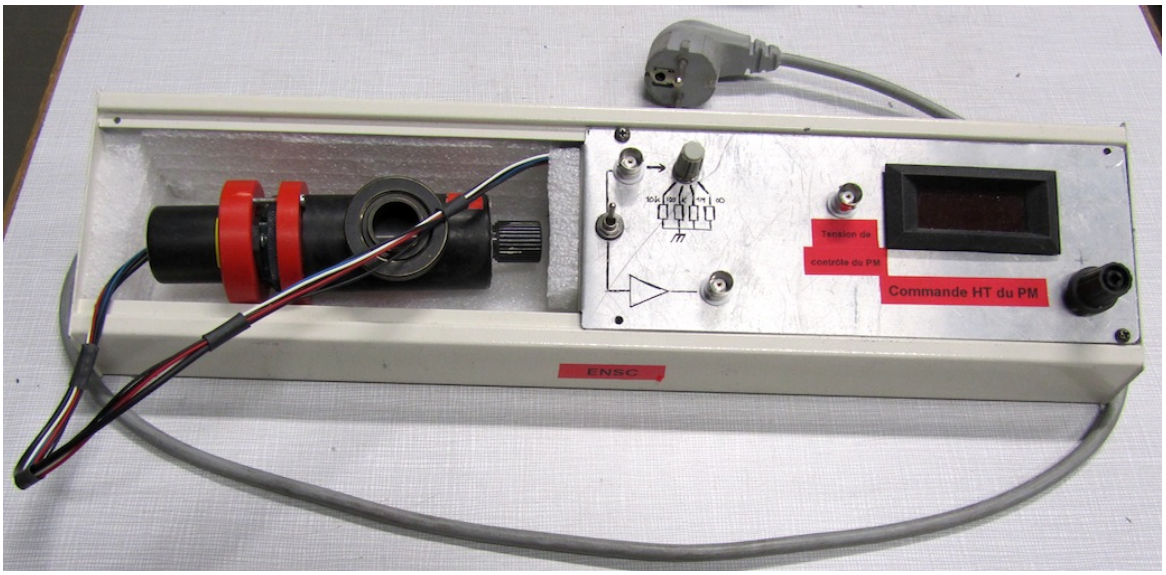
notice 0.72

Tube photo-multiplicateur avec alimentation.

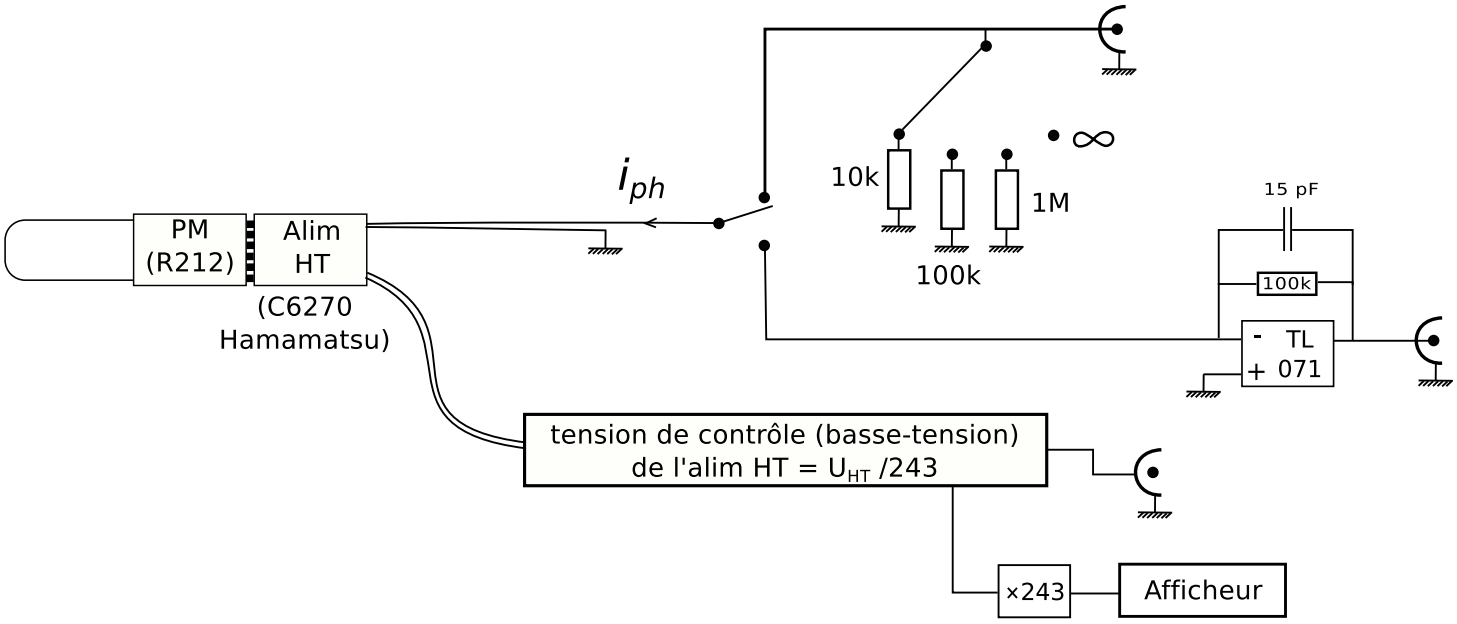


Notice simplifiée à destination des oraux de l'agrégation.

Tube photo-multiplicateur : Hamamatsu R212 (caractéristiques ci-dessous)

Boitier d'alimentation :

1-Schéma de principe :



2-Fonctionnement :

*/ l'afficheur indique la tension U_{HT} appliquée au PM. Cette tension est réglable de 0 à 1250 V à l'aide du potentiomètre.
La sortie BNC "tension de contrôle du PM" donne une image basse tension de U_{HT} qui vaut $U_{HT}/243$.

*/ le (photo-)courant produit par le PM peut être
- visualisé/mesuré à l'aide de résistances de charge (10 kOhms ; 100 kOhms ; 1,0 MOhms),
- envoyé directement en sortie du boitier,
- visualisé/mesuré à l'aide d'un montage trans-impédance utilisant un A.O.

