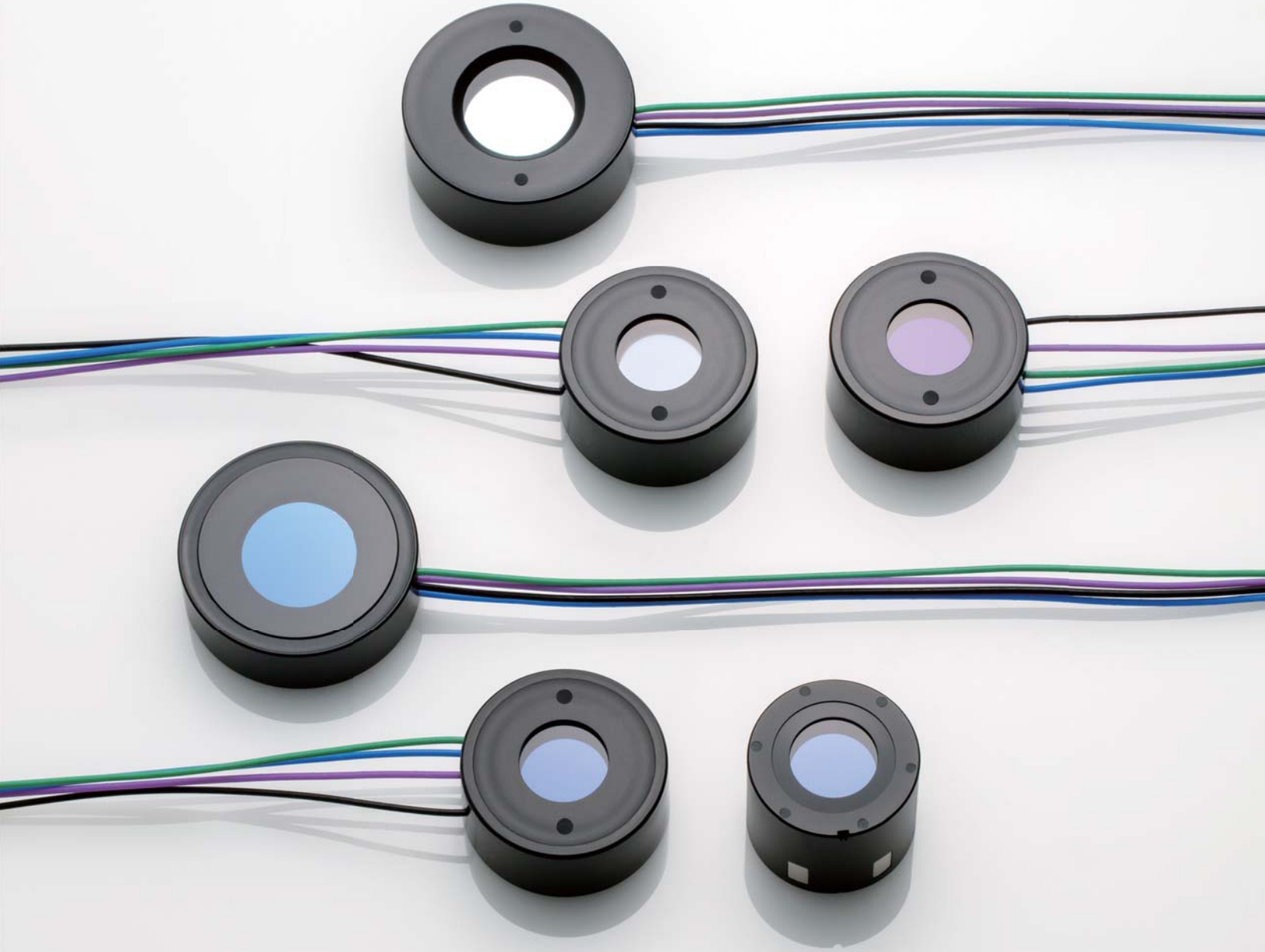
HAMAMATSU

PHOTON IS OUR BUSINESS

Image Intensifiers



HAMAMATSU PHOTONICS K.K.

Image Intensifiers (I.I.: Image Intensifiers)

Image intensifiers (often abbreviated as I.I.) are imaging devices capable of detecting and amplifying very low level light. Image intensifiers are used in a wide range of applications, including imaging of micro-discharges in the invisible regions and observation of high-speed phenomena.

High Sensitivity

Photoelectric conversion with a high SN ratio allows capturing low level light invisible to human eyes.

High Quality High Resolution

Clear, sharp image with no distortion and little noise

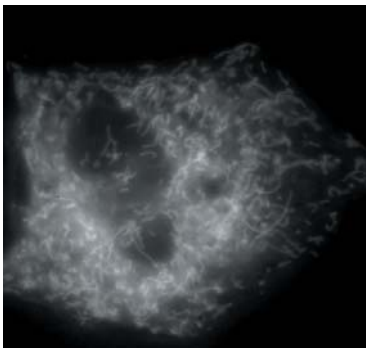
Wide Lineup

Offers specifications optimized for specific applications and objects

Application examples

Biotechnology

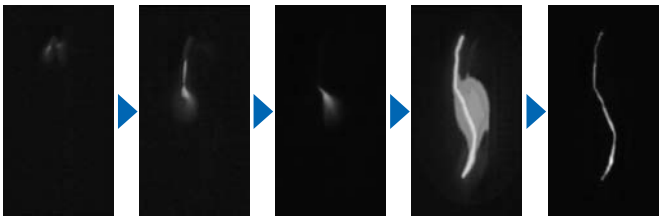
Fluorescence imaging



Mitochondria inside a nerve system culture cell NG108-15, specificitylabeled with fluorescent dye MITO TRACKER.

Industry

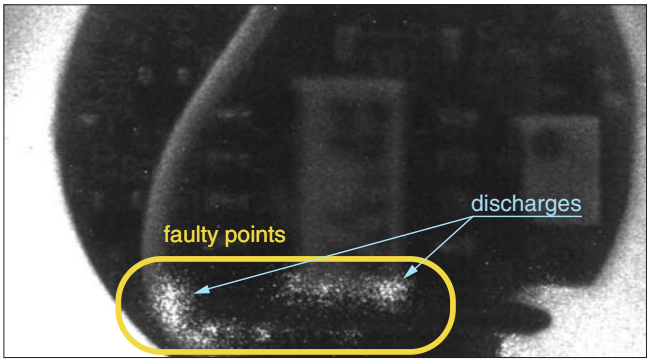
Time-resolved observation of micro-discharge



When combined with a high-speed camera, images of weak light emission can be captured at a high frame rate.

Industry

Observation of discharges occurring on a printed circuit board



Visualization of discharges caused by poor insulation in the printed circuit board allows finding the faulty points.

Astronomy

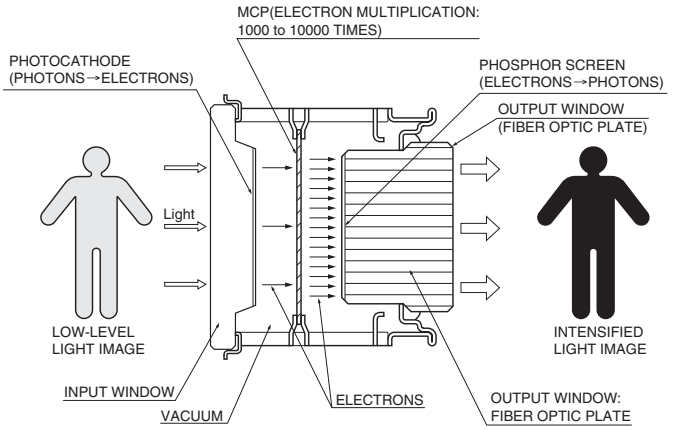
Celestial body observation

Star wind from the protostar L1551-IRS5 (red star at upper left), twinkling in yellowish green when it collides with surrounding gases.

Photo courtesy of National Astronomical Observatory in Japan
In cooperation with NHK (Nippon Hoso Kyokai)

Structure and operation

A photocathode that converts light into photoelectrons, a microchannel plate (MCP) that multiplies electrons, and a phosphor screen that reconverts electrons into light are arranged in close proximity in an evacuated ceramic case.
The close proximity design from the photocathode to the phosphor screen delivers an image with no geometric distortion even at the periphery.
Light focused on the photocathode is converted into photoelectrons.
These electrons then enter each channel of the MCP where they are multiplied by the potential gradient across both ends of the MCP and are released from the output end of the MCP. The electrons multiplied by the MCP then strike the phosphor screen that emits light according to the amount of electrons.
Through this process, an input optical image is intensified about 10000 times (in the case of a one-stage MCP) and appears as the output image on the phosphor screen.

