



PLANAR TRIODE TUBES FOR UHF AMATEUR SERVICE

Planar triodes (or lighthouse tubes) are well suited for amateur use in the UHF spectrum. Various surplus versions, such as the 2C40, 446B and 2C39 have been used at frequencies up to 1300 Mc. A new planar triode, the 3CX100A5 is now available for improved service in this frequency region.

The 3CX100A5 is relatively unknown to the amateur fraternity, but its older relative, the 2C39A, has been long a favorite UHF tube of the "surplus hounds". The 3CX100A5 is an improved, modern version of this old World War II tube, dressed up in a brand-new ceramic and metal envelope. This tube, and its twin, the 7289 fit into the amateur picture very nicely as a straight-through amplifier, a doubler, or as a tripler in the frequency range of 1000 to 3000 Mc. In addition, it is not expensive, and various glass versions of the older 2C39/2C39A/2C39WA can often be obtained at give-away prices on the surplus market.

The following data covers grounded grid operation of the 3CX100A5 as a UHF power amplifier and multiplier. Because of the high power gain of the tube, grounded grid circuitry is desirable, since intercoupling between the input and output circuits is reduced to a minimum, and neutralization is not required. This data can be used to estimate the performance of the 2C39 glass family of tubes by noting that the useful power output of this style tube will be somewhat less (depending upon the frequency) by an amount up to 25-percent at 2.5 kMc as shown on the graphs.

Various 3CX100A5 tubes were run in a coaxial cavity capable of tuning from 1000 mc (1 kMc) to 3000 mc (3 kMc). A series of measurements was made using a representative sample of standard production tubes, with the tube under test operating as an amplifier, doubler and tripler. Drive and output power were carefully measured for each test, and appropriate filters were used to eliminate feedthrough and harmonic power. In the case of the amplifier configuration, the feedthrough power was useful output and therefore was measured as such. When the tube is operated as a doubler or tripler, the feedthrough power is at the driving frequency and is undesired. In actual use, it is necessary to eliminate this power from the output circuit of any grounded grid frequency multiplier. High-Q tuned circuits or wave filters will do the job.

The 3CX100A5 as a Grounded Grid Amplifier

A graph of average tube performance is shown in figure 2 of the UHF grounded grid amplifier circuit. Grid drive, grid bias, and plate loading were adjusted to provide maximum power output while maintaining the plate current at 100 ma. Average potentials for tubes tested are indicated on the graph. At 1300 mc, for example, the 3CX100A5 is capable of a power output of about 47 watts at an efficiency of 47%. The power gain of the tube is 8 decibels, indicating a required drive level of about 7.5 watts as measured at the input of the coaxial fitting to the cavity. Power output gradually decreases as the frequency of operation is raised. At 2400 Mc, power output

(at 100 watts input) drops to 25 watts, and grid driving power increases to 10 watts. Power gain at this frequency is 2.5. The comparative curve for the 2C39A tube over the same frequency range is shown by a dotted line on the graph.

The 3CX100A5 as a Grounded Grid Doubler

The same sample of tubes used in previous tests was used in performing the gain and power output measurements for the doubler configuration. Excitation was applied at half-frequency and the same precautions were followed as in the case of the amplifier. Test conditions were adjusted for maximum power output at a plate current of 100 ma. At 1300 Mc, power output is about 27 watts, with a circuit efficiency of 27%. Power gain is 5.4 decibels. Accordingly, a drive power of about 8 watts is required. At 2400 Mc, power output is 13 watts, with a drive power of about 9 watts. Power gain drops to unity at a frequency of about 2700 Mc. The tube is still useful as a frequency doubler to this frequency, however, as a power output of 10 watts can be obtained. 2C39A curve is shown as dotted line on the graph (figure 3).

The 3CX100A5 as a Grounded Grid Frequency Tripler

The same tubes and general test techniques were used to determine the operating parameters of this tube as a frequency tripler. Drive power was applied at one-third output frequency, and the circuit was adjusted for maximum power output. At 1300 Mc, 17 watts of power were obtained with about 10 watts driving power. At 2400 Mc, power output was about 8 watts, with about 12 watts drive power (figure 4).

Socket and Collets for the Planar Tubes

A complete socket for the 3CX100A5/2C39 type tube is a rare bird indeed: most equipments have the tube sockets built directly into r.f. cavities. Collet rings for the tube, however, may be bought from Instrument Specialties Co., Little Falls, N.J. The catalog numbers are: Plate collet, #97-70; grid collet, #97-72; cathode collet, #97-76; filament collet, #97-280. The Braun Tool & Instrument Co., 140 5th Avenue, Hawthorne, N.J. can supply the following: Plate collet, #134-53; grid collet, #134-51; cathode collet, #165; filament collet (none). A complete socket assembly may be purchased from Jettron Products, Inc., 56 Route 10, Hanover, N.J.