Précaution :

ATTENTION : Veiller à ce que le courant produit ne dépasse pas 100 μA.
Au delà les électrodes du PM s'abiment irrémédiablement.

Pour ne pas dépasser cette valeur de 100 μA (pour ne pas "éblouir" le PM de manière irréversible), il faut veiller à ce que le flux lumineux reste assez faible et/ou à ce que le gain du PM (correspondant à l'amplification interne dans celui-ci) ne soit pas trop grand (-> tension d'alimentation pas trop grande).

A titre d'exemple, sous 1200 V, une faisceau lumineux @532nm, *de puissance 0,3 nW*, produit déjà le photo-courant à ne pas dépasser de 100 μA (de même que la lumière provenant d'un ciel étoilé *sans lune*).

Un PM est destiné à mesurer de toutes petites puissances lumineuses, et un flux lumineux même très faible peut le détériorer de manière irréversible. Soyez donc précautionneux

*/Signe du signal.
Lorsqu'on éclaire le PM,
- la tension aux bornes des résistances de charge (par rapport à la masse) devient négative,
- La tension délivrée par le montage à amplificateur devient quand à elle positive (par rapport à la masse).

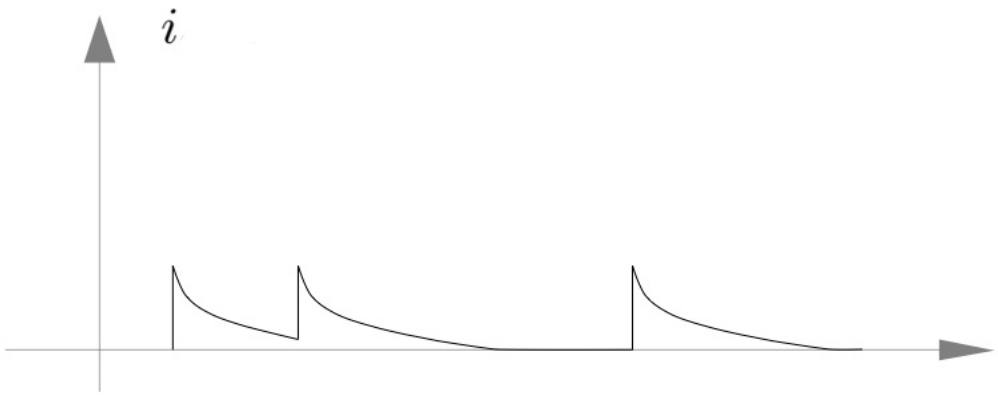
L'ensemble a été testé le 18/05/2013 (J.C.), et ses caractéristiques correspondent bien aux spécifications du constructeur, données en fin de notice.

3-Bruit :

Les puissances lumineuses mesurées sont en général très faibles. Le bruit de photon joue alors un rôle important, et entraine des rapports signal/bruit faibles.

L'ensemble de l'électronique produit suffisamment peu de bruit technique pour que le bruit observé en sortie du dispositif soit du uniquement (même si cela peut paraître surprenant) :
- au courant d'obscurité produit par le PM,
- au bruit de photon.

*/ courant d'obscurité.
Mesuré le 18/05/2013, après une heure d'utilisation : courant moyen de 2 nA.
Remarquer que ce courant d'obscurité est loin d'être continu : il correspond à des évènements discrets (émission thermique d'un électron par une des électrodes, ultérieurement amplifié) ayant l'allure ci-dessous :



HAMAMATSU

PHOTOMULTIPLIER TUBE
R212

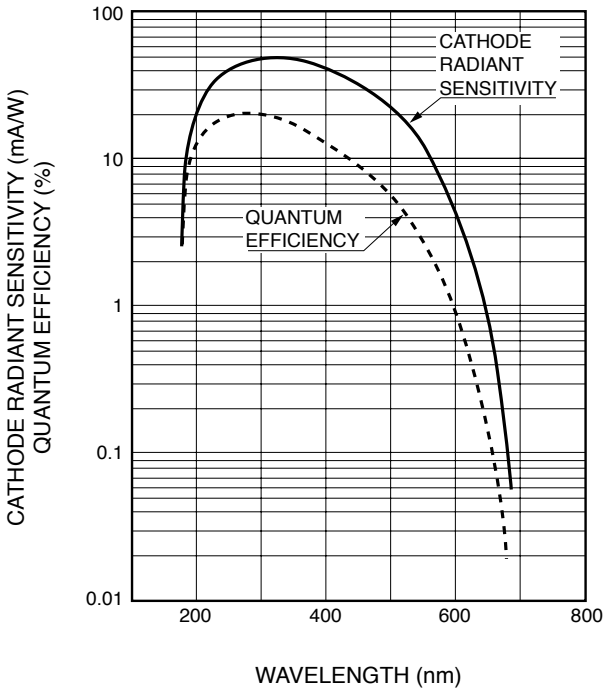
FEATURES

- **28mm (1-1/8 Inch) Diameter Side-on**
- **185 to 650nm Spectral Response**
- **High Gain and Low Dark Current Variant of 1P28**

GENERAL

Parameter		Description/value	Unit
Spectral Response		185 to 650	nm
Wavelength of Maximum Response		340	nm
Photo-cathode	Material	Sb-Cs	—
	Minimum Useful Size	8 × 24	mm
Window Material		UV glass	—
Dynode	Structure	Circular-cage	—
	Number of Stages	9	—
Direct Interelectrode Capacitances	Anode to Last Dynode	4	pF
	Anode to All Other Electrodes	6	pF
Base		JEDEC No. B11-88	—
Suitable Socket		E678-11A	—

Figure 1: Typical Spectral Response



PHOTOMULTIPLIER TUBE R212

MAXIMUM RATINGS (Absolute Maximum Values)

Parameter		Value	Unit
Supply Voltage	Between Anode and Cathode	1250	Vdc
	Between Anode and Last Dynode	250	Vdc
Average Anode Current		0.1	mA
Ambient Temperature		-80 to +50	°C

CHARACTERISTICS (at 25°C)

