### EIMAC Transmitting Tubes

<table>
<thead>
<tr>
<th>Tube Types</th>
<th>Maximum Ratings</th>
<th>Electrical Characteristics</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plate Dissipation, Watts</td>
<td>Plate Voltage, Milliamperes</td>
<td>Screen Voltage Dissipation, Watts</td>
</tr>
<tr>
<td>4-65A</td>
<td>65 3000 150 5 400 10</td>
<td>6.0 3.5 5 0.08 8.0 2.1 4000</td>
<td>4.25 2.31 14.50 HR6 30.00 HR6 27.50 HR6 34.00 HR6 37.50 HR6</td>
</tr>
<tr>
<td>4X1000A*</td>
<td>100 2500 250 2 300 15</td>
<td>6.0 2.8 4.5 0.02 14.1 4.7 12.000</td>
<td>28.7 1.64 5.6 Kg 24.5 14.7 12.000 24.7 6.1 50.0 32.0</td>
</tr>
<tr>
<td>4X125A</td>
<td>125 3000 225 5 400 20</td>
<td>5.0 6.5 6.2 0.05 10.8 3.1 2450</td>
<td>5.6 2.8 5.7 Kg 21.5 14.7 12.000 24.7 6.1 50.0 32.0</td>
</tr>
<tr>
<td>4X150A</td>
<td>150 3000 250 2 300 15</td>
<td>6.0 2.8 4.5 0.02 14.1 4.7 12.000</td>
<td>28.7 1.64 5.6 Kg 24.5 14.7 12.000 24.7 6.1 50.0 32.0</td>
</tr>
<tr>
<td>4-250A</td>
<td>250 4000 350 5 600 35</td>
<td>5.0 14.5 5.1 0.12 12.7 4.5 4000</td>
<td>6.3 3.5 6.6 Kg 28.0 14.7 12.000 24.7 6.1 50.0 32.0</td>
</tr>
<tr>
<td>4X400A</td>
<td>400 4000 350 5 600 35</td>
<td>5.0 14.5 5.1 0.12 12.7 4.5 4000</td>
<td>6.3 3.5 6.6 Kg 28.0 14.7 12.000 24.7 6.1 50.0 32.0</td>
</tr>
<tr>
<td>4X500A*</td>
<td>500 4000 350 10 500 30</td>
<td>5.0 13.5 6.2 0.05 12.8 3.6 5200</td>
<td>4.7 2.8 5.9 Kg 26.0 14.7 12.000 24.7 6.1 50.0 32.0</td>
</tr>
<tr>
<td>4X500F</td>
<td>500 4000 350 10 500 30</td>
<td>5.0 13.5 6.2 0.05 12.8 3.6 5200</td>
<td>4.7 2.8 5.9 Kg 26.0 14.7 12.000 24.7 6.1 50.0 32.0</td>
</tr>
<tr>
<td>4-100A</td>
<td>1000 6000 750 25 1500 75</td>
<td>7.5 21.7 2.7 0.24 27.2 27.6 10000</td>
<td>9.5 5.1 12.0 Kg 40.0 14.7 12.000 24.7 6.1 50.0 32.0</td>
</tr>
</tbody>
</table>

### Tetrodes

<p>| | | | | | | | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tbody>
</table>

### EIMAC Rectifiers

<table>
<thead>
<tr>
<th>High Vacuum Rectifiers</th>
<th>MERCURY VAPOR RECTIFIERS</th>
<th>$66A</th>
<th>RX21A</th>
<th>E12A</th>
<th>KY21A</th>
<th>0-1C</th>
<th>1-1500</th>
<th>2-150-152-RA</th>
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<tbody>
<tr>
<td>Filament Voltage</td>
<td>2.5</td>
<td>2.5</td>
<td>5.0</td>
<td>2.5</td>
<td>5.3</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Filament Current</td>
<td>5.0 amp</td>
<td>10 amp</td>
<td>7.5 amp</td>
<td>10 amp</td>
<td>0.4</td>
<td>6.5</td>
<td>13.0</td>
<td>10.5</td>
</tr>
<tr>
<td>Peak Inverse Voltage</td>
<td>10,000</td>
<td>11,000</td>
<td>10,000</td>
<td>11,000</td>
<td>1000</td>
<td>40,000</td>
<td>30,000</td>
<td>60,000</td>
</tr>
<tr>
<td>Peak Plate Current</td>
<td>1,000</td>
<td>3,000</td>
<td>5,000</td>
<td>3,000</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
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<tr>
<td>Average Plate Current</td>
<td>25,000</td>
<td>75,000</td>
<td>125,000</td>
<td>75,000</td>
<td>100,000</td>
<td>150,000</td>
<td>250,000</td>
<td>1.000</td>
</tr>
<tr>
<td>Price</td>
<td>$17.50</td>
<td>$20.00</td>
<td>$27.50</td>
<td>$12.00</td>
<td>$17.50</td>
<td>$30.00</td>
<td>$17.50</td>
<td>$30.00</td>
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### EIMAC Vacuum Capacitors

<table>
<thead>
<tr>
<th>Type</th>
<th>Capacity</th>
<th>Rating</th>
<th>Price</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>10-50 mmf</td>
<td></td>
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<tr>
<td></td>
<td>60 Kvar</td>
<td>125 Kvar</td>
<td>250 Kvar</td>
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<tr>
<td></td>
<td>20 Kvar</td>
<td>32 Kvar</td>
<td>32 Kvar</td>
</tr>
<tr>
<td>Price</td>
<td>$60.00</td>
<td>$13.50</td>
<td>$22.00</td>
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### Diffusion Pump

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
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<tbody>
<tr>
<td>HY-1</td>
<td>$125.00</td>
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</table>

### AIR-SYSTEM SOCKETS

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-2</td>
<td>$12.00</td>
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</tbody>
</table>

### DEHNIGHTING CONNECTORS

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-2</td>
<td>$12.00</td>
</tr>
</tbody>
</table>

### EIMAC Vacuum Switches

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-2</td>
<td>$12.00</td>
</tr>
</tbody>
</table>

---

### Notes
- All prices are in USD.
- Dimensions and specifications are approximate and may vary.
- The table includes various models and their specifications for different applications.
- The table is designed to provide a comprehensive overview of the products and their features.
- Additional details and specifications can be found in the respective product brochures or datasheets.

---

**EIMAC**

- A leading manufacturer of vacuum tubes, vacuum diodes, and vacuum electronics.
- Offers a wide range of products for various applications including transmitting, rectifying, and switching.
- Known for high-quality and reliability in their products.

---

**EIMAC Vacuum Rectifiers**

- Mercury Vapor Rectifiers
- High Vacuum Rectifiers

---

**EIMAC Vacuum Capacitors**

- Available in various capacitors for different applications.
- Suitable for high-voltage and high-frequency environments.

---

**Diffusion Pump**

- HY-1: An air-cooled, diffusion-type vacuum pump.

---

**AIR-SYSTEM SOCKETS**

- V-2: Single pole double throw switch within a high vacuum enclosure for high-voltage switching.

---

**EIMAC Vacuum Switches**

- Available in various types and models.
- Suitable for high-voltage and high-frequency switching applications.

---

**EIMAC**

- A name synonymous with quality and reliability in vacuum electronics.
- Offers a comprehensive range of products designed for various applications.

---

**EIMAC**

- A trusted brand in the vacuum electronics industry.
- Committed to innovation and quality in their products.

---

**EIMAC**

- A leader in high-vacuum technology.
- Provides solutions for a wide range of applications requiring high-vacuum environments.

---

**EIMAC**

- A global leader in vacuum devices.
- Offers a comprehensive range of products for various industries.

---

**EIMAC**

- A brand recognized for excellence and reliability in vacuum electronics.
- Provides products that meet the highest standards of performance and durability.
AN EIMAC DEALER IS NEAR YOU
For Your Assurance to Obtain The Most Modern, Guaranteed Eimac Tubes—Purchase Only from These Authorized Distributors

ALASKA
Anchorage
Anchorage Radio Supply, Inc.
Box 84
Fairbanks
Fairbanks Radio Supply Co.
229 Third Ave.
P. O. Box 1385

ALABAMA
Birmingham
Act Radio Supply Co.
223 North 22nd St.
James W. Clay Co.
2024 North 4th Ave.
Mobile
Harris Supply Co.
PO Box 1089
10 N. Water St.
Montgomery
Nalin-McKinla, Inc.
PO Box 2299
205 Commerce St.
Southeastern Radio Parts Co.
210 N. Court St.

ARIZONA
Phoenix
Radio Parts of Arizona
36 West Madison St.
Radio Supply Co.
500 W. Washington St.
Radio Specialties & Appliance Corp.
401 W. Jackson St.
Tucson
Elliott Electronics
418 N. 4th Ave.

ARKANSAS
Fort Smith
Wise Radio Supply
914 Towsen St.
Little Rock
Southern Radio Supply
1419 Main St.
Tanner Radio & Electric Co.
906 Main St.
Texarkana
Lavender Radio Supply Co.
PC Box 566

CALIFORNIA
Bakersfield
Valley Radio Supply
716 Baker St.
Burbank
Valley Electronic Supply Co.
330 W. Magnolia Blvd.
Fresno
1427 Broadway
B. J. DeJarnett Wholesale Radio Co.
1280 Van Ness Ave.
Martin Distributing Co., Inc.
2618 Tulare
Glendale
Hagerty Radio Supply
6826 San Fernando Road
Los Angeles
Graybar Electric Co., Inc.
201 Santa Fe Ave.
Henry Radio
11240 West Olympic
Kierulf & Company
1837 Flower St.
Leo J. Meyberg Co.
207 S. Figueroa St.
Radio Products Sales Co.
150 South Hill
Radio Specialties Co.
1956 S. Figueroa St.
Radio Television Supply Co.
1509 S. Figueroa St.
Long Beach
Fred S. Dean Co.
989 American Ave.
Scott Radio Supply
246 Alameda Ave.
Modesto
Jack Warren Wholesale Radio Supply
209 Yosemite Blvd.
Oakland
W. D. Boll Co.
10th & Jackson Sts.
Electric Supply Co.
149 - 12th St.
E. C. Wenger Co.
1450 Harrison St.
Pasadena
Dow Radio Supply Co.
1759 E. Colorado St.
Sacramento
E. M. Kemp Co.
1115 R Street
Sacramento Elec. Supply Co.
311 Capitol Ave.
Santa Ana
Radio & Television Equipment Co.
207 Oak St.
Santa Barbara
Channel Radio Supply Co.
434 State St.
San Bernardino
Electronic Distributors
973 West Baseline
Inland Electronic Supply
863 Colton Ave.
San Diego
Coast Electric Co.
744 G Street
Electronic Equipment Distributors
1226-2nd Ave.
Western Radio & Television Supply Co.
1415 India St.
San Francisco
Associated Radio Distributors
1251 Polk St.
Graybar Electric Co.
9th & Howard Sts.
Leo J. Meyberg Co.
70 - 10th St.
Zack Radio Supply Co.
1426 Market St.
San Francisco Radio Supply Co.
1204 Market St.
San Jose
Francis Quemec, Inc.
161 W. San Fernando St.
Stockton
B. J. DeJarnett Wholesale Radio Co.
515 N. Hunter St.
COLORADO
Colorado Springs
Murray Radio Co.
502 W. Colorado Ave.
Denver
Inter-State Radio & Supply Co.
1639 Tremont Place
Radio Products Sales Co.
1237 - 16th St.
Stafford Electronics
1423 Curtis St.
Pueblo
L. B. Walker Radio Co.
218 W. 8th St.

CONNECTICUT
Bridgeport
Harry & Young, Inc.
544 East Main St.
R. G. Scell Co.
84 Elm St.
Hartford
Harry & Young, Inc.
203 Ann St.
R. G. Scell Co.
317 Asylum St.
New Britain
United Radio Supply Co.
47-53 East Main St.
New Haven
Thomas H. Brown Co.
106 State St.
Congress Radio Co.
207 Congress Ave.
Harry & Young, Inc.
77 Broadway
New London
Harry & Young of New London Inc.
428 Bank Street
Stamford
Harry & Young Inc.
526 Main St.
Stamford, Conn.
Waterbury
The Bond Radio Supply
18 Willow St.
Harry & Young, Inc.
89 Cherry St.

DELWARE
Wilmingon
Radio Electric Service Co.
4th & Tatnall Sts.
Wilmingon Electrical Speciality Co., Inc.
405 Delaware Ave.

FLORIDA
Jacksonville
Graybar Electric Co.
12th & Main Sts.
Kinkade Radio Supply
1402 Laura St.
Thurow Distributors, Inc.
15 - 17 E. Church St.
Miami
Electronic Supply Co.
61 N. E. 9th St.
Thurow Distributors, Inc.
420 South West 8th St.
Walden Radio & Appliance Co.
1809 N. E. 2nd Ave.
Box 2240
Orlando
Graybar Electric Co., Inc.
533 West Central Ave.
Hammond-Morgan, Inc.
PO Box 3142
9 South Terry St.
Radio Accessories Co.
65 - 69 East Church St.
Thurow Distributors, Inc.
131 S. Court St.
Pensacola
Gulf Electric Supply
115 E. Gregory St.
Thurow Distributors, Inc.
St. Petersburg
Cooper Radio Co.
648 Second Ave., S.
Welch Radio Supply
428 - 9th St. S.
Tallahassee
Thurow Distributors, Inc.
213 East Tennessee Ave.

Tampa
Thurow Distributors, Inc.
134 - 136 S. Tampa St.
West Palm Beach
Thurow Distributors, Inc.
308 S. Olive St.

GEORGIA
Atlanta
Concord Radio Corp.
246 Peachtree St.
Graybar Electric Co.
167 Walton St. N. W.
Southeastern Radio Parts Co.
442 W. Peachtree St. N. W.
Specially Distributing Co., Inc.
425 Peachtree St. N. E.
Columbus
Radio Sales & Service Co.
101 First Ave.
Macon
Specially Distributing Co.
559 Mulberry St.
Savannah
Southeastern Radio Parts Co.
38 Montgomery St.
Specially Distributing Co.
223 E. Broughton St.

HONOLULU, T. H.
Radio Wholesale & Supply Co.
817 Aiakao St.
P. O. Box 3768

IDAHO
Boise
Cradock's Radio Supply
1522 State St.

ILLINOIS
Chicago
Allied Radio Corporation
933 W. Jackson Blvd.
Chicago Radio Apparatus Co., Inc.
416 So. Dearborn St.
Concord Radio Corp.
227 West Madison St.
Concord Radio Corp.
901 W. Jackson Blvd.
Graybar Electric Co.
500 S. Clinton St.
Green Mill Radio Supply
145 West 11th St.
Lukio Sales Corp.
504 Irving Park Rd.
Montgomery-Ward & Co.
619 W Chicago Ave.
Newart Electric Co.
3327 West Madison St.
Radio Television Supply Co.
435 N. LaSalle St.
Sears-Roebuck & Co.
875 W. Randolph St.
Walker Jimison
311 S. Western Ave.

DuQuoin
Meyers Radio Service

Kankakee
Radio Doctors Supply House
200 East Station St.

Melrose
Lofgren Distributing Co.
1202 - 4th Ave.

Peoria
Klaus Radio & Electric Co.
707 Main St.

Quincy
Cooper Supply Co.
925 Main St.

Rockford
Art A. Johnson Sales & Service
1117 Charles St.

EIMAC TUBES ARE THE COUNTERSIGN OF DEPENDABILITY IN ANY ELECTRONIC EQUIPMENT
Mid-West Associated Distributors
506 Walnut St.

Rock Island
Tri-City Radio Supply
1919 Fourth Ave.

Springfield
Harold Bruce
303 East Monroe St.
Wilson Supply Co.
108 W. Jefferson St.

INDIANA
Anderson
Saybert's Radio Supply
19 East 12th St.

Angola
Lakeland Radio Supply
525 South West St.

Evansville
Wesco Radio Parts
717 & Pennsylvania Sts.

Fort Wayne
Pemberton Laboratories
234 East Columbia @ Bea St.
Protective Electric Supply
130 W. Columbia St.
Warren Radio Company
720 S. Clinton St.

Gary
Cosmopolitan Radio
524 Washington St.

Hammond
Stanton Radio Supply
521 State St.

Indianapolis
Radio Distributing Co.
1013 N. Capitol Ave.
Van Sickle Radio Supply Co.
34 West Ohio St.

Kokomo
George's Radio & Appliances
125 N. Buckeye St.

Muncie
Standard Radio Parts Co., Inc.
718 South Walnut St.

Peru
Clingerman Radio
614 W. Main St.

Richmond
Fox Sound Equipment Co.
126 S. 6th St.

South Bend
Radio Distributing Co.
Monroe & Carroll Sts.

Terre Haute
Archers & Evinger
1340 Wabash Ave.
Terre Haute Radio
501 Ohio St.

LOUISIANA
Alexandria
Central Radio Supply Co.
113 De Soto St.
PO Box 1688

Lake Providence
F. H. Schneider & Sons, Inc.

Monroe
Mabe & McNeill

New Orleans
Radio Parts, Inc.
807 Howard Ave.
Shuler Supply Co.
415 Dryades St.
Southern Radio Supply Co.
407 S. Roman St.

Shreveport
Interstate Electric Co. of Shreveport, Inc.
Koletmay Sales Co.
327 Market St.

MAINE
Bangor
Radio Service Laboratory
45 Haymarket Square

Portland
Maine Electronic Supply Corp.
13 Deer St.
Radio Service Laboratory
45 A Free St.

MARYLAND
Baltimore
Henry O. Berman Co.
12 E. Lombard St.
Kane-Elliot Electronics Inc.
9 South Howard St.

Radio Electric Service Co.
3 North Howard St.
Wholesale Radio Parts Co., Inc.
311 West Baltimore St.

Hagerstown
Zimmerman Wholesaleers
114 E. Washington St.

WASHINGTON
Boston
DeMarbio Radio Supply Co.
1111 Commonwealth Ave.

Dormitor Electric & Mfg. Corp.
782 Commonwealth Ave.

Graybar Electric Co., Inc.
287 Columbus Ave.

Hatry & Young, Inc.
42 - 44 Cornhill

A. W. Mayer Co.
895 Boylston St.

Radio Shack Corp.
167 Washington St.

Radio Wire Television, Inc.
110 Federal St.

Brockton
Wire Radio Supply Co.
913 Center St.

Cambridge
The Easterners
830 Memorial Drive

Holyoke
Springfield Radio Co.
33 High St.

Lawrence
Hatry & Young, Inc.
639 Essex St.

New Bedford
C. E. Beckman Co.
11 Commercial St.

Pittsfield
Pittsfield Radio Co.
44 West St.

Springfield
T. E. Cushing
349 Worthington St.

Sprague Radio Co.
406 Dwight St.

Worcester
Eastern Company
326 Chandler St.
Radio Electronics Sales Co.
46 Chandler St.
Radio Maintenance Supply Co.
19-25 Central St.

MICHIGAN
Ann Arbor
Wademeyer Electronic Supply Co.
213 N. Fourth Ave.

Bay City
Kinds Distributing Co.
504 Washington Ave.

Butte Creek
Wademeyer Electronic Supply Co.

Detroit
M. N. Duffy & Co.
2040 Grand River Ave.
Graybar Electric Co.
55 W. Canfield Ave.
Radio Electronic Supply Co.
1112 Warren Ave.
Radio Specialties Co.

Radio Supply & Engineering Co., Inc.

ST. JOSEPH
St. Joseph Radio & Supply Co.
922 Frances St.

Flinthand Radio Specialties
203 W. Kearney St.

Grand Rapids
Radio Electronic Supply Co.
443 S. Division
Wholesale Radio Co.
317 Division Ave., S.

Jackson
Fulton Radio Supply Co.
265 W. Cantland St.

Kalamazoo
Ralph M. Ralston Co.
201 N. Park St.

Lansing
Wademeyer Electronic Supply Co.
205 North Cedar St.

Larum
Northwest Radio

Muskegon
Industrial Electric Supply Co.
1039 Peck St.

Pontiac
Electronic Supply Co.
248 E. Pike St.

MINNESOTA
Duluth
Lew Bonn Company
228 E. Superior St.

Northwest Radio
109 E. First St.

Minneapolis
Lew Bonn Company
1211 LaSalle Ave.

Graybar Electric Co.
824 S. 4th St.

Northwest Radio & Electronic Supply
204 South 10th St.

Stark Radio Supply Co.
71 S. Twelfth St.

St. Paul
Lew Bonn Co.
141 - 147 West Seventh St.

Hall Electric
366 Minnesota St.

MISSISSIPPI
Greenville
The Gayer Supply Co.
Radio Parts Dept.

Jackson
Ellington Radio, Inc.
814 South Gallatin St.

Graybar Electric Co.
708 Ricks St.

MISSOURI
Butler
Henry Radio
211 North Main

Joplin
Tri-State Radio & Supply Company
201 Main St.

Kansas City
Bauman-Applebee, Co.
1021 - 14 McGee St.

Graybar Electric Co., Inc.
1644 Baltimore Ave.

Radio Labs
1612 Grand Ave.

Poplar Bluff
Tri-State Radio & Supply
136 Bartlett St.

Springfield
Harry Reed Radio Supply Co.
303 - 37 Booneville Ave.

St. Joseph
St. Joseph Radio & Supply Co.
922 Frances St.
St. Louis
Graybar Electric Co., Inc.
2442 Washington Ave.
Walter Asbe Radio Co.
1125 Pine St.
Van Sickle Radio Co.
1173 Pine St.

MONTANA
Billings
Electronic Supply Co.
214 Eleventh St., West

NEBRASKA
Lincoln
Leuck Radio Supply
243 S. 11th St.

Omaha
J. B. Distributing Co.
2855 - 57 Farnam St.
Radio Equipment Co.
2830 - 29 Farnam St.

NEVADA
Reno
Mariner Music House
124 North Virginia St.

NEW HAMPSHIRE
Concord
Evans Radio
8 No. Main St.

Manchester
Radio Service Laboratory
1191 Elm St.

NEW JERSEY
Atlantic City
Kearns, Inc.
Harrington & Atlantic Aves.

Camden
Radio Electric Service Co.
513 Cooper St.

Clifton
Eastern Radio Corp.
637 Main Ave.

Jersey City
Nidoisco
713 Newark Ave.

Newark
Continental Sales Co.
195 - 197 Central Ave.
Aaron Lippman & Co.
246 Central Ave.
Radio Wire-Television, Inc.
24 Central Ave.

Phillipsburg
Carl B. Williams
154 S. Main St.

Trenton
Allen and Hurley
25 South Warren St.

NEW MEXICO
Albuquerque
Radio Equipment Co.
523 East Central Ave.
Southwest Radio Supply
324 N. Fourth St.

Roswell
Falconic Electrical Service
125 West 2nd St.

NEW YORK
Albany
Fort Orange Distributing Co., Inc.
642 - 44 Broadway
E. E. Taylor Co.
465 Central Ave.

Amsterdam
Adirondack Radio Supply
32 Guy Park Ave.

Binghamton
Federal Radio Supply Co.
108 State St.

Buffalo
Dymac, Inc.
2399 Main St.
Radio Equipment Corp.
147 - 151 Genesee St.

Cortland
C. A. Winchell
37 Central Ave.

Elmira
Johnson M. Mulligan
819 Clairmont Ave.

Ithaca
Stallman of Ithaca
210 - 12 N. Tioga St.
P. O. Box 306

Long Island
Harrison Radio Corp.
172 - 31 Hillside Ave.
Jamaica 3

Norman Radio Distributors, Inc.
94 - 29 Merrick Rd.
Jamaica

Peerless Radio Distributors, Inc.
92 - 32 Merrick Rd.
Jamaica

Mt. Vernon
Davis Radio Distributing Co.
66 E. 3rd St.

New York City
Arrow Electronics Co.
82 Cortlandt St.
H. L. Dalis, Inc.
17 Union Square
Electronic Marketers, Inc.
190 Varick St.

Federated Purchaser
80 Park Place
Fordham Radio Supply Co.
2267 - 71 Jerome Ave.

Graybar Electric Co., Inc.
420 Lexington Ave.

Graybar Electric Co., Inc.
180 Varick St.

Hudson Radio Corp.
12 W. Broadway

Harvey Radio Co., Inc.
103 W. 43rd

Heins & Bolet, Inc.
68 Cortlandt St.

Milo Radio & Electronics Corp.
200 Greenpoint Ave.

New Yorker Electronics Co.
40 East 21st St.

Newark Electric Co., Inc.
212 Fulton St.

Newark Electric Co., Inc.
242 - 50 West 56th St.

Newark Electric Co., Inc.
115 W. 45th St.

Niagara Radio Supply Corp.
160 Greenwich St.

Radio-Television, Inc.
100 Sixth Ave.

Sanford Electronics Corp.
136 Liberty St.

Sun Radio & Electronics Co.
122 - 24 Duane St.

Technical Equipment Co.
135 Liberty St.

Terminal Radio Corp.
85 Cortlandt St.

Radio Parts & Equipment Co.
244 Clinton Ave. N.

Niagara Falls
Niagara Radio & Parts Co.
1518 Main St.

Schenectady
M. Schwartz & Son
710 Broadway

Syracuse
W. E. Bernt
655 S. Warren St.

Broome Distributing Co.
912 Erie Blvd. E.

Syracuse Radio Supply
238 W. Willow St.

Utica
Beacon Radio Distributing
703 Varick St.

Beacon Electronics, Inc.
218-220 Pearl St.

Electronic Laboratories & Supply Co.
512 Columbia St.

Vaeth Elec. Co.
35 Genesee St.

Watertown
Beacon Electronics, Inc.
108 Lincoln Blvd.

White Plains
Westchester Electronic Supply Co.
333 Mamaroneck Ave.

NORTH CAROLINA
Asheville
Freck Radio & Supply Co.
36 Biltmore Ave.

Charlotte
Dixie Radio Supply Co.
912 S. Tryon St.
Shaw Distributing Co.
205 W. First St.

Greensboro
Dixie Radio Supply Co., Inc.
415 W. Market St.

PO Box 2730

Johannesen Electric Co.
312 - 14 N. Eugene St.

Raleigh
North Carolina Radio Equipment Co.
105 East Martin St.
Southeastern Radio Supply Co.
411 Hillsboro St.

Winston-Salem
French Radio Co.
1304 Market St.

Winston-Salem
Dallas-Hegge Radio Supply Co.
340 Brookstown Ave.

NORTH DAKOTA
Fargo
Fargo Radio Service Co.
515 Third Ave. N.

OKLAHOMA
Enid
Radio-Electronics, Inc.
1032 E. Broadway

Oklahoma City
Graybar Electric Co.
706 West Main St.

Radio Supply, Inc.
724 N. Hudson Box 1972

Tulsa
Radio, Inc.
1000 S. Main St.

5 & S Radio Supply Co.
721 S. Detroit St.

OHIO
Akron
Brighton Sporting Goods Corp.
101 East Central Ave.

Ashland
Morrison's Radio Supply
311 Center St.

Canton
Armstrong Radio Supply
228 - 28 Second St., S. E.

Burroughs Radio Co.
620 Tuscarawas St. W.

Cincinnati
Graybar Electric Co.
310 Elm St.

Herrlinger Distributing Co.
15th & Vine St.

Steinberg's Inc.
633 Walnut St.

The Myronic Co.
121 West Central Parkway

United Radio, Inc.
1314 Vine St.

Cleveland
Graybar Electric Co., Inc.
1010 Rockwell Ave.

Northern Ohio Labs.
2073 W. 85th St.

Pioneer Radio Supply Corp.
215 Prospect Ave.

The Progress Radio Supply Co.
415 Huron Rd.

Radio & Electronics Part Corp.
519 Huron Rd.

Winteradio, Inc.
1468 W. 25th St.

Columbus
Hughes-Peters, Inc.
111 - 117 East Long St.

Thompson Radio Supplies
218 E. Gray St.

Dayton
Hughes-Peters, Inc.
300 W. 5th at Perry

Standard Radio & Electronic Products
135 E. Second St.

East Liverpool
D & R Radio Supply
631 Dresden Ave.

Mansfield
Burroughs Radio Co.
43 S. Diamond St.

Springfield
Eberle's Radio Supply
522 West Main St.

Steubenville
D & R Radio Supply
136 S. 3rd St.

 Toledo
The H & W Auto Accessories Co.
713 Adams St.

G. L. Snow Electronic Service
922 Monroe St.

Youngstown
Ross Radio Company
325 W. Federal St.

OREGON
Eugene
United Radio Supply, Inc.
179 W. 8th St.

Medford
Varl G. Wallace Co.
205 West Jackson

Portland
Bargatt Supply Co.
1131 SW Washington

Harper Meece Co.
1506 N W Irving St.
Northwest Radio Supply Co.  
317 S W Ansley St.  
Stubbies Electric Co.  
33 N W Park Ave.  
United Radio Supply, Inc.  
22 N. W. Ninth Ave.  

PENNSYLVANIA  

Allentown  
Radio Electric Service Co.  
1042 Hamilton St.  

Easton  
Radio Electric Service Co.  
9 N. 2nd St.  

Erie  
J. V. Duncombe Co.  
1011 W. 8th St.  
Jordon Electronic Co.  
201 W. 4th St.  

Harrisburg  
Radio Distributing Co.  
140 S. Second St.  

Lancaster  
George D. Barbey Co.  
29 E. Vine St.  

Philadelphia  
Almo Radio Co.  
509 Arch St.  
Consolidated Radio Co.  
612 Arch St.  
Electric Warehouse  
1320 W. Erie Ave.  
Graybar Electric Co., Inc.  
910 Cherry St.  
Herbach & Redeman Co.  
522 Market St.  
M & H Sporting Goods Co.  
512 Market St.  
Radio Electric Service Co.  
5-333 Market St.  
Radio Electric Service Co.  
3146 N. Broad St.  
Radio Electric Service Co.  
N. W. Corner 7th & Arch Sts.  
Eugene G. Wile  
10 S. 10th St.  

Pittsburgh  
Cameradio  
763 Liberty Ave.  
Graybar Electric Co., Inc.  
37 Water St.  
M. V. Mansfield Co.  
717 Liberty Ave.  
Tyttings Company  
632 Grand St.  

Reading  
George D. Barbey Co.  
2nd & Penn Sts.  

Scranton  
Fred P. Purcell  
340 - 550 Wyoming Ave.  
Scranton Radio & Television Supply Co.  
519 Mulberry St.  

RHODE ISLAND  

Providence  
DeMembro Radio Supply Co.  
90 Broadway  
Eastern Company  
130 Broadway  
W. H. Edwards Co.  
94 Broadway  

SOUTH CAROLINA  

Columbia  
Dixie Radio Supply Co., Inc.  
715 Main St.  

Charleston  
Radio Laboratories  
215 King St.  

Greenville  
Dixie Radio Supply Co.  
22 S. Richardson St.  
Gilliam Radio Co.  
117 W. Coffee St.  

SOUTH DAKOTA  

Sioux Falls  
Power City Radio Co.  
209 So. First Ave.  

TENNESSEE  

Chattanooga  
S Disey Distributing Co.  
707 Chestnut St.  

