SONY

A-D9A-100-**11** (1)

Digital Video Camera Module

Technical Manual

XCL-U100

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Overview

The XCL-U100 is a black and white digital video camera module. This camera module outputs digital images utilizing LVDS via the DIGITAL IF (interface) connector.

Features

DIGITAL IF connector

Equipped with a Camera Link standard mini connector. The XCL-U100 can output a digital image at 15 frames per second.

Supports the Camera Link PoCL Standard

The XCL-U100 supports the PoCL (Power over Camera Link) standard. By connecting a PoCL-compatible camera link cable to a PoCL-compatible camera module interface board, you can power, control, and output images from the camera using a single cable.
This module is also provided with a DC IN connector to enable you to use a power adaptor and a camera module interface board without support for PoCL (non-PoCL) to operate the camera.

High image quality

The XCL-U100 has a progressive scan CCD of 2,000,000 pixels. This module produce high-resolution images. By adopting square pixels, images can be processed using the original aspect ratio without a converting procedure.

Various mode settings

Sending a command from the host device allows the following mode settings.

- Gain
- Read mode: normal/binning
- Partial scan
- Shutter: Normal/Trigger shutter
- Shutter speed
- Gamma
- Switching an output Bit Depth
- 3 × 3 filter
- Binarization

Electronic shutter function

Shutter speed can be selected from variety of available speeds.

External trigger shutter function (2 to 1/10,000 s)

You can obtain a still picture by inputting an external trigger. This function is useful to shoot a fast-moving object clearly.

Partial scan

The camera module can limit the number of the actual video output lines to achieve high frame rates, enabling high-speed image processing.

Body fixing

The screw holes to install the camera module are located under the front panel (the CCD reference plane). Installing the camera module on the front panel minimizes deviation of the optical axis.

Gamma

You can switch to OFF or ON.
When you switch to ON, you can select from various modes, and draw not only the default gamma line but also an original gamma curve.

Switching an Output Bit Depth

You can select 8 bit output, 10 bit output, or 12 bit output.

Binning

By “binning” two pixels that align vertically, you can acquire a frame rate twice as high as that in the normal mode.

3 × 3 filter

You can configure the 3 × 3 filter manually. Six different table presets are also available.
Outline detection detects an outline from a picture and outputs an image made up of the outline only.

Binarization

Outputs an binarized image. Sensitivity can be changed.

Note

The CCD is driven at high speed during a Partial scan or Binning operation. In this situation, if intense light is input to the camera, the peripheral areas of the video image may be affected. In such a situation, adjust the amout of light using the iris.

Typical CCD Phenomena

The following effects on the monitor screen are characteristic of CCD cameras. They do not indicate any fault with the camera module.

Smear

This occurs when shooting a very bright object such as electric lighting, the sun, or a strong reflection.
This phenomenon is caused by an electric charge induced by infrared radiation deep in the photosensor. It appears as a vertical smear, since the CCD imaging element uses an interline transfer system.

Vertical aliasing

When you shoot vertical stripes or lines, they may appear jagged.

Blemishes

A CCD image sensor consists of an array of individual sensor elements (pixels). A malfunctioning sensor element will cause a single pixel blemish in the picture (This is generally not a problem.).

White speckles

While CCD image pickup device is made by an accurate technique, imperceptible speckless may rarely come up on the screen due to cosmic rays and so on. This is connected to the principle of CCD image pickup device, not a malfunction. And the white speckless are easy to come up in the following conditions.

- Using the camera in high temperature
- When turning up the gain

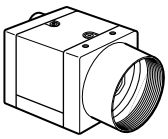
Note

If strong light enters a wide area of the screen, the screen may become dark. This is not a malfunction.
If this occurs, avoid strong light or adjust the lens iris to reduce the light amount.

Note on laser beams

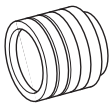
Laser beams may damage a CCD. You are cautioned that the surface of a CCD should not be exposed to laser beam radiation in an environment where a laser beam device is used.

System Components

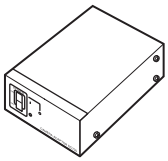


Video Camera Module
XCL-U100

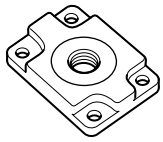
Camera cable
CCXC-12P02N (2 m, 6.6 ft)
CCXC-12P05N (5 m, 16.4 ft)
CCXC-12P10N (10 m, 32.8 ft)
CCXC-12P25N (25 m, 82 ft)



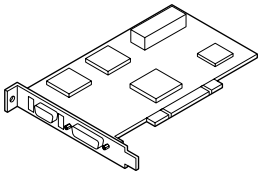
C-mount lens
High-resolution lens



Camera adaptor
DC-700/700CE

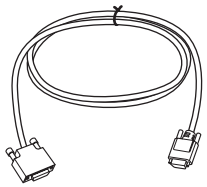


Tripod adaptor
VCT-333I (Insulated type)



Camera module interface board

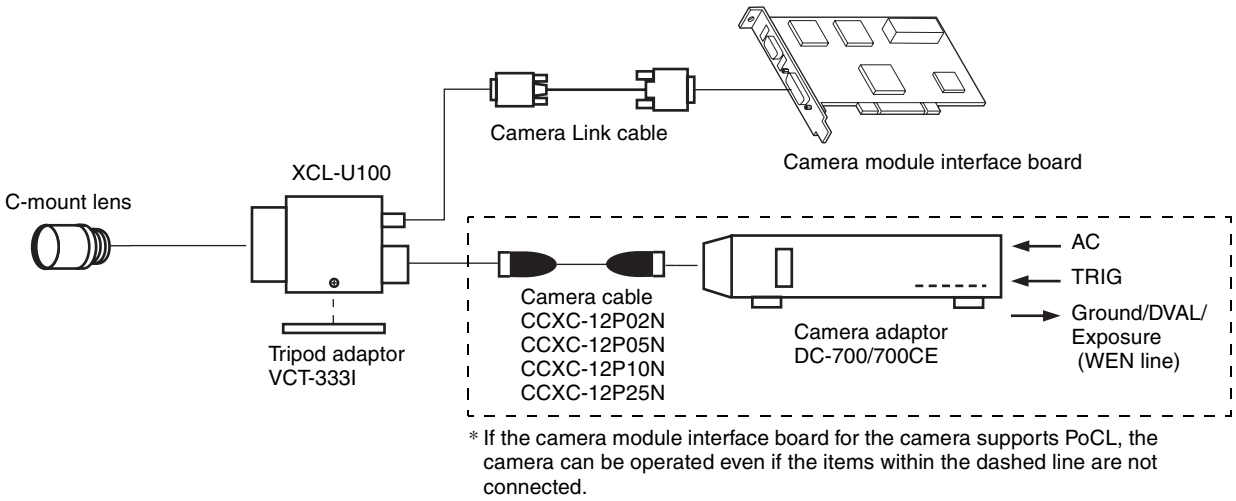
Install the board in a PCI bus slot in devices such as a computer. Select a commercially available interface board compatible with the Camera Link feature. You can use either a board that supports PoCL, or one that does not.
Performance may also be dependent on the host device (e.g., Computer), so consult the dealer if images are not displayed properly.



Camera Link cable
(Sony Camera-compatible)

This cable connects to the DIGITAL IF connector on the rear panel of the camera module. Image/control signals are transmitted via this cable.
If there is support for PoCL, power is also supplied at the same time. If you use a camera module interface board with support for PoCL, be sure to use a camera link cable with support for PoCL. The maximum usable length of a cable is 10 m, but the actual usable length may vary based on the attributes of each cable. Keep this in mind when selecting a cable.
Spotted noise may appear in a specific brightness in the window according to the attribute of the cable. If this noise is an obstacle, shorten the cable.

Connection



* If the camera module interface board for the camera supports PoCL, the camera can be operated even if the items within the dashed line are not connected.

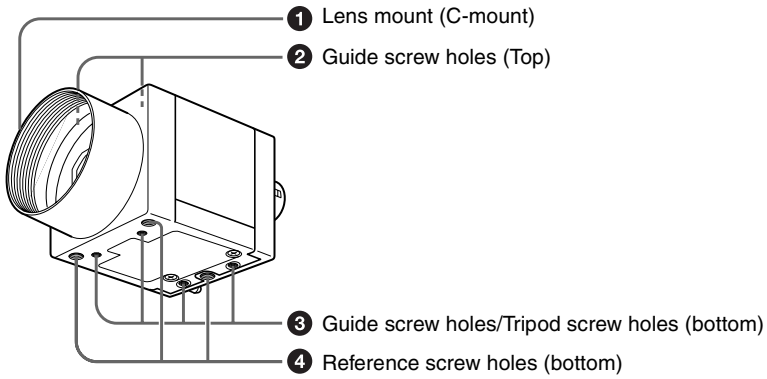
Power supply
You can supply power to the XCL-U100 using the following methods.

Using the DIGITAL IF connector
The XCL-U100 supports the PoCL (Power over Camera Link) standard. By connecting a PoCL-compatible camera link cable to a PoCL-compatible camera module interface board, you can power, control, and output images from the camera using a single cable.

Using the DC IN connector
You can supply power via the DC IN connector using the power adapter.
Use DC-700/700CE which is the stable power source free from ripple or noise.
When both the DIGITAL IF and DC IN connectors are used, the power supply from the DC IN connector is given priority.

Location and Function of Parts and Operation

Front/Top/Bottom



❶ 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.
When you use the camera with the lens attached, the resolution of the image output from the camera may differ according to the performance of the lens. Note it when you select a lens.
The performance of a lens may change according to the aperture level.
If the resolution is not enough, adjust the aperture level.

❷ Guide screw holes (Top)

❸ Guide screw holes/Tripod screw holes (bottom)
When using a tripod, use these four screw holes to attach a VCT-333I tripod adaptor.

❹ Reference screw holes (bottom)
These precision screw holes are for locking the camera module. Locking the camera module into these holes secures the optical axis alignment.

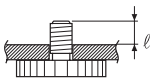
Note

Refer to XCL-U100 Demensions in page 43 for about the position/size of the Guide hole and the Reference hole.

Using a tripod

To use the tripod, install the tripod adaptor VCT-333I (not supplied) on the camera module.
Use a tripod screw with a protrusion (ℓ) extending from the installation surface, as follows, and tighten it, using a screwdriver. Be sure that the protrusion (ℓ) does not exceed 5.5 mm (0.2 in.) in length.