Parameter			Min.	Typ.	Max.	Unit
Anode Sensitivity	Luminous (2856K)		50	300	—	A/lm
	Radiant	at 340nm	—	3.6×10^5	—	A/W
		at 254nm	—	3.0×10^5	—	A/W
Cathode Sensitivity	Luminous (2856K)		25	40	—	μA/lm
	Radiant	at 340nm	—	48	—	mA/W
		at 254nm	—	40	—	mA/W
	Quantum Efficiency		—	20 at 270nm	—	%
Gain			—	7.5×10^6	—	—
Anode Dark Current (after 30minutes)			—	1	10	nA
Time Response	Anode Pulse Rise Time		—	2.2	—	ns
	Electron Transit Time		—	22	—	ns

VOLTAGE DISTRIBUTION RATIO AND SUPPLY VOLTAGE

Electrodes	K	Dy1	Dy2	Dy3	Dy4	Dy5	Dy6	Dy7	Dy8	Dy9	P
Ratio	1	1	1	1	1	1	1	1	1	1	1

Supply Voltage: 1000Vdc, K: Cathode, Dy: Dynode, P: Anode

Figure 2: Typical Gain Characteristics

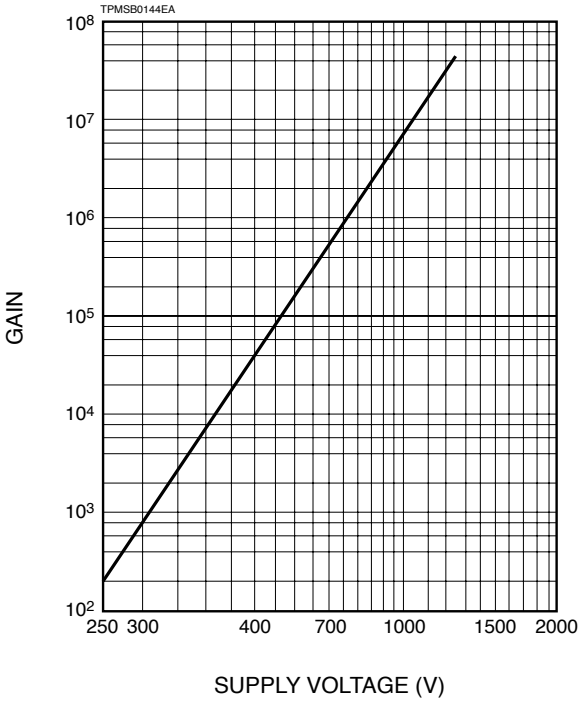
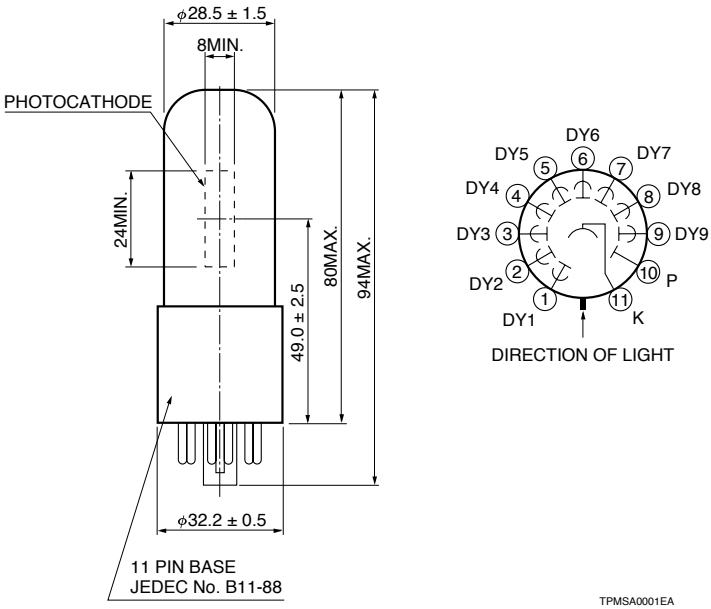
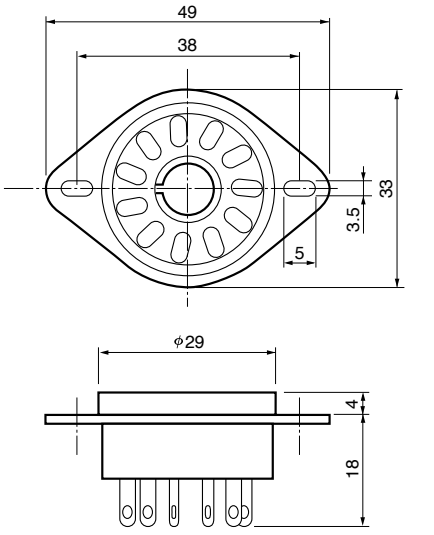


Figure 3: Dimensional Outline and Basing Diagram
(Unit: mm)



Socket (Option)
(E678-11A)



HAMAMATSU

HAMAMATSU PHOTONICS K.K., Electoron Tube Center
314-5, Shimokanzo, Toyooka-village, Iwata-gun, Shizuoka-ken, 438-0193, Japan, Telephone: (81)539/62-5248, Fax: (81)539/62-2205

U.S.A.: Hamamatsu Corporation: 360 Foothill Road, P. O. Box 6910, Bridgewater. N.J. 08807-0910, U.S.A., Telephone: (1)908-231-0960, Fax: (1)908-231-1218
Germany: Hamamatsu Photonics Deutschland GmbH: Arzbergerstr. 10, D-82211 Herrsching am Ammersee, Germany, Telephone: (49)8152-375-0, Fax: (49)8152-2658
France: Hamamatsu Photonics France S.A.R.L.: 8, Rue du Saule Trapu, Parc du Moulin de Massy, 91882 Massy Cedex, France, Telephone: (33)1 69 53 71 00, Fax: (33)1 69 53 71 10
United Kingdom: Hamamatsu Photonics UK Limted: Lough Point, 2 Gladbeck Way, Windmill Hill, Enfield, Middlesex EN2 7JA, United Kingdom, Telephone: (44)181-367-3560, Fax: (44)181-367-6384
North Europe: Hamamatsu Photonics Norden AB: Färögatan 7, S-164-40 Kista Sweden, Telephone: (46)8-703-29-50, Fax: (46)8-750-58-95
Italy: Hamamatsu Photonics Italia: S.R.L.: Via Della Moia, 1/E, 20020 Arese, (Milano), Italy, Telephone: (39)2-935 81 733, Fax: (39)2-935 81 741

