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Report on

Retest of Preliminary Model

of

Class IV Radio Receiving Equipment

Consisting of

One RAG-1 Receiving Equipment, One RAH-1 Receiving Equipment

and

One Type CHS-23067 Control Unit

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AUTHORIZATION

1. The tests herein reported were authorized by reference (a). Other pertinent data are listed as references (b) to (o), inclusive.

Reference: (a) Bueng. ltr. S67/46(1-19-W8) of 22 Jan. 1935.
(b) Bueng. Specifications RE 13A 466B.
(c) NRL Report No. R-1093.
(d) Bueng. ltr. NOs-32226(10-16-W8) of 2 Jan. 1935 to INM, New York.
(e) Bueng. Minutes of Conference of 12 and 13 Dec.1934 between representatives of Hygrade-Sylvania Corp. and Bueng.
(f) BuS&A ltr. NOs-32226(SPM) of 2 Feb. 1935 to Hygrade Sylvania Corp.
(g) Bueng. ltr. NOs-32226(2-7-W8) of 25 Feb. 1935 to INM, New York.
(h) Specifications RE 13A 488B, Foil Paper Capacitors.
(i) Specifications 17-I-12, Electrical Indicating Instruments.
(j) Specifications RE 10A 263H, Nameplates.
(k) Specifications RE 13A 346U, Vacuum Tubes.
(l) Specifications RE 13A 317F, Ceramic Insulating Materials.
(m) Specifications 17-I-14, Phenolic Insulating Materials.
(n) Specifications RE 13A 481B, Telephone Jacks.
(o) Hygrade-Sylvania Corp. Descriptive Specifications.

OBJECT OF TEST

2. The object of the re-test was to determine first, compliance on the part of the subject equipment with the governing specifications, reference (b); second, to determine to what extent specification compliance has either been met or improved as the result of changes in electrical or mechanical features not incorporated in the original models as reported in reference (c); third, the presence of desirable features over and above the specific requirements; and fourth, any objectionable features which require correction in the subject equipment and which should be avoided in future like equipments.

ABSTRACT OF TEST

3. The Models RAG-1 and RAH-1 radio receiving equipments were set up in the Laboratory and given a general inspection of mechanical construction and wiring. The following tests were conducted to determine specification compliance as regards electrical performance:

(a) Sensitivity - a.c. operation only.
(b) Selectivity - at optimum gain only.
(c) Maximum noise level.
(d) Resonant overload.
(e) Audio frequency characteristics.

(f) Automatic volume control characteristics.
(g) Interaction between units operating on common antenna.
(h) A.C. load power consumption.
(i) Reaction between adjacent units operating on adjacent antennas and common power supply.
(j) Reaction between adjacent units operating at different radio frequencies.
(k) Frequency overlap.
(l) Accuracy of resettability.
(m) Frequency range of oscillator wobbler (Model RAH-1).
(n) Capacity range and variation of oscillator wobbler (Model RAH-1).
(o) Frequency stability with change in input signal intensity.
(p) Frequency stability with change in sensitivity control setting.
(q) Frequency stability with change in line voltage.
(r) Transrectification.
(s) Regulation of CHS-20032 rectifier power unit.
(t) Sensitivity with complete change in tubes in R.F. and oscillator circuits.
(u) Range and linearity of sensitivity control.
(v) R.F. bias and total d.c. supply voltage with AVC on and off (Model RAG-1 only).
(w) Output signal plus noise characteristic.

Conclusions

(a) In general, the Models RAG-1 and RAH-1 equipments present a good appearance and are mechanically exceptionally good. The internal arrangement of parts and their accessibility demonstrate good engineering design.

(b) The insulation employed for the radio frequency circuits is, with but one exception, of isolantite. The only exception is in connection with the band changing switch in the Model RAG-1 equipment and here bakelite insulation is used, but it is employed where higher quality of insulation is not necessary.

(c) The specification requirements are met with respect to size and weight.

(d) The adoption of the ganged tuning condensers, having silver contacts, and submitted by the manufacturer's representative for alternate approval in place of those furnished with the subject equipments should be electrically and mechanically satisfactory.

(e) Although Band 1 of the Model RAG-1 equipment fails to comply with the governing specifications for sensitivity, a practical test has demonstrated that this equipment performs better on the frequencies covered by Band 1 than any other commercially obtainable receiver yet tested at the Laboratory, by virtue of its high degree of selectivity and low maximum noise level.

(f) Automatic volume control when "in" upsets the gain of the R.F. amplifiers of both equipments and also causes a large shift in the output frequency at the high frequency end of the frequency range of the type CHS-46043 receiver. These defects are easily corrected by an additional bleeder resistor to be connected between ground and the plate of the output tube when the AVC is "in."

(g) Specification requirements with respect to selectivity are well above the requirements for both equipments, resulting in improved performance by comparison with existing receivers of the tuned radio frequency type when tested with an antenna under actual operation conditions.

(h) Most of the defects which were apparent in the original equipments have been corrected or eliminated in the revised models. Such defects as do exist are of a minor nature, with the exception of the ganged variable tuning condensers, and are easily corrected with little or no additional expense to the contractor. The use of the type of ganged variable tuning condenser construction as submitted for alternate approval should correct the major objection to these equipments as furnished.

Recommendations

It is recommended:

(a) That the nameplate data be changed on the separate coil systems to indicate that they are a part of the type CHS-47090 inductance system.

(b) That the audio attenuator switch be changed so that there will be no position where the phone output will exceed that obtained when the switch is in the normal operating positions.

(c) That the bottom plate on the receiver chassis of both types of receivers be secured at the side and center as well as the front and back to assure that there will be no movement with respect to the chassis when subjected to vibration.

(d) That the interconnecting power supply battery cables be rubber covered as agreed upon in the conference and approved in reference (d).

(e) That the ganged variable condenser units in both types of receivers be replaced with ones having silver contacts and similar to those submitted by the manufacturer as alternates for approval, with the understanding that the performance of either type of receiver as required by the governing specifications will not be abrogated.

(f) That the cable clamps in the control unit be redesigned to provide better clearance for the securing nuts and that the stud size be increased from 6-32 to 8-32 for greater strength.

(g) That the threaded ends of the thumb screws on the receiver be increased from size 8-32 to size 10-24 for greater strength.

(h) That Navy type numbers be placed on all important parts of the equipment and that the system of marking all parts with identification numbers be extended to the control box and be sufficiently complete as to assure that any item shown in the wiring diagram can be immediately identified upon reference to a parts list without tracing wires in any unit.

(i) That all connection to the male plug contacts which mate with the jacks on the plug-in coil assemblies be directly soldered thereto and not depend upon pressure contact from a nut which may become loosened.

(j) That spare shockproofing rubber parts be furnished and that these parts be so wrapped as to retard aging.

(k) That the coil retaining springs in the coil storage box (type CHS-47090) be redesigned so that removal and replacement can be accomplished with dispatch and certainty.

(l) All wires connecting to coil terminals and their associated trimmer condensers, pass through the holes provided for them in the solder

lug terminals, that they also be bent around the terminals prior to soldering.

(m) That the design of the main tuning control knobs on both types of receivers conform to the design of the other control knobs.

(n) That telephone jacks be supplied which are interchangeable with Navy standard jacks.

(o) That since neither equipment fully complies with the sensitivity requirements under all conditions, consideration be given to the discussion given under paragraphs 82 to 90, inclusive, of this report.

(p) That the wobbler condenser in the type CHS-46043 receiver unit be redesigned so that its characteristic will approach that of a straight line capacity condenser and will approach a uniform increase in capacitance when rotated from its minimum to its maximum capacity positions.

(q) That such circuit changes be made that the radio frequency gain of either type of receiver will not be affected by more than 2 db. by throwing the automatic volume control in and out; that circuit changes be made as to assure that the beat note frequency will not be shifted by the insertion of the automatic volume control feature by an amount that will reduce the audio output, with the audio attenuator in, by more than 6 db. in the highest frequency band, or 2 db. in any other band. That these corrections be accomplished by the addition of a suitable resistor connected between the plate of the output tube and ground with the AVC "in."

(r) That the contractural specifications be changed to require that the AVC level control have a range extending from 0.1 to 5 milliwatts.

(s) That the subject equipments be considered satisfactory for Naval purposes provided the above recommendations are complied with by the contractor.

DESCRIPTION OF MATERIAL UNDER TEST

4. The material under test consisted of one revised preliminary Class IV radio receiving equipment consisting of the following:

A Model RAG-1 radio receiving equipment.
A Model RAH-1 radio receiving equipment.
A Type CHS-23067 control unit.

These units were manufactured by the Hygrade Sylvania Corporation, Clifton, New Jersey, and were received at the Laboratory on 28 May 1935.

5. The Model RAG-1 radio receiving equipment covers a rated frequency range of from 15 to 600 kilocycles and consists of the following units:

(a) One - Navy type CHS-46042 receiver.
(b) One - Navy type CHS-20032 power unit.
(c) One set - Interconnecting cables.

6. The Model RAH-1 radio receiving equipment covers a rated frequency range of from 0.3 to 23 megacycles and consists of the following units:

(a) One - Navy type CHS-46043 receiver.
(b) One - Navy type CHS-47090 inductance system.
(c) One - Navy type CHS-20032 power unit.
(d) One set - Interconnecting cables.

The type CHS-23067 control unit is used for controlling both of the Models RAG-1 and RAH-1 equipments when used for two channel reception.

7. In the following discussion, reference will be made to the original report (reference (c) of this report) covering the tests made in the original preliminary models of the Model RAG radio receiving equipment. In order to avoid repetition, the subject matter of the paragraphs in reference (c) which apply equally well to the revised preliminary models will not be discussed further in this report and no reference to them will appear herein. Such paragraph references to the original report, reference (c), and to the governing specifications, reference (b), which are disclosed herein will be discussed in detail only because the original discussions as set forth in reference (c) do not apply to the subject equipments and the original comments in reference (c) shall be ignored. Therefore, the discussions as presented in the reference paragraphs of the original report and not discussed further herein will be assumed as applying in their entireties to the subject equipments.

METHOD OF TEST

8. Paragraph 5, reference (c). Radio frequency input voltages were obtained from General Radio type LC-1 Serial No. 18 standard signal generator for tests applied to the Model RAG-1 equipment and from a

General Radio type LC-A Serial No. 8 standard signal general for tests applied to the Model RAH-1 equipment.

9. Par. 6, ref. (c). Audio frequency voltages were obtained from a General Radio type 617A Serial No. 30 interpolation audio oscillator used in conjunction with a Laboratory audio amplifier and a General Radio type 546A, Serial No. 119 microvolter and General Radio type 483C output meter.

10. Par. 7, ref.(c). For tests which involved overall performance characteristics, the outputs were measured with an output meter of Laboratory construction, which had an internal impedance of 600 ohms and was calibrated both in terms of voltage and power. A General Radio type 636A, Serial No. 102, wave analyzer was used for measuring output voltages for the tests to determine audio frequency response characteristics and AVC characteristics as applied only to the audio systems.

11. Par. 9, ref.(c). Selectivity measurements were made with the receivers under test adjusted for optimum gain only.

12. Maximum noise level measurements were made in accordance with paragraph 6-9, reference (b).

13. Resonant overload measurements were made in accordance with paragraph 6-10, reference (b).

14. Par. 10, 11, ref.(c). Overload selectivity measurements were omitted from the subject tests owing to the lack of adequate equipment for conducting these measurements.

15. Par. 14, 15, 16, ref.(c). No tests were made for determining time constants nor for determining the effect of vibration upon frequency stability, it being felt that the subject models of equipment would not be materially different in these respects than were the original models covered by reference (c).

16. The effect of changes in line voltage, input signal intensity and changes in sensitivity control settings upon the frequency stability of the receivers under test was determined by measuring the drift in the beat note frequency with a General Radio interpolation audio oscillator so long as the drift stayed within audibility. When the beat note drifted out of audibility the frequency of the standard signal generator was adjusted to bring the beat note back to the original frequency and the actual drift thus determined from the calibration charts of the standard signal generator.

DATA RECORDED DURING TEST

17. Par. 17, ref. (c). Complete data were recorded on all tests conducted and this information is contained in Tables 1 to 32, inclusive, and Plates 1 to 53, inclusive.

PROBABLE ERRORS IN RESULTS

18. Par. 21, ref.(c). The table of estimated overall accuracy for the various tests must be amended in order to strictly apply to the tests reported herein as follows:

Nature of Test	Estimated Overall Accuracy
Time constant measurements	Omitted
Capacity range and variation of oscillator wobbler measurements	± 25%
Audio frequency characteristics	± 0.5 db. from 0 to 30 db. ± 1 db. from 30 to 70 db.
Sensitivity control characteristics	± 10%, 15 to 7500 kcs. ± 25%, 7500 to 23,000 kcs.
Regulation of CHS-20032 rectifier power unit	± 1%

RESULTS OF TESTS

19. Par. 3-13, Par. 25, ref.(c). The cabinets of all units have been provided with a satisfactory black wrinkle finish. The panels have a smooth dull black finish as produced by a photoetched process.

20. Par. 27, ref.(c). Antenna Circuit. Two antenna binding posts are provided, one labeled "Ant." and the other "Comm.Ant." The "Ant." post connects to the high potential side of the first tuned circuit through first an antenna alignment condenser and then through the antenna coupling condenser both connected in series. The antenna alignment condenser is shunted with a fixed capacity and is provided with a screw driver adjustment to compensate for variations in antenna capacity. The antenna coupling condenser is ganged to the other three coupling condensers which in turn are geared to the main ganged tuning condenser drive. The antenna coupling condenser is further shunted with an air dielectric variable condenser whose setting is fixed. The antenna post is connected to ground through a 2 megohm resistor. The "Com.Ant." post is connected to the "Ant." post through a 1000 ohm resistor. This post is used for antenna connections when two receiver units are operated on a common antenna, the resistor serving as a measure of isolation between the two receivers.

21. Par. 34, ref.(c). Each R.F. amplifier tube has its own bias furnished by a cathode resistor. Additional fixed bias, setting the maximum gain possible with each band, is furnished by the introduction of a voltage into the common cathode lead of the R.F. amplifier tubes by the band switch. This is accomplished by returning the common cathode lead to ground through fixed resistors of various values depending upon the band selected. Each R.F. tube is supplied with screen voltage through separate resistance-capacitance filters from a tap on the voltage divider. The suppressor is tied to the cathode on all stages.

22. Par. 46, ref.(c). Detector Tube. The detector tube is a 76 triode (6 volt heater type) with self bias obtained from a cathode resistor.

.23. Par. 48, ref.(c). Variable A.F. Attenuator. The variable A.F. attenuator is an A.F. tuned circuit bridged from grid to cathode of the first A.F. amplifier tube. It thus builds up the input to this amplifier at the tuned frequency of the attenuator by virtue of its resonant step-up. It consists of two fixed condensers, alternately switchable across a variable iron-cored inductance to give two frequency bands which, together and in conjunction with the variable inductance is made continuously adjustable by varying an air gap in the core and is controlled from the front panel. The switch selecting the desired one of the two frequency bands is provided with an "off" position in which the capacities and inductance are removed from their connections to the grid and resistance is substituted. This resistance is made equal to the average equivalent parallel resistance of the variable A.F. attenuator circuit at resonance in order to keep the termination of the transformer from the band pass filter (and hence the band-pass filter characteristic) substantially the same whether the variable A.F. attenuator is in use or not. In addition a fixed resistance equal to that inserted by the attenuator range switch in its off position, is permanently connected across the band pass output transformer so as to reflect a definite impedance back to the band pass filter. This resistor is in circuit for all positions of the variable A.F. attenuator range switch. One fault with this arrangement is that as the attenuator range switch is shifted from "off" to either its "high" or "low" range, there is an apparent increase in audio gain due to the fact that before the final connection is made (either to "high" or "low" positions) the loading across the band pass filter output transformer is reduced one half. While this condition is not apparent with the switch normally closed, the effect produced in passing from "off" to "high" or "low" position is that the audio output is materially increased.

24. Par. 56, ref.(c). Oscillator and Coupling System to R.F. Amplifier. The original discussion on this subject still applies except that it should be noted that the "Heterodyne Excitation Control" has been replaced by a series of fixed resistors which provide fixed excitation to the plate of the third R.F. tube.

25. Par. 57, ref.(c). Two separate voltage dividers are furnished in the receiver. They are arranged so that the high voltage d.c. from the power source is at a single potential. One divider provides the necessary screen and other voltages, while the other provides a means for adjusting the potential on the cathode of the AVC tube. The ground connection to the divider is at such a point as to provide a voltage negative to ground for R.F. amplifier gain control and for AVC level control. R.F. chokes are provided on the +B and -B leads from the source to the voltage divider.

26. Par. 59, ref.(c). The antenna circuit is identical with that described for the low frequency unit.

27. Par. 62, ref.(c). First R.F. Amplifier Tube. The original discussion given in reference (c) on this subject applies to the CHS-46043 receiver except that it should be noted that gain adjustment is accomplished by simultaneous control of the negative bias of all of the R.F. stages (instead of only the first three R.F. stages as was the case in the original model), this control bias being obtained from a potentiometer (labeled "Sensitivity Control") connected from ground to the negative end of the voltage divider. Also it is to be noted that this bias is not fed through a resistance capacity filter in the case of the fourth R.F. tube.

28. Par. 68, ref.(c). Fourth R.F. Amplifier Tube. The fourth R.F. amplifier tube is a commercial type 6D6 tube. The gain adjustment operates simultaneously with those of the other three R.F. tubes as described in paragraph 27, above. Screen voltage is supplied through a resistance-capacitance filter from a tap on the voltage divider. The suppressor is tied to the cathode. The output of the heterodyne oscillator is coupled to the plate of this tube through a fixed condenser.

29. Par. 70, ref.(c). Detector Tube. This tube and its associated circuits is the same as described for the low frequency unit.

30. Par. 79, ref.(c). Oscillator and Coupling System to R.F. Amplifier. The oscillator is of the "electron coupled" type employing the control grid, cathode and screen of a 6D6 pentode as the elements of an oscillator. The cathode is above ground and the screen is at ground potential with respect to the a.c. component and the suppressor is directly connected to ground. Excitation voltage is applied to the plate of the fourth R.F. tube through a condenser. The oscillator is self-biased by means of a grid current resistor, and separate inductance-capacitance filters are provided in the heater supply leads and a combination resistance-capacitance filter in the high potential plate supply lead, which are in addition to the filter supply in the common heater and plate potential leads. The oscillator inductance coils are a part of a plug-in coil assembly, changed for each band, a separate grid capacitor and resistor for each band being also mounted in the coil assembly. The tuning capacitor is ganged with the others operated by the main tuning control and is paralleled by two trimmer capacitors. One of these trimmers has a screw and lock nut adjustment within the receiver case and the second is operated by a control on the front of the panel labeled "Oscillator Wobbler."

31. Par. 80, ref.(c). The voltage divider is the same as described for the low frequency unit.

32. Par. 4-2, Par. 82, ref.(c).

(a) The type numbers as furnished by the Bureau in reference (g) have been furnished on the nameplates of all major units. Attention is called to the fact that all separate coil systems for the Model RAH-1 equipment bear the same type number as assigned to the entire system consisting of 7 coil systems and as included in the nameplate on the box housing all of the coil systems.

(b) The nameplate on the coil system has been described in (a) above. The use of the same type number on all coil systems appears to be an error. The number of the system should be made large, as has been done in the model, and each system should be indicated as "a part of type CHS-47090." The range of each system should be indicated as in the model.

(c) The vacuum tubes used in the Models RAG-1 and RAH-1 equipments are as follows:

RAG-1 Equipment

Four - type 6D6, R.F. amplifiers, oscillator.
Two - type 76, detectors, 1st A.F. amplifier.
One - type 41, AVC rectifier.
One - type 80, rectifier power unit.

RAH-1 Equipment

Five - type 6D6, R.F. amplifiers, oscillator.
Two - type 76, detectors, 1st A.F. amplifier.
One - type 41, AVC rectifier.
One - type 80, rectifier power unit.

(d) Isolantite insulators have been employed for all R.F. lead supports. Ceramic material has also been used for all radio frequency coil forms, R.F. tube sockets, trimmer condenser insulation, and plug-in coil bases (both on the CHS-47090 coil systems and on the CHS-46043 receiver. The only bakelite insulation used in R.F. circuits is employed in the band switch in the CHS-46042 receiver and here it has not been used in a manner that will noticeably affect receiver performance.

33. Par. 4-3, Par. 83, ref.(c). The ganged condenser stator assemblies in both of the CHS-46042 and CHS-46043 receiver units are mounted on isolantite.

34. Par. 84, ref.(c). The "Best" type of multi-contact switch used for band switching in the original model of the low frequency unit is no longer used. In its stead in the present model of the type CHS-46042 receiver, a multi-contact switch which is manufactured by the Hygrade Sylvania Corporation has been employed and appears to be entirely satisfactory and suitable for the purpose. The audio attenuator range switch, manufactured by the Automatic Electric Company, is a multi-contact telephone switch which is satisfactory in all three of its operating positions, but when thrown from the off position to either of the attenuator positions, there will be a rise in signal output of about 12 decibels between switch positions. In the "off" position, the grid circuit of the first A.F. stage is loaded to compensate for the resonant loss of the attenuators, so that in shifting from the "off" position to the "attenuator" position, the signal level will be substantially the same level. It happens that between these positions the load is removed before the attenuator is cut in and hence the rise in output. This is objectionable from the psychological standpoint,

as an operator is made to feel that when the switch is in the normal operating positions it is not functioning at maximum efficiency.

35. Par. 85, ref.(c). The paper capacitors are generally of the metal enclosed type which comply with the requirements of reference (h). Three exceptions were noted in the type CHS-46042 receiver and it was stated by the manufacturer's representative that a similar number were present in the type CHS-46043 receiver. Although the governing specifications do not require this type of capacitor, the manufacturer's representative stated that it was the intention to furnish them in production regardless of the increased cost to them.

36. Par. 86, ref.(c). The front main panels of the CHS-46042 and CHS-46043 receivers are of 1/8" thick Dural and are satisfactory. The front panel of the CHS-20032 power unit is of 3/32" thick steel and is also satisfactory.

37. Par. 87, ref.(c). On both of the CHS-46042 and CHS-46043 receivers the bottom cover plate is secured by screws at the front and back of the chassis. Additional screws are needed at the sides to prevent movement of this plate, of such large area, when subjected to vibration.

38. Par. 88, ref.(c). The plate choke originally used in the oscillator circuit has been replaced with a resistor in the CHS-46043 receiver and is satisfactory.

39. Par. 89, ref.(c). The discussions presented in paragraph 89 of reference (c) still apply except that the "two terminal" strips have been improved to give at least 1/4" of insulation between terminals and are satisfactory.

40. Par. 90, ref.(c). Practically all of the fixed resistors other than those of wire wound construction are of the IRC 1/2 watt type having molded bakelite insulation and pig tail connections. Their rating is adequate for the power dissipation expected of them. The main B potential divider unit is of wire wound construction and is manufactured by Hardwick and Hindle and is of ample size to dissipate all of the power required. The heater supply interconnecting battery cables as furnished have a wire size that gave approximately 0.17 volt drop. The wire size is satisfactory. The cables have a woven fabric outer covering and are not in accordance with the sample submitted at the conference of 12 and 13 December 1934. The manufacturer's representative states that production cables will be rubber-covered as previously agreed.

41. Par. 91, ref.(c). The ends of the leads in the interconnecting cables furnished with the Models RAG-1 and RAH-1 equipments are terminated with standard lug terminals instead of Jones plugs as originally furnished. All of the cables furnished were not in accordance with the submitted sample as mentioned above. However, assurance has been given that the production cables will all have a rubber outer covering. Terminal blocks are provided in all units for making the cable connections. The sensitivity

control and AVC level control are wire wound clarostats. The chassis construction is such that the diaphragm shields are removable after loosening two screws in each, thus making all wiring in the socket and coil contact compartments readily accessible for repairs, adjustments, or replacements.

42. Par. 4-4. Par. 92, 93, and 94, ref.(c). The ganged air dielectric variable condensers in the type CHS-46042 receiver have soldered cadmium plated brass plates. Although this unit functioned satisfactorily throughout the short duration of tests, its general construction and particularly the brush contacts were less satisfactory than shown in a separate ganged unit which was furnished for inspection after the start of tests. The new unit employs a sturdy 3/8" shaft with ball bearings at each end. The frame is of cadmium plated brass fabricated with solder bonded mortise and tenon joints. The fixed plates are solder bonded and mounted on isolantite insulators. The rotor plates are solder bonded to a sturdy brass hub which is in turn secured to the drive shaft with two #10 screws in each section. The end of each hub is fitted with a 1/32" thick sterling silver ring against which ride the brush contacts. The brush contacts are heavy German silver radius bent flat springs, each being fitted with four silver contact buttons which are riveted into the springs. The buttons are about 1/16" in diameter and are so arranged that two are located on each side of the shaft, the flat spring being forked so as to straddle the shaft. The flat spring is bowed, one end being bolted to the frame and the other making pressure contact thereon. The contacts, being in the middle of the spring, are forced into contact with the ring on the rotor hub. The unit is generally sturdy and appears to possess unusually good electrical and mechanical characteristics. The shaft is presumably of stainless steel, as it appears to be reasonably hard and is only slightly magnetic. The ball bearings appear to be of steel and may possibly rust. Stainless steel balls are believed to be more suitable and they should be packed in a high viscosity grease. The model has satisfactory contact between rotors and brush contacts which has presumably been obtained with careful adjustment. Improper spring tension and alignment would result in questionable contact sooner or later, due to the probable wearing away of the relatively soft silver contact buttons. The ganged air dielectric variable condensers as furnished in the type CHS-46043 receiver were suspected of giving some contact trouble due to the fact that sensitivities could not be satisfactorily duplicated after resetting the condenser. The main shaft is of 1/4" material and the rotor assemblies are secured thereto by a chuck-like arrangement, as in the first model submitted. There was also noticeable backlash which amounted to as much as two divisions, or .002 of the condenser range. This, it was claimed by the manufacturer's representative, was due to slippage between the shaft and the worm wheel hub. The manufacturer's representative submitted a redesigned ganged condenser unit which, if satisfactory, will be incorporated in production. This unit has a 3/8" stainless steel shaft for all tuning capacitor units and a micalex extension for the variable coupling unit. The two parts of this shaft are coupled to make a single unit with a heavy collar using two 10-32 set screws for connection to each part. The complete shaft is mounted between two single ball thrust bearings, one at each end, and has three intermediate collar

bearings, one being located adjacent to the worm wheel in the center which is used for drive. The frame is of 1/16" fabricated brass cadmium plated. It is assembled with mortise and tenon joints either staked or solder bonded. The insulation is isolantite throughout, including that provided for the terminal leads which connect to the coil plug bases. The drive is through a worm and worm wheel, the latter being of canvas base phenolic material in two parts with spring take-up to reduce backlash. The spring is apparently of steel and is magnetic, which would indicate that corrosion might be expected. A heavier non-corrosive spring is desired. Air dielectric, isolantite insulated trimmer condensers have been furnished for all sections. It was observed that all terminal tabs on the stator sections are of cadmium plated magnetic material. Non-corrosive, non-magnetic material is desired. The cadmium plating was incomplete in the corners of the frame. The brush contacts are similar to those described for the type CHS-46042 receiver. The antenna and wobbler condensers have excessive bearing play and require additional bracing auxiliary to the single hole mounting provided which is in 1/32" material and is not rigid enough in its present form. With the corrections as implied herein, this unit would appear to be satisfactory.

43. Par. 95, ref.(c). In general, it may be said that all units of the Models RAG-1 and RAH-1 equipments are mechanically very good. The arrangement of parts and accessibility is also very good. Wiring and soldering can be considered as being exceptionally neat. All radio frequency sockets employ isolantite insulation with cadmium plated steel reinforcing springs and cadmium plated phosphor bronze contacts. The screws securing the cable clamps to the bakelite terminal panel in the type CHS-23007 control unit are threaded into tapped holes in this panel and depend upon nuts for final securing. Insufficient clearance has been provided to permit tightening the nuts. The nuts must be accessible, as the screw is threaded into the bakelite and the assembly cannot be tightened from the screw head. 8-32 instead of 6-32 screws should be employed.

44. Par. 4-5. Par. 96, ref.(c). The frame, front and side panels of the chassis and cabinets of the types CHS-46042 and CHS-46043 receivers and of the type CHS-23007 control unit are either of aluminum or Dural. The interiors of the cabinets of all of these units have an aluminum spray finish, but the manufacturer's representative has stated that the production units will be provided with an anodized finish. The chassis of all units are provided with an anodized finish. The diaphragm shields as well as the coil and tube shields of the type CHS-46042, CHS-46043, and CHS-47090 units are of aluminum. The diaphragm shields and coil shields are anodized while the tube shields, being of a commercial type, have a bright aluminum finish. The chassis construction and cabinet construction of all units, the construction of the diaphragm shields, coil shields and tube shields are all sufficiently rugged for their respective purposes. The cabinet of the type CHS-20032 power unit is fabricated from steel and has its interior sprayed with a black lacquer. The production cabinets will have the interior anodized. The front panel is also of steel and is cadmium plated. The chassis is fabricated from either aluminum or Dural and has an anodized finish. The construction

of the power unit chassis and cabinet is considered to be rugged. The cabinet for the CHS-47090 coil systems is constructed from aluminum and has its interior anodized.

45. Par. 4-6. Par. 97, ref.(c). The use of iron or steel, except where specifications require it for electro-magnetic purposes, has been reduced to a reasonable minimum. The R.F. choke coil assemblies are potted in aluminum cases and are thus protected from corrosion. The core material in the variable A.F. attenuator inductances has a protective coating against corrosion. The A.F. transformer cases have been constructed from aluminum. All aluminum cases have an anodized finish to protect them from corrosive action.

46. Par. 4-8. Par. 99, ref.(c). The type CHS-20032 power unit has been provided with automobile type fuses placed one in series with each side of the line.

47. Par. 4-13. Par. 104, ref.(c). The following parts are interchangeable in the CHS-46042 and CHS-46043 receiver units. Sensitivity controls, telephone jacks, complete audio systems or individual parts thereof, including band pass filters and attenuators, R.F. and A.F. chokes, by-pass capacitors of the larger sizes, tube sockets, meters, meter range switches, A.F. attenuator range switch and rectifier power units. The various parts in the Class IV equipment have been marked with the manufacturer's designating or code numbers to the extent indicated below. None of the parts are identified by Navy type numbers.

Type CHS-46042 Receiver Unit

The following parts are identified by manufacturer's code marking:

(1) Main ganged tuning condenser.
(2) Antenna alignment condenser.
(3) All R.F. inductances.
(4) Antenna trimming condenser.
(5) Band changing switch.
(6) All iron cored filter reactors.
(7) Audio frequency transformers.
(8) Inductors of the band-pass filter.
(9) Shielded R.F. choke coils.
(10) Most of the metal clad paper dielectric by-pass condensers.
(11) AVC level control potentiometer.
(12) Sensitivity control potentiometer.

The following parts are not identified by manufacturer's coding:

(1) A few of the metal clad paper dielectric by-pass condensers.
(2) All molded mica dielectric by-pass condensers.*
(3) Wire wound (non-color coded) vitreous enameled resistors.
(4) Tube sockets.**
(5) Inductor for variable attenuator.

(6) Attenuator range switch.
(7) Telephone jack.
(8) Oscillator test button.
(9) Power "On-Off" and AVC "On-Off" toggle switches.
(10) Terminal strips.
(11) Precision wire wound resistors for output meters. (Manufacturer's name and resistance value given.)
(12) Output meter range switch.
(13) Output meter.
(14) Filament voltmeter.
(15) Trimmer condensers.
(16) Link switch on power line.

* A few of the molded mica dielectric condensers are color coded.
** The type number of the tube for each socket is stenciled on the receiver chassis or coil shield and adjacent to the socket.

All carbon rod resistors have color code identification which is satisfactory.

Type CHS-46043 Receiver Unit

The following parts are identified by manufacturer's code marking:

(1) Iron cored chokes.
(2) Air core R.F. chokes.
(3) Rectangular metal clad paper dielectric by-pass condensers (most).
(4) Unshielded R.F. chokes (groupings marked).
(5) Audio tuning range switch.
(6) AVC level control potentiometer.
(7) Sensitivity control potentiometer.
(8) Wire wound vitreous enamel resistor (1).
(9) Tubular metal clad paper dielectric by-pass condensers (some).
(10) Antenna coupling condenser.
(11) Main gang tuning condenser (marking in a confusing place).
(12) Antenna alignment condenser.
(13) Audio frequency transformer.
(14) Variable attenuator reactor.
(15) Elements of band-pass filter.
(16) Precision resistors on output range switch are marked with manufacturer's name and resistance value.

The following parts are not identified by manufacturer's coding:

(1) Tube sockets (tube type numbers stenciled adjacent to each socket).
(2) Wire wound vitreous (non-color coded) enamel resistors (some).
(3) Tubular metal clad paper dielectric by-pass condensers (some).
(4) Telephone jacks.
(5) All toggle switches.
(6) All molded mica dielectric by-pass condensers (a few are color coded).
(7) Oscillator test button.

(8) Link switches in power line.
(9) Some rectangular metal clad paper dielectric by-pass condensers.
(10) All trimmer condensers.
(11) Antenna trimmer condenser.
(12) Frequency wobbler.
(13) Output range switch.
(14) Filament voltmeter.
(15) Output meter.

Type CHS-20032 Power Unit

The following parts are stenciled with manufacturer's code marking:

(1) Power transformer.
(2) Filter reactor.
(3) Filter condenser.
(4) R.F. filter chokes.
(5) R.F. by-pass condensers (metal clad, paper dielectric).

The following parts are not identified by manufacturer's code marking:

(1) Tube socket (type number of tube is stenciled on socket).
(2) Wire wound vitreous enameled load resistor used only for Model RAG-1 equipment.
(3) "On-Off" toggle switch.
(4) Fuses.

Type CHS-23067 Control Box

None of the parts, namely, two "On-Off" toggle switches, two telephone jacks, and one "Automatic Electric" mixer switch, is identified by either Navy type numbers or manufacturer's coding.

48. Par. 4-14. Par. 105, ref.(c). A satisfactory nameplate has been furnished on the cabinet of the type CHS-47090 inductance system.

49. Par. 4-16. Par. 107, ref.(c). The original comments appearing in reference (c) still apply except that in the type CHS-46043 receiver unit the radio frequency plug studs have been soldered directly to their associated terminals as recommended. The remaining studs depend upon the clamping action of the nut for contact with a terminal lug as before.

50. Par. 4-18. Par. 109, ref.(c). The numbering and graduations on the main tuning dial of the type CHS-46042 and CHS-46043 receivers are in accordance with these specifications.

51. Par. 4-2-a. Par. 111, ref.(c). The receivers (proper) consist of two separate, distinct, and complete receivers, one for each channel, and housed in individual cabinets. Each receiver is operated from its own rectifier power unit. A control box is furnished for operating the two receivers simultaneously and includes line power switches for both receivers and an output telephone jack which is connected to either or both receivers as desired through a mixer selector switch.

52. Par. 4-3-a. Par. 112, ref.(c). The cabinets of the types CHS-46042 and CHS-46043 receiver units are of uniform height and depth and may be secured together to form a complete unit. The sides and backs of the outer surfaces of the cabinets present a smooth appearance. Round head rivets have been used at the top back edge and bottom of the receiver boxes. The shockproof mounting has been improved and is satisfactory. The shockproofing rubber mounts are novel and very effective. Although rubber provides the best known type of mounting, it is not a stable material and may permanently compress or harden with age. For this reason assurance should be obtained that spare rubber parts will be available for replacement purposes. The antenna and ground binding posts protrude from the top of the cabinet by 1-1/8".

53. Par. 4-5-a. Par. 114, ref.(c). The dimensions and weights of the several units of the Models RAG-1 and RAH-1 equipments are as follows:

Receiver type CHS-46042, Model RAG-1 Equipment

Height - (table to top of cabinet) 16-5/8".
Height - (overall, table to top of antenna and ground binding posts, and including shock mountings) 17-7/8".
Width - 18-1/4".
Depth - 17-1/2" (back of panel excluding controls).
Depth - 18-1/2" (back of panel including controls).
Weight - 90 lbs.

Receiver type CHS-46043, Model RAH-1 Equipment

Height - (table to top of cabinet) 16-5/8".
Height - (overall, table to top of antenna and ground binding posts and including shock mountings) 17-7/8".
Width - 18-1/4".
Depth - 17-1/2" (back to panel including controls).
Depth - 18-1/2" (overall, including controls).
Weight - 80 lbs. without coils.

Receiver types CHS-46042 and CHS-46043, when assembled for installation.

Height - (overall, table to top of antenna and ground binding posts and including shock mountings) 17-7/8".
Length - 36-1/2".
Depth - 17-1/2" (back of panel excluding controls).
Total weight - 170 lbs. as given in the specifications.

Inductance System, type CHS-47090, Model RAH-1 Equipment
(Complete system of 7 coils in storage box.)

Height - 13-1/2".
Width - 15".
Depth - 9-1/2" (excluding handle).
Weight of storage box - 8-1/2 lbs.
Weight of single coil set - 3-1/4 lbs.
Weight of complete system with box - 30-1/2 lbs.

Control Unit type 23067, Models RAG-1 and/or RAH-1 Equipments

Height - 5-3/4".
Depth - (panel to rear, including rear grommets) 4-1/2".
Depth - (panel to rear, including all projections) 5-1/2".
Width - 3-7/8".
Weight - 1 lb. 9-1/2 oz.

Auxiliary Equipment, Models RAG-1 and/or RAH-1 Equipments

Line power cable - (tips of connector plug to power unit terminals) 9 ft. 2-1/2 in. Weight - 9 oz.
A.C. power cable - (between terminal tips) 7 ft. 9 in. Weight - 10-1/2 oz.
D.C. power cable - (between terminal tips) 7 ft. 11 in. Weight - 10 oz.
Two conductor control box power cable - (2 required) 7 ft. 7 in. each. Weight - 6 oz. each.
Three conductor control box phone cable - (2 required) 7 ft. 6 in. each. Weight - 8-3/4 oz. each.

54. Par. 4-6-a. Par. 115, ref.(c). A separate power unit (type CHS-20032) has been supplied with each of the Models RAG-1 and RAH-1 equipments. The power unit uses Paranol 600 volt capacitors except for the one 600 volt .02 mfd. paper capacitor in the first section of the filter, and the two 300 volt .05 mfd. paper across each side of the line to ground. The transformers and filter reactors, used in this unit, it is claimed by the manufacturer's representative, are vacuum varnish impregnated, dipped in Mitchel Rand Company's #2438 compound and then placed in a metal case and potted. This transformer unit has a bakelite terminal strip and all terminals are marked. The two iron cored chokes are potted and have no terminal block, but instead have color coded leads which are brought out of the side of the container. The bleeder resistor has a resistance of 7500 ohms, is wire wound, vitreous enameled, of the Hardwick Hindle 10 watt type. This bleeder resistor is used only in conjunction with the type CHS-46042 receiver unit. All parts of the power unit are very accessible and all of the wiring is color coded. A bakelite terminal block to which the power cables are connected is mounted at the top of the chassis. A fuse is provided in each side of the line. An R.F. choke wound on an insulating spool and wax impregnated is mounted on the base of the power unit chassis. It is provided with terminals and is connected in series between one side of the rectifier tube filament winding and the two A.F. filter chokes. The cabinet is arranged for either top of table or under table mounting by the simple expedient of transforming the mounting angles to the top or bottom of the cabinet to suit the desired method of mounting. These mounting angles are secured to the cabinet with screws threaded into tapped holes in the cabinet. The case and front panel are made of steel. The interior of the cabinet has been sprayed with a black lacquer, while the front panel has a cadmium plating, clear lacquered on the back side, while the front side is black as the result of the photo-etched process. The chassis frame is fabricated from aluminum or Dural with welded seams and has an anodized finish. The chassis is easily removable from its case and is fitted with guide slots which are satisfactory.

55. Par. 4-7-a. Par. 117, ref.(c). The dimensions and weight of the type CHS-20032 power unit are as follows:

Height - 7-1/8".
Width, cabinet only - 12".
Width, cabinet and mounting flanges - 13-5/8".
Depth (rear to panel) - 8" (includes rubber grommets in rear).
Weight - 31 lbs.

56. Par. 4-8-a. Par. 118, ref.(c). The chassis of either of the CHS-46042 or CHS-46043 receiver units may be completely removed from its cabinet for servicing without disturbing the cabinet simply by removing the screws securing the terminal panel cover in place, disconnecting the interconnecting cables from the terminal panels, unloosening the thumb screws in the front panel and removing a "stop screw" in the chassis frame which limits the extent to which the chassis may be withdrawn from the cabinet. For tube replacement the chassis may be withdrawn from the cabinet far enough to permit access to all of the tubes without disturbing the cabinet or the interconnecting cables. The chassis of either the type CHS-20032 power unit or type CHS-23067 control unit may be completely withdrawn from their respective cabinets for servicing or tube replacement (power unit only) by simply unloosening the thumb screws in their corresponding front panels and pulling the chassis out. The interconnecting cables to these units need not be disconnected if sufficient slack is left for this purpose upon installation.

