



MECHANICAL DATA

Bulb	T-12
Base	B8-150, B8-159, Small Wafer Octal 8-Pin With Metal Sleeve
Outline	See Drawing
Top Cap	C1-1
Basing	7CK
Cathode	Coated Unipotential
Mounting Position	Any
Bulb Temperature (At Hottest Point)	260 Degrees C

ELECTRICAL DATA

HEATER CHARACTERISTICS

Heater Voltage $\pm 10\%$	6.3 Volts
Heater Current at Specified Voltage	1125 Ma
Heater Current Range at Specified Voltage	1050-1200 Ma
Heater-Cathode Voltage (Absolute Maximum Values)	
Heater Negative with Respect to Cathode	135 Volts
Heater Positive with Respect to Cathode	135 Volts

MAINTENANCE OF POWER CAPABILITY

With heater voltage reduced to 5.0 Volts, the power output obtained under the classes of service contained in these defining data will not be reduced by more than ten percent from that obtained at rated heater voltage. Plate input power for the classes of service would be maintained at that obtained using rated heater voltage.

DIRECT INTERELECTRODE CAPACITANCES (Unshielded)

Grid No. 1 to Plate	0.22 pf Max.
Input	13.0 pf
Output	8.5 pf

RATINGS (Absolute Maximum Values)

AF Amplifier and Modulator

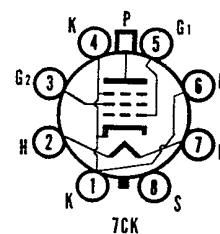
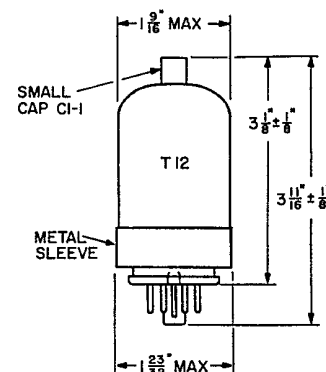
	Class AB1		Class AB2	
	CCS	ICAS	CCS	ICAS
Plate Voltage	600	750	600	750 Volts
Grid No. 2 Voltage	250	250	250	250 Volts
Plate Current				
(Max. Signal) ¹	175	220	175	220 Ma
Plate Input (Max. Signal) ¹	90	120	90	120 Watts
Plate Dissipation ¹	27	35	27	35 Watts
Grid No. 2 Input				
(Max. Signal) ¹	3	3	3	3 Watts
Grid No. 1 Circuit				
Resistance ^{4,6}	0.1	0.1	0.03	0.03 Megohm

Linear RF Amplifier—Class AB1 (Single Sideband Suppressed Carrier)

	CCS	ICAS
Plate Voltage	600	750 Volts
Grid No. 2 Voltage	250	250 Volts
Plate Current (Max. Signal)	175	220 Ma
Plate Dissipation	27	35 Watts
Grid No. 2 Dissipation	3	3 Watts

QUICK REFERENCE DATA

The Sylvania Type 6146B/8298A is a beam power pentode featuring high efficiency and sensitivity. It is designed for use as an AF power amplifier or modulator; linear RF power amplifier for a Class C, RF power amplifier or oscillator.



SYLVANIA ELECTRIC PRODUCTS INC.

Electronic Components Group
ELECTRONIC TUBE DIVISION
EMPORIUM, PA.

A Technical Publication

SEPTEMBER 1964

PAGE 1 OF 8

File Under

RECEIVING TUBES

RATINGS (Absolute Maximum Values) (Continued)

RF Amplifier Service—Class C

	Telephony ¹		Telegraphy or F.M. Telephony	
	CCS	ICAS	CCS	ICAS
Plate Voltage	480	600	600	750 Volts
Grid No. 2 Voltage	250	250	250	250 Volts
Grid No. 1 Voltage	-150	-150	-150	-150 Volts
Plate Current	145	180	175	220 Ma
Grid No. 1 Current	3.5	4.0	3.5	4.0 Ma
Plate Input	60	85	90	120 Watts
Plate Dissipation	18	23	27	35 Watts
Grid No. 2 Input	2	2	3	3 Watts
Grid No. 1 Circuit Resistance ¹³	0.03	0.03	0.03	0.03 Megohm

CHARACTERISTICS

Plate Voltage	200 Volts
Grid No. 2 Voltage	200 Volts
Plate Current	100 Ma
Transconductance	7000 μ mhos
Amplification Factor (G1 to G2)	4.5

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.
Grid No. 1 to Plate	—	0.22 pf
Input: g1 to (k+g3+I.S.+Base Sleeve+g2+h)	12.0	15.0 pf
Output: p to (k+g3+I.S.+Base Sleeve+g2+h)	7.3	9.5 pf
Plate Current (Ef = 6.75 V, Eb = 400 V, Ec2 = 200 V, Ec1 = -34 V)	46	94 Ma
Grid No. 2 Current (Ef = 6.75 V, Eb = 400 V, Ec2 = 200 V, Ec1 = -34 V)	—	5.5 Ma
Zero Bias Plate Current (Ef = 6.75 V, Eb = 100 V, Ec2 = 200 V, Ec1 = -100 V)	330	— Ma
G1 is square wave pulsed at 1000 KC to zero volts. Limit value is peak pulse current.		