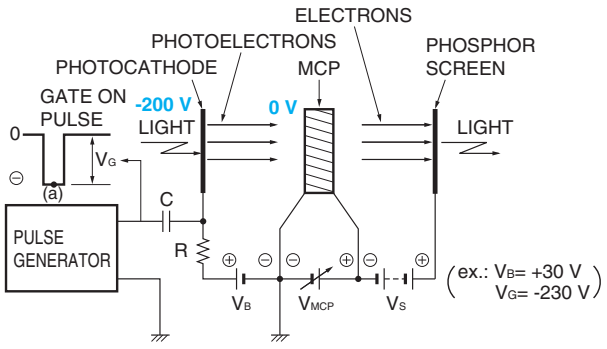


TII C0051ED

Gate operation

An image intensifier can be gated to open or close the electronic shutter by varying the potential between the photocathode and the MCP-in.
When the gate is ON, the photocathode potential is lower than the MCP-in so the electrons emitted from the photocathode enter the MCP at a positive potential.
An intensified image can then be obtained on the phosphor screen.
When the gate is OFF, however, the photocathode has a higher potential than the MCP-in so the electrons emitted from the photocathode are forced to return to the photocathode at the positive potential and do not reach the MCP. In the gate OFF mode, no output image appears on the phosphor screen even if light is incident on the photocathode.
To actually turn on the gate operation, a high-speed, negative polarity pulse of about 200 volts is applied to the photocathode while the MCP-in potential is fixed. The width (time) of this pulse will be the gate time.
High-speed gated image intensifiers (see page 16) are designed to operate in high-speed gated mode that allows capturing instantaneous images of high-speed phenomena and so is very effective in analyzing high-speed phenomena.

Gate ON at point (a)



V_{MCP} .....MCP-in TO MCP-out VOLTAGE
V_S .....MCP-out TO PHOSPHOR SCREEN VOLTAGE
V_B .....BIAS VOLTAGE
V_G .....GATE PULSE

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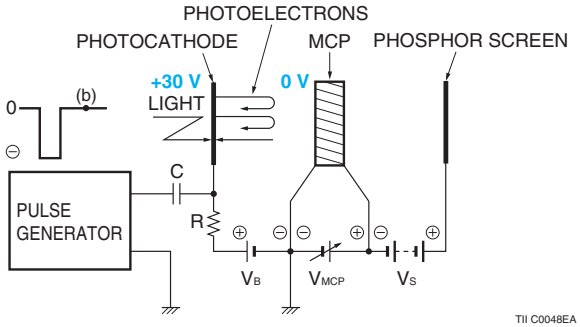
Gate OFF at point (b)



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Selection guide

Image intensifiers are available with various characteristics that can be selected by a combination of the components such as photocathodes and window materials. This selection guide describes the components of image intensifiers and the criteria for selecting an image intensifier that best matches your application.

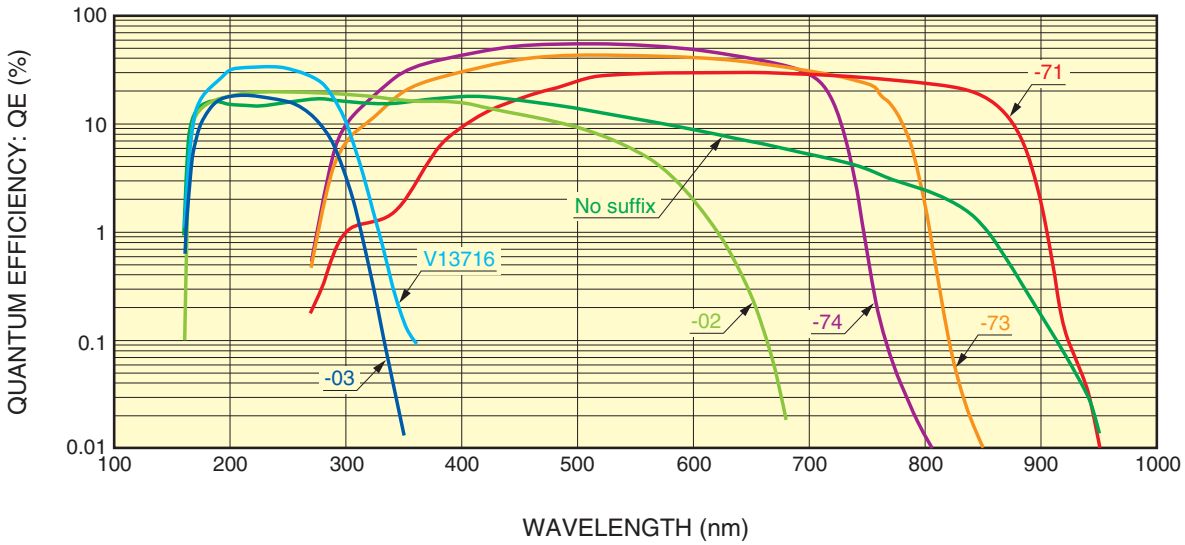
1 Select an image intensifier with sensitivity optimized for objects (light) to be observed

The input window and photocathode must be selected according to the wavelength and intensity of light to be observed. To obtain an intensified image with a high SN ratio, select a photocathode with high sensitivity in the measurement wavelength range.

Photocathode

Select a photocathode with the required S/N ratio and a spectral response that matches the wavelength to be observed.

Type	Feature	Photocathode type
Cs-Te (-03)	Solar blind spectral response with no sensitivity in the visible region (wavelength longer than 320 nm)	Alkali Photocathodes
High sensitivity Cs-Te (V13716)	Cs-Te photocathode with enhanced UV sensitivity	
Bialkali (-02)	UV to visible sensitivity and low noise	
Multialkali (No suffix)	UV to near-infrared sensitivity	
GaAs (-71)	Uniform and high sensitivity from the visible to near-infrared region	Semiconductor Photochathodes
GaAsP (-74)	Very high sensitivity in the visible region	
Extended Red GaAsP (-73)	GaAsP photocathode with extended red sensitivity	



NOTE: The above graph shows spectral response data (quantum efficiency vs. wavelength) of various photocathodes combined with an input window of borosilicate glass (-71/-73/-74) or synthetic silica (no suffix/-02/-03). Quantum efficiency (QE) is the number of photoelectrons emitted from the photocathode divided by the number of incident photons and is generally expressed as a percent (%). Quantum efficiency and radiant sensitivity have the following relationship at a given wavelength.

$$QE = \frac{S \times 1240}{\lambda} \times 100\ (\%)$$

where S is the radiant sensitivity in A/W at a given wavelength and λ is the wavelength in nm (nanometers).

Input window

The borosilicate glass is used for GaAs and GaAsP photocathodes, and synthetic silica is used for alkali photocathodes.

MCP

Image intensification depends on the number of MCP stages. Select a 1-stage or 2-stage MCP according to the light intensity and measurement environment of objects to be observed.

Number of MCP	Image intensification
1	Electron multiplication (gain): about 10^3
2	Electron multiplication (gain): about 10^5

2 Select an image intensifier with a time resolution high enough to capture objects to be observed

Photocathode electrode

Gate operation is determined by the photocathode electrode materials. To allow high-speed gate operation, some of our alkali photocathode image intensifiers use a metallic thin film electrode deposited between the photocathode and the input window, so select from among them (see page 5) when gate operation is needed. Image intensifiers using a GaAs or GaAsP photocathode have a gate function, except for the V6833P and V7090P that contain a power supply.

3 Select an image intensifier compatible with the readout device and method

Select an image intensifier that matches the performance and specifications of the image readout device to be used. The following describes the components of an image intensifier related to readout devices and an important point to consider when selecting them.

Effective area

Alkali photocathode image intensifiers have an effective area of 18 mm or 25 mm in diameter. GaAs and GaAsP photocathode image intensifiers have an effective area of 13.5 mm × 10 mm (input window diameter: 18mm) or 16 mm × 16 mm (input window diameter: 25 mm).

Output window

It is necessary to select an output window that efficiently couples to the readout device.

Type	Note
Fiber optic plate (FOP)	Ideal for direct coupling to a CCD/CMOS camera with an FOP window, allowing highly efficient image readout.
Borosilicate glass	Suitable for image readout using a relay lens.
Inverting concave fiber optics	Select this type when viewing the output image directly with eyes.

Phosphor screen

Select a phosphor screen compatible with the readout device sensitivity and method.

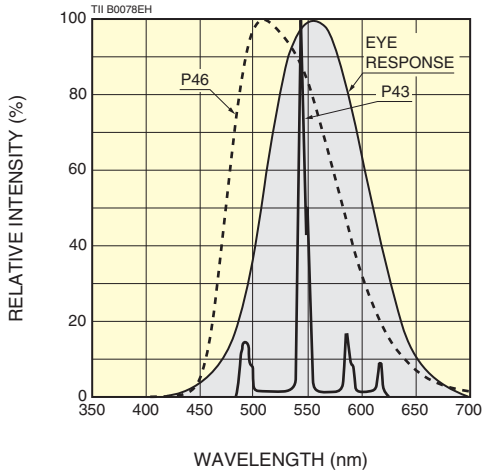
Phosphor type	Peak emission	10 % Decay time	Relative power efficiency	Emission color	Note
P43	545 nm	1 ms	1	Yellowish green	Standard
P46	510 nm	0.2 µs	0.3	Green	Short decay time

The decay time of P46 varies depending on the input pulse width.
The relative power efficiency is a value relative to the power efficiency of P43 measured at a supply voltage of 6 kV and normalized to 1.

