



CCD Camera FireDragon2

**CSFV90BC3-B/CC3-B
CSFX36BC3-B/CC3-B
CSFS20BC2-B/CC2-B
CSFU15BC18-B/CC18-B**

Specifications

Ver.1.0

TOSHIBA TELI CORPORATION

D4178879A

Contents

RESTRICTION FOR USE	1
CASES FOR INDEMNITY (LIMITED WARRANTY).....	2
USAGE PRECAUTIONS.....	3
1 Overview	5
2 Features.....	5
3 Configuration.....	6
4 Optional part	6
5 Functions	6
6 Specifications.....	17
7 Guarantee.....	31
8 Repair	31
9 Outline Drawing	32

RESTRICTION FOR USE

- Should the equipment be used in the following conditions or environments, give consideration to safety measures and inform us of such usage:
 - (1) Use of the equipment in the conditions or environment contrary to those specified, or use outdoors.
 - (2) Use of the equipment in applications expected to cause potential hazard to people or property, which require special safety measures to be adopted.
- This product can be used under diverse operating conditions. Determination of applicability of equipment or devices concerned shall be determined after analysis or testing as necessary by the designer of such equipment or devices, or personnel related to the specifications. Such designer or personnel shall assure the performance and safety of the equipment or devices.
- This product is not designed or manufactured to be used for control of equipment directly concerned with human life (*1) or equipment relating to maintenance of public services/functions involving factors of safety (*2). Therefore, the product shall not be used for such applications.
 - (*1): Equipment directly concerned with human life refers to.
 - Medical equipment such as life-support systems, equipment for operating theaters.
 - Exhaust control equipment for exhaust gases such as toxic fumes or smoke.
 - Equipment mandatory to be installed by various laws and regulations such as the Fire Act or Building Standard Law
 - Equipment related to the above
 - (*2) :Equipment relating to maintenance of public services/functions involving factors of safety refers to.
 - Traffic control systems for air transportation, railways, roads, or marine transportation
 - Equipment for nuclear power generation
 - Equipment related to the above

CASES FOR INDEMNITY (LIMITED WARRANTY)

We shall be exempted from taking responsibility and held harmless for damage or losses incurred by the user in the following cases.

- In the case damage or losses are caused by fire, earthquake, or other acts of God, acts by a third party, deliberate or accidental misuse by the user, or use under extreme operating conditions.
- In the case of indirect, additional, consequential damages (loss of business interests, suspension of business activities) are incurred as result of malfunction or non-function of the equipment, we shall be exempted from responsibility for such damages.
- In the case damage or losses are caused by failure to observe the information contained in the instructions in this instruction manual and specifications.
- In the case damage or losses are caused by use contrary to the instructions in this instruction manual and specifications.
- In the case damage or losses are caused by malfunction or other problems resulting from use of equipment or software that is not specified.
- In the case damage or losses are caused by repair or modification conducted by the customer or any unauthorized third party (such as an unauthorized service representative).
- Expenses we bear on this product shall be limited to the individual price of the product.
- The item that is not described in specifications of this product is off the subject of the guarantee.

USAGE PRECAUTIONS

- **Handle carefully**

Do not drop the equipment or allow it to be subject to strong impact or vibration, as such action may cause malfunctions. Further, do not damage the connection cable, since this may cause wire breakage.

- **Inserting/removing 1394.b connector**

Proper care must be taken when inserting or removing the 1394.b cable into the camera. The connector must be inserted/removed straight into the connector to protect the equipment or devices.

- **Environmental operating conditions**

Do not use the product in locations where the ambient temperature or humidity exceeds the specifications.

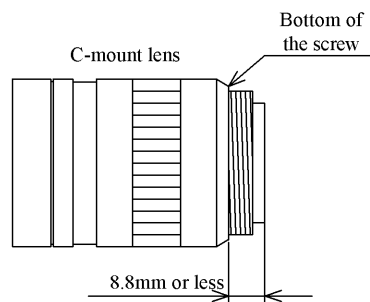
Otherwise, image quality may be degraded or internal components may be adversely affected. In particular, do not use the product in areas exposed to direct sunlight. Moreover, during shooting under high temperatures, vertical stripes or white spots (noise) may be produced, depending on the subject or camera conditions (such as increased gain). However, such phenomena are not malfunctions.

- **Combination of C-mount lens**

Depending on the lens you use, the performance of the camera may not be brought out fully due to the deterioration in resolution and brightness in the peripheral area, occurrence of a ghost, aberration and others.

When you check the combination between the lens and camera, be sure to use the lens you actually use.

As for the C-mount lens used combining this product, the projection distance from bottom of the screw should use 8.8mm or less.



- **Check a combination with the lens**

Depending on the lens and lighting you use, an image is reflected as a ghost in the imaging area. However, this is not because of a fault of the camera.

In addition, depending on the lens you use, the performance of the camera may not be brought out fully due to deterioration in resolution and brightness in the peripheral area, aberration and others.

Be sure to check a combination with the camera by using the lens and lightning you actually use.

When installing a lens in the camera, make sure carefully that it is not tilted.

In addition, use a mounting screw free from defects and dirt. Otherwise, the camera may be unable to be removed.

● **Do not shoot under intense light**

Avoid intense light such as spot lights on part of the screen because it may cause blooming or smears. If intense light falls on the screen, vertical stripes may appear on the screen, but this is not a malfunction.

● **Occurrence of moiré**

If you shoot thin stripe patterns, moiré patterns (interference fringes) may appear. This is not a malfunction.

● **Occurrence of noise on the screen**

If an intense magnetic or electromagnetic field is generated near the camera or connection cable, noise may be generated on the screen. If this occurs, move the camera or the cable.

Handling of the protective cap

If the camera is not in use, attach the lens cap to the camera to protect the image pickup surface.

If the equipment is not to be used for a long duration

Turn off power to the camera for safety.

● **If the equipment is not to be used for along duration**

Turn off power to the camera for safety and attach the lens cap to the camera to protect the image pickup surface.

● **Maintenance**

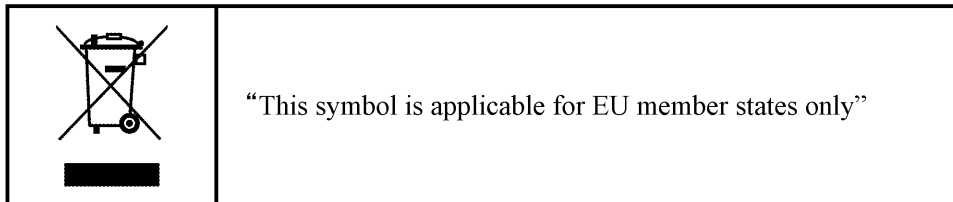
Turn off power to the equipment and wipe it with a dry cloth.

If it becomes severely contaminated, gently wipe the affected areas with a soft cloth dampened with diluted neutral detergent. Never use alcohol, benzene, thinner, or other chemicals because such chemicals may damage or discolor the paint and indications.

If the image pickup surface becomes dusty, contaminated, or scratched, consult your sales representative.

● **Disposal**

When disposing of the camera, it may be necessary to disassemble it into separate parts, in accordance with the laws and regulations of your country and/or municipality concerning environmental contamination.



1 Overview

This FireDragon2 series is an integrated-(one-body)-type camera that adopts all pixel data readout inter line CCD. There are 8 models according to the sensor type. These are CSFV90BC3-B / CC3-B (VGA), CSFX36BC3-B / CC3-B (XGA), CSFS20BC2-B / CC2-B (SXGA), and CSFU15BC18-B / CC18-B (UXGA). For video output, the serial digital bus standard “IEEE1394.b” is adopted for high transfer rate, and it is easy to integrate into industrial equipment.

2 Features

- **High frame rate and high resolution**

Supported high frame rate CSFV90BC3-B / CC3-B (90fps/VGA), CSFX36BC3-B / CC3-B (36fps/XGA), CSFS20BC2-B / CC2-B (20fps/SXGA), and CSFU15BC18-B / CC18-B (15fps/UXGA).

- **All pixel readout**

All pixel signals (in the effective area) are output in one frame processing.

- **Full frame shutter**

Since all pixels are output even by shutter operation, high resolution can be achieved, without deteriorating the vertical resolution.

- **Square grids**

The CCD pixels arrayed in square grids facilitates computation for image processing.

- **Color processing (Color models only)**

Since color processing is built in, there are also RGB, YUV 4:2:2, YUV 4:1:1, Bayer output modes besides Raw output mode.

- **IEEE1394 interface (bilingual support)**

Video output and control of the camera use the IEEE Standard 1394b-2002 (simply IEEE1394.b hereinafter) high-speed serial interface. Data is transferred at 800 Mbps for high frame rate output. Bilingual support is also provided, allowing connection to IEEE Standard 1394a-2000 (IEEE1394.a hereinafter) devices.

● **Random Trigger Shutter**

The Random Trigger Shutter function provides images in any timing by input of an external trigger signal. Trigger control from PC is possible.

● **Scalable**

Selectable video output area. It can be higher frame rate by reducing vertical output area. And can be reduce occupied data rate of IEEE1394 by reducing horizontal output area.

● **Compact and lightweight**

This product is compact and lightweight, and it is easy to integrate into industrial equipment.

● **RoHS compliant**

3 Configuration

(1) Camera body..... 1

(2) Accessories

- Instruction Manual 1

*No application software is attached to this product.

4 Optional part

(1) Camera mounting kit..... Model name: CPT1100CL

*Contact your dealer / distributor for details of option units.

5 Functions

5.1 Endian switching

The video data can be output using the desired endian for Mono 16 bit, Raw 16 bit, or Bayer 16 bit output.

5.2 One Shot and Multi Shot

One Shot and Multi Shot modes are available, in addition to Continuous Shot. One Shot outputs a single video frame. Multi Shot outputs the number of video frames specified.

Both One Shot and Multi Shot modes are enabled when Iso_EN = 0.

5.3 Image Buffer and Retransmit

Video data can be stored temporarily to internal camera memory (the Image Buffer) and read out when desired.

