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Image sensor modules

C16091 series

Built-in InGaAs linear image sensor, USB 3.1 Gen 1 interface

The C16091 series is an image sensor module with an InGaAs linear image sensor. This product consists of a driver circuit, temperature controller, and high-speed communication controller, etc. It outputs analog video signals from an InGaAs linear image sensor as digital output. The driver circuit consists of an analog front end, A/D converter, and digital controller. From a PC connected via USB 3.1 Gen 1 interface, various settings can be configured, images can be retrieved, and the temperature of the InGaAs linear image sensor can be controlled.

Features

- **Compact**
- **The temperature of the InGaAs linear image sensor can be controlled.**
- **C mount lens compatible**
- **USB 3.1 Gen 1 interface**

Applications

- **Near infrared non-destructive inspection (farm product inspection, semiconductor inspection, etc.)**

Selection guide

Type no.	InGaAs image sensors (built-in)								
	Type no.	Spectral response range (μm)	Number of pixels (ch)	Pixel size (μm)	Pixel pitch (μm)	Image size (mm)	Number of ports	Cooling	Sensor cooling temperature*1 (°C)
C16091-01	G11475-256WB	0.9 to 1.85	256	50 × 250	50	12.8 × 0.25	1	Two-stage TE-cooled	-20
C16091-02	G11475-512WB		512	25 × 250	25		2		
C16091-03	G11476-256WB	0.9 to 2.05	256	50 × 250	50		1		
C16091-04	G11477-256WB	0.9 to 2.15	256	50 × 250	50		1		
C16091-05	G11477-512WB		512	25 × 250	25		2		
C16091-06	G11478-256WB	0.9 to 2.55	256	50 × 250	50		1		
C16091-07	G11478-512WB		512	25 × 250	25		2		
C16091-08	G11508-256SA	0.9 to 1.67	256	50 × 500	50	12.8 × 0.5	1	One-stage TE-cooled	-10
C16091-09	G11508-512SA		512	25 × 500	25		2		
C16091-10	G14237-512WA	0.85 to 1.4	512	25 × 500	25		2	Two-stage TE-cooled	-20
C16091-11	G11620-256SA	0.95 to 1.67	256	50 × 500	50		1	One-stage TE-cooled	-10
C16091-12	G11620-512SA		512	25 × 500	25				
C16091-13	G12230-512WB*2	0.95 to 1.65 1.4 to 2.15	512	25 × 250	25	12.8 × 0.25	1	Two-stage TE-cooled	-20

*1: Factory setup prior to shipping (can be changed with driver software)
*2: Built-in two InGaAs chips (cutoff wavelength: 1.65 μm, 2.15 μm)

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

Parameter	Specification	Unit
A/D resolution	16	bit
Interface	USB 3.1 Gen 1 (data transfer speed: 5 Gbps)	-
Internal/external trigger mode	Internal trigger mode: runs without external triggers External trigger mode: runs in sync with external triggers. Rising or falling edge selectable. Trigger level: LVTTL (0/3.3 V)	
Cooling temperature	-20 to +15	°C
Gain switching	Can be switched according to built-in sensor	-
Drive frequency switching	Can be switched between three values (1.25 MHz, 2.5 MHz, 5 MHz)	-

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

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	Vs		-0.3	-	15	V
Input signal voltage (external trigger)	Vix		-0.5	-	6.5	V
Operating temperature	Topr	No dew condensation*3	0	-	40*4	°C
Storage temperature	Tstg	No dew condensation*3	-20	-	70	°C

*3: 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.
*4: When setting the sensor cooling temperature to -20 °C, set the operating temperature to 30 °C or less.
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.

