HTV PHOTOSENSITIVE DEVICES

HTV-1P21

PHOTOMULTIPLIER TUBE

3000 to 6500 Å RESPONSE

Very Low Dark Current

March 1966 **TECHNICAL DATA SHEET**

Hysteresis Free, 9—Stage, Side—On Type with S—4 Spectral Response

DESCRIPTION

HTV-1P21 is a 9-stage side-on type photomultiplier tube having a cesium—antimony (Sb—Cs) photocathode S-4 type. Especially, the new improved electrodes have been designed to be Hysteresis Free to offer better operating stability. It is intended especially for use in critical applications for the detection and measurement of low level light. Features of the HTV-1P21 include very low dark current, high current gain and improved operating stability.

The spectral response of the HTV—1P21 covers the range from about 3000 to 6500 angstroms, as shown in Fig. 4. Maximum response occurs at approximately 4000 angstroms. The 1P21, therefore, has high sensitivity to blue and less sensitivity in the red regions of visible spectrum.

The outline and base connection are the same as the R106, R132, R136, R166, R196, R212, R213, 931A, 1P22 and 1P28.

2/3 size

DATA

GENERAL:

Spectral Response	S—4 (See Fig.4)
Wavelength of Maximum Response	4000 ± 500 angstroms
Spectral Response Range	3000 to 6500 angstroms
Direct Interelectrode Capacitances (approx.):	
Anode to dynode No.9	4 pF
Anode to all other electrodes	6 pF
Outline, Basing Diagram	See Fig. 1
Length from Base Seat to Center of Useful Cathode Area	49.0 ± 2.5 mm
Operating position	any
Net Weight (approx.)	44 gr

MAXIMUM RATINGS, *Absolute—Maximum Values:*

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE	1250 volts dc
SUPPLY VOLTAGE BETWEEN ANODE AND DYNODE No.9	250 volts dc
AVERAGE ANODE CURRENT (Note ❶, ❷)	0.1 ma
AMBIENT TEMPERATURE RANGE	−80 to + 75 °C

CHARACTERISTICS:

Under condition with dc 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.

With E=1000 volts dc (except as noted below)

Sensitivity:	*Min.*	*Median*	*Max.*	
Anode Luminous, at 0 cps (Note ❸)	40	120	—	amp/ 1m
Cathode Luminous (Note ❹)	—	40	—	μa/ 1m
Current Amplification	—	3×10^6	—	
Equivalent Anode Dark Current Input (Note ❺)		—	0.5×10^{-9}	1m
Anode Dark Current (at 1000 volts dc)	—	—	0.01×10^{-6}	amp
Anode Current Stability, Hysteresis (Note ❻)		—	1	%

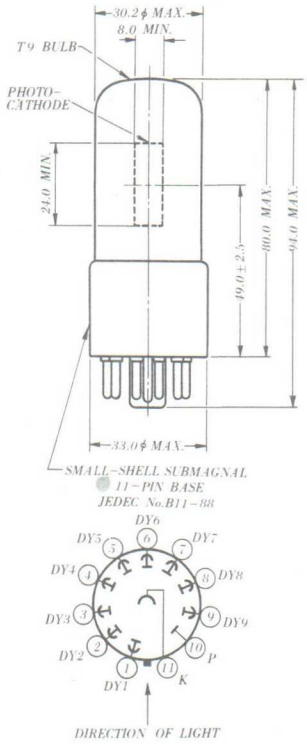


FIG.1
DIMENSIONAL OUTLINES AND BASING DIAGRAMS—DIMENSIONS IN MILLIMETER

NOTES

❶: Averaged over any interval of 30 seconds maximum.

❷: When maximum stability is required, the anode current should not exceed 1 microampere.

❸: Under the following conditions: The light source is a tungsten—filament lamp operated at a color temperature of 2870°K. A light input of 10 micrlumens is used. The load resistor has a value of 0.01 megohm.

❹: For conditions the same as shown above (Note ❸) except that the value of light flux is 0.01 lumen and 100 volts are applied between cathode and all other electrodes connected together as anode.

❺: Measured at a tube temperature of 25 °C and with the supply voltage (E) adjusted to give an anode luminous sensitivity of 20 amperes per lumen.

NOTES

⑥: Anode Current Stability (Hysteresis) :

Measuring method:

1. Supply voltage . . . . . 500 volts
2. Anode current※ (A) . . . . . 0.005 to 0.008 μa
   (B) . . . . . 0.05 to 0.08 μa
   ※ The light intensity was adjusted so as to take the anode current (A) and (B) respectively.
3. The light pulse of from about 30 to 40 seconds interval was supplied to the tube as in the Fig. 2 and Fig. 3.

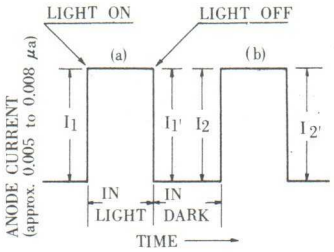


FIG.2

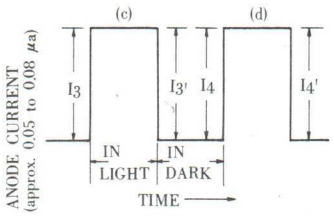


FIG.3

$$\text{(a)}\ \frac{I_1 - I_1'}{I_1} \times 100, \quad \text{(b)}\ \frac{I_2 - I_2'}{I_2} \times 100 \quad \text{(c)}\ \frac{I_3 - I_3'}{I_3} \times 100 \quad \text{(d)}\ \frac{I_4 - I_4'}{I_4} \times 100$$

I_1, I_2, I_3, I_4, : Initial anode current.

I_1', I_2', I_3', I_4' : Anode current after 30 to 40 seconds excitation.

The value of anode current stability is calculated as follows.

$$(\text{(a)} + \text{(b)} + \text{(c)} + \text{(d)}) \times \frac{1}{4}$$

The variation of I_1', I_2, I_2' against I_1 . . . . . less than 2%

The variation of I_3', I_4, I_4' against I_3 . . . . . less than 2%

FIG.4 TYPICAL SPECTRAL RESPONSE OF HTV- 1P21

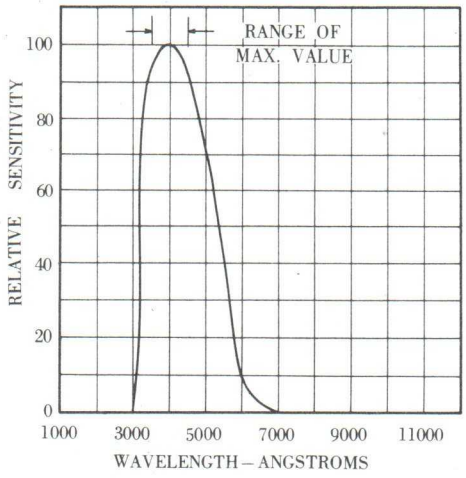


FIG.5 TYPICAL ANODE CHARACTERISTICS OF HTV-1P21

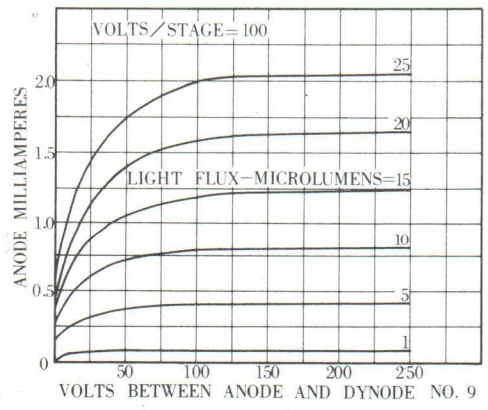
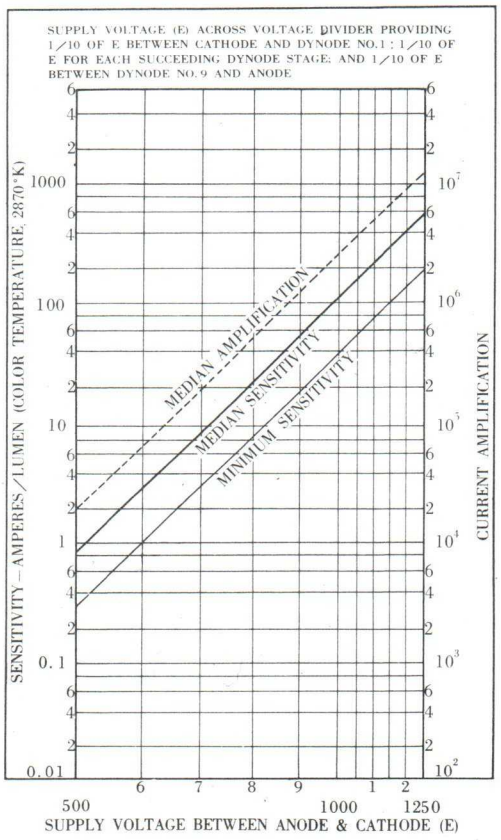


FIG. 6
SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS OF HTV-1P21



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Printed in JAPAN

HTV PHOTOSENSITIVE DEVICES

HTV-1P28

PHOTOMULTIPLIER TUBE

1850 to 6500 Å RESPONSE

TENTATIVE **TECHNICAL DATA SHEET** September 1966

Hysteresis Free, 9–Stage, Side–On Type
with S–5 Spectral Response

DESCRIPTION

HTV–1P28 is a 9–stage side–on type photomultiplier tube having a U.V. transmitting glass envelope and Sb–Cs photocathode S–5 type. Especially, the new improved electrodes have been designed to be Hysteresis Free to offer operating better stability. It is intended for use with ultraviolet and visible radiation in spectrophotometer and other similar applications.

The HTV–1P28 features low dark current and good operating stability.

The spectral response of the HTV–1P28 covers the range from about 1850 to 6500 angstroms, as shown in Fig.4. Maximum response occurs at approximately 3400 angstroms.

The outline and base connection are the same as the R106, R136, R196, R212, R213, 931A, 1P21, and 1P22.

2/3 size

DATA

GENERAL:

Spectral Response	S–5 (see Fig.4)
Wavelength of Maximum Response	3400 ± 500 angstroms
Spectral Response Range	1850 to 6500 angstroms
Direct Interelectrode Capacitances (approx.)	
Anode to dynode No.9	4 pF
Anode to all other electrodes	6 pF
Outline . Basing Diagram	See Fig.1
Length from Base Seat to Center of Useful Cathode Area	49.0 ± 2.5 mm
Envelope	U.V. Transmitting Glass
Operating Position	any
Net Weight (approx.)	41 gr

MAXIMUM RATINGS, *Absolute–Maximum Values* :

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE	1250 Volts dc
SUPPLY VOLTAGE BETWEEN ANODE AND DYNODE No.9	250 Volts dc
AVERAGE ANODE CURRENT (Note ❶)	0.1 ma
AMBIENT TEMPERATURE RANGE	−80 to + 75°C

CHARACTERISTICS:

Under conditions with dc 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.

With E = 1000 volts dc (except as noted below)

	Min.	*Median*	*Max.*	
Sensitivity:				
Anode Luminous, at 0 cps (Note ❷)	17.5	100	—	amp/lm
Cathode Luminous (Note ❸)	—	40	—	μa/lm
Current Amplification	—	2.5×10^{6}	—	—
Equivalent Anode Dark Current Input (Note ❹)	—	—	1.25×10^{-9}	lm
Anode dark Current	—	—	0.1	μamp
Anode Current Stability, Hysteresis (Note ❺)	—	—	1	%

□ □ □

NOTES

❶ Averaged over any interval of 30 seconds maximum.

❷ Under the following conditions: The light source is a tungsten–filament lamp operated at a color temperature of 2870°K. A light input 10 microlumens is used. The load resistor has a value of 0.01 megohm.

❸ For conditions the same as shown above (Note ❷) except that the value of light flux is 0.01 lumen and 100 volts are applied between cathode and all other electrodes connected together as anode.

❹ Measured at a tube temperature of 25℃ and with the supply voltage (E) adjusted to give an anode luminous sensitivity of 20 amperes per lumen.

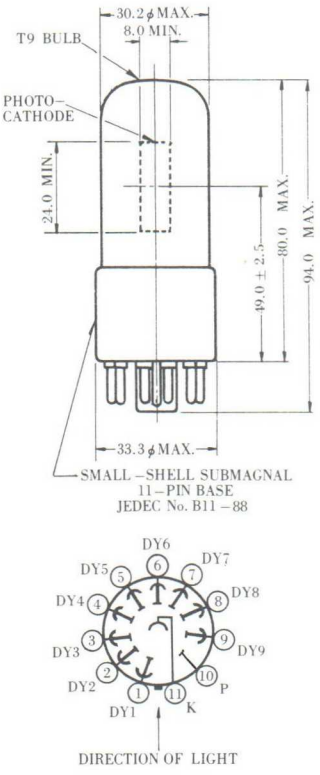


FIG.1
DIMENSIONAL OUTLINE AND BASING DIAGRAM
DIMENSIONS IN MILLIMETERS

NOTES

❺ Anode Current Stability (Hysteresis):

Measuring method:

1. Supply voltage . . . . . 500 volts
2. Anode current※ A) . . . . . 0.005 to 0.008 μa
   B) . . . . . 0.05 to 0.08 μa
   ※ The light intensity was adjusted so as to take the anode current (A) and (B) respectively.
3. The light pulse of from about 30 to 40 seconds interval was supplied to the tube as in the Fig. 2 and Fig. 3.

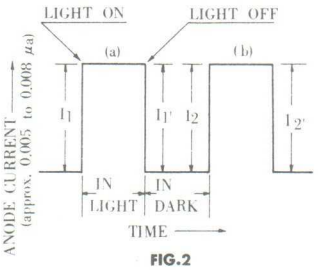


FIG.2

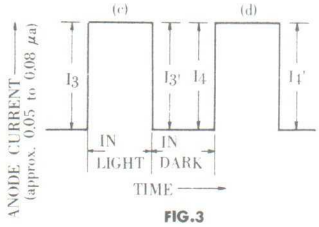


FIG.3

(a): $\frac{I_1 - I_1'}{I_1} \times 100$ (b): $\frac{I_2 - I_2'}{I_2} \times 100$ (c): $\frac{I_3 - I_3'}{I_3} \times 100$ (d): $\frac{I_4 - I_4'}{I_4} \times 100$

I_1, I_2, I_3, I_4 : Initial anode current.
I_1', I_2', I_3', I_4' : Anode current after 30 to 40 seconds excitation.

