compressed in both the vertical and horizontal directions.

When Binning mode is used, set either Format7 Mode1 (2×2 binning), or Format7 Mode2 (1×2 binning).

Format7 Mode4 for XCD-V60/V60CR

As 90 fps mode is not defined by the IIDC standard, this camera realizes 90 fps mode in Format7, Mode4.

16-bit Mode

This camera supports 16-bit Black & white (Monochrome) mode. Only the least significant 10 bits of the 16 bits will handle data. The upper 6 bits will be filled with zeros.

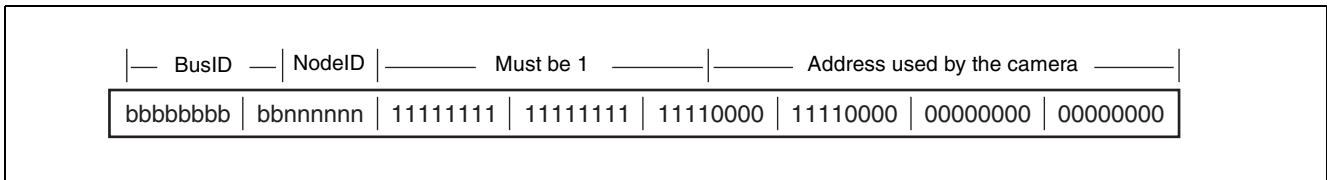
000000dd		ddddddd
----------	--	---------

Camera Command Status Register

This camera complies with IIDC 1394-based Digital Camera Specification, Version 1.31 (hereinafter referred to as IIDC v1.31).

The standards document can be purchased from 1394TA (the 1394 Trade Association). As it is very helpful in understanding the explanations in this Technical Manual, we recommend that you purchase a copy of IIDC v1.31.

Memory Map



1394 devices have a 64-bit address space. The upper 10 bits show the bus ID (0-1023), and the next six bits show the node ID (0-63). The IIDC standards require the next 20 bits to be 1.

The remaining 28 bits can be allocated to the camera as addresses.

The bus and node IDs may be changed if the topology is restructured because of bus reset, so only the least significant 32 address bits are shown in this Guide.

Address	Register
F0000000	Base address
F0000400	ConfigROM area
F0F00000	Base address for camera commands
F0F00000	CameraInitialize
F0F00100	Video Format Inq
F0F00180	Video Mode Inq
F0F00200	Frame Rate Inq
F0F002E0	Format7 CSR Inq
F0F00400	Basic Func Inq
F0F00500	Feature Element Inq
F0F00600	Isochronous Control register
F0F0071C	AbsoluteControlCSR Inq for Shutter
F0F00800	FeatureControl
F0F00970	AbsoluteControlCSR for Shutter
F0F10000	Format7Mode0 CSR
F0F11000	Format7Mode1 CSR
F0F12000	Format7Mode2 CSR
F0F13000	Format7Mode3 CSR
F0F30000	AccessControlRegister
F0F40000	MemoryShotControl
F0F50000	UserFreeMemory
F0F60000 – F0F61FFC	LookUpTable
F0F62000 – F0F62020	Filter
F0F63000 – F0F63024	AWB parameters
F0F64000 – F0F64020	AE parameters

ConfigurationROM

The ConfigurationROM is normally used for the OS to identify the device.

The serial number and firmware version of the camera are stored in ConfigurationROM to be used when required. Note that the setting method for the serial number and firmware version information is of Sony's unique specification and is not compatible with cameras of other manufacturers.

The following explanation uses XCD-V60CR as an example.

	Offset	0-7	8-15	16-23	24-31	
Bus Info Block	400h	04	22	ROM CRC		
	404h	31	33	39	34	
	408h	20	FF	A2	13	
	40ch	08	00	46	10	NodeVendorID/ChipID-Hi
	410h	00	37	1A	96	Chip ID-Lo
Root Directory	414h	0003		CRC		
	418h	03	08	00	46	ModuleVendorID
	41ch	0C	00	83	C0	
	420h	D1	00	00	01	UnitDirectoryOffset

With the exception of bits 8 to 15 of the 400h offset address field, the length of the entire ConfigROM is made up of 22h Quadlets. Therefore, the ConfigROM from 400h to 48Bh is 140 bytes.

The UnitDirectory offset address is required to be
 $424h + 000004h \times 1 = 424h$

	Offset	0-7	8-15	16-23	24-31	
Unit Directory	424h	0003		CRC		
	428h	12	00	A0	2D	UnitSpecID
	42Ch	13	00	01	02	UnitSoftwareVersion
	430h	D4	00	00	01	UnitDependentDirectory Offset

For offset address 424h, the length of the UnitDirectory is 3 Quadlets.

UnitSpecID (00A02Dh) conforms to 1394TA standards.

UnitSoftwareVersion (000102h) conforms to IIDC Standards, Version 1.3.

The offset address of UnitDependentInfo is required to be
 $430h + 000001h \times 1 = 434h$

	Offset	0-7	8-15	16-23	24-31	
Unit Dependent Info	434h	000B		CRC		
	438h	40	3C	00	00	CommandRegsBase
	43ch	81	00	00	0A	VendorNameLeaf
	440h	82	00	00	0D	ModelNameLeaf
	444h	38	00	00	10	Unit_sub_sw_version
	448h	39	00	00	00	Reserved
	44Ch	3A	00	00	00	Reserved
	450h	3B	00	00	00	Reserved
	454h	3C	00	01	00	Vendor_unique_info_0
	458h	3D	01	00	00	Vendor_unique_info_1
	45Ch	3E	00	00	30	Vendor_unique_info_2
	460h	3F	01	86	A1	Vendor_unique_info_3

For offset address 434h, the length of the UnitDependentInfo is 0Bh Quadlets.

CommandRegsBase is the base address of the camera control register.

$$F0000000h + 3c0000h \times 4 = F0F00000h$$

The offset address of VendorNameLeaf is required to be

$$43Ch + 00000Ah \times 4 = 464h$$

The offset address of ModelNameLeaf is required to be

$$440h + 00000Dh \times 4 = 474h$$

Unit_sub_sw_version conforms to IIDC Standards, Version 1.31.