TPMS1041E01
JUN. 1998

DA-TYPE SOCKET ASSEMBLIES C7246 SERIES, C7247 SERIES

The C7246 and C7247 series are DA type socket assemblies designed for 28 mm (1-1/8 inch) diameter side-on and head-on photomultiplier tubes. A voltage-divider circuit and an amplifier are incorporated in the same package.
The C7247 series uses an amplifier with a wide bandwidth of DC to 5 MHz, while the C7246 uses an amplifier with a practical bandwidth of DC to 20 kHz to improve the effective S/N ratio. The photomultiplier tube low-level, high-impedance current can be converted into a low-impedance voltage output.
Both the C7246 and C7247 series use an active voltage-divider circuit that ensures excellent DC linearity at low power consumption. The C7246 series also has a PMT gain adjustment function that does not affect amplifier frequency bandwidth.

Specifications

Parameter	C7246/C7246-22	C7246-01/C7246-23	C7247/C7247-22	C7247-01/C7247-23	Unit
Applicable PMTs	28 mm Dia. Head-on R374, R2228, R5929 R6094, R6095, etc.	28 mm Dia. Side-on	28 mm Dia. Head-on R374, R2228, R5929 R6094, R6095, etc.	28 mm Dia. Side-on	—

MAXIMUM RATINGS

Parameter	C7246/C7246-22	C7246-01/C7246-23	C7247/C7247-22	C7247-01/C7247-23	Unit
Supply Voltage for Amplifier	±18				V
Supply Voltage for Divider	-1500				V
Operating Ambient Temperature	0 to +40				°C
Storage Temperature	-15 to +60				°C

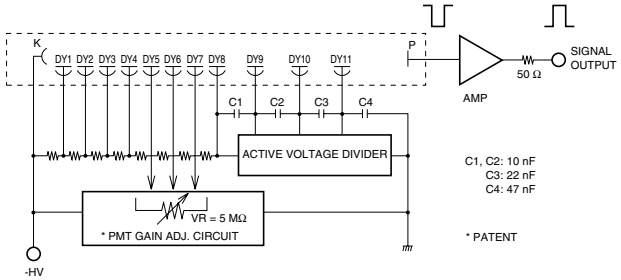
GENERAL

Parameter		C7246/C7246-22	C7246-01/C7246-23	C7247/C7247-22	C7247-01/C7247-23	Unit
Frequency Bandwidth (-3 dB)		DC to 20 kHz		DC to 5 MHz		—
Current to Voltage Conversion Factor		0.3 (at load resistance 10 kΩ)		0.15 (at load resistance 50 Ω)		V/μA
Maximum Output Signal Voltage		10 (at load resistance 10 kΩ)		3 (at load resistance 50 Ω)		V
Maximum Output Signal Current		18		60		mA
Output Impedance		50		50		Ω
Offset Voltage	Max.	±1		±3		mV
Output Noise Voltage (rms)	Typ.	0.09 (at load resistance 10 kΩ)		4.5 (at load resistance 50 Ω)		mV
PMT Gain Adjustable Range	Min.	10	30	—		dB
Supply Voltage for Amplifier		±12 to ±15		±12 to ±15		V
Supply Current for Amplifier (at ±15 V)	Max.	+20 / -0.53		+140 / -50		mA
Recommended Supply Voltage for Divider		-400 to -1000 Ⓐ	-300 to -1000 Ⓐ	-400 to -900	-300 to -600	V
Divider Current	Typ.	174 (at HV = -1000 V)	211 (at HV = -1000 V)	219 (at HV = -900 V)	166 (at HV = -600 V)	μA
Weight	Typ.	55 / 170	50 / 170	55 / 170	50 / 170	g

NOTE: Ⓐ If the output signal voltage is 3 V or higher (with 10 kΩ load), the divider circuit input voltage should be -600 V or higher. (C7246/-01/-22/-23)

Circuit Diagrams

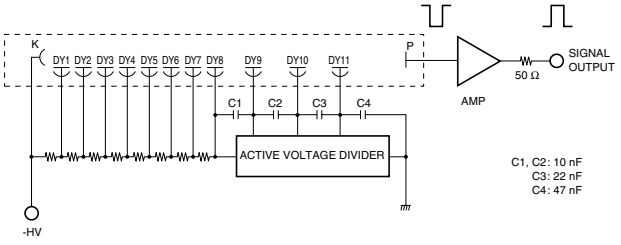
C7246 (-01Ⓑ/-22/-23Ⓑ)



NOTE: ⒷC7246-01/-23 are for 28 mm side-on PMT so that the last dynode number is "DY9"

TACCC0103EC

C7247 (-01Ⓑ/-22/-23Ⓑ)

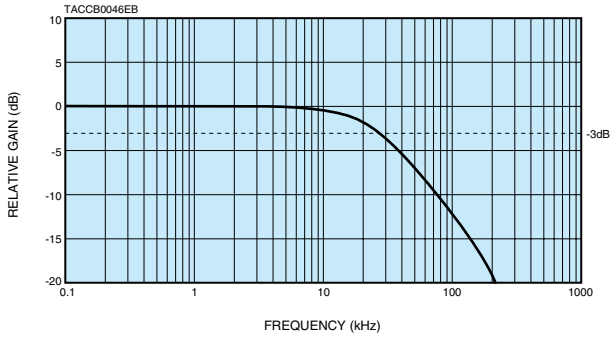


NOTE: ⒷC7247-01/-23 are for 28 mm side-on PMT so that the last dynode number is "DY9"

