2006

PHOTONIC DEVICES

Electron Tube Devices and Applied Products

HAMAMATSU

SUB ASSEMBLY

Customized Design & Manufacturing of Sub Assemblies

HAMAMATSU PHOTONICS TECHNOLOGY

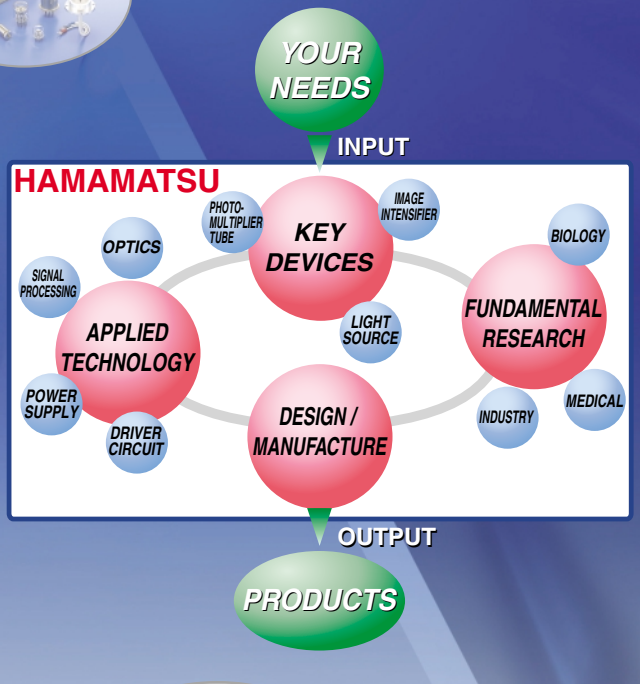
HAMAMATSU is ready to support your needs using opto-electronics, applied circuits and fundamental research.

KEY DEVICES

Benefits

Reduce your development costs.
Shorten development time.
Maximize the performance of your device.

SUB ASSEMBLY



Please consult your local sales office for more information.

www.hamamatsu.com

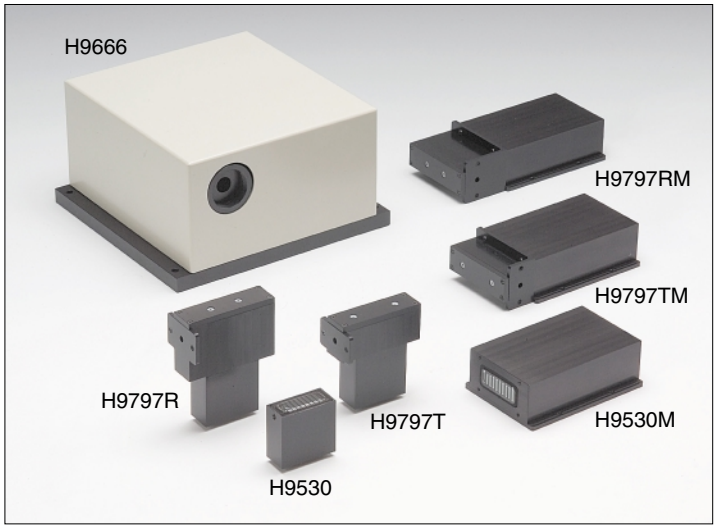
For detailed information about individual products, please access our Website: www.hamamatsu.com

CONTENTS

Specifications shown in this brochure are typical values unless otherwise specified.
Specifications are subject to change without notice.

FLUORESCENCE DETECTOR SERIES

Multi Color Fluorescence Detection



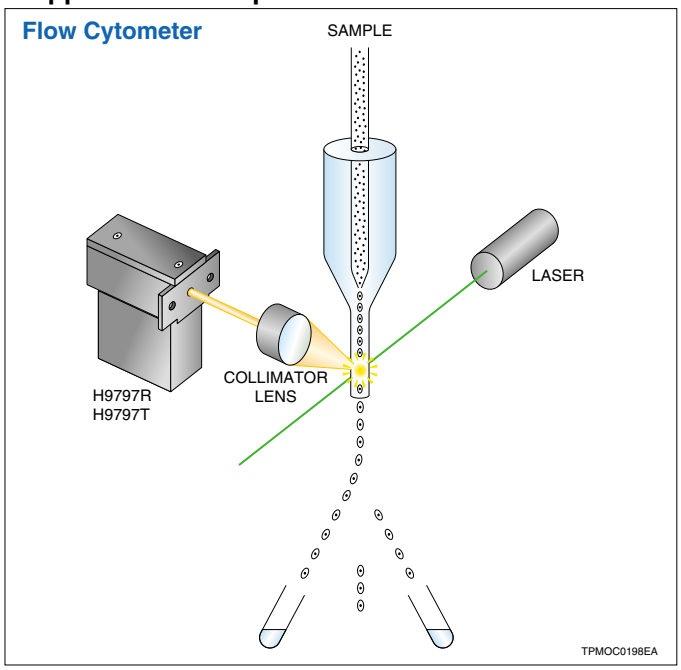
■APPLICATIONS

- Flow cytometer
- MTP reader (Microplate reader)
- DNA analytical instrument
- Fluorescence spectroscopy
- Micro fluidic chip
- Laser scanning microscopy

Type No.	H9530	Devlp. H9530M Ⓑ	Devlp. H9797R H9797T	Devlp. H9797RM H9797TM	NEW H9666
Filter Ⓐ			●	●	●
PMT	●	●	●	●	●
Divider Circuit	●	●	●	●	●
Pre Amplifier		●		●	●
High Voltage Power Supply		●		●	●

Ⓐ All filters are custom made upon your requirements. Please consult with us.
Ⓑ Please refer to specifications of pre amplifier and high voltage power supply on H9797RM, H9797TM

● Application Example



8 CHANNEL LINEAR ARRAY MULTIANODE PMT ASSEMBLY H9530 SERIES

■FEATURES

- Low cross-talk 0.1 %
- Good anode uniformitiy* 1: 1.1

* At -1000 V and peak wavelength

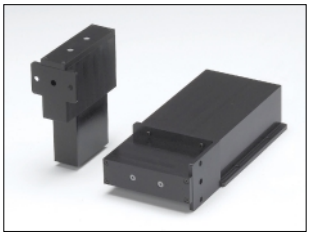
Parameter	H9530-01	H9530-20	Unit
Spectral Response	300 to 880	300 to 920	nm
Cathode Luminous Sensitivity	250	500	μA/lm
Gain	3×10^6		—
Effective Area (per channel)	2.0×2.5		mm
Channel Pitch	2.8		mm

FLUORESCENCE DETECTION ASSEMBLY H9797R/H9797T SERIES
FLUORESCENCE DETECTION UNIT H9797RM/H9797TM SERIES, H9666

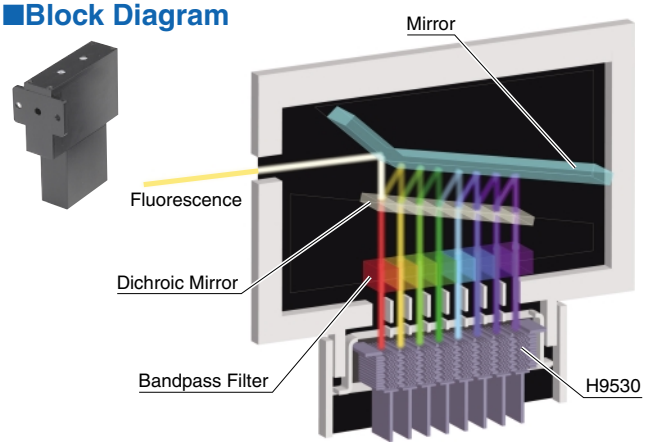
H9797R, H9797RM

■FEATURES

- Reflection transfer type
- Max. 8 ch
- High S/N ratio in NIR range
- Detecting from long wavelength



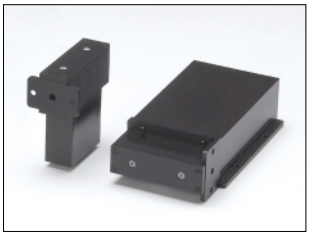
■Block Diagram



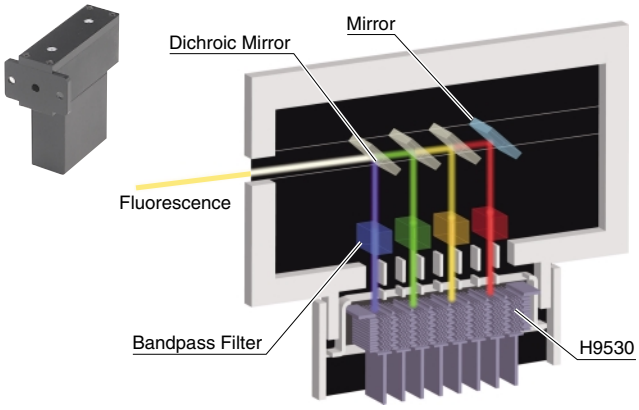
H9797T, H9797TM

■FEATURES

- Transmission type
- Max. 4 ch
- Compact
- Detecting from short wavelength



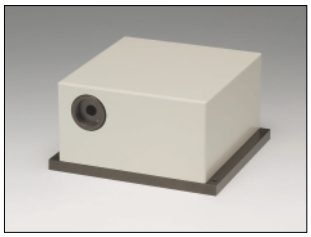
■Block Diagram



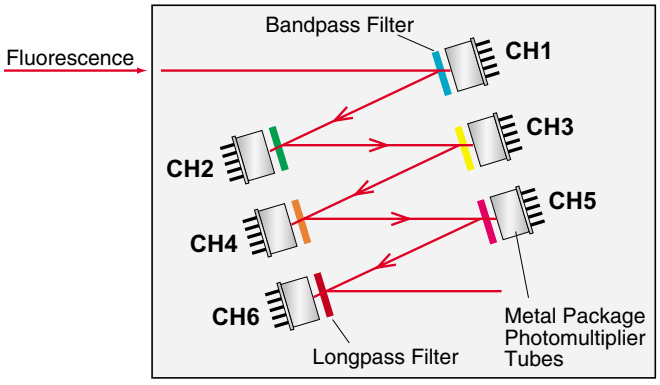
H9666

■FEATURES

- Max. 6 ch
- High filter transmittance and high laser rejection
- Individual PMT gain adjustment
- Detecting from short wavelength



■Block Diagram



Parameter	H9797RM, H9797TM	H9666	Unit
Input Voltage	±11.5 to ±15.5	±15	V
Recommended Control Voltage	+1.2 to +4.0	+0.25 to +0.9	V
Frequency Bandwidth	DC to 1 MHz	DC to 300 kHz	—
Current-to-Voltage Conversion Factor	0.1	0.1	V/µA
Signal Output Voltage (Max.)	10	10	V

PHOTOMULTIPLIER TUBE MODULES

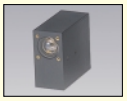
A Single Compact Package for Easy Use

■FUNCTIONS

Photomultiplier Tube (PMT) module functions are shown in the chart below. PMT modules comprise of a photomultiplier tube to convert light into electrical signals, a high voltage power supply circuit, and a voltage divider circuit to distribute the optimum voltage to each dynode, all assembled into a single compact case. In addition to these basic PMT modules, Hamamatsu also provides modules having various additional functions such as signal processing, cooling and interface to PC.

■SELECTION GUIDE

Photomultiplier Tube + Voltage Divider Circuit + High Voltage Power Supply Circuit

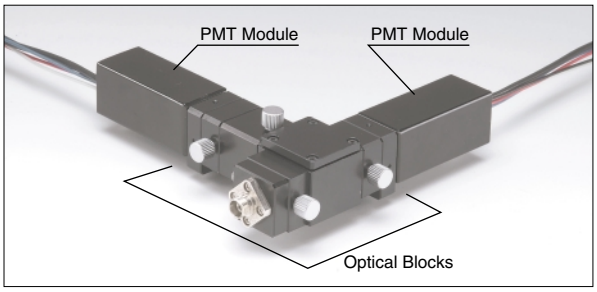
	Metal Package Type	Compact Head-on Type	Head-on Type	Compact Side-on Type	Side-on Type
Photosensor Modules	 H5773, H5783 H6779, H6780 *	 H7826	 H8443	 H9305	 H7732
Low Power Consumption	 H9858 NEW *				
Cooler	 H7422				 H7844 NEW
Current to Voltage Conversion Amp.	 H5784, H9656 *	 H7827		 H9306, H9307	 H8249
Charge Amp. + ADC / CPU + Interface	 H7468 *				
Photon Counting Heads	 H7155 *	 H7828	 H7360		
Gating Circuit					 H8259
Cooler	 H7421				
Counter / CPU + Interface	 H7467 *		 H9319		
PMT Module with Added Function					
High Speed Gating Circuit			 H7680		

* Products are applicable to "OPTICAL BLOCKS FOR PMT MODULES" listed on page 4.