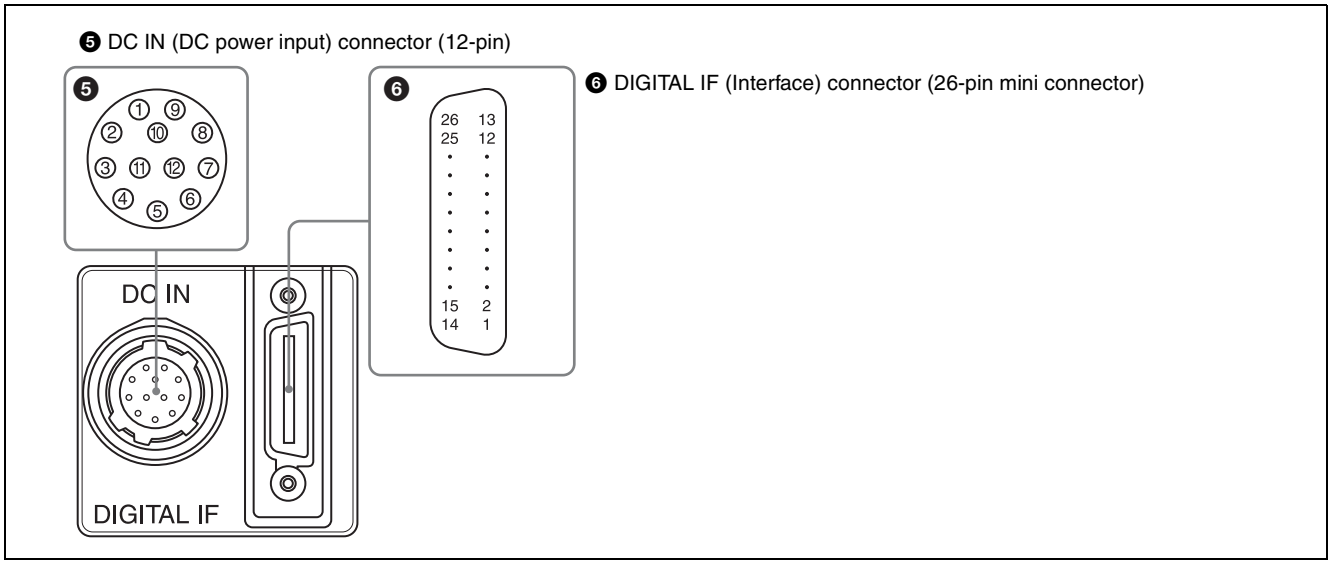
Length 4.5 to 5.5 mm
Length 0.18 to 0.22 inches



Note

If you install a tripod adapter (not supplied), use the screws provided.

Rear



❺ DC IN (DC power input) connector (12-pin)

You can connect a camera cable CCXC-12P05N etc. to input the +12 V DC power supply. The pin configuration of this connector is as follows. You can operate the camera without using this connector when using a PoCL-compatible camera module interface board. For details on the pin arrangement, see the following table.

Pin No.	Signal	Pin No.	Signal
1	Ground	7	NC
2	+12 V DC	8	Ground
3	Ground	9	NC
4	NC	10	Signal output*
5	Ground	11	Triger pulse input
6	NC	12	Ground

*** Signal output from the Tenth pin of 12 pins connector**

You can select one of the following signals according to the setting.

Ground / DVAL output / Exposure pules output

The default setting in the factory is Ground.

❻ DIGITAL IF (Interface) connector (26-pin mini conector)

Camera Link Base Configuration:

You can connect a Camera Link cable to this connector to control a camera module from a host device utilizing the serial communication protocol while outputting a video signal from the camera module. If you use a camera module interface board with support for PoCL, you can also supply power from this connecter. You can input the external trigger signal via the 26-pin mini connector and operate a camera module in the external trigger mode.

The following table shows the relation between the pin numbers of the DIGITAL IF connector and the input/ output signals and the like.

Pin No.	Signal	Pin No.	Signal
1	Power supply or Ground*	14	INNER_SHIELD (Ground)
2	X0– output (Signal)	15	X0+ output (Signal)
3	X1– output (Signal)	16	X1+ output (Signal)
4	X2– output (Signal)	17	X2+ output (Signal)
5	XCLK– output (Signal)	18	XCLK+ output (Signal)
6	X3– output (Signal)	19	X3+ output (Signal)
7	SerTC+ (Signal)	20	SerTC– (Signal)
8	SerTFG– (Signal)	21	SerTFG+ (Signal)
9	TRIG– input (Signal)	22	TRIG+ input (Signal)
10	NC	23	NC
11	NC	24	NC
12	NC	25	NC
13	INNER_SHIELD (Ground)	26	Power supply or Ground*

*** About the 1st pin and 26th pin of the 26-pin mini connector**

The connection differs depending on the type of camera module interface board you use.

In the case of PoCL support:

Both the 1st pin and 26th pin are POWER (power supply)

In the case of non-PoCL support:

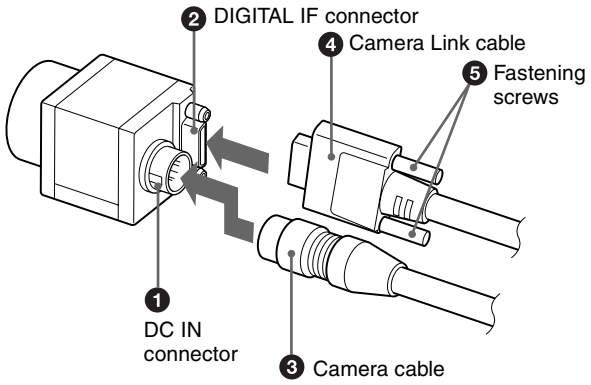
Both the 1st pin and 26th pin are INNER_SHIELD (Ground)

Note

When you operate a camera module by inputting an external trigger signal via the 26-pin mini connector, make sure to input external trigger signals that meet the following specifications to both the two pins.

Specifications for the External Trigger Signal
Amplitude: LVDS using a 3.3 volt IC
Connections: Input a TRIG (–) signal to the 9th pin.
Input a TRIG (+) signal to the 22nd pin.
Polarity: Positive

Connecting the cables



Connect the camera cable to the DC IN connector and the Camera Link cable to the DIGITAL IF cable respectively. If you use a camera module interface board with support for PoCL, you can operate the camera even if you do not connect the camera cable to the DC IN connector. When you connect the Camera Link cable, turn the two fastening screws on the connector to secure the cable tightly.
Connect the other end of the camera cable to the DC-700/700CE and the other end of the Camera Link cable to the camera module interface board.

Note

When using the camera with a PoCL connection, make sure you connect a PoCL compatible cable. Connecting a cable that is not compatible with PoCL (non-PoCL) may cause a malfunction of the camera or camera module interface board.

Controlling the camera from the host device

You can control the camera from host device such as a computer. The following table shows the control functions.
You can send a command corresponding to the control items, with parameters for the desired settings, if necessary, from the host device to control the camera.

Refer to “Camera Control Commands” on page 33 for details on how to send a command, the commands, and their parameters.

Control functions	Description	
Operating mode	Normal/Trigger	
Shutter speed	Normal	2 to 1/10,000 s
	Trigger edge	2 to 1/10,000 s
	Trigger pulse width	Setting by trigger pulse width
Gain	0 to +18 dB	
Partial Scan	OFF/ON	
Gamma control	OFF/ON (Mode 1 to 5)	
External trigger input	26 pin mini connector/12 pin connector	
Video output switch	8 bits/10 bits/12 bits	
Binning	OFF/ON	
Binarization	OFF/ON	
3×3 filter	OFF/ON (manual or preset)	

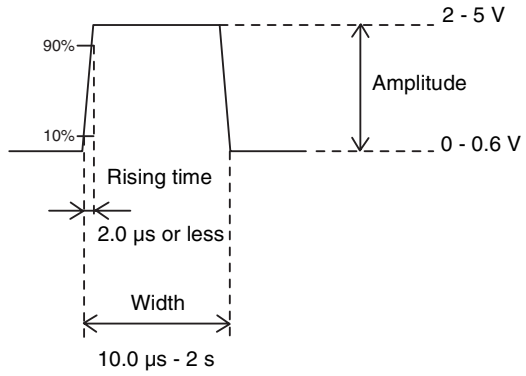
Note

Make sure to supply power to the camera module and confirm that the camera module is operating before inputting a trigger signal. If you input trigger signal to a camera module without the power supplied, this may cause a malfunction of the camera module.

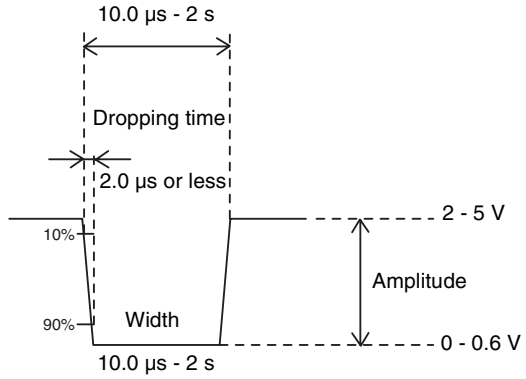
Trigger signal specifications

DC IN terminal

When trigger pulse polarity is positive



When trigger pulse polarity is negative



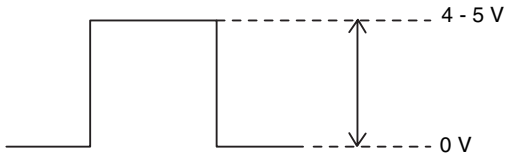
Input impedance: Stated in the voltage determined at more than 10 k ohms

DIGITAL IF terminal

Convert the signal which meets the specifications above into LVDS format (3.3 V power drive IC output), and inputs the converted signal.
Note that the signal level cannot be recognized correctly by the camera if it does not meet the following conditions.

H level: 1.5 V to 1.7 V
L level: 0.8 V to 1.0 V

DVAL/Exposure output specific (only DC IN terminal)



Stated in the voltage of when terminating at more than 10 k ohms

1. Compatibility with previous model XCL-5005

The XCL-U100 is a 2-megapixel digital video camera model that is based on the XCL-5005 and supports the PoCL standard.
Some of the control commands used on the XCL-U100 differ from those on the XCL-5005. The main differences are as follows.

Command	Command string		Difference from XCL-5005
Gain setting (dB)	GAIN-STEP	○	
Gain setting (step)	GAIN-FINE	○	
Pedestal adjustment	PEDESTAL	○	
Shutter speed	SHUTTER	△	Parameters are different.
Trigger mode	TRG-MODE	○	
External trigger polarity setting	TRG-POL	○	
External trigger overlap	TRG-OVLP	○	
External trigger delay	TRG-DELAY	△	Added command.
Digital gain	DGAIN	△	Parameters are different.
Digital pedestal	DPEDESTAL	△	Parameters are different.
Digital clamp	DCLAMP	△	Parameters are different.
Binarize setting	BINARIZE	○	
Gamma mode setting	GAMMA-MODE	△	Parameters are different.
LUT value setting	GAMMA	○	
Filter mode	FILTER-MODE	○	
Filter setting	FILTER	○	
Binning setting	BINNING	○	
Partial scan setting	PARTIAL	△	Parameters are different.
Horizontal partial scan setting	HPARTIAL	△	Parameters are different.
External trigger signal input	EXTTRG	○	
Grayscale chart output	GRAYSCALE	○	
DC IN connector signal output setting	WEN-STRB	○	
Image output data depth	BIT-DEPTH	×	The command and parameters are different. (Can be configured with IMG-WIZE.)
Serial communication speed setting	BRATE	○	
Initialization of settings	INIT	○	
Save setting values	SAVE	○	
Load setting values	LOAD	○	
Setting value accession	RMEM	○	
Version display	VERSION	○	
Help display	HELP	○	

For details on commands and their parameters, see the “Camera Control Commands” on page 33.