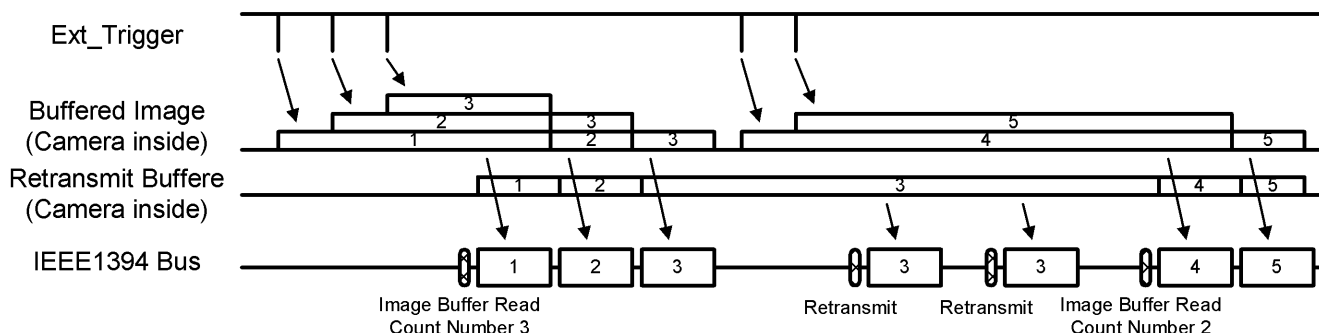
The maximum number of buffered images depends on the output resolution and format set.

The final frame of video output is stored automatically and can be retransmitted when desired. Both Image

Buffer and Retransmit are enabled when Iso_EN = 0. If using retransmit, set the number of frames that can be stored in the image buffer no higher than two [MaxNumIma minus 2].

The buffered video data is cleared in the following cases:

- When the Image Buffer function is on
- When any parameters for Video Format, Video Mode, Image Size, or Color Coding are changed
- When the Random Trigger Shutter function is switched on or off while the Image Buffer function is on



5.4 Brightness-level setting

This sets brightness-levels from -5% to +25%, with saturation-level set to 100%.

* The function is not compatible with Raw output.

5.5 Spatial Filter (B/W models only) and Sharpness

The B/W model features a 3x3 spatial filter. Spatial Filter coefficients can be set for easy image processing.

Both models feature sharpness functions. The level of sharpness correction can be adjusted for video output to control the strength of contour corrections.

Spatial filter and sharpness cannot be enabled simultaneously.

5.6 White balance (Color models only)

Three white balance modes are provided: manual white balance (MWB), one-push auto white balance (OPWB), and full-auto white balance (FAWB). Select the mode to suit the subject and purpose.

5.6.1 MWB

R/B gain can be set independently for each.

5.6.2 OPWB

When OPWB is used, the camera itself adjusts R/B gain to ensure the correct white balance for the effective area.

5.6.3 FAWB

The camera automatically detects white areas and then adjusts R/B gain to ensure the correct white balance.

5.7 Hue (Color models only)

Hue can be set.

* This function is not compatible with Raw or Bayer output.

5.8 Saturation (Color models only)

Saturation can be set.

* This function is not compatible with Raw or Bayer output.

5.9 Gamma

The gamma can be selected for the output image.

* This function is not compatible with Raw output.

5.10 Look Up Table (LUT)

The gamma can be set or binarized using input 10 bit and output 10 bit LUT.

* This function is not compatible with Raw output.

5.11 Electrical Shutter

Automatic exposure time control (AE) and manual exposure time (MANU) settings are provided. If functions are disabled, exposure times will equal frame rates.

5.11.1 AE

The exposure time is adjusted automatically to suit subject brightness.

This mode can also be combined with AGC (automatic gain control) to automatically adjust fluctuations in subject brightness across a wide range (ALC operation).

* This function is not compatible with Raw output.

5.11.2 MANU

Exposure is controlled using an internal sync signal. This can be set in one of two ways:

- Preset setting

The exposure time is set to one of eight preset settings.

- Absolute setting

The exposure time is set using a IEEE*4 floating-point value.

Notes on long exposure:

- When you set the exposure time longer than approximately 1 second, white spots and the unevenness in highlight portion might occasionally be observed on screen. This phenomenon is due to the characteristics of the CCD image-pickup device, and do not reflect performance error in the pickup device or CCD Camera itself.

5.12 Gain setting

Manual (MANU) and automatic gain control (AGC) settings are provided. AGC automatically adjusts the gain to suit subject brightness.

* AGC function is not compatible with Raw output.

5.13 Raw / Bayer Mode switching (Color models only)

You can switch the output between Raw output, which outputs the raw CCD sensor video, and Bayer mode output, which includes some color processing.

The following color processing is enabled in Bayer mode:

- Brightness
- White Balance (MWB, OPWB and FAWB)
- Gamma
- LUT
- AE / AGC / ALC

5.14 Random Trigger Shutter

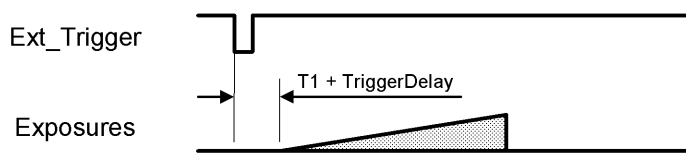
Images can be captured at the desired timing using an external trigger signal input. You can use the trigger signal via the trigger input connector or use a command controlled software trigger via the IEEE 1394 interface (IIDC compatible, with TriggerMode0 only). You can also select polarity of trigger input (High active / Low active).

This can also be used with the sequential shutter.

Note that using the Random Trigger Shutter will result in a delay between the input of the external trigger and the actual exposure start.

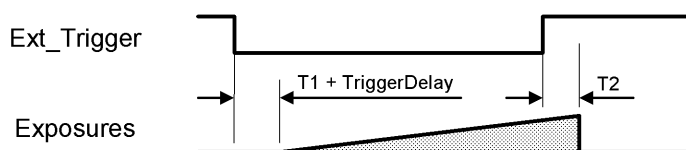
- MANU setting (Trigger Mode0)

The exposure time is determined by the electronic shutter MANU setting.



- Pulse width setting (Trigger Mode1)

The exposure time is determined by the pulse width of the trigger signal. The exposure is initiated using an external trigger. This function is not compatible with software trigger.



- Bulk Trigger (Trigger Mode14)

Inputting a single external trigger enables multiple continuous exposures and video output. Up to 15 frames can be output.

	CSFV90BC3-B /CC3-B	CSFX36BC3-B /CC3-B	CSFS20BC2-B /CC2-B	CSFU15BC18-B /CC18-B
T1 (μs)	2.1	2.8	2.1	3.1
T2 (μs)	3.4	26	6.1	8.2

Notes on long exposure:

- When you set the exposure time longer than approximately 1 second, white spots and the unevenness in highlight portion might occasionally be observed on screen. This phenomenon is due to the characteristics of the CCD image-pickup device, and do not reflect performance error in the pickup device or CCD Camera itself.

Note on Random Trigger Shutter:

- When the trigger signal is noisy, there is a possibility of causing the malfunction. In this case, please input a proper trigger signal.

5.15 Trigger Delay

You can set the delay between trigger signal input and the start of exposure.

5.16 Trigger Over Lap

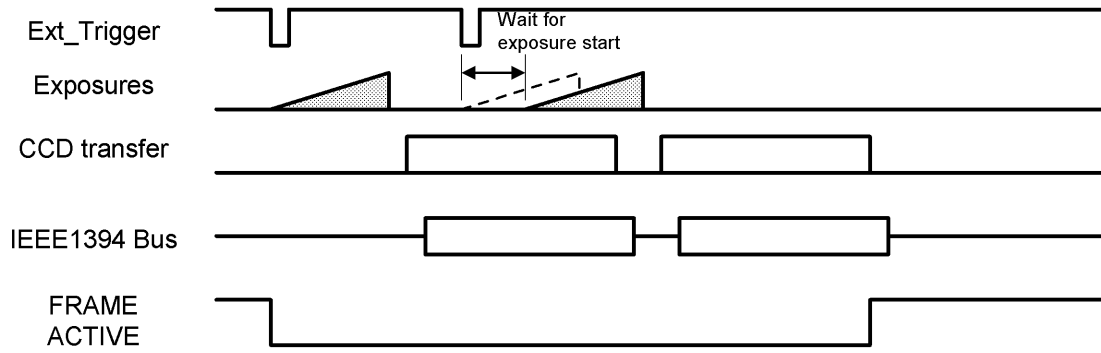
You can set to receive/reject the external trigger while the FRAME ACTIVE.

- Over Lap enabled

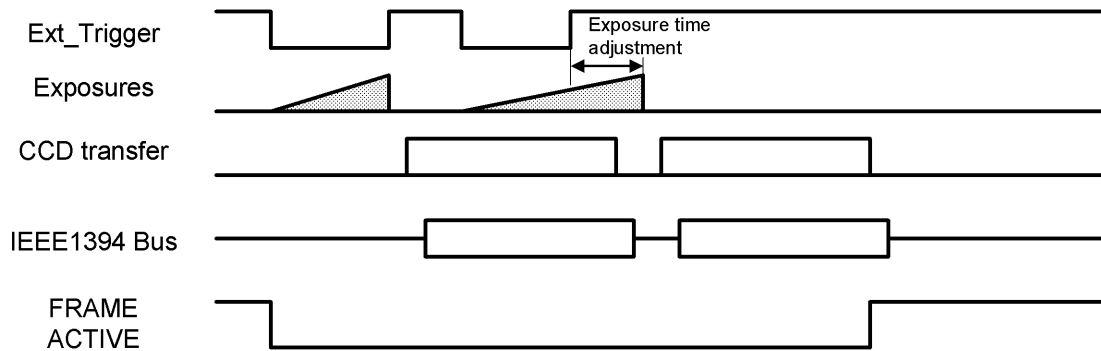
Exposes using an external trigger input during the FRAME ACTIVE period.

To prevent double exposures, for TriggerMode0, the start of the exposure is delayed until the exposure ends after the end of the FRAME ACTIVE period. Likewise, for TriggerMode1, the exposure time is adjusted so that the exposure ends after the end of the FRAME ACTIVE period.

