RCA

RCA RADIOTRON DIVISION

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RCA

1628

ULTRA-HIGH-FREQUENCY TRANSMITTING TRIODE

Tantalum Plate

RCA-1628 is a three-electrode transmitting tube of the high-perveance type designed especially for use as an oscillator, r-f power amplifier and frequency multiplier at the ultra-high frequencies. *The 1628 may be operated at maximum ratings at frequencies as high as 500 Mc and at reduced ratings as high as 675 Mc.* Maximum plate dissipation of the tube is 40 watts for class C telegraph service.

The thoriated-tungsten filament of the 1628 is of the double-helical type, and is center-tapped within the tube to minimize the effects of filament lead inductance. Another unusual feature of the tube is its double grid and plate leads which are brought out of the bulb through individual seals. The double leads facilitate neutralization by eliminating common impedances between the tank and neutralizing circuits within the tube. The grid and plate leads are short and heavy in order to further minimize lead inductance and resistance.

The tantalum plate and grid are closely spaced to increase plate efficiency at the higher frequencies by decreasing electron transit-time between filament and plate.

TENTATIVE CHARACTERISTICS and RATINGS

FILAMENT VOLTAGE (A.C. or D.C.)	3.5	Volts
FILAMENT CURRENT	3.25	Amperes
AMPLIFICATION FACTOR	23	
DIRECT INTERELECTRODE CAPACITANCES:		
Grid-Plate	2	μμf
Grid-Filament	2	μμf
Plate-Filament	0.4	μμf
BULB	T-8	
TERMINAL CONNECTIONS (see page 7)	Special	

MAXIMUM CCS RATINGS and TYPICAL OPERATING CONDITIONS

CCS = Continuous Commercial Service

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

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

	(CCS)	
D-C PLATE VOLTAGE	1000 *max.*	Volts
D-C GRID VOLTAGE	-200 *max.*	Volts
D-C PLATE CURRENT	50 *max.*	Milliamperes
PLATE INPUT	50 *max.*	Watts
PLATE DISSIPATION	40 *max.*	Watts

	(CCS)	
TYPICAL OPERATION:		
D-C Plate Voltage	1000	Volts
D-C Grid Voltage of	-120	Volts
from a cathode resistor of	2250	Ohms
Peak R-F Grid Voltage	156	Volts
Peak A-F Grid Voltage	80	Volts
D-C Plate Current	50	Milliamperes
D-C Grid Current (Approx.) **	3.5	Milliamperes
Driving Power (Approx.) o **	5	Watts
Power Output (Approx.)	20	Watts

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

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

	(CCS)	
D-C PLATE VOLTAGE	800 *max.*	Volts
D-C GRID VOLTAGE	-200 *max.*	Volts
D-C PLATE CURRENT	50 *max.*	Milliamperes
D-C GRID CURRENT	15 *max.*	Milliamperes
PLATE INPUT	33 *max.*	Watts
PLATE DISSIPATION	27 *max.*	Watts
TYPICAL OPERATION:		
D-C Plate Voltage	800	Volts
D-C Grid Voltage of	-100	Volts
from a grid resistor of	9000	Ohms
Peak R-F Grid Voltage	160	Volts
D-C Plate Current	40	Milliamperes
D-C Grid Current (Approx.) **	11	Milliamperes
Driving Power (Approx.) **	1.6	Watts
Power Output (Approx.)	22	Watts

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

Key-down conditions per tube without modulation #

	(CCS)	
D-C PLATE VOLTAGE	1000 *max.*	Volts
D-C GRID VOLTAGE	-200 *max.*	Volts
D-C PLATE CURRENT	60 *max.*	Milliamperes
D-C GRID CURRENT	15 *max.*	Milliamperes
PLATE INPUT	50 *max.*	Watts
PLATE DISSIPATION	40 *max.*	Watts
TYPICAL OPERATION:		
D-C Plate Voltage	1000	Volts
D-C Grid Voltage:		
from a fixed supply of *	-65	Volts
from a grid resistor of	4400	Ohms
from a cathode resistor of	1000	Ohms
Peak R-F Grid Voltage	123	Volts
D-C Plate Current	50	Milliamperes
D-C Grid Current (Approx.) **	15	Milliamperes
Driving Power (Approx.) **	1.7	Watts
Power Output (Approx.)	35	Watts

* Grid voltages are given with respect to the mid-point of filament operated on a.c. If d.c. is used, each stated value of grid voltage should be decreased by 1.75 volts and the circuit returns made to the negative end of the filament.

o At crest of audio-frequency 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.

