

ELECTRONIC TUBE REFERENCE

CONSOLIDATED TECHNICAL DATA

1A1P

1 SECTION
CONSTRUCTION
HEPTODE

Voltage Radio Detector Converter electronic tube

Battery or receiving-tube frequency converter combining local-oscillator and mixer action for superheterodyne radio service. Its multi-grid structure provides frequency conversion while minimizing component count and, in battery types, filament power.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	7
NOMINAL HEATER	1.2 V / 60 mA	PARALLEL HEATER	— / —
HEATING	Direct	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION1 Heptode	
MAXIMUM PLATE VOLTAGE	100 V
MAXIMUM SCREEN VOLTAGE	75 V
MAXIMUM CATHODE CURRENT	6.5 mA
Russian 1A1P directly heated oxide-coated battery heptode frequency changer, filament 1.2 V 60 mA. Published maximum anode voltage 100 V, grids 2/4 screen 75 V, total cathode current 6.5 mA. Typical operation uses anode 90 V, grids 2/4 45 V, anode current ~0.64 mA, total cathode ~2.4 mA. Conversion transconductance ~0.25 mA/V and oscillator transconductance ~0.825 mA/V are different frequency-converter mode characteristics, not intrinsic static gm. Seven-pin base, published interelectrode capacitances.	

1A1P — Miniature Heptode Frequency Converter

The **1A1P** (also designated as **1A1Π**) is a miniature, directly heated heptode vacuum tube of Russian origin designed primarily for frequency conversion applications. Featuring an oxide-coated cathode and a

seven-pin glass envelope, this heptode is optimized for low-power operation, making it highly suitable for portable or battery-operated radio receiver designs.

Construction and Physical Characteristics

The 1A1P is constructed in a miniature glass envelope with a maximum mass of 10 grams. It utilizes the RSH4 socket type. The physical dimensions are compact, with a maximum overall diameter of 19.2 mm, a maximum height of 57 mm, and a height excluding the base pins of 50 ± 2 mm.

The tube features a directly heated, oxide-coated filamentary cathode designed for low current consumption. The internal structure consists of five grids surrounding the central filament, arranged to perform the complex mixing and local oscillator functions required in frequency conversion circuits.

Environmental and Service Conditions

The 1A1P is rated to operate under demanding environmental conditions, including:

- **Vibration resistance:** Capable of withstanding vibration at a frequency of 50 Hz with acceleration levels up to 2.5 g.
- **Ambient temperature range:** Operates reliably from -45 °C to +70 °C.
- **Relative humidity:** Withstands up to 98% relative humidity at temperatures up to 25 °C.
- **Microphonic noise:** The tube exhibits a microphonic noise level of 500 mV under specified conditions.

Pinout and Electrode Connections

The 1A1P uses a standard seven-pin base layout. The electrodes are connected to the pins as follows:

Pin Number	Electrode Connection
Pin 1	Cathode (negative filament terminal) and Grid 5
Pin 2	Anode
Pin 3	Grid 2 and Grid 4
Pin 4	Grid 1
Pin 5	Cathode (negative filament terminal) and Grid 5
Pin 6	Grid 3
Pin 7	Cathode (positive filament terminal)

In this configuration, Grid 5 is internally tied to the negative side of the filament (Pins 1 and 5). Grid 2 and Grid 4 are internally connected together and brought out to Pin 3, acting as screen grids, while Grid 1 (Pin 4) and Grid 3 (Pin 6) serve as the independent control grids for the oscillator and signal input functions respectively.

Electrical Parameters and Typical Operating Points

Under typical operating conditions, the 1A1P is configured with the following electrical parameters:

Parameter	Nominal Value	Tolerance / Range
Filament Voltage	1.2 V	—
Filament Current	60 mA (0.06 A)	53 to 67 mA (60 $\pm$ 7 mA)
Anode Voltage	90 V	—
Grid 2 & Grid 4 Voltage	45 V	—
Grid 3 A.C. Voltage	0 V	—
Grid 1 A.C. Voltage (r.m.s.)	15 V	—
Anode Current	0.64 mA	0.34 to 0.94 mA (0.64 $\pm$ 0.3 mA)
Cathode Current	2.48 mA	1.53 to 3.45 mA
Grid 1 Current	$\geq 80 \mu\text{A}$ ($\geq 80 \pm 10 \mu\text{mA}$)	—
Grid 1 Resistance	0.1 M	—
Conversion Transconductance	0.25 mA/V	At alternating Grid 3 voltage of 0.7 V r.m.s. (minimum 0.16 mA/V)
Heterodyne Oscillator Transconductance	$\geq 0.825 \text{ mA/V}$	At anode voltage of 45 V, alternating Grid 1 voltage of 0.5 V r.m.s.
Inverse Grid 3 Current	$\leq 0.6 \mu\text{A}$	At Grid 3 voltage of -1 V, Grid 3 circuit resistance of 0.5 M

Interelectrode Capacitances

The capacitive coupling between electrodes is kept low to ensure stable high-frequency operation:

- **Input Capacitance:** 7 $\pm$ 1.4 pF
- **Output Capacitance:** 7 $\pm$ 1.8 pF
- **Transfer Capacitance:** $\leq 0.4 \text{ pF}$

Limit Values of Operating Conditions

To ensure the longevity and reliability of the tube, operating parameters must be kept within the following absolute limits:

- **Filament Voltage:** Minimum 0.95 V, Maximum 1.4 V

- **Anode Voltage:** Maximum 100 V
- **Grid 2 Voltage:** Maximum 75 V
- **Grid 3 Voltage:** Maximum 0 V
- **Cathode Current:** Maximum 6.5 mA

Lifetime Parameters

The 1A1P is rated for a minimum operating lifetime of 1500 hours. Over this period, the degradation of key parameters is restricted to the following limits:

- **Conversion Transconductance:** Remains ≥ 0.125 mA/V.
- **Grid 1 Current:** Remains ≥ 64 μ A.