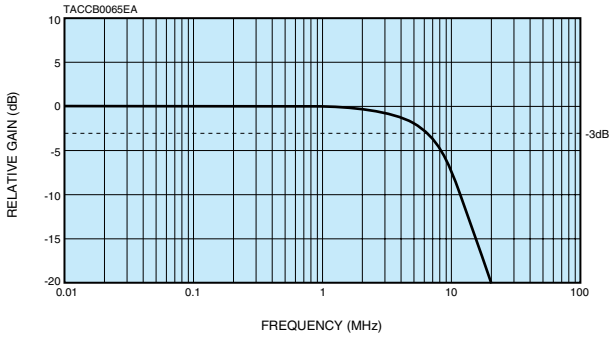
TACCC0115EB

Frequency Response of Built-in Amplifier

C7246/-01/-22/-23

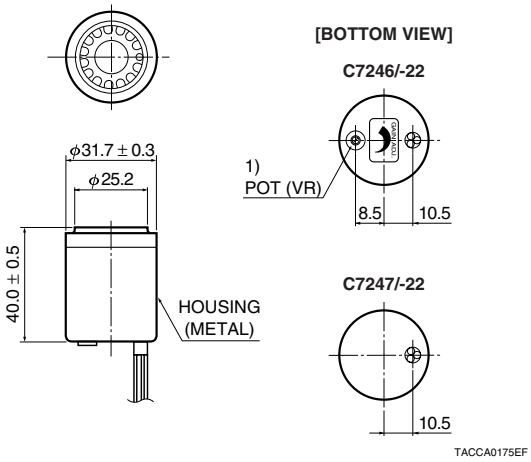


C7247/-01/-22/-23

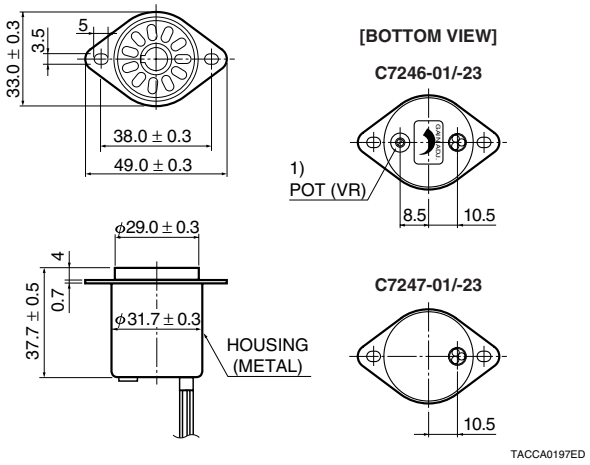


Dimensional Outlines (Unit : mm)

C7246/-22, C7247/-22



C7246-01/-23, C7247-01/-23



Type No.	Input/output	Cable Type	Cable Length	Connector
C7246/-01 C7247/-01	-HV	COAXIAL CABLE 2) (RED)	450 ± 10	—
	Signal Output	COAXIAL CABLE: RG-174/U (BLACK)		—
	±15 V	TWISTED PAIR CABLE WITH SHIELD 3) (GRAY)		—
C7246-22/-23 C7247-22/-23	-HV	COAXIAL CABLE (RED)	1500 ± 25	SHV-P
	Signal Output	COAXIAL CABLE: RG-174/U (BLACK)		BNC-P
	±15 V	TWISTED PAIR CABLE WITH SHIELD (GRAY)		DIN (6 PIN)-P

NOTES: 1) Turning this pot clockwise decreases the PMT gain. (25 turns max.)
2) At the end of HV cable, it's possible to attach SHV connector fitting RG-174/U.
3) Connect as follow.
WHITE····· -15 V
ORANGE···· +15 V
SHIELD····· GND

* See page 123 for details on flanges and housing.

HIGH VOLTAGE POWER SUPPLY SOCKET ASSEMBLY C6270, C9028-01, C9773, C8991, C10344-03 (DP Type)

C6270, C9028 and C9773 are high voltage power supply socket assemblies, incorporating a regulated high voltage power supply and an active voltage divider. It enables simple yet stable photomultiplier tube operations with extended DC output linearity by only supplying +15 V and connecting to a potentiometer or a 0 V to +5 V for high voltage adjustments.
The C8991 and C10344-03 use a Cockcroft-Walton type high voltage power supply that ensures high output linearity of photomultiplier tube while maintaining low power consumption.

Features (C6270, C9028-01, C9773)

- **Active Voltage Divider**
- **Superior DC Output Linearity**
- **Fast High Voltage Programming Response**
- **Wide High Voltage Output Range**
- **Low Ripple / Noise**

Features (C8991, C10344-03)

- **Cockcroft-Walton Circuit**
- **Low Power Consumption**
- **Superior DC Output Linearity**

Common Specifications

GENERAL

Parameter			C6270	C9028-01	C9773	C8991	C10344-03	Unit
Applicable PMTs			φ28 mm side-on type	φ28 mm head-on type R374, R2228 R5929, R6094 R6095, etc.	φ25 mm head-on type R1924A, R1925A R3550A, R5070A	φ28 mm side-on type	φ28 mm head-on type R374, R2228 R5929, R6094 R6095, etc.	—
Input Voltage			+15 ± 1			+11.5 to +15.5		V
Input Current		Typ.	45	60	50	8		mA
Linear DC Output Current of PMT Ⓐ	at -1000 V	Typ.	100 Ⓐ		90 Ⓐ	100 Ⓑ		μA
	at -500 V	Typ.	50 Ⓐ		45 Ⓐ	100 Ⓑ		μA
Operating Ambient Temperature / Humidity Ⓒ			0 to +40 / Below 80			0 to +50 / Below 85		°C/%
Storage Temperature / Humidity Ⓒ			-15 to +60 / Below 80			-15 to +60 / Below 85		°C/%
Weight		Typ.	50	60		57		g

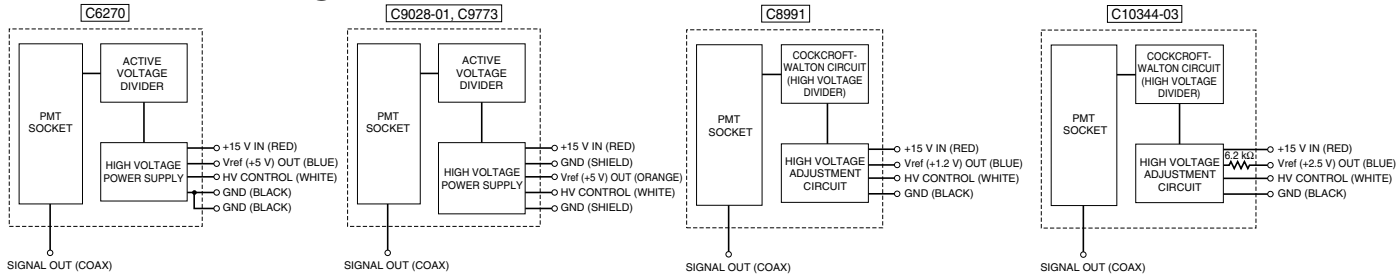
NOTE: Ⓐ Within: ±2 % linearity Ⓑ Within: ±0.5 % linearity Ⓒ No condensation

