HAMAMATSU

METAL PACKAGE PHOTOMULTIPLIER TUBE R7400U SERIES

Compact size (16 mm diameter, 12 mm seated length), Fast Time response (rise time 0.78 ns)

The R7400U series is a subminiature photomultiplier tube with a 16 mm diameter and 12 mm seated length. A precision engineered 8-stage electron multiplier (composed of metal channel dynodes) is incorporated in the TO-8 package to produce a noise free gain of 700,000 times (R7400U). The R7400U series also features excellent response time with a rise time of 0.78 ns. Various types of the R7400U series are available with different spectral response and gain ranges, including those selected specifically for photon counting applications. Hamamatsu also provides a hemispherical lens input option to the series (R7401 and R7402), effectively doubling the active area.

Left: R7400U Right: R7401/R7402

FEATURES

- World's smallest photomultiplier tubes assembled in a TO-8 metal package (1/7th of the Hamamatsu R647).
  The necessary components are built into a TO-8 package while retaining full photomultiplier tube performance to create a new generation of photosensors.
- Photon counting type: R7400P.
  The R7400P is specially selected on account of low noise and high gain for use in photon counting applications.
- Hemispherical lens window types: R7401 (bialkali), R7402 (multialkali).
  The hemispherical lens window doubles the effective input area to 12 mm in diameter.

SERIES

	Solar Blind	UV to Visible Range	UV to Near IR Range	Insulation Cover
Standard	R7400U-09	R7400U/R7400U-03/R7400U-06	R7400U-01/R7400U-02/R7400U-04/R7400U-20	Yes
For Photon Counting	—	R7400P	—	Yes
With Lens	—	R7401 (Visible Range)	R7402 (Visible to Near IR Range)	Yes

GENERAL

Parameter		Description/Value	Unit
Minimum Effective Area		8	mmϕ
Dynode	Structure	Metal Channel	—
	Number of Stage	8	
Weight	R7400U Series/R7400P	Approx. 5.3	g
	R7401/R7402/R7401P	Approx. 6.3	
Ambient Temperature	R7400U Series/R7400P	-80 to +50	°C
	R7401/R7402/R7401P	-30 to +50	

VOLTAGE DISTRIBUTION RATIO

Electrodes	K	Dy1	Dy2	Dy3	Dy4	Dy5	Dy6	Dy7	Dy8	P
Ratio	1	1	1	1	1	1	1	1	0.5	

Supply Voltage: 800 V K: Cathode Dy: Dynode P: Anode

METAL PACKAGE PHOTOMULTIPLIER TUBE R7400U SERIES

CHARACTERISTICS (at 25 °C)

Type No.	Remarks	Spectral Response		Photo-cathode Material	Window Material	Out-line No.	Maximum Ratings		Cathode Sensitivity				
		Range (nm)	Peak Wave-length (nm)				Anode to Cathode Voltage (V dc)	Average Anode Current (mA)	Luminous Min. (μA/lm)	Luminous Typ. (μA/lm)	Blue(5-58) Typ. (μA/lm-b)	Red/White Ratio Typ. ×10^{-3}	Radiant Typ. (mA/W)
R7400U-09	Solar Blind	160 to 320	240	Cs-Te	Synthetic silica	②	1000(d)	0.01	—	—	—	—	22(a)
R7400U	Visible	300 to 650	420	Bialkali	Borosilicate glass	①		0.1(e)	40	70	8	—	62
R7400U-03	UV to Visible	185 to 650			UV glass								
R7400U-06		160 to 650			Synthetic silica	②							
R7400U-01	Visible	300 to 850	400	Multialkali	Borosilicate glass	①			80	150	—	200	60
R7400U-02	UV to Near IR	300 to 880	500						200	250		250	58
R7400U-20		300 to 900	630						350	500		450	78 (at 630 nm)
R7400U-04		185 to 850	400		UV glass				80	150		200	60
R7401	With Lens	300 to 650	420	Bialkali	Borosilicate glass	③			40	70	8	—	62
R7402		300 to 850	400	Multialkali					80	150	—	200	60

(a): Measured at 254 nm.
(b): Measured after a 30-minute storage in darkness.
(c): Measured at a gain of 10^6
(d): Do not apply the maximum supply voltage for more than 30 seconds continuously.

