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APPENDIX II

PHOTOMULTIPLIER SPECIFICATIONS

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Side On Type Photomultiplier Tubes

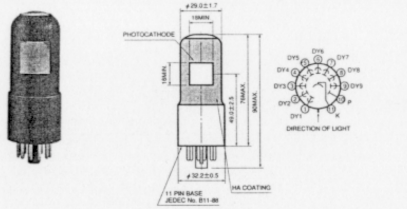
(at 25℃)

Type No.	Remarks	Spectral Response: Curve Code	Spectral Response: Range (nm)	Spectral Response: Peak Wavelength (nm)	Photocathode Material	Window Material	Outline No.	Dynode Structure: No. of Stages	Dynode Structure: Socket Assembly	Socket	Maximum Ratings: Anode to Cathode Voltage (Vdc)	Maximum Ratings: Average Anode Current (mA)	Cathode Sensitivity: Luminous Min. (μA/lm)	Cathode Sensitivity: Luminous Typ. (μA/lm)
28mm (1-1/8") Dia. Types with UV to Near IR Sensitivity														
R2368	Transmission-mode multialkali photocathode	500U	185 to 850	420	MA	U	❶	CC/9	E678-11A■/2|3		1250	0.1	80	150
R928	For UV to near IR, high sensitivity	562U	185 to 900	400	MA	U	❸	CC/9	E678-11A■/2|3		1250	0.1	140	250
R2949	For UV to near IR range, low dark current	552U	185 to 900	400	MA	U	❻	CC/9	E678-11A■/2|3		1250	0.1	140	200
*R1477-06	High sensitivity variant of R928	554U	185 to 900	450	MA	U	❸	CC/9	E678-11A■/2|3		1250	0.1	350	375
R3896	High sensitivity variant of R1477-06	555U	185 to 900	450	MA	U	❸	CC/9	E678-11A■/2|3		1250	0.1	475	525
R4632	High sensitivity in 400 to 700nm range, low dark current	556U	185 to 850	430	MA	U	❸	CC/9	E678-11A■/2|3		1250	0.1	140	200
R636-10	GaAs photocathode, high quantum efficiency	650U	185 to 930	300 to 800	GaAs(Cs)	U	❹	CC/9	E678-11A■/2|3		1500	0.001	400	550
R2658	InGaAs photocathode, for UV to 1010nm range	850U	185 to 1010	400	InGaAs (Cs)	U	❺	CC/9	E678-11A■/2|3		1500	0.001	50	100
R5108	For near IR range	751K	400 to 1200	800	Ag-O-Cs	K	❷	CC/9	E678-11A■/2|3		1500	0.1	10	25

Type No.	Cathode Sensitivity: Blue (5-58) Typ. (μA/lm-b)	Cathode Sensitivity: Red / White Ratio Typ.	Cathode Sensitivity: Radiant Typ. (mA/W)	Anode to Cathode Supply Voltage (Vdc)	Anode Characteristics: Anode Sensitivity: Luminous Min. (A/lm)	Anode Characteristics: Anode Sensitivity: Luminous Typ. (A/lm)	Anode Characteristics: Anode Sensitivity: Radiant Typ. (A/W)	Anode Characteristics: Current Amplification Typ.	Anode Characteristics: Anode Dark Current (After 30 min.): Typ. (nA)	Anode Characteristics: Anode Dark Current (After 30 min.): Max. (nA)	Anode Characteristics: Time Response: Rise Time Typ. (ns)	Anode Characteristics: Time Response: Electron Transit Time Typ. (ns)	Notes	Type No.
—	0.15	64	1000 ⑩	50	200	8.3×10^4	1.3×10^6	5	50	1.2	18		R2368
8.0	0.3	74	1000 ⑩	400	2500	7.4×10^5	1.0×10^7	3	50	2.2	22	Synthetic silica window type: R955	R928
7.5	0.3	68	1000 ⑩	1000	2000	6.8×10^5	1.0×10^7	300[h]	500[h]	2.2	22		R2949
10.0	0.35	80	1000 ⑩	1000	2000	4.2×10^5	5.3×10^6	3	50	2.2	22		R1477-06*
15.0	0.4	90	1000 ⑩	3000	5000	8.6×10^5	9.5×10^6	10	50	2.2	22		R3896
7.5	0.15	80	1000 ⑩	300	700	2.8×10^5	3.5×10^6	50[h]	100[h]	2.2	22		R4632
9.0	0.53	62	1250 ⑩	100	250	2.8×10^4	4.5×10^5	0.1[f]	2[f]	2.0	20	Synthetic silica window type : R758-10	R636-10
4.5	0.4	1 (at 1 μm)	1250 ⑩	5	16	1.6×10^2	1.6×10^5	1	10	2.0	20	Photon counting type: R2658P	R2658
—	—	2.2	1250 ⑩	3.5	7.5	6.6×10^3	3.0×10^5	350[g]	1000[g]	1.2	18		R5108

