



▲Left: C9016-2x series + Controller, Center: C9546 series, Right: C9547 series

OVERVIEW

Image intensifiers (I.I.) are devices capable of intensifying an image at high gain and high-speed gating (electronic shutter operation). This allows them to capture "instantaneous images" of ultra-fast phenomena that occur in extremely short periods of time. Hamamatsu C9016-2x, C9546 and C9547 series image intensifier units consist of a compact main unit that integrates an image intensifier with a high-speed gate operation circuit and a remote controller.

Built-in image intensifiers are available with three standard photocathodes which are GaAsP, GaAs, and multialkali photocathodes. A high-sensitivity, high-speed shutter camera can be configured by simply connecting to the front of a camera such as a CCD camera. Various types of CCD cameras can be optically connected through a relay lens.

Image intensifier gain can be adjusted from the remote controller or a PC (personal computer) through USB interface. Built-in over-light protection circuit allows using these image intensifier units without having to worry much about the input light level.

FEATURES

- **High speed gating**
C9016-2x series: 20 ns ~
C9546 series: 3 ns ~
C9547-01/-02/-05/-06: 5 ns ~
C9547-03/-04: 10 ns ~
- **Gate operation in accordance with input gate pulse width and its repetition rate**
- **Superior shutter ratio even in UV region**
MCP gating: C9546, C9547 series
- **High performance image intensifier**
High quantum efficiency: GaAsP model
Wide spectral response: Multialkali model
High sensitivity: GaAs model
- **Built-in protective circuit prevents damage from excessive light**

APPLICATIONS

- **Analysis of high-speed phenomenon**
Engine combustion state
Plasma emission / Discharge / PIV / Flow / Spray and so on.
- **Imaging of low-light-level emission and fluorescence**
Time resolved fluorescence imaging for dyed cell/tissue

SPECIFICATIONS

Parameter		Type No.	C9016-21	C9016-22	C9016-23	C9016-24	C9016-25	C9016-26	Unit
			C9546-01	C9546-02	C9546-03	C9546-04	C9546-05	C9546-06	
			C9547-01	C9547-02	C9547-03	C9547-04	C9547-05	C9547-06	
Photocathode sensitivity	Luminous sensitivity (Typ.)	C9016-2x	700		230	150	1500		$\mu\text{A}/\text{lm}$
		C9546					1100		
		C9547	650						
	Radiant sensitivity [Ⓐ] (Typ.)	C9016-2x	214		53	47	170		mA/W
		C9546					124		
		C9547	192						
Quantum efficiency [Ⓐ] (Typ.)	C9016-2x	50		15	14	30		%	
	C9546					22			
	C9547	45							
Photocathode	Effective diameter	C9016-2x	17 [Ⓑ]						mm
		C9546							
		C9547	25 [Ⓒ]						
	Window material	Borosilicate glass		Synthetic silica		Borosilicate glass			—
	Photocathode material	GaAsP		Multialkali		GaAs			—
Spectral response	280 to 720		185 to 900		370 to 920			nm	
Phosphor screen	Window material	FOP						—	
	Phosphor material [Ⓓ]	P43						—	
	Decay time	See Figuer 8						—	
Gain	Luminous gain (Typ.)	C9016-2x	2.2×10^4	5.0×10^6	1.1×10^4	4.0×10^6	4.0×10^4	9.6×10^6	$(\text{lm}/\text{m}^2)/\text{lx}$
		C9546	2.0×10^4	3.0×10^6	1.0×10^4	2.4×10^6	3.6×10^4	5.8×10^6	
		C9547	1.8×10^4		3.0×10^4	5.3×10^6			
	Radiant emittance gain [Ⓐ] (Typ.)	C9016-2x	1.4×10^4	3.4×10^6	6.8×10^3	3.0×10^6	1.2×10^4	2.7×10^6	$(\text{W}/\text{m}^2)/(\text{W}/\text{m}^2)$
		C9546	1.3×10^4	2.0×10^6	6.2×10^3	1.8×10^6	1.1×10^4	1.6×10^6	
		C9547	1.2×10^4	1.9×10^6			8.2×10^3	1.2×10^6	
Equivalent back-ground input (EBI)	Luminous (Typ.)	3×10^{-12}		1×10^{-11}		2×10^{-11}		lm/cm^2	
	Radiant [Ⓐ] (Typ.)	8×10^{-15}		3×10^{-14}		4×10^{-14}		W/cm^2	
Limiting resolution (Typ.)	C9016-2x	64	57	64	57	64	57	Lp/mm	
	C9546					57	51		
	C9547	57	51						
Image magnification	1						—		
Maximum input light level [Ⓔ]	Luminous (Typ.)	C9016-2x	1.4×10^{-3}	6.3×10^{-6}	2.9×10^{-3}	7.9×10^{-6}	7.9×10^{-4}	3.3×10^{-6}	lx
		C9546	1.6×10^{-3}	1.0×10^{-5}	3.1×10^{-3}	1.3×10^{-5}	8.6×10^{-4}	5.5×10^{-6}	
		C9547	1.7×10^{-3}		1.0×10^{-3}	5.9×10^{-6}			
	Radiant [Ⓐ] (Typ.)	C9016-2x	3.4×10^{-10}	1.4×10^{-12}	6.9×10^{-10}	1.6×10^{-12}	3.9×10^{-10}	1.7×10^{-12}	W/cm^2
		C9546	3.7×10^{-10}	2.3×10^{-12}	7.6×10^{-10}	2.6×10^{-12}	4.3×10^{-10}	2.9×10^{-12}	
		C9547	4.0×10^{-10}	2.5×10^{-12}			5.7×10^{-10}	3.9×10^{-12}	
Average of max. phosphor screen brightness	10						cd/m^2		
Power requirement	AC 100 to AC 240						V		
Power consumption (Max.)	C9016-2x	4.8						W	
	C9546	6	8.4	6	8.4	6	8.4		
	C9547	7.2	10.8	7.2	10.8	7.2	10.8		
Operating ambient temperature	0 to +40						°C		
Storage temperature	-20 to +50								
Operating and storage humidity [Ⓕ]	Below 70						%		

