



ELECTRONIC TUBE REFERENCE

18506

Specialized - Radiation Counter electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION

CONSTRUCTION

GEIGERMULLERCOUNTER

Self-quenching Philips mica-window Geiger-Müller counter for alpha, beta, and gamma measurement. It combines a long operating plateau with halogen quenching and an enlarged sensitive window for radiation counting.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	—
NOMINAL HEATER	— / —	PARALLEL HEATER	— / —
HEATING	Indirect; cold cathode	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1 GeigerMullerCounter	
MAXIMUM PLATE VOLTAGE	475 V
<i>Published ratings and characteristics promoted semantically from the approved Philips source.</i>	

18506 — Self-Quenching Geiger-Müller Counter Tube

A halogen-quenched, mica-window radiation counter tube designed for the detection and measurement of alpha, beta, and gamma radiation.

Overview

The **18506** is a self-quenching Geiger-Müller radiation counter tube designed for the detection and measurement of alpha, beta, and gamma radiation. It features a thin mica window at one end to permit the entry of low-energy alpha and beta particles, while its robust metal cathode and halogen-quenched gas filling ensure long-term stability and an exceptionally long operating life.

Construction and Physical Dimensions

The 18506 is constructed with a cylindrical metal cathode and a thin mica window.

- **Cathode:** Made of an alloy consisting of 28% chromium and 72% iron. It has a wall thickness of 1.3 mm and an inside diameter of 27.8 mm. Depending on the production version, the effective cathode length is specified as 26 mm, 36 mm, or 37 mm.
- **Mica Window:** Positioned at the front of the tube, the window has an effective diameter of 27.8 mm, corresponding to an effective area of 6 cm² (or 6.1 cm² in some versions). The window thickness is extremely low, ranging between 2.5 and 3.5 mg/cm², which minimizes attenuation of incoming radiation.
- **Gas Filling:** The tube is filled with a mixture of Neon (Ne) and Argon (Ar), along with a halogen quenching agent that automatically terminates the ionization discharge after each pulse.
- **Physical Dimensions:**
 - Body Diameter: 30.4 mm (increasing to a maximum of 33.5 mm at the window flange).
 - Body Length: 36 mm (excluding the anode pin and a 2.2 mm window recess).
 - Anode Pin: Measures 12 mm in length and 1 mm in diameter, spaced 5 mm from the main body.
- **Interelectrode Capacitance:** The capacitance of the tube is rated at 2 pF (or up to 3.5 pF in later versions).

Electrical and Operating Characteristics

The 18506 operates in the Geiger-Müller region, where the output pulse amplitude is independent of the primary ionization. Typical operating parameters at an ambient temperature of 25 °C include:

- **Starting Voltage (V_a / V_{ign}):** Minimum of 325 V and maximum of 375 V. The starting voltage exhibits a temperature coefficient of approximately 0.5 V/°C.
- **Operating Voltage (V_a / V_b):** The tube can be operated arbitrarily within its plateau region, with a minimum recommended supply voltage (V_b) of 450 V in later specifications.
- **Plateau Characteristics:** Measured at a count rate of 100 counts/second with a 10 MΩ anode resistor:
 - **Beginning of Plateau:** Maximum of 475 V.
 - **Plateau Length:** Typically 300 V (with a minimum limit of 250 V or 300 V depending on the specific operating conditions and version).
 - **Plateau Slope:** Typically 0.01 %/V, with a maximum limit of 0.02 %/V (specifically evaluated over the range of 450 V to 750 V).
- **Dead Time:** The maximum dead time is 225 μs when measured at 100 counts/second with a 10 MΩ anode resistor. Typically, the dead time is around 180 μs at an operating voltage of 450 V.
- **Background Radiation:** When shielded with 2 inches of lead (Pb) and 1/8 inch of aluminum (Al), the background count rate is extremely low, with a maximum of 25 to 40 counts per minute (impulses/min).
- **Expected Lifetime:** The halogen quenching agent prevents degradation of the gas mixture, yielding an expected operating life of at least 5×10^{10} counts.

