



ELECTRONIC TUBE REFERENCE

18048

Voltage - Pentode electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION

CONSTRUCTION

PENTODE

Philips professional signal pentode with published heater, capacitance, characteristic, operating-condition, and limiting-value data. The available source supports general professional signal amplification but does not clearly establish a narrower functional category.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	8
NOMINAL HEATER	20 V / 125 mA	PARALLEL HEATER	— / —
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1 Pentode	
TRANSCONDUCTANCE	0.0065 S
MAXIMUM PLATE VOLTAGE	300 V
MAXIMUM SCREEN VOLTAGE	300 V
Published electrical data extracted from supplied datasheet.	

18048 — Special Quality Pentode

The **18048** (also designated as **18048/C3m**) is a Special Quality (SQ), long-life pentode designed for high-reliability applications. It features a metal envelope and a Loctal base, and is intended for use as an audio frequency (A.F.), intermediate frequency (I.F.), or radio frequency (R.F.) amplifier, as well as an output tube or oscillator. With a robust design that guarantees a life expectancy of 10,000 hours under specified test conditions, the 18048 is engineered for demanding industrial and telecommunications environments.

Overview

The 18048 is a versatile pentode that can be operated in standard pentode, triode, or even diode configurations. Its Special Quality designation ensures tight parameter tolerances, high insulation resistance, and long operating life. The tube is particularly suited for applications requiring stable amplification across audio and radio frequencies, or as a low-power output stage.

Construction, Heater, and Pinout

The 18048 is constructed with a durable metal envelope and utilizes an eight-pin Loctal base with a central metal spigot. The cathode is an indirectly heated type, suitable for operation from either an AC or DC supply in series or parallel configurations.

Heater Specifications

The nominal heater voltage is **20 V** and the nominal heater current is **125 mA** (with an acceptable range of 120 to 130 mA). Depending on the supply configuration, strict absolute limits must be maintained:

- **Parallel Supply:** 20 V $\pm$ 5%
- **Series Supply:** 125 mA $\pm$ 1.5%

Pin Connections

The Loctal base connections, viewed from the underside, are assigned as follows:

- **Pin 1:** Heater (f)
- **Pin 2:** Anode (a)
- **Pin 3:** Grid No. 3 / Suppressor Grid (g3)
- **Pin 4:** Grid No. 2 / Screen Grid (g2)
- **Pin 6:** Grid No. 1 / Control Grid (g1)
- **Pin 7:** Cathode, internal shield, and metal envelope (k, s)
- **Pin 8:** Heater (f)
- **Center Pin:** Metal base/spigot (m)

The integration of the internal shield and the metal envelope with the cathode on Pin 7 provides excellent self-shielding, which is critical for stable high-frequency operation.

Electrical Characteristics and Typical Operation

The typical operating parameters of a new 18048 pentode are measured under specific supply and bias conditions. The table below outlines these typical values, alongside the design ranges and end-of-life limits.

Typical Operating Conditions

- **Anode Supply Voltage (V_{ba}):** 225 V

- **Grid No. 3 Voltage (V_{g3}):** 0 V
- **Grid No. 2 Supply Voltage (V_{bg2}):** 155 V
- **Cathode Resistor (R_k):** 250 Ω

Measured Characteristics

Parameter	New Tube Typical	Design Range	End of Life
Anode Current (I_a)	16 mA	13.5–19 mA	11.5 mA
Grid No. 2 Current (I_{g2}) (/tubes/G2))	3 mA	2–4 mA	—
Mutual Conductance (S)	6.5 mA/V	5.5–7.8 mA/V	4.5 mA/V
Internal Resistance (R_i)	0.25 M Ω	> 0.2 M Ω	—
Grid No. 2 Amplification Factor (μ_{g2g1})	19	—	—

Grid Current and Insulation

Under the typical operating conditions listed above, with a grid No. 1 circuit resistance (R_{g1}) of 0.1 M Ω , the negative grid current ($-I_{g1}$) is less than 0.5 μ A for a new tube, rising to a maximum of 1.0 μ A at the end of life. The grid current starting point, where $+I_{g1}$ reaches 0.3 μ A, occurs at a negative grid voltage ($-V_{g1}$) of less than 1.3 V.

Insulation resistance is exceptionally high, reflecting the Special Quality nature of the tube:

- **Heater to Cathode** (at $V_k f = 50$ V, cathode positive): > 100 M Ω (design range), 50 M Ω (end of life).
- **Between any two arbitrary electrodes** (at $V = 50$ V): > 1000 M Ω (design range), 300 M Ω (end of life).

The typical heating time required for the anode current to rise from 0 to 4 mA is 26 seconds, with a design range of 19 to 33 seconds. Hum voltage referred to grid No. 1 is extremely low, measuring less than 10 μ V under test conditions with a 50 Hz heater supply (center tap grounded), $R_{g1} = 0.5$ M Ω , and a cathode bypass capacitance (C_k) greater than 100 μ F.

Interelectrode Capacitances

The 18048 exhibits low interelectrode capacitances, which vary depending on whether the tube is operated in a standard pentode configuration or a triode-connected configuration (where grids No. 2 and 3 are strapped to the anode).

