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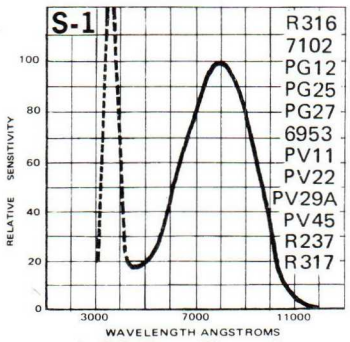
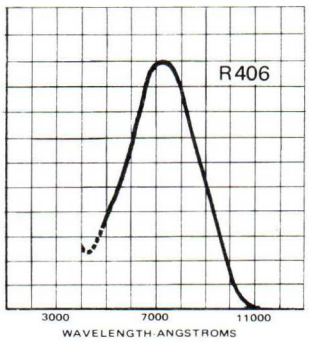
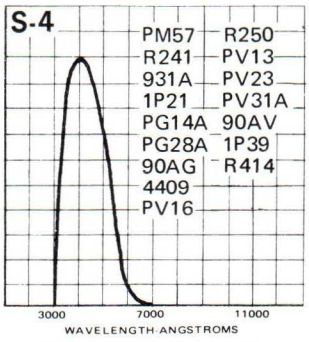
RELATIVE SPECTRAL RESPONSE CURVES



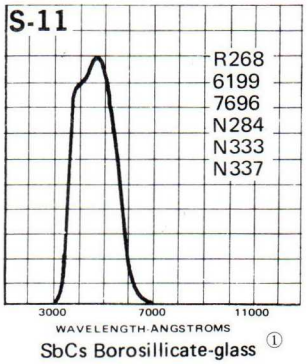
AgOCs Borosillicate-glass



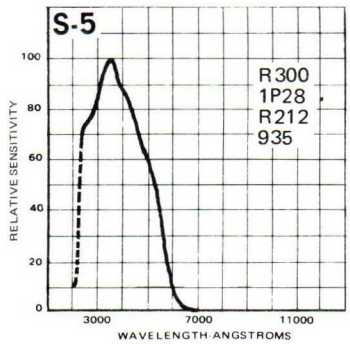
Similar to AgOCs



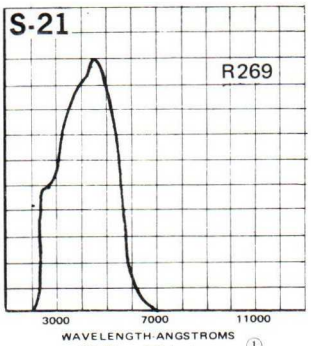
SbCs Borosillicate-glass



SbCs Borosillicate-glass ①



SbCs UV-glass



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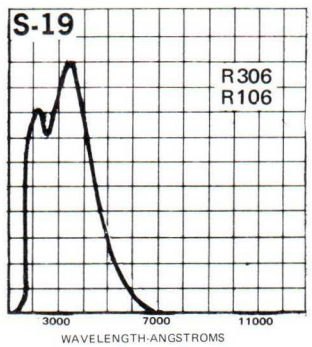
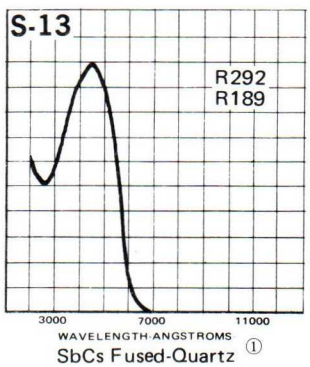


SbCs Fused-Quartz



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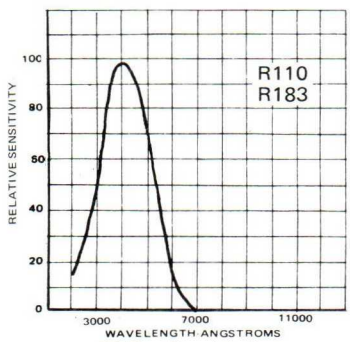
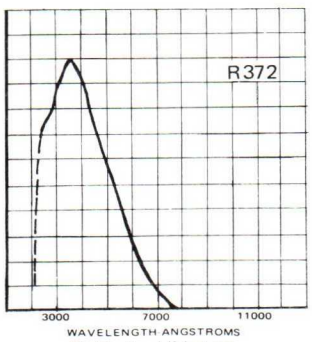
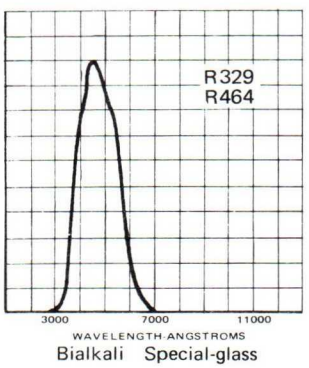


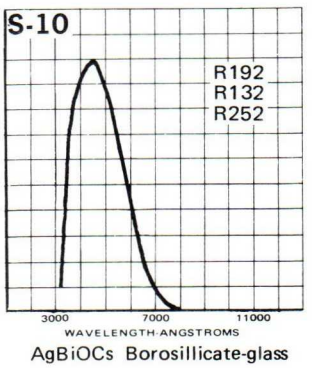
SbCs Special-glass



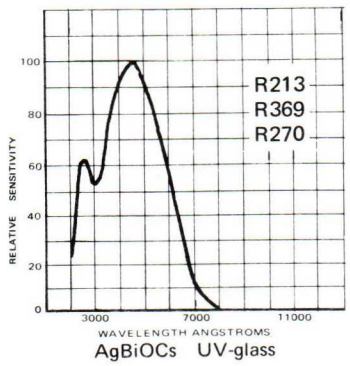
Bialkali UV-glass



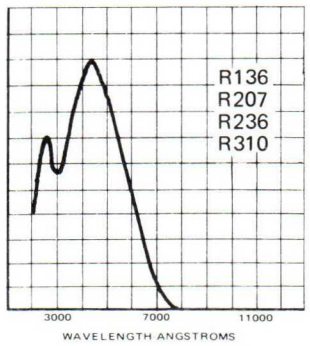
Bialkali Special-glass



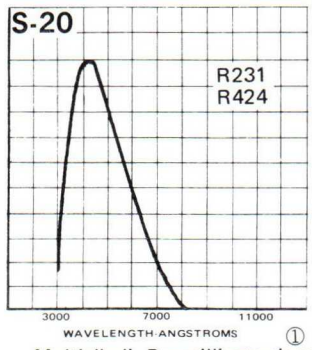
AgBiOCs Borosillicate-glass



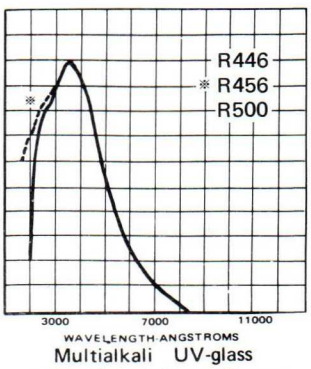
AgBiOCs UV-glass



AgBiOCs Fused-Quartz

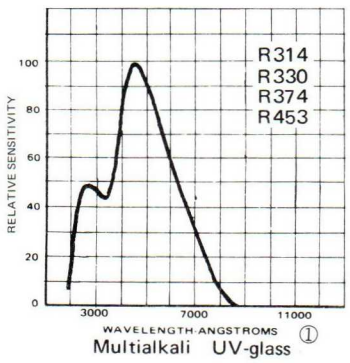


Multialkali Borosillicate-glass ①

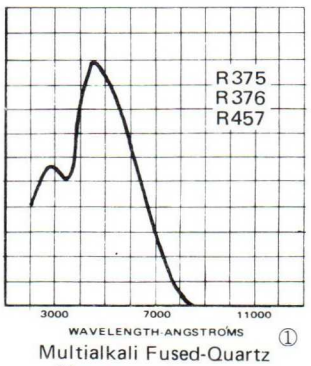


Multialkali UV-glass

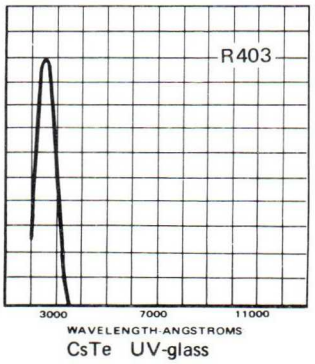
※ Multialkall Fused-Quartz



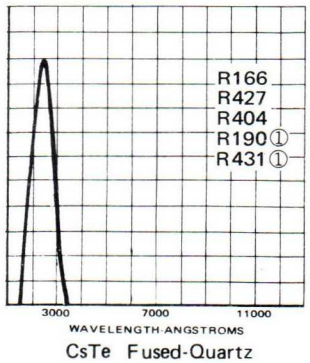
Multialkali UV-glass ①



Multialkali Fused-Quartz ①



CsTe UV-glass

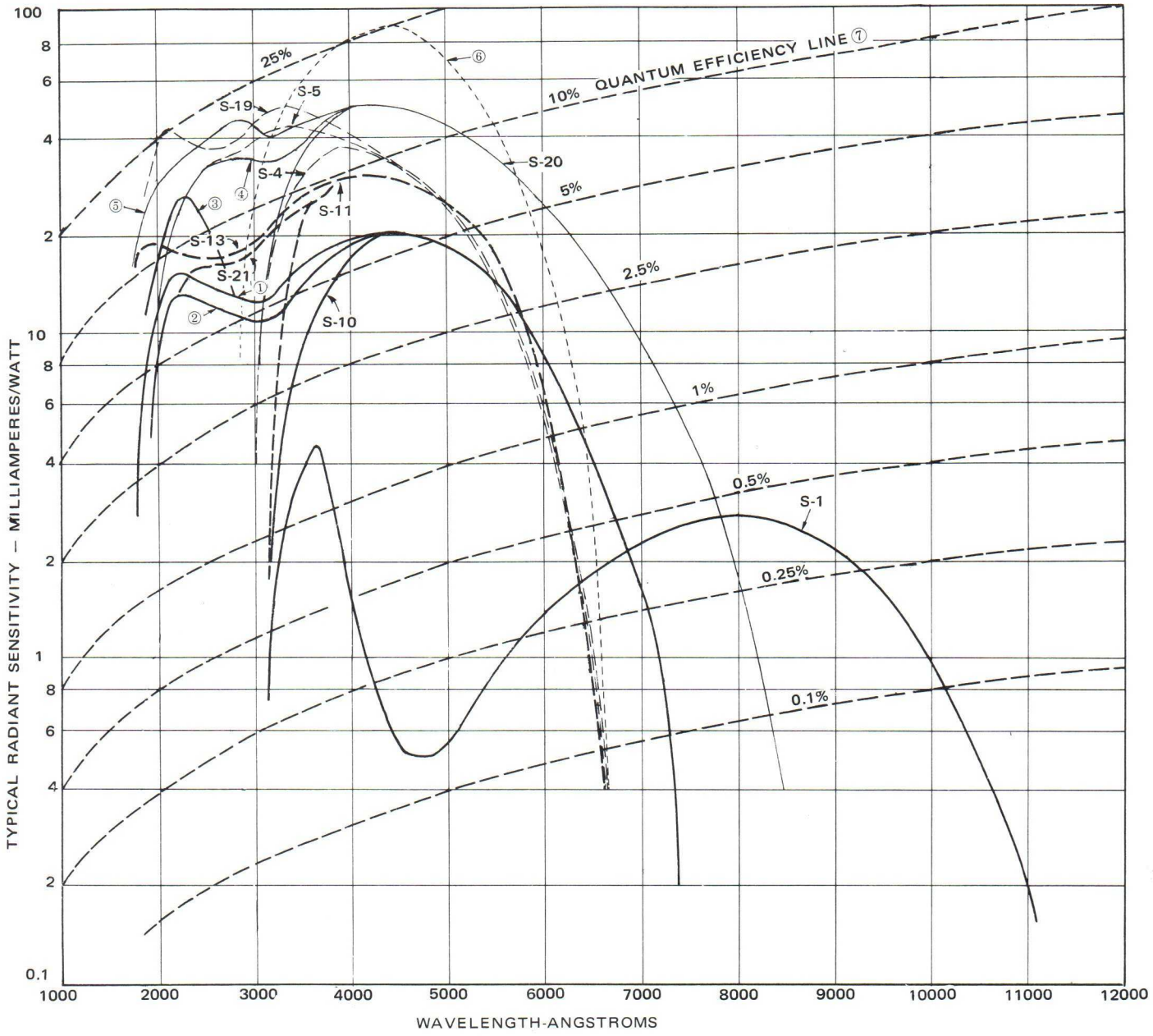


CsTe Fused-Quartz

Notes

① Semitransparent Photocathode

Typical Spectral Response Characteristics of Photocathode



These spectral sensitivity curves are based on typical values of cathode radiant sensitivity for the different photocathode and window materials. Lines of constant quantum efficiency are shown on the graph. Quantum efficiency in percent at any given wavelength can be calculated from the following formula:

$$QE = Sk \left(\frac{12395}{\lambda x}\right) \times 100\ (\%)$$

where QE is the quantum efficiency in percent at λx. Sk is the cathode radiant sensitivity at λx in amperes per watt. λx is the wavelength in angstroms.

As an example in the use of this formula consider tube R136 which has a rated cathode radiant sensitivity of 0.02 ampere per watt at 4300 angstroms. Therefore,

$$QE = 0.02 \left(\frac{12395}{4300}\right) \times 100 \approx 5.8\%$$

Notes:

①..... For type R136, R207, R236 and R310. An S-number has not been assigned for this spectral response characteristic. Its photocathode type and envelope is shown in page 2.

②..... For type R213, R270 and R369. Its photocathode type and envelope is shown in page 2.

③..... For type R166, R427, R190, R431 and R404. Its CsTe photocathode sensitivity is measured at 2537 angstroms in mA per watt. The tentative values are shown in page 5, page 7 and page 9.

④..... For type R374, R453, R314 and R330. Its photocathode type and envelope is shown in page 2.

⑤..... For type R375, R376 and R457. Its photocathode type and envelope is shown in page 2.