TriggerMode0

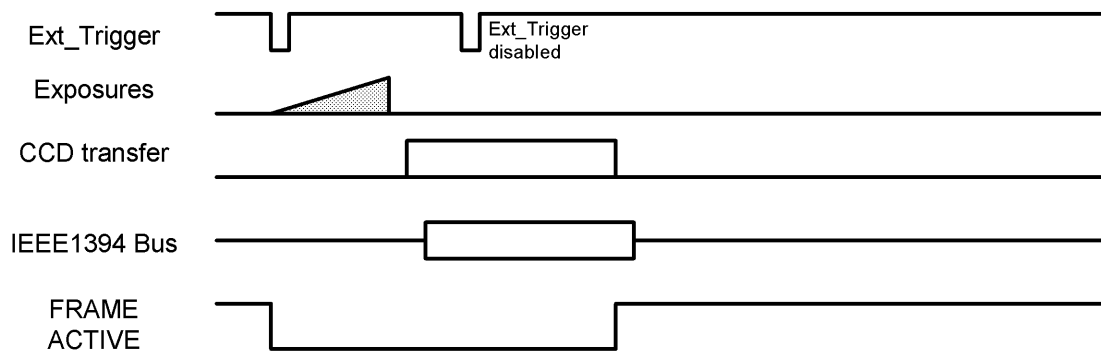


TriggerMode1



- Over Lap disabled

External triggers input during the FRAME ACTIVE period are ignored. No exposure or video output will occur.

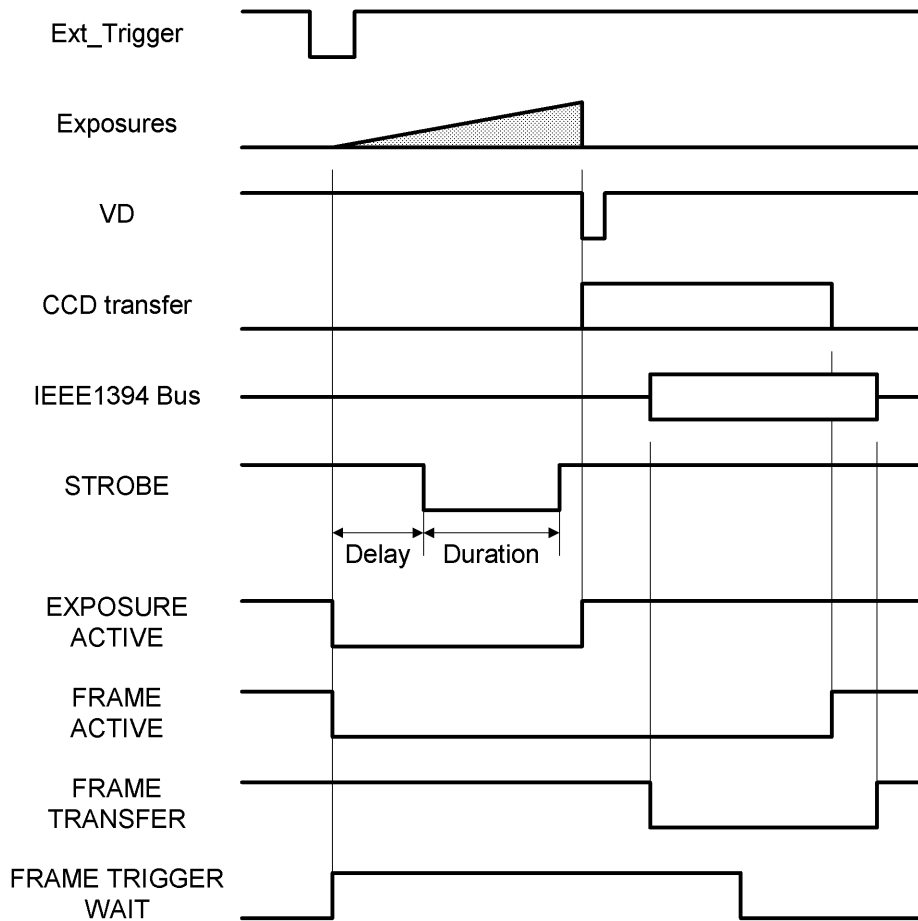


5.17 PIO Output signal

Any of the following signals can be selected from the I/O connector general output pins. The output is of the open-collector type.

- VD: VD sync signal. Inputs to another FireDragon2 with VD synchronization.
- STROBE: Strobe control signal. This sets the delay before exposure start and the width.
- EXPOSURE ACTIVE: Period from exposure start to end.
- FRAME ACTIVE: Period from exposure start to CCD transfer completion.

- FRAME TRANSFER: Period isochronous transfer.
- FRAME TRIGGER WAIT: Signal indicating the trigger wait time for Random Trigger Shutter. If an external trigger is input during this period, the exposure will start, regardless of the status of the previous frame.
- PIO: Allows output level control via PIO_OUTPUT register.



*When the setting is for non-inverted GPIO.

5.18 Scalable mode (Format_7 Mode_0)

This product has the scalable mode that can read out defined area of the screen. Only continuous rectangle units can be selected, concave or convex shape cannot be selected. Only one window can be selected.

- Window size: $\{32*m (H)\} * \{24*n (V)\}$

m, n = integer

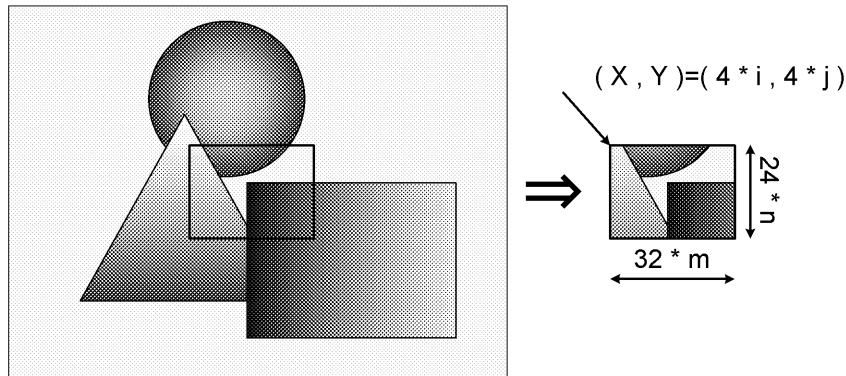
The image of maximum unit size or less can be selected.

- Start address: $\{4*i (H)\} * \{4*j (V)\}$

i, j = integer

The image of maximum unit size or less can be selected.

	CSFV90BC3-B /CC3-B	CSFX36BC3-B /CC3-B	CSFS20BC2-B /CC2-B	CSFU15BC18-B /CC18-B
Maximum unit size (H) * (V)	640×480	1024×768	1280×960	1600×1200



In the scalable mode, this camera reads out only the necessary portions at the standard speed while it scans through other unnecessary portions at high speed, so the trigger interval can be shorter if the vertical cutout width is small. However, the trigger interval cannot be short in the horizontal direction even if the cutout width is small due to the operation mechanism of the CCD sensor.

Notes on scalable mode:

- White lines may occur in the upper portions of the screen when strong light exists in a wide area during the scalable mode. This is not a malfunction. If white lines occur, adjust the amount of incident light using the lens.

5.19 High Speed Draft Readout mode (Format_7 Mode_1)

(This function is supported by the CSFX36CC3-B, CSFS20CC2-B, and CSFU15CC18-B.)

By thinning out vertical lines, it can be read all effective area at high-speed frame rate.

	CSFX36CC3-B	CSFS20CC2-B	CSFU15CC18-B
Draft mode	1/3 line readout	1/2 line readout	1/4 line readout
Readout vertical line	254	480	300

* For the CSFX36CC3-B, lines 253 and 254 are output with brightness of 0 LSB.

5.20 Binning Mode (Format_7 Mode_2)

(This function is supported by all B/W models and by the CSFS20CC2-B and CSFU15CC18-B.)

Allows high frame rates; supports binning to combine vertical and horizontal pixel data.

● **B/W models**

	CSFV90BC3-B	CSFX36BC3-B	CSFS20BC2-B	CSFU15BC18-B
Binning mode	1(H)*2(V) 2(H)*2(V)	1(H)*2(V) 2(H)*2(V)	1(H)*2(V) 2(H)*2(V)	1(H)*2(V) 2(H)*2(V) 1(H)*4(V) 2(H)*4(V)

● **Color models**

	CSFS20CC2-B	CSFU15CC18-B
Binning mode	1(H)*2(V) 2(H)*2(V)	1(H)*2(V) 2(H)*2(V)

* 1 does not add pixel data; 2 combines data for two pixels; 4 combines data for 4 pixels.

5.21 Color Matrix adjustment (Color models only)

Allows adjustment of R-G, R-B, G-R, G-B, B-R, and B-G parameters.

5.22 Broadcast

Supports broadcast transfer to control multiple devices connected to the same bus. For example, transferring a software trigger via broadcast packets enables simultaneous exposure starts for multiple FireDragon2 connected to the same bus.

5.23 Bus Synchronization

Automatically synchronizes exposure times for multiple FireDragon2 connected to the same bus without the input of an external synch signal.

5.24 VD Synchronization

Synchronizes multiple FireDragon2 using a VD signal cascade connection. This differs from Bus Synchronization in that it enables synchronization of FireDragon2 connected to different buses.

5.25 Sequential Shutter

Saves camera settings such as exposure time and gain in memory channels and switches parameters automatically for each exposure and video output. Up to 15 memory channels can be used to save parameters.

The following parameters can be read out.