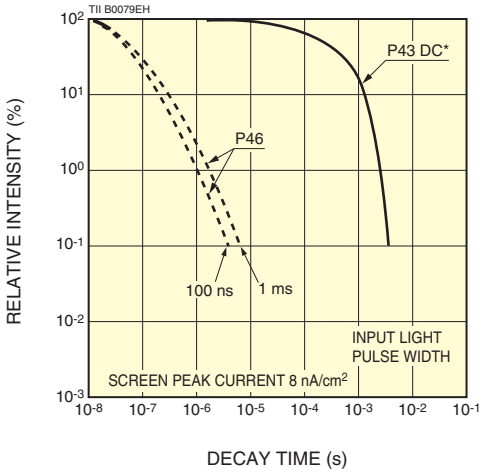
POINT Phosphor screen decay characteristics

Phosphor screen decay characteristics must be considered when coupling to an image readout device. When used with a high-speed readout CCD/CMOS or linear image sensor, a phosphor screen with a short decay time is recommended so that no afterimage remains in the next frame. For nighttime viewing and surveillance applications, a phosphor screen with a longer decay time is suggested to minimize flicker.

Typical phosphor spectral emission characteristics



Typical decay characteristics



* Decay time obtained following to the continuous input light removal.

Selection guide (by Type No.)

GaAs and GaAsP photocathode image intensifiers

V○○○○ A–○○ –B C D E

Series type No.

A Potting method (See dimensional drawing.)

Suffix	Potting method
U	Input window is positioned inwards from the front edge of the case.
D	Input window protrudes from the front edge of the case. This type is ideal when using a Peltier cooling to reduce noise.

B Gate operation

Suffix	Gate type
N	Non-Gate
G	Gatable (5 ns)

C Number of MCPs

Suffix	Stage of MCP
1	1
2	2

D Phosphor screen

Suffix	Phosphor screen material
3	P43
6	P46

E Output window

Suffix	Output window
0	Fiber optic plate
2	Borosilicate glass

Type No.	Spectral response range (nm)	Wavelength range of peak QE (nm)	Photocathode	Effective photocathode area (mm)
V7090□-71	370 to 920	600 to 700	GaAs	13.5 × 10
V9569□-71				16 × 16
V8070□-73	280 to 820	480 to 530	Extended red GaAsP	13.5 × 10
V9501□-73				16 × 16
V8070□-74	280 to 720	480 to 530	GaAsP	13.5 × 10
V9501□-74				16 × 16
V6833P	370 to 920	600 to 700	GaAs	ϕ17.5
V6833P-G				
V7090P				

□...Potting method

The output window of standard products is a fiber optic plate coated with P43 phosphor material.

The V6833P, V6833P-G and V7090P contain a power supply (input voltage: +2 V to +3 V). These are limited in selecting the number of MCPs and the gate function as noted below.

❍Number of MCPs

The number of MCP stages can be selected from 1 or 2, except for the following types that contain a power supply.

V6833P, V6833P-G, V7090P: Only 1-stage MCP is available.

❍Gate function

The gate function with a gate time of 5 ns can be selected, except for the following types that contain a power supply.

V6833P, V7090P: No gate function is available.

V6833P-G: Only auto-gating is available.

Alkali photocathode image intensifiers

V○○○○ U–○○

Series type No. Suffix No.

If you cannot find what you need from our standard products, please contact us with your custom requests (output window, phosphor screen material, low-resistance MCP, potting method, etc.).

Type No.	Effective photocathode area (mm)	Number of MCP	Gate function (ns)
V6886U	ϕ18	1 stage MCP	Non
V4170U		2 stages MCP	
V6887U		1 stage MCP	5
V4183U		2 stages MCP	
V7669U	ϕ25	1 stage MCP	Non
V10308U		2 stages MCP	
V7670U		1 stage MCP	10
V10309U		2 stages MCP	

Suffix	Spectral response range (nm)	Wavelength of peak response (nm)	Photocathode
—	160 to 900	430	Multialkali
-02	160 to 650	400	Bialkali
-03	160 to 320	230	Cs-Te

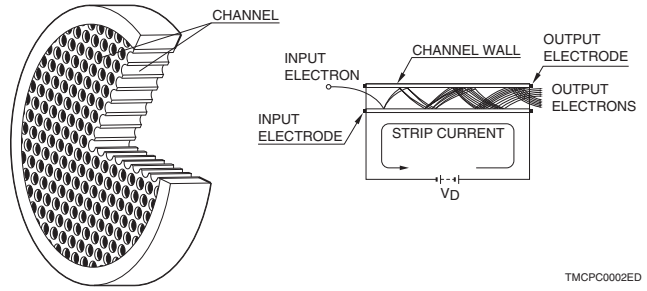
Type No.	Spectral response range (nm)	Wavelength of peak response (nm)	Photocathode	Effective photocathode area (mm)	Number of MCP	Gate function (ns)
V13716U-N130	160 to 320	230	High sensitivity Cs-Te	ϕ18	1 stage MCP	Non
V13716U-N230					2 stages MCP	

Glossary of terms

MCP (Microchannel Plate)

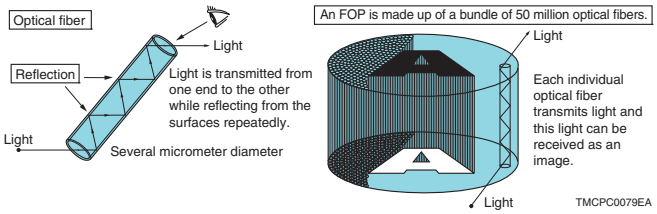
An MCP is a secondary electron multiplier consisting of an array of millions of very thin glass channels (glass pipes) bundled in parallel and sliced in the form of a disk. Each channel works as an independent electron multiplier. Electrons entering an MCP are repeatedly multiplied by secondary emission within each channel and are released from the output end of the MCP.
The dynamic range (linearity) of an image intensifier depends on the so-called strip current which flows through the MCP during operation. When a higher dynamic range is required, a low-resistance MCP is preferable.

MCP structure and operation



Fiber optic plate (FOP)

An FOP is an optical device made up of a bundle of a few millions to hundreds of millions of optical fibers with a diameter of several micrometers.
An FOP is capable of transmitting an optical image from one surface to another without causing any image distortion.



Photocathode sensitivity

Luminous sensitivity

The output current from the photocathode per the input luminous flux from a standard tungsten lamp (color temperature: 2856 K), usually expressed in μA/lm (microamperes per lumen).

Quantum efficiency (QE)

The number of photoelectrons emitted from the photocathode divided by the number of input photons, generally expressed in % (percentage). The higher the quantum efficiency, the better the photoelectric conversion efficiency.

Radiant sensitivity

The output current from the photocathode per the input radiant power at a given wavelength, usually expressed in A/W (amperes per watt).

Luminous emittance

This is the luminous flux density emitted from a phosphor screen and is usually expressed in lm/m^2 (lumens per square meter). The luminous emittance from a completely diffused surface emitting an equal luminance in every direction is equivalent to the luminance (cd/m^2) multiplied by π.

Gain

Gain is a measure of how much an image is intensified. It is designated by different terms according to the wavelength and properties of light as described below.

- **Gain of image intensifiers with sensitivity in the visible range**
  - ①**Luminous gain**
    The ratio of the phosphor screen luminous emittance (lm/m^2) to the illuminance (lx) incident on the photocathode.
- **Gain of image intensifiers for invisible light or single wavelength light**
  - ①**Radiant emittance gain**
    The ratio of the phosphor screen radiant emittance density (W/m^2) to the radiant flux density (W/m^2) incident on the photocathode.
    In this catalog, the radiant emittance gain is calculated using the radiant flux density at the wavelength of maximum photocathode sensitivity and the radiant emittance density at the peak emission wavelength (545 nm) of a P43 phosphor screen.
  - ②**Photon gain**
    The ratio of the number of input photons per square meter at a given wavelength to the number of photons per square meter emitted from the phosphor screen.

MTF (Modulation Transfer Function)

When a black-and-white stripe pattern producing sine-wave changes in brightness is focused on the photocathode, the contrast on the output phosphor screen drops gradually as the stripe pattern density is increased.
The relationship between this contrast and the stripe density (number of line-pairs per millimeter) is referred to as the MTF.

Limiting resolution

The limiting resolution shows the ability to delineate image detail. This is expressed as the maximum number of line-pairs per millimeter on the photocathode (1 line-pair = a pair of black and white lines) that can be discerned when a black-and-white stripe pattern is focused on the photocathode. In this catalog, the value at 5 % MTF is listed as the limiting resolution.

EBI (Equivalent Background Input)

This indicates the input illuminance required to produce a luminous emittance from the phosphor screen, equal to that obtained when the input illuminance on the photocathode is zero.
This indicates the inherent background level or lower limit of detectable illuminance of an image intensifier.

Shutter ratio

The ratio of the brightness on the phosphor screen during gate ON to that during gate OFF, measured when a gated image intensifier is operated under standard conditions.

Characteristics

GaAs and GaAsP photocathode image intensifiers

Type No.		Suffix	Stage of MCP	Spectral response range	Peak radiation sensitivity spectral response range	Luminous sensitivity (μA/lm)		Radiant sensitivity ④ (mA/W)		Quantum efficiency (QE) ④ (%)		Peak quantum efficiency spectral response range
Effective photocathode area ①												
13.5 mm × 10 mm	16 mm × 16 mm			(nm)	(nm)	Min.	Typ.	Min.	Typ.	Min.	Typ.	(nm)
V7090□	V9569□	-71	1	370 to 920	700 to 800	1000	1500	—	170	—	30	600 to 700
V7090□	V9569□	-71	2	370 to 920	700 to 800	1000	1500	—	170	—	30	600 to 700
V8070□	V9501□	-73	1	280 to 820	530 to 580	400	800	—	192	35	45	480 to 530
V8070□	V9501□	-73	2	280 to 820	530 to 580	400	800	—	192	35	45	480 to 530
V8070□	V9501□	-74	1	280 to 720	530 to 580	400	700	—	214	38	50	480 to 530
V8070□	V9501□	-74	2	280 to 720	530 to 580	400	700	—	214	38	50	480 to 530
V6833P, V7090P②	—	No suffix	1	370 to 920	700 to 800	1000	1500	—	170	—	30	600 to 700
V6833P-G ②	—	No suffix	1	370 to 920	700 to 800	1000	1500	—	170	—	30	600 to 700

□...Type No. suffix differs depending on the potting method. See page 5 for details.

