

Amperex eleven-stage photomultiplier for high-gain detection of weak optical signals.

GENERAL CHARACTERISTICS

BASE DESIGNATION	B8 700 4G	BASE PINS	14
NOMINAL HEATER	– / –	PARALLEL HEATER	– / –
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1	Photoemissive Detector
MAXIMUM PLATE DISSIPATION	0.5 W
Amperex 11-stage photomultiplier; source states other characteristics are as for 53AVP on the same table.	

153AVP — Eleven-Stage Photomultiplier Tube

An 11-stage photomultiplier tube featuring a flat, semi-transparent caesium-antimony photocathode, designed for head-on incident radiation and optimized for applications such as gamma-ray spectrometry.

Overview

The **153AVP** is an 11-stage photomultiplier tube designed for detection and measurement of low-level light signals, particularly in scintillation counting and gamma-ray spectrometry. It features a flat, semi-transparent caesium-antimony (SbCs) photocathode with a minimum useful diameter of 44 mm. The multiplier system consists of 11 dynode stages utilizing silver-magnesium-oxygen-caesium (AgMgOCs) secondary-emitting material. The tube is housed in a glass envelope with a 14-pin diheptal base.

Construction and Physical Dimensions

The 153AVP is constructed with a head-on, flat-surface photocathode. The internal multiplier structure contains 11 dynode stages.

Dimensions and Mounting

- **Maximum Diameter:** 57 mm
- **Seated Length:** 129 ± 5 mm
- **Overall Length:** 148 ± 5 mm
- **Base Type:** 14-pin diheptal (compatible with socket type No. B8 700 40)

Magnetic Shielding

Due to the sensitivity of the electron trajectories within the multiplier system to external magnetic fields, magnetic shielding is highly recommended. A mu-metal screening cylinder (type No. 56128) can be utilized with the following dimensions:

- **Length:** 90 ± 1 mm
- **Diameter:** $57 +1/-0$ mm

Photocathode and Multiplier Characteristics

The tube's photocathode and multiplier system are characterized by specific spectral, luminous, and capacitive properties.

Photocathode Properties

- **Cathode Material:** Caesium-antimony (SbCs)
- **Minimum Useful Diameter:** 44 mm
- **Wavelength of Maximum Response:** 4200 ± 300 Å (primarily in the visible spectrum)
- **Luminous Sensitivity:** Average of 70 $\mu\text{A/lm}$, with a minimum limit of 50 $\mu\text{A/lm}$ (measured using a tungsten ribbon lamp at a color temperature of 2850 °K)
- **Radiant Sensitivity:** Average of 55 mA/W at the peak wavelength of 4200 Å
- **Dark Current:** 10^{-15} A/cm² at room temperature

Multiplier System Capacitances

- **Anode to Final Dynode (S11):** 3 pF
- **Anode to All Other Electrodes:** 5 pF
- **Dynode Material:** Silver-magnesium-oxygen-caesium (AgMgOCs)

Typical and Operating Characteristics

Under typical operating conditions with a total supply voltage of 1800 V, the 153AVP exhibits high gain and low noise:

- **Anode Sensitivity:** Average of 4500 A/lm, with a minimum of 100 A/lm
- **Anode Dark Current:** Maximum of 0.05 μ A when operated at an anode sensitivity of 60 A/lm
- **Linearity:** The relationship between the anode-pulse amplitude and the input-light flux is linear up to 30 mA.
- **Energy Resolution:** The tube is tested with a 1.5" x 1" NaI (sodium iodide) crystal to guarantee an energy resolution of less than 9% (with a typical average of 8.5%) for the 0.661-MeV caesium-137 line.

Voltage Divider and Decoupling

The operating voltage is distributed across the electrodes using a resistive voltage divider. The recommended distribution relies on a stage voltage unit (Vs):

- **Cathode to Accelerating Electrode:** 2 to 4 Vs
- **Accelerating Electrode to First Dynode (S1):** 1 Vs
- **Between Consecutive Dynodes (Sn to Sn+1):** 1 Vs
- **Final Dynode (S11) to Anode:** 1 Vs

To maintain voltage stability during high-amplitude pulses, decoupling capacitors are connected across the final stages:

- **C1 (S9 to S10):** 220 pF
- **C2 (S10 to S11):** 470 pF
- **C3 (S11 to Anode):** 1000 pF

The total supply voltage (Vb) is typically 13 to 15 times Vs.

