RCA-5893 is a medium-mu triode of the "pencil-type" construction intended particularly for use in grounded-grid service as a plate-pulsed oscillator up to 3300 megacycles per second. In such service, it is capable of giving a useful peak power output of 1200 watts.

The 5893 may also be used as an rf power amplifier, cw oscillator, or frequency doubler up to 1000 megacycles per second particularly in low-power mobile transmitters. As an unmodulated class C rf power amplifier under ICAS conditions, this tube is capable of delivering a useful power output of approximately 6 watts at 1000 megacycles per second.

Featured in the 5893 is an improved "pencil-type" construction which not only meets requirements as to minimum transit time, low lead inductance, and low interelectrode capacitances, but also provides other desirable design features such as extreme sturdiness, small size, light weight, low heater wattage, good thermal stability, and convenience of use in equipment design. The tube has a length of only 2-5/16 inches and a diameter of only 1/4 inch exclusive of the grid flange.

The coaxial-electrode structure is of the double-ended metal-glass type in which the plate cylinder and cathode cylinder extend outward from each side of the grid flange. The latter is particularly effective in permitting isolation of the plate circuit from the cathode circuit in grounded-grid service. In addition, the disk-seal type of electrode termination, inherent in the design of "pencil-type" tubes, permits the utilization of closed-cavity resonators which minimize power loss through radiation, besides giving much lower inductance values and higher resonant frequencies than are obtainable with wire leads. Although designed for use in circuits of the coaxial-cylinder type, the 5893 is also suitable for use in circuits of the line type and lumped-circuit type.

**GENERAL DATA**

Electrical:
- Heater for Unipotential Cathode:
  - Voltage (AC or DC): 6.0 ± 10% volts
  - Under Standby Conditions: 6.3 max. volts
  - Current: 0.330 ampere
- Direct-Current Inter-electrode Capacitance (Approx.):
  - Grid to Plate: 1.75 μuf
  - Grid to Cathode: 2.5 μuf
  - Plate to Cathode: 0.07 max. μuf
- Characteristics, Class A Amplifier:
  - Plate Voltage: 200 volts
  - Cathode-Bias Resistor: 100 ohms
  - Amplification Factor: 27
  - Plate Resistance: 6500 ohms
  - Transconductance: 5600 μhos
  - Plate Current: 25 ma

Mechanical:
- Mounting Position: Any
- Dimensions and Terminal Connections: See Outline Drawing
- Plate Seal Temperature: 175 max. DC

**PLATE-PULSED OSCILLATOR** - Class C

Maximum Ratings, Absolute Values:
- For a maximum "on" time of 5 microseconds:
  - PEAK POSITIVE-PULSE PLATE-SUPPLY VOLTAGE: 1750 max. volts
  - PEAK NEGATIVE-PULSE GRID-BIAS VOLTAGE: 150 max. volts
  - PEAK PLATE CURRENT FROM PULSE SUPPLY: 9 max. amp
  - PEAK RECTIFIED GRID CURRENT: 1.3 max. amp
  - DC PLATE CURRENT: 0.003 max. amp
  - PLATE DISSIPATION (Approx.): 1.5 max. watts
  - PULSE DURATION: 5.0 max. μsec

Typical Operation with Rectangular Wave Shape in Grounded-Grid Circuit at 3300 Mc:
- With duty factor of 0.001:
  - Peak Positive-Pulse Plate-Supply Voltage: 1750 volts
  - Peak Negative-Pulse Grid-Bias Voltage: 110 volts
  - Peak Plate Current from Pulse Supply: 3.0 amp
  - Peak Rectified Grid Current: 1.1 amp
  - DC Plate Current: 0.003 amp
  - Useable Power Output at Peak of Pulse (Approx.): 1200 watts
  - Pulse Duration: 1.0 μsec
  - Pulse Repetition Rate: 1000pps

**PLATE-MODULATED RF POWER AMPLIFIER** - Class C Telephony

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

**Maximum Ratings, Absolute Values:**
- DC PLATE VOLTAGE: 260 max. volts
- DC GRID VOLTAGE: -100 max. volts
- DC PLATE CURRENT: 33 max. ma
| DC GRD CURRENT | 15 max. | 15 max. | ma |
| PLATE INPUT | 8.5 max. | 15 max. | ma |
| PLATE DISSIPATION | 5 max. | 5.5 max. | watts |

**PEAK HEATER-CATHODE VOLTAGE:***

- Heater negative with respect to cathode: 90 max. 90 max. volts
- Heater positive with respect to cathode: 90 max. 90 max. volts

**Typical Operation in Grounded-Grid Circuit at 500 Mc:**

- DC Plate Voltage: 250 300 volts
- DC Grid Voltage: -36 -45 volts
- DC Plate Current: 30 30 ma
- DC Grid Current (Approx.): 11 12 ma
- Driver Power Output (Approx.): 1.8 2.0 watts
- Useful Power Output (Approx.): 5.5 6.5 watts

**Maximum Circuit Value:**

Grid-Circuit Resistance: 0.1 max. 0.1 max. megohm

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**RF POWER AMPLIFIER AND OSCILLATOR - Class C Telegraphy**

**Maximum Ratings, Absolute Values:**

| DC PLATE VOLTAGE | 320 max. | 400 max. volts |
| DC GRID VOLTAGE | -100 max. | -100 max. volts |
| DC PLATE CURRENT | 15 max. | 15 max. ma |
| DC GRID CURRENT (Approx.) | 11.5 13 ma |
| DRIVER POWER OUTPUT (Approx.) | 2 2.5 watts |
| USEFUL POWER OUTPUT (Approx.) | 7.5 8.5 watts |