Absolute Maximum Ratings

To prevent damage and ensure reliable operation, the following absolute limits must be observed:

- **Minimum Anode Resistor (R_a):** 2 M Ω .
- **Ambient Temperature Range (t_{amb}):** Minimum of -55 °C (or -50 °C in some versions) to a maximum of +75 °C.

Circuit and Mounting Recommendations

Proper electrical and mechanical installation is critical to prevent spurious pulses and leakage currents:

- **Mounting:** A low-capacity mounting configuration with short connections is required. The connection between the anode and the anode resistor must be kept as short as possible, and the stray capacitance between the anode connection and ground (earth) must be minimized.
- **Maintenance:** The tube envelope must be kept dry and thoroughly clean. Any surface contamination can lead to leakage currents, which degrade performance or cause false counts.
- **Measuring Circuit:** The recommended series anode resistor (R) is 10 M Ω . The output signal can be extracted via a coupling capacitor in two ways:
 1. Directly from the anode.
 2. From the junction of the 10 M Ω anode resistor and an auxiliary $1/10R$ (1 M Ω) resistor connected to the positive high-voltage supply.

Qualitative Performance Curves

The operational behavior of the 18506 is characterized by several key relationships:

- **Count Rate vs. Anode Voltage:** The discharge threshold begins near 350 V. A highly stable, flat plateau is maintained from approximately 400 V to 700–750 V, where the count rate remains steady (holding near 100 counts/second). Above 750 V, the count rate rises sharply as the tube enters the continuous discharge region, reaching approximately 120 counts/second at 900 V.
- **Dead Time vs. Anode Voltage:** At the onset of conduction near 320–360 V, the dead time is approximately 110 μ s. As the voltage increases, the dead time rises to a broad peak of approximately 180–190 μ s between 450 V and 600 V, before gently declining to about 120–175 μ s at 800–900 V.
- **Starting Voltage vs. Ambient Temperature:** The starting voltage is highly stable at approximately 350 V across a wide temperature range from -20 °C to +80 °C. Below -20 °C, the starting voltage drops progressively, reaching approximately 290 V at -60 °C.

Technical Summary

The **18506** is a halogen-quenched, self-quenching Geiger-Müller counter tube featuring a 27.8 mm effective diameter mica window (2.5 to 3.5 mg/cm² thickness) and a chromium-iron cathode. Operating with a starting voltage between 325 V and 375 V, it provides a wide, stable plateau of at least 250 to 300 V with a very low slope (typically 0.01 %/V to 0.02 %/V). Designed for alpha, beta, and gamma radiation

detection, the tube requires a 10 M Ω anode resistor, low-capacity mounting, and clean, dry operating conditions to achieve its rated lifetime of over 5×10^{10} counts.

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1957 Philips Receiving and Amplifying Tubes

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

1957 PHILIPS RECEIVING AND AMPLIFYING TUBES

Section 1 · GeigerMullerCounter

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Starting / Threshold Voltage Minimum	325 V	—
Starting Voltage Maximum	375 V	—
Plateau Length	300 V	—
Beginning of Plateau Maximum	475 V	—
Plateau Slope Maximum	0.02 %/V	At published counting condition
Dead Time Maximum	225 us	—
Background Count Maximum	40 counts/min	Published shielding condition
Count Life Expectancy Minimum	50000000000 counts	—

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum Ambient Temperature	75 C	—

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

CONSTRUCTION		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Filling	Neon, argon and halogen quenching agent	—
Mica window effective diameter	27.8 mm	—
Mica window area	6 cm2	—

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Interelectrode capacitance	2 pF	—

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Starting voltage minimum	325 V	—
Starting voltage maximum	375 V	—
Beginning of plateau maximum	475 V	—
Plateau length minimum	250 V	—
Plateau slope typical	0.01 %/V	—
Plateau slope maximum	0.02 %/V	—
Shielded background maximum	40 counts/min	2inPb;1/8inAl
Expected count life minimum	50000000000 counts	—

TUBE TINKER

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