832

PUSH-PULL R-F BEAM POWER AMPLIFIER

RCA-832 is a heater-cathode type of transmitting tube containing in one envelope two beam power units. The tube is designed primarily for use as a push-pull r-f power amplifier with maximum ratings at frequencies as high as 200 megacycles and with reduced ratings at frequencies as high as 250 Mc. Its total plate dissipation is 15 watts for class C telegraph service. Neutralization of the tube is unnecessary in adequately shielded circuits.

The exceptional efficiency of the 832 at the ultra-high frequencies is made possible by the balanced and compact structure of the beam power units, excellent internal shielding, and close electrode spacing. The internal leads are short and heavy in order to minimize internal lead inductance. The terminal arrangement provides excellent insulation and is designed to facilitate symmetry of circuit layout.

The heaters are arranged to allow operation from either a 12.6- or a 6.3-volt supply.

CHARACTERISTICS and RATINGS

Unless otherwise specified, values are for both units

HEATER (A.C. or D.C.):			
Voltage per Unit	6.3		Volts
Current per Unit	0.8		Ampere
TRANSCONDUCTANCE, For plate cur. of 30 ma.	3500	*approx.*	Micromhos
GRID-SCREEN MU-FACTOR	7		
DIRECT INTERELECTRODE CAPACITANCES (Each Unit):			
Grid-Plate (With external shielding)	0.05	*max.*	μμf
Input	7.5		μμf
Output	3.8		μμf
SCREEN-CATHODE CAPACITANCE (Including internal screen by-pass condenser)	65	*approx.*	μμf
BULB	T-16		
RCA SOCKET	See INSTALLATION		

MAXIMUM CCS RATINGS and TYPICAL OPERATING CONDITIONS

CCS = Continuous Commercial Service

Maximum Ratings Are Absolute Values

As Grid-Modulated Push-Pull R-F Power Amplifier - Class C Telephony

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

D-C PLATE VOLTAGE		500 *max.*	Volts
D-C SCREEN VOLTAGE (Grid No. 2)		250 *max.*	Volts
D-C GRID VOLTAGE (Grid No. 1)		-100 *max.*	Volts
D-C PLATE CURRENT		55 *max.*	Ma.
PLATE INPUT		22 *max.*	Watts
SCREEN INPUT		3.4 *max.*	Watts
PLATE DISSIPATION		15 *max.*	Watts
TYPICAL OPERATION:			
With modulation factor of	*0.7*	*0.8*	
D-C Plate Voltage	400	500	Volts
D-C Screen Voltage	250	200	Volts
D-C Grid Voltage	-60	-55	Volts
Peak R-F Grid-to-Grid Voltage	110	100	Volts
Peak A-F Grid Voltage	14	14	Volts
D-C Plate Current	55	44	Ma.
D-C Screen Current	6	3	Ma.
D-C Grid Current (Approx.)	0	0	Ma.
Driving Power (Approx.)	0.1	0.1	Watt
Power Output (Approx.)	7.6	8	Watts

As Plate-Modulated Push-Pull R-F Power Amplifier - Class C Telephony

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

D-C PLATE VOLTAGE		425 *max.*	Volts
D-C SCREEN VOLTAGE (Grid No. 2)		250 *max.*	Volts
D-C GRID VOLTAGE (Grid No. 1)		-100 *max.*	Volts
D-C PLATE CURRENT		68 *max.*	Ma.
D-C GRID CURRENT		6 *max.*	Ma.
PLATE INPUT		22 *max.*	Watts
SCREEN INPUT		3.4 *max.*	Watts
PLATE DISSIPATION		10 *max.*	Watts
TYPICAL OPERATION:			
D-C Plate Voltage	325	425	Volts
D-C Screen Voltage:			
from a fixed supply of	210	200	Volts
*from a series resistor of***	7700	14000	Ohms
D-C Grid Voltage*:			
from a fixed supply of	-50	-60	Volts
from a grid resistor of	21000	25000	Ohms
Peak R-F Grid-to-Grid Voltage	100	140	Volts
D-C Plate Current	68	52	Ma.
D-C Screen Current	15	16	Ma.
D-C Grid Current (Approx.)	2.4	2.4	Ma.
Driving Power (Approx.)	0.11	0.15	Watt
Power Output (Approx.)	12	16	Watts

As Push-Pull R-F Power Amplifier and Oscillator - Class C Telegraphy

Key-down conditions per tube without modulation ##

D-C PLATE VOLTAGE		500 *max.*	Volts
D-C SCREEN VOLTAGE (Grid No. 2)		250 *max.*	Volts
D-C GRID VOLTAGE (Grid No. 1)		-100 *max.*	Volts
D-C PLATE CURRENT		90 *max.*	Ma.
D-C GRID CURRENT		6 *max.*	Ma.
PLATE INPUT		36 *max.*	Watts
SCREEN INPUT		5 *max.*	Watts
PLATE DISSIPATION		15 *max.*	Watts
TYPICAL OPERATION:			
D-C Plate Voltage	400	500	Volts
D-C Screen Voltage:			
from a fixed supply	250	200	Volts
from a series resistor of	8300	21000	Ohms
D-C Grid Voltage*:			
from a fixed supply of	-60	-65	Volts
from a grid resistor of	20000	25000	Ohms
from a cathode resistor of	540	730	Ohms
Peak R-F Grid-to-Grid Voltage	124	150	Volts
D-C Plate Current	90	72	Ma.
D-C Screen Current	18	14	Ma.
D-C Grid Current (Approx.)	3	2.6	Ma.
Driving Power (Approx.)	0.18	0.18	Watt
Power Output (Approx.)	22	26	Watts

