

Triode-heptode frequency converter for superheterodyne receivers. The triode supplies local oscillation while the heptode performs mixing, integrating oscillator and frequency-changing functions within one envelope for compact radio front ends.

GENERAL CHARACTERISTICS

BASE DESIGNATION	8RV	BASE PINS	8
NOMINAL HEATER	12.6 V / 150 mA	PARALLEL HEATER	– / –
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION1 Heptode	
PLATE RESISTANCE	500000 Ω
TRANSCONDUCTANCE	0.00045 S
MAXIMUM PLATE VOLTAGE	300 V
MAXIMUM SCREEN VOLTAGE	100 V
MAXIMUM PLATE DISSIPATION	1 W
Published promoted fields populated semantically; identical repeated sections compressed.	

12SY7 — Pentagrid Converter Vacuum Tube

The **12SY7** is a single-ended metal-shell pentagrid converter (also classified as a heptode pentagrid converter) designed primarily for superheterodyne receiver circuits. It is specifically engineered for operation in equipment powered by a 12-cell storage-battery supply, making it highly suitable for mobile, automotive, and specialized industrial applications where the supply voltage typically ranges from 24 to

28 volts. The 12SY7 features an indirectly heated, coated unipotential cathode and is electrically similar to the [6SA7](#), differing principally in its heater requirements.

Mechanical Specifications and Basing

The 12SY7 is constructed with a metal envelope (MT-8G bulb) and utilizes a small wafer octal 8-pin phenolic base. The tube is designed to operate reliably when mounted in any position.

Physical Dimensions

- **Maximum Overall Length:** 2-5/8 inches
- **Maximum Seated Length:** 2-1/16 inches
- **Maximum Diameter:** 1-5/16 inches

Pin Connections (8R Basing Designation)

The 12SY7 uses the 8R basing arrangement, viewed from the bottom of the tube:

Pin Number	Electrode Connection
Pin 1	Metal Shell, Grid No. 5 (Suppressor Grid)
Pin 2	Heater
Pin 3	Plate (Anode)
Pin 4	Grids No. 2 & No. 4 (Screen Grid)
Pin 5	Grid No. 1 (Oscillator Grid)
Pin 6	Cathode
Pin 7	Heater
Pin 8	Grid No. 3 (Signal Grid / Control Grid)

Electrical Ratings and Capacitances

The maximum ratings are established under the design-center system. Operating the tube within these limits ensures optimal performance and longevity.

Maximum Ratings

- **Plate Voltage:** 300 max. volts
- **Grids-No. 2 and No. 4 (Screen) Voltage:** 100 max. volts
- **Grids-No. 2 and No. 4 Supply Voltage:** 300 max. volts
- **Plate Dissipation:** 1.0 max. watt
- **Grids-No. 2 & No. 4 Dissipation:** 1.0 max. watt

- **Total Cathode Current:** 14 max. mA
- **Grid-No. 3 (Control Grid) Voltage (Negative Bias):** 50 max. volts
- **Grid-No. 3 (Control Grid) Voltage (Positive Bias):** 0 max. volts
- **Minimum External Signal Grid Bias Voltage:** 0 volts (with self-excited oscillator)
- **Peak Heater-Cathode Voltage (Heater Negative or Positive with respect to Cathode):** 90 max. volts

Heater Characteristics

- **Heater Voltage (AC or DC):** 12.6 volts
- **Heater Current:** 0.15 amperes

Direct Interelectrode Capacitances

The capacitances below are measured with the metal shell connected to the cathode:

Electrode Pair / Group	Capacitance Value
Grid No. 3 to All Other Electrodes (RF Input)	9.5 $\mu\mu\text{F}$
Plate to All Other Electrodes (Mixer Output)	12.0 $\mu\mu\text{F}$
Grid No. 1 to All Other Electrodes (Oscillator Input)	7.0 $\mu\mu\text{F}$
Grid No. 3 to Plate	0.13 max. $\mu\mu\text{F}$
Grid No. 1 to Grid No. 3	0.15 max. $\mu\mu\text{F}$
Grid No. 1 to Plate	0.06 max. $\mu\mu\text{F}$
Grid No. 1 to Shell, Grid No. 5, and All Except Cathode	4.4 $\mu\mu\text{F}$
Grid No. 1 to Cathode	2.6 $\mu\mu\text{F}$
Cathode to Shell, Grid No. 5, and All Except Cathode	5.0 $\mu\mu\text{F}$