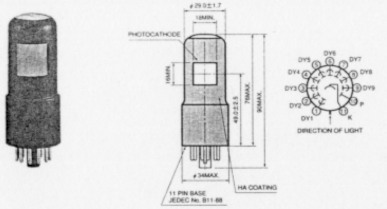
(Unit: mm)

❶ R2368



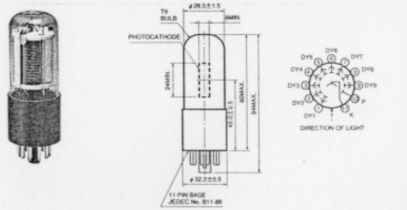
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❷ R5108



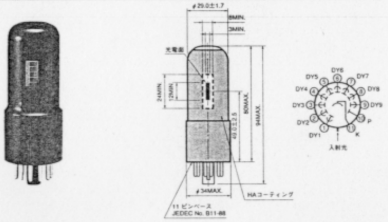
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❸ R928, R1477-06, R4632, etc.



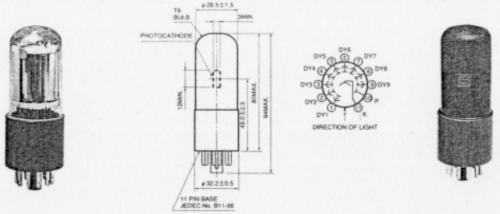
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❹ R636-10



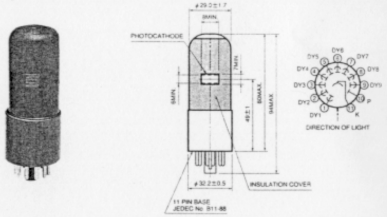
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❺ R2658



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❻ R2949



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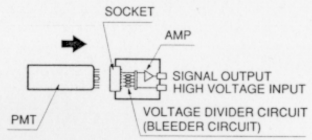
Socket Assemblies

(For further information, a detailed catalog is available.)

Operating a photomultiplier tube requires a voltage-divider circuit (bleeder circuit). For easier handling and operation of photomultiplier tubes, Hamamatsu provides a complete line of socket assemblies which are carefully engineered to integrate a socket and optimum voltage-divider circuit into a compact case. In addition, socket assemblies which further include a preamplifier or high-voltage power supply are available.

The socket assemblies are classified into three types by their functions as described below.

DA-Type Socket Assemblies (with built-in voltage divider and amplifier)

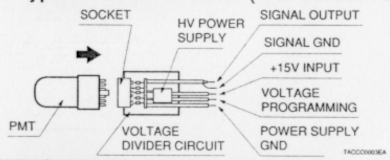


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The DA-type socket assemblies incorporate a current-to-voltage conversion amplifier in addition to a voltage-divider circuit. High voltage (for PMT) and low voltage (for amplifier) power supplies are required. Since the high impedance output of the photomultiplier tube is connected to the amplifier at a minimum distance, the problem of external noise induced in connecting cables can be eliminated. Two families of DA-type socket assemblies are available: the C1556 series for a bandwidth from DC to 10kHz and the C1053 series from DC up to 5MHz. Both families are designed for use with 28mm (1-1/8 inch)diameter side-on and head-on photomultiplier tubes.

Type No.		C1556-50	C1556-51	C1556-03	C1053-50	C1053-51	C1053-03
Applicable PMT		28mm (1-1/8") dia. Head-on	28mm (1-1/8") dia. Side-on	BNC Connector Input	28mm (1-1/8") dia. Head-on	28mm (1-1/8") dia. Side-on	BNC Connector Input
Max. Supply Voltage to Voltage Divider		−1500Vdc		—	−1500Vdc		—
Supply Voltage to Amplifier		±12 to 15Vdc			±12 to 15 Vdc		
Current-to-Voltage Conversion Factor		0.3 V/μA			0.3V/μA		
Max. Input Signal Current (at -1000V, 10V output)	DC	12.5 μA	15 μA	33 μA	12.5 μA	15 μA	33 μA
	Pulse	33 μA			33 μA(DC to 2.5MHz) 6.6 μA(DC to 5MHz, 2V output)		
Max. Output Voltage (Unterminated)		10V peak (10 kHz)			10V peak (2.5MHz), 2V peak (5MHz)		
Frequency Bandwidth		DC to 10 kHz			DC to 5MHz		

DP-Type Socket Assemblies (with built-in voltage divider and power supply)

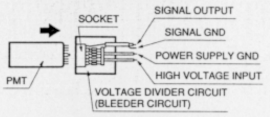


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The DP-type socket assemblies feature a built-in voltage divider and compact high-voltage power supply. By applying a +15 V supply to the power supply, easy operation of a photomultiplier tube is possible. As standard products, the C956 series assemblies are provided for use with 28mm (1-1/8 inch) diameter side-on and head-on photomultiplier tubes.

