



ELECTRONIC TUBE REFERENCE

12F31

Voltage Pentode - Sharp Cutoff (single) electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION
CONSTRUCTION
PENTODE

150 mA series-heater RF and IF pentode designed for high-frequency amplifier service. Manufacturer documentation provides nominal, operating, and maximum data for receiver signal stages using series heater strings.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	—
NOMINAL HEATER	12.6 V / 150 mA	PARALLEL HEATER	— / —
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1 Pentode	
TRANSCONDUCTANCE	0.0044 S
MAXIMUM PLATE VOLTAGE	250 V
MAXIMUM SCREEN VOLTAGE	100 V
MAXIMUM PLATE DISSIPATION	3 W
MAXIMUM SCREEN DISSIPATION	0.6 W
<i>Published ratings and characteristics promoted from the approved TESLA source.</i>	

12F31 — Variable-Mu RF and IF Pentode

The **12F31** is an indirectly heated, variable-mu pentode designed primarily for radio frequency (RF) and intermediate frequency (IF) amplification. Featuring a compact Size M3 construction, this tube is optimized for high-frequency receiver stages where automatic gain control (AGC) or manual gain control is implemented via grid bias variation.

Construction, Heater, and Pinout

The 12F31 is constructed with an indirectly heated, coated cathode. The heater is designed for series or parallel operation in equipment utilizing a nominal 12.6 V supply.

Heater Parameter	Value
Heater Voltage (U_f)	12.6 V
Heater Current (I_f)	150 mA
Calculated Heater Power	1.89 W
Heating Method	Indirect

The calculated heater power is derived from the nominal inputs: 12.6 V multiplied by 0.150 A equals 1.89 W.

The tube features a 7-pin miniature base configuration (Size M3). The physical pin connections, viewed from the bottom of the tube base, are assigned as follows:

Pin Number	Electrode Connection
1	Control Grid (g_1)
2	Cathode (k)
3	Heater (f)
4	Heater (f)
5	Anode / Plate (a)
6	Suppressor Grid (g_3)
7	Screen Grid (g_2)

Static Operating Characteristics

Under static conditions, the 12F31 exhibits characteristics typical of a high-performance variable- μ pentode. The variable- μ (remote cutoff) design is characterized by a control grid structure with variable pitch, allowing the transconductance to be smoothly controlled over a wide range of negative grid voltages.

When operated at a nominal anode voltage of 250 V and screen grid voltage of 100 V, with a cathode bias resistor of 68 ohms, the static parameters are:

- Anode Voltage (U_a): 250 V
- Suppressor Grid Voltage (U_{g3}): 0 V

- Screen Grid Voltage ($U_{[g2]}/(tubes/G2)$): 100 V
- Cathode Bias Resistor (R_k): 68 ohms
- Anode Current (I_a): 11 mA
- Screen Grid Current ($I_{[g2]}/(tubes/G2)$): 4.2 mA
- Internal Plate Resistance (R_i): 1.5 megohms
- Transconductance (S): 4.4 mA/V

The remote cutoff characteristic is demonstrated by the plate current behavior at high negative grid bias. When the control grid voltage (U_{g1}) is biased to -20 V, the anode current (I_{az}) is reduced to less than 0.4 mA, demonstrating the tube's ability to handle strong signals without severe cross-modulation when AGC voltage is applied.

RF and IF Amplifier Operational Data

The 12F31 is specified for operation at two distinct anode voltage levels in RF and IF amplifier service. In both operating points, the suppressor grid is tied to 0 V (typically connected directly to the cathode), and the screen grid is maintained at 100 V.

Parameter	Operating Point A	Operating Point B
Anode Voltage (U_a)	100 V	250 V
Suppressor Grid Voltage (U_{g3})	0 V	0 V
Screen Grid Voltage ($U_{[g2]}/(tubes/G2)$)	100 V	100 V
Cathode Bias Resistor (R_k)	68 ohms	68 ohms
Anode Current (I_a)	10.8 mA	11 mA
Screen Grid Current ($I_{[g2]}/(tubes/G2)$)	4.4 mA	4.2 mA
Transconductance (S)	4.3 mA/V	4.4 mA/V
Internal Plate Resistance (R_i)	0.25 megohms	1.5 megohms

At a lower anode voltage of 100 V (Operating Point A), the internal plate resistance is 0.25 megohms, while the transconductance remains high at 4.3 mA/V. At the higher anode voltage of 250 V (Operating Point B), the internal plate resistance increases to 1.5 megohms, which minimizes loading on the subsequent tuned IF or RF transformer stages, thereby preserving the selectivity and Q-factor of the resonant circuits.

Maximum Ratings

To ensure reliable operation and prevent premature degradation of the tube, the following maximum ratings must not be exceeded. These ratings represent the absolute limits of safe operation:

Parameter	Symbol	Maximum Rating
Cold Anode Voltage (at start-up)	U_{a0}	500 V
Anode Voltage	U_a	300 V
Anode Dissipation	W_a	3 W
Cold Screen Grid Voltage (at start-up)	U_{g20}	300 V
Screen Grid Voltage	$U_{[g2]}(/tubes/G2)$	125 V
Screen Grid Dissipation	$W_{[g2]}(/tubes/G2)$	0.6 W
Control Grid Voltage (positive limit)	U_{g1}	0 V
Control Grid Voltage (negative limit)	$-U_{g1}$	-50 V
Control Grid Circuit Resistance	R_{g1}	3 megohms
Heater-to-Cathode Voltage	$U_{k/f}$	150 V
Bulb Temperature	T_b	150 °C

The maximum anode dissipation of 3 W and screen grid dissipation of 0.6 W must be strictly observed under all operating conditions. The maximum heater-to-cathode voltage of 150 V allows for flexible circuit configurations, such as series heater strings or elevated cathode topologies, provided the potential difference does not exceed this limit.

Interelectrode Capacitances

For high-frequency RF and IF applications, the internal capacitances of the tube are critical design parameters. The 12F31 is designed with extremely low feedback capacitance to ensure stable amplification and prevent parasitic oscillations:

- Input Capacitance (C_{g1}): 5.5 pF
- Output Capacitance (C_a): 5 pF
- Grid-to-Plate Capacitance ($C_{a/g1}$): < 0.005 pF

The exceptionally low grid-to-plate feedback capacitance ($C_{a/g1} < 0.005$ pF) is achieved through internal shielding. This minimizes the Miller effect and allows the tube to provide high stable gain in tuned

amplifier stages without requiring neutralization circuits.

Technical Summary

The **12F31** is a high-performance, variable-mu RF and IF pentode housed in a compact Size M3 7-pin miniature envelope. Operating with a 12.6 V, 150 mA heater, it is well-suited for mobile, automotive, or series-string receiver designs. With a transconductance of 4.4 mA/V and an internal plate resistance of up to 1.5 megohms at typical operating points, the tube provides excellent gain and selectivity. Its remote-cutoff characteristic allows for effective automatic gain control, while its extremely low grid-to-plate capacitance (< 0.005 pF) ensures stable, oscillation-free operation in high-frequency circuits.

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1969 Tesla Manual of Electronic Tubes

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

1969 TESLA MANUAL OF ELECTRONIC TUBES

Section 1 · Pentode

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Heater voltage	12.6 V	Published nominal value
Heater current	150 mA	Published nominal value
Transconductance	4400 μ S	Published operating characteristic
Transconductance	4400 μ S	Published nominal characteristic

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum plate dissipation	3 W	Published maximum rating