FULL-WAVE VACUUM RECTIFIER

GENERAL DATA

Electrical:
Filament, Coated:
Voltage .................. 5 ................ ac volts
Current .................. 3 ................ amp

Mechanical:
Mounting Position ........ Vertical, base up or down, or Horizontal with pins 2 and 4 in vertical plane
Maximum Overall Length ............... 4-3/4"
Maximum Seated Length ............... 4-3/16"
Maximum Diameter ................ 1-23/32"
Bulb .................... T-12
Base ..................... Flared Medium-Shell Octal 5-Pin with External Barriers (JETEC No.B5-127) or Short Medium-Shell Octal 5-Pin with External Barriers (JETEC No.B5-121)
Basing Designation for BOTTOM VIEW .............. G-5T

Pin 1—No Connection
Pin 2—Filament
Pin 4—Plate No.2
Pin 5—No Connection
Pin 6—Plate No.1
Pin 8—Filament

FULL-WAVE RECTIFIER

Maximum Ratings, Design-Center Values:
PEAK INVERSE PLATE VOLTAGE ........ 1550 max. volts
PEAK PLATE CURRENT PER PLATE ........ 1 max. amp
AC PLATE SUPPLY VOLTAGE (RMS) PER PLATE .... See Rating Chart I
DC OUTPUT CURRENT PER PLATE ......... See Rating Chart I
HOT-SWITCHING TRANSIENT PLATE CURRENT PER PLATE ....... See Operating Considerations

Typical Operation with Capacitor-Input to Filter:
AC Plate-to-Plate Supply
Voltage (RMS) .................. 600 900 1100 volts
Filter-Input Capacitor* ........... 40 40 40 μf
Total Effective Plate-Supply Impedance Per Plate ........ 21 67 97 ohms
DC Output Voltage at Input to Filter (Approx.):
At full-load current of 300 ma 290 - - volts
275 ma - 460 - volts
162 ma - - 630 volts

* When capacitance values higher than 40 μf are used, the effective plate-supply impedance should be increased so that the maximum rating for peak plate current is not exceeded.
FULL-WAVE VACUUM RECTIFIER

DC Output Voltage at Input to Filter (Approx.):

<table>
<thead>
<tr>
<th>Current (mA)</th>
<th>Voltage (Volts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>335</td>
</tr>
<tr>
<td>137.5</td>
<td>520</td>
</tr>
<tr>
<td>81</td>
<td>680</td>
</tr>
</tbody>
</table>

Voltage Regulation (Approx.):

<table>
<thead>
<tr>
<th>Current (mA)</th>
<th>Voltage (Volts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half-load</td>
<td>45</td>
</tr>
<tr>
<td>Full-load</td>
<td>60</td>
</tr>
</tbody>
</table>

Typical Operation with Choke-Input to Filter:

AC Plate-to-Plate Supply
Voltage (RMS) ......... 900 1100 volts
Filter-Input Choke .... 10 10 henries

DC Output Voltage at Input to Filter (Approx.):

<table>
<thead>
<tr>
<th>Current (mA)</th>
<th>Voltage (Volts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-load</td>
<td>340</td>
</tr>
<tr>
<td>275</td>
<td>440</td>
</tr>
<tr>
<td>Half-load</td>
<td>355</td>
</tr>
<tr>
<td>137.5</td>
<td>455</td>
</tr>
</tbody>
</table>

Voltage Regulation (Approx.):

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<th>Current (mA)</th>
<th>Voltage (Volts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half-load to Full-load</td>
<td>15</td>
</tr>
</tbody>
</table>

AVERAGE PLATE CHARACTERISTIC

OPERATING CONSIDERATIONS

Even occasional hot-switching with capacitor-input circuits permits the flow of plate current having magnitudes which can adversely affect tube life and reliability. If
capacitor-input circuits are to be used, it is essential that the tube be protected against the possible adverse effects of hot-switching. The tube can be protected by circuits, designed to incorporate sufficient plate-supply resistance, as determined from Rating Chart III, to limit the maximum peak current value per plate to 4.6 amperes during the initial cycles of hot-switching operation. For applications in which hot-switching is required, choke-input circuits are recommended. Such circuits limit the hot-switching current to a value no higher than that of the peak plate current.

