

## Beam Power Tube

CERAMIC-METAL SEALS  
 "ONE-PIECE" ELECTRODE DESIGN  
 CONDUCTION COOLED

COAXIAL-ELECTRODE STRUCTURE  
 INTEGRAL CONDUCTION CYLINDER  
 180-WATTS CW INPUT UP TO 1215 Mc

MATRIX-TYPE, OXIDE-COATED, UNIPOTENTIAL CATHODE

For Use at Frequencies up to 2000  
 Mc under Severe Shock and Vibration

### GENERAL DATA

#### Electrical:

Heater, for Matrix-Type, Oxide-Coated,  
 Unipotential Cathode:

Voltage (AC or DC) . . . . .	6.3 ± 10%	volts
Current at heater volts = 6.3 . . . . .	3.2	amp →
Minimum heating time . . . . .	60	sec

Mu-Factor, Grid No.2 to Grid No.1

for plate volts = 250, grid-No.2 volts = 250, and plate ma. = 100 . . . . .	18
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Direct Interelectrode Capacitances:\*

Grid No.1 to plate . . . . .	0.065 max.	μf
Grid No.1 to cathode & heater. . . . .	14	μf
Plate to cathode & heater. . . . .	0.019 max.	μf
Grid No.1 to grid No.2 . . . . .	19	μf
Grid No.2 to plate . . . . .	4.5	μf
Grid No.2 to cathode & heater. . . . .	1.3 max.	μf

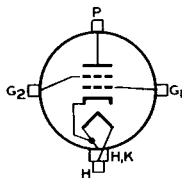
#### Mechanical:

Operating Position . . . . .	. . . . .	Any
Overall Length . . . . .	1.885" + 0.70" - 0.80"	
Greatest Diameter (See <i>Dimensional Outline</i> ). . . . .	1.119"	
Weight (Approx.) . . . . .	2 oz	

Socket:  
 For frequencies up to about 400 Mc . . . . . \*  
 For use at higher frequencies. . . See *Mounting Arrangement*

Terminal Connections (See *Dimensional Outline*):

- G<sub>1</sub> - Grid-No.1-  
 Terminal  
 Contact  
 Surface
- G<sub>2</sub> - Grid-No.2-  
 Terminal  
 Contact  
 Surface
- H - Heater-  
 Terminal  
 Contact  
 Surface



- H,K - Heater- &  
 Cathode-  
 Terminal  
 Contact  
 Surface
- P - Plate-  
 Terminal  
 Contact  
 Surface

#### Thermal:

Conduction-Cylinder Temperature. . . . .	250 max.	°C
Seal Temperature (Plate, grid No.2, grid No.1, cathode, and heater). . . . .	250 max.	°C

→ Indicates a change.



## Cooling, Conduction:

The conduction cylinder must be thermally coupled to a constant-temperature device (heat sink—solid or liquid) to limit the conduction cylinder to the specified maximum value of 250° C. The plate, grid-No.2, grid-No.1, cathode, and heater terminals may also require coupling to the heat sink to limit their respective seal temperature to the specified maximum value of 250° C.

### AF POWER AMPLIFIER & MODULATOR — Class AB<sub>1</sub>♦

#### Maximum CCS<sup>†</sup> Ratings, Absolute-Maximum Values:

DC PLATE VOLTAGE. . . . .	1000	max.	volts
DC GRID-No.2 VOLTAGE. . . . .	300	max.	volts
MAX.-SIGNAL DC PLATE CURRENT♦ . . . . .	180	max.	ma
MAX.-SIGNAL PLATE INPUT♦. . . . .	180	max.	watts
MAX.-SIGNAL GRID-No.2 INPUT♦. . . . .	4.5	max.	watts
PLATE DISSIPATION♦. . . . .			♣

#### Typical CCS Push-Pull Operation:

*Values are for 2 tubes*

DC Plate Voltage. . . . .	650	850	volts
DC Grid-No.2 Voltage* . . . . .	300	300	volts
DC Grid-No.1 Voltage from fixed-bias source . . . . .	-15	-15	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage#. . . . .	30	30	volts
Zero-Signal DC Plate Current. . . . .	80	80	ma
Max.-Signal DC Plate Current. . . . .	200	200	ma
Zero-Signal DC Grid-No.2 Current. . . . .	0	0	ma
Max.-Signal DC Grid-No.2 Current. . . . .	20	20	ma
Effective Load Resistance (Plate to plate). . . . .	4330	7000	ohms
Max.-Signal Driving Power (Approx.) . . . . .	0	0	watts
Max.-Signal Power Output (Approx.). . . . .	50	80	watts

#### Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition:* For fixed-bias operation. . . . .	30000	max.	ohms
For cathode-bias operation. . . . .			Not recommended