57. Par. 4-9-a. Par. 119, ref.(c). The cabinets of all units have been provided with a satisfactory black wrinkled finish. The panels are of smooth dull black as produced by a photo-etching process.

58. Par. 4-11-a. Par. 121, ref.(c). The handles on the receivers are satisfactory.

59. Par. 4-12-a. Par. 122, ref.(c). The panel securing screws function satisfactorily but are not considered rugged enough. The 8-32 studs should be replaced with 10-24 studs.

60. Par. 4-13-a. Par. 123, ref.(c). The arrangement of meters is symmetrical in each unit and similarly arranged on both units.

61. Par. 4-14-a. Par. 124, ref.(c). The markings on the band pass and automatic volume control switches are satisfactory. The band selector switch on the CHS-46042 receiver unit is suitably and satisfactorily marked to indicate the frequency range of each band.

62. Par. 4-15-a. Par. 125, ref.(c). The photo-etched process used for the front panels of all units provides raised characters; that is, white letters on a black background. This presents a satisfactory appearance.

63. Par. 4-16-a. Par. 126, ref.(c). Photo-etched nameplates have been exclusively used in all units.

64. Par. 4-20-a. Par. 130, ref.(c). The original discussion given in reference (c) still applies except as follows:

(a) The coils have been given a wax treatment which is satisfactory.

(b) The two parts of the ceramic tube forms have been cemented together and wax coated, which appears to give a rugged structure. A locking feature using a metal insert in the tube which is screwed to the base has also been provided, which furnishes additional security should the cement joint become loosened.

(c) The coil windings have been rearranged so that no windings carrying different d.c. potentials are in direct contact through their own insulation.

(d) The Litz #10-42 wire coils have been retained, but have been well wax treated.

65. Par. 4-21-a. Par. 131, ref.(c). The construction of the type CHS-47090 inductance systems is essentially the same as originally furnished and the weaknesses as pointed out in the original discussion of this subject in reference (c) still applies.

66. Par. 4-22-a. Par. 132, ref.(c). Air dielectric trimmer condensers are provided for trimming each individual condenser on the main ganged tuning unit on the type CHS-46043 receiver unit. In addition each coil of the CHS-47090 inductance system is provided with an air dielectric trimmer condenser. Adjustment of these trimmer condensers is provided through holes suitably arranged under the handles of each inductance system. To gain access to these holes it is necessary to remove the handle by taking out the screws which secure it to the inductance assembly. A special wrench and screw driver combination tool is furnished for this purpose.

67. Par. 4-26-2 and 4-27-a. Par. 136, ref.(c). The type CHS-47090 inductance system box has been completely redesigned. It has been made more compact and sturdy by giving both the box and the cover the same dimensions, placing four coil systems in one part and three in the other. When fully opened, the box and cover give the same stowage arrangement as if all coil systems are in a single box and thus eliminates the inconvenience of having to allow space for an empty cover or the possibility of losing same if detached. It has the further advantage of making it possible to divide the two sections of the box for convenience in mounting. The method of securing the coil systems in the box is unsatisfactory in that it is a two hand and uncertain operation to remove them from or replace them in the box. If the box length were increased by 1/2", it should be possible to redesign the retaining springs so that a satisfactory design could be accomplished.

68. Par. 4-28-a. Par. 137, ref.(c). The coil system retaining dogs furnished in the first model have been replaced with the spring retaining mechanism mentioned above. The dogs with proper securing means are preferable to the springs in their present form, but it appears probable that with proper redesign the latter method will be the more satisfactory.

69. Par. 4-29-a. Par. 138, ref.(c). The dial markings are satisfactory.

70. Par. 4-30-a. Par. 139, ref.(c). The main tuning dials rotate in like directions for the two equipments and are satisfactory.

71. Par. 4-31-a. Par. 140, ref.(c). The knobs furnished provide satisfactory visibility of the panel markings. The main tuning dial is satisfactory if provided with a knurled or fluted surface to prevent slippage when operating. The decibel meter and the glass over the main tuning dial of the types CHS-46042 and CHS-46043 receiver have anti-glare characteristics and are satisfactory. Neither of the source voltmeters on these two units possess anti-glare glass and under certain conditions of light are difficult to read.

72. Par. 4-33-a. Par. 142, ref.(c). The main tuning vernier of the type CHS-46042 receiver unit has a driving ratio of 10 to 1, while that of the type CHS-46043 receiver unit is 20 to 1.

73. Par. 4-35-a. Par. 144, ref.(c). There is no apparent back lash or torque lash in the main tuning drive mechanism of the type CHS-46042 receiver. In the case of the main tuning drive of the type CHS-46043 receiver, there is evidence of back lash due, the manufacturer's representative claims, to slippage between the condenser shaft and the worm wheel hub. It is believed that this defect will be eliminated in the new ganged condenser design.

74. Par. 4-37-a. Par. 146, ref.(c). The capacitance coupling gang assembly on the main tuning gang condenser assembly of the type CHS-46042 receiver is now gear driven from the main tuning control instead of cable driven as in the original model. This drive mechanism is superior to the cable driven device and appears to be satisfactory in its present form.

75. Par. 4-39-a. Par. 148, ref.(c). All of the so-called "Best" type of switches have been replaced with satisfactory switches. German silver has been used in brush and contact construction of all rotary switches which are also provided with a satisfactory "wipe" feature.

76. Par. 4-40-a. Par. 149, ref.(c). The panel of either the type CHS-46042 or CHS-46043 receiver is secured to the chassis with "hex" head screws which are satisfactory. The parts are generally accessible for replacement, the exception being the tube socket closest to the panel in the type CHS-46042 receiver. This can be removed only after the removal of three R.F. leads and several power supply leads and a resistor-condenser mounting strip. The tuning meter has been eliminated thus giving ample clearance for other meters. The radio frequency filter chokes and condensers are readily removable for replacement. The bakelite sub panel

previously mentioned has been removed.

77. Par. 4-41-a. Par. 150, ref.(c). An oscillation test button has been supplied on each of the types CHS-46042 and CHS-46043 receivers and when depressed, connects the cathode of the oscillator tube directly to ground and simultaneously shorts the coupling coil on the cathode circuit.

78. Par. 4-42-a. Par. 151, ref.(c). The so-called "mid-line" type of variable condenser plus some padding, is used which approaches straight line frequency variation. Calibration curves for the type CHS-46042 receiver are shown on Plate 1 and on Plate 27 for the type CHS-46043 receiver.

79. Par. 4-44-a. Par. 153, ref.(c). The control unit, type CHS-23067, contains the following devices: An "On-Off" toggle switch for controlling each power unit, an output telephone jack and a three position telephone switch so wired as to provide connection of the telephone jack to either of the two receiver outputs at its extreme positions and to both receiver outputs in parallel when in its center position. This switch is of sturdy construction, is satisfactory, and supercedes the "Best" type of switch originally employed. The Yaxley telephone jacks are not in accordance with Navy Specifications, reference (n), in that they are not so mounted as to prevent rotation and will not fit into the mounting usually provided for standard jacks which have been designed to prevent rotation. The dimensions of the control unit are given in paragraph 53 of this report.

80. Par. 4-52-a. Par. 160, ref.(c). An "On-Off" toggle switch is provided in each of the types CHS-46042 and CHS-46043 receivers for controlling the heater and +B circuits. Removable links have been provided which, when removed or opened, make these switches operable for d.c. power supply operation. When these links are in place these switches are shorted out as for a.c. operation of either receiver. For a.c. operation of the Models RAG-1 or RAH-1 equipments, power may be controlled from the "On-Off" toggle switch on the power unit or a similar switch in the control unit, since these two toggle switches are in parallel. These switches, it is to be noted, operate in the a.c. line rather than in the heater and +B circuits as is the case with the "On-Off" toggle switches on the receiver units.

81. Par. 4-53-a. Par. 161, ref.(c). The previous comment applies to the types of tubes used. The tubes are of the commercial type 6.3 volt heater type and are as near to the specification requirements as regards the range of heater voltage at which satisfactory operation may be expected, as are commercially available.

82. Par. 5-1. Par. 162, 163, ref.(c). **Sensitivity.** The CW sensitivity curves on Plate 3 show that the sensitivity requirements are not fully met in any band of the type CHS-46042 receiver with the radio frequency tubes furnished with the receiver and considering the unit as a single dial controlled receiver, while the specifications are met in all but the lowest frequency band with the same tubes, if the antenna trimmer adjustment is considered as a second control and is adjusted for maximum response. The curves shown on Plate 2 indicate to what extent the antenna trimmer must be adjusted to obtain the optimum sensitivities shown on Plate 3. As indicated

in Table 11, fixed adjustment of the antenna trimmer at -2.5 divisions instead of at zero for each frequency setting for band 3, the sensitivities at these frequencies are fairly uniform and within the specification limits except for the high frequency end of the band, where the sensitivity falls outside of the specification limits. Moreover, these sensitivities are, except for the highest frequency of the band, approximately of the same magnitudes as the corresponding sensitivities obtained when the antenna trimmer was adjusted for maximum sensitivity at each frequency setting. This, together with the curves shown on Plate 2 for antenna trimmer calibrations, would indicate that if the receiver is to be operated as a single dial controlled receiver, the antenna trimmer should be set at -2.0 divisions instead of at zero for optimum sensitivities at any frequency within the range of the receiver.

83. The CW sensitivity curves shown on Plate 28 indicate the sensitivity requirements of the type CHS-46043 receiver are not fully met in bands 1, 2, 4, 5 and 7 with the radio frequency tubes furnished and considering this unit as a single dial controlled receiver. All bands except 1 and 7 can be considered within the limits of accuracy, as being within the specification limits with the same tubes when considering the antenna trimmer as a permissible second control. Band 1 averaged, under the latter condition, about 25% outside of specification limits, while band 7 averaged about 100% outside of the specification limits. Plate 17 shown to what extent the antenna trimmer and oscillation wobbler were adjusted for best sensitivities.

84. The radio frequency and oscillator tube furnished in both types of receivers were of Hygrade-Sylvania manufacture. Their mutual conductances were measured on a Weston Model OD tube tester and the results of these measurements are given in Tables 14 and 28 for the Models RAG-1 and RAH-1 equipments respectively. It will be observed that the mutual conductances for the tubes in the Model RAH-1 equipment were below the 1600 value set by the tube manufacturer. New tubes of RCA manufacture were substituted for the Hygrade-Sylvania tubes in both types of receivers and sensitivities again measured. The mutual conductances of the new tubes are also given in the above mentioned tables.

85. The new tubes generally increased the sensitivity of both receivers. In the case of the type CHS-46042 receiver, the improvement was due to a lower noise level with the new tubes as the mutual conductances of both sets of tubes were practically the same and it was improbable that the receiver alignment was materially changed as a result of interelectrode capacitance differences. The new tubes were not of sufficient help as to permit the type CHS-46042 receiver to pass the governing specifications in the lowest frequency band, it averaging about 80% high in microvolts required.

86. In the case of the type CHS-46043 receiver, an improvement resulting from the change in tubes was evidenced in all bands except 6 and 7. The improvement was not sufficient, however, to meet the specification limit of 3 microvolts at both ends of band 1. Band 6, when considered as a two control receiver, although slightly less sensitive than with the original tubes was within the specifications. Band 7 was forced further outside of specification limits requiring an average of over 5 times the microvolts

input permitted by the specifications. This test showed definitely that it will be essential to require that bands 6 and 7 be realigned whenever it becomes necessary to change tubes. With the arrangements provided in the model and simple instructions together with an alignment oscillator, the realignment should be a simple operation.

87. In the above tests it was believed by the manufacturer's representative that the alignment in the type CHS-46043 receiver may have been affected by the handling given the receiver prior to performance tests in making the mechanical inspection. The representative was therefore given an opportunity to retrim and upon retest band 7 was found to come within the specification limits up to 21,000 kilocycles as shown on Table 29. New tubes were substituted and it was again realigned with the results as shown on Table 30 which very nearly complied with the specifications.

88. It was observed during the tests that the sensitivity in band 7 of the type CHS-46043 receiver was affected by tuning to the extent that sensitivities could not be duplicated within about 30% after the receiver had been tuned off of resonance and back again. The reason for this is not definitely known, but believed to be due to contact resistance variation in the variable gang condenser. A gang condenser was submitted for inspection which is described under paragraph 42 above. The contact design in this latter unit appears to be satisfactory.

89. It has been demonstrated that the sensitivity requirements can be met in all bands except the highest and lowest frequency bands of each receiver. The low frequency bands of both receivers could no doubt be made to pass the specification requirements by an increase in antenna coupling which would increase the number of bands required and decrease the selectivity. It is probable that the selectivity would not be decreased sufficiently but that it would still pass the specifications. However, a greater number of bands, particularly in the case of the type CHS-46043 receiver, is not desirable. The low frequency band of the type CHS-46042 receiver is believed to have greater sensitivity than can ever be used under practical operating conditions. The type CHS-46043 receiver fails to pass in the low frequency band only at its lowest frequency end where it is overlapped with the type CHS-46042 receiver. The highest frequency band of the type CHS-46043 receiver can be considered to have complied with the specifications, within the accuracy of measurement after new tubes were employed and the receiver was realigned. It is probable that the sensitivity will be improved slightly throughout the range with the installation of the better gang condenser recommended. It is also probable that the sensitivity could be increased by using inductive instead of variable capacitive coupling. This is not recommended, however, as the selectivity would be decreased and there is always a possibility of resonant primaries. Another advantage of the capacity coupling is in the fact that but a single coil is employed in each stage which eliminates greatly the possibility of electrolytic action.

90. Complete sensitivity data when using the Hygrade-Sylvania tubes and the RCA tubes are shown in Tables 12 and 26 for the Models RAG-1 and RAH-1 equipments respectively. These tables are self-explanatory and no further comment need be given at this time.

91. Par. 5-2. Par. 164, ref.(c). Selectivity. Selectivity curves are shown on Plates 5 to 8, inclusive, for the type CHS-46042 receiver. Measurements were taken at the overlap frequencies of each band and with the receiver adjusted for optimum gain for each measurement. The selectivities obtained were well within the specification limits in all instances.

92. Par. 165, ref.(c). Selectivity curves are shown on Plates 30, 31 and 32 for the type CHS-46043 receiver. Measurements were taken at the overlap and middle frequencies of bands 1, 4 and 7, and with the receiver adjusted for optimum gain for each measurement. The selectivities obtained were well within the specification limits.

93. Par. 5-3. Par. 166, ref.(c). Maximum Noise Level. The variation of maximum noise level throughout the frequency range of each band of the type CHS-46042 receiver is shown on Plate 4. Curves are shown for two runs first, with the antenna trimmer set at zero for all frequency settings and second, with the antenna trimmer adjusted for best sensitivity at each frequency setting. While the maximum noise level does not exceed the specification limit of 1.25 milliwatts under any condition, it will be noted that when the antenna trimmer is adjusted for best sensitivity, the maximum noise level is higher than when the antenna trimmer is fixed at its zero setting. Moreover, it will be noted further that with the antenna trimmer adjusted for best sensitivity, the increase in maximum noise level is several times greater at the high frequency end of each band than for the low frequency end. Table 13 shows the effect on maximum noise when the original tubes had been replaced by RCA tubes. This table is self-explanatory and no further comment is required.

94. Par. 167, ref.(c). The variation of maximum noise level throughout the frequency range of each band of the type CHS-46042 receiver when using the original tubes and without bands 6 and 7 being realigned is shown on Plate 29. The specification limit is exceeded at the highest frequency end of band 4. Table 27 shows the effect on maximum noise level when the original tubes had been replaced by RCA tubes. It will be noted that when the R.F. tubes were replaced, the specification limit was exceeded at the high frequency ends of bands 3 and 4. Replacing only the oscillator tubes gave results which were approximately the same as shown on Plate 29. As indicated in Tables 29 and 30, and as is to be expected since the sensitivities of band 7 were very materially improved as the net result of the realignment of this band, the maximum noise level was also increased. However, this increase in maximum noise level was not as great with the RCA tubes as with the original Hygrade-Sylvania tubes and was generally accompanied with a corresponding decrease in sensitivity. It is to be pointed out here that the data in Tables 29 and 30 were obtained after realignment of band 7, using the tubes noted in Tables 29 and 30 and was not a case of substituting one set of tubes for the other after realignment when using only one set of tubes.

95. Par. 5-4. Par. 168, ref.(c). Resonant Overload. For the type CHS-46042 receiver unit the maximum output obtainable is greater than 300 milliwatts for all bands. However, as shown in Table 3, resonant overload as defined by paragraph 2-11, reference (b), and as amended by reference (d), occurs for outputs less than 260 milliwatts for bands 3 and 4.

In band 3 it is 7.2% and in band 4, 4% lower than required. This is not considered a serious defect. This receiver shows excellent anti-blocking characteristics in that there is no noticeable drop in output voltage with as much as 0.5 volt of radio frequency input or the limit of the standard signal generator employed in the test.

96. Par. 169, ref.(c). For the type CHS-46043 receiver unit the maximum output obtainable is better than 300 milliwatts for bands 1 to 5 inclusive, and while under 300 milliwatts is better than 250 milliwatts for bands 6 and 7. As shown in Table 20, resonant overload as defined by paragraph 2-11, reference (b), and amended by reference (d), occurs for outputs greater than 250 milliwatts, the specification limit as per reference (d) for bands 1 to 5 inclusive and under 250 milliwatts for bands 6 and 7. In band 6 it is 2.4% below the required limit and 32% below the required limit for band 7. This is not considered as being a serious defect since the worst condition (band 7) represents a decrease in output of only 3.36 db. which is only barely perceptable by the ear. The receiver shows excellent anti-blocking characteristics for R.F. inputs up to 0.5 volt.

97. Par. 5-11. Par. 175, ref.(b). Capacity of Trimmer Capacitors. The full scale capacitance of the antenna trimmer condenser in the type CHS-46042 receiver unit is within 5% of the full scale capacitance of the main tuning condenser being approximately 4.2%. The maximum capacity of the main tuning condensers is a nominal 800 mmf.

98. Par. 176, ref.(c). The full scale capacitance of the antenna trimming condenser in the type CHS-46043 receiver unit is 10 mmf. which is less than 5% of the total full scale capacity of the main tuning condenser for bands 1 to 5 inclusive. However, since only a portion of the total capacity of the main tuning condenser is used in bands 6 and 7, the capacity of the antenna trimmer condenser becomes 10.4% of the active full scale capacity of the main tuning condenser. The active full scale capacity of the main tuning condensers for bands 6 and 7 is 96 mmf. Reference to sensitivity curves for bands 6 and 7 shown in Plate 28 together with the data given in Table 17 relative to the setting of the antenna trimmer for best sensitivity will show that best sensitivity is obtained at either zero setting or very close thereto on the condenser dial, and that when the antenna setting is different from zero the improvement in sensitivity is only slight. Therefore, the fact that the full scale capacity of the antenna trimmer condenser with respect to the full scale capacity of the main tuning condensers for bands 6 and 7 exceeds the specification limits is of too small importance to warrant its change.

99. Par. 5-16. Par. 182, ref.(c). Battery Drain. The measured battery drain for the Model RAG-1 equipment is as follows:

A Battery - 2.64 amperes at 6 volts
B Battery - 35 milliamperes at 180 volts

No test was made for the Model RAH-1 equipment.

100. Par. 5-19. Par. 186, ref.(c). A.C. Power Consumption. The total supply line consumption for the Model RAG-1 equipment is 54.5 watts. No similar measurement was made for the Model RAH-1 equipment.

101. Par. 5-22. Par. 189, ref.(c). The manually operated heterodyne excitation control has been eliminated from both of the types CHS-46042 and CHS-46043 receivers in accordance with subparagraph (b) of reference (b).

102. Par. 5-25. Par. 193, ref.(c). The Models RAG-1 and RAH-1 equipments comply with the requirements of these specifications, no beat notes having been detected.

103. Par. 5-27, 5-28. Par. 195, 196, ref.(c). Humidity Test. No tests were made on either of the subject equipments in accordance with these specifications owing to the lack of adequate equipment.

104. Par. 5-29. Par. 197, 198, ref.(c). Frequency Overlap. The results of tests for frequency overlap shown in Table 1 for the type CHS-46042 receiver and in Table 16 for the type CHS-46043, show that the specification limit of 5% has been met by all bands of each type of receiver.

105. Par. 5-30. Par. 199, 200, ref.(c). Capability of being Reset from Calibration Data. As indicated in Table 2, the type CHS-46042 receiver unit more than complies with the requirements of these specifications. Table 19 shows that the type CHS-46043 receiver unit fails to comply only at the low frequency end of band 5, by a small margin and more than complies in all of the other bands. The change in output frequency cannot be laid wholly to the receiver since the tabulated figures in Table 19 include also the natural drift of the standard signal generator. Allowing for this drift, the receiver complies with these specifications by a wide margin for all bands.

106. Par. 5-31. Par. 202, ref.(c). The total variation of the wobbler capacity in the type CHS-46043 receiver unit is approximately 1.0 mmf. Its physical shape gives an irregular capacitance variation curve as shown on Plate 50 and is unsatisfactory. Table 18 shows the frequency variation by change of wobbler from a +5 to a -5 setting as called for in the specifications, reference (b).

107. Par. 5-32. Par. 204, ref.(c). The sensitivities as discussed relative to the type CHS-46043 receiver unit in paragraph 82 of this report were obtained with the wobbler at 0. Tests have indicated that there is a negligible change in effect of the wobbler from -2 to +2 on the scale, due to the odd shape of the rotor plate. The wobbler condenser unit should be changed to approach a straight line capacitance change throughout its range when varied from -5 to +5.

108. Par. 5-33, 5-34. Par. 205, ref.(c). Output Circuits - Types CHS-46042 and CHS-46043 Receiver Units. The receivers are designed for operation into a pair of 600 ohm telephones as indicated on Plate 20. Since the output transformers of the two units are identical, the curve shown on Plate 20 applies to both units. The output transformers have shielding between windings with a grounded center tap on the low impedance winding.

109. Par. 5-36. Par. 207, 208, ref.(c). Oscillator Stability with Change in A.C. Supply Voltage. The variation in oscillator frequency due

to change in line voltage from 103.5 to 126.5 volts is shown in Table 4 for the type CHS-46042 receiver unit and in Table 21 for the type CHS-46043 receiver unit. Both units comply with these specifications by a wide margin.

110. Par. 5-37. Par. 209, 210, ref.(c). Oscillator Stability with Change in Heterodyne Excitation. Since the degree of heterodyne excitation for both of the subject equipments is fixed, this test was omitted.

111. Par. 5-40. Par. 214, 215, ref.(c). Oscillator Stability with Change in Input. As indicated in Tables 5 and 22, the types CHS-46042 and CHS-46043 receiver units comply with these specifications.

112. Par. 5-41. Par. 216, 217, ref.(c). Oscillator Stability with Change in Sensitivity Control. These specifications are amply met by both of the subject equipments as indicated in Tables 6 and 23.

113. Par. 5-44. Par. 219, 220, ref.(c). Band Pass Filter Characteristics Type CHS-46042 Receiver Unit.

(a) Minimum attenuation (centered) within ± 10% of 800 cycles.
(b) Total band width at -6 db., 785 cycles (specification limit not less than 800 cycles).
(c) Total band width at -40 db., 1505 cycles (specification limit not more than 1300 cycles).

Type CHS-46043 Receiver Unit

(a) Minimum attenuation (centered) within ± 10% of 800 cycles.
(b) Total band width at -6 db., 765 cycles (specification limit not less than 800 cycles).
(c) Total band width at -40 db., 1255 cycles (specification limit not more than 1300 cycles).

While these band pass filters fail to comply with all of the requirements of these specifications, the degree of failure is very slight. Their characteristics are practically the same as for those furnished in the original equipments reported upon in reference (c). In view of the fact that paragraph 3, subparagraph 2(e), (f), (g), (h) of reference (d) shows official approval of the original band pass filter, those furnished in the subject equipments may likewise be considered as acceptable. Attenuation characteristics of the band pass filters are shown on Plates 24 and 48.

114. Par. 5-47. Par. 223, 224, ref.(c). Band Pass Filter Attenuation - Types CHS-46042 and CHS-46043 Receiver Units. The insertion of the band pass filter in either unit is not greater than 4 decibels and is within the specifications.

115. Par. 5-49. Par. 226, 227, 228, ref.(c). Band Pass Filter Characteristic Change with Load. The characteristic of the band pass filter in either of the subject equipments is not affected for a change in load up to 300 milliwatts.

116. Par. 5-51, 5-52, 5-53. Par. 230, ref.(c). Variable A.F. Attenuator Frequency Range and Adjustments. The variable A.F. attenuator adjustment is continuous within each of two bands, giving a measured total range of peak adjustment of 425 to 1386 cycles for the type CHS-46042 receiver unit and 437 to 1393 cycles for the type CHS-46043 receiver unit. The specification limit for the total frequency range is from 450 to 1300 cycles and hence both equipments comply in this respect. The band adjustment switch on either receiver has also an "off" position which permits removal of the variable A.F. attenuator from the circuit. Both the band switch and the continuous adjustment appear as controls on the front panel of the receiver.

117. Par. 5-54. Par. 231, ref.(c). Variable A.F. Attenuator Characteristics. Types CHS-46042 and CHS-46043 receiver units. By reference to Plates 25 and 49 and Tables 8 and 32, it will be seen that the characteristics of the variable A.F. attenuators are in accordance with the specifications.

118. Par. 5-55. Par. 232, ref.(c). Variable A.F. Attenuator Peak Loss. Types CHS-46042 and CHS-46043 receiver units. By reference to Tables 7 and 31, it will be seen that the peak loss is less than 8 db. for all peak values. The attenuators do not incur an attenuation in the audio amplifier of more than 8 decibels at peak frequency with the switches controlling them in their operating position. Attention is called to the fact, however, that when the switch passes from the "out" to the "in" position there is a rise of around 12 decibels between the on and off operating positions. This is due to the fact that the loading resistor, provided to attenuate the audio amplifier in the "off" attenuator position for matching with the level when the attenuators are on, is out of circuit, momentarily before the attenuator is cut in or vice versa. In the low frequency end of the high frequency band, there is a gain of as much as 3.5 decibels over the conditions with the attenuator out.

119. Par. 5-57. Par. 234, ref.(c). Variable A.F. Attenuator Characteristic Change with Load. Types CHS-46042 and CHS-46043 receiver units. The variable A.F. attenuators in either of the above units comply with these specifications.

120. Par. 5-60. Par. 237, 238, ref.(c). Sensitivity Control Range - Types CHS-46042 and CHS-46043 receiver units. The sensitivity controls provide the required attenuation. Cutting in the automatic volume control, when a signal is of sufficiently low amplitude, as not to be attenuated by its action, reduces the bias on the radio frequency tubes to the extent that the radio frequency gain is increased, and under certain conditions may be as much as 20 decibels. This is apparently due to the fact that when the automatic volume control is cut in, the plate supply voltage on the output stage is reduced, thus reducing the current through the potential divider, the I.R. drop of a part of which is used for bias control of the radio frequency stages. This condition is particularly noticeable and objectionable when the receiver is adjusted for a maximum sensitivity level as determined by the maximum tolerable noise level for phone reception. If such an adjustment is made prior to cutting in the automatic volume control and the automatic volume control is then cut in the noise level will increase by as much as 20 decibels, in some cases, which would give an operator the impression that the automatic volume control is noisy and will

be a handicap to reception under these conditions. This is not true, however, as the increase in noise is due to increase in gain and by readjustment of the manual volume control the same signal noise ratio can be obtained. This condition should be remedied so that the overall receiver gain, within the non-limiting range of the automatic volume control, shall not be appreciably different with the automatic volume control either "in" or "out." This condition particularly applies to the low frequency band of the Model RAG-1 equipment. In the Model RAH-1 equipment, the gain increase is around 2 db. on all bands except band 1 where it is 9 db. Cutting in the automatic volume control shifts the frequency of the beat note as much as 2000 cycles at the highest frequency end of band 7 of the RAH-1 equipment and outside of the range of the audio attenuators on bands 5 and 6. Bands 3 and 4 are not shifted outside of the audio attenuator band so but what a .5 mw signal would be audible for attenuator readjustment. A test was made to remedy the condition described above in connection with the change in overall gain when using the AVC within its non-limiting range. To accomplish the maintenance of the same bias of the R.F. tubes with the AVC in or out an additional bleeder resistance of suitable value was placed between the plate of the output tube and ground to equalize the current flow in the voltage divider when the plate current was reduced by reason of inserting the 10,000 ohm resistor (R 14) in the plate circuit with the AVC switch in. This also reduced the change in frequency caused by the change in supply voltages.

121. Par. 5-61. Par. 239, ref.(c). Transrectification. Transrectification was noted for all of the R.F. amplifiers and the tabulated figures shown in Table 10 for the type CHS-46042 receiver unit and in Table 25 for the type CHS-46043 receiver unit are total values. These values are believed to be within the limits of these specifications and are acceptable in accordance with paragraph 3, subparagraph 2(i) of reference (d). The results of these tests show that the subject equipments are superior, in regard to transrectification, to the original models reported upon in reference (c).

122. Par. 5-63. Par. 242, ref.(c). Linearity of Sensitivity Control. These specifications are met with considerable leeway as shown on Plates 13 to 16 inclusive for the type CHS-46042 receiver unit and on Plates 40 to 45 inclusive for the type CHS-46043 receiver unit.

123. Par. 5-65. Par. 245, ref.(c). Volume Control Effect on Signal to Noise Ratio. As indicated on Plate 17 for the type CHS-46042 receiver unit and on Plate 46 for the type CHS-46043 receiver unit, these specifications are substantially met.

124. Par. 5-69. Par. 250, 251, ref.(c). The automatic volume control systems are fundamentally the same in both equipments. The variation in overall gain as experienced from cutting the automatic volume control in and out within its non-limiting range was much less noticeable in the case of the Model RAH-1 equipment than in the Model RAG-1 equipment.

125. Par. 5-71. Par. 253, ref.(c). Connection between Manual and Automatic Volume Controls - Types CHS-46042 and CHS-46043 receiver units. While the sensitivity and AVC control are electrically and mechanically

separate and distinct from one another, cutting the automatic volume control in influences the gain of the R.F. amplifiers as the direct result of upsetting the biases to the R.F. amplifier as described in paragraph 120 above. A method for correcting this defect is mentioned also in paragraph 120.

126. Par. 5-72. Par. 254, 255, ref.(c). AVC Change in A.F. Output with Change in R.F. Input - Type CHS-46043 Receiver Unit. The change in A.F. output with change in MCW input is shown on Plate 51. Curves are shown with and without AVC, the latter being represented by four curves covering the range of the level control. The output variation for all curves (with AVC) is within the specified limits. These curves were taken with the sensitivity control adjusted for a 50 microwatt noise level with no input signal and without AVC. Similar curves are shown on Plate 52, the test conditions being the same except that the 10,000 ohm resistor which is normally connected in series with the primary of the AVC transformers and +B when AVC is in was shorted out. The effect of shorting out this resistor, which is apparent upon examining the curves on the two plates, is to increase the level at which limiting action takes place for each setting of the AVC level control. Since the AVC circuit for the type CHS-46042 receiver unit is the same as for the subject unit, no tests of this nature were conducted.

127. Par. 5-73. Par. 256, ref.(c). AVC Level Adjustment - Types CHS-46042 and CHS-46043 Receiver Units. The AVC level adjustment is continuous between the limits of 0.50 to 21.80 milliwatts as shown on Plate 19. This complies with the requirements of these specifications. It was found, experimentally, that the range could be altered to extend from 0.03 to 15.5 milliwatts by shorting out the 1500 ohm resistor in the AVC voltage divider as shown on Plate 53. This range is more useful than that provided or required by the governing specifications.

128. No instability was observed in either of the subject equipments when the tubes were replaced with new ones having mutual conductance higher than the usual rating for such tubes as given by the tube manufacturer.

129. Regulation curves for the type CHS-20032 rectifier power unit are shown on Plate 26.

130. The following is a summary of defects noted and particulars of the specifications which are not complied with.

131. Par. 4-3. The heater and high voltage supply cables do not conform with the samples submitted at the conference and approved in reference (d). The variable attenuator range switch causes an increase in the output when it is changed from neutral to either one of its two extreme positions. This is unsatisfactory. The bottom cover plates on the chassis of either type of receiver are secured with screws at only its front and back. This plate rattles when subjected to vibration and the method of securing is therefore unsatisfactory.

132. Par. 4-4. The ganged variable condensers furnished in both of the types CHS-46042 and CHS-46043 receiver units, particularly in the

latter are not entirely satisfactory and are inferior to those submitted for alternate approval. The cable clamps in the type CHS-23067 do not provide sufficient clearance for the securing screws. The size of studs is too small for the purpose for which they are employed. The screw size on the thumb screws on the receiver panels is too small to withstand the wear due to repeated servicing.

133. Par. 4-13. Not all of the major component parts have been marked with the manufacturer's identification numbers and none are marked with Navy type numbers as indicated in paragraph 47 of this report.

134. Par. 4-16. The male plug contacts, which mate with the jacks on the plug-in coil assemblies, depend upon the clamping action of a nut for contact with a terminal lug. This is unsatisfactory since the nut may become loosened under conditions of severe vibration.

135. Par. 4-20-a. The leads to the R.F. coils in the type CHS-47090 inductance system and trimmer capacitors associated with them do not pass through the holes in the lead terminals, nor are they bent around the terminals prior to soldering. This is not considered good practice; the soldering job otherwise is considered to be good.

136. Par. 4-26-a. The method of securing the coil systems in the type CHS-47090 coil box is unsatisfactory in that it is a two hand and uncertain operation to remove them from or replace them in the box.

137. Par. 4-31-a. The main tuning knobs on both types of receivers do not conform in appearance with the other control knobs.

138. Par. 4-44-a. The telephone jacks supplied are not interchangeable with Navy standard jacks.

139. Par. 5-1. The sensitivity requirements have not been fully met under all conditions by either type of receiver. A discussion of this feature is given under paragraph 82 of this report.

140. Par. 5-31. The wobbler condenser has an odd capacity variation characteristic and is not satisfactory in its present form.

141. Par. 5-60. The radio frequency gain of either type of receiver is affected when the AVC is cut in or out. In the high frequency model there is an appreciable shift in frequency in band 7 when the AVC is cut into the circuit. These defects may be easily overcome by the simple expedient of inserting an additional bleeder resistor of suitable size between ground and the plate of the output tube, which connection would be inserted when the AVC is in and hence maintain the same R.F. amplifier gain with the AVC in or out. This expedient will also overcome the shift in the beat note in band 7 of the high frequency unit when the AVC is cut in.

142. The following comments are given to show to what extent the contracting manufacturer has corrected the defects which existed in the

original equipments and listed in reference (c).

143. Par. 261, ref.(c). Par. 4-2-a. Type numbers have been furnished on all name plates.

(b) The name plate on the box for the inductance system is marked with the type number of the inductance system. Each coil system is marked with the type number applying to the whole inductance system and with the frequency range of the individual coil system. This is in accordance with reference (g).

(c) The Laboratory has been informed by the Bureau that all of the tubes used in the Models RAG-1 and RAH-1 equipments have been given type approval.

(d) The stand off insulators used for the control grid terminal supports are of isolantite.

144. Par. 262, ref.(c). Par. 4-3-a. The "Best" type of multi-contact switch originally used in the low frequency receiver for band switching has been replaced by one of Hygrade-Sylvania manufacture and is satisfactory. The variable A.F. attenuator range switch is one of Automatic Electric Company manufacture and is satisfactory from the mechanical standpoint. It would be satisfactory from the electrical standpoint if additional contacts were provided which would permit switching from one circuit to another without opening the first circuit before the second circuit is made.

(b) While not required by the governing specifications, most of the small paper dielectric capacitors are totally metal clad except for terminal insulations in accordance with reference (h). The manufacturer's representative has stated that all of the paper dielectric capacitors furnished in the production models will comply with the requirements of reference (h).

(c) The front main panels of the types CHS-46042 and CHS-46043 receivers are of 1/8" Dural and are satisfactory.

(d) The diaphragm referred to here has been omitted.

(e) The plate choke originally used in the oscillator circuit has been replaced by a resistor which is satisfactory in each of the revised models.

(f) The terminal strips used in connection with power supply terminals have been redesigned to afford 1/4" spacing between terminals and are now satisfactory.

(g) The heater supply interconnecting battery cables are satisfactory with respect to size of wire, the voltage drop now being approximately 0.17 volt. While all of the cables furnished with the revised equipments were not in accordance with the sample previously

submitted for approval, as per paragraph 3, subparagraph 4(j), of reference (d), the manufacturer's representative has assured the Laboratory that the production units will be provided with cable having the approved type of construction.

(h) The ganged variable condenser assemblies are mounted on isolantite in both of the type CHS-46042 and CHS-46043 receivers.

145. Par. 263, ref.(c). Par. 4-4. The ganged variable condensers in the type CHS-46042 receiver have soldered cadmium plated brass plates and are satisfactory.

146. Par. 264, ref.(c). Par. 4-6. The transformer cases in both types of receivers are of aluminum and have an anodized finish. These cases are satisfactory.

147. Par. 265, ref.(c). Par. 4-8. An automobile type fuse is provided in each side of the line in the type CHS-20032 rectifier power unit.

148. Par. 266, ref.(c). Par. 4-13. Some of the component parts are provided with the manufacturer's code marking as indicated in paragraph 47 of this report.

149. Par. 267, ref.(c). Par. 4-14. A name plate has been supplied on the high frequency unit coil box.

150. Par. 268, ref.(c). Par. 4-16. In the type CHS-46043 receiver unit, the radio frequency plug studs have been soldered directly to their associated terminals.

151. Par. 269, ref.(c). Par. 4-18. The numbering and graduations on the main tuning dial of the type CHS-46042 and CHS-46043 receivers are in accordance with the governing specifications. The main dial is marked from 0 to 10 in ten equal divisions, while the vernier is marked from 0 to 100 in 100 equal divisions. The main dial turns clockwise for an increase in the final effect.

152. Par. 270, ref.(c). Par. 4-3-a. The use of rivets on the sides of the cabinets of the two types of receivers has been eliminated. The shockproof mounting has been improved and is satisfactory. The shockproof cradle formerly employed on both units has been eliminated.

153. Par. 271, ref.(c). Par. 4-5-a. The weights and dimensions of the two receiver units combined complies with the amendment of reference (f) to these specifications of reference (b).

154. Par. 272, ref.(c). Par. 4-6-a. The chassis of the type CHS-20032 power unit has been rebuilt and provided with runners to facilitate its easy removal from the cabinet. There are no obstructions to prevent the easy removal of the chassis. The handles have been removed since, owing to the light weight of the chassis, it can be removed from the cabinet by means of thumb screws.

155. Par. 273, ref.(c). Par. 4-9-a. The cabinets of all units have been provided with a satisfactory black wrinkle finish. The panels are of smooth dull black as produced by a photo-etching process.

156. Par. 273, ref.(c). Par. 4-11-a. The handles on the types CHS-46042 and CHS-46043 receivers are satisfactory.

157. Par. 275, ref.(c). Par. 4-13-a. The arrangements of the meters on the receiver units are symmetrical in each unit and similarly arranged on both units.

158. Par. 276, ref.(c). Par. 4-14-a. The markings on the band pass and AVC switches on both receiver units are satisfactory. The band selector switch on the type CHS-46042 receiver unit is suitably and satisfactorily marked to indicate the frequency range of each band.

159. Par. 277, ref.(c). Par. 4-20-a. The coils for both receiver units have been given a satisfactory wax treatment.

160. Par. 278, ref.(c). The two parts of the ceramic tube forms have been cemented together and wax coated which appears to give a rugged structure. A locking feature using a metal insert in the tube which is screwed to the base has also been provided which furnishes additional security should the cement joint become loosened. The coil windings have been rearranged so that no windings carrying different d.c. potentials are in direct contact through their own insulation. The Litz #10-42 wire coils have been retained, but have been well wax treated.

161. Par. 279, ref.(c). Par. 4-26-a. The coil box for the type CHS-47090 inductance system has been completely redesigned. It has been made more compact and sturdy by giving both the box and the cover the same dimensions, placing four coil systems in one part and three in the other. Except for the method of securing the coils in the box, the coil box is satisfactory. The box has a satisfactory black wrinkle finish as specified.

162. Par. 281, ref.(c). Par. 4-29-a. All dials are marked on a 0 to 10 or 0 to 100 basis and are in accordance with these specifications.

163. Par. 282, ref.(c). Par. 4-30-a. The main tuning dials of both types of receivers rotate in a clockwise direction for an increase in the final effect in accordance with these specifications.