Vendor_unique_info 0 to Vendor_unique_info 3 are terms of information that the vendor of the camera can define. The meanings in this camera are as follows:

Vendor_unique_info_0 is the firmware version.

Vendor_unique_info_1 is the hardware version.

Vendor_unique_info_2 is the link version.

Vendor_unique_info_3 is the serial number of the camera.

VendorNameLeaf

	Offset	0-7	8-15	16-23	24-31	
Vender Name Leaf	464h	0003		CRC		
	468h	00	00	00	00	
	46h	00	00	00	00	
	470ch	53	4F	4E	59	“ SONY ”

For offset address 464h, the length of the VendorNameLeaf is 3 Quadlets.

The subsequent 8 bytes are fixed at 00.

After that, the four characters for “SONY” are entered.

ModelNameLeaf

	Offset	0-7	8-15	16-23	24-31	
Model Name Leaf	474h	0005		CRC		
	478h	00	00	00	00	
	47ch	00	00	00	00	
	480h	58	43	44	2D	“ XCD- ”
	484h	56	36	30	43	“ V60C ”
	488h	52	00	00	00	“ R... ”

For offset address 474h, the length of the ModelNameLeaf is 5 Quadlets.

The subsequent 8 bytes are fixed at 00.

After that, the model name is entered.

Control Base Address

Every register address is decided based on the base address found in the CommandRegsBase field of ConfigurationROM. F0F00000h is the control base address on this camera.

Inquiring about Supported Video Modes

First, we will find out what video formats are supported.

Address	Data		
	XCD-V60/ V60CR	XCD-SX90/ SX90CR	XCD-U100/ U100CR
F0F00100h	81000000h	E1000000h	E1000000h

Next, for each format, we will find out which video modes are supported.

Format0

Address	Data		
	XCD-V60/ V60CR	XCD-SX90/ SX90CR	XCD-U100/ U100CR
F0F00180h	06000000h	06000000h	06000000h

Format1

Address	Data		
	XCD-V60/ V60CR	XCD-SX90/ SX90CR	XCD-U100/ U100CR
F0F00180h	00000000h	27000000h	27000000h

Format2

Address	Data		
	XCD-V60/ V60CR	XCD-SX90/ SX90CR	XCD-U100/ U100CR
F0F00180h	00000000h	22000000h	27000000h

Format7

Address	Data		
	XCD-V60/ V60CR	XCD-SX90/ SX90CR	XCD-U100/ U100CR
F0F00180h	F8000000h	F0000000h	F0000000h

Next, for each video mode, we will find out which frame rates are supported.

Address	Data		
	XCD-V60/ V60CR	XCD-SX90/ SX90CR	XCD-U100/ U100CR
F0F00214h (Format0Mode5)	FC000000h	F8000000h	F0000000h
F0F00218h (Format0Mode6)	FC000000h	F8000000h	F0000000h
F0F00228h (Format1Mode2)	–	38000000h	30000000h
F0F00234h (Format1Mode5)	–	F8000000h	F0000000h
F0F00238h (Format1Mode6)	–	78000000h	70000000h
F0F0023Ch (Format1Mode7)	–	F8000000h	F0000000h
F0F00248h (Format2Mode2)	–	F8000000h	F0000000h
F0F00254h (Format2Mode5)	–	–	F0000000h
F0F00258h (Format2Mode6)	–	F0000000h	F0000000h
F0F0025Ch (Format2Mode7)	–	–	F0000000h

Video Mode Settings (S800)

Select the video mode you want to use from the tables, and make the required settings.

As examples, the register settings for Format0, Mode5, and a frame rate of 60 fps for the XCD-V60; Format2, Mode2, and a frame rate of 30 fps for the XCD-SX90, and Format2, Mode5, and a frame rate of 15 fps for the XCD-U100 are shown.

In addition, an isochronous transfer speed of 800 Mbps, and isochronous channel 0 are used in these examples. Normally, set the isochronous transfer speed to 800 Mbps.

When multiple cameras are used simultaneously, set different isochronous channels for each.

Address	Data		
	XCD-V60/ V60CR	XCD-SX90/ SX90CR	XCD-U100/ U100CR
F0F00600h (FrameRate)	A0000000h	80000000h	60000000h
F0F00604h (VideoMode)	A0000000h	40000000h	A0000000h
F0F00608h (VideoFormat)	00000000h	40000000h	40000000h
F0F0060Ch (IsoChannel / IsoSpeed)	00008003h	00008003h	00008003h

Video Mode Settings (S400)

When the camera is used under I394A (S400) conditions, set the isochronous transfer speed to 400 Mbps.

In this case, set the frame rate to 15 fps, as this mode does not support data transfer of SXGA 30 fps.

Address	Data		
	XCD-V60/ V60CR	XCD-SX90/ SX90CR	XCD-U100/ U100CR
F0F00600h (FrameRate)	A0000000h	60000000h	60000000h
F0F00604h (VideoMode)	A0000000h	40000000h	A0000000h
F0F00608h (VideoFormat)	00000000h	40000000h	40000000h
F0F0060Ch (IsoChannel / IsoSpeed)	02000000h	02000000h	02000000h

Starting/Stopping Video Transfer (ContinuousShot)

In the device driver, after the preparations for receiving isochronous data are made, video transfer starts when the following commands are issued.

Address	Data
F0F00614h	80000000h

When the following command is issued video transfer stops.

Address	Data
F0F00614h	00000000h

OneShot and MultiShot

This camera supports both OneShot and MultiShot commands. With a OneShot command, after outputting just one single-frame image, the camera enters an “idling” state. With a MultiShot command, the camera enters the “idling” state after outputting exactly the specified number of images.

OneShot

Address	Data
F0F0061Ch	80000000h

MultiShot

Address	Data
F0F0061Ch	4000nnnnh

nnnn indicates the number of frames to be output. You can specify any number between 0001h and FFFFh (1 and 65535). If 0000h is specified, you can think of it as being 1.

Execution of ContinuousShot, OneShot, and MultiShot are prioritized as follows. When a command with higher priority is being executed, the one with the lower priority is ignored.

