



CMOS CAMERA

CSB4000F-20

PRODUCT SPECIFICATION

Version 1.0

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TOSHIBA TELI CORPORATION

BEFORE USE – GENERAL SAFETY INSTRUCTIONS



This instruction manual contains important information for the operator (user) and/or people in the vicinity to avoid personal injury, or property damage.

- Prior to use, read this operation manual carefully to fully understand its instructions for correct use.
- After reading, keep this manual near the equipment for future reference.

WARNINGS & CAUTIONS



[Definition of markings]

The meaning of each mark used in this instruction manual is given below.

 WARNING	This mark warns the user that improper use may cause death or severe personal injury of the user or people in the vicinity.
 CAUTION	This mark warns the user that improper use may cause personal injuries (*1) or material damages (*2) against the user or people in the vicinity.

Notes *1: Personal injury means wounds, burns, electric shocks, and others for which hospitalization or long term care are not required.

*2: Material damage means any direct or consequential damage related to property or material loss.

	This mark indicates what the user SHOULD NOT DO . The details are given adjacent the mark.
	This mark indicates what the user MUST DO . The details are given adjacent the mark.

 **WARNING**



unplug

- **Immediately cease use of the equipment in the event of abnormality or malfunction.**
If abnormal conditions are present, such as smoke, a burning smell, ingress of water or foreign matter, or if the equipment is dropped or malfunctions, fire or electric shock may result. If such abnormalities occur, disconnect the power plug from the outlet and contact your sales representative.
-



Do not get wet

- **Do not use the equipment in locations subject to water splashes.**
Otherwise, fire or electric shock may result.
-



Never pull apart

- **Do not disassemble, repair, or modify the equipment.**
Otherwise, fire or electric shock may result. For internal repair, inspection, or cleaning, contact your sales representative.
-



Avoid

- **Do not place anything on the equipment.**
If metallic objects, liquid, or other foreign matter enters the equipment, fire or electric shock may result.
-



Avoid

- **Do not install the equipment in an unstable or inclined location or locations subject to vibration or impact.**
Otherwise, the equipment may topple over and cause personal injury.
-



Do not touch

- **During an electrical storm, do not touch the power cord or connection cable.**
Otherwise, an electric shock may result.
-



Instruction

- **Use the specified power supply.**
Use of an unspecified power supply may result in fire or electric shock.
-



CAUTION



Instruction

- **Observe the following when installing the equipment:**

- Do not cover the equipment with a cloth, etc.
- Do not place the equipment in a narrow location where heat is likely to accumulate. Otherwise, heat will accumulate inside the equipment, possibly resulting in a fire.



Avoid

- **Do not place the equipment in locations subject to high moisture, oil fumes, steam, or dust.**

Otherwise, fire or electric shock may result.



Avoid

- **Do not install the equipment in locations exposed to direct sunlight or humidity.**

Otherwise, the internal temperature of the equipment will rise, which may cause a fire.



Avoid

- **Use only specified DC power cables and connection cables.**

Otherwise, fire or electric shock may result.



Avoid

- **When performing connection, turn off power.**

When connecting the power cable or connection cable, turn off the equipment power. Otherwise, fire or electric shock may result.



Instruction

- **Contact your sales representative to request periodic inspection and cleaning (every approx. five years).**

Accumulation of dust inside the equipment may result in fire or electric shock. For inspection and cleaning costs, contact your sales representative.

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.

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

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.
- **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.
- **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.
- **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.

CMOS sensor characteristics

- **Defective pixels**

A CMOS image sensor is composed of photo sensor pixels in a square grid array. Due to the characteristics of CMOS image sensors, over- or under-driving of the pixels results in temporary white or black areas (as if these are noises) appearing on the screen. This phenomenon, which is not a defect is exacerbated under higher temperatures and long exposure times.

- **Image shading**

Under global shutter operation, the brightness of the upper part of the screen may differ from the lower part. However, this does not mean the CMOS image sensor is defective.

This phenomenon occurs under short exposure times and high illumination.

To counteract this phenomenon, reduce the illumination by setting a longer exposure time, or adjust the lens aperture.

It may be blurred by this phenomenon when fast-moving subject captured.

