

ELECTRONIC TUBE REFERENCE

18504

Specialized - Radiation Counter electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION

CONSTRUCTION

GEIGERMULLERCOUNTER

Philips self-quenching Geiger-Müller radiation counter intended for ionizing-radiation measurement, with published characteristics for operating plateau, background count, dead time, expected life, and construction.

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

SECTION1	GeigerMullerCounter
MAXIMUM PLATE VOLTAGE	425 V
Published ratings and characteristics promoted semantically from the approved Philips source.	

18504 — Halogen-Quenched Radiation Counter Tube

A self-quenching Geiger-Müller radiation counter tube featuring a thin mica window, designed for the detection and measurement of alpha, beta, gamma, and neutron radiation.

Overview

The **18504** is a halogen-quenched radiation counter tube designed for highly sensitive detection across multiple radiation types. It features a thin, delicate mica window at one end to permit the entry of low-energy alpha and beta particles, while its robust metal cathode and gas filling facilitate the detection of

gamma rays and neutrons. The tube is filled with a mixture of neon, argon, and a halogen quenching agent, which ensures a self-quenching operation and an exceptionally long operating life.

With a compact physical profile, low operating voltage, and a wide operating temperature range, the 18504 is suitable for portable and laboratory radiation measurement equipment. Proper operation requires low-capacity mounting, clean and dry conditions to prevent leakage currents, and a high-value anode series resistor.

Construction and Physical Dimensions

The 18504 is built with a cylindrical metal cathode and a thin mica window sealed at one end.

- **Cathode Material:** 28% chromium and 72% iron.
- **Cathode Dimensions:** Inside diameter of 14.4 mm, effective length of 40 mm, and a wall thickness of 250 mg/cm².
- **Mica Window:** Features an effective diameter of 9 mm, an area of 63.5 mm², and a thickness of 2 to 3 mg/cm².
- **Protective Cap:** A removable aluminum cap (16.1 mm diameter, 4 mm length) is provided to protect the delicate mica window when the tube is not being used to measure low-energy radiation.
- **Physical Dimensions:** The body diameter ranges from 14.5 to 15.5 mm, with a maximum collar diameter of 17 mm. The overall length is 39 to 43 mm (excluding the anode pin, which has a maximum extension of 10 mm).
- **Weight:** 7 g.

Electrical and Operating Characteristics

The electrical characteristics of the 18504 are specified at an ambient temperature of 25°C. The tube operates on a relatively low voltage plateau, making it compatible with portable high-voltage power supplies.

Parameter	Minimum	Typical	Maximum
Starting Voltage (V_ign / V_a)	275 V	—	325 V
Beginning of Plateau	—	—	425 V
Plateau Length	225 V	250 V	—
Plateau Slope	—	0.01%/V	0.02%/V
Dead Time (R = 10 MΩ)	—	—	100 μs
Background (Shielded with 2" Pb and 1/8" Al)	—	7 counts/min	10 to 20 counts/min
Anode Capacitance	—	2 pF	—

Temperature and Life Ratings

- **Temperature Coefficient of Starting Voltage:** Approximately 0.5 V/°C.
- **Operating Voltage (V_a or V_b):** Arbitrary within the plateau region.
- **Expected Life:** Minimum of 5×10^{10} counts.
- **Ambient Temperature Range (t_{amb}):** Minimum -55°C, maximum +75°C.
- **Recommended Minimum Temperature:** -40°C.

Circuit and Mounting Requirements

To maintain the high insulation resistance required for stable operation, specific circuit and physical mounting guidelines must be followed:

- **Mounting:** Low-capacity mounting with short connections is required to minimize stray capacitance, which can affect dead time and pulse characteristics.
- **Maintenance:** The tube must be kept dry and thoroughly cleaned. Accumulations of moisture or dirt can create leakage currents across the external envelope, leading to spurious counts or unstable operation.
- **Measuring Circuit:** The recommended anode resistor (R) is 10 MΩ. The output signal is typically taken via a coupling capacitor from a tap between the anode resistor R and a series resistor of 1/10 R (i.e., 1 MΩ).

Qualitative Curve Observations

- **Count Rate vs. Anode Voltage:** The characteristic curve of count rate versus anode voltage (measured with R_a = 10 MΩ) shows a flat, stable plateau region centered around 100 counts/sec. This plateau starts around 350 V to 400 V and extends past 650 V. Above 650 V, the count rate rises sharply, indicating the end of the plateau and the transition into continuous discharge.
- **Dead Time vs. Anode Voltage:** The dead time is voltage-dependent. At an anode voltage of 300 V, the dead time starts near 40 μs, rises to a peak of approximately 80 to 85 μs around 500 V to 550 V, and then gradually decreases to about 70 μs at 700 V.

Radiation Detection Applications

The 18504 is a versatile detector capable of measuring several types of radiation:

- **Alpha and Beta Radiation:** The thin mica window (2 to 3 mg/cm²) allows low-energy alpha and beta particles to penetrate into the active volume of the tube, where they initiate ionization.
- **Gamma Radiation:** Gamma rays are detected via interaction with the cathode wall and gas filling.
- **Neutron Detection:** For measuring thermal neutrons, the tube must be wrapped in a cadmium foil of approximately 0.5 mm thickness. The cadmium foil acts as a converter, capturing thermal neutrons and emitting secondary radiation that is subsequently detected by the tube.

Technical Summary

The **18504** is a compact, 7-gram, halogen-quenched Geiger-Müller radiation counter tube featuring a 9 mm effective diameter mica window and a chromium-iron cathode. Operating with a starting voltage between 275 V and 325 V, it provides a stable plateau of at least 225 V (typically 250 V) with a very low slope of 0.01%/V to 0.02%/V. It is highly resilient, offering an expected lifetime of at least 5×10^{10} counts and operating reliably from -55°C to +75°C. Proper operation requires a 10 MΩ anode resistor, low-capacity mounting, and clean, dry conditions.

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	275 V	—
Starting Voltage Maximum	325 V	—
Plateau Length	250 V	—
Minimum Plateau Length	225 V	—
Beginning of Plateau Maximum	425 V	—
Plateau Slope Maximum	0.02 %/V	At published counting condition
Dead Time Maximum	100 us	—
Background Count Maximum	20 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	9 mm	—
Mica window area	63.5 mm2	—
Mica window thickness	2-3 mg/cm2	—

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

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Starting voltage minimum	275 V	—
Starting voltage maximum	325 V	—
Beginning of plateau maximum	425 V	—
Plateau length minimum	225 V	—
Plateau slope typical	0.01 %/V	—
Plateau slope maximum	0.02 %/V	—
Dead time maximum	100 usec	—
Shielded background maximum	20 counts/min	2inPb;1/8inAl
Expected count life minimum	50000000000 counts	—

TUBE TINKER

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