Westinghouse

AUDIO
ULTRASONIC
R. F. HEATING
COMMUNICATION
TUBES

WESTINGHOUSE ELECTRIC CORPORATION
ELECTRONIC TUBE DIVISION
ELMIRA • NEW YORK

THE WESTINGHOUSE ELECTRONIC TUBE DIVISION

Westinghouse has manufactured and developed electronic tubes for over thirty years as a part of the Corporation's Lamp Division in Bloomfield, New Jersey. In 1951, the Electronic Tube Division was created by the building of separate facilities in Elmira and Bath, New York. In addition to an expanded manufacturing area, these two plants provided Westinghouse with the latest in manufacturing and laboratory facilities.

In this expansion program, engineering has played an important part. Each engineering section, representing a particular family of tubes, has its own laboratory for the development of new tube types.

Out of these facilities have come the families of tubes which will be described in the following pages. These examples have been selected because of their noteworthy characteristics and because they are typical of the important contributions Westinghouse has made to the electronics industry.

Westinghouse Electronic Tube Division is proud of it's complete line of audio, communications, ultrasonic, and R.F. tubes. As the bar charts following this page indicate, we have complete coverage for every application in both liquid and air cooled tubes.

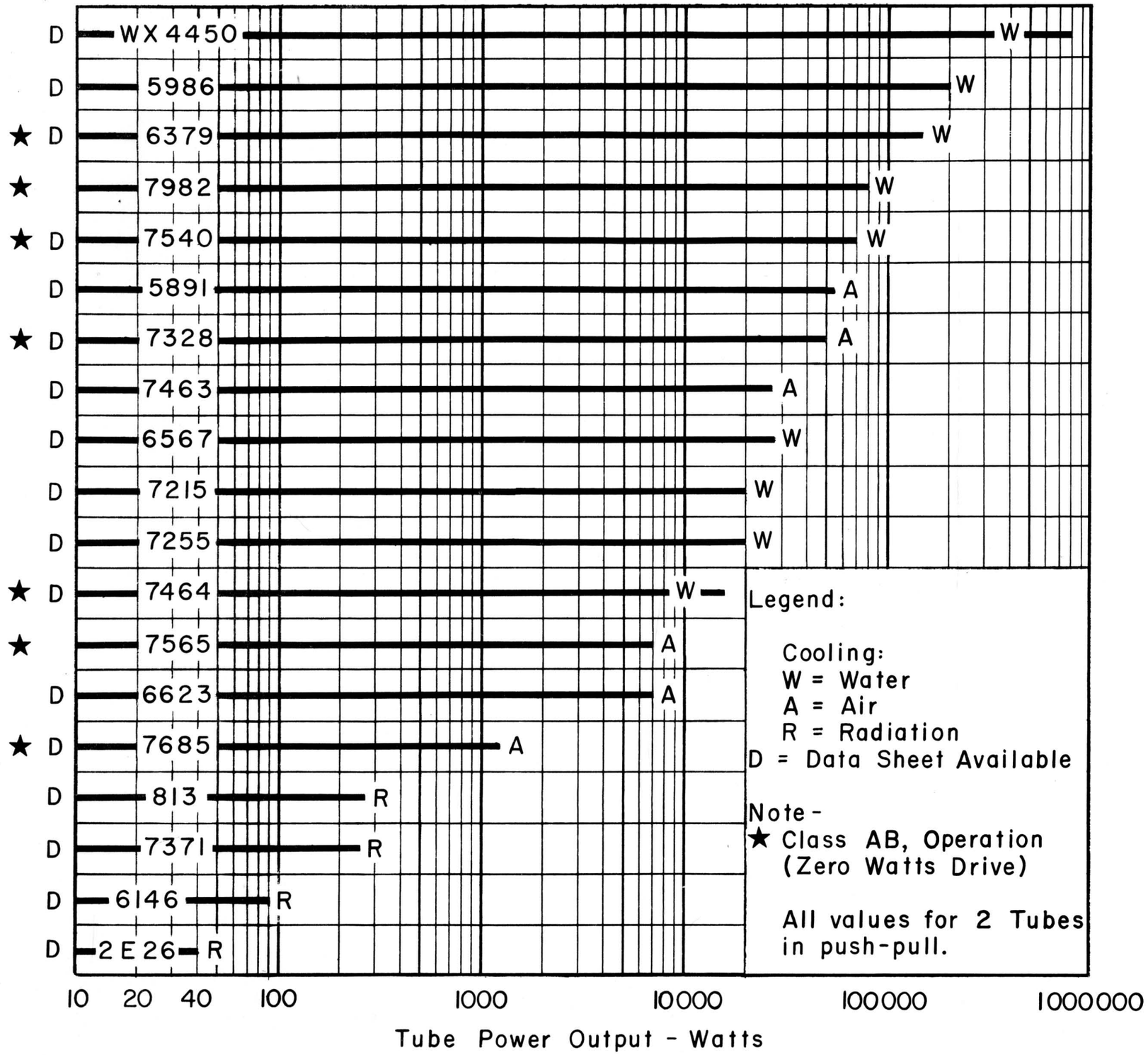
Westinghouse has been a pioneer in high vacuum tubes and has a long history of dependable service in broadcast and R.F. heating applications. Many of the original Westinghouse design tubes are still in continuous service.

This catalog is being sent to you and your name retained on our mailing list to receive all new data sheets and additional data on existing tubes as it becomes available.

For additional information on these tubes, or special tubes for your application, contact the nearest Westinghouse Electronic Tube Sales Engineering Office.

TUBES FOR AUDIO AND ULTRASONICS

(CLASS B or AB)



WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK

TUBES FOR RADIO COMMUNICATIONS

D	WX 4361	25 MC	W	
D	WX 4450	20 MC	W	
D	5986	20 MC	W	
D	5891	10 MC	A	
D	7748	30 MC	W	
	8044	30 MC	A	
D	6567	60 MC	W	
D	WX4276	60 MC	A	
D	7215	30 MC	W	
D	7463	60 MC	A	
D	5736	60 MC	A	
D	6623	60 MC	A	
D	7604	60 MC	A	
D	813	30 MC	R	
D	7371	150 MC	R	
D	6159 6146 6883	75 MC	R	
D	2E26 6893	125 MC	R	

10 20 40 100 1000 10000 100000 1000000

Tube Power Output - Watts

Anode Cooling Code:

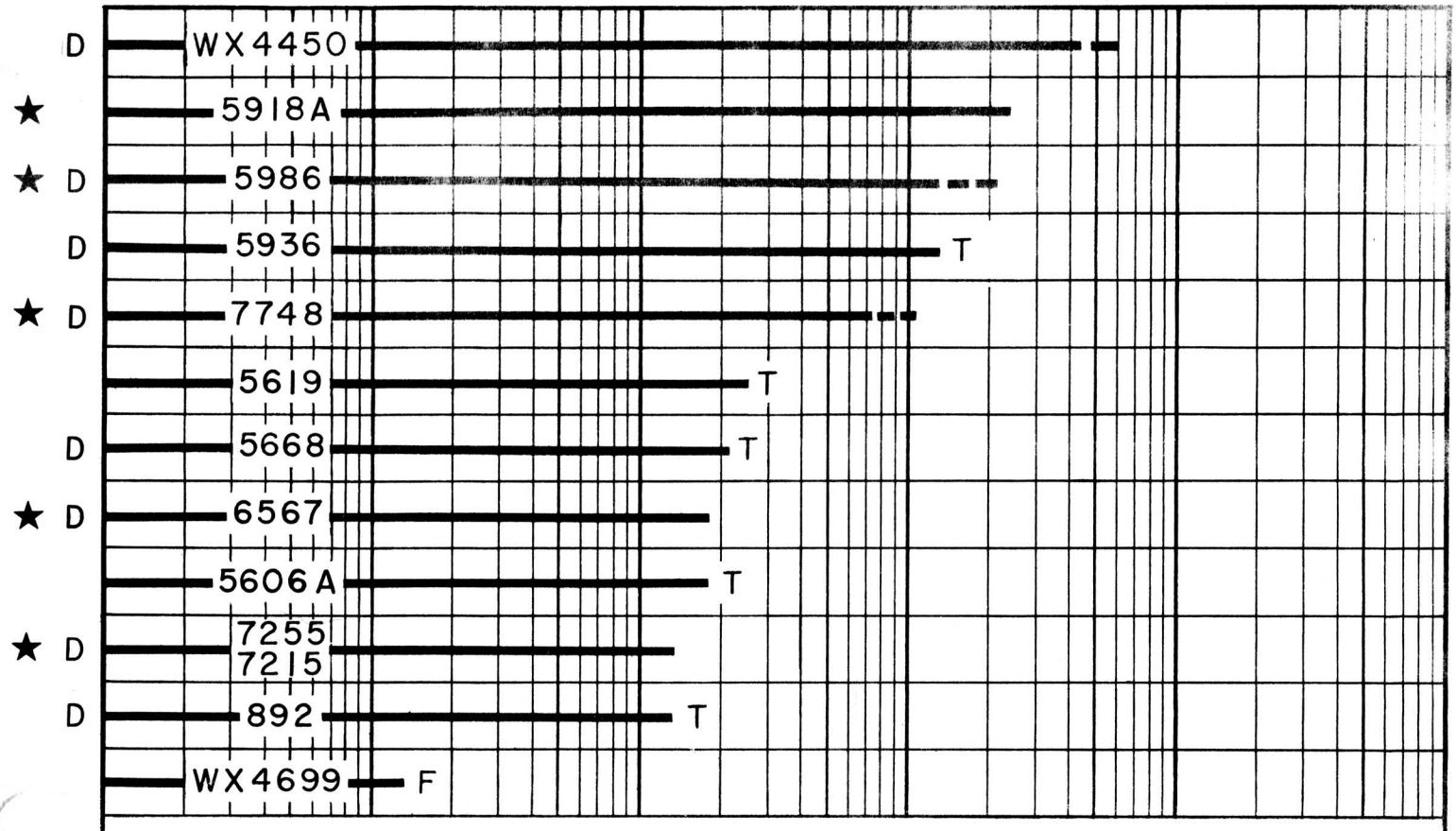
W = Water
A = Forced Air
R = Radiation

D = Data Sheet Available

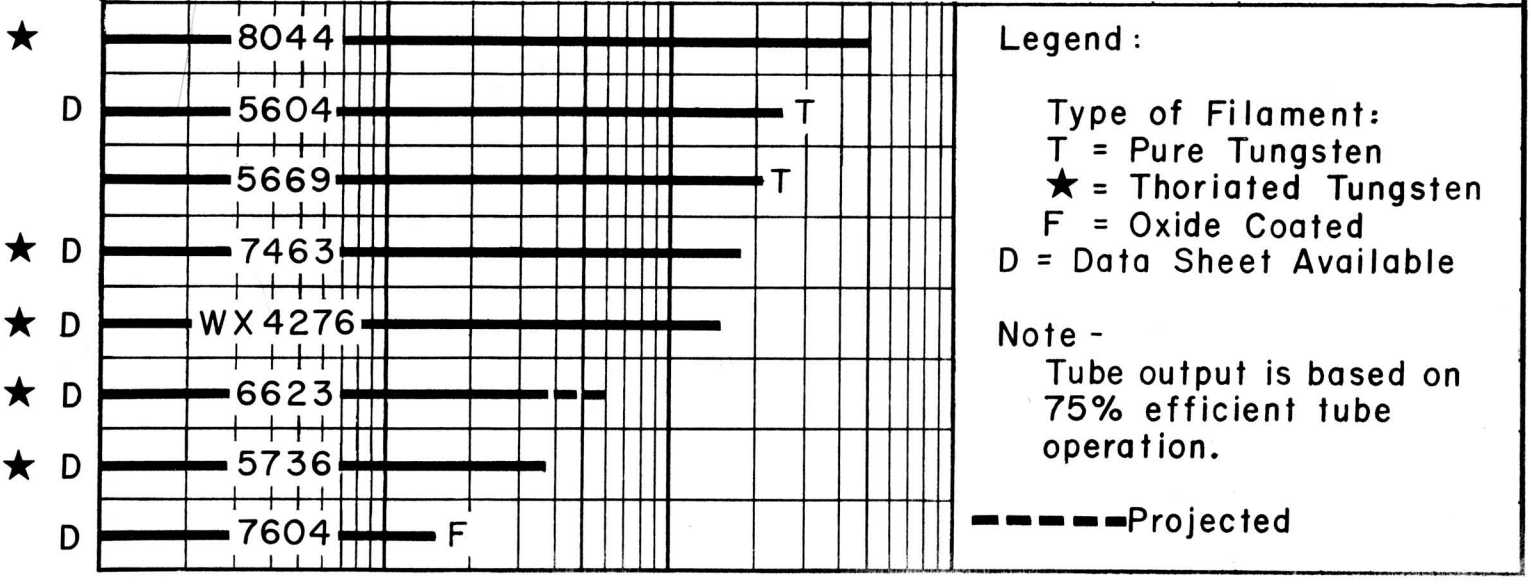
Note:

Power output rated for 1.0 modulation factor, plate modulation Class C. Frequency listed is for maximum operation. Reduced rating are available for higher frequencies.

WATER COOLED TUBES FOR R.F. HEATING SERVICE



FORCED AIR COOLED TUBES FOR R.F. HEATING SERVICE



Legend:

Type of Filament:
T = Pure Tungsten
★ = Thoriated Tungsten
F = Oxide Coated
D = Data Sheet Available

Note -
Tube output is based on 75% efficient tube operation.

▬ ▬ ▬ ▬ Projected

0.1 1.0 10 100 1000

Tube Power Output - Kilowatts
(See Note)

INDEX TO
WESTINGHOUSE HIGH VACUUM AMPLIFIERS
January 1965

August 15, 1960

VHF BEAM-POWER TYPES 2E26 AND 6893

The 2E26 and 6893 are octal based beam-power pentode type tubes. They are designed for service as very-high-frequency amplifiers or oscillators. They may also be used as audio amplifiers or modulators. Their small size makes them ideal for compact mobile and stationary communications equipment. These types are characterized by high power sensitivity, low plate and grid 2 voltages and low driving power.

The cathode and grid 3 are connected to an internal shield and three base pins. These connections make possible an effective radio frequency ground. A T-9 bulb and a short internal lead button stem contribute to cooler operation and longer life. The short metal sleeve around the base provides shielding for the input. The top-cap plate connection isolates the input circuit from the output circuit. The top-cap is skirted to secure a better bond with the envelope and to increase its heat dissipation capabilities.

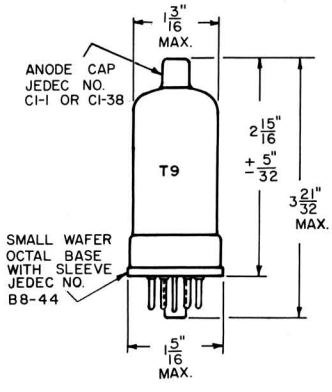
The 2E26 has a conventional 6.3 volt heater. The 6893 has a 12.6 volt heater and is intended for service in vehicles with a 12 volt storage battery.

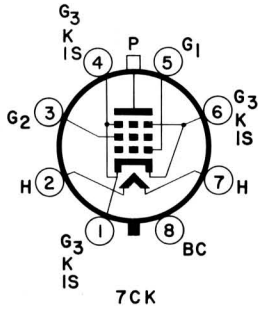
ELECTRICAL:

Cathode	Coated Unipotential		
Heater:	2E26	6893	
Voltage (ac or dc)	6.3	12.6	Volts
Current	0.8	0.4	Ampere
Direct Interelectrode Capacitances: (Unshielded)			
Grid 1 to Plate	0.20 max.		μμf
Input	13.0		μμf
Output	7.0		μμf

MECHANICAL:

Bulb	T-9
Base	Small Wafer Octal with Sleeve (JEDEC B8-44)
Basing	7CK
Top Cap	Small (JEDEC C1-1) or Small Skirted (JEDEC C1-38)
Mounting Position	Any
Max. Bulb Temperature at Hottest Point	210° C





CLASS AB1 OPERATION⊕

MAXIMUM RATINGS

Absolute Maximum Values	CCS▲	ICAS★	
DC Plate Voltage	600	750 max.	Volts
DC Grid 2 Voltage	250	250 max.	Volts
DC Plate Current§	75	75 max.	Ma.
DC Plate Power Input§	30	37.5 max.	Watts
DC Grid 2 Power Input§	2.5	2.5 max.	Watts
Plate Dissipation	10	12.5 max.	Watts
Peak Heater-Cathode Voltage:			
Heater Positive with Respect to Cathode	100	100 max.	Volts
Heater Negative with Respect to Cathode	100	100 max.	Volts
Grid 1 Circuit Resistance:			
With Fixed Bias	30000	30000 max.	Ohms
With Cathode-Resistor Bias		Not Recommended	

TYPICAL OPERATING CHARACTERISTICS

Two Tubes in Push-Pull	CCS▲	ICAS★	
Plate Voltage	500	700	Volts
Grid 2 Voltage■	250	235	Volts
Grid 1 Voltage (Fixed Bias)	−40	−40	Volts
Peak Signal Grid 1-to-Grid 1 Voltage●	70	72	Volts
Peak Signal Driving Power●	0	0	Watts
Plate Current:			
Zero Signal	13	12	Ma.
Max. Signal	120	110	Ma.
Grid 2 Current:			
Max. Signal	10	10	Ma.
Plate-to-Plate Load Resistance	8650	14100	Ohms
Peak Signal Power Output	40	50	Watts

CLASS AB_2 OPERATION□

MAXIMUM RATINGS

Absolute Maximum Values	CCS▲	ICAS★		
DC Plate Voltage	600	750	max.	Volts
DC Grid 2 Voltage	250	250	max.	Volts
DC Plate Current	75	75	max.	Ma.
DC Plate Power Input	30	37.5	max.	Watts
DC Grid 2 Power Input	2.5	2.5	max.	Watts
Plate Dissipation	10	12.5	max.	Watts
Peak Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode	100	100	max.	Volts
Heater Positive with Respect to Cathode	100	100	max.	Volts
Grid 1 Circuit Resistance:				
With Fixed Bias	30000	30000	max.	Ohms
With Cathode-Resistor Bias		Not Recommended		

TYPICAL OPERATING CHARACTERISTICS

Two Tubes in Push-Pull	CCS▲	ICAS★	
Plate Voltage	400	500	Volts
Grid 2 Voltage	125	125	Volts
Grid 1 Voltage (Fixed Bias)	−15	−15	Volts
Peak Signal Grid 1-to-Grid 1 Voltage●	60	60	Volts
Peak Signal Driving Power●	0.36	0.36	Watts
Plate Current:			
Zero Signal	20	22	Ma.
Max. Signal	150	150	Ma.
Grid 2 Current:			
Max. Signal	32	32	Ma.
Plate-to-Plate Load Resistance	6200	8000	Ohms
Peak Signal Power Output	42	54	Watts

PLATE MODULATED CLASS C TELEPHONY
MAX. MODULATION FACTOR OF 1.0

MAXIMUM RATINGS:

Absolute Maximum Values	CCS▲	ICAS★		
DC Plate Voltage	400	500	max.	Volts
DC Grid 2 Voltage	200	200	max.	Volts
DC Grid 1 Voltage	−175	−175	max.	Volts
DC Plate Current	60	70	max.	Ma.
DC Grid 1 Current	3.5	3.5	max.	Ma.
DC Plate Power Input	20	27	max.	Watts
DC Grid 2 Power Input	1.7	2.3	max.	Watts
Plate Dissipation	6.7	9	max.	Watts
Peak Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode	100	100	max.	Volts
Heater Positive with Respect to Cathode	100	100	max.	Volts
Grid 1 Circuit Resistance♦:				
Operated at Max. Ratings	30000	30000	max.	Ohms
Operated below Max. Ratings	100000	100000	max.	Ohms

TYPICAL OPERATING CHARACTERISTICS

	CCS▲	ICAS★	
Plate Voltage	400	500	Volts
Grid 2 Voltage◈	160	180	Volts
Grid 2 Series Resistor◈	32000	35500	Ohms
Grid 1 Voltage†	−50	−50	Volts
Grid Resistor†	20000	20000	Ohms
Peak RF Driving Signal:			
Voltage	60	60	Volts
Power	0.15	0.4	Watt
Plate Current	50	54	Ma.
Grid 2 Current	7.5	9	Ma.
Grid 1 Current	2.5	2.5	Ma.
Power Output	13.5	18	Watts

CONTINUOUS WAVE CLASS C TELEGRAPHY
AND
FREQUENCY MODULATED CLASS C TELEPHONY

MAXIMUM RATINGS

Absolute Maximum Values	CCS▲	ICAS★		
DC Plate Voltage	500	600	max.	Volts
DC Grid 2 Voltage◈	200	200	max.	Volts
DC Grid 2 Key-Up Voltage	600	600	max.	Volts
DC Grid 1 Voltage	−175	−175	max.	Volts
DC Plate Current	75	85	max.	Ma.
DC Grid 1 Current	3.5	3.5	max.	Ma.
DC Plate Power Input	30	40	max.	Watts
DC Grid 2 Power Input	2.5	2.5	max.	Watts
Plate Dissipation	10	13.5	max.	Watts
Peak Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode	100	100	max.	Volts
Heater Positive with Respect to Cathode	100	100	max.	Volts
Grid 1 Circuit Resistance♦:				
Operated at Max. Ratings	30000	30000	max.	Ohms
Operated below Max. Ratings	100000	100000	max.	Ohms

TYPICAL OPERATING CHARACTERISTICS

Frequencies up to 125 Megacycles	CCS▲		ICAS★	
Plate Voltage	400	500	600	Volts
Grid 2 Voltage◈	190	185	185	Volts
Grid 2 Series Resistor	19000	28500	41500	Ohms
Grid 1 Voltage	−30	−40	−45	Volts
From Grid Resistor of	10000	13500	15000	Ohms
Peak RF Driving Signal:				
Voltage	41	50	57	Volts
Power	0.12	0.15	0.17	Watts
Plate Current	75	60	66	Ma.
Grid 2 Current	11	11	10	Ma.
Grid 1 Current	3	3	3	Ma.
Power Output	20	20	27	Watts

TYPICAL OPERATING CHARACTERISTICS

160 Megacycle Amplifier	CCS▲	ICAS★	
Plate Voltage	300	350	Volts
Grid 2 Voltage◈	170	200	Volts
Grid 2 Series Resistor	21500	21500	Ohms
Grid 1 Voltage	−75	−90	Volts
From Grid Resistor of	30000	30000	Ohms
Peak RF Driving Signal:			
Voltage	85	105	Volts
Power	1.5	2	Watts
Plate Current	75	85	Ma.
Grid 2 Current	6	7	Ma.
Grid 1 Current	2.5	3	Ma.
Power Output	13	16.5	Watts

CHARACTERISTICS RANGE VALUES
FOR EQUIPMENT DESIGN

	2E26	6893	
Heater Voltage	6.3	12.6	ac Volts
Heater Current:			
Minimum	0.74	0.37	Ampere
Maximum	0.86	0.43	Ampere
Grid 1 Plate Capacitance:			
Maximum	0.20		μμf
Input Capacitance:			
Minimum	11.6		μμf
Maximum	14.0		μμf
Output Capacitance:			
Minimum	6.4		μμf
Maximum	8.0		μμf

	Amplifier	Oscillator‡	
Plate Volts	200	500	Volts
Grid 2 Volts	135	200	Volts
Grid 1 Volts	−10	--	Volts
Grid 1 Resistor	--	15000 ± 10%	Ohms
Plate Current:			
Maximum	47	60	Ma.
Minimum	23	100	Ma.
Grid 2 Current:			
Maximum	4	--	Ma.
Grid 1 Current:			
Maximum	--	2.2	Ma.
Minimum	--	1.8	Ma.
Power Output:			
Minimum	--	18	Watts

⊕ Subscript 1 indicates that no grid current flows during any part of the input cycle.

▲ Continuous Commercial Service.

★ Intermittent Commercial and Amateur Service.

♦ The input-coupling network used should not introduce too much resistance in the grid 1 circuit. Transformer or impedance coupling arrangements are recommended.

● The driving stage should be capable of supplying these values of voltage and power at low distortion.

■ The grid 2 voltage should not change with power supply load. A separate power supply or independent voltage-divider voltage source is recommended. In applications requiring the use of screen voltages above 135 volts, provision should be made for the adjustment of grid 1 bias for each tube separately. The necessity for this adjustment at the lower screen voltages depends on the distortion requirements and on whether the plate dissipation rating is exceeded at zero-signal plate current.

§ Averaged over any audio-frequency cycle of sine-wave form.

□ Subscript 2 indicates grid 1 draws current during some part of the input cycle.

♦ When grid 1 is driven positive and draws current the listed values must not be exceeded. If these values are insufficient to provide proper operating bias, other biasing methods must be used to provide the required extra bias without increasing grid 1 circuit resistance.

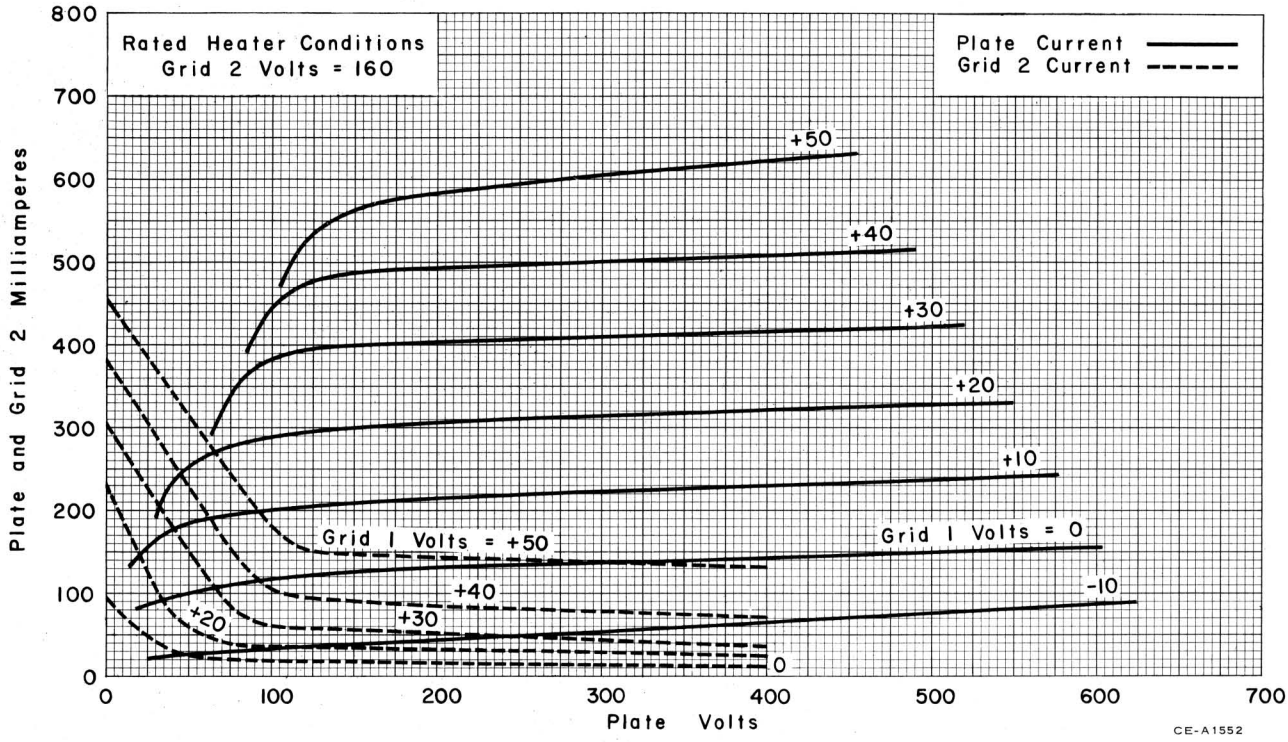
◈ It is recommended that the screen voltage be modulated with the plate voltage. This can be accomplished by an independent modulated power supply or a series resistor from the plate voltage supply.

† The grid 1 bias should be generated by either grid resistor or combination grid resistor and cathode-bias resistor methods.

‡ Operated as a single tube self excited 15 Mc. Oscillator.

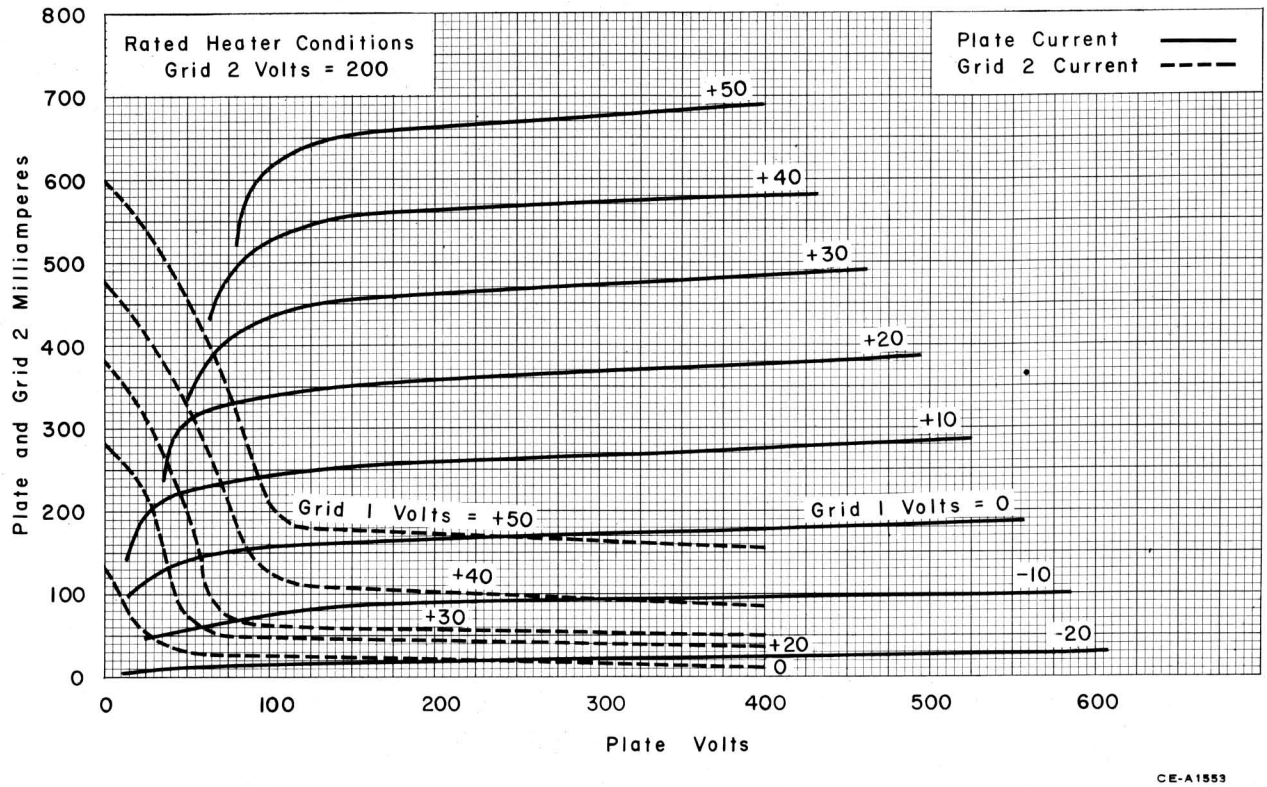
◈ The grid 2 voltage should not change with power supply load. A separate power supply or independent voltage-divider voltage source should be used. A series voltage-dropping grid 2 resistor should not be used in keyed circuits.

AVERAGE PLATE CHARACTERISTICS



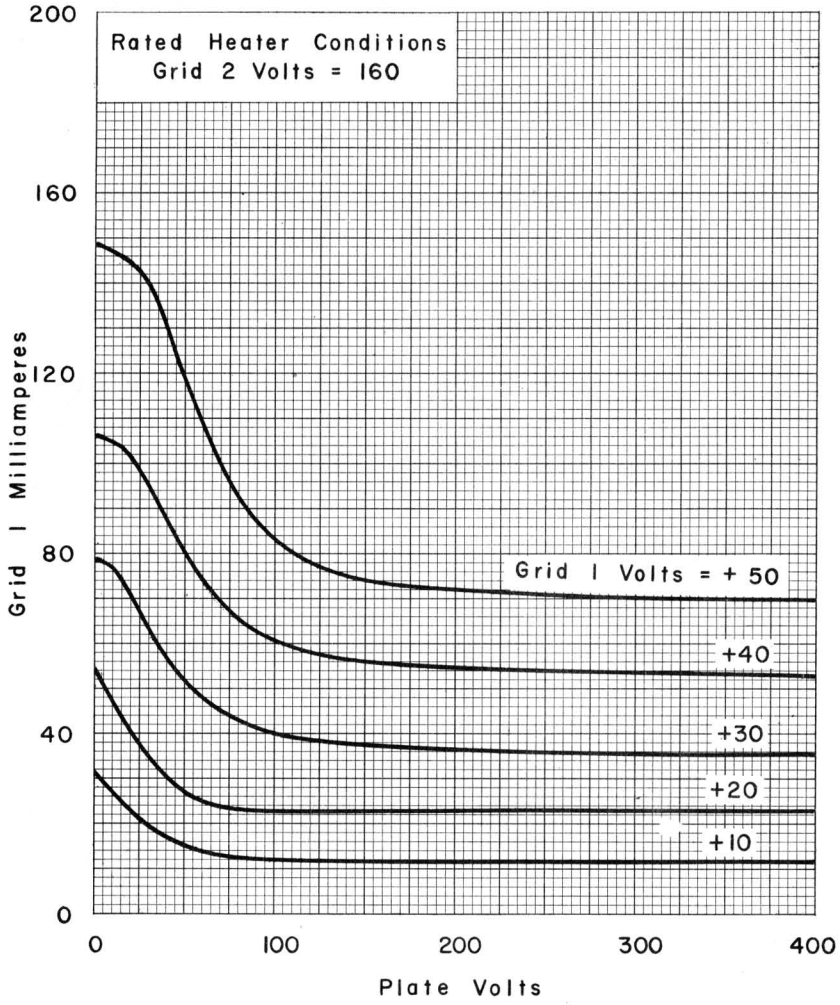
CE-A1552

AVERAGE PLATE CHARACTERISTICS



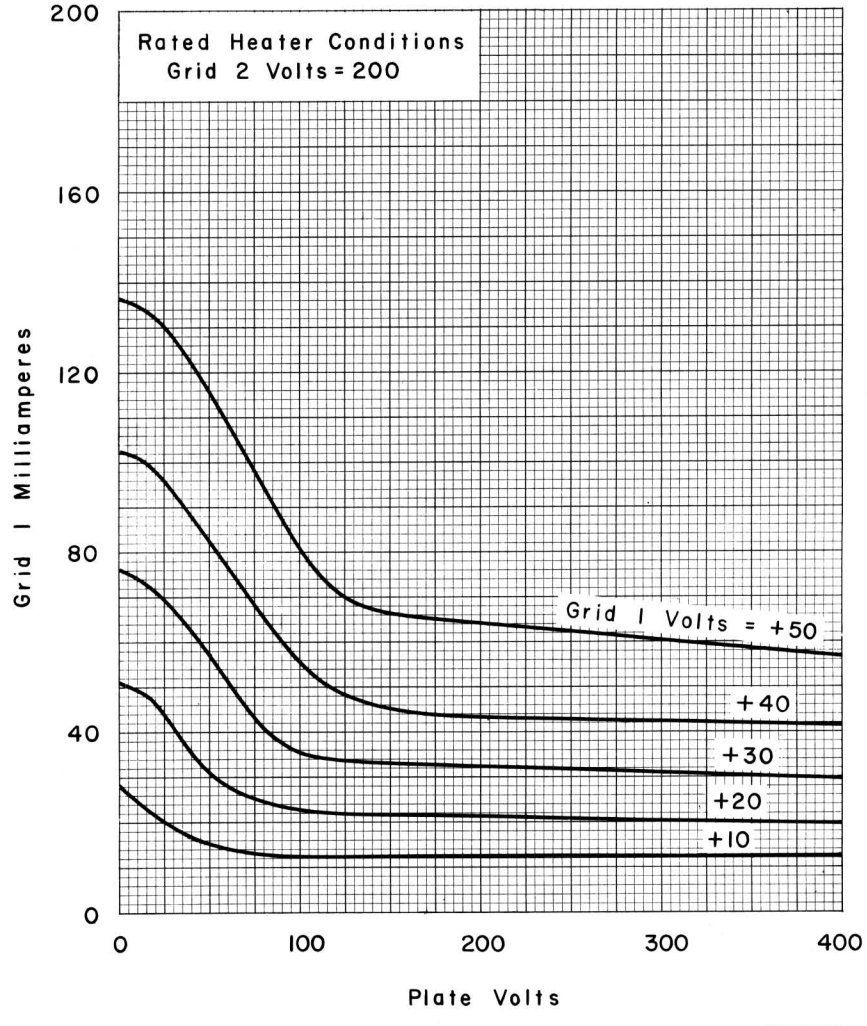
CE-A1553

TYPICAL GRID I CHARACTERISTICS



CE-A1555

TYPICAL GRID 1 CHARACTERISTICS



CE-A1554

HIGH-VACUUM AMPLIFIER TYPE 813

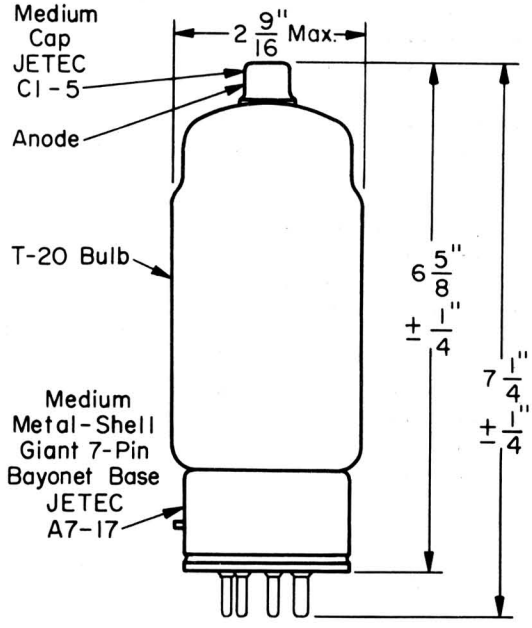
The 813 is a five-electrode beam-power transmitting tube of high sensitivity, designed for use as a modulator, amplifier, and oscillator. The anode is capable of dissipating 125 watts. The cathode is a thoriated-tungsten filament. Maximum ratings apply up to a frequency of 30 megacycles. Cooling is obtained by radiation. For continuous commercial service the output for Class C telegraph service is 275 watts. With adequately shielded circuits neutralization is unnecessary.

GENERAL DATA

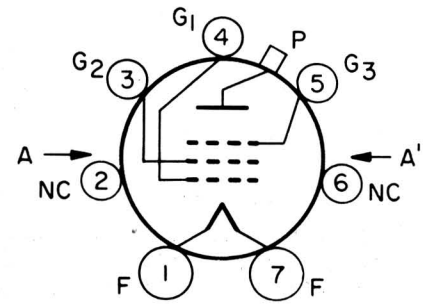
Electrical	Minimum	Bogey	Maximum	
Filament Voltage	9.5	10	10.5	volts
Filament Current at Bogey Voltage	4.7	5	5.3	amp
Transconductance, I_p = 50 ma, E_b = 2000V, G_2 = 400V	-	3750	-	μmhos
Amplification Factor, G_1 to G_2 (Mu), E_b = 2000 Vdc, I_b = 50 ma, G_2 = 400V	-	8.5	-	
Interelectrode Capacitances, measured without external shielding				
G_1 to Plate	-	-	0.25	μμf
Input, G_1 to filament, G_2, and G_3	13	16.3	19.6	μμf
Output, plate to filament, G_2, and G_3	10.5	14.0	17.5	μμf

Mechanical

Mounting Position	Vertical, base up or down. Horizontal, plate in vertical plane.	
Basing	JETEC	5BA
Cap, medium	JETEC	C1-5
Base, medium metal-shell, giant 7-pin bayonet	JETEC	A7-17
Bulb		T-20
Net Weight, approximate	8	oz
Shipping Weight	2.5	lbs



CE-A1086



AA' = Plane of Electrodes

JETEC 5BA

BASE CONNECTIONS

F-Filament
G_1-Control Grid
G_2-Screen Grid
G_3-Suppressor Grid
P-Plate & Anode
NC-No Connection

CE-A1087

Supersedes WL-813 Data Sheet Dated March 15, 1947

High-Vacuum Amplifier Section

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR - CLASS AB_1

Maximum Ratings, Absolute Values	CCS[1]	ICAS[2]	
DC Plate Voltage, maximum	2250	2500	volts
DC Grid No. 2 Voltage, maximum[3]	1100	1100	volts
Maximum DC Plate Current, maximum signal[3]	180	225	ma
Maximum Plate Input, maximum signal[3]	360	450	watts
Maximum Grid No. 2 Input, maximum signal[3]	22	22	watts
Plate Dissipation, maximum[3]	100	125	watts

Typical Operation, for two tubes, unless otherwise specified	CCS[1]			ICAS[2]	
DC Plate Voltage	1500	2000	2250	2500	volts
DC Grid No. 3 Voltage	0	0	0	0	volts
DC Grid No. 2 Voltage	750	750	750	750	volts
DC Grid No. 1 Voltage	-85	-90	-95	-95	volts
Peak Audio-Frequency G_1 to G_1 Voltage	160	160	170	180	volts
Zero-Signal DC Plate Current	50	50	50	50	ma
Maximum Signal DC Plate Current	305	265	255	290	ma
Zero Signal DC Grid No. 2 Current	2	2	2	2	ma
Maximum Signal DC Grid No. 2 Current	45	43	53	54	ma
Effective Load Resistance (plate to plate)	9300	16000	20000	19000	ohms
Maximum Signal Driving Power[4]	0	0	0	0	watts
Maximum Signal Power Output	260	335	380	490	watts

RADIO-FREQUENCY POWER AMPLIFIER - CLASS B TELEPHONY

Carrier conditions per tube for use with a maximum modulation factor of 1.0

Maximum Ratings, Absolute Values	CCS[1]	ICAS[2]	
DC Plate Voltage, maximum	2000	2250	volts
DC Grid No. 2 Voltage, maximum	400	400	volts
DC Plate Current, maximum	100	125	ma
Plate Input, maximum	150	200	watts
Grid No. 2 Input, maximum	15	20	watts
Plate Dissipation, maximum	100	125	watts

Typical Operation	CCS[1]		ICAS[2]	
DC Plate Voltage	1500	2000	2250	volts
DC Grid No. 3 Voltage	0	0	0	volts
DC Grid No. 2 Voltage	400	400	400	volts
DC Grid No. 1 Voltage	-60	-75	-60	volts
Peak R-F Grid No. 1 Voltage	70	80	70	volts
DC Plate Current	100	75	85	ma
DC Grid No. 2 Current	4	3	3	ma
DC Grid No. 1 Current, approximate[5]	-	-	-	ma
Driving Power, approximate[6,7]	-	-	-	watts
Power Output, approximate	50	50	70	watts

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER - CLASS C TELEPHONY

Carrier conditions per tube for use with a maximum modulation factor of 1.0

Maximum Ratings, Absolute Values	CCS[1]	ICAS[2]	
DC Plate Voltage, maximum	1600	2000	volts
DC Grid No. 2 Voltage, maximum	400	400	volts
DC Grid No. 1 Voltage, maximum	-300	-300	volts
DC Plate Current, maximum	150	200	ma
DC Grid No. 1 Current, maximum	25	30	ma
Plate Input, maximum	240	400	watts
Grid No. 2 Input, maximum	15	20	watts
Plate Dissipation, maximum	67	100	watts

Typical Operation	CCS[1]		ICAS[2]	
DC Plate Voltage	1250	1600	2000	volts
DC Grid No. 3 Voltage[8]	0	0	0	volts
DC Grid No. 2 Voltage	300	300	350	volts
From a series resistor of	27000	43000	41000	ohms
DC Grid No. 1 Voltage	-160	-160	-175	volts
From a grid resistor of	12500	13500	11000	ohms
Peak R-F Grid No. 1 Voltage	250	250	300	volts
DC Plate Current	150	150	200	ma
DC Grid No. 2 Current	35	30	40	ma
DC Grid No. 1 Current, approximate	13	12	16	ma
Driving Power, approximate	2.9	2.7	4.3	watts
Power Output, approximate	140	160	300	watts

GRID-MODULATED RADIO-FREQUENCY POWER AMPLIFIER - CLASS C TELEPHONY

Carrier conditions per tube for use with a maximum modulation factor of 1.0

Maximum Ratings, Absolute Values	CCS[1]	ICAS[2]	
DC Plate Voltage, maximum	2000	2250	volts
DC Grid No. 2 Voltage, maximum	400	400	volts
DC Grid No. 1 Voltage, maximum	-200	-200	volts
DC Plate Current, maximum	100	125	ma
Plate Input, maximum	150	200	watts
Grid No. 2 Input, maximum	15	20	watts
Plate Dissipation, maximum	100	125	watts

Typical Operation	CCS[1]		ICAS[2]	
DC Plate Voltage	1500	2000	2250	volts
DC Grid No. 3 Voltage[8]	0	0	0	volts
DC Grid No. 2 Voltage	400	400	400	volts
DC Grid No. 1 Voltage	-140	-120	-110	volts
Peak R-F Grid No. 1 Voltage	145	120	135	volts
Peak A-F Grid No. 1 Voltage	60	60	55	volts
DC Plate Current	70	75	85	ma
DC Grid No. 2 Current	3	3	2.5	ma
DC Grid No. 1 Current, approximate[9]	-	-	-	ma
Driving Power, approximate[6,10]	-	-	-	watts
Power Output, approximate	40	50	75	watts

RADIO-FREQUENCY POWER AMPLIFIER AND OSCILLATOR - CLASS C TELEGRAPHY

Key-down conditions per tube without amplitude modulation[11]

Maximum Ratings, Absolute Values	CCS[1]	ICAS[2]	
DC Plate Voltage, maximum	2000	2250	volts
DC Grid No. 2 Voltage, maximum	400	400	volts
DC Grid No. 1 Voltage, maximum	-300	-300	volts
DC Plate Current, maximum	180	225	ma
DC Grid No. 1 Current, maximum	25	30	ma
Plate Input, maximum	360	500	watts
Grid No. 2 Input, maximum	22	22	watts
Plate Dissipation, maximum	100	125	watts

Typical Operation	CCS[1]			ICAS[2]	
DC Plate Voltage	1250	1500	2000	2250	volts
DC Grid No. 3 Voltage[8]	0	0	0	0	volts
DC Grid No. 2 Voltage	300	300	400	400	volts
From a series resistor of	27000	40000	36000	46000	ohms
DC Grid No. 1 Voltage	-75	-90	-120	-155	volts
Peak R-F Grid No. 1 Voltage	160	175	205	275	volts
DC Plate Current	180	180	180	220	ma
DC Grid No. 2 Current	35	30	45	40	ma
DC Grid No. 1 Current, approximate	12	12	10	15	ma
Driving Power, approximate	1.7	1.9	1.9	4.0	watts
Power Output, approximate	170	210	275	375	watts

SELF-RECTIFYING OSCILLATOR OR AMPLIFIER - CLASS C

Maximum Ratings, Absolute Values	CCS[1]	
AC Plate Voltage, rms, maximum	2800	volts
AC Grid No. 2 Voltage, rms, maximum	550	volts
DC Grid No. 1 Voltage, maximum	-100	volts
DC Plate Current, maximum	95	ma
DC Grid No. 1 Current, maximum	10	ma
Plate Input, maximum	295	watts
Grid No. 2 Input, maximum	22	watts
Plate Dissipation, maximum	100	watts

Typical Operation	CCS[1]	
AC Plate Voltage, rms	2800	volts
DC Grid No. 3 Voltage	0	volts
AC Grid No. 2 Voltage, rms	530	volts
DC Grid No. 1 Voltage	-37	volts
From a grid resistor of	37000	ohms
DC Plate Current	95	ma
DC Grid No. 2 Current	12	ma
DC Grid No. 1 Current, approximate	1	ma
Driving Power, approximate[12]	1	watt
Power Output, approximate	230	watts
Useful Power Output, (approximate) 75% circuit efficiency	170	watts

FOOTNOTES

1. Constant commercial service.
2. Intermittent commercial and amateur service.
3. Averaged over any audio-frequency cycle of sine-wave form.

AMPLIFIER OR OSCILLATOR - CLASS C

With rectified, unfiltered, single-phase, full-wave plate supply

Maximum Ratings, Absolute Values	CCS[1]	
DC Plate Voltage, maximum	1800	volts
DC Grid No. 2 Voltage, maximum	360	volts
DC Grid No. 1 Voltage, maximum	-200	volts
DC Plate Current, maximum	190	ma
DC Grid No. 1 Current, maximum	22	ma
Plate Input, maximum[13]	360	watts
Grid No. 2 Input, maximum	22	watts
Plate Dissipation, maximum	100	watts

Typical Operation	CCS[1]	
DC Plate Voltage	1800	volts
DC Grid No. 3 Voltage	0	volts
DC Grid No. 2 Voltage	250	volts
DC Grid No. 1 Voltage	-120	volts
From a grid resistor of	10000	ohms
DC Plate Current	160	ma
DC Grid No. 2 Current	37	ma
DC Grid No. 1 Current, approximate	12	ma
Driving Power, approximate[14]	2	watts
Power Output, approximate	280	watts
Useful Power Output, (approximate) 75% circuit efficiency	210	watts

MAXIMUM RATINGS VERSUS FREQUENCY

NOTE: Maximum ratings apply up to 30 megacycles. The tube may be operated at higher frequencies provided the maximum values of plate voltage and power input are reduced according to the tabulation below (other maximum ratings are the same as shown above). Special attention should be given to adequate ventilation of the tube at these frequencies.

Frequency	30	45	60	120	mc
Maximum Permissible Percentage of Maximum Rated Plate Voltage and Plate Input					
Class B Telephony	100	93	88	76	percent
Class C Telephony					
Grid-Modulated	100	93	88	76	percent
Plate-Modulated	100	87	75	50	percent
Class C Telegraphy	100	87	75	50	percent
Class C, Self-Rectified Oscillator, Amplifier	100	87	75	50	percent
Class C, Separately-Rectified Oscillator, Amplifier	100	87	75	50	percent

FOOTNOTES

4. Driver stage should be capable of supplying the No. 1 grids of the class AB stage with the specified driving power at low distortion.
5. Usually negligible. Fixed supply or bypassed cathode resistor bias recommended.
6. At crest of audio frequency cycle with modulation factor of 1.0.
7. Usually negligible. Never more than two watts.
8. Suppressor should be connected to the mid-point of the filament circuit when operated on ac or to the negative end when operated on dc.
9. Usually negligible. Fixed supply or unbypassed cathode resistor bias recommended.

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Notes	Minimum	Maximum	
Plate Current	1,2	35	65	ma
Grid No. 2 Current	1,2	–	4	ma
Plate Current	1,3	–	2	ma
Power Output	1,4	198	–	watts

NOTE 1: DC filament volts = 10.0.

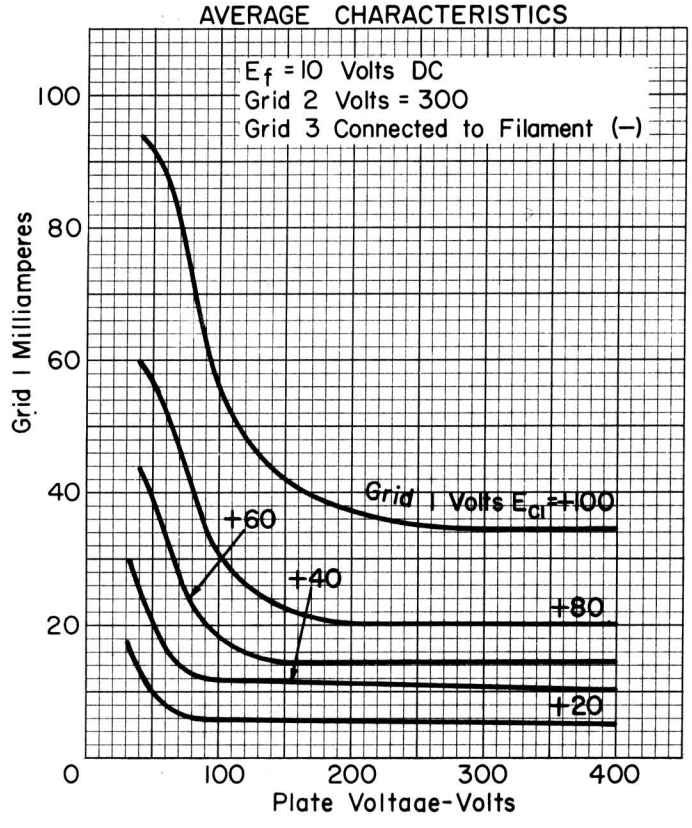
NOTE 2: With dc plate voltage of 2000 volts; dc grid No. 3 voltage = 0 volts; dc grid No. 2 voltage = 400 volts; dc grid No. 1 voltage = −35 volts.

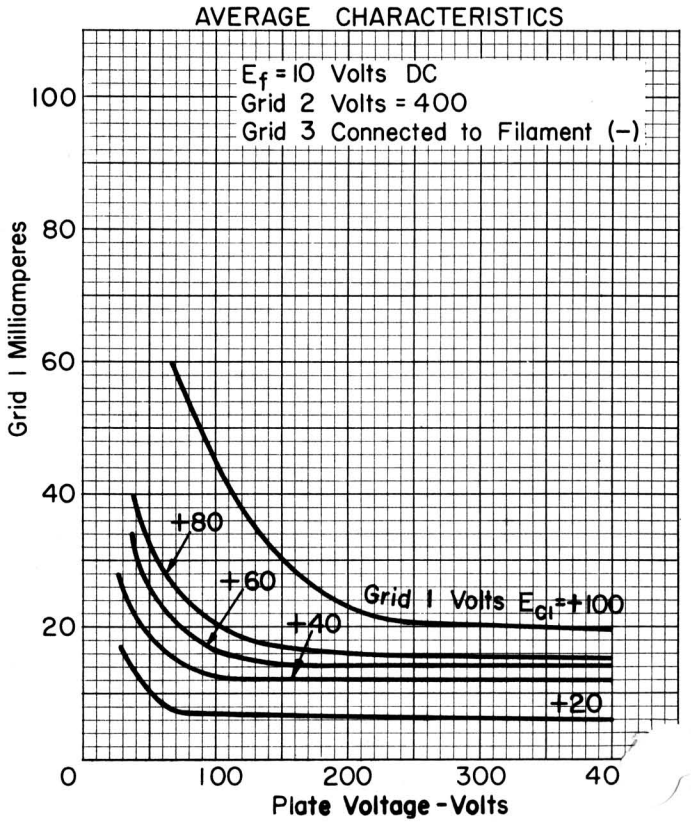
NOTE 3: With dc plate voltage of 2000 volts; dc grid No. 3 voltage = 0 volts; dc grid No. 2 voltage = 400 volts; dc grid No. 1 voltage = −80 volts.

NOTE 4: With dc plate voltage of 2000 volts; dc grid No. 3 voltage = 0 volts; dc grid No. 2 voltage = 400 volts; plate current = 180 ma; grid No. 1 current of 9.6 to 14.4 ma; grid No. 1 resistor of 10000 ohms ±10 percent, and frequency of 15 mc.

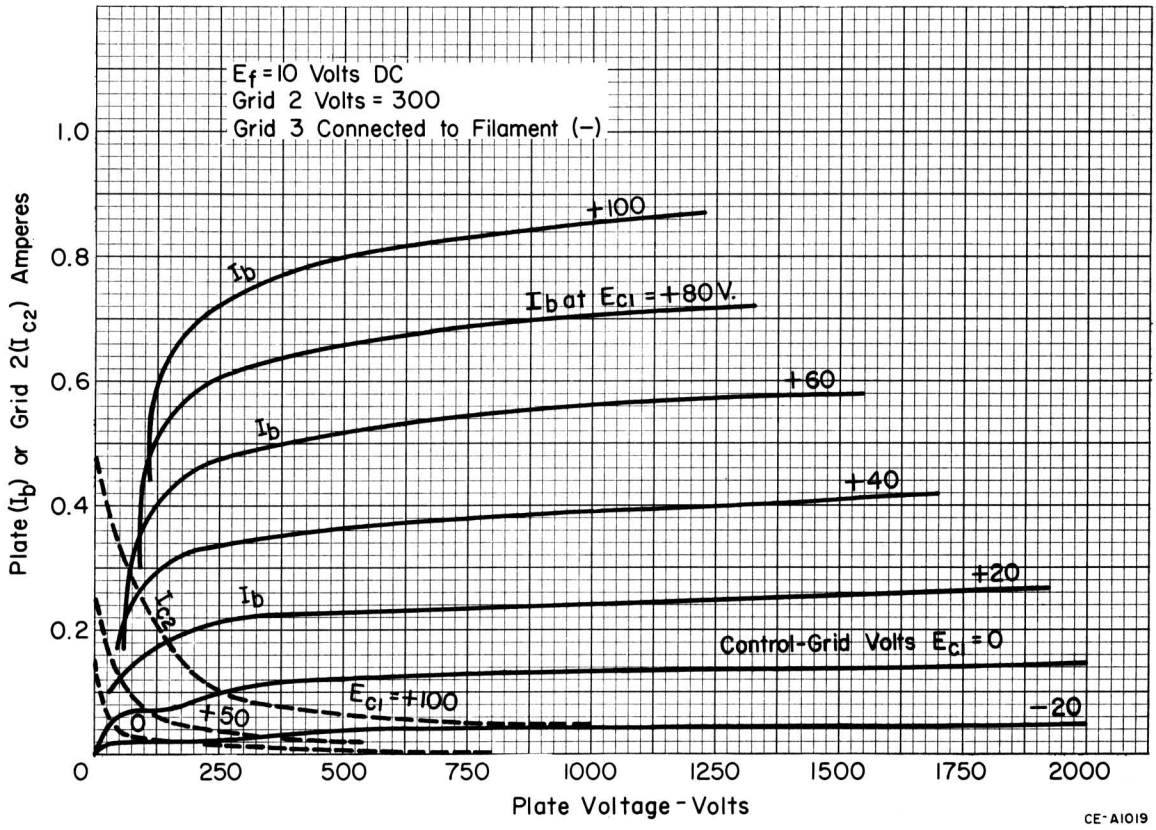
FOOTNOTES

10. Usually negligible. R-F driving power never more than two watts; A-F power usually not more than one watt.
11. Modulation, essentially negative, may be used if the positive peak of the envelope does not exceed 115 percent of the carrier conditions.
12. From a self-rectified driver.
13. Power Input is 1.23 times the product of DC Plate Voltage and DC Plate Current.
14. From a driver with a rectified, unfiltered, single-phase, full-wave plate supply.



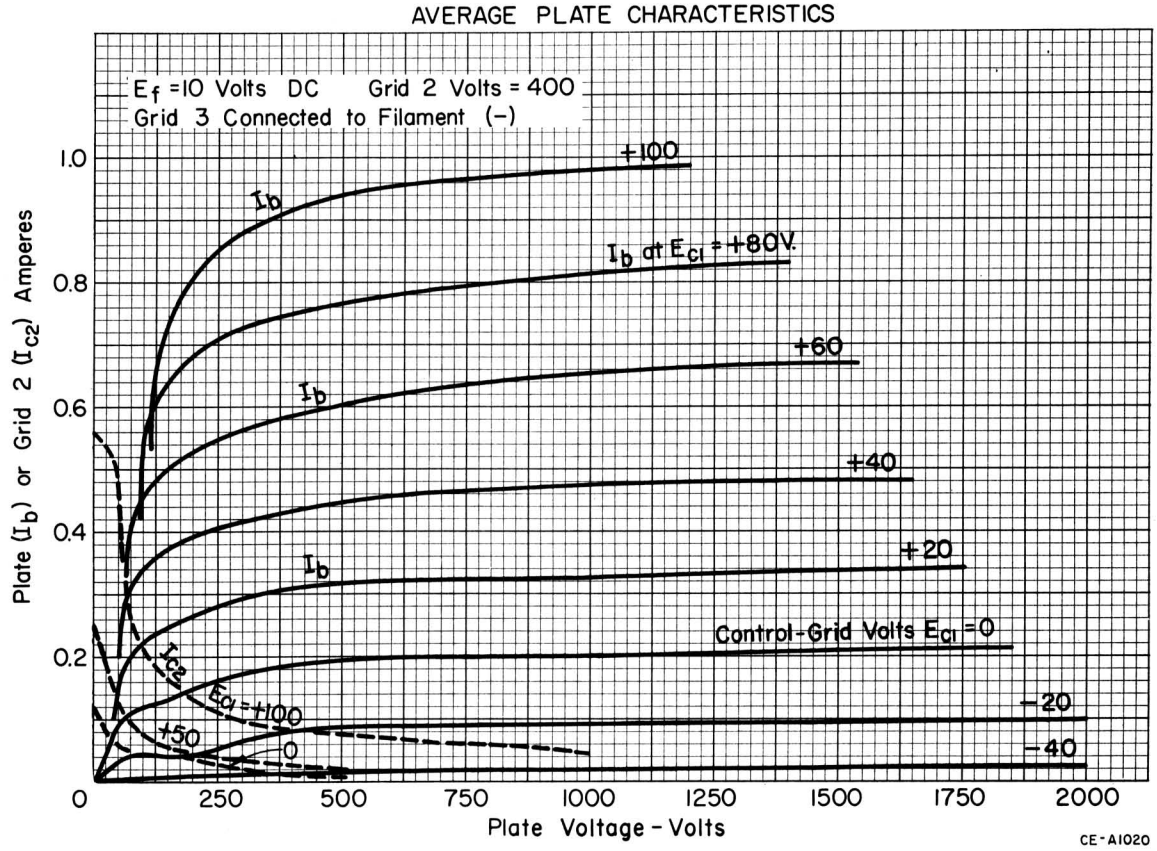


AVERAGE PLATE CHARACTERISTICS

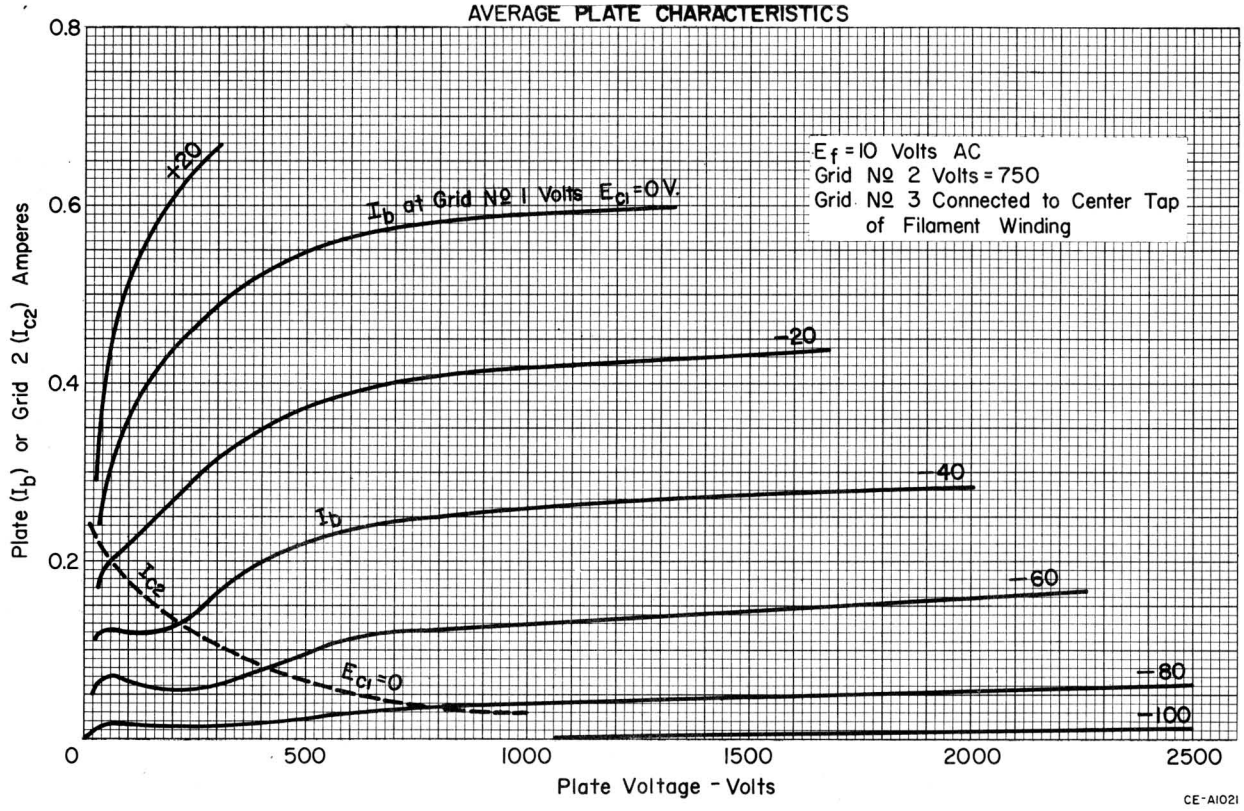


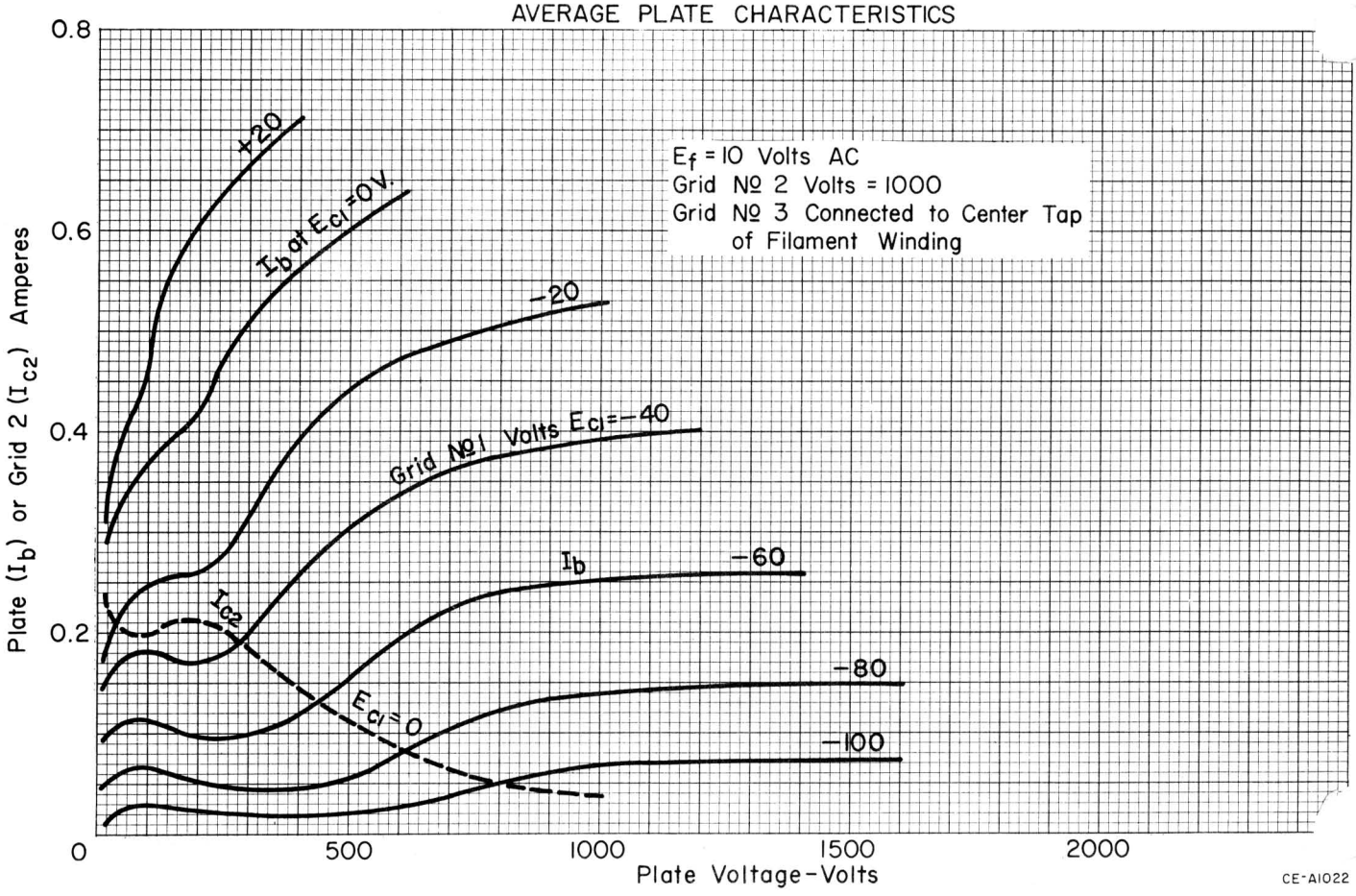
CE-A1019

AVERAGE PLATE CHARACTERISTICS



CE-A1020


AVERAGE PLATE CHARACTERISTICS
E_f = 10 Volts AC
Grid Nº 2 Volts = 750
Grid Nº 3 Connected to Center Tap of Filament Winding
I_b at Grid Nº 1 Volts E_{c1} = 0V.
+20
-20
-40
-60
-80
-100
I_b
I_{c2}
E_{c1} = 0
Plate (I_b) or Grid 2 (I_{c2}) Amperes
Plate Voltage - Volts
0
0.2
0.4
0.6
0.8
500
1000
1500
2000
2500
CE-AI021


AVERAGE PLATE CHARACTERISTICS
E_f = 10 Volts AC
Grid Nº 2 Volts = 1000
Grid Nº 3 Connected to Center Tap of Filament Winding
+20
I_b at E_{c1} = 0V.
-20
Grid Nº1 Volts E_{c1} = -40
I_b
-60
I_{c2}
-80
E_{c1} = 0
-100
Plate (I_b) or Grid 2 (I_{c2}) Amperes
Plate Voltage - Volts
0
0.2
0.4
0.6
0.8
500
1000
1500
2000
CE-AI022

July 1, 1955

Power Triode Type WL-892

The WL-892 is a three-electrode transmitting tube of the double-filament type. It is designed for use as a radio-frequency power amplifier, oscillator, and Class B modulator. The construction of the filament permits operation from two-phase or single-phase alternating current as well as from direct current, for all classes of service. The plate is water-cooled and is capable of dissipating 6.6 to 10 kilowatts of power. The WL-892 can be operated at maximum ratings at frequencies as high as 1.6 megacycles and up to 20 megacycles at reduced ratings.

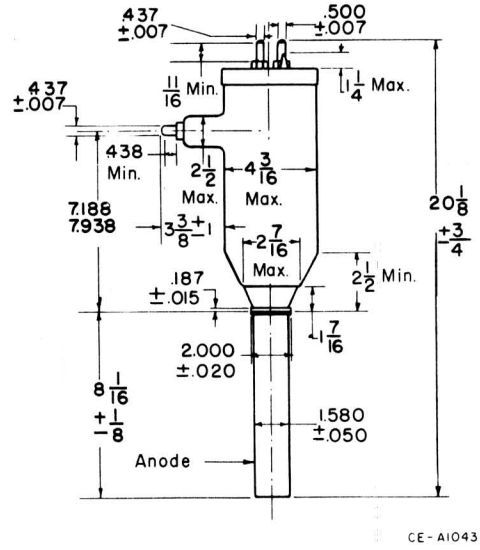
GENERAL DATA

Electrical:

Filament	
Type	Tungsten, Two Section
Excitation	Single or Two Phase AC or DC
Voltage†	22 Volts
Current	60 Amps.
Amplification Factor	50
Inter-electrode Capacitances	
Grid-plate	30 μμf
Grid-filament	20 μμf
Plate-filament	1.5 μμf

Mechanical:

Mounting position	Vertical, Anode down
Type of Cooling#	Water
Base	JETEC A3-80
Grid Cap	JETEC J1-1



AF Power Amplifier and Modulator, Class B

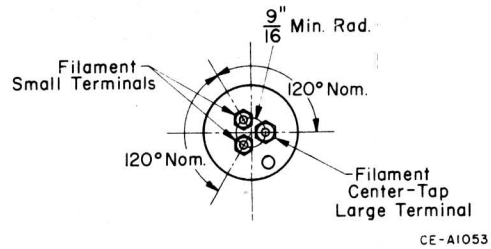
Maximum Ratings:

DC Plate Voltage	15000 Volts
DC Plate Current, Max. Signal*	2.0 Amps.
Plate Input, Max. Signal*	20000 Watts
Plate Dissipation*	7500 Watts

Typical Operation:

Unless otherwise specified, values are for 2 tubes.

DC Plate Voltage	6000	10000	12500	Volts
DC Grid Voltage##	0	-90	-170	Volts
Peak AF Voltage, Grid to Grid	1200	1620	1530	Volts
DC Plate Current, Zero Signal	0.5	0.5	0.4	Amps.
DC Plate Current, Max. Signal	2.5	3.2	2.8	Amps.
Effective Load Resistance, Plate to Plate	4200	6400	10000	Ohms
Driving Power, Max. Signal	415	525	420	Watts
Power Output, Max. Signal	8000	20000	22000	Watts



† When operated on DC or on single-phase AC the filament must be operated at the total voltage indicated and with the two strands in series. When used on two-phase the filament voltage must be 11 volts for each strand. The large post is at the junction of the two strands. This tube can often be operated with reduced filament voltages when the load conditions are lower than maximum.