2. Video output format

2.1. Port assignment

The following table shows the assignment for the three ports (A, B, and C) and the video signal (D1) as defined in the base configuration.

Port	8 bits	10 bits	12 bits
Port A0	D1 [0]	D1 [0]	D1 [0]
Port A1	D1 [1]	D1 [1]	D1 [1]
Port A2	D1 [2]	D1 [2]	D1 [2]
Port A3	D1 [3]	D1 [3]	D1 [3]
Port A4	D1 [4]	D1 [4]	D1 [4]
Port A5	D1 [5]	D1 [5]	D1 [5]
Port A6	D1 [6]	D1 [6]	D1 [6]
Port A7	D1 [7]	D1 [7]	D1 [7]
Port B0		D1 [8]	D1 [8]
Port B1		D1 [9]	D1 [9]
Port B2			D1 [10]
Port B3			D1 [11]
Port B4			
Port B5			
Port B6			
Port B7			
Port C0			
Port C1			
Port C2			
Port C3			
Port C4			
Port C5			
Port C6			
Port C7			

2.2. Output data size

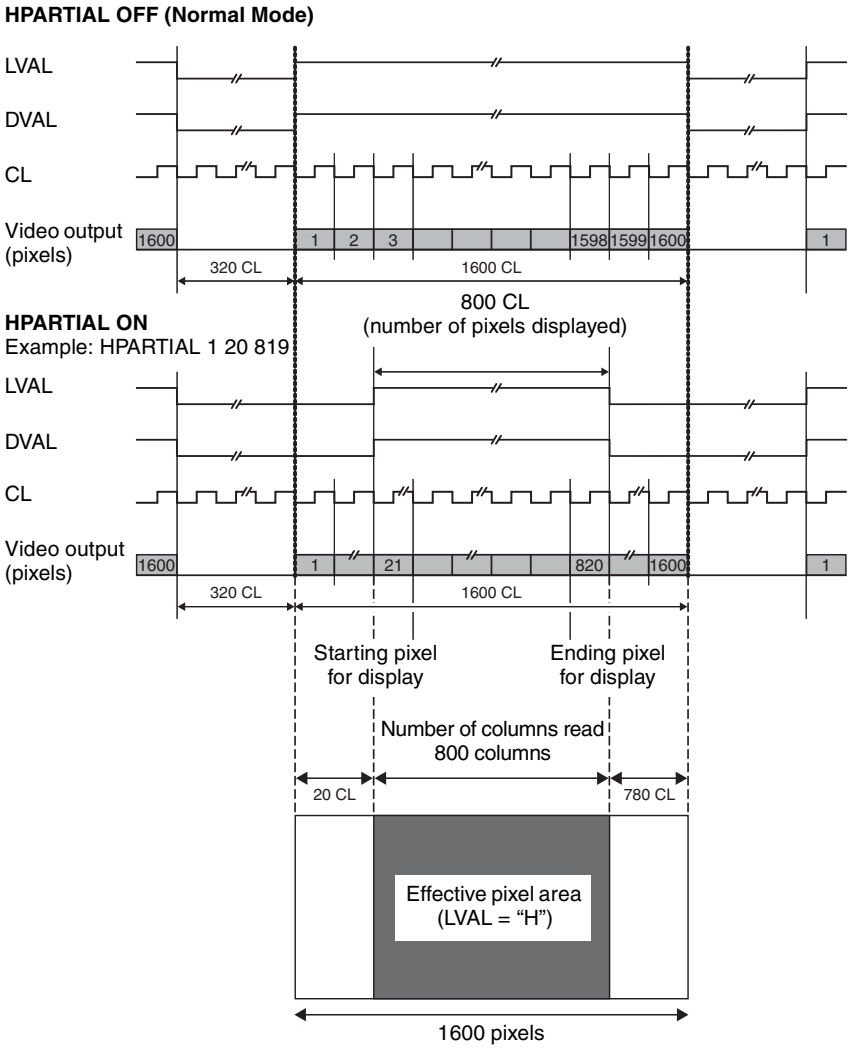
The XCL-U100 has an effective resolution of 1600 × 1200 (horizontal/vertical). The effective clock for standard LVAL is 1600, and the effective lines for FVAL is 1200.

3. Camera mode

3.1. Horizontal timing

The horizontal timing is common for all modes. The XCL-U100 is provided with a horizontal partial scan function (HPARTIAL) that is capable of changing the length of the Hi section of the LVAL signal. Configuring a minimum of 128 columns anywhere between columns 0 and 1599 of the horizontal effective video area enables a reduction in the number of columns imported on the host device (computer) side. The frame rate does not change even if HPARTIAL is set to ON.

Horizontal timing: Common for each mode



1H = 53.333 µs
1 CL = 27.777 ns

Note

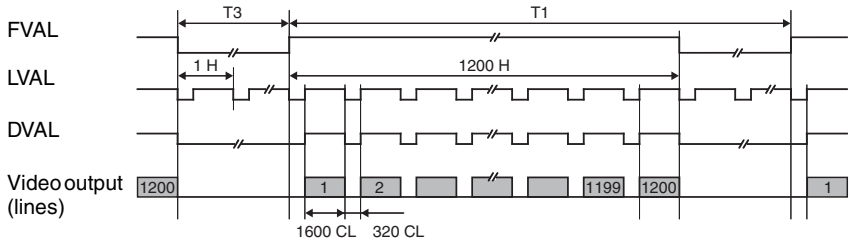
When horizontal partial scan is set to ON, set the line number for the effective video area.
Set the number of columns to read to a number between 128 and 1600. An error will occur if the number of columns configured is not within this range.

3.2. Vertical timing

The vertical timing differs between each mode.

3.2.1. Normal mode

This mode is for outputting the individual video signals of all pixels as continuous video at 15 frames per second.



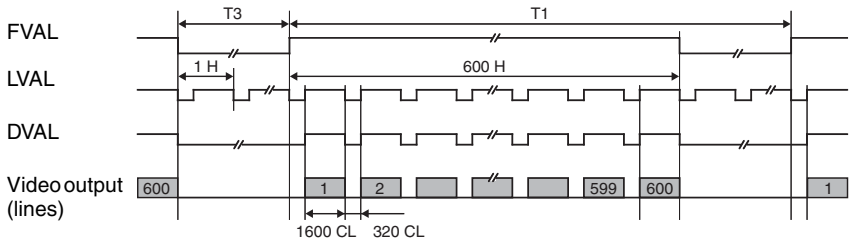
1H = 53.333 µs
1 CL = 27.777 ns

Shutter	T1	T3	Frame rate
2 s	2 s	36302 H	0.5 fps
1 s	1 s	17552 H	1 fps
1/2 s	500 ms	8177 H	2 fps
1/7.5 s	133.34 ms	1302 H	7.5 fps
1/15 s (OFF)	**66.8 ms**	**53 H**	**14.97 fps**
1/30 s	66.8 ms	53 H	14.97 fps
1/60 s	66.8 ms	53 H	14.97 fps
1/100 s	66.8 ms	53 H	14.97 fps
1/120 s	66.8 ms	53 H	14.97 fps
1/250 s	66.8 ms	53 H	14.97 fps
1/500 s	66.8 ms	53 H	14.97 fps
1/1,000 s	66.8 ms	53 H	14.97 fps
1/2,000 s	66.8 ms	53 H	14.97 fps
1/5,000 s	66.8 ms	53 H	14.97 fps
1/10,000 s	66.8 ms	53 H	14.97 fps
Arbitrary	≥ 66.8 ms	≥ 53 H	*1

*1 Frame rate = 1 / shutter speed
However, the maximum frame rate is 14.97 fps.
1 H = 53.333 µs

3.2.2. Binning mode

This mode is for adding two vertical lines to read from the CDD in order to almost double the frame rate.



1H = 53.333 µs
1 CL = 27.777 ns

Shutter	T1	T3	Frame rate
2 s	2 s	36902 H	0.5 fps
1 s	1 s	18152 H	1 fps
1/2 s	500 ms	8777 H	2 fps
1/7.5 s	133.34 ms	1902 H	7.5 fps
1/15 s	66.80 ms	653 H	14.97 fps
1/30 s (OFF)	**33.44 ms**	**27 H**	**29.90 fps**
1/60 s	33.44 ms	27 H	29.90 fps
1/100 s	33.44 ms	27 H	29.90 fps
1/120 s	33.44 ms	27 H	29.90 fps
1/250 s	33.44 ms	27 H	29.90 fps
1/500 s	33.44 ms	27 H	29.90 fps
1/1,000 s	33.44 ms	27 H	29.90 fps
1/2,000 s	33.44 ms	27 H	29.90 fps
1/5,000 s	33.44 ms	27 H	29.90 fps
1/10,000 s	33.44 ms	27 H	29.90 fps
Arbitrary	≥ 33.4 ms	≥ 27 H	*1

*1 Frame rate = 1 / shutter speed
However, the maximum frame rate is 29.90 fps.

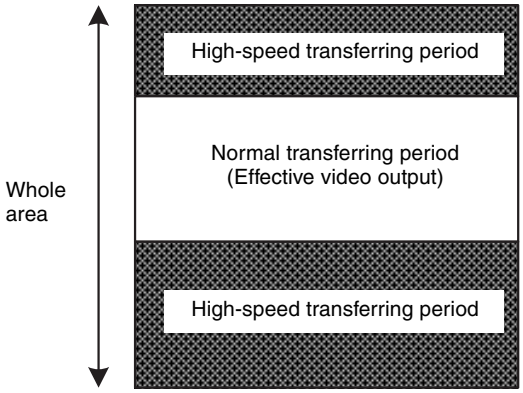
1 H = 53.333 µs

Note

The camera cannot be operated with the binning mode and the partial scan mode set to ON at the same time.

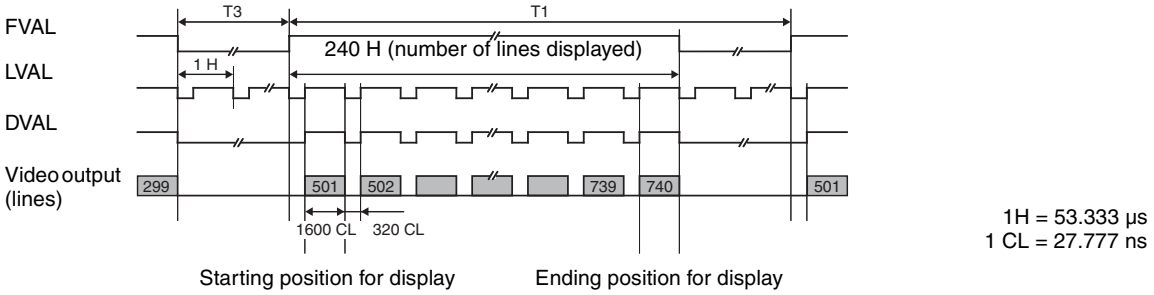
3.2.3. Partial scan mode

This mode increases the frame rate by dividing the whole video period vertically, reading only the necessary lines as the actual video, and transferring unnecessary lines at high-speed. You can set the area between the starting and ending positions for reading to a minimum of 240 lines.



