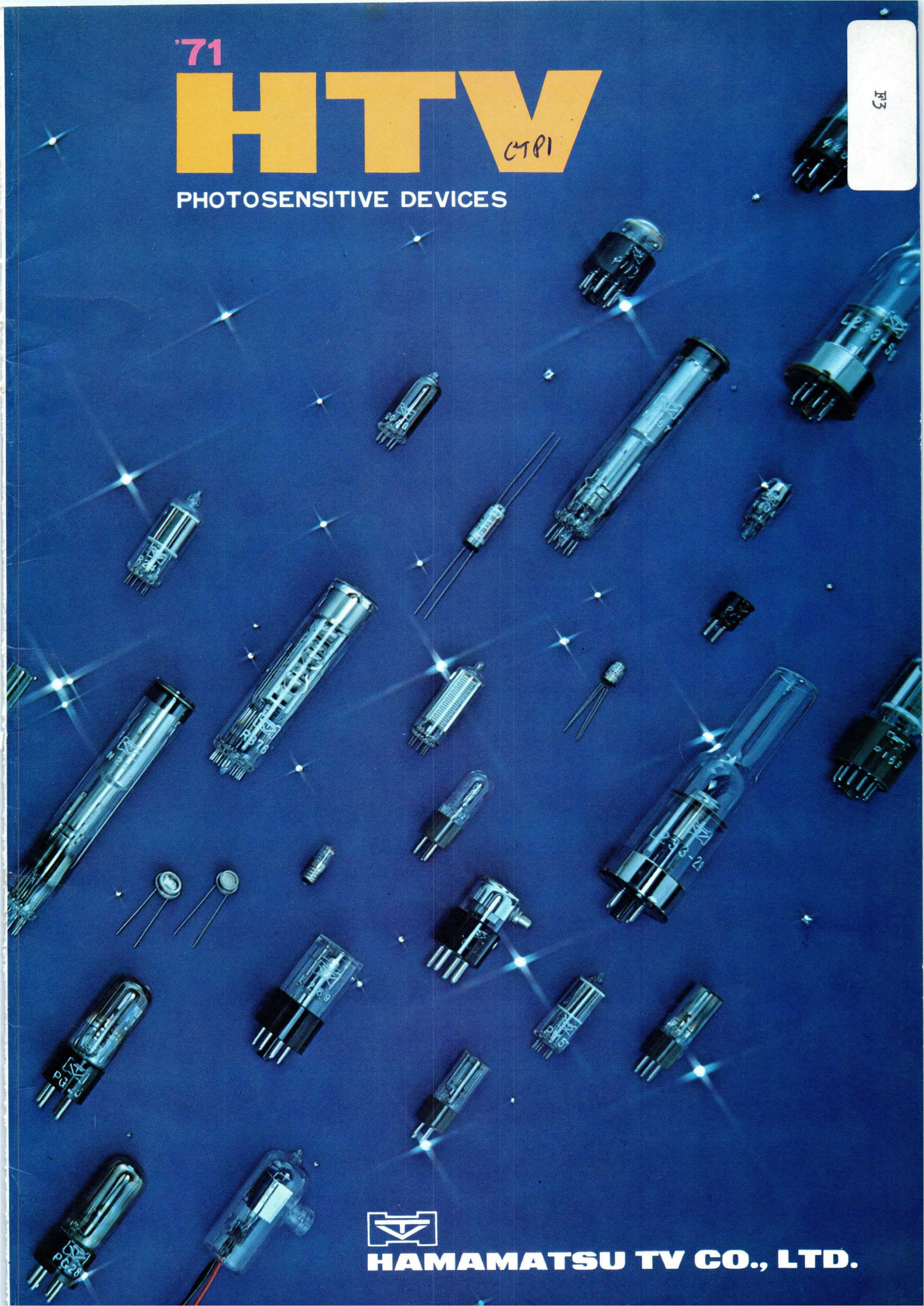
'71

HTV

CTP1

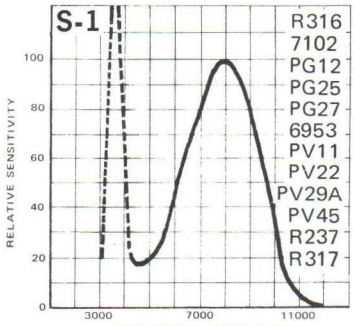
F3

PHOTOSENSITIVE DEVICES

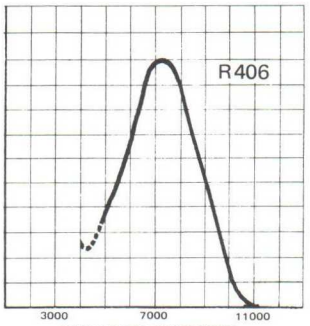


HAMAMATSU TV CO., LTD.

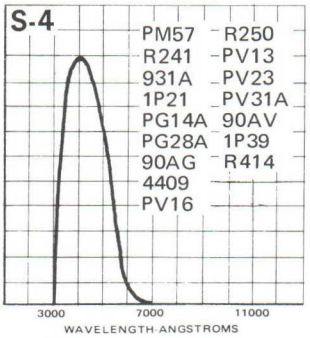
RELATIVE SPECTRAL RESPONSE CURVES



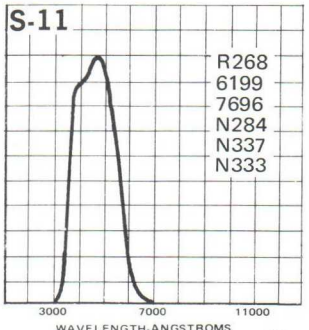
AgOCs Borosillicate-glass



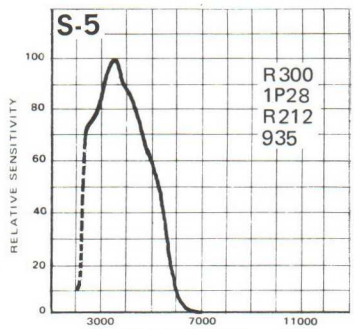
Similar to AgOCs



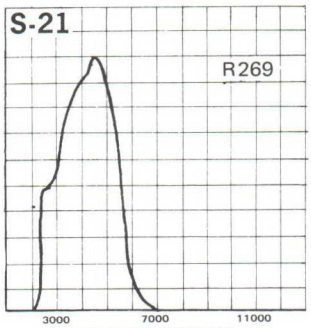
SbCs Borosillicate-glass



SbCs Borosillicate-glass ①



SbCs UV-glass



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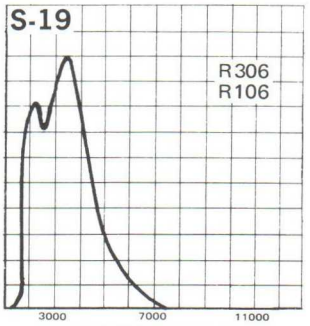
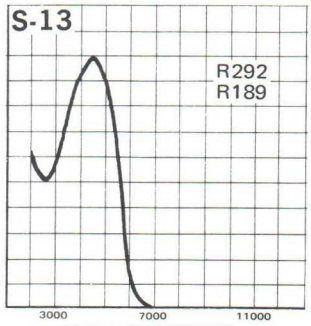
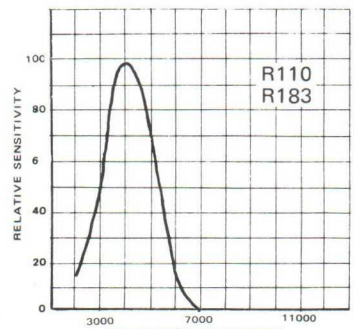


