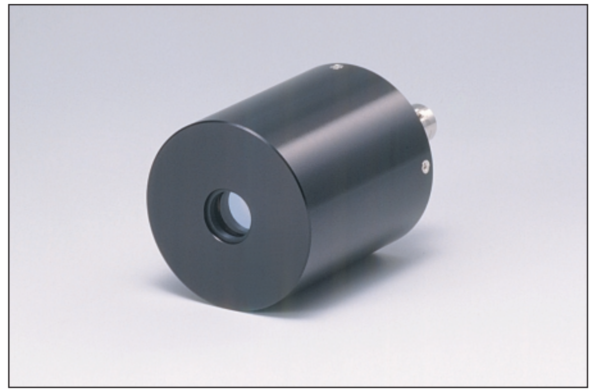
MICROCHANNEL PLATE-PHOTOMULTIPLIER TUBE (MCP-PMTs)

R3809U-50 SERIES

Compact MCP-PMT Series Featuring Variety of Spectral Response with Fast Time Response



FEATURES

- ●High Speed
  Rise Time: 150 ps
  TTS (Transit Time Spread)Ⓐ: ≦25 ps (FWHM)
- ●Low Noise
- ●Compact Profile
  Useful Photocathode: 11 mm diameter
  (Overall length: 70.2 mm Outer diameter: 45.0 mm)

APPLICATIONS

- ●Molecular Science
  Analysis of Molecular Structure
- ●Medical Science
  Optical Computer Tomography
- ●Biochemistry
  Fast Gene Sequencing
- ●Material Engineering
  Semiconductor Analysis
  Crystal Research

Figure 1: Spectral Response Characteristics

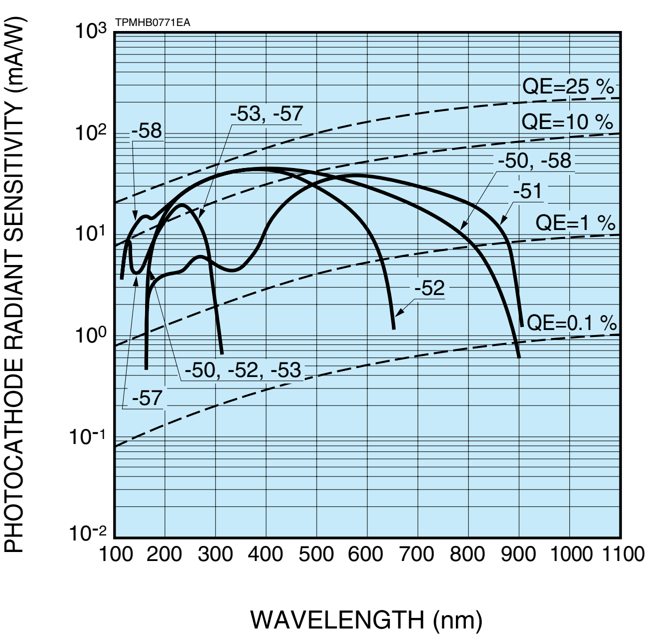


Figure 2: Transit Time Spread

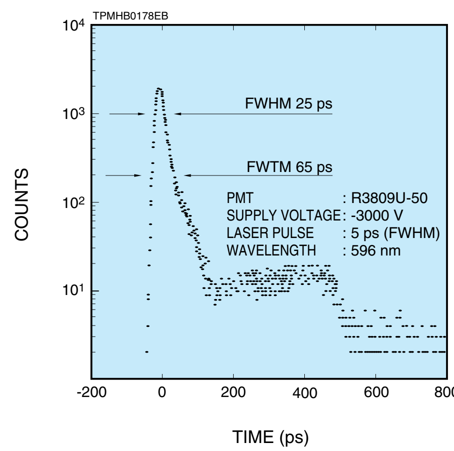
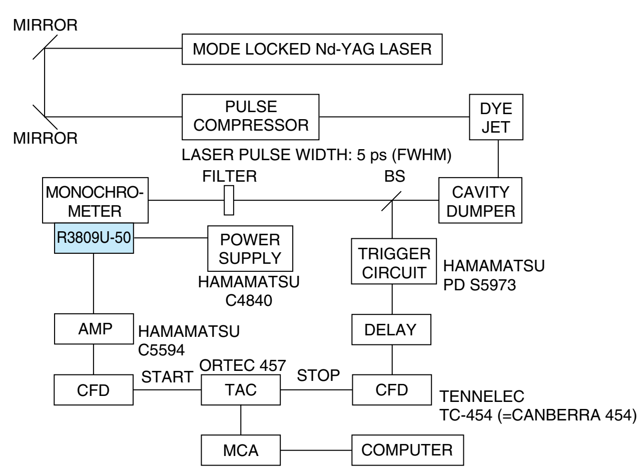


