Image sensor module

C15821-2351

Built-in CCD linear image sensor, CameraLink interface

The C15821-2351 is an image sensor module with a built-in CCD linear image sensor. This product consists of a driver circuit, controller, etc. It outputs analog video signals from CCD linear image sensor as digital output. From a PC connected via CameraLink interface, various settings can be made, and images can be acquired.

Features

- **High-speed line rate: 70 kHz**
- **Number of pixels: 2048 pixels (512 pixels × 4 taps)**
- **Single 12 V supply voltage operation**
- **High near infrared sensitivity (>60%, λ=850 nm)**
- **CameraLink interface**

Applications

- **SD-OCT (spectral domain-optical coherence tomography)**

Built-in sensor

CCD linear image sensor				
Type no.	Spectral response range (μm)	Number of effective pixels (ch)	Pixel size (μm)	Maximum line rate (kHz)
S15729-01	0.4 to 1.1	2048	10 × 180	70

Structure (Typ. Ta=25 °C, unless otherwise noted)

Parameter	Specification	Unit
Output type	Digital	-
A/D resolution	12	bit
Weight	Approx. 260	g

Absolute maximum ratings (Typ. Ta=25 °C, unless otherwise noted)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	Vs		-0.3	-	17	V
Operating temperature	Topr	No dew condensation[1]	0	-	50	°C
Storage temperature	Tstg	No dew condensation[1]	-20	-	70	°C

*1: When there is a temperature difference between a product and the surrounding area in high humidity environments, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.

Note: Exceeding the absolute maximum ratings even momentarily may cause a drop in product quality. Always be sure to use the product within the absolute maximum ratings.

Recommended operating conditions

Parameter	Symbol	Condition	Value	Unit
Supply voltage	Vs	Ta=25 °C	+12.0	V
Operating temperature	Topr	No dew condensation	0 to +40	°C

Electrical and optical characteristics (Ta=25 °C, unless otherwise noted)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	Vs		+11.5	+12.0	+12.5	V
Readout frequency*2	fop		-	42.5	-	MHz
Line rate	LR		0.6	-	70	kHz
Conversion gain	Gc		-	24.4	-	e$^-$/ADU
Current consumption	Ic	LR=70 kHz	-	450	500	mA
Integration time	Texp		14.24	-	1542	µs
Readout noise	Nread	LR=70 kHz	-	1.6	-	ADU rms
Saturation output*3	Dsat		-	-	4095	ADU
Dynamic range*4	Drange		-	2550	-	-

*2: Fixed value
*3: The data bit is 12-bit.
*4: Quotient of saturation output divided by readout noise
   Drange = Dsat/Nread

Function

Parameter		Specification
Operation mode*5 *6	Internal synchronization mode	Data is acquired according to the trigger timing from the application software.
	External synchronization mode 1	Data is acquired according to the trigger timing from the application software and the external trigger timing from a CameraLink connector.
	External synchronization mode 2	
	External synchronization mode 3	
Gain adjustment		The value can be adjusted in the range of 1 to 32 in 1 step. The default value is 1.
Offset adjustment		The value can be adjusted in the range of 0 to 511 in 1 step. The default value is 10.
Sensitivity correction*7		Simple linear function correction can be performed. Correction data = ax + b (a: correction factor, b: correction constant, x: acquired data) The range of settings for a is 0.744 to 1.255 and for b is -2048 to +2047.