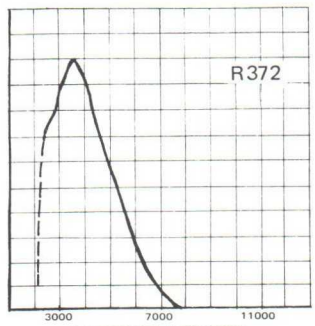
SbCs Fused-Quartz



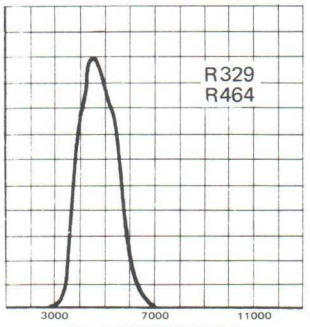
SbCs Fused-Quartz ①



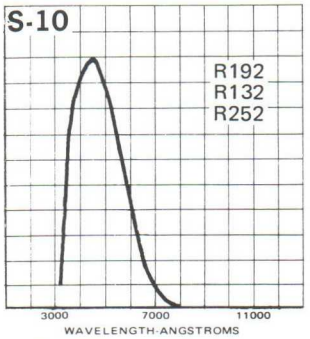
SbCs Special-glass



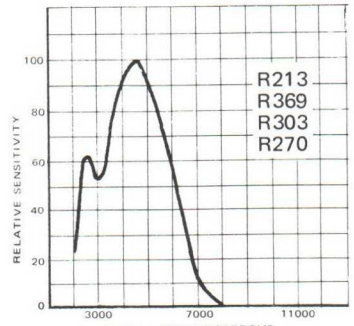
Bialkali UV-glass



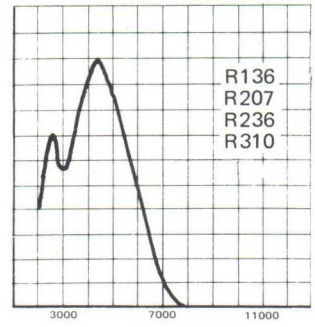
Bialkali Special-glass



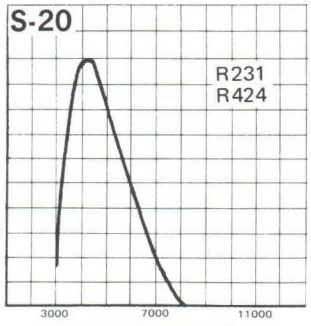
AgBiOCs Borosillicate-glass



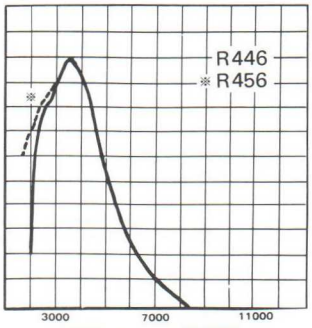
AgBiOCs UV-glass



AgBiOCs Fused-Quartz

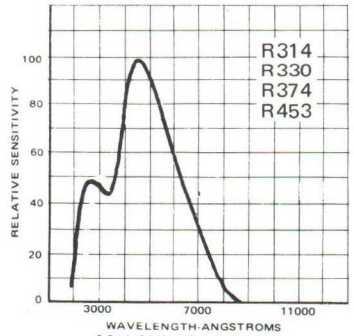


Multialkali Borosillicate-glass

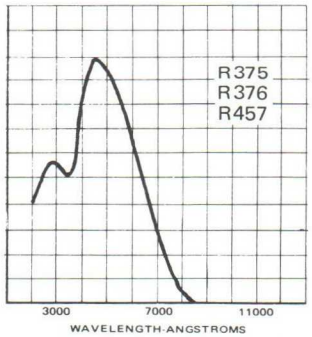


Multialkali UV-glass

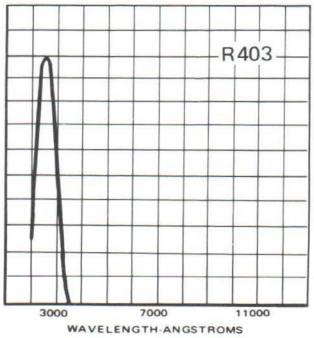
※ Multialkall Fused-Quartz



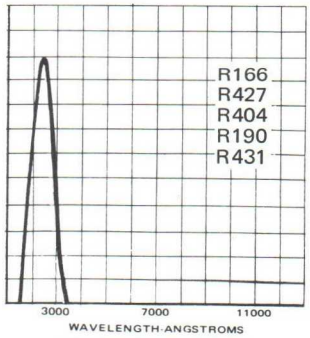
Multialkali UV-glass



Multialkali Fused-Quartz



CsTe UV-glass

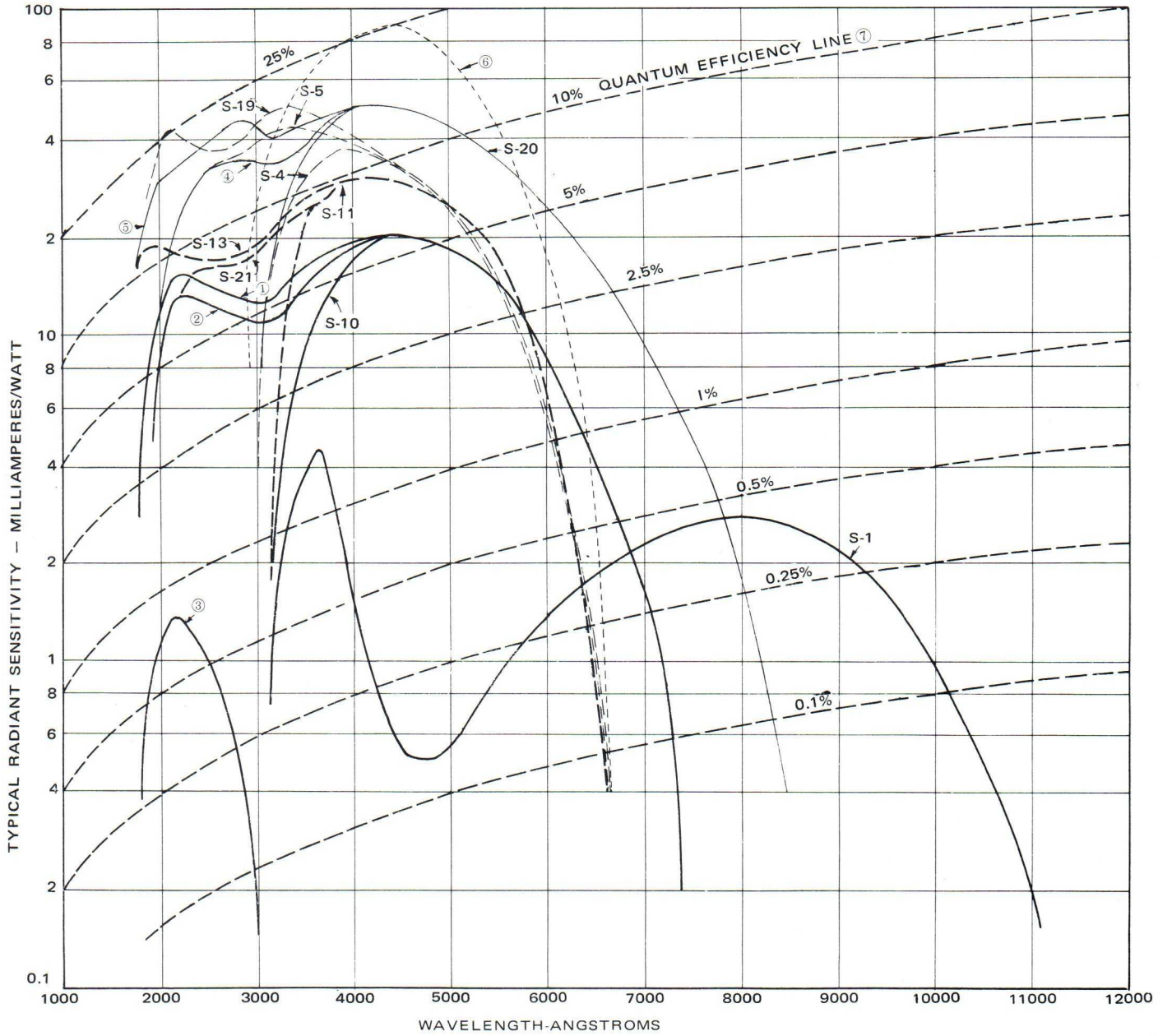


CsTe Fused-Quartz

Note

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, R369, R303 and R270. Its photocathode type and envelope is shown in page 2.

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

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

⑤..... For type R375, R457 and R376. 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
R303		1	A	9	1850~8000	4300	U.V. glass	Ag-Bi-O-Cs	1000
R306		1	A	9	S-19	3300	Quartz ⑨	Sb-Cs	1000
R427		1	A	9	1600~3200	2200	Quartz ⑨	Cs-Te	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
R132		4	D	9	S-10	4300	⑰	Ag-Bi-O-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	1850~8200	3500	U.V. glass	Multi Alkali	1250
R456		4	D	9	1600~8200	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 ..... Measured in amperes/watt. 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 ..... Averange 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).

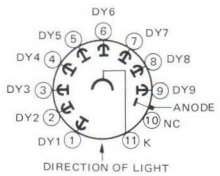
⑪ ..... Supply voltage (E) across a voltage divider providing ¼ of E between cathode and dynode No. 1; ¼ of E for each succeeding dynode stage; and ¼ of E between dynode No. 3 and anode.

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:

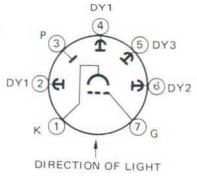
R-IK ..... Cathode current is measured with incident light transmitted from a tungsten-filament lamp operated at a color temperature of 2854°K through a red filter (Corning 2-62 sharp cut filter). The value of light flux on the filter is 0.01 lumen. The load resistor has a value of 0.01 megohm, and 100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

A



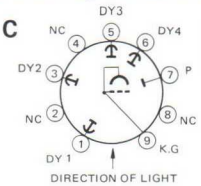
R300
R303
R306
R427

B



PM57

C

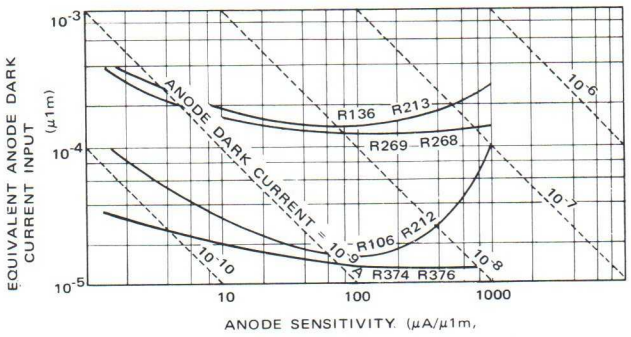


R241
R252

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		TYPE
			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)	
			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	–	30	–	10	30	1.6×10^4	1×10^6	0.2	1.7	2	R303
0.01	150	1000 ⑧	10	30	–	30	60	7.2×10^4	2×10^6	0.007	1.7	2	R306
0.01	150	1000 ⑧	–	–	–	1000 ⑩ (μA/μW)	4000 ⑩ (μA/μW)	5.6×10^3	–	0.0005	1.7	2	R427
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	R132
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 (μA/μW)	4000 ⑩ (μA/μW)	5.6×10^3	–	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	R45

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:

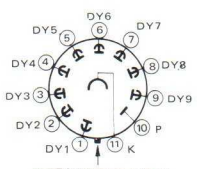
IR-IK ..... Cathode current is measured with incident light transmitted from a tungsten-filament lamp operated at a color temperature of 2854° K through an infrared fitler (Toshiba IR-DIA infrared filter) The value of light flux on the filter is 0.01 lumen. The load resistor has a value of 0.01 megohm, 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