TYPICAL OPERATION

AF Power Amplifier—Class AB1 (2 Tubes)

	CCS	CCS
Plate Voltage	600	750 Volts
Grid No. 2 Voltage ²	200	200 Volts
Grid No. 1 Voltage	-47	-48 Volts
Peak AF G1 to G1 Voltage ³	94	96 Volts
Plate Current (Zero Signal)	48	50 Ma
Plate Current (Max. Signal)	250	250 Ma
Grid No. 2 Current (Max. Signal)	14.8	12.6 Ma
Load Resistance (P1 to P1)	5.6	7.2 K Ohms
Power Output	96	124 Watts

AF Power Amplifier—Class AB2 (2 Tubes)

	CCS	CCS	ICAS	ICAS
Plate Voltage	500	600	600	750 Volts
Grid No. 2 Voltage ²	200	200	200	150 Volts
Grid No. 1 Voltage	-46	-48	-47	-39 Volts
Peak AF G1 to G1 Voltage	108	106	114	110 Volts
Plate Current (Zero Signal)	50	40	50	40 Ma
Plate Current (Max. Signal)	308	270	328	294 Ma
Grid No. 2 Current (Max. Signal)	26	27	26	28 Ma
Grid No. 1 Current (Max. Signal)	2.7	1.3	3.4	7.6 Ma
Load Resistance (P1 to P1)	3620	5200	4160	6050 Ohms
Driving Power (Max. Signal) ⁵	0.2	0.7	0.2	0.5 Watts
Power Output (Max. Signal)	100	110	130	148 Watts

TYPICAL OPERATION (Continued)

Linear RF Amplifier (At 30 Mc)

	CCS	ICAS
Plate Voltage	600	750 Volts
Grid No. 2 Voltage ⁷	200	200 Volts
Grid No. 1 Voltage ⁷	-47	-48 Volts
Plate Current (Zero Signal)	24	25 Ma
Load Resistance	2800	3600 Ohms
Plate Current (Max. Signal)	125	125 Ma
Average Plate Current	86	86 Ma
Grid No. 2 Current (Max. Signal)	7.4	6.3 Ma
Average Grid No. 2 Current	5.0	3.9 Ma
Distortion Level ⁸		
Third Order	24	26 db
Fifth Order	30	31 db
Useful Power Output		
Average	24.5	30.5 Watts
Peak-Envelope	49	61 Watts

RF Power Amplifier—Class C Telephony (Up to 60 Mc)

	CCS	ICAS
Plate Voltage	475	600 Volts
Grid No. 2 Voltage ⁹	165	175 Volts
Grid No. 1 Voltage ¹⁰	-86	-92 Volts
Grid No. 1 Resistor	26K	27K Ohms
Peak RF Grid No. 1 Voltage	106	114 Volts
Grid No. 1 Current	3.3	3.4 Ma
Plate Current	125	140 Ma
Grid No. 2 Current	8.5	9.5 Ma
Driving Power (Approx.)	0.4	0.5 Watts
Power Output (Approx.)	42	62 Watts

RF Power Amplifier—Class C Telegraphy—F.M. Telephony

	Up to 60 Mc		Up to 175 Mc		
	CCS	ICAS	CCS	ICAS	ICAS
Plate Voltage	600	750	320	400	435 Volts
Grid No. 2 Voltage ¹¹	200	200	210	220	230 Volts
Grid No. 1 Voltage ¹²	-70	-77	-52	-55	-56 Volts
Grid No. 1 Resistor	24K	28K	26K	30K	24K Ohms
Peak RF Grid No. 1 Voltage	90	95	65	67	73 Volts
Grid No. 1 Current	2.8	2.7	2	1.9	2.3 Ma
Plate Current	150	160	170	180	210 Ma
Grid No. 2 Current	10	10	12	12	11 Ma
Driving Power (Approx.)	0.3	0.3	2	2	3 Watts
Power Output	63	85	29	40	50 Watts