Partial scan

Example: PARTIAL 1 500 739



starting position for display ≤ 32
exposure time ≤ T1
T1 = ending position for display + 31 + ROUNDUP ((1217 - ending position for display) / 8,0) (H)
T3 = T1 - number of lines displayed

starting position for display > 32
exposure time ≤ T1
T1 = number of lines displayed + 62 + ROUNDUP ((starting position for display - 32) / 8,0) + ROUNDUP ((1217 - ending position for display) / 8,0) (H)
T3 = T1 - number of lines displayed

<ROUNDUP functions>
Round up the value for the function, ROUNDUP (x,0) = x, to the nearest whole number.
Example: ROUNDUP (50.0,0) = 50 / ROUNDUP (50.3,0) = 51

Shutter	T1
2 s	2 s
1 s	1 s
1/2 s	500 ms
1/7.5 s	133.34 ms
1/15 s	66.68 ms
1/30 s	33.34 ms
1/60 s	16.67 ms
1/100 s	10.01 ms
1/120 s	8.33 ms
1/250 s	4.01 ms
1/500 s	1.983 ms
1/1,000 s	1.023 ms
1/2,000 s	543 µs
1/5,000 s	223 µs
1/10,000 s	117 µs
Arbitrary	*1

When the shutter is OFF, the exposure time is equal to T1.

When configuring the shutter, the shutter speed must be less than or equal to T1 to be valid.
The setting will be ignored otherwise.

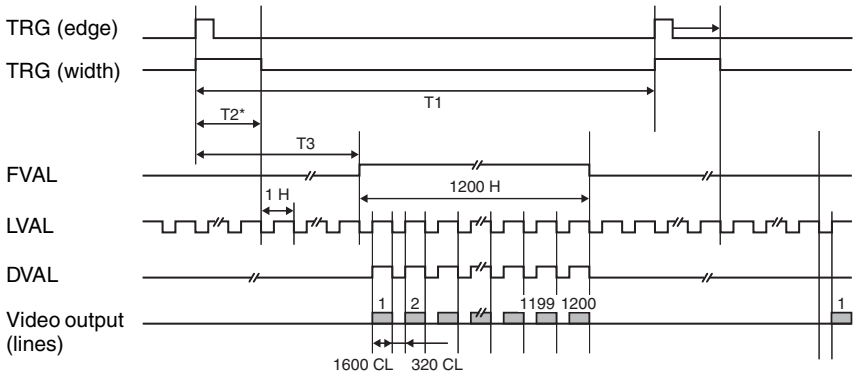
Example: When T1 = 18 ms
Valid: 1/60 s = 16.667 ms ≤ 18 ms
Ignored: 1/30 s = 33.333 ms > 18 ms
Configurations between 1/10,000 s and 1/60 s are valid, and configurations between 1/30 s and 2 s will be ignored.

*1 Even when the shutter is arbitrary, the shutter speed is less than or equal to T1.

3.2.4. Trigger mode

This mode is for starting exposure by synchronization with the external trigger input (DC IN connector or DIGITAL IF connector) and then outputting the individual video signals of all pixels after the time that was set for the shutter elapses. There is the edge detection mode for detecting the rise edge of the external trigger signal and the width detection mode for detecting the effective period of the trigger. The period of the external trigger signal cannot be set shorter than the shutter speed. Furthermore, if the shutter is set to OFF, frame period (fps) is prioritized and the shutter speed will be the reciprocal of the maximum exposure time that can be set.
The shutter speed will be 1/15 s in normal mode, 1/30 s in binning mode, and 1/15 s to 1/48 s depending on the number of lines in partial scan mode. For details on partial scan mode, see page 21.
T1 is the maximum exposure time.

When trigger pulse polarity is positive



1H = 53.333 µs
1 CL = 27.777 ns

T1 > 1253 H
T3 = T2 + 32 H
exposure time ≤ T1

* Shutter setting value in edge mode; pulse width in width mode.

Edge trigger mode

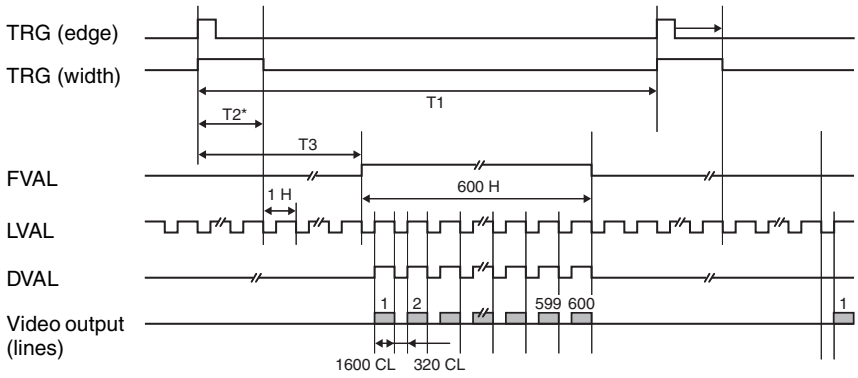
Shutter	T1	Trigger width	T2	T3
2 s	2.001 s or more	100 µs or more 2 s or less	2 s	2.002 s
1 s	1.001 s or more		1 s	1.002 s
1/2 s	501 ms or more		500 ms	501.71 ms
1/7.5 s	134 ms or more		133.34 ms	135.05 ms
1/15 s	66.8 ms or more		66.68 ms	68.39 ms
1/30 s			33.34 ms	35.05 ms
1/60 s			16.67 ms	18.38 ms
1/100 s			10.01 ms	11.72 ms
1/120 s			8.33 ms	10.04 ms
1/250 s			4.01 ms	5.72 ms
1/500 s			1.983 ms	3.69 ms
1/1,000 s			1.023 ms	2.73 ms
1/2,000 s			543 µs	2.25 ms
1/5,000 s			223 µs	1.93 ms
1/10,000 s			117 µs	1.83 ms

Width trigger mode

Shutter	T1	Trigger width = T2		T3
OFF	2.001 s or more	100 µs or more 2 s or less	2 s	2.002 s
	1.001 s or more		1 s	1.002 s
	501 ms or more		500 ms	501.71 ms
	134 ms or more		133.34 ms	135.05 ms
	66.8 ms or more		66.67 ms	68.38 ms
			33.34 ms	35.05 ms
			16.67 ms	18.38 ms
			10 ms	11.71 ms
			8.33 ms	10.04 ms
			4 ms	5.71 ms
			2 ms	3.71 ms
			1 ms	2.71 ms
			500 µs	2.21 ms
			250 µs	1.96 ms
			100 µs	1.81 ms

3.2.5. Trigger binning mode

In this mode the binning action begins through synchronization with the external trigger input.



1H = 53.333 µs
1 CL = 27.777 ns

T1 > 627 H
T3 = T2 + 18 H
exposure time ≤ T1
* Shutter setting value in edge mode; pulse width in width mode.

Edge trigger mode

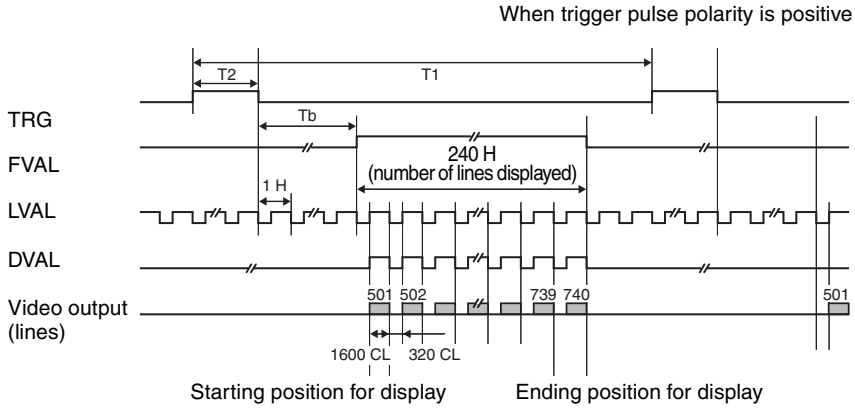
Shutter	T1	Trigger width	T2	T3
2 s	2.001 s or more	100 µs or more 2 s or less	2 s	2.001 s
1 s	1.001 s or more		1 s	1.001 s
1/2 s	501 ms or more		500 ms	501 ms
1/7.5 s	134 ms or more		133.34 ms	134.3 ms
1/15 s	66.8 ms or more		66.68 ms	67.64 ms
1/30 s	33.6 ms or more		33.34 ms	34.3 ms
1/60 s			16.67 ms	17.63 ms
1/100 s			10.01 ms	10.97 ms
1/120 s			8.33 ms	9.29 ms
1/250 s			4.01 ms	4.97 ms
1/500 s			1.983 ms	2.94 ms
1/1,000 s			1.023 ms	1.98 ms
1/2,000 s			543 µs	1.50 ms
1/5,000 s			223 µs	1.18 ms
1/10,000 s			117 µs	1.08 ms

Width trigger mode

Shutter	T1	Trigger width = T2		T3
OFF	2.001 s or more	100 µs or more 2 s or less	2 s	2.001 s
	1.001 s or more		1 s	1.001 s
	501 ms or more		500 ms	501 ms
	134 ms or more		133.34 ms	134.3 ms
	66.8 ms or more		66.67 ms	67.63 ms
	33.6 ms or more		33.34 ms	34.3 ms
			16.67 ms	17.63 ms
			10 ms	10.96 ms
			8.33 ms	9.29 ms
			4 ms	4.96 ms
			2 ms	2.96 ms
			1 ms	1.96 ms
			500 µs	1.46 ms
			250 µs	1.21 ms
			100 µs	1.06 ms

3.2.6. Trigger partial scan mode

In this mode the partial scan action begins through synchronization with the external trigger input.



starting position for display ≤ 32
exposure time ≤ T1
T1 = ending position for display + 31 + ROUNDUP ((1217 - ending position for display) / 8,0) (H)
Tb = 14 + starting position for display (H)

starting position for display > 32
exposure time ≤ T1
T1 = number of lines displayed + 62 + ROUNDUP ((starting position for display - 32) / 8,0) + ROUNDUP ((1217 - ending position for display) / 8,0) (H)
Tb = 62 + ROUNDUP ((starting line for display - 32) / 8,0) (H)

<ROUNDUP functions>
Round up the value for the function, ROUNDUP (x,0) = x, to the nearest whole number.
Example: ROUNDUP (50.0,0) = 50 / ROUNDUP (50.3,0) = 51

Shutter	T2
2 s	2 s
1 s	1 s
1/2 s	500 ms
1/7.5 s	133.34 ms
1/15 s	66.68 ms
1/30 s	33.34 ms
1/60 s	16.67 ms
1/100 s	10.01 ms
1/120 s	8.33 ms
1/250 s	4.01 ms
1/500 s	1.983 ms
1/1,000 s	1.023 ms
1/2,000 s	543 µs
1/5,000 s	223 µs
1/10,000 s	117 µs

In edge mode, T2 will be set to the values on the right side of the table when the shutter is set to the values on the left side of the table.

