



C7020/C7021/C7025 series

**Designed for front-illuminated CCD area image sensors**

The C7020/C7021/C7025 series are high sensitivity multichannel detector heads intended for use with front-illuminated CCD area image sensors (S9970/S9971/S9972/S9973 series). The C7020 series is designed for non-cooled CCD, while the C7021/C7025 series for thermoelectric cooled CCD. All of the C7020/C7021/C7025 series contain a low-noise driver circuit that operates on input of simple external signals. Mounting holes are provided on the front panel for attaching to other devices such as spectrometers. The C7021/C7025 series also include a highly stable temperature control circuit that cools the sensor to a preset temperature ( $T_s = -10\text{ }^\circ\text{C}$ ) as soon as the power is turned on. If the cooler fails and causes overheating, the internal protection circuit automatically turns off the power to ensure safety. Despite the compact size, the housing configuration is designed for good heat dissipation. As an option, HAMAMATSU also provides the C7557-01 controller for multichannel detector heads. Using the dedicated software for the C7557-01 allows easy control and data acquisition of a multichannel detector head from a PC.

**Features**

- **Designed for front-illuminated CCD area image sensor \*1**  
**C7020/-02: for non-cooled type**  
**C7021/-02, C7025/-02: for TE-cooled types**
- **Line binning operation \*2/area scanning operation**
- **Driver circuit for low noise CCD operation**
- **Highly stable temperature controller (C7021/-02, C7025/-02)**  
**Cooling temperature: fixed at  $-10 \pm 0.05\text{ }^\circ\text{C}$**
- **Simple signal input operation**
- **Compact configuration**

**Applications**

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

**Selection guide**

The table below shows CCD area image sensors applicable for C7020/C7021/C7025 series.  
 Since C7020/C7021/C7025 series do not include a CCD area image sensor, so select the desired sensor and order it separately.

Type No.	CCD area image sensor			
	Type No.	Number of pixels	Number of active pixels	Active area [mm (H) × mm (V)]
C7020	S9970-0906	532 × 64	512 × 60	12.288 × 1.440
	S9970-1006	1044 × 64	1024 × 60	24.576 × 1.440
	S9970-1007	1044 × 128	1024 × 124	24.576 × 2.976
	S9970-1008	1044 × 256	1024 × 252	24.576 × 6.048
C7020-02	S9972-1007	1044 × 128	1024 × 124	24.576 × 2.976
	S9972-1008	1044 × 256	1024 × 252	24.576 × 6.048
C7021	S9971-0906	532 × 64	512 × 60	12.288 × 1.440
	S9971-1006	1044 × 64	1024 × 60	24.576 × 1.440
	S9971-1007	1044 × 128	1024 × 124	24.576 × 2.976
C7021-02	S9973-1007	1044 × 128	1024 × 124	24.576 × 2.976
C7025	S9971-1008	1044 × 256	1024 × 252	24.576 × 6.048
C7025-02	S9973-1008	1044 × 256	1024 × 252	24.576 × 6.048

\*1: The FFT-CCD (full frame transfer CCD) has charge transfer sections that are also used as light receiving areas, being different from interline transfer CCD (IT-CCD) commonly used in video cameras. Compared to the IT-CCD, the FFT-CCD offers advantages of low dark current, a 100 % open area ratio and low image lag.

\*2: The FFT-CCD area image sensor can be operated like a linear image sensor having a large active area by transferring all the pixel signals in the vertical direction to the horizontal register (this is referred to as line binning).

**Absolute maximum ratings**

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply voltage (for digital circuitry)	VD1	-0.5	-	+7	V
Supply voltage (for analog circuitry)	VA1+	-	-	+18	
	VA1-	-	-	-18	
	VA2	-	-	+30	
Supply voltage *3	VD2	-	-	+7	
	Vp	-	-	+7	
	VF	-	-	+14	
Digital input voltage	-	-	-	V <sub>D</sub> (1, 2)	
Operating temperature	C7020/-02	0	-	+50	°C
	C7021/-02, C7025/-02	+10	-	+35 *3	
Storage temperature	C7020/-02	-20	-	+70	
	C7021/-02, C7025/-02	0	-	+50	