NOTE: [Ⓐ]At wavelength of maximum response

[Ⓑ]Effective output area is 12.8 mm × 9.6 mm. Take the effective area of the camera and reduction rate of the relay lens to be used into account.

[Ⓒ]Effective output area is 16 mm × 16 mm. Take the effective area of the camera and reduction rate of the relay lens to be used into account.

[Ⓓ]P24 and P46 phosphor screens are also available.

[Ⓔ]During normal (continuous) mode at maximum gain

[Ⓕ]No condensation

Protective functions

Parameter		C9016-2x	C9546 · C9547
Repetition rate	Max.	2 kHz	30 kHz
	Display *	Red LED is lit continuously	
Excessive light protection	Shuts off operation during excessive light		
Excessive light protection display *	During excessive light warning	Red LED flashes	
	During shut off operation	Red LED is lit continuously	
Protection circuit reset	Reset switch on the remote controller or sending command via USB interface		

NOTE: * C9016 series

The LED on the rear side of the main unit can be turned on/off by control from a PC.

C9546 and C9547 series

The LED at the side of the main unit can be turned on/off by control from a PC.

Controllable functions

Parameter	Remote controller		PC (software)	
	C9016-2x	C9546 [Ⓖ] C9547	C9016-2x	C9546 [Ⓖ] C9547
Gain setting	Yes	Yes	Yes	Yes
Operation mode switching	Yes	Yes	Yes	Yes
Excessive light protection display	Yes	Yes	Yes	Yes
Excessive light protection reset	Yes	Yes	Yes	Yes
Excessive gate input monitor	Yes	Yes	Yes	Yes
Integrated screen current monitor	No	No	Yes	Yes

NOTE: [Ⓖ]The control mode automatically switches to PC by connecting USB cable even if the remote controller is connected.

GATE SPECIFICATIONS

Parameter		C9016-2x	C9546 series	C9547-01, -02, -05, -06	C9547-03, -04
Operation mode	Normal mode	Continuous Mode			
	Gate mode	Normally OFF, Turns ON when the gate signal is input			
Gate signal input	Level	C-MOS Positive logic	TTL Positive logic		
	Input impedance	50 Ω			
	Pulse width [Ⓐ]	20 ns to DC	5 ns to DC	8 ns to DC	15 ns to DC
	Repetition rate [Ⓑ] (Max.) when MCP is gated	2 kHz		30 kHz	
		—		10 kHz	
	Gate off time	—		20 μs Min.	
Gate output	Gate time [Ⓐ]	20 ns to DC	3 ns to DC	5 ns to DC	10 ns to DC
	Gate rise time (Typ.)	15 ns	2 ns	3 ns	8 ns
	Gate fall time (Typ.)	15 ns	3 ns	4 ns	10 ns
	Delay time when MCP is gated	46 ns ± 2 ns		36 ns ± 2 ns	
		—		86 ns ± 2 ns	
	Jitter (Max.)	0.5 ns			
Gate time monitor	Output level	2 V Positive logic (at 50 Ω termination)			
	Pulse width	Gate time (FWHM)			
	Output impedance	50 Ω			

NOTE: Ⓐ Please refer to Figure 1 and Figure 3.