### AF POWER AMPLIFIER & MODULATOR — Class AB<sub>2</sub>\*

#### Maximum CCS<sup>†</sup> Ratings, Absolute-Maximum Values:

DC PLATE VOLTAGE. . . . .	1000	max.	volts
DC GRID-No.2 VOLTAGE. . . . .	300	max.	volts
MAX.-SIGNAL DC PLATE CURRENT♦ . . . . .	180	max.	ma
MAX.-SIGNAL DC GRID-No.1 CURRENT♦ . . . . .	30	max.	ma
MAX.-SIGNAL PLATE INPUT♦. . . . .	180	max.	watts
MAX.-SIGNAL GRID-No.2 INPUT♦. . . . .	4.5	max.	watts
PLATE DISSIPATION♦. . . . .			♣



**Typical CCS Push-Pull Operation:***Values are for 2 tubes*

DC Plate Voltage. . . . .	650	850	volts
DC Grid-No.2 Voltage* . . . . .	300	300	volts
DC Grid-No.1 Voltage from fixed-bias source . . . . .	-15	-15	volts
Peak AF Grid-No.1-to-Grid-No.1 Voltage . . . . .	46	46	volts
Zero-Signal DC Plate Current. . . . .	80	80	ma
Max.-Signal DC Plate Current. . . . .	355	355	ma
Zero-Signal DC Grid-No.2 Current. . . . .	0	0	ma
Max.-Signal DC Grid-No.2 Current. . . . .	25	25	ma
Max.-Signal DC Grid-No.1 Current. . . . .	15	15	ma
Effective Load Resistance (Plate to plate). . . . .	2450	3960	ohms
Max.-Signal Driving Power (Approx.)†. . . . .	0.3	0.3	watt
Max.-Signal Power Output (Approx.). . . . .	85	140	watts

**LINEAR RF POWER AMPLIFIER****Single-Sideband Suppressed-Carrier Service****Maximum CCS<sup>1</sup> Ratings, Absolute-Maximum Values:***Up to 1215 Mc*

DC PLATE VOLTAGE. . . . .	1000	max.	volts
DC GRID-NO.2 VOLTAGE. . . . .	300	max.	volts
MAX.-SIGNAL DC PLATE CURRENT. . . . .	180	max.	ma
MAX.-SIGNAL DC GRID-NO.1 CURRENT. . . . .	30	max.	ma
MAX.-SIGNAL PLATE INPUT . . . . .	180	max.	watts
MAX.-SIGNAL GRID-NO.2 INPUT . . . . .	4.5	max.	watts
PLATE DISSIPATION . . . . .		*	

**Typical CCS Class AB<sub>1</sub> "Single-Tone" Operation:‡***Up to 60 Mc*

DC Plate Voltage. . . . .	650	850	volts
DC Grid-No.2 Voltage* . . . . .	300	300	volts
DC Grid-No.1 Voltage. . . . .	-15	-15	volts
Zero-Signal DC Plate Current. . . . .	40	40	ma
Zero-Signal DC Grid-No.2 Current. . . . .	0	0	ma
Effective RF Load Resistance. . . . .	2165	3500	ohms
Max.-Signal DC Plate Current. . . . .	100	100	ma
Max.-Signal DC Grid-No.2 Current. . . . .	10	10	ma
Max.-Signal DC Grid-No.1 Current. . . . .	0	0	ma
Max.-Signal Peak RF Grid-No.1 Voltage . . . . .	15	15	volts
Max.-Signal Driving Power (Approx.) . . . . .	0	0	watts
Max.-Signal Power Output (Approx.). . . . .	25	40	watts

**Maximum Circuit Values:**

Grid-No.1-Circuit Resistance under any condition:

For fixed-bias operation. . . . . 30000 max. ohms

For cathode-bias operation. . . . . Not recommended



## PLATE-MODULATED RF POWER AMPLIFIER — Class C Telephony

Carrier conditions per tube for use  
with a maximum modulation factor of 1

### Maximum CCS<sup>↓</sup> Ratings, Absolute-Maximum Values:

	Up to 1215 Mc		
DC PLATE VOLTAGE. . . . .	800	max.	volts
DC GRID-No.2 VOLTAGE. . . . .	300	max.	volts
DC GRID-No.1 VOLTAGE. . . . .	-100	max.	volts
DC PLATE CURRENT. . . . .	150	max.	ma
DC GRID-No.1 CURRENT. . . . .	30	max.	ma
PLATE INPUT . . . . .	120	max.	watts
GRID-No.2 INPUT . . . . .	3	max.	watts
PLATE DISSIPATION . . . . .	*		

### Typical CCS Operation:

	At 400 Mc		
DC Plate Voltage. . . . .	400	700	volts
DC Grid-No.2 Voltage <sup>§</sup> . . . . .	200	250	volts
DC Grid-No.1 Voltage <sup>¶</sup> . . . . .	-20	-50	volts
DC Plate Current. . . . .	100	130	ma
DC Grid-No.2 Current. . . . .	5	10	ma
DC Grid-No.1 Current. . . . .	5	10	ma
Driver Power Output (Approx.) <sup>◇</sup> . . . . .	2	3	watts
Useful Power Output (Approx.) . . . . .	16	45	watts

### Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition . . . . .	30000 <sup>▽</sup> max.	ohms
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## RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy<sup>▲▲</sup> and

## RF POWER AMPLIFIER — Class C FM Telephony

### Maximum CCS<sup>↓</sup> Ratings, Absolute-Maximum Values:

	Up to 1215 Mc		
DC PLATE VOLTAGE. . . . .	1000	max.	volts
DC GRID-No.2 VOLTAGE. . . . .	300	max.	volts
DC GRID-No.1 VOLTAGE. . . . .	-100	max.	volts
DC PLATE CURRENT. . . . .	180	max.	ma
DC GRID-No.1 CURRENT. . . . .	30	max.	ma
PLATE INPUT . . . . .	180	max.	watts
GRID-No.2 INPUT . . . . .	4.5	max.	watts
PLATE DISSIPATION . . . . .	*		

### Typical CCS Operation:

	At 400 Mc		At 1215 Mc	
DC Plate Voltage. . . . .	400	900	900	volts
DC Grid-No.2 Voltage <sup>●●</sup> . . . . .	200	300	300	volts
DC Grid-No.1 Voltage <sup>★★</sup> . . . . .	-35	-30	-22	volts
DC Plate Current. . . . .	150	170	170	ma
DC Grid-No.2 Current. . . . .	5	1	1	ma
DC Grid-No.1 Current. . . . .	3	10	4	ma



Driver Power Output (Approx.) <sup>◇</sup> . . . . .	3	3	5	watts
Useful Power Output (Approx.) . . . . .	23	80	40	watts

**Maximum Circuit Values:**

Grid-No.1-Circuit Resistance under any condition . . . . . 30000<sup>♡</sup> max. ohms

- ▲ Because the cathode is subjected to considerable back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.
- Measured with special shield adapter.
- ★ For socket to be used with the 7842, consult manufacturers such as J-V-M Microwave Company, 9300 West 47th Street, Brookfield, Illinois; E.F. Johnson Company, Waseca, Minnesota; Collins Radio Company, 855 35th Street North, Cedar Rapids, Iowa; and Jettron Products, Route 10, Hanover, New Jersey.
- ♠ Subscript 1 indicates that grid-No.1 current does not flow during any part of the input cycle.
- ♣ Continuous Commercial Service.
- ♣ Averaged over any audio-frequency cycle of sine-wave form.
- ♣ Maximum plate dissipation is a function of the maximum plate input, efficiency of the class of service, and the effectiveness of the cooling system. See *Cooling, Conduction* under *General Data*, and also *Cooling Considerations*.
- ⊙ Preferably obtained from a fixed supply.
- \* The driver stage should be capable of supplying the No.1 grids of the Class AB<sub>1</sub> stage with the specified driving voltage at low distortion.
- \* The resistance introduced into the grid-No.1 circuit by the input coupling should be held to a low value. In no case should it exceed the specified maximum value. Transformer- or impedance-coupling devices are recommended.
- ♣ Subscript 2 indicates that grid-No.1 current flows during some part of the input cycle.
- † Driver stage should be capable of supplying the specified driving power at low distortion to the No.1 grids of the AB<sub>2</sub> stage. To minimize distortion, the effective resistance per grid-No.1 circuit of the AB<sub>2</sub> stage should be held at a low value. For this purpose, the use of transformer coupling is recommended.
- ‡ "Single-Tone" operation refers to that class of amplifier service in which the grid-No.1 input consists of a monofrequency rf signal having constant amplitude. This signal is produced in a single-sideband suppressed-carrier system when a single audio frequency of constant amplitude is applied to the input of the system.
- § Obtained preferably from a separate source modulated along with the plate supply.
- Obtained from grid-No.1 resistor or from a combination of grid-No.1 resistor with either fixed supply or cathode resistor.
- ◇ The driver stage is required to supply tube losses and rf-circuit losses. It should be designed to provide an excess of power above the indicated values to take care of variations in line voltage, components, initial tube characteristics, and tube characteristics during life.
- ♡ If this value is insufficient to provide adequate bias, the additional required bias must be supplied by a cathode resistor or fixed supply.
- ▲▲ Key-down conditions per tube without amplitude modulation. Amplitude modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115 per cent of the carrier conditions.
- ⊙⊙ Obtained preferably from a fixed supply, or from the plate supply voltage with a voltage divider.
- ★★ Obtained from fixed supply, by grid-No.1 resistor, by cathode resistor, or by combination methods.



## CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	Min.	Max.	
→ 1. Heater Current . . . . .	1	2.90	3.55	amp
2. Direct Interelectrode Capacitances:				
Grid No.1 to plate . . . . .	2	-	0.065	$\mu\mu\text{f}$
Grid No.1 to cathode & heater . . . . .	2	11.8	15.2	$\mu\mu\text{f}$
Plate to cathode & heater . . . . .	2	-	0.019	$\mu\mu\text{f}$
Grid No.1 to grid No.2 . . . . .	2	17.3	21.9	$\mu\mu\text{f}$
Grid No.2 to plate . . . . .	2	4	5.1	$\mu\mu\text{f}$
Grid No.2 to cathode & heater . . . . .	2	-	1.3	$\mu\mu\text{f}$
→ 3. Grid-No.1 Voltage . . . . .	1,3	-6	-18	volts
4. Reverse Grid-No.1 Current . . . . .	1,3	-	-20	$\mu\text{a}$
5. Grid-No.2 Current . . . . .	1,3	-8	2	ma
6. Peak Emission Voltage . . . . .	1,4	-	400	volts
7. Interelectrode Leakage Resistance . . . . .	5	1	-	megohm
8. Useful Power Output . . . . .	6	80	-	watts

Note 1: With 6.3 volts ac or dc on heater.

Note 2: Measured with special shield adapter.

Note 3: With dc voltage of 1000 volts, dc grid-No.2 voltage of 300 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 115 ma.

Note 4: For conditions with 6.3 volts on heater; grid No.1, grid No.2, and plate tied together; and pulse-voltage source connected between plate and cathode. Pulse duration is 2 microseconds, pulse-repetition frequency is 60 pps, and duty factor is 0.00012. The voltage-pulse amplitude is adjusted until a peak cathode current of 10 amperes is obtained. After 1 minute at this value, the voltage-pulse amplitude will not exceed 400 volts (peak).

Note 5: Under conditions with tube at 20° to 30° C for at least 30 minutes without any voltages applied to the tube. The minimum resistance between any two adjacent electrodes as measured with a 200-volt Megger-type ohmmeter having an internal impedance of 1 megohm, will be 1 megohm.

Note 6: In a single-tube, grid-driven, coaxial-cavity, class-C-amplifier circuit at 400 Mc and for conditions with 5.7 volts ac or dc on heater, dc plate voltage of 1000 volts, dc grid-No.2 voltage of 300 volts, grid-No.1 resistor adjustable between 1000 and 10,000 ohms, dc plate current of 180 ma. maximum, dc grid-No.1 current of 20 ma. maximum, and driver power output of 3 watts.

## SPECIAL TESTS &amp; PERFORMANCE DATA

Resonances in the tube mountings used in the following tests can cause the specified environmental conditions to produce greatly amplified effects. Extreme care must, therefore, be used in the design of the mountings to minimize resonances. Design details of mountings used by the RCA Electron Tube Division to perform these tests may be obtained from RCA Commercial Engineering, Harrison, N.J., on request.

## 50-g, 11-Millisecond Shock Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand the specified long-

→ Indicates a change.



duration impact acceleration. Tubes are held rigid in six different positions in a Medium-Impact Shock Machine and are subjected to three blows in each position. At the end of this test, tubes are required to meet the limits for items 1, 3, 4, 7, and 8 under *Characteristics Range Values for Equipment Design*.

#### 500-g, Nominal 3/4-Millisecond Shock Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand the specified impact acceleration. Tubes are held rigid in four different positions in a High-Impact Shock Machine and are subjected to five blows in each position. At the end of this test, tubes are required to meet the limits for items 1, 3, 4, 7, and 8 under *Characteristics Range Values for Equipment Design*.

#### 5-to-2000 cps Vibration Test:

This test is performed on sample lots of tubes to determine the ability of the tube to withstand variable-frequency vibration. With heater voltage of 6.3 volts ac or dc, dc plate supply voltage of 300 volts, dc grid-No.2 voltage of 250 volts, grid-No.1 voltage adjusted to give dc plate current of 10 ma., and plate load resistor of 2000 ohms. The tube is vibrated along each of three mutually perpendicular axes over an 8-minute sweep consisting of:

- a. 5-to-10 cps with fixed double amplitude of 0.080 inch  $\pm 10\%$ .
- b. 10-to-15 cps at fixed acceleration of 0.41 g  $\pm 10\%$ .
- c. 15-to-75 cps with fixed double amplitude of 0.036 inch  $\pm 10\%$ .
- d. 75-to-2000 cps at fixed acceleration of 10 g  $\pm 10\%$ .

During the above vibration tests, tubes will not show an rms output voltage in excess of 15 volts across the plate load resistor in the 5-to-2000 cycle range. At the end of this test, tubes are required to meet the limits for items 1, 3, 4, 7, and 8 under *Characteristics Range Values for Equipment Design*.

### COOLING CONSIDERATIONS

The conduction-cooling system consists, in general, of a constant-temperature device (heat sink) and suitable heat-flow path (coupling) between the heat sink and tube. Careful consideration should be given to the design of a heat-flow path through a coupling device having low electrical conductivity and high thermal conductivity.

