

ELECTRONIC TUBE REFERENCE

CONSOLIDATED TECHNICAL DATA

12K4

1 SECTION  
CONSTRUCTION  
PENTODE

Voltage Pentode - High Frequency (single) electronic tube

Russian high-frequency pentode with a tailored characteristic, designed for amplification of high-frequency voltage. Its manufacturer description places it firmly in RF voltage-amplifier service rather than power-output operation.

GENERAL CHARACTERISTICS

|                     |                   |                      |               |
|---------------------|-------------------|----------------------|---------------|
| BASE DESIGNATION    | —                 | BASE PINS            | 8             |
| NOMINAL HEATER      | 12.6 V / 150 mA   | PARALLEL HEATER      | — / —         |
| HEATING             | Indirect          | SERIES OPERATION     | Not specified |
| CATHODE ARRANGEMENT | Separate cathodes | SECTION CONSTRUCTION | Similar       |

SECTION RATINGS

|                                                                                                                          |          |
|--------------------------------------------------------------------------------------------------------------------------|----------|
| SECTION1 Pentode                                                                                                         |          |
| TRANSCONDUCTANCE                                                                                                         | 0.0047 S |
| MAXIMUM PLATE VOLTAGE                                                                                                    | 330 V    |
| MAXIMUM SCREEN VOLTAGE                                                                                                   | 220 V    |
| MAXIMUM PLATE DISSIPATION                                                                                                | 3.3 W    |
| MAXIMUM SCREEN DISSIPATION                                                                                               | 0.7 W    |
| Published ratings/characteristics promoted where clearly identified; additional bilingual values retained as parameters. |          |

# 12K4 — High-Frequency Pentode with Tailed Characteristic

An indirectly heated, metal-envelope high-frequency pentode featuring a remote-cut-off characteristic, designed for high-frequency voltage amplification under demanding environmental conditions.

# Overview

The **12K4** is a specialized high-frequency pentode designed for the amplification of high-frequency voltage. It features a "tailed" (remote-cut-off or variable-mu) control grid characteristic, which allows for effective gain control when operating with automatic volume control (AVC) or automatic gain control (AGC) systems. The tube is constructed with an indirectly heated, oxide-coated cathode and is housed in a rugged metal envelope with a standard octal base.

Engineered for high reliability in demanding environments, the 12K4 is rated to operate across a wide ambient temperature range from -60 to +70 °C and can withstand relative humidity levels of 95% to 98% at +20 °C. It is also highly resistant to mechanical stress, withstanding vibration loads up to 6 g. The device has a maximum weight of 45 grams and carries a guaranteed service life of 2000 hours.

## Construction, Heater, and Pinout

The 12K4 is enclosed in a cylindrical metal envelope that provides inherent electrostatic shielding. The physical dimensions of the device are compact, with a maximum envelope diameter of 27 mm, a maximum base diameter of 33 mm, and a maximum overall height of 67 mm.

The tube is equipped with an octal base. The pin connections, viewed from the bottom of the base, are assigned as follows:

| Pin | Electrode Connection    | Description                                        |
|-----|-------------------------|----------------------------------------------------|
| 1   | Shield (6)              | Metal envelope shield                              |
| 2   | Heater (h)              | Heater filament                                    |
| 3   | Cathode, Grid 3 (k, g3) | Cathode and suppressor grid (internally connected) |
| 4   | Grid 1 (g1)             | Control grid                                       |
| 5   | Cathode (k)             | Independent cathode terminal                       |
| 6   | Grid 2 (g2)             | Screen grid                                        |
| 7   | Heater (h)              | Heater filament                                    |
| 8   | Plate (a)               | Anode (plate)                                      |

The heater is designed for series or parallel AC or DC operation. The nominal heater voltage is 12.6 V, and the nominal heater current is  $150 \pm 12$  mA.

## Heater Power Calculation

Using the nominal heater voltage ( $U_h = 12.6$  V) and the nominal heater current ( $I_h = 0.15$  A), the nominal heater power consumption is calculated as:  $\text{Heater Power} = U_h \times I_h = 12.6 \text{ V} \times 0.15 \text{ A} = 1.89 \text{ W}$

The dual cathode connections on Pin 3 and Pin 5 provide circuit designers with flexibility in layout, allowing for low-inductance RF grounding or separate cathode biasing arrangements.

## Electrical Characteristics and Operating Points

The nominal electrical characteristics of the 12K4 are defined at a specific Class A high-frequency amplifier operating point:

- **Plate Voltage ( $U_a$ ):** 250 V
- **Grid 2 Voltage ( $U_{[g2]}$  (/tubes/G2)):** 125 V
- **Grid 1 Voltage ( $U_{g1}$ ):** -1 V
- **Plate Current ( $I_a$ ):**  $11.8 \pm 2.8$  mA
- **Grid 2 Current ( $I_{[g2]}$  (/tubes/G2)):**  $4.4 \pm 1.5$  mA
- **Transconductance ( $S$ ):**  $4.7 \pm 0.9$  mA/V

## Remote Cut-Off ("Tailed") Behavior

The defining feature of the 12K4 is its "tailed" transfer characteristic. At the standard operating bias of -1 V, the transconductance is relatively high at 4.7 mA/V. However, when a large negative bias is applied to the control grid, the transconductance decreases gradually rather than cutting off abruptly. At a control grid voltage ( $U_{g1}$ ) of -14 V, the transconductance ( $S_{az}$ ) is reduced to a range of 10 to 100  $\mu$ A/V (0.01 to 0.1 mA/V). This wide range of transconductance variation enables smooth gain control over a broad dynamic range of input signals.