Ⓑ Built-in protection circuit

Figure 1: C9016-2x series gate time input / output characteristics

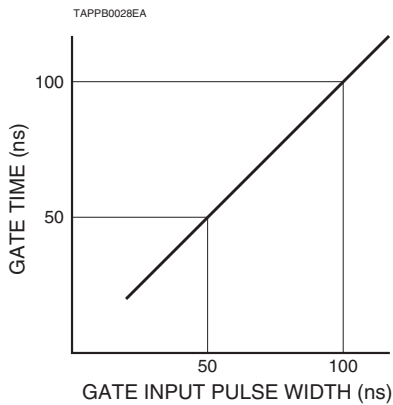


Figure 2: C9016-2x series time sequence

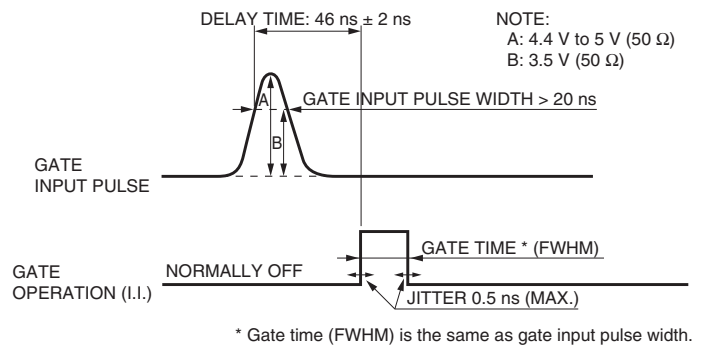


Figure 3: C9546 · C9547 series gate time input / output characteristics

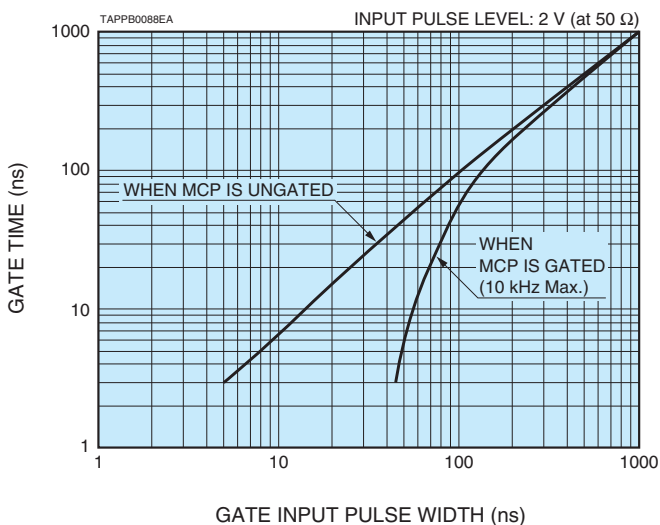
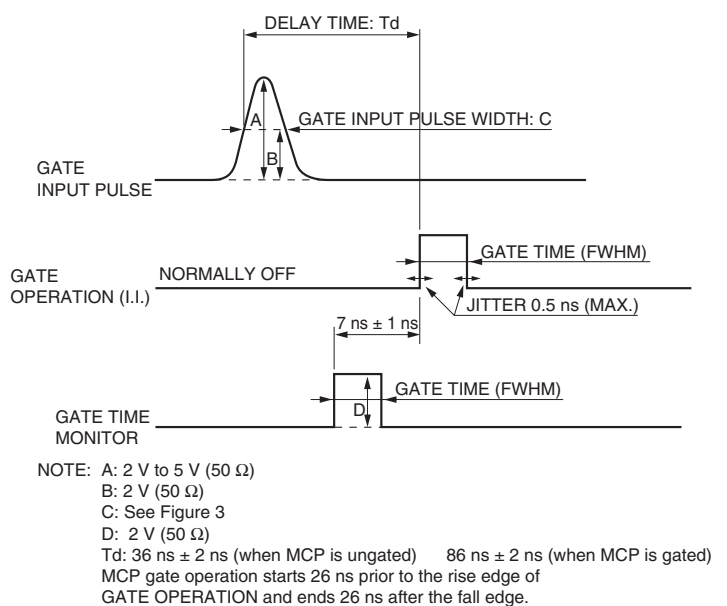


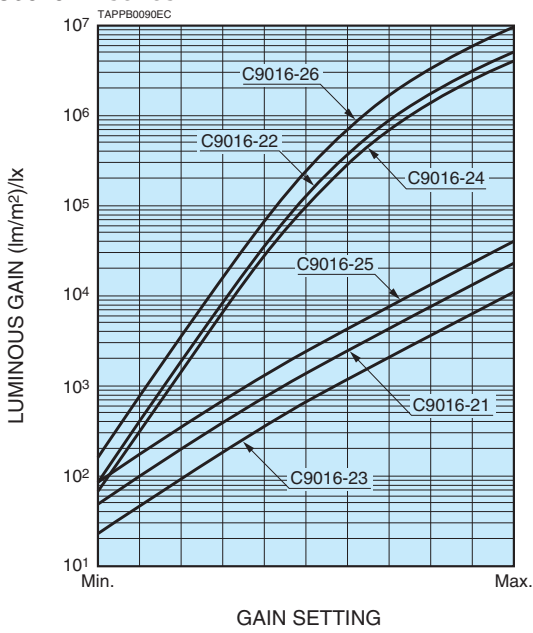
Figure 4: C9546 · C9547 series time sequence