Typical Operating Conditions and Characteristics

The 12SY7 can be operated under separate excitation or self-excited oscillator configurations. The typical characteristics under separate excitation correspond closely to those obtained in a self-excited oscillator circuit operating with zero bias.

The tube is characterized across three distinct operating points, including a low-voltage condition optimized for 12-cell storage-battery systems (nominal 26.5 V to 28 V):

Parameter	Low-Voltage Point	Medium-Voltage Point	High-Voltage Point
Plate Voltage	26.5 V / 28 V	100 V	250 V
Screen Voltage (Grids No. 2 & 4)	26.5 V / 28 V	100 V	100 V
Signal Grid Bias (Grid No. 3)	-1 V	-2 V	-2 V
Anode-Grid Voltage	0 V	0 V	0 V
Oscillator-Grid Resistor (Grid No. 1)	20,000 Ω	20,000 Ω	20,000 Ω
Plate Current	0.45 mA / 0.5 mA	3.3 mA	3.5 mA
Screen Current (Grids No. 2 & 4)	1.7 mA / 1.8 mA	8.5 mA	8.5 mA
Oscillator-Grid Current (Grid No. 1)	0.1 mA	0.5 mA	0.5 mA
Total Cathode Current	2.25 mA / 2.4 mA	12.3 mA	12.5 mA
Plate Resistance (Approx.)	—	0.5 M Ω	1.0 M Ω
Conversion Transconductance	250 μ mhos	425 μ mhos	450 μ mhos

Conversion Transconductance at Various Bias Levels

The conversion transconductance varies significantly with the negative bias applied to Grid No. 3 (Signal Grid):

- **At -6 V Bias:** Conversion transconductance drops to approximately 8 μ mhos at the low-voltage operating point, 310 μ mhos at the 100 V point, and 320–325 μ mhos at the 250 V point.
- **At -10 V Bias:** Conversion transconductance is approximately 75 μ mhos (100 V point) and 80 μ mhos (250 V point).
- **At -35 V Bias (Cutoff):** Conversion transconductance is reduced to approximately 2 μ mhos for both the 100 V and 250 V operating points.

Non-Oscillating Transconductance Characteristics

When the tube is operated in a non-oscillating state with Grid No. 1 and Grids No. 2 & No. 4 connected directly to the plate, the transconductance between Grid No. 1 and the combined plate/screen structure is approximately **4500 μ mhos**. This measurement is taken under the following specific conditions:

- Grids No. 1, No. 3, No. 5, and the metal shell are held at 0 volts.
- Grids No. 2 & No. 4 and the plate are maintained at 100 volts.
- Grid No. 3 is connected to ground. Under these test conditions, the plate current is **27 mA** and the amplification factor is **13**.

Operation Characteristics and Curves

The performance of the 12SY7 under low-voltage conditions (26.5 V plate and screen supply) is highly dependent on the bias of Grid No. 3 and the current flowing through Grid No. 1.

Conversion Transconductance vs. Grid No. 3 Voltage

At a plate and screen potential of 26.5 V and a Grid No. 1 current of 0.1 mA, the conversion transconductance peaks at approximately **270 to 280 μmhos** when the Grid No. 3 bias is near -0.5 V. As the negative bias on Grid No. 3 increases, the conversion transconductance decreases smoothly, reaching near-zero levels (cutoff) at approximately -4 V.