1. Product Description

Model CSB4000F-20 is a CMOS camera developed specifically for FA and image measurement.

High-speed image processing is available by a random access. The video output interface of CSB4000F-20 conforms to the serial digital bus standard IEEE1394.

2. Features

(1)Ultra-high resolution

The CSB4000F-20 features a high-pixel CMOS sensor (Total pixel count: 4.19 Mega pixels), enabling high-density images (i.e., significantly reduced moiré and beat) to be obtained.

(2)Electronic shutter mode

This model features a Global shutter mode, which means that clear images of a fast-moving subject with little blurring are obtained.

(3)Random trigger shutter mode

Random trigger shutter, which starts light-exposure in synchronization with external trigger signal, is built in. This function enables the camera to capture images at any given timing.

(4)WOI (Window Of Interest)

WOI, which is suitable for high-speed image processing, is available.

Only arbitrary area can be read out by the designation of horizontal and vertical address.

(5)High-dynamic range

As this model can be achieved high-dynamic range featuring multi slope integrate mode, both of the high- and the low-intensity subject sharply contrasted can be shot at the same time.

3. Configuration

(1)Camera body	1
(2)Operation unit	1

4. Rating

4.1. Input/Output power supply voltage and current

4.1.1. Power supply	From DC+8V through DC+30V (IEEE1394 cable power supply)
4.1.2. Power consumption	2.0W max (at +30V) 1.8W max (at +12V) 1.7W max (at +8V)

4.2. Insulation Resistance/Withstand Voltage

Since this is a DC device, this standard does not apply.

4.3. Operation and storage environment conditions

4.3.1. Performance guaranteed	Temperature: From 0 through 40 degrees Humidity: From 30 through 70% (No condensing)
4.3.2. Operation guaranteed	Temperature: From -5 through 45 degrees Humidity: From 30 through 90% (No condensing) Barometric pressure: From 70 through 106kPa
4.3.3. Storage	Temperature: From -20 through 60 degrees Humidity: From 10 through 90% (No condensing) Barometric pressure: From 50 through 106kPa

4.4. Weight

Approx. 180g

4.5. Other rating required

33.333MHz, 49.152MHz

5. Performance

- 5.1. Image sensor CMOS image sensor
 - 5.1.1. Total pixels 2048(H) x 2048(V)
 - 5.1.2. Scanning area 12.048 x 12.282mm (Diagonal length: 17.2 mm)
 - 5.1.3. Unit pixel size 6.0 x 6.0 micro m (Square grid pattern)
 - 5.1.4. Driving frequency 33.3333MHz
- 5.2. Video output pixels 2008(H) x 2044(V)
- 5.3. Scanning system Progressive
- 5.4. Aspect ratio 1:1
- 5.5. Sensitivity 2000 lx F4 219/255 (in exposure at approx. 16 msec)
- 5.6. Video output time Approx. 140 msec (in all-pixel-data-readout mode)(Refer to “Timing charts”)
- 5.7. Sync system Internal synchronization
- 5.8. Interface Conforms to IEEE std. 1394a-2000
 - 5.8.1. Transfer speed 400Mbps
- 5.9. Video mode Format7/Special format (in WOI) Mono 8bit
- 5.10. Protocol Conforms to 1394-based Digital Camera Specification ver.1.3
- 5.11. Input signal TRIG (Shutter Trigger) Conforms to 3.3V CMOS level
 - 5.11.1. Grabbing timing Falling edge detection
 - 5.11.2. Pulse width Minimum: 10.15 micro s
Max: no limit
- 5.12. Electronic shutter Initial: Normal electric shutter
 - 5.12.1. Normal electronic shutter Shutter speed (preset inside the camera) selection via communication command 1 through 3941 (approx. 60 micro sec through 1sec)
 - 5.12.2. Random trigger shutter
 - 5.12.2.1. Mode0 RTS operation is available via external trigger input.
Shutter speed preset mode (preset inside camera)
 - 5.12.2.2. Mode1 RTS operation is available via external trigger input RTS mode shutter-speed can be controlled via shutter speed preset or shutter speed pulse width.
The camera starts light-exposure at the falling edge timing and ends it at the rising edge timing.
- 5.13. Lens mount TFL mount (M35 P=0.75)
- 5.14. Flange back 17.526 mm
- 5.15. EMC conditions(Electro-Magnetic Compatibility)
 - 5.15.1. EMI(Electro-Magnetic Interference) EN50081-2(Examination level EN55011-A)Conformity
 - 5.15.2. EMS(Electro-Magnetic Susceptibility) EN61000-6-2 Conformity

*Conformity of EMC conditions

About the conformity of the EMC standard of this machine, it has guaranteed in the conditions combined with the option part of the 5th clause.