Alkali photocathode image intensifiers

Type No.		Suffix	Stage of MCP	Spectral response range	Peak wavelength	Luminous sensitivity (μA/lm)		Radiant sensitivity ④ (mA/W)		Quantum efficiency (QE) (%)		
Effective photocathode area ①												
ϕ18 mm	ϕ25 mm			(nm)	(nm)	Min.	Typ.	Min.	Typ.	Min.	Typ.	(nm)
V6886U	V7669U	No suffix	1	160 to 900	430	150	280	—	62	—	18	410
V6887U	V7670U	No suffix	1	160 to 900	430	150	230	—	53	—	15	410
V4170U	V10308U	No suffix	2	160 to 900	430	100	170	—	60	—	17	410
V4183U	V10309U	No suffix	2	160 to 900	430	100	150	—	47	—	14	410
V6886U	V7669U	-02	1	160 to 650	400	20	50	—	50	—	14	380
V6887U	V7670U	-02	1	160 to 650	400	20	40	—	40	—	12	380
V4170U	V10308U	-02	2	160 to 650	400	20	50	—	50	—	14	380
V4183U	V10309U	-02	2	160 to 650	400	20	40	—	40	—	12	380
V6886U	V7669U	-03	1	160 to 320	230	—	—	10	32	5.4	17	220
V6887U	V7670U	-03	1	160 to 320	230	—	—	10	22	5.4	12	220
V4170U	V10308U	-03	2	160 to 320	230	—	—	10	32	5.4	17	220
V4183U	V10309U	-03	2	160 to 320	230	—	—	10	22	5.4	12	220
V13716U	—	No suffix	1	160 to 320	230	—	—	48	59	26	32	220
V13716U	—	No suffix	2	160 to 320	230	—	—	48	59	26	32	220

* The phosphor screen of standard products is P43 coated on an FOP output window. Please contact us for other phosphor screens and output windows.

NOTE: ①Photocathode area other than effective area is not guaranteed.
②Effective photocathode area: ϕ17.5 mm
③Auto gating function
④Typical values measured at the wavelength of peak response
⑤Typical values measured at 20 °C
⑥Values measured using a P43 phosphor screen.

Gate function	Luminous gain ⑥ [(lm/m²)/lx]		Radiant emittance gain ④⑥ [(W/m²)/(W/m²)]		Equivalent background input (EBI) ⑤⑥			Limiting resolution ⑥		Limiting resolution ⑥	
					(lm/cm²)		(W/cm²) ④	ϕ18 (Lp/mm)		ϕ25 (Lp/mm)	
	Min.	Typ.	Min.	Typ.	Typ.	Max.	Typ.	Min.	Typ.	Min.	Typ.
— / √	1.0×10^4	4.0×10^4	—	1.2×10^4	2.0×10^{-11}	5.0×10^{-11}	4.0×10^{-14}	51	64	45	57
— / √	1.0×10^6	9.6×10^6	—	2.7×10^6	2.0×10^{-11}	5.0×10^{-11}	4.0×10^{-14}	45	57	40	51
— / √	1.0×10^4	2.5×10^4	—	1.3×10^4	3.0×10^{-12}	3.0×10^{-11}	8.0×10^{-15}	51	64	45	57
— / √	1.0×10^6	5.7×10^6	—	3.0×10^6	3.0×10^{-12}	3.0×10^{-11}	8.0×10^{-15}	45	57	40	51
— / √	1.0×10^4	2.2×10^4	—	1.4×10^4	3.0×10^{-12}	3.0×10^{-11}	8.0×10^{-15}	51	64	45	57
— / √	1.0×10^6	5.0×10^6	—	3.4×10^6	3.0×10^{-12}	3.0×10^{-11}	8.0×10^{-15}	45	57	40	51
—	—	4.0×10^4	—	1.2×10^4	2.0×10^{-11}	5.0×10^{-11}	4.0×10^{-14}	51	64	—	—
√ ③	—	4.0×10^4	—	1.2×10^4	2.0×10^{-11}	5.0×10^{-11}	4.0×10^{-14}	51	64	—	—

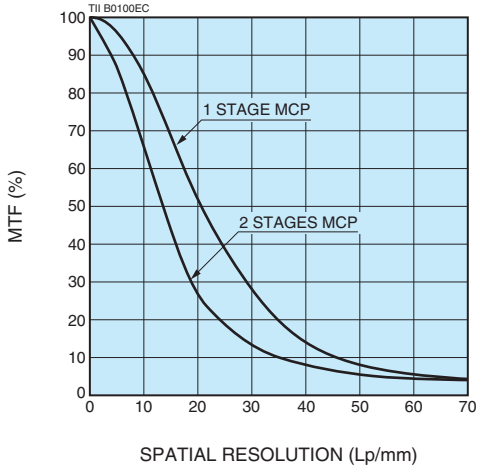
Gate function	Luminous gain ⑥ [(lm/m²)/lx]		Radiant emittance gain ④⑥ [(W/m²)/(W/m²)]		Equivalent background input (EBI) ⑤⑥				Limiting resolution ⑥ (Lp/mm)	
					(lm/cm²)		(W/cm²) ④			
	Min.	Typ.	Min.	Typ.	Typ.	Max.	Typ.	Max.	Min.	Typ.
—	7.0×10^3	1.2×10^4	—	8.7×10^3	1.0×10^{-11}	4.0×10^{-11}	3.0×10^{-14}	—	51	64
√	7.0×10^3	1.1×10^4	—	6.8×10^3	1.0×10^{-11}	4.0×10^{-11}	3.0×10^{-14}	—	51	64
—	1.0×10^6	5.0×10^6	—	4.0×10^6	1.0×10^{-11}	4.0×10^{-11}	3.0×10^{-14}	—	45	57
√	1.0×10^6	4.0×10^6	—	3.0×10^6	1.0×10^{-11}	4.0×10^{-11}	3.0×10^{-14}	—	45	57
—	1.4×10^3	3.1×10^3	—	7.0×10^3	5.0×10^{-13}	4.0×10^{-12}	5.0×10^{-16}	—	40	51
√	1.4×10^3	2.5×10^3	—	5.9×10^3	5.0×10^{-13}	4.0×10^{-12}	5.0×10^{-16}	—	40	51
—	2.0×10^5	1.0×10^6	—	4.0×10^6	5.0×10^{-13}	4.0×10^{-12}	5.0×10^{-16}	—	36	45
√	2.0×10^5	1.0×10^6	—	3.0×10^6	5.0×10^{-13}	4.0×10^{-12}	5.0×10^{-16}	—	36	45
—	—	—	1.2×10^3	3.8×10^3	—	—	1.0×10^{-15}	4.0×10^{-15}	28	40
√	—	—	1.2×10^3	2.6×10^3	—	—	1.0×10^{-15}	4.0×10^{-15}	28	40
—	—	—	2.0×10^5	1.6×10^6	—	—	1.0×10^{-15}	4.0×10^{-15}	22	28
√	—	—	2.0×10^5	1.1×10^6	—	—	1.0×10^{-15}	4.0×10^{-15}	22	28
—	—	—	2.2×10^3	7.3×10^3	—	—	1.0×10^{-15}	4.0×10^{-15}	28	40
—	—	—	6.0×10^5	3.0×10^6	—	—	1.0×10^{-15}	4.0×10^{-15}	22	28

· Operating ambient temperature: -20 °C to +40 °C
· Storage ambient temperature: -55 °C to +60 °C
· Maximum shock: 300 m/s² (30 G), 18 ms
· Maximum vibration: 10 Hz to 55 Hz, 0.35 mm (p-p)

Characteristics graphs

Figure 1: MTF

Alkali photocathode image intensifiers



GaAs and GaAsP photocathode image intensifiers

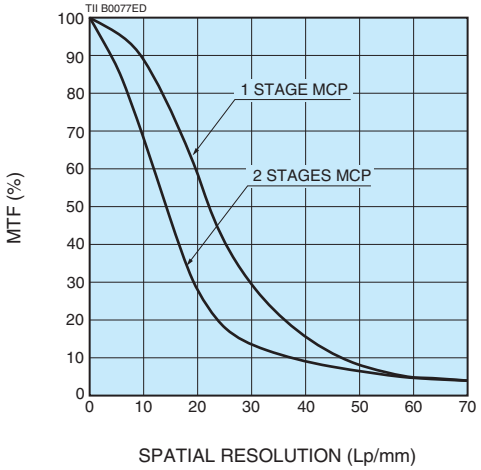


Figure 2: Luminous gain vs. MCP voltage (V8070 series)