ContinuousShot > OneShot > MultiShot

Control of IIDC Standard Features

Before transmitting the control command, check the variable ranges of settings and if there is an automatic mode for each feature.

As the variable ranges of the settings vary with video modes for the Pan and Tilt features, be sure to check them if the video mode is changed.

Control

Address	Data	Bit	
F0F00500h (Brightness)	890003FFh	0	This feature exists.
		4	The value can be read out.
		7	Manual setting can be selected.
		8-19	Min. 0
		20-31	Max. 1023
F0F00504h (AutoExposure)	891003FFh	0	This feature exists.
		4	The value can be read out.
		7	Manual setting can be selected.
		8-19	Min. 256
		20-31	Max. 1023
F0F00508h (Sharpness) (Black and white models only)	89000007h	0	This feature exists.
		4	The value can be read out.
		7	Manual setting can be selected.
		8-19	Min. 0
		20-31	Max. 7
F0F0050Ch (WhiteBalance) (Color models only)	9B7009FFh	0	This feature exists.
		4	The value can be read out.
		6	Auto setting can be selected.
		7	Manual setting can be selected.
		8-19	Min. 1792
		20-31	Max. 2559
F0F00510h (Hue) (Color models only)	897009FF	0	This feature exists.
		4	The value can be read out.
		7	Manual setting can be selected.
		8-19	Min. 1792
		20-31	Max. 2559
F0F00514h (Saturation)	890401FF	0	This feature exists.
		4	The value can be read out.
		7	Manual setting can be selected.
		8-19	Min. 64
		20-31	Max. 511
F0F00518h (Gamma)	89000003h	0	This feature exists.
		4	The value can be read out.
		7	Manual setting can be selected.
		8-19	Min. 0
		20-31	Max. 3

Address	Data	Bit	
F0F0051Ch (Shutter)	CB00347Eh	0	This feature exists.
		1	Absolute value control possible.
		4	The value can be read out.
		6	Auto setting can be selected.
		7	Manual setting can be selected.
		8-19	Min. 3
		20-31	Max. 1150
F0F00520h (Gain)	8B000***h	0	This feature exists.
		4	The value can be read out.
		6	Auto setting can be selected.
		7	Manual setting can be selected.
		8-19	Min. 0
		20-31	Max. 511 (color), 680 (black and white)
F0F00530h (Trigger)	8C81C003h	0	This feature exists.
		4	The value can be read out.
		5	Feature can be switched between ON and OFF.
		8	Trigger Source 0 exists.
		15	Software Trigger Mode exists.
		16	Trigger Mode0 exists.
		17	Trigger Mode1 exists.
		30	Trigger Mode14 exists.
		31	Trigger Mode15 exists.
F0F00534h (TriggerDelay)	89000FFFh	0	This feature exists.
		4	The value can be read out.
		7	Manual setting can be selected.
		8-19	Min. 0
		20-31	Max. 4095
F0F00584h (Pan)	89*****h	0	This feature exists.
		4	The value can be read out.
		7	Manual setting can be selected.
		8-19	Min. (Depends on the video mode.)
		20-31	Max. (Depends on the video mode.)
F0F00588h (Tilt)	89*****h	0	This feature exists.
		4	The value can be read out.
		7	Manual setting can be selected.
		8-19	Min. (Depends on the video mode.)
		20-31	Max. (Depends on the video mode.)
F0F0058Ch (OpticalFilter)	89000***h	0	This feature exists.
		4	The value can be read out.
		7	Manual setting can be selected.
		8-19	Min. 0
		20-31	Max. 3 (color), 8 (black and white)

* According to the IEEE 1394 specifications, the most significant bit is shown as 0, and the least significant bit as 31.

Actual control can be carried out by setting registers from F0F00800 onward.

ddd indicates the control value expressed as a 12 bit hexadecimal number.

xxx indicates that any setting made will be ignored.

Brightness control

Address	Data	
F0F00800	82000ddd	Adjusts the black level.

AE reference control

Address	Data	
F0F00804	82000ddd	Sets the AE reference value.

Sharpness control

Address	Data	
F0F00808	82000000	Sets to the soft image quality.
	82000007	Sets to the sharp image quality.

White balance control

Address	Data	
F0F0080C	82BBBRRR	Adjusts the white balance manually.
	83xxxxxx	Adjusts the white balance automatically.
	86xxxxxx	Perform the one-push auto white balance function.

Hue (G level) control

Address	Data	
F0F00810	82000ddd	Sets the green video level.

Saturation control

Address	Data	
F0F00814	82000ddd	Adjusts the color intensity.

Gamma control

Address	Data	
F0F00818	82000000	Sets Gamma to OFF.
	82000001	Reverses the black and white.
	82000002	Sets the gamma curve equivalent to 0.7.
	82000003	Sets an optional gamma curve by a user. (See "LUT.")

Shutter (exposure time) control

Address	Data	
F0F0081C	82000ddd	Controls shutter using the manually set relative value.
	83000xxx	Sets the shutter control to AUTO (relative value).
	C2000xxx	Controls shutter using the manually set absolute value.
	C3000xxx	Sets the shutter control to AUTO (absolute value).
F0F00978h (To obtain this address, see "The formula for absolute value shutter control register address" on page 25.)	Determines the optional value using the 32-bit floating-point format.	After F0F0081C has been set to the absolute value control, set the exposure time using this register.

Gain control

Address	Data	
F0F00820	82000ddd	Set Gain manually.
	83000xxx	Set Gain to AUTO.

Trigger control

Address	Data	
F0F00830	82000000	Sets to Hardware Trigger Mode0.
	82010000	Sets to Hardware Trigger Mode1.
	820E000d	Sets to Hardware Trigger Mode14.
	820F000d	Sets to Hardware Trigger Mode15.
	82E00000	Sets to Software Trigger Mode0.
	82E10000	Sets to Software Trigger Mode1.
	82EE000d	Sets to Software Trigger Mode14.
	82EF000d	Sets to Software Trigger Mode15.
F0F0062C	80000000	Outputs a software trigger. In Trigger Mode0, automatically resets to 0 when exposure ends.
	00000000	In Trigger Mode1, ends exposure if "0" is set.