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

5.16. Connector

5.16.1. IEEE1394

- Connector HSB-ARA62-SN15A-FA (Supplied by DDK)
 - Bracket HSB-R001BJ-CA (Supplied by DDK)
 - Recommended harness HSB-HCC-*** (Supplied by DDK)
- (*This is not included in product.)

Pin assignment

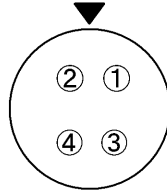
Pin No.	Signal name	I/O	Notes
1	POWER	I	
2	POWER(GND)	I	
3	TPB-	I/O	
4	TPB+	I/O	
5	TPA-	I/O	
6	TPA+	I/O	

5.16.2. TRIG

Connector HR25-7TR-4PA (73)(Supplied by HIROSE ELEC.)
Compatible connector HR25-7TR-4S (72)(Supplied by HIROSE ELC.)
(*This is not included in product.)

Pin assignment

Pin no.	Signal name	I/O	Notes
1	TRIG	I	
2	S.G	I	
3	NC	---	Be sure use in Open
4	S.G	I	



Camera connector (View from insert side)

6. Function

The camera control via IEEE1394 is possible.

Various camera control is possible by the IIDC protocols Ver 1.3, such as a quality-of-image adjustment function, a WOI setting function, and a camera mode setting function, and additional specification.

6.1. Shutter mode selection

By manipulating the command status register setting value via IEEE1394 serial bus, you can change the shutter mode.

6.2.1. Normal electric shutter Exposure control with internal sync signal.

Register value: from 1 through 3941 (Approx. 60 micro s to 1 sec)

6.2.2. Random trigger shutter

Under the RTS mode, the camera's inner CMOS image sensor starts light-exposure in synchronization with external trigger signal inputs, so you can let the camera capture image at any user-defined timing. The RTS is effective in shooting any fast-moving object, or when you are operating more than one camera at the same capture timing.

6.2. Exposure selection of Random Trigger Shutter

Model CSB4000F-20 supports both Trigger mode 0 and Trigger mode 1 of IIDC1394 digital camera protocol. By operation of command status register setting, the exposure mode of RTS mode can be changed.

6.2.1. Fix mode Exposure-time control via IEEE1394 serial bus.

Register value: from 1 through 3941 (Approx. 60 micro s to 1 sec)

6.2.2. Pulse width mode

Exposure-time control via TRIG signal pulse width.

Minimum pulse width: 10.15 micro s

- WOI window setting (protocol additional specification)
- Memory setting (setting value read/setting value save)
- IEEE1212 standard Configuration ROM read

* For the video output time calculation formula, refer to the CSB4000F-20 application manual supplied separately.

6.3. WOI (Window Of Interest) reading method

Window setting conditions

By addressing in horizontal and vertical directions, an arbitrary area can be read selectively. However, the following rules are applied:

- The size of the specified area can only be changed by multiples of the unit.
- The number of selectable windows must be up to 16 windows.
- Windows can be set in any position. However, each window must not overlap other windows and each window must not extend beyond the valid pixel area.
- The direction of H address can set up only even number.