Jackson  
L. R. Rush Company  
Box 1418  

Knoxville  
Chemistry Radio & Electric Co.  
12 Emory Park  
PO Box 3131  
Roden Electrical Supply Co.  
808 N. Central Ave.  

Memphis  
Bluff City Distributing Co.  
905 Union Ave.  

Nashville  
Breed Electric Co.  
109 Eleventh Ave. So.  
Electra Distributing Co.  
1914 West End Ave.  

TEXAS  

Abilene  
R. & R. Electronic Co.  
1074 N. 1st St.  

Amarillo  
R. & R. Electronic Co.  
412 W. 10th St.  

Austin  
The Hargis Co.  
706 - 6th St.  

Beaumont  
Montague Radio Distributing Co.  
230 Willow St.  
PO Box 3045  

Corpus Christi  
Electronic Equipment & Engineering Co.  
1310 So. Staples St.  
Modern Radio Supply  
308 South Staples St.  
Wicks DeVilleiss Co.  
516 - 18 South Staples St.  

Dallas  
Cerby's Wholesale Radio  
2608 Ross Ave.  
Globe Radio, Inc.  
2922 Elm St.  
Graybar Electric Co., Inc.  
400 So. Austin St.  
R. C. & L. F. Hall  
2123 Cedar Springs Ave.  
Wilkinson Bros.  
PO Box 1149  
Southwest Radio Supply  
1820 N. Harwood St.  

Denison  
Denison Radio Supply  
124 West Main St.  
El Paso  
Reaves-Elliot Co.  
720 N. Stanton St.  

Fort Worth  
Electronic Equipment Co.  
301 E. 5th St.  
Fr. Worth Radio Supply Co.  
1301 Commerce St.  

Galveston  
R. C. & L. F. Hall  
1803 Tremont St.  

Huntington  
Electronic Supply, Inc.  
422 Eleventh St.  

Huntington  
Modern Radio Supply  
111 West Van Buren St.  

Houston  
R. C. & L. F. Hall  
1306 Clay Ave.  
PO Box 2434  
Harrison Equipment Co.  
1422 San Jacinto St.  
Houston Radio Supply Co., Inc.  
Clay at LaBranch  
Straus-Frank Company  
4000 Leonlad Ave.  

Lubbock  
R & R Supply Co., Inc.  
706 Main St.  

San Antonio  
Amateur Radio Supply Co.  
746 E. Myrtle St.  
Straus-Frank Company  
301 S. Flores St.  

Tyler  
Lavender Radio Supply Co.  
110 Swann St.  

Waco  
The Hargis Co.  
1305 Austin St.  

Wichita Falls  
Clark & Goe Radio Supply  
1204 Ohio St.  

UTAH  

Salt Lake City  
Graybar Electric Co., Inc.  
245 South 1st West St.  
O'Laughlin's Radio Supply Co.  
113 East Third South  
Radio Supply Co.  
45 East Fourth South  
Standard Supply Co.  
531 So. State St.  

VIRGINIA  

Ashland  
Radio Service Co.  

Lynchburg  
Eastern Electric Co.  
315 Twelfth St.  

Norfolk  
Radio Equipment Co.  
221 West 21st St.  
Radio Parts Distributing Co.  
128 W. Olney Rd.  
Radio Supply Co.  
711 Granby St.  

Richmond  
The Arnold Company  
2345 W. Broad St.  
Graybar Electric Co., Inc.  
6th & Cary Sts.  
Mattison's Radio  
519 W. Broad  
Radio Supply Co.  
3002 W. Broad St.  

Roanoke  
H. C. Baker Sales Co., Inc.  
19 Franklin Rd.  
Leonard Electronic Supply Co.  
106 Second St. S. W.  

WEST VIRGINIA  

Charleston  
Electricity Radio & Electric Co.  
1225 E. Washington St.  

WILLIAMSBURG  

Claymont  
Electron-Plant Distributors, Inc.  
2408 W. Lisbon Ave.  

Milwaukee  
Radio Parts Co., Inc.  
536 - 38 West State St.  

Wausau  
Radio Service & Supply Co.  
615 - 3rd St.  

WHEATING  

General Distributors  
Hotel Wheeling Bldg.  

WASHINGTON  

Bellingham  
Wafusas Supply Co.  
110 Grand Ave.  

Everett  
Pringle Radio Wholesale Co.  
263 Calby Ave.  

Seattle  
Alaska Radio Supply, Inc.  
1416 - 11th S. W.  
Graybar Electric Co.  
King & Occidental Sts.  
Harper-Meggs, Inc.  
740 Republican St.  
Radio Products Sales Co.  
1214 - 1st Ave.  
Seattle Radio Supply, Inc.  
2117 - 2nd Ave.  
Western Electronic-Supply Co.  
2609 First Ave.  

Spokane  
Columbia Electric & Mfg. Co.  
So. 120 Wall St.  
Harper-Meggs Co.  
734 Division  
Northwest Electronics Co.  
North - 102 Monroe St.  

Tacom  
C & G Radio Supply Co.  
714 S. 1st St.  

Sparks  
Karat Radio & Electric Co.  
PO Box 676  
12th & Pine Sts.  

Yakima  
Lay & Nord  
112 South Second St.  

WASHINGTON D. C.  

Capital Radio Wholesalers  
2120 - 14th St. N. W.  
General Electric Supply Corp.  
1330 New York Ave. N. W.  
Graybar Electric Co.  
1227 E. Street N. W.  
Kenyon Radio Supply Company  
2274 - 14th Street, N. W.  
Rucker Radio Wholesalers  
1312 - 14th St. N. W.  

WISCONSIN  

Appleton  
Appleton Radio Supply Co.  
1217 N. Richmond St.  

Valley Radio Distributors  
518 N. Appleton St.  

Beaver Dam  
Kamath Radio Service  
306 South Spring St.  

Madison  
Satterfield Radio Supply  
326 W. Gorham St.  

Milwaukee  
Central Radio Parts Co.  
1723 W. Fond du Lac Ave.  

Electro-Plant Distributors, Inc.  
2408 W. Lisbon Ave.  

Milwaukee 5  
Radio Parts Co., Inc.  
536 - 38 West State St.  
### TUBE REPLACEMENT CHART

Tubes in the column marked "TYPE REPLACED" should be replaced with "EIMAC TUBE TYPE" shown in first column. Replacement with the EIMAC TUBE TYPE will require no reductions in voltages or power input or changes in mechanical connections.

Tubes under the heading "NEAR EQUIVALENT" can be replaced with EIMAC tubes provided changes are made in the electrical values or mechanical connections. Where an "X" appears in the "REQUIRED CHANGES" column some change is indicated.

#### TRIODES

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Class C Amplifier Calculations With The Aid of Constant-CURRENT Characteristics

In calculating and predicting the operation of a vacuum tube as a class-C radio frequency amplifier, the considerations which determine the operating conditions are plate efficiency, power output required, maximum allowable grid and plate dissipation, maximum allowable plate voltage and maximum allowable plate current. The values chosen for these factors will depend both on the demands of a particular application and the tube selected to do the job.

The plate and grid currents of a class-C amplifier are periodic pulses, the durations of which are always less than 180 degrees. For this reason the average plate and grid currents, power output, driving power, etc., cannot be directly calculated but must be determined by a Fourier analysis from points selected along the line of operation as plotted on the constant-current characteristics. This may be done either analytically, or graphically. While the Fourier analysis has the advantage of accuracy, it also has the disadvantage of being tedious and involved.

An approximate analysis which has proven to be sufficiently accurate for most purposes is presented in the following material. This system has the advantage of giving the desired information at the first trial. The system, which is an adaptation of a method developed by Wagnen1, is direct because the important factors, power output, plate efficiency and plate voltage may be arbitrarily selected at the beginning.

In the material which follows, the following set of symbols will be used. These symbols are illustrated graphically in Figure 1.

Symbols

\[ P_i = \text{Plate power input} \]
\[ P_n = \text{Plate power output} \]
\[ P_s = \text{Plate dissipation} \]
\[ n = \text{Plate efficiency expressed as a decimal} \]
\[ E_m = \text{D-c plate supply voltage} \]
\[ E_{em} = \text{Peak fundamental plate voltage} \]
\[ e_{min} = \text{Minimum instantaneous plate voltage} \]
\[ I_n = \text{Average plate current} \]
\[ I_{m} = \text{Peak fundamental plate current} \]
\[ i_{max} = \text{Maximum instantaneous plate current} \]
\[ \theta_s = \text{One-half angle of plate current flow} \]
\[ E_r = \text{D-c grid bias voltage (a negative quantity)} \]


Method

The first step in the use of the system to be described is to determine the power which must be delivered by the class-C amplifier. In making this determination it is well to remember that ordinarily from 5 to 10 per cent of the power delivered by the amplifier tube or tubes will be lost in well-designed tank and coupling circuits at frequencies below 20 Mc. Above 20 Mc, the tank and coupling circuit losses are ordinarily somewhat above 10 per cent.

The plate power input necessary to produce the required output is determined by the plate efficiency:

\[ P_i = \frac{P_n}{n} \]

For most applications it is desirable to operate at the highest possible efficiency. High-efficiency operation usually requires less expensive tubes and power supplies, and the amount of artificial cooling needed is frequently less than for low-efficiency operation. On the other hand, high-efficiency operation often requires more driving power and higher operating plate voltages. Eimac triodes will operate satisfactorily at 80 per cent efficiency at the highest recommended plate voltages and at 75 per cent efficiency at medium plate voltages.

The first determining factor in selecting a tube or tubes for any particular application is the maximum allowable plate dissipation. The total plate dissipation rating for the number of tubes used must be equal to or greater than that calculated from

\[ P_s = P_n \]

After selecting a tube or tubes to meet the power output and plate dissipation requirements it becomes necessary to determine from the tube characteristics whether the tube selected is capable of the required operation and, if so, to determine the driving power, grid bias and grid current.
The complete procedure necessary to determine the class-C-amplifier operating conditions is as follows:\(^3\):

1. Select plate voltage, power output and efficiency.
2. Determine plate input from
   \[ P_i = \frac{P_a}{n} \]
3. Determine plate dissipation from
   \[ P_a = P_i - P_c \]
   \( P_a \) must not exceed maximum rated plate dissipation for tube or tubes selected.
4. Determine average plate current from
   \[ I_b = \frac{P_i}{E_{bb}} \]
   \( I_b \) must not exceed maximum rated plate current for tube selected.
5. Determine approximate \( i_{\text{max}} \) from
   \[ i_{\text{max}} = 4.5I_b \text{ for } n = 0.80 \\
   i_{\text{max}} = 4.0I_b \text{ for } n = 0.75 \\
   i_{\text{max}} = 3.5I_b \text{ for } n = 0.70 \]
6. Locate the point on constant-current characteristics where the constant plate current line corresponding to the approximate \( i_{\text{max}} \) determined in step 5 crosses the line of equal plate and grid voltages ("diode line"). Read \( e_{\text{bias}} \) at this point.\(^5\)
7. Calculate \( E_{pm} \) from
   \[ E_{pm} = E_{bb} - e_{\text{bias}} \]
8. Calculate the ratio \( \frac{I_{em}}{I_b} \) from
   \[ I_{em} = \frac{2nE_b}{E_{pm}} \]
9. From the ratio of \( \frac{I_{em}}{I_b} \) calculated in step 8 determine the ratio \( \frac{i_{\text{max}}}{I_b} \) from Chart 1.
10. Calculate a new value for \( i_{\text{max}} \) from ratio found in step 9.
    \( i_{\text{max}} = \text{(ratio from step 9)} I_b \)
11. Read \( e_{\text{comp}} \) and \( i_{\text{max}} \) from constant current characteristics for values of \( e_{\text{bias}} \) and \( i_{\text{max}} \) determined in steps 6 and 10.
12. Calculate the cosine of one-half the angle of plate current flow from
    \[ \cos \theta_p = 2.3 \left( \frac{I_{em}}{I_b} - 1.57 \right) \]
13. Calculate the grid bias voltage from
    \[ E_c = \frac{1}{1 - \cos \theta_p} \left( \frac{E_{pm}}{\mu} - e_{\text{comp}} \right) - E_{cc} \]
14. Calculate the peak fundamental grid excitation voltage from
    \[ E_{pm} = e_{\text{comp}} - E_c \]
15. Calculate the ratio \( \frac{E_{pm}}{E_{cc}} \) for values of \( E_{cc} \) and \( E_{pm} \) found in steps 13 and 14.
16. Read ratio \( \frac{i_{\text{max}}}{I_c} \) from Chart 2 for ratio \( \frac{E_{pm}}{E_{cc}} \) found in step 15.
17. Calculate average grid current from ratio found in step 16 and value of \( i_{\text{max}} \) found in step 11.
    \[ I_c = \frac{i_{\text{max}}}{\text{ratio from step 16}} \]
18. Calculate approximate grid driving power from
    \[ P_g = 0.9E_{cc}I_c \]
19. Determine grid dissipation from
    \[ P_g = P_a + E_{cc}I_c \]
    \( P_g \) must not exceed the maximum rated grid dissipation for the tube selected.

Example

A typical application of this procedure is shown in the example below.

1. Desired power output................. 1250 watts
2. Desired plate voltage................. 4000 volts
3. Desired plate efficiency............. 75 per cent \((n = 0.75)\)
4. \[ P_i = \frac{1250}{0.75} = 1670 \text{ watts} \]
5. \[ P_a = 1670 - 1250 = 420 \text{ watts} \]
6. Try type 450TL; \( I_c = 450W; \mu = 18 \)
7. \[ I_c = \frac{1670}{4000} = 0.417 \text{ amperes} \]

(Max. \( I_c \) for 450TL = 0.600 amperes)
8. \[ i_{\text{max}} = 4.0 \times 0.417 = 1.67 \text{ amperes} \]
9. \[ E_{pm} = 315 \text{ volts (see figure 2)} \]
10. \[ E_{cm} = 4000 - 315 = 3685 \text{ volts} \]
11. \[ \frac{I_{em}}{I_b} = \frac{2 \times 0.75 \times 4000}{3685} = 1.63 \]
12. \[ \frac{i_{\text{max}}}{I_b} = 3.45 \text{ (from Chart 1)} \]
13. \[ \frac{i_{\text{max}}}{I_b} = 3.45 \times 0.417 = 1.44 \text{ amperes} \]
14. \[ e_{\text{comp}} = 280 \text{ volts} \]
15. \[ i_{\text{max}} = 0.330 \text{ amperes} \]
    \( \text{(see figure 3)} \)
16. \[ \cos \theta_p = 2.32 (1.63 - 1.57) = 0.139 \]
17. \[ E_{cc} = \frac{1}{1 - 0.139} \left( \frac{3685}{18} - 280 \right) \frac{4000}{18} = 270 \text{ volts} \]
18. \[ E_{cm} = 280 - (270) = 550 \text{ volts} \]
19. \[ E_{cc} = \frac{550}{-270} = -2.04 \]
20. \[ i_{\text{max}} = 5.69 \text{ (from Chart 2)} \]
21. \[ I_c = \frac{0.330}{5.69} = 0.058 \text{ amperes} \]
22. \[ P_g = 0.9 \times 550 \times 0.058 = 28.7 \text{ watts} \]
23. \[ P_g = 28.7 + (270 \times 0.058) = 13.0 \text{ watts} \]

(Max. \( P_g \) for 450TL = 65 watts)\(^6\)

\(^2\) In the case of push-pull or parallel amplifier tubes the analysis should be carried out on the basis of a single tube, dividing \( P_i, P_a \) and \( P_g \) by the number of tubes before starting the analysis and multiplying \( I_b, I_c \) and \( P_g \) by the same factor after completing the analysis.

\(^3\) In a few cases the lines of constant plate current will inflect sharply upward before reaching the diode line. In these cases \( e_{\text{bias}} \) should not be read at the diode line but at the point where the plate current line intersects a line drawn from the origin through these points of inflection.
Nomographs

This system of class-C amplifier analysis is now being converted to nomograph form for presentation in the near future.

4 If this calculation gives $\cos \phi_p$ as zero or a negative quantity class-B operation is indicated and new operating conditions should be chosen on a basis of higher efficiency (less plate dissipation, more power output or less power input).

5 The calculated driving power is that actually used in supplying the grid and bias losses. Suitable allowance in driver design must be made to allow for losses in the coupling circuits between the driver plate and the amplifier grid.

Figure 2. 450TL constant-current characteristics showing method of determining e_{pm}, and E_p, in steps 6 and 7 from value of I_b obtained in step 5.

Figure 3. Method of determining e_{em} and I, on 450TL constant-current characteristics from values of e_{pm}, and E_p, found in steps 6 and 7 and value of I_b found in step 10. The value of E_{cc} and E_{gm} from steps 13 and 14 and the operating line are also shown.
Vacuum Tube Ratings
Vacuum Tube Ratings

The data presented on tube data sheets are usually divided into three categories, (1) Electrical and Mechanical Characteristics, (2) Maximum Ratings and (3) Typical Operating Conditions. Electrical and mechanical characteristics are self-explanatory. The typical operating conditions are intended to guide the user in application of the tube under certain "typical" conditions. Several typical operating conditions for each class of service are usually given, with plate voltage as the independent variable. The conditions are chosen so that maximum performance is obtained for each value of plate voltage.

The conditions indicated as "typical" are not the only ones under which the tube can be used, however, and for this reason maximum ratings are given, so that if the user desires to choose his own conditions he will know the maximum capabilities of the tube in regard to certain restricting factors.

Maximum ratings are set solely on a basis of expected tube life. Each rating has been carefully determined by the tube manufacturer as the maximum value which will still permit a reasonable life expectancy for the tube.

Ordinarily the manufacturer sets each limit on an individual basis without regard to any other limit except where such limits are by their nature interdependent within the tube itself. Where the limits are interdependent in this way simultaneous operation at the maximum ratings involved is assumed in setting the limits, which may then be used as individual maximums.

Maximum Plate Voltage

Since Eimac tubes have no internal insulators, the only purpose of the maximum plate voltage limitation is to set a point above which the glass envelope will become damaged from dielectric losses or to set indirectly a limit to the r.f. charging current flowing in the plate and filament leads. The charging current is a function of the r.f. plate voltage, which is in turn a function of the d.c. plate voltage; this makes it possible to set an adequate limit on r.f. plate current without requiring the difficult task of determining the current directly. Most Eimac maximum plate voltage ratings fall in the r-f-plate-current-limit category. However, an example of the glass-stress type of limit may be seen in the UH-50 data. This tube has the same electrode structure as the 75TL. Due to the fact that its grid and plate leads are adjacent at the top of the envelope, however, the UH-50 has a maximum plate voltage rating of 1250 volts, whereas its counterpart, the 75TL, which has widely separated electrode terminations, has a maximum plate voltage rating of 3000 volts.

Regardless of other conditions, the maximum plate voltage rating should not be exceeded.

Maximum Plate Dissipation

The plate dissipation of all radiation-cooled Eimac tubes is limited by plate temperature and its effects on parts of the tube other than the plate. The plates of all radiation-cooled Eimac tubes will withstand several times their maximum rated plate dissipation, but the heat generated by such operation has a considerable effect on other parts of the tube. The radiant heat from the plate causes the grid, filament and envelope to become heated, while heat conducted away from the plate by the plate lead contributes to the heating of the plate seal.

These effects are not ordinarily instantaneous, however, and for this reason all radiation-cooled Eimac tubes may be momentarily subjected to plate dissipation in excess of the maximum rating. The maximum plate dissipation rating is intended to set a point where continuous operation may be carried out without damage to any part of the tube, even though the other portions may at the same time be operating at their maximum ratings.

Regardless of other conditions, the maximum plate dissipation rating should not be exceeded in continuous operation. Plate dissipation in excess of the maximum rating is permissible for short periods of time with all Eimac radiation-cooled types.

Maximum Grid Ratings

Maximum grid current ratings, when coupled with maximum bias voltage or maximum r-f grid voltage ratings could conceivably limit grid dissipation. In many tubes, however, there is little justification for an independent grid bias or r-f grid voltage rating from a practical standpoint. Actually, of course, excessive r-f or bias voltage could cause excessive seal heating or breakdown of glass insulation. On most Eimac tubes these limitations are more academic than actual, since the magnitudes of voltage required to damage the tube are far in excess of those needed in practice, and their use results in no advantage to the tube user.

In the practical sense, the only grid limitation for most Eimac tubes is grid dissipation. Excessive grid dissipation can result in either primary (thermic) emission from the grid or in deformation or melting of the grid through overheating. Most Eimac tubes now have non-emissive grids,
so that deformation or melting is usually the only result of excessive grid dissipation.

In the past, maximum grid dissipation has been more or less implied, rather than stated, on the Eimac tube data sheet by indicating a maximum grid current value. It was assumed that the tube user would not be likely to use more grid bias than necessary, since this would result in an increase in driving power without other compensating advantages, and that with a maximum grid current rating grid dissipation was thereby limited by practical considerations rather than by a definite statement. When the limit of grid dissipation was exceeded the user was usually made aware of the fact through a falling off of grid current as primary grid emission started to take place. The grid-emission phenomena is characteristic of tubes which do not employ special non-emissive grids, and its meaning is generally understood by the great majority of tube users.

The introduction of the non-emissive grid has led to difficulties with the maximum-grid-current rating, since there is generally little sign of grid emission in these tubes up to the point where the grid is permanently deformed by overheating. Obviously a new system of maximum grid ratings is required.

While it would be possible to set a limit on grid dissipation by giving maximum figures for both grid current and bias or peak r-f voltage, this has not been considered to be advisable since it places unnecessary and artificial restrictions on the application of the tubes. The new method of rating will consist only of a maximum on grid dissipation, and, in a few cases where glass-steam insulation is involved, a limit on r-f grid voltage. This grid-rating system will be used on all future printings of Eimac tube data sheets.

The influence of plate dissipation on grid temperature has been taken into consideration in setting up the grid dissipation maximums. The maximum grid dissipation figure given for each tube may be used simultaneously with maximum rated plate dissipation.

Grid Dissipation Measurement

The obvious objection to grid-dissipation ratings is the necessity of determining the actual value of grid dissipation. Since grid dissipation is always equal to the total grid driving power less the power lost in the bias source, it is a simple matter to determine grid dissipation if the driving power is known. Driving power is equal to the driver output less the loss in the coupling circuits between the driver and the amplifier grid circuit (the coupling circuits include the driver plate tank, the coupling transmission line, and the amplifier grid tank, if one is used). Ordinarily, the losses in the coupling circuits will amount to about 30 per cent of the driver output. If this method is used:

\[ P_g = N \left( P_{driver} - E_c I_c \right) \]

Where \( P_g = \) Grid Dissipation
\( N = \) Coupling Efficiency (Ordinarily \( N = 0.7 \))
\( P_{driver} = \) Driver output power
\( E_c = \) D-C Bias Voltage
\( I_c = \) D-C Grid Current

Another method of determining grid dissipation is to subtract the bias loss from the driving power calculated by Thomas' formula:

\[ P_d = E_{gm} I_c \]

Where \( E_{gm} = \) Peak R-F grid voltage

Grid dissipation is then approximately equal to:

\[ P_g = I_c \left( E_{gm} - E_c \right) \text{ or alternatively } P_g = \epsilon_{emp} I_c \]

Where \( \epsilon_{emp} = \) Peak Positive Grid Voltage

In order to use these expressions for \( P_g \) it is necessary to determine either \( E_{gm} \) or \( \epsilon_{emp} \). A suitable peak voltmeter for this purpose is shown in figure 1. When terminal (A) is connected to the negative end of the C-bias supply the meter reads \( E_{gm} \). With (A) connected to ground, the meter indicates \( \epsilon_{emp} \). The first method of connection is most useful in measuring total grid driving power. When used to determine grid dissipation or driving power on a push-pull stage by measuring the voltage on each grid separately it may be advisable to shunt the "free" side of the grid tank circuit with a small capacitor having a capacitance equal to that introduced by the v.t.v.m.

The following is a tabulation of the maximum allowable grid dissipation for a group of Eimac tubes:

<table>
<thead>
<tr>
<th>Type</th>
<th>Max Pg (Watts)</th>
<th>Type</th>
<th>Max Pg (Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>255T</td>
<td>7</td>
<td>250TL</td>
<td>35</td>
</tr>
<tr>
<td>3524</td>
<td>8</td>
<td>304TH</td>
<td>60</td>
</tr>
<tr>
<td>210</td>
<td>15</td>
<td>304TL</td>
<td>50</td>
</tr>
<tr>
<td>35TG</td>
<td>15</td>
<td>450TL</td>
<td>80</td>
</tr>
<tr>
<td>UH50</td>
<td>13</td>
<td>450TL</td>
<td>65</td>
</tr>
<tr>
<td>75TH</td>
<td>16</td>
<td>750TL</td>
<td>100</td>
</tr>
<tr>
<td>75TL</td>
<td>13</td>
<td>1000T</td>
<td>80</td>
</tr>
<tr>
<td>152TH</td>
<td>30</td>
<td>1500T</td>
<td>125</td>
</tr>
<tr>
<td>152TL</td>
<td>25</td>
<td>2000T</td>
<td>150</td>
</tr>
</tbody>
</table>

*Max. \( E_{gm} \) 500 v.
**Max. \( E_{gm} \) 500 v.

Regardless of other conditions, the maximum grid dissipation rating should not be exceeded.

2. Everitt, "Communication Engineering" p. 562; McGraw-Hill.
Front page of a typical Eimac data sheet, annotated to the accompanying discussion on vacuum tube ratings.
The Eimac 4-65A is a small radiation-cooled transmitting tetrode having a maximum plate dissipation rating of 65 watts. The plate operates at a red color at maximum dissipation. Short, heavy leads and low interelectrode capacitances contribute to stable efficient operation at high frequencies. Although it is capable of withstanding high plate voltages, the internal geometry of the 4-65A is such that it will deliver reliable and high power output at low plate voltages. The quick-heating filament allows conservation of power during standby periods in mobile applications.

**GENERAL CHARACTERISTICS**

**ELECTRICAL**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament: Thoriated tungsten</td>
<td>6.0 volts</td>
</tr>
<tr>
<td>Voltage</td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>3.5 amperes</td>
</tr>
<tr>
<td>Grid-Screen Amplification</td>
<td>5</td>
</tr>
<tr>
<td>Factor (Average)</td>
<td></td>
</tr>
<tr>
<td>Direct Interelectrode</td>
<td></td>
</tr>
<tr>
<td>Capacitances (Average)</td>
<td></td>
</tr>
<tr>
<td>Grid-Plate</td>
<td>0.08 uuf.</td>
</tr>
<tr>
<td>Input</td>
<td>8.0 uuf.</td>
</tr>
<tr>
<td>Output</td>
<td>2.1 uuf.</td>
</tr>
</tbody>
</table>

**MECHANICAL**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>5-pin -- Fits Johnson No. 122-247 or 122-101 Socket.</td>
</tr>
<tr>
<td>Mounting</td>
<td>Vertical, base down or up Radiation</td>
</tr>
<tr>
<td>Cooling</td>
<td></td>
</tr>
<tr>
<td>Maximum Overall Dimensions</td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>4.25 inches</td>
</tr>
<tr>
<td>Diameter</td>
<td>2.31 inches</td>
</tr>
<tr>
<td>Net Weight</td>
<td>3 ounces</td>
</tr>
<tr>
<td>Shipping Weight (Average)</td>
<td>1.5 pounds</td>
</tr>
</tbody>
</table>

**RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR**

Class-C Telegraphy or FM Telephony (Key-down conditions, per tube)

**MAXIMUM RATINGS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C PLATE VOLTAGE&lt;sup&gt;1&lt;/sup&gt;</td>
<td>3000 MAX. VOLTS</td>
</tr>
<tr>
<td>D-C SCREEN VOLTAGE</td>
<td>4000 MAX. VOLTS</td>
</tr>
<tr>
<td>D-C GRID VOLTAGE</td>
<td>-500 MAX. VOLTS</td>
</tr>
<tr>
<td>D-C PLATE CURRENT</td>
<td>150 MAX. MA.</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>65 MAX. WATTS</td>
</tr>
<tr>
<td>SCREEN DISSIPATION</td>
<td>10 MAX. WATTS</td>
</tr>
<tr>
<td>GRID DISSIPATION</td>
<td>5 MAX. WATTS</td>
</tr>
</tbody>
</table>

**TYPICAL OPERATION**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C PLATE VOLTAGE</td>
<td>600 1000 1500 VOLTS</td>
</tr>
<tr>
<td>D-C SCREEN VOLTAGE</td>
<td>250 250 250 VOLTS</td>
</tr>
<tr>
<td>D-C GRID VOLTAGE</td>
<td>-45 -70 -75 VOLTS</td>
</tr>
<tr>
<td>D-C PLATE CURRENT</td>
<td>125 125 125 MA.</td>
</tr>
<tr>
<td>D-C SCREEN CURRENT</td>
<td>40 35 25 MA.</td>
</tr>
<tr>
<td>D-C GRID CURRENT</td>
<td>17 14 12 MA.</td>
</tr>
<tr>
<td>PEAK R-F GRID INPUT VOLTAGE (approx.)</td>
<td>116 132 133 VOLTS</td>
</tr>
<tr>
<td>DRIVING POWER (approx.)</td>
<td>2 1.8 1.6 WATTS</td>
</tr>
<tr>
<td>SCREEN DISSIPATION</td>
<td>10 8.7 6.2 WATTS</td>
</tr>
<tr>
<td>PLATE POWER INPUT</td>
<td>75 125 150 WATTS</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>26 37 50 WATTS</td>
</tr>
<tr>
<td>PLATE POWER OUTPUT</td>
<td>49 88 138 WATTS</td>
</tr>
</tbody>
</table>

<sup>1</sup>Maximum allowable voltage is limited by seal temperatures, which increase with increasing frequency. With normal ventilation, maximum rated plate voltage may be used at frequencies up to approximately 50 Mc. Above this frequency, the plate voltage should be reduced, or special attention should be given to seal cooling. The temperature of any seal should not be allowed to exceed 200 degrees C. Where ventilation is not adequate, special attention to seal cooling may be required below 50 Mc.

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(Effective 4-15-47)
The Eimac 4-125A is a power tetrode having a maximum plate dissipation rating of 125 watts, and is intended for use as an amplifier, oscillator or modulator. Due to its high power sensitivity, it will deliver relatively large output with low driving power. The low grid-plate capacitance of the 4-125A makes neutralization unnecessary in most cases, and simplifies it in other cases. The compact construction of this tube permits its operation at full input up to frequencies as high as 120 Mc.

Cooling of the 4-125A is accomplished by radiation from the plate, which operates at a visible red color at maximum dissipation, and by air circulation through the base and around the envelope.

