

2011 *PHOTONIC DEVICES*

Electron Tube Devices and Applied Products



HAMAMATSU
PHOTON IS OUR BUSINESS

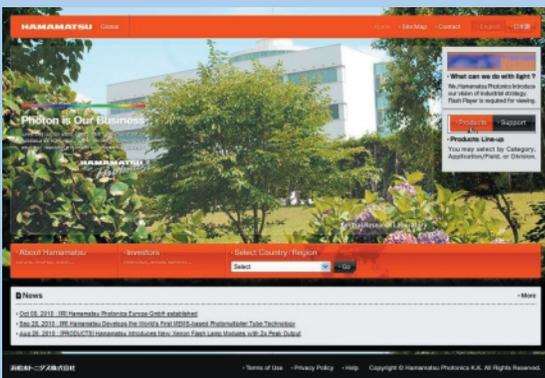
Visit our website to find out all about us

The latest catalog and detailed product information are available from our website.

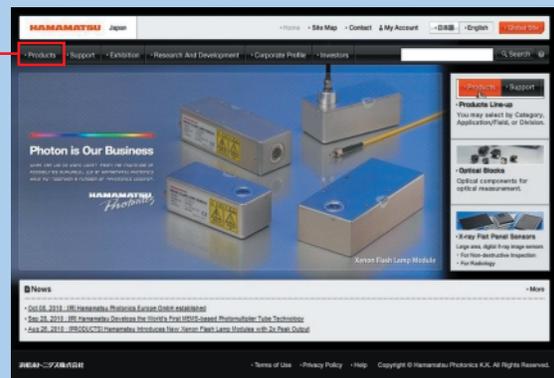
Our website contains a wealth of information including our corporate profile, history and news, as well as product introductions, new technology briefs, exhibition / workshop / seminar introductions, and general information about light itself.

The product introduction contains the latest catalog, in PDF data format, for each product listed. Please visit our website for the latest information on products found in this catalog.

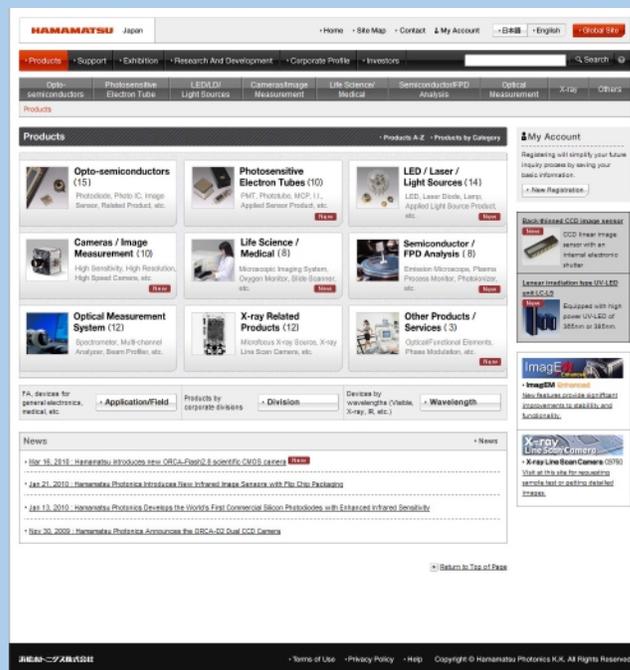
www.hamamatsu.com



▲Global site (www.hamamatsu.com)
Corporate profile, business philosophy, etc.



▲Japanese site in English (jp.hamamatsu.com/en/index.html)
Product information, product support, exhibition information, research & development, stockholder/investor information, recruitment information, etc.



▲Product information in English
(http://jp.hamamatsu.com/en/product_info/index.html)

The navigation tool is updated to make it easier to find the products you are interested in.
(Catalogs can be downloaded from each product introduction page.)

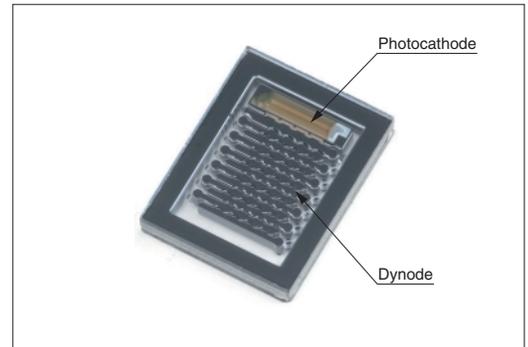
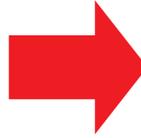
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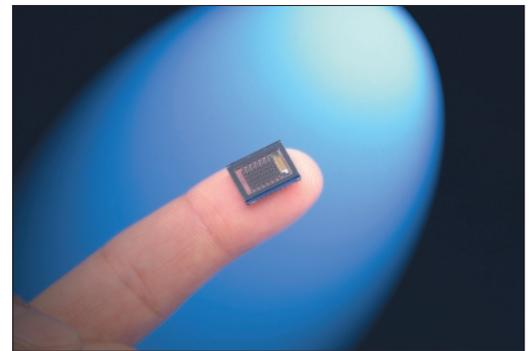
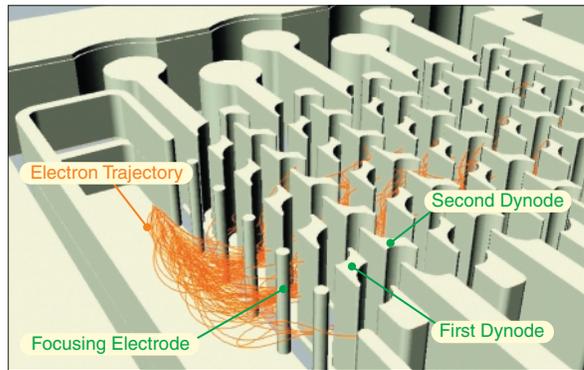
Specifications shown in this brochure are typical values unless otherwise specified. Specifications are subject to change without notice.

The μPMT (micro-PMT) is a completely new type of photomultiplier tube in an ultra-miniature size and easy to mass-produce. The μPMT was developed by taking advantage of the following technologies fostered over long years at Hamamatsu:

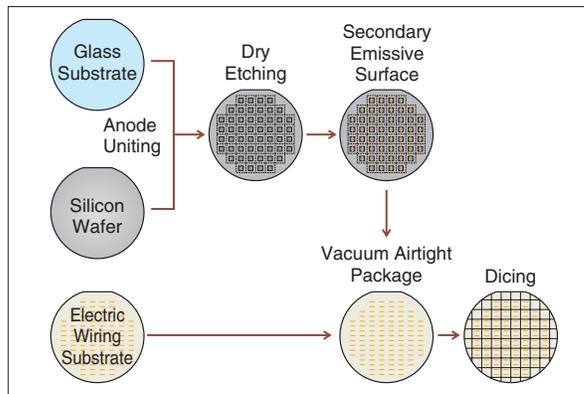
- ① **Electron trajectory simulation**
(tracking electron trajectories)
- ② **PMT manufacturing**
(vacuum seal packaging and photocathode fabrication)
- ③ **Vacuum tube design**
(from electrode structure to production process design)
- ④ **Semiconductor microlithography**
(silicon dry etching process)



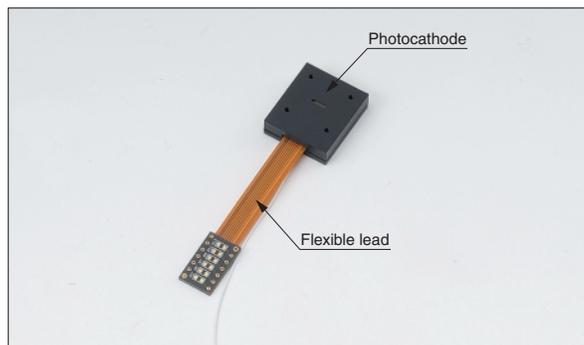
CONSTRUCTION



PRODUCTION PROCESS CONCEPT



CONCEPT MODEL



APPLICATION EXAMPLES

Compact size & Super high sensitivity equipments

1. Portable medical equipment

Laboratory determination
POCT (Point of Care Testing)
Daily health monitor

2. Portable environment measurement

Air pollution monitor
Water analyzer
Survey monitor

3. Others

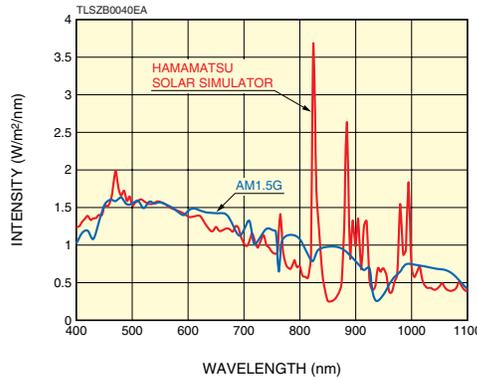
Hygiene monitor
etc.

SOLAR SIMULATOR

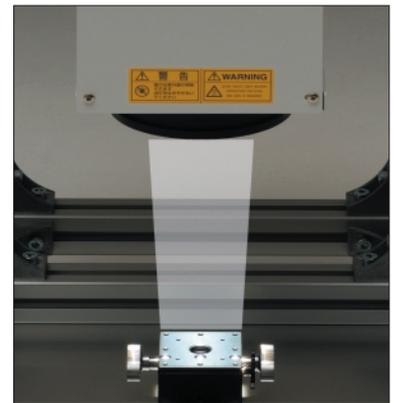
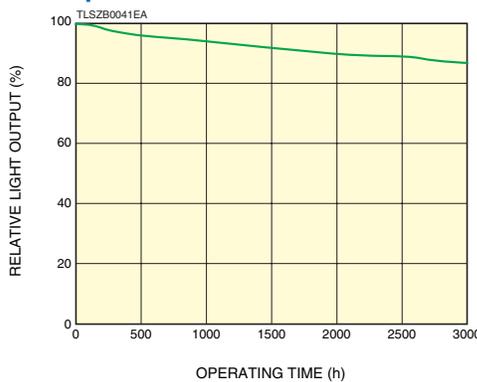
FEATURES

- Long life lamp installed
- No optical adjustment required
- Class AAA
IEC 60904-9 Edition 2 (2007),
ASTM E927-05, JIS C8912
Non-uniformity of irradiance:
±2 % or less
Time fluctuation of irradiance:
±1 % or less
Spectral coincidence: 0.75 to 1.25
- High coincidence spectrum
- AM1.5G
- Air mass filter is removable and radiant heat test is also possible.
- Safety guarantee function
Lamp shut-down, alarm signal output in emergency situations
- External control function
(lamp turn on/off, lamp stable signal output, shutter open/close, iris control)
- Output intensity:
1 sun (100 mW/cm²) or more
- Illumination area: 50 mm × 50 mm

Spectral Distribution



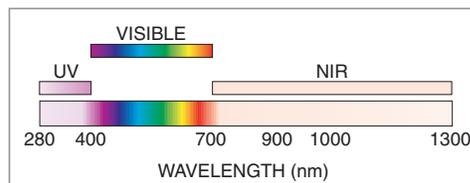
Lamp Life Characteristics



OPTO-SPECTRUM GENERATOR

LINEUP & APPLICATION

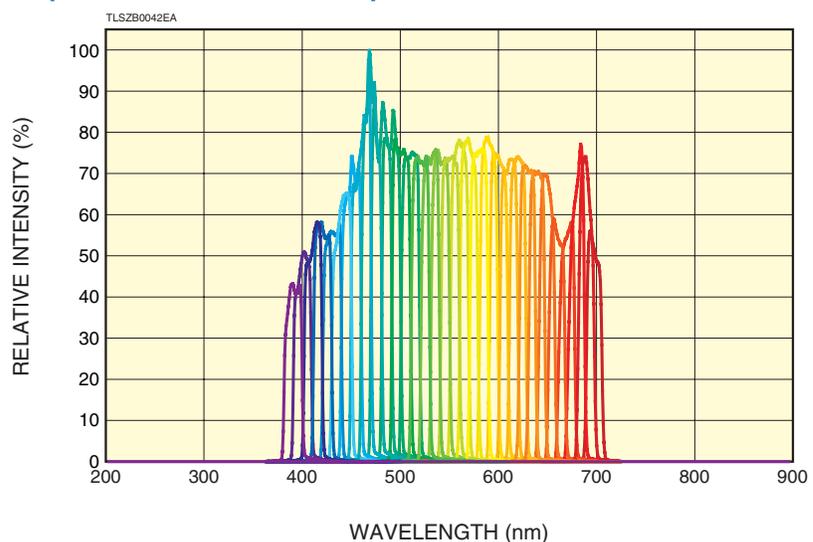
- UV range: 280 nm to 400 nm
(for fluorescence excitation & analysis equipment)
- Visible range: 390 nm to 700 nm
(for solar simulator: solar cell)
- NIR range: 700 nm to 1300 nm
(to simulate bioluminescence)
(for semiconductor inspection)



FEATURES

- Continuously changeable over a wide spectrum
- Possible to output at a narrow band: 5 nm Min.
- The changeable speed of wavelength is fast: 100 nm/s Max.
- Possible to output the same amount at each wavelength
- Light output intensity: 15 mW or more

Spectral Distribution Example



LOW ENERGY ELECTRON BEAM IRRADIATION ENGINE



FEATURES

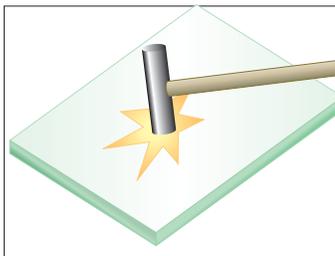
- Suitable acceleration voltage for thin-film modification: 40 kV to 70 kV
- Modular parts allow easy maintenance
- Electron beam irradiation in air
- Compact and lightweight
- Simple X-ray shield
(Not included a shield chamber. However, consulting its design by HAMAMATSU.)
- Including PC control unit and vacuum pump

APPLICATIONS

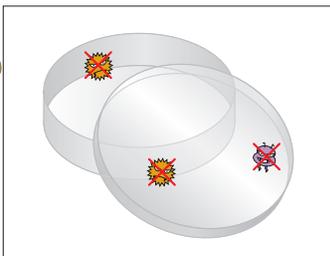
- Modifying of resins and films
- EB coating and ink curing
- Sterilizing food packages
- Basic research

Modification Example

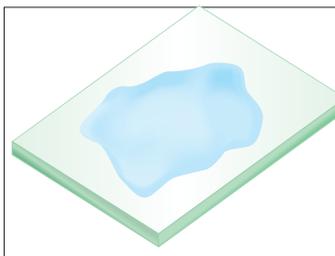
Surface hardening of materials



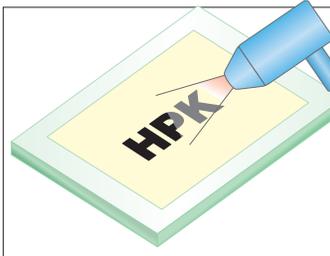
Sterilization and disinfection



Giving a hydrophilicity to resin



EB curing



RF DISCHARGE TYPE EXCIMER LAMP



FEATURES

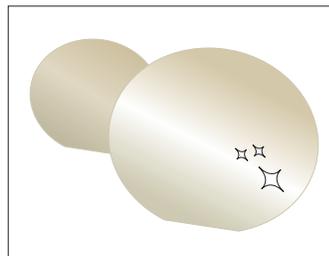
- High efficiency via use of monochromatic wavelength (172 nm) and low-temperature processing
- Instantaneous on/off operation
- Highly uniform illuminance

APPLICATIONS

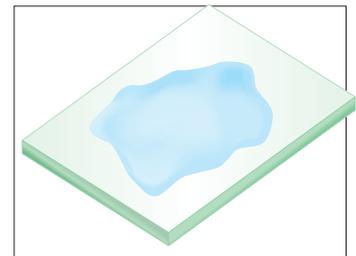
- Dry cleaning
Si wafer
Glass substrate (organic EL, FPD, etc.)
- Optical surface modification
Improvement of PET film hydrophilic properties, etc.

