



ELECTRONIC TUBE REFERENCE

1630

Hexode electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION

CONSTRUCTION

HEXODE

Acorn orbital-beam hexode designed for UHF detector or RF-amplifier service, particularly experimental and radar receiving applications.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	5
NOMINAL HEATER	— / —	PARALLEL HEATER	— / —
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1 Hexode

No fixed ratings recorded.

Source-derived section; promoted fields populated where applicable.

1630 — U-H-F Orbital-Beam Hexode

The **1630** (also known by its developmental designation **A-5588** and military designation **VT-128**) is a specialized vacuum-tube orbital-beam amplifier designed for ultra-high-frequency (UHF) applications in the order of 500 MHz. Utilizing an acorn-type envelope and incorporating a secondary-electron multiplier stage, the 1630 is engineered for high transconductance and low lead inductance, making it highly suitable for detector or radio-frequency (r-f) amplifier service in UHF receivers, particularly in early radar systems.

Construction and Operating Principles

The 1630 features a compact acorn-type construction designed to minimize lead resistance and inductance. Its operation is based on the orbital-beam principle, which employs focused electron beams to

isolate the input and output electrodes.

To significantly augment the transconductance of the input electrodes, the tube incorporates a stage of secondary-emission multiplication via a dynode (secondary-electron emitter). The electron stream is focused into an orbital path, striking the dynode to release secondary electrons, which are then collected by the output anode (plate).

To minimize input loading caused by common cathode lead inductance at ultra-high frequencies, the 1630 is constructed with two separate cathode leads. This allows separate returns for the input and output circuits. Additionally, double leads are provided for several other electrodes to facilitate the reduction of lead inductance and resistance.

Physical Specifications and Installation

The 1630 is housed in a T-8 glass bulb with an acorn-style envelope.

Physical Parameter	Value
Bulb Style	T-8 (Acorn type)
Maximum Overall Length	2-1/2 inches
Maximum Diameter	2-5/32 inches
Base Configuration	Special 12-terminal base
Terminal Spacing	30° and 25° spacing between adjacent terminals (±2° tolerance)

Socketing and Mounting

The tube can be held by a special 12-contact socket, such as the RCA stock No. 9916. It may be mounted in a vertical position, or horizontally with terminals No. 2 and 8 positioned in a horizontal plane.

Installation Precautions

Due to the delicate nature of the acorn-type glass seal, connections must not be soldered directly to the terminal pins. The heat of soldering can weaken or crack the bulb seal, destroying the vacuum. For general installation guidelines, reference is made to the installation practices of the type [955](#) acorn tube.

Heater Ratings

The 1630 is equipped with a heater-cathode structure designed for either alternating or direct current operation.

- **Heater Voltage (A.C. or D.C.):** 6.3 V
- **Permissible Voltage Variation:** ±10% maximum under any operating condition
- **Heater Current:** 0.3 A

Pinout Configurations

Two distinct terminal connection layouts are recorded for the 12-terminal base (viewed from the bottom). Designers must verify the specific pinout configuration of the device in use.

Pinout Configuration A

- **Pin 1:** Grid No. 1 (G_1)
- **Pin 2:** Heater (H)
- **Pin 3:** Cathode (K)
- **Pin 4:** Focus (outer) [Focus 4]
- **Pin 5:** Focus (inner) [Focus 5]
- **Pin 6:** Dynode (Secondary-electron emitter)
- **Pin 7:** Anode Focus (inner)
- **Pin 8:** Plate / Anode (P)
- **Pin 10:** Grid No. 2 (G_2)
- **Pin 11:** Heater (H)
- **Pin 12:** Grid No. 1 (G_1)

Pinout Configuration B

- **Pins 1, 12:** Heater (H)
- **Pins 2, 8:** Cathode (K)
- **Pin 5:** Grid No. 1 (G_1)
- **Pin 11:** Grid No. 2 / Screen (G_2)
- **Pins 3, 9:** Inner Focusing Electrode (G_3)
- **Pins 4, 10:** Outer Focusing Electrode (G_4)
- **Pin 7:** Plate (P)
- **Pin 6:** Dynode (DY)

Electrical Characteristics and Typical Operating Points

The 1630 operates with high transconductance, achieved through its secondary-emission multiplier stage. Two typical operating points are documented, reflecting developmental and standard operating conditions:

Parameter	Operating Point 1	Operating Point 2
Plate (Output Anode) Voltage	370 V	375 V
Dynode (Secondary-Emitter) Voltage	240 V	250 V

Parameter	Operating Point 1	Operating Point 2
Outer Focusing-Electrode Voltage	0 V	0 V
Inner Focusing-Electrode Voltage	300 V	300 V
Grid No. 2 (Screen) Voltage	45 V	Supplied via 1 MΩ resistor from 375 V supply
Grid No. 1 (Control Grid) Voltage	-1 V	-1 V
Plate Current	12 mA	11.8 mA
Dynode Current	-9.5 mA (magnitude)	-9.4 mA
Outer Focusing Electrode Current	—	0 mA
Inner Focusing Electrode Current	—	0.6 mA
Screen Current	—	0.32 mA
Cathode Current	3.5 mA	3.5 mA
Grid No. 1-to-Plate Transconductance	15,000 μmhos	15,000 μmhos
Figure of Merit	3,100 μmhos/μpF	—

Interelectrode Capacitances

Direct interelectrode capacitances measured without an external shield are recorded in two variants:

Capacitance Set 1

- **Input Capacitance:** 6.5 μpF
- **Output Capacitance:** 3.5 μpF

Capacitance Set 2

- **Input (Grid No. 1 to all other electrodes except Plate):** 6 μpF
- **Output (Plate to all other electrodes except Grid No. 1):** 3.2 μpF
- **Grid No. 1 to Plate:** 0.0005 max. μpF

The extremely low grid-to-plate capacitance (0.0005 μpF maximum) highlights the excellent isolation between the input and output circuits provided by the orbital-beam design.

Absolute Maximum Ratings

The following absolute maximum limits must not be exceeded under any operating conditions:

- **Plate Voltage:** 375 max. V
- **Dynode Voltage:** 250 max. V
- **Outer Focusing Electrode Voltage:** ± 25 max. V
- **Inner Focusing Electrode Voltage:** 300 max. V
- **Screen (Grid No. 2) Voltage:** 100 max. V
- **Screen Supply Voltage:** 375 max. V
- **Inner Focusing Electrode Dissipation:** 0.75 max. W
- **Screen Dissipation:** 0.2 max. W

Dissipation Calculations

The maximum plate and dynode dissipations are calculated using specific voltage and current relationships:

- **Plate Dissipation (1.5 max. Watts):** Calculated as the plate current multiplied by the difference between the plate voltage and the dynode voltage: $P_D = I_b \times (E_b - E_{dynode})$
- **Dynode Dissipation (0.6 max. Watt):** Calculated as the dynode voltage multiplied by the sum of the plate current and the dynode current (noting that dynode current is inherently negative): $P_{dynode} = E_{dynode} \times (I_b + I_{dynode})$

Circuit-Specific Operating and Application Guidelines

UHF Tank Circuits

For operation at frequencies around 500 MHz, a practical tank circuit consists of two concentric cylindrical transmission lines placed on opposite sides of the tube socket. These lines are connected directly to the grid and plate terminals and are tuned using sliding short-circuiting bars.

By-passing and R-F Grounding

To ensure stable operation, every electrode terminal except the control grid and plate must be bypassed to an r-f ground using low-inductance condensers. At very high frequencies, these bypass condensers should be supplemented by r-f chokes placed as close as possible to the condenser terminals.

Biasing and Power Supplies

- **Screen Supply:** The screen (Grid No. 2) voltage is typically obtained from the high-voltage supply through a 1-megohm voltage-dropping resistor.
- **Other Electrodes:** Direct-current voltages for the remaining electrodes (excluding the screen) should be derived from a voltage divider connected across the high-voltage supply. The design of this voltage

divider must account for the inherently negative dynode current resulting from secondary-electron emission.

Qualitative Curve Observations

Average Plate Characteristics

The plate current of the 1630 is highly dependent on the dynode potential. Below the dynode voltage (approximately 240 V to 250 V), the plate current remains extremely low, near zero. As the plate voltage rises above the dynode potential, the plate current increases sharply (typically between 250 V and 350 V) and then levels off, exhibiting a flat, pentode-like saturation characteristic above 350 V.

Average Volume-Control Characteristics

When plate current is plotted against the Outer Focusing Electrode (G_4 or J_2) voltage, it forms a symmetrical, bell-shaped curve.