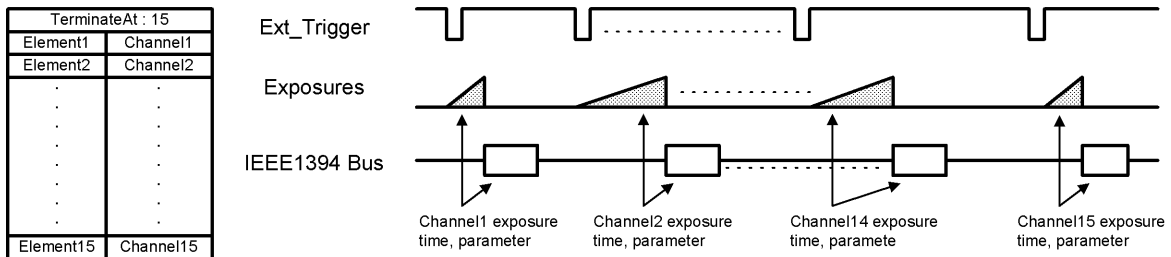
- Exposure time
- Brightness
- Gain
- White Balance (Color models only)
- Sharpness
- Spatial filter (B/W models only)
- Hue (Color models only)

- Saturation (Color models only)
- Color matrix (Color models only)
- Noise Reduction (B/W models only)

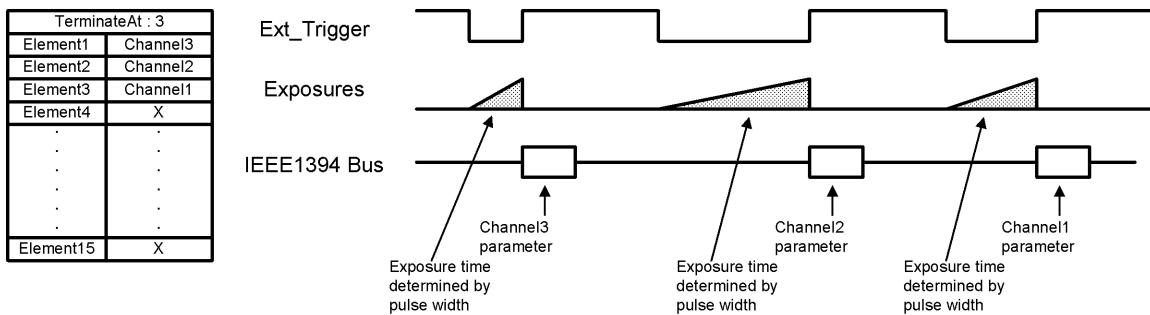
When using the sequential shutter, disable FAWB, AGC, and AE before saving to memory.

Additionally, note that LUT settings are not saved. If LUT is enabled, the LUT settings used will be those in effect at the time video is output.

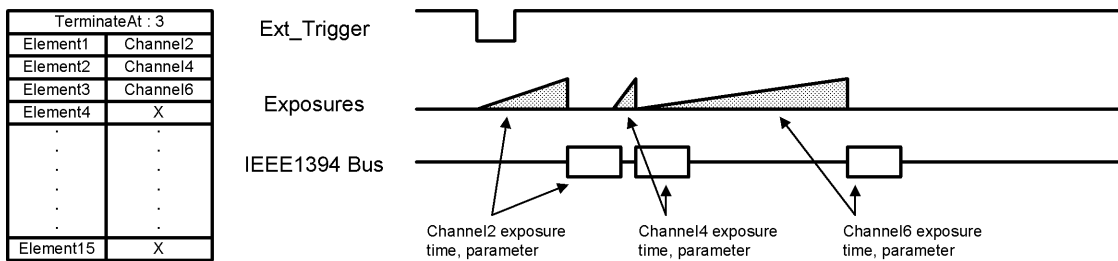
Sequential Shutter and Random Trigger Shutter TiggerMode0 combination
When using memory channels 1 to 15 in sequence



Sequential Shutter and Random Trigger Shutter TiggerMode1 combination
When using memory channels 1 to 3



Sequential Shutter and Random Trigger Shutter TiggerMode14 combination
When using memory channels 2,4 and 6



5.26 User Free Memory

A memory area is provided for reading and writing data as desired by the user. Individual numbers can be assigned when multiple FireDragon2 are connected.

5.27 Test Pattern Output

The following test patterns can be output:

- Black : Full screen 0 LSB (@ 8-bit)
- White : All pixels 255 LSB (@ 8-bit)
- Gray A : Full screen 85 LSB (0101010_B) (@ 8-bit)
- Gray B : Full screen 170 LSB (10101010_B) (@ 8-bit)
- Ramp waveform
- Grayscale (B/W models only)
- Color bar (Color models only)

5.28 Flips the image (B/W models only)

The video output can be flipped horizontally.

5.29 Noise Reduction (B/W models only)

Use the camera's low-pass filter to reduce image noise. Increasing the setting value increases filtering strength and reduces noise.

Note:

- Noise reduction uses a low-pass filter, which reduces resolution for increased filtering. Check the image under actual operating conditions before enabling this function.
The actual efficacy of filtering will vary, depending on the subject. Inspect the image before using this function.

5.30 Event notification

Notifies events such as exposure start and exposure end.

5.31 Stream Leader

Displays image height, width, and data length.

5.32 Iso Stop / Abort switching

When Iso_En is changed from 1 to 0, switching is available between Stop mode, which stops frame data from being output once all data has been transferred, or Abort mode, which immediately aborts frame data transfers, even in mid-transfer.

5.33 FireDragon series compatibility mode

The setting ranges and steps for controlling the following items are available to ensure compatibility with FireDragon series models (CSFV90BC3/CC3, CSFX36BC3/CC3, CSFS20BC2/CC2, CSFU15BC18/CC18).

- Brightness
- Gain

6 Specifications

[Electrical specification]

● B/W Models

	CSFV90BC3-B	CSFX36BC3-B	CSFS20BC2-B	CSFU15BC18-B
Imager	all-pixel-data-readout interline transfer CCD			
Number of total pixels (H) * (V)	692*504	1077*788	1434*1050	1688*1248
Number of effective pixels (H) * (V)	659*494	1034*779	1392*1040	1628*1236
Number of Video out pixels (H) * (V)	640*480	1024*768	1280*960	1600*1200
Scanning area (H) * (V)	4.88mm*3.66mm (1/3 type)	4.81mm*3.62mm (1/3 type)	6.47mm*4.84mm (1/2 type)	7.16mm*5.44mm (1/1.8 type)
Pixel size (H) * (V)	7.4μm *7.4μm	4.65μm *4.65μm	4.65μm *4.65μm	4.40μm *4.40μm
Scan method	Non-interlace			
Aspect ratio	4:3			
Standard sensitivity	600 lx F5.6	800 lx F5.6	500 lx F5.6	400 lx F8
Minimum sensitivity	F1.4, Gain +18dB, Video level 50%, Gamma 1			
	2.9 lx	3.9 lx	2.4 lx	1.0 lx
Image Buffer	Use the following equation to calculate the number of frames that can be buffered: $\text{MaxNumIma} = \frac{134217728}{H \times V \times W} \text{ (Decimas omitted)}$ The maximum buffer number is 256 frames. H: No. of horizontal output pixels V: No. of vertical output pixels W: Image bit depth / pixel			
Example of permissible buffer number	640*480	1024*768	1280*960	1600*1200
Mono 8 bit	54	21	13	8
Mono 16 bit	27	10	6	4
Brightness	-5 to 25% (factory setting : 6.3% [16LSB@8bit]) , 0.1% / step			
Spatial Filter coefficient	-16.0 to +16.0 (factory setting : OFF)			
Sharpness	7-levels selection (factory setting : Sharpness OFF)			
Gamma	OFF (γ=1), PRESET setting, Absolute value setting (factory setting : OFF)			
PRESET	Selection from two 2-levels below (factory setting : Value0)			
	Value	Gamma	Value	Gamma
	0	Equivalent to 0.65	1	Equivalent to 0.45
Absolute value	Equivalent to 1.0 to 0.45			
LUT	Input 10 bit, Output 10 bit			
Gain	MANU, AGC (factory setting : MANU)			
Setting range	CSFV90BC3-B : -6 to +18dB (factory setting : 0dB), 0.1dB / step CSFX36BC3-B : -6 to +18dB (factory setting : 0dB), 0.1dB / step CSFS20BC2-B : -4 to +18dB (factory setting : 0dB), 0.1dB / step CSFU15BC18-B : -4 to +18dB (factory setting : 0dB), 0.1dB / step			
AGC effective area	Selection of the percentage of the image area output (from central 1% to 100%) (factory setting : 80%)			

Number of Memory channel	15 channels
User Free Memory	256Byte
Test Pattern	Black, White, Gray A, Gray B, Ramp waveform, Gray Scale (factory setting : OFF)
Power supply	DC +8V to +30 V (ripple 100 mV(p-p) or less) via IEEE1394 connector
Power consumption	2.5W (maximum)

● Color Models

	CSFV90CC3-B	CSFX36CC3-B	CSFS20CC2-B	CSFU15CC18-B
Imager	all-pixel-data-readout interline transfer CCD			
Number of total pixels (H) * (V)	692*504	1077*788	1434*1050	1688*1248
Number of effective pixels (H) * (V)	659*494	1034*779	1392*1040	1628*1236
Number of Video out pixels (H) * (V)	640*480	1024*768	1280*960	1600*1200
Scanning area (H) * (V)	4.88mm *3.66mm (1/3 type)	4.81mm *3.62mm (1/3 type)	6.47mm*4.84mm (1/2 type)	7.16mm*5.44mm (1/1.8 type)
Pixel size (H) * (V)	7.4μm *7.4μm	4.65μm *4.65μm	4.65μm *4.65μm	4.40μm *4.40μm
Color filter	RGB primary color mosaic-on-tip color filter			
Scan method	Non-interlace			
Aspect ratio	4:3			
Standard sensitivity	1700 lx F5.6 5000K	2400 lx F5.6 5000K	1400 lx F5.6 5000K	1000 lx F8 5000K
Minimum sensitivity	F1.4, GAIN : +18dB, Video level 50%, Gamma 0.65			
	5.5 lx	7.8 lx	4.6 lx	1.8 lx
Image Buffer	<p>Use the following equation to calculate the number of frames that can be buffered:</p> $\text{MaxNumIma} = \frac{134217728}{H \times V \times W} \text{ (Decimas omitted)}$ <p>The maximum buffer number is 256 frames. H: No. of horizontal output pixels V: No. of vertical output pixels W : Image bit depth / pixel</p>			
Example of permissible buffer number	640*480	1024*768	1280*960	1600*1200
YUV4:1:1 12 bit	36	14	9	5
YUV4:2:2 16 bit	27	10	6	4
RGB 24 bit	18	7	4	2
Raw/Bayer 8 bit	54	21	13	8
Raw/Bayer 16 bit	27	10	6	4
Brightness	-5 to 25% (factory setting : 6.3% [16LSB@8bit]) , 0.1% / step			
Sharpness	7-levels selection (factory setting : Sharpness OFF)			
White balance	MWB, OPWB, FAWB (factory setting : MWB)			
Effective range	2500~6500K			
MWB setting format	R/B gain independent setting			
OPWB effective area	Selection of the percentage of the image area output (from central 1% to 100%) (factory setting : 80%)			
FAWB effective area	Full screen			

Hue	16-levels selection				
Saturation	26-levels selection				
Gamma	OFF ($\gamma=1$), PRESET setting, Absolute value setting (factory setting : PRESET)				
PRESET	Selection from two 2-levels below (factory setting : Value0)				
	Value	Gamma	Value	Gamma	
	0	Equivalent to 0.65	1	Equivalent to 0.45	
Absolute value	Equivalent to 1.0 to 0.45				
LUT	Input 10 bit, Output 10 bit				
Gain	MANU, AGC (factory setting : MANU)				
Setting range	CSFV90CC3-B : -6 to +18dB (factory setting : 0dB), 0.1dB / step CSFX36CC3-B : -6 to +18dB (factory setting : 0dB), 0.1dB / step CSFS20CC2-B : -2 to +18dB (factory setting : 0dB), 0.1dB / step CSFU15CC18-B : -6 to +18dB (factory setting : 0dB), 0.1dB / step				
AGC effective area	Selection of the percentage of the image area output (from central 1% to 100%) (factory setting : 80%)				
Number of Memory channel	15 channels				
User Free Memory	256 Byte				
Test Pattern	Black, White, Gray A, Gray B, Ramp waveform, Color Bar (factory setting : OFF)				
Power supply	DC +8V to +30 V (ripple 100 mV(p-p) or less) via IEEE1394 connector				
Power consumption	2.6W (maximum)				

* Effective areas that can be set for OPWB, AGC, and AE are same areas.