6.4. Video output mode

6.4.1. Format 7 Mode 0 Video transmission at 2008 x 2044 (Mono 8bit)

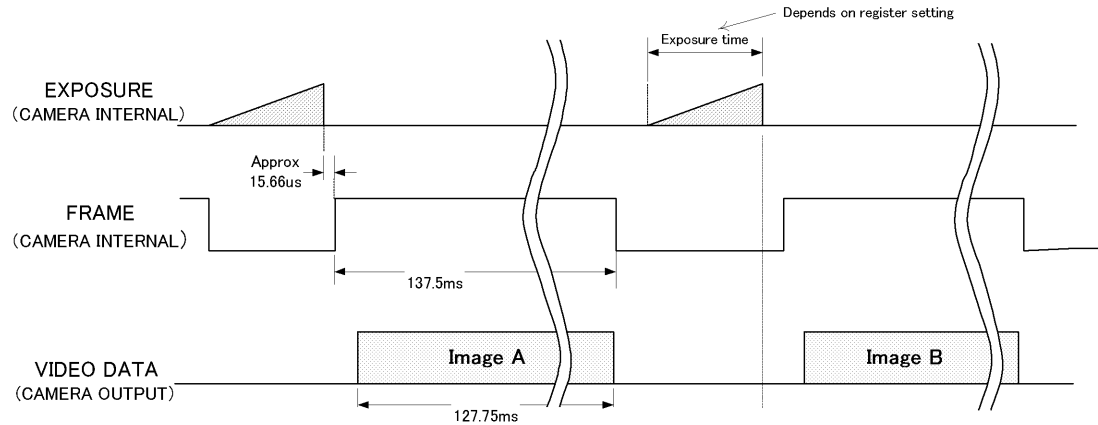
6.4.2. Format 7 Mode 1 Window of 100 x 100 pixels (mono8bit) per unit
H: 100*m, V: 100*n (m/n=An integer: 1,2,3,4...20)
Selectable the video of 2000 x 2000 pixels (maximum)
Playable the position freely except in lying off-screen
* However, the direction of H address can set up only even number.
Up to 1 window

6.4.3. Format X Window of 100 x 100 (mono8bit) unit
H: 100*m, V: 100*n (m/n=An integer: 1,2,3,4...20)
Selectable the video of 2000 x 2000 (maximum)
Playable the position freely except in lying off-screen
* However, the direction of H address can set up only even number.
Selectable the window from 2 through 16 windows
Overlaid windows setting is prohibited

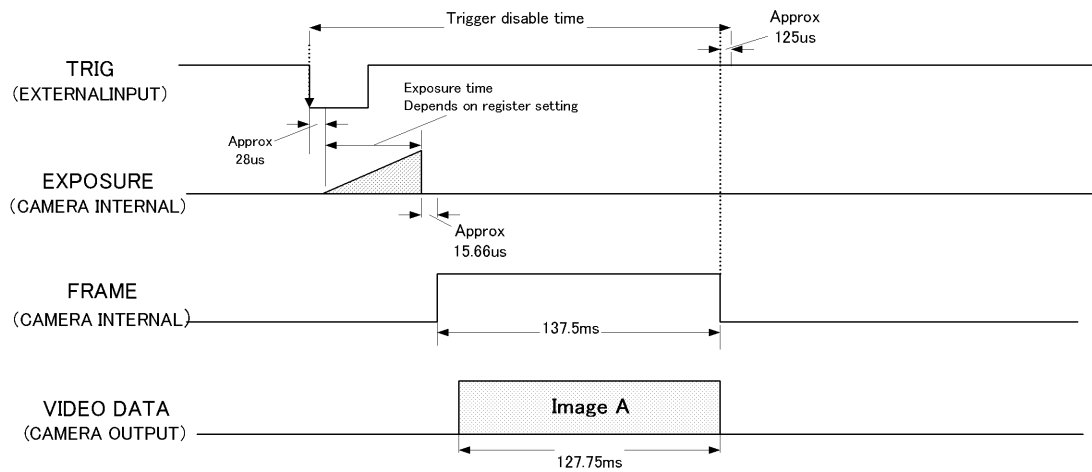
7. Timing charts

For video data output of this camera, Isochronous transmission of IEEE1394 is used. For the timing values defined below, a necessary condition is that this camera can use the Isochronous band without any restriction from other node. If any node is performing Isochronous transmission on the IEEE1394 local bus concurrently with camera, the values are not a define below.