Modification Example

More complete cleaning



Giving a hydrophilicity to resin



200°C

NEW

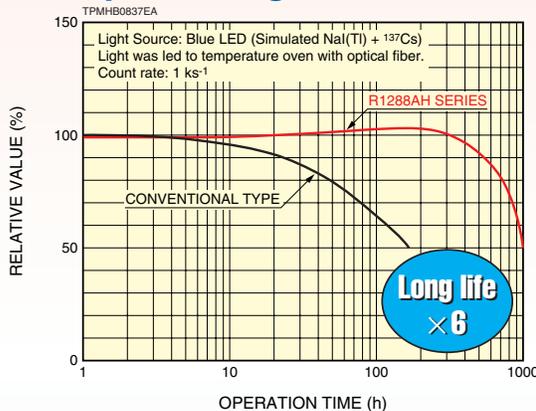
RUGGEDIZED, HIGH-TEMPERATURE PMT R1288AH SERIES

The R1288AH series is a ruggedized, high-temperature-resistant, head-on PMT for geological surveys deep underground. It has a long life of 3000 hours even at a high temperature of 175 °C, lasting nearly 8 times longer than our conventional PMTs. Even at 200 °C, this PMT still achieves an actual service life of 1000 hours, which is 6 times longer than conventional types.

FEATURES

- High sensitivity
- Low dark current
- Low deterioration
- Less material expansion due to heat
- Shock and vibration resistance

Output Changes at 200 °C



APPLICATION



Oil well logging
Resistance to high temperature and vibration is needed here since the drilling unit (PMT is installed nearby) digs deep underground.

- * High temperature : 150 °C to 200 °C
- * Resistance to vibration : 50 G, 50 Hz to 200 Hz

NEW

PMTs FOR DARK MATTER DETECTION R11065, R11410

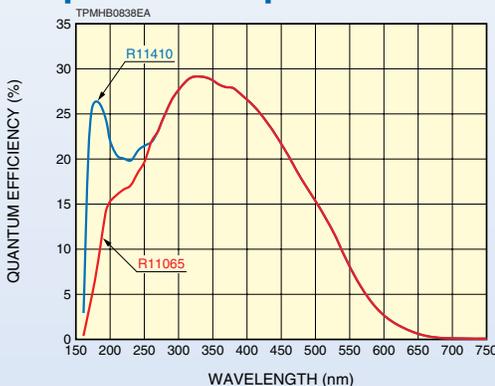
The R11065 and R11410 are 76 mm (3") diameter head-on PMTs with extremely low radioactivity, and are operable in low-temperature environments such as liquid Xe (-110 °C) and liquid Ar (-186 °C).

FEATURES

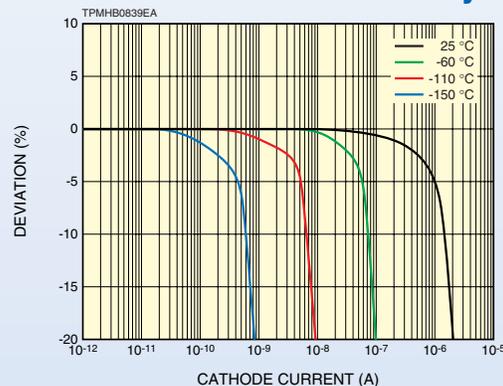
- High QE
- High cathode linearity
- Extremely low radioactivity



Spectral Response



Cathode Current Linearity Example



-186°C

UBA (Ultra Bialkali) & SBA (Super Bialkali) PHOTOMULTIPLIER TUBE SERIES

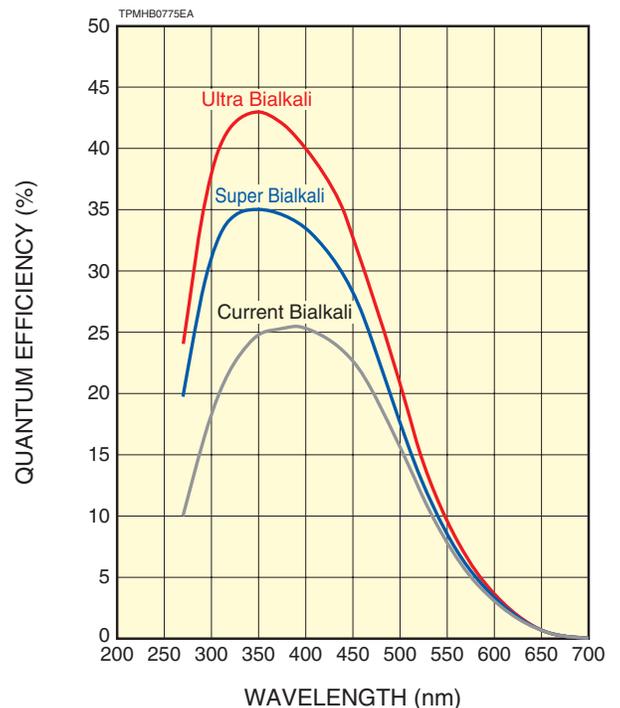
Photocathode Type	Quantum Efficiency		
	Peak Wavelength (nm)	at Peak Wavelength Typ. (%)	at 400 nm Typ. (%)
SBA	350	35	34
UBA		43	40



Type No.	Photocathode Type	Effective Area (mm)	Suitable Socket Assembly	Cathode Blue Sensitivity Index (CS 5-58) Typ.	Gain Typ.
R9880U-110	SBA	φ8	E10679	13.5	2.0 × 10 ⁶
R9880U-210	UBA	φ8	E10679	15.5	2.0 × 10 ⁶
R5900U-100-L16	SBA	16 × 15.8	E6736	13.5	3.0 × 10 ⁶
R5900U-200-L16	UBA	16 × 15.8	E6736	15.5	3.0 × 10 ⁶
R7600U-100	SBA	18 × 18	E5996	13.5	1.0 × 10 ⁶
R7600U-200	UBA	18 × 18	E5996	15.5	1.0 × 10 ⁶
R7600U-100-M4	SBA	18 × 18	E7083	13.5	1.3 × 10 ⁶
R7600U-200-M4	UBA	18 × 18	E7083	15.5	1.3 × 10 ⁶
R8900U-100	SBA	23.5 × 23.5	E10411	13.5	1.0 × 10 ⁶
R8900U-100-M4	SBA	23.5 × 23.5	—	13.5	1.0 × 10 ⁶
R8900U-100-M16	SBA	23.5 × 23.5	E9349	13.5	1.0 × 10 ⁶
R8900U-100-C12	SBA	23.5 × 23.5	E7514	13.5	6.7 × 10 ⁵
H8711-100	SBA	18.1 × 18.1	—	13.5	2.0 × 10 ⁶
H8711-200	UBA	18.1 × 18.1	—	15.5	2.0 × 10 ⁶
H7546B-100	SBA	18.1 × 18.1	—	13.5	3.0 × 10 ⁵
H7546B-200	UBA	18.1 × 18.1	—	15.5	3.0 × 10 ⁵
H7260-100	SBA	7 × 31.8	—	13.5	2.0 × 10 ⁶
H7260-200	UBA	7 × 31.8	—	15.5	2.0 × 10 ⁶
R1924A-100	SBA	φ22	E2924 E2924-500 E2924-05	13.5	2.0 × 10 ⁶
R3998-100-02	SBA	φ25	E990-29	13.5	1.0 × 10 ⁶
R9420-100	SBA	φ34	—	13.5	3.7 × 10 ⁵
R6231-100	SBA	φ46	E1198-26 E1198-27	13.5	2.3 × 10 ⁵
R6233-100	SBA	φ70	E1198-26 E1198-27	13.5	2.3 × 10 ⁵
R877-100	SBA	φ111	E1198-22 E1198-23	13.5	3.1 × 10 ⁵

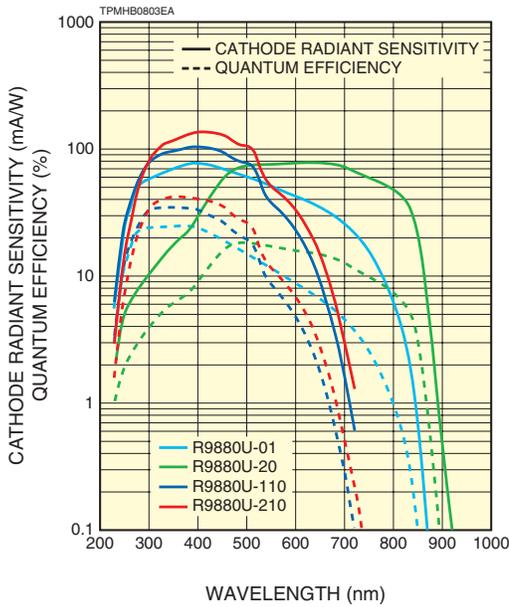


■ Spectral Response (R7600U-100/-200 Series)

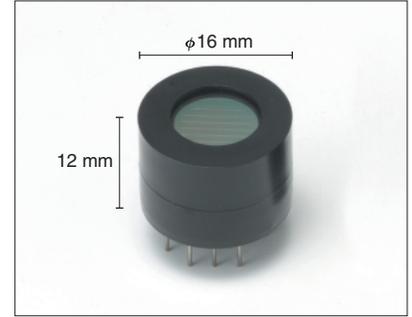
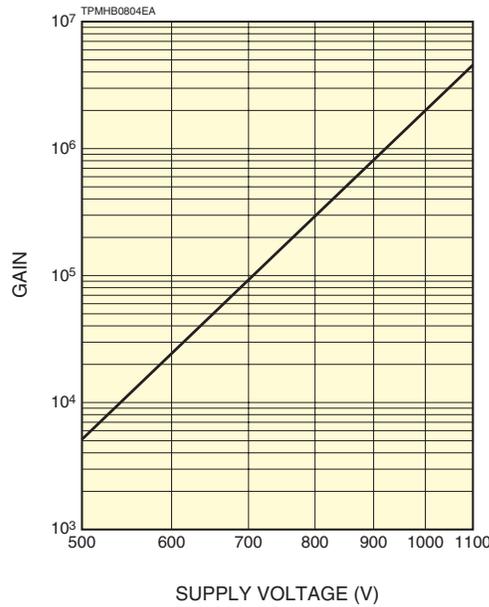


METAL PACKAGE PHOTOMULTIPLIER TUBE R9880U SERIES

Spectral Response



Gain



FEATURES

- High gain
- High resistance to vibration and shock
- Compact
- Lightweight

Parameter	R9880U-01	R9880U-20	R9880U-110	R9880U-210	Unit
Photocathode	Multialkali		SBA	UBA	—
Cathode Luminous Sensitivity	200	500	105	135	μA/lm
Cathode Blue Sensitivity Index (CS 5-58)	—		13.5	15.5	—
Red / White Ratio (R-68)	0.2	0.45	—		—
Dark Current at 1 kV (after 30 min)	1	10	1		nA
Anode Luminous Sensitivity at 1 kV	400	1000	210	270	A/lm
Gain	2.0×10^6				—
Rise Time	0.57				ns

MODULE INTEGRATING R9880 SERIES

Type No.	Output Type		Input Voltage	Configuration
H10720 Series	Current Output	On-board	+5 V	PMT R9880 series + Voltage divider circuit + High voltage power supply circuit
H10721 Series				
H10722 Series	Voltage Output	Cable Output	±5 V	PMT R9880 series + Voltage divider circuit + High voltage power supply circuit + Current to voltage conversion amp.
H10723 Series				
H10682 Series ①	Photon Counting		+5 V	PMT R9880 series + Voltage divider circuit + High voltage power supply circuit + Photon counting circuit



①-20 type is not available.

PHOTOMULTIPLIER TUBE MODULES

A single compact package for easy use

FUNCTIONS

Photomultiplier tube (PMT) module functions are shown in the chart below. PMT modules are comprised 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 with various additional functions such as signal processing, cooling and interface to PC.

SELECTION GUIDE

		Built-in PMT Type				
		Metal Package	Compact Head-on	Head-on	Compact Side-on	Side-on
Photomultiplier Tube Voltage Divider Circuit High Voltage Power Supply Circuit	Photosensor Modules					
	Cooler					
	High Speed Gating Circuit					
	Current to Voltage Conversion Amp.					
	Photon Counting Heads					
	Photon Counting Circuit					
	Gating Circuit					
	Cooler					
	Counter					
CPU + Interface						

PHOTOMULTIPLIER TUBE MODULES

NEW H11526

The H11526 series is a family of photosensor modules capable of high-speed gate operation at a high repetition rate.

Each module contains a metal package PMT, a high voltage power supply, and a dedicated gate circuit. Modules have excellent characteristics such as a minimum gate width of 100 ns, maximum repetition rate of 10 kHz, and fast response of 0.57 ns.

SPECIFICATIONS

Parameter	H11526 Series			Unit
	-110	-01	-20	
Suffix	-110	-01	-20	—
Input Voltage	-14.5 to +15.5			V
Max. Output Signal Current	100			μA
Effective Area	φ8			mm
Spectral Response	230 to 700	230 to 870	230 to 920	nm
Cathode Luminous Sensitivity (Typ.)	105	200	500	μA/lm
Anode Luminous Sensitivity ^① (Typ.)	210	400	1000	A/lm

①Control voltage: +0.8 V



FEATURES

- High-speed gate
- Small size (thin package)
- Excessive light monitor

APPLICATION

- Laser radars

NEW H11461

The H11461 series is a family of current-output type photosensor modules that include a 28 mm (1-1/8") diameter side-on PMT and a high voltage power supply.

These modules feature high sensitivity and high gain, yet offer lower power consumption than conventional types. The H11461 also includes "P type" specially selected for a low dark count.

SPECIFICATIONS

Parameter	H11461 Series				Unit
	-01	-02	-03	-09	
Suffix	-01	-02	-03	-09	—
Input Voltage	+4.5 to +5.5				V
Max. Output Signal Current ^①	100				μA
Effective Area	4 × 20				mm
Spectral Response	185 to 710	185 to 900	185 to 900	160 to 320	nm
Cathode Luminous Sensitivity (Typ.)	100	250	525	—	μA/lm
Anode Luminous Sensitivity ^① (Typ.)	1200	2500	5000	—	A/lm
Ripple Noise ^{①②} (Max.)	0.6				mV
Settling Time ^③ (Max.)	10				s

①Control voltage: +1.0 V

②Cable RG-174/U, Cable length 450 mm, Load resistance 1 MΩ, Load capacitance 22 pF

③The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V.



FEATURES

- Wide spectral response range
- Low power consumption
- Low cost

APPLICATIONS

- Flow cytometer
- Spectrophotometry

NEW H11432

The H11432 is a current-output type photomultiplier tube assembly that contains a 38 mm (1-1/2") diameter head-on PMT and a high voltage power supply.

Incident light is efficiently collected by a large photosensitive area, making the H11432 ideal for scintillation counting.

SPECIFICATIONS

Parameter	Rating	Unit
Input Voltage	+4.5 to +5.5	V
Max. Output Signal Current	100	μA
Effective Area	φ34	mm
Spectral Response	300 to 650	nm
Cathode Luminous Sensitivity (Typ.)	95	μA/lm
Anode Luminous Sensitivity ^① (Typ.)	47	A/lm
Ripple Noise ^{①②} (Max.)	0.6	mV
Settling Time ^③ (Max.)	10	s

①Control voltage: +1.3 V

②Cable RG-174/U, Cable length 450 mm, Load resistance 1 MΩ, Load capacitance 22 pF

③The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V.



FEATURES

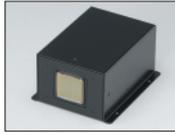
- Large area, highly efficient light collection
- Lower power consumption

APPLICATION

- Scintillation counting

FLUORESCENCE DETECTOR SERIES

SELECTION GUIDE

Type No.	H11451	H11452	H11459	H11460	NEW H11658	NEW H11659
						
Anode Type	8 ch		16 ch	32 ch	16 ch	32 ch
Configuration	PMT	●	●	●	●	●
	Divider Circuit	●	●	●	●	●
	Preamplifier	●	●	●	—	—
	Photon Counting Circuit	—	—	—	—	●
	High Voltage Power Supply	●	●	●	●	●
	Gain Control Function ^①	—	●	—	—	—
Effective Area (W × H) (per channel)	2.0 mm × 2.5 mm		0.8 mm × 16 mm	0.8 mm × 7 mm	0.8 mm × 16 mm	0.8 mm × 7 mm
Channel Pitch	2.8 mm		1 mm		1 mm	
Count Linearity	—				2 × 10 ⁶ s ⁻¹	
Supply Voltage	±11.5 V to ±15.5 V				+4.75 V to +5.25 V	
Amplifier Bandwidth (Min.)	DC to 1 MHz				—	
Dimensions ^② (W × H × D)	65 mm × 29.2 mm × 75 mm	65 mm × 40.8 mm × 75 mm	72 mm × 44.9 mm × 85.3 mm	72 mm × 40.5 mm × 84 mm	72 mm × 40 mm × 98 mm	

Photon counting type is also available.