Conclusions

The planar triode tubes of the 3CX100A5 family perform well in the frequency range encompassing the 1215 Mc and 2400 Mc amateur bands. Efficiency is good, considering the frequency of operation. "Radio Engineering" by F.E. Terman indicates that a doubler will provide about 65% of the power output of a straight-through amplifier, and a frequency tripler will provide about 40% of the power output of the amplifier. These figures agree closely with the data shown herein. A pair of 3CX100A5's should make quite a dent in the 1215 Mc band! See you on the high end!

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Type	Manufacturer	Comment
2C39A	Eimac, Machlett	Glass or ceramic construction
2C39WA	"	"
6897	General Electric	Not interchangeable electrically in most high frequency sockets with 3CX100A5 or 7289
2C41	Machlett	Not interchangeable physically with 3CX100A5 or 7289
381	Eimac, Machlett	3CX100A5 type, rated for pulse service (Eimac-glass or ceramic)
3CX100A5	Eimac, Machlett General Electric	All ceramic construction
7289	Eimac, Machlett, General Electric	Identical to 3CX100A5
3CX100F5	Eimac	Identical to 3CX100A5 except heater voltage is 26.5 volts

Figure 1. Planar Triode Tubes

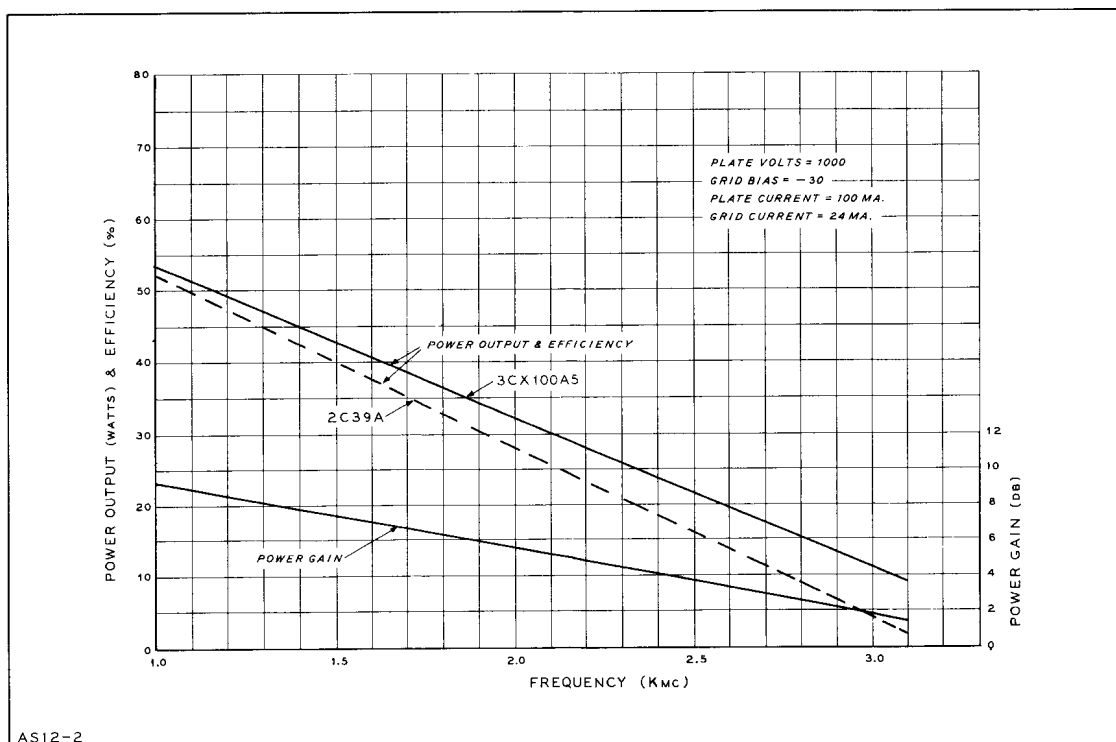


Figure 2. 3CX100A5 grounded grid amplifier; typical power output, gain and efficiency. Glass 2C39A power output shown by dashed line.

