



ELECTRONIC TUBE REFERENCE

15

Voltage Radio Detector Converter electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION

CONSTRUCTION

PENTODE

Two-volt battery pentode for high-frequency amplification, detection, and converter service in portable radio receivers. Its low-power filament suits battery operation, while high plate resistance provides useful gain in RF, detector, or superheterodyne frequency-changing circuits.

GENERAL CHARACTERISTICS

BASE DESIGNATION	5F	BASE PINS	5
NOMINAL HEATER	2 V / 220 mA	PARALLEL HEATER	– / –
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1 Pentode	
PLATE RESISTANCE	800000 Ω
TRANSCONDUCTANCE	0.00075 S
AMPLIFICATION FACTOR	600
MAXIMUM PLATE VOLTAGE	135 V
MAXIMUM SCREEN VOLTAGE	67.5 V
<i>Promoted from clearly identified printed ratings/characteristics; additional published operating points and capacitances retained in TUBE_SECTION_PARAMETER.</i>	

15 — Sharp-Cutoff RF Pentode Vacuum Tube

The **15** is an indirectly heated, sharp-cutoff radio-frequency (RF) pentode vacuum tube designed primarily for use in battery-operated radio receivers. It features a unipotential cathode with a low-power heater, allowing for independent cathode biasing—a significant design advantage over directly heated filament

tubes of its era. The tube is housed in an ST-12 glass envelope and utilizes a small 5-pin base with a top-cap connection for the control grid.

Construction, Heater, and Base Configuration

The 15 is constructed with a unipotential (indirectly heated) coated cathode. This design allows the cathode to be electrically isolated from the heater, enabling independent biasing and minimizing the introduction of hum when operated under various circuit configurations.

Heater Ratings

The heater is designed for low power consumption, making it highly suitable for battery-operated equipment.

- **Heater Voltage (DC):** 2.0 V
- **Heater Current:** 0.22 A (220 mA)
- **Calculated Heater Power:** 0.44 W

Physical Dimensions and Bulb

- **Bulb Type:** ST-12 (also designated as ST-12C or ST 12-D)
- **Maximum Overall Length:** 4-17/32 inches (approx. 115 mm)
- **Minimum Overall Length:** 4-9/32 inches
- **Maximum Seated Height:** 3-25/32 inches
- **Maximum Diameter:** 1-9/16 inches
- **Top Cap:** Small metal cap for the control grid (G1)
- **Mounting Position:** Any (vertical or horizontal)

Base and Pin Connections

The tube uses a small 5-pin base (often referred to as a U.X. base or 5-F configuration). The control grid (G1) is connected to the top cap to maximize isolation from the other electrodes and minimize input capacitance. The suppressor grid (G3) is internally connected to the cathode (K).

Pin Number	Connection
1	Heater (H)
2	Plate / Anode (P)
3	Screen Grid (<u>G2</u>)
4	Cathode / Suppressor Grid (K / G3)
5	Heater (H)
Top Cap	Control Grid (G1)

Note: While some historical drawings contain a "7 prong" label in the outline diagram, the actual socket layout and all manufacturer specifications confirm a standard 5-pin base.

Electrical Characteristics and Class A Operating Points

The 15 is characterized by high plate resistance and high amplification factor, typical of sharp-cutoff RF pentodes. Manufacturers document two primary Class A operating points:

Parameter	Operating Point A	Operating Point B
Plate Voltage	67.5 V	135 V (Max)
Screen Voltage (Grid No. 2)	67.5 V	67.5 V (Max)
Control Grid Voltage (Grid No. 1)	-1.5 V	-1.5 V
Plate Current	1.85 mA	1.85 mA
Screen Current	0.3 mA	0.3 mA
Plate Resistance	0.63 MΩ	0.8 MΩ
Transconductance	710 μmhos	750 μmhos
Amplification Factor	450	600

Brimar documents a slightly different mutual conductance of **0.7 mA/V** (equivalent to 700 μmhos) at the 135 V operating point, while other manufacturers specify 750 μmhos.