Figure 1: Typical Spectral Response (Solar Blind)

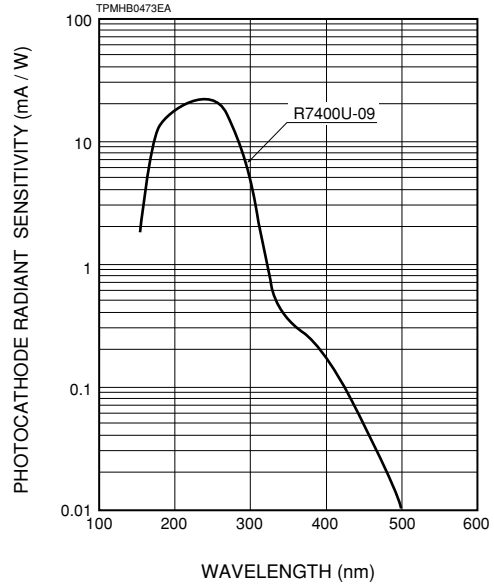


Figure 2: Typical Spectral Response (Bialkali)

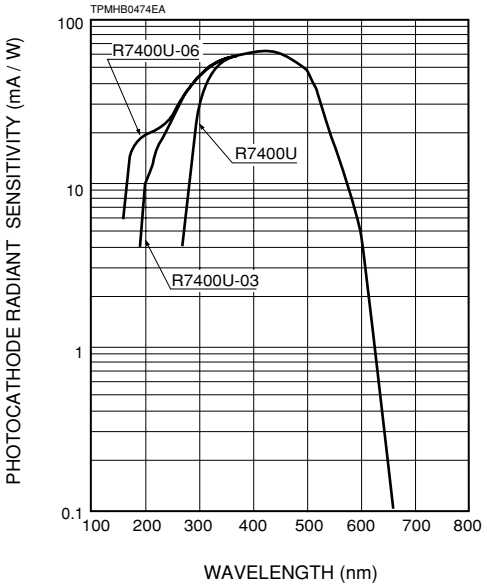


Figure 3: Typical Spectral Response (Multialkali)

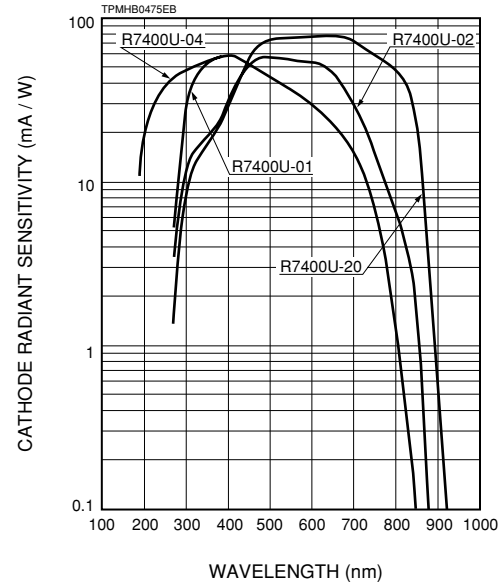
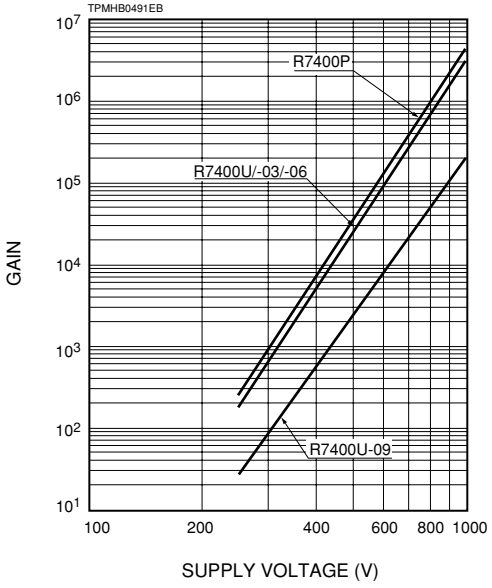