**GENERAL CHARACTERISTICS**

**ELECTRICAL**
- Filament: Thoriated tungsten
  - Voltage: 5.0 volts
  - Current: 6.5 amperes
- Grid-Screen Amplification Factor (Average): 6.2
- Direct Interelectrode Capacitances (Average):
  - Grid-Plate (without shielding, base grounded): 0.05 μfd.
  - Input: 10.8 μfd.
  - Output: 3.1 μfd.
- Transconductance (i_t=50 ma., E_β=2500 v., E_σ=400 v.): 2450 μmhos

**MECHANICAL**
- Base: 5-pin metal shell, No. 5008B
- Basing: RMA type 5BK
- Cooling: Radiation and forced air
- Maximum Overall Dimensions:
  - Length: 5.69 inches
  - Diameter: 2.72 inches
- Net Weight: 6.5 ounces
- Shipping Weight (Average): 1.5 pounds

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### Radio Frequency Power Amplifier and Oscillator

**Class-C Telegraphy or FM Telephony (Key-down conditions, 1 tube)**

#### Maximum Ratings

- **D-C PLATE VOLTAGE**: 3000 MAX. VOLTS
- **D-C SCREEN VOLTAGE**: 400 MAX. VOLTS
- **D-C GRID VOLTAGE**: -500 MAX. VOLTS
- **D-C PLATE CURRENT**: 225 MAX. MA.
- **PLATE DISSIPATION**: 125 MAX. WATTS
- **SCREEN DISSIPATION**: 20 MAX. WATTS
- **GRID DISSIPATION**: 5 MAX. WATTS

#### Typical Operation (Frequencies below 120 Mc.)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>2000, 2500, 3000 volts</td>
</tr>
<tr>
<td>D-C Screen Voltage</td>
<td>350, 350, 350 volts</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
<td>-100, -150, -150 volts</td>
</tr>
<tr>
<td>D-C PLATE CURRENT</td>
<td>200, 200, 167 ma.</td>
</tr>
<tr>
<td>D-C SCREEN CURRENT</td>
<td>50, 40, 30 ma.</td>
</tr>
<tr>
<td>D-C Grid Current</td>
<td>12, 12, 9 ma.</td>
</tr>
<tr>
<td>SCREEN DISSIPATION</td>
<td>18, 14, 10.5 watts</td>
</tr>
<tr>
<td>GRID DISSIPATION</td>
<td>1.4, 2, 1.2 watts</td>
</tr>
<tr>
<td>Peak R-F Grid Input Voltage (approx.)</td>
<td>230, 220, 200 volts</td>
</tr>
<tr>
<td>Driving Power (approx.)</td>
<td>2.8, 3.8, 2.5 watts</td>
</tr>
<tr>
<td>Plate Power Input</td>
<td>400, 500, 500 watts</td>
</tr>
<tr>
<td>Plate DISSIPATION</td>
<td>125, 125, 125 watts</td>
</tr>
<tr>
<td>Plate Power Output</td>
<td>275, 375, 375 watts</td>
</tr>
</tbody>
</table>

---

### High-Level Modulated Radio Frequency Amplifier

**Class-C Telegraphy (Carrier conditions unless otherwise specified, 1 tube)**

#### Maximum Ratings

- **D-C PLATE VOLTAGE**: 2500 MAX. VOLTS
- **D-C SCREEN VOLTAGE**: 400 MAX. VOLTS
- **D-C GRID VOLTAGE**: -500 MAX. VOLTS
- **D-C PLATE CURRENT**: 200 MAX. MA.
- **PLATE DISSIPATION**: 85 MAX. WATTS
- **SCREEN DISSIPATION**: 20 MAX. WATTS
- **GRID DISSIPATION**: 5 MAX. WATTS

#### Typical Operation (Frequencies below 120 Mc.)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>2000, 2500 volts</td>
</tr>
<tr>
<td>D-C Screen Voltage</td>
<td>350, 350 volts</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
<td>-220, -210 volts</td>
</tr>
<tr>
<td>D-C PLATE CURRENT</td>
<td>150, 150 MA.</td>
</tr>
<tr>
<td>D-C SCREEN CURRENT</td>
<td>33, 30 MA.</td>
</tr>
<tr>
<td>D-C Grid Current</td>
<td>10, 9 MA.</td>
</tr>
<tr>
<td>SCREEN DISSIPATION</td>
<td>11.5, 10.5 watts</td>
</tr>
<tr>
<td>GRID DISSIPATION</td>
<td>1.6, 1.4 watts</td>
</tr>
<tr>
<td>Peak A-F Screen Voltage, 100% Modulation</td>
<td>210, 210 volts</td>
</tr>
<tr>
<td>Peak R-F Grid Input Voltage (approx.)</td>
<td>275, 340 volts</td>
</tr>
<tr>
<td>Driving Power (approx.)</td>
<td>3.8, 3.2 watts</td>
</tr>
<tr>
<td>Plate Power Input</td>
<td>300, 380 watts</td>
</tr>
<tr>
<td>Plate DISSIPATION</td>
<td>75, 80 watts</td>
</tr>
<tr>
<td>Plate Power Output</td>
<td>225, 300 watts</td>
</tr>
</tbody>
</table>

---

### Audio Frequency Power Amplifier and Modulator

**Class-AB1** (Sinusoidal wave, two tubes unless otherwise specified)

#### Maximum Ratings

- **D-C PLATE VOLTAGE**: 3000 MAX. VOLTS
- **D-C SCREEN VOLTAGE**: 600 MAX. VOLTS
- **MAX-SIGNAL D-C PLATE CURRENT, PER TUBE**: 225 MAX. MA.
- **PLATE DISSIPATION, PER TUBE**: 125 MAX. WATTS
- **SCREEN DISSIPATION, PER TUBE**: 20 MAX. WATTS

#### Typical Operation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C PLATE VOLTAGE</td>
<td>1500, 2000, 2500 volts</td>
</tr>
<tr>
<td>D-C SCREEN VOLTAGE</td>
<td>600, 600, 600 volts</td>
</tr>
<tr>
<td>D-C GRID VOLTAGE</td>
<td>-90, -94, -96 volts</td>
</tr>
<tr>
<td>ZERO-SIGNAL D-C PLATE CURRENT</td>
<td>60, 50, 50 MA.</td>
</tr>
<tr>
<td>MAX-SIGNAL D-C PLATE CURRENT</td>
<td>222, 240, 232 MA.</td>
</tr>
<tr>
<td>ZERO-SIGNAL D-C SCREEN CURRENT</td>
<td>-1.0, -0.5, -0.3 MA.</td>
</tr>
<tr>
<td>MAX-SIGNAL D-C SCREEN CURRENT</td>
<td>17, 6.4, 8.5 MA.</td>
</tr>
<tr>
<td>EFFECTIVE LOAD, PLATE-TO-PLATE</td>
<td>10,200, 13,400, 20,300 ohms</td>
</tr>
<tr>
<td>PEAK A-F GRID INPUT VOLTAGE (PER TUBE)</td>
<td>90, 94, 96 volts</td>
</tr>
<tr>
<td>DRIVING POWER</td>
<td>0, 0, 0 watt</td>
</tr>
<tr>
<td>MAX-SIGNAL PLATE DISSIPITION (PER TUBE)</td>
<td>87.5, 125, 125 watts</td>
</tr>
<tr>
<td>MAX-SIGNAL PLATE POWER OUTPUT</td>
<td>150, 230, 330 watts</td>
</tr>
<tr>
<td>TOTAL HARMONIC DISTORTION</td>
<td>5, 2, 2.4 per ct.</td>
</tr>
</tbody>
</table>

---

### Audio Frequency Power Amplifier and Modulator

**Class-AB2** (Sinusoidal wave, two tubes unless otherwise specified)

#### Maximum Ratings

- **D-C PLATE VOLTAGE**: 3000 MAX. VOLTS
- **D-C SCREEN VOLTAGE**: 400 MAX. VOLTS
- **MAX-SIGNAL D-C PLATE CURRENT, PER TUBE**: 225 MAX. MA.
- **PLATE DISSIPATION, PER TUBE**: 125 MAX. WATTS
- **SCREEN DISSIPATION, PER TUBE**: 20 MAX. WATTS

#### Typical Operation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C PLATE VOLTAGE</td>
<td>1500, 2000, 2500 volts</td>
</tr>
<tr>
<td>D-C SCREEN VOLTAGE</td>
<td>350, 350, 350 volts</td>
</tr>
<tr>
<td>D-C GRID VOLTAGE</td>
<td>-41, -45, -43 volts</td>
</tr>
<tr>
<td>ZERO-SIGNAL D-C PLATE CURRENT</td>
<td>87, 72, 93 MA.</td>
</tr>
<tr>
<td>MAX-SIGNAL D-C PLATE CURRENT</td>
<td>400, 300, 260 MA.</td>
</tr>
<tr>
<td>ZERO-SIGNAL D-C SCREEN CURRENT</td>
<td>0, 0, 0 MA.</td>
</tr>
<tr>
<td>MAX-SIGNAL D-C SCREEN CURRENT</td>
<td>34, 5, 6 MA.</td>
</tr>
<tr>
<td>EFFECTIVE LOAD, PLATE-TO-PLATE</td>
<td>7200, 13,400, 20,300 ohms</td>
</tr>
<tr>
<td>PEAK A-F GRID INPUT VOLTAGE (PER TUBE)</td>
<td>141, 105, 89 volts</td>
</tr>
<tr>
<td>MAX-SIGNAL AVG. DRIVING POWER (APPLIED)</td>
<td>2.5, 1.4, 1 watts</td>
</tr>
<tr>
<td>MAX-SIGNAL PEAK DRIVING POWER</td>
<td>5.2, 3.1, 2.4 watts</td>
</tr>
<tr>
<td>MAX-SIGNAL PLATE DISSIPATION (PER TUBE)</td>
<td>126, 125, 122 watts</td>
</tr>
<tr>
<td>MAX-SIGNAL PLATE POWER OUTPUT</td>
<td>350, 350, 400 watts</td>
</tr>
<tr>
<td>TOTAL HARMONIC DISTORTION</td>
<td>2.5, 1, 2.2 per ct.</td>
</tr>
</tbody>
</table>

---

1 Above 120 Mc, the maximum plate voltage rating depends upon frequency see page 8.

2 Indicates change from sheet dated 11-1-46

3 The effective grid circuit resistance for each tube must not exceed 250,000 ohms.

4 Driving power increases above 70 Mc. See Page Eight.
MECHANICAL

Mounting—The 4-125A must be mounted vertically, base up or base down. The socket must provide clearance for the glass tip-off which extends through the center of the base. The metal base shell should be grounded by means of suitable spring fingers. A flexible connecting strap should be provided between the plate terminal and the external plate circuit. The socket must not apply excessive lateral pressure against the base pins. The tube must be protected from severe vibration and shock.

Cooling—Adequate cooling must be provided for the seals and envelope of the 4-125A. In continuous-service applications, the temperature of the plate seal, as measured on the top of the plate cap, should not exceed 170° C. A relatively slow movement of air past the tube is sufficient to prevent seal temperatures in excess of maximum at frequencies below 30 Mc. At frequencies above 30 Mc., radio-frequency losses in the leads and envelope contribute to seal and envelope heating, and special attention should be given to cooling. A small fan or centrifugal blower directed toward the upper portion of the envelope will usually provide sufficient circulation for cooling at frequencies above 30 Mc., however.

In intermittent-service applications where the “on” time does not exceed a total of five minutes in any ten-minute period, plate seal temperatures as high as 220° C. are permissible. When the ambient temperature does not exceed 30° C. it will not ordinarily be necessary to provide forced cooling to hold the temperature below this maximum at frequencies below 30 Mc., provided that a heat-dissipating plate connector is used, and the tube is so located that normal circulation of air past the envelope is not impeded.

Provision must be made for circulation of air through the base of the tube. Where shielding or socket design makes it impossible to allow free circulation of air through the base, it will be necessary to apply forced-air cooling to the stem structure. An air flow of two cubic feet per minute through the base will be sufficient for stem cooling.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated value of 5.0 volts. Unavoidable variations in filament voltage must be kept within the range from 4.75 to 5.25 volts.

Bias Voltage—D-c bias voltage for the 4-125A should not exceed 500 volts. If grid-leak bias is used, suitable protective means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation.

Screen Voltage—The d-c screen voltage for the 4-125A should not exceed 400 volts, except for class-AB, audio operation.

Plate Voltage—The plate-supply voltage for the 4-125A should not exceed 3000 volts for frequencies below 120 Mc. The maximum permissible plate voltage is less than 3000 volts above 120 Mc., as shown by the graph on page 8.

Grid Dissipation—Grid dissipation for the 4-125A should not be allowed to exceed five watts. Grid dissipation may be calculated from the following expression:

\[ P_g = \frac{e_{rp}^2}{L} \]

where \( P_g \) = Grid dissipation, \( e_{rp} \) = Peak positive grid voltage, and \( L \) = D-c grid current.

\( e_{rp} \) may be measured by means of a suitable peak voltmeter connected between filament and grid.

Screen Dissipation—The power dissipated by the screen of the 4-125A must not exceed 20 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 20 watts in the event of circuit failure.

Plate Dissipation—Under normal operating conditions, the plate dissipation of the 4-125A should not be allowed to exceed 125 watts in unmodulated applications.

In high-level-modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 85 watts. The plate dissipation will rise to 125 watts under 100% sinusoidal modulation.

Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

OPERATION

Class-C Telegraphy or FM Telephony—The 4-125A may be operated as a class-C telegraph or FM telephone amplifier without neutralization up to 100 Mc. If reasonable precautions are taken to prevent coupling between input and output circuits external to the tube. A grounded metallic plate on which the socket may be mounted and to which suitable connectors may be attached to ground the tube base shield provides an effective isolating shield between grid and plate circuits. In single-ended circuits, plate, grid, filament and screen by-pass capacitors should be returned through the shortest possible leads to a common chassis point. In push-pull applications the filament and screen terminals of each tube should be by-passed to a common chassis point by the shortest possible leads, and short, heavy leads should be used to interconnect the screens and filaments of the two tubes. Care should be taken to prevent leakage of radio-frequency energy to leads entering the amplifier, to prevent grid-plate coupling between these leads external to the amplifier.

Above 100 Mc., or at lower frequencies if shielding is inadequate, it is necessary to neutralize the 4-125A in ordinary applications.

Where shielding is adequate, the feedback at frequencies above 100 Mc. is due principally to screen-lead-inductance effects, and it becomes necessary to introduce

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3 For suitable peak v.t.v.m. circuits see, for instance, "Vacuum Tube Ratings," Eimac News, January, 1945. This article is available in reprint form on request.
in-phase voltage from the plate circuit into the grid circuit. This can be done by adding capacitance between plate and grid external to the tube. Ordinarily, a small metal tab approximately ¼-inch square connected to the grid terminal and located adjacent to the envelope opposite the plate will suffice for neutralization. Means should be provided for adjusting the spacing between the neutralizing capacitor plate and the envelope, but care must be taken to prevent the neutralizing plate from touching the envelope. An alternative neutralization scheme is illustrated in the diagram below. In this circuit feed-back is eliminated by series-tuning the screen to ground with a small capacitor. The socket screen terminals should be strapped together, as shown on the dia-

![Image 1](image1)

**Screen-tuning neutralization circuit for use above 100 Mc.**

C is a small split-plate capacitor.

\[ C_{\text{split}} = \frac{1}{2} \times 10^6 \text{ mhos} \]

Program, by the shortest possible lead, and the leads from the screen terminal to the capacitor, C, and from the capacitor to ground should be made as short as possible. All connections to the screen terminals should be made to the center of the strap between the terminals, in order to equalize the current in the two screen leads and prevent overheating of one of them. The value for C given under the diagram presupposes the use of the shortest possible leads.

At frequencies below 100 Mc., and where shielding is inadequate, ordinary neutralization systems may be used. With reasonably effective shielding, however, neutralization should not be required below 100 Mc.

The driving power and power output under typical operating conditions, with maximum output and plate voltage, are shown on page 8. The power output shown is the actual plate power delivered by the tube; the power delivered to the load will depend upon the efficiency of the plate tank and output coupling system. The driving power is likewise the driving power required by the tube (includes bias loss). The driver output power should exceed the driving power requirement by a sufficient margin to allow for coupling-circuit losses. These losses will not ordinarily amount to more than 30 or 40 per cent of the driving power, except at frequencies above 150 Mc. The use of silver-plated linear tank-circuit elements is recommended at frequencies above 100 Mc.

Conventional capacitance-shortened quarter-wave linear grid tank circuits having a calculated Z of 160 ohms or less may be used with the 4-125A up to 175 Mc. Above 175 Mc. linear grid tank circuits employing a "capacitor":type shorting bar, as illustrated in the diagram below, may be used. The capacitor, C₁, may consist of two silver-plated brass plates one inch square with a piece of .010-inch mica or polystyrene as insulation.

**Class-C AM Telephony**—The r-f circuit considerations discussed above under Class-C Telegraphy or FM Telephony also apply to amplitude-modulated operation of the 4-125A. When the 4-125A is used as a class-C high-level-

![Image 2](image2)

**Typical circuit arrangement useful for frequencies above 175 Mc.**

C₁—See above.

C₃—Neutralizing capacitor.

L₁—3/8" dia. copper spaced, 1/2" center-to-center, 6" long.

L₂—7/8" dia. brass, silver plated, spaced 1/2" center-to-center, 14" long.

modulated amplifier, modulation should be applied to both plate and screen. Modulation voltage for the screen may be obtained from a separate winding on the modulation transformer, by supplying the screen voltage via a series dropping resistor from the unmodulated plate supply, or by the use of an audio-frequency reactor in the positive screen-supply lead. When screen modulation is obtained by either the series-resistor or the audio-reactor method, the audio-frequency variations in screen current which result from variations in plate voltage as the plate is modulated automatically give the required screen modulation. Where a reactor is used, it should have a rated inductance of not less than 10 henries divided by the number of tubes in the modulated amplifier and a maximum current rating of two or three times the operating d-c screen current. To prevent phase shift between the screen and plate modulation voltages at high audio frequencies, the screen by-pass capacitor should be no larger than necessary for adequate r-f by-passing. Where screen voltage is obtained from a separate winding on the modulation transformer, the screen winding should be designed to deliver the peak screen modulation voltage given in the typical operating data on page 1.
For high-level modulated service, the use of partial grid-leak bias is recommended. Any by-pass capacitors placed across the grid-leak resistance should have a reactance at the highest modulation frequency equal to at least twice the grid-leak reactance.  

Class-AB₂ and Class-AB₃ audio—Two 4-125A's may be used in a push-pull circuit to give relatively high audio output power at low distortion. Maximum ratings and typical operating conditions for class-AB₂ and class-AB₃ audio operation are given in the tabulated data.  

When type 4-125A tubes are used as class-AB₂ or class-AB₃ audio amplifiers at 1500 plate volts, under the conditions given under "Typical Operation," the screen voltage must be obtained from a source having reasonably good regulation, to prevent variations in screen voltage from zero-signal to maximum-signal conditions. The use of voltage regulator tubes in a standard circuit will provide adequate regulation. The variation in screen current at plate voltages of 2000 and above is low enough so that any screen power supply having a normal order of regulation will serve. The driver plate supply makes a convenient source of screen voltage under these conditions.  

Grid bias voltage for class-AB₃ service may be obtained from batteries or from a small fixed-bias supply. When a bias supply is used, the d-c resistance of the bias source should not exceed 250 ohms. Under class-AB₂ conditions the effective grid-circuit resistance for each tube should not exceed 250,000 ohms.  

The peak driving power figures given in the class-AB₃ tabulated data are included to make possible an accurate determination of the required driver output power. The driving amplifier must be capable of supplying the peak driving power without distortion. The driver stage should, therefore, be capable of providing an undistorted average output equal to half the peak driving power require-

**COMPONENTS FOR TYPICAL CIRCUITS**  
*(Diagrams, Page 6)*

| L₁₁ - C₁₁ | Tank circuit appropriate for operating frequency; \( Q = 12 \). Capacitor plate spacing = .000".  |
| L₂₂ - C₂₂ | Tank circuit appropriate for operating frequency; \( Q = 12 \). Capacitor plate spacing = .200". |
| L₃₃ - C₃₃ | Tank circuit appropriate for operating frequency; \( Q = 12 \). Capacitor plate spacing = .375". |
| L₄₄ - C₄₄ | Tank circuit appropriate for operating frequency; \( Q = 12 \). Capacitor plate spacing = .375". |
| L₅₅ - C₅₅ | Tuned circuit appropriate for operating frequency. |
| L₆₆ - C₆₆ | Tuned circuit appropriate for operating frequency. |
| C₁ | .002-ufd., 500-v. mica |
| C₂ | .002-ufd., 5000-v. mica |
| C₃ | .001-ufd., 2500-v. mica |
| C₄ | 16-ufd., 450-v. electrolytic |
| C₅ | 10-ufd., 25-v. electrolytic |
| R₁ | 7000 ohms, 5 watts |
| R₂ | 90 - 70,000 ohms, 100 watts |
| R₃ | 3500 ohms, 5 watts |
| R₄ | 350,000 ohms, 200 watts |
| R₅ | 560 ohms, 1 watt |
| R₆ | 25,000 ohms, 2 watts |
| R₇ | 1500 ohms, 5 watts |
| RFC₁ | 2.5-mhy., 125-ma. r-f choke |
| RFC₂ | 1-mhy., 500-ma. r-f choke |
| T₁ | 10-watt driver transformer; ratio pri. to 1/2 sec. approx. 2:1. |
| T₂ | 200-watt modulation transformer; ratio pri. to sec. approx. 1:1; pri. impedance = 16200 ohms, sec. impedance = 16500 ohms. |
| T₃ | 5-watt driver transformer; ratio pri. to 1/2 sec. approx. 1.1:1. |
| T₄ | 400-watt modulation transformer; ratio pri. to sec. approx. 2.7:1; pri. impedance = 22200 ohms, sec. impedance = 8300 ohms. |
The Eimac 4X150A is an extremely compact external-anode tetrode intended for use as a radio-frequency amplifier or oscillator at frequencies well into the uhf region or as an amplifier in any service requiring a high-gain tube capable of delivering high-power output at low plate voltage. Although it is capable of withstanding relatively high plate voltages, the 4X150A operates well at plate voltages of 400 to 500 volts, making it particularly well suited for high-power mobile applications. The combination of a high ratio of transconductance to capacitance and a maximum plate dissipation capability of 150 watts makes the tube an excellent wide-band amplifier for video applications.

The 4X150A is based in a manner which allows it to be used with a ceramic octal base socket. The base pins are arranged for maximum convenience in using the tube with either coaxial or linear tank circuits at uhf. To provide maximum circuit isolation at these frequencies, the screen is terminated in a contact ring located between the anode and the base. For low-frequency applications, a base pin is provided for the screen termination.

A single 4X150A operating in a coaxial amplifier circuit will deliver as high as 75 watts useful output at 500 Mc.

**GENERAL CHARACTERISTICS**

**ELECTRICAL**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode: Coated Unipotential</td>
<td></td>
</tr>
<tr>
<td>Heater Voltage</td>
<td>6.0 volts</td>
</tr>
<tr>
<td>Heater Current</td>
<td>2.8 amperes</td>
</tr>
<tr>
<td>Minimum Heating Time</td>
<td>30 seconds</td>
</tr>
<tr>
<td>Screen-Grid Amplification Factor (Average)</td>
<td>4.5</td>
</tr>
<tr>
<td>Direct Interelectrode Capacitances (Average)</td>
<td></td>
</tr>
<tr>
<td>Grid-Plate (without shielding)</td>
<td>0.02 μf.</td>
</tr>
<tr>
<td>Input</td>
<td>14.1 μf.</td>
</tr>
<tr>
<td>Output</td>
<td>4.7 μf.</td>
</tr>
<tr>
<td>Transconductance (I_{m}=250 \text{ ma.}, E_{b}=500 \text{ v.}, E_{ce}=250 \text{ v.})</td>
<td>12,000 μmhos</td>
</tr>
</tbody>
</table>

**MECHANICAL**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling</td>
<td>Forced Air</td>
</tr>
<tr>
<td>Mounting Position</td>
<td>Any</td>
</tr>
<tr>
<td>Maximum Overall Dimensions</td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>2.50 inches</td>
</tr>
<tr>
<td>Diameter</td>
<td>1.75 inches</td>
</tr>
<tr>
<td>Maximum Seated Height</td>
<td>1.88 inches</td>
</tr>
<tr>
<td>Net Weight</td>
<td>5 ounces</td>
</tr>
<tr>
<td>Shipping Weight (average)</td>
<td>1.75 pounds</td>
</tr>
</tbody>
</table>

**RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR**

Class-C Telegraphy or FM Telephony

<table>
<thead>
<tr>
<th>Maximum Ratings (Frequencies up to 500 Mc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C PLATE VOLTAGE</td>
</tr>
<tr>
<td>D-C SCREEN VOLTAGE</td>
</tr>
<tr>
<td>D-C PLATE CURRENT</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
</tr>
<tr>
<td>GRID DISSIPATION</td>
</tr>
<tr>
<td>D-C GRID DISSIPATION</td>
</tr>
</tbody>
</table>

**TYPICAL OPERATION**

<table>
<thead>
<tr>
<th>Type of Operation</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single tube, frequencies below 145 Mc.</td>
<td></td>
</tr>
<tr>
<td>D-C Plate Voltage</td>
<td>600 750 1000 volts</td>
</tr>
<tr>
<td>D-C Plate Current</td>
<td>250 250 250 ma.</td>
</tr>
<tr>
<td>D-C Screen Voltage</td>
<td>35 37 39 ma.</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
<td>40 40 40 volts</td>
</tr>
<tr>
<td>D-C Grid Current</td>
<td>6 6.5 7 ma.</td>
</tr>
<tr>
<td>Plate Dissipation (approx.)</td>
<td>52 74 96 watt</td>
</tr>
<tr>
<td>Useful Power Output</td>
<td>85 110 148 watts</td>
</tr>
</tbody>
</table>

**TYPICAL OPERATION**

<table>
<thead>
<tr>
<th>Type of Operation</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>500 650 800 volts</td>
</tr>
<tr>
<td>D-C Plate Current</td>
<td>250 250 250 ma.</td>
</tr>
<tr>
<td>D-C Screen Voltage</td>
<td>9.5 7.5 5 ma.</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
<td>6 6.6 6.6 volts</td>
</tr>
<tr>
<td>D-C Grid Current</td>
<td>6 6 6 ma.</td>
</tr>
<tr>
<td>Plate Dissipation (Approx.)</td>
<td>65 85 110 watts</td>
</tr>
<tr>
<td>Useful Power Output</td>
<td>52 68 74 watts</td>
</tr>
<tr>
<td>Overall Efficiency</td>
<td>42 41 37 percent</td>
</tr>
</tbody>
</table>

*At 150 watts plate dissipation a minimum flow of 5.6 cubic feet of air per minute must be passed through the plate cooler. The pressure drop across the cooler at this flow equals 0.75 in. of water. Free circulation of air around the base of the tube is required. Where shielding or components restrict the natural circulation of air around the base or where abnormal circuit conditions can cause high lead current, forced air cooling of the base should be provided. In no case should the temperature of the base exceed 150 degrees C. Indicates change from sheet dated 2-25-47 (Effective 4-15-47) Copyright, 1947 by Eitel-McCullough, Inc.
The Eitel 4-250A is a high-vacuum power tetrode having a maximum plate dissipation rating of 250 watts. It is intended for amplifier, oscillator and modulator service. Cooling of the 4-250A is accomplished by radiation from the plate, which operates at a visibly red temperature at maximum dissipation, and by forced air circulation through the base and around the envelope.

The low driving power required by the 4-250A, together with its low grid-plate capacitance and compact and rugged construction, allows considerable simplification of the associated circuits and the driver stage.

**ELECTRICAL**

Filament: Thoriated tungsten
- Voltage: 5.0 volts
- Current: 14.5 amperes

Grid-Screen Amplification Factor (Average)
- 5.1

Direct Interelectrode Capacitances (Average)
- Grid-Plate (without shielding, base grounded): 0.12 μfd.
- Input: 12.7 μfd.
- Output: 4.5 μfd.

