

Image sensor module

C7020/C7021 series

Modules with a built-in front-illuminated CCD image sensor

C7020/C7021 series are image sensor modules with a built-in front-illuminated CCD area image sensor (S9970/S9971 series). A low-noise driver circuit is built in, allowing operation by applying simple external signals.

C7021 series have a built-in highly stable temperature control circuit, which cools the sensor to the predetermined temperature ($T_{chip} = -10\text{ }^{\circ}\text{C}$) as soon as the power is supplied. They are designed with a safety feature that automatically turns off the power via a protective circuit in the event of overheating caused by a cooler failure. The main unit has a highly effective heat dissipation structure despite its compact exterior, and is equipped with mounting holes on its front surface for attaching a spectrometer or other devices.

A controller (C7557-01) for operating these image sensor modules is also available separately. The dedicated software allows you to control the module and collect data from it via the PC.

Features

- Built-in front-illuminated FFT- CCD area image sensor*1
C7020 series: Non-cooled CCD
C7021 series: Thermoelectrically cooled CCD
- Selectable line binning*2 / area scanning operation
- Built-in dedicated driver circuit
- Highly stable temperature control method adopted (C7021 series)
- Operation via simple signal inputs
- Compact exterior

*1: FFT-CCD (full frame transfer CCD) is a type of CCD different from IT-CCD (interline transfer CCD) commonly used in video cameras, featuring a structure in which the charge transfer section also serves as the photosensitive area. Compared to IT-CCDs, it has features such as low dark current, 100% fill factor, and minimal image lag.

*2: By adding all vertically transferred charges to the corresponding horizontal register (line binning), it can operate like a linear image sensor with a large photosensitive area.

Applications

- Fluorescence spectroscopy
- Raman spectroscopy
- Other low-light-level detection

Selection guide

The following CCD area image sensors are built in.

The circuit is also available for purchase separately. Contact us for detailed information.

Type no.	Built-in CCD area image sensors				
	Type no.	Cooling	Total number of pixels	Number of effective pixels	Photosensitive area [mm (H) × mm (V)]
C7020A	S9970-0906	Non-cooled type	532 × 64	512 × 60	12.288 × 1.440
C7020B	S9970-1006		1044 × 64	1024 × 60	24.576 × 1.440
C7021A	S9971-0906	TE-cooled type	532 × 64	512 × 60	12.288 × 1.440
C7021B	S9971-1006		1044 × 64	1024 × 60	24.576 × 1.440

■ Absolute maximum ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply voltage (digital)	VD1	-0.5	-	+7	V
Supply voltage (analog)	VA1+	-	-	+18	
	VA1-	-	-	-18	
	VA2	-	-	+30	
Supply voltage*3	VD2	-	-	+7	
	Vp	-	-	+7	
	VF	-	-	+14	
Digital input voltage	-	-	-	VD (1, 2)	°C
Operating temperature*4	C7020 series	0	-	+50	
	C7021 series	+10	-	+30	
Storage temperature*4	C7020 series	-20	-	+70	
	C7021 series	0	-	+50	

*3: C7021 series

*4: No dew condensation

When there is a temperature difference between a product and the surrounding area in high-humidity environment, 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.

■ Electrical characteristics

(Ta=25 °C, VD1=+5 V, VA1+=+15 V, VA1-=-15 V, VA2=+24 V, VD2=+5 V, Vp=+5 V, VF=+12 V, unless otherwise noted)

Parameter		Symbol	Min.	Typ.	Max.	Unit
Digital input	High level	V _{IH}	+2.0	-	V _D (1, 2)	V
	Low level	V _{IL}	-0.5	-	+0.8	V
CLK frequency		f _{clk}	-	-	1	MHz
Video signal readout frequency		f _v	-	-	f _{CLK} /4	Hz
Start pulse width		t _{st}	1/f _{CLK}	-	-	s
Digital output	High level (I _o =-6 mA)	V _{IH}	+2.0	-	-	V
	Low level (I _o =+6 mA)	V _{IL}	-	-	+0.8	V
Operating power supply conditions						
Voltage	Digital	V _{D1}	+4.75	+5.0	+5.25	V
	Analog	V _{A1+}	+14.75	+15.0	+15.25	V
		V _{A1-}	-14.75	-15.0	-15.25	V
		V _{A2}	+23.75	+24.0	+24.25	V
	Others* ³	V _{D2}	+4.75	+5.0	+5.25	V
		V _p	+4.75	+5.0	+5.25	V
		V _F	+11.75	+12.0	+12.25	V
Current	V _{D1} (+5 V)	-	-	-	+200	mA
	V _{A1+} (+15 V)	-	-	-	+100	mA
	V _{A1-} (-15 V)	-	-	-	-100	mA
	V _{A2} (+24 V)	-	-	-	+30	mA
	V _{D2} (+5 V)* ³	-	-	-	+30	mA
	V _p (+5 V)* ³	-	-	-	+2.5	A
	V _F (+12 V)* ³	-	-	-	+150	mA