RATING CHARTS AND OPERATION CHARACTERISTICS

Rating Chart I represents graphically the relationships between maximum ac voltage input and maximum dc output current derived from the fundamental ratings for conditions of capacitor-input and choke-input filters. This graphical presentation gives the equipment designer considerable latitude in choice of operating conditions.

Rating Chart II represents graphically the relationship between maximum rectification efficiency and maximum dc output current per plate for conditions of capacitor-input to filter.

A choice of operating values of dc output current per plate and rectification efficiency should be made such that they fall within the area of permissible operation to insure that the maximum peak plate current will not be exceeded. If the operating values chosen fall outside the permissible operating area, a different choice of parameters should be made. For a given value of ac voltage input and dc output current, it is possible to reduce the rectification efficiency by either increasing the plate-supply resistance per plate or by using a smaller value of input filter capacitor.

Rating Chart III represents graphically the relationships between minimum plate-supply resistance per plate and maximum ac plate-supply voltage per plate under no-load conditions of capacitor-input filter when occasional hot-switching is employed.

If occasional hot-switching is required with capacitor-input circuits, it is important to protect the tube and the circuits against the flow of plate currents having magnitude in excess of the maximum permissible hot-switching current of 4.6 amperes. To limit the hot-switching current, adequate series plate-supply resistance per plate is necessary. The minimum value of this resistance may be determined from Rating Chart III. If the transformer windings do not provide this minimum value of resistance, then additional dc series resistance is required. The value of this dc resistance, \( R_a \), may be determined from the relationship shown in the legend for Rating Chart III.
If appreciable series inductance is present in the plate supply, a value of series plate-supply resistance smaller than that indicated by the curve may be employed provided it is experimentally determined that the combined effect of inductance and plate-supply resistance used are adequate to limit the hot-switching current to the indicated maximum value.

The Operation Characteristics for Full-Wave Circuit with Capacitor-Input to Filter show the usual typical operating curves for a full-wave rectifier with capacitor-input filter. In addition, they show by means of the boundary line "AED" the limiting current and voltage relationships presented in Rating Chart I. A choice of operating values to the left of the boundary line should be made such that the operation of the tube at these values will insure that the maximum ratings will not be exceeded.

The Operation Characteristics for Full-Wave Circuit with Choke-Input to Filter show the usual typical operating curves for a full-wave rectifier with choke-input filter. They not only show by means of boundary line "ABC" the limiting current and voltage relationships presented in Rating Chart I, but also give information as to the effect of various sizes of chokes on regulation. The solid-line curves show the dc voltage outputs which would be obtained if the filter chokes had infinite inductance. The long-dash lines radiating from the zero position are boundary lines for various sizes of chokes as indicated. The intersection of one of these lines with a solid-line curve indicates the point on the curve at which the choke no longer behaves as though it had infinite inductance. To the left of the choke boundary line, the regulation curves depart from the solid-line curves as shown by the representative short-dash regulation curves. It will be noted that regulation improves with an increase in value of choke inductance, but for cost reasons, the value of inductance is usually held to the smallest value which will give the desired regulation over the operating current range. It is also to be noted that at the lower load currents, higher values of inductance are required to maintain good regulation. A choice of operating values to the left of the boundary line "ABC" should be made such that operation of the tube at these values will insure that the maximum ratings are not exceeded.
$E_f = 50 \text{ VOLTS AC}$
MAX. PEAK PLATE CURRENT PER PLATE = 1 AMP.
RECTIFICATION EFFICIENCY = $\frac{E}{\sqrt{2} E_S}$
WHERE $E = \text{DC OUTPUT VOLTS AT INPUT TO FILTER}$
$E_S = \text{AC PLATE SUPPLY VOLTS (RMS) PER PLATE}$
5U4-GB