NEW

OPTICAL BLOCKS FOR PMT MODULES

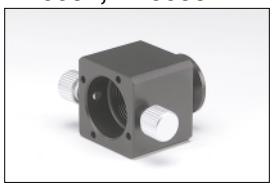
The optical block is a compact unit containing a built-in optical component such as a bandpass filter and a dichroic filter. Optical component is accurately arranged in angular "minutes" by high-precision machining technology. The joint section is fully light-shielded by its V shape and an O-ring. It can easily be attached to another block or removed by the thumb screw, allowing any desired combination of blocks.



▲Optical block combinations

■LINE UP

A10032, A10033

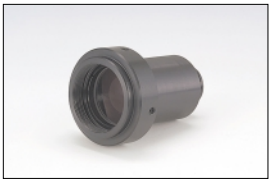


Filter Block
& ND Filter Block

A10034, A10035

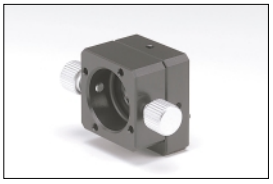
Dichroic Block
& Beam Splitter Block

A10031



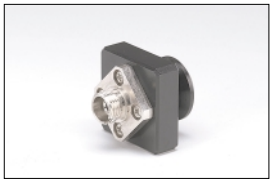
Beam Expander Block

A10030



Adapter Block

A10037



Fiber Adapter Block

NEW

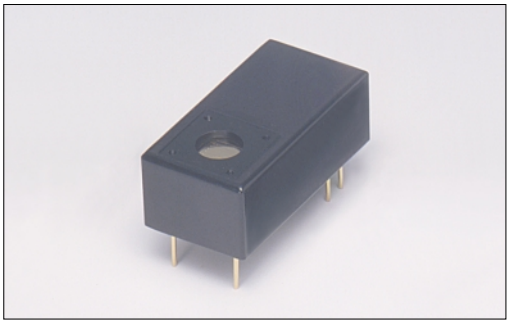
METAL PACKAGE PMT PHOTOSENSOR MODULE H9858 SERIES

Low Power Consumption

The H9858 is a new member of our "photosensor modules" that incorporate a TO-8 style metal package PMT and a high-voltage power supply circuit. Compared to the previous types, the power consumption is reduced to 1/15 and the weight to 2/3, making the H9858 ideal for portable measurement devices. The H9858 continuously operates up to 1,000 hours on two AA alkaline batteries.

Parameter	H9858	Unit
Input Voltage	+2.0 to +5.0	V
Input Current (Max.)	2.7	mA
Effective Area	φ8	mm
Weight	45	g

Various spectral response ranges from 185 nm to 920 nm are available. Contact us for more information.



■APPLICATIONS

- **Portable measurement device**

NEW

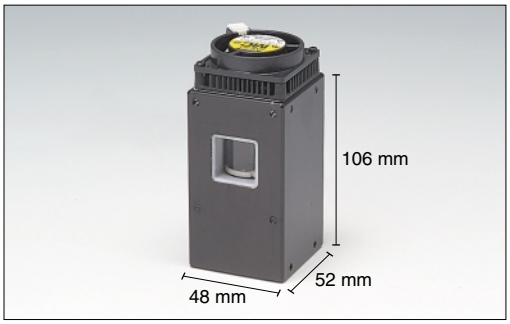
PHOTOSENSOR MODULE with THERMOELECTRIC COOLER H7844

Much Less Dark Current: 1/50th at Room Temperature Level After 3 minutes of Cooling

The H7844 is a low noise PMT module with a directly cooled photocathode.

Parameter	H7844	Unit
Spectral Response	185 to 900	nm
Cathode Luminous Sensitivity	300	μA/lm
Anode Luminous Sensitivity Ⓐ	3000	A/lm
Dark Current ⒶⒷ	0.1	nA

ⒶControl voltage +1.0 V with cooler operated
ⒷAfter 30 minutes storage in darkness



■APPLICATIONS

- **NOx monitor**
- **Fluorescence spectrophotometer**
- **Laser scanning fluorescence detection**
- **Light scattering detection**

Devlp.

MULTICHANNEL PHOTON COUNTING HEAD H9531 (16 ch), H9532 (32 ch), H9946 (64 ch)

New PMT Module Built-in "ASIC" (Application Specific Integrated Circuit)

Simultaneous 16 channel, 32 channel, 64 channel or general multichannel photon counting is now easily achieved within a single detector. In order to greatly enhance the throughput of multichannel photon counting, Hamamatsu has developed an Application Specific Integrated Circuit (ASIC) with a built in high performance multichannel amplifier/discriminator array. This ASIC offers many advantages over conventional single photon counting electronics including very compact size, high speed counting operation and low power consumption, making it possible to apply multichannel photon counting to many new fields of application.

Left: H9531, Center: H9532, Right: H9946

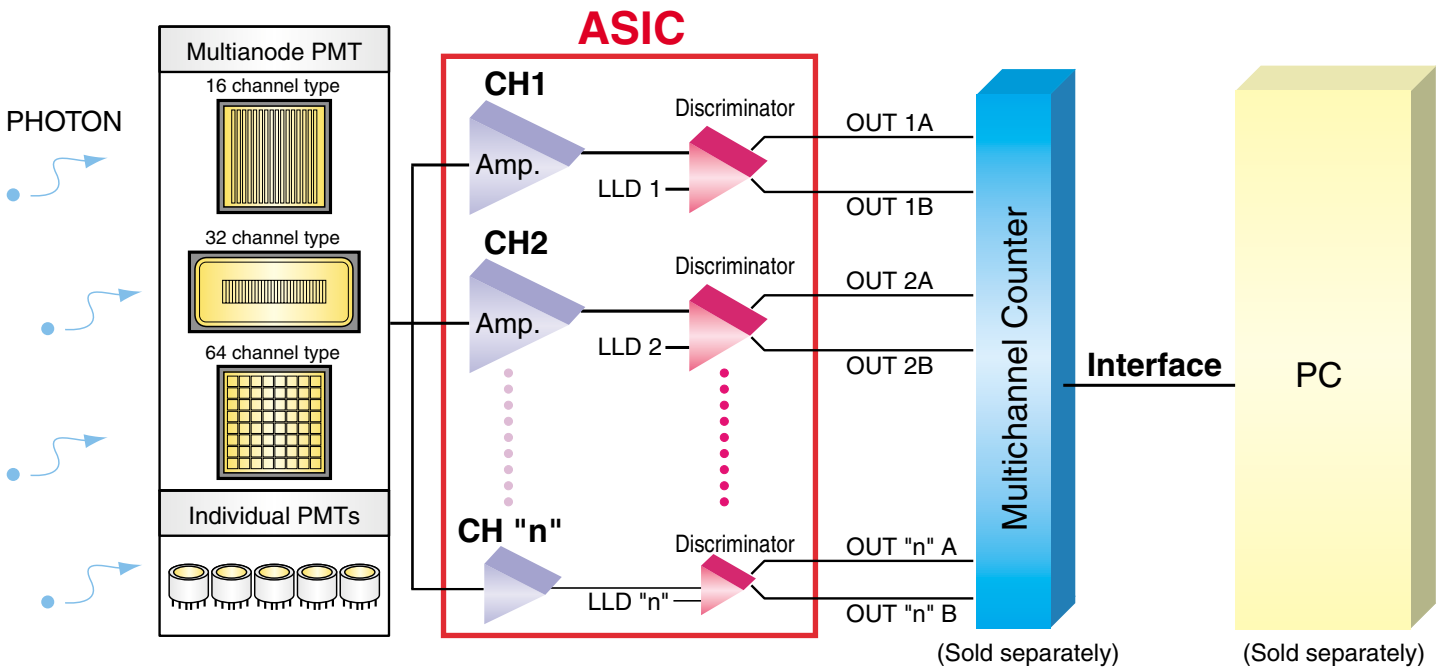
■FEATURES

- PMT arrays + ASIC device + readout electronics
- Integrated multichannel device
- Compact (integrated) size
- Low power consumption
- Better cost performance

■APPLICATIONS

- MTP reader (Microplate reader)
- Fluorescence microscopy
- HEP (High Energy Physics) experiment

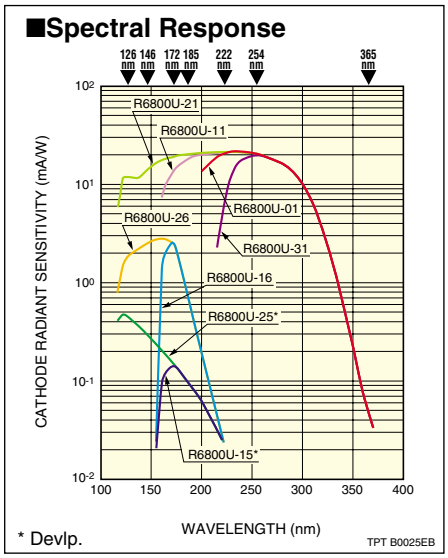
■BLOCK DIAGRAM



Parameter	H9531	H9532	H9946	Unit
Spectral Response	300 to 650			nm
Input Voltage	+12		+5	V
Count Sensitivity at 400 nm	3.1×10^5		3.3×10^5	$s^{-1} \cdot pW^{-1}$
Number of Channels	16	32	64 (8 × 8)	—
Effective Area (per Channel)	0.8 × 14	0.8 × 7	2 × 2	mm
Dark Count* (per Channel)	10			s^{-1}
Output Logic	LVDS			—
Pulse Pair Resolution	50			ns

* After 30 minutes storage in darkness.

VUV to UV REGION



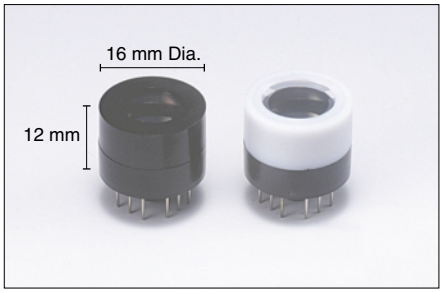
■APPLICATIONS

- **UV laser monitor**
  Excimer laser
  YAG laser (4 w: 266 nm, 5 w: 213 nm)
- **Excimer lamp monitor, Mercury lamp monitor**
- **UV power meter**
  (R6800U series only)

METAL PACKAGE SOLAR BLIND PHOTOTUBE R6800U SERIES

Compact & Solar Blind

These have a solar blind spectral response and allow detection in the VUV to UV region without using filters. The solar blind phototube exhibits far less deterioration in sensitivity due to UV radiation, ensuring a long stable operation.

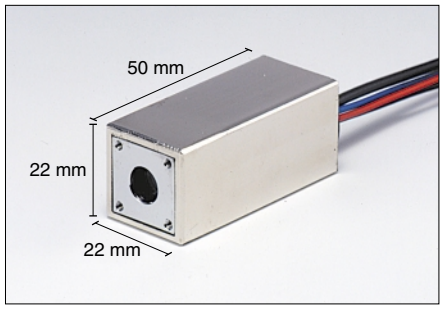


UV LASER SENSOR MODULE H8496/H8497 SERIES

Ideal for VUV to UV Laser Power Monitor

VUV to UV laser detectors containing a solar blind spectral response phototube and a high voltage power supply optimized to obtain high pulse linearity.

H8496 series: Current output type
(without an amplifier)
H8497 series: Voltage output type
(with an amplifier)



VISIBLE to NEAR INFRARED (NIR) REGION

FLAT PANEL PMT ASSEMBLY H8500, H8500B, H9500

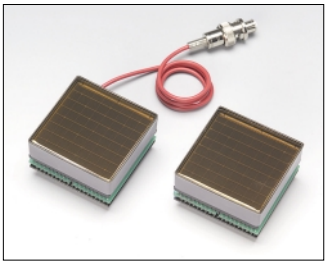
Effective Area Ratio: 89 %

These flat panel PMT's offer high sensitivity detection in an innovatively thin, square body. Effective area is 49 mm².

