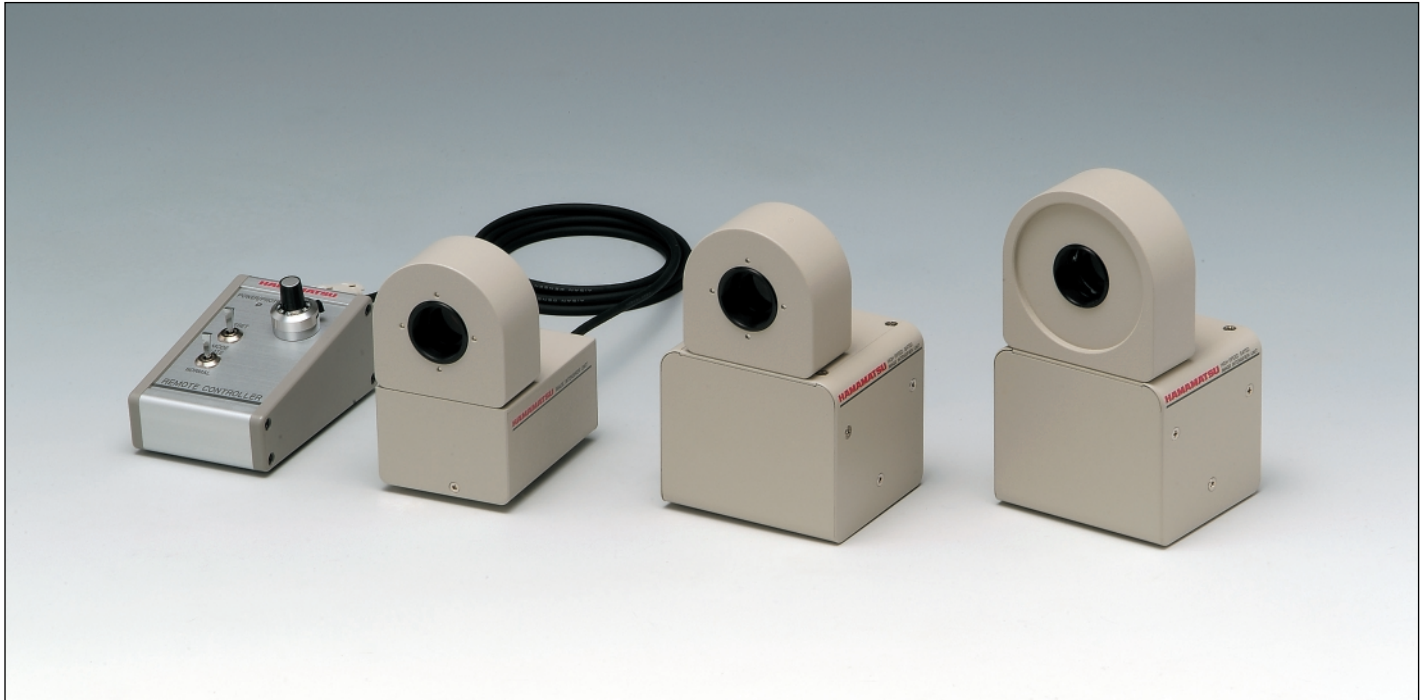


HAMAMATSU

PHOTON IS OUR BUSINESS

HIGH-SPEED GATED IMAGE INTENSIFIER UNITS C9016-2x, C9546, C9547 SERIES



▲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 head 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 an image intensifier head to the front of a camera such as a CCD camera. Various types of CCD cameras can be optically connected through a relay lens.

CCD cameras with fiber optic window are available as options. Image intensifier gain can be adjusted from the remote controller or a PC (personal computer) through USB interface (Ver. 1.1 compatible with Windows Vista business / 7 Pro). 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 C9547-01	C9546-02 C9547-02	C9546-03 C9547-03	C9546-04 C9547-04	C9546-05 C9547-05	C9546-06 C9547-06	
Photocathode sensitivity	Luminous sensitivity (Typ.)	C9016-2x	700		230	150	1500		$\mu\text{A}/\text{lm}$
		C9546					1100		
		C9547							
	Radiant sensitivity ^(A) (Typ.)	C9016-2x	214		53	47	170		mA/W
		C9546					147		
	Quantum efficiency ^(A) (Typ.)	C9016-2x	50		15	14	30		%
C9546		22							
Photocathode	Effective diameter	C9016-2x	17 ^(B)						mm
		C9546	25 ^(C)						
		C9547							
	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
	Peak wavelength	530		430		800			
Phosphor screen	Window material	FOP						—	
	Phosphor material ^(D)	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 ^(A) (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	6.2×10^3	1.8×10^6	8.2×10^3	1.2×10^6	
Equivalent background input (EBI)	Luminous (Typ.)	3×10^{-12}		1×10^{-11}		2×10^{-11}		lm/cm^2	
	Radiant ^(A) (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			57	51		
	C9547								
Image magnification		1						—	
Maximum input light level ^(E)	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 ^(A) (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 ^(F)		Below 70							

NOTE: ^(A)At wavelength of peak sensitivity

^(B)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.