Electrode Currents and Transconductance vs. Grid No. 1 Current

With a fixed Grid No. 3 bias of -1 V and a 26.5 V supply:

- **Cathode Current:** Rises steadily from approximately 1.5 mA to 4.8 mA as Grid No. 1 current increases from 0 to 0.8 mA.
- **Screen Current (Grids No. 2 & 4):** Increases in tandem with cathode current, rising from 1.2 mA to approximately 3.8 mA over the same range.
- **Plate Current:** Remains low and relatively flat, fluctuating slightly between 0.3 mA and 0.5 mA.
- **Conversion Transconductance:** Reaches its optimum value of approximately **260 μmhos** at a Grid No. 1 current of 0.15 to 0.2 mA. Increasing the Grid No. 1 current further causes a gradual decline in conversion transconductance, falling to approximately 160 μmhos at 0.8 mA.

The characteristic curves of the 12SY7 are identical in form to those of the [6SA7](#), allowing the same graphical analysis techniques to be applied for circuit design.

Related Designations and Variations

The 12SY7 is closely related to several other vacuum tubes in the pentagrid converter family:

- **12SY7-GT:** A glass-envelope variant of the 12SY7. It features an 8ADV basing configuration and shares the same electrical characteristics and ratings as the metal-shell 12SY7.
- **6SA7:** The 6.3-volt equivalent of the 12SY7. Aside from the heater voltage (6.3 V vs. 12.6 V) and heater current (0.3 A vs. 0.15 A), the two tubes share identical electrical characteristics, and their performance curves are directly interchangeable.

Technical Summary

The **12SY7** is an octal-based, metal-shell pentagrid converter designed for frequency conversion and mixer service in superheterodyne receivers. Operating with a **12.6 V, 0.15 A** heater, it is optimized for mobile and automotive systems running on 12-cell storage batteries. The tube features a unipotential cathode, a maximum plate voltage rating of **300 V**, and a maximum screen voltage rating of **100 V**.

At its typical high-voltage operating point (250 V plate, 100 V screen), the 12SY7 provides a conversion transconductance of **450 μmhos** and a plate resistance of **1.0 M Ω** . For low-voltage battery operation (26.5 V to 28 V), it delivers a conversion transconductance of **250 μmhos** . The 12SY7 offers a robust, compact, and self-shielded solution for RF mixing and oscillation within a single envelope.

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

195X General Electric Essential Characteristics

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

195X GENERAL ELECTRIC ESSENTIAL CHARACTERISTICS

Section 1 · Heptode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum plate voltage	300 V	Published handbook rating
Maximum screen voltage	100 V	Published handbook rating
Plate voltage	250 V	ClassA
Screen voltage	100 V	ClassA
Control-grid bias	2 V	ClassA
Plate current	3.5 mA	ClassA
Screen current	8.5 mA	ClassA

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate resistance	1000000 ohm	Published handbook characteristic
Transconductance	450 μ S	Published handbook characteristic
Heater voltage	12.6 V	Published heater rating
Heater current	150 mA	Published heater rating

1960 RCA Industrial and Communications Types

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

1960 RCA INDUSTRIAL AND COMMUNICATIONS TYPES

Section 1 · Heptode

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
HeaterOrFilamentVoltage	12.6 V	—
HeaterOrFilamentCurrent	150 mA	—
Conversion Transconductance	450 μ S	PlateVoltage=250V



SOURCE DATA APPENDIX

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

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Conversion Transconductance	450 μ S	ZeroGridBias



