



ELECTRONIC TUBE REFERENCE

10

Power - Triode electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION

CONSTRUCTION

TRIODE

Directly heated receiving power triode for audio-frequency output service, with Class A operation to about 1.6 W single-ended and published push-pull Class B operation reaching roughly 25 W from a pair.

GENERAL CHARACTERISTICS

BASE DESIGNATION	4D	BASE PINS	4
NOMINAL HEATER	7.5 V / 1.25 A	PARALLEL HEATER	– / –
HEATING	Direct	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1 Triode	
PLATE RESISTANCE	5150 Ω
TRANSCONDUCTANCE	0.00155 S
AMPLIFICATION FACTOR	8
MAXIMUM PLATE VOLTAGE	425 V
MAXIMUM PLATE DISSIPATION	12 W
<i>Published ratings and characteristics promoted from the approved datasheet.</i>	

10 — Triode Power Amplifier and Oscillator

The **10** (also designated as the **Type '10'**, **CX-310**, or **RCA-10**) is a high-vacuum, filament-type power triode designed for service in the output stage of audio-frequency power amplifiers and as an oscillator. Featuring a thoriated tungsten filament and a relatively high amplification factor for a power triode of its era, the 10 is capable of delivering significant undistorted power output in both Class A and Class B configurations.

Physical Specifications and Construction

The 10 is constructed with a thoriated tungsten filamentary emitter. It was produced in two primary envelope styles: the **S-17** straight-sided glass bulb and the **ST-16** shouldered glass bulb. The physical dimensions of the device are as follows:

- **Maximum Overall Length:** 5-5/8 inches (5.625 inches)
- **Maximum Bulb Height (excluding pins):** 5 inches
- **Maximum Bulb Diameter:** 2-3/16 inches (2.188 inches)
- **Maximum Base Diameter:** 1-3/8 inches

The tube is equipped with a **Medium 4-Pin Bayonet Base** (also designated as M-4 or 4-D) and fits standard four-contact sockets. To ensure proper operation and prevent internal structural damage, the tube must be mounted in a **vertical position with the base down**.

Filament Ratings and Pinout

The 10 utilizes a directly heated filament designed for either alternating current (AC) or direct current (DC) operation. The filament is typically powered from an AC line via a step-down transformer.

Filament Parameter	Value
Filament Voltage (AC or DC)	7.5 V
Filament Current	1.25 A

Pin Connection Diagram

Viewed from the bottom of the socket, the terminal connections are arranged as follows:

- **Pin 1:** Filament (F)
- **Pin 2:** Plate (P)
- **Pin 3:** Grid (G / G1)
- **Pin 4:** Filament (F)

Direct Interelectrode Capacitances

The direct interelectrode capacitances of the 10 vary slightly depending on the manufacturer's construction and measurement conditions. Two sets of approximate values are documented:

Standard Capacitance Values

- **Grid to Plate:** 7.0 pF ($\mu\mu\text{F}$)
- **Input (Grid to Filament):** 4.0 pF ($\mu\mu\text{F}$)
- **Output (Plate to Filament):** 3.0 pF ($\mu\mu\text{F}$)

Alternative Capacitance Values

- **Grid to Plate:** 8.0 pF (μpF)
- **Grid to Filament:** 5.0 pF (μpF)
- **Plate to Filament:** 4.0 pF (μpF)

Typical Operating Conditions (Class A Amplifier)

When operated as a single-ended Class A audio-frequency power amplifier, the 10 requires a minimum plate voltage of 250 V with appropriate negative grid bias. The grid voltage is typically referenced to the mid-point of an AC-operated filament. If a DC filament supply is used, the grid bias must be adjusted to refer to the negative end of the filament.

Depending on the specific design guidelines, the DC grid voltage adjustment is as follows:

- **Adjustment Option A:** Decrease the tabulated grid bias values by **5.0 V** when using DC.
- **Adjustment Option B:** Decrease the tabulated grid bias values by **3.75 V** when using DC.

The typical operating parameters under three distinct plate voltage conditions are detailed below:

Parameter	Condition 1	Condition 2	Condition 3
AC Filament Voltage	7.5 V	7.5 V	7.5 V
DC Plate Voltage	250 V	350 V	425 V
DC Grid Voltage (AC Mid-point)	-22.0 V to -23.5 V	-31.0 V to -32.0 V	-39.0 V to -40.0 V
Peak Grid Swing (Signal Peak)	18.5 V	27.0 V	35.0 V
DC Plate Current	10.0 mA	16.0 mA	18.0 mA
Cathode (Self-Bias) Resistor	2350 Ω	2000 Ω	2220 Ω
Plate Resistance	6000 Ω	5150 Ω	5000 Ω
Transconductance	1330 μmhos	1550 μmhos	1600 μmhos
Amplification Factor	8.0	8.0	8.0
Load Resistance	13000 Ω	11000 Ω	10200 Ω
Undistorted Power Output	0.4 W	0.9 W	1.6 W

The amplification factor of 8.0 is notably higher than what is typically found in standard Class A power triodes of similar power capabilities, allowing for higher sensitivity in the output stage.

