

ELECTRONIC TUBE REFERENCE

12X4

Rectifier - Full Wave electronic tube

CONSOLIDATED TECHNICAL DATA
2 SECTIONS
CONSTRUCTION
RECTIFIER-RECTIFIER

Full-wave vacuum rectifier intended for automobile and AC-operated radio-receiver power supplies. Its 12.6 V heater and useful current capability suit compact receiving-equipment B-plus supplies.

GENERAL CHARACTERISTICS

BASE DESIGNATION	5BS	BASE PINS	7
NOMINAL HEATER	12.6 V / 300 mA	PARALLEL HEATER	– / –
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Common cathode	SECTION CONSTRUCTION	Similar

5BS - TERMINAL PINOUT

TERMINAL	SECTION	ELEMENT	STATUS
PIN1 – P2	A	P – Plate (Anode)	CONNECTED
PIN3 – H	–	H – Heater	CONNECTED
PIN4 – H	–	H – Heater	CONNECTED
PIN6 – P1	A	P – Plate (Anode)	CONNECTED
PIN7 – K	A	K – Cathode	CONNECTED

SECTION RATINGS

SECTION1 Rectifier	
PEAK INVERSE VOLTAGE	1250 V
NOMINAL OUTPUT CURRENT	70 mA
PEAK FORWARD CURRENT	245 mA
FORWARD VOLTAGE DROP	22 V
MAXIMUM HEATER-CATHODE VOLTAGE	450 V
<i>Published promoted fields populated semantically; identical repeated sections compressed.</i>	

SECTION2 Rectifier	
PEAK INVERSE VOLTAGE	1250 V
NOMINAL OUTPUT CURRENT	70 mA
PEAK FORWARD CURRENT	245 mA
FORWARD VOLTAGE DROP	22 V
MAXIMUM HEATER-CATHODE VOLTAGE	450 V
<i>Physical rectifier section 2; electrical properties populated from the same published ratings applicable to the identical rectifier path.</i>	

12X4 — Full-Wave Vacuum Rectifier

The **12X4** is a miniature, 7-pin, indirectly heated full-wave high-vacuum rectifier designed for service in compact power supplies. It is widely utilized in automobile receivers and AC-operated radio equipment. In terms of electrical performance, the 12X4 is equivalent to the larger, octal-based **6X5GT** and is identical to the **6X4** rectifier except for its heater ratings.

Construction, Mechanical Specifications, and Basing

The 12X4 features a coated unipotential cathode and is housed in a T-5 1/2 glass bulb. It utilizes a miniature 7-pin button base (JETEC E7-1) with a JEDEC 5-3 outline. The tube is designed to be mounted in any position. Because it is a power-handling device, adequate ventilation must be provided in practical layouts to ensure reliable operation.

Physical Dimensions

- **Maximum Overall Height:** 2.625 inches
- **Maximum Seated Height:** 2.375 inches
- **Maximum Diameter:** 0.750 inches

Basing Configuration

The tube uses the **5BS** basing arrangement. Viewed from the bottom of the base, the pin connections are as follows:

Pin Number	Connection
1	Plate No. 2 (PD2)
2	No Connection (NC)
3	Heater (H)
4	Heater (H)
5	No Connection (NC)
6	Plate No. 1 (PD1)
7	Cathode (K)

Heater Characteristics

The heater is designed for either AC or DC operation. The nominal heater ratings and operational limits are:

Parameter	Value
Nominal Heater Voltage	12.6 V
Nominal Heater Current	0.3 A (300 mA)
Heater Supply Limits (Standard)	12.6 $\pm$ 0.6 V
Automotive Battery Supply Range	10.0 to 15.9 V

When operated in mobile or automotive applications directly from a nominal 12-volt battery source, the heater is rated to withstand a wider voltage variation of 10.0 to 15.9 volts to accommodate battery charging and discharging cycles.

Electrical Ratings and Operating Limits

The maximum ratings of the 12X4 are defined under both the Design-Maximum and Design-Center rating systems. These values represent the limiting conditions beyond which the serviceability and life of the tube may be severely impaired.

Maximum Rectifier Ratings

- **Peak Inverse Plate Voltage:** 1250 max. Volts

- **Steady-State Peak Plate Current (per plate):** 245 max. mA (Design-Maximum) or 210 max. mA (Design-Center)
- **Transient Peak Plate Current (per plate):** 1.1 max. Amperes (with a maximum duration of 0.2 seconds under certain specifications)
- **DC Output Current:** Bounded by the operational rating charts based on supply voltage and filter type.