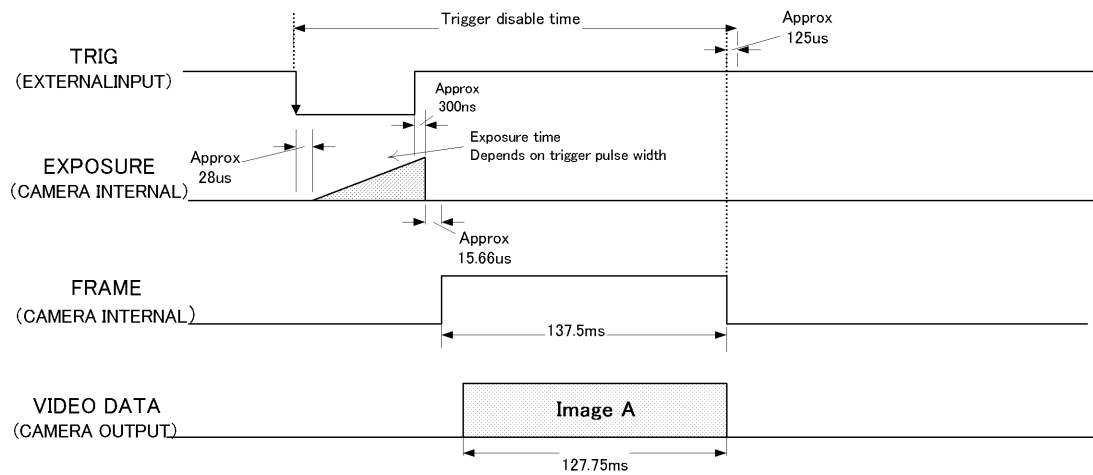
7.1. Normal shutter mode (Format 7 Mode 0)