Class B Push-Pull Operation

For higher power output, two 10 tubes can be operated in a Class B push-pull configuration. In this mode, the grid bias must be adjusted to a high negative value to reduce the zero-signal plate current to a very low level.

The typical operating conditions for a two-tube Class B amplifier are as follows:

Parameter	Condition 1	Condition 2	Condition 3
AC Filament Voltage	7.5 V	7.5 V	7.5 V
DC Plate Voltage	250 V	350 V	425 V
DC Grid Voltage (Approx.)	-28 V	-40 V	-50 V
Peak AF Grid-to-Grid Voltage	110 V	120 V	130 V
Zero-Signal DC Plate Current (per tube)	4 mA	4 mA	4 mA
Max.-Signal DC Plate Current (per tube)	55 mA	55 mA	55 mA
Load Resistance (per tube)	1000 Ω	1500 Ω	2000 Ω
Effective Plate-to-Plate Load Resistance	4000 Ω	6000 Ω	8000 Ω
Max.-Signal Driving Power (Approx.)	2.1 W	2.3 W	2.5 W
Max.-Signal Power Output (Approx.)	13 W	20 W	25 W

Maximum Ratings

The maximum ratings for the 10 are established under the RMA Standard M8-210 convention. These limits must not be exceeded under the worst-case operating conditions.

Class A Amplifier Service

- **Maximum DC Plate Voltage:** 425 V
- **Maximum Plate Dissipation:** 12 W

Class B Amplifier Service (Per Tube)

- **Maximum DC Plate Voltage:** 425 V
- **Maximum Plate Dissipation (Averaged over any AF cycle):** 12 W
- **Maximum-Signal Maximum DC Plate Current:** 60 mA
- **Maximum-Signal Maximum Plate Input:** 25 W

Circuit Integration and Bias Methods

Filament Supply Connections

Because the 10 uses a directly heated filament, the method of connecting the grid and plate return leads is critical to minimizing hum:

- **AC Filament Operation:** The grid and plate returns must connect to either a mid-tapped resistor (typically 20 to 40 Ohms) placed across the filament winding, or directly to a center tap on the filament transformer winding itself.
- **DC Filament Operation:** The grid and plate returns must connect directly to the negative terminal of the filament supply.

Grid Bias Methods

Grid bias can be obtained using one of two primary methods:

1. **Fixed Bias (C-Supply):** An external negative voltage source connected to the grid circuit.
2. **Self-Bias:** Obtained by placing a self-biasing resistor in the negative plate return lead. This method is generally not recommended or applicable for battery-operated receivers.

Qualitative Curve Observations

Average Plate Characteristics

The average plate characteristics of the 10 show plate current (ranging from 0 to 50 mA) plotted against plate voltage (ranging from 0 to 800 V or 900 V) for grid bias steps from +20 V down to -100 V. The curves exhibit standard triode behavior, characterized by a distinct triode knee at lower plate voltages and highly linear, evenly spaced curves in the active operating region.

A load line representing 10,200 Ohms is typically superimposed across these curves, passing directly through the primary Class A operating point of 425 V plate voltage and -39 V or -40 V grid bias.

Load Resistance and Distortion Characteristics

Under typical Class A operating conditions (with a plate voltage of 425 V, grid bias of -40 V, and an input signal of 25 V RMS), the relationship between load resistance, power output, and harmonic distortion reveals the following trends:

- **Power Output:** Peaks at approximately 1.6 W when the load resistance is optimized around 10,000 Ohms.
- **Plate Current:** Remains remarkably stable, holding nearly constant at approximately 18 mA across a wide range of load resistances from 0 to 20,000 Ohms.
- **Harmonic Distortion:** The second harmonic distortion is relatively high at lower load resistances, measuring approximately 15% at a 4,000 Ohm load, but decreases steadily to about 4% as the load resistance is increased to 20,000 Ohms. The third harmonic distortion remains extremely low, staying well under 2% across the entire load resistance range.

Technical Summary

The **10** is a classic directly heated power triode featuring a thoriated tungsten filament, designed for vertical mounting in a standard four-contact socket. With a filament rating of **7.5 V / 1.25 A** and a maximum plate voltage of **425 V**, it serves as a versatile power amplifier and oscillator.