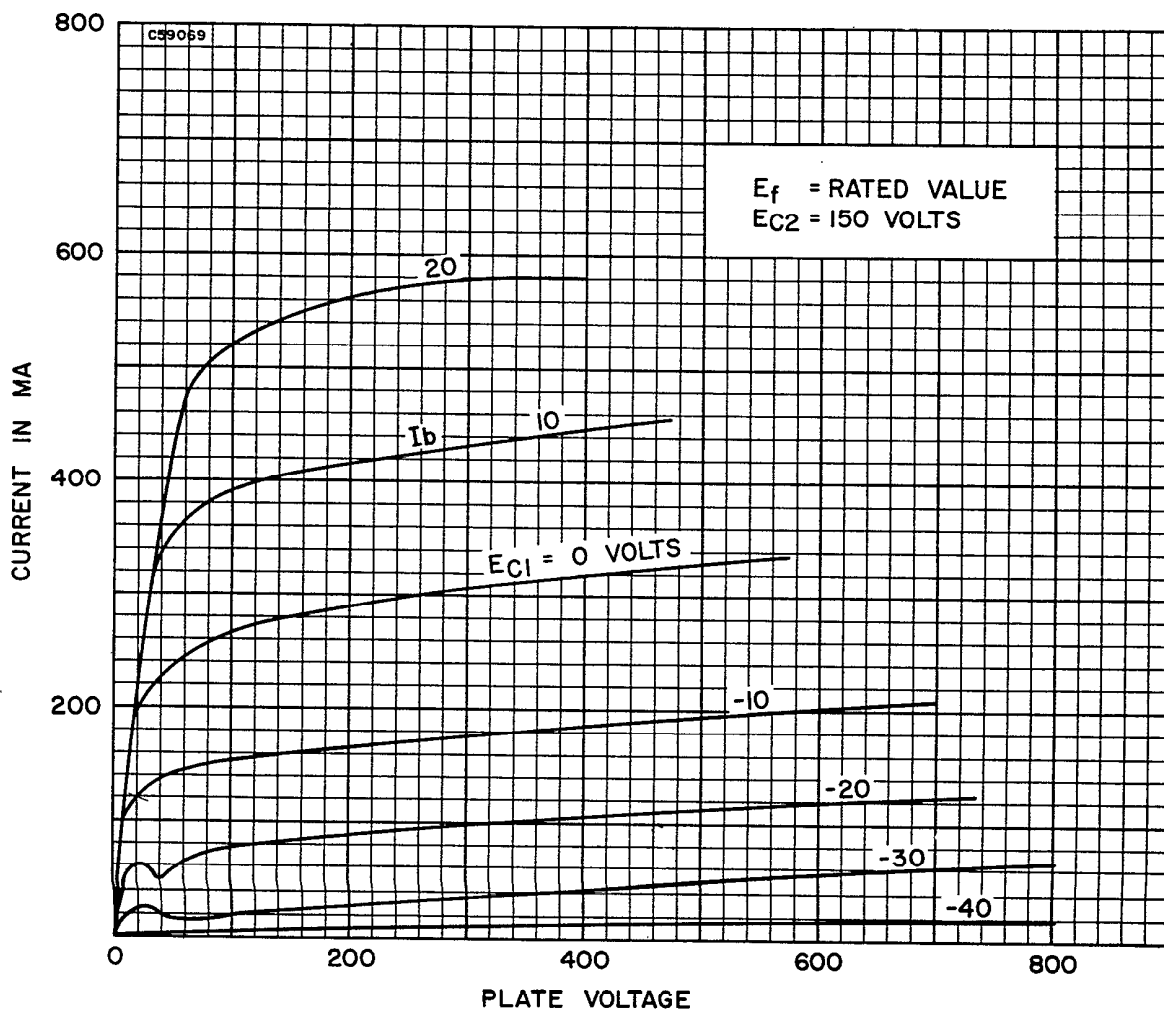
NOTES:

1. Averaged over any audio-frequency cycle of sinewave form.
2. Obtained preferably from a separate source or from the plate voltage supply with a voltage divider.
3. The driver stage should be capable of supplying the No. 1 grids of the Class AB1 stage with the specified driving voltage at low distortion.
4. The type of input coupling network used should not introduce too much resistance in the Grid No. 1 circuit. Transformer or impedance coupling devices are recommended.
5. Driver stage should be capable of supplying the specified driving power at low distortion to the No. 1 grids of the AB2 stage.
6. To minimize distortion, the effective resistance per Grid No. 1 circuit of the AB2 stage should be held at a low value. For this purpose the use of transformer coupling is recommended. In no case, however, should the total dc Grid No. 1 circuit resistance exceed 30,000 ohms when the tube is operated at maximum ratings. For operation at less than maximum ratings, the dc Grid No. 1 circuit resistance may be as high as 100,000 ohms.
7. Obtained preferably from a separate, well-regulated source.
8. Referenced to either of the two tones and without the use of feedback to enhance linearity.

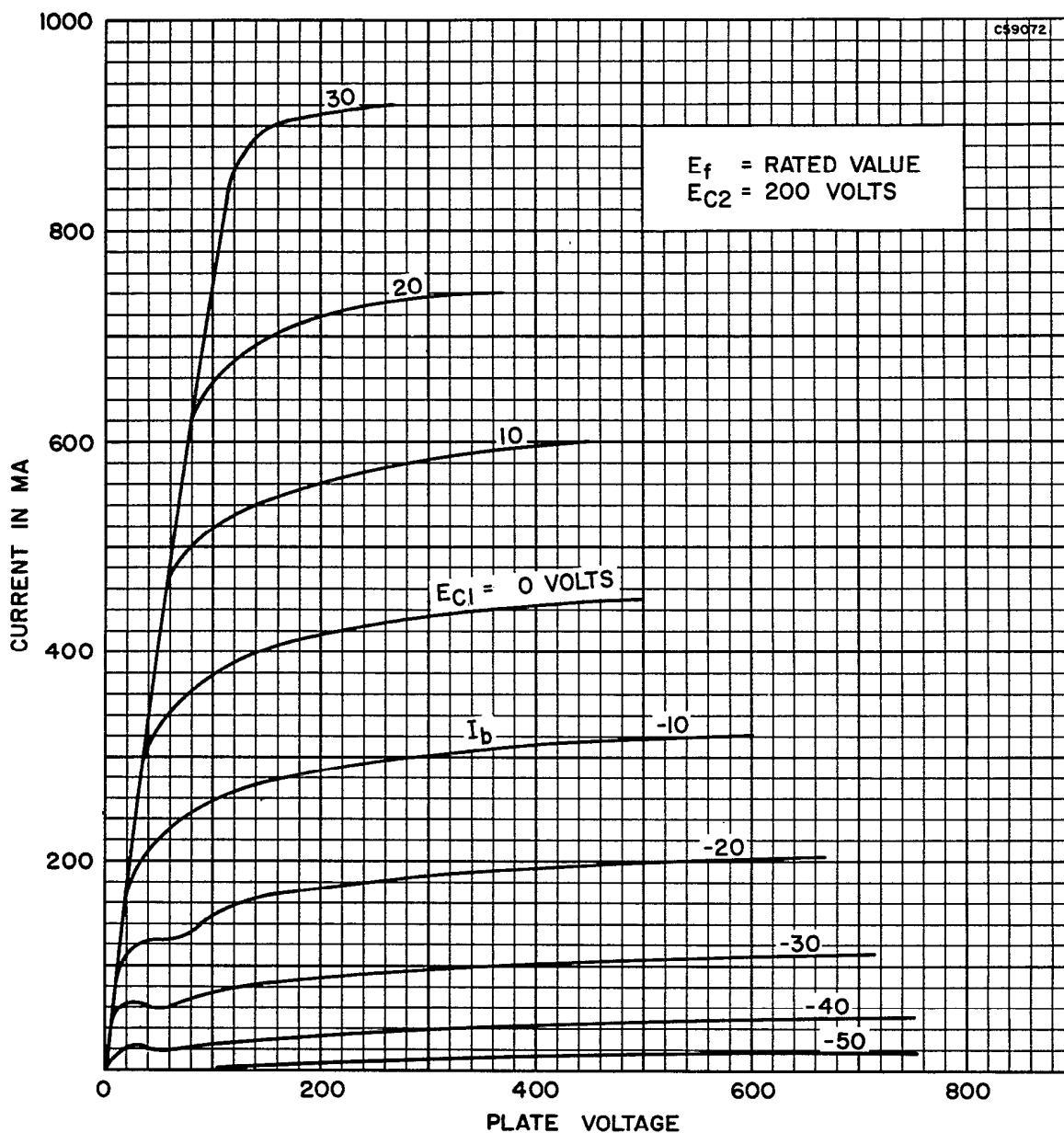
NOTES (Continued)