In width mode, the shutter will be set to the values on the left side of the table when the trigger width is set to the values (T2) on the right side of the table. The shutter setting is ignored in width mode.

4. Shutter setting

You can use the electronic shutter to set to the exposure time.
Furthermore, when the exposure output setting (command: WEN-STRB 2) is selected for the 10th pin signal output terminal of the DC IN connector (12-pin connector), Hi is output for the exposure period. The shutter has preset shutter settings in which the exposure time is fixed, and an arbitrary shutter setting that can be set in increments of 1 µs or clock units (27.78 ns). Use of the overlap function allows for preventing the inclusion of noise even if one of the following triggers is input during image transmission.

4.1. Preset shutter

You can set 16 types of exposure time ranges from OFF to 2 s.
The settable shutter value differs depending on the mode. Refer to the following table.
○: Settable
– : Not settable
△: Depends on the number of lines configured for PARTIAL.

	Normal	Binning	Partial	Trigger (Edge detection) *1
OFF	○	○	○	○
1/15 s	○	○	–	○
1/30 s	○	○	△*2	○
1/60 s	○	○	○	○
1/100 s	○	○	○	○
1/120 s	○	○	○	○
1/250 s	○	○	○	○
1/500 s	○	○	○	○
1/1,000 s	○	○	○	○
1/2,000 s	○	○	○	○
1/5,000 s	○	○	○	○
1/10,000 s	○	○	○	○
1/7.5 s*1	○	○	–	○
1/2 s	○	○	–	○
1 s	○	○	–	○
2 s	○	○	–	○

*1 The trigger signal period must be longer than the shutter speed.
Shutter OFF is the same as 1/15 s.

*2 If the partial starting position for display is ≥ 32, set the ending position to a value ≥ 504.

If the partial starting position for display is > 32:
set the number of lines displayed to a value ≥ 472 if the "starting position for display - 33 = a multiple of 8" or set the number of lines displayed to a value ≥ 473 if the "starting position for display - 33 ≠ a multiple of 8."

4.2. Arbitrary shutter setting

You can set the shutter setting from a minimum of 10 µs to a maximum of 60 s in increments of 1 CLK or 1 µs.

♦ Configuring an arbitrary shutter setting

Set three parameters with SHUTTER commands.

Parameter 1: 16 (Arbitrary shutter selection)
Parameter 2: Numeral in increments of 1 µs. 0 - 60000000
Parameter 3: 1/36 MHz = integer in increments of 27.78 ns 0 - 35

Setting example

Exposure time [µs]	Command	
10 µs.	SHUTTER 16 10 0	(Minimum setting)
31.500	SHUTTER 16 31 30	
1500000	SHUTTER 16 1500000 0	
60000000 (60 s)	SHUTTER 16 60000000 0	(Maximum setting)

You can set an arbitrary setting in any mode other than trigger mode.

Mode	Settable	Remark
Normal	○	
Binning	○	
Partial	○	1/15 s or less and 1/7.5 s or more is also settable
Trigger	–	Cannot be set in both edge mode and width mode. (Cannot be set in trigger binning mode and trigger partial scan mode as well.)

Note

Use of an arbitrary shutter may result in horizontal noise occurring in the captured image. In such a case, you can remove the noise by using the overlap function.
When the exposure time is set to 100 µs and below, or 2 s and above, smear and noise may appear in images. This is not a malfunction.

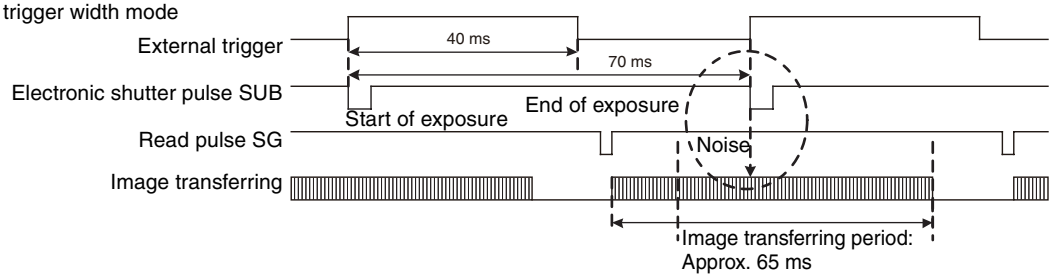
4.3. Overlap

Configure this setting with TRG-OVLP. In trigger mode or various modes that use an arbitrary shutter, horizontal noise may occur on the screen if an electronic shutter pulse SUB exists in the horizontal transferring period of the CCD. If TRG-OVLP=1 is set, SUB is automatically adjusted so that it occurs in the horizontal transferring blanking period, thus enabling you to prevent the inclusion of noise. In such a case, there is no change to the exposure time even if there is a delay in the exposure timing when in the trigger edge detection mode, but the exposure time may increase slightly when in the trigger width detection mode.

When inclusion of noise

The width of the external trigger is set to 40 ms, and the period to 70 ms. At that time, the SUB resulting from the next trigger exists in the image transferring period resulting from the previous trigger. The existence of SUB within the horizontal transferring period results in the inclusion of noise. If SUB exists in the horizontal blanking period, no noise occurs.

The timing chart is when in trigger width mode



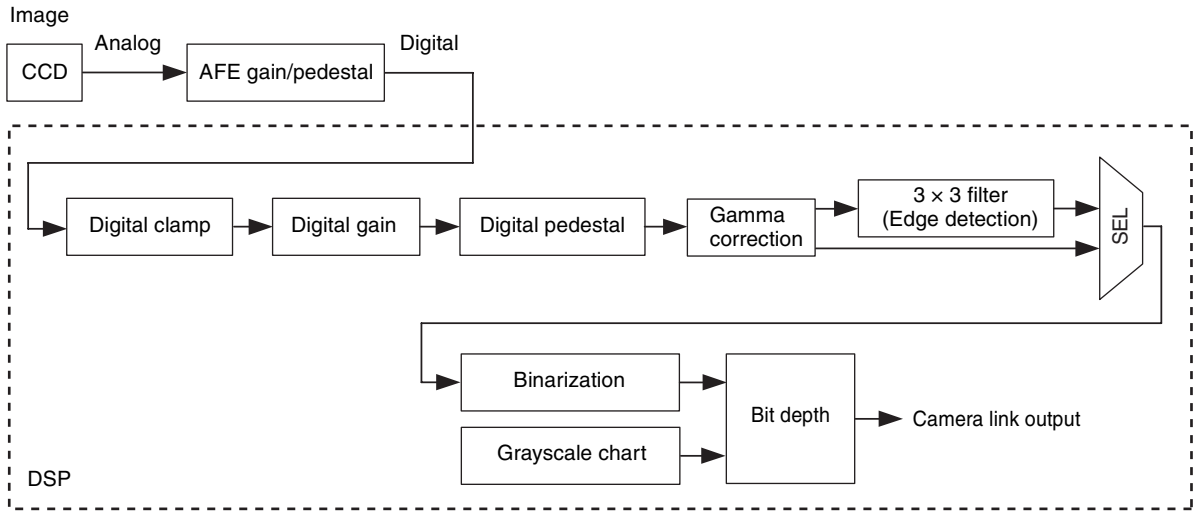
4.4. WEN-STRB

Configure this setting with WEN-STRB. You can change the output format of the 10th pin signal of the DC IN connector (12-pin connector).

WEN-STRB	10th pin signal output of DC IN connector (12-pin connector)
0	GND (ground)
1	DVAL signal
2	Exposure (Positive polarity: Hi output)

5. DSP Operation

5.1. Signal processing block chart



As each DSP function is composed of an independent module, DSP functions can be used in combination. For example, you can extract the outline portion by detecting the edges of an image for which gamma correction has been performed, and then perform Binarization processing. The DSP functions can be used in all camera modes.

5.2. Digital clamp

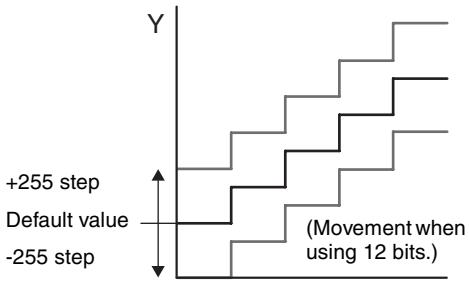
You can adjust between +255 and 0 steps for 12-bit output images.
With the value of 1023 (default value) at 0 step, you can adjust to +255 step by entering 0.

5.3. Digital gain

Configure this setting with DGAIN. Set the variable between x0 (black) to x15 and set the factor between 0 and 15, and Yout = Yin x factor.
Multiply by one when the factor is equal to 1.
Use this, for example, when the image is dark with regards to AFE gain only.

5.4. Digital pedestal

You can adjust between -255 and +255 steps for 12-bit output images.
With the value of 1023 (default value) at 0 step, you can adjust to -255 step by entering 0, and to +255 step by entering 2047.
This setting raises the whole level.



Input value	Yin (during 12-bit output)
Digital clamp addition amount	A (0 to +255)
Digital gain factor	K (x0 to x15)
Digital pedestal addition amount	B (-255 to +255 step)
Output value	Yout

$$Yout = K \times (Yin + A) + B$$

Note

The digital gain changes the whole level. Therefore, if it is used when the previous step of the digital clamp has been changed from the default value (1023), the change in the black level will be (digital gain factor) × (digital clamp additional value).
If the digital clamp setting has been changed, use the digital pedestal to adjust the black level.

5.5. Gamma correction

Configure each mode with GAMMA-MODE. There is a method for setting LUT arbitrarily, and a method for setting the gamma curve coefficient. There are five gamma modes from Mode 1 to Mode 5. Apart from Mode 3, which performs LUT initialization to return the setting to value at the time of shipment, the modes load the LUT value saved last time and are capable of accepting a GAMMA command. After you select a mode with GAMMA-MODE, input a parameter with a GAMMA command. You can use the RMEM 2 command to read the LUT setting value. When you set the mode to Mode 3, the LUT setting is returned to the value at the time of shipment, but the gamma curve will be a curve for which an offset of 300 and γ curve of 0.6 has been selected.