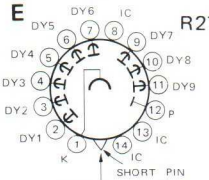
D



DIRECTION OF LIGHT

931A R106 R166
1P21 R132 R406
1P28 R213 R446
R212 R136 R456
R372 R197

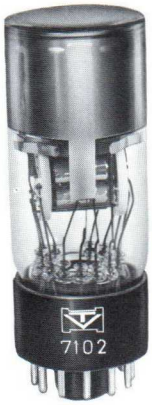
E R270

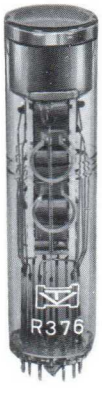


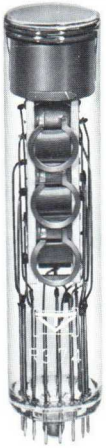
SHORT PIN

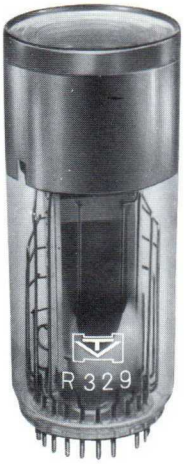
DIRECTION OF LIGHT

HEAD-ON TYPE PHOTOMULTIPLIER TUBES

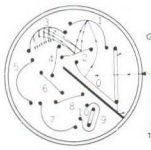








Dynode Structures of Photomultiplier Tubes



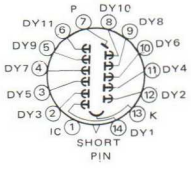
(a)

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:

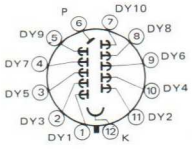
① ..... For dimensional outline, see page 16.
② ..... The basing diagrams are shown at bottom of this page.
③ ..... Measured in amperes/watt. For spectral response curves, see page 2 to 3.
④ ..... Ambient temperature of all the types is ranged from -80°C to +50°C.
⑤ ..... Averaged over any interval of 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 (min.) 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



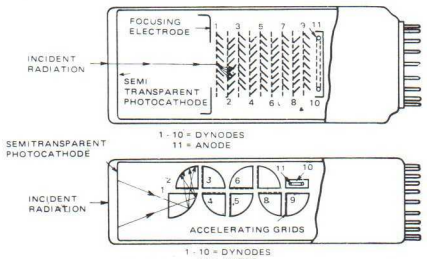
R189 R192
R207 7102
6199 R190

Dynode Chains for Photomultiplier Tubes

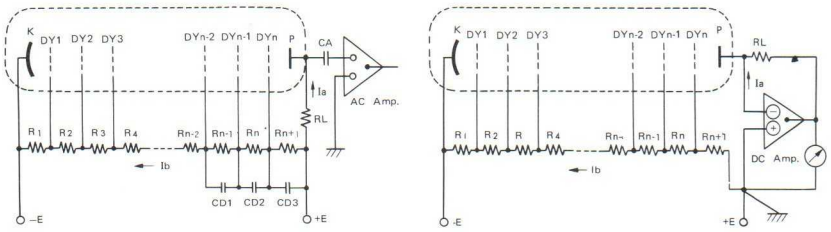
= Photomultiplier Tube
K = Photocathode
DY1-DYn = Dynodes
P = Anode
Ia = Anode current: When maximum stability is required the anode current should not exceed 1 μA
Ib = Chain current (Ib > 10Ia)
CA = Coupling capacitor
CD = Decoupling capacitors

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

RL = Load resistor of anode
R1-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 (μA/μW)	4000 ⑲ (μA/μW)	–	–	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 (μA/μW)	400 ⑲ (μA/μW)	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.

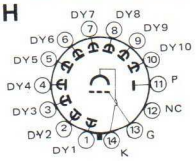
W-IK ..... Test condition is the same as the (R-IK) except that a filter is not used.

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).

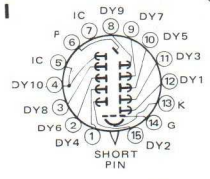
⑳ ..... Borosillicate glass

H



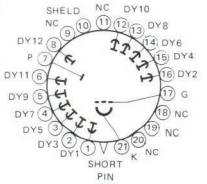
7696

I



R236
R375

J

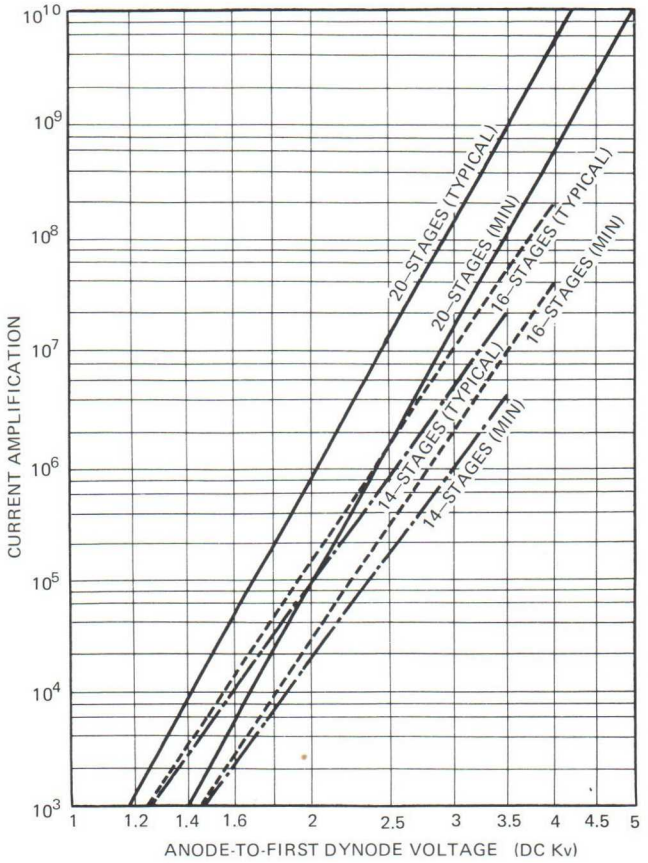


R329
R464

ELECTRON MULTIPLIERS

Hamamatsu Electron Multipliers feature excellent gain and very low dark current for application in the vaccum system to detect electrons, charged particles, vaccum 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 vaccum U.V. radiation, the first dynode can be interchanged with a pure metal-coated cathode such as an Au, Ni, or Cu.

Amplification Characteristics



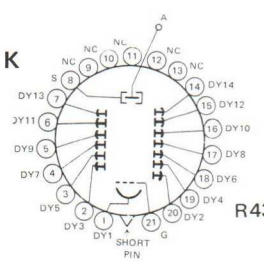
Type	Dimensional Outline ①	Basing Diagram ②	Dynode Stages	Dynode Material	Current Amplification at 250v/stage (Min.)	Maximum Ratings (Absolute Values)		
						Anode-to-First Dynode Voltage (dc volts)	Average Anode Current (μA)	Anode-to-Last Dynode Voltage (dc volts)
R438	12	K	14	Cu-BeO	4×10^6	4500	10	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.

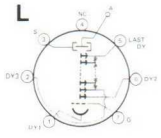
② ..... The basing diagrams are shown in bottom of this page.

K



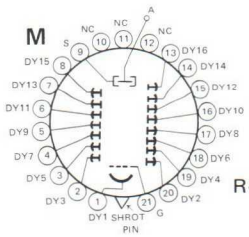
R438

L



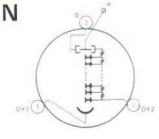
R475
R422
R425

M



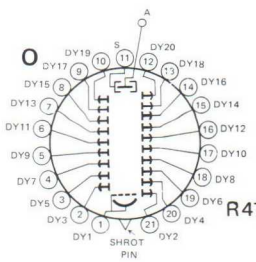
R476

N



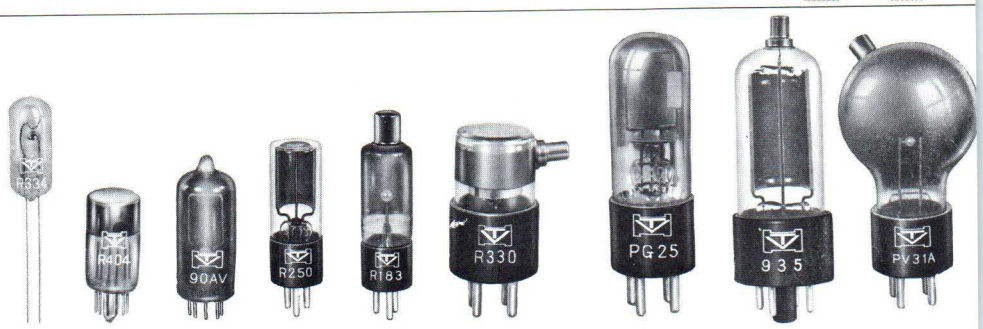
R474

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 (volts)	Luminous Sensitivity (μA/lumen) [5] 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	0.025	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] (nA/μW)	20 [9] (nA/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	25K	1 (A)	–	50	75	250	10	15	–	50 [10]

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

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 (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 ..... As to symbols, see appropriate illustration in Dimensional Outlines Section of this brochure. Measured in amperes/watt. 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.

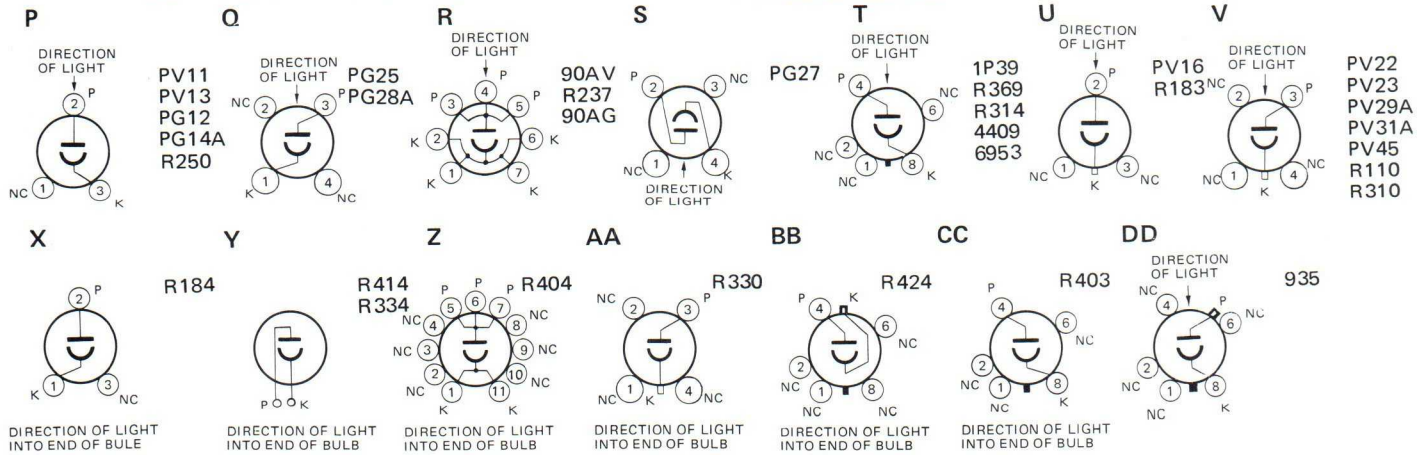
⑦ ..... Cathode luminous sensitivity is measured through filter which passes only infrared radiation. (Toshiba IR-D1 filter).

