13 December 1935

NRL Report No. R-1225
BuEng.Prob. No.R2-5

NAVY DEPARTMENT

BUREAU OF ENGINEERING

Report on

Test of U. S. Coast Guard Type CGR-32

High Frequency Receiver

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D. C.

Number of Pages: Text - 26 Tables - 9 Plates - 30

Authorization: BuEng let.S67/46(7-29-W8) of 30 July 1935.

Date of Test: 24 September to 11 October 1935.

Prepared by: S. A. Greenleaf, Asst.Radio Engineer

Reviewed by: T. McL. Davis, Radio Engineer
(Chief of Section)

A. Hoyt Taylor, Principal Physicist
Superintendent, Radio Division

Approved by: H. M. Cooley, Captain, U.S.N., Director

Distribution: BuEng (10)

APPROVED FOR PUBLIC
RELEASE - DISTRIBUTION
UNLIMITED

LP

Table of Contents

Authorization for Test	Page 1
Object of Test	1
Abstract of Test	1
Conclusions	2a
Recommendations	2b
Material under Test	3
Method of Test	3
Data Recorded during Test	5
Probable Error in Results	5
Results of Test	6
Conclusions	25

Appendices

First Oscillator Feed Back to Antenna Binding Posts	Table 1
Accuracy of Resettability	2
Frequency Stability, with Change in Line Voltage	3
Frequency Stability, with Change in Input	4
Frequency Stability with Variation of Manual Volume Control	5
Transrectification	6
Input Impedance	7
Effect of Temperature Change	8
Image Response	9
Wiring Diagram of Type CGR-32 Receiver	Plate 1
Sensitivity - CW for Both Type CGR-32 and Model RAB	2
Sensitivity - MCW for Both Type CGR-32 and Model RAB	3
Selectivity - Band 1	4
Selectivity - Model RAB	4A-4B
Selectivity - Band 2	5
Selectivity - Band 3	6
Selectivity - Model RAB	6A-6B
Maximum Noise Level for CW Reception	7
Maximum Noise Level for MCW Reception	8
Resonant Overload, Band 1	9
Resonant Overload, Model RAB	9A
Resonant Overload, Band 2	10
Resonant Overload, Band 3	11
Load Resistance vs. Audio Output	12
Load Resistance vs. Audio Output, Model RAB	12A
Audio Characteristics, 20,000 ohm output terminals	13
Audio Characteristics, 600 ohm output terminals	14
Audio Characteristics, Model RAB	14A
Audio Characteristics, Model RAB	14B
Audio Overload Characteristics, 20,000 ohm terminals	15
Audio Overload Characteristics, 600 ohm terminals	16
Manual Volume Control Characteristics	17
Manual Volume Control Range and Linearity, 2750 kilocycles	18
Manual Volume Control Range and Linearity, 4500 kilocycles	19
Manual Volume Control Range and Linearity, 12,250 kilocycles	20
Noise Level vs. Signal plus Noise	21
Automatic Volume Control Characteristics	22

AUTHORIZATION FOR TEST

1. The tests herein reported were authorized by ref.(a). Other additional references pertinent to the tests are listed as refs.(b) to (m).

Reference: (a) BuEng let.S67/46(7-29-W8) of 30 July 1935.
(b) Specifications RE 13A 403C.
(c) Specifications RE 13A 500A.
(d) Specifications 17-I-12.
(e) Specifications RE 10A 263H.
(f) Specifications RE 13A 346U.
(g) Specifications RE 13A 317F.
(h) Specifications 17-I-14.
(i) Hygrade Sylvania Corp'n Instruction Book for Type CGR-32 receiver.
(j) NRL let.F42-1/JJ (4750) of 23 June 1932.
(k) Specifications RE 13A 600.
(l) Specifications RE 13A 488B.
(m) NRL let.S67/46 of 12 Sept.1935 to BuEng.

OBJECT OF TEST

2. The object of test is to obtain performance data on subject equipment for comparison with data taken on Navy standard equipments of a similar nature; also to determine to what extent the mechanical and constructional details and status of the component parts meet the requirements of the latest specifications for standard Navy equipments, for which purpose the specifications, ref.(c), covering the Class IA and IIA radio receivers have been taken as a guide, in so far as applicable.

ABSTRACT OF TEST

3. The Type CGR-32 receiver was tested for performance in a manner similar to test previously made on the Model RAB equipments, particularly with respect to sensitivity and selectivity. Other tests were made for compliance with the mechanical, constructional and electrical requirements of ref.(c), which specifications are considered as embodying conformity to the advancement in the radio art since the issuance of the specifications under which the Model RAB receivers were built, ref.(b). The following tests were made:

(a) Sensitivity.
(b) Selectivity.
(c) Maximum noise level.
(d) Resonant overload.
(e) Manual volume control.
(f) Automatic volume control.
(g) Frequency range.
(h) Resettability.
(i) Image response.
(j) Audio frequency cross talk.
(k) Frequency stability with change in input signal.
(l) Frequency stability with change in sensitivity control.
(m) Frequency stability with change in line voltage.
(n) Frequency stability under vibration.
(o) Interaction (multiple operation).

Recommendations

(a) While the nature of this problem is such that recommendations are not called for, it will be noted by reference to the summary of defects and items wherein subject receiver falls short of the requirements of standard specifications, that the Type CGR-32 receiver could not be recommended for use in the Naval Service.

MATERIAL UNDER TEST

4. One Type CGR-32 high frequency receiver, Serial #2.
One Type CGR-35 receiver power pack, Serial #1.

This equipment was manufactured for the U. S. Coast Guard by the Hygrade Sylvania Corporation, Clifton, New Jersey, under Contract TCG-20349 dated 3 May 1933. The material was received at the Laboratory on 11 August 1935 from the New York Navy Yard, and its condition indicated that it had seen considerable service.

METHOD OF TEST

5. Radio frequency input voltages were obtained from standard signal generator, Model LC-1, Serial #18. Audio frequency voltages were obtained from a General Radio Type 513B audio oscillator, Serial #44, used in conjunction with a General Radio Model 546A microvolter, Serial #119, and an audio amplifier of Laboratory construction.

6. Outputs were measured with an output meter of Laboratory construction, impedance 600 ohms, employing a Model 600 rectifier type voltmeter, and also a General Radio Type 483C output meter, Serial #107, impedance 20,000 ohms.

7. A General Radio Type 617A, Serial #30, interpolation audio oscillator was used in connection with frequency stability tests.

8. The equipment used for the measurement of time constants was as follows:

General Radio Type 377B, Serial #136, audio frequency oscillator.
General Electric Type HC-10-A1, Serial #712,478, cathode ray oscillograph, modified to use an RCA Type 905 tube.
Circular time sweep of Laboratory construction.
Electronic relay of Laboratory construction.
Standard signal generator, Model LC-1, Serial #18.

9. Vibration tests were made on a table devised for use in testing aircraft receivers and is described in ref.(j).

10. The tubes used in the subject receiver during the tests were selected from Laboratory stock and had characteristics which were within the Naval specifications for the particular types of tubes employed.

11. Sensitivity. Measurements of sensitivity were made by the application of a pure CW signal through a 300-ohm resistance, and with the gain adjusted for 0.42 milliwatts of noise. Standard output was taken at 5 milliwatts, at the speaker terminals, across the 600-ohm load of the output meter, with a 1,000 cycle output signal. MCW sensitivity was measured with the application of a CW signal modulated 30% at 1,000 cycles, through a 300-ohm resistance, with the CW oscillator off and the gain adjusted for 0.42 milliwatts of noise, except where maximum noise was less than 0.42 milliwatts. Standard output was taken as 5 milliwatts across 600 ohms as above. The standards were adopted that the results might be directly compared with those previously taken on the Model RAB.

22. Interaction. Interaction between receivers when operated on common antenna was determined by noting the response at various frequencies on the Model RAB receiver, as the signal was set up by the r.f. oscillator of the subject receiver.

23. Audio Frequency Characteristics. Audio characteristic measurements were made by disconnecting the plate of the detector tube, inserting the equivalent plate impedance of the tube in the plate circuit, and applying audio frequency voltage through a blocking condenser across the circuit from plate terminal to ground.

DATA RECORDED DURING TEST

24. Complete data was recorded for all tests conducted and this together with data obtained previously on the Model RAB equipments which are included for comparative purposes, are contained in Tables 1 to 9, inclusive, and Plates 1 to 22, inclusive appended hereto.

PROBABLE ERROR IN RESULTS

25. The equipment under test and all measuring instruments incorporating tubes or other devices which are dependent upon temperature for stability were allowed to operate for a sufficient length of time prior to each test to permit them to become stabilized.

26. In estimating the overall accuracy of the results obtained, consideration is given to the manufacturer's rating of probable errors in the instruments used, and the factors entering into the measurements involved, notwithstanding the fact that the greatest care was used in the manipulation of all controls and the maintenance of correct voltages.

27. Particular attention was given to the elimination of leakage from the signal generator inasmuch as there were many measurements made with outputs less than one microvolt. No rating of accuracy is given by the manufacturer under five microvolts, and there are no graduations on the "microvolts" dial under 0.3, the readings under 0.3 microvolts having to be estimated. The estimated overall accuracy for the various tests made is given below:

Nature of Test	Estimated Overall Accuracy
Sensitivity	± 25%
Selectivity	Sensitivity ± 25%) Frequency variation ± .001%)
Maximum noise level	± 10%
Resonant overload	± 10%
Audio frequency characteristics	± 0.5 dbs.
Manual volume control	± 10%
Automatic volume control	± 10%
Frequency range	± 1%
Resettability	± 10%
Image response	± 10%
Audio frequency cross talk	± 20%

Nature of Test	Estimated Overall Accuracy
Frequency stability	3 parts in 10^6
Interaction	± 10%
Output impedance characteristics	± 10%
Time constant	± 10%
Effect on change in temperature	Freq. 3 parts in 10^6) Sensitivity variation .1μv.)

RESULTS OF TEST

28. The following results are reported with reference to specifications for the Class IA and IIA equipments, ref.(c), which are used in this report as a guide and as a standard of requirements for equipments which are considered suitable for use in the Naval Service.

29. The sub-paragraphs are identical with those in ref.(c), the purpose being to show wherein the subject equipment exceeds or falls short of meeting the requirements for standard equipments. Where the paragraphs of ref.(c) are not applicable, due to the difference in the circuits and the associated features involved, this will be indicated. Other paragraphs are inserted covering details where comparison is made with Model RAB equipments, which will also be indicated, using the paragraph numbers of ref.(c) covering similar items.

30. Description of Type CGR-32 Receiver. The type CGR-32 receiver is of the double detection, or superheterodyne type, with one stage of tuned radio frequency amplification, first detector and separate heterodyne oscillator, two stages of intermediate frequency amplification, second detector and separate heterodyne oscillator, a volume control tube, and one stage of audio frequency amplification. The receiver operates from a 100 - 120 volt, a.c. supply, and covers the following frequency range by the use of plug-in coils:

2.6 to 2.75 megacycles
3.95 to 4.5 megacycles
8.0 to 12.25 megacycles

31. The fundamental elements of the circuit are as follows:

(a) Antenna circuit
(b) First tuned circuit
(c) H.F. amplifier tube
(d) R.F. transformer and second tuned circuit
(e) First detector tube
(f) H.F. oscillator tube
(g) First I.F. transformer
(h) First I.F. tube
(i) Second I.F. transformer
(j) Second I.F. tube
(k) Third I.F. transformer
(l) Second detector tube
(m) I.F. oscillator
(n) Volume control tube
(o) A.F. transformer
(p) A.F. amplifier tube
(q) Output transformer
(r) Voltage divider.

Details of the circuits involved may be found by reference to the wiring diagram which is a part of this report, Plate 1.

32. Description of Type CGR-35 Power Pack. The fundamental elements of the power pack are as follows:

(a) Transformer
(b) Rectifier tube
(c) Filter system

(a) Transformer. The transformer primary has a .1 mfd. by-pass condenser to ground from each side of the supply line. The secondary consists of three separate windings, one for filament supply to the receiver, one for the filament of the rectifier tube, and one for the high voltage supply to the plates of the rectifier tube.

(b) Rectifier tube. The rectifier tube is a commercial Type 80 full wave rectifier.

(c) Filter system. The filter system is made up of three sections with one 4 millihenry r.f. choke, two audio chokes of 2.5 henries each, one .02 mfd. condenser, and three 8 mfd. condensers.

There are two of the above complete units in the CGR-35 power pack.

33. Par.1-1. These specifications, ref.(c), do not apply, but are used only as a guide, as outlined in the introduction, par.28, under RESULTS OF TEST.

34. Par.1-2. The subject receiver is not of the general service type suitable for operation over a wide range of frequencies, as the frequency range is limited to three small bands considerably separated. The subject receiver is not suitable for satisfactory operation on vessels of the U.S. Navy or Naval Radio Shore Stations inasmuch as the requirements of standard specifications are not met in several respects.

35. Par.1-3. Does not apply. Subject equipment is complete in itself, and capable of operating independently from a 115-volt a.c. power line.

36. Par.1-4. The frequency range covered by the subject receiver is as follows:

2.6 to 2.75 megacycles
3.95 to 4.5 megacycles
8.0 to 12.25 megacycles

37. Par.1-5. The requirements of this paragraph have been met in subject receiver.

38. Par.1-6. Subject receiver is designed for operation on either a single wire or dipole antenna, or a 50 to 600 ohm transmission line.

39. Par.1-7. (a) Subject receiver has a moderately high maximum noise level.

(b) The sensitivity to noise ratio is considered to be good.

(c) Subject receiver is notably lacking in protection against strong local signals to permit duplex operation, due to the long time constant and failure of the AVC to function when high signal voltages are applied.

(d) A high degree of oscillator frequency stability is shown in subject receiver.

(e) The recovery of subject receiver from the effects of static is very poor due to the long time constant.

(f) The design of subject equipment is such that failures may be expected when subjected to high humidities, particularly with respect to the cartridge type paper foil condensers, mica trimmer condensers, r.f. inductances, and the fabric covered wiring.

40. Par.1-8. The receiver and power pack are both designed for relay rack mounting and are not advantageously adaptable for table mounting. The receiver is not completely housed in a metal cabinet about two inches of the chassis frame being exposed on two sides and the back, although the sides and back of this frame are solid and act as a continuation of the case. They are not black lacquer finish, however, to match the case.

41. Par.1-9. Subject receiver is of the superheterodyne type and employs plug-in coils.

42. Par.1-10. Subject equipment is designed for a.c. power supply, but the receiver may also be used with battery supply.

43. Par.2-1 to 2-26. Consideration was given to the definitions contained in these paragraphs in determining the proper test procedures except where other methods were used in order to make the results comparable to those obtained in tests previously made on the Model RAB equipments.

44. Par.3-1. The maximum undistorted output is 650 milliwatts which is governed by the limitations of the audio amplifier tube.

45. Par.3-2. Subject receiver is designed to use single wire antenna as specified and dipole antenna or transmission line may also be used.

46. Par.3-3. Frequency range is:

2.6 to 2.75 megacycles
3.95 to 4.5 megacycles
8.0 to 12.25 megacycles

47. Par.3-4. There is but one main tuning control.

48. Par.3-5. Type of operation - superheterodyne.

49. Par.3-6. Frequency changing, plug-in coils.

50. Par.3-7. Total number tuned r.f. circuits - two, not including h.f. oscillator.

51. Par.3-8. Number of pre-tube selective circuits - one.

52. Par.3-9. Mounting, panel construction, relay rack mounting.

53. Par.3-10. Finish, black, semi-gloss leatherette lacquer.

54. Par.3-11. Type of reception - pure CW, ICW, MCW, damped, and voice.

55. Par.3-12. CW reception, heterodyne oscillator.

56. Par.3-13. Audio tuning, fixed and peaked at approximately 800 cycles.

57. Par.3-14. Volume control, manual and automatic.

58. Par.3-15. Output impedance, 600 and 20,000 ohms.

59. Par.4-1. No comment.

60. Par.4-2. Electrical indicating instruments. None.

Name plates. Plated and etched name plates are provided, one on the receiver panel 2-1/4" x 2-5/8", and one on the power pack 1-3/4" x 2-5/8", giving the name of the unit and type number, contract number and date, serial number and manufacturer's name, and manufactured for the U.S. Coast Guard, the range also being given on the receiver name plate. These, for obvious reasons, do not meet the requirements of ref.(e).

Vacuum Tubes. The tube complement of the subject equipment is as follows:

1 - Type 36 volume control
1 - Type 37 second detector
6 - Type 39 oscillators, h.f. amplifier, 1st detector, and i.f. amplifier.
1 - Type 41 a.f. amplifier
2 - Type 80 rectifiers

All of the above are listed as having been given type approval in ref.(f) except the Type 41, which is covered in ref.(k), indicating subsequent approval.

Ceramic insulating materials. Ceramic insulation is used for tube sockets, the bases supporting the plugs for plug-in coils, supports for tuning condenser stator plates, radio frequency coil forms, and supporting end plates. Non-compliance with specifications, ref.(g), is noted in that r.f. coil forms are cemented to the end plates supporting them. Small blocks of ceramic material are also used to support the grid leads to the main tuning condenser.

Phenolic insulating materials. Bakelite of unknown quality is used for the output terminal block, and the multi-contact switches have fiber insulation.

Capacitors. There are two paper foil by-pass condensers in steel containers.

There are five molded mica condensers and 19 cartridge type paper foil condensers with paper cases all of Aerovox manufacture. There is one adjustable mica condenser 2 to 35 mmf., 1 Dubilier molded mica condenser (apparently a replacement) and 13 "toothpick" type mica condensers. The figure 13 includes the condensers of this type mentioned under description of coils in a subsequent paragraph.

There are three electrolytic condensers of 8 mfd. capacity each.

The trimmer condensers are variable mica dielectric.

The main tuning condenser consists of three separate variable air condensers all operated by a rack and pinion geared to the main tuning dial control. The rack is of the floating type, with springs to take up any slack in the meshing of the gears. The main shaft to which the tuning dial is secured is an extension of the shaft of the center condenser. Secured to this shaft also is the pinion which meshes with the rack, the rack being meshed at either side with the pinions secured to the other two condenser shafts.

The individual condensers are single hole mounting type of frail construction with thin stamped plates and much less rugged than any which have been considered acceptable in the various types of receiving equipment for the regular Naval Service. The contact to the rotor plates is made through a pig-tail which runs through the center of the shaft, and being subject to torsion, the fine strands will in time crystalize and break, causing a noisy contact.

61. Par.4-3. Receiver chassis and cover. The panel, chassis, and cover are of aluminum, the outside of panel and cover having a semi-gloss black leatherette lacquer finish of a coarser grain than the standard black wrinkle finish. The inside has a sand blast finish, also the shield plates and chassis. The panel is 3/16" thick, 10-1/2" high and 19" wide and is secured at the bottom with screws and elastic stop nuts to front of the chassis, and at the top with diagonal braces 5/8" wide and 3/32" thick which are screwed to the top of the chassis. The chassis is a one-piece box of pressed aluminum 2-1/2" high, 17" wide and 10-3/8" deep, the open bottom being covered with an aluminum shield plate of 1/16" thickness.

The cover has a top, two sides, and back only, is of 1/16" aluminum which slips under two clips on the back of panel, and has three slots at the bottom edge of the back to slip over screws for securing to the chassis. The top and sides are of one piece, formed and riveted to the back piece, the top measuring 10-7/16" x 17", the sides 7-1/2" x 10-7/16", and the back 7-1/2" x 17".

The panel, being made for rack mounting, extends 1" beyond the chassis on either side and has four slots at the edge of either side for securing screws. The frame supporting the interchangeable coils is riveted to the panel.

R.F. coil assemblies. The r.f. coils are wound with enameled wire on ceramic forms which are grooved to hold the winding in position. The pitch is such as to allow spacing between the turns. However, the plate coil windings have the turns in between the turns of the enameled wire and are of silk-covered wire of a size which fills the space, thus making continuous contact except for the wire insulation.

The coil forms have ceramic end plates of 1/4" thickness which are slipped over the ends of the form and cemented to the form. One end plate is bolted to the metal coil assembly shield and supports the coil as well as the jacks for the coil terminals. The other end plate supports two each variable mica trimmer condensers, adjustable through holes in the coil shields. "Toothpick" type mica condensers are mounted on the bare wire leads running from the coil terminal jacks to the trimmer terminals. There are six of this type condenser in the lowest frequency coil assembly, and three each in the other two higher frequency assemblies. There are three coils in each assembly. Coil terminals are soldered to lugs which depend upon the pressure of the nuts securing the jacks for contact. The coils appear to have a light amyl-acetate coating only.

The antenna coil in each assembly is layer-wound with silk-covered wire on one end of the first coil form and has copper spacers held in position by slots in the form.

Intermediate Frequency Coils. The i.f. coils have a top ceramic plate 1/4" thick bolted to the top of a shield can, and which in turn supports two variable mica trimmer condensers. Also bolted to this plate with wooden spacers, is a fiber strip to which strip the wooden coil form of 9/16" diameter is secured. Two universal wound self supporting coils are mounted on this form and the form, spacers, and coils are wax treated. Coil terminals are soldered to the trimmer condenser terminals, to which are also soldered the leads from the coil.

R.F. Choke Coil. The choke coil in the plate circuit of the detector tube consists of universal wound coils on a wooden form, and the entire assembly is wax treated.