■APPLICATIONS

- **Ring image Cherenkov counter**
- **Compact gamma camera**
- **Scintimammography**
- **2-D radiation monitor**

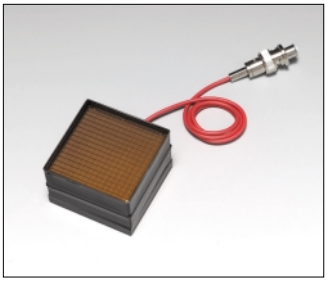
H8500
H8500B
64
channels



Left: H8500 (with cable)
Right: H8500B (without cable)

Parameter	H8500, H8500B, H9500	Unit
Spectral Response	300 to 650	nm
Number of Stages	12	—
Rise Time	0.8	ns
Transit Time	6	ns
Transit Time Spread (FWHM)	0.4	ns

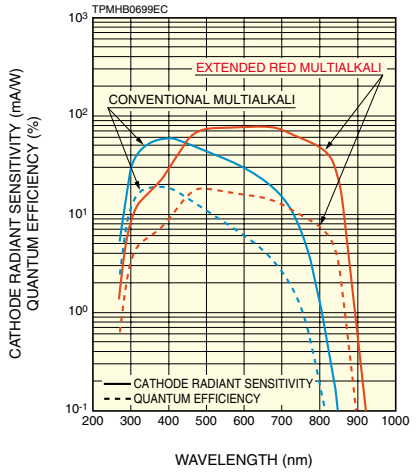
H9500
256
channels



VISIBLE to NEAR INFRARED (NIR) REGION

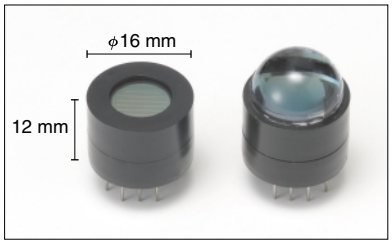
HEAD-ON PMT SERIES OF EXTENDED RED MULTIALKALI PHOTOCATHODE

■Spectral Response

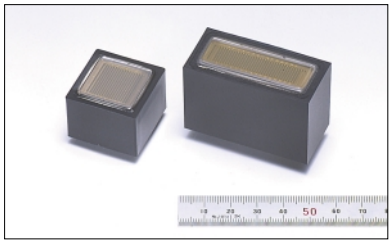


High Cathode Luminous Sensitivity: 500 μA/lm

New extended red photocathode provides high cathode sensitivity especially in the NIR region. Its cathode luminous sensitivity (500 μA/lm) is more than 3 times higher than one of the conventional multialkali photocathode (150 μA/lm).



Left: R7400U-20, Right: R7402-20

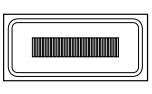


Left: R5900U-20-L16, Right: H7260-20

■APPLICATIONS

- Laser scattering detection
- Fluorescence detection
- Optical CT
- Particle analyzer
- NOx monitor

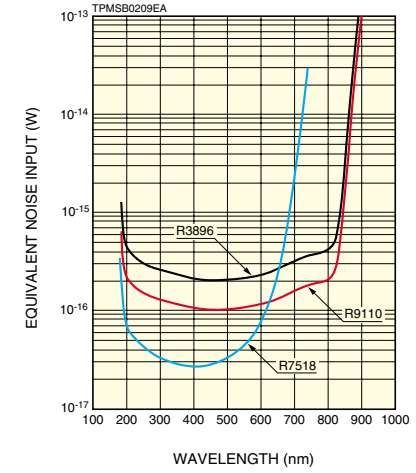
■SELECTION GUIDE

Type No.	R7400U-20	R7402-20 Ⓐ	R5900U-20	R5900U-20-L16 NEW	H7260-20	R5900U-20-M4	H8711-20 NEW	H7546B-20
Anode Type	Single Anode	Single Anode	Single Anode	Linear Multianode (16 ch)	Linear Multianode (32 ch)	Multianode (2 × 2 ch)	Multianode (4 × 4 ch)	Multianode (8 × 8 ch)
								
Effective Area	ϕ8 mm	ϕ12 mm Ⓑ	18 mm × 18 mm	16 mm × 15.8 mm	7 mm × 31.8 mm	18 mm × 18 mm	18.1 mm × 18.1 mm	18.1 mm × 18.1 mm
Effective Area (per Channel)	—	—	—	16 mm × 0.8 mm	7 mm × 0.8 mm	8.9 mm × 8.9 mm	4.2 mm × 4.2 mm	2 mm × 2 mm

Ⓐ R7402-20 is R7400U-20 with a lens. Ⓑ For collimated light. Photocathode area is ϕ8 mm.

28 mm (1-1/8") SIDE-ON PMT R9110, R7518

■ENI (Equivalent Noise Input)



■SPECIFICATIONS

R9110

- Twice the gain
- 1/2 the dark current
  Compared to our previous model (R3896)

R7518

- Low noise

■APPLICATIONS

R9110

- Laser scanning fluorescence detection
- Light scattering detection

R7518

- Fluorescence spectrophotometer
- Chemiluminescence, bioluminescence detection

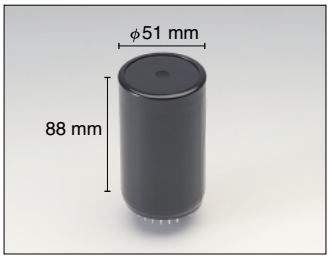
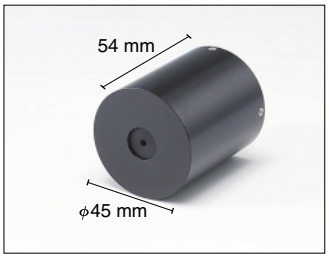
Left: R9110, Right: R7518

Parameter	R9110	R7518	Unit
Spectral Response	185 to 900	185 to 730	nm
Cathode Luminous Sensitivity	525	130	μA/lm
Anode Luminous Sensitivity at 1000 V	10 000	1560	A/lm
Dark Current Ⓐ	5	0.2	nA

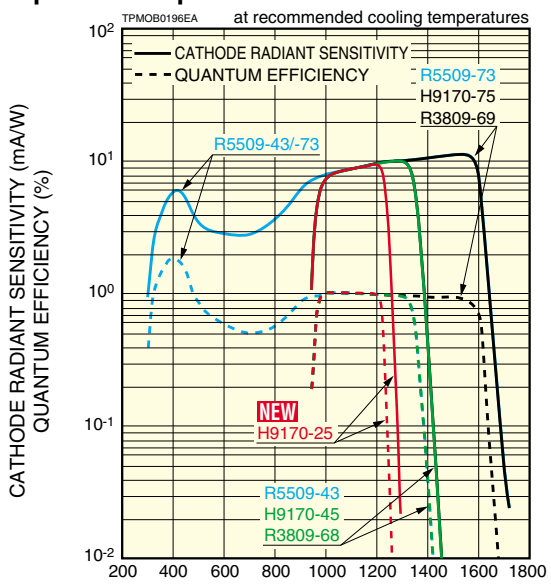
Ⓐ After 30 minutes storage in darkness at 1000 V.

NEAR INFRARED (NIR) DETECTOR SERIES

A new detector module (suffix -25) with even lower noise has now been added to our line-up of near infrared (NIR) PMT modules. We now offer a full line of products to support diverse measurements of weak or fast phenomena in the NIR region.

Product Type	NIR PMT Module			NIR PMT		NIR MCP-PMT		
Specifications	Easy Handling, Low Noise (H9170-25)			Wide Spectral Response		Fast Time Response		
				 Cooler is not shown.		 Cooler is not shown.		
Type No.	H9170			R5509		R3809U		Unit
Suffix No.	NEW -25	-45	-75	-43	-73	-68	-69	
Spectral Response	950 to 1250	950 to 1400	950 to 1700	300 to 1400	300 to 1700	950 to 1400	950 to 1700	nm
Rise Time	900			3000		180		ps
T.T.S. (FWHM)	300			1500		70		ps
Dark Count	1×10^2	2×10^4	2×10^5	1.6×10^4	1.6×10^5	2×10^4	5×10^4	s^{-1}
Cooling Methode	Thermoelectrically Cooled (No Liquid Nitrogen, No Cooling Water)			Liquid Nitrogen Cooled				—
Cooler	Yes			C9940-01/-02 (Sold Separately)		Yes		—
High Voltage Power Supply	Yes			C3830 or C4840 (Sold Separately)		C4840 (Sold Separately)		—

■Spectral Response



■APPLICATIONS

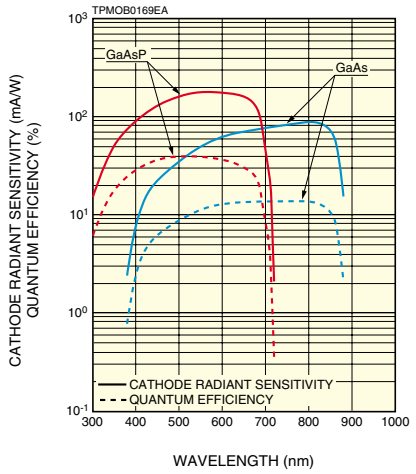
- **Photoluminescence**
- **Singlet oxygen measurement**
- **Raman spectroscopy**
- **Cathodoluminescence**
- **Fluorescence**
- **LIDAR**
- **Photoluminescence / fluorescence lifetime (R3809 series)**

VISIBLE to NEAR INFRARED (NIR) REGION

GaAsP / GaAs PHOTOCATHODE PHOTOSENSOR

—High Sensitivity! QE 40 % at 580 nm (GaAsP)—

■Spectral Response



METAL PACKAGE PMT MODULE WITH COOLER
H7421-40, H7422-40 (GaAsP)
H7421-50, H7422-50 (GaAs)

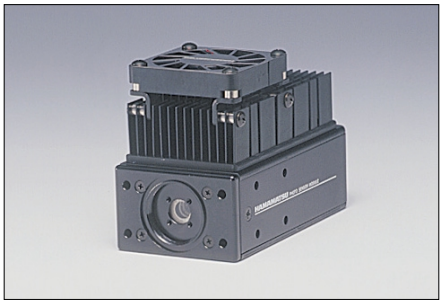
Built-In Thermoelectric Cooler, Quick Cooling

Efficient cooling was achieved by placing the cooling elements near the photomultiplier tube to reduce thermal noise emitted from the photocathode. A high S/N ratio can be obtained even at extremely low light levels.

●H7421 series
[Compact photon counting head]
Metal package PMT + Thermoelectric cooler + High voltage power supply + High speed photon counting circuit (TTL positive logic output)

●H7422 series
[Current output type photosensor module]
Metal package PMT + Thermoelectric cooler + High voltage power supply

* Photon counting selection is also available.



Heatsink with fan (A7423) is sold separately.

■APPLICATIONS

- Fluorescence correlation spectroscopy
- Two-photon excitation microscopy
- Low light level measurement

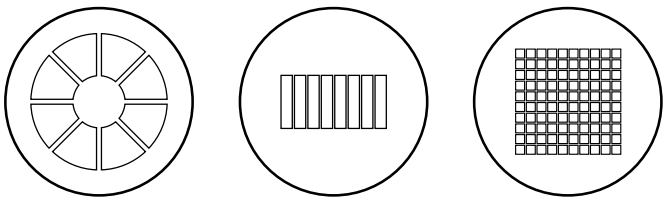
MCP-PMT (MICROCHANNEL PLATE PHOTOMULTIPLIER TUBE)
R3809U-61, R4110U-71 SERIES (GaAs)
R3809U-64, R4110U-74 SERIES (GaAsP)

Fast Time Response
Rise Time: 200 ps (R3809U-61), 180 ps (R3809U-64)

MCP-PMT is a detector which enables to detect a weak light with high time resolution. R4110U allows multichannel or 2 dimentional detection.

Left: R4110U-71/-74, Right: R3809U-61/-64

■R4110U ANODE TYPE



FAN-SHAPED　LINEAR　MATRIX

* Please contact your local sales office for further details.

