829

PUSH-PULL R-F BEAM POWER AMPLIFIER

RCA-829 is a push-pull, beam-power transmitting tube of the heater-cathode type. It contains two beam power units within one envelope. Total maximum plate dissipation is 40 watts. The exceptional efficiency and high power sensitivity of the 829 permit full power output with very low driving power. *For example, a single tube operated in push-pull class C telegraph service is capable of handling a power input of 120 watts with less than a watt of driving power--at frequencies as high as 200 Mc (1-1/2 meters).* The 829 may be operated at reduced ratings at frequencies as high as 250 Mc.

The exceptional efficiency of the 829 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. Neutralization of the tube is unnecessary in adequately shielded circuits.

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:		
Voltage (A.C. or D.C.) per unit	6.3	Volts
Current per Unit	1.125	Amperes
TRANSCONDUCTANCE, for plate current of 60 ma.	8500 *approx.*	Micromhos
GRID-SCREEN MU-FACTOR	7	
DIRECT INTERELECTRODE CAPACITANCES (Each Unit):		
Grid-Plate (with external shielding)	0.1 *max.*	μμf
Input	14.5	μμf
Output	7.0	μμf
SCREEN-CATHODE CAPACITANCE (Including internal screen by-pass condenser)	65 *approx.*	μμf
BULB	T-16	
TERMINAL MOUNTING	See INSTALLATION	
TYPE OF COOLING	See INSTALLATION (under *Bulb*)	

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)	225 *max.*	Volts
D-C GRID VOLTAGE (Grid No.1)	-175 *max.*	Volts
D-C PLATE CURRENT	120 *max.*	Ma.
PLATE INPUT	60 *max.*	Watts
SCREEN INPUT	6 *max.*	Watts
PLATE DISSIPATION	40 *max.*	Watts
TYPICAL OPERATION: *With modulation factor of 0.7*		
D-C Plate Voltage	500	Volts
D-C Screen Voltage	200	Volts
D-C Grid Voltage	-38	Volts
Peak R-F Grid-to-Grid Voltage	82	Volts
Peak A-F Grid Voltage	17	Volts
D-C Plate Current	120	Ma.
D-C Screen Current	10	Ma.
D-C Grid Current (Approx.)	2	Ma.
Driving Power (Approx.)*	0.5	Watt
Power Output (Approx.)	23	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)	225 *max.*	Volts
D-C GRID VOLTAGE (Grid No.1)	-175 *max.*	Volts
D-C PLATE CURRENT	212 *max.*	Ma.
D-C GRID CURRENT	15 *max.*	Ma.
PLATE INPUT	90 *max.*	Watts
SCREEN INPUT	7 *max.*	Watts
PLATE DISSIPATION	28 *max.*	Watts
TYPICAL OPERATION:		
D-C Plate Voltage	425	Volts
D-C Screen Voltage of *from a series resistor of* *	200 6400	Volts Ohms
D-C Grid Voltage of *from a grid resistor of***	-60 5500	Volts Ohms
Peak R-F Grid-to-Grid Voltage	154	Volts
D-C Plate Current	212	Ma.
D-C Screen Current	35	Ma.
D-C Grid Current (Approx.)	11	Ma.
Driving Power (Approx.)	0.8	Watt
Power Output (Approx.)	63	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)	225 *max.*	Volts
D-C GRID VOLTAGE (Grid No.1)	-175 *max.*	Volts
D-C PLATE CURRENT	240 *max.*	Ma.
D-C GRID CURRENT	15 *max.*	Ma.
PLATE INPUT	120 *max.*	Watts
SCREEN INPUT	7 *max.*	Watts
PLATE DISSIPATION	40 *max.*	Watts
TYPICAL OPERATION:		
D-C Plate Voltage	500	Volts
D-C Screen Voltage:		
from a fixed supply of	200	Volts
from a series resistor of	9300	Ohms
D-C Grid Voltage:		
from a fixed supply of	-45	Volts
from a cathode resistor of	160	Ohms
*from a grid resistor of***	3750	Ohms
Peak R-F Grid-to-Grid Voltage	124	Volts
D-C Plate Current	240	Ma.
D-C Screen Current	32	Ma.
D-C Grid Current (Approx.)	12	Ma.
Driving Power (Approx.)	0.7	Watt
Power Output (Approx.)	83	Watts

* At crest of audio-frequency cycle with modulation factor of 0.7

** The grid-circuit resistance should never exceed 15000 ohms (total) per tube, or 30000 ohms per unit. If additional bias is necessary, use a cathode resistor or a fixed supply.

‡ 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 829 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 normal expansion will not place a strain on the glass at the seals. Each lead should be connected to its clip before the clip is placed on the plate terminal. Connections should never be soldered directly to the tube terminals because the heat of the soldering operation may crack the lead seals. The 829 may be mounted in a vertical position with the plate terminals either up or down. It may also be mounted in a horizontal position provided the plane of each plate is vertical (on edge).

