TRANSMITTING TUBE
HANDBOOK

This HANDBOOK has been prepared to meet the demand for a ready reference to the characteristics of certain RCA tubes employed in radio transmitters and associated equipment. The material is compiled in loose-leaf form in order that additions and revisions may be made as conditions require.

The first part contains general information on RCA Transmitting Tubes, while the second part consists of data and curve sheets on the various tube types arranged in sequence.

Each data sheet gives for a particular type the use or uses for which that type is designed as well as maximum ratings, typical conditions of operation, physical dimensions and terminal connections. This information is supplemented by average characteristics curves.

The RCA Transmitting Tube Handbook will prove helpful to anyone who has need for concise data on our transmitting types. If further data on any type are desired, we shall be glad to be of assistance.

RCA RADIOTRON DIVISION
RCA MANUFACTURING COMPANY, INC.
HARRISON, N. J.

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TRANSMITTING TUBE SECTION

In this section, data are given for certain RCA tubes mainly employed in radio transmitters and associated equipment.

Attention is directed to the general information found in the first few pages of this section. Following the Contents is the Index. This has been so arranged as to classify the various tubes by (1) use, and (2) power output. With this arrangement, it is easy to select the type best suited for the desired requirements.

The information following the Index is of pertinent value to the tube user. It is based on experience gained in the design, manufacture, and operation of transmitting tubes over a long period. By following this information, therefore, the user will obtain the most satisfactory operating performance from the various types.

Requests for further technical data on any RCA tube type should be addressed to the Commercial Engineering Section, RCA RADIOTRON DIVISION, RCA Manufacturing Company, Inc., Harrison, N. J.

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SECTION CONTENTS

(Reference is to front of sheet only)

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TRANSMITTING TUBE SECTION CONTENTS

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*This type is not intended for use in the design of new transmitting equipment. Since, however, this type is required for renewal installation in equipment designed for it, data on this type have been included for the convenience of users of such equipment.

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LIST PRICES□
OF TRANSMITTING TYPES

Type	Price	Type	Price	Type	Price
203-A	$ 15.00	831	$ 265.00	861	$ 295.00
204-A	97.50	834	12.50	862	1650.00
207	350.00	835	18.50	863	325.00
211	15.00	836	11.50	864	1.00
214	300.00	837	8.50	865	12.75
217-A	20.00	838	16.00	866	1.75
217-C	20.00	841	3.25	866-A	4.00
218	132.50	842	3.25	869-A	140.00
219	215.00	843	12.50	870	1040.00
520-B	210.00	844	18.00	871	7.50
800	10.00	845	15.00	872	14.00
801	3.45	846	300.00	872-A	16.50
802	3.90	848	325.00	891	325.00
803	34.50	849	160.00	892	325.00
804	15.00	850	37.50	896	4.50
805	15.00	851	350.00	898	1650.00
806	24.50	852	16.40	1602	2.75
807	3.90	857-B	275.00	1651	100.00
808	10.00	858	500.00	1652	325.00
830-B	10.00	860	32.50		

□ This price list applies only in the United States of America and is subject to change without notice.

INFORMATION ON PURCHASING ABOVE TYPES

Information as to where RCA Transmitting Tubes can be purchased may be obtained from our *district office* nearest you or from *Sales Department, RCA Manufacturing Company, Inc., Camden, N.J.*

RCA

INDEX OF TRANSMITTING TYPES
BY USE AND TYPICAL POWER OUTPUT

CLASS A AMPLIFIERS:
A-F Amplifier and Modulator Service

TYPICAL POWER OUTPUT (watts)	TYPE†	FILAMENT VOLTS	FILAMENT AMP.	TYPICAL PLATE VOLTS
Volt. Ampl'r.	864	1.1	0.25	90
1.6	843	2.5	2.5	425
1.6	1602	7.5	1.25	425
Volt. Ampl'r.	841	7.5	1.25	425
3.0	842	7.5	1.25	425
3.8	801	7.5	1.25	600
6.5	802	6.3	0.9	500
12	211, 835	10	3.25	1000
21	845	10	3.25	1000
81	849	11	5.0	2500
100	851	11	15.5	2000
2000	848	22	52	8000
2000	891	See data page		8000

† When used as modulators, each of these types is capable of modulating 100% an input to a Class C r-f amplifier of twice the power output shown.