① Gain adjustment on each channel individually. ② Includes projection part.

Devlp.

COOLING MODULE for H11836

This module uses a thermoelectric cooler to reduce thermal electrons emitted from the PMT photocathode. A PMT is built into the aluminum case which is nitrogen-purged to prevent moisture condensation. The cooling area also has a thermistor to constantly monitor the photocathode temperature.

FEATURES

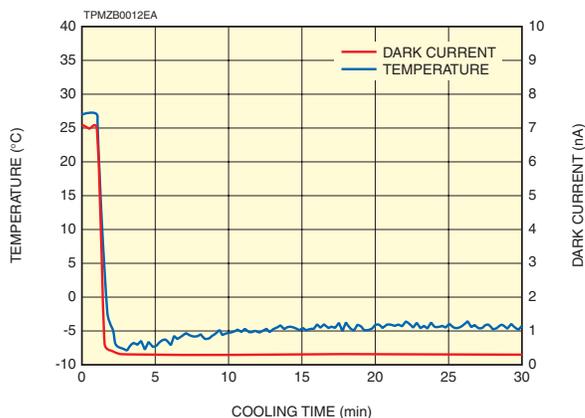
- Dark current reduction by cooling
- Photon counting measurement with extended red photocathode

APPLICATIONS

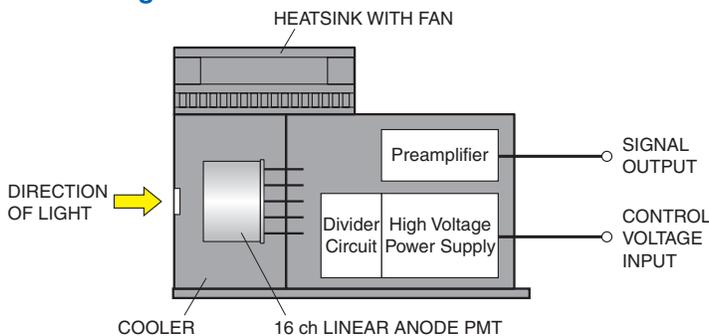
- Biomedical fluorescence detection
- Laser scanning detection
- Low light level measurement



Cooling Characteristics



Block Diagram



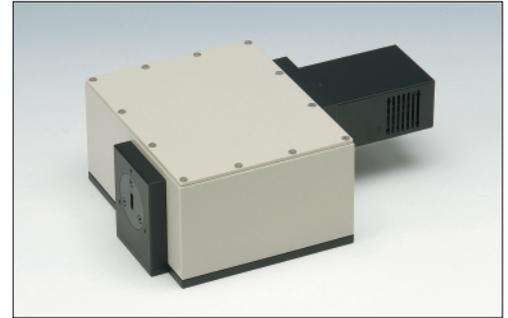
* Technically applicable for photon counting module

TPMZC0012EA

NEW HIGH SENSITIVITY, COMPACT SPECTROMETER A10766 (WITH H11459 / H11460 SERIES)

FEATURES

- Combines spectrometer grating with PMT module (sold separately)
- Rapid multiwavelength detection from UV to NIR
- High S/N ratio
- Low-light-level detection at single photon levels
- Choice of grating and PMT module determines spectral range, resolution, blaze wavelength, etc.
- Easy operation from data logger (H11459 or H11460 only)
- Easy light input via optical fiber bundle (sold separately)



A10766 + H11460

SPECIFICATIONS

Parameter	Description / Value	Unit
Focal Length	Approx. 100	mm
F Value	3.3	—
Spectral Range	200 to 900 ^①	nm
Dimensions	163.5 (W) × 85 (H) × 159.5 (D) ^②	mm
Applicable PMT and PMT Module	H7260/H11460 (32 ch) and H10515B/H11459 (16 ch)	—

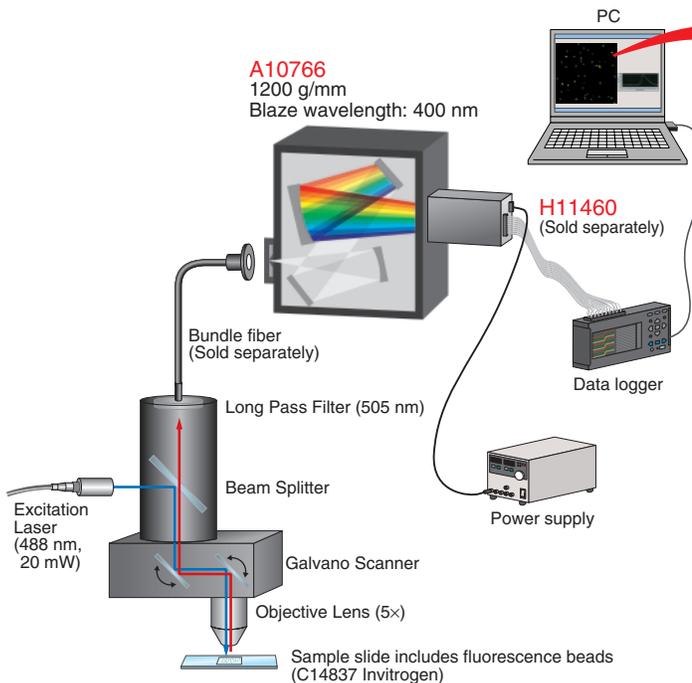
① Spectral range can be defined with combination of PMT type and grating mirror.

② PMT, PMT module and bundle fiber are not included.

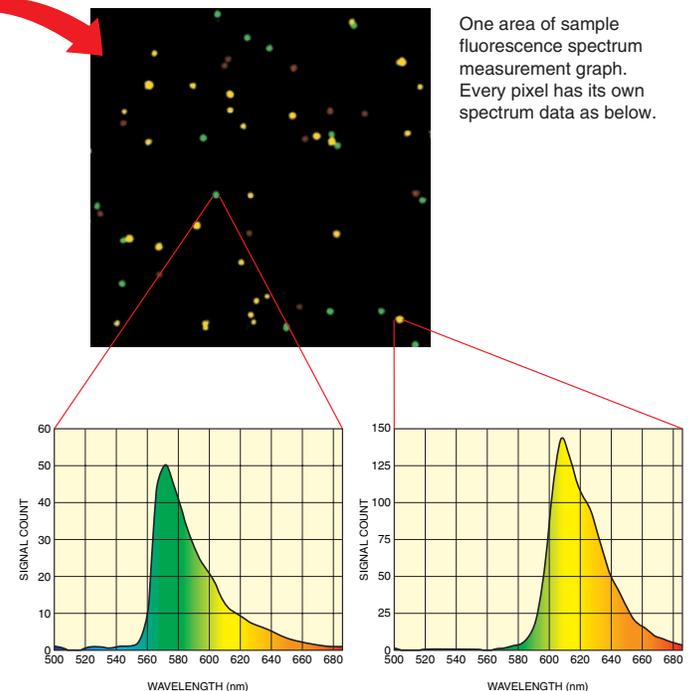
SELECTION OF GRATING MIRRORS

Groove Density (g/mm)	Resolution (nm/ch)	
	H7260/H11460 (32 ch)	H10515B/H11459 (16 ch)
1200	6.3	6.3
900	8.7	8.7
600	13.6	13.6
300	—	28

BLOCK DIAGRAM FOR MEASUREMENT



EXAMPLE OF FLUORESCENCE IMAGE (1024 × 1024 pixels, Objective lens 5x)



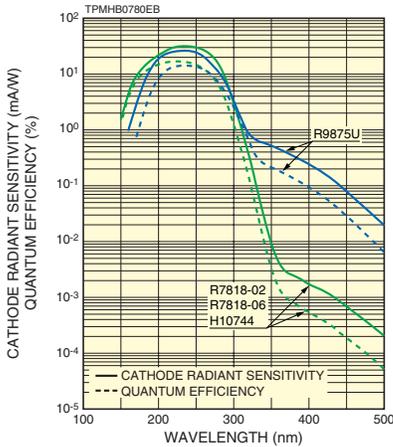
TPMHC0114EB

VUV to UV REGION

HEAD-ON PMT SERIES R7818-02/-06, H10744, R9875U

Solar blind ruggedized PMT

■ Spectral Response



■ FEATURES

- Excellent solar blind characteristic (R7818-02/-06, H10744)
- High resistance to vibration and shock (R7818-02/-06)
- Coupled with a filter (H10744)
- Compact (R9875U)

■ APPLICATIONS

- Fire detection
- UV-LIDAR
- Corona discharge monitoring (R7818-02/-06, H10744)
- UV communication (R7818-02/-06, H10744)



H10744, R7818-02, R7818-06, R9875U

Parameter	R7818-02	R7818-06	H10744	R9875U	Unit
Type	PMT Assembly				—
Output Type	Current Output	Photon Counting		Current Output or Photon Counting	—
Spectral Response ①	150 to 320			160 to 320	nm
Dimension	φ35 × 80	φ34.6 × 80	φ50 × 100	φ14 × 13	mm
Photocathode Material	Cs-Te				—
Photocathode Effective Area (Min.)	φ27.4			φ8	mm
Cathode Radiant Sensitivity ②	28			26	mA/W
Cathode Quantum Efficiency ②	13.7			12	%
Anode Radiant Sensitivity ②	1.4 × 10 ⁶	—	—	9.7 × 10 ³	A/W
Gain	5.0 × 10 ⁷ ④		1.0 × 10 ⁷ ⑤	3.7 × 10 ⁵ ⑥	—
Dark Current ③	100 ④	—	—	10 ⑥	pA
Dark Counts	—	—	5 ⑦	15 ⑦	s ⁻¹

① Operate in a nitrogen-purged environment for VUV detection.

② At 254 nm ③ After 30 min storage in darkness ④ At 2500 V ⑤ At 2000 V ⑥ At 1000 V ⑦ Plateau voltage

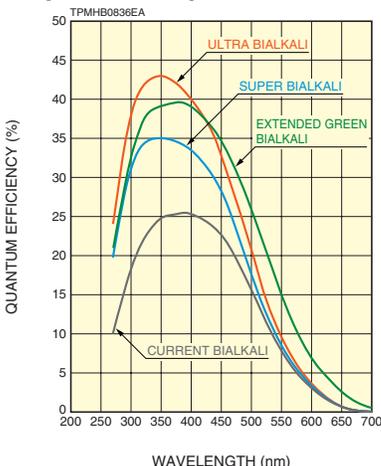
VISIBLE REGION

NEW

HEAD-ON PMT WITH EXTENDED GREEN BIALKALI PHOTOCATHODE R7600U-300, R7600U-300-M4

Photomultiplier tube with higher sensitivity in the green spectrum region than ordinary bialkali photocathodes

■ Spectral Response



■ FEATURES

- Extended green bialkali photocathode: QE 14 % (at 550 nm)
- Spectral response: 300 nm to 700 nm
- 2 × 2 multianode (R7600U-300-M4)
- High speed response
- Low dark count

■ APPLICATIONS

- Academic research
- Medical equipment
- Spectrophotometry
- SEM (scanning electron microscope)



Left: R7600U-300, Right: R7600U-300-M4

- Confocal microscope
- Semiconductor inspection system
- Neutron structure analysis

MULTIANODE PMT ASSEMBLY H8500C, H8500D, H9500 & POSITION SENSITIVE PMT R8900-00-C12

High packing density

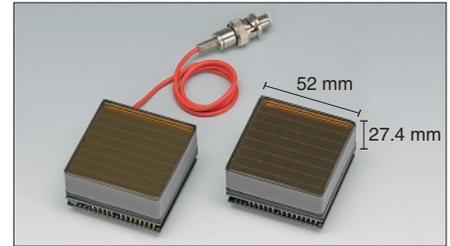
These low profile PMTs or PMT assemblies have anode structures of either matrix or cross plate, which provide positioning information. The effective area ratio^① is so high that they are suitable to cover a wide area by placing multiple detectors side by side.

APPLICATIONS

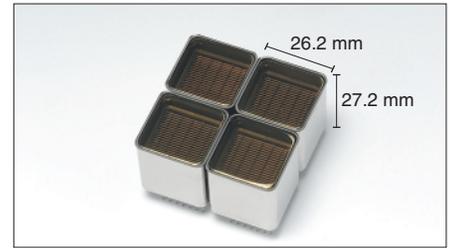
- High resolution PET
- Compact gamma camera
- Scintimammography
- 2-D radiation monitor

Parameter	H8500C ^② , H8500D ^②	H9500 ^②	R8900-00-C12	Unit
Spectral Response	300 to 650			nm
Transit Time Spread (FWHM)	0.4		0.75	ns
Anode Type	Matrix		Cross Plate	—
	8 × 8	16 × 16	6(X)+6(Y)	—
Effective Area	49 × 49		23.5 × 23.5	mm
Effective Area Ratio ^①	89		80	%

① (Effective Area) / (External Size) ② UV type is also available. Suffix: -03, 185 nm to 650 nm



Left: H8500C (HV cable input)
Right: H8500D (HV pin input)

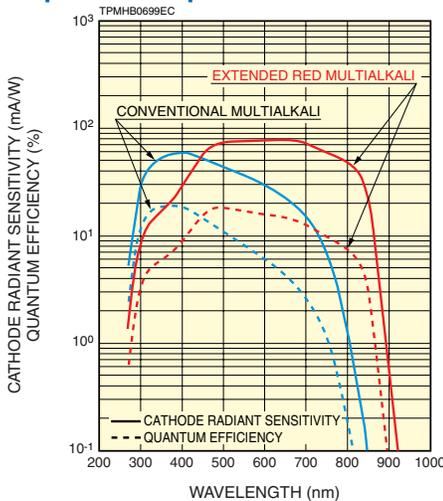


R8900-00-C12 × 4 pieces

VISIBLE to NEAR INFRARED (NIR) REGION

HEAD-ON PMT SERIES WITH EXTENDED RED MULTIALKALI PHOTOCATHODE

Spectral Response



High cathode luminous sensitivity: 500 μA/lm

The 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 the conventional semitransparent multialkali photocathode (150 μA/lm).