Figure 4: Typical Gain Characteristics



Anode to Cathode Supply Voltage (V dc)	Anode Characteristics							Type No.
	Anode Sensitivity			Gain	Anode Dark[b] Current		Time Response		
	Luminous		Radiant					
	Min. (A/lm)	Typ. (A/lm)	Typ. (A/W)	Typ.	Typ. (nA)	Max. (nA)	RiseTime Typ. (ns)	Electron Transit Time Typ. (ns)	
800	—	—	1100(a)	5×10^4	0.025	0.5	0.78	5.4	R7400U-09
	10	50	4.3×10^4	7×10^5	0.2	2			R7400U
									R7400U-03
									R7400U-06
	15	75	3.0×10^4	5×10^5	0.4	4			R7400U-01
	25	125	2.9×10^4		2	20			R7400U-02
	35	250	3.9×10^4						R7400U-20
	15	75	3.0×10^4		0.4	4			R7400U-04
	10	50	4.3×10^4	7×10^5	0.2	2			R7401
	15	75	3.0×10^4	5×10^5	0.4	4			R7402

For Photon Counting (P Type)				
Type No.	Gain		Dark Count (c) (s^{-1})	
	Min.	Typ.	Typ.	Max.
R7400P	7.5×10^5	1×10^6	80	400
R7401P				

(e): The output current averaged over 30 seconds should not exceed 0.1 mA.

Figure 5: Typical Gain Characteristics

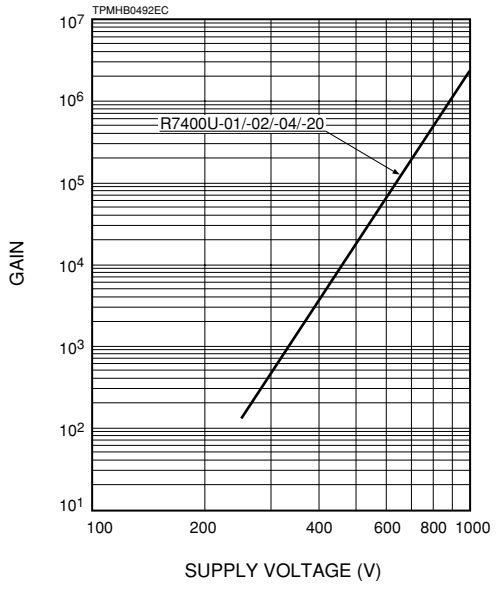


Figure 6: Anode Dark Current (v.s. Supply Voltage)

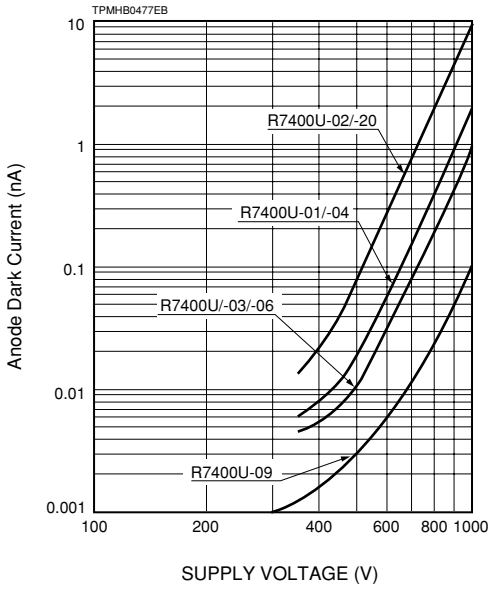


Figure 7: Anode Dark Current (v.s. Temperature)