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

Parameter	Condition	Symbol	Min.	Typ.	Max.	Unit
Operating frequency		fop	-	1.25, 2, 5	-	MHz
Line rate*5	Integration time=2 µs	LR	-	-	17	klines/s
Integration time*6		-	8, 4, 2	-	30000000	µs
Noise	CE=16 nV/e⁻ Integration time=10 ms	Nread	-	4.5	-	ADU
Dynamic range	CE=16 nV/e⁻	Drange	-	14000	-	-
Conversion gain		Gc	-	47	-	µV/ADU
Input signal voltage (external trigger)		Vih	2.0	3.3	5.5	V
		Vil	-	0	0.8	V
Supply voltage		Vs	11.4	12.0	12.6	V
Current consumption		Ic	-	2	3	A
USB bus power current consumption		Ic_USB	-	560	700	mA
A/D resolution		-	16			bit
Interface		-	USB 3.1 Gen 1 (data transfer speed: 5 Gbps)			-
Trigger mode		-	Internal/External			-

*5 : 512 ch/2 ports readout or 256 ch/1 port readout
*6: The minimum integration time depends on the operating frequency (1.25 MHz: 8 µs, 2.5 MHz: 4 µs, 5 MHz: 2 µs).

Temperature controller (Ta=25 °C unless otherwise noted)

Parameter	Min.	Typ.	Max.	Unit
Sensor cooling temperature*7	-20	-	+15	°C
Temperature setting	Can be set in 1 °C step			-
Temperature accuracy*8	-1	-	+1	°C
Temperature stability*9	-0.1	-	+0.1	°C
Setting temperature achievement time	-	-	5	min

*7: Keep the difference between the setting temperature and the ambient temperature to 50 °C or less. If the temperature exceeds 50 °C, the sensor may not reach the setting temperature.
*8: Deviation of the actual temperature from the setting temperature
*9: Temperature fluctuation after temperature stabilization

Sensor gain, line rate compatibility table

Type no.	Sensor gain	Line rate
G11475-256WB	A	C
G11475-512WB		
G11476-256WB		
G11477-256WB		
G11477-512WB		
G11478-256WB		
G11478-512WB		
G11508-256SA		
G11508-512SA		
G11620-256SA		
G11620-512SA	A	D
G12230-512WB		
G14237-512WA	B	

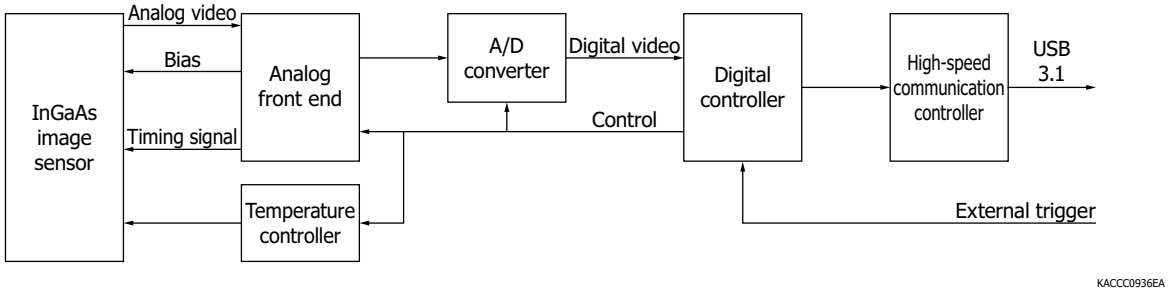
■ Sensor gain

Sensor gain	Gain 1	Gain 2	Gain 3	Gain 4
A	16 nV/e$^-$	160 nV/e$^-$	-	-
B	16 nV/e$^-$	160 nV/e$^-$	320 nV/e$^-$	930 nV/e$^-$