APPLICATIONS

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



H7546B-20, H7260-20, H7600U-20, H8711-20



H9530-20

SELECTION GUIDE

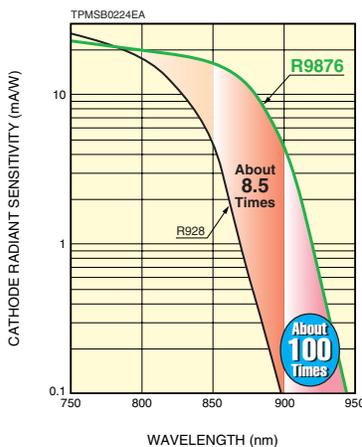
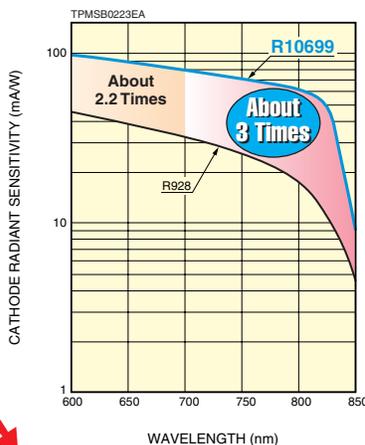
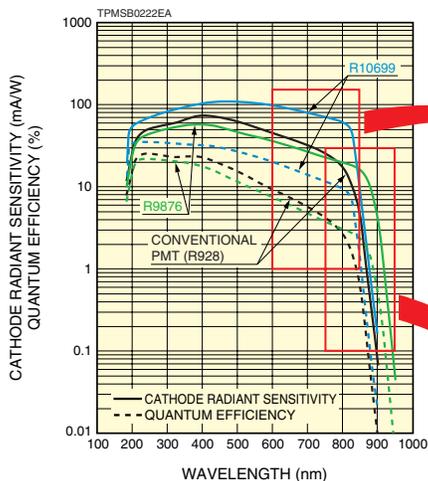
Type No.	R9880U-20	R7600U-20	R8900-20	H9530-20	H10515B-20	H7260-20	R7600U-20-M4	H8711-20	H7546B-20
Anode Type	Single	Single	Single	Linear (8 ch)	Linear (16 ch)	Linear (32 ch)	Matrix (2 × 2 ch)	Matrix (4 × 4 ch)	Matrix (8 × 8 ch)
Effective Area	φ8 mm	18 mm × 18 mm	23.5 mm × 23.5 mm	21.6 mm × 2.5 mm	15.8 mm × 16 mm	31.8 mm × 7 mm	18 mm × 18 mm	18.1 mm × 18.1 mm	18.1 mm × 18.1 mm
Effective Area (per channel)	—	—	—	2 mm × 2.5 mm	0.8 mm × 16 mm	0.8 mm × 7 mm	8.9 mm × 8.9 mm	4.2 mm × 4.2 mm	2 mm × 2 mm

VISIBLE to NEAR INFRARED (NIR) REGION

28 mm (1-1/8") SIDE-ON PMT R10699, R9876

R10699--- High sensitivity from VISIBLE to NIR region

R9876----- High sensitivity in NIR region



Parameter	R928	R9876	R10699	Unit
Cathode Luminous Sensitivity	250	140	650	μA/lm
Anode Luminous Sensitivity at 1000 V	2500	140	8500	A/lm
Dark Current	3 ^①	0.5 ^①	2 ^②	nA
Red / White Ratio (R-68)	0.3	0.3	0.43	—

① After 30 minutes storage in darkness at 1000 V
② After 30 minutes storage in darkness at 1×10^6 gain

APPLICATIONS

- Biological analysis
 - Flow cytometry
 - Microscopy, etc.
- Spectroscopy, etc.

Devip.

PHOTOSENSOR WITH GaAsP / GaAs PHOTOCATHODE

High sensitivity! QE 40% at peak wavelength (GaAsP), wide FOV (field of view) types available

	Type	Type No.	Thermo-electric Cooler	Cooling Temperature(ΔT) (Max.)	High Voltage Power Supply	Heat Sink with Fan	FOV (Field of view)	Features
	Photocathode module	H7422A ^① -40-50	Built-in	35 °C	A7423 (sold separately)	A7423 (sold separately)	68°	Revised protection circuit threshold, Low dark noise
	Photon counting head	H7421-40/50						Built-in photon counting circuit
	Photocathode module	H10769A ^① -40/50	Built-in	25 °C	Built-in	A7423 (sold separately)	78°	Revised protection circuit threshold, Wide FOV
	Photocathode module	H8224A ^① -40/50					68°	Revised protection circuit threshold, Compact
	Photocathode module	H10770A ^① -40/50	—	—	—	—	136°	Revised protection circuit threshold, Wide FOV

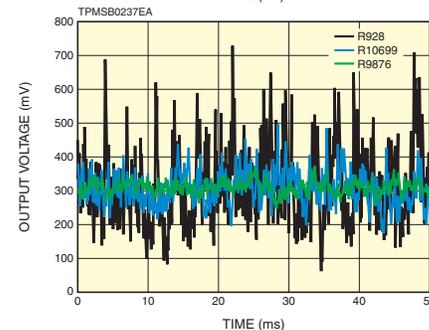
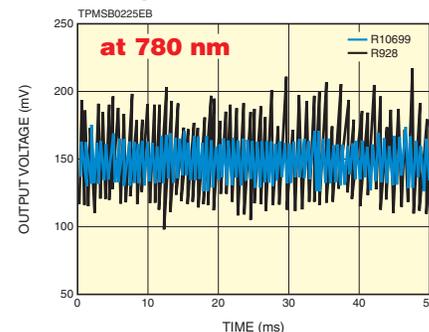
① "P" type for photon counting is available.

Parameter	-40	-50	Unit
Photocathode	GaAsP	GaAs	—
Spectral Response	300 to 720	380 to 890	nm
Peak Wavelength	580	800	nm



Left: R10699, Right: R9876

S/N Comparison

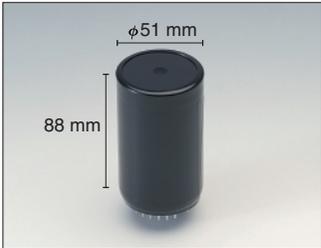


APPLICATIONS

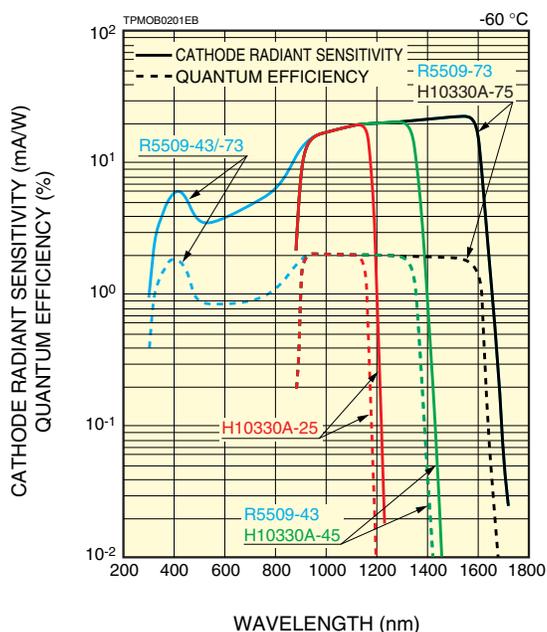
- Fluorescence correlation spectroscopy
- Confocal / Two-photon excitation microscopy
- Low light level measurement

NEAR INFRARED (NIR) DETECTOR SERIES

The new photodetector module H10330A series has now been added to our lineup of near infrared (NIR) detector series. 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		
Features	Easy handling, Low noise (H10330A-25)			Wide spectral response		
						
Type No.	H10330A			R5509		Unit
Suffix No.	-25	-45	-75	-43	-73	
Spectral Response	950 to 1200	950 to 1400	950 to 1700	300 to 1400	300 to 1700	nm
Rise Time	900			3000		ps
T.T.S. (FWHM)	300			1500		ps
Dark Count	2×10^3	2×10^4	2×10^5	1.6×10^4	1.6×10^5	s ⁻¹
Cooling Method	Thermoelectrically cooled (No liquid nitrogen, no cooling water)			Liquid nitrogen cooled		—
Cooler	Included			C9940-01/-02 (Sold separately)		—
High Voltage Power Supply	Included			C9525 (Sold separately)		—

■ Spectral Response



■ APPLICATIONS

- Photoluminescence
- Singlet oxygen measurement
- Raman spectroscopy
- Cathodoluminescence
- Fluorescence / Fluorescence lifetime
- LIDAR (light detection and ranging)

FAST TIME RESPONSE SERIES

HIGH SPEED COMPACT HPD (HYBRID PHOTODETECTOR) MODULE H10777-06/-40/-50

The HPD (Hybrid Photodetector) utilizes the "electron bombardment" method in which photoelectrons are accelerated in a strong electric field to directly strike an avalanche diode (AD) in a vacuum tube. This mechanism achieves excellent quality of amplification.

Using a new AD with very low capacitance, we have developed a compact HPD with an excellent time resolution.

The H10777 is an HPD module incorporating high voltage and AD bias voltage power supplies with temperature stabilization function of the AD.

APPLICATIONS

- Laser scanning microscope (confocal / two-photon)
- FCS (fluorescence correlation spectroscopy)
- LIDAR (light detection and ranging)
- TCSPC (time-correlated single photon counting)

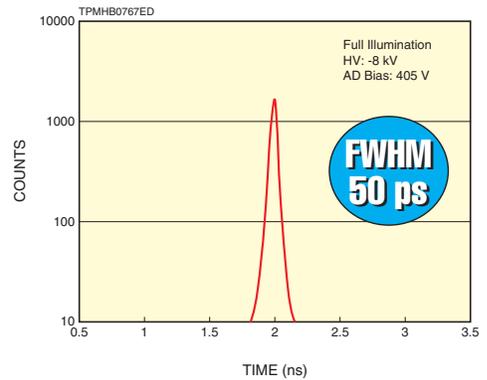
Parameter	H10777-06	H10777-40	Dev. H10777-50	Unit
Spectral Response	220 to 650	300 to 720	380 to 890	nm
Photocathode	Material	Bialkali	GaAsP	GaAs
	Effective Area	φ6	φ3	
Quantum Efficiency	28 ^①	45 ^②	14 ^③	%
Gain ^④	1 × 10 ⁵			—
Rise Time	400			ps
T.T.S. (Transit Time Spread) ^⑤ (FWHM)	50	90	130	ps

① At 350 nm ② At 500 nm ③ At 800 nm
 ④ At the photocathode voltage of -8 kV and the AD bias voltage of Vb - 5 V.
 ⑤ At the single photon state and full illumination on the photocathode, specified as FWHM (Full Width at Half Maximum). These values include the jitter of the electronics of about 30 ps.



H10777

T.T.S. (H10777-06)



HIGH SPEED PMT R9800, R9420, R9779 & HIGH SPEED PMT ASSEMBLY H10580, H10828, H10570

A new series of high speed photomultiplier tubes (PMT) from Hamamatsu has now appeared on the market. These offer a very small transit time spread that is uniform across the entire effective area. This excellent time resolution has been achieved with a simple PMT design that is suitable for mass production.

The new high speed PMT series can be used as a powerful tool for precision timing measurement in many application fields.

H10580, H10828 and H10570 are the hybrid assembly type with a voltage divider and magnetic shield case.

APPLICATIONS

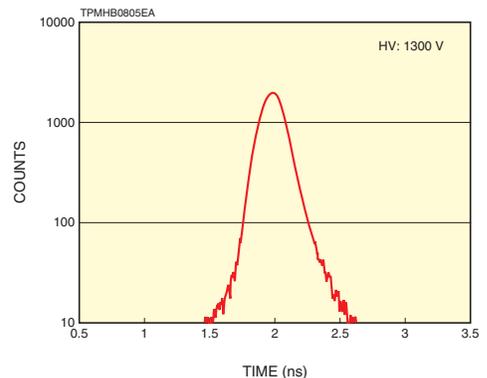
- TOF-PET in nuclear medicine
- TOF counter in HEP experiments
- Radiation monitor in security instruments

Parameter	R9800 / H10580	R9420 / H10828	R9779 / H10570	Unit
Diameter	25 mm (1 inch)	38 mm (1.5 inch)	51 mm (2 inch)	—
Spectral Response	300 to 650			nm
Photocathode	Bialkali			—
Gain	1.0 × 10 ⁶	5.0 × 10 ⁵		—
Supply Voltage	1300		1500	V
Rise Time	1.0	1.6	1.8	ns
T.T.S. (Transit Time Spread) (FWHM)	270	550	250	ps



Left: H10570, Center: H10828, Right: H10580

T.T.S. (R9800 / H10580)



ION / ELECTRON DETECTOR

NEW

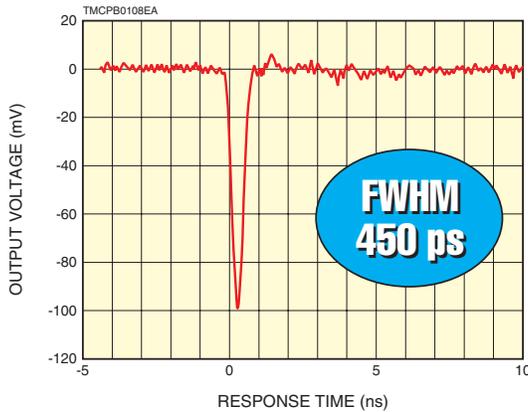
MCP ASSEMBLY F9890-32

High time resolution TOF-MS detector

FEATURES

- Fast time response: 450 ps Typ. (FWHM)
- Large effective area: $\phi 27$ mm
- High voltage floating operation: MCP-IN ± 10 kV
- Excellent MCP flatness: ± 10 μ m Typ.
- Small ringing
- Robust MCP

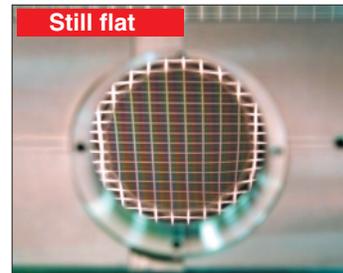
Typical Output Waveform



Effective area: $\phi 27$ mm
MCP channel diameter: 6 μ m
Number of MCP stages: 2
Gain: 1×10^6 (Min.) at 2.0 kV (MCP)

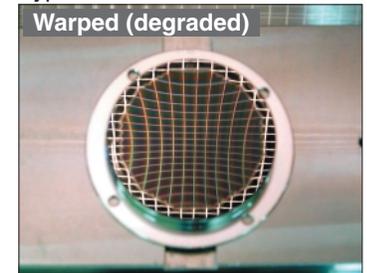
Robust MCP Inside

Robust MCP



After 120 days

Typical MCP



After 120 days

FLAME SENSOR

UVTRON[®] R9533, R9454

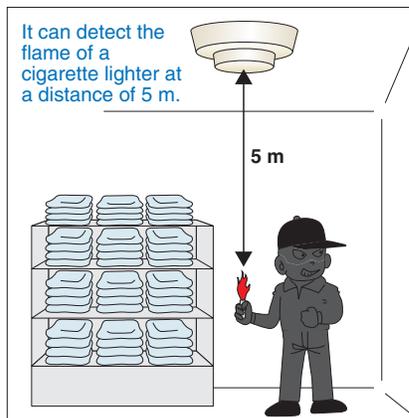
Quick detection of flame from a distance

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: 10000 min⁻¹, R9454: 4000 min⁻¹
- **Easy handling**
Head-on type R9533
- **Easy operation**
Driver circuit: C10423 for R9454
C10807 for R9533

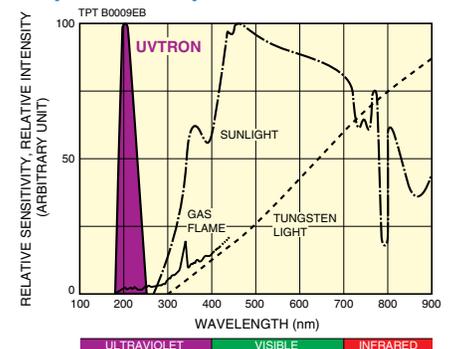
APPLICATIONS

- Flame detectors for gas/oil lighters and matches
- Combustion monitors for burners
- Detection of discharge (corona discharge of high voltage transmission lines, etc.)