RATING CHART III
CAPACITOR INPUT TO FILTER

$E_p = 5.0$ VOLTS AC  MAX. HOT-SWITCHING CUR. $\leq 4.6$ AMP.
PLATE-SUPPLY RESISTANCE PER PLATE $= R_{sec} + N^2 R_{pri} + R_A$
WHERE $R_{sec} =$ DC RESISTANCE OF TRANSFORMER
SECONDARY PER SECTION
$R_{pri} =$ DC RESISTANCE OF TRANSFORMER
PRIMARY
$R_A =$ DC RESISTANCE OF ADDED SERIES
RESISTANCE PER PLATE
$N =$ TRANSFORMER VOLTAGE STEP-UP
RATIO PER SECTION

MINIMUM PLATE-SUPPLY RESISTANCE PER PLATE—OHMS

0 100 200 300 400 500 600
AC PLATE SUPPLY VOLTS (RMS) PER PLATE—NO LOAD

OCT. 5, 1954 TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY 92CM-8452
OPERATION CHARACTERISTICS
FULL-WAVE CIRCUIT, CAPACITOR INPUT TO FILTER

\( E_s = 5.0 \, \text{VOLTS AC} \)
SUPPLY FREQUENCY = 60 CPS
CAPACITOR (C) INPUT TO FILTER = 40 \( \mu \)F
TOTAL EFFECTIVE PLATE-SUPPLY IMPEDANCE

<table>
<thead>
<tr>
<th>CURVE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<td>67</td>
<td>82</td>
<td>97</td>
</tr>
</tbody>
</table>

CURRENT-AND VOLTAGE BOUNDARY LINE 'DEA' IS THE SAME AS SHOWN ON RATING CHART I
OPERATION CHARACTERISTICS
FULL-WAVE CIRCUIT, CHOKE INPUT TO FILTER

\[ E_f = 5.0 \text{ VOLTS AC} \]
\[ \text{SUPPLY FREQUENCY} = 60 \text{ CPS} \]

SOLID-LINE CURVES = CHOKE SIZES OF INFINITE INDUCTANCE
LONG-DASH LINES = BOUNDARY LINES FOR CHOKE SIZES AS SHOWN
SHORT-DASH CURVES = REGULATION CURVES FOR REPRESENTATIVE CHOKE SIZES
CURRENT-AND-VOLTAGE BOUNDARY LINE 'CBA' IS THE SAME AS SHOWN ON RATING CHART I

\[ \begin{align*}
L & \quad \text{AS SHOWN} \\
C & \quad 18 \mu F
\end{align*} \]

DC OUTPUT VOLTGS AT INPUT TO FILTER
DC LOAD MILLIAMPERES

OCT. 1, 1954
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
92CM-8447
## Full-Wave Vacuum Rectifier

### GENERAL DATA

**Electrical:**
- Filament, Coated:
  - Voltage (AC or DC) .................. 5 volts
  - Current .......................... 3 amp

**Mechanical:**
- Operating Position: Vertical, base down or up, or Horizontal with pins 1 and 4 in vertical plane
- Maximum Overall Length ................ 4-5/8"
- Maximum Seated Length .................. 4-1/16"
- Diameter ................................ 1.438" to 1.562"
- Bulb .................................... T12
- Base .................................... Short Medium-Shell Octal 5-Pin with External Barriers, Style B, Arrangement 1 (JEDEC Group 1, No.B5-121), or Short Medium-Shell Octal 8-Pin with External Barriers, Style B (JEDEC Group 1, No.B8-118)
- Basing Designation for BOTTOM VIEW .......... 5T

![Pin Configuration Diagram]

**FULL-WAVE RECTIFIER**

Maximum Ratings, Design-Center Values:
- For power-supply frequencies of 25 to 1000 cps
- PEAK INVERSE PLATE VOLTAGE ................. 1550 max. volts
- AC PLATE SUPPLY VOLTAGE PER PLATE (RMS, without load) .............. See Rating Chart I
- STEADY-STATE PEAK PLATE CURRENT PER PLATE (See Rating Chart II) ........ 1 max. amp
- TRANSIENT PEAK PLATE CURRENT PER PLATE (See Rating Chart III) .......... 4.6 max. amp
- DC OUTPUT CURRENT .............. See Rating Chart I