■ **Electrical and optical characteristics** [$T_a=25\text{ }^{\circ}\text{C}$, $T_{\text{chip}}=-10\text{ }^{\circ}\text{C}$ ($T_{\text{chip}}=25\text{ }^{\circ}\text{C}$ for C7020 series), $V_{D1}=+5\text{ V}$, $V_{A1}=+15\text{ V}$, $V_{A1}=-15\text{ V}$, $V_{A2}=+24\text{ V}$, $V_{D2}=+5\text{ V}$, $V_p=+5\text{ V}$, $V_F=+12\text{ V}$, unless otherwise noted]

Parameter	Symbol	C7020 series			C7021 series			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Spectral response range	λ	-	400 to 1100	-	-	400 to 1100	-	nm
Saturation charge	Vertical	150	300	-	150	300	-	ke^-
	Horizontal	300	600	-	300	600	-	
Conversion gain*5	S_v	-	15	-	-	15	-	$\mu\text{V}/\text{e}^-$
Saturation output voltage	V_{sat}	10	-	-	10	-	-	V
Dark current*6	D_S	-	200	3000	-	3	45	$\text{e}^-/\text{pixel}/\text{s}$
Readout noise	N_{read}	-	20	45	-	20	45	$\text{e}^- \text{ rms}$
Dynamic range	Line binning	-	30000	-	-	30000	-	-
	Area scanning	-	15000	-	-	15000	-	-
Photoresponse nonuniformity*7	PRNU	-	-	± 10	-	-	± 10	%

*5: Including circuit gain

*6: In MPP mode. Due to the binning operation, the actual value is the sum of the vertical pixels.

*7: Measured at half of the saturation charge.

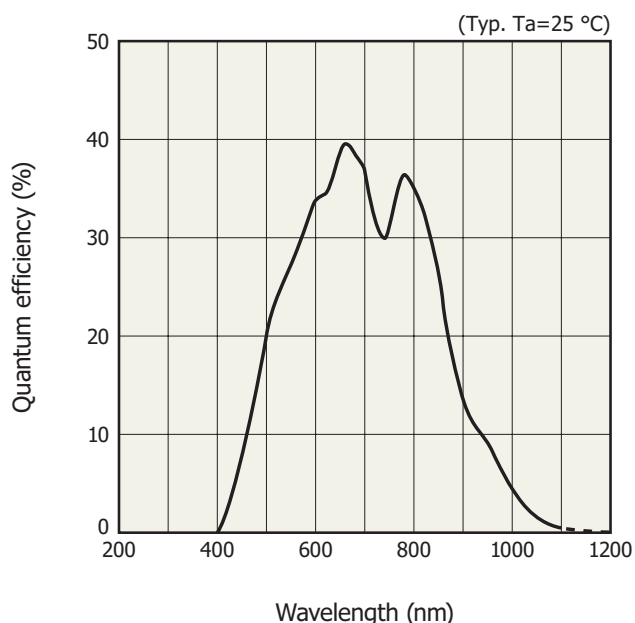
■ **Temperature controller specifications (C7021 series)**
($T_a=25\text{ }^{\circ}\text{C}$, $V_{D1}=+5\text{ V}$, $V_{A1}=+15\text{ V}$, $V_{A1}=-15\text{ V}$, $V_{A2}=+24\text{ V}$, $V_{D2}=+5\text{ V}$, $V_p=+5\text{ V}$, $V_F=+12\text{ V}$)