CLASS B AMPLIFIERS:
(I) A-F Amplifier and Modulator Service (2 tubes)

TYPICAL POWER OUTPUT (watts)	TYPE★	FILAMENT VOLTS	FILAMENT AMP.	TYPICAL PLATE VOLTS
20	1602	7.5	1.25	350
21	841	7.5	1.25	350
36	801	7.5	1.25	500
60	807	6.3	0.9	400
75	845‡	10	3.25	1000
100	800	7.5	3.25	1000
135	830–B	10	2.0	800
190	808	7.5	4.0	1250
200	203–A	10	3.25	1000
200	211, 835	10	3.25	1000
200	838	10	3.25	1000
220	852	10	3.25	2000
300	805	10	3.25	1250
600	204–A	11	3.85	2000
660	806	5.0	10	3000
1000	849	11	5.0	2500
2200	851	11	15.5	2000
20000	207	22	52	10000
20000	848	22	52	10000
20000	863	22	52	10000
20000	891	See data page		10000
20000	892	See data page		10000
26500	858	22	52	12000
90000	862	33	207	12000
90000	898	See data page		12000

★ When used as modulators, two of each of these types are capable of modulating 100% an input to a Class C r-f amplifier of twice the power output shown.

‡ Class AB operation.

(2) R-F Amplifier Service—Telephony

For operating frequencies, see sheet TRANS. TUBE RATINGS vs. FREQUENCY.

TYPICAL CARRIER P. O. ♦ (watts)	TYPE	FILAMENT VOLTS	FILAMENT AMP.	TYPICAL PLATE VOLTS
2	843	2.5	2.5	350
2.4	844	2.5	3.25	400
3	1602	7.5	1.25	350
3	865	7.5	2.0	500
3.5	802	6.3	0.9	500
4.25	841	7.5	1.25	350
5	837	12.6	0.7	500
6	801	7.5	1.25	500

♦ See next page. (Continued on next page)

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BY USE AND TYPICAL POWER OUTPUT

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TYPICAL CARRIER P. O.♦ (watts)	TYPE	FILAMENT VOLTS	FILAMENT AMP.	TYPICAL PLATE VOLTS
9	807	6.3	0.9	400
12	804	7.5	3.0	1000
14	800	7.5	3.25	1000
16	834	7.5	3.25	1000
22	808	7.5	4.0	1250
23	830–B	10	2.0	800
30	850	10	3.25	1000
30	852	10	3.25	2000
30	860	10	3.25	2000
40	203–A	10	3.25	1000
40	211, 835	10	3.25	1000
40	803	10	5.0	1500
40	838	10	3.25	1000
55	805	10	3.25	1250
70	806	5.0	10	3000
100	204–A	11	3.25	2000
150	831	11	10	3000
150	861	11	10	3000
170	849	11	5.0	2000
300	851	11	15.5	2000
1000	846	11	51	7000
1000	520–B	22	34	7500
1000	891	See data page		6000
1000	892	See data page		6000
1000	1652	14.5	52	6000
2275	848	22	52	14000
2500	207	22	52	10000
4000	863	22	52	14000
5600	858	22	52	18000
25000	862	33	207	18000
25000	898	See data page		18000

CLASS C AMPLIFIERS:

For operating frequencies, see sheet TRANS. TUBE RATINGS vs. FREQUENCY.

(1) Plate-Modulated R-F Amplifier Service—Telephony

TYPICAL POWER OUTPUT (watts)	TYPE	FILAMENT VOLTS	FILAMENT AMP.	TYPICAL PLATE VOLTS
2	844	2.5	3.25	400
5	843	2.5	2.5	350
8	802	6.3	0.9	400
8	1602	7.5	1.25	350
10	865	7.5	2.0	500
11	841	7.5	1.25	350
11	837	12.6	0.7	400
17	807	6.3	0.9	325
18	801	7.5	1.25	500
50	800	7.5	3.25	1000
50	830–B	10	2.0	800
50	804	7.5	3.0	1000
58	834	7.5	3.25	1000
65	850	10	3.25	1000
75	852	10	3.25	2000
75	860	10	3.25	2000
100	203–A	10	3.25	1000
100	211, 835	10	3.25	1000
100	838	10	3.25	1000
105	808	7.5	4.0	1250
140	805	10	3.25	1250
155	803	10	5.0	1600
350	204–A	11	3.85	2000
360	831	11	10	3000
360	861	11	10	3000
390	806	5.0	10	3000
425	849	11	5.0	2000
1250	851	11	15.5	2000