Left: R9533, Right: R9454

Spectral Response

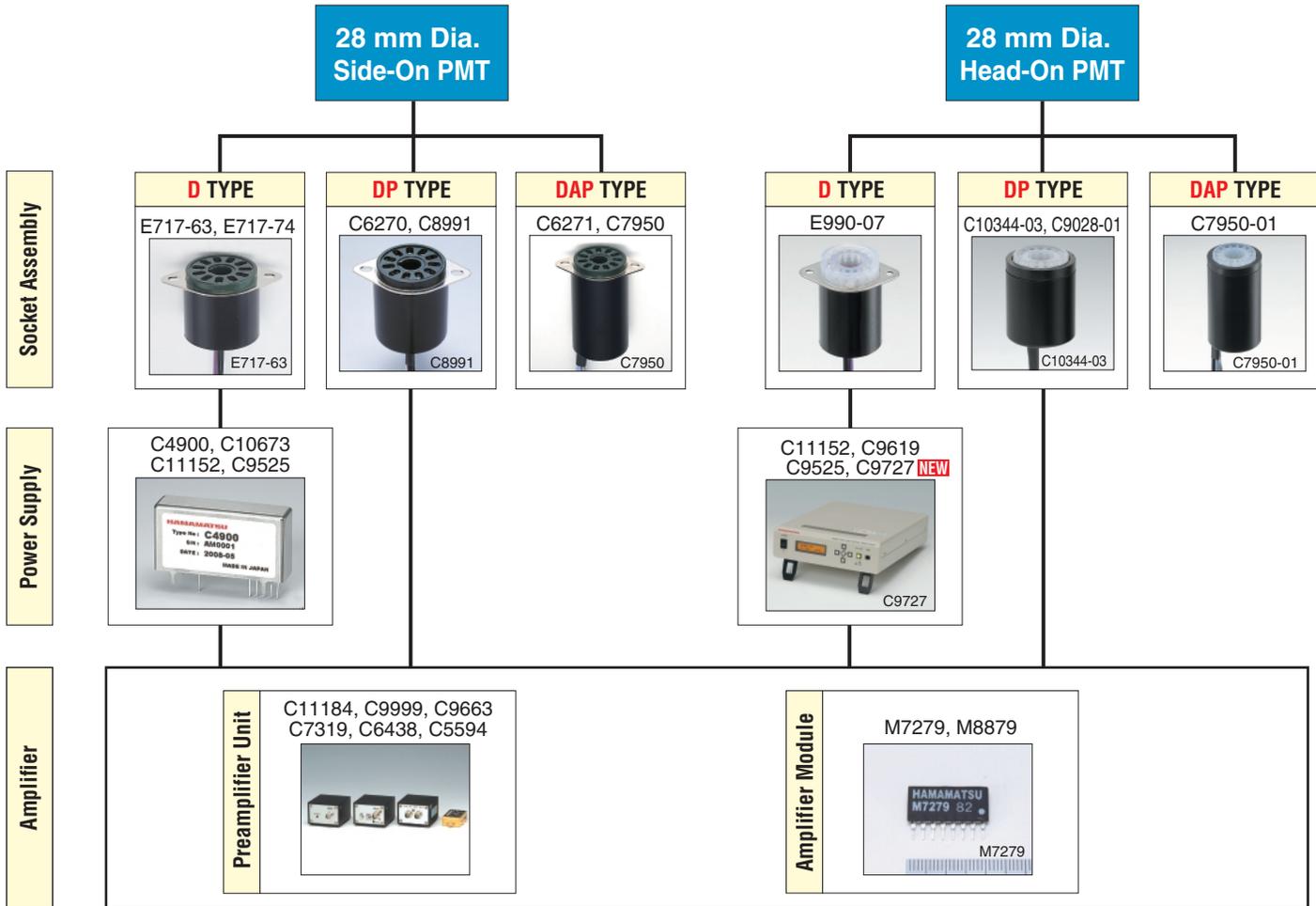


PMT PERIPHERAL PRODUCTS

ACCESSORIES

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

D...Voltage Divider **DP...Voltage Divider and HV Power Supply** **DAP...Voltage Divider, Amplifier and HV Power Supply**



NEW **COMPACT BENCH-TOP TYPE HIGH VOLTAGE POWER SUPPLY C9727**

Compact bench-top type multipurpose power supply capable of simultaneous outputs of ± 5 V, ± 15 V and high voltage

The C9727 series is a bench-top type multipurpose power supply incorporating a high voltage power supply (maximum output of +3500 V/-3500 V for a photomultiplier tube) and constant voltage power supplies (± 5 V and ± 15 V for peripheral devices such as Hamamatsu amplifier units and photon counting unit). The four-digit digital voltmeter on the front panel shows the output value of high voltage with high accuracy.

FEATURES

- Multiple outputs of ± 5 V, ± 15 V and high voltage (+3500 V, -3500 V)
- High stability
- USB control (Ver. 2.0)
- High voltage output current monitor



HIGH VOLTAGE POWER SUPPLY SERIES

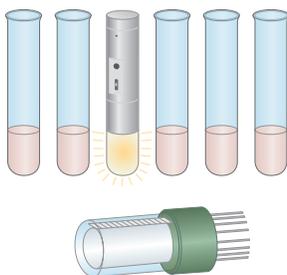
	Type No.	Output Voltage (Max.) (V)	Output Current (mA)	Input Voltage (V)	Ripple /Noise (p-p)	Stability		Size W × H × D (mm)	Note	
						Line (%)	Load (%)			
	C4900	—	-1250	0.6	+15	0.003 %	±0.01	±0.01	46 × 24 × 12	Standard HVPS for Side/Head-on PMT
		-01		0.5	+12					
		-50	+1250	0.6	+15					
		-51		0.5	+12					
	C10673	—	-1250	0.6	+15	0.003 %	±0.01	±0.01	46 × 24 × 12	UL Recognized
		-01		0.5	+12					
	C10764	—	-1250	1.0	+15	0.01 %	±0.01	±0.01	46 × 24 × 12	High Current Type of C4900
		-50								
	C9619	—	-2000	2.0	+15	0.003 %	±0.03	±0.03	65 × 15 × 45	Standard HVPS for Side/Head-on PMT
		-01			+12					
		-50	+2000		+15					
		-51			+12					
	C11152	—	-1500	1.0	+15	8 mVp-p	±0.01	±0.01	41 × 10 × 41	Low Ripple/Noise Monitor Out and Inhibit In
		-01			+12					
		-50	+1500		+15					
		-51			+12					
	C11323	-02	-1800	20	+24	40 mVp-p	±0.01	±0.01	98 × 27 × 52	High Current & High Stability HVPS for Multiple PMTs
		-52	+1800							

NEW

STABILIZED LIGHT SOURCES FOR PMT L11416, L11494

Accurate low-light-level measurement even at photon counting levels

The L11416 series is available in a package identical to test tubes for blood analyzers, and the L11494 series in a thin plate-like package used on sample stages in MTP readers, etc. Both LED light sources emit stable light even at photon counting levels, making them ideal for adjustment of PMT sensitivity.



TACCC0149EA



①L11494
②Photo sensor

TACCC0150EA



Left: L11494, Right: L11416

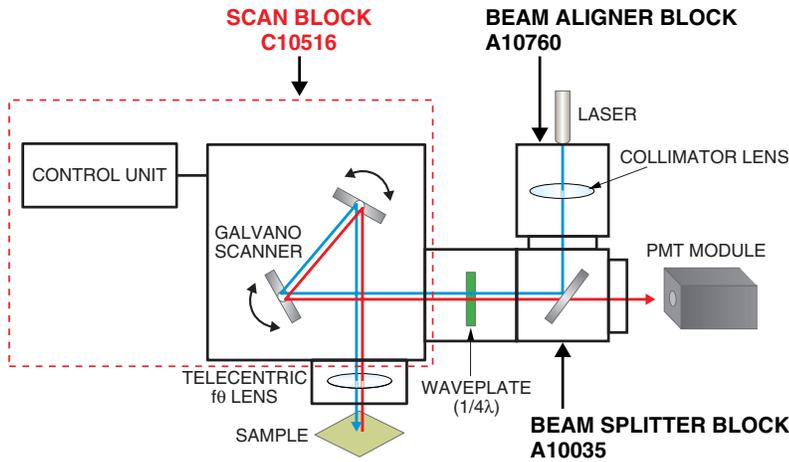
FEATURES

- High stability even at photon counting light levels
- Battery operation: 24 hours or more

PMT PERIPHERAL PRODUCTS

SCAN BLOCK C10516 (OPTICAL BLOCK)

Laser scanning measurement using PMT module and optical blocks



Left: Scan block, Right: Control unit

APPLICATIONS

- Laser scanning microscope
- Confocal laser scanning microscope
- Life science microscope
- Metallurgical microscopes
- DNA chip reader, protein chip reader

NEW

OPTICAL BLOCKS

Optical polarizer holder block A11026



- Adjustable the angular rotation of polarizing filters or wavelength plates.

Pinhole holder block A11027



- Position-adjustable in the XY direction

Beam splitter holder block A10035-90



- Interchangeable with a 15 mm cube beam splitter

Fiber adapter block A10037-10/A10037-11



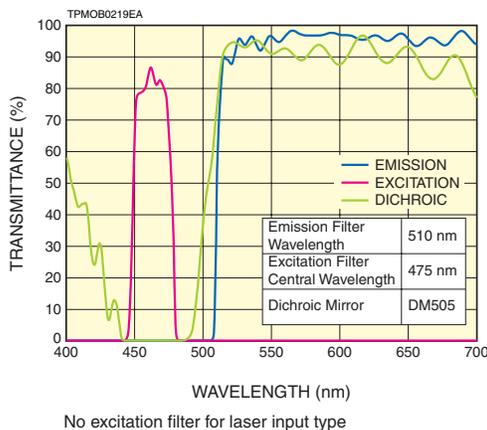
- Includes a quartz lens for UV light

Devlp.

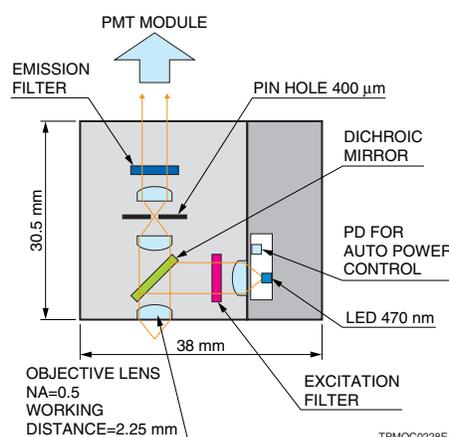
OPTICAL PICK UP A11417 SERIES, A11420 SERIES

Compact optical modules that have an excitation light source, excitation filter, dichroic mirror, objective lens, fluorescence filter, and pin hole, all integrated into a single case. A built-in LED type and a laser input type are available.

■ Transmittance for LED Type (A11417-470)



■ Structure of LED Type (A11417-470)



Left: LED type A11417, Right: Laser input type A11420

APPLICATIONS

LED type

- Real time PCR
- Environmental monitor

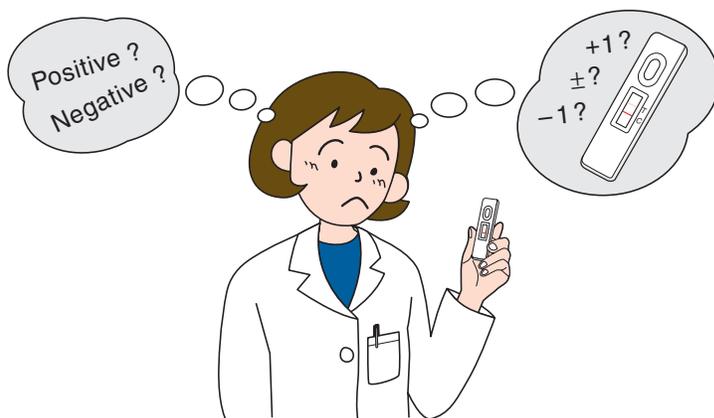
Laser input type

- Flow cytometry
- Biochip reader

IMMUNOCHROMATO READER C10066, C11666

Introducing a quantitative solution for the R&D and quality control of immunochromatography reagent kits

As an alternative to checking reagent kits by eye, the Immunochromato Reader offers a fast, reliable way to quantitatively measure the color intensities of reagent kits. This is especially useful with high-sensitivity reagent kits, where faint coloration can be difficult to check visually.



C10066 (PC is not included)



C11666 (Semi-automatic type)

FEATURES

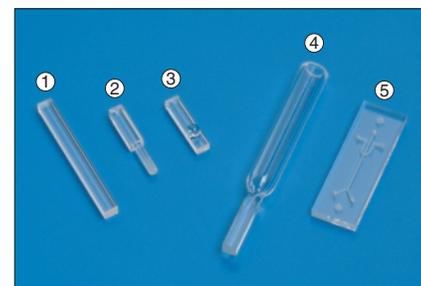
- Repeatable, high-sensitivity measurements
- Flexible with various reagent kits (C10066)
- Samples can be measured by time or by lot
- Includes color reference sample & software
- Two different labels (Blue / Red) can be measured
- Semi-automatic measurement of 30 samples (C11666)
- High-throughput measurement (C11666)

BIOMEDICAL PRODUCT

FLOW CELL FOR FLOW CYTOMETRY J11020 SERIES

APPLICATIONS

- Micro-flow path: Minimum 50 μm square
- Welding processing by hydrogen burner results in smooth laminar flow
- Inlet / outlet ports and shape can be custom-made
- Thin structure allows for close proximity to an objective lens: Allows using general-purpose objective lens and makes a sample clearer to view

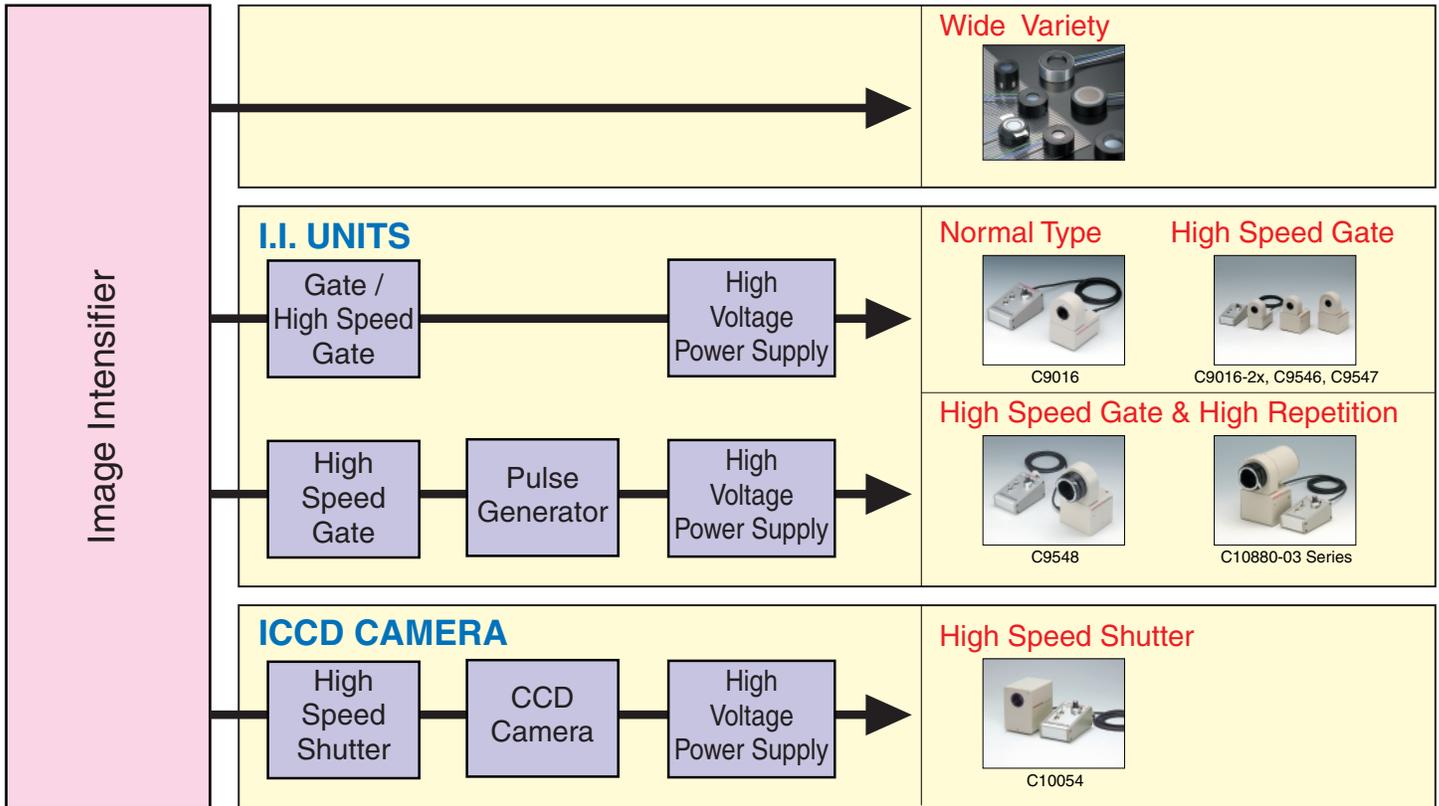


EXAMPLES

Shape Type	Photo No.	Material	Flow Channel Size (mm)	Features
Standard	①	Quartz	$\square 0.25 \pm 0.02$	Suitable flow channel for detecting minute particles.
Nipple	②			Standard type with nipple-type outlet.
With lens	③			Improved light condensing.
With chamber	④			Gas-processed chamber and orifice. Easy laminar flow.
Plate	⑤			Easy assembly, and suitable design for high detection and high throughput.
With holder	—		$\square 0.25 \pm 0.02$	Easy handling and maintenance to flow cytometer.