The *bulb* becomes very hot during continuous operation of the tube so that forced-air cooling is recommended. Forced-air cooling is not required for the 829 in intermittent service where the "on" period of plate-power application is ordinarily not more than five minutes, and where the "off" period is not less than the "on" period.

The *heaters* of the 829 are connected in series 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. Either an a-c or a d-c supply may be used. Under any condition of operation, the heater-voltage should not deviate more than ±10% from the rated value.

The *cathodes* of the 829 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 heater and cathode in some circuits, it should be by-passed to avoid the possibility of hum.

The *plates* of the 829 show no color when the tube is operated at its maximum plate-dissipation rating.

The *screens* of the 829 are connected together within the tube, and they are by-passed by means of a 65 μμf condenser connected inside the tube between the screens and cathodes. Screen voltage may be obtained from a separate source, 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 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 power input 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 CHARACTERISTICS.

The screen current is a very sensitive indication of plate-circuit loading and the screen current rises excessively (often to the point of damaging the tube) when the amplifier is operated without a load. Therefore, care should be taken when tuning an 829 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 screens and plates against overloads. When a bleeder resistor of poor regulation or a series resistor is used for obtaining the screen voltage, this device should be placed in the common positive high-voltage supply lead. It should remove the high-voltage supply when the d-c 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 also be placed in the screen-supply lead. It should remove the screen voltage when the d-c screen current reaches a value of 50% greater than normal.

Shielding of the r-f amplifier stage employing the 829 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 829 at its 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 heater and screen 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 determined. An average value of voltage for each electrode should then be chosen so that under the usual voltage variations the maximum rated volt-

ages will not be exceeded.

When a new circuit is tried or when adjustments are made, it is advisable to reduce the plate and screen voltage. This may be done conveniently by means of a protective resistance of about 2000 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 829 is supplied with unmodulated r-f grid excitation voltage and with a 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 and need be sufficient only to meet the peak power requirement of the grids of the class C amplifier on the positive crest of the input signal. The actual peak value is generally never more than 0.15 watt. The screen voltage should be obtained from a separate source or from a voltage divider connected across the plate supply.

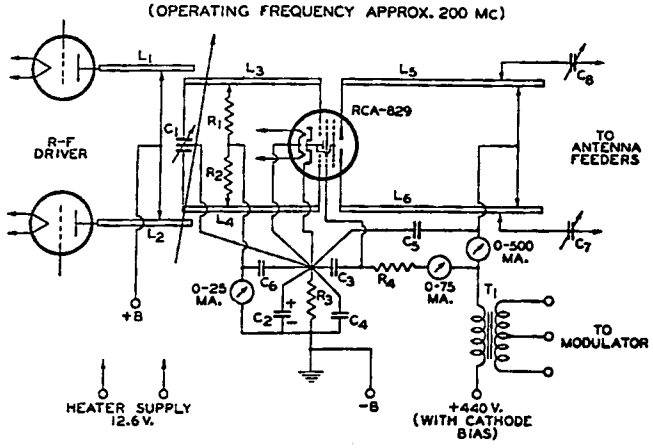
In *plate-modulated class C r-f amplifier service*, RCA-829 can be modulated 100%. The screen voltage may be obtained from a separate source; a voltage-dropping resistor in series with the *modulated* plate supply may also be used. In any case, the screen voltage must be modulated simultaneously with 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 audio frequencies should be connected in series with the screen-supply lead. Control-grid bias should be obtained from a grid resistor or from a combination of either grid resistor and fixed supply, or grid resistor and cathode bias resistor. The combination method of grid resistor and fixed supply has the advantage of not only protecting the tube from damage through loss of excitation but also of minimizing distortion effects by bias-supply compensation.

In *class C r-f telegraph service*, the 829 may be supplied with screen voltage by any of the methods shown under INSTALLATION. When a series screen resistor is used, the regulation of the plate supply should be 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-829 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 CHARACTERISTICS). The tabulation below shows the highest percentage of maximum plate voltage and power input that can be used up to 250 Mc for any class of service. Special attention should be given to shielding, cooling and r-f by-passing at these frequencies.

FREQUENCY	200	250	Mc
MAX. PERMISSIBLE PERCENTAGE of MAX. RATED PLATE VOLTAGE and PLATE INPUT:			
Class C (grid-modulation	100	94	Per Cent
Class C (plate-modulation	100	89	Per Cent
Class C (telegraphy	100	89	Per Cent

ULTRA-HIGH-FREQUENCY PLATE-MODULATED PUSH-PULL R-F POWER AMPLIFIER
(OPERATING FREQUENCY APPROX. 200 Mc)