** Subject to wide variations depending on the impedance of the load circuit. High-impedance load circuits require more grid current and driving power to obtain the desired output. Low-impedance circuits need less grid current and driving power, but plate-circuit efficiency is sacrificed. The driving stage should be capable of delivering considerably more than the required driving power.

INSTALLATION

Terminal connections for the 1628 can conveniently be made by means of spring clamps. The clamps should have large-surface contact but should be of small size in order to minimize circuit capacitances. The filament terminals are brought out through a separate seal at one end of the bulb. See page 7 for terminal connections. The 1628 should be installed to operate in a vertical position.

Connections to the grid and plate terminals must be flexible enough so that normal expansion will not place a strain on the glass at the seals, yet heavy enough to carry the high circulating r-f current. The terminal clamps should be fastened to the grid and plate lead connections before the tube is mounted in position. Clamps should be slightly sprung so that they can easily be slipped over their respective terminals. Connections should never be soldered directly to the tube terminals because the heat of the soldering operation may result in cracking of the lead seals. The tube terminal tips should not be used to support circuit parts.

The *bulb* becomes very hot during continuous operation of the tube so that free circulation of air around the tube should be provided. The installation of all wires and connections should be made so that they will not be close to or touch the bulb, in order to avoid puncture of the glass due to peak voltage effects.

The *thoriated-tungsten filament* of the 1628 is center-tapped within the tube. The center lead is brought out of the bulb to a separate connection. With this design, it is possible to minimize filament-lead inductance by connecting all three leads in parallel through r-f by-pass condensers. The center lead of this parallel connection should not be returned directly to the center-tap of the filament-transformer winding or to ground, although it may be by-passed to either of these points if desired. The filament voltage should not vary more than ±5% from the rated value; otherwise, a loss of filament emission may result. It is recommended that, in intermittent service where the average number of daily transmissions is greater than 100, the filament be maintained at 80% of normal voltage during standby periods. If the number of transmissions is less than 100 per day, the filament power should be removed during standby periods.

Overheating of the 1628 by severe overload may decrease its filament emission. The filament activity can sometimes be restored by operating the filament at rated voltage for ten minutes or more with no voltage on the plate or grid. This process may be accelerated by

raising the filament voltage to 4.0 volts (not higher) for a few minutes. The positive high-voltage supply lead should be provided with a protective device, such as a relay. This device should instantly remove the plate voltage when the d-c plate current reaches a value 50% greater than normal.

The *plate* of the 1628 shows a bright red color at its maximum plate-dissipation rating for each service.

R-f by-passing of the grid-and plate-return circuits should be made to the center lead of the filament. It is important that the returns be made to this common connection in order to avoid r-f interaction through common return circuits. In some applications it may also be advisable 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 will not be exceeded, changes in plate and filament voltages due to line-voltage fluctuation, load variation, and manufacturing variation of the associated apparatus must be determined. An average value of plate and filament voltage 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, the plate voltage should be reduced in order to prevent damage to the tube or associated apparatus in case the circuit adjustments are incorrect. It is advisable to use a protective resistance of about 6000 ohms in series with the plate lead during such adjustments. *The rated plate voltage of this tube is high enough to be dangerous to the user. Care should be taken during the adjustment of circuits, especially when the exposed circuit parts are at the high d-c plate potential.*

APPLICATION

In *grid-modulated class C telephone service,* the 1628 may be supplied with d-c grid bias from a cathode resistor, unby-passed for audio frequencies, or from a fixed supply. The audio power required in this service is very small. It need be sufficient only to meet the peak power requirement of the grid of the class C amplifier on the positive crest of the input signal. The actual peak value is generally never more than 3 watts.

In *plate-modulated class C r-f service,* the 1628 may be supplied with grid bias from a grid leak, or from a combination of grid leak and fixed supply, or grid leak and cathode resistor. The cathode resistor should be suitably by-passed for both a.f. and r.f. The combination method of grid leak and fixed supply has the advantage of not only protecting the tube from damage through loss of excitation but also of minimizing distortion by bias-supply compensation.