⑥..... For type R329 and R464. Its photocathode type and envelope is shown in page 2.

⑦..... 100 percent quantum efficiency implies one photoelectron per incident quantum, or $e/h\nu = {}^{\lambda}/_{12395}$, where λ is expressed in angstrom units. Quantum efficiency at maximum response is computed by comparing the radiant sensitivity at maximum response with the 100 percent quantum efficiency.

SIDE-ON TYPE PHOTOMULTIPLIER TUBES

Type	Nominal Diameter	Dimensional Outline ①	Basing Diagram ②	Number of Stage	Spectral Response ③	Wavelength of Maximum Response ③ (angstroms)	Window Material	Photocathode Material	Maximum Anode to Cathode Voltage (dc only)
R300	1/2″	1	A	9	S-5	3400	U.V. glass	Sb-Cs	1000
R3U6		1	A	9	S-19	3300	Quartz ⑨	Sb-Cs	1000
R427		1	A	9	1600~3200	2200	Quartz ⑨	Cs-Te	1000
R500		1	A	9	1850~8500	3500	U.V. glass	Multi Alkali	1000
PM57	3/4″	2	B	3	S-4	4000	⑰	Sb-Cs	500
R241	7/8″	3	C	4	S-4	4000	⑰	Sb-Cs	500
R252		3	C	4	S-10	4300	⑰	Ag-Bi-O-Cs	500
931A	1-1/8″	4	D	9	S-4	4000	⑰	Sb-Cs	1250
1P21		4	D	9	S-4	4000	⑰	Sb-Cs	1250
1P28		4	D	9	S-5	3400	U.V. glass	Sb-Cs	1250
R212		4	D	9	S-5	3400	U.V. glass	Sb-Cs	1250
R372		4	D	9	1850~7300	3400	U.V. glass	Bialkali	1250
R106		4	D	9	S-19	3300	Quartz ⑨	Sb-Cs	1250
R213		4	D	9	1850~8000	4300	U.V. glass	Ag-Bi-O-Cs	1250
R270		5	E	9	1850~8000	4300	U.V. glass	Ag-Bi-O-Cs	1250
R136		4	D	9	1600~8000	4300	Quartz ⑨	Ag-Bi-O-Cs	1250
R197		4	D	9	–	–	Windowless	Au, Cu, Be	2500
R166		4	D	9	1600~3200	2200	Quartz ⑨	Cs-Te	1250
R406		4	D	9	Similar to S-1	7300	⑰	Ag-O-Cs	1500
R446		4	D	9	1850~8500	3500	U.V. glass	Multi Alkali	1250
R456		4	D	9	1600~8500	3400	Quartz ⑨	Multi Alkali	1250

Notes:

① ..... For dimensional outline, see page 16.

② ..... See basing diagrams shown in bottom of this page.

③ ..... For spectral sensitivity curves, see page 2 to 3.

④ ..... Ambient temperature of all the types is ranged from −80°C to +50°C.

⑤ ..... Average over any interval of 30 seconds maximum.

⑥ ..... On basis of tungsten-filament light source operated at 2854°K.

⑦ ..... Measured at wavelength of maximum response.

⑧ ..... Supply voltage (E) across a voltage divider providing 1/10 of E between cathode and dynode No. 1, 1/10 of E for each succeeding dynode stage; and 1/10 of E between dynode No. 9 and anode.

⑨ ..... CAUTION: When replacing the tube, be sure to hold only by the base. Use care in handling so as not to give any shock to the bulb.

⑩ ..... The light source is a low pressure mercury lamp with Fused-Quartz window (dominant radiating spectral line is 2537 angstroms).

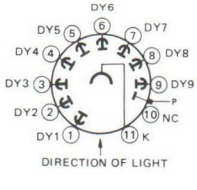
⑪ ..... Supply voltage (E) across a voltage divider providing 1/4 of E between cathode and dynode No. 1; 1/4 of E for each succeeding dynode stage; and 1/4 of E between dynode No. 3 and anode.

⑫ ..... Supply voltage (E) across a voltage divider providing 1/5 of E between cathode and dynode No. 1; 1/5 of E for each succeeding dynode stage; 1/5 of E between dynode No. 4 and anode.

⑬ ..... The red and white light sensitivity ratio (min.) is calculated as R-IK/W-IK:

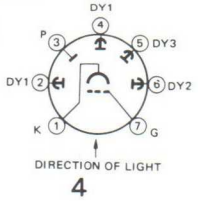
R-IK ..... Cathode current is measured with incident light transmitted from a tungsten-filament lamp operated at a color temperature of 2854°K through a red filter (Corning 2-62 sharp cut filter). The value of light flux on the filter is 0.01 lumen. The load resistor has a value of 0.01 megohm, and 100 volts are applied between the cathode and all other electrodes together as anode.

A



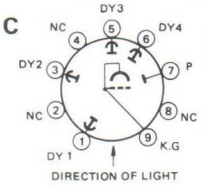
R300
R306
R427
R500

B



PM57

C

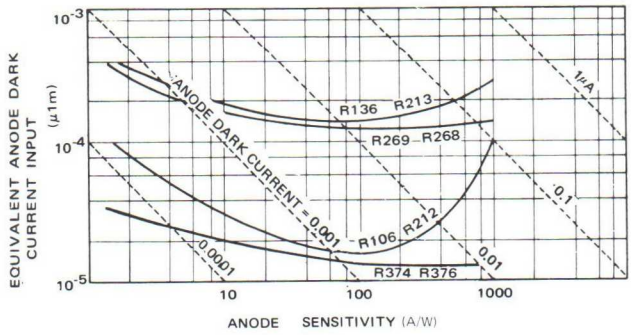


R241
R252

Typical Equivalent Anode-Dark-Current Input Characteristics

Note:

Equivalent anode-dark-current input (EADCI) as a function of the luminous sensitivity for various photomultiplier tubes. The EADCI represents the light flux which would result in an output current change just equal to the dark current. Optimum operating range is usually where this function is near a minimum.



Ratings (Absolute Values) ④		Characteristics at 25°C and Specified Voltage									Direct Interelectrode Capacitances		
			Cathode Sensitivity			Anode Sensitivity							
Average Anode Current (mA) ⑤	Anode to Last Dynode Voltage (dc volts)	Anode to Cathode Voltage (dc volts)	Cathode Luminous (μA/lumen) ⑥		Red and White Light Sensitivity Ratio Min.	Anode Luminous at 0 cps (A/lumen)		Anode Radiant Sensitivity (A/W) ⑦	Current Amplification	Maximum Anode Dark Current (μA)	Anode to Last Dynode (pF)	Anode to All Other Electrodes (pF)	Type
			Min.	Median		Min.	Median						
0.01	150	1000 ⑧	10	30	–	30	60	6.6×10^4	2×10^6	0.007	1.7	2	R300
0.01	150	1000 ⑧	0	30	–	30	60	7.2×10^4	2×10^6	0.007	1.7	2	R306
0.01	150	1000 ⑧	–	–	–	1000 ⑩ A/W	4000 ⑩ A/W	5.6×10^3	2×10^5	0.0005	1.7	2	R427
0.01	150	1000 ⑧	20	35	0.06 ⑭	30	80	–	2.3×10^6	0.01	1.7	2	R500
0.01	150	400 ⑪	20	40	–	0.001	0.003	2.9	7.5 X 10	0.001	2.5	3.2	PM57
0.01	150	400 ⑫	20	40	–	0.003	0.01	9.8	2.5×10^2	0.001	1	2	R241
0.01	150	400 ⑫	10	40	–	0.003	0.01	5.2	2.5×10^2	0.001	1	2	R252
0.1	250	1000 ⑧	10	30	–	20	100	9.8×10^4	3.3×10^6	0.5	4	6	931A
0.1	250	1000 ⑧	20	40	–	40	150	1.5×10^5	3.75×10^6	0.01	4	6	1P21
0.1	250	1000 ⑧	10	40	–	20	100	1.1×10^5	2.5×10^6	0.1	4	6	1P28
0.1	250	1000 ⑧	10	40	–	40	120	1.4×10^5	3×10^6	0.01	4	6	R212
0.1	250	1000 ⑧	10	40	0.05 ⑬	40	120	1.4×10^5	3×10^6	0.05	4	6	R372
0.1	250	1000 ⑧	10	40	–	50	120	1.5×10^5	3×10^6	0.01	4	6	R106
0.1	250	1000 ⑧	10	40	0.035 ⑭	20	80	4.2×10^4	2×10^6	0.2	4	6	R213
0.1	250	1000 ⑧	10	40	0.035 ⑭	20	80	4.2×10^4	2×10^6	0.2	4	6	R270
0.1	250	1000 ⑧	10	40	0.035 ⑭	20	80	4.2×10^4	2×10^6	0.2	4	6	R136
0.05	250	2300 ⑧	–	–	–	–	–	–	1.7×10^5	0.01	4	6	R197
0.01	250	1000 ⑧	–	–	–	1000 ⑩ A/W	4000 ⑩ A/W	5.6×10^3	2×10^5	0.0005	4	6	R166
0.01	250	1250 ⑧	10	20	IR/W 0.04 ⑮	1	4	3.8×10^3	2.5×10^5	0.1 ⑯	4	6	R406
0.1	250	1000 ⑧	20	35	0.06 ⑭	40	80	–	2.3×10^6	0.05	4	6	R446
0.1	250	1000 ⑧	20	35	0.06 ⑭	40	80	–	2.3×10^6	0.05	4	6	R456

W-IK ..... Test condition is the same as the (R-IK) except that a filter is not used.

⑭..... The red and white light sensitivity ratio (min.) is calculated as R-IK/W-IK:

R-IK..... Cathode current is measured with incident light transmitted from a tungsten-filament lamp operated at a color temperature of 2854°K through a red filter (Toshiba V-R68 sharp cut filter). The value of light flux on the filter is 0.01 lumen. The load resistor has a value of 0.01 megohm, and 100 volts are applied between the cathode and all other electrodes together as anode.

W-IK..... Test condition is the same as the (R-IK) except that a filter is not used.

⑮..... Medium Value:

The infrared and white light sensitivity ratio is calculated as IR-IK/W-IK:

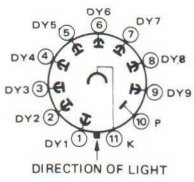
IR-IK.... Cathode current is measured with incident light transmitted from a tungsten-filament lamp operated at a color temperature of 2854°K through an infrared filter (Toshiba IR-DIA infrared filter). The value of light flux on the filter is 0.01 lumen. The load resistor has a value of 0.01 megohm, and 100 volts are applied between the cathode and all other electrodes together as anode.

W-IK..... Test condition is the same as the (IR-IK) except that a filter is not used.

⑯..... Measured with supply voltage (E) adjusted to give a luminous sensitivity of 2 amperes per lumen.

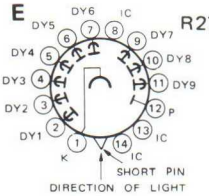
⑰..... Borosillicate glass

D

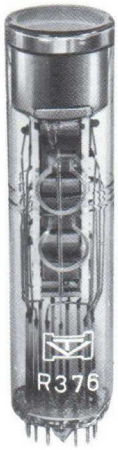


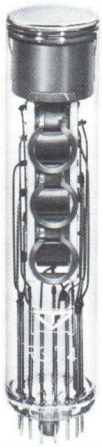
931A R106 R166
1P21 R213 R406
1P28 R136 R446
R212 R197 R456
R372

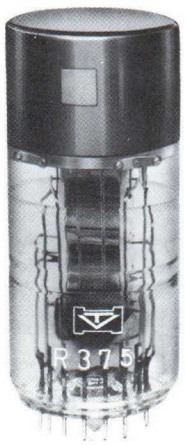
E R270



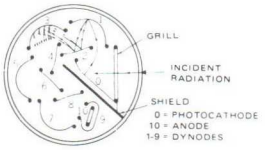
HEAD-ON TYPE PHOTOMULTIPLIER TUBES







Dynode Structures of Photomultiplier Tubes



(a)

Type	Nominal Diameter ①	Dimensional Outline ②	Basing Diagram	Number of Stage	Spectral Response ③	Wavelength of Maximum Response (angstroms) ③	Window Material	Photocathode Material	Maximum Anode to Cathode Voltage (dc only)
R268	1-1/8"	6	F	11	S-11	4400	⑳	Sb-Cs	1500
R269		6	F	11	S-21	4400	U.V. glass	Sb-Cs	1500
R292		6	F	11	S-13	4400	Quartz ⑧	Sb-Cs	1500
R396		6	F	11	1850~7300	4700	U.V. glass	Bialkali	1500
R430		6	F	11	1850~6500	4500	U.V. glass	Bialkali	1500
R374		6	F	11	1850~8500	4200	U.V. glass	Multialkali	1500
R453		6	F	11	1850~8500	4200	U.V. glass	Multialkali	1500
R376		6	F	11	1600~8500	4200	Quartz ⑧	Multialkali	1500
R457		6	F	11	1600~8500	4200	Quartz ⑧	Multialkali	1500
R316		6	F	11	S-1	8000	⑳	Ag-O-Cs	1500
R431		6	F	11	1600~3200	2200	Quartz ⑧	Cs-Te	1500
6199	1-1/2"	7	G	10	S-11	4400	⑳	Sb-Cs	1250
R189		7	G	10	S-13	4400	Quartz ⑧	Sb-Cs	1250
R192		7	G	10	S-10	4500	⑳	Ag-Bi-O-Cs	1250
R207		7	G	10	1600~8000	4500	Quartz ⑧	Ag-Bi-O-Cs	1250
7102		7	G	10	S-1	8000	⑳	Ag-O-Cs	1500
R190		7	G	10	1600~3200	2200	Quartz ⑧	Cs-Te	1250
7696	2"	8	H	10	S-11	4400	⑳	Sb-Cs	1500
R236		9	I	10	1600~8000	4500	Quartz ⑧	Ag-Bi-O-Cs	1250
R375		9	I	10	1600~8500	4200	Quartz ⑧	Multialkali	1500
R329		10	J	12	2800~6500	4500	Special	Bialkali	2700
R464		11	J	12	3000~6500	4500	⑳	Bialkali	2250

Notes:

① ..... For dimensional outline, see page 16.