## Interelectrode Capacitances

To ensure stable operation at high frequencies and minimize internal feedback, the 12K4 is designed with extremely low feedback capacitance. The interelectrode capacitances, measured without an external shield, are:

- **Grid 1 to Cathode ( $C_{g1k}$ ):**  $8.5 \pm 1.7$  pF
- **Plate to Cathode ( $C_{ak}$ ):**  $7.0 \pm 2.1$  pF
- **Grid 1 to Plate ( $C_{g1a}$ ):**  $\leq 0.005$  pF

The exceptionally low grid-to-plate capacitance ( $C_{g1a}$ ) of 0.005 pF or less is achieved through the internal shielding of the pentode structure and the metal envelope, which effectively prevents self-oscillation in high-gain high-frequency amplifier stages.

## Maximum and Minimum Permissible Ratings

To maintain the performance and guarantee the 2000-hour service life of the 12K4, the operating conditions must not exceed the following maximum and minimum limits:

| Parameter                                    | Minimum Limit | Maximum Limit |
|----------------------------------------------|---------------|---------------|
| Heater Voltage ( $U_h$ )                     | 11.4 V        | 13.8 V        |
| Plate Voltage ( $U_a$ )                      | —             | 330 V         |
| Grid 2 Voltage ( $U_{[g2]}$ (/tubes/G2))     | —             | 220 V         |
| Grid 1 Voltage ( $U_{g1}$ )                  | —             | 0 V           |
| Plate Dissipation ( $P_a$ )                  | —             | 3.3 W         |
| Grid 2 Dissipation ( $P_{[g2]}$ (/tubes/G2)) | —             | 0.7 W         |
| Heater-to-Cathode Voltage ( $U_{kh}$ )       | —             | 100 V         |

Operating the tube outside these limits may lead to premature degradation of the cathode emission, excessive grid emission, or thermal runaway.

## Analysis of Characteristic Curves

The electrical behavior of the 12K4 is further illustrated by its characteristic curves, which describe the relationships between electrode voltages and currents:

- **Plate Characteristics ( $I_a = f(U_a)$ ):** At a fixed control grid voltage of -1 V, the plate current rises sharply at low plate voltages (below 50 V) and then transitions into a flat, horizontal region. This flat characteristic is maintained up to 400 V, demonstrating the high internal plate resistance typical of a pentode. Increasing the screen grid voltage ( $U_{[g2]}$  (/tubes/G2)) from 50 V to 125 V shifts the entire plate current family upward, increasing the overall current capacity.
- **Grid Bias Characteristics ( $I_a, I_{[g2]} (/tubes/G2) = f(U_{g1})$ ):** With a constant screen grid voltage of 100 V, varying the control grid voltage ( $U_{g1}$ ) from 0 V down to -7 V shows a uniform reduction in both plate current (solid curves) and screen grid current (dashed curves). The curves remain parallel and flat across the plate voltage range, indicating stable pentode behavior across different bias levels.
- **Transfer Characteristics ( $I_a, I_{[g2]} (/tubes/G2) = f(U_{g1})$ ):** At a plate voltage of 250 V, the transfer curves show the gradual decay of plate and screen currents as the control grid bias becomes more negative. The long, tail-like approach to zero current as bias increases past -6 V visually demonstrates the remote-cut-off design.
- **Transconductance vs. Grid Bias ( $S = f(U_{g1})$ ):** The transconductance curves at a plate voltage of 250 V show that the slope of the transfer characteristic (transconductance) is highly dependent on both the control grid bias and the screen grid voltage. Higher screen grid voltages yield higher peak transconductance, while more negative control grid bias smoothly reduces the transconductance, confirming the suitability of the 12K4 for automatic gain control circuits.

## Technical Summary

The **12K4** is an **octal-based, metal-envelope high-frequency pentode** featuring a **remote-cut-off ("tailed") characteristic** and an **indirectly heated 12.6 V / 150 mA heater**. It is optimized for high-frequency voltage amplification where gain control is required. At its typical operating point ( $U_a = 250\text{ V}$ ,  $U_{g2} = 125\text{ V}$ ,  $U_{g1} = -1\text{ V}$ ), the tube provides a transconductance of  $4.7\text{ mA/V}$ , which can be smoothly controlled down to  $10\text{--}100\text{ }\mu\text{A/V}$  at a grid bias of  $-14\text{ V}$ .