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



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 ⑥					γ (1 to 100 Lux) ⑧
						Voltage between Terminals (dc volts)	Power Dissipation at 25°C (Watt) ④	Cell Resistance			Time Response at 10 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	170	130	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	170	130	0.6~0.75
P227A	44	EE	5500±200	Glass Metal	CdS	100	0.05	1	4.2~12.8	0.7~2.3	170	130	0.6~0.75
P201B	42	EE	5500±200	Glass Metal	CdS	200	0.1	10	22.5~67.5	2.9~8.7	25	20	0.9~1
P202B	43	EE	5500±200	Glass Metal	CdS	200	0.1	5	17.5~52.5	2.2~6.8	25	20	0.9~1
P227B	44	EE	5500±200	Glass Metal	CdS	200	0.05	10	50~150	7~21	25	20	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	35	20	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	35	20	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	35	20	0.75~0.9
P203	42	EE	6000±300	Glass Metal	Cd(S,Se)	300	0.05	300	250~1000	40~120	15	10	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	20	10	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	35	20	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	35	20	0.75~0.9
P204	42	EE	6000±300	Glass Metal	Cd(S,Se)	200	0.05	200	10~30	1.2~3.8	15	10	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	35	20	0.75~0.9
P328	44	EE	6000±300	Glass Metal	Cd(S,Se)	100	0.05	10	40~120	5~15	35	20	0.8~0.95
P347	45	EE	6000±300	Glass Metal	Cd(S,Se)	100	0.03	300	200~600	25~75	15	10	0.8~0.95
P401	45	EE	6000±300	Glass Metal	Cd(S,Se)	100	0.03	10	9~50	1~6	35	20	0.8~0.95
P201D	42	EE	5500±200	Glass Metal	CdS	200	0.1	10	25~75	2~6	30	15	0.85~0.95
P227D	44	EE	5500±200	Glass Metal	CdS	200	0.05	10	75~225	6~18	30	15	0.85~0.95
P315	44	EE	5500±200	Glass Metal	CdS	200	0.1	10	2.5~7.5	1~3	150	120	0.6~0.7
P320	44	EE	5500±200	Glass Metal	CdS	200	0.05	10	35~105	5~15	15	10	0.8~0.9
P322	46	EE	5500±200	Glass Metal	CdS	200	0.3	10	2.2~6.6	0.35~1.05	60	40	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	80	40	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	80	40	0.7~0.85
P202	43	EE	5600±600	Glass Metal	CdS	150	0.3	5	0.7~8	0.17~1.5	80	40	0.7~0.85
P113	49	FF	5600±600	Glass with Octal Base	CdS	300	0.6	10	5~30	0.9~5	80	40	0.7~0.85
P255	50	EE	5600±600	All Glass	CdS	300	0.4	10	6~50	1~8	80	40	0.7~0.85
P240	51	GG	5600±600	All Glass	CdS	300	0.6	10	3.3~33	0.6~6	80	40	0.7~0.85
P109	52	EE	5600±600	Glass with Screw Base	CdS	200	0.1	30	300~10000	70~2000	80	40	0.7~0.85
P273	52	EE	5600±600	Glass with Screw Base	CdS	200	0.1	100	45~350	10~75	80	40	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.

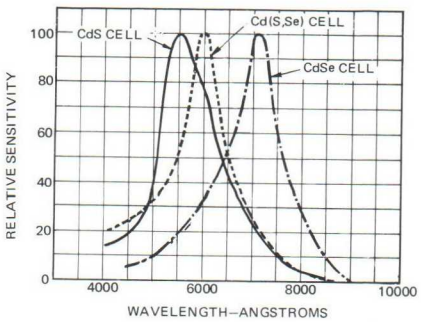
⑤..... Minimum values. Measured 60 seconds after removal of incident illumination level.

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).

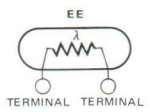
⑦..... The time required for the conductance to rise to 63.2 per cent of the maximum value or to fall from the peak to 36.8 per cent of the maximum value.

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

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

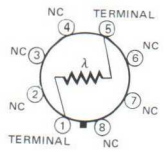


EE

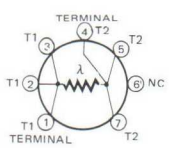


P201A P227C P347 P141
P202A P203 P401 P179
P227A P346 P201D P202
P201B P368 P315 P255
P202B P380 P320 P273
P227B P411 P322 P109
P201C P204 P285
P202C P328 P295

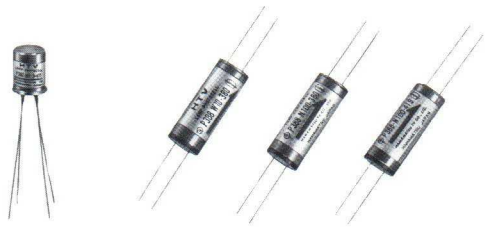
FF P113



GG P240



LAMP-PHOTOCELLS



Hamamatsu Lamp-Photocells are 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 25KΩ.

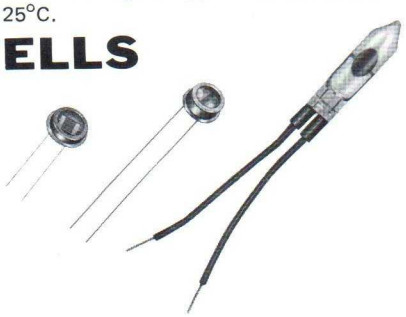
③..... The nominal "ON" resitance is a typical value of photocell when the nominal voltage is applied at the control terminals, measured at 25°C.

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 between Terminals (dc volts)	Characteristics at 25°C ④⑧		
								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~ 5	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.

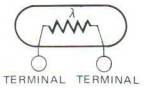
⑤..... Applied to 5 volts dc for each type.

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.

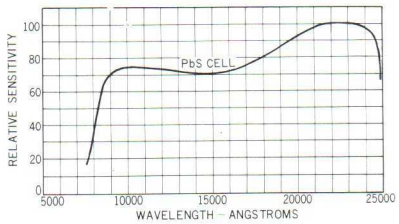
⑧..... Absolute values. The maximum ambient temperature rating of these cells are +60°C.

HH



P124
P394
P397

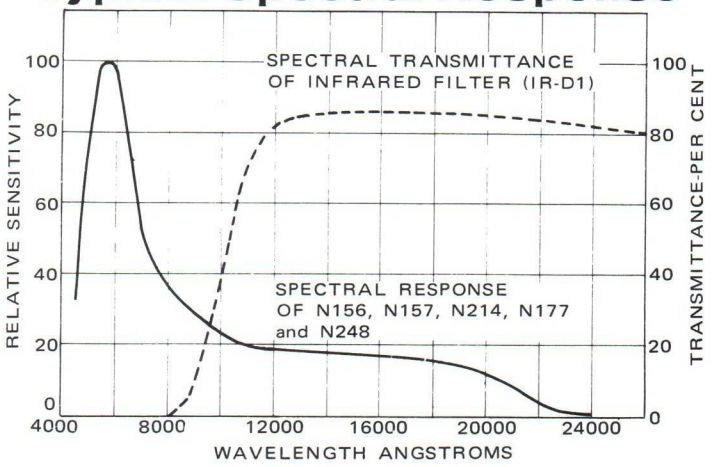
Spectral Response for PbS Cells



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, 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	③ ④ Maximum Ratings: Signal Electrode Voltage (volts)	Grid No. 3 & 4 Voltage (volts)	Grid No. 2 Voltage (volts)	Dark Current (μA)	④ ⑤ ⑥ Characteristics: Signal Electrode Voltage (volts)	Grid No. 3 & 4 Voltage (volts)	Grid No. 2 Voltage (volts)	Grid No. 1 Voltage (volts) ⑦	Dark Current (μA)	Signal Output Current at 10 I.R. Lux (μA)	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										
N248	58	KK	5 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 2870°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 (volts)	Grid No. 4 Voltage (volts)	Grid No. 3 Voltage (volts)	Grid No. 2 Voltage (volts)	Dark Current (μA)	Characteristics: Signal Electrode Voltage (volts)	Grid No. 4 Voltage (volts)	Grid No. 3 Voltage (volts)	Grid No. 2 Voltage (volts)	Grid No. 1 Votlage (volts)	Dark Current (μA)
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	550	0.2	10 to 100	1400 ③	800 to 1000 ③	300	-45 to -100	0.02

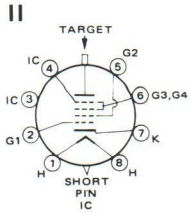
Notes:

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

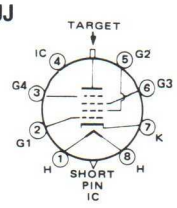
② ..... The basing diagrams are shown in bottom of this page.