Trigger Delay control

Address	Data	
F0F00834	82000ddd	Sets Trigger Delay.

Pan/Tilt control

Address	Data	
F0F00884	82000ddd	Sets Pan manually.
F0F00888	82000ddd	Sets Tilt manually.

Optical Filter control

Address	Data																	
F0F0088C	882000ddd	<p>For black and white models, selects 3 × 3 filter. For color models, changes the Bayer pattern. The Bayer output pattern changes by shifting one pixel at the image output starting position from right to left and/or up or down.</p> <p>Bayer array patterns</p> <p>Pattern 0</p> <table border="1" style="margin-left: 20px;"> <tr><td>G</td><td>B</td></tr> <tr><td>R</td><td>G</td></tr> </table> <p>Pattern 1</p> <table border="1" style="margin-left: 20px;"> <tr><td>B</td><td>G</td></tr> <tr><td>G</td><td>R</td></tr> </table> <p>Pattern 2</p> <table border="1" style="margin-left: 20px;"> <tr><td>R</td><td>G</td></tr> <tr><td>G</td><td>B</td></tr> </table> <p>Pattern 3</p> <table border="1" style="margin-left: 20px;"> <tr><td>G</td><td>R</td></tr> <tr><td>B</td><td>G</td></tr> </table>	G	B	R	G	B	G	G	R	R	G	G	B	G	R	B	G
G	B																	
R	G																	
B	G																	
G	R																	
R	G																	
G	B																	
G	R																	
B	G																	

GPIO control

Address	Data	
F0F20400	0000000d	Outputs a signal to the output port. Selectable values are 0 to 3.
F0F20404		Reads out the status of the input port. Readable values are 0 to 3.

Strobe control

Address	Data	
F0F20200	80000000	A strobe signal is not output.
	82000000	Outputs an exposure signal.
	82dddwww	ddd = delay, www = signal width, unit = μs.

The formula for absolute value shutter control register address

Absolute value shutter control CSR offset address

Address	Data	
F0F0071C	003C025C	Absolute value shutter control CSR offset.

The register address for absolute value shutter control is given by the following formula.

$$F0000000h + 003C025Ch \times 4 = F0F00970h$$

Address	Data	
F0F00970	3727C5AC	Absolute value shutter control minimum value. (ReadOnly)
F0F00974	418C0000	Absolute value shutter control maximum value. (ReadOnly)
F0F00978		Absolute value shutter control setting value.

The data is indicated by 32-bit floating-point format. 3727C5AC is 0.00001, and 418C0000 is 16.

Control of IIDC Optional Features

Check if the camera is equipped with optional features by reading bit 3 of BASIC_FUNC_INQ.

Address	Data		
F0F00400 (BASIC_FUNC_INQ)	9080018F	0	Vendar unique feature exists.
		1	Does not support the error status in video mode.
		2	Does not support the feature control error.
		3	The optional feature exists.
		8	1394b mode is available.
		16	The power control is not available.
		19	OneShot is available.
		20	MultiShot is available.
		28..31	15 memory channels

Check the supported feature by reading Opt_Function_Inq.

Address	Data	Bit	
F0F0040Ch Opt_Function_Inq	50000000h	0	
		1	Does not support PIO.
		2	Does not support SIO.
		3	Supports Strobe output.

PIO control

Check the offset address of PIO.

Address	Data	Control register address
F0F00484h PIO_Control_CSR_Inq	003C8100h	F0F20400h

F0F20400h indicates the address of the PIO output port.
F0F20404h indicates the address of the PIO input port.

Address	Data	
F0F20400h	0000000dh	Outputs a signal to the output port. (d = 0 to 3)
F0F20404h	0000000dh	Reads the status of the input port. (d = 0 to 3)

Strobe control

Check the offset address of Strobe control.

Address	Data	Control register address
F0F0048Ch Strobe_output_CSR_Inq	003C8000h	F0F20000h

F0F20200h indicates the control address of the strobe signal.

Address	Data	Output signal
F0F20200h	80000000h	A strobe signal is not output.
	82000000h	Outputs the signal indicating the exposure time. (ExposureOut)
	82dddwww	Outputs a signal having a width "www" after a delay "ddd" from the start of exposure. The unit is μ s.

Control of Sony's Unique Features

LUT (LookUp Table)

Enabling writing the Lookup table

Write the following three commands in sequence.

Address	Data	
F0F30000	08004600	
F0F30004	0030FFFF	
F0F30008	80000000	

Disabling writing the Lookup table

Write the following three commands in sequence.

Address	Data	
F0F30000	08004600	
F0F30004	0030FFFF	
F0F30008	00000000	

When writing of the Lookup table is enabled, the addresses 0xF0F60000 to 0xF0F61FFC that store the Lookup table become open.

The table has two channels. Channel 0 is in EEPROM write mode, and channel 1 is in RAM write mode.

The table written in EEPROM is read out when Gamma is set to 3.

The table written in RAM is directly reflected to images regardless of the Gamma setting.

Channel 0 (EEPROM mode)

Address	Data	
F0F60000	Any data	Output data when input data is 0.
F0F60004		Output data when input data is 1.
F0F60008		Output data when input data is 2.
:	:	
F0F60FF8		Output data when input data is 0x3FE.
F0F60FFC		Output data when input data is 0x3FF.

Channel 1 (RAM mode)

Address	Data	
F0F61000	Any data	Output data when input data is 0.
F0F61004		Output data when input data is 1.
F0F61008		Output data when input data is 2.
:	:	
F0F61FF8		Output data when input data is 0x3FE.
F0F61FFC		Output data when input data is 0x3FF.

Although block writing is applicable for either mode, transfer the next data in EEPROM mode only after confirming that the previous writing has been completed, because writing in EEPROM mode requires a long time.

The common Lookup table is used for both the 16-bit mode and 8-bit mode. For the 8-bit mode, the most significant 8 bits of the 10 bits will handle data.

3 × 3 Filter

Enabling writing the filter

Write the following three commands in sequence.