High sensitivity! QE 50 % at 530 nm (GaAsP)

SELECTION GUIDE



Devp. IMAGE INTENSIFIER WITH AUTO GATE FUNCTION

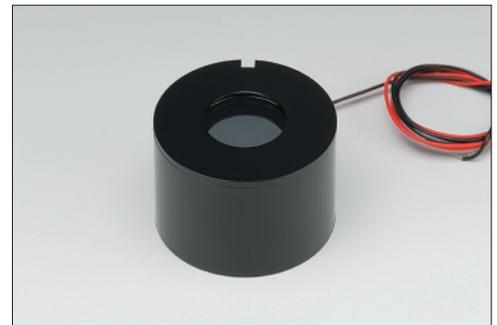
Image intensifier using a wrap-around power supply with internal auto gate function

FEATURES

- Wide dynamic range
- Resistant to excessive light
- Long service life

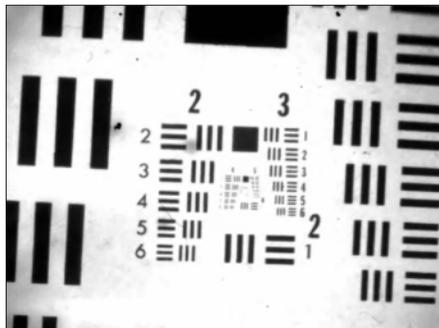
APPLICATIONS

- Security cameras
- Scientific measurement
- In-car cameras

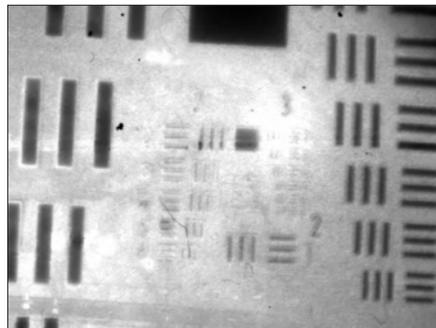


IMAGING EXAMPLE (at 1000 lx)

● With auto gate function



● Normal type

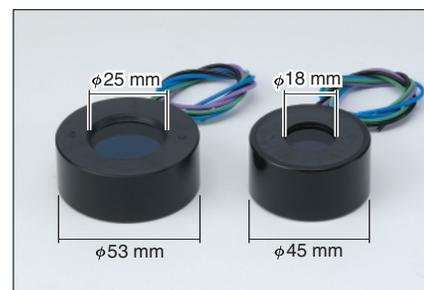


PROXIMITY FOCUSED IMAGE INTENSIFIERS

The 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). GaN will be available. This photocathode has higher sensitivity in UV region and good solar blind characteristic. Our Gen3 tubes can be used in various applications.

APPLICATIONS

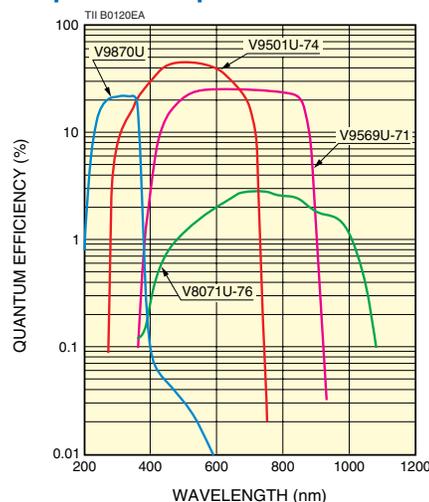
- Bio-imaging
- High speed shutter camera
- Time-resolved low light level imaging



Left: V9569U-71, Right: V8070U-74

Parameter	V9569U	V7090U	V9501U	V8070U	V8071U	Unit
Photocathode Material	GaAs		GaAsP		InGaAs	—
Photocathode Size	φ25	φ18	φ25	φ18		mm
Effective Area	16 × 16	13.5 × 10	16 × 16	13.5 × 10		mm
Suffix	Borosilicate Input	-71	-74	-73	-76	—
	FOP Input	—	-72	-75	—	—

Spectral Response



Parameter		V9870U	Unit
Photocathode Material		GaN	—
Photocathode Size		φ18	mm
Spectral Response		200 to 400	nm
Wavelength of Peak Response		250 to 350	nm
Photo-cathode	Radiant Sensitivity ^①	48.4	mA/W
	Quantum Efficiency ^①	20	%
Effective Area		13.5 × 10	mm
Radiant Emittance Gain ^②		2.4 × 10 ⁶	(W/m ²)/(W/m ²)
Limiting Resolution		22	Lp/mm

① At the wavelength of peak response

② In the case of 2 stages of MCP

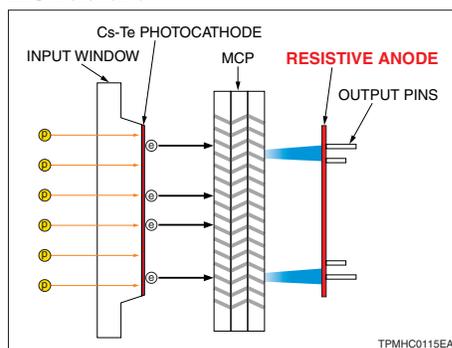
RESISTIVE ANODE MCP-PMT R10110U-03

High speed position detection at photon counting levels

FEATURES

- Resistive anode
high spatial resolution,
good time resolution (1 ns)
and minimum dead area
- Single photon detection
- High sensitivity in UV region
- Solar blind characteristic

Structure



APPLICATIONS

- LIDAR
(light detection and ranging)
- Astronomical observation
- UV flame detection

Parameter	R10110U-03	Unit
Spectral Response	160 to 320	nm
Wavelength of Peak Response	250	nm
Photocathode	Radiant Sensitivity ^①	30
	Quantum Efficiency ^①	15
Gain	2-stage MCP	3 × 10 ⁵
	3-stage MCP	3 × 10 ⁶
	5-stage MCP	5 × 10 ⁷
Anode Dark Counts at +25 °C	10	s ⁻¹
Effective Area	10 × 10	mm

① At the wavelength of peak response

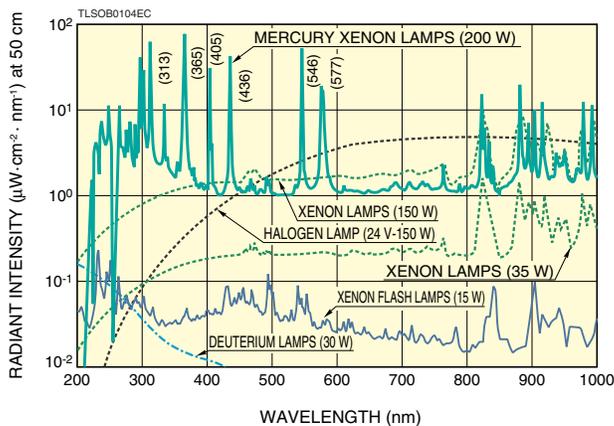
SELECTION GUIDE

Lamp Type	Spectral Distribution (nm)	Lamp Rating (W)	Output Stability Fluctuation p-p (%)	Life (h)	Related Products	Calibrated Light Source	
Xenon Lamp 	185 to 2000	35 to 300	0.2 Typ.	1000 to 3000	Lamp Housing  Power Supply  Spot Light Source  Xenon Short Arc Reflection Lamp  (See page 28)	Calibrated Xenon Lamp Light Source 	
Xenon Flash Lamp 	160 to 2000	5 to 60	Less than 3	400 ^① to 5000	Trigger Socket  Shield Box  Power Supply  Xenon Flash Lamp Module  Flash Light Source  (See page 25) (See page 26)		
Mercury Xenon Lamp 	185 to 2000	50 to 500	0.5 Typ.	500 to 2000	Lamp Housing  Power Supply  Spot Light Source  (See page 28)		
Dev. H2D2 Lamp (High Brightness High End Deuterium Lamp) 	115 to 400	100	0.05 Typ.	1000			
X2D2 Lamp (High Brightness) L2D2 Lamp (Long Life) 	115 to 400	30	0.005 Typ.	2000, 4000	Lamp Housing  Power Supply  UV-VIS Fiber Light Source  VUV Light Source Unit  (See page 31)	Calibrated Deuterium Lamp Light Source 	
S2D2 Lamp^② (Stable and Small Deuterium Lamp) 	115 to 400	5 to 7	0.005 Typ.	800, 1000	S2D2 Module  (See page 24)	S2D2 UV-VIS Fiber Light Source  (See page 24)	S2D2 VUV Light Source Unit  (See page 31)

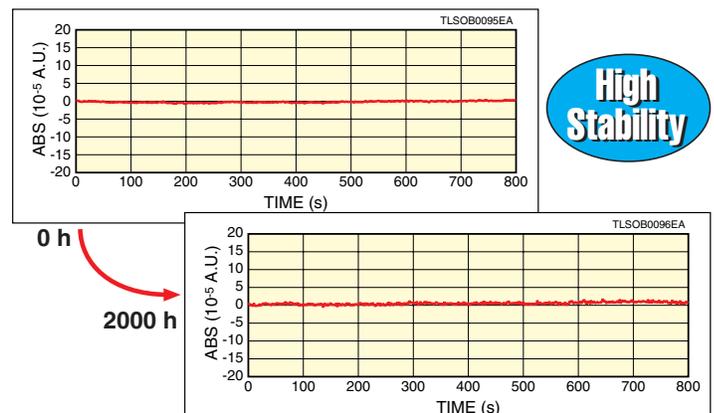
① Depends on the repetition rate.

② Single lamps are only sold as light source replacement parts.

Radiant Spectral Distribution



Light Output Stability (Deuterium Lamp)



Devip.

H2D2 (HIGH BRIGHTNESS, HIGH END DEUTERIUM) LAMP

The H2D2 lamp is a high-brightness deuterium lamp that emits UV light at a brightness 6 times higher than ordinary lamps (in-house comparison of our L2D2 lamps with 0.5 mm aperture). Even with 6 times higher brightness, H2D2 lamps deliver high stability (0.05 % p-p) and long life (1000 hours). They need only natural air cooling when used in a dedicated housing. Hamamatsu provides MgF₂ and synthetic silica windows to expand usability to a wide range of applications.

FEATURES

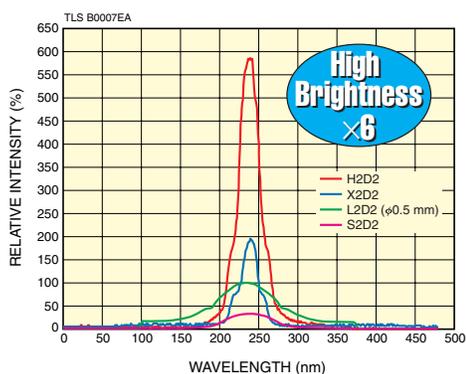
- High brightness: 6 times higher than L2D2 lamp with 0.5 mm aperture
- High stability: 0.05 % p-p
- Long life

APPLICATIONS

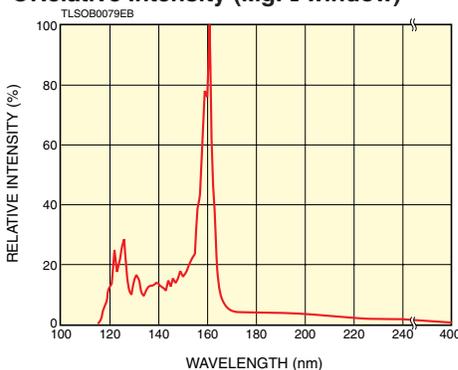
- Spectrophotometry
- Semiconductor inspection
- Environmental analysis
- Film thickness measurement
- Electrostatic remover



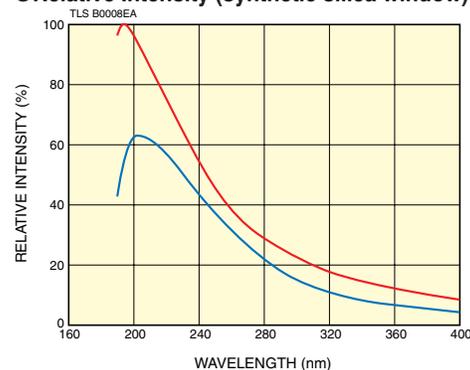
Spectral Distribution



Relative Intensity (MgF₂ window)

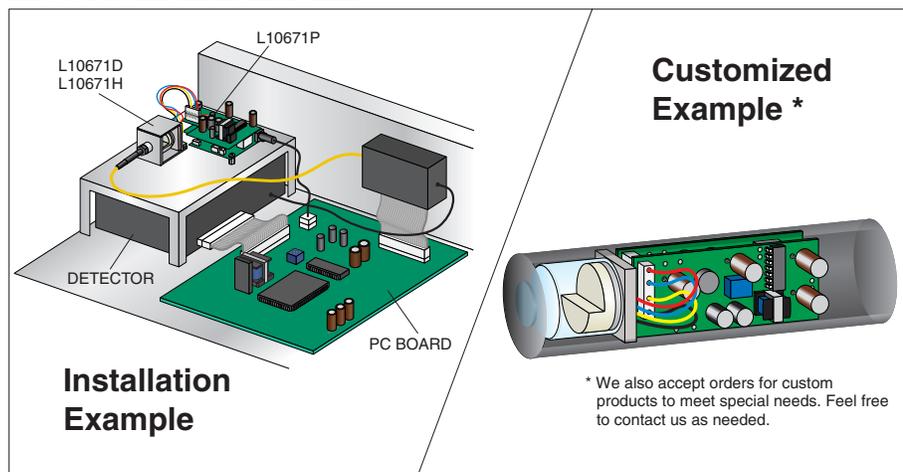


Relative Intensity (synthetic silica window)



S2D2 (STABLE AND SMALL DEUTERIUM) LAMP SERIES

USAGE EXAMPLE



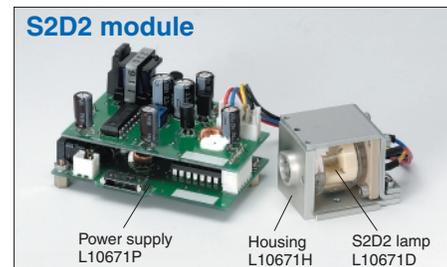
Left: S2D2 lamp, Right: L2D2 lamp

FEATURES

- High stability: 0.004 % p-p Typ. (Equivalent to 2×10^{-5} A.U.)
- Continuous line spectra from UV to IR
- Low power consumption (all-in-one)

APPLICATIONS

- Spectrophotometry
- Environmental measurement
- Pharmaceutical testing
- High performance liquid chromatography
- Film thickness measurement



Light guide is sold separately.

COMPACT 5 W XENON FLASH LAMP MODULES

Hamamatsu offers compact xenon flash lamp modules containing a 5 W xenon flash lamp along with its power supply and trigger socket. Up to 5 W of energy can be input, which is the maximum among lamp modules of this size. These xenon flash lamp modules also deliver high stability and long service life, making them ideal as a light source for water quality and atmosphere analyzers.

TYPE NUMBER GUIDE

L9455 - **0** **1** - **0** **1** **1**
 ① ② ③ ⑤ ⑥ ⑦

L11316 - **0** **2** - **0** **1**
 ① ② ④ ⑤ ⑥ ⑦*

* ⑤⑥ and ⑦ are omitted in case of "0"

① Type No.

Type No.	Arc size	Type	Maximum input
L9455	1.5 mm	Side-on	50 mJ
L9456	3.0 mm		
L11035	1.5 mm	Head-on	50 mJ
L11036	3.0 mm		
L11316	1.5 mm	High output	100 mJ
L11317	3.0 mm		

* Type with an arc size of 3.0 mm are not available as a module ② with an SMA fiber adapter.