The value of anode current stability is calculated as follows.

$$(a + b + c + d) \times \frac{1}{4}$$

The variation of I_1', I_2, I_2', against I_1 . . . . . less than 2 %
The variation of I_3', I_4, I_4', against I_3 . . . . . less than 2 %

FIG. 4 TYPICAL SPECTRAL RESPONSE OF THE HTV-1P28

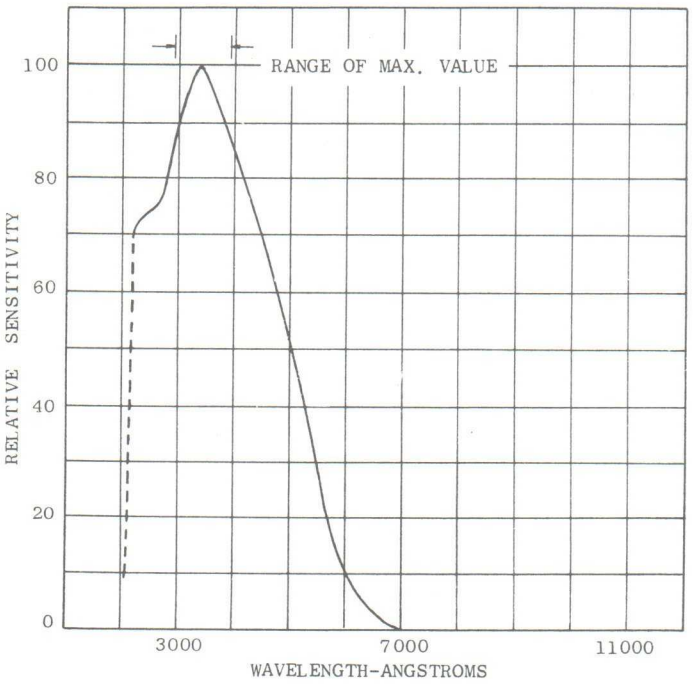
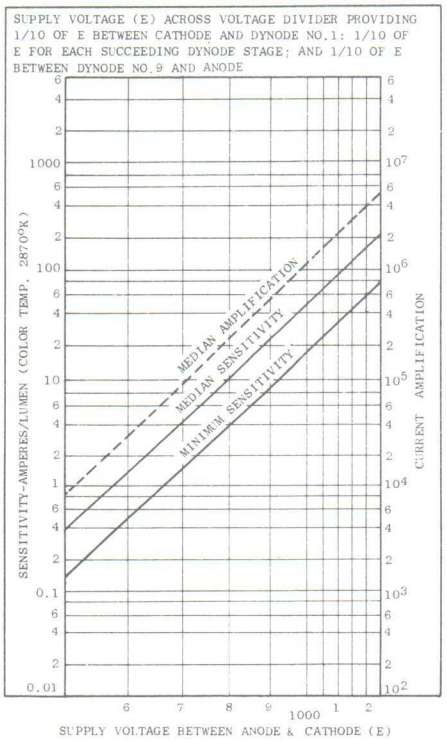


FIG. 5 SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS OF THE HTV-1P28



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Printed in JAPAN

HTV PHOTOSENSITIVE DEVICES

HTV-R106
PHOTOMULTIPLIER TUBE
1600 to 6500 Å RESPONSE

Critical Applications

TECHNICAL DATA SHEET November 1966

Hysteresis Free, 9–Stage, Side–On, Fused–Silica Window Type with S–19 Spectral Response

DESCRIPTION

HTV–R106 is a 9–stage side–on type photomultiplier tube having a fused–silica window and Sb–Cs photocathode S–19 type. Especially, the new improved electrodes have been designed to be Hysteresis Free to offer better operating stability. It is suited for use in critical applications such as spectrometry, which require extremely low dark current as well as ultraviolet sensitivity below 2000 angstroms.

The spectral response of the R106 covers the range from about 1600 to 6500 angstroms, as shown in Fig. 4. Maximum response occurs at approximately 3300 angstroms. The R106, therefore, has high sensitivity to blue–rich light and negligible sensitivity to red radiation.

The outline and base connection are the same as the R136, R166, R196, R212, R213, 931A, 1P21, 1P22 and 1P28.

2/3 size

DATA

GENERAL:

Spectral Response	S–19 (See Fig.4)
Wavelength of Maximum Response	3300 ± 500 angstroms
Spectral Response Range	1600 to 6500 angstroms
Direct Interelectrode Capacitances (approx.):	
Anode to dynode No.9	4 pF
Anode to all other electrodes	6 pF
Outline, Basing Diagram	See Fig. 1
Length from Base Seat to Center of Useful Cathode Area	49.0 ± 2.5 mm
Envelope	Fused–Silica with Graded Seal Section
Operating position (Note ❶)	any
Net Weight (approx.)	38 gr

MAXIMUM RATINGS, *Absolute–Maximum Values:*

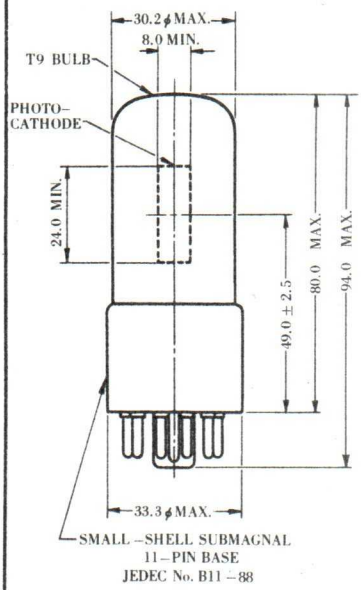
SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE	1250 volts dc
SUPPLY VOLTAGE BETWEEN ANODE AND DYNODE No.9	250 volts dc
AVERAGE ANODE CURRENT (Note ❷, ❸)	0.1 ma
AMBIENT TEMPERATURE RANGE	−80 to + 75 °C

CHARACTERISTICS:

Under condition with dc 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.

With E=1000 volts dc (except as noted below)

Sensitivity:	*Min.*	*Median*	*Max.*	
Anode Luminous, at O cps (Note ❹)	50	120	—	amp/ 1m
Cathode Luminous (Note ❺)	—	40	—	μa/ 1m
Current Amplification	—	3×10^6	—	
Equivalent Anode Dark Current Input (Note ❻)	—	—	0.5×10^{-9}	1m
Anode Dark Current	—	—	0.01	μamp
Anode Current Stability, Hysteresis (Note ❼)	—	—	1	%



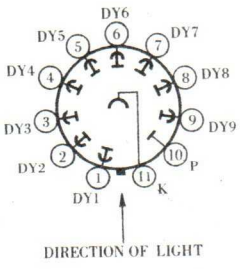


FIG.1 DIMENSIONAL OUTLINE AND BASING-DIAGRAM
DIMENSIONS IN MILLIMETERS

NOTES

❶ Caution: When replacing the tube, be sure to hold the base and do not give any shock to the bulb.

❷ Averaged over any interval of 30 seconds maximum.

❸ When maximum stability is required, the anode current should not exceed 1 microampere.

❹ Under the following conditions: The light source is a tungsten–filament lamp operated at a color temperature of 2870°K. A light input of 10 microlumens is used. The load resistor has a value of 0.01 megohm.

❺ For conditions the same as shown above (Note ❹) except that the value of light flux is 0.01 lumen and 100 volts are applied between cathode and all other electrodes connected together as anode.

❻ Measured at a tube temperature of 25 °C and with the supply voltage (E) adjusted to give an anode luminous sensitivity of 20 amperes per lumen.

NOTES

7: Anode Current Stability (Hysteresis) :

Measuring method:

1. Supply voltage . . . . . 500 volts
2. Anode current※ (A) . . . . . 0.005 to 0.008 μa
   (B) . . . . . 0.05 to 0.08 μa

※ The light intensity was adjusted so as to take the anode current (A) and (B) respectively.

3. The light pulse of from about 30 to 40 seconds interval was supplied to the tube as in the Fig. 2 and Fig. 3.

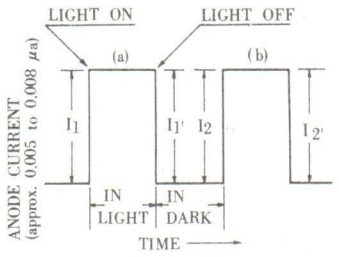


FIG.2

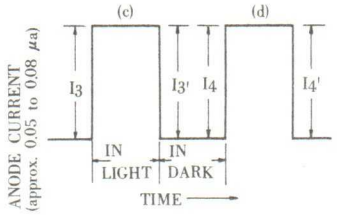


FIG.3

$$\text{(a)}\ \frac{I_1 - I_1'}{I_1} \times 100 \quad \text{(b)}\ \frac{I_2 - I_2'}{I_2} \times 100 \quad \text{(c)}\ \frac{I_3 - I_3'}{I_3} \times 100 \quad \text{(d)}\ \frac{I_4 - I_4'}{I_4} \times 100$$

I_1, I_2, I_3, I_4, : Initial anode current.

I_1', I_2', I_3', I_4' : Anode current after 30 to 40 seconds excitation.

The value of anode current stability is calculated as follows.

$$(a + b + c + d) \times \frac{1}{4}$$

The variation of I_1', I_2, I_2' against I_1 . . . . . less than 2%

The variation of I_3', I_4, I_4' against I_3 . . . . . less than 2%

FIG. 4 TYPICAL SPECTRAL RESPONSE OF THE HTV-R106

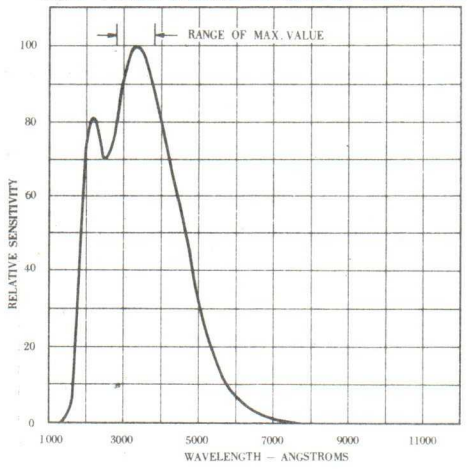


FIG. 5 TYPICAL ANODE CHARACTERISTICS OF THE HTV-R106

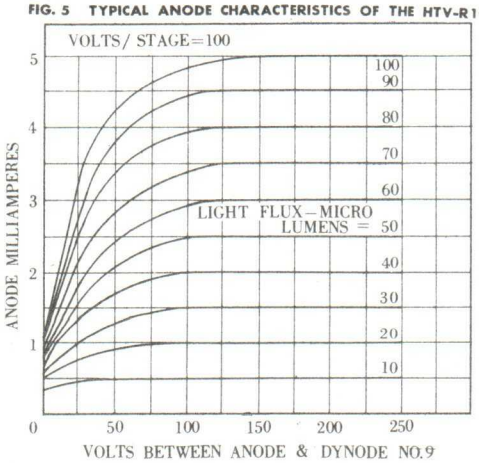
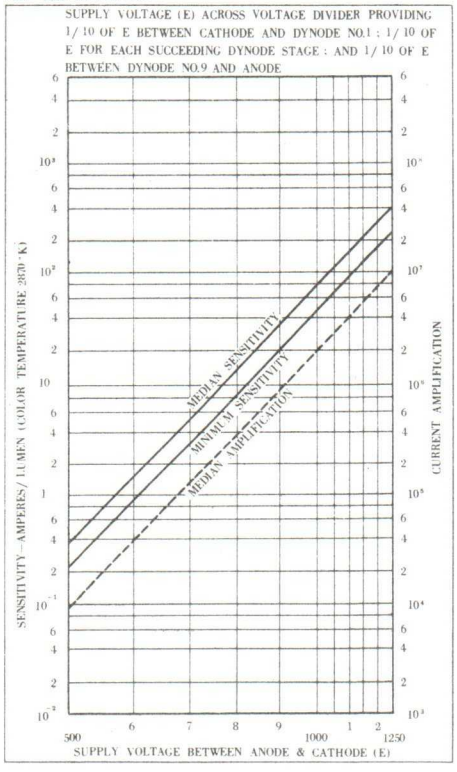


FIG. 6 SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS OF THE HTV-R106



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Printed in JAPAN

HTV PHOTOSENSITIVE DEVICES

HTV-R132
PHOTOMULTIPLIER TUBE
3000 to 8000Å RESPONSE
Similar to S-10

TECHNICAL DATA SHEET November 1965

Hysteresis Free, 9-Stage, Side-On Type
with Similar to S-10 Spectral Response

DESCRIPTION

HTV-R132 is a 9-stage side-on type photomultiplier tube having a new improved photocathode and cage type dynodes. It is similar in spectral response to S-10 but with the improved photocathode characterized by good near-infrared sensitivity and low dark current. It also employs the new electrodes which permit better operating stability of anode current without Hysteresis.

The R-132 is intended for use in the detection and measurement of visible and near-infrared radiation. It is especially suitable for near-infrared spetrometry and optical pyrometry.

The spectral response of the R132 covers the range from about 3000 to 8000 angstroms, as shown in Fig.4. Maximum response occurs at approximately 4300 angstroms.

The outline and base connection are the same as the R106, R136, R166, R196, R212, R213, 931A, 1P21, 1P22 and 1P28.

2/3 size

DATA

GENERAL:

Spectral Response	See Fig. 4
Wavelength of Maximum Response	4300 ± 500 angstroms
Spectral Response Range	3000 to 8000 angstroms
Direct Interelectrode Capacitances (approx.)	
Anode to dynode No.9	4 pF
Anode to all other electrodes	6 pF
Outline, Basing Diagram	See Fig.1
Length from Base Seat to Center of Useful Cathode Area	49.0 ± 2.5 mm
Operating Position	any
Net Weight (approx.)	44 gr

MAXIMUM RATINGS, *Absolute-Maximum Values:*

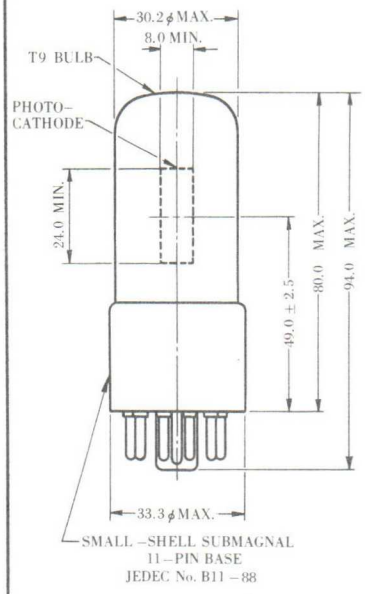
SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE	1250 volts dc
SUPPLY VOLTAGE BETWEEN ANODE AND DYNODE No.9	250 volts dc
AVERAGE ANODE CURRENT (Note ❶, ❷)	0.1 ma
AMBIENT TEMPERATURE RANGE	−80 to + 75 °C

CHARACTERISTICS:

Under condition with dc 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.

With E=1000 volts dc (except as noted below)

	Min.	*Median*	*Max.*	
Anode Sensitivity:				
Anode Luminous, at 0 cps (Note ❸)	20	80	—	amp/ 1m
Radiant, at 7700 angstroms	—	20	—	μa/ μw
Cathode Sensitivity:				
Red and White Light Sensitivity Ratio (Note ❹)	0.035	—	—	
Cathode Luminous (Note ❺)	10	40	—	μa/ 1m
Current Amplification	—	2×10^6	—	
Equivalent Anode Dark Current Input (Note ❻)	—	—	5×10^{-9}	1m
Anode Dark Current	—	—	0.2	μamp
Anode Current Stability, Hysteresis (Note ❼)	—	—	1	%



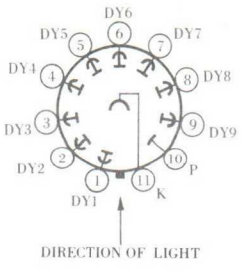


FIG.1 DIMENSIONAL OUTLINE AND BASING-DIAGRAM
DIMENSIONS IN MILLIMETERS

NOTES

❶ Averaged over any interval of 30 seconds maximum.