Water flow of 3 to 8 gallons per minute must start before application of any voltages and continue for at least 5 minutes after removal of voltages. Water temperature must not exceed 70°C under any conditions of operation.

* Averaged over any audio-frequency cycle of sine-wave form.

With AC filament supply.

Westinghouse

RF Power Amplifier, Class B

Carrier conditions per tube for use with a maximum modulation factor of 1.0.

Maximum Ratings:			
DC Plate Voltage		15000	Volts
DC Plate Current		1.0	Amps.
Plate Input		15000	Watts
Plate Dissipation		10000	Watts
Typical Operation:			
DC Plate Voltage	6000	10000	14000 Volts
DC Grid Voltage**	0	-100	-190 Volts
Peak RF Grid Voltage†	300	470	510 Volts
DC Plate Current	0.67	0.93	0.95 Amps.
Driving Power	65	50	30 Watts
Power Output	1000	2500	4000 Watts

Plate-Modulated RF Power Amplifier, Class C Telephony.

Carrier conditions per tube for use with a maximum modulation factor of 1.0.

Maximum Ratings:			
DC Plate Voltage		10000	Volts
DC Grid Voltage		-3000	Volts
DC Plate Current		1.0	Amps.
DC Grid Current		0.25	Amps.
Plate Input		10000	Watts
Plate Dissipation		6600	Watts
Typical Operation:			
DC Plate Voltage	6000	8000	10000 Volts
DC Grid Voltage	-1000	-1300	-1600 Volts
Peak RF Grid Voltage	1675	2000	2400 Volts
DC Plate Current	0.77	0.75	0.72 Amps.
DC Grid Current	0.19	0.18	0.12 Amps.
Driving Power	310	350	260 Watts
Power Output	3500	5000	6000 Watts

RF Power Amplifier and Oscillator, Class C Telegraphy.

Key-down conditions per tube without modulation.###

Maximum Ratings:			
DC Plate Voltage		15000	Volts
DC Grid Voltage		-3000	Volts
DC Plate Current		2.0	Amps.
DC Grid Current		0.25	Amps.
Plate Input		30000	Watts
Plate Dissipation		10000	Watts
Typical Operation:			
DC Plate Voltage	8000	10000	12000 Volts
DC Grid Voltage	-1000	-1300	-1600 Volts
Peak RF Grid Voltage	1800	2300	2800 Volts
DC Plate Current	1.1	1.4	1.64 Amps.
DC Grid Current	0.18	0.18	0.18 Amps.
Driving Power	320	400	500 Watts
Power Output	6500	10000	14000 Watts

o At crest of AF cycle with modulation factor of 1.0.

Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

** With DC filament supply.

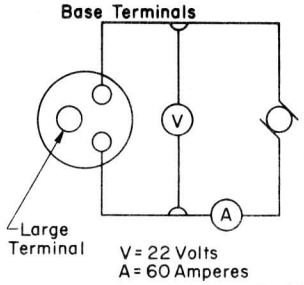
Frequency Ratings

Maximum ratings apply up to 1.6 MC. The tube may be operated at higher frequencies provided the maximum values of plate voltage and power input are reduced according to the table below.

Frequency	Class B, RF	Class C, Plate Modulated	Class C, Unmodulated
1.6 MC	100%	100%	100%
7.5 MC	85%	85%	75%
20.0 MC	76%	75%	50%

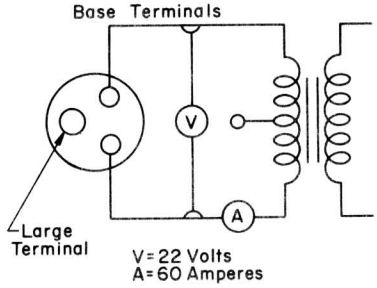
FILAMENT CONNECTIONS

DC SUPPLY



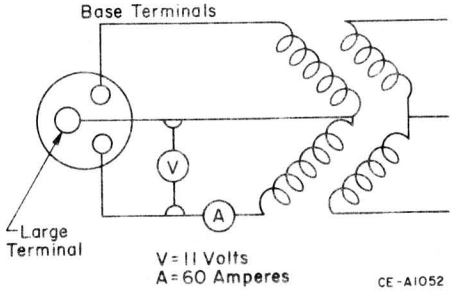
CE-A1050

SINGLE-PHASE AC SUPPLY



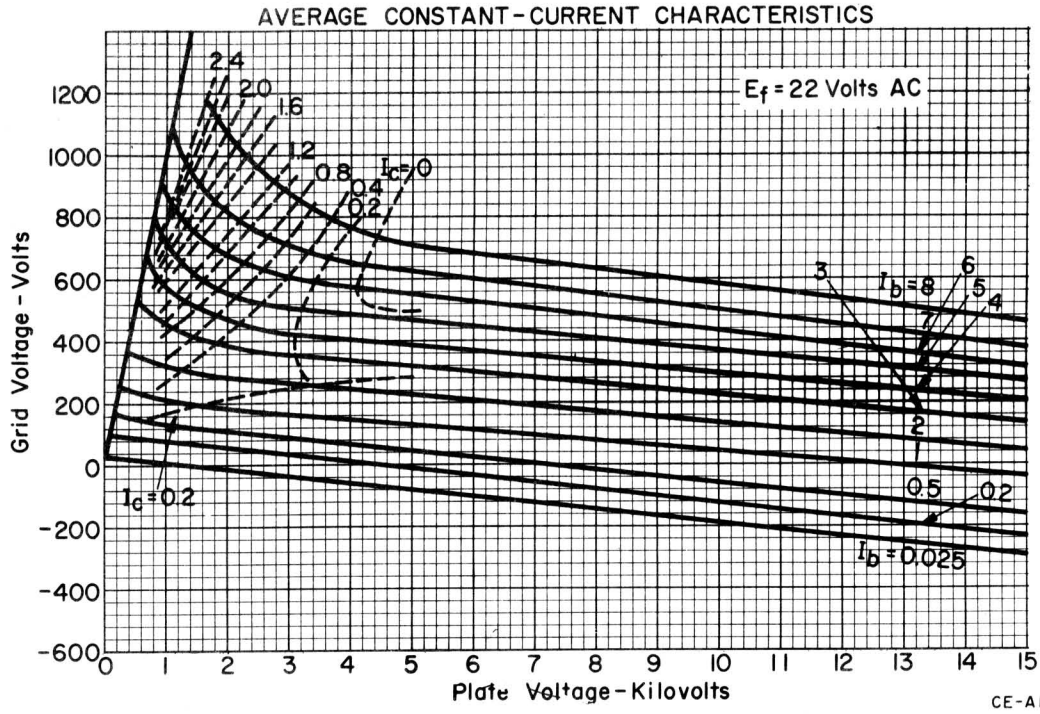
CE-A1051

TWO-PHASE AC SUPPLY



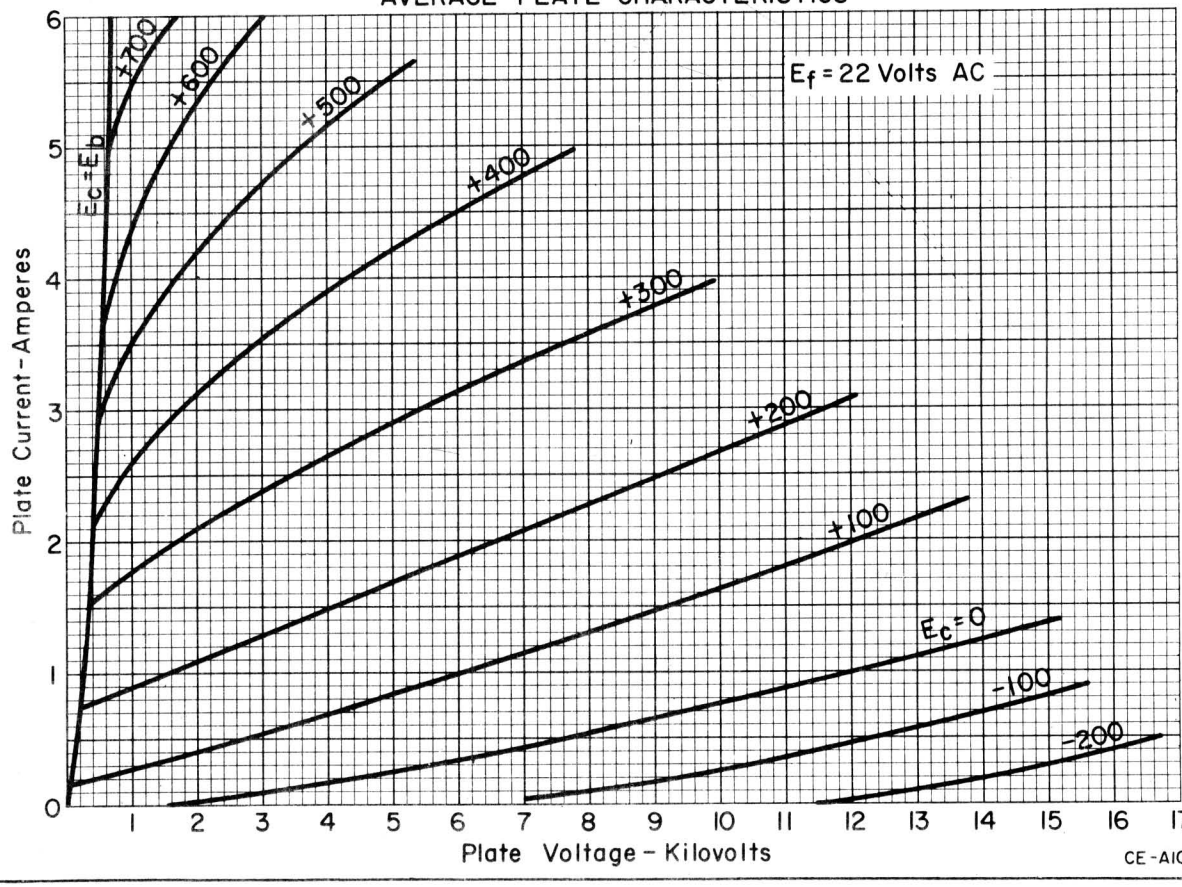
CE-A1052

AVERAGE CONSTANT-CURRENT CHARACTERISTICS

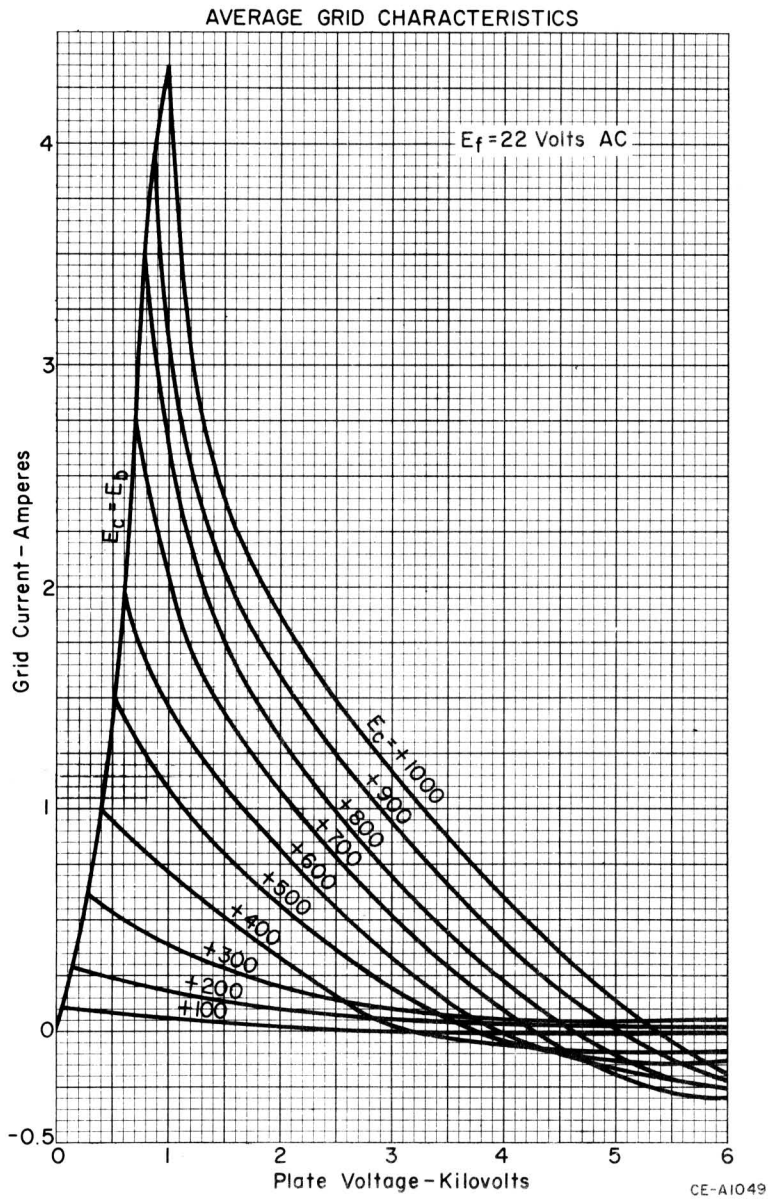


CE-A1047

AVERAGE PLATE CHARACTERISTICS



CE-A1048


AVERAGE GRID CHARACTERISTICS
Ef=22 Volts AC
Eg=Eb
Ec=+1000
+900
+800
+700
+600
+500
+400
+300
+200
+100
Grid Current - Amperes
Plate Voltage - Kilovolts
4
3
2
1
0
-0.5
0
1
2
3
4
5
6
CE-A1049

The WX-4276 is a three-electrode tube designed for use as an oscillator, modulator, or amplifier. The anode is forced air-cooled and is capable of dissipating 5 kilowatts. The cathode is a single phase thoriated tungsten filament. Maximum ratings apply up to 60 megacycles; reduced ratings up to 200 megacycles.

ELECTRICAL DATA, GENERAL

Filament Voltage	6.0	volts
Filament Current	70	amperes
Amplification Factor	33	
Direct Interelectrode Capacitances(Approx.).		
Grid to Plate	16	uuf
Grid to Filament	30	uuf
Plate to Filament	.5	uuf

MECHANICAL DATA, GENERAL

Type of Cooling	Forced Air	
Air Flow	350	CFM
Air Flow to Filament and Grid Seals	30	cubic ft./min.
Bulb Temperature	180	°C. maximum

MAXIMUM RATINGS - CLASS C TELEGRAPHY
(key down conditions per tube without modulation)

D.C. Plate Voltage	12,000	volts
D.C. Plate Current	2.0	amperes
D.C. Grid Voltage	-1200	volts
D.C. Grid Current	.50	amperes
Plate Input	20	K.W.
Plate Dissipation	5	K.W.

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK

For additional information on this or other Westinghouse Electronic Tube Division products, contact the field sales representative nearest you:

Elmira, New York
P.O. Box 284
REgent 9-3611

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LIberty 2-0600

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2211 W. Pershing Road
WHitehall 4-3860

Los Angeles 17, California
600 St. Paul Avenue
HUntley 2-9660

San Lorenzo, California
2222 Grant Avenue
BRowning 6-1800

TYPICAL OPERATION - CLASS C TELEGRAPHY
(key down without A.M.)

D.C. Plate Voltage	9000	10,000	volts
D.C. Grid Voltage	-600	-700	volts
Peak R.F. Grid Voltage	960	1,100	volts
D.C. Plate Current	1.97	1.96	amperes
D.C. Grid Current	0.45	0.42	amperes
Peak R.F. Plate Voltage	8000	9000	volts
*Driving Power	414	441	watts
Power Output	14.1	15.9	kilowatts
Power Input	17.8	19.6	kilowatts

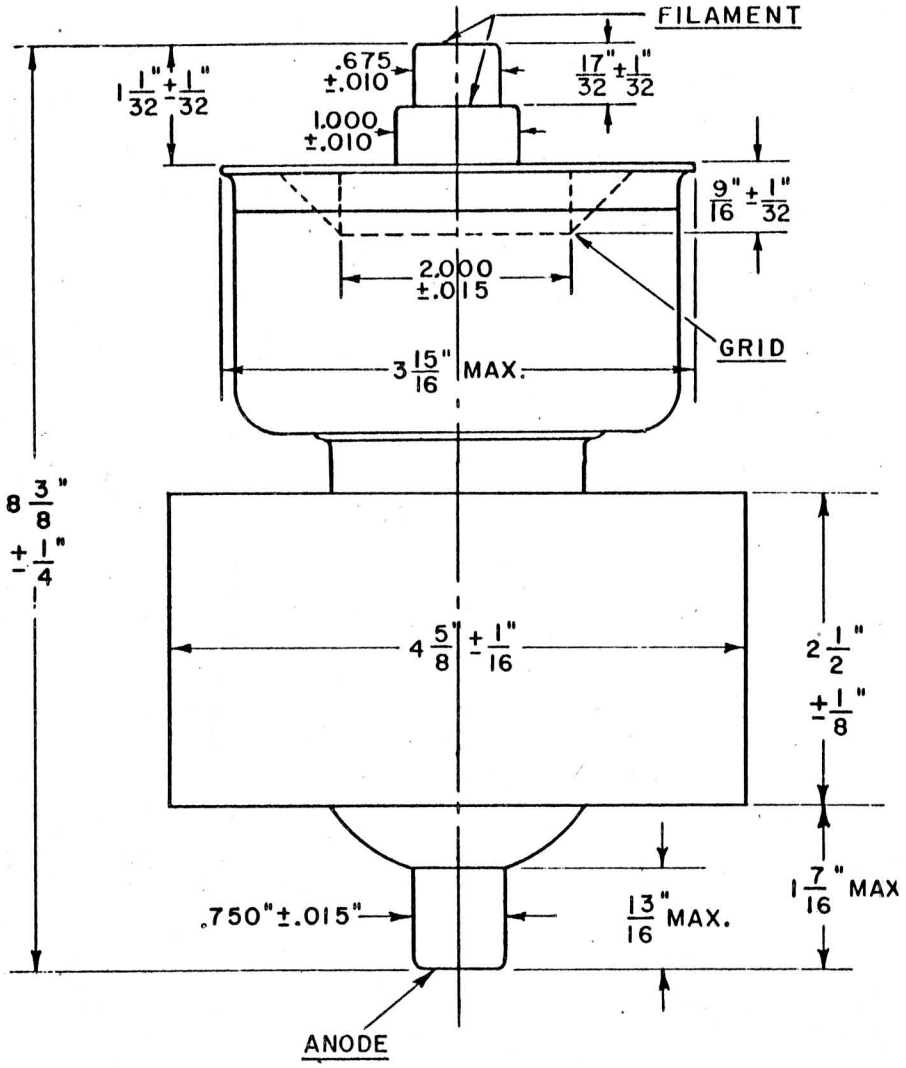
*Allowance must be made for grid circuit losses which are not included in the numbers listed above.

MAXIMUM RATINGS - CLASS B
(A-F Power Amplifier & Modulator) (Conditions per tube)

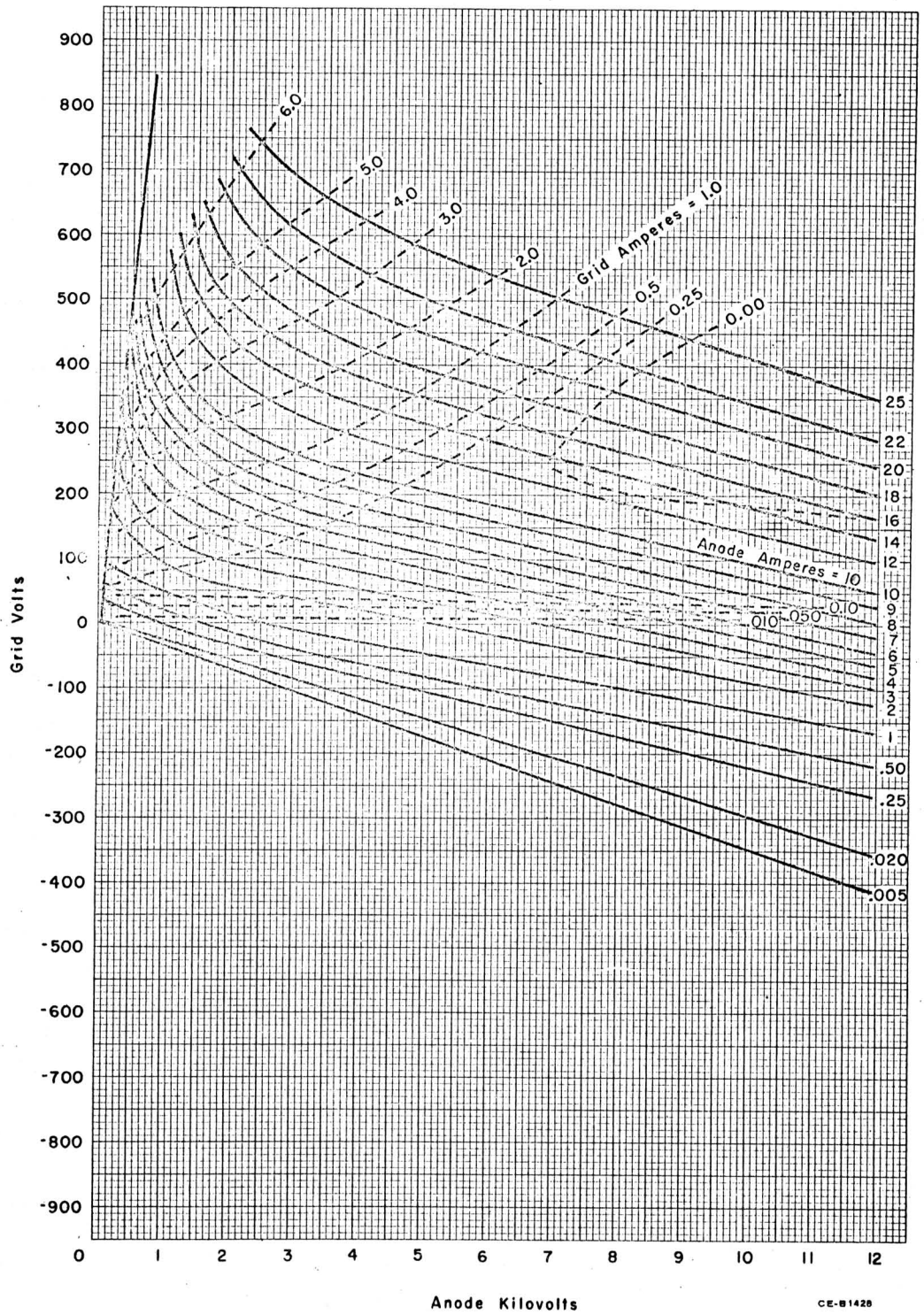
D.C. Plate Voltage	12,000	volts
D.C. Plate Current (max. signal)	2.50	amperes
D.C. Grid Current (max. signal)	0.50	amperes
Plate Input	15	kilowatts
Plate Dissipation	5	kilowatts

TYPICAL OPERATION - CLASS B
(A-F Amplifier or Modulator)
(Conditions for 2 tubes unless otherwise specified)

D.C. Plate Voltage	7000	volts
D.C. Plate Current (max. signal)	2.8	amperes
Plate Current, Zero Signal (per tube)	.5	amperes
Grid to Grid Peak A.F.	550	volts
D.C. Grid Voltage	-120	volts
Driving Power (max. signal)	50	watts
Power Output	12	kilowatts
Power Input	19.6	kilowatts
Plate Load (plate to plate)	4700	ohms
Distortion-Harmonic	2	percent
Peak R.F. Plate Voltage	5300	volts


FILAMENT
.675 ±.010
17/32" ±1/32"
1 1/32" ±1/32"
1.000 ±.010
9/16" ±1/32"
2.000 ±.015
GRID
3 15/16" MAX.
8 3/8" ±1/4"
4 5/8" ±1/16"
2 1/2" ±1/8"
1 7/16" MAX
.750" ±.015"
13/16" MAX.
ANODE

AVERAGE CONSTANT CURRENT CHARACTERISTICS



POWER AMPLIFIER TETRODE TYPE WX-4361

The WX-4361 is a large, four-electrode, immersion cooled tube designed for service as a hard-tube modulator and RF power amplifier. The anode is capable of dissipating 30 kilowatts, exclusive of filament heating power, when oil cooled or 175 kilowatts when water cooled. The cathode is a multiple-strand, thoriated-tungsten filament operated 3 phase.

ELECTRICAL:

Cathode . . . . Multiple-strand, Thoriated-Tungsten Filament			
Filament:			
Voltage (3 phase line to line) . .	23.4	26.0	Volts
Current (3 phase connection per line)	190	200	Amperes
Minimum Heating time		30	Seconds
Mu-Factor, Grid 2 to Grid 1		7	

Direct Interelectrode Capacitances:

Input	410	uuf
Output	78	uuf
Feedback	0.6	uuf

MECHANICAL:

Mounting	Vertical, Anode Down		
Cooling:			
Type	Water	Oil	
Max. fluid temperature	45	80	°C
Max. bulb and seal temperature	180	180	°C
Min. water flow	40	- -	GPM

PULSE MODULATOR SERVICE

MAXIMUM RATINGS:

Absolute Maximum Values

D.C. Plate Voltage.....	80	max.	Kilovolts
D.C. Grid 2 Voltage.....	3000	max.	Volts
D.C. Grid 1 Voltage.....	-1500	max.	Volts
Peak Pulse Plate Current.....	500	max.	Amperes
Peak Pulse Cathode Current.....	700	max.	Amperes
Plate Dissipation:			
Oil Cooled.....	30	max.	Kilowatts
Water Cooled.....	175	max.	Kilowatts
Grid 1 Dissipation.....	2.5	max.	Kilowatts
Grid 2 Dissipation.....	4.25	max.	Kilowatts
Pulse Length.....	1000	max.	Microseconds
Duty Factor.....	0.008	max.	

Westinghouse

DEVELOPMENTAL DEVICE
Tentative Data

PLATE MODULATED RF POWER AMPLIFIER CLASS C TELEPHONY
Carrier Conditions per Tube with Max. Mod. Factor of 1.0

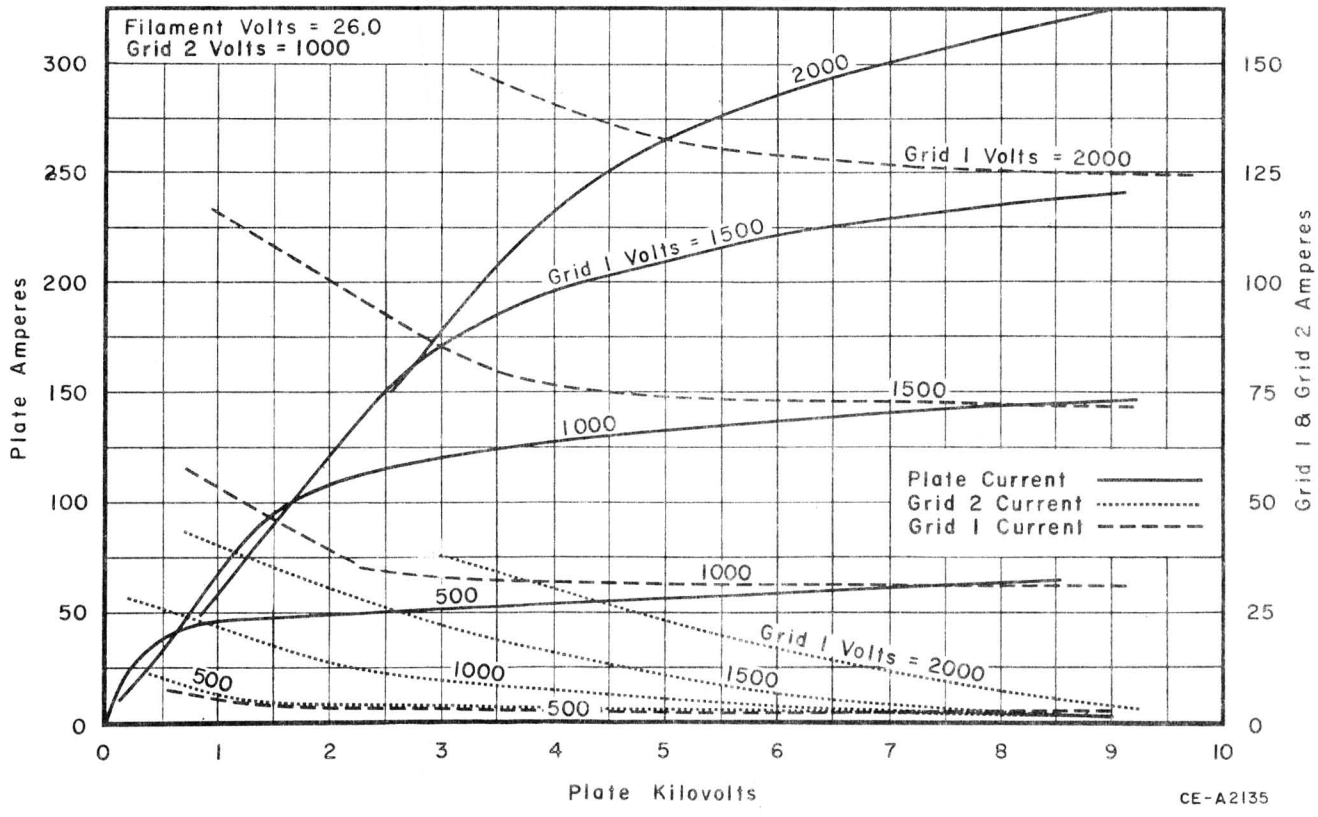
MAXIMUM RATINGS
Absolute Maximum Values

D.C. Plate Voltage.....	17.5	max.	Kilovolts
D.C. Grid 2 Voltage.....	1250	max.	Volts
D.C. Grid 1 Voltage.....	-1000	max.	Volts
D.C. Plate Current.....	30	max.	Amperes
Plate Dissipation:			
Oil Cooled.....	30	max.	Kilowatts
Water Cooled.....	175	max.	Kilowatts
Grid 2 Dissipation.....	4.25	max.	Kilowatts
Grid 1 Dissipation.....	2.5	max.	Kilowatts

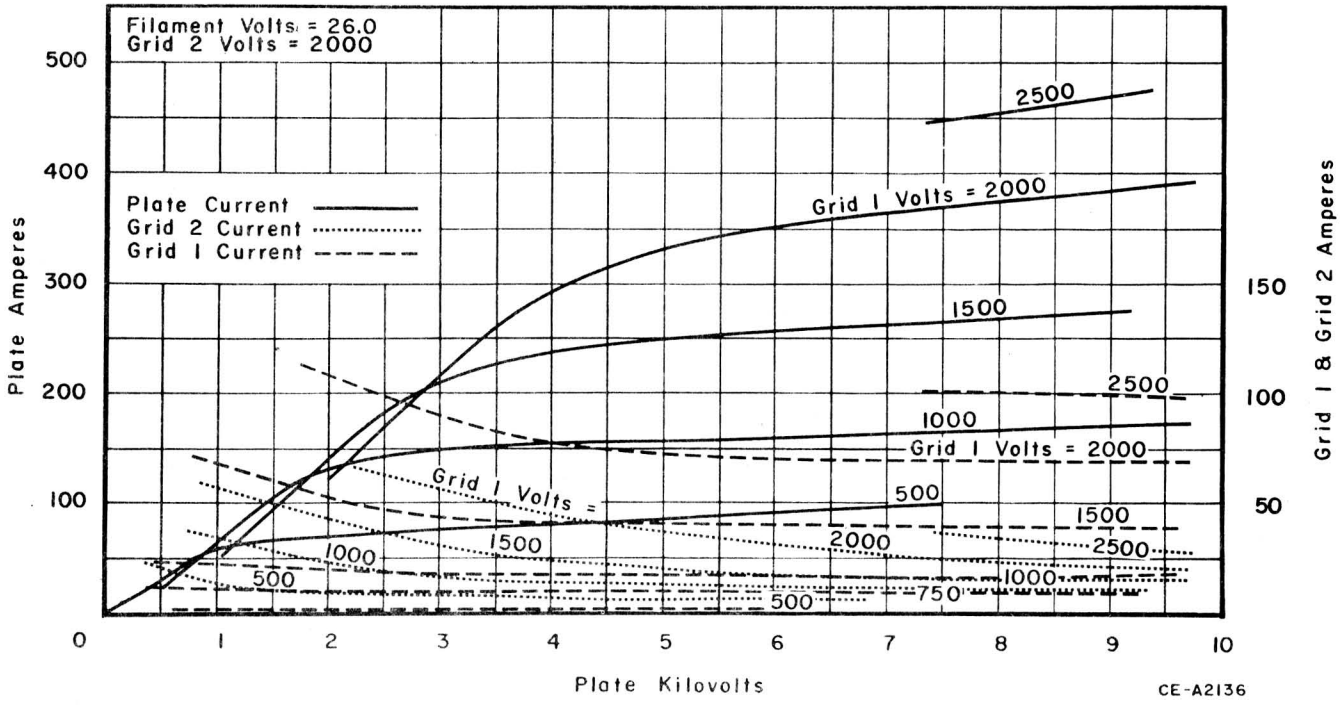
TYPICAL OPERATION

D.C. Plate Voltage.....	17.5	17.5	Kilovolts
D.C. Grid 2 Voltage.....	1000	1000	Volts
Peak AF Grid 2 Voltage for 100% Mod.....	2000	2000	Volts
D.C. Grid 1 Voltage.....	-350	-350	Volts
Peak RF Grid 1 Voltage.....	1070	1110	Volts
D.C. Plate Current.....	20.2	21.5	Amperes
D.C. Grid 2 Current.....	2.92	3.4	Amperes
D.C. Grid 1 Current.....	3.29	3.67	Amperes
Driving Power.....	3000	3500	Watts
Power Output.....	274	296	Kilowatts

AVERAGE PLATE CHARACTERISTICS

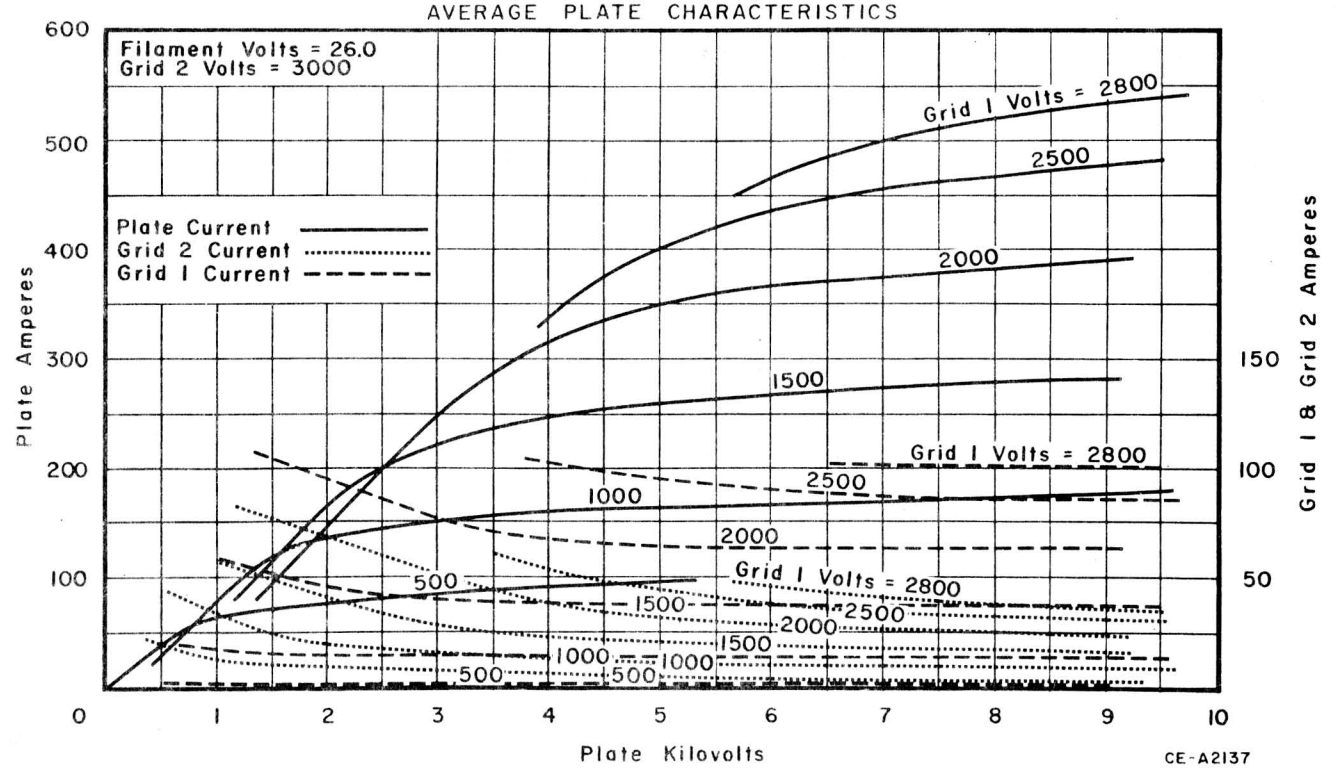


AVERAGE PLATE CHARACTERISTICS



CE-A2136

AVERAGE PLATE CHARACTERISTICS



CE-A2137

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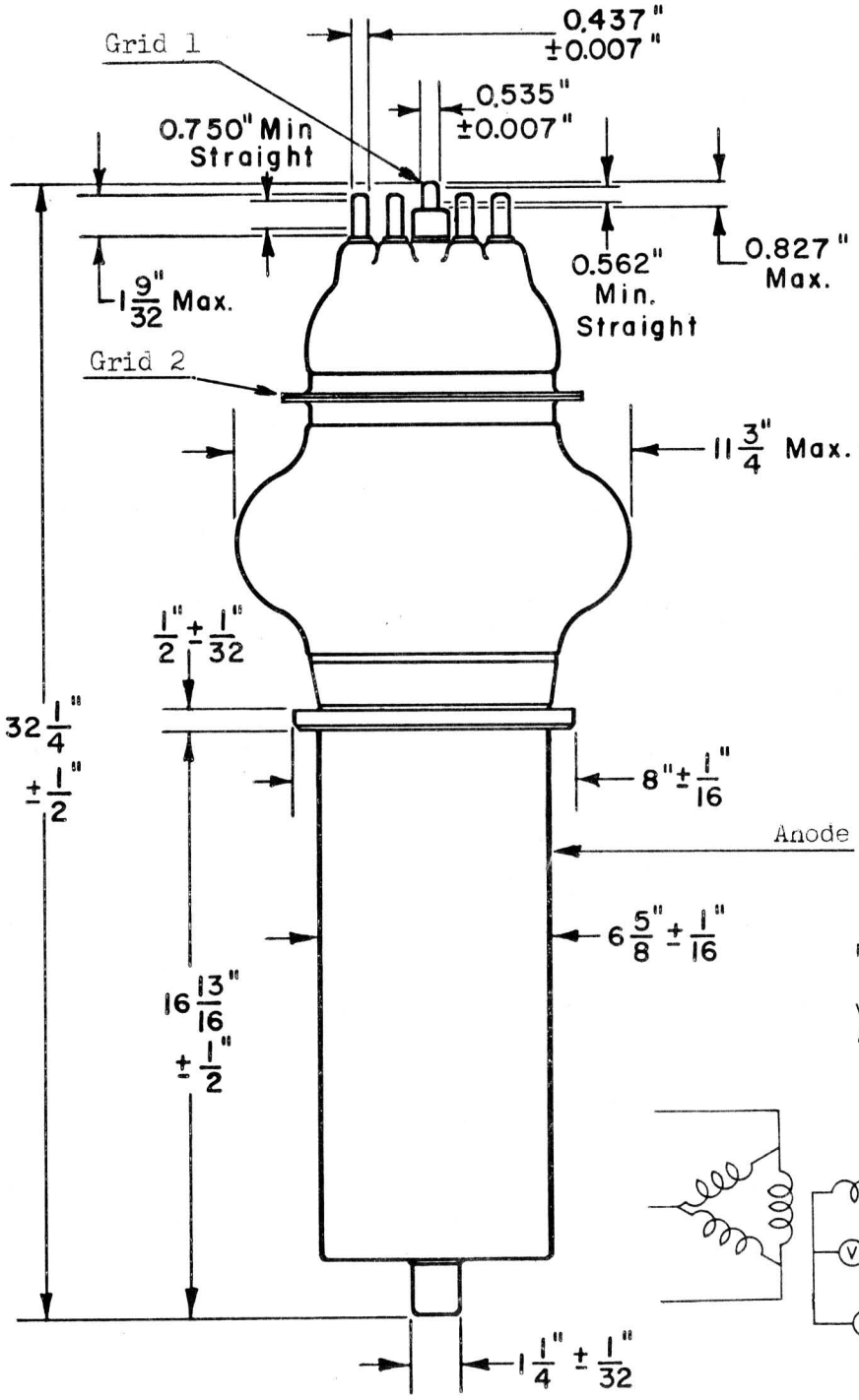
DEVELOPMENTAL DEVICE
Tentative Data



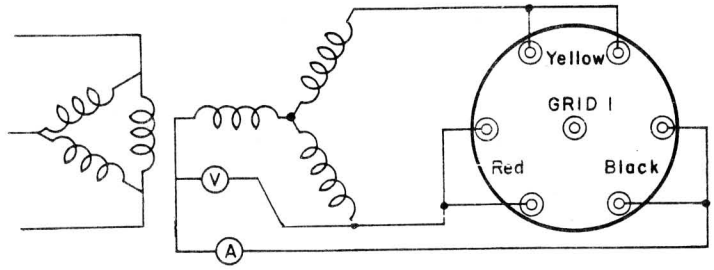
ACCESSORIES

Water Jacket . WL-22688
Gasket 43-203
Fil. Connector WL-22677
Grid 1 Conn. . WL-22682
Grid 2 Conn. . WL-22689

NET WEIGHT . .50 Pounds

FILAMENT CONNECTIONS

V = 26 Volts Line to Line
A = 200 Amperes per Phase



Westinghouse
ELECTRONIC TUBE DIVISION, ELMIRA, NEW YORK

POWER AMPLIFIER TRIODE TYPE WX-4715A

The WX-4715A is a three-electrode tube designed for use as an oscillator, amplifier and modulator. The water cooled anode is capable of dissipating 200 kilowatts. A thoriated-tungsten filament is employed. Maximum ratings apply up to 15 megacycles.

ELECTRICAL

Filament Voltage	13.5 Volts
Filament Current	550 Amperes
Filament Starting Current	1500 Amperes
Filament Cold Resistance	0.0033 Ohms
Amplification Factor	35
Interelectrode Capacitances (Approx.):	
Grid to plate	95 pf
Grid to filament	180 pf
Plate to filament	3 pf

MECHANICAL

Mounting Position	Vertical - Anode Down
Type of Cooling - Water	40 GPM
Max. Outgoing Water Temperature	70 °C
Max. Glass Temperature	180 °C
Net Weight (Approx.)	70 Pounds

RF POWER AMPLIFIER AND OSCILLATOR
CLASS C TELEGRAPHY
Key-Down Conditions per Tube (Without Amplitude Modulation)

MAXIMUM RATINGS
Absolute Maximum Values

DC Plate Voltage	22 max. Kilovolts
DC Grid Voltage	-2200 max. Volts
DC Plate Current	33.0 max. Amperes
DC Grid Current	5.0 max. Amperes
Plate Power Input	600 max. Kilowatts
Plate Dissipation	200 max. Kilowatts
Grid Dissipation	4.6 max. Kilowatts

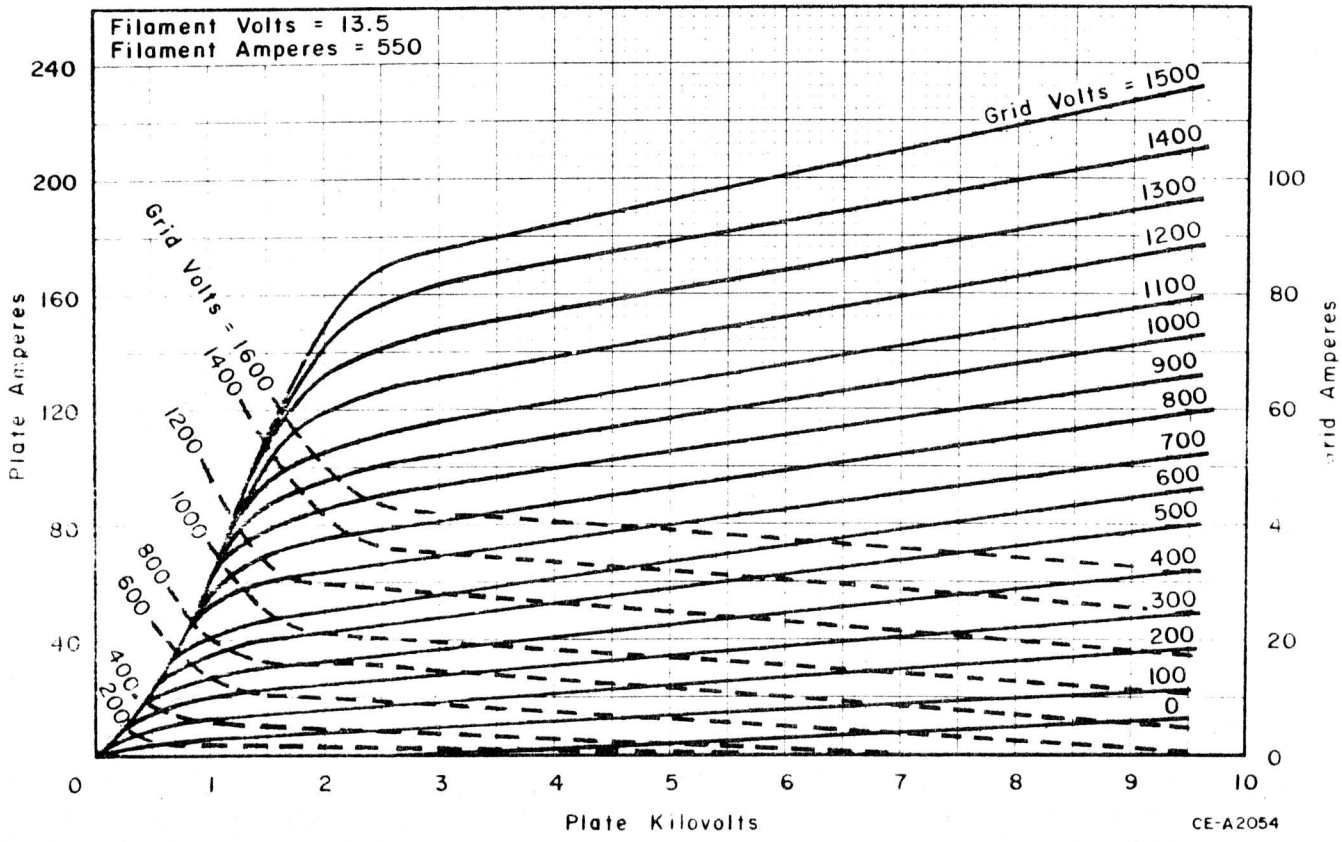
Westinghouse

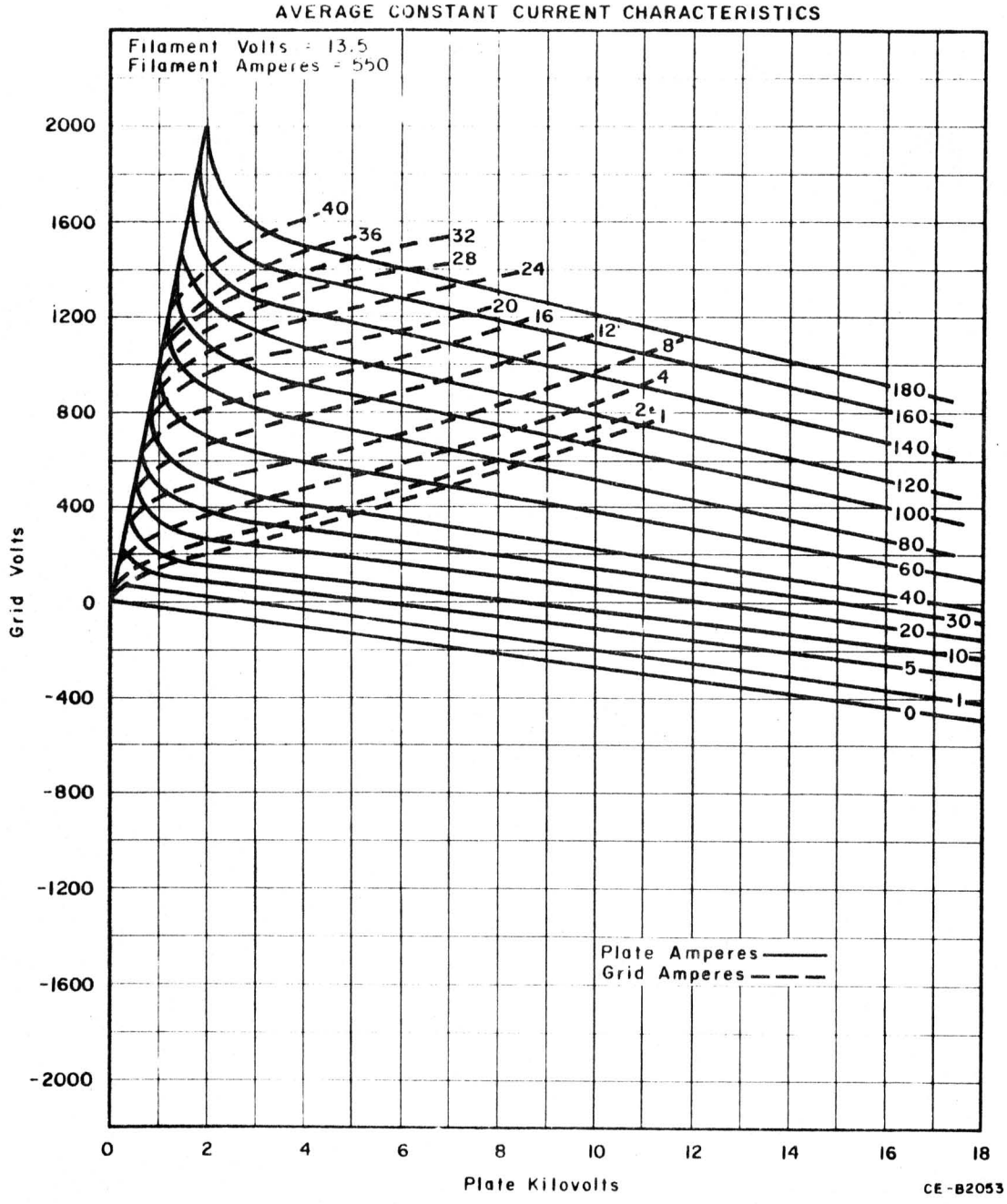
DEVELOPMENTAL DEVICE
Tentative Data

TYPICAL OPERATION (Oscillating Service)

DC Plate Voltage	16	17	17	18	19	20	KV
Peak RF Plate Voltage	14	15	15	16	17	18	KV
DC Grid Voltage	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	KV
Peak RF Grid Voltage	2.45	2.4	2.5	2.45	2.45	2.45	KV
DC Plate Current	28.7	27.5	32.5	29.5	30	30	Amp.
DC Grid Current	3.62	3.42	4.08	3.85	3.8	3.8	Amp.
DC Power Input	460	468	553	535	570	600	KW
Power Output	360	373	415	421	457	485	KW
Plate Dissipation	100	95	138	114	113	115	KW
Efficiency	78	80	75	77.8	80	81.5	%
Plate Swing	87.5	88	88	88.5	89.5	90	%
Driving Power	8.6	7.75	9.65	8.9	8.8	8.8	KW
Grid Dissipation	3.53	3.0	3.95	3.5	3.5	3.5	KW
Peak Fund. Plate Current	52.4	50.6	56.6	54	54.5	55.2	Amp.
Peak Fund. Grid Current	6.87	6.45	7.75	7.3	7.2	7.2	Amp.

AVERAGE PLATE CHARACTERISTICS




AVERAGE CONSTANT CURRENT CHARACTERISTICS
Filament Volts = 13.5
Filament Amperes = 550
2000
1600
1200
800
400
0
-400
-800
-1200
-1600
-2000
Grid Volts
40
36
32
28
24
20
16
12
8
4
2
1
180
160
140
120
100
80
60
40
30
20
10
5
1
0
Plate Amperes
Grid Amperes
0
2
4
6
8
10
12
14
16
18
Plate Kilovolts
CE-B2053

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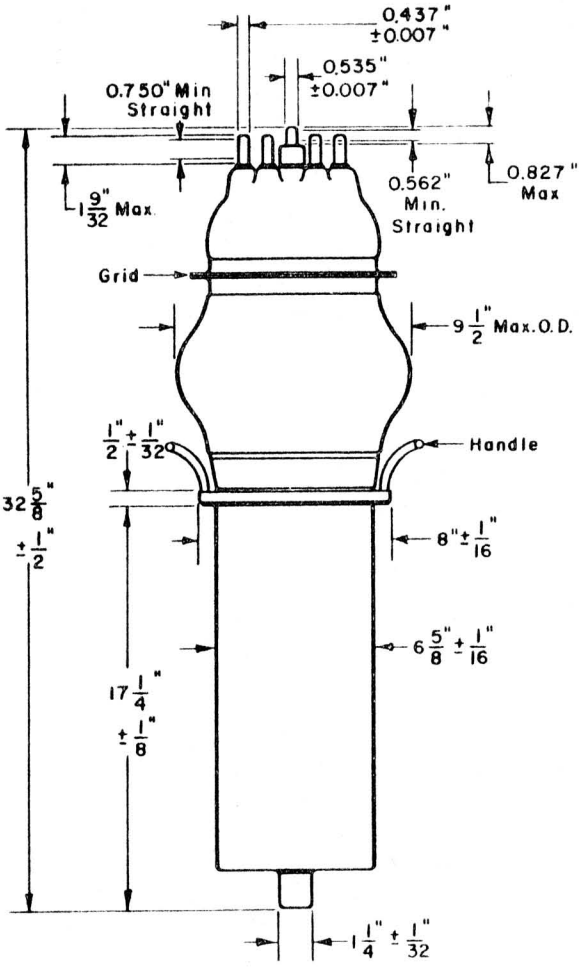
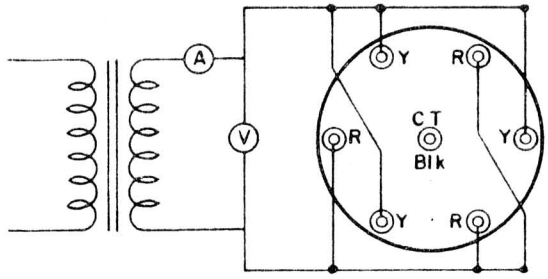
DEVELOPMENTAL DEVICE
Tentative Data



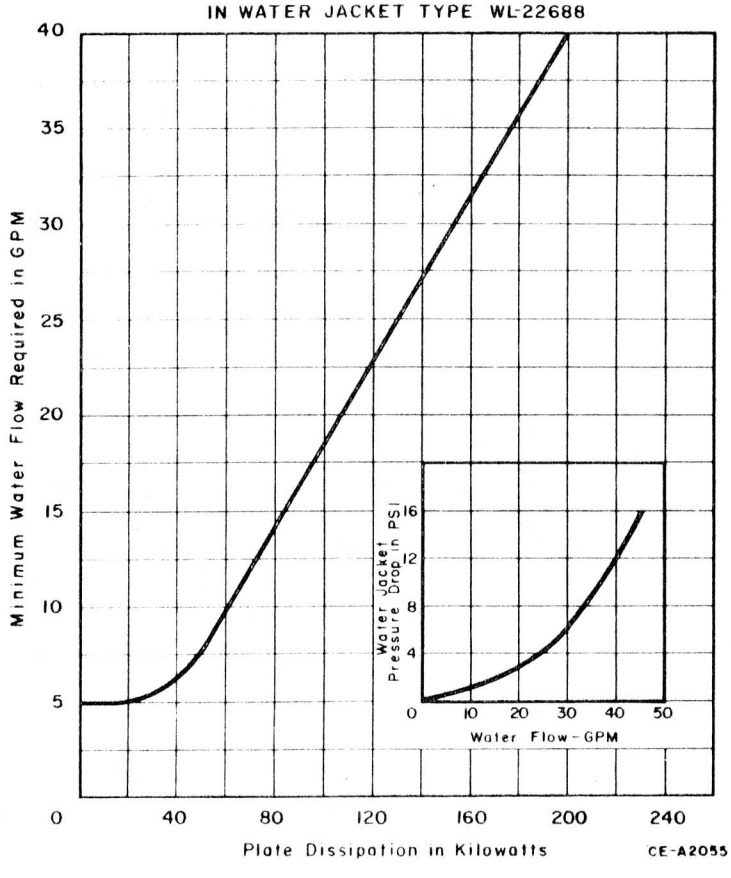
FILAMENT CONNECTIONS

V = 13.5 Volts
A = 550 Amperes



CE-A2060

COOLING CHARACTERISTICS
IN WATER JACKET TYPE WL-22688



CE-A2055

HIGH VACUUM AMPLIFIER TYPE WX-4959

The WX-4959 is a three-electrode tube designed for use as an oscillator or amplifier. The anode is vapor-cooled and is capable of dissipating 15 kilowatts continuously. Efficient cooling is accomplished by vaporization of water in a boiler and transport of the vapor to a secondary cooling circuit at a temperature of approximately 100°C. The cathode is a single-phase thoriated-tungsten filament. Maximum ratings apply up to 30 megacycles.

ELECTRICAL

Filament	6.0	volts
Filament Current	70	amperes
Amplification Factor	20	
Direct Interelectrode Capacitances:		
Grid-to-plate	23	μμf
Grid-to-filament	32	μμf
Plate-to-filament	1.5	μμf

MECHANICAL

*Mounting Position	Vertical, anode down	
Type of Cooling	Vaporization of water	
Net Weight	16	pounds
Air Flow to Filament and Grid Seals	30	CFM
Maximum Temperature:		
Bulb	180	°C

CLASS B AUDIO FREQUENCY AMPLIFIER OR MODULATOR

Maximum Ratings (per tube)
Absolute Maximum Values:

DC Plate Voltage	9500	volts
DC Plate Current (max. signal)	2.50	amperes
DC Grid Current (max. signal)	0.50	ampere
Plate Input	24	kilowatts
Plate Dissipation	15.0	kilowatts

*Connectors for WX-4959 are available from Westinghouse.

Boiler for WX-4959 available from Westinghouse.

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DEVELOPMENTAL DEVICE
Tentative Data

CLASS C TELEGRAPHY (Key down without modulation)

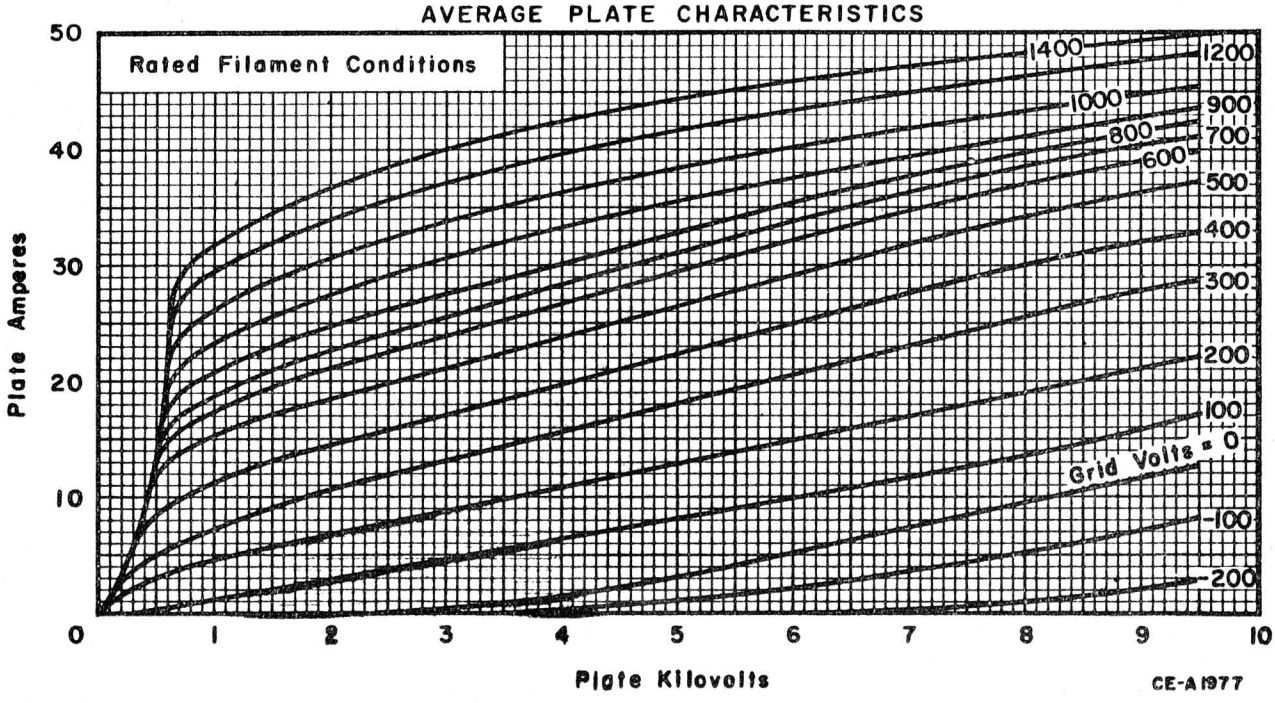
Maximum Ratings
Absolute Maximum Values:

DC Plate Voltage	9500	volts
DC Plate Current	2.5	amperes
DC Grid Voltage	-1200	volts
DC Grid Current	0.75	amperes
Plate Input	24	kilowatts
Plate Dissipation	15	kilowatts

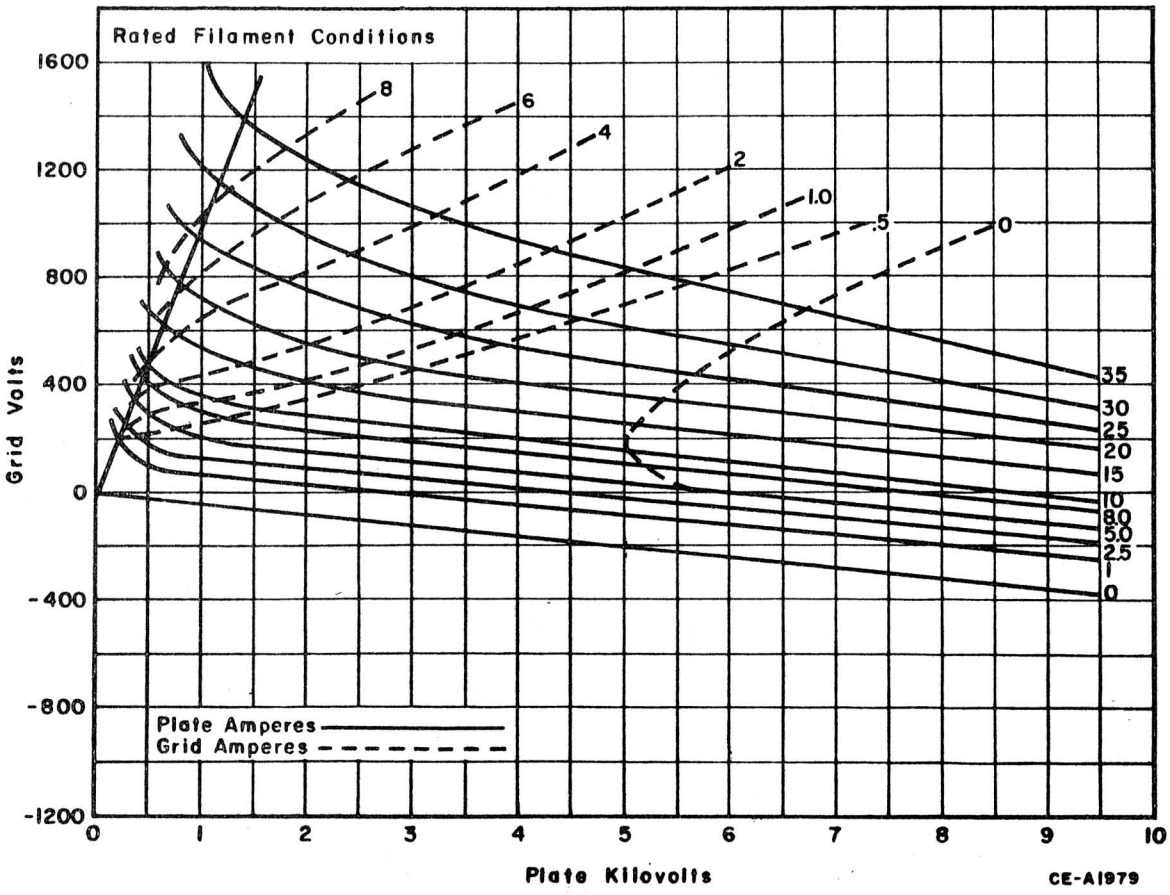
Typical Operating Characteristics:

DC Plate Voltage	8500	volts
DC Grid Voltage	-1050	volts
Peak R.F. Grid Voltage	1550	volts
DC Plate Current	2.35	amperes
DC Grid Current	0.35	ampere
Peak R.F. Plate Voltage	7900	volts
**Driving Power	530	watts
Power Output	17.2	kilowatts
Power Input	20.0	kilowatts

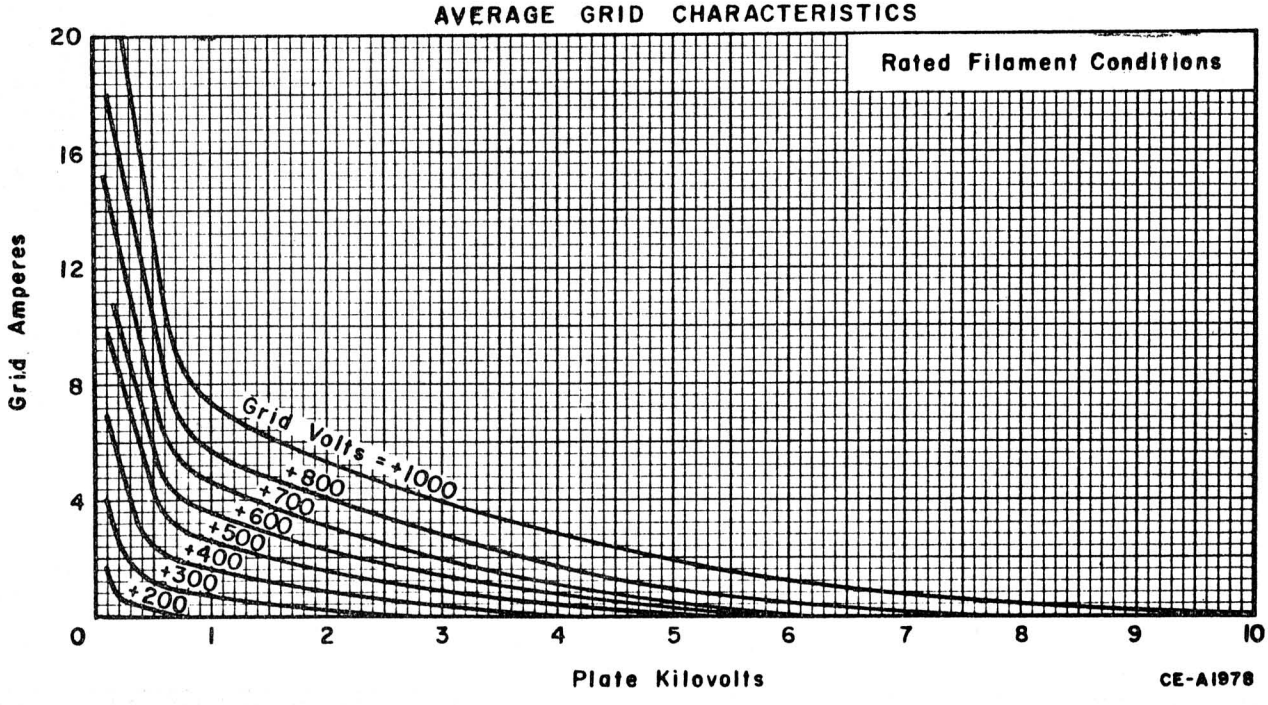
**Allowance must be made for grid circuit losses which are not included.



AVERAGE CONSTANT CURRENT CHARACTERISTICS



AVERAGE GRID CHARACTERISTICS



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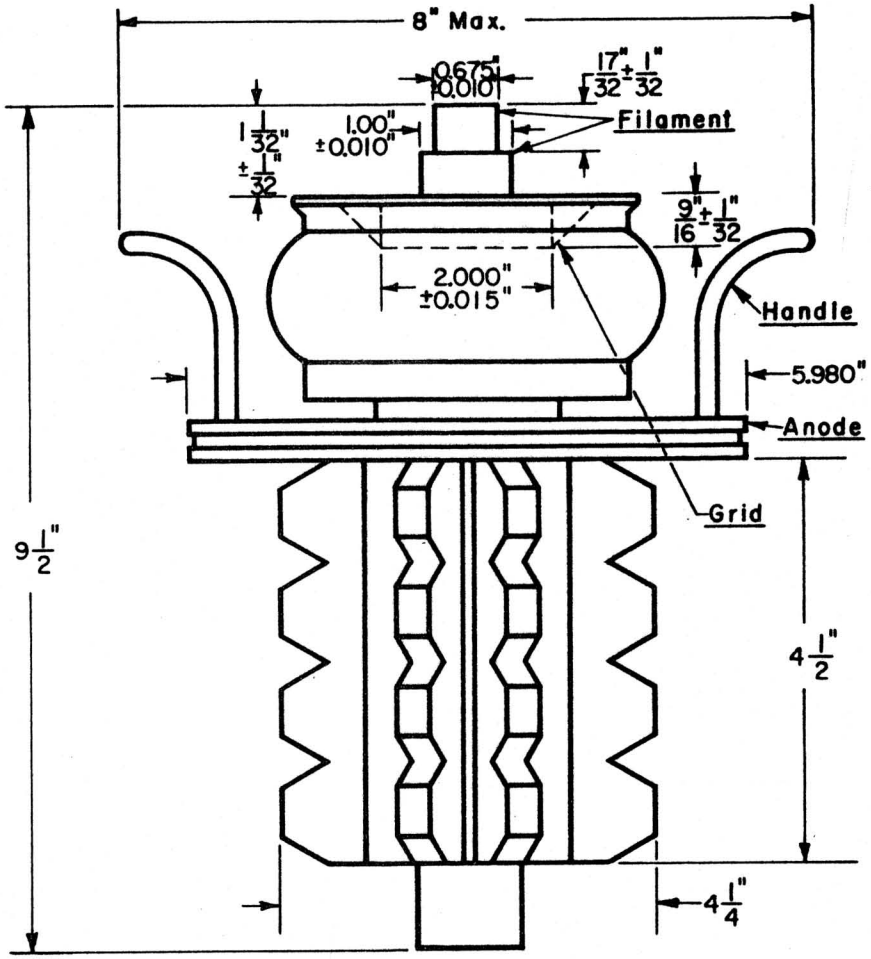
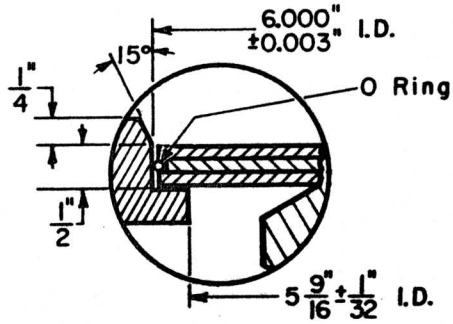
DEVELOPMENTAL DEVICE
Tentative Data





Dimensions Of Recommended Boiler Opening

CE-A1984

HIGH VACUUM AMPLIFIER TYPE WX-5394

The WX-5394 is a vapor-cooled three electrode tube designed for 40 to 50 KW industrial heating service and AM broadcasting. The tube features rugged coaxial mounting structures providing high-dissipation, low-inductance r-f electrode terminals. The heavy wall anode is capable of dissipating 40 kilowatts by vaporization of water in a boiler. The increased mass of the anode-rib structure permits substantially higher power during momentary overloads. The cathode is a sturdy, self-supporting, stress-free, thoriated-tungsten filament. Maximum ratings apply to 30 megacycles.

ELECTRICAL

Cathode	Thoriated-Tungsten Filament
Filament:	
Voltage	8.0 Volts
Current	200 Amperes
Starting Current (max.)	800 Amperes
Cold Resistance	0.0051 Ohms
Amplification Factor	20
Interelectrode Capacitances:	
Grid-to-Plate	38 pf
Grid-to Filament	50 pf
Plate-to-Filament	1.8 pf

MECHANICAL

Mounting Position	Vertical, Anode Down
Type of Cooling	Water Vaporization
Maximum Glass Temperature (Note 1)	165 °C

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR, CLASS B

MAXIMUM RATINGS

Absolute Maximum Values

DC Plate Voltage	12.5 max. Kilovolts
DC Plate Current	8.0 max. Amperes
Plate Power Input	80 max. Kilowatts
Plate Dissipation (Note 2)	40 max. Kilowatts

Δ The WX- number identifies a specific laboratory design; the design and, consequently, the data and type number are subject to change. No obligations are assumed to manufacture this particular device in the future unless otherwise arranged. These drawings and specifications are the property of Westinghouse Electric Corporation, Electronic Tube Division, and shall not be reproduced or copied or used as the basis for the manufacture or sale of apparatus and/or devices without permission.

