

# EITEL-MCCULLOUGH, INC.

2-240R

HIGH-VACUUM RECTIFIER

The Eimac 2-240A is a high vacuum diode rectifier intended for use in rectifier units, voltage multipliers, or in special applications, whenever conditions of extreme ambient temperatures, high operating frequency, high peak inverse voltages, or the production of high-frequency transients would prevent the use of gas-filled rectifier tubes.

The 2-240A has a maximum d-c current rating of 500 milliamperes and a maximum peak inverse voltage rating of 25,000 volts. Cooling is by convection and radiation.

A single 2-240A will deliver 320 milliamperes at 10,000 volts to a capacitor-input filter with 9,000 volts single-phase supply. Four 2-240A's in a bridge circuit will deliver 1.0 ampere at 16,000 volts to a choke-input filter with 18,000 volts single-phase supply.

## GENERAL CHARACTERISTICS

	GEI	4EV	AL '	UNA			.KIJ		<b>J</b>				10	1
ELECTRICA	AL											İ		
Filament	: Thoriated	Tung	sten									1		
	Voltage	-	-	-	-	-	-	-	-	7.5	volts		1	v v
	Current	-	-	-	-	-	-	-	•	12.0	amperes	h		<del></del>
MECHANI	CAL													
Base		-	•	-	-	-	-	•	-		- 50-w	att jumb	o 4-pin b	payonet
Basing		-	-	-	-	-	-	-	-	-	- R	efer to	outline c	drawing
Socket		-	-	-	-	-	-	-	-	Refe	r to discussi	on unde	r "Appli	cation"
Mountin	g Position	•	-	-	-	-	-	-	-	-	- Ve	rtical, b	ase dow	n or up
		-	-	-	-	-	-	-	-	-	- Co	nvectio	n and ra	ıdiation
Maximu	m Temperat	ure o	f Plate	Seal	-	-	-	-	-	•		-		225°C
	ended Hea					nnect	or -	-	-	-		-	Eima	c HR-6
Maximu	m Over-all	Dime	nsions:											
	Length	-	-	-	-	-	-	-	-	-		•	11.2	inches
	Diameter	-	-	-	-	-	-	-	-	-		-	3.82	inches
Net We	ight -	-	-	-	-	-	•	-	-	-		-	10	ounces
Shipping	g Weight (	appro	x.)	•	-	•	-	-	-	•		•	3	pounds
MAXIMUM	A RATINGS	(Per	tube)											
	PEAK INV	ERSE	PLATE	VOL	TAGE		-	-	-	2	5,000 MAX	. VOLTS	3	
	PLATE DI	SSIPA	MOIT	-	-	-	-	-	-		I50 MAX	. WATT	'S	
	D-C PLAT	E CU	RRENT		-	-	-	•	-	•	500 MAX	. MA		
	PEAK PLA	TE C	URREN	١T	-	-	-	-	-		4.0 MAX	. AMPE	RES	

Averaged over one cycle for each tube. Applies only when the rectifier is coupled to the load by a choke-input filter incorporating the "critical" value (or larger) of input inductance. For maximum d-c current ratings under this and other load conditions see discussion under "Application".

## **APPLICATION**

### **MECHANICAL**

Mounting—The 2-240A must be mounted vertically with the base either down or up. The lead to the plate terminal of the tube should be flexible.

The 50-watt jumbo 4-pin bayonet base fits an E. F. Johnson Co. No. 123-211, a National Co. No. XM-50, or an equivalent socket. In some circuits, particularly those of the voltage multipliers illustrated in Fig. 2, it may be necessary to mount

the socket on stand-off insulators, or on a sheet of insulating material, to provide adequate insulation to ground.

Cooling—The 2-240A is cooled by convection and radiation. Clearance should be provided around the glass envelope adequate for the free circulation of air. An Eimac HR-6 Heat Dissipating Connector or equivalent is required on the plate terminal.

The maximum temperature at the plate seal must not exceed

#### APPLICATION (Continued)

225°C. A convenient accessory for measuring this temperature is "Tempilaq", a temperature-sensitive lacquer available from the Tempil Corporation, 132 W. 22nd St., New York 11, N. Y.

#### **ELECTRICAL**

Filament Operation—For maximum tube life, the filament voltage, as measured at the base pins, should be the rated value of 7.5 volts. Variations must be kept within the range from 7.15 to 7.85 volts. In applications which require the diode to deliver high peak currents, it is important to maintain the filament voltage at the rated value. All four socket terminals should be used, placing two in parallel for each filament connection.

CAUTION SHOULD BE OBSERVED WHEN MEASURING RECTIFIER FILAMENT VOLTAGE. THE FILAMENT CIRCUIT MAY BE AT HIGH POTENTIAL.