Figure 3: Block Diagram of TTS Mesuring System



TPMHC0078ED

SPECIFICATIONS

PHOTOCATHODE SELECTION GUIDE

Suffix Number	Spectral Response (nm)		Photocathode Material	Window Material
	Range	Peek Wavelength		
50	160 to 850	430	Multialkali	Synthetic Silica
51	160 to 910	600	Extended Red Multialkali	Synthetic Silica
52	160 to 650	400	Bialkali	Synthetic Silica
53	160 to 320	230	Cs-Te	Synthetic Silica
57	115 to 320	230	Cs-Te	MgF_2
58	115 to 850	430	Multialkali	MgF_2

GENERAL

Parameter	Description / Value	Unit
Photocathode Useful Area in Diameter	11	mm
MCP Channel Diameter	6	µm
Dynode Structure Ⓑ	2-Stage Filmed MCP	—
Capacitance Between Anode and MCP out	3	pF
Weight	98	g
Operating Ambient Temperature Ⓒ	-50 to +50	°C
Storage Temperature	-50 to +50	°C

MAXIMUM RATINGS (Absolute Maximum Values)

Parameter	Value	Unit
Supply Voltage	-3400	V
Average Anode Current	100	nA
Pulsed Peak Current Ⓓ	350	mA

ELECTRICAL CHARACTERISTICS (R3809U-50) at 25 °C Ⓔ

Parameter		Min.	Typ.	Max.	Unit
Cathode Sensitivity	Luminous Ⓕ	100	150	—	µA/lm
	Radiant at 430 nm	—	50	—	mA/W
Gain at -3000 V		1×10^5	2×10^5	—	—
Anode Dark Counts at -3000 V		—	—	2000	s^{-1}
Voltage Divider Current at -3000 V		—	—	75	µA
Time Response	Rise Time Ⓖ	—	150	—	ps
	Fall Time Ⓗ	—	360	—	ps
	IRF (FWHM) Ⓘ	—	45 Ⓙ	—	ps
	TTS (FWHM)	—	—	25 Ⓚ	ps

NOTES

Ⓐ Transit-time spread (TTS) is the fluctuation in transit time between individual pulse and specified as an FWHM (full width at half maximum) with the incident light having a single photoelectron state.
Ⓑ Two microchannel plates (MCP) are incorporated as a standard but we can provide it with either one or three MCPs as an option depending upon your request.
Ⓒ We recommend use R3809U-51 with thermoelectric cooling unit to reduce dark counts (Refer to Figure 5)
Ⓓ This is specified under the operating conditions that the repetition rate of light input is 100 Hz or below and its pulse width is 70 ps.
Ⓔ This data is based on R3809U-50. All other types (suffix number 51 through 58) have different characteristics on cathode sensitivity and anode dark counts.
Ⓕ The light source used to measure the luminous sensitivity is a tungsten filament lamp operated at a distribution temperature of 2856 K. The incident light intensity is 10^{-4} lumen and 100 V is applied between the photocathode and all other electrodes connected as an anode.
Ⓖ This is the mean time difference between the 10 % and 90 % amplitude points on the output waveform for full cathode illumination.
Ⓗ This is the mean time difference between the 90 % and 10 % amplitude points on the tailing edge of the output waveform for full cathode illumination.
Ⓘ IRF stands for Instrument Response Function which is a convolution of the δ pulse function (H(t)) of the measuring system and the excitation function (E(t)) of a laser. The IRF is given by the following formula:

$$IRF = H(t) \times E(t)$$

Ⓙ We specify the IRF as an FWHM of the time distribution taken by using the measuring system in Figure 13 that is Hamamatsu standard IRF measurement. It can be temporary estimated by the following equation:

$$(IRF\ (FWHM))^2 = (TTS)^2 + (Tw)^2 + (Tj)^2$$

where Tw is the pulse width of the laser used and Tj is the time jitter of all equipments used. An IRF data is provided with the tube purchased as a standard.
Ⓚ TTS stands for Transit Time Spread (seeⒶ above). Assuming that a laser pulse width (Tw) and time jitter of all equipments (Tj) used in Figure 3 are negligible, IRF can be estimated as equal to TTS (seeⒿ) above. Therefore, TTS can be estimated to be 25 picoseconds or less.

TECHNICAL REFERENCE DATA

Figure 4: Typical Gain

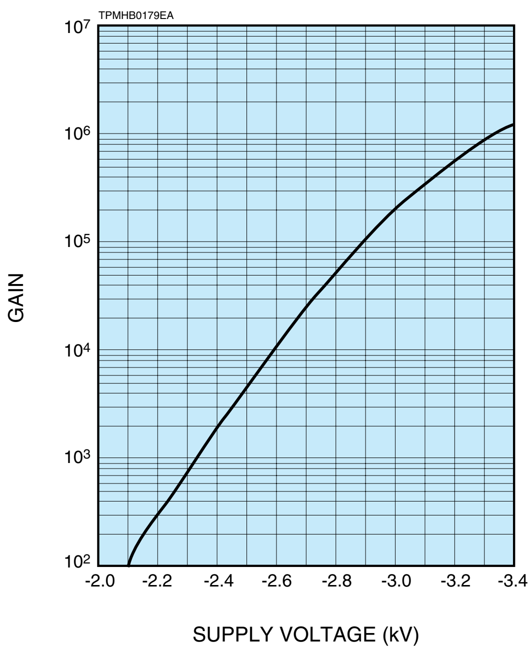


Figure 5: Variation of Dark Counts Depending on Ambient Temperature

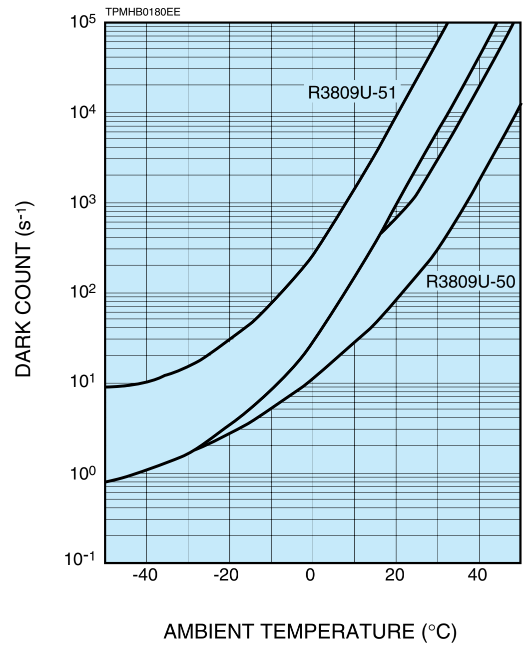


Figure 6: Typical Output Deviation as a Function of Anode DC Current

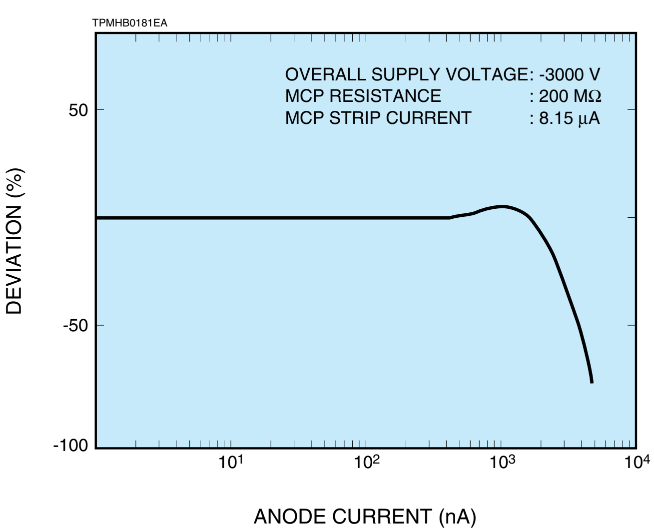


Figure 7: Typical Output Deviation as a Function of Anode Count Rate

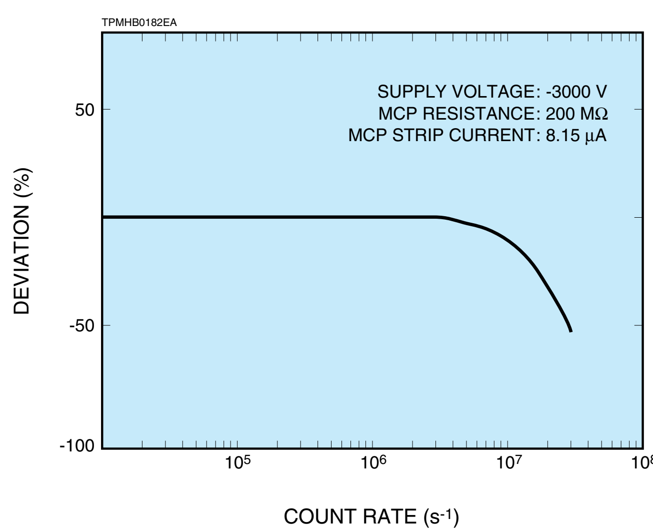


Figure 8: Typical Output Waveform

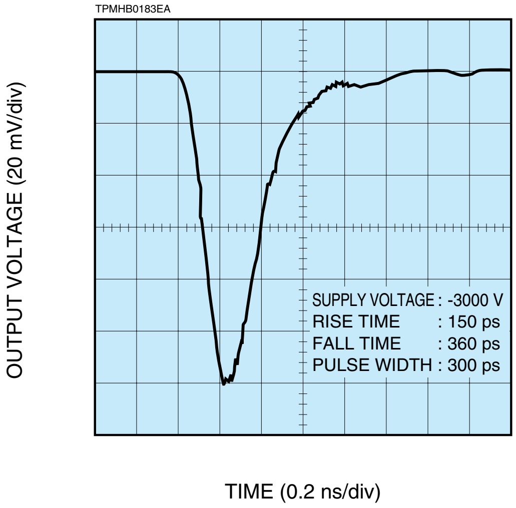


Figure 9: Block Diagram of Output Waveform Measuring System

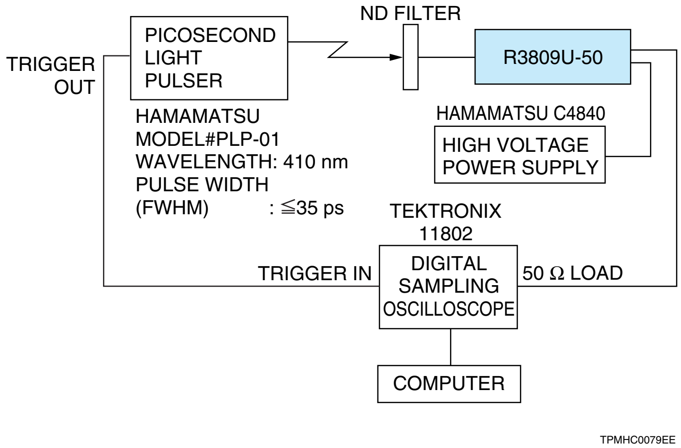


Figure 10: Typical Pulse Height Distribution (PHD)