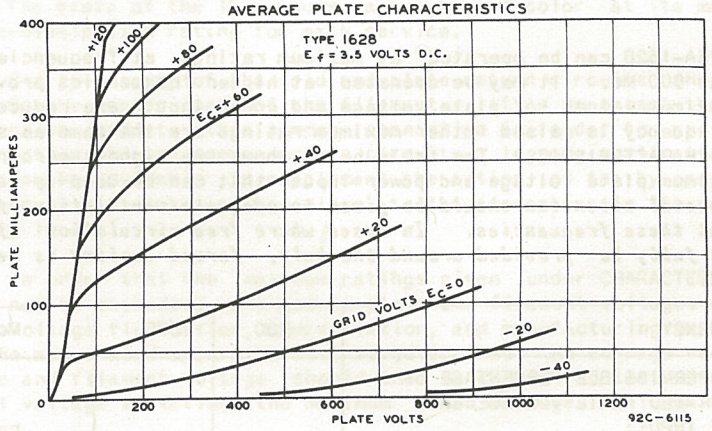
In *class C r-f telegraph service,* the 1628 may be supplied with

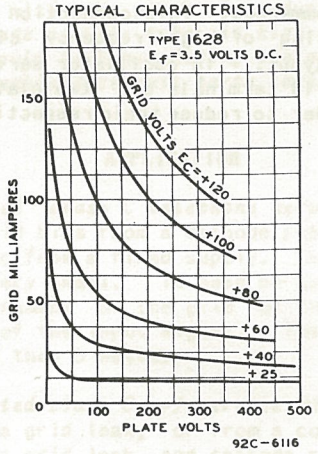
grid bias by any convenient method. When the tube is used in the final amplifier or a preceding stage of a transmitter designed for break-in operation and oscillator keying, a small amount of fixed bias must be used to maintain the plate current at a safe value. If the 1628 is operated at the maximum rated plate voltage of 1000 volts, a fixed bias of -45 volts will reduce the plate current nearly to zero.

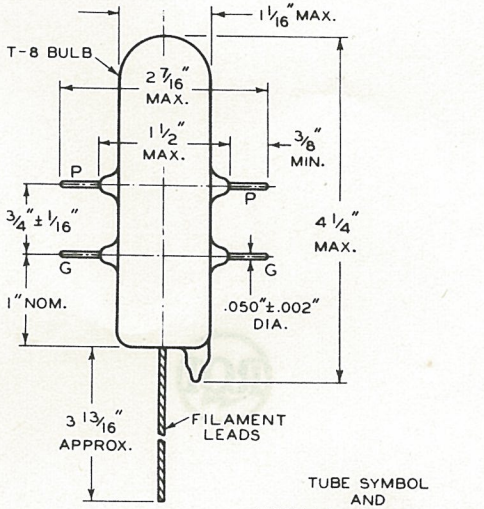
RCA-1628 can be operated at maximum ratings at frequencies as high as 500 Mc. It may be operated at higher frequencies provided the maximum values of plate voltage and power input are reduced as the frequency is raised (other maximum ratings are the same as shown under CHARACTERISTICS). The table below shows the highest percentage of maximum plate voltage and power input that can be used up to 675 Mc. *Special attention should be given to adequate ventilation of the 1628 at these frequencies. In cases where free circulation of air cannot fully be provided around the bulb, forced cooling is recommended.*

FREQUENCY		500	675	Mc
MAX. PERMISSIBLE PERCENTAGE of MAX. RATED PLATE VOLTAGE and PLATE INPUT:				
class C	telephony, grid-mod.	100	83	Per Cent
class C	telephony, plate-mod.	100	83	Per Cent
class C	telegraphy	100	83	Per Cent

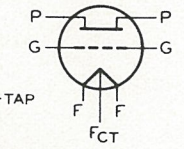
When the 1628 is operated at the ultra-high frequencies, push-pull operation is recommended. This connection has the advantage of simplifying the balancing of high-frequency circuits by providing symmetry of circuit layout. In oscillator service, it is desirable to connect the two grid terminals and two plate terminals of each tube in parallel in order to reduce their respective lead inductances.







TUBE SYMBOL AND TERMINAL CONNECTIONS



P = PLATE
G = GRID
F = FILAMENT
F_{CT} = FILAMENT CENTER-TAP

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