^(C)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.

^(D)P24 and P46 phosphor screens are also available. ^(E)During normal (continuous) mode at maximum gain ^(F)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 (on rear of head and remote controller operation panel)	
	During shut off operation	Red LED is lit continuously (on rear of head and remote controller operation panel)	
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 head can be turned on/off by control from a PC. C9546 and C9547 series

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

Controllable functions

Parameter	Remote controller		PC (software)	
	C9016-2x	C9546 ^(G) C9547	C9016-2x	C9546 ^(G) 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	No	Yes

NOTE: ^(G)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 ^(A)	20 ns to DC	5 ns to DC	8 ns to DC	15 ns to DC
	Repetition rate ^(B) (Max.) when MCP is gated	2 kHz	30 kHz		
		—	10 kHz		
	Gate off time	—	20 μs Min.		
Gate output	Gate time ^(A)	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: (A) Please refer to Figure 1 and Figure 3.
(B) Built-in protection circuit

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

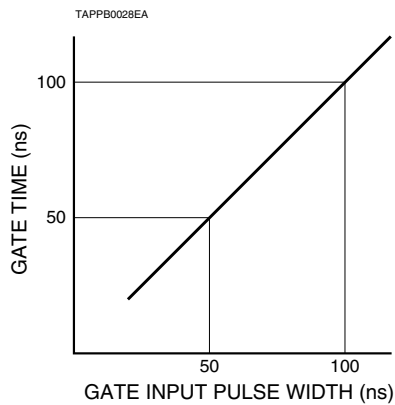


Figure 2: C9016-2x series time sequence

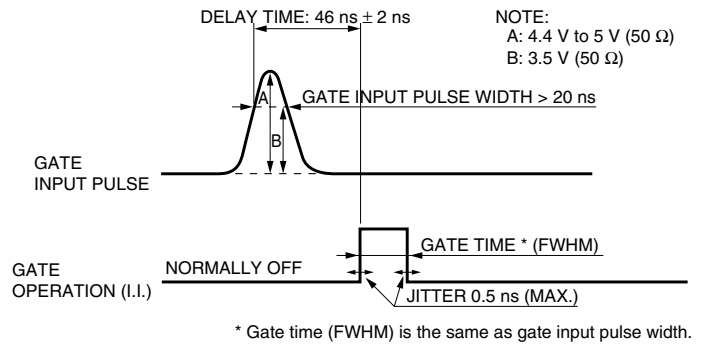


Figure 3: C9546 · C9547 series gate time input / output characteristics

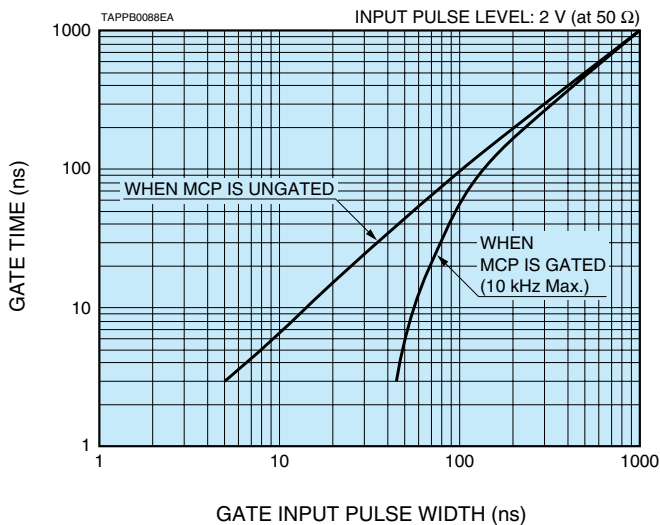
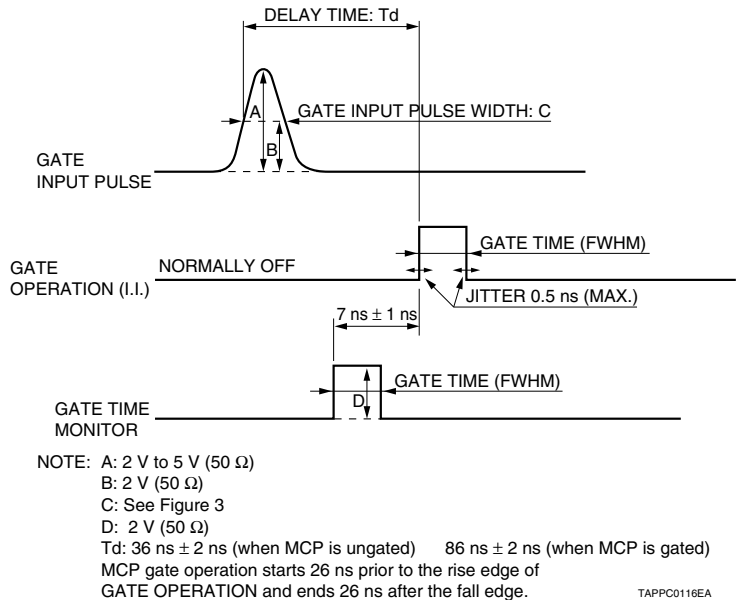