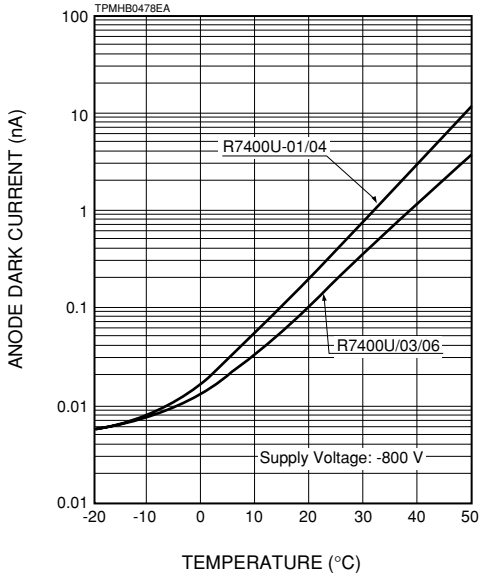


Figure 8: Transmittance of Lens

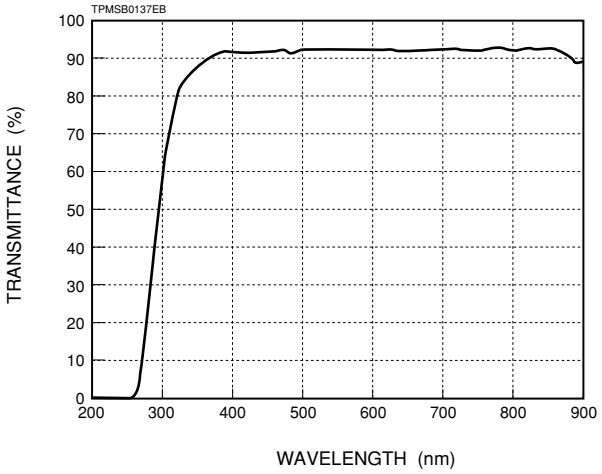
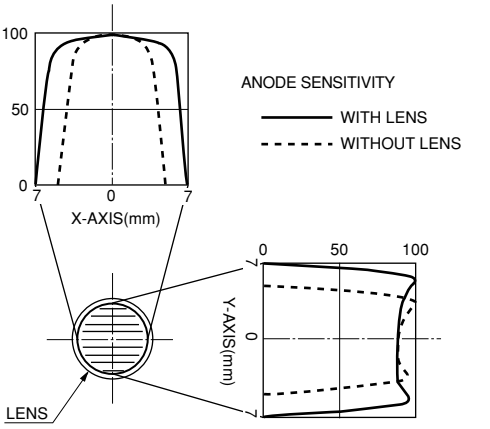


Figure 9: Lens Effect

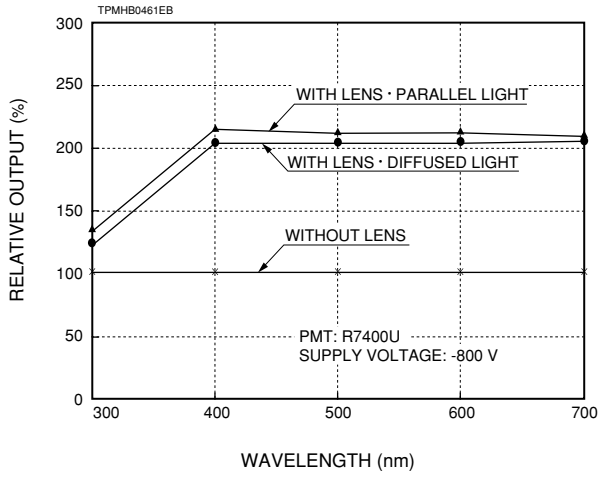


MEASUREMENT CONDITIONS
WAVELENGTH : 400 nm
SUPPLY VOLTAGE : -800 V
A 1 mm diameter spot light (parallel light) is scanned
at the center of the photocathode in X and Y directions.

