



ELECTRONIC TUBE REFERENCE

18015

Voltage Pentode electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION

CONSTRUCTION

PENTODE

Philips professional pentode designed for long-life telephone-equipment service. Manufacturer documentation places it in reliable communications signal amplification, emphasizing extended service life for continuously operated telephone installations.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	7
NOMINAL HEATER	21 V / 285 mA	PARALLEL HEATER	— / —
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1 Pentode	
TRANSCONDUCTANCE	0.0083 S
MAXIMUM PLATE VOLTAGE	150 V
MAXIMUM SCREEN VOLTAGE	150 V
MAXIMUM PLATE DISSIPATION	1.2 W
MAXIMUM SCREEN DISSIPATION	0.4 W
MAXIMUM CATHODE CURRENT	13 mA
<i>Indirectly heated Philips pentode for telephone equipment, with published preamplifier and output-stage operating conditions.</i>	

18015 — Telephone Equipment Pentode

The **18015** is a specialized, indirectly heated pentode designed primarily for use in professional telephone equipment. It is engineered to deliver reliable performance in both voltage amplification (pre-amplifier) and low-power output stages. Characterized by its high mutual conductance, high internal resistance, and

low noise figures, the 18015 is optimized for parallel-supply systems operating with AC or DC heater sources.

Construction, Heater, and Physical Dimensions

The 18015 is constructed with an indirectly heated, unipotential cathode. The heater is designed for parallel supply and can be operated using either alternating current (AC) or direct current (DC).

Heater Parameter	Value
Nominal Heater Voltage (V_f)	21 V
Nominal Heater Current (I_f)	0.285 A
Calculated Heater Power (P_f)	5.985 W

Physically, the tube features a robust glass envelope with the following maximum dimensions:

- **Maximum Diameter:** 46 mm
- **Maximum Height (excluding pins):** 126 mm
- **Maximum Base/Pin Height:** 18 mm

Pinout and Base Configurations

The documented pinout configurations for the 18015 show variations in base connections and the presence of a top cap. Depending on the specific manufacturing variant, the tube utilizes either a top-cap control grid configuration or an all-pin base connection.

Configuration A (Top-Cap Control Grid, 10-Pin Base Variant 1)

In this configuration, the control grid (g_1) is brought out to a top cap to minimize input capacitance and improve high-frequency isolation:

- **Top Cap:** Control Grid (g_1)
- **Pin 1:** Heater (f)
- **Pin 2:** Heater (f)
- **Pin 4:** Cathode (k)
- **Pin 5:** Anode (a)
- **Pin 6:** Metallization/Shield (m)
- **Pin 8:** Screen Grid (g_2)
- **Pin 10:** Suppressor Grid (g_3) and internal shield (s)

Configuration B (Top-Cap Control Grid, 10-Pin Base Variant 2)

An alternative top-cap layout assigns the pins as follows:

- **Top Cap:** Control Grid (g_1)
- **Pin 3:** Heater (f)
- **Pin 4:** Suppressor Grid (g_3) and internal shield (s)
- **Pin 5:** Anode (a)
- **Pin 7:** Metallization/Shield (m)
- **Pin 8:** Screen Grid (g_2)
- **Pin 9:** Heater (f)
- **Pin 10:** Cathode (k)

Configuration C (All-Pin 10-Pin Base)

In this layout, all electrodes, including the control grid, are connected directly to the base pins:

- **Pin 1:** Control Grid (g_1)
- **Pin 2:** Cathode (k)
- **Pin 3:** Metallization/Shield (m)
- **Pin 4:** Suppressor Grid (g_3) and internal shield (s)
- **Pin 5:** Anode (a)
- **Pin 6:** Metallization/Shield (m)
- **Pin 7:** Screen Grid (g_2)
- **Pin 8:** Heater (f)
- **Pin 9:** Heater (f)
- **Pin 10:** Cathode (k)

Interelectrode Capacitances

The 18015 is designed with low feedback capacitance to ensure stability in high-gain and high-frequency applications. The typical interelectrode capacitances are:

- **Anode Capacitance (C_a):** 10.5 pF
- **Control Grid Capacitance (C_{g1}):** 16 pF
- **Feedback Capacitance (C_{ag1}):** < 0.02 pF
- **Grid-to-Heater Capacitance (C_{g1f}):** < 0.1 pF

The extremely low grid-to-plate capacitance ($C_{ag1} < 0.02$ pF) is a key factor in preventing unwanted oscillations in high-gain pre-amplifier stages.