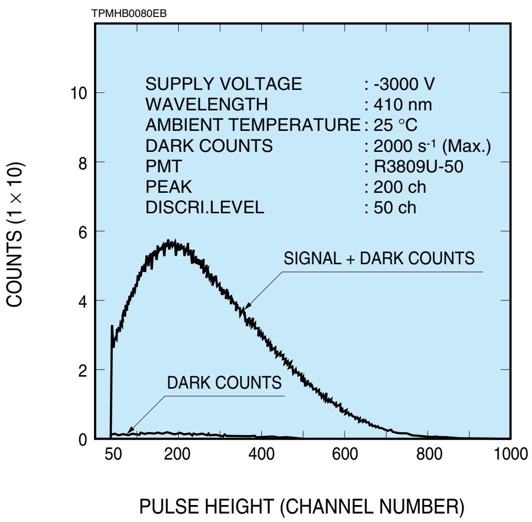


Figure 11: Block Diagram of PHD Measuring System

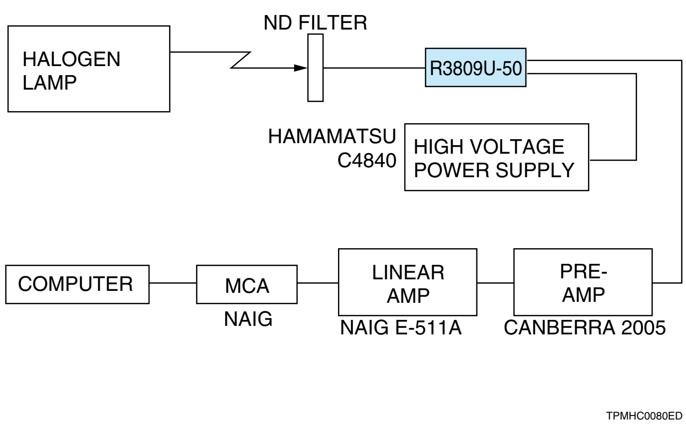


Figure 12: Typical Instrument Response Function (IRF)