② ..... The basing diagrams are shown at bottom of this page.

③ ..... Measured in amperes/watt. For spectral response curves, see page 2 to 3.

④ ..... Ambient temperature of all the types is ranged from -80°C to +50°C.

⑤ ..... Averaged over any interval of 30 seconds maximum.

⑥ ..... On basis of tungsten-filament light source operated at 2854°K.

⑦ ..... Measured at wavelength of maximum response.

⑧ ..... CAUTION: When replacing the tube, be sure to handle very carefully so as not to damage the bulb. Also, hold only by the base.

⑨ ..... Supply voltage (E) across a voltage divider providing 1/12 of E between cathode and dynode No. 1; 1/12 of E for each succeeding dynode stage, and 1/12 of E between dynode No. 11 and anode.

⑩ ..... Supply voltage (E) across a voltage divider providing 1/6 of E between cathode and dynode No. 1; 1/12 of E for each succeeding dynode stage; and 1/12 of E between dynode No. 10 and anode.

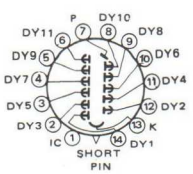
⑪ ..... Supply voltage (E) across a voltage divider providing 1/6 of E between cathode and dynode No. 1; 1/12 of E for each succeeding dynode stage; and 1/12 of E between dynode No. 10 and anode. Focusing electrode voltage is adjusted to level that is approximately 1/2 of cathode-to-dynode No. 1 voltage.

⑫ ..... Supply voltage (E) across a voltage divider providing 4/16.4 of E between cathode and dynode No. 1; 1/16.4 of E between dynode No. 1 and dynode No. 2; 1.4/16.4 of E between dynode No. 2 and dynode No. 3; 1/16.4 of E for each succeeding dynode stage, and 1/16.4 of E between dynode No. 12 and anode. Focusing electrode voltage is adjusted to potential that is approximately of dynode No. 1. Multiplier shield is operated at dynode No. 5 potential.

⑬ ..... The red and white light sensitivity ratio is calculated as R-IK/W-IK:

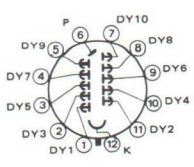
R-IK ..... Cathode current is measured with incident light transmitted from a tungsten-filament lamp operat-

F



R292 R374
R376 R269
R453 R268
R430 R316
R431 R396
R457

G



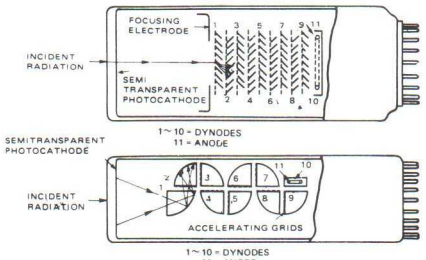
R189 R192
R207 7102
6199 R190

Dynode Chains for Photomultiplier Tubes

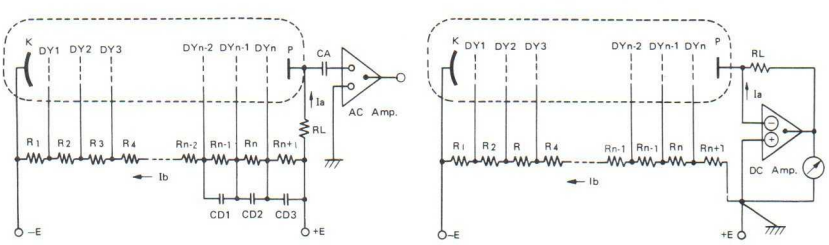
= Photomultiplier Tube
K = Photocathode
DY1-DYn = Dynodes
P = Anode
Ia = Anode current: When maximum stability is required the anode current should not exceed 1 μA
Ib = Chain current (Ib > 10Ia)
CA = Coupling capacitor
CD = Decoupling capacitors

$CD1 > 100\frac{Ia \cdot t}{Ib \cdot Rn-1}$ $CD2 > 100\frac{Ia \cdot t}{Ib \cdot Rn}$ $CD3 > 100\frac{Ia \cdot t}{Ib \cdot Rn+1}$ t = Pulse Width

RL = Load resistor of anode
Ri-Rn = Chain resistors: Value of the chain resistors are chosen from 100 kΩ to 1000 kΩ



Various dynode structures available in "HTV" photomultiplier tubes : (a) circular-cage type. (b) venetian-blind type. (c) box-and-grid type.



Ratings (Absolute Values) ④		Characteristics at 25°C and Specified Voltage									Direct Interelectrode Capacitances		
			Cathode Sensitivity			Anode Sensitivity							
Average Anode Current (mA) ⑤	Anode to Last Dynode Voltage (dc volts)	Anode to Cathdoe Voltage (dc volts)	Cathode Luminous (μA/lumen) ⑥		Red and White Light Sensitivity Ratio Min.	Anode Luminous at 0 cps (A/lumen)		Anode Radiant Sensitivity (A/W) ⑦	Current Amplification	Maximum Anode Dark Current (μA)	Anode to Last Dynode (pF)	Anode to All Other Electrodes (pF)	Type
			Min.	Median		Min.	Median						
0.01	250	1000 ⑨	40	60	–	50	150	1.2×10^5	2.5×10^6	0.03	3	3.5	R268
0.01	250	1000 ⑨	40	60	–	50	150	1.2×10^5	2.5×10^6	0.03	3	3.5	R269
0.01	250	1000 ⑨	40	60	–	50	150	1.2×10^5	2.5×10^6	0.03	3	3.5	R292
0.01	250	1000 ⑨	40	50	0.05 ⑬	50	100	–	2.0×10^6	0.05	3	3.5	R396
0.01	250	1000 ⑨	40	70	–	50	100	1×10^5	1.4×10^6	0.002	3	3.5	R430
0.01	250	1000 ⑨	80	120	0.15 ⑰	10	50	2×10^4	4×10^5	0.005	3	3.5	R374
0.01	250	1000 ⑨	30	60	0.05 ⑰	10	50	2×10^4	8×10^5	0.05	3	3.5	R453
0.01	250	1000 ⑨	80	120	0.15 ⑰	10	50	2×10^4	4×10^5	0.005	3	3.5	R376
0.01	250	1000 ⑨	30	60	0.05 ⑰	10	50	2×10^4	8×10^5	0.05	3	3.5	R457
0.01	250	1250 ⑨	10	20	0.1 ⑭	2	5	4.7×10^3	2.5×10^5	5 ⑯	3	3.5	R316
0.01	250	1000 ⑨	–	–	–	1000 ⑲ (A/W)	4000 ⑲ (A/W)	–	–	0.0005	3	3.5	R431
0.1	250	1000 ⑩	20	50	–	10	50	4×10^4	1×10^6	0.05	3	4	6199
0.1	250	1000 ⑩	20	50	–	10	50	4×10^4	1×10^6	0.05	3	4	R189
0.1	250	1000 ⑩	20	30	0.03 ⑰	10	30	1.5×10^4	1×10^6	0.5	3	4	R192
0.1	250	1000 ⑩	20	30	0.03 ⑰	10	30	1.5×10^4	1×10^6	0.5	3	4	R207
0.01	250	1250 ⑩	10	20	0.1 ⑭	1	4.5	4.2×10^3	2.25×10^5	5 ⑯	3	4	7102
0.01	250	1000 ⑩	–	–	–	100 ⑲ (A/W)	400 ⑲ (A/W)	5.6×10^2	–	0.001	3	4	R190
0.1	250	1250 ⑪	40	60	–	20	50	2×10^4	8.3×10^5	0.1	2.5	3.5	7696
0.01	250	1000 ⑪	20	40	0.03 ⑰	10	40	2×10^4	1×10^6	0.5	2.5	3	R236
0.01	250	1000 ⑪	80	120	0.15 ⑰	10	50	2×10^4	4×10^5	0.02	2.5	3	R375
0.02	500	1500 ⑫	60	90	0.16μA ⑮	40	160	1.6×10^5	1.8×10^6	0.002 ⑱	2	2.5	R329
0.02	250	1500 ⑫	30	50	0.06μA ⑮	15	50	4.7×10^4	1×10^6	0.0005 ⑱	2	2.5	R464

ed at a color temperature of 2854°K through a red filter (corning 2-62 sharp cut filter). The value of light flux on the filter is 0.01 lumen. The load resistor has a value of 0.01 megohm, and 150 volts are applied between the cathode and all other electrodes together as anode.

W-IK. . . . Test condition is the same as the (R-IK) except that a filter is not used.

⑭ ..... The infrared and white light sensitivity ratio (median) is calculated as IR-IK/W-IK:

IR-IK. . . . Cathode current is measured with incident light transmitted from a tungsten-filament lamp operated at a color temperature of 2854°K through an infrared filter (Toshiba IR-DIA infrared filter). The value of light flux on the filter is 0.01 lumen. The load resistor has a value of 0.01 megohm, and 150 volts are applied between the cathode and all other electrodes together as anode.

W-IK. . . . Test condition is the same as the (IR-IK) except that a filter is not used.

⑮ ..... Cathode current (min.) for blue-light transmitted through the Toshiba VV-40 filter from a 2854°K tungsten-filament lamp. The value of light flux on the filter is 0.02 lumen.

⑯ ..... Measured with supply voltage (E) adjusted to give anode luminous sensitivity of 4 amperes per lumen.

⑰ ..... The red and white light sensitivity ratio (min.) is calculated as R-IK/W-IK:

R-IK . . . . Cathode current is measured with incident light transmitted from a tungsten-filament lamp operated at a color temperature of 2854°K through a red filter (Toshiba V-R68 sharp cut filter). The value of light flux on the filter is 0.01 lumen. The load resistor has a value of 0.01 megohm, and 150 volts are applied between the cathode and all other electrodes together as anode.

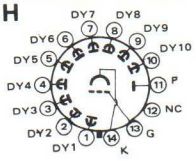
W-IK. . . . . Test condition is the same as the (R-IK) except that a filter is not used.

⑱ ..... After 3 hours storage in darkness.

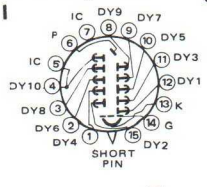
⑲ ..... The light source is a low pressure mercury lamp with Fused-Quartz window (dominant radiating spectral line is 2537 angstroms).

⑳ ..... Borosillicate glass

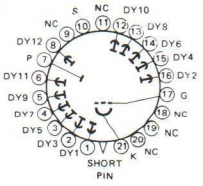
H 7696



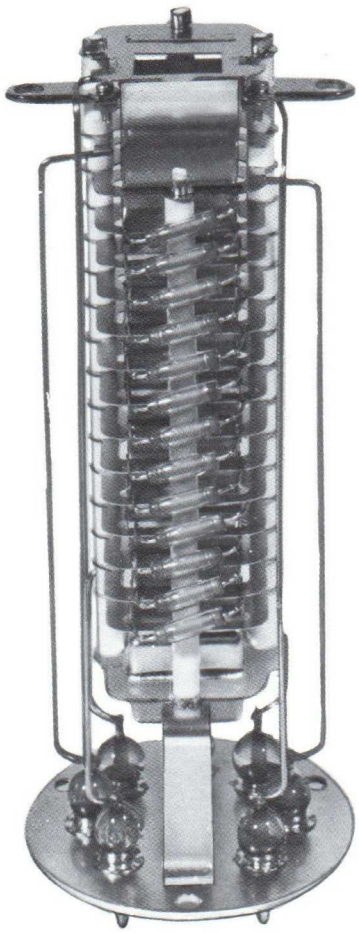
I R236 R375



J R329 R464



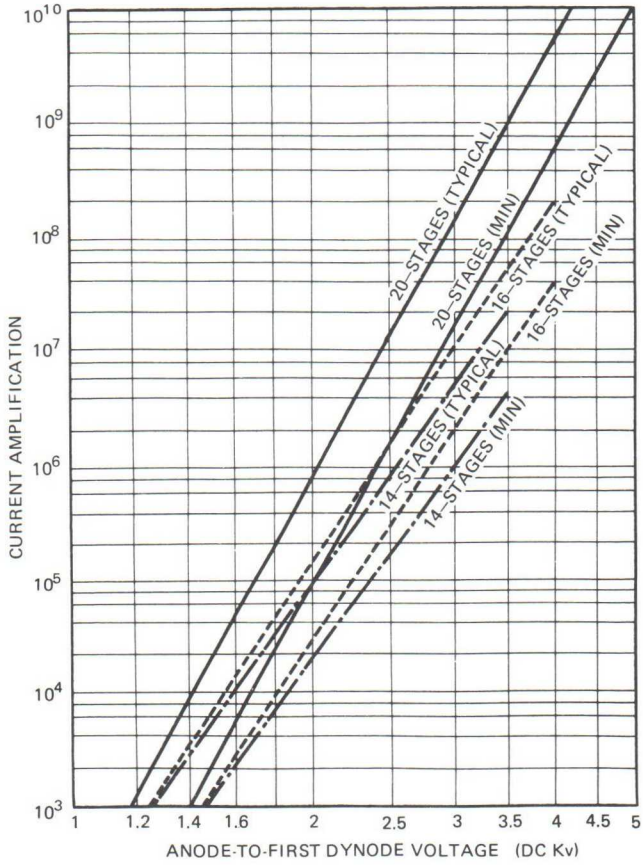
ELECTRON MULTIPLIERS



R422

Hamamatsu Electron Multipliers feature excellent gain and very low dark current for application in the vacuum system to detect electrons, charged particles, vacuum U.V. radiation, soft X-rays, etc. As a special design feature: when the first dynode is damaged by particle bombardment, it can be replaced by a new one. Also, in the case of vacuum U.V. radiation, the first dynode can be interchanged with a pure metal-coated cathode such as an Au, Ni, or Cu.