TYPICAL OPERATION(Two Tubes in Push-Pull)

DC Plate Voltage	8.5	12.0	Kilovolts
DC Grid Voltage	-400	-550	Volts
Peak AF Grid-to-Grid Voltage	1600	2120	Volts
Zero-Signal DC Plate Current	1.3	2.4	Amperes
Max.-Signal DC Plate Current	7.8	12.4	Amperes
Effective Plate-to-Plate Load Resistance	2300	1950	Ohms
Driving Power	200	170	Watts
Power Output	42	93	Kilowatts

RADIO FREQUENCY POWER AMPLIFIER, CLASS B
Carrier Conditions per Tube with Max. Modulation Factor of 1.0

MAXIMUM RATINGS
Absolute Maximum Values

DC Plate Voltage	12.5 max.	Kilovolts
DC Plate Current	8.0 max.	Amperes
Plate Power Input	80 max.	Kilowatts
Plate Dissipation	40 max.	Kilowatts

TYPICAL OPERATION

DC Plate Voltage	10.0	12.0	Kilovolts
DC Grid Voltage	-450	-550	Volts
Peak RF Grid Voltage	580	600	Volts
DC Plate Current	3.6	3.2	Amperes
DC Grid Current	0	0	Amperes
Driving Power	550	480	Watts
Power Output	12	13.5	Kilowatts

PLATE MODULATED RF POWER AMPLIFIER
CLASS C TELEPHONY
Carrier Conditions per Tube with Max. Modulation Factor of 1.0

MAXIMUM RATINGS
Absolute Maximum Values

DC Plate Voltage	9.0 max.	Kilovolts
DC Grid Voltage	-2000 max.	Volts
DC Plate Current	6.0 max.	Amperes
DC Grid Current	1.0 max.	Amperes
Plate Power Input	53 max.	Kilowatts
Plate Dissipation	26 max.	Kilowatts

TYPICAL OPERATION

DC Plate Voltage	8.5	Kilovolts
Peak RF Plate Voltage	7.0	Kilovolts
DC Grid Voltage	-1400	Volts
Peak RF Grid Voltage	2140	Volts
DC Plate Current	4.8	Amperes
DC Grid Current	0.50	Amperes
Driving Power	1100	Watts
Power Output	30.7	Kilowatts

RF POWER AMPLIFIER AND OSCILLATOR
CLASS C TELEGRAPHY

MAXIMUM RATINGS

Absolute Maximum Values	30 Mc.	70 Mc.	
DC Plate Voltage	12.5	7.5	max. Kilovolts
DC Grid Voltage	-2000	-2000	max. Volts
DC Plate Current	8.0	8.0	max. Amperes
DC Grid Current	1.0	0.8	max. Amperes
Plate Power Input	80	48	max. Kilowatts
Plate Dissipation	40	40	max. Kilowatts

TYPICAL OPERATION	Cathode Drive	Grid Drive		
DC Plate Voltage	7.5	10.0	12.0	Kilovolts
Peak RF Plate Voltage	5.6	8.0	9.8	Kilovolts
DC Grid Voltage	-850	-1100	-1200	Volts
Peak RF Grid Voltage	1500	1880	1940	Volts
DC Plate Current	5.3	6.5	6.4	Amperes
DC Grid Current	0.35	0.48	0.35	Ampere
Driving Power	7500	900	670	Watts
Power Output	33	46.4	55.4	Kilowatts

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

Characteristic		Conditions	Min.	Bogey	Max.	Units
Grid Voltage	(1)	Plate Volts=1500 Plate Amp=28	--	--	1000	Volts
	(2)	Plate KV=10 Plate Amp=0.02	-480	-560	-640	Volts
Grid Current		Plate Volts=1500 Plate Amp=28	--	--	8.5	Amperes
Plate Voltage	(1)	Grid Volts=0 Plate Amp=3	3.3	3.8	4.3	Kilovolts
	(2)	Grid Volts=-400 Plate Amp=3	10.2	11.3	12.4	Kilovolts
Plate Power Out.		Plate KV=12 Plate Amp=6.4 Grid Volts=-1200 Grid Amp=0.35	47	--	--	Kilowatts

FREQUENCY DERATING CHART

Service	30 Mc.	50 Mc.	70 Mc.
Class B	100 %	90 %	70 %
Class C	100 %	75 %	60 %

Westinghouse

DEVELOPMENTAL DEVICE
Tentative Data

TUBE PROTECTION NOTES

The handling of high power requires particular attention to the removal of power under fault conditions, since the large amount of energy involved can severely damage the electron tube if not properly controlled. Therefore the ground leads of the plate and grid circuits should be equipped with individual quick-acting overload relays which will remove power from these circuits within 1/10 second.

Additional protection is recommended and may be obtained by connecting a resistor in series with the plate lead of each tube for protection of the tube during the time required for the plate overload relay to act. A suitable resistor should be added unless the equivalent circuit impedance exists, e.g. in transformer reactance. The criterion is the total energy to which the tube can be subjected. The minimum value of resistance which alone will give adequate protection with reasonably low power loss is as follows:

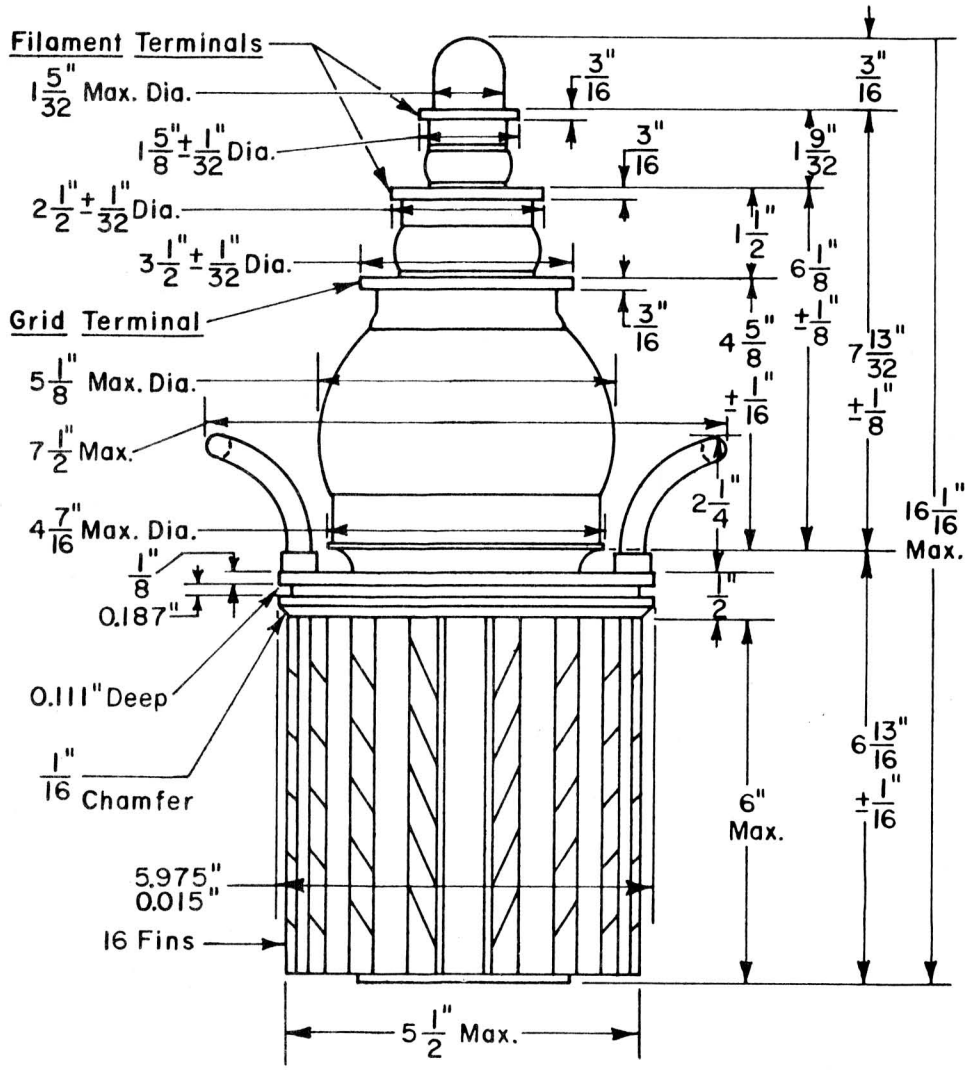
Series Resistor.	15	25	40	60	ohms
Maximum Power Output of Rectifier .	80	160	320	640	kW

NOTE

1. Approximately 100 cubic feet per minute of cooling air is required on the filament and grid seals.
2. With regular boiler. Using a new design boiler, 60 KW , may be dissipated. For details see Ind. & S.P. Tube Engineering, Westinghouse Electric Corp., Elmira, N. Y.

ACCESSORIES

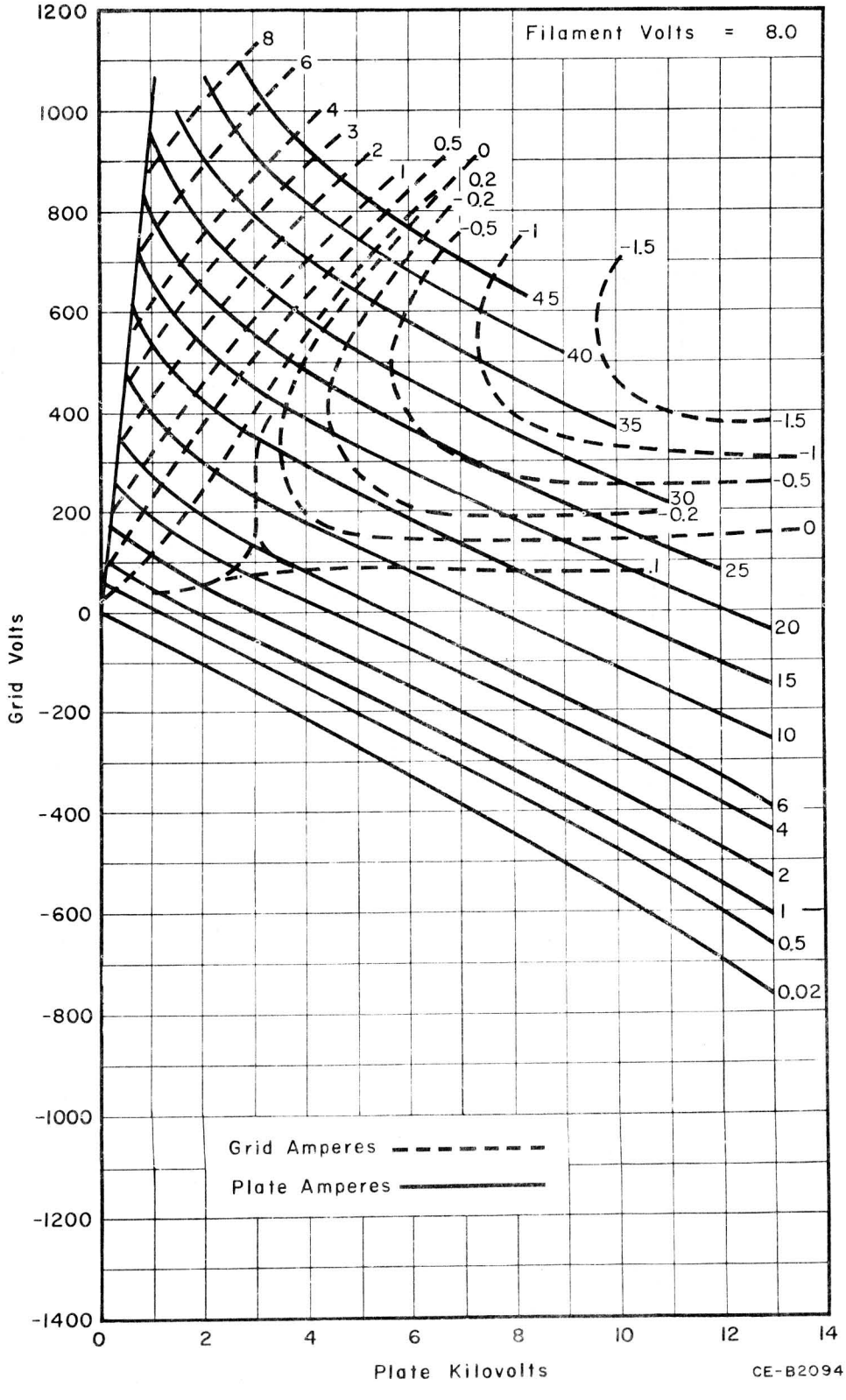
Small Filament Connector	WL-22700
Large Filament Connector	WL-22699
Grid Connector	WL-22701
Boiler	See Tube Manufacturer
O-Ring	Parker No. 2-256


Filament Terminals
1 5/32" Max. Dia.
1 5/8" ± 1/32" Dia.
2 1/2" ± 1/32" Dia.
3 1/2" ± 1/32" Dia.
Grid Terminal
5 1/8" Max. Dia.
7 1/2" Max.
4 7/16" Max. Dia.
1/8"
0.187"
0.111" Deep
1/16" Chamfer
5.975"
0.015"
16 Fins
5 1/2" Max.
3/16"
3/16"
3/16"
3/16"
1 9/32"
1 1/2"
6 1/8"
± 1/8"
4 5/8"
± 1/16"
7 13/32"
± 1/8"
2 1/4"
16 1/16"
Max.
1/2"
6"
Max.
6 13/16"
± 1/16"

Westinghouse

DEVELOPMENTAL DEVICE
Tentative Data

AVERAGE CONSTANT CURRENT CHARACTERISTICS



CE-B2094

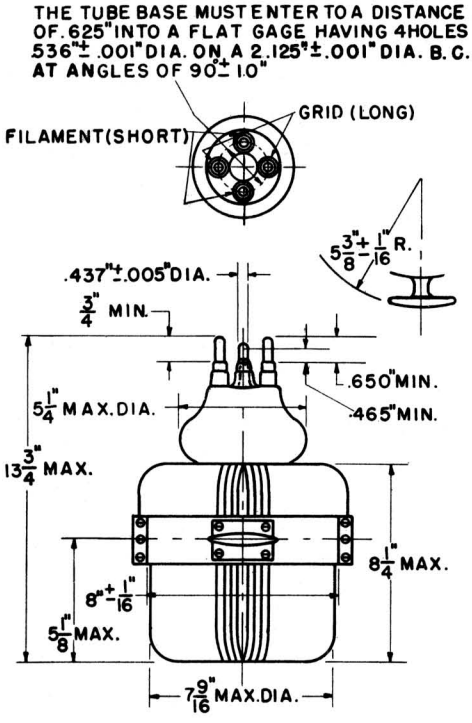
POWER AMPLIFIER TRIODE TYPE 5604

The 5604 is a three-electrode tube designed for use as an oscillator, amplifier, and modulator. The forced-air-cooled anode is capable of dissipating 10 kilowatts. A pure tungsten filament is employed. Maximum ratings apply up to 22.5 megacycles.

ELECTRICAL:	Min.	Bogey	Max.	
Filament Voltage	--	11.0	11.5	Volts
Filament Current at Bogey Voltage	168	176	184	Amperes
Filament Starting Current	--	--	270	Amperes
Filament Cold Resistance	--	0.0052	--	Ohms
Amplification Factor	17.5	19.5	22.5	
Interelectrode Capacitances:				
Grid to Plate	22.5	25.0	27.5	$\mu\mu$f
Grid to Filament	27.0	30.0	33.0	$\mu\mu$f
Plate to Filament	1.00	1.25	1.50	$\mu\mu$f

MECHANICAL:

Mounting Position	Vertical, Anode Down			
Type of Cooling	Forced Air			
Maximum Incoming Air Temperature	45 °C			
Minimum Required Air Flow on Anode:				
Plate Dissipation	100	80	60	% Rating
Air Flow	750	525	350	CFM
Pressure (static)	2.0	1.0	0.45	Inches H_2O
Required Air Flow on Filament and Grid Seals: (Note 1)				
Maximum Glass Temperature	160 °C			
Maximum Radiator Temperature	230 °C			
Net Weight, (approximate)	45 Pounds			
Shipping Weight, (approximate)	96 Pounds			



AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR, CLASS B

MAXIMUM RATINGS:

Absolute Maximum Values			
DC Plate Voltage	12500 max.		Volts
DC Plate Current at Maximum Signal (Note 2)	2.75 max.		Amperes
Plate Input at Maximum Signal (Note 2)	32.5 max.		Kilowatts
Plate Dissipation (Note 2)	10.0 max.		Kilowatts

TYPICAL OPERATION:

Unless Otherwise Specified, Values are for Two Tubes				
Filament Voltage	10.2	10.6	11.0	
DC Plate Voltage	8000	10000	12000	Volts
DC Grid Voltage	-370	-480	-600	Volts
Peak Audio-Frequency Voltage Grid-to-Grid	1620	2020	2380	Volts
DC Plate Current at Zero Signal	0.4	0.5	0.6	Amperes
DC Plate Current at Maximum Signal	2.6	3.7	4.5	Amperes
Effective Load Resistance, Plate-to-Plate	7200	6100	5900	Ohms
Maximum Signal Driving Power, (approximate)	140	150	160	Watts
Maximum Signal Power Output	14.5	25	36	Kilowatts

RADIO-FREQUENCY POWER AMPLIFIER, CLASS B

Carrier Conditions per tube for use with a Maximum Modulation Factor of 1.0

MAXIMUM RATINGS:

Absolute Maximum Values			
DC Plate Voltage	12500 max.		Volts
DC Plate Current	1.4 max.		Amperes
Plate Input	16 max.		Kilowatts
Plate Dissipation	10 max.		Kilowatts

TYPICAL OPERATION:

Filament Voltage	9.9	10.2	10.5	Volts
DC Plate Voltage	8000	10000	12000	Volts
DC Grid Voltage	-400	-500	-610	Volts
Peak Radio-Frequency Grid Voltage	410	490	590	Volts
DC Plate Current	0.6	0.8	1.0	Ampere
DC Grid Current, (approximate)	0.00	0.00	0.00	Ampere
Driving Power, (approximate) (Note 3)	75	70	65	Watts
Power Output, (approximate)	1700	2800	4400	Watts

RADIO-FREQUENCY POWER AMPLIFIER AND OSCILLATOR, CLASS C TELEGRAPHY

Key-Down Conditions per Tube
Without Amplitude Modulation (Note 4)

MAXIMUM RATINGS:
Absolute Maximum Values

Plate Voltage	12500 max.	Volts
Plate Current	3.0 max.	Amperes
Plate Input	32.5 max.	Kilowatts
Plate Dissipation	10 max.	Kilowatts
DC Grid Voltage	−2000 max.	Volts
DC Grid Current	0.45 max.	Ampere

TYPICAL OPERATION:

Filament Voltage	10.5	10.7	10.9	Volts
DC Plate Voltage	8000	10000	12000	Volts
DC Grid Voltage	−680	−870	−1170	Volts
Peak Radio-Frequency Grid Voltage	1300	1620	2130	Volts
DC Plate Current	1.5	2.0	2.5	Amperes
DC Grid Current	0.19	0.20	0.22	Ampere
Driving Power, (approximate)	250	320	470	Watts
Power Output, (approximate)	9.2	15	22.5	Kilowatts

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER CLASS C TELEPHONY

Carrier Conditions per Tube for Use with a Maximum Modulation Factor of 1.0

MAXIMUM RATINGS:
Absolute Maximum Values

DC Plate Voltage	8000 max.	Volts
DC Grid Voltage	−2000 max.	Volts
DC Plate Current	1.5 max.	Amperes
DC Grid Current	0.45 max.	Ampere
Plate Input	12 max.	Kilowatts
Plate Dissipation	6 max.	Kilowatts

TYPICAL OPERATION:

Filament Voltage	10.4	10.7	Volts
DC Plate Voltage	6000	8000	Volts
DC Grid Voltage	−740	−1000	Volts
Peak Radio-Frequency Grid Voltage	1140	1540	Volts
DC Plate Current	0.7	1.1	Amperes
DC Grid Current, (approximate)	0.09	0.13	Ampere
Driving Power, (approximate)	100	200	Watts
Power Output, (approximate)	3.4	7.1	Kilowatts

HIGH FREQUENCY RATINGS

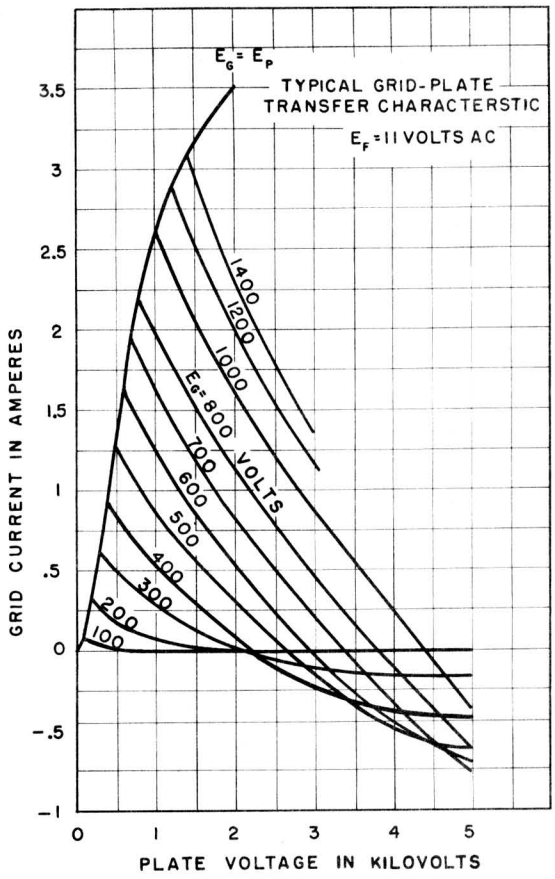
Maximum ratings apply up to 22.5 megacycles. The tube may be operated at higher frequencies provided the maximum values of the plate voltage and power input are reduced according to the tabulation below. All other maximum ratings remain as shown above. Special attention should be given to adequate ventilation of the bulb at these frequencies.

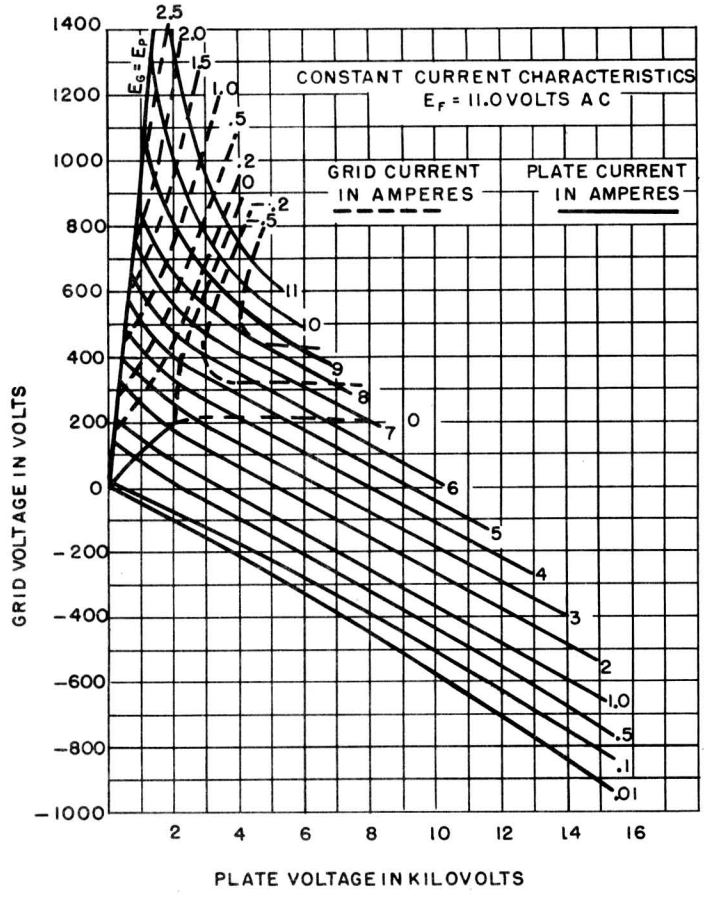
FREQUENCY	CLASS B		CLASS C	
	Percent of Maximum		Percent of Maximum	
Megacycles	Plate Volts	Input Watts	Plate Volts	Input Watts
22.5	100	100	100	100
30	85	85	80	80
45	70	70	50	50

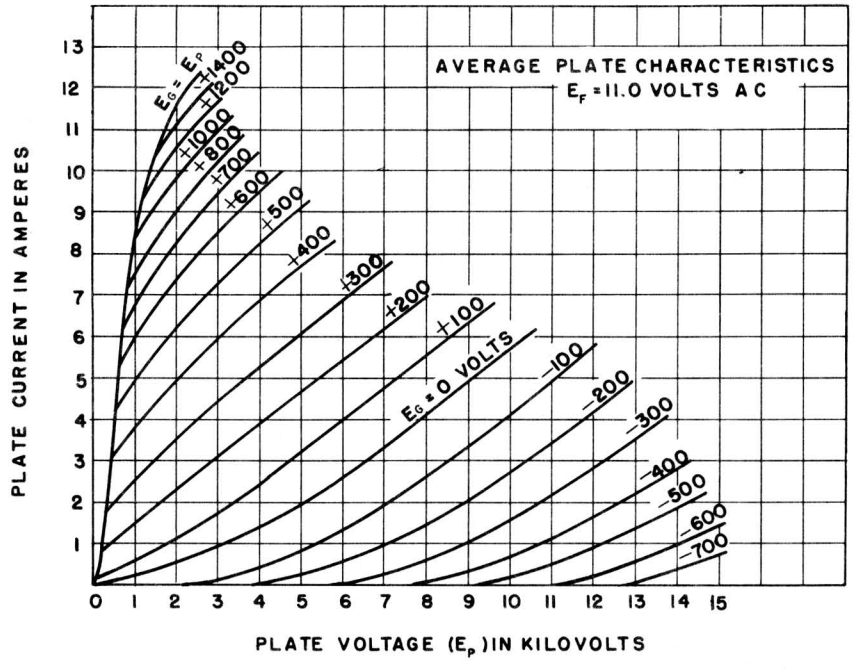
CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

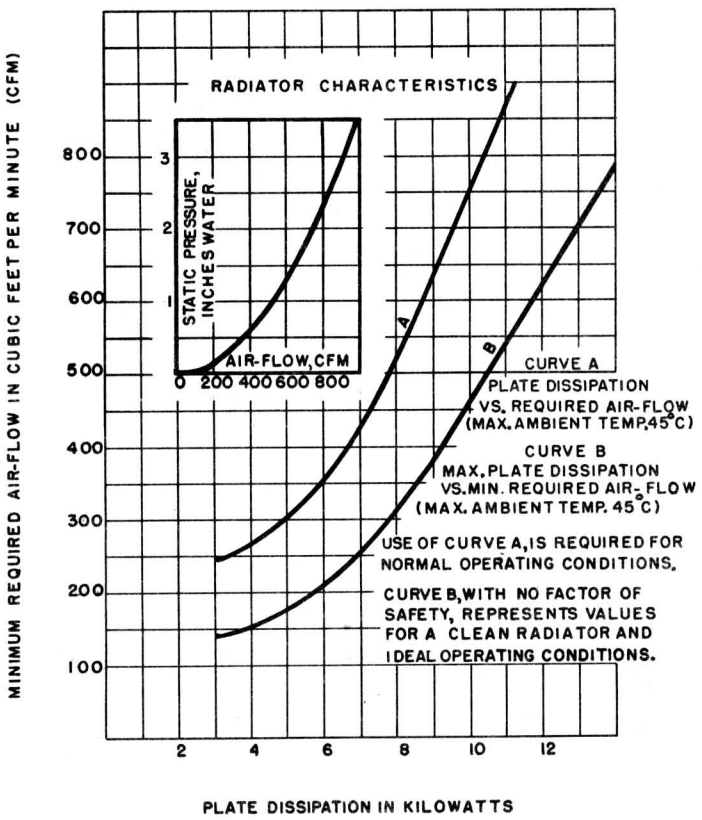
Characteristic	Conditions	Min.	Bogey	Max.	
Grid Voltage	i_b = 8 amperes e_b = 1500 volts	--	--	830	Volts
Grid Voltage	I_b = 0.20 amperes E_b = 10000 volts	−480	−520	−600	Volts
Grid Current	i_b = 8 amperes e_b = 1500 volts	--	--	1.6	Amperes
Plate Voltage	I_b = 1.25 amperes E_c = 0 volts	3300	3700	4100	Volts
Plate Voltage	I_b = 1.25 amperes E_c = −200 volts	6900	7600	8300	Volts
Peak Cathode Current (Note 5)		11.6	--	--	Ampere
Power Output (Note 6)	E_b = 12500 volts R_g = 6000 ohms I_b = 2.6 amperes I_g = 0.23 amperes	22	--	--	Kilowatts
Power Output (Note 7)	E_b = 6250 volts R_g = 2700 ohms I_b = 2.6 amperes I_g = 0.26 amperes	8	--	--	Kilowatts

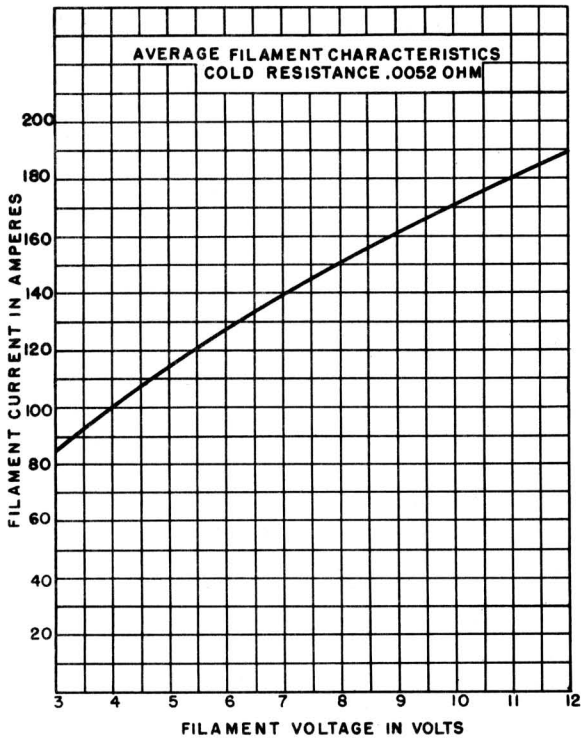
1. At frequencies above 15 mc/sec. additional air flow on the center of the dish by deflection of the anode cooling air or by a separate blower providing 50 cfm through a 3" nozzle may be required to keep the grid and filament seals and the dish itself below 160°C. Under extreme conditions it may also be necessary to utilize heat radiating connectors for the grid and filament posts.
2. Averaged over any audio-frequency cycle of sine-wave form.
3. At crest of audio-frequency cycle with modulation factor of 1.0.
4. Modulation, essentially negative, may be used if the positive peak of the carrier envelope does not exceed 115 percent of the carrier conditions.
5. Represents maximum usable cathode current for the tube as plate current plus grid current for any condition of operation.
6. Amplifier or oscillator performance. Conditions chosen for frequency not affecting performance.
7. Amplifier or oscillator performance at maximum rated frequency.

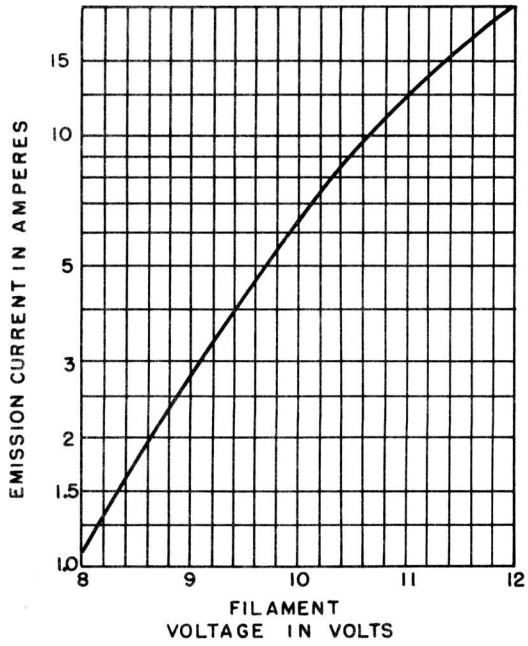

TYPICAL GRID-PLATE TRANSFER CHARACTERSTIC
E_F = 11 VOLTS AC
$E_G = E_P$
1400
1200
1000
E_G = 800 VOLTS
700
600
500
400
300
200
100
GRID CURRENT IN AMPERES
PLATE VOLTAGE IN KILOVOLTS


CONSTANT CURRENT CHARACTERISTICS
E_F = 11.0 VOLTS AC
GRID CURRENT IN AMPERES
PLATE CURRENT IN AMPERES
$E_G = E_P$
GRID VOLTAGE IN VOLTS
PLATE VOLTAGE IN KILOVOLTS


AVERAGE PLATE CHARACTERISTICS
E_F = 11.0 VOLTS AC
$E_G = E_P$
+1400
+1200
+1000
+800
+700
+600
+500
+400
+300
+200
+100
E_G = 0 VOLTS
-100
-200
-300
-400
-500
-600
-700
PLATE CURRENT IN AMPERES
PLATE VOLTAGE (E_P) IN KILOVOLTS







Westinghouse

5606

May 15, 1961

INDUSTRIAL HEATING TRIODE TYPE 5606

The 5606 is a three electrode tube designed for service as an industrial heating power oscillator. The external, water-cooled anode is capable of dissipating 10 kilowatts. The cathode is a pure tungsten filament. Maximum ratings apply to 1.6 megacycles.

ELECTRICAL:

Cathode	Pure Tungsten Filament			
Filament:	Min.	Bogey	Max.	
Voltage	--	22	--	Volts
Current at Bogey Volts	57	60	62	Amperes
Starting Current	--	--	120	Amperes
Cold Resistance	--	0.032	--	Ohms
Amplification Factor with Plate Amps = 0.75 & Grid Volts = -50	42.5	50	57.5	
Interelectrode Capacitances:				
Grid-to-Plate	27	30	33	$\mu\mu f$
Grid-to-Filament	12	16	20	$\mu\mu f$
Plate-to-Filament	0.5	1.5	2.5	$\mu\mu f$

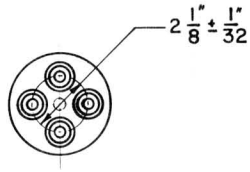
MECHANICAL:

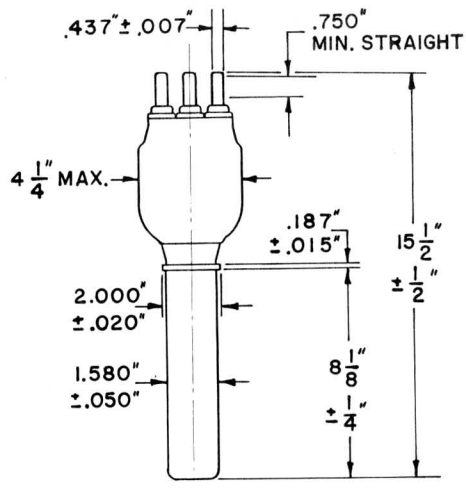
Mounting Position	Vertical, Anode Down
Type of Cooling	Water
Water Flow on Anode	3 to 8 GPM
Maximum Outgoing Water Temperature	70°C
Air Flow on Grid and Filament Seals⊕	35 CFM
Maximum Glass Temperature	160°C
Net Weight (Approx.)	3.5 Pounds

⊕ Sufficient flow should be directed on center of dish from 3" nozzle to keep temperature of any part of bulb, dish or seals below 160 °C.

BASE CONNECTIONS

GRID – RED
FILAMENT – BLACK





MAXIMUM RATINGS:

Absolute Maximum Values

DC Plate Voltage	14 max.		Kilovolts
DC Grid Voltage	-1600 max.		Volts
DC Plate Current	2.0 max.		Amperes
DC Grid Current	0.40 max.		Amperes
Plate Power Input	25 max.		Kilowatts
Plate Power Dissipation	10 max.		Kilowatts

TYPICAL OPERATING CHARACTERISTICS:

DC Plate Voltage	8000	10000	12000	Volts
DC Grid Voltage	-700	-900	-1100	Volts
Peak R-F Grid Voltage	1440	1730	2040	Volts
Peak R-F Plate Voltage	6400	8100	9900	Volts
DC Plate Current	1.4	1.6	1.8	Amperes
DC Grid Current, (Approx.)	0.20	0.20	0.20	Amperes
Power Output, (Approx.)	7800	11300	15500	Watts

FREQUENCY DERATING

Maximum Ratings apply up to 1.6 megacycles. The 5606 may be operated at higher frequencies if Plate Voltage and Plate Power Input is reduced as shown.

Frequency	1.6	7.5	20	Megacycles
Percentage of Maximum Permissible Plate Voltage and Plate Power Input	100	75	50	Percent

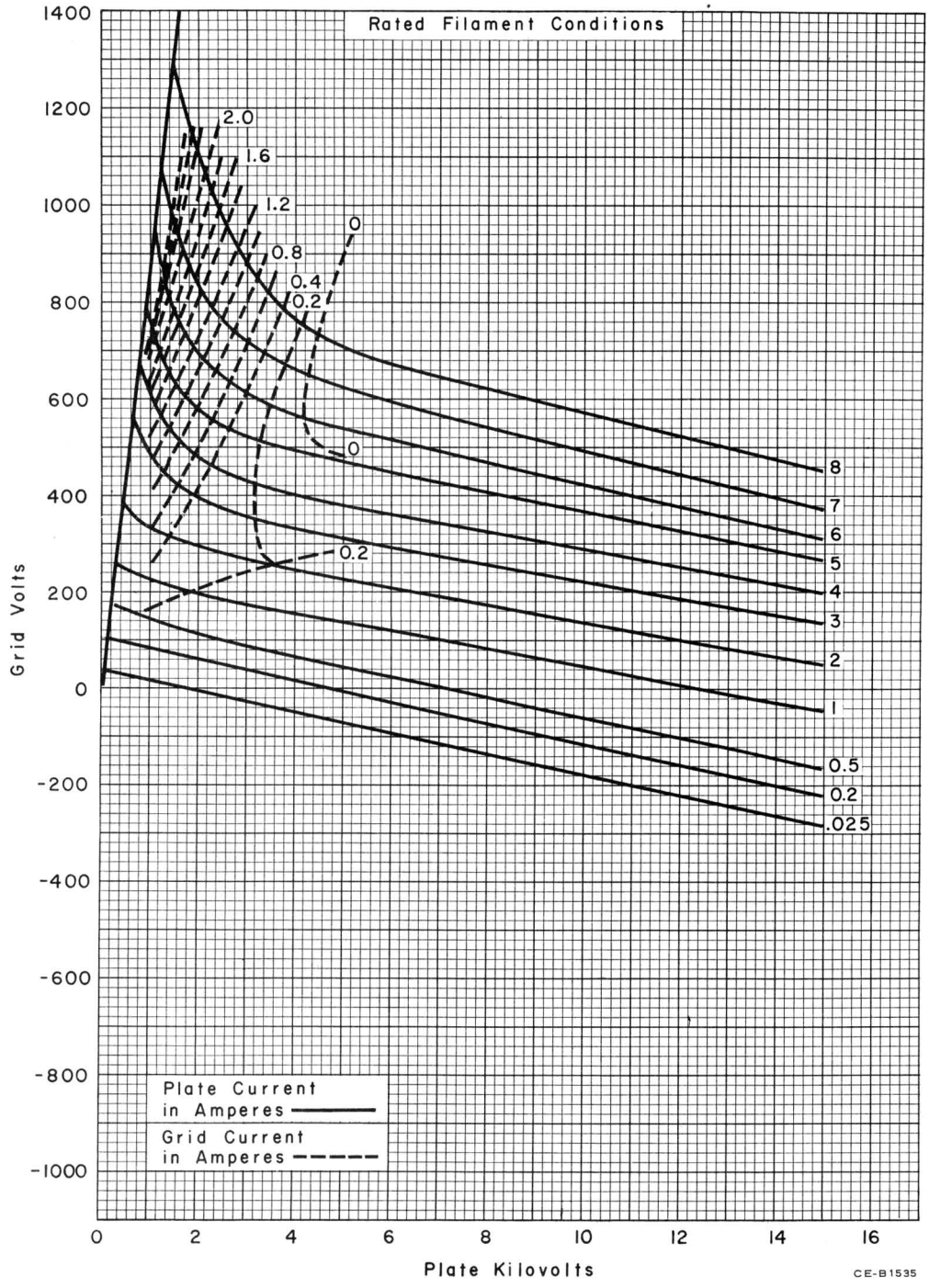
With operation at frequencies exceeding 3 megacycles, special attention should be given to the cooling of the bulb and terminal seals. Heat radiating connectors for grid and filament leads should be used when operating frequencies exceed 3 megacycles.

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN:

	Min.	Bogey	Max.	
Grid Voltage: Plate Kilovolts = 2.0, Plate Amperes = 8.0, Grid Voltage	--	--	1300	Volts
Grid Current: Plate Kilovolts = 2.0, Plate Amperes = 8.0, Grid Current	--	--	3.5	Amperes
Plate Voltage: Grid Volts = 0, Plate Amperes = 0.5, Plate Voltage	5.0	7.3	8.6	Kilovolts
Grid Volts = -100, Plate Amperes = 0.5, Plate Voltage	10.0	12.3	14.8	Kilovolts
Grid Cutoff Voltage: Plate Kilovolts = 15, Plate Amperes = 0.02, Grid Cutoff Voltage	-220	-300	-420	Volts
Power Output: Plate Kilovolts = 12, Grid Volts = -1100, Plate Amperes = 1.8, Grid Amperes = 0.2, Power Output	13.0	..	--	Kilowatts

High Vacuum Amplifier Section

AVERAGE CONSTANT CURRENT CHARACTERISTICS



September 15, 1961

INDUSTRIAL HEATING TRIODE TYPE 5606A

The type 5606A is a three electrode tube designed for service as an industrial heating power oscillator. The external, water-cooled anode is capable of dissipating 10 kilowatts. The cathode is a pure tungsten filament. Maximum ratings apply to 1.6 megacycles.

The type 5606A differs from the type 5606 in having a lower mu. The design is not standardized at this time. To obtain engineering and sales information on type 5606A, contact:

Westinghouse Electric Corp.
Electronic Tube Division
P.O. Box 284
Elmira, New York

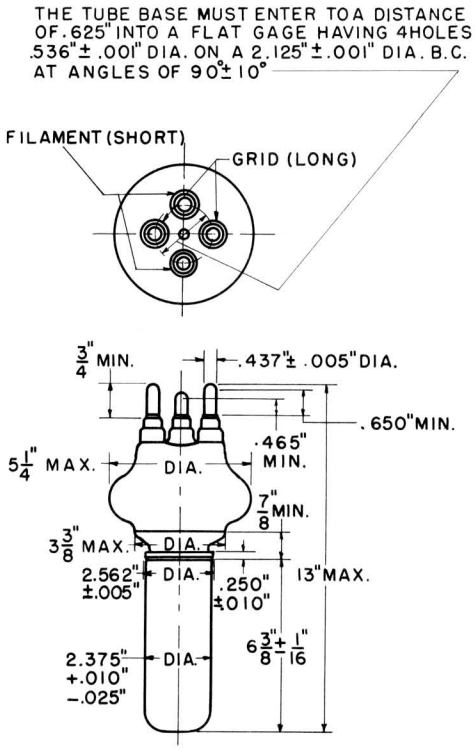
POWER AMPLIFIER TRIODE TYPE 5619

The 5619 is a three-electrode tube designed for use as an oscillator, amplifier, and modulator. The water cooled anode is capable of dissipating 20 kilowatts. A pure tungsten filament is employed. Maximum ratings apply up to 22.5 megacycles.

ELECTRICAL:	Min.	Bogey	Max.	
Filament Voltage	--	11.0	11.5	Volts
Filament Current at Bogey Voltage	168	176	184	Amperes
Filament Starting Current	--	--	270	Amperes
Filament Cold Resistance	--	0.0052	--	Ohms
Amplification Factor	17.5	19.5	22.5	
Interelectrode Capacitances:				
Grid to Plate	21.5	24.0	26.5	$\mu\mu$f
Grid to Filament	27.0	30.0	33.0	$\mu\mu$f
Plate to Filament	0.75	1.00	1.25	$\mu\mu$f

MECHANICAL:

Mounting Position	Vertical, Anode Down
Type of Cooling	Water
Required Water Flow	See Curve, Page 4
Maximum Outgoing Water Temperature	70 °C
Required Air Flow on Filament and Grid Seals: (Note 1)	
Maximum Glass Temperature	160 °C
Net Weight, (approximate)	6 Pounds
Shipping Weight, (approximate)	12 Pounds



AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR, CLASS B

MAXIMUM RATINGS:

Absolute Maximum Values

DC Plate Voltage	12500 max.		Volts
DC Plate Current at Maximum Signal (Note 2)	3.0 max.		Amperes
Plate Input at Maximum Signal (Note 2)	32.5 max.		Kilowatts
Plate Dissipation (Note 2)	20.0 max.		Kilowatts

TYPICAL OPERATION:

Unless Otherwise Specified, Values are for Two Tubes

Filament Voltage	10.2	10.6	11.0	Volts
DC Plate Voltage	8000	10000	12000	Volts
DC Grid Voltage	-370	-480	-600	Volts
Peak Audio-Frequency Voltage Grid-to-Grid	1620	2020	2380	Volts
DC Plate Current at Zero Signal	0.4	0.5	0.6	Amperes
DC Plate Current at Maximum Signal	2.6	3.7	4.5	Amperes
Effective Load Resistance, Plate-to-Plate	7200	6100	5900	Ohms
Maximum Signal Driving Power, (approximate)	140	150	160	Watts
Maximum Signal Power Output	14.5	25	36	Kilowatts

RADIO-FREQUENCY POWER AMPLIFIER, CLASS B

Carrier Conditions per tube for use with a Maximum Modulation Factor of 1.0

MAXIMUM RATINGS:

Absolute Maximum Values

DC Plate Voltage	12500	max.	Volts
DC Plate Current	1.5	max.	Amperes
Plate Input	18.5	max.	Kilowatts
Plate Dissipation	16	max.	Kilowatts

TYPICAL OPERATION:

Filament Voltage	9.9	10.2	10.5	Volts
DC Plate Voltage	8000	10000	12000	Volts
DC Grid Voltage	-400	-500	-610	Volts
Peak Radio-Frequency Grid Voltage	410	490	590	Volts
DC Plate Current	0.6	0.8	1.0	Ampere
DC Grid Current, (approximate)	0.00	0.00	0.00	Ampere
Driving Power, (approximate) (Note 3)	75	70	65	Watts
Power Output, (approximate)	1700	2800	4400	Watts

RADIO-FREQUENCY POWER AMPLIFIER AND OSCILLATOR, CLASS C TELEGRAPHY

Key-Down Conditions per Tube
Without Amplitude Modulation (Note 4)

MAXIMUM RATINGS:
Absolute Maximum Values

Plate Voltage	12500 max.	Volts
Plate Current	3.0 max.	Amperes
Plate Input	32.5 max.	Kilowatts
Plate Dissipation	20 max.	Kilowatts
DC Grid Voltage	−2000 max.	Volts
DC Grid Current	0.45 max.	Ampere

TYPICAL OPERATION:

Filament Voltage	10.5	10.7	10.9	Volts
DC Plate Voltage	8000	10000	12000	Volts
DC Grid Voltage	−680	−870	−1170	Volts
Peak Radio-Frequency Grid Voltage	1300	1620	2130	Volts
DC Plate Current	1.5	2.0	2.5	Amperes
DC Grid Current	0.19	0.20	0.22	Ampere
Driving Power, (approximate)	250	320	470	Watts
Power Output, (approximate)	9.2	15	22.5	Kilowatts

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER CLASS C TELEPHONY

Carrier Conditions per Tube for Use with a Maximum Modulation Factor of 1.0

MAXIMUM RATINGS:
Absolute Maximum Values

DC Plate Voltage	10500 max.	Volts
DC Grid Voltage	−2000 max.	Volts
DC Plate Current	1.5 max.	Amperes
DC Grid Current	0.45 max.	Ampere
Plate Input	15 max.	Kilowatts
Plate Dissipation	13.3 max.	Kilowatts

TYPICAL OPERATION:

Filament Voltage	10.4	10.7	11.0	Volts
DC Plate Voltage	6000	8000	10000	Volts
DC Grid Voltage	−740	−1000	−1300	Volts
Peak Radio-Frequency Grid Voltage	1140	1540	1930	Volts
DC Plate Current	0.7	1.1	1.4	Amperes
DC Grid Current, (approximate)	0.09	0.13	0.15	Ampere
Driving Power, (approximate)	100	200	280	Watts
Power Output, (approximate)	3.4	7.1	11.9	Kilowatts

HIGH FREQUENCY RATINGS

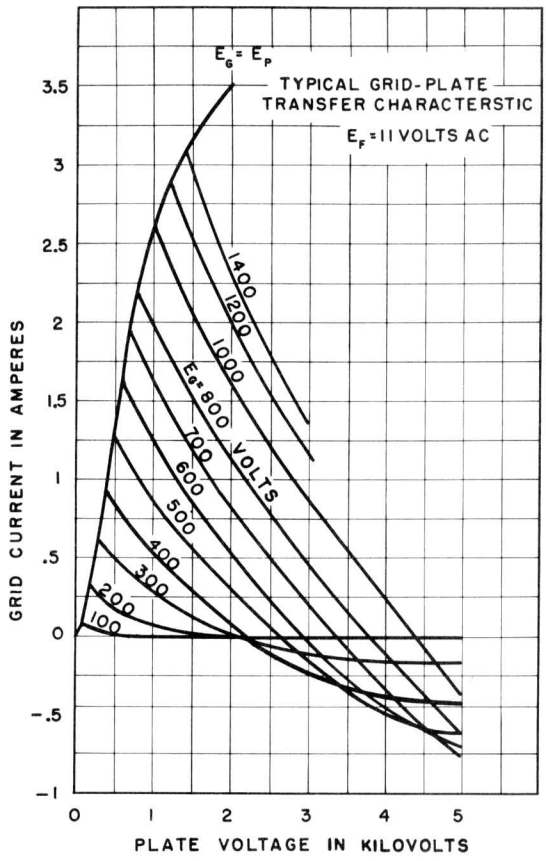
Maximum ratings apply up to 22.5 megacycles. The tube may be operated at higher frequencies provided the maximum values of the plate voltage and power input are reduced according to the tabulation below. All other maximum ratings remain as shown above. Special attention should be given to adequate ventilation of the bulb at these frequencies.

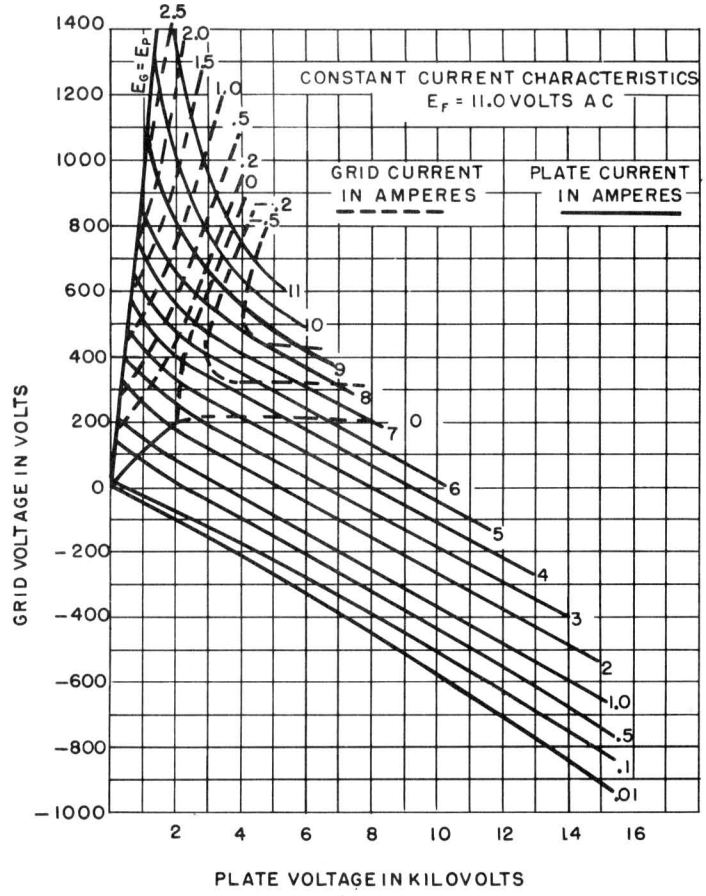
FREQUENCY	CLASS B		CLASS C	
	Percent of Maximum		Percent of Maximum	
Megacycles	Plate Volts	Input Watts	Plate Volts	Input Watts
22.5	100	100	100	100
30	85	85	80	80
45	70	70	50	50

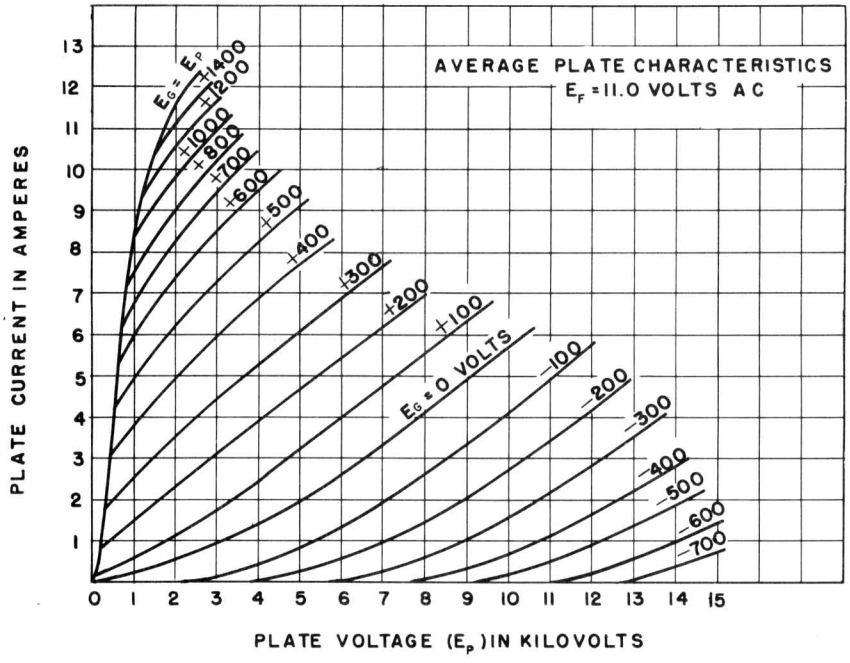
CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

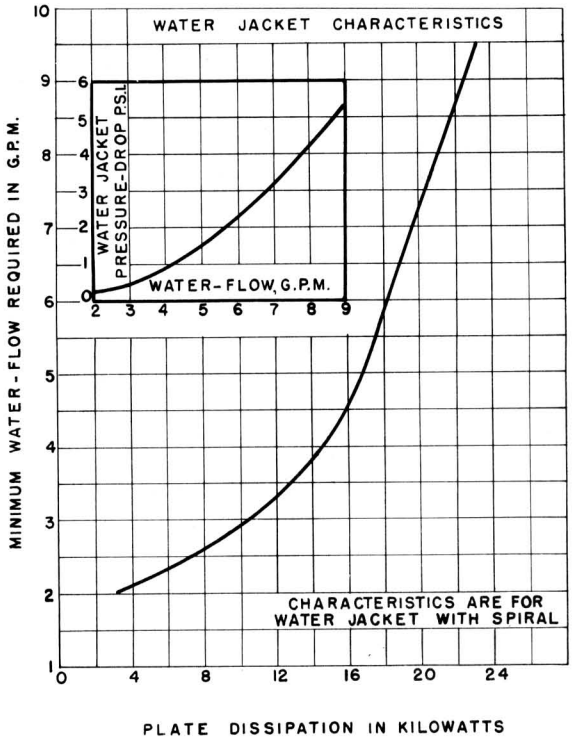
Characteristic	Conditions	Min.	Bogey	Max.	
Grid Voltage	i_b = 8 amperes e_b = 1500 volts	--	--	830	Volts
Grid Voltage	I_b = 0.20 amperes E_b = 10000 volts	−480	−520	−600	Volts
Grid Current	i_b = 8 amperes e_b = 1500 volts	--	--	1.6	Amperes
Plate Voltage	I_b = 1.25 amperes E_c = 0 volts	3300	3700	4100	Volts
Plate Voltage	I_b = 1.25 amperes E_c = −200 volts	6900	7600	8300	Volts
Peak Cathode Current (Note 5)		11.6	--	--	Ampere
Power Output (Note 6)	E_b = 12500 volts R_g = 6000 ohms I_b = 2.6 amperes I_g = 0.23 amperes	22	--	--	Kilowatts
Power Output (Note 7)	E_b = 6250 volts R_g = 2700 ohms I_b = 2.6 amperes I_g = 0.26 amperes	8	--	--	Kilowatts

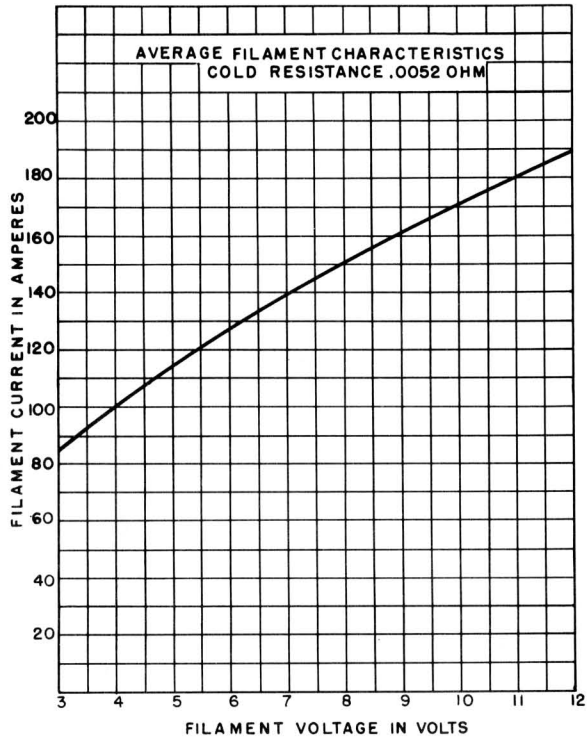
1. Air flow on the center of the dish providing 50 cfm through a 3" nozzle may be required to keep the grid and filament seals and the dish itself below 160 °C. Under extreme conditions it may also be necessary to utilize heat radiating connectors for the grid and filament posts.
2. Averaged over any audio-frequency cycle of sine-wave form.
3. At crest of audio-frequency cycle with modulation factor of 1.0.
4. Modulation, essentially negative, may be used if the positive peak of the carrier envelope does not exceed 115 percent of the carrier conditions.
5. Represents maximum usable cathode current for the tube as plate current plus grid current for any condition of operation.
6. Amplifier or oscillator performance. Conditions chosen for frequency not affecting performance.
7. Amplifier or oscillator performance at maximum rated frequency.

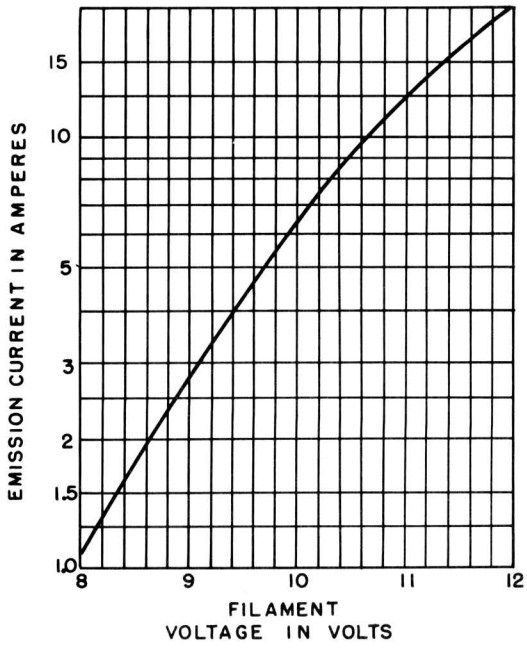

TYPICAL GRID-PLATE TRANSFER CHARACTERSTIC
E_F = 11 VOLTS AC
$E_G = E_P$
E_g = 800 VOLTS
1400
1200
1000
700
600
500
400
300
200
100
GRID CURRENT IN AMPERES
PLATE VOLTAGE IN KILOVOLTS


CONSTANT CURRENT CHARACTERISTICS
E_F = 11.0 VOLTS AC
GRID CURRENT IN AMPERES
PLATE CURRENT IN AMPERES
$E_G = E_P$
GRID VOLTAGE IN VOLTS
PLATE VOLTAGE IN KILOVOLTS


AVERAGE PLATE CHARACTERISTICS
E_F = 11.0 VOLTS AC
$E_G = E_P$
+1400
+1200
+1000
+800
+700
+600
+500
+400
+300
+200
+100
E_G = 0 VOLTS
-100
-200
-300
-400
-500
-600
-700
PLATE CURRENT IN AMPERES
PLATE VOLTAGE (E_p) IN KILOVOLTS







January 15, 1960

INDUSTRIAL HEATING TRIODE TYPE WL-5668

The WL-5668 is a three electrode tube designed for service as an industrial heating power oscillator. The external, water-cooled anode is capable of dissipating 20 kilowatts. The cathode is a pure tungsten filament. Maximum ratings apply to 5 megacycles.

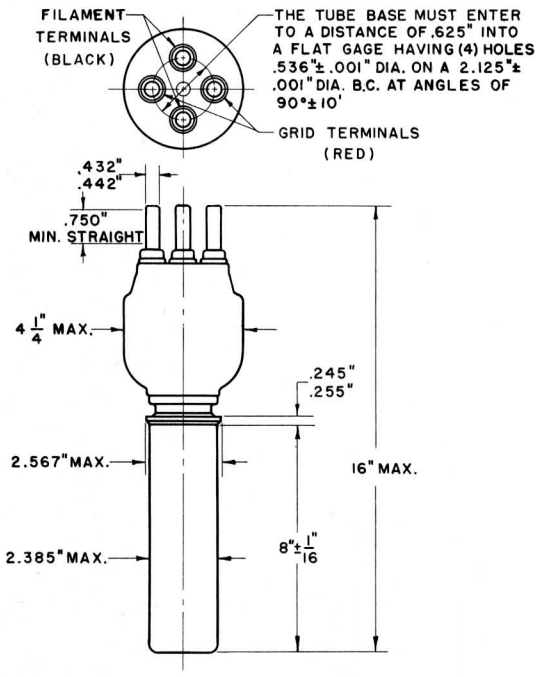
ELECTRICAL:

	Min.	Bogey	Max.	
Cathode		Pure Tungsten Filament		
Filament:				
Voltage	--	22	--	Volts
Current at Bogey Volts	57	60	62	Amperes
Starting Current	--	--	120	Amperes
Cold Resistance	--	0.032	--	Ohms
Emission	--	9.4	--	Amperes
Amplification Factor with Plate Amps = 0.75 & Grid Volts = −50	42.5	50	57.5	
Interelectrode Capacitances:				
Grid-to-Plate	27	30	33	μμf
Grid-to-Filament	15	20	24	μμf
Plate-to-Filament	0.5	1.5	2.5	μμf

MECHANICAL:

Mounting Position	Vertical, Anode Down
Type of Cooling	Water
Water Flow on Anode	8 to 15 GPM
Maximum Outgoing Water Temperature	70°C
Air Flow on Grid and Filament Seals ⊕	35 CFM
Maximum Glass Temperature	160 °C
Net Weight (approx.)	10 Pounds
Shipping Weight	14 Pounds

⊕ Sufficient flow should be directed on center of dish from 3" nozzle to keep temperature of any part of bulb, dish or seals below 160°C.



MAXIMUM RATINGS

Absolute Maximum Values

DC Plate Voltage	14	max.	Kilovolts
DC Grid Voltage	-1600	max.	Volts
DC Plate Current	2.0	max.	Amperes
DC Grid Current	0.40	max.	Amperes
Plate Power Input	28	max.	Kilowatts
Plate Power Dissipation	20	max.	Kilowatts

TYPICAL OPERATING CHARACTERISTICS

DC Plate Voltage	8.0	10.0	12.0	Kilovolts
Peak RF Plate Voltage	6.3	8.1	9.9	Kilovolts
DC Grid Voltage	-500	-600	-700	Volts
Peak RF Grid Voltage	1240	1420	1600	Volts
DC Plate Current	1.6	1.8	2.0	Amperes
DC Grid Current	0.2	0.2	0.2	Amperes
Power Output (approx.)	8.3	12.3	17.0	Kilowatts

FREQUENCY DERATING

Maximum Ratings apply up to 5 megacycles. The WL-5668 may be operated at higher frequencies if Plate Voltage and Plate Power Input is reduced as shown.

Frequency	5	12.5	20	Megacycles
Percentage of Maximum Permissible Plate Voltage and Plate Power Input	100	75	50	Percent

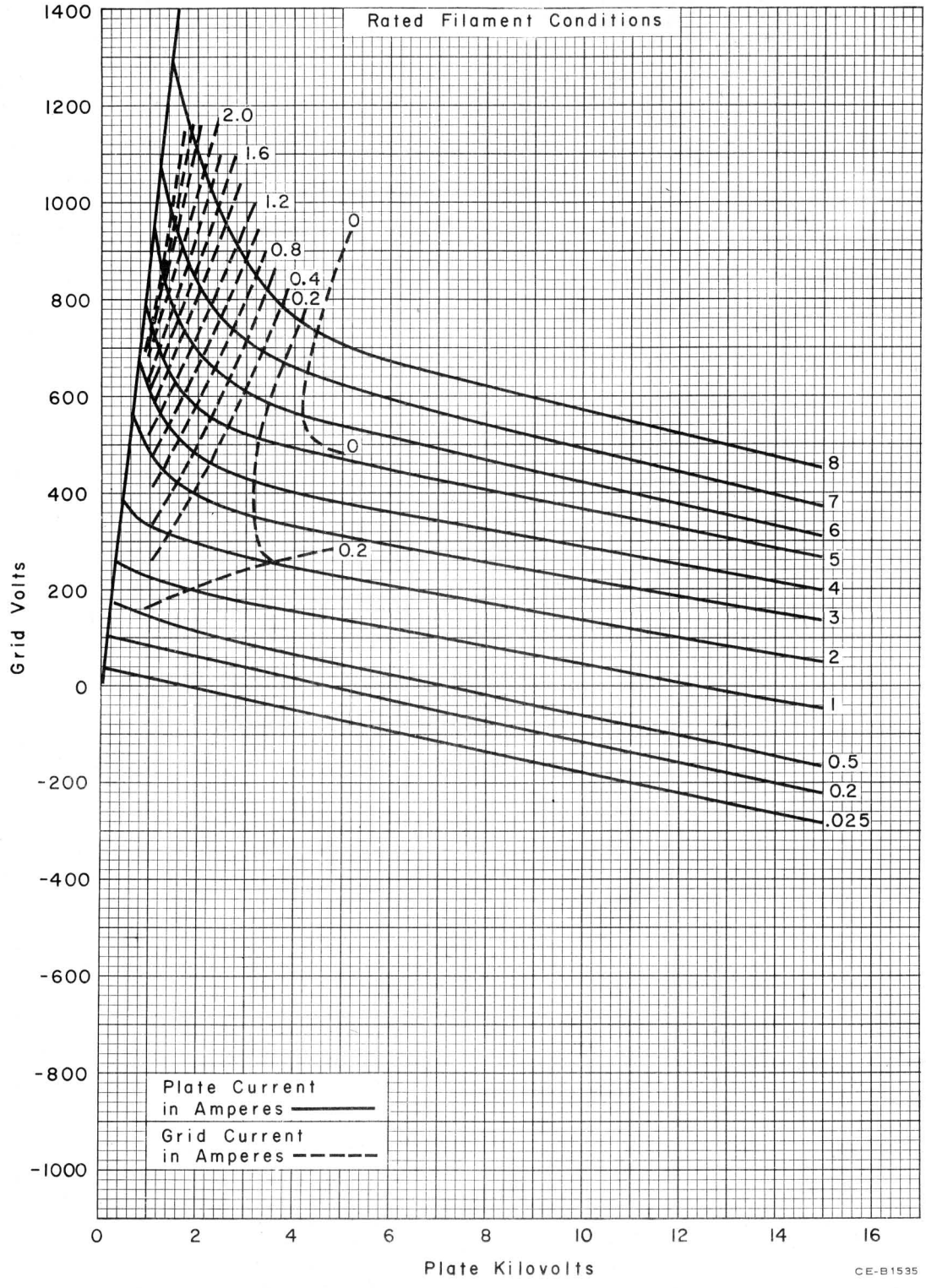
With operation at frequencies exceeding 3 megacycles, special attention should be given to the cooling of the bulb and terminal seals. Heat radiating connectors for grid and filament leads should be used when operating frequencies exceed 3 megacycles.

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Bogey	Max.	
Grid Voltage: Plate Kilovolts = 2.0, Plate Amperes = 8.0, Grid Voltage	--	--	1300	Volts
Grid Current: Plate Kilovolts = 2.0, Plate Amperes = 8.0, Grid Current	--	--	3.5	Amperes
Plate Voltage: Grid Volts = 0, Plate Amperes = 0.5, Plate Voltage	5.0	7.3	8.6	Kilovolts
Grid Volts = −100, Plate Amperes = 0.5, Plate Voltage	10.0	12.3	14.8	Kilovolts
Grid Cutoff Voltage: Plate Kilovolts = 15, Plate Amperes = 0.02, Grid Cutoff Voltage	-220	-300	-420	Volts
Power Output: Plate Kilovolts = 12, Grid Volts = −700, Plate Amperes = 2.0, Grid Amperes = 0.2, Power Output	14.5	--	--	Kilowatts

High Vacuum Amplifier Section

AVERAGE CONSTANT CURRENT CHARACTERISTICS



Westinghouse

5669

July 1, 1961

INDUSTRIAL HEATING TRIODE TYPE 5669

The 5669 is a three electrode tube designed for service as an industrial heating power oscillator. The external, forced-air-cooled anode is capable of dissipating 10 kilowatts. The cathode is a pure tungsten filament. Maximum ratings apply to 5 megacycles.

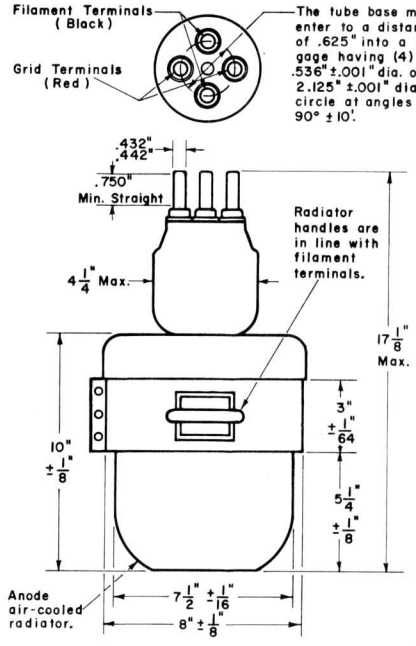
ELECTRICAL:

Cathode		Pure Tungsten Filament		
Filament:	Min.	Bogey	Max.	
Voltage	--	22	--	Volts
Current at Bogey Volts	57	60	62	Amperes
Starting Current	--	--	120	Amperes
Cold Resistance	--	0.031	--	Ohms
Emission	--	9.4	--	Amperes
Amplification Factor with Plate Amps = 0.75 & Grid Volts = -50	42.5	50	57.5	
Interelectrode Capacitances:				
Grid-to-Plate	28	31	34	$\mu\mu$f
Grid-to-Filament	15	20	24	$\mu\mu$f
Plate-to-Filament	1.0	2.0	3.0	$\mu\mu$f

MECHANICAL:

Mounting Position	Vertical, Anode Down
Type of Cooling	Forced Air
Required Air Flow on Anode:	
Per Cent Plate Dissipation Rating	100 80 60
Air Flow-Cubic Feet per Minute	700 500 350
Maximum Incoming Air Temperature	45 °C
Maximum Anode Temperature	230 °C
Air Flow on Grid and Filament Seals⊕	35 CFM
Maximum Glass Temperature	160 °C
Net Weight (Approx.)	52 Pounds
Shipping Weight (Approx.)	87 Pounds

⊕ Sufficient flow should be directed on center of dish from 3" nozzle to keep temperature of any part of bulb, dish or seals below 160°C.



MAXIMUM RATINGS

Absolute Maximum Values

DC Plate Voltage	14 max.		Kilovolts
DC Grid Voltage	-1600 max.		Volts
DC Plate Current	2.0 max.		Amperes
DC Grid Current	0.40 max.		Amperes
Plate Power Input	28 max.		Kilowatts
Plate Power Dissipation	20 max.		Kilowatts

TYPICAL OPERATING CHARACTERISTICS

DC Plate Voltage	8.0	10.0	12.0	Kilovolts
Peak RF Plate Voltage	6.3	8.1	9.9	Kilovolts
DC Grid Voltage	-500	-600	-700	Volts
Peak RF Grid Voltage	1240	1420	1600	Volts
DC Plate Current	1.6	1.8	2.0	Amperes
DC Grid Current	0.2	0.2	0.2	Amperes
Power Output (approx.)	8.3	12.3	17.0	Kilowatts

FREQUENCY DERATING

Maximum Ratings apply up to 5 megacycles. The 5669 may be operated at higher frequencies if Plate Voltage and Plate Power Input is reduced as shown.