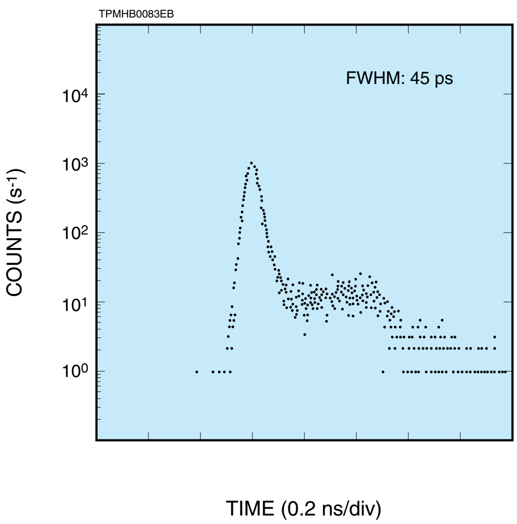


Figure 13: Block Diagram of IRF Measuring System

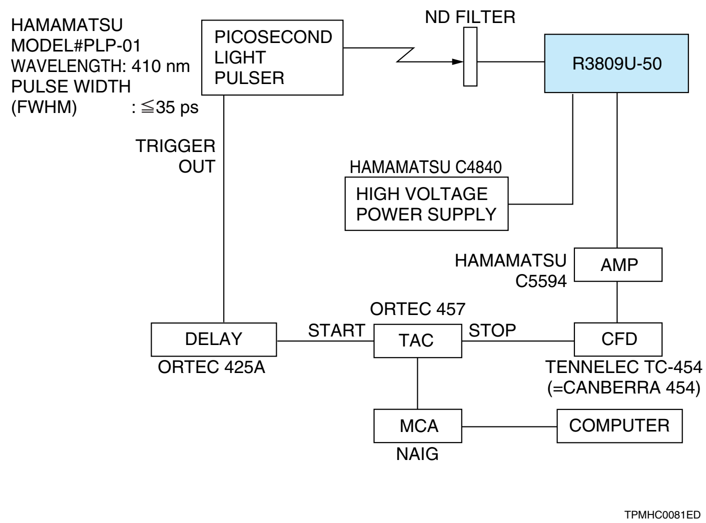
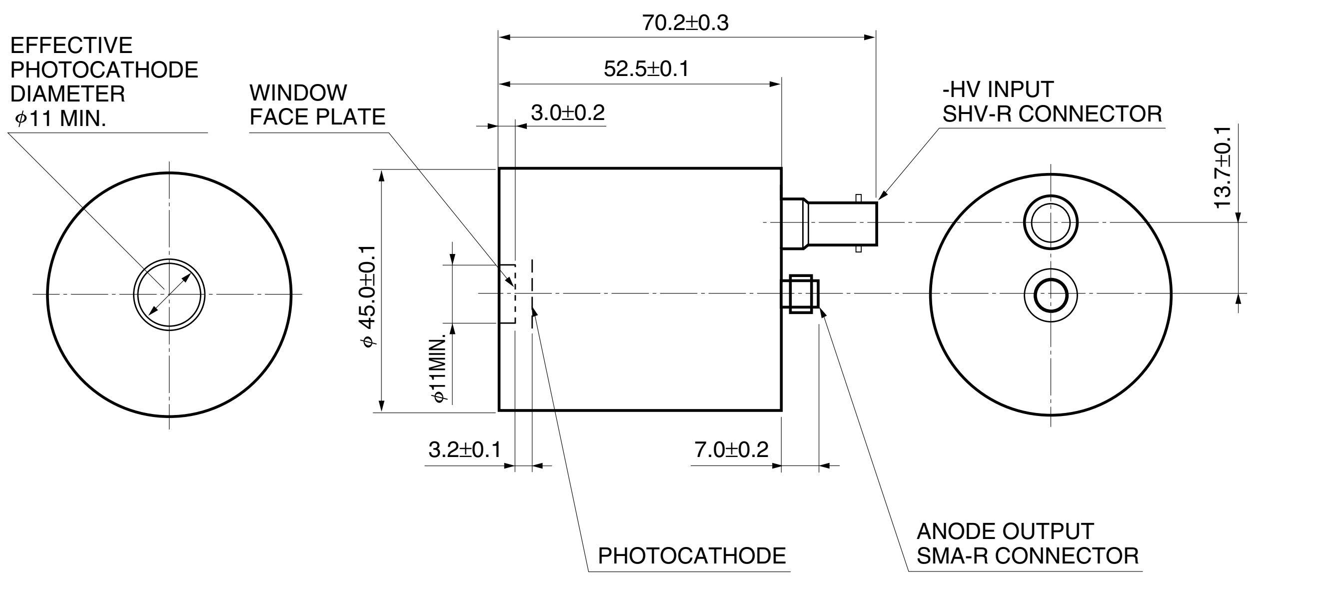


Figure 14: Dimensional Outline (Unit: mm)



PRECAUTIONS FOR PROPER OPERATION

Handling on set-up

1) The photomultiplier tube (PMT) is a glass product under high vacuum. EXCESSIVE PRESSURE, VIBRATIONS OR SHOCKS TO THE TUBE FROM THE SURROUNDING COULD CAUSE A PERMANENT DAMAGE. Please pay special attention on insuring proper handling.
2) DO NOT PLACE ANY OBJECTS OF GROUND POTENTIAL CLOSER THAN 5mm TO THE PHOTOCATHODE WINDOW when negative high voltage is applied to the photocathode. It could generate extra noise and damage the photocathode permanently.
3) DO NOT EXPOSE THE PHOTOCATHODE TO SUNLIGHT DIRECTLY and any light stronger than the room light even during of no operation.
4) NEVER TOUCH THE INPUT WINDOW WITH YOUR BARE HANDS. In case the window contaminated by dust or grease, wipe it off using alcohol and a soft cloth or dust free tissue.
5) DO NOT OPERATE OR STORE IN A PLACE OF UNSPECIFIED TEMPERATURE AND HUMIDITY.