[Internal sync signal specification]

Base clock frequency	36.000 MHz +/- 100ppm
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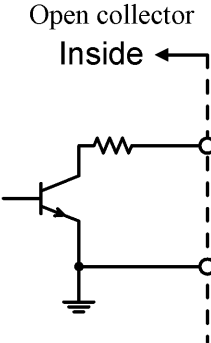
[Electronic shutter specification]

Exposure time	OFF, AE, PRESET setting, Absolute value setting (factory setting : OFF)					
AE effective range	1/20000s to OFF					
AE effective area	Selection of the percentage of the image area output (from central 1% to 100%) (factory setting : 80%)					
AE Exposure value	Value	Exposure value	Value	Exposure value	Value	Exposure value
	0	0	6	+2 [EV]	12	-4/3 [EV]
	1	+1/3 [EV]	7	+7/3 [EV]	13	-1 [EV]
	2	+2/3 [EV]	8	-8/3 [EV]	14	-2/3 [EV]
	3	+1 [EV]	9	-7/3 [EV]	15	-1/3 [EV]
	4	+4/3 [EV]	10	-2 [EV]		
	5	+5/3 [EV]	11	-5/3 [EV]		
PRESET	Value	Exposure time	Value	Exposure time	Value	Exposure time
	0	1/100s	3	1/1000s	6	1/10000s
	1	1/250s	4	1/2000s	7	1/20000s
	2	1/500s	5	1/4000s		
Absolute value	CSFV90BC3-B / CC3-B : 10 μ s to 16s CSFX36BC3-B / CC3-B : 30 μ s to 16s CSFS20BC2-B / CC2-B : 30 μ s to 16s CSFU15BC18-B / CC18-B : 10 μ s to 16s					

[Random Trigger Shutter specification]

Trigger Mode	Mode0, Mode1, Mode14
Trigger	External trigger, Software trigger (factory setting : External trigger)
External trigger	Input via the I/O connector
Input level	Low : 0 to 0.5V, High : 2.0 to 24.0V
Polarity	High active / Low active (factory setting : Low active)
Pulse width	2 μ s or more
Input impedance	High impedance
Software trigger	Set via the IEEE1394 interface
Exposure time	PRESET setting, Absolute value setting, Pulse width
Mode0、 Mode14	The exposure time depends on the normal shutter speed setting
Mode1 (External trigger only)	The exposure time depends on the pulse width
Mode14	15 frames (maximum)
Number of output frame	
Trigger Delay	PRESET setting, Absolute value setting (factory setting : PRESET)
PRESET setting	0 to 4095 μ s (factory setting : 0s), 1 μ s / step
Absolute value setting	0 to 16s
Trigger Over Lap	Enable / Disable (factory setting : Enable)

[PIO Output signal specification]

Output signal	VD, STROBE, EXPOSURE ACTIVE, FRAME ACTIVE, FRAME TRANSFER, FRAME TRIGGER WAIT, or PIO
Output circuit	<p>Open collector</p> 
Recommended pull-up condition	5V, 1k Ω
Maximum pull-up condition	5 to 12V, 15mA
Pulse width	Positive : 47 μ s, Negative : 3 μ s (minimum) (in recommended pull-up condition)
Polarity	High active / Low active (factory setting : Low active)
STROBE	PRESET setting
Delay	0 to 4095 μ s (factory setting : 0s), 1 μ s / step
Duration	0 to 4095 μ s (factory setting : 0s), 1 μ s / step

[VD Input signal specification]

Input signal	FireDragon2 VD output
Polarity	High active / Low active (factory setting : Low active)

[Interface specification]

Interface	IEEE Std. 1394b-2002 conformity, Bilingual correspondence
Transmission speed	S800 (800Mbps)
Protocol	IIDC 1394-based Digital Camera Specification Ver.1.32 conformity

Endian	Big Endian / Little Endian [※] (factory setting : Big Endian) Can be set only for mono 16 bit, Raw 16 bit, and Bayer 16 bit.
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[Video output]

<CSFV90BC3-B> (factory setting: Format_7 Mode_0, 640*480, Mono8)

Format	Mode	Resolution	Output method	Frame rate [fps]					
				1.875	3.75	7.5	15	30	60
0	5	640*480	Mono 8 bit	◎	◎	◎	◎	◎	◎
	6	640*480	Mono 16 bit [※]	◎	◎	◎	◎	◎	○
7	0	32*24 to 640*480	Mono 8 bit	Changed by scalable setting 583 fps (max) : 32*24					
			Mono 16 bit [※]						
	2	640*240	Mono 8 bit	168 fps (max)					
			Mono 16 bit [※]						
		320*240	Mono 8 bit						
			Mono 16 bit [※]						

◎: either of IEEE1394.a and IEEE1394.b is effective

○: effective only in IEEE1394.b

<CSFX36BC3-B> (factory setting: Format_7 Mode_0, 1024*768, Mono8)

Format	Mode	Resolution	Output method	Frame rate [fps]				
				1.875	3.75	7.5	15	30
1	5	1024*768	Mono 8 bit	◎	◎	◎	◎	◎
	7	1024*768	Mono 16 bit [※]	◎	◎	◎	◎	○
7	0	32*24 to 1024*768	Mono 8 bit	Changed by scalable setting 218 fps (max) : 32*24				
			Mono 16 bit [※]					
	2	1024*384	Mono 8 bit	64 fps (max)				
			Mono 16 bit [※]					
		512*384	Mono 8 bit					
			Mono 16 bit [※]					

◎: either of IEEE1394.a and IEEE1394.b is effective

○: effective only in IEEE1394.b

<CSFS20BC2-B> (factory setting: Format_7 Mode_0, 1280*960, Mono8)

Format	Mode	Resolution	Output method	Frame rate [fps]			
				1.875	3.75	7.5	15
2	2	1280*960	Mono 8 bit	⊙	⊙	⊙	⊙
	6	1280*960	Mono 16 bit [※]	⊙	⊙	⊙	○
7	0	32*24 to 1280*960	Mono 8 bit	Changed by scalable setting 133 fps (max) : 32*24			
			Mono 16 bit [※]				
	2	1280*480	Mono 8 bit	34 fps (max)			
			Mono 16 bit [※]				
			640*480				
Mono 16 bit [※]							

⊙: either of IEEE1394.a and IEEE1394.b is effective

○: effective only in IEEE1394.b

<CSFU15BC18-B> (factory setting: Format_7 Mode_0, 1600*1200, Mono8)

Format	Mode	Resolution	Output method	Frame rate [fps]			
				1.875	3.75	7.5	15
2	5	1600*1200	Mono 8 bit	⊙	⊙	⊙	⊙
	7	1600*1200	Mono 16 bit [※]	⊙	⊙	⊙	○
7	0	32*24 to 1600*1200	Mono 8 bit	Changed by scalable setting 114 fps (max) : 32*24			
			Mono 16 bit [※]				
	2	1600*600	Mono 8 bit	46 fps (max)			
			Mono 16 bit [※]				
		800*600	Mono 8 bit				
			Mono 16 bit [※]				
		1600*300	Mono 8 bit				
			Mono 16 bit [※]				
		800*300	Mono 8 bit				
Mono 16 bit [※]							

⊙: either of IEEE1394.a and IEEE1394.b is effective

○: effective only in IEEE1394.b

<CSFV90CC3-B> (factory setting: Format_7 Mode_0, 640*480, YUV4:2:2)

Format	Mode	Resolution	Output method	Frame rate [fps]					
				1.875	3.75	7.5	15	30	60
0	2	640*480	YUV4:1:1 12 bit	⊙	⊙	⊙	⊙	⊙	⊙
	3	640*480	YUV4:2:2 16 bit	⊙	⊙	⊙	⊙	⊙	○
	4	640*480	RGB 24 bit	⊙	⊙	⊙	⊙	⊙	○
7	0	32*24 to 640*480	YUV4:1:1 12 bit	Changed by scalable setting 583 fps (max) : 32*24					
			YUV4:2:2 16 bit						
			RGB 24 bit						
			Raw/Bayer 8 bit						
			Raw/Bayer 16 bit [※]						

⊙: either of IEEE1394.a and IEEE1394.b is effective

○: effective only in IEEE1394.b

<CSFX36CC3-B> (factory setting: Format_7 Mode_0, 1024*768, YUV4:2:2)

Format	Mode	Resolution	Output method	Frame rate [fps]				
				1.875	3.75	7.5	15	30
1	3	1024*768	YUV4:2:2 16 bit	◎	◎	◎	◎	○
	4	1024*768	RGB 24 bit	◎	◎	◎	○	×
7	0	32*24 to 1024*768	YUV4:1:1 12 bit	Changed by scalable setting 218 fps (max) : 32*24				
			YUV4:2:2 16 bit					
			RGB 24 bit					
			Raw/Bayer 8 bit					
			Raw/Bayer 16 bit [※]					
7	1	1024*254	YUV4:1:1 12 bit	86 fps (max)				
			YUV4:2:2 16 bit					
			RGB 24 bit					
			Raw/Bayer 8 bit					
			Raw/Bayer 16 bit [※]					