The maximum plate dissipation may be calculated from the equation:

$$W = KA \frac{(T_2 - T_1)}{L}$$



where:

W = maximum plate dissipation in watts

K = thermal conductivity♦♦ of the coupling material

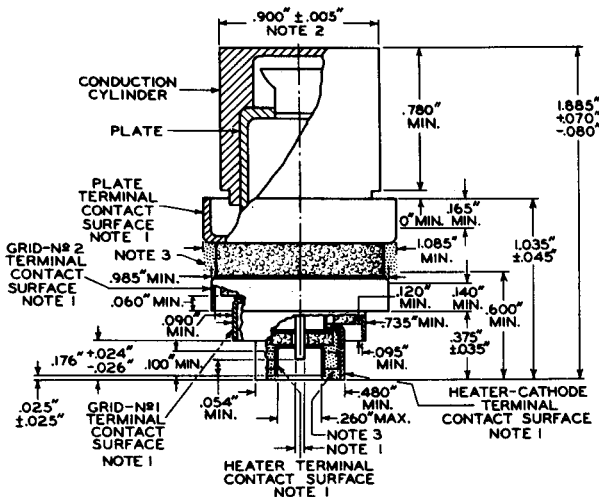
A = area measured at right angles to the direction of the flow of heat in square inches

$T_2, T_1$  = temperature in degrees Centigrade of planes or surfaces under consideration

L = length of heat path in inches through coupling material to produce temperature gradient

♦♦ Thermal conductivity is defined as the time rate of transfer of heat by conduction, through unit thickness, across unit area for unit difference of temperature. It is measured in watts per square inch for a thickness of one inch and a difference of temperature of  $1^{\circ}$  C.





 STIPPLED REGION  
NOTE 3

 CERAMIC

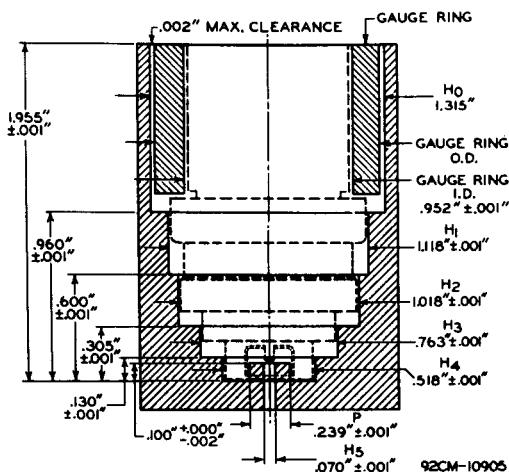
92CM-9218R4

**NOTE 1:** WITH THE CYLINDRICAL SURFACES OF THE PLATE TERMINAL, GRID-NO. 2 TERMINAL, GRID-NO. 1 TERMINAL, HEATER-CATHODE TERMINAL, AND HEATER TERMINAL CLEAN, SMOOTH, AND FREE OF BURRS, THE TUBE WILL ENTER A GAUGE AS SHOWN IN SKETCH  $G_1$ . THE TUBE IS PROPERLY SEATED IN THE GAUGE WHEN A 0.010"-THICKNESS GAUGE 1/8" WIDE WILL NOT ENTER BETWEEN THE HEATER-CATHODE TERMINAL AND THE BOTTOM SURFACE OF  $H_4$ . THE GAUGE IS PROVIDED WITH A SLOT TO PERMIT MAKING MEASUREMENT OF SEATING OF HEATER-CATHODE TERMINAL ON BOTTOM OF HOLE  $H_4$ .

**NOTE 2:** WITH THE TUBE SEATED IN GAUGE AND WITH THE CONDUCTION CYLINDER CLEAN, SMOOTH, AND FREE OF BURRS, THE GAUGE RING WILL SLIP OVER CONDUCTION CYLINDER AS SHOWN IN SKETCH  $G_1$ .

**NOTE 3:** KEEP ALL STIPPLED REGIONS CLEAR. DO NOT ALLOW CONTACTS OR CIRCUIT COMPONENTS TO PROTRUDE INTO THESE ANNULAR VOLUMES.