**PEAK HEATER-CATHODE VOLTAGE:**

- Heater negative with respect to cathode: 90 max. 90 max. volts
- Heater positive with respect to cathode: 90 max. 90 max. volts

**Typical Operation as RF Power Amplifier in Grounded-Grid Circuit at 500 Mc:**

- DC Plate Voltage: 300 350 volts
- DC Grid Voltage: -30 -35 volts
- DC Plate Current: 35 35 ma
- DC Grid Current (Approx.): 12 13 ma
- Driver Power Output (Approx.): 1.9 2.4 watts
- Useful Power Output (Approx.): 5.5 6.5 watts

**Typical Operation as RF Power Amplifier in Grounded-Grid Circuit at 1000 Mc:**

- DC Plate Voltage: 300 350 volts
- DC Grid Voltage: -47 -51 volts
- DC Plate Current: 35 35 ma
- DC Grid Current (Approx.): 13 13 ma
- Useul Power Output (Approx.): 5 6 watts

**Maximum Circuit Value:**

Grid-Circuit Resistance: 0.1 max. 0.1 max. megohm

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**FREQUENCY DOUBLER**

**Maximum Ratings, Absolute Values:**

| DC PLATE VOLTAGE | 260 max. | 320 max. volts |
| DC GRID VOLTAGE | -100 max. | -100 max. volts |
OPERATING CONSIDERATIONS

The maximum ratings are limiting values above which the serviceability of the 5893 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 the rating by an amount such that the absolute values will never be exceeded under any usual conditions of supply-voltage variation, load variation, or manufacturing variation in the equipment itself.

The temperature of the plate seal should not exceed 175 degrees centigrade (at the hottest point). The temperature may be measured with temperature sensitive paint, such as Tempilaq. The latter is made by the Tempil Corporation, 132 West 22nd Street, New York II, N. Y., in the form of liquid and stick, and is stated by the manufacturer to have an accuracy of one per cent.

Connections to the cathode cylinder, grid flange, and plate cylinder should be made by flexible spring contacts only. The connectors must make firm, large-surface contact, yet must be sufficiently flexible so that no part of the tube is subjected to strain. Unless this recommendation is observed, the glass-to-metal seals may be damaged.

The heater leads of the 5893 fit the Cinch socket No. 5411953. They should not be soldered to circuit elements. The heat of the soldering operation may crack the glass seals of the heater leads and damage the tube.

The cathode should preferably be connected to one side of the heater. When, in some circuit designs, the heater is not connected directly to the cathode, precautions must be taken to hold the peak heater-cathode voltage to the maximum values shown in the tabulated data.

In grounded-grid plate-pulsed oscillator service, the 5893 should be supplied with bias from a grid resistor. In such service, if the pulse is applied to the plate through a pulse transformer, it is necessary that the contact-potential current in the plate and grid circuits (which can be measured while the modulator is off) be subtracted from the dc plate and grid currents measured during operation in order to obtain the value of plate current for measuring peak plate current and power input. For example, the average contact-potential currents are approximately 0.4 milliampere dc in the plate circuit and 1 milliampere dc in the grid circuit. The value in the grid circuit will vary to some extent with the grid-circuit impedance. A plate current reading of 3 milliamperes during the pulse would, therefore, be corrected to 2.6 milliamperes for use in determining the peak power input.

In plate-modulated class C rf power amplifier service, the 5893 should be supplied with bias from a grid resistor, or from a suitable combination of grid resistor and fixed supply or grid resistor and cathode resistor. The cathode resistor should be bypassed for both audio and radio frequencies. 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 by bias-supply compensation. Grid-bias voltage is not particularly critical so that correct adjustment may be obtained with values differing widely from the calculated values.

In grounded-grid plate-modulated class C telephony service, the 5893 can be modulated 100 per cent if the rf driver stage is also modulated 100 per cent simultaneously. Care should be taken to insure that the driver-modulation and the amplifier-modulation voltages are exactly in phase. In such service, the 5893 requires increased driving power, but increased power output is obtained as shown in the tabulated data.
In class C rf telegraphy service, the 5893 may be supplied with 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 limit the plate current and, therefore, the plate dissipation to a safe value. If the 5893 is operated at a plate voltage of 300 volts, a fixed bias of at least -10 volts should be used.

This effect will be noticed by the simultaneous increase in plate currents of both the output and driving stages.

**Push-pull or parallel circuit arrangements** may be used when more radio-frequency power is required than can be obtained from a single tube. Two tubes in parallel or push-pull will give approximately twice the power output of one tube. The parallel connection requires no increase in exciting voltage necessary to drive a single tube. With either connection, the driving power required is approximately twice that for a single tube. The push-pull arrangement has the advantage of cancelling the even-order harmonics from the output and of simplifying the balancing of high-frequency circuits. When two or more tubes are used in the circuit, precautions should be taken to balance the plate currents.

**Fig. 2 - Average Plate Characteristics of Type 5893.**

**Fig. 3 - Average Plate Characteristics of Type 5893.**

In grounded-grid circuits, the grid-driving voltage and the developed rf plate voltage act in series to supply the load circuit. As a result, the required driving power is increased over that needed for grounded-cathode circuits. The increased driving power is not lost because it appears as output from the grounded-grid stage. If the driving voltage and grid current are increased, the output will always increase.

In tuning a grounded-grid rf amplifier, it must be remembered that variations in the load on the output stage will produce corresponding variations in the load on the driving stage.

**REFERENCES**


Fig. 4 - Average Performance Characteristic of Type 5893.