Amplification Characteristics



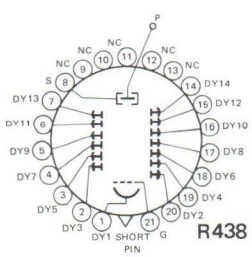
Type	Dimensional Outline ①	Basing Diagram ②	Dynode Stages	Dynode Material	Current Amplification at 250v/stage (Min.)	Maximum Ratings (Absolute Values)		
						Anode-to-First Dynode Voltage (dc volts)	Average Anode Current (μA)	Anode-to-Last Dynode Voltage (dc volts)
R438	12	K	14	Cu-BeO	4×10^6	4500	10	350
R475	13	L	14	Cu-BeO	4×10^6	4500	10	350
R476	14	M	16	Cu-BeO	4×10^7	5000	10	350
R422	15	L	16	Cu-BeO	4×10^7	5000	10	350
R474	16	N	16	Cu-BeO	4×10^7	5000	10	350
R477	17	O	20	Cu-BeO	1×10^{10}	6000	10	350
R425	18	L	20	Cu-BeO	1×10^{10}	6000	10	350

Notes:

① ..... For dimensional outline, see page 16 and 17.

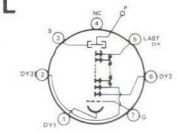
② ..... The basing diagrams are shown in bottom of this page.

K



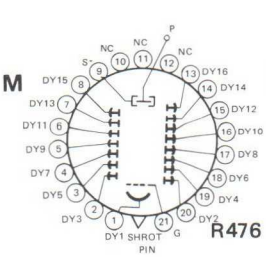
R438

L



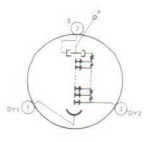
R475
R422
R425

M



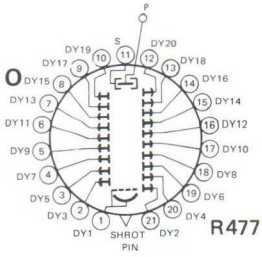
R476

N



R474

O



R477

PHOTOTUBES

Vacuum Types

TYPE	Dimensional Outline ①	Basing Diagram ②	Spectral Response ③	Wavelength of Maximum Response (angstroms) ③	Window Material	Photocathode Material	Maximum Ratings (Absolute Values): Anode Supply Voltage (volts) ※	Peak Cathode Current (μA)	Average Cathode Current Density ④ (μA/sq-mm)	Average Cathode Current (μA)	Ambient Temperature (°C)	Characteristics at 25°C: Anode Supply Voltage (DC volts)	Luminous Sensitivity (μA/lumen) ⑥ Min.	Median	Max.	Max. Anode Dark Current (nA)
PV11	19	P	S-1	8000	⑪	Ag-O-Cs	250	6	0.05	2	50	250	15	25	60	50
PV13	19	P	S-4	4000	⑪	Sb-Cs	250	6	0.05	2	50	250	15	25	70	50
PV16	20	U	S-4	4000	⑪	Sb-Cs	250	6	0.05	2	50	250	30	45	100	0.5
PV22	21	V	S-1	8000	⑪	Ag-O-Cs	250	9	0.05	3	50	250	25	35	70	1
PV23	21	V	S-4	4000	⑪	Sb-Cs	250	9	0.05	3	50	250	25	35	100	1
PV29A	22	V	S-1	8000	⑪	Ag-O-Cs	250	30	0.05	10	50	250	20	30	60	1
PV31A	22	V	S-4	4000	⑪	Sb-Cs	250	30	0.05	10	50	250	20	35	100	0.5
PV45	23	V	S-1	8000	⑪	Ag-O-Cs	250	0.3	0.005	0.1	50	250	6 ⑦	–	–	5
90AV	24	R	S-4	4000	⑪	Sb-Cs	100	6	0.0125	2	50	100	30	45	–	50
1P39	25	T	S-4	4000	⑪	Sb-Cs	250	20	0.05	5	75	250	25	45	70	5
935	26	DD	S-5	3400	U.V. glass	Sb-Cs	250	30	0.05	10	75	250	18	35	70	0.5
R110	27	V	2000~6500	3300	Quartz ⑧	Sb-Cs	250	9	0.05	3	50	250	25	35	100	1
R183	28	U	2000~6500	3300	Quartz ⑧	Sb-Cs	250	6	0.05	2	50	250	25	35	100	1
R310	27	V	1800~8000	4300	Quartz ⑧	Ag-Bi-O-Cs	250	9	0.05	3	50	250	25	45	–	1
R414	29	Y	S-4	4000	⑪	Sb-Cs	100	1	0.05	0.3	50	100	25	40	–	0.05
R369	25	T	2000~8000	4300	U.V. glass	Ag-Bi-O-Cs	250	6	0.05	2	50	250	25	35	–	5
R237	24	R	S-1	8000	⑪	Ag-O-Cs	250	6	0.05	2	50	250	15	25	70	50
R403	30	CC	2000~3200	2300	U.V. glass	Cs-Te	250	4.8	0.05	1.6	50	250	10 ⑨ (mA/μW)	20 ⑨ (mA/μW)	–	1
R404	31	Z	1800~3200	2200	Quartz ⑧	Cs-Te	100	1.2	0.05	0.4	50	100			–	1
R314	25	T	2000~8500	4200	U.V. glass	Multialkali	250	1	0.005	0.1	50	250	80	120	–	0.05
R330	32	AA	2000~8500	4200	U.V. glass	Multialkali	100	1	0.005	0.075	50	100	80	120	–	0.005
R424	33	BB	S-20	4200	⑪	Multialkali	100	1	0.005	0.075	50	100	80	120	–	0.005
R317	34		S-1	8000	⑪	Ag-O-Cs	2500	1 (A)	–	50	75	250	10	15	–	50 ⑩

Conservation tubes: PV15, PV24, PV26, PV36, PV46, PV47, 929 and 5652

※DC or Peak AC

Gas-Filled Types

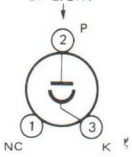
TYPE	Dimensional Outline ①	Basing Diagram ②	Spectral Response ③	Wavelength of Maximum Response (angstroms) ③	Window Material	Photocathode Material	Maximum Ratings (Absolute Values): Anode Supply Voltage (volts) ※	Peak Cathode Current (μA)	Average Cathode Current Density ④ (μA/sq-mm)	Average Cathode Current (μA)	Ambient Temperature (°C)	Characteristics at 25°C: Anode Supply Voltage (DC volts)	Luminous Sensitivity (μA/lumen) ⑤ Min.	Median	Max.	Maximum Gas Amplification Factor	Max. Anode Dark Current (nA)
PG12	19	P	S-1	8000	⑪	Ag-O-Cs	90	6	0.05	2	50	90	75	125	360	10	100
PG14A	19	P	S-4	4000	⑪	Sb-Cs	90	6	0.05	2	50	90	150	–	360	8	100
PG25	35	Q	S-1	8000	⑪	Ag-O-Cs	90	9	0.05	3	50	90	120	180	360	7.5	100
PG27	36	S	S-1	8000	⑪	Ag-O-Cs	90	9	0.05	3	50	90	120	180	360	7.5	100
PG28A	37	Q	S-4	4000	⑪	Sb-Cs	90	9	0.05	3	50	90	75	135	360	5.5	100
90AG	24	R	S-4	4000	⑪	Sb-Cs	90	6	0.05	2	50	90	90	150	270	7.5	100
4409	38	T	S-4	4000	⑪	Sb-Cs	100	10	0.05	3	75	90	75	135	205	5.5	2
6953	38	T	S-1	8000	⑪	Ag-O-Cs	90	9	0.05	3	100	90	140	200	330	10	2
R250	39	P	S-4	4000	⑪	Sb-Cs	80	6	0.05	2	50	75	200	300	–	8	0.5
R184	40	X	1700~2900	2100	Quartz ⑧	–	–	–	–	–	95	Discharge operation phototubes.					
R334	41	Y	1700~2900	2100	Quartz ⑧	–	–	–	–	–	95						

Conservation tubes: PG14, R121, R193 and R228.

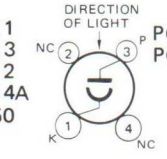
Notes:

① ..... For dimensional outline, see page 17 to 18.
② ..... Basing diagrams are shown on the bottom of this page.
③ ..... For spectral response curves, see page 2 to 3.
④ ..... Averaged over any interval of 30 seconds maximum.
⑤ ..... On basis of tungsten-filament light source operated at 2854°K, dc anode supply voltage as indicated and a 1-megohm load resistor. A light input of 0.05 lumen is used.
⑥ ..... On basis of tungsten-filament light source operated at 2854°K, dc anode supply voltage as indicated and a 1-megohm load resistor. A light input of 0.1 lumen is used.
⑦ ..... Cathode luminous sensitivity is measured through filter which passes only infrared radiation. (Toshiba IR-D1 filter).
⑧ ..... CAUTION: When replacing the tube be sure to handle very carefully so as not to damage the bulb. Also, hold only by the base.
⑨ ..... The light source is a low pressure mercury lamp with Fused-Quartz window (radiating spectral line is 2537 angstroms).
⑩ ..... Measured at 2500 volts.
⑪ ..... Borosillicate glass.

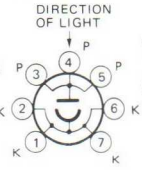
P — DIRECTION OF LIGHT
PV11, PV13, PG12, PG14A, R250