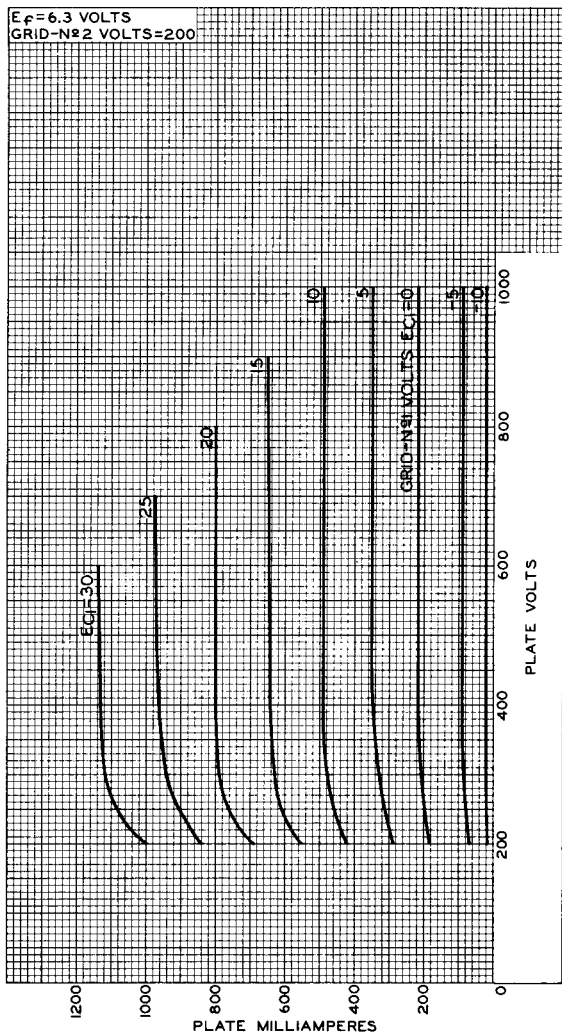
SKETCH G<sub>1</sub>

THE AXES OF THE CYLINDRICAL HOLES H<sub>1</sub> THROUGH H<sub>5</sub> AND THE AXIS OF POST P ARE COINCIDENT WITHIN 0.001".

THE AXES OF THE GAUGE-RING INSIDE DIAMETER AND GAUGE-RING OUTSIDE DIAMETER ARE COINCIDENT WITHIN 0.001".