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INDEX OF TRANSMITTING TYPES

BY USE AND TYPICAL POWER OUTPUT

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TYPICAL POWER OUTPUT (watts)	TYPE	FILAMENT VOLTS	FILAMENT AMP.	TYPICAL PLATE VOLTS
1500	846	11	51	5000
2000	520–B	22	34	6000
2500	1652	14.5	52	6000
3500	891	See data page		6000
3500	892	See data page		6000
5000	848	22	52	8000
6000	207	22	52	10000
6000	863	22	52	10000
8000	858	22	52	12000
34000	862	33	207	10000
45000	898	See data page		12000

(2) Suppressor-Modulated R-F Amplifier Service—Telephony

TYPICAL CARRIER P. O.♦ (watts)	TYPE	FILAMENT VOLTS	FILAMENT AMP.	TYPICAL PLATE VOLTS
3	802	6.3	0.9	500
5	837	12.6	0.7	500
16	804	7.5	3.0	1000
40	803	10	5.0	1500

(3) Grid-Modulated R-F Amplifier Service—Telephony

TYPICAL CARRIER P. O.♦ (watts)	TYPE	FILAMENT VOLTS	FILAMENT AMP.	TYPICAL PLATE VOLTS
4	802	6.3	0.9	500
5	837	12.6	0.7	500
16	804	7.5	3.0	1000
40	803	10	5.0	1500

♦ Peak power output for any type is 4 times the output given.

(4) R-F Amplifier and Oscillator Service—Telegraphy

TYPICAL POWER OUTPUT (watts)	TYPE	FILAMENT VOLTS	FILAMENT AMP.	TYPICAL PLATE VOLTS
5	843	2.5	2.5	350
6	844	2.5	3.25	400
9	1602	7.5	1.25	350
10	802	6.3	0.9	400
11	841	7.5	1.25	350
14	865	7.5	2.0	625
20	801	7.5	1.25	500
20	837	12.6	0.7	500
25	807	6.3	0.9	400
50	800	7.5	3.25	1000
58	834	7.5	3.25	1000
70	830–B	10	2.0	800
80	804	7.5	3.0	1250
100	203–A	10	3.25	1000
100	211, 835	10	3.25	1000
100	838	10	3.25	1000
100	850	10	3.25	1000
120	808	7.5	4.0	1250
135	852	10	3.25	2500
135	860	10	3.25	2500
160	803	10	5.0	1500
170	805	10	3.25	1250
350	204–A	11	3.85	2000
425	849	11	5.0	2000
450	806	5.0	10	3000
540	831	11	10	3000
540	861	11	10	3000
1250	851	11	15.5	2000
3000	846	11	51	6000
4000	1652	14.5	52	6000
5000	520–B	22	34	7500

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TYPICAL POWER OUTPUT (watts)	TYPE	FILAMENT VOLTS	FILAMENT AMP.	TYPICAL PLATE VOLTS
10000	848	22	52	10000
10000	891	See data page		10000
10000	892	See data page		10000
14000	863	22	52	12000
15000	207	22	52	12000
22400	858	22	52	18000
100000	862	33	207	18000
100000	898	See data page		18000

RECTIFIERS:

(1) Half-Wave, Mercury-Vapor

MAX. AV. PLATE AMPERES	MAX. PEAK PLATE AMPERES	MAX. PEAK INVERSE VOLTS	TYPE	FILAMENT VOLTS	FILAMENT AMP.
0.125	0.5	5000 10–60°	871	2.5	2.0
0.25	1.0	5000 25–70° 10000 25–60°	866–A	2.5	5.0
0.25	1.0	7500 10–60°	866	2.5	5.0
1.25	5.0	7500 10–60°	872	5.0	10
1.25	5.0	5000 20–70° 10000 20–60°	872–A	5.0	6.75
2.5	10	20000 25–60°	869–A	5.0	18
10	40	10000 25–65° 22000 30–40°	857■	5.0	30
10	40	10000 25–60° 22000 30–40°	857–B	5.0	30
75	450	7500 35–50° 16000 35–40°	870	5.0	65

Where two ratings are given for any type, better temperature control is required for the higher rating.