Vibrator Operation Ratings

When the 12X4 is used in vibrator-type power supplies (with a minimum duty cycle of 75%), the following specific maximum ratings apply:

- **DC Output Voltage (at filter input):** 350 max. Volts
- **DC Output Current (per plate):** 45 max. mA

Heater-Cathode Voltage Limits

To prevent insulation breakdown between the heater and the cathode, the following voltage limits must be strictly observed:

- **Heater Negative with Respect to Cathode:**
 - DC Component: 450 max. Volts
 - Total DC + Peak: 450 max. Volts
- **Heater Positive with Respect to Cathode:**
 - DC Component: 100 max. Volts
 - Total DC + Peak: 200 max. Volts

Typical Operating Characteristics

The 12X4 can operate with either capacitor-input or choke-input filter configurations. Typical operating conditions for sinusoidal supply voltages within a frequency range of 25 to 1000 cycles per second are detailed below:

Parameter	Sine Wave (Capacitor Input)	Sine Wave (Choke Input)	Vibrator (Capacitor Input)
AC Plate Supply Voltage per Plate (RMS, no-load)	325 V	400 V / 450 V	—
Filter Input Capacitor	10 μ F	—	10 μ F
Filter Input Choke	—	10 H	—

Parameter	Sine Wave (Capacitor Input)	Sine Wave (Choke Input)	Vibrator (Capacitor Input)
Effective Plate-Supply Impedance per Plate	525 Ω	—	—
DC Output Current	70 mA	70 mA	70 mA
DC Output Voltage at Filter Input (Approx.)			
At 35 mA Load Current	365 V	395 V	—
At 70 mA Load Current	310 V	340 V / 385 V	240 V

Tube Voltage Drop

The internal tube voltage drop is low, measuring **22 Volts** when each plate is conducting a DC current of 70 mA.

Rectifier Circuit Design and Rating Charts

The application of maximum ratings to practical circuit design requires analyzing the interdependence of the AC plate supply voltage, the DC output current, and the filter type.

Rating Chart I: Boundary Limits

The permissible operating area for the 12X4 is bounded by specific limits depending on the filter configuration:

- **Capacitor-Input Filter:** Operation is restricted to the area bounded by the points **FAEDG** (or **A-E-D** depending on the specific chart representation), where the maximum DC output current is progressively derated as the AC plate supply voltage increases. For example, with a capacitor-input filter, the maximum DC output current is 45 mA per plate up to 325 V RMS, derating to 37 mA at 360 V RMS, and further to 24 mA at 450 V RMS.
- **Choke-Input Filter:** Operation is permissible within the larger area bounded by the points **FABCDG** (or **A-B-C**), allowing higher current delivery at elevated voltages due to the current-limiting action of the input choke.

Rectification Efficiency (Rating Chart II)

To ensure that the steady-state peak plate current does not exceed the maximum rating of 245 mA (or 210 mA) in capacitor-input circuits, designers must evaluate the rectification efficiency. The rectification efficiency is calculated using the following formula:

$$\text{Rectification Efficiency} = \frac{\bar{E}}{\sqrt{2}E_s}$$

Where:

- $\bar{E}$ is the DC output voltage at the input to the filter.
- E_s is the RMS plate supply voltage per plate measured under no-load conditions.

The calculated efficiency must fall within the permissible area of operation defined on the rectification efficiency chart.

Transient Current Protection and Plate-Supply Resistance (Rating Chart III)

During the initial cycles of the hot-switching transient, a high inrush current occurs as the filter capacitor charges. To prevent this transient peak plate current from exceeding the absolute maximum limit of **1.1 Amperes**, a minimum value of effective plate-supply resistance (R_s) per plate must be present in the circuit.

The effective plate-supply resistance per plate is calculated as:

$$R_s = N^2 R_{pri} + R_{sec} + R_a$$

Where:

- N is the voltage step-up ratio of the plate transformer (secondary-to-primary turns ratio).
- R_{pri} is the DC resistance of the transformer primary winding.
- R_{sec} is the average DC resistance of each transformer secondary winding.
- R_a is the DC resistance of any added series resistor per plate.

For a 325-volt RMS supply, the minimum required plate-supply resistance is **325 Ohms** per plate (though typical operating circuits often utilize **525 Ohms** to provide an additional safety margin). If hot-switching is a regular operational requirement, the use of a choke-input filter is highly recommended, as the input choke naturally limits the transient inrush current to a value no higher than the steady-state peak plate current.

Technical Summary

The **12X4** is a miniature, 7-pin full-wave vacuum rectifier featuring a coated unipotential cathode, a **12.6 V / 0.3 A** heater, and a compact T-5 1/2 envelope with a **5BS** pinout. Designed as a space-saving alternative to octal rectifiers like the **6X5GT**, it is optimized for compact AC-operated receivers and 12-volt automotive vibrator power supplies.