164. Par. 283, ref.(c). Par. 4-31-a. The control knobs furnished on both types of receivers permit visibility from any point source lighting at any angle up to 60° from the perpendicular and have sufficient control radii.

165. Par. 284, ref.(c). Par. 4-39-a. The "Best" type of multi-step switches has been eliminated from both types of receivers.

166. Par. 285, ref.(c). Par. 4-40-a. The front panels of all units are secured to their respective chassis with hex head machine screws.

167. Par. 286, ref.(c). The coupling gang pulley referred to in reference (c) has been replaced by a gear train. The tuning meters have been eliminated.

168. Par. 287, ref.(c). The radio frequency filter chokes and condensers are readily removable for replacement in either type of receiver.

169. Par. 288, ref.(c). The bakelite sub-panel referred to in reference (c) has been eliminated.

170. Par. 289, ref.(c). Par. 4-44-a. The mixing switch provided in the type CHS-23067 control unit is of sturdy construction and is satisfactory. It is secured to the front panel with four screws thus eliminating any possibility of its rotating or becoming loose during operation.

171. Par. 290, ref.(c). Par. 4-52-a. An "on and off" toggle switch for controlling the tube heater circuits and other circuits drawing current with the heaters off has been furnished on the front panel of each of the types CHS-46042 and CHS-46043 receivers. Removable links have been provided which, when removed or opened, make these switches operable for d.c. power supply operation. For a.c. operation of the subject equipments, power may be controlled from the "on-off" toggle switch on the power unit or a similar switch in the control unit, since these two toggle switches are in parallel.

172. Par. 291, ref.(c). Par. 4-53-a. The tubes used are of the commercial 6.3 volt heater type and are as near to the specification requirements as regards the range of heater voltage at which satisfactory operation may be expected, as are commercially available.

173. Par. 5-4. For the type CHS-46042 receiver unit, the maximum output obtainable is greater than 300 milliwatts for all bands. However, resonant overload as defined by paragraph 2-11, reference (b) and as amended by reference (d), occurs for outputs less than 250 milliwatts for bands 3 and 4. In band 3, it is 7.2% and in band 4 it is 4% lower than required. From the standpoint of practial operation, these small percentages would never be detected and hence this defect cannot be considered as being serious. For the type CHS-46043 receiver unit, the maximum output obtainable is better than 300 milliwatts for bands 1 to 5 inclusive, and while under 300 milliwatts is better than 250 milliwatts for bands 6 and 7. Resonant overload as defined by paragraph 2-11, reference (b), and amended by reference (d), occurs for outputs greater than 250 milliwatts for bands 1 to 5 inclusive, and under 250 milliwatts for bands 6 and 7. In band 6 it is 2.4% below the required limit and 32% below the required limit for band 7. This is not considered to be a serious defect since for the worst condition band 7 represents a decrease in output of only 3.36 db., which is only barely perceptible by the human ear. Both types of receivers show excellent anti-blocking characteristics for R.F. inputs up to 0.5 volt.

174. Par. 294, ref.(c). Par. 5-11. In the type CHS-46042 receiver unit, the full scale capacitance of the antenna trimmer condenser is within 5% of the full scale capacitance of the main tuning condenser. In the type CHS-46043 receiver unit the full scale capacitance of the antenna

trimmer condenser is within 5% of the full scale capacitance of the main tuning condenser for bands 1 to 5 inclusive. For bands 6 and 7, the percentage is in excess of that allowed since only a portion of the main tuning condensers is used. Since for both of these bands best sensitivities are obtained at or very near zero setting of the antenna trimmer, the size of this condenser is considered satisfactory and its slight departure from the specification requirements does not warrant its change.

175. Par. 295, ref.(c). Par. 5-13. The Laboratory has been advised by the Bureau that all of the types of tubes employed in both of the Models RAG-1 and RAH-1 equipments have been given type approval.

176. Par. 296, ref.(c). Par. 5-29. Both of the types CHS-46042 and CHS-46043 receiver units comply with the specification requirements for frequency overlap between bands.

177. Par. 299, ref.(c). Par. 5-45. The frequency of minimum attenuation of band pass filter on each type of receiver is within $\pm$ 10% of 800 cycles as specified.

178. Par. 300, 301, ref.(c). While the band pass filter in both units does not strictly comply with the governing specifications for band width at -6 and -40 db., their characteristics are essentially the same as the original filters officially approved in reference (d). The extent to which the present filters fail to comply with the requirements of these specifications is too small to warrant their redesign.

179. Par. 302, ref.(c). Par. 5-47. The attenuation caused by the insertion of the band pass filter in either unit does not cause an attenuation greater than 4 db. and is within the specifications.

180. Par. 303, ref.(c). Par. 5-51. The variable A.F. attenuator adjustment is continuous within each of two bands, giving a measured total range of peak frequency adjustment of 425 to 1386 cycles for the type CHS-46042 receiver unit and 432 to 1396 cycles for the type CHS-46043 receiver unit. The specification limit for the total frequency range is 450 to 1300 cycles.

181. Par. 304, ref.(c). Par. 5-60. The attenuation range of the sensitivity controls of both types of receivers complies with the governing specifications. While their action is affected by the AVC system, this defect may be corrected by inserting a suitable bleeder resistor between ground and the plate of the output tube so as to maintain the same bias on the R.F. tubes with the AVC in or out.

182. Par. 305, ref.(c). Par. 5-61. Transrectification was found to exist in the R.F. amplifiers of both types of receivers. This transrectification is not considered to be excessive and in accordance with paragraph 3, subparagraph 2(i) of reference (d), is believed to be within the spirit of the requirements of the governing specifications.

183. Par. 306, ref.(c). Par. 5-69. The AVC systems of both types of receivers are mechanically identical and electrically identical except

for the fact that the variation in overall gain as experienced from cutting the AVC in and out within its non-limiting range was much less noticeable in the case of the Model RAH-1 equipment than for the Model RAG-1 equipment.

184. Par. 307, ref.(c). Par. 5-73. The AVC level adjustment for both types of receivers operates to cover the limits required by the governing specifications.

185. Par. 308, ref.(c). No instability was observed in either of the subject equipments when the tubes were replaced with new ones having mutual conductances higher than the usual rating for such tubes as given by the tube manufacturers.

CONCLUSIONS

186. In general, the Models RAG-1 and RAH-1 equipments present a good appearance and are mechanically exceptionally good. The internal arrangement of parts and their accessibility demonstrate good engineering design.

187. The insulation employed for the radio frequency circuits is with but one exception, of isolantite. The only exception is in connection with the band changing switch in the Model RAG-1 equipment and here bakelite insulation is used, but it is employed where higher quality of insulation is not necessary.

188. The specification requirements are met with respect to size and weight.

189. The adoption of the ganged tuning condensers, having silver contacts, and submitted by the manufacturer's representative for alternate approval in place of those furnished with the subject equipments, should be electrically and mechanically satisfactory.

190. Although band 1 of the Model RAG-1 equipment fails to comply with the governing specifications for sensitivity, a practical test has demonstrated that this equipment performs better on the frequencies covered by band 1 than any other commercially obtainable receiver yet tested at the Laboratory, by virtue of its high degree of selectivity and low maximum noise level.

191. Automatic volume control when "in" upsets the gain of the R.F. amplifiers of both equipments and also causes a large shift in the output frequency at the high frequency end of the frequency range of the type CHS-46043 receiver. These defects are easily corrected by an additional bleeder resistor to be connected between ground and the plate of the output tube when the AVC is "in."

192. Specification requirements with respect to selectivity are well above the requirements for both equipments, resulting in improved performance by comparison with existing receivers of the tuned radio frequency type when tested with an antenna under actual operation conditions.

193. Most of the defects which were apparent in the original equipments have been corrected or eliminated in the revised models. Such defects as do exist are of a minor nature, with the exception of the ganged variable tuning condensers, and are easily corrected with little or no additional expense to the contractor. The use of the type of ganged variable tuning condenser construction as submitted for alternate approval should correct the major objection to these equipments as furnished.

Table 1

Model RAG-1
Frequency Overlap

Band No.	Freq. Range Kcs.	Overlap Bands	Frequency Kcs.	Overlap %
1	14.45 to 38.95			3.33*
		1 and 2	38	7.24
2	36.20 to 100.00			
		2 and 3	95	7.68
3	92.70 to 261.00			
		3 and 4	240	10.62
4	235.5 to 660			10.00**

* Per cent overlap from 14.45 to 15 kcs.
** Per cent overlap from 600 to 660 kcs.

Table 2

Model RAG-1
Accuracy of Resettability

Band No.	Frequency Kcs.	Change in Output upon Reset Decibels*
1	15	+ 0.12
1	38	- 0.22
2	38	± 0
2	95	- 0.62
3	95	± 0
3	240	- 0.94
4	240	± 0
4	600	- 0.46

* Specification limit - 20 decibels.

Table 3

Model RAG-1
Resonant Overload

Band No.	Freq. Kcs.	Microvolts Input for Resonant Overload	Output at Resonant Overload - Milliwatts*
1	15	63.0	298
1	38	41.0	278
2	95	22.5	282
3	240	15.0	232
4	600	12.8	240

* Approved limit - 250 milliwatts.

Table 4

Model RAG-1
Frequency Stability vs. Change in Line Voltage

Band No.	Freq. Kcs.	Beat Note Frequency Change - Cycles* 103.5 volts	115 volts	126.5 volts
1	38	+ 11.0	0	- 9.0
2	95	+ 11.0	0	- 8.0
3	240	+ 17.0	0	- 6.0
4	600	+ 26.0	0	- 12.0

* Specification limit - 100 cycles.

Table 5

Model RAG-1
Frequency Stability vs. Change in Input Signal Intensity

Band No.	Freq. Kcs.	Change in Oscillator Frequency - Cycles*
1	38	0.0
2	95	1.0
3	240	3.0
4	600	6.0

* Specification limit - 100 cycles.

Table 6

Model RAG-1
Frequency Stability vs. Change in Sensitivity Control Setting

Band No.	Freq. Kcs.	Change in Oscillator Frequency*
1	38	2 cycles
2	95	2 cycles
3	240	0.00083 %
4	600	0.00083 %

* Specification limits:
15 to 200 kcs. - 100 cycles
200 to 600 kcs. - 0.05%

Table 7

Model RAG-1
Peak Frequency Attenuation of Variable Attenuators for 6 mw Output

Range	Tap	Peak Freq. Cycles	Attenuation at Peak Freq. Decibels*	Range	Tap	Peak Freq. Cycles	Attenuation at Peak Freq. Decibels*
Low	0	425	-0.588	High	0	731	+3.52
"	1	428	-0.700	"	1	742	+3.46
"	2	447	-0.83	"	2	786	+3.35
"	3	495	-1.51	"	3	869	+3.05
"	4	534	-2.14	"	4	930	+2.67
"	5	571	-2.80	"	5	993	+3.86
"	6	610	-4.50	"	6	1073	+2.14
"	7	660	-5.67	"	7	1162	+0.46
"	8	725	-6.90	"	8	1276	-0.46
"	9	770	-7.64	"	9	1356	-1.29
"	10	800	-8.00	"	10	1386	-1.73

* Specification limit - 8.0 decibels.

Table 8

Model RAG-1
Summary of Attenuation Characteristics of Variable Attenuators

Range	Tap	Peak Freq. Cycles	Attenuation in Decibels for 6 mw Output* +5% Peak Freq.	-5% Peak Freq.	+150% Peak Freq.	-60% Peak Freq.
Low	0	425	-2.8	-2.8	-23.3	-24.8
	5	571	-2.2	-3.5	-24.5	-24.8
	10	800	-2.4	-3.2	-22.4	-24.0
High	0	731	-2.1	-2.3	-23.6	-25.1
	5	993	-3.7	-3.2	-25.0	-26.9
	10	1386	-2.3	-2.8	-23.8	-25.6

* Specification limits:
Down not more than 6 decibels at ± 5% of peak frequency.
Down not less than 20 decibels at + 150% or -60% of peak frequency.

Table 9

Model RAG-1
Range of Sensitivity Control

Band No.	Freq. Kcs.	Microvolts Input Range	Sensitivity Control Range Div.	Attenuation Decibels
1	15	4.14 to 500,000	10 to 1	+3.52 to -98.14
4	600	1.28 to 500,000	10 to 3	0 to -111.84

Table 10

Model RAG-1
Total Transrectification of all R.F. Tubes

Band No.	Freq.Kcs.	Sensitivity Control Setting	Total Plate Current - μa. Input Zero	Input 0.5 Volt	Change in Plate Current Microamps.	%
1	38	0	42.8	53.8	11.0	26.2
2	95	0	44.6	61.0	16.4	36.8
3	240	0	46.7	56.2	9.5	20.3
4	600	0	48.5	61.0	12.5	25.8

Table 11

Model RAG-1
CW Sensitivities, Band 3

	Test A		Test B		Test C	
Freq. Kcs.	Ant.Trim. Setting Div.	Microvolts Input	Ant.Trim. Setting Div.	Microvolts Input	Ant.Trim. Setting Div.	Microvolts Input
95	0	3.08	-2.5	2.98	-0.7	2.95
120	0	5.80	-2.5	2.91	-3.6	2.75
150	0	8.20	-2.5	2.88	-3.4	2.81
190	0	2.45	-2.5	2.28	-1.40	1.61
240	0	4.38	-2.5	6.80	+1.70	2.02

Table 12

Model RAG-1 Effect on CW Sensitivity when Original Tubes are Replaced by New RCA Tubes

Band No.	Freq. Kcs.	Original Seasoned Hygrade-Sylvania Tubes*				All R.F. Tubes Replaced by New RCA Tubes*				All R.F. Tubes and Oscillator Tube Replaced by New RCA Tubes*			
		Ant. Trim. Div.	Input µv.	Ant. Trim. Div.	Input µv.	Ant. Trim. Div.	Input µv.	Ant. Trim. Div.	Input µv.	Ant. Trim. Div.	Input µv.	Ant. Trim. Div.	Input µv.
	15	0	6.70	0	6.70	0	5.20	0	5.20	0	5.30	0	5.30
	19	0	5.20	-1.9	5.00	0	4.22	-1.9	4.92	-	-	-	-
1	24	0	5.20	-2.1	4.37	0	4.82	-2.0	4.08	-	-	-	-
	30	0	4.97	-0.4	5.00	0	4.85	-0.4	4.12	-	-	-	-
	38	0	8.70	+1.7	4.62	0	7.80	+1.7	4.60	0	7.20	+1.7	4.25
	38	0	2.98	+0.7	2.98	0	2.88	+0.6	2.85	0	2.68	+0.6	2.58
	48	0	3.88	-2.7	2.98	0	3.41	-3.0	2.58	-	-	-	-
2	60	0	3.82	-3.2	2.43	0	3.18	-3.1	2.35	-	-	-	-
	75	0	3.02	-1.2	2.19	0	2.90	-1.3	2.20	-	-	-	-
	95	0	5.08	+1.6	2.53	0	5.20	+1.70	2.52	0	5.20	+1.7	2.48
	95	0	3.08	-0.7	2.95	0	2.08	-0.7	2.00	0	2.00	-0.7	2.00
	120	0	5.80	-3.6	2.75	0	3.42	-3.7	1.51	-	-	-	-
3	150	0	8.20	-3.4	2.81	0	4.83	-3.5	1.65	-	-	-	-
	190	0	2.45	-1.4	1.61	0	1.70	-1.7	1.53	-	-	-	-
	240	0	4.38	+1.70	2.02	0	3.08	+1.3	1.83	0	3.02	+1.3	1.82
	240	0	2.17	-1.1	1.94	0	1.56	-1.1	1.34	0	1.42	-1.1	1.31
	301	0	5.60	-3.7	2.21	0	4.42	-3.9	1.55	-	-	-	-
4	378	0	4.46	-3.4	1.22	0	3.46	-3.5	0.98	-	-	-	-
	475	0	2.57	-1.4	1.08	0	2.49	-1.70	0.92	-	-	-	-
	600	0	3.14	+1.3	1.37	0	3.71	+1.2	2.67	0	2.63	+1.3	1.73

* Refer to Table 14 for mutual conductance values of tubes used.

Table 13

Model RAG-1 – Effect on Maximum Noise when Original Tubes are Replaced by New RCA Tubes.

Band No.	Freq. Kcs.	Original Seasoned Hygrade Sylvania Tubes*				All R.F. Tubes Replaced by New RCA Tubes*				All R.F. Tubes & Oscillator Tube Replaced by New RCA Tubes*			
		Ant. Trim. Div.	Max. Noise µw.	Ant. Trim. Div.	Max. Noise µw.	Ant. Trim. Div.	Max. Noise µw.	Ant. Trim. Div.	Max. Noise µw.	Ant. Trim. Div.	Max. Noise µw.	Ant. Trim. Div.	Max. Noise µw.
	15	0	122	0	122	0	50	0	50	0	50	0	50
	19	0	193	-1.9	216	0	66.5	-1.9	113	–	–	–	–
1	24	0	204	-2.1	337	0	113	-2.0	150	–	–	–	–
	30	0	468	-0.4	700	0	308	-0.4	267	–	–	–	–
	38	0	241	+1.7	771	0	100	+1.7	308	0	77.2	+1.7	267
	38	0	102.2	+0.7	113	0	113	+0.6	113	0	122	+0.6	113
	48	0	88.5	-2.7	171	0	80.8	-3.0	181	–	–	–	–
2	60	0	73.5	-3.2	242	0	57	-3.1	181	–	–	–	–
	75	0	102.2	-1.2	353	0	80.8	-1.3	267	–	–	–	–
	95	0	73.5	+1.6	417	0	42.7	+1.7	338	0	45.4	+1.7	308
	95	0	28.2	-0.7	30.5	0	63.5	-0.7	63.5	0	63.5	-0.7	63.5
	120	0	12.2	-3.6	24.2	0	22.2	-3.7	50.0	–	–	–	–
3	150	0	9.4	-3.4	22.2	0	9.35	-3.5	42.7	–	–	–	–
	190	0	37.6	-1.4	121	0	42.7	-1.7	204	–	–	–	–
	240	0	77.2	+1.7	266	0	87.9	+1.3	338	0	73.5	+1.3	338
	240	0	16.7	-1.1	22.2	0	37.6	-1.1	40.1	0	37.6	-1.1	42.7
	301	0	4.17	-3.7	11.2	0	7.05	-3.9	24.0	–	–	–	–
4	378	0	8.18	-3.4	28.3	0	10.7	-3.5	45.3	–	–	–	–
	475	0	18.4	-1.4	35.0	0	13.5	-1.7	50.0	–	–	–	–
	600	0	26.1	+1.3	88.5	0	88.2	+1.2	416	0	77.2	+1.3	204

* Refer to Table 14 for mutual conductance values of tubes used.

Table 14

Model RAG-1
Mutual Conductance of Tubes Used for Data Shown in Tables 12 and 13.

Position of Tube	Mutual Conductance	
	Original Seasoned Hygrade-Sylvania Tubes	Substituted New RCA Tubes
1st R.F.	1590	1600
2nd R.F.	1740	1660
3rd R.F.	1630	1740
Oscillator	1670	1770

Table 15

Model RAG-1
R.F. Grid Bias and Total D.C. Supply Voltages with A.V.C. On and Off.

Sensitivity Control Div.	A.V.C. Level Control Div.	A.V.C. Off		A.V.C. On	
		R.F. Bias Volts	Total D.C. Supply Volts	R.F.Bias Volts	Total D.C. Supply Volts
0	10	45.7	175	38.8	183
4	10	28.6	175	23.8	183
8.4	10	7.3	175	6.3	183

Table 16

Model RAH-1
Frequency Overlap

Band No.	Freq. Range Kcs.	Overlap Frequency Bands	Kcs.	Overlap Percent
1	296 to 640			1.33*
		1 and 2	620	5.48
2	606 to 1,283			
		2 and 3	1250	5.68
3	1,212 to 2,642			
		3 and 4	2560	6.84
4	2,467 to 5,470			
		4 and 5	5385	5.20
5	5,190 to 11,280			
		5 and 6	10500	11.72
6	10,050 to 16,660			
		6 and 7	16325	5.52
7	15,760 to 25,940			12.8 **

* Percent overlap from 296 to 300 kcs.
** Percent overlap from 23,000 to 25,940 kcs.

Table 17

Model RAH-1
Settings of Panel Verniers for Maximum Sensitivity

Band No.	Freq. Kcs.	Antenna Trimmer Setting - Divs.	Osc. Wobbler Setting - Divs.
1	300	-2.0	+5 to -5
	360	+0.6	
	430	0	+5 to -5
	520	-0.4	
	620	+0.9	0
2	620	-1.3	0
	740	-1.7	
	880	-3.4	0
	1050	-2.5	
	1250	-1.5	0
3	1250	-5.0	+5.0
	1495	-5.0	
	1790	-2.3	0
	2135	0	
	2560	0	-2.0

(Continued)

Table 17 - Continued

Band No.	Freq. Kcs.	Antenna Trimmer Setting - Div.	Osc. Wobbler Setting - Divs.
4	2560	+3.2	-5.0
	3080	0	
	3715	-2.6	-4.0
	4470	-2.1	
	5385	-1.6	-2.2
5	5385	0	0
	6360	-2.4	
	7510	-2.2	0
	8880	-1.5	
	10500	0	-2.2
6	10500	0	0
	11720	0	
	13170	-1.0	-4.4
	14630	-0.6	
	16325	0	-2.5
7	16325	0	-3.0
	17800	+0.5	
	19400	+0.7	-3.6
	21100	0	
	23000	0	0

Table 18

Model RAH-1
Variation of Frequency by Change of Oscillator Wobbler from -5 to +5.

Band No.	Freq. Kcs.	Variation per cent*
1	300	0.21
	620	0.81
2	620	0.24
	1250	0.83
3	1250	0.20
	2560	0.91
4	2560	0.21
	5385	1.01
5	5385	0.18
	10500	0.81
6	10500	0.45
	16325	1.10
7	16325	0.40
	23000	0.84

* Specification limits - 0.05 to 0.35%.

Table 19

Model RAH-1
Accuracy of Resettability

Band No.	Freq. Kcs.	Change in Output upon Reset*		
1	300	-0.75 decibels		
1	620	-375	cycles	-.061 per cent
2	620	+83	"	+.013 " "
2	1250	-225	"	-.018 " "
3	1250	-245	"	-.020 " "
3	2560	+1884	"	+.073 " "
4	2560	-381	"	-.015 " "
4	5385	+1962	"	+.036 " "
5	5385	+908.	"	+.017 " "
5	10500	+2085	"	+.020 " "
6	10500	+1301	"	+.012 " "
6	16325	-4869	"	-.030 " "
7	16325	+5950	"	+.036 " "
7	23000	-19400	"	-.084 " "

* Specification limit - 0.1% or 350 cycles, with change in output of -20 decibels (300 - 600 kcs.).

Table 20

Model RAH-1
Resonant Overload

Band No.	Freq. Kcs.	Microvolts Input for Resonant Overload	Output at Resonant Overload Milliwatts*
1	620	109	370
2	1250	82	332
3	2560	54	299
4	5385	78	336
5	10500	54	277
6	16325	72	244
7	23000	125	170

* Approved limit - 250 milliwatts.

Table 21

Model RAH-1
Frequency Stability vs. Change in Line Voltage

Band No.	Freq. Kcs.	Beat Note Frequency Change - Cycles* 103.5 volts Cycles	103.5 volts Per Cent	126.5 volts Cycles	126.5 volts Per Cent.
1	300	-6	-.002	+4	+.001
1	620	+38	+.006	-16	-.003
2	620	+1	+.0002	- 3	-.0005
2	1250	-4	-.0003	+4	+.0003
3	1250	+59	+.005	-57	-.005
3	2560	+154	+.006	-140	-.005
4	2560	+8	+.0003	-7	-.0003
4	5385	-24	-.0004	+23	+.0004
5	5385	-60	-.001	+41	+.0008
5	10500	-50	-.0005	+62	+.0006
6	10500	+70	+.0007	-70	-.0007
6	16325	+367	+.002	-290	-.002
7	16325	-467	-.003	+430	+.003
7	23000	-485	-.002	+317	+.001

* Specification limit - 0.01% or 100 cycles.

Table 22

Model RAH-1
Frequency Stability vs. Change in Input Signal Intensity

Band No.	Freq. Kcs.	Change in Oscillator Frequency - Cycles*
1	300	-2
1	620	+5
2	620	-2
2	1250	+7
3	1250	-8
3	2560	-28
4	2560	+6
4	5385	-55
5	5385	+5
5	10500	-39
6	10500	-39
6	16325	+44
7	16325	-113
7	23000	-29

* Specification limit - 300 cycles.

Table 23

Model RAH-1
Frequency Stability vs. Change in Sensitivity Control Setting.

Band No.	Freq. Kcs.	Change in Oscillator Frequency - per cent*
1	300	+.0003
1	620	-.0015
2	620	-.0003
2	1250	+.0022
3	1250	-.0064
3	2560	-.015
4	2560	-.0019
4	5385	-.0027
5	5385	+.0031
5	10500	-.0061
6	10500	-.0039
6	16325	-.0075
7	16325	-.011
7	23000	-.013

* Specification limit - 300 - 8000 kcs. -0.05%
8000 - 23000 kcs. -0.025%

Table 24

Model RAH-1
Range of Sensitivity Control

Band No.	Freq. Kcs.	Microvolts Input Range*	Sensitivity Control Range - Divs.	Attenuation Decibels
1	620	4.8 - 500,000	8.7 - 2.8	-100.3
4	5385	3.64 - 30,000	9.3 - 5.7	- 78.3
7	23000	26.5 - 30,000	10 - 8.4	- 61.1

* Range determined from standard conditions.

Table 25

Model RAH-1
Total Transrectification of all R.F. Tubes

Band No.	Freq. Kcs.	Sensitivity Control Setting	Total Plate Current - μa.		Change in Plate Current	
			Input Zero	Input 0.5 Volt	μa.	Per cent
1	620	0	13.0	20.1	7.1	53.8
2	1250	0	13.0	17.3	4.3	33.1
3	2560	0	13.0	17.0	4.0	30.8
4	5385	0	13.0	15.5	2.5	19.2
5	10500	0	13.0	14.6	1.6	12.3
6	16325	0	12.7	14.6	1.9	14.9
7	23000	0	12.8	13.8	1.0	7.8

Table 26

Model RAH-1
Effect on CW Sensitivity when Original Tubes are Replaced by New RCA Tubes

Band No.	Freq. Kcs.	Original Seasoned Hygrade-Sylvania Tubes*				All R.F. Tubes Replaced by New RCA Tubes*				Oscillator Tube only Replaced by a New RCA Tube*			
		Ant. Trim. Div.	Input μV.	Ant. Trim. Div.	Input μV.	Ant. Trim. Div.	Input μV.	Ant. Trim. Div.	Input μV.	Ant. Trim. Div.	Input μV.	Ant. Trim. Div.	Input μV.
	300	0	4.31	-2.0	4.15	0	4.45	-2.6	4.12	0	4.19	-4.0	3.73
	360	0	3.49	+0.6	3.48	0	3.78	+0.7	3.70	0	4.68	-4.5	3.52
1	430	0	3.40	0	3.40	0	2.85	0	2.85	0	3.88	-3.1	2.97
	520	0	3.58	-0.4	3.52	0	3.00	0	3.00	0	4.28	-1.3	3.68
	620	0	4.35	+0.9	3.90	0	3.67	+1.0	3.12	0	3.78	+0.5	3.64
	620	0	2.07	-1.3	2.02	0	2.58	-1.2	2.45	0	3.77	-5.0	2.85
	740	0	3.10	-1.7	2.72	0	3.08	-3.3	2.14	0	3.73	-5.0	2.50
2	880	0	2.82	-3.4	1.68	0	3.45	-3.3	2.03	0	2.90	-5.0	1.71
	1050	0	3.56	-2.5	2.14	0	3.58	-2.1	2.20	0	4.41	-3.0	3.00
	1250	0	4.54	-1.5	3.22	0	3.38	-1.15	2.50	0	3.48	-1.5	2.67
	1250	0	1.75	-5.0	1.69	0	2.57	-5.0	2.41	0	2.44	-5.0	2.32
	1495	0	1.88	-5.0	1.65	0	2.40	-5.0	2.09	0	2.45	-5.0	2.13
3	1790	0	2.10	-2.3	1.94	0	1.97	-2.5	1.70	0	2.12	-2.0	2.06
	2135	0	2.20	0	2.20	0	2.12	-1.0	2.04	0	2.15	-0.7	2.06
	2560	0	1.90	0	1.90	0	2.78	0	2.78	0	2.49	0	2.49
	2560	0	3.15	+3.2	2.83	0	3.20	+2.1	3.04	0	3.58	+2.8	3.40
	3080	0	2.65	0	2.65	0	2.91	-1.2	2.82	0	3.14	-1.5	3.10
4	3715	0	2.84	-2.6	2.35	0	3.06	-3.0	2.45	0	3.08	-2.3	2.61
	4470	0	2.98	-2.1	2.14	0	2.72	-2.5	1.94	0	3.52	-2.0	2.62
	5385	0	3.12	-4.6	2.16	0	3.06	-1.5	2.03	0	3.78	-1.5	2.72

(Continued)

Table 26 (Continued)

Band No.	Freq. Kcs.	Original Seasoned Hygrade-Sylvania Tubes*				All R.F. Tubes Replaced by New RCA Tubes*				Oscillator Tube only Replaced by a New RCA Tube*			
		Ant. Trim. Div.	Input μV.	Ant. Trim. Div.	Input μV.	Ant. Trim. Div.	Input μV.	Ant. Trim. Div.	Input μV.	Ant. Trim. Div.	Input μV.	Ant. Trim. Div.	Input μV.
	5385	0	3.48	0	3.48	0	3.02	0	3.02	0	3.68	-2.5	3.48
	6360	0	3.28	-2.4	2.81	0	2.67	-3.0	2.04	0	4.32	-4.0	2.78
5	7510	0	2.95	-2.2	2.78	0	3.47	-2.5	2.98	0	3.63	-3.0	3.12
	8880	0	3.41	-1.5	3.02	0	2.56	-2.3	2.21	0	2.78	-1.6	2.53
	10500	0	4.21	0	4.21	0	3.81	0	3.81	0	2.80	-5.0	2.78
	10500	0	7.20	0	7.20	0	6.0	0	6.1	0	13.0	-1.1	11.9
	11720	0	6.20	0	6.20	0	6.8	0	6.8	0	10.8	0	10.8
6	13170	0	8.80	-1.0	7.3	0	10.2	-1.5	7.8	0	20.4	0	20.4
	14630	0	6.90	-0.6	6.1	0	9.7	-1.0	8.0	0	17.2	-1.0	15.3
	16325	0	3.50	0	3.5	0	5.2	0	5.2	0	8.7	-0.6	7.5
	16325	0	16.80	0	16.80	0	28.8	0	28.8	0	15.3	-0.6	15.0
	17800	0	17.70	+0.5	17.0	0	36.0	+1.0	34.1	0	13.2	-0.5	12.5
7	19400	0	32.0	+0.7	30.0	0	108.0	+1.0	93.0	0	28.8	0	30.5
	21100	0	29.0	0	29.0	0	137.0	+0.6	129.0	0	30.5	0	30.5
	23000	0	12.0	0	12.0	0	50.0	-0.6	48.8	0	32.8	-0.6	25.0

* Refer to Table 28 for mutual conductance values of tubes used.

Table 27

Model RAH-1
Effect on Maximum Noise when Original Tubes are Replaced by New RCA Tubes.

Band No.	Freq. Kcs.	Maximum Noise Level - Microwatts: Original Seasoned Hygrade-Sylvania Tubes*	All R.F. Tubes Replaced by New RCA Tubes*	Oscillator Tube only Replaced by a New RCA Tube*
	300	120	160	80
	360	150	240	280
1	430	250	320	440
	520	460	520	875
	620	600	750	750
	620	120	280	200
	740	160	400	200
2	880	290	1250	240
	1050	440	1250	1000
	1250	675	1000	500
	1250	160	280	100
	1495	60	120	50
3	1790	280	400	280
	2135	520	1000	625
	2560	1250	1500	1125
	2560	260	600	300
	3080	240	480	280
4	3715	380	520	440
	4470	875	1000	750
	5385	1500	1750	1500
	5385	200	440	160
	6360	120	200	100
5	7510	200	280	200
	8880	360	160	240
	10500	950	750	240
	10500	8	22	10
	11720	10	18	12
6	13170	10	28	5
	14630	10	20	7
	16325	60	45	35
	16325	5	3	8
	17800	5	4	10
7	19400	2	Less than 1	3
	21100	2	"	2
	23000	18	"	5

* Refer to Table 28 for mutual conductance of the tubes used.

Table 28

Mutual Conductance of the Tube used for Data Shown in Tables 26 and 27.

Position of Tube	Mutual Conductance: Original Seasoned Hygrade-Sylvania Tubes	Mutual Conductance: Substituted New RCA Tubes
1st R.F.	1518	1600
2nd R.F.	1510	1660
3rd R.F.	1518	1740
4th R.F.	1515	1700
Oscillator	1500	1750

Table 29

Model RAH-1
Sensitivity, Band 7, with Original Hygrade-Sylvania Tubes, after Realignment by Manufacturer's Representative

Freq. Kcs.	Main Tuning Dial Divs.	Sensitivity Control Divs.	Antenna Trimmer Divs.	Osc. Wobbler Divs.	Microvolts Input for 6 MW Output	Maximum Noise Microwatts
16325	61.7	10	0	0	5.6	40
		9.8	0*	+1.8*	5.2	50
17800	195.2	10	0	0	6.9	30
		10	0*	0*	6.9	30
19400	320.0	10	0	0	13.0	10
		10	+1.1*	0*	8.1	30
21100	460.0	10	0	0	12.3	11
		10	+0.8*	0*	10.3	18
23000	633.8	10	0	0	16.2	8
		10	+0.3*	0*	14.5	10

* Optimum settings of panel verniers.

Table 30

Model RAH-1
Sensitivity, Band 7, with New RCA Tubes
in R.F. Stages and Oscillator, after Realignment.

Freq. Kcs.	Sensitivity Control Divs.	Antenna Trimmer Divs.	Oscillator Wobbler Divs.	Microvolts Input for 6 MW Output: Immediately After Alignment	Microvolts Input for 6 MW Output: After Rough Handling of Induct. Sys.**	Maximum Noise Microwatts
16325	10	0	0	17.7	14.7	
		-1.0*	0	9.8	10.2	15
17800	10	0	0	18.6	15.9	
		-1.0*	0	10.0	9.4	17
19400	10	0	0	7.7	9.8	
		0*	0	7.7	9.8	25
21100	10	0	0	9.4	10.2	
		0*	0	9.4	10.2	20
23000	10	0	0	11.3	14.3	
		0*	0	11.3	14.3	12

* Optimum setting of antenna trimmer.
** Before these readings were taken the inductance system was jarred and banged on the table to imitate such rough-handling as might be expected in service.

Table 31

Model RAH-1
Peak Frequency Attenuation of Variable Attenuators for 6 MW Output

Range	Tap	Peak Freq. Cycles	Attenuation at Peak Frequency Decibels*
Low	0	437	-1.47
Low	10	790	-3.35
High	0	763	+2.81
High	10	1393	-2.74

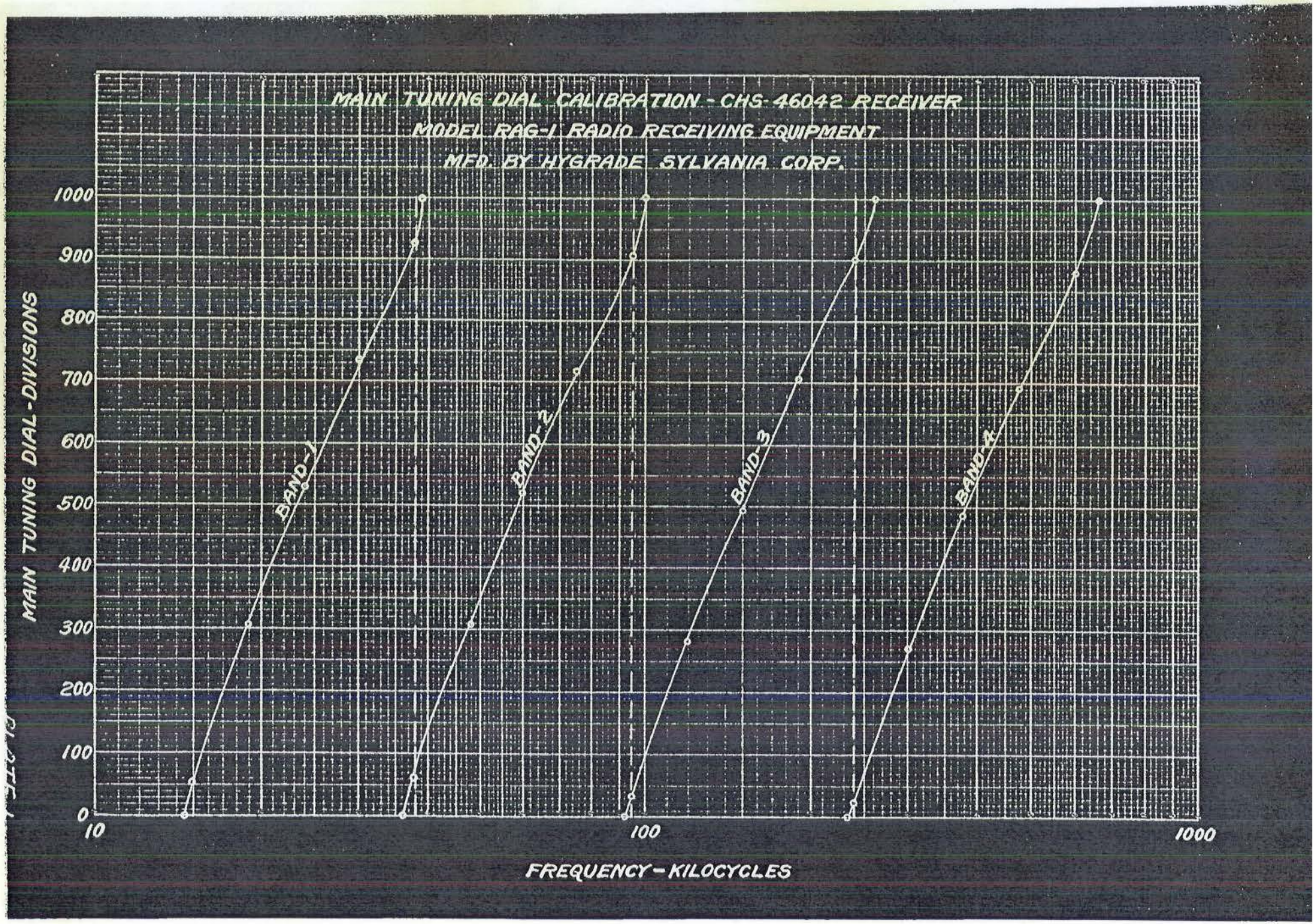
* Specification limit - 8.0 decibels.

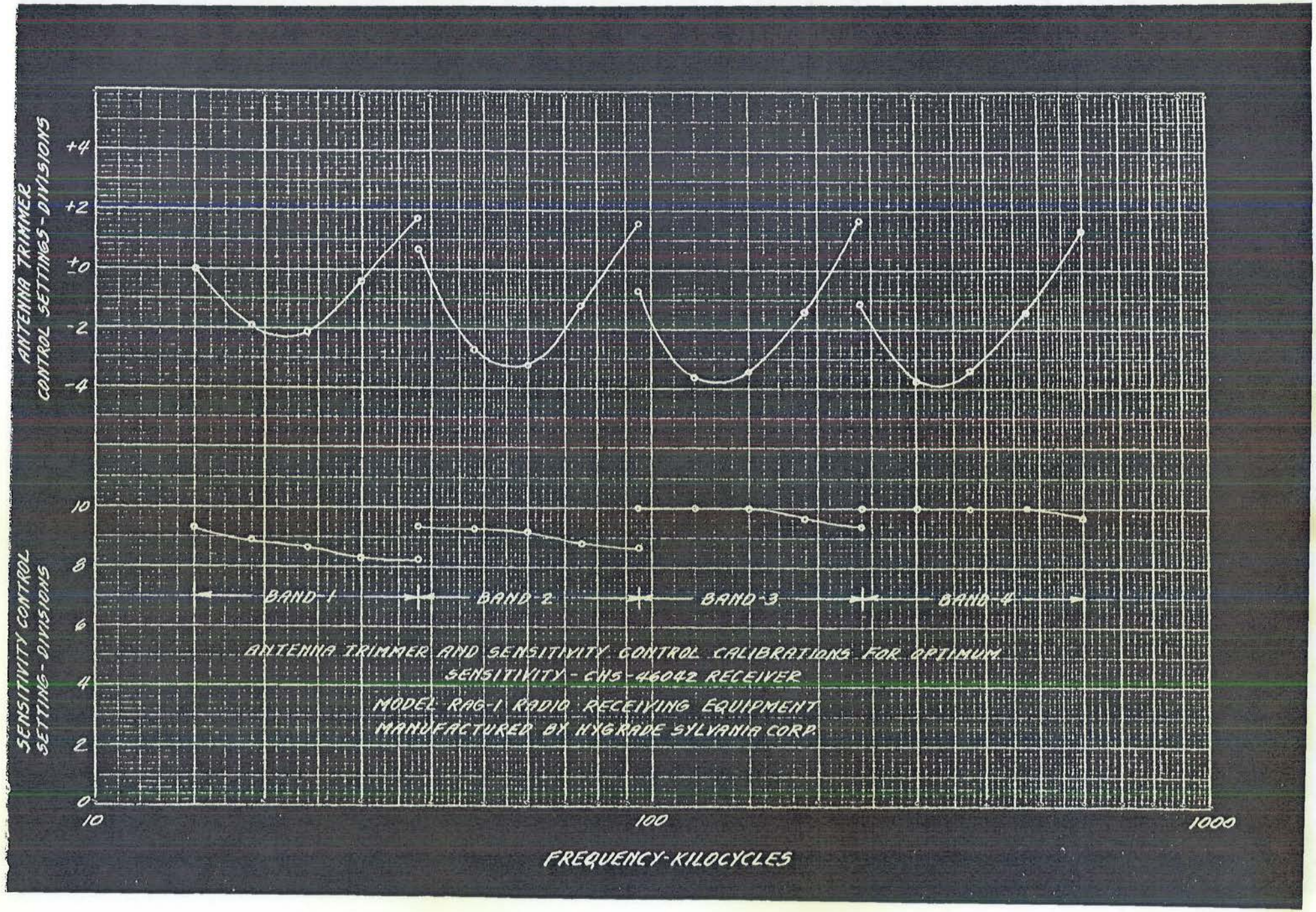
Table 32

Model RAH-1
Summary of Attenuation Characteristics
of Variable Attenuators.