**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 <sub>IH</sub>	+2.0	-	V <sub>D</sub> (1, 2)	
	Low level	V <sub>IL</sub>	-0.5	-	+0.8	
CLK frequency	f <sub>clk</sub>	-	-	1	MHz	
Data video readout frequency	f <sub>v</sub>	-	-	f <sub>CLK</sub> /4	Hz	
Start pulse width	t <sub>st</sub>	1/f <sub>CLK</sub>	-	-	s	
Digital output	High level (I <sub>o</sub> =-6 mA)	V <sub>IH</sub>	+2.0	-	V	
	Low level (I <sub>o</sub> =+6 mA)	V <sub>IL</sub>	-	-	+0.8	
Power supply operating conditions						
Voltage	Digital circuitry	VD1	+4.75	+5.0	+5.25	V
	Analog circuitry	VA1+	+14.5	+15.0	+15.5	V
		VA1-	-14.5	-15.0	-15.5	V
		VA2	+23.5	+24.0	+24.5	V
	Other *4	VD2	+4.75	+5.0	+5.25	V
		Vp	+4.75	+5.0	+5.25	V
VF		+11.75	+12.0	+12.75	V	
Current	VD1 (+5 V)	-	-	-	+200	mA
	VA1+ (+15 V)	-	-	-	+100	mA
	VA1- (-15 V)	-	-	-	-100	mA
	VA2 (+24 V)	-	-	-	+30	mA
	VD2 (+5 V) *4	-	-	-	+30	mA
	Vp (+5 V) *4	-	-	-	+2.5	A
	VF (+12 V) *4	-	-	+100	-	mA

**Electrical and optical characteristics**

(Ta=25 °C, Ts= -10 °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	C7020, C7021, C7025			C7020-02, C7021-02, C7025-02			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Spectral response range	λ	-	400~1100	-	-	400~1100	-	nm
Full well capacity	Vertical	150	300	-	120	240	-	ke <sup>-</sup>
	Horizontal	300	600	-	240	480	-	
Conversion gain *5	S <sub>v</sub>	-	15	-	-	12	-	μV/e <sup>-</sup>
Dark current *6	C7020/-02	-	200	3000	-	2000	30000	e <sup>-</sup> /pixel/s
	C7021/-02, C7025/-02	-	3	45	-	30	450	
Readout noise	N <sub>r</sub>	-	20	45	-	60	120	e <sup>-</sup> rms
Dynamic range	Line binning	-	30000	-	-	8000	-	-
	Area binning	-	15000	-	-	4000	-	-
Photo response non-uniformity *7	PRNU	-	-	±10	-	-	±10	%

\*3: The maximum value may be lower, depending on the drive frequency and the number of sensor pixels.

\*4: C7021/C7025 series

\*5: Including the circuit gain

\*6: At MPP mode. Vertical register value. The actual value equals the sum of the vertical direction because of the binning operation.

\*7: Measured at 50 % of the full well capacity

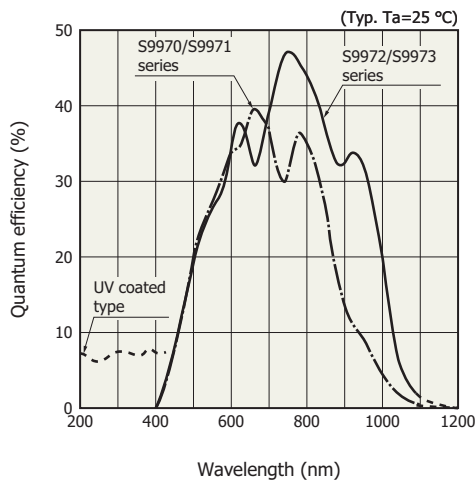
**Specifications for temperature controller (C7021/-02, C7025/-02)**

( $T_a=25\text{ }^\circ\text{C}$ ,  $V_{D1}=+5\text{ V}$ ,  $V_{A1}+=+15\text{ V}$ ,  $V_{A1}-=-15\text{ V}$ ,  $V_{A2}=+24\text{ V}$ ,  $V_{D2}=+5\text{ V}$ ,  $V_p=+5\text{ V}$ ,  $V_f=+12\text{ V}$ )