❷ When maximum stability is required, the anode current should not exceed 1 microampere.

❸ Under the following conditions: The light source is a tungsten-filament lamp operated at a color temperature of 2870 °K. A light input of 10 microlumens is used. The load resistor has a value of 0.01 megohm.

NOTES

❹ The red and white light sensitivity ratio is calculated as RIk/WIk;

RIk··Cathode current is measured with incident light transmitted through a red filter (Toshiba V—R68 sharp cut filter) from a tungsten—filament lamp operated at a color temperature of 2870°K. The value of light flux on the filter is 0.1 lumen. The load resistor has a value of 0.01 megohm, and 100 volts are applied between cathode and all other electrodes connected together as anode.

WIk··Test condition is the same as (RIk) except that for non-employment of filter.

❺ For conditions the same as shown above (Note 3) except that the value of light flux is 0.01 lumen and 100 volts are applied between cathode and all other electrodes together as anode.

❻ Measured at a tube temperature of 25°C and with the supply voltage (E) adjusted to give an anode luminous sensitivity of 20 amperesper lumen.

❼ Anode Current Stability (Hysteresis) :

Measuring method:

1. Supply voltage . . . . . 500 volts
2. Anode current ※ (A) . . . . . 0.005 to 0.008 μa
   (B) . . . . . 0.05 to 0.08 μa

   ※ The light intensity was adjusted so as to take the anode current (A) and (B) respectively.
3. The light pulse of from about 30 to 40 seconds interval was supplied to the tube as in the Fig. 2 and Fig. 3.

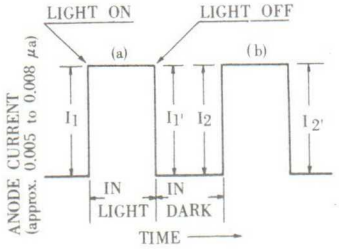


FIG.2

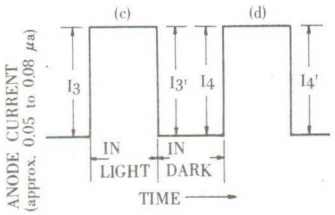


FIG.3

(a) : $\frac{I_1 - I_1'}{I_1} \times 100$ (b) : $\frac{I_2 - I_2'}{I_2} \times 100$ (c) : $\frac{I_3 - I_3'}{I_3} \times 100$ (d) : $\frac{I_4 - I_4'}{I_4} \times 100$

I_1, I_2, I_3, I_4 : Initial anode current

I_1', I_2', I_3', I_4', : Anode current after 30 to 40 seconds excitation.

The value of anode current stability is calculated as follows.

$$(a + b + c + d) \times \frac{1}{4}$$

The variation of I_1', I_2, I_2' against I_1 . . . . . less than 2 %

The variation of I_3', I_4, I_4' against I_3 . . . . . less than 2 %

FIG. 4 TYPICAL SPECTRAL RESPONSE OF THE HTV-R132

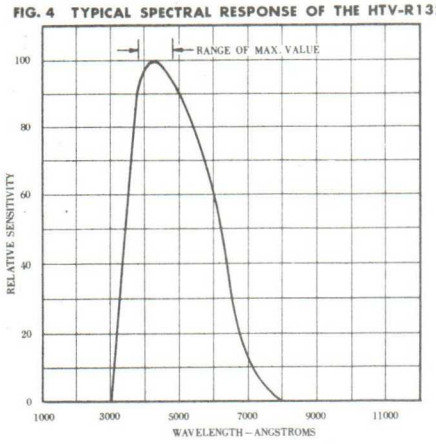


FIG. 5 TYPICAL ANODE CHARACTERISTICS OF THE HTV-R132

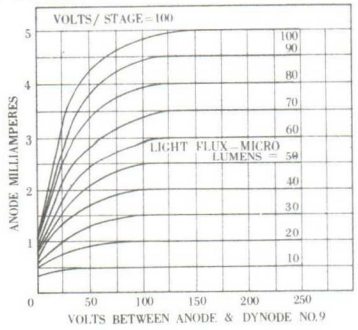
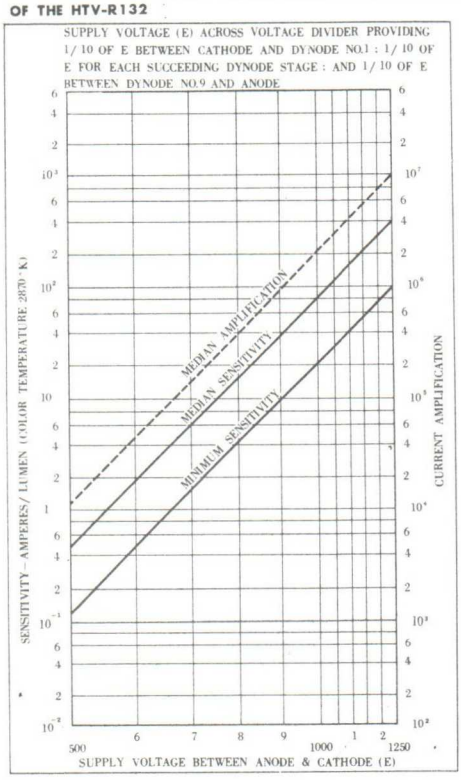


FIG. 6 SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS OF THE HTV-R132



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Printed in JAPAN

HTV PHOTOSENSITIVE DEVICES

HTV-R136
PHOTOMULTIPLIER TUBE
1600 to 8000 Å WIDE RANGE SPECTRAL RESPONSE

November 1965 **TECHNICAL DATA SHEET**

Hysteresis Free, 9–Stage, Side–On, Fused–Silica Window Type with Wide Range Spectral Response

2 / 3 size

DESCRIPTION

HTV–R136 is a 9–stage side–on type photomultiplier tube having a fused–silica window and a new improved photocathode. It is similar in spectral response of the visible region to S–10 but with the fused–silica window it is characterized by the ideal ultraviolet sensitivity below 2000 angstroms. The improved photocathode extends near–infrared sensitivity up to 8000 angstroms and minimized the dark current. It also employs the new electrodes which permit better operating stability of anode current without Hysteresis.

The R136 is intended for use in the detection and measurement of ultraviolet, visible and near-infrared radiation. It is particularly suitable for near-infrared spectrometry and optical pyrometry.

The spectral response of the R136 covers the range from about 1600 to 8000 angstroms, as shown in Fig. 4. Maximum response occurs at approximately 4300 angstroms. It will be noted that the response extends beyond the visible region into the ultraviolet region on the one end and well into the near-infrared region on the other end.

The outline and base connection are the same as the R106, R166, R196, R212, R213, 931A, 1P21, 1P22 and 1P28.

DATA

GENERAL:

Spectral Response	See Fig.4
Wavelength of Maximum Response	4300 ± 500 angstroms
Spectral Response Range	1600 to 8000 angstroms
Direct Interelectrode Capacitances (approx.)	
Anode to dynode No.9	4 pF
Anode to all other electrodes	6 pF
Outline, Basing Diagram	See Fig. 1
Length from Base Seat to Center of Useful Cathode Area	49.0 ± 2.5 mm
Envelope	Fused–Silica with Graded Seal Section
Operating Position (Note 1)	any
Net Weight (approx.)	38 gr

MAXIMUM RATINGS, *Absolute–Maximum Values:*

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE	1250 volts dc
SUPPLY VOLTAGE BETWEEN ANODE AND DYNODE No.9	250 volts dc
AVERAGE ANODE CURRENT (Note 2,3)	0.1 ma
AMBIENT TEMPERATURE RANGE	−80 to + 75 °C

CHARACTERISTICS

Under condition with dc 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.

With E=1000 volts dc (except as noted below)

	Min.	*Median*	*Max.*	
Anode Sensitivity:				
Anode Luminous, at O cps (Note 4)	20	80	—	amp/ lm
Radiant, at 7700 angstroms	—	20	—	μa/ μw
Cathode Sensitivity:				
Red and White Light Sensitivity Ratio (Note 5)	0.035	—	—	
Cathode Luminous (Note 6)	10	40	—	μa/ lm
Current Amplification		2×10^6		
Equivalent Anode Dark Current Input (Note 7)		—	5×10^{-9}	lm
Anode Current Stability, Hysteresis (Note 8)		—	1	%

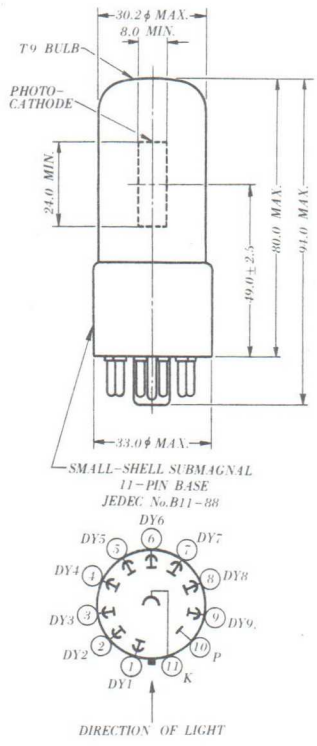


FIG.1
DIMENSIONAL OUTLINES AND BASING DIAGRAMS–DIMENSIONS IN MILLIMETER

NOTES

1: Caution: When replacing the tube, be sure to hold the base and do not give any shock to the bulb.

2: Averaged over any interval of 30 seconds maximum.

3: When maximum stability is required, the anode current should not exceed 1 microampere.

4: Under the following conditions: The light source is a tungsten–filament lamp operated at a color temperature of 2870 °K. A light input of 10 microlumens is used. The load resistor has a value of 0.01 megohm.

NOTES

5: The red and white light sensitivity ratio is calculated as RIk/WIk;

RIk; Cathode current is measured with incident light transmitted through a red filter (Toshiba V–R68 sharp cut filter) from a tungsten–filament lamp operated at a color temperature of 2870°K. The value of light flux on the filter is 0.1 lumen. The load resistor has a value of 0.01 megohm, and 100 volts are applied between cathode and all other electrodes connectcted together as anode.

WIk; Test condition is the same as (RIk) except for non-employment of filter.

6: For conditions the same as shown above (Note 4) except that the value of light flux is 0.01 lumen and 100 volts are applied between cathode and all other electrodes together as anode.

7: Measured at a tube temperature of 25℃ and with the supply voltage (E) adjusted to give an anode luminous sensitivity of 20 amperesper lumen.

8: Anode Current Stability (Hysteresis):

Measuring method:

1. Supply voltage . . . . . 500 volts
2. Anode current※ (A) . . . . . 0.005 to 0.008 μa
   (B) . . . . . 0.05 to 0.08 μa

※ The light intensity was adjusted as to so take the anode current (A) and (B) respectively.

3. The light pulse of from about 30 to 40 seconds interval was supplied to the tube as in the Fig.2 and Fig.3.

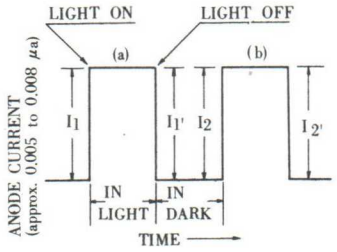


FIG.2

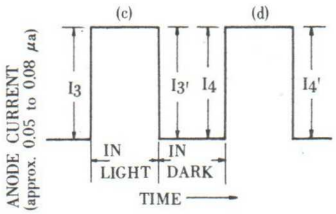


FIG.3

$$(a): \frac{I_1 - I_1'}{I_1} \times 100 \qquad (b): \frac{I_2 - I_2'}{I_2} \times 100 \qquad (c): \frac{I_3 - I_3'}{I_3} \times 100 \qquad (d): \frac{I_4 - I_4'}{I_4} \times 100$$

I_1, I_2, I_3, I_4 : Initial anode current

I_1', I_2', I_3', I_4': Anode current stability is calculated as follows.

$$(a + b + c + d) \times \frac{1}{4}$$

The variation of I_1', I_2, I_2' against I_1 . . . . . less than 2%

The variation of I_3', I_4, I_4' against I_4 . . . . . less than 2%

FIG.4 TYPICAL SPECTRAL RESPONSE OF HTV–R136

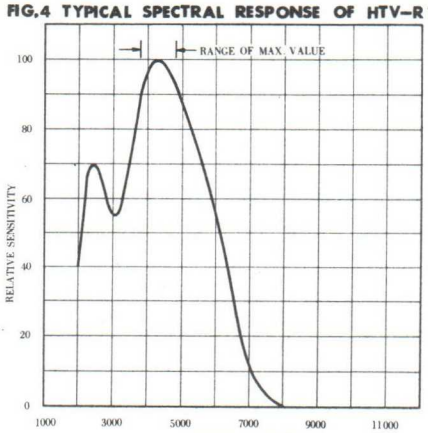


FIG.5
TYPICAL ANODE CHARACTERISTICS OF HTV–R136

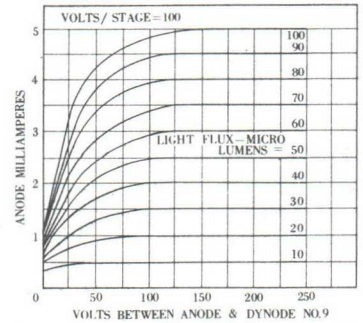
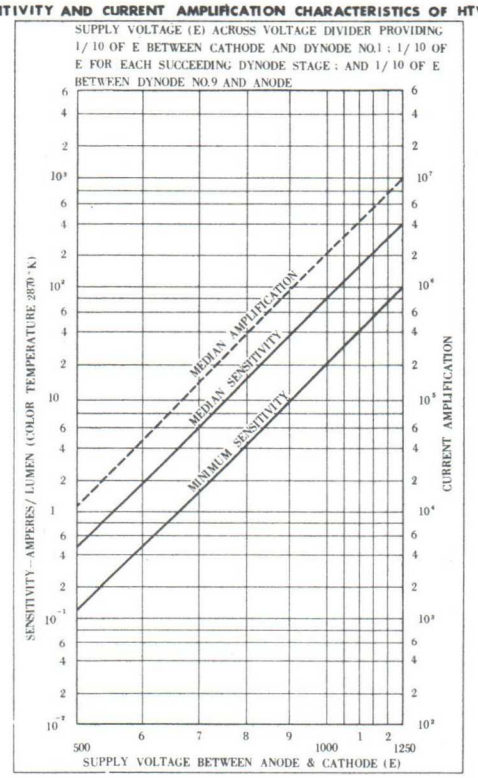


FIG.6
SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS OF HTV–R136



These are tentative data only. HTV is under no obligation as to adherence to these data in case of future manufacture.