(2) Half-Wave, High-Vacuum

MAX. PEAK PLATE AMPERES	MAX. PEAK INVERSE VOLTS	TYPE	FILAMENT VOLTS	FILAMENT AMP.
0.6	3500	217–A	10	3.25
0.6	7500	217–C	10	3.25
0.75	11000	1651■	11	14.75
0.75	50000	218■	11	14.75
1.0	5000	836	2.5	5.0
2.5	50000	219■	22	24.5
7.5	50000	214■	22	52

■ Only for renewal use.

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TRANSMITTING TUBE RATINGS

The filament or heater voltage given on the DATA pages is a normal value unless otherwise stated. This means that transformers and/or resistances in the cathode circuit should be designed to operate the filament or heater at rated value for full-load operating conditions under average line-voltage conditions. Variations from this rated value due to line voltage fluctuation or other causes, should not exceed plus or minus 5%, unless otherwise specified.

In general, the filament of a transmitting tube may be operated with either a.c. or d.c. A.c. is usually employed unless d.c. is necessary from the standpoint of hum. With a-c operation, the grid return and the plate return should be connected to the mid-point of the filament-supply winding of the transformer. When d-c is used, the return leads should be connected to the negative filament terminal.

In case it is required to use d-c filament excitation on any filament type for which the data are given on an a-c basis, the grid-bias values as given on the respective DATA pages should be decreased by an amount approximately equal to one-half the rated filament voltage and be referred to the negative filament terminal instead of the mid-point (as in a-c operation).

In the rating of RCA transmitting tubes, certain values on the DATA pages are given as MAXIMUM. These are limiting values above which the serviceability of the tube will be impaired from the viewpoint of life and satisfactory performance. If these limiting values are not to be exceeded under the usual operating variations, it will be necessary to determine the amount of voltage fluctuation due to line-voltage variation, load variation, and manufacturing variation in the apparatus itself. Average design values must then be decided upon so that maximum ratings will never be exceeded under the usual operating conditions.

Each maximum rating must be considered in relation to all other maximum ratings, so that under no condition of operation will any maximum rating be exceeded. For example, consider a tube with the following maximum ratings for Class B r-f service: d-c plate voltage, 1250 max. volts; d-c plate current, 150 max. ma.; and plate input, 150 max. watts. From these maximum ratings, it is apparent that when the maximum plate voltage of 1250 volts is used, the plate current must be reduced so that the maximum plate-input rating of 150 watts is not exceeded. Likewise, and for the same reason, when the maximum plate current of 150 milliamperes is used, the plate voltage must be reduced.

The DATA pages also show *Typical Operation* values for each respective tube type in its recommended classes of op-

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eration. These values must not be considered as ratings, in as much as the tube can be used under any suitable conditions within the Maximum Ratings to obtain the required output. The output value for any operating condition is an approximate tube output, i.e., tube input minus plate loss. Circuit losses must be subtracted from tube output in determining useful output. Output values are approximate and are not to be used as output ratings.

The typical values of d-c grid current and driving power shown for triodes and tetrodes in Class B r-f service and in Class C service are subject to wide variations depending on the impedance of the load circuit. High-impedance load circuits require more grid current and driving power to obtain the desired output. Low-impedance circuits need less grid current and driving power, but plate circuit efficiency is sacrificed. The driving stage should have a tank circuit of good regulation and should be capable of delivering considerably more than the required driving power.

The typical operating values have been given in order to show concisely some guiding information for the use of each type. Since any transmitting type may be used under widely different conditions within Maximum Ratings, we suggest that you write us before you proceed with the design of equipment.

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TRANSMITTING TUBE RATINGS vs. OPERATING FREQUENCY

The MAXIMUM RATINGS given for each type on its data pages apply only when the type is operated at a frequency not higher than that shown in the 2nd column below. As the frequency is raised above this value, the radio-frequency currents, the dielectric losses, and the heating effects increase. Increasing the frequency to that of the 3rd column requires decreasing of plate voltage and plate input so that at the frequency of the 3rd column, they will not exceed 75% of the MAXIMUM RATINGS. Increasing the frequency to that of the 4th column requires a further decrease such that at the frequency of the 4th column, the plate voltage and plate input will not exceed 50% of the MAXIMUM RATINGS.