With its robust construction, low feedback capacitance ( $C_{g1a} \leq 0.005\text{ pF}$ ), and ability to withstand extreme temperatures, humidity, and vibration, the 12K4 is a highly reliable component for high-frequency receiver and amplifier applications.

## SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

# 195X Russian

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

## 195X RUSSIAN

## Section 1 · Pentode

| CHARACTERISTICS                |                    |                                                                                         |
|--------------------------------|--------------------|-----------------------------------------------------------------------------------------|
| PARAMETER                      | PUBLISHED VALUE    | CONDITION / NOTE                                                                        |
| Source symbol Bricoko          | <b>4 A</b>         | Bricoko4acTOTHBIH [EHTOA ¢ YAJHHEHHON Xa- The 12K4 high-frequency pentode with a tailed |
| Source symbol K                | <b>4 h</b>         | Bricoko4acTOTHBIH [EHTOA ¢ YAJHHEHHON Xa- The 12K4 high-frequency pentode with a tailed |
| Service life                   | <b>2000 h</b>      | [apantupoBanHas poJaroseuysocts 2000 uwacos. Service life guarantee: 2000 hr.           |
| Source symbol U,               | <b>126 V</b>       | U, 126V Up, 125V Iy 44%15mA                                                             |
| Source symbol Up,              | <b>125 V</b>       | U, 126V Up, 125V Iy 44%15mA                                                             |
| Published electrical parameter | <b>15 mA</b>       | U, 126V Up, 125V Iy 44%15mA                                                             |
| Published electrical parameter | <b>150±12 mA</b>   | 1, 150=12 mA Uy —1V S 47409 mA/V                                                        |
| Published electrical parameter | <b>1 V</b>         | 1, 150=12 mA Uy —1V S 47409 mA/V                                                        |
| Source symbol S                | <b>47409 mA/V</b>  | 1, 150=12 mA Uy —1V S 47409 mA/V                                                        |
| Source symbol U,               | <b>250 V</b>       | U, 250V 1, 11,8+28 mA S,,) 10—100 pA/V                                                  |
| Published electrical parameter | <b>11.8+28 mA</b>  | U, 250V 1, 11,8+28 mA S,,) 10—100 pA/V                                                  |
| Published electrical parameter | <b>10-100 pA</b>   | U, 250V 1, 11,8+28 mA S,,) 10—100 pA/V                                                  |
| Source symbol Cop              | <b>85±17 pF</b>    | Cop 85=17 pF                                                                            |
| Published electrical parameter | <b>21 pF</b>       | C,. T7.0%21 pF                                                                          |
| Source symbol Cgra             | <b>&lt;0005 pF</b> | Cgra <0005 pF                                                                           |
| Source symbol u,               | <b>138 V</b>       | u, 138 V 114V P, 33W                                                                    |

| PARAMETER                      | PUBLISHED VALUE | CONDITION / NOTE                            |
|--------------------------------|-----------------|---------------------------------------------|
| Source symbol V                | 114 V           | u, 138 V 114V P, 33W                        |
| Source symbol P,               | 33 W            | u, 138 V 114V P, 33W                        |
| Source symbol U,               | 330 V           | U, 330V Pg2 0,7 W                           |
| Source symbol Pg2              | 0.7 W           | U, 330V Pg2 0,7 W                           |
| Source symbol Ug2              | 220 V           | Ug2 220V Uy 10V                             |
| Source symbol Uy               | 10 V            | Ug2 220V Uy 10V                             |
| Published electrical parameter | 227 mA          | 227max                                      |
| Source symbol I                | 3 mA            | I3 max                                      |
| Source symbol L                | -0.5 V          | A WA L -0.5V                                |
| Source symbol o                | 0 V             | i L 1o0v S - SAMTS                          |
| Source symbol L                | 75 V            | L 75v ] & /N —t—t T                         |
| Source symbol v                | 4 h             | v 4 h 4 N -+ ey [{Z,=0V “_gv                |
| Published electrical parameter | 0 V             | v 4 h 4 N -+ ey [{Z,=0V “_gv                |
| Published electrical parameter | 50 V            | 4 50V . 4 M1 Mt t b                         |
| Published electrical parameter | 2 V             | — 2V                                        |
| Published electrical parameter | 300 W           | 0 100 200 300 400 Ygv g 100 200 300 Wy Ug.¥ |
| Published electrical parameter | 126 V           | U,=126V —_—, U,=126V                        |
| Source symbol Ug               | 2±100 V         | Ug1=—1V — — —Iy Ug2=100V                    |
| Published electrical parameter | 250 V           | - — =1 U, =250 V U, =250V                   |



SOURCE DATA APPENDIX

## SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

# 1970 Russian Tubes Mashpriborintorg

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

1970 RUSSIAN TUBES MASHPRIBORINTORG

| CHARACTERISTICS         |                 |                                    |
|-------------------------|-----------------|------------------------------------|
| PARAMETER               | PUBLISHED VALUE | CONDITION / NOTE                   |
| Guaranteed service life | 2000 h          | PublishedGuarantee                 |
| Transconductance        | 47409 mA/V      | PublishedElectricalCharacteristics |