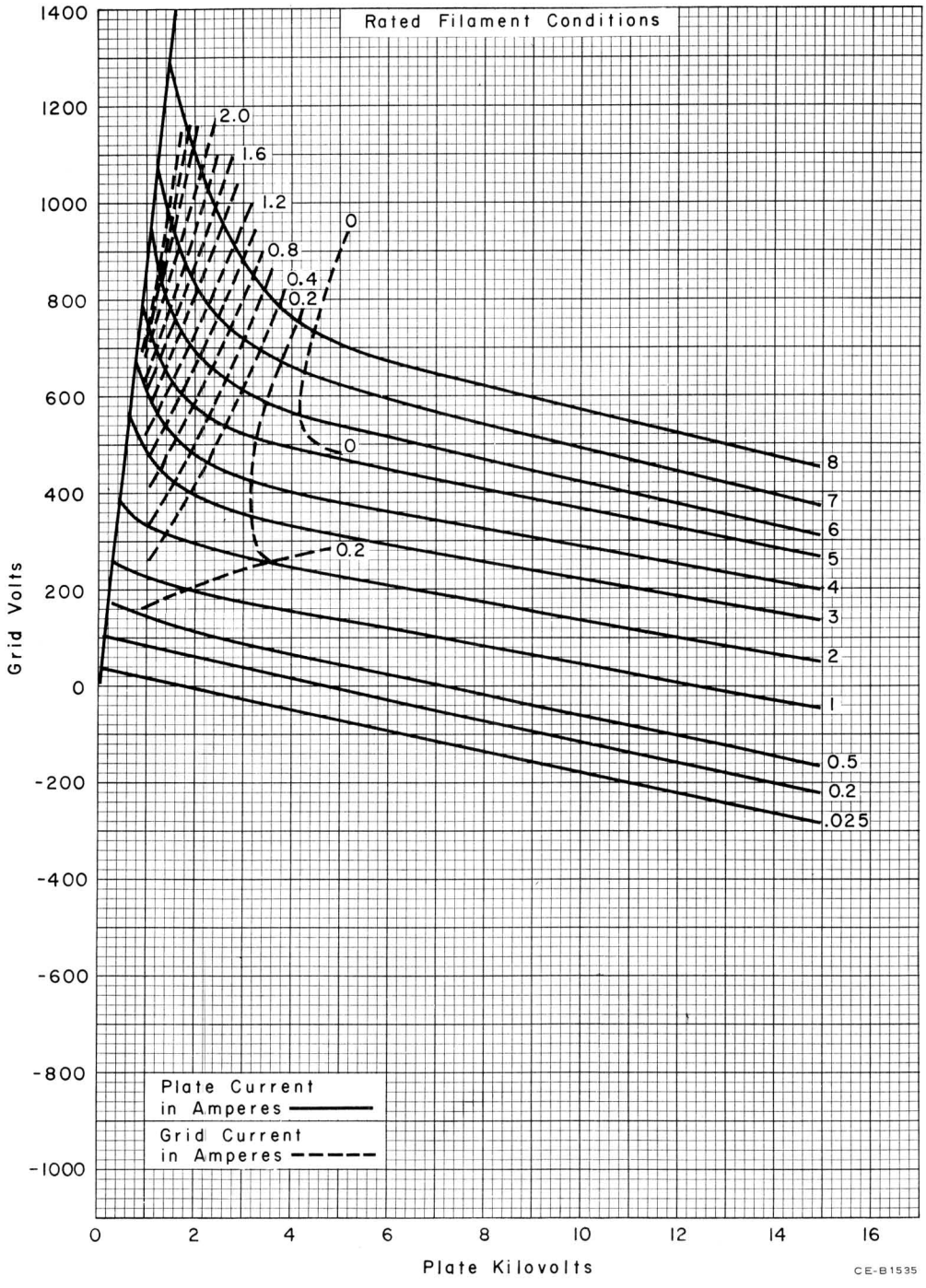
Frequency	5	12.5	20	Megacycles
Percentage of Maximum Permissible Plate Voltage and Plate Power Input	100	75	50	Percent

With operation at frequencies exceeding 3 megacycles, special attention should be given to the cooling of the bulb and terminal seals. Heat radiating connectors for grid and filament leads should be used when operating frequencies exceed 3 megacycles.

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Bogey	Max.	
Grid Voltage:				
Plate Kilovolts = 2.0				
Plate Amperes = 8.0				
Grid Voltage	--	--	1300	Volts
Grid Current:				
Plate Kilovolts = 2.0				
Plate Amperes = 8.0				
Grid Current	--	--	3.5	Amperes
Plate Voltage:				
Grid Volts = 0				
Plate Amperes = 0.5				
Plate Voltage	5.0	7.3	8.6	Kilovolts
Grid Volts = -100				
Plate Amperes = 0.5				
Plate Voltage	10.0	12.3	14.8	Kilovolts
Grid Cutoff Voltage:				
Plate Kilovolts = 15				
Plate Amperes = 0.02				
Grid Cutoff Voltage	-220	-300	-420	Volts
Power Output:				
Plate Kilovolts = 12				
Grid Volts = -700				
Plate Amperes = 2.0				
Grid Amperes = 0.2				
Power Output	14.5	--	--	Kilowatts

AVERAGE CONSTANT CURRENT CHARACTERISTICS

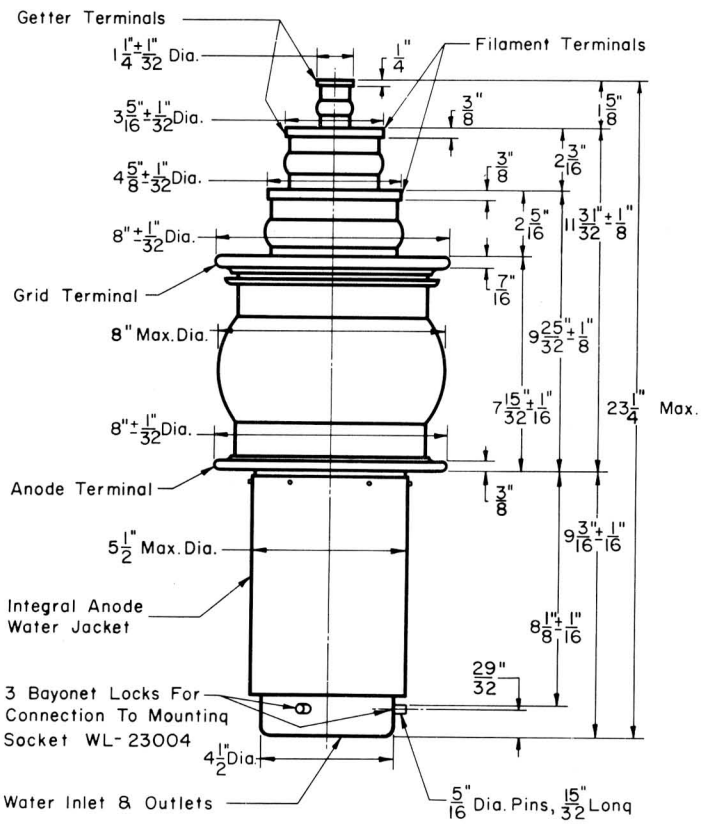


POWER AMPLIFIER TRIODE TYPE WL-5682

The WL-5682 is a general-purpose water and forced-air cooled three electrode tube designed for service in AM, FM & TV broadcasting, particle accelerator and industrial heating application. The tube features rugged coaxial mounting structures providing high-dissipation, low-inductance electrode terminals. The integral water-jacketed anode is capable of dissipating 120 kilowatts. The cathode is a sturdy, stress-free, multistrand thoriated-tungsten filament. Maximum Ratings apply up to 30 megacycles.

ELECTRICAL

Cathode	Multi-Strand Thoriated-Tungsten Filament	
Filament Voltage	16.5	Volts
Filament Current	325	Amps
Filament Starting Current, maximum	800	Amps
Filament Cold Resistance	0.0052	Ohms
Amplification Factor	30	–
Interelectrode Capacitances:		
Grid-Plate	85	pf
Grid-Filament	110	pf
Plate-Filament	2.6	pf



Electrical Contacts Should Be Made On The Periphery Of The Electrode Terminals.

MECHANICAL

Mounting Position	Vertical, Anode Down	
Type of Cooling	Water & Forced Air	
Water Flow on Anode	See Figure 1	
Max. Water Pressure	75	PSI
Max. Outlet Water Temperature	70	°C
Air Flow on Seals	250	CFM
Max. Glass Temperature	165	°C
Net Weight, approximate	50	Pounds

ACCESSORIES

Small Filament Connector	WL-22999
Large Filament Connector	WL-23000
Grid Connector	WL-23001
Anode Connector	WL-23001
Mounting Socket	WL-23004
Large Gasket	WL-23005
Small Gasket	WL-23006
Protective Gaps:	
Grid to Plate	WL-23002
Grid to Filament	WL-23003

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR, CLASS B

MAXIMUM RATINGS

Absolute Maximum Values

DC Plate Voltage	16	max.	Kilovolts
DC Plate Current (Max. Signal) (Note 1)	18	max.	Amperes
Plate Power Input (Max. Signal) (Note 1)	280	max.	Kilowatts
Plate Dissipation	120	max.	Kilowatts

TYPICAL OPERATION (Two Tubes in Push-Pull)

DC Plate Voltage	12	15	Kilovolts
DC Grid Voltage	–320	–370	Volts
Peak AF Grid-to-Grid Voltage	1410	1660	Volts
Zero-Signal DC Plate Current	4.0	6.0	Amperes
Max.-Signal DC Plate Current	26.7	35.0	Amperes
Effective Plate-to-Plate Load Resistance	885	873	Ohms
Driving Power	1200	1900	Watts
Power Output	200	330	Kilowatts

RADIO FREQUENCY POWER AMPLIFIER, CLASS B

Carrier Conditions per Tube with Max. Modulation Factor of 1.0

MAXIMUM RATINGS			
Absolute Maximum Values			
DC Plate Voltage	16	max.	Kilovolts
DC Plate Current	14	max.	Amperes
Plate Power Input	150	max.	Kilowatts
Plate Dissipation	120	max.	Kilowatts

TYPICAL OPERATION			
DC Plate Voltage	10	12	Kilovolts
DC Grid Voltage	−270	−330	Volts
Peak RF Grid Voltage	420	520	Volts
Peak RF Plate Voltage	4.2	5.0	Kilovolts
DC Plate Current	9	12	Amperes
DC Grid Current	111	93	mAmperes
Driving Power (Note 2)	2100	3900	Watts
Power Output	30	48	Kilowatts

RF POWER AMPLIFIER
CLASS B TELEVISION SERVICE

Synchronizing-level Condition per Tube

MAXIMUM RATINGS			
Absolute Maximum Values			
DC Plate Voltage	9	max.	Kilovolts
DC Plate Current	20	max.	Amperes
DC Grid Current	4	max.	Amperes
Plate Power Input	170	max.	Kilovolts
Plate Dissipation	120	max.	Kilowatts
Frequency	88	max.	Megacycles

TYPICAL OPERATION IN CATHODE DRIVE CIRCUIT AT 88 MC. WITH BANDWIDTH OF 5 MC.			
DC Plate Voltage	6	8	Kilovolts
DC Grid Voltage	−200	−250	Volts
Peak RF Driving Voltage:			
Synchronizing Level	650	840	Volts
Pedestal Level	500	650	Volts
Peak RF Plate Voltage:			
Synchronizing Level	4.6	6.2	Kilovolts
Pedestal Level	3.6	4.8	Kilovolts
DC Plate Current:			
Synchronizing Level	12.2	19	Amperes
Pedestal Level	9	14.3	Amperes
DC Grid Current:			
Synchronizing Level	2.3	3.2	Amperes
Pedestal Level	1.4	2	Amperes
Driving Power at Tube:			
Synchronizing Level	7800	15100	Watts
Pedestal Level	4000	8300	Watts
Power Output: (Note 3)			
Synchronizing Level	52	107	Kilowatts
Pedestal Level	30	62	Kilowatts

DOHERTY HIGH-EFFICIENCY LINEAR AMPLIFIER

Carrier Conditions per Tube, unless specified otherwise, with Max. Modulation Factor of 1.0

MAXIMUM RATINGS Absolute Maximum Values	Carrier Tube	Peak Tube		
DC Plate Voltage	16	16	max.	Kilovolts
DC Grid Voltage	−3200	−3200	max.	Volts
DC Plate Current	16	10	max.	Amperes
DC Grid Current	4	2	max.	Amperes
Plate Power Input	250	150	max.	Kilowatts
Plate Dissipation	120	120	max.	Kilowatts

TYPICAL OPERATION	Carrier Tube	Peak Tube	
DC Plate Voltage	13	13	Kilovolts
Peak RF Plate Voltage:			
Carrier	1	5.5	Kilovolts
Crest (Note 2)	11	11	Kilovolts
DC Grid Voltage	−400	−1200	Volts
Peak RF Grid Voltage:			
Carrier	800	1050	Volts
Crest (Note 2)	1130	2100	Volts
DC Plate Current:			
Carrier	12.4	0.3	Amperes
Modulated (Note 3)	12.4	7.2	Amperes
DC Grid Current:			
Carrier	1.0	0	Amperes
Modulated (Note 3)	1.6	0.7	Amperes
Driving Power (Note 2)	4.1	8.8	Kilowatts
Power Output:			
Carrier	110	2	Kilowatts
Modulated (Note 3)	102	63	Kilowatts

TYPICAL OPERATION	Carrier Tube	Peak Tube	
DC Plate Voltage	15	15	Kilovolts
Peak RF Plate Voltage:			
Carrier	12.5	6.25	Kilovolts
Crest (Note 2)	12.5	12.5	Kilovolts
DC Grid Voltage	−460	−1300	Volts
Peak RF Grid Voltage:			
Carrier	860	1110	Volts
Crest (Note 2)	1180	2220	Volts
DC Plate Current:			
Carrier	13.3	0.8	Amperes
Modulated (Note 3)	13.3	7.6	Amperes
DC Grid Current:			
Carrier	0.7	0	Amperes
Modulated (Note 3)	1.2	0.6	Amperes
Driving Power (Note 2)	3.7	9.3	Kilowatts
Power Output:			
Carrier	134	4	Kilowatts
Modulated (Note 3)	125	76	Kilowatts

PLATE MODULATED RF POWER AMPLIFIER
CLASS C TELEPHONY
Carrier Conditions per Tube with Max. Modulation Factor of 1.0

MAXIMUM RATINGS
Absolute Maximum Values

DC Plate Voltage	14 max.	Kilovolts
DC Grid Voltage	−3200 max.	Volts
DC Plate Current	14 max.	Amperes
DC Grid Current	.4 max.	Amperes
Plate Power Input	185 max.	Kilowatts
Plate Dissipation	80 max.	Kilowatts

TYPICAL OPERATION

DC Plate Voltage	10	14	Kilovolts
Peak RF Plate Voltage	8.7	12.3	Kilovolts
DC Grid Voltage	−950	−1270	Volts
Peak RF Grid Voltage	1450	1810	Volts
DC Plate Current	9.2	10.3	Amperes
DC Grid Current	2.1	2	Amperes
Driving Power	2900	3400	Watts
Power Output	72	118	Kilowatts

GRID MODULATED RF POWER AMPLIFIER
CLASS C TELEPHONY
Carrier Conditions per Tube with Max. Modulation Factor of 1.0

MAXIMUM RATINGS
Absolute Maximum Values

DC Plate Voltage	16 max.	Kilovolts
DC Plate Current	10 max.	Amperes
DC Grid Current	.4 max.	Amperes
Plate Power Input	150 max.	Kilowatts
Plate Dissipation	120 max.	Kilowatts

TYPICAL OPERATION

DC Plate Voltage	15	Kilovolts
Peak RF Plate Voltage	7	Kilovolts
DC Grid Voltage	−1000	Volts
Peak RF Grid Voltage	1090	Volts
Peak AF Grid Voltage for Max. Modulation	380	Volts
DC Plate Current	.5	Amperes
DC Grid Current	50	mAmperes
Driving Power	55	Watts
Power Output	30	Kilowatts

RF POWER AMPLIFIER AND OSCILLATOR
CLASS C TELEGRAPHY

MAXIMUM RATINGS
Absolute Maximum Values

	88 Mc.	30 Mc.		
DC Plate Voltage	9	16	max.	Kilovolts
DC Grid Voltage	−3200	−3200	max.	Volts
DC Plate Current	20	20	max.	Amperes
DC Grid Current	.4	4	max.	Amperes
Plate Power Input	170	300	max.	Kilowatts
Plate Dissipation	120	120	max.	Kilowatts

TYPICAL – GRID DRIVE – 30 MEGACYCLES

DC Plate Voltage	8	12	15	Kilovolts
Peak RF Plate Voltage	6.6	10.3	12.8	Kilovolts
DC Grid Voltage	−750	−1100	−1400	Volts
Peak RF Grid Voltage	1210	1750	2200	Volts
DC Plate Current	9.7	14.3	18.4	Amperes
DC Grid Current	2.1	2.9	3.4	Amperes
Driving Power	2500	4900	7200	Watts
Power Output	58	132	215	Kilowatts

TYPICAL OPERATION – CATHODE DRIVE – 88 MEGACYCLES

DC Plate Voltage	7	8	Kilovolts
Peak RF Plate Voltage	5.8	6.4	Kilovolts
DC Grid Voltage	−550	−650	Volts
Peak RF Grid Voltage	1020	1200	Volts
DC Plate Current	9.5	12.5	Amperes
DC Grid Current	2.3	2.5	Amperes
Driving Power	10.6	16.2	Kilowatts
Power Output	57	85	Kilowatts

EQUIPMENT DESIGN RANGE OF CHARACTERISTICS

Characteristic	Min.	Bogey	Max.	Units
Grid Voltage:				
(1) Plate Volts = 1700. Plate Amp. = 90	–	–	1050	Volts
(2) Plate Kilovolts = 16. Plate Ma. = 200	−420	−500	−660	Volts
Grid Current:. Plate Volts = 1700 Plate Amp. = 90	–	–	45	Amperes
Plate Voltage:				
(1) Grid Volts = 0. Plate Amp. = 3	1.8	2.4	3.0	Kilovolts
(2) Grid Volts = −300 Plate Amp. = 3	10.3	11.8	13.3	Kilovolts
Plate Power Output (30 Mc.). Plate Kilovolts = 15 Plate Amp. = 18.4 Grid Volts = −1400 Grid Amp. = 3.4	177	–	–	Kilowatts
Plate Power Output (88 Mc.). Plate Kilovolts = 9 Plate Amp. = 18 Grid Volts = −850 Grid Amp. = 3.5	81	–	–	Kilowatts

FREQUENCY DERATING CHART (Note 4)

Service	30 Mc.	60 Mc.	88 Mc.
Class B	100%	91%	56%
Class C-AM	100%	78%	56%
Class C-CW	100%	78%	56%

NOTES

1. Averaging time of any audio frequency cycle of sine-wave form.
2. Measured at crest of audio-frequency cycle with modulation factor of 1.0.
3. Includes power transferred from driver stage.
4. Higher frequency operation requires special attention to ensure adequate cooling of the bulb.

COOLING SYSTEMS

The water system should be the closed type using distilled or deionized water to preclude the possibility of scale formation and corrosion, both of which can be expected with tap water. Scale restricts water flow and prevents proper transfer of heat from the anode to the cooling water, and corrosion may damage the elements and pasages. The rates of scale formation and corrosion depend on the electrical conductivity of the water. To minimize the formation of scale and corrosion, the use of a coolant having an initial resistance of at least 100,000 ohms per cubic centimeter is recommended. Since a very small amount of contamination can change the conductivity of distilled water, frequent measurement is desirable. The water should be changed when its resistance falls below 20,000 ohms per cubic centimeter. A filter should be placed in the water supply line to the tube to trap foreign particles likely to impair the flow. It is suggested that a filter with a 100-mesh screen (0.005" openings) be used.

The water-cooling system must function properly at all times since even a momentary failure of flow will damage the WL-5682. Without cooling water, the heat of the filament alone is sufficient to cause serious harm. It is necessary to keep the water-flow interlocks in correct adjustment and never to set them to operate below the recommended level. The flow of water and air must start before the application of any tube voltages; it is recommended that the flow of coolants continue for 5 minutes after the removal of all tube voltages. In the event of emergency or fault conditions, however, the simultaneous shut down of all power will not damage the tube. Specific water-flow data are given in the Water-Cooling Characteristics. Under no circumstances should the outlet water temperature exceed 70°C nor should the temperature of the entering water be permitted to fall below 10°C with plate potential on. Water pressure at the tube socket should never exceed 7 5 psi.

Forced-air cooling of the cathode terminals, the grid flange, and the glass envelope is required, and the cooling should be uniformly distributed around the circumference of the seals. Air flow of 250 cfm provides adequate cooling.

TUBE PROTECTION NOTES

The handling of very high power requires particular attention to the removal of power from tubes during fault conditions (initiated by tube or circuit instabilities) since the larger amount of energy involved can cause tube damage if not properly controlled. The tube must, therefore, be protected by limiting the time elapsed from inception of a fault condition to diverting the energy from the tube, as well as the amount of energy expended in the tube during this interval.

In addition to the normal circuit breakers and overload relays, it is necessary that a fast-acting electronic protective device (crowbar) or equivalent be used. This device will in most cases be a triggered device connected across the output of the plate supply filter, if used, to dissipate the filter-circuit energy as well as the rectifier output. The complete energy source must be shorted out as quickly as possible after the inception of a "fault", and in most cases the time interval should not be allowed to exceed approximately ten microseconds. For some basic electronic-crowbar fault-protection circuit considerations, as well as tests of the effectiveness of a protection device, refer to the references listed.

A nominal value of resistance must be placed in the plate lead of the tube being protected in order to be assured that the impedance of this tube under a flash arc condition is greater than that of the crowbar device when the latter is triggered. Critical damping is required for the crowbar discharge circuit. It is also recommended that a minimum of five to ten ohms resistance be connected in series with each rectifier tube in order to limit surge currents.

In circuits where high transient voltages may be developed due to a shorted load or other fault, special precautions are necessary to keep these excessive voltages from appearing at the tube electrodes.

REFERENCES

1. W. N. Parker and M. V. Hoover, "Gas Tubes Protect High Power Transmitters", Electronics, 29, 144, January 1956.
2. A. J. Morris and J. P. Swanson, "The High Speed Protection of Microwave Tubes and Systems", The Microwave Journal, Vol. V, No 11, Nov., 1962.

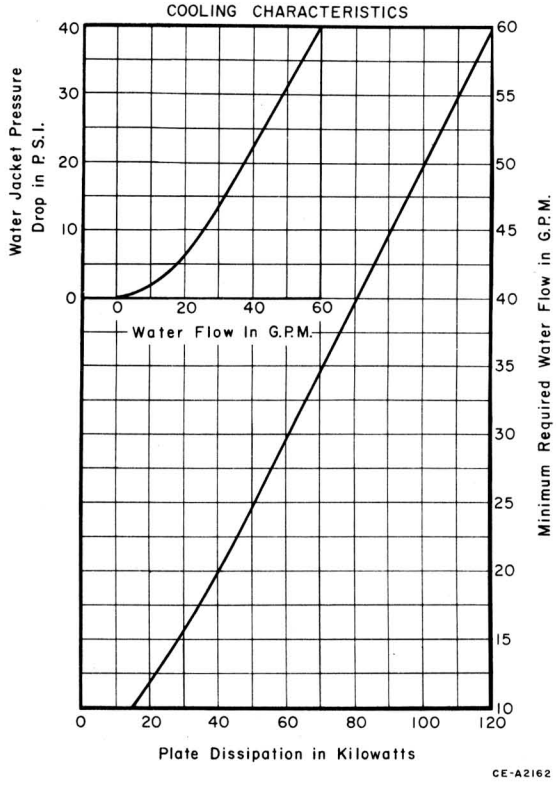


FIGURE 1

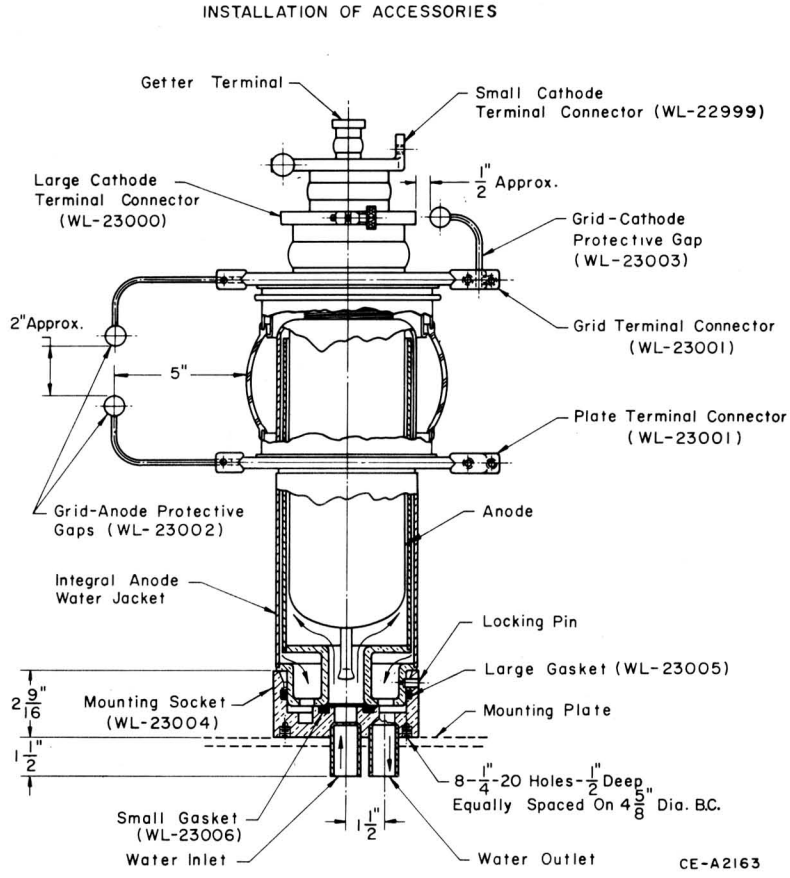
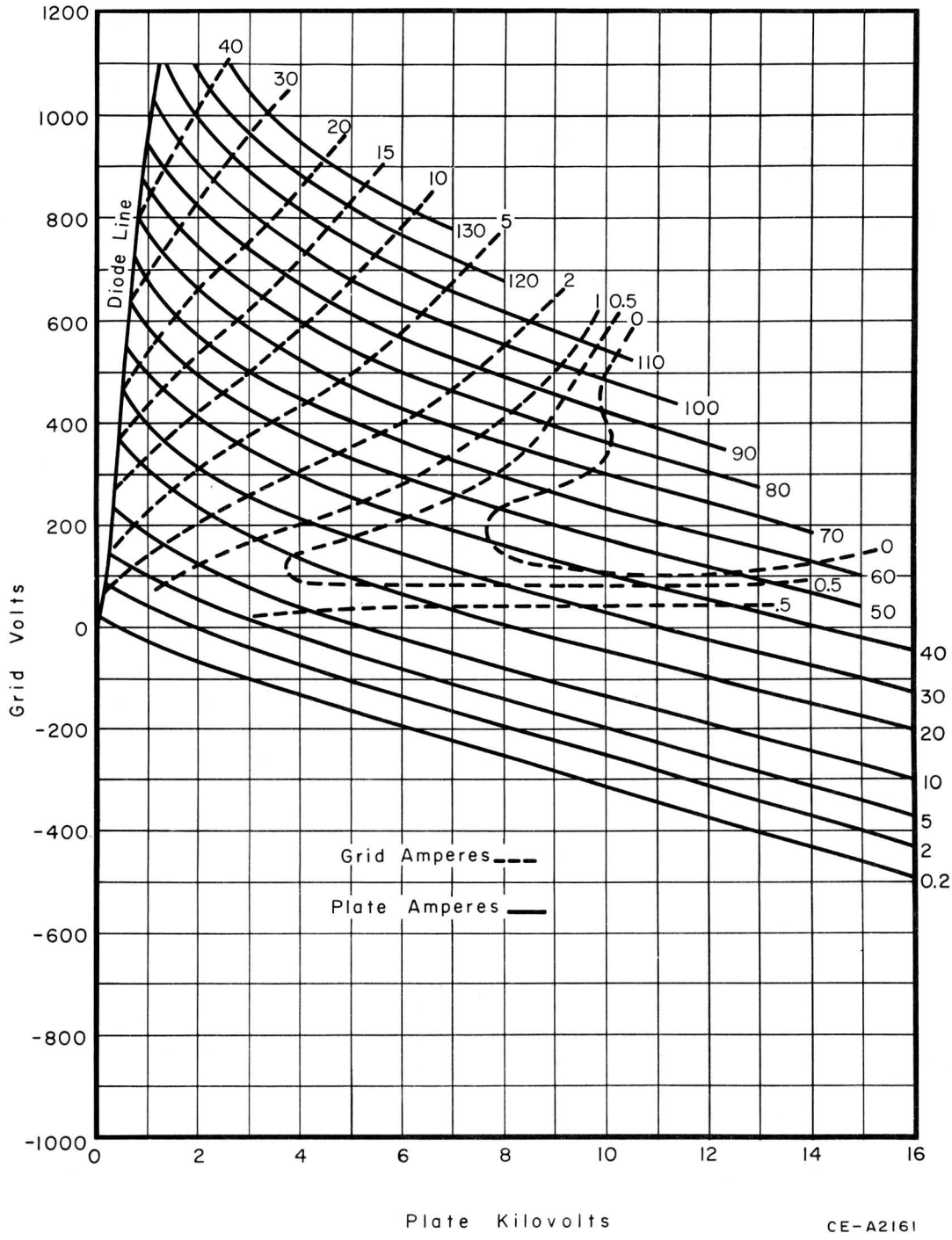


FIGURE 2

AVERAGE CONSTANT CURRENT CHARACTERISTICS



June 25, 1958

POWER AMPLIFIER TRIODE TYPE WL-5891

The WL-5891 is a large, forced air cooled, directly heated triode designed for service as an amplifier, modulator and oscillator. The cathode is a thoriated tungsten filament which may be operated either three-phase wye or single phase.

In Continuous Commercial Service, the anode is capable of dissipating 25 kilowatts. The tube may be operated with maximum power input up to 10 megacycles and at reduced rating up to 25 megacycles.

ELECTRICAL:

	Min.	Bogey	Max.	
Filament Voltage:				
Three-Phase Line to Neutral	10	11	11.6	Volts
Filament Current per Phase at Bogey Voltage†	89	95	101	Amps
Filament Voltage:				
Single-Phase	10	11	11.6	Volts
Filament Current at Bogey Voltage: †				
Single-Phase	267	285	303	Amps
Filament Heating Time	10			Sec.
Amplification Factor:				
E_c = -200 v; I_b = 1.0A		36		
Peak Cathode Current #			90	Amps
Direct Interelectrode Capacitances:				
Grid-Plate	32	40	48	uuf
Grid-Filament	64	80	96	uuf
Plate-Filament	3	6	9	uuf

MECHANICAL:

Mounting Position	Vertical - Anode Down		
Net Weight, approx.	150		Pounds
Shipping Weight, approx.	380		Pounds
Cooling:			
Type of Cooling	Forced Air		
Ratings based on Maximum Incoming Air Temperature of	45		°C
Required Vertical Air Flow through Radiator: ‡			
Plate Dissipation - % of Rating	100	80	60
Air Flow - Cubic Ft. per Min.	1800	1450	1100
Static Pressure - Inches of Water	2.2	1.5	0.85
Required Air Flow to Filament and Grid Seals ‡	10 min.		cfm
Bulb & Seal Temperature □	180 max.		°C
Radiator Temperature	180 max.		°C

AF POWER AMPLIFIER AND MODULATOR, CLASS B:

Maximum Ratings, Absolute Values (per tube)	CCS	
DC Plate Voltage	15 max.	kv
Max. Signal DC Plate Current*	6 max.	Amps
Max. Signal Plate Input*	90 max.	kw
Plate Dissipation*	25 max.	kw

TYPICAL PUSH-PULL OPERATION (2 Tubes):

DC Plate Voltage	15	10.5	kv
DC Grid Voltage	-370	-260	Volts
Peak AF Grid-to-Grid Voltage	1180	900	Volts
Zero Signal DC Plate Current	1.0	1.0	Amp
Max. Signal DC Plate Current	6.73	4.5	Amps
Plate-to-Plate Load Resistance	4940	5000	Ohms
Driving Power, approx.	160	116	Watts
Power Output, approx.	64	31	kw
Percent Distortion, approx.	3.75	2.7	

RF POWER AMPLIFIER AND OSCILLATOR:
Class C Telegraphy

Key-down conditions per tube without amplitude modulation §

Maximum Ratings, Absolute Values	CCS	
DC Plate Voltage	15 max.	kv
DC Grid Voltage	-2000 max.	Volts
DC Plate Current	8 max.	Amps
DC Grid Current	1.5 max.	Amp
Plate Input	100 max.	kw
Plate Dissipation	25 max.	kw

TYPICAL OPERATING CHARACTERISTICS:

	CCS	
DC Plate Voltage	15	kv
Peak RF Plate Voltage	13	kv
DC Grid Voltage	-1500	Volts
Peak RF Grid Voltage	2120	Volts
DC Plate Current	6.1	Amps
DC Grid Current, approx.	0.88	Amp
Driving Power, approx. ▲	1785	Watts
Power Output, approx. ▲	73.5	kw

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Bogey	Max.	
GRID VOLTAGE:				
Filament Volts, ac = 11				
Plate Kilovolts = 2.6				
Plate Current, amps = 35				
Grid Voltage	-	-	900	Volts
GRID CURRENT:				
Filament Volts, ac = 11				
Plate Kilovolts = 2.6				
Plate Current, amps = 35				
Grid Current	-	-	9	Amperes
PLATE VOLTAGE (Zero Bias):				
Filament Volts, ac = 11				
Grid Volts = 0				
Plate Current, dc amp = 1.0				
Plate Voltage, dc	2600	3300	4000	Volts
PLATE VOLTAGE:				
Filament Volts, ac = 11				
Grid Volts, dc = -200				
Plate Current, dc amp = 1.0				
Plate Voltage	9700	11300	12900	Volts
GRID VOLTAGE (Cutoff):				
Filament Volts, ac = 11				
Plate Kilovolts, dc = 10				
Plate Current, dc amp = 0.02				
Grid Voltage, dc	-180	-250	-320	Volts
PLATE POWER OUTPUT:				
Filament Volts, ac = 11				
Plate Kilovolts, dc = 15				
Plate Current, dc amp = 6				
Grid Volts, dc = -1500				
Power Output	65000	-	-	Watts

PLATE-MODULATED RF POWER AMPLIFIER:
Class C Telephony

Carrier conditions per tube for use with a maximum modulation factor of 1.0

Maximum Ratings, Absolute Values	CCS	
DC Plate Voltage	12.5 max.	kv
DC Grid Voltage	-2000 max.	Volts
DC Plate Current	6.0 max.	Amps
DC Grid Current	1.5 max.	Amp
Plate Input	75 max.	kw
Plate Dissipation	17 max.	kw

TYPICAL OPERATING CHARACTERISTICS:

	CCS	CCS	
DC Plate Voltage	11.5	12.5	kv
Peak RF Plate Voltage	10.1	11.8	kv
DC Grid Voltage	-1500	-1050	Volts
Peak RF Grid Voltage	1920	1640	Volts
DC Plate Current	2.9	5.3	Amps
DC Grid Current, approx.	.45	1.48	Amp
Driving Power, approx. ▲	832	2310	Watts
Power Output, approx. ▲	27.8	56.7	kw

NOTES

† No limiting of filament starting current is necessary on either single or three-phase excitation.

Represents maximum usable cathode current (plate current plus grid current), for any condition of operation.

‡ Cooling air may be applied and removed simultaneously with all voltages.

* Averaged over any af cycle of sine-wave form.

§ Modulation essentially negative may be used if the positive peak of the envelope does not exceed 115% of the carrier conditions.

▲ With essentially sine-wave excitation.

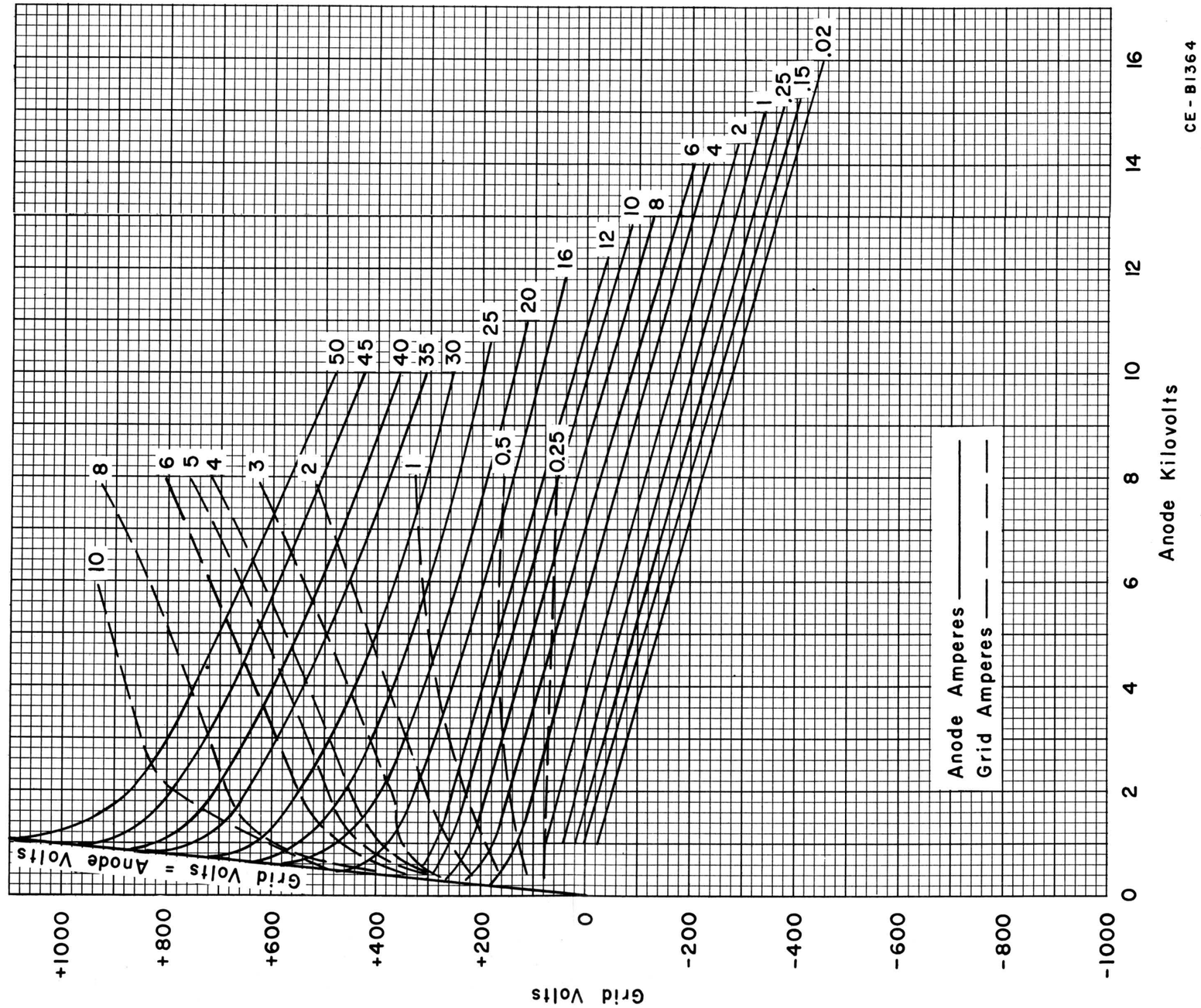
□ The maximum published bulb and seal temperatures must not be exceeded at any frequency of operation. Tube temperature may be measured by using "Tempilaq", a temperature-sensitive lacquer made by the Tempil Corporation, 132 W. 22nd Street, New York 11, New York.

RATINGS VS. FREQUENCY

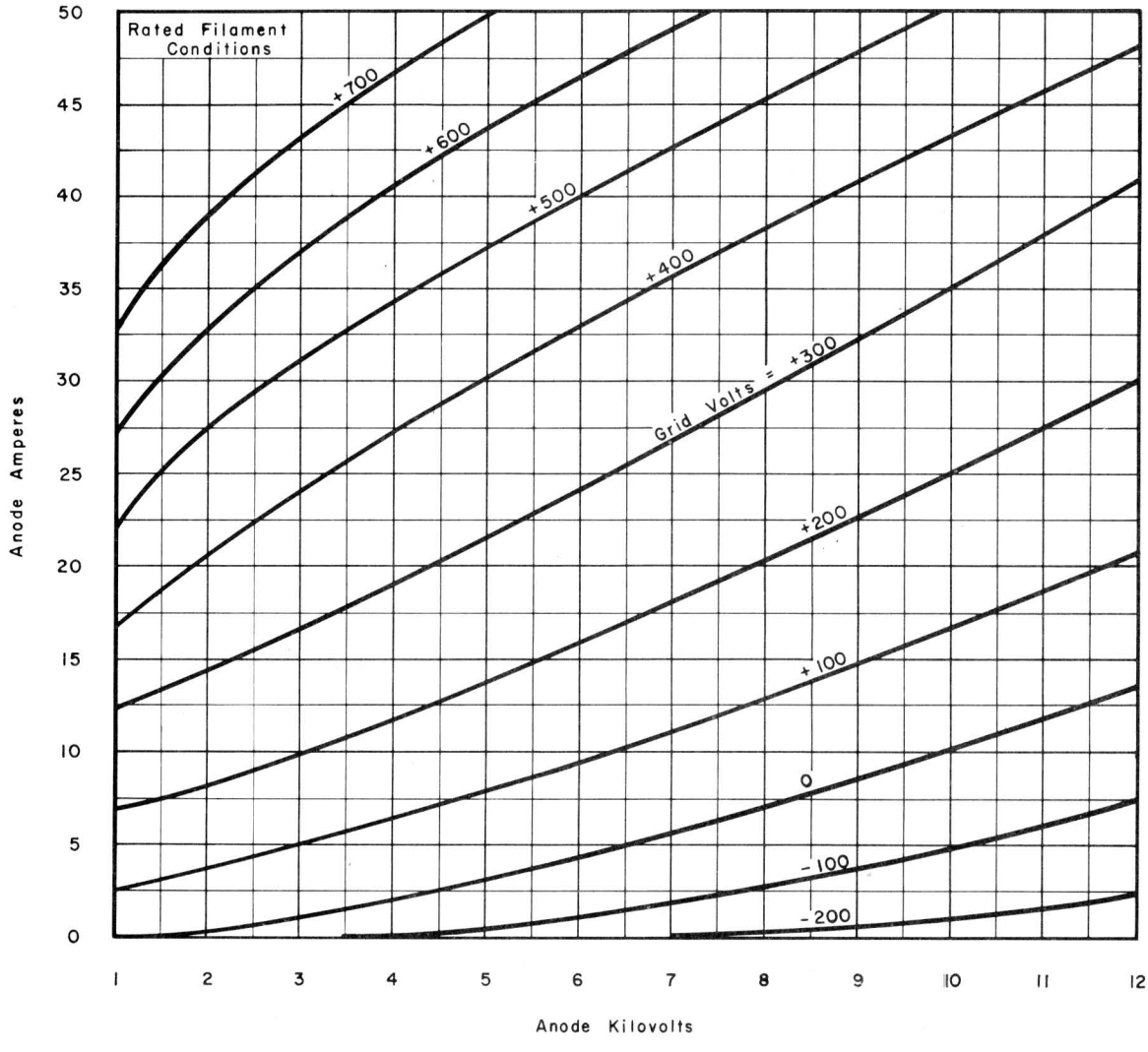
Maximum ratings apply up to 10 megacycles. The tube may be operated at higher frequencies provided the maximum values of plate voltage and power input are reduced according to the tabulation (other maximum ratings are the same as shown above.)

Frequency	10	18	25	mc
Percentage of Maximum Rated Plate Voltage and Plate Input:				
Class C Telegraphy	100	88	80	%
Class C Plate Telephony	100	88	80	%

AVERAGE CONSTANT CURRENT CHARACTERISTICS
E_f = 11 VOLTS 3 PHASE LINE-TO-NEUTRAL



AVERAGE PLATE CHARACTERISTICS



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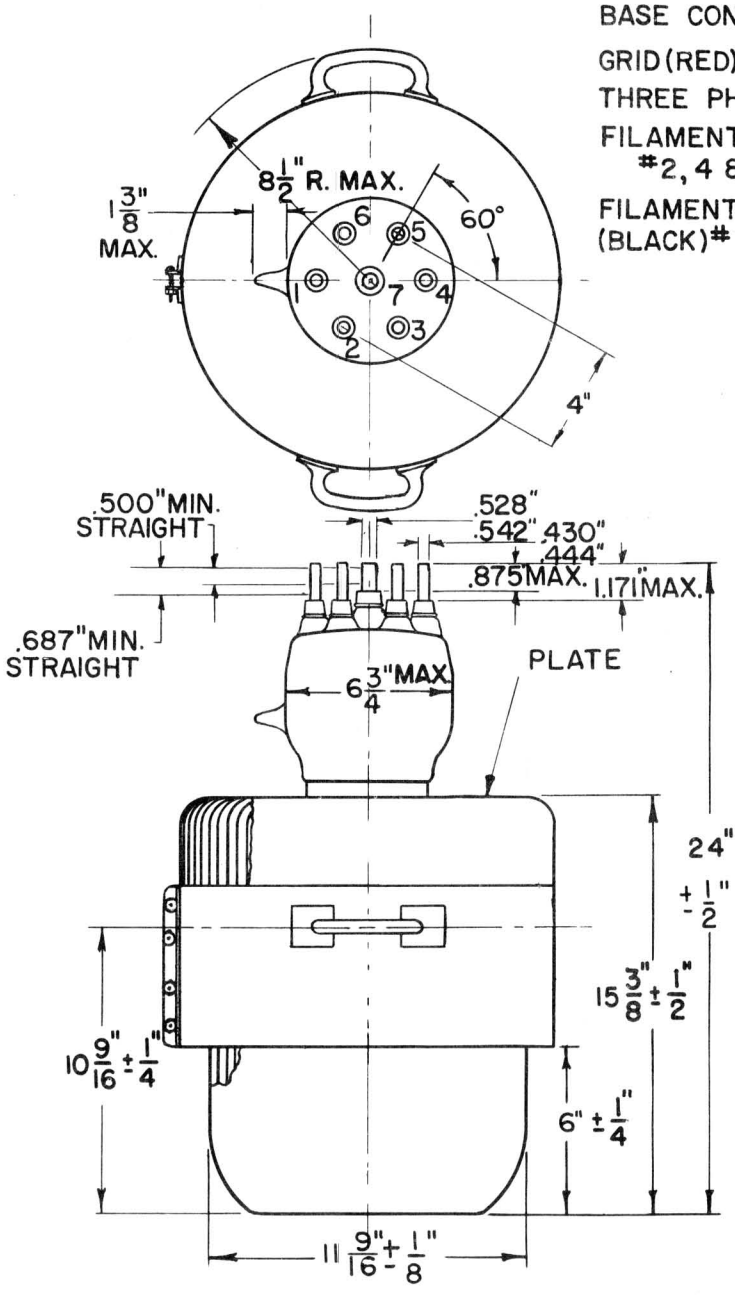
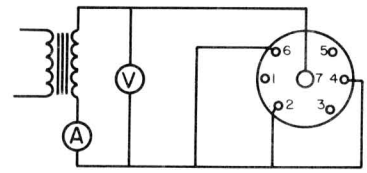


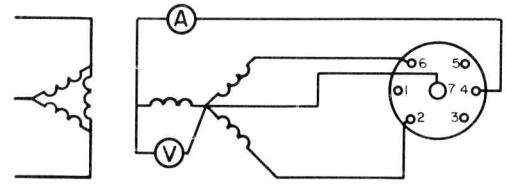
FILAMENT CONNECTIONS

SINGLE PHASE AC SUPPLY



V = 11 VOLTS
A = 285 AMPERES

THREE PHASE AC SUPPLY



V = 11 VOLTS TO NEUTRAL
A = 95 AMPERES PER. PHASE

POWER AMPLIFIER TRIODE TYPE 5918A

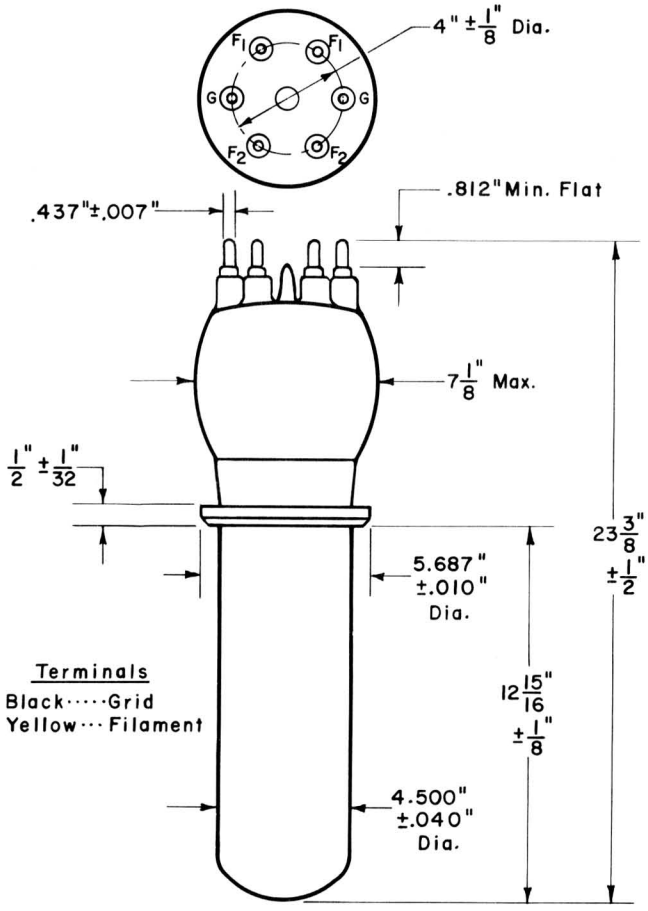
The 5918A is a three-electrode tube designed for use as an oscillator, amplifier, and modulator. The water-cooled anode is capable of dissipating 70 kilowatts. A thoriated-tungsten filament is employed. Maximum ratings apply up to 22 megacycles.

ELECTRICAL:

Filament Voltage	11	Volts
Filament Current at Bogey Voltage	285	Amperes
Filament Statring Current	1000	Amperes
Filament Cold Resistance	0.005	Ohms
Amplification Factor	37	
Interelectrode Capacitances:		
Grid to Plate	34.5	$\mu\mu$f
Grid to Filament	75	$\mu\mu$f
Plate to Filament	2.4	$\mu\mu$f

MECHANICAL:

Mounting Position	Vertical, Anode Down
Type of Cooling	Water flow on Anode, 30 GPM
Maximum Outgoing Water Temperature	70 °C
Maximum Glass Temperature	150 °C
Net Weight, approximate	25 lbs.



AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR
CLASS B

MAXIMUM RATINGS:
Absolute Maximum Values

DC Plate Voltage	17.5	max.	Kilovolts
DC Plate Current at Maximum Signal (Note 1)	15	max.	Amperes
Plate Input at Maximum Signal (Note 1)	175	max.	Kilowatts
Plate Dissipation (Note 1)	70	max.	Kilowatts

TYPICAL OPERATION:
Unless otherwise specified, values are for two tubes.

DC Plate Voltage	14	Kilovolts
DC Grid Voltage	−300	Volts
Peak Audio-Frequency Grid-to-Grid Voltage	1600	Volts
Zero-Signal DC Plate Current	2	Amperes
Maximum-Signal DC Plate Current	16	Amperes
Effective Load Resistance, Plate to Plate	2250	Ohms
Maximum-Signal Driving Power (Approx.)	1500	Watts
Maximum-Signal Power Output	150	Kilowatts

RADIO-FREQUENCY POWER AMPLIFIER
CLASS B

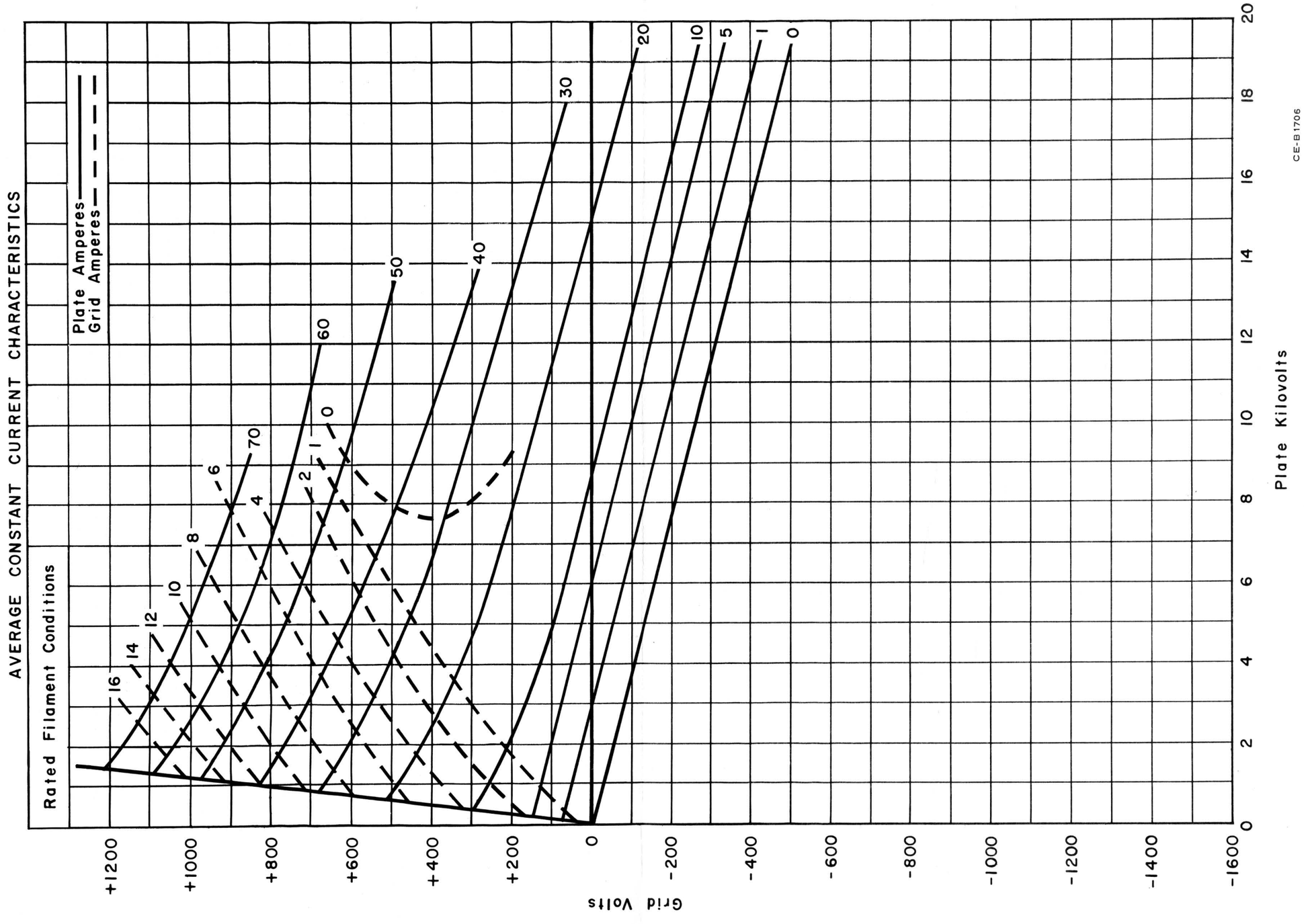
Carrier conditions per tube for use with a maximum modulation factor of 1.0.

MAXIMUM RATINGS:
Absolute Maximum Values

DC Plate Voltage	17.5	max.	Kilovolts
DC Plate Current	12	max.	Amperes
Plate Input	100	max.	Kilowatts
Plate Dissipation	70	max.	Kilowatts

TYPICAL OPERATION:

DC Plate Voltage	15	Kilovolts
DC Grid Voltage	−375	Volts
Peak Radio-Frequency Grid Voltage	500	Volts
DC Plate Current	4.9	Amperes
DC Grid Current, approximate	0.0	Amperes
Driving Power (Approx.) (Note 2)	770	Watts
Power Output (Approx.)	25	Kilowatts


AVERAGE CONSTANT CURRENT CHARACTERISTICS
Plate Amperes
Grid Amperes
Rated Filament Conditions
Grid Volts
Plate Kilovolts
+1200
+1000
+800
+600
+400
+200
0
-200
-400
-600
-800
-1000
-1200
-1400
-1600
0
2
4
6
8
10
12
14
16
18
20
30
60
50
40
20
10
5
1
0
70
6
4
2
1
8
10
12
14
16

CE-B1706

RADIO-FREQUENCY POWER AMPLIFIER AND OSCILLATOR CLASS C TELEGRAPHY

Key-down conditions per tube without amplitude modulation (Note 3)

MAXIMUM RATINGS:

Absolute Maximum Values

Plate Voltage	17.5	max.	Kilovolts
Plate Current	18	max.	Amperes
Plate Input	300	max.	Kilowatts
Plate Dissipation	70	max.	Kilowatts
DC Grid Voltage	−3000	max.	Volts
DC Grid Current	2	max.	Amperes

TYPICAL OPERATION:

DC Plate Voltage	17.5	Kilovolts
DC Grid Voltage	−1000	Volts
Peak Radio-Frequency Grid Voltage	1960	Volts
DC Plate Current	13.8	Amperes
DC Grid Current	2	Amperes
Driving Power (Approx.)	3600	Watts
Power Output (Approx.)	180	Kilowatts

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER CLASS C TELEPHONY

Carrier conditions per tube for use with a maximum modulation factor of 1.0.

MAXIMUM RATINGS:

Absolute Maximum Values

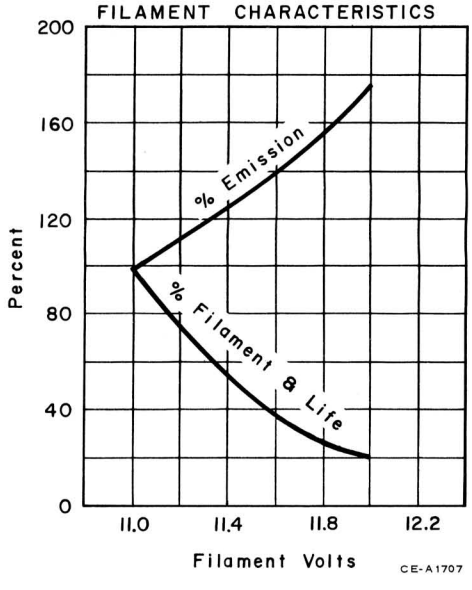
DC Plate Voltage	14	max.	Kilovolts
DC Grid Voltage	−3000	max.	Volts
DC Plate Current	12	max.	Amperes
DC Grid Current	2	max.	Amperes
Plate Input	165	max.	Kilowatts
Plate Dissipation	47	max.	Kilowatts

TYPICAL OPERATION:

DC Plate Voltage	14	Kilovolts
DC Grid Voltage	−800	Volts
Peak Radio-Frequency Grid Voltage	1550	Volts
DC Plate Current	10	Amperes
DC Grid Current (Approx.)	1.4	Amperes
Driving Power (Approx.)	2	Watts
Power Output (Approx.)	104	Kilowatts

NOTES

1. Averaged over any audio-frequency cycle of sine-wave form.
2. At crest of audio-frequency cycle with modulation factor of 1.0.
3. Modulation, essentially negative, may be used if the positive peak of the envelope does not exceed 115 percent of the carrier conditions.



POWER AMPLIFIER TRIODE TYPE 5936

The 5936 is a water cooled, directly heated triode designed for service as an amplifier, modulator or oscillator. The cathode is a pure tungsten three phase filament.

In Continuous Commercial Service, the anode is capable of dissipating 70 kilowatts. The tube may be operated with maximum power input up to 15 megacycles.

ELECTRICAL:

	Min.	Bogey	Max.	
Filament Voltage:				
Three-Phase Line to Neutral	--	20	21	Volts
Filament Current per Phase at Bogey Voltage	--	143	--	Amperes
Filament Starting Current (Per Phase)	--	--	215	Amperes
Filament Cold Resistance (Per Phase)	--	0.013	--	Ohms
Filament Heating Time	10	--	--	Sec.
Amplification Factor	--	37	--	
Peak Cathode Current (Note 1)	--	--	60	Amperes
Direct Interelectrode Capacitances:				
Grid-Plate	--	38	--	$\mu\mu$f
Grid-Filament	--	80	--	$\mu\mu$f
Plate-Filament	--	5	--	$\mu\mu$f

MECHANICAL:

Mounting Position	Vertical, Anode Down
Type of Cooling (Note 2)	Water & Forced Air
Minimum Water Flow	30 GPM
Maximum Outlet Water Temperature	70 °C
Air Flow to Filament and Grid Seals	30 CFM
Maximum Bulb Temperature	180 °C
Maximum Seal Temperature	180 °C
Net Weight (Approx.)	26 Pounds
Shipping Weight (Approx.)	85 Pounds

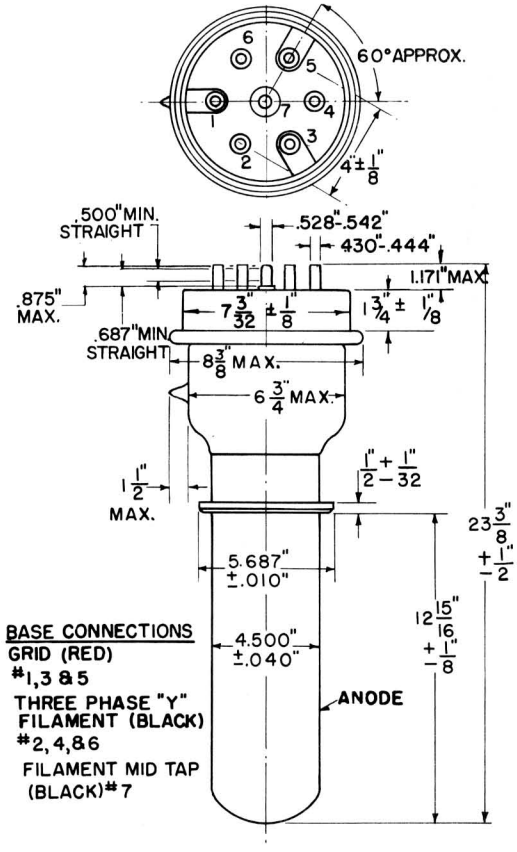
AF POWER AMPLIFIER AND MODULATOR, CLASS B:

Maximum Ratings

Absolute Maximum Values (per tube)	CCS		
DC Plate Voltage	18 max.		Kilovolts
Max. Signal DC Plate Current (Note 3)	10 max.		Amperes
Max. Signal Plate Input (Note 3)	180 max.		Kilowatts
Plate Dissipation (Note 3)	70 max.		Kilowatts

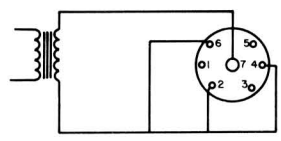
TYPICAL PUSH-PULL OPERATION (2 Tubes):

DC Plate Voltage	12	14	18	Kilovolts
DC Grid Voltage	-260	-320	-440	Volts
Peak AF Grid-to-Grid Voltage	1520	1560	2340	Volts
Zero Signal DC Plate Current	0.5	0.5	0.5	Ampere
Max. Signal DC Plate Current	11.6	10.3	15.6	Amperes
Plate-to-Plate Load Resistance	2432	3380	2880	Ohms
Driving Power, (Approx.)	856	740	1930	Watts
Power Output, (Approx.)	100	100	200	Kilowatts

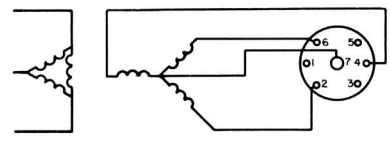


FILAMENT CONNECTIONS

SINGLE PHASE AC SUPPLY



THREE PHASE AC SUPPLY



FILAMENT TERMINALS 2, 4, 6 & 7 PAINTED BLACK
GRID TERMINALS 1, 3, & 5 PAINTED RED

CE-A1523

RF POWER AMPLIFIER AND OSCILLATOR:
Class C Telegraphy

Key-Down Conditions per Tube Without Amplitude Modulation (Note 4)

Maximum Ratings

Absolute Maximum Values	CCS		
DC Plate Voltage	18	max.	Kilovolts
DC Grid Voltage	−2000	max.	Volts
DC Plate Current	10	max.	Amperes
DC Grid Current	2	max.	Amperes
Plate Input	180	max.	Kilowatts
Plate Dissipation	70	max.	Kilowatts

TYPICAL OPERATING CHARACTERISTICS:

		CCS	
DC Plate Voltage	17	17	Kilovolts
DC Grid Voltage	−800	−1400	Volts
Peak RF Grid Voltage	1700	2500	Volts
DC Plate Current	9.6	10.0	Amps
DC Grid Current, (Approx.)	1.55	1.7	Amperes
Driving Power, (Note 5)	2500	4500	Watts
Power Output, (Note 5)	125	136	Kilowatts

RATINGS VS. FREQUENCY

Maximum ratings apply up to 15 megacycles. The tube may be operated at higher frequencies provided the maximum values of plate voltage and power input are reduced according to the tabulation (other maximum ratings are the same as shown above.) Special attention should be given to bulb cooling at these frequencies.

Frequency	15	20	25	mc
Percentage of Maximum Rated Plate Voltage and Plate Input:				
Class C Telegraphy	100	82	70	%
Class C Plate Telephony	100	88	81	%

NOTES

1. Represents maximum usable cathode current (plate current plus grid current), for any condition of operation.
2. Cooling water and air may be applied and removed simultaneously with all voltages. The maximum published bulb and seal temperatures must not be exceeded at any frequency of operation. Tube temperature may be measured by using "Tempilaq", a temperature-sensitive lacquer made by the Tempil Corporation, 132 W. 22nd Street, New York 11, New York.
3. Averaged over any of cycle of sine-wave form.
4. Modulation essentially negative may be used if the positive peak of the envelope does not exceed 115% of the carrier conditions.
5. With essentially sine-wave excitation.

PLATE-MODULATED RF POWER AMPLIFIER:
Class C Telephony

Carrier Conditions per Tube for Use with a Maximum Modulation Factor of 1.0

Maximum Ratings

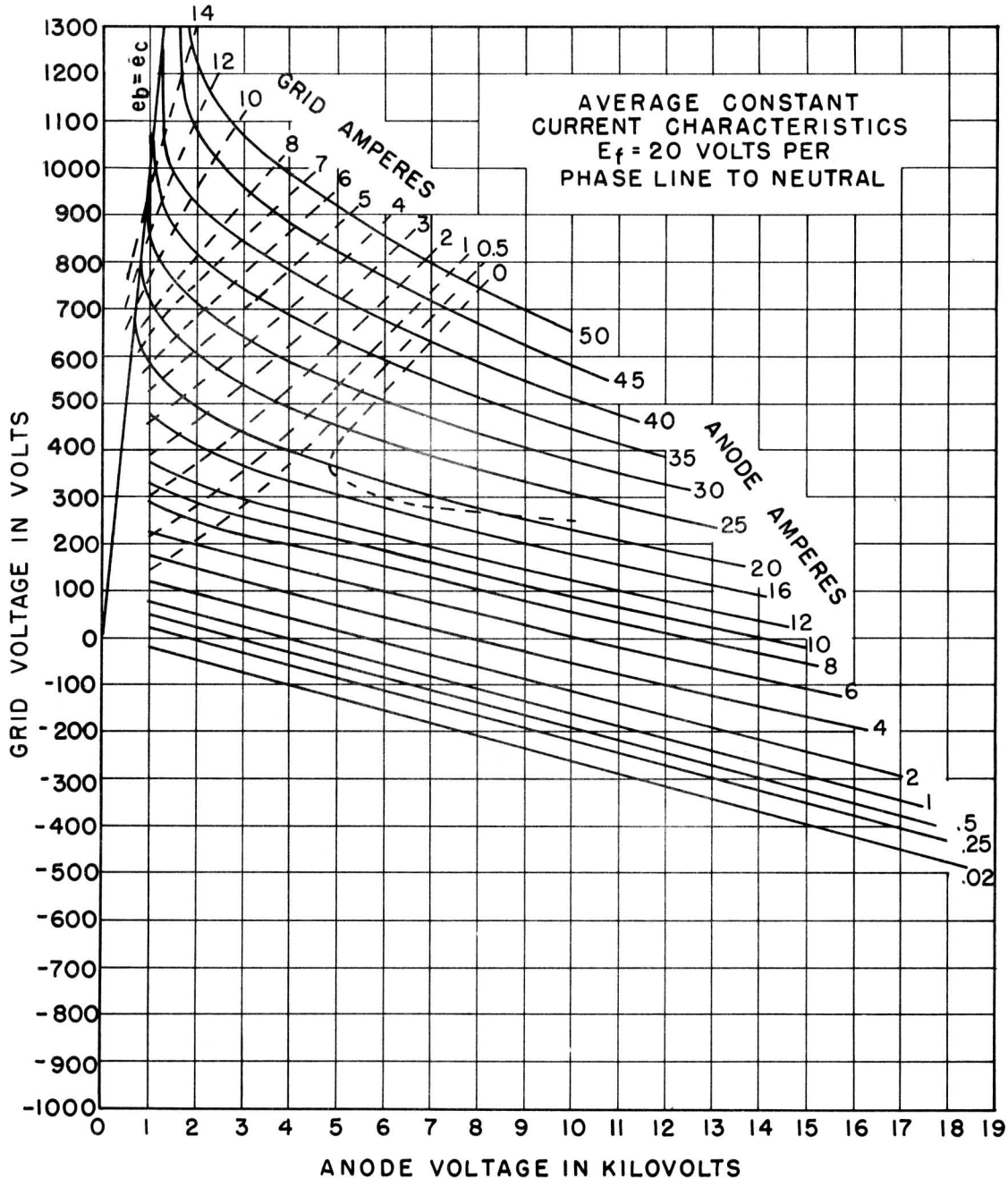
Absolute Maximum Values	CCS		
DC Plate Voltage	14	max.	Kilovolts
DC Grid Voltage	−2000	max.	Volts
DC Plate Current	5.0	max.	Amperes
DC Grid Current	2.0	max.	Amperes
Plate Input	70	max.	Kilowatts
Plate Dissipation	46	max.	Kilowatts

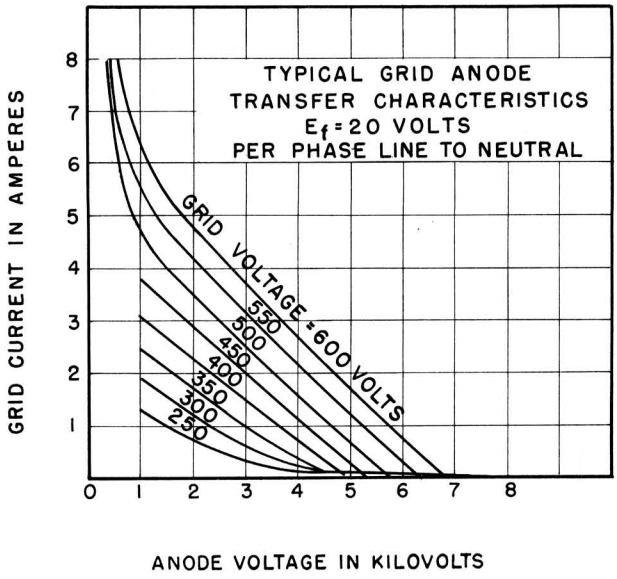
TYPICAL OPERATING CHARACTERISTICS:

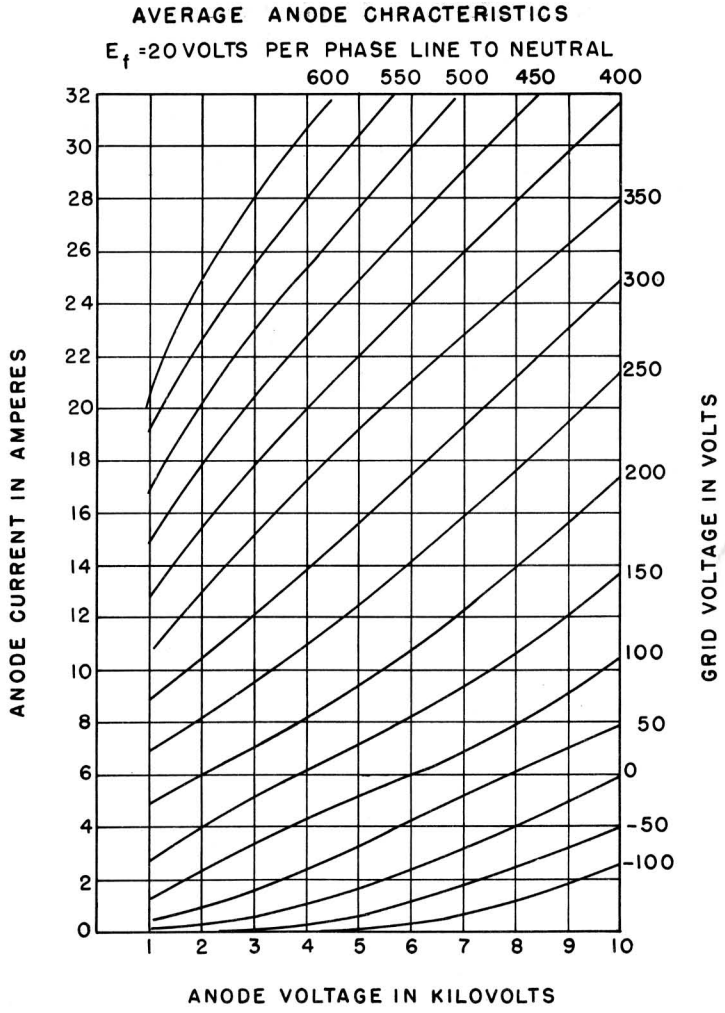
	CCS	CCS	
DC Plate Voltage	12.5	12.5	Kilovolts
Peak RF Plate Voltage	11.5	11.5	Kilovolts
DC Grid Voltage	−1500	−1500	Volts
Peak RF Grid Voltage	1975	2200	Volts
DC Plate Current	2.45	4.8	Amperes
DC Grid Current, (Approx.)	0.43	0.7	Amperes
Driving Power, (Approx.) ▲	820	2000	Watts
Power Output, (Approx.) ▲	27	50	Kilowatts

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Bogey	Max.	
GRID VOLTAGE:				
Plate Kilovolts = 2.0				
Plate Current, amps = 40				
Grid Voltage	--	--	1100	Volts
GRID CURRENT:				
Plate Kilovolts = 2.0				
Plate Current, amps = 40				
Grid Current	--	--	115	Amperes
PLATE VOLTAGE (Zero Bias):				
Grid Volts = 0				
Plate Current, dc amp = 1.0				
Plate Voltage, dc	3100	3800	4500	Volts
PLATE VOLTAGE:				
Grid Volts, dc = −200				
Plate Current, dc amp = 1.0				
Plate Voltage	10.1	11.5	12.9	Kilovolts
GRID VOLTAGE (Cutoff):				
Plate Kilovolts, dc = 10				
Plate Current, dc amp = 0.02				
Grid Voltage, dc	−180	−250	−320	Volts
PLATE POWER OUTPUT:				
Class C Telegraphy				
0 to 15 Mc.				
Power Output	120	--	--	Kilowatts


AVERAGE CONSTANT
CURRENT CHARACTERISTICS
Ef = 20 VOLTS PER
PHASE LINE TO NEUTRAL
eb = ec
GRID AMPERES
14
12
10
8
7
6
5
4
3
2
1
0.5
0
ANODE AMPERES
50
45
40
35
30
25
20
16
12
10
8
6
4
2
1
.5
.25
.02
GRID VOLTAGE IN VOLTS
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
-1000
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
ANODE VOLTAGE IN KILOVOLTS





POWER AMPLIFIER TRIODE TYPE WL-5986

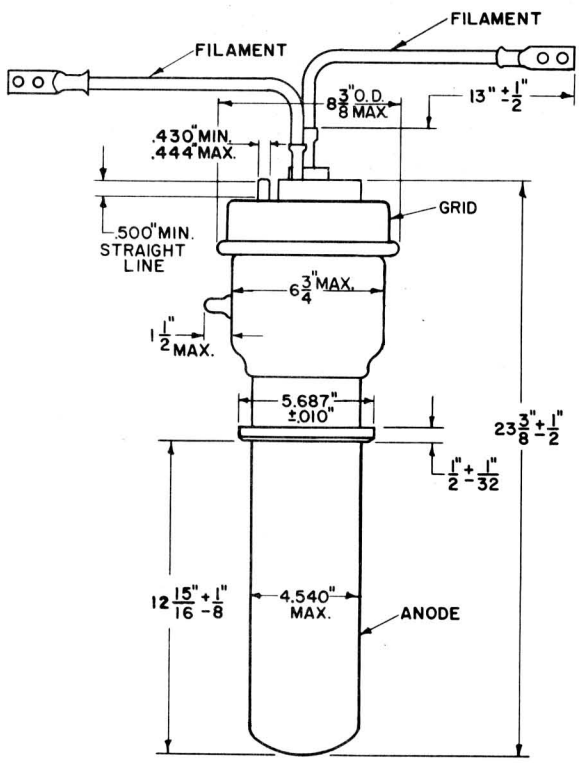
The WL-5986 is a three-electrode tube designed for use as an oscillator or amplifier. The anode is water cooled and is capable of dissipating 70 kilowatts. The cathode is a thoriated tungsten filament. Maximum ratings apply upto 15 megacycles.