9. Obtained preferably from a separate source modulated with the plate supply, or from the modulated plate supply through a series resistor.
10. Obtained from Grid No. 1 resistor or from a combination of Grid No. 1 resistor with either fixed supply or cathode resistor.
11. Obtained preferably from separate source, or from the plate-supply voltage with a voltage divider or through a series resistor. A series Grid No. 2 resistor should be used only when the tube is used in a circuit which is not keyed. Grid No. 2 voltage must not exceed 435 volts under key-up conditions.
12. Obtained from fixed supply, by Grid No. 1 resistor, by cathode resistor, or by combination methods.
13. When Grid No. 1 is driven positive and the tube is operated at maximum ratings, the total dc Grid No. 1 circuit resistance should not exceed the specified value of 30,000 ohms. If this value is insufficient to provide adequate bias, the additional required bias must be supplied by a cathode resistor or fixed supply. For operation at less than maximum ratings, the dc Grid No. 1 circuit resistance may be as high as 100,000 ohms.

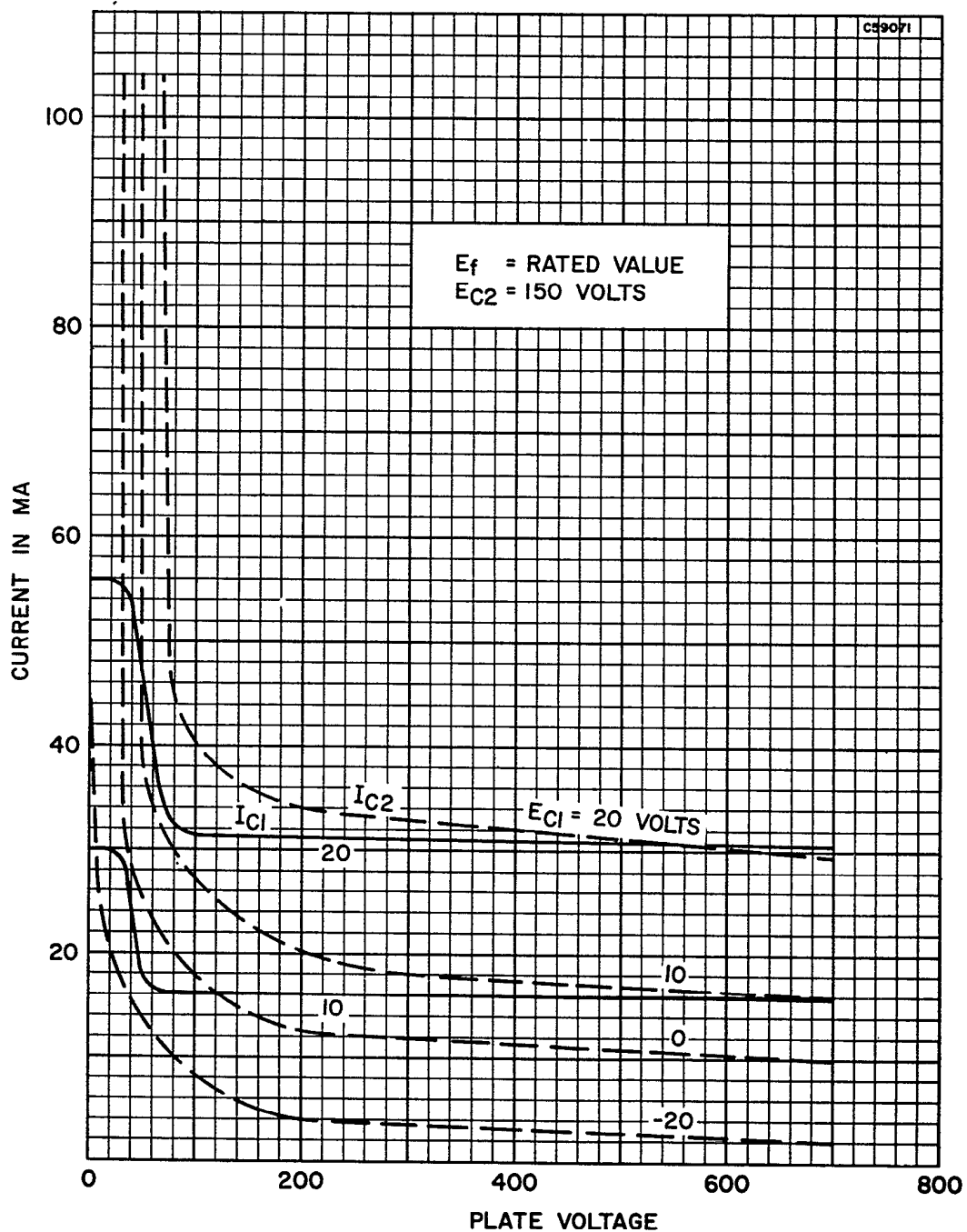
AVERAGE PLATE CHARACTERISTICS



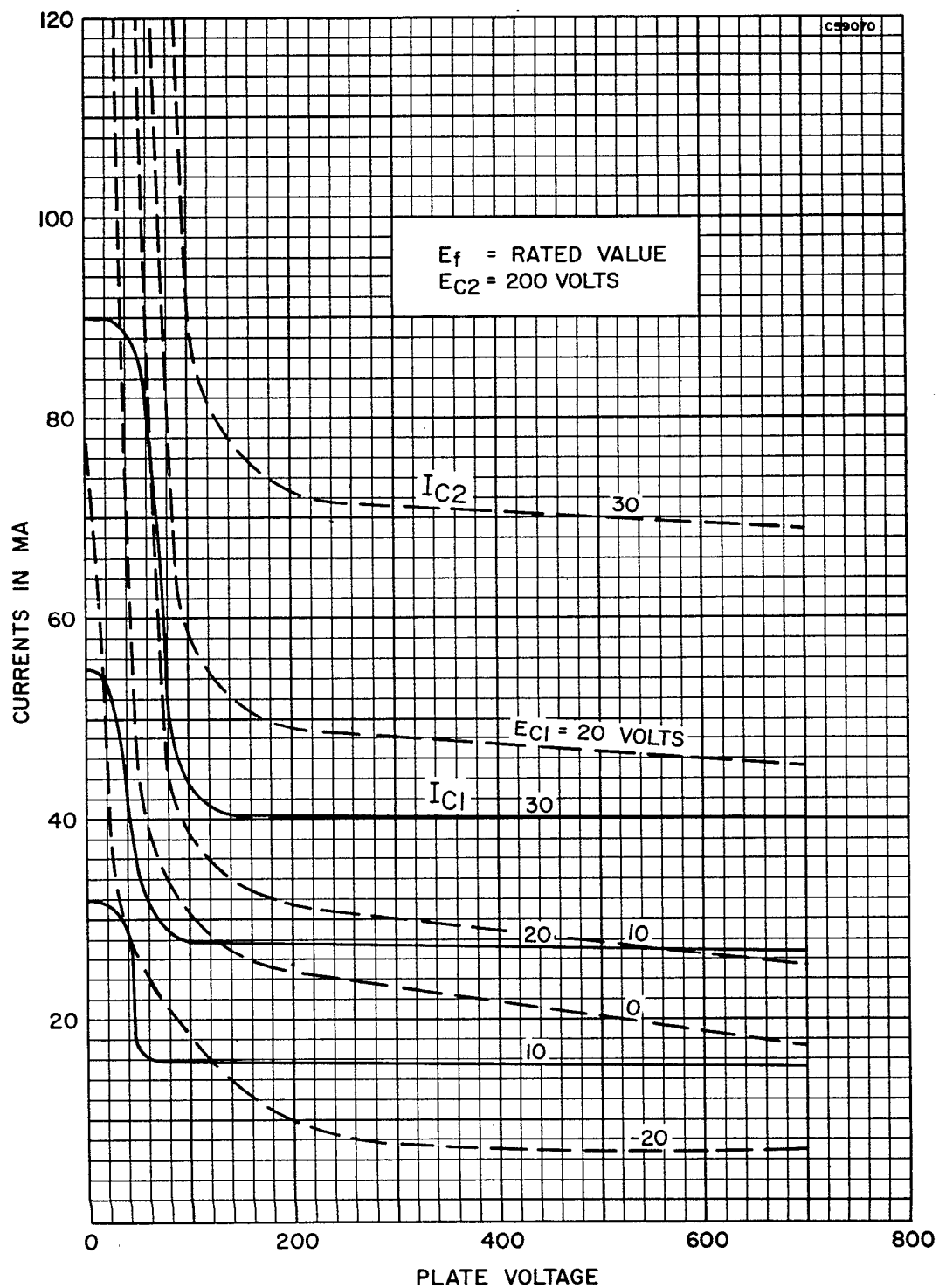
AVERAGE PLATE CHARACTERISTICS



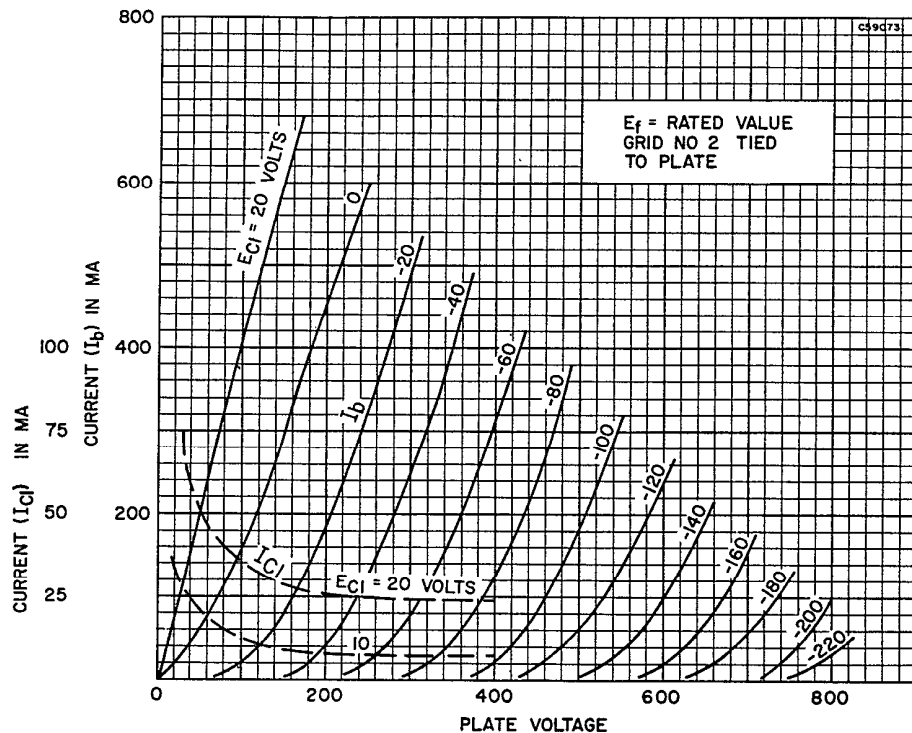
GRID NO. 1 AND GRID NO. 2 CHARACTERISTICS



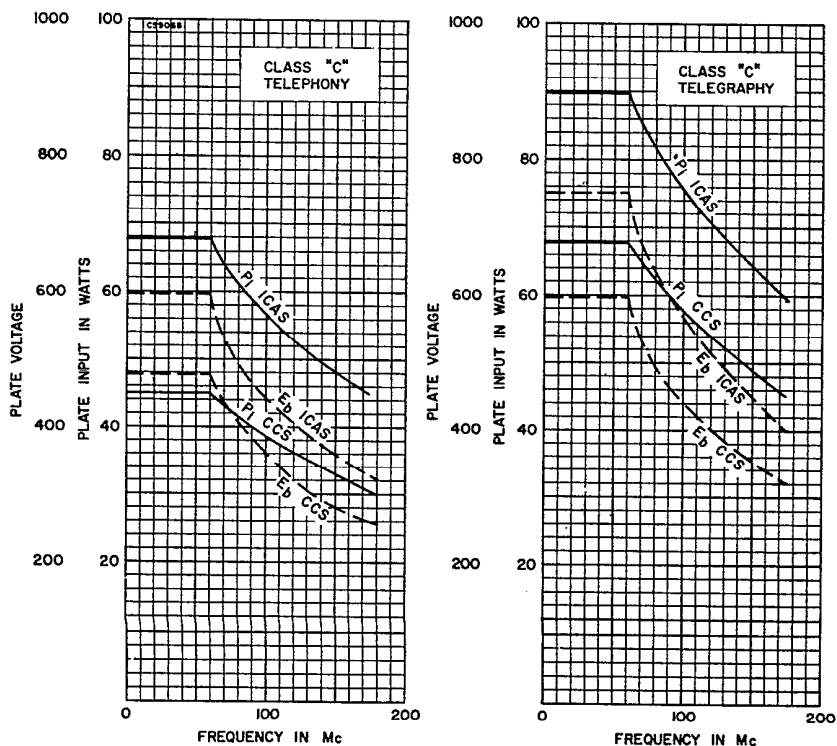
GRID NO. 1 AND GRID NO. 2 CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS (Triode Connected)



MAXIMUM RATINGS VS. OPERATING FREQUENCY





C6J-A/5685

XENON THYRATRON

Negative-Control Triode Type
TENTATIVE DATA

RCA-C6J-A/5685 is a three-electrode, xenon-filled thyatron with a negative-control characteristic. It is intended for use as a grid-controlled rectifier.

GENERAL DATA

Electrical:	Min.	Average	Max.	
Filamentary Cathode, Coated:				
Voltage (AC or DC)	2.4	2.5	2.6	volts
Current at 2.5 volts	19	21	23	amp
Minimum heating time prior to tube conduction			60	sec
Direct Interelectrode Capacitances (Approx.):				
Grid to anode			4	μf
Grid to cathode			21	μf
Maximum Deionization Time			1000	μamp
Maximum Critical Grid Current			10	μamp
Anode Voltage Drop:				
Average at beginning of life		9		volts
Maximum at end of life		12		volts
Maximum Commutation Factor \square averaged over first 350 volts of inverse anode voltage rise		0.66		$\text{va}/\mu\text{s}^2$
Grid Control Ratio (Approx.) under conditions: 10000-ohm grid resistor, circuit returns to filament transformer center tap, filament pin 2 negative with respect to filament pin 3 when anode is positive, dc anode voltage, and dc grid voltage.			210	
Mechanical:				
Mounting Position	Vertical, base down			
Maximum Overall Length	9-1/2"			
Maximum Diameter	2-1/32"			
Bulb	T-16			
Cap.	Medium (JETEC No. C1-5)			
Base	Medium-Metal-Shell Super-Jumbo 4-Pin (JETEC No. A4-81)			
Weight (Approx.)	7 oz			