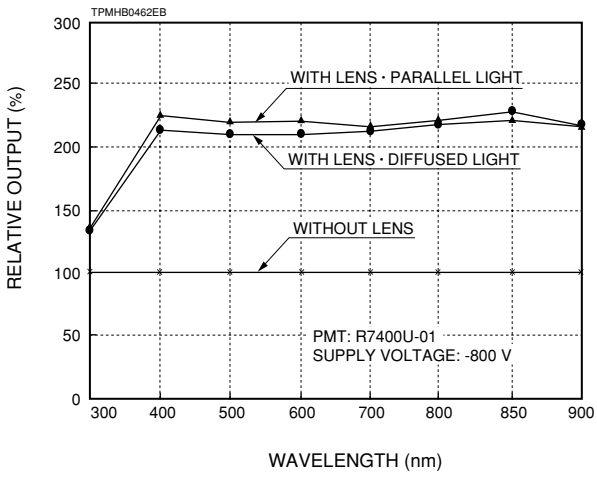
TPMHC0153EA

Figure 10: Lens Effect

● **R7401**



● **R7402**

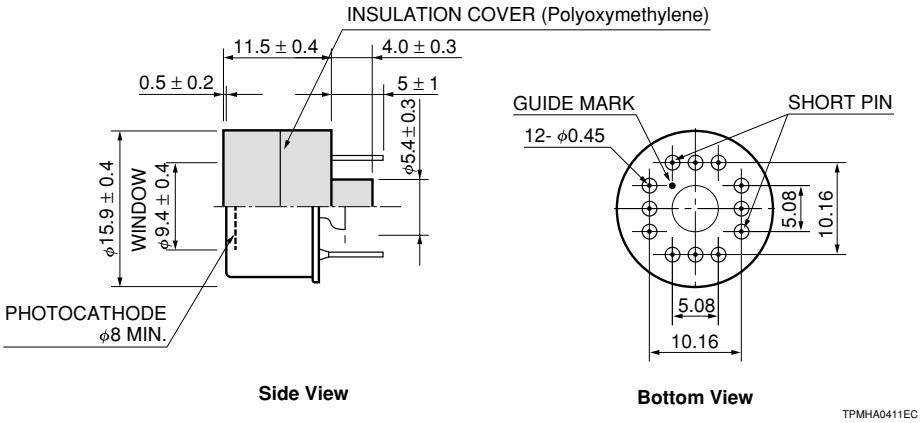


Parallel light : Parallel Light: from a 40 mm diameter parallel light source insuring uniform intensity over the entire active area of the photomultiplier tube.

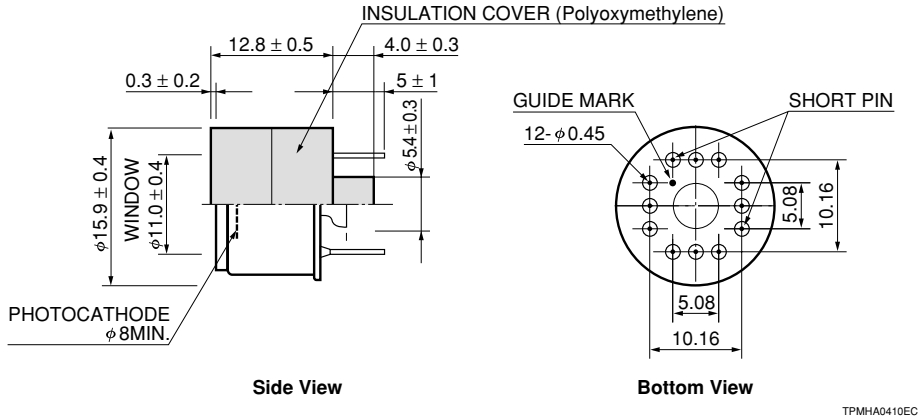
Diffused light: Diffused light: from a 40 mm diameter parallel light source and a diffuser placed 10cm from the detector. The entire active area of the PMT is exposed.

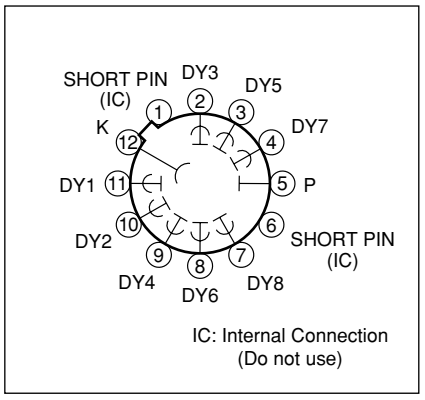
Figure 11: Dimensional Outline and Basing Diagram (Unit: mm)