Supplying high voltage

1) DO NOT SUPPLY ANY VOLTAGE HIGHER THAN SPECIFIED. Also make sure the output current does NOT EXCEED THE MAXIMUM CURRENT specified.
2) This device is very sensitive even with weak light input. When applying high voltage to the tube, GRADUALLY (IDEALLY 100 Vdc STEP BUT 500 Vdc STEP IS OK) AND CAREFULLY INCREASE THE VOLTAGE while monitoring the output using an ammeter or oscilloscope. Also make sure before use that the polarity of the applied voltage is correct.
3) DO NOT REMOVE OR CONNECT ANY INPUT OR OUTPUT CABLES WHILE HIGH VOLTAGE IS APPLIED. If a high voltage is applied when its output is opened, DO NOT CONNECT ANY READOUT CIRCUIT TO THE TUBE IMMEDIATELY after turning the high voltage off. Ground the anode of the tube before connecting in order to avoid possible damage to the readout circuit due to an excessive electron charge flowing from its anode.
4) IT IS RECOMMENDED TO TURN HIGH VOLTAGE OFF WHILE NOT BEING USED FOR MEASUREMENTS. This is to avoid shortening its period of life time as well as a risk of damage due to an exposure of excessive incident light.

Incident light amount

1) KEEP THE INCIDENT LIGHT AMOUNT AS LOWS AS POSSIBLE to extend its period of life time.
2) In a case of photon counting application, it is recommended to KEEP THE SIGNAL COUNT RATE LESS THAN 20kcps.
3) ILLUMINATE PHOTOCATHODE EFFECTIVE AREA AS LARGE AS POSSIBLE to keep better linearity characteristics and avoid an excessive stress in partial area, which may result in a reduction of sensitivity partially.

Usage in vacuum

1) DO NOT USE A PMT AS AN INTERFACE BETWEEN VACUUM AND ENVIRONMENTAL PRESSURE. Standard MCP-PMT is not designed for vacuum-tight construction.
2) KEEP THE TUBE CLEAN. Unless otherwise, it would cause outgassing in a vacuum.
3) DO NOT SUPPLY HIGH VOLTAGE UNLESS THE VACUUM LEVEL REACHES 1×10^{-3} Pa OR HIGHER.
4) DO NOT PROCEED BAKING VACUUM INSTRUMENTS WHILE THE TUBE IS PLACED INSIDE.

OTHERS

1) If the tube won't be used with a cooler, it is recommended to LEAVE THE TUBE IN DARKNESS (YOUR INSTRUMENT WITHOUT ANY INPUT LIGHT) FOR 30 MINUTES OR SO before start any measurements because it occasionally takes a little while until its dark noise settles down.

WARRANTY

The detectors indicated in this data sheet are warranted to the original purchaser for a period of 12 MONTHS following the date of shipment. The warranty is limited to repair or replacement of any defective material due to defects in workmanship or materials used in manufacture.

1) Any claim for damage of shipment must be made directly to the delivering carrier within five days.
2) Customer must inspect and test all detectors within 30 days after shipment. Failure to accomplish said incoming inspection shall limit all claims to 75% of invoice value.
3) No credit will be issued for broken detector unless in the opinion of Hamamatsu the damage is due to a manufacturing defect.
4) No credit will be issued for any detector which in the judgement of Hamamatsu has been damaged, abused, modified or whose serial number or type number have been obliterated or defaced.
5) No detector will be accepted for return unless permission has been obtaind from Hamamatsu in writing, the shipment has been returned repaired and insured, the detector is packed in their original box and accompanied by the original data sheet furnished to the customer with the tube, and a full written explanation of the reason for rejection of detector.