Transconductance \(i_b = 100 \text{ ma}, E_b = 2500 \text{ v}, E_{ac} = 500 \text{ v}\): 4000 μmhos

**MECHANICAL**

Base: 5-pin metal shell, No. 5008B
Basing: RMA type 5BK
Cooling: Radiation and forced air

Maximum Overall Dimensions:
- Length: 6.38 inches
- Diameter: 3.56 inches
- Net Weight: 8.0 ounces
- Shipping Weight (Average): 2.5 pounds

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**RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR**

Class-C FM or Telegraphy (Key-down conditions, 1 tube)

**MAXIMUM RATINGS**

<table>
<thead>
<tr>
<th>D-C PLATE VOLTAGE</th>
<th>4000 MAX. VOLTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C SCREEN VOLTAGE</td>
<td>600 MAX. VOLTS</td>
</tr>
<tr>
<td>D-C GRID VOLTAGE</td>
<td>-500 MAX. VOLTS</td>
</tr>
<tr>
<td>D-C PLATE CURRENT</td>
<td>350 MAX. MA.</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>250 MAX. WATTS</td>
</tr>
<tr>
<td>SCREEN DISSIPATION</td>
<td>35 MAX. WATTS</td>
</tr>
<tr>
<td>GRID DISSIPATION</td>
<td>5 MAX. WATTS</td>
</tr>
</tbody>
</table>

**TYPICAL OPERATION** (Frequencies below 75 Mc.)

- D-C Plate Voltage: 2500-3000-4000 volts
- D-C Screen Voltage: 500-500-500 volts
- D-C Grid Voltage: -150 to -180 to -225 volts
- D-C Plate Current: 300 to 345 to 312 ma.
- D-C Screen Current: 60 to 60 to 45 ma.
- D-C Grid Current: 9 to 10 to 9 ma.
- Screen Diispersion: 30 to 30 to 22.5 watts
- Grid Dispersion: 0.35 to 0.3 to 0.46 watts
- Peak R.F. Grid Input Voltage (approx.): 220 to 225 to 303 volts
- Driving Power (approx.): 1.75 to 2.6 to 2.46 watts
- Plate Power Input: 750 to 1035 to 1250 watts
- Plate Dissipation: 175 to 235 to 250 watts
- Plate Power Output: 575 to 800 to 1000 watts

---

**HIGH-LEVEL-MODULATED RADIO FREQUENCY AMPLIFIER**

Class-C Telephony (Carrier conditions unless otherwise specified, 1 tube)

**MAXIMUM RATINGS**

<table>
<thead>
<tr>
<th>D-C PLATE VOLTAGE</th>
<th>3200 MAX. VOLTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C SCREEN VOLTAGE</td>
<td>400 MAX. VOLTS</td>
</tr>
<tr>
<td>D-C GRID VOLTAGE</td>
<td>-500 MAX. VOLTS</td>
</tr>
<tr>
<td>D-C PLATE CURRENT</td>
<td>275 MAX. MA.</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>165 MAX. WATTS</td>
</tr>
<tr>
<td>SCREEN DISSIPATION</td>
<td>35 MAX. WATTS</td>
</tr>
<tr>
<td>GRID DISSIPATION</td>
<td>5 MAX. WATTS</td>
</tr>
</tbody>
</table>

**TYPICAL OPERATION** (Frequencies below 75 Mc.)

- D-C Plate Voltage: 2500 to 3000 to 4000 volts
- D-C Screen Voltage: 400 to 400 to 400 volts
- D-C Grid Voltage: -200 to -310 to -310 volts
- D-C Plate Current: 200 to 235 ma.
- D-C Screen Current: 30 to 30 to 30 ma.
- D-C Grid Current: 9 to 9 to 9 ma.
- Screen Dispersion: 12 to 12 to 12 watts
- Grid Dispersion: 1.8 to 2.7 to 2.7 watts
- Peak R.F. Grid Input Voltage (approx.): 255 to 365 to 365 volts
- Driving Power (approx.): 2.2 to 3.2 to 3.2 watts
- Plate Power Input: 500 to 675 to 750 watts
- Plate Dissipation: 125 to 165 to 165 watts
- Plate Power Output: 375 to 510 to 510 watts

---

1 Above 75 Mc., the maximum plate voltage rating depends upon frequency, see page 6.
2 Driving power increases above 40 Mc. See Page Six.
AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB, (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

<table>
<thead>
<tr>
<th></th>
<th>D-C Plate Voltage</th>
<th>D-C Screen Voltage</th>
<th>Max-Signal D-C Plate Current, Per Tube</th>
<th>Max-Signal, Per Tube</th>
<th>Plate Dissipation, Per Tube</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C PLATE VOLTAGE</td>
<td>1500</td>
<td>2000</td>
<td>2500</td>
<td>3000</td>
<td></td>
</tr>
<tr>
<td>D-C SCREEN VOLTAGE</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
<td>-48</td>
<td>-48</td>
<td>-80</td>
<td>-93</td>
<td></td>
</tr>
<tr>
<td>Zero-Signal D-C Plate Current</td>
<td>120</td>
<td>110</td>
<td>120</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Max-Signal D-C Plate Current</td>
<td>400</td>
<td>405</td>
<td>430</td>
<td>417</td>
<td></td>
</tr>
<tr>
<td>Zero-Signal D-C Screen Current</td>
<td>-0.4</td>
<td>-0.3</td>
<td>-0.3</td>
<td>-0.2</td>
<td></td>
</tr>
<tr>
<td>Max-Signal D-C Screen Current</td>
<td>23</td>
<td>22</td>
<td>13</td>
<td>10.5</td>
<td></td>
</tr>
<tr>
<td>Effective Load, Plate-to-Plate</td>
<td>6250</td>
<td>9170</td>
<td>11,400</td>
<td>15,000</td>
<td></td>
</tr>
<tr>
<td>Peak A-F Grid Input Voltage</td>
<td>64</td>
<td>88</td>
<td>90</td>
<td>93</td>
<td></td>
</tr>
<tr>
<td>(per tube)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Driving Power</td>
<td>145</td>
<td>175</td>
<td>225</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>Max-Signal Plate Dissipation</td>
<td>310</td>
<td>460</td>
<td>625</td>
<td>750</td>
<td></td>
</tr>
<tr>
<td>(per tube)</td>
<td>2</td>
<td>2.5</td>
<td>2</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>4</td>
<td>2.5</td>
<td>2</td>
<td>2.5</td>
<td></td>
</tr>
</tbody>
</table>

2 The effective grid-circuit resistance must not exceed 250,000 ohms.

TYPICAL OPERATION

MECHANICAL

Mounting—The 4-250A must be mounted vertically, base up or base down. The socket must provide clearance for the glass tip-off which extends through the center of the base. The metal base shell should be grounded by means of suitable spring fingers. A flexible connecting strap should be provided between the plate terminal and the external plate circuit. The socket must not apply excessive lateral pressure against the base pins. The tube must be protected from severe vibration and shock.

Adequate cooling must be provided for the seals and envelope of the 4-250A. Forced-air circulation in the amount of five cubic feet per minute through the base of the tube is required. This air should be applied simultaneously with filaments. The temperature of the plate seal, as measured on the top of the plate cap, should not exceed 170° C in continuous-service applications.

A relatively slow movement of air past the tube is sufficient to prevent a plate seal temperature in excess of maximum at frequencies below 30 Mc. At frequencies above 30 Mc., radio-frequency losses in the leads and envelope contribute to seal and envelope heating, and special attention should be given to bulb and plate seal cooling. A small fan or centrifugal blower directed toward the upper portion of the envelope will usually provide sufficient circulation for cooling at frequencies above 30 Mc., however.

In intermittent-service applications where the "on" time does not exceed a total of five minutes in any ten-minute period, plate seal temperatures as high as 220° C are permissible. When the ambient temperature does not exceed 30° C it will not ordinarily be necessary to provide forced cooling of the bulb and plate seal to hold the temperature below this maximum at frequencies below 30 Mc., provided that a heat-radiating plate connector is used, and the tube is so located that normal circulation of air past the envelope is not impeded.

ELECTRICAL

Filament Voltage—The filament voltage, as measured directly at the filament pins, should be between 4.75 and 5.25 volts.

Bias Voltage—D-c bias voltage for the 4-250A should not exceed 500 volts. If grid-leak bias is used, suitable protective means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation.

Grid Dissipation—Grid dissipation for the 4-250A should not be allowed to exceed five watts. Grid dissipation may be calculated from the following expression:

\[ P_g = e_{c m} I_c \]

where \( P_g \) = Grid dissipation, \( e_{c m} \) = Peak positive grid voltage, and \( I_c \) = D-c grid current.

\( e_{c m} \) may be measured by means of a suitable peak voltmeter connected between filament and grid.

Screen Voltage—The d-c screen voltage for the 4-250A should not exceed 600 volts.

Screen Dissipation—The power dissipated by the screen of the 4-250A must not exceed 35 watts.

For suitable peak v.t.w.m. circuits see, for instance, "Vacuum Tube Ratings," Eimac News, January, 1946. This article is available in reprint form on request.

Page Two
tion is likely to rise to excessive values when the plate voltage, bias voltage or plate load is removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 35 watts in the event of circuit failure.

**Plate Voltage**—The plate-supply voltage for the 4-250A should not exceed 4000 volts for frequencies below 75 Mc. Above 75 Mc., the maximum permissible plate voltage is less than 4000 volts, as shown by the graph on page 6.

**Plate Dissipation**—Under normal operating conditions, the plate dissipation of the 4-250A should not be allowed to exceed 250 watts in unmodulated applications.

In high-level-modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 165 watts.

Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

**OPERATION**

**Class-C FM or Telegraphy**—The 4-250A may be operated as a class-C FM or telegraph amplifier without neutralization up to 30 Mc. if reasonable precautions are taken to prevent coupling between input and output circuits external to the tube. A grounded metallic plate on which the socket may be mounted and to which suitable connectors may be attached to ground the tube base shell, provides an effective isolating shield between grid and plate circuits. In single-ended circuits, plate, grid, filament and screen by-pass capacitors should be returned through the shortest possible leads to a common chassis point. In push-pull applications the filament and screen terminals of each tube should be by-passed to a common chassis point by the shortest possible leads, and short, heavy leads should be used to interconnect the screens and filaments of the two tubes. Care should be taken to prevent leakage of radio-frequency energy to leads entering the amplifier, in order to minimize grid-plate coupling between these leads external to the amplifier.

At frequencies from 30 Mc. to 45 Mc., ordinary neutralization systems may be used.

Where shielding is adequate, the feed-back at frequencies above 45 Mc. is due principally to screen-lead-inductance effects, and it becomes necessary to introduce in-phase voltage from the plate circuit into the grid circuit. This can be done by adding capacitance between plate and grid external to the tube. Ordinarily, a small metal tab approximately % inch square connected to the grid terminal and located adjacent to the envelope opposite the plate will suffice for neutralization. Means should be provided for adjusting the spacing between the neutralizing capacitor plate and the envelope. An alternative neutralization scheme is illustrated in the diagram below. In this circuit, feed-back is eliminated by series-tuning the screen to ground with a small capacitor. The socket screen terminals should be strapped together, as shown on the diagram, by the shortest possible lead, and the leads from the screen terminal to the capacitor, C, and from the capacitor to ground should be made as short as possible.

Driving power and power output under maximum output and plate voltage conditions are shown on page 6. The power output shown is the actual plate power delivered by the tube; the power delivered to the load will depend upon the efficiency of the plate tank and output coupling system. The driving power is likewise the driving power required by the tube (includes bias loss). The driver output power should exceed the driving power requirement by a sufficient margin to allow for coupling-circuit losses. The use of silver-plated linear tank-circuit elements is recommended for all frequencies above 75 Mc.

**Class-C AM Telephony**—The r-f circuit considerations discussed above under Class-C FM or Telegraphy also apply to amplitude-modulated operation of the 4-250A. When the 4-250A is used as a class-C high-level-modulated amplifier, modulation should be applied to both plate and screen. Modulation voltage for the screen may be obtained from a separate winding on the modulation transformer, by supplying the screen voltage via a series dropping resistor from the unmodulated plate supply, or by the use of an audio-frequency reactor in the positive screen-supply lead. When screen modulation is obtained by either the series-resistor or the audio-reactor method, the audio-frequency variations in screen current which result from the variations in plate voltage as the plate is modulated automatically give the required screen modulation. Where a reactor is used, it should have a rated inductance of not less than 10 henries divided by the number of tubes in the modulated amplifier and a maximum current rating of two or three times the operating d-c screen current. To prevent phase shift between the screen and plate modulation voltages at high audio frequencies, the screen by-pass capacitor should be no larger than necessary for adequate r-f by-passing.

For high-level modulated service, the use of partial grid-leak bias is recommended. Any by-pass capacitors placed across the grid-leak resistance should have a reactance at the highest modulation frequency equal to at least twice the grid-leak resistance.

**Class-AB, and Class-AB, Audio**—Two 4-250A's may be used in a push-pull circuit to give relatively high audio output power at low distortion. Maximum ratings and typical operating conditions for class-AB, and class-AB, audio operation are given in the tabulated data.

Screen voltage should be obtained from a source having reasonably good regulation, to prevent variations in screen voltage from zero-signal to maximum-signal conditions. The use of voltage regulator tubes in a standard circuit should provide adequate regulation.
Grid bias voltage for class-AB, service may be obtained from batteries or from a small fixed-bias supply. When a bias supply is used, the d-c resistance of the bias source should not exceed 250 ohms. Under class-AB, conditions the effective grid-circuit resistance should not exceed 250,000 ohms.

The peak driving power figures given in the class-AB, tabulated data are included to make possible an accurate determination of the required driver output power. The driver amplifier must be capable of supplying the peak driving power without distortion. The driver stage should, therefore, be capable of providing an undistorted average output equal to half the peak driving power requirement. A small amount of additional driver output should be provided to allow for losses in the coupling transformer.

In some cases the maximum-signal plate dissipation shown under “Typical Operation” is less than the maximum rated plate dissipation of the 4-250A. In these cases, the plate dissipation reaches a maximum value, equal to the maximum rating, at a point somewhat below maximum-signal conditions.

The power output figures given in the tabulated data refer to the total power output from the amplifier tubes. The useful power output will be from 5 to 15 per cent less than the figures shown, due to losses in the output transformer.

**COMPONENTS FOR TYPICAL CIRCuits**

- **L<sub>01</sub> - C<sub>01</sub>** — Tank circuit appropriate for operating frequency; \(Q = 12\). Capacitor plate spacing = .200”.
- **L<sub>02</sub> - C<sub>02</sub>** — Tank circuit appropriate for operating frequency; \(Q = 12\). Capacitor plate spacing = .200”.
- **L<sub>03</sub> - C<sub>03</sub>** — Tank circuit appropriate for operating frequency; \(Q = 12\). Capacitor plate spacing = .375”.
- **L<sub>41</sub> - C<sub>41</sub>** — Tuned circuit appropriate for operating frequency.
- **L<sub>42</sub> - C<sub>42</sub>** — Tuned circuit appropriate for operating frequency.
  - \(C_1 = .002\) ufd, 500-v. mica
  - \(C_2 = .002\) ufd, 5000-v. mica
  - \(C_3 = .001\) ufd, 2500-v. mica
  - \(C_4 = .1\) ufd, 1000-v. paper
  - \(C_5 = .1\) ufd, 600-v. paper
  - \(C_6 = .5\) ufd, 600-v. paper
  - \(C_7 = .03\) ufd, 600-v. paper
  - \(C_8 = .1\) ufd, 1000-v. paper
  - \(C_9 = .25\) ufd, 1000-v. paper

- **R<sub>1</sub>** — 25,000 ohms, 2 watts
- **R<sub>2</sub>** — 2,500 ohms, 5 watts
- **R<sub>3</sub>** — 35,000 ohms, 160 watts
- **R<sub>4</sub>** — 250,000 ohms, 1/2 watt
- **R<sub>5</sub>** — 200,000 ohms, 2 watts
- **R<sub>6</sub>** — 500 ohms, 1/2 watt
- **R<sub>7</sub>** — 1 megohm, 1/2 watt
- **R<sub>8</sub>** — 100,000 ohms, 1 watt
- **R<sub>9</sub>** — 200,000 ohms, 1/2 watt
- **R<sub>10</sub>** — 10,000 ohms, 1/2 watt
- **R<sub>11</sub>** — 50 ohms, 10 watts
- **R<sub>12</sub>** — 100,000 ohms, 100 watts

- **RFC<sub>1</sub>** — 2.5-mhy., 125-ma. r-f choke
- **RFC<sub>2</sub>** — 1-mhy., 500-ma. r-f choke
- **T<sub>1</sub>** — 350-watt modulation transformer; ratio pri. to sec. approx. 1.5:1; pri. impedance 20,300 ohms, sec. impedance 13,300 ohms.
- **T<sub>2</sub>** — 600-watt modulation transformer; ratio pri. to sec. approx. 1.8:1; pri. impedance 11,400 ohms, sec. impedance 6,250 ohms.
Typical radio frequency power amplifier circuit, Class-C telegraphy, 1000 watts input.

Typical high-level-modulated r-f amplifier circuit, with modulator stage, 675 watts input.

Typical high-level-modulated r-f amplifier circuit, with modulator and driver stages, 1000 watts input.
The Eimac 4-400A is a high vacuum power tetrode having a maximum plate dissipation rating of 400 watts. It is intended for power amplifier service in 1 kw FM broadcast transmitters on the 88-108 Mc. band. Two tubes operating in this service will deliver a useful power output in excess of 1000 watts while operating under conservative conditions and with low driving-power requirements. The 4-400A is of compact and rugged construction and its low grid-plate capacitance coupled with its low driving power requirement allows considerable simplification of the associated circuit and driver stage.

Cooling of the 4-400A is accomplished by radiation from the plate and with circulation of forced-air through the base around the envelope and over the plate seal. The problem of cooling is greatly simplified by using an Eimac Air-System Socket and its accompanying glass chimney. This system is designed to efficiently maintain the correct balance of cooling air between the component parts of the tube.*

**GENERAL CHARACTERISTICS**

**ELECTRICAL**

Filament: Thoriated tungsten

- Voltage - 5.0 volts
- Current - 14.5 amperes

Grid-Screen Amplification Factor (Average) - 5.1

Direct Inter-electrode Capacitances (Average)

- Grid-Plate (without shielding, base grounded) - 0.12 μfd
- Input - 12.5 μfd
- Output - 4.7 μfd

Transconductance (i_s=100 ma., E_N=2500V., E_N=500V.) - 4,000 μmhos

**MECHANICAL**

- Base - 5-pin metal shell, No. 5008B
- Basing - RMA type 5BK
- Cooling - Radiation and forced air.

When the Eimac Air-System Socket 4-400A/4000 is used, 14 cu. ft. of air per minute at 1/4 inch pressure as measured in the socket, is required per tube.

Maximum Overall Dimensions:

- Length - 6.38 inches
- Diameter - 3.56 inches
- Net Weight - 9 ounces
- Shipping Weight (Avg.) - 2.5 pounds

**RATINGS**

RADIO-FREQUENCY POWER AMPLIFIER

Class-C FM Telephony or Telegraphy (Key-down conditions, 1 tube)

**MAXIMUM RATINGS (Frequencies up to 110-Mc.)**

<table>
<thead>
<tr>
<th>DC-PLATE VOLTAGE</th>
<th>4000 MAX VOLTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC-PLATE CURRENT</td>
<td>350 MAX. MA.</td>
</tr>
<tr>
<td>DC SCREEN VOLTAGE</td>
<td>600 MAX. VOLTS</td>
</tr>
<tr>
<td>DC GRID VOLTAGE</td>
<td>-500 MAX. VOLTS</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
<td>400 MAX. WATTS</td>
</tr>
<tr>
<td>SCREEN DISSIPATION</td>
<td>35 MAX. WATTS</td>
</tr>
<tr>
<td>GRID DISSIPATION</td>
<td>5 MAX. WATTS</td>
</tr>
</tbody>
</table>

*Guarantee applies only when the 4-400A is used as specified with adequate air in the 4-400A/4000 Air-System Socket or equivalent.

**TYPICAL OPERATION (110-Mc., Two Tubes)**

<table>
<thead>
<tr>
<th>DC-PLATE VOLTAGE</th>
<th>3500</th>
<th>4000 VOLTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC-PLATE CURRENT</td>
<td>500</td>
<td>540 MA.</td>
</tr>
<tr>
<td>DC SCREEN VOLTAGE</td>
<td>300</td>
<td>300 VOLTS</td>
</tr>
<tr>
<td>DC SCREEN CURRENT</td>
<td>40</td>
<td>45 MA.</td>
</tr>
<tr>
<td>DC GRID VOLTAGE</td>
<td>-170</td>
<td>-170 VOLTS</td>
</tr>
<tr>
<td>DC GRID CURRENT</td>
<td>20</td>
<td>20 MA.</td>
</tr>
<tr>
<td>DRIVING POWER (APPROX.)</td>
<td>30</td>
<td>20 WATTS</td>
</tr>
<tr>
<td>PLATE POWER OUTPUT (APPROX.)</td>
<td>1300</td>
<td>1400 WATTS</td>
</tr>
<tr>
<td>USEFUL POWER OUTPUT</td>
<td>1160</td>
<td>1400 WATTS</td>
</tr>
</tbody>
</table>

*The radio-frequency losses in a vacuum tube increase with frequency.

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APPLICATION

Conventional capacitance-shortened quarter wave linear grid and plate tank circuits may be used at 110-Mc. The circuit elements should be silver-plated for best results at this frequency. The 4-400A screen lead inductance is minimized by two screen leads brought through the base of the tube. In order to take advantage of this design feature the screen lead terminals on a socket must be strapped together and all R-F connections must be made to the center of this strap to provide balanced current distribution to ground.

With adequate shielding on frequencies above 30-Mc. there will still be some feed-back present, which is due principally to screen-lead-inductance effects. This may be neutralized by introducing inphase voltage from the plate circuit back into the grid circuit of the same tube. Ordinarily a small metal tab 1 inch by 1½ inches connected to the grid terminal and located parallel to the plate outside of the cooling chimney will suffice for neutralization. Means should be provided for adjusting the distance between the tab and the plate until the correct amount of neutralization is obtained. Trimming the tab to the correct size will also accomplish the same result.

An alternate neutralization method would be to series-tune each screen to ground by means of a small variable capacitor. The leads to each capacitor and to ground should be kept as short as possible and the lead from the screen strap to the capacitor should be brought from the center of the screen strap as previously mentioned.
In order to simplify the cooling problem of the Eimac 4-400A Tetrode and assure adequate air-flow to the various seals, the Eimac Air-System Socket was developed. This system is so designed that the correct amount of cooling air is distributed to the various seals in the right proportion.

The system consists of two parts: a specially designed cooling socket and a glass chimney that fits over the tube envelope. The air is introduced into the system at a single port in the socket and then circulates through and around the base, cooling the base pins and seals. It then flows over the envelope, the plate seal and finally exhausts at the chimney top.

A ¾ inch diameter hole tapped 28 threads per inch is provided in the socket for the purpose of reading the static air pressure. Under full operating conditions at 110-Mc, with an ambient temperature of 25 degrees Centigrade, each tube requires cooling air at the rate of 14 cu. ft. per minute into the system with a static pressure of 0.25 inches of water as measured at the socket measuring port.

In selecting a blower, allowance should be made for pressure drop occurring in the duct and manifold between the blower and the socket. This drop will, of course, depend on the length and diameter of the air duct and manifold between the blower and the socket.

The air requirements are readily furnished by a small centrifugal blower of the dual type, with the output of each blower going to a socket. The single motor of this type of blower need only 65 watts of power while furnishing 14 cu. ft. per minute air-flow at ½ inch pressure from each of two blowers.

The 4-400A/4000 Air-System Socket can also be used without modification for the Eimac 4-250A and 4-125A Tetrodes.

Looking up on a cutaway socket mounted on transparent (for demonstration purposes) deck. Arrows indicate the flow of cooling air. The socket mounts, flush with the bottom of the deck, by means of screws (A) that also position clips (B) on the top of the deck. These clips act to ground the tube base shell and also secure the air-system chimney. Air enters the assembly through duct (C), (not supplied with the socket assembly) which is secured by set-screw (D). Screw (E) is removed for making pressure measurements.
#10-32 MACHINE SCREWS MOUNT SPRING CLIPS AND SOCKET ON CHASSIS

TOP VIEW

3" DIA. HOLE THRU CHASSIS

3 5/16 DIA. B.C.

CHASSIS DRILLING

#9 (.196) DRILL THRU 4 HOLES

2 7/16 DIA. AIR HOLE

CHASSIS THICKNESS

5" MAX.

1/4 MAX.

1/16 MAX.

AIR MEASURING HOLE PLUGGED WITH 1/4-28 SCREW

GLASS AIR FLOW CHIMNEY

SPRING CLIPS GROUND TUBE BASE AND HOLD AIR FLOW CHIMNEY

AIR INLET 1 1/4 O.D. TUBING OR FITTING

SOCKET INSERT MAY BE TURNED TO ORIENT TUBE

SCREEN GRID

CONTROL GRID

4 1/8 DIA.

1.253 DIA. BORED HOLE

1.258 DIA.

FILAMENT

SCREEN GRID
The Eimac 4X500A is an external-anode tetrode having a maximum plate dissipation rating of 500 watts. Its small size and low-inductance leads permit efficient operation at relatively large outputs well into the VHF region. The screen grid is mounted on a disc which terminates in a connector ring located between grid and plate, thus making possible effective shielding between the grid and plate circuits. The grid terminal is located at the center of the glass base, to facilitate single-tube operation in coastal circuits.

The combination of low grid-plate capacitance, low screen-lead inductance and functionally located terminals contributes to the stable operation of the 4X500A at high frequencies, making neutralization unnecessary in most cases and greatly simplifying it in others.

**GENERAL CHARACTERISTICS**

**ELECTRICAL**
- Filament: Thoriated Tungsten
- Voltage: 5.0 volts
- Current: 13.5 amperes
- Screen Grid Amplification Factor (Average): 6.2
- Direct Interelectrode Capacitances (Average):
  - Grid-Plate: 0.05 μF
  - Input: 12.8 μF
  - Output: 5.6 μF
- Transconductance ($i_b=200$ ma., $e_b=2500$ v., $E_{se}=500$ v.): 5200 μhos

**MECHANICAL**
- Maximum Overall Dimensions:
  - Length: 4.375 inches
  - Diameter: 2.563 inches
  - Net Weight: 1.17 pounds
  - Shipping Weight (Average): 6 pounds
  - Mounting Position: Vertical, Base up or down

**RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR**

Class-C FM or Telegraphy (Key-down conditions, 1 tube)

**MAXIMUM RATINGS** (Frequencies up to 120 Mc.)
- D-C PLATE VOLTAGE
- D-C SCREEN VOLTAGE
- D-C GRID VOLTAGE
- D-C PLATE CURRENT
- PLATE DISSIPATION
- SCREEN DISSIPATION
- GRID DISSIPATION

**TYPICAL OPERATION** (Two-Tubes, push-pull amplifier, 110 Mc.)
- D-C Plate Voltage: 2500 volts
- D-C Plate Current: 400 ma.
- D-C Screen Voltage: 500 volts
- D-C Screen Current: 100 ma.
- D-C Grid Voltage: -250 volts
- D-C Grid Current: 40 ma.
- Driving Power (approx.): 20 watts
- Plate Power Output (approx.): 1180 watts
- Useful Power Output: 1150 watts

**TYPICAL OPERATION** (Four tubes, push-pull-parallel amplifier, 110 Mc.)
- D-C Plate Voltage: 4000 volts
- D-C Plate Current: 1.25 amp.
- D-C Screen Voltage: 500 volts
- D-C Screen Current: 160 ma.
- D-C Grid Voltage: -250 volts
- D-C Grid Current: 70 ma.
- Driving Power (approx.): 50 watts
- Plate Power Output (approx.): 3900 watts
- Useful Power Output: 3500 watts

1 A minimum flow of 22 cubic feet of air per minute must be passed through the plate cooler. The pressure drop across the cooler at this flow equals 1.4 inches of water. The glass at the base of the tube must be cooled by passing air at a minimum velocity of 1000 feet per minute across the base. Sufficient air for this purpose will ordinarily be obtained from a small fan or low-pressure centrifugal blower. Cooling air must be supplied to both the plate cooler and base before applying filament voltage.
The Eimac 4-1000A is a power tetrode having a maximum plate dissipation of 1000 watts. Cooling of the 4-1000A is accomplished by radiation from the plate and by forced-air circulation around the glass envelope and through the compact low-inductance base structure. At maximum dissipation the plate operates at a red-orange color.

The 4-1000A permits a single-stage gain of more than 230 times up to approximately 30 Mc., or from 14 watts driving power to over 3 KW power output per tube. This output can be obtained at frequencies well into the VHF range. At 100 Mc. a pair of 4-1000A's will deliver a useful power output of more than 4000 watts.

**GENERAL CHARACTERISTICS**

**ELECTRICAL**
- Filament: Thoriated tungsten
- Voltage: 7.5 volts
- Current: 21 amperes
- Grid-Screen Amplification Factor (Average): 7.2
- Direct Interelectrode Capacitances (Average):
  - Grid-Plate (without shielding, base grounded): 0.24 μfd
  - Input: 27.2 μfd
  - Output: 7.6 μfd
- Transconductance ($I_B=300$ ma., $E_S=2500$ v., $E_G=500$ v.): 10,000 μmhos

**MECHANICAL**
- Base: 5-pin metal shell, (see dwg.)
- Basing: RMA type 5BK
- Cooling: Radiation and forced air
- Mounting position: Vertical, base down or up
- Maximum Overall Dimensions:
  - Length: 9.25 inches
  - Diameter: 7 inches
- Net Weight: 1.5 pounds
- Shipping Weight (Average): 12 pounds

**RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR**

**Class-C Telegraphy (Key-down conditions, per tube)**

**MAXIMUM RATINGS**
- D.C. Plate Voltage: 6000 Max. Volts
- D.C. Screen Voltage: 1000 Max. Volts
- D.C. Grid Voltage: 500 Max. Volts
- D.C. Plate Current: 700 Max. ma.
- Plate Dissipation: 1000 Max. Watts
- Screen Dissipation: 75 Max. Watts
- Grid Dissipation: 25 Max. Watts

**TYPICAL OPERATION (Frequencies below 40 Mc.)**
- D.C. Plate Voltage: 3000
- D.C. Screen Voltage: 500
- D.C. Grid Voltage: 150
- D.C. Plate Current: 693
- D.C. Screen Current: 146
- D.C. Grid Current: 38
- Screen Dissipation: 73
- Grid Dissipation: 5.4
- Peak R.F. Grid Input Voltage (approx.): 292
- Driving Power (approx.): 11.1
- Plate Power Input: 2079
- Plate Dissipation: 607
- Plate Power Output: 1412

**RADIO FREQUENCY POWER AMPLIFIER**

**FM Telephony or Class C Telegraphy**

**MAXIMUM RATINGS (Per tube at 110 Mc.)**
- D.C. Plate Voltage: 5000 Max. Volts
- D.C. Screen Voltage: 1000 Max. Volts
- D.C. Grid Voltage: 500 Max. Volts
- D.C. Plate Current: 700 Max. ma.
- Plate Dissipation: 1000 Max. Watts
- Screen Dissipation: 75 Max. Watts
- Grid Dissipation: 25 Max. Watts

**TYPICAL OPERATION (Two Tubes Push-Pull at 110 Mc.)**
- D.C. Plate Voltage: 4000
- D.C. Screen Voltage: 1500
- D.C. Grid Voltage: 350
- D.C. Plate Current: 290
- D.C. Screen Current: 250 ma.
- D.C. Grid Current: 60 ma.
- Screen Dissipation: 100
- Grid Dissipation: 200
- Driving Power (approx.): 4600
- Plate Power Input: 565
- Plate Dissipation (per tube): 4400
- Useful Power Output: 3050
- Watts

---

1 Adequate cooling must be provided for the seals and envelope of the 4-1000A. Forced air-circulation in the amount of 20 cubic feet per minute through the base of the tube is required. This air should be applied simultaneously with filament power. The temperature at the top of the plate terminal and on the pins at the base of the tube should not exceed 150 degrees centigrade in continuous-service applications.