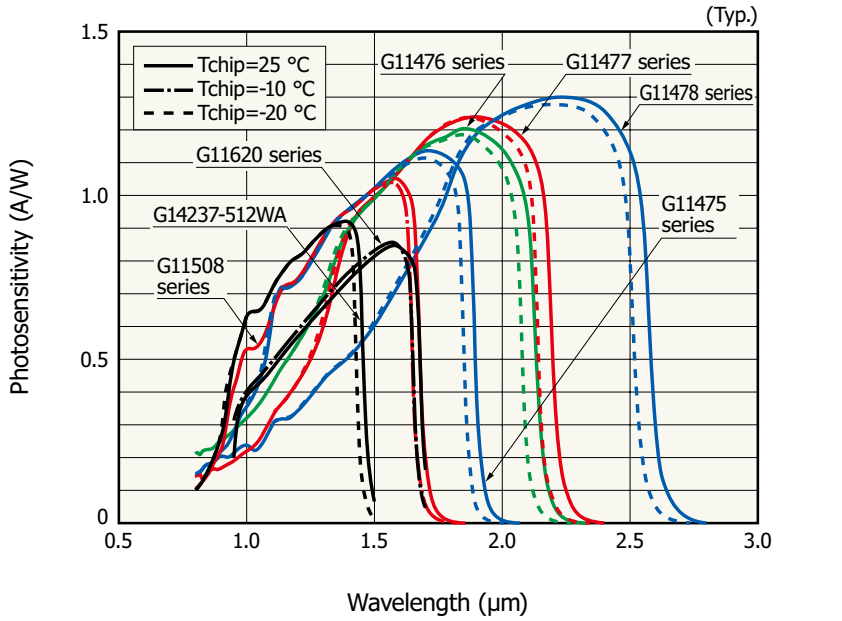
■ Line rate

Line rate	Line rate 1 fop=1.25 MHz	Line rate 2 fop=2.5 MHz	Line rate 3 fop=5 MHz
C	4.24 klines/s max.	8.47 klines/s max.	16.95 klines/s max.
D	2.27 klines/s max.	4.54 klines/s max.	9.07 klines/s max.

Block diagram

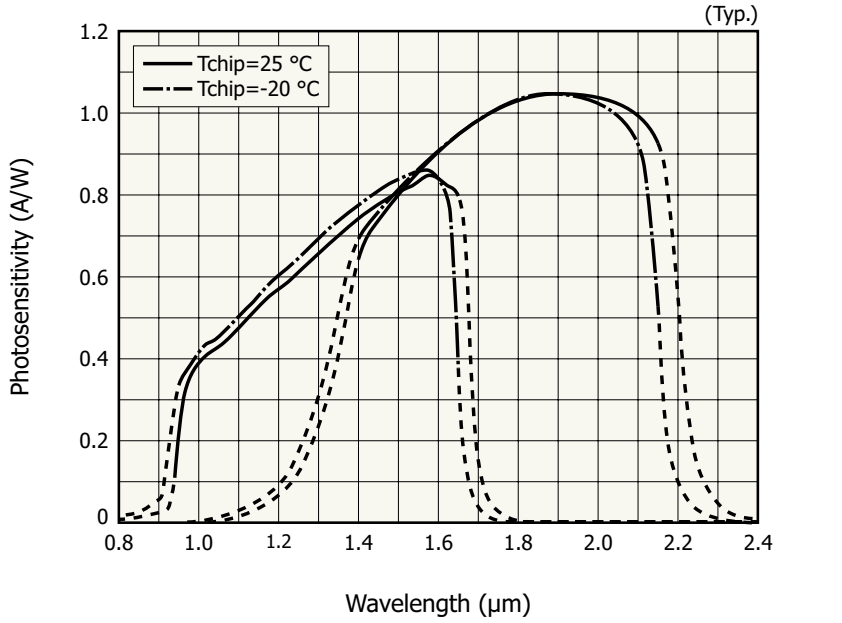


Spectral response



KMIRB0115EB

■ G12230-512WB



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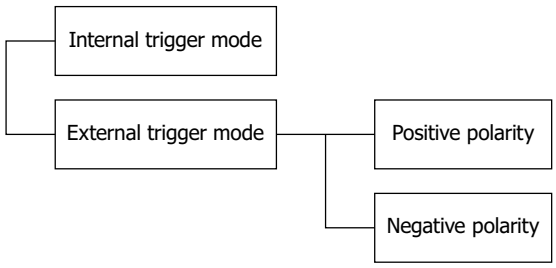
C mount

C mount lens can be attached using the C mount holder included with the product.

Imaging mode

There are two imaging modes: internal trigger mode in which the image sensor module operates by itself and external trigger mode in which the exposure timing can be set using external triggers.