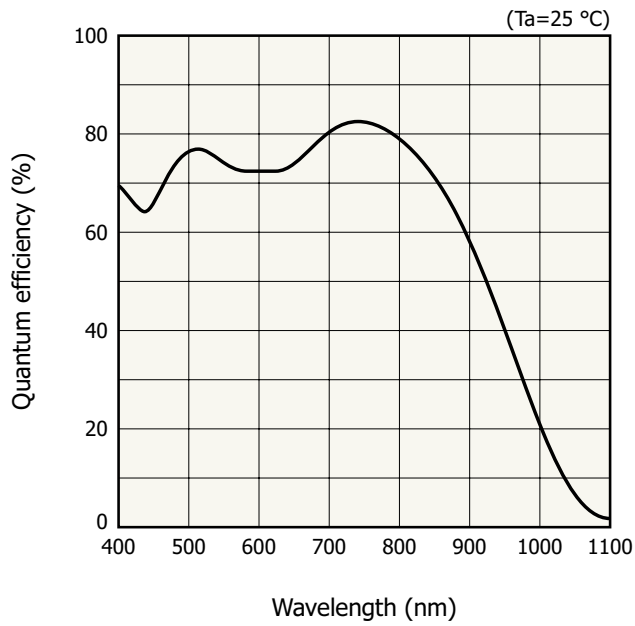*5: For the detailed timing of each mode, see the timing chart.
*6: The functions of the external trigger are as follows.
   CC1: Input an external trigger to the image sensor module from the CC1 terminal of the CameraLink connector, through the frame grabber board. The external trigger controls integration start timing.
   CC2: Input an external trigger to the image sensor module from the CC2 terminal of the CameraLink connector, through the frame grabber board. The external trigger controls the integration time and number of lines measured.
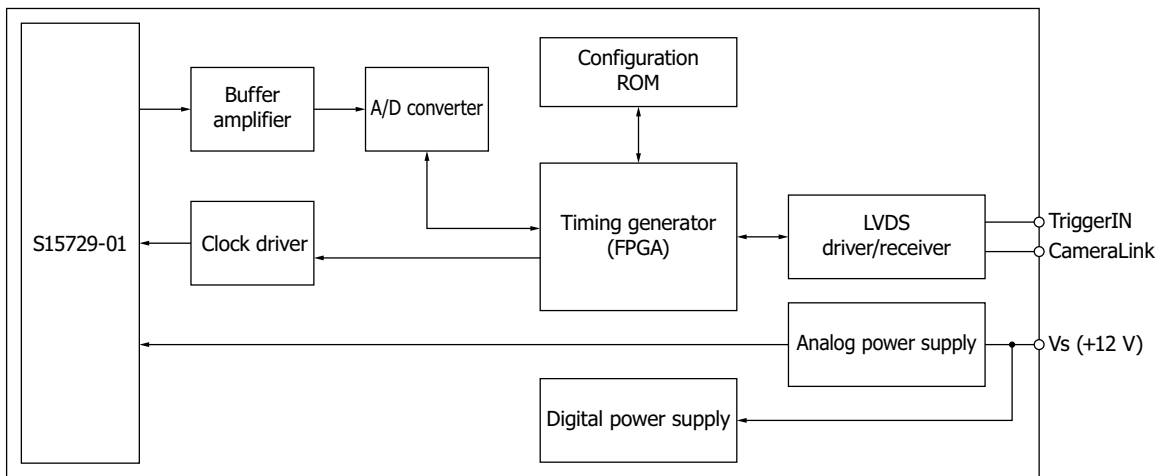*7: The C15821-2351 can save correction data to internal memory. After setting correction, whether to enable or disable correction can be selected.

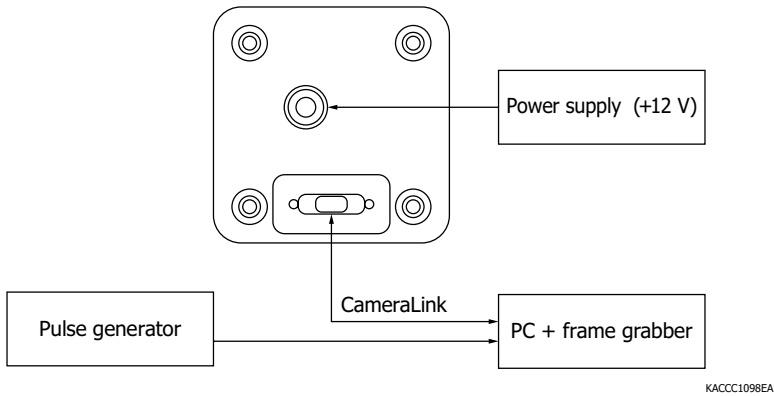## Spectral response (S15729-01, typical example)

(Ta=25 °C)

Quantum efficiency (%) vs Wavelength (nm)

KMPDB0611EA

Block diagram

Buffer amplifier → A/D converter

Configuration ROM

S15729-01

Clock driver

Timing generator (FPGA)

LVDS driver/receiver → TriggerIN / CameraLink

Analog power supply → Vs (+12 V)

Digital power supply

KACCC1097EA

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Connection example

KACCC1098EA

· Use the supplied power cable. Hamamatsu cannot ensure its warranty if other power cables are used.
· Be careful not to make the wrong connection to an external power supply.
· Do not connect or disconnect various cables with the power supply turned on.
· In order to realize EMC, attach the ferrite core [recommendation: ZCAT2436-1330 (TDK)] near the image sensor module in the power cable, then wrap the cable around the ferrite core twice.
· Use a frame grabber with a maximum pixel clock frequency of 85 MHz.
· We recommend the following CameraLink cables for connection to PCs.
CameraLink cable (Daitron)
CameraLink standard: CL, cable length: 2 m or shorter, connector shape: CS (Mini straight standard) or MD [Mini L type (DOWN) - Standard]

· If the cable is too long, the waveform may be blunted, making it impossible to obtain normal data.