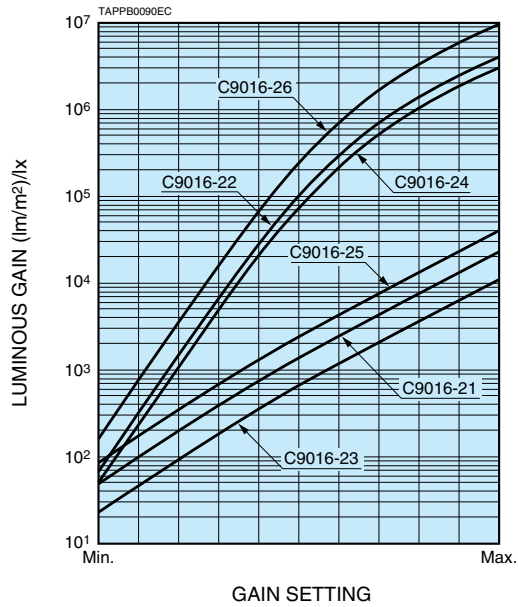
Figure 4: C9546 · C9547 series time sequence



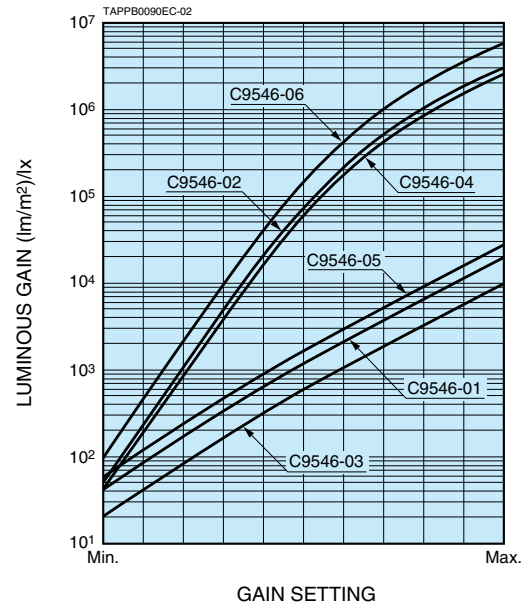
CHARACTERISTICS

Figure 5: Typical luminous gain (Typ.)