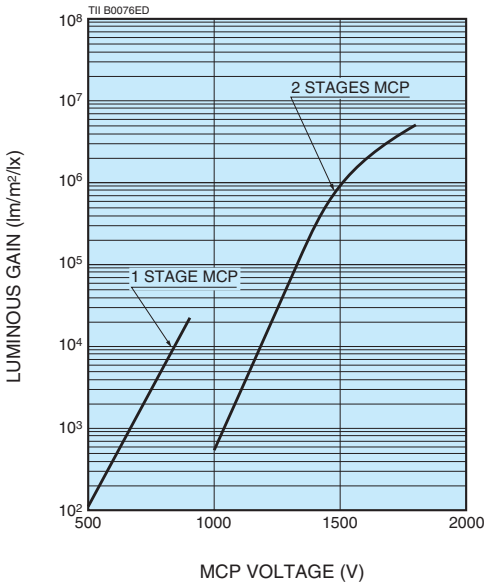


Figure 3: Equivalent background input (EBI) vs. Temperature

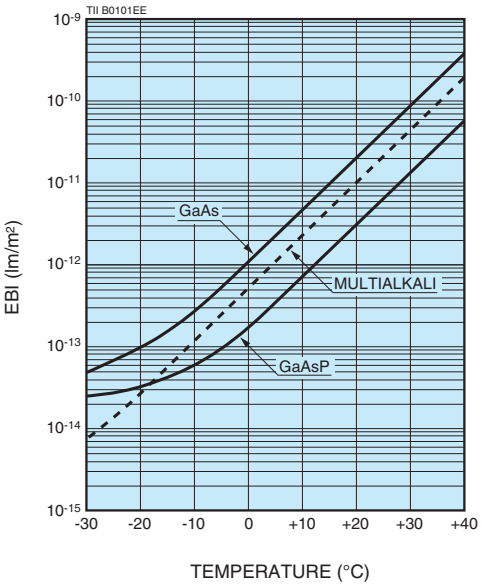


Figure 4: Photocathode illuminance vs. Phosphor screen luminous emittance

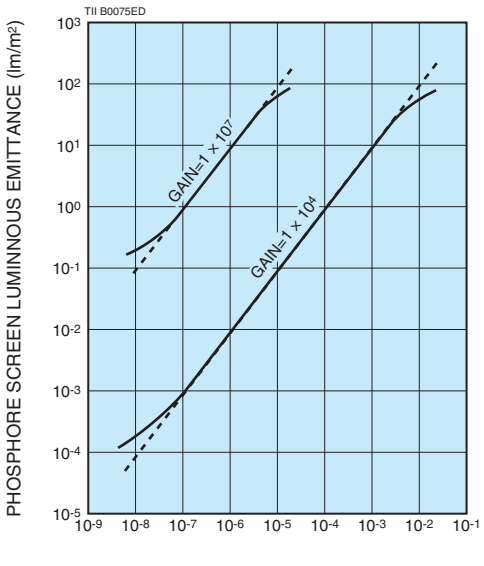
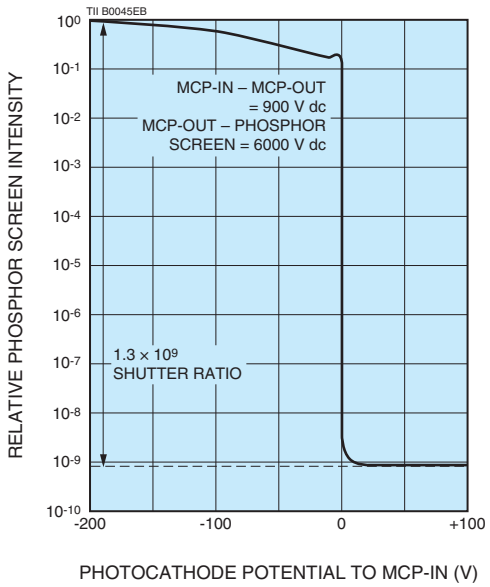


Figure 5: Shutter ratio (color temperature: 2856 k)



Wiring diagram

Recommended operation (Example)

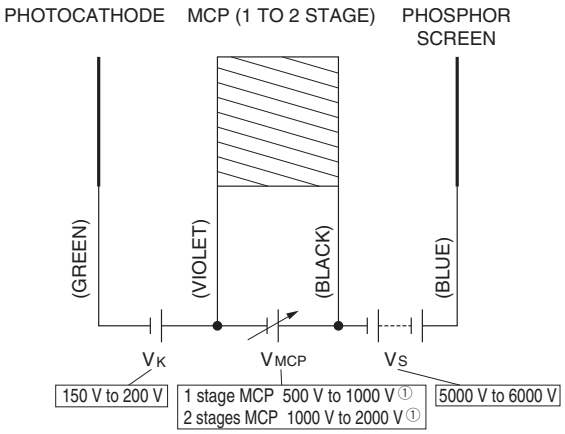
Normal operation

Supply voltage (See Figure 6.)

Photocathode – MCP-in (Vk) ..... 150 V to 200 V
MCP-in – MCP-out (V_{MCP})① .... 1 stage MCP 500 V to 1000 V
2 stages MCP 1000 V to 2000 V
MCP-out – Phosphor screen (Vs) ..... 5000 V to 6000 V

NOTE: ①The maximum supply voltage and recommended supply voltage for the MCP-in and MCP-out are noted on the test data sheet when the products is delivered. Please refer to the test data sheet for these values.

Figure 6: Normal operation



TII C0017EF

NOTE: A compact high-voltage power supply is available. (See page 15.) Any electrode (for photocathode, MCP and phosphor screen) can be connected to ground potential.

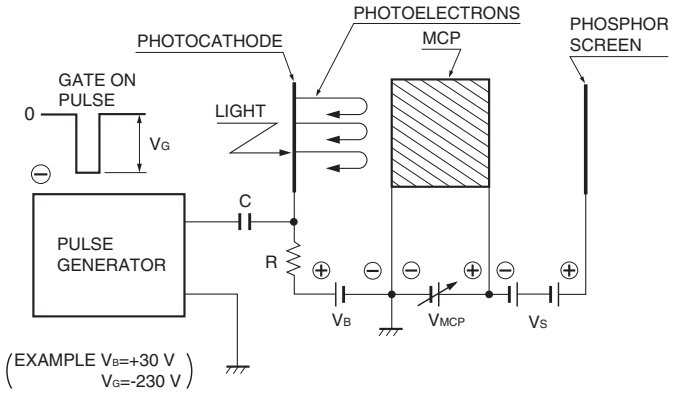
Gate operation

There are two basic circuits for gate operation as shown in Figure 7 below. The supply voltages V_{MCP} and Vs are the same as those in normal operation. Gate operation is controlled by changing the bias voltage (V_B) between the photocathode and MCP-in.

Figure 7: Gate operation

Normally-OFF mode

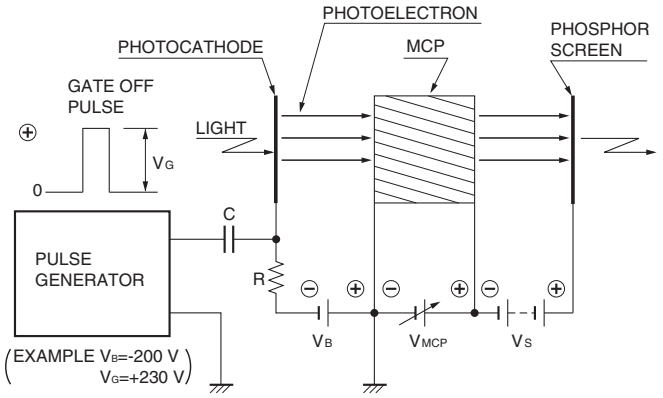
The V_B is constantly applied as a reverse bias to the photocathode, so no image appears on the phosphor screen. An image appears only when a gate pulse (V_G) is applied to the photocathode.



TII C0018EC

Normally-ON mode

The V_B is constantly applied as a forward bias to the photocathode, so an image is always seen on the phosphor screen during operation. The image disappears only when a gate pulse (V_G) is applied to the photocathode.



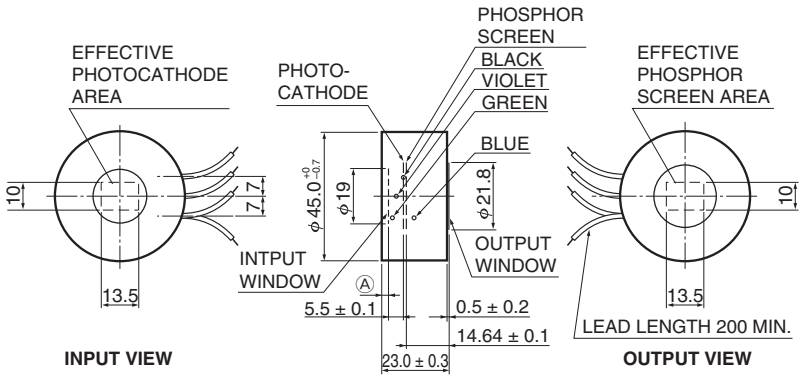
TII C0019EF

C, R: Chose the value in consideration of pulse width and repetition rate.
C: High voltage type.