Controls. There are five knurled composition knobs symmetrically arranged on the front of the panel. Three of these operate multiple switches of Yaxley manufacture, with fiber insulation and inserted contact points of a special alloy. These switches are single hole mounting and subject to turning if the clamping nut becomes loosened. These are the "TEL-SPKR", "CW-VOICE", and "MVC-AVC" switches. The fourth knob operates the volume potentiometer of 10,000 ohms resistance and of carbon coated bakelite construction with a sliding contact. This is also single hole mounting. The fifth knob is the main tuning control which is a friction vernier drive on the main dial. The dial is enclosed with a window in the panel and is of celluloid illuminated with a pilot lamp from behind.

Power Pack. The front panel is of 3/16" aluminum and extends one inch beyond the case at either side, with slots for rack mounting as on the receiver. The chassis and cover are of 1/16" steel, the chassis being secured to the panel with screws and elastic stop nuts. The cover has top, sides, and back only, and slips under clips on the panel and is secured with screws to the chassis at the back as in the receiver unit. The panel and cover have black leatherette lacquer finish the same as on the receiver unit. There is a removable plate on the front of panel for the insertion of tubes, and ventilating holes are provided in this plate and in the cover. There are two separate and complete power units contained in the one power pack, each consisting of one Type 80 tube, phenolic base tube socket, multi-wound transformer in a steel case, choke coil in steel case, three section electrolytic condenser in one aluminum case, one choke coil wound on a slotted composition form, one cartridge type paper

foil condenser with paper covering, one pilot lamp, one "on-off" toggle switch with phenolic insulation and single hole mounting, and one phenolic base tube socket for connection of the power leads to the interconnecting cable from receiver. A cartridge type paper foil condenser is placed across the line input terminals, but no fuses are provided in either side of the line.

62. Par.4-4. The workmanship is considered to be good, although re-soldering of leads in the coil assemblies was necessary before this test was made.

63. Par.4-5. The plating on the metal containers for transformers and other parts where steel is used appears to be of such quality as to be reasonably resistant to corrosive action of a moist sea atmosphere. Switch points are of silver or other special alloy which is also resistant to this action.

64. Par.4-6. Iron or steel has been used in the following places in subject equipment: cases containing the audio filter coil, audio transformer, and output transformer, the chassis and cover of the power pack.

65. Par.4-7. Complete data for the temperature test are given in Table 8.

66. Par.4-8. No fuses are provided in the a.c. line supply to the power pack.

67. Par.4-9. Ventilating holes are provided in the power pack. No provision is made for ventilation in the receiver unit, but the size of the cover is considered sufficient to permit dissipation of the heat generated by the tubes, resistors, or other elements.

68. Par.4-10. The equipment operated continuously for the periods of the tests without damage or interruption. However, it was necessary to resolder joints, recement the ceramic coil forms, replace the volume control potentiometer, and clear grounds due to poor condition of the rubber covered grid leads; also to readjust the trimmer condensers prior to starting the tests, indicating inability to withstand service use without damage.

69. Par.4-11. Subject equipment was found to operate satisfactorily in any position inclining up to 45° from the vertical.

70. Par.4-12. Satisfactory operation was obtained when the receiver was placed on a vibration table, vibrating from 1200 to 2000 cycles per minute, the table used being the one described in ref.(j).

71. Par.4-13. The requirements of this paragraph are not applicable.

72. Par.4-14. Name plates are provided, as heretofore described, applicable only to Coast Guard equipment.

73. Par.4-15. No comment.

74. Par.4-16. All machine screws and nuts have been secured by the use of lock washers in the receiver chassis. Screws in the receiver panel and power pack are secured with elastic stop nuts.

90. Par.5-7. The dimensions and weight of the power pack are as follows:

Height - 5-1/4 inches
Length - 19 inches
Depth - 9-7/16 inches, not including projections
Depth - 10-1/4 inches overall
Weight - With tubes, 30 lbs.

91. Par.5-8. Subject receiver is designed for rack mounting and is removed from the rack as a complete unit, the cover being removed as a separate operation.

92. Par.5-9. One interconnecting cable is furnished, permanently connected at the receiver end.

93. Par.5-10. The interconnecting cable is 6 feet long and the cover is removable without interference with the cable.

94. Par.5-11. The finish is not black wrinkle, but a black leatherette lacquer.

95. Par.5-12. Special access opening for the removal of tubes is provided in the power pack panel only.

96. Par.5-13. No handles are provided on the front of panel on receiver or power pack.

97. Par.5-14. No bolts are provided for securing the panels to rack.

98. Par.5-15. All controls are on the front of panel and are symmetrically arranged.

99. Par.5-16. The purpose of each control is marked on the panel adjacent to each control.

100. Par.5-17. All markings are engraved and filled with aluminum paint, and are plainly readable at a distance of 24 inches.

101. Par.5-18. Not applicable.

102. Par.5-19. This specification is not applicable except that the total number of tubes is in excess of allowance, there being nine in the receiver and one required in the power pack. The tubes employed are as follows:

1 - commercial Type 36
1 - " " 37
6 - " " 39
1 - " " 41
2 - " " 80 (one for each receiver used)

103. Par.5-20. There are no r.f. band change switches.

104. Par.5-21. Not applicable.

105. Par.5-22. Not applicable.

106. Par.5-23. The main tuning dial is provided with a scale 0 to 150 with 150 equal divisions.

107. Par.5-24. The main tuning control is so arranged that the values of settings increase numerically with the final controlled effect; i.e., with frequency. Rotating the vernier in a clockwise direction rotates the main tuning dial and scale in a counterclockwise direction past the stationary indicator, which has the same effect as the indicator moving in a clockwise direction over the scale.

108. Par.5-25. The main tuning scale markings are not visible at an angle exceeding 45° from the perpendicular due to the dial surface being set in one-half inch from the front of panel with an opening approximately 1-1/4 inches wide at the top and 1 inch wide at the bottom.

109. Par.5-26. Main tuning is accomplished with vernier control only.

110. Par.5-27. The main tuning vernier has a ratio of approximately 6 to 1.

111. Par.5-28. The vernier on the main tuning dial is friction driven instead of gear driven and inasmuch as there is no vernier dial, the accuracy of setting depends upon the reading of the main dial. This drive operates smoothly and without any apparent back or torque lash.

112. Par.5-29. The vernier is a friction drive on the main tuning dial, which dial is directly secured to the shaft of the center one of the ganged tuning condensers. This shaft has a pinion which is geared to the rack, the rack in turn being geared to the pinions on the shafts of the other two tuning condensers. To compensate for back and torque lash, and "spot wear", the rack is of the floating type, upon which is a spring tension at all times.

113. Par.5-30. There are no panel operated verniers.

114. Par.5-31. Not applicable.

115. Par.5-32. Not applicable.

116. Par.5-33. Not applicable.

117. Par.5-34. Not applicable.

118. Par.5-35. The number of friction or pressure contacts have been kept to a reasonable minimum except in the case of jacks and plugs for the plug-in coil assembly. These are of the General Radio "banana" type which depend upon retention of an initial spring shape for pressure contact. The spring tension tends to become less from continued use and thereby cause faulty contacts.

119. Par.5-36. The accessibility of the integral parts is good, permitting ready replacement without extensive disassembling.

120. Par.5-37. Oscillations for CW reception are controlled by the "CW-MCW" switch.

121. Par.5-38. The tuning arrangements are such that approximate straight line frequency is obtained.

122. Par.5-39. Subject receiver is provided with a shielded output transformer, the secondary of which, however, does not connect to a standard open circuit telephone jack mounted on the front panel. Instead, the output of the secondary both 600 ohm and 20,000 ohm, is connected to terminals on a block at the back of the chassis.

123. Par.5-40, 5-41, 5-42,5-43. Not applicable.

124. Par.5-44. No voltmeter is provided to read heater voltage.

125. Par.5-45, 5-46, 5-47. No output level indicator is provided.

126. Par.5-48. No "on-off" switches are provided on subject receivers for controlling the tube heater circuits and other circuits drawing current with heaters off. The only control is on the power pack.

127. Par.5-49. Not applicable.

128. Par.5-50. The power unit is provided with "on-off" switches operating from the front panel for controlling the a.c. line voltage.

129. Par.5-51. No applicable.

130. Par.5-52. Antenna-ground terminals are not on the operating panel, but are provided on the chassis with a slot in the cover for entry of the leads.

131. Prior to making tests for electrical performance, the following necessary repairs were made:

Coil forms re-cemented to bases.
Open coil windings resoldered to terminal jacks.
Shielding on grid leads cleared from grounds.
Volume control potentiometer was replaced as old one was noisy.
Screws in housing of main tuning condenser replaced where missing.

From the condition of the subject receiver when received at the Laboratory, it was apparent that it had seen considerable service use and handling.

132. Par.6-1. Sensitivity. Sensitivity was measured with a gain setting for 0.42 milliwatts of noise and 5 milliwatts output for comparison with measurements previously taken on the Model RAB equipment, and the results are shown on Plates 2 and 3, along with the measurements of the Model RAB over the same range of frequencies. The sensitivity requirements of this paragraph for the Class IA and IIA receivers are not applicable for direct comparison, as they are predicated upon a different gain setting and output level. The sensitivities obtained in this test are lower than those obtained in the preliminary test, reported in ref.(m), which may be accounted for by the use of extremely short leads replacing the regular output cable supplied with standard signal generators, and the fact that careful realignment of the r.f. and i.f. circuits was made prior to this test.

133. Par.6-2. Selectivity. Selectivity was measured with all receiver adjustments as for MCW sensitivity, at three frequencies in each band, and the results are shown on Plates 4, 5, and 6. Selectivity measurements for the Model RAB for the nearest available frequencies to those covered by the subject receiver, are shown on Plates 4A-4B and 6A-6B. It will be noted that the selectivity measurements for subject receiver are well within the requirements for the Class IA and IIA equipments.

134. Par.6-3. Noise Level. Maximum noise level is shown on Plates 7 and 8. The variation in noise level exceeds 12 decibels in the highest frequency band.

135. Par.6-4. Resonant Overload. Resonant overload does not occur under 300 milliwatts, as shown on Plates 9, 10, and 11. Resonant overload curve for the Model RAB is shown on Plate 9A.

136. Par.6-5. Overload Selectivity. The overload selectivity was not measured due to adequate equipment not being available.

137. Par.6-6. Subject receiver is of the superheterodyne type, radio frequency amplification being accomplished both at the received frequency and an intermediate frequency of 525 kilocycles.

138. Par.6-7. There are but two resonant tuned circuits ahead of the detector.

139. Par.6-8. CW reception is accomplished by means of a separate heterodyne oscillator.

140. Par.6-9. There is but one main tuning control.

141. Par.6-10. Not applicable.

142. Par.6-11. The input impedance of this receiver is relatively low, being in the approximate order as the Model RAB. This should assure satisfactory operation on the same antenna as an RAB, but would cause a serious shunting effect if used with some of the older receivers used in the service which have a high input impedance. The input impedance is shown on Table 7.

143. Par.6-12. Measurement of the current drain from the power pack is as follows:

Filament supply	6.1 volts	2.65 amps.
Plate supply	180 volts	46 milliamps.

144. Par.6-13. No "C" batteries are required, negative bias voltages being obtained from the voltage divider within the receiver.

145. Par.6-14. All "B" potentials are obtained from the voltage divider.

146. Par.6-15. The total supply line consumption is 42 watts.

147. Par.6-16. Similar results are obtained on any supply line frequency from 58 to 62 cycles per second.

148. Par.6-17. Not applicable.

149. Par.6-18. With the application of recurrent impacts of CW signals having a maximum amplitude of 5 volts the time of recovery of normal sensitivity was found to be approximately 1.5 seconds or greatly in excess of the requirements of these specifications.

150. Par.6-19. The subject receiver was connected to the same antenna with a Model RAB through a 300-ohm resistor. The first oscillator voltage produced by the subject receiver on the antenna input of the RAB was measured by substituting a known voltage from a signal generator to give identical output in the RAB. The results are given in microvolts in Table 1.

151. Par.6-20. The stray fields from the audio system were found to be of a low order.

152. Par.6-21. Humidity test was not made due to lack of adequate facilities.

153. Par.6-22, 6-23. No sample parts were submitted for the immersion tests as outlined in these paragraphs.

154. Par.6-24. Not applicable, as the bands cover ranges considerably separated from each other.

155. Par.6-25. Resettability. Subject receiver complies with the requirements of this paragraph, the accuracy of resettability being shown in Table 2.

156. Par.6-26. Not applicable.

157. Par.6-27. Not applicable.

158. Par.6-28. Subject receiver has two sets of output terminals, one designed for operation into 20,000 ohm telephone receivers and the other into a 600 ohm loud speaker. The optimum output load for the speaker terminals is found to be 1500 ohms, instead of 600. Plate 12 shows curves for load resistance vs. audio output for both sets of terminals. Output impedance characteristics for the Model RAB are shown on Plate 12A.

159. Par.6-29. The output is transformer coupled, two secondary windings being furnished thus isolating all d.c. potentials therefrom. There is also an electrostatic shield between the primary and secondary windings. The audio frequency output voltage at the phone terminals is supplied from the terminals of an ungrounded secondary transformer winding. The secondary winding for the speaker terminals is also normally ungrounded, but it has a center tap which is brought out to a terminal on the output terminal block, and may be grounded if desired.

160. Par.6-30. No information is available relative to continuous operation without damage or deterioration except that when the subject equipment was received at the Laboratory after service use; the ceramic coil forms which were cemented to the end plates had become loosened and the mica dielectric trimmer condensers were out of adjustment; also, the wire insulation was badly deteriorated.

161. Par.6-31. Frequency Stability. Frequency stability with change in line voltage ± 10% from 115 volts is shown in Table 3 and is well within specification requirements.

162. Par.6-32. Not applicable.

163. Par.6-33. Not applicable.

164. Par.6-34. No change in output frequency was noted when the subject receiver was placed on a vibration table, vibrating from 1200 to 2000 cycles per minute.

165. Par.6-35. Frequency stability with change in input from 0.1 microvolt to 50 microvolts input required for maximum output with optimum gain setting is shown in Table 4 and is within specification requirements except at the highest frequency.

166. Par.6-36. Frequency stability with variation of the manual volume control from maximum to zero is shown in Table 5 and is within the requirements of this paragraph.

167. Par.6-37. There are no controls other than the main tuning control and volume control.

168. Par.6-38 to 6-43, incl. An audio filter consisting of an inductance of 2.5 henries in parallel with an .02 mfd. condenser is connected across the primary of the audio transformer when the "CW-MCW" switch is on CW and disconnected when this switch is on MCW. The characteristics of the audio system, with this filter in and out, are shown for both the phone terminal output and the speaker terminal output on Plates 13 and 14. Audio characteristics for the Model RAB, with the band pass filter out but low pass filter in, are shown on Plate 14A and with the band pass filter in on Plate 14B. Overload characteristics of the audio system are shown on Plates 15 and 16.

169. Par.6-44 to 6-52, incl. Not applicable. No variable frequency audio attenuator is provided in subject receiver.

170. Par.6-53. A manually operated volume control operating from the front of panel is provided.

171. Par.6-54. The range of attenuation is from 72-1/2 to 77 decibels, effective only when inputs do not exceed 470 microvolts at 2750 kilocycles, 364 microvolts at 4500 kilocycles, and 540 microvolts at 12,250 kilocycles, as shown on Plate 17.

172. Par.6-55. Transrectification in the r.f. amplifier tube is found to be excessive, as shown in Table 6.

173. Par.6-56. Selectivities, when measured with minimum gain, and sufficient input to obtain standard output at resonance, do not fall below the measurements taken with optimum gain.

174. Par.6-57. The relationship between the angular rotation of the manual volume control and the audio output in decibels for various input values is shown at three frequencies on Plates 18, 19, and 20. The re-

lationship is not linear and it will be noted that the control becomes decreasingly effective with increased values of input until at 50,000 microvolts and above there is no attenuation whatever with the control at zero degrees of its angular rotation.

175. Since volume control is accomplished by placing bias voltage on the grids of the r.f. and two i.f. Type 39 tubes in addition to the normal 3 volts obtained by use of cathode resistors, it is necessary to have available a grid bias voltage of approximately 45 volts to obtain adequate volume control with this type of tube, according to the tube manuals published by the manufacturers of subject equipment, and other manufacturers. In subject receiver this additional voltage is obtained by use of the drop across a 500,000 ohm resistor in the plate circuit of the volume control tube. The potentiometer regulating the grid bias on the volume control tube, when rotated from maximum to zero, is found to cause a change in plate current in this tube from 0 to .017 milliamperes. This in turn produces a maximum drop across the 500,000 ohm resistor of 8.5 volts. The effectiveness of the volume control is therefore limited by the inadequate bias voltage supply obtainable.

176. Par.6-58. The volume control operates in such a manner as to permit continuous variation in output over its effective range of operation only, these limitations being as indicated in the preceding paragraph.

177. Par.6-59. The manual volume control operates in such a manner as to reduce the noise level in direct proportion to a CW signal, as is shown on Plate 21.

178. Par.6-60. The potentiometer regulating the d.c. bias on the grid of the volume control tube was found to be excessively noisy, and was replaced prior to this test.

179. Par.6-61. The potentiometer control regulates the d.c. grid potential of the volume control tube both for manual and automatic volume control operation.

180. Par.6-62. The variable resistor or potentiometer used for the volume control is not of wire wound construction. The construction is a carbon coated bakelite ring, with a sliding contact over the coated surface.

181. Par.6-63. Subject receiver is provided with an automatic volume control with level adjustment operating from the front of panel.

182. Par.6-64. A separate switch changes the volume control from manual to automatic.

183. Par.6-65. The volume control tube functions for both manual and automatic operation. When on "manual", the potentiometer control regulates the d.c. bias potential on the grid of the volume control tube. When on "automatic", this control functions in the same manner, regulation of the d.c. grid bias potential fixing the level for the AVC. In addition, the switch places the grid of the detector tube, through a coupling capacitor, in parallel with the volume control tube gird, thereby impressing the voltage of the detector grid on the control grid of the volume control tube, with the object of increasing the plate current flow in proportion to the value of the signal voltage applied. The drop across

the 500,000 ohm resistor in the plate circuit regulates the bias on the grids of the r.f. and two i.f. tubes, as heretofore described. Reference to Plate 22 will show that the range over which the AVC is effective is very limited and that in its most favorable condition the output will not be held to closer than 6 db variation for one order of input voltage variation. It is further shown that for inputs greater than 1000 microvolts it is wholly ineffective, the output being approximately the same whether the AVC is in or out. The degree of control could be varied over wide limits by the proper selection of plate potential on the AVC tube and it is not understood why so low a voltage has been furnished as to restrict the control to the extent indicated. This like all other carrier operated AVC systems is not instantaneously effective when the carrier is applied and therefore cannot be classed as an output limiter of the type used in the Model RAB which is particularly adapted to keyed signal level control. The subject system is not designed for keyed signal control as indicated by the instruction book furnished with the equipment; it is intended for MCW only.

184. Par.6-66. Variation in output with respect to variation in input is shown on Plate 22 for five different level adjustments, showing the AVC operation to be such that an input variation of 10 to 1 varies the output approximately 2 to 1 instead of an input variation of 5,000 to 1 for the same output variation as specified.

185. Par.6-67. Operation with respect to holding the output to any predetermined level from 0.5 to 30 milliwatts is ineffective.

186. Par.6-68. The time constant of subject receiver is excessive with or without AVC operation, being at least 50 times greater than allowed.

187. Par.6-69. The variable resistor is the same as described under Par.6-62 and does not comply with the requirements of these specifications.

188. The image response of subject receiver is shown in Table 9. The primary image sensitivity is shown to be 355 microvolts for standard output at a frequency of 4,000 kilocycles. By comparison, the Model RAB gives no audible response for a 500,000 microvolt input and gives 17 microwatts of tone response for a 2 volt input.

189. The following is a summary of defects noted and items wherein the subject receiver falls below the requirements of standard specifications for Naval equipments, in constructional details and electrical performance, the specifications for Class IA and IIA equipments, ref.(c), having been used as a guide in so far as applicable:

(a) The subject receiver is not of the general service type suitable for operation over a wide range of frequencies, as the frequency range is limited to three small bands, considerably separated.

(b) Subject receiver is notably lacking in protection against strong local signals to permit duplex operation and recovery from static surges, due to the long time constant and inadequate functioning of the automatic volume control.

(c) There is insufficient protection from the effects of humidity and salt sea atmospheres.

(d) Subject receiver is not readily adaptable for table mounting as it is designed for rack mounting.

(e) The finish is not standard "black wrinkle".

(f) The total number of tuned r.f. circuits is but two (not including the high frequency oscillator).

(g) No variable audio tuning is provided.

(h) No electrical indicating instruments are provided.

(i) A large number of paper foil condensers are not metal enclosed.

(j) The ganged main tuning condenser is of frail construction, the individual units being of the single hole mounting type and much less rugged than any which have been considered acceptable in receiving equipments for the Naval Service.

(k) Radio frequency coils do not have an approved wax treatment and windings carrying d.c. potentials are not protected from the r.f. windings except by wire insulation.

(l) Cement is used to secure the coil forms to end plates which does not withstand aging, several of the plates having been found loosened.

(m) Coil terminals are soldered to lugs which depend upon the pressure of the nuts securing the jacks for contact.

(n) Trimmer condensers have mica dielectric instead of air.

(o) Electrolytic condensers are used in some instances.

(p) Wire with braided fabric covering is used instead of rubber covering.