Typical Electrical Characteristics

Under standard test conditions, the 18015 exhibits high mutual conductance and a high amplification factor. The typical characteristics measured at a nominal operating point are as follows:

Parameter	Value
Anode Voltage (V_a)	125 V
Suppressor Grid Voltage (V_{g3})	0 V
Screen Grid Voltage ($V_{[g2]}(/tubes/G2)$)	125 V
Cathode Bias Resistor (R_k)	200 Ω
Anode Current (I_a)	8 mA
Screen Grid Current ($I_{[g2]}(/tubes/G2)$)	2.5 mA
Mutual Conductance (S)	8.3 mA/V
Screen-to-Control Grid Amplification Factor (μ_{g2g1})	42
Internal Plate Resistance (R_i)	350 k Ω
Max. Equivalent Noise Resistance, H.F. (R_{eq})	1 k Ω
Max. Equivalent Noise Resistance, L.F. (R_{eq})	10 k Ω

Operating Conditions

The 18015 is highly versatile and can be configured either as a high-gain pre-amplifier or as a low-power output stage.

As a Pre-Amplifier

When configured as a pre-amplifier, the tube is biased for lower current consumption and higher internal resistance to maximize voltage gain:

- **Anode Voltage (V_a):** 125 V
- **Suppressor Grid Voltage (V_{g3}):** 0 V
- **Screen Grid Voltage ($V_{[g2]}(/tubes/G2)$):** 125 V
- **Cathode Resistor (R_k):** 440 Ω
- **Anode Load Resistor (R_a):** 16 k Ω
- **Anode Current (I_a):** 4.5 mA
- **Screen Grid Current ($I_{[g2]}(/tubes/G2)$):** 1.3 mA
- **Mutual Conductance (S):** 5.5 mA/V
- **Internal Plate Resistance (R_i):** 550 k Ω
- **Voltage Gain (V_o/V_i):** 4.35 N (Nepers)

- *Calculation:* Converting Nepers to decibels ($1 \text{ N} \approx 8.686 \text{ dB}$), the voltage gain is approximately $4.35 \times 8.686 \approx 37.8 \text{ dB}$.

- **Maximum Grid 1 Resistor (R_{g1}):**

- With automatic bias: $1 \text{ M}\Omega$
- With fixed grid bias: $0.5 \text{ M}\Omega$

As an Output Valve

When used in the output stage, the tube is biased to deliver maximum power to the load with low distortion:

- **Anode Voltage (V_a):** 125 V
- **Suppressor Grid Voltage (V_{g3}):** 0 V
- **Screen Grid Voltage ($V_{[g2]}(/tubes/G2)$):** 125 V
- **Cathode Resistor (R_k):** 200Ω
- **Anode Load Resistor (R_a):** $30 \text{ k}\Omega$
- **Anode Current (I_a):** 8 mA
- **Screen Grid Current ($I_{[g2]}(/tubes/G2)$):** 2.5 mA
- **Mutual Conductance (S):** 8.3 mA/V
- **Internal Plate Resistance (R_i):** $350 \text{ k}\Omega$
- **Output Power (W_o):** 0.1 W (100 mW)
- **Total Distortion (d_{tot}):** $< 5\%$
- **Maximum Grid 1 Resistor (R_{g1}):**
 - With automatic bias: $0.3 \text{ M}\Omega$
 - With fixed grid bias: $0.15 \text{ M}\Omega$

Limiting Values (Absolute Maxima)

To ensure reliable operation and long life in telephone equipment, the following maximum ratings must not be exceeded:

Parameter	Absolute Maximum
Cold Anode Voltage (V_{a0})	300 V
Anode Voltage (V_a)	150 V
Anode Dissipation (W_a)	1.2 W
Cold Screen Grid Voltage (V_{g20})	300 V
Screen Grid Voltage ($V_{[g2]}(/tubes/G2)$)	150 V
Screen Grid Dissipation ($W_{[g2]}(/tubes/G2)$)	0.4 W

Parameter	Absolute Maximum
Cathode Current (I_k)	13 mA
Grid 1 Voltage (V_{g1} at $I_{g1} = +0.3 \mu\text{A}$)	-1.3 V
Filament-to-Cathode Voltage (V_{fk})	50 V
Filament-to-Cathode Resistance (R_{fk})	20 k Ω

Curve Analysis and Qualitative Behavior

The transfer and plate characteristics of the 18015 illustrate its linear behavior and high internal resistance:

- **Transfer Characteristics ($I_a, I_{[g2]}$ (/tubes/G2) vs. V_{g1}):** At an anode voltage of 125 V, screen grid voltage of 125 V, and suppressor grid voltage of 0 V, the control grid cutoff voltage is located near $V_{g1} = -4.5$ V. As the grid bias approaches zero, the anode current rises sharply, reaching approximately 31 mA at $V_{g1} = 0$ V, while the screen grid current reaches approximately 9 mA.
- **Plate Characteristics (I_a vs. V_a):** Under the same screen and suppressor grid conditions ($V_{[g2]}$ (/tubes/G2) = 125 V, $V_{g3} = 0$ V), the plate curves display a sharp knee below $V_a = 40$ V. Above this knee, the curves are remarkably flat and parallel, which qualitatively confirms the tube's high internal plate resistance ($R_i = 350$ k Ω to 550 k Ω). At $V_{g1} = 0$ V, the anode current saturates at approximately 32 mA.

Technical Summary

The **18015** is a high-performance, indirectly heated pentode designed specifically for professional telephone applications. Operating with a 21 V, 0.285 A heater, it is optimized for parallel AC or DC supply. The tube features a low-noise design with an equivalent noise resistance of at most 1 k Ω at high frequencies and 10 k Ω at low frequencies.

With a mutual conductance of up to 8.3 mA/V and an internal resistance ranging from 350 k Ω to 550 k Ω , the 18015 provides excellent gain and linearity. It is highly adaptable, serving as a pre-amplifier with a voltage gain of 4.35 N (approx. 37.8 dB) or as a low-power output stage delivering 0.1 W of power with less than 5% total distortion. Designers must adhere to its strict limiting values, including a maximum anode dissipation of 1.2 W and a maximum cathode current of 13 mA, to maintain the high reliability required in telecommunications infrastructure.



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 · Pentode

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Anode Voltage	125 V	—
Screen Voltage	125 V	—
Anode Current	8 mA	—
Screen Current	2.5 mA	—



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1963 Philips Electron Tubes Handbook V1

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

1963 PHILIPS ELECTRON TUBES HANDBOOK V1

Section 1 · Pentode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate voltage	125 V	TelephoneAmplifier
Screen voltage	125 V	TelephoneAmplifier
Cathode resistor	200 ohm	TelephoneAmplifier
Plate current	8 mA	TelephoneAmplifier
Screen current	2.5 mA	TelephoneAmplifier

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Output power	0.1 W	OutputValve

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Transconductance	8300 uS	—
Plate resistance	0.35 MOhm	—

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Anode capacitance	10.5 pF	—
Control-grid capacitance	16 pF	—
Anode-to-control-grid capacitance	0.02 pF	Maximum where stated
Control-grid-to-heater capacitance	0.1 pF	Maximum where stated


SOURCE DATA APPENDIX

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	21 V	Nominal
Heater current	285 mA	Nominal
Maximum screen voltage	150 V	Maximum

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate resistance	350000 ohm	Typical
Transconductance	8300 uS	Typical