Address	Data	
F0F30000	08004600	
F0F30004	0031FFFF	
F0F30008	80000000	

Disabling writing the filter

Write the following three commands in sequence.

Address	Data	
F0F30000	08004600	
F0F30004	0031FFFF	
F0F30008	00000000	

When writing of the filter is enabled, the addresses 0xF0F62000 to 0xF0F62020 that store the filter table become open.

F0F62000 Top left	F0F62004 Top	F0F62008 Top right
F0F6200C Left	F0F62010 Center	F0F62014 Right
F0F62018 Bottom left	F0F6201C Bottom	F0F62020 Bottom right

The filter coefficients are specified with 16 bits from 0x0000 to 0xFFFF.

The most significant bit of the 16 bits represents a sign, the following 7 bits are the integer portion, and the least significant 8 bits are the fractional portion.

0100: 1.0

FF00: -1.0

0080: 0.5

0040: 0.25

The filter written here is read out when the optical filter is set to 8.

Display of Test Chart

Displaying the color bar

Write the following three commands in sequence.

Address	Data	
F0F30000	08004600	
F0F30004	0037FFFF	
F0F30008	80000001	

Displaying the gray scale

Write the following three commands in sequence.

Address	Data	
F0F30000	08004600	
F0F30004	0037FFFF	
F0F30008	80000002	

Turning off the test chart

Write the following three commands in sequence.

Address	Data	
F0F30000	08004600	
F0F30004	0037FFFF	
F0F30008	00000000	

Trigger Inhibition

Enabling Trigger inhibition

Write the following three commands in sequence.

Address	Data	
F0F30000	08004600	
F0F30004	0032FFFF	
F0F30008	80000000	

Disabling Trigger inhibition

Write the following three commands in sequence.

Address	Data	
F0F30000	08004600	
F0F30004	0032FFFF	
F0F30008	00000000	

User Free Memory

Enabling User free memory

Write the following three commands in sequence.

Address	Data	
F0F30000	08004600	
F0F30004	0011FFFF	
F0F30008	80000001	

Disabling User free memory

Write the following three commands in sequence.

Address	Data	
F0F30000	08004600	
F0F30004	0011FFFF	
F0F30008	00000000	

When User free memory is enabled, the addresses 0xF0F50000 to 0xF0F500FC become open. These addresses are available for writing data freely. The written data are retained even if the power is turned off.

Address	Data	
F0F50000	Any data	
F0F50004		
:		
F0F500FC		

Setting AWB (Auto White Balance) Parameters

Enabling AWB parameter setting

Write the following three commands in sequence.

Address	Data	
F0F30000	08004600	
F0F30004	0034FFFF	
F0F30008	80000000	

The detection frame is highlighted.

Disabling AWB parameter setting

Write the following three commands in sequence.

Address	Data	
F0F30000	08004600	
F0F30004	0034FFFF	
F0F30008	00000000	

When AWB parameter setting is enabled, addresses 0xF0F63000 or later for the setting become open.

Address	Data	
F0F63000	00ss00ee	Sets horizontal range in percentage units.
F0F63004	00ss00ee	Sets vertical range in percentage units.
F0F63010		R level can be obtained. (example value)
F0F63014		G level can be obtained. (example value)
F0F63018		B level can be obtained. (example value)
F0F63020	00dd00dd	Sets the OnePush AWB speed using the most significant 16 bits. Sets the AWB speed using the least significant 16 bits.
F0F63024	0000000d	Sets algorithm selection 0 or 1.

Setting AE (Auto Exposure) Parameters

Enabling AE parameter setting

Write the following three commands in sequence.

Address	Data	
F0F30000	08004600	
F0F30004	0035FFFF	
F0F30008	80000000	

The detection frame is highlighted.

Disabling AE parameter setting

Write the following three commands in sequence.

Address	Data	
F0F30000	08004600	
F0F30004	0035FFFF	
F0F30008	00000000	

When AE parameter setting is enabled, addresses 0xF0F64000 or later for the setting become open.

Address	Data	
F0F64000	00ss00ee	Sets horizontal range in percentage units.
F0F64004	00ss00ee	Sets vertical range in percentage units.
F0F64010		Video level can be obtained. (example value)
F0F64020	00dd00dd	Sets the AE response speed.
F0F64024	00dd00dd	Sets the AE restart time using the most significant 16 bits. Sets the level of AE restart using the least significant 16 bits. Setting a lower value makes the AE sensitive to change in video level.
F0F64028	000000dd	Sets the limit of the high-speed shutter. The default setting is 0A (1/10000). The variable range is from 3 to 20 in hexadecimal numbers. Note that a lower value may lead to hunting.

Memory Shot

Switching to Memory shot mode

Write the following three commands in sequence.

Address	Data	
F0F30000	08004600	
F0F30004	0010FFFF	
F0F30008	80000000	

Switching to normal mode

Write the following three commands in sequence.

Address	Data	
F0F30000	08004600	
F0F30004	0010FFFF	
F0F30008	00000000	

When the Memory shot mode is set, the following control registers become effective.

Address	Data	
F0F40000	010000nn	Starts recording and obtains the status information.
F0F40004		Obtains the number of frames that can be recorded.

Operation when the trigger mode is set

- 1 Before starting, stop video and open the isochronous resource.
- 2 Set trigger mode to ON.
- 3 Switch to Memory shot mode.
- 4 Read F0F40004 to obtain the maximum number of frames.
- 5 Write 010000nn for F0F40000 to start recording. (nn represents the number of frames to be used for recording.)
- 6 Input triggers required number of times.
- 7 Read F0F40000 to check the recording status. 01000000 indicates during recording, and 010100nn indicates recording has stopped.
- 8 Set trigger mode to OFF.
- 9 Secure the isochronous resource and start video. The recorded images are output continuously. If trigger mode remains ON, one image is output each time a trigger is input.

- 10 Read F0F40000 to check the playback status. 02000000 indicates during playback, and 02010000 indicates playback has stopped. When playback stop is confirmed, stop video and open the isochronous resource. To continue recording/playback, go back to step 5.

- 11 To stop Memory shot, switch to normal mode.