GRID-CONTROLLED RECTIFIER SERVICE

Maximum Ratings, Absolute Values:

PEAK ANODE VOLTAGE:			
Forward	1000 max.	volts	
Inverse	1250 max.	volts	
GRID VOLTAGE:			
Peak, before anode conduction	-100 max.	volts	
ANODE CURRENT:			
Peak	77 max.	amp	
Average \bullet	6.4 max.	amp	
Overload:			
Rating I^* , for duration of	0.5 sec. 77.0 max. amp		
	1.0 sec. 38.5 max. amp		
	2.0 sec. 19.2 max. amp		
	3.0 sec. 12.8 max. amp		
	4.0 sec. 9.6 max. amp		
	5.0 sec. 7.7 max. amp		

Rating II^{**} , for duration of	3.0 sec. 12.8 max. amp	
	4.0 sec. 11.2 max. amp	
	5.0 sec. 10.3 max. amp	
	6.0 sec. 9.6 max. amp	

Fault, Δ for duration of 0.1 second maximum	770 max.	amp
AMBIENT-TEMPERATURE RANGE	-55 to +75	$^{\circ}\text{C}$

- \square For definition, see page 3.
- \bullet Averaged over any period of 6 seconds.
- $*$ Averaged over duration of overload occurring no more than once in any period of 6 seconds.
- $**$ Averaged over duration of overload occurring no more than once in any period of 30 seconds.
- Δ For definition, see page 2.

OPERATING CONSIDERATIONS

The *maximum ratings* in the tabulated data are limiting values above which the serviceability of the C6J-A/5685 may be impaired from the viewpoint of life and satisfactory performance. Therefore, in order not to exceed these absolute ratings, the equipment designer has the responsibility of determining an average design value for each rating below the absolute value of that rating by an amount such that the absolute values will never be exceeded under any usual condition of supply-voltage variation, load variation, or manufacturing variation in the equipment itself.

The C6J-A/5685 has a *negative-control characteristic* which is essentially independent of ambient temperature over a wide range by virtue of the inert-gas content.

The *filament voltage*, measured directly at the filament terminals, should not vary more than ± 5 per cent from the rated value. Less than the rated value may result in a high tube drop with consequent bombardment of the filament and eventual loss of emission. Greater than rated voltage will cause excessive evaporation of the filament coating with resultant increase in grid emission and shortened filament life.

The filament should be allowed to reach operating temperature before tube conduction is permitted to start. The delay period should be not less than 60 seconds after application of filament voltage. Unless this recommendation is followed, the filament will be damaged.

The *anode* of the C6J-A/5685 will show a red color when the tube is operated at full load.



The anode circuit should be provided with a time-delay relay to prevent tube conduction until the filament has reached normal operating value.

Sufficient anode-circuit resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.

The C6J-A/5685 has a critical grid voltage which will initiate tube conduction for any specific positive value of anode voltage. Careful consideration should be given to the range values of critical grid voltage shown in Fig. 1. From them can be determined for specified operating conditions not only the proper value of grid bias necessary to prevent conduction until it is desired, but also the magnitude of the signal (triggering) voltage necessary to initiate conduction. Ample triggering voltage should always be provided to insure anode conduction even under the worst operating conditions to which the equipment will usually be subjected.

As indicated by the curve in Fig. 1, there is a range where anode breakdown voltage does not

The maximum fault anode current rating shown in the tabulated data is the highest value of abnormal peak current of short duration (0.1 second maximum) that should pass through the tube under the most adverse conditions of service. This rating is intended to assist the equipment designer in a choice of circuit components such that the tube will not be subjected to disastrous currents under abnormal service conditions approximating a short circuit. It is not intended for use under normal operating conditions because even a single fault current at the maximum value may impair tube life. Repeated fault currents will seriously reduce or even terminate tube life. The equipment designer should also note that if the maximum fault-current rating is exceeded, the thyatron may cease to conduct momentarily with the result that excessive surge voltages are developed in the associated components, thereby causing their failure.

The anode voltages at which the C6J-A/5685 is operated are extremely dangerous to the user. The tube and its associated apparatus, especially all parts which may be at high potential above ground, should be housed in a protective enclosure. The protective housing should be designed with interlocks so that personnel cannot possibly come in contact with any high-potential point in the electrical system. The interlock devices should function to break the primary circuit of the anode supply when any gate or door on the protective housing is opened, and should prevent the closing of this primary circuit until the door is again locked.

Ion bombardment of the anode may occur in some circuits where high inverse voltage is applied immediately after current conduction ceases during the cycle. If there is insufficient time for the positive ions to re-combine into atoms, the negative anode voltage may attract the ions still present with enough velocity to sputter anode material and cause gas clean-up (gradual disappearance of the gas filling).

In circuits where the inverse voltage after conduction rises slowly in sine-wave fashion at ordinary supply frequencies, the bombardment problem is negligible. Such circuits include grid-controlled rectifiers with resistive loads operating in the discontinuous-current region, rectifiers without firing delay, and grid-controlled rectifiers with back rectifiers.

Slight bombardment with some loss in tube life may occur in circuits where tube current decays at a slow rate and where high inverse voltage with a steep wave front is applied immediately after conduction ceases. Circuits where this condition exists include half-wave rectifiers, relaxation inverters, series transformers, and rectifiers supplying motors or capacitive loads operating in the discontinuous-current region.