In Class A service, a single tube delivers up to **1.6 W** of undistorted audio output into a 10,200 Ohm load, utilizing its relatively high amplification factor of **8.0**. In Class B push-pull service, a pair of 10 tubes can deliver up to **25 W** of output power, making it highly effective for driving loudspeakers in high-power audio stages. Proper circuit implementation requires careful attention to filament return connections to minimize hum, alongside appropriate selection of bias methods to match the power supply configuration.

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1932 Cunningham Radio Tubes

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

1932 CUNNINGHAM RADIO TUBES

Section 1 · Triode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Grid-plate capacitance	8 pF	Published direct interelectrode capacitance
Grid-filament capacitance	5 pF	Published direct interelectrode capacitance
Plate-filament capacitance	4 pF	Published direct interelectrode capacitance
Undistorted power output	1600 mW	Published operating characteristic
Load resistance	13000 ohm	Published operating characteristic

SOURCE OPERATING CONDITIONS

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1937 Raytheon Radio Receiving Tubes

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

1937 RAYTHEON RADIO RECEIVING TUBES

Section 1 · Triode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate voltage	250 V	ClassA
Grid bias	-23.5 V	ClassA; PlateVoltage=250V
Plate current	10 mA	ClassA; PlateVoltage=250V
Load resistance	13000 ohm	ClassA; PlateVoltage=250V
Power output	0.4 W	ClassA; PlateVoltage=250V
Plate voltage	350 V	ClassA
Grid bias	-32 V	ClassA; PlateVoltage=350V

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate current	16 mA	ClassA; PlateVoltage=350V
Power output	0.9 W	ClassA; PlateVoltage=350V
Plate voltage	425 V	ClassA
Grid bias	-40 V	ClassA; PlateVoltage=425V
Plate current	18 mA	ClassA; PlateVoltage=425V
Power output	1.6 W	ClassA; PlateVoltage=425V
Maximum plate current with signal	80 mA	ClassB; PerTube
Maximum plate input with signal	25 W	ClassB; PerTube
Load resistance	8000 ohm	ClassB; PushPull; TwoTubes; PlateVoltage=425V
Power output	25 W	ClassB; PushPull; TwoTubes; PlateVoltage=425V
Driving power	2.5 W	ClassB; PushPull; TwoTubes; PlateVoltage=425V

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Grid-to-plate capacitance	7 pF	—
Input capacitance	4 pF	—
Output capacitance	3 pF	—



SOURCE DATA APPENDIX

SOURCE OPERATING CONDITIONS

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193X Cunningham

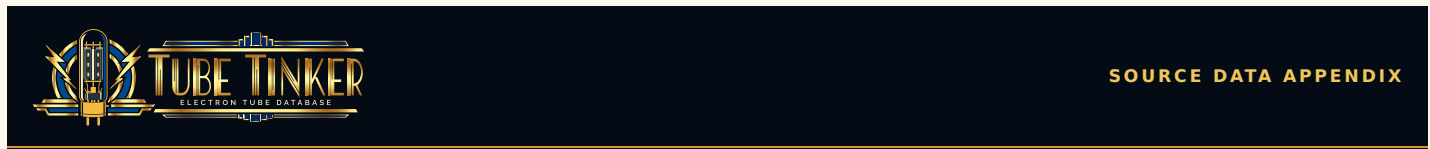
Published test conditions and operating points. Values on this page are preserved as reported by this source.

193X CUNNINGHAM

Section 1 · Triode

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Heater/filament voltage	7.5 V	Published nominal
Heater/filament current	1.25 A	Published nominal

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Transconductance	1600 μ S	Published characteristic
Amplification factor	8	Published characteristic
Plate resistance	5000 Ω m	Published characteristic



SOURCE OPERATING CONDITIONS

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1940 RCA

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

1940 RCA

Section 1 · Triode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Power Output	1.6 W	ClassA;OneTube



SOURCE OPERATING CONDITIONS

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195X General Electric Essential Characteristics

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

195X GENERAL ELECTRIC ESSENTIAL CHARACTERISTICS

Section 1 · Triode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum plate voltage	425 V	Published handbook rating
Plate voltage	425 V	ClassA
Control-grid bias	35 V	ClassA
Plate current	18 mA	ClassA

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate resistance	5000 ohm	Published handbook characteristic
Transconductance	1600 μ S	Published handbook characteristic
Amplification factor	8	Published handbook characteristic
Heater/filament voltage	7.5 V	Published heater/filament rating
Heater/filament current	1.25 A	Published heater/filament rating



SOURCE DATA APPENDIX

SOURCE OPERATING CONDITIONS

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1961 Tung Sol

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

1961 TUNG SOL

Section 1 · Triode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Voltage	250 V	ClassA

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Current	18 mA	ClassA