

ELECTRONIC TUBE REFERENCE

12HL7

Voltage - Pentode Sharp Cutoff (single) electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION
CONSTRUCTION
PENTODE

Frame-grid sharp-cutoff pentode used as a video-output amplifier in color television receivers. Its high-transconductance wideband construction provides the signal drive required by television video-output stages.

GENERAL CHARACTERISTICS

BASE DESIGNATION	9BF	BASE PINS	9
NOMINAL HEATER	12.6 V / 300 mA	PARALLEL HEATER	6.3 V / 600 mA
HEATING	Indirect	SERIES OPERATION	Capable
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

9BF - TERMINAL PINOUT

TERMINAL	SECTION	ELEMENT	STATUS
PIN1 – K	A	K – Cathode	CONNECTED
PIN2 – G1	A	G1 – Control Grid	CONNECTED
PIN3 – G3	A	G3 – Suppressor Grid	CONNECTED
PIN4 – H	–	H – Heater	CONNECTED
PIN5 – H	–	H – Heater	CONNECTED
PIN6 – HCT	–	HCT – Heater Center Tap	CONNECTED
PIN7 – P	A	P – Plate (Anode)	CONNECTED
PIN8 – G2	A	G2 – Screen Grid	CONNECTED
PIN9 – G3	A	G3 – Suppressor Grid	CONNECTED

SECTION RATINGS

SECTION 1 Pentode

PLATE RESISTANCE	55000 Ω
TRANSCONDUCTANCE	0.021 S
MAXIMUM PLATE VOLTAGE	330 V
MAXIMUM PLATE DISSIPATION	10 W
MAXIMUM SCREEN DISSIPATION	1 W

Approved individual PDF contains only the entry heading/heater data and/or a reference to another type for ratings; no external electrical values were imported.

12HL7 — Sharp-Cutoff Frame-Grid Pentode

The **12HL7** is a miniature, sharp-cutoff pentode featuring frame-grid construction. It is designed primarily for use as a video output amplifier in color television receivers. The tube is housed in a T-6 1/2 glass envelope with a 9-pin miniature button base (E9-1) and utilizes the 9BF basing diagram.

Heater Characteristics and Configurations

The 12HL7 features a versatile heater design consisting of two sections that can be configured in series or parallel depending on the circuit requirements:

- **Series Heater Configuration:** When the two heater sections are connected in series, the nominal heater voltage is **12.6 V** (with a permissible range of 12.6 ± 1.2 V) and the heater current is **0.3 A** (300 mA). This configuration is typically used in parallel heater circuits.
- **Parallel Heater Configuration:** When the two heater sections are connected in parallel, the nominal heater voltage is **6.3 V** (with a permissible range of 6.3 ± 0.6 V) and the heater current is **0.6 A** (600 mA). This configuration can be operated in series with other heaters sharing the same bogey current (0.6 A) or in parallel with other heaters sharing the same bogey voltage.
- **Heater Warm-up Time:** For the 6.3 V connection, the average heater warm-up time is **11 seconds**. This warm-up time represents the time required for the voltage across the heater to reach 80 percent of its bogey value when 4 times the bogey heater voltage is applied to a circuit consisting of the tube heater in series with a resistance equal to 3 times the bogey heater voltage divided by the bogey heater current.
- **Heater-Cathode Voltage Ratings:**
 - Heater negative with respect to cathode: Maximum total DC and peak voltage of **200 V**.
 - Heater positive with respect to cathode: Maximum DC component of **100 V**, and maximum total DC and peak voltage of **200 V**.

Physical and Mechanical Specifications

The 12HL7 is designed for flexible physical installation and has the following mechanical characteristics:

- **Operating Position:** Any

- **Envelope:** T-6 1/2 glass
- **Base:** E9-1 small button 9-pin
- **Basing Diagram:** EIA 9BF
- **Outline Drawing:** EIA 6-3
- **Physical Dimensions:**
 - Maximum Diameter: 0.875 inches
 - Minimum Diameter: 0.750 inches
 - Maximum Seated Height: 2.375 inches
 - Maximum Overall Length: 2.625 inches

Terminal Connections (9BF Pinout)

The 9-pin miniature base provides the following connections:

Pin	Connection
1	Cathode
2	Grid Number 1 (Control Grid)
3	Grid Number 3 (Suppressor Grid) and Internal Shield
4	Heater
5	Heater
6	Heater Center Tap
7	Plate
8	Grid Number 2 (Screen Grid)
9	Grid Number 3 (Suppressor Grid) and Internal Shield

Electrical Characteristics and Typical Operation

The 12HL7 is characterized by very high transconductance, made possible by its frame-grid construction.