Dimensional outlines (Unit:mm)

V7090U/D series, V8070U/D series (Effective photocathode area: 13.5 mm × 10 mm)

V7090U, V8070U series



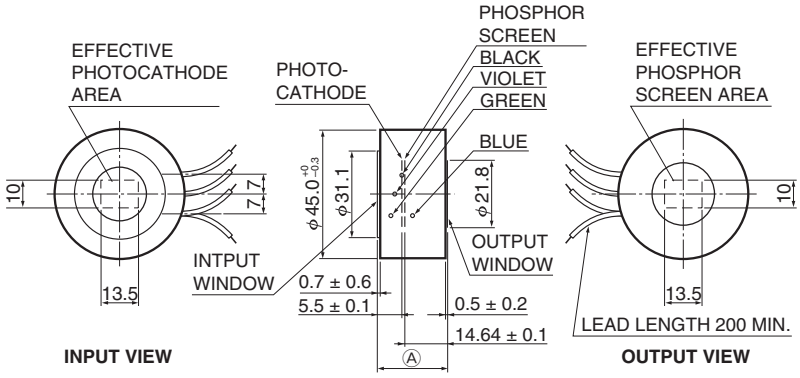
MCP	Ⓐ
1 stage	1.8 ± 0.6
2 stages	1.3 ± 0.6

LEAD (COVER: PTFE [Polytetrafluoroethylene])
GREEN (PHOTOCATHODE)
VIOLET (MCP-in)
BLACK (MCP-out)
BLUE (PHOSPHOR SCREEN)

HOUSING MATERIAL: POM [Polyoxymethylene]

TII A0043EE

V7090D, V8070D series



MCP	Ⓐ
1 stage	21.2 ± 0.5
2 stages	21.7 ± 0.5

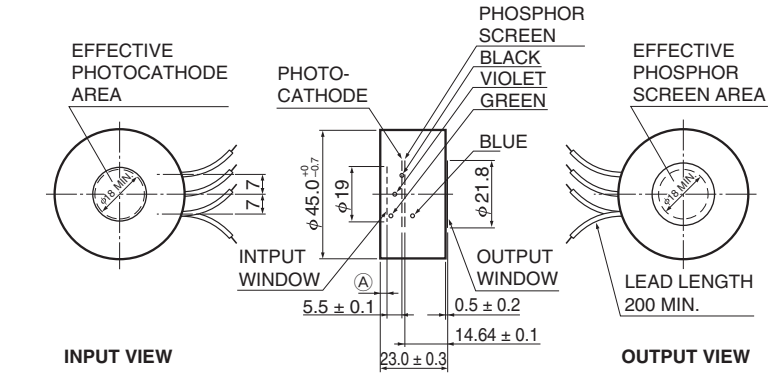
LEAD (COVER: PTFE [Polytetrafluoroethylene])
GREEN (PHOTOCATHODE)
VIOLET (MCP-in)
BLACK (MCP-out)
BLUE (PHOSPHOR SCREEN)

HOUSING MATERIAL: POM [Polyoxymethylene]

TII A0053EG

V6886U, V6887U, V4170U, V4183U series, V13716

Suffix: Non, -02, -03



TYPE No.	Ⓐ
V6886U, V6887U, V13716U-N130	1.7 ± 0.6
V4170U, V4183U, V13716U-N230	1.3 ± 0.7

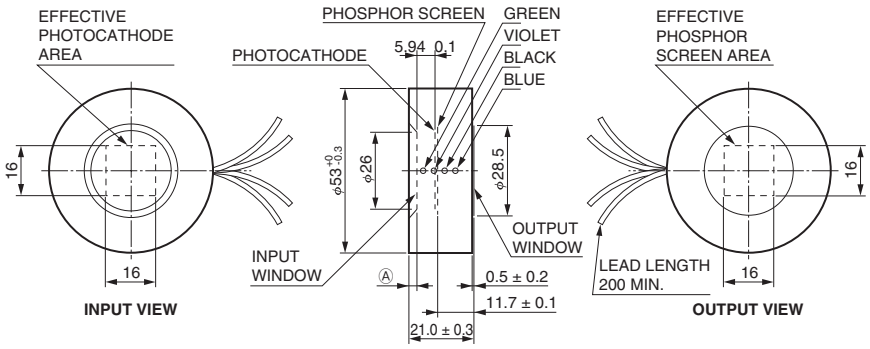
LEAD (COVER: PTFE [Polytetrafluoroethylene])
GREEN (PHOTOCATHODE)
VIOLET (MCP-in)
BLACK (MCP-out)
BLUE (PHOSPHOR SCREEN)

HOUSING MATERIAL: POM [Polyoxymethylene]

TII A0033EF

V9501U/D series, V9569U/D series (Effective photocathode area: 16 mm × 16 mm)

V9501U, V9569U series



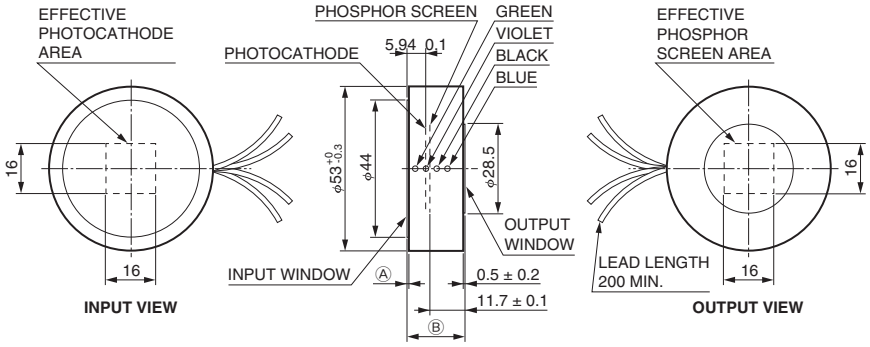
MCP	Ⓐ
1 stage	2.2 ± 0.6
2 stage	1.9 ± 0.6

LEAD (COVER: PTFE [Polytetrafluoroethylene])
GREEN (PHOTOCATHODE)
VIOLET (MCP-in)
BLACK (MCP-out)
BLUE (PHOSPHOR SCREEN)

HOUSING MATERIAL: POM [Polyoxymethylene]

TII A0063EB

V9501D, V9569D series



MCP	Ⓐ	Ⓑ
1 stage	0.8 ± 0.6	18.8 ± 0.5
2 stage	0.6 ± 0.6	19.1 ± 0.5

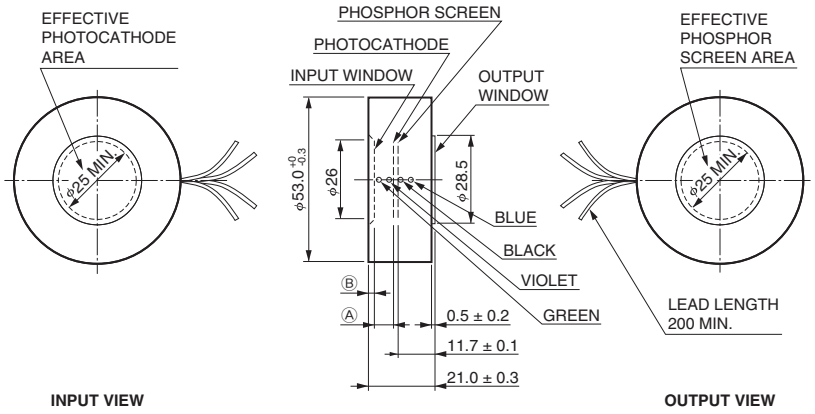
LEAD (COVER: PTFE [Polytetrafluoroethylene])
GREEN (PHOTOCATHODE)
VIOLET (MCP-in)
BLACK (MCP-out)
BLUE (PHOSPHOR SCREEN)

HOUSING MATERIAL: POM [Polyoxymethylene]

TII A0064EB

V7669U, V7670U, V10308U, V10309U series

Suffix: Non, -02, -03



TYPE No.	Ⓐ	Ⓑ
V7669U, V7670U	5.94 ± 0.1	2.2 ± 0.6
V10308U, V10309U	5.53 ± 0.1	2.1 ± 0.7

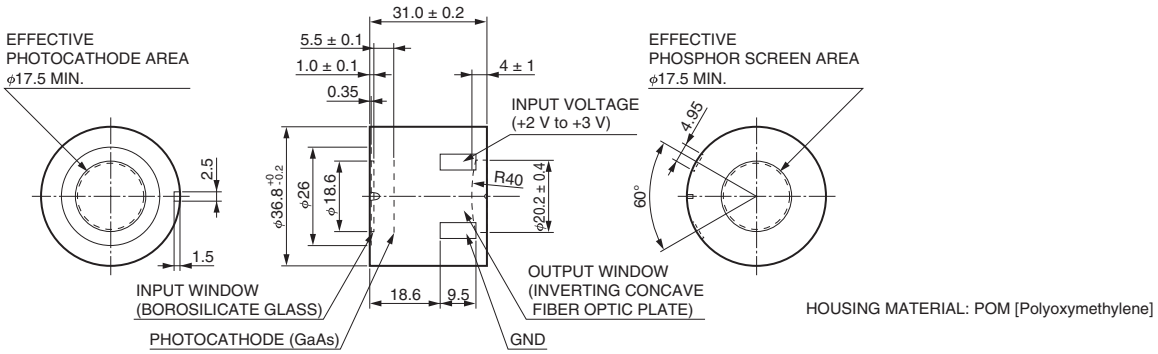
LEAD (COVER: PTFE [Polytetrafluoroethylene])
GREEN (PHOTOCATHODE)
VIOLET (MCP-in)
BLACK (MCP-out)
BLUE (PHOSPHOR SCREEN)