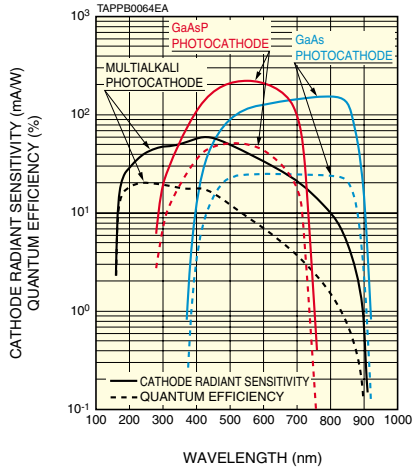
■APPLICATIONS

- Fluorescence lifetime measurement
- Time-resolved spectroscopy
- Time-resolved fluorescence measurement
- Optical CT

GaAsP / GaAs PHOTOCATHODE IMAGE INTENSIFIER

—High Sensitivity! QE 50 % at 530 nm (GaAsP)—

■Spectral Response



Devlp. HIGH SPEED GATED IMAGE INTENSIFIER UNIT C9548 SERIES

Ideal for Imaging of Low Light Level Fluorescence and Emissions

The C9548 series consist of an image intensifier with a Pulse Generator, a high speed gate drive circuit and a high voltage power supply. It can be controlled by a PC (sample software included) via RS232C, or by using the remote controller.
Gate pulse control is also possible.
• Gate width: 10 ns to 9.99 ms (Minimum time resolution is 10 ns)
• Gate Delay: 10 ns to 9.99 ms (Minimum time resolution is 10 ns)

■APPLICATIONS

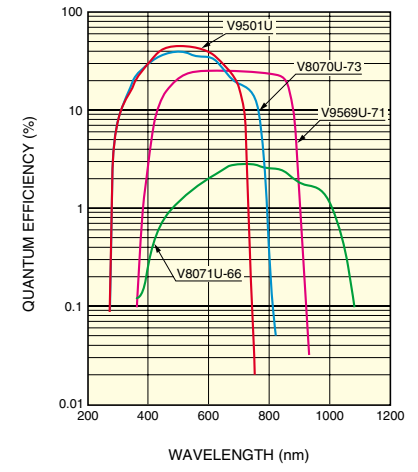
- **Analysis of explosion and combustion**
- **Imaging of high speed phenomena**

Parameter	C9548-01	C9548-02	C9548-03	C9548-04	Unit
Photocathode	GaAsP		Multialkali		—
Luminous Gain	6.6×10^3	1.5×10^6	3.3×10^3	1.0×10^6	$(lm/m^2)/lx$
Limiting Resolution	50	36	57	32	Lp/mm
Gate Time	10				ns
Gate Repetition Rate	200				kHz
Effective Area	16×16				mm

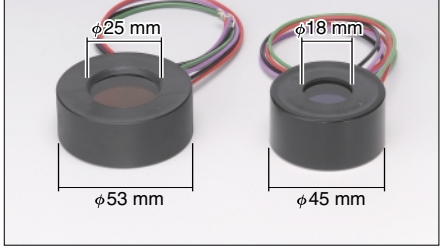
* GaAs photocathode is also available.

PROXIMITY FOCUSED IMAGE INTENSIFIER

■Spectral Response



The new crystalline photocathodes (Extended red GaAsP which has sensitivity up to 820 nm and InGaAs which has sensitivity up to 1100 nm) are available in proximity focused image intensifiers. In addition V7090U/ V8070U can have FOP input window (-72/-75) and wide effective area (V9569U/V9501U). Our Gen3 tubes can be used in various applications.



Left: V9501U-74, Right: V7090U-71

■APPLICATIONS

- **Bio-imaging**
- **High speed shutter camera**
- **Time resolved low light level imaging**

Parameter		V9569U (NEW)	V7090U	V9501U	V8070U		V8071U (NEW)	Unit
Photocathode		GaAs		GaAsP		Extended Red GaAsP	InGaAs	—
Photocathode		ϕ25	ϕ18	ϕ25	ϕ18			mm
Effective Area		16×16	13.5×10	16×16	13.5×10			mm
Suffix	Borosilicate Input	-71		-74		-73	-66	—
	FOP Input	—	-72	—	-75	—	—	—

PMT PERIPHERAL PRODUCTS

ACCESSORIES

We provide a wide variety of quality socket assemblies which enable easy yet reliable operations of photomultiplier tubes. They can further be combined with other peripheral products such as high voltage (HV) power supplies, preamplifiers, etc.

For 28 mm Dia. Side-On Type PMT

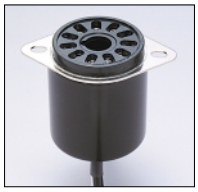
Voltage Divider

E717-35 (On-Board Type)
E717-63 (Cable Output Type)

E717-63

Voltage Divider and HV Power Supply

C6270 (Low Ripple / Noise)
C8991 (Low Power Consumption)



C8991

Voltage Divider, Amplifier and HV Power Supply

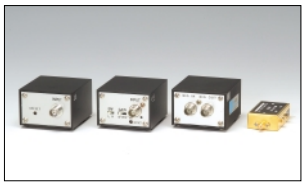
C7950

HV Power Supply

C4900 Series

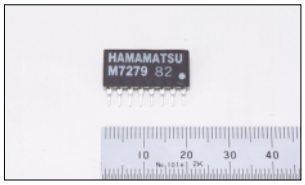
Preamplifier Unit

C9663, C7319, C6438, C5594



Amplifier Module

M7279, M8879



M7279

AIR-COOLED THERMOELECTRIC COOLER FOR 28 mm Dia. SIDE-ON PMT C9144

The C9144 is an air-cooled thermoelectric cooler equipped with the RS232C serial interface bus. You can remotely control the cooling temperature, high voltage to the PMT when the optional C9145 HV socket assembly with HV power supply is used, and monitor the cooling temperature on the computer screen.
The C9143 (water-cooled) is also available.

Parameter	C9144	C9143	Unit
Heat Exchange Medium	Forced air	Water	—
Cooling Temperature	Approx. -25 (at ambient temperature of +25 °C)	Approx. -30 (with cooling water of +20 °C)	°C
Time to Stable Cooling Temperature	Approx. 90	Approx. 70	min
Cooling Method	Thermoelectric cooling using Peltier module		—
Lowest Cooling Temperature (Max.)	-30		°C
Applicable Socket Assembly (Sold Separately)	C9145 (DP-Type), E9146 (D-Type)		—

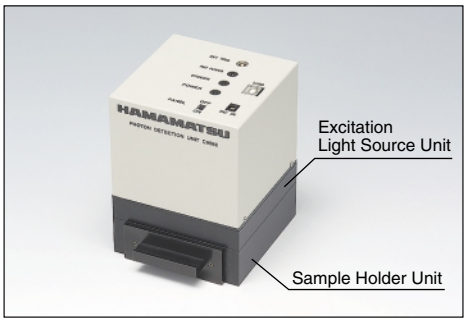
Left: Controller for C9144, C9143
Center: Cooled PMT housing for C9144
Right: Cooled PMT housing for C9143

NEW

PHOTON DETECTION UNIT C9692 SERIES

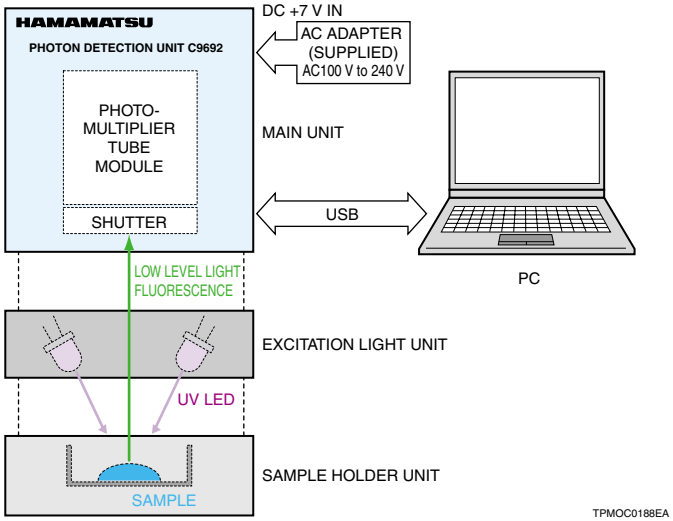
No setup required !
Simplifies low-level luminescence/fluorescence measurement

The C9692 is a single photon counting unit that eliminates the time needed for making measurement setups. It lets you start making low-level luminescence/fluorescence measurements quickly and easily.



C9692-03

■SETUP DIAGRAM (C9692-03)



TPMOC0188EA

■APPLICATIONS

- **Bioluminescence, chemiluminescence**
- **Various measurements using optical fiber (FC type) (C9692-01)**
- **UV LED delayed fluorescence (C9692-03)**

COUNTING UNIT C8855, COUNTING BOARD M8784, M9003

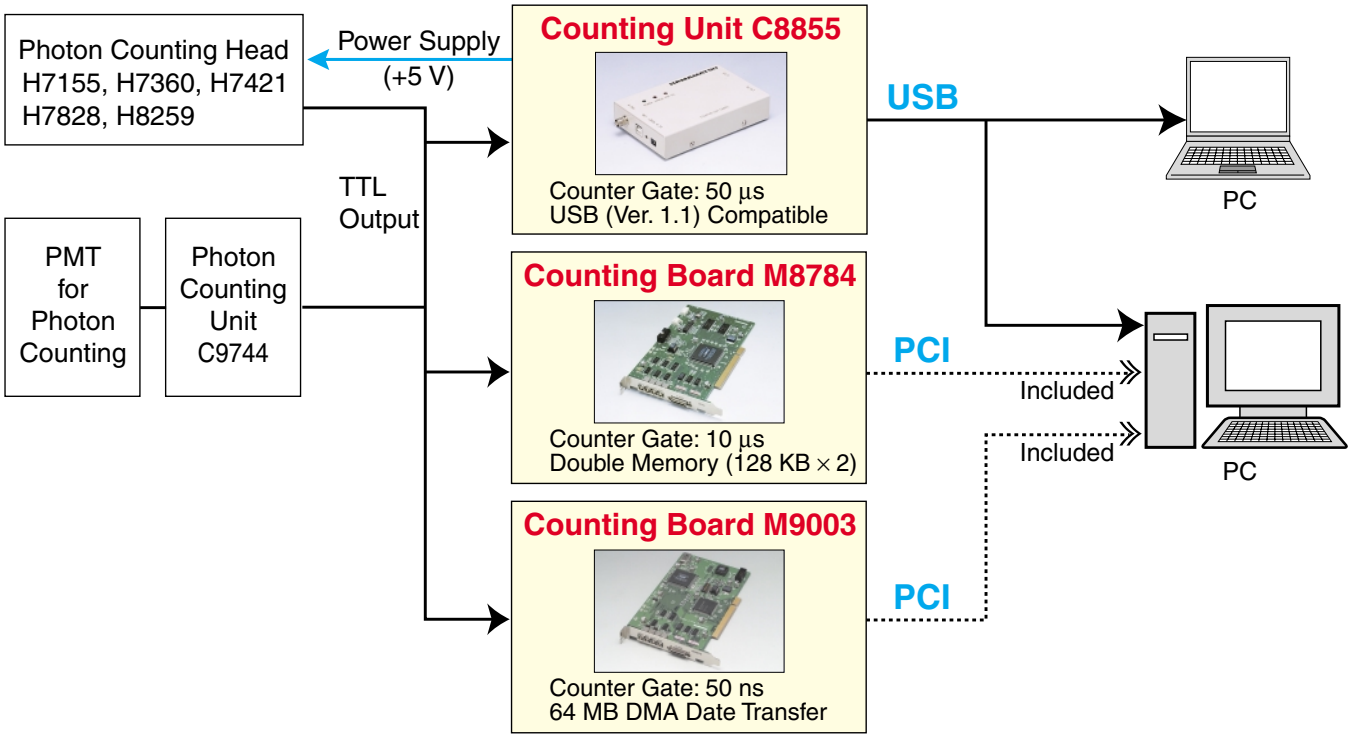
Making Photon Counting Easier

These are designed to plug directly into a PC and can be used as a photon counter when combined with a photon counting head, etc.
M9003 is faster than M8784.