Notes on the Camera Operations

If Frame Rate Decrease Occurs

On this camera, frame rate may decrease depending on your shutter settings.

- a When the exposure time is shorter than one frame, and the exposure time setting is shortened using the shutter
- b When the shutter is set to Auto, and the exposure time decreases automatically

In either case, the camera tends to skip 1 frame image, resulting in a decrease in the frame rate. Keep this in mind when using an application that switches exposure times frequently.

- c With a long exposure
In long exposure mode, the exposure time is set longer than the image transmission cycle. In this case, frame rate decreases according to the exposure time.

When Using Trigger Mode

This camera is set to accept a trigger at the fastest possible timing and it can accept overlap of the next trigger signal during video transmission as the default setting. For this reason, a trigger inhibition period is not available. Thus, if a trigger signal is input before the CCD can change to the state where it can accept exposures, multiple exposures can occur, and it cannot capture the correct image. Design the trigger generation circuit so that the trigger cycle is not faster than necessary.

For the same reason, a malfunction may occur when noise overlaps a trigger signal. In this case, suppress noise in the trigger generation circuit.

When the above conditions are unavoidable, the trigger inhibition period can be limited only while the image is being output.

Keep in mind, however, that if the trigger inhibition feature is enabled, the overlap trigger cannot be accepted and the minimum trigger input cycle becomes longer according to the exposure time.

On Sensitivity in Binning Mode

In the Binning mode, the vertical signal is factored in, so the sensitivity is doubled. The frame rate is also doubled and the exposure time is halved, so this effect is canceled out.

On the other hand, when a shorter exposure time is set, the effect of this inclusion appears, and the sensitivity increases. When setting the exposure time in the Binning mode, take this into consideration.

Auto Shutter Control and Absolute Value Shutter Control

The auto shutter control function cannot be used in the Absolute value control mode. When Shutter is set to AUTO, the Absolute value control mode is automatically canceled.

On Accuracy of Auto White Balance

This camera integrates the R, G and B levels within the area specified by the AWB detection frame, and adjust the R and B gains so as to equalize each level. For this reason, the correct white balance is obtained when a white subject is shot on the whole detection frame. The correct color reproduction may not be obtained during a normal scene shooting.

Specifications

	XCD-V60/V60CR	XCD-SX90/SX90CR	XCD-U100/U100CR
Image sensor	1/3-type progressive scan IT transfer CCD	1/3-type progressive scan IT transfer CCD	1/1.8-type progressive scan IT transfer CCD
Number of effective pixels	Approx. 330,000 659 (H) × 494 (V)	Approx. 1,200,000 1296 (H) × 966 (V)	Approx. 2,000,000 1628 (H) × 1236 (V)
Cell size	7.4 (H) × 7.4 (V) μm	3.75 (H) × 3.75 (V) μm	4.4 (H) × 4.4(V) μm
Chip size	5.79 (H) × 4.89 (V) mm	6.26 (H) × 5.01 (V) mm	8.50 (H) × 6.80 (V) mm
Interface format	IEEE1394b-2002		
Transfer speed	800, 400 Mbps		
Protocol	IIDC 1394-based Digital Camera Specification Version 1.31 Compliant		
Image format (fixed size)	640 × 480 Mono8/16	1280 × 960 Mono8/16 1024 × 768 Mono8/16 800 × 600 Mono8/16 640 × 480 Mono8/16	1600 × 1200 Mono8/16 1280 × 960 Mono8/16 1024 × 768 Mono8/16 800 × 600 Mono8/16 640 × 480 Mono8/16
Frame rate (depends on the image format)	90 to 1.875 fps	30 to 1.875 fps	15 to 1.875 fps
Image format (Format7) (* for Partial scan)	680 × 480 Mono8/16* 320 × 240 (Binning) 640 × 240 (Binning) 640 × 480 (90 fps)	1280 × 960 Mono8/16* 640 × 480 (Binning) 1280 × 480 (Binning)	1600 × 1200 Mono8/16* 800 × 600 (Binning) 1600 × 600 (Binning)
Partial scan function	Minimum unit: 32 × 24 Trimming position selectable by the unit of 4 × 4		
Lens mount	C-mount		
Flange back	17.526 mm		
Minimum illumination	Black and white model: 2 lx (Iris: F1.4, Gain: +24 dB, Shutter: 1/60s (129) (XCD-V60), 1/30s (182) (XCD-SX90), 1/15s (258) (XCD-U100)) Color model: 20 lx (Iris: F1.4, Gain: +18 dB, Shutter: 1/60s (129) (XCD-V60CR), 1/30s (182) (XCD-SX90CR), 1/15s (258) (XCD-U100CR))		
Brightness	Adjustable		
Gamma	Adjustable using the Lookup table		
Shutter speed	1/100,000 to 16 s (Absolute value control possible)		
Gain	Auto/Manual (Black and white model: 0 to 24 dB / Color model: 0 to 18 dB)		
External trigger shutter	Edge detection (Mode0), Exposure time setting by trigger width (Mode1), Software trigger (IEEE1394 bus), Bulk trigger, Sequential trigger, Trigger inhibition setting, Trigger/strobe delay setting		
Power supply	+8 to +30 V (from IEEE1394b cable or 12-pin connector)		
Power consumption	2.8 W (12 V)	2.8 W (12 V)	3 W (12 V)
Performance guaranty temperature	0 to +40 °C (32 to 104 °F)		
Operating temperature	-5 to +45 °C (23 to 113 °F)		
Storage temperature	-30 to +60 °C (-22 to +140 °F)		
Operating relative humidity	20 to 80 % (No condensation)		
Storage relative humidity	20 to 95 % (No condensation)		
Vibration resistance	10 G (20 to 200 Hz, 20 minutes for each direction X, Y, Z)		
MTBF	57170 Hrs (Approx. 6.5 years)	58260 Hrs (Approx. 6.7 years)	56270 Hrs (Approx. 6.4 years)
Shock resistance	70G		
Dimensions	44 (W) × 33 (H) × 57.5 (D) mm, not including projecting parts (1 3/4 (W) × 1 5/16 (H) × 2 3/8 (D) inches)		
Mass	140 g (5 oz)		