HOUSING MATERIAL: POM [Polyoxymethylene]

TII A0018ED

Dimensional outlines (Unit:mm)

V6833P, V6833P-G (Built-in power supply)

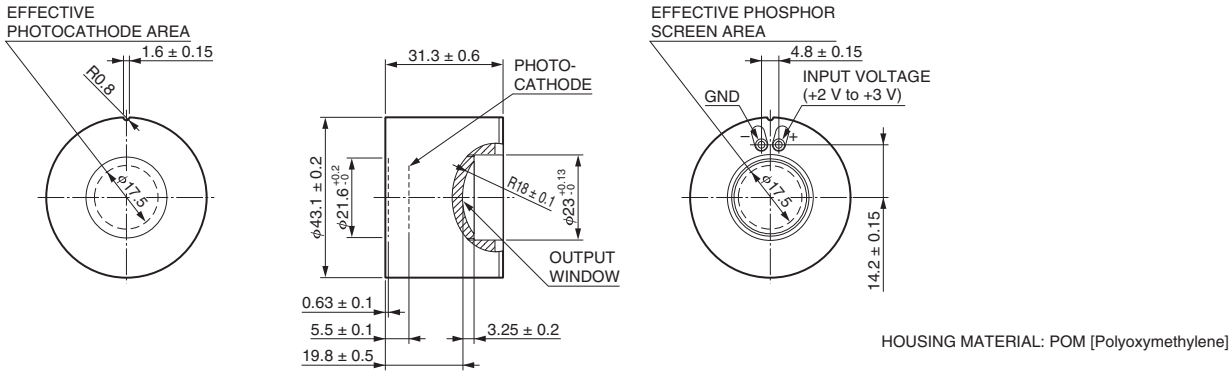


HOUSING MATERIAL: POM [Polyoxymethylene]

INPUT VIEW **OUTPUT VIEW**

TII A0031EG

V7090P (Built-in power supply)



HOUSING MATERIAL: POM [Polyoxymethylene]

INPUT VIEW **OUTPUT VIEW**

TII A0048EF

HANDLING PRECAUTIONS

- Do not apply excessive shocks or vibrations during transportation, installation, storage or operation. Image intensifiers are an image tube evacuated to a high degree of vacuum. Excessive shocks or vibrations may cause failures or malfunctions. For reshipping or storage, use the original package received from Hamamatsu.
- Never touch the input or output window with bare hands during installation or operation. The window may become greasy or electrical shocks or failures may result.
  Do not allow any object to make contact with the input or output window. The window might become scratched.
- Dust or dirt on the input or output window will appear as black blemishes or smudges. To remove dust or dirt, use a soft cloth to wipe the windows thoroughly before operation. If fingerprints or marks adhere to the windows, use a soft cloth moistened with alcohol to wipe off the windows. Never attempt cleaning any part of image intensifiers while it is in operation.
- Never attempt to modify or to machine any part of image intensifiers or power supplies.
- Do not store or use in harsh environments. If image intensifiers is left in a high-temperature, salt or acidic atmosphere for a long time, the metallic parts may corrode causing contact failure or a deterioration in the vacuum level.
- Image intensifiers are extremely sensitive optical devices. When applying the MCP voltage without using an excessive light protective circuit, always increase it gradually while viewing the emission state on the phosphor screen until an optimum level is reached.
- Do not expose the photocathode to strong light such as sunlight regardless of whether in operation or storage.
  Operating the image intensifiers while a bright light (e.g. room illumination) is striking the photocathode, might seriously damage the photocathode.
  The total amount of photocurrent charge that flows in the photocathode while light is incident during operation has an inverse proportional effect on photocathode life. This means that the amount of incident light should be kept as small as possible.
- Never apply the voltage to image intensifiers exceeds the maximum rating. Especially if using a power supply made by another company, check before making connections to the image intensifier, that the voltage appling to each electrode is correct.
  If a voltage in excess of the maximum rating is applied even momentarily, the image intensifier might fail and serious damage might occur.
- Use only the specified instructions when connecting an image intensifier to a high-voltage power supply module.
  If the connections are incorrect, image intensifiers might be instantly damaged after the power is turned on. Use high-voltage connectors or solder having a high breakdown voltage. When soldering, provide sufficient insulation at the solder joint by using electrical insulation tape capable of withstanding at least 10 kV or silicon rubber that hardens at room-temperature and withstands at least 20 kV/mm.

WARRANTY

Hamamatsu image intensifiers are warranted for one year from the date of delivery or 1000 hours of actual operation, whichever comes first. This warranty is limited to repair or replacement of the product. The warranty shall not apply to failure or defects caused by natural disasters, misused or incorrect usage that exceeds the maximum allowable ratings.
When ordering, please double-check all detailed information.

DISPOSAL METHOD

When disposing of the used image intensifier, take appropriate measures in compliance with applicable regulations regarding waste disposal and correctly dispose of it yourself, or entrust disposal to a licensed industrial waste disposal company.
In any case, be sure to comply with the regulations in your country, state, region or province to ensure the used image intensifier is disposed of legally and correctly.

Separate power supplies

Hamamatsu offers various types of separate modular power supplies designed to provide the high voltages needed for image intensifier operation. These power supplies are compact, lightweight and operate on a low voltage input. Image intensifier gain is easily controlled by adjusting the control voltage for the MCP voltage or the control resistance. Please select the desired product that matches your application.

FOR DC OPERATION

Type No.	Input			Output					Ground ①	Features	Applicable I.I.
	Voltage ① (V)	Max. current (mA)	MCP control voltage (V)	Photocathode – MCP-in Voltage (V)	MCP-in – MCP-out Voltage (V)	MCP-in – MCP-out Max. Current (μA)	MCP-out – Phosphor screen Voltage (V)	MCP-out – Phosphor screen Max. current (μA)			
C6706-010 ①	+15±1.5	60	+5 to +10	-200	500 to 1000	20	6000	0.25 to 0.75	MCP-in	ABC (Automatic Brightness Control) ②	V6886U,V7669U V7090○-7○-N1○○
C6706-210 ①	+12±1.2							0.1 to 1		Excess current (excess light) protective function	V8070○-7○-N1○○ V13716
C8499-020	+10±0.5	150			1000 to 2000	100		0.05 to 5		ABC (Automatic Brightness Control) ②	V4170U,V10308U V7090○-7○-N2○○
C8499-220										Excess current (excess light) protective function	V8070○-7○-N2○○

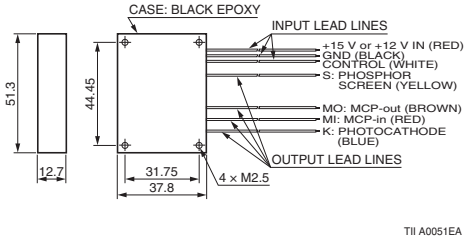
FOR GATE OPERATION (100 ns to DC operation at maximum repetition rate of 1 kHz)

Type No.	Input			Gate signal input level		Output					Ground ①	Features	Applicable I.I.
	Volatage ① (V)	Current (mA Max.)	MCP control voltage ④ (V)	Gate on voltage (V)	Gate off voltage (V)	Phosphor screen – MCP-in Voltage (V)	MCP-in – MCP-out Voltage (V)	MCP-in – MCP-out Max. current (μA)	MCP-out – Phosphor screen Voltage (V)	MCP-out – Phosphor screen Max. current (μA)			
C6083-010 ①	+10±0.5	200	+5 to +10	0 (TTL Low)	+5 (TTL High)	-200	500 to 1000	50	6000	0.05 to 5	MCP-in	ABC ②	V6887U, V7670U V7090○-7○-G1○○ V8070○-7○-G1○○
C6083-020							1000 to 2000						V4183U, V10309U V7090○-7○-G2○○ V8070○-7○-G2○○

NOTE: ①Other ground terminal types and other input voltage types are also available. Please consult our sales office. ②ABC: Automatic Brightness Control

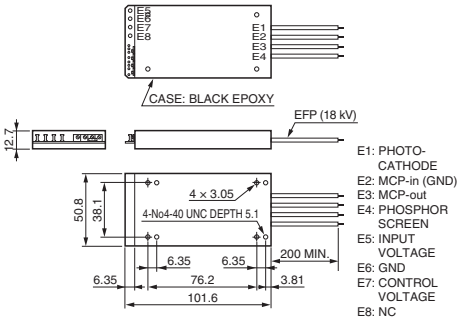
Dimensional outlines (Unit: mm)

C6706-010, -210



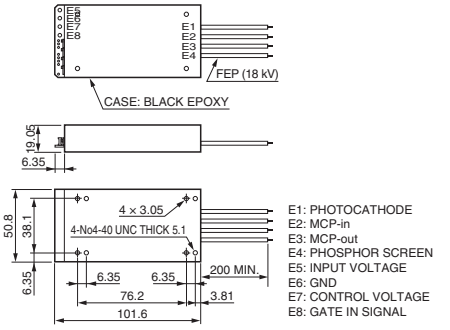
TII A0051EA

C8499-020, -220



TII A0070EA

C6083-010, -020

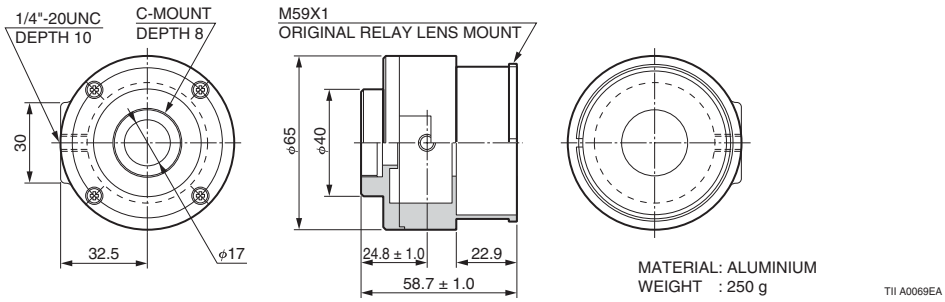


TII A0052EB

Housing case for I.I. A10505

A10505 is a Housing case for easy to use 45mm outer diameter of Image Intensifier (output window: FOP, MCP: 1 stage).
It is available for 1 stage MCP type of V7090U/D, V8070U/D, V8071U/D, V6886U and V6887U series.
Input: C-mount, Output: Hamamatsu's relay lens mount. Screw hole for a tripod can be used for holding.

