



ELECTRONIC TUBE REFERENCE

12AX7MG

Voltage - Dual Triode (similar) electronic tube

CONSOLIDATED TECHNICAL DATA

2 SECTIONS

CONSTRUCTION

TRIODE-TRIODE

High-mu audio-frequency double triode in MG construction, also designated ECC83MG, providing the classic approximately 100 amplification factor of the 12AX7/ECC83 family.

GENERAL CHARACTERISTICS

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

SECTION RATINGS

SECTION1 Triode	
PLATE RESISTANCE	62500 Ω
TRANSCONDUCTANCE	0.0016 S
AMPLIFICATION FACTOR	100
MAXIMUM PLATE VOLTAGE	300 V
MAXIMUM PLATE DISSIPATION	1 W
MAXIMUM CATHODE CURRENT	8 mA

Representative section for two electrically identical sections.

SECTION2 Triode	
PLATE RESISTANCE	62500 Ω
TRANSCONDUCTANCE	0.0016 S
AMPLIFICATION FACTOR	100
MAXIMUM PLATE VOLTAGE	300 V
MAXIMUM PLATE DISSIPATION	1 W
MAXIMUM CATHODE CURRENT	8 mA
Second physical triode section; electrically identical twin section.	

12AX7MG — Audio Frequency Double Triode Vacuum Tube

The **12AX7MG** (also designated as the **ECC83MG**) is a high-mu, miniature double triode vacuum tube designed specifically for audio frequency (A.F.) applications. Featuring two independent triode systems within a single glass envelope, the device is optimized for voltage amplification where high gain and low noise are required. The tube utilizes a standard nine-pin Noval base and is characterized by an amplification factor of 100.

Physical Dimensions and Base Configuration

The 12AX7MG is housed in a small glass envelope with a standard **Noval (9-pin)** base. The physical dimensions of the tube are specified as follows:

- **Maximum overall length:** 56.3 mm
- **Maximum bulb height (excluding pins):** 49.2 mm
- **Maximum diameter:** 22.0 mm

The base diagram provides independent connections for each of the two triode systems, with a shared heater that features a center-tap connection. The pin assignments, viewed from the bottom of the tube, are:

Pin	Symbol	Electrode Connection
1	a'	Plate (Anode), System II
2	g'	Control Grid, System II
3	k'	Cathode, System II
4	f	Heater
5	f	Heater

Pin	Symbol	Electrode Connection
6	a	Plate (Anode), System I
7	g	Control Grid, System I
8	k	Cathode, System I
9	f	Heater Center Tap

The heater configuration allows for dual-voltage operation. By utilizing the center tap (Pin 9), the heater filaments can be wired in series or parallel to accommodate different supply voltages.

Heater Ratings and Power Consumption

The heater of the 12AX7MG is designed for flexible operation from either a 6.3 V or 12.6 V power source, using AC or DC:

- **Series Connection (12.6 V):** When the heater voltage (U_f) is applied across Pin 4 and Pin 5, the nominal heater current (I_f) is **150 mA**.
- **Parallel Connection (6.3 V):** When the heater voltage (U_f) is applied between Pin 9 (center tap) and Pins 4 and 5 connected together, the nominal heater current (I_f) is **300 mA**.

Under either connection scheme, the calculated nominal heater power consumption is:

- For 12.6 V: $12.6\text{ V} \times 0.150\text{ A} = 1.89\text{ W}$
- For 6.3 V: $6.3\text{ V} \times 0.300\text{ A} = 1.89\text{ W}$

Typical Operating Characteristics

At the standard Class A operating point, each triode section of the 12AX7MG exhibits the following typical electrical characteristics:

Parameter	Symbol	Value
Plate Voltage	U_a	250 V
Grid Voltage	U_g	-2 V
Plate Current	I_a	1.2 mA
Transconductance	S	1.6 mA/V
Internal Plate Resistance	R_i	62.5 kΩ
Amplification Factor	μ	100

The fundamental triode relationship is verified by multiplying the transconductance by the internal plate resistance: $\mu = S \times R_i = 0.0016 \text{ A/V} \times 62,500 \text{ } \Omega = 100$ This high amplification factor makes the

12AX7MG highly suitable for preamplifier stages, tone control circuits, and other high-gain voltage amplifier applications.

Interelectrode Capacitances

The internal capacitances of the two triode systems are identical and are measured without external shielding. These values are critical for determining the high-frequency response and input impedance of the amplifier stage:

Capacitance Parameter	Symbol	System I	System II
Grid-to-Cathode Capacitance	$c_{g/k}$	1.6 pF	1.6 pF
Plate Capacitance	c_a	0.4 pF	0.4 pF
Grid-to-Plate Capacitance	$c_{g/a}$	1.7 pF	1.7 pF

Due to the high amplification factor ($\mu = 100$), the effective input capacitance of an operating stage will be significantly increased by the Miller effect, which is primarily determined by the grid-to-plate capacitance ($c_{g/a}$) and the actual voltage gain of the circuit.

Limiting Values (Absolute Maximum Ratings)

To ensure reliable operation and prevent premature failure of the tube, the operating conditions must be kept within the following maximum limiting values:

- **Maximum Plate Voltage (U_a):** 300 V
- **Maximum Negative Grid Voltage (U_g):** -50 V
- **Maximum Grid Resistor (R_g):** 2.2 M Ω
- **Maximum Plate Dissipation per Section (W_a):** 1 W
- **Maximum Cathode Current (I_k):** 8 mA
- **Maximum Heater-to-Cathode Voltage ($U_{k/f}$):** 180 V
- **Maximum Heater-to-Cathode Resistance ($R_{k/f}$):** 150 k Ω

These limits represent the maximum stress levels that the tube can withstand. Operating the tube at or near multiple limits simultaneously is not recommended.

Analysis of Characteristic Curves

The electrical behavior of the 12AX7MG is further illustrated by its transfer and plate characteristic curves, which describe the relationship between electrode voltages and plate current.

Transfer Characteristics (I_a vs. U_g)

The transfer curves plot plate current (I_a) as a function of grid bias voltage (U_g) for several constant plate voltages ($U_a = 100\text{ V}$, 150 V , 200 V , and 250 V):

- At a plate voltage of 250 V , the typical operating point of $I_a = 1.2\text{ mA}$ is reached at $U_g = -2\text{ V}$. The plate current approaches cutoff (zero current) as the grid bias is made more negative, reaching near-zero at approximately -3.5 V to -4 V .
- At lower plate voltages, the cutoff point shifts to less negative grid voltages. For example, at $U_a = 100\text{ V}$, the plate current is approximately 2.1 mA at $U_g = 0\text{ V}$ and drops to zero near $U_g = -1.5\text{ V}$.
- The slope of these curves represents the transconductance (S). The curves show that transconductance is highest at lower negative grid bias values (where the curves are steepest) and decreases as the grid bias approaches cutoff.

Plate Characteristics (I_a vs. U_a)

The plate curves plot plate current (I_a) against plate voltage (U_a) for discrete grid bias steps from 0 V to -4 V in 0.5 V increments:

- At $U_g = 0\text{ V}$, the plate current rises rapidly with plate voltage, reaching 5 mA at approximately 225 V .
- As the grid bias is made more negative, the curves shift to the right, requiring higher plate voltages to achieve the same plate current. For instance, at $U_g = -2\text{ V}$, a plate voltage of 250 V is required to obtain the typical plate current of 1.2 mA .
- The reciprocal of the slope of these curves represents the internal plate resistance (R_i). The relatively flat slope of the curves at lower plate currents indicates a higher plate resistance, which is typical of high- μ triodes.

Technical Summary

The **12AX7MG** ([ECC83MG](#)) is a high-performance, high- μ double triode designed for audio frequency voltage amplification. It features a Noval 9-pin base, a dual-voltage heater ($6.3\text{ V} / 12.6\text{ V}$) consuming 1.89 W , and two identical, independent triode sections. Each section provides an amplification factor of 100, a transconductance of 1.6 mA/V , and a plate resistance of $62.5\text{ k}\Omega$ at a typical operating point of 250 V plate voltage and -2 V grid bias. With a maximum plate voltage rating of 300 V and a maximum plate dissipation of 1 W per section, the 12AX7MG is well-suited for high-gain preamplifier stages and other precision audio applications.

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 · Triode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Rg	2.2 MΩ	Published value

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Ua	250 V	Published value
Ug	-2 V	Published value
Ia	1.2 mA	Published value
S	1600 μS	Published value
Ri	62.5 kΩ	Published value
μ	100	Published value

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
cg/k	1.6	Published value
ca	0.4	Published value
cg/a	1.7	Published value