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

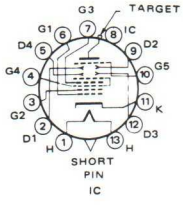
II — N156, N157, N350



JJ — N214



KK — N177, N248



LL — N400

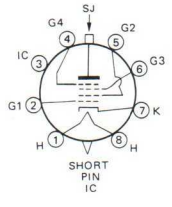
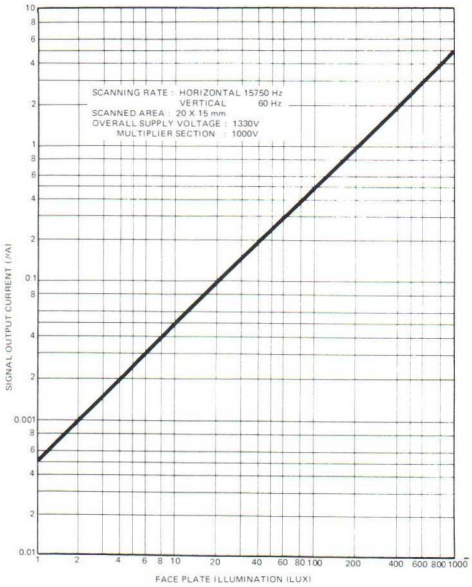


IMAGE DISSECTOR TUBE

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 (volts)	Grid No. 4 Voltage (volts)	Dynode No. 1 Voltage (volts)	Blanking Electrode Voltage (volts)	Dynode Voltage (volts/stage)	Anode Voltage (volts)	④ Signal to Noise Ratio (dB)	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.

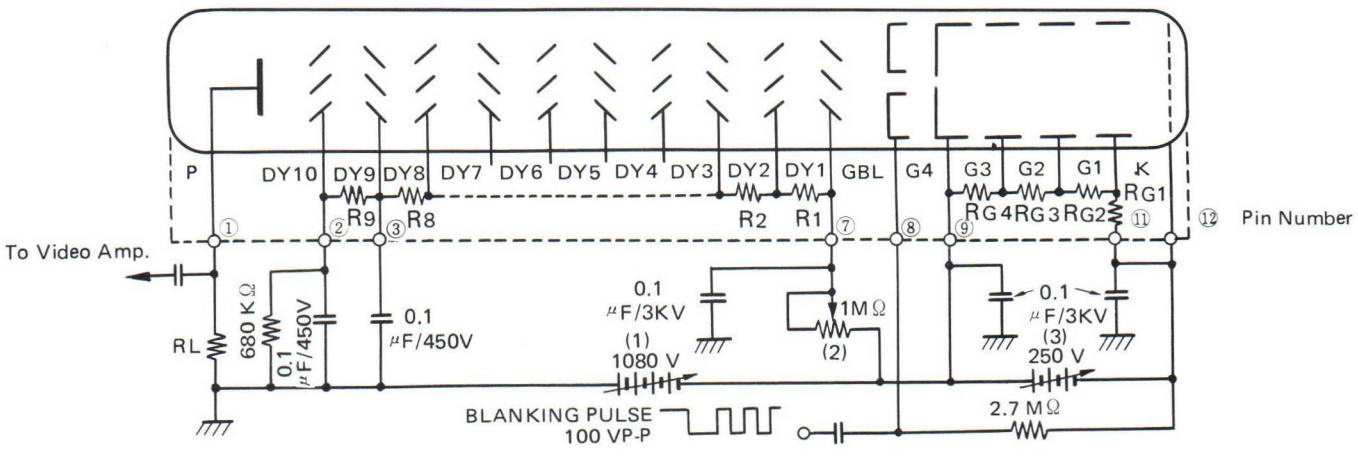
② ..... The basing diagram is shown at bottom of this page.

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

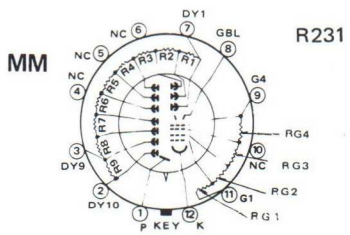
④ ..... Bandwith of video amplifier (-3dB points): 6MHz.
Scanning Rate
Horizontal: 15750 Hz.
Vertical: 60 Hz
Interace: 2 : 1
Face plate illumination: 300 lux

⑤ ..... For your requirement, the version type of R231 will be furnished as follows.
1) Photocathode and window material
2) Aperture size and shapes
3) Dividing resistors and none-base

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-N284, N337 and N333 are the image memory pickup tubes; the former two types are 1½-inch in diameter and the later 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

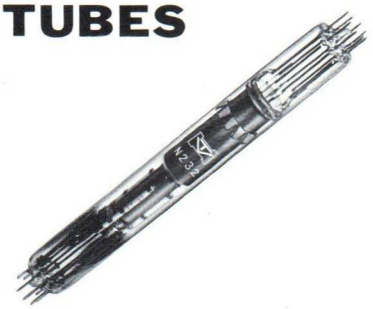
Type	Dimensional Outline	Basing Diagram	Focusing Method	Deflection Method	Spectral Response ②	Resolution (TV-lines)	Luminous Sensitivity (μA/lm)	Minimum Erasing & Priming Time (flame times)	Exposure Value (lx-sec)	③ Storage Capability
N284	62	NN	Magnetic	Magnetic	S-11	350	30	2	0.5 to 1.0	Few minutes, with scanning beam. Few hours without scanning beam.
N337	63	OO								
N333	64	PP				600				

Typical Operation

Type	mage Section					Scanning Section				Strage Section				
	Grid No. 7 Voltage (volts)	Grid No. 6 Voltage (volts)	Grid No. 5 Voltage (volts)	Grid No. 4 Voltage (volts)	Field Strength (gauses)	Grid No. 3 Voltage (volts)	Grid No. 2 Voltage (volts)	Grid No. 1 Voltage (volts)	Field Strength (gausses)	① Mode / Electrode	Erasing Voltage (volts)	Priming Voltage (volts)	Writing Voltage (volts)	Reading Voltage (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				30	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 for converting a reader signal to television signal, and for reducing the effective exposing ammount to X-ray in combination with X-ray television system, etc.

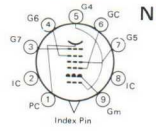
Type	Dimensional Outline	Basing Diagram	Focusing Method	Deflection Method	Minimum Erasing & Priming Time (flame times)	① Storage Capability
N232	65	QQ	Magnetic	Magnetic	2	Few minutes, with scanning beam. Few hours without scanning beam.
N319	66	QQ				

Typcal Operation

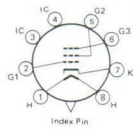
Type	Scanning Section				Strage Section					
	Grid No. 3 Voltage (volts)	Grid No. 2 Voltage (volts)	Grid No. 1 Voltage (volts)	Field Strength (gausess)	Signal Electrode Voltage (volts)	Mode / Electrode	Erasing Voltage (volts)	Priming Voltage (volts)	Writing Voltage (volts)	Reading Voltage (volts)
N232	250 to 300	300	-45 to -100	40	350	Collector	350	350	350	350
						Storage	360	10	350	2 to 7
N319						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.

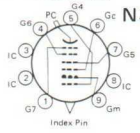
NN Image Section N284



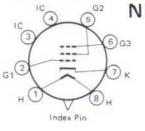
NN Scanning Section N284



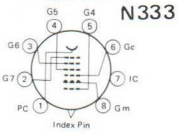
OO Image Section N337



OO Scanning Section N337



PP Image Section 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 phenimena and decreases remarkably the line of back ground, therefore they have the absobance 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	Dimensional Outline ①	Basing Diagram ②	Element	Filled Gas	Window Glass ③	Tube Drop Voltage (volts)	Maximum Current (mA)	Starting Voltage (volts)	Analysis Line (angstroms)
L233-4NQ	67	SS	Be	Ne	Q	170	35	225	2348.6
L233-12NQ	67	SS	Mg	Ne	Q	135	20	250	2852.1
L233-13NU	67	SS	Al	Ne	UV	190	20	320	3092.7
L233-14NQ	67	SS	Si	Ne	Q	170	20	330	2516.1
L233-20NU	67	SS	Ca	Ne	UV	210	18	335	4226.7
L233-22NU	67	SS	Ti	Ne	UV	160	35	240	3642.7
L233-23NU	67	SS	V	Ne	UV	170	35	305	3184.0
L233-24NU	67	SS	Cr	Ne	UV	160	30	375	3578.7
L233-24AU	67	SS	Cr	Ar	UV	160	30	375	4254.4
L233-25NQ	67	SS	Mn	Ne	Q	180	30	400	2794.8
L233-26NQ	67	SS	Fe	Ne	Q	170	30	380	2483.8
L233-27NQ	67	SS	Co	Ne	Q	180	30	330	2407.3
L233-28NQ	67	SS	Ni	Ne	Q	200	25	385	2320.0
L233-29NU	67	SS	Cu	Ne	UV	205	30	375	3247.5
L233-30NQ	67	SS	Zn	Ne	Q	195	18	260	2138.6
L233-32NQ	67	SS	Ge	Ne	Q	195	20	400	2651.6
L233-42NU	67	SS	Mo	Ne	UV	140	30	340	3132.6
L233-47NU	67	SS	Ag	Ne	UV	180	20	320	3280.7
L233-48NQ	67	SS	Cd	Ne	Q	195	12	350	2288.0
L233-50NQ	67	SS	Sn	Ne	Q	250	15	290	2246.1
L233-51NQ	67	SS	Sb	Ne	Q		18		2175.9
L233-56NU	67	SS	Ba	Ne	UV	130	25	170	5535.5
L233-74NQ	67	SS	W	Ne	Q	155	35	330	2551.4
L233-78NQ	67	SS	Pt	Ne	Q	190	30	375	2659.5
L233-79NQ	67	SS	Au	Ne	Q	230	16	400	2428.0
L233-83NQ	67	SS	Bi	Ne	Q		12		2230.6

Notes:

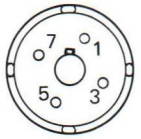
① ..... For dimensional outline, see page 19.