◎: either of IEEE1394.a and IEEE1394.b is effective

○: effective only in IEEE1394.b

×: Setting is invalid

<CSFS20CC2-B> (factory setting: Format_7 Mode_0, 1280*960, YUV4:2:2)

Format	Mode	Resolution	Output method	Frame rate [fps]			
				1.875	3.75	7.5	15
2	0	1280*960	YUV4:2:2 16 bit	◎	◎	◎	○
	1	1280*960	RGB 24 bit	◎	◎	◎	○
7	0	32*24 to 1280*960	YUV4:1:1 12 bit	Changed by scalable setting 133 fps (max) : 32*24			
			YUV4:2:2 16 bit				
			RGB 24 bit				
			Raw/Bayer 8 bit				
			Raw/Bayer 16 bit [※]				
7	1	1280*480	YUV4:1:1 12 bit	34 fps (max)			
			YUV4:2:2 16 bit				
			RGB 24 bit				
			Raw/Bayer 8 bit				
			Raw/Bayer 16 bit [※]				
7	2	1280*480	YUV4:1:1 12 bit	34 fps (max)			
			YUV4:2:2 16 bit				
			RGB 24 bit				
			Raw/Bayer 8 bit				
			Raw/Bayer 16 bit [※]				
		640*480	YUV4:1:1 12 bit				
			YUV4:2:2 16 bit				
			RGB 24 bit				
			Raw/Bayer 8 bit				
			Raw/Bayer 16 bit [※]				

◎: either of IEEE1394.a and IEEE1394.b is effective

○: effective only in IEEE1394.b

<CSFU15CC18-B> (factory setting: Format_7 Mode_0, 1600*1200, YUV4:2:2)

Format	Mode	Resolution	Output method	Frame rate [fps]			
				1.875	3.75	7.5	15
2	3	1600*1200	YUV4:2:2 16 bit	◎	◎	◎	○
	4	1600*1200	RGB 24 bit	◎	◎	○	×
7	0	32*24 to 1600*1200	YUV4:1:1 12 bit	Changed by scalable setting 114 fps (max) : 32*24			
			YUV4:2:2 16 bit				
			RGB 24 bit				
			Raw/Bayer 8 bit				
			Raw/Bayer 16 bit [※]				
7	1	1600*300	YUV4:1:1 12 bit	44 fps (max)			
			YUV4:2:2 16 bit				
			RGB 24 bit				
			Raw/Bayer 8 bit				
			Raw/Bayer 16 bit [※]				
7	2	1600*600	YUV4:1:1 12 bit	28 fps (max)			
			YUV4:2:2 16 bit				
			RGB 24 bit				
			Raw/Bayer 8 bit				
			Raw/Bayer 16 bit [※]				
	800*600	YUV4:1:1 12 bit					
		YUV4:2:2 16 bit					
		RGB 24 bit					
		Raw/Bayer 8 bit					
		Raw/Bayer 16 bit [※]					

◎: either of IEEE1394.a and IEEE1394.b is effective

○: effective only in IEEE1394.b

×: Setting is invalid

[※]For Mono 16-bit, Raw 16-bit, and Bayer 16-bit, only the 10 lower bits of the 16 bits are used as valid data.

Notes on Frame Drops of Image:

- Depends on your PC or IEEE1394 interface board configurations, images may not be captured normally (e.g. frame drops may occur). In this case, change to frame rate setting lower.

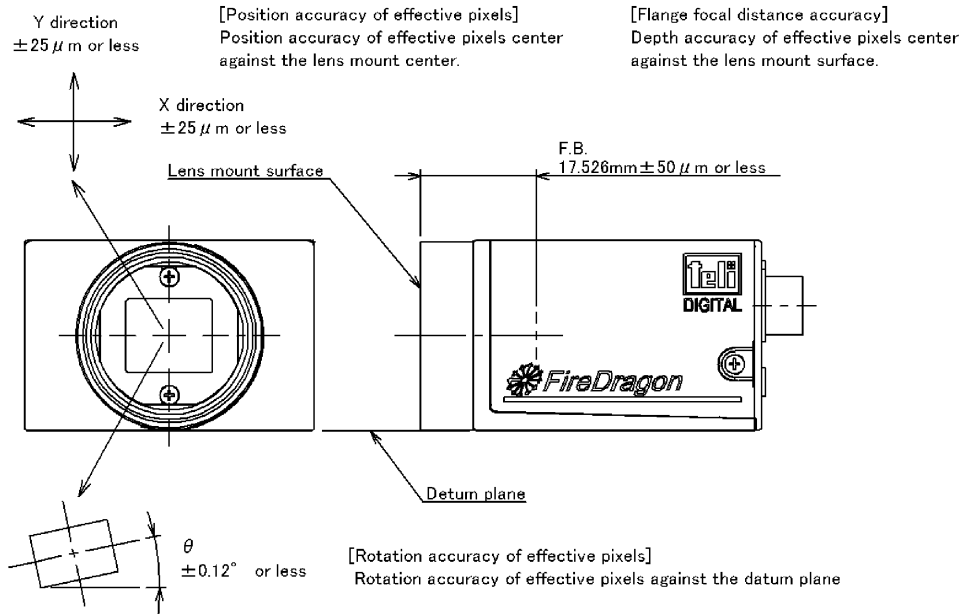
[Machine external specification]

Dimensions	44 mm(W) * 29 mm (H) * 52 mm (D)
Mass	Approximately 80g
Lens mount	C-mount
Flange back	fix
Camera body grounding insulation status	Conductive between circuit GND and camera body

[Optical axis accuracy]

	Position accuracy of Effective pixels		Rotation accuracy of Effective pixels (θ)	Flange focal distances (Flange back) (for 17.526mm)
	(X)	(Y)		
Optical axis accuracy	+/- 25 μ m	+/- 25 μ m	+/- 0.12°	+/- 50 μ m

According to our measurement standard



[Operation Ambient conditions]

Performance assurance	Temperature : 0 to +40°C, Humidity : +10% to +90% (no condensation)
Operation assurance	Temperature : -5 to +45°C, Humidity : +90% or less (no condensation)
Storage assurance	Temperature : -20 to +60°C, Humidity : +90% or less (no condensation)
EMC condition	EMI (Electro-Magnetic interference) : EN61000-6-4, FCC Part 15 Subpart B Class A EMS (Electro-Magnetic susceptibility) : EN61000-6-2

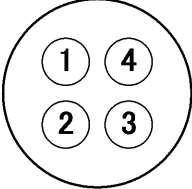
Notes on Conformity of the EMC:

- About the standard of this machine, it has guaranteed in the conditions combined with IEEE1394 Cable "1394b K 045" (Manufactured by Oki Electric Cable CO., LTD.).

When used combining parts other than specification of our company, I ask you to have final EMC conformity checked of a visitor with a machine and the whole equipment.

[Connector pin assignment]

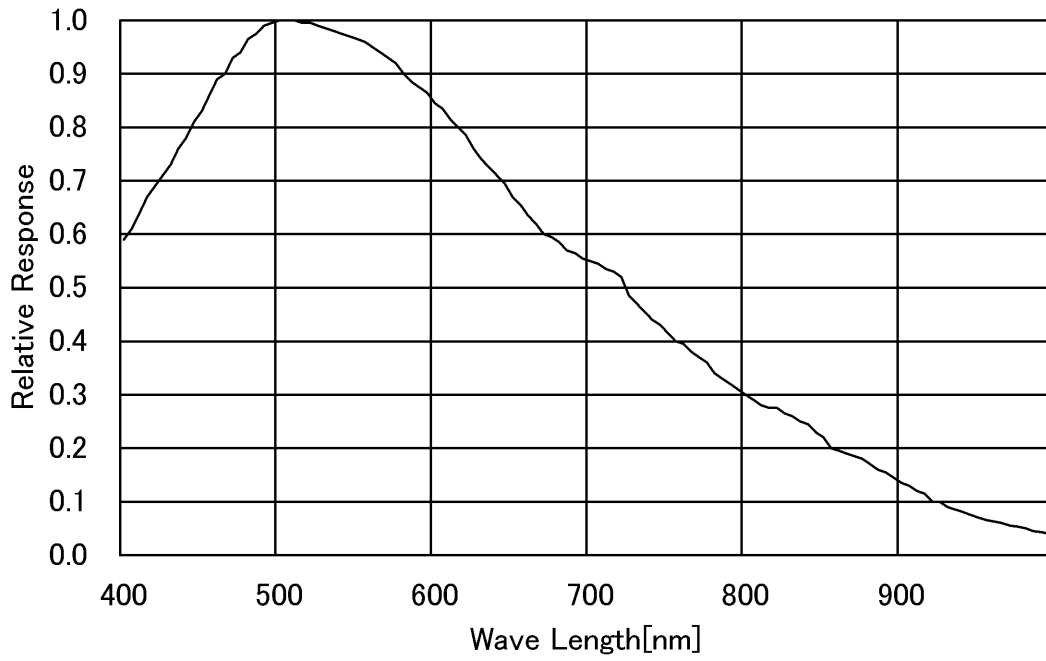
IEEE1394 interface connector (Bilingual connector)			
Connector model		HSR-BV011 (manufactured by COMOSS)	
Pin No.	I/O	Signal Name	Function
1	I/O	TPB*	Twisted Pair B (-)
2	I/O	TPB	Twisted Pair B (+)
3	I/O	TPA*	Twisted Pair A (-)
4	I/O	TPA	Twisted Pair A (+)
5	-	TPA(R)	Twisted Pair A (Reference Ground)
6	-	V _G	Power (Ground)
7	-	SC	Status Contact (Reserved)
8	I	V _P	Power (Voltage)
9	-	TPB(R)	Twisted Pair B (Reference Ground)

PIO connector			
Connector model (Camera side)	HR10A-7R-4PB(73) (manufactured by HIROSE DENKI)		
Plug (Cable side)	HR10A-7P-4S(73) (manufactured by HIROSE DENKI)		
Pin assignment			
			
* Above figure is connector view from insert side.			
Pin No.	I/O	Signal Name	Function
1	I	PIO input	PIO Input
2	-	GND	Ground
3	O	PIO output	PIO Output
4	-	GND	Ground