Parameter*8	Symbol	Min.	Typ.	Max.	Unit
Cooling temperature	T_s	-11.5	-10	-8.5	$^{\circ}\text{C}$
Control temperature range	ΔT_s	-0.05	-	+0.05	$^{\circ}\text{C}$
TE-cooler power dissipation	P_p	-	-	7	W
Setting temperature achievement time	t_o	-	-	5	minutes
Overheat protection setting temperature	T_o	-	+45	-	$^{\circ}\text{C}$

*8: In addition, the following functions are included:

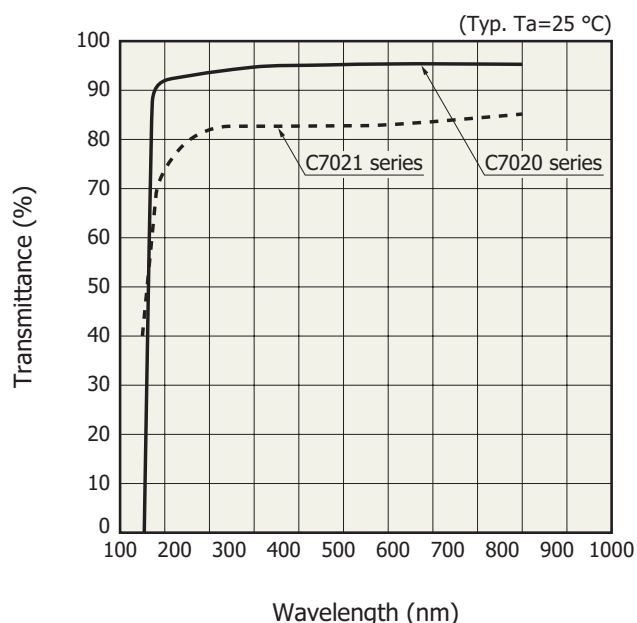
Error display, automatic power-off, detection of open or short in the temperature sensor

■ **Spectral response**
(without window, typical example)



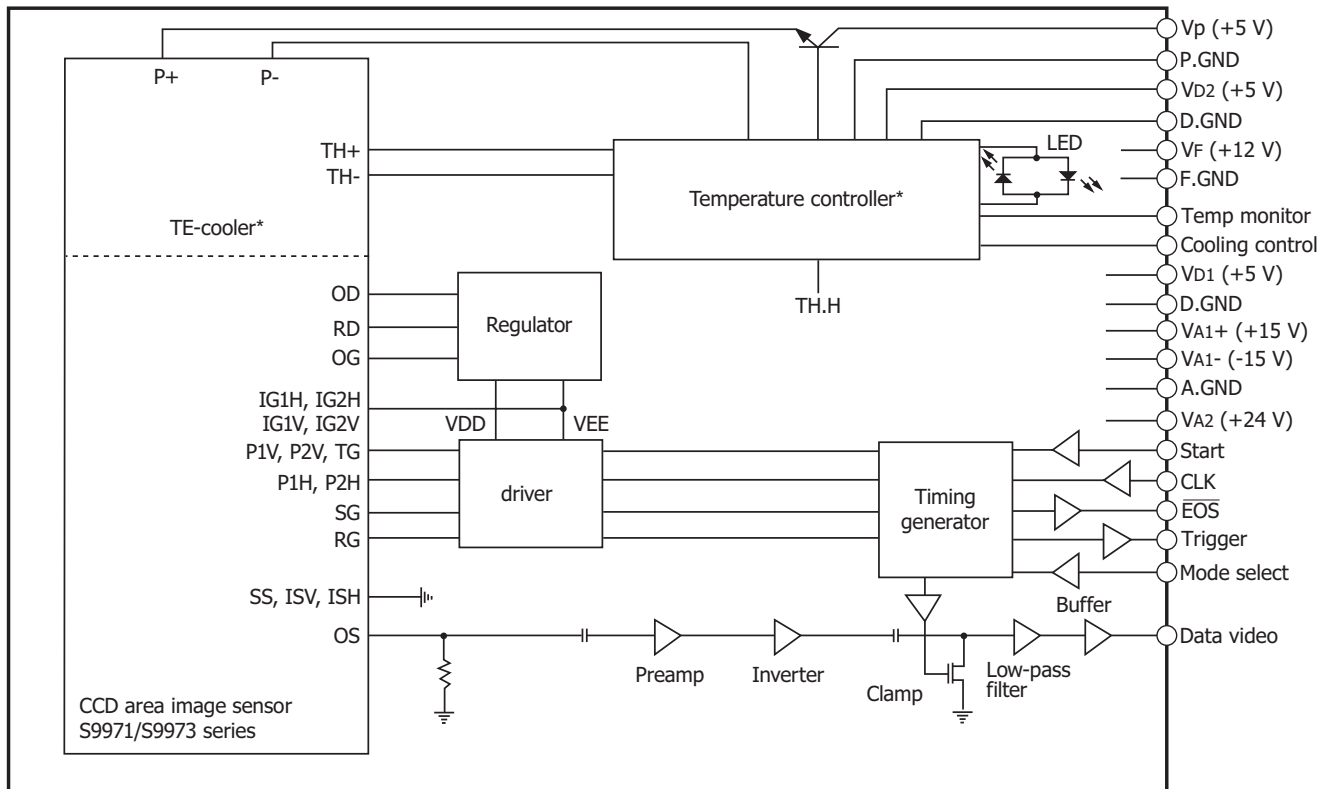
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■ **Spectral transmittance characteristics of window material**