● **C9016-2x series**



● **C9546 series**



● **C9547 series**

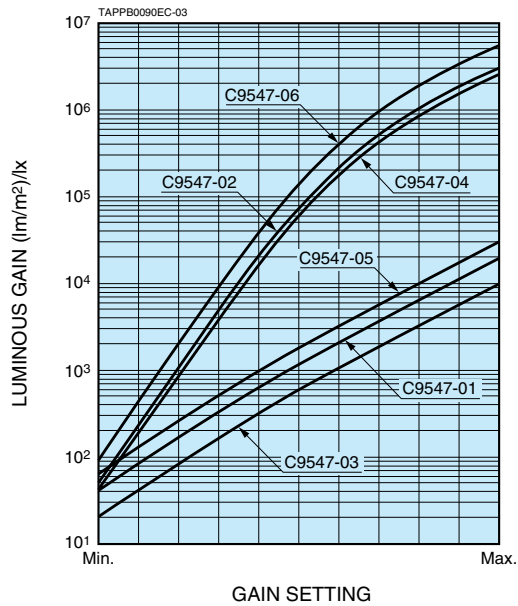


Figure 6: Typical spectral response

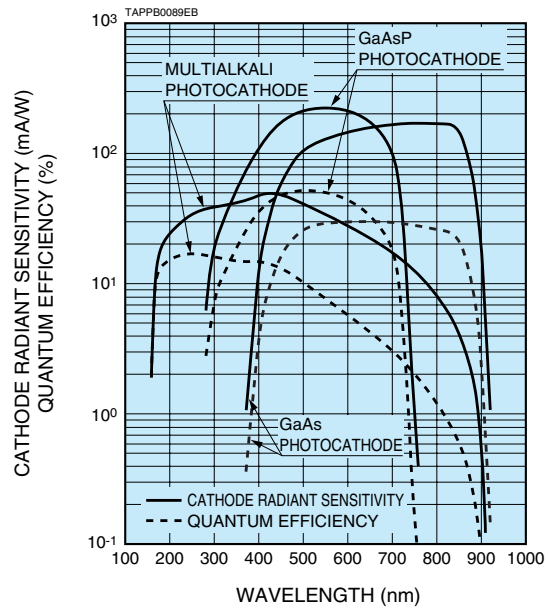


Figure 7: Typical phosphor screen spectral emission

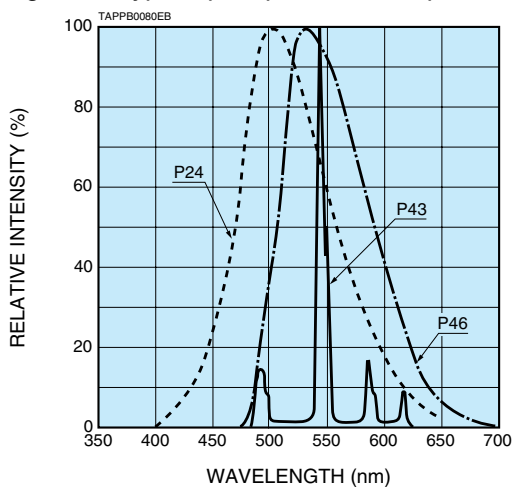
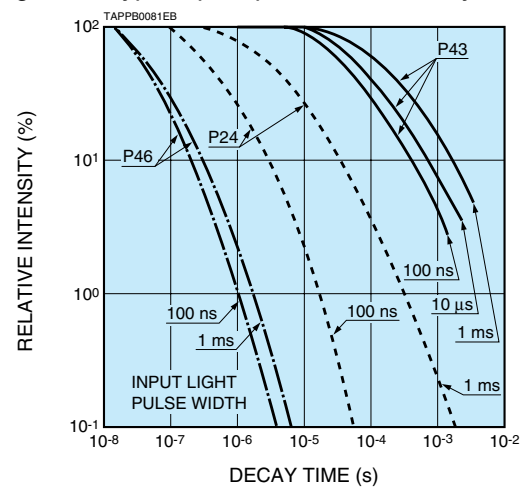


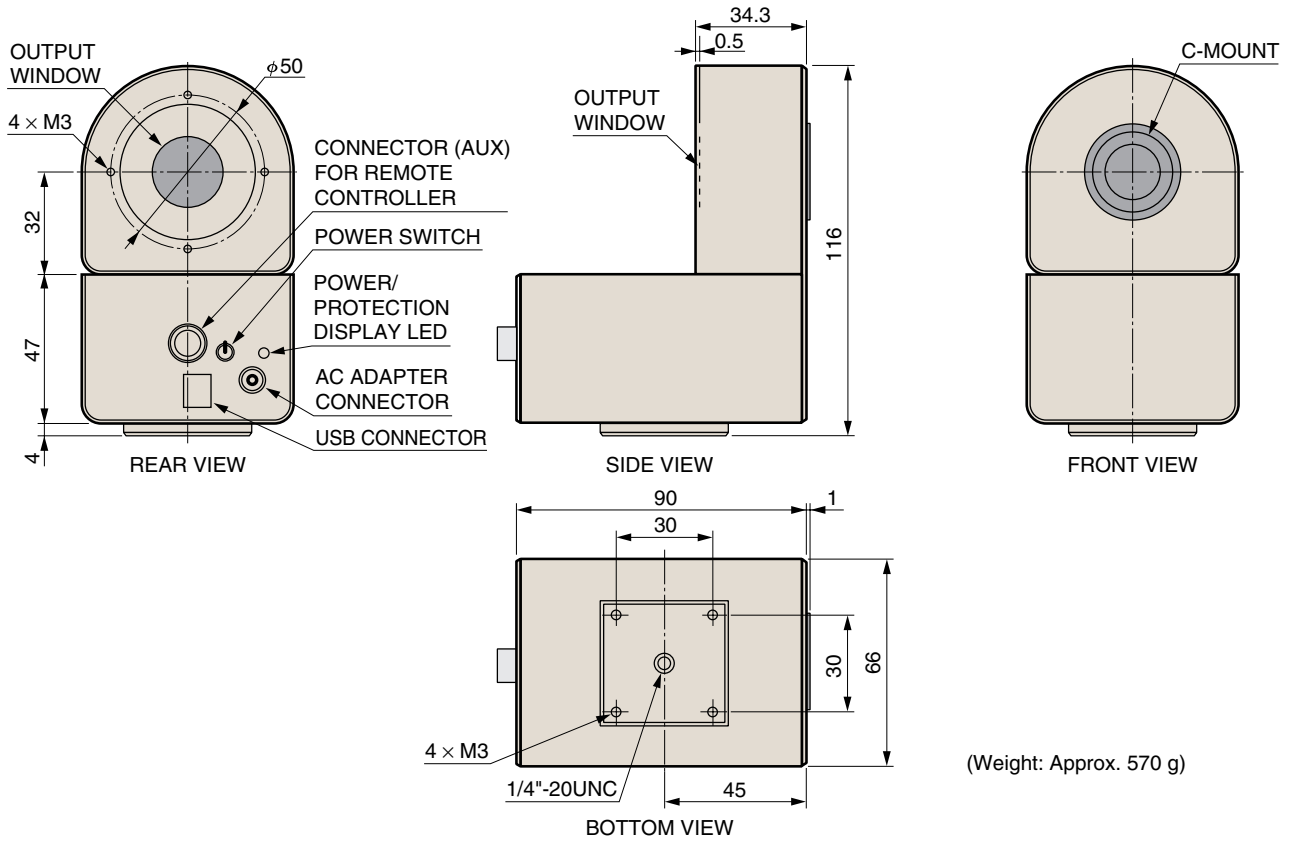
Figure 8: Typical phosphor screen decay characteristics