(q) No fuses are provided in the a.c. line supply to the power pack.

(r) No asbestos covered wire is used in the power pack.

(s) The main tuning dial is not marked on a 0 - 10 or 0 - 100 basis.

(t) The vernier for the main tuning dial has a ratio of approximately 6 to 1 instead of not less than 20 to 1.

(u) Scale markings are not visible at an angle exceeding 45° from the perpendicular.

(v) The vernier is friction driven instead of gear driven.

(w) Friction or pressure contacts, in the case of the plug-in coil plugs, are not sufficiently rugged to avoid faulty contacts in service use.

(x) There is no telephone jack mounted on the front of the panel.

(y) No "on-off" switches are provided for controlling the tube heater circuits and other circuits drawing current with heater supply off.

(z) The variation in noise level is in excess of 12 decibels in the highest frequency band.

(aa) Subject receiver has a time constant of 1.5 seconds, the excessive time of recovery making efficient reception impossible in the presence of heavy signals or strong static surges.

(bb) Image response, both primary and secondary, is excessive.

(cc) The output of subject receiver first oscillator frequency, fed back into the antenna is excessive.

(dd) Frequency stability with change in input does not meet standard requirements at the highest frequency.

(ee) The manual volume control has a range of attenuation slightly under the requirements of specifications, ref.(c), effective only when the input signal does not exceed the equivalent of 350 to 550 microvolts. The relationship between the angular rotation and the audio output is not linear, and with inputs exceeding the values given above, the control becomes less effective until, with an input of 50,000 microvolts, there is no attenuation whatever.

(ff) The variable resistor used for volume control is not of wire wound construction.

(gg) The operation of the automatic volume control in holding the output to any predetermined level is ineffective.

CONCLUSIONS

190. The Type CGR-32 receiving equipment in its present form, while possessing some performance characteristics which are superior to those found in the Model RAB equipments, notably sensitivity, selectivity, and resonant overload, has many other characteristics of performance, and constructional features which entirely preclude suitability for satisfactory operation in the Naval Service.

191. The prime factors contributing to unsatisfactory performance are the excessive time constant and image response, making the receiver effectively inoperative in the presence of strong key clicks, heavy surges of static, or other interference; also the inadequate functioning of both the manual and automatic volume control. Many of the component parts used in construction are not of an approved type, notably the condensers, both fixed and variable; the inductance coils, and wiring do not meet standard requirements, and other items are not provided which are necessary to meet specifications for standard equipment for the Naval Service. There is also insufficient protection against the effects of humidity and salt sea atmosphere.

192. As compared to the Model RAB receiver, the better showing of the Type CGR-32 receiver in sensitivity and weak signal selectivity is attributed to the fact that less consideration was given to image response, and the use of the comparatively low intermediate frequency of 525 kilocycles. Inasmuch as the selectivity of a superheterodyne receiver is practically inversely proportional to the intermediate frequency used, this should account for the better showing as compared to the Model RAB. It also follows that the better selectivity cuts out more of the impact energy from what are termed "first circuit" noises, permitting a higher gain to be used for the standard noise level at which measurements are made for sensitivity. Under these conditions, less microvolts input are required to produce standard output.

Table 1

(Par. 6-19)

FIRST OSCILLATOR FEED BACK TO ANTENNA BINDING POSTS

Frequency of Oscillator	Frequency at which Voltage Measured	Equivalent Strength of Oscillator Feed Back in Microvolts
4525 kcs	4525 kcs	3000
4525 "	9050 "	1000
4525 "	18100 "	3800

Table 2

(Par. 6-25)

ACCURACY OF RESETTABILITY

Freq.Kcs.	Tuning	Volume Control Setting in degrees	Variation in frequency after resetting-cycles
2600	9.1	139	+300
2750	142.9	137	+101
3950	6.2	122	+427
4500	144.8	120	- 71
8000	9.0	144	+4065
12250	141.2	124	+1843

Table 4

(Par. 6-35)

FREQUENCY STABILITY WITH CHANGE IN INPUT

Freq. Kcs.	Output Frequency 0.1 microvolts input cycles	Output Frequency 50.0 microvolts input cycles	Variation cycles
2600	800	784	- 16
2750	790	765	- 25
3950	800	795	- 5
4500	820	731	- 89
8000	755	702	- 53
12250	800	445	-355

Table 5

(Par. 6-36)

FREQUENCY STABILITY WITH VARIATION OF MANUAL VOLUME CONTROL

Freq. Kcs.	Output Frequency Vol.Control Maximum cycles	Output Frequency Vol.Control Zero cycles	Variation cycles
2600	800	843	+ 43
2750	803	863	+ 63
3950	800	831	+ 31
4500	800	972	+172
8000	800	1044	+244
12250	800	1234	+434

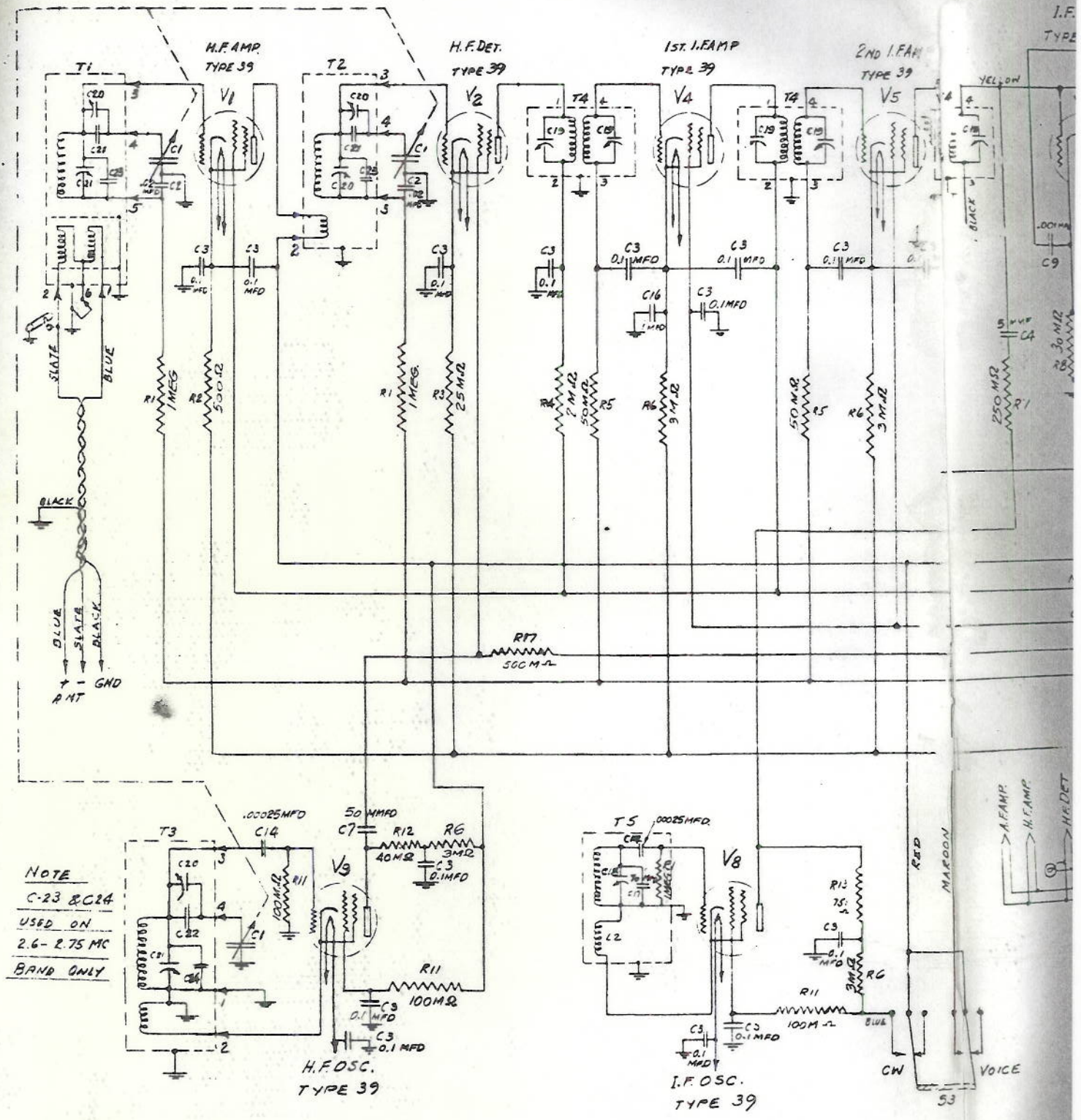
Table 8

(Par. 4-7)

EFFECT OF TEMPERATURE CHANGE

Time	Freq.Kcs.	Temp. °C.	Sensitivity	Remarks
1145, 7 Oct.	12234.5	28	0.2 microvolts	Temp. ambient
1155		0		Placed in control box pre-cooled.
1530	12238.5	+1.5		
1532				Heat turned on
1620	12207.1	+24.5	0.45	
0830, 8 Oct.	12188.4	+48	10.	
1005	12186.7	+48	10.	
1030				Heat turned off
1100	12212.6	+24.5	1.72	
1150	12217.4	+24.5	1.05	
1300	12217.1	+25	0.5	
1600	12215.9	+23	0.8	
0900, 9 Oct.	12216.4	+21	0.55	

Normal sensitivity was restored only after retrimming.



NOTE

C-23 & C24 USED ON 2.6 - 2.75 MC BAND ONLY

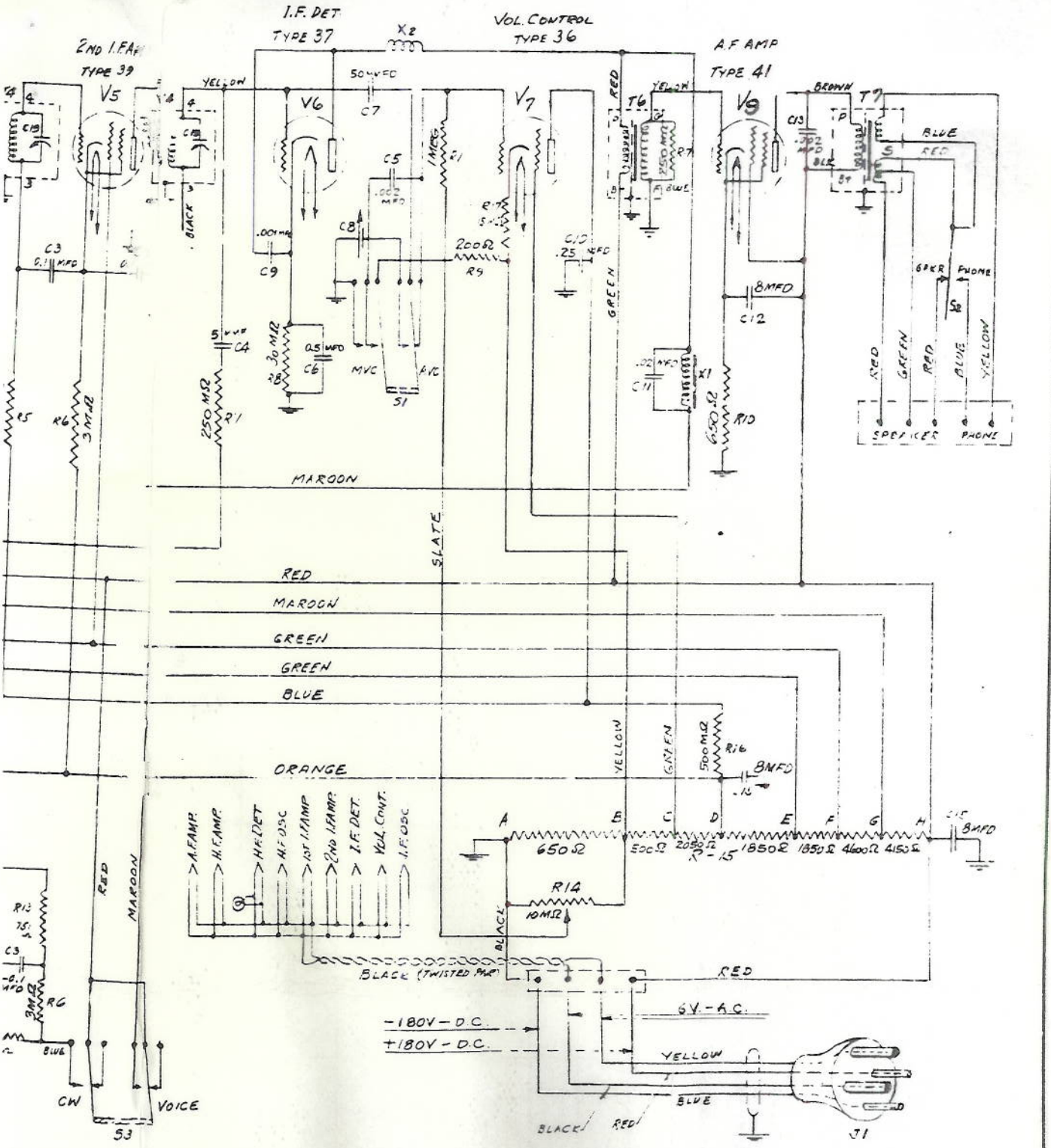
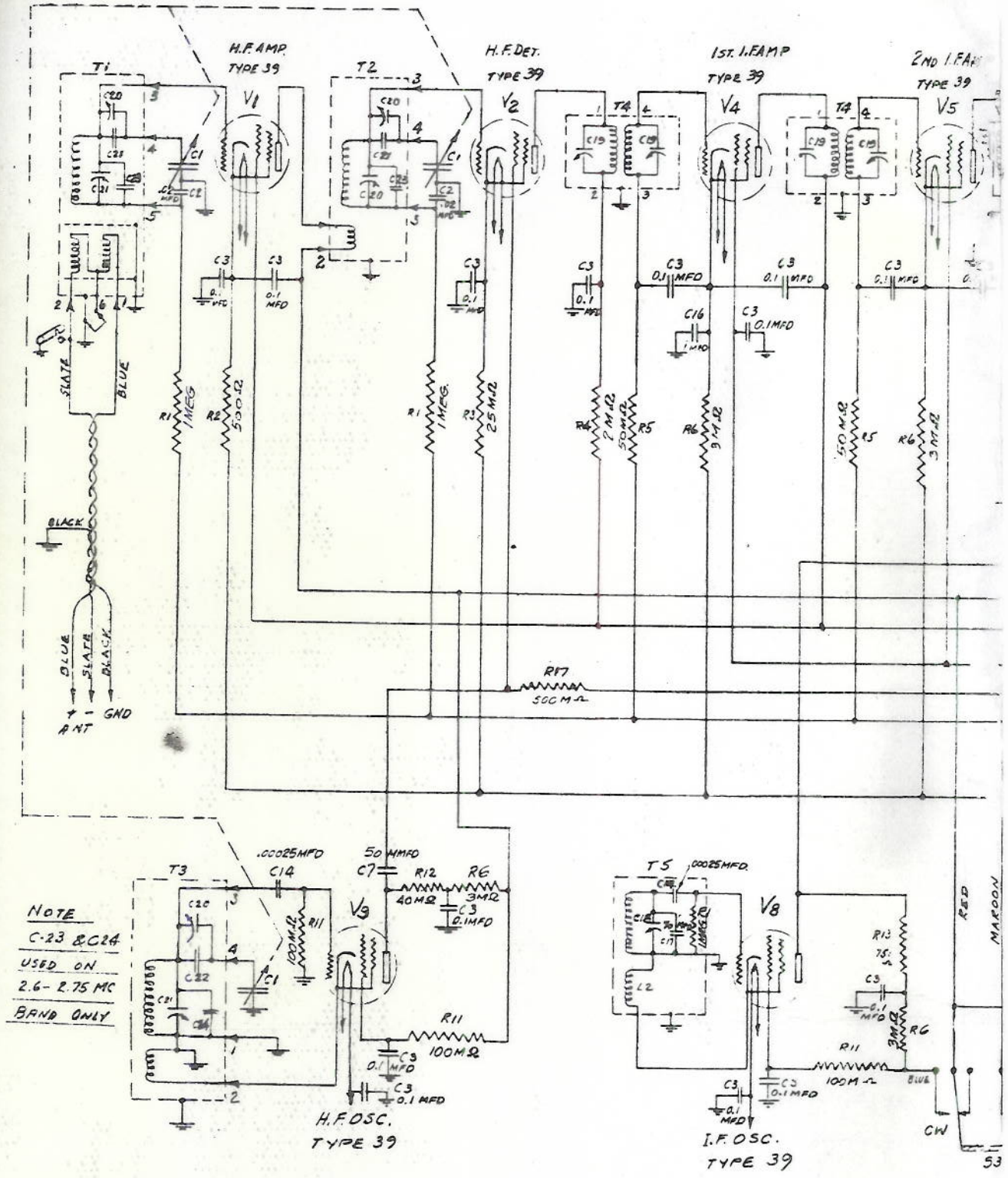


PLATE I

FIGURE XXIII

ALTERATION	APPROVED		
		DRAWN BY H.S.P.	TITLE RECEIVER CGR-32 (RHR-21)
		DESIGNER	
		CHECKED	PART SCHEMATIC CIRCUIT
		APPROVED	
		SCALE —	HYGRADE SYLVANIA CORP. ELECTRONICS DEPT.
SPEC. IB-CGR-32		DATE 8-23-33	DRAWING NO. B-50L-9



NOTE
C-23 & C24 USED ON 2.6 - 2.75 MC BAND ONLY

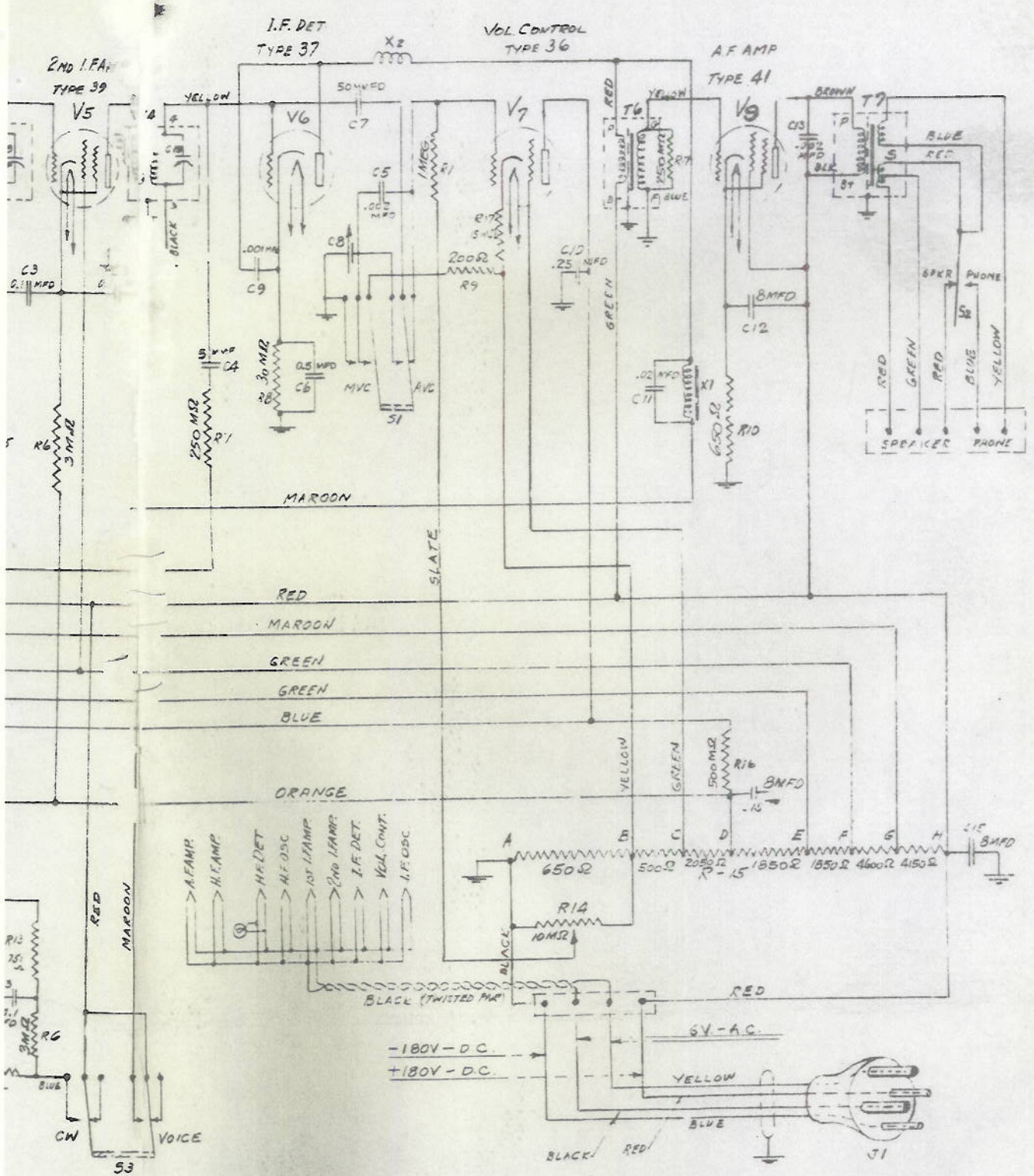
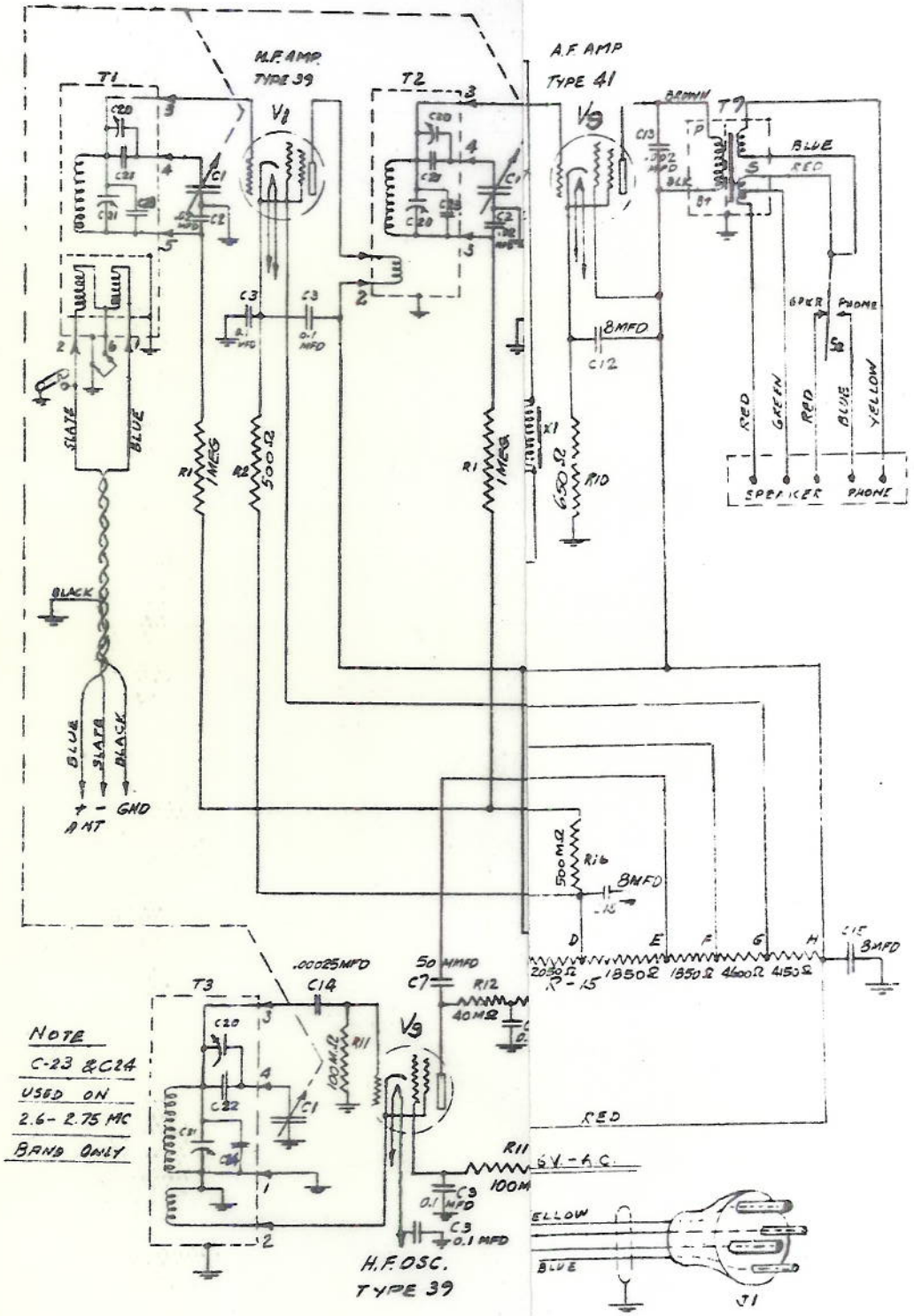