- In some operating conditions, this curve peaks at an outer focusing voltage of 0 V, with peak plate currents of approximately 28 mA (for a screen voltage of 100 V) and 14 mA (for a screen voltage of 50 V), dropping to near zero at ± 80 V.
- In other conditions, the curve peaks near +10 V to +20 V and drops off sharply toward both negative and positive potentials.

This characteristic allows effective gain (volume) control by varying the outer focusing electrode potential. This method of gain control does not alter the cathode current or affect the input capacitance and inductance, preserving circuit tuning and stability.

Transfer Characteristics

The transfer characteristic curves (plate current versus control-grid G_1 voltage) show a sharp rise from cutoff near -5 V up to 0 V. At a plate voltage of 360 V, an inner focusing voltage of 300 V, and a dynode voltage of 240 V, the plate current reaches approximately 48 mA when the screen voltage is 100 V, and approximately 24 mA when the screen voltage is 50 V.

Technical Summary

The **1630** is an acorn-type, indirectly heated orbital-beam hexode designed for UHF receiver applications up to 500 MHz. By combining focused electron beams with a secondary-emission dynode, the tube achieves an exceptionally high transconductance of **15,000 μmhos** and an extremely low grid-to-plate capacitance of **0.0005 μpF maximum**. Operating with a **6.3 V, 0.3 A** heater, the 1630 requires careful attention to its dual-cathode returns, negative dynode current, and delicate glass seals. It provides a unique, high-performance solution for UHF amplification and detection where minimizing lead inductance and input loading is critical.

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1940 RCA

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

1940 RCA

Section 1 · Hexode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
6.3-volt heater-cathode types, designed for	6.3 V	6.3-volt heater-cathode types, designed for
Heater voltage	6.3 V	Heater voltage 6.3 volts
Heater current	300 mA	Heater current 0.3 ampere
Plate (output anode) voltage	370 V	Plate (output anode) voltage 370 volts
Secondary-emitter voltage	240 V	Secondary-emitter voltage 240 volts
Outer focusing-electrode voltage	0 V	Outer focusing-electrode voltage 0 volts
Inner focusingrelectrode voltage	300 V	Inner focusingrelectrode voltage 300 volts
Grgd No	45 V	Grgd No. 2 voltage 45 volts
Gnd No	1 V	Gnd No. 1 voltage —1 volt
Plate current	12	Plate current 12 milliamperes
Secondary-emitter current	9.5	Secondary-emitter current 9.5 milhamperes
Cathode current	3.5	Cathode current 3.5 milhamperes
Figure of ment	3100 μS	Figure of ment 3100 micromhos per put
PLATE VOLTS =	360 V	PLATE VOLTS =360
FOCUSING ELECTRODE Nz1 (J;) VOLTS =	360 V	FOCUSING ELECTRODE Nz1 (J;) VOLTS =300 PLATE VOLTS =360
SECONDARY -ELECTRON EMITTER VOLTS =	300 V	SECONDARY -ELECTRON EMITTER VOLTS =240 FOCUSING ELECTRODE N2I (J)) VOLTS =300
_ CONTROL-GRID (GRID N2t} VOLTS = - — FOCUSING ELECTRODE N2	2 V	_ CONTROL-GRID (GRID N2t} VOLTS = - — FOCUSING ELECTRODE N22 {J5)VOLTS

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
)r\ SECONDARY ~ELECTRON EMITTER VOLTS =	240 V	)r\ SECONDARY ~ELECTRON EMITTER VOLTS = 240
FOCUSING ELECTRODE N2	2 V	FOCUSING ELECTRODE N22 (Ja) VOLTS /
GRID Ne2 VOLTS =	5 V	GRID Ne2 VOLTS =50 5=
FOCUSING ELECTRODE N2I(J)) VOLTS=	300 V	FOCUSING ELECTRODE N2I(J)) VOLTS=300 net) VOERTSD
FOCUSING ELECTRODE N2	2 V	FOCUSING ELECTRODE N22 (J2)VOLTS=0 A, o
SECONDARY-ELECTRON EMITTER VOLTS=	240 V	SECONDARY-ELECTRON EMITTER VOLTS=240
Source	1	Source. 1) EThe Orbital-Beam Secondary- Electron Multiplier for Ultra-High-Frequency Amplificationa

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Gnd N o	0 μS	Gnd N o. 1-plate transconductance 15, 000 micromhos
Input capacitance	6.5 pF	Input capacitance 6.5 uuf

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