

LOW-LIGHT-LEVEL MEASUREMENT OF NIR

NIR (NEAR INFRARED: 1.4 μm /1.7 μm) PHOTOMULTIPLIER TUBES R5509-43/R5509-73

and EXCLUSIVE COOLERS

OVER VIEW

Hamamatsu near infrared photomultiplier tubes (NIR-PMT) R5509-43 and -73 have photocathodes with extended spectral response ranges to 1.4 μm or 1.7 μm where beyond 1.1 μm have been the limit of conventional photocathodes. The R5509-43 is recommended for detection up to 1.35 μm , while the R5509-73 is up to 1.7 μm .



TPMHF0484

FEATURES

- **High sensitivity enables accurate PL (Photoluminescence) measurement with a low excitation power that could not be obtained with a strong excitation.**

High gain and low noise improve the detection limit.

- **Flat response from visible to near IR minimizes spectral sensitivity correction.**

The spectral response covers a wide range from 0.3 μm to 1.4 μm or 1.7 μm .

- **Photoluminescence from a room temperature sample can be measured.**

High sensitivity enables weak light emission measurement.

- **Time resolved measurement in near IR is realized.**

Fast time response (Rise time): 3 ns.

SPECIFICATIONS

●GENERAL

Parameter		R5509-43	R5509-73	Unit
Spectral response		300 to 1400	300 to 1700	nm
Photocathode	Material	InP / InGaAsP	InP / InGaAs	—
	Minimum effective area	3 × 8		mm
Window	Material	Borosilicate glass		—
	Secondary emitting surface	Cu-BeO		—
Dynode	Structure	Line focused		—
	Number of stage	10		—
Socket		C9940-01, -02		—
Operating temperature		-90 to -70		°C
Recommended operating temperature		-80		°C
Storage temperature		-90 to +50		°C

●MAXIMUM RATING (Absolute maximum values)

Parameter		Value	Unit
Supply voltage	Between anode and cathode	-1750	V
Average anode current		2	μA

●CHARACTERISTICS (at -80 °C, supply voltage: -1500 V)

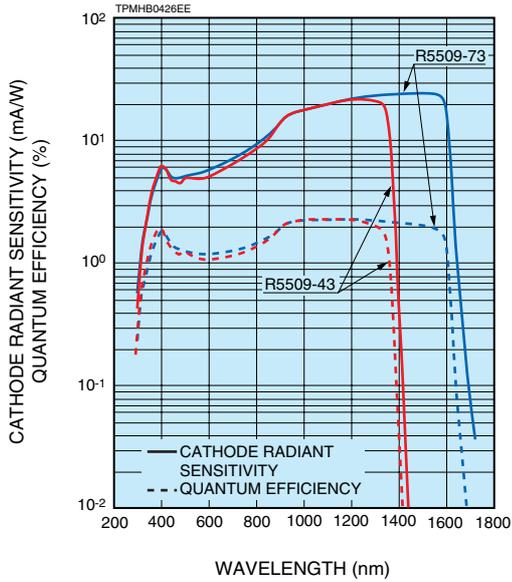
Parameter		R5509-43			R5509-73			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Cathode sensitivity	Quantum efficiency ^(A)	1	2	—	1	2	—	%
	Radiant ^(A)	10	—	—	12	—	—	mA/W
Anode sensitivity	Radiant ^(A)	5000	—	—	6000	—	—	A/W
Gain		5×10^5	1×10^6	—	5×10^5	1×10^6	—	—
Anode dark current ^(B)		—	4	10	—	40	100	nA
Anode dark counts ^(B)		—	2.5×10^4	—	—	2.5×10^5	—	s ⁻¹
Time response	Anode pulse rise time	—	3	—	—	3	—	ns
	Electron transit time	—	23	—	—	23	—	ns
	Transit time spread	—	1.5	—	—	1.5	—	ns

NOTE: (A) at 1300 nm (R5509-43), at 1500 nm (R5509-73) (B) After 30 minutes storage in darkness

The dedicated coolers C9940-01 and C9940-02 are shipped after adjusting the voltage divider circuit to provide the optimum voltage distribution ratio that best matches the PMT.