In the 5th column are given the resonant frequencies of the tubes alone. Each of the resonant values is obtained with the shortest practical connection between grid and plate.

Tube Type	Max. Freq. for 100% Rated Max. Plate Volts & Plate Input	Max. Freq. for 75% Rated Max. Plate Volts & Plate Input	Max. Freq. for 50% Rated Max. Plate Volts & Plate Input	Resonant Frequency of Tube Only
	Megacycles	*Megacycles*	*Megacycles*	*Megacycles*
203-A	15	30	80	100
204-A	3	10	30	50
207	1.5	7.5	20	60
211	15	30	80	100
520-B	2	-	-	-
800	60	100	180	300
801	60	75	120	170
802	30	55	110	150
803	20	35	70	115
804	15	35	80	140
805	30	45	85	115
806	30	50	100	197
807	60	80	155	155
808	30	60	130	272
830-B	15	30	60	90
831	20	30	60	100
834	100	170	350	500
835	20	40	100	120
837	20	35	80	125
838	30	50	120	140
841	6	45	170	170
843	6	50	200	200
844	8	45	155	155
846	50	100	150	200
848	1.5	7.5	20	60

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TRANSMITTING TUBE RATINGS vs. OPERATING FREQUENCY

(continued from preceding page)

Tube Type	Max. Freq. for 100% Rated Max. Plate Volts & Plate Input	Max. Freq. for 75% Rated Max. Plate Volts & Plate Input	Max. Freq. for 50% Rated Max. Plate Volts & Plate Input	Resonant Frequency of Tube Only
	Megacycles	*Megacycles*	*Megacycles*	*Megacycles*
849	3	10	30	40
850	13	35	100	130
851	3	7	15	28
852	30	70	120	210
858	1.5	20	40	65
860	30	70	120	195
861	20	30	60	100
862	1.5	–	–	–
863	1.5	7.5	20	60
865	15	30	70	125
891	1.5	7.5	20	60
892	1.5	7.5	20	60
898	1.5	–	–	–
1602	6	45	170	170

DEFINITIONS

Definitions taken from the 1933 Report of the Standards Committee of the I.R.E. are followed by the definition number in the report.

AMPLIFICATION FACTOR (μ) is a measure of the effectiveness of the control electrode voltage relative to that of the plate voltage upon the plate current. It is the ratio of the change in plate voltage to a change in control electrode voltage in the opposite direction, under the condition that the plate current remains unchanged. As most precisely defined, the term refers to infinitesimal changes as indicated by the defining equation,

$$\mu = -\left[\frac{\partial e_p}{\partial e_g}\right] i_p \text{ constant}$$

13-043

CLASS A AMPLIFIER: An amplifier in which the grid bias and the exciting grid voltage are such that the plate current through the tube flows at all times.

The ideal Class A amplifier is one in which the alternating component of the plate current is an exact reproduction of the form of the alternating grid voltage, and the plate current flows during the 360 electrical degrees of the cycle.

The characteristics of a Class A amplifier are low efficiency and output. 13-201

CLASS AB AMPLIFIER: An amplifier in which the grid bias and the exciting grid voltage are such that the plate current flows during appreciably more than 180 electrical degrees but less than 360 electrical degrees of the cycle. This has been called Class "A prime".

The characteristics of a Class AB amplifier are efficiency and output intermediate to those of a Class A and a Class B amplifier. The idle plate current and attendant dissipation may be made substantially less than is possible with Class A amplifiers.

CLASS B AMPLIFIER: An amplifier in which the grid bias is approximately equal to the cut-off value so that the plate current is approximately zero when no exciting grid voltage is applied, and so that the plate current in each tube flows during approximately one half of each cycle when an exciting grid voltage is present.

The ideal Class B amplifier is one in which the alternating component of plate current is an exact replica of the alternating grid voltage for the half cycle when the grid is positive with respect to the bias voltage, and the plate current flows during 180 electrical degrees of the cycle.