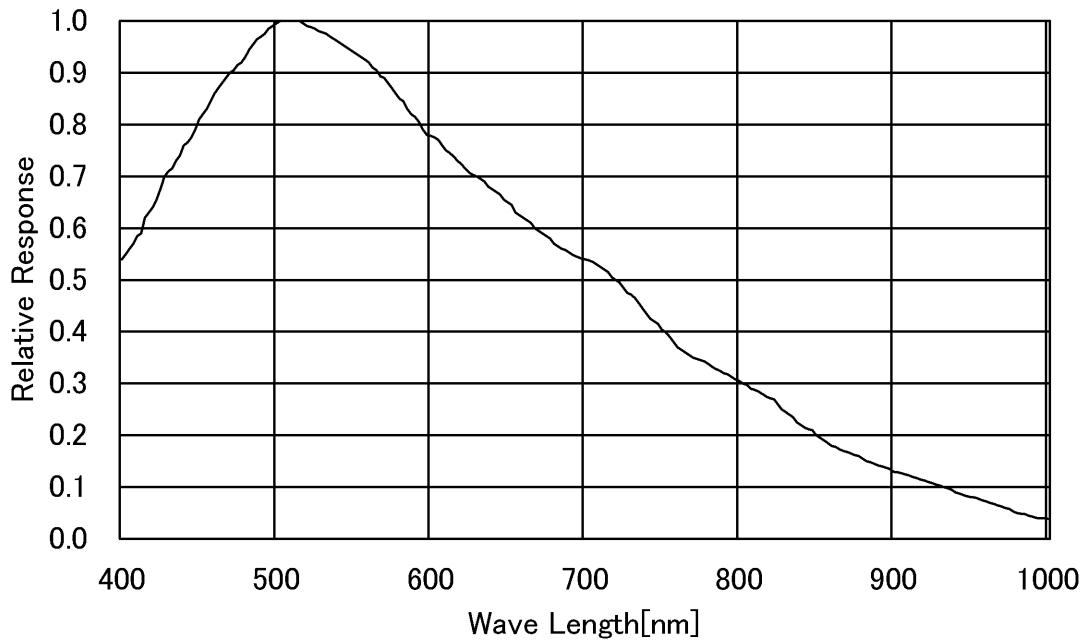
[Typical spectral response]

The lens characteristics and light source characteristics is not reflected in table.