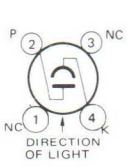
Q
PG25, PG28A



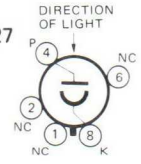
R
90AV, R237, 90AG



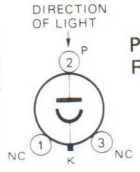
S
PG27



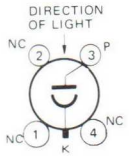
T
1P39, R369, R314, 4409, 6953



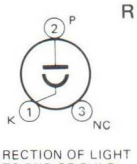
U
PV16, R183



V
PV22, PV23, PV29A, PV31A, PV45, R110, R310



X
R184

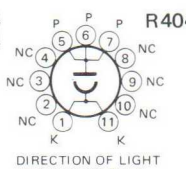


DIRECTION OF LIGHT INTO END OF BULB

Y
R414, R334

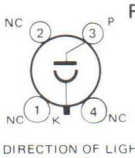
DIRECTION OF LIGHT INTO END OF BULB

Z
R404



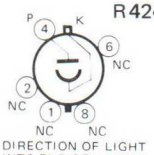
DIRECTION OF LIGHT INTO END OF BULB

AA
R330



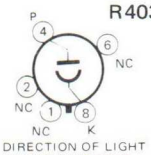
DIRECTION OF LIGHT INTO END OF BULB

BB
R424



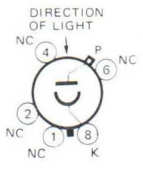
DIRECTION OF LIGHT INTO END OF BULB

CC
R403

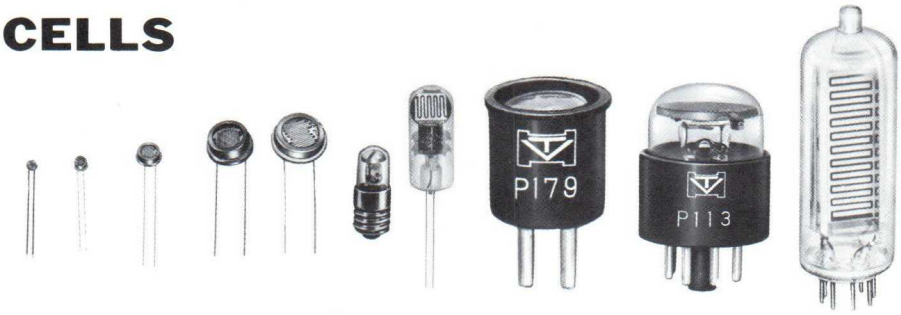


DIRECTION OF LIGHT INTO END OF BULB

DD
935



CdS, Cd(S,Se), CdSe CELLS



TYPE	Dimensional Outline ①	Basing Diagram ②	Wavelength of Maximum Response (angstroms)	Envelope	Photo-Conductive Material	Maximum Ratings Absolute Values ③		Characteristics at 25°C ⑥					γ (1 to 100 Lux) ⑧
						Voltage between Terminals (dc volts)	Power Dissipation at 25°C (Watt) ④	Cell Resistance			Time Response at 100 Lux ⑦		
								0 Lux (MΩ) ⑤	10 Lux (KΩ)	100 Lux (KΩ)	Rise (m sec)	Decay (m sec)	
P201A	42	EE	5500±200	Glass Metal	CdS	100	0.1	1	2.6~7.8	0.5~1.5	50	30	0.6~0.75
P202A	43	EE	5500±200	Glass Metal	CdS	100	0.2	0.5	0.9~2.7	0.2~0.7	50	30	0.6~0.75
P227A	44	EE	5500±200	Glass Metal	CdS	100	0.05	1	4.2~12.8	0.7~2.3	50	30	0.6~0.75
P201B	42	EE	5500±200	Glass Metal	CdS	200	0.1	10	22.5~67.5	2.9~8.7	7	2	0.9~1
P202B	43	EE	5500±200	Glass Metal	CdS	200	0.1	5	17.5~52.5	2.2~6.8	7	2	0.9~1
P227B	44	EE	5500±200	Glass Metal	CdS	200	0.05	10	50~150	7~21	7	2	0.9~1
P201C	42	EE	6000±300	Glass Metal	Cd(S,Se)	100	0.1	1	1.5~4.5	0.25~0.75	10	10	0.75~0.9
P202C	43	EE	6000±300	Glass Metal	Cd(S,Se)	100	0.2	1	2.5~7.5	0.35~1.05	10	10	0.75~0.9
P227C	44	EE	6000±300	Glass Metal	Cd(S,Se)	100	0.01	1	3.5~10.5	0.5~1.5	10	10	0.75~0.9
P203	42	EE	6000±300	Glass Metal	Cd(S,Se)	300	0.05	300	250~1000	40~120	7	2	0.8~0.95
P346	42	EE	6000±300	Glass Metal	Cd(S,Se)	300	0.05	200	27.5~82.5	3.9~11.7	7	2	0.8~0.95
P368	42	EE	6000±300	Glass Metal	Cd(S,Se)	300	0.05	200	14.1~42.4	2.2~6.8	7	2	0.75~0.9
P380	42	EE	6000±300	Glass Metal	Cd(S,Se)	200	0.05	200	4.4~13.2	0.7~2.1	7	2	0.75~0.9
P204	42	EE	6000±300	Glass Metal	Cd(S,Se)	200	0.05	200	10~30	1.2~3.8	7	2	0.8~0.95
P411	42	EE	6000±300	Glass Metal	Cd(S,Se)	100	0.1	10	2.5~7.5	0.3~1	7	2	0.75~0.9
P328	44	EE	6000±300	Glass Metal	Cd(S,Se)	100	0.05	10	40~120	5~15	10	2	0.8~0.95
P347	45	EE	6000±300	Glass Metal	Cd(S,Se)	100	0.03	300	200~600	25~75	7	2	0.8~0.95
P401	45	EE	6000±300	Glass Metal	Cd(S,Se)	100	0.03	10	9~50	1~6	10	5	0.8~0.95
P201D	42	EE	5500±200	Glass Metal	CdS	200	0.1	10	25~75	2~6	8	4	0.85~0.95
P227D	44	EE	5500±200	Glass Metal	CdS	200	0.05	10	75~225	6~18	8	4	0.85~0.95
P320	44	EE	5500±200	Glass Metal	CdS	200	0.05	10	35~105	5~15	10	8	0.8~0.9
P322	46	EE	5500±200	Glass Metal	CdS	200	0.3	10	2.2~6.6	0.35~1.05	20	20	0.7~0.8
P285	44	EE	7200±400	Glass Metal	CdSe	200	0.05	500	1000~10000	50~500	5	5	1.3
P295	42	EE	7200±400	Glass Metal	CdSe	200	0.05	500	100~1000	5~50	5	5	1.3
P141	47	EE	5600±600	All Glass	CdS	150	0.3	5	0.7~8	0.17~1.5	20	10	0.7~0.85
P179	48	EE	5600±600	Glass with 2-pin Base	CdS	150	0.3	5	0.7~8	0.17~1.5	20	10	0.7~0.85
P202	43	EE	5600±600	Glass Metal	CdS	150	0.3	5	0.7~8	0.17~1.5	20	10	0.7~0.85
P113	49	FF	5600±600	Glass with Octal Base	CdS	300	0.6	10	5~30	0.9~5	20	10	0.7~0.85
P255	50	EE	5600±600	All Glass	CdS	300	0.4	10	6~50	1~8	20	10	0.7~0.85
P240	51	GG	5600±600	All Glass	CdS	300	0.6	10	3.3~33	0.6~6	20	10	0.7~0.85
P109	52	EE	5600±600	Glass with Screw Base	CdS	200	0.1	300	500~3500	100~500	20	10	0.7~0.85
P273	52	EE	5600±600	Glass with Screw Base	CdS	200	0.1	100	45~350	10~75	20	10	0.7~0.85

Notes:

①..... For dimensional outline, see page 18 to 19.

②..... The basing diagrams are shown in bottom of this page.

③..... Ambient temperature of all the types is ranged from -30°C to 60°C.

④..... In continuous service with sensitive surface of cell fully illuminated. The dissipation allowed for cell is decreased with elevated ambient temperature, therefore, must not exceed one-fourth of its value of maximum rating at 60°C.

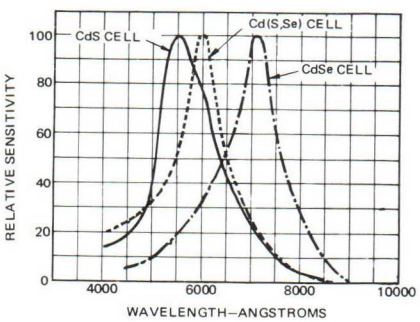
⑤..... Minimum values. Measured 60 seconds after removal of incident illumination level.

⑥..... At 25°C and specified voltage for each type. For conditions where the light source is a tungsten filament lamp operated at a color temperature of 2854°K. This characteristic is determined after the cell has been exposed for a period of 16 to 24 hours to about 500 lux illumination (white fluorescent light).

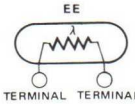
⑦..... The time required for the conductance to rise to 63.2 per cent of the maximum value or to fall from the peak to 36.8 per cent of the maximum value.

⑧..... γ is the slope of conductance as a function of illumination.

Spectral Response for Cds.Cd(S.Se).CdSe Cells

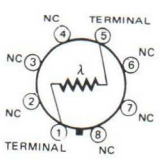


EE

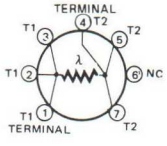


P201A P227C P347 P141
P202A P203 P401 P179
P227A P346 P201D P202
P201B P368 P315 P255
P202B P380 P320 P273
P227B P411 P322 P109
P201C P204 P285
P202C P328 P295

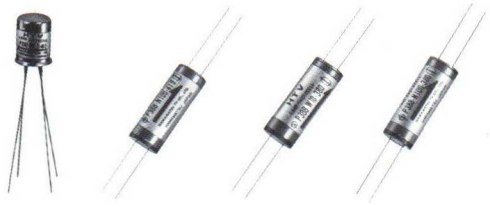
FF P113



GG P240



LAMP-PHOTOCELLS



Hamamatsu Lamp-Photocell is optoelectronic component which consists of a light source (Ne-lamp or tungsten-filament lamp) and a photoconductive element assembled in a light tight metal case. Features of Lamp-Photocells include low noise, wide dynamic range, and high isolation between signal and control circuit. It provides volume control of the musical instrument, photo-chopper in the degital voltmeter, various switching and AGC circuit.

Type	Dimensional Outline ①	Envelope	Control (Lamp)			Signal (Photocell)					
			Lamp Type ②	Voltage (dc volts)	Current (mA)	Resistance		Maximum Voltage (volts)	Maximum Power (mW)	Time Response	
						On ③ (Ω)	Off ④ (MΩ)			On ⑤ (m sec)	Off ⑥ (m sec)
P388-W6-380	53	Metal Tube	Tungsten	6	15	300	10	200	50	30	30
P388-W6-411	53	Metal Tube	Tungsten	6	15	120	1	100	50	30	30
P388-W10-380	53	Metal Tube	Tungsten	10	20	250	10	200	50	20	20
P388-W10-411	53	Metal Tube	Tungsten	10	20	100	1	100	50	20	20
P388-N100-295	53	Metal Tube	Neon	100 (ac)	1.5 Max.	5000	100	200	50	10	5
P388-N100-380	53	Metal Tube	Neon	100 (ac)	1.5 Max.	500	10	200	50	15	15
P388-N100-411	53	Metal Tube	Neon	100 (ac)	1.5 Max.	200	1	100	50	15	15
P388-N100-419	53	Metal Tube	Neon	100 (ac)	1.5 Max.	100	1	100	50	15	15
P392-W1.5-411	54	Metal Tube	Tungsten	1.5	15	300	1	100	50	30	30

Notes:

①..... For dimensional outline and basing diagram, see page 19.

②..... Voltage stated is dc or ac peak. A current limiting resistor must be used in series with the control Ne-lamp. A typical value is 30KΩ.

③..... The nominal "ON" resitance is a typical value of photocell when the nominal voltage is applied at the control terminals, measured at 25°C.

④..... Minimum values. Measured 60 seconds after turned off of lamp.

⑤..... The "ON" response time is defined as the time required for the cell resistance to fall to 20% of its initial value, measured from the instant that maximum rated control voltage is applied to the lamp.

⑥..... The "OFF" response time is defined as the time required for the cell resistance to rise to 80% of its final value from the instant that maximum rated control voltage is removed from the lamp.

PbS CELLS

Hamamatsu type P124, P394 and P397 are IR sensitive Lead-Sulfied photoconductive cells having high sensitivity, high response speed and good linearity. It is intended for use in radiation pyrometer, spectrophotometer, communication with IR signal and other instruments. P124 is vaccum-evaporated on inner wall of glass envelope, P394 and P397 are chemically deposited on substrate and hermetically sealed in metal-glass case.

Type	Dimensional Outline ①	Basing Diagram ②	Envelope	Spectral Response (angstroms) ③	Wavelength of Maximum Response (angstroms)	Useful Photosurface Area (mm^2)	Maximum Voltage ⑧ between Terminals (dc volts)	Characteristics at 25°C ④		
								Sensitivity ⑤⑥	Dark Resistance (MΩ)	Signal to Noise Ratio (dB) ⑦
P124	55	HH	All Glass	8000~25000	22000	2 x 4	90	0.4	0.3~10	55
P394	56	HH	Glass Metal	8000~25000	22000	1 X 5	90	0.6	0.3~ 2	55
P397	46	HH	Glass Metal	8000~25000	22000	4 x 5	90	0.6	0.3~ 2	55

Notes:

①..... For dimensional outline, see page 18 to 19.

②..... The basing diagram is shown at bottom of this page.

③..... Long wavelength cutoff: Spectral point at which the response is down to 30% of maximum. By cooling the cell, it is capable to expand the spectral response to further long wavelength.

④..... Minimum Values.

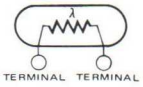
⑤..... Applied to 5 volts dc for each type.

⑥..... Sensitivity of the cell is defined by $\frac{IL-ID}{ID}$ where IL is photo-current include of dark current and ID is dark current. For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2854°K and light flux of 0.1 holo-lumen/sq-cm is used.

⑦..... Measuring conditions of Signal-to-Noise Ratio as follow; Radiation source: monochromatic flux of 2 microns. Illumination intensity: 15 μw/sq-cm
Interruption frequency of the radiation: 90Hz
Band width of the amplifer: 8Hz
Voltage between terminals: 25 volts dc
Load resistor: equal to the dark-resistance of the cell.

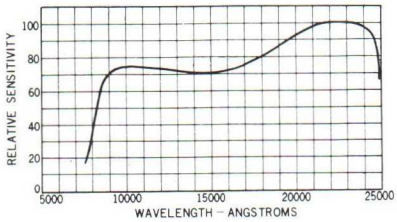
⑧..... Absolute values. The maximum ambient temperature rating of these cells are +60°C.

HH



P124
P394
P397

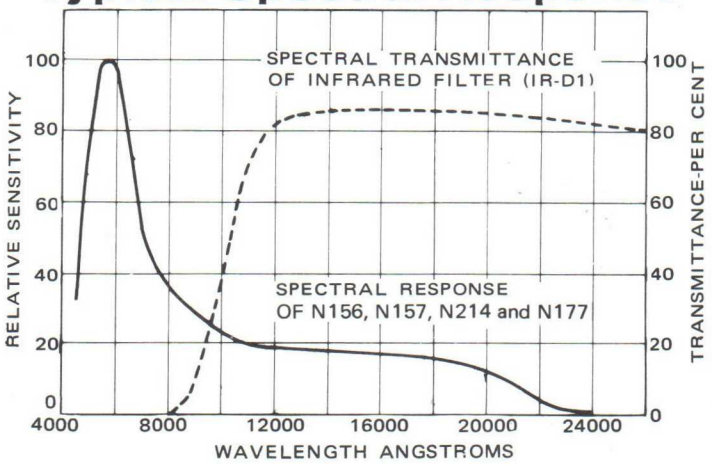
Spectral Response for PbS Cells



INFRARED VIDICONS

Hamamatsu IR Vidicons provide observation of objects illuminated in darkness by infrared radiation which could not be viewed by ordinary means. The sensitivity of these tubes are sufficient to image objects by their own thermal radiation at 200°C, therefore, these are useful in the measurement of temperature and the observation of its distribution. Other applications are the observation of microscopic image of dislocations in silicon and germanium single crystal, the viewing of laser patterns, the observation of hydrogen flame in sunlight, space applications, and other infrared closed-circuit TV systems.

Typical Spectral Response



Type	① Dimensional Outline	② Basing Diagram	③④ Maximum Ratings: Signal Electrode Voltage (DC Volts)	Grid No. 3 & 4 Voltage (DC Volts)	Grid No. 2 Voltage (DC Volts)	Dark Current (μA dc)	④⑤⑥ Characteristics: Signal Electorde Voltage (DC Volts)	Grid No. 3 & 4 Voltage (DC Volts)	Grid No. 2 Voltage (DC Volts)	Grid No. 1 Voltage (DC Volts) ⑦	Dark Current (μA dc)	Signal Output Current at 10 I.R. Lux (μA dc)	Resolution (TV-Lines)
N156	57	II	125	350	350	0.05	10 to 100	250 to 300	300	−45 to −100	0.02	0.1	500
N157	58	II											
N214	57	JJ	6 inches long, High Resolution IR Vidicon										
N177	57	KK	6 inches long, Static Type IR Vidicon										

Notes:

① ..... For dimensional outline, see page 19.

② ..... The basing diagrams are shown in bottom of this page.

③ ..... Absolute values: The maximum ambient temperature rating of these tubes are +60°C and the maximum faceplate illumination is 500 lux or 1000 I.R. lux.

④ ..... For scanned area of 12.7 x 9.5 mm².

⑤ ..... Grid No.3 connected to grid No.4 and faceplate temperature of 25°C to 35°C.

⑥ ..... One I.R. lux is defined as the infrared illumination intensity through a infrared filter (IR-D1) where illumination intensity from a tungsten-filament lamp of color temperature 2854°K is one lux.

⑦ ..... For picture cutoff, with no blanking voltage on grid No. 1.

X-RAY VIDICONS

HTV-N350 and N400, available 1-inch diameter type and 1-1/2-inch type, are Vidicon camera tubes designed for direct detection of X-RAY radiation. A beryllium faceplate is employed for enabling the operation of picking up the object images not only in the hard X-ray but in the soft. In the HTV-N400, grid NO. 4 and grid NO. 3 are connected separately for the high resolution characteristics. They can be used to observe soft tissues in medical and biological applications or for observing the image of X-ray diffractions, and other object in the industrial fields.