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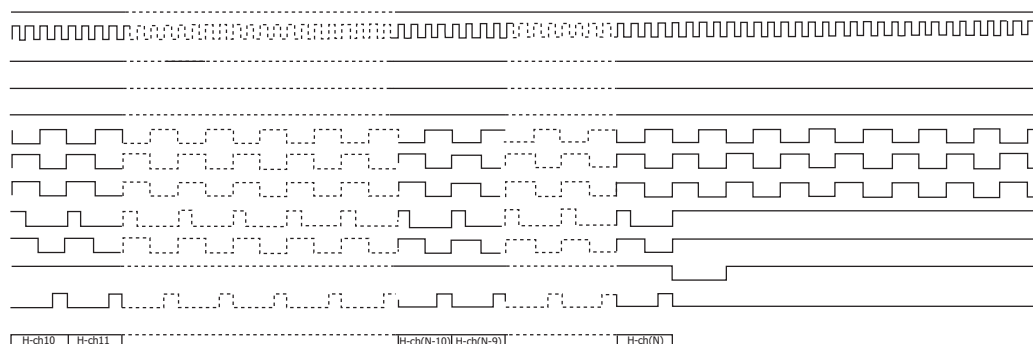
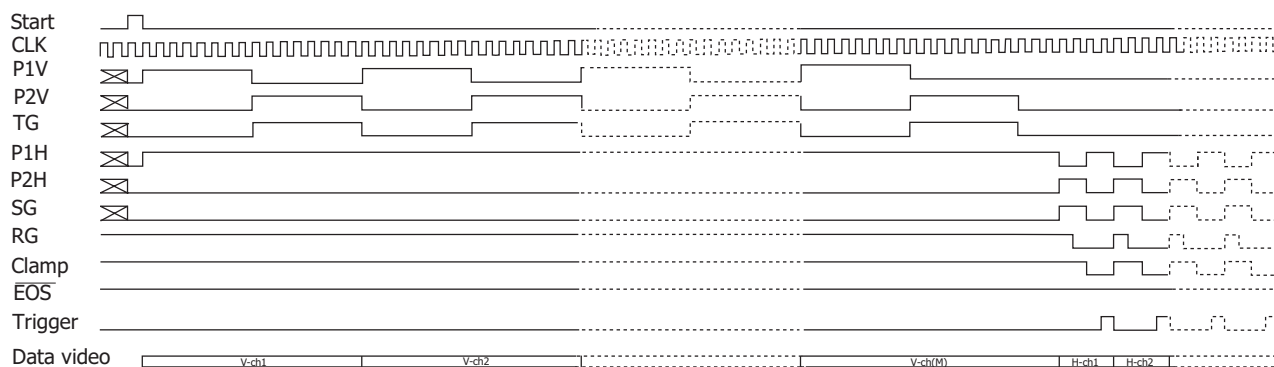
Block diagram (C7021 series)



* C7020 series does not have a temperature controller or a TE-cooler.