■APPLICATIONS

- **Time-resolved measurement**
- **Bioluminescence**

■Example Diagram of Photon Counting



ION / ELECTRON DETECTOR

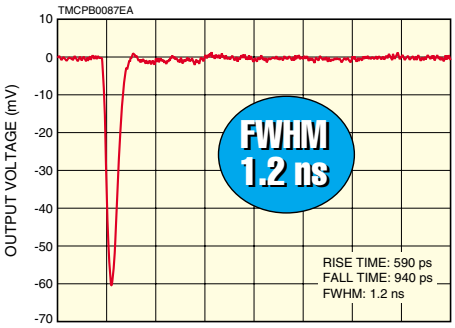
NEW

MCP ASSEMBLY F9892-12

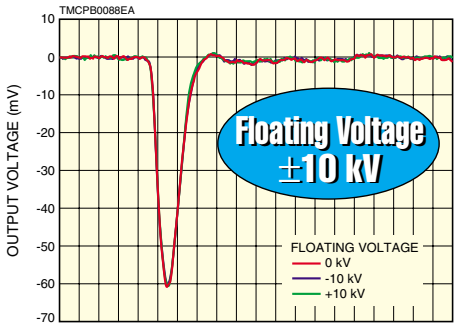
High Resolution TOF-MS Detector

Minimized Ringing & High Voltage Floating Operation

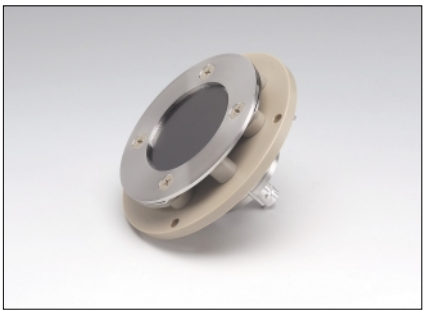
MCP assemblies with an active area of 40 mm diameter, and is designed to permit floating operation at an input surface voltage of ±10 kV. Output waveform has almost no ringing.



RESPONSE TIME (5 ns/div.)



RESPONSE TIME (1 ns/div.)

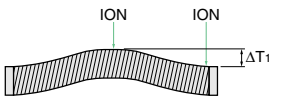


Effective area: 40 mm dia.
MCP channel diameter: 6 μm
Number of MCP stages: 2
Gain: 1×10^6

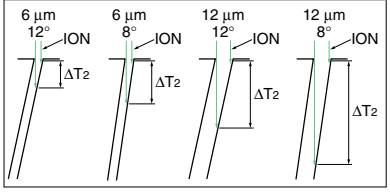
Small Time Jitter from Flat MCP

There are two major factors creating time jitter. One is a warp of MCP which has larger effect on the time jitter. The other is a combination of the channel diameter and bias angle.

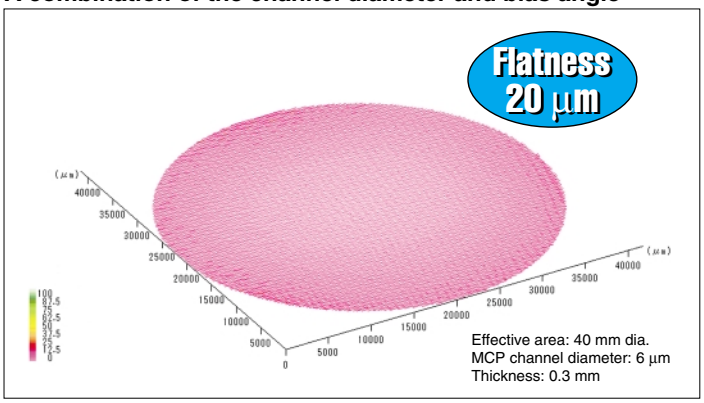
A Ion transit time difference due to warp of MCP



B Ion transit time difference due to input position in channel



A combination of the channel diameter and bias angle



TIME JITTER COMPARISON

Factor	A	Warp (μm)	20				200			
	B	Channel Dia. (μm)	6		12		6		12	
		Bias angle (°)	12	8	12	8	12	8	12	8
Jitter	A	ΔT1 (ns)	0.5				4.6			
	B	ΔT2 (ns)	0.7	1.0	1.3	2.0	0.7	1.0	1.3	2.0
Sum (ns)			1.2	1.5	1.8	2.5	5.3	5.6	5.9	6.6

* Ion mass: 1000 u., Ion acceleration voltage: 10 kV, calculation data

NEW

FAST DECAY PHOSPHOR J9758

For Electron Beam Detection

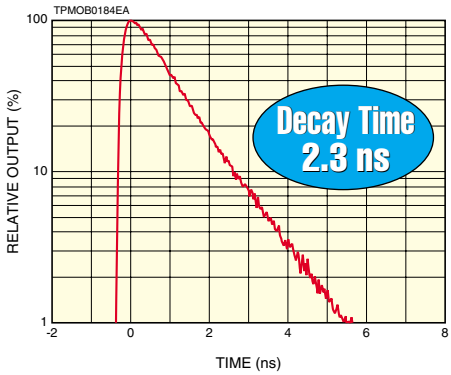
■FEATURES

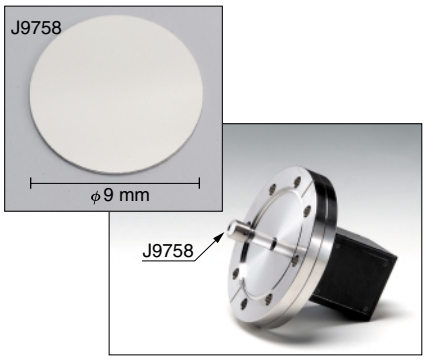
- Short decay time
- Long life
- High luminescence efficiency

■APPLICATIONS

- Semiconductor inspection instrument
- SEM (Scanning Electron Microscope)
- Mass spectrometry
- General electron detection

■Phosphor Decay Characteristics





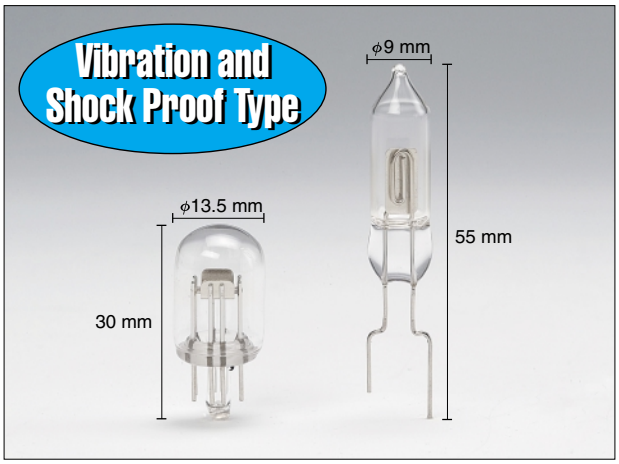
Application Product
ELECTRON DETECTION UNIT H8770

UVTRON™

NEW

UVTRON™ *R9533, R9454*

Quick Detection of Flame from a Distance



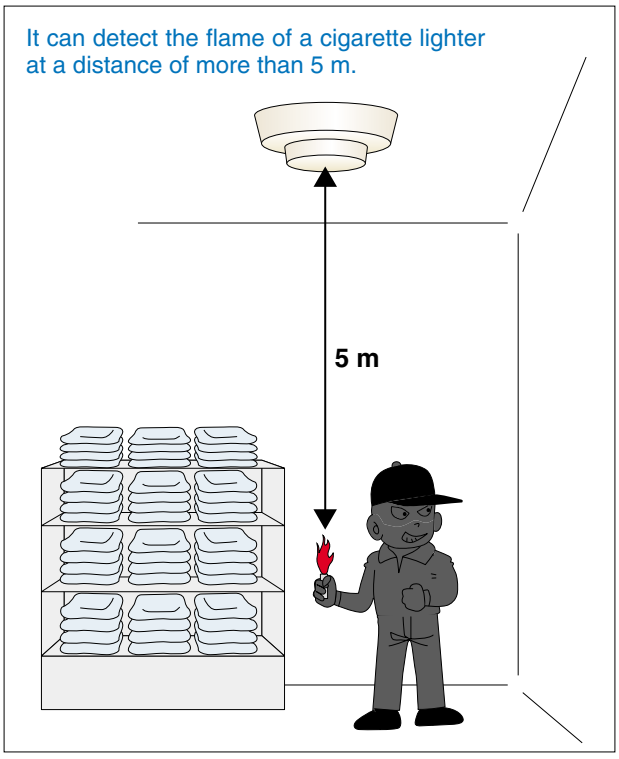
Left: R9533, Right: R9454

■FEATURES

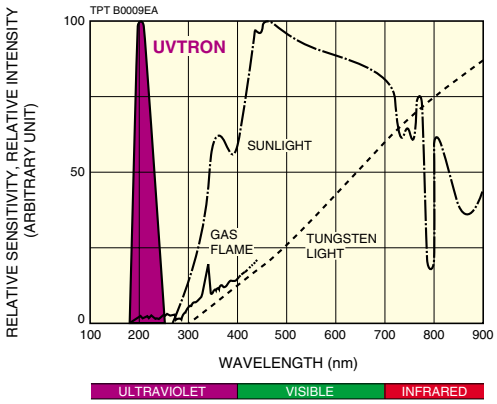
- **Highly resistant to vibration and shock**
  Same level as semiconductor devices
  Guaranteed shock resistance: 1000 G
  Shock absorption time: 1 ms
- **Optical visible-cut filter not required**
  Spectral response: 185 nm to 260 nm
- **High sensitivity**
  R9533: 10 000 min^{-1}
  R9454: 4000 min^{-1}
- **Easy handling (R9533): Head-on type**

■APPLICATIONS

- **Flame detectors for gas/oil lighters and matches**
- **Fire alarm**
- **Combustion monitors for burners**
- **Inspection of ultraviolet leakage**
- **Detection of discharge (corona discharge of high voltage transmission lines, etc.)**
- **Ultraviolet switching**



■Spectral Response



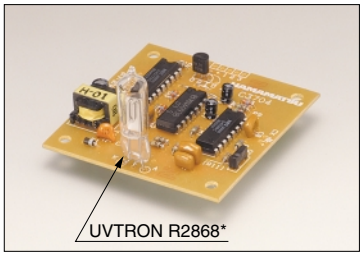
LINE UP OF UVTRON™

Our product line-up includes high sensitivity type and general-purpose type that have been widely used in various applications.

Left: R1753-01, Center: R244, Right: R2868

UVTRON™ DRIVING CIRCUIT C3704 SERIES

The C3704 series can be operated as a UV sensor by connecting the UVTRON and applying DC low voltage, as they have both a high-voltage power supply and a signal processing circuit on the same printed circuit board.



* UVTRON R2868 is sold separately.

SPOT LIGHT SOURCE

NEW

LIGHTNINGCURE™ *LC8 SERIES*

Operate It from Your PC Via the RS232C Port

This unit has a built-in RS232C port to allow PC or microcomputer control. Making program entries (irradiation intensity, irradiation time) for the Memory Step is now accurate and easy. You can operate the light source even in a location where direct access to it is impossible.
The USB adapter connector lets you use a PC if it has no RS232C port. We also offer sample software that displays easy-to-use setup screens, etc.

Light Intensity Monitor with Internal Optical Feedback Function (Option: Sold separately)

This unit maintains the light intensity at a fixed level for stable irradiation.
The irradiation intensity (reference value) is displayed as a digital value (in watts) on the LCD display. This eliminates problems that occur due to human error and different operating conditions. Full control even of detailed settings makes it ideal for fully automated production lines.

Anybody Can Use It! Easy Bulb Replacement!

Selectable Positions of Light Guide Port

A front port type and a rear port type are available.

CE Marking Compliance

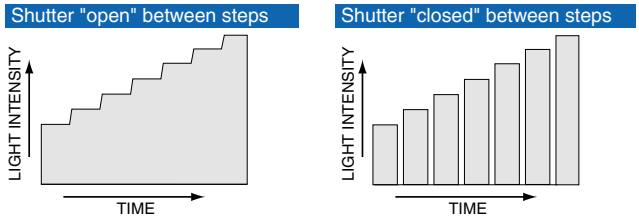
Instantaneous Power-outage Response

This function is especially convenient in places where the supply of power is intermittent or unstable.

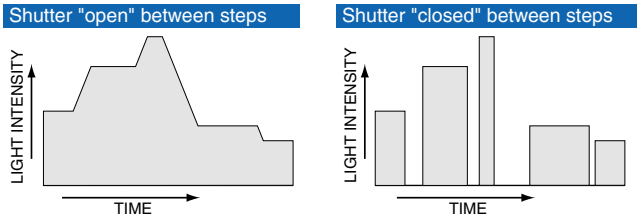
Memory Step™ for 9-Type 7-Step Programs

Program the irradiation intensity and irradiation time to any level you want. The UV irradiation conditions can be matched to the component you want to bond.