* The grid-circuit resistance should never exceed 25000 ohms (total) per tube, or 50000 ohms per unit. If additional bias is necessary, use a cathode resistor or a fixed supply.
At crest of audio-frequency cycle with modulation factor indicated.

** Connected to *modulated* plate-voltage supply.

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

INSTALLATION

The 832 may be mounted by means of a special socket having floating contacts, such as the RCA stock Nos. 9934 or 9935. No. 9934 (UT-106) is made for use at frequencies below 60 Mc; No. 9935 (UT-107) has built-in by-pass condensers for the heater and the screen and is designed for use at frequencies above 60 Mc. The plate terminals take clips with flexible leads.

Flexible leads are necessary so that strains will not be placed on the glass at the seals. Connections should never be soldered directly to the plate terminals as the heat of soldering may crack the lead seals. The 832 may be mounted in any position.

The *heaters* of the 832 are connected together within the tube. The center connection is brought out of the bulb to a separate pin terminal to permit either series operation from a 12.6-volt supply or parallel operation from a 6.3-volt supply. Under any condition of operation, the heater voltage should not deviate more than ± 10% from the rated value.

The *cathodes* of the 832 are connected together within the tube. The cathode circuit should be connected to the electrical mid-point of the heater circuit when the heaters are operated from an a-c supply or to the negative heater-supply lead when the heaters are operated from a d-c source. In circuits where the cathode is not directly connected to the heater, the potential difference between them should not exceed 100 volts. If the use of a large resistor is necessary between the heater and cathode in some circuits, it should be by-passed by a suitable filter network to avoid the possibility of hum.

The *plates* of the 832 show no color when the tube is operated at its maximum plate-dissipation rating.

The *screens* of the 832 are connected together within the tube and by-passed by means of a 65-μμf condenser connected inside the tube between the screens and the cathodes. Screen voltage can be obtained from a separate source or from the plate-supply through a series resistor or by means of a voltage divider. The choice of method depends on the service in which the tube is used (see APPLICATION). When the screen voltage is obtained from a separate source, or from a voltage divider, plate voltage should be applied before or simultaneously with the screen voltage. Otherwise, with voltage on the screens only, the screen current may rise high enough to cause excessive screen dissipation. When screen-voltage regulation is not an important factor, the series-resistance method for obtaining screen voltage is desirable because of its simplicity and because it limits the d-c input power to the screen. A d-c milliammeter should be used in the screen circuit so that the screen current can be measured and the d-c power input to the screen determined. The screens should not be allowed to attain a temperature corresponding to more than a barely perceptible red color. This temperature corresponds to the screen-input values shown under MAXIMUM RATINGS.

The screen current is a very sensitive indication of the plate-circuit loading and rises excessively (often to the point of damaging the tube) when the amplifier is operated without load. Therefore, care should be taken when tuning an 832 under no-load conditions in order to prevent exceeding the screen-input rating of the tube.

A *protective device*, such as a high-voltage fuse, should be used to protect both the plate and screen against overloads. When a voltage divider or a resistor in series with the plate-voltage supply is used for obtaining the screen voltage, the protective device should be placed in the common positive high-voltage supply lead. It should remove the high voltage when the plate current reaches a value 50% greater than normal. When the screen voltage is obtained from a separate source or from a voltage divider of good regulation, a protective device should be placed in the screen-supply lead. It should remove the screen voltage when the screen current reaches a value of 50% greater than normal.

Shielding of the r-f amplifier stage employing the 832 is required for stable operation. A convenient method of shielding is to insert the plate end of the tube through a hole in a metal plate so that the edge of the opening is in close proximity to the internal shield of the tube. An alternative shielding and mounting arrangement is to insert the grid end of the tube through a hole in the shield and then clamp a ring or cup to the chassis so as to complete the shielding and lock the tube in the mounting.

R-f by-passing of the 832 at the tube terminals is necessary in order to realize the full capabilities of the tube at the ultra-high frequencies. Conventional by-passing methods and grounding are not adequate. One convenient method of by-passing is to use ribbon leads to the tube terminals and to insulate the leads from the external shield plate by means of mica spacers to form by-pass condensers right at the tube terminals. It is important that the grid-, plate-, and screen-circuit returns are made to the common cathode connection in order to avoid r-f interaction through common return circuits. It may also be advisable in some applications to supplement the action of the by-pass condensers by r-f chokes placed close to the condensers in the voltage-supply leads.