**Typical Operation:**
- With capacitor
  - Supply Voltage (RMS, without load) ........ 600 900 1100 volts
  - Filter-Input Capacitorb ............. 40 40 — µf
  - Filter-Input Choke ................ - - 10 henrys

With choke

---

Indicates a change.
Total Effective Plate
Supply Impedance
Per Plate .......... 21  67  – ohms
DC Output Voltage at
input to filter ....... 290  460  420 volts
DC Output Current .... 300  275  275 ma

Characteristics:
Tube Voltage Drop for
plate ma. (Per plate) =
225 ........................................ 44 volts
275 ........................................ 50 volts
300 ........................................ 54 volts

a On the 5-pin base, pins 3, 5, and 7 are omitted.
b Values of capacitance greater than 40 μf may be used, provided the plate
supply impedance is increased to prevent exceeding the maximum peak-plate-
current rating.

→ Indicates a change.

92CS-B444R2
RATING CHART I

FOR SUITABLE CHOKE VALUES, SEE CURVE "OPERATION CHARACTERISTICS, Choke-Input Filter"

MAXIMUM OPERATING VALUES WITH:
- CHOKE-INPUT FILTER
- CAPACITOR-INPUT FILTER

DC OUTPUT MILLIAMPERES PER PLATE

AC PLATE SUPPLY VOLTS (RMS) PER PLATE (WITHOUT LOAD)

RATING CHART II

Capacitor-Input Filter

$E_T = 5$ VOLTS AC

MAXIMUM STEADY-STATE PEAK PLATE CURRENT PER PLATE (AMPERES) = $I$

RECTIFICATION EFFICIENCY $= \frac{E}{E_T}$

WHERE $E$ = DC OUTPUT VOLTS AT INPUT TO FILTER

$E_T$ = AC PLATE SUPPLY VOLTS (RMS) PER PLATE

AREA OF PERMISSIBLE OPERATION

RECTIFICATION EFFICIENCY

92CS-845IRI
RATING CHART III
Capacitor-Input Filter

$E_T = 5$ VOLTS AC
MAXIMUM TRANSIENT PEAK PLATE CURRENT PER PLATE (AMPERES) = 4.6
EFFECTIVE PLATE SUPPLY RESISTANCE PER PLATE =
$R_{sec.} + N^2 R_{pri.} + R_A$
WHERE $R_{sec.} =$ DC RESISTANCE OF TRANSFORMER SECONDARY PER SECTION
$R_{pri.} =$ DC RESISTANCE OF TRANSFORMER PRIMARY
$R_A =$ DC RESISTANCE OF ADDED SERIES RESISTANCE PER PLATE
$N =$ TRANSFORMER VOLTAGE STEP-UP RATIO PER SECTION

MINIMUM EFFECTIVE PLATE SUPPLY RESISTANCE (OHMS)

AC PLATE SUPPLY VOLTS (RMS) PER PLATE (WITHOUT LOAD)

92CS-8452RI
OPERATION CHARACTERISTICS
Full-Wave Circuit, Capacitor-Input Filter

$E_f = 5$ VOLTS AC
SUPPLY FREQUENCY (CPS) = 60
CAPACITOR (C) INPUT TO FILTER: $(\mu f) = 40$
TOTAL EFFECTIVE PLATE SUPPLY IMPEDANCE

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CURRENT- AND VOLTAGE-BOUNDARY LINE 'DEA' IS THE SAME AS SHOWN ON RATING CHART.
OPERATION CHARACTERISTICS
Full-Wave Circuit, Choke-Input Filter

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SOLID LINE CURVES = CHOKE OF INFINITE
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SHORT-DASH CURVES = REGULATION CURVES
FOR REPRESENTATIVE CHOKE SIZES
CURRENT- AND VOLTAGE-BOUNDARY LINE 'CBA'
IS THE SAME AS SHOWN ON RATING CHART I

[Diagram of circuit with annotations]

AS SHOWN $C = 16\mu F$

DC OUTPUT VOLTS AT INPUT TO FILTER

DC LOAD MILLIAMPERES