Typical Class A Operating Point

Under typical operating conditions, the pentode exhibits the following characteristics:

- **Plate Voltage:** 250 V
- **Grid No. 2 (Screen) Supply Voltage:** 150 V
- **Grid No. 1 (Control Grid) Voltage:** 0 V
- **Grid No. 3 (Suppressor Grid) Voltage:** 0 V (referred to the negative end of the cathode resistor)

- **Cathode Bias Resistor (Bypassed):** 122 Ω
- **Plate Current:** 25 mA
- **Grid No. 2 Current:** 6.0 mA
- **Transconductance (Grid No. 1 to Plate):** 21,000 μmhos
- **Plate Resistance (Approximate):** 55,000 Ω
- **Grid No. 1 Voltage for Plate Current of 100 μA (approximate, with $R_k = 0$):** -7.2 V

Instantaneous Plate Knee Characteristics

Under short-interval conditions (to prevent damage to the tube), the 12HL7 exhibits the following knee characteristics:

- **Plate Voltage (E_b):** 50 V
- **Grid No. 2 Voltage (E_{c2}):** 125 V
- **Grid No. 1 Voltage (E_{c1}):** 0 V
- **Grid No. 3 Voltage (E_{c3}):** 0 V
- **Plate Current (I_b):** 76 mA
- **Grid No. 2 Current (I_{c2}):** 32 mA

Maximum Ratings and Circuit Values

The 12HL7 is rated under the Design-Maximum Rating System. Operating conditions must not exceed these limits under the worst probable conditions:

- **Maximum Plate Voltage:** 400 V
- **Maximum Grid No. 2 (Screen) Supply Voltage:** 330 V
- **Maximum Grid No. 2 Voltage:** See Screen Rating Chart (permissible screen dissipation is 1.0 W up to 165 V, and decreases linearly to 0 W at 330 V)
- **Maximum Positive DC Grid No. 1 Voltage:** 0 V
- **Maximum Plate Dissipation:** 10.0 W
- **Maximum Grid No. 2 Dissipation:** 1.0 W
- **Maximum Grid No. 1 Circuit Resistance:**
 - With Fixed Bias: 0.1 M Ω
 - With Cathode Bias: 0.25 M Ω

Testing Precaution

Due to the extremely close spacing between the control grid and the cathode (typical of frame-grid construction), the voltage between these elements must be restricted to a maximum of 50 V DC or peak AC in commercial tube checkers or shorts-indicating devices. This is especially critical when mechanical excitation (tapping) of the tube is employed.

Direct Interelectrode Capacitances

The capacitances of the 12HL7 are measured without an external shield:

- **Grid No. 1 to Plate (g1 to p):** 0.15 pF (maximum)
- **Input (g1 to k + g3 + IS + g2 + h):** 15.0 pF
- **Output (p to k + g3 + IS + g2 + h):** 6.0 pF

Characteristic Curves and Interpretation

The published curves for the 12HL7 include average plate characteristics and transfer characteristics.

Average Plate Characteristics

- **At a fixed screen voltage (E_{c2}) of 150 V and suppressor voltage (E_{c3}) of 0 V:** The plate current (I_b) rises sharply at low plate voltages (below 50 V) and flattens out, demonstrating typical pentode behavior. For a control grid voltage (E_{c1}) of 0 V, the plate current exceeds 100 mA at plate voltages above 100 V, while at E_{c1} of -5.5 V, the plate current is reduced to near zero.
- **At a fixed control grid voltage (E_{c1}) of 0 V and suppressor voltage (E_{c3}) of 0 V:** Curves for various screen voltages (E_{c2} from 50 V to 175 V) show that higher screen voltages significantly shift the plate current curves upward. For example, at $E_{c2} = 175$ V, the plate current plateaus near 150 mA.

Average Transfer Characteristics

- **At a plate voltage (E_b) of 250 V and suppressor voltage (E_{c3}) of 0 V:** Transfer curves show plate current and screen current as a function of grid-number 1 voltage (from 0 V down to -10 V) for screen voltages (E_{c2}) ranging from 50 V to 175 V.
- **Plate Current Transfer:** The plate current transfer curves show a sharp cutoff characteristic, with current approaching zero near -7.2 V for typical operating screen voltages. At $E_{c2} = 150$ V, the plate current rises from near zero at -6 V to 25 mA at 0 V.
- **Screen Current Transfer:** The screen current transfer curves follow a similar profile but at a lower magnitude, rising to about 6 mA at 0 V grid bias under typical operating conditions.

Technical Summary

The **12HL7** is a high-performance, frame-grid, sharp-cutoff pentode designed for video output amplifier service in color television receivers. Housed in a 9-pin miniature T-6 1/2 envelope, it features a flexible heater that can be operated at 12.6 V / 0.3 A (series) or 6.3 V / 0.6 A (parallel). With an exceptionally high transconductance of 21,000 μ mhos and a plate dissipation rating of 10.0 W, it provides robust amplification capabilities. Designers must observe the strict 50 V limit between the control grid and cathode during testing due to the extremely close frame-grid spacing, and adhere to the screen dissipation limits outlined in the screen rating chart.



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

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

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Section 1 · Pentode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Typical Plate Voltage	250 V	—
Typical Screen Voltage	150 V	—

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