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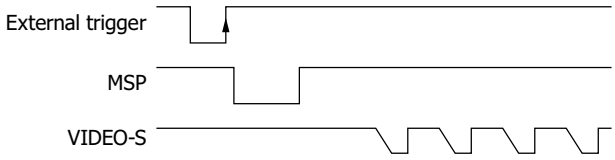
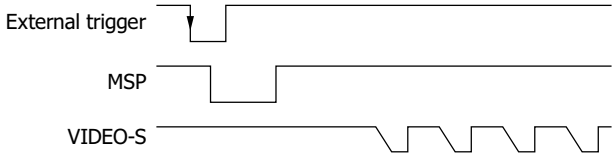
Timing chart (external trigger mode)

[Positive polarity]



[Negative polarity]



Delay time from when an external trigger is input to when exposure is started=30 ns
Jitter=±10 ns
Minimum pulse width of external triggers=100 ns

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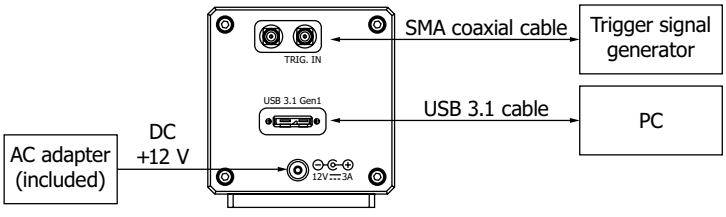
Connection example

A USB 3.1 Gen 1 interface is required on the PC. Connect to the PC using the USB 3.1 cable, and install the driver software in the PC. The digital controller runs on the bus power through the USB 3.1 cable. When the digital controller starts, the power supply input from the AC adapter turns on. Power is supplied to the analog front end and temperature controller from the AC adapter.
Connect an external trigger generator to TRIG IN using an SMA coaxial cable to use external trigger mode. Apply an LVTTL level input (3.3 V) signal.



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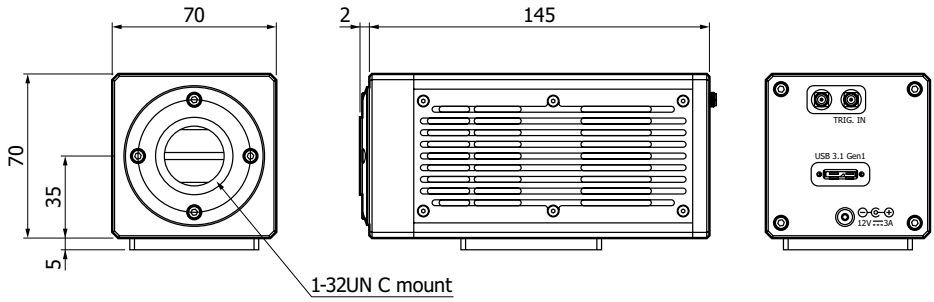
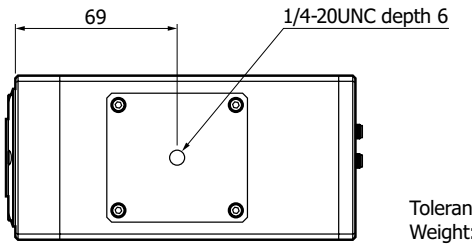
Dimensional outline (unit: mm)





Tolerance: ±1
Weight: 900 g

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AC adapter

Parameter		Specification
Input voltage, Input frequency		AC 100 to 240 V, 50 Hz/60 Hz
Output voltage, Output current		DC 12 V, 3.8 A
Cabe length	Image sensor module to adapter	1800 ± 100 mm
	Adapter to outlet	1200 ± 100 mm
Dimensions (adapter)		46.8 × 98.5 × 32.1 mm (W × D × H)
Weight		200 ± 10 g

Software

· Compatible OS: Windows 10
· DCAM-API (digital camera application programming interface): Download from http://dcam-api.com. It includes Hamamatsu driver software, DLL, and image capture software. DCAM-SDK, which includes the function manual and sample software, is available.

Note: Image processing library is not provided.

Accessories

· AC adapter
· USB cable

Related information

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

■ Precautions
· Disclaimer

Information described in this material is current as of May 2022.
Product specifications are subject to change without prior notice due to improvements or other reasons. This document has been carefully prepared and the information contained is believed to be accurate. In rare cases, however, there may be inaccuracies such as text errors. Before using these products, always contact us for the delivery specification sheet to check the latest specifications.
The product warranty is valid for one year after delivery and is limited to product repair or replacement for defects discovered and reported to us within that one year period. However, even if within the warranty period we accept absolutely no liability for any loss caused by natural disasters or improper product use.
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