Video Modes Supported

Fixed format

Format	Mode	Image Size	Color Coding	Frame Rate	XCD-V60/ V60CR	XCD-SX90/ SX90CR	XCD-U100/ U100CR
0	5	640 × 480	Mono8	1.875	○	○	○
				3.75	○	○	○
				7.5	○	○	○
				15	○	○	○
				30	○	○	
				60	○		
	6	640 × 480	Mono16	1.875	○	○	○
				3.75	○	○	○
				7.5	○	○	○
				15	○	○	○
				30	○	○	
				60	◎		
1	2	800 × 600	Mono8	7.5		○	○
				15		○	○
				30		○	
	5	1024 × 768	Mono8	1.875		○	○
				3.75		○	○
				7.5		○	○
				15		○	○
				30		○	
	6	800 × 600	Mono16	3.75		○	○
				7.5		○	○
				15		○	○
				30		○	
	7	1024 × 768	Mono16	1.875		○	○
				3.75		○	○
				7.5		○	○
				15		○	○
30					◎		

Specifications

Format	Mode	Image Size	Color Coding	Frame Rate	XCD-V60/ V60CR	XCD-SX90/ SX90CR	XCD-U100/ U100CR
2	2	1280 × 960	Mono8	1.875		○	○
				3.75		○	○
				7.5		○	○
				15		○	○
				30		◎	
	5	1600 × 1200	Mono8	1.875			○
				3.75			○
				7.5			○
				15			○
	6	1280 × 960	Mono16	1.875		○	○
				3.75		○	○
				7.5		○	○
				15		◎	◎
	7	1600 × 1200	Mono16	1.875			○
				3.75			○
				7.5			○
15						◎	

◎ S800 band is required.

Free format

Format	Mode		XCD-V60	XCD-V60CR	XCD-SX90	XCD-SX90CR	XCD-U100	XCD-U100CR
7	0	Partial scan	○	○	○	○	○	○
		Frame rate	Depends on the area.					
	1	2 × 2 binning	○		○		○	
		Frame rate	180 fps		60 fps		30 fps	
	2	1 × 2 binning	○		○		○	
		Frame rate	180 fps		60 fps		30 fps	
	3	Full size mode	○	○	○	○	○	○
		Frame rate	90 fps	90 fps	30 fps	30 fps	15 fps	15 fps
	4	90 fps mode	○	○				
		Frame rate	90 fps	90 fps				

The frame rates indicate the values in 8-bit mode and under S800 conditions.

To operate with a frame rate of 180 fps, the shutter speed should be faster than 1/180 s.

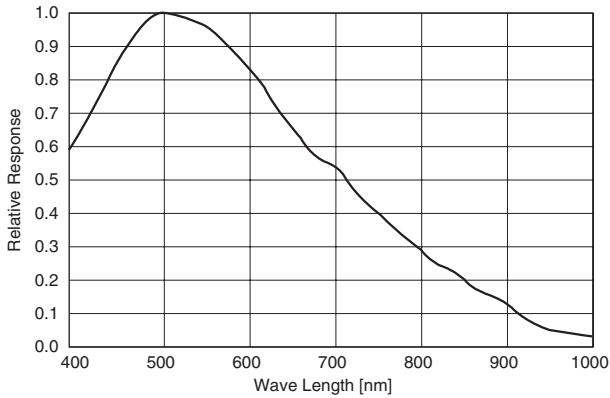
To operate with a frame rate of 90 fps, the shutter speed should be faster than 1/90 s.

To operate with a frame rate of 60 fps, the shutter speed should be faster than 1/60 s.

Spectral Sensitivity (Relative Response) Parameters

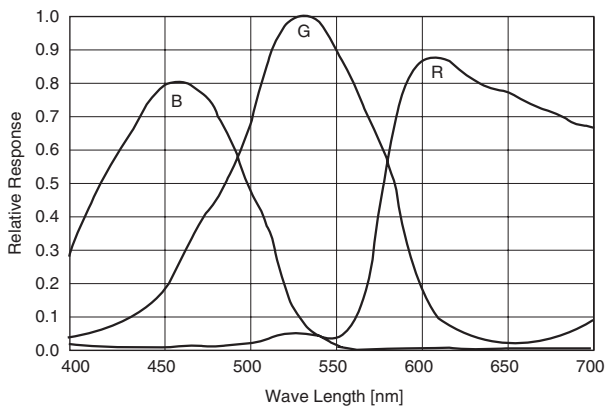
XCD-V60

Spectral sensitivity (relative response) parameters (without lens and light source parameters)



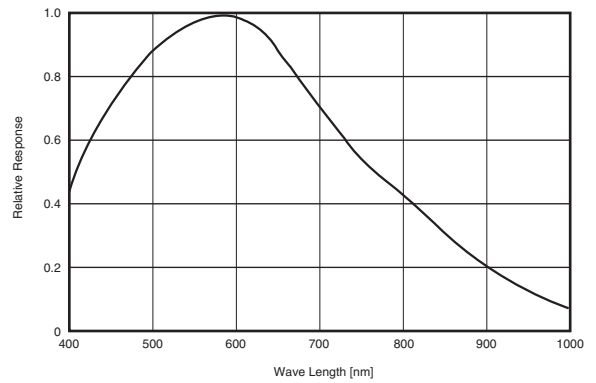
XCD-V60CR

Spectral sensitivity (relative response) parameters (without lens and light source parameters)



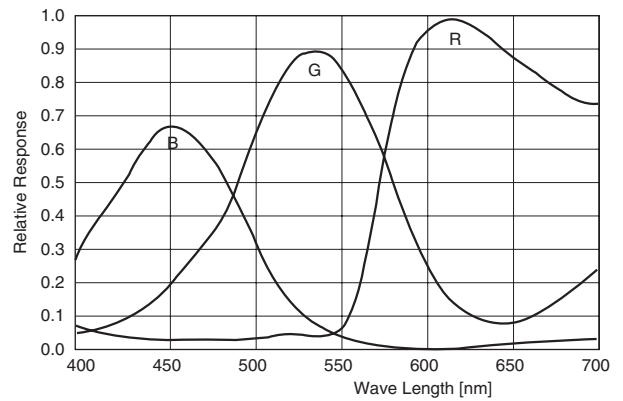
XCD-SX90

Spectral sensitivity (relative response) parameters (without lens and light source parameters)