Program example 1: Increasing light intensity in 7 steps

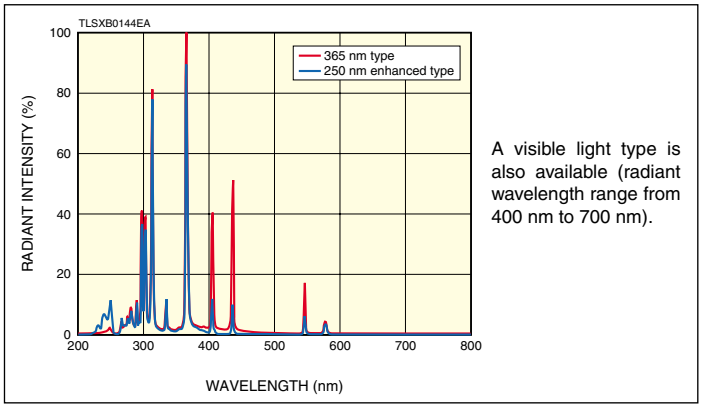


Program example 2: Random light intensity and irradiation time settings



Light guide is sold separately. Computer is provided by the customer.

■Radiant Spectral Distribution



A visible light type is also available (radiant wavelength range from 400 nm to 700 nm).

■APPLICATIONS

● UV curing

- Catheter
- CD / DVD pick-up devices
- Sealing of LCD panel
- CCD packaging
- Electronic parts attachment

SPOT LIGHT SOURCE PERIPHERAL PRODUCTS

ACCESSORIES

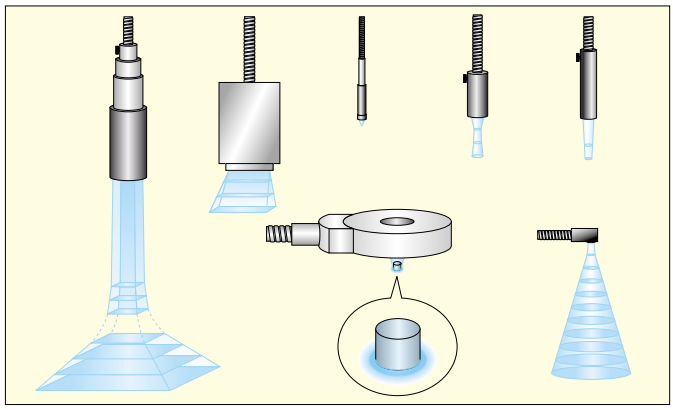
Custom Products for Specific Requests

We offer a broad line up of products to meet a wide range of user needs. Yet we will gladly modify standard products or design new custom products in response to special requests. Please consult your local Hamamatsu sales office for more details.

■LINE UP

● **Light Guide**

● **Condenser Lens & Specially Shaped Light Guides**



- **Mercury-Xenon Lamp**
- **UV Filter**
- **UV Power Meter**
- **Protective Glasses**
- **Foot Switch**

LIGHT CHECKER (UV POWER METER) C9386

Portable Pocket Size, Small Sensor Head

The C9386 is a compact UV power meter designed to measure and display the UV output irradiance emitted from a UV light source using a mercury-xenon lamp. The sensor head is very small and remotely controlled. This allows easy measurement of UV light irradiated on components in high-density arrays where conventional UV sensors are difficult to use. The main control unit is also portable, handy to use, and ideal for making daily checks of the UV light source output irradiance.

■APPLICATIONS

- **Measurement and control of UV irradiance**
  - UV spot light source
  - Photochemical reaction energy
  - UV curing adhesive irradiation energy
  - UV ink irradiation energy

Devlp.

LIGHTNINGCURE™ LC-L1 (LED Lighting Method)

Long Life 30 000 hours! Allows UV Bonding with No Thermal Damage

The LC-L1 is a UV-LED light source that emits UV light at 365 nm.
This monochromatic light source causes no thermal damage or harmful DUV (deep UV) effects on workpieces or samples.
Its low power consumption makes it an energy-saving and environmentally friendly light source.
The built-in LED has a very long life of 30 000 hours. This reduces costly down time from shutting down the production line to change the lamp.
The LC-L1 is a light source designed by integrating lamp and semiconductor technologies.

■SPECIFICATIONS

- **365 nm monochromatic light source**
- **Less thermal effects**
- **UV irradiation intensity: 2000 mW/cm²**
- **Up to 4 heads can be individually controlled to provide the desired output power**
- **UV checker shows the UV light intensity whenever needed**
- **Low power consumption saves energy**
- **World-wide operation**

■APPLICATIONS

- **UV irradiation experiments**
- **UV adhesive curing**

VUV to UV REGION

Devlp.

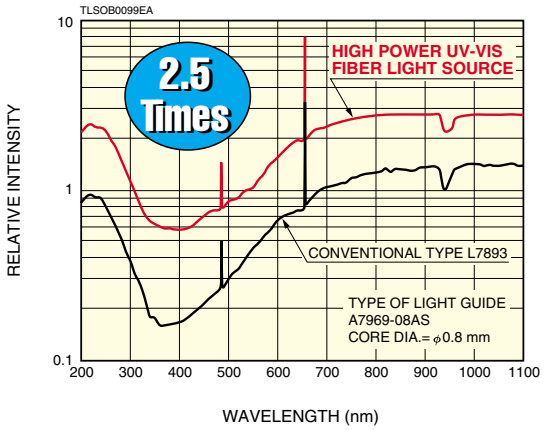
HIGH POWER UV-VIS FIBER LIGHT SOURCE

High Power ! From UV to VIS

■FEATURES

- High power output: 2.5 times (Compared to L7893)
- High stability: 2 × 10^{-5} A.U. (p-p)
- Long service life: 2000 hours (Guaranteed)

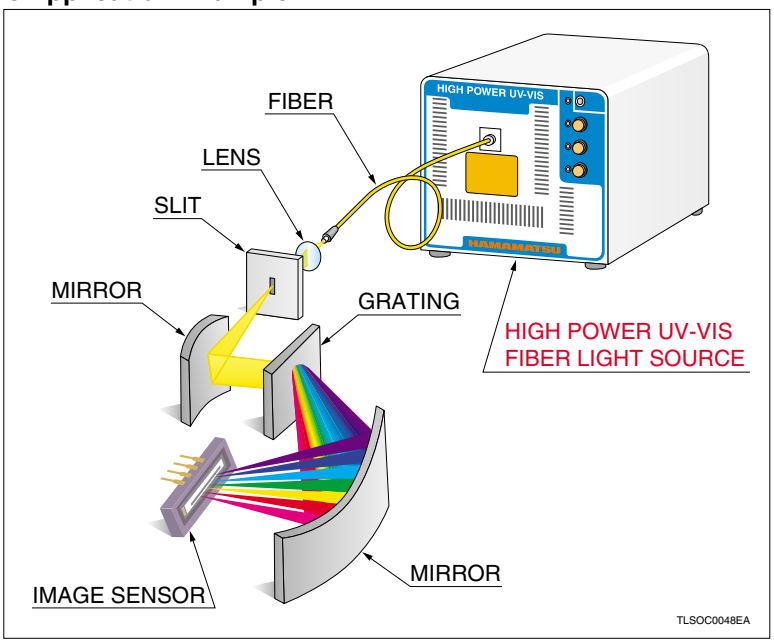
■Spectral Distribution (Reference Data)



■APPLICATIONS

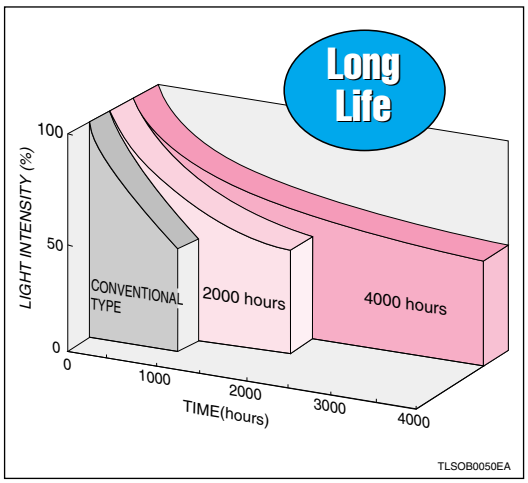
- Spectrophotometer
- Environmental measurement instrument
- Absorption spectrum measurement
- MTP reader (Microplate reader)
- Pharmaceutical test
- Film thickness measurement
- Semiconductor inspection
- Optical component inspection
- Reflectometry

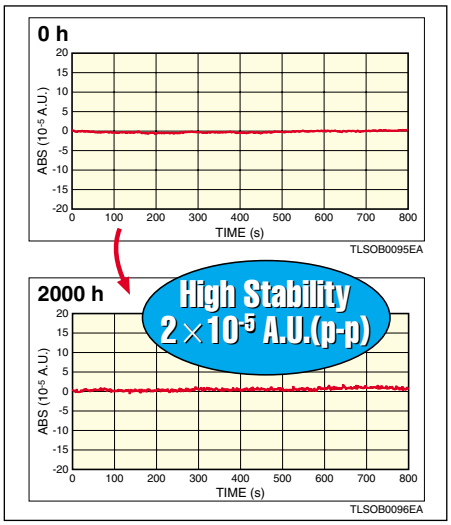
● Application Example



L2D2 LAMP (Deuterium Lamp)

World's Most Popular





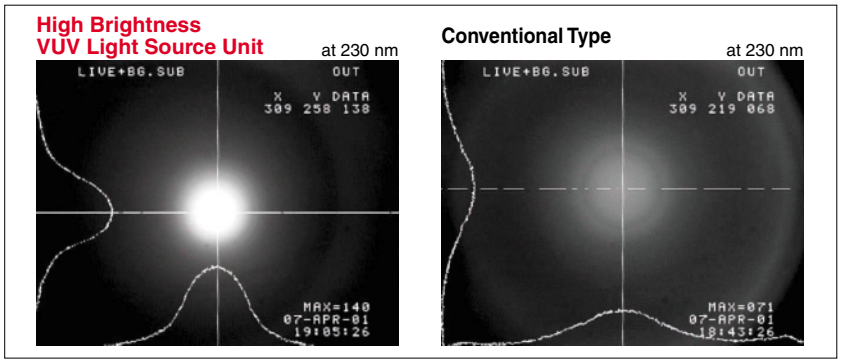
Devlp.

HIGH BRIGHTNESS VUV LIGHT SOURCE UNIT

■FEATURES

- **High brightness: 2 times higher than a conventional type**
- **Air-cooled: no cooling water required**

■Arc Distribution



■APPLICATIONS

- **Spectrophotometry (VUV spectrophotometer, etc.)**
- **Scientific research (Experiment and study using VUV light, etc.)**
- **Semiconductor (Film thickness gauge, etc.)**

CALIBRATED LAMP LIGHT SOURCE L7810, L7810-02, L7820, L7820-02

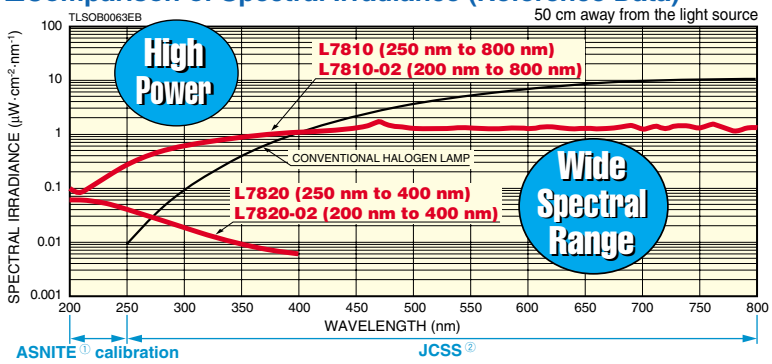
NEW NEW

Easy to Reproduce Highly Stable Light!

These are available as an optimal set including a lamp, lamp housing and power supply, so that anyone can easily produce a highly stable light output.

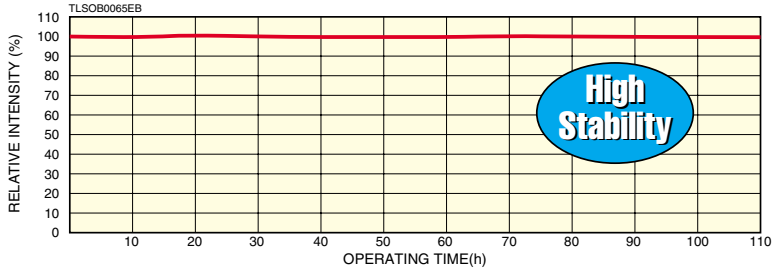
Left: Lamp Housing, Right: Power Supply

■Comparison of Spectral Irradiance (Reference Data)



①JCSS (Japan Calibration Service System)
②ASNITE (Accreditation System of National Institute of Technology and Evaluation)

■Light Intensity Drift (Typ.)