ELECTRICAL:

	Min.	Bogey	Max.	
Cathode	Thoriated Tungsten Filament			
Filament:				
Voltage	11.5	12.0	12.5	Volts
Current at Bogey Voltage	275	300	315	Amperes
Heating Time	15	--	--	Seconds
Amplification Factor with Plate Amps=1.0 & Grid Volts= -200		37		
Direct Interelectrode Capacitances (approx.):				
Grid to Plate		37		μμf
Grid to Filament		90		μμf
Plate to Filament		6		μμf

MECHANICAL:

Mounting Position	Vertical, Anode Down
Type of Cooling	Water
Minimum Water Flow	30 GPM
Maximum Outlet Water Temperature	70 °C
Air Flow to Filament and Grid Seals	30 CFM
Maximum Bulb Temperature	180 °C
Maximum Seal Temperature	165 °C
Net Weight (approx.)	28 Pounds
Shipping Weight (approx.)	87 Pounds



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

MAXIMUM RATINGS♦

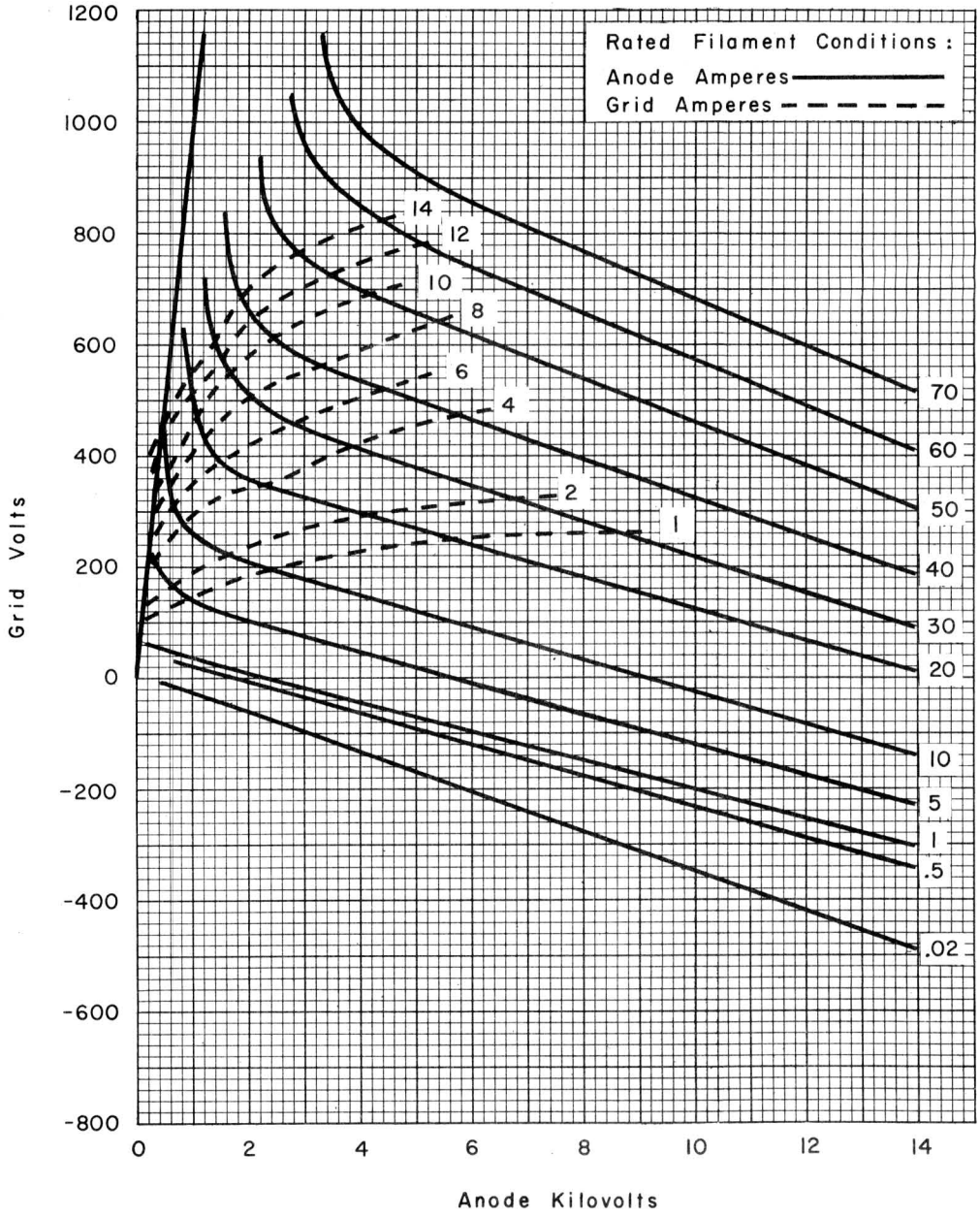
Absolute Maximum Values:			
DC Plate Voltage	17500	max.	Volts
DC Grid Voltage	-2400	max.	Volts
DC Plate Current	15.0	max.	Amperes
DC Grid Current	2.0	max.	Amperes
Plate Power Input	200	max.	Kilowatts
Plate Dissipation	70	max.	Kilowatts
Typical Operating Characteristics:			
DC Plate Voltage	1700		Volts
DC Grid Voltage	-1500		Volts
Peak RF Grid Voltage	2290		Volts
DC Plate Current	10.6		Amperes
DC Grid Current (approx.)	1.95		Amperes
Driving Power (approx.)	4.25		Kilowatts
Power Output (approx.)	136		Kilowatts

♦ Maximum ratings apply up to 15 megacycles. The tube may be operated at higher frequencies with reduced maximum plate voltage and plate power input as shown below. At the higher frequencies, special attention must be given to cooling. Increased air flow as high as 250 CFM may be required to maintain bulb and seal temperatures.

Frequency Derating Chart

Frequency	15	20	30	Megacycles
Maximum Permissable:				
DC Plate Voltage	100	90	78	Percent
Plate Power Input	100	90	78	Percent

AVERAGE CONSTANT CURRENT CHARACTERISTICS



February 3, 1958

VHF BEAM-POWER TYPES WL-6146, WL-6159, WL-6883

The WL-6146, WL-6159 and WL-6883 are new, improved octal based beam-power pentode type tubes. They are designed for service as very-high-frequency amplifiers or oscillators. They may also be used as audio amplifiers or modulators. Their small size makes them ideal for compact mobile and stationary communications equipment. These types are characterized by high power sensitivity, low plate and grid 2 voltages and low driving power.

The cathode and grid 3 are connected to an internal shield and three base pins. These connections make possible an effective radio frequency ground. A T-12 bulb and a short internal lead button stem contribute to cooler operation and longer life. The short metal sleeve around the base provides shielding for the input. The top-cap plate connection isolates the input circuit from the output circuit. The top-cap is skirted to secure a better bond with the envelope and to increase its heat dissipation capabilities.

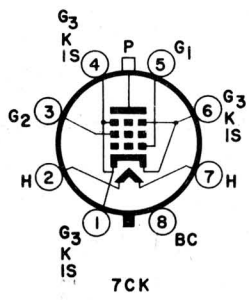
The WL-6146 has a conventional 6.3 volt heater. The WL-6159 has a 26.5 volt heater and is intended for service in aircraft equipment. The WL-6883 has a 12.6 volt heater and is intended for service in vehicles with a 12 volt storage battery.

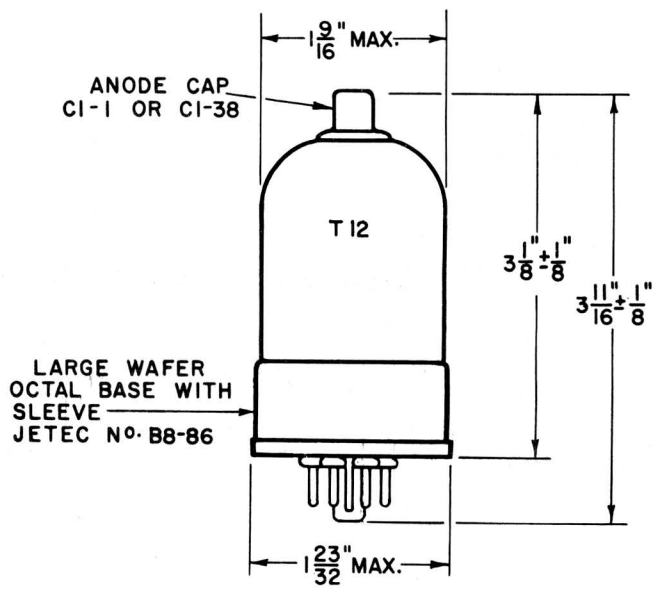
ELECTRICAL:

	6146	6159	6883	
Cathode		Coated Unipotential		
Heater:				
Voltage (ac or dc)	6.3	26.5	12.6	Volts
Current	1.25	0.30	0.625	Ampere
Direct Interelectrode Capacitances: (Unshielded) §				
Grid 1 to Plate		0.22 max.		uuf
Input		13.5		uuf
Output		8.5		uuf

MECHANICAL

Bulb	T-12
Base	Large Wafer Octal with Sleeve (JETEC B8-86)
Basing	7CK
Top Cap	Small (JETEC C1-1) or Small Skirted (JETEC C1-38)
Mounting Position	Any
Max. Bulb Temperature at Hottest Point	220° C





AF POWER AMPLIFIER AND MODULATOR

CLASS AB_1 OPERATION⊕
TRIODE CONNECTED

MAXIMUM RATINGS

Absolute Maximum Values	CCS▲	ICAS*		
DC Plate Voltage	400	400	max.	Volts
Grid 2	Connected to Plate			
DC Plate Current	90	90	max.	Ma.
DC Plate Power Input	35	35	max.	Watts
Plate Dissipation	20	25	max.	Watts
Peak Heater-Cathode Voltage:				
Heater Positive with Respect to Cathode	135	135	max.	Volts
Heater Negative with Respect to Cathode	135	135	max.	Volts
Grid 1 Circuit Resistance: ♦				
With Fixed Bias	0.1	0.1	max.	Megohm
With Cathode Resistor Bias	0.5	0.5	max.	Megohm

TYPICAL OPERATING CHARACTERISTICS

Two Tubes in Push-Pull	CCS▲		ICAS*	
Plate Voltage	250	400	400	Volts
Grid 1 Voltage	-50	-100	-100	Volts
Peak Signal Grid 1 to Grid 1 Voltage●	100	200	200	Volts
Peak Signal Grid Driving Power●	0	0	0	Watts
Plate Current:				
Zero-Signal	120	40	40	Ma.
Maximum-Signal	125	100	100	Ma.
Plate-to-Plate Load Resistance	5000	8000	8000	Ohms
Peak Signal Power Output	10	22	22	Watts

CLASS AB_1 OPERATION⊕

MAXIMUM RATINGS

Absolute Maximum Values	CCS▲	ICAS*		
DC Plate Voltage	600	750	max.	Volts
DC Grid 2 Voltage	250	250	max.	Volts
DC Plate Current	125	135	max.	Ma.
DC Plate Power Input	60	85	max.	Watts
DC Grid 2 Power Input	3	3	max.	Watts
Plate Dissipation	20	25	max.	Watts
Peak Heater-Cathode Voltage:				
Heater Positive with Respect to Cathode	135	135	max.	Volts
Heater Negative with Respect to Cathode	135	135	max.	Volts
Grid 1 Circuit Resistance:				
With Fixed Bias	0.1	0.1	max.	Megohms
With Cathode-Resistor Bias		Not Recommended		

TYPICAL OPERATING CHARACTERISTICS IN CCS▲

Two Tubes in Push-Pull				
Plate Voltage	400	500	600	Volts
Grid 2 Voltage■	190	185	180	Volts
Grid 1 Voltage (Fixed Bias)	-40	-40	-45	Volts
Peak Signal Grid 1 to Grid 1 Voltage●	80	80	90	Volts
Peak Signal Driving Power●	0	0	0	Watts
Plate Current:				
Zero Signal	63	57	26	Ma.
Max. Signal	228	215	200	Ma.
Grid 2 Current:				
Zero Signal	2.5	2.0	1.0	Ma.
Max. Signal	25	25	23	Ma.
Plate-to-Plate Load Resistance	4000	5500	7000	Ohms
Peak Signal Power Output	55	70	82	Watts

TYPICAL OPERATING CHARACTERISTICS IN ICAS*

Two Tubes in Push-Pull			
Plate Voltage	600	750	Volts
Grid 2 Voltage■	200	195	Volts
Grid 1 Voltage (Fixed Bias)	-50	-50	Volts
Peak Signal Grid 1 to Grid 1 Voltage●	100	100	Volts
Peak Signal Driving Power●	0	0	Watts
Plate Current:			
Zero Signal	28	23	Ma.
Max. Signal	229	220	Ma.
Grid 2 Current:			
Zero Signal	1.0	1.0	Ma.
Max. Signal	27	26	Ma.
Plate-to-Plate Load Resistance	6000	8000	Ohms
Peak Signal Power Output	95	120	Watts

CLASS AB_2 OPERATION□

MAXIMUM RATINGS

Absolute Maximum Values	CCS▲	ICAS*		
DC Plate Voltage	600	750	max.	Volts
DC Grid 2 Voltage	250	250	max.	Volts
DC Plate Current	125	135	max.	Ma.
DC Plate Power Input	62.5	90	max.	Watts
DC Grid 2 Power Input	3	3	max.	Watts
Plate Dissipation	20	25	max.	Watts
Peak Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode	135	135	max.	Volts
Heater Positive with Respect to Cathode	135	135	max.	Volts
Grid 1 Circuit Resistance:				
With Fixed Bias:				
Operated at Max. Ratings	300000	300000	max.	Ohms
Operated below Max. Ratings	100000	100000	max.	Ohms
With Cathode-Resistor Bias		Not Recommended		

TYPICAL OPERATING CHARACTERISTICS IN CCS▲

Two Tubes in Push-Pull

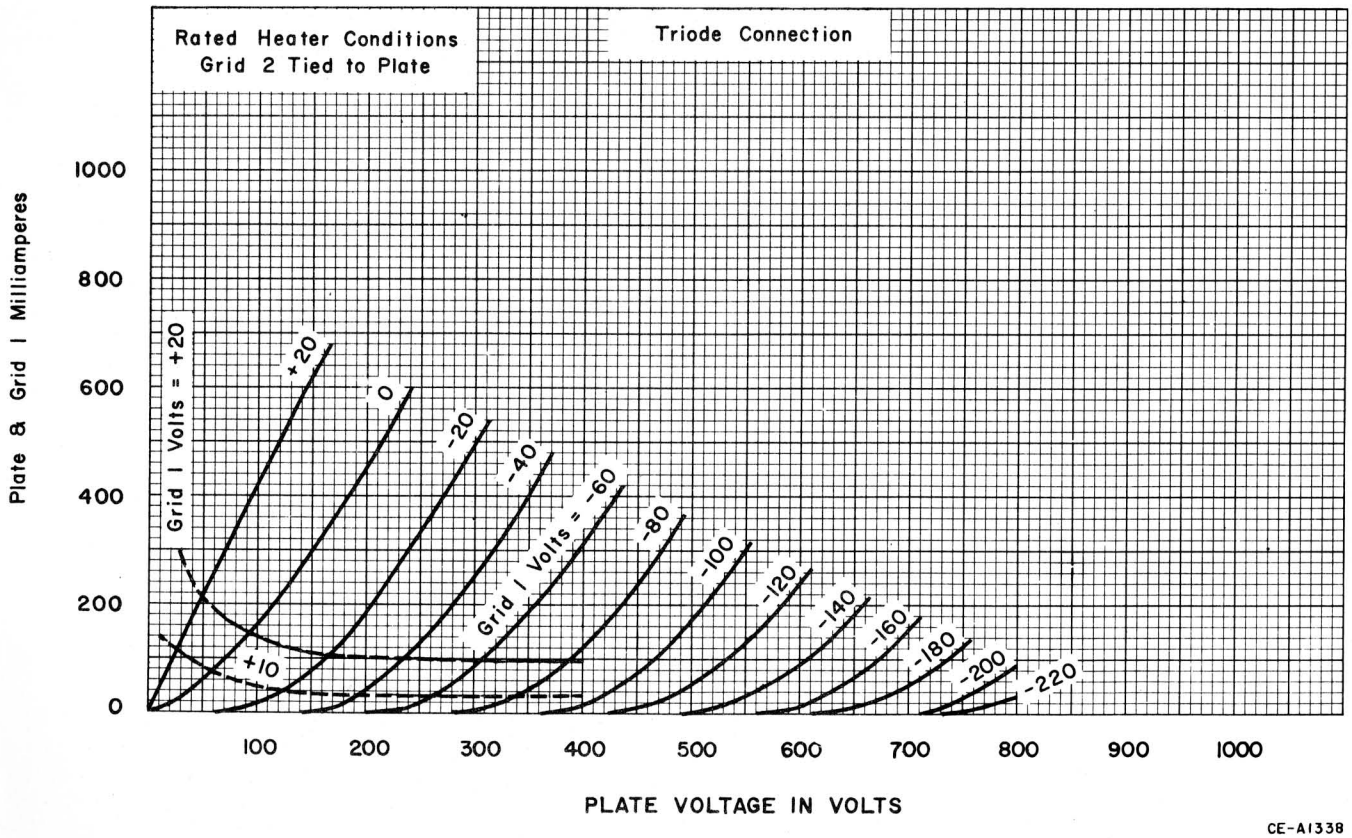
Plate Voltage	400	500	600	Volts
Grid 2 Voltage	175	175	165	Volts
Grid 1 Voltage (Fixed Bias)	-41	-44	-44	Volts
Peak Signal Grid 1 to Grid 1 Voltage●	95	102	97	Volts
Peak Signal Driving Power●	0.2	0.3	0.2	Watts
Peak Current:				
Zero Signal	33	27	22	Ma.
Max. Signal	232	242	207	Ma.
Grid 2 Current:				
Zero Signal	1.1	0.7	0.6	Ma.
Max. Signal	18	18	17	Ma.
Peak Signal Grid 1 Current	1.6	1.9	1.1	Ma.
Plate-to-Plate Load Resistance	3700	4600	6800	Ohms
Peak Signal Power Output	62	83	90	Watts

TYPICAL OPERATING CHARACTERISTICS IN ICAS*

Two Tubes in Push-Pull

Plate Voltage	600	750	Volts
Grid 2 Voltage	190	165	Volts
Grid 1 Voltage (Fixed Bias)	-48	-46	Volts
Peak Signal Grid 1 to Grid 1 Voltage●	109	108	Volts
Peak Signal Driving Power●	0.03	0.04	Watts
Plate Current:			
Zero Signal	28	22	Ma.
Max. Signal	270	240	Ma.
Grid 2 Current:			
Zero Signal	1.2	0.3	Ma.
Max. Signal	20	20	Ma.
Peak Signal Grid 1 Current	2.0	2.6	Ma.
Plate-to-Plate Load Resistance	5000	7400	Ohms
Peak Signal Power Output	113	131	Watts

AVERAGE PLATE CHARACTERISTICS



CE-A1338

RF POWER AMPLIFIER AND OSCILLATOR

PLATE MODULATED CLASS C TELEPHONY
MAX. MODULATED FACTOR OF 1.0

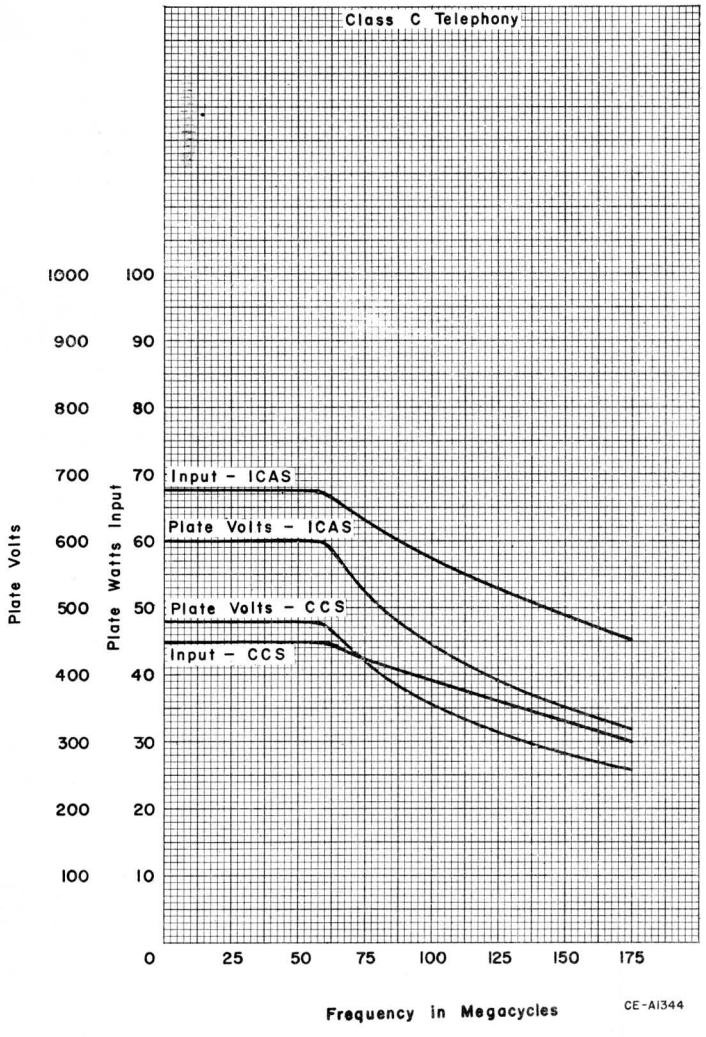
MAXIMUM RATINGS:

Absolute Maximum Values	CCS▲	ICAS*		
DC Plate Voltage	480	600	max.	Volts
DC Grid 2 Voltage	250	250	max.	Volts
DC Grid 1 Voltage	-150	-150	max.	Volts
DC Plate Current	117	125	max.	Ma.
DC Grid 1 Current	3.5	4.0	max.	Ma.
DC Plate Power Input	45	67.5	max.	Watts
DC Grid 2 Power Input	2	2	max.	Watts
Plate Dissipation	13.3	16.7	max.	Watts
Peak Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode	135	135	max.	Volts
Heater Positive with Respect to Cathode	135	135	max.	Volts
Grid 1 Circuit Resistance♦				
Operated at Max. Ratings	30000	30000	max.	Ohms
Operated below Max. Ratings	100000	100000	max.	Ohms

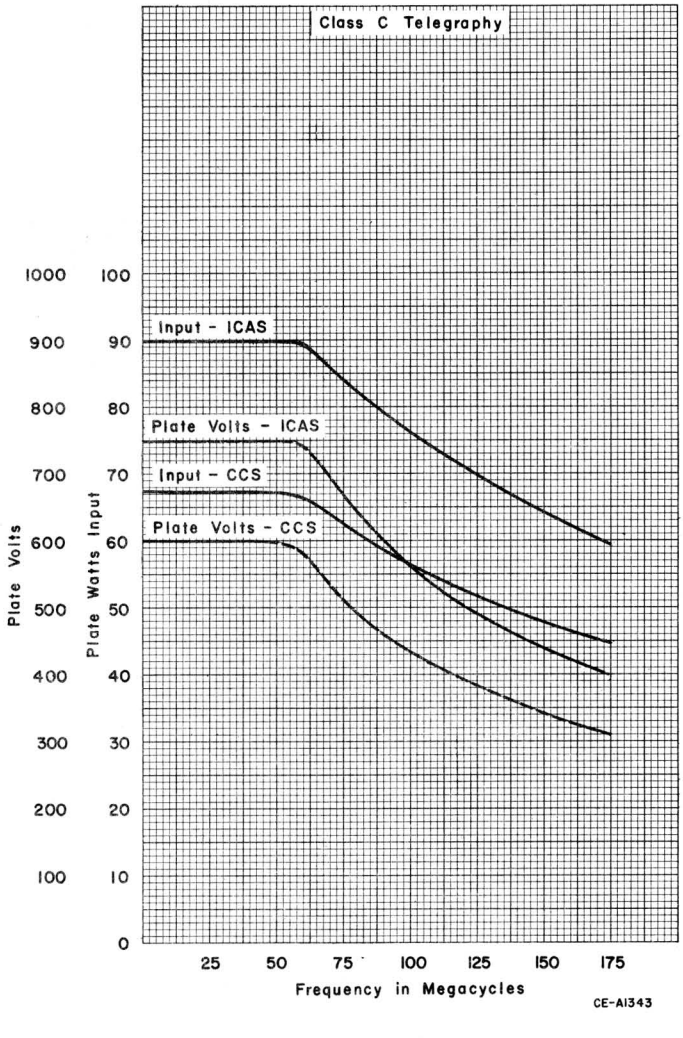
TYPICAL OPERATING CHARACTERISTICS

	CCS▲		ICAS*	
Plate Voltage	400	475	600	Volts
Grid 2 Voltage*	150	135	150	Volts
Grid 2 Series Resistor*	33000	51000	56000	Ohms
Grid 1 Voltage †	-87	-77	-87	Volts
Grid 1 Resistor †	27000	27000	27000	Ohms
Peak RF Driving Signal:				
Voltage	107	95	107	Volts
Power	0.4	0.3	0.4	Watt
Plate Current	112	94	112	Ma.
Grid 2 Current	7.8	6.4	7.8	Ma.
Grid 1 Current	3.4	2.8	3.4	Ma.
Power Output	32	34	52	Watts

POWER INPUT - FREQUENCY CHARACTERISTICS



POWER INPUT - FREQUENCY CHARACTERISTICS



CONTINUOUS WAVE CLASS C TELEGRAPHY AND FREQUENCY MODULATED CLASS C TELEGRAPHY

MAXIMUM RATINGS

Absolute Maximum Values	CCS▲	ICAS*		
DC Plate Voltage	600	750	max.	Volts
DC Grid 2 Voltage	250	250	max.	Volts
DC Grid 2 Key-Up Voltage	400	400	max.	Volts
DC Grid 1 Voltage	-150	-150	max.	Volts
DC Plate Current	140	150	max.	Ma.
DC Grid 1 Current	3.5	4.0	max.	Ma.
DC Plate Power Input	7.5	90	max.	Watts
DC Grid 2 Power Input	3.0	3.0	max.	Watts
Plate Dissipation	20	25	max.	Watts
Peak Heater-Cathode Voltage:				
Heater Negative with Respect to Cathode	135	135	max.	Volts
Heater Positive with Respect to Cathode	135	135	max.	Volts
Grid 1 Circuit Resistance♦				
Operated at Max. Ratings	30000	30000	max.	Ohms
Operated below Max. Ratings	100000	100000	max.	Ohms

TYPICAL OPERATING CHARACTERISTICS

Frequencies up to 60 Megacycles	CCS▲		ICAS*		
Plate Voltage	500	600	600	750	Volts
Grid 2 Voltage■	170	150	180	160	Volts
Grid 2 Series Resistor	36000	51000	43000	56000	Ohms
Grid 1 Voltage	-66	-58	-71	-62	Volts
From Grid Resistor of	27000	20000	24000	20000	Ohms
or Cathode-Bias Resistor of	470	470	430	470	Ohms
Peak RF Driving Signal:					
Voltage	84	73	91	79	Volts
Power	0.2	0.2	0.3	0.2	Watts
Plate Current	135	112	150	120	Ma.
Grid 2 Current	9	9	10	11	Ma.
Grid 1 Current	2.5	2.8	2.8	3.1	Ma.
Power Output	48	52	66	70	Watts

TYPICAL OPERATING CHARACTERISTICS

175 Megacycle Amplifier	CCS▲	ICAS*	
Plate Voltage	320	400	Volts
Grid 2 Voltage■	180	190	Volts
Grid 2 Series Resistor	13000	20000	Ohms
Grid 1 Voltage	-51	-54	Volts
From Grid Resistor of	27000	24000	Ohms
or a Cathode Resistor of	330	330	Ohms
Peak RF Driving Signal:			
Voltage	64	68	Volts
Power	3	3	Watts
Plate Current	140	150	Ma.
Grid 2 Current	10	10.4	Ma.
Grid 1 Current	2	2.2	Ma.
Power Output	25	35	Watts

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Heater Voltage	6.3		ac Volts
Heater Current:			
Minimum	1.175		Ampere
Maximum	1.325		Ampere
Grid 1 Plate Capacitance:			
Maximum	0.22		uuf
Input Capacitance			
Minimum	11.1		uuf
Maximum	15.9		uuf
Output Capacitance:			
Minimum	6.4		uuf
Maximum	10.6		uuf
	Amplifier	Oscillator‡	
Plate Volts	300	600	Volts
Grid 2 Volts	200	180	Volts
Grid 1 Volts	-33	--	Volts
Grid 1 Resistor	--	30000	Ohms
Plate Current:			
Maximum	94	112	Ma.
Minimum	46	100	Ma.
Grid 2 Current:			
Maximum	5.5	--	Ma.
Minimum	--	--	Ma.
Grid 1 Current:			
Maximum	--	2.5	Ma.
Minimum	--	2.0	Ma.
Power Output:			
Minimum	--	47	Watts

NOTES

§ Pin 8 grounded.

⊕ Subscript 1 indicates that no grid current flows during any part of the input cycle.

▲ Continuous Commercial Service

* Intermittent Commercial and Amateur Service

♦ The input-coupling network used should not introduce too much resistance in the Grid 1 circuit. Transformer or impedance coupling arrangements are recommended.

● The driving stage should be capable of supplying these values of voltage and power at low distrotion.

■ The grid 1 voltage should not change with power supply load. A separate power supply or independent voltage-divider voltage source is recommended.

□ Subscript 2 indicates grid 1 draws current during some part of the input cycle.

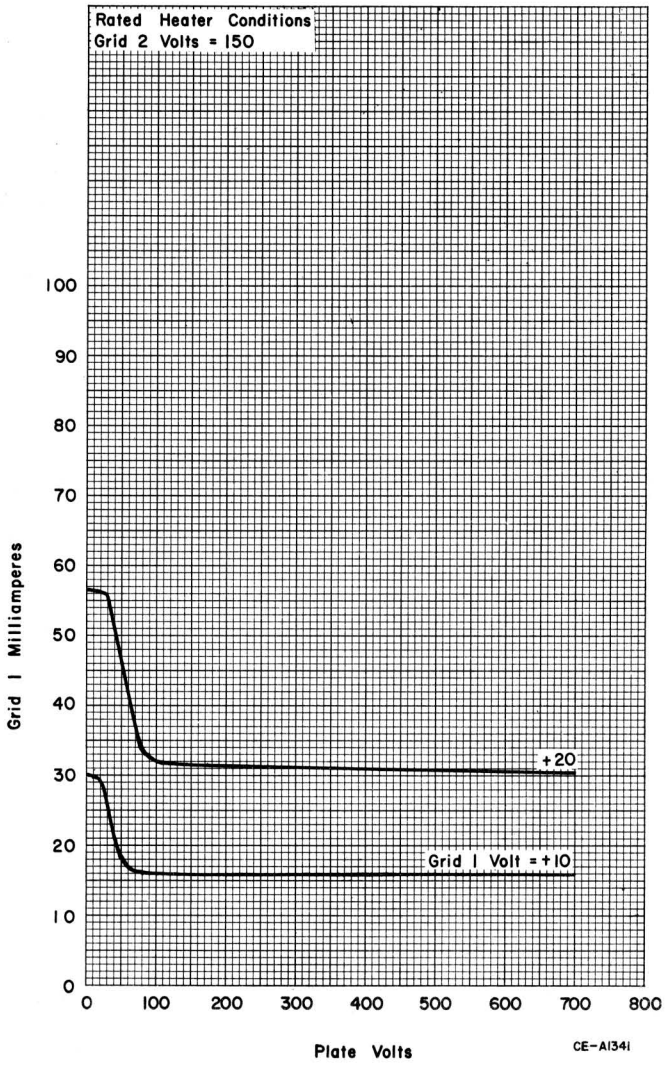
♦ When grid 1 is driven positive and draws current the listed values must not be exceeded. If these values are insufficient to provide proper operating bias, other biasing methods must be used to provide the required extra bias without increasing grid 1 circuit resistance.

★ It is recommended that the screen voltage be modulated with the plate voltage. This can be accomplished by an independent modulated power supply or a series resistor from the plate voltage supply.

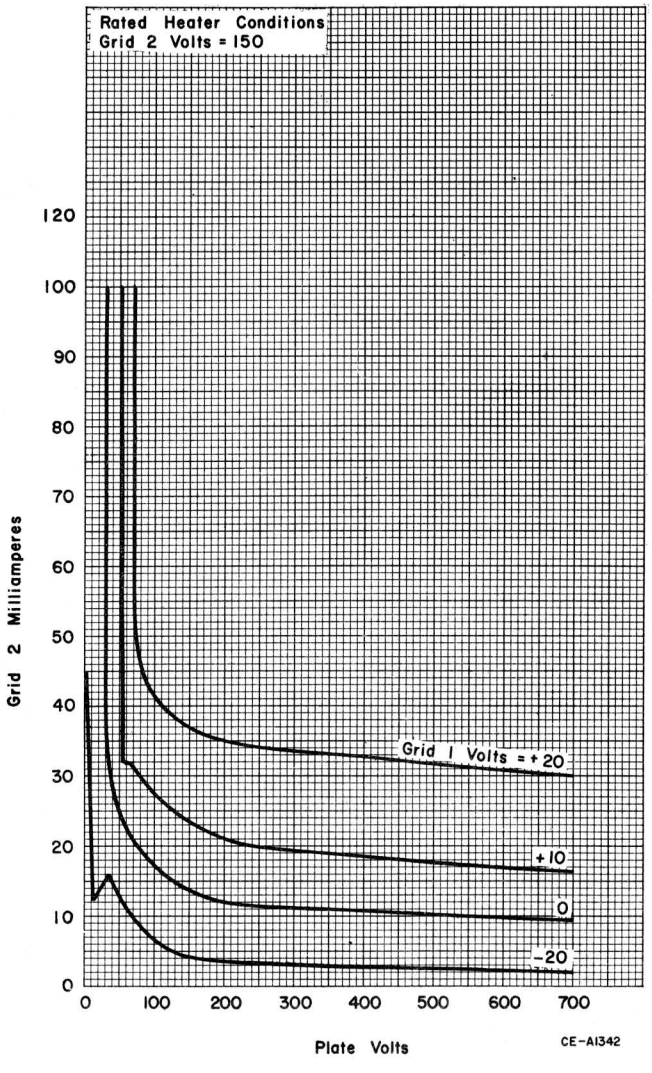
† The grid 1 bias should be generated by either grid resistor or combination grid resistor and cathode-bias resistor methods.

‡ Operated as a single tube self excited 15 Mc. Oscillator.

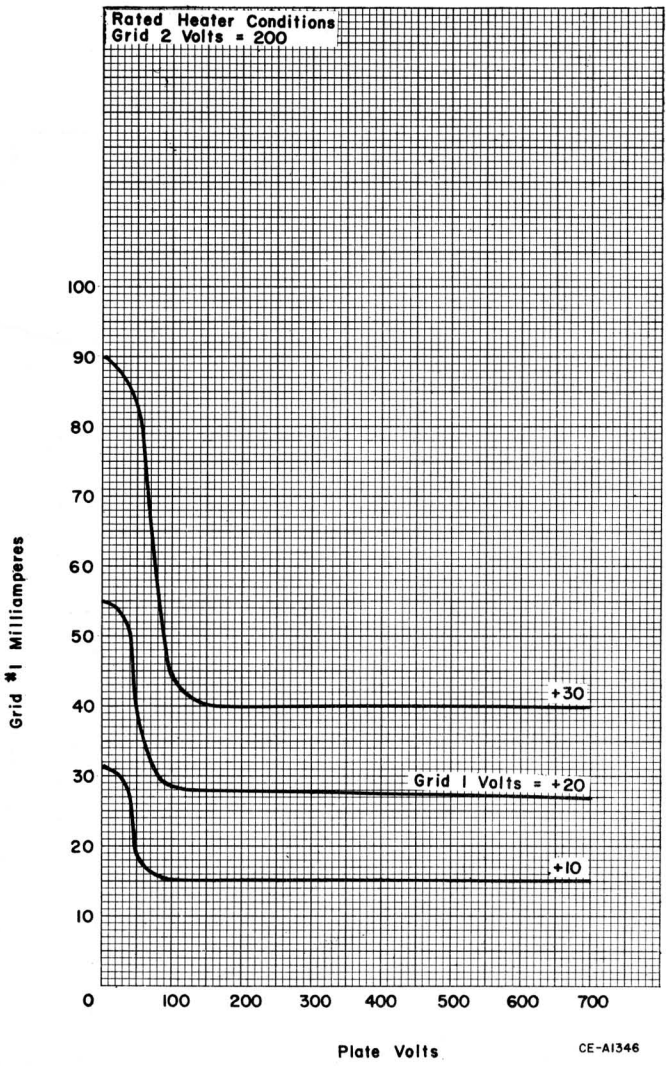
AVERAGE CHARACTERISTICS



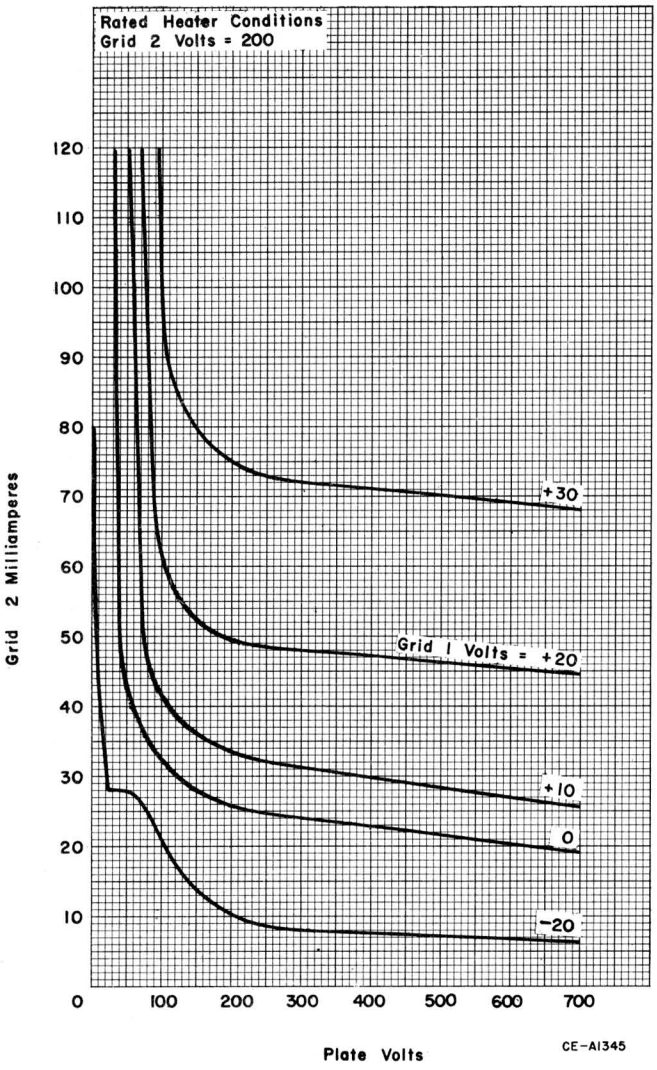
AVERAGE CHARACTERISTICS



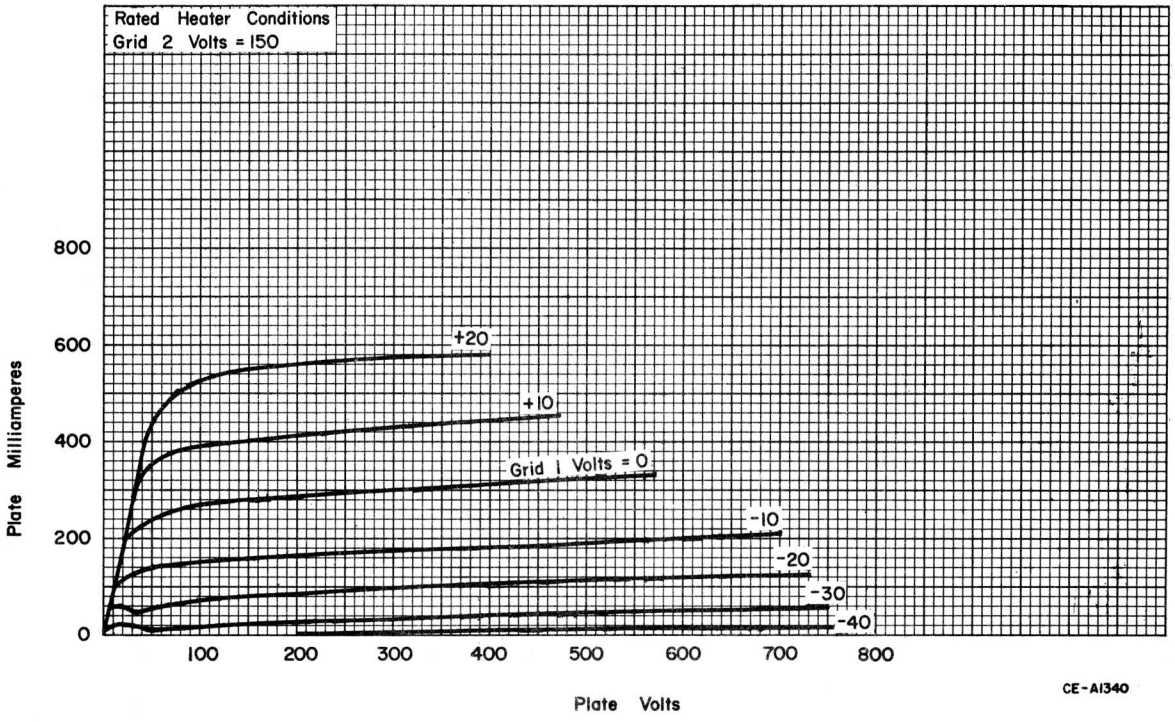
AVERAGE CHARACTERISTICS



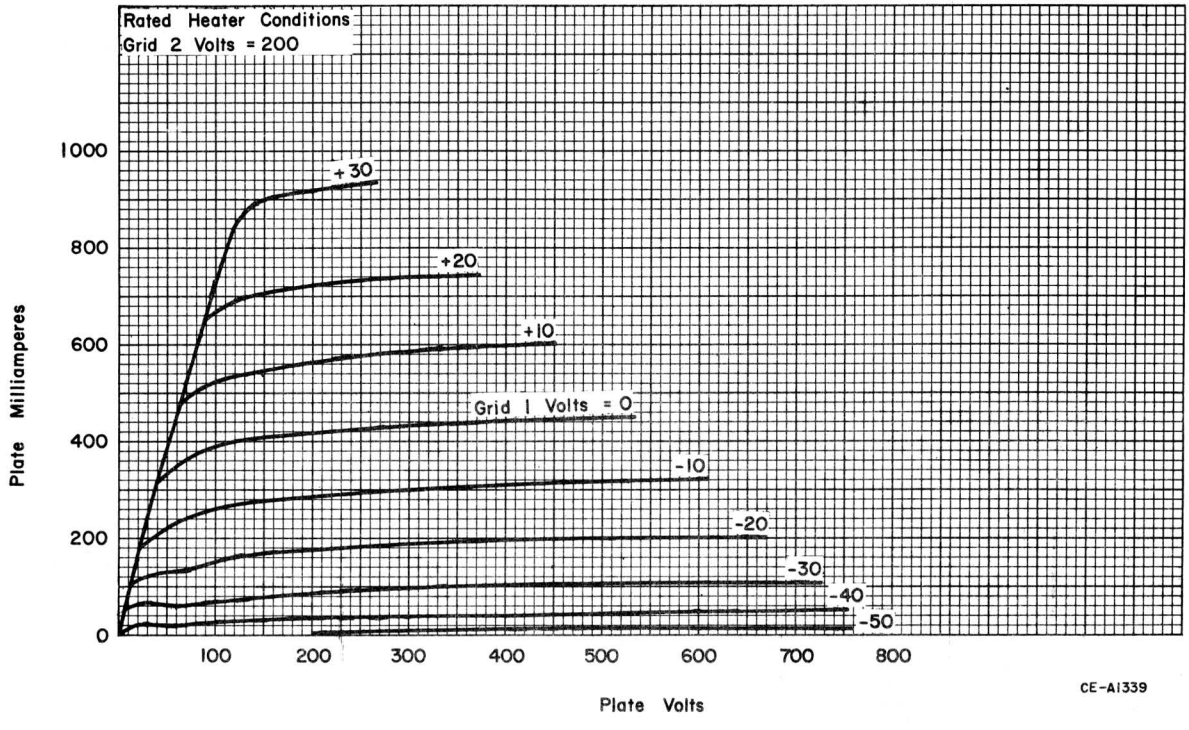
AVERAGE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS

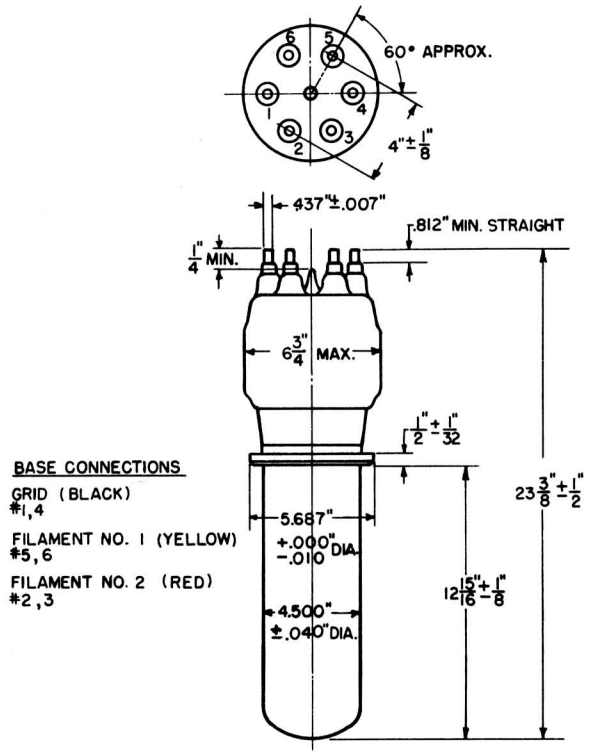


POWER AMPLIFIER TRIODE TYPE WL-6379

The WL-6379 is a three electrode tube designed for service as a high power audio amplifier in Class AB, service. The anode is of external water cooled design and is capable of dissipating 70 Kilowatts during Continuous Commercial Service. The thoriated tungsten filament may be operated on dc or single-phase ac. The maximum ratings of the WL-6379 apply for audio frequencies.

Electrical:

Filament	Thoriated Tungsten	
Voltage	11	Volts
Current	285	Amperes
Minimum Heating Time	15	Seconds
Direct Interelectrode Capacitances (approx):		
Grid to Plate	85	μμf
Grid to Filament	82	μμf
Plate to Filament	8.5	μμf
Amplification Factor	5	



CE-A1453

Mechanical:

Mounting Position	Vertical Anode Down		
Type of Cooling			Water
Water Flow	30	min.	G.P.M.
Outlet Water Temperature	70	max.	°C
Bulb and Seal Temperature▲	180	max.	°C
Net Weight (approx)	25		Pounds

Maximum Ratings:

Absolute Maximum Values

DC Plate Voltage	17,500	max.	Volts
Maximum Signal DC Plate Current■	15	max.	Amperes
Maximum Signal Plate Power Input■	150	max.	Kilowatts
Plate Dissipation	70	max.	Kilowatts

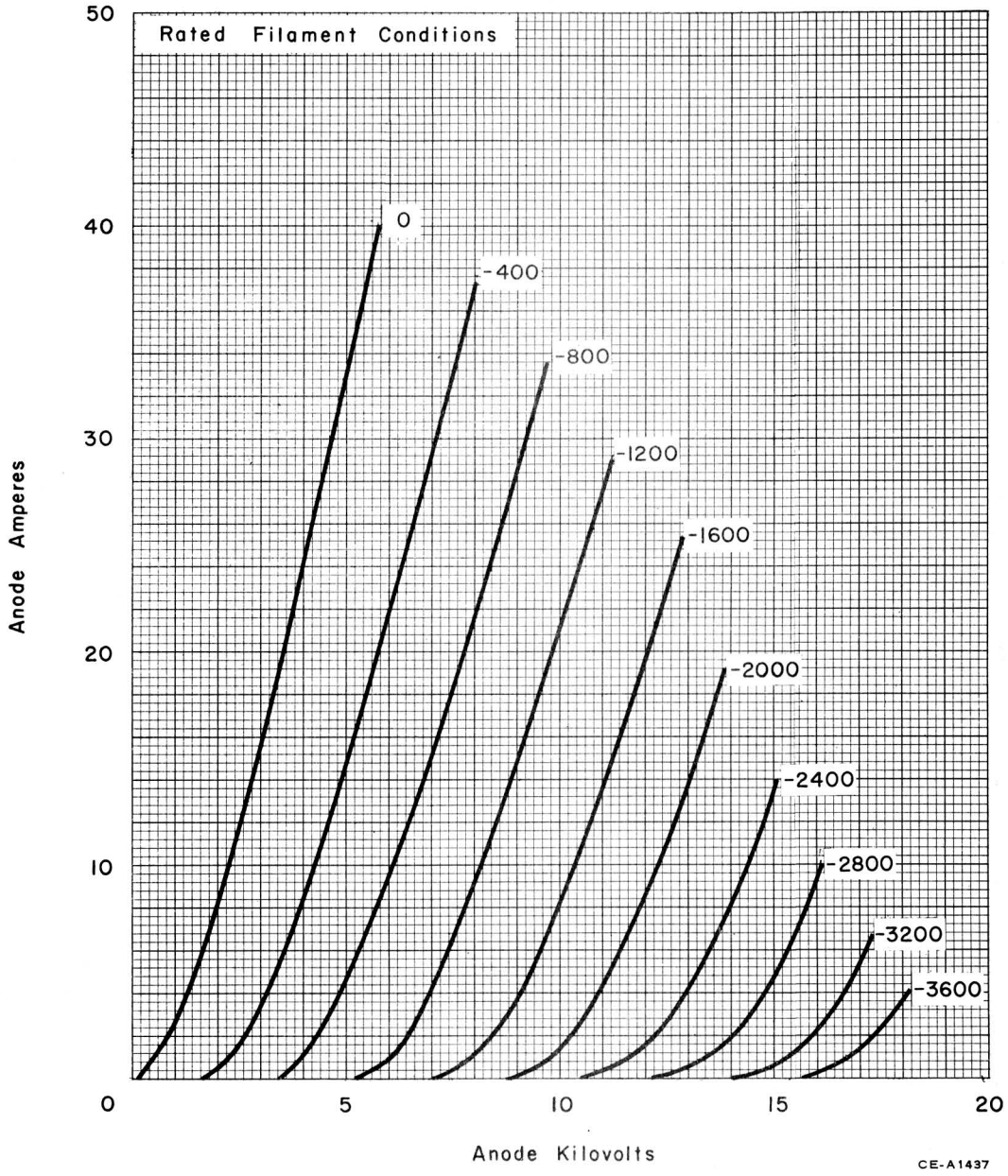
Typical Operating Conditions: Class AB,
(Values are for 2 tubes)

DC Plate Voltage	14,700	Volts
DC Grid Voltage	-3100	Volts
Peak AF Grid to Grid Voltage	6140	Volts
Zero Signal DC Plate Current	1.2	Amperes
Maximum Signal DC Plate Current	20	Amperes
Effective Plate to Plate Load Resistance	1212	Ohms
Maximum Signal Driving Power	0	Watts
Maximum Signal Power Output	150	Kilowatts

▲ Air flow to filament and grid seals is 30 cubic feet per minute.

■ Averaged over sine wave audio frequency cycle.

AVERAGE PLATE CHARACTERISTICS



HIGH VACUUM AMPLIFIER TYPES WL-6422, WL-6423 & WL-6423F

The WL-6422, WL-6423 and WL-6423F are 3-electrode tubes designed for service in industrial heating and communications applications. Rugged coaxial mounting structures, high amplification factor and sturdy, self-supported, stress-free thoriated tungsten filament are outstanding features common to all the tubes.

The WL-6422 is water cooled with a 20-kilowatt plate dissipation. The WL-6423 and WL-6423F are forced air cooled. The WL-6423 has a 12.5-kilowatt plate dissipation using an annular finned copper anode. The WL-6423F has a 10-kilowatts plate dissipation with a radial-finned copper radiator. Maximum ratings apply to all three types to frequencies up to 30 megacycles.

ELECTRICAL

Cathode	Thoriated-Tungsten Filament		
Filament:			
Voltage	7.0		Volts
Current	85		Amperes
Starting Current (Max.)	400		Amperes
Cold Resistance	0.0095		Ohms
Amplification Factor	90		–
Interelectrode Capacitances:	WL-6422 WL-6423	WL-6423F	
Grid-to-Plate	25	26	pf
Grid-to-Filament	32	32	pf
Plate-to-Filament	1.5	1.9	pf

MECHANICAL

Mounting Position ..... Vertical, Anode Down

Cooling:

WL-6422: Water cooled with 7 GPM needed for 20KW dissipation in WL-22696 Jacket with a Max. outgoing temp. of 70°C.

WL-6423: Forced-air cooled with 710 CFM at 4.7" H_2O needed for 12.5 KW dissipation in WL-22784 Air Distributor with a Max. incoming temp. of 50°C.

WL-6423F: Forced-air cooled with 750 CFM needed for 10 KW dissipation in WL-22678 Crock with a Max. incoming temp. of 50°C.

Maximum Glass Temperature ..... 165°C

Net Weight: (Approx.)

WL-6422	10 Pounds
WL-6423	15 Pounds
WL-6423F	50 Pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR, CLASS B

MAXIMUM RATINGS

Absolute Maximum Values

DC Plate Voltage	12.5	max.	Kilovolts
DC Plate Current	2.5	max.	Amperes
Plate Power Input	30	max.	Kilowatts
Plate Dissipation:			
WL-6422	20	max.	Kilowatts
WL-6423	12.5	max.	Kilowatts
WL-6423F	10	max.	Kilowatts

TYPICAL OPERATION (Two Tubes in Push-Pull)

DC Plate Voltage	9	10	Kilovolts
DC Grid Voltage	–50	–50	Volts
Peak AF Grid-to-Grid Voltage	1040	1120	Volts
Zero-Signal DC Plate Current	0.4	0.4	Amperes
Max.-Signal DC Plate Current	4.0	4.6	Amperes
Effective Plate-to-Plate Load Resistance	4700	4400	Ohms
Driving Power	160	170	Watts
Power Output	23	29	Kilowatts

RADIO FREQUENCY POWER AMPLIFIER, CLASS B

Carrier Conditions per Tube with Max. Modulation Factor of 1.0

MAXIMUM RATINGS

Absolute Maximum Values

DC Plate Voltage	12.5	max.	Kilovolts
DC Plate Current	1.8	max.	Amperes
Plate Power Input:			
WL-6422	22	max.	Kilowatts
WL-6423	19	max.	Kilowatts
WL-6423F	15	max.	Kilowatts
Plate Dissipation:			
WL-6422	20	max.	Kilowatts
WL-6423	12.5	max.	Kilowatts
WL-6423F	10	max.	Kilowatts

TYPICAL OPERATION

DC Plate Voltage	12	Kilovolts
DC Grid Voltage	–80	Volts
Peak RF Grid Voltage	235	Volts
Peak RF Plate Voltage	5200	Volts
DC Plate Current	0.74	Amperes
DC Grid Current	0	mA
Driving Power	40	Watts
Power Output	3	Kilowatts
RF Load Resistance	4500	Ohms

PLATE MODULATED RF POWER AMPLIFIER
CLASS C TELEPHONY

Carrier Conditions per Tube with Max. Modulation Factor of 1.0

MAXIMUM RATINGS

Absolute Maximum Values

DC Plate Voltage	9 max.	Kilovolts
DC Grid Voltage	−1400 max.	Volts
DC Plate Current	1.8 max.	Amperes
DC Grid Current	0.5 max.	Amperes
Plate Power Input	16 max.	Kilowatts
Plate Dissipation:		
WL-6422	13 max.	Kilowatts
WL-6423	8 max.	Kilowatts
WL-6423F	7 max.	Kilowatts

TYPICAL OPERATION

DC Plate Voltage	9	Kilovolts
Peak RF Plate Voltage	8	Kilovolts
DC Grid 1 Voltage	−600	Volts
Peak RF Grid Voltage	985	Volts
DC Plate Current	0.85	Amperes
DC Grid Current	0.14	Amperes
Driving Power	135	Watts
Power Output	6.3	Kilowatts
RF Load Resistance	6500	Ohms

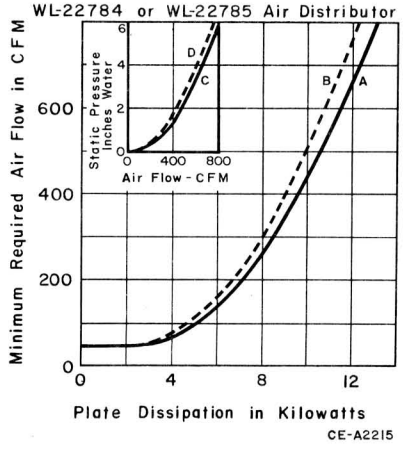
RF POWER AMPLIFIER AND OSCILLATOR
CLASS C TELEGRAPHY

MAXIMUM RATINGS

Absolute Maximum Values

DC Plate Voltage	12.5 max.	Kilovolts
DC Grid Voltage	−1400 max.	Volts
DC Plate Current	2.5 max.	Amperes
DC Grid Current	0.5 max.	Amperes
Plate Power Input	30 max.	Kilowatts
Plate Dissipation:		
WL-6422	20 max.	Kilowatts
WL-6423	12.5 max.	Kilowatts
WL-6423F	10 max.	Kilowatts

COOLING CHARACTERISTICS
WL-22784 or WL-22785 Air Distributor



Curves A & C Apply to Pressure Air Flow

Curves B & D Apply to Exhaust Air Flow

TYPICAL OPERATION

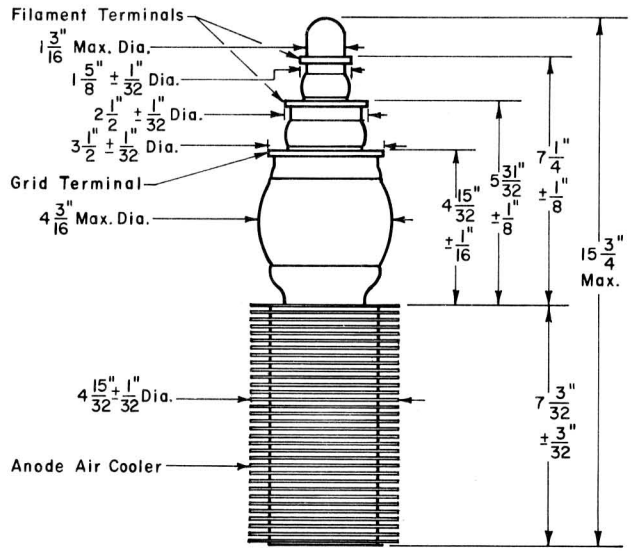
DC Plate Voltage	10	10	12	Kilovolts
Peak RF Plate Voltage	8500	8200	10200	Kilovolts
DC Grid Voltage	−400	−400	−400	Volts
Peak RF Grid Voltage	900	1050	970	Volts
DC Plate Current	1.6	2.4	2.1	Amperes
DC Grid Current	0.18	0.29	0.20	Amperes
Driving Power	160	300	200	Watts
Power Output	11.9	17.1	18.2	Kilowatts

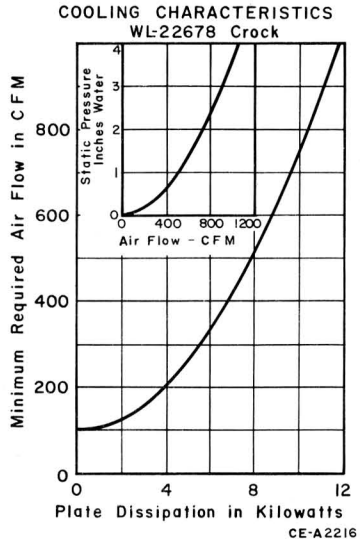
CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

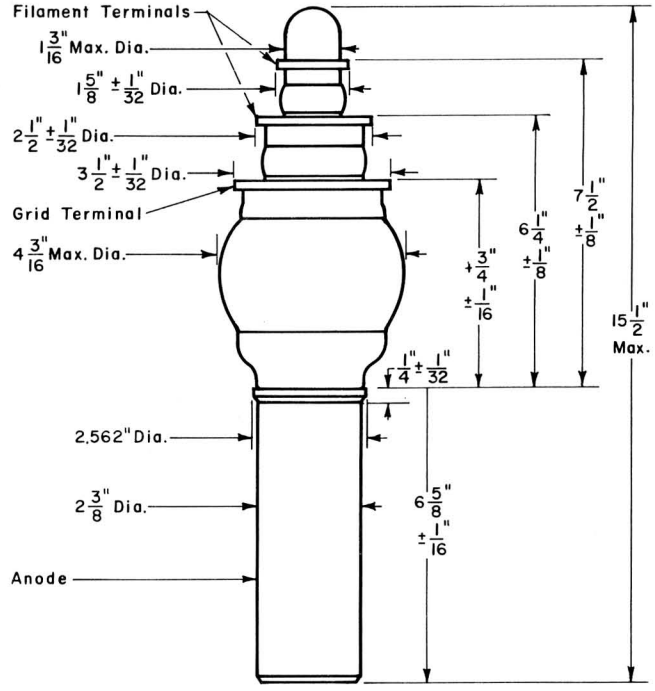
Characteristic		Conditions	Min.	Bogey	Max.	Units
Grid Voltage	(1)	Plate Volts = 1400 Plate Amp = 9	–	–	800	Volts
	(2)	Plate KV = 12 Plate Amp = 0.02	−100	−130	−160	Volts
Grid Current		Plate Volts = 1400 Plate Amp = 9	–	–	4.0	Amperes
Plate Voltage	(1)	Grid Volts = 0 Plate Amp = 0.5	6.4	7.2	8.1	Kilovolts
	(2)	Grid Volts = −50 Plate Amp = 0.5	10.6	11.8	13.0	Kilovolts
Plate Power Out.		Plate KV = 12 Plate Amp = 2.1 Grid Volts = −400 Grid Amp = 0.20	15.5	–	–	Kilowatts

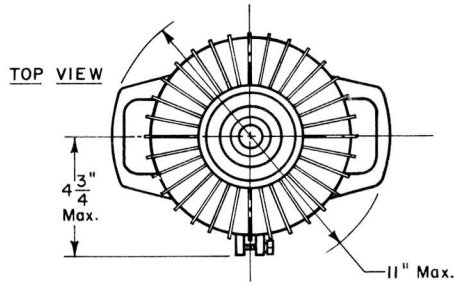
FREQUENCY DERATING CHART

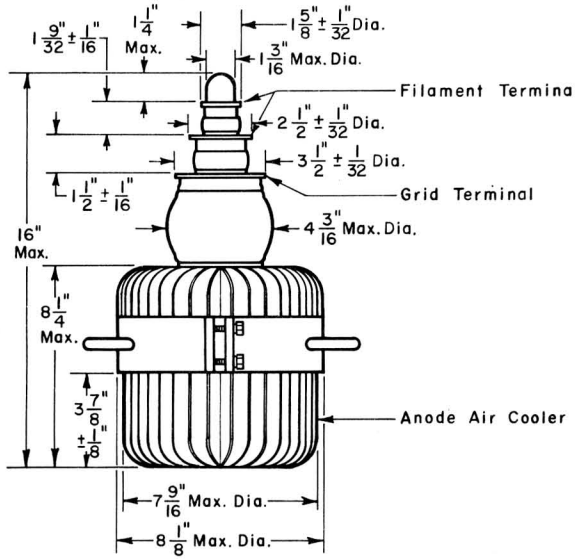
Service	30 Mc.	50 Mc.	70 Mc.
Class B	100 %	90 %	70 %
Class C	100 %	75 %	60 %

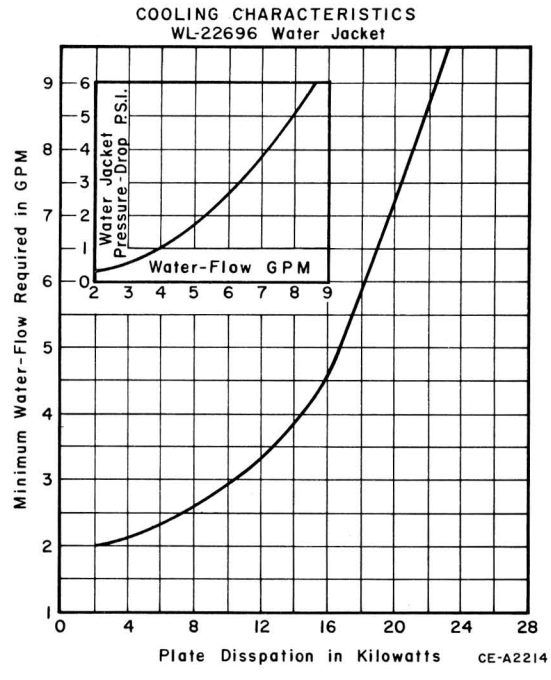


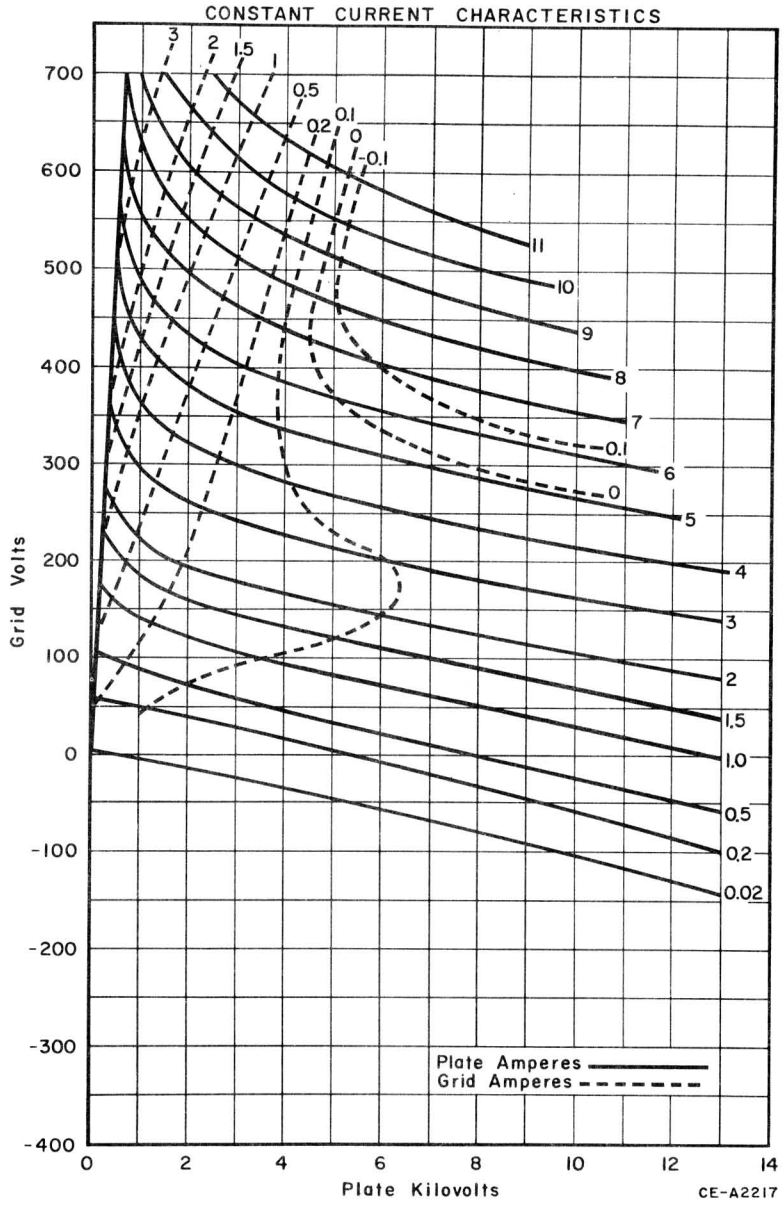

COOLING CHARACTERISTICS
WL-22678 Crock
Minimum Required Air Flow in CFM
800
600
400
200
0
0
4
8
12
Plate Dissipation in Kilowatts
Static Pressure Inches Water
4
3
2
1
0
0
400
800
1200
Air Flow - CFM
CE-A2216


Filament Terminals
1 3/16" Max. Dia.
1 5/8" ± 1/32" Dia.
2 1/2" ± 1/32" Dia.
3 1/2" ± 1/32" Dia.
Grid Terminal
4 3/16" Max. Dia.
2.562" Dia.
2 3/8" Dia.
Anode
+ 3/4" ± 1/16"
6 1/4" ± 1/8"
7 1/2" ± 1/8"
15 1/2" Max.
1/4" ± 1/32"
6 5/8" ± 1/16"


TOP VIEW
4 3/4" Max.
11" Max.