PLATE I

FIGURE XXIII

ALTERATION	APPROVED		
		DRAWN BY H.S.P.	TITLE RECEIVER CGR-32 (RHR-21)
		DESIGNER	
		CHECKED	PART SCHEMATIC CIRCUIT
		APPROVED	
Spec IB-CGR-32		SCALE —	HYGRADE SYLVANIA CORP. ELECTRONICS DEPT.
		DATE 8-23-33	DRAWING NO. B-50L-9



NOTE
C-23 & C24
USED ON
2.6 - 2.75 MC
BAND ONLY

PLATE I

TITLE	RECEIVER CGR-32 (RHR-21)
PART	SCHEMATIC CIRCUIT
HYGRADE SYLVANIA CORP. ELECTRONICS DEPT.	DRAWING NO. B-50L-9

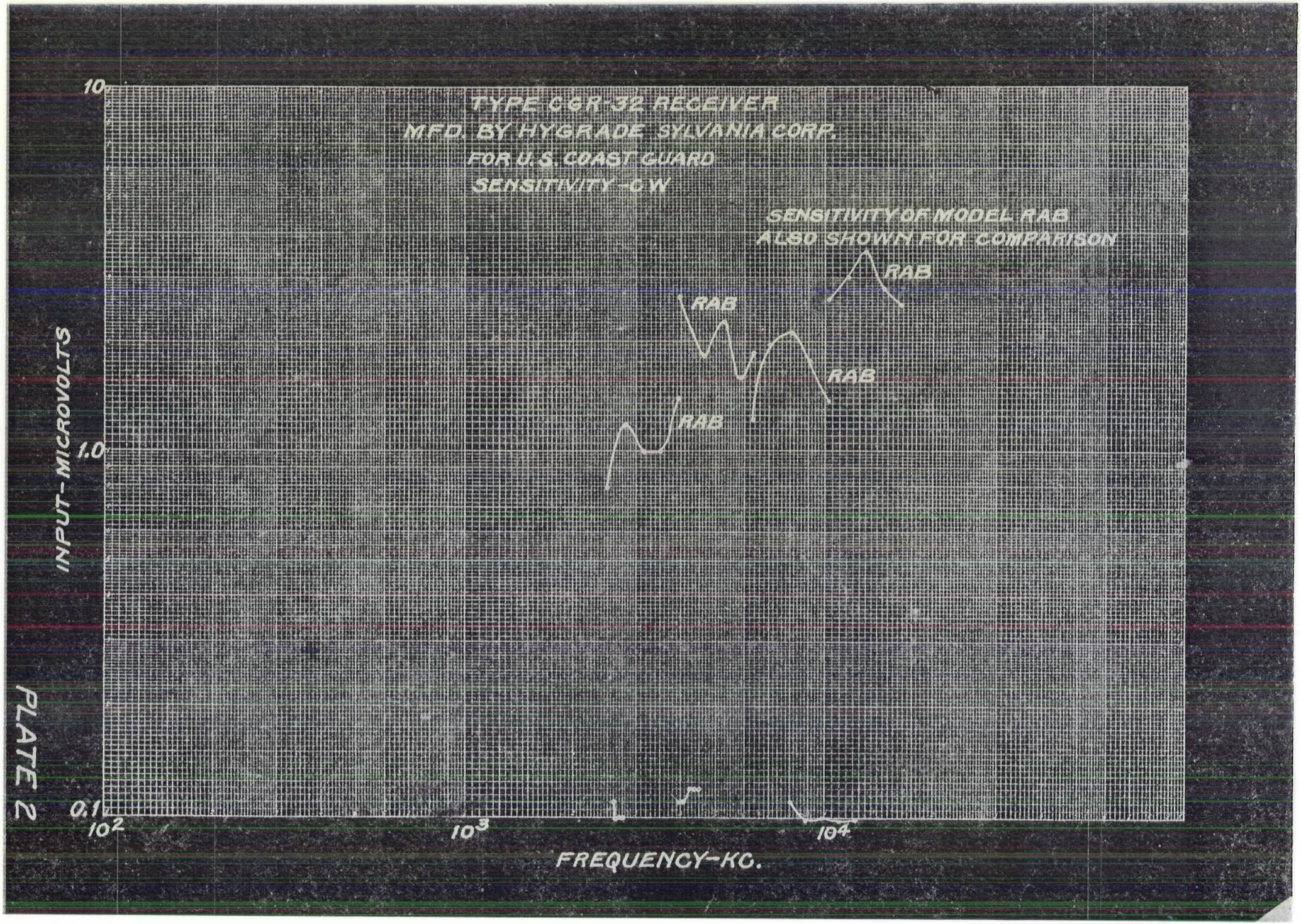
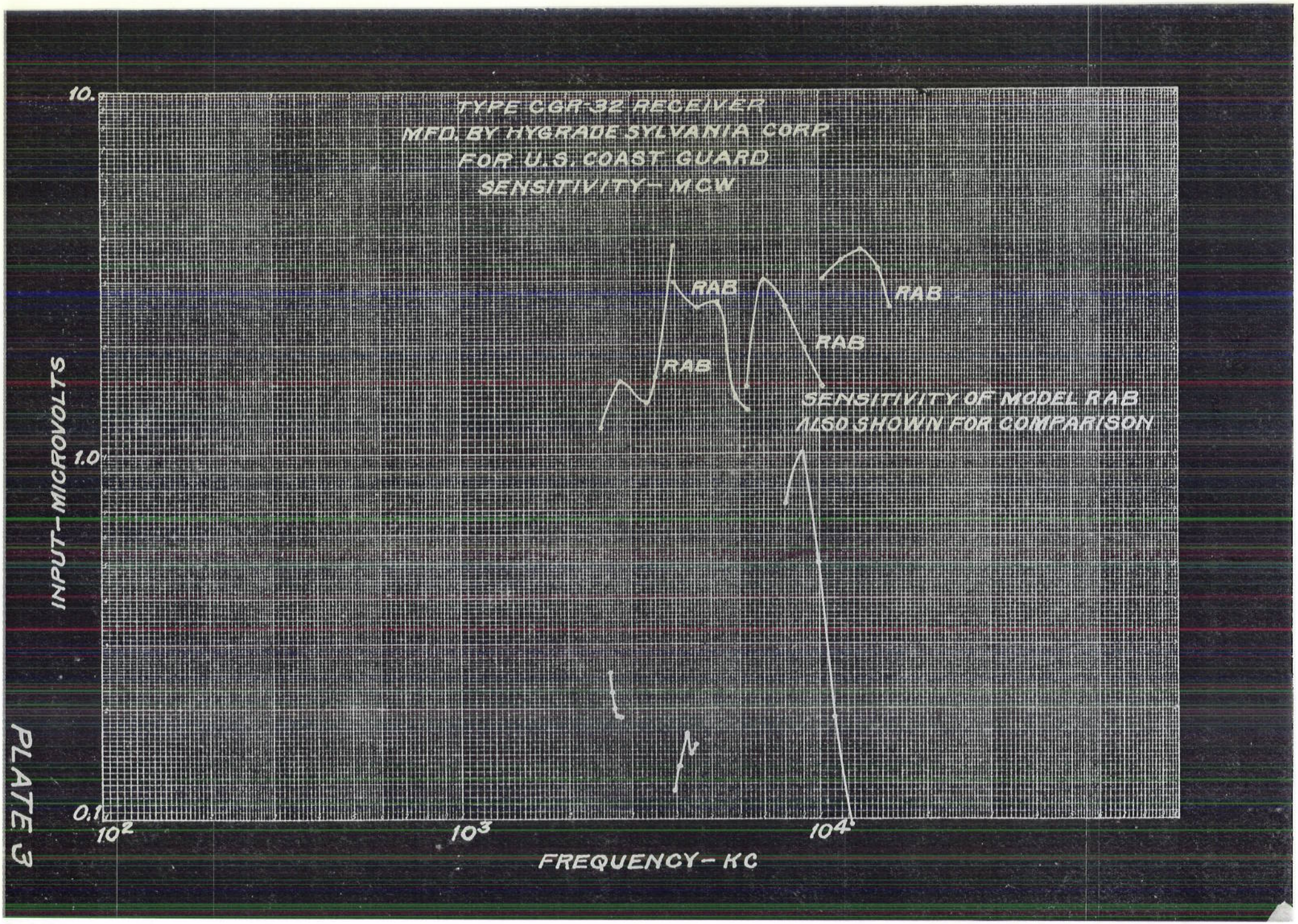

TYPE CGR-32 RECEIVER
M.F.D. BY HYGRADE SYLVANIA CORP.
FOR U.S. COAST GUARD
SENSITIVITY - 6 W
SENSITIVITY OF MODEL RAB
ALSO SHOWN FOR COMPARISON
RAB
RAB
RAB
RAB
10
1.0
0.1
INPUT - MICROVOLTS
10^2
10^3
10^4
FREQUENCY - KC.

PLATE 2


TYPE CGR-32 RECEIVER
MFD. BY HYGRADE SYLVANIA CORP.
FOR U.S. COAST GUARD
SENSITIVITY – MCW
RAB
RAB
RAB
RAB
SENSITIVITY OF MODEL RAB
ALSO SHOWN FOR COMPARISON
10.
1.0
0.1
INPUT – MICROVOLTS
10^2
10^3
10^4
FREQUENCY – KC
PLATE 3

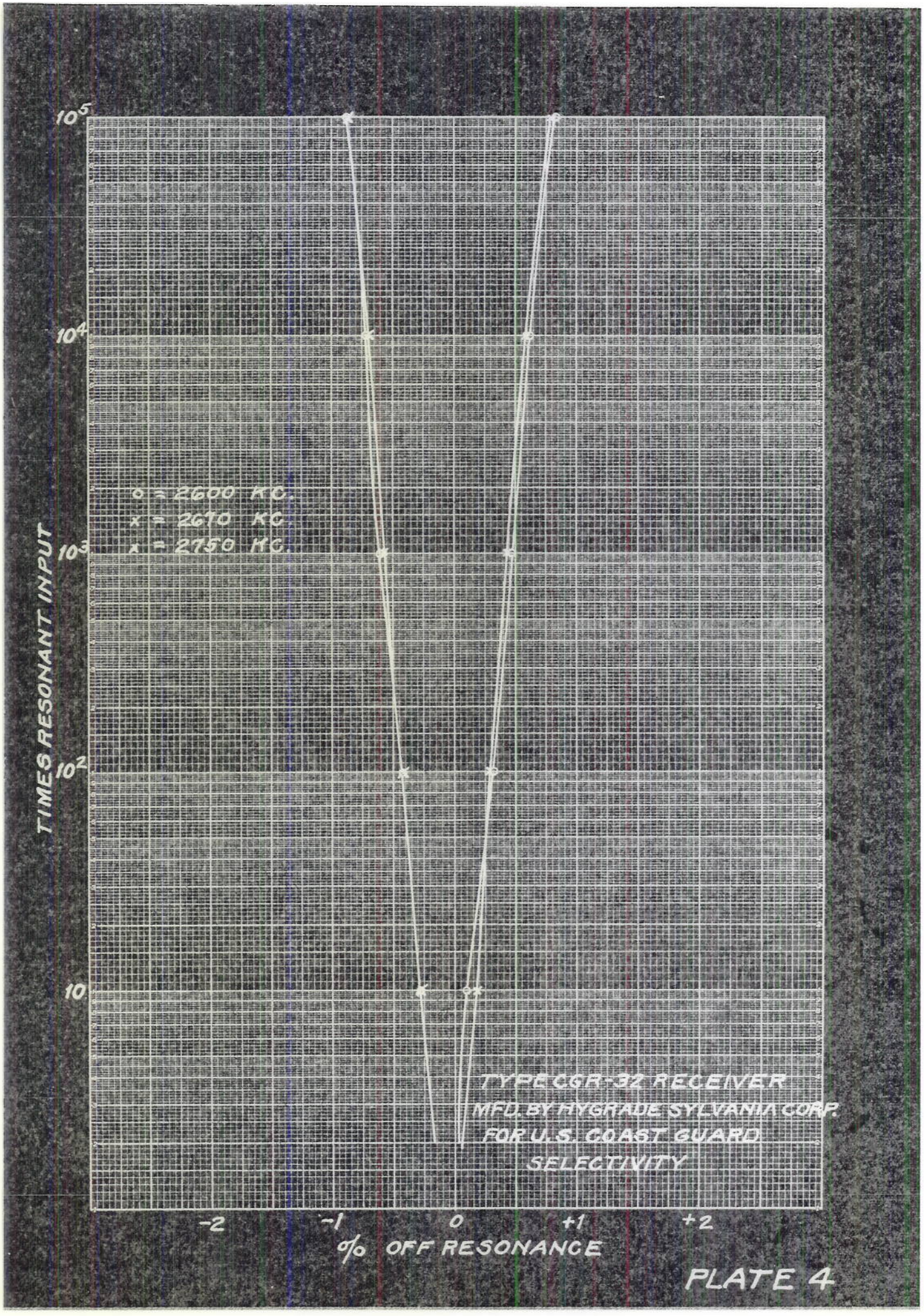

TIMES RESONANT INPUT
10^5
10^4
10^3
10^2
10
o = 2600 KC.
x = 2610 KC.
x = 2750 KC.
TYPE CGR-32 RECEIVER
MFD. BY HYGRADE SYLVANIA CORP.
FOR U.S. COAST GUARD
SELECTIVITY
-2
-1
0
+1
+2
% OFF RESONANCE

PLATE 4

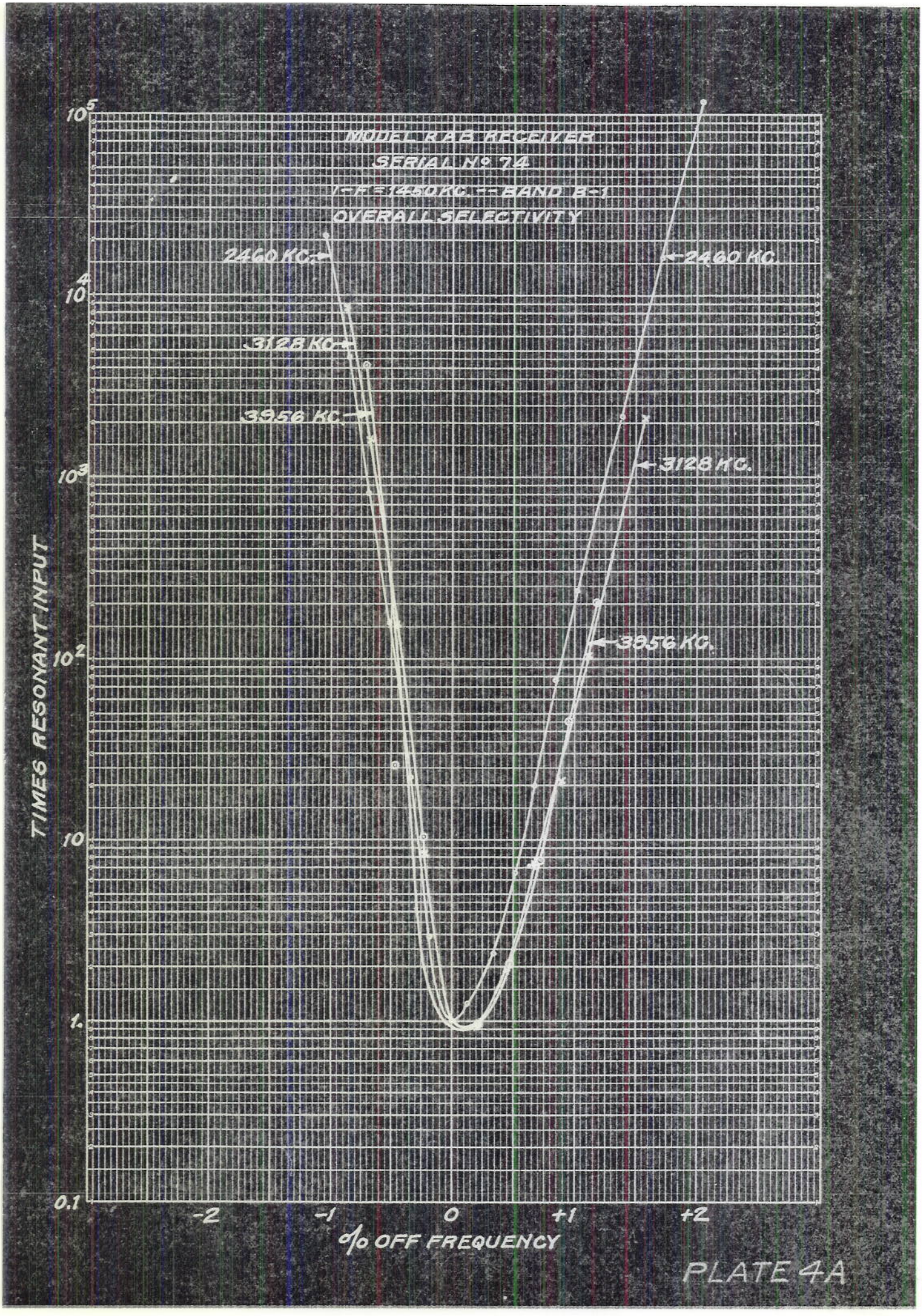

MODEL RAB RECEIVER
SERIAL No. 74
I.F. 2.1450 KC. -- BAND B-1
OVERALL SELECTIVITY
2460 KC.
3128 KC.
3956 KC.
2460 KC.
3128 KC.
3956 KC.
10^5
10^4
10^3
10^2
10
1.
0.1
TIMES RESONANT INPUT
-2
-1
0
+1
+2
% OFF FREQUENCY