DIMENSIONAL OUTLINES (Unit: mm)

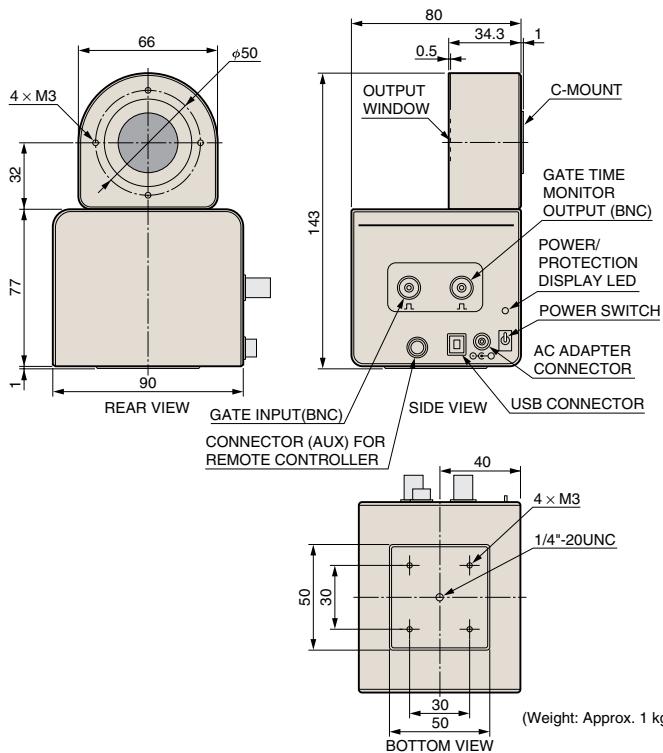
●Head

C9016-2x series



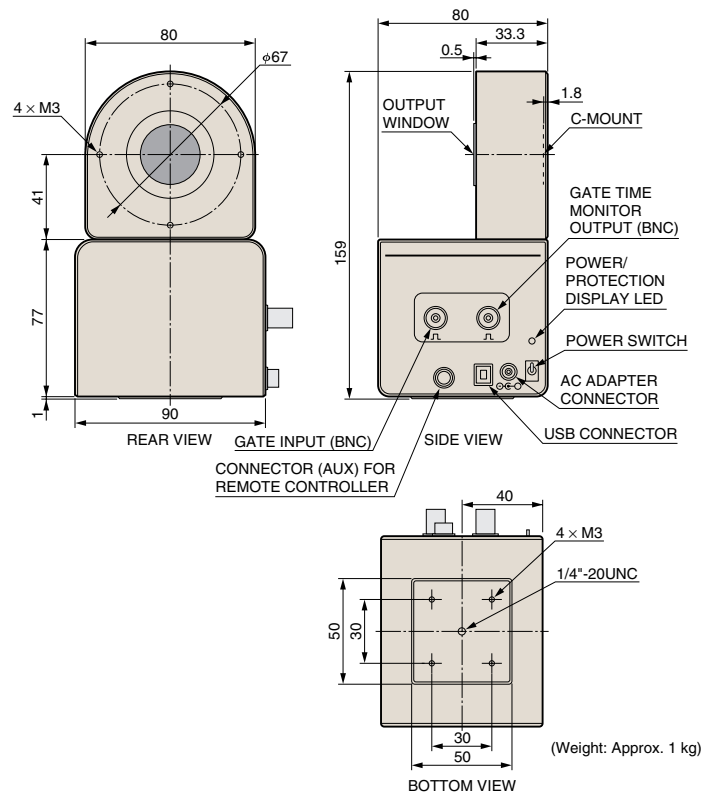
TAPPA0061ED

C9546 series



TAPPA0071ED

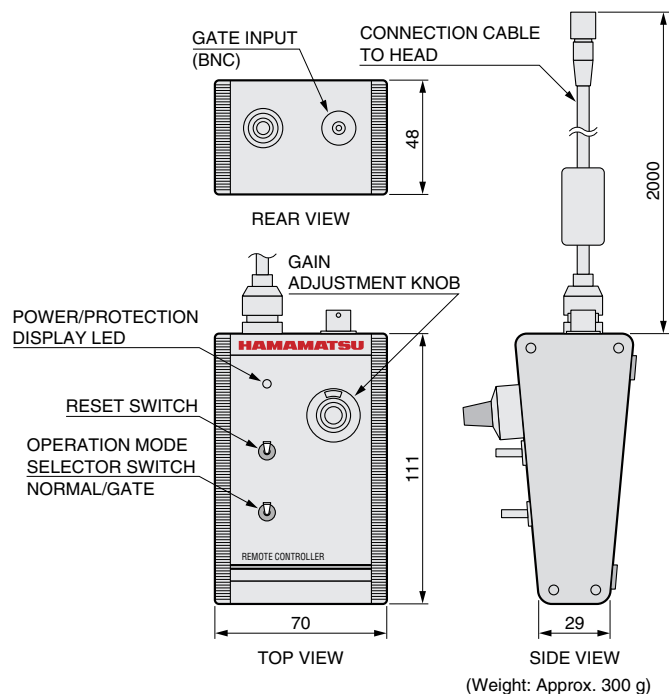
C9547 series



TAPPA0072EC

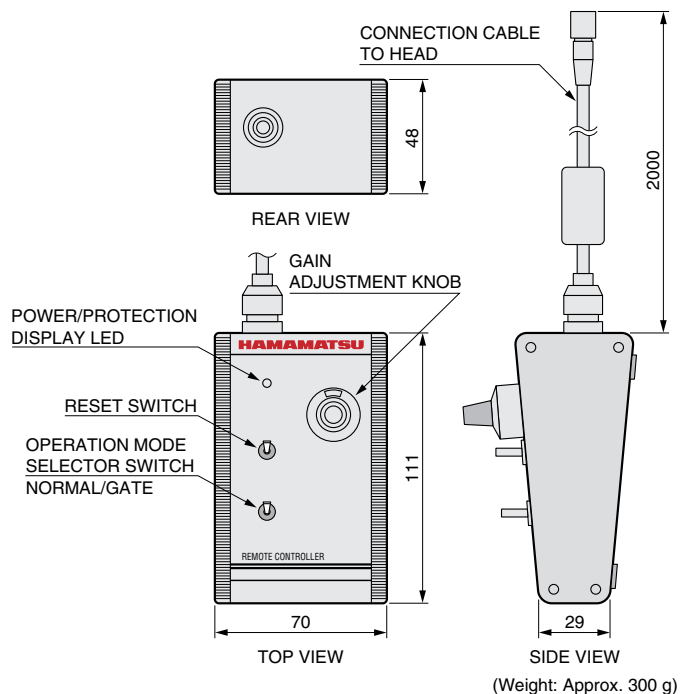
●Remote controller

C9016-2x series