Type No.	C6270	C956-07
Applicable PMT	28mm (1-1/8") dia. side-on	28mm (1-1/8") dia. head-on
Input Voltage	+15±1Vdc	
Input Current	45 mA Max.	140mA Max.
Output Voltage Range	0 to −1250 Vdc Typ.	−200 to −1250Vdc Typ.
Input Regulation	±0.01% Typ. (at +15±1Vdc)	±0.05% Max. (at +15±1Vdc)
Maximum PMT Signal Output at −1000V	100 μA Typ.	15mA μA Typ.

D-Type Socket Assemblies



TACCD0001EA

The D-type socket assemblies incorporate a socket and voltage-divider circuit. A high voltage power supply and a current/electric charge signal processing circuit are required. The following four types are available according to the grounded electrode, supply voltage polarity and output signal form.

1. Anode ground, DC output
2. Anode ground, DC/pulse output
3. Cathode ground, pulse output
4. Anode or cathode ground, DC/pulse output

For Side-On Photomultiplier Tubes

Code	Socket Assembly Type No.	Applicable PMT Diameter	Grounded Electrode/ Supply Voltage Polarity	Output Signal
1	E850 -13	13mm(1/2")	Anode/−	DC/Pulse
2	E717 -63	28mm(1-1/8")	Anode/−	DC/Pulse
3	-35		Anode/− • Cathode/+	DC/Pulse

For Head-On Photomultiplier Tubes

Code	Socket Assembly Type No.	Applicable PMT Diameter	Grounded Electrode/ Supply Voltage Polarity	Output Signal
4	-04	10mm(3/8")	Anode/−	DC/Pulse
5	-05		Anode/−	DC/Pulse
6	-21		Anode/−	DC/Pulse
7	-35	13mm(1/2")	Anode/−	DC/Pulse
8	-52		Anode/−	DC/Pulse
9	-68		Anode/−	DC/Pulse
10	-90		Anode/−	DC/Pulse
11	E2253 -08	19mm(3/4")	Cathode/+	Pulse
12	-05		Anode/−	DC/Pulse
13	E974 -13		Anode/−	DC/Pulse
14	-14		Cathode/+	Pulse
15	-17		Anode/−	DC/Pulse
16	-18		Anode/−	DC/Pulse
17	-22		Anode/−	DC/Pulse
18	E2924	25mm(1")	Anode/−	DC/Pulse
19	-500		Anode/−	DC/Pulse
20	-05		Cathode/+	Pulse
21	E2624 -500		Anode/−	DC/Pulse
22	E2624	28mm(1-1/8")	Anode/−	DC/Pulse
23	-05		Cathode/+	Pulse
24	E990 -07		Anode/−	DC/Pulse
25	-08		Cathode/+	Pulse
26	-28		Anode/−	DC/Pulse
27	E2183 -502	38mm(1-1/2")	Cathode/+	Pulse
28	-500		Anode/−	DC/Pulse

NOTE) Please consult our sales office when you use a photomultiplier tube in a vacuum.

Code	Socket Assembly Type No.	Applicable PMT Diameter	Grounded Electrode/ Supply Voltage Polarity	Output Signal
29	E1198 -502	51mm(2") [76mm(3")] [127mm(5")]	Cathode/+	Pulse
30	-05		Anode/−	DC/Pulse
31	-07		Anode/−	DC/Pulse
32	-22		Anode/−	DC/Pulse
33	E2380 -500		Anode/−	DC/Pulse
34	-501		Anode/−	DC/Pulse
35	-502		Anode/−	DC/Pulse
36	-503		Anode/−	DC/Pulse
37	E2979 -500		Anode/−	DC/Pulse
38	E4512 -503		Cathode/+	Pulse
39	-504		Cathode/+	Pulse
40	-505		Cathode/+	Pulse
41	E934 -503		Anode/−	DC/Pulse
42	E1435 -02		Anode/−	DC/Pulse
43	E4229 -501		Anode/−	DC/Pulse
44	E1458 -501		Anode/−	DC/Pulse
45	-502		Cathode/+	Pulse
46	E6133 -03	25mm(1") For highly magnetic environments	Anode/−	DC/Pulse
47	E6132-02	51mm(2") For highly magnetic environments	Anode/−	DC/Pulse