Type	① Dimensional Outline	② Basing Diagram	Maximum Ratings: Signal Electrode Voltage (DC Volts)	Grid No. 4 Voltage (DC Volts)	Grid No. 3 Voltage (DC Volts)	Grind No. 2 Voltage (DC Volts)	Dark Current (μA dc)	Characteristics: Signal Electrode Voltage (DC Volts)	Grid No. 4 Voltage (DC Volts)	Grid No. 3 Voltage (DC Volts)	Grid No. 2 Voltage (DC Volts)	Grid No. 1 Voltage (DC Volts)	Dark Current (μA dc)
N350	59	II	125	350	350	350	0.005	10 to 100	250 to 300	250 to 300	300	−45 to −100	0.0001 to 0.001
N400	60	LL	125	1500 ③	1500 ③	350	0.2	10 to 100	1400 ③	800 to 1000 ③	300	−45 to −100	0.02

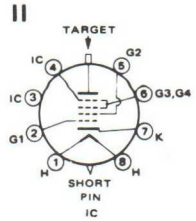
Notes:

① ..... For dimensional outline, see page 19.

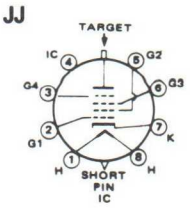
② ..... The basing diagrams are shown in bottom of this page.

③ ..... N400 is separate connection for grid No. 4 and No. 3.

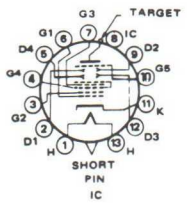
II — N156, N157, N350



JJ — N214



KK — N177



LL — N400

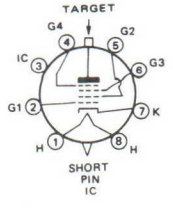
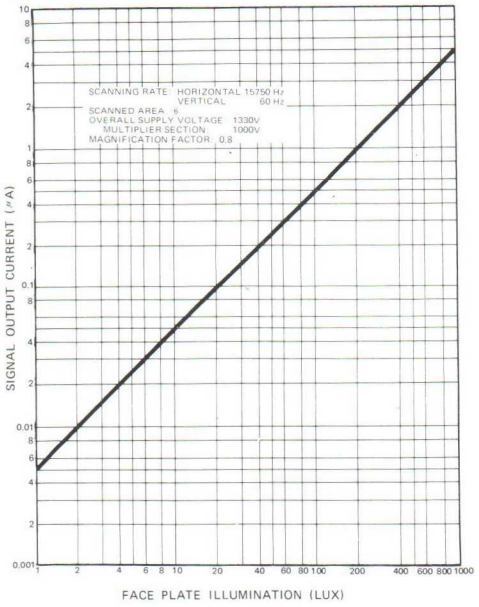


IMAGE DISSECTOR TUBE

HTV-R231 is a 1½-inch type magnetically focused and deflected Image Dissector Camera Tube. Photocathodes of the S-20 or the other spectral responses can be provided with various scanning aperutre shapes and sizes. This tube has nonstorage characteristic, which enables the applications as measuring and controlling systems of high speed moving or rotating objects, sensors of OCR (Optical Character Reader) in the computers, and others in the industry.

Type	① Dimensional Outline	② Basing Diagram	③⑤ Spectral Response	Image Section: Minimum Cathode Luminous Sensitivity (μA/lm)	Image Section: ⑤ Aperture Diameter (mmφ)	Multiplier Section: Number of Stage	Multiplier Section: Minimum Current Amplification	Operating Supply Voltage: Cathode Voltage (DC Volts)	Grid No. 4 Voltage (DC Volts)	Dynode No. 1 Voltage (DC Volts)	Blanking Electrode Voltage (DC Volts)	Dynode Voltage (DC Volts/stage)	Anode Voltage (DC Volts)	④ Signal to Noise Ratio (dB)	Focusing Field Strength (gausses)
R231	61	MM	S-20	100	0.05	10	1×10^4	-1330	-1080	-1000	-1330	100	0	20	30

Transfer Characteristic



Notes:

①..... For dimensional outline, see page 19.

②..... The basing diagram is shown at bottom of this page.

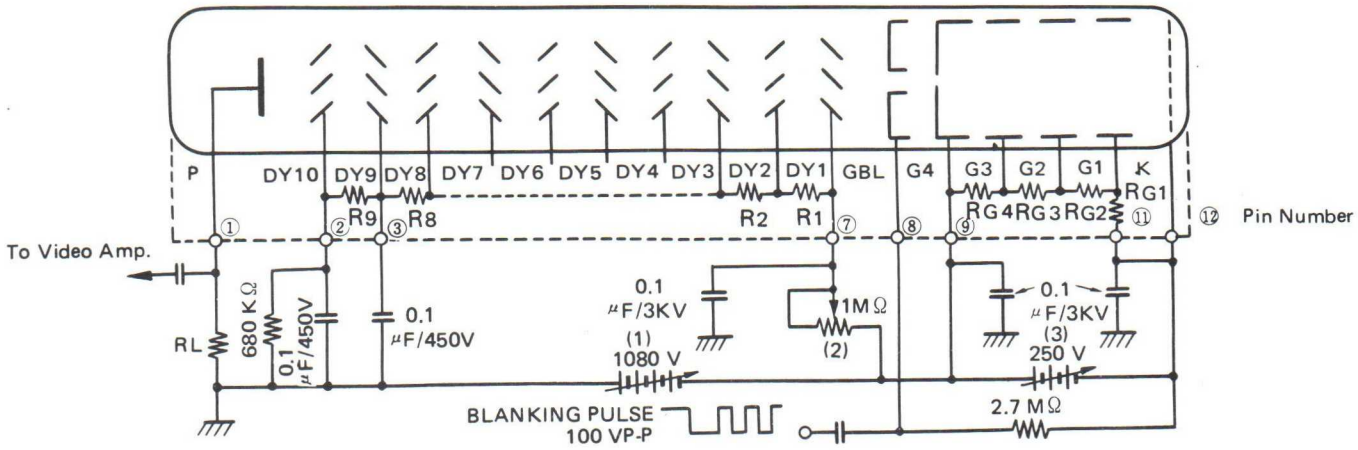
③..... For spectral response curves, see page 2 and 3.

④..... Bandwith of video amplifier (-3dB points): 6MHz.
Scanning Rate
Horizontal: 15750 Hz.
Vertical: 60 Hz
Interace: 2 : 1
Face plate illumination: 300 lμx

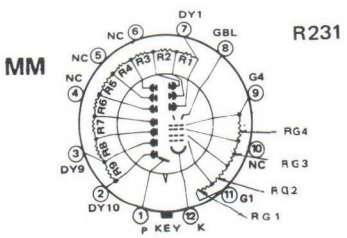
⑤..... For your requirement, the version type of R231 will be furnished as follows.
1) Photocathode and window material
2) Aperture sizes and shapes
3) Dividing resistors and non-base

⑥····Limitation of useful photocathode diameter
applications requiring better uniformity and resolution ...20 mmφ (16 x 12 mm)
other applications .....25 mmφ (20 x 15 mm)

Recommended Circuit Diagram of the R231



Internal divider RG1, ... RG4 : 220 KΩ each
R1, ... R9 : 680 KΩ each



Notes:
(1)...Gain Controller
(2)...Semi-variable: Adjuster for obtaining best S/N ratio
(3)...Focus controller

IMAGE MEMORY TUBES

HTV N337 and N333 are the Image Memory Pickup Tubes; the former type is 1½-inch in diameter and the latter one is 2-inch in diameter. These are the grid control types written by the light image of the scene, read by the modulated transmission current of the electron beam from electron gun and erased by nonmodulated beam from the gun. Any shutter time, shutter chance and scanning speed can be applied to these tubes. The applications are the recording of the object image moving in a high speed in the fields of the industries, and for the space engineering, etc.

General

Type	Dimensional Outline	Basing Diagram	Focusing Method	Deflection Method	Spectral ② Response	Resolution (TV-lines)	Luminous Sensitivity (μA/lm)	Minimum Erasing & Priming Time (flame times)	Exposure Value (lx-sec)	③ Storage Capability
N337	63	NN	Magnetic	Magnetic	S-11	350	30	2	1.0	Few minutes, with scanning beam. Few hours without scanning beam.
N333	64	OO				600				

Typical Operation

Type	Image Section					Scanning Section				Strage Section				
	Grid No. 7 Voltage (DC Volts)	Grid No. 6 Voltage (DC Volts)	Grid No. 5 Voltage (DC Volts)	Grid No. 4 Voltage (DC Volts)	Focusing Field Strength (gauess)	Grid No. 3 Voltage (DC Volts)	Grid No. 2 Voltage (DC Volts)	Grid No. 1 Voltage (DC Volts)	Focusing Field Strength (gauess)	Mode / ① Electrode	Erasing Voltage (DC Volts)	Priming Voltage (DC Volts)	Writing Voltage (DC Volts)	Reading Voltage (DC Volts)
N284	90	180	270	300 to 400	80	250 to 300	300	−45 to −100	40	Collector	0	0	350	350
										Storage	350	20	350	5 to 15
N337										Collector	0	0	350	350
										Storage	350	20	350	5 to 15
N333					60	300			25	Collector	0	0	350	350
										Storage	350	20	350	5 to 15

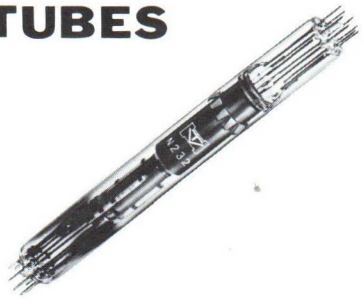
Notes:

① ..... Collector electrode corresponds to signal electrode.

② ..... S-20, S-1 etc. can also meet your requirements.

③ ..... When the storage electrode voltage and bias voltage are adjusted properly for the optimum operation.

MEMORY TUBES



HTV-N232 and N319 are the signal convertor storage tubes, 1-inch and 1½-inch in diameter. These are the grid control types written and non-destructively read out with the electron beam, and useful especially for computer, for converting a rader signal to television signal, and for reducing the effective exposing ammount to X-ray in combination with X-ray television system, etc.

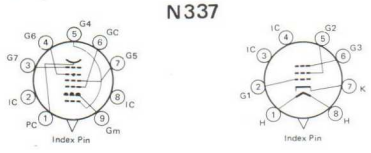
Type	Dimensional Outline	Basing Diagram	Focusing Method	Deflection Method	Minimum Erasing & Priming Time (flame times)	① Storage Capability
N232	65	PP	Magnetic	Magnetic	2	Few minutes, with scanning beam. Few hours without scanning beam.
N319	66	PP				

Typical Operation

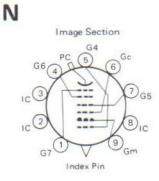
Type	Scanning Section				Storage Section					
	Grid No. 3 Voltage (DC Volts)	Grid No. 2 Voltage (DC Volts)	Grid No. 1 Voltage (DC Volts)	Focusing Field Strength (gauess)	Signal Electrode Voltage (DC Volts)	Mode / Electrode	Erasing Voltage (DC Volts)	Priming Voltage (DC Volts)	Writing Voltage (DC Volts)	Reading Voltage (DC Volts)
N232	250 to 300	300	−45 to −100	40	350	Collector	350	350	350	350
						Storage	360	10	350	2 to 7
N319				25		Collector	350	350	350	350
						Storage	360	10	350	2 to 7

Notes: ① ..... When the storage electrode voltage and bias voltage are adjusted properly for the optimum operation.

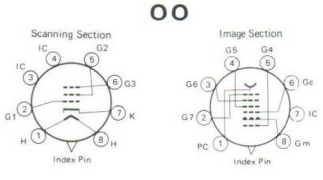
NN N337



NN N337



OO N333



HOLLOW CATHODE LAMPS

HTV-L233 series are completely sealed type hollow cathode tubes developed as light sources for the atomic absorption spectroscopy. Generally, Neon or Argon gas as the filled gas are used properly not to interfere with resonance lines, and Neon producing the strong line intensity is usually selected. The special base metal included in cathode gives the high spectral purity to the tubes, reduces the clean up phenomena and decreases remarkably the line of back ground, therefore they have the absorbance curves having good linearity at the low tube current and make possible the very precise analysis. It is necessary to warm up the tubes for 10 to 15 minutes to employ the tubes in good stability.

Type	Element	Dimensional Outline ①	Basing Diagram ②	Filled Gas	Window Glass ③	Tube Drop Voltage (DC Volts)	Maximum Current (mA)	Starting Voltage (DC Volts)	Analysis Line (angstoms)
L233-47NU	Al	67	SS	Ne	UV	190	20	320	3092.7
L233-13NU	Ag	67	SS	Ne	UV	180	20	320	3280.7
L233-79NQ	Au	67	SS	Ne	Q	230	16	400	2428.0
L233-56NU	Ba	67	SS	Ne	UV	130	25	170	5535.5
L233-4NQ	Be	67	SS	Ne	Q	170	35	225	2348.6
L233-83NQ	Bi	67	SS	Ne	Q		12		2230.6
L233-20NU	Ca	67	SS	Ne	UV	210	18	335	4226.7
L233-48NQ	Cd	67	SS	Ne	Q	195	12	350	2288.0
L233-27NQ	Co	67	SS	Ne	Q	180	30	330	2407.3
L233-24NU	Cr	67	SS	Ne	UV	160	30	375	3578.7
L233-29NU	Cu	67	SS	Ne	UV	205	30	275	3247.5
L233-26NQ	Fe	67	SS	Ne	Q	170	30	380	2483.3
L233-32NQ	Ge	67	SS	Ne	Q	195	20	400	2651.6
L233-19NU	K	67	SS	Ne	B	200	20	200	7664.9
L233-12NU	Mg	67	SS	Ne	UV	135	20	250	2852.1
L233-25NQ	Mn	67	SS	Ne	Q	180	30	400	2794.8
L233-42NU	Mo	67	SS	Ne	UV	140	30	340	3132.6
L233-11NB	Na	67	SS	Ne	B	150	20	160	5890.0
L233-41NU	Nb	67	SS	Ne	UV		30		3349.1
L233-28NQ	Ni	67	SS	Ne	Q	200	25	385	2320.0
L233-82NQ	Pb	67	SS	Ne	Q	220	20	290	2170.0
L233-78NQ	Pt	67	SS	Ne	Q	190	30	375	2659.5
L233-51NQ	Sb	67	SS	Ne	Q	200	18	350	2175.9
L233-14NQ	Si	67	SS	Ne	Q	170	20	330	2516.1
L233-50NQ	Sn	67	SS	Ne	Q	250	15	290	2246.1
L233-38NU	Sr	67	SS	Ne	UV		30		4607.3
L233-22NU	Ti	67	SS	Ne	UV	160	35	240	3642.7
L233-23NU	V	67	SS	Ne	UV	170	35	305	3184.0
L233-74NQ	W	67	SS	Ne	Q	155	35	330	2551.4
L233-30NQ	Zn	67	SS	Ne	Q	195	18	260	2138.6
L233-40NU	Zr	67	SS	Ne	UV		30		3601.2

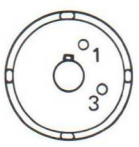
Notes:

①..... For dimensional outline, see page 19.
②..... See basing diagrams shown at bottom of this page.
③.... Q: Fused Quartz
UV: U.V. transmitting glass
B: Borosillicate glass

Because of constant improvement and changes being made hollow cathode lamps, the values listed above may be revised.