Timing chart

KACCC1099EA
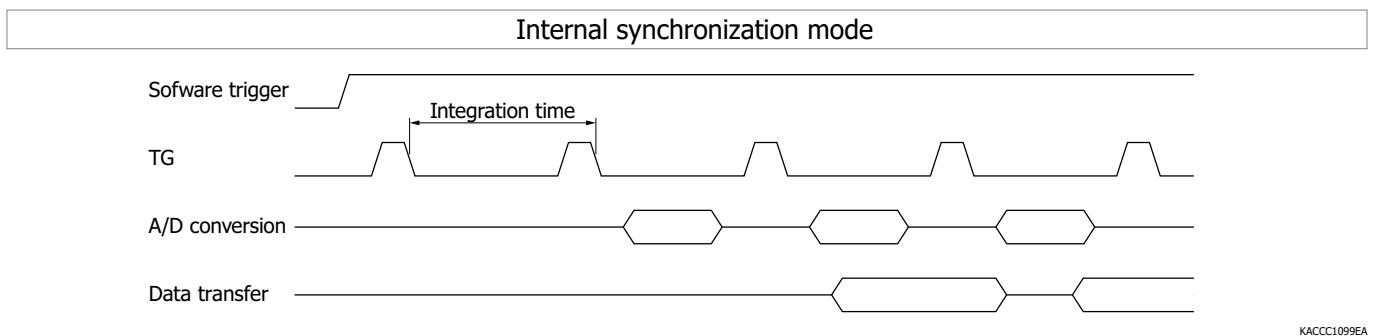
· The operation with minimum integration time is repeated until the software trigger is input.
· It starts integration when the image sensor module receives a software trigger from the application software.
· The integration time is set using application software.

External synchronization mode 1

Sofware trigger

External trigger (CC2)

TG

A/D conversion

Data transfer

Integration time (1 line)
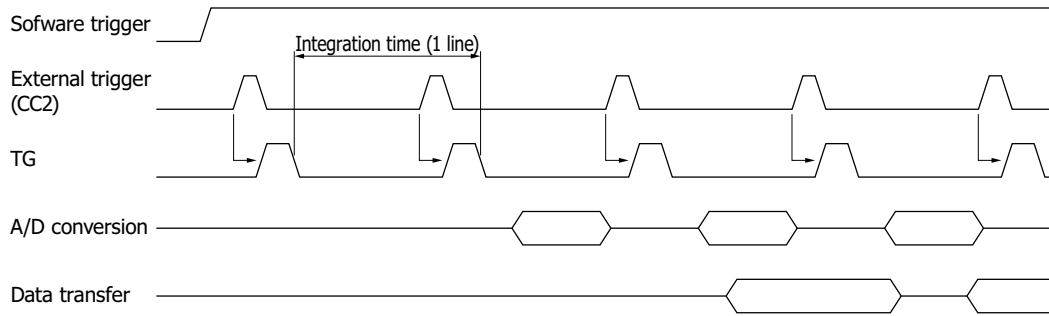
KACCC1100EA

· The charge readout operation in the minimum integration time will be repeated, and the external trigger will be disabled, until the software trigger is input.
· After the software trigger is input, data is acquired synchronizing with the external trigger input to CC2. CC1 is not used.
· Image acquisition does not start at the timing of the first external trigger input. Image acquisition starts at the timing of the second external trigger input. Integration time is determined by the cycle of the external trigger.
· The number of external triggers that must be input is the number of lines for which data is obtained + 2 (see the instruction manual for details).
· When doing a raster scan of a specific area with OCT or the like, it is necessary to input the software trigger before the external trigger (CC2) (see the following figure). The charge integrated in the line scan stop period is read out in the minimum integration time by turning off the software trigger.