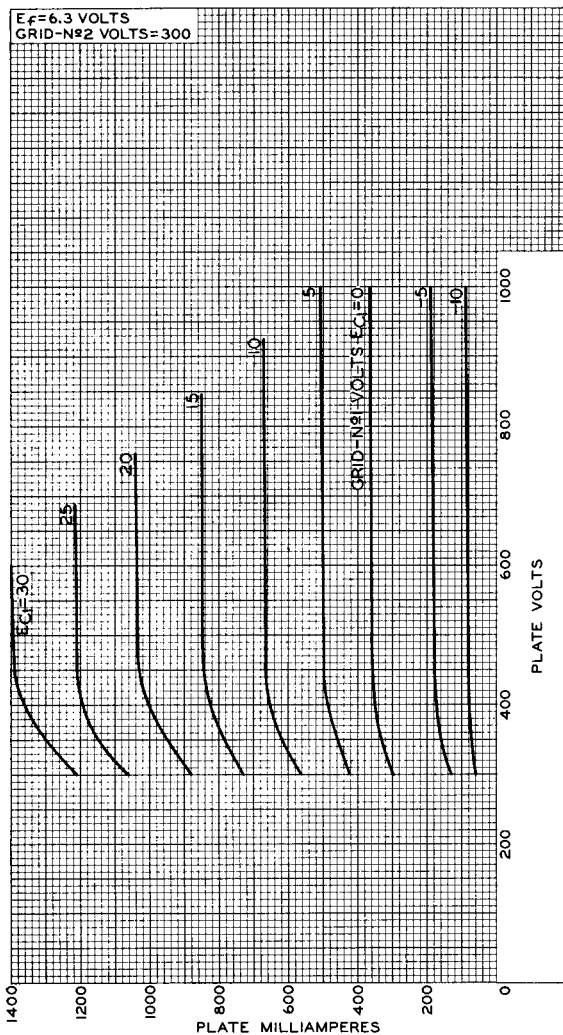
## TYPICAL PLATE CHARACTERISTICS



92CM-9228R2



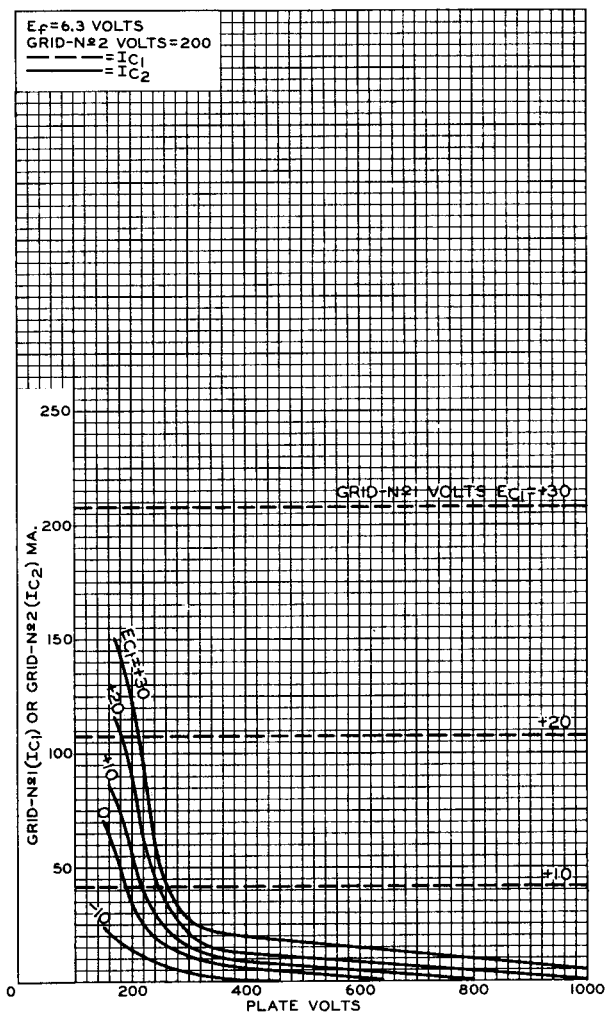
## TYPICAL PLATE CHARACTERISTICS



92CM-9222R1



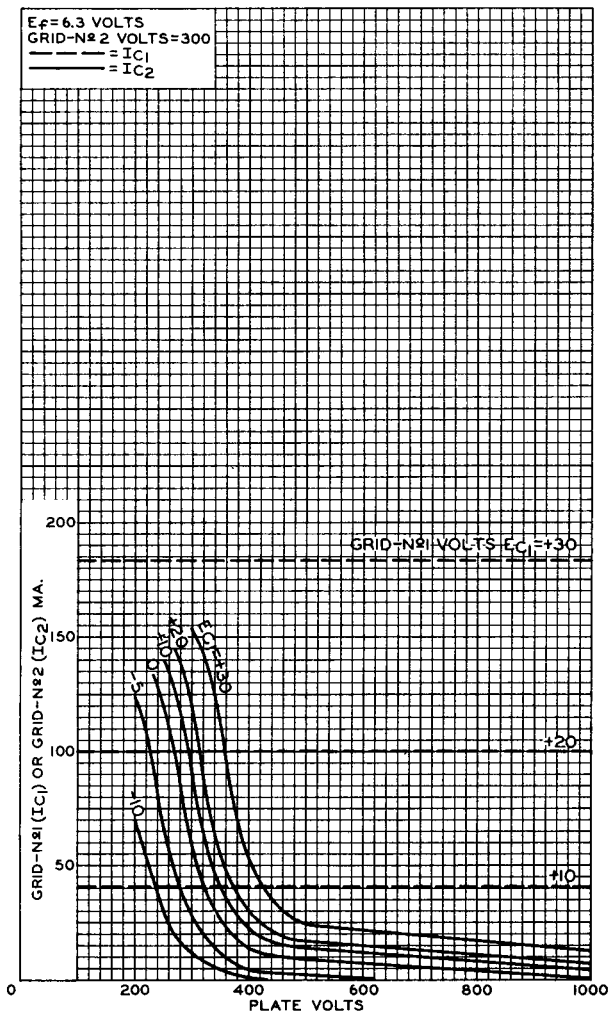
## TYPICAL CHARACTERISTICS



92CM-9224RI



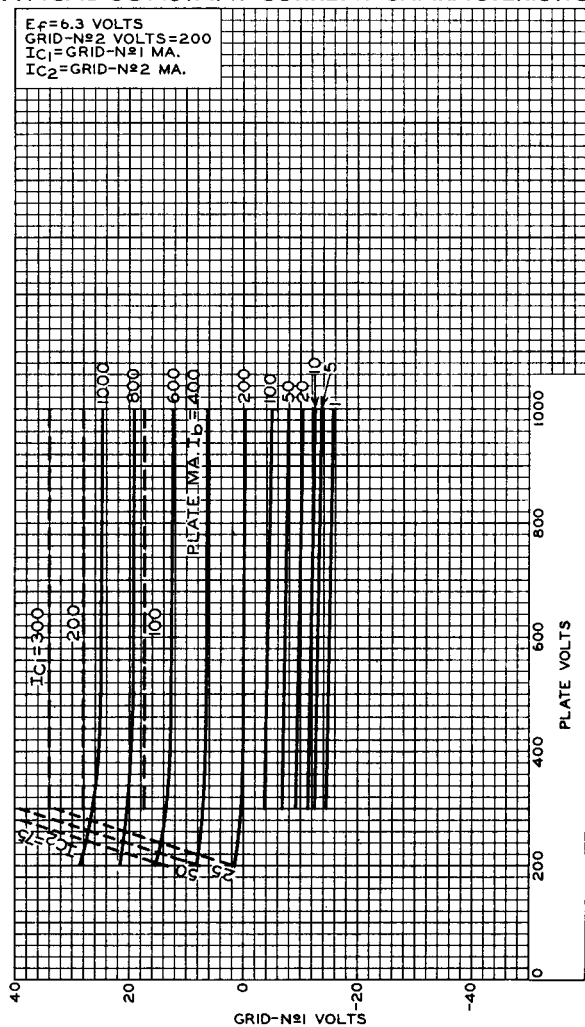
## TYPICAL CHARACTERISTICS



92CM-9225R2



## TYPICAL CONSTANT-CURRENT CHARACTERISTICS

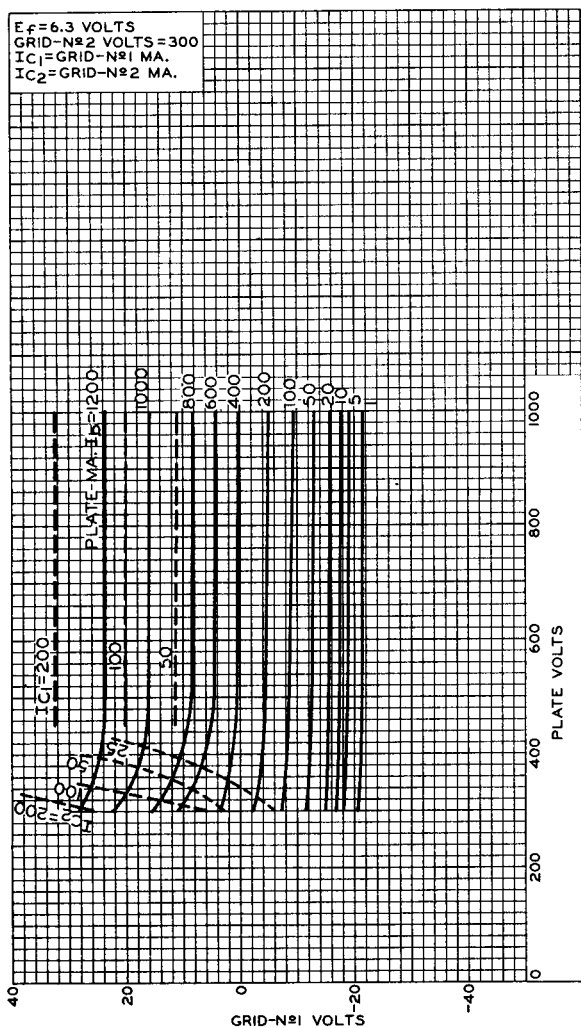


92CM-9233RI



## TYPICAL CONSTANT-CURRENT CHARACTERISTICS

$E_f = 6.3$  VOLTS  
 GRID-N $\#$ 2 VOLTS = 300  