The thoriated-tungsten filament of the 2-240A reaches operating temperature in a fraction of a second after application of voltage. Plate voltage may be applied simultaneously with filament voltage. All four socket terminals should be used, putting two in parallel for each filament connection.

Plate Operation—With low room illumination, the plate of the 2-240A begins to show color as the maximum plate dissipation rating of 150 watts is approached. The maximum peak inverse voltage rating of 25,000 volts should not be exceeded at any time.

**Performance**—The accompanying table shows some maximum performance capabilities of the 2-240A when used as a power-supply rectifier.

2-240A MAXIMUM-PERFORMANCE CAPABILITIES

		Capacitor-	Input Filter	Choke-Input Filter			
Circuit Type	A-C Input Voltage (volts rms)	D-C Output Voitage (voits)	D-C Output Current (amperes)	D-C Output Voltage (volts)	D-C Outpu Current (amperes)		
Single- Phase, Half- Wave	9,000	10,000	0.320		*******		
Single- Phase, Full- Wave	9,0001	10,000	0.640	8,000	1.00		
Single- Phase, Bridge	18,000	20,000	0.640	16,000	1.00		

<sup>1</sup>One-half the transformer secondary voltage.

Maximum D-C Current Ratings—Plate dissipation rather than peak current usually limits the d-c current which the 2-240A is capable of delivering to the load. Because the plate dissipation associated with a given d-c current depends upon the amount of ripple and its wave-shape, circuit conditions will determine the maximum d-c current rating of the tube.

Choke-Input Filter—The maximum d-c current rating of the 2-240A is 500 milliamperes when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance (L<sub>1</sub> in Fig. 1):

$$L_o = \frac{R_{eff}}{18.8f} \quad \text{for full-wave single-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{75f}$$
 for half-wave three-phase rectifiers,

$$L_o = \frac{R_{eff}}{660f}$$
 for full-wave three-phase rectifiers,

where: Lo="critical" value of input inductance (henries),

f = supply-line frequency (cycles per second).

Choke-input filters are not normally used with single-phase half-wave rectifiers.

Capacitor-Input Filter—The 2-240A is particularly suitable for power-supply applications demanding high voltage at low cur-

rent. Under these conditions capacitor-input filter circuits become desirable. The maximum d-c current rating of the 2-240A when no input choke is incorporated in the filter depends upon the total series resistance of the capacitor-charging circuit relative to the effective load resistance seen by each tube. The circuit diagrams and tabulation in Fig. 2 are so arranged and labeled that this required series resistance may be found for a wide range of load conditions. This may be done by determining the value of the following quantities:

 $\rm E_{\rm c}$  is the filter-input d-c voltage. While this is usually the entire load voltage, in the case of voltage multipliers it is the load voltage divided by the multiplication factor.

Ip is the d-c current per tube. This is the entire load current only in the case of the simple half-wave rectifier or half- or full-wave multiplier. In the case of full-wave center-tapped or bridge rectifiers, Ip is half the load current.

 $R_{\rm c}$  is the total charging-circuit resistance. A certain minimum value of charging-circuit resistance is necessary to limit the peak value of current to which the tubes will be subjected under given load conditions. This required minimum depends upon the d-c current per tube  $\{l_p\}$ , and has been tabulated in Fig. 2 as a percentage of the effective load resistance per tube  $\{E_c/I_p\}$ . The total charging-circuit resistance involves the internal resistance of the rectifer tube,  $R_p$ , the added series resistor,  $R_s$ , and the equivalent internal resistance of the a-c voltage supply,  $R_i$ .

 $R_{\,p}$  is the plate resistance of the 2-240A, which may be taken as 200 ohms.

R; is the equivalent internal resistance of the supply. This may be taken as the regulation of the high-voltage supply expressed as a decimal multiplied by the load resistance used in measuring this regulation.

R<sub>s</sub> is the series resistor which must be inserted in the charging circuit to bring the total charging-circuit resistance up to the required minimum. Its value may be found from the formula associated with each of the circuits of Fig. 2. This resistor must be inserted in such a position in the circuit that it protects all tubes.

Tubes may be operated in parallel to increase the output capability in a given circuit. When two tubes are placed in parallel at each place where one is shown in the circuits of Fig. 2, the plate resistance  $\{R_p\}$  will be half as great and the maximum allowable load current twice as great as indicated.

Peak Inverse Voltage—The peak inverse voltage rating of the 2-240A is 25,000 volts. In single-phase power-supply rectifier circuits the peak inverse voltage to be used in design is the peak a-c supply voltage (1.41 times Erms in Fig. 2) in the case of bridge circuits, and twice this value in the case of half- and full-wave rectifiers and voltage multipliers. Peak inverse voltage in three-phase operation depends upon the circuit employed and will be found listed in the handbooks.