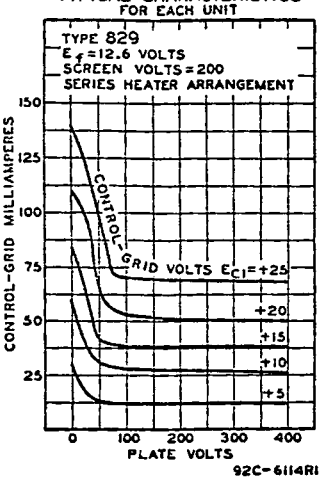


C_1 = 1.2 TO 10 μμf PER SECTION
C_2 = 25 μf, 200 VOLTS
C_3 C_4 C_5 C_6 = 500 μμf, MICA
C_7 C_8 = 3 to 35 μμf
R_1 R_2 = 7500 TO 15000 OHMS, 1 WATT
R_3 = 60 OHMS, 10 WATTS
R_4 = 6400 OHMS, 15 WATTS
T_1 = MODULATION TRANSFORMER
L_1 L_2 = DIMENSIONS DEPENDENT ON TYPE OF DRIVER TUBE: APPROX. SAME AS L_5 L_6
L_3 L_4 = 1/4" DIA. COPPER TUBING, APPROX. 10" LONG AND SPACED APPROX. 7/8" BETWEEN CENTERS
L_5 L_6 = 3/8" DIA. COPPER TUBING, APPROX. 7" LONG AND SPACED APPROX. 7/8" BETWEEN CENTERS

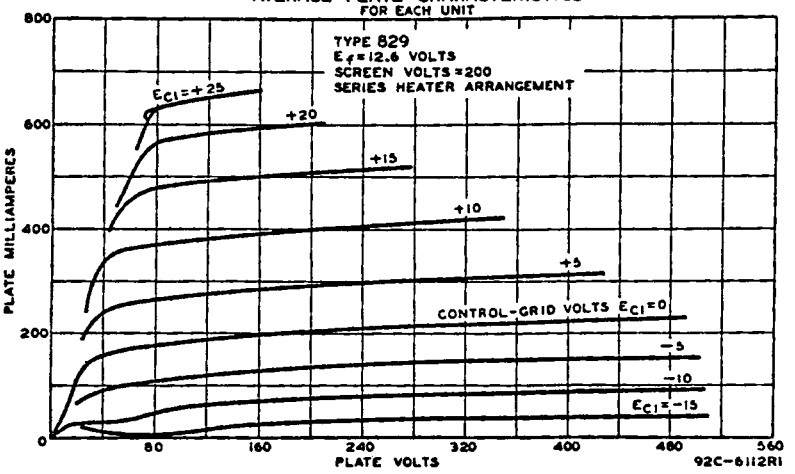
NOTE 1: ADJUST COUPLING OF L_1L_2 AND L_3L_4 FOR OPTIMUM GRID EXCITATION.

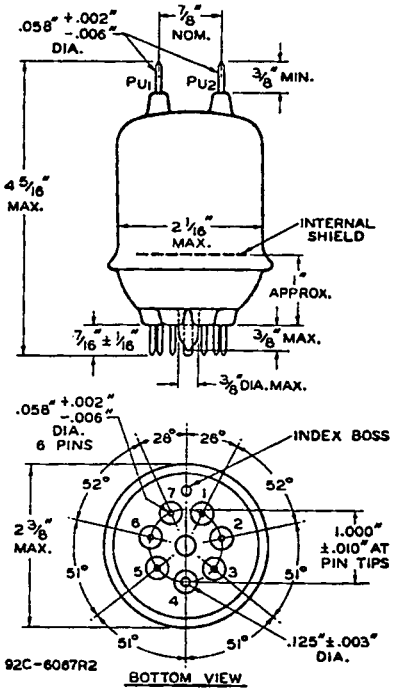
NOTE 2: GRID RESISTORS SHOULD BE ADJUSTED ON L_3L_4 AT VOLTAGE NODE.

TYPICAL CHARACTERISTICS
FOR EACH UNIT



AVERAGE PLATE CHARACTERISTICS
FOR EACH UNIT

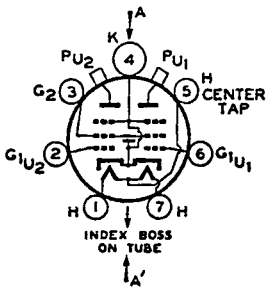




ANGULAR VARIATIONS BETWEEN PINS ARE HELD TO TOLERANCES SUCH THAT PINS WILL FIT GAUGE HAVING SIX 0.080" HOLES AND ONE 0.145" HOLE ARRANGED AT EXACT ANGLES ON 1.000" CIRCLE.

THE PLANE THROUGH THE TUBE AXIS AND EITHER PLATE TERMINAL WILL NOT VARY FROM THE PLANE THROUGH THE TUBE AXIS AT RIGHT ANGLES TO THE PLANE THROUGH PIN 4 AND THE TUBE AXIS BY MORE THAN ±5°.

Bottom View of Socket Connections



PLANE OF ELECTRODES OF EACH UNIT IS PARALLEL TO PLANE THROUGH AXIS OF TUBE AND AA'

Pin 1 – Heater
Pin 2 – Grid No.1 of Unit No.2
Pin 3 – Screen
Pin 4 – Cathode
Pin 5 – Heater Center Tap
Pin 6 – Grid No.1 of Unit No.1
Pin 7 – Heater
P_{U1} & P_{U2} – Plate Terminals of Units No.1 and No.2, respectively