Heater-to-Cathode Voltage Limits

Because the 15 utilizes an indirectly heated cathode, a potential difference can exist between the heater and the cathode. To prevent insulation breakdown and minimize noise injection, this voltage must be kept as low as possible.

- **Maximum Heater-Cathode Potential:** 22.5 V (some European specifications list a maximum of 22 V).

Interelectrode Capacitances

The physical separation of the control grid (via the top cap) and the plate, combined with internal shielding, results in extremely low grid-to-plate capacitance. This is essential for stable high-gain RF amplification without neutralisation.

- **Grid-to-Plate Capacitance (with shield-can):** 0.01 μF (max)
- **Input Capacitance (Grid to Cathode):** 2.35 μF
- **Output Capacitance (Plate to Cathode):** 7.80 μF

Applications and Circuit Design

The 15 is a versatile tube designed for several roles in receiver circuits:

1. **RF and IF Amplifier:** Its primary application is as a high-gain radio-frequency or intermediate-frequency amplifier. The sharp-cutoff characteristic ensures stable operation when bias is fixed.
2. **First Detector / Mixer-Oscillator:** In superheterodyne receivers, the 15 can function as the first detector, mixing the incoming RF signal with a local oscillator signal.
3. **Second Detector:** It can be configured as a second detector, where its pentode characteristics and automatic bias capability are highly advantageous.
4. **Automatic Bias Circuits:** Unlike directly heated battery tubes, the separate cathode connection of the 15 allows the use of a cathode resistor to provide automatic self-bias, simplifying power supply design.
5. **AC/DC Operation:** Although optimized for 2.0 V battery operation, the indirectly heated cathode permits operation from AC heater supplies, provided the heater-to-cathode voltage limits are strictly observed and low power consumption is a priority.

The application of the 15 is highly similar to that of the type **32** vacuum tube, sharing comparable circuit topologies and operating philosophies.

Analysis of Characteristic Curves

The published average plate characteristics for the 15 illustrate classic pentode behavior.

- **Plate Current vs. Plate Voltage:** At a fixed screen voltage of 67.5 V, the plate current rises sharply as plate voltage increases from 0 V to approximately 40 V. Beyond this knee, the curves become nearly horizontal, demonstrating very high plate resistance. For a control grid bias of -1.5 V, the plate current remains virtually constant at 1.85 mA from 60 V up to 400 V.
- **Control Grid Cutoff:** The transfer characteristics show that plate current and transconductance decrease smoothly as the control grid bias is made more negative. At a grid bias of -1.5 V, transconductance is approximately 750 μmhos . The plate current approaches zero (cutoff) at approximately -6.0 V to -8.0 V, confirming the sharp-cutoff nature of the grid design.
- **Screen Current:** The screen current remains low and stable at approximately 0.3 mA across the normal operating range, representing a small fraction of the total cathode current.

Technical Summary

The **15** is a **sharp-cutoff RF pentode** featuring a **2.0 V, 0.22 A indirectly heated cathode**, housed in an **ST-12 glass bulb** with a **small 5-pin base** and a **top cap** for the control grid. It is optimized for battery-operated receivers, offering an amplification factor of up to **600**, a transconductance of **750 μmhos** , and a high plate resistance of **0.8 M Ω** at its maximum rated plate voltage of **135 V**. Its separate cathode connection enables automatic bias configurations and flexible circuit designs, including RF amplification, first and second detection, and low-power AC/DC receiver applications.