■APPLICATIONS

- **Light level control of light source**
- **Sensitivity control of optical sensor**
- **Light intensity measurement and study of photoreaction**
- **Quality control of photometric equipment**

■SELECTION GUIDE

Parameter		L7810	L7810-02	L7820	L7820-02	Unit
Lamp		Xenon lamp		Deuterium lamp		—
Calibrated Range Ⓐ	ASNITE Calibration	—	200 to 245	—	200 to 245	nm
	JCSS	250 to 800		250 to 400		nm
Type of Calibration		Spectral irradiance				—
Calibration Unit		μW·cm^{-2}·nm^{-1}				—

Ⓐ Spectral irradiance is measured at a point 50 cm away from the reference plane of the lamp housing. Calibration has been done at each 5 nm step.

UV to IR REGION

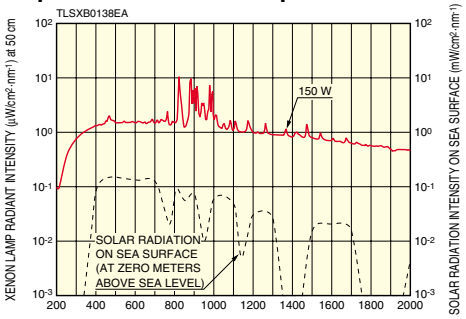
SUPER-QUIET XENON LAMP & SUPER-QUIET MERCURY-XENON LAMP

■FEATURES

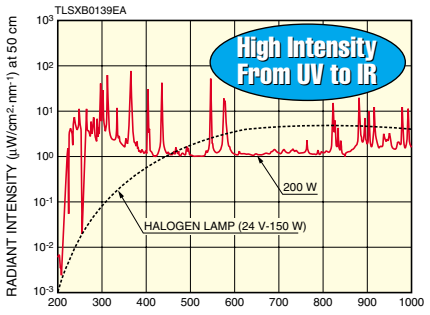
- High stability: 0.3 %
- Long life: 2000 hours

■Spectral Distribution

Super-Quiet Xenon Lamp



Super-Quiet Mercury-Xenon Lamp



■APPLICATIONS

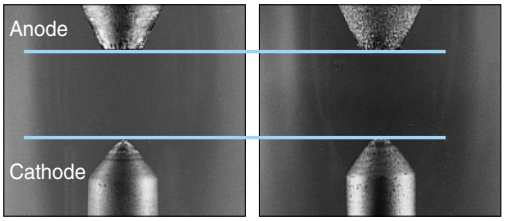
- Spectrophotometer
- Fluorospectrophotometer
- Semiconductor inspection

■Comparison of Cathode Tip Wear

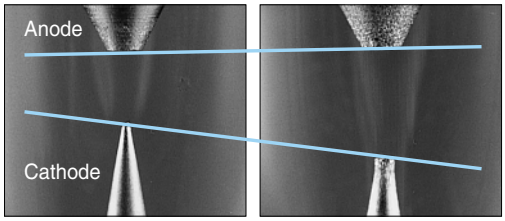
Point Light Source

No Arc Point Shift

HAMAMATSU Barium-impregnated cathode



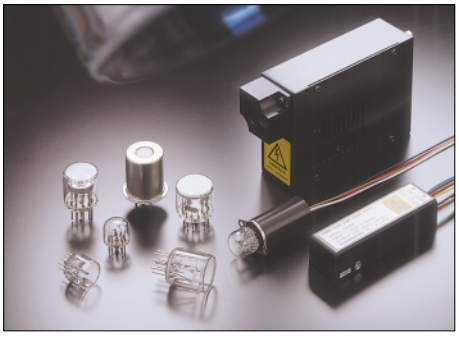
Conventional cathode



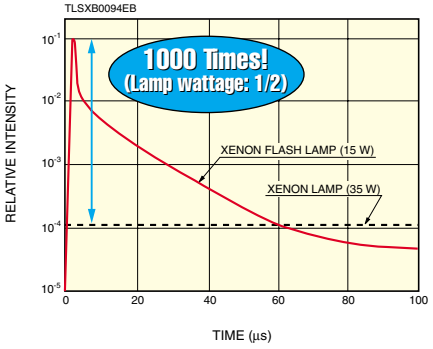
SUPER-QUIET XENON FLASH LAMP & ACCESSORIES

■FEATURES

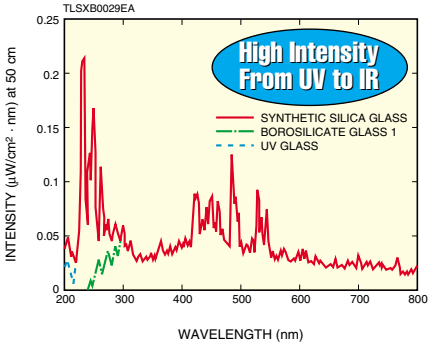
- High stability: Fluctuation 1.0 % (p-p)
- Long life: 1.2 × 10^9 flash



■Light Output Intensity



■Spectral Distribution



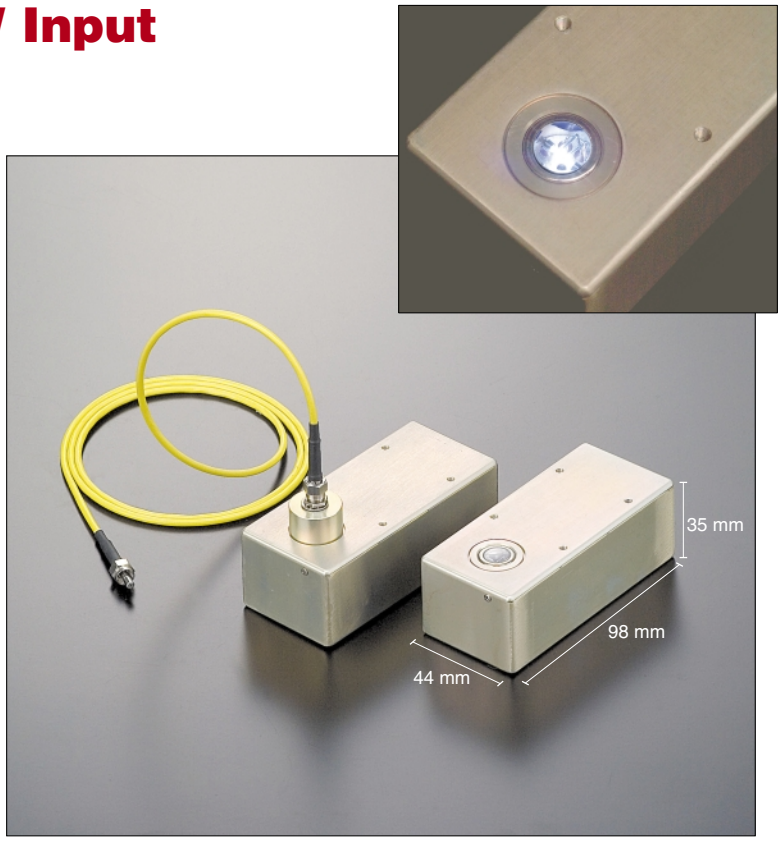
■APPLICATIONS

- Atmospheric analyzer
- Water quality analyzer
- Blood analyzer
- MTP reader (Microplate reader)
- Strobe light for high speed image processing

COMPACT 5 W XENON FLASH LAMP MODULE L9455/L9456 SERIES

Smallest Size Among 5 W Input Lamp Module

This lamp module consists of a 5 W xenon flash lamp, trigger socket and power supply, all integrated into a compact case.

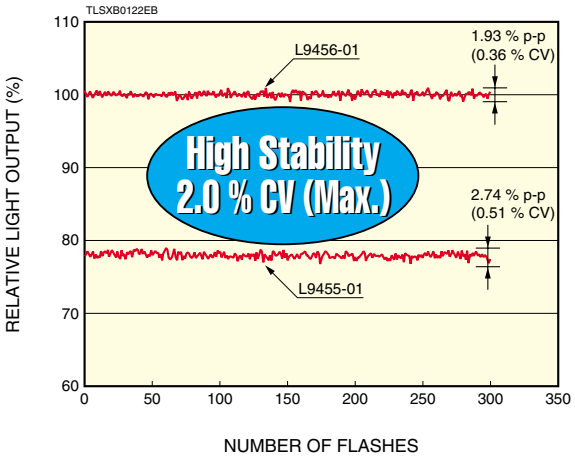


Left: with SMA Fiber Adapter Type, Right: Standard Type
Fiber adapter is sold separately.

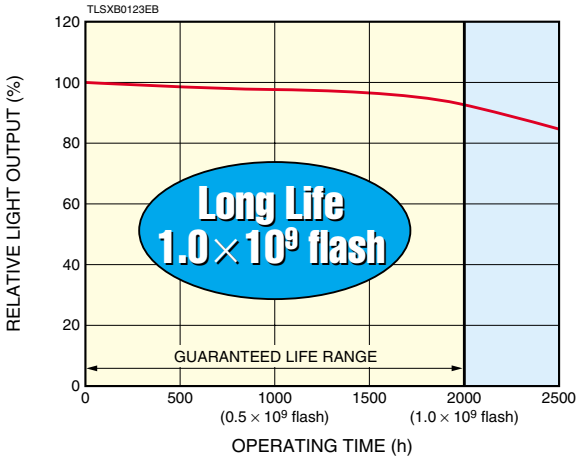
■APPLICATIONS

- Atmospheric analyzer
- Water quality analyzer
- Blood analyzer
- In-vitro testing
- MTP reader (Microplate reader)
- Fluorescence spectrophotometer

■Light Output Stability*

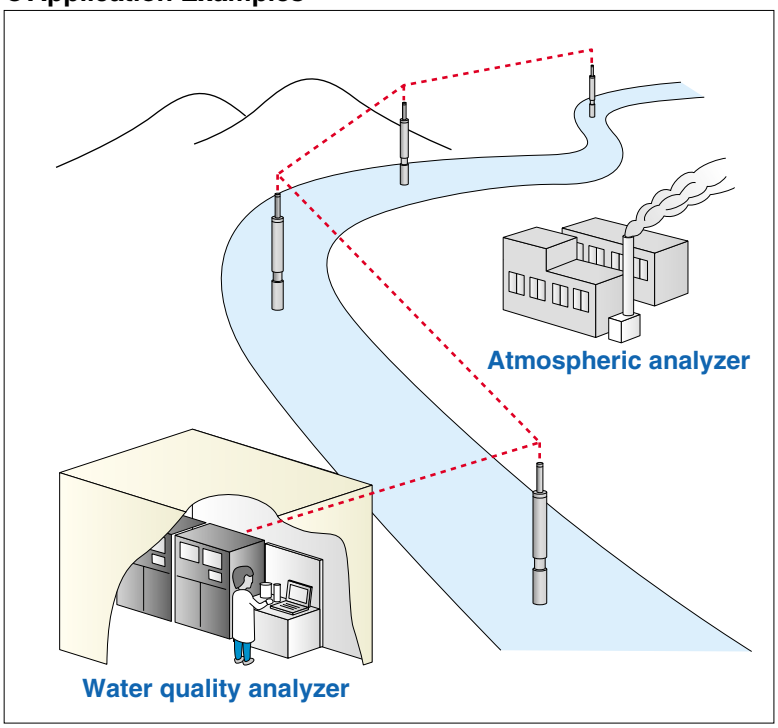


■Life*



* Operating Condition
Main Discharge Voltage: 600 V,
Main Discharge Capacitor: 0.22 µF
Repetition Rate: 126 Hz, Average Input: 5 W

●Application Examples



MICROFOCUS X-RAY SOURCE

APPLICATIONS

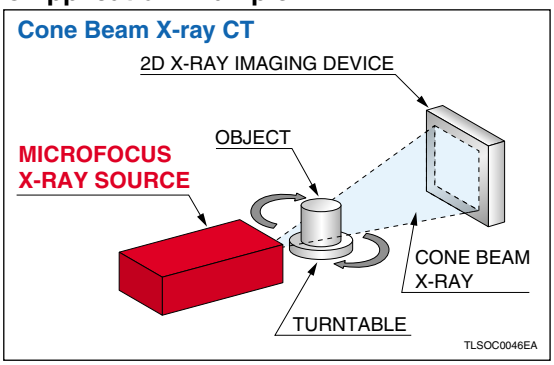
- **Non-destructive inspection**
  - **X-ray CT system (Ex.: Cone beam X-ray CT)**
  - **In-line X-ray inspection system**