Qualitative Curve Analysis and Device Behavior

The performance of the 1A1P under varying electrode potentials is characterized by several distinct operating curves:

- **Average Anode Characteristics (with Grid 3 at 0 V):** When the filament is at 1.2 V and Grid 2 is held at 45 V, the plot of anode current (I_a) versus anode voltage (U_a) for Grid 1 voltages (U_{g1}) from 0 to -5 V exhibits a typical pentode-like knee around $U_a = 30$ V. Above this knee, the anode current remains relatively flat, demonstrating high dynamic plate resistance.
- **Average Anode Characteristics (with Grid 1 at 0 V):** Under the same filament and Grid 2 conditions, varying Grid 3 voltage (U_{g3}) from 0 to -5 V produces a similar family of curves, showing how Grid 3 controls the anode current independently of Grid 1.
- **Heterodyne Oscillator Characteristics:** When Grids 2 and 4 are connected directly to the anode (triode-strapped configuration) with $U_f = 1.2$ V and $U_a = U_{[g2]}(/tubes/G2) = 45$ V, the transconductance of the heterodyne oscillator (S_{het}) and the combined anode-grid current ($I_a + I_{[g2]}(/tubes/G2)$) can be plotted against Grid 1 voltage (U_{g1}) from -7 to 0 V. This shows the control characteristics of the oscillator section.
- **Heterodyne Oscillator Anode Characteristics:** In the same triode-strapped configuration with Grid 3 at 0 V, the total current ($I_a + I_{[g2]}(/tubes/G2) + I_{g4}$) plotted against the combined voltage ($U_a, U_{[g2]}(/tubes/G2), U_{g4}$) up to 200 V for various Grid 1 voltages from 0 to -30 V illustrates the power handling and current capability of the oscillator portion of the heptode.
- **Averaged Dynamic Characteristics:** With $U_f = 1.2$ V, $U_a = 90$ V, $U_{[g2]}(/tubes/G2) = 45$ V, $U_{g3} = 0$ V, and an effective Grid 1 drive voltage of 14 V_{eff}, the conversion transconductance (S_{tr}) and cathode current (I_k) plotted against Grid 3 voltage (U_{g3}) from -28 to 0 V demonstrate the AGC (automatic gain control) capability of the mixer stage.
- **Averaged Grid 1 Current Characteristics:** Under typical operating voltages with a Grid 1 resistance of 0.1 M Ω , the conversion transconductance (S_{tr}) and cathode current (I_k) plotted against Grid 1 current (I_{g1}) from 0 to 300 μ A show how the oscillator grid self-bias current affects the overall conversion efficiency.

- **Averaged Grid 3 Control Characteristics:** With $U_f = 1.2 \text{ V}$, $U_a = 90 \text{ V}$, $U_{[g2]}(/tubes/G2) = 45 \text{ V}$, and a fixed Grid 1 current of 125 μA (using a 0.1 M grid leak resistor), the conversion transconductance (S_{tr}), anode current (I_a), and Grid 2 current ($I_{[g2]}(/tubes/G2)$) plotted against Grid 3 voltage (U_{g3}) from -6 to 0 V illustrate the precise control Grid 3 exerts over the mixing process.

Technical Summary

The **1A1P** is a specialized, directly heated miniature heptode designed for frequency conversion in portable radio equipment. Operating with a nominal filament voltage of 1.2 V and a low current of 60 mA, it provides efficient mixing performance. At a typical anode voltage of 90 V and screen grid voltage of 45 V, it delivers a conversion transconductance of 0.25 mA/V and a heterodyne oscillator transconductance of at least 0.825 mA/V. Its robust construction allows it to withstand significant vibration and extreme temperatures, making it a reliable choice for compact, battery-powered superheterodyne receivers.

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 · Heptode

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Anode voltage	90 V	Published operating point
Grid 2 and grid 4 voltage	45 V	Published operating point
Grid 1 AC voltage	15 V	RMS
Anode current	0.64 mA	Published nominal
Cathode current	2.4 mA	Published nominal
Grid 1 resistance	0.1 MOhm	Published value
Conversion transconductance	0.25 mA/V	Grid 3 AC 0.7 V RMS
Heterodyne oscillator transconductance	0.825 mA/V	Anode 45 V; grid 1 AC 0.5 V RMS
Grid 3 inverse current	0.6 uA	Grid 3 -1 V
Input capacitance	7 pF	Published nominal
Output capacitance	7 pF	Published nominal
Transfer capacitance	0.4 pF	Published value