①R7400U, -01, -02, -03, -04, -20, R7400P

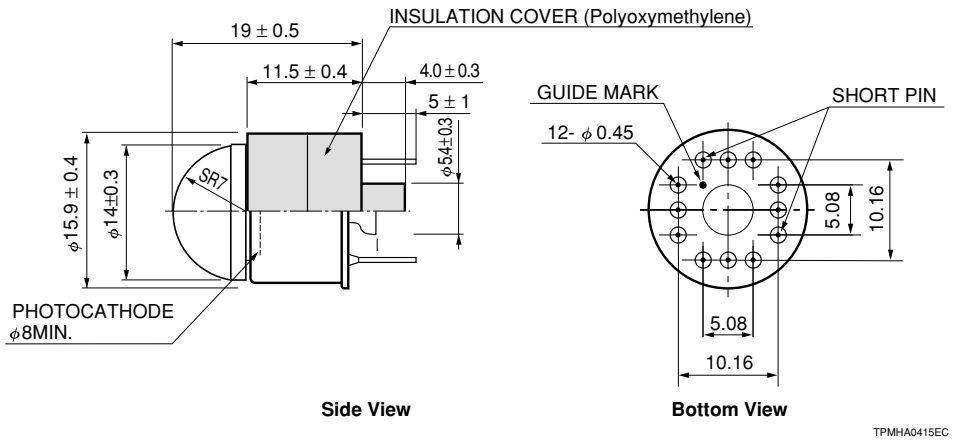


②R7400U-06,-09



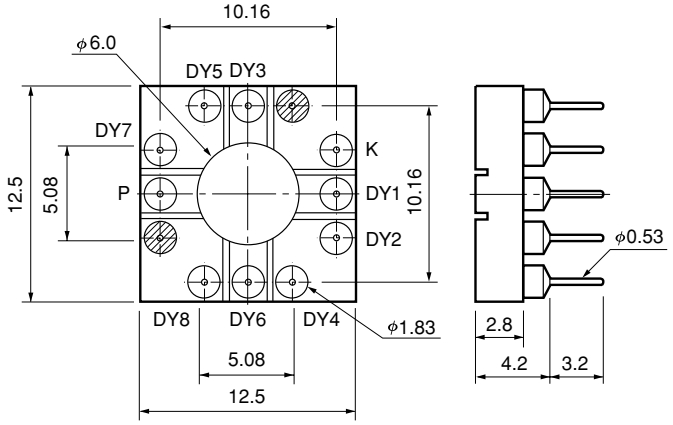


③R7401, R7402, R7401P



ACCESSORIES OPTION

● Socket E678-12M



Top View Side View TACCA0059EC

● D Type Socket Assemblies E5770/E5780

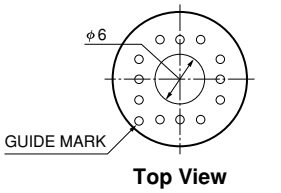
The E5770 and E5780 are compact socket assemblies incorporating a voltage divider circuit comprised of resistors and capacitors. These socket assemblies are designed to provide the output signal directly from the anode of the metal package photomultiplier tube.

Type No.	Grounded Electrode	Divider Resistance (Total)	Maximum Linear Output of Photomultiplier Tube (DC Mode)	Output Signal	
				Cathode Grounded	Anode Grounded
E5770	Anode/Cathode	2.8 MΩ	13 μA	Pulse	DC/Pulse
E5780	Anode			—	DC/Pulse

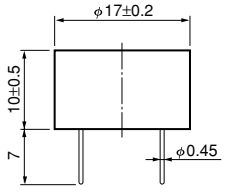
* When the E5770 is used with the anode at a positive high voltage, the negative high voltage (-HV) terminal should be grounded and a positive high voltage applied to the ground terminal. In this arrangement, a high voltage differential is generated between the output and an external amplifier, so use a decoupling capacitor that can withstand a high voltage.

** In the E5780, the shield of the signal output cable is connected to the grounded cable, so the E5780 can be used only for negative high voltage operation. Consult our sales office when the E5780 is needed for positive high voltage operation.

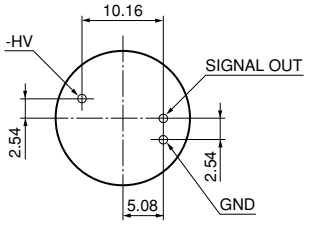
PC-board Mounting Type E5770



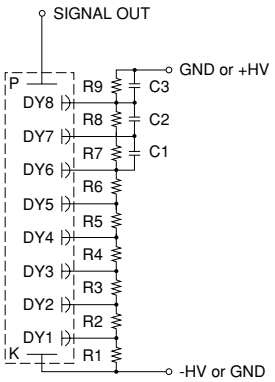
Top View



Side View



Bottom View

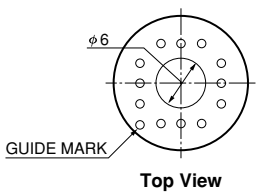


R1 to R8 : 330 kΩ
R9 : 160 kΩ
C1 to C3 : 0.01 μF/ 200 V

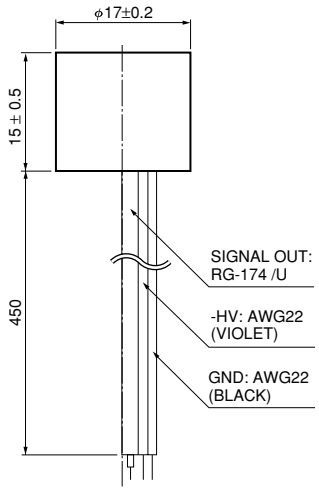
For +HV, it will be necessary to use a coupling capacitor between the output and the customer's signal processing circuit.