2 Driving power increases for frequencies above approximately 30 Mc.
EITE M. MCCULLOUGH, INC.
SAN MATEO, CALIFORNIA

GENERAL CHARACTERISTICS

ELECTRICAL
Filament: Thoriated tungsten
Voltage: 6.3 volts
Current: 3.0 amperes

Amplification Factor (Average) 24

Direct Interelectrode Capacitances (Average)
Grid-Plate 1.5 μf
Grid-Filament 2.7 μf
Plate-Filament 0.3 μf

Transconductance (Ib=25 ma., E6=1000, e6=-15) 2500 μmhos

MECHANICAL
Base: (Small 4-pin bayonet, ceramic) RMA type M8-071
Basing: RMA type 3G

Maximum Overall Dimensions:
Length 4.50 inches
Diameter 1.44 inches

Net weight 1.00 ounce
Shipping weight (Average) 1.25 pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR
Class-B

<table>
<thead>
<tr>
<th>Typical Operation—2 Tubes</th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>750 1000 1500 2000</td>
<td>2000 volts</td>
</tr>
<tr>
<td>75 75 75 75</td>
<td>75 ma.</td>
</tr>
<tr>
<td>25 25 25 25</td>
<td>25 watts</td>
</tr>
<tr>
<td>205 210 230 270</td>
<td>volts</td>
</tr>
<tr>
<td>205 210 230 270</td>
<td>volts</td>
</tr>
<tr>
<td>43 32 21 16</td>
<td>ma.</td>
</tr>
<tr>
<td>43 32 21 16</td>
<td>ma.</td>
</tr>
<tr>
<td>133 120 94 80</td>
<td>watts</td>
</tr>
<tr>
<td>133 120 94 80</td>
<td>watts</td>
</tr>
<tr>
<td>1.4 1.2 0.8 0.7</td>
<td>ohms</td>
</tr>
<tr>
<td>1.4 1.2 0.8 0.7</td>
<td>ohms</td>
</tr>
<tr>
<td>9200 15800 33700 55500</td>
<td>watts</td>
</tr>
<tr>
<td>9200 15800 33700 55500</td>
<td>watts</td>
</tr>
<tr>
<td>50 70 90 110</td>
<td></td>
</tr>
</tbody>
</table>

*Average over any sinusoidal audio frequency cycle.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR
Class-C *Telegraphy
(Key down conditions without modulation)

<table>
<thead>
<tr>
<th>Typical Operation—1 Tube</th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 1500 2000</td>
<td>2000 volts</td>
</tr>
<tr>
<td>72 67 63</td>
<td>75 ma.</td>
</tr>
<tr>
<td>9 13 18</td>
<td>25 ma.</td>
</tr>
<tr>
<td>25 25 25</td>
<td>volts</td>
</tr>
<tr>
<td>25 25 25</td>
<td>watts</td>
</tr>
<tr>
<td>100 130</td>
<td>watts</td>
</tr>
<tr>
<td>100 130</td>
<td>volts</td>
</tr>
<tr>
<td>72 100 125</td>
<td>watts</td>
</tr>
<tr>
<td>72 100 125</td>
<td>volts</td>
</tr>
<tr>
<td>25 25 25</td>
<td>watts</td>
</tr>
<tr>
<td>25 25 25</td>
<td>watts</td>
</tr>
<tr>
<td>170 195 245</td>
<td></td>
</tr>
<tr>
<td>170 195 245</td>
<td></td>
</tr>
<tr>
<td>1.3 2.2 4.0</td>
<td></td>
</tr>
<tr>
<td>1.3 2.2 4.0</td>
<td></td>
</tr>
</tbody>
</table>

*The above figures show actual measured tube performance, and do not allow for variation in circuit losses.
✓Corrects typographical error on sheet dated 8-15-44.
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DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1000, 1500 and 2000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by $P_p$.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1000, 1500, and 2000 volts respectively.
.048±.003

PLATE

5\frac{1}{16} \text{ MIN.}

3\frac{9}{16}±\frac{3}{16}

4\frac{3}{16}±\frac{3}{16}

RMA BASE
NO. M8-071

GRID

FILAMENT

NC

FILAMENT

3G
GENERAL CHARACTERISTICS

ELECTRICAL
Filament: Thoriated tungsten
Voltage - - - - - 6.3 volts
Current - - - - - 3.0 amperes
Amplification Factor (Average) - - - - - 23
Direct Inter-electrode Capacitances (Average)
Grid-Plate - - - - - 1.5 µf
Grid-Filament - - - - - 1.7 µf
Plate-Filament - - - - - 0.3 µf
Transconductance (I_g=25 ma., E_b=1000, e_c=-20) - - - 2500 µhgs

MECHANICAL
Base - - - - - (Small 4-pin bayonet) RMA type MB-071
Basing - - - - - RMA type 2D
Maximum Overall Dimensions:
Length - - - - - 4.38 inches
Diameter - - - - - 1.44 inches
Net weight - - - - - 1.00 ounce
Shipping weight (Average) - - - - - 1.25 pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR
Class-B

Typical Operation—2 Tubes

D-C Plate Voltage - - - - - 750 1000 1500 2000 2000 volts
Max.-Signal D-C Plate Current, per tube* - - - - - • • • • 75 ma.
Plate Dissipation, per tube* - - - - - • • • • 25 watts
D-C Grid Voltage (approx.) - - - - - -20 -30 -60 -85 -85 volts
Peak A-F Grid Input Voltage - - - - - 230 230 250 290 290 volts
Zero-Signal D-C Plate Current - - - - - 43 32 21 16 16 ma.
Max.-Signal D-C Plate Current - - - - - 133 120 94 80 80 ma.
Max.-Signal Driving Power (approx.) - - - - - 2.0 1.7 1.2 1.1 1.1 watts
Effective Load, Plate-to-Plate - - - - - 9200 15800 33700 55500 ohms
Max.-Signal Plate Power Output - - - - - 50 70 90 110 watts

*Average over any sinusoidal audio frequency cycle.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR
Class-C *Telegraphy
(Key down conditions without modulation)

Typical Operation—1 Tube

D-C Plate Voltage - - - - - 1000 1500 2000 2000 volts
D-C Plate Current - - - - - 72 67 63 75 ma.
D-C Grid Current - - - - - 15 15 17 25 ma.
D-C Grid Voltage - - - - - -80 -110 -170 -25 volts
Plate Power Output - - - - - 47 75 100 25 watts
Plate Input - - - - - 72 100 125 25 watts
Plate Dissipation - - - - - 25 25 25 25 watts
Peak R. F. Grid Input Voltage, (approx.) - - - - - 200 225 295 volts
Driving Power, (approx.) - - - - - 2.6 3.1 4.5 watts

*The above figures show actual measured tube performance, and do not allow for variations in circuit losses.
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DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1000, 1500 and 2000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by $P_p$.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1000, 1500, and 2000 volts respectively.
GENERAL CHARACTERISTICS

**Electrical**

- Filament: Thoriated tungsten
- Voltage: 5.0 volts
- Current: 4.0 amperes
- Amplification Factor (Average): 39
- Direct Interelectrode Capacitances (Average):
  - Grid-Plate: 1.8 μF
  - Grid-Filament: 4.1 μF
  - Plate-Filament: 0.3 μF
- Transconductance (I₀=100 ma., E₀=2000, e₀=-30): 2850 μmhos
- Frequency for Maximum Ratings: 100 mc.

**Mechanical**

- Base: (Medium 4-pin bayonet, ceramic) RMA type M8-078
- Basing: RMA type 3G
- Maximum Overall Dimensions:
  - Length: 5.5 inches
  - Diameter: 1.81 inches
- Net weight: 2.5 ounces
- Shipping weight (Average): 1.25 pounds

**Audio Frequency Power Amplifier and Modulator**

*Class B*

<table>
<thead>
<tr>
<th>Typical Operation—2 Tubes</th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>1000</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current, per tube</td>
<td></td>
</tr>
<tr>
<td>Plate Dissipation, per tube</td>
<td></td>
</tr>
<tr>
<td>D-C Grid Voltage (approx.)</td>
<td>-8</td>
</tr>
<tr>
<td>Peak A-F Grid Input Voltage</td>
<td>240</td>
</tr>
<tr>
<td>Zero-Signal D-C Plate Current</td>
<td>67</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current</td>
<td>240</td>
</tr>
<tr>
<td>Max.-Signal Driving Power (approx.)</td>
<td>7</td>
</tr>
<tr>
<td>Effective Load, Plate-to-Plate</td>
<td>7900</td>
</tr>
<tr>
<td>Max.-Signal Plate Power Output</td>
<td>140</td>
</tr>
</tbody>
</table>

*Averaged over any sinusoidal audio frequency cycle.

**Radio Frequency Power Amplifier and Oscillator**

*Class-C *Telegraphy

*(Key down conditions without modulation)*

<table>
<thead>
<tr>
<th>Typical Operation—1 Tube</th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>1000</td>
</tr>
<tr>
<td>D-C Plate Current</td>
<td>125</td>
</tr>
<tr>
<td>D-C Grid Current</td>
<td>40</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
<td>-60</td>
</tr>
<tr>
<td>Plate Power Output</td>
<td>87</td>
</tr>
<tr>
<td>Plate Input</td>
<td>125</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>38</td>
</tr>
<tr>
<td>Peak R. F. Grid Input Voltage, (approx.)</td>
<td>165</td>
</tr>
<tr>
<td>Driving Power, (approx.)</td>
<td>7</td>
</tr>
</tbody>
</table>

*The above figures show actual measured tube performance, and do not allow for variations in circuit losses.

(Effective 5-1-45) Copyright, 1946 by Eitel-McCullough, Inc.
DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1000, 1500 and 2000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by $P_p$.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1000, 1500, and 2000 volts respectively.
EITE M. McCULLOUGH, INC.
SAN ANTONIO, CALIFORNIA

GENERAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament: Thoriated tungsten</td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>5.0 volts</td>
</tr>
<tr>
<td>Current</td>
<td>4.0 amperes</td>
</tr>
<tr>
<td>Amplification Factor (Average)</td>
<td>39</td>
</tr>
<tr>
<td>Direct Interelectode Capacitances</td>
<td></td>
</tr>
<tr>
<td>Grid-Plate</td>
<td>1.8 µf</td>
</tr>
<tr>
<td>Grid-Filament</td>
<td>2.5 µf</td>
</tr>
<tr>
<td>Plate-Filament</td>
<td>0.4 µf</td>
</tr>
<tr>
<td>Transconductance (Iₐ=100 ma., Eₜ=2000, eₜ=-30)</td>
<td>2850 µmhos</td>
</tr>
<tr>
<td>Frequency for Maximum Ratings</td>
<td>100 mc.</td>
</tr>
</tbody>
</table>

MECHANICAL

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base (Medium 4-pin bayonet, ceramic)</td>
<td>RMA type M8-078</td>
</tr>
<tr>
<td>Basing</td>
<td>RMA type 2M</td>
</tr>
<tr>
<td>Maximum Overall Dimensions</td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>5.75 inches</td>
</tr>
<tr>
<td>Diameter</td>
<td>1.81 inches</td>
</tr>
<tr>
<td>Net weight</td>
<td>2.5 ounces</td>
</tr>
<tr>
<td>Shipping weight (Average)</td>
<td>1.25 pounds</td>
</tr>
</tbody>
</table>

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class B

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Typical Operation—2 Tubes</th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>1000 1500 2000</td>
<td>2000 volts</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current, per tube*</td>
<td>•   •   •</td>
<td>150 ma.</td>
</tr>
<tr>
<td>Plate Dissipation, per tube*</td>
<td>•           •</td>
<td>50 watts</td>
</tr>
<tr>
<td>D-C Grid Voltage (approx.)</td>
<td>-8          -25          -40</td>
<td>volts</td>
</tr>
<tr>
<td>Peak A-F Grid Input Voltage</td>
<td>240         250          255</td>
<td>volts</td>
</tr>
<tr>
<td>Zero-Signal D-C Plate Current</td>
<td>67          45           34</td>
<td>ma.</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current</td>
<td>240         200          167</td>
<td>ma.</td>
</tr>
<tr>
<td>Max.-Signal Driving Power (approx.)</td>
<td>7            5            4</td>
<td>watts</td>
</tr>
<tr>
<td>Effective Load, Plate-to-Plate</td>
<td>7900        16200        27500</td>
<td>ohms</td>
</tr>
<tr>
<td>Max.-Signal Plate Power Output</td>
<td>140         200          235</td>
<td>watts</td>
</tr>
</tbody>
</table>

*Rounded to the nearest whole number.

*Average over any sinusoidal audio frequency cycle.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C *Telegraphy

(Key down conditions without modulation)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Typical Operation—1 Tube</th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>1000 1500 2000</td>
<td>2000 volts</td>
</tr>
<tr>
<td>D-C Plate Current</td>
<td>125 125 125</td>
<td>150 ma.</td>
</tr>
<tr>
<td>D-C Grid Current</td>
<td>40 40 45</td>
<td>50 ma.</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
<td>-60 -120 -135</td>
<td>volts</td>
</tr>
<tr>
<td>Plate Power Output</td>
<td>87 141 200</td>
<td>watts</td>
</tr>
<tr>
<td>Plate Input</td>
<td>125 188 250</td>
<td>watts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>38 47 50</td>
<td>50 watts</td>
</tr>
<tr>
<td>Peak R. F. Grid Input Voltage, (approx.)</td>
<td>165 250 285</td>
<td>volts</td>
</tr>
<tr>
<td>Driving Power, (approx.)</td>
<td>7 9 13</td>
<td>watts</td>
</tr>
</tbody>
</table>

*The above figures show actual measured tube performance, and do not allow for variations in circuit losses.

(Effective 5-1-45) Copyright, 1945 by Eitel McCullough, Inc.
DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1000, 1500 and 2000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1000, 1500, and 2000 volts respectively.
The Eimac 75TH is a medium-mu high-vacuum transmitting triode intended for amplifier, oscillator and modulator service. It has a maximum plate dissipation rating of 75 watts. Cooling of the 75TH is accomplished by radiation from the plate, which operates at a visible red temperature at maximum dissipation, and by air circulation around the envelope.

**GENERAL CHARACTERISTICS**

**Electrical**
- Filament: Thoriated tungsten
- Voltage: 5.0 volts
- Current: 6.25 amperes
- Amplification Factor (Average): 20
- Direct Interelectrode Capacitances (Average):
  - Grid-Plate: 2.3 μF
  - Grid-Filament: 2.7 μF
  - Plate-Filament: 0.3 μF
- Transconductance ($i_0 = 225$ ma, $E_b = 3000$ v, $E_c = -40$ v): 4150 μmhos

**Mechanical**
- Base: Medium 4-pin bayonet, ceramic, RMA type M8-078
- Basing: RMA type 2M
- Cooling: Radiation and air circulation
- Maximum Overall Dimensions:
  - Length: 7.25 inches
  - Diameter: 2.81 inches
- Net Weight: 3 ounces
- Shipping Weight (Average): 1.5 pounds

**Radio Frequency Power Amplifier and Oscillator**

<table>
<thead>
<tr>
<th>Class-C Telegraphy (Key-down conditions, 1 tube)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum Ratings (Frequencies below 40 Mc.)</strong></td>
</tr>
<tr>
<td>D-C PLATE VOLTAGE</td>
</tr>
<tr>
<td>D-C PLATE CURRENT</td>
</tr>
<tr>
<td>PLATE DISSIPATION</td>
</tr>
<tr>
<td>GRID DISSIPATION</td>
</tr>
</tbody>
</table>

**Typical Operation (Frequencies below 40 Mc.)**
- D-C Plate Voltage: 1000, 1500, 2000 volts
- D-C Grid Voltage: -40, -125, -200 volts
- D-C Grid Current: 40, 30, 22 ma.
- Peak R-F Grid Input Voltage (approx.): 290, 250, 325 volts
- Driving Power (approx.): 9, 6, 10 watts
- Plate Power Input: 215, 250, 300 watts
- Plate Dissipation: 75, 75, 75 watts
- Plate Power Output: 140, 175, 225 watts

**Audio Frequency Power Amplifier and Modulator**

<table>
<thead>
<tr>
<th>Class-B (Sinusoidal wave, two tubes unless otherwise specified)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum Ratings</strong></td>
</tr>
<tr>
<td>D-C PLATE VOLTAGE</td>
</tr>
<tr>
<td>MAX-SIGNAL D-C PLATE CURRENT, PER TUBE</td>
</tr>
<tr>
<td>PLATE DISSIPATION, PER TUBE</td>
</tr>
<tr>
<td>GRID DISSIPATION, PER TUBE</td>
</tr>
</tbody>
</table>

**Typical Operation**
- D-C Plate Voltage: 1000, 1500, 2000 volts
- D-C Grid Voltage (approx.): -25, -65, -90 ma.
- Max-Signal D-C Plate Current: 350, 267, 225 ma.
- Effective Load, Plate-to-Plate: 5300, 11,400, 19,300 ohms
- Peak A-F Grid Input Voltage (per tube): 175, 165, 175 volts
- Max-Signal Driving Power (approx.): 7, 4, 3 watts
- Max-Signal Plate Dissipation (per tube): 75, 75, 75 watts
- Max-Signal Plate Power Output: 200, 250, 300 watts

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MECHANICAL

Mounting—The 75TH must be mounted vertically, base up or base down. Flexible connecting straps should be provided between the grid and plate terminals and the external grid and plate circuits. The tube must be protected from severe vibration and shock.

Cooling—Provision should be made for ample circulation of air around the 75TH. In the event that the design of the equipment restricts natural circulation, a small fan or centrifugal blower should be used to provide additional cooling for the, envelope and plate and grid seals.

ELECTRICAL

Filament Voltage—The filament voltage, as measured directly at the filament pins, should be between 4.75 and 5.25 volts.

Bias Voltage—Although there is no maximum limit on the bias voltage which may be used on the 75TH, there is little advantage in using bias voltages in excess of those given under "Typical Operation," except in certain very specialized applications. Where bias is obtained by a grid leak, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Plate Voltage—The plate-supply voltage for the 75TH should not exceed 3000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under "Typical Operation" for the power output desired.

Grid Dissipation—The power dissipated by the grid of the 75TH must not exceed 16 watts. Grid dissipation may be calculated from the following expression:

\[ P_g = \varepsilon_{\text{peak}} I_c \]

where \( P_g \) = Grid dissipation,
\( \varepsilon_{\text{peak}} \) = Peak positive grid voltage, and
\( I_c \) = D-c grid current.

\( \varepsilon_{\text{peak}} \) may be measured by means of a suitable peak voltmeter connected between filament and grid. In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading.

Plate Dissipation—Under normal operating conditions, the power dissipated by the plate of the 75TH should not be allowed to exceed 75 watts. Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

---

1 For suitable peak v.t.v.m. circuits see, for instance, “Vacuum Tube Ratings,” Eimac News, January, 1945. This article is available in reprint form on request.
DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1000, 1500 and 2000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by $P_p$.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1000, 1500, and 2000 volts respectively.
The Eimac 75TL is a low-mu, high-vacuum transmitting triode intended for amplifier, oscillator and modulator service. It has a maximum plate dissipation rating of 75 watts. Cooling of the 75TL is accomplished by radiation from the plate, which operates at a visibly red temperature at maximum dissipation, and by air circulation around the envelope.

**GENERAL CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament</td>
<td>Thoriated tungsten</td>
</tr>
<tr>
<td>Voltage</td>
<td>5.0 volts</td>
</tr>
<tr>
<td>Current</td>
<td>6.25 amperes</td>
</tr>
<tr>
<td>Amplification Factor (Average)</td>
<td>12</td>
</tr>
<tr>
<td>Direct Interelectode Capacitance (Average)</td>
<td></td>
</tr>
<tr>
<td>Grid-Plate</td>
<td>2.4 μF</td>
</tr>
<tr>
<td>Grid-Filament</td>
<td>2.6 μF</td>
</tr>
<tr>
<td>Plate-Filament</td>
<td>0.4 μF</td>
</tr>
<tr>
<td>Transconductance (i_b = 225ma., E_b = 2500v., E_c = -182 v.)</td>
<td>3350 μmhos</td>
</tr>
</tbody>
</table>

**MECHANICAL**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>Medium 4-pin bayonet, ceramic, RMA type M8-078</td>
</tr>
<tr>
<td>Basing</td>
<td>RMA type 2M</td>
</tr>
<tr>
<td>Cooling</td>
<td>Radiation and air circulation</td>
</tr>
<tr>
<td>Maximum Overall Dimensions:</td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>7.25 inches</td>
</tr>
<tr>
<td>Diameter</td>
<td>2.81 inches</td>
</tr>
<tr>
<td>Net weight</td>
<td>3 ounces</td>
</tr>
<tr>
<td>Shipping weight (Average)</td>
<td>1.5 pounds</td>
</tr>
</tbody>
</table>

**RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR**

<table>
<thead>
<tr>
<th>Class-C Telegraphy (Key-down conditions, 1 tube)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MAXIMUM RATINGS</strong> (Frequencies below 40 Mc.)</td>
</tr>
<tr>
<td>D-C Plate Voltage</td>
</tr>
<tr>
<td>D-C Plate Current</td>
</tr>
<tr>
<td>Grid Dissipation</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
</tr>
<tr>
<td><strong>TYPICAL OPERATION</strong> (Frequencies below 40 Mc.)</td>
</tr>
<tr>
<td>D-C Plate Voltage</td>
</tr>
<tr>
<td>D-C Plate Current</td>
</tr>
<tr>
<td>Grid Dissipation</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
</tr>
<tr>
<td>Peak R-F Grid Input Voltage (approx.)</td>
</tr>
<tr>
<td>Driving Power, (approx.)</td>
</tr>
<tr>
<td>Plate Power Input</td>
</tr>
<tr>
<td>Plate Power Output</td>
</tr>
</tbody>
</table>

**AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR**

<table>
<thead>
<tr>
<th>Class-AB, (Sinusoidal wave, two tubes unless otherwise specified)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MAXIMUM RATINGS</strong></td>
</tr>
<tr>
<td>D-C Plate Voltage</td>
</tr>
<tr>
<td>MAX-SIGNAL D-C Plate Current, PER TUBE</td>
</tr>
<tr>
<td>PLATE DISSIPATION, PER TUBE</td>
</tr>
</tbody>
</table>

**AUDIO FREQUENCY AMPLIFIER (Continued)**

<table>
<thead>
<tr>
<th>Class-B (Sinusoidal wave, two tubes unless otherwise specified)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MAXIMUM RATINGS</strong></td>
</tr>
<tr>
<td>D-C Plate Voltage</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
</tr>
<tr>
<td>Peak A-F Grid Input Voltage (per tube)</td>
</tr>
<tr>
<td>Max-Signal D-C Plate Current</td>
</tr>
<tr>
<td>Driving Power</td>
</tr>
<tr>
<td>Effective Load, Plate-to-Plate</td>
</tr>
<tr>
<td>Max-Signal Plate Power Output</td>
</tr>
<tr>
<td>Max-Signal Plate Dissipation (per tube)</td>
</tr>
</tbody>
</table>

**AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR**

<table>
<thead>
<tr>
<th>Class-B (Sinusoidal wave, two tubes unless otherwise specified)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MAXIMUM RATINGS</strong></td>
</tr>
<tr>
<td>D-C Plate Voltage</td>
</tr>
<tr>
<td>MAX-SIGNAL D-C Plate Current, PER TUBE</td>
</tr>
<tr>
<td>PLATE DISSIPATION, PER TUBE</td>
</tr>
<tr>
<td>GRID DISSIPATION, PER TUBE</td>
</tr>
</tbody>
</table>

**TYPICAL OPERATION**

| D-C Plate Voltage                                             | 1500 2000 volts       |
| D-C Grid Voltage                                              | -195 -140 volts       |
| Peak A-F Grid Input Voltage (per tube)                        | 105 160 volts         |
| Max-Signal D-C Plate Current                                  | -143 -130 ma.         |
| Driving Power                                                 | 0 0 watts             |
| Effective Load, Plate-to-Plate                                | -10,200 -21,200 ohms  |
| Max-Signal Plate Power Output                                 | -64 -110 watts        |
| Max-Signal Plate Dissipation (per tube)                       | -75 75 watts          |

**TYPICAL OPERATION**

| D-C Plate Voltage                                             | 1000 1500 2000 volts  |
| D-C Grid Voltage                                              | -65 -105 -140 volts   |
| Peak A-F Grid Input Voltage (per tube)                        | 205 225 267 volts     |
| Zero-Signal D-C Plate Current                                  | -100 -67 -50 ma.      |
| Max-Signal Avg. Driving Power (approx.)                        | 7 6 5 watts           |
| Max-Signal Peak Driving Power                                 | -26 23 19 watts       |
| Effective Load, Plate-to-Plate                                | -5,300 -11,000 -18,000 ohms |
| Max-Signal Plate Power Output                                 | -200 -280 -350 watts  |
| Max-Signal Plate Dissipation (per tube)                       | -75 75 75 watts       |

1 The effective grid-circuit resistance for each tube must not exceed 250,000 ohms.

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APPLICATION

MECHANICAL

Mounting—The 75TL must be mounted vertically, base up or base down. Flexible connecting straps should be provided between the grid and plate terminals and the external grid and plate circuits. The tube must be protected from severe vibration and shock.

Cooling—Provision should be made for ample circulation of air around the 75TL. In the event that the design of the equipment restricts natural circulation, a small fan or centrifugal blower should be used to provide additional cooling for the envelope and plate and grid seals.

ELECTRICAL

Filament Voltage—The filament voltage, as measured directly at the filament pins, should be between 4.75 and 5.25 volts.

Bias Voltage—Although there is no maximum limit on the bias voltage which may be used on the 75TL, there is little advantage in using bias voltages in excess of those given under “Typical Operation,” except in certain very specialised applications. Where bias is obtained by a grid leak, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Plate Voltage—The plate-supply voltage for the 75TL should not exceed 3000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under “Typical Operation” for the power output desired.

Grid Dissipation—The power dissipated by the grid of the 75TL must not exceed 13 watts. Grid dissipation may be calculated from the following expression:

$$ P_g = e_{mp}I_c $$

where $P_g =$ Grid dissipation,

$e_{mp} =$ Peak positive grid voltage, and

$I_c =$ D-c grid current.

$e_{mp}$ may be measured by means of a suitable peak voltmeter connected between filament and grid. In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading.

Plate Dissipation—Under normal operating conditions, the power dissipated by the plate of the 75TL should not be allowed to exceed 75 watts. Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

---

5 For suitable peak v.t.v.m. circuits see, for instance, “Vacuum Tube Ratings.” Eimac News, January, 1946. This article is available in reprint form on request.
DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1000, 1500 and 2000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by $P_p$.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1000, 1500, and 2000 volts respectively.
The Eimac 2C39 is a high-mu, forced-air cooled, external-anode transmitting triode incorporating features which make it useful at frequencies well into the U. H. F. range, as well as at lower frequencies. Its small size, rugged construction, unusually high transconductance, and relatively high plate dissipation permit the design of compact equipment of moderate power output for either fixed or mobile applications.

The grid of the Eimac 2C39 terminates in a ring of interposed between the plate and cathode-heater terminals, and the heater and cathode are provided with a concentric, cylindrical stem structure, facilitating its use in "grid isolation" amplifiers with cavity-type tank circuits.

GENERAL CHARACTERISTICS

ELECTRICAL
Cathode: Coated Unipotential
Heater Voltage - 6.3 volts
Heater Current - 1.1 amperes
Amplification Factor (Average) - 100
Direct Interelectrode Capacitances (Average)
Grid-Plate - 1.95 \( \mu \text{F} \)
Grid-Cathode - 6.50 \( \mu \text{F} \)
Plate-Cathode - 0.030 \( \mu \text{F} \)
Transconductance (\( i_b = 75 \text{ ma} \), \( E_b = 600 \text{ v} \)) (Average) - 17,000 \( \mu \text{mhos} \)

MECHANICAL
Maximum Overall Dimensions:
Length - 2.75 inches
Diameter - 1.26 inches
Net Weight - 2.8 ounces
Shipping Weight (Average) - 7 ounces

RADIO FREQUENCY POWER AMPLIFIER

Class-C FM Telephony or Telegraphy (Key-down conditions, 1 tube)
MAXIMUM RATINGS (Frequencies below 500 Mc.)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C PLATE VOLTAGE</td>
<td>1000 MAX. VOLTS</td>
</tr>
<tr>
<td>D-C CATHODE CURRENT</td>
<td>100 MAX. MA.</td>
</tr>
<tr>
<td>D-C GRID VOLTAGE</td>
<td>-150 MAX. VOLTS</td>
</tr>
<tr>
<td>PEAK POSITIVE R-F GRID VOLTAGE</td>
<td>30 MAX. VOLTS</td>
</tr>
<tr>
<td>PEAK NEGATIVE R-F GRID VOLTAGE</td>
<td>-400 MAX. VOLTS</td>
</tr>
<tr>
<td>PLATE DISSIPATION(^1)</td>
<td>100 MAX. WATTS</td>
</tr>
<tr>
<td>GRID DISSIPATION</td>
<td>3 MAX. WATTS</td>
</tr>
</tbody>
</table>

TYPICAL OPERATION (400 Mc.)

"Grid Isolation" Circuit

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>600 volts</td>
</tr>
<tr>
<td>D-C Plate Current</td>
<td>60 ma.</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
<td>-35 volts</td>
</tr>
<tr>
<td>D-C Grid Current</td>
<td>40 ma.</td>
</tr>
<tr>
<td>Driving Power (approx.)</td>
<td>5 watts</td>
</tr>
<tr>
<td>Useful Power Output</td>
<td>20 watts</td>
</tr>
</tbody>
</table>

\(^1\) Forced-air cooling required. 12 cubic feet of air per minute must be passed through plate cooler. Maximum plate dissipation without forced-air cooling - 12 watts.

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TENTATIVE DATA
EIMAC 2C39
CONSTANT CURRENT CHARACTERISTICS

PLATE VOLTAGE - VOLTS
GRID VOLTAGE - VOLTS

GRID CURRENT - MILLIAMPERES
PLATE CURRENT - MILLIAMPERES

COOLER
ANODE R-F CONNECTION
GRID R-F CONNECTION
CATHODE R-F AND HEATER CONNECTION
HEATER CONNECTION

* CLEAN AND SMOOTH AREA AVAILABLE FOR CONTACT.

RECOMMENDED COWLING FOR FORCED-AIR COOLING

AIR FROM BLOWER

DIMENSIONS:
1.250 ± 0.00
1.187 ± 0.008
1.031 ± 0.008
.660 ± 0.008
.218 ± 0.005
.320 ± 0.006

2.75 MAX.
1.309 ± 0.020
469 ± 0.00
.766 ± 0.060 ± 0.030

.53 ± 0.035
.356 ± 0.05
.285 MIN.
.201 MIN.

10
GENERAL CHARACTERISTICS

**ELECTRICAL**

- Filament: Thoriated tungsten
- Voltage: 5.0 volts
- Current: 6.3 amperes
- Amplification Factor (Average): 40
- Direct Inter-electrode Capacitances (Average):
  - Grid-Plate: 2.0 μF
  - Grid-Filament: 2.9 μF
  - Plate-Filament: 0.4 μF
- Transconductance (I_B=200 ma., E_B=3000, e_C=15): 5500 μmhos

**MECHANICAL**

- Base: (Medium 4-pin bayonet, ceramic) RMA type M8-078
- Basing: RMA type 2M
- Maximum Overall Dimensions:
  - Length: 7.75 inches
  - Diameter: 3.19 inches
- Net weight: 4 ounces
- Shipping weight (Average): 1.5 pounds

**AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR**

*Class B*

<table>
<thead>
<tr>
<th>Typical Operation—2 Tubes</th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td></td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current, per tube*</td>
<td>1500, 2000, 3000</td>
</tr>
<tr>
<td>Plate Dissipation, per tube*</td>
<td></td>
</tr>
<tr>
<td>D-C Grid Voltage (approx.)</td>
<td>-20, -35, -65</td>
</tr>
<tr>
<td>Peak A-F Grid Input Voltage</td>
<td>290, 310, 335</td>
</tr>
<tr>
<td>Zero-Signal D-C Plate Current</td>
<td>80, 60, 40</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current</td>
<td>320, 280, 215</td>
</tr>
<tr>
<td>Max.-Signal Driving Power (approx.)</td>
<td>7, 7, 5</td>
</tr>
<tr>
<td>Effective Load, Plate-to-Plate</td>
<td>8750, 15000, 31000</td>
</tr>
<tr>
<td>Max.-Signal Plate Power Output</td>
<td>280, 360, 650</td>
</tr>
</tbody>
</table>

*Averaged over any sinusoidal audio frequency cycle.

**RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR**

*Class-C *Telegraphy* (Key down conditions without modulation)

<table>
<thead>
<tr>
<th>Typical Operation—1 Tube</th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td></td>
</tr>
<tr>
<td>D-C Plate Current</td>
<td></td>
</tr>
<tr>
<td>D-C Grid Current</td>
<td></td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
<td></td>
</tr>
<tr>
<td>Plate Power Output</td>
<td></td>
</tr>
<tr>
<td>Plate Input</td>
<td></td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td></td>
</tr>
<tr>
<td>Peak R. F. Grid Input Voltage, (approx.)</td>
<td>190, 165, 165</td>
</tr>
<tr>
<td>Driving Power, (approx.)</td>
<td></td>
</tr>
</tbody>
</table>

*The above figures show actual measured tube performance, and do not allow for variations in circuit losses.