Range	Tap	Peak Freq. Cycles	Attenuation in Decibels for 6 MW Output			
			+5% Peak Freq.	-5% Peak Freq.	+150% Peak Freq.	-60% Peak Freq.
Low	0	437	-1.5	-1.5	-25.1	-23.7
Low	10	790	-5.0	-4.6	-28.2	-28.4
High	0	763	-1.4	-2.1	-24.9	-24.3
High	10	1393	-1.8	-2.4	-22.9	-23.9

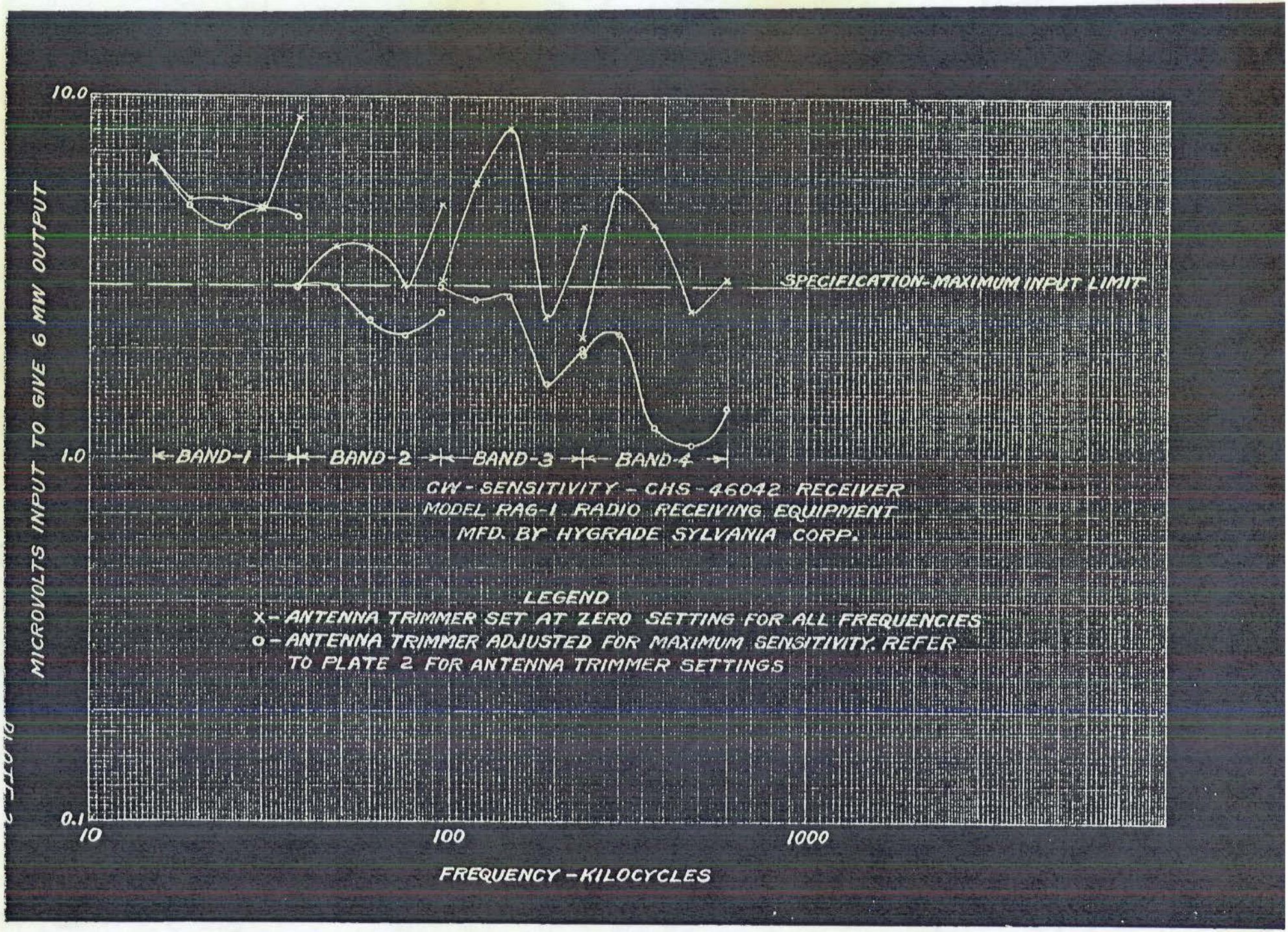
* Specification limits:
Down not more than 6 decibels at plus or minus 5% of peak frequency.
Down not less than 20 decibels at plus 150% or minus 60% of peak frequency.

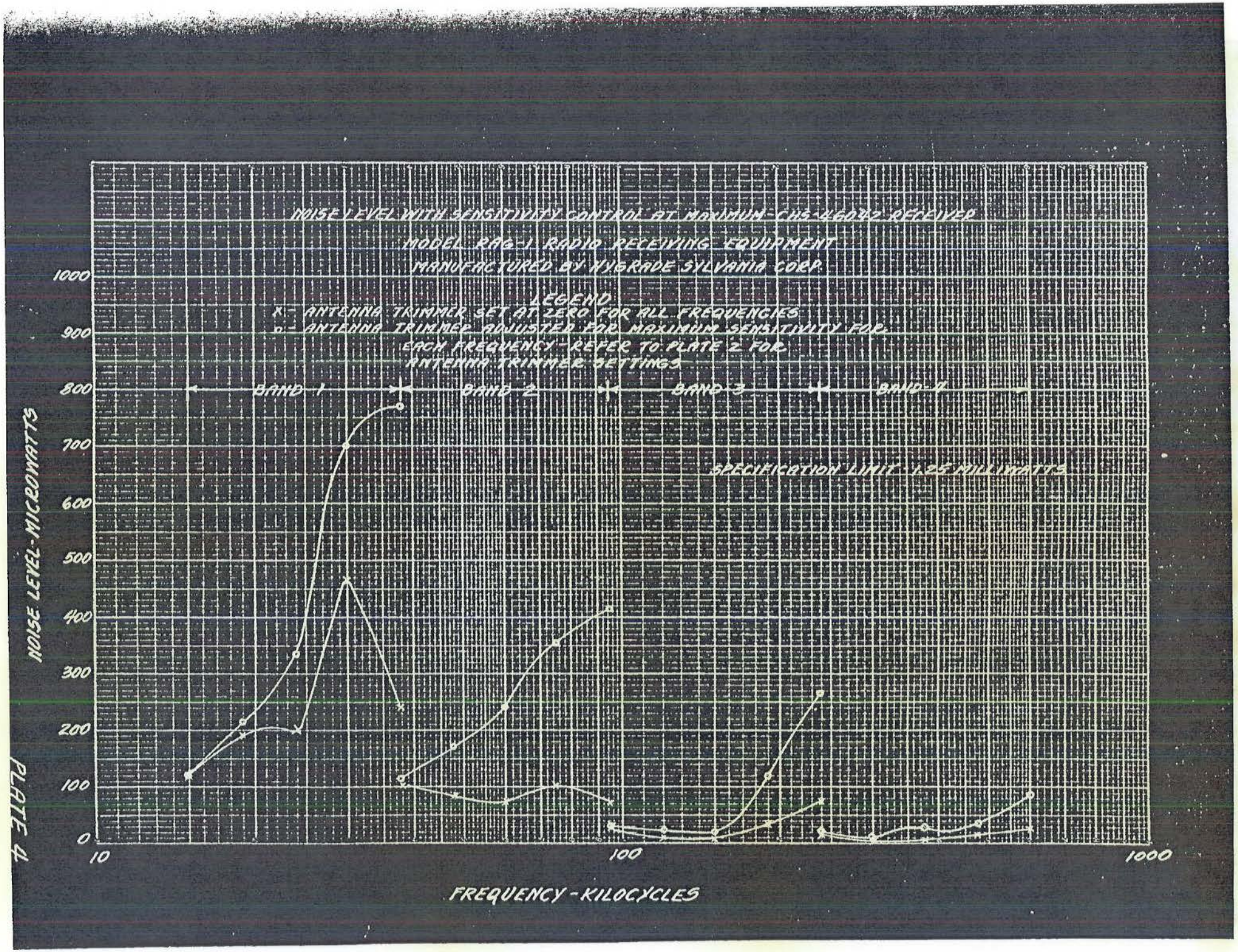

MAIN TUNING DIAL CALIBRATION - CHS-46042 RECEIVER
MODEL RAG-1 RADIO RECEIVING EQUIPMENT
MFD. BY HYGRADE SYLVANIA CORP.
MAIN TUNING DIAL - DIVISIONS
0
100
200
300
400
500
600
700
800
900
1000
BAND-1
BAND-2
BAND-3
BAND-4
10
100
1000
FREQUENCY - KILOCYCLES

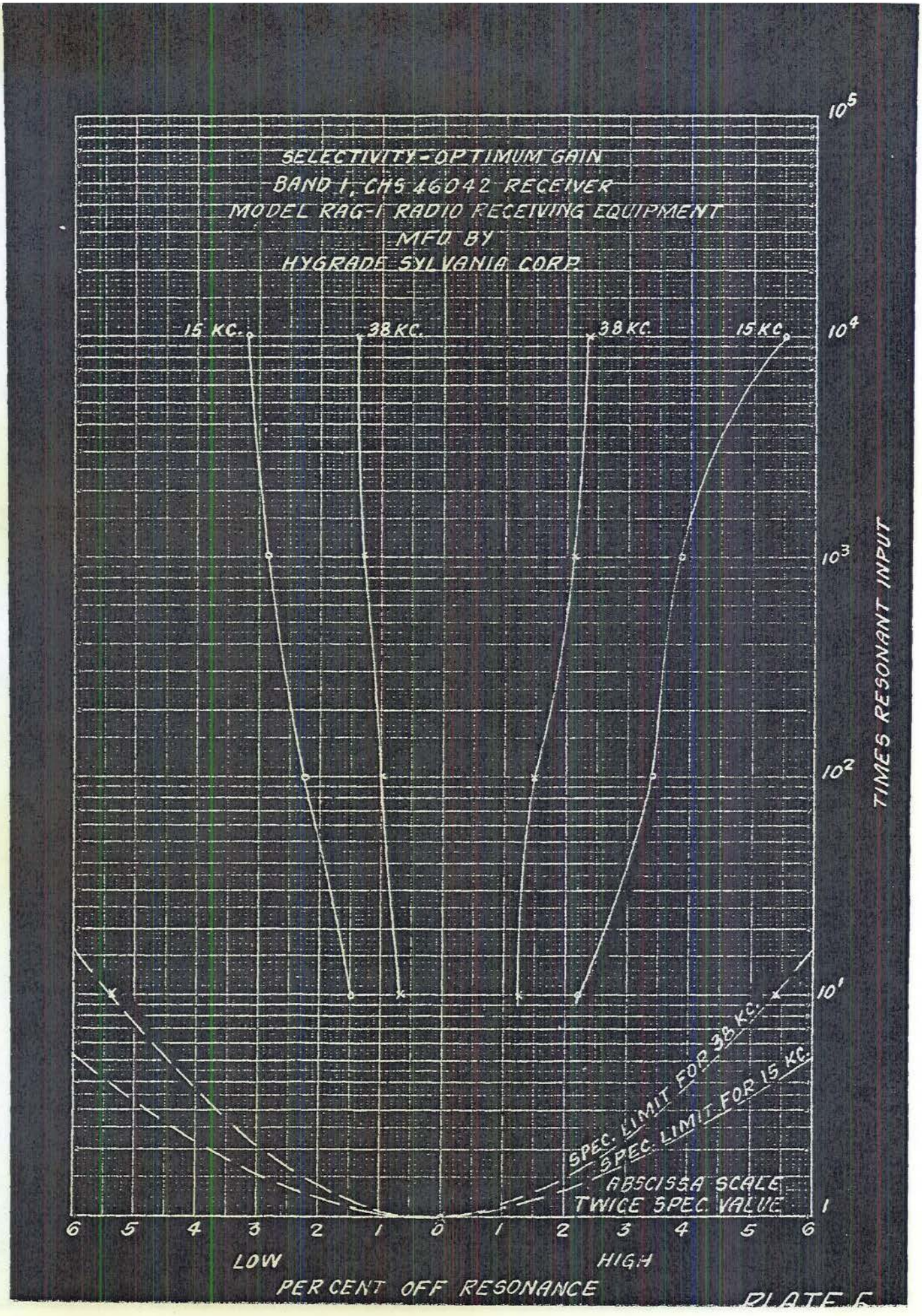


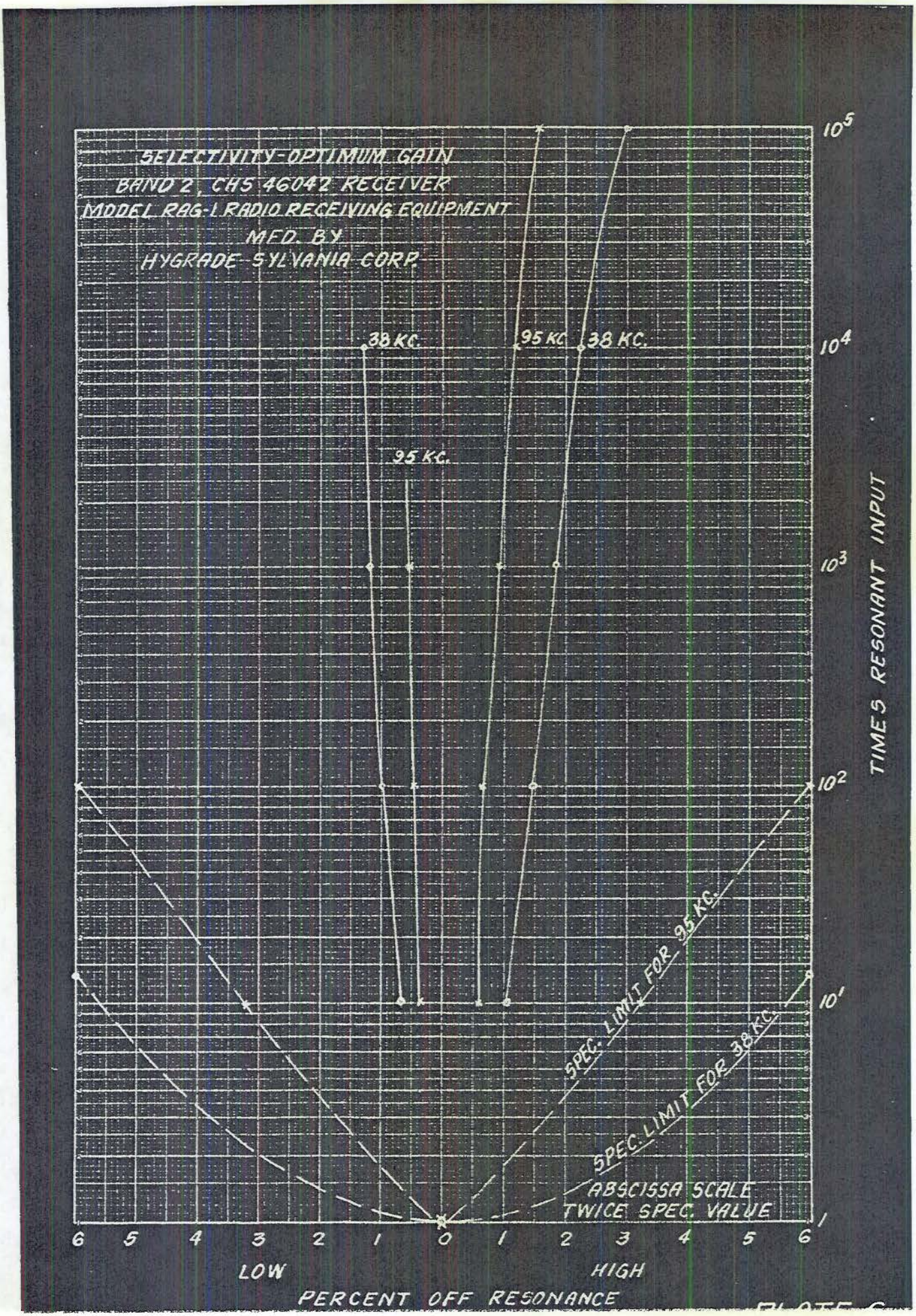
ANTENNA TRIMMER AND SENSITIVITY CONTROL CALIBRATIONS FOR OPTIMUM SENSITIVITY - CNS-46042 RECEIVER

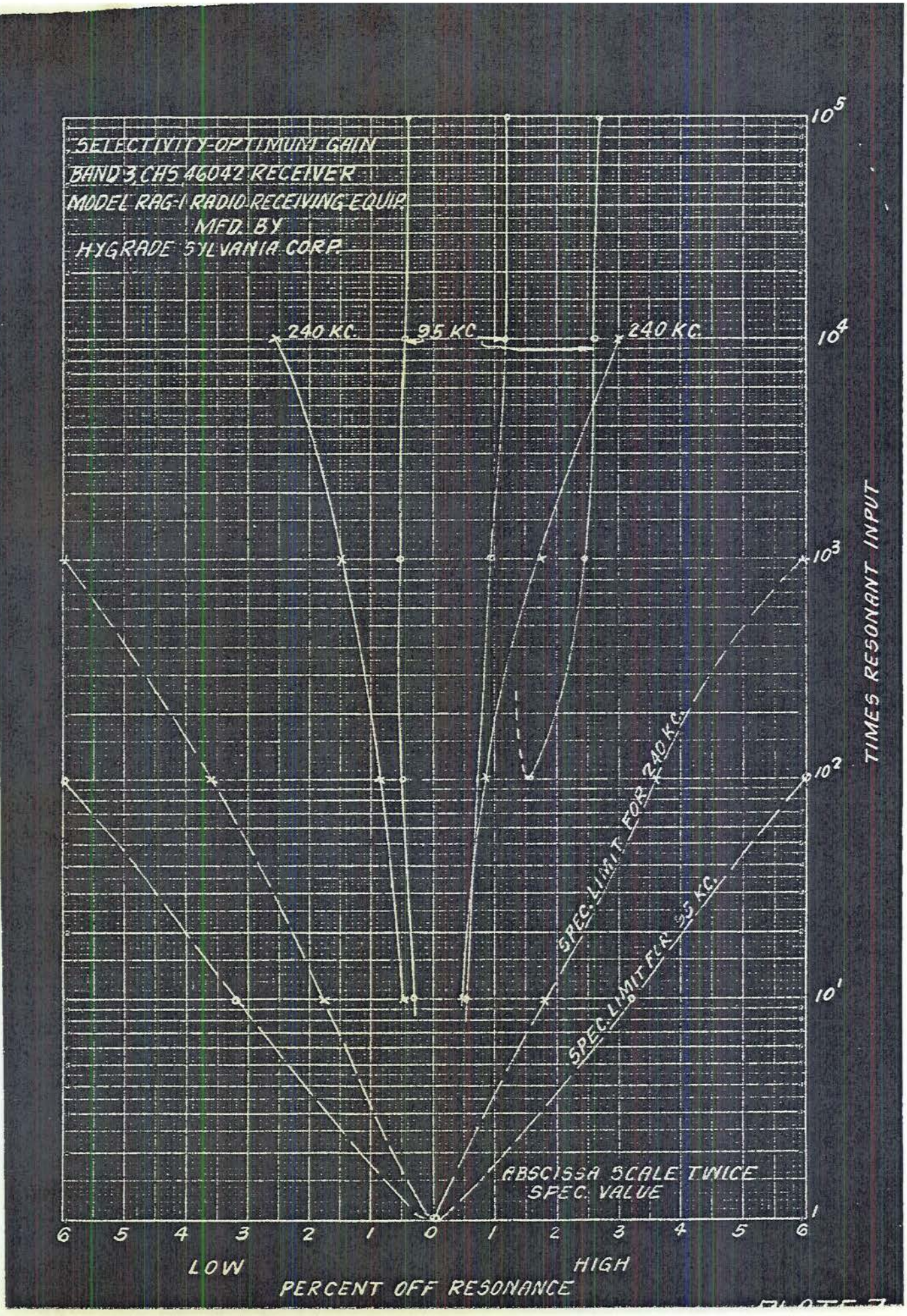
MODEL RAG-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY HYGRADE SYLVANIA CORP.


10.0
1.0
0.1
MICROVOLTS INPUT TO GIVE 6 MW OUTPUT
SPECIFICATION-MAXIMUM INPUT LIMIT
BAND-1
BAND-2
BAND-3
BAND-4
CW-SENSITIVITY - CHS-46042 RECEIVER
MODEL RAG-1 RADIO RECEIVING EQUIPMENT
MFD. BY HYGRADE SYLVANIA CORP.
LEGEND
X-ANTENNA TRIMMER SET AT ZERO SETTING FOR ALL FREQUENCIES
o-ANTENNA TRIMMER ADJUSTED FOR MAXIMUM SENSITIVITY. REFER TO PLATE 2 FOR ANTENNA TRIMMER SETTINGS
10
100
1000
FREQUENCY-KILOCYCLES


NOISE LEVEL WITH SENSITIVITY CONTROL AT MAXIMUM - CHS-4 GOOD RECEIVER
MODEL RAG-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY HYGRADE SYLVANIA CORP.
LEGEND
X - ANTENNA TRIMMER SET AT ZERO FOR ALL FREQUENCIES
o - ANTENNA TRIMMER ADJUSTED FOR MAXIMUM SENSITIVITY FOR EACH FREQUENCY - REFER TO PLATE 2 FOR ANTENNA TRIMMER SETTINGS
BAND 1
BAND 2
BAND 3
BAND 4
SPECIFICATION LIMIT 1.25 MILLIWATTS
NOISE LEVEL-MICROWATTS
1000
900
800
700
600
500
400
300
200
100
0
10
100
1000
FREQUENCY - KILOCYCLES
PLATE 4


SELECTIVITY - OPTIMUM GAIN
BAND 1, CHS 46042 RECEIVER
MODEL RAG-1 RADIO RECEIVING EQUIPMENT
MFD BY
HYGRADE SYLVANIA CORP.
15 KC.
38 KC.
38 KC.
15 KC.
10^5
10^4
10^3
10^2
10^1
1
TIMES RESONANT INPUT
SPEC. LIMIT FOR 38 KC.
SPEC. LIMIT FOR 15 KC.
ABSCISSA SCALE
TWICE SPEC. VALUE
6 5 4 3 2 1 0 1 2 3 4 5 6
LOW
HIGH
PER CENT OFF RESONANCE
PLATE E


SELECTIVITY-OPTIMUM GAIN
BAND 2, CHS 46042 RECEIVER
MODEL RAG-1 RADIO RECEIVING EQUIPMENT
MFD. BY
HYGRADE SYLVANIA CORP.
38 KC.
95 KC.
95 KC.
38 KC.
95 KC.
SPEC. LIMIT FOR 95 KC.
SPEC. LIMIT FOR 38 KC.
ABSCISSA SCALE
TWICE SPEC. VALUE
10^5
10^4
10^3
10^2
10^1
1
TIMES RESONANT INPUT
6 5 4 3 2 1 0 1 2 3 4 5 6
LOW
HIGH
PERCENT OFF RESONANCE


SELECTIVITY-OPTIMUM GAIN
BAND 3 CHS 46042 RECEIVER
MODEL RAG-1 RADIO RECEIVING EQUIP
MFD. BY
HYGRADE SYLVANIA CORP.
240 KC.
95 KC.
240 KC.
SPEC. LIMIT FOR 240 KC.
SPEC. LIMIT FOR 95 KC.
ABSCISSA SCALE TWICE SPEC. VALUE
10⁵
10⁴
10³
10²
10¹
1
TIMES RESONANT INPUT
6 5 4 3 2 1 0 1 2 3 4 5 6
LOW
HIGH
PERCENT OFF RESONANCE

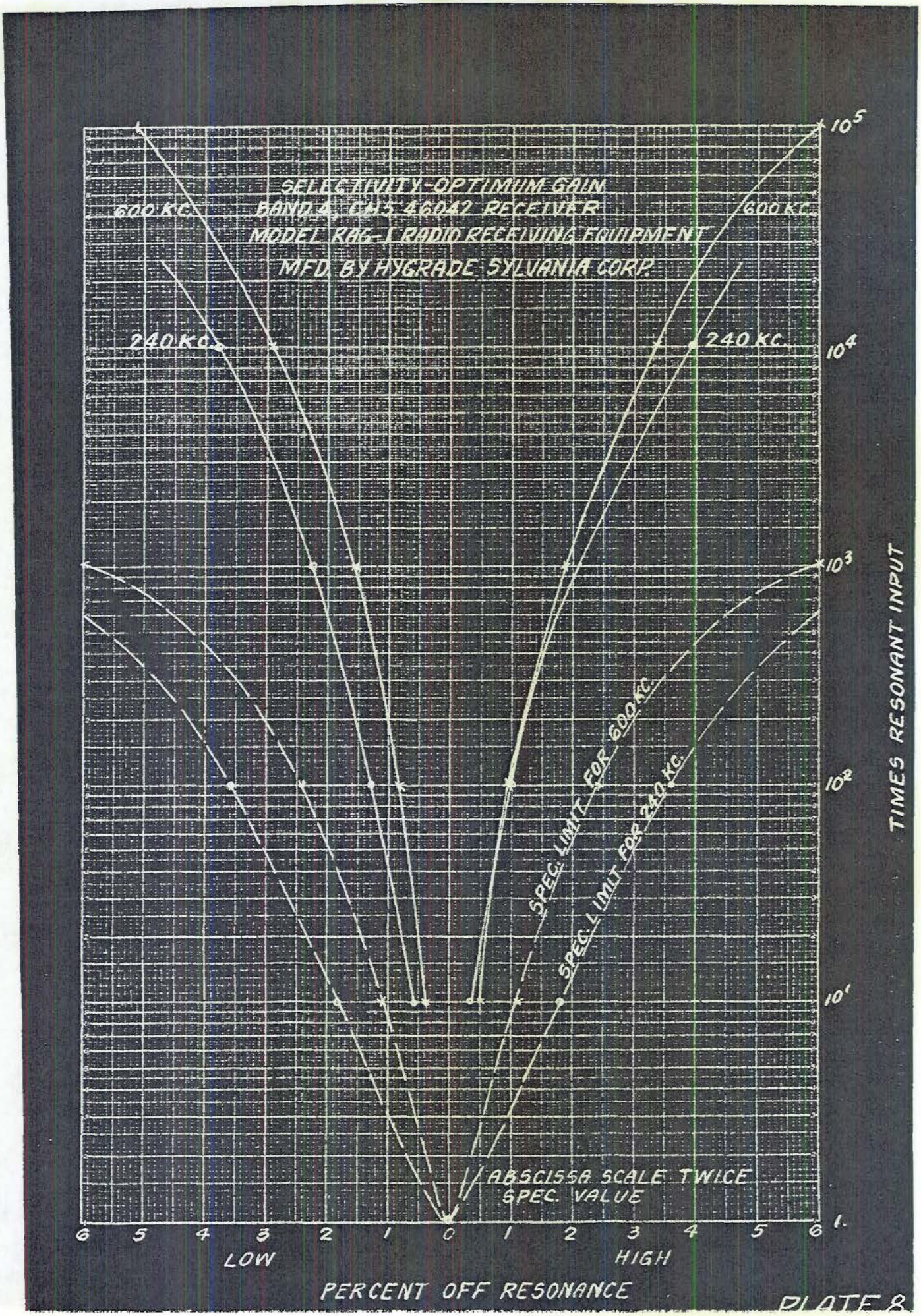
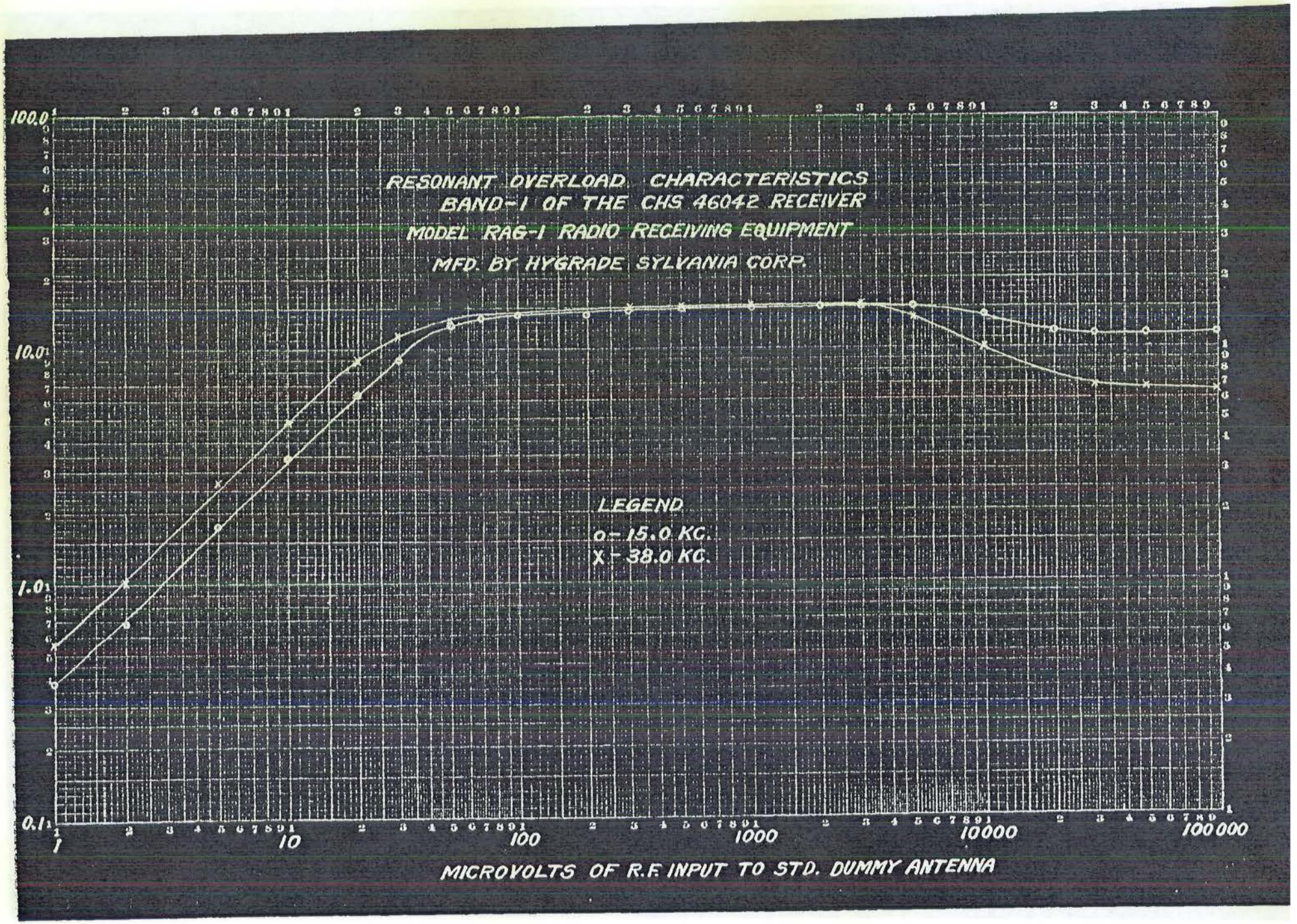
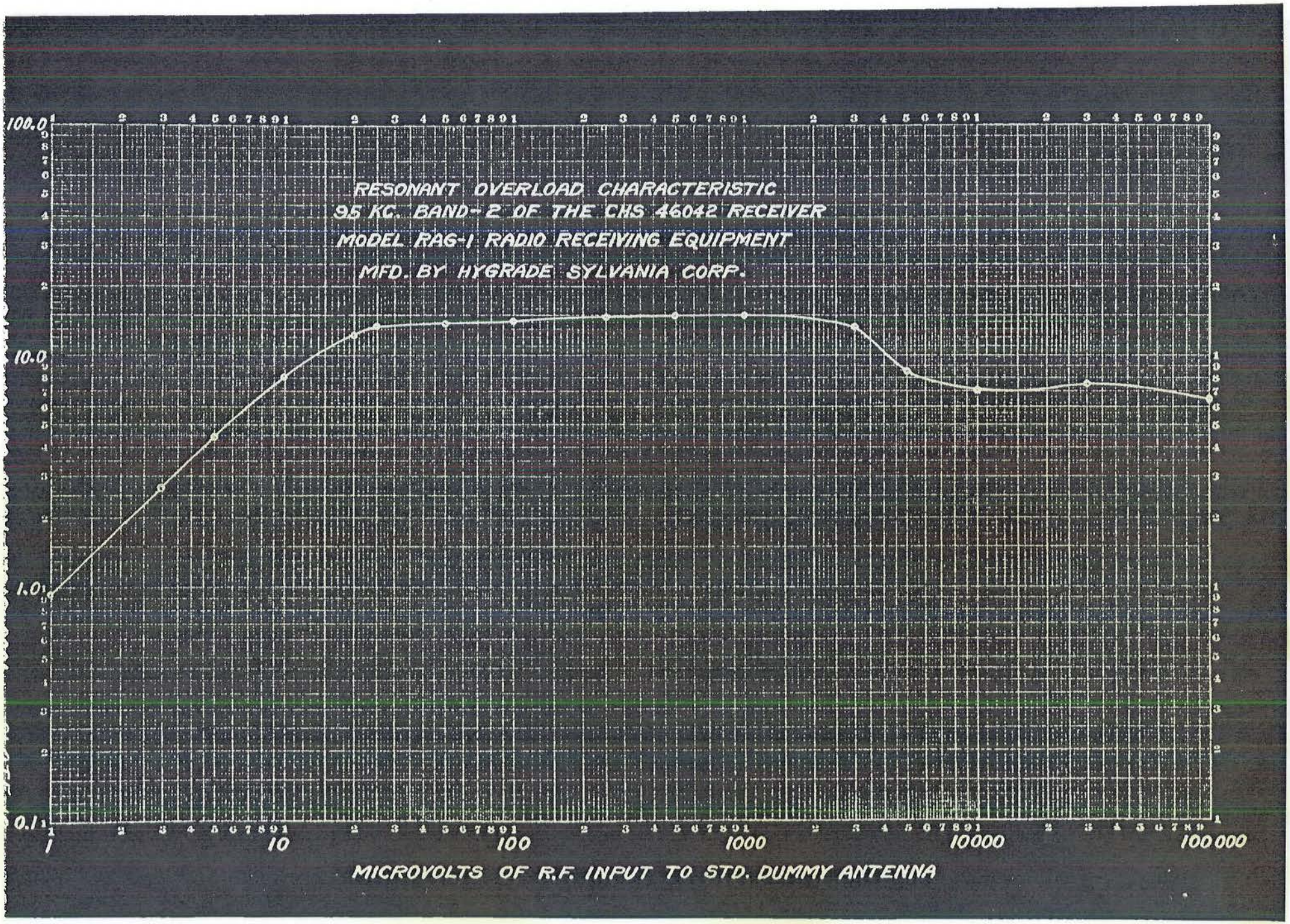
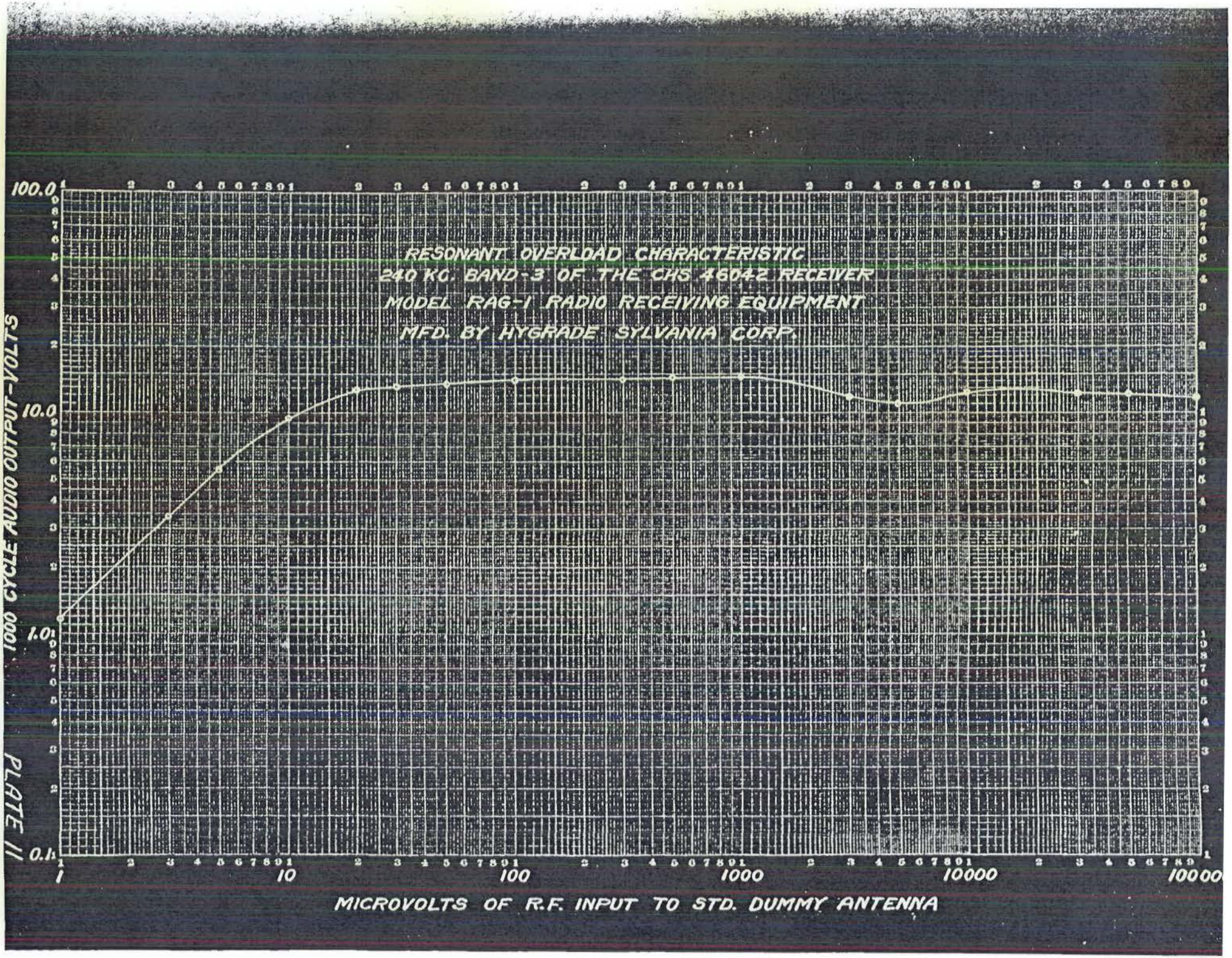

SELECTIVITY-OPTIMUM GAIN
BAND 4 CH-46042 RECEIVER
MODEL RAG-1 RADIO RECEIVING EQUIPMENT
MFD. BY HYGRADE SYLVANIA CORP.
600 KC.
600 KC.
240 KC.
240 KC.
SPEC. LIMIT FOR 600 KC.
SPEC. LIMIT FOR 240 KC.
ABSCISSA SCALE TWICE SPEC. VALUE
10^5
10^4
10^3
10^2
10^1
1.
TIMES RESONANT INPUT
6 5 4 3 2 1 0 1 2 3 4 5 6
LOW
HIGH
PERCENT OFF RESONANCE