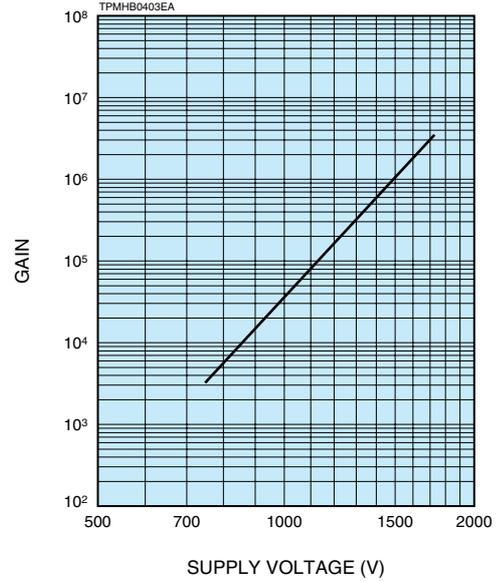
CHARACTERISTICS FIGURES

●Spectral response

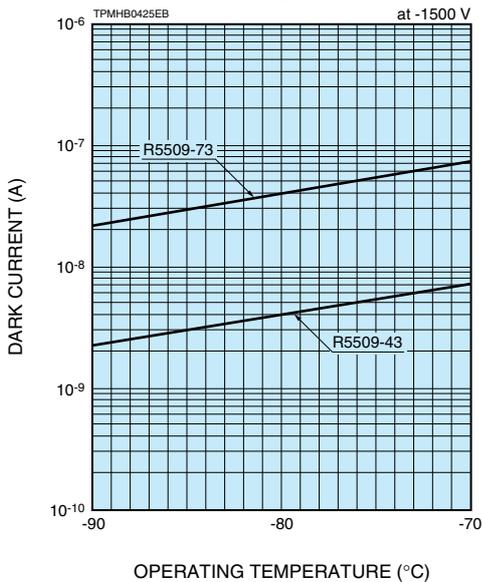


* Spectral response characteristics when used with the dedicated cooler

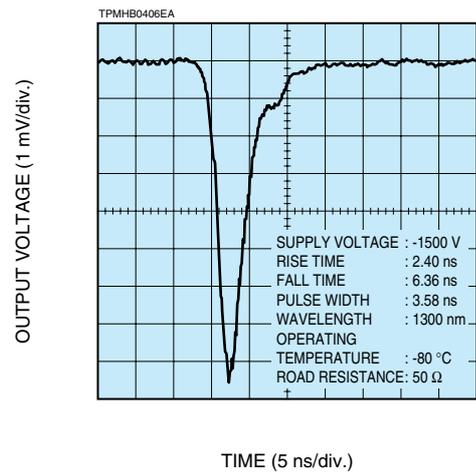
●Typical gain (R5509-43, -73)



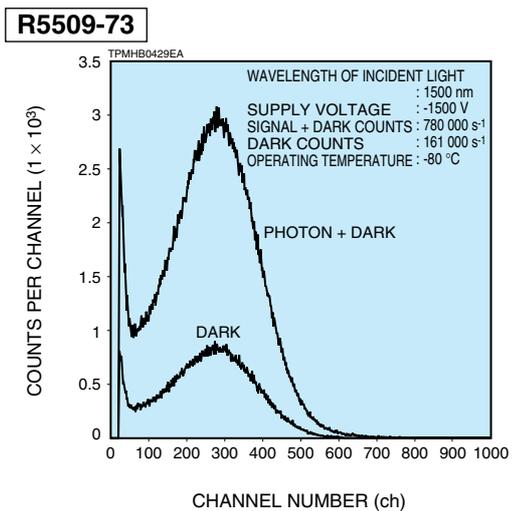
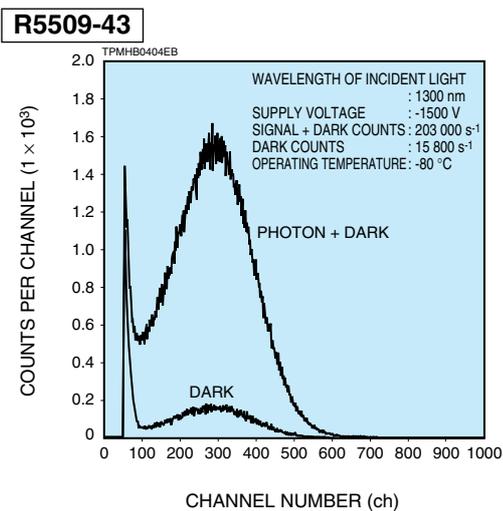
●Temperature characteristics of dark current (After 30 minutes storage in darkness)