TAPPA0062EC

C9546, C9547 series



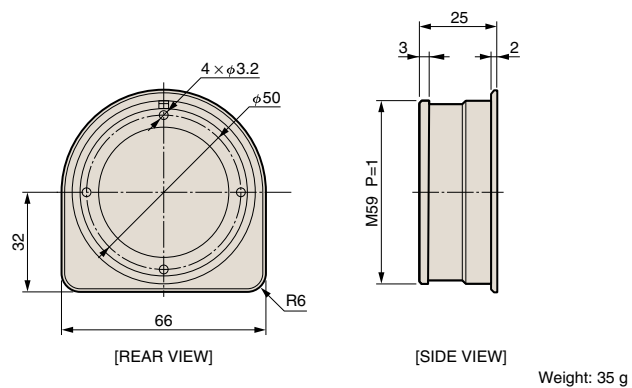
TAPPA0073EA

ACCESSORIES (SOLD SEPARATELY)

●Relay lens adapter A9017, A9549

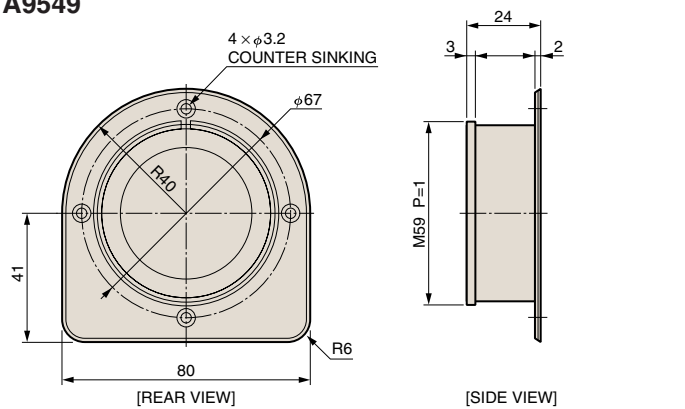
DIMENSIONAL OUTLINE (Unit: mm)

A9017



TAPPA0107EA

A9549



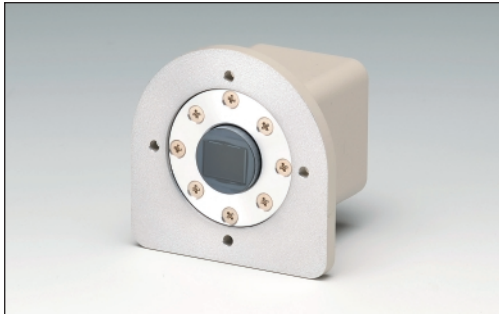
TAPPA0087EA

ACCESSORIES (SOLD SEPARATELY)