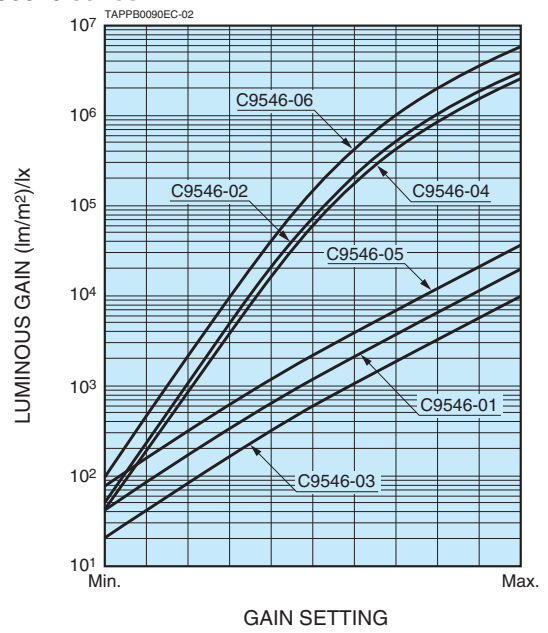
CHARACTERISTICS

Figure 5: Typical luminous gain (Typ.)

●C9016-2x series



●C9546 series



●C9547 series

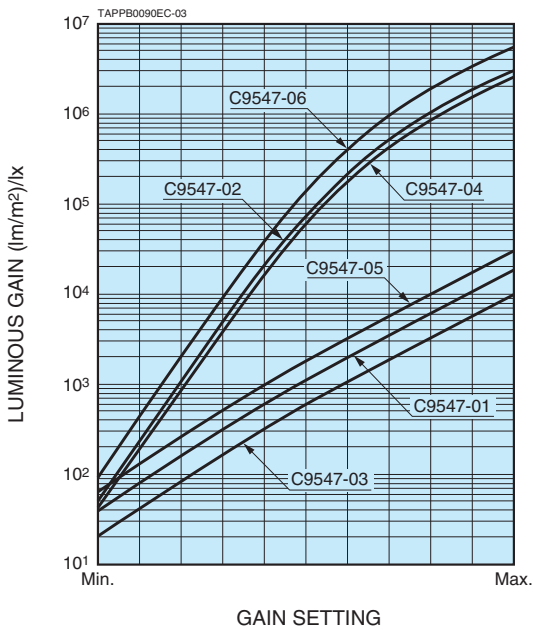


Figure 6: Typical spectral response

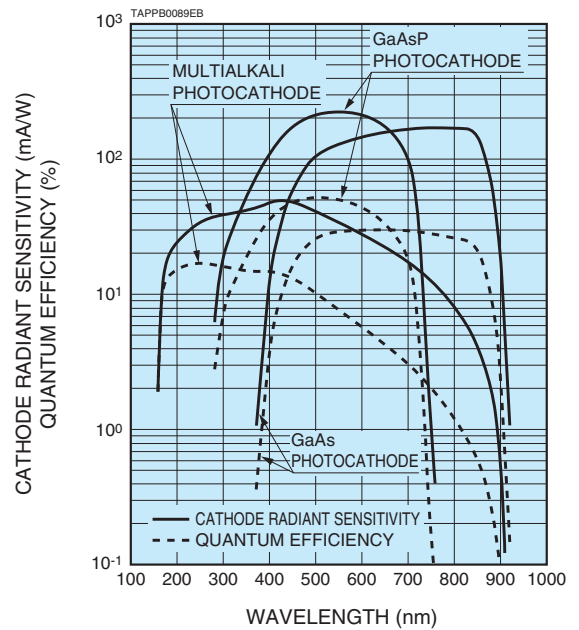


Figure 7: Typical phosphor screen spectral emission

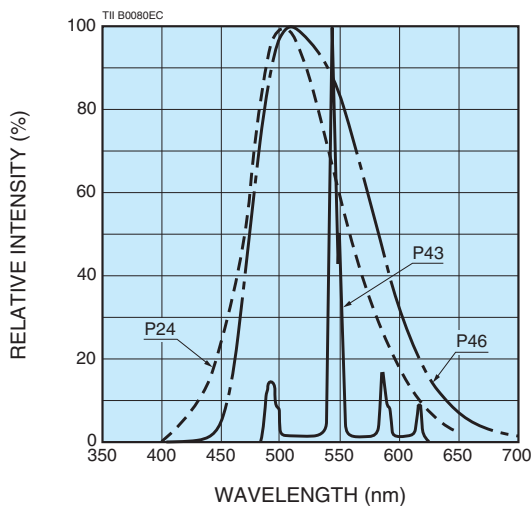
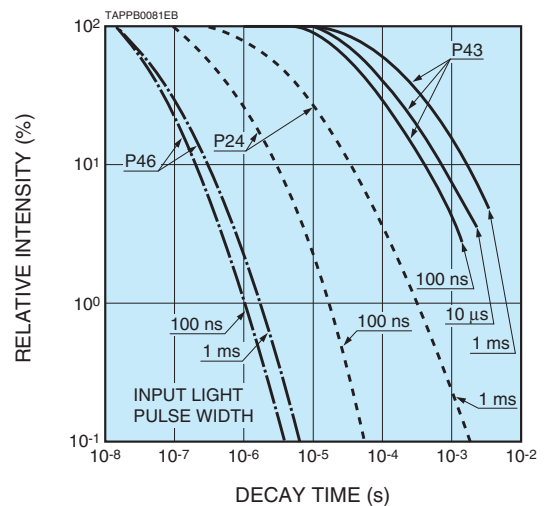