Mode	GAMMA-MODE operation	Mode settings after SAVE	LUT setting value	GAMMA command
0	OFF (γ=1)	Saved	Through (γ=1)	Not possible
1	Loads last set value	Saved	Arbitrary setting (saved)	Possible
2	Loads last set value	Not saved	Arbitrary setting (not saved)	Possible
3	Reset to initial value	Not saved	Value at time of shipment (saved)	Not possible
4	Loads last set value	Saved	γ coefficient (saved)	Possible
5	Loads last set value	Not saved	γ coefficient (not saved)	Possible

Note

If the LUT setting is changed in Mode 2 (arbitrary setting) or Mode 5 (γ coefficient), the LUT setting will return to its previous configuration after the mode is switched. If you want to save the setting value, change the setting in Mode 1 or 4.
However, if you change settings in Mode 1 or 2 after configuring the γ coefficient, the gamma value and offset value return to 0. Load setting values as necessary using the RMEM 2 command.
To return values that you are currently configuring to their default setting values, use Mode 3 (γ=6, offset 300).

When setting the LUT, configure a 12-bit conversion value even if you use the camera in 8 bits or 10 bits.

5.5.1. Arbitrary setting method

The arbitrary setting method is for inputting an LUT value for an arbitrary value from 0 to 4095. The relation of level OUT of the output image to level IN of the input image is expressed by the following equation.

$$OUT = IN$$

5.5.2. Coefficient input method

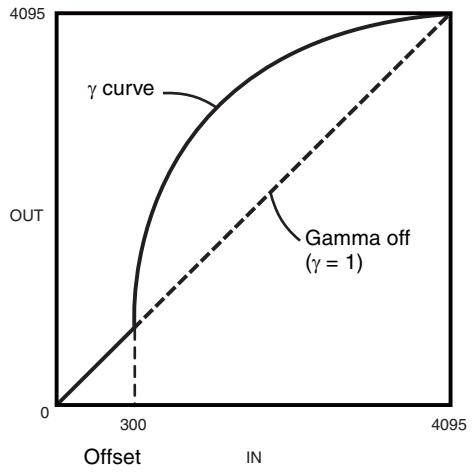
You can use Modes 4 and 5 of GAMMA-MODE to create your own gamma curve by setting the γ coefficient and offset value.

If the level of the input image is IN (12-bit conversion) and the coefficient is γ, the level OUT (12-bit conversion) of the output image is expressed by the following equation.

$$OUT = (4095 - \text{offset}) \left(\frac{(IN - \text{offset})}{(4095 - \text{offset})} \right)^{\gamma} + \text{offset}$$

The setting range available for the γ coefficient is 0.00 to 1.00.

Setting an offset allows for γ = 1 to be set for the level on and below the offset, and allows you to prevent white appearing in black parts.
For example, if you set the offset value to 300, the curve will be that of γ = 1 for an input image level of 300 and below, and the curve will be that of the configured γ value for an input image level over 300. The gamma curve for all input levels is depicted in the solid line of the graph, and this curve is used to determine the OUT level of the output image corresponding to an IN level of a particular input image.



■ Example of gamma command

Set the gamma mode to 1, set input level 500 to output level 300, and then save.
> GAMMA-MODE 1
OK
> GAMMA 500 300 (The gamma value is saved.)
OK
> SAVE (The gamma mode is saved and will be MODE 1 at the next launch.)
OK

Set the gamma mode to 2, return input level 500 to output level 500, and then check the picture.
The gamma value and mode setting are not saved in this mode.
> GAMMA-MODE 2
OK
> GAMMA 500 500 (Check the picture. The setting is not saved.)
OK
> SAVE (The gamma value and gamma mode are not saved. The gamma mode will be MODE 1 and input level 500 will be output level 300 at the next launch.)
OK

Turn off the gamma mode. You cannot input GAMMA commands when the mode is off.
> GAMMA-MODE 0 (Gamma mode off.)
OK
> GAMMA 512 1
ERROR STATUS

Create a gamma curve by setting the gamma mode to 4, setting the offset to 300, and setting the γ coefficient to 0.45, and then save it.
> GAMMA-MODE 4
OK
> GAMMA 0.45 300 (The gamma value is saved.)
OK

Create a gamma curve by setting the gamma mode to 5, setting the offset to 500, and setting the γ coefficient to 0.60, and then check the screen.
> GAMMMA-MODE 5
OK
> GAMMA 0.60 500 (Check the picture. The gamma value is not saved here.)
OK
> SAVE (The gamma mode is also not saved. The gamma mode will be MODE 4, the offset will be 300, and the ? coefficient will be 0.45 at the next launch.)
OK
Return the gamma curve to 4.
> GAMMA-MODE 4 (Check that the picture returns to an offset of 300 and γ coefficient of 0.45.)
OK

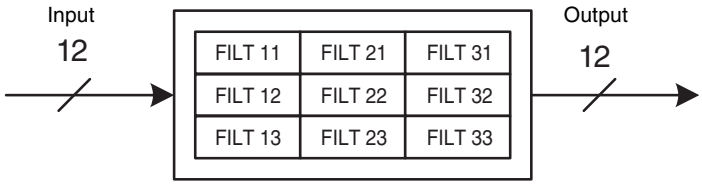
Create a gamma curve by setting the gamma mode to 3, setting the offset to 300, and setting the ? coefficient to 0.60, and then save the gamma value.
> GAMMMA-MODE 3
(The gamma value returns to the factory default setting with an offset of 300 and γ coefficient of 0.60, and is saved. However, the gamma mode is not saved.)
OK

Note

Executing the INIT command will not return the gamma value to the factory default setting (γ=0.60, offset 300).

5.6. 3 × 3 filter

Configure each mode with FILTER-MODE. This executes a matrix operation of 3 × 3 pixels to add various processing to the image. In Mode 1, you can set nine filter coefficients within the range of –10.000 to +10.000 in increments of 0.001.
Mode 2 allows you to set pre-defined filters such as Laplacian easily.
You can use the RMEM 1 command to call the current setting value.



Note

When used in conjunction with partial scan mode, noise may occur in the last line due to the fact that 3 × 3 pixel data is used for conversion.
Adjust the ending position for partial scan reading, and use data that does not include noise.

5.6.1. Mode 1

Use FILTER to specify the parameters for the coordinates and coefficient of 3 × 3 squares. The coordinates of the factor are as shown below.

11	21	31
12	22	32
13	23	33

■ Setting example
(a) Secondary differentiation (Laplacian) filter of 8 proximity
This filter detects an edge-a point where the contrast is changed like the outline of the object in the picture.

1	1	1
1	–8	1
1	1	1

(b) Image sharpening filter

Parts where the density varies such as edges are emphasized by subtracting the secondary differentiation from the target image. The following filter multiplies the Laplacian filter of 8 proximity by a weighting coefficient of 0.111, and then subtracts the value from the original image, so the edges are emphasized while controlling the sharpness level.

–0.111	–0.111	–0.111
–0.111	1.888	–0.111
–0.111	–0.111	–0.111

5.6.2. Mode 2

Six patterns have been provided.

	Filter type **Effect**	**Factor**		
1	Laplacian filter of 8 proximity Detects edges.	1	1	1
		1	–8	1
		1	1	1
2	Laplacian filter of 4 proximity Detects edges.	0	1	0
		1	–4	1
		0	1	0
3	Moving average filter Blurs the image.	0.111	0.111	0.111
		0.111	0.111	0.111
		0.111	0.111	0.111
4	Weighted average filter Blurs the image.	0.062	0.125	0.062
		0.125	0.250	0.125
		0.062	0.125	0.062
5	↓ direction edge detection filter Detects top/bottom LowToHi pixels.	–1	–1	–1
		0	0	0
		1	1	1
6	→ direction edge detection filter Detects left/right LowToHi pixels.	–1	0	1
		–1	0	1
		–1	0	1

5.7. Binarization

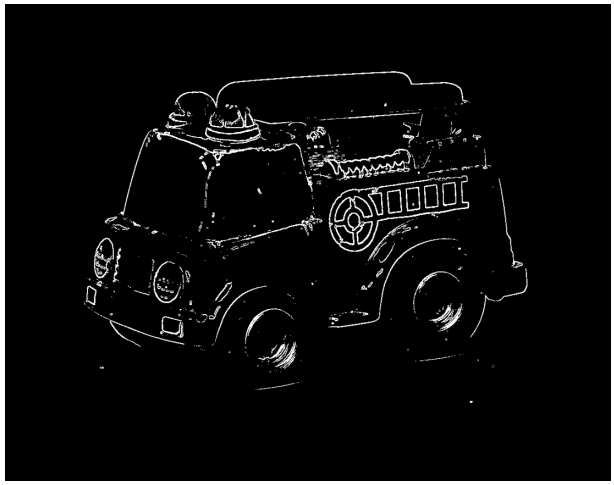
Configure this setting with BINARIZE. This setting performs the binarization processing. You can set the threshold value within the range of 16 to 243 (when 8 bits). If the image output bit is changed, the setting ranges for the threshold value will be 64 to 975 (when 10 bits) and 256 to 3800 (when 12 bits).

Note

When setting the parameter, convert the threshold value setting into a value of 12 bits even if you use the camera in 8 bits or 10 bits.

Reference

The edge detection image can be emphasized by using a combination of edge detection and binarization processing.

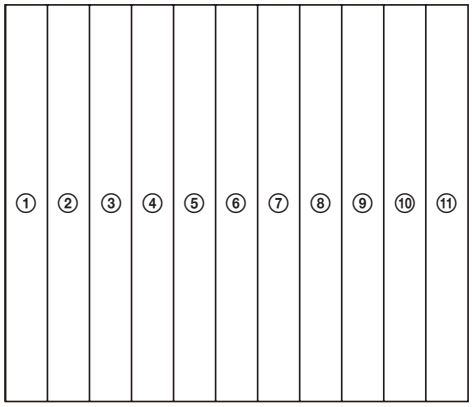


5.8. 8/10/12 bit depth selection

Configure this setting with BIT-DEPTH. You can select 8-bit output, 10-bit output, and 12-bit output.

5.9. Grayscale chart

Configure this setting with GRAYSCALE. This setting outputs the grayscale chart in the camera instead of video signals. This is common for all modes. It can be used to, for example, set the condition and check the level in the current usage environment.



Block	Level (12 bits)	Width [Pixel]	Height [Pixel]
①	250	148	1200
②	640	145	
③	1030		
④	1420		
⑤	1810		
⑥	2200		
⑦	2590		
⑧	2980		
⑨	3370		
⑩	3760		
⑪	4095	147	

General

The XCL-U100 can be controlled externally via a serial communication using such communication software as “HyperTerminal” or “Tera Term”.

Serial Communication Specifications

The serial communication system is an asynchronous method compliant with RS-232C. The following table shows the transmission control specifications.
Command inputs are echoed back.

Baud rate	57600 / 38400 / 19200 / 9600 [bps] Default setting: 38400 [bps]
Data bit	8
Parity	None
Stop bit	1
Flow control	None

Command system

Command category	Explanation
Camera control command	Controls the camera.
Setting value control command	Controls setting data saved inside the camera.

