



BULLETIN

CX-330, CX-331 and CX-332

TWO VOLT FILAMENT TUBES

This group of new and improved battery operated tubes includes a general purpose tube (CX-330), a power output tube (CX-331) and a screen grid tube (CX-332). All three are of the high vacuum type and employ a strong coated type filament. The filament in each type has been carefully designed to take as little power as possible, consistent with satisfactory operating performance. These tubes are particularly suited for use in radio receivers operating either from dry cells or from a storage battery where economy of filament current drain is important.

FILAMENT OPERATING DATA

In order to keep the filament voltage of these tubes within their safe operating range (1.8 to 2.2 volts), two methods are herewith described. The first and preferred method is by use of a rheostat and filament voltmeter connected permanently in the circuit. As these tubes will usually be operated with their filaments in parallel, the size of the rheostat required with various tube combinations and batteries is shown in Table 1. The other method is to make use of a fixed resistance of correct value to limit the voltage to a maximum safe value of 2.2 volts at the peak battery voltage. As the battery is being used the tubes will be operated through their operating range of 2.2 to 1.8 volts. Care must be taken, however, to check the socket voltage with a good quality voltmeter while making the initial installation. Table 2 shows the size of fixed resistor to be used with various tube combinations.

Each of these tubes is discussed in detail as follows:

CX-330

GENERAL PURPOSE TUBE

The CX-330 is a new general purpose tube designed to operate in battery receivers where economy of filament consumption is important. It may be used as a detector or amplifier and has an appearance similar to the CX-299, but has electrical characteristics which are considerably better. By using the CX-330 with the CX-331 (power tube) and CX-332 (screen grid tube) it is possible to construct a modern radio receiver having screen grid R.F. amplification and a power output stage.



CX-331

POWER AMPLIFIER



The CX-331 is a new power amplifier tube designed to give good output volume from battery operated receivers where economy of filament consumption is important. It is the power output member of the "Two Volt Line" which has been developed for economical battery operation. The other tubes in this line are the CX-330 (general purpose tube) and the CX-332 (screen grid tube). By employing these three types of tubes, it is possible to construct a modern radio receiver employing screen grid tubes for R.F. amplification, general purpose tubes for detection and first audio amplification, and this special tube for power output purposes.

The power output of CX-331 is 150 milliwatts which is probably sufficient for loud speaker operation in portable sets but where additional loud speaker volume is required two of these tubes may be used in push-pull to give sufficient volume for ordinary home reception when an efficient loud speaker is used.

FILAMENT

The CX-331 has a coated type filament which operates at a normal voltage of 2 volts and a current of 130 milliamperes. The filament should be operated in accordance with the data specified on page 50.

PLATE AND GRID

The plate of this new power output tube is of the oval construction. This type of plate results in extremely good mutual conductance or power output capabilities with extremely small filament consumption. The grid is also of oval construction and its spacing and wire size has been so chosen to give the greatest possible power output with the limitations of the small amount of filament power consumed. The maximum recommended plate voltage for the CX-331 is 135 volts. At this voltage with the proper grid bias, the average plate current is 6.8 milliamperes. This value should be regarded as an average and tubes will be found to vary somewhat around it.

This tube should always be operated with a grid bias of $-22\frac{1}{2}$ volts and precautions should be taken to prevent operation without this required voltage.

CIRCUIT RECOMMENDATIONS

Tables No. 1 and 2 give the recommended rheostat or fixed resistance values to control the filament voltage. The load resistance for maximum undistorted power output should be approximately 9,000 ohms when the tube is operated with 135 volts on the plate. In resistance coupled amplifiers a grid resistor should have a value of 1 megohm or less. The use of a self-biasing voltage supply is recommended where it is possible to obtain it economically. A typical circuit diagram using the CX-331 connected in push-pull is shown in Fig. 19.

SUBSTITUTION FOR OTHER CUNNINGHAM TUBES

Although it is not generally recommended that CX-331 be used as a substitute for the CX-220, it may be employed by making circuit changes. It will be necessary to provide the proper filament voltage by means outlined under the filament heading. It is also very essential that the proper plate and grid bias voltage be used and in all cases, the initial installation of CX-331 should be carefully made and checked with a good voltmeter.

OPERATING CONDITIONS

Filament Voltage	2.0 volts
Filament Current	0.130 amperes
Plate Voltage (maximum)	135 volts
Grid Bias Voltage	-22.5 volts

AVERAGE CHARACTERISTICS

Amplification Factor	3.8
Mutual Conductance	760 micromhos
Plate Resistance	4950 ohms
Plate Current	6.8 milliamperes
Maximum Undistorted Power Output . .	150 milliwatts
Grid-Plate Capacitance	6.0 mmf.
Grid-Filament Capacitance	3.5 mmf.
Plate-Filament Capacitance	2.0 mmf.

DIMENSIONS

Maximum Overall Length	4¼"
Maximum Overall Diameter	1⅜"

BASE

The new small CX type base is employed on this tube. This base has the same maximum diameter as the base used on CX-299 and CX-220 tubes but instead of the tapered shell a straight side shell is used. This new style base was developed for the slightly larger bulb size employed for CX-331. The standard pin dimensions and connections are employed.

AVERAGE CHARACTERISTIC CURVES

(Pages 63 and 64)

Filament Characteristic—Fig. 7 shows the change of filament current with various filament voltages.

Plate Characteristics—Fig. 9 shows the relation between plate current and plate voltage at various bias voltages.

Mutual Characteristics—Fig. 8 shows a family of grid voltage-plate current curves at various plate voltages.

Dynamic Characteristics—Fig. 10 shows the effect of plate current upon the amplification factor, mutual conductance and plate resistance.

Output Characteristic—Fig. 11 shows the undistorted power output obtainable at various load resistances.

CX-332

SCREEN GRID TUBE



The CX-332 is a new screen grid tube designed for use as a radio frequency amplifier or detector in battery operated receivers where economy of filament consumption is important. This tube used with the others of the new "Two Volt Filament" type, makes possible the construction of a most modern type of receiver operating with much greater economy than has heretofore been possible when using batteries.

The amplification factor of the CX-332 is 580 and the control grid to plate capacity is 0.020 mmf. This high amplification factor and low control grid to plate capacitance makes possible a high voltage amplification per stage.