● CCD cameras with fiber optic window C9018/-01/-04, C12550 series

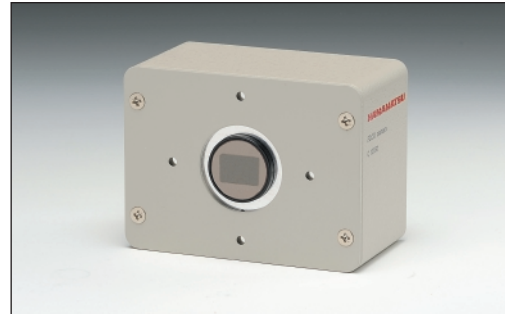
The C9018 series CCD cameras have a restart / reset function and are designed to read out images from C9016 and C9546 series image intensifier units. Fiber coupling allows more highly efficient image readout than lens coupling.

● Analog camera



C9018 series

● Digital camera



C12550 series

SPECIFICATIONS

● C9018 series

Parameter	C9018	C9018-01	C9018-04	Unit
Signal systems	EIA	CCIR	Progressive scan *1	—
Charge accumulation	Frame storage / Field storage, switchable		Frame storage	—
Effective image area (H × V)	12.8 × 9.6			mm
Number of pixels (H × V)	768 × 494	752 × 582	659 × 494	—
Resolution (Horizontal)	570	560	500	TV lines
Synchronization method	Internal / External (auto switching)			—
Power requirement	+9.0 to +16.0		+10.5 to +15.0	V
Power consumption	1.6		1.8	W
Weight	170			g
Operating ambient temperature	0 to +40			°C
Operating ambient humidity	70 (no condensation)			%

*1: Progressive scan at a vertical frequency of 59.94 Hz

● C12550 series

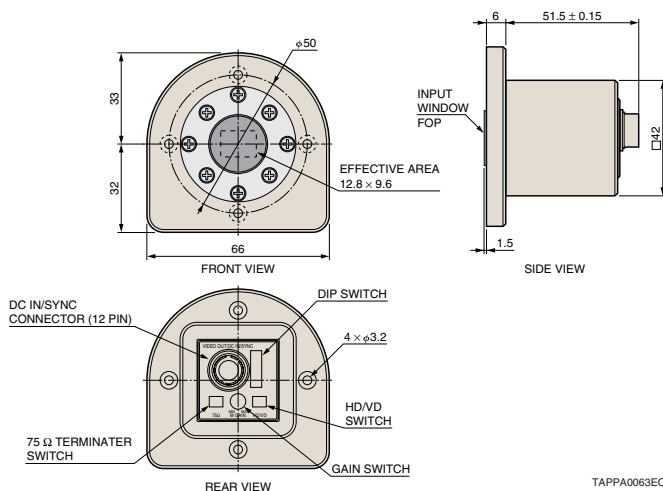
Parameter	C12550 series	Unit
Image device	full pixel readout interline CCD	—
Effective image area (H × V)	13.2 × 9.9	mm
Number of pixels (H × V)	1360 × 1024	—
AD converter	12	bit
Readout rate	10 (Max.)	fps
Exposure control	Electronic shutter capable of long exposure	—
External trigger	Edge trigger, start trigger	—
Digital output	USB 2.0	—
Power requirement	AC100 to AC240	V
Power consumption	3.6	W
Weight	400 *2	g
Operating ambient temperature	0 to +40	°C
Operating ambient humidity	70 (no condensation)	%

*2: Main body only

Supplied: AC adapter, AC cable, USB cable,
CD-ROM (instruction manual, image acquisition software)

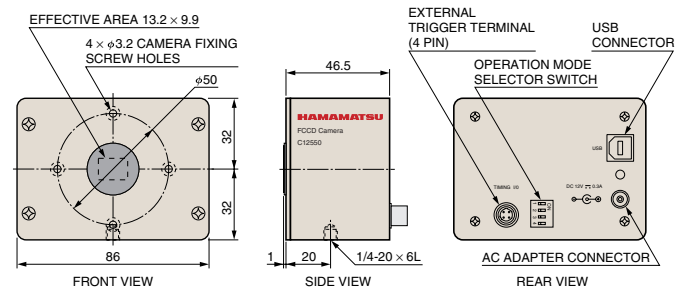
DIMENSIONAL OUTLINE (Unit: mm)