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Printed in JAPAN

HTV PHOTOSENSITIVE DEVICES

HTV-R166

PHOTOMULTIPLIER TUBE

1600 to 3200 Å RESPONSE

Solar-Blind

TENTATIVE TECHNICAL DATA SHEET September 1966

Hysteresis Free, 9-Stage, Side-On Type with Solar-Blind Photocathode

2/3 size

DESCRIPTION

HTV-R166 is a 9-stage side-on type photomultiplier tube having a fused-silica window, Cs-Te photocathode and utilizing cage type dynodes. Especially, the new improved electrodes have been designed to be Hysteresis Free to offer better operating stability. The R166 is intended for the detection and measurement of low level ultraviolet radiation with Solar-Blind.

The spectral response of the R166 covers range from about 1600 to 3200 angstroms, as shown in Fig.4. Maximum response occurs at approximately 2200 angstroms.

The outline and base connection are the same as the R106, R136, R196, R212, R213, 1P21, 931A, 1P22 and 1P28.

DATA

GENERAL:

Spectral Response	See Fig.4
Wavelength of Maximum Response	2200 ± 200 angstroms
Spectral Response Range	1600 to 3200 angstroms
Direct Interelectrode Capacitances (approx.)	
Anode to dynode No.9	4 pF
Anode to all other electrodes	6 pF
Outline, Basing Diagram	See Fig.1
Length from Base Seat to Center of Useful Cathode Area	49.0 ± 2.5 mm
Envelope	Fused-Silica with Graded Seal Section
Operating Position (Note ❶)	any
Net Weight (approx.)	38 gr

MAXIMUM RATINGS, *Absolute-Maximum Values* :

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE	1250 volts dc
SUPPLY VOLTAGE BETWEEN ANODE AND DYNODE No.9	250 volts dc
AVERAGE ANODE CURRENT (Note ❷)	0.1 ma
AMBIENT TEMPERATURE RANGE	−80 to + 75 °C

CHARACTERISTICS:

Under condition with dc 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.

With E = 1000 volts dc (except as noted below)

	Min.	*Median*	*Max.*	
Sensitivity:				
Anode Sensitivity, at 0 cps (Note ❸)	1000	4000	—	μa/μw
Anode Dark Current	—	—	0.0005	μamp
Anode Current Stability, Hysteresis (Note ❹)	—	—	1	%

□ □ □

NOTES

❶ Caution: When replacing the tube, be sure to hold the base and do not give any shock to the bulb.

❷ Averaged over any interval of 30 seconds maximum.

❸ Under the following conditions: The light source is a low pressure mercury lamp with fused-silica window (dominant radiating spectral line is 2537 angstroms).

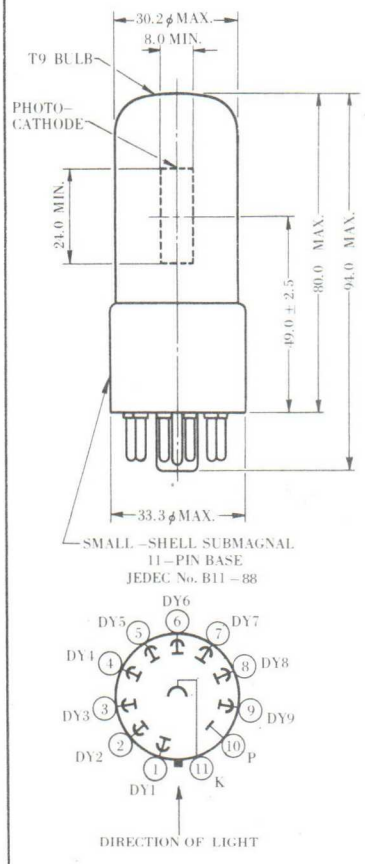

FIG.1 DIMENSIONAL OUTLINE AND BASING DIAGRAM
DIMENSIONS IN MILLIMETERS

HAMAMATSU TV CO., LTD.

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NOTES

❹ Anode Current Stability (Hysteresis):

Measuring method:

1. Supply voltage . . . . . 500 volts
2. Anode current ※ A) . . . . . 0.005 to 0.008 μa
   B) . . . . . 0.05 to 0.08 μa

※ The light intensity was adjusted so as to take the anode current (A) and (B) respectively.

3. The light pulse of from about 30 to 40 seconds interval was supplied to the tube as in the Fig.2 and Fig.3.

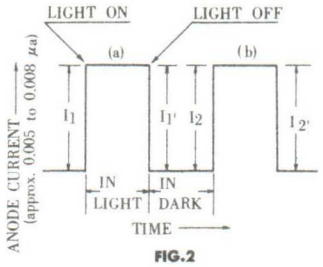

FIG.2

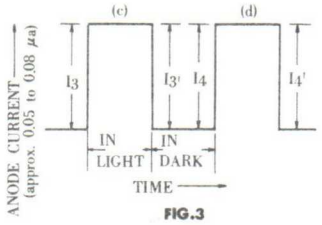

FIG.3

(a): $\frac{I_1 - I_1'}{I_1} \times 100$ (b): $\frac{I_2 - I_2'}{I_2} \times 100$ (c): $\frac{I_3 - I_3'}{I_3} \times 100$ (d): $\frac{I_4 - I_4'}{I_4} \times 100$

I_1, I_2, I_3, I_4 : Initial anode current.
I_1', I_2', I_3', I_4',: Anode current after 30 to 40 seconds excitation.

The value of anode current stability is calculated as follows.

$$(a + b + c + d) \times \frac{1}{4}$$

The variation of I_1', I_2, I_2' against I_1 . . . . . less than 2 %
The variation of I_3', I_4, I_4' against I_3 . . . . . less than 2 %

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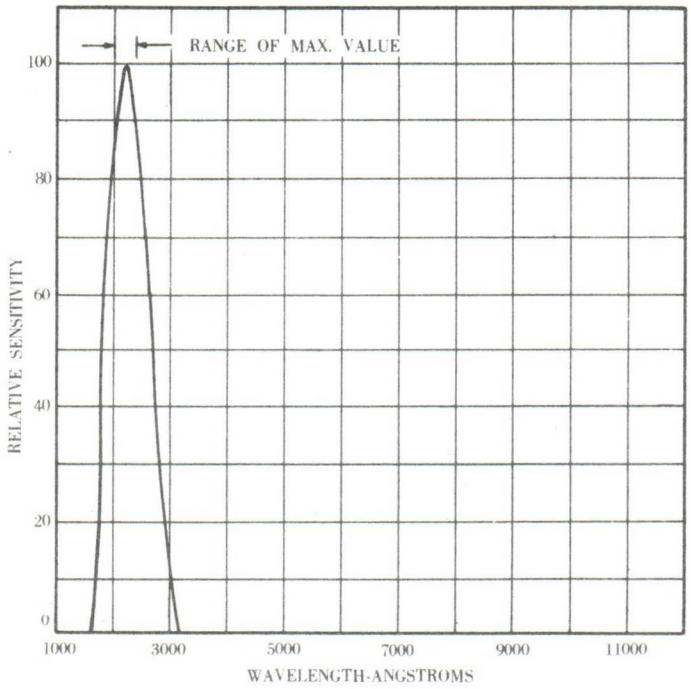
FIG. 4 TYPICAL SPECTRAL RESPONSE OF THE HTV-R166



These are tentative data only. HTV is under no obligation as to adherence to these data in case of future manufacture.

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HTV PHOTOSENSITIVE DEVICES

HTV-R184 PHOTOTUBE

1700 to 2900Å RESPONSE

Ultraviolet Radiation Detector

TENTATIVE **TECHNICAL DATA SHEET** **April 1966**

Gas Filled Phototube, Head-On Type, Sensitive
Only between 1700 and 2900 angstroms

DESCRIPTION

HTV-R184 is a head-on type and gas filled phototube having a fused-silica bulb and an ultraviolet sensitive photocathode.

The R184 is sensitive only to ultraviolet radiation of wavelength between 1700 and 2900 angstroms. Maximum sensitivity occurs at approximately 2100 angstroms.

Applications include flame detector for furnace control, fire detection and ultraviolet radiation detection and measurements.

The outline and base connection are the same as those of the R239 and R244.

CONSTRUCTION AND PRINCIPLES OF OPERATION

a) As shown in Fig.1. the R184 consisits of activated photocathode and inert gas which is enclosed in the bulb under a certain pressure. When photoelectrons are emitted from the photcathode they ionized the inner gas, as a result of ionization a discharge operation begins. Especially, the R184 have a fused-silica bulb to obtain ultraviolet sensitivity below 2000 angstroms.

b) Voltage-Current characteristic in the dark under the different applied voltage is as per the curve A in Fig.2. Voltage-Current characteristic in ultraviolet radiation is as per the curve B in Fig.2. In the glow discharge region the current value is limited by the applied voltage and series resistance value.

c) Setting the applied voltage between E(D) and E(L), discharge is made only for the incident ultraviolet radiation. Stoppage of discharge is only to be made outer circuits, i.e. by stoppage of supplied voltage —— for instance the unsmoothed single phase rectfied ac applied voltage of 50 or 60 c/s is sufficient to make such stoppage.

****

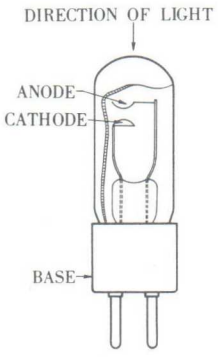


FIG. 1

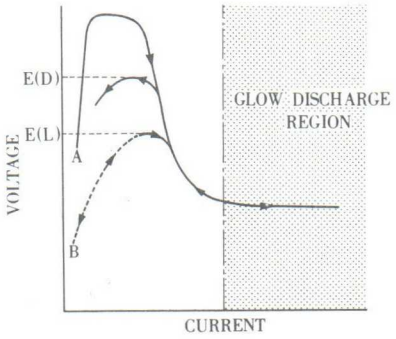
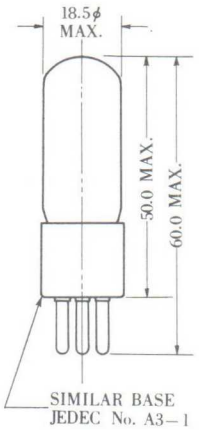
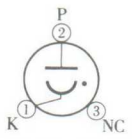


FIG. 2

actual size





DIRECTION OF LIGHT:
INTO END OF BULB

FIG.3 DIMENSIONAL OUTLINES AND BASING DIAGRAMS — *DIMENSIONS IN MILLIMETER*

HAMAMATSU TV CO., LTD.

PHOTON IS OUR BUSINESS

HTV-R184

GENERAL:

Wavelength of Maximum Response (approx.) ..... 2100 angstroms
Spectral Response Range (approx.) ..... 1700 to 2900 angstroms
The tube is practically insensitive to visible light.
Outline, Basing Diagram ..... See Fig.3.
Bulb ..... Fused-Silica with Graded Seal Section
Operating Position (Note 1) ..... any
Net Weight (approx.) ..... 7 gr

MAXIMUM RATINGS, Absolute-Maximum Values:

SUPPLY VOLTAGE, DC or PEAK AC ..... 560 volts max.
PEAK OUTPUT CURRENT ..... 10 ma max.
AVERAGE OUTPUT CURRENT (I r.m.s.) ..... 3 ma
AMBIENT TEMPERATURE RANGE ..... -25 to +100 °C

CHARACTERISTICS:

Sensitivity (Note 2) ..... 1000 to 2000 counts/min/μw/cm2
Maximum Background ..... 10 counts/min
Maintaining Voltage ..... 350 volts

RECOMENDED OPERATING CONDITION:

Supply Voltage (V r.m.s.) ..... 350 ± 10 % volts
The supply voltage may be;
a) Unsmoothed single phase halfwave rectfied ac voltage.
b) Unsmoothed single phase fullwave rectfied ac voltage.
Average Output Current (I r.m.s.) ..... 0.3 ma max.

LIFE EXPECTANCY:

The life of the tube depends on the ambient temperature, the average output current and the peak output current.
When the tube is used in the recomended circuit, the life expectancy is;
* Over 5000 hours at an ambient temperture up to 60°C, average output current of 0.3 milliampere(r.m.s.).
* At ambient temperature up to 50°C and with on output current of 3 milliamperes (r.m.s.) the life expectancy is greater than 1000 hours.

NOTES:

1. **CAUTION**; When replacing the tube, be sure to hold the base and not to give any shock to the bulb.
2. Under the following conditions; The ultraviolet radiation source is a low vapour pressure marcury lamp (dominant wavelength at 2537 angstroms).

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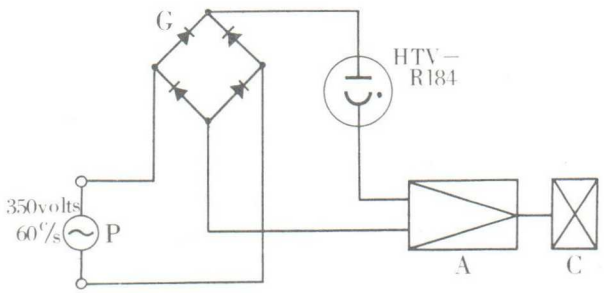

P: POWER SUPPLY
G: BRIDGE RECTIFIER
A: AMPLIFIER
C: COUNTER

FIG.4 BLOCKDIAGRAM OF THE HTV-R184 MEASURING EQUIPMENT

These are tentative data only. HTV is under no obligation as to adherence to these data in case of future manufacture.

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HTV PHOTOSENSITIVE DEVICES

HTV- R196

PHOTOMULTIPLIER TUBE

4000 to 12000 Å RESPONSE

September 1966 **TECHNICAL DATA SHEET** TENTATIVE

9– Stage, Side– On, Sensitive up to 12000 angstroms

DESCRIPTION

HTV– R196 is a 9– stage side– on type photomultiplier tube having a Ag– O– Cs photocathode S– 1 type and utilizing cage type dynodes. The R196 is intended for use in the detection and measurement of visible and near– infrared radiation. It is especially suited for near– infrared spectrometry, gas laser, astronomical measurements and other similar applications.

The spectral response of the HTV– R196 covers the range from about 4000 to 12000 angstroms, as shown in Fig.2. Maximum response occurs at a approximately 8000 angstroms.

The outline and base connection are the same as the R106, R136, R166, R212, R213, 931A, 1P21, 1P22 and 1P28.

2/3 size

DATA

GENERAL:

Spectral Response	S– 1 (See Fig.2)
Wavelength of Maximum Response	8000 ± 1000 angstroms
Spectral Response Range	4000 to 12000 angstroms
Direct Interelectrode Capacitances (approx.)	
Anode to dynode No.9	4 pF
Anode to all other electrodes	6 pF
Outline, Basing Diagram	See Fig.1
Length from Base Seat to Center of Useful Cathode Area	49.0 ± 2.5 mm
Operating Position	any
Net Weight (approx.)	44 gr

MAXIMUM RATINGS, *Absolute– Maximum Values* :

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE	1500 volts dc
SUPPLY VOLTAGE BETWEEN ANODE AND DYNODE No.9	250 volts dc
AVERAGE ANODE CURRENT (Note ❶)	10 μa
AMBIENT TEMPERATURE	– 80 to + 75 °C

CHARACTERISTICS:

Under condition with dc 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.