With a peak inverse plate voltage rating of **1250 Volts** and a steady-state peak plate current limit of **245 mA** per plate, the 12X4 reliably delivers up to **70 mA** of DC output current under typical operating conditions. Designers must incorporate adequate plate-supply resistance (minimum **325 Ohms** for a 325 V RMS supply) or utilize choke-input filtering to protect the tube from damaging transient inrush currents during hot-switching.

SOURCE OPERATING CONDITIONS

1950 Sylvania

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

1950 SYLVANIA

Section 1 · Rectifier

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
DC output current capacitor-input	70 mA	CapacitorInputFilter
DC output current choke-input	70 mA	ChokeInputFilter

1950 SYLVANIA

Section 2 · Rectifier

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
DC output current capacitor-input	70 mA	CapacitorInputFilter
DC output current choke-input	70 mA	ChokeInputFilter

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 · Rectifier

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Heater voltage	12.6 V	Published heater rating
Heater current	300 mA	Published heater rating
Tube voltage drop	22 V	At 70 mA DC

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
DC output current	70 mA	RectifierService
Peak inverse voltage	1250 V	RectifierService
RMS supply voltage	325 V	RectifierService
Peak current	210 mA	RectifierService

195X GENERAL ELECTRIC ESSENTIAL CHARACTERISTICS

Section 2 · Rectifier

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Heater voltage	12.6 V	Published heater rating
Heater current	300 mA	Published heater rating
Tube voltage drop	22 V	At 70 mA DC

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
DC output current	70 mA	RectifierService
Peak inverse voltage	1250 V	RectifierService
RMS supply voltage	325 V	RectifierService
Peak current	210 mA	RectifierService



TUBE TINKER
ELECTRON TUBE DATABASE

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 · Rectifier

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Peak Inverse Plate Voltage	1250 V	EachPlate
DC Output Current	70 mA	FullWave

1961 TUNG SOL

Section 2 · Rectifier

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Peak Inverse Plate Voltage	1250 V	EachPlate
Peak Inverse Plate Voltage	1250 V	EachPlate
DC Output Current	70 mA	FullWave
DC Output Current	70 mA	FullWave



SOURCE DATA APPENDIX

1965 Sylvania Electronic Tubes Vol3

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

1965 SYLVANIA ELECTRONIC TUBES VOL3

Section 1 · Rectifier

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Peak inverse plate voltage	1250 V	—
Steady-state peak plate current per plate	245 mA	—
Transient peak plate current per plate	1.1 A	Duration<=0.2s

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
DC output current	70 mA	—
DC output voltage	385 V	I _{out} =70mA

1965 SYLVANIA ELECTRONIC TUBES VOL3

Section 2 · Rectifier

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Peak inverse plate voltage	1250 V	—
Peak inverse plate voltage	1250 V	—
Steady-state peak plate current per plate	245 mA	—
Steady-state peak plate current per plate	245 mA	—
Transient peak plate current per plate	1.1 A	Duration<=0.2s
Transient peak plate current per plate	1.1 A	Duration<=0.2s
DC output current	70 mA	—
DC output current	70 mA	—
DC output voltage	385 V	I _{out} =70mA


SOURCE DATA APPENDIX

SOURCE OPERATING CONDITIONS

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1966 Tung Sol Electronic Tubes 3 of 4

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

1966 TUNG SOL ELECTRONIC TUBES 3 OF 4

Section 1 · Rectifier

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Transient peak plate current	1.1 A	EachPlate
Vibrator DC output voltage	360 V	Vibrator
Vibrator DC output current each plate	45 mA	Vibrator

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Capacitor-input DC output current	70 mA	CapacitorInputFilter
Choke-input DC output current	70 mA	ChokeInputFilter
Capacitor-input DC output voltage	370 V	CapacitorInputFilter
Choke-input DC output voltage	340 V	ChokeInputFilter

1966 TUNG SOL ELECTRONIC TUBES 3 OF 4

Section 2 · Rectifier

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Transient peak plate current	1.1 A	EachPlate
Vibrator DC output voltage	360 V	Vibrator
Vibrator DC output current each plate	45 mA	Vibrator
Capacitor-input DC output current	70 mA	CapacitorInputFilter
Choke-input DC output current	70 mA	ChokeInputFilter
Capacitor-input DC output voltage	370 V	CapacitorInputFilter
Choke-input DC output voltage	340 V	ChokeInputFilter



SOURCE DATA APPENDIX

SOURCE OPERATING CONDITIONS

SOURCE PDF

1971 RCA HB3 Binder 5 of 7

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

1971 RCA HB3 BINDER 5 OF 7

Section 1 · Rectifier

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Peak Inverse Voltage	1250 V	Inherited from explicitly referenced 6X4 parent except heater data.
DC Output Current	70 mA	Inherited from explicitly referenced 6X4 parent except heater data.
Peak Forward Current	245 mA	Inherited from explicitly referenced 6X4 parent except heater data.
Maximum Heater-Cathode Voltage	450 V	Inherited from explicitly referenced 6X4 parent except heater data.