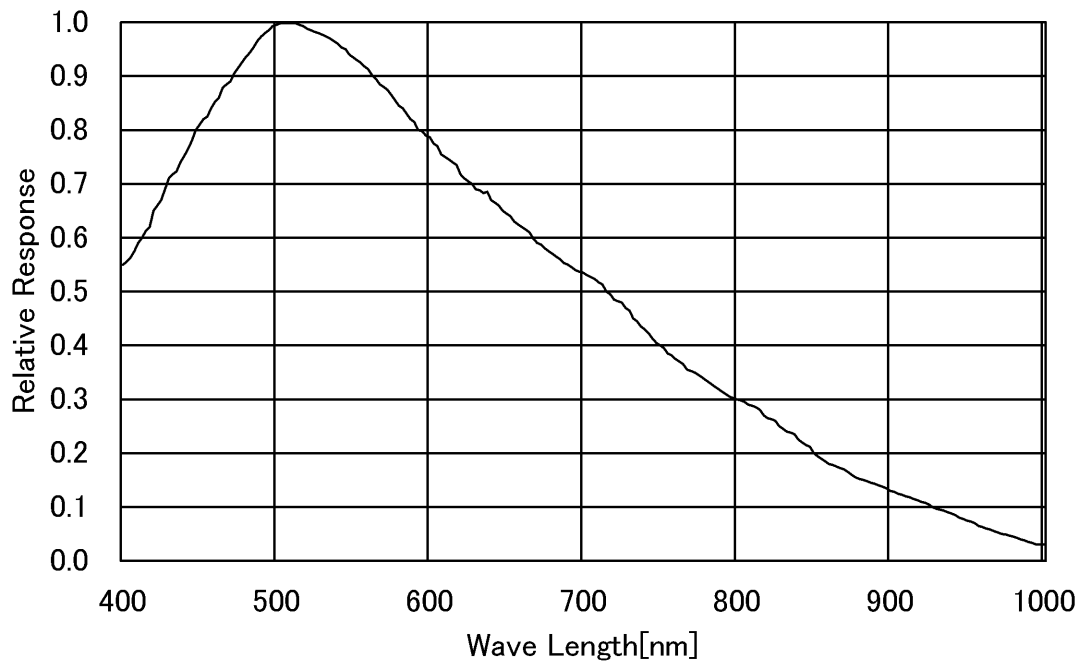
<CSFV90BC3-B>



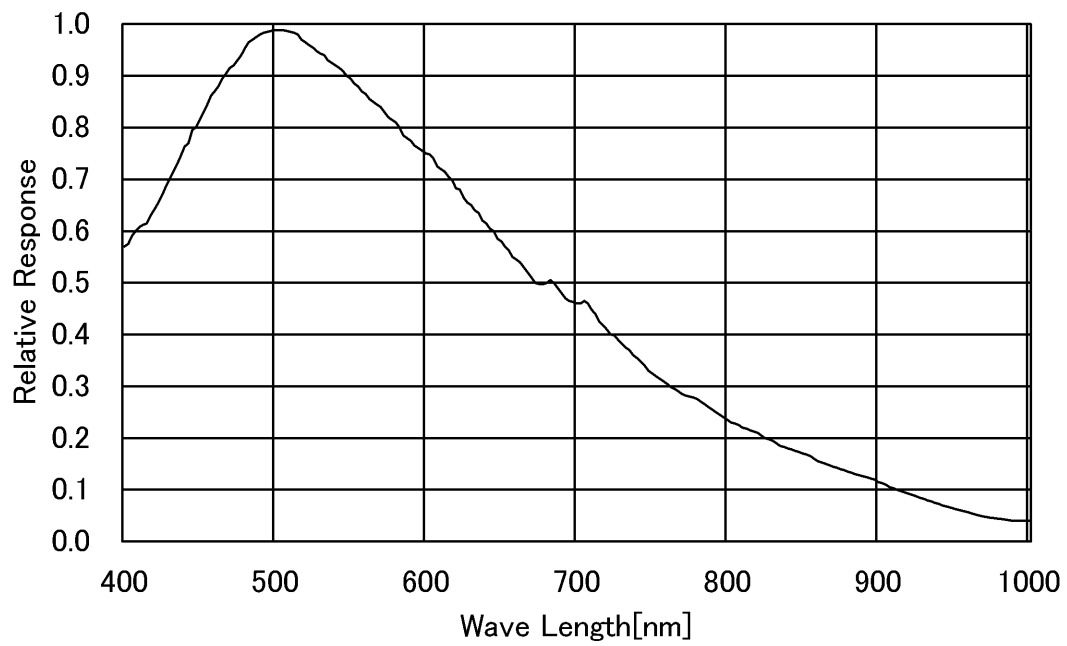
<CSFX36BC3-B>



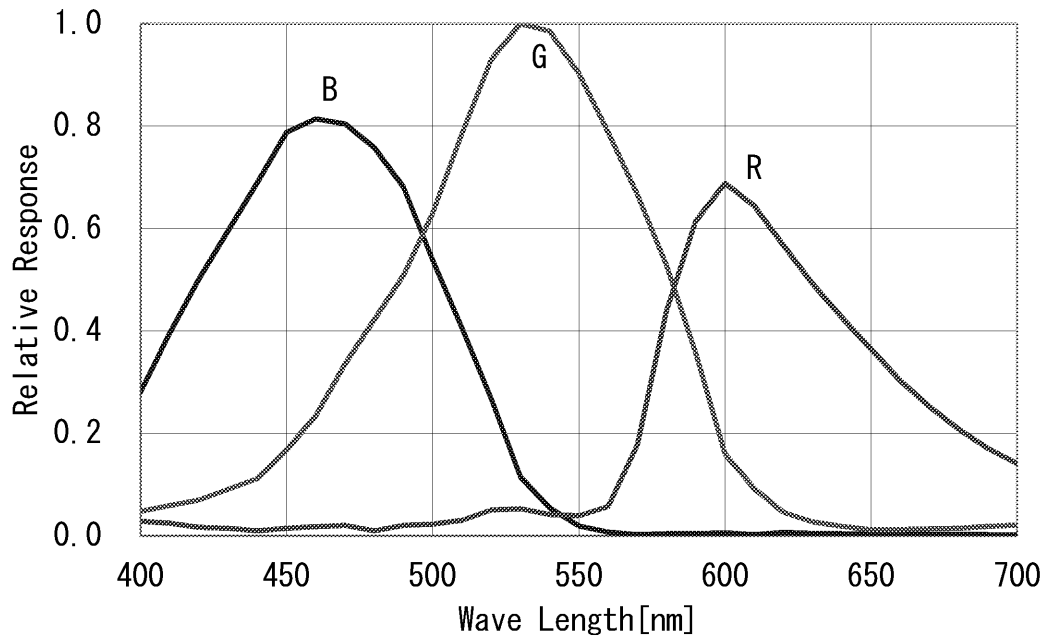
<CSFS20BC2-B>



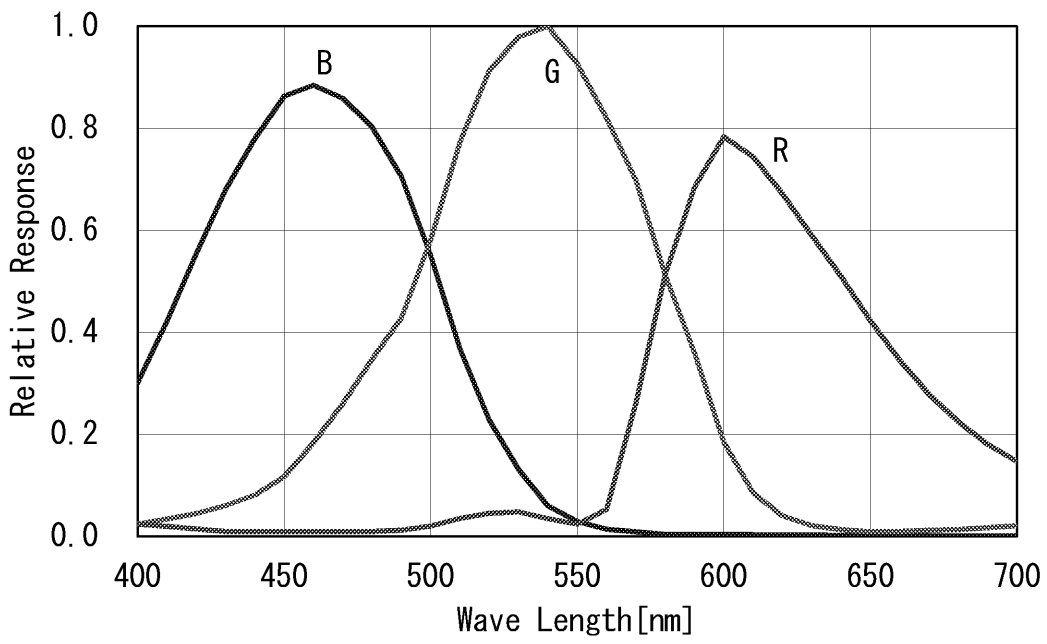
<CSFU15BC18-B>



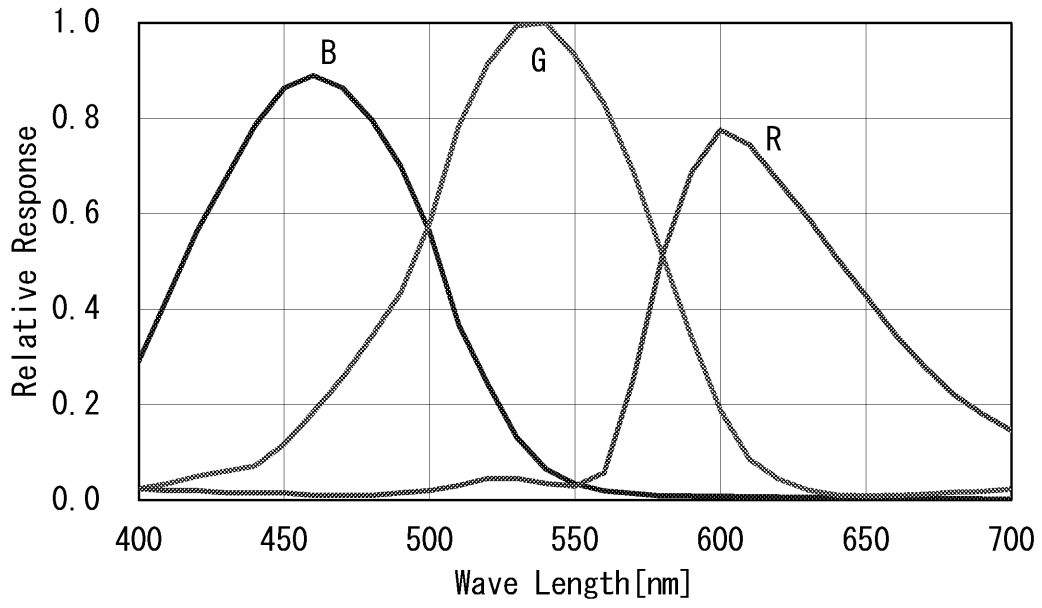
<CSFV90CC3-B>



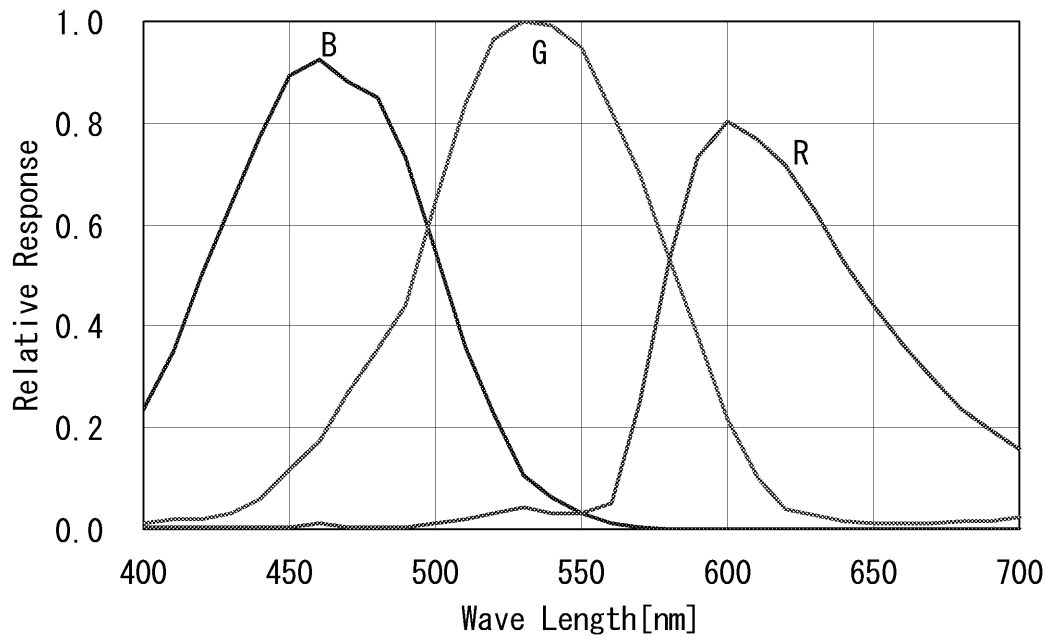
<CSFX36CC3-B>



<CSFS20CC2-B>



<CSFU15CC18-B>



7 Guarantee

The term of guarantee is one year after the product delivery.

If by any chance trouble by responsibility of our company occurs before an above period, TELI repairs it free of charge.

-During terms of a guarantee, when the trouble cause is the case of below, TELI charges the repair costs.

- (1) Troubles and the damages that causes by misuse, unsuitable repair or remodeling.
- (2) Distribution hazards like drops and vibrations after purchase. Troubles and damages by transportation.
- (3) Troubles and damages by fire, natural calamity (earthquake, storm and flood damage, thunderbolt), damages from salty breeze, gas harm, abnormal voltage.

8 Repair

(1) Condition for repair

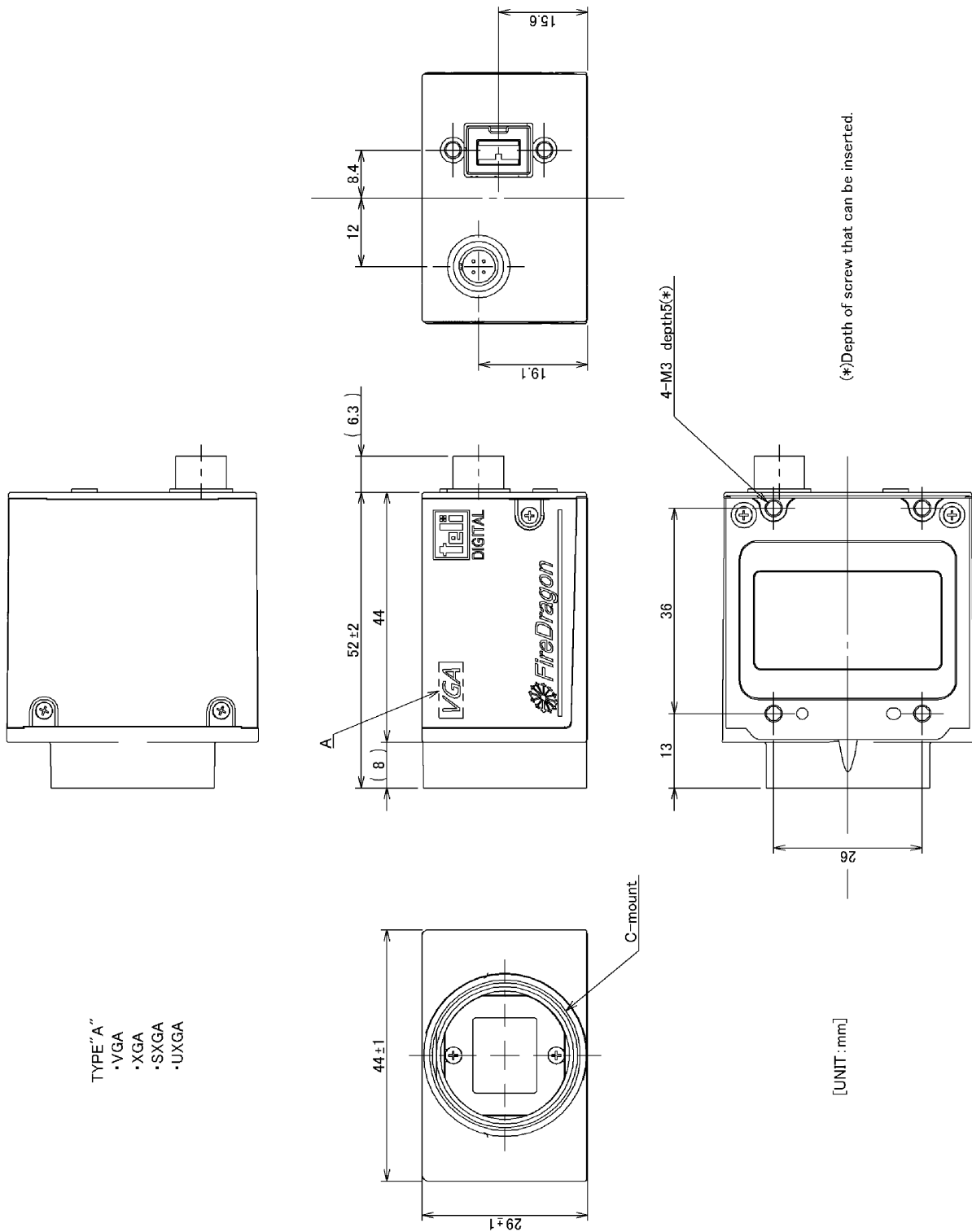
Basically, has to return it to our company when the user requests us to repair product.

Beside that, customer should pay these expenses (travel expenses, camera disassembly technology costs) of both customer and end user. Also customer should pay in themselves costs for return camera to us.

(2) The period of repairing product

- Repair free of charge Refer to Clause 7.
- Charged repair Basically, repair period is 7 years after the last production end of products.

9 Outline Drawing





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