PLATE 4A

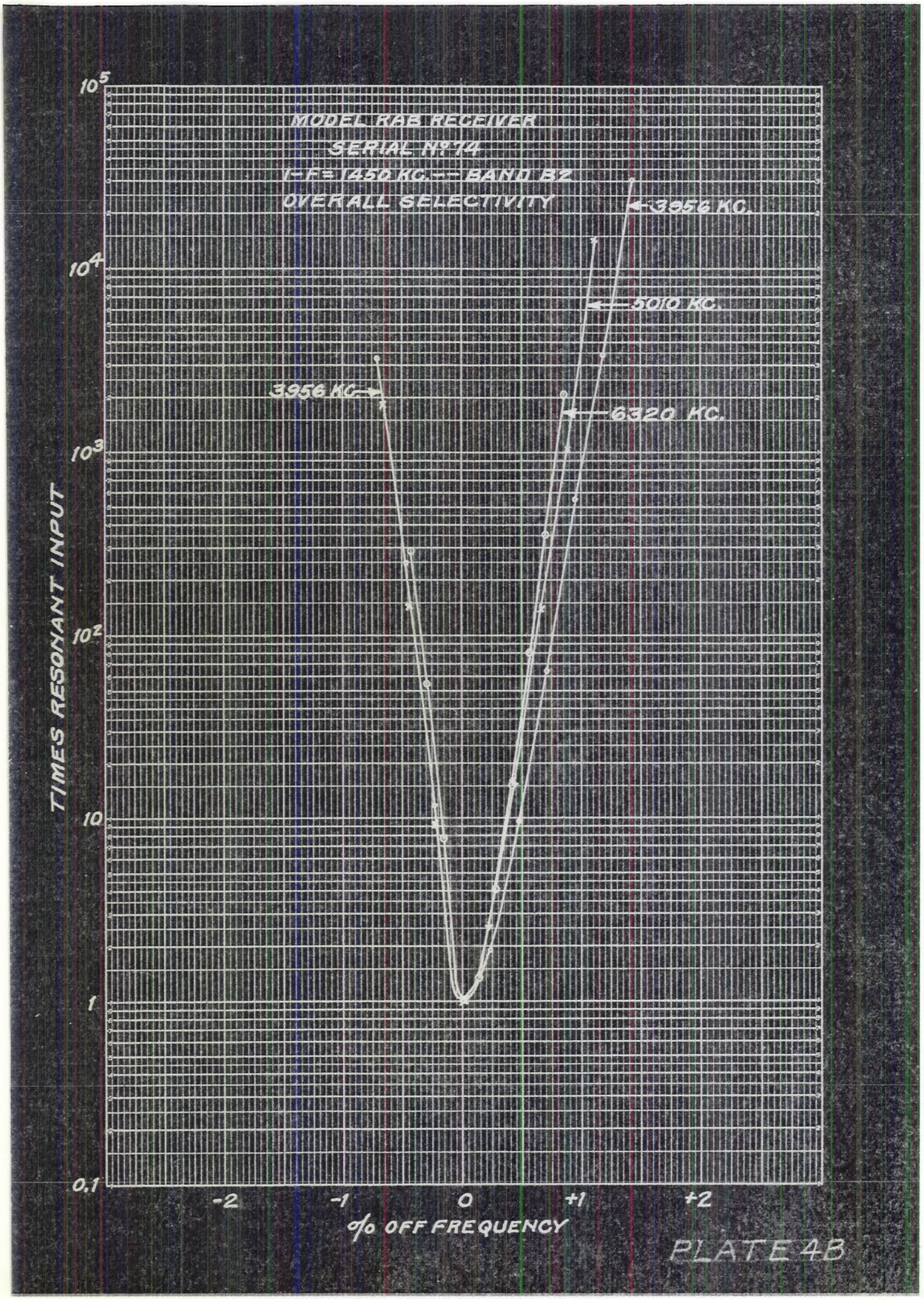

MODEL RAB RECEIVER
SERIAL Nº 74
I-F = 1450 KC. -- BAND B2
OVERALL SELECTIVITY
3956 KC.
5010 KC.
3956 KC.
6320 KC.
10⁵
10⁴
10³
10²
10
1
0.1
TIMES RESONANT INPUT
-2
-1
0
+1
+2
% OFF FREQUENCY

PLATE 4B

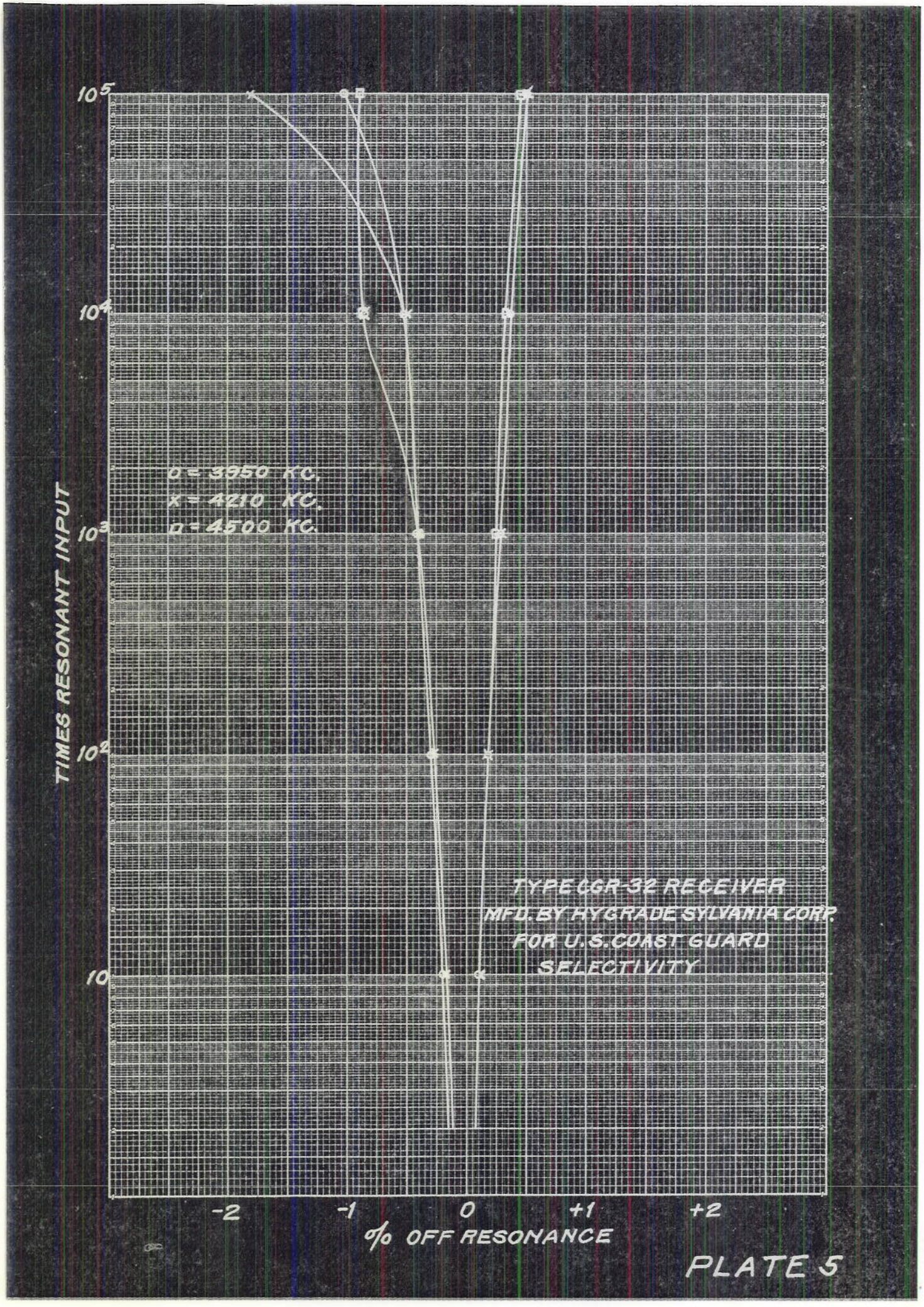
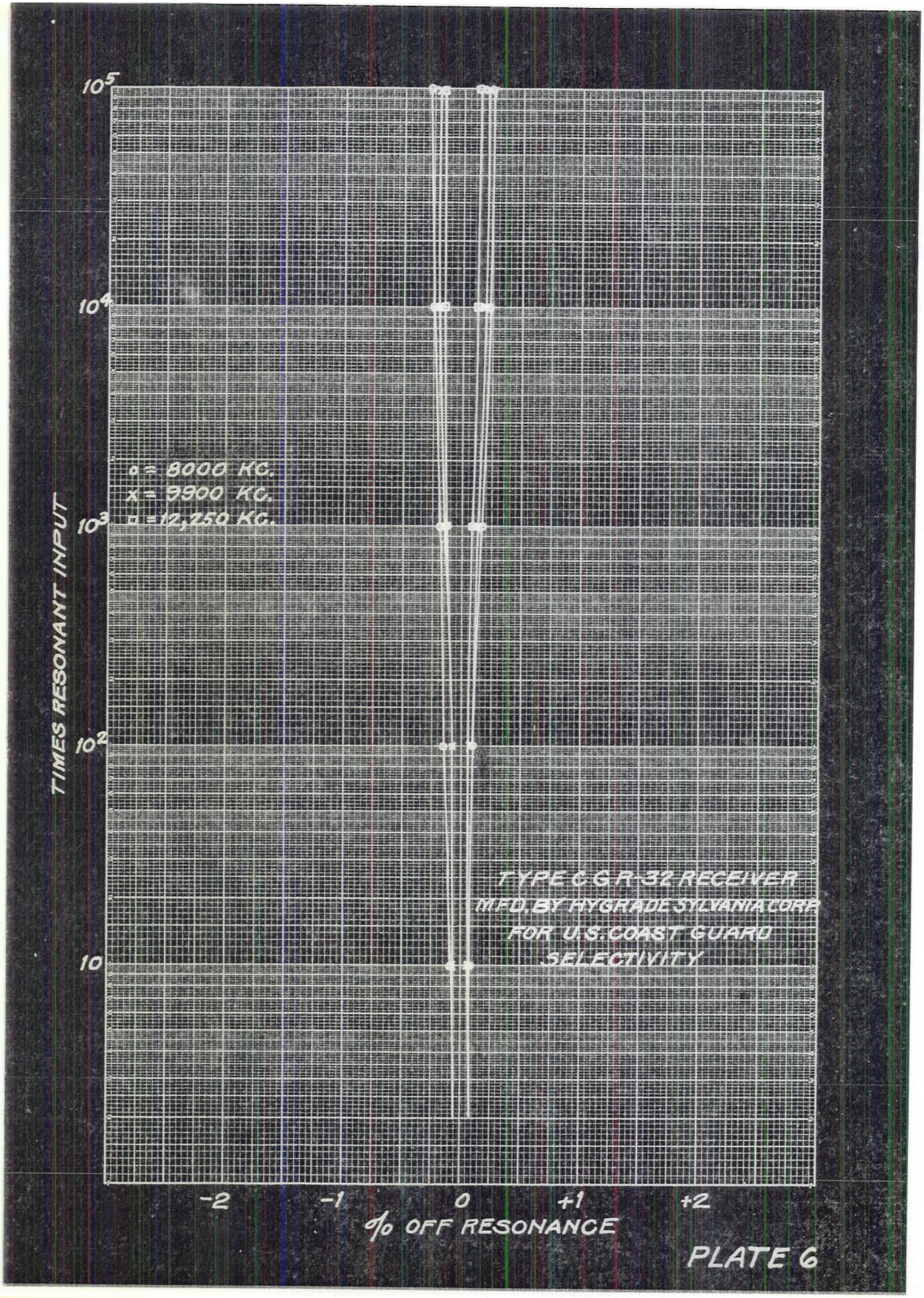

TIMES RESONANT INPUT
10^5
10^4
10^3
10^2
10
o = 3950 KC.
x = 4210 KC.
□ = 4500 KC.
TYPE GGR-32 RECEIVER
MFD. BY HYGRADE SYLVANIA CORP.
FOR U.S. COAST GUARD
SELECTIVITY
-2
-1
0
+1
+2
% OFF RESONANCE

PLATE 5


10^5
10^4
10^3
10^2
10
TIMES RESONANT INPUT
o = 8000 KC.
x = 9900 KC.
□ = 12,250 KC.
TYPE C.G.R.-32 RECEIVER
MFD. BY HYGRADE SYLVANIA CORP
FOR U.S. COAST GUARD
SELECTIVITY
-2
-1
0
+1
+2
% OFF RESONANCE
PLATE 6

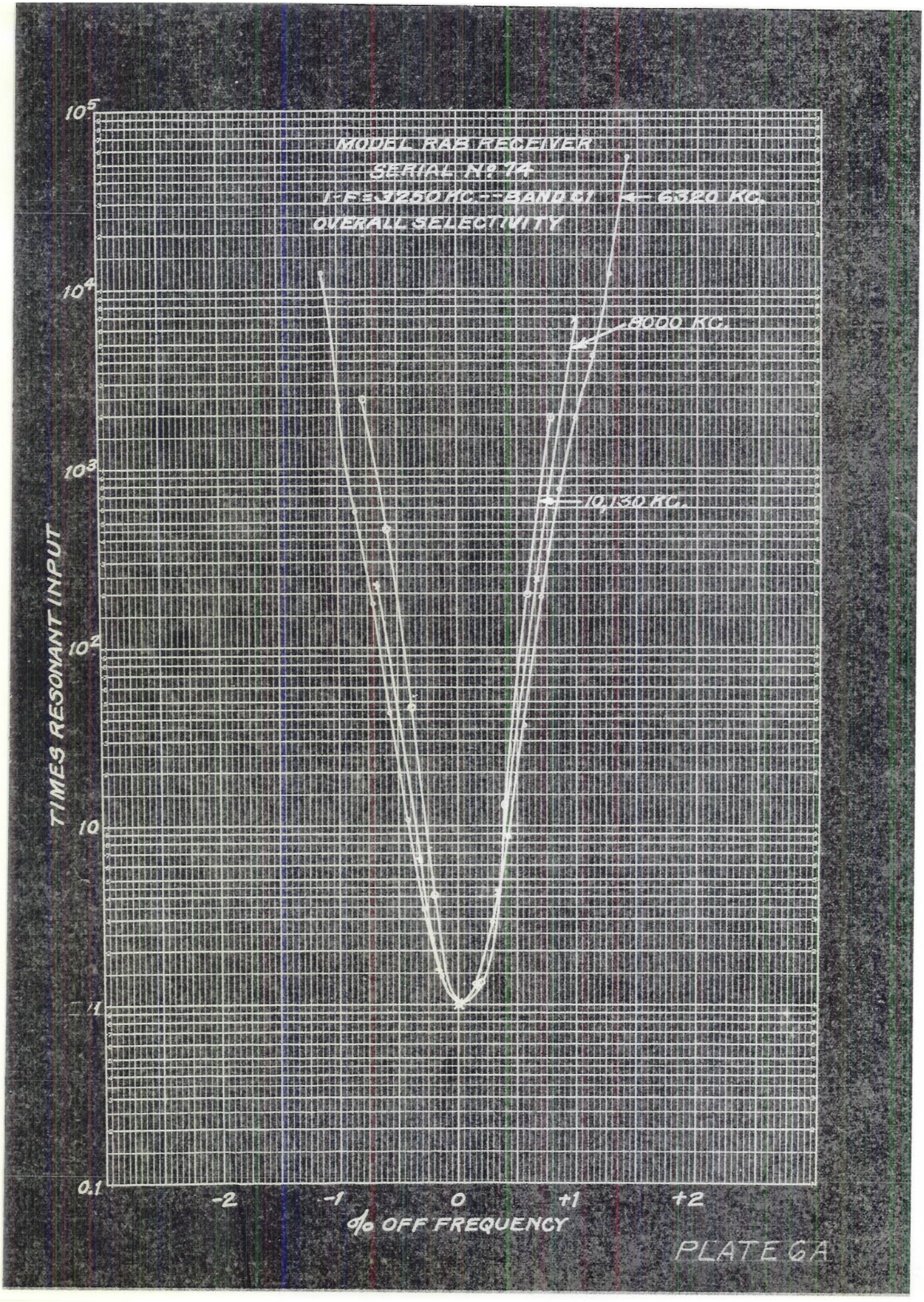

MODEL RAB RECEIVER
SERIAL No. 14
R.F. 3260 KC. - BAND C
OVERALL SELECTIVITY
63.20 KC.
8000 KC.
10,150 KC.
TIMES RESONANT INPUT
10^5
10^4
10^3
10^2
10
1
0.1
-2
-1
0
+1
+2
% OFF FREQUENCY

PLATE GA

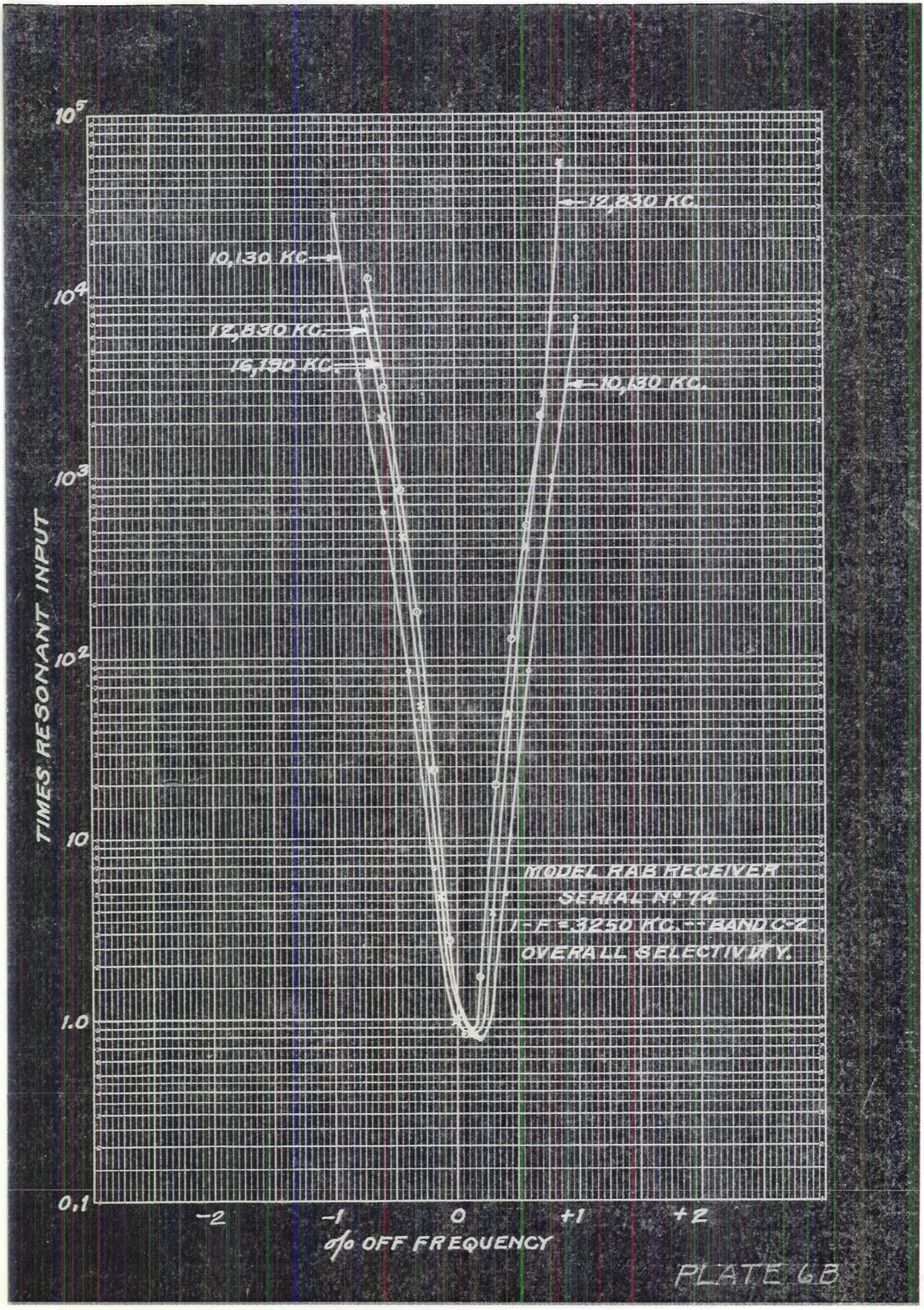

TIMES RESONANT INPUT
10^5
10^4
10^3
10^2
10
1.0
0,1
12,830 KC.
10,130 KC.
12,830 KC.
16,150 KC.
10,130 KC.
MODEL RAB RECEIVER
SERIAL No. 74
I.F. = 3250 KC. — BAND C-2
OVERALL SELECTIVITY.
-2
-1
0
+1
+2
% OFF FREQUENCY