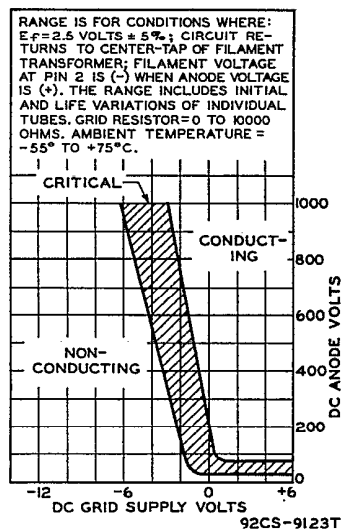


Fig. 1 - Operational Range of Critical Grid Voltage.

change materially with change of grid voltage. This condition usually occurs near a grid potential of +4 volts. Below this anode voltage, the tube can be started at anode voltages as low as 10 to 15 volts by the application of sufficient positive grid drive.

Grid control ratio is defined as the slope $(-\Delta e_p / \Delta e_g)$ of the straight portion of the control characteristic.



Heavy bombardment with serious loss in tube life may result in circuits where the tube conducts full current up to the instant that high inverse anode voltage is applied. Circuits where this condition exists include half-wave back rectifiers with the firing angle of the controlled tube retarded, and full-wave and polyphase rectifier or inverter circuits operating in the continuous-current region with firing delay provided through grid action.

Commutation factor is the product of the rate of current decay in amperes per microsecond just before conduction ceases and the rate of inverse voltage rise in volts per microsecond following current conduction. Expressed as an equation,

$$\begin{aligned}\text{Commutation Factor} &= \text{volts}/\mu\text{sec} \times \text{amperes}/\mu\text{sec} \\ &= \text{volts-amperes}/\mu\text{sec}^2 \\ &= \text{va}/\mu\text{s}^2\end{aligned}$$

If this product for the circuit exceeds the commutation factor rating for the tube, gas clean-up will occur and shorten or terminate tube life.

In determining commutation factor, it is customary to take the average rate of current decay over the last ten microseconds of current conduction and to take the average rate of inverse voltage rise over the specified voltage rise shown in the tabulated data.

Current-decay rate and inverse-voltage-rise rate are best determined by measurement on an oscilloscope. Both the voltage and time scales should be calibrated. A low-resistance non-inductive voltage divider is connected to two anodes that fire in sequence. Then a sample of the waveform is taken from across a portion of the voltage divider and applied to the oscilloscope. The inverse-voltage-rise rate may be derived directly from the calibrated scale readings. The current-decay rate is computed by dividing

the load current by the commutation time in microseconds as read on the time scale. *Commutation time* is defined as the time of simultaneous conduction during which current of out-going tube falls and current of on-coming tube rises. Commutation time appears in the waveform as the flat portion of the curve.

An oscilloscope with a triggered sweep and an internal delay line will facilitate making these measurements. Unless the oscilloscope can pass high frequencies, it is necessary to insert the waveform voltage directly on the deflecting-electrode terminals of the scope from a low-resistance, non-inductive voltage divider. Very high inverse-voltage rise rates are hard to measure but may be estimated very roughly from the resonant frequency of the supply transformer.

Circuit cushioning, which slows down the rate of rise of inverse anode voltage, may be accomplished by connecting a capacitance in series with a small resistance between cathode and anode. Proper cushioning-circuit design can delay the voltage rise by the necessary few microseconds to allow sweeping out the residual ions at relatively low voltage and thus avoid anode sputtering and resultant gas clean-up (See Reference 4).

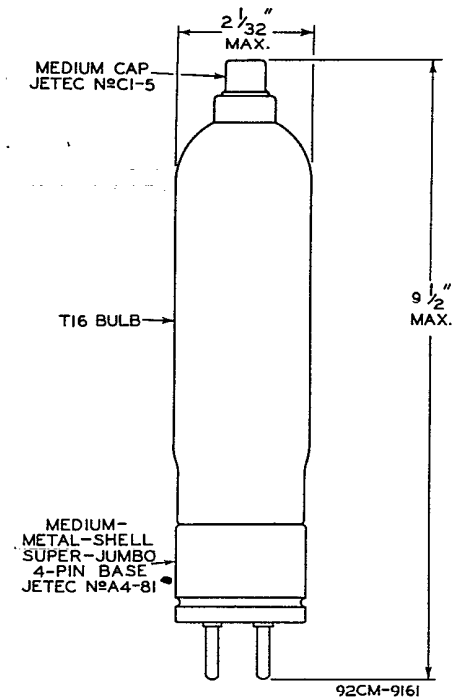
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3. Wittenberg, H.H., "Frequency Performance of Thyratrons", Trans. of A.I.E.E., Vol. 65, No. 12, pp. 843-848 (1946).
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5. Marshall, D.E. & Shackelford, C.L., "Commutation Factor Rating of Inert Gas Thyratrons and Its Influence on Circuit Design", A.I.E.E. Conference Paper, Winter Meeting 1950.

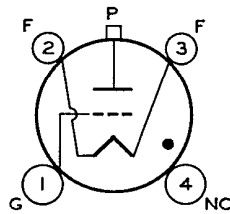
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DIMENSIONAL OUTLINE



SOCKET CONNECTIONS Bottom View



PIN 1: GRID
PIN 2: FILAMENT
PIN 3: FILAMENT
PIN 4: NO CONNECTION
CAP: ANODE