SOURCE DATA APPENDIX

1971 RCA HB3 Binder 3 of 7

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

1971 RCA HB3 BINDER 3 OF 7

Section 1 · Heptode

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Voltage	12.6 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Current	0.15	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grid No.3 to All Other Electrodes (RF Input)	9.5	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Plate to All Other Electrodes (Mixer Output)	12	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grid No.1 to All Other Electrodes (Osc. Input)	7	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grid No.1 to Cathode	2.6	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Pin 1-- Shell, -- published value 1	0	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Pin 1-- Shell, -- published value 2	5	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grid No.5	6	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Pin 2 - Heater -- published value 1	2	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Pin 2 - Heater -- published value 2	7	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Pin 3 - Plate -- published value 1	3	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Pin 3 - Plate -- published value 2	8	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Pin 4 - Grids No.2 ~	4	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Plate Voltage – published value 1	26.5 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Plate Voltage – published value 2	100 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Plate Voltage – published value 3	250 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grids-No.2 & No.4 Voltage – published value 1	26.5 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grids-No.2 & No.4 Voltage – published value 2	100 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grids-No.2 & No.4 Voltage – published value 3	100 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grid-No.3 Voltage – published value 1	-1 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grid-No.3 Voltage – published value 2	-2 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grid-No.3 Voltage – published value 3	-2 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grid) Resistor – published value 1	20000 ohm	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grid) Resistor – published value 2	20000 ohm	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grid) Resistor – published value 3	20000 ohm	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Plate Resistance (Approx.) – published value 1	0.5 Mohm	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Resistance (Approx.) – published value 2	1 Mohm	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Conversion Transconductance – published value 1	250	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Conversion Transconductance – published value 2	425	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Conversion Transconductance – published value 3	450	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Plate Current – published value 1	0.45 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Plate Current – published value 2	3.3 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Plate Current – published value 3	3.5 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grids-No.2 & – published value 1	1.7 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grids-No.2 & – published value 2	8.5 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grids-No.2 & – published value 3	8.5 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grid-No.1 Current – published value 1	0.1 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grid-No.1 Current – published value 2	0.5 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grid-No.1 Current – published value 3	0.5 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Total Cathode Current – published value 1	2.25 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Total Cathode Current – published value 2	12.3 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Total Cathode Current – published value 3	12.5 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
at 0 volts; gritls No.2 and No.0 and plate at 100 volts. Under the – published value 1	0 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
at 0 volts; gritls No.2 and No.0 and plate at 100 volts. Under the – published value 2	100 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
same conditions, the plate current is 27 mill iamperes, and the	27 A	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
With grid-N 0.3 Dias of -6 volts – published value 1	0.3 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
With grid-N 0.3 Dias of -6 volts – published value 2	-6 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
PLATE VOLTS=26.5	26.5 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
GRIDS-N'28 N' 4 VOLTS =28.5 – published value 1	28 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
GRIDS-N'28 N' 4 VOLTS =28.5 – published value 2	4 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
GRIDS-N'28 N' 4 VOLTS =28.5 – published value 3	28.5 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
GRID-N~ 7 MILLIAMPERES=0-t	7 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
GRID- N' 7RESISTOR-OHMS=20000 – published value 1	7 ohm	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
GRID- N' 7RESISTOR-OHMS=20000 – published value 2	20000 ohm	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
GRID-N' 3 VOLTS	3 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
PLATE VOLTS=26.5 – published value 1	26.5 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
PLATE VOLTS=26.5 – published value 2	9 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
GRIDS-N" 2b Ns4 VOLTS= 26.5 – published value 1	2 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
GRIDS-N" 2b Ns4 VOLTS= 26.5 – published value 2	26.5 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
GRIDS-N" 2b Ns4 VOLTS= 26.5 – published value 3	9 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
GRID-N~ i RESISTOR -OHMS= 20000	20000 ohm	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
GRID•N' 3VOLTS= - 1 – published value 1	3 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
GRID•N' 3VOLTS= - 1 – published value 2	1 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Grid No.3 to Plate – published value 1	0 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grid No.3 to Plate – published value 2	13 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grid No.1 to Grid No.3 – published value 1	0 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grid No.1 to Grid No.3 – published value 2	15 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Grid No.1 to Plate – published value 1	0 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Grid No.1 to Plate – published value 2	6 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
PLATE VOLTAGE	300 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
GRIDS-No.2 and No.4 (SCREEN) VOLTAGE	100 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
GRIDS-No.2 and No.4 SUPPLY VCLTAGE	300 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
PLATE DISSIPATION	1 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
GRIDS-No.2 & No.4 DISSIPATION	1 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
TOTAL CATHODE CURRENT	14 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Negative bias value	50 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Positive bias value	0 mA	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Heater negative with respect to cathode	9 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.
Heater positive with respect to cathode	90 V	Published datasheet value; multiple numbers on one source row represent separate limits or operating conditions.