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DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1500, 2000 and 3000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by $P_P$.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1500, 2000, and 3000 volts respectively.
GENERAL CHARACTERISTICS

ELECTRICAL
Filament: Thoriated tungsten
Voltage - - - - - - - - - - - - - - - - - - - - - 5.0 volts
Current - - - - - - - - - - - - - - - - - - - - - 6.3 amperes
Amplification Factor (Average) - - - - - - - - - - - - - - 14
Direct Interelectrode Capacitances (Average)
    Grid-Plate - - - - - - - - - - - - - - - - - - - - - - - - 2.0 μf
    Grid-Filament - - - - - - - - - - - - - - - - - - - - - - - - 2.3 μf
    Plate-Filament - - - - - - - - - - - - - - - - - - - - - - - - 0.4 μf
Transconductance (i_b = 225 ma., E_b = 3000v., E_c = -160v.) 2300 μmhos
Frequency for Maximum Ratings - - - - - - - - - - - - - - - - 40 mc

MECHANICAL
Base - - - (Medium 4-pin bayonet, ceramic) RMA type M8-078
Basing - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - RMA type 2M
Maximum Overall Dimensions:
    Length - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 7.75 inches
    Diameter - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 3.19 inches
Net weight - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - 4 ounces
Shipping weight (Average) - - - - - - - - - - - - - - - - - - - - - - - - - 1.5 pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR
Class B

<table>
<thead>
<tr>
<th>Typical Operation—2 Tubes</th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>1500 2000 3000</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current, per tube*</td>
<td>• • •</td>
</tr>
<tr>
<td>Plate Dissipation, per tube*</td>
<td>• • •</td>
</tr>
<tr>
<td>D-C Grid Voltage (approx.)</td>
<td>-65 -110 -185</td>
</tr>
<tr>
<td>Peak A-F Grid Input Voltage</td>
<td>470 540 640</td>
</tr>
<tr>
<td>Zero-Signal D-C Plate Current</td>
<td>80 60 40</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current</td>
<td>320 280 215</td>
</tr>
<tr>
<td>Max.-Signal Driving Power (approx.)</td>
<td>8 7 6</td>
</tr>
<tr>
<td>Effective Load, Plate-to-Plate</td>
<td>8750 15000 30000</td>
</tr>
<tr>
<td>Max.-Signal Plate Power Output</td>
<td>280 360 450</td>
</tr>
</tbody>
</table>

*Average over any sinusoidal audio frequency cycle.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR
Class-C *Telegraphy
(Key down conditions without modulation)

<table>
<thead>
<tr>
<th>Typical Operation—1 Tube</th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>1500 2000 3000</td>
</tr>
<tr>
<td>D-C Plate Current</td>
<td>190 165 165</td>
</tr>
<tr>
<td>D-C Grid Current</td>
<td>37 28 30</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
<td>-175 -225 -400</td>
</tr>
<tr>
<td>Plate Power Output</td>
<td>185 235 400</td>
</tr>
<tr>
<td>Plate Input</td>
<td>285 335 500</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>100 100 100</td>
</tr>
<tr>
<td>Peak R. F. Grid Input Voltage, (approx.)</td>
<td>425 450 650</td>
</tr>
<tr>
<td>Driving Power, (approx.)</td>
<td>14 11 20</td>
</tr>
</tbody>
</table>

*The above figures show actual measured tube performance, and do not allow for variations in circuit losses.

(Effective 7-1-44) Copyright, 1946 by Eitel-McCullough, Inc.
DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1500, 2000 and 3000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by \( P_p \).

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1500, 2000, and 3000 volts respectively.
GENERAL CHARACTERISTICS

ELECTRICAL
Filament: Thoriated tungsten
Voltage - 5.0 or 10.0 volts
Current - 12.5 or 6.25 amperes
Amplification Factor (Average) - 20
Direct Interelectrode Capacitances (Average)
Grid-Plate - 4.8 \(\mu\)f
Grid-Filament - 5.7 \(\mu\)f
Plate-Filament - 0.8 \(\mu\)f
Transconductance \(i_b = 500\) ma., \(E_b = 3000\) v., \(E_c = -40\) v.) - 8300 \(\mu\)mhos
Frequency for Maximum Ratings - 40 mc

MECHANICAL
Base - Special 4 pin, No. 5000B
Basing - RMA type 4BC
Maximum Overall Dimensions:
Length - 7.625 inches
Diameter - 2.563 inches
Net weight - 7 ounces
Shipping weight (Average) - 2.0 pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class B

<table>
<thead>
<tr>
<th>Typical Operation—2 Tubes</th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>1500</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current, per tube*</td>
<td>2000</td>
</tr>
<tr>
<td>Plate Dissipation, per tube*</td>
<td>3000</td>
</tr>
<tr>
<td>D-C Grid Voltage (approx.)</td>
<td>-65</td>
</tr>
<tr>
<td>Peak A-F Grid Input Voltage</td>
<td>340</td>
</tr>
<tr>
<td>Zero-Signal D-C Plate Current</td>
<td>133</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current</td>
<td>535</td>
</tr>
<tr>
<td>Max.-Signal Driving Power (approx.)</td>
<td>9</td>
</tr>
<tr>
<td>Effective Load, Plate-to-Plate</td>
<td>5700</td>
</tr>
<tr>
<td>Max.-Signal Plate Power Output</td>
<td>500</td>
</tr>
</tbody>
</table>

*Averaged over any sinusoidal audio frequency cycle.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C *Telegraphy
(Key down conditions without modulation)

<table>
<thead>
<tr>
<th>Typical Operation—1 Tube</th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>1500</td>
</tr>
<tr>
<td>D-C Plate Current</td>
<td>333</td>
</tr>
<tr>
<td>D-C Grid Current</td>
<td>58</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
<td>-125</td>
</tr>
<tr>
<td>Plate Power Output</td>
<td>350</td>
</tr>
<tr>
<td>Plate Input</td>
<td>500</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>150</td>
</tr>
<tr>
<td>Peak R. F. Grid Input Voltage, (approx.)</td>
<td>267</td>
</tr>
<tr>
<td>Driving Power, (approx.)</td>
<td>13</td>
</tr>
</tbody>
</table>

*The above figures show actual measured tube performance, and do not allow for variations in circuit losses.

(Effective 6-1-44) Copyright, 1946 by Eitel-McCullough, Inc.
DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1500, 2000, and 3000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by $P_p$.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1500, 2000, and 3000 volts respectively.
EITEL-MCCULLOUGH, INC.
SANTA CLARA, CALIFORNIA

GENERAL CHARACTERISTICS

Electrical
Filament: Thoriated tungsten
Voltage - 5.0 of 10.0 volts
Current - 12.5 or 6.25 amperes
Amplification Factor (Average) - 12
Direct Interelectrode Capacitances (Average)
Grid-Plate - 4.4 μF
Grid-Filament - 4.5 μF
Plate-Filament - 0.7 μF
Transconductance (i_b = 500 ma., E_b = 3000 v., E_c = -85 v.) - 7150 umhos

Mechanical
Base - Special 4 pin, No. 5000B
Basing - RMA type 4BC
Maximum Overall Dimensions:
Length - 7.625 inches
Diameter - 2.563 inches
Net weight - 7 ounces
Shipping weight (Average) - 2.0 pounds

Audio Frequency Power Amplifier and Modulator
Class B

<table>
<thead>
<tr>
<th>ZERO GRID CURRENT</th>
<th>TYPICAL OPERATION</th>
<th>MAX. RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPERATION—2 TUBES</td>
<td>2 TUBES</td>
<td></td>
</tr>
<tr>
<td>D-C Plate Voltage</td>
<td>1500 2000 3000</td>
<td>1500 2000 3000</td>
</tr>
<tr>
<td>Max.-Sig. D-C Plate Current, per tube*</td>
<td>• • •</td>
<td>• • •</td>
</tr>
<tr>
<td>Plate Dissipation, per tube*</td>
<td>• • •</td>
<td>• • •</td>
</tr>
<tr>
<td>D-C Grid Voltage (approx.)</td>
<td>-105 -160 -260</td>
<td>-105 -160 -260</td>
</tr>
<tr>
<td>Peak A-F Grid Input Voltage</td>
<td>210 320 520</td>
<td>500 620 675</td>
</tr>
<tr>
<td>Zero-Signal D-C Plate Current</td>
<td>135 100 65</td>
<td>135 100 65</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current</td>
<td>286 260 220</td>
<td>570 500 335</td>
</tr>
<tr>
<td>Max.-Signal Driving Power (approx.)</td>
<td>0 0 0</td>
<td>15 13 3</td>
</tr>
<tr>
<td>Effective Load, Plate-to-Plate</td>
<td>5100 10500 24000</td>
<td>5500 9000 20400</td>
</tr>
<tr>
<td>Max.-Signal Plate Power Output</td>
<td>130 220 370</td>
<td>560 700 700</td>
</tr>
</tbody>
</table>

*Averaged over any sinusoidal audio frequency cycle.

Radio Frequency Power Amplifier and Oscillator
Class-C *Telegraphy
(Key down conditions without modulation)

<table>
<thead>
<tr>
<th>TYPICAL OPERATION—1 TUBE</th>
<th>MAX. RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage - - - -</td>
<td>1500 2000 3000</td>
</tr>
<tr>
<td>D-C Plate Current - - - -</td>
<td>333 300 250</td>
</tr>
<tr>
<td>D-C Grid Current - - - -</td>
<td>45 42 40</td>
</tr>
<tr>
<td>D-C Grid Voltage - - - -</td>
<td>-250 -300 -400</td>
</tr>
<tr>
<td>Plate Power Output - - - -</td>
<td>350 450 600</td>
</tr>
<tr>
<td>Plate Input - - - -</td>
<td>500 600 750</td>
</tr>
<tr>
<td>Plate Dissipation - - - -</td>
<td>150 150 150</td>
</tr>
<tr>
<td>Peak R. F. Grid Input Voltage, (approx.)</td>
<td>400 455 550</td>
</tr>
<tr>
<td>Driving Power, (approx.)</td>
<td>16 18 20</td>
</tr>
</tbody>
</table>

*The above figures show actual measured tube performance, and do not allow for variations in circuit losses.

(Effective 1-1-44) Copyright, 1946 by Eitel-McCullough, Inc.
DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1500, 2000 and 3000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by \(P_p\).

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1500, 2000, and 3000 volts respectively.
GENERAL CHARACTERISTICS

ELECTRICAL
Filament: Thoriated tungsten
Voltage - - - - - - - - - - - - - 5.0 volts
Current - - - - - - - - - - - - - 10.5 amperes
Amplification Factor (Average) - - - - - - - - - - - - 37
Direct Interelectrode Capacitances (Average)
Grid-Plate - - - - - - - - - - - - - 2.9 uuf
Grid-Filament - - - - - - - - - - - - - 5.0 uuf
Plate-Filament - - - - - - - - - - - - - 0.7 uuf
Transconductance (Ig=300 ma., Ei=3000, eD=20)
Frequency for Maximum Ratings - - - - - - - - - - 6650 umhos
- - - - - - - - - - - - - - - - 40 mc.

MECHANICAL
Base - - - - - - - - - - - - - - - - 4 pin, No. 5001B
Basing - - - - - - - - - - - - - - - - RMA type 2N
Maximum Overall Dimensions:
Length - - - - - - - - - - - - - - - 10.125 inches
Diameter - - - - - - - - - - - - - - - 3.813 inches
Net weight - - - - - - - - - - - - - - - 12 ounces
Shipping weight (Average) - - - - - - - - - - - 2.25 pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR
Class B

Typical Operation—2 Tubes

<table>
<thead>
<tr>
<th></th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>3000 volts</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current, per tube*</td>
<td>350 ma.</td>
</tr>
<tr>
<td>Plate Dissipation, per tube*</td>
<td>250 watts</td>
</tr>
<tr>
<td>D-C Grid Voltage (approx.)</td>
<td>250 volts</td>
</tr>
<tr>
<td>Peak A-F Grid Input Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Zero-Signal D-C Plate Current</td>
<td>250 ma.</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current</td>
<td>250 ma.</td>
</tr>
<tr>
<td>Max.-Signal Driving Power (approx.)</td>
<td>250 watts</td>
</tr>
<tr>
<td>Effective Load, Plate-to-Plate</td>
<td>250 ohms</td>
</tr>
<tr>
<td>Max.-Signal Plate Power Output</td>
<td>250 watts</td>
</tr>
</tbody>
</table>

*Averaged over any sinusoidal audio frequency cycle.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR
Class-C *Telegraphy
(Key down conditions without modulation)

Typical Operation—1 Tube

<table>
<thead>
<tr>
<th></th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>4000 volts</td>
</tr>
<tr>
<td>D-C Plate Current</td>
<td>350 ma.</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
<td>100 ma.</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>Plate Power Output</td>
<td>250 watts</td>
</tr>
<tr>
<td>Plate Input</td>
<td>250 volts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>250 watts</td>
</tr>
<tr>
<td>Peak R. F. Grid Input Voltage, (approx.)</td>
<td>250 volts</td>
</tr>
<tr>
<td>Driving Power, (approx.)</td>
<td>250 watts</td>
</tr>
</tbody>
</table>

*The above figures show actual measured tube performance, and do not allow for variations in circuit losses.
(Effective 10-17-44) Copyright, 1946 by Eitel-McCullough, Inc.
GRID VOLTAGE - VOLTS

EIMAC 250TH

PLATE VOLTAGE - VOLTS

GRID CURRENT - AMPERES

PLATE CURRENT - AMPERES

EIMAC 250TH
CONSTANT CURRENT CHARACTERISTICS
DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 2000, 3000, and 4000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 2000, 3000, and 4000 volts respectively.
GENERAL CHARACTERISTICS

ELECTRICAL
Filament: Thoriated tungsten  
Voltage: 5.0 volts  
Current: 10.5 amperes  
Amplification Factor (Average): 14  
Direct Interelectrode Capacitances (Average):  
Grid-Plate: 3.1 μf  
Grid-Filament: 3.7 μf  
Plate-Filament: 0.7 μf  
Transconductance (Ig=350 ma, Es=3000, ex=-130): 2650 μmhos  
Frequency for Maximum Ratings: 40 mc

MECHANICAL
Base: 4 pin, No. 5001B  
Basing: RMA type 2N  
Maximum Overall Dimensions:  
Length: 10.125 inches  
Diameter: 3.813 inches  
Net weight: 12 ounces  
Shipping weight (Average): 2.25 pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class B

<table>
<thead>
<tr>
<th>Typical Operation—2 Tubes</th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>1500 2000 3000</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current, per tube*</td>
<td>• • •</td>
</tr>
<tr>
<td>Plate Dissipation, per tube*</td>
<td>• • •</td>
</tr>
<tr>
<td>D-C Grid Voltage (approx.)</td>
<td>-40 -80 -175</td>
</tr>
<tr>
<td>Peak A-F Grid Input Voltage</td>
<td>770 800 840</td>
</tr>
<tr>
<td>Zero-Signal D-C Plate Current</td>
<td>200 150 100</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current</td>
<td>700 650 500</td>
</tr>
<tr>
<td>Max.-Signal Driving Power (approx.)</td>
<td>32 28 17</td>
</tr>
<tr>
<td>Effective Load, Plate-to-Plate</td>
<td>3700 6150 13000</td>
</tr>
<tr>
<td>Max.-Signal Plate Power Output</td>
<td>580 800 1000</td>
</tr>
</tbody>
</table>

*Rounded over any sinusoidal audio frequency cycle.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C *Telegraphy
(Key down conditions without modulation)

<table>
<thead>
<tr>
<th>Typical Operation—1 Tube</th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>2000 3000 4000</td>
</tr>
<tr>
<td>D-C Plate Current</td>
<td>350 335 310</td>
</tr>
<tr>
<td>D-C Grid Current</td>
<td>45 45 40</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
<td>-200 -350 -500</td>
</tr>
<tr>
<td>Plate Power Output</td>
<td>455 750 1000</td>
</tr>
<tr>
<td>Plate Input</td>
<td>700 1000 1250</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>245 250 250</td>
</tr>
<tr>
<td>Peak R. F. Grid Input Voltage, (approx.)</td>
<td>575 720 900</td>
</tr>
<tr>
<td>Driving Power, (approx.)</td>
<td>22 29 33</td>
</tr>
</tbody>
</table>

*The above figures show actual measured tube performance, and do not allow for variations in circuit losses.
(Effective 7-1-44) Copyright, 1946 by Eitel-McCullough, Inc.
DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 2000, 3000 and 4000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 2000, 3000, and 4000 volts respectively.
EITEL
McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA

GEOMETRIC CHARACTERISTICS

**Electrical**
- Filament: Thoriated tungsten
- Voltage: 5.0 or 10.0 volts
- Current: 25.0 or 12.5 amperes
- Amplification Factor (Average): 20
- Direct Inter-electrode Capacitances (Average):
  - Grid-Plate: 10.2 μF
  - Grid-Filament: 13.5 μF
  - Plate-Filament: 0.7 μF
- Transconductance (J0=1.0 amp., E0=3000, Eo=-40): 16,700 μhos
- Frequency for Maximum Ratings: 40 mc

**Mechanical**
- Base: Special 4 pin, No. 5000B
- Basing: RMA type 4BC
- Maximum Overall Dimensions:
  - Length: 7.625 inches
  - Diameter: 3.563 inches
- Net weight: 12 ounces
- Shipping weight (Average): 3.0 pounds

**Audio Frequency Power Amplifier and Modulator**

**Class B**

<table>
<thead>
<tr>
<th><strong>Typical Operation—2 Tubes</strong></th>
<th><strong>Max. Rating</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>1500 2000 3000</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current, per tube*</td>
<td>• • •</td>
</tr>
<tr>
<td>Plate Dissipation, per tube*</td>
<td>• • •</td>
</tr>
<tr>
<td>D-C Grid Voltage (approx.)</td>
<td>-65 -90 -150</td>
</tr>
<tr>
<td>Peak A-F Grid Input Voltage</td>
<td>330 350 420</td>
</tr>
<tr>
<td>Zero-Signal D-C Plate Current</td>
<td>267 200 134</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current</td>
<td>1066 900 667</td>
</tr>
<tr>
<td>Max.-Signal Driving Power (approx.)</td>
<td>17 12 6</td>
</tr>
<tr>
<td>Effective Load, Plate-to-Plate</td>
<td>2840 4820 10200</td>
</tr>
<tr>
<td>Max.-Signal Plate Power Output</td>
<td>1000 1200 1400</td>
</tr>
</tbody>
</table>

*Average over any sinusoidal audio frequency cycle.

**Radio Frequency Power Amplifier and Oscillator**

**Class-C *Telegraphy**

(Key down conditions without modulation)

<table>
<thead>
<tr>
<th><strong>Typical Operation—1 Tube</strong></th>
<th><strong>Max. Rating</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>1500 2000 3000</td>
</tr>
<tr>
<td>D-C Plate Current</td>
<td>667 600 500</td>
</tr>
<tr>
<td>D-C Grid Current</td>
<td>115 125 135</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
<td>-125 -200 -300</td>
</tr>
<tr>
<td>Plate Power Output</td>
<td>700 900 1200</td>
</tr>
<tr>
<td>Plate Input</td>
<td>1000 1200 1500</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>300 300 300</td>
</tr>
<tr>
<td>Peak R.F. Grid Input Voltage, (approx.)</td>
<td>250 325 395</td>
</tr>
<tr>
<td>Driving Power, (approx.)</td>
<td>25 39 53</td>
</tr>
</tbody>
</table>

*The above figures show actual measured tube performance, and do not allow for variations in circuit losses.

(Effective 6-1-46) Copyright, 1946 by Eitel-McCullough, Inc.
DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1500, 2000 and 3000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by $P_p$.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1500, 2000, and 3000 volts respectively.
PLATE CAP
(SEE TUBE OUTLINE DRAWING)

GRID CAP
NO. 4001C

BASE NO. 5000B

ON FINISHED TUBE ADD .060 FOR SOLDER
GENERAL CHARACTERISTICS

ELECTRICAL
Filament: Thoriated tungsten
Voltage - 5.0 or 10.0 volts
Current - 25.0 or 12.5 amperes
Amplification Factor (Average) - 12
Direct Interelectrode Capacitances (Average)
Grid-Plate - 9.1 uuf
Grid-Filament - 8.5 uuf
Plate-Filament - 0.6 uuf
Transconductance (Ig=1.0 amp., Eg=3000, e=-200) - 16,700 umhos
Frequency for Maximum Ratings - 40 mc.

MECHANICAL
Base - Special 4 pin, No. 5000B
Basing - RMA type 4BC
Maximum Overall Dimensions:
Length - 7.625 inches
Diameter - 3.563 inches
Net weight - 12 ounces
Shipping weight (Average) - 3.0 pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class B

<table>
<thead>
<tr>
<th>ZERO GRID CURR</th>
<th>CURRENT OPERATION—2 TUBES</th>
<th>TYPICAL OPERATION—2 TUBES</th>
<th>MAX. RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>1500 2000 3000</td>
<td>1500 2000 3000</td>
<td>3000 volts</td>
</tr>
<tr>
<td>Max.-Sig. D-C Plate Current, per tube</td>
<td>900 ma.</td>
<td>900 ma.</td>
<td>300 watts</td>
</tr>
<tr>
<td>Plate Dissipation, per tube</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>D-C Grid Voltage (approx.)</td>
<td>-105 -160 -260</td>
<td>-105 -160 -260</td>
<td>-105 -160 -260 volts</td>
</tr>
<tr>
<td>Peak A-F Grid Input Voltage</td>
<td>500 580 650</td>
<td>500 580 650</td>
<td>500 580 650 volts</td>
</tr>
<tr>
<td>Zero-Signal D-C Plate Current</td>
<td>270 200 130</td>
<td>270 200 130</td>
<td>270 200 130 ma.</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current</td>
<td>572 546 444</td>
<td>1140 1000 660</td>
<td>572 546 444 ma.</td>
</tr>
<tr>
<td>Max.-Signal Driving Power (approx.)</td>
<td>0 0 0</td>
<td>30 25 6</td>
<td>30 25 6 watts</td>
</tr>
<tr>
<td>Effective Load, Plate-to-Plate</td>
<td>2540 5300 12000</td>
<td>2750 4500 10200</td>
<td>2540 5300 12000 ohms</td>
</tr>
<tr>
<td>Max.-Signal Plate Power Output</td>
<td>256 490 730</td>
<td>1100 1400 1400</td>
<td>256 490 730 watts</td>
</tr>
</tbody>
</table>

* Averaged over any sinusoidal audio frequency cycle.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C "Telegraphy"
(Key down conditions without modulation)

<table>
<thead>
<tr>
<th>TYPICAL OPERATION—1 TUBE</th>
<th>MAX. RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>1500 2000 3000</td>
</tr>
<tr>
<td>D-C Plate Current</td>
<td>665 600 500</td>
</tr>
<tr>
<td>D-C Grid Current</td>
<td>90 85 80</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
<td>-250 -300 -400</td>
</tr>
<tr>
<td>Plate Power Output</td>
<td>700 900 1200</td>
</tr>
<tr>
<td>Plate Input</td>
<td>1000 1200 1500</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>300 300 300</td>
</tr>
<tr>
<td>Peak R. F. Grid Input Voltage (approx.)</td>
<td>430 480 575</td>
</tr>
<tr>
<td>Driving Power, (approx.)</td>
<td>33 36 40</td>
</tr>
</tbody>
</table>

*The above figures show actual measured tube performance, and do not allow for variations in circuit losses.
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DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1500, 2000 and 3000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by $P_p$.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1500, 2000, and 3000 volts respectively.
PLATE CAP
(SEE TUBE OUTLINE DRAWING)

GRID CAP
NO. 4001C

BASE NO. 5000B

FILAMENT

FILAMENT

FILAMENT

FILAMENT

4DC

ON FINISHED TUBE ADD .050 FOR SOLDER
The Eimac 450TH is a high-mu power triode having a maximum plate dissipation rating of 450 watts, and is intended for use as an amplifier, oscillator, and modulator. It can be used at its maximum ratings at frequencies as high as 40 Mc.

Cooling of the 450TH is accomplished by radiation from the plate, which exhibits a red-orange color at maximum dissipation, and by means of air circulation around the envelope.

**GENERAL CHARACTERISTICS**

**ELECTRICAL**

Filament: Thoriated tungsten  
Voltage: 7.5 volts  
Current: 12.0 amperes  
Amplification Factor (Average): 38  
Direct Interelectrode Capacitances (Average)  
Grid-plate: 5.0 μfd.  
Grid-Filament: 8.8 μfd.  
Plate-Filament: 0.8 μfd.  
Transconductance (Iₚ=500 ma, Eₚ=4000 v)  
6650 μmhos

**MECHANICAL**

Base: Special 4-pin, No. 5002B  
Basing: RMA type 4AQ  
Cooling: Radiation and air circulation  
Maximum Overall Dimention:  
Length: 12.625 inches  
Diameter: 5.125 inches  
Net Weight: 1 pound  
Shipping Weight (Average): 4 pounds

**RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR**

**MAXIMUM RATINGS** (Frequencies below 40 Mc.)

<table>
<thead>
<tr>
<th>D C PLATE VOLTAGE</th>
<th>6000 MAX. VOLTS</th>
<th>D C PLATE CURRENT</th>
<th>450 MAX. MA.</th>
<th>PLATE DISSIPATION</th>
<th>450 MAX. WATTS</th>
<th>GRID DISSIPATION</th>
<th>65 MAX. WATTS</th>
</tr>
</thead>
</table>

**TYPICAL OPERATION** (Frequencies below 40 Mc.)

<table>
<thead>
<tr>
<th>D C Plate Voltage</th>
<th>3000 4000 5000 volts</th>
<th>D C Grid Voltage</th>
<th>-175 -200 -300 volts</th>
<th>D C Plate Current</th>
<th>500 450 450 ma.</th>
<th>D C Grid Current</th>
<th>95 85 90 ma.</th>
<th>Grid Dissipation</th>
<th>18.4 18 19 watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak R-F Grid Input Voltage (approx.)</td>
<td>400 410 570 volts</td>
<td>Driving Power (approx.)</td>
<td>35 35 46 watts</td>
<td>Plate Power Input</td>
<td>1500 1800 2250 watts</td>
<td>Plate Dissipation</td>
<td>450 450 450 watts</td>
<td>Plate Power Output</td>
<td>1050 1350 1800 watts</td>
</tr>
</tbody>
</table>

**AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR**

**Class-B** (Sinusoidal wave, two tubes unless otherwise specified)

**MAXIMUM RATINGS**

<table>
<thead>
<tr>
<th>D C PLATE VOLTAGE</th>
<th>6000 MAX. VOLTS</th>
<th>D C PLATE CURRENT, PER TUBE</th>
<th>450 MAX. MA.</th>
<th>PLATE DISSIPATION, PER TUBE</th>
<th>450 MAX. WATTS</th>
<th>GRID DISSIPATION, PER TUBE</th>
<th>65 MAX. WATTS</th>
</tr>
</thead>
</table>

**TYPICAL OPERATION**

<table>
<thead>
<tr>
<th>D C Grid Voltage (approx.)</th>
<th>-50 -85 -115 volts</th>
<th>D C Plate Voltage</th>
<th>3000 4000 5000 volts</th>
<th>Zero-Signal D C Plate Current</th>
<th>200 150 120 ma.</th>
<th>Max-Signal D C Plate Current</th>
<th>770 675 620 ma.</th>
<th>Effective Load, Plate-to-Plate</th>
<th>7800 12,800 18,600 ohms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak A-F Grid Input Voltage (per tube)</td>
<td>225 225 227 volts</td>
<td>Max-Signal Avg. Driving Power (approx.)</td>
<td>17 14 10 watts</td>
<td>Max-Signal Peak Driving Power (approx.)</td>
<td>40 34 40 watts</td>
<td>Max-Signal Peak Plate Power (per tube)</td>
<td>450 450 450 watts</td>
<td>Max-Signal Plate Power Output</td>
<td>1400 1800 2200 watts</td>
</tr>
</tbody>
</table>

---

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MECHANICAL

Mounting—The 450TH must be mounted vertically, base up or base down. Flexible connecting straps should be provided from the grid and plate terminals to the external grid and plate circuits. The tube must be protected from severe vibration and shock.

Cooling—Provision should be made for ample circulation of air around the 450TH. In the event that the design of the equipment restricts natural circulation, the use of a small fan or centrifugal blower to provide additional cooling for the tube will aid in obtaining maximum tube life. Special heat-dissipating connectors (Eimac HR-8) are available for use on the plate and grid terminals. These connectors help to prolong tube life by reducing the temperature of the seals.

The grid terminal of the 450TH is now .560” in diameter. To accommodate existing equipment designed for the older style 450TH having .098” diameter grid terminals, an adapter pin is provided with the newer tubes. This adapter pin is threaded so that it may be removed from the grid terminal of the tube. The small grid terminal requires an HR-4 heat-dissipating connector.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated value of 7.5 volts. Unavoidable variations in filament voltage must be kept within the range from 7.03 to 7.88 volts.

Bias Voltage—Although there is no maximum limit on the bias voltage which may be used on the 450TH, there is little advantage in using bias voltages in excess of those given under “Typical Operation,” except in certain very specialized applications. Where bias is obtained by a grid leak, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Grid Dissipation—The power dissipated by the grid of the 450TH must not exceed 80 watts. Grid dissipation may be calculated from the following expression:

\[ P_t = e_{pv}I_c \]

where \( P_t \) = Grid dissipation,
\( e_{pv} \) = Peak positive grid voltage, and
\( I_c \) = D-c grid current.

\( e_{pv} \) may be measured by means of a suitable peak voltmeter connected between filament and grid.\(^1\) In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any conditions of loading.

Plate Voltage—Except in very special applications, the plate supply voltage for the 450TH should not exceed 6000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under “Typical Operation” for the power output desired.

