



ELECTRONIC TUBE REFERENCE

12EG6

Heptode electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION

CONSTRUCTION

HEPTODE

Dual-control heptode for gated amplification and specialized signal processing, with separate control grids allowing one signal to modulate or gate another.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	7
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 0 Heptode	
PLATE RESISTANCE	150000 Ω
TRANSCONDUCTANCE	0.0008 S
MAXIMUM PLATE VOLTAGE	330 V
MAXIMUM SCREEN VOLTAGE	330 V
MAXIMUM PLATE DISSIPATION	2 W
MAXIMUM CATHODE CURRENT	20 mA

CRT operating ratings and direct interelectrode capacitances are published in the approved datasheet.

12EG6 — Dual-Control Heptode and Cathode-Ray Tube

The designation **12EG6** refers to two entirely distinct electronic devices: a miniature dual-control heptode (or pentagrid amplifier) designed for low-voltage mobile radio applications, and a large electrostatic-focus, electrostatic-deflection cathode-ray oscilloscope tube.

Part I: The 12EG6 Dual-Control Heptode

Overview and Applications

The heptode variant of the 12EG6 is a miniature, 7-pin receiving tube designed primarily for radio-frequency (RF) amplifier service in "hybrid" automobile receivers. In these receivers, the tube's heater, plate, and screen grid potentials are obtained directly from a nominal 12-volt automotive battery.

The dual-control design features two independent control grids (Grid No. 1 and Grid No. 3). This configuration allows automatic volume control (AVC) voltage to be applied to both grids simultaneously, which significantly reduces back-biasing of the AVC line when the receiver encounters large RF signals.

Construction and Mechanical Specifications

The heptode is housed in a T-5 1/2 glass envelope with a small-button miniature 7-pin base (JETEC No. E7-1, basing diagram EIA 7CH). It utilizes a coated unipotential cathode and is rated for operation in any mounting position.

- **Maximum Overall Height:** 2 1/8 inches
- **Maximum Diameter:** 3/4 inch

Pin Connections

Viewed from the bottom of the base, the 7-pin layout (7CH) is connected as follows:

- **Pin 1:** Grid No. 1 (Oscillator Grid / Control Grid)
- **Pin 2:** Cathode and Grid No. 5 (Internal Shield)
- **Pin 3:** Heater
- **Pin 4:** Heater
- **Pin 5:** Plate
- **Pin 6:** Grid No. 2 & Grid No. 4 (Screen Grids)
- **Pin 7:** Grid No. 3 (Mixer Grid / Control Grid)

Heater Ratings

- **Nominal Heater Voltage:** 12.6 V (AC or DC)
- **Heater Current:** 0.15 A
- **Automotive Service Range:** Designed to operate over a voltage range of 10.0 V to 15.9 V to accommodate the voltage fluctuations of automotive electrical systems. For maximum service life, the recommended operating range is 11 V to 14 V.

Maximum Ratings (Design-Center System)

- **Plate Voltage:** 16 V to 30 V maximum
- **Grids No. 2 & No. 4 (Screen) Voltage:** 16 V to 30 V maximum

- **Grids No. 2 & No. 4 Supply Voltage:** 16 V to 30 V maximum
- **Grid No. 3 Voltage (Negative DC):** 16 V to 30 V maximum
- **Grid No. 3 Voltage (Positive DC):** 0 V maximum
- **DC Cathode Current:** 20 mA maximum
- **Peak Heater-Cathode Voltage:** 16 V to 30 V (with heater either positive or negative with respect to the cathode)
- **Grid No. 3 Circuit Resistance:** 10 Megohms maximum

Typical Characteristics and Operating Conditions

When operated as a Class A1 heptode-connected amplifier, the typical operating parameters are:

- **Heater Voltage:** 12.6 V
- **Plate Voltage:** 12.6 V
- **Grids No. 2 & No. 4 Voltage:** 12.6 V
- **Grid No. 1 Voltage:** -0.6 V to -0.8 V (average bias developed across a 2.2 Megohm grid resistor)
- **Grid No. 3 Voltage:** -0.8 V (provided by Grid No. 1 voltage through a suitable grid resistor, or with Grid No. 3 connected to Grid No. 1 through a 100,000-ohm resistor)
- **Plate Current:** 0.4 mA to 0.55 mA (400 μ A to 550 μ A)
- **Screen Current (Grids No. 2 & No. 4):** 2.4 mA to 2.8 mA (2400 μ A to 2800 μ A)
- **Transconductance (Grid No. 3 to Plate):** 800 μ mhos
- **Plate Resistance (Approximate):** 0.15 Megohms
- **Cut-off Characteristics:** A negative bias of approximately -3.0 V on Grid No. 1 and Grid No. 3 reduces the Grid No. 3-to-plate transconductance to a range of 10 to 20 μ mhos.

Direct Interelectrode Capacitances

Measured with an external shield (EIA/JETEC No. 315 or 316) connected to Pin 2 (Cathode):

- **Grid No. 3 to Plate (g3 to p):** 0.25 pF maximum
- **Grid No. 3 to Grid No. 1 (g3 to g1):** 0.15 pF maximum
- **Grid No. 1 to Plate (g1 to p):** 0.04 pF maximum
- **Grid No. 3 Input (g3 to all except p):** 6.5 pF
- **Grid No. 1 Input (g1 to all except p):** 5.7 pF
- **Output (p to all except grids):** 12 pF
- **Grid No. 1 to Cathode (g1 to k+g5):** 3.2 pF
- **Cathode to All Except Grid No. 1:** 23 pF

Part II: The 12EG6 Cathode-Ray Tube

Overview and Applications

The oscilloscope variant of the 12EG6 is a cathode-ray tube (CRT) designed for visual display applications in oscilloscopes. It utilizes electrostatic focusing and electrostatic deflection to control the electron beam.

Physical and Mechanical Characteristics

- **Envelope/Bulb:** Glass bulb with a nominal 12-inch diameter (307 mm minimum, 312 mm maximum)
- **Neck Diameter:** 70 mm
- **Overall Length:** 635 ± 5 mm
- **Minimum Useful Screen Diameter:** 280 mm
- **Mounting Position:** Any
- **Base:** B12D

Screen Properties

- **Fluorescence:** Green
- **Persistence of Afterglow:** Short (10 ms minimum to 100 ms maximum for decay to 1% of initial brightness)

Pin Connections

The B12D base pinout is configured as follows:

- **Pin 1:** Modulator
- **Pin 2:** Cathode
- **Pin 3:** Heater
- **Pin 4:** Heater
- **Pin 5:** Anode 1
- **Pin 6:** Anode 2
- **Pin 7:** Internal Conductive Coating
- **Pin 8:** Y2 Deflector Plate
- **Pin 9:** X2 Deflector Plate
- **Pin 10:** Anode 3
- **Pin 11:** X1 Deflector Plate
- **Pin 12:** Y1 Deflector Plate

Heater Ratings

- **Heater Voltage:** 4.0 V (AC or DC)
- **Heater Current:** 1.0 A

Maximum Ratings

- **Anode 3 Voltage (Maximum):** 5500 V

Typical Operating Conditions

The tube can be operated under different voltage configurations to optimize deflection sensitivity and brightness:

Parameter	Condition A	Condition B
Anode 1 Voltage	1000 V	1000 V
Anode 2 Voltage	550 V	900 V
Anode 3 Voltage	3000 V	5000 V
Modulator Voltage (for cut-off)	-60 V to -110 V	-60 V to -110 V
Deflection Sensitivity (X Plate)	0.4 mm/V	0.24 mm/V
Deflection Sensitivity (Y Plate)	0.4 mm/V	0.24 mm/V

Alignment and Deflection Characteristics

- **Trace Alignment:** The angle between the X1-X2 trace and the Y1-Y2 trace is $90^\circ \pm 3^\circ$.
- **Spot Centering:** The undeflected, focused spot falls within a 15 mm radius circle concentric with the center of the tube face.
- **Deflection Polarity:** When viewed from the screen with the base spigot uppermost, a positive voltage applied to the X1 plate deflects the spot to the left, while a positive voltage applied to the Y1 plate deflects the spot upwards.

Direct Interelectrode Capacitances

- **Modulator to all other electrodes:** 15 pF
- **Each X Plate to all other electrodes:** 15 pF
- **Each Y Plate to all other electrodes:** 15 pF
- **One X to one Y Deflector Plate:** 4.0 pF
- **Cathode to all other electrodes:** 15 pF

Technical Summary

The **12EG6** designation represents two distinct classes of vacuum devices:

1. A **miniature heptode** (dual-control pentagrid amplifier) featuring a 12.6 V, 0.15 A heater, designed for low-voltage (12 V battery) automotive RF receiver applications. It provides a transconductance of 800 μmhos and a plate resistance of 0.15 $\text{M}\Omega$ under typical operating conditions.
2. A **12-inch electrostatic oscilloscope tube** featuring a 4.0 V, 1.0 A heater, green fluorescence with short afterglow, and high-voltage operation up to 5500 V on Anode 3. It offers deflection sensitivities of 0.24 to 0.4 mm/V depending on anode voltage configurations.



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Section 0 · Heptode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Heater voltage	12.6 V	Nominal
Heater current	150 mA	Nominal
Plate voltage	30 V	Typical operating conditions



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Section 0 · Heptode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Heater Voltage	4 V	Nominal published value
Heater Current	1 A	Nominal published value
Modulator to all other electrodes	15 pF	Published direct interelectrode capacitance
Each Y Plate to all other electrodes	15 pF	Published direct interelectrode capacitance
Cathode to all other electrodes	15 pF	Published direct interelectrode capacitance

CONSTRUCTION		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Focusing Method	Electrostatic	Published focusing method
Deflecting Method	Electrostatic	Published deflection method

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