HIGH VOLTAGE POWER SUPPLY

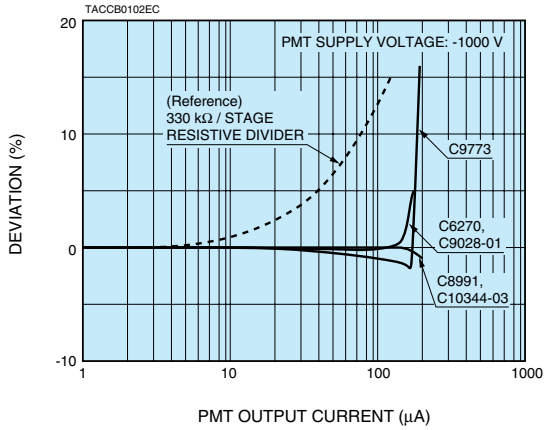
Parameter		C6270	C9028-01	C9773	C8991	C10344-03	Unit
Output Voltage Range		0 to -1250			-200 to -1200 Ⓖ	-200 to -1500	V
Line Regulation Against ±1 V Input Change	Typ.	±0.01					%
Anode Ripple Noise Ⓓ (p-p)	Typ.	0.5			1		mV
Output Voltage Control		0 V to +5 V or external 50 kΩ potentiometer			0 V to +1.2 V or external 10 kΩ potentiometer	0 V to +1.5 V or external 10 kΩ potentiometer	—
Output Voltage Programming Response Ⓔ	Typ.	80			—		ms
Settling Time Ⓕ		—			10		s
Temperature Coefficient	Typ.	±0.01			±0.005		%/°C

NOTE: Ⓓ Load resistance = 1 MΩ, Load capacitance = 20 pF Ⓔ for 0 %→99 % HV change
Ⓕ The 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.
Ⓖ C8991-01 with an output voltage range of -200 V to -1500 V is also provided.

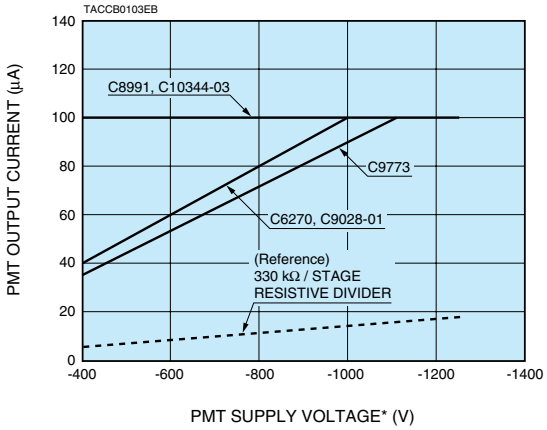
Schematic Diagrams



DC Linearity Characteristics

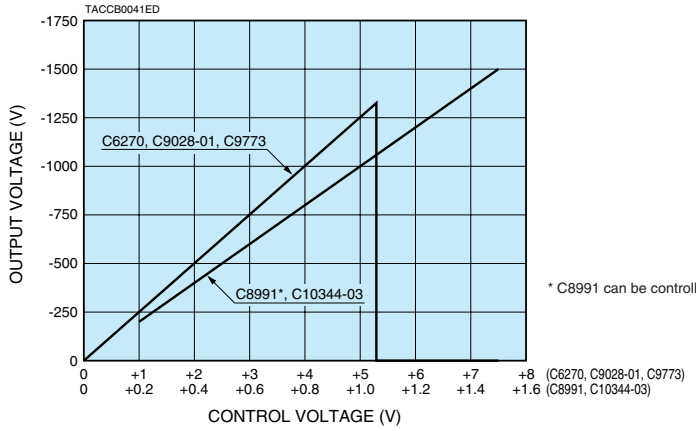


Practical PMT DC Output Limits



* Photomultiplier tube must be used with a supply voltage within the rated range.

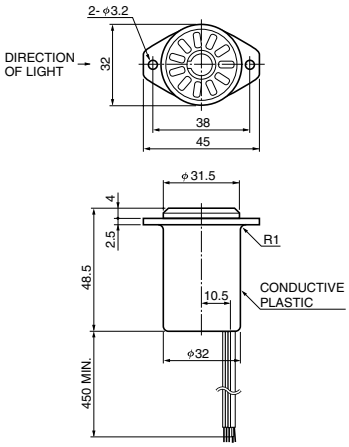
High Voltage Controlling Characteristics



* C8991 can be controlled up to +1.2 V (output voltage -1200 V).

Dimensional Outlines (Unit: mm)

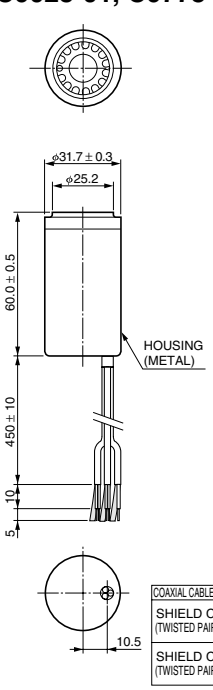
C6270



SIGNAL OUTPUT	COAXIAL CABLE RG-174/U
+15 V INPUT	AWG 24, RED
Vref OUTPUT	AWG 24, BLUE
HV CONTROL INPUT	AWG 24, WHITE
GND	AWG 24, BLACK
GND	AWG 24, BLACK