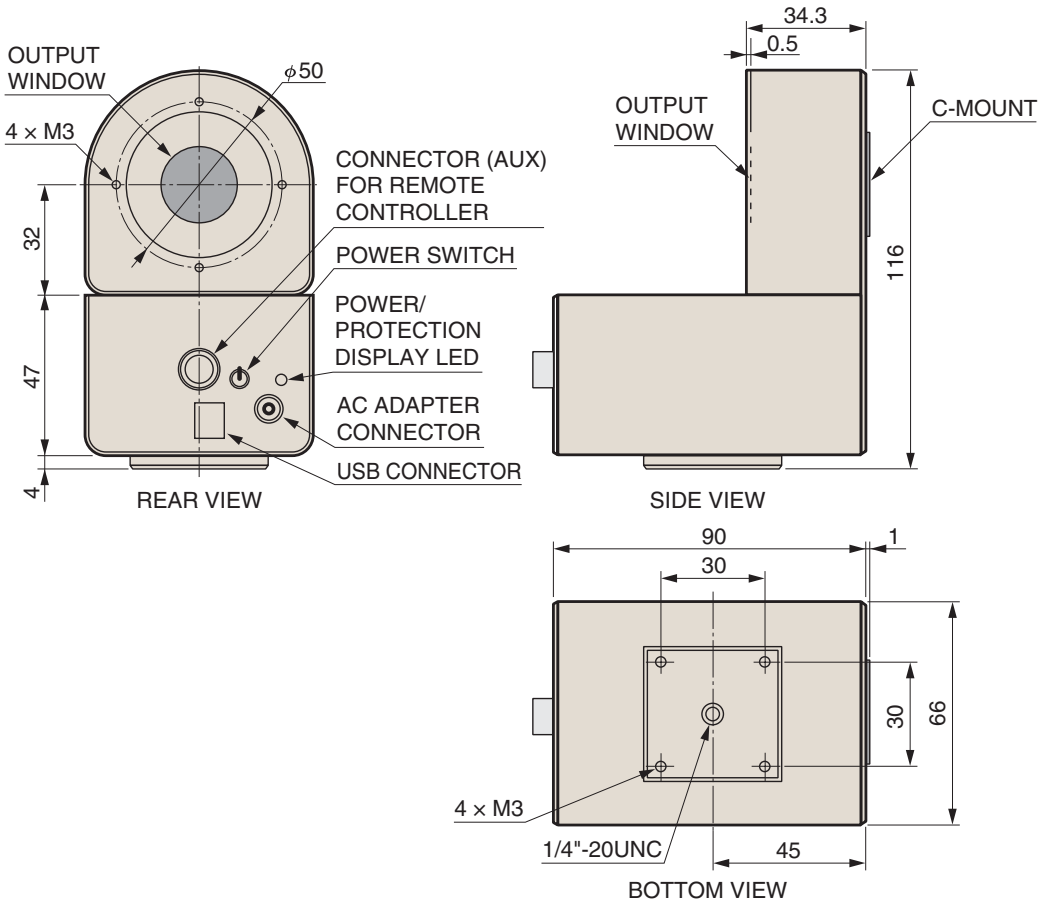
Figure 8: Typical phosphor screen decay characteristics



DIMENSIONAL OUTLINES (Unit: mm)