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

③ .... Q: Fused Quartz
UV: U.V. transmitting glass

SS

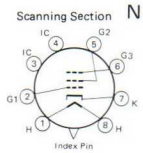
L233



1 : Cathode
3 : Anode
5 : NC
7 : NC

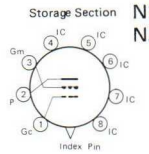
PP

Scanning Section N333



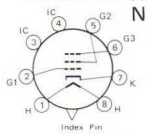
QQ

Storage Section N232 N319



QQ

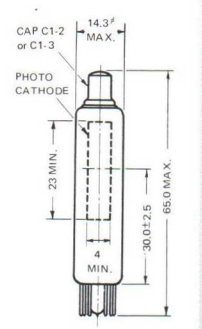
Scanning Section N232 N319



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

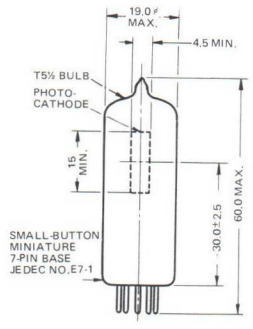
DIMENSIONAL OUTLINES (Unit: mm)

①



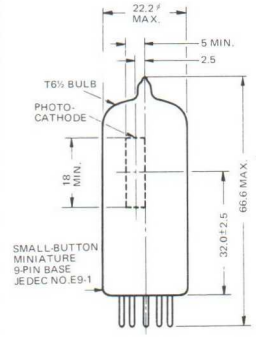
R306 R303
R300 R427

②



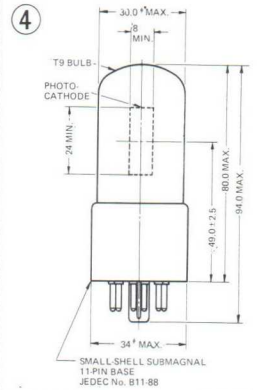
PM57

③



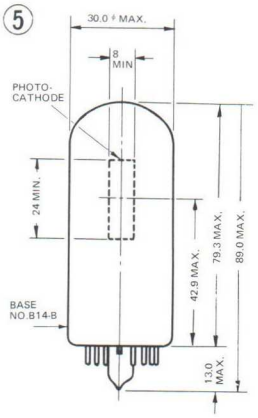
R241
R252

④



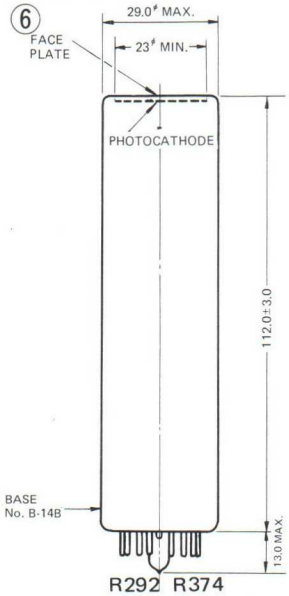
R106 1P28 R197
931A R212 R166
1P21 R213 R372
R136 R132 R406
R446 R456

⑤



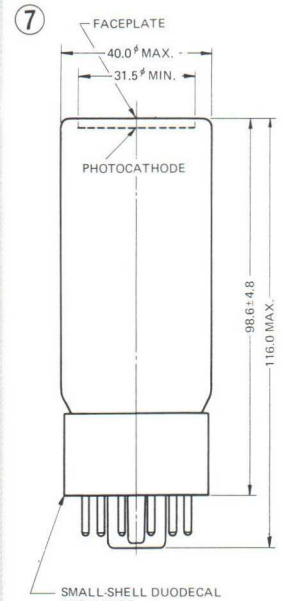
R270

⑥



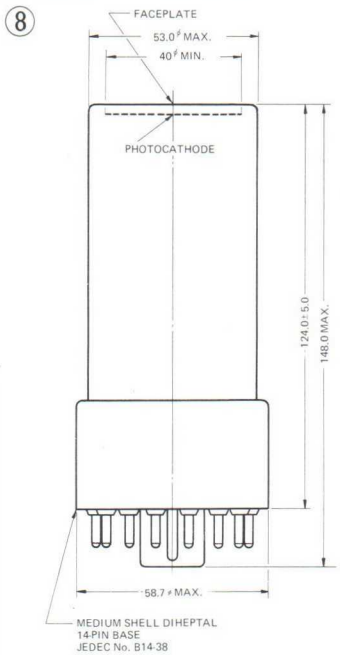
R292 R374
R376 R269
R453 R268
R430 R316
R431 R396
R457

⑦



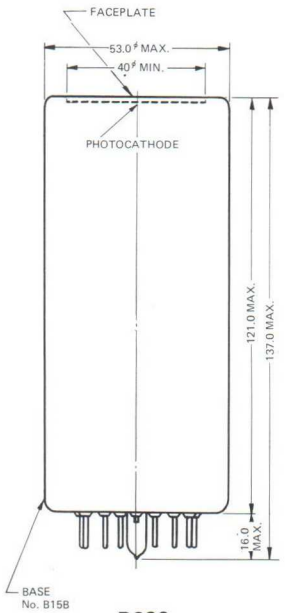
R189 R192
R207 7102
6199 R190

⑧



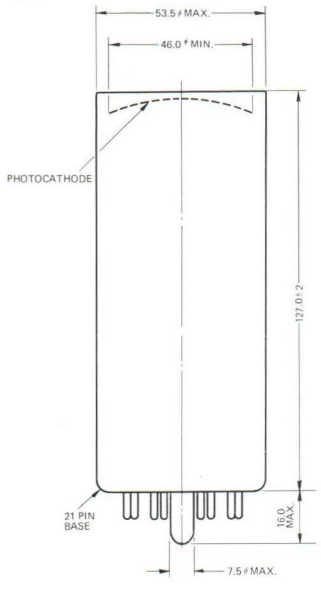
7696

⑨



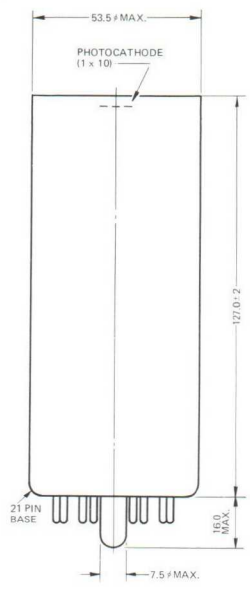
R236
R375

⑩



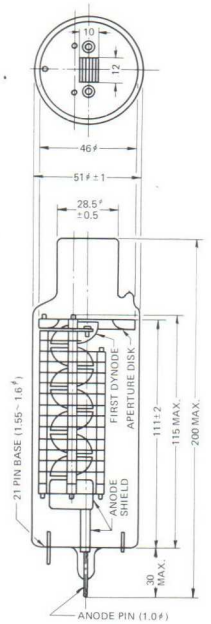
R329

⑪



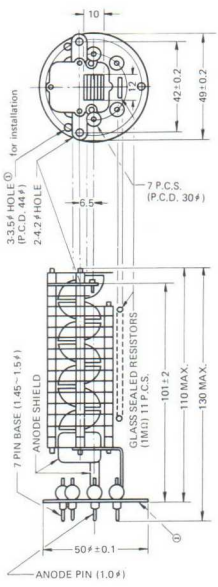
R464

⑫



R438

⑬



R475

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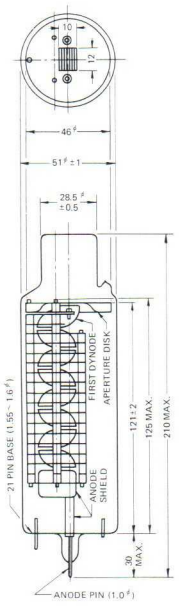
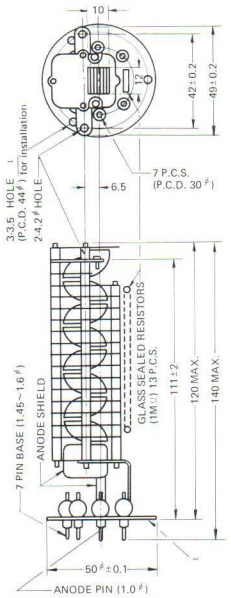


R476

⑮



R422

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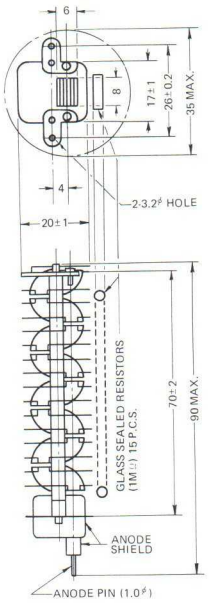

R474

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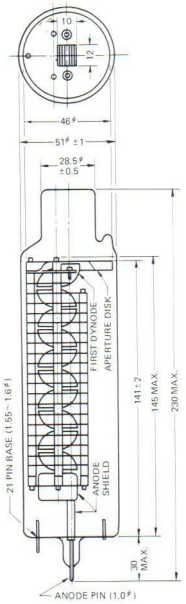
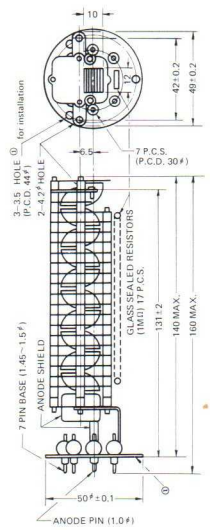


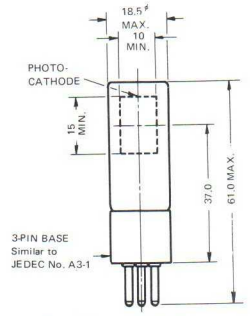
R477

⑱



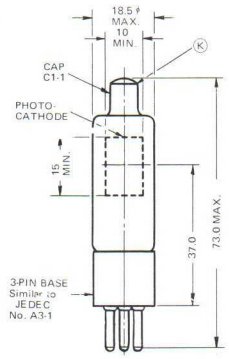
R425

⑲



PV11 PG12
PV13 PG14A

⑳



PV16

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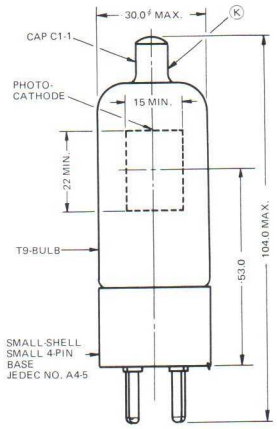