PLATE 6B

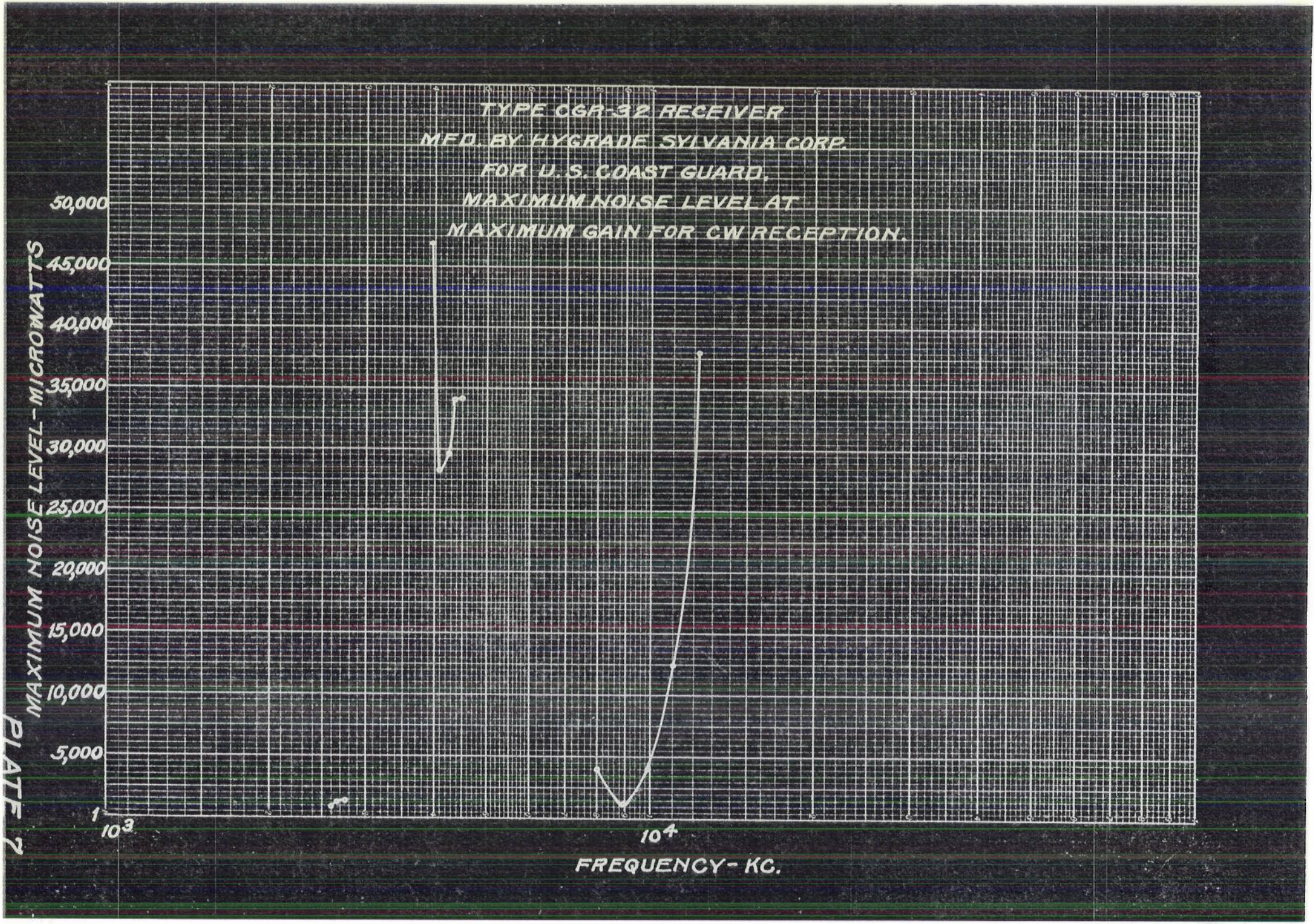
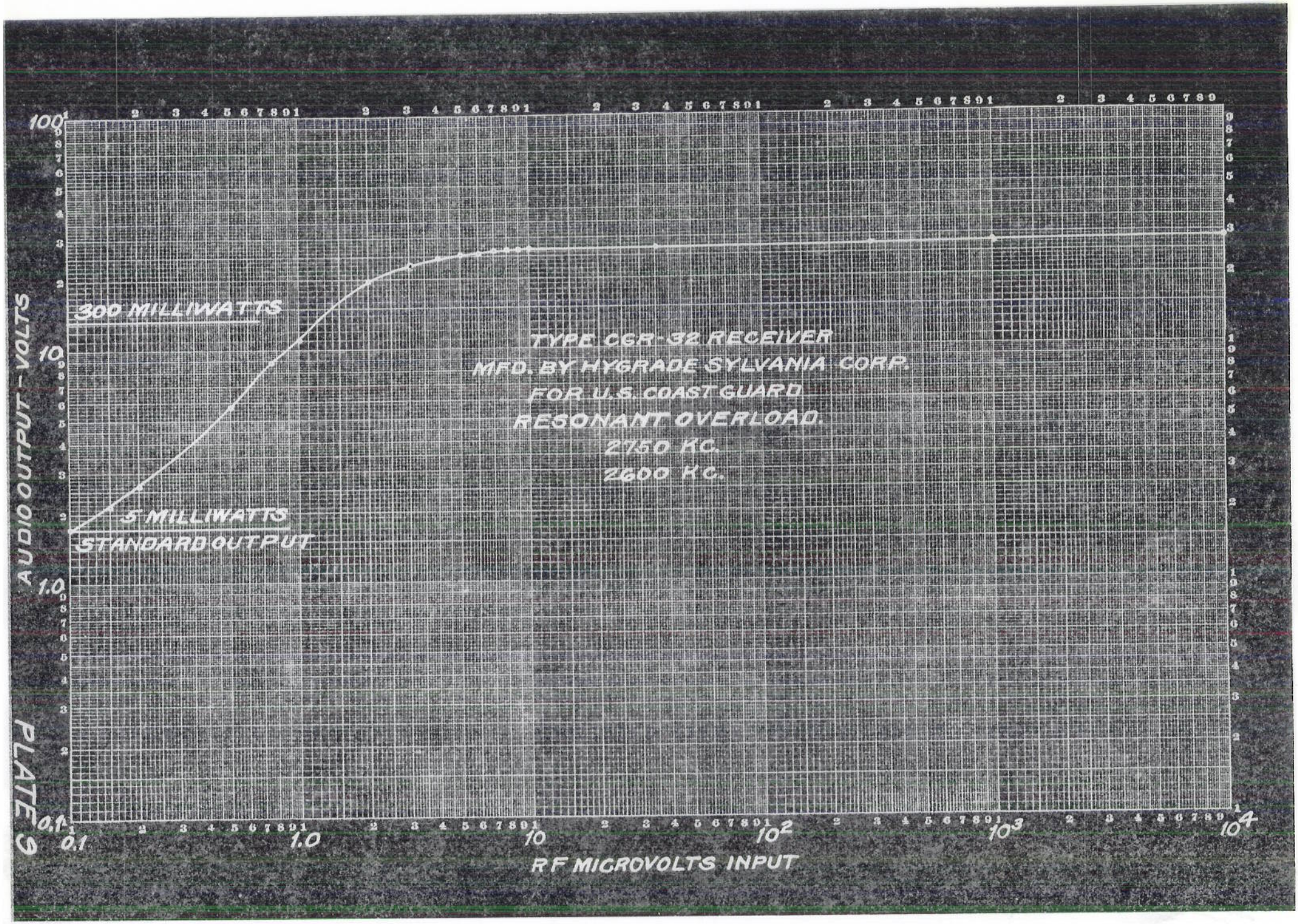
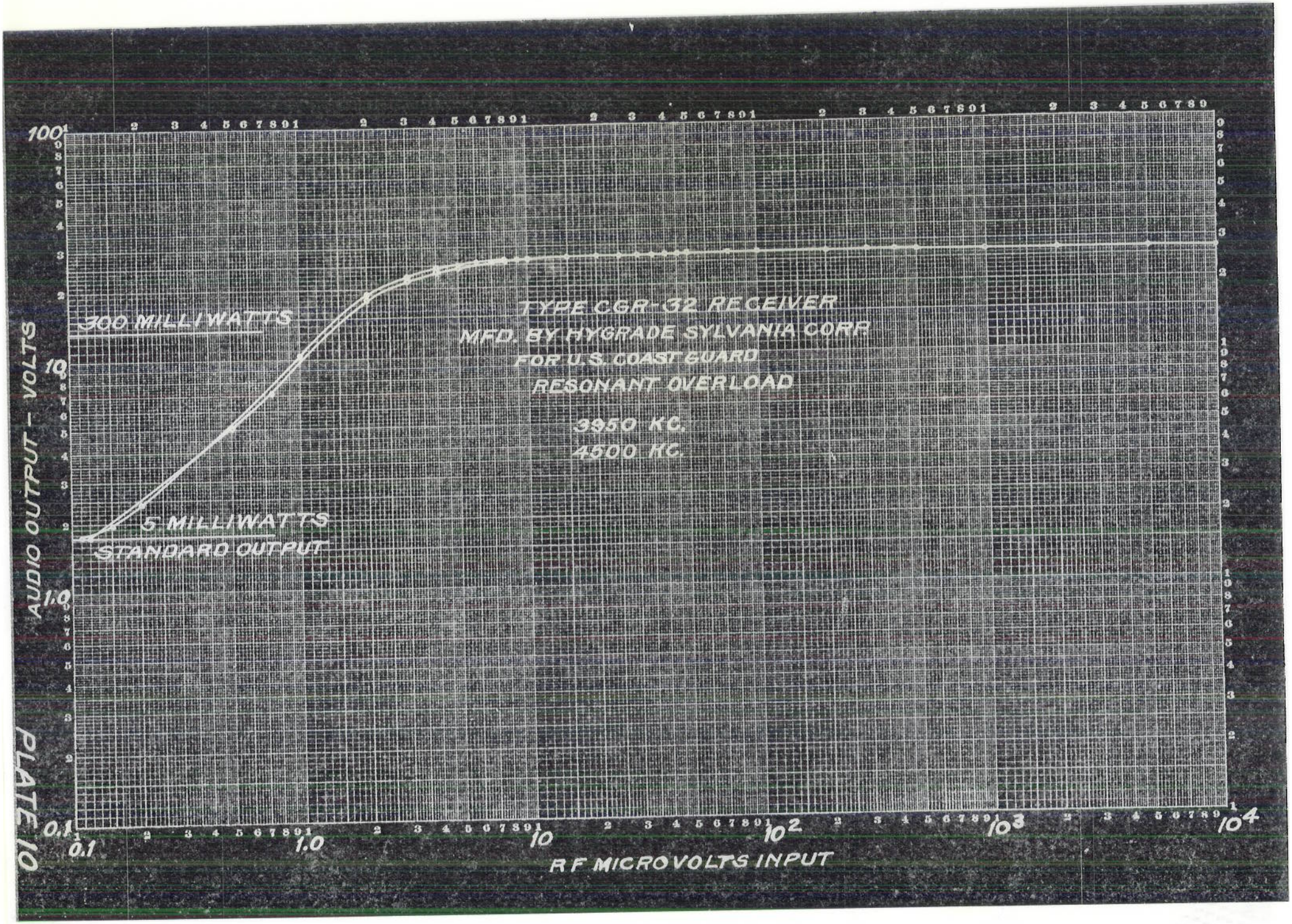

TYPE CGR-32 RECEIVER
MFD. BY HYGRADE SYLVANIA CORP.
FOR U.S. COAST GUARD.
MAXIMUM NOISE LEVEL AT
MAXIMUM GAIN FOR CW RECEPTION.
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
1
MAXIMUM NOISE LEVEL - MICROWATTS
10^3
10^4
FREQUENCY - KC.

PLATE 2


AUDIO OUTPUT - VOLTS
PLATE 9
RF MICROVOLTS INPUT
0.1
1.0
10
10^2
10^3
10^4
300 MILLIWATTS
5 MILLIWATTS
STANDARD OUTPUT
TYPE CGR-32 RECEIVER
MFD. BY HYGRADE SYLVANIA CORP.
FOR U.S. COAST GUARD
RESONANT OVERLOAD.
2750 KC.
2600 KC.


TYPE CGR-32 RECEIVER
MFD. BY HYGRADE SYLVANIA CORP.
FOR U.S. COAST GUARD
RESONANT OVERLOAD
3950 KC.
4500 KC.
300 MILLIWATTS
5 MILLIWATTS
STANDARD OUTPUT
AUDIO OUTPUT - VOLTS
RF MICROVOLTS INPUT
PLATE 10

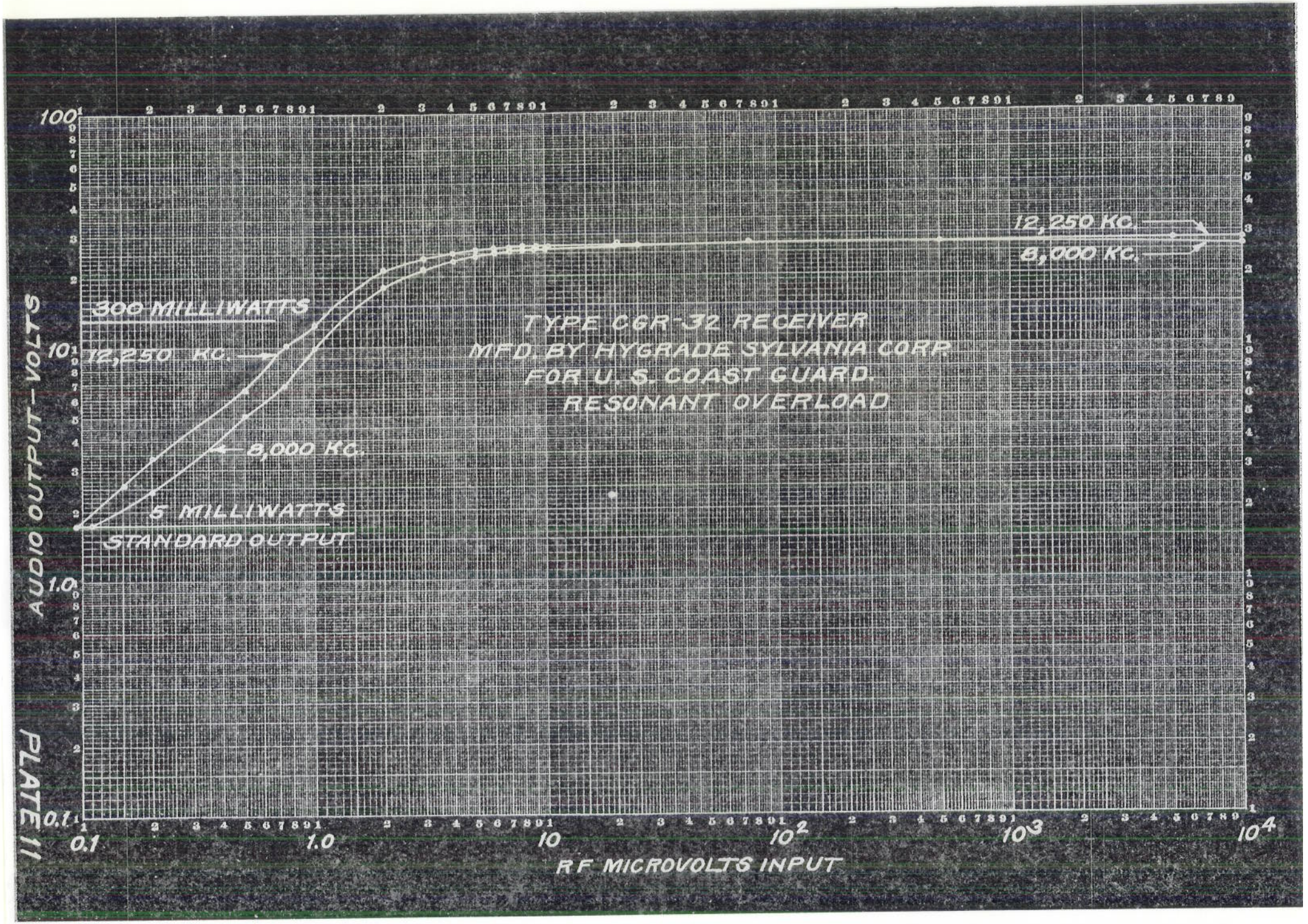

AUDIO OUTPUT—VOLTS
RF MICROVOLTS INPUT
0.1
1.0
10
10^2
10^3
10^4
100
10
1.0
0.1
12,250 KC.
6,000 KC.
300 MILLIWATTS
12,250 KC.
6,000 KC.
5 MILLIWATTS
STANDARD OUTPUT
TYPE CGR-32 RECEIVER
MFD. BY HYGRADE SYLVANIA CORP.
FOR U. S. COAST GUARD.
RESONANT OVERLOAD

PLATE 11

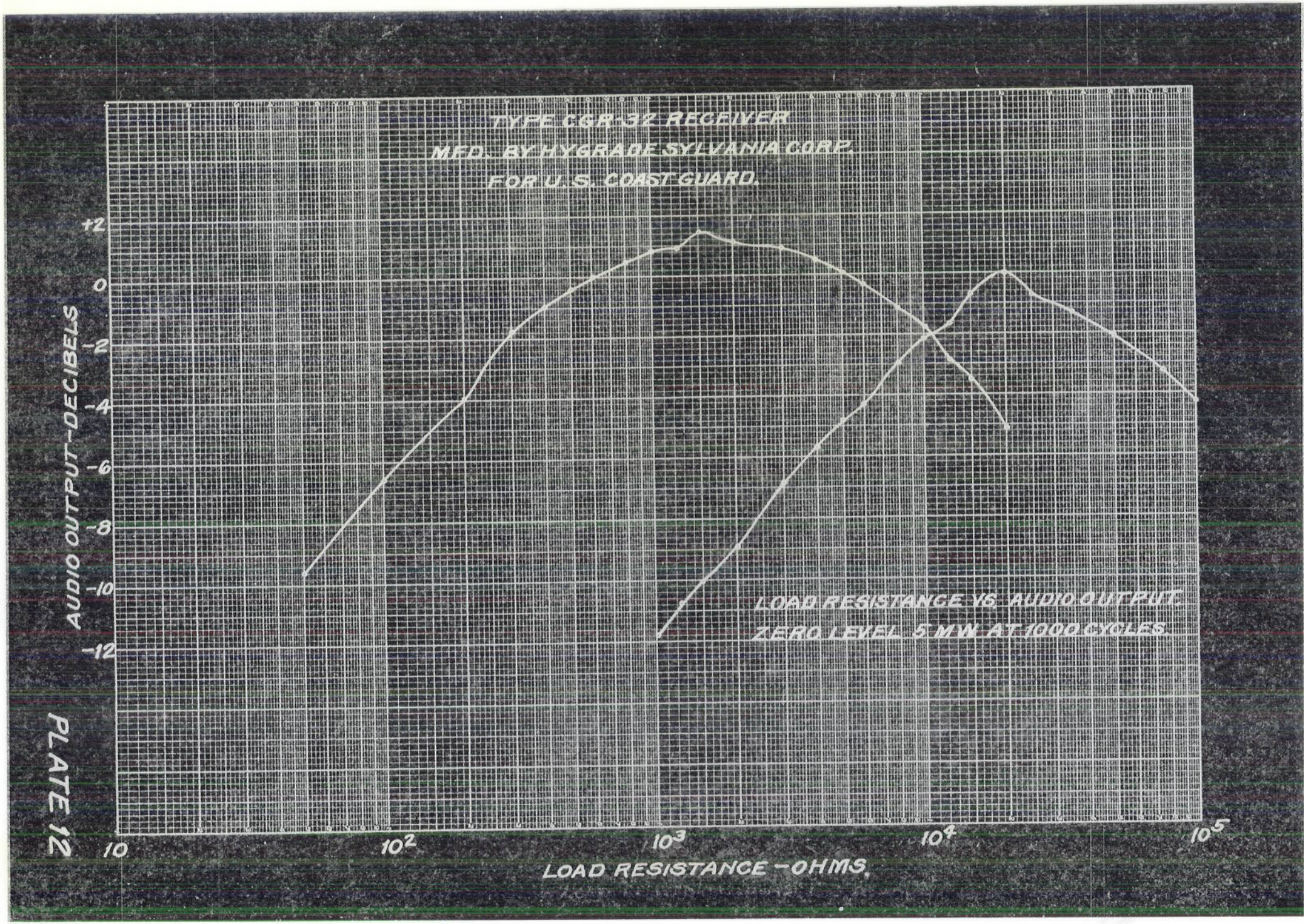

TYPE CGR-32 RECEIVER
MFD. BY HYGRADE SYLVANIA CORP.
FOR U. S. COAST GUARD.
+2
0
-2
-4
-6
-8
-10
-12
AUDIO OUTPUT-DECIBELS
LOAD RESISTANCE VS. AUDIO OUTPUT
ZERO LEVEL .5 MW AT 1000 CYCLES.
10
10^2
10^3
10^4
10^5
LOAD RESISTANCE - OHMS.