TACCA0156ED

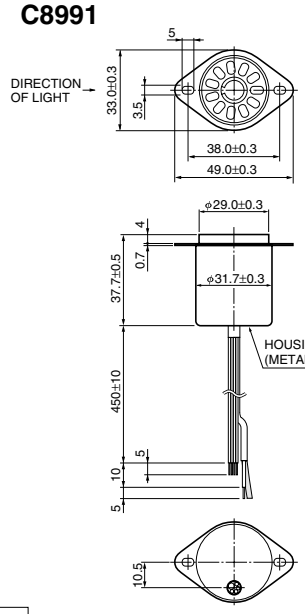
C9028-01, C9773



COAXIAL CABLE RG-174/U		SIGNAL OUTPUT	
SHIELD CABLE (TWISTED PAIR CABLE)	GRAY	HV CONTROL INPUT	WHITE
		Vref OUTPUT	ORANGE
		GND	SHIELD
SHIELD CABLE (TWISTED PAIR CABLE)	LIGHT BLUE	+15 V INPUT	RED
		—	BLUE
		GND	SHIELD

TACCA0258EA

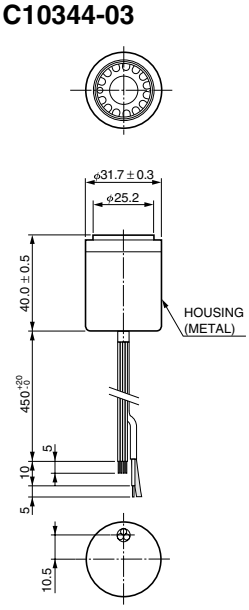
C8991



SIGNAL OUTPUT	COAXIAL CABLE RG-174/U
+15 V INPUT	AWG 24, RED
Vref OUTPUT	AWG 24, BLUE
HV CONTROL INPUT	AWG 24, WHITE
GND	AWG 24, BLACK

TACCA0053EE

C10344-03



SIGNAL OUTPUT	COAXIAL CABLE RG-174/U
+15 V INPUT	AWG 24, RED
Vref OUTPUT	AWG 24, BLUE
HV CONTROL INPUT	AWG 24, WHITE
GND	AWG 24, BLACK

TACCA0294EA

* See page 123 for details on flanges and housings.
(C9773 has no suitable flange and housing.)

HIGH VOLTAGE POWER SUPPLY SOCKET ASSEMBLY WITH TRANSIMPEDANCE AMPLIFIER C6271, C7950, C7950-01 (DAP Type)

These DAP type socket assemblies incorporate a regulated high voltage power supply and transimpedance amplifier that converts high-impedance current signals of a photomultiplier tube into low-impedance voltage signals.
The C7950 series are compatible with a wide band from DC to 5 MHz. The C6271 has lower noise than that of the C7950 series, although the frequency range is from DC to 10 kHz.

Features

- **Superior DC Output Linearity**
- **Fast High Voltage Programming Response**
- **Wide High Voltage Output Range**
- **Low Ripple / Noise**
- **Wide Frequency Bandwidth (C7950, C7950-01)**

Common Specifications

GENERAL

Parameter			C6271	C7950	C7950-01	Unit
Applicable PMTs			ϕ28 mm (1-1/8") side-on type		ϕ28 mm (1-1/8") head-on type R374, R2228, R5929 R6094, R6095, etc.	—
Input Voltage			+15 ± 1	±15 ± 1		V
Input Current	+15 V	Typ.	+55	+60	+65	mA
	-15 V	Typ.	—	-20		mA
Linear DC Output Current of PMT Ⓐ	at -1000 V	Typ.	43			µA
	at -500 V	Typ.	43			µA
Operating Ambient Temperature / Humidity Ⓑ			0 to +40 / Below 80			°C/%
Storage Temperature / Humidity Ⓑ			-15 to +60 / Below 80			°C/%
Weight		Typ.	55	65	70	g

NOTE: Ⓐ Within: ±2 % linearity Ⓑ No condensation

HIGH VOLTAGE POWER SUPPLY

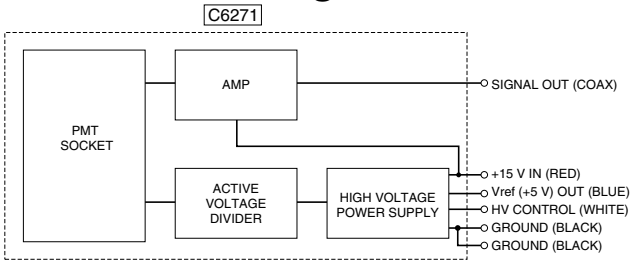
Parameter		C6271	C7950	C7950-01	Unit
Output Voltage Range		0 to -1250	0 to -900		V
Line Regulation Against ±1 V Input Change	Typ.	±0.01	±0.03		%
Output Voltage Control		0 V to +5 V or external 50 kΩ potentiometer	0 V to +3.6 V		—
Output Voltage Programming Response Ⓒ	Typ.	80			ms
Temperature Coefficient	Typ.	±0.01	±0.03		%/°C

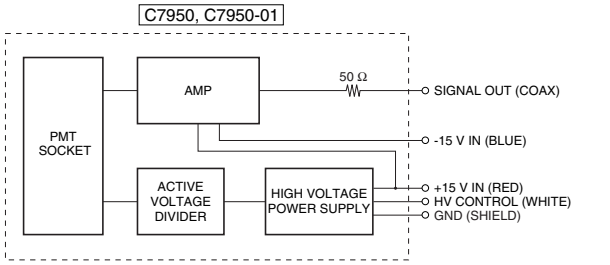
NOTE: Ⓒ for 0 %→99 % HV change

TRANSIMPEDANCE AMPLIFIER SECTION

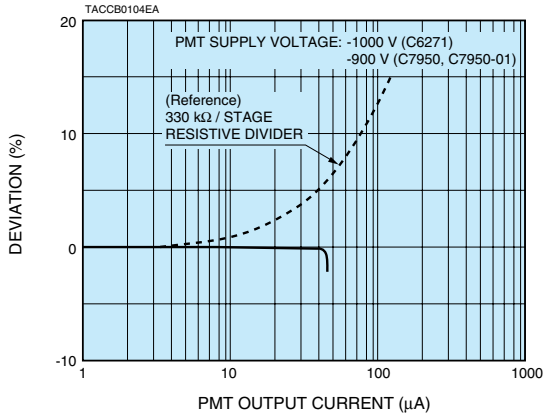
Parameter		C6271	C7950	C7950-01	Unit
Frequency Bandwidth (-3 dB)		DC to 10 kHz	DC to 5 MHz		—
Current to Voltage Conversion Factor		0.3 (at load resistance 10 kΩ)	0.15 (at load resistance 50 Ω)		V/µA
Maximum Output Voltage		+13 (at load resistance 10 kΩ)	+1.6 (at load resistance 50 Ω)		V
Signal Output Offset Voltage	Typ.	±0.3	±10		mV
Induced Ripple on Signal Output	Typ.	2 mV p-p	10 mV rms		—