Parameter *8	Symbol	Min.	Typ.	Max.	Unit
Cooling temperature	Ts	-11	-10	-9	°C
Temperature control range	$\Delta T_s$	-0.05	-	+0.05	°C
Power dissipation of TE-cooler element	Pp	-	-	7	W
Cool down time to reset temperature	t <sub>o</sub>	-	-	5	min
Setting temperature for overheat protection	T <sub>o</sub>	-	+45	-	°C

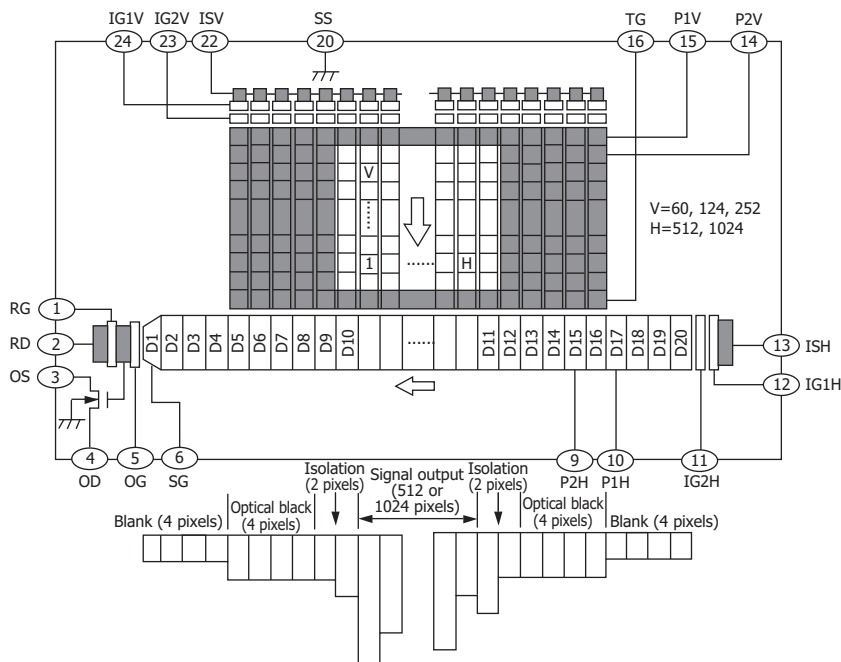
\*8: Other functions include error display, automatic power off, and detection of electrical opens and shorts by the thermosensor.