PLATE 12

U. S. NAVAL RESEARCH LABORATORY
BELLEVUE, D. C.

DATE

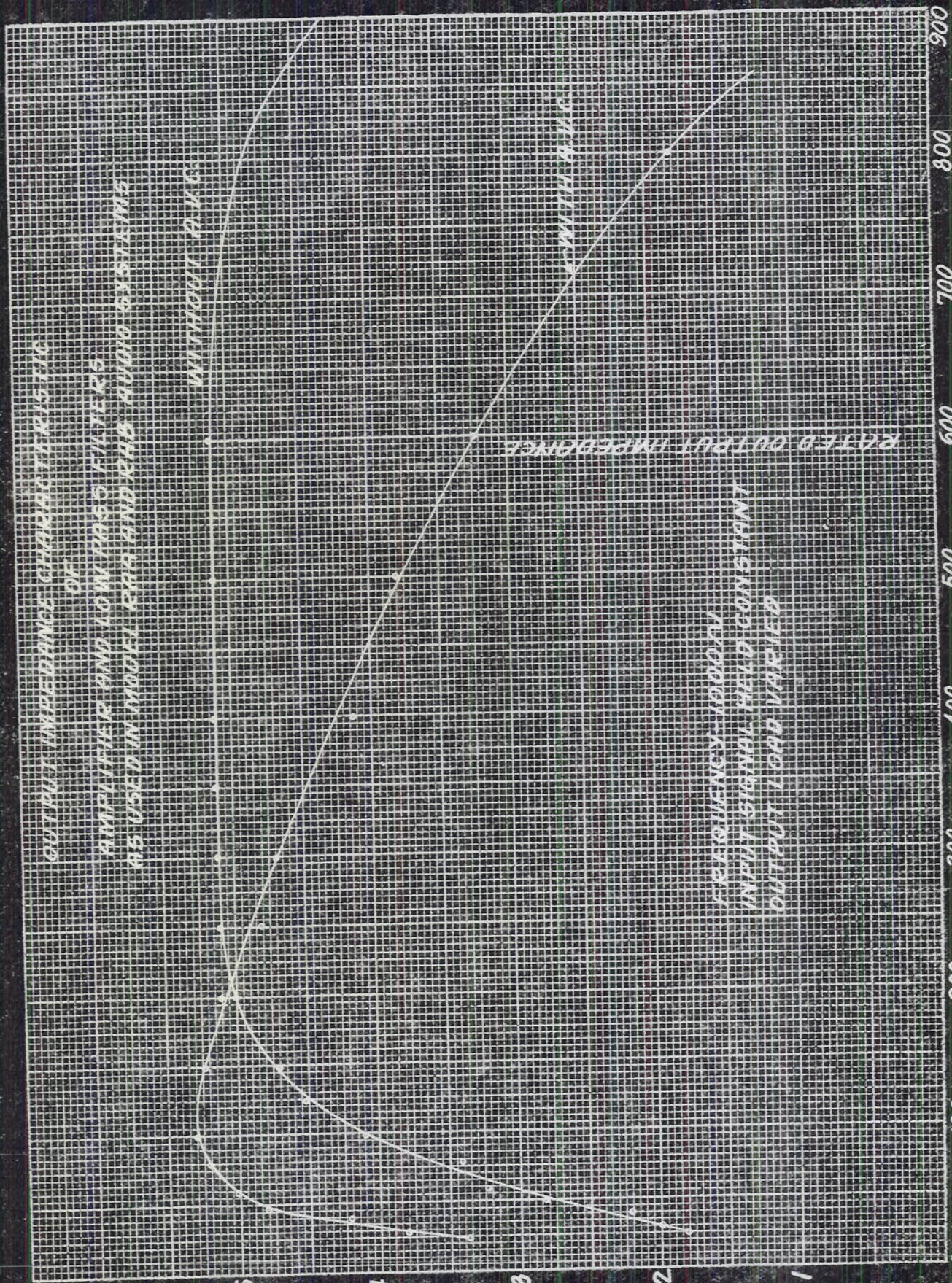


Plate 12A

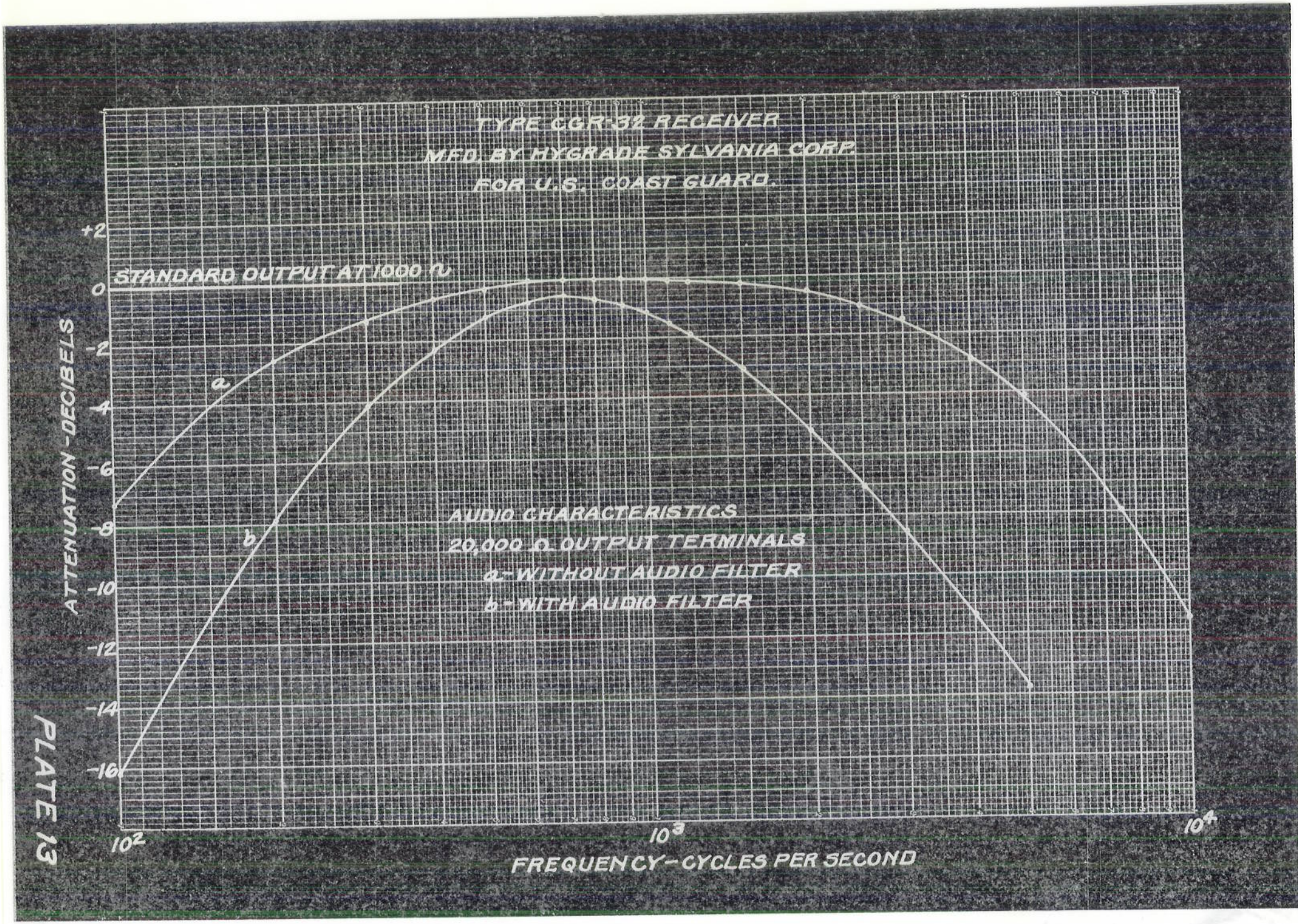
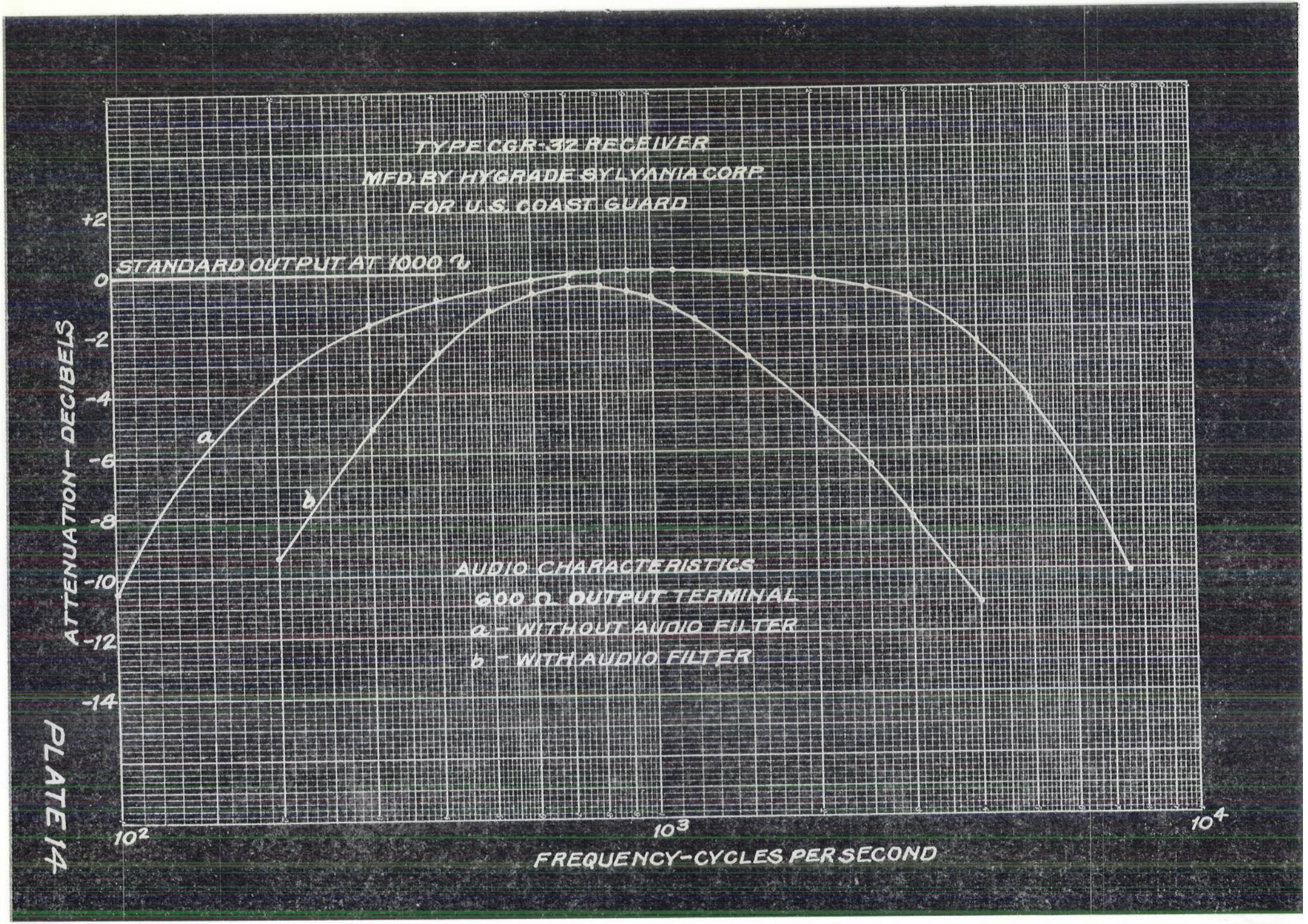

TYPE CGR-32 RECEIVER
MFD. BY HYGRADE SYLVANIA CORP.
FOR U.S. COAST GUARD.
STANDARD OUTPUT AT 1000 ~
+2
0
-2
-4
-6
-8
-10
-12
-14
-16
ATTENUATION - DECIBELS
a
b
AUDIO CHARACTERISTICS
20,000 Ω OUTPUT TERMINALS
a - WITHOUT AUDIO FILTER
b - WITH AUDIO FILTER
10^2
10^3
10^4
FREQUENCY - CYCLES PER SECOND

PLATE 13


TYPE CGR-32 RECEIVER
MFD. BY HYGRADE SYLVANIA CORP.
FOR U.S. COAST GUARD
STANDARD OUTPUT AT 1000 ~
+2
0
-2
-4
-6
-8
-10
-12
-14
ATTENUATION — DECIBELS
a
b
AUDIO CHARACTERISTICS
600 Ω OUTPUT TERMINAL
a — WITHOUT AUDIO FILTER
b — WITH AUDIO FILTER
10^2
10^3
10^4
FREQUENCY-CYCLES PER SECOND
PLATE 14

12,000 CYCLES
10,000
1,000
100
FREQUENCY-CYCLES PER SECOND
DECIBELS
0
5
10
15
20
25
30
40
50
60
70
80
90
SCALE CHANGE
WITH AGC
WITHOUT AGC
AGC CHARACTERISTICS OF
4 RCA AVC SYSTEMS
AND LOW PASS FILTER (CUT-OFF 4,000 CYCLES) USED IN
INPUT TRANSFORMER (CUT-OFF 4,000 CYCLES) USED IN
INPUT SIGNAL ADJUSTED FOR 5 MILLIWATTS OUTPUT
ACROSS 600 OHMS AT 1000 CYCLES FOR BOTH CURVES
NOTE - APPLYING AGC ATTENUATES THE OUTPUT
SIGNAL 7 DB AT 100 CYCLES.

Plate 14A

AUDIO & TENSION CHARACTERISTICS
OF
INDIVIDUAL TRANSDUCER (CARTRIDGE)
AMERICAN RECORDING CO.
LOW RANGE 0 TO 4 DECIBELS
AND 25 TO 30 DECIBELS
ALLOWED FOR RELATIVE
BIAS OF RECEIVER
FOR 500 CYCLES
NOTE: DECIBEL SCALE
MEDIUM STRENGTH OF 6 VOLTS
THE 4 DECIBELS
SCALE CHANGE
Minimum Audio
Maximum Audio
FREQUENCY- CYCLES PER SECOND
DECIBELS
0
5
10
15
20
25
30
40
50
60
70
80
90
10,000
1000
100