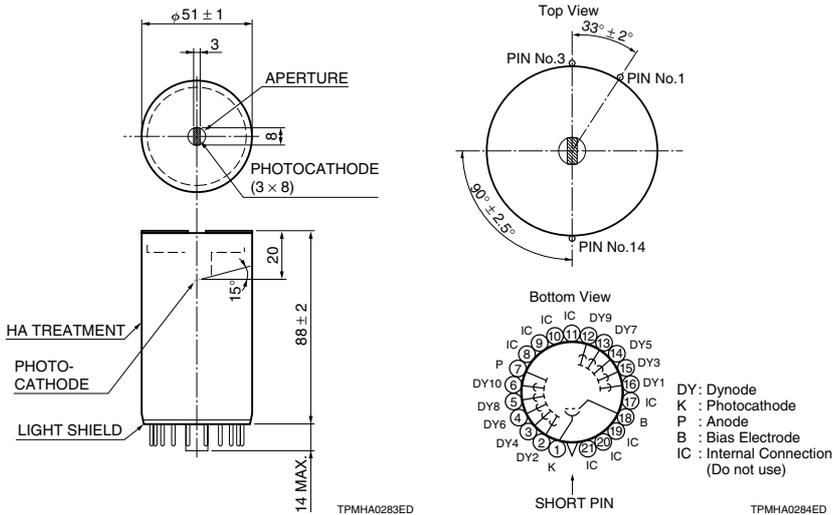
●Output waveform (R5509-43)



●Single photoelectron pulse height distribution (PHD)



DIMENSIONAL OUTLINE AND BASING DIAGRAM (Unit: mm)



[Cautions for operation]

- Operate the tube at the maximum average anode current of less than 2 μA while the entire photocathode is illuminated in order to avoid the photocathode damage due to excessive cathode current.
- In order to protect the photocathode, the high voltage should be increased or decreased gradually.
- When the R5509-43 or -73 shall be operated, do not supply the high voltage before the tube is cooled down to $-70\text{ }^\circ\text{C}$ at least.
- Use the exclusive cooler C9940-01 or C9940-02 for cooling.

[Warranty]

- A cooler other than specified may cause a trouble in the tube like loss of performance or a mechanical damage. Any trouble caused in association with a cooler other than specified shall not be subject to warranty.
- Hamamatsu photomultiplier tubes are warranted to the original purchase 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.

RELATED PRODUCTS

Exclusive coolers C9940-01, C9940-02

The C9940-01, -02 are exclusive coolers for R5509 series photomultiplier tubes. To operate the R5509 series, it is necessary to cool it down to $-70\text{ }^\circ\text{C}$ to $-90\text{ }^\circ\text{C}$ range (recommended temperature: $-80\text{ }^\circ\text{C}$). Cooling suppresses dark current and improves signal to noise ratio to make weak near infrared light measurements possible with high sensitivity.

Two types are available with different line voltage regulations, 100 V to 115 V (C9940-01) and 230 V (C9940-02).

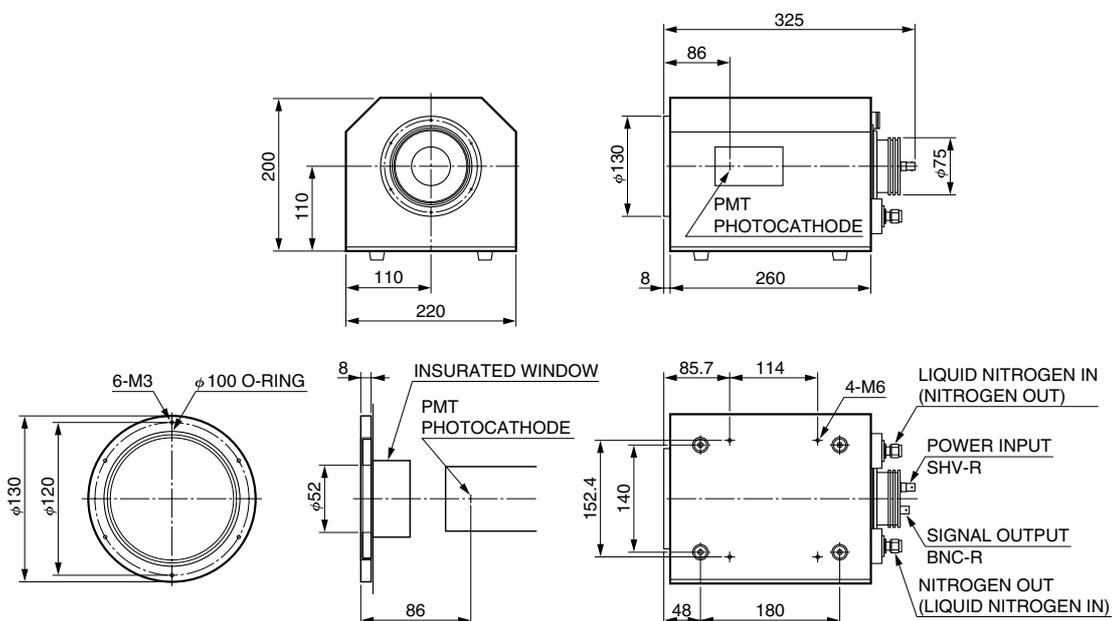
FEATURES

- Temperature range: $-70\text{ }^\circ\text{C}$ to $-90\text{ }^\circ\text{C}$
- Voltage divider, Magnetic shield case included
- Alarm with output when liquid nitrogen is running out
- No external dry nitrogen is required