1971 RCA HB3 BINDER 5 OF 7

Section 2 · Rectifier

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Peak Inverse Voltage	1250 V	Inherited from explicitly referenced 6X4 parent except heater data.
Peak Inverse Voltage	1250 V	Inherited from explicitly referenced 6X4 parent except heater data.
Peak Inverse Voltage	1250 V	Inherited from explicitly referenced 6X4 parent except heater data.
DC Output Current	70 mA	Inherited from explicitly referenced 6X4 parent except heater data.
DC Output Current	70 mA	Inherited from explicitly referenced 6X4 parent except heater data.
DC Output Current	70 mA	Inherited from explicitly referenced 6X4 parent except heater data.
Peak Forward Current	245 mA	Inherited from explicitly referenced 6X4 parent except heater data.
Peak Forward Current	245 mA	Inherited from explicitly referenced 6X4 parent except heater data.
Peak Forward Current	245 mA	Inherited from explicitly referenced 6X4 parent except heater data.
Maximum Heater-Cathode Voltage	450 V	Inherited from explicitly referenced 6X4 parent except heater data.
Maximum Heater-Cathode Voltage	450 V	Inherited from explicitly referenced 6X4 parent except heater data.
Maximum Heater-Cathode Voltage	450 V	Inherited from explicitly referenced 6X4 parent except heater data.

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1975 RCA RC30

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

1975 RCA RC30

Section 1 · Rectifier

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
volte	4 V	Characteristic;PublishedValue1
volte	3 V	Characteristic;PublishedValue2
volte	6 V	Characteristic;PublishedValue3
missible heater-voltage range is from	6 V	Characteristic;PublishedValue1
missible heater-voltage range is from	8 V	Characteristic;PublishedValue2

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Peak Inverse Plate Voltage	1250 V	MaximumRating
Steady-State Peak Plate Current (Per Plate)	245 mA	MaximumRating
DC Output Voltage (At filter input)t	360 V	MaximumRating
Average Output Current (Each plate)t	45 mA	MaximumRating
cycle	75 %	MaximumRating
per plate of	1.1 A	MaximumRating
Ef=	6 V	TypicalOperation;PublishedValue1
Ef=	6.3 V	TypicalOperation;PublishedValue2
Ef=	60 V	TypicalOperation;PublishedValue3
"" .. (	520 ohm	TypicalOperation
PER PLATE ^	400 ohm	TypicalOperation;PublishedValue1
PER PLATE ^	6 ohm	TypicalOperation;PublishedValue2

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
PER PLATE ^	-8 ohm	TypicalOperation;PublishedValue3
Effective Plate Supply Impedance (Each plate)	525 ohm	TypicalOperation
< „. II	6.3 V	TypicalOperation
Peak Inverse Plate Voltage	1250 V	Section1
Nominal Output Current	70 mA	Section1
Peak Forward Current	245 mA	Section1
Maximum Heater-Cathode Voltage	450 V	Section1

1975 RCA RC30

Section 2 · Rectifier

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
volte	4 V	Characteristic;PublishedValue1
volte	3 V	Characteristic;PublishedValue2
volte	6 V	Characteristic;PublishedValue3
missible heater-voltage range is from	6 V	Characteristic;PublishedValue1
missible heater-voltage range is from	8 V	Characteristic;PublishedValue2

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Peak Inverse Plate Voltage	1250 V	MaximumRating
Steady-State Peak Plate Current (Per Plate)	245 mA	MaximumRating
DC Output Voltage (At filter input)t	360 V	MaximumRating
Average Output Current (Each plate)t	45 mA	MaximumRating
cycle	75 %	MaximumRating
per plate of	1.1 A	MaximumRating
Ef=	6 V	TypicalOperation;PublishedValue1
Ef=	6.3 V	TypicalOperation;PublishedValue2
Ef=	60 V	TypicalOperation;PublishedValue3

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
„„ . „ (	520 ohm	TypicalOperation
PER PLATE ^	400 ohm	TypicalOperation;PublishedValue1
PER PLATE ^	6 ohm	TypicalOperation;PublishedValue2
PER PLATE ^	-8 ohm	TypicalOperation;PublishedValue3
Effective Plate Supply Impedance (Each plate)	525 ohm	TypicalOperation
< „. II	6.3 V	TypicalOperation
Peak Inverse Plate Voltage	1250 V	Section1
Nominal Output Current	70 mA	Section1
Peak Forward Current	245 mA	Section1
Maximum Heater-Cathode Voltage	450 V	Section1

TUBE TINKER

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