ACCESSORIES

THERMOELECTRIC COOLING UNIT C10373

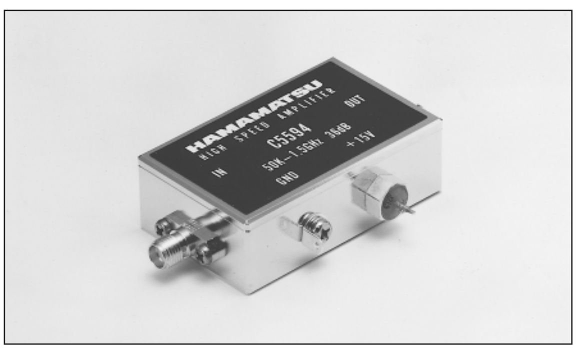
Left: Power Supply   Right: Cooled PMT Housing

Parameter	Description / Value
Cooling Methode	Thermoelectric cooling using peltier module
Heat Exchange Medium	Water
Amount of Cooling Water	1 L/min to 3 L/min (water pressure: below 0.3 MPa)
Cooling Temperature (with cooling water at +20 °C)	Approx. -30 °C
Temperature Controllable Range (with cooling water at +20 °C)	-30 °C to 0 °C (continuously adjustable)
Cooling Time	Approx. 120 min
Optical Window Material	Evacuated double-pane synthetic silica window with heater (185 nm to 2200 nm)
Operating Ambient Temperature Ⓐ	+5 °C to +40 °C / Below 75 %
Storage Temperature Ⓐ	-15 °C to +50 °C / Below 80 %
Weight	5.5 kg

NOTE: ⒶNo condensation

HOLDER E3059-500

HIGH SPEED AMPLIFIER C5594 Series



Suffix numbers and input / output connectors

Input Connectors	Output Connectors	
	SMA Jack	BNC Jack
SMA Plug (male)	C5594-12	C5594-14
SMA Receptacle (female)	C5594-22	C5594-24
BNC Plug (male)	C5594-32	C5594-34
BNC Receptacle (female)	C5594-42	C5594-44

Specifications

Parameters		Description / Value
Frequency Response Range		50 kHz to 1.5 GHz
Gain	Typ.	36 dB
Input / Output Impedance		50 Ω
Noise Figure (NF)	Typ.	5 dB
Recommend Input Voltage		+12 V to 16 V
Supply Current	Typ.	95 mA
Absolute Maximum Ratings	Supply Voltage	+17 V
	Input Power	+10 mW

BENCH-TOP HIGH VOLTAGE POWER SUPPLY C4840 Series

Specifications

Parameter		Description / Value
Output Voltage		0 V to ±3000 V
Maximum Output Current		10 mA
Line Regulation Against ±10 % Line Voltage Change ⒶⒷ	Max.	±(0.005 % + 10 mV)
Load Regulation Against 0 % to 100 % Load Change Ⓐ	Max.	±(0.01 % + 50 mV)
Ripple / Noise (p-p) ⒶⒷ	Max.	0.0007 %
Drift (after 1 h Warm-up) ⒶⒷ	Max.	±(0.02 % + 10 mV)/8 h
Temperature Coefficient ⒶⒷ	Max.	±0.01 % / °C
AC Input Voltage	C4840-01	120 V (±10 %) (50 / 60 Hz)
	C4840-02	230 V (±10 %) (50 / 60 Hz)
Power Consumption ⒶⒷ		Approx. 100 V·A
Operating Ambient Temperature / Humidity Ⓒ		0 °C to +40 °C / below 80 %
Storage Temperature / Humidity Ⓒ		-20 °C to +50 °C / below 85 %

NOTE: ⒶAt maximum output voltage   ⒷAt maximum output current
ⒸNo condensation

HAMAMATSU

WEB SITE www.hamamatsu.com

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