Command format

To input or send a command, input a command name and concomitant parameters setting off with spaces, and press [Enter] (Carriage Return) key.
The following are input format and input examples.
<Input format>

```
command param1 param2 param3[enter]
```

<Input example>

```
PARTIAL 1 100 699<CR>
```

Note

Do not omit a command and parameters before the last one. But the parameter stated inside the double brackets like ([Parameter]) can be omitted.
Regarding the parameter without setting value, it will be processed in the present value.

- Input alphabets are not case-sensitive.
- Input parameters of decimal number.

Command input and response

The camera returns an echo to valid inputs: letters of the alphabet, numbers, “+”, “-”, “.”, spaces, backspaces and [Enter] (Carriage Return).
Input of letters and symbols other than those above are ignored.

- When command execution is completed normally, “OK” is displayed.
  <Input> `PARTIAL 1 100 699 <CR>`
  <Window display> `OK <CRLF>`
- When command execution is not completed normally, “ERROR STATUS” is displayed. Also, details of the execution are displayed for some commands (saying later for each command).
- If a value out of the range is input as a parameter, the input command is invalidated and “ERROR SYNTAX” is displayed.
  <Input> `PARTIAL 1 0 20 <CR>`
  <Window display> `ERROR SYNTAX <CRLF>`
- If an invalid command is input, “ERROR SYNTAX” is displayed.
  <Input> `PART 1 0 20 <CR>`
  <Window display> `ERROR SYNTAX <CRLF>`
- When [Enter] key is pressed with no command input, only the carriage return is carried out.
  When an invalid letter or symbol is input, it is ignored.

Command Specification

This section describes the details of control commands available for the XCL-U100, classified by category.

Camera control commands

The camera control commands are classified in 8 categories.

Category	Explanation
AFE	Executes setting of AFE.
Shutter/Trigger	Executes settings connected to Shutter/Trigger function.
Binarization	Executes setting of Binarization.
Digital	Executes setting connected to digital processes.
Gamma	Executes setting of Gamma correction curve.
Filter	Executes setting of Filter.
Binning/Partial	Executes settings of Binning/Partial.
IN/OUT	Executes settings connected to input/output of the camera.

All concomitant parameter values of the camera control commands are saved in the EEPROM inside the camera.

AFE Setting Command

■ Gain-Step Setting

[Command] GAIN-STEP
[Parameter 1] <Gain (0 - 18)> [dB]
[Process] Sets Gain of AFE.

■ Gain-Fine Setting

[Command] GAIN-FINE
[Parameter 1] <Gain (0 - 502)>
[Process] Divides the range from 0 to 18 dB of "Gain-Step setting" into 502 parts, and fine adjusts Gain of AFE and sets them.

■ Pedestal Setting

[Command] PEDESTAL
[Parameter 1] <Pedestal level (0 - 1023)>
[Process] Sets AFE pedestal level.

Shutter / Trigger Setting Command

■ Shutter Speed Setting

[Command] SHUTTER
[Parameter 1] <Shutter setting (0 - 16)>
0: OFF 5: 1/120 s 10: 1/5,000 s 15: 2 s
1: 1/15 s 6: 1/250 s 11: 1/10,000 s 16: Arbitrary setting
2: 1/30 s 7: 1/500 s 12: 1/7.5 s
3: 1/60 s 8: 1/1,000 s 13: 1/2 s
4: 1/100 s 9: 1/2,000 s 14: 1 s
([Parameter 2]) <Shutter speed adjusting value (0 - 60000000)>
([Parameter 3]) <Shutter speed fine adjusting (0 - 35)>
[Process] Sets the shutter speed.
If Parameter 1 is set to arbitrary setting, Parameter 2 and Parameter 3 are valid.
(When minimum) | Speed adjusting value (10) + Speed fine adjusting (0) |
(When maximum) | Speed adjusting value (60000000) + Speed fine adjusting (0) |

Note

The command varies depending on Parameter 1.
<When Parameter 1 is between 0 and 15 (OFF or preset)>
SHUTTER [Parameter 1] (Parameters 2 and 3 are unnecessary)
<When Parameter 1 is 16 (arbitrary setting)>
SHUTTER 16 [Parameter 2] [Parameter 3]

■ Trigger Mode Setting

[Command] TRG-MODE
[Parameter 1] <Mode (0 - 2)>
0: OFF
→ Normal output of moving picture
1: External trigger/Edge detection
→ Controls the shutter speed beginning exposure from the valid edge of the external trigger.
2: External trigger/Pulse width detection
→ Controls the shutter speed with the valid pulse width of the external trigger.
[Process] Sets the trigger operation mode.

■ External Trigger Pulse Polarity Setting

[Command] TRG-POL
[Parameter 1] <Mode (0 - 1)>
0: Negative
1: Positive
[Process] Specifies the polarity of the external trigger pulse.

■ External Trigger Overlap Setting

[Command] TRG-OVLP
[Parameter 1] <Mode (0 - 1)>
0: OFF
1: ON
[Process] Sets the external trigger overlap.

■ External Trigger Delay Setting

[Command] TRG-DELAY
[Parameter 1] <Mode (0 - 1)>
0: OFF
1: ON
[Parameter 2] <Start time delay (0 - 255)>
[Parameter 3] <End time delay (0 - 255)>
[Process] The camera internally delays valid pulses from external triggers.

Each parameter delays by (setting value) × clock unit (27.777 ns).

Binarization Setting Command

■ Binarization Threshold Value Setting

[Command] BINARIZE
[Parameter 1] <Mode (0 - 1)>
0: OFF
1: ON
([Parameter 2]) <Binarization threshold value (240 - 3900)>
[Process] Sets the binarization mode and the binarization threshold value.

Digital Setting Command

■ Digital Gain Setting

[Command] DGAIN
[Parameter 1] <Mode (0 - 1)>
0: OFF
1: ON
[Parameter 2] <Gain (0.000 - 15.000)>
[Process] Sets the digital gain.

■ Digital Pedestal Setting

[Command] DPEDESTAL
[Parameter 1] <Mode (0 - 1)>
0: OFF
1: ON
([Parameter 2]) <Pedestal level (0 - 2047)>
[Process] Sets the digital pedestal level.

■ Digital Clamp Setting

[Command] DCLAMP
[Parameter 1] <Mode (0 - 1)>
0: OFF
1: ON
([Parameter 2]) <Clamp adjusting value (0 - 1023)>
[Process] Sets the digital clamp and the clamp adjusting value.

Gamma Setting Command

■ Gamma Correction Mode Setting

[Command] GAMMA-MODE
[Parameter 1] <Mode (0 - 5)>
0: OFF
1: Optional setting
2: Optional setting (Setting value is not saved.)
3: Default setting
4: Gamma value setting
5: Gamma value setting (Setting value not saved.)
[Process] Sets the gamma mode.
Setting gamma mode 3 initializes LUT value.

■ LUT Value Setting (the case of gamma mode 1 and 2)

[Command] GAMMA
[Parameter 1] <IN data (0 - 4095)>
[Parameter 2] <OUT data (0 - 4095)>
[Process] Sets the LUT value optionally.

■ LUT Value Setting (When gamma modes 4 and 5)

[Command] GAMMA
[Parameter 1] <Gamma value (0.00 - 1.00)>
([Parameter 2]) <Gamma offset value (0 - 4095)>
[Process] Sets the LUT value with a gamma value.

Filter Setting Command

■ Filter Mode Setting

[Command] FILTER-MODE
[Parameter 1] <Mode (0 - 2)>
0: OFF
1: Optional setting
2: Table setting
[Process] Sets the filter mode.

■ Filter Setting (the case of filter mode 1)

[Command] FILTER
[Parameter 1] <Address (11 / 12 / 13 / 21 / 22 / 23 / 31 / 32 / 33)>
[Parameter 2] <Filter factor (± 0.000 – ±10.000)>
[Process] Sets the filter optionally.

■ Filter Setting (the case of filter mode 2)

[Command] FILTER
[Parameter 1] <Table pattern (1 - 6)>
[Process] Sets the filter table pattern.

Binning / Partial Setting Command

■ Binning Mode Setting

[Command] BINNING
[Parameter 1] <Mode (0 - 1)>
0: OFF
1: ON
[Process] Sets the binning mode.

■ Partial Scan Setting

[Command] PARTIAL
[Parameter 1] <Mode (0 - 1)>
0: OFF
1: ON
([Parameter 2]) <Read beginning point (0 - 960)>
([Parameter 3]) <Read ending point (239 - 1199)>
[Process] You can configure any position within a minimum range of 240 lines.

■ Horizontal Partial Scan Setting

[Command] HPARTIAL
[Parameter 1] <Mode (0 - 1)>

0: OFF
1: ON
[Parameter 2] <Read beginning column (0 - 1472)>
[Parameter 3] <Read ending column (127 - 1599)>
[Process] Sets the beginning column and ending column numbers for reading during horizontal partial scan operation.
Set the number of columns to read to a number between 128 and 1600.

Note

Depending on the setting for the number of lines or number columns to read, images prior to configuration may appear in the disabled image display areas. Refer to the operating instructions for the interface board, and enable compatibility with camera file settings.

IN/OUT Setting Command

■ External Trigger Signal Input Selection

[Command] EXTTRG
[Parameter 1] <Input specification (0 - 1)>
0: Camera Link
→ DIGITAL IF connector
1: DC
→ DC IN connector
[Process] Selects an input route of the external trigger signal.

■ Grayscale Output Setting

[Command] GRAYSCALE
[Parameter 1] <Mode (0 - 1)>
0: OFF
1: ON
[Process] Sets the grayscale mode.

■ DC IN Connector Signal Output Setting

[Command] WEN-STRB
[Parameter 1] <Specification for 10th pin output (0 - 2)>
0: GND output
1: DVAL output
2: EXPOSURE output
[Process] Sets the 10th pin of DC IN connector signal output specification.

■ Signal Output Bit Depth

[Command] BIT-DEPTH
[Parameter 1] <Signal Output Bit Depth (0 - 2)>
0: 12 bit output
1: 10 bit output
2: 8 bit output
[Process] Sets the signal output bit depth.

Note

This can also be changed with the IMG-WIZE command.

■ Serial Transmission Speed Setting

[Command] BRATE
[Parameter 1] <Baud rate (0 - 3)>
0: 9600 bps
1: 19200 bps
2: 38400 bps
3: 57600 bps
[Process] Sets the serial transmission speed.

Setting Value Control Command

The setting value control command controls camera setting data saved in the EEPROM inside the camera. The following list shows the contents.

Command	Explanation
Initialization of setting value	Initializes the data corresponding to the camera control command to the factory setting value.
Save setting	Writes the data corresponding to the camera control command in the EEPROM.
Read setting	Reads the data corresponding to the camera control command in the EEPROM.
Setting value accession	Sends the necessary data to the camera control application.