Sofware trigger

External trigger (CC2)

Stop period
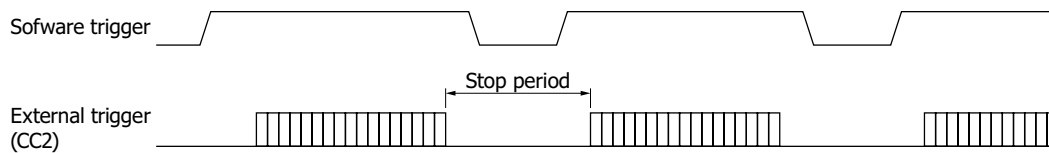
KACCC1101EA

External synchronization mode 2

Sofware trigger

External trigger (CC1)

External trigger (CC2)

TG

A/D conversion

Data transfer
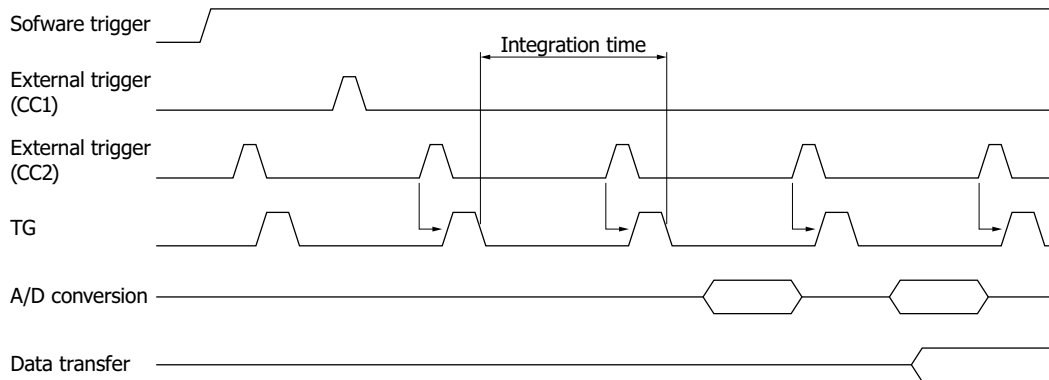
Integration time

KACCC1102EA

· To obtain data, enter the external triggers to CC1 and CC2.
· The charge readout operation in the minimum integration time will be repeated, and the external trigger will be disabled, until the software trigger is input.
· The basic operation is the same as external synchronous mode 1. Image acquisition starts at the timing of the external trigger input to CC1.
· The number of external triggers that must be input to CC2 is the number of lines for which data is obtained + 2 (see the instruction manual for details).
· Different from external synchronization mode 1, timing of image acquisition is controlled by CC1, so it is possible to input the software trigger at any time.

Sofware trigger

External trigger (CC1)

External trigger (CC2)

Stop period

KACCC1103EA

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External synchronization mode 3

Sofware trigger

External trigger (CC1)

Integration time

TG

A/D conversion

Data transfer
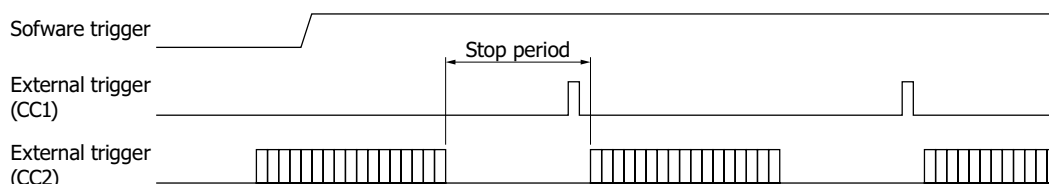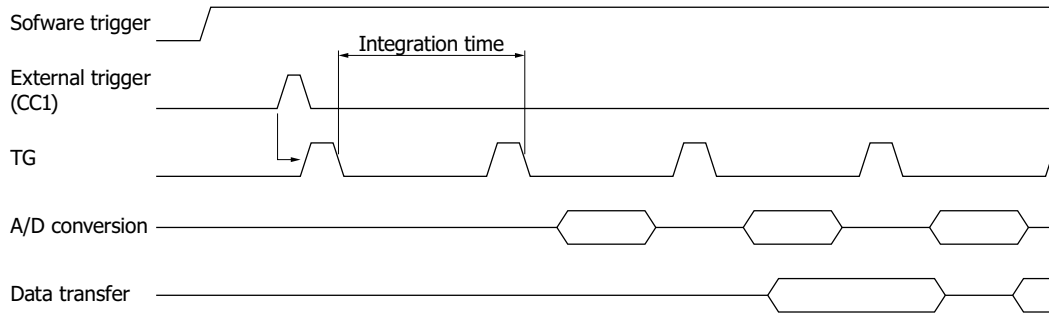
KACCC1104EA

· After the software trigger is input, data is acquired synchronizing with the external trigger input to CC1. CC2 is not used.
· The charge readout operation in the minimum integration time will be repeated, and the external trigger will be disabled, until the software trigger is input.
· When the external trigger is input, the charge readout operation starts with the integration time set using the application software. Subsequently, data acquisition is repeated for a number of lines which is set with software. Data on the line immediately after input is swept away, then data is output from the next line.