7.2. Random trigger shutter mode (Fix mode, Format 7 mode 0)

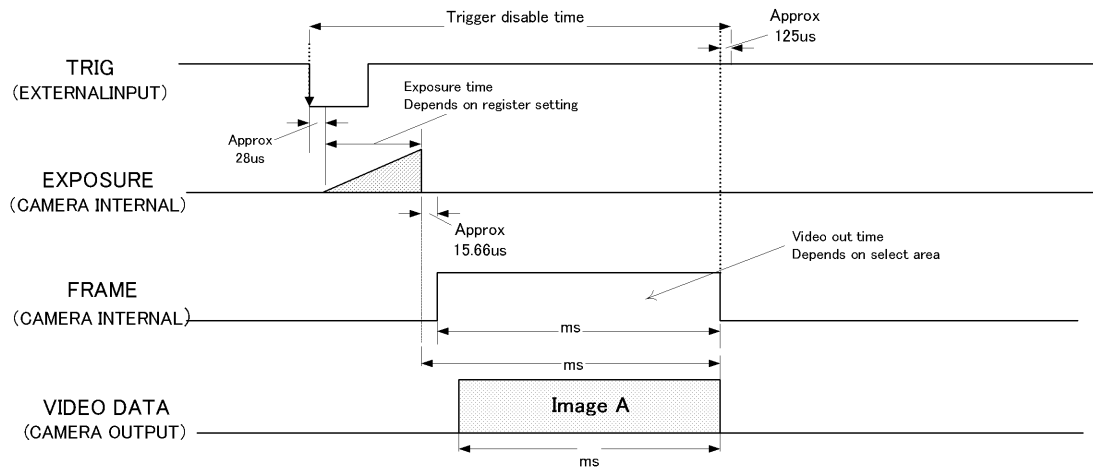


7.3. Random shutter mode (Pulse width mode, Format 7 Mode 0)



7.4. Scalable (Fix mode, Format 7 Mode 1)

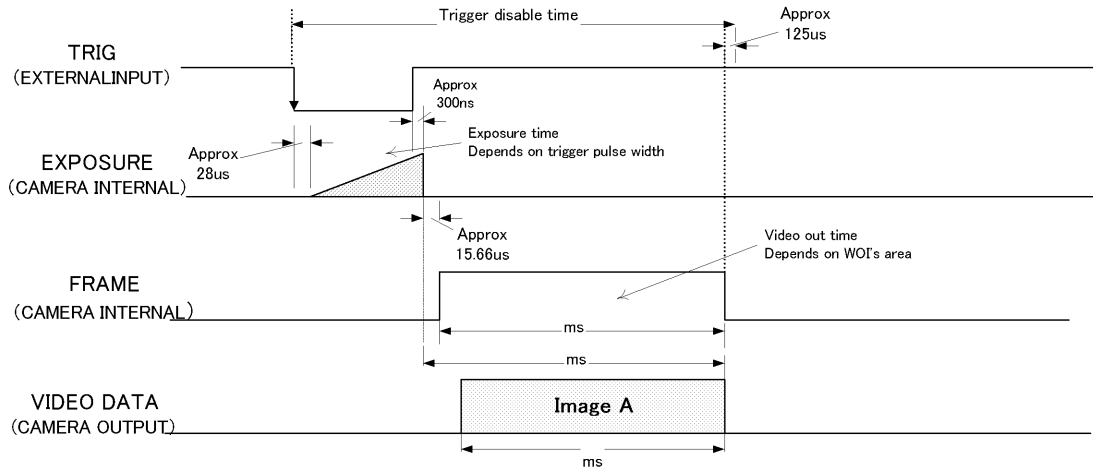
The video output time varies depending on the cut-out position and cut-out width.



* For the video output time calculation formula, refer to the CSB4000F-20 application manual supplied separately.

7.5. Scalable (Pulse width control, Format 7 Mode 1)

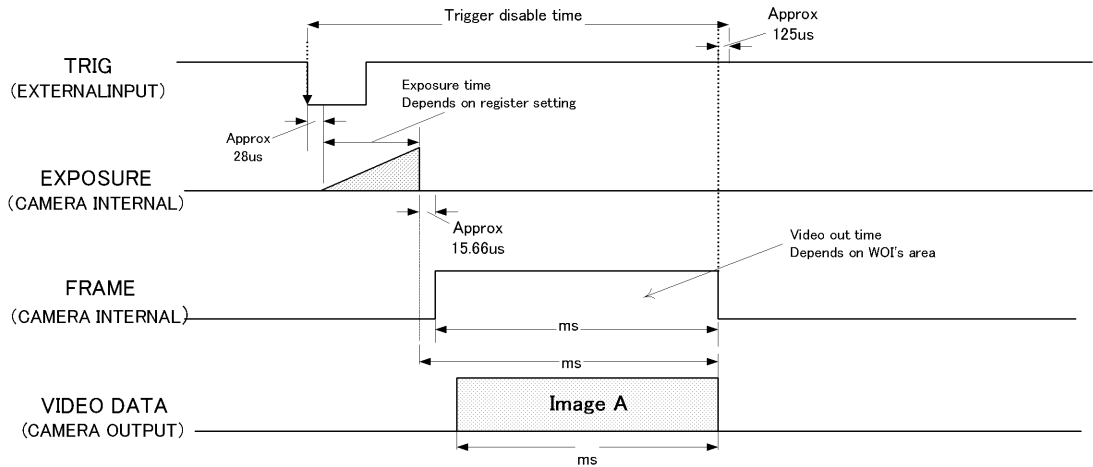
The video output time varies depending on the cut-out position and cut-out width.



* For the video output time calculation formula, refer to the CSB4000F-20 application manual supplied separately.

7.6. WOI mode (Fix mode, Format X)

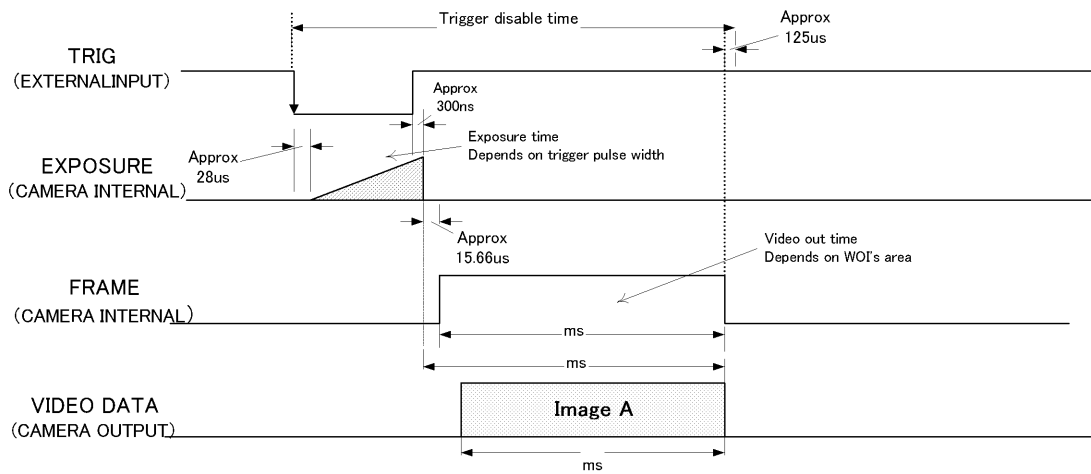
The video output time varies depending on the cut-out position and cut-out width.