C9018/-01/-04



TAPPA0063EC

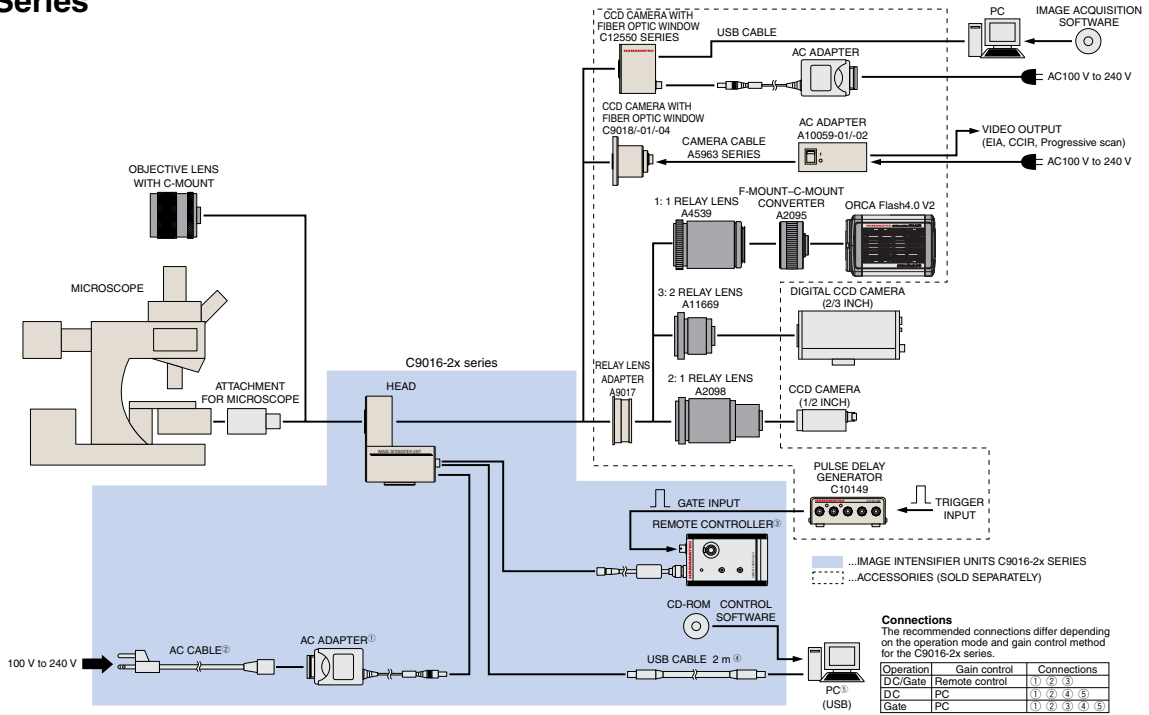
C12550 series



TAPPA0108EA

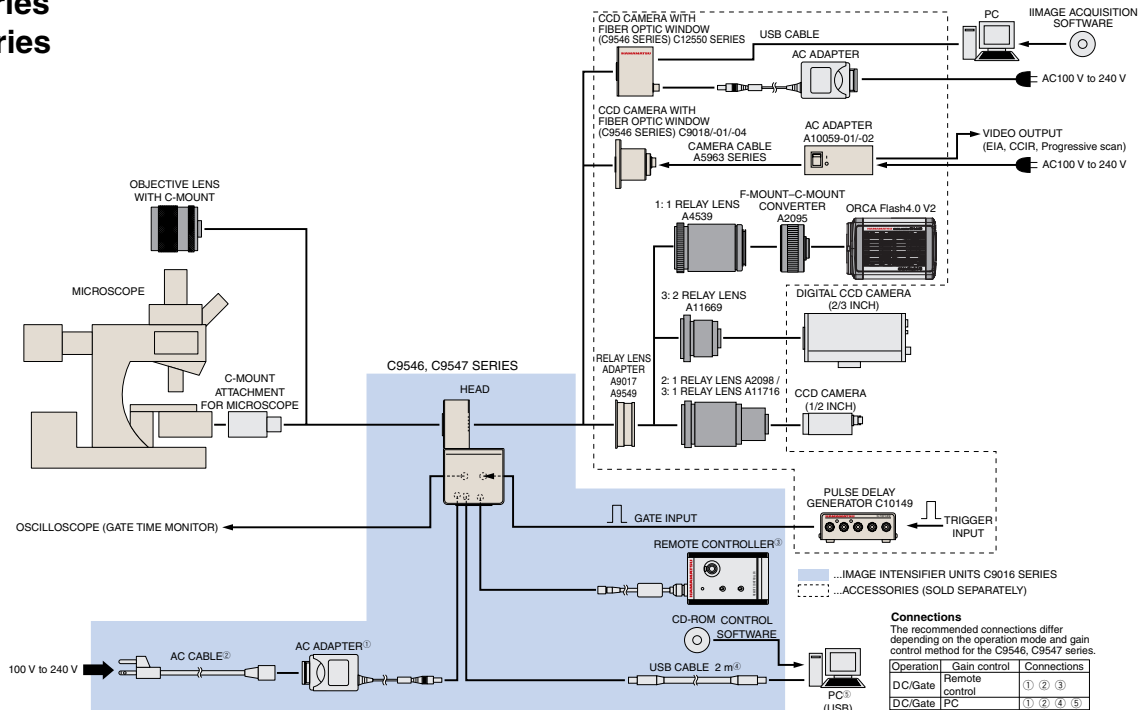
SETUP EXAMPLE WITH OPTICAL ACCESSORIES

●C9016-2x Series



TAPPC0175EA

●C9546 Series C9547 Series



TAPPC0121EC

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