**Spectral response (without window)**



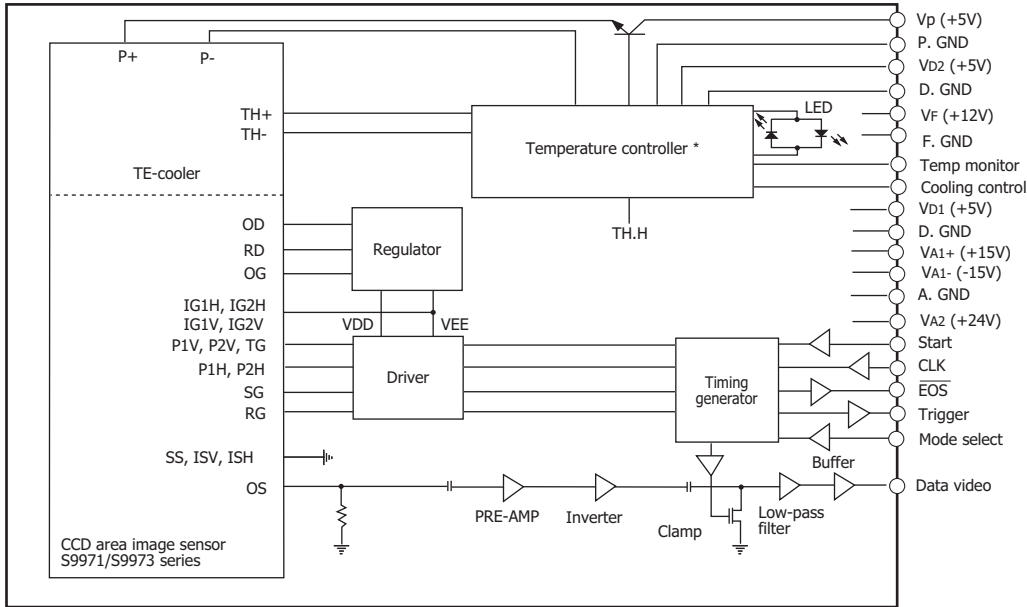
KMPDB0257ED

**Device structure (front-illuminated CCD area image sensor)**



KMPDC0015EB

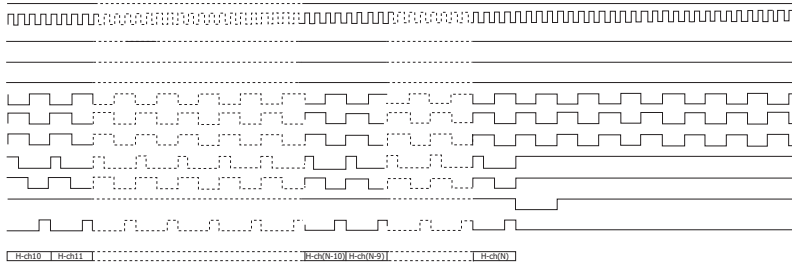
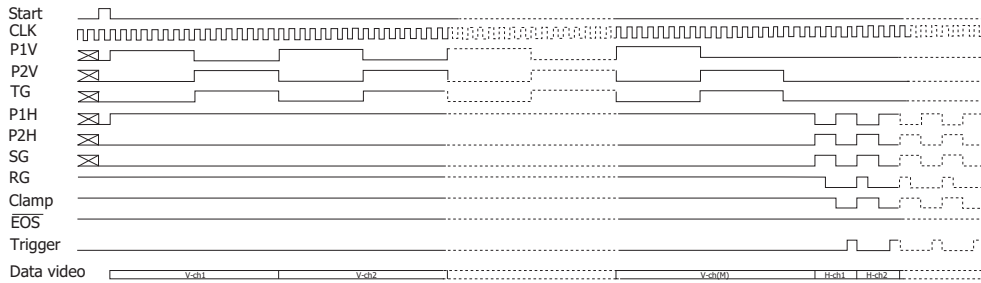
Block diagram (C7021 series, C7025 series)



\* The C7020 series does not include the temperature controller and TE-cooler.

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Timing chart

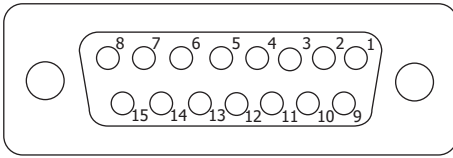


M=64, 128, 256 N=532, 1044  
 V-ch1--V-ch2, V-ch (M-3)--V-ch (M): Isolation pixels  
 H-ch1--H-ch4, H-ch (N-3)--H-ch (N): Blank pixels  
 H-ch5--H-ch10, H-ch (N-9)--H-ch (N-4): Isolation pixels

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**Pin assignment of "SIGNAL I/O" connector**

15-pin D-sub connector

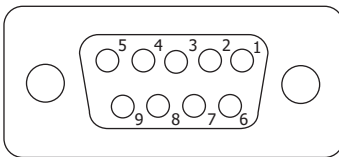


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Pin No.	Terminal name	Description
1	Mode select	Digital input signal used to select between the line binning operation and area scanning operation HCMOS compatible High level or left open: line binning operation Low level: area scanning operation
2	Data video	Analog video output. 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 initializing the circuit. HCMOS compatible. Positive logic. The interval of the start pulses determines the integration time of the CCD image sensor.
7	CLK	Digital input signal for operating the circuit. HCMOS compatible. Rising edge operation.
8	$\overline{\text{EOS}}$	Digital input signal for indicating end-of-scan of the image sensor. 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.