Setting Initialization Command

■ Initialization of Setting

[Command] INIT
[Process] Initializes the data corresponding to the camera control command to the factory setting value. However, the settings are not saved (SAVE).

Save Setting Command

■ Save Setting

[Command] SAVE
[Process] Writes the data corresponding to the camera control command in the EEPROM.
Another command is not accepted during execution of the process. After completion of execution, the following message is displayed.
"OK": Normal completion

Note

If the completion is not normal, the saved data may be damaged.

Read Setting Command

■ Read Setting

[Command] LOAD
[Process] Reads the data corresponding to the camera control command in the EEPROM.

Setting Value Accession Command

■ Setting Value Accession

[Command] RMEM

([Parameter 1]) <Setting value selection (None, 1 - 2)>

None: Camera setting value accession

1: Filter factor accession

2: LUT value accession

[Process] Sends the data which can be set by Serial communication and the camera information (version) to the camera control application. Another command is not accepted during transmission of data.

[Data transmission] Transmits data continuously in each category.

The transmitting data are shown in decimal number. The followings are transmission format and the transmission examples.

<Transmission format>

<Category>: <Data 1>, <Data 2>, <Data 3>, ..., <CRLF>

<Transmission example>

CA: 1.00 <CRLF>

AF: 0, 0, 1023, 1023, ..., <CRLF>

SH: 0 <CRLF>

⋮

OK <CRLF>

Setting Values

Category name	Content	Data number	Data
CA	Camera information	1	<Version>
AF	AFE	2	<AFE gain>, <Pedestal>
SH	Shutter	3	<Shutter speed>, <Shutter speed adjusting value>, <Shutter speed fine-adjusting>
TR	Trigger	6	<Trigger mode>, <External trigger pulse polarity>, <Trigger overlap mode>, <Trigger delay>, <Start time adjusting value>, <End time adjusting value>
BR	Binarization	2	<Binarization mode>, <Binarization threshold value>
DG	Digital	6	<Digital gain mode>, <Digital gain step>, <Digital pedestal mode>, <Digital pedestal-step>, <Digital clamp mode>, <Digital clamp-step>
GM	Gamma	1/2	<Gamma mode>, When Gamma mode 4, 5: <Gamma>, <Gamma offset>
FL	Filter	1	<Filter mode>
BN	Binning	1	<Binning mode>
PT	Partial	6	<Partial scan mode>, <Partial scan read beginning position>, <Partial scan read ending position>, <Horizontal partial scan mode>, <Horizontal partial scan beginning column number>, <Horizontal partial scan ending column number>
IO	IN/OUT	5	<Trigger signal input selection>, <Grayscale output mode>, <Signal Output Bit Depth>, <DC IN connector signal output setting>, <Serial communication speed setting>

Others

■ Version Indication

[Command] VERSION
[Process] The camera model name and the camera version are displayed.
<Input> `VERSION<CR>`
<Window display> `XCL-U100 Ver. * . **<CRLF>`
`OK<CRLF>`

■ Help Indication

[Command] HELP
[Parameter 1] <None, command name>
None: List of command names
Command name: Command details
[Process] The list of camera control commands is displayed.

Command Limitation

Even a valid parameter can be invalid in combination with some settings. In this case, the command is invalid and “ERROR STATUS” is displayed.
For details on shutter speed during partial scan, see pages 16, and 21.

Partial scan mode

BINNING	Partial scan mode
0 (OFF)	Setting is possible.
1 (ON)	Setting is not possible.

Trigger mode and pulse polarity

Shutter speed setting	Trigger mode	Pulse polarity
0 to 15	Setting is possible.	Setting is possible.
16	Setting is not possible.	Setting is not possible.

Command List

The following is the list of camera control commands.

Command	Parameter 1	Parameter 2	Parameter 3	Explanation
GAIN-STEP	Gain	–	–	Gain-step setting
GAIN-FINE	Gain	–	–	Gain-fine setting
PEDESTAL	Pedestal level	–	–	Pedestal level setting
DGAIN	Mode	Gain	–	Digital gain mode setting
DPEDESTAL	Mode	Pedestal level	–	Digital pedestal setting
DCLAMP	Mode	Clamp level	–	Digital clamp level setting
SHUTTER	Shutter setting	Shutter adjusting value	Shutter fine adjusting	Shutter speed setting
TRG-MODE	Mode	–	–	Trigger mode setting
TRG-POL	Pulse polarity	–	–	External trigger polarity setting
TRG-OVLP	Mode	–	–	Trigger overlap mode setting
TRG-DELAY	Trigger delay	Start time adjusting value	End time adjusting value	Trigger delay time setting
GAMMA-MODE	Mode	–	–	Gamma mode setting
GAMMA (MODE1, 2) (MODE4, 5)	 IN data change point Gamma value	 OUT data change point Gamma offset value	– – –	 LUT value setting LUT value setting
FILTER-MODE	Mode	–	–	Filter mode setting
FILTER (MODE1) (MODE2)	 Address Table pattern	 Filter factor –	 – –	 Filter table setting Filter table pattern setting
BINARIZE	Mode	Binarization threshold value	–	Binarization mode, Binarization threshold value setting
BINNING	Mode	–	–	Binning mode setting
PARTIAL	Mode	Read beginning position	Read ending position	Partial scan setting
HPARTIAL	Mode	Read beginning column number	Read ending column number	Horizontal partial scan setting
EXTTRG	Trigger selection	–	–	External trigger signal input selection
GRAYSCALE	Mode	–	–	Grayscale output setting
WEN-STRB	Signal output selection	–	–	DC IN connector signal output setting
BIT-DEPTH	Bit depth selection	–	–	Bit depth setting for signal outputs
BRATE	Baud rate setting	–	–	Serial communication speed setting
INIT	–	–	–	Initialization of setting
SAVE	–	–	–	Save setting
LOAD	–	–	–	Read setting
RMEM	Setting value selection	–	–	Setting value acquisition
VERSION	–	–	–	Version indication
HELP	None (command)	–	–	Help list (details) indication

Parameter List

The following is the camera initial value parameter list.

Command	Parameter 1	Parameter 2	Parameter 3	Explanation
GAIN-STEP	0	–	–	Gain-step setting
GAIN-FINE	0	–	–	Gain-fine setting
PEDESTAL	1023	–	–	Pedestal level setting
DGAIN	0 (OFF)	01.000	–	Digital gain mode setting
DPEDESTAL	0 (OFF)	1023	–	Digital pedestal setting
DCLAMP	0 (OFF)	1023	–	Digital clamp level setting
SHUTTER	0	–	–	Shutter speed setting
TRG-MODE	0 (OFF)	–	–	Trigger mode setting
TRG-POL	1: Positive polarity	–	–	External trigger polarity setting
TRG-OVLP	0 (OFF)	–	–	Trigger overlap mode setting
TRG-DELAY	0 (OFF)	000	000	Trigger delay time setting
GAMMA-MODE	0 (OFF)	–	–	Gamma mode setting
FILTER-MODE	0 (OFF)	–	–	Filter mode setting
BINARIZE	0 (OFF)	1911	–	Binarization mode, Binarization threshold value setting
BINNING	0 (OFF)	–	–	Binning mode setting
PARTIAL	0 (OFF)	0	1199	Partial scan setting
HPARTIAL	OFF	0	1599	Horizontal partial scan setting
EXTTRG	0: DIGITAL IF connector	–	–	External trigger signal input selection
GRAYSCALE	0 (OFF)	–	–	Grayscale output setting
WEN-STRB	0: GND output	–	–	DC IN connector signal output setting
BIT-DEPTH	2: 8 bit	–	–	Bit depth setting for signal outputs
BRATE	2: 38400 bps	–	–	Serial communication speed setting

Specifications

Imaging system

Pickup device Progressive scan 1/1.8 type CCD
Effective pixels 1628 × 1236 (horizontal/vertical)
CCD vertical drive frequency
18.75 kHz
CCD horizontal drive frequency
36.0 MHz
Cell size 4.4 × 4.4 µm (horizontal/vertical)
Chip size 8.5 × 6.8 mm (horizontal/vertical)

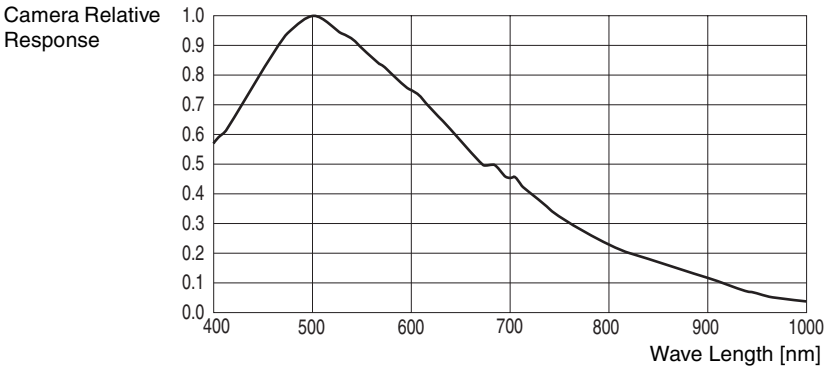
Optical system and others

Lens mount C-mount
Flange focal length
17.526 mm
Synchronization
Internal
Video output LVDS 8 bits (default setting)/10 bits/12 bits switching
Reference video output level
235 steps (8 bits) /
940 steps (10 bits) /
3760 steps (12 bits)
Reference pedestal level
16 steps (8 bits) /
64 steps (10 bits) /
256 steps (12 bits)
Range of guarantee video output
16 to 243 steps (8 bits) /
64 to 975 steps (10 bits) /
256 to 3900 steps (12 bits)
Output signal frequency
15 Hz (normal mode)
Effective lines 1600 × 1200 (horizontal/vertical)
Sensitivity 400 lx, F5.6 (0 dB)
Minimum illumination
1 lx (with the gain control at +18 dB, F1.4)
Gain 0 to +18 dB
Gamma correction
OFF/ON (Mode 1 to 5)
Read mode normal/binning
Shutter External trigger shutter
Shutter speed External trigger shutter: 2 to 1/10,000 s.
Power +12 V DC (10 to 15 V: with DC IN connector/ 10 to 13 V: with DIGITAL IF connector)
Performance guarantee temperature
0 to +40 °C (32 to 104 °F)
Power consumption
2.2 W
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 Hz to 200 Hz)
Shock resistance
70 G
External dimension (w/h/d)
29 × 29 × 30 mm (1 3/16 × 1 3/16 × 1 3/16 inches)
Mass Approx. 55 g (1.9 oz)
MTBF 83,100 hours (Approx. 9.5 years)
Accessories Lens mount cap (1)
Operating Instructions (1)

Design and specifications are subject to change without notice.

IMPORTANT
The nameplate is located on the bottom.

Spectral Sensitivity Characteristics (Typical Values)



(Lens characteristics included, and light source characteristics excluded.)

XCL-U100 Dimensions