Pentode Connection Capacitances

- **Input Capacitance (C_{g1} to all except anode):** 8.5 pF typical (7.5–9.5 pF design range). This value increases to a typical value of 10.5 pF when operating at a cathode current (I_k) of 19 mA.
- **Output Capacitance (C_a to all except grid No. 1):** 6.0 pF typical (4.5–7.7 pF design range).
- **Combined Input and Output ($C_{g1} + C_a$):** < 16 pF (design limit).
- **Feedback Capacitance (C_{ag1}):** 0.014 pF typical (< 0.018 pF design limit).
- **Other Capacitances:**
 - C_{ag3} : 1.2 pF (typical)
 - C_{af} : 0.12 pF (typical)
 - C_{g1g2} : 3 pF (typical)
 - C_{g1k} : 4.5 pF (typical)
 - C_{g1f} : 0.02 pF typical (< 0.04 pF design limit)
 - C_{g2g3} : 2.2 pF (typical)
 - C_{kf} : 7 pF (typical)

Triode Connection Capacitances

When grids No. 2 and 3 are connected directly to the anode, the capacitances are modified as follows:

- **Input Capacitance (C_{g1} to all except anode + g2 + g3):** 5 pF typical (< 6 pF design limit).
- **Output Capacitance (anode + g2 + g3 to all except grid No. 1):** 7.5 pF typical (< 9 pF design limit).
- **Feedback Capacitance (anode + g2 + g3 to grid No. 1):** 3.2 pF typical (< 4 pF design limit).

Circuit-Specific Operation and Output Power

When configured as a class-A power output stage, the 18048 can deliver useful audio power. Under typical operating conditions ($V_{ba} = 225$ V, $V_{g3} = 0$ V, $V_{bg2} = 155$ V, and $R_k = 250$ Ω) with an AC load resistance ($R_{a\sim}$) of 10 k Ω , the tube delivers an output power (W_o) of **1.5 W** at a total distortion (d_{tot}) of 10%.

Limiting Values (Design Centre Limits)

To ensure the long-life rating of 10,000 hours, the following Design Centre Limits must not be exceeded:

- **Anode Voltage:**
 - Cold condition (V_{ao}): max. 550 V
 - Operating (V_a): max. 300 V
- **Anode Dissipation (W_a):** max. 4 W
 - *Note:* In triode connection, the combined dissipation ($W_a + W_{[g2]}(/tubes/G2) + W_{g3}$) must not exceed 5 W.

- **Grid No. 3 Voltage:**
 - Cold condition (V_{g3o}): max. 550 V
 - Operating (V_{g3}): max. 300 V
- **Grid No. 3 Dissipation (W_{g3}):** max. 1 W
- **Grid No. 2 Voltage:**
 - Cold condition (V_{g2o}): max. 550 V
 - Operating ($V_{g2}(/tubes/G2)$): max. 300 V
- **Grid No. 2 Dissipation ($W_{g2}(/tubes/G2)$):** max. 1 W
- **Grid No. 1 Negative Voltage ($-V_{g1}$):** max. 100 V
- **Grid No. 1 Dissipation (W_{g1}):** max. 50 mW
- **Grid No. 1 Circuit Resistance (R_{g1}):**
 - Max. 0.5 M Ω when $W_a > 1.5$ W
 - Max. 3 M Ω when $W_a < 1.5$ W
- **Cathode Current (I_k):** max. 30 mA
- **Heater-to-Cathode Voltage (V_{kf}):** max. 120 V
- **Heater-to-Cathode Circuit Resistance (R_{kf}):** max. 20 k Ω
- **Envelope Temperature (t_{bulb}):** max. 120 $^{\circ}\text{C}$

Qualitative Curve Analysis

The electrical behavior of the 18048 is characterized by several distinct operating curves:

- **Transfer Characteristics:** The curves of anode current (I_a), screen grid current ($I_{g2}(/tubes/G2)$), and mutual conductance (S) plotted against control grid voltage ($-V_{g1}$) show the expected control action. At a screen grid voltage ($V_{g2}(/tubes/G2)$) of 200 V, the anode current rises to approximately 85 mA when the control grid is at 0 V.
- **Anode Characteristics:** The I_a versus V_a curves display typical pentode knee behavior, with a sharp transition into a flat, high-impedance region. The maximum anode dissipation boundary of $W_a = 4$ W is clearly defined across these curves to guide safe operating area selection.
- **Suppressor Grid Control:** The dual-control capability of the tube is demonstrated by curves of I_a and $I_{g2}(/tubes/G2)$ versus suppressor grid voltage (V_{g3}) down to -80 V. Applying a negative voltage to grid No. 3 effectively diverts current away from the anode and into grid No. 2.
- **Tetrode vs. Pentode Comparison:** When grid No. 3 is connected to the cathode, the curves show a smooth pentode knee. In contrast, if grid No. 3 is omitted or improperly biased, the characteristic tetrode dynatron kink becomes visible, demonstrating the effectiveness of the suppressor grid in eliminating secondary emission effects.
- **Triode and Diode Connections:** In triode-connected operation, the curves show typical low-impedance triode characteristics, bounded by the combined 5 W dissipation limit. When all grids are strapped to the anode in a diode configuration, the curves illustrate the distribution of total diode current (I_d) among the individual grids and anode up to a diode voltage of 20 V.

Technical Summary

The **18048** is a high-reliability, Special Quality pentode featuring a metal envelope and a Loctal base. Designed for a service life of 10,000 hours, it operates with a nominal 20 V, 125 mA heater. Under typical operating conditions ($V_a = 225$ V, $V_{[g2]}(/tubes/G2) = 155$ V), it exhibits a mutual conductance of 6.5 mA/V and an anode current of 16 mA. The tube is highly versatile, supporting pentode, triode, and dual-control configurations, and is capable of delivering 1.5 W of output power in class-A amplifier service.

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 · Pentode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Heater voltage	20 V	Nominal
Heater current	125 mA	Nominal
Maximum plate voltage	300 V	Maximum
Maximum screen voltage	300 V	Maximum

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Transconductance	6500 μ S	Typical

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