

ELECTRONIC TUBE REFERENCE

12FA6

Voltage - Pentode or Tetrode (under 100V) electronic tube

CONSOLIDATED TECHNICAL DATA
1 SECTION
CONSTRUCTION
HEPTODE

Pentagrid oscillator-converter designed specifically for 12 V automobile superheterodyne receivers. It combines local-oscillator and mixer functions while operating directly from the vehicle electrical supply.

GENERAL CHARACTERISTICS

BASE DESIGNATION	7CH	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

7CH - TERMINAL PINOUT

TERMINAL	SECTION	ELEMENT	STATUS
PIN1 – G1	A	G1 – Control Grid	CONNECTED
PIN2 – G5	A	G5 – Fifth Grid	CONNECTED
PIN2 – K	A	K – Cathode	CONNECTED
PIN3 – H	–	H – Heater	CONNECTED
PIN4 – H	–	H – Heater	CONNECTED
PIN5 – P	A	P – Plate (Anode)	CONNECTED
PIN6 – G2	A	G2 – Screen Grid	CONNECTED
PIN6 – G4	A	G4 – Fourth Grid	CONNECTED
PIN7 – G3	A	G3 – Suppressor Grid	CONNECTED

SECTION RATINGS

SECTION1 Heptode	
PLATE RESISTANCE	800000 Ω
MAXIMUM PLATE VOLTAGE	30 V
MAXIMUM SCREEN VOLTAGE	30 V
MAXIMUM CATHODE CURRENT	20 mA
<i>Pentagrid converter.</i>	

12FA6 — Heptode Miniature Pentagrid Converter

An indirectly heated, low-voltage heptode designed for combined mixer and oscillator service in automotive superheterodyne receivers.

Overview

The **12FA6** is a miniature heptode, designed as a pentagrid converter for use in superheterodyne radio receivers. Its primary application is to serve as a combined local oscillator and mixer stage. The tube is specifically engineered for mobile and automotive environments where all operating potentials—including the heater, plate, and screen grids (Grids No. 2 and No. 4)—are supplied directly from a nominal 12-volt vehicle battery system. This design eliminates the need for a high-voltage vibrator power supply or step-up DC-to-DC converter for the receiver's front-end stages.

While some early manufacturer documentation contains a typographical reference to the designation "12AF6" within the introductory text, the device is officially designated as the **12FA6**. It must not be confused with other tube types, and direct substitution should only be performed with verified equivalent designations.

Construction, Physical Specifications, and Heater

The 12FA6 is constructed in a compact 7-pin miniature glass envelope. It features a coated unipotential cathode and can be operated in any mounting position.

Physical Dimensions

- **Bulb Type:** T-5 1/2 glass bulb
- **Base Type:** Miniature button 7-pin base (7CH basing configuration)
- **Maximum Diameter:** 3/4 inch (0.75 in)
- **Maximum Seated Height:** 1 7/8 inches
- **Maximum Overall Length:** 2 1/8 inches

Heater Characteristics

Because the tube is intended for automotive service, its heater is designed to withstand the wide voltage fluctuations typical of vehicle charging systems. The heater is rated to operate reliably over a voltage range spanning from **10.0 to 15.9 Volts**, providing an adequate safety margin against battery overcharging or voltage drops.

Heater Parameter	Value
Nominal Heater Voltage	12.6 V
Nominal Heater Current	0.15 A
Heater Supply Type	AC or DC
Permissible Operating Range	10.0 to 15.9 V
Cathode Type	Coated, unipotential

Pinout and Electrode Connections

The 12FA6 utilizes the **7CH** basing arrangement. When viewed from the bottom of the tube, the pin connections are assigned as follows:

Pin Number	Electrode Connection
1	Grid No. 1 (Oscillator Grid / G_1)
2	Cathode & Grid No. 5 ($K + G_5$)
3	Heater (H)
4	Heater (H)
5	Plate (P)
6	Grid No. 2 & Grid No. 4 (Screen Grid / $G_2 \& G_4$)
7	Grid No. 3 (Mixer Grid / RF Input / G_3)

Direct Interelectrode Capacitances

The capacitances of the 12FA6 are measured with an external shield (specifically shield #316) connected to Pin 2 (Cathode & Grid No. 5). The direct interelectrode capacitances are:

Capacitance Parameter	Value
Mixer Grid to Plate: G_3 to P (Max.)	0.25 pF
Mixer Grid to Oscillator Grid: G_3 to G_1 (Max.)	0.15 pF

Capacitance Parameter	Value
RF Input: G_3 to $(H + K + G_1 + G_{2\&4} + G_5 + P)$	7.2 pF
Oscillator Input: G_1 to $(H + K + G_{2\&4} + G_3 + G_5)$	7.2 pF
Mixer Output: P to $(H + K + G_1 + G_{2\&4} + G_3 + G_5)$	12.0 pF
Oscillator Grid to Cathode: G_1 to $(K + G_5)$	5.0 pF
Oscillator Output: K to $(H + G_{2\&4} + G_3 + P)$	20 pF
Oscillator Grid to Plate: G_1 to P (Max.)	0.05 pF

Maximum Ratings

The maximum electrical ratings for the 12FA6 are established under the **Design Center System**. Operating the tube beyond these limits may impair performance or shorten its service life.

Parameter	Design Center Maximum
Maximum Plate Voltage	30 V
Maximum Grids No. 2 & No. 4 Voltage	30 V
Maximum Grids No. 2 & No. 4 Supply Voltage	30 V
Maximum Negative DC Grid No. 3 Voltage	30 V
Maximum Positive DC Grid No. 3 Voltage	0 V
Maximum Cathode Current	20 mA
Maximum Grid No. 3 Circuit Resistance	10 MΩ
Maximum Heater-Cathode Voltage	±30 V

Typical Operating Conditions and Characteristics

The 12FA6 is versatile in its application as a frequency converter, supporting both self-excited and externally excited circuit topologies. Additionally, the characteristics of its oscillator section can be evaluated independently under non-oscillating conditions.

Converter Service (Self-Excitation)

In self-excited converter service, screen feedback is utilized. The feedback is configured such that the G_2 to cathode voltage is approximately 13% of the G_1 to cathode voltage. Typical operating parameters under these conditions are:

- **Heater Voltage:** 12.6 V
- **Plate Voltage:** 12.6 V
- **Grid No. 3 Voltage:** 0.50 V (*Average contact potential developed across a 2.2 MΩ grid resistor*)
- **Grids No. 2 & No. 4 Voltage:** 12.6 V
- **Grid No. 1 Voltage (Oscillator Grid) RMS:** 2.5 V
- **Grid No. 1 Resistance (Oscillator Grid):** 33,000 Ω
- **Plate Resistance (Approximate):** 0.8 MΩ
- **Grid No. 1 Current (Oscillator Grid):** 60 μA
- **Conversion Transconductance (G_C):** 320 μmhos
- **Plate Current:** 450 μA
- **Grids No. 2 & No. 4 Current:** 1,000 μA
- **Cathode Current:** 1,500 μA
- **Grid No. 3 Voltage for $G_C = 5$ μmhos (Approx.):** -3.5 V
- **Grid No. 3 Voltage for $G_C = 20$ μmhos (Approx.):** -3.0 V

Cathode Current Verification (Calculation)

Using the individual electrode currents under self-excited operation, the total cathode current (I_k) can be calculated as: $I_k = I_b + I_{[g2]} + I_{g1}$ Inputting the typical values: $I_k = 450 \mu\text{A} + 1,000 \mu\text{A} + 60 \mu\text{A} = 1,510 \mu\text{A}$ This calculated total of **1,510 μA** closely aligns with the published typical cathode current of **1,500 μA**.

Converter Service (External Excitation)

When the local oscillator signal is injected from an external source, and Grids No. 2 and No. 4 are connected directly to the plate, the typical operating parameters are:

- **Heater Voltage:** 12.6 V
- **Grid No. 3 Voltage:** 0 V
- **Grid No. 1 Voltage (Oscillator Grid) RMS:** 0.85 V
- **Grids No. 2 & No. 4 Connected to Plate Voltage:** 12.6 V
- **Conversion Transconductance (G_C):** 300 μmhos
- **Plate Current:** 670 μA
- **Grids No. 2 & No. 4 Current:** 1,200 μA
- **Cathode Current:** 1,900 μA
- **Grid No. 1 Current:** 45 μA
- **Grid No. 3 Voltage for $G_C = 10$ μmhos:** -3.2 V

Cathode Current Verification (Calculation)

Using the individual electrode currents under externally excited operation, the total cathode current (I_k) is calculated as: $I_k = I_b + I_{[g2]} + I_{g1}$ Inputting the typical values: $I_k = 670 \mu\text{A} + 1,200 \mu\text{A} + 45 \mu\text{A} = 1,915 \mu\text{A}$ This calculated total of **1,915 μA** is in close agreement with the published typical cathode current of **1,900 μA** .

Oscillator Characteristics (Non-Oscillating)

To evaluate the performance of the oscillator section independently, the tube can be tested under non-oscillating conditions with Grids No. 2 and No. 4 connected directly to the plate:

- **Grid No. 3 Voltage:** 0 V
- **Grid No. 1 Voltage (Oscillator Grid):** 0 V
- **Grid No. 2 & No. 4 Connected to Plate Voltage:** 12.6 V
- **Transconductance (between Grid No. 1 and Grids No. 2 & No. 4):** 4,000 μmhos
- **Amplification Factor (between Grid No. 1 and Grids No. 2 & No. 4):** 9
- **Cathode Current:** 4.5 mA
- **Grid No. 1 Voltage (Approximate) for $I_b = 10 \mu\text{A}$:** -3.5 V

Technical Summary

The **12FA6** is a specialized, low-voltage heptode pentagrid converter designed for automotive superheterodyne radio receivers. By operating directly from a nominal 12-volt battery supply (with a ruggedized heater designed for the 10.0 to 15.9 V range), it eliminates the need for high-voltage power generation in mobile receiver designs.

The tube features a 7-pin miniature construction, a coated unipotential cathode, and a 7CH basing configuration. Under typical operating conditions at 12.6 V, it provides a conversion transconductance of 300 to 320 μmhos , making it an efficient and reliable choice for combined oscillator and mixer service in low-voltage mobile applications.



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1961 Tung Sol

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

1961 TUNG SOL

Section 1 · Heptode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Heater voltage	12.6 V	—
Heater current	150 mA	—

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Conversion transconductance	320 μ S	Converter
Oscillator transconductance	4000 μ S	NotOscillating



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1966 Tung Sol Electronic Tubes 2 of 4

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

1966 TUNG SOL ELECTRONIC TUBES 2 OF 4

Section 1 · Heptode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
MAX	12.6 V	Published datasheet; published column 1
MAX	0.15 V	Published datasheet; published column 2
MAXIMUM HEATER-CATHODE VOLTAGE $\pm$	30 V	Maximum ratings
MAXIMUM PLATE VOLTAGE	3 V	Maximum ratings; published column 1
MAXIMUM PLATE VOLTAGE	0 V	Maximum ratings; published column 2

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
MAXIMUM GRIDS #2 h #4 VOLTAGE	30 V	Maximum ratings
MAXIMUM GRIDS #2	6 V	Maximum ratings
MAXIMUM NEGATIVE DC GRID #3 VOLTAGE	3 V	Maximum ratings; published column 1
MAXIMUM NEGATIVE DC GRID #3 VOLTAGE	0 V	Maximum ratings; published column 2
MAXIMUM POSITIVE	0 V	Maximum ratings; published column 1
MAXIMUM CATHODE CURRENT	2 mA	Maximum ratings; published column 1
MAXIMUM CATHODE CURRENT	0 mA	Maximum ratings; published column 2
MAXIMUM GRID #3 CIRCUIT RESISTANCE	10000000 ohm	Maximum ratings
HEATER VOLTAGE j2	6 V	Typical operating conditions
PLATE VOLTAGE j2	6 V	Typical operating conditions
GRID #3 VOLTAGE . Q	50 V	Typical operating conditions
GRIDS #2	6 V	Typical operating conditions; published column 1
GRID #i VOLTAGE (	0 V	Typical operating conditions; published column 1
GRID #i VOLTAGE (	2 V	Typical operating conditions; published column 2
GRID #1 RESISTANCE (	0 ohm	Typical operating conditions; published column 1
GRID #1 RESISTANCE (	33 ohm	Typical operating conditions; published column 2
PLATE RESISTANCE (APPROX.)	0 ohm	Typical operating conditions
CONVERSION TRANSCONDUCTANCE	320 uS	Typical operating conditions
PLATE CURRENT	1 uA	Typical operating conditions; published column 1
PLATE CURRENT	0 uA	Typical operating conditions; published column 2
GRID #3 VOLTAGE FOR GC=Sμ MHOS (APPROX.)	-35 V	Typical operating conditions
GRID #3 VOLTAGE FOR G~=	20 uS	Typical operating conditions; published column 1
GRID #3 VOLTAGE FOR G~=	-3 uS	Typical operating conditions; published column 2

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
GRID #3 VOLTAGE FOR $G_{\sim}$	0 uS	Typical operating conditions; published column 3
GRID #3 VOLTAGE	0 V	Typical operating conditions
GRIDS #2 & #4 CONNECTED TO PLATE j2	6 V	Typical operating conditions
CONVERSION TRANSCONDUCTANCE	3 uS	Typical operating conditions; published column 1
CONVERSION TRANSCONDUCTANCE	0 uS	Typical operating conditions; published column 2
CATHODE CURRENT j	900 uA	Typical operating conditions
GRIDS #2 d~ #4 CURRENT j	200 uA	Typical operating conditions
GRID #1 CURRENT	45 uA	Typical operating conditions
GRID #3 VOLTAGE FOR. $G_{\sim}$ =	10 uS	Typical operating conditions; published column 1
GRID #3 VOLTAGE FOR. $G_{\sim}$ =	-32 uS	Typical operating conditions; published column 2
GR h0 #3 VOLTAGE	0 V	Typical operating conditions
GRID #1 VOLTAGE (	0 V	Typical operating conditions; published column 1
GRID #2 & #4 CONNECTED TO PLATE j2	6 V	Typical operating conditions
GRID #2 & #4 CONNECTED TO PLATE	4 uS	Typical operating conditions; published column 1
GRID #2 & #4 CONNECTED TO PLATE	0 uS	Typical operating conditions; published column 2
CATHODE CURRENT	4.5 mA	Typical operating conditions
FOR	1 V	Typical operating conditions; published column 1
FOR	10 V	Typical operating conditions; published column 2
FOR	-35 V	Typical operating conditions; published column 3
TNIS TUBE	1 V	Typical operating conditions; published column 1
Maximum plate voltage	30 V	Published datasheet; promoted section value
Maximum screen voltage	30 V	Published datasheet; promoted section value
Maximum cathode current	20 mA	Published datasheet; promoted section value

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
MIXER GRID TO PLATE: (G} TO P) MAX	0.25 pF	Interelectrode capacitances
MIXER GRID TO	0 pF	Interelectrode capacitances; published column 1
MIXER GRID TO	0.15 pF	Interelectrode capacitances; published column 2
MIXER	0 pF	Interelectrode capacitances; published column 1
MIXER	4 pF	Interelectrode capacitances; published column 2
MIXER	5 pF	Interelectrode capacitances; published column 3
MIXER	12 pF	Interelectrode capacitances; published column 4

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate resistance	800000 ohm	Published datasheet; promoted section value
Conversion transconductance	320 uS	SelfExcitation
Conversion transconductance	300 uS	ExternalExcitation

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