② Module types

Suffix	Type
0	Standard
1	SMA fiber adapter
2*	Silent
4*	High precision

*: Made to order

③ Main discharge capacitance (L9455/L9456/L11035/L11036)

Suffix	Capacitance
1	0.22 μF
2	0.11 μF
3	0.047 μF
4	0.28 μF

④ Main discharge capacitance (L11316/L11317)

Suffix	Capacitance
1	0.2 μF
2	0.1 μF

⑤ Lamp window material

Suffix	Window material (emission spectral range)
0	UV glass (185 nm to 2000 nm)
1*	Borosilicate glass (280 nm to 2000 nm)
2*	Synthetic silica (160 nm to 2000 nm)

*: Made to order

⑥ EMC noise filter

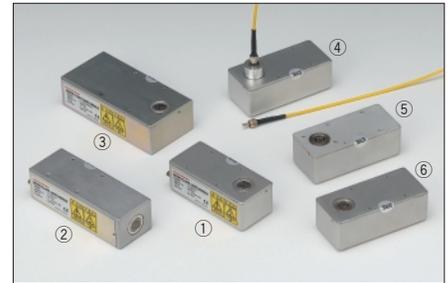
Suffix	Noise filter
0	Not included
1*	Included

*: Made to order

⑦ Lamp electrode angle (with respect to longitudinal direction of package)

Suffix	Electrode angle
0	0° (vertical)
1*	90° (horizontal)

*: Made to order



- ①: L9455/L9456 series (side-on type)
 - ②: L11035/L11036 series (head-on type)
 - ③: L11316/L11317 series (high output type)
 - ④: L9455/L9456 series (SMA fiber adapter type)
 - ⑤: L9455/L9456 series (high precision type)
 - ⑥: L9455/L9456 series (silent type)
- * SMA fiber is optional (sold separately).

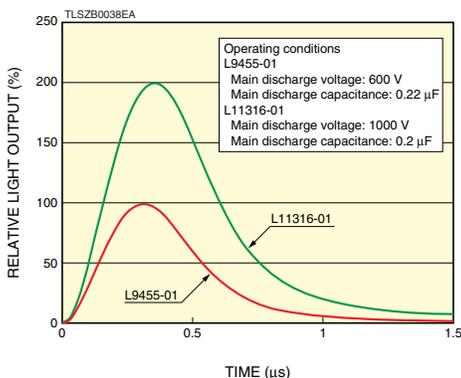
FEATURES

- **High stability:**
1.5 % CV or less
- **Long life:**
1 × 10⁹ flashes or more
- **Compact size**
- **Repetitive emission frequency:**
530 Hz Max.
- **Broad radiant spectrum:**
Covers from UV to near IR
- **Silent type:**
Audible noise reduced to 1/10 or less
- **High precision type:**
±0.05 mm precision

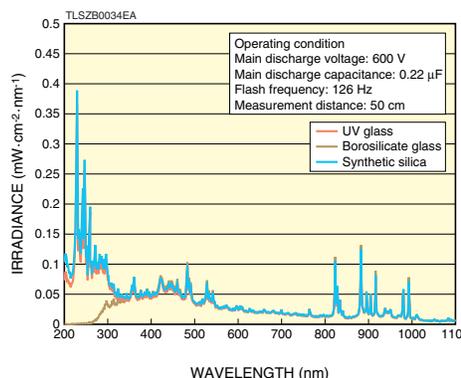
APPLICATIONS

- Blood analyzers
- Air pollution analysis
- Microplate readers
- Semiconductor inspection
- Laboratory testing
- Water quality and pollution analysis

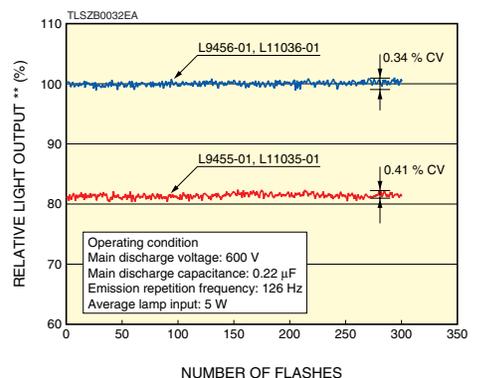
Emission Pulse Waveform



Emission Spectrum (L9455-01 series)



Light Output Stability* (typical initial value)



* Light output stability (% CV)
 = light output standard deviation / average light output × 100
 ** Output value with average light output of L9456-01 set to 100 %.

FLASH LIGHT SOURCE LIGHTNINGFLASH™ LF1

Ideal for strobe light source!
Irradiates high power pulsed light to any desired area!

The LF1 integrates a 40 W xenon flash lamp, power supply, control circuit, and focusing mirror into one package. The LF1 also yields high luminance, 6 times higher than our conventional light source products, making it an ideal tool for camera flash light sources used in various types of inspections.

By choosing a light guide and irradiation control program, high-power and high-luminance pulsed light can be irradiated onto an object or device under test at the optimal conditions for a wide variety of inspection processes.



Light guide is sold separately.

FEATURES

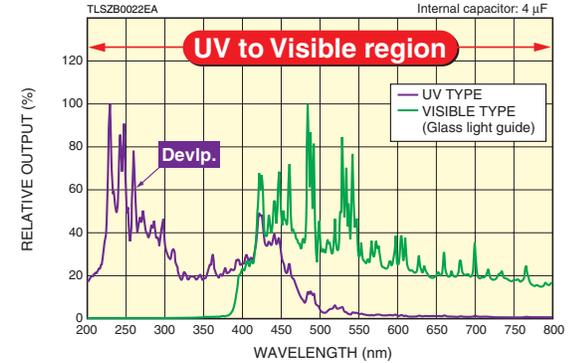
- Long life: 1×10^8 flashes
- Cassette type lamp: Easy lamp replacement, no optical axis alignment required
- Can be synchronized with CCD camera: External trigger emission

APPLICATIONS

- Flash light sources for various inspection cameras (Example: Macro-inspections in semiconductor manufacturing processes)

Parameter	Value
Maximum Lamp Input Power	40 W
Maximum Lamp Input Energy	1.28 J (per flash)
Maximum Emission Frequency	70 Hz (Internal capacitor: 1 μ F)

Spectral Distribution

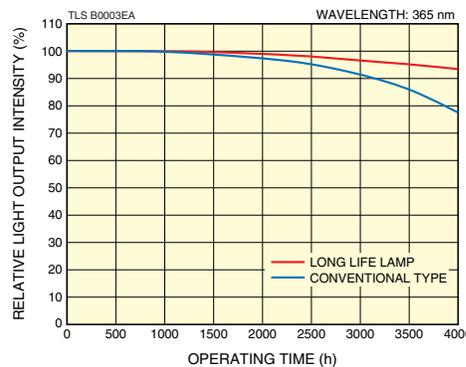
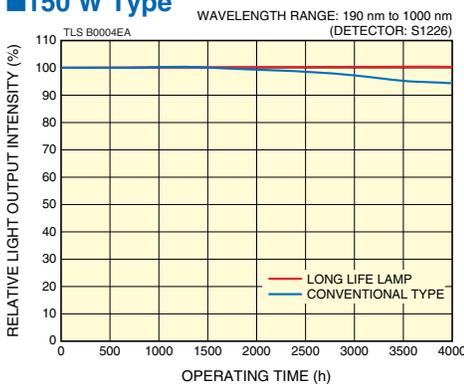


NEW

LONG LIFE XENON LAMP L11033, L11034

Reduce time-consuming maintenance tasks such as lamp replacement and lamp position alignment

150 W Type



L11033

FEATURES

- Long life: About 1.7 times as long as conventional type (150 W)
- High stability: Fluctuation 0.2 % p-p Typ. Drift ± 0.5 %/h Typ.

LINEUP

Type No.	Lamp Rating (W)	Window Material	Transmission Wavelength (nm)	Guaranteed Operation Life* (h)	Average Life (h)	Metal Base	
						Anode (mm)	Cathode (mm)
L11033	150	Fused Silica	185 to 2000	3000	4000	$\phi 12$	$\phi 12$
L11034		Ozone-free Silica	240 to 2000				

* The life end is defined as the time at which the radiant intensity falls to 50 % of its initial value or when the output fluctuation exceeds 1.0 %.

APPLICATIONS

- Semiconductor inspection
- Spectrophotometer
- Microscopy
- Scanner

NEW

LINEAR IRRADIATION TYPE UV-LED UNIT LIGHTNINGCURE™ LC-L5

Breaking all the old limits on product line irradiation work using UV lamps!
A whole new generation of light sources is on the scene!

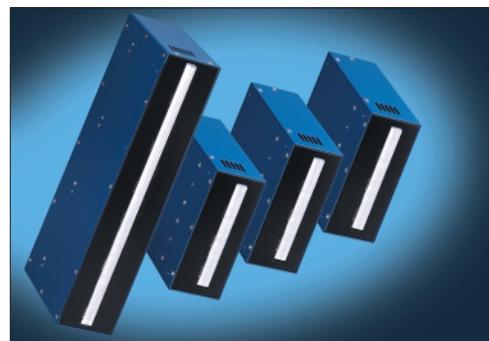
SPECIFICATIONS

Parameter	L11403-1104	L11403-2104	L11403-1112	L11403-2112	Unit
Illumination Area ①	105 × 10		305 × 10		mm
UV Irradiation Intensity ②	1000	1200	1000	1200	mW/cm ²
Peak Wavelength	365 ± 5	385 ± 5	365 ± 5	385 ± 5	nm

NOTE: ① Area subject to at least 80% irradiation intensity at distance of 2 mm

② 5 minutes after lamp ON at distance of 2 mm within irradiation area

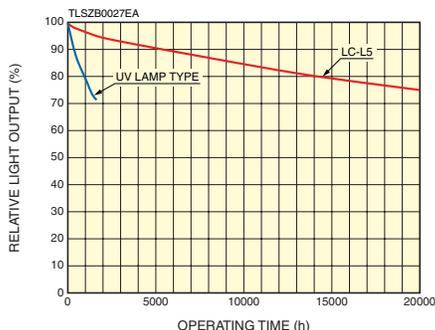
* Feel free to consult us about any custom specifications you might need.



FEATURES

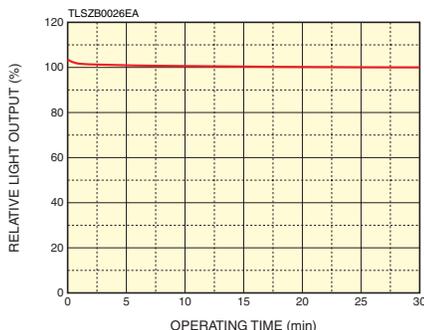
- No duct installation or chiller equipment needed
- Huge cuts in maintenance costs
- Greater freedom in component layout and no worries about space
- Reduced environmental impact
- Long service life and huge cut in running costs

Service Life Characteristics



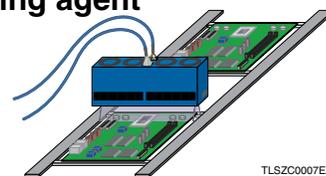
Stable output accuracy

Drift Characteristics



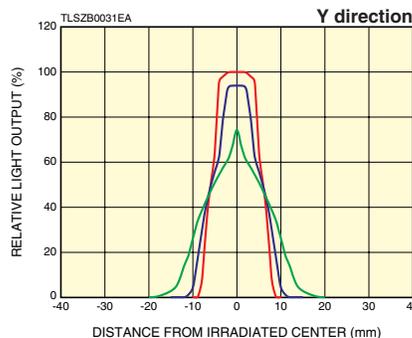
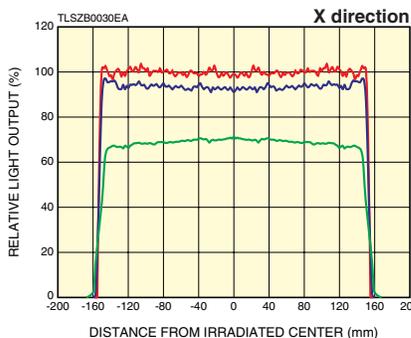
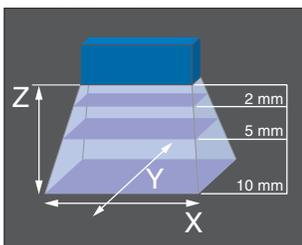
APPLICATIONS

- UV ink drying
- UV coating agent drying
- UV tape peeling
- UV curing
- Fluorescence excitation / Scratch & flaw inspection lighting



Uniform UV irradiation over a wide range

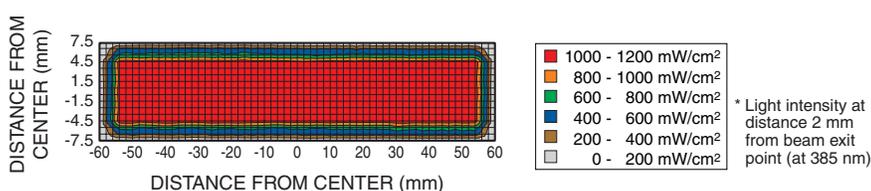
Irradiated Area



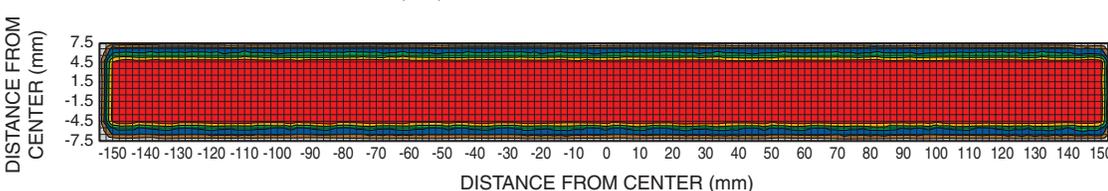
Z: Distance from beam exit point
 — Z=2 mm
 — Z=5 mm
 — Z=10 mm

Irradiation Intensity Distribution (typical example)

L11403-2104



L11403-2112



* Light intensity at distance 2 mm from beam exit point (at 385 nm)

TLSZB0029EA

TLSZB0028EA

UV-LED MODULE LIGHTNINGCURE™ LC-L2

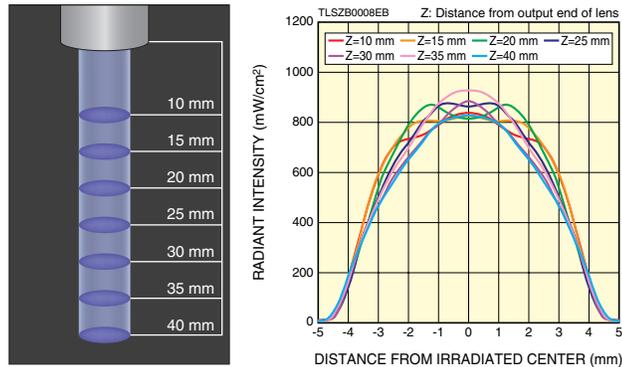
Space-saving design reduces the cubic volume by up to 98 %!



FEATURES

- Minimal thermal effects
- No fan: Can be operated in a clean room
- Low power consumption (8 W): Saves energy
- External control to meet every need: MIL connectors, RS-232C and terminal block
- Various types of irradiation patterns

EX: Collimate Type L10906-101



APPLICATIONS

- UV curing
- UV irradiation experiments

UV-LED UNIT LIGHTNINGCURE™ LC-L3

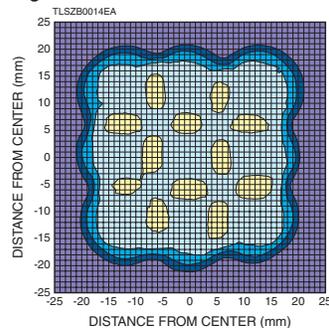
UV-LED light source unit for irradiating a large area or linear areas



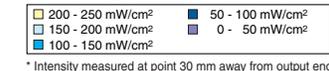
FEATURES

- Uses a high output UV-LED (365 nm or 385 nm)
- Long life and high stability
- Highly uniform irradiation via our dedicated optical system

Uniform Irradiation Type – Full Irradiation:
Light level 100 % at 365 nm

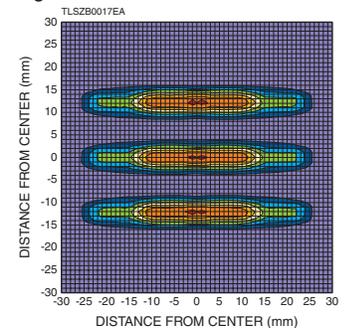


* Large area irradiation type is also available. Please contact us for information.