Schematic Diagrams

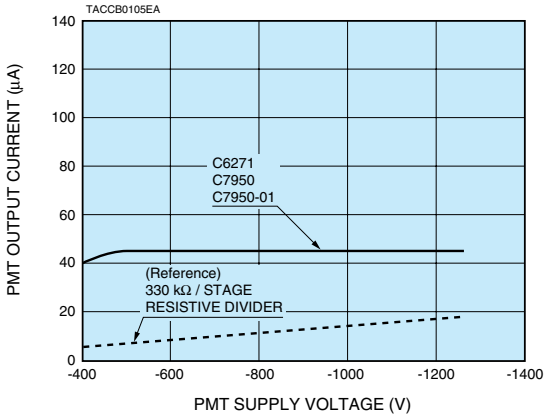




DC Linearity Characteristics

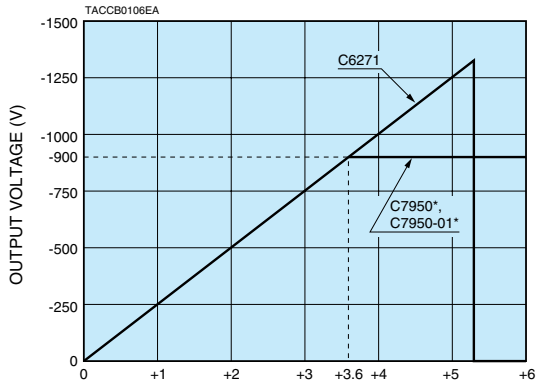


Practical PMT DC Output Limits



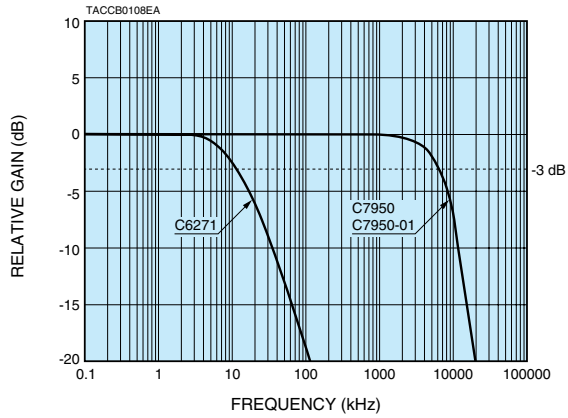
* Use the C7950 and C7950-01 in a range up to -900 V.

High Voltage Controlling Characteristics



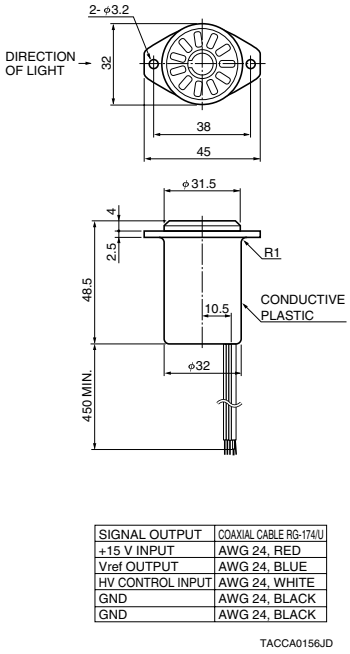
* The output is -900 V even if the control voltage is set higher than +3.6 V.

Frequency Bandwidth



Dimensional Outlines (Unit: mm)

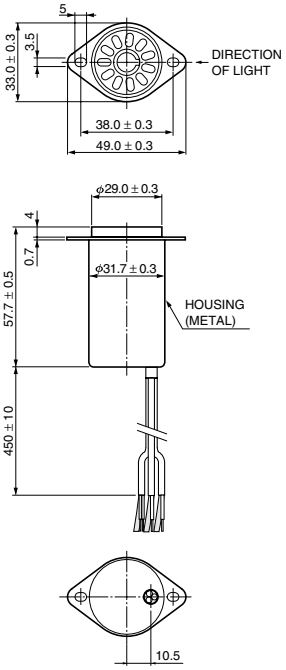
C6271



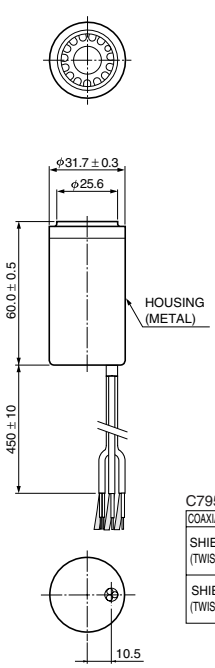
SIGNAL OUTPUT	COAXIAL CABLE RG-174/U
+15 V INPUT	AWG 24, RED
Vref OUTPUT	AWG 24, BLUE
HV CONTROL INPUT	AWG 24, WHITE
GND	AWG 24, BLACK
GND	AWG 24, BLACK

TACCA0156JD

C7950



C7950-01



C7950, C7950-01

COAXIAL CABLE RG-174/U	BLACK	SIGNAL OUTPUT	—
SHIELDED CABLE (TWISTED PAIR CABLE)	GRAY	HV CONTROL INPUT	WHITE
		—	ORANGE
		GND	SHIELD
SHIELDED CABLE (TWISTED PAIR CABLE)	LIGHT BLUE	+15 V INPUT	RED
		-15 V INPUT	BLUE
		GND	SHIELD

TACCA0261EA

* See page 123 for details on flanges and housings.