 $I_{C1}$  = GRID-N $\#$ 1 MA.  
 $I_{C2}$  = GRID-N $\#$ 2 MA.

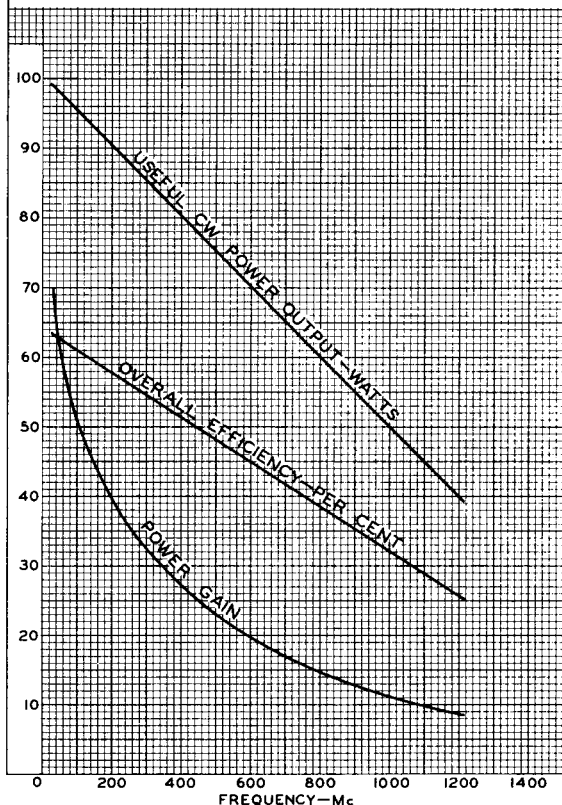


92CM-9232RI



## TYPICAL PERFORMANCE CHARACTERISTICS In Class C Telegraphy or Class C FM Telephony Amplifier Service

$E_f$  = ADJUSTED TO SIMULATE NORMAL OPERATING  
CONDITIONS OF HEATER IN UHF SERVICE  
PLATE VOLTS = 900  
GRID-N $\times$ 2 VOLTS = 300  
PLATE AMPERES = 0.170  
OVERALL EFFICIENCY = USEFUL POWER OUTPUT IN LOAD  
DIVIDED BY DC PLATE INPUT  
POWER GAIN = USEFUL POWER OUTPUT IN LOAD  
DIVIDED BY DRIVER POWER OUTPUT



92CM-9221