TACCA0057EF

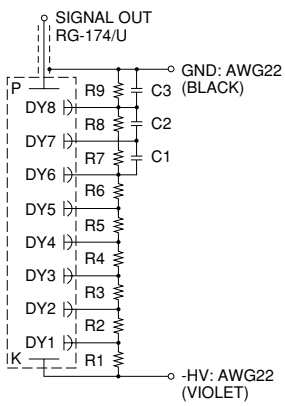
Cable Output Type E5780



Top View



Side View



R1 to R8 : 330 kΩ
R9 : 160 kΩ
C1 to C3 : 0.01 μF /200 V

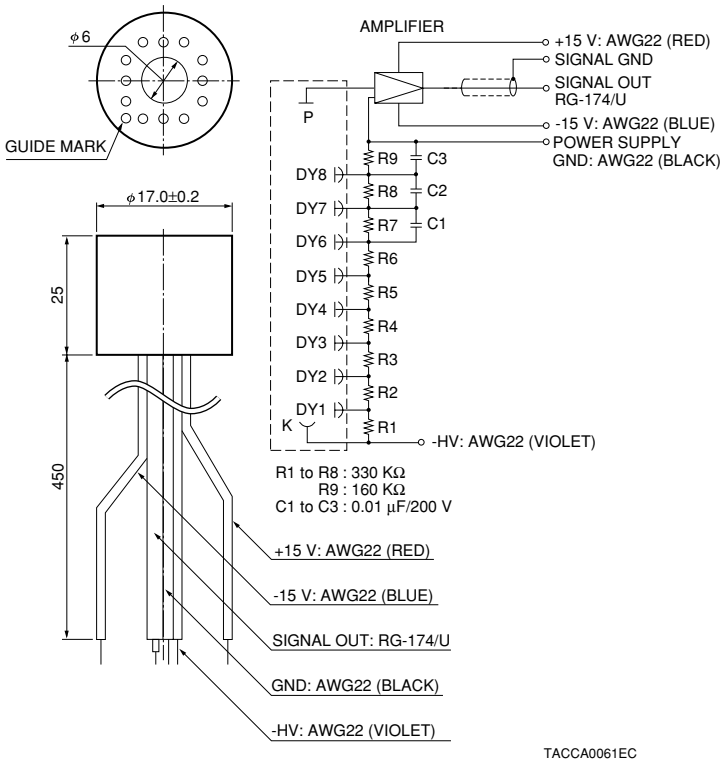
TACCA0060EC

● DA Type Socket Assembly C5781

The C5781 is a subminiature socket assembly that incorporates a voltage divider circuit and a low-noise amplifier.

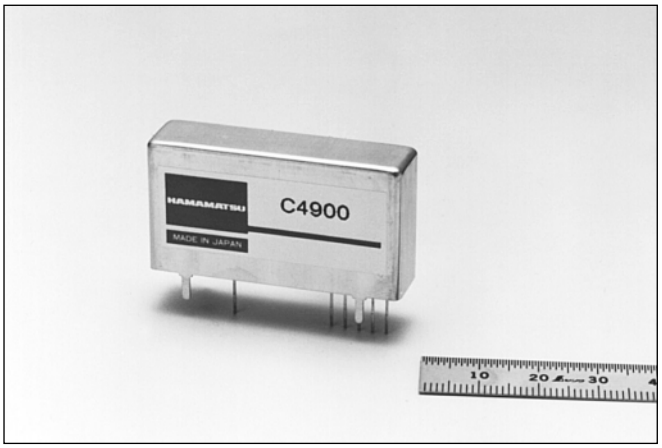
SPECIFICATION of Built-in Amplifier

Parameter	Value	Unit
Input Voltage for Amplifier	±15	V
Current to Voltage Conversion Factor	1	V/μA
Maximum Output Voltage (with no load resistor)	10	V
Bandwidth (-3 db)	DC to 20	kHz Typ.



● Compact High Voltage Power Supply Units C4900 Series

The C4900 series is an on-board type high voltage power supply unit, with a design that aims at providing both “compactness and high performance”.
The newly developed circuit achieves high performance and low power consumption. The C4900 series in addition provides enhanced protective functions yet is offered at lower costs.