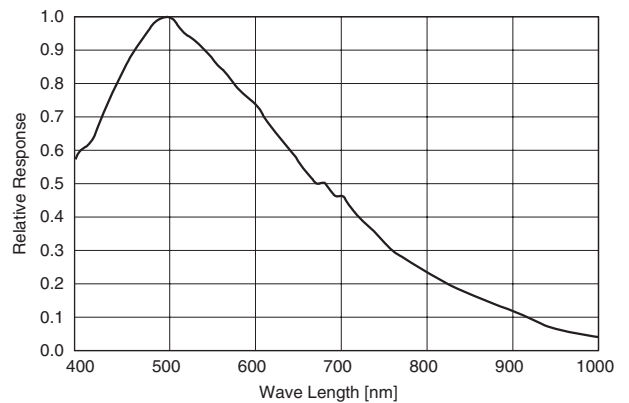
XCD-SX90CR

Spectral sensitivity (relative response) parameters (without lens and light source parameters)



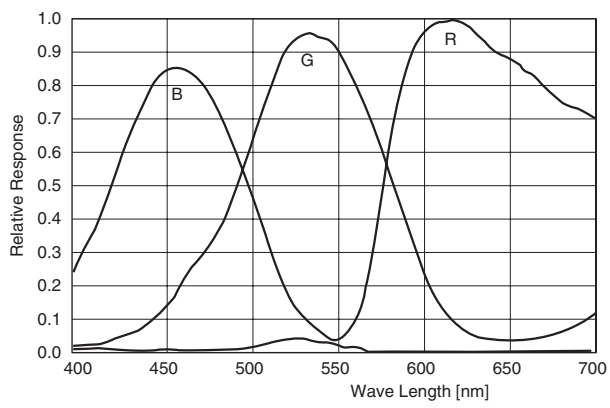
XCD-U100

Spectral sensitivity (relative response) parameters (without lens and light source parameters)

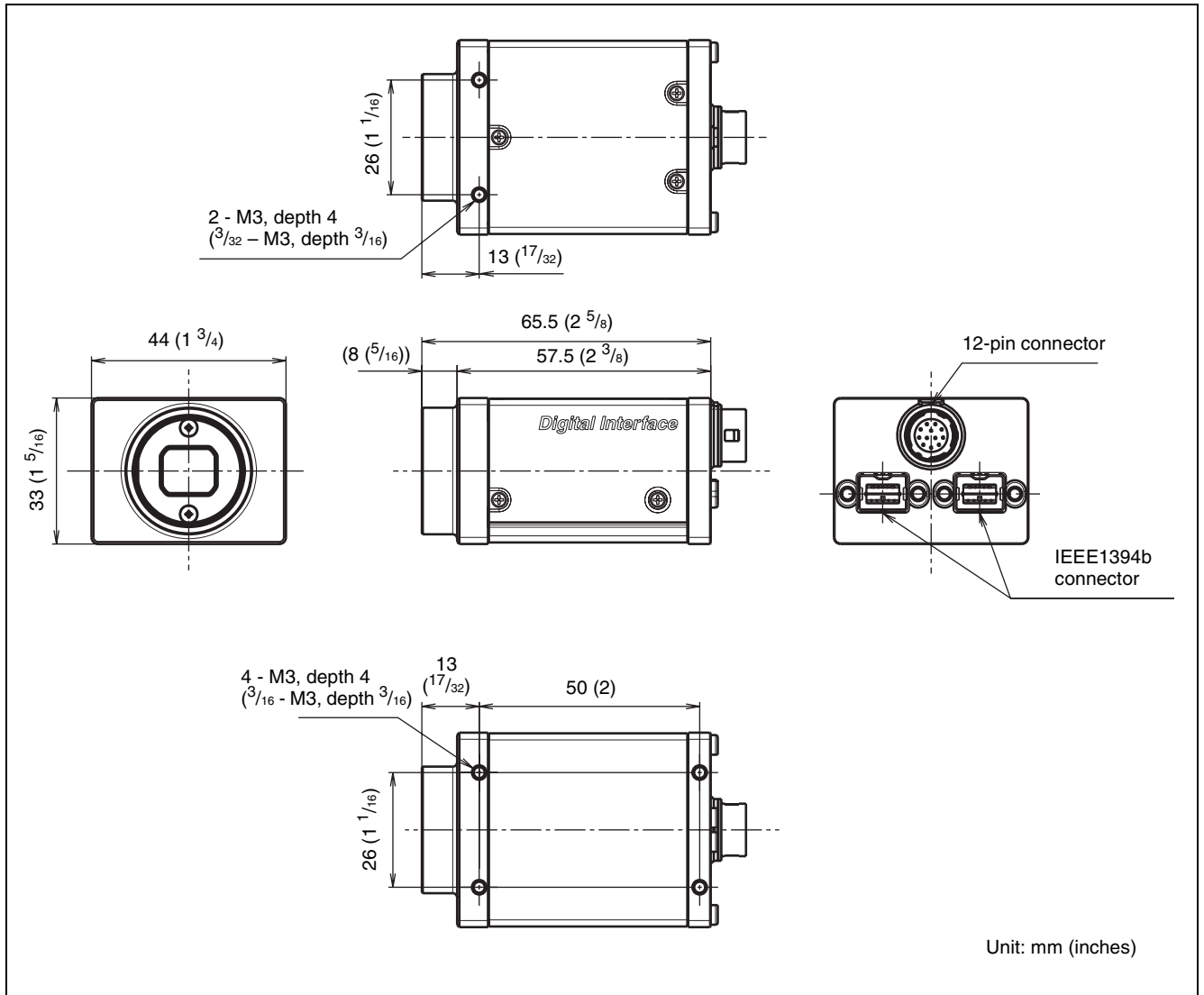


XCD-U100CR

Spectral sensitivity (relative response) parameters
(without lens and light source parameters)



Dimensions



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