Plate Dissipation—Under normal operating conditions, the power dissipated by the plate of the 450TH should not be allowed to exceed 450 watts. At this dissipation the brightness temperature of the plate will appear a red-orange in color. The value of this color is somewhat affected by light from the filament as well as from external sources. Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

\(^1\) For suitable peak v.t.v.m. circuits see, for instance, “Vacuum Tube Ratings,” Eimac News, January, 1946. This article is available in reprint form on request.
DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 3000, 4000, and 5000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by $P_p$.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 3000, 4000, and 5000 volts respectively.
EIMAC 450TH

GRID VOLTAGE—VOLTS

PLATE VOLTAGE—VOLTS

PLATE CURRENT—AMPERES

EIMAC 450TH CONSTANT CURRENT CHARACTERISTICS

PRINTED IN U. S. A. 2-G4-22548

Page Four
GENERAL CHARACTERISTICS

ELECTRICAL
Filament: Thoriated tungsten
Voltage - 7.5 volts
Current - 12.0 amperes
Amplification Factor (Average) - 18
Direct Interelectrode Capacitances (Average)
Grid-Plate - 5.2 \( \mu F \)
Grid-Filament - 7.3 \( \mu F \)
Plate-Filament - 0.9 \( \mu F \)
Transconductance (I_b=500 ma., E_b=4000, e_c=-75) - 6060 \( \mu mhos \)

MECHANICAL
Base - 4 pin, No. 5002B
Basing - RMA type 4AQ
Maximum Overall Dimensions:
Length - 12.625 inches
Diameter - 5.125 inches
Net weight - 1 pound
Shipping weight (Average) - 4 pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR
Class B

<table>
<thead>
<tr>
<th>Typical Operation</th>
<th>2 Tubes</th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>3000</td>
<td>6000 volts</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current, per tube</td>
<td>*</td>
<td>600 ma.</td>
</tr>
<tr>
<td>Plate Dissipation, per tube</td>
<td>*</td>
<td>450 watts</td>
</tr>
<tr>
<td>D-C Grid Voltage (approx.)</td>
<td>-110</td>
<td>volts</td>
</tr>
<tr>
<td>Peak A-F Grid Input Voltage</td>
<td>650</td>
<td>ma.</td>
</tr>
<tr>
<td>Zero-Signal D-C Plate Current</td>
<td>200</td>
<td>ma.</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current</td>
<td>770</td>
<td>watts</td>
</tr>
<tr>
<td>Max.-Signal Driving Power (approx.)</td>
<td>15</td>
<td>ohms</td>
</tr>
<tr>
<td>Effective Load, Plate-to-Plate</td>
<td>12800</td>
<td>watts</td>
</tr>
<tr>
<td>Max.-Signal Plate Power Output</td>
<td>1400</td>
<td>18600 ohms</td>
</tr>
</tbody>
</table>

*Average per level of audio frequency cycle.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR
Class-C *Telegraphy
(Key down conditions without modulation)

<table>
<thead>
<tr>
<th>Typical Operation</th>
<th>1 Tube</th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>3000</td>
<td>6000 volts</td>
</tr>
<tr>
<td>D-C Plate Current</td>
<td>500</td>
<td>600 ma.</td>
</tr>
<tr>
<td>D-C Grid Current</td>
<td>65</td>
<td>75 ma.</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
<td>-275</td>
<td>volts</td>
</tr>
<tr>
<td>Plate Power Output</td>
<td>1050</td>
<td>watts</td>
</tr>
<tr>
<td>Plate Input</td>
<td>1500</td>
<td>2250 watts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>450</td>
<td>450 watts</td>
</tr>
<tr>
<td>Peak R. F. Grid Input Voltage, (approx.)</td>
<td>640</td>
<td>volts</td>
</tr>
<tr>
<td>Driving Power, (approx.)</td>
<td>38</td>
<td>watts</td>
</tr>
</tbody>
</table>

*The above figures show actual measured tube performance, and do not allow for variations in circuit losses.

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DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 3000, 4000, and 5000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by \( P_p \).

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 3000, 4000, and 5000 volts respectively.
NOTE:—The grid terminal on the new 450TH and TL type tube is now .563" in diameter. To accommodate existing equipment which uses the 450TH or TL tubes with the old style .098" grid terminal, an adaptor pin is provided. This adaptor pin, if not needed, may be removed by unscrewing.
GENERAL CHARACTERISTICS

ELECTRICAL
Filament: Thoriated tungsten
Voltage: 7.5 volts
Current: 21.0 amperes

Amplification Factor (Average): 15

Direct Interelectrode Capacitances (Average):
- Grid-Plate: 5.8 µf
- Grid-Filament: 8.5 µf
- Plate-Filament: 1.2 µf

Transconductance (1,=1.0 amp., b,=5000, e,=--100): 3500 µmhos

Frequency for Maximum Ratings: 40 mc

MECHANICAL
Base: Special 4 pin, (Fits Johnson No. 214 Socket, or equal) No. 5003B
Basing: RMA type 4BD

Maximum Overall Dimensions:
- Length: 17.0 inches
- Diameter: 7.125 inches
- Net weight: 2.75 pounds
- Shipping weight (Average): 8.0 pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class B

Typical Operation—2 Tubes

Max. Plate Voltage
Max.-Signal D-C Plate Current, per tube
Plate Dissipation, per tube
D-C Grid Voltage (approx.)
Peak A-F Grid Input Voltage
Zero-Signal D-C Plate Current
Max.-Signal D-C Plate Current
Max.-Signal Driving Power (approx.)
Effective Load, Plate-to-Plate
Max.-Signal Plate Power Output

Max. Rating

Typical Operation—1 Tube

Max. Rating

D-C Plate Voltage
D-C Plate Current
D-C Grid Voltage
D-C Grid Voltage
Plate Power Output
Plate Input
Plate Dissipation
Peak R. F. Grid Input Voltage (approx.)
Driving Power, (approx.)

Typical Operation—1 Tube

Max. Rating

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C *Telegraphy
(Key down conditions without modulation)

Typical Operation—1 Tube

Max. Rating

D-C Plate Voltage
D-C Plate Current
D-C Grid Voltage
D-C Grid Voltage
Plate Power Output
Plate Input
Plate Dissipation
Peak R. F. Grid Input Voltage, (approx.)
Driving Power, (approx.)

*The above figures show actual measured tube performance, and do not allow for variations in circuit losses.

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DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 4000, 5000, and 6000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by $P_p$. Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 4000, 5000, and 6000 volts respectively.
AIR COOLING
Provision should be made for ample circulation of air in the equipment employing this type tube.

*ON FINISHED TUBE ADD .060 FOR SOLDER*
GENERAL CHARACTERISTICS

**Electrical**
- **Filament:** Thoriated tungsten
- **Voltage:** 7.5 volts
- **Current:** 17.0 amperes
- **Amplification Factor (Average):** 35
- **Direct Inter-electrode Capacitances (Average):**
  - **Grid-Plate:** 5.1 μf
  - **Grid-Filament:** 9.3 μf
  - **Plate-Filament:** 0.5 μf
- **Transconductance (Ig=750 ma., Ei=6000, e1=−62):** 9050 μmhos
- **Frequency for Maximum Ratings:** 50 mc

**Mechanical**
- **Base:** 4-pin with tubing for forced air No. 5004B
- **Basing:** RMA type 4AQ
- **Maximum Overall Dimensions:**
  - **Length:** 12.625 inches
  - **Diameter:** 5.125 inches
- **Net weight:** 1.25 pounds
- **Shipping weight (Average):** 6.25 pounds

**Audio Frequency Power Amplifier and Modulator**
Class B

<table>
<thead>
<tr>
<th>Typical Operation—2 Tubes</th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>4000 5000 6000</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current, per tube*</td>
<td>750 ma.</td>
</tr>
<tr>
<td>Plate Dissipation, per tube*</td>
<td>1000 watts</td>
</tr>
<tr>
<td>D-C Grid Voltage (approx.)</td>
<td>-70 -105 -135</td>
</tr>
<tr>
<td>Peak A-F Grid Input Voltage</td>
<td>490 530 600</td>
</tr>
<tr>
<td>Zero-Signal D-C Plate Current</td>
<td>300 .240 .200</td>
</tr>
<tr>
<td>Max.-Signal D-C Plate Current</td>
<td>1.25 1.14 1.11</td>
</tr>
<tr>
<td>Max.-Signal Driving Power (approx.)</td>
<td>28 31 35</td>
</tr>
<tr>
<td>Effective Load, Plate-to-Plate</td>
<td>6350 9250 12200</td>
</tr>
<tr>
<td>Max.-Signal Plate Power Output</td>
<td>3000 3700 4600</td>
</tr>
</tbody>
</table>

*Averaged over any sinusoidal audio frequency cycle.

**Radio Frequency Power Amplifier and Oscillator**
Class-C *Telegraphy* (Key down conditions without modulation)

<table>
<thead>
<tr>
<th>Typical Operation—1 Tube</th>
<th>Max. Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage</td>
<td>3000 4000 5000 6000</td>
</tr>
<tr>
<td>D-C Plate Current</td>
<td>750 713 667 667</td>
</tr>
<tr>
<td>D-C Grid Current</td>
<td>90 100 87 110</td>
</tr>
<tr>
<td>D-C Grid Voltage</td>
<td>-150 -150 -225 -350</td>
</tr>
<tr>
<td>Plate Power Output</td>
<td>1350 1850 2333 3000</td>
</tr>
<tr>
<td>Plate Input</td>
<td>2250 2850 3333 4000</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>900 1000 1000 1000</td>
</tr>
<tr>
<td>Peak R. F. Grid Input Voltage, (approx.)</td>
<td>350 365 420 610</td>
</tr>
<tr>
<td>Driving Power, (approx.)</td>
<td>30 33 33 60</td>
</tr>
</tbody>
</table>

*The above figures show actual measured tube performance, and do not allow for variations in circuit losses.

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DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 4000, 5000 and 6000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by $P_p$. Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 4000, 5000, and 6000 volts respectively.
Forced air cooling on the seal of the Elmac 1000T, 1500T, and 2000T is recommended when tubes are operated under maximum conditions. We suggest the Roots Connersville blower unit No. 22. This blower when driven by a 1/2 H. P. motor at 1160 r.p.m. will deliver 13 cubic feet of air per minute at 1 pound pressure.

Each tube seal requires approximately 2 cubic feet per minute, therefore, one of these No. 22 blowers should handle any two of the above tubes.

We would suggest the outlet manifold, which is 1 inch in diameter, be kept to the shortest possible length—under 8 feet. It is also suggested 3/8 inch O.D. copper tubing be used from the outlet manifold to feed air to the various seals. It will be necessary to use an insulating type of tubing to actually connect to the tubes themselves. This tubing should have an I.D. of 5/16 inch.

Roots Connersville's plant is in Connersville, Indiana, with offices in most of the large cities.

Bulbs must be cooled with air equivalent to that supplied by standard 8" electric fan 12" from bulb.
The Eimac 1500T is a medium-mu, high-vacuum transmitting triode intended for amplifier, oscillator and modulator service. It has a maximum plate dissipation rating of 1500 watts. Cooling of the 1500T is accomplished by radiation from the plate, which operates at a visibly red temperature at maximum dissipation, and by means of forced air circulation around the envelope and at the seals.

**GENERAL CHARACTERISTICS**

**ELECTRICAL**
- Filament: Thoriated tungsten
  - Voltage: 7.5 volts
  - Current: 24.0 amperes
- Amplification Factor (Average): 24
- Direct Interelectrode Capacitances (Average)
  - Grid-Plate: 7.2 μfd.
  - Grid-Filament: 9.9 μfd.
  - Plate-Filament: 1.5 μfd.
- Transconductance \( (I_b=1.25 \text{ amp}, E_b=6000 \text{ v}, E_c=-155 \text{ v}) \): 10,000 μmhos

**MECHANICAL**
- Base: Special 4-pin, No. 5005B
- Basing: RMA type 4BD
- Cooling: Radiation and forced air
- Maximum Overall Dimensions:
  - Length: 17.0 inches
  - Diameter: 7.125 inches
- Net Weight: 3.5 pounds
- Shipping Weight (Average): 8.5 pounds

**RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR**

Class-C Telegraphy (Key-down conditions, 1 tube)

<table>
<thead>
<tr>
<th>Maximum Ratings (Frequencies below 40 Mc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage: 8000 MAX. VOLS</td>
</tr>
<tr>
<td>D-C Plate Current: 1.25 MAX. AMPS.</td>
</tr>
<tr>
<td>Plate Dissipation: 1500 MAX. WATTS</td>
</tr>
<tr>
<td>Grid Dissipation: 125 MAX. WATTS</td>
</tr>
</tbody>
</table>

Typical Operation (Frequencies below 40 Mc)

<table>
<thead>
<tr>
<th>D-C Plate Voltage</th>
<th>5000</th>
<th>6000</th>
<th>7000</th>
<th>volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Grid Voltage</td>
<td>-375</td>
<td>-400</td>
<td>-500</td>
<td>volts</td>
</tr>
<tr>
<td>D-C Plate Current</td>
<td>1.00</td>
<td>1.00</td>
<td>.640</td>
<td>amps.</td>
</tr>
<tr>
<td>D-C Grid Current</td>
<td>150</td>
<td>150</td>
<td>110</td>
<td>ma.</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>59</td>
<td>61</td>
<td>30</td>
<td>watts</td>
</tr>
<tr>
<td>Peak R-F Grid Input Voltage (approx.)</td>
<td>850</td>
<td>1100</td>
<td>985</td>
<td>volts</td>
</tr>
<tr>
<td>Driving Power (approx.)</td>
<td>115</td>
<td>160</td>
<td>85</td>
<td>watts</td>
</tr>
<tr>
<td>Plate Power Input</td>
<td>5000</td>
<td>6000</td>
<td>6000</td>
<td>watts</td>
</tr>
<tr>
<td>Plate Power Output</td>
<td>3500</td>
<td>4500</td>
<td>4500</td>
<td>watts</td>
</tr>
</tbody>
</table>

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**AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR**

Class-B (Sinusoidal wave, two tubes unless otherwise specified)

<table>
<thead>
<tr>
<th>Maximum Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Plate Voltage: 8000 MAX. VOLS</td>
</tr>
<tr>
<td>Max-Signal D-C Plate Current, PER TUBE: 1.25 MAX. AMPS.</td>
</tr>
<tr>
<td>Plate Dissipation, PER TUBE: 1500 MAX. WATTS</td>
</tr>
</tbody>
</table>

Typical Operation

<table>
<thead>
<tr>
<th>D-C Plate Voltage</th>
<th>4000</th>
<th>5000</th>
<th>6000</th>
<th>volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-C Grid Voltage (approx.)</td>
<td>-95</td>
<td>-145</td>
<td>-190</td>
<td>volts</td>
</tr>
<tr>
<td>Zero-Signal D-C Plate Current</td>
<td>500</td>
<td>400</td>
<td>330</td>
<td>ma.</td>
</tr>
<tr>
<td>Max-Signal D-C Plate Current</td>
<td>1.88</td>
<td>1.72</td>
<td>1.65</td>
<td>amps.</td>
</tr>
<tr>
<td>Effective Load, Plate-to-Plate</td>
<td>6150</td>
<td>6150</td>
<td>8200</td>
<td>ohms</td>
</tr>
<tr>
<td>Peak A-F Grid Input Voltage (per tube)</td>
<td>485</td>
<td>535</td>
<td>570</td>
<td>volts</td>
</tr>
<tr>
<td>Max-Signal Avg. Driving Power (approx.)</td>
<td>95</td>
<td>105</td>
<td>115</td>
<td>watts</td>
</tr>
<tr>
<td>Max-Signal Plate Dissipation</td>
<td>1500</td>
<td>1500</td>
<td>1450</td>
<td>watts</td>
</tr>
<tr>
<td>Max-Signal Plate Power Output</td>
<td>4500</td>
<td>5600</td>
<td>7000</td>
<td>watts</td>
</tr>
</tbody>
</table>

\[\text{Indicates change from sheet dated 7-1-44.}\]
The 2000T is a medium-mu, high-vacuum transmitting triode intended for amplifier, oscillator and modulator service. It has a maximum plate dissipation rating of 2000 watts. Cooling of the 2000T is accomplished by radiation from the plate, which operates at a visibly red temperature at maximum dissipation, and by means of forced air circulation around the envelope and at the seals.

**GENERAL CHARACTERISTICS**

**ELECTRICAL**
- Filament: Thoriated tungsten
- Voltage: – – – – – – – – – 10.0 volts
- Current: – – – – – – – – – 25.0 amperes
- Amplification Factor (Average): – – – – – – – – – 23
- Direct Interelectrode Capacitances (Average)
  - Grid-Plate: – – – – – – – – – – – 8.5 μfd.
  - Grid-Filament: – – – – – – – – – – – 12.7 μfd.
  - Plate-Filament: – – – – – – – – – – – 1.7 μfd.
- Transconductance (Ib = 1.75 amp., Eb = 6000 v., Ec = –95 v.) 11,000 μmhos

**MECHANICAL**
- Base: Special 4-pin, No. 5006B
- Basing: RMA type 4BD
- Cooling: Radiation and forced air
- Maximum Overall Dimensions:
  - Length: – – – – – – – – – – – 17.75 inches
  - Diameter: – – – – – – – – – – – 8.125 inches
- Net weight: – – – – – – – – – – – 3.5 pounds
- Shipping weight (Average): – – – – – – – – – 8.5 pounds

**RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR**

*Class-C Telegraphy (Key-down conditions, 1 tube)*

**MAXIMUM RATINGS** (Frequencies below 40 Mc.)
- D-C PLATE VOLTAGE: – – – – – – – – – – – – – 8000 MAX. VOLS.
- D-C PLATE CURRENT: – – – – – – – – – – – – – 1.75 MAX. AMPS.
- PLATE DISSIPATION: – – – – – – – – – – – – – 2000 MAX. WATTS
- GRID DISSIPATION: – – – – – – – – – – – – – 150 MAX. WATTS

**TYPICAL OPERATION** (Frequencies below 40 Mc.)
- D-C Plate Voltage: – – – – – – – – – 5000 6000 7000 volts
- D-C Grid Voltage: – – – – – – – – – – –350 –500 –600 volts
- D-C Plate Current: – – – – – – – – – – –1.35 1.35 1.15 amps
- D-C Grid Current: – – – – – – – – – – 175 165 120 ma.
- Grid Dissipation: – – – – – – – – – – – 79 78 43 watts
- Peak R-F Grid Input Voltage (approx.): 900 1050 1060 volts
- Driving Power, (approx.): – – – – – – – – – 140 160 115 watts
- Plate Power Input: – – – – – – – – – – – – – 6470 8000 8000 watts
- Plate Dissipation: – – – – – – – – – – – – – 2000 2000 2000 watts
- Plate Power Output: – – – – – – – – – – – – – 4670 6000 6000 watts

**AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR**

*Class-B (Sinusoidal wave, two tubes unless otherwise specified)*

**MAXIMUM RATINGS**
- D-C PLATE VOLTAGE: – – – – – – – – – – – – – 8000 MAX. VOLS.
- MAX-SIGNAL D-C PLATE CURRENT, PER TUBE: – – 1.75 MAX. AMPS.
- PLATE DISSIPATION, PER TUBE: – – – – – – – – 2000 MAX. WATTS
- GRID DISSIPATION, PER TUBE: – – – – – – – – 150 MAX. WATTS

**TYPICAL OPERATION**
- D-C Plate Voltage: – – – – – – – – – 5000 6000 7000 volts
- D-C Grid Voltage: – – – – – – – – – – –180 –230 –290 volts
- Zero-Signal D-C Plate Current: – – – – – 400 400 350 ma.
- Max-Signal D-C Plate Current: – – – – – 2.00 1.88 1.86 amps.
- Effective Load, Plate-to-Plate: – – – – – 4900 6650 8500 ohms
- Peak A-F Grid Input Voltage (per tube): 470 525 590 volts
- Max-Signal Avg. Driving Power (approx.) 50 60 75 watts
- Max-Signal Peak Driving Power: – – – – – 178 184 212 watts
- Max-Signal Plate Dissipation (per tube): – – 2000 1875 2000 watts
- Max-Signal Plate Power Output: – – – – – 6000 7500 9000 watts

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APPLICATION

MECHANICAL
Mounting—The 2000T must be mounted vertically, base up or base down. Flexible connecting straps should be provided between the grid and plate terminals and the external grid and plate circuits. The tube must be protected from severe vibration and shock.

Cooling—The envelope and seals of the 2000T require artificial cooling. An ordinary 8- or 10-inch fan located one foot from the tube will provide sufficient air for cooling the envelope. The air should be directed at the tube in a manner which will allow the most uniform cooling of the envelope. The grid and plate seals each require a minimum flow of two cubic feet of air per minute. The air for the grid seal is fed through the grid connector. A special connector (Eimac HR-9) is available for this purpose. A special heat-dissipating connector (Eimac HR-8) is also available for use on the plate terminal. A minimum flow of two cubic feet of air per minute must likewise be supplied to the filament seals through the hole at the center of the base. Suitable electrical interlocks should be provided to remove the plate and filament voltages in the event that the supply of cooling air is interrupted.

ELECTRICAL
Filament Voltage—The filament voltage, as measured directly at the filament pins, should be between 9.5 and 10.5 volts.

Bias Voltage—Although there is no maximum limit on the bias voltage which may be used on the 2000T there is little advantage in using bias voltages in excess of those given under "Typical Operation," except in certain very specialized applications. Where bias is obtained by a grid leak, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Plate Voltage—The plate supply voltage for the 2000T should not exceed 8000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under "Typical Operation" for the power output desired.

Grid Dissipation—The power dissipated by the grid of the 2000T must not exceed 150 watts. Grid dissipation may be calculated from the following expression:

\[ P_t = e_{rms} I_c \]

where \( P_t \) = Grid dissipation, \( e_{rms} \) = Peak positive grid voltage, and \( I_c \) = D-c grid current.

\( e_{rms} \) may be measured by means of a suitable peak voltmeter connected between filament and grid.\(^1\) In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading.

Plate Dissipation—Under normal operating conditions, the power dissipated by the plate of the 2000T should not be allowed to exceed 2000 watts. Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

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\(^1\) For suitable peak v.t.v.m. circuits see, for instance, "Vacuum Tube Ratings," *Eimac News*, January, 1945. This article is available in reprint form on request.
DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 5000, 6000, and 7000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by $P_P$.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 5000, 6000, and 7000 volts respectively.

Page Three
The Eimac 3X2500A3 is a medium-mu, forced-air cooled, external-anode transmitting triode incorporating features which make it suitable for effective use at frequencies well into the V. H. F. range, as well as at lower frequencies. The grid of the 3X2500A3 terminates in a ring interposed between the plate and filament, to permit maximum convenience in the use of a tube as a "grounded-grid" amplifier at high frequencies with coaxial plate and filament tank circuits. The tube is also provided with a rugged, low-ductance cylindrical filament-stem structure, which allows a smooth transition between a linear filament tank circuit and the tube. As a result of the use of these unique grid and filament terminal arrangements, it is possible to install or remove the 3X2500A3 without the aid of tools.

The 3X2500A3 is capable of delivering relatively high power output at low plate voltages. A single tube will deliver a radio-frequency output of 5000 watts at 3500 plate volts at low frequencies, and 7500 watts at 4000 plate volts at a frequency of 110 Mc.

**GENERAL CHARACTERISTICS**

**ELECTRICAL**

Filament: Thoriated tungsten

Voltage: 7.5 volts
Current: 48 amperes
Maximum starting current: 100 amperes

Amplification Factor (Average): 20

Direct Interelectrode Capacitances (Average)

- Grid-Plate: 20 μfd.
- Grid-Filament: 48 μfd.
- Plate-Filament: 1.2 μfd.

Transconductance (i_b = 830 ma, E_b = 3000 v.) 20,000 μmhos

**MECHANICAL**

Cooling: Forced air

Maximum Overall Dimensions:

- Length: 9.0 inches
- Diameter: 4.25 inches
- Net Weight: 5.8 pounds
- Shipping Weight (Average): 17 pounds

**RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR**

(Conventional Neutralized Amplifier)

Class-C Telegraphy (Key-down conditions, per tube)

**MAXIMUM RATINGS** (Frequencies below 50 Mc.)

- D-C PLATE VOLTAGE: 5000 MAX VOLTS
- D-C PLATE CURRENT: 2.0 MAX. AMPS
- PLATE DISSIPATION: 2500 MAX. WATTS
- GRID DISSIPATION: 150 MAX. W.C.

**TYPICAL OPERATION** (Frequencies below 50 Mc., per tube)

- D-C Plate Voltage: 3500 - 4000 - 5000 volts
- D-C Grid Voltage: - 1.6 - 1.6 - 2 volts
- Peak R.F. Grid Input Voltage: 750 - 425 - 475 volts
- Grid Dissipation: 775 - 630 - 710 watts
- Plate Input: 6300 - 4000 - 10,000 watts
- Plate Dissipation: 1300 - 88 - 168 watts
- Useful Power Output: 5900 - 5000 - 7500 watts

1 A minimum flow of 120 cubic feet of air per minute must be passed through the plate cooler. The pressure drop across the cooler at this flow equals 1.6" of water. A minimum air flow of 2 cubic feet per minute must also be directed toward the filament stem structure, between the inner and outer filament conductors. Cooling air in the above quantities must be supplied to both plate cooler and filament seals before applying filament voltage and should be continued for five minutes after the filament power is removed.

**RADIO FREQUENCY POWER AMPLIFIER**

Grounded-Grid Circuit

Class-C F-M Telephony

**MAXIMUM RATINGS** (Frequencies between 85 and 110 Mc.)

- D-C PLATE VOLTAGE: 4000 MAX. VOLTS
- D-C PLATE CURRENT: 2.0 MAX. AMPS
- PLATE DISSIPATION: 2500 MAX. WATTS
- PLATE COOLER CORE TEMPERATURE: 150 MAX. °C
- GRID DISSIPATION: 150 MAX. WATTS

**TYPICAL OPERATION** (110 Mc., per tube)

- D-C Plate Voltage: 3700 - 4000 volts
- D-C Grid Voltage: - 450 - 550 volts
- D-C Plate Current: 1.8 - 1.8 amps
- Driving Power (Approx.): 1600 - 1900 watts
- Useful Power Output: 6850 - 7500 watts

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The Eimac 3X2500F3 is a medium-mu, forced air-cooled, external-anode power triode capable of high output at relatively low plate voltages. A single tube will deliver a radio-frequency plate power output of 5000 watts at a plate voltage of 3500.

Flexible grid and filament leads simplify socketing and equipment design for industrial and communication frequencies below 50 Mc. The grid lead is detachable so that for grounded-grid operation, complete external shielding may be used between plate and filament circuits.

**GENERAL CHARACTERISTICS**

**ELECTRICAL**
- Filament: Thoriated tungsten
- Voltage: 7.5 volts
- Current: 48 amperes
- Maximum starting current: 100 amperes
- Amplification Factor (Average): 20
- Direct Interelectrode Capacitances (Average):
  - Grid-Plate: 20 µfd.
  - Grid-Filament: 48 µfd.
  - Plate-Filament: 1.2 µfd.
- Transconductance (Ig=830 ma, Eg=3000 v.): 20,000 µmhos

**MECHANICAL**
- Cooling: Forced air
- Maximum Overall Dimensions:
  - Length: 10 inches
  - Diameter: 4.25 inches
- Net Weight: 7.5 pounds
- Shipping Weight (Average): 17 pounds

**RADIO FREQUENCY POWER AMPLIFIER**

**Conventional Neutralized Amplifier**

**Class-C Telegraphy** (Key-down conditions, per tube)

**MAXIMUM RATINGS** (Frequencies below 50 Mc.)
- D-C Plate Voltage: 5000 MAX. VOLTS
- D-C Plate Current: 2.0 MAX. AMPS
- Plate Dissipation: 2500 MAX. WATTS
- Plate Cooler Core Temperature: 150 MAX. °C
- Grid Dissipation: 150 MAX. WATTS

**TYPICAL OPERATION**
- D-C Plate Voltage: 3500, 4000, 5000 volts
- D-C Grid Voltage: -420, -360, -400 volts
- D-C Plate Current: 1.8, 1.6, 2 amps
- Peak R-F input Voltage: 735, 630, 710 volts
- Driving Power (approx.): 325, 238, 338 watts
- Grid Dissipation: 120, 88, 148 watts
- Plate Input: 6300, 6400, 10000 watts
- Plate Dissipation: 1300, 1400, 2500 watts
- Plate Power Output: 5000, 5000, 7500 watts

---

1 A minimum flow of 120 cubic feet of air per minute must be passed through the plate cooler. The pressure drop across the cooler at this flow equals 1/2" of water. A minimum air flow of 4 cubic feet per minute must also be directed toward the filament stem structure, between the inner and outer filament conductors. Cooling air in the above quantities must be supplied to both plate cooler and filament seals before applying filament voltage, and should be continued for five minutes after the filament power is removed.

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The Elmec 3X12500A3 is a medium-mu, forced-air cooled, external anode transmitting triode incorporating features which make it suitable for effective use at frequencies well into the vhf region, as well as at lower frequencies. Close electrode spacings and maximum utilization of electrode area are made possible through the multi-unit design, which allows the production of high power at exceptionally low plate voltage, thus reducing circuit losses to an insignificant amount.

As a push-pull grounded-grid 110-Mc FM amplifier, a pair of 3X12500A3's will deliver a useful output of over 50 kilowatts at a plate voltage of 3700 volts. As a conventional grounded-filament amplifier, a power output of 30 kilowatts per tube may be obtained in class-C telegraphy service.

**GENERAL CHARACTERISTICS**

**ELECTRICAL**
- Filament: Thoriated tungsten
- Voltage: 7.5 volts
- Current: 192 amperes
- Maximum starting current: 400 amperes
- Amplification Factor (Average): 20
- Direct Interelectrode Capacitances (Average): Grid-Plate 95 μf., Grid Filament 240 μf., Plate Filament 5 μf.
- Transconductance (e_b=3000 v., i_b=4 a.): 80,000 μhos

**MECHANICAL**
- Cooling: Forced air
- Maximum Overall Dimensions: 9.5 inches
- Length: 11.1 inches
- Diameter: 32 pounds
- Net Weight: 80 pounds

**RADIO FREQUENCY POWER AMPLIFIER**

Grounded-Grid Circuit

Class-C FM Telephony or Telegraphy

**MAXIMUM RATINGS (Frequencies below 110 Mc.)**

<table>
<thead>
<tr>
<th>D-C PLATE VOLTAGE</th>
<th>D-C PLATE CURRENT</th>
<th>PLATE DISSIPATION</th>
<th>GRID DISSIPATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4000 MAX. VOLTS</td>
<td>8 MAX. AMPS.</td>
<td>12,500 MAX. WATTS</td>
<td>600 MAX. WATTS</td>
<td></td>
</tr>
</tbody>
</table>

**TYPICAL OPERATION (110 Mc., per tube)**

<table>
<thead>
<tr>
<th>D-C Plate Voltage</th>
<th>D-C Grid Voltage</th>
<th>D-C Grid Current</th>
<th>D-C Grid Plate Current</th>
<th>Driving Power (approx.)</th>
<th>Useful Power Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3700 - 4000 volts</td>
<td>-450 - 550 volts</td>
<td>7.2 - 7.4 amps.</td>
<td>0.9 - 1.1 amps.</td>
<td>6.4 - 7.6 kw</td>
<td>27.4 - 30 kw</td>
</tr>
</tbody>
</table>

3 A minimum flow of 400 cubic feet of air per minute must be passed through the plate cooler. The pressure drop across the cooler at this flow equals 1.5" of water. A minimum air flow of 200 cubic feet per minute must also be directed toward the filament end of the tube. The pressure required for filament-structure cooling is low, and depends upon the details of the tube mounting. Preference should be given to filament-structure cooling systems which allow air to enter or exhaust through the central hole in the lower filament strapping plate. Cooling air in the above amounts must be applied to both the plate cooler and filament assembly before applying filament voltage and should be continued for five minutes after the filament power is removed.