PV22
PV23

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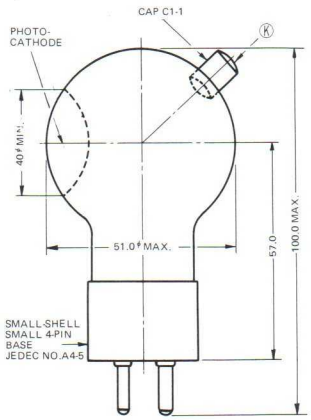

PV29A
PV31A

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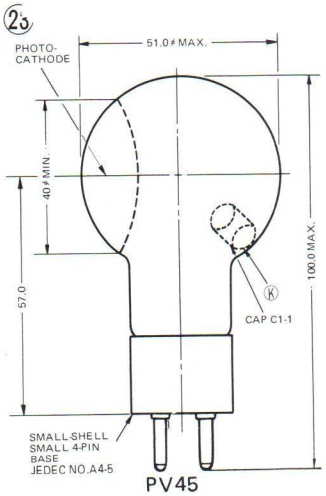

PV45

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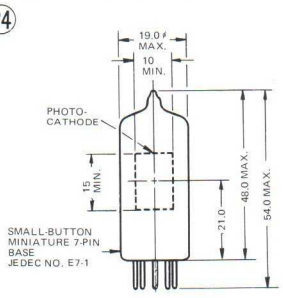
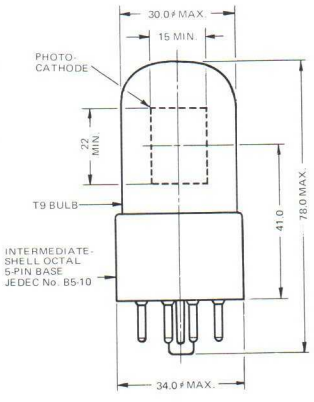


90AV R237
90AG

㉕



1P39 R314
R369

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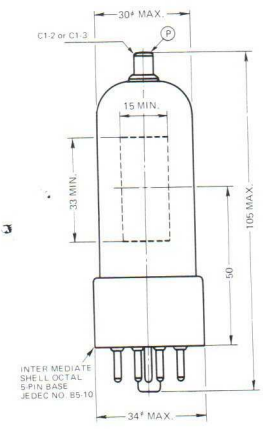
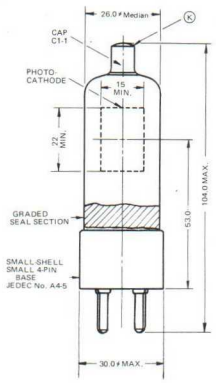


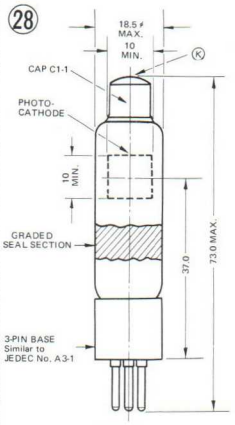
935

(27)



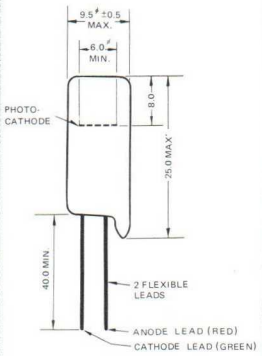
R110
R310

(28)



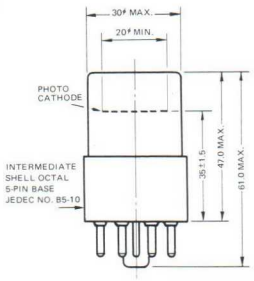
R183

(29)



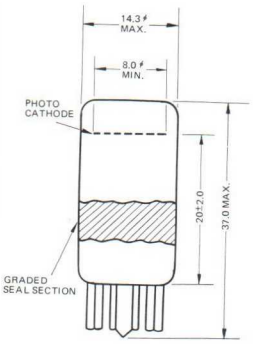
R414

(30)



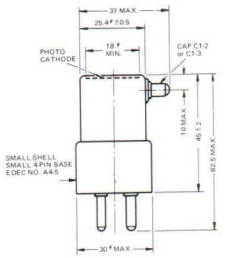
R403

(31)



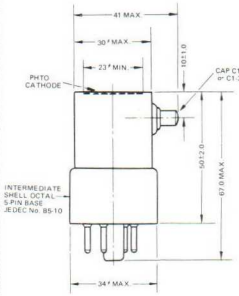
R404

(32)



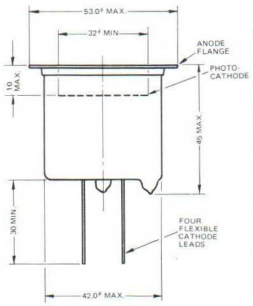
R330

(33)



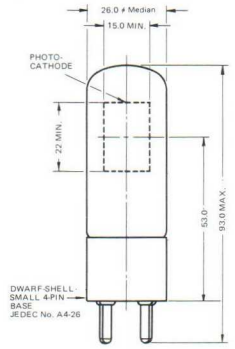
R424

(34)



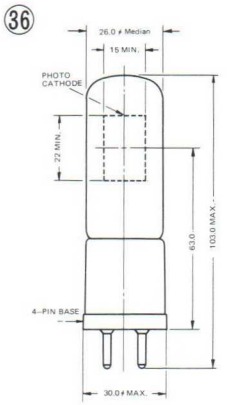
R317

(35)



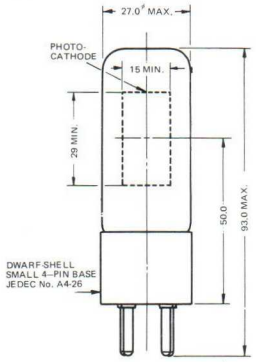
PG25

(36)



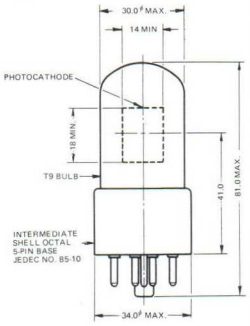
PG27

(37)



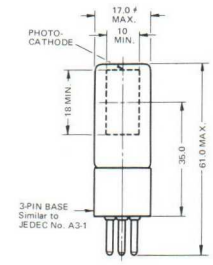
PG28A

(38)



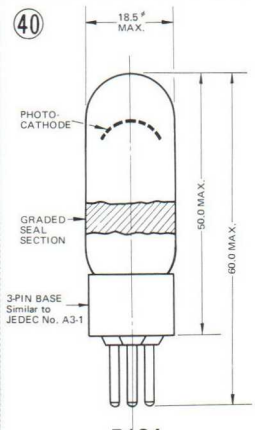
4409
6953

(39)



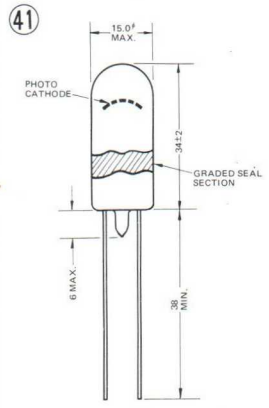
R250

(40)



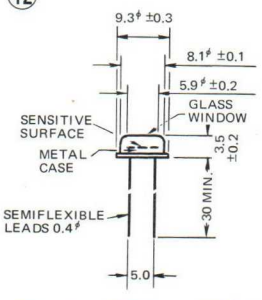
R184

(41)



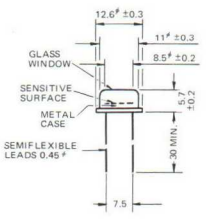
R334

(42)



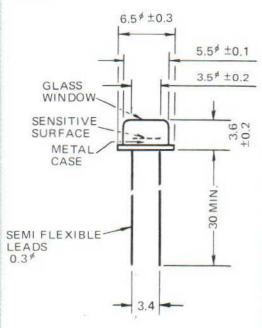
P201A P203 P368
P201B P204 P380
P201C P295 P411
P201D P346

(43)



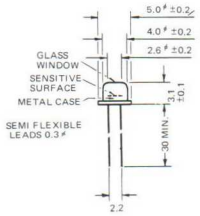
P202
P202A
P202B
P202C

(44)



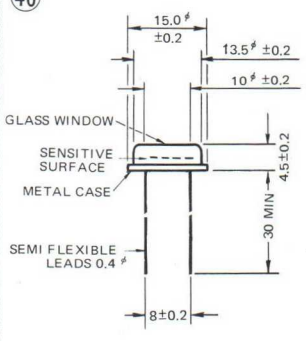
P227A P285
P227B P315
P227C P320
P227D P328

(45)