[Applicable objects]

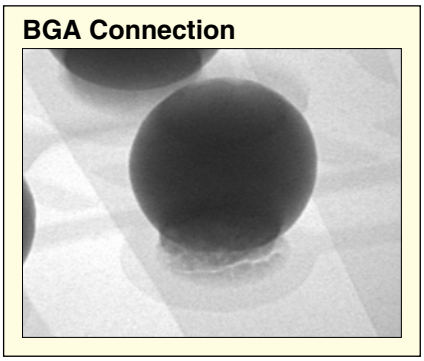
- Electronic component
- Plastic component
- Food
- Medicine & drug
- Small animal, insect
- Printed circuit board
- Metal component
- Beverage
- Bioproduct

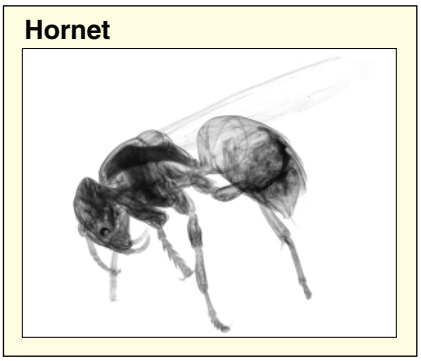
Left: L9191, Center: L9181S, Right: L9631

Application Example



X-RAY IMAGING EXAMPLES



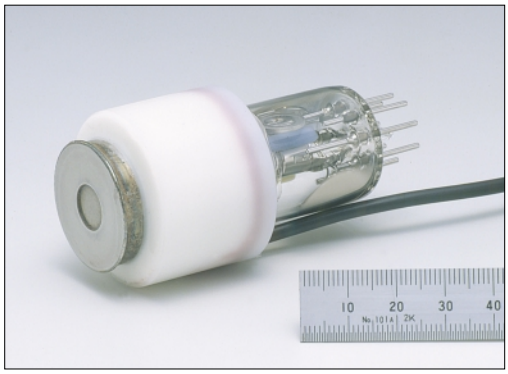


SELECTION GUIDE

Type No.	Type	Tube Voltage Operation Range (kV)	Max. Tube Current (μA)	Focal Spot Size (μm)	Min. FOD (mm)
NEW L9421	Sealed	20 to 90	250	5	9.5
L7901-01		20 to 100			
L9631		40 to 110	800	15	16.5
L9181S		40 to 130	300	5	13
L8121-01		40 to 150	500		17
L9191	Open	20 to 160	200	1	0.5
L8321-01				<1	

SOFT X-RAY TUBE N7599

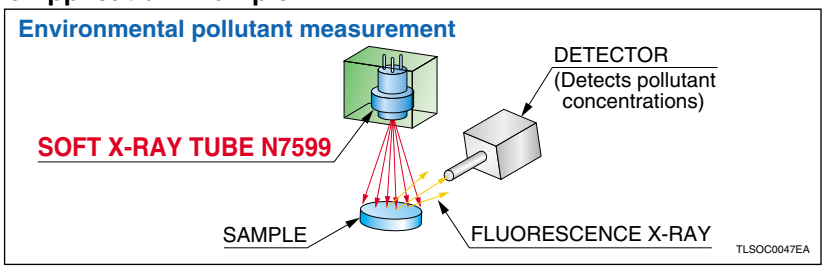
Easier to Handle Than RI (Radioisotope),
Adaptable for Various Thicknesses and Materials



APPLICATIONS

- **Film thickness measurement**
- **X-ray analysis**
- **Environmental pollutant measurement**

Application Example



X-RAY SCINTILLATORS (ACS™/ALS™/FOS™)

Next Generation of Large Format X-ray Imaging Device Series

■FEATURES

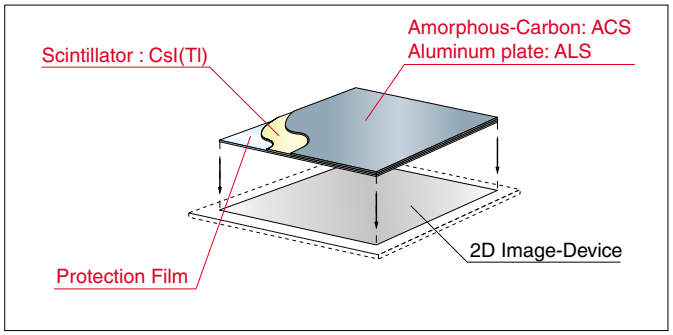
● **Large format**
Maximum size: 468 mm (17") x 468 mm (17") for ACS and ALS

● **High light output**
2.5 times higher with ACS-HL type (CsI 600 μm) than Lanex-R (powdery phosphor)

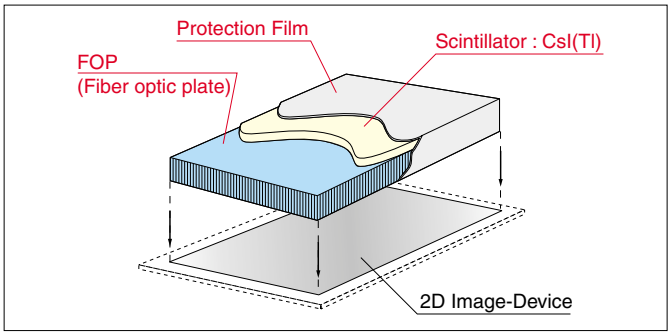
● **High resolution**
20 Lp/mm at CTF 13 % FOS-HR type (CsI 150 μm)

■STRUCTURE

●**ACS / ALS**



●**FOS**

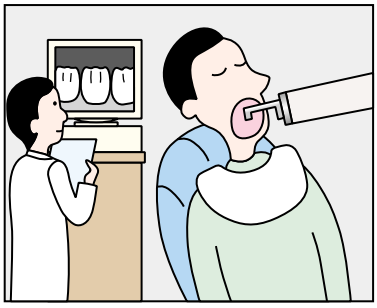


■SELECTION GUIDE

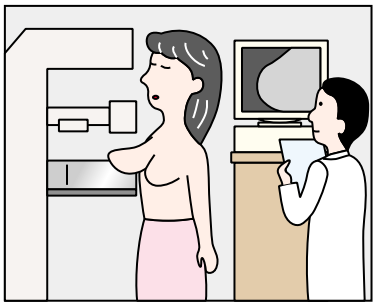
Product Name	Structure	Dimension				Features	Applications
		Scintillator Effective Area (mm)		Substrate Thickness (mm)	Scintillator Thickness (μm)		
		Max.	Min.				
ACS	Amorphous-Carbon Plate with CsI Scintillator	440 × 440 (17" × 17")	14 × 14	0.5 or 2	600 Max.	High resolution, Large format	Dental intraoral, Mammography, Chest examination
ALS	Aluminum Plate with CsI Scintillator	440 × 440 (17" × 17")	14 × 14	1		High light output, Large format	Dental-panoramic, Chest examination
FOS	Fiber Optic Plate with CsI Scintillator	240 × 180 (9" × 7")	10 × 10	1 to 3		X-ray shield, Low energy X-ray detection	Dental intraoral, Dental-panoramic, Mammography

■APPLICATIONS

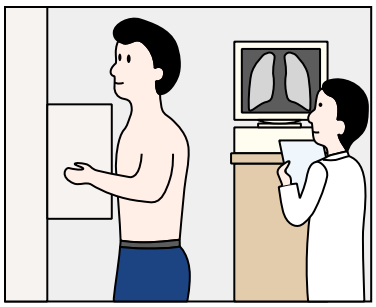
●**Dental**



●**Mammography**

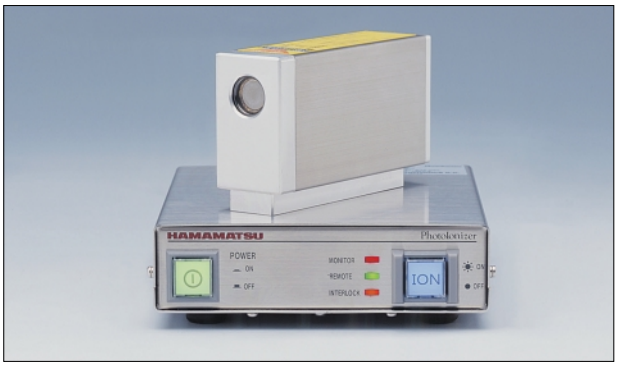


●**Chest examination**

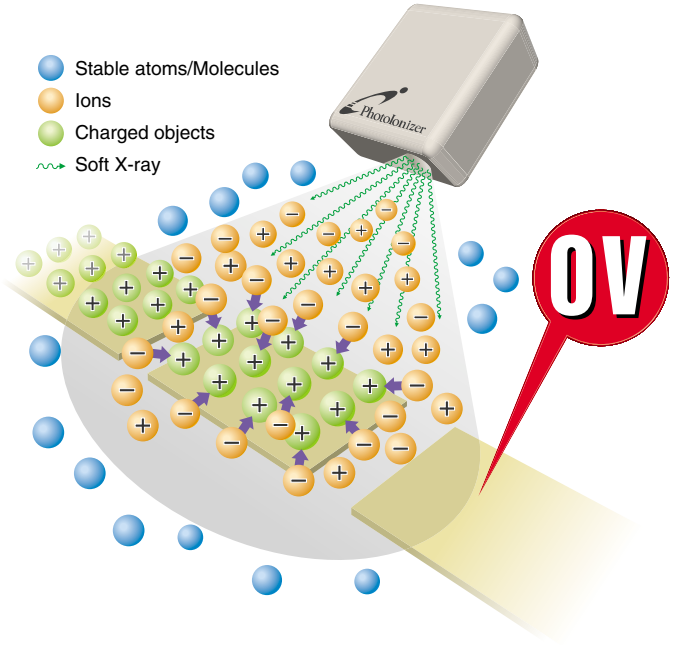


ELECTROSTATIC REMOVER Photolonizer™ L9490*

The PhotoIonizer is an electrostatic remover utilizing the "photoionization" effect.



■PRINCIPLE OF PHOTOIONIZATION



* L9490 is the model number of a set that includes the L9491 head, C9492 controller, and control cable. When ordering a new head for replacement, specify head model number L9491.

■FEATURES

- No air flow
- High ion density
- No overshoot
- Ozone free
- Particle free

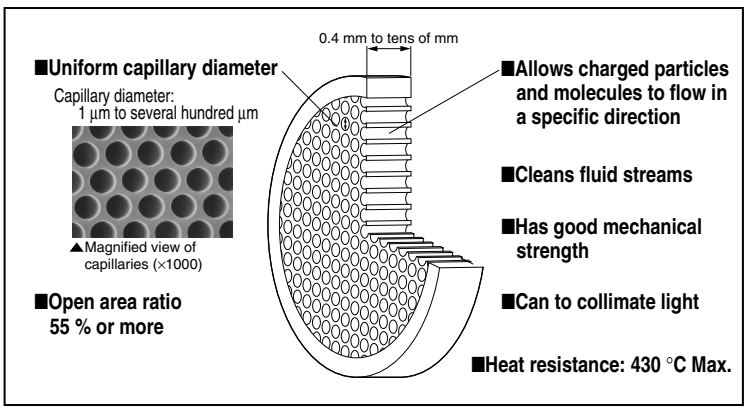
■APPLICATIONS

- Packing of powdered products
- High-speed moving objects (films, printed matters, etc.)
- IC/LCD/PDP process lines
- Large size glasses
- PCB mounting, chip mounter
- Plastic component molding process

CAPILLARY PLATE

A capillary plate is a bundle of thin glass capillaries, with diameter sizes available from 1 µm to several hundred µm, evenly spaced. The plate can be made circular or rectangular, and the dimensional accuracy of the capillary diameter is better than ±1 %. The diameter, the thickness of the plate, and the number of capillaries can be adjusted to suit the application.

■SCHEMATIC CONSTRUCTION AND FEATURE



■APPLICATIONS

- X-ray or neutron guide
- Liquid, gas filter
- Differential pressure pumping system
- Orifice for mass spectroscopy
- Light, soft X-ray collimator
- MSGC (Micro Strip Gas Chamber)

MEMO

HAMAMATSU

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Microfocus X-ray Sources
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X-ray Image Intensifiers
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Fiber Optic Plates

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Image sensors
Light Emitting Diodes
Application Products and Modules
Optical Communication Devices
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Image Processing Systems
Streak Cameras
Optical Measurement Systems
Imaging and Analysis Systems

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