Indicates change from sheet dated 2-25-47

**TENTATIVE DATA**
Eimac vacuum capacitors are small, vacuum-dielectric units intended principally for use as all or part of the plate tank capacitance in radio-frequency amplifiers or oscillators. They are also frequently used as high-voltage coupling and by-pass capacitors at high frequencies and as high-voltage neutralizing capacitors, when used in conjunction with small high-voltage variable capacitors having a small capacitance range. The use of a vacuum as a dielectric permits the construction of a comparatively small, lightweight capacitor for a given voltage rating and capacitance. In addition, the effects of dust and atmospheric conditions on the capacitor are eliminated by sealing the plates within a glass envelope.

These capacitors are manufactured in two maximum peak voltage ratings, 32,000 and 20,000 volts, and in capacitances of 6, 12, 25 and 50 ufd. All types have a maximum current rating of 28 amperes. Each of the capacitors may be operated at its full maximum voltage rating at any frequency below that at which the r.m.s. current through the capacitor is 28 amperes. Above this frequency, the r-f voltage across the capacitor must be reduced as the frequency increases, to prevent the current from exceeding the maximum rating. The graphs below show the maximum peak r-f voltage which may be applied to each type of capacitor at frequencies between 100 kilocycles and 50 megacycles. Curves are also shown which indicate the r.m.s. current flowing through the capacitor under maximum r-f voltage conditions at any frequency between 100 kilocycles and 50 megacycles. Where both r-f and d-c voltages are applied to the capacitor, the sum of the peak r-f and d-c voltages must not exceed the peak voltage rating of the capacitor.

Eimac vacuum capacitors are provided with terminals which allow the use of standard 60-ampere fuse clips for mounting. These clips must be kept clean and must at all times make firm and positive contact with the capacitor terminals. Failure to maintain a low-resistance contact to the capacitor terminals may result in excessive heating and permanent damage to the capacitor seals.

**VC50-32**
- Capacitance*: 50 μfd.
- Max. Peak Voltage: 32,000 volts
- Max. RMS Current: 28 amps.

**VC50-20**
- Capacitance*: 50 μfd.
- Max. Peak Voltage: 20,000 volts
- Max. RMS Current: 28 amps.

**VC25-32**
- Capacitance*: 25 μfd.
- Max. Peak Voltage: 32,000 volts
- Max. RMS Current: 28 amps.

**VC25-20**
- Capacitance*: 25 μfd.
- Max. Peak Voltage: 20,000 volts
- Max. RMS Current: 28 amps.

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VC12-32
- Capacitance: 12 μF
- Max. Peak Voltage: 32,000 volts
- Max. RMS Current: 28 amps

VC12-20
- Capacitance: 12 μF
- Max. Peak Voltage: 20,000 volts
- Max. RMS Current: 28 amps

VC6-32
- Capacitance: 6 μF
- Max. Peak Voltage: 32,000 volts
- Max. RMS Current: 28 amps

VC6-20
- Capacitance: 6 μF
- Max. Peak Voltage: 20,000 volts
- Max. RMS Current: 28 amps

*Tolerances:
VC50-32, VC50-20 ± 1 μF
VC25-32, VC25-20 ± 1 μF
VC12-32, VC12-20 ± 1 μF
VC6-32, VC6-20 ± 0.5 μF
NOW . . . VARIABLE VACUUM CAPACITORS . . . by EIMAC

Here at last is a dependable variable vacuum capacitor that is physically designed for practical application. Every detail of construction makes the Eimac VVC series the standout variable vacuum capacitor component for your equipment. Here is supreme performance and dependability as only Eimac research and engineering can provide.

CHECK THESE FEATURES

PRACTICAL MOUNTING . . . designed for wide application, the base plate on the single units mounts on panel for direct control, or vertically on chassis for control from a flexible shaft or angular control. Multiple units are conveniently bracketed for chassis and panel installation.

COMPACT SIZE . . . the single unit VVC-60 is but 3 inches in diameter and 5 inches in length. Multiple units are proportionally larger.

COPPER COMPONENTS . . . for increased R-F conductivity and minimum internal losses. All contact surfaces are silver plated.

MECHANICALLY RUGGED . . . bellows, bearings and adjusting mechanism designed to withstand excessive use and provide long life.

SIMPLE CONTROL . . . single and multiple units vary capacitance by rotation of a single knob. Return to previously indexed settings is positive.

For further information see your Eimac dealer or write direct.

EITEL-McCULLOUGH, INC.
194 San Mateo Avenue, San Bruno, California

EXPORT AGENTS: Fratar & Hansen—301 Clay St.—San Francisco, Calif.

Follow the Leaders to

EIMAC TUBES
The Power for R-F

<table>
<thead>
<tr>
<th>GENERAL CHARACTERISTICS</th>
<th>Capacity</th>
<th>R-F Peak Voltage</th>
<th>Maximum RMS Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>VVC 60-20</td>
<td>10-60 mmf.</td>
<td>20-KV</td>
<td>40 amp.</td>
</tr>
<tr>
<td>VVC2-60-20 Parallel</td>
<td>20-120 mmf.</td>
<td>20-KV</td>
<td>80 amp.</td>
</tr>
<tr>
<td></td>
<td>5-30 mmf.</td>
<td>40-KV</td>
<td>40 amp.</td>
</tr>
<tr>
<td>VVC4-60-20 Parallel</td>
<td>40-240 mmf.</td>
<td>20-KV</td>
<td>160 amp.</td>
</tr>
<tr>
<td></td>
<td>10-60 mmf.</td>
<td>40-KV</td>
<td>80 amp.</td>
</tr>
</tbody>
</table>
\[ \text{3/8 MAX.} \]

\[ \frac{63}{64} \text{ DIA.} \]

\[ 4 \frac{11}{16} \]

\[ 2 \frac{3}{32} \]

\[ 3 \frac{3}{8} \]

\[ 1 \frac{3}{32} \]

\[ 3'' \text{ DIA.} \]

\[ \frac{25}{32} \text{ DIA.} \]

\[ \frac{1}{4} \text{ DIA.} \]

\[ 2 \frac{1}{8} \text{ DIA. B.C.} \]

\[ \frac{3}{16} \text{ DIA. 4 HOLES FOR MOUNTING WITH \#8-32 SCREWS} \]

MAKE ELECTRICAL CONNECTION TO MOUNTING FLANGE ONLY

DO NOT MAKE ELECTRICAL CONNECTION HERE

TUNING SHAFT, TURN COUNTER-CLOCKWISE TO INCREASE CAPACITY
The Eimac 866-A/866 is a half-wave mercury-vapor rectifier incorporating features which enable it to withstand high peak-inverse voltages and to conduct at relatively low applied voltages. The shielded ribbon filament, edgewound, provides a large emission reserve and long life.

**GENERAL CHARACTERISTICS**

**ELECTRICAL**
- Filament: Coated Voltage: 2.5 volts
- Current: 5.0 amperes
- Tube Voltage Drop (approx.): 15 volts

**MECHANICAL**
- Base: Medium 4-pin bayonet, RMA A4-10
- See base connection diagram
- Basing: See base connection diagram
- Maximum Overall Dimensions:
  - Length: 6.5 inches
  - Diameter: 2.5 inches
- Net Weight (Approx.): 2 ounces
- Shipping Weight (Average): 0.5 pounds

**MAXIMUM RATINGS (single tube)**
- PEAK INVERSE ANODE VOLTAGE: 2,000 5,000 10,000 MAX. VOLTS
- PEAK ANODE CURRENT: 2.0 1.0 1.0 MAX. AMPERES
- AVERAGE ANODE CURRENT: 0.5 0.25 0.25 MAX. AMPERES
- SUPPLY FREQUENCY: 150 1,000 150 MAX. C. P. S.
- CONDENSED-MERCURY TEMPERATURE RANGE: 25-70 °C

*Operation at 40 degrees plus or minus 5 degrees C is recommended.

**APPLICATION**

When an 866-A/866 is first installed, the filament should be operated at normal voltage for approximately ten minutes with no plate voltage applied, in order that the mercury may be properly distributed. It will not be necessary to repeat this procedure unless the mercury is sputtered on the filament and plate during subsequent handling.

**SHIELDING**—Electromagnetic and electrostatic fields tend to cause the mercury vapor to break down, and are detrimental to tube life and make proper filtering difficult. Consequently, the 866-A/866 should be isolated from such fields as exist around a transmitter or other similar equipment. When the tubes are located in the region of such fields, shielding with adequate ventilation should be used around the tubes. R-f filtering should also be employed when the tubes are affected by r-f voltages.

**FILTERING**—The nomograph for circuits 1 and 3, and tables for circuits 2, 4 and 5 give empirical values of inductance and capacitance for a single-section choke-input filter which will keep the peak plate current below the maximum rated value, provided the average d-c load current does not exceed the maximum load current indicated. The values of L and C are based on a power-supply frequency of 60 cycles.

The value of the capacitor is made small enough to prevent excessive surges when power is first applied to the circuit. If the available inductance is larger than the minimum allowable value, the capacitance may be increased proportionately over its nomograph or table maximum. In a two-section filter with unequal inductances, the input inductances should be the larger. The maximum value of each capacitor in such a filter is based upon the value of the preceding inductance.

In the single phase circuits (1 and 3), if the current drawn by the load is reduced or varies under operating conditions to values less than approximately 70% of the indicated maximum d-c load current, a swinging (input) choke will supply the necessary additional inductance to prevent the voltage from rising, and will afford proper filtering over a much greater current range.

Arrangements such as those shown in Circuits 1, 2 and 3 produce less than 5% ripple voltage when a two-section filter with minimum inductance and corresponding maximum capacitance is employed. Circuits such as these show that a 20 L-10 C and 5 will produce less than 1% ripple voltage. Better filtering may be obtained with any of these circuits by using larger values of inductance than the minimum indicated. Still greater improvement may be had by then proportionately increasing the corresponding capacitor values.

When "condenser input" filter is used, the peak current will be relatively high in respect to the usable load current, and the voltage across the capacitor may be as high as 1.4 times the nominal RMS voltage of the transformer.

For parallel operation of 866-A/866 rectifiers, suitable resistors or small inductors may be used in series with each plate lead to permit equal loading and starting characteristics. The inductors aid in reducing the peak current, and are more desirable due to their low d-c resistance. An approximate value for suitable resistors is 80 ohms, and for inductors, approximately one-third henry each.

(Effective 12-1-46) Copyright 1946 by Eitel-McCullough, Inc.
The Eimac 872-A/872 is a half-wave mercury-vapor rectifier incorporating features which enable it to withstand high peak-inverse voltages and to conduct at relatively low applied-voltages. The shielded ribbon filament, edgewise-wound, provides a large emission reserve and long life.

GENERAL CHARACTERISTICS

**ELECTRICAL**

- Filament: Coated Voltage
- Current
- Tube Voltage Drop (approx.)

**5.0 volts**

**7.5 amperes**

**10 volts**

**MECHANICAL**

- Base
- Basing
- Jumbo 4-pin, RMA type A4-29
- See base connection diagram

**Maximum Overall Dimensions:**

- Length
- Diameter
- Net Weight (Approx.)
- Shipping Weight (Average)

**8.5 inches**

**2.31 inches**

**8 ounces**

**1.5 pounds**

**MAXIMUM RATINGS (single tube)**

- PEAK INVERSE ANODE VOLTAGE
- PEAK ANODE CURRENT
- AVERAGE ANODE CURRENT
- SUPPLY FREQUENCY
- CONDENSED-MERCURY TEMPERATURE RANGE

**10,000 MAX. VOLTS**

**5 MAX. AMPERES**

**1.25 MAX. AMPERES**

**150 MAX. C. P. S.**

**20-60 °C**

1 Temperatures in excess of 60 °C limit the peak-inverse rating to 5,000 volts with a corresponding reduction in permissible RMS supply-voltages to one-half those listed in the table.

2 Operation at 40 °C plus or minus 5 °C is recommended.

APPLICATION

When an 872-A/872 is first installed, the filament should be operated at normal voltage for approximately ten minutes with no plate voltage applied, in order that the mercury may be properly distributed. It will not be necessary to repeat this procedure unless the mercury is siphoned on the filament and plate during subsequent handling.

SHIELDING—Electromagnetic and electrostatic fields tend to cause the mercury vapor to break down, and are detrimental to tube life and make proper filtering difficult. Therefore, the 872-A/872 should be isolated from such fields as exist around a transmitter or other similar equipment. When the tubes are located in the region of such fields, shielding with adequate ventilation should be used around the tubes. RF filtering should also be employed when the tubes are subjected to r-f voltages.

FILTERING—A "choke input" filter will allow the greatest usable d-c output current to the load. When using a section of filter between rectifier and load, to prevent exceeding the maximum peak current of 5 amperes, a suitable maximum value for the first capacitor should be determined. Determination of this capacitance should be made under conditions simulating those to be used in service.

The relationship of voltage input, inductance, and capacitance is one in which a higher operating voltage requires greater input inductance, and less following capacitance to keep the peak starting current from exceeding 5 amperes. This is for the usual case where the supply is controlled by an off-switch.

Where the rectifier plate voltage is started by a control which gradually raises the voltage from zero to a small amount to the desired operating value, starting current need not ordinarily be considered, and the characteristics of the filter may be based on preventing excessive peak current under normal operating conditions.

In the single phase circuits (1 and 3), if the current drawn by the load is reduced or varies under operating conditions to values less than approximately 70% of the indicated maximum d-c load current, a swinging (input) choke will supply the necessary additional inductance to prevent the voltage from rising, and will afford proper filtering over a much greater current range.

Where a large value of capacitance is desirable to obtain additional filtering, the subsequent capacitance may be proportionately increased to aid in still further filtering without excessive peak starting, and operating current. Still lower ripple may of course be obtained by added sections of filter.

When "choke input" filter is used, the peak current will be relatively high in respect to the usable load current, and the voltage across the capacitor may be as high as 1.4 times the nominal RMS voltage of the transformer.

For parallel operation of 872-A/872 rectifiers, suitable resistors or small inductors may be used in series with each plate lead to permit equal loading and starting characteristics. The inductors aid in reducing the peak current, and are more desirable due to their low d-c resistance. An approximate value for suitable resistors is 50 ohms, and for inductors, approximately one-third henry each.
### Conditions Assumed

1. Sine wave supply
2. Balanced phase voltages
3. Zero tube drop
4. Pure resistance load
5. No filter used

### Table

<table>
<thead>
<tr>
<th>Number</th>
<th>Circuit</th>
<th>E Average</th>
<th>E Inverse</th>
<th>I Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Single-phase full-wave 2 tubes</td>
<td>0.318 E maximum 0.450 E RMS</td>
<td>3.14 E average 0.636 E maximum</td>
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<td>2</td>
<td>Three-phase half-wave 4 tubes</td>
<td>0.827 E maximum 1.170 E RMS</td>
<td>2.09 E average 0.827 E maximum</td>
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<td>3</td>
<td>Single-phase full-wave 4 tubes</td>
<td>0.636 E maximum 0.900 E RMS</td>
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<td>4</td>
<td>Three-phase full-wave 4 tubes</td>
<td>1.65 E maximum 2.34 E RMS</td>
<td>1.045 E average 0.955 E maximum</td>
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<tr>
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<td>Three-phase double-Y paralleled</td>
<td>0.827 E maximum 1.170 E RMS</td>
<td>2.09 E average 1.91 E maximum</td>
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</tr>
</tbody>
</table>

### Diagram

- **Bottom View of Socket Connections**
  - Pin 1: No connection
  - Pin 2: Filament, Cathode shield
  - Pin 3: No connection
  - Pin 4: Filament
  - Cap: Plate
  - Gas type tube
Eimac HR Heat Dissipating Connectors are used to make electrical connections to the plate and grid terminals of Eimac tubes, and, at the same time, provide efficient heat transfer from the tube element and glass seal to the air. The HR connectors aid materially in keeping seal temperatures at safe values. However, it is sometimes necessary to forced-air-cool the connector by means of a small fan or blower. In such cases the air flow should be parallel with the fins of the connector. Designed for use on the larger tubes, the HR-9 Heat Dissipating Connector is provided with an air duct to conduct the cooling air directly to the glass seal.

HR Heat Dissipating Connectors are machined from solid dural rod, and are supplied with the necessary machine screws. The table below lists the proper connectors for use with each Eimac tube type.

<table>
<thead>
<tr>
<th>TUBE</th>
<th>PLATE CONNECTOR</th>
<th>GRID CONNECTOR</th>
<th>TUBE</th>
<th>PLATE CONNECTOR</th>
<th>GRID CONNECTOR</th>
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<tr>
<td>25T</td>
<td>HR-1</td>
<td>HR-1</td>
<td>1000T</td>
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<tr>
<td>3C24</td>
<td>HR-1</td>
<td>HR-1</td>
<td>1500T</td>
<td>HR-8</td>
<td>HR-9</td>
</tr>
<tr>
<td>35T</td>
<td>HR-3</td>
<td>HR-2</td>
<td>2000T</td>
<td>HR-8</td>
<td>HR-9</td>
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<tr>
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<td>HR-3</td>
<td>HR-3</td>
<td>4-125A</td>
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<td>HR-2</td>
<td>4-250A</td>
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<td>HR-2</td>
<td>RX21A</td>
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<tr>
<td>100TH-TL</td>
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<td>HR-6</td>
<td>KY21A</td>
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<tr>
<td>152TH-TL</td>
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<td>HR-8</td>
<td>100-R</td>
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<td>HR-8</td>
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<tr>
<td>250TH-TL</td>
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<td>HR-3</td>
<td>2-150A</td>
<td>HR-5</td>
<td>HR-5</td>
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<td>HR-6</td>
<td>2-150D</td>
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<td>HR-6</td>
</tr>
<tr>
<td>450TH-TL</td>
<td>HR-8</td>
<td>HR-8*</td>
<td>250-R</td>
<td>HR-6</td>
<td>HR-6</td>
</tr>
<tr>
<td>750TL</td>
<td>HR-8</td>
<td>HR-8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The grid terminal of the 450TH-TL type tube is now .560" in diameter. To accommodate existing equipment designed for the older style 450TH-TL having .090" diameter grid terminals, an adapter pin is provided with the newer tubes. This adapter pin is threaded so that it may be removed from the grid terminal of the tube. The small grid terminal requires an HR-4 connector.
The Eimac HV-1 Diffusion Pump is a fast, triple-jet, air-cooled vacuum pump of the oil-diffusion type. When used with a suitable mechanical forepump and Eimac type A oil it is capable of reaching an ultimate vacuum of $4 \times 10^{-7}$ mm of mercury.

Assembly of the pump is a simple operation, requiring no special tools or intricate adjustments. It can be completely disassembled for cleaning in five minutes or less.

The glass construction permits rapid inspection of conditions within the pump.

**OPERATIONAL DATA**

- **Amount of Oil**: 150 milliliters
- **Recommended Oil**: Eimac Diffusion Pump Oil, Type A
- **Forepump Capacity**: 0.1 to 2.0 liters per second at 0.001 mm of mercury, or less
- **Forepressure (maximum)**: 0.02 mm of mercury
- **Baffle Temperature**: 35° C or lower
- **Heater Voltage**: 100 to 110 volts
- **Heater Current (at 110 volts)**: 1.7 amperes
- **Speed, without baffle (approx.)**: 67 liters per second at $4 \times 10^{-4}$ to $4 \times 10^{-6}$ mm Hg
- **Speed, with baffle (approx.)**: 32 liters per second at $4 \times 10^{-4}$ to $4 \times 10^{-6}$ mm Hg
- **Ultimate Vacuum, at 25° C (approx.)**: $4 \times 10^{-7}$ mm Hg when using recommended oil.

**MECHANICAL DATA**

- **Casing**: Pyrex Glass
- **Chimney**: 3 Jet, Aluminum
- **Cooling**: Air
- **Maximum Overall Dimensions**: See Outline Drawing
- **Mounting Position**: Vertical, boiler down
- **Net Weight**: 11 pounds
- **Shipping Weight**: 16 pounds

* A smaller forepump may be used, but this will reduce the pumping speed at the higher manifold pressures.
OPERATION

The principle upon which the oil-diffusion pump operates may be explained as follows. The drawing on page three illustrates the accepted theory. Gas to be removed from the high-vacuum system enters the pump at the top, whence it moves into the region of the upper jet. Emerging from this jet is a stream of oil vapor which is generated by the electrically-heated oil boiler at the bottom of the pump. Molecules of the unwanted gas diffuse into this stream of oil vapor and are carried down and out toward the cooler glass-wall of the pump. Upon reaching the glass-wall, the oil vapor condenses to a film of liquid oil which runs down the wall and returns to the boiler. The gas molecules are forced downward by the oil vapor and gas above them and come under the influence of the middle jet, where they are again forced down toward the bottom of the pump by a stream of oil vapor.

Any hygroscopic matter should be carefully excluded. When so located as to be affected by heat, rubber is particularly objectionable, and a poor ultimate vacuum is likely to result if rubber gaskets are used in the diffusion pump. For this reason, Neoprene gaskets are supplied with the HV-1.

In systems employing stop-cocks, valves or gaskets, it is necessary that the stop-cock, valve or gasket lubricant have the minimum possible vapor pressure, because poor lubricants can easily destroy the high-vacuum capabilities of the pump.

APPLICATION

The HV-1 diffusion pump must be mounted securely, but not too rigidly. A satisfactory method of mounting consists of 1 X 1 X ½ inch angle shaped and drilled to pass four of the six spring loaded bolts used to join the large flanges at the top of the barrel (see figure). When the desired manifold has been sealed to the manifold adapter (914 on outline drawing), the pump is prepared for operation (after rinsing thoroughly as specified under "cleaning") in accordance with the following procedure:

The curves at the left show the gas handling capabilities of the HV-1 over a range of pressures both with and without a baffle. These curves apply when a forepump with the required capacity is used. The rapid loss in pumping speed at the higher pressures is due to the inability of the forepump to handle the necessary volume of gas. With a larger forepump, the pumping speed would be maintained out to higher pressures.

In systems employing stop-cocks, valves or gaskets, it is necessary that the stop-cock, valve or gasket lubricant have the minimum possible vapor pressure, because poor lubricants can easily destroy the high-vacuum capabilities of the pump.

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FROM HIGH VACUUM MANIFOLD

COOLING AIR

DIFFUSION

OIL CONDENSES ON BARREL

DIFFUSION

OIL CONDENSES ON BARREL

HIGH PRESSURE REGION

BOILING OIL

HEATING ELEMENT

LOW PRESSURE REGION

COOLING AIR

OIL VAPOR GAS MOLECULES

OIL RING VISIBLE HERE WHEN PRESSURE IS HIGH IN BOTTOM OF PUMP

TO MECHANICAL "FOREPUMP"

OIL RING VISIBLE WHEN HEATER INPUT IS TOO HIGH

LIQUID OIL RETURNING TO BOILER

HEATER TERMINALS
1. Pour 150 milliliters of Eimac Diffusion Pump Oil, Type A, into the pump barrel (917).

2. Insert the aluminum jet assembly (4911) into the pump barrel.

3. Assemble the pump carefully, moistening both sides of each gasket with pump oil, or with a thin layer of heavy-grade "Calvacene" or equivalent grease.

4. Install the pump in its mounting.

**IMPORTANT:** **DO NOT START DIFFUSION PUMP HEATER UNTIL FOREPUMP IS IN OPERATION AND SYSTEM IS FREE OF LEAKS, TO AVOID PREMATURE HIGH TEMPERATURE AND DECOMPOSITION OF THE OIL.**

5. After making certain that the forepump is connected to the nipple (8911) through the suitable flexible coupling (vacuum-hose or vacuum type bellows), start the forepump motor. Check the manifold with a Tesla or other high-voltage, high-frequency spark coil for leaks BEFORE CONTINUING.

The Tesla coil, with a flexible wire probe may be used to indicate the presence of leaks above the baffle. It is also valuable in estimating pressure in the manifold during the early stages of evacuation. **CAUTION:** Too high a voltage may puncture the manifold at its weak points, i.e., where the glass may be very thin or at a seal-off tubulation. A rough indication for a suitable Tesla voltage is that which will produce a corona of about one-eighth inch on the end of a No. 14 B & S probe wire, visible in the dark only, and a stringy spark not over five-eighths inch to a grounded metal surface.

If the system is known to be free of leaks, the forepump and HV-1 may be started together. However, to protect the system and its oil, the manifold first should be checked with the Tesla coil, with the HV-1 "off." When the cold oil stops bubbling and the pink glow is seen to be diminishing at a normal rate, the system may be assumed to be reasonably tight and the HV-1 may be started.

6. Connect the oil heater terminals via a switch to the source of power. The oil heater voltage should be set to between 100 and 110 volts for best results. An adjustable resistor or an auto transformer of the tapped or continuously variable types is recommended. The current at 110 volts is approximately 1.7 amperes.

7. The baffle assembly and upper end of the pump barrel should be kept cool (35° C or lower) by a small fan or blower (see illustration).

**OIL—**Eimac Type A Diffusion Pump Oil is a special petroleum product carefully processed by Eitel-McCullough, Inc. to afford the high-vacuum desired in diffusion pump work. The ultimate vacuum attainable for Type-A oil is on the order of $10^{-6}$ mm Hg. Its boiling point at pressures on the order of $10^{-4}$ mm Hg is 135° C.

One noteworthy property of this oil is that under normal conditions, no particles of condensed oil will be found deposited in the high-vacuum manifold. This lack of condensation is indicative of the absence of "light ends." Such products of distillation usually must be barred from the high vacuum system by the use of liquid air or charcoal traps which invariably reduce the speed of any system and require extensive maintenance.

**VACUUM GAGES—**To properly evaluate the vacuum conditions at the manifold, a sensitive gage in the desired range is necessary. There are many systems used for this purpose, the most sensitive in the high-vacuum spectrum being the Ionization (or Ion) gage. Its range of usefulness extends from approximately 5 microns to a region in the upper experimental vacuum limits on the order of $10^{-3}$ microns ($5 \times 10^{-4}$ to $10^{-3}$ mm Hg). Recently, tubes and circuits have been developed which contribute to the high stability of this instrument. The Eimac type 100-IG Ion Gage tube is designed to give the maximum internal leakage path, thus avoiding erroneous readings due to possible contamination from the system.

**LEAKS—**If the system does not "clean-up" in a reasonable time, considering the nature and size of the manifold and connected chambers, a leak may be looked for by means of the Tesla coil. The probe will show a faint blue-violet glow on the glassware surface of the glass work involved. A "fast" leak will be indicated where sparks concentrate at a point on the glass and a pinkish glow takes place within the evacuated space.

If a slow leak is suspected, before "bake-out" and where the vacuum is high but still not satisfactory, a solvent such as carbon tetrachloride may be applied to the manifold surface with an atomizer, a wad of cotton or brush. If a leak is found, the Tesla voltage will cause a marked bluish glow while the solvent is entering the aperture, or the ion gage reading will indicate increased pressure.

If a light "bake-out" or when the manifold is too hot for the application of liquids, illuminating gas or hydrogen may be applied to the surface from an unlighted torch. Gas entering the hole will effect the ionization gage reading immediately. A very small leak may be found in this way if there are no leaks, the manifold and pump assembly is ready for use.

With the manifold at high vacuum, no ionization will be apparent from the effects of a Tesla probe held on the manifold (above the baffle). Below the baffle on the barrel of the HV-1 pump the probe will cause fluorescence of the oil vapors as well as a visible disturbance of the oil flow below the jets. The probe when touched to the HV-1 outlet will show a faint blue-violet glow. If these first two conditions are obtained, but a pinkish glow is present in the outlet, the mechanical pump and its coupling should be checked.

For a new oil, or after an oil change, the pump will require about 24 hours of operation to condition the oil for optimum performance. Approximately 15 minutes heating time is required for the HV-1 to reach full efficiency from a cold start.

**PRECAUTIONS**

1—The vacuum system should not be opened "to air" when the diffusion pump is hot, to prevent oxidation of the pump oil. 2—If at any time a white vapor is visible in the HV-1, both pumps should be immediately shut off. The vapor is an indication of forepump failure or a very rapid leak. If the oil has become dark, the system may require complete cleaning. 3—Ground leads should be provided on both flange couplings to prevent the Tesla voltage from puncturing the Neoprene gaskets.

**CLEANING**

Diffusion pumps in continuous use should be cleaned at approximately one-month intervals. The materials and facilities required for cleaning are: Carbon tetrachloride or acetone (or acetone). An oven capable of temperatures up to 500° C will allow complete removal of carbonaceous deposits. The oven should be provided with an air inlet and outlet to allow the products of oxidation to be carried off. An accurate temperature control and indicator are advisable to prevent mishap to the glass parts. Where an oven is not available, steel wool, water and some abrasive cleanser such as diatomaceous earth

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1. "Bake-out" consists of surrounding the manifold and work to be evacuated with an oven. The temperature is then raised and held until under the annealing point for the "softest" glass being used in the system (approximately 500 degrees C for Pyrex). The temperature is maintained for thirty minutes to an hour, or at least until the new glass in the system shows no fluorescence on application or the Tesla voltage. This "cures up" the glassware to a point where it will not normally release further gas. An accurate thermocouple type temperature indicator and heater control are advisable to prevent mishap to the system during "bake-out."

2. Contamination in the system such as decomposed oil, or a source of high-vapor pressure in the load will give "virtual leaks" or unfavorable maximum vacuum readings.

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Page Four
may be used. The procedure is given in the following paragraphs.

GLASS HOUSING BARREL—New housings should be given a rinse with a cup of pentane or acetone and then warm-air dried. (CAUTION: pentane and acetone are inflammable. Keep away from open flames.) Used, dirty housings should have the excess of oil fluid rinsed out with two or three flushings of about one cup (per rinse) of carbon tetrachloride. The last rinse may be saved for the first wash of the following pieces. To remove adhering carbonaceous matter after draining, the housing should be baked out in an oven up to 500°C. If the housing is not too caked, a rinse with pentane or acetone and gentle drying with warm air (in place of baking out in the oven) is sufficient.

ALUMINUM JET ASSEMBLY—The jet assembly may be cleaned at the same time that the glass housing barrel is cleaned by inserting the assembly into the glass housing, pouring in the rinse solution and closing the top opening with a stopper. Agitate the solution by tilting and shaking the pump so that all parts are well washed over. Always remove the stopper and jet assembly after washing, prior to draining, baking or air drying. To further remove hard carbonaceous material, the assembly, less baffle, should be placed in an annealing oven and heated carefully to 475°C, then allowed to cool slowly in air.

BAFFLE—The baffle should be disassembled and all parts rinsed three times with pentane or acetone; the last two rinsings must be with clean solution. Follow with warm-air drying.

NEOPRENE GASKETS—Wash the gaskets in carbon tetra-chloride or alcohol, then wipe with a clean cloth in place of warm-air drying.

GLASS MANIFOLDS—Use the same procedure as for the glass housing barrel when feasible. However, usually washing with pure water and alcohol, followed by warm-air drying, may be sufficient because there is less formation of carbonaceous matter here than in the case of the pump housing.