In order that the maximum ratings given under CHARACTERISTICS are not exceeded, changes in electrode voltages due to battery- or line-voltage fluctuation, load variation, and manufacturing variation of the associated apparatus must be determined. An average value of voltage for each electrode should then be chosen so that under the usual voltage variations the maximum rated voltages will not be exceeded.

When a new circuit is tried or when adjustments are made, it is advisable to reduce the plate and screen voltages. This may be done conveniently by means of a protective resistance of about 10000 ohms (total) in series with the screen lead and a protective resistance of about 2000 ohms in series with the high-voltage supply lead.

APPLICATION

In *grid-modulated class C telephone service*, the 832 is supplied with unmodulated r-f grid excitation voltage and with d-c grid bias which is modulated at audio frequencies. Grid bias should preferably be obtained from a fixed supply. The plates are supplied with unmodulated d-c voltage. The audio power required in this service is very small. It must be sufficient to meet the peak power requirement of the grids of the class C amplifier on the positive crest of the input signal. The screen voltage should be obtained from a separate source or from a voltage divider connected across the high-voltage supply.

In *plate-modulated class C amplifier service,* RCA-832 can be modulated 100%. The screen voltage may be obtained from a separate source or from a voltage-dropping resistor connected in series with the *modulated* plate supply. The screen voltage must be modulated simultaneously with the plate voltage so that the ratio of screen voltage to plate voltage remains constant. Modulation of a fixed screen-voltage supply can be accomplished either by connecting the screen lead to a separate winding on the modulation transformer or by connecting it through a blocking condenser to a tap on the modulation transformer or choke. With the latter method, an a-f choke of suitable impedance for low frequencies should be connected in series with the screen-supply lead. Control-grid bias may be obtained from a grid resistor or from a combination of either grid resistor and fixed supply or grid resistor and cathode resistor. The combination method has the advantage not only of protecting the tube from damage through loss of excitation but also of minimizing distortion through bias-supply compensation.

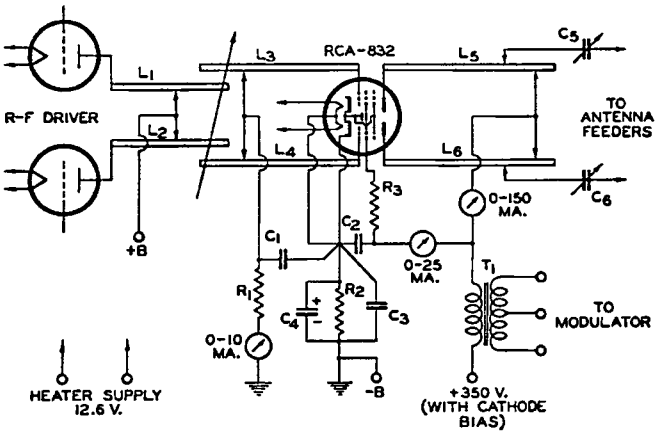
In *class C r-f telegraph service,* the 832 may be supplied with screen voltage from a fixed supply such as a voltage divider or from a separate source. The screen voltage may also be obtained from the plate-voltage supply through a series resistor, provided the regulation of the plate supply is good enough so that the screen voltage will not exceed 600 volts under key-up conditions. Grid bias may be obtained by any convenient method.

RCA-832 may be operated at maximum ratings in all classes of service at frequencies as high as 200 megacycles. The tube may be operated at higher frequencies provided the maximum values of plate voltage and power input are reduced as the frequency is raised (other maximum ratings are the same as shown under MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS). The tabulation below shows the highest percentage of maximum plate voltage and power input that can be used at frequencies up to 250 Mc.

FREQUENCY	200	250	Mc
MAX. PERMISSIBLE PERCENTAGE OF MAX. RATED PLATE VOLTAGE and PLATE INPUT:			
grid-mod. class C r-f amplifier	100	94	Per Cent
plate-mod. class C r-f amplifier	100	89	Per Cent
class C telegraphy	100	89	Per Cent

ULTRA-HIGH-FREQUENCY PLATE-MODULATED PUSH-PULL R-F POWER AMPLIFIER

POWER OUTPUT 12 WATTS (APPROX.) AT 2 METERS



C_1, C_2, C_3 = 500 μμf
C_4 = 25 μf, 200 VOLTS
C_5, C_6 = 3 TO 35 μμf
R_1 = 10000 TO 20000 OHMS, 1 WATT
R_2 = 300 OHMS, 5 WATTS
R_3 = 7500 OHMS, 5 WATTS
L_1, L_2 = DIMENSIONS DEPENDENT ON TYPE OF DRIVER TUBE; APPROX. SAME AS L_5 L_6.

L_3, L_4 = ¼" DIA. COPPER TUBING, APPROX. 10" LONG AND SPACED 1" BETWEEN CENTERS.
L_5, L_6 = ¼" DIA. COPPER TUBING, APPROX. 12" LONG AND SPACED 1" BETWEEN CENTERS.
T_1 = MODULATION TRANSFORMER

NOTE: ADJUST COUPLING OF L_1 L_2 AND L_3 L_4 FOR OPTIMUM GRID EXCITATION.