1 9/32" ± 1/16"
1 1/4" Max.
1 5/8" ± 1/32" Dia.
1 3/16" Max. Dia.
Filament Terminals
2 1/2" ± 1/32" Dia.
3 1/2" ± 1/32" Dia.
1 1/2" ± 1/16"
Grid Terminal
4 3/16" Max. Dia.
16" Max.
8 1/4" Max.
3 7/8" ± 1/8"
Anode Air Cooler
7 9/16" Max. Dia.
8 1/8" Max. Dia.


COOLING CHARACTERISTICS
WL-22696 Water Jacket
Minimum Water-Flow Required in GPM
9
8
7
6
5
4
3
2
1
0
4
8
12
16
20
24
28
Plate Disspation in Kilowatts
Water Jacket Pressure-Drop P.S.I.
6
5
4
3
2
1
0
2
3
4
5
6
7
8
9
Water-Flow GPM
CE-A2214



POWER AMPLIFIER TRIODE TYPE WL-6426

The WL-6426 is a general purpose water- and forced-air-cooled three-electrode tube designed specifically for 40-50 kW industrial heating service and for AM broadcasting. The tube features rugged coaxial mounting structures providing high-dissipation, low-inductance r-f electrode terminals. The heavy-wall anode is capable of dissipating 40 kilowatts with a moderate rate of water flow. The cathode is a sturdy, self-supporting stress-free thoriated-tungsten filament. Maximum ratings apply at frequencies up to 30 Mc.

ELECTRICAL

Filament Voltage	8.0	Volts
Filament Current	200	Amps
Filament Starting Current, maximum	800	Amps
Filament Cold Resistance	0.0051	Ohms
Amplification Factor	20	–
Interelectrode Capacitances:		
Grid-Plate	38	pf
Grid-Filament	50	pf
Plate-Filament	1.8	pf

MECHANICAL

Mounting Position	Vertical, Anode Down
Type of Cooling (Note 1)	Water and Forced-Air
Water flow on anode, minimum for 40 kw dissipation	20 GPM
Maximum outgoing water temperature	70 °C
Maximum Glass Temperature	165 °C
Net Weight, approximate	13 Pounds

ACCESSORIES

Water Jacket	WL-22698
Large Filament Connector	WL-22699
Small Filament Connector	WL-22700
Grid Connector	WL-22701
"O" Gasket	WL-22702
Mount Clamp	WL-22703
Mount Plate	WL-22704

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR, CLASS B

MAXIMUM RATINGS

Absolute Maximum Values

DC Plate Voltage	12.5	max.	Kilovolts
DC Plate Current (Note 2)	8.0	max.	Amperes
Plate Power Input (Note 2)	80	max.	Kilowatts
Plate Dissipation (Note 2)	40	max.	Kilowatts

TYPICAL OPERATION (Two Tubes in Push-Pull)

DC Plate Voltage	8.5	12	Kilovolts
DC Grid Voltage	–400	–550	Volts
Peak AF Grid-to-Grid Voltage	1600	2120	Volts
Zero-Signal DC Plate Current	1.3	2.4	Amperes
Max.-Signal DC Plate Current	7.8	12.4	Amperes
Effective Plate-to-Plate Load Resistance	2300	1950	Ohms
Driving Power	200	170	Watts
Power Output	42	93	Kilowatts

RADIO FREQUENCY POWER AMPLIFIER, CLASS B

Carrier Conditions per Tube with Max. Modulation Factor of 1.0

MAXIMUM RATINGS

Absolute Maximum Values

DC Plate Voltage	12.5	max.	Kilovolts
DC Plate Current	8.0	max.	Amperes
Plate Power Input	80	max.	Kilowatts
Plate Dissipation	40	max.	Kilowatts

TYPICAL OPERATION

DC Plate Voltage	10	12	Kilovolts
Peak RF Plate Voltage	4200	5300	Amperes
DC Grid Voltage	–450	–550	Volts
Peak RF Grid Voltage	580	600	Volts
DC Plate Current	3.6	3.2	Amperes
DC Grid Current	0	0	Amperes
Driving Power (Note 3)	550	480	Watts
Power Output	12	13.5	Kilowatts

PLATE MODULATED RF POWER AMPLIFIER CLASS C TELEPHONY

Carrier Conditions per Tube with Max. Modulation Factor of 1.0

MAXIMUM RATINGS

Absolute Maximum Values

DC Plate Voltage	9	max.	Kilovolts
DC Grid Voltage	–2000	max.	Volts
DC Plate Current	6.0	max.	Amperes
DC Grid Current	1.0	max.	Amperes
Plate Power Input	53	max.	Kilowatts
Plate Dissipation	26	max.	Kilowatts

TYPICAL OPERATION

DC Plate Voltage	8.5	Kilovolts
Peak RF Plate Voltage	7.0	Kilovolts
DC Grid Voltage	–1400	Volts
Peak RF Grid 1 Voltage	2140	Volts
DC Plate Current	4.8	Amperes
DC Grid Current	0.5	Amperes
Driving Power	1100	Watts
Power Output	30.7	Kilowatts

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR CLASS C TELEGRAPHY

Carrier Conditions per Tube with Zero Modulation (Note 4)

MAXIMUM RATINGS

Absolute Maximum Values

DC Plate Voltage	12.5	max.	Kilovolts
DC Grid Voltage	−2000	max.	Volts
DC Plate Current	8.0	max.	Amperes
DC Grid Current	1.0	max.	Amperes
Plate Power Input	80	max.	Kilowatts
Plate Dissipation	40	max.	Kilowatts

TYPICAL OPERATION

	Cathode Drive	Grid Drive		
DC Plate Voltage	7.5	10	12	Kilovolts
Peak RF Plate Voltage	5.6	8	9.8	Kilovolts
DC Grid Voltage	−850	−1100	−1200	Volts
Peak RF Grid Voltage	1500	1880	1940	Volts
DC Plate Current	5.3	6.5	6.4	Amperes
DC Grid Current	0.35	0.48	0.35	Amperes
Driving Power	7500	900	670	Watts
Power Output	33	46.4	55.4	Kilowatts

EQUIPMENT DESIGN RANGE OF CHARACTERISTICS

Characteristic	Min.	Bogey	Max.	Units
Grid Voltage:				
(1) Plate Volts = 1500, Plate Amp. = 28	–	–	1000	Volts
(2) Plate Kilovolts = 10, Plate Ma. = 20	−490	−580	−670	Volts
Grid Current:, Plate Volts = 1500, Plate Amp. = 28	–	–	8.5	Amperes
Plate Voltage:				
(1) Grid Volts = 0, Plate Amp. = 3	2.8	3.3	3.8	Kilovolts
(2) Grid Volts = −400, Plate Amp. = 3	10.2	11.3	12.4	Kilovolts
Plate Power Output, Plate Kilovolts = 12, Plate Amp. = 6.4, Grid Volts = −1200, Grid Ma. = 350	.47	–	–	Kilowatts

FREQUENCY DERATING CHART

Service	30 Mc.	70 Mc.	110 Mc.
Class B	100 %	90 %	70 %
Class C	100 %	75 %	60 %

NOTES

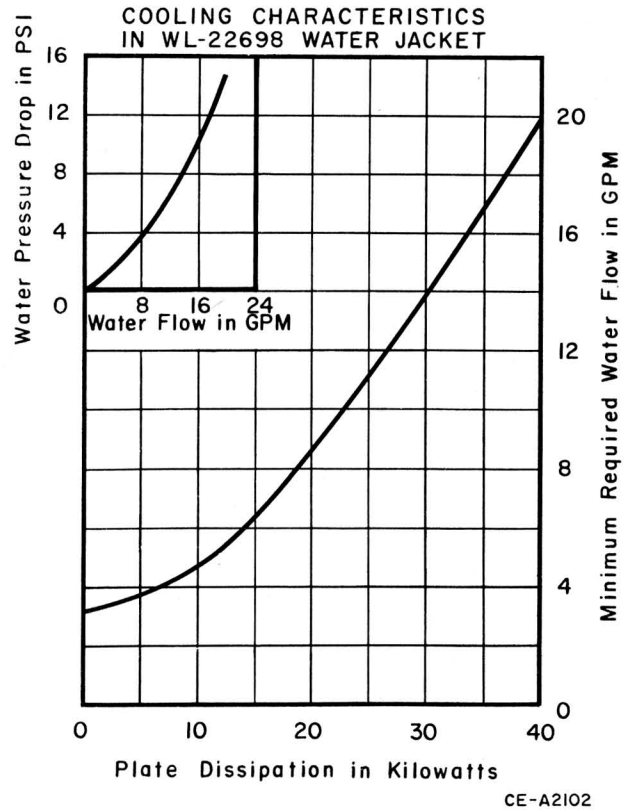
1. At frequencies up to 15 Mc., normal cabinet ventilation should be sufficient; at higher frequencies or high ambient temperatures, auxiliary air flow of 50-150 cfm may be required and should be distributed to maintain uniform glass temperature, not greater than 165°C, around the circumference of the seals.
2. Averaged over any audio-frequency cycle of sine-wave form.
3. At crest of audio-frequency cycle with modulation factor of 1.0.
4. Modulation essentially negative may be used if the positive peak of the envelope does not exceed 115% of the carrier conditions.

TUBE PROTECTION NOTES

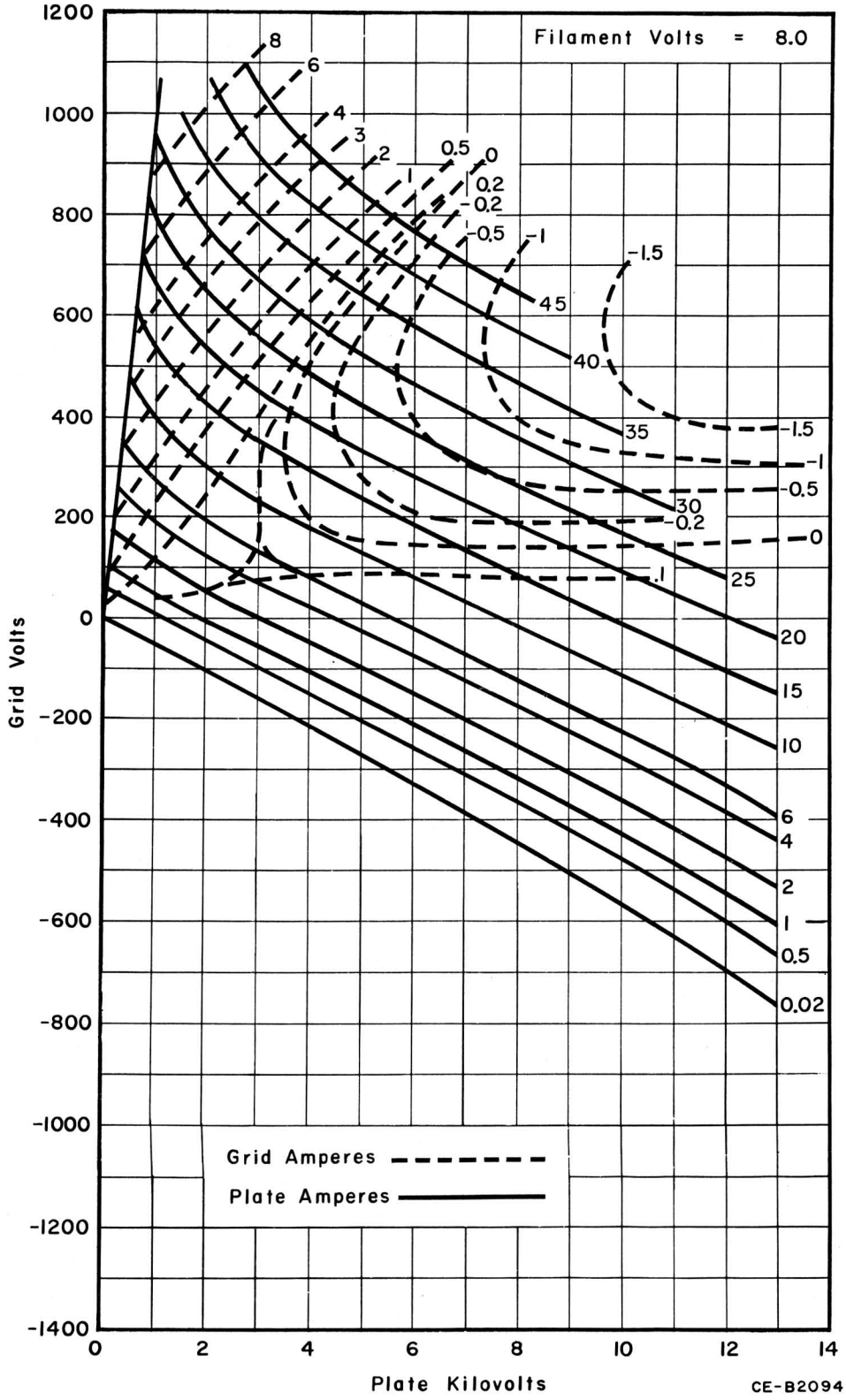
The handling of high power requires particular attention to the removal of power under fault conditions, since the large amount of energy involved can severly damage the electron tube if not properly controlled. Therefore the ground leads of the plate and grid circuits should be equipped with individual quick-acting overload relays which will remove power from these circuits within 1/10 second.

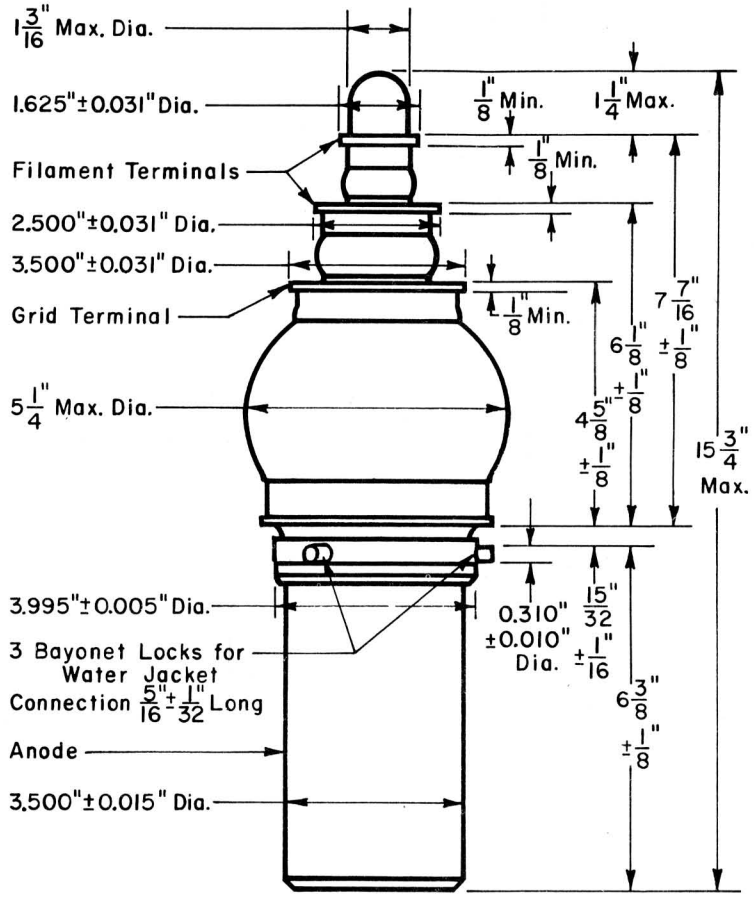
Additional protection is recommended and may be obtained by connecting a resistor in series with the plate lead of each tube for protection of the tube during the time required for the plate overload relay to act. A suitable resistor should be added unless the equivalent circuit impedance exists, e.g. in transformer reactance. The criterion is the total energy to which the tube can be subjected. The minimum value of resistance which alone will give adequate protection with reasonably low power loss as follows:

Series Resistor	15	25	40	60	ohms
Maximum Power Output of Rectified	80	160	320	640	kW



AVERAGE CONSTANT CURRENT CHARACTERISTICS





March 17, 1959

HIGH VACUUM AMPLIFIER TYPE WL-6567

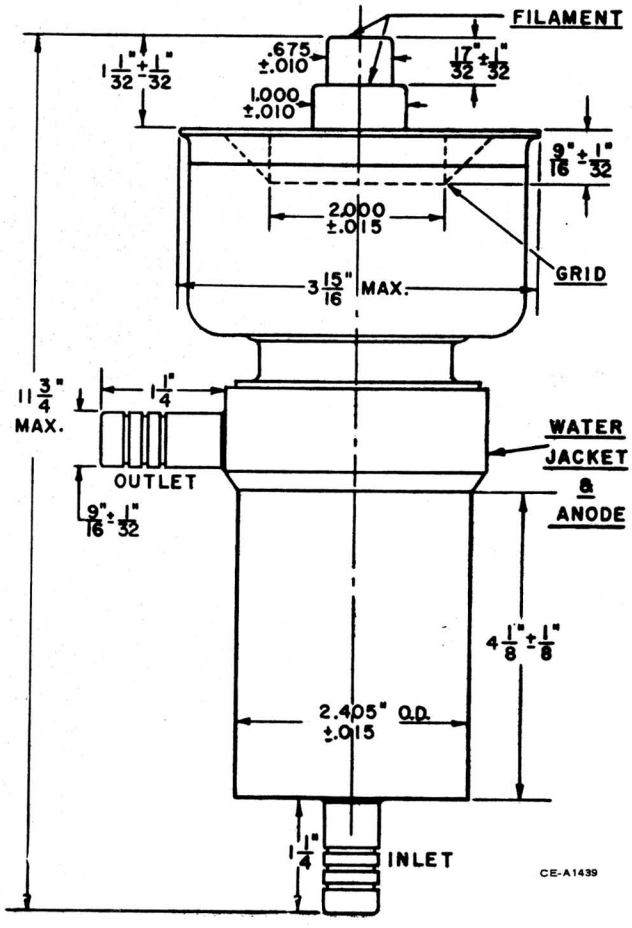
The WL-6567 is a three-electrode tube designed for use as an oscillator or amplifier. The anode is water-cooled and is capable of dissipating 15 kilowatts. The cathode is a single phase thoriated tungsten filament. Maximum ratings apply up to 50 megacycles.

Electrical:

Filament	6.0	Volts
Filament Current	70	Amperes
Amplification Factor	33	
Direct Interelectrode Capacitances:		
Grid to Plate	14	μμf
Grid to Filament	30	μμf
Plate to Filament	.5	μμf

Mechanical:

Mounting Position▲	Vertical, Anode Down
Anode	External with Integral Water Jacket
Type of Cooling	Water
Minimum Water Flow■	7 GPM
Air Flow to Filament and Grid Seals	30 CFM
Maximum Temperature:	
Outlet Water	70° C
Bulb	180° C



CLASS C TELEGRAPHY
(Key down without modulation)

Maximum Ratings:

Absolute Maximum Values

DC Plate Voltage	12,000 max.		Volts
DC Plate Current	2.5 max.		Amperes
DC Grid Voltage	-1200 max.		Volts
DC Grid Current	.75 max.		Amperes
Plate Input	24 max.		Kilowatts
Plate Dissipation	15 max.		Kilowatts

Typical Operating Characteristics:

DC Plate Voltage	9000	10,000	12,000	Volts
DC Grid Voltage	-600	-700	-800	Volts
Peak R.F. Grid Voltage	960	1,100	1,200	Volts
DC Plate Current	1.97	1.96	1.94	Amp
DC Grid Current	0.45	0.42	0.39	Amp
Peak R.F. Plate Voltage	8000	9,000	11,000	Volts
Driving Power♦	414	441	445	Watts
Power Output	14.1	15.9	19.3	Kilowatts
Power Input	17.8	19.6	23.3	Kilowatts

CLASS B AUDIO FREQUENCY AMPLIFIER OR MODULATOR

Maximum Ratings (Per Tube)

Absolute Maximum Values

DC Plate Voltage	12,000 max.		volts
DC Plate Current (max. signal)	2.50 max.		amperes
DC Grid Current (max. signal)	0.50 max.		amperes
Plate Input	26.0 max.		kilowatts
Plate Dissipation	15.0 max.		kilowatts

Typical Operating Characteristics:
(Values are for two tubes)

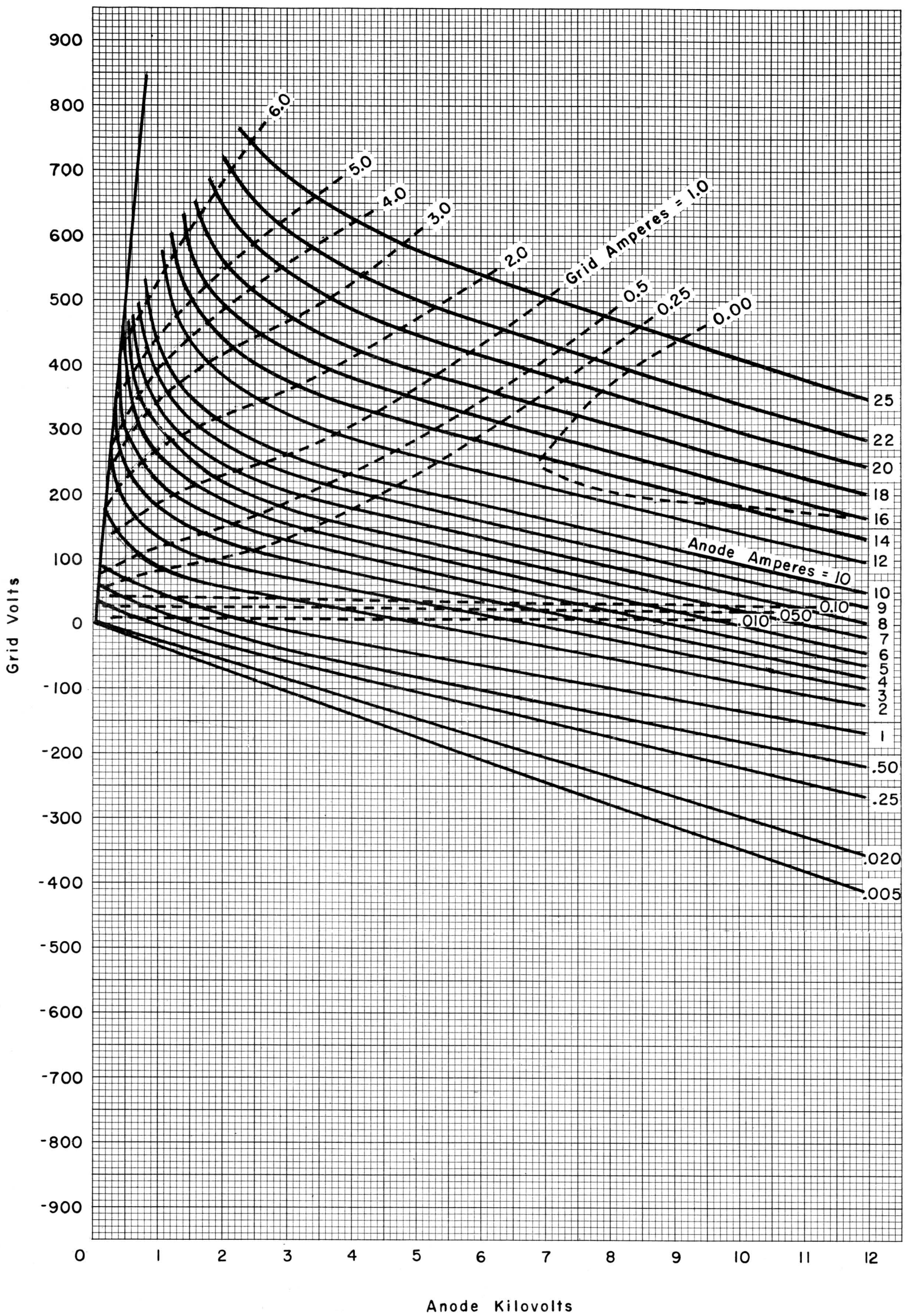
DC Plate Voltage	5500	10,500	volts
DC Plate Current (max. signal)	3.95	4.0	amperes
Plate Current, Zero-Signal	.80	0.200	amperes
Grid to Grid Peak A.F.	680	1030	volts
DC Grid Voltage	-100	-300	volts
Driving Power (max. signal)	185	150	watts
Power Output	13.2	27.0	kilowatts
Power Input	21.7	42.0	kilowatts
Plate Load (plate to plate)	2780	5600	ohms
Distortion-Harmonic (Approx.)	4.8	3	percent
Peak R.F. Plate Voltage	4300	8820	volts

♦ Allowance must be made for grid circuit losses which are not included.

▲ Connectors for WL-6567 are available from Westinghouse.

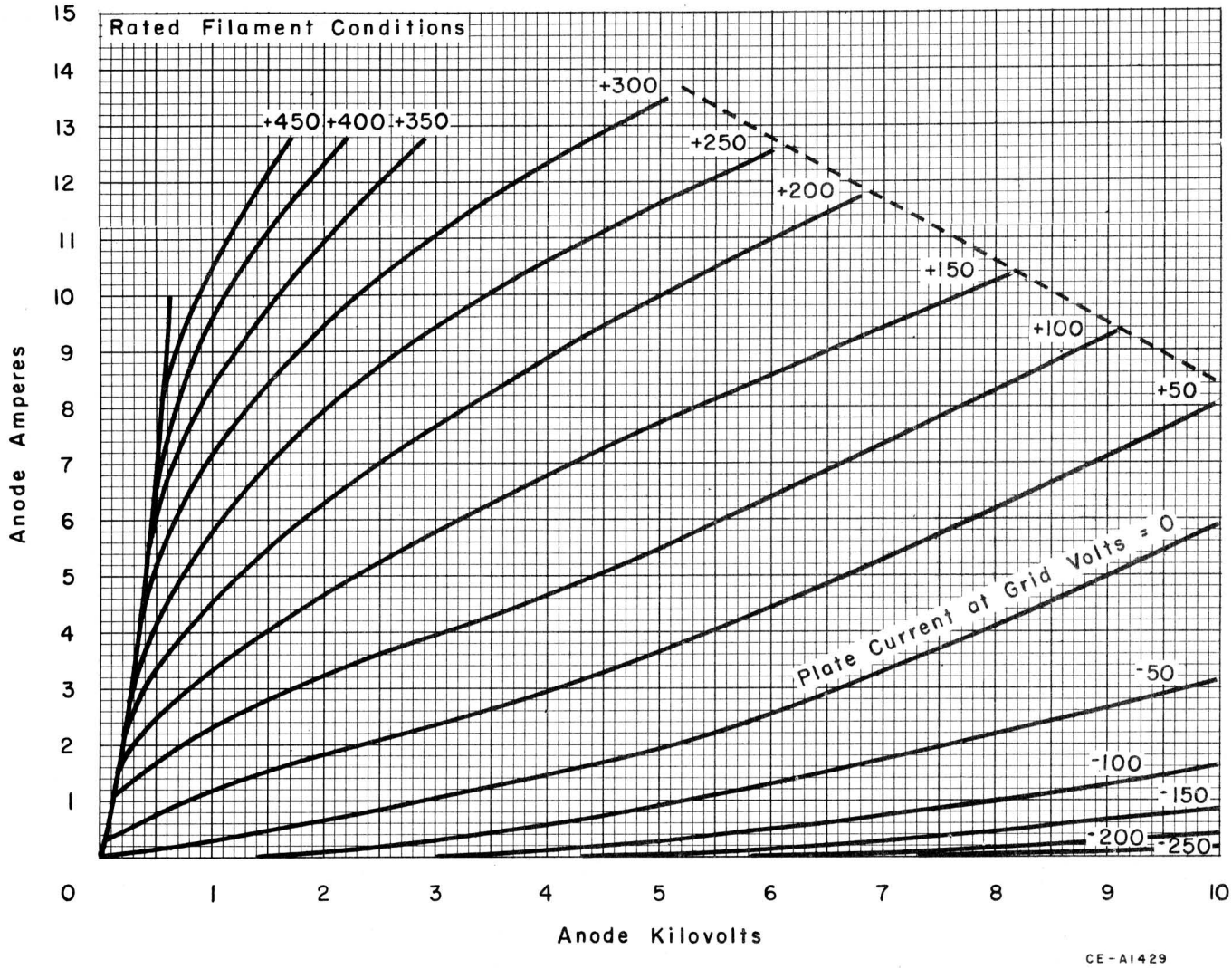
■ Pressure drop at 7 GPM is 16 lb/in^2.

AVERAGE CONSTANT CURRENT CHARACTERISTICS



CE-B1428

AVERAGE PLATE CHARACTERISTICS



CE-A1429

February 15, 1960

POWER AMPLIFIER TRIODE TYPE WL-6623

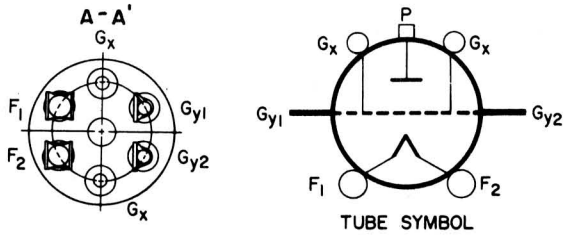
The WL-6623 is a three-electrode tube designed for use as an oscillator, amplifier, and modulator. The forced-air-cooled anode is capable of dissipating 2.5 kilowatts. An efficient thoriated-tungsten filament is employed. Maximum ratings apply up to 30 megacycles. The WL-6623 is similar to the WL-5736, but it is provided with flexible ribbon leads for the grid and the filament. A low back-pressure radiator is an integral part of the tube.

GENERAL DATA

Electrical	**Minimum**	**Bogey**	**Maximum**	
Filament Voltage	5.7	6.0	6.3	volts
Filament Current at Bogey Voltage	57	60	63	amp
Filament Starting Current	–	–	300	amp
Filament Cold Resistance	–	0.016	–	ohms
Amplification Factor	18	22	26	
Interelectrode Capacitances				
Grid to Plate	12	16	21	μμf
Grid to Filament	15	19	22	μμf
Plate to Filament	0.2	0.85	1.0	μμf

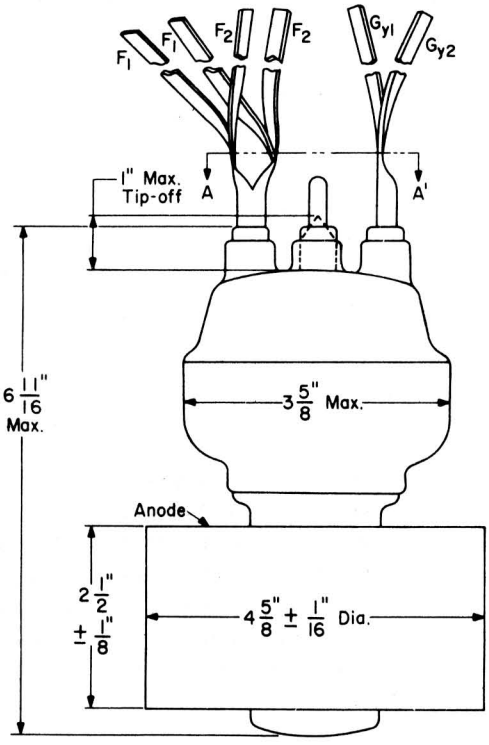
Mechanical

Mounting Position..Vertical, anode up or down
Type of Cooling..... Forced air
Maximum Incoming Air Temperature.. 45 °C
Minimum Required Air Flow on Anode
Air Flow at 100 Percent
Plate Dissipation..... 150 cfm
Required Air Flow on Filament
and Grid Seals
Air flow through radiator is
normally sufficient
Static Pressure of Water..... 0.9 in.
Maximum Glass Temperature..... 160 °C
Net Weight, approximate.....4-7/8 lbs
Shipping Weight, approximate..... 10 lbs



LEAD CONNECTIONS

F_1 - Filament
F_2 - Filament
G_{y1} - Grid
G_{y2} - Grid
G_x - Extra Grid Terminals
P - Plate and Anode



Note: Leads are .020" Thick, $\frac{1}{2}" \pm \frac{1}{16}"$ Wide, $7\frac{5}{8}" \pm \frac{1}{8}"$ Long.

CE-A1105

High Vacuum Amplifier Section

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR, CLASS B

Maximum Ratings, Absolute Values	CCS[1]	
Maximum DC Plate Voltage	3000	volts
Maximum DC Plate Current at Maximum Signal[2]	1.75	amp
Maximum Plate Input at Maximum Signal[2]	4200	watts
Maximum Plate Dissipation[2]	2500	watts

Typical Operation Unless otherwise specified, values are for two tubes	CCS[1]	
DC Plate Voltage	3000	volts
DC Grid Voltage	−160	volts
Peak Audio-Frequency Voltage, grid to grid	820	volts
DC Plate Current at Zero Signal	0.66	amp
DC Plate Current at Maximum Signal	2.80	amp
Effective Load Resistance, plate to plate	3060	ohms
Maximum Signal Driving Power, approximate	140	watts
Maximum Signal Power Output	4350	watts
Load Resistance, per tube	765	ohms

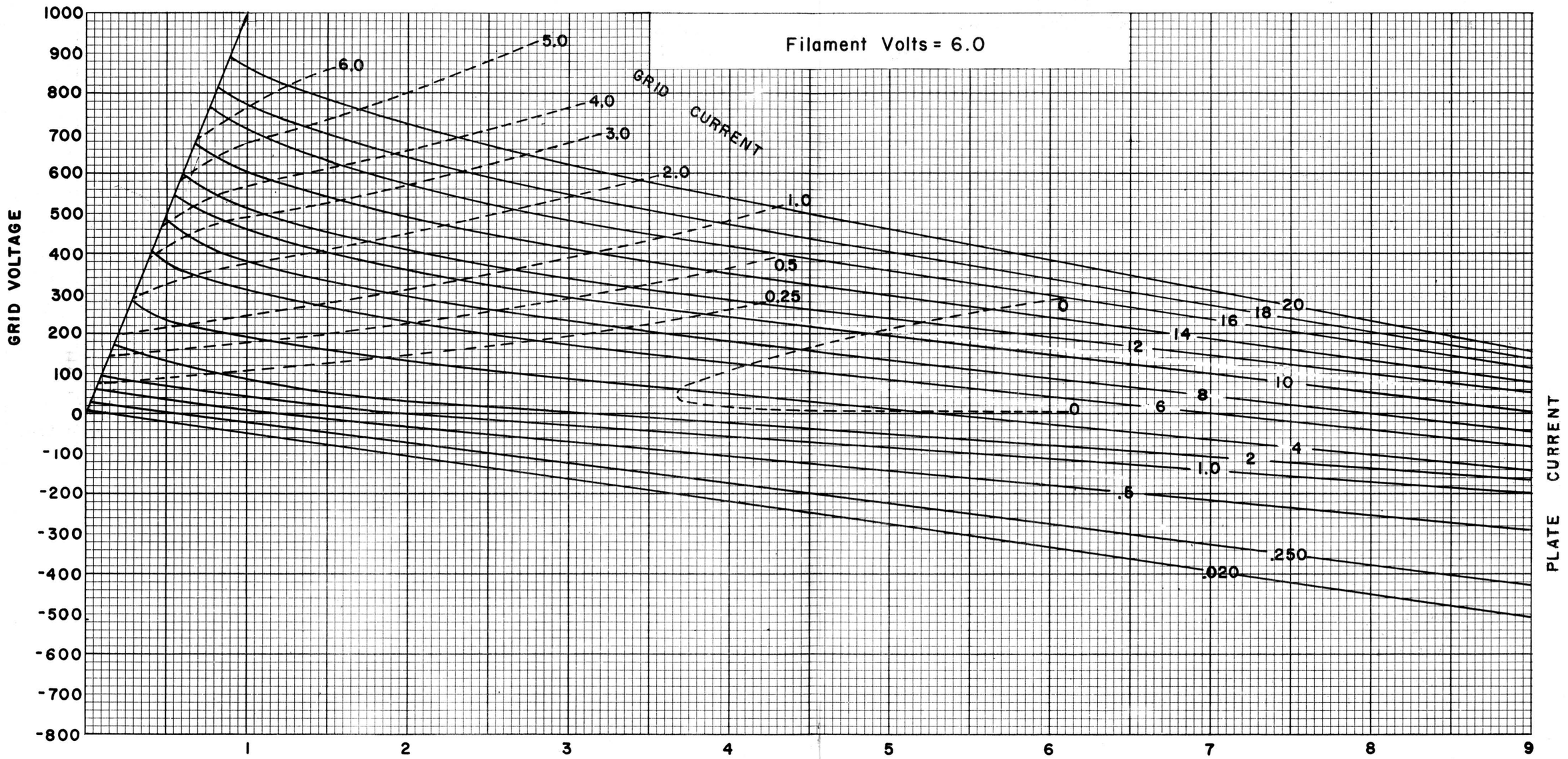
RADIO-FREQUENCY POWER AMPLIFIER AND OSCILLATOR, CLASS C TELEGRAPHY

Key-down conditions per tube without amplitude modulation[3]

Maximum Ratings, Absolute Values	CCS[1] At 30 Megacycles	
Plate Voltage, maximum	5000	volts
Plate Current, maximum	1.4	amp
Plate Input, maximum	5000	watts
Plate Dissipation, maximum	2500	watts
DC Grid Voltage, maximum	−1000	volts
DC Grid Current, maximum	0.5	amp

Typical Operation	CCS[1] At 30 Megacycles	
DC Plate Voltage	5000	volts
DC Grid Voltage	−850	volts
Peak Radio-Frequency Grid Voltage	1200	volts
DC Plate Current	1.0	amp
DC Grid Current	0.210	amp
Driving Power, approximate	250	watts
Power Output, approximate	4100	watts

AVERAGE CONSTANT-CURRENT-CHARACTERISTICS



ELECTRICAL DATA AND LIMITS

Characteristic	Conditions	LIMITS Minimum	Bogey	Maximum	
Grid Voltage	i_b = 6 amperes e_b = 1000 volts	-	-	360	volts
Grid Current	i_b = 6 amperes e_b = 1000 volts	-	-	2.2	amp
Plate Voltage	I_b = 0.40 amperes E_c = -20 volts	1150	1400	1650	volts
Plate Voltage	I_b = 0.04 amperes E_c = -30 volts	1370	1620	1870	volts
Peak Cathode Current[4]	(Symbol i_k)	10	-	-	amp
Power Output	E_b = 5000 volts I_b = 1.0 amperes E_c = -850 volts I_g = 0.3 amperes (Symbol P_o)	3800	-	-	watts

FOOTNOTES

1. Continuous commercial service.
2. Averaged over any audio-frequency cycle of sine-wave form.
3. Modulation, essentially negative, may be used if the positive peak of the carrier envelope does not exceed 115 percent of the carrier conditions.
4. Represents maximum usable cathode current for tube as plate current plus grid current for any condition of operation.

December 15, 1959

POWER AMPLIFIER TRIODE TYPE WL-7215

The WL-7215 is a three element power amplifier and oscillator tube especially designed for operation with lower voltage power supplies. Its high perveance structure permits the generation of 6 kilowatts at a plate voltage of only 5 kilovolts at excellent efficiency. Outputs of 13-1/2 kilowatts are obtainable at 9 kilovolts.

The anode design features an integral water jacket with an internal spiral water diverter which maintains turbulence of cooling water. This prevents the occurrence of anode hot spots and accounts for high power density capability of the tube. The WL-7215 will dissipate 9 kilowatts with only 3-3/4 gallons per minute and still provides ample safety margin for instantaneous overloads.

The filament structure incorporates a unique spring loaded high efficiency design. The high efficiency thoriated tungsten filament provides 50 amperes peak emission at only 350 watts of filament power. The rugged spring loaded structure inhibits sagging and breaking of filament strands thus insuring long life and uniformity of characteristics with life.

These features make the WL-7215 a particularly attractive design for induction and dielectric heating applications. The internal structure is very precisely designed and production controls assure uniformity from tube to tube. These design features are reflected in a high degree of uniformity of performance in class B and class C RF power amplifier and oscillator operation. Ratings apply to 30 megacycles.

GENERAL DATA

ELECTRICAL:

	min.	bogey	max.	
Filament Voltage	5.7	6.0	6.3	Volts
Filament Current	57	60	63	Amp.
Filament Starting Current	-	-	300	Amp.
Filament Cold Resistance	-	0.016	-	Ohms
Amplification Factor	18	22	26	
Interelectrode Capacitances:				
Grid to Plate	12	16	21	uuf
Grid to Filament	15	19	22	uuf
Plate to Filament	0.2	0.80	1.0	uuf

MECHANICAL:

Mounting Position		Vertical, Anode Down		
Type of Cooling		Water and Forced Air		
Min. Required Water Flow:				
Plate Dissipation	3	6	9	KW
Water Flow in Gallons per Minute	1	2	3.75	gpm
Pressure Drop	0.85	1.9	7	in. psi
Required Air Flow on Filament and Grid Seals			30	CFM
Max. Glass Temperature			180	°C
Net Weight, approx.			1-3/4	lbs.

RADIO-FREQUENCY POWER AMPLIFIER AND OSCILLATOR, CLASS C TELEGRAPHY

(Key-down conditions per tube without amplitude modulation)

MAXIMUM RATINGS:

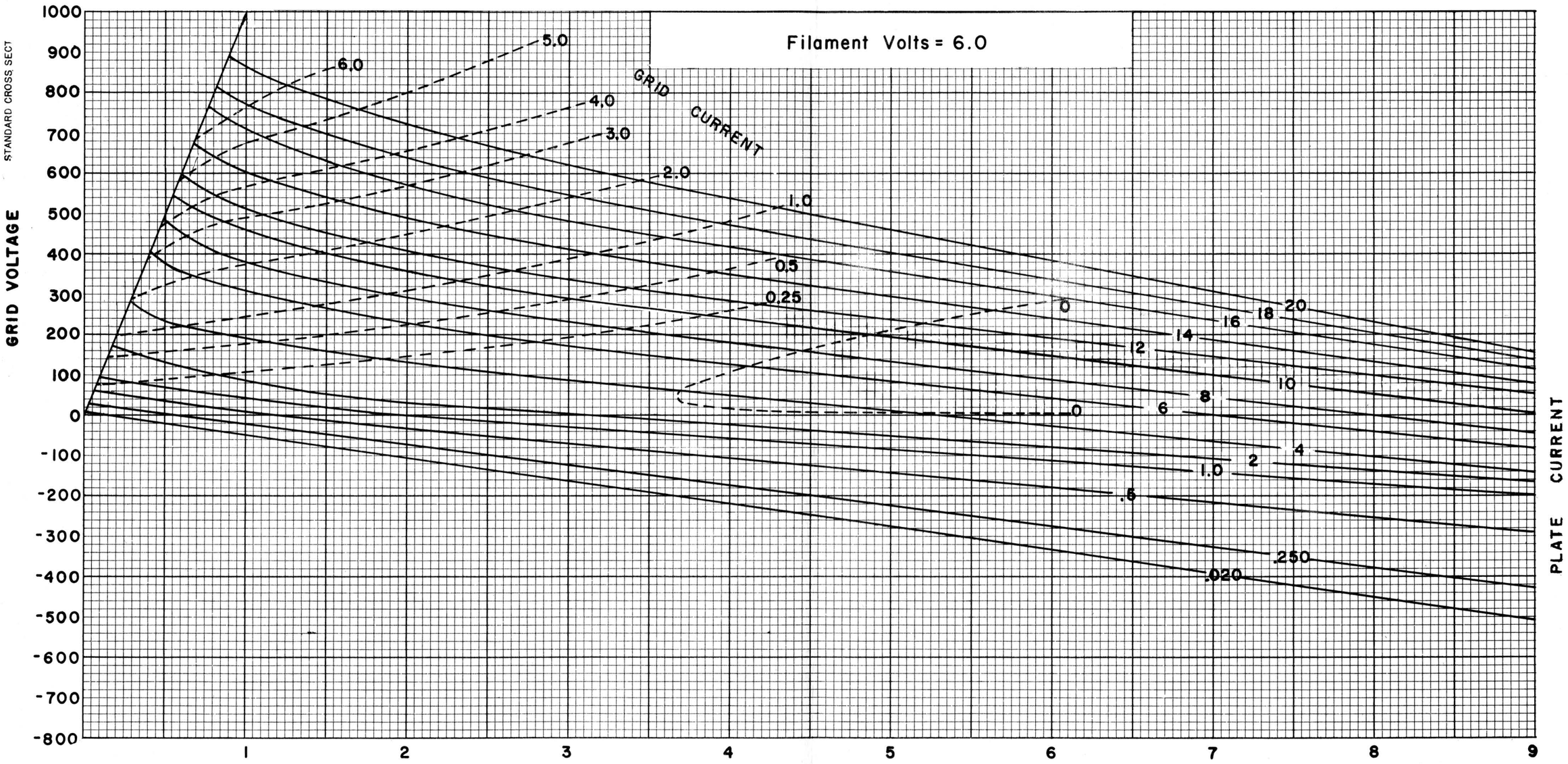
Absolute Maximum Values

DC Plate Voltage	9200	max.	Volts
DC Plate Current	2.0	max.	Amp.
Plate Input	18000	max.	Watts
Plate Dissipation	9000	max.	Watts
DC Grid Voltage	-1500	max.	Volts
DC Grid Current	0.5	max.	Amp.

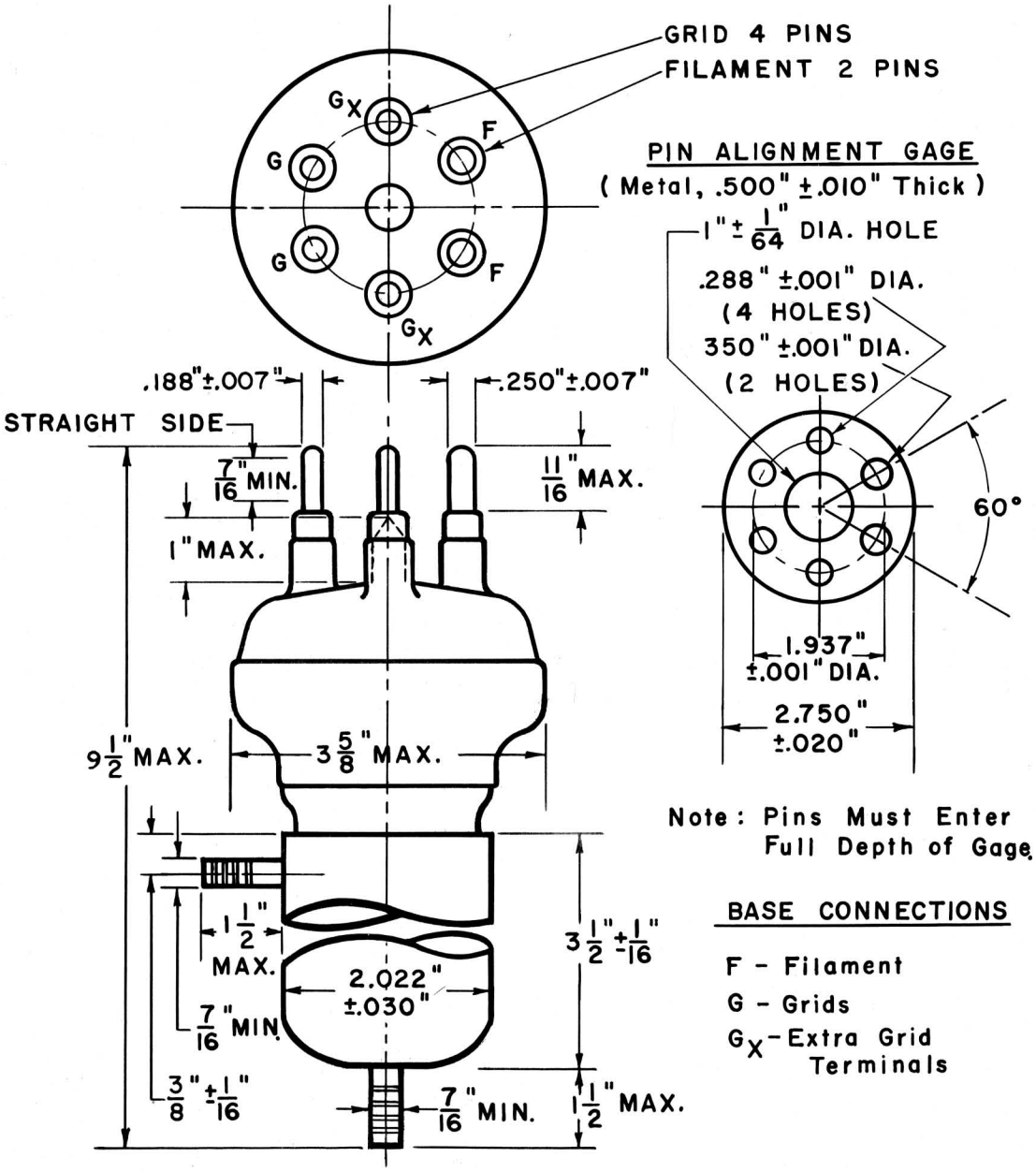
TYPICAL OPERATION:

DC Plate Voltage	5000	9000	Volts
DC Grid Voltage	-800	-1400	Volts
Peak Radio-Frequency Grid Voltage	1240	1850	Volts
DC Plate Current	1.61	2.0	Amp.
DC Grid Current	0.40	0.18	Amp.
Driving Power, approx.	480	337	Watts
Power Output, approx.	6430	13600	Watts

AVERAGE CONSTANT-CURRENT-CHARACTERISTICS



CE-C1366



Note: Pins Must Enter Full Depth of Gage

BASE CONNECTIONS

F - Filament

G - Grids

G_X - Extra Grid Terminals

May 15, 1961

POWER AMPLIFIER TRIODE TYPE 7255

The 7255 is a three element power amplifier and oscillator tube especially designed for operation with lower voltage power supplies. Its high perveance structure permits the generation of 6 kilowatts at a plate voltage of only 5 kilovolts at excellent efficiency. Outputs of 13-1/2 kilowatts are obtainable at 9 kilovolts.

The anode design features an integral water jacket with an internal spiral water diverter which maintains turbulence of cooling water. This prevents the occurrence of anode hot spots and accounts for high power density capability of the tube. The 7255 will dissipate 9 kilowatts with only 3-3/4 gallons per minute and still provides ample safety margin for instantaneous overloads.

The filament structure incorporates a unique spring loaded high efficiency design. The high efficiency thoriated tungsten filament provides 50 amperes peak emission at only 350 watts of filament power. The rugged spring loaded structure inhibits sagging and breaking of filament strands thus insuring long life and uniformity of characteristics with life.

These features make the 7255 a particularly attractive design for induction and dielectric heating applications. The internal structure is very precisely designed and production controls assure uniformity from tube to tube. These design features are reflected in a high degree of uniformity of performance in class B and class C RF power amplifier and oscillator operation. Ratings apply to 30 megacycles.

GENERAL DATA

ELECTRICAL:

	min.	bogey	max.	
Filament Voltage	5.7	6.0	6.3	Volts
Filament Current	57	60	63	Amp.
Filament Starting Current	-	-	300	Amp.
Filament Cold Resistance	-	0.016	-	Ohms
Amplification Factor	18	22	26	
Interelectrode Capacitances:				
Grid to Plate	12	16	21	$\mu\mu$f
Grid to Filament	15	19	22	$\mu\mu$f
Plate to Filament	0.2	0.80	1.0	$\mu\mu$f

MECHANICAL:

Mounting Position		Vertical, Anode Down		
Type of Cooling		Water and Forced Air		
Min. Required Water Flow:				
Plate Dissipation	3	6	9	KW
Water Flow in Gallons per Minute	1	2	3.75	gpm
Pressure Drop	0.85	1.9	7	in. psi
Required Air Flow on Filament and Grid Seals			30	CFM
Max. Glass Temperature			180	°C
Net Weight, approx.			1-3/4	lbs.

RADIO-FREQUENCY POWER AMPLIFIER AND OSCILLATOR, CLASS C TELEGRAPHY

(Key-down conditions per tube without amplitude modulation)

MAXIMUM RATINGS:

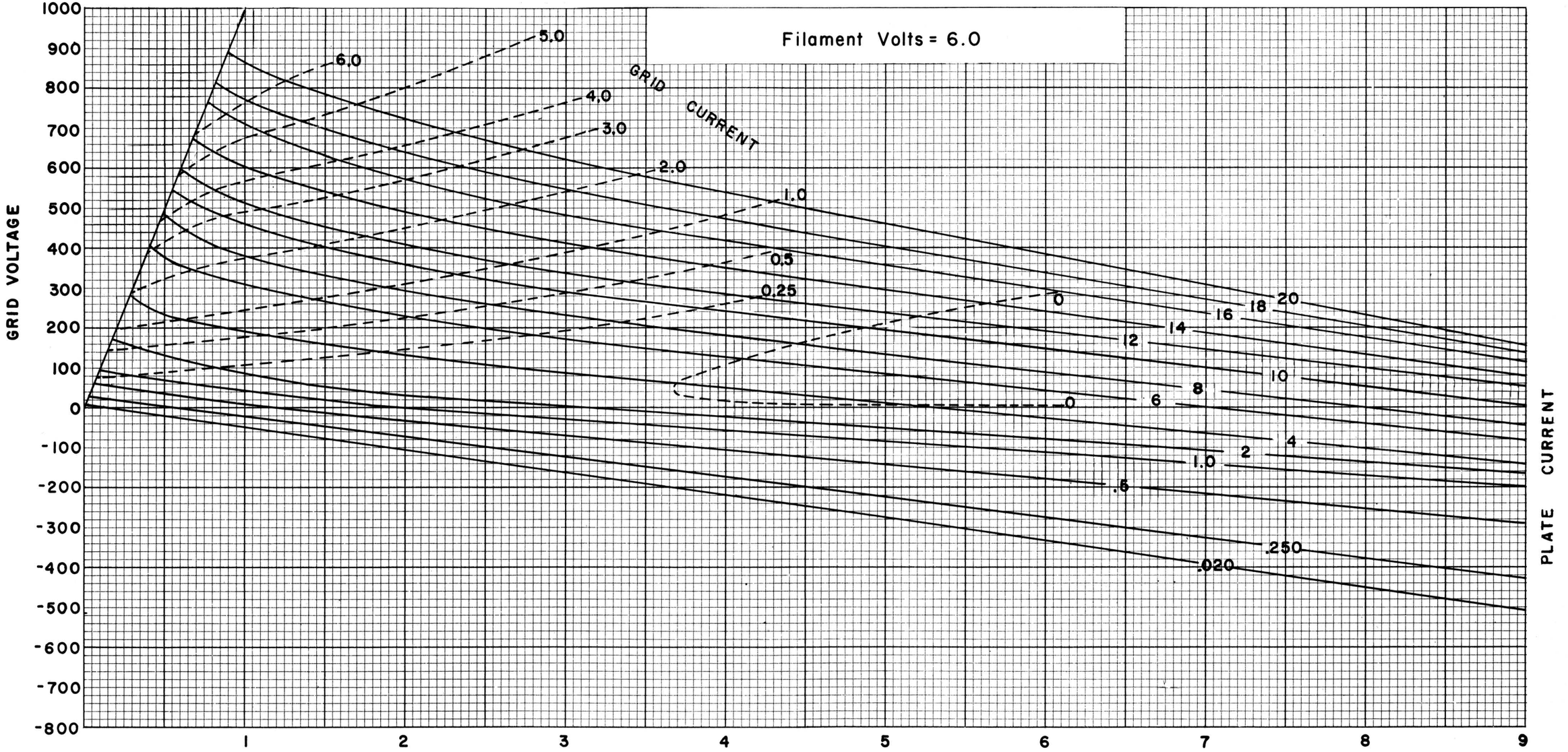
Absolute Maximum Values

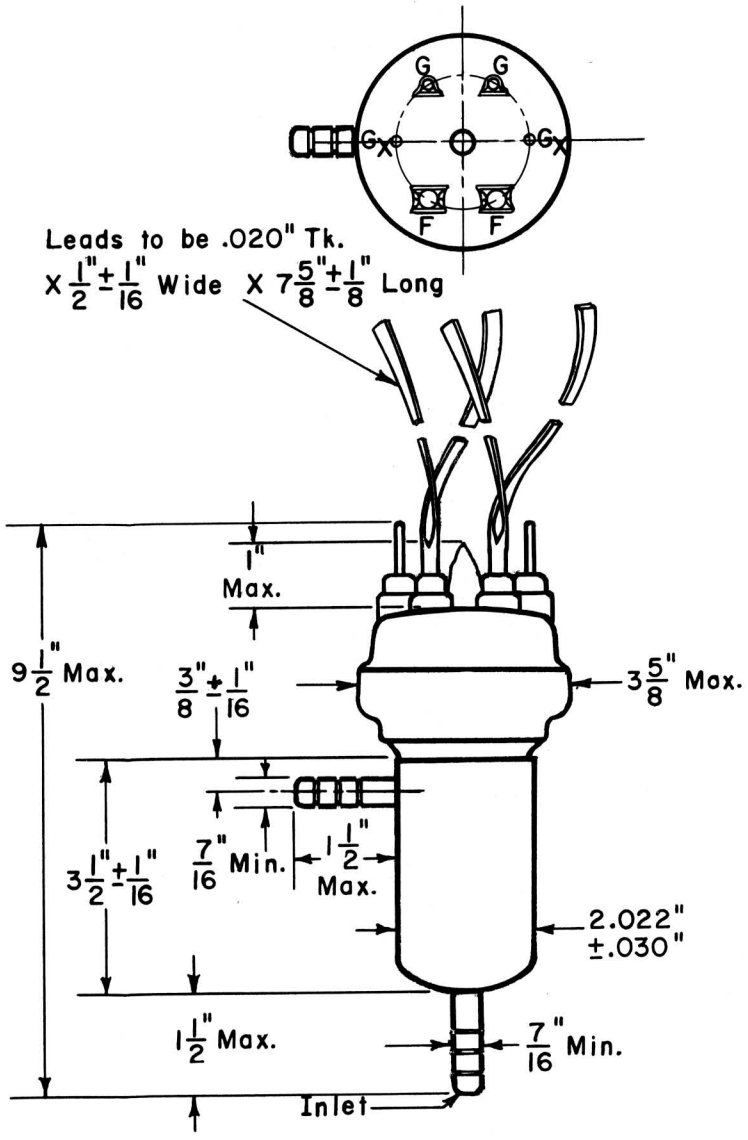
DC Plate Voltage	9200	max.	Volts
DC Plate Current	2.0	max.	Amp.
Plate Input	18000	max.	Watts
Plate Dissipation	9000	max.	Watts
DC Grid Voltage	-1500	max.	Volts
DC Grid Current	0.5	max.	Amp.

TYPICAL OPERATION:

DC Plate Voltage	5000	9000	Volts
DC Grid Voltage	-800	-1400	Volts
Peak Radio-Frequency Grid Voltage	1240	1850	Volts
DC Plate Current	1.61	2.0	Amp.
DC Grid Current	0.40	0.18	Amp.
Driving Power, approx.	480	337	Watts
Power Output, approx.	6430	13600	Watts

AVERAGE CONSTANT-CURRENT CHARACTERISTICS





LOW MU POWER TRIODE TYPE 7328A

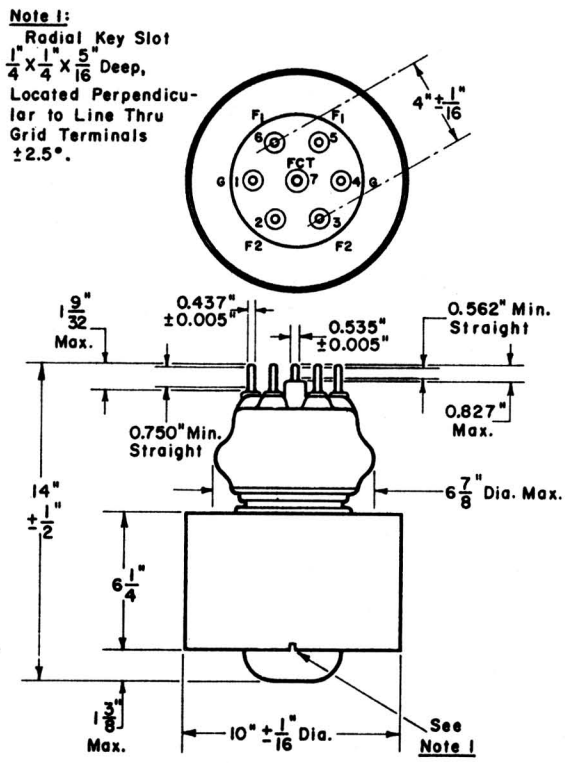
The 7328A is a three element tube designed for service as a modulator or AF amplifier. Electrical characteristics make it particularly suitable for Class AB_1 or AB_2 circuits. The anode is capable of dissipating 20 KW CCS with forced air cooling. The cathode is a single phase, thoriated tungsten filament.

ELECTRICAL:

Cathode	Thoriated Tungsten Filament	
Filament:		
Voltage	7.0	Volts
Current	245	Amperes
Starting Current (max.)	1000	Amperes
Amplification Factor: Grid Volts = –450, Plate Amperes = 5.0	6	
Maximum Usable Cathode Current	60	Amperes
Direct Interelectrode Capacitances:		
Grid to Plate	78	μμf
Grid to Filament	68	μμf
Plate to Filament	7	μμf

MECHANICAL:

Mounting Position	Vertical, Anode Down			
Cooling:				
Type	Forced Air			
Amount Required:				
Plate Dissipation	10	15	20	Kilowatts
Air Flow	800	1250	1700	CFM
Static Pressure	2.0	3.5	6.0	In. H_2O
Maximum Incoming Air Temperature	45 °C			
Maximum Seal Temperature	180 °C			
Net Weight	72 Pounds			



MAXIMUM RATINGS:

Absolute Maximum Values

DC Plate Voltage	10 max.	Kilovolts
DC Plate Current	10 max.	Amperes
Plate Power Input (Note 1)	50 max.	Kilowatts
Plate Dissipation (Note 1)	20 max.	Kilowatts
Grid Dissipation	300 Max.	Watts

TYPICAL OPERATING CHARACTERISTICS:

(Values for Two Tubes)

AF Power Amplifier & Modulator Service

Class AB_1 Operation				
DC Plate Voltage	8	9	10	Kilovolts
DC Grid Voltage	–1700	–1900	–2200	Volts
Peak AF Grid-to-Grid Voltage	3350	3750	4350	Volts
Zero Signal DC Plate Current	0.5	0.5	0.5	Amperes
Maximum Signal DC Plate Current	6.4	7.4	8.2	Amperes
Effective Plate-to-Plate Load Impedance	2400	2400	2400	Ohms
Driving Power	0	0	0	Watts
Maximum Signal Power Output	30	39.5	49.5	Kilowatts
Class AB_2 Operation				
DC Plate Voltage	8	9	10	Kilovolts
DC Grid Voltage	–1700	–1900	–2200	Volts
Peak AF Grid-to-Grid Voltage	3700	4100	4700	Volts
Zero Signal DC Plate Current	0.5	0.5	0.5	Amperes
Maximum Signal DC Plate Current	7.4	8.4	9.3	Amperes
Effective Plate-to-Plate Load Impedance	2400	2400	2400	Ohms
Driving Power	50	55	61	Watts
Maximum Signal Power Output	40	51	65	Kilowatts

PULSE SERVICE

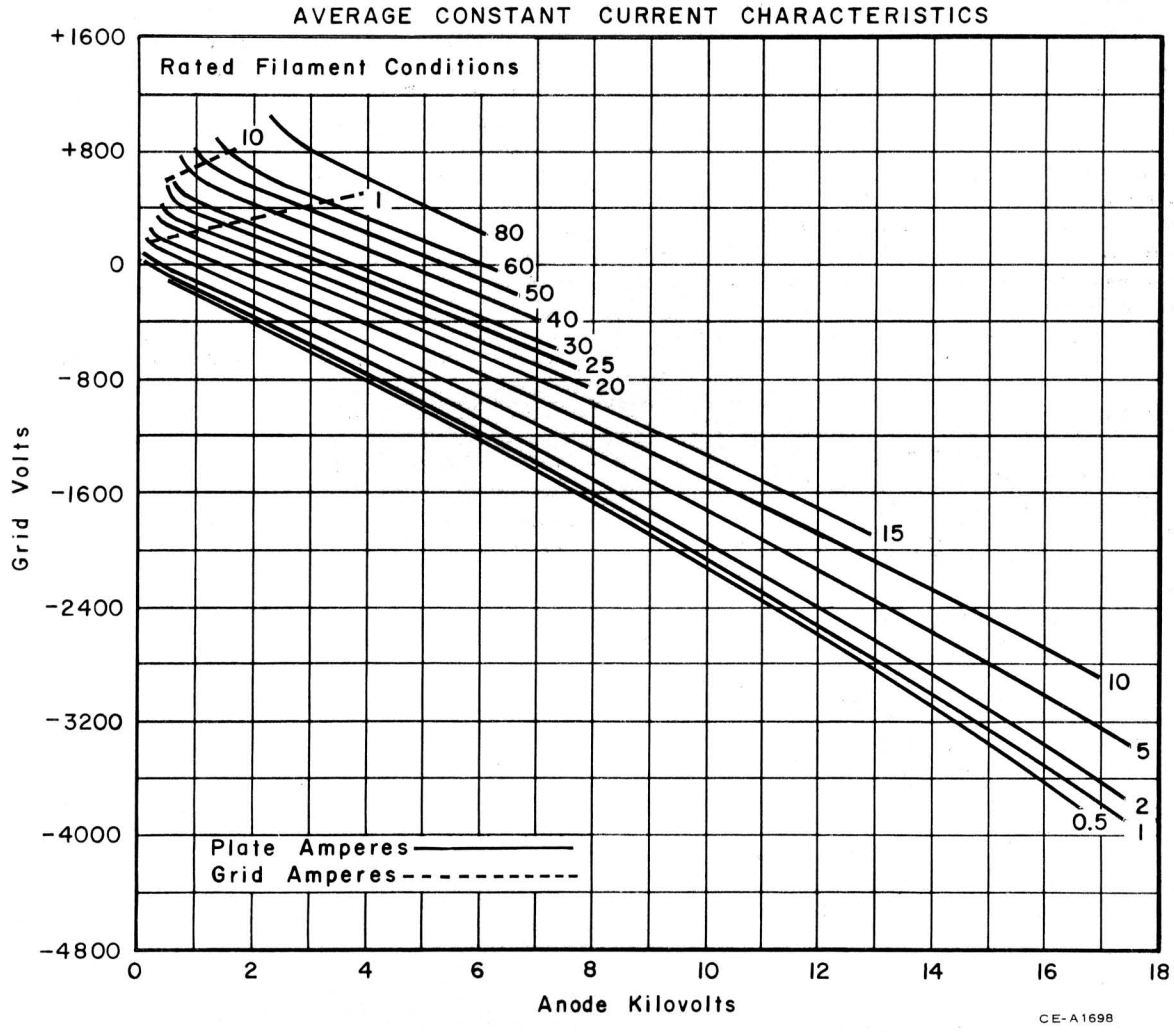
MAXIMUM RATINGS:
Absolute Maximum Values

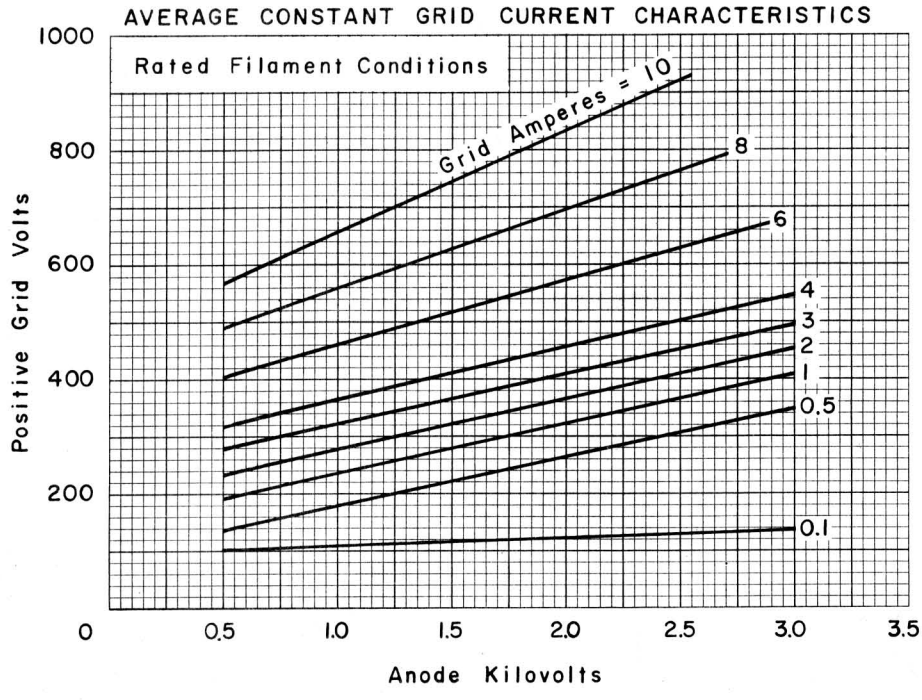
DC Plate Voltage	20	max.	Kilovolts
DC Grid Voltage	-6000	max.	Volts
Peak Positive Grid Voltage	2500	max.	Volts
Peak Pulse Plate Current	88	max.	Amperes
Peak Pulse Grid Current	12	max.	Amperes
Plate Dissipation	20	max.	Kilowatts
Grid Dissipation	300	max.	Watts
Pulse Length	2000	max.	μseconds
Duty Factor	0.01	max.	
Peak Pulse Cathode Current (Note 2)	100	max.	Amperes

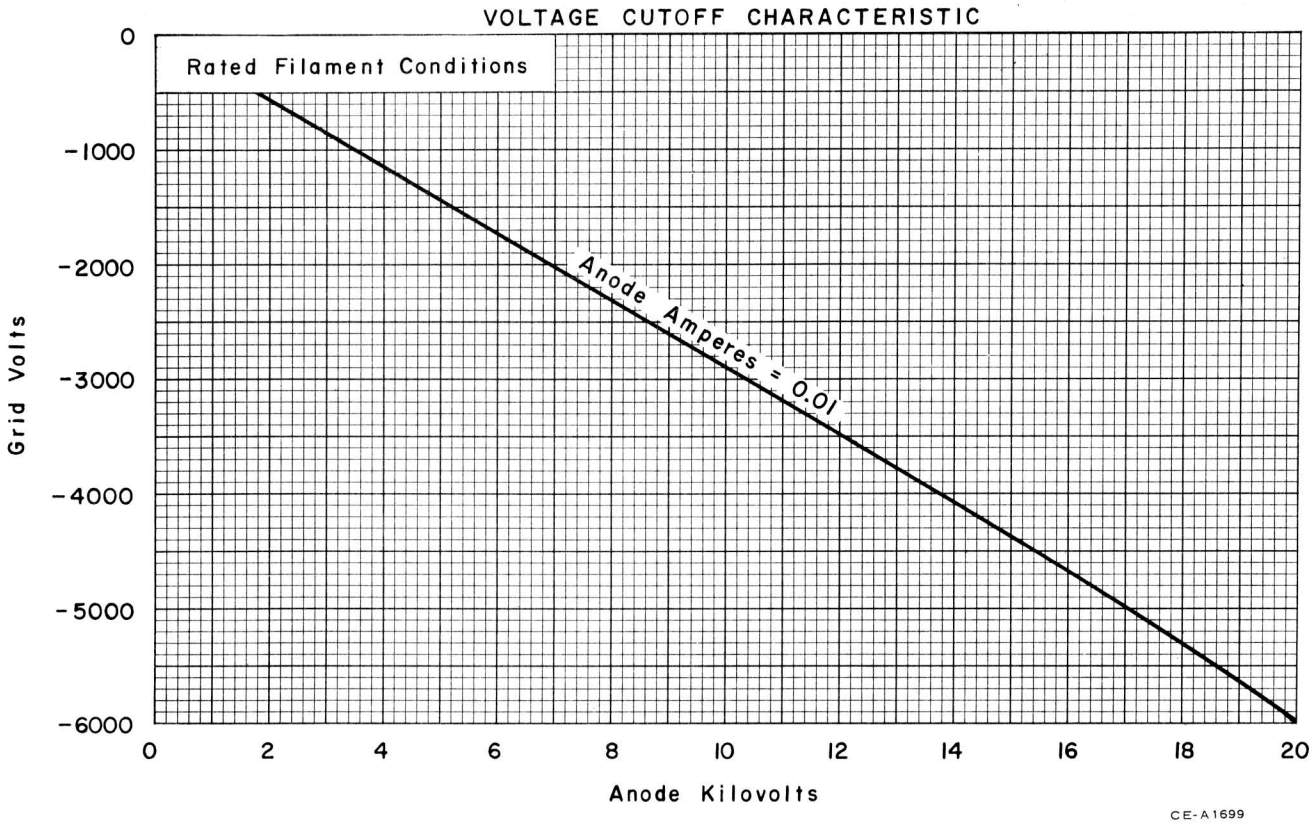
X-Ray Warning: The Maximum Ratings of the 7328A permit operation at voltages in excess of 16 KV. Therefore equipment design considerations should include the possible generation of soft x-rays.