Plate 14B

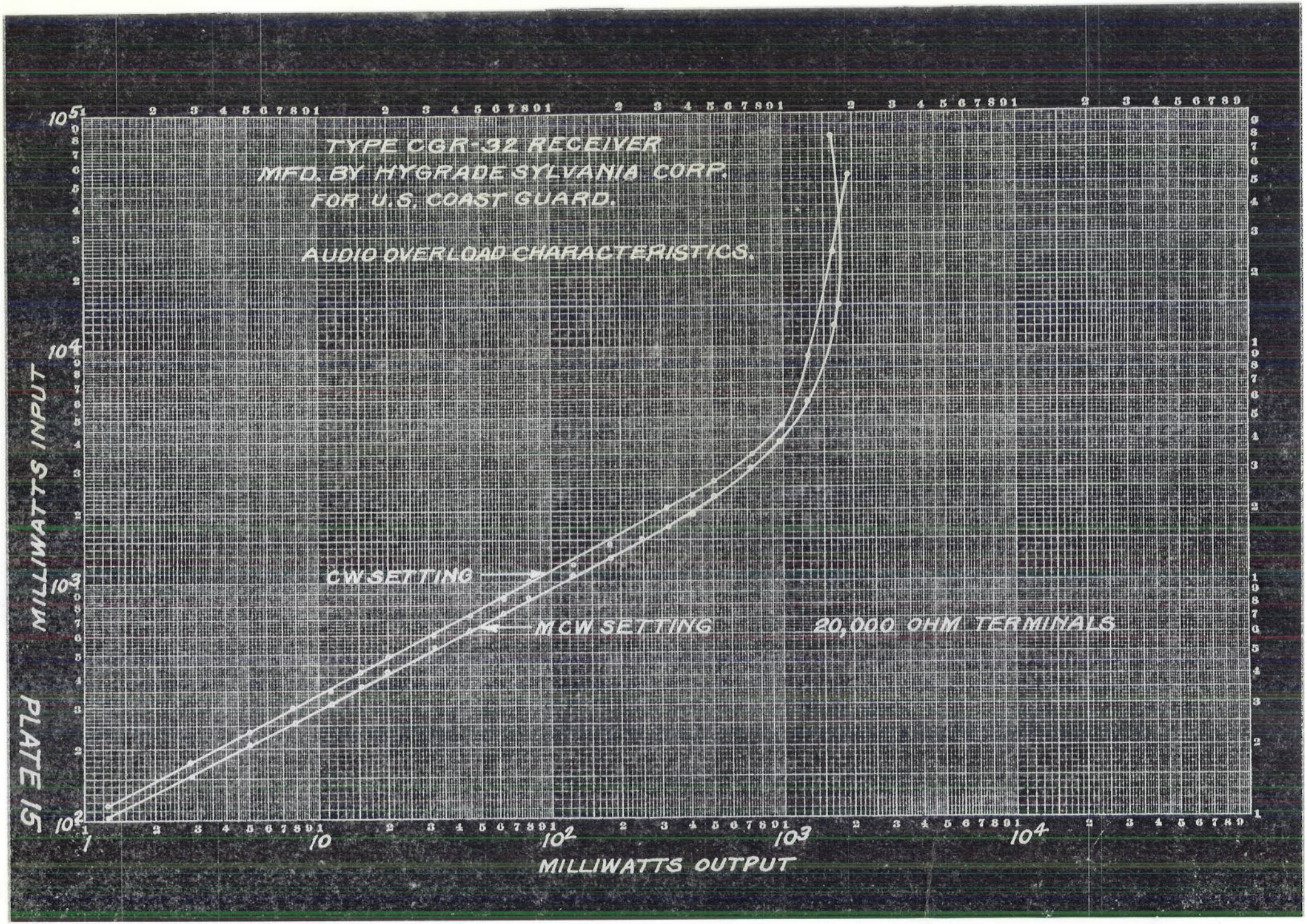
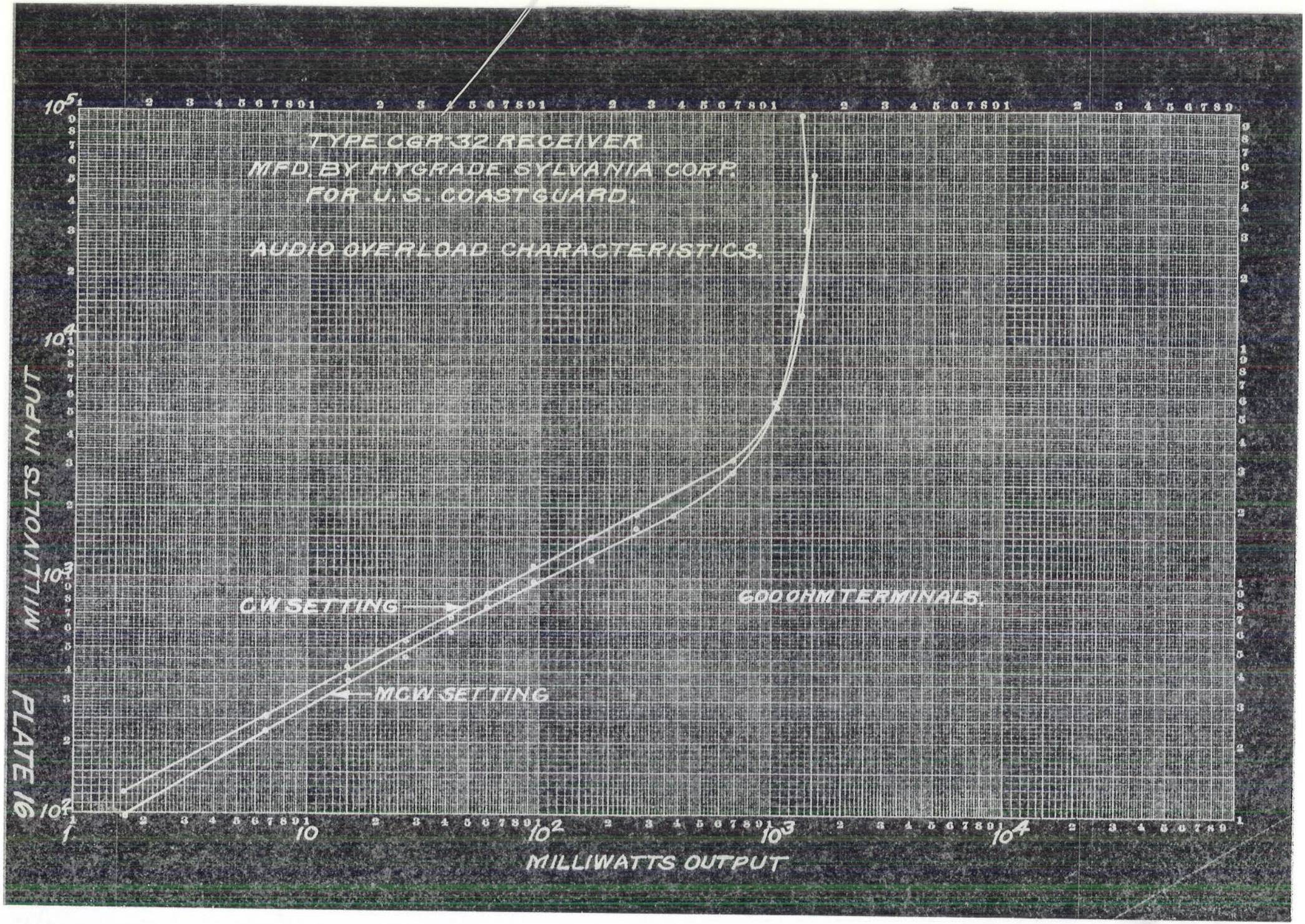
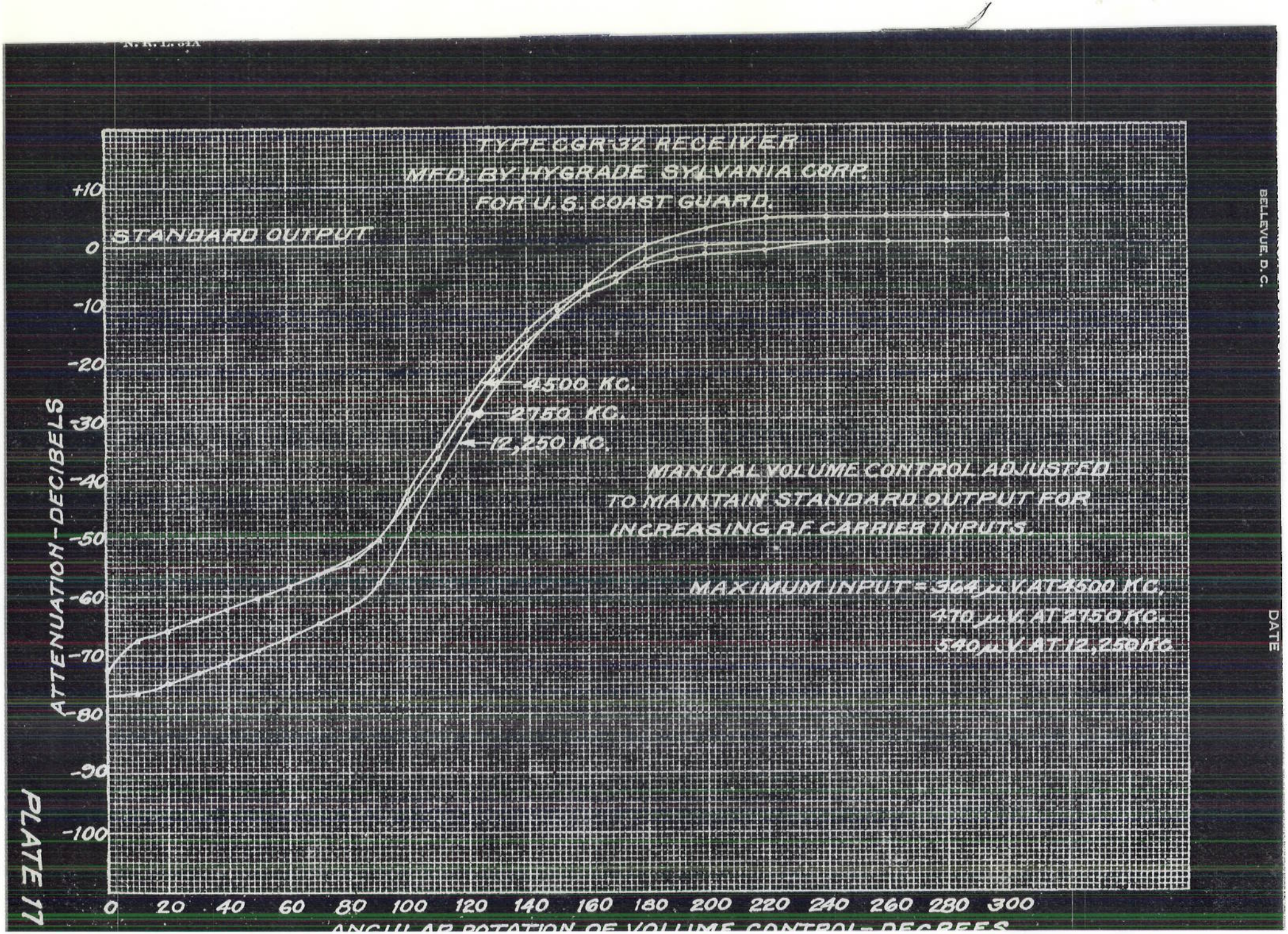
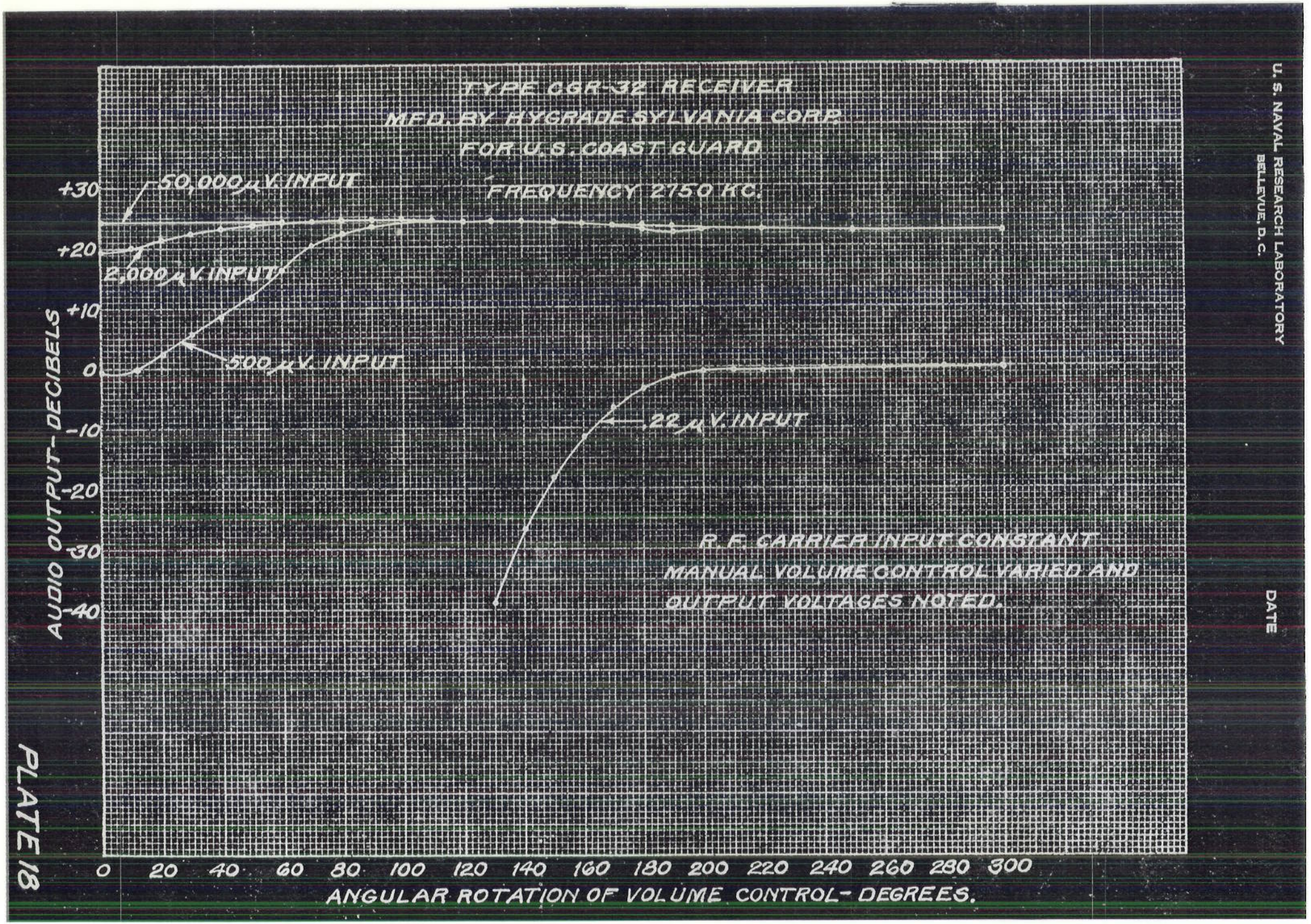
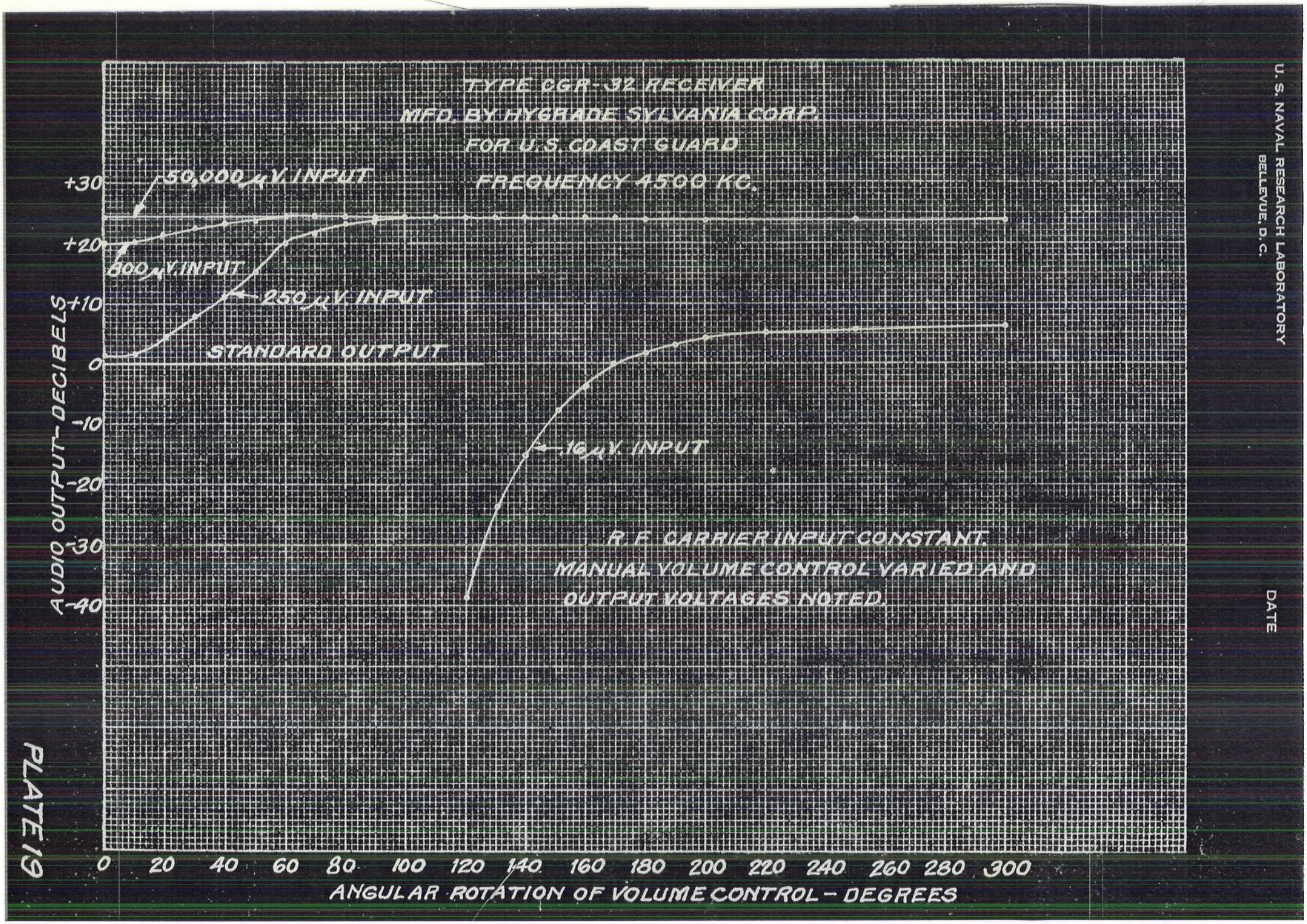

TYPE CGR-32 RECEIVER
MFD. BY HYGRADE SYLVANIA CORP.
FOR U.S. COAST GUARD.
AUDIO OVERLOAD CHARACTERISTICS.
C.W. SETTING
M.C.W. SETTING
20,000 OHM TERMINALS
MILLIWATTS INPUT
MILLIWATTS OUTPUT
1
10
10²
10³
10⁴
10⁵

PLATE 15


TYPE CGR-32 RECEIVER
MFD. BY HYGRADE SYLVANIA CORP.
FOR U.S. COAST GUARD.
AUDIO OVERLOAD CHARACTERISTICS.
CW SETTING
MCW SETTING
600 OHM TERMINALS.
MILLIVOLTS INPUT
MILLIWATTS OUTPUT
PLATE 16


TYPE CGR-32 RECEIVER
MFD. BY HYGRADE SYLVANIA CORP.
FOR U.S. COAST GUARD.
STANDARD OUTPUT
+10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
ATTENUATION - DECIBELS
4500 KC.
2750 KC.
12,250 KC.
MANUAL VOLUME CONTROL ADJUSTED
TO MAINTAIN STANDARD OUTPUT FOR
INCREASING R.F. CARRIER INPUTS.
MAXIMUM INPUT = 364 μ V. AT 4500 KC.
470 μ V. AT 2750 KC.
540 μ V. AT 12,250 KC.
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
ANGULAR ROTATION OF VOLUME CONTROL - DEGREES
PLATE 17
BELLEVUE, D.C.
DATE


TYPE CGR-32 RECEIVER
MFD. BY HYGRADE SYLVANIA CORP.
FOR U.S. COAST GUARD
FREQUENCY 2750 KC.
50,000 μV. INPUT
2,000 μV. INPUT
500 μV. INPUT
22 μV. INPUT
R.F. CARRIER INPUT CONSTANT
MANUAL VOLUME CONTROL VARIED AND
OUTPUT VOLTAGES NOTED.
+30
+20
+10
0
-10
-20
-30
-40
AUDIO OUTPUT - DECIBELS
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
ANGULAR ROTATION OF VOLUME CONTROL - DEGREES.
U. S. NAVAL RESEARCH LABORATORY
BELLEVUE, D.C.
DATE
PLATE 18


TYPE CGR-32 RECEIVER
MFD. BY HYGRADE SYLVANIA CORP.
FOR U.S. COAST GUARD
FREQUENCY 4500 KC.
50,000 μV. INPUT
800 μV. INPUT
250 μV. INPUT
16 μV. INPUT
STANDARD OUTPUT
R.F. CARRIER INPUT CONSTANT.
MANUAL VOLUME CONTROL VARIED AND
OUTPUT VOLTAGES NOTED.
AUDIO OUTPUT-DECIBELS
+30
+20
+10
0
-10
-20
-30
-40
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
ANGULAR ROTATION OF VOLUME CONTROL - DEGREES
PLATE 19
U. S. NAVAL RESEARCH LABORATORY
BELLEVUE, D. C.
DATE

N. R. L. 34A

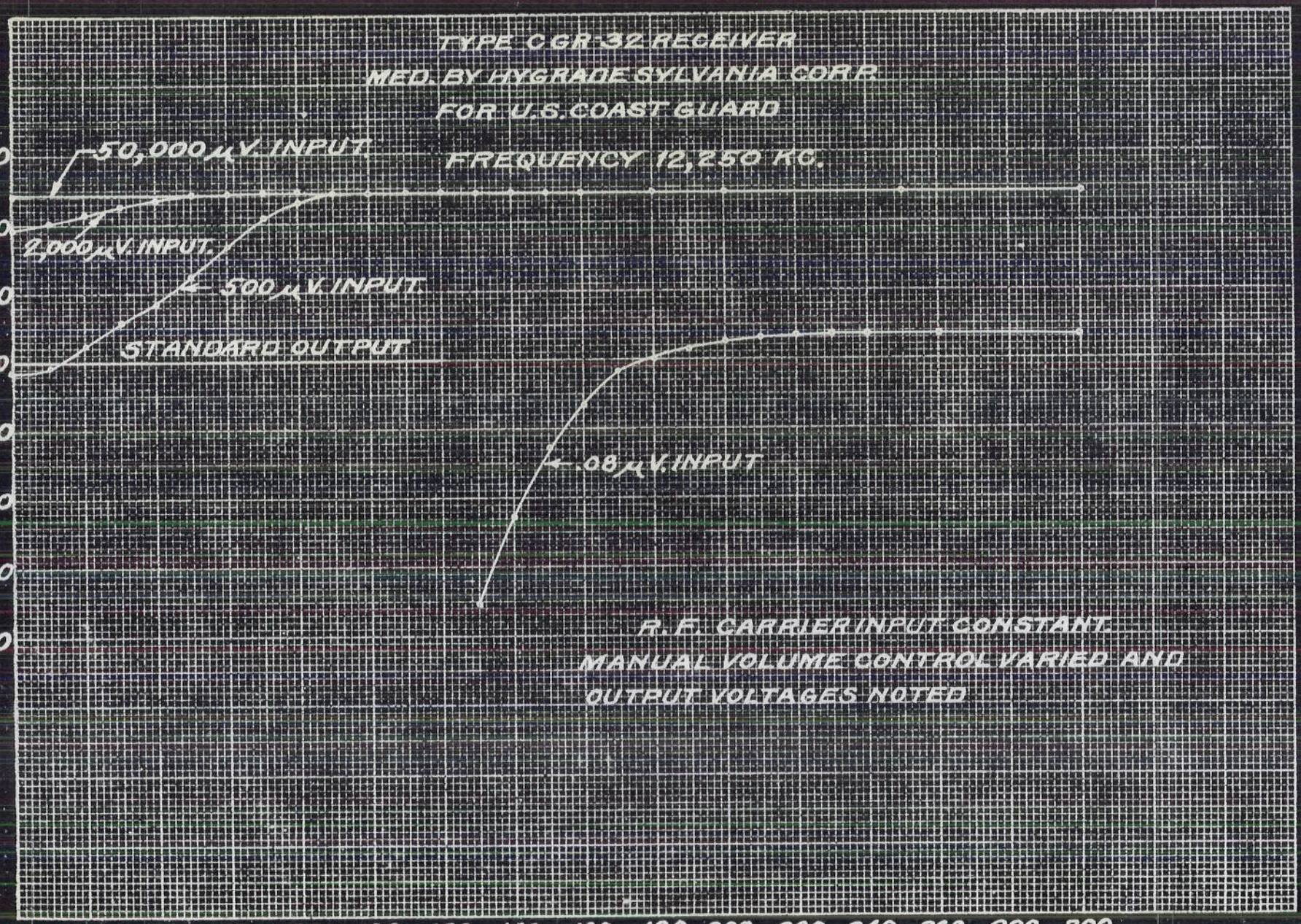
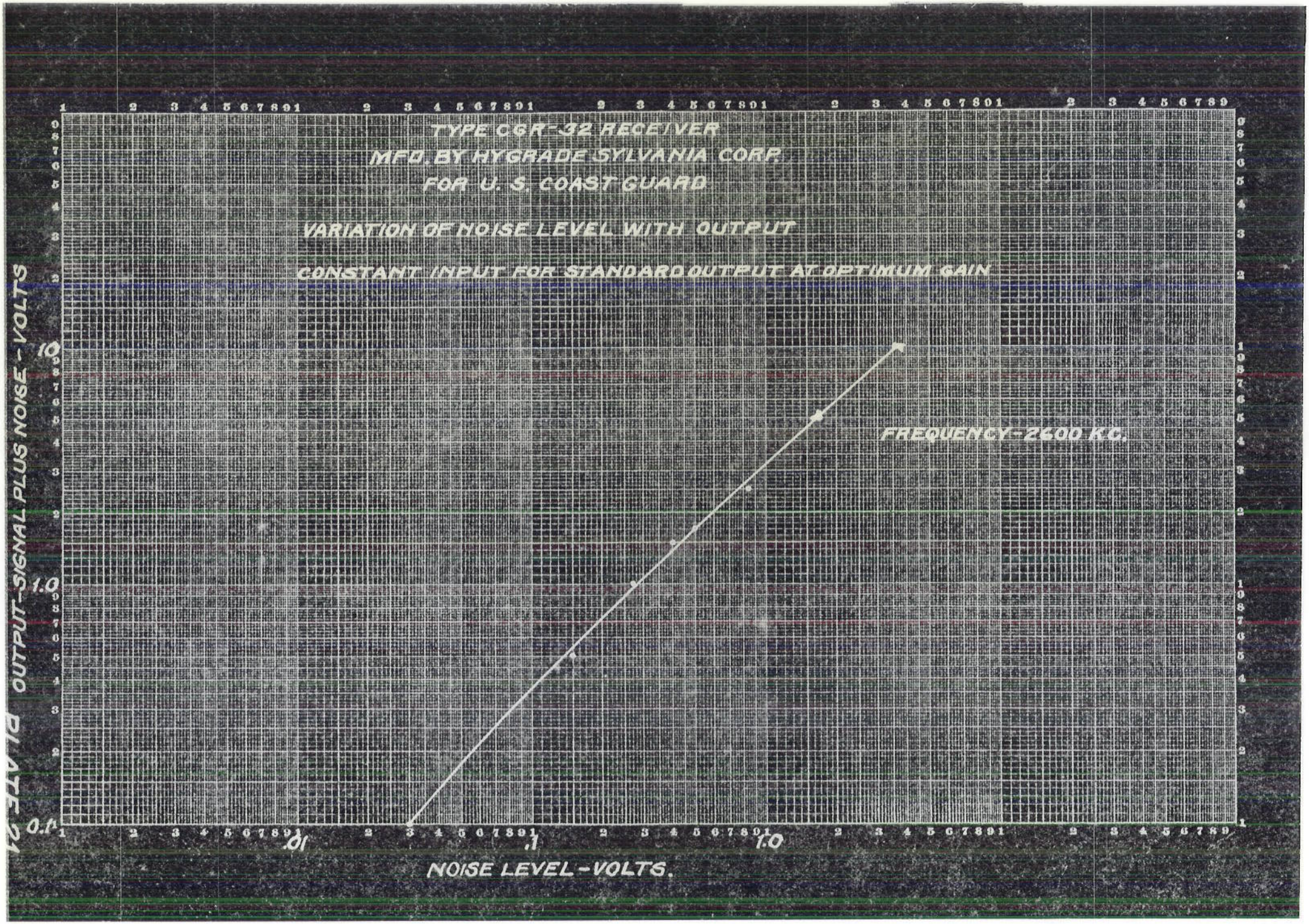


PLATE 20

U.S. NAVAL RESEARCH LABORATORY
BELLEVUE, D. C.

DATE


TYPE CGR-32 RECEIVER
MFD. BY HYGRADE SYLVANIA CORP.
FOR U. S. COAST GUARD.
VARIATION OF NOISE LEVEL WITH OUTPUT
CONSTANT INPUT FOR STANDARD OUTPUT AT OPTIMUM GAIN
FREQUENCY-2400 K.C.
OUTPUT-SIGNAL PLUS NOISE-VOLTS
10
1.0
0.1
.01
.1
1.0
NOISE LEVEL-VOLTS.