PLATE 8


RESONANT OVERLOAD CHARACTERISTICS
BAND-1 OF THE CHS 46042 RECEIVER
MODEL RAG-1 RADIO RECEIVING EQUIPMENT
MFD. BY HYGRADE SYLVANIA CORP.
LEGEND
o- 15.0 KC.
X- 38.0 KC.
100.0
10.0
1.0
0.1
1
10
100
1000
10000
100 000
MICROVOLTS OF R.F. INPUT TO STD. DUMMY ANTENNA


RESONANT OVERLOAD CHARACTERISTIC
95 KC. BAND-2 OF THE CHS 46042 RECEIVER
MODEL RAG-1 RADIO RECEIVING EQUIPMENT
MFD. BY HYGRADE SYLVANIA CORP.
100.0
10.0
1.0
0.1
1
10
100
1000
10000
100 000
MICROVOLTS OF R.F. INPUT TO STD. DUMMY ANTENNA


RESONANT OVERLOAD CHARACTERISTIC
240 KC. BAND-3 OF THE CHS 46042 RECEIVER
MODEL RAG-1 RADIO RECEIVING EQUIPMENT
MFD. BY HYGRADE SYLVANIA CORP.
100.0
10.0
1.0
0.1
1000 CYCLE AUDIO OUTPUT-VOLTS
PLATE 11
1
10
100
1000
10000
100000
MICROVOLTS OF R.F. INPUT TO STD. DUMMY ANTENNA

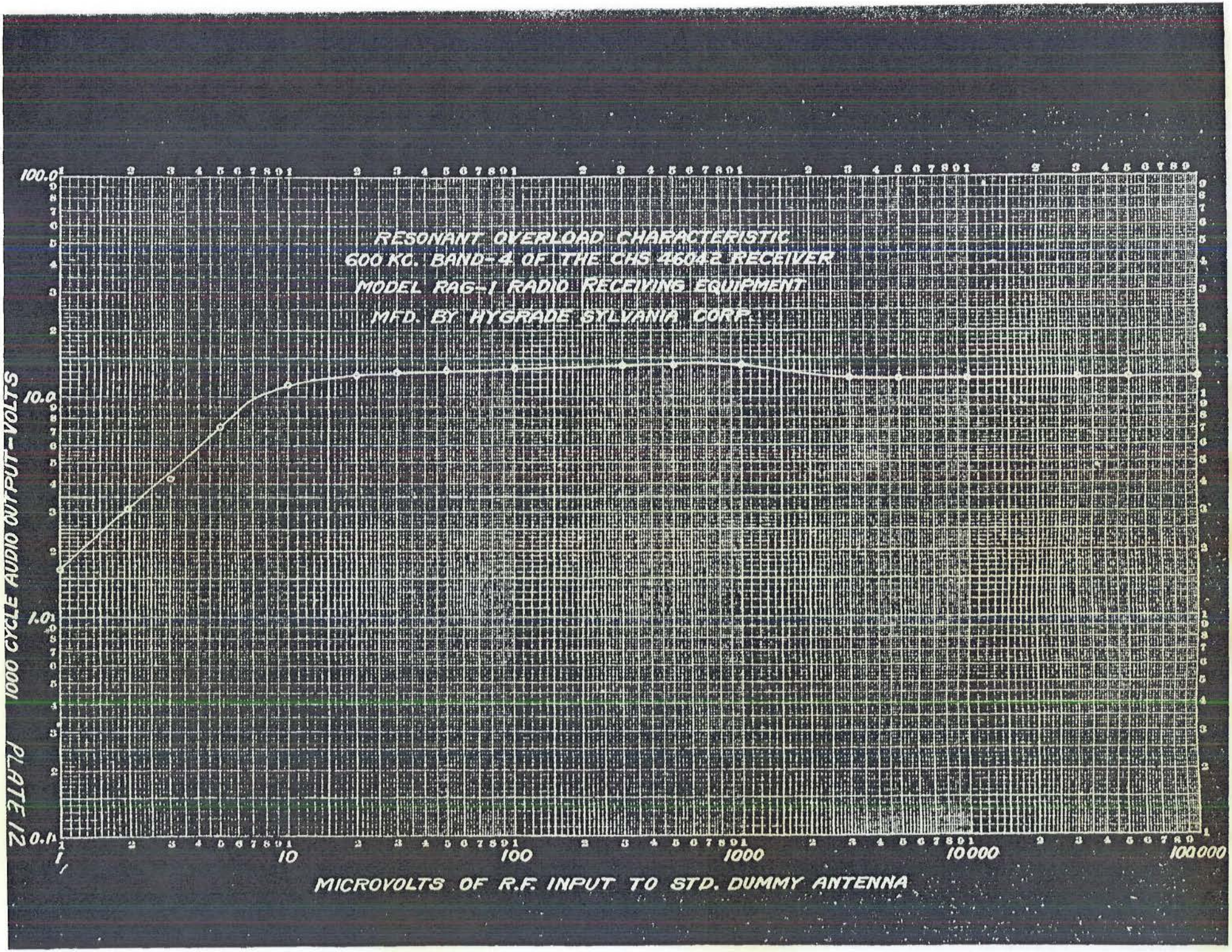

RESONANT OVERLOAD CHARACTERISTIC
600 KC. BAND-4 OF THE CHS 46042 RECEIVER
MODEL RAG-1 RADIO RECEIVING EQUIPMENT
MFD. BY HYGRADE SYLVANIA CORP.
100.0
10.0
1.0
0.1
1000 CYCLE AUDIO OUTPUT-VOLTS
10
100
1000
10000
100000
MICROVOLTS OF R.F. INPUT TO STD. DUMMY ANTENNA

PLATE 12

S. NAVAL RESEARCH LABORATORY
BELLEVUE, D. C.

DATE

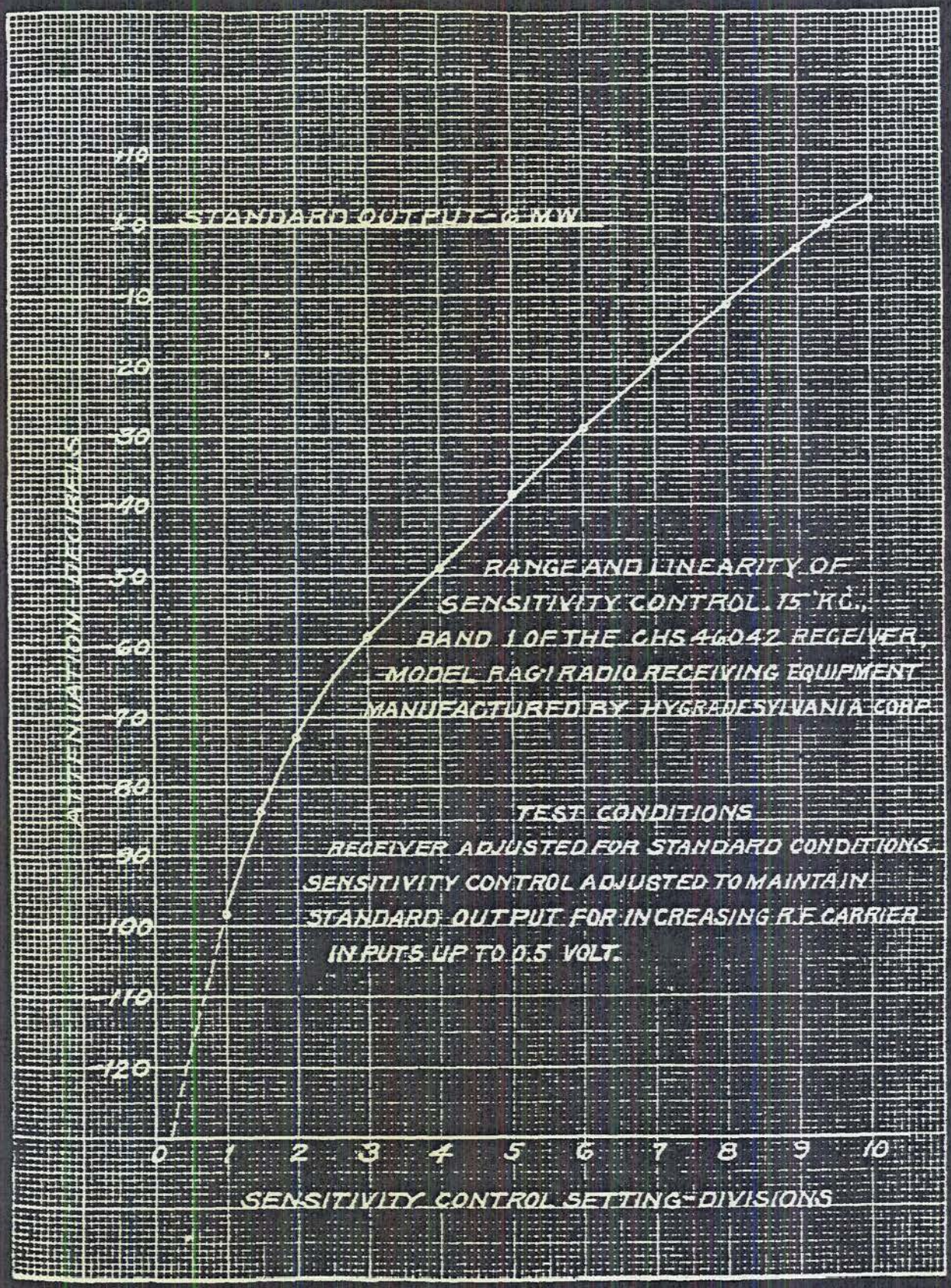


PLATE 13

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

DATE

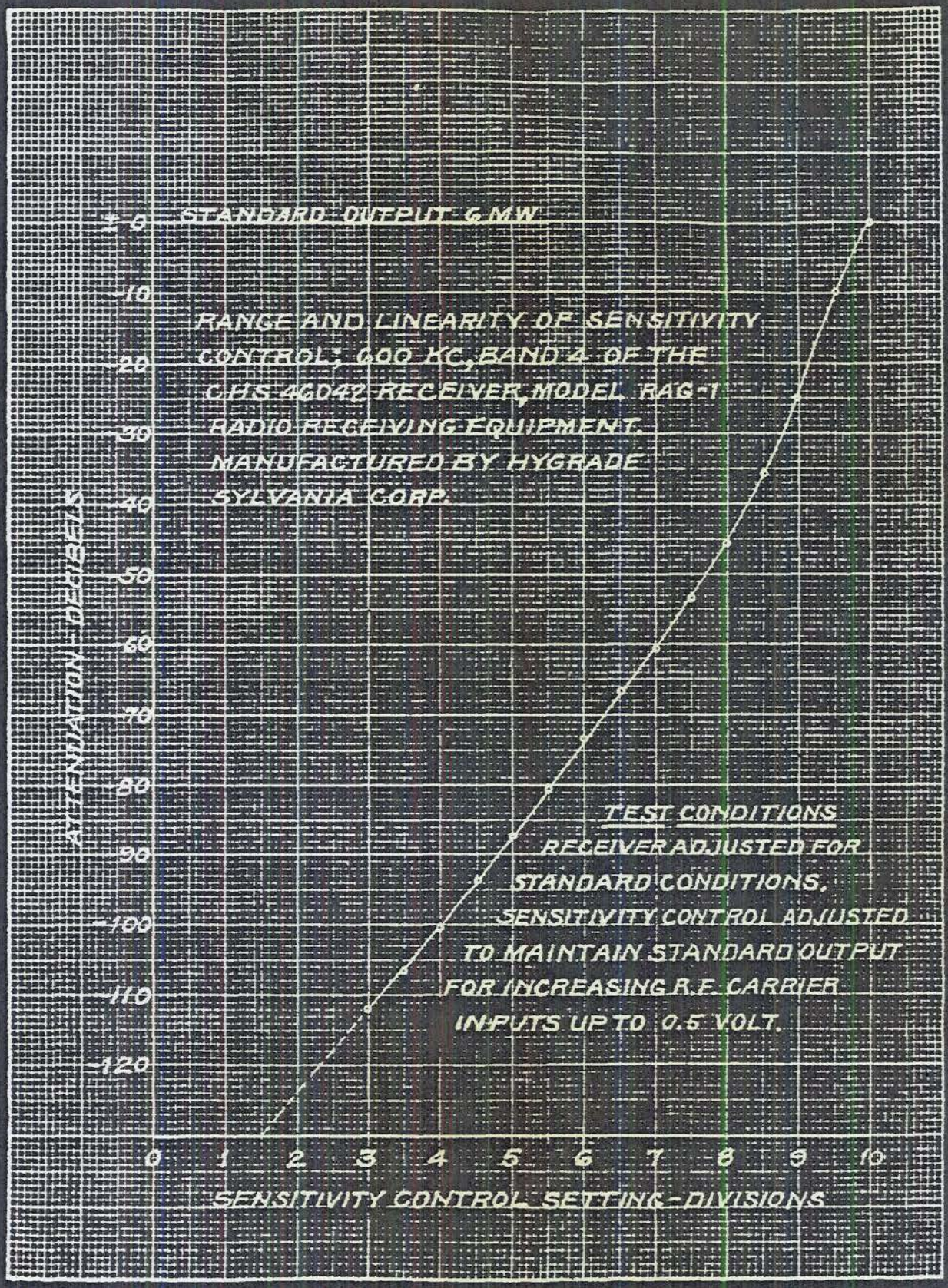


PLATE 14

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

DATE

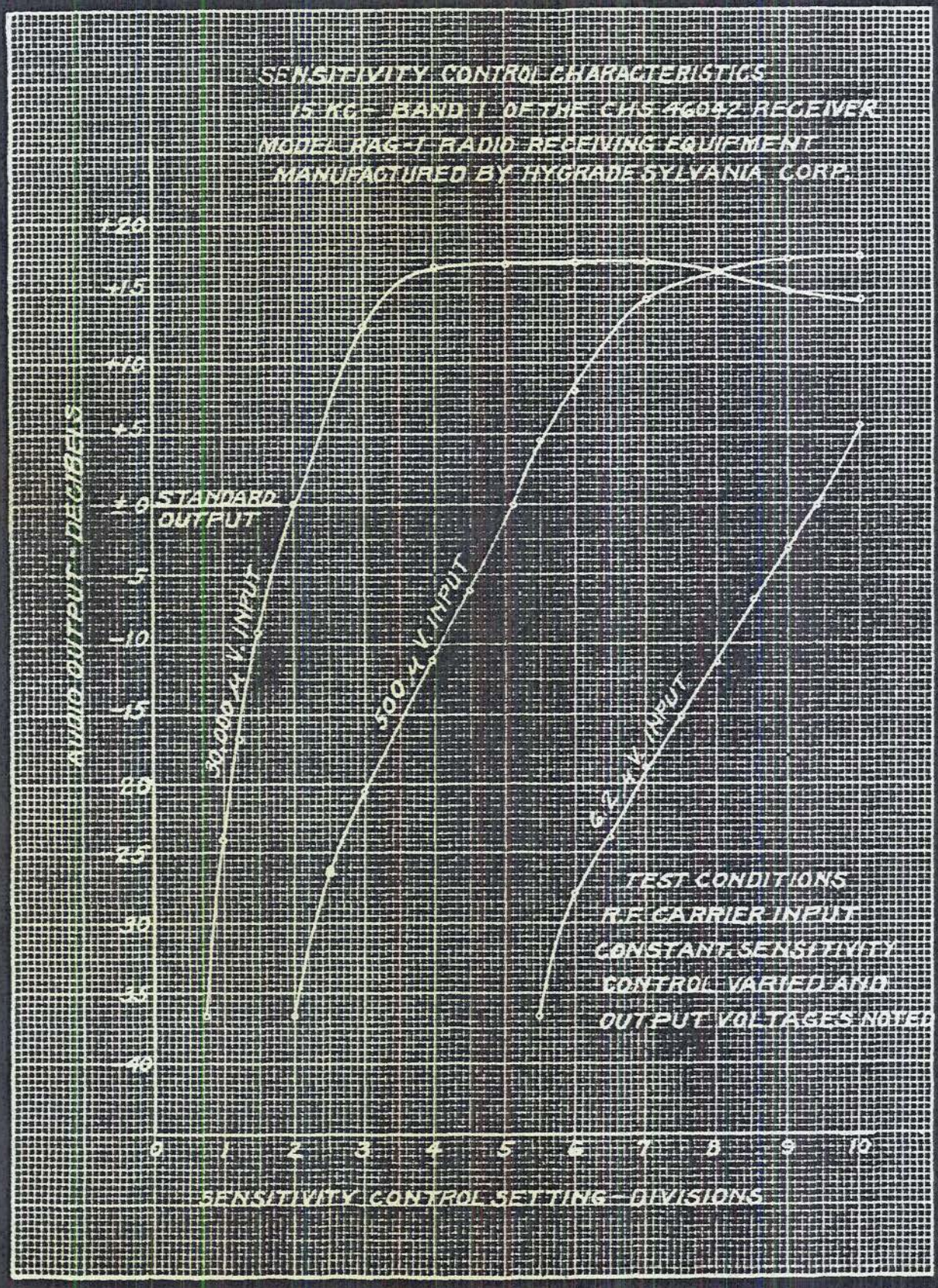


PLATE 15

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

DATE

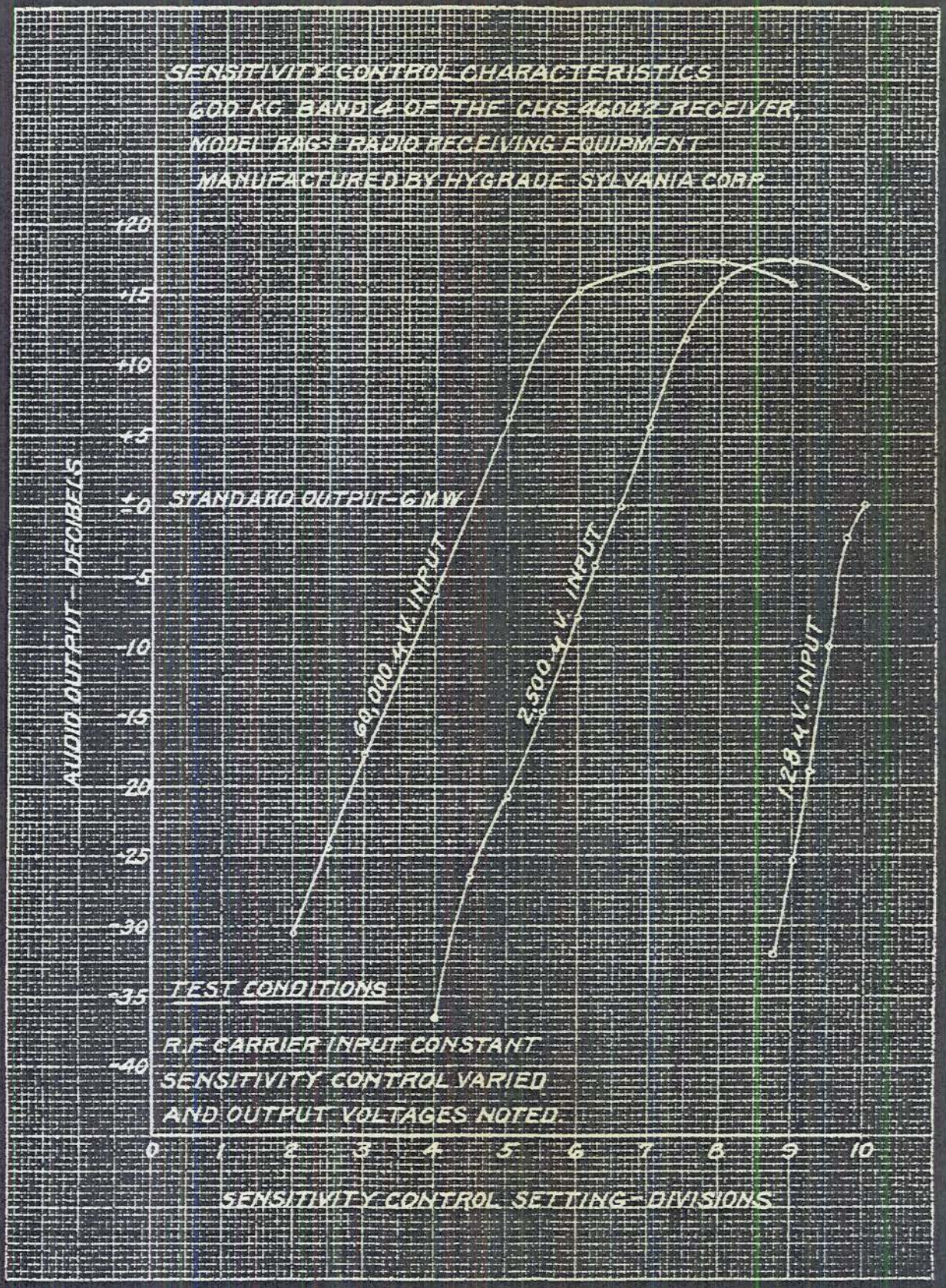


PLATE 16

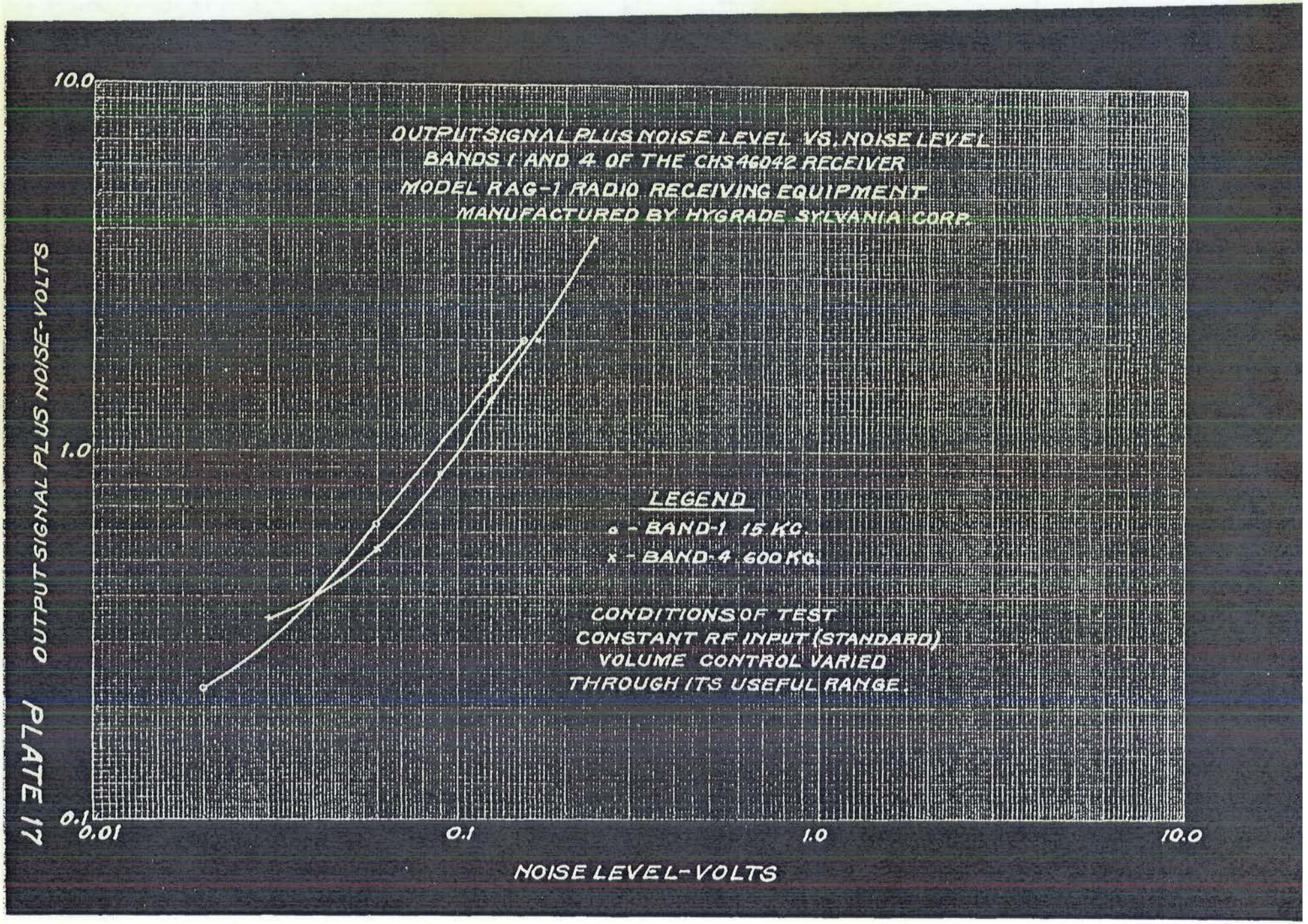

OUTPUT SIGNAL PLUS NOISE LEVEL VS. NOISE LEVEL
BANDS 1 AND 4 OF THE CHS 46042 RECEIVER
MODEL RAG-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY HYGRADE SYLVANIA CORP.
LEGEND
o - BAND-1 15 KC.
x - BAND-4 600 KC.
CONDITIONS OF TEST
CONSTANT RF INPUT (STANDARD)
VOLUME CONTROL VARIED
THROUGH ITS USEFUL RANGE.
10.0
1.0
0.1
0.01
0.1
1.0
10.0
OUTPUT SIGNAL PLUS NOISE-VOLTS
NOISE LEVEL-VOLTS

PLATE 17

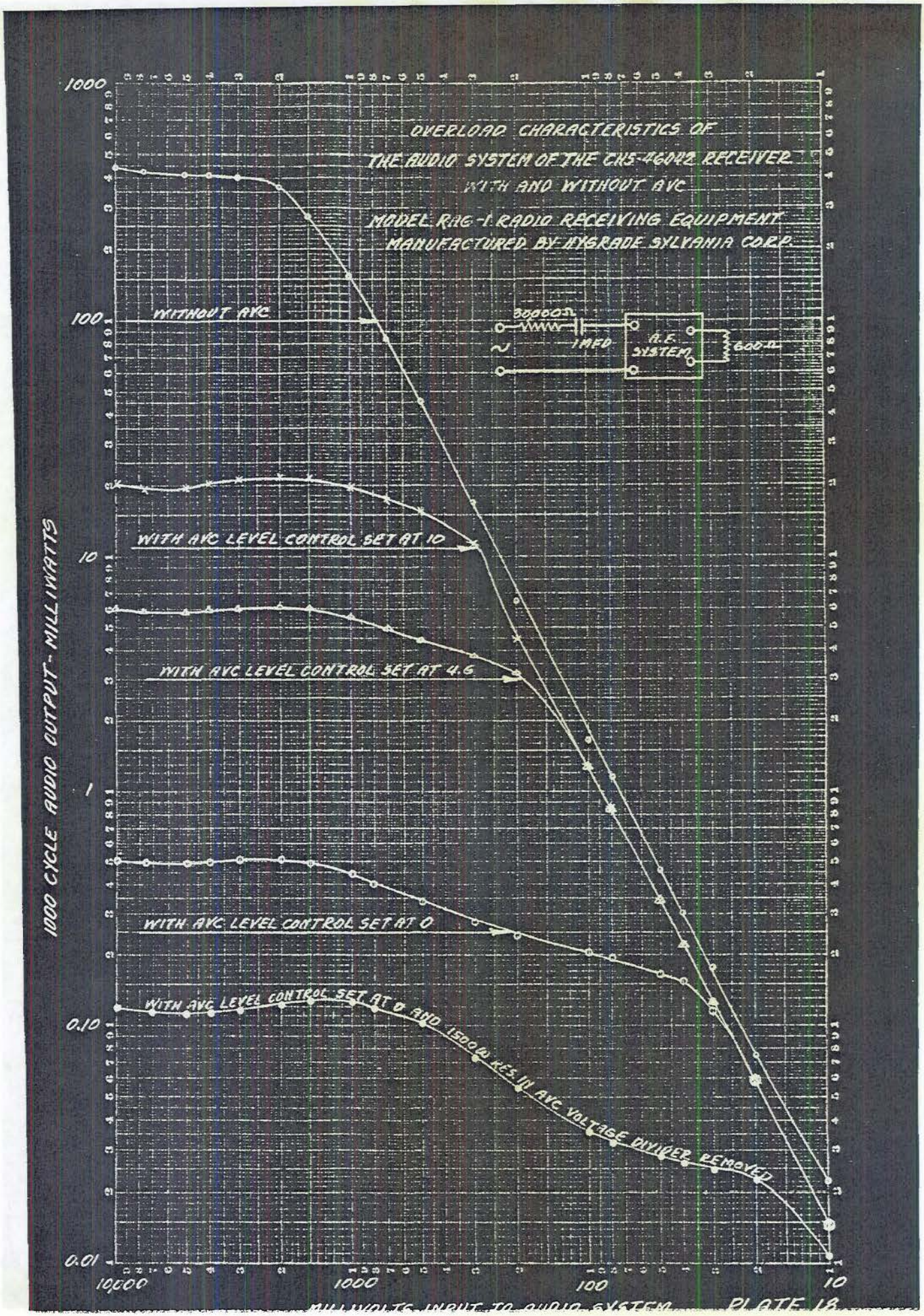

OVERLOAD CHARACTERISTICS OF
THE AUDIO SYSTEM OF THE CRS-46042 RECEIVER
WITH AND WITHOUT AVC
MODEL RAG-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY AYGRADE SYLVANIA CORP.
WITHOUT AVC
WITH AVC LEVEL CONTROL SET AT 10
WITH AVC LEVEL CONTROL SET AT 4.6
WITH AVC LEVEL CONTROL SET AT 0
WITH AVC LEVEL CONTROL SET AT 0 AND 1500Ω RES. IN AVC VOLTAGE DIVIDER REMOVED
50000Ω
1 MFD
A.F. SYSTEM
600Ω
1000 CYCLE AUDIO OUTPUT - MILLIWATTS
1000
100
10
1
0.10
0.01
10,000
1000
100
10
MILLIVOLTS INPUT TO AUDIO SYSTEM

PLATE 18

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

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RANGE AND LINEARITY OF THE AVC LEVEL CONTROL OF THE CHS 46042 RECEIVER MODEL RAG-1 RADIO RECEIVING EQUIPMENT MFD. BY HYGRADE SYLVANIA CORP.

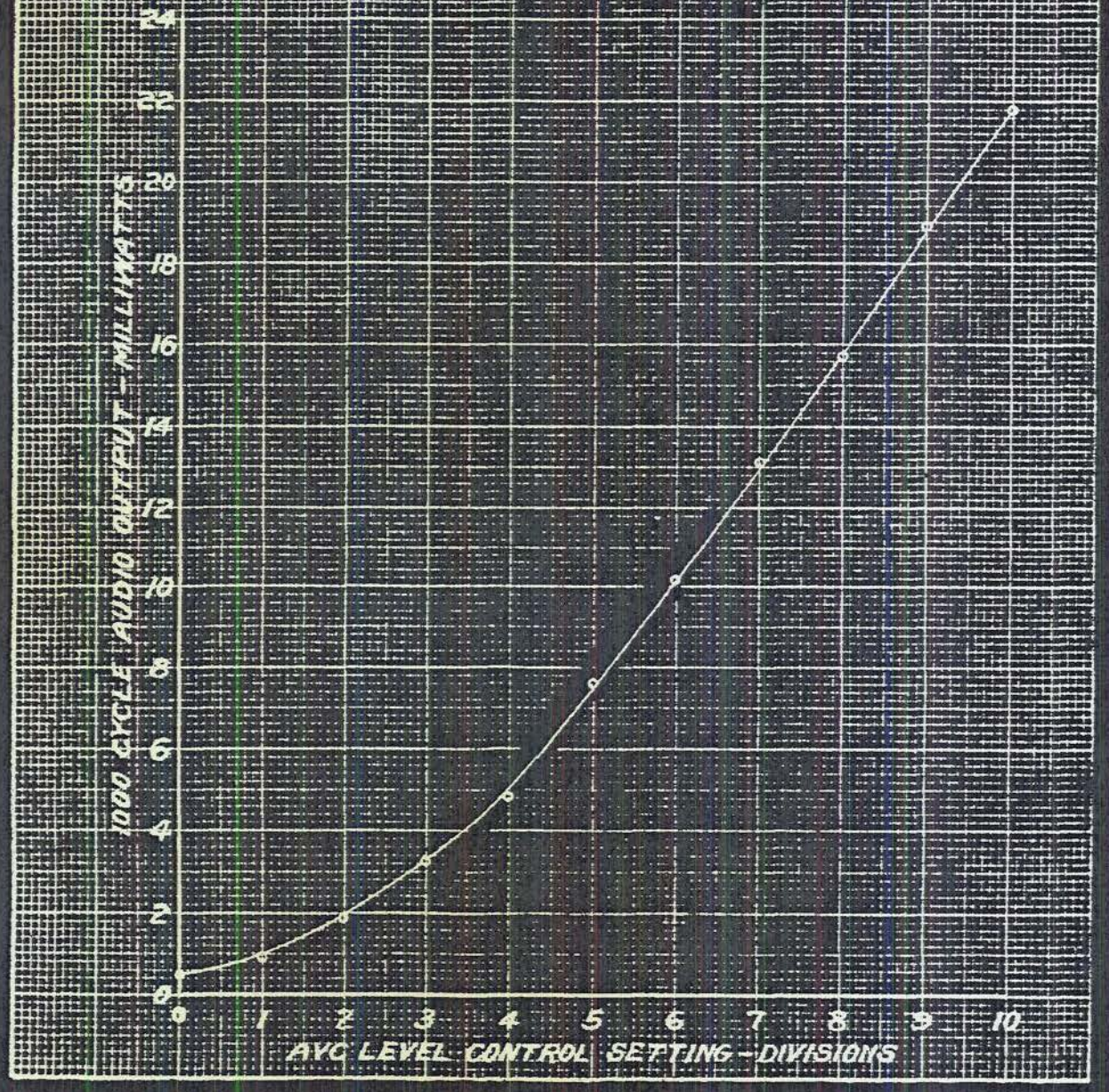


PLATE 19

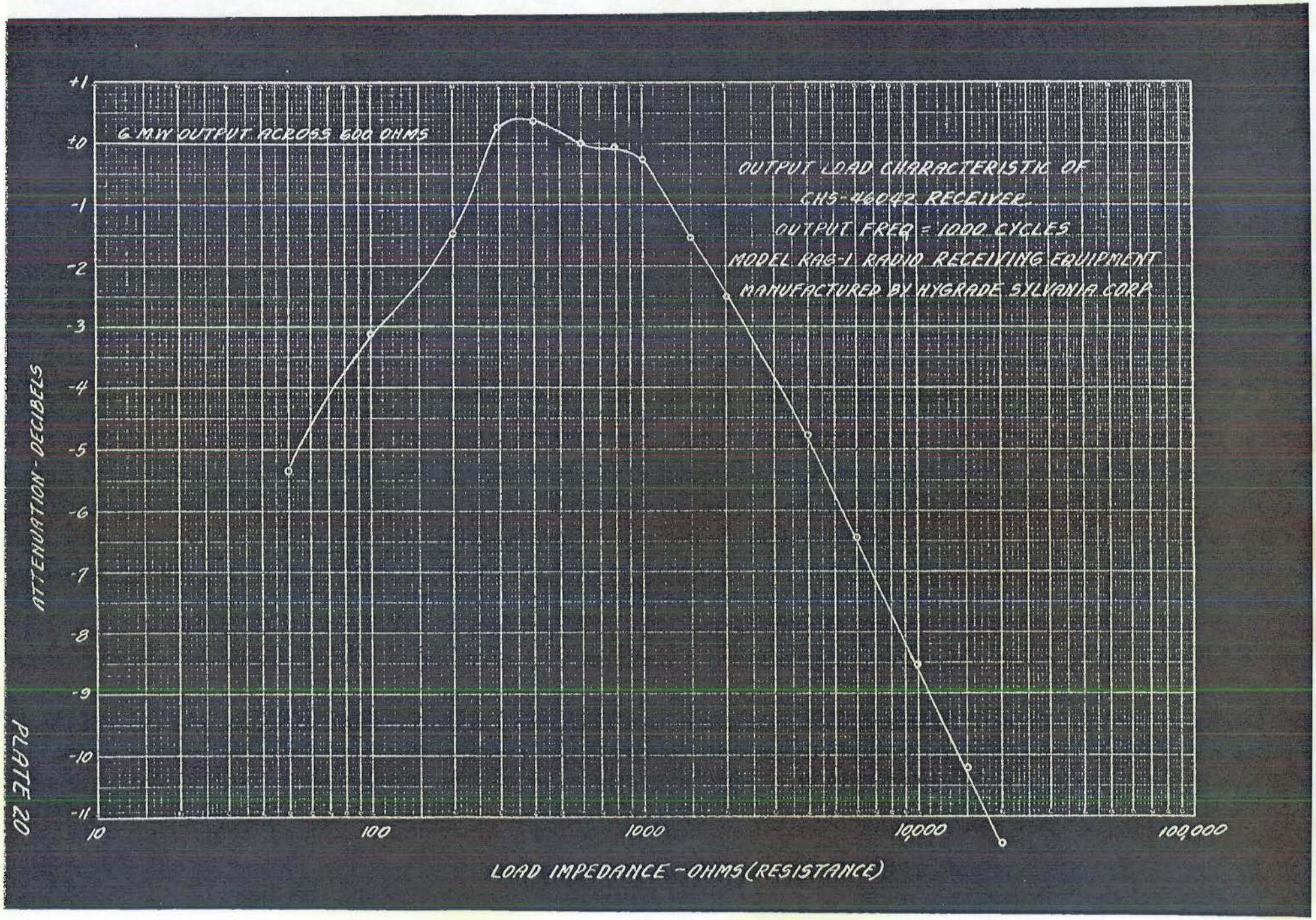

6 M.W OUTPUT ACROSS 600 OHMS
OUTPUT LOAD CHARACTERISTIC OF
CHS-46042 RECEIVER.
OUTPUT FREQ = 1000 CYCLES
MODEL RAG-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY HYGRADE SYLVANIA CORP.
+1
±0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
ATTENUATION - DECIBELS
10
100
1000
10,000
100,000
LOAD IMPEDANCE - OHMS (RESISTANCE)