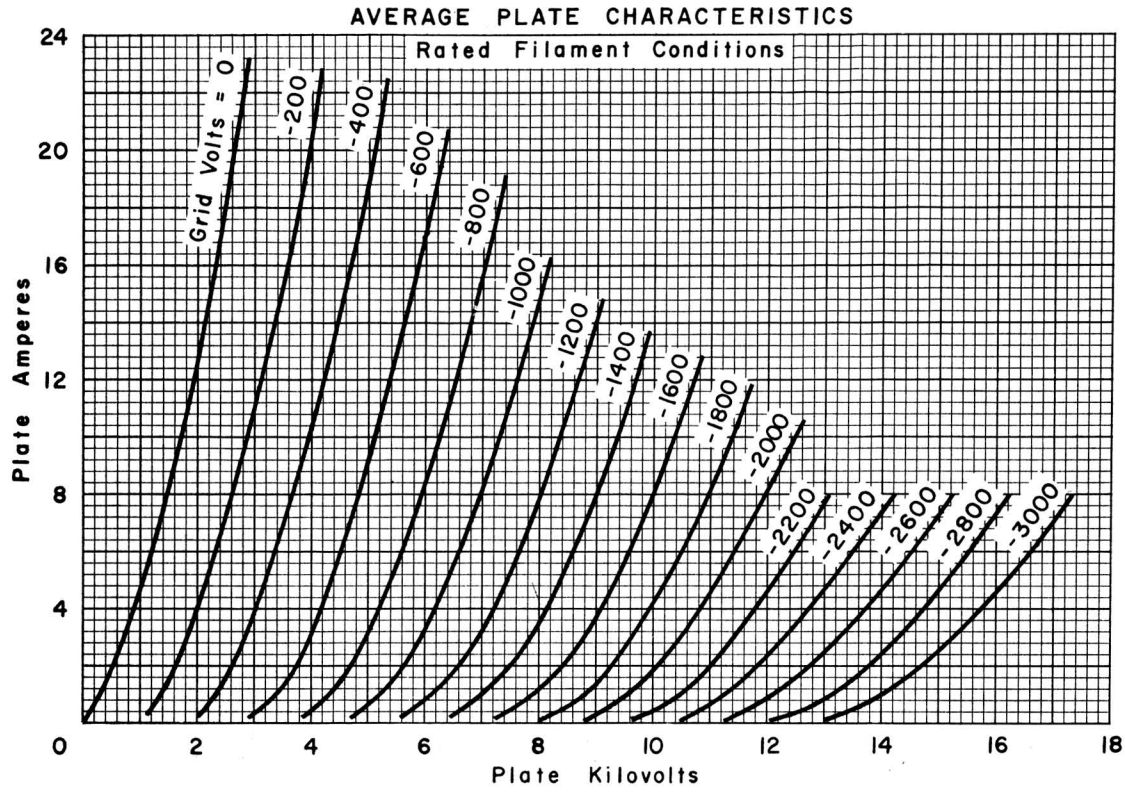
1. Averaged over any AF cycle of sine wave form.

2. A maximum of 160 amperes is permitted with 7.6 volts applied to filament. Continuous operation at elevated filament temperature will reduce length of service received.

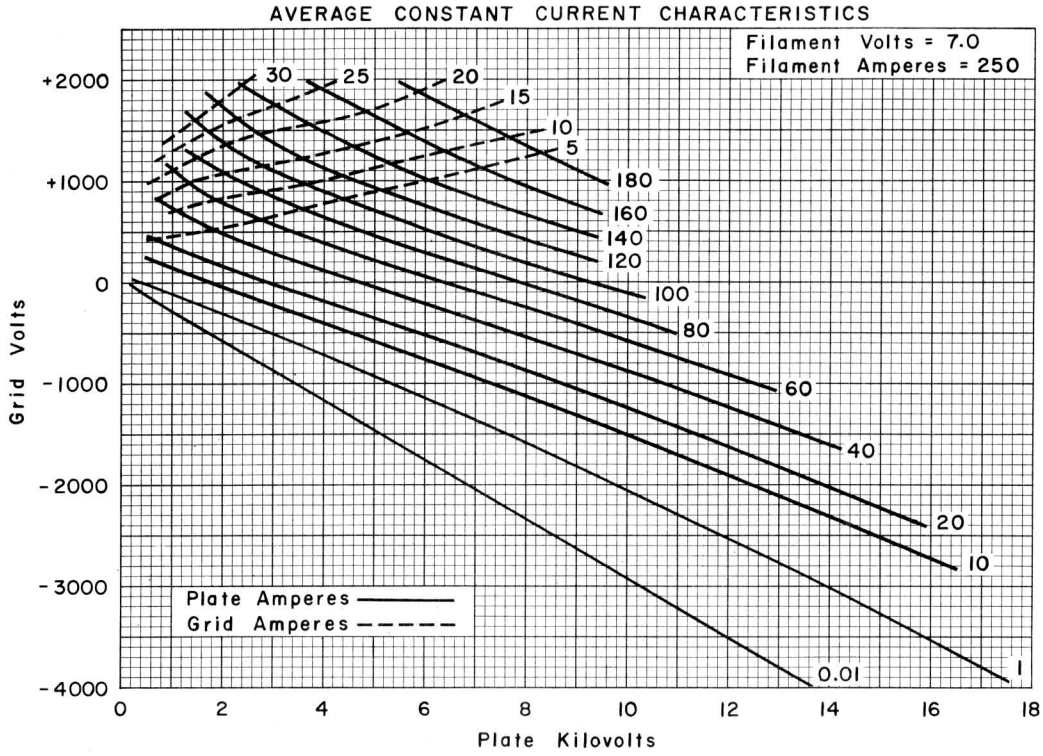


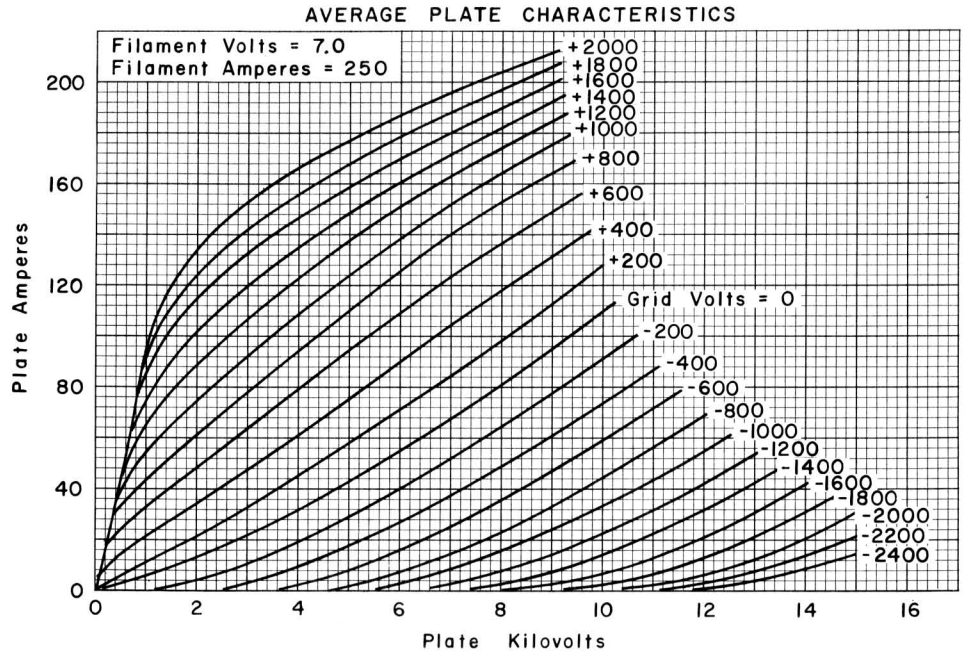

AVERAGE CONSTANT GRID CURRENT CHARACTERISTICS
Rated Filament Conditions
Grid Amperes = 10
8
6
4
3
2
1
0.5
0.1
Positive Grid Volts
1000
800
600
400
200
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Anode Kilovolts
CE-A1697


VOLTAGE CUTOFF CHARACTERISTIC
Rated Filament Conditions
Anode Amperes = 0.01
Grid Volts
0
-1000
-2000
-3000
-4000
-5000
-6000
0
2
4
6
8
10
12
14
16
18
20
Anode Kilovolts
CE-A1699

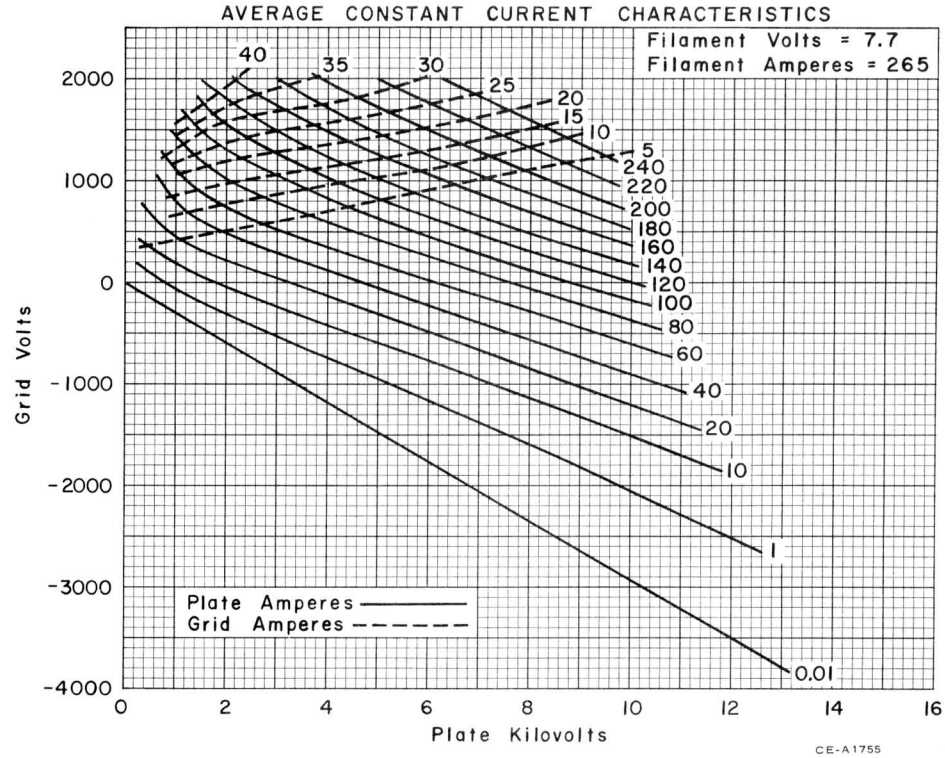

AVERAGE PLATE CHARACTERISTICS
Rated Filament Conditions
Grid Volts = 0
-200
-400
-600
-800
-1000
-1200
-1400
-1600
-1800
-2000
-2200
-2400
-2600
-2800
-3000
Plate Amperes
0
4
8
12
16
20
24
2
4
6
8
10
12
14
16
18
Plate Kilovolts
CE-A1646

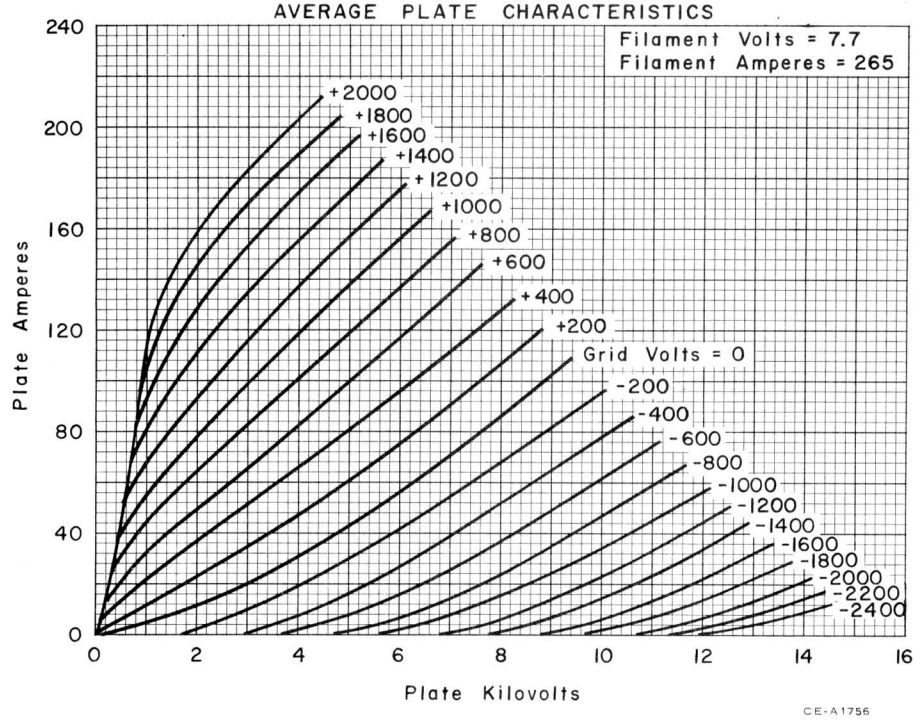
HIGH CURRENT CHARACTERISTICS FOR TYPE 7328A





CE-A1754





LINEAR BEAM-POWER PENTODE TYPE WL-7371

The WL-7371 is a beam-power pentode designed for service in the linear amplifier stages of Single-Sideband-Suppressed-Carrier transmitters. The radiation cooled anode can dissipate 75 watts. The cathode is a thoriated tungsten filament. Maximum ratings apply up to 175 megacycles.

The WL-7371 incorporates a vane-type suppressor grid which permits high-efficiency linear-radio-frequency-amplifier performance with zero suppressor-grid voltage. Its high-perveance design and high power sensitivity enable the WL-7371 to deliver high power output with low power-supply voltage and driving power requirements.

ELECTRICAL:

Cathode	Thoriated Tungsten Filament			
Filament:	Min.	Bogey	Max.	
Voltage	--	6.3	--	Volts
Current	3.0	3.2	3.6	Amperes
Grid 1 to Grid 2 Amplification Factor	5			
Direct Interelectrode Capacitances:	Min.	Bogey	Max.	
Grid 1 to Plate	--	0.06	0.1	$\mu\mu$f
Input	5.4	7.5	7.6	$\mu\mu$f
Output	3.5	4.2	4.9	$\mu\mu$f
Transconductance:				
Plate Volts = 500, Grid 2 Volts = 400, Plate Milliamperes = 150			4500	μmhos

MECHANICAL:

Mounting Position	Vertical
Cooling:	
Below 160 Mc.	Unrestricted Convection
Above 160 Mc.	15 CFM Air Flow on Anode Seal
Maximum Bulb Temperature	180°C
Base♦	7-Pin Septar (JEDEC E7-2)
Top Cap	Skirted Small
Net Weight	3.6 Ounces
Shipping Weight	3 Pounds

MAXIMUM RATINGS

Continuous Commercial Service

	Class AB_1	Class C		
DC plate Voltage	2000	2000	max.	Volts
DC Grid 2 Voltage	600	600	max.	Volts
DC Grid 3 Voltage (Suppressor)	100	100	max.	Volts
DC Plate Current	175	175	max.	Ma.
Grid 2 Power Input	10	10	max.	Watts
Plate Dissipation	75	75	max.	Watts

CLASS AB_1 LINEAR AMPLIFIER

TYPICAL OPERATING CHARACTERISTICS

Single-Sideband-Suppressed-Carrier (Intermittent Modulation) *

DC Plate Voltage	1000	1500	2000	Volts
DC Grid 3 Voltage (Suppressor)	0	0	0	Volts
DC Grid 2 Voltage	600	600	600	Volts
DC Grid 1 Voltage (Control)	-100	-110	-115	Volts
Plate Current:				
Zero Signal	38	30	25	Ma.
Maximum Signal	175	175	175	Ma.
Grid 2 Current: (Screen)				
Zero Signal	0	0	0	Ma.
Maximum Signal	10	8	7	Ma.
Peak RF Grid Voltage	100	110	115	Volts
Maximum Signal Plate Power Input	175	260	350	Watts
Maximum Signal Plate Dissipation	70	110*	125*	Watts
Maximum Signal Power Output to Load	96	140	210	Watts

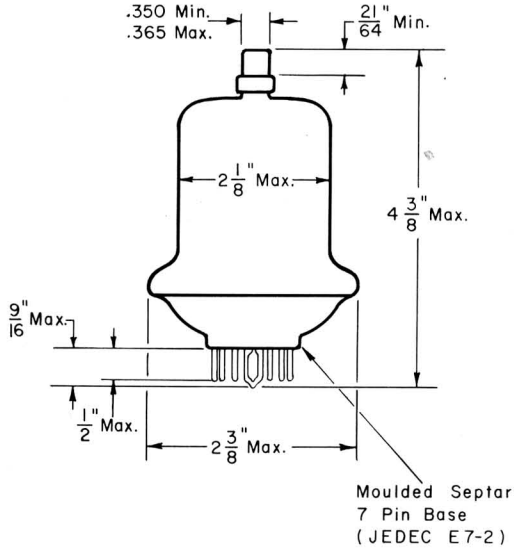
♦ Base fits Johnson No.122-101 or 122-247 or National No.HX-29 socket.

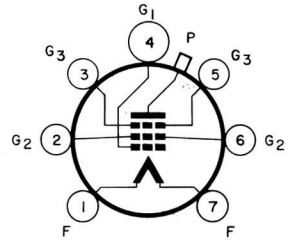
* During normal voice modulation, average plate dissipation will not exceed 75 watts.

CLASS C AMPLIFIER
CW. or FM

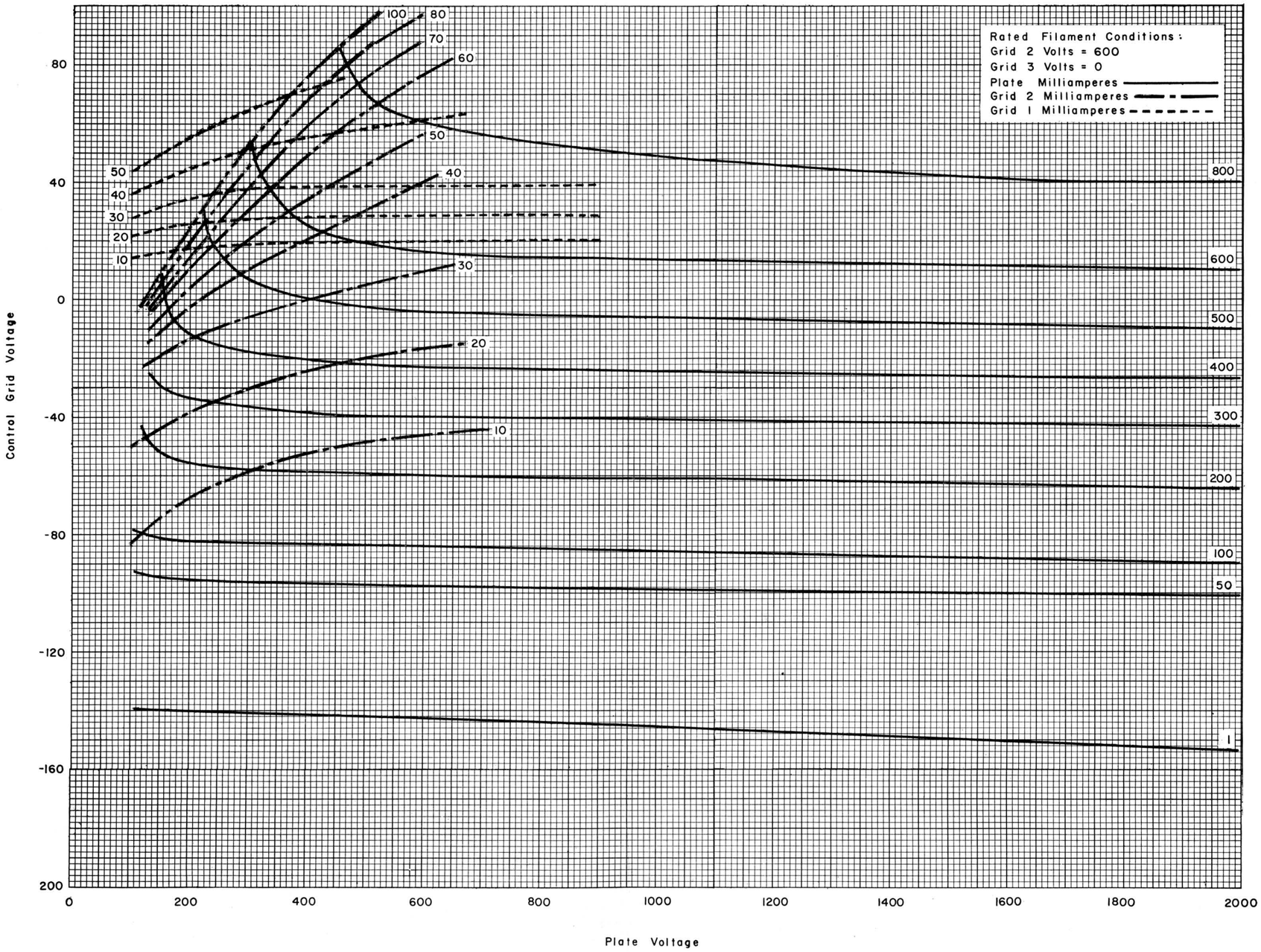
TYPICAL OPERATING CHARACTERISTICS
For Frequencies up to 175 Mc.

DC Plate Voltage	1000	1000	1500	1500	2000	2000	Volts
DC Grid 3 Voltage (Suppressor)	0	+50	0	+50	0	+50	Volts
DC Grid 2 Voltage	400	400	400	400	600	400	Volts
DC Grid 1 Voltage (Control)	-140	-150	-160	-170	-200	-200	Volts
DC Plate Current	127	166	140	146	144	140	Ma.
DC Grid 2 Current	19	10	18	8	9	6	Ma.
DC Grid 1 Current (Control)	5	5	3	3	2.5	2.5	Ma.
Peak RF Grid 1 Voltage	190	215	218	220	238	250	Volts
Driving Power	1.2	1.2	1.0	1.0	0.5	0.5	Watts
Plate Power Input	127	166	210	219	288	280	Watts
Grid 2 Power Input	7.5	4	7.2	3.2	5.4	2.4	Watts
Plate Dissipation	47	52	60	58	69	61	Watts
Power Output	80	114	150	161	219	219	Watts



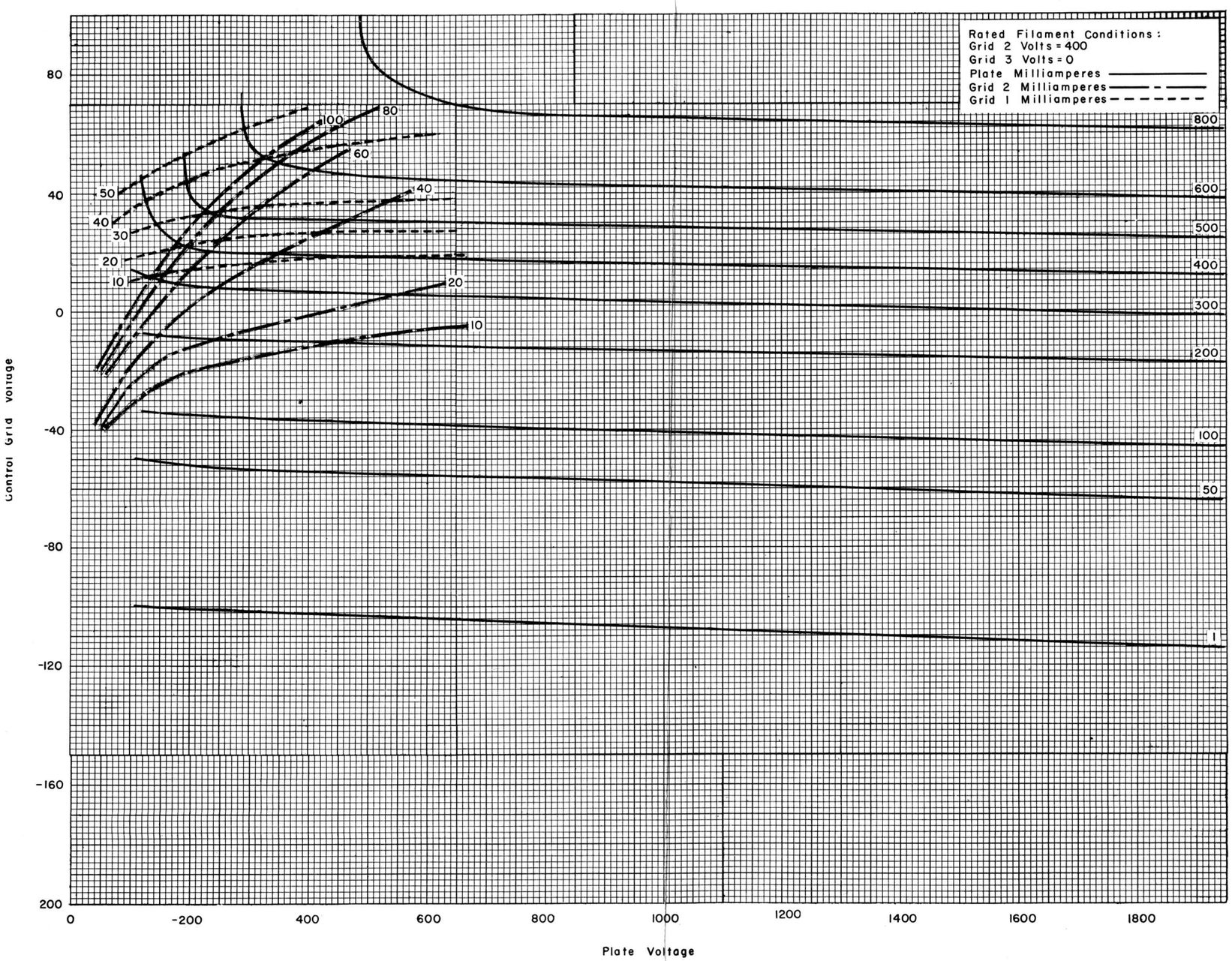


AVERAGE CONSTANT CURRENT CHARACTERISTICS



Westinghouse

AVERAGE CONSTANT CURRENT CHARACTERISTICS



Westinghouse®

WL-7463

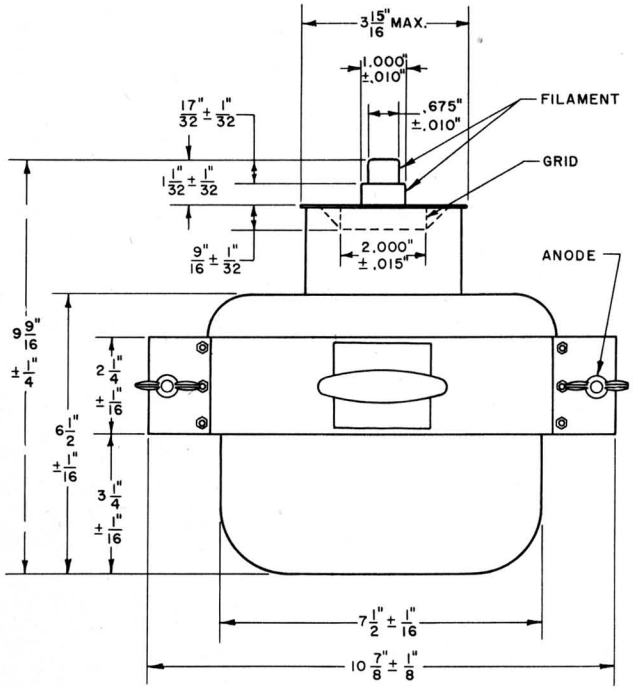
December 15, 1959

HIGH VACUUM AMPLIFIER TYPE WL-7463

The WL-7463 is a three-electrode tube designed for use as an oscillator or amplifier. The anode is forced air and is capable of dissipating 12 kilowatts. The cathode is a single phase thoriated tungsten filament. Maximum ratings apply up to 60 megacycles.

Electrical:		
Filament	6.0	Volts
Filament Current	70	Amperes
Amplification Factor	33	
Direct Interelectrode Capacitances:		
Grid to Plate	14	μμf
Grid to Filament	30	μμf
Plate to Filament	.5	μμf

Mechanical:				
Mounting Position▲	Vertical, Anode Down			
Type of Cooling	Forced Air			
Required Air Flow Through Radiator:				
Plate Dissipation	8	10	12	KW
Air Flow	550	850	1100	CFM
Static Back Pressure	0.4	0.9	1.4	In. Water
Required Air Flow to Filament and Grid Seals⊕	30			CFM
Maximum Bulb Temperature	180			°C
Net Weight (Approx.)	36			Lbs.



CLASS C TELEGRAPHY
(Key down without modulation)

Maximum Ratings:			
Absolute Maximum Values			
DC Plate Voltage	12,000 max.		Volts
DC Plate Current	2.5 max.		Amperes
DC Grid Voltage	-1200 max.		Volts
DC Grid Current	.75 max.		Amperes
Plate Input	24 max.		Kilowatts
Plate Dissipation	12 max.		Kilowatts

Typical Operating Characteristics:				
DC Plate Voltage	9000	10,000	12,000	Volts
DC Grid Voltage	-600	-700	-800	Volts
Peak R.F. Grid Voltage	960	1,100	1,200	Volts
DC Plate Current	1.97	1.96	1.94	Amp
DC Grid Current	0.45	0.42	0.39	Amp
Peak R.F. Plate Voltage	8000	9,000	11,000	Volts
Driving Power♦	414	441	445	Watts
Power Output	14.1	15.9	19.3	Kilowatts
Power Input	17.8	19.6	23.3	Kilowatts

CLASS B AUDIO FREQUENCY AMPLIFIER OR MODULATOR

Maximum Ratings (Per Tube)			
Absolute Maximum Values			
DC Plate Voltage	12,000 max.		volts
DC Plate Current (max. signal)	2.50 max.		amperes
DC Grid Current (max. signal)	0.50 max.		amperes
Plate Input	26.0 max.		kilowatts
Plate Dissipation	12.0 max.		kilowatts

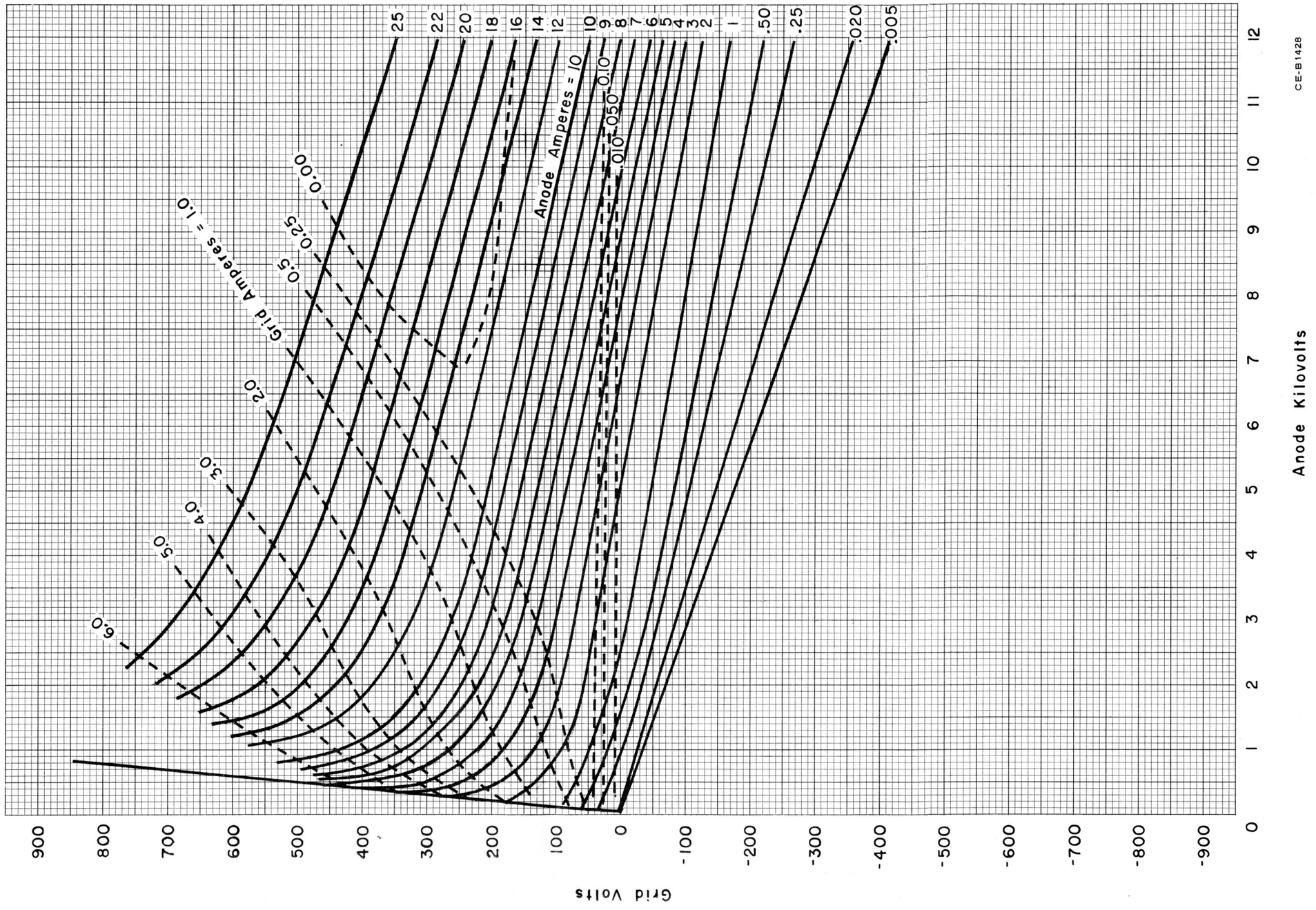
Typical Operating Characteristics: (Values are for two tubes)			
DC Plate Voltage	5500	10,500	volts
DC Plate Current (max. signal)	3.95	4.0	amperes
Plate Current, Zero-Signal	.80	0.200	amperes
Grid to Grid Peak A.F.	680	1030	volts
DC Grid Voltage	-100	-300	volts
Driving Power (max. signal)	185	150	watts
Power Output	13.2	27.0	kilowatts
Power Input	21.7	42.0	kilowatts
Plate Load (plate to plate)	2780	5600	ohms
Distortion-Harmonic (Approx.)	4.8	3	percent
Peak R.F. Plate Voltage	4300	8820	volts

♦ Allowance must be made for grid circuit losses which are not included.

▲ Connectors for WL-7463 are available from Westinghouse.

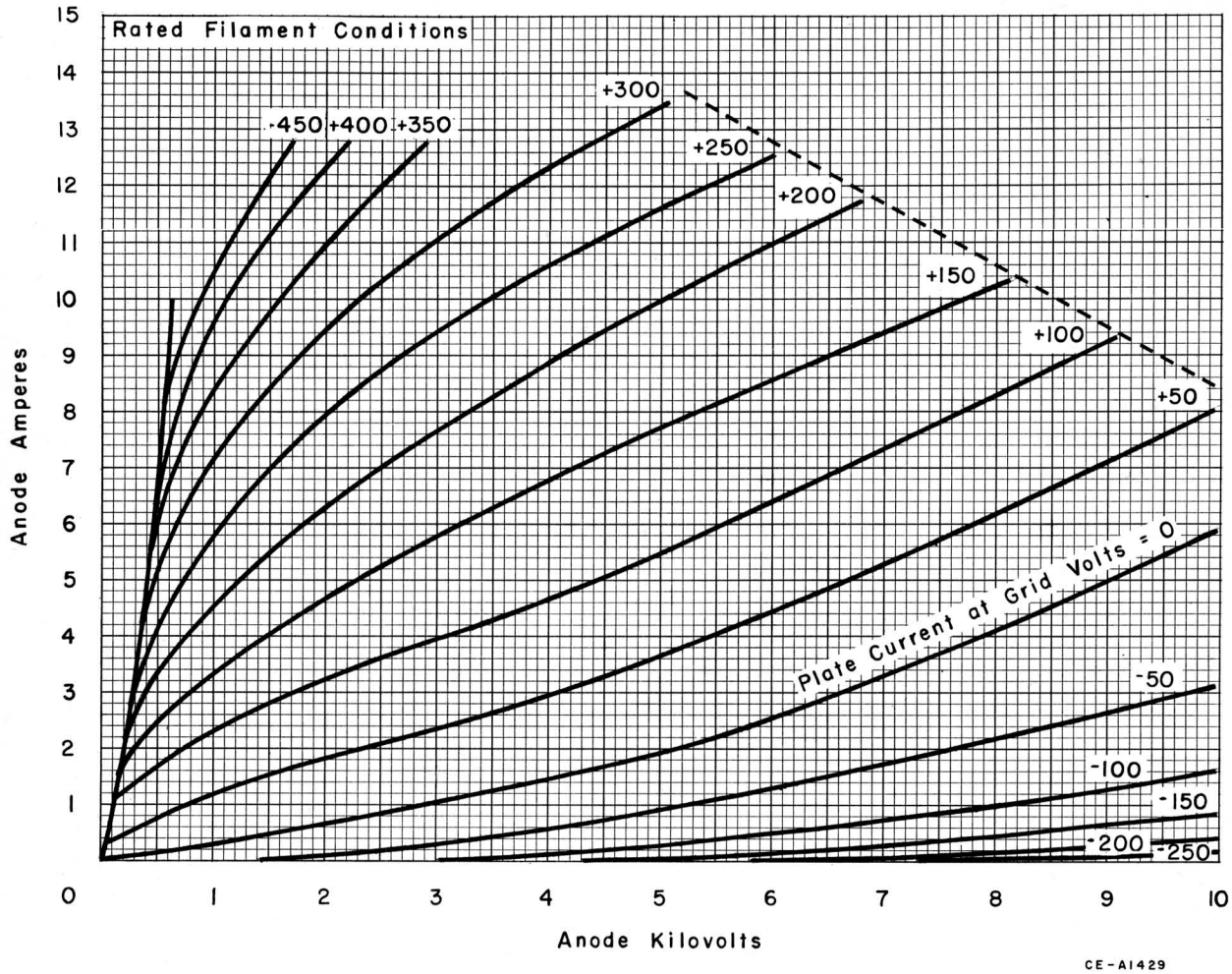
⊕ A portion of the air flowing through the radiator may be deflected to provide cooling of the filament and grid seals.

AVERAGE CONSTANT CURRENT CHARACTERISTICS



CE-B1428

AVERAGE PLATE CHARACTERISTICS



CE-A1429

POWER AMPLIFIER TRIODE TYPE WL-7464

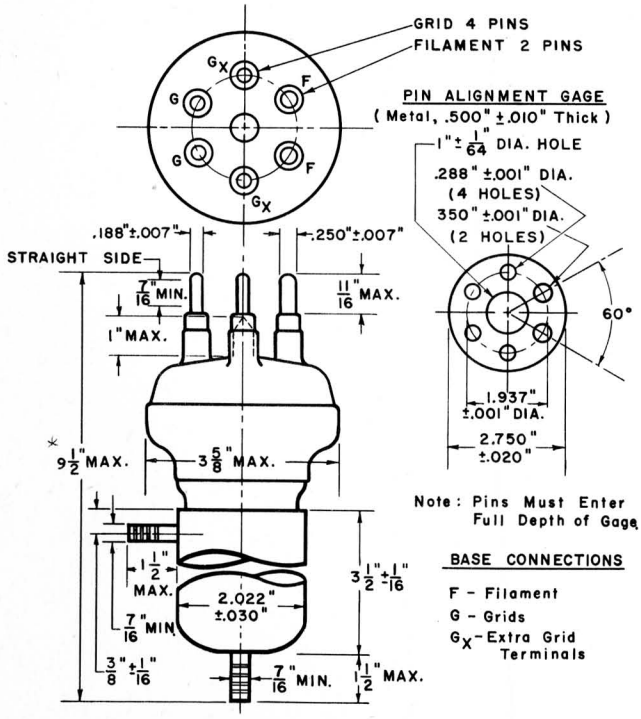
The WL-7464 is a three electrode tube designed for use as a modulator or amplifier. The anode is capable of dissipating 8.0 kilowatts of power in Continuous Commercial Service. Cooling is accomplished by water flow through an integral water jacket. The cathode is a thoriated tungsten filament. Maximum ratings apply for audio frequencies.

ELECTRICAL:

	Min.	Bogey	Max.	
Filament Voltage	5.7	6.0	6.3	Volts
Filament Current	57	60	63	Amperes
Filament Starting Current	--	--	300	Amperes
Filament Resistance, (cold)	--	.016	--	Ohms
Amplification Factor	--	6.0	--	
Direct Interelectrode Capacitance (Avg.):				
Grid-Plate		14		$\mu\mu$f
Grid-Filament		15		$\mu\mu$f
Plate-Filament		1.5		$\mu\mu$f

MECHANICAL:

Mounting Position	Vertical, Anode Down
Type of Cooling	Water
Water Flow Required	3.75 GPM
Water Pressure	7.0 PSI
Maximum Outlet Water Temperature	70°C
Airflow on Filament & Grid Seals	30 CFM
Maximum Glass Temperature	180° C
Net Weight	1.75 Pounds



AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR-CLASS A

MAXIMUM RATINGS

Absolute Maximum Values

DC Plate Voltage	8.0	max.	Kilovolts
Negative DC Grid Voltage	1500	max.	Volts
Plate Input	8.0	max.	Kilowatts
Plate Dissipation	8.0	max.	Kilowatts

TYPICAL OPERATING CHARACTERISTICS

DC Plate Voltage	5250	Volts
DC Grid Voltage	-625	Volts
Peak AF Grid Voltage	625	Volts
Peak AF Plate Voltage	2850	Volts
DC Plate Current	1.5	Amperes
Load Resistance	2060	Ohms
2nd Harmonic Distortion (approx.)	5	Per Cent
Power Output	2.0	Kilowatts

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR CLASS AB_1

MAXIMUM RATINGS (PER TUBE)

Absolute Maximum Values	CCS		
DC Plate Voltage	8.0	max.	Kilovolts
DC Plate Current	2.5	max.	Amperes
Negative DC Grid Voltage	2000	max.	Volts
Plate Input	18.0	max.	Kilowatts
Plate Dissipation	8.0	max.	Kilowatts

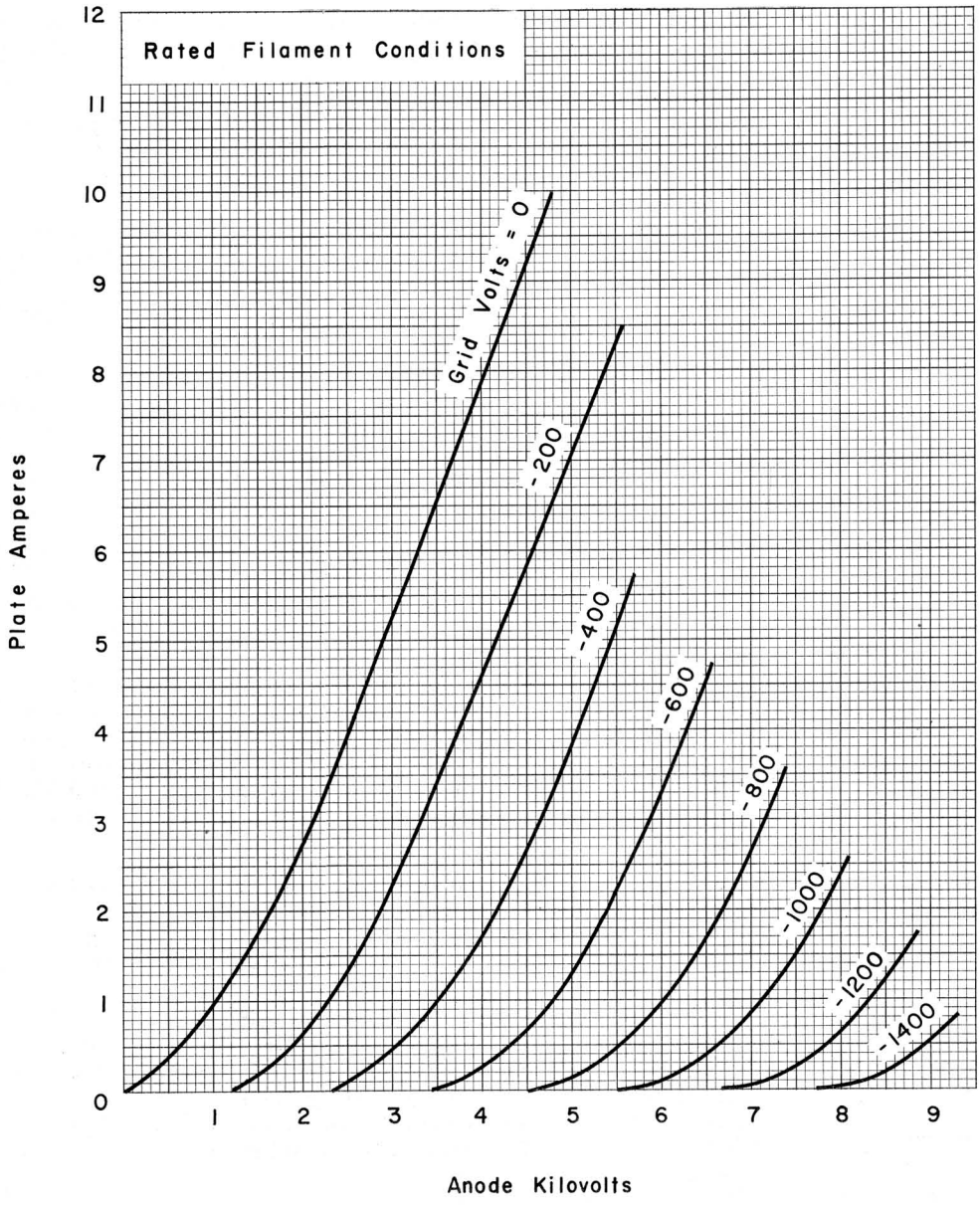
TYPICAL OPERATING CHARACTERISTICS

(Unless Otherwise Specified, Values are for Two Tubes)

DC Plate Voltage	7.5	Kilovolts
DC Grid Voltage	1200	Volts
Peak AF Grid to Grid Voltage	2340	Volts
Zero Signal Plate Current	.30	Amperes
Maximum Signal DC Plate Current	2.68	Amperes
Peak AF Plate to Plate Voltage	9.4	Kilovolts
Effective Load Resistance (Plate to Plate)	4820	Ohms
Maximum Signal Driving Power	0	Watts
Maximum Signal Power Output	10.8	Kilowatts
Total Harmonic Distortion (approx.)	2.3	Per Cent

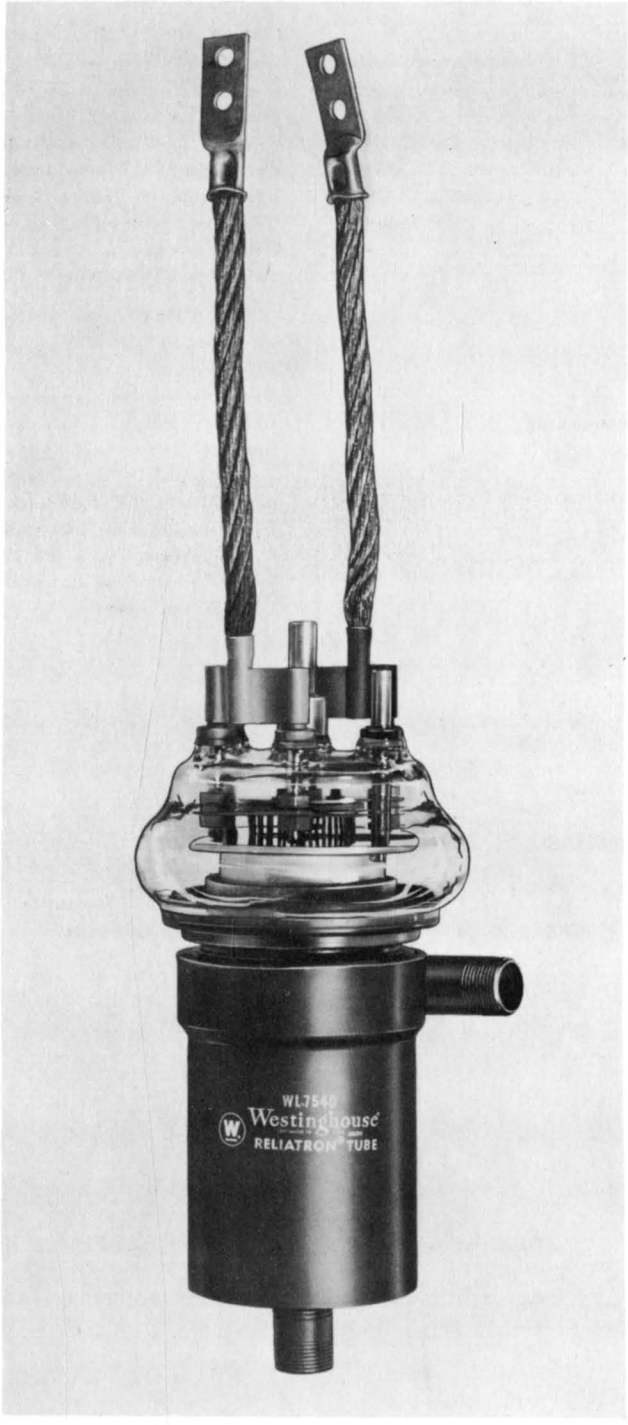
Westinghouse®

AVERAGE PLATE CHARACTERISTICS



LO MU POWER TRIODE TYPE 7540

The 7540 is a three electrode tube designed for zero drive modulator service. The anode is rated for 35KW dissipation during Continuous Commercial Service. An accuratly aligned integral water jacket assures steam free operation even under most severe beaming conditions. The cathode is thoriated tungsten. Ratings are for audio frequency only.

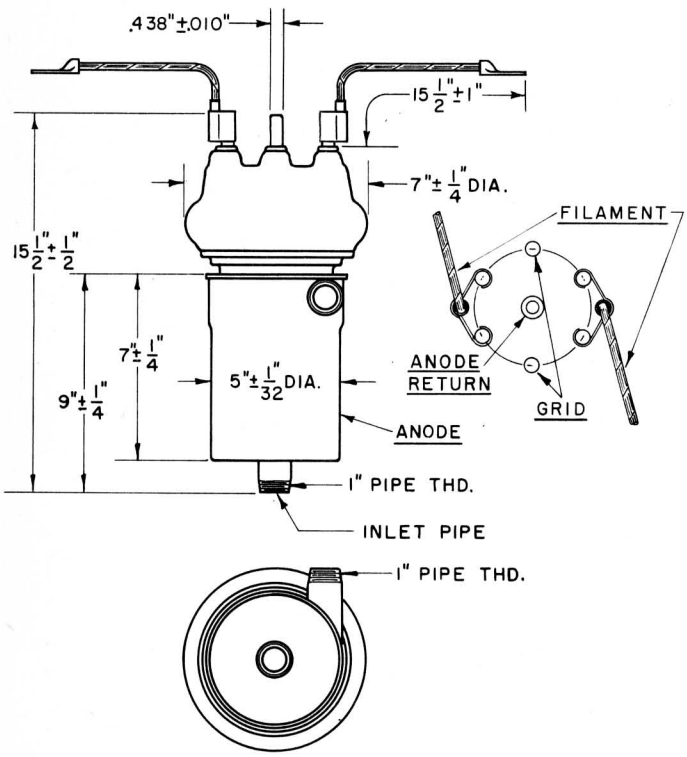


ELECTRICAL:

Filament Voltage	5.0	
Filament Amperes	250	
Amplification Factor	5	
Interelectrode Capacities: (approx.)		
Grid to Plate	50	μμf
Grid to Filament	65	μμf
Plate to Filament	8	μμf

MECHANICAL:

Mounting Position	Vertical anode down
Anode Cooling	water-30gpm
Max. water outlet Temperature	70°C
Water Pressure drop	8psi/30gpm
Max. Glass Temperature	180°C
Glass Seal Cooling	50 CFM
Net Weight	18 Pounds
Shipping Weight	



MAXIMUM RATINGS

Absolute Maximum Values	CCS		
DC Plate Voltage	15	max.	Kilovolts
DC Plate Current*	10	max.	Amperes
Plate Power Input*	70	max.	Kilowatts
Plate Dissipation*	35	max.	Kilowatts
Grid Dissipation	0	max.	Watts

* Averaged over AF cycle of sine wave.

TYPICAL OPERATING CHARACTERISTICS
(Two Tubes in Push-Pull)

DC Plate Voltage	10	12.5	Kilovolts
DC Grid Voltage	-2000	-2800	Volts
Peak AF Grid to Grid Voltage	3950	5500	Volts
Zero Signal DC Plate Current	2	1	Amperes
Max. Signal DC Plate Current	9.5	8	Amperes
Effective Plate-to-Plate Load Resistance	1880	3000	Ohms
Driving power	0	0	Watts
Max. Signal Power Output	52.5	59	Kilowatts

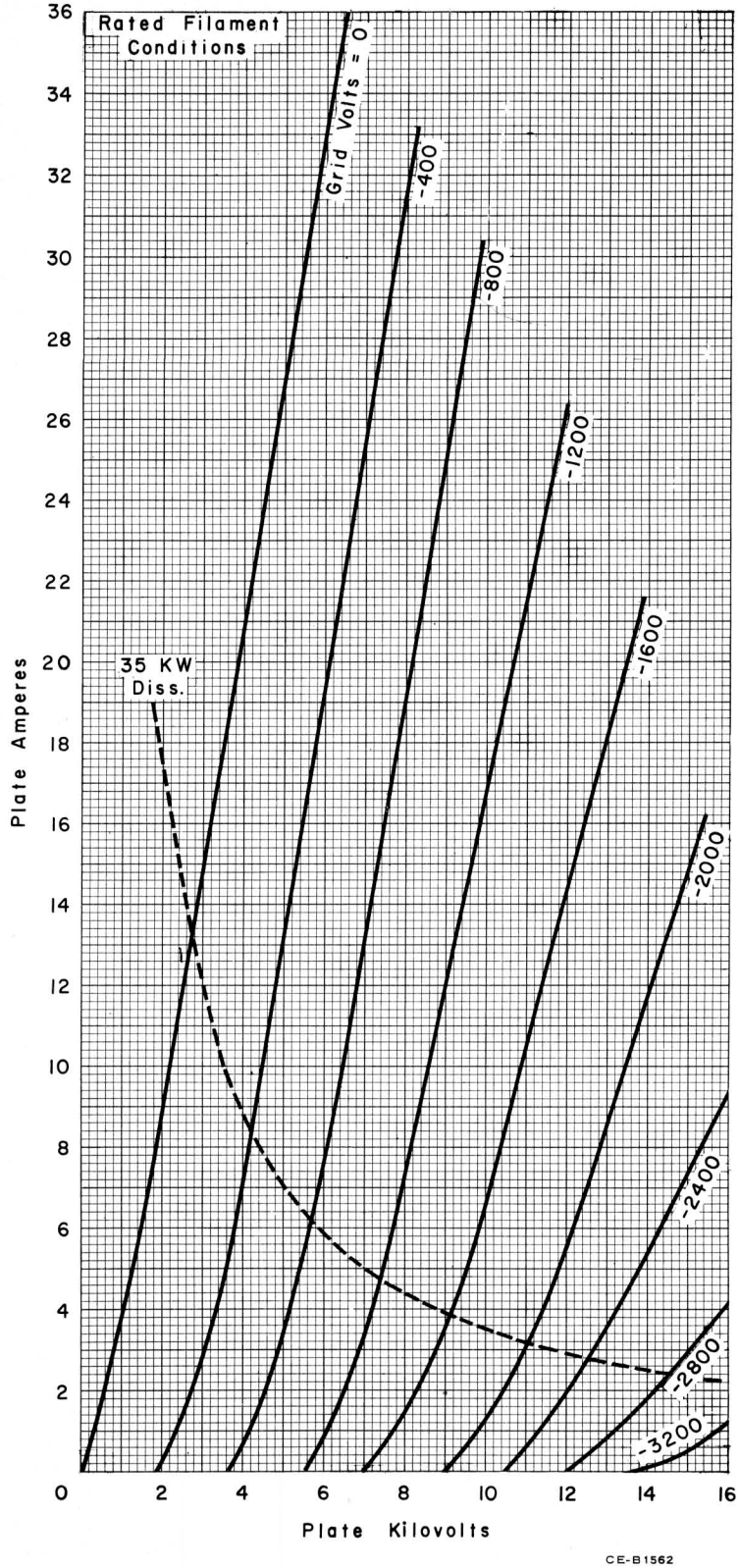
TYPICAL OPERATING CHARACTERISTICS
(Two Tubes in Push-Pull)
(Reactive Load)

DC Plate Voltage	12.5	Kilovolts
DC Grid Voltage	-2800	Volts
Peak AF Grid to Grid Voltage	5500	Volts
Zero Signal DC Plate Current	1.0	Amperes
Max. Signal DC Plate Current	3.1	Amperes
Effective Plate-to-Plate Load Resistance	9400	Ohms
Driving Power	0	Watts
Instantaneous Peak Power Output	37.5	K.V.A.
Load power Factor	0.2	

COOLING WATER REQUIREMENTS

Anode Dissipation Kilowatts	Water Flow Gallons/Minute
17	15
23	20
29	25
35	30

AVERAGE PLATE CHARACTERISTICS



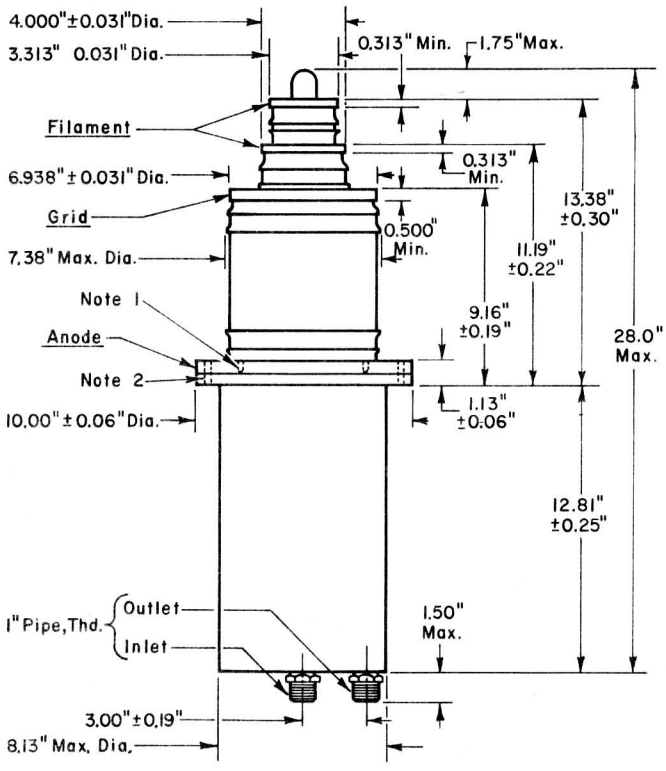
CE-B1562

POWER TRIODE TYPE WL-7560

The WL-7560 is a general-purpose, water-cooled, 3-electrode tube designed for service as a continuous or pulsed class C power amplifier and as a pulse modulator. The integral-water-jacketed anode is capable of dissipating 175 kilowatts. The cathode is a sturdy, spring loaded thoriated-tungsten filament. Coaxial electrodes with ceramic insulators provide low inductance, low-r-f-loss terminals. Maximum ratings apply to 30 Mc.

ELECTRICAL

Cathode	Thoriated-Tungsten Filament	
Filament:		
Voltage (Note 1)	14.5	Volts
Current	450	Amperes
Max. Starting Current	1200	Amperes
Cold Resistance	0.0045	Ohms
Amplification Factor	45	–
Interelectrode Capacitances:		
Grid to Plate	75	pf
Grid to Filament	200	pf
Plate to Filament	4	pf



Notes:

1. Four Holes, $\frac{5}{16}$" Deep, $\frac{1}{4}$"-20 Tap, Equally Spaced on 8.19"±0.03" B.C., for Lifting.
2. Four Thru Holes .290 Dia. on 9.16"±0.03" for Mounting, Located Approx. 45° from Tapped Holes.

MECHANICAL

Mounting Position	Vertical, Anode Down
Net Weight	110 Pounds
Cooling Water Required for Full Input	40 GPM
Air Flow on Bulb and Seals	500 CFM
Maximum Ceramic Temperature	165°C

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR, CLASS B

MAXIMUM RATINGS

Absolute Maximum Values

DC Plate Voltage	20	max.	Kilovolts
DC Plate Current	30	max.	Amperes
Plate Power Input	600	max.	Kilowatts
Plate Dissipation	175	max.	Kilowatts

TYPICAL OPERATION (Two Tubes in Push-Pull)

DC Plate Voltage	12	15	Kilovolts
DC Grid Voltage	–250	–320	Volts
Peak AF Grid-to-Grid Voltage	960	1740	Volts
Peak AF Plate-to-Plate Voltage	20.4	25.2	Kilovolts
Zero-Signal DC Plate Current	2	2	Amperes
Max.-Signal DC Plate Current	20	56	Amperes
Effective Plate-to-Plate Load Resistance	1300	570	Ohms
Driving Power	800	5000	Watts
Power Output	160	550	Kilowatts

LINEAR RADIO FREQUENCY POWER AMPLIFIER, CLASS AB

Single-Sideband, Suppressed-Carrier Service

MAXIMUM RATINGS

Absolute Maximum Values

DC Plate Voltage	20	max.	Kilovolts
Grid Dissipation	2500	max.	Watts
Plate Dissipation	175	max.	Kilowatts

TYPICAL OPERATION

	2 Tone	16 Tone	
DC Plate Voltage	20	20	Kilovolts
DC Grid Voltage	–450	–450	Volts
Zero-Signal DC Plate Current	1	1	Ampere
Max.-Signal Peak Plate Current	54	135	Amperes
Max.-Signal Peak RF Grid Voltage	690	1100	Volts
Max.-Signal Peak Driving Power	10	41	Kilowatts
Peak Envelope Power Output	230	585	Kilowatts
Average Power Output	115	58	Kilowatts

PLATE MODULATED RF POWER AMPLIFIER
CLASS C TELEPHONY

Carrier Conditions per Tube with Max. Modulation Factor of 1.0

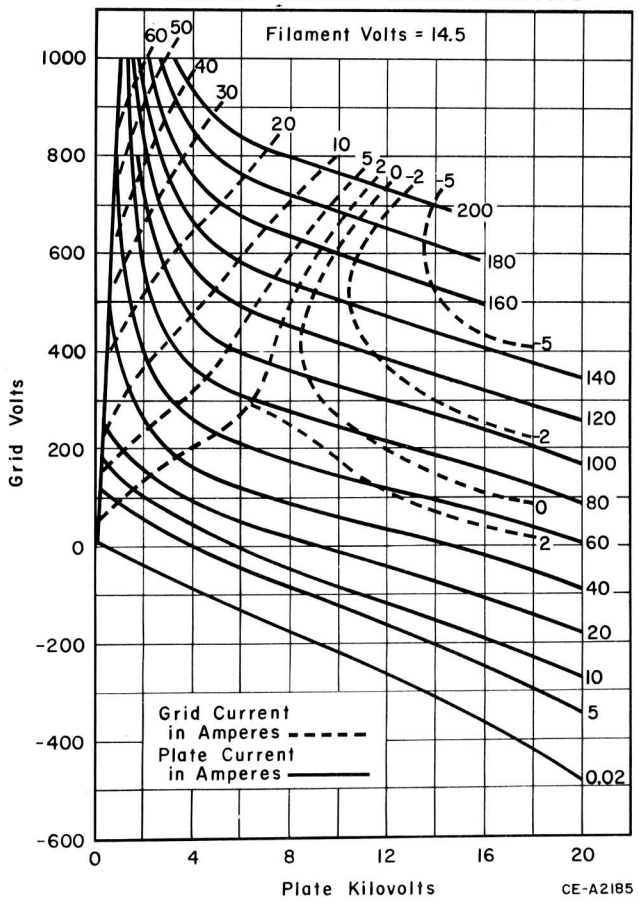
MAXIMUM RATINGS

Absolute Maximum Values

DC Plate Voltage	15 max.	Kilovolts
DC Grid Voltage	−1500 max.	Volts
DC Plate Current	20 max.	Amperes
DC Grid 1 Current	4 max.	Amperes
Plate Power Input	300 max.	Kilowatts
Plate Dissipation	115 max.	Kilowatts

TYPICAL OPERATION	Cathode Drive		
DC Plate Voltage	12	14	Kilovolts
Peak RF Plate Voltage	10.6	11.8	Kilovolts
DC Grid Voltage	−800	−1000	Volts
Peak RF Grid Voltage	1350	1630	Volts
DC Plate Current	13.5	20.5	Amperes
DC Grid Current	3.5	3.5	Amperes
RF Load Resistance	490	320	Ohms
Driving Power	20	5.7	Kilowatts
Power Output	145	220	Kilowatts

CONSTANT CURRENT CHARACTERISTICS



RF POWER AMPLIFIER AND OSCILLATOR
CLASS C TELEGRAPHY

MAXIMUM RATINGS

Absolute Maximum Values

DC Plate Voltage	20 max.	Kilovolts
DC Grid Voltage	−1500 max.	Volts
DC Plate Current	35 max.	Amperes
DC Grid Current	4 max.	Amperes
Plate Power Input	600 max.	Kilowatts
Plate Dissipation	175 max.	Kilowatts

TYPICAL OPERATION			
DC Plate Voltage	14	20	Kilovolts
Peak RF Plate Voltage	12	17.4	Kilovolts
DC Grid Voltage	−600	−1000	Volts
Peak RF Grid Voltage	1200	1680	Volts
DC Plate Current	25	29	Amperes
DC Grid Current	3.6	3.4	Amperes
RF Load Resistance	250	330	Ohms
Driving Power	4500	6000	Watts
Power Output	260	440	Kilowatts

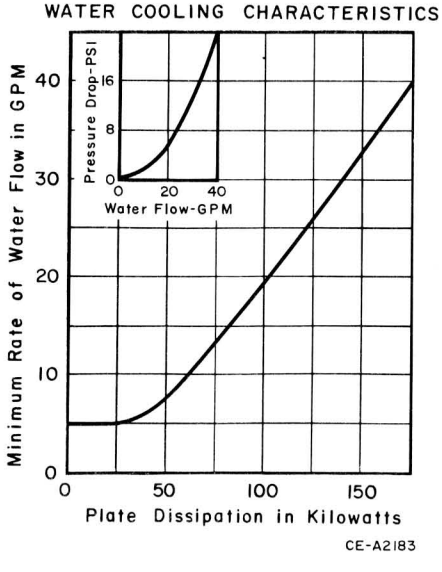
PLATE-PULSED RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR, CLASS C

MAXIMUM RATINGS

Absolute Maximum Values

Peak Plate Pulse Supply Voltage	40 max.	Kilovolts
DC Grid Voltage	−3500 max.	Volts
Peak Cathode Current	550 max.	Amperes
Grid Dissipation	3000 max.	Watts
Plate Dissipation	175 max.	Kilowatts
Pulse Duration (Note 2)	500 max.	μSeconds
Duty Factor	0.10 max.	–

WATER COOLING CHARACTERISTICS



TYPICAL OPERATION		Cathode Drive	
Peak Plate Pulse Supply Voltage	40	40	Kilovolts
Peak RF Plate Voltage	34	34	Kilovolts
DC Grid Voltage	−1400	−1400	Volts
Peak RF Grid Voltage	3000	3000	Volts
Peak Plate Current (Pulsed)	100	100	Amperes
Peak Grid Current	16	16	Amperes
RF Load Resistance	210	200	Ohms
Driving Power During Pulse	310	45	Kilowatts
Power Output During Pulse	3.2	3.0	Megawatts

PULSE MODULATOR OR PULSE AMPLIFIER

MAXIMUM RATINGS

Absolute Maximum Values

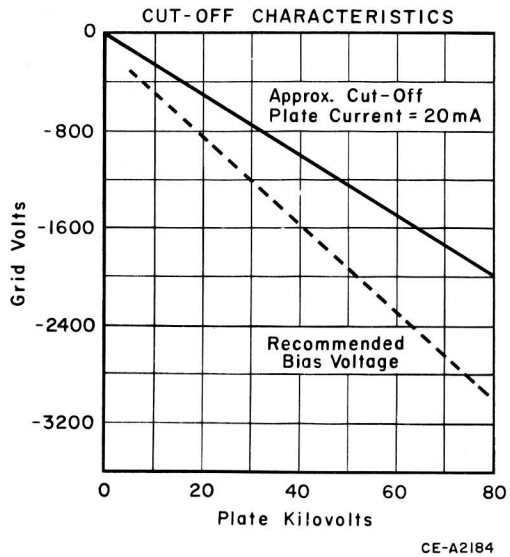
DC Plate Voltage	50	max.	Kilovolts
Peak Plate Voltage	55	max.	Kilovolts
DC Grid Voltage	−3500	max.	Volts
Pulse Cathode Current	550	max.	Amperes
Grid Dissipation	3000	max.	Watts
Plate Dissipation	175	max.	Kilowatts
Pulse Duration (Note 2)	1000	max.	μSeconds
Duty Factor	0.01	max.	–

TYPICAL OPERATION

DC Plate Voltage	50	Kilovolts
DC Grid Voltage	−1800	Volts
Pulse Positive Grid Voltage	1600	Volts
Pulse Plate Current	350	Amperes
Pulse Grid Current	80	Amperes
Pulse Driving Power	275	Kilowatts
Pulse Power Output	15.7	Megawatts
Pulse Voltage Output	45	Kilovolts

NOTES

1. 15.0 Volts for cathode currents above 350 amperes.
2. Consult manufacturer for information on operation with longer pulse length.



TUBE PROTECTION NOTES

The handling of very high power requires particular attention to the removal of power from tubes during fault conditions (initiated by tube or circuit instabilities) since the larger amount of energy involved can cause tube damage if not properly controlled. The tube must, therefore, be protected by limiting the time elapsed from inception of a fault condition to diverting the energy from the tube, as well as the amount of energy expended in the tube during this interval.

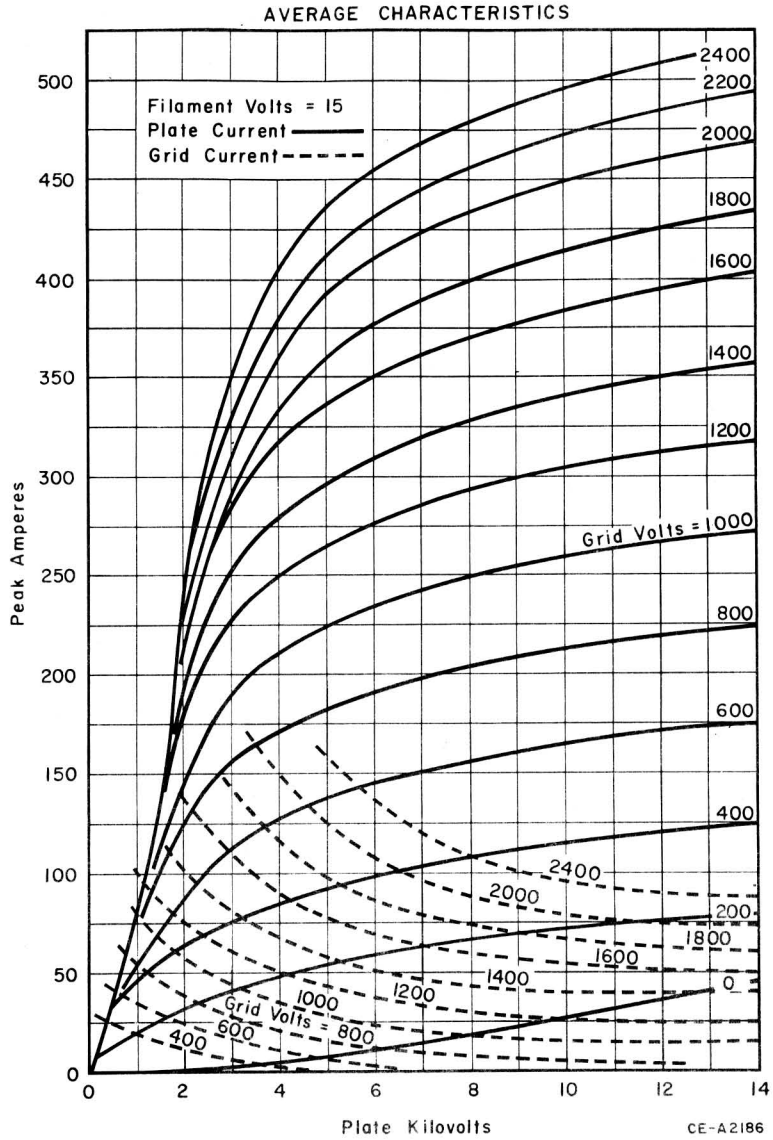
In addition to the normal circuit breakers and overload relays, it is necessary that a fast-acting electronic protective device (crowbar) or equivalent be used. This device will in most cases be a triggered device connected across the output of the plate supply filter, if used, to dissipate the filter-circuit energy as well as the rectifier output. The complete energy source must be shorted out as quickly as possible after the inception of a "fault", and in most cases the time interval should not be allowed to exceed approximately ten microseconds. For some basic electronic-crowbar fault-protection circuit considerations, as well as tests of the effectiveness of a protection device, refer to the reference listed.