SPECIFICATION

Parameter		C4900	C4900-01	C4900-50	C4900-51
Input Voltage		+15 V dc	+12 V dc	+15 V dc	+12 V dc
Input Current *A	①	14 mA	15 mA	14 mA	15 mA
	②	90 mA	95 mA	90 mA	95 mA
Variable Output Range		0 V to -1250 V		0 V to +1250 V	
Maximum Output Current		0.6 mA	0.5 mA	0.6 mA	0.5 mA
Ripple Noise		0.007 % p-p Typ.			
Line Regulation *B		±0.01 % p-p Typ.			
Load Regulation *C		±0.01 % p-p Typ.			

①with no load
②with full load
*A: at maximum output voltage
*B: against ±1 V Change.
*C: against 0 to 100 % Load Change.

METAL PACKAGE PHOTOMULTIPLIER TUBE R7400U SERIES

WARNING: HIGH VOLTAGE

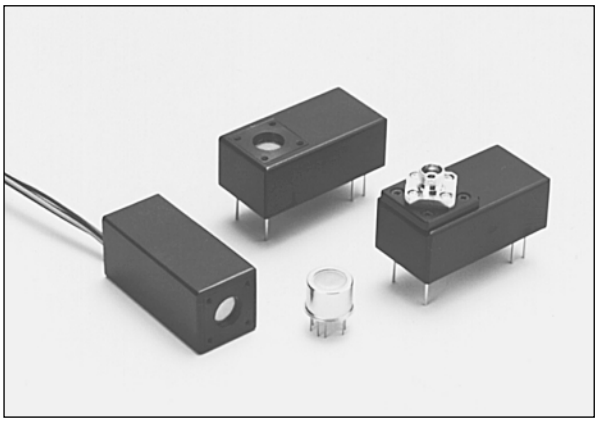
HIGH VOLTAGE

The metal package photomultiplier tubes are operated by applying a high voltage. Use extreme caution to avoid electrical shock and damage to the peripheral equipment and be sure to provide adequate safety measures as needed. As safety measures, an insulation cover is fitted to the metal package which is electrically connected to the photocathode. When operated with the cathode at a high voltage (anode ground scheme), the metal package will be at this same high voltage level. Removing the insulation cover is extremely dangerous, so never attempt to remove it from the package.

RELATED PRODUCTS

PHOTOSENSOR MODULES H6779/H6780/H5784 SERIES

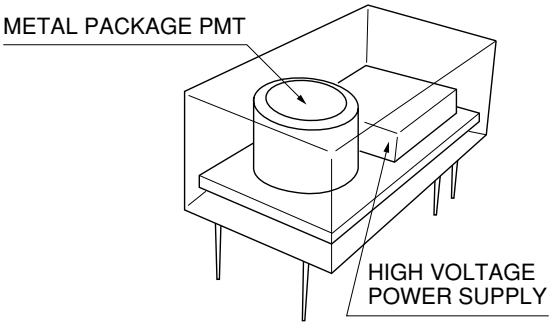
The H6779/H6780 series are new light sensor modules including the compact photomultiplier tube, (METAL PACKAGE PMT) and operating power supply. It features low voltage operation (+15 V) and low power consumption (Approx. 450 mW for H6779/H6780). Compared with current light sensors, it has several advantages like high sensitivity, wide dynamic range and fast time response. These are featured by the PMT and the Cockcroft-Walton high voltage power supply. The H5773/H6779 series are on-board types which facilitates mounting directly on a printed circuit board and the H5783/H6780 series have a cable output. H5784 series are cable out type with an amplifier of DC to 20 kHz bandwidth. These versions accept direct light input or an optical fiber with the optional fiber connector of E5776.



Left: H6780 Center: H6779 Right: H6779 with E5776
Front: METAL PACKAGE PMT

FEATURES

- **Low Power Consumption**
- **Low Voltage Drive**
- **Easy to Use**
- **High Sensitivity**
- **Wide Dynamic Range**
- **Fast Time Response**



H6779 Series TPMHC0093EB

Please refer the individual detail data sheet of H6779/H6780/H5784 series

H5773, H6779 Series: SIZE 25(W) × 50(D) × 18(L) mm WEIGHT: 50 g
H5783,H6780 Series : SIZE 22(W) × 22(D) × 50(L) mm WEIGHT: 80 g
H5784 Series : SIZE 22(W) × 22(D) × 60(L) mm WEIGHT: 100 g

PATENT: USA 1 (PAT. No. 5410211) PATENT PENDING: JAPAN 12, USA 8, EUROPE 9

HAMAMATSU HOMEPAGE URL http://www.hamamatsu.com
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