**Pin assignment of "TE CONTROL I/O" connector (C7021/-02, C7025/-02)**

9-pin D-sub connector



KACCC0075EA

Pin No.	Terminal name	Description
1	VD2 (+5 V)	Digital power supply
2	Temp monitor	Analog output signal of the temperature of the CCD image sensor
3	Cooling control	Digital input signal for starting to cool down. HCMOS compatible. High level or left open: cooling Low level: stand-by
4	Vp (+5 V)	Power supply for the thermoelectric cooler in the CCD image sensor (Please use AWG 18 wire.)
5	VF (+12 V)	Power supply for cooling fan
6	D. GND	Ground
7	D. GND	Ground
8	P. GND	Power supply return of the thermoelectric cooler mounted in the CCD image sensor (Please use AWG 18 wire.)
9	F. GND	Power supply return for cooling fan

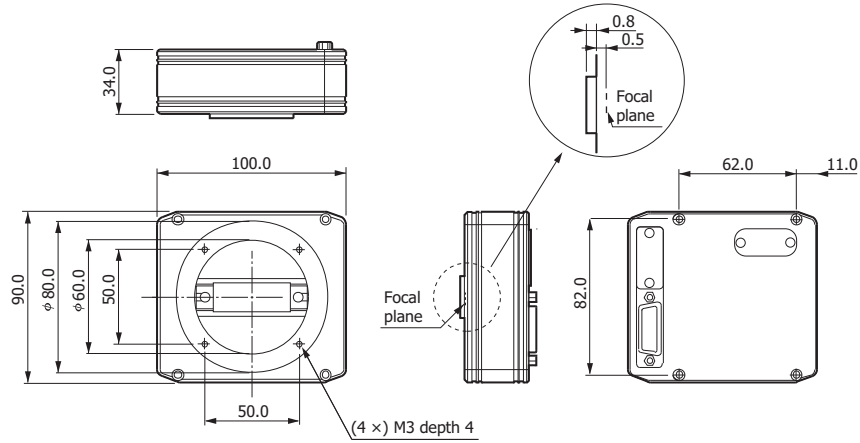
Available for using same power supply (+5 V) for "+VD2" and "+Vp".

Caution: Do not connect "VD2" and "Vp" together on the backside of the 9-pin D-sub connector.

These may be connected (shorted) at the power supply end, not 9-pin D-sub connector.

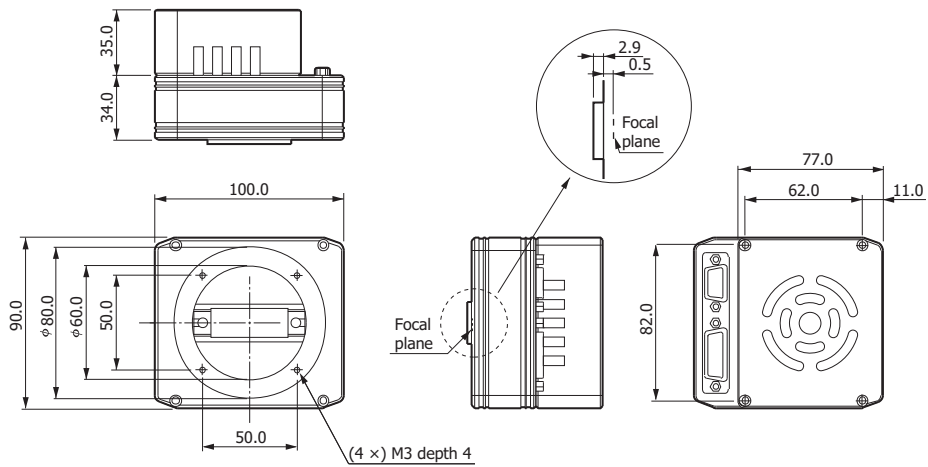
Dimensional outlines (unit: mm)

C7020/-02



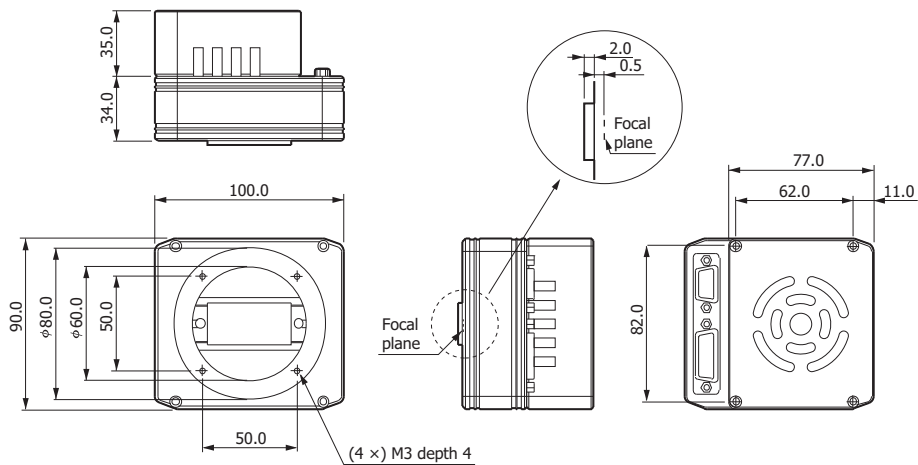
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C7021/-02