Metal Package Photomultiplier Tubes

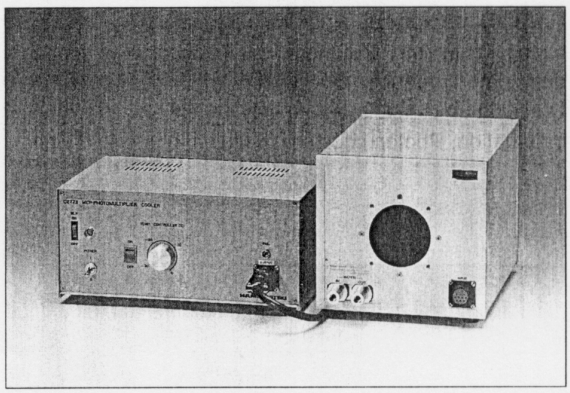
Code	Socket Assembly Type No.	Applicable PMT	Grounded Electrode/ Supply Voltage Polarity	Output Signal
48	E5780	R5600U	Anode/−	DC/Pulse
49	E5996	R5900U	Anode/−	DC/Pulse

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Thermoelectric Coolers

(For more information, a detailed catalog is available.)

The thermionic electron emission from a photocathode and dynodes is a major factor that determines the dark current of the photomultiplier tube. (See page 8.) Cooling the photomultiplier tube can efficiently reduce the dark current and improve the S/N ratio, resulting in an significant enhancement in the detection limit. Hamamatsu provides a variety of thermoelectric coolers specifically designed for photomultiplier tubes to meet various needs.



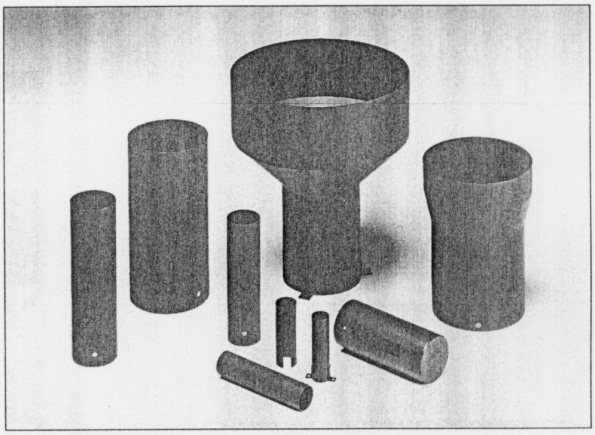
▲ C2773

Type No.	Applicable PMT	Input Voltage (Vac)	Cooling Temperature (℃)★	Remarks
C659-70 Series	28mm (1-1/8") Dia. Side-on	100/115/220	Approx. −15	
C659-50 Series	28mm (1-1/8"),38mm (1-1/2") Dia. Head-on	100/115/220	Approx. −20	
C2761 Series	38mm (1-1/2") ,51mm (2") Dia. Head-on	100/115/120/220/230/240	Approx. −30	Temperature controllable
C2773 Series	MCP-PMT	100/115/120/220/230/240	Approx. −30	Temperature controllable

★ With +20℃ coolant.
Socket assemblies and holders are sold separately.

Magnetic Shield Cases

Photomultiplier tubes are generally very susceptible to magnetic fields. Even terrestrial magnetism will have a detrimental effect on the photomultiplier tube output. (See page 9.) Hamamatsu E989 series magnetic shield cases are designed to protect photomultiplier tubes from magnetic field effects. Since the E989 series magnetic shield cases are made of permalloy which has high permeability (about 10^5), the magnetic field strength within the shield case with respect to the external magnetic field strength (the reciprocal of this is called shielding factor) can be greatly attenuated down to 1/1000 to 1/10000, thus ensuring stable output from photomultiplier tubes even operating in magnetic fields.



▲ Magnetic Shield Cases

Applicable PMT Diameter		Type No.	Internal Diameter (mm)	Thickness (mm)	Length (mm)	Weight (g)
Side-on	13 mm (1/2")	E989-10	14.5	0.5±0.1	47±0.5	10
	28 mm (1-1/8")	E989	33.6±0.8	0.8±0.1	80±1	66
Head-on	10 mm (3/8")	E989-28*	12 ±0.5	0.5±0.1	48±0.5	9
	13 mm (1/2")	E989-09	16 ±0.5	0.8±0.1	75±0.5	28
	19 mm (3/4")	E989-02	23 ±0.5	0.8±0.1	95±1	50
	25 mm (1")	E989-39	29 ±0.5	0.8±0.1	48±0.5	32
	28 mm (1-1/8")	E989-03	32 ±0.5	0.8±0.1	120±1	90
	38 mm (1-1/2")	E989-04	44 $^{+1}_{-0}$	0.8±0.1	100±1	102
	51 mm (2")	E989-05	60 $^{+1}_{-0}$	0.8±0.1	130±1	180
	76 mm (3")	E989-15	80 $^{+1.5}_{-0}$	0.8±0.1	120±1	200
	127 mm (5")	E989-26*	138 ±1.5	0.8±0.1	170±1	600

* With mounting tabs.

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