* For the video output time calculation formula, refer to the CSB4000F-20 application manual supplied separately.

7.7. WOI mode (Pulse width control, Format X)

The video output time varies depending on the cut-out position and cut-out width.



* For the video output time calculation formula, refer to the CSB4000F-20 application manual supplied separately.

8. Serial Number and Model Name

The serial number and model name is shown as follows.

8.1. Cassis

The serial number and model name of this camera are indicated on the cassis. The serial number is shown with 7-digits number.

Indication pattern :0123456 (An example)
 0123456 :The serial number of product (The 123456th)

8.2. Camera inside register

This model organizes the serial number and the model name in configuration ROM register mounted inside this camera with the following format.

	Offset	0-7	8-15	16-23	24-31
Node	0000h	0002h		(CRC is only for this leaf)	
Unique	0004h	Node_vendor_id			chip_id_hi
ID leaf	0008h	Chip_id_lo			

Node Unique ID leaf

The contents of node unique ID leaf are indicated as follows.

node_vedor_id Company ID pre-registered to IEEE is written.
 Our company ID is H'000600 in hexadecimal notation.

chip_id_hi H'00 is written for the identification of models in higher order of 1-byte.
 chip_id_lo H'2B is written for the identification of models in higher order of 1-byte.
 The serial number is written for individual identification of units in lower order of 3-byte. The possible values are 0 to 16,777,215, however, 7-digit values from 1 to 9,999,999 in decimal notation (H'1 to H'98967F in hexadecimal) are used as serial numbers.

Node unique ID leaf are referred as follows.

0000h : 0002xxxx (xxxx is changed on each unit due to CRC)

0004h : 00060000

0008h : 2Byyyyyy (yyyyyy is a serial number.)

	Offset	0-7	8-15	16-23	24-31
Name Leaf	0000h	Leaf_length		CRC(CRC is only for this leaf)	
	0004h	00	00	00	00
	0008h	00	00	00	00
	000Ch	char_0	char_1	char_2	char_3
	0010h	char_4	char_5	char_6	char_7
	0014h	char_8	...		
	N+6h	...			
	N+Ah	char_n-2	Char_n-1	NUL	NUL

ASCII representation

Vendor Name / Model Name Leaves

The information of a vendor name and a model name are stored with ASCII code.

This offsets of leaf are need to determine the each address vendor_name_leaf / model name leaf of Depend Directory.

Vendor name is shown as follows.

	Offset	0-7	8-15	16-23	24-31
Vendor Name Leaf	0000h	0003		CRC(CRC is only for this leaf)	
	0004h	00	00	00	00
	0008h	00	00	00	00
	000Ch	'T'	'E'	'L'	'I'

ASCII representation

Vendor Name Leaf

Model name is shown as follows.

	Offset	0-7	8-15	16-23	24-31
Name Leaf	0000h	0007		CRC(CRC is only for this leaf)	
	0004h	00	00	00	00
	0008h	00	00	00	00
	000Ch	'C'	'S'	'B'	'4'
	0010h	'0'	'0'	'0'	'F'
	0014h	'-'	'2'	'0'	SP(0x20)
	0018h	'V'	*	'.'	*
	001Ch	*	NUL	NUL	NUL

ASCII representation

Model Name Leaf

The lower two bytes and of 0018h and the upper 2 bytes of 001Ch represent a firmware version. (ASCII representation 0x30 to 0x39)

9. External-view Drawing