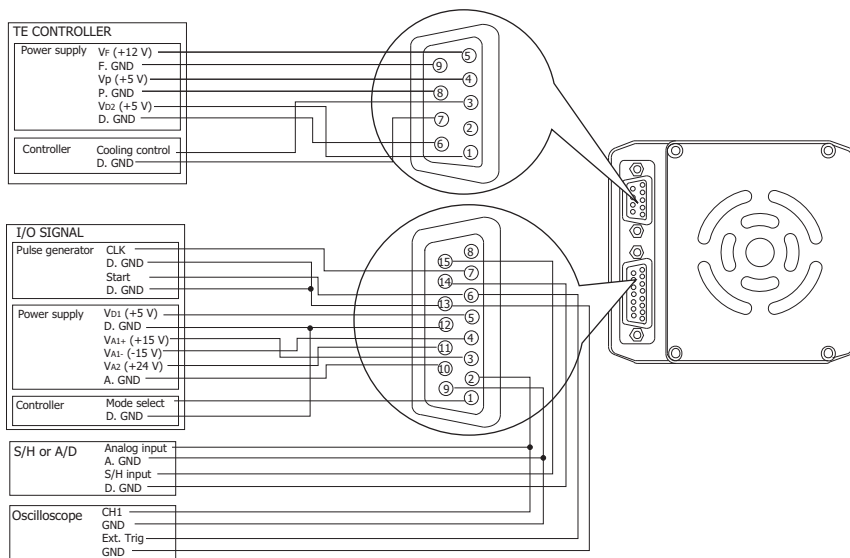
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C7025/-02



KACCA0060EC

**Pin connections**



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Multichannel detector head controller C7557-01

The C7557-01 is specifically designed for basic control in multichannel photometry. When connected to a HAMAMATSU multichannel detector head and PC, the C7557-01 allows easy control of the detector head and data acquisition by using dedicated software that comes with the unit.

**Suitable multichannel detector head**

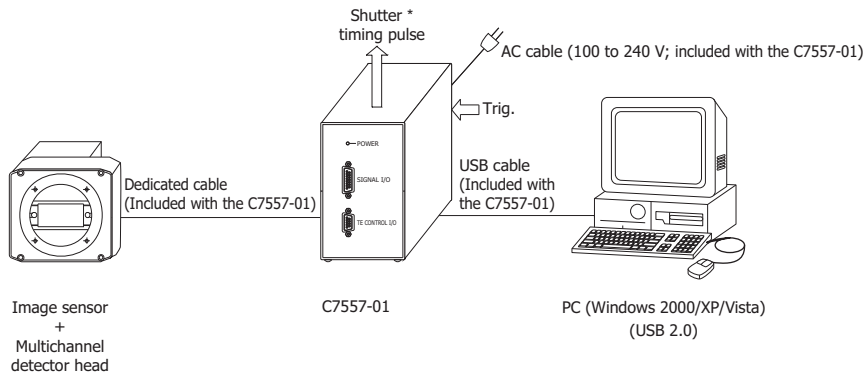
C7020/-02, C7021/-02, C7025/-02,  
 C7040, C7041, C7043, C7044, C7180,  
 C7181, C8061-01, C8062-01, C10150, C10151  
 C5964 series, C8892



**Accessories**

- Spare fuse (2.5 A)
- AC cable
- 2 to 3 conversion adapter
- USB cable
- Detector head connection cables (for "SIGNAL I/O" and "TE CONTROL I/O" terminal of multichannel detector head)
- CD-R (MCD USB driver, Software, Operation manual)
- MOS adapter

**Connection example**



\* Shutter, etc. are not available.

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