PLATE 20

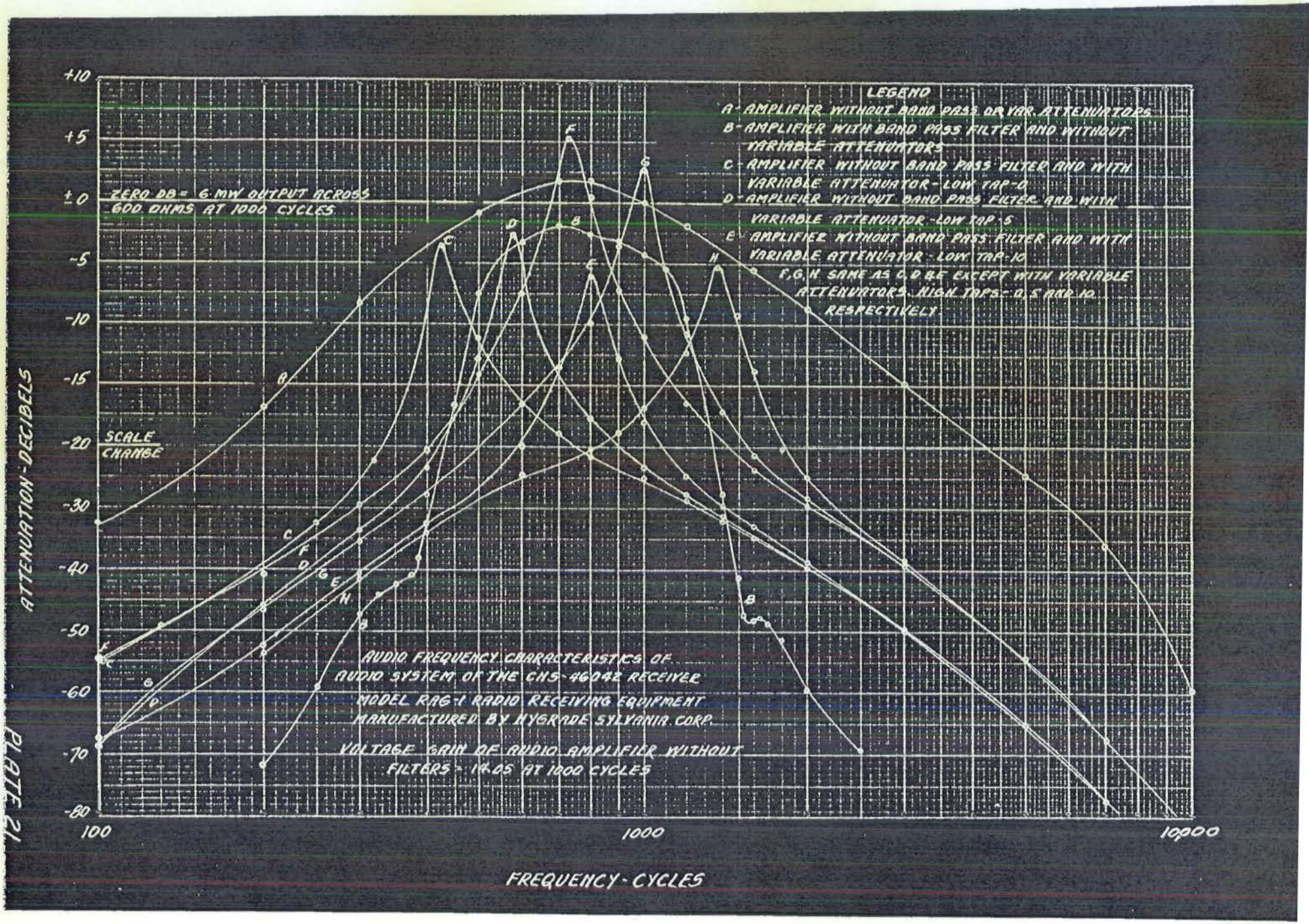

LEGEND
A - AMPLIFIER WITHOUT BAND PASS OR VAR. ATTENUATORS
B - AMPLIFIER WITH BAND PASS FILTER AND WITHOUT VARIABLE ATTENUATORS
C - AMPLIFIER WITHOUT BAND PASS FILTER AND WITH VARIABLE ATTENUATOR - LOW TAP - C
D - AMPLIFIER WITHOUT BAND PASS FILTER AND WITH VARIABLE ATTENUATOR - LOW TAP - S
E - AMPLIFIER WITHOUT BAND PASS FILTER AND WITH VARIABLE ATTENUATOR - LOW TAP - 10
F, G, H SAME AS C, D & E EXCEPT WITH VARIABLE ATTENUATORS HIGH TAPS - C, S AND 10 RESPECTIVELY.
ZERO DB = 6 MW OUTPUT ACROSS 600 OHMS AT 1000 CYCLES
SCALE CHANGE
AUDIO FREQUENCY CHARACTERISTICS OF AUDIO SYSTEM OF THE CMS-46042 RECEIVER MODEL RAG-1 RADIO RECEIVING EQUIPMENT MANUFACTURED BY HYGRADE SYLVANIA CORP.
VOLTAGE GAIN OF AUDIO AMPLIFIER WITHOUT FILTERS = 14.05 AT 1000 CYCLES
+10
+5
± 0
-5
-10
-15
-20
-30
-40
-50
-60
-70
-80
ATTENUATION - DECIBELS
100
1000
10,000
FREQUENCY - CYCLES

PLATE 21

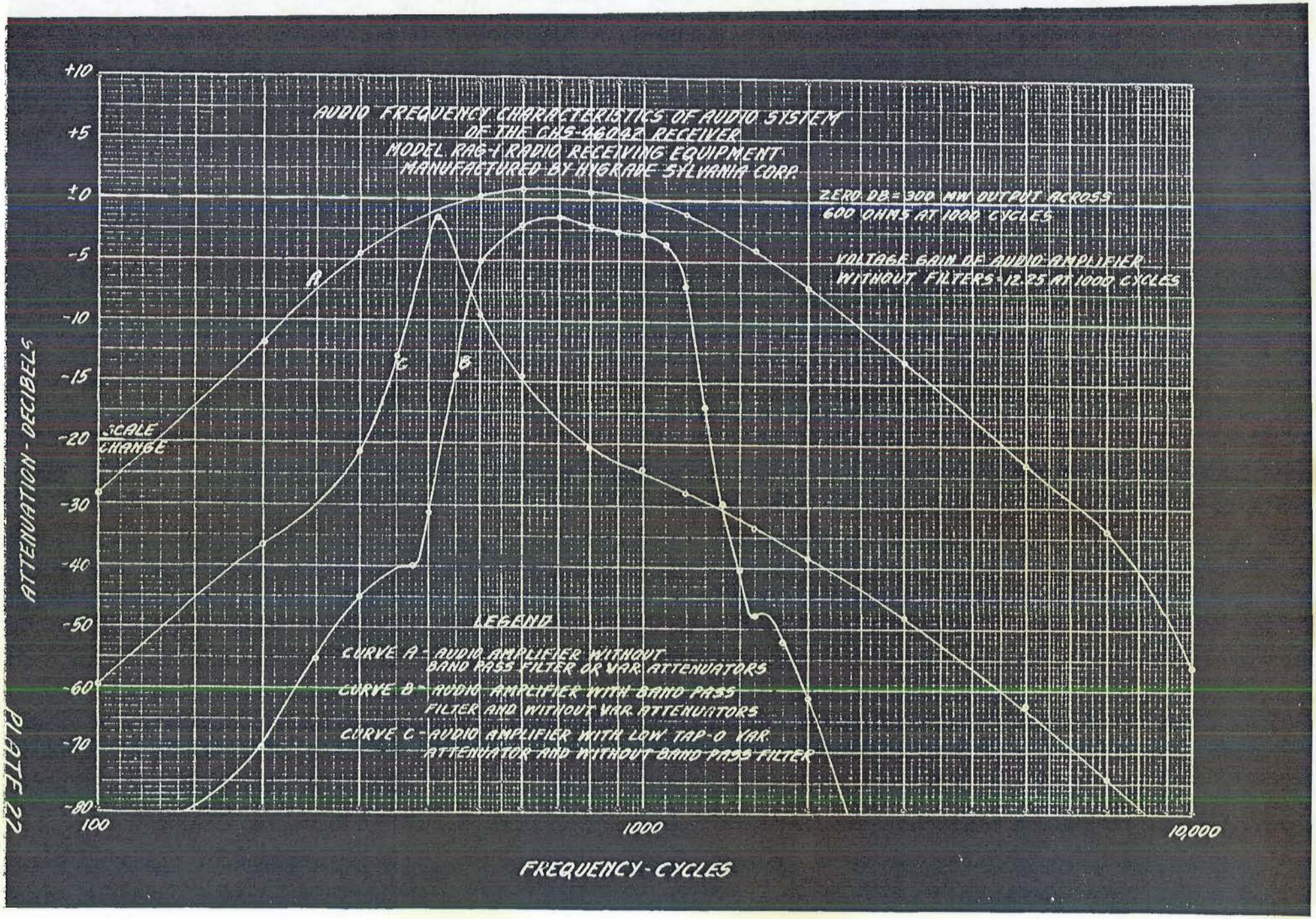
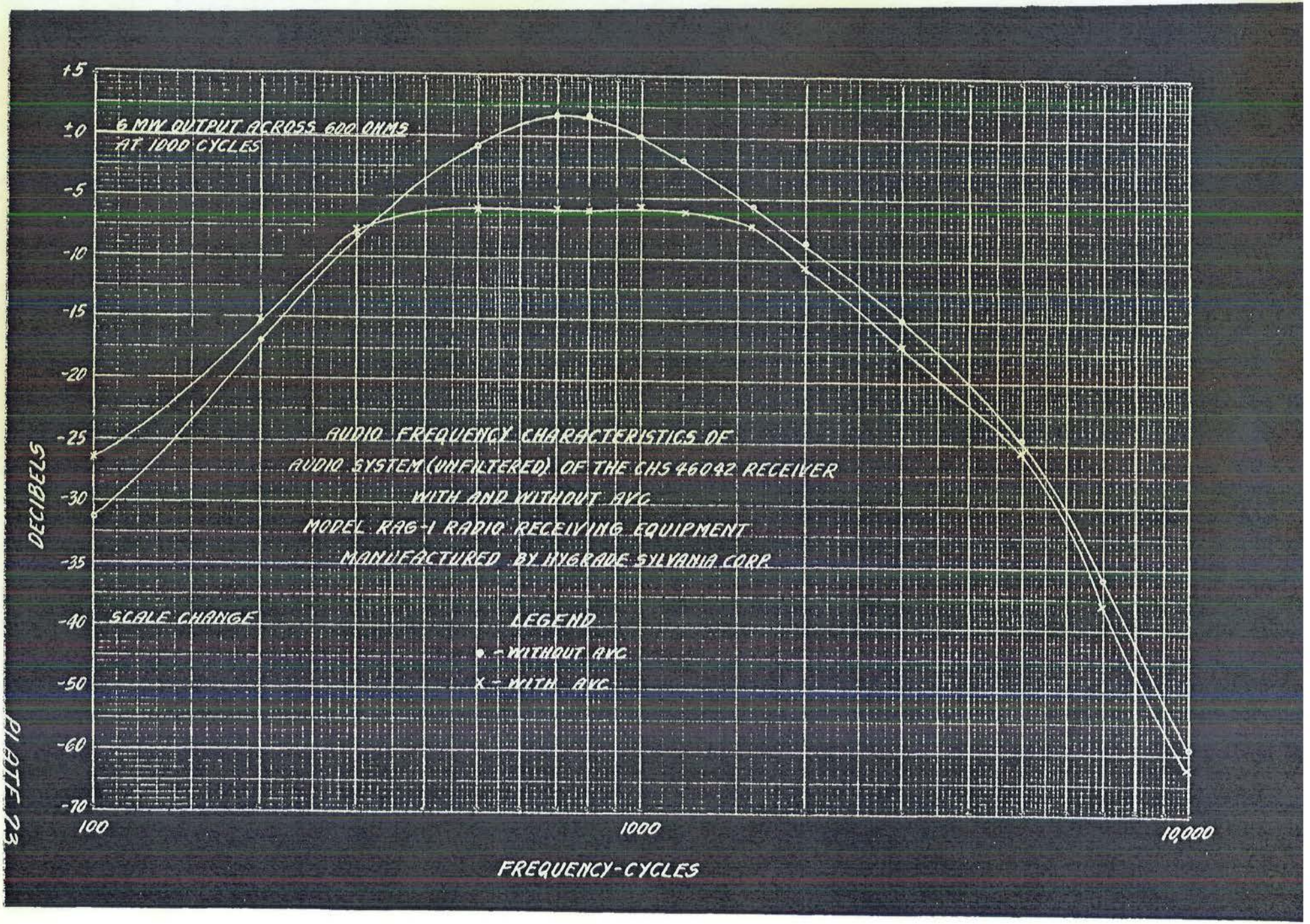
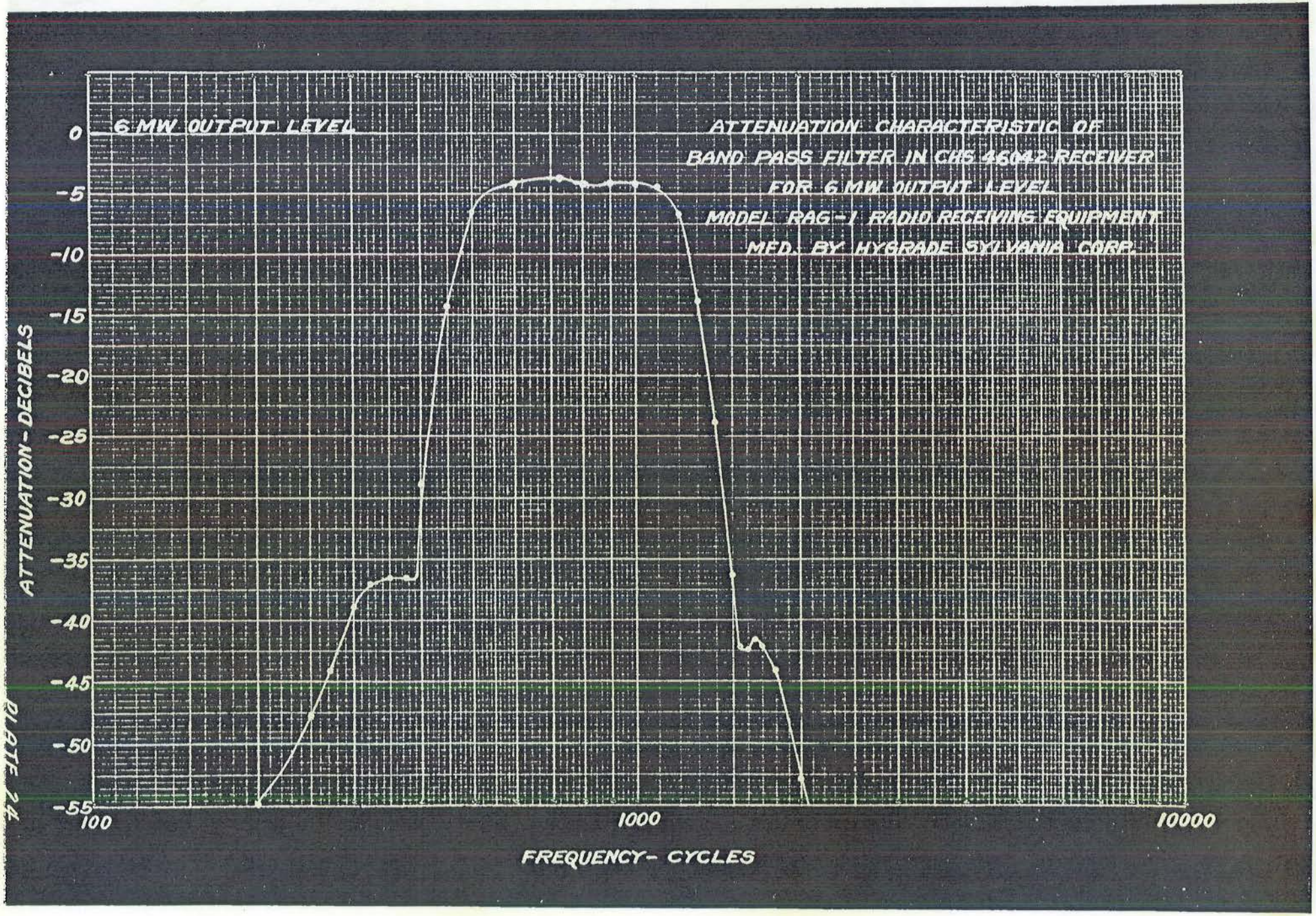
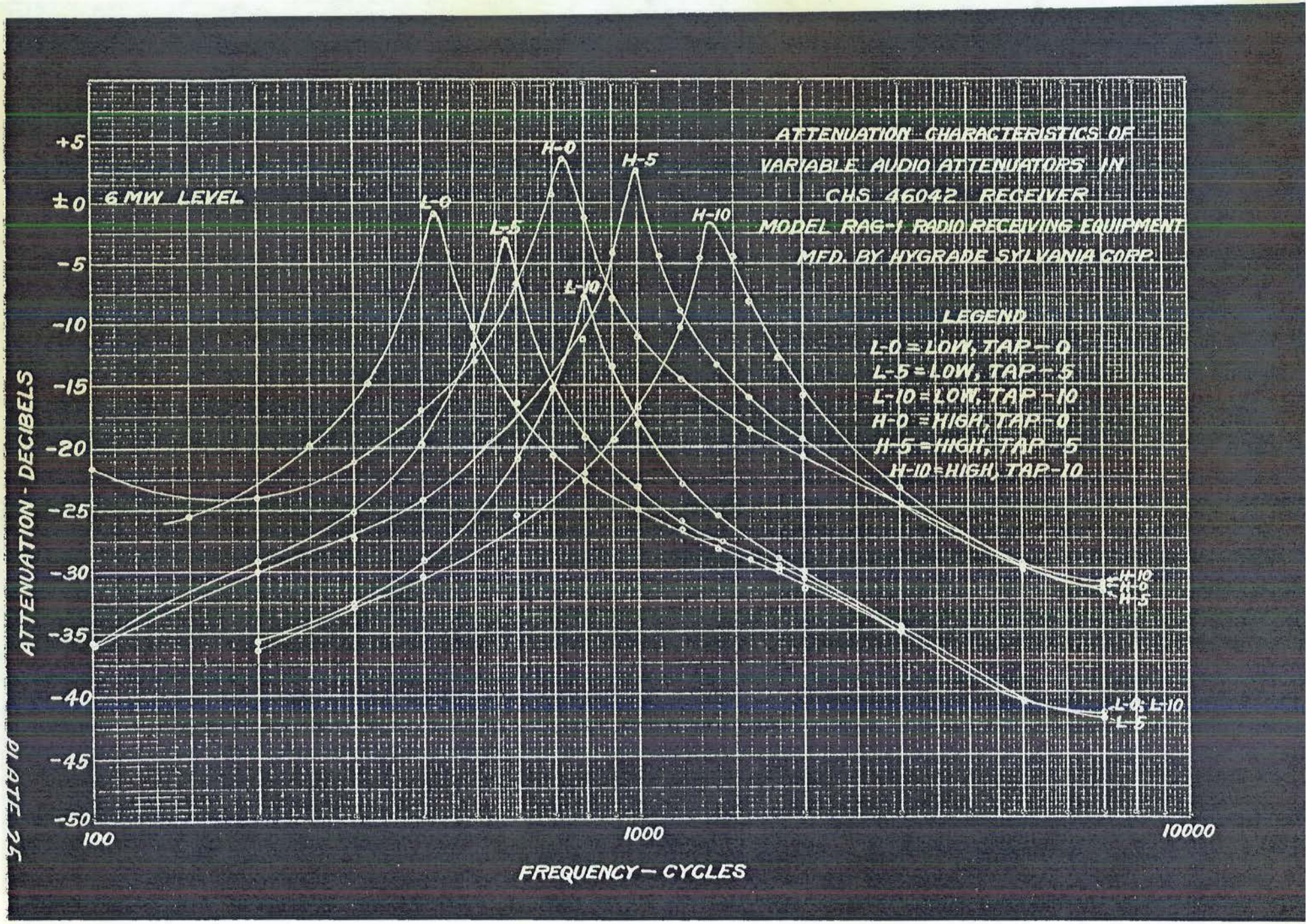

AUDIO FREQUENCY CHARACTERISTICS OF AUDIO SYSTEM
OF THE CHS-46042 RECEIVER
MODEL RAG-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY HYGRADE SYLVANIA CORP.
ZERO DB = 300 MW OUTPUT ACROSS
600 OHMS AT 1000 CYCLES
VOLTAGE GAIN OF AUDIO AMPLIFIER
WITHOUT FILTERS = 12.25 AT 1000 CYCLES
SCALE CHANGE
LEGEND
CURVE A - AUDIO AMPLIFIER WITHOUT BAND PASS FILTER OR VAR. ATTENUATORS
CURVE B - AUDIO AMPLIFIER WITH BAND PASS FILTER AND WITHOUT VAR. ATTENUATORS
CURVE C - AUDIO AMPLIFIER WITH LOW TAP-O VAR. ATTENUATOR AND WITHOUT BAND PASS FILTER
+10
+5
±0
-5
-10
-15
-20
-30
-40
-50
-60
-70
-80
ATTENUATION - DECIBELS
100
1000
10,000
FREQUENCY - CYCLES
A
B
C

PLATE 22


+5
±0
-5
-10
-15
-20
-25
-30
-35
-40
-50
-60
-70
DECIBELS
6 MW OUTPUT ACROSS 600 OHMS
AT 1000 CYCLES
AUDIO FREQUENCY CHARACTERISTICS OF
AUDIO SYSTEM (UNFILTERED) OF THE CHS 46042 RECEIVER
WITH AND WITHOUT AVC
MODEL RAG-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY HYGRADE SYLVANIA CORP.
SCALE CHANGE
LEGEND
• - WITHOUT AVC
X - WITH AVC
100
1000
10,000
FREQUENCY-CYCLES
PLATE 23


6 MW OUTPUT LEVEL
ATTENUATION CHARACTERISTIC OF
BAND PASS FILTER IN CHS 46042 RECEIVER
FOR 6 MW OUTPUT LEVEL
MODEL RAG-1 RADIO RECEIVING EQUIPMENT
MFD. BY HYGRADE SYLVANIA CORP.
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
ATTENUATION - DECIBELS
100
1000
10000
FREQUENCY - CYCLES
PLATE 24


ATTENUATION CHARACTERISTICS OF
VARIABLE AUDIO ATTENUATORS IN
CHS 46042 RECEIVER
MODEL RAG-1 RADIO RECEIVING EQUIPMENT
MFD. BY HYGRADE SYLVANIA CORP.
6 MW LEVEL
LEGEND
L-0 = LOW, TAP - 0
L-5 = LOW, TAP - 5
L-10 = LOW, TAP - 10
H-0 = HIGH, TAP - 0
H-5 = HIGH, TAP - 5
H-10 = HIGH, TAP - 10
L-0
L-5
L-10
H-0
H-5
H-10
+5
±0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
ATTENUATION - DECIBELS
100
1000
10000
FREQUENCY — CYCLES
L-0 & L-10
L-5
H-10
H-0
H-5

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

DATE

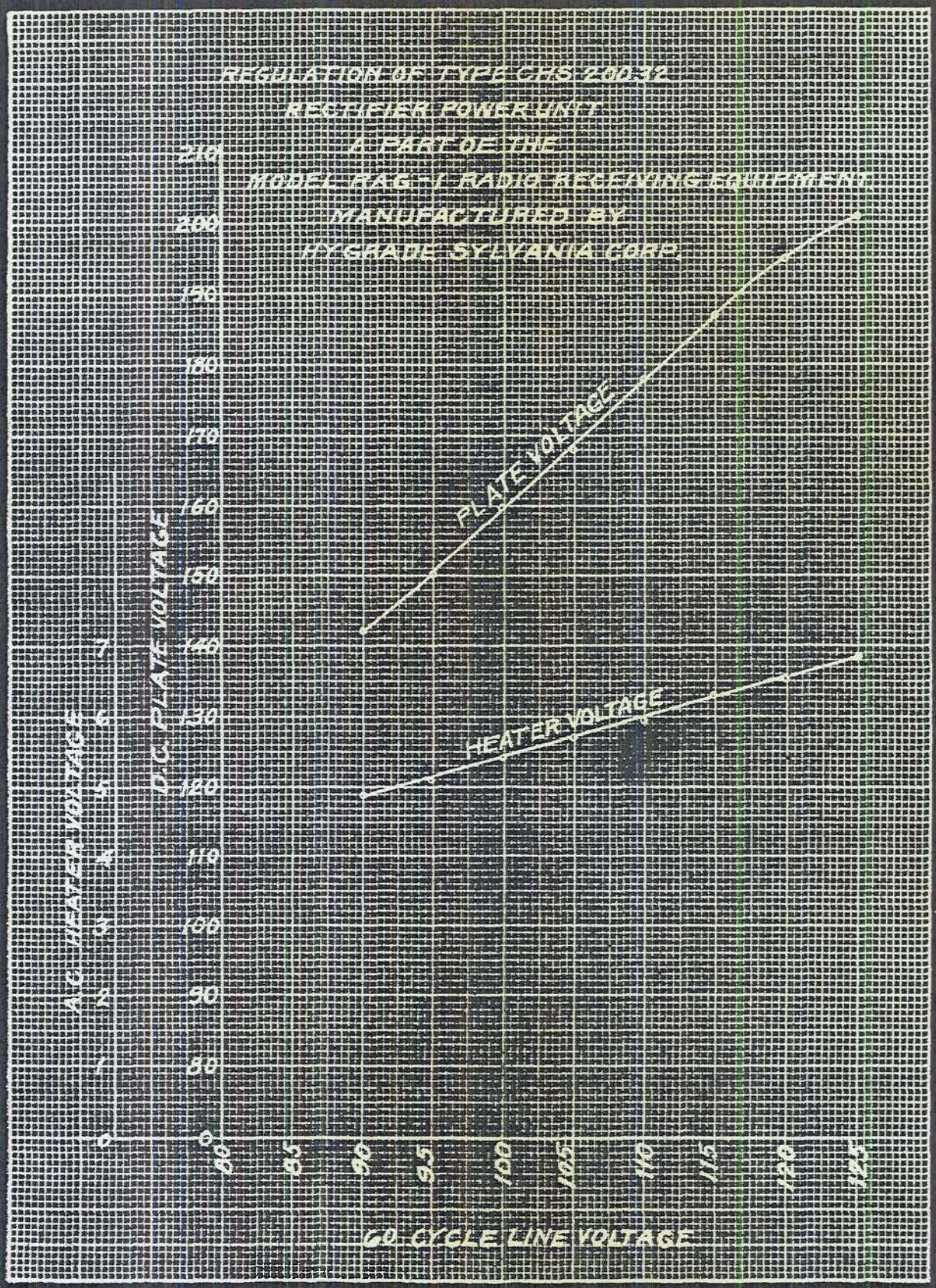


PLATE 26

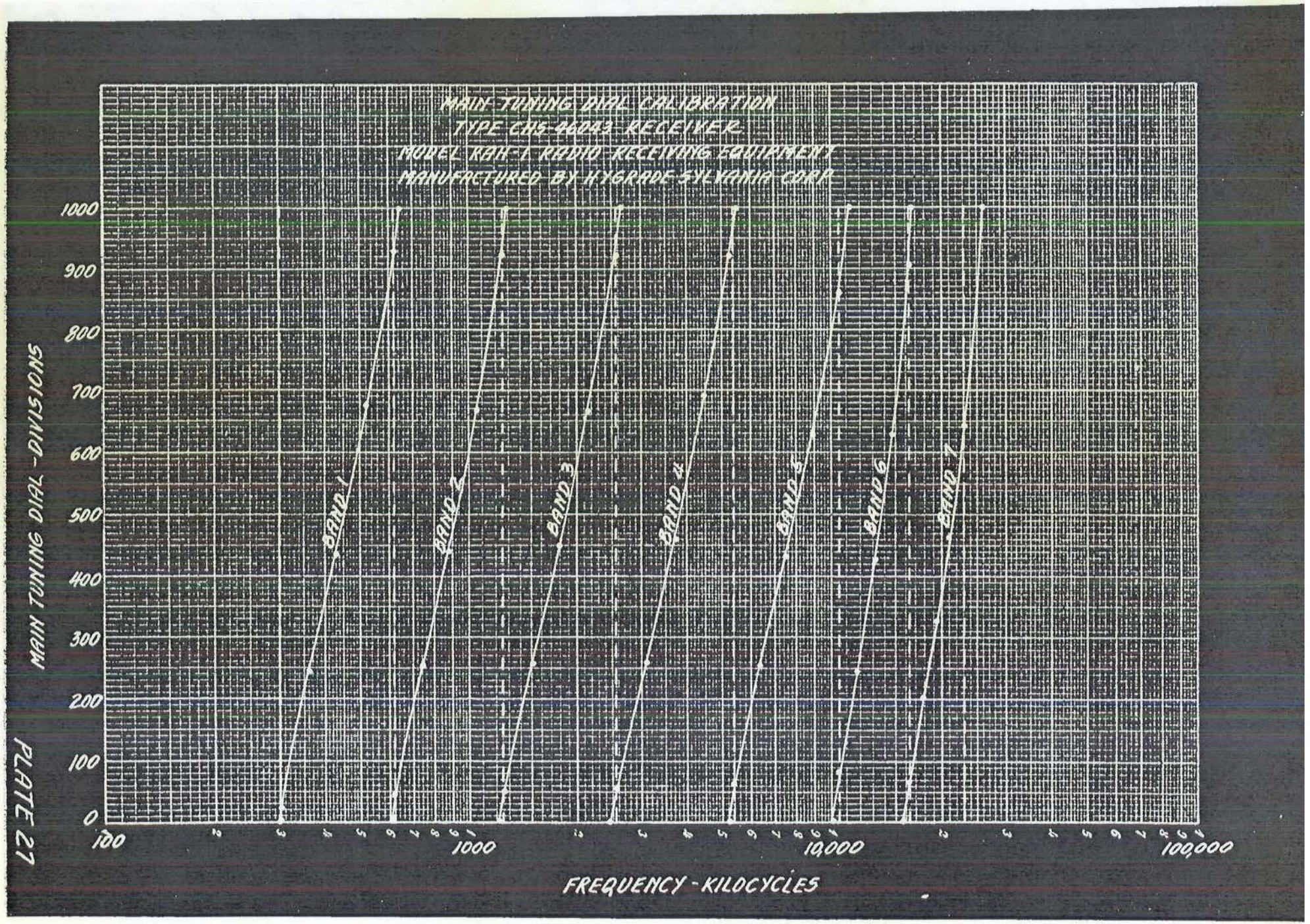

MAIN TUNING DIAL CALIBRATION
TYPE CHS-46043 RECEIVER
MODEL RAH-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY HYGRADE SYLVANIA CORP
MAIN TUNING DIAL - DIVISIONS
1000
900
800
700
600
500
400
300
200
100
0
BAND 1
BAND 2
BAND 3
BAND 4
BAND 5
BAND 6
BAND 7
100
1000
10,000
100,000
FREQUENCY - KILOCYCLES

PLATE 27

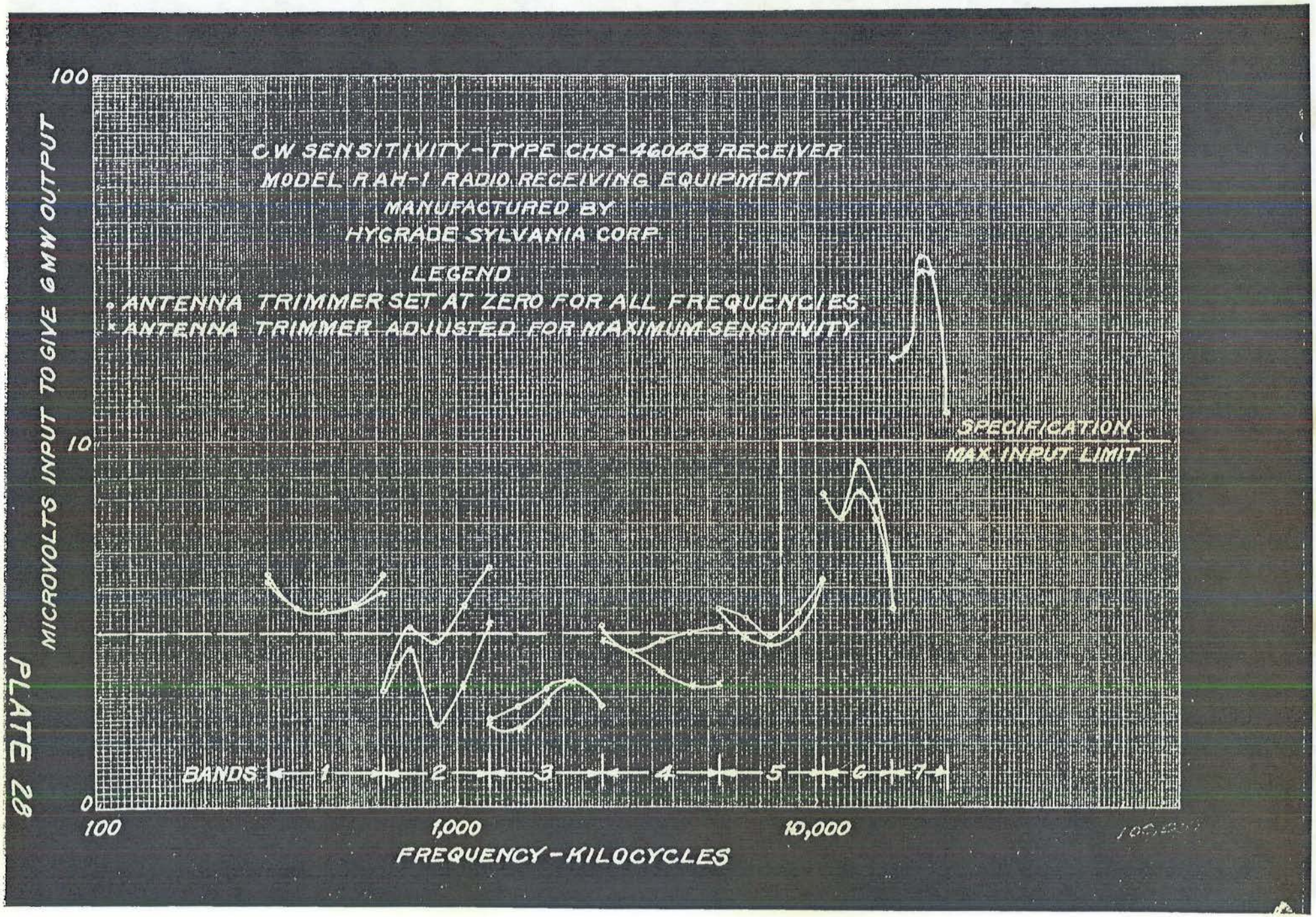

C W SENSITIVITY - TYPE CHS-46043 RECEIVER
MODEL RAH-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY
HYGRADE SYLVANIA CORP.
LEGEND
• ANTENNA TRIMMER SET AT ZERO FOR ALL FREQUENCIES.
* ANTENNA TRIMMER ADJUSTED FOR MAXIMUM SENSITIVITY
SPECIFICATION
MAX. INPUT LIMIT
MICROVOLTS INPUT TO GIVE 6 MW OUTPUT
100
10
0
BANDS
1
2
3
4
5
6
7
100
1,000
10,000
FREQUENCY - KILOCYCLES

PLATE 28

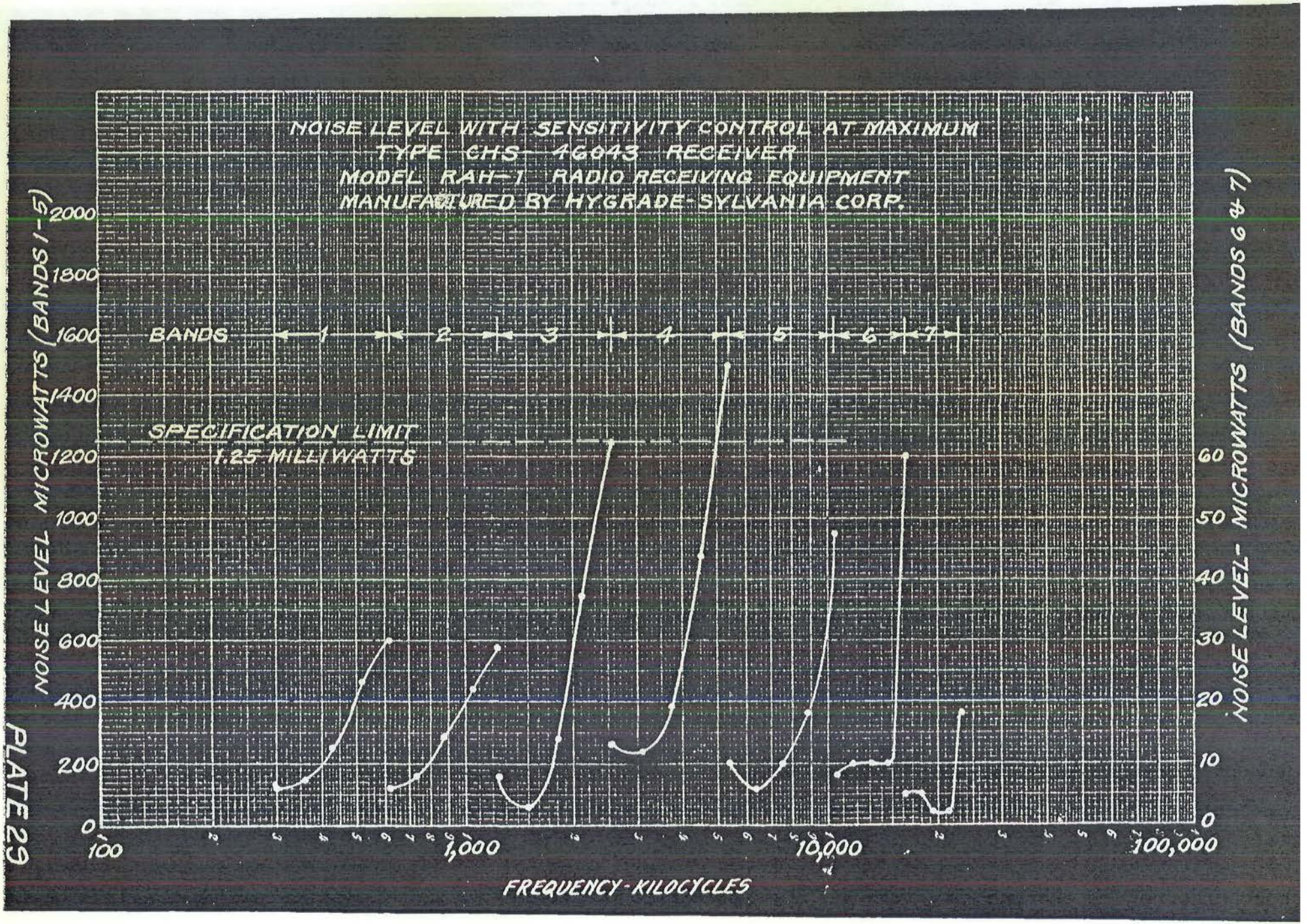

NOISE LEVEL WITH SENSITIVITY CONTROL AT MAXIMUM
TYPE CHS-46043 RECEIVER
MODEL RAH-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY HYGRADE-SYLVANIA CORP.
NOISE LEVEL MICROWATTS (BANDS 1-5)
NOISE LEVEL- MICROWATTS (BANDS 6 & 7)
BANDS 1 2 3 4 5 6 7
SPECIFICATION LIMIT
1.25 MILLIWATTS
2000
1800
1600
1400
1200
1000
800
600
400
200
0
60
50
40
30
20
10
0
100
1,000
10,000
100,000
FREQUENCY-KILOCYCLES

PLATE 29

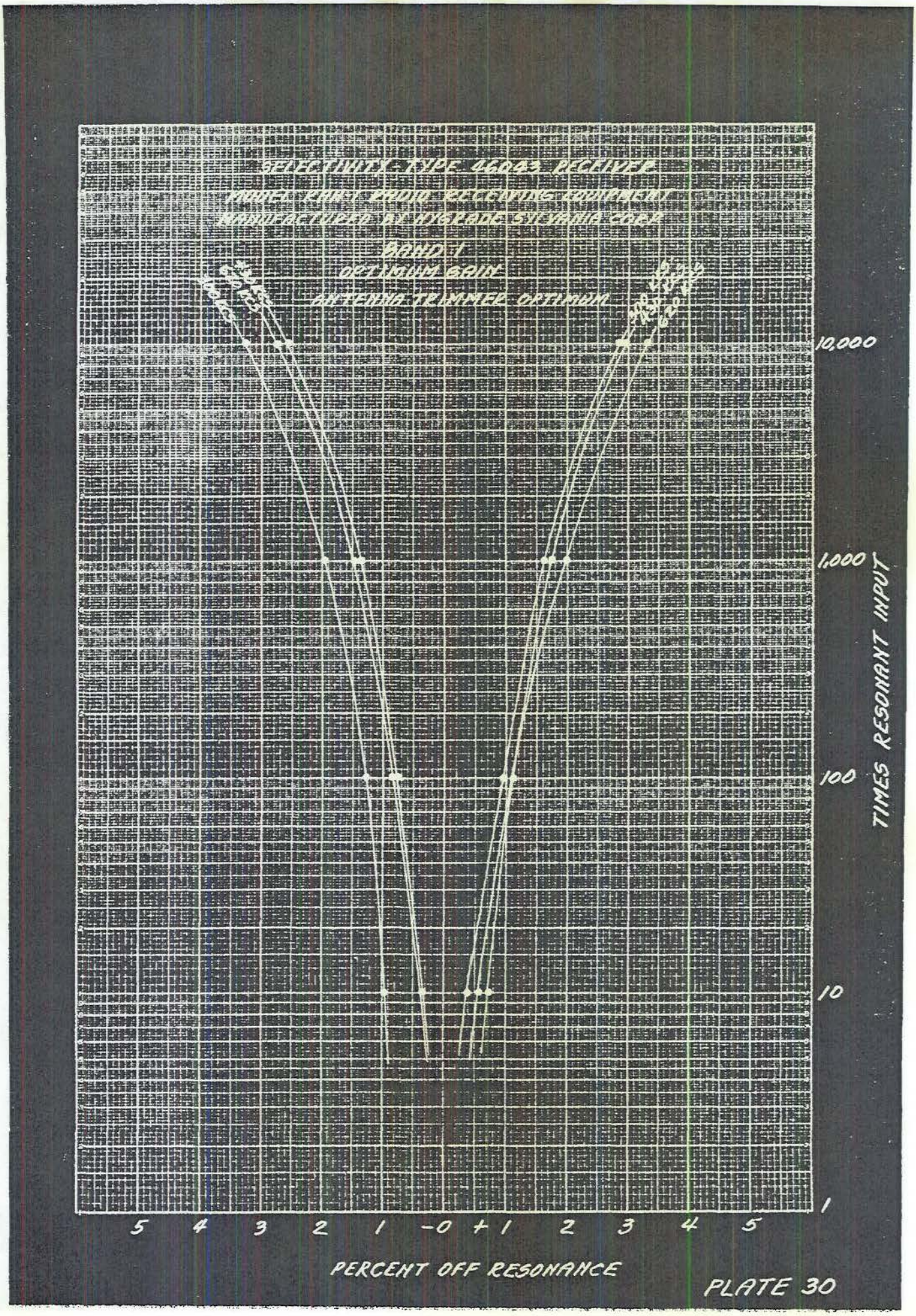

SELECTIVITY CURVE TYPE 46B43 RECEIVER
RADIO CORP. RADIO RECEIVING CORP.
MANUFACTURED BY HIGH GRADE STERLING CORP.
BAND I
OPTIMUM GAIN
ANTENNA TRIMMER OPTIMUM
10,000
1,000
100
10
1
TIMES RESONANT INPUT
5 4 3 2 1 -0 +1 2 3 4 5
PERCENT OFF RESONANCE