Dimensional outlines (Unit: mm)



TII A0069EA

Related products

High-speed gated image intensifier units

High-speed gated Image Intensifier (I.I.) unit comprises I.I., high voltage power supply and gate driver circuit. Depending on application, a best gated I.I. unit can be selected from among various models.
The built-in I.I. is available with GaAsP photocathode, multialkali photocathode or GaAs photocathode. The GaAsP photocathode type delivers very high quantum efficiency in visible region ideal for bio-/fluorescence imaging application under a microscope. The multialkali photocathode type offers a wide spectral range from UV (Ultra Violet) to NIR (Near Infrared Region). The GaAs photocathode type has high sensitivity from visible region to NIR. All of gated I.I. units can be operated and controlled from a remote controller or a PC (Personal Computer) via the USB interface.
Input: C-mount, Output: Hamamatsu's relay mount. Screw hole for a tripod can be used for holding.

SELECTION GUIDE

Type No.	C9546-01, -02	C9546-03, -04	C9546-05, -06	C9547-01, -02	C9547-03, -04	C9547-05, -06	Unit
Effective area	ϕ17 ①			ϕ25 ②			mm
Gate time	3 ns			5 ns	10 ns	5 ns	—
Gate repetition rate	30 kHz			30 kHz			—
Spectral response	280 to 720	185 to 900	370 to 920	280 to 720	185 to 900	370 to 920	nm
Photocathode material	GaAsP	Multialkali	GaAs	GaAsP	Multialkali	GaAs	—

NOTE: ①Effective 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.
②Effective 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.

High-speed gated image intensifier units C10880-03C/-03F/-13C/-13F

No lighting required during imaging with High-speed camera

Image intensifiers (I.I.) are devices capable of intensifying an image at high gain and high-speed gating (electronic shutter operation).
The C10880 series is an image intensifier unit which is suitable for High-speed camera application. It has a built-in pulse generator to allow multi-exposure (burst) operation.
By using a relay lens, the C10880 series can be easily connected to various High-speed cameras. The image intensifier gain, gate width and delay time can be controlled and set from a PC through the RS-232C interface. (The image intensifier gain can also be controlled and set from the remote controller.)

▲C10880-03F

Features

- ●Maximum repetition frequency: 200 kHz
- ●Built-in pulse generator
- ●Multi-exposure
- ●Built-in low distortion image booster
  (C10880-13C/C10880-13F)
- ●High-speed gating: 10 ns minimum
- ●High performance image intensifier
  Wide spectral response range from UV to near IR: Multialkali photocathode type.
  High linearity compatible with high frame rate: Image booster included.

MEMO

MEMO

HAMAMATSU

PHOTON IS OUR BUSINESS

Electron Tube Division, HAMAMATSU PHOTONICS K.K.
314-5, Shimokanzo, Iwata City, Shizuoka Pref., 438-0193, Japan
Telephone: (81)539/62-5248, Fax: (81)539/62-2205
www.hamamatsu.com

Main Products

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Photomultiplier tubes
Photomultiplier tube modules
Microchannel plates
Image intensifiers
Xenon lamps / mercury-xenon lamps
Deuterium lamps
Light source applied products
Laser applied products
Microfocus X-ray sources
X-ray imaging devices

Opto-semiconductors
Si photodiodes
APD
MPPC®
Photo IC
Image sensors
PSD
Infrared detectors
LED
Optical communication devices
Automotive devices
X-ray flat panel sensors
Mini-spectrometers
Opto-semiconductor modules

Imaging and Processing Systems
Cameras / image processing measuring systems
X-ray products
Life science systems
Medical systems
Semiconductor failure analysis systems
FPD / LED characteristic evaluation systems
Spectroscopic and optical measurement systems

Laser Products
Semiconductor lasers
Applied products of semiconductor lasers
Solid state lasers

REVISED MAY 2020

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Quality, technology and service are part of every product.

Sales Offices

Japan:
HAMAMATSU PHOTONICS K.K.
325-6, Sunayama-cho, Naka-ku,
Hamamatsu City, Shizuoka Pref. 430-8587, Japan
Telephone: (81)53-452-2141, Fax: (81)53-456-7889
E-mail: intl-div@hq.hpk.co.jp

China:
HAMAMATSU PHOTONICS (CHINA) Co., Ltd.
Main Office
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

Shanghai Branch
4905 Wheelock Square, 1717 Nanjing Road West,
Jingan District, 200040 Shanghai, P.R. China
Telephone: (86)21-6089-7018, Fax: (86)21-6089-7017

Taiwan:
HAMAMATSU PHOTONICS TAIWAN Co., Ltd.
Main Office
8F-3, No.158, Section 2, 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

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

California Office
2875 Moorpark Ave., San Jose, CA 95128, U.S.A.
Telephone: (1)408-261-2022, Fax: (1)408-261-2522
E-mail: usa@hamamatsu.com

Chicago Office
4711 W. Golf Road, Suite 805, Skokie, IL 60076, U.S.A.
Telephone: (1)847-825-6046, Fax: (1)847-825-2189
E-mail: usa@hamamatsu.com

Boston Office
20 Park Plaza, Suite 312, Boston, MA 02116, U.S.A.
Telephone: (1)617-536-9900, Fax: (1)617-536-9901
E-mail: usa@hamamatsu.com

United Kingdom:
HAMAMATSU PHOTONICS UK Limited
Main Office
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

South Africa Contact:
9 Beukes Avenue, Highway Gardens, Edenvale
1609 South Africa
Telephone/Fax: (27)11-609-0367

France, Portugal, Belgium, Switzerland, Spain:
HAMAMATSU PHOTONICS FRANCE S.A.R.L.
Main Office
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

Swiss Office
Dornacherplatz 7, 4500 Solothurn, Switzerland
Telephone: (41)32-625-60-60, Fax: (41)32-625-60-61
E-mail: swiss@hamamatsu.ch

Belgian Office
Axisparc Technology, rue Andre Dumont 7
1435 Mont-Saint-Guibert, Belgium
Telephone: (32)10 45 63 34, Fax: (32)10 45 63 67
E-mail: info@hamamatsu.be

Spanish Office
C. Argenters, 4 edif 2 Parque Tecnológico del Vallés
08290 Cerdanyola (Barcelona), Spain
Telephone: (34)93 582 44 30, Fax: (34)93 582 44 31
E-mail: infospain@hamamatsu.es

Germany, Denmark, The Netherlands, Poland, Israel:
HAMAMATSU PHOTONICS DEUTSCHLAND GmbH
Main Office
Arzbergerstr. 10, D-82211 Herrsching am Ammersee,
Germany
Telephone: (49)8152-375-0, Fax: (49)8152-265-8
E-mail: info@hamamatsu.de

Danish Office
Lautruphøj 1-3, DK-2750 Ballerup, Denmark
Telephone: (45)70 20 93 69, Fax: (45)44 20 99 10
Email: info@hamamatsu.dk

Netherlands Office
Transistorstraat 7, NL-1322 CJ Almere, The Netherlands
Telephone: (31)36-5405384, Fax: (31)36-5244948
E-mail: info@hamamatsu.nl

Poland Office
10 Ciolka Street, RN 126-127 01-402 Warsaw, Poland
Telephone: (48)22-646-0016, Fax: (48)22-646-0018
E-mail: poland@hamamatsu.de

Israel Office (Hamamatsu Photonics Israel Ltd.)
Hahoshlim 6, Building C, 4672201 Herzliya, Israel
E-mail: Info@hamamatsu.co.il

North Europe and CIS:
HAMAMATSU PHOTONICS NORDEN AB
Main Office
Torshamnsgatan 35 16440 Kista, Sweden
Telephone: (46)8-509 031 00, Fax: (46)8-509 031 01
E-mail: info@hamamatsu.se

Russian Office
11, Christoprudny Boulevard, Building 1, Office 114,
101000, Moscow, Russia
Telephone: (7)495 258 85 18, Fax: (7)495 258 85 19
E-mail: info@hamamatsu.ru

Italy:
HAMAMATSU PHOTONICS ITALIA S.r.l.
Main Office
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

Rome Office
Viale Cesare Pavese, 435, 00144 Roma, Italy
Telephone: (39)06-50 51 34 54
E-mail: inforoma@hamamatsu.it

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