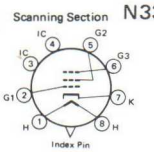
SS

L233

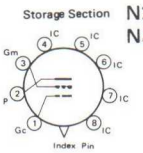


1 : Cathode
3 : Anode

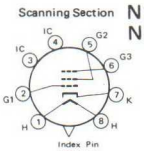
OO



PP



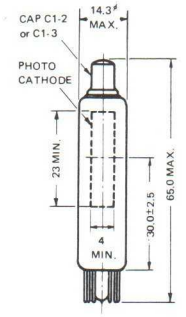
PP



Gc : Collector electrode & signal electrode
Gm : Storage electrode
PC : Photocathode

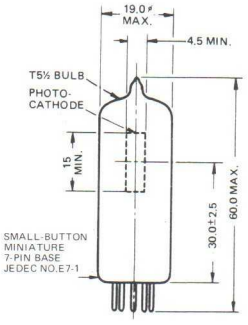
DIMENSIONAL OUTLINES (Unit: mm)

①



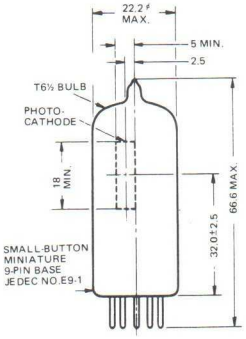
R300 R427
R306 R500

②



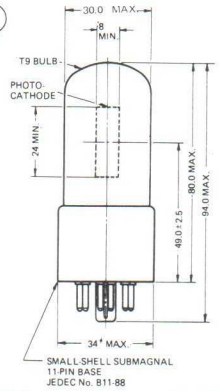
PM57

③



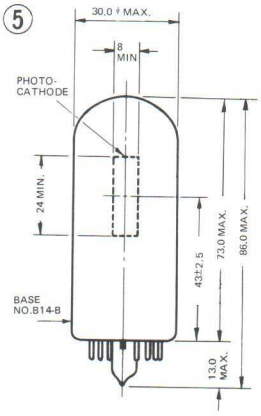
R241
R252

④



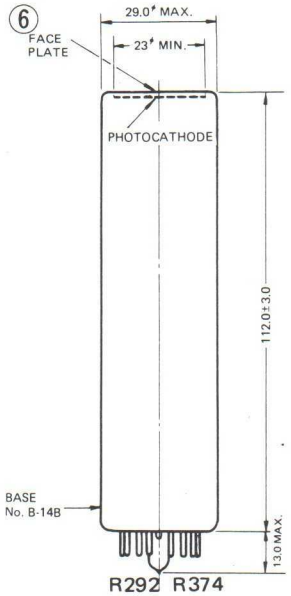
R106 1P28 R166
931A R212 R372
1P21 R213 R406
R136 R456
R446 R197

⑤



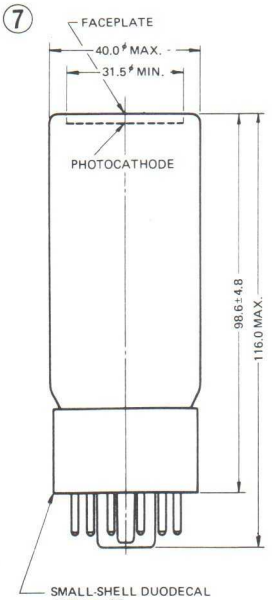
R270

⑥



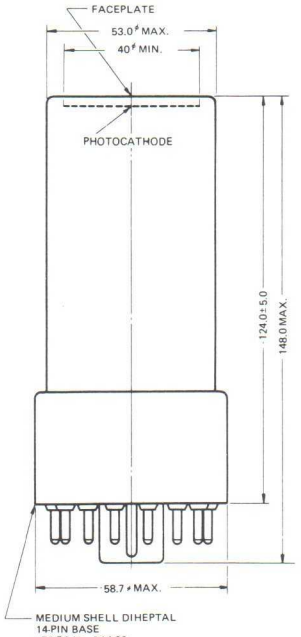
R292 R374
R376 R269
R453 R268
R430 R316
R431 R396
R457

⑦



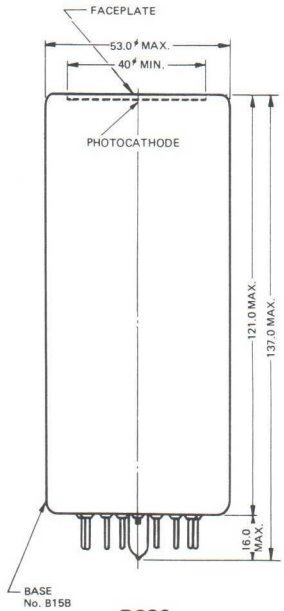
R189 R192
R207 7102
6199 R190

⑧



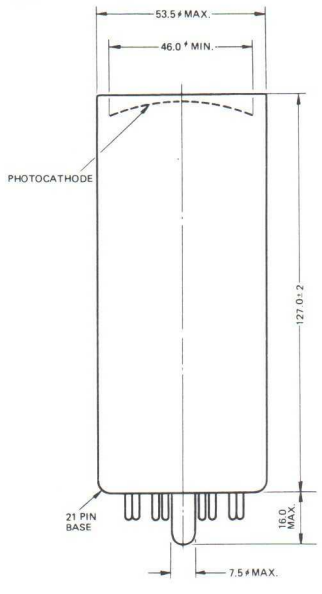
7696

⑨



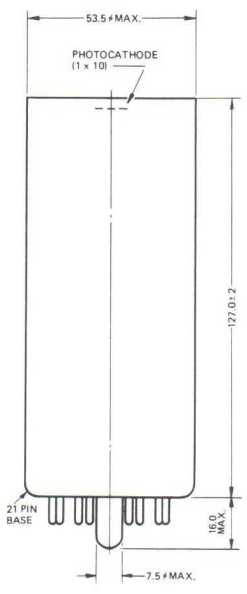
R236
R375

⑩



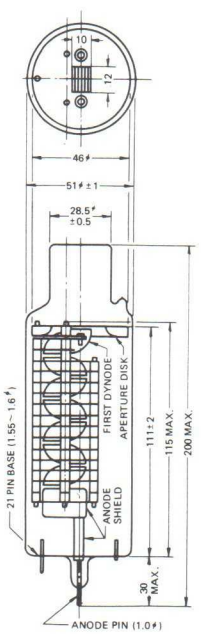
R329

⑪



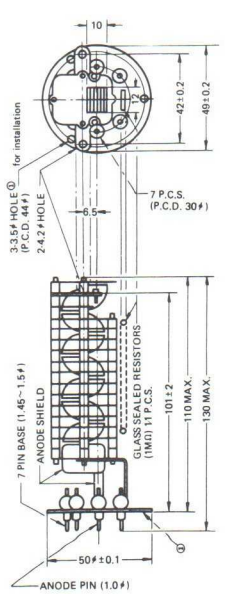
R464

⑫



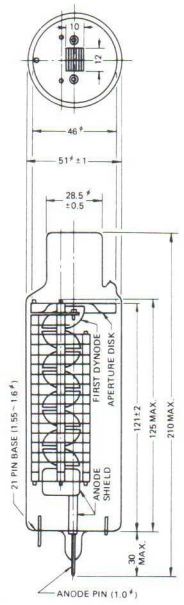
R438

⑬



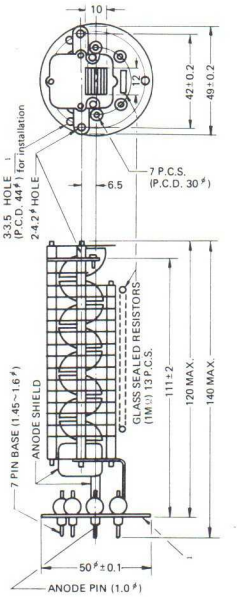
R475

⑭



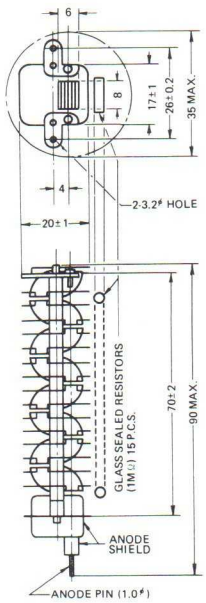
R476

⑮



R422

⑯



R474

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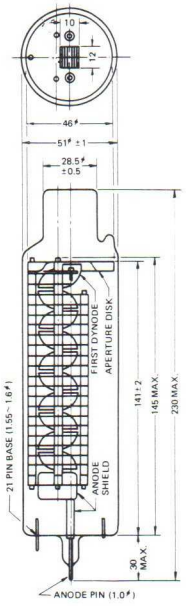
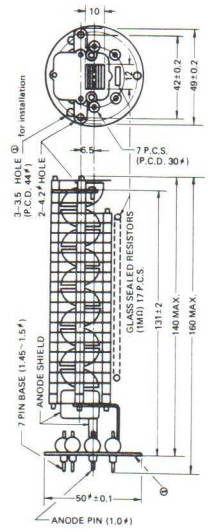


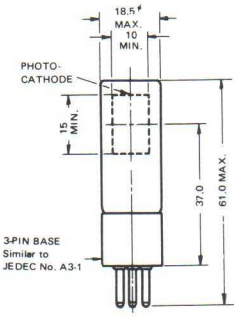
R477

⑱



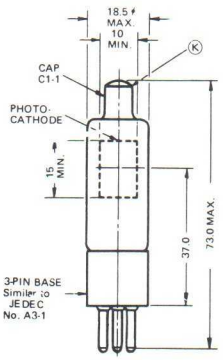
R425

⑲



PV11 PG12
PV13 PG14A

⑳



PV16

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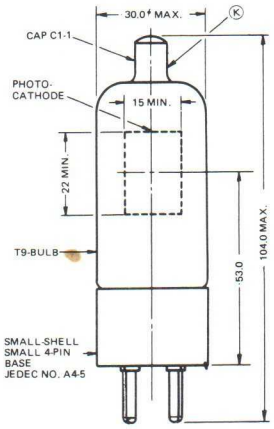

PV22
PV23

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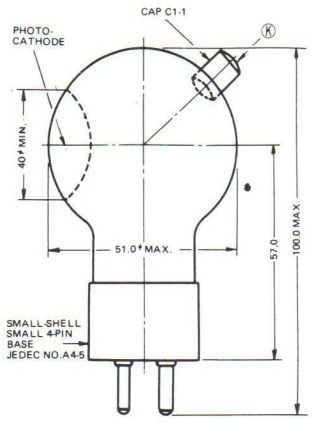

PV29A
PV31A

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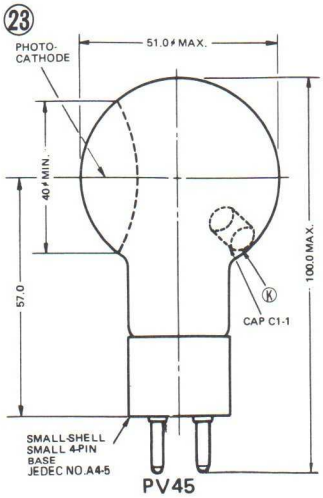
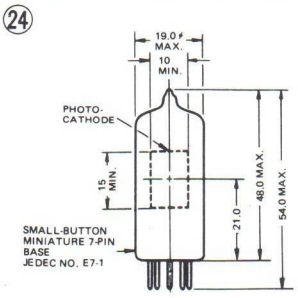


PV45

㉔



90AV R237
90AG

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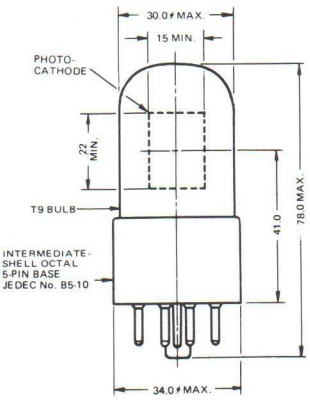

1P39 R314
R369

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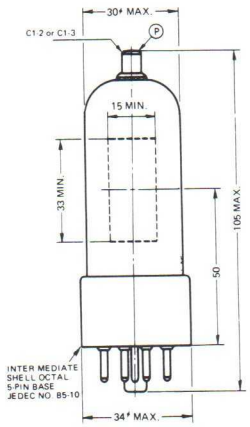

935

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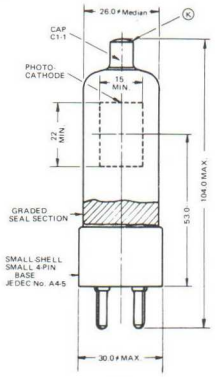
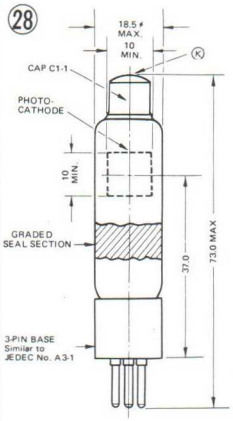