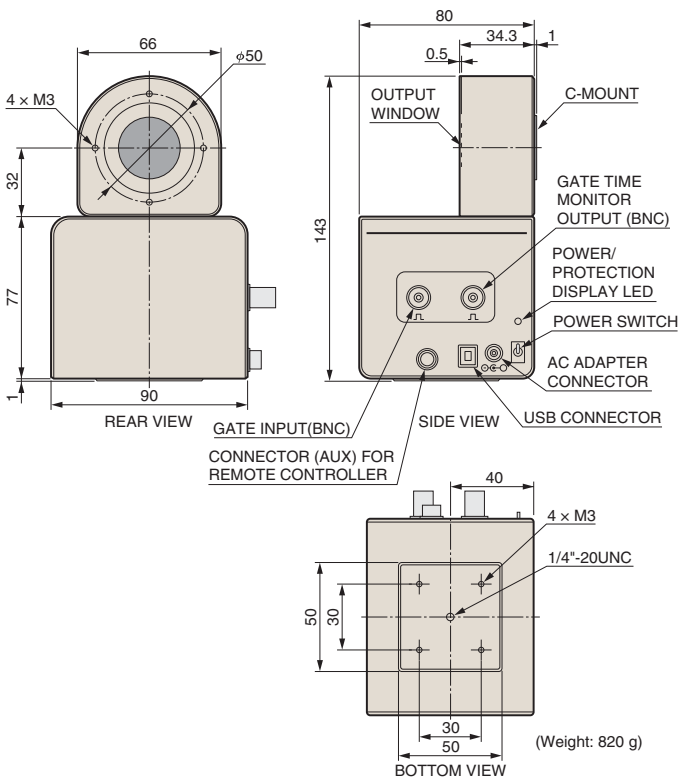
● Main unit

C9016-2x series



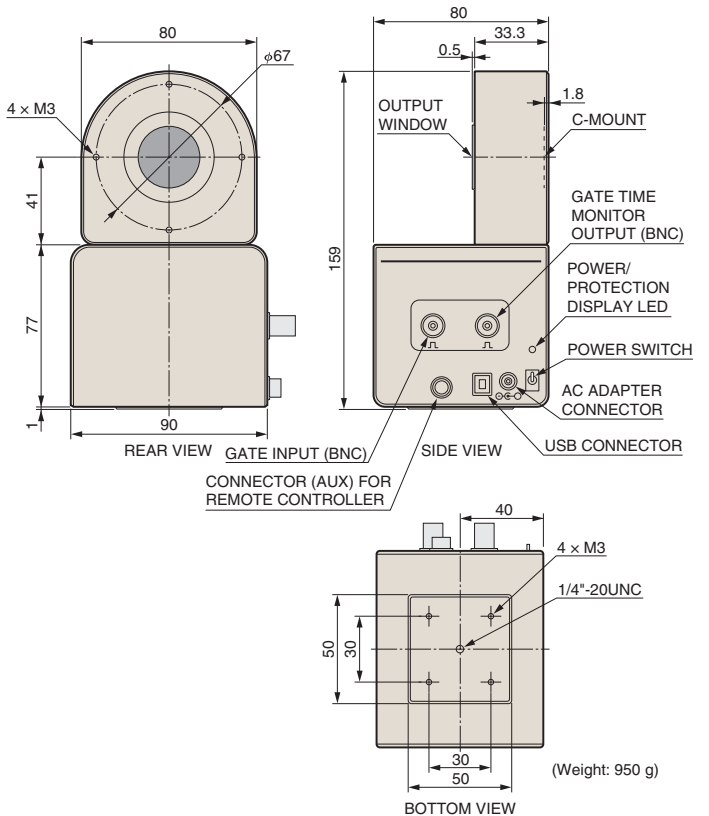
TAPPA0061ED

C9546 series



TAPPA0071ED

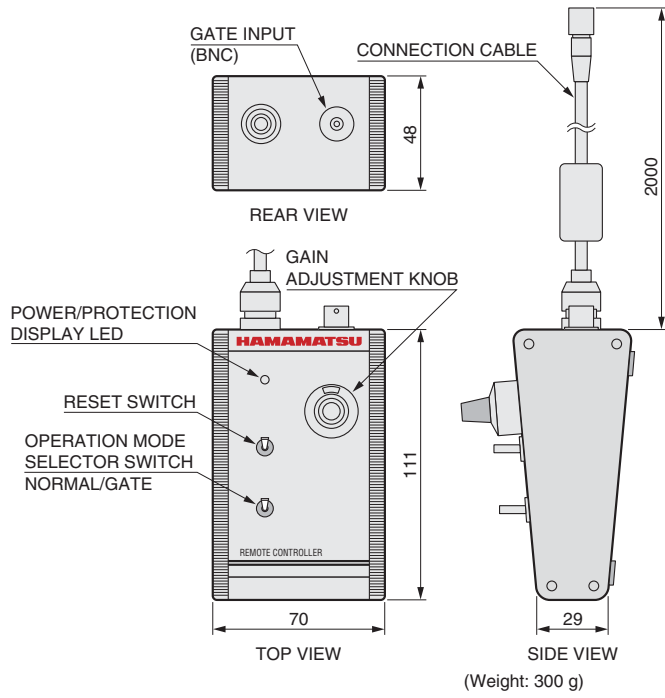
C9547 series



TAPPA0072EB

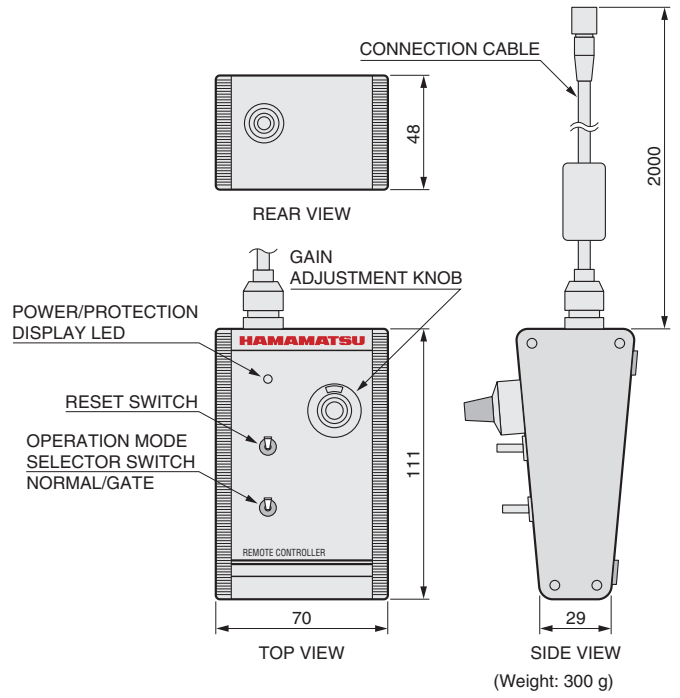