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Timing chart



M=64, 256 N=532, 1044

V-ch1--V-ch2, V-ch (M-1)--V-ch (M): Isolation pixels

H-ch1--H-ch4, H-ch (N-3)--H-ch (N): Blank pixels

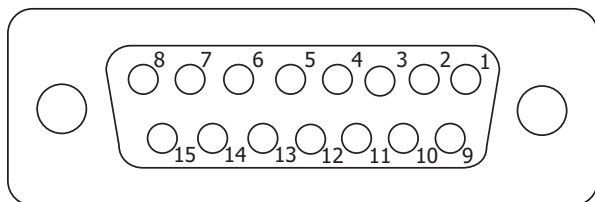
H-ch5--H-ch8, H-ch (N-7)--H-ch (N-4): Optical black pixels

H-ch9--H-ch10, H-ch (N-9)--H-ch (N-8): Isolation pixels

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Signal I/O connector pin connections

15-pin D-sub connector

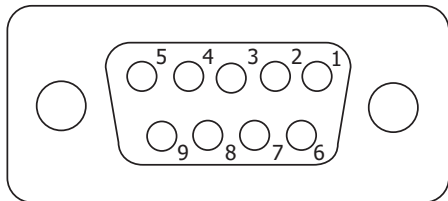


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Pin no.	Symbol	Note
1	Mode Select	Digital input signal for switching between binning and area scanning operations HCMOS compatible High level or open: Binning operation Low level: Area scanning operation
2	Data video	Analog video output signal, positive polarity
3	VA1+(+15 V)	Analog power supply
4	VA1-(-15 V)	Analog power supply
5	VD1(+5 V)	Digital power supply
6	Start	Digital input signal for circuit initialization HCMOS compatible, positive logic This pulse interval corresponds to the sensor's integration time.
7	CLK	Digital input signal for defining circuit operation HCMOS compatible, operates on the rising edge
8	EOS	Digital output signal indicating the end of CCD image sensor sweep HCMOS compatible, negative logic
9	A.GND	Analog ground
10	A.GND	Analog ground
11	VA2(+24 V)	Analog power supply
12	D.GND	Digital ground
13	D.GND	Digital ground
14	D.GND	Digital ground
15	Trigger	Digital output signal for A/D conversion, HCMOS compatible, positive logic

TE-cooling controller I/O connector pin connections (C7021 series)

9-pin D-sub connector



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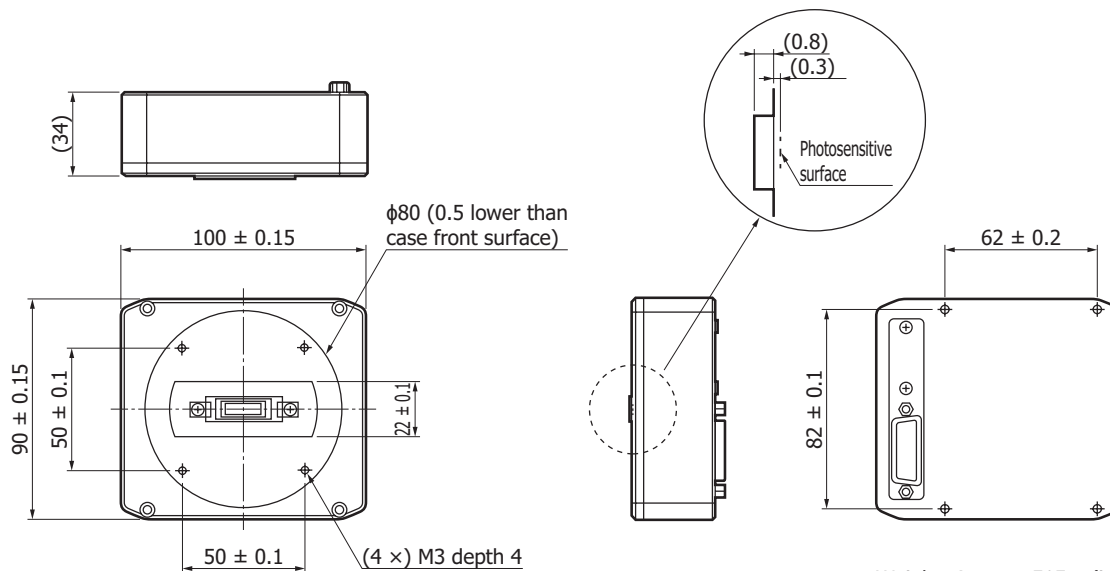
Pin no.	Symbol	Note
1	V _{D2} (+5 V)	Digital power supply
2	Temp Monitor	Analog signal output of the CCD image sensor temperature
3	Cooling Control	Digital input signal for cooling start, HCMOS compatible High level or open: Cooling Low level: Standby
4	V _p (+5 V)	Power supply for the TE-cooler inside the CCD image sensor (please use AWG 18 wire).
5	V _F (+12 V)	Power supply for cooling fan
6	D.GND	Ground
7	D.GND	Ground
8	P.GND	Power supply return for the TE-cooler inside the CCD image sensor (please use AWG 18 wire).
9	F.GND	Power supply return for the cooling fan

"V_{D2}" and "V_p" can be used with the same power supply (+5 V).