Dimensional outline (unit: mm)

60
48
44
60
48
15
Pixel no.1 (4 ×) M3 Depth6

(45.82)
(6.97) (6.3)
Focal plane

25.5
23.5
19.2
20.4
9.85
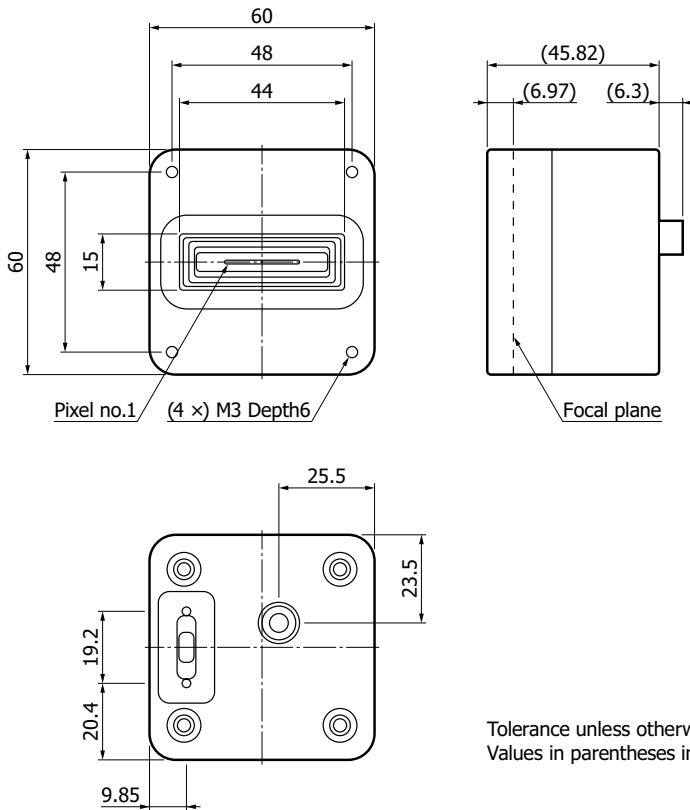
Tolerance unless otherwise noted: ±0.15
Values in parentheses indicate reference values.

KACCA0482EB

Pin layout

· Power connector Hirose HR10A-7R-6PB
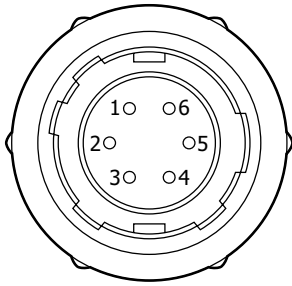
KACCC1105EA

Pin no.	Symbol
1	+12 V
2	+12 V
3	+12 V
4	GND
5	GND
6	GND

· CameraLink connector 3M 12226-1100-00 PL
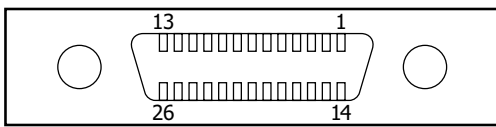
KACCC1106EA

Pin no.	Symbol	Pin no.	Symbol
1	GND	14	GND
2	X0-	15	X0+
3	X1-	16	X1+
4	X2-	17	X2+
5	Xclk-	18	Xclk+
6	X3-	19	X3+
7	SerTC+	20	SerTC-
8	SerTFG-	21	SerTFG+
9	CC1-	22	CC1+
10	CC2+	23	CC2-
11	CC3-	24	CC3+
12	CC4+	25	CC4-
13	GND	26	GND

Accessories

· Power cable (2 m)
· Application software (DCam-CL)
· Function library (SSDic.dll)
Note: A National Instrument frame grabber board and NI-IMAQ are necessary in order to use the included application software (DCam-CL) and function library (SSDic.dll). The following operation with frame grabber boards has been confirmed. Check with the manufacturer regarding frame grabber boards.

Manufacturer	Frame grabber board	Compatible OS
National Instruments	PCIe-1429	Windows® 10 (64-bit)
	PCIe-1433	

Note: Windows is a registered trademark of Microsoft Corporation in the United States and/or other countries.

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Related information

www.hamamatsu.com/sp/ssd/doc_en.html

■ Precautions
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