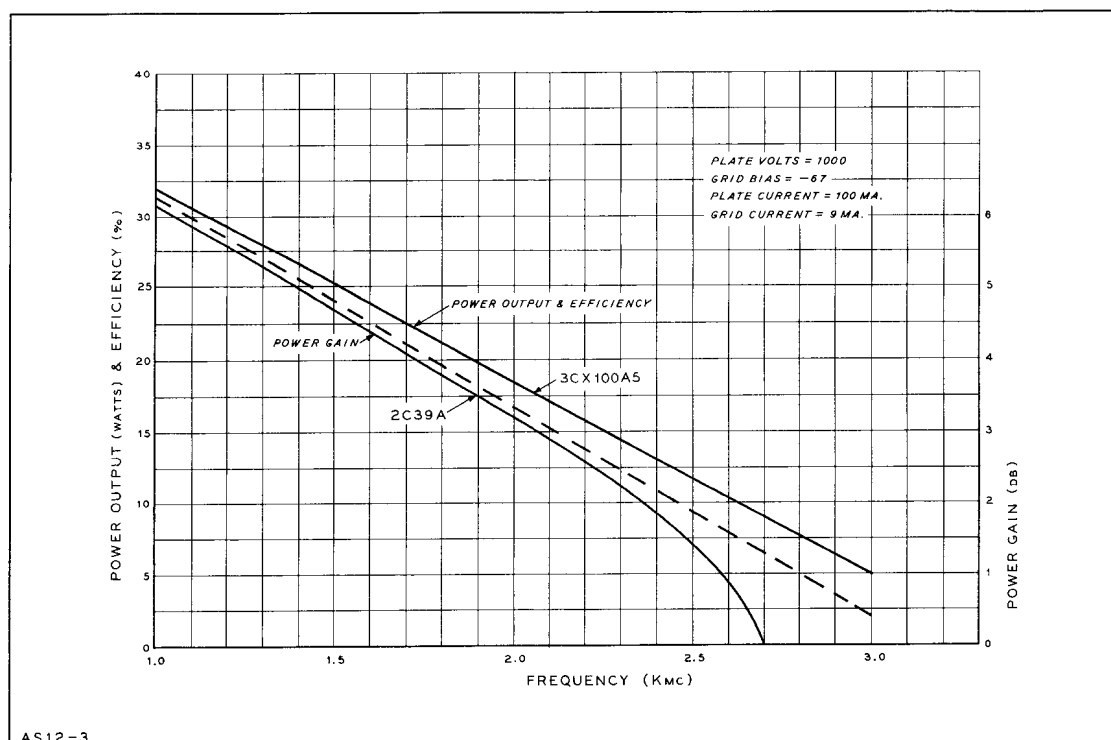


Figure 3. 3CX100A5 grounded grid doubler; typical power output, gain and efficiency. Glass 2C39A power output shown by dashed line.

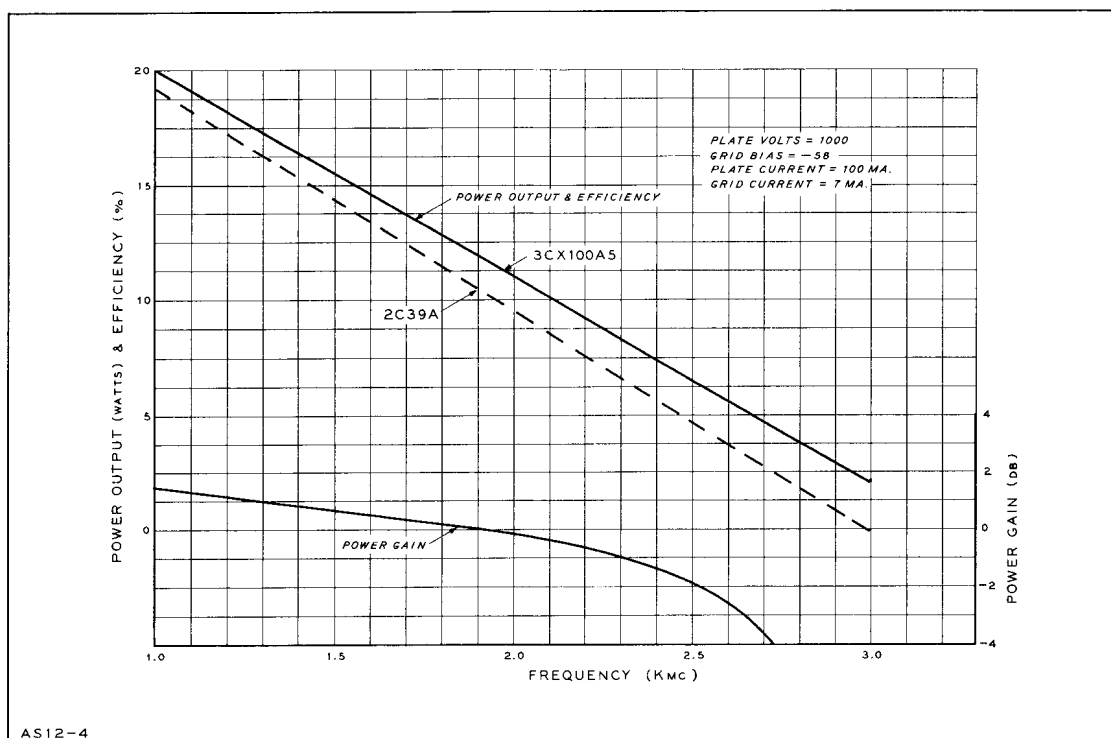


Figure 4. 3CX100A5 grounded grid tripler; typical power output, gain and efficiency. Glass 2C39A power output shown by dashed line.