Special Applications—The ratings given for capacitor-input filter circuits assume values of input capacitance large enough to hold the ripple to a low value. In special applications where a larger percent ripple is tolerable, and filter capacitance is low, the 2-240A is capable of larger d-c output currents.

As a unidirectional conductor in d-c circuits where the current is continuous and the percent ripple is moderate, the maximum current rating of the 2-240A is 800 milliamperes.

The plate characteristic curve for the 2-240A serves as a guide to special applications. The maximum plate dissipation rating of 150 watts, the maximum peak inverse voltage rating of 25,000 volts, and the maximum peak plate current of 4.0 amperes must not be exceeded.

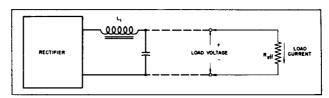
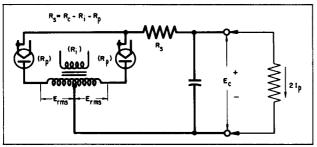
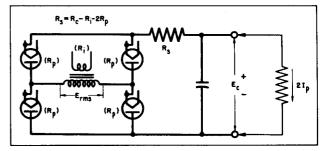


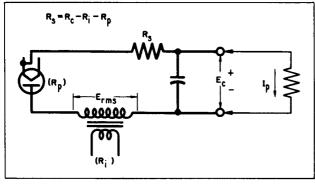
Fig. 1. Rectifier with Choke-Input Filter



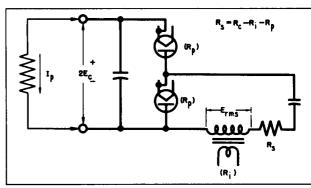




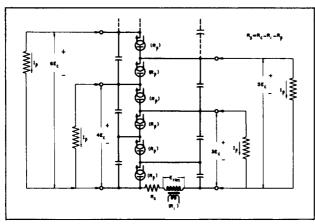
b. Full-Wave Bridge Rectifier



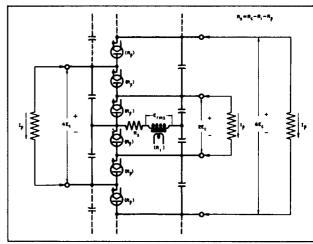
c. Half-Wave Rectifier



d. Half-Wave Voltage Doubler



 Half-Wave Voltage Multiplier (with common ground when R<sub>s</sub> is inserted on the "high" side of E<sub>rms</sub>)



f. Full-Wave Voltage Multiplier

Eimac 2-240A Maximum D-C Current Ratings for R-C Filter Applications								
D-C Plate Current (Ip)	280	300	320	340	360	380	400	milliamperes per tube
Total Charging- Circuit Resistance (R <sub>c</sub> )	1.0	1.8	3.0	5.0	7.5	12	20	percent of Effective Load Resistance per Tube (E <sub>c</sub> /I <sub>p</sub> )
A-C Supply Voltage (E <sub>rms</sub> )	0.80	0.83	0.87	0.94	1.01	1.14	1.33	times Filter-Input D-C Voltage (E <sub>c</sub> )
Peak-Inverse Voltage (1/2 these values for circuit b.)	2.3	2.4	2.5	2.7	2.9	3.2	3.8	times Filter-Input D-C Voltage (E <sub>c</sub> )

Fig. 2 Eimac 2-240A Basic R-C Circuits (for any one of the indicated loads)

 $R_i = Equivalent$  resistance of voltage source

 $R_p = 200$  ohms (100 ohms for two tubes in parallel)

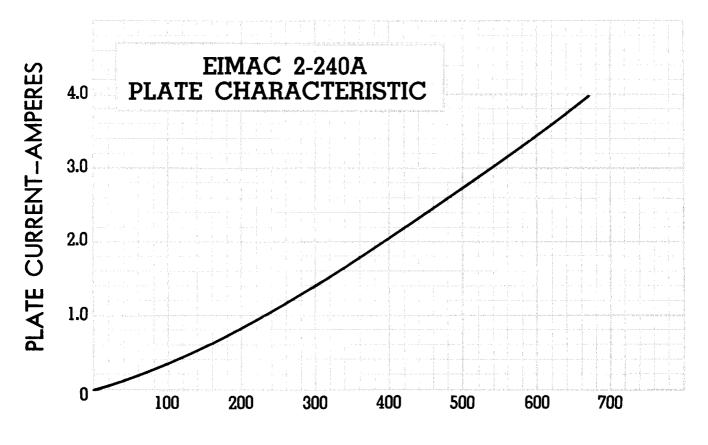


PLATE VOLTAGE-VOLTS