The characteristics of a Class B amplifier are medium efficiency and output. 13-202

CLASS BC AMPLIFIER: An amplifier in which the grid bias and the exciting grid voltage are such that the plate current flows during less than 180 electrical degrees but yet for a considerable part of the cycle.

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DEFINITIONS

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The characteristics of a Class BC amplifier are efficiency and output intermediate to those of a Class B and a Class amplifier. Class BC amplifiers are not in general use.

CLASS C AMPLIFIER: An amplifier in which the grid bias is appreciably beyond the cut-off so that the plate current in each tube is zero when no exciting grid voltage is present, and so that the plate current flows in each tube for appreciably less than one half of each cycle when an exciting grid voltage is present.

Class C amplifiers find application where high plate-circuit efficiency is a paramount requirement and where departures from linearity between input and output are permissible.

The characteristics of a Class C amplifier are high plate-circuit efficiency and high power output. 13-203

CONVERSION TRANSCONDUCTANCE (s_c) is a characteristic associated with the mixer (first detector) function of tubes and may be defined as the ratio of the intermediate-frequency (i-f) current in the primary of the i-f transformer to the applied radio-frequency (r-f) voltage producing it; or more precisely, it is the limiting value of this ratio as the r-f voltage and i-f current approach zero.

When the performance of a frequency converter is determined, conversion transconductance is used in the same way as mutual conductance is used in single-frequency amplifier computations.

DIRECT CAPACITANCE is the quotient of the charge, produced on one conductor by the voltage between it and another conductor, by this voltage, all other conductors in the neighborhood being at the potential of one of the conductors. 7-012

INPUT CAPACITANCE of a vacuum tube is the direct capacitance between the control grid and the cathode, together with such other electrodes as are ordinarily operated at the same signal-frequency potential as the cathode. 13-060

MAXIMUM PEAK INVERSE VOLTAGE is the highest peak voltage that a rectifier tube can safely stand in the direction opposite to that in which it is designed to pass current. In other words, it is the safe arc-back limit with the tube operating within the specified temperature range. The relations between peak inverse voltage, RMS value of a-c input voltage, and d-c output voltage depend largely on the individual characteristics of the rectifier circuit and the power supply. The presence of line surges, keying surges, or

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DEFINITIONS

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any other transient, or wave-form distortion may raise the actual peak voltage to a value higher than that calculated for sine-wave voltages. Therefore, the *actual* inverse voltage, and not the calculated value, should be such as not to exceed the rated maximum peak inverse voltage for the rectifier tube. A cathode-ray oscillograph or a spark gap connected across the tube is useful in determining the actual peak inverse voltage. In single-phase, full-wave circuits with sine-wave input, the peak inverse voltage on a rectifier tube is approximately 1.4 times the RMS value of the plate-to-plate voltage applied to the tubes. In single-phase, half-wave circuits with sine-wave input and with condenser input to the filter, the peak inverse voltage may be as high as 2.8 times the RMS value of the applied plate voltage. In polyphase circuits, the peak inverse voltage must be calculated for the individual case.

MAXIMUM PEAK PLATE CURRENT is the highest peak current that a rectifier tube can safely stand in the direction in which it is designed to pass current. The safe value of this peak current in hot-cathode types of rectifiers is a function of the electron emission available and the duration of the pulsating current flow from the rectifier tube during each half cycle. In a given circuit, the value of peak plate current is largely determined by filter constants. If a large choke is used in the filter circuit next to the rectifier tube(s), the peak plate current is not much greater than the load current; but if a large condenser is used in the filter next to the rectifier tube(s), the peak current is often many times the load current. In order to determine accurately the peak current in any circuit, the best procedure usually is to measure it with a peak-indicating meter or to use an oscillograph.

MODULATION FACTOR is the ratio of the maximum departure (positive or negative) of the envelope of a modulated wave from its unmodulated value to its unmodulated value.

NOTE: In linear modulation the average amplitude of the envelope is equal to the amplitude of the unmodulated wave provided there is no zero-frequency component in the modulating-signal wave. For modulated-signal waves having unequal positive and negative peak values, both modulation factors must be given separately.