A nominal value of resistance must be placed in the plate lead of the tube being protected in order to be assured that the impedance of this tube under a flash arc condition is greater than that of the crowbar device when the latter is triggered. Critical damping is required for the crowbar discharge circuit. It is also recommended that a minimum of five to ten ohms resistance be connected in series with each rectifier tube in order to limit surge currents.

In circuits where high transient voltages may be developed due to a shorted load or other fault, special precautions are necessary to keep these excessive voltages from appearing at the tube electrodes.

REFERENCES

1. W. N. Parker and M. V. Hoover, "Gas Tubes Protect High Power Transmitters", Electronics, 29, 144, January 1956.
2. A. J. Morris and J. P. Swanson, "The High Speed Protection of Microwave Tubes and Systems", The Microwave Journal, Vol. V, No. 11, Nov. 1962.



POWER AMPLIFIER TRIODE TYPE 7565

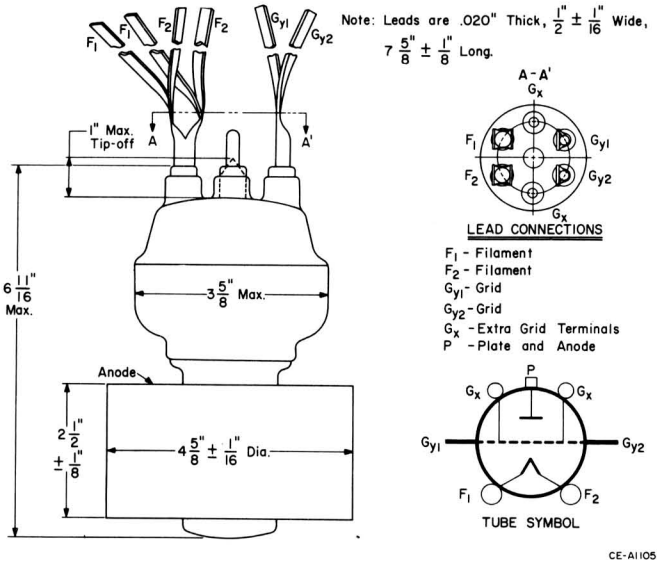
The 7565 is a three electrode tube designed for use as a modulator or amplifier. The anode is capable of dissipating 4 kilowatts of power in Continuous Commercial Service. Cooling is accomplished by forced air. The cathode is a thoriated tungsten filament. Maximum ratings apply for audio frequencies.

ELECTRICAL:

	Min.	Bogey	Max.	
Filament Voltage	5.7	6.0	6.3	Volts
Filament Current	57	60	63	Amperes
Filament Starting Current	--	--	300	Amperes
Filament Resistance, (cold)	--	.016	--	Ohms
Amplification Factor	--	6.0	--	
Direct Interelectrode Capacitances (Avg.):				
Grid-Plate			14	μμf
Grid-Filament			15	μμf
Plate-Filament			1.5	μμf

MECHANICAL:

Mounting Position	Vertical, Anode Up or Down		
Type of Cooling	Forced Air		
Maximum Incoming Air Temperature	45 °C		
Required Air Flow on Anode:			
Per Cent Plate Dissipation Rating	100	75	50
Air Flow-Cubic Feet per Minute	300	200	125
Static Pressure-Inches of Water	2.5	1.25	0.7
Required Air Flow on Filament	Air flow through radiator is normally sufficient		
Maximum Glass Temperature	160 °C		
Net Weight, approximate	4-7/8 lbs.		
Shipping Weight, approximate	10 lbs.		



CE-A1105

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR-CLASS A

MAXIMUM RATINGS:

Absolute Maximum Values

DC Plate Voltage	8.0	max.	Kilovolts
Negative DC Grid Voltage	1000	max.	Volts
Plate Input	4.0	max.	Kilowatts
Plate Dissipation	4.0	max.	Kilowatts

TYPICAL OPERATING CHARACTERISTICS:

DC Plate Voltage	4500	Volts
DC Grid Voltage	-570	Volts
Peak AF Grid Voltage	570	Volts
Peak AF Plate Voltage	2700	Volts
DC Plate Current	0.88	Amperes
Load Resistance	4500	Ohms
2nd Harmonic Distortion (approx.)	3.8	Per Cent
Power Output	950	Watts

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR CLASS AB

MAXIMUM RATINGS (PER TUBE):

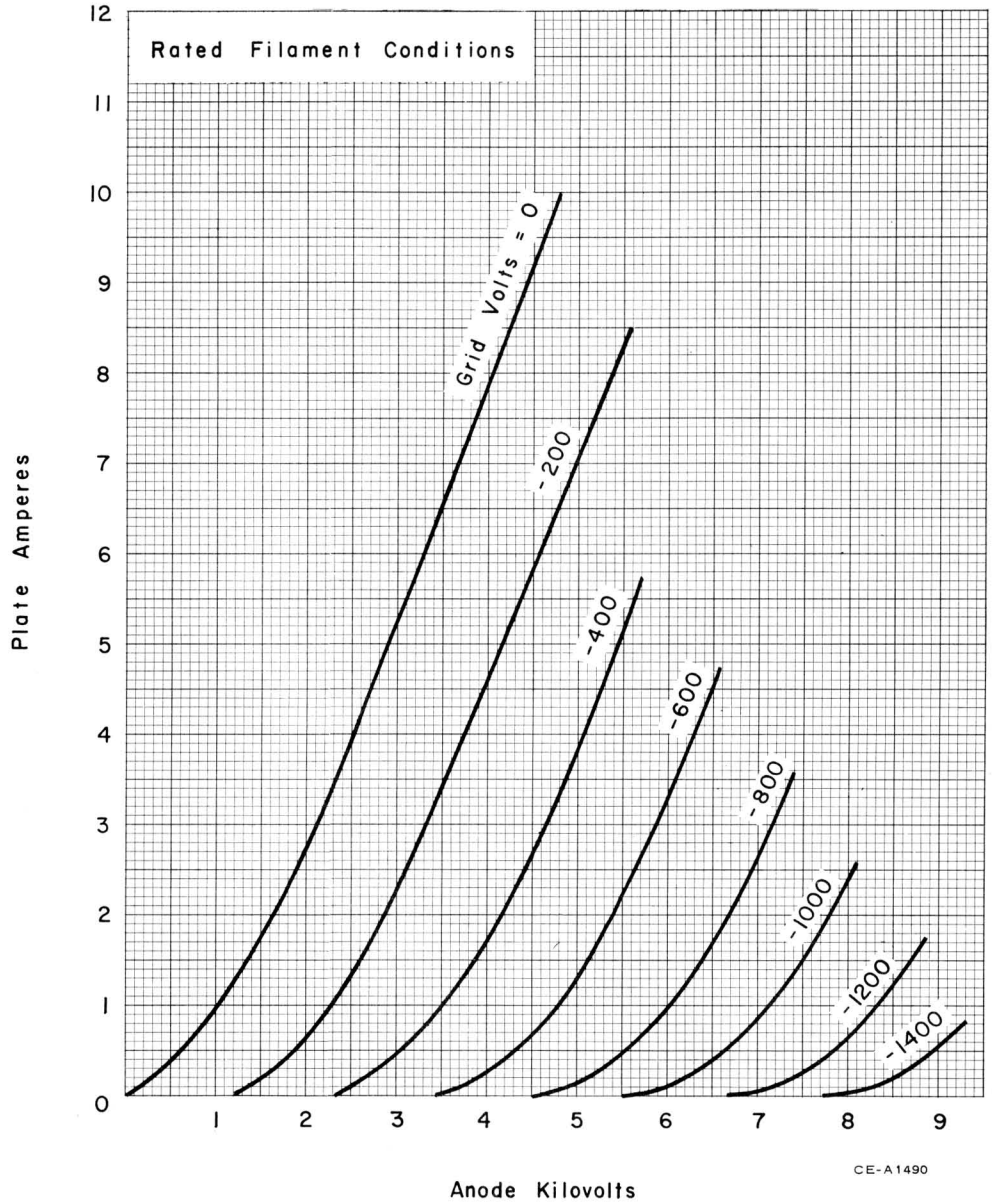
Absolute Maximum Values	CCS		
DC Plate Voltage	8.0	max.	Kilovolts
DC Plate Current	2.5	max.	Amperes
Negative DC Grid Voltage	1500	max.	Volts
Plate Input	8.0	max.	Kilowatts
Plate Dissipation	4.0	max.	Kilowatts

TYPICAL OPERATING CHARACTERISTICS:

(Unless Otherwise Specified, Values are for Two Tubes)

DC Plate Voltage	7.0	Kilovolts
DC Grid Voltage	-1140	Volts
Peak AF Grid to Grid Voltage	2280	Volts
Zero Signal Plate Current	0.5	Amperes
Maximum Signal DC Plate Current	2.2	Amperes
Peak AF Plate to Plate Voltage	9.2	Kilovolts
Effective Load Resistance (Plate to Plate)	5100	Ohms
Maximum Signal Driving Power	0	Watts
Maximum Signal Power Output	7.7	Kilowatts
Total Harmonic Distortion (Approx.)	4.5	Per Cent

AVERAGE PLATE CHARACTERISTICS



VHF POWER TRIODE TYPE 7604

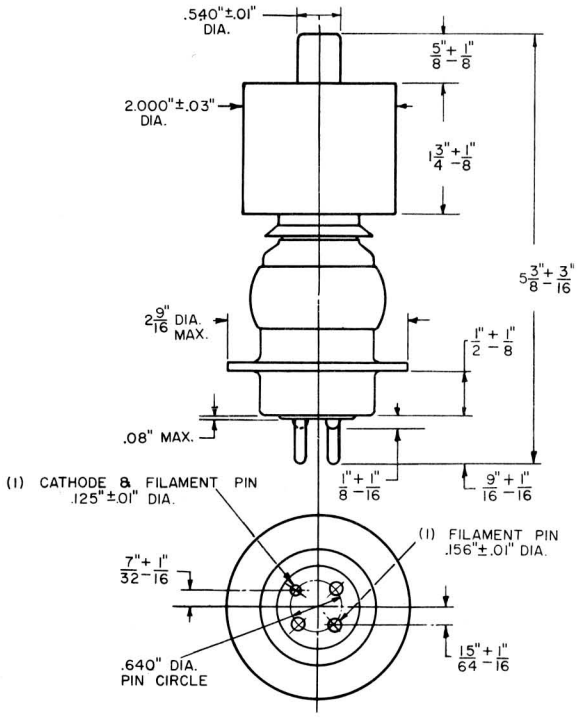
The 7604 is a three electrode tube designed for use as an oscillator, amplifier or modulator. The forced-air-cooled external radiator is capable of dissipating 600 watts. An efficient oxide coated cathode is employed. Maximum ratings apply to 60 megacycles and operation with reduced input is permissable to 350 megacycles.

ELECTRICAL:

Cathode	Oxide Coated Unipotential	
Heater:		
Voltage	5.0	Volts
Current	8.0	Amperes
Amplification Factor	20	
Interelectrode Capacitances:		
Grid to Plate	11.8	μμf
Grid to Cathode	26	μμf
Plate to Cathode	0.25	μμf
Interelectrode Capacitances with Socket in Place:□		
Grid to Plate	12	μμf
Grid to Cathode	35	μμf
Plate to Cathode	0.24	μμf

MECHANICAL:

Mounting Position□	Vertical - anode up or down	
Type of Cooling	Forced Air	
Maximum Incoming Air Temperature	45	°C
Minimum Required Air Flow on Radiator:		
Plate Dissipation	600	Watts
Air Flow Cubic Feet per Min.	30	CFM
Pressure in Inches	0.9	Inches
Maximum Glass Temperature	160	°C
Net Weight	14	Ounces
Shipping Weight	3	Pounds



MAXIMUM RATINGS - CLASS C TELEGRAPHY

(Key down conditions per tube without modulation)

D.C. Plate Voltage	4000	Volts
D.C. Plate Current	0.50	Amperes
D.C. Grid Voltage	−500	Volts
D.C. Grid Current	0.075	Amperes
Plate Input	1.8	Kilowatt
Plate Dissipation	600	Watts
Grid Dissipation	15	Watts

TYPICAL OPERATION - CLASS C TELEGRAPHY

(Key down without A.M.)

D.C. Plate Voltage	2500	3500	Volts
D.C. Grid Voltage	−275	−400	Volts
Peak R.F. Grid Voltage	370	525	Volts
D.C. Plate Current	0.272	0.400	Amperes
D.C. Grid Current	0.046	0.069	Amperes
Peak R.F. Plate Voltage	2100	2950	Volts
Driving Power (Approx.)⊕	17	35	Watts
Power Output	530	1100	Watts

R.F. POWER AMPLIFIER - CLASS AB

Maximum Ratings:

D.C. Plate Voltage	4000	Volts
Max. Signal D.C. Plate Current	0.600	Amperes
Max. Signal Plate Input	1.5	Kilowatts
Plate Dissipation	600	Watts
Grid Dissipation	15	Watts

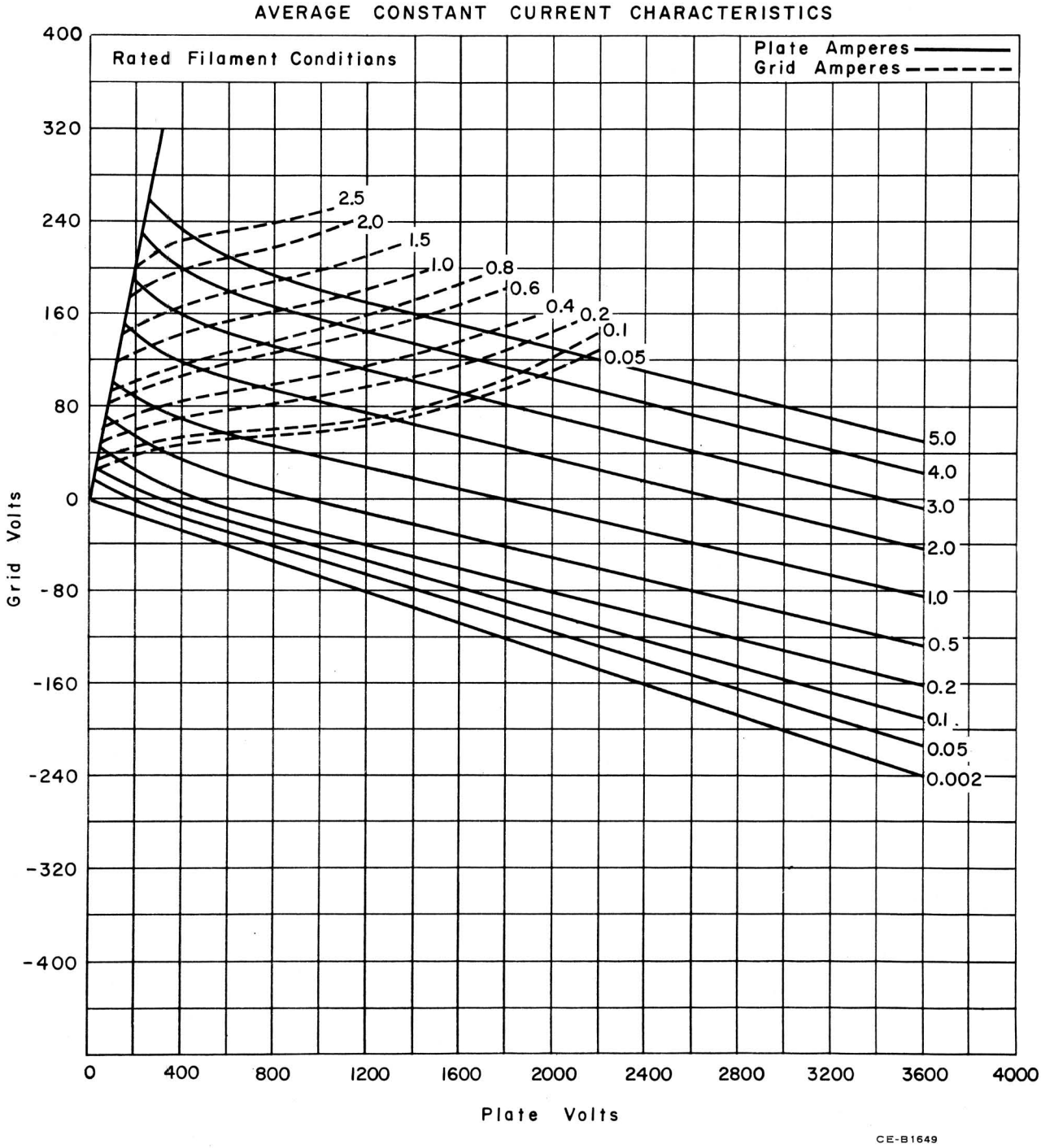
TYPICAL OPERATION

Class AB_2 R-F Linear Amplifier (One Tube)

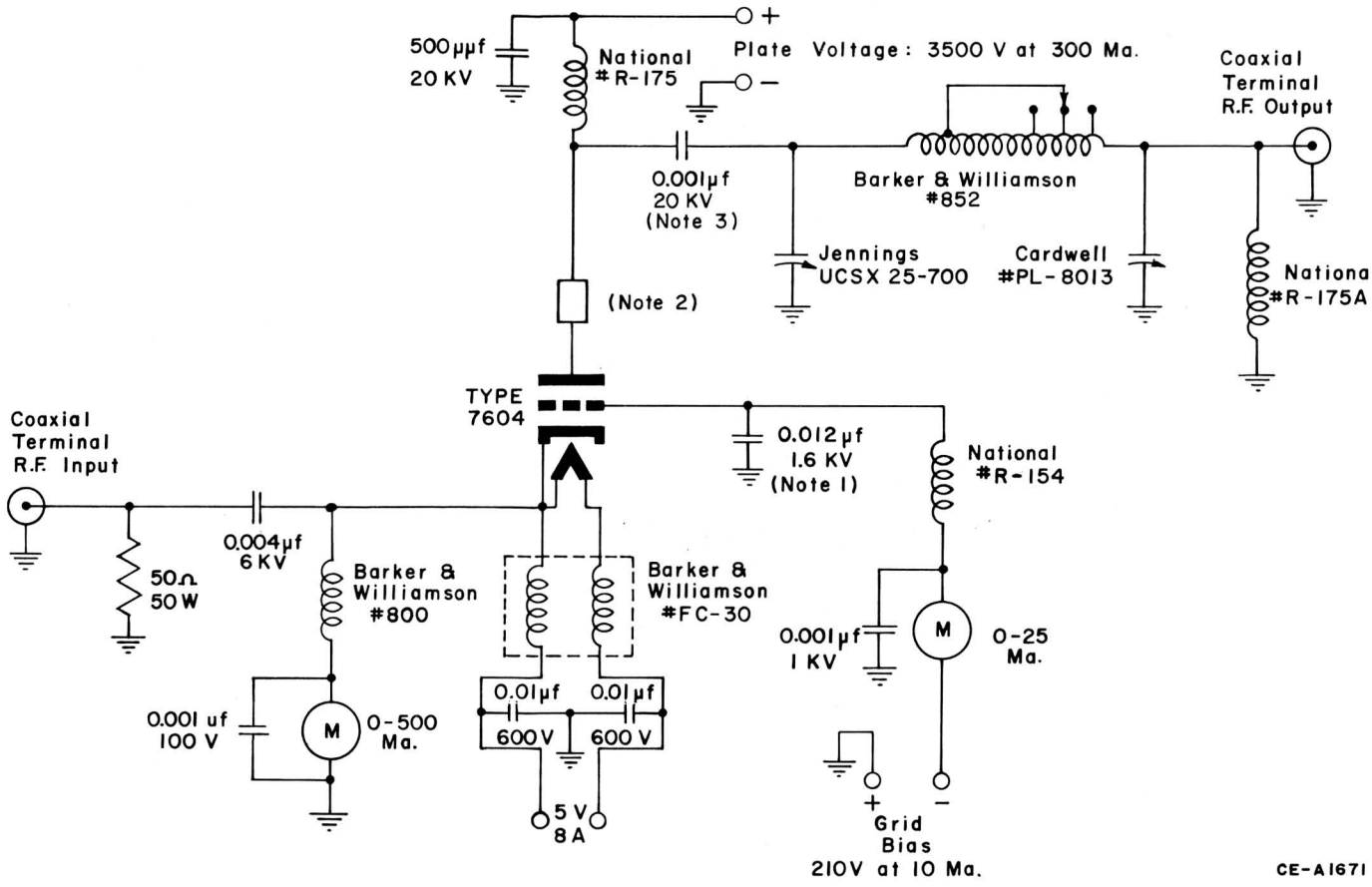
Grounded Grid Operation - Frequencies Below 60 mc.:

D.C. Plate Voltage	3500	Volts
D.C. Grid Voltage	−210	Volts
D.C. Plate Current	.285	Amperes
Zero Signal Plate Current	0.045	Amperes
D.C. Grid Current	0.008	Amperes
Peak R.F. Grid Voltage	270	Volts
Plate Dissipation	245	Watts
Driving Power (Approx.)	65	Watts
Power Output (Approx.)	755	Watts

□ The tube may be supported either by the anode or by use of a socket, Westinghouse Part No. 3-2H-4290. This socket is designed to provide a low inductance contact to the grid. Anode support of the tube may be done with a Lapp No. 43751 Insulating Support, sold by Lapp Insulator Co., Leroy, N.Y. or equivalent. When tube is operated anode down, cooling of the base end of the tube is necessary. Free air convection will suffice for most applications.

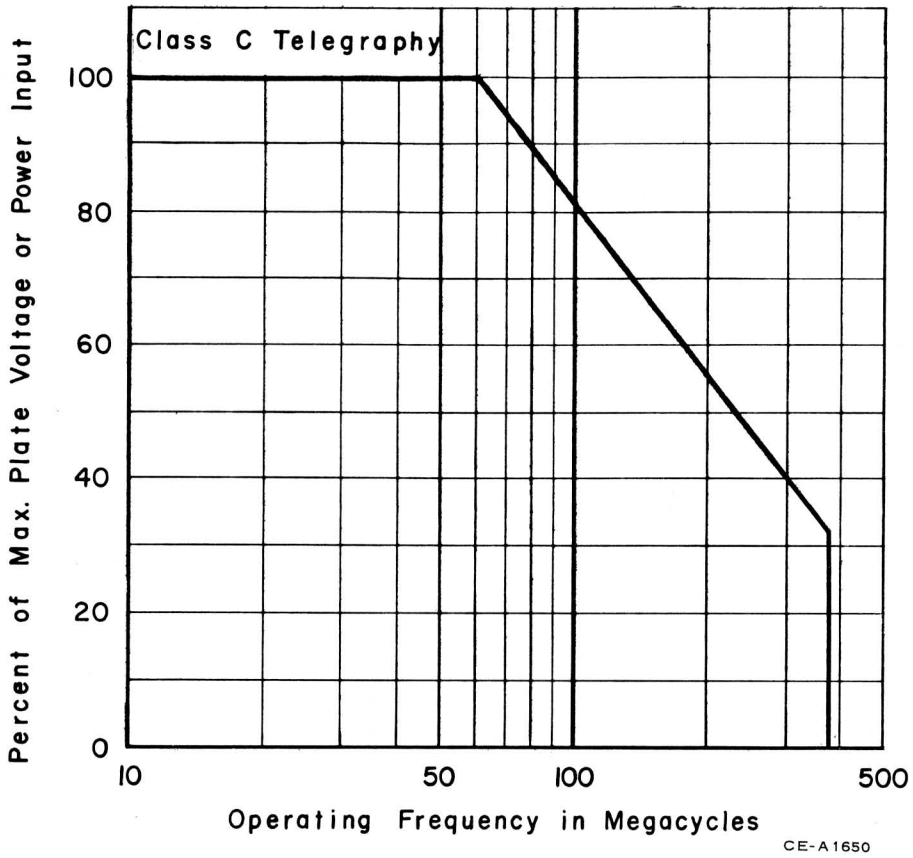

AVERAGE CONSTANT CURRENT CHARACTERISTICS
Rated Filament Conditions
Plate Amperes
Grid Amperes
400
320
240
160
80
0
-80
-160
-240
-320
-400
Grid Volts
2.5
2.0
1.5
1.0
0.8
0.6
0.4
0.2
0.1
0.05
5.0
4.0
3.0
2.0
1.0
0.5
0.2
0.1
0.05
0.002
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
Plate Volts
CE-B1649

KILOWATT LINEAR AMPLIFIER FOR 80 THROUGH 10 METERS



Note 1: Four 0.003 μf, 1.6 KV disc-caps attached at 90° intervals around grid ring.
Note 2: Parasitic suppressor consists of 7 turns of #12 wire on 47 Ω, 2 watt resistor.
Note 3: Two TV high voltage filter capacitors in parallel.

FREQUENCY DERATING CURVE



LINEAR LOW-MU TRIODE TYPE 7685

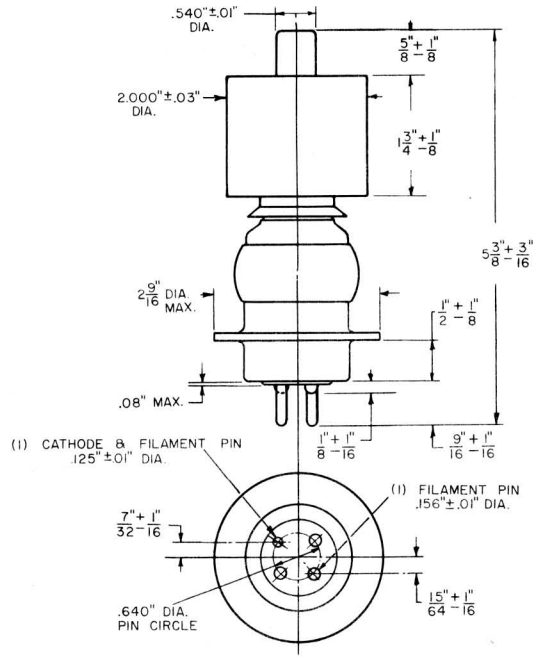
The 7685 is a low-mu triode designed for service as a class AB_1 or class B linear amplifier in audio or r-f service. The 7685 is well suited for application in broadcast and single-sideband transmitters, ultrasonic generators, and sonar pulse amplifiers. The forced air cooled anode is capable of dissipating 600 watts. The cathode is of indirectly-heated, oxide-coated, unipotential design. Maximum ratings apply to 60 megacycles.

ELECTRICAL:

Cathode	Oxide-Coated Unipotential		
Heater:			
Voltage	5.0		Volts
Current	8.0		Amperes
Starting Current (Max.)	24		Amperes
Resistance (Cold)	0.1		Ohm
Minimum Filament Heating Time	120		Seconds
Amplification Factor	6.5		
Direct Interelectrode Capacitances:	Tube Only	Tube in Socket	
Grid to Plate	11.8	11.9	$\mu\mu$f
Grid to Cathode	26.0	35.0	$\mu\mu$f
Cathode to Plate	0.6	0.6	$\mu\mu$f

MECHANICAL:

Mounting Position□	Vertical, Anode Up or Down			
Cooling:				
Method	Forced Air			
Maximum Incoming Air Temperature	45 °C			
Required Air Flow on Anode:				
Plate Dissipation	200	400	600	Watts
Air Flow Required	15	20	30	CFM
Static Pressure	0.3	0.5	0.9	In. H_2O
Maximum Glass Temperature	180			°C
Net Weight	14			Ounces
Shipping Weight	3			Pounds



CLASS AB POWER AMPLIFIER†

MAXIMUM RATINGS:

Absolute Maximum Values

DC Plate Voltage	4.0 max.		Kilovolts
DC Grid Voltage⊕	−800 max.		Volts
DC Plate Current	600 max.		Ma.
DC Plate Power Input★	1.5 max.		Kilowatts
Plate Dissipation★	600 max.		Watts
Grid Dissipation	3 max.		Watts

TYPICAL OPERATING CHARACTERISTICS - Class AB_1

(Values for two tubes)

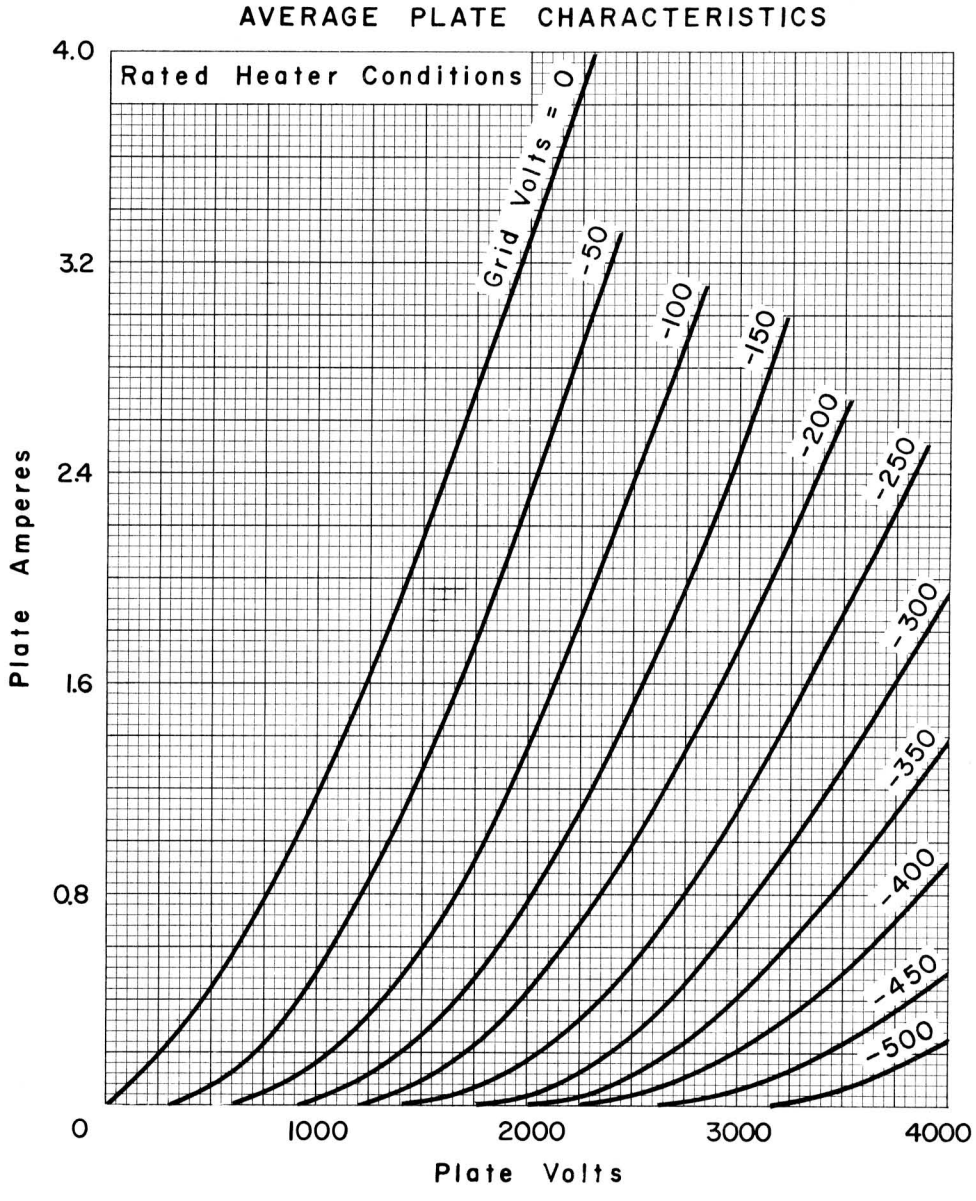
DC Plate Voltage	4000	Volts
DC Grid Voltage	−550	Volts
Peak A-F Grid-to-Grid Voltage	1100	Volts
Zero Signal Plate Current	0.120	Amperes
Maximum Signal Plate Current	0.635	Amperes
Effective Plate-to-Plate Load Resistance	12300	Ohms
Maximum Signal Driving Power	0	
Maximum Signal Power Output	1550	Watts

⊕ Grid circuit resistance should not exceed 100000 ohms.

★ Averaged over any cycle of sine wave form.

□ The tube may be supported either by the anode or by use of a socket, Westinghouse Part No. 3-2H-4290. This socket is designed to provide a low inductance contact to the grid. Anode support of the tube may be done with a Lapp No. 43751 Insulating Support, sold by Lapp Insulator Co., Leroy, N.Y. or equivalent. When tube is operated anode down, cooling of the base end of the tube is necessary. Free air convection will suffice for most applications.

† Operation in other classes of service is possible. For information on specific applications, contact Westinghouse Electronic Tube Division Sales Department outlining your design requirements.


AVERAGE PLATE CHARACTERISTICS
Rated Heater Conditions
Grid Volts = 0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
Plate Amperes
4.0
3.2
2.4
1.6
0.8
0
1000
2000
3000
4000
Plate Volts

CE-A1587

February 15, 1961

POWER AMPLIFIER TRIODE TYPE 7748

The type 7748 is a three electrode tube designed for service as an oscillator, amplifier or modulator in Class B & C operation. The anode is water cooled with an integral water jacket and is capable of dissipating 35 kilowatts during C.C.S. The cathode is a thoriated tungsten filament which may be operated either with d-c or single-phase a-c. Maximum ratings apply to 30 megacycles.

ELECTRICAL:

Cathode	Thoriated Tungsten Filament	
Filament:		
Voltage	8.0	Volts
Current	150	Amperes
Minimum Heating Time	15	Seconds
Amplification Factor	20	
Direct Interelectrode Capacitances:		
Grid to Plate	79	μμf
Grid to Filament	71	μμf
Plate to Filament	4	μμf

MECHANICAL:

Mounting Position	Vertical, Anode Down
Type of Cooling	Water
Water Flow Required	30 GPM
Static Pressure (at 30 GPM)	8 PSI
Maximum Outlet-Water Temperature	70 °C
Maximum Grid and Filament Seal Temperature	180 °C
Net Weight	18 Pounds

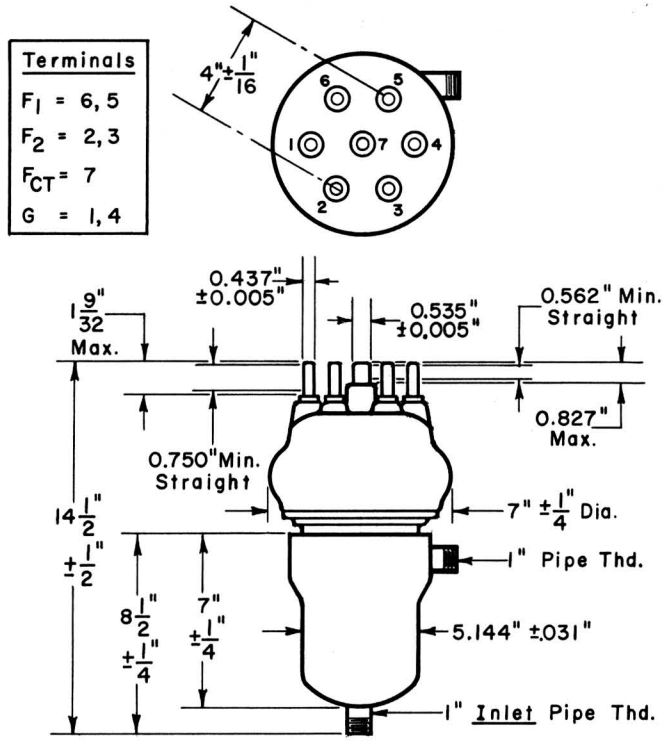
MAXIMUM RATINGS:

Absolute Maximum Values

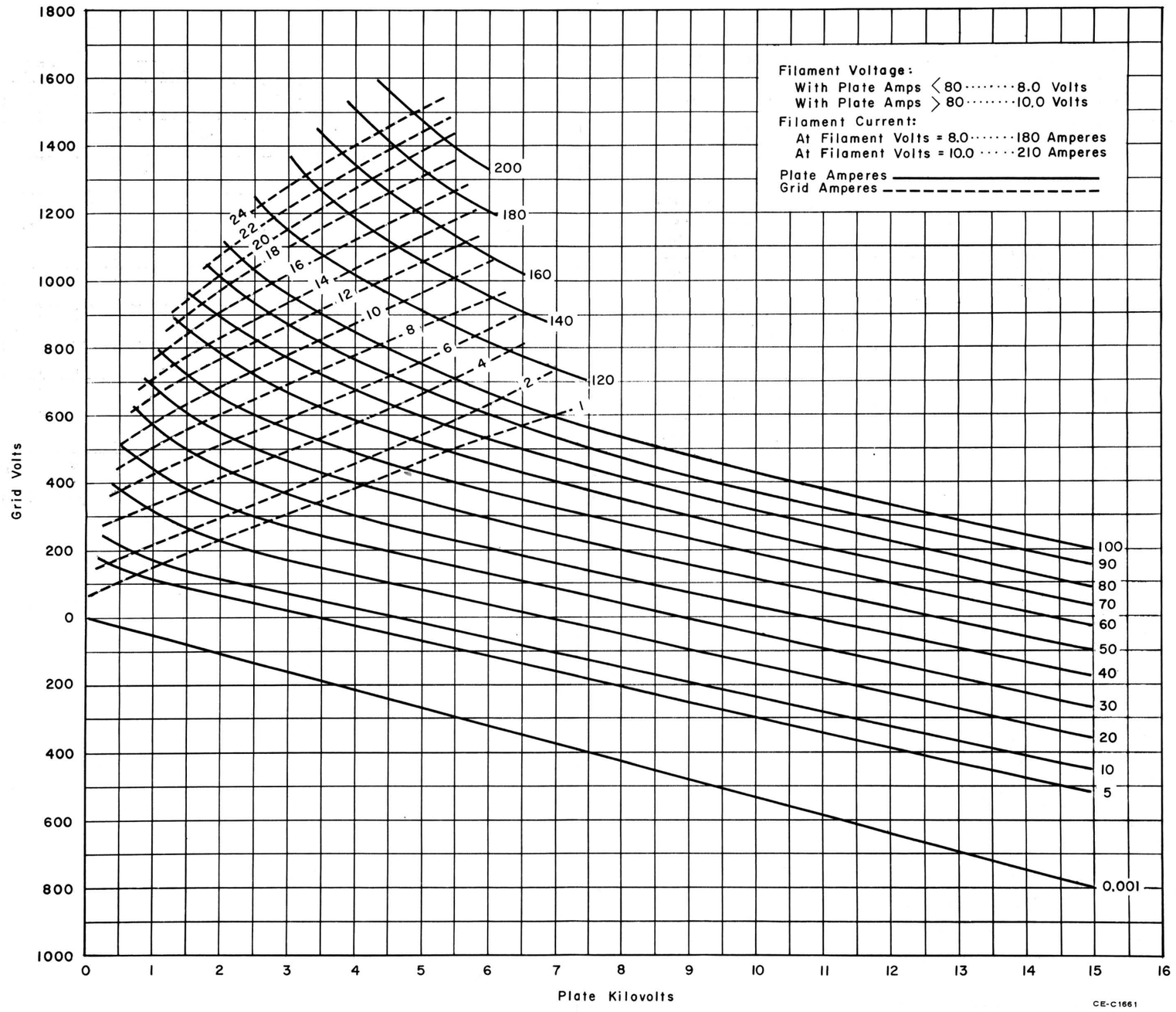
DC Plate Voltage	12.5	max.	Kilovolts
DC Plate Current	10	max.	Amperes
DC Grid Voltage	−3000	max.	Volts
DC Grid Current	1.25	max.	Amperes
Plate Power Input	80	max.	Kilowatts
Plate Dissipation	35	max.	Kilowatts

TYPICAL OPERATING CHARACTERISTICS:

DC Plate Voltage	7500	10000	12500	Volts
DC Grid Voltage	−800	−1100	−1300	Volts
Peak R.F. Grid Voltage	1250	1500	1700	Volts
DC Plate Current	5.5	4.7	4.25	Amperes
DC Grid Current	0.875	0.58	0.59	Amperes
Driving Power	1050	850	970	Watts
Power Output	33.5	40	46.5	Kilowatts



AVERAGE CONSTANT-CURRENT CHARACTERISTICS



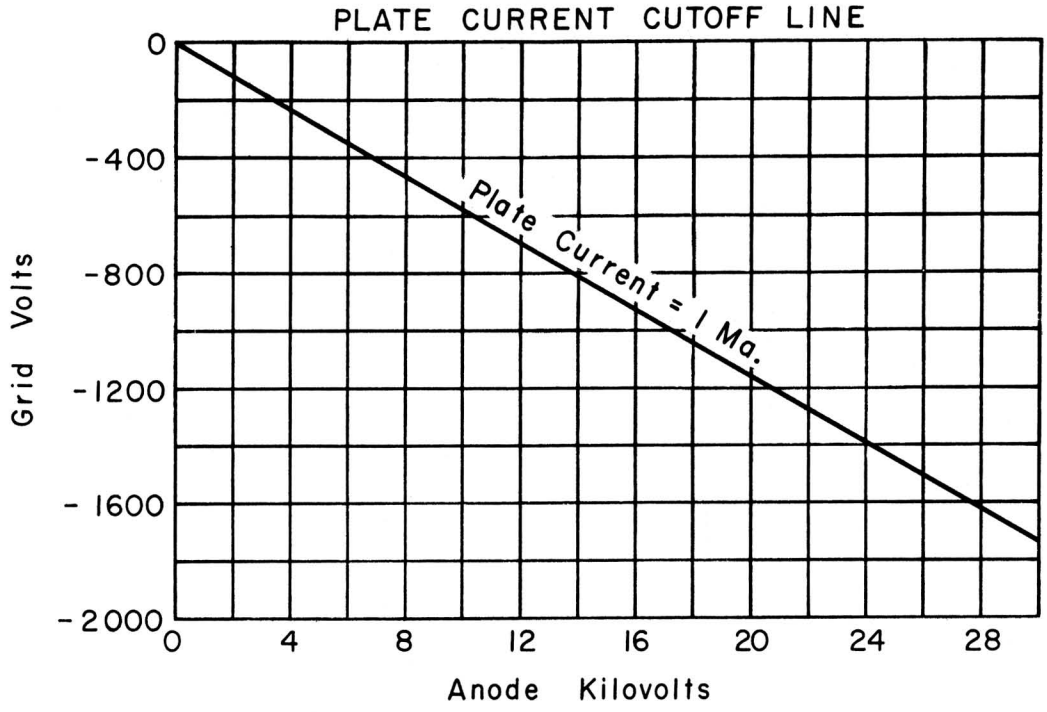


PLATE CURRENT CUTOFF LINE
0
-400
-800
-1200
-1600
-2000
Grid Volts
Plate Current = 1 Ma.
0
4
8
12
16
20
24
28
Anode Kilovolts

CE-A1675

LOW MU POWER TRIODE TYPE 7982

The 7982 is a three element tube designed for service as a modulator or AF amplifier. Electrical characteristics make it particularly suitable for Class AB_1 or AB_2 circuits. The anode is capable of dissipating 35 KW CCS with water cooling. The cathode is a single phase, thoriated tungsten filament.

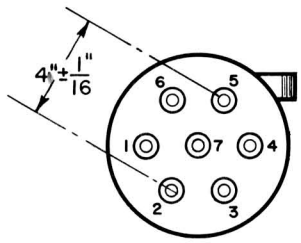
ELECTRICAL:

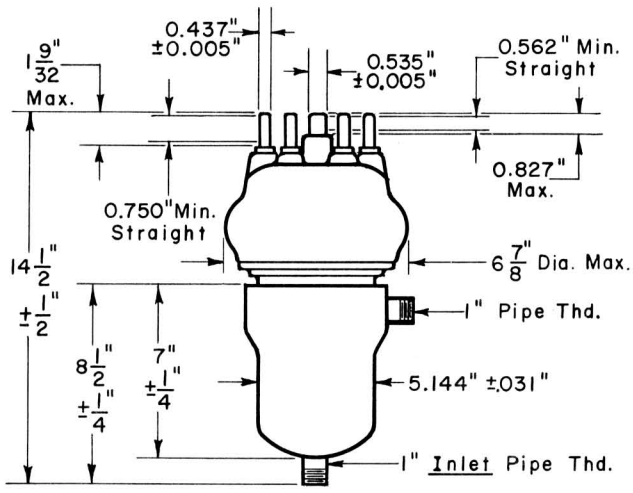
Cathode	Thoriated Tungsten Filament	
Filament:		
Voltage	7.0	Volts
Current	265	Amperes
Starting Current (max.)	1000	Amperes
Amplification Factor: Grid Volts = –450, Plate Amperes = 5.0	5.5	
Maximum Usable Cathode Current	60	Amperes
Direct Interelectrode Capacitances:		
Grid to Plate	78	μμf
Grid to Filament	68	μμf
Plate to Filament	7	μμf

MECHANICAL:

Mounting Position	Vertical, Anode Down
Type of Cooling (Note 3)	Water
Water Flow Required	30 GPM
Static Pressure (at 30 GPM)	8 PSI
Maximum Outlet-Water Temperature	70 °C
Maximum Grid and Filament Seal Temperature	180 °C
Net Weight	18 Pounds

Terminals
F_1 = 6, 5
F_2 = 2, 3
F_{CT} = 7
G = 1, 4





MAXIMUM RATINGS:

Absolute Maximum Values

DC Plate Voltage	10	max.	Kilovolts
DC Plate Current	10	max.	Amperes
Plate Power Input (Note 1)	75	max.	Kilowatts
Plate Dissipation (Note 1)	35	max.	Kilowatts
Grid Dissipation	800	Max.	Watts

TYPICAL OPERATING CHARACTERISTICS:

(Values for Two Tubes)

AF Power Amplifier & Modulator Service

Class AB_1 Operation				
DC Plate Voltage	8	9	10	Kilovolts
DC Grid Voltage	–1700	–1900	–2200	Volts
Peak AF Grid-to-Grid Voltage	3350	3750	4350	Volts
Zero Signal DC Plate Current	0.5	0.5	0.5	Amperes
Maximum Signal DC Plate Current	6.4	7.4	8.2	Amperes
Effective Plate-to-Plate Load Impedance	2400	2400	2400	Ohms
Driving Power	0	0	0	Watts
Maximum Signal Power Output	30	39.5	49.5	Kilowatts
Class AB_2 Operation				
DC Plate Voltage	8	9	10	Kilovolts
DC Grid Voltage	–1700	–1900	–2200	Volts
Peak AF Grid-to-Grid Voltage	3700	4100	4700	Volts
Zero Signal DC Plate Current	0.5	0.5	0.5	Amperes
Maximum Signal DC Plate Current	7.4	8.4	9.3	Amperes
Effective Plate-to-Plate Load Impedance	2400	2400	2400	Ohms
Driving Power	50	55	61	Watts
Maximum Signal Power Output	40	51	65	Kilowatts

PULSE SERVICE

MAXIMUM RATINGS:

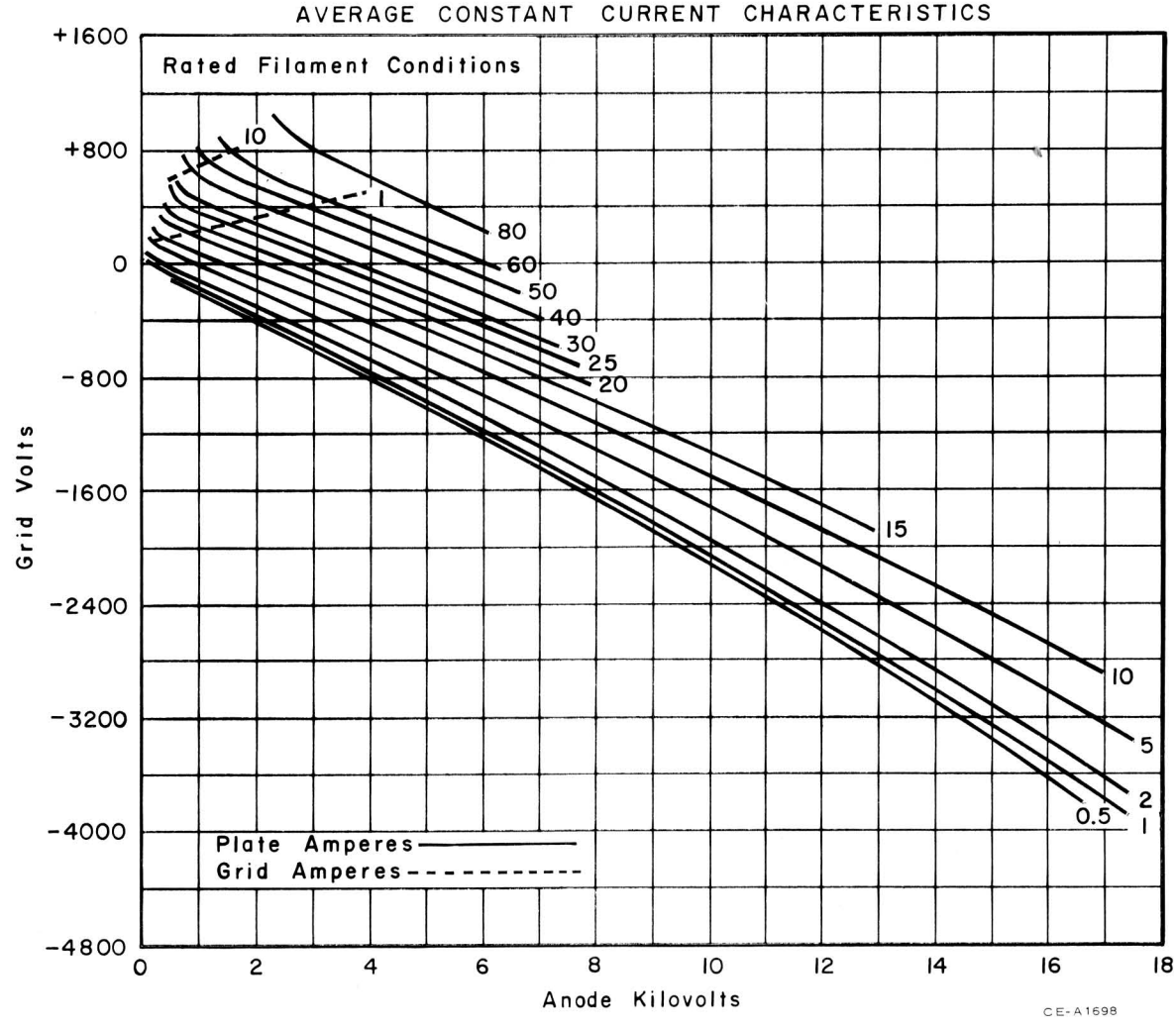
Absolute Maximum Values

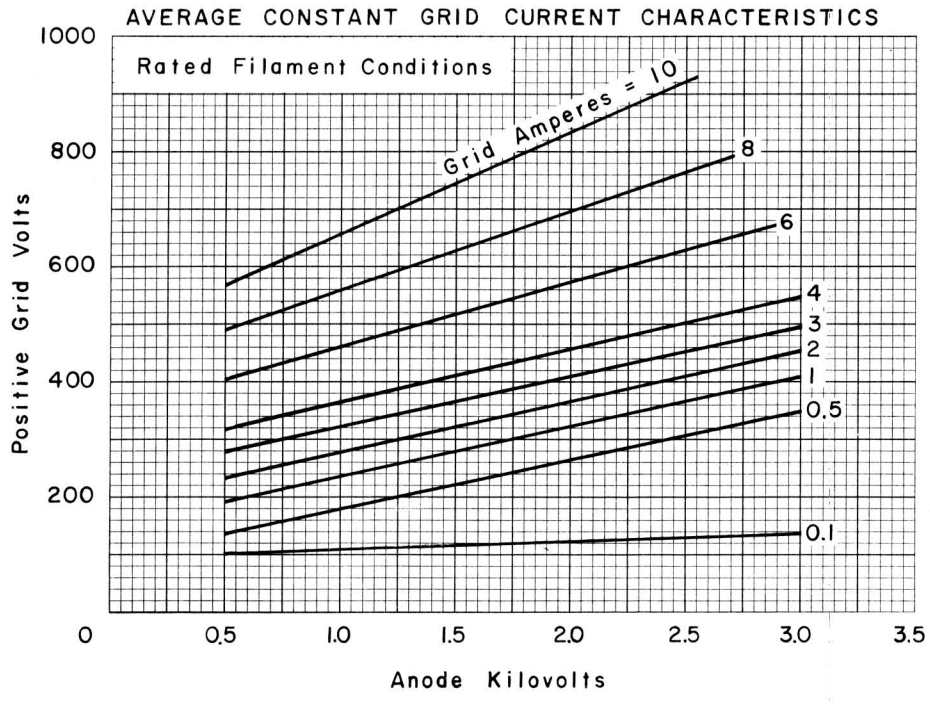
DC Plate Voltage	20	max.	Kilovolts
DC Grid Voltage	-6000	max.	Volts
Peak Positive Grid Voltage	2500	max.	Volts
Peak Pulse Plate Current (Note 4)	88	max.	Amperes
Peak Pulse Grid Current	12	max.	Amperes
Plate Dissipation	35	max.	Kilowatts
Grid Dissipation	800	max.	Watts
Pulse Length	2000	max.	μseconds
Duty Factor	0.01	max.	
Peak Pulse Cathode Current (Note 2)	100	max.	Amperes

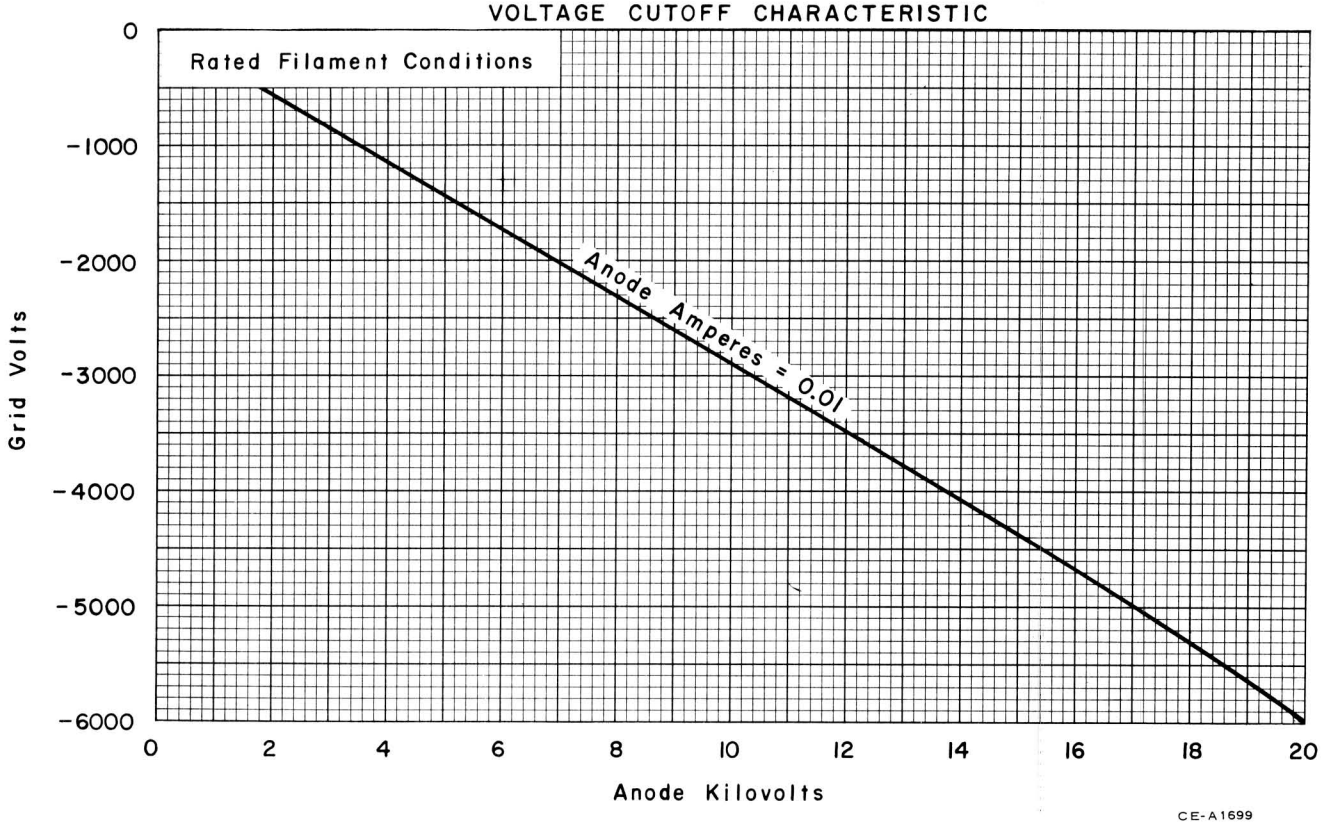
X-Ray Warning: The Maximum Ratings of the 7982 permit operation at voltages in excess of 16 KV. Therefore equipment design considerations should include the possible generation of soft x-rays.

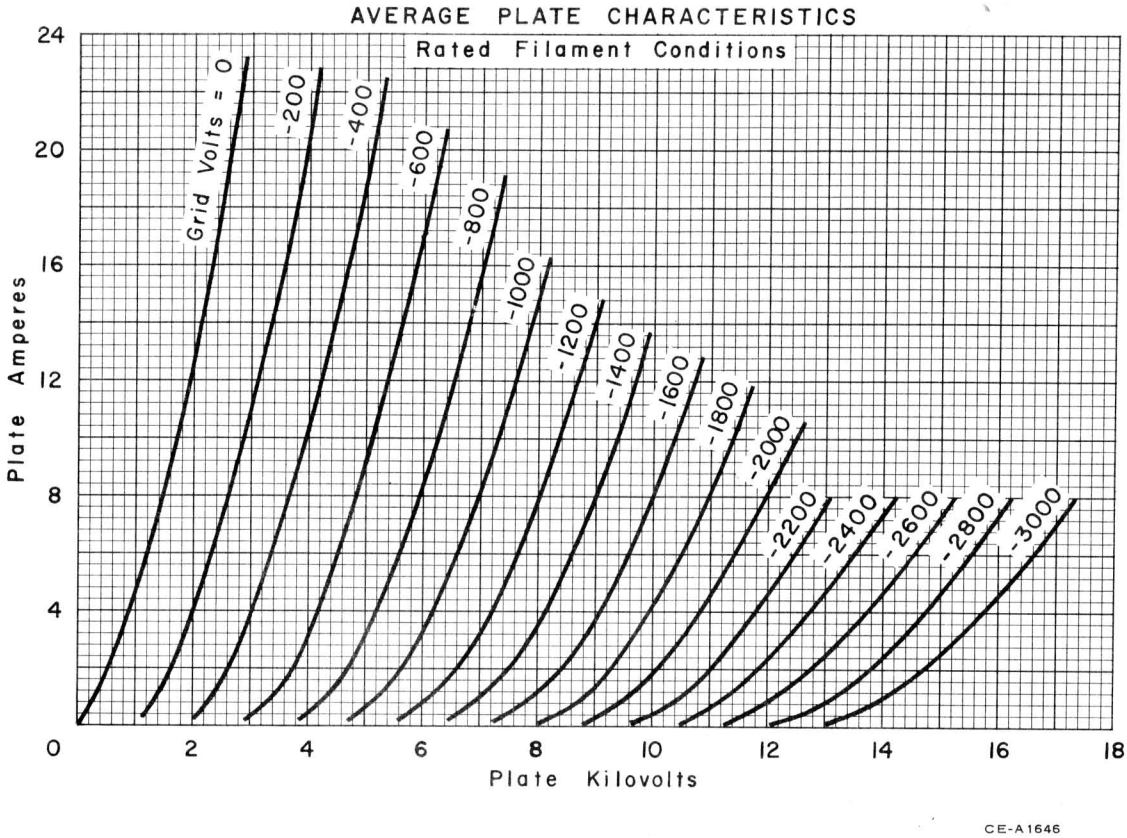
1. Averaged over any AF cycle of sine wave form.
2. A maximum of 160 amperes is permitted with 7.6 volts applied to filament. Continuous operation at elevated filament temperature will reduce length of service received.
3. 50 CFM of air shall be directed on filament and grid seals.
4. 200 amperes for pulse durations of 10 μseconds or less.

AVERAGE CONSTANT CURRENT CHARACTERISTICS

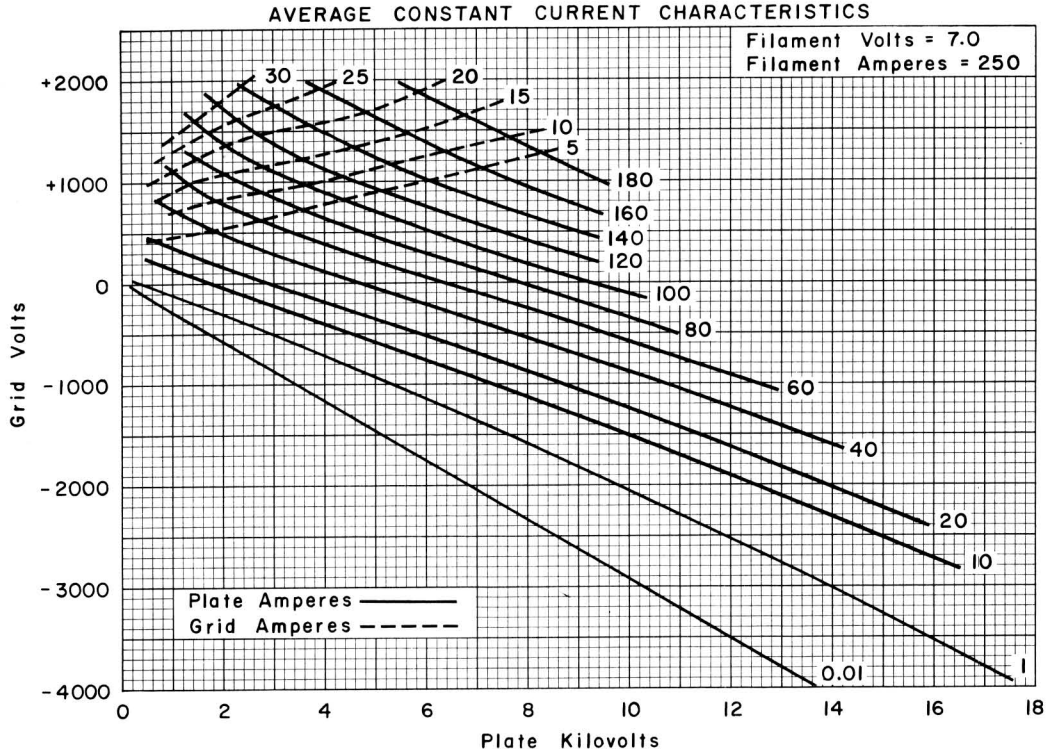



AVERAGE CONSTANT GRID CURRENT CHARACTERISTICS
Rated Filament Conditions
Grid Amperes = 10
8
6
4
3
2
1
0.5
0.1
Positive Grid Volts
1000
800
600
400
200
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Anode Kilovolts
CE-A1697

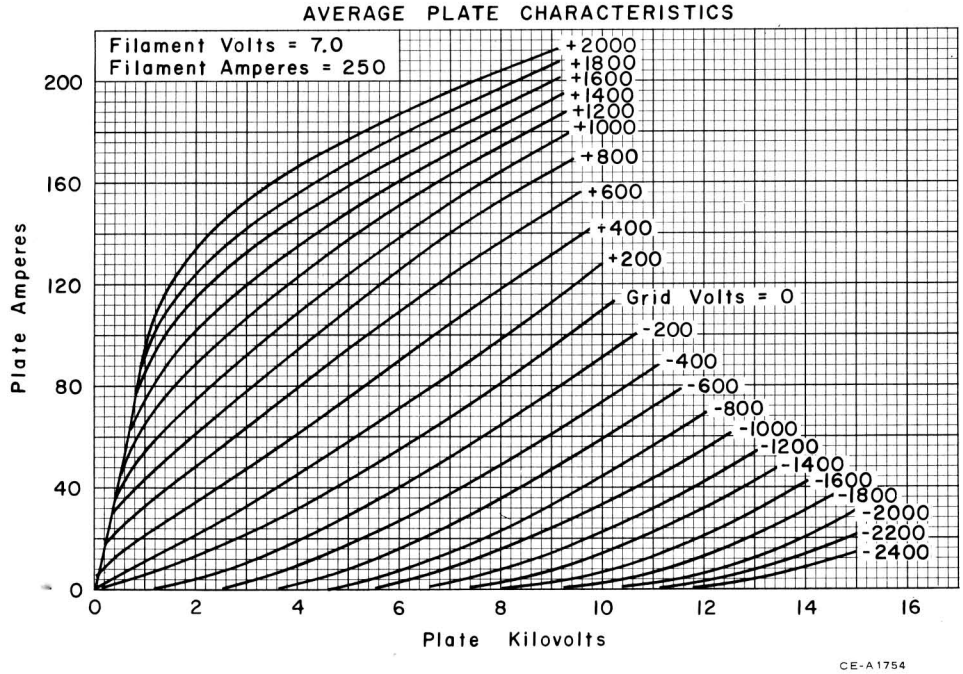

VOLTAGE CUTOFF CHARACTERISTIC
Rated Filament Conditions
Anode Amperes = 0.01
Grid Volts
0
-1000
-2000
-3000
-4000
-5000
-6000
0
2
4
6
8
10
12
14
16
18
20
Anode Kilovolts
CE-A1699


AVERAGE PLATE CHARACTERISTICS
Rated Filament Conditions
Grid Volts = 0
-200
-400
-600
-800
-1000
-1200
-1400
-1600
-1800
-2000
-2200
-2400
-2600
-2800
-3000
Plate Amperes
0
4
8
12
16
20
24
2
4
6
8
10
12
14
16
18
Plate Kilovolts
CE-A1646

AVERAGE CONSTANT CURRENT CHARACTERISTICS

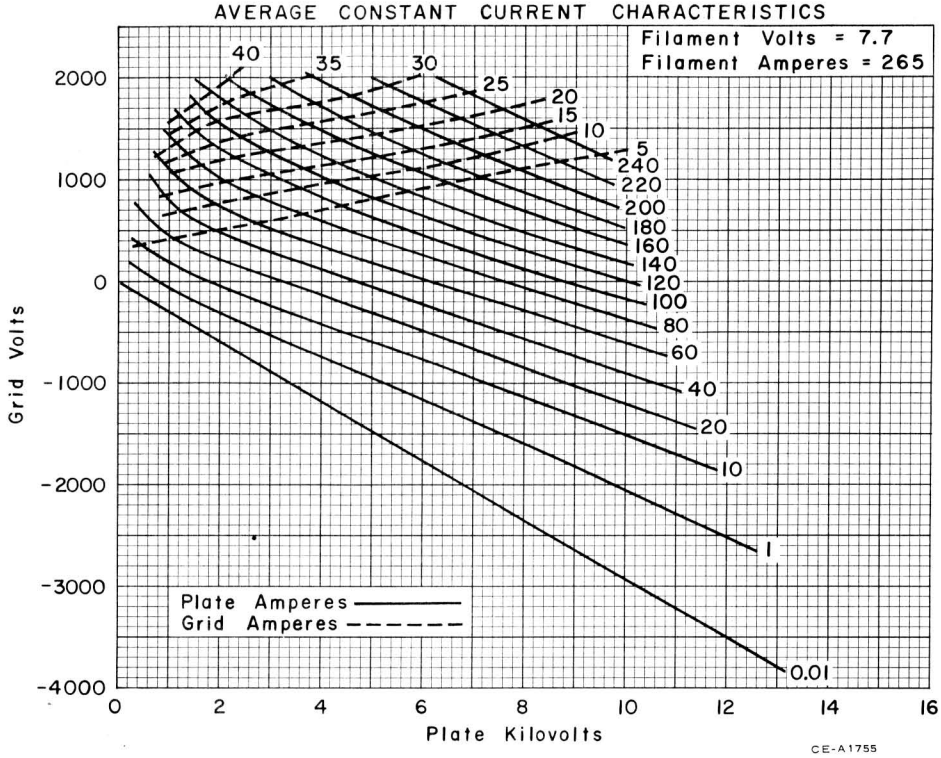


AVERAGE PLATE CHARACTERISTICS



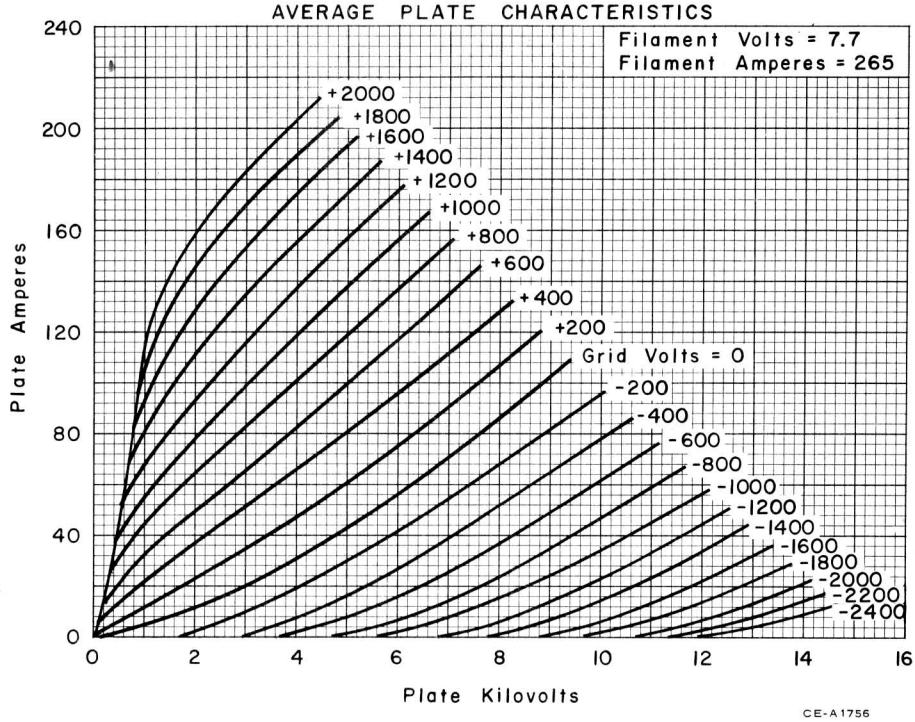
CE-A1754

AVERAGE CONSTANT CURRENT CHARACTERISTICS



CE-A1755

AVERAGE PLATE CHARACTERISTICS



CE-A1756

Westinghouse

WL-22789

January 15, 1964

POWER AMPLIFIER TRIODE TYPE 22789

The 22789 is a three element power amplifier and oscillator tube especially designed for operation with lower voltage power supplies. Its high perveance structure permits the generation of 6 kilowatts at a plate voltage of only 5 kilovolts at excellent efficiency. Outputs of 13-1/2 kilowatts are obtainable at 9 kilovolts.

The anode design features an integral water jacket with an internal spiral water diverter which maintains turbulence of cooling water. This prevents the occurrence of anode hot spots and accounts for high power density capability of the tube. The 22789 will dissipate 9 kilowatts with only 3-3/4 gallons per minute and still provides ample safety margin for instantaneous overloads.

The filament structure incorporates a unique spring loaded high efficiency design. The high efficiency thoriated tungsten filament provides 50 amperes peak emission at only 350 watts of filament power. The rugged spring loaded structure inhibits sagging and breaking of filament strands thus insuring long life and uniformity of characteristics with life.

These features make the 22789 a particularly attractive design for induction and dielectric heating applications. The internal structure is very precisely designed and production controls assure uniformity from tube to tube. These design features are reflected in a high degree of uniformity of performance in class B and class C RF power amplifier and oscillator operation. Ratings apply to 30 megacycles.

GENERAL DATA

ELECTRICAL:

	min.	bogey	max.	
Filament Voltage	5.7	6.0	6.3	Volts
Filament Current	57	60	63	Amp.
Filament Starting Current	-	-	300	Amp.
Filament Cold Resistance	-	0.016	-	Ohms
Amplification Factor	18	22	26	
Interelectrode Capacitances:				
Grid to Plate	12	16	21	uuf
Grid to Filament	15	19	22	uuf
Plate to Filament	0.2	0.80	1.0	uuf

MECHANICAL:

Mounting Position		Vertical, Anode Down		
Type of Cooling		Water and Forced Air		
Min. Required Water Flow:				
Plate Dissipation	3	6	9	KW
Water Flow in Gallons per Minute	1	2	3.75	gpm
Pressure Drop	0.85	1.9	7	in. psi
Required Air Flow on Filament and Grid Seals			30	CFM
Max. Glass Temperature			180	°C
Net Weight, approx.			1-3/4	lbs.

RADIO-FREQUENCY POWER AMPLIFIER AND OSCILLATOR, CLASS C TELEGRAPHY

(Key-down conditions per tube without amplitude modulation)

MAXIMUM RATINGS:

Absolute Maximum Values

DC Plate Voltage	9300	max.	Volts
DC Plate Current	2.3	max.	Amp.
Plate Input	21000	max.	Watts
Plate Dissipation	9000	max.	Watts
DC Grid Voltage	-1500	max.	Volts
DC Grid Current	0.5	max.	Amp.

TYPICAL OPERATION:

DC Plate Voltage	5000	9000	Volts
DC Grid Voltage	-800	-1400	Volts
Peak Radio-Frequency Grid Voltage	1240	1850	Volts
DC Plate Current	1.61	2.0	Amp.
DC Grid Current	0.40	0.18	Amp.
Driving Power, approx.	480	337	Watts
Power Output, approx.	6430	13600	Watts

AVERAGE CONSTANT-CURRENT-CHARACTERISTICS