● Remote controller

C9016-2x series



TAPPA0062EC

C9546, C9547 series



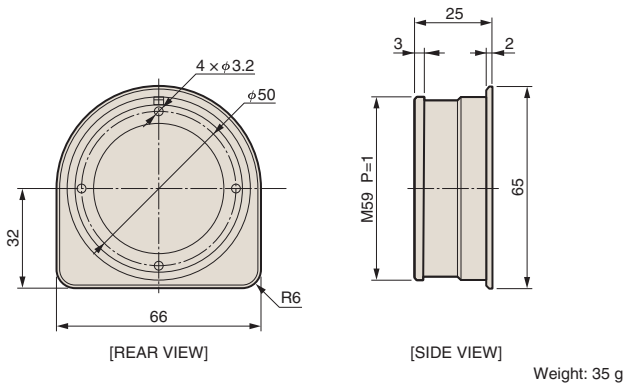
TAPPA0073EA

ACCESSORIES (SOLD SEPARATELY)

● Relay lens adapter A9017, A9549

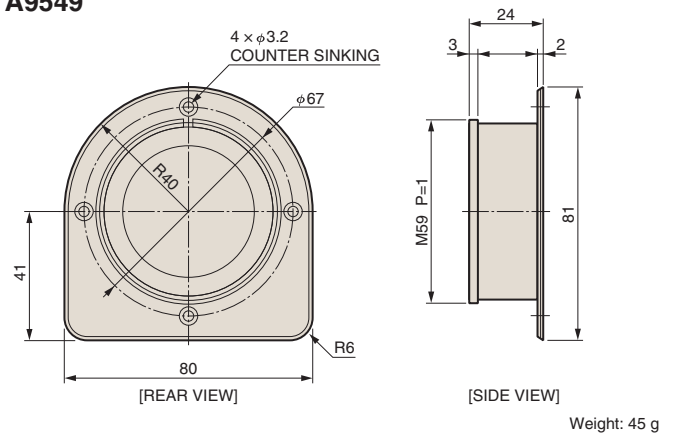
DIMENSIONAL OUTLINE (Unit: mm)