Warning: Do not connect "V_{D2}" and "V_p" on the back of the 9-pin D-sub connector. Shorting them on the power supply side is acceptable.

Dimensional outline (unit: mm)

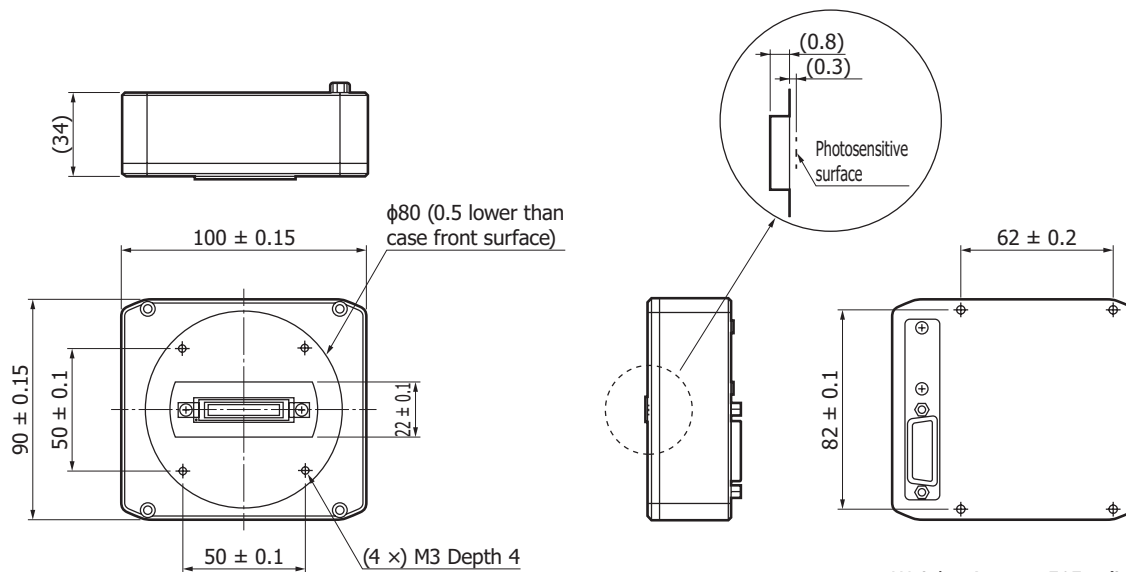
C7020A



Weight: Approx. 515 g (including the sensor)

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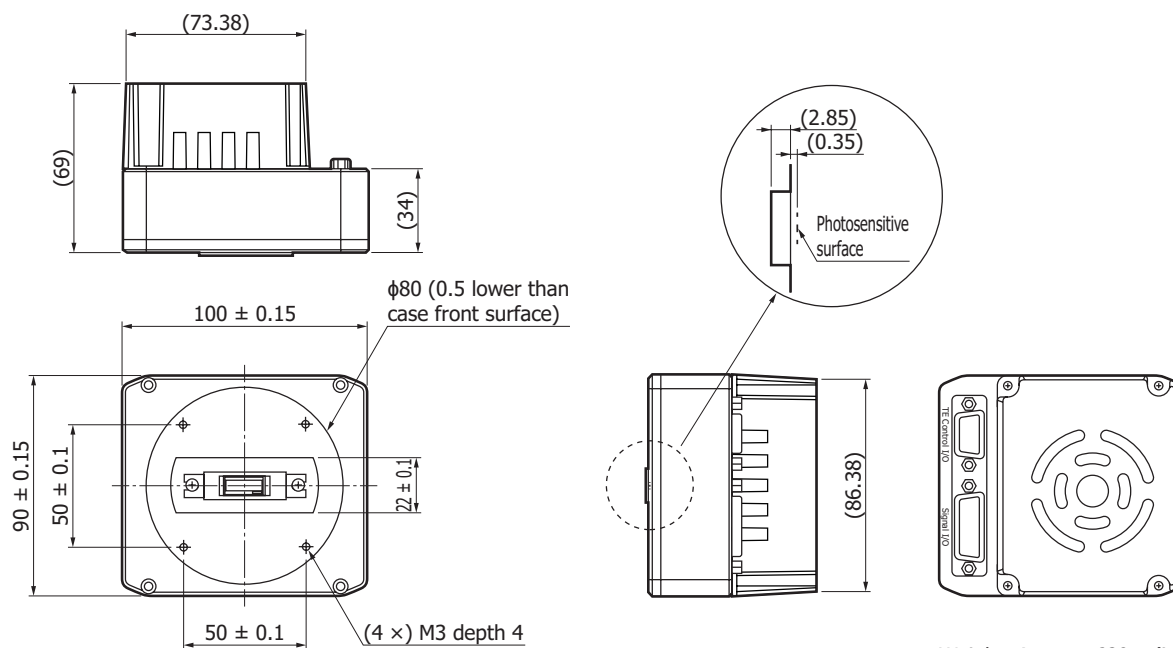
C7020B