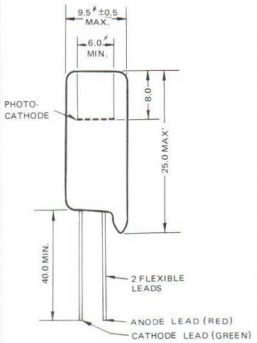
R110
R310

(28)



R183

(29)



R414

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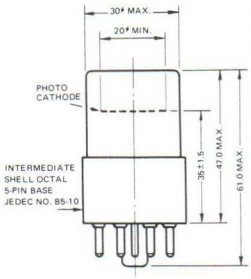

R403

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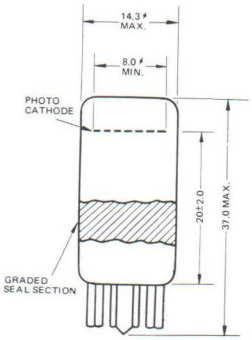

R404

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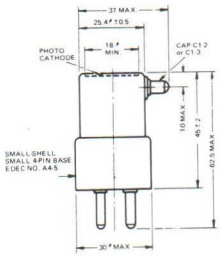

R330

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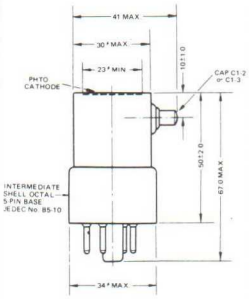

R424

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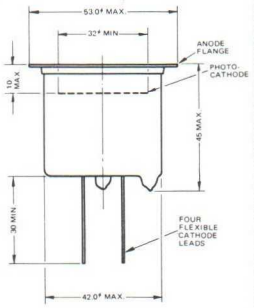
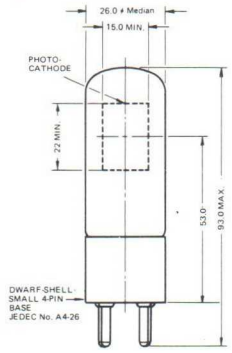


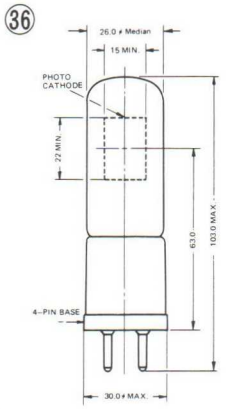
R317

(35)



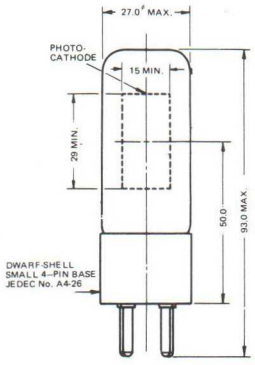
PG25

(36)



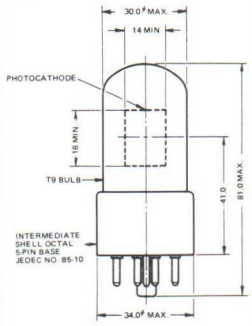
PG27

(37)



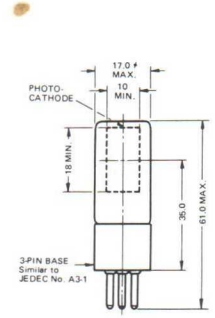
PG28A

(38)



4409
6953

(39)



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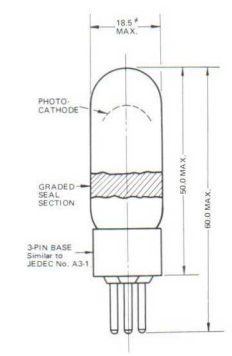

R184

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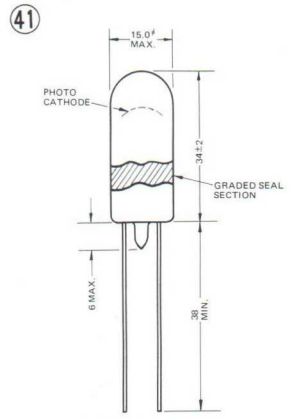
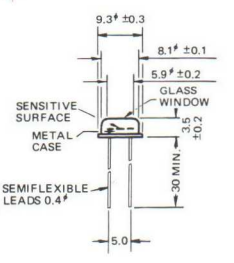


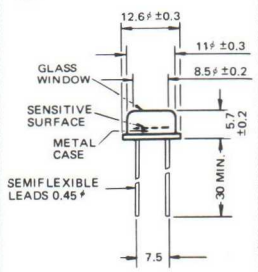
R334

(42)



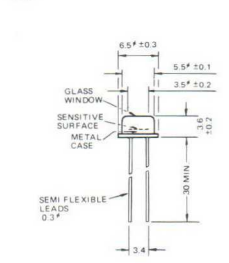
P201A P203 P368
P201B P204 P380
P201C P295 P411
P201D P346

(43)



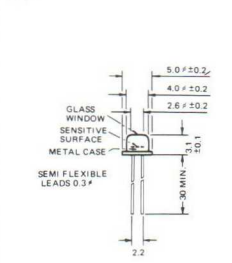
P202
P202A
P202B
P202C

(44)



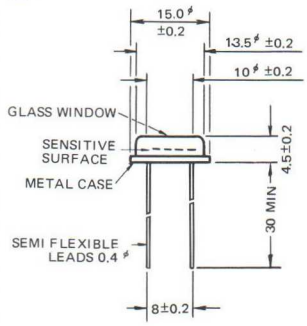
P227A P285
P227B P315
P227C P320
P227D P328

(45)



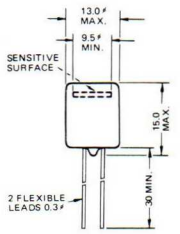
P347
P401

(46)



P322
P397

47



P141

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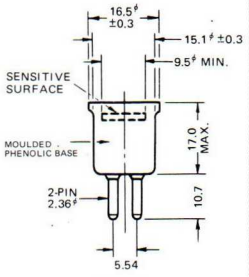

P179

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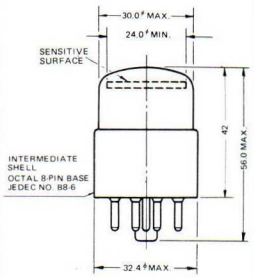
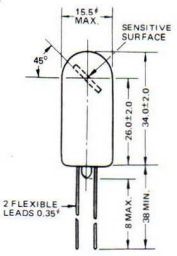


P113

50



P255

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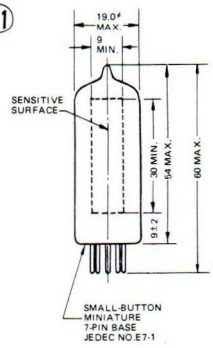
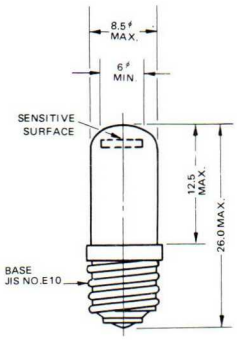


P240

52



P109
P273

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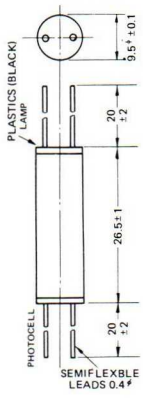

P388

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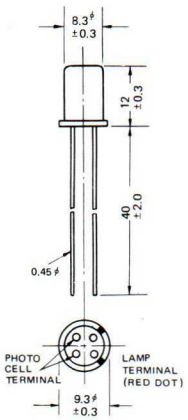

P392

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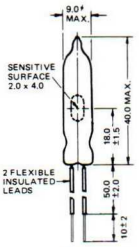

P124

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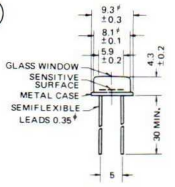

P394

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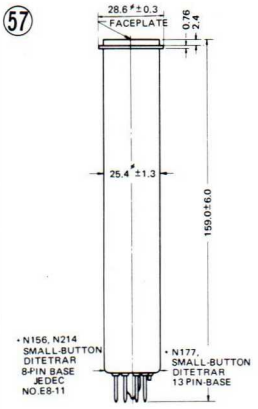
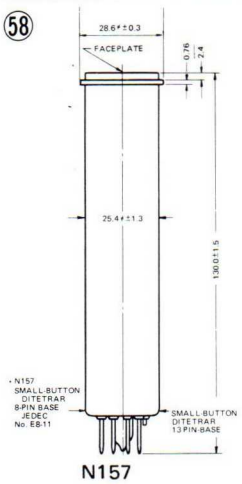


N156
N177
N214

58



N157

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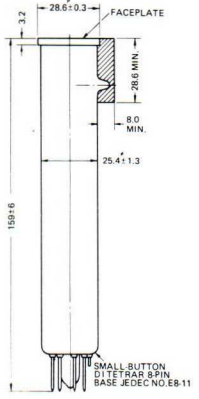

N350

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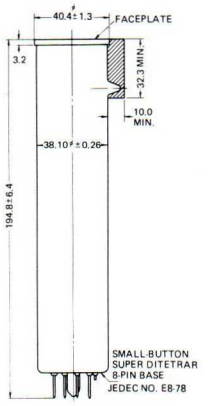

N400

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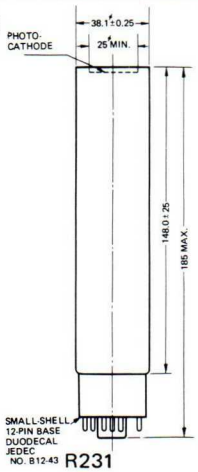

R231

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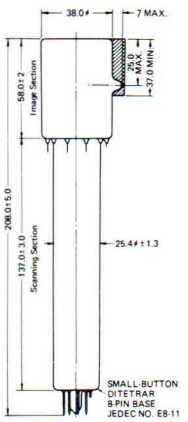

N284

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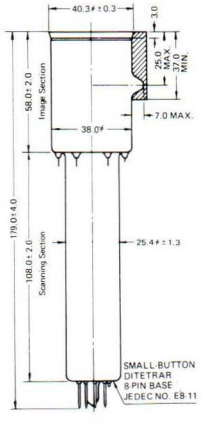

N337

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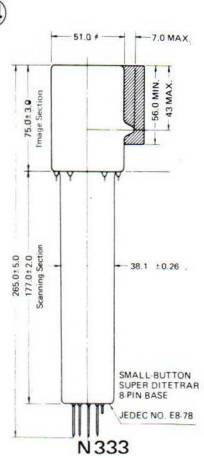

N333

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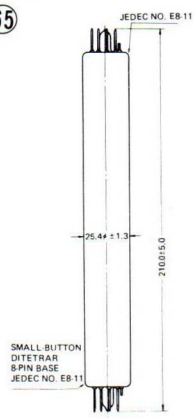

N232

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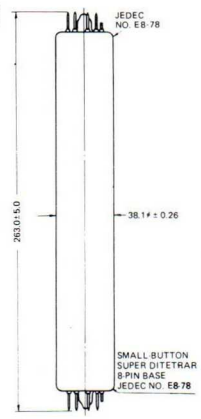

N319

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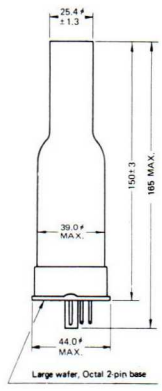

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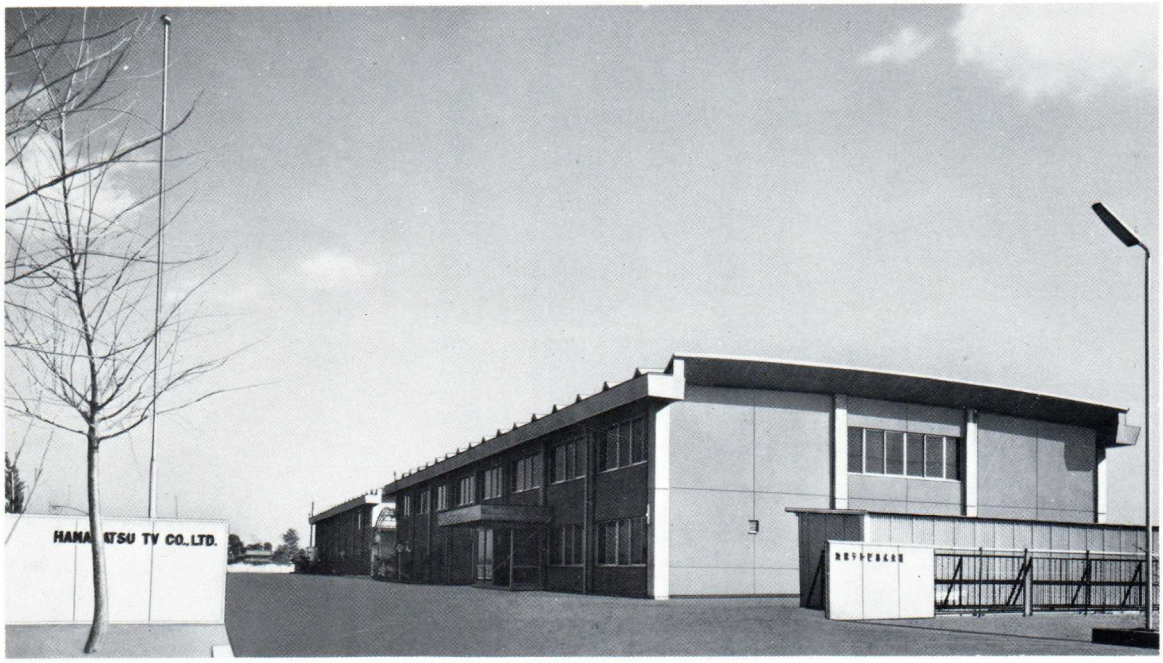

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