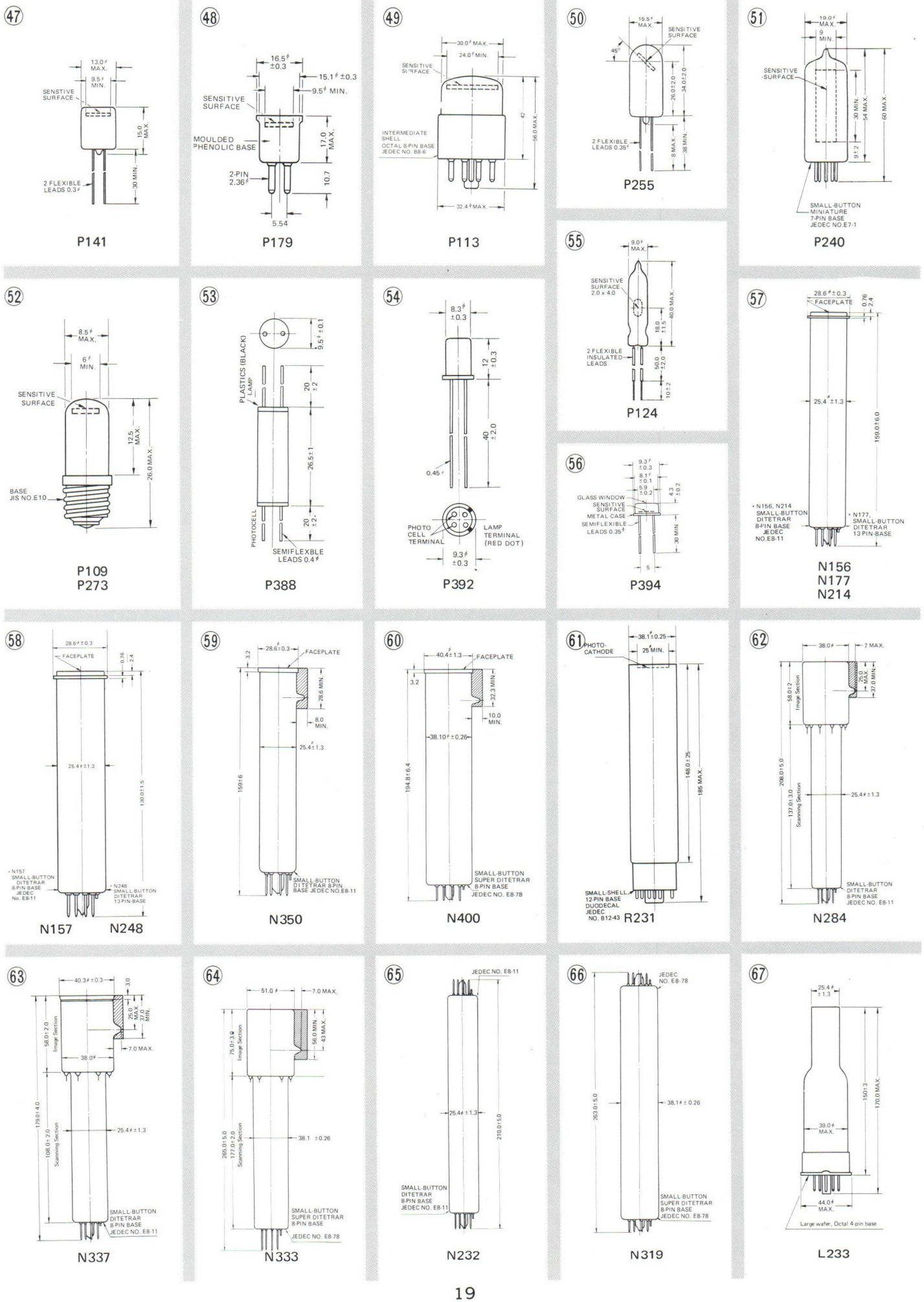


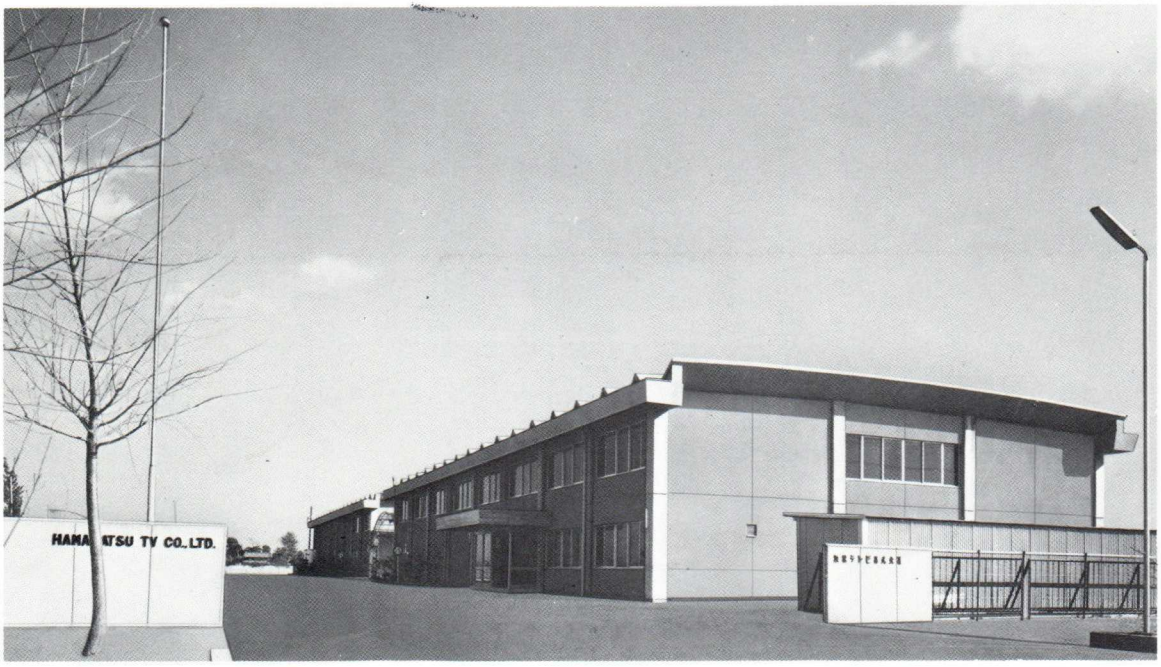
P347
P401

(46)



P322
P397


47
13.0ϕ MAX.
9.5ϕ MIN.
SENSTIVE SURFACE
15.0 MAX.
30 MIN.
2 FLEXIBLE LEADS 0.3ϕ
P141
48
16.5ϕ ±0.3
15.1ϕ ±0.3
9.5ϕ MIN.
SENSITIVE SURFACE
MOULDED PHENOLIC BASE
17.0 MAX.
10.7
2-PIN 2.36ϕ
5.54
P179
49
30.0ϕ MAX.
24.0ϕ MIN.
SENSITIVE SURFACE
42
56.0 MAX.
INTERMEDIATE SHELL
OCTAL 8-PIN BASE
JEDEC NO. B8-6
32.4ϕ MAX.
P113
50
15.5ϕ MAX.
SENSITIVE SURFACE
45°
26.0±2.0
34.0±2.0
8 MAX.
38 MIN.
2 FLEXIBLE LEADS 0.35ϕ
P255
51
19.0ϕ MAX.
9 MIN.
SENSITIVE SURFACE
30 MIN.
54 MAX.
60 MAX.
9±2
SMALL-BUTTON MINIATURE 7-PIN BASE JEDEC NO.E7-1
P240
52
8.5ϕ MAX.
6ϕ MIN.
SENSITIVE SURFACE
12.5 MAX.
26.0 MAX.
BASE JIS NO.E10
P109
P273
53
9.5ϕ ±0.1
PLASTICS (BLACK)
LAMP
20 ±2
26.5±1
PHOTOCELL
20 ±2
SEMIFLEXBLE LEADS 0.4ϕ
P388
54
8.3ϕ ±0.3
12 ±0.3
40 ±2.0
0.45ϕ
PHOTO CELL TERMINAL
LAMP TERMINAL (RED DOT)
9.3ϕ ±0.3
P392
55
9.0ϕ MAX.
SENSITIVE SURFACE 2.0 x 4.0
18.0 ±1.5
40.0 MAX.
2 FLEXIBLE INSULATED LEADS
50.0 ±2.0
10±2
P124
56
9.3ϕ ±0.3
8.1ϕ ±0.1
5.9 ±0.2
4.3 ±0.2
GLASS WINDOW
SENSITIVE SURFACE
METAL CASE
SEMIFLEXIBLE LEADS 0.35ϕ
30 MIN.
5
P394
57
28.6ϕ±0.3
FACEPLATE
0.76
2.4
25.4ϕ±1.3
159.0±6.0
• N156, N214 SMALL-BUTTON DITETRAR 8-PIN BASE JEDEC NO.E8-11
• N177, SMALL-BUTTON DITETRAR 13 PIN-BASE
N156
N177
N214
58
28.6ϕ±0.3
FACEPLATE
0.76
2.4
25.4ϕ±1.3
130.0±1.5
• N157 SMALL-BUTTON DITETRAR 8-PIN BASE JEDEC No. E8-11
• N248 SMALL-BUTTON DITETRAR 13-PIN-BASE
N157
N248
59
3.2
28.6±0.3
FACEPLATE
28.6 MIN.
8.0 MIN.
25.4ϕ±1.3
159±6
SMALL-BUTTON DITETRAR 8-PIN BASE JEDEC NO.E8-11
N350
60
40.4ϕ±1.3
FACEPLATE
3.2
32.3 MIN.
10.0 MIN.
38.10ϕ±0.26
194.8±6.4
SMALL-BUTTON SUPER DITETRAR 8-PIN BASE JEDEC NO. E8-78
N400
61
PHOTO-CATHODE
38.1ϕ±0.25
25ϕ MIN.
148.0±2.5
185 MAX.
SMALL-SHELL 12-PIN BASE DUODECAL JEDEC NO. B12-43
R231
62
38.0ϕ
7 MAX.
22.0 MAX.
37.0 MIN.
58.0±2
Image Section
208.0±5.0
137.0±3.0
Scanning Section
25.4ϕ±1.3
SMALL-BUTTON DITETRAR 8-PIN BASE JEDEC NO. E8-11
N284
63
40.3ϕ±0.3
3.0
25.0 MAX.
37.0 MIN.
58.0±2.0
Image Section
7.0 MAX.
38.0ϕ
179.0±4.0
108.0±2.0
Scanning Section
25.4ϕ±1.3
SMALL-BUTTON DITETRAR 8-PIN BASE JEDEC NO. E8-11
N337
64
51.0ϕ
7.0 MAX.
56.0 MIN.
43 MAX.
75.0±3.0
Image Section
265.0±5.0
177.0±2.0
Scanning Section
38.1 ±0.26
SMALL-BUTTON SUPER DITETRAR 8-PIN BASE
JEDEC NO. E8-78
N333
65
JEDEC NO. E8-11
25.4ϕ±1.3
210.0±5.0
SMALL-BUTTON DITETRAR 8-PIN BASE JEDEC NO. E8-11
N232
66
JEDEC NO. E8-78
263.0±5.0
38.1ϕ±0.26
SMALL-BUTTON SUPER DITETRAR 8-PIN BASE JEDEC NO. E8-78
N319
67
25.4ϕ ±1.3
150±3
170.0 MAX.
39.0ϕ MAX.
44.0ϕ MAX.
Large wafer, Octal 4-pin base
L233



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