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

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 · Pentode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate voltage	67.5 V	ClassA
Screen voltage	67.5 V	ClassA
Grid bias	-1.5 V	ClassA
Plate current	1.85 mA	ClassA
Screen current	0.3 mA	ClassA
Plate voltage	135 V	ClassA
Screen voltage	67.5 V	ClassA; PlateVoltage=135V
Grid bias	-1.5 V	ClassA; PlateVoltage=135V
Maximum heater-cathode voltage	22.5 V	—

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate resistance	0.8 MOhm	ClassA; PlateVoltage=135V
Transconductance	750 uS	ClassA; PlateVoltage=135V

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Grid-to-plate capacitance	—0.01 pF	WithShield; Maximum
Input capacitance	2.35 pF	—
Output capacitance	7.8 pF	—

1940 RCA

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

1940 RCA
Section 1 · Pentode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
of the	2 V	of the 2.0-volt type for use in bat-
Heater VorLtace (D. C.)...oovivieiin it	2 V	Heater VorLtace (D. C.)...oovivieiin it 2.0 Volts
HEATER CURRENT ...ivvtinneneneninnennranaannss	220 mA	HEATER CURRENT ...ivvtinneneneninnennranaannss 0.22 Ampere
PLATE VOLTAGE cinveennnn cenees	135 V	PLATE VOLTAGE cinveennnn cenees 67.5 135 max. Volts
ScREeN VOLTAGE (Grid No	67.5 V	ScREeN VOLTAGE (Grid No. 2)..... 67.5 67.5 max. Volts
GRD VOLTAGE (Grid No	-1.5 V	GRD VOLTAGE (Grid No. 1).....cvnvu... -1.5 -1.5 Volts
PLATE CURRENT coveievnnnnnnnnnnnnns	1.85	PLATE CURRENT coveievnnnnnnnnnnnnns 1.85 1.85 Milliamperes
SCREEN CURRENT ccivveivnrvnnnnnann	0.3	SCREEN CURRENT ccivveivnrvnnnnnann 0.3 0.3 Milliampere
possible. In no event should it exceed	22.5 V	possible. In no event should it exceed 22.5 volts.
SCREEN VOLTS =	67.5 V	SCREEN VOLTS =67.5
CONTROL ~GRID VOLTS E _g ,=	0 V	CONTROL ~GRID VOLTS E _g ,=0
PLATE VOLTS	4662 V	PLATE VOLTS 92C-4662

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
PLATE RESISTANCE c.ovivnnnnnnns	0.8	PLATE RESISTANCE c.ovivnnnnnnns 0.63 0.8 Megohm
AMPLIFICATION FACTOR	600	AMPLIFICATION FACTOR 450 600
TRANSCONDUCTANCE . e.vuvevneensanunnnn	750 μS	TRANSCONDUCTANCE . e.vuvevneensanunnnn 710 750 Micromhos



SOURCE OPERATING CONDITIONS

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1948 Brimar Radio Valve Manual

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

1948 BRIMAR RADIO VALVE MANUAL

Section 1 · Pentode

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Anode Voltage	135 V	—
Anode Current	1.85 mA	—
Screen Voltage	67.5 V	—
Screen Current	0.3 mA	—
Control Grid Voltage	-1.5 V	—

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum Heater-Cathode Voltage	22 V	—



SOURCE OPERATING CONDITIONS

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1950 Sylvania

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

1950 SYLVANIA

Section 1 · Pentode

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Resistance	630000 ohm	—
Transconductance	710 μ S	—
Amplification Factor	450	—

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Transconductance	750 μ S	135 V plate

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Voltage	67.5 V	Condition1
Plate Voltage	135 V	Condition2
Screen Voltage	67.5 V	—
Plate Current	1.85 mA	—


SOURCE DATA APPENDIX

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

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 · Pentode

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Input capacitance	2.35 pF	Section1
Output capacitance	7.8 pF	Section1
Grid-to-plate capacitance	0.01 pF	Section1

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate voltage	135 V	ClassA
Screen voltage	67.5 V	ClassA
Control-grid voltage	-1.5 V	ClassA
Plate current	1.85 mA	ClassA
Screen current	0.3 mA	ClassA

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate resistance	800000 Ω	ClassA
Transconductance	750 μS	ClassA



SOURCE DATA APPENDIX

SOURCE OPERATING CONDITIONS

SOURCE PDF

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 · Pentode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Voltage	135 V	ClassA

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Current	1.85 mA	ClassA