With E = 1250 volts dc (except as noted below).

	Min.	*Median*	*Max.*	
Anode Sensitivity:				
Anode Luminous, at 0 cps (Note ❷)	—	2	—	amp/lm
Cathode Sensitivity:				
Cathode Luminous (Note ❸)	—	15	—	μa/lm
Infrared and White Light Sensitivity Ratio (Note ❹)	—	0.05	—	—
Current Amplification	—	1.3×10^5	—	—
Equivalent Anode Dark Current Input (Note ❺)	—	—	5×10^{-6}	lm
Anode Dark Current	—	—	1×10^{-6}	amp

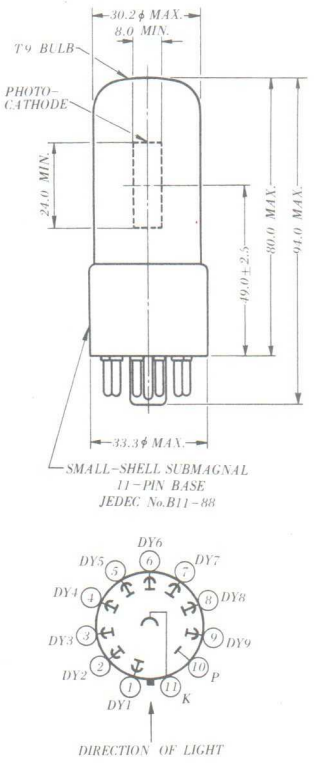

FIG. 1 DIMENSIONAL OUTLINE AND BASING DIAGRAM– *DIMENSIONS IN MILLIMETER*

□ □ □

NOTES

❶ Averaged over any interval of 30 seconds maximum.

❷ Under the following conditions: The light source is a tungsten– filament lamp operated at a color temperature of 2870°K. A light input of 10 microlumens is used. The load resistor has a value of 0.01 megohm.

❸ For conditions the same as shown above (Note ❷) except that the value of light flux is 0.01 lumen and 100 volts are applied between cathode and all other electrodes connected together as anode.

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HTV-R196

NOTES

❹ The infrared and white light sensitivity ratio is calculated as IRIk/WIk:

IRIk; Cathode current is measured with incident light transmitted through a infrared filter (Toshiba IR-D1A infrared filter; see Fig.3) from a tungsten-filament lamp operated at a color temperature of 2870°K. The value of light flux on the filter is 0.1 lumen. The load resistor has a value of 0.01 megohm, and 150 volts are applied between cathode and all other electrodes together as anode.

WIk; Test condition is the same as the (IRIk) except for non-employment of filter.

❺ Measured at a tube temperature of 25℃ and with the supply voltage (E) adjusted to give an anode luminous sensitivity of 2 amperes/lumen.

****

FIG. 2 TYPICAL SPECTRAL RESPONSE OF THE HTV-R196

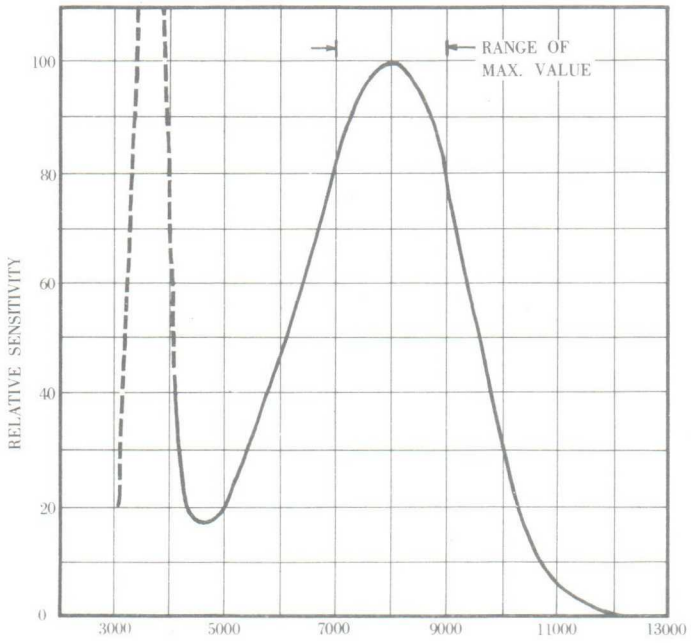
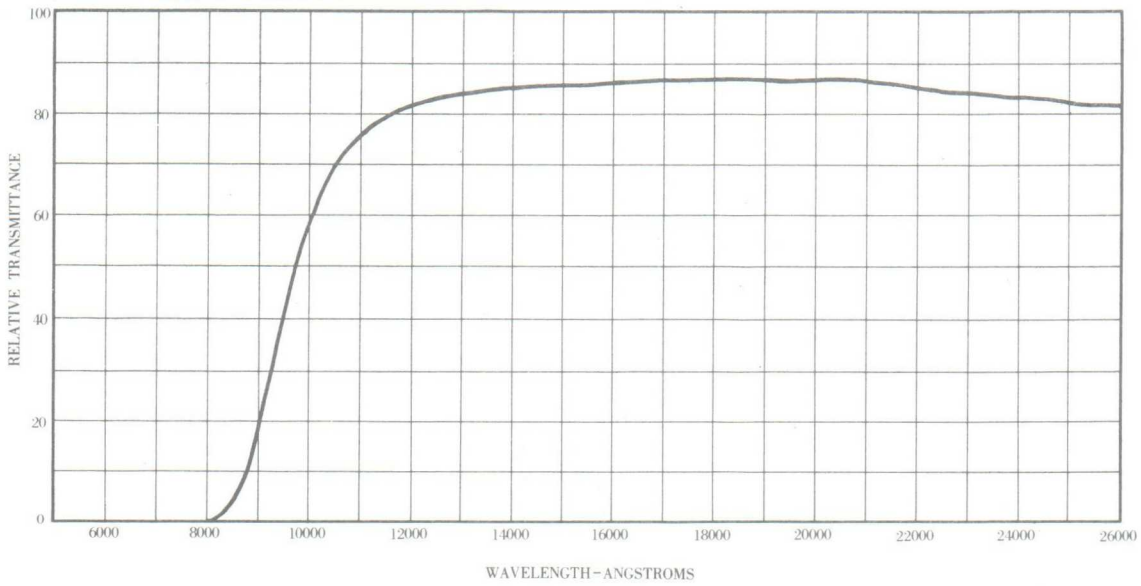


FIG.3 SPECTRAL TRANSMITTANCE OF TOSHIBA IR-D1A INFRARED FILTER



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HTV PHOTOSENSITIVE DEVICES

HTV-R212
PHOTOMULTIPLIER TUBE
1850 to 6500 Å RESPONSE

TENTATIVE **TECHNICAL DATA SHEET** **September 1966**

High Current Gain

Hysteresis Free, 9–Stage, Side–On Type
with S–5 Spectral Response

DESCRIPTION

HTV–R212 is a 9–stage side–on type photomultiplier tube having a U.V. transmitting glass envelope and Sb–Cs photocathode S–5 type. Especially, the new improved electrodes have been designed to be Hysteresis Free to offer better operating stability. It is intended for use in critical applications for detection and measurment of low level ultraviolet and visible radiation. Features of the R212 include very low dark current, high current gain and good operating stability.

The spectral response of the R212 covers the range from about 1850 to 6500 angstroms, as shown in Fig.4. Maximum response occurs at approximately 3400 angstroms.

The outline and base connection are the same as the R106, R136, R196, R213, 931A, 1P21, 1P22 and 1P28.

2/3 size

DATA

GENERAL:

Spectral Response	S–5 (see Fig.4)
Wavelength of Maximum Response	3400 ± 500 angstroms
Spectral Response Range	1850 to 6500 angstroms
Direct Interelectrode Capacitances (approx.)	
Anode to dynode No.9	4 pF
Anode to all other electrodes	6 pF
Outline, Basing Diagram	See Fig.1
Length from Base Seat to Center of Useful Cathode Area	49.0 ± 2.5 mm
Envelpoe	U.V. Transmitting Glass
Operating Position	any
Net Weight (approx.)	41 gr

MAXIMUM RATINGS, *Absolute–Maximum Values* :

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE	1250 volts dc
SUPPLY VOLTAGE BETWEEN ANODE AND DYNODE No.9	250 volts dc
AVERAGE ANODE CURRENT (Note ❶)	0.1 ma
AMBIENT TEMPERATURE RANGE	–80 to +75°C

CHARACTERISTICS:

Under conditions with dc 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.

With E = 1000 volts dc (except as noted below)

	Min.	*Median*	*Max.*	
Sensitivity:				
Anode Luminous, at 0 cps (Note ❷)	40	120	—	amp/lm
Cathode Luminous (Note ❸)	—	40	—	μa/lm
Current Amplification	—	3×10^6	—	
Equivalent Anode Dark Current Input (Note ❹)	—	—	0.5×10^{-9}	lm
Anode Dark Current	—	—	0.01	μamp
Anode Current Stability, Hysteresis (Note ❺)	—	—	1	%

□ □ □

NOTES

❶ Averaged over any interval of 30 seconds maximum.

❷ Under the following condition: The light source is a tungsten–filament lamp operated at a color temperature of 2870°K. A light input 10 microlumens is used. The load resistor has a value of 0.01 megohm.

❸ For conditions the same as shown above (Note ❷) except that the value of light flux is 0.01 lumen and 100 volts are applied between cathode and all other electrodes connected together as anode.

❹ Measured at a tube temperature of 25°C and with the supply voltage (E) adjusted to give an anode luminous sensitivity of 20 amperes per lumen.

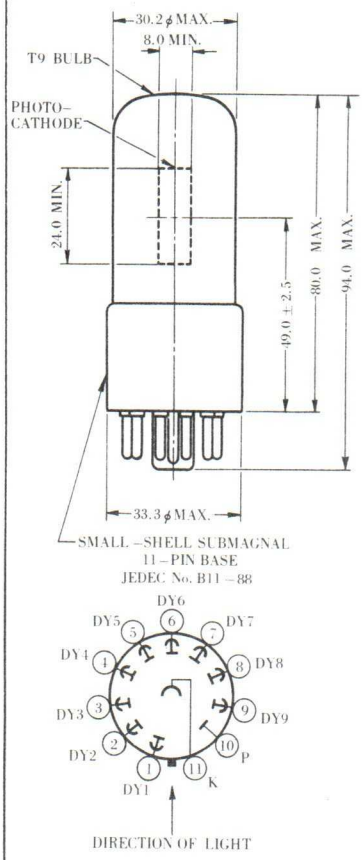

FIG.1 DIMENSIONAL OUTLINE AND BASING DIAGRAM
DIMENSIONS IN MILLIMETERS

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NOTES

❺ Anode Current Stability (Hysteresis):

Measuring method:

1. Supply voltage . . . . . 500 volts
2. Anode current ※ A) . . . . . 0.005 to 0.008 μa
   B) . . . . . 0.05 to 0.08 μa
   ※ The light intensity was adjusted so as to take the anode current (A) and (B) respectively.
3. The light pulse of from about 30 to 40 seconds interval was supplied to the tube as in the Fig. 2 and Fig. 3.

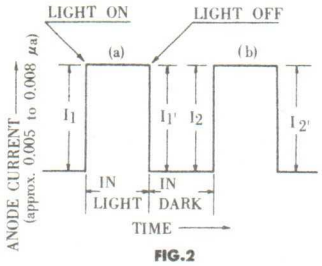


FIG.2

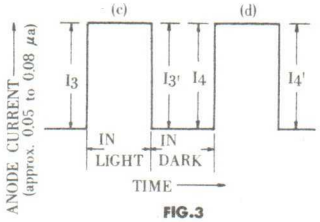


FIG.3

(a): $\frac{I_1 - I_1'}{I_1} \times 100$ (b): $\frac{I_2 - I_2'}{I_2} \times 100$ (c): $\frac{I_3 - I_3'}{I_3} \times 100$ (d): $\frac{I_4 - I_4'}{I_4} \times 100$

I_1, I_2, I_3, I_4 : Initial anode current.
I_1', I_2', I_3', I_4' : Anode current after 30 to 40 seconds excitation.

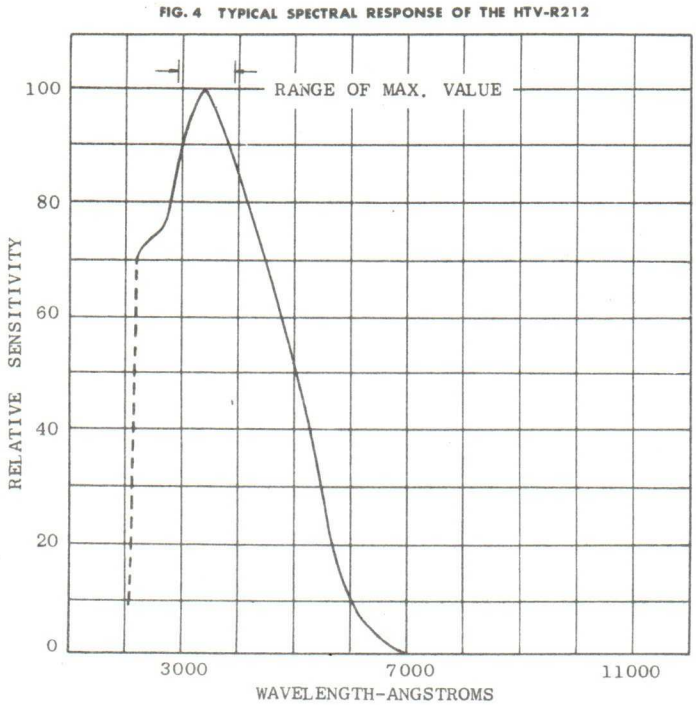
The value of anode current stability is calculated as follows.

$$(a + b + c + d) \times \frac{1}{4}$$

The variation of I_1', I_2, I_2' against I_1 . . . . . ,less than 2%
The variation of I_3', I_4, I_4' against I_3 . . . . . ,less than 2%

****

FIG. 4 TYPICAL SPECTRAL RESPONSE OF THE HTV-R212



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HTV PHOTOSENSITIVE DEVICES

HTV-R213

PHOTOMULTIPLIER TUBE

1850 to 8000 Å RESPONSE

U.V. to Near-Infrared Sensitivity

TENTATIVE TECHNICAL DATA SHEET September 1966

Hysteresis Free, Side-On, Sensitive up to 8000 angstroms

DESCRIPTION

HTV-R213 is 9-stage side-on type photomultiplier tube having a U.V. transmitting glass envelope and a new improved photocathode. Especially, the new improved electrodes have been designed to be Hysteresis Free to offer better operating stability. It is intended for use with ultraviolet, visible and near-infrared radiation in spectrophotometer and other similar applications. Features of the HTV-R213 include good near-infrared, low dark current and good operating stability.