SPECIFICATIONS

Parameter	C9940-01	C9940-02
Input voltage	AC 100 V to AC 115 V, 50 Hz / 60 Hz	AC 230 V, 50 Hz
Power consumption	60 VA	
Temperature controllable range	$-70\text{ }^\circ\text{C}$ to $-90\text{ }^\circ\text{C}$	
Cool-down time	Approx. 2 h ($-80\text{ }^\circ\text{C}$ setting)	
Liquid nitrogen consumption rate	0.5 L/h	
Weight	Cooling unit	5.6 kg
	Cooling controller	5.1 kg
	Liquid nitrogen drawing pipe, etc.	1.5 kg
Window material	Borosilicate glass	
Alarm output	DC 24 V, 100 mA Max.	
Operating ambient temperature	$+10\text{ }^\circ\text{C}$ to $+40\text{ }^\circ\text{C}$	
Storage temperature	$-20\text{ }^\circ\text{C}$ to $+50\text{ }^\circ\text{C}$	
Accessory	100 k Ω Load resistor (with BNC connector)	

DIMENSIONAL OUTLINE (Unit: mm)

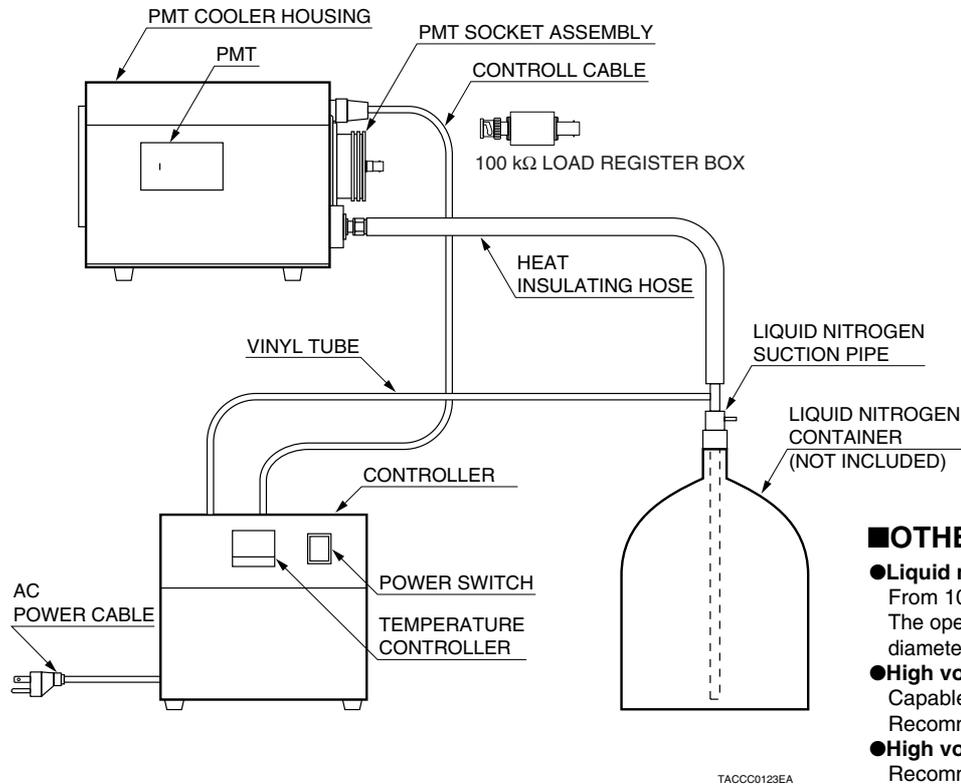


RELATED PRODUCTS

Exclusive coolers C9940-01, C9940-02

SYSTEM CONFIGURATION

PMT housing, Controller, Liquid nitrogen suction pipe, Heat insulating hose, PMT socket assembly, Controller cable, Vinyl tube, 100 kΩ load resistor box.
(Liquid nitrogen container is not included in C9940-01/-02)



OTHER ACCESSORIES REQUIRED

- **Liquid nitrogen container**
From 10 L to 25 L capacity
The opening of the container should allow the 15 mm diameter liquid nitrogen suction pipe to be inserted.
- **High voltage power supply**
Capable to provide stable output of -1500 V (-1750 V Max.)
Recommended : C9525-02/-03
- **High voltage cable with an SHV-P connector**
Recommended : E1168-17 (supplied with C9525 series)
- **Signal COAX cable with a BNC-P connector**
Recommended : E1168-05

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