PLATE 30

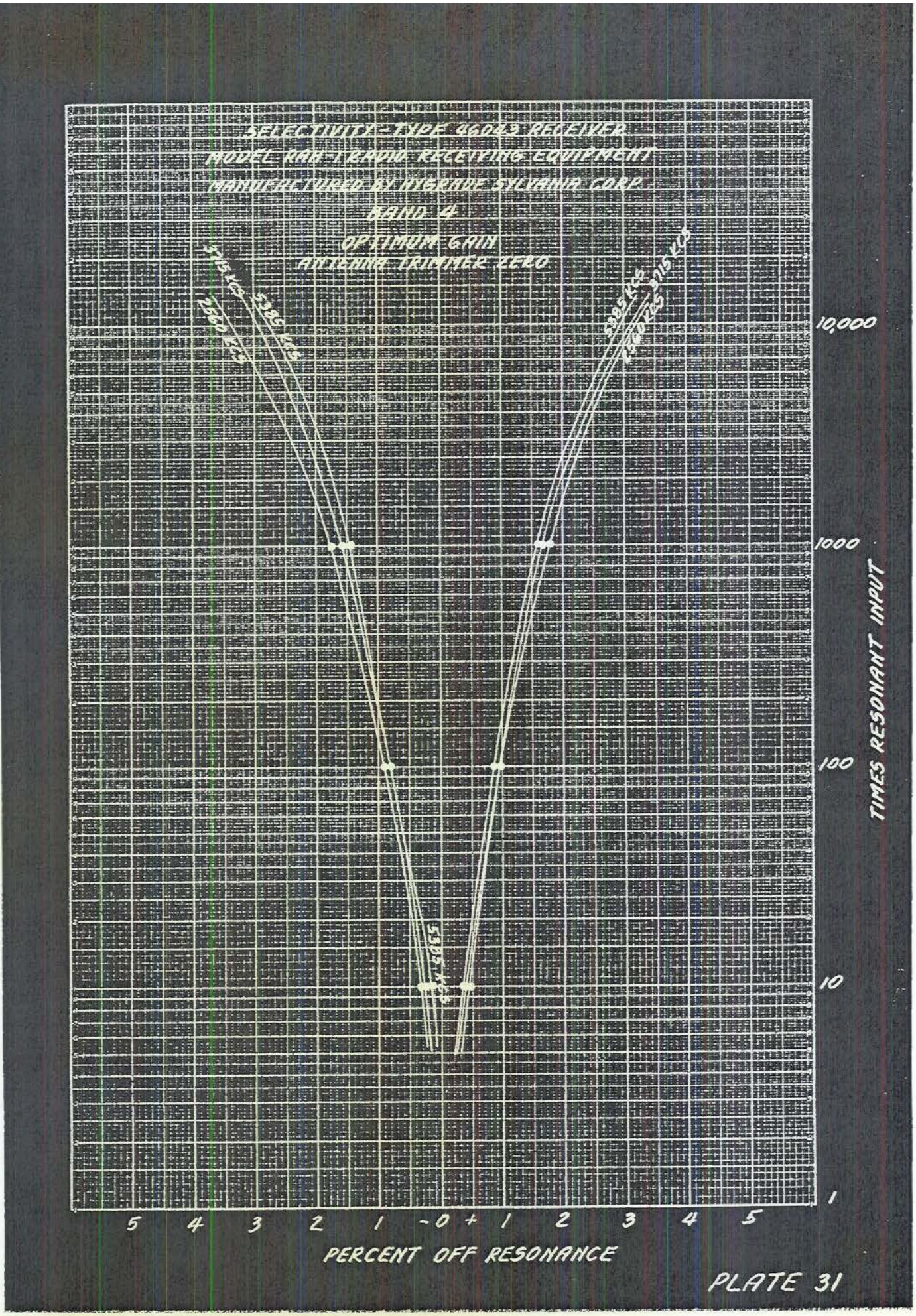

SELECTIVITY - TYPE 46049 RECEIVER
MODEL KAB-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY MIGRADE SYLVANIA CORP.
BAND 4
OPTIMUM GAIN
ANTENNA TRIMMER ZERO
10,000
1000
100
10
1
TIMES RESONANT INPUT
5 4 3 2 1 -0+ 1 2 3 4 5
PERCENT OFF RESONANCE

PLATE 31

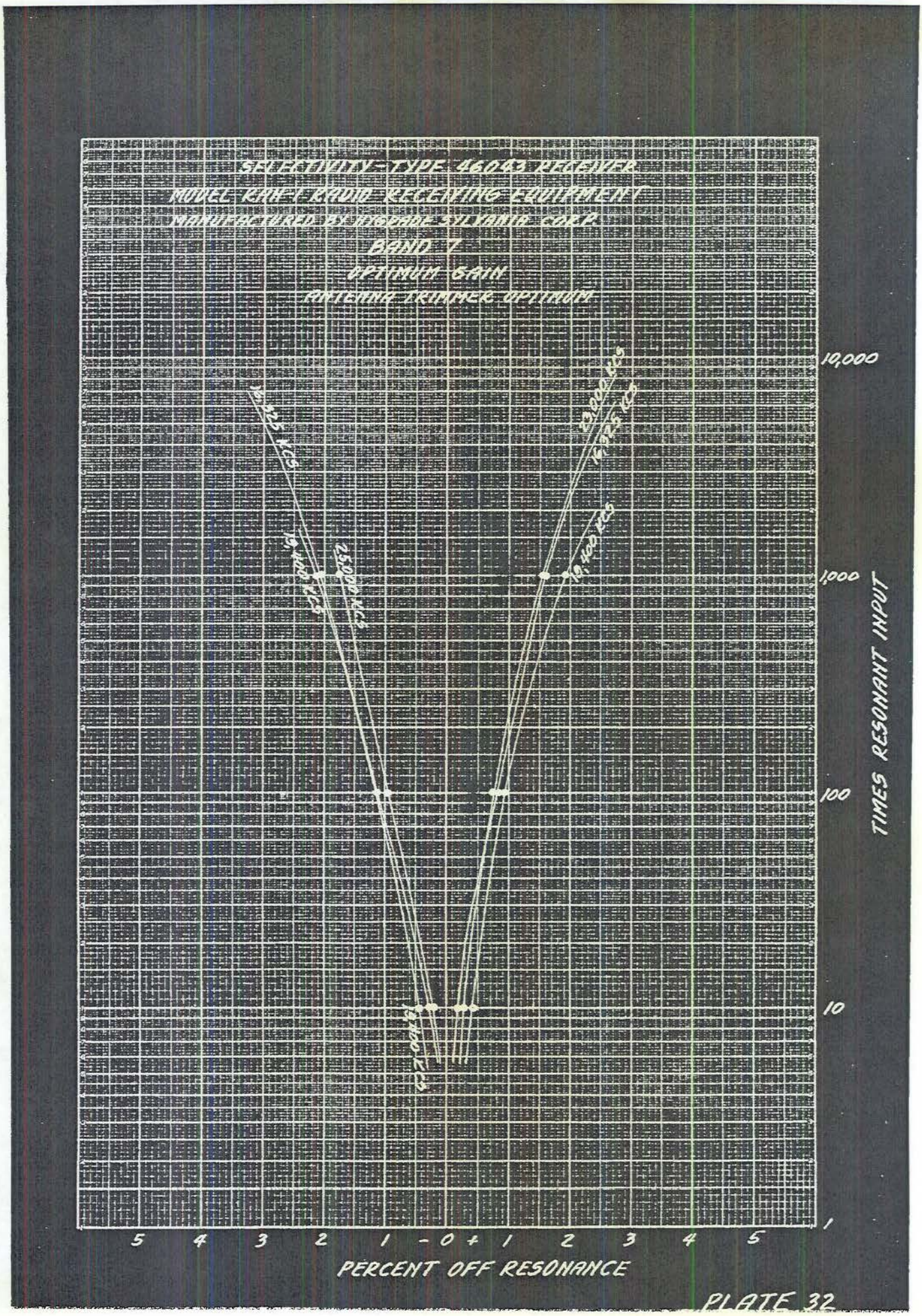
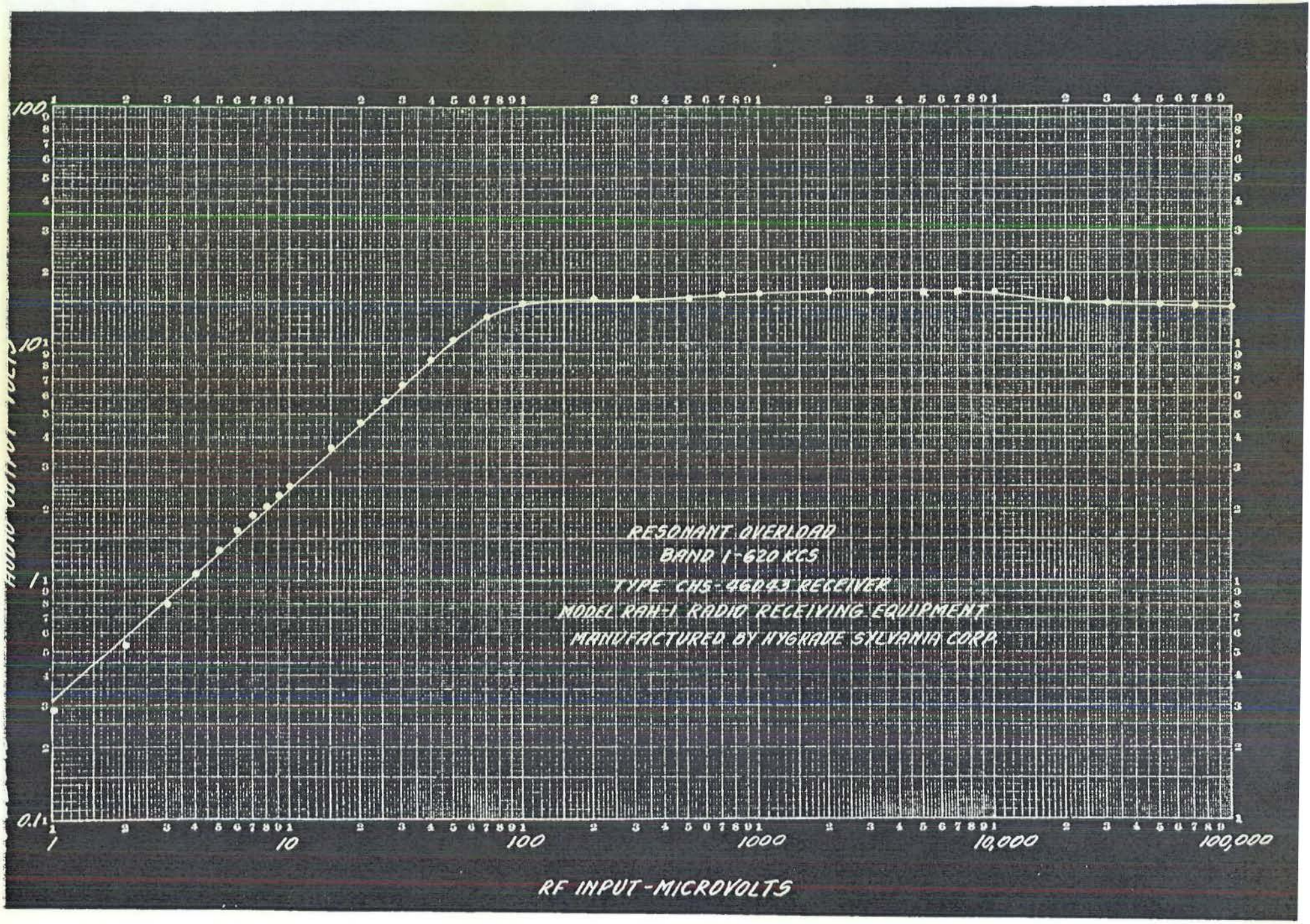
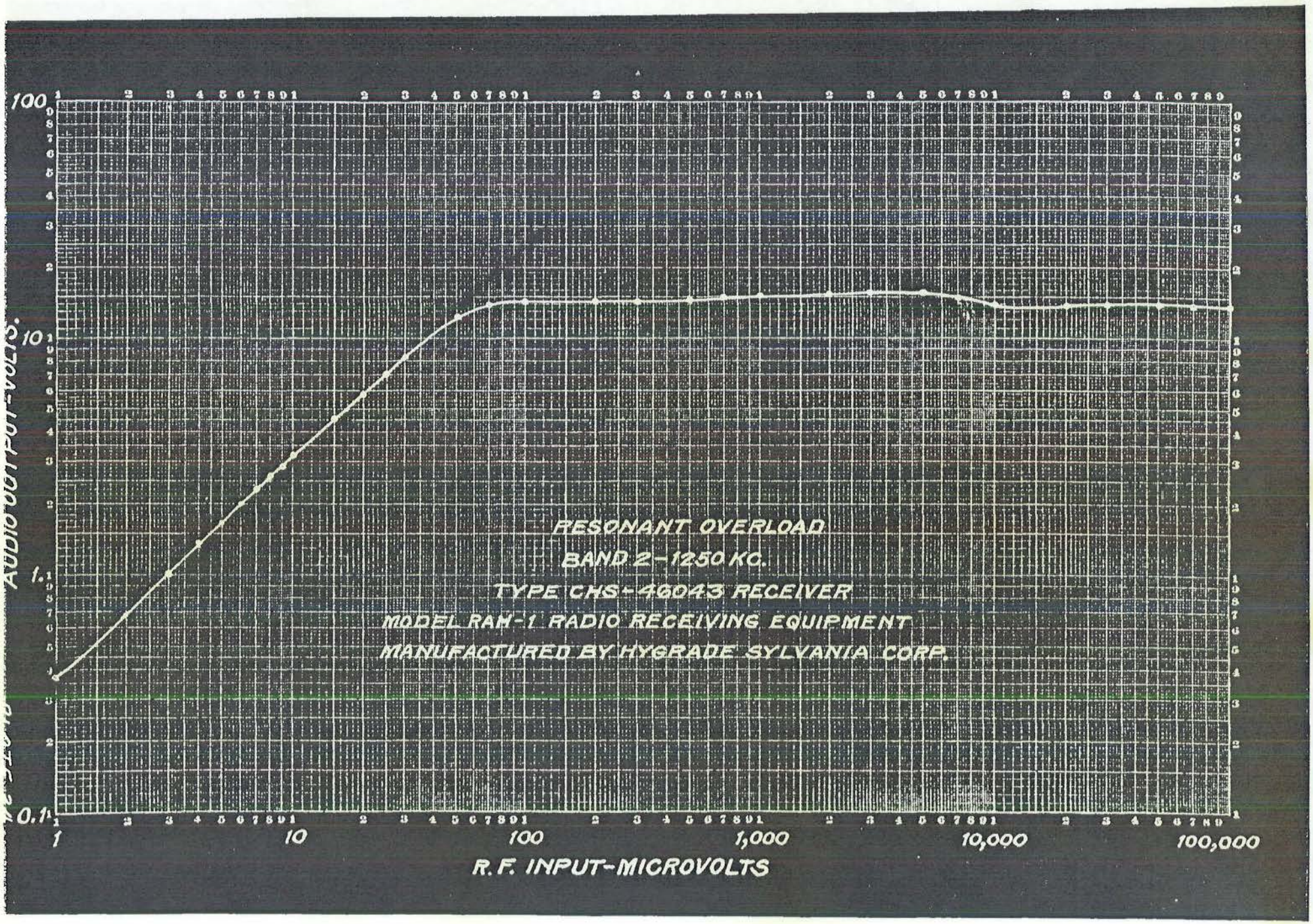
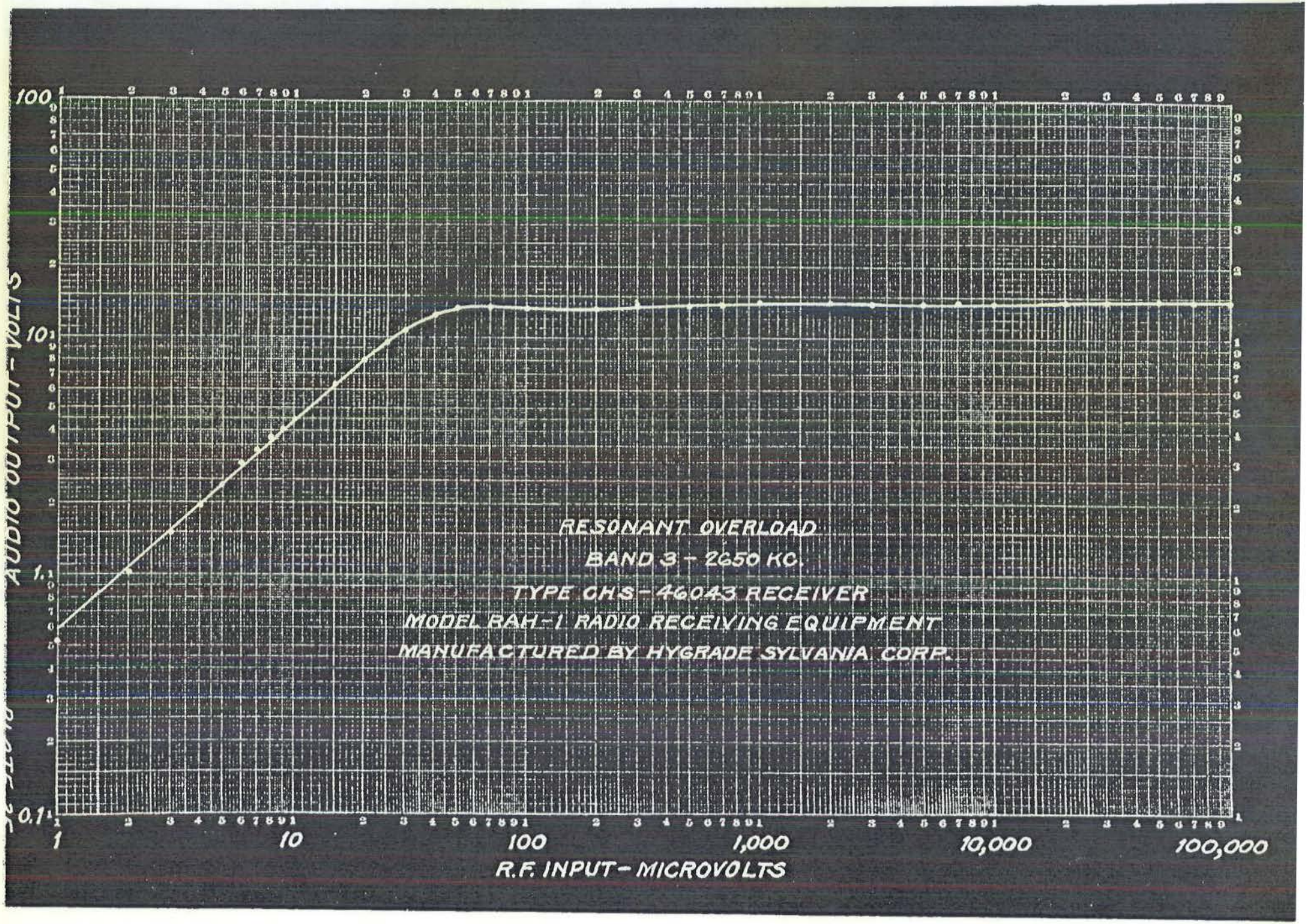
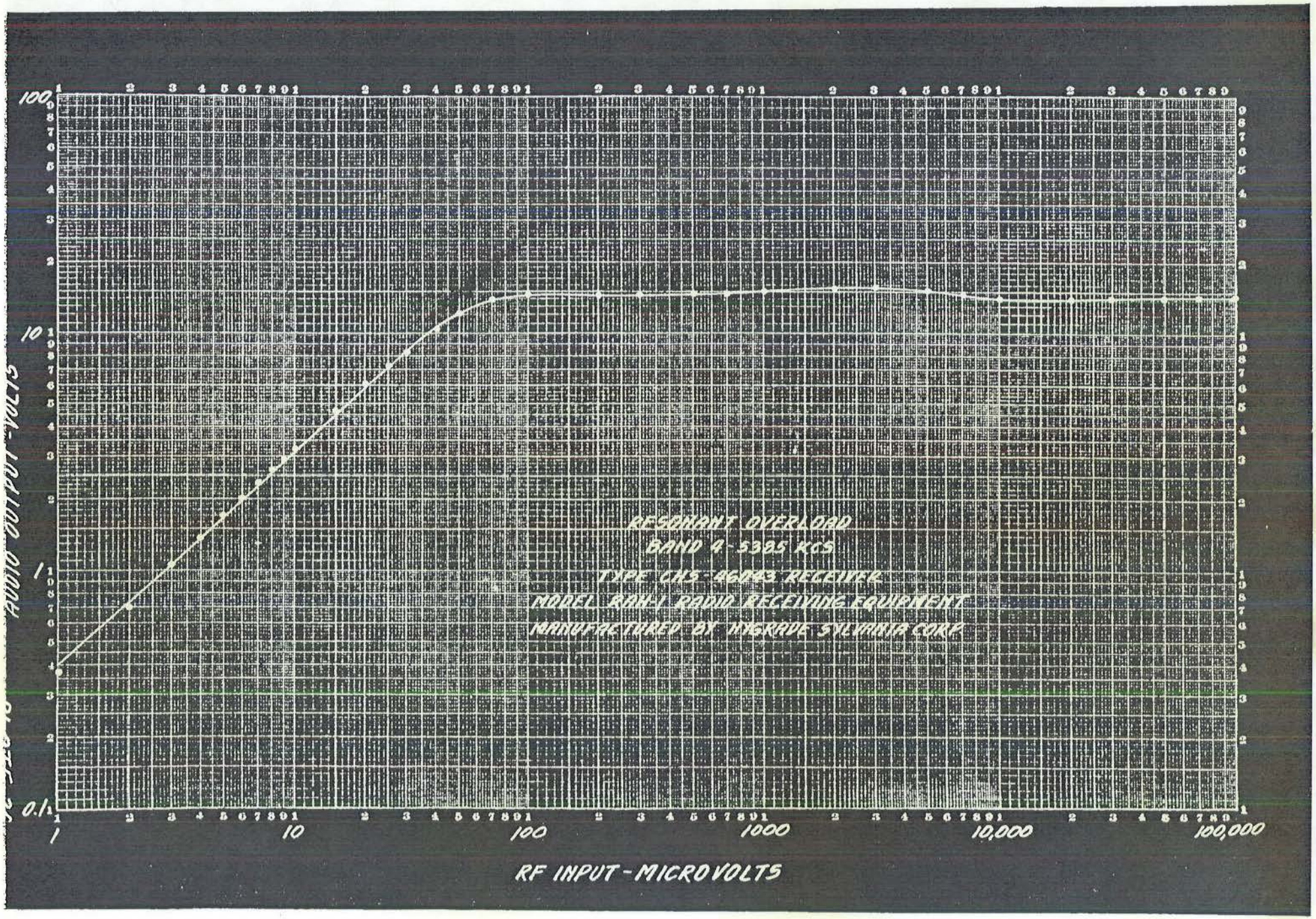

SELECTIVITY-TYPE 46043 RECEIVER
MODEL RAK-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY HOWARD SYLVANIA CORP.
BAND 7
OPTIMUM GAIN
ANTENNA TRIMMER OPTIMUM
10,000
1,000
100
10
1
TIMES RESONANT INPUT
5 4 3 2 1 -0+ 1 2 3 4 5
PERCENT OFF RESONANCE

PLATE 32


RESONANT OVERLOAD
BAND 1-620 KCS
TYPE CHS-46043 RECEIVER
MODEL RAH-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY HYGRADE SYLVANIA CORP.
RADIO OUTPUT VOLTS
100
10
1
0.1
1
10
100
1000
10,000
100,000
RF INPUT-MICROVOLTS


RESONANT OVERLOAD
BAND 2 - 1250 KC.
TYPE CHS-46043 RECEIVER
MODEL RAN-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY HYGRADE SYLVANIA CORP.
100
10
1.
0.1
1
10
100
1,000
10,000
100,000
R.F. INPUT-MICROVOLTS


AUDIO OUTPUT - VOLTS
100
10
1.1
0.1
1
10
100
1,000
10,000
100,000
R.F. INPUT - MICROVOLTS
RESONANT OVERLOAD
BAND 3 - 2650 KC.
TYPE CHS - 46043 RECEIVER
MODEL RAH-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY HYGRADE SYLVANIA CORP.


RESONANT OVERLOAD
BAND 4 - 5305 KCS
TYPE CHS-46043 RECEIVER
MODEL RAK-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY HYGRADE SYLVANIA CORP.
RF INPUT - MICROVOLTS
1
10
100
1000
10,000
100,000
0.1
1
10
100

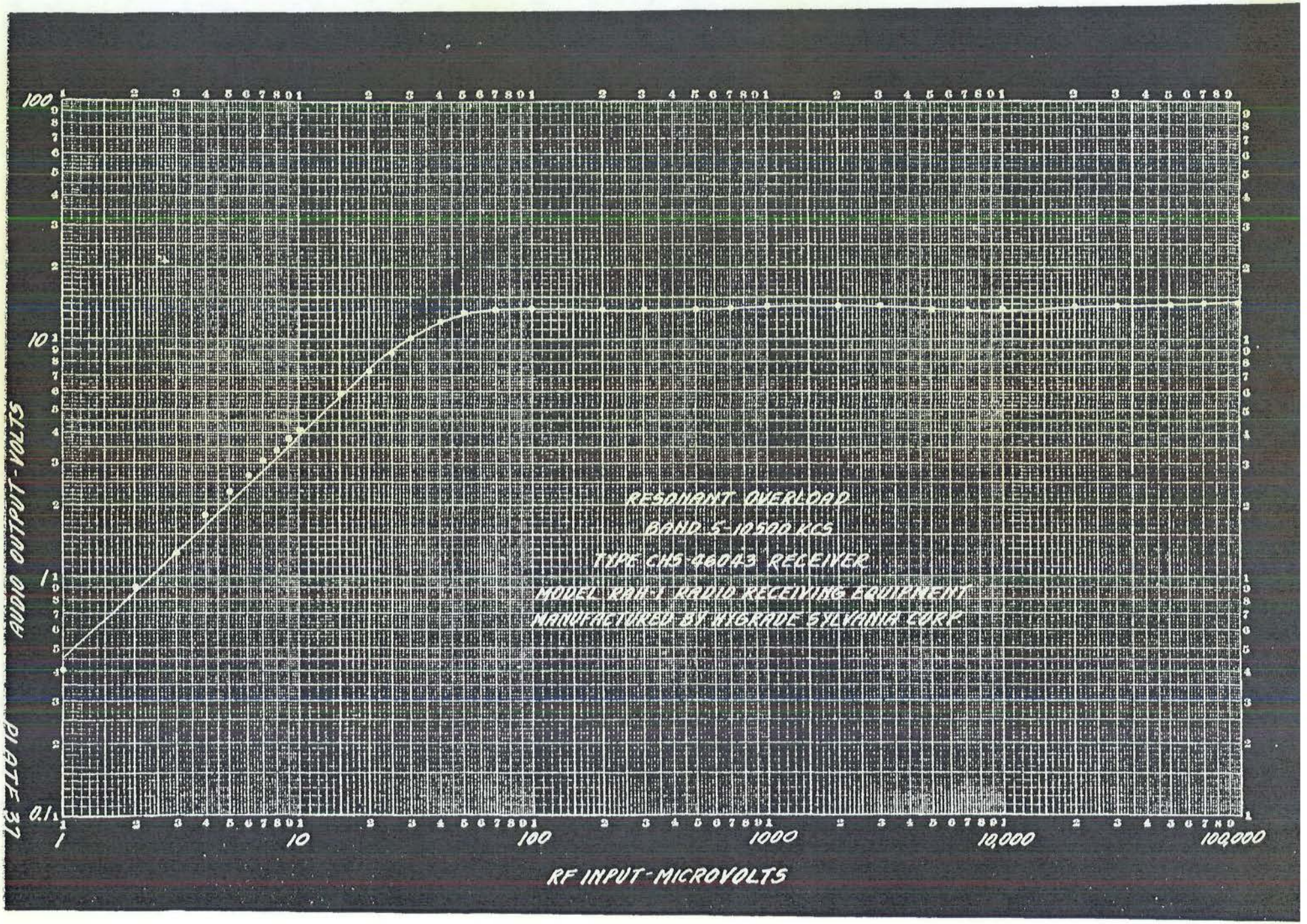
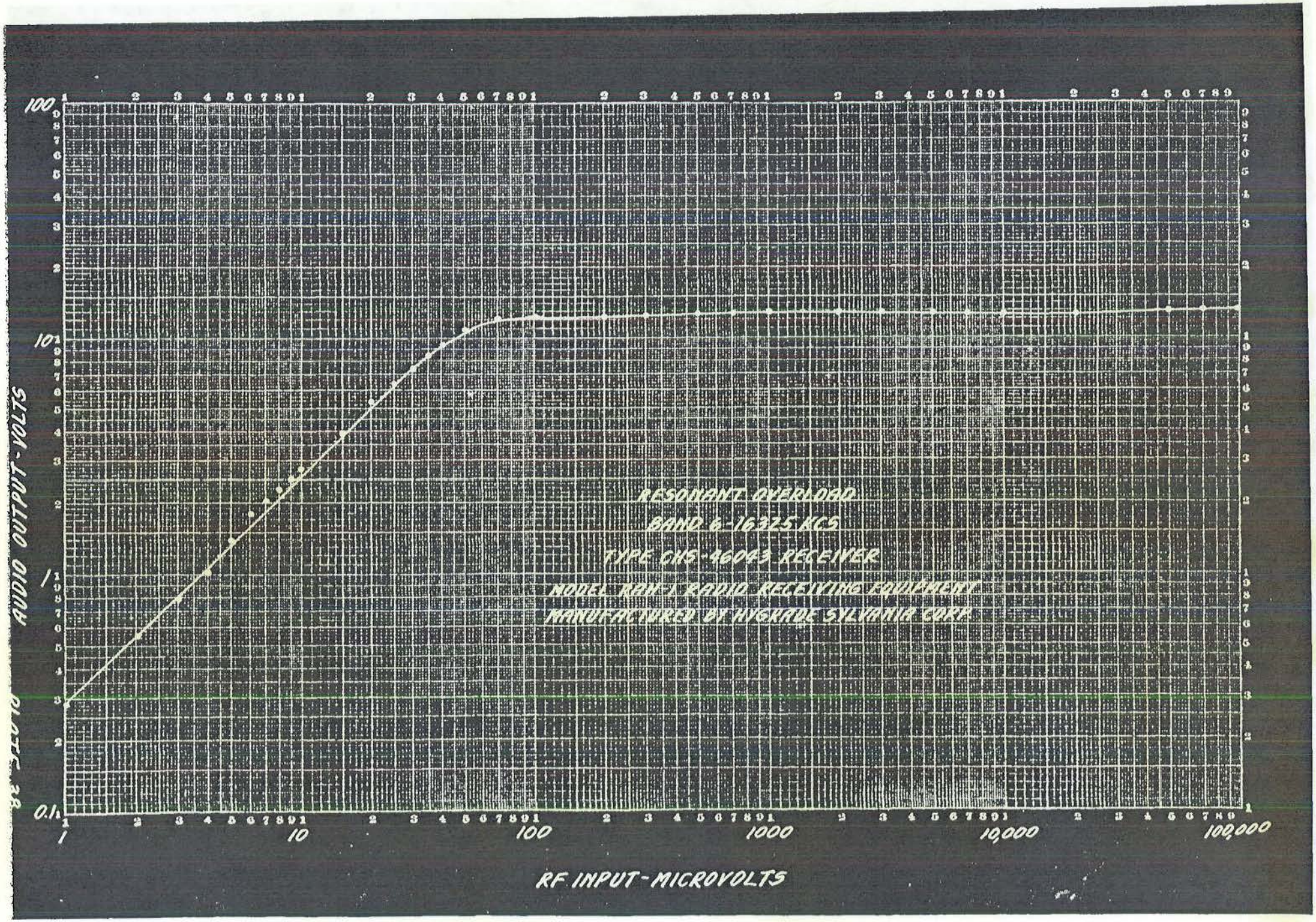
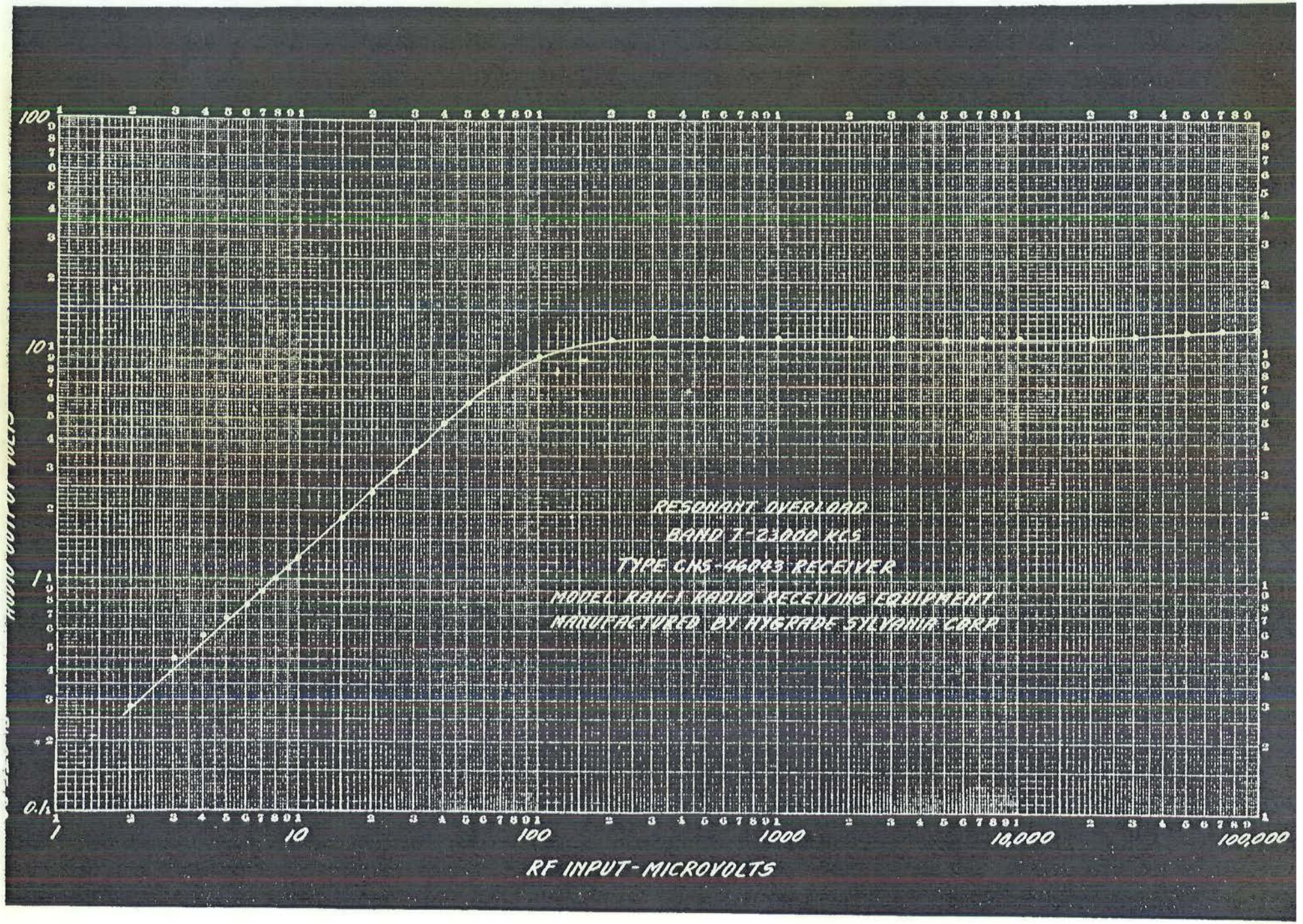

RESONANT OVERLOAD
BAND 5-10500 KCS
TYPE CHS-46043 RECEIVER
MODEL RAH-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY HYGRADE SYLVANIA CORP
AUDIO OUTPUT-VOLTS
RF INPUT-MICROVOLTS
100
10
1
0.1
1
10
100
1000
10,000
100,000

PLATE 37


AUDIO OUTPUT - VOLTS
RF INPUT - MICROVOLTS
1
10
100
1000
10,000
100,000
0.1
1
10
100
RESONANT OVERLOAD
BAND 6 - 16325 KCS
TYPE CHS-46043 RECEIVER
MODEL RAK-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY HYGRADE SYLVANIA CORP.


RESONANT OVERLOAD
BAND 1 - 23000 KCS
TYPE CNS-46043 RECEIVER
MODEL RAH-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY HYGRADE SYLVANIA CORP.
RADIO OUTPUT VOLTS
RF INPUT - MICROVOLTS
100
10
1
0.1
1
10
100
1000
10,000
100,000

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BELLEVUE, D. C.

DATE

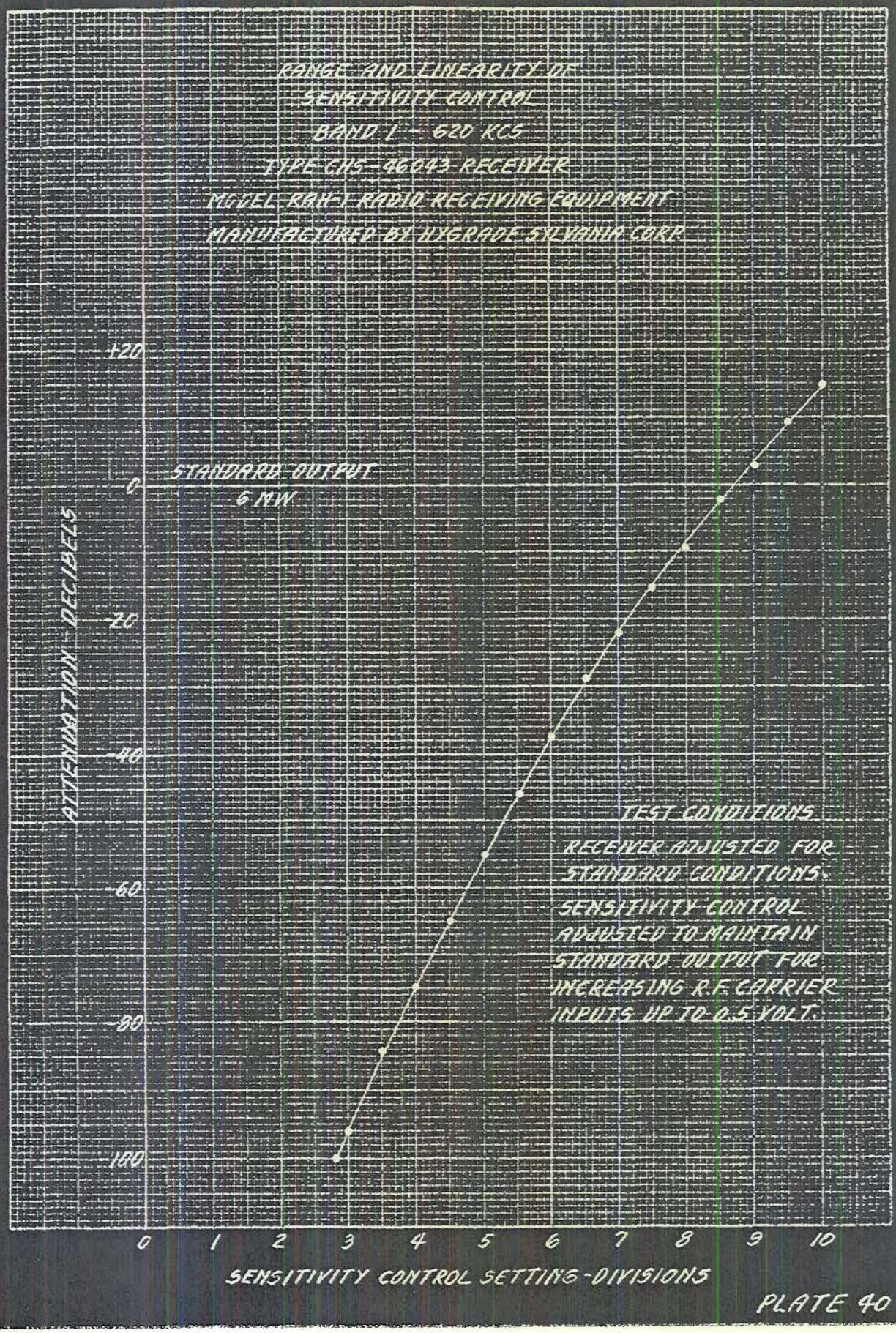

PLATE 40

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DATE

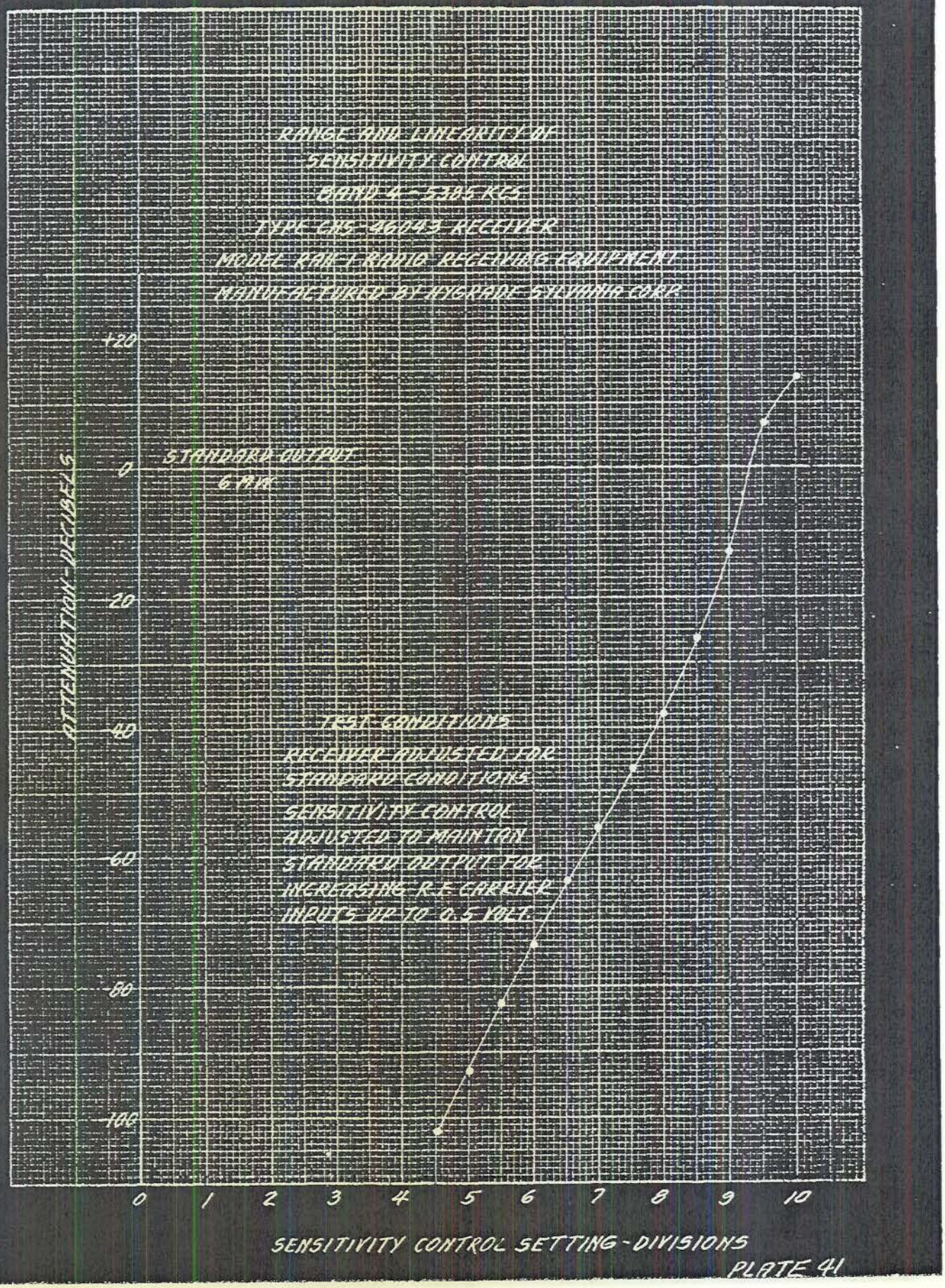

PLATE 41

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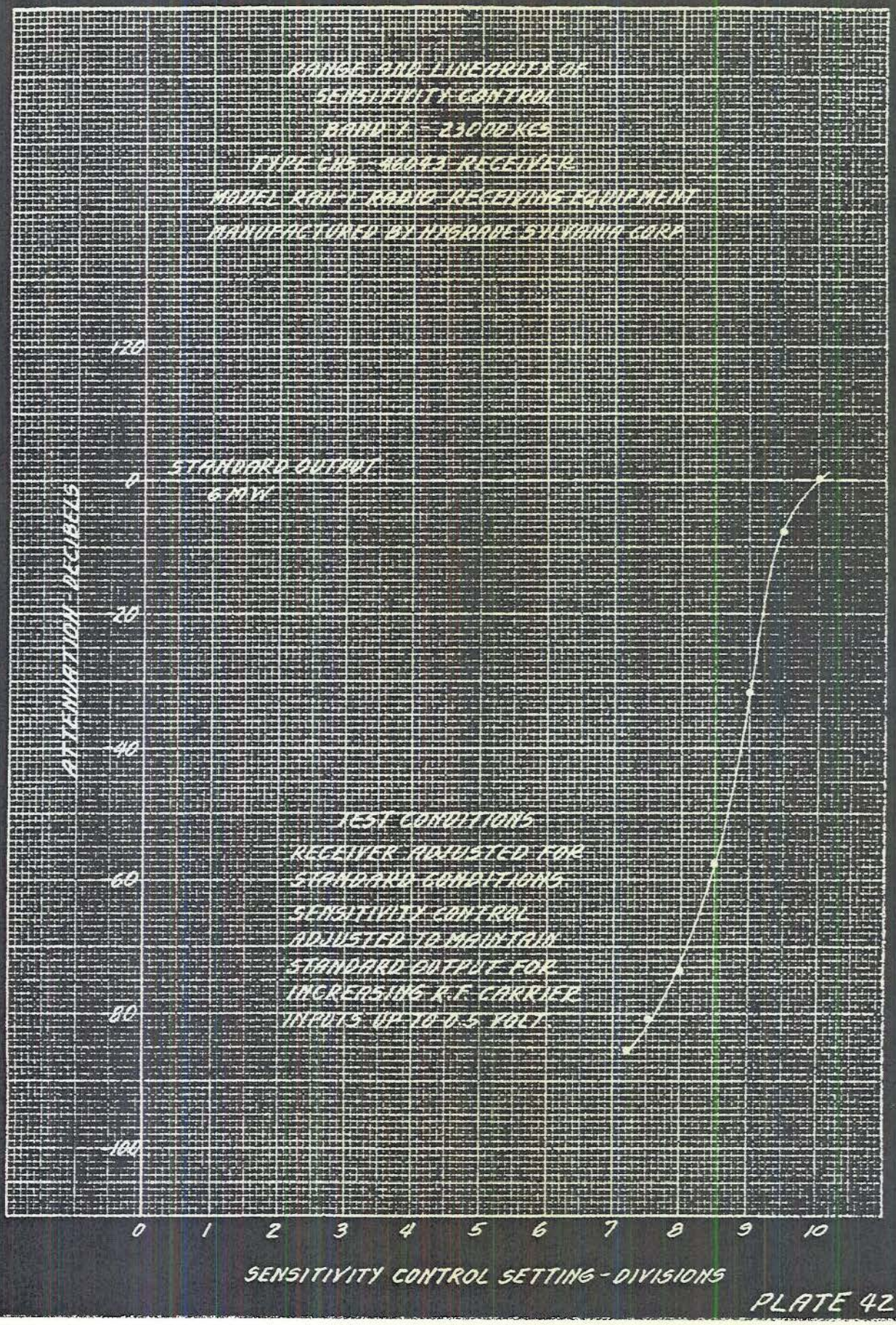

PLATE 42

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DATE

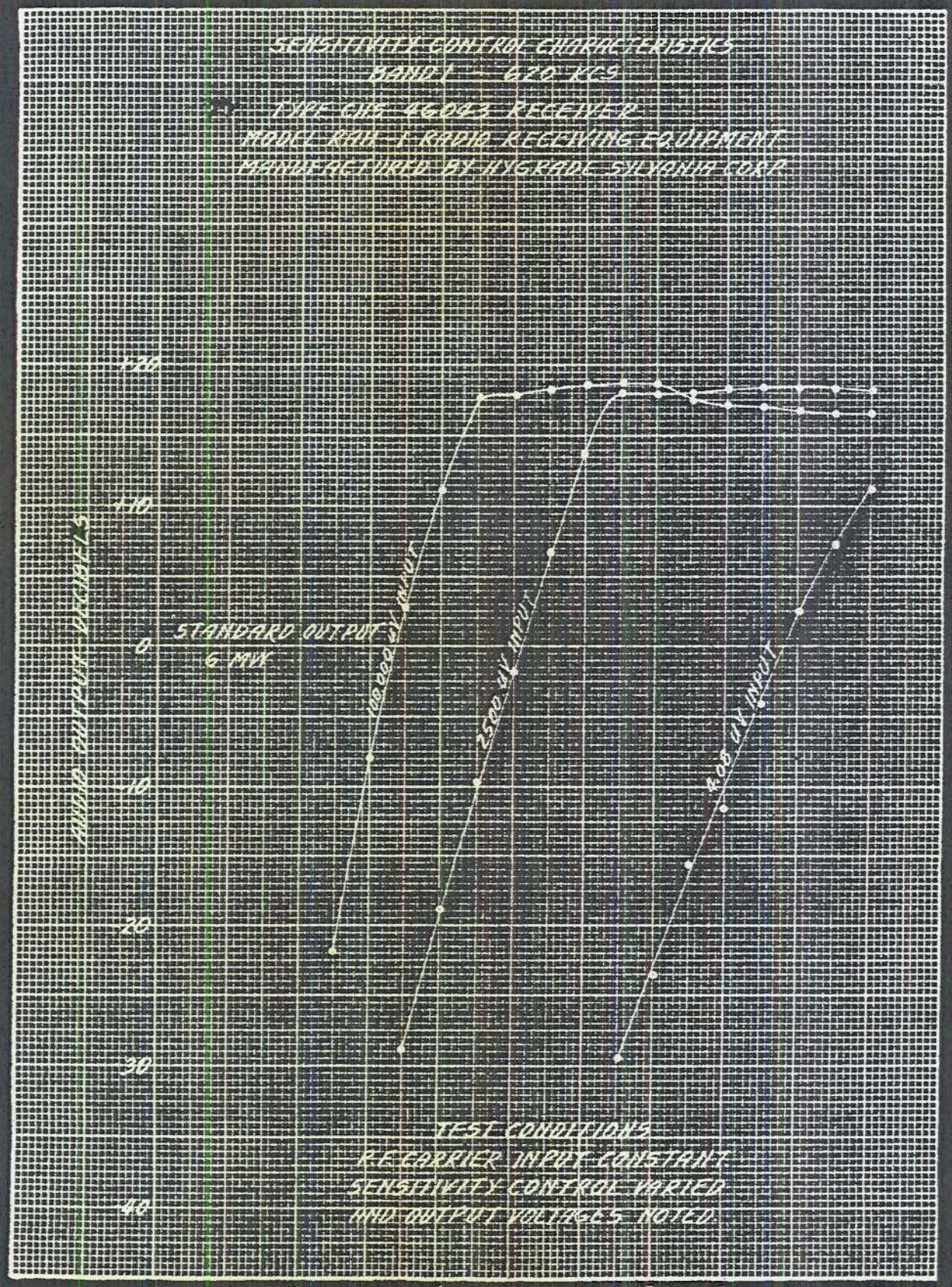

PLATE 43

U. S. NAVAL RESEARCH LABORATORY
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DATE

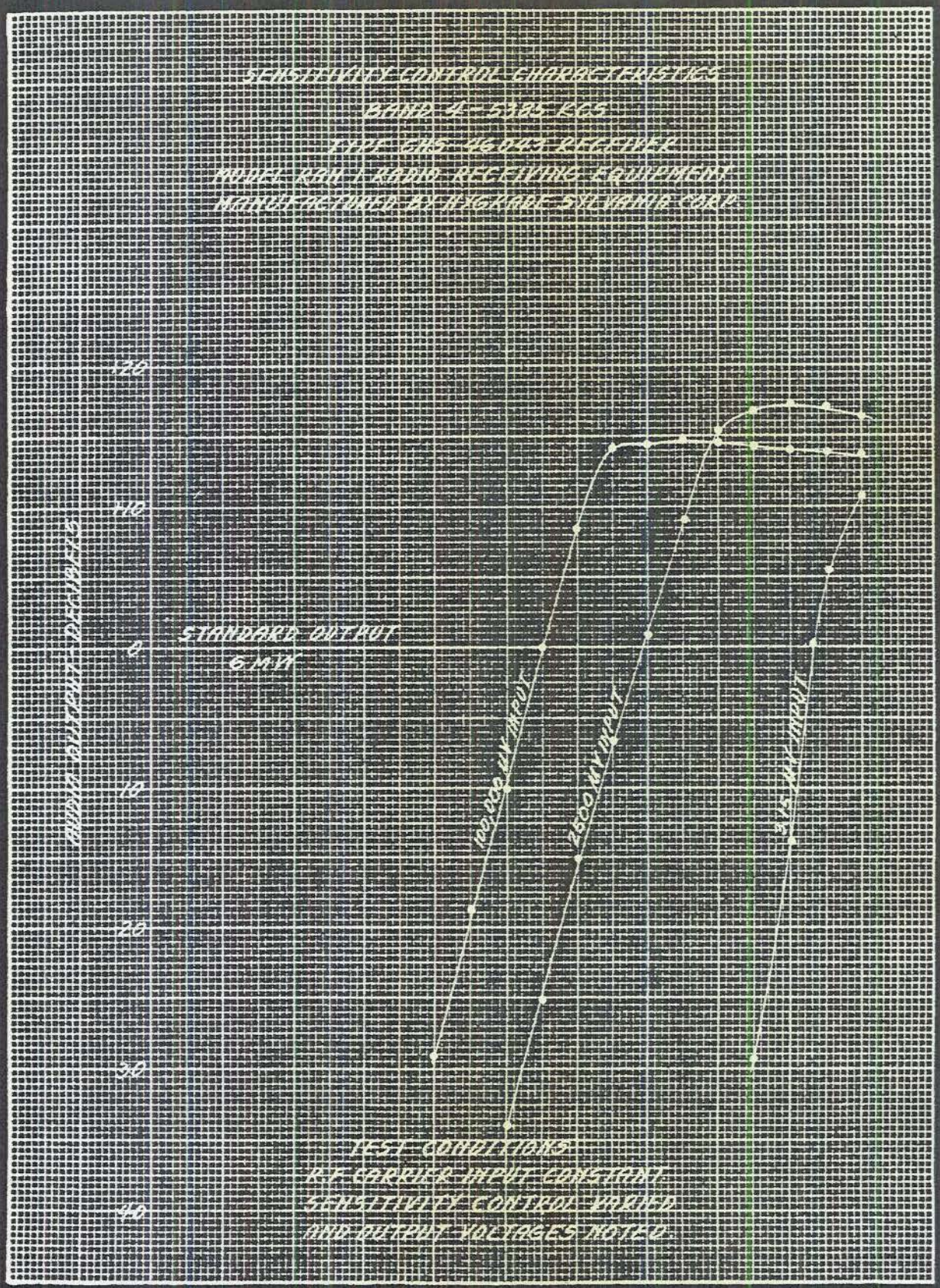

PLATE 44

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DATE

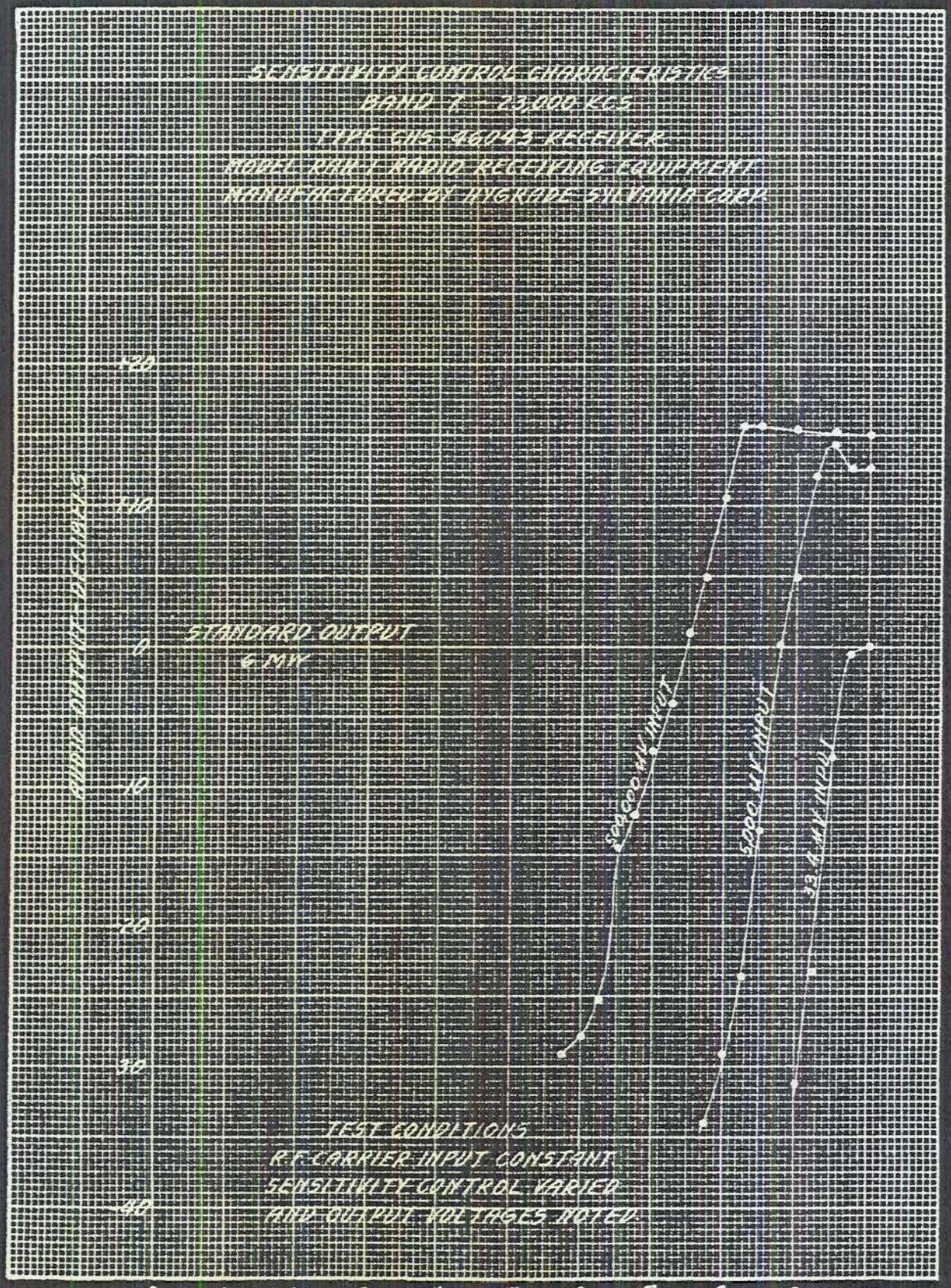


PLATE 45

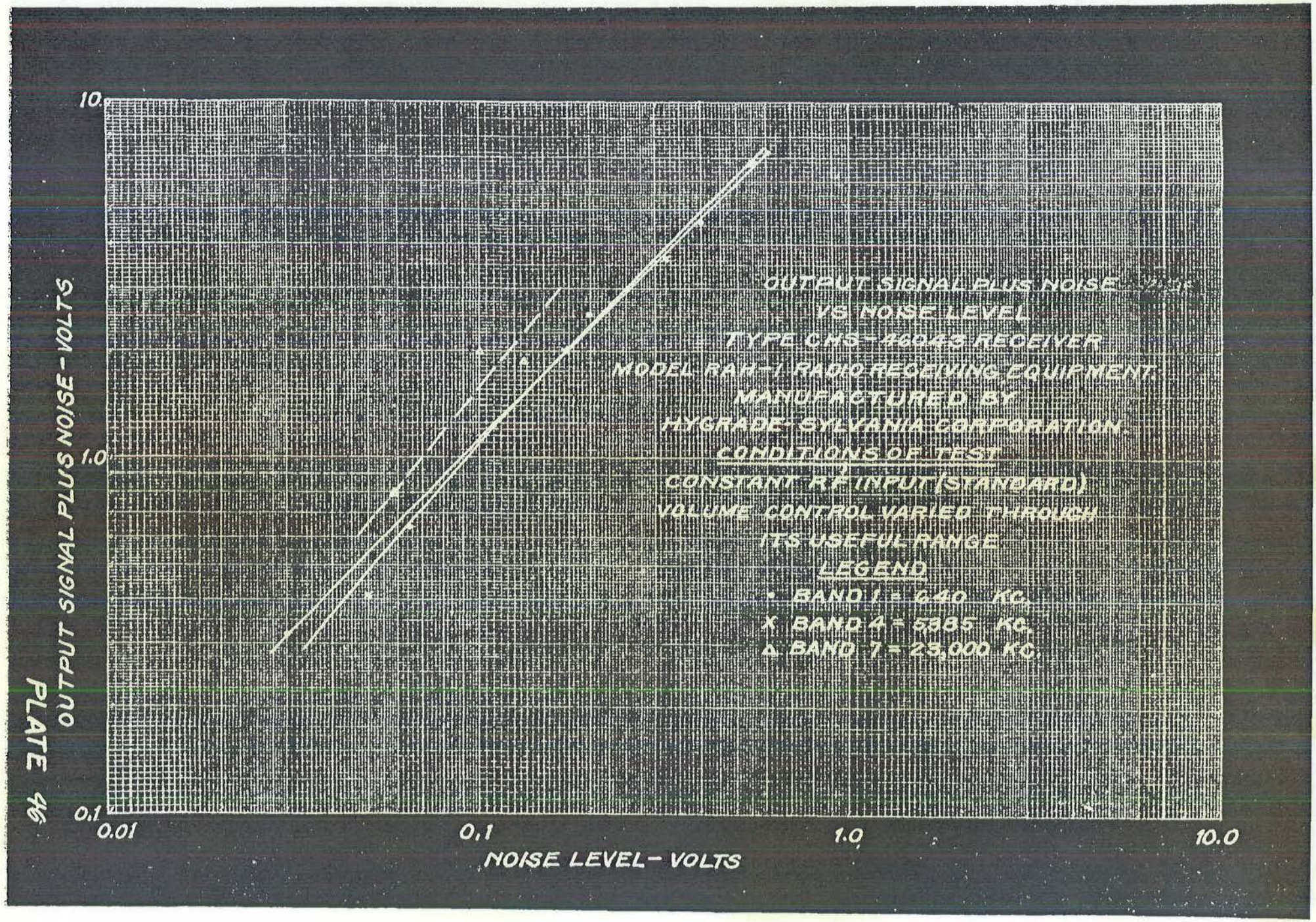

OUTPUT SIGNAL PLUS NOISE - VOLTS
10.
1.0
0.1
0.01
0.1
1.0
10.0
NOISE LEVEL - VOLTS
OUTPUT SIGNAL PLUS NOISE - VOLTS
VS. NOISE LEVEL
TYPE CMS-46043 RECEIVER
MODEL RAT-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY
HYGRADE SYLVANIA CORPORATION
CONDITIONS OF TEST
CONSTANT R.F. INPUT (STANDARD)
VOLUME CONTROL VARIED THROUGH
ITS USEFUL RANGE
LEGEND
• BAND 1 = 2.40 KC.
X BAND 4 = 5385 KC.
Δ BAND 7 = 23,000 KC.

PLATE 46

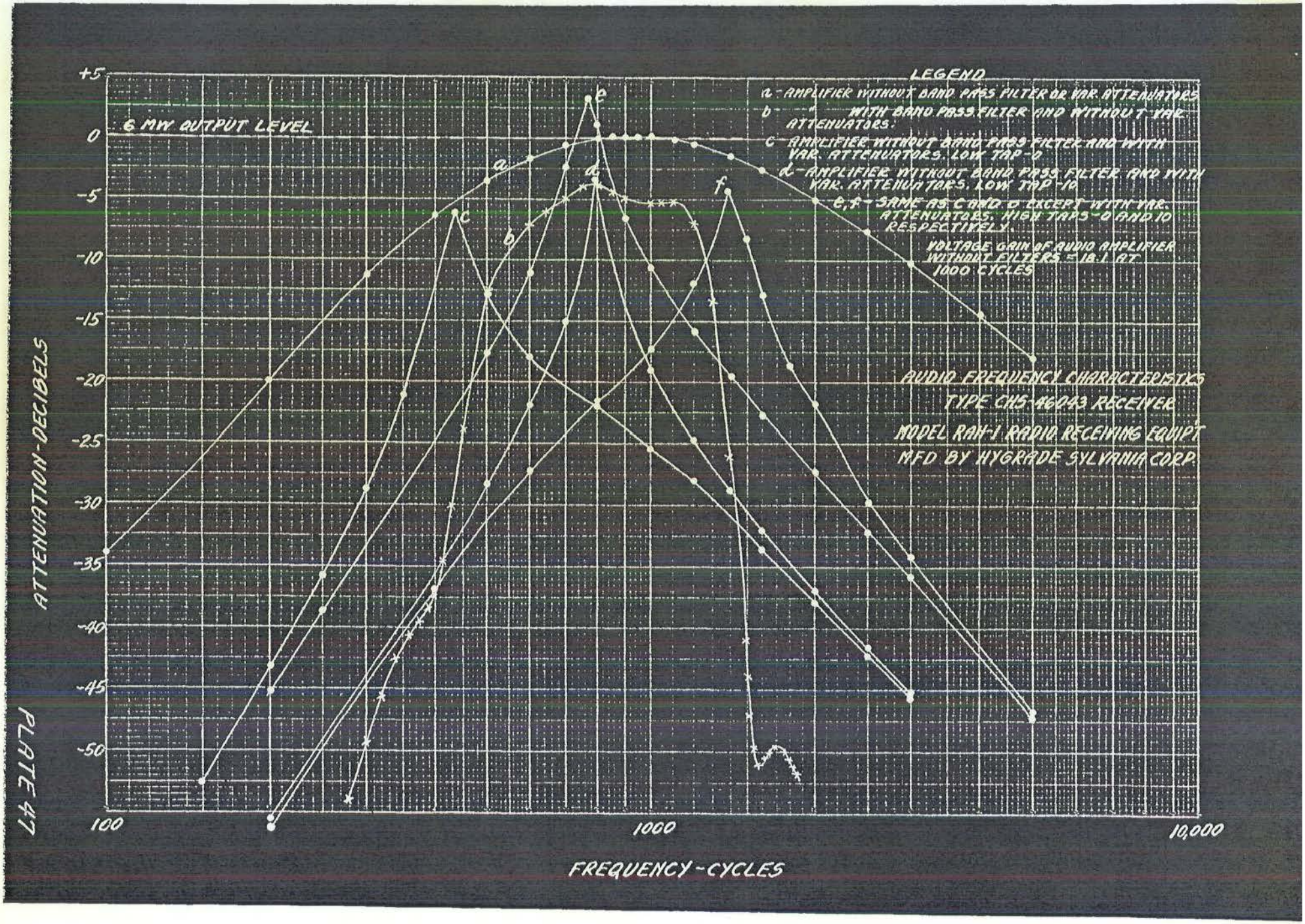

LEGEND
a - AMPLIFIER WITHOUT BAND PASS FILTER OR VAR. ATTENUATORS
b - " WITH BAND PASS FILTER AND WITHOUT VAR. ATTENUATORS.
c - AMPLIFIER WITHOUT BAND PASS FILTER AND WITH VAR. ATTENUATORS. LOW TAP-0
d - AMPLIFIER WITHOUT BAND PASS FILTER AND WITH VAR. ATTENUATORS. LOW TAP-10
e, f - SAME AS C AND D EXCEPT WITH VAR. ATTENUATORS. HIGH TAPS-0 AND 10 RESPECTIVELY.
VOLTAGE GAIN OF AUDIO AMPLIFIER WITHOUT FILTERS = 18.1 AT 1000 CYCLES
6 MW OUTPUT LEVEL
AUDIO FREQUENCY CHARACTERISTICS
TYPE CHS-46043 RECEIVER
MODEL RAH-1 RADIO RECEIVING EQUIPT
MFD BY HYGRADE SYLVANIA CORP.
+5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
ATTENUATION-DECIBELS
100
1000
10,000
FREQUENCY-CYCLES
a
b
c
d
e
f

PLATE 47

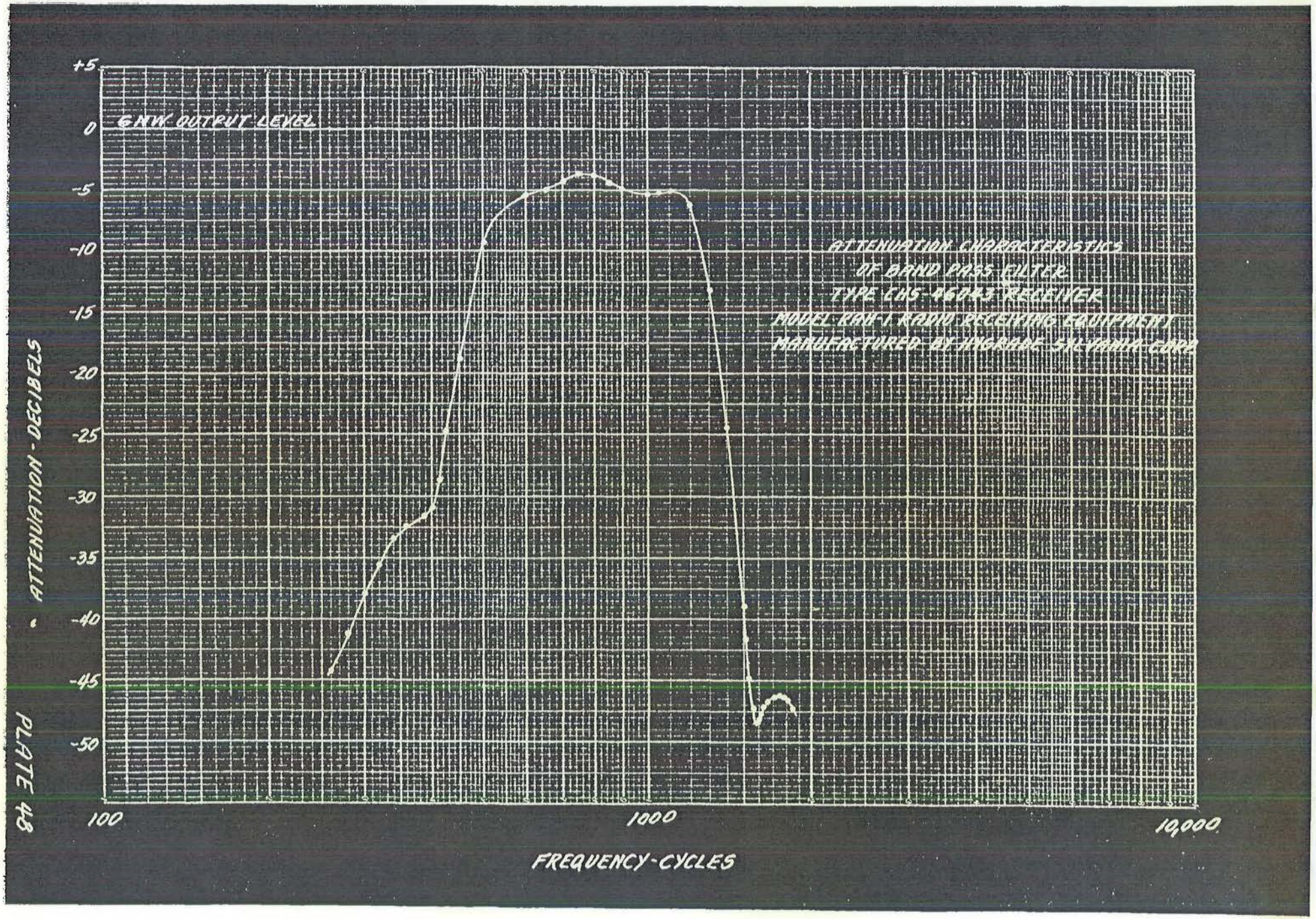
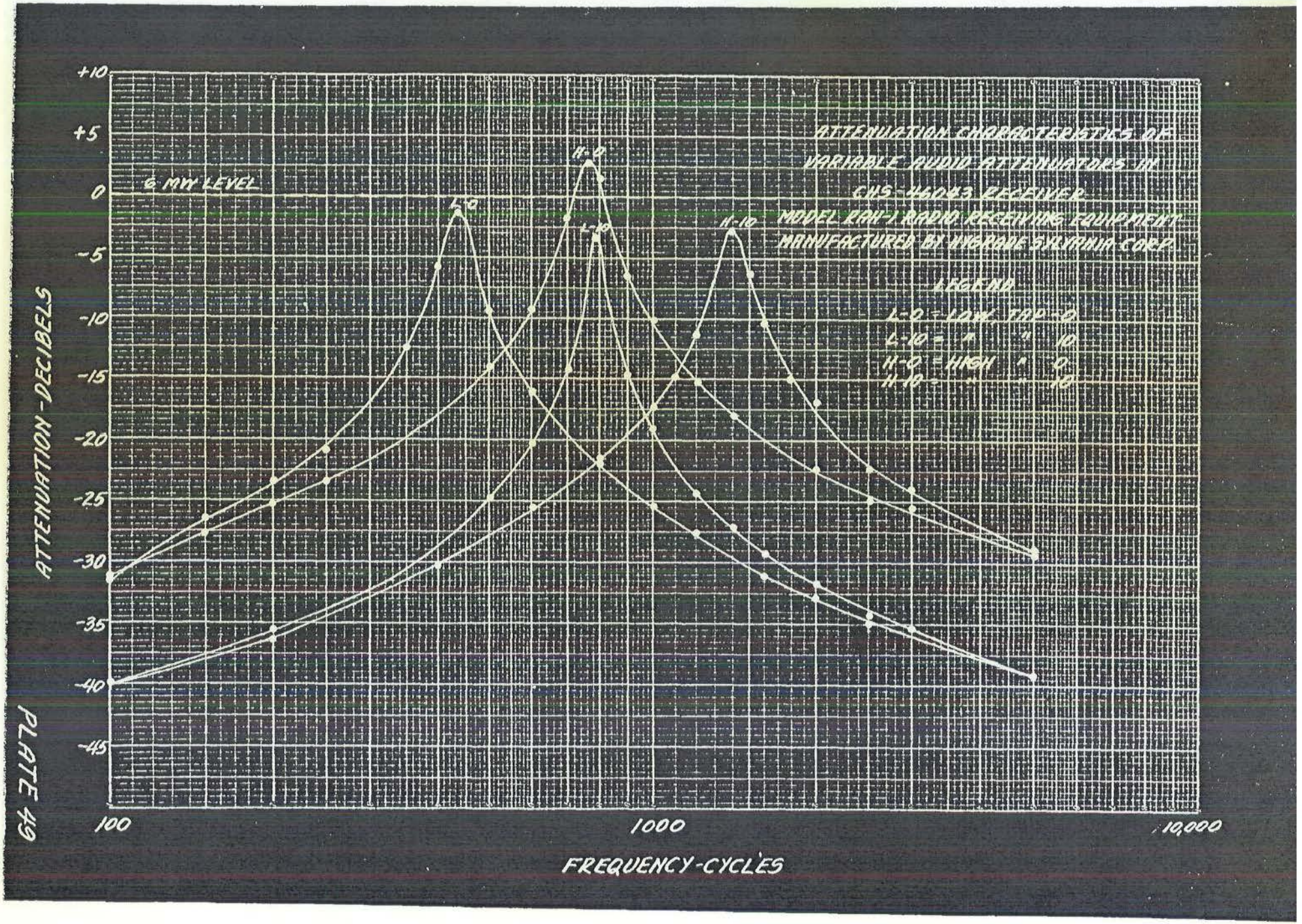

+5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
6 MW OUTPUT LEVEL
ATTENUATION - DECIBELS
100
1000
10,000
FREQUENCY - CYCLES
ATTENUATION CHARACTERISTICS
OF BAND PASS FILTER
TYPE CHS-46043 RECEIVER
MODEL RAH-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY INGRAHAM SYLVANIA CORP.

PLATE 48


ATTENUATION CHARACTERISTICS OF
VARIABLE AUDIO ATTENUATORS IN
CHS-46043 RECEIVER
MODEL RAH-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY HYDRADE SYLVANIA CORP.
L-0 = LOW TAP-0
L-10 = " " 10
H-0 = HIGH " 0
H-10 = " " 10
6 MW LEVEL
+10
+5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
ATTENUATION-DECIBELS
100
1000
10,000
FREQUENCY-CYCLES
PLATE 49

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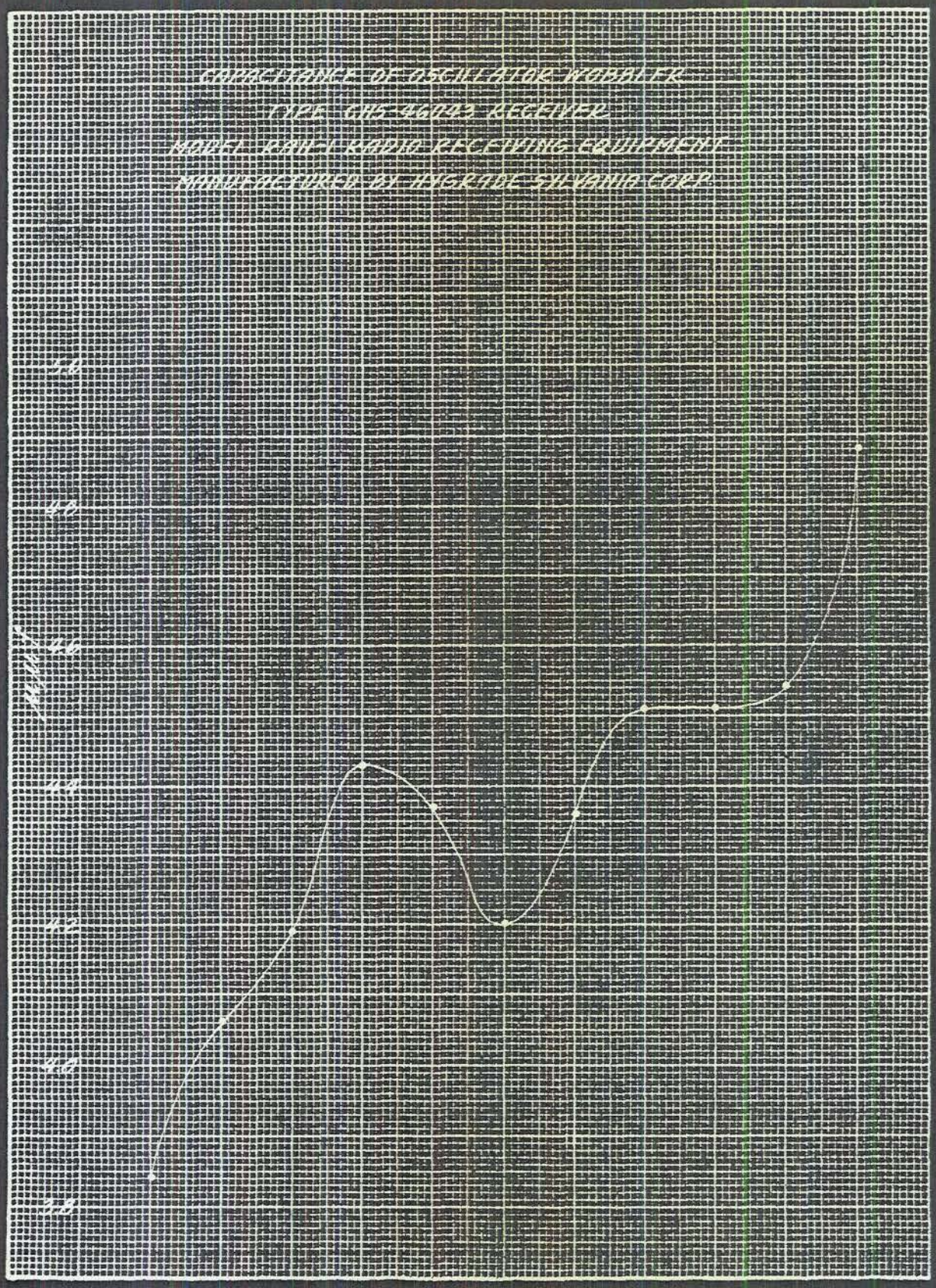