The spectral response of the HTV-R213 covers the range from about 1850 to 8000 angstroms, as shown in Fig. 1. Maximum response occurs at approximately 4300 angstroms.

The outline and base connection are the same as the R106, R136, R196, R212, 931A, 1P21, 1P22 and 1P28.

2/3 size

DATA

GENERAL:

Spectral Response	See Fig.4
Wavelength of Maximum Response	4300 ± 500 angstroms
Spectral Response Range	1850 to 8000 angstroms
Direct Interelectrode Capacitances (approx.)	
Anode to dynode No.9	4 pF
Anode to all other electrodes	6 pF
Outline, Basing Diagram	See Fig.1
Length from Base Seat to Center of Useful Cathode Area	49.0 ± 2.5mm
Envelope	U.V. Transmitting glass
Operating Position	any
Net Weight (approx.)	41 gr

MAXIMUM RATINGS, *Absolute-Maximum Values* :

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE	1250 volts dc
SUPPLY VOLTAGE BETWEEN ANODE AND DYNODE No.9	250 volts dc
AVERAGE ANODE CURRENT (Note ❶)	0.1 ma
AMBIENT TEMPERATURE RANGE	−80 to+75℃

CHARACTERISTICS:

Under conditions with dc 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.

With E = 1000 volts dc (except as noted below)

	Min.	*Mediar*	*Max.*	
Anode Sensitivity:				
Anode Luminous, at O cps (Note ❷)	20	80	—	amp/lm
Radiant, at 7700 angstroms	—	20	—	μa/μw
Cathode Sensitivity:				
Red and white light sensitivity ratio (Note ❸)	0.035	—	—	—
Cathode Luminous (Note ❹)	10	40	—	μa/lm
Current Amplification	—	2×10^6	—	
Equivalent Anode Dark Current input (Note ❺)	—	—	5×10^{-9}	lm
Anode Dark Current	—	—	0.2	μamp
Anode Current Stability, Hysteresis (Note ❻)	—	—	1	%

□ □ □

NOTES

❶ Average over any interval of 30 seconds maximum.

❷ Under the following conditions: The light source is a tungsten-filament lamp operated at a color temperature of 2870°K. A light input of 10 microlumens is used. The load resistor has a value of 0.01 megohm.

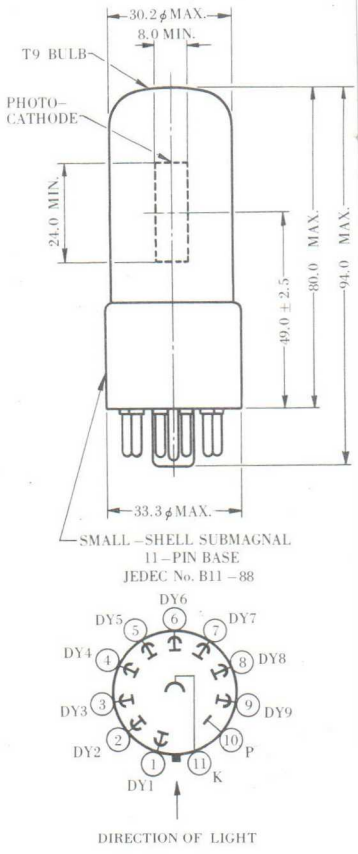


FIG.1 DIMENSIONAL OUTLINES AND BASING DIAGRAM
DIMENSIONS IN MILLIMETERS

NOTES

❸ The red and white light sensitivity ratio is calculated as RIk/WIk;

RIk··· Cathode current is measured with incident light transmitted through a red filter (Toshiba V－R68 sharp cut filter) from a tungsten－filament lamp operated at a color temperature of 2870°K. The value of light flux on the filter is 0.1 lumen. The load resistor has a value of 0.01 megohm, and 100 volts are applied between cathode and all other electrodes connected together as anode.

WIk··· Test condition is the same as (RIk) except for non－employment of filter.

❹ For condition is the same as shown above (Note ❷) except that the light flux is 0.01 lumen and 100 volts are applied between cathode and all other electrodes connected together as anode.

❺ Measured at a tube temperature of 25℃ and with the supply voltage (E) adjusted to give an anode luminous sensitivity of 20 amperes/lumen.

❻ Anode Current Stability (Hysteresis) :

Measuring method:

1. Supply voltage . . . . . 500 volts
2. Anode current※ (A) . . . . . 0.005 to 0.008 μa
   (B) . . . . . 0.05 to 0.08 μa

※ The light intensity was adjusted so as to take the anode current (A) and (B) respectively.

3. The light pulse of from about 30 to 40 seconds interval was supplied to the tube as in the Fig. 2 and Fig. 3.

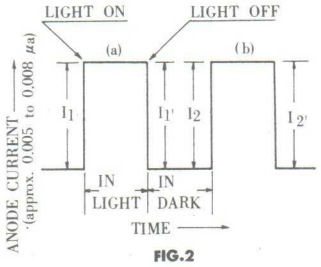


FIG.2

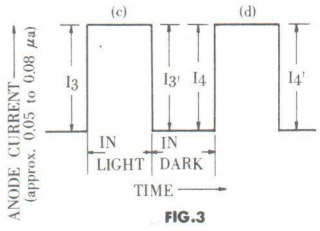


FIG.3

(a): $\frac{I_1 - I_1'}{I_1} \times 100$ (b): $\frac{I_2 - I_2'}{I_2} \times 100$ (c): $\frac{I_3 - I_3'}{I_3} \times 100$ (d): $\frac{I_4 - I_4'}{I_4} \times 100$

I_1, I_2, I_3, I_4 : Initial anode current.

I_1', I_2', I_3', I_4' : Anode current after 30 to 40 seconds exitation.

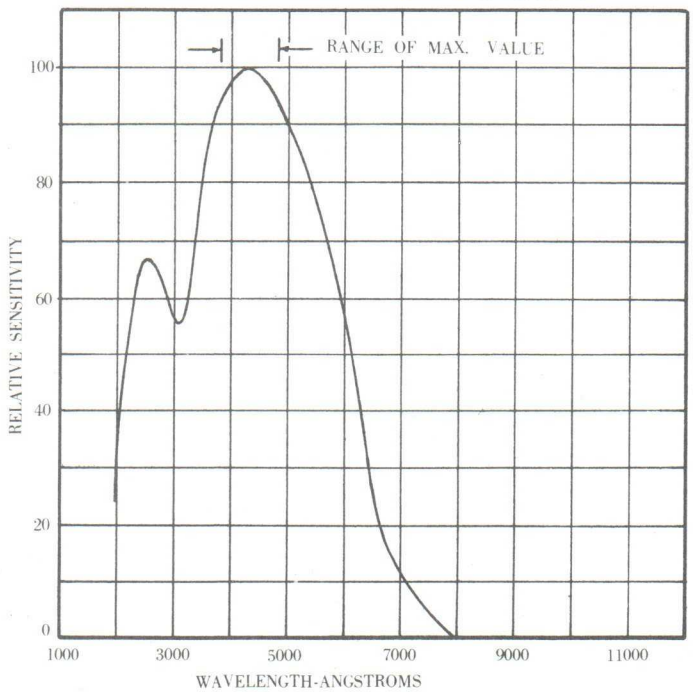
The value of anode current stability is calculated as follows.

$$(a + b + c + d) \times \frac{1}{4}$$

The variation of I_1', I_2, I_2' against I_1 . . . . . less than 2 %

The variation of I_3', I_4, I_4', against I_3 . . . . . less than 2 %

FIG. 4 TYPICAL SPECTRAL RESPONSE OF THE HTV-R213



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HTV PHOTOSENSITIVE DEVICES

HTV-R241 PHOTOMULTIPLIER TUBES

3000 to 6500 Å RESPONSE
4 – Stage
Miniature Type

TENTATIVE TECHNICAL DATA SHEET June 1966

400 Volts Operation, 4-Stage, Side-On,
Miniature Type with S-4 Spectral Response

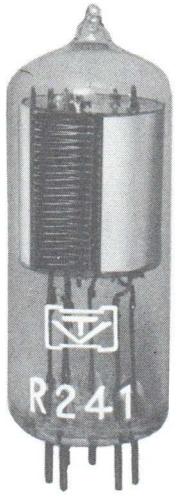
DESCRIPTION

HTV-R241 is a small, 4-stage, side-on type photomultiplier tube having a SbCs photocathode of S-4 response. It is intended for use in general applications, such as densitometer, exposure control, facsimile transmission and light-operated relay.

Anode sensitivity of the R241 is about 250 times as high as that of vacuum phototubes, and about 80 times as high as that of gas-filled phototubes. Therefore, R241 can measure low light level than in any other phototubes.

The spectral response of the R241 covers the range from about 3000 to 6500 angstroms as shown in Fig.2, with maximum response at approximately 4000 angstroms.

The R241 utilizes a miniature type glass bulb with 9-pin base type E9-1 as shown in Fig.1.



actual size

DATA

GENERAL:

Spectral Response	See Fig.2
Wavelength of Maximum Response	4000 ± 500 angstroms
Spectral Response Range	3000 to 6500 angstroms
Direct Interelectrode Capacitance (approx.)	
Anode to all other electrodes	2 pF
Outline, Basing Diagram	See Fig.1
Length from Base Seat to Center of Useful Cathode Area	32.0 ± 2.5 mm
Useful Cathode Area	18.0 x 5.0 mm min.
Base	9-Pin Base JEDEC No. E9-1
Operating Position	any
Net Weight (approx.)	13 gr

MAXIMUM RATINGS, Absolute-Maximum Values:

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE	500 volts dc
SUPPLY VOLTAGE BETWEEN ANODE AND DYNODE No.4	150 volts dc
AVERAGE ANODE CURRENT	10 μa
AVERAGE ANODE DISSIPATION	0.001 watt
AMBIENT TEMPERATURE RANGE	-60 to +60 °C

CHARACTERISTICS:

Under condition with dc 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; and 1/5 of E between dynode No.4 and anode.

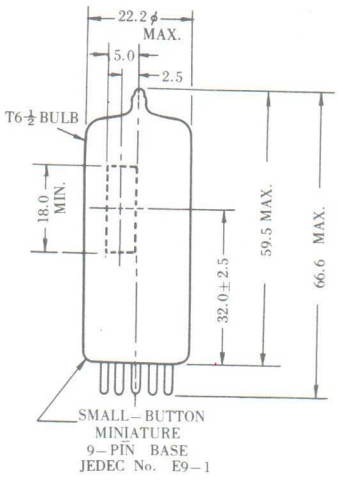
With E = 400 volts dc (except as noted below.)

	Min.	Median	Max.	
Sensitivity:				
Anode Luminous, at 0 cps (Note 1)	3	10	-	ma/lm
Cahtode Luminous (Note 2)	-	40	-	μa/lm
Current Amplification	-	250	-	
Anode Dark Current (Note 3)	-	-	0.001×10^{-6}	amp

****

NOTES:

1. Under the following condition:
   The light source is a tungsten-filament lamp operated at a color temperature of 2870°K. A light input of 0.005 lumen is used. The load resistor has a value of 0.1 megohm.
2. For conditions the same as shown above (No.1) except that the value of light flux is 0.005 lumen and 80 volts are applied between cathode and all other electrodes connected together as anode.
3. Supply voltage (E) 400 volts dc.



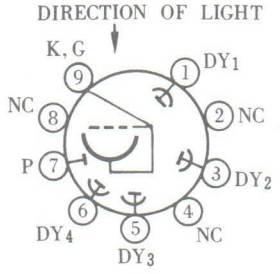


FIG. 1
DIMENSIONAL OUTLINE AND BASING DIAGRAM
DIMENSIONS IN MILLIMETER

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HTV–R241

FIG. 2 TYPICAL SPECTRAL RESPONSE OF THE HTV–241

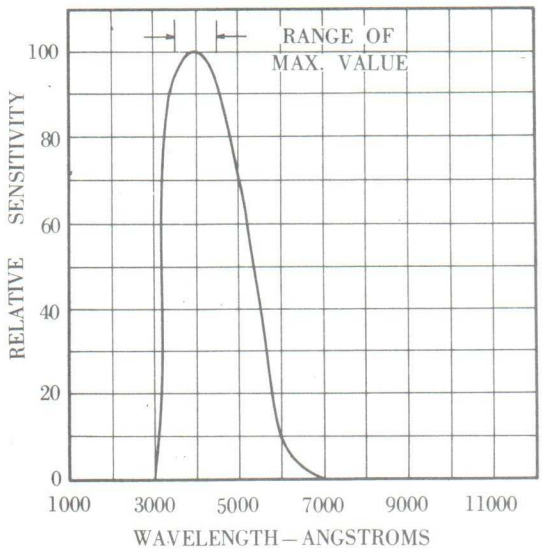


FIG. 3 TYPICAL ANODE CHARACTERISTICS OF THE HTV–R241

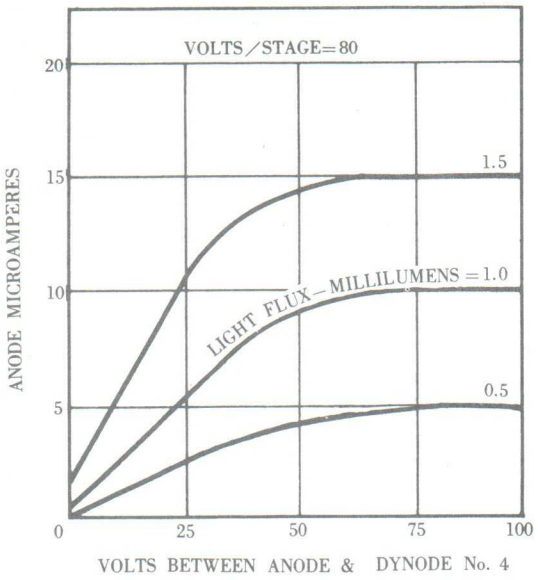
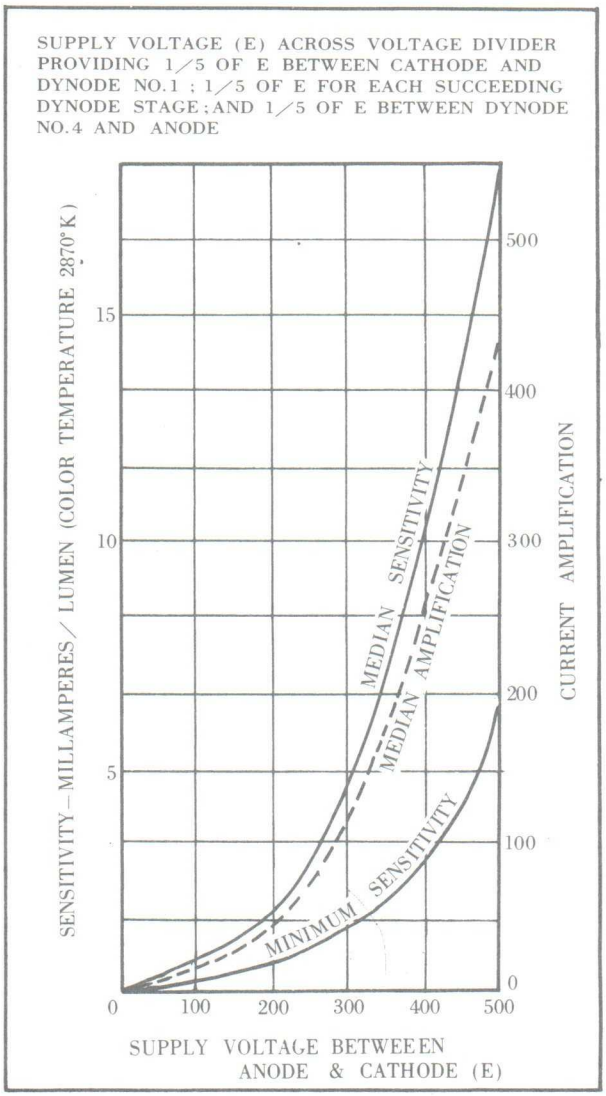


FIG.4 SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS OF THE HTV–R241



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HTV PHOTOSENSITIVE DEVICES

HTV-931A

PHOTOMULTIPLIER TUBE

3000 to 6500 Å RESPONSE

General - Purpose applications

March 1966 **TECHNICAL DATA SHEET**

Hysteresis Free, 9-Stage, Side-On Type with S-4 Spectral Response

DESCRIPTION

HTV-931A is a 9-stage side-on type photomultiplier tube having a cesium-antimony (Sb-Cs) photocathode S-4 type. Especially, the new improved electrodes have been designed to be Hysteresis Free to offer better operating stability. It is suited for use in general applications, such as light-operated relay, X-radiation exposure control and facsimile transmission. It is similar to type 1P21, but intend for applications having relaxed dark current and minimum sensitivity requirements.