4-C09

MUTUAL CONDUCTANCE (g_m), or CONTROL-GRID—PLATE TRANSCONDUCTANCE (s_m) is the name for the plate current to

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DEFINITIONS

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control-grid voltage transconductance. Symbolically,

$$g_m \equiv s_m \equiv s_{pg} = [\frac{\partial i_p}{\partial e_g}] \; e_p \text{ constant}$$

See Transconductance.

OUTPUT CAPACITANCE of a vacuum tube is the direct capacitance between the output electrodes (usually the plate and the cathode) together with such other electrodes as are ordinarily operated at the same signal-frequency potential as the cathode. 13-061

PLATE RESISTANCE is the ratio of a change in plate voltage to the change in plate current produced thereby, all other electrode voltages being maintained constant. As most precisely used, the term refers to infinitesimal changes as indicated by the defining equation,

$$r_p = \frac{\partial e_p}{\partial i_p}$$

POWER AMPLIFICATION is the ratio of the power delivered by the output circuit of an amplifier, or other four-terminal network containing a source of local power, to the power supplied to its input circuit. 3-004

TRANSCONDUCTANCE is the ratio of the change in the current in the circuit of an electrode to the change in the voltage on another electrode, under the condition that all other voltages remain unchanged. As most precisely used, the term refers to infinitesimal changes as indicated by the defining equation,

$$s_{jk} = [\frac{\partial i_j}{\partial e_k}] \; e \text{ constant}$$

13-046

UNDISTORTED POWER OUTPUT of a vacuum tube is defined as the power output into a resistance load under the conditions that the total generated harmonics with a sinusoidal excitation voltage shall not exceed five per cent.

VOLTAGE AMPLIFICATION is the ratio of the signal voltage available at the output terminals of an amplifier, transformer, or other four-terminal network, to the signal voltage impressed at the input terminals. 3-002

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TYPES OF CATHODES

THORIATED-FILAMENT TYPES

Certain tubes have thoriated-tungsten filaments. These are designed with current and voltage ratings in accordance with the service expected of the particular type.

The operating life of the thoriated-filament types is ordinarily ended by a decrease in electron emission. Decreased emission, however, may be caused by the accidental application of too high filament or plate voltage. If the over-voltage has not been continued for a long time, the activity of the filament can often be restored as follows:

Receiving-Tube Types - Operate the filament at its normal voltage for 10 to 20 minutes without plate, grid, or screen voltage. If this is not effective in restoring the emission, the filament should be flashed at 300% of normal voltage for 30 seconds to 1 minute and then seasoned at 150% of normal voltage for 10 minutes. No plate, grid, or screen voltage is used during these operations. Since reactivation of the filament by the latter method involves higher voltages than normal, it is very important to set these filament voltages at the correct values if reactivation is to be accomplished. Even with careful adjustments, the filaments occasionally will burn out during the process.

Transmitting-Tube Types - Operate the filament at its normal voltage for 10 minutes or longer without plate, grid, or screen voltage. The reactivation process may be accelerated by raising the filament voltage to not higher than 120% of normal value for a few minutes.

These reactivation schedules are often effective in restoring the emission of thoriated-filament tubes which have failed after normal service. Sometimes a few hundred hours of additional life may be obtained after reactivation.

COATED-FILAMENT and HEATER-CATHODE TYPES

The coated-filament types employ a coating of alkaline-earth compounds on a metallic base as a source of electronic emission. The metallic base carries the heating current. For proper performance of these types, rated filament voltage should be applied at the filament terminals.

Separate and distinct from these types are the unipotential-cathode types. These employ a metallic sleeve within which is an electrically insulated heater element or filament that carries the heating current. The sleeve known as the cathode, is coated with alkaline-earth compounds and serves as the source of electronic emission.

Both the coated-filament and heater-cathode types after having given normal service or after having been oper-

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TYPES OF CATHODES

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ated at excessive voltages, may become inoperative due to loss of emission. When such is the case, the usefulness of these types may be considered as terminated.

TUNGSTEN-FILAMENT TYPES

Certain tubes, especially those for high-voltage transmitting applications, have pure tungsten filaments. These are designed with voltage and current ratings in accordance with the service expected of the particular type.

Since tungsten filaments must be operated at high temperature, their operating life is determined by the rate of tungsten evaporation. Failure of the filament, therefore, occurs through decreased emission or burn-out.

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