A9017



TAPPA0107EA

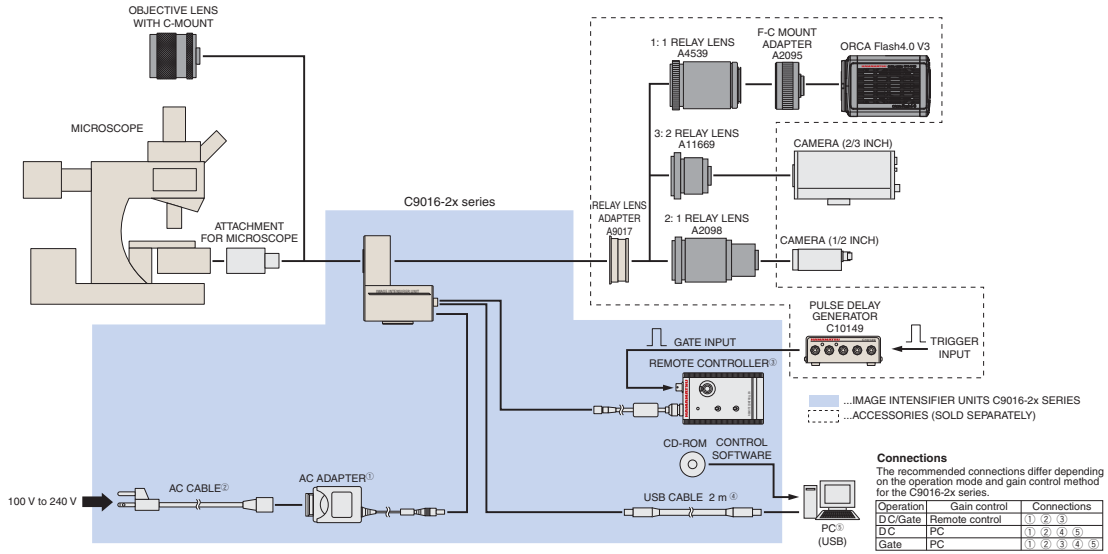
A9549



TAPPA0087EA

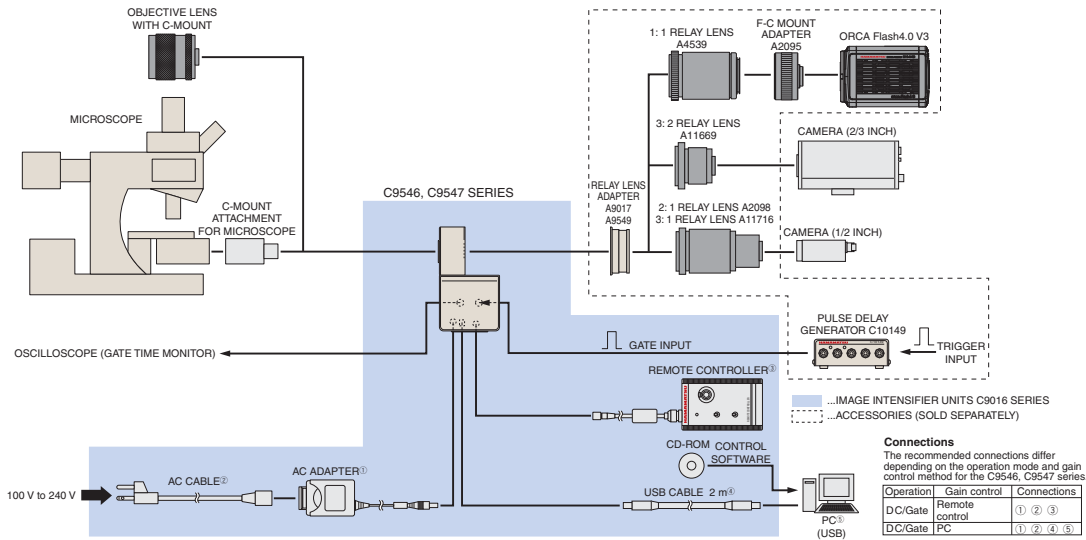
SETUP EXAMPLE WITH OPTICAL ACCESSORIES

● C9016-2x series



TAPPC0175EA

● C9546 series C9547 series



TAPPC0121ED

] Subject to local technical requirements and regulations, availability of products included in this promotional material may vary. Please consult with our sales office.]

Information furnished by HAMAMATSU is believed to be reliable. However, no responsibility is assumed for possible inaccuracies or omissions. Specifications are subject to change without notice. No patent rights are granted to any of the circuits described herein. ©2019 Hamamatsu Photonics K.K.

HAMAMATSU PHOTONICS K.K. www.hamamatsu.com

HAMAMATSU PHOTONICS K.K., Electron Tube Division

314-5, Shimokanzo, Iwata City, Shizuoka Pref., 438-0193, Japan, Telephone: (81)539/62-5248, Fax: (81)539/62-2205

U.S.A.: Hamamatsu Corporation: 360 Foothill Road, Bridgewater, NJ 08807, U.S.A., Telephone: (1)908-231-0960, Fax: (1)908-231-1218 E-mail: usa@hamamatsu.com

Germany: Hamamatsu Photonics Deutschland GmbH.: Arzbergerstr. 10, D-82211 Herrsching am Ammersee, Germany, Telephone: (49)8152-375-0, Fax: (49)8152-265-8 E-mail: info@hamamatsu.de

France: Hamamatsu Photonics France S.A.R.L.: 19, Rue du Saule Trapu, Parc du Moulin de Massy, 91882 Massy Cedex, France, Telephone: (33)1 69 53 71 00, Fax: (33)1 69 53 71 10 E-mail: infos@hamamatsu.fr

United Kingdom: Hamamatsu Photonics UK Limited: 2 Howard Court, 10 Tewin Road, Welwyn Garden City, Hertfordshire AL7 1BW, UK, Telephone: (44)1707-294888, Fax: (44)1707-325777 E-mail: info@hamamatsu.co.uk

North Europe: Hamamatsu Photonics Norden AB: Torshamnsgatan 35 16440 Kista, Sweden, Telephone: (46)8-509 031 00, Fax: (46)8-509 031 01 E-mail: info@hamamatsu.se

Italy: Hamamatsu Photonics Italia S.r.l.: Strada della Moia, 1 int. 6, 20020 Arese (Milano), Italy, Telephone: (39)02-93 58 17 33, Fax: (39)02-93 58 17 41 E-mail: info@hamamatsu.it

China: Hamamatsu Photonics (China) Co., Ltd.: 1201 Tower B, Jiaming Center, 27 Dongsanhuan Beilu, Chaoyang District, 100020 Beijing, P.R.China, Telephone: (86)10-6586-6006, Fax: (86)10-6586-2866 E-mail: hpc@hamamatsu.com.cn

Taiwan: Hamamatsu Photonics Taiwan Co., Ltd.: 8F-3, No.158, Section2, Gongdao 5th Road, East District, Hsinchu, 300, Taiwan R.O.C. Telephone: (886)3-659-0080, Fax: (886)3-659-0081 E-mail: info@hamamatsu.com.tw

TII 1063E02
MAY 2019 IP