The spectral response of the HTV-931A covers the range from about 3000 to 6500 angstroms, as shown in Fig. 4. Maximum response occurs at approximately 4000 angstroms. The 931A, therefore, has high sensitivity to blue and less sensitivity in the red regions of visible spectrum.

The outline and base connection are the same as the R106, R132, R136, R166, R196, R212, R213, 1P21, 1P22 and 1P28.

2/3 size

DATA

GENERAL:

Spectral Response	S-4 (See Fig.4)
Wavelength of Maximum Response	4000 ± 500 angstroms
Spectral Response Range	3000 to 6500 angstroms
Direct Interelectrode Capacitances (approx.):	
Anode to dynode No.9	4 pF
Anode to all other electrodes	6 pF
Outline, Basing Diagram	See Fig. 1
Length from Base Seat to Center of Useful Cathode Area	49.0 ± 2.5 mm
Operating position	any
Net Weight (approx.)	44 gr

MAXIMUM RATINGS, *Absolute-Maximum Values:*

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE	1250 volts dc
SUPPLY VOLTAGE BETWEEN ANODE AND DYNODE No.9	250 volts dc
AVERAGE ANODE CURRENT (Note ❶, ❷)	1 ma
AMBIENT TEMPERATURE RANGE	−80 to + 75 °C

CHARACTERISTICS:

Under condition with dc 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.

With E=1000 volts dc (except as noted below)

Sensitivity:	*Min.*	*Median*	*Max.*	
Anode Luminous, at 0 cps (Note ❸)	20	100	—	amp/ 1m
Cathode Luminous (Note ❹)	—	30	—	μa/ 1m
Current Amplification	—	3.3×10^{6}	—	
Equivalent Anode Dark Current Input (Note ❺)		—	2.5×10^{-9}	1m
Anode Dark Current (at 1000 volts dc)	—	—	0.5×10^{-6}	amp
Anode Current Stability, Hysteresis (Note ❻)		—	1	%

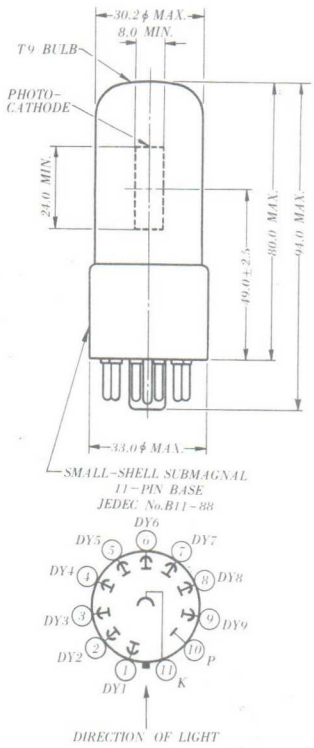

FIG.1
DIMENSIONAL OUTLINES AND BASING DIAGRAMS—DIMENSIONS IN MILLIMETER

NOTES

❶: Averaged over any interval of 30 seconds maximum.

❷: When maximum stability is required, the anode current should not exceed 1 microampere.

❸: Under the following conditions: The light source is a tungsten-filament lamp operated at a color temperature of 2870°K. A light input of 10 microlumens is used. The load resistor has a value of 0.01 megohm.

❹: For conditions the same as shown above (Note ❸) except that the value of light flux is 0.01 lumen and 100 volts are applied between cathode and all other electrodes connected together as anode.

❺: Measured at a tube temperature of 25 °C and with the supply voltage (E) adjusted to give an anode luminous sensitivity of 20 amperes per lumen.

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HTV-931A

NOTES

⑥: Anode Current Stability (Hysteresis) :

Measuring method:

1. Supply voltage . . . . . 500 volts
2. Anode current※ (A) . . . . . 0.005 to 0.008 μa
   (B) . . . . . 0.05 to 0.08 μa
   ※ The light intensity was adjusted so as to take the anode current (A) and (B) respectively.
3. The light pulse of from about 30 to 40 seconds interval was supplied to the tube as in the Fig. 2 and Fig. 3.

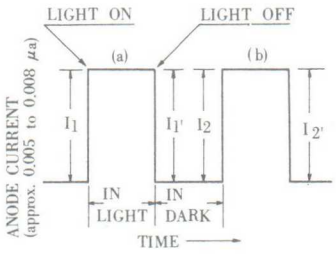


FIG.2

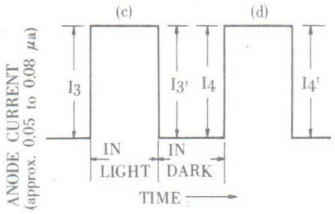


FIG.3

$$\text{(a)}\ \frac{I_1 - I_1'}{I_1} \times 100 \quad \text{(b)}\ \frac{I_2 - I_2'}{I_2} \times 100 \quad \text{(c)}\ \frac{I_3 - I_3'}{I_3} \times 100 \quad \text{(d)}\ \frac{I_4 - I_4'}{I_4} \times 100$$

I_1, I_2, I_3, I_4, : Initial anode current.

I_1', I_2', I_3', I_4' : Anode current after 30 to 40 seconds excitation.

The value of anode current stability is calculated as follows.

$$(\text{(a)} + \text{(b)} + \text{(c)} + \text{(d)}) \times \frac{1}{4}$$

The variation of I_1', I_2, I_2' against I_1 . . . . . less than 2%

The variation of I_3', I_4, I_4' against I_3 . . . . . less than 2%

FIG.4
TYPICAL SPECTRAL RESPONSE OF HTV-931A

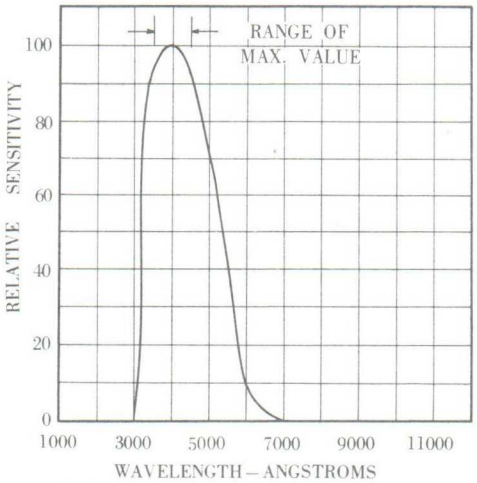


FIG.5
TYPICAL ANODE CHARACTERISTICS OF HTV-931A

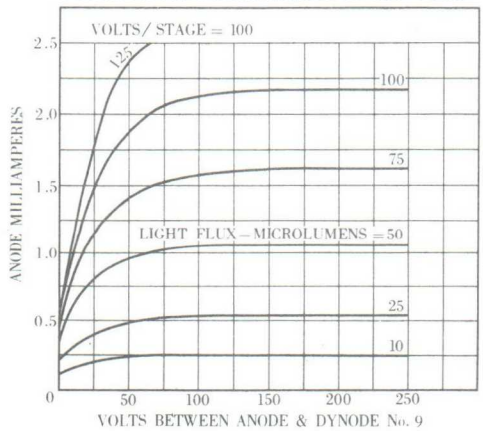
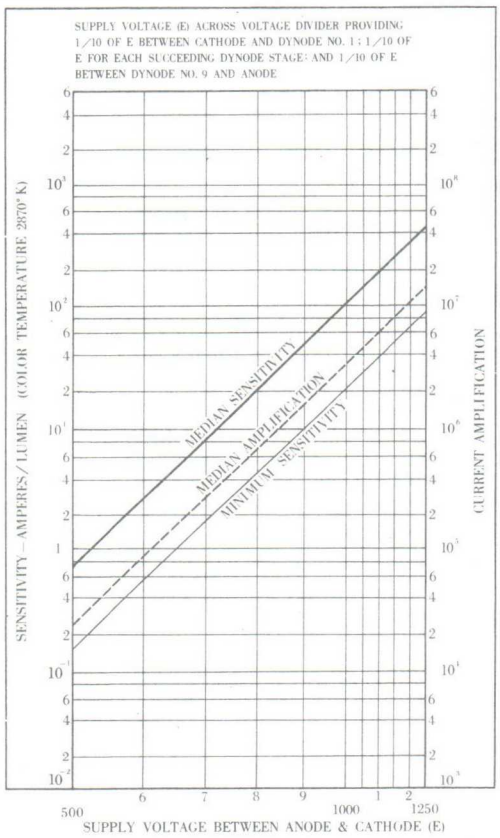


FIG.6
SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS OF HTV-931A



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Printed in JAPAN

HTV PHOTOSENSITIVE DEVICES

HTV-6199
PHOTOMULTIPLIER TUBE
3000 to 6500Å RESPONSE

TECHNICAL DATA SHEET November 1966

10—Stage, Head—On Type with S—11 Spectral Response

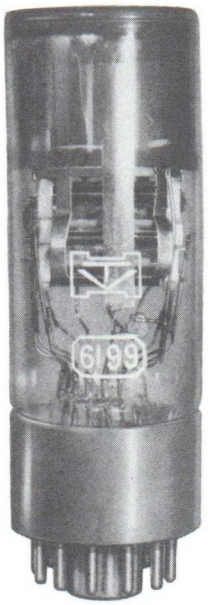
DESCRIPTION

HTV—6199 is a 10—stage, head—on, flat—faceplate type photomultiplier tube having a Sb—Cs photocathode S—11 type and utilizing circular cage type dynodes. Especially, the new improved electrodes have been designed to be Hysteresis Free to offer better operating stability. It is intended for use in the portable scintillation counter for nuclear radiation.

The HTV—6199 features low dark current and good operating stability.

The spectral response of the HTV—6199 covers the range from about 3000 to 6500 angstroms, as shown in Fig.4. Maximum response occurs at approximately 4400 angstroms.

The HTV—6199 is interchangeable with the ordinary type 6199 and 6291.



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DATA

GENERAL:

Spectral Response	S—11 (See Fig.4)
Wavelength of Maximum Response	4400 ± 500 angstroms
Spectral Response Range	3000 to 6500 angstroms
Direct Interelectrode Capacitances (approx.) :	
Anode to dynode No.10	4 pF
Anode to all other electrodes	7 pF
Outline, Basing Diagram	See Fig.1
Useful Cathode Area	31.5 mmϕ
Operating Position	any
Net Weight (approx.)	66 gr

MAXIMUM RATINGS, *Absolute—Maximum Values:*

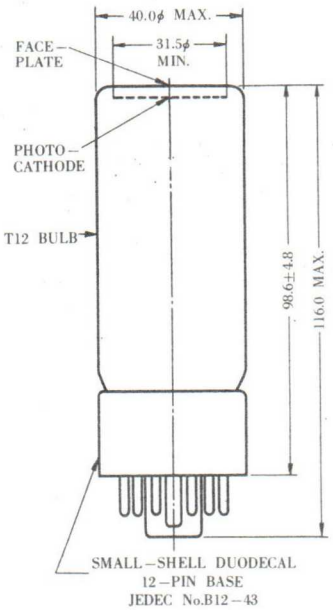
SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE	1250 volts dc
SUPPLY VOLTAGE BETWEEN ANODE AND DYNODE No.10	250 volts dc
AVERAGE ANODE CURRENT (Note ❶)	0.75 ma
AMBIENT TEMPERATURE	−80 to + 75 ℃

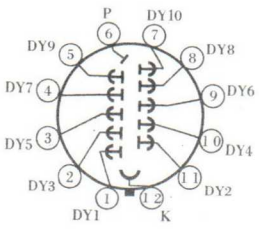
CHARACTERISTICS:

Under condition with dc 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.

With E=1000 volts dc (except as noted below).

	Min.	*Median*	*Max.*	
Sensitivity:				
Anode Luminous, at O cps (Note ❷)	10	30	—	amp/ 1m
Cathode Luminous (Note ❸)	20	40	—	μa/ 1m
Current Amplification	—	7.5×10^5	—	—
Equivalent Anode Dark Current Input (Note ❹)	—	—	2.5×10^{-9}	1m
Anode Dark Current	—	—	0.05	μ amp
Anode Current Stability, Hysteresis (Note ❺)	—	—	1	%





DIRECTION OF LIGHT: INTO END OF BULB

FIG.1 DIMENSIONAL OUTLINE AND BASING DIAGRAM—*DIMENSIONS IN MILLIMETER*

NOTES

❶ Averaged over any interval of 30 seconds maximum.

❷ Under the following conditions: The light source is a tungsten-filament lamp operated at a color temperature of 2870°K. A light input of 10 microlumens is used. The load resistor has a value of 0.01 megohm.

❸ For conditions the same as shown above (Note ❷) except that the value of light flux is 0.01 lumen and 150 volts are applied between cathode and all other electrodes connected together as anode.

❹ Measured at a tude temperature of 25 °C and with the supply voltage (E) adjusted to give an anode luminous sensitivity of 20 amperes per lumen.

❺ Anode Current Stability (Hystreresis):

Measuring method:

1. Supply voltage . . . . . 500 volts

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HTV-6199

❷ Anode current※ (A) . . . . . 0.005 to 0.008 μa
(B) . . . . . 0.05 to 0.08 μa

※ The light intensity was adjusted so as to take the anode current (A) and (B) respectively.

❸ The light pulse of from about 30 to 40 seconds interval was supplied to the tube as in the Fig. 2 and Fig. 3.

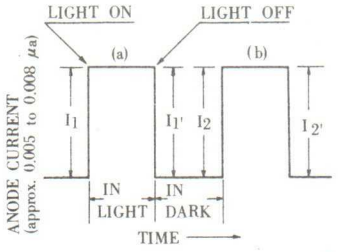


FIG.2

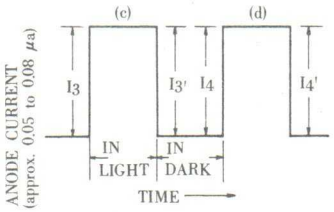


FIG.3

$$\text{(a)}\ \frac{I_1 - I_{1'}}{I_1} \times 100 \quad \text{(b)}\ \frac{I_2 - I_{2'}}{I_2} \times 100 \quad \text{(c)}\ \frac{I_3 - I_{3'}}{I_3} \times 100 \quad \text{(d)}\ \frac{I_4 - I_{4'}}{I_4} \times 100$$

I_1, I_2, I_3, I_4, : Initial anode current.
$I_{1'}$, $I_{2'}$, $I_{3'}$, $I_{4'}$: Anode current after 30 to 40 seconds excitation.

The value of anode current stability is calculated as follows.

$$(a + b + c + d) \times \frac{1}{4}$$

The variation of $I_{1'}$, $I_{2'}$, $I_{2'}$ against I_1 . . . . . less than 2%
The variation of $I_{3'}$, $I_{4'}$, $I_{4'}$ against I_3 . . . . . less than 2%

FIG. 4 TYPICAL SPECTRAL RESPONSE OF THE HTV-6199

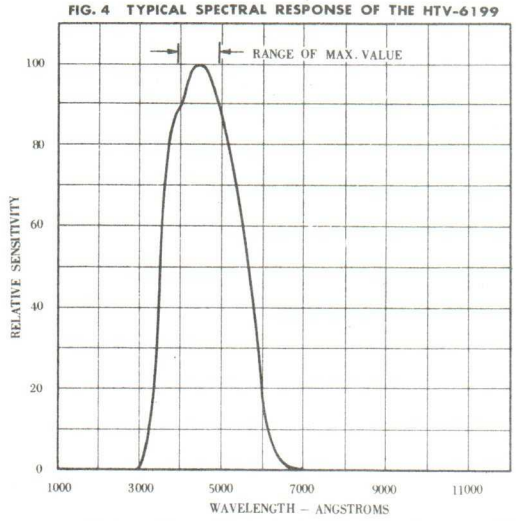


FIG. 5 TYPICAL ANODE CHARACTERICS OF THE HTV-6199

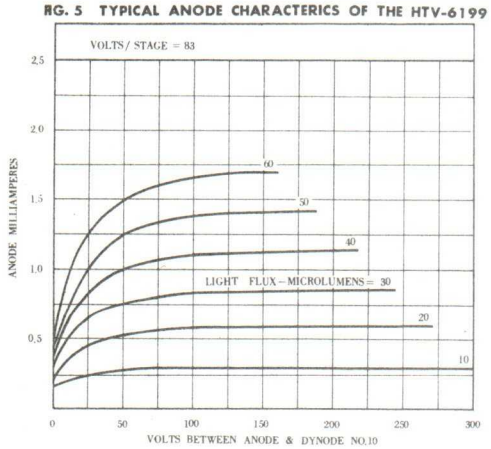
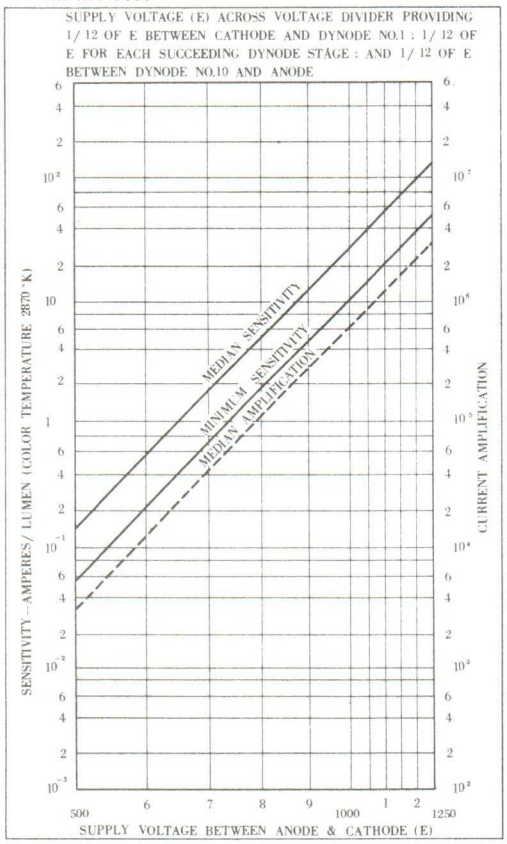


FIG. 6 SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS OF THE HTV-6199



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HTV PHOTOSENSITIVE DEVICES

HTV- 7102

PHOTOMULTIPLIER TUBE

4000 to 12000 Å RESPONSE

September 1966 **TECHNICAL DATA SHEET** TENTATIVE

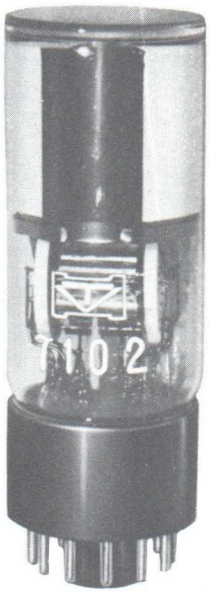
10 – Stage, Head – On Type with S – 1 Response

DESCRIPTION

HTV – 7102 is a 10 – stage, head – on, flat – faceplate type photomultiplier tube having a Ag – O – Cs, semitransparent photocathode S – 1 type and utilizing circular cage type dynodes. The HTV- 7102 is intended for use in the detection and measurement of visible and near-infrared radiation. It is especially suited for near - infrared spectrometry, gas laser, astronomical measurements and other similar applications.

The spectral response of the HTV – 7102 covers the range from about 4000 to 12000 angstroms, as shown in Fig.2. Maximum response occurs at approximately 8000 angstroms.

The outline and base connection are the same as the ordinary type 7102.



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DATA

GENERAL:

Spectral Response	S – 1 (See Fig.2)
Wavelength of Maximum Response	8000 ± 1000 angstroms
Spectral Response Range	4000 to 12000 angstroms
Direct Interelectrode Capacitances (approx.)	
Anode to dynode No.9	4 pF
Anode to all other electrodes	7 pF
Outline, Basing Diagram	See Fig.1
Useful Cathode Area	31.5 mm ϕ
Operating Position	any
Net weight (approx.)	68 gr

MAXIMUM RATINGS, *Absolute – Maximum Values* :

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE	1500 volts dc
SUPPLY VOLTAGE BETWEEN ANODE AND DYNODE No.10	250 volts dc
AVERAGE ANODE CURRENT (Note ❶)	10 μa
AMBIENT TEMPERATURE	– 80 to + 75 °C

CHARACTERISTICS:

Under condition with dc 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.

With E = 1250 volts dc (except as noted below).

	Min.	*Median*	*Max.*	
Anode Sensitivity;				
Anode Luminous, at 0 cps (Note ❷)	1	4.5	30	amp/lm
Cathode Sensitivity;				
Cathode Luminous (Note ❸)	10	30	—	μa/lm
Infrared and White Light Sensitivity Ratio (Note ❹)	—	0.1	—	—
Current Amplification	—	1.5×10^5	—	—
Equivalent Anode Dark Current Input (Note ❺)	—	—	5×10^{-6}	lm
Anode Dark Current	—	—	1×10^{-6}	amp

□ □ □

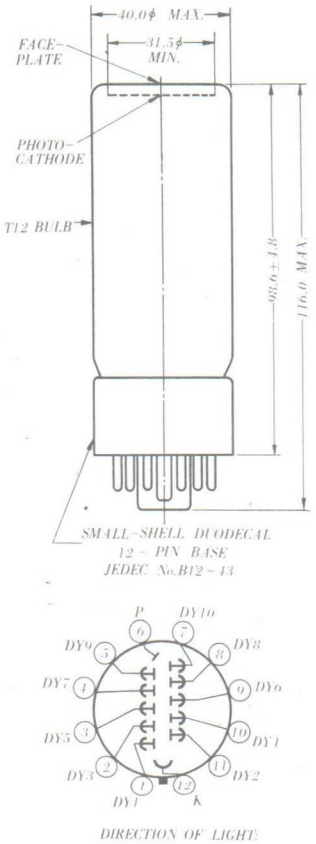


FIG. 1 DIMENSIONAL OUTLINE AND BASING DIAGRAM– *DIMENSIONS IN MILLIMETER*

NOTES

❶ Averaged over any interval of 30 seconds maximum.

❷ Under the following conditions: The light source is a tungsten – filament lamp operated at a color temperature of 2870°K. A light input of 10 microlumens is used. The load resistor has a value of 0.01 megohm.

❸ For conditions the same as shown above (Note ❷) except that the value of light

NOTES

flux is 0.01 lumen and 150 volts are applied between cathode and all other electrodes connected together as anode.

❹ The infrared and white light sensitivity ratio is calculated as IRIk/WIk:

IRIk; Cathode current is measured with incident light transmitted through a infrared (Toshiba IR－D1A infrared filter ; see Fig. 4) from a tungsten-filament lamp operated at a color temperature of 2870°K.

The value of light flux on the filter is 0.1 lumen. The load resistor has a value of 0.01 megohm, and 150 volts are applied between cathode and all other electrodes together as anode.

WIk; Test condition is the same as the (IRIk) except for non－employment of filter.

❺ Measured at a tube temperature of 25℃ and with the supply voltage (E) adjusted to give an anode luminous sensitivity of 4 amperes/lumen.

****

FIG. 3 SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS OF THE HTV-7102

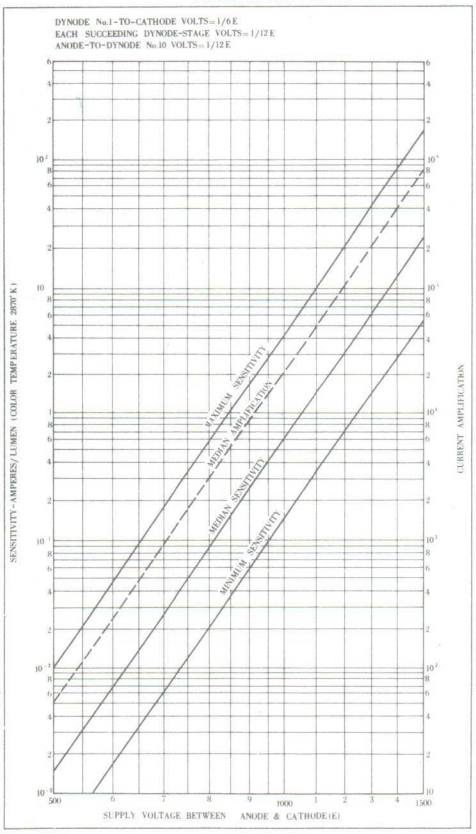


FIG. 2 TYPICAL SPECTRAL RESPONSE OF THE HTV-7102

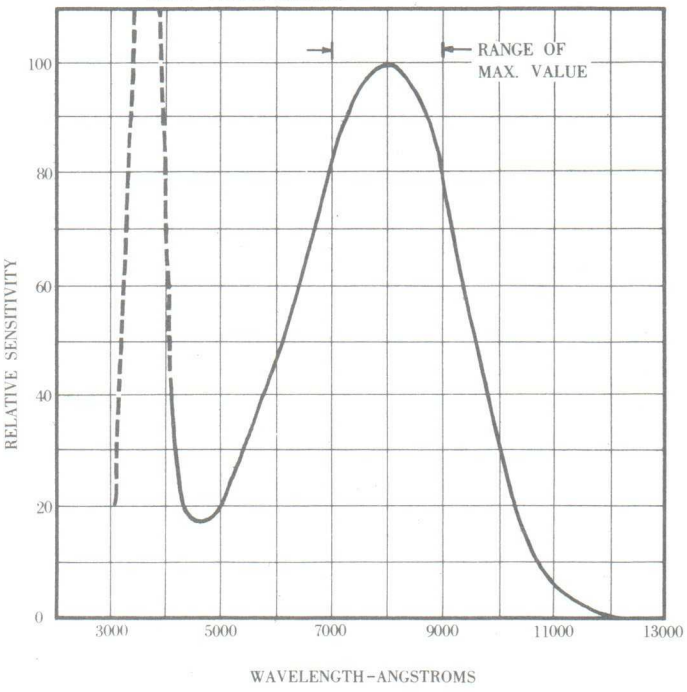
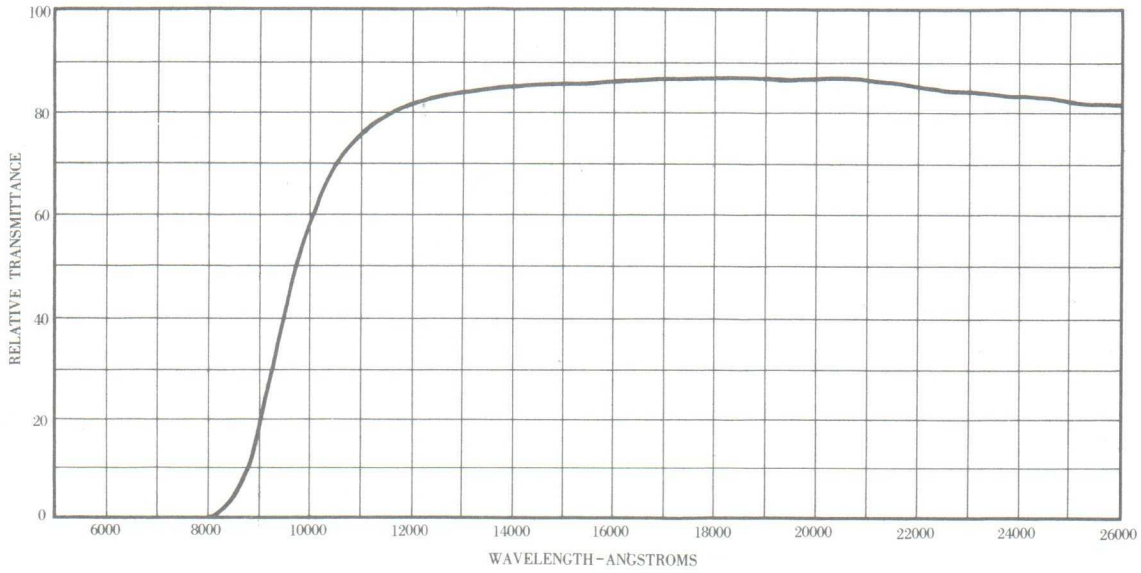


FIG. 4 SPECTRAL TRANSMITTANCE OF TOSHIBA IR-D1A INFRARED FILTER



These are tentative data only. HTV is under no obligation as to adherence to these data in case of future manufacture.

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