Weight: Approx. 515 g (including the sensor)

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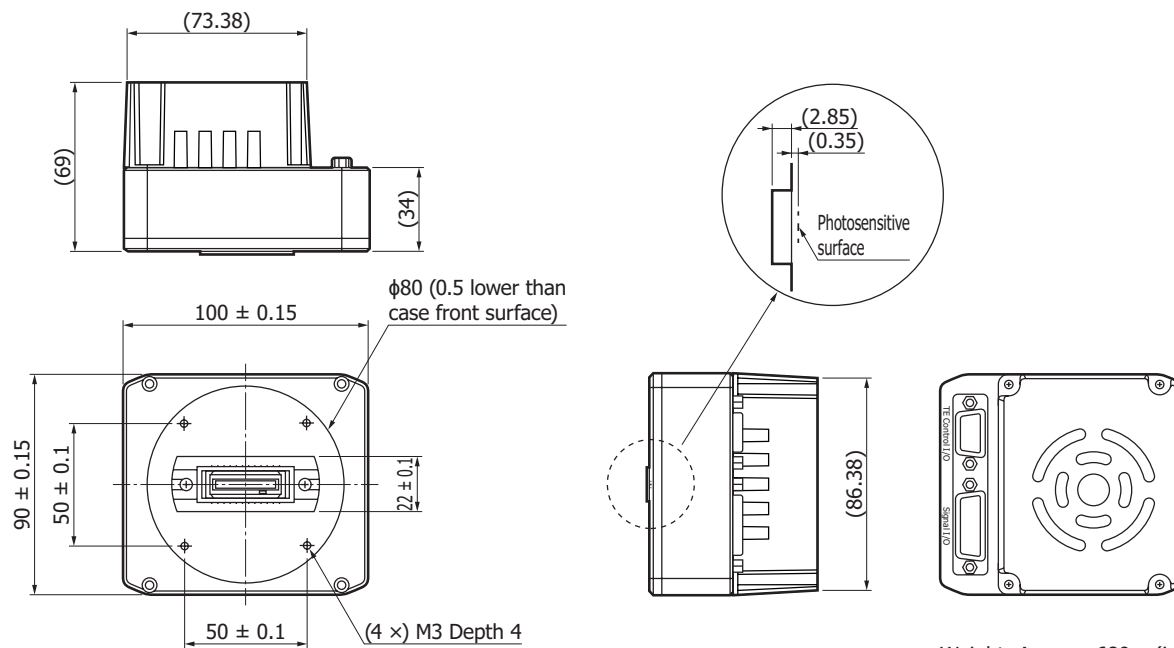
C7021A



Weight: Approx. 680 g (including the sensor)

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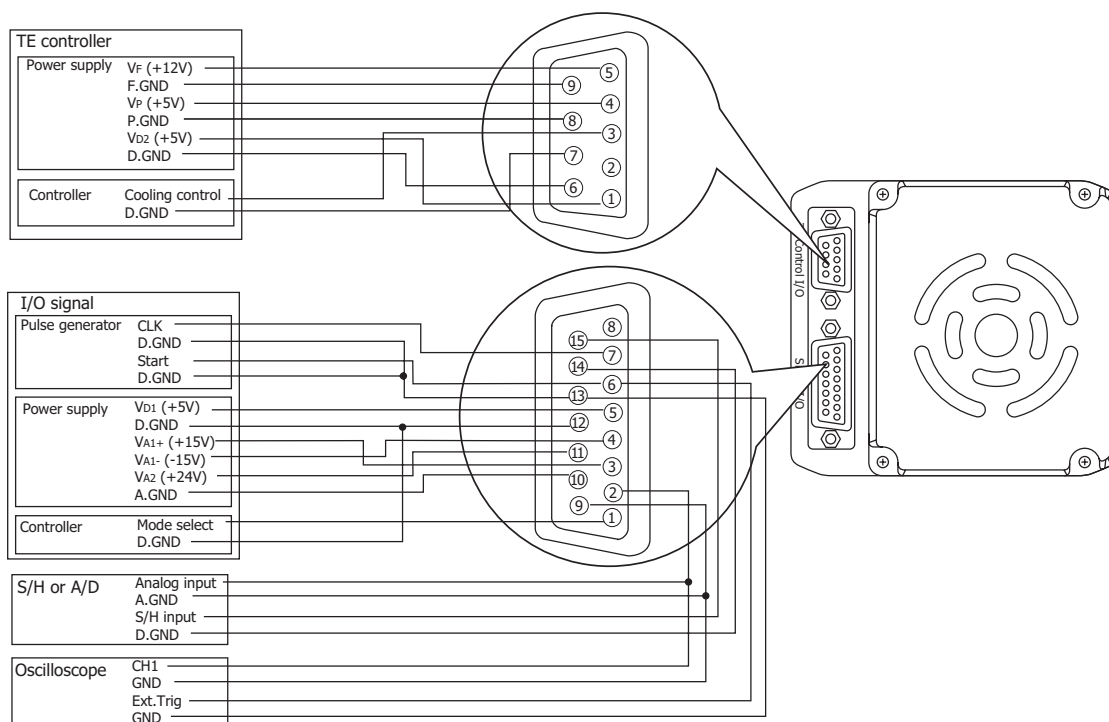
C7021B



Weight: Approx. 680 g (including the sensor)

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Connection example (C7021 series)



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Related information

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

- Precautions
- Disclaimer

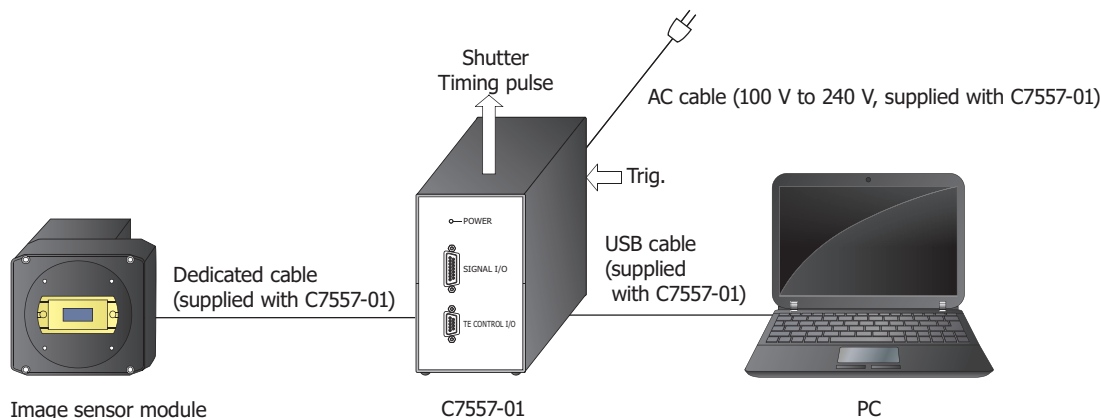
Image sensor module controller C7557-01

By connecting it to a Hamamatsu image sensor module and a PC, you can easily control the module and acquire data via the USB interface using the dedicated software.

C7557-01 accessories

- Spare fuse (2.5 A)*⁹
- AC cable
- USB cable
- Dedicated connection cable
(for the "SIGNAL I/O" and "TE CONTROL I/O" terminals of the image sensor module)
- CD-ROM (MCD USB driver, software, instruction manual)

*9: It is built in above the AC cable inlet of the C7557-01 main unit.

**Connection diagram**

Note: Shutters are not available.

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Information described in this material is current as of March 2026.

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.

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