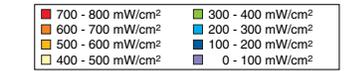


* Intensity measured at point 30 mm away from output end

Linear Beam Type:
Light level 100 % at 365 nm



* Intensity measured at point 15 mm away from output end



* Intensity measured at point 15 mm away from output end

APPLICATIONS

- UV curing
- UV ink drying
- Semiconductor and liquid crystal exposure
- High-resolution optical microscopes
- Wide range of experiments requiring UV irradiation

SPOT LIGHT SOURCE LIGHTNINGCURE™ LC8

Operate it from your PC via RS-232C port

FEATURES

- Long life: 4000 h guaranteed
- Light intensity monitor with internal optical feedback function (option: sold separately)
- Easy lamp replacement
- Selectable positions of light guide port
- CE marking compliance
- Instantaneous power-outage response
- Memory Step™ for 9-type 7-step programs

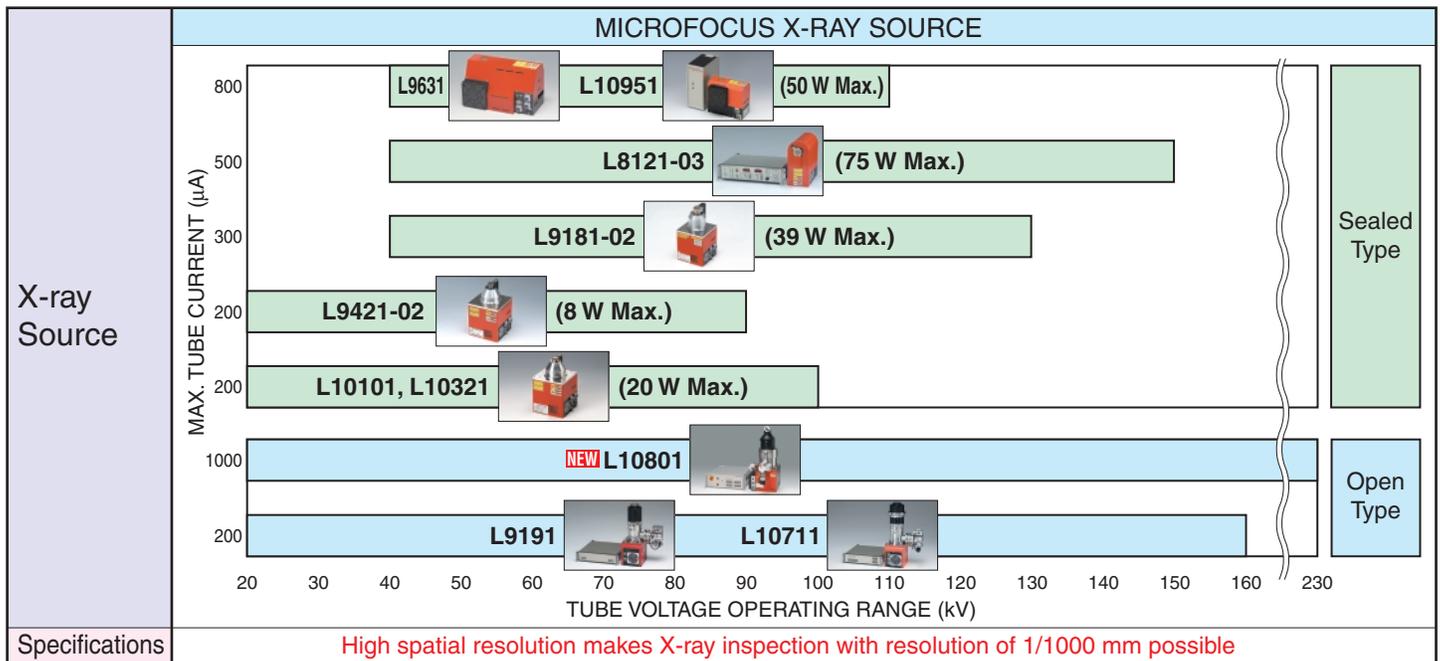
APPLICATIONS

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



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

SELECTION GUIDE



	CAMERA	DEVICE	SCINTILLATOR	
X-ray Detector	X-RAY I.I. DIGITAL CAMERA UNIT C7336-03/-04  (See page 30)	NEW COMPACT X-RAY CCD CAMERA X-CUBE™ C11660 	ENERGY DIFFERENTIATION TYPE 64 CH CdTe RADIATION LINE SENSOR C10413 	ACS® / ALS® / FOS®  FOS (See page 30)
Specifications	Digital output: Camera Link compliance, high resolution, high contrast	X-ray imaging as easy as handling ordinary CCD cameras	X-ray and gamma-ray imaging with featured energy differentiation (multicolor)	Next generation of large format X-ray imaging device series

MICROFOCUS X-RAY SOURCE

Type No.	Tube Voltage Setting Range (kV)	Focal Spot Size (µm)	Min. FOD ^② (mm)
L9421-02	20 to 90	5	9.5
L10101	20 to 100		6.8
L10321			7.3
L9631	40 to 110	15	16.8
L10951			
L9181-02	40 to 130	5	13
L8121-03	40 to 150		17
L9191	20 to 160	1 ^①	0.5
L10711		0.25 ^①	
NEW L10801		4 ^①	



L10801

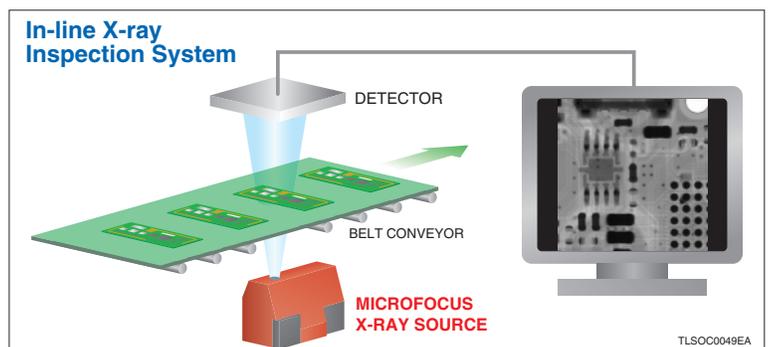
① Minimum resolution ② FOD is Focus to Object Distance

APPLICATIONS

- Non-destructive inspection
- X-ray CT
- In-line X-ray inspection

[Applicable objects]

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



TL50C0049EA

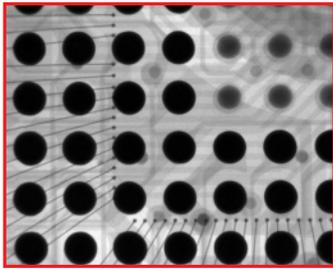
X-RAY IMAGE INTENSIFIER DIGITAL CAMERA UNIT C7336-03/-04

1.45 megapixel digital camera

IMAGING EXAMPLES (Sample: BGA)

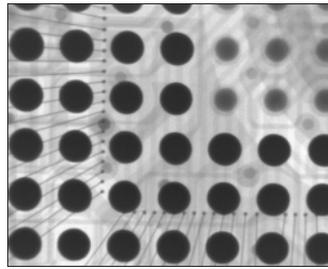
Clear and Sharp

Digital type C7336-03



X-ray tube voltage: 80 kV

Analog type



X-ray tube voltage: 80 kV



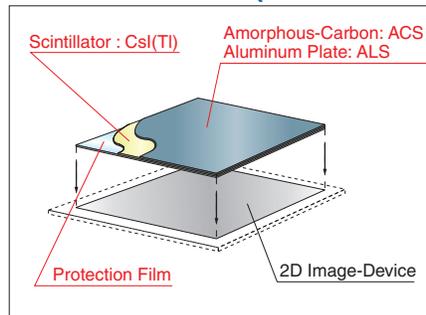
Parameter	C7336-03	C7336-04
Frame Rate	24 frames/s	12 frames/s
Signal Output	10 bit Camera Link	12 bit Camera Link

X-RAY SCINTILLATOR ACS® / ALS® / FOS®

FEATURES

- **Large format**
- **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)

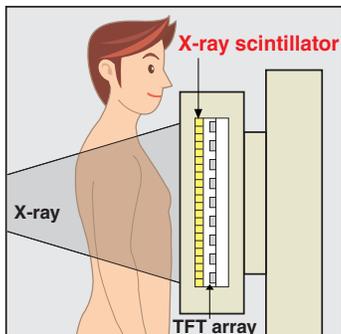
STRUCTURE (ACS / ALS)



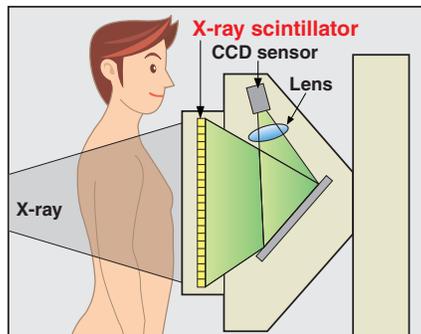
Product Name	Structure	Dimension			Scintillator Thickness (μm)	Features	Applications
		Scintillator Effective Area (mm)		Substrate Thickness (mm)			
		Max.	Min.				
ACS	Amorphous-Carbon Plate with CsI Scintillator	468 × 468 (17" × 17")	14 × 14	0.5 or 2	600 Max.	High resolution, Large format	Dental intraoral, Mammography, Chest examination
ALS	Aluminum Plate with CsI Scintillator	468 × 468 (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

APPLICATION EXAMPLE

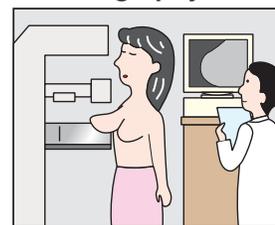
Chest examination
FPD-DR



CCD-DR



Mammography



Dental examination

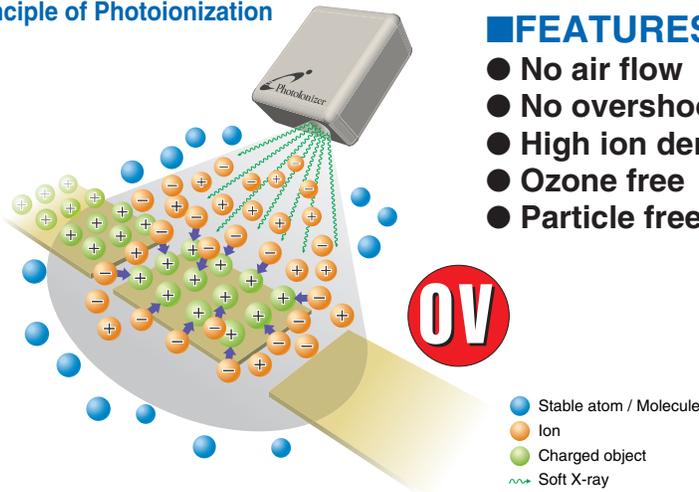


ELECTROSTATIC REMOVER SERIES

Removal of static electricity in air

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

■ Principle of Photoionization



■ FEATURES

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



Left: HEAD L9491 (4 pcs), Right: Controller C9991

■ LINEUP

● Photolonizer L9490 (Basic type)

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

● Multiple Four-Head Type Photolonizer Controller C9991

The C9991 can operate four Photolonizer heads (L9491: sold separately) in parallel. It is convenient for the customer who needs to synchronize them.

■ APPLICATIONS

- Packing of powdered product
- High speed moving objects (film, printed matter, etc.)
- IC / LCD / PDP process line
- Large size glass plate product
- PCB mounting, chip mounter
- Plastic component molding process

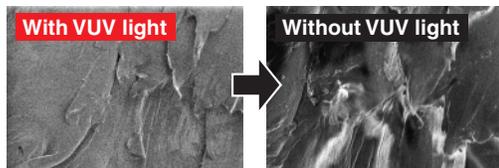
VUV LIGHT SOURCE UNIT SERIES

Removal of static electricity under depressurized conditions

■ Effect of VUV Light

SEM Image (Sample: Polyvinylidene-fluoride)

When the VUV light is radiated, the electrostatic charge is neutralized.



L10706

(built-in S2D2 lamp)



L10366

(built-in X2D2 lamp)

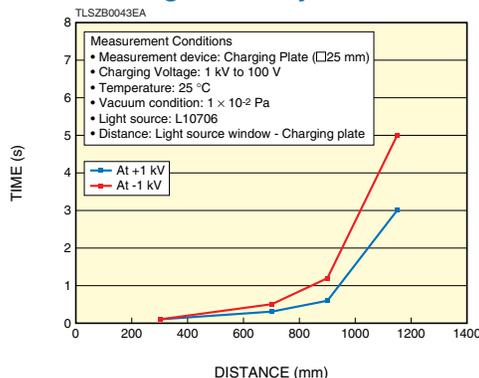


L1835

(150 W D2 lamp)



■ Neutralizing Efficiency



■ FEATURES

- No air flow
- No overshooting
- Particle free
- Proximity irradiation (L10706)

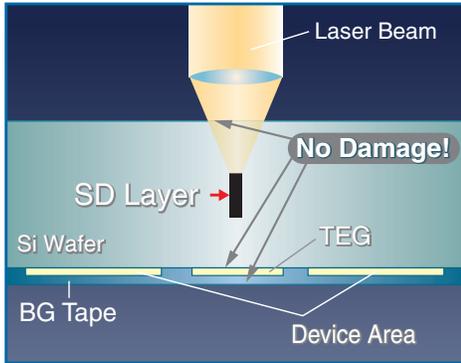
■ APPLICATIONS

- Electrostatic remover
- VUV spectrophotometer
- Photoionization
- UV resistance testing of various materials
- Excitation light source

STEALTH DICING™ TECHNOLOGY

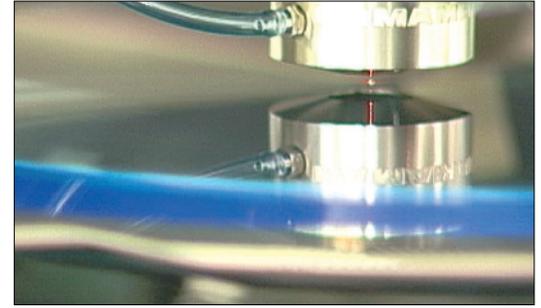
Laser dicing technology with a completely dry process

Stealth Dicing (SD) is capable of dividing the wafer from the inside of the silicon wafer. The laser is irradiated at any desired depth to create the modified layer (SD layer). With an external force such as tape expansion, the cracks inside the silicon wafer extend to the surface level and divide the wafer without the cutting loss.



FEATURES

- Completely dry process
- Particle free
- No chipping
- Zero cutting loss



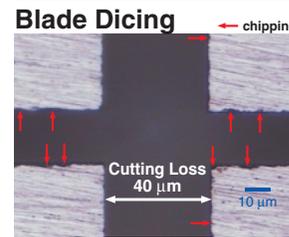
APPLICABLE DEVICE

- MEMS
- Si wafer
 - Si (5 μm to 775 μm)
 - SOI
- Glass wafer
- Glass-silicon bonded wafer
- Compound semiconductor wafer
 - GaAs / InP / GaN
 - SiC
- Sapphire wafer

Cutting Surface Comparison (Before Tape Expansion)



Si wafer thickness: 50 μm
Dicing speed: 300 mm/s



Si wafer thickness: 50 μm
Dicing speed: 50 mm/s

Allows glass-silicon wafers to be easily separated into chips by tape expansion only

Si-Si [Room Temperature Bonding]

Sample components
Si : 400 μm × 2

Process flow

- Through transparent DC tape backside dicing
- Wafer is inverted and is diced from the front side
- Separation into chips by tape expansion

Cutting results

Intersection point

No chipping

Diced cross-section

Si Thickness: 400 μm

Si Thickness: 400 μm

Good process quality because no mechanical break process is required.

Glass-Si [Resin bonding]

Sample components

Glass : 400 μm
Resin layer: 50 μm
Si : 100 μm

Process flow

- Laser process (Si)
- Tape remount
- Laser process (Glass)
- Separation into chips by tape expansion

Cutting results

Intersection point

No chipping

Diced cross-section

Glass t: 400 μm

Resin layer t: 50 μm

Si t: 100 μm

Good process quality because no mechanical break process is required.

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Main Products

Electron Tubes

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

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APD
Photo IC
Image sensors
PSD
Infrared detectors
LED
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Automotive devices
X-ray flat panel sensors
Mini-spectrometers
Opto-semiconductor modules

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FPD / LED Characteristic Evaluation Systems
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