Limiting Values

The following absolute maximum and minimum ratings must be maintained to prevent damage and ensure stable operation:

Parameter	Symbol	Minimum	Maximum
Total Supply Voltage	Vb	—	1800 V
Continuous Anode Current	Ia	—	1 mA
Anode Dissipation	Wa	—	0.5 W
Voltage between Cathode and First Dynode	Vk-S1	200 V	500 V

Parameter	Symbol	Minimum	Maximum
Voltage between Consecutive Dynodes	$V_{Sn-Sn+1}$	80 V	300 V
Voltage between Final Dynode and Anode	V_{a-S11}	80 V	300 V

Note: When calculating the actual anode voltage, the voltage drop across the load resistance (RL) must be subtracted from the supply voltage.

Operational Considerations

Stability and Divider Current

To achieve an operating stability of approximately 1%, the current flowing through the voltage-divider bridge must be approximately 100 times greater than the current through the heaviest loaded stage of the tube. For moderate radiation intensities, a practical bridge current value is approximately 0.5 mA.

Spectrometry Optimization

For optimal performance in gamma-ray spectrometry, the voltage between the cathode and the first dynode should be set to 4 times the stage voltage (V_s), provided that the maximum limit of 500 V is not exceeded. The tube operates most favorably at a high tension of 1200 V.

Exposure to Light

If the photomultiplier is exposed to full daylight prior to installation, it will temporarily exhibit an increased dark current. The dark current will return to its normal specified value after several hours of operation in darkness under voltage.

Technical Summary

The **153AVP** is an 11-stage, head-on photomultiplier tube featuring a 44 mm flat caesium-antimony photocathode and silver-magnesium-oxygen-caesium dynodes. It is optimized for high-resolution applications such as gamma-ray spectrometry, offering a guaranteed energy resolution of under 9% for the 0.661-MeV caesium line. Operating with a maximum supply voltage of 1800 V, it provides an average anode sensitivity of 4500 A/lm and maintains pulse linearity up to 30 mA. Proper implementation requires magnetic shielding with a mu-metal cylinder and careful design of the voltage divider network to ensure stability and protect the tube from exceeding its maximum ratings.

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1963 Amperex Condensed

Published test conditions and operating points. Values on this page are preserved as reported by this source.

1963 AMPEREX CONDENSED

Section 1 · PhotoemissiveDetector

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Number of stages	11 count	—
Base	diheptal	—
Recommended supply voltage	1800 V	Same-table 53AVP reference
Maximum anode dissipation	0.5 W	Same-table 53AVP reference

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum spectral response wavelength	4200 angstrom	Same-table 53AVP reference
Minimum photocathode sensitivity	25 uA/lm	Same-table 53AVP reference
Average photocathode sensitivity	50 uA/lm	Same-table 53AVP reference
Minimum anode sensitivity	60 A/lm	Same-table 53AVP reference
Average anode sensitivity	500 A/lm	Same-table 53AVP reference
Maximum direct dark current	50 nA	Same-table 53AVP reference

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1999 Philips 0-D

Published test conditions and operating points. Values on this page are preserved as reported by this source.

1999 PHILIPS 0-D

Section 1 · PhotoemissiveDetector

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Photocathode useful diameter	44 mm	—
Wavelength of maximum response	3900–4500 angstrom	—
Luminous sensitivity average	70 uA/lm	—
Luminous sensitivity minimum	50 uA/lm	—
Radiant sensitivity average	55 mA/W	At 4200 angstrom
Anode sensitivity average	4500 A/lm	Total voltage 1800 V
Anode sensitivity minimum	100 A/lm	Total voltage 1800 V

CONSTRUCTION		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Multiplier stages	11	—

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Anode to final dynode capacitance	3 pF	—
Anode to all other electrodes capacitance	5 pF	—

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Anode dark current maximum	0.05 uA	Anode sensitivity 60 A/lm
Maximum total voltage	1800 V	—
Maximum continuous anode current	1 mA	—
Cathode-first dynode voltage	200–500 V	—
Consecutive dynode voltage	80–300 V	—
Final dynode-anode voltage	80–300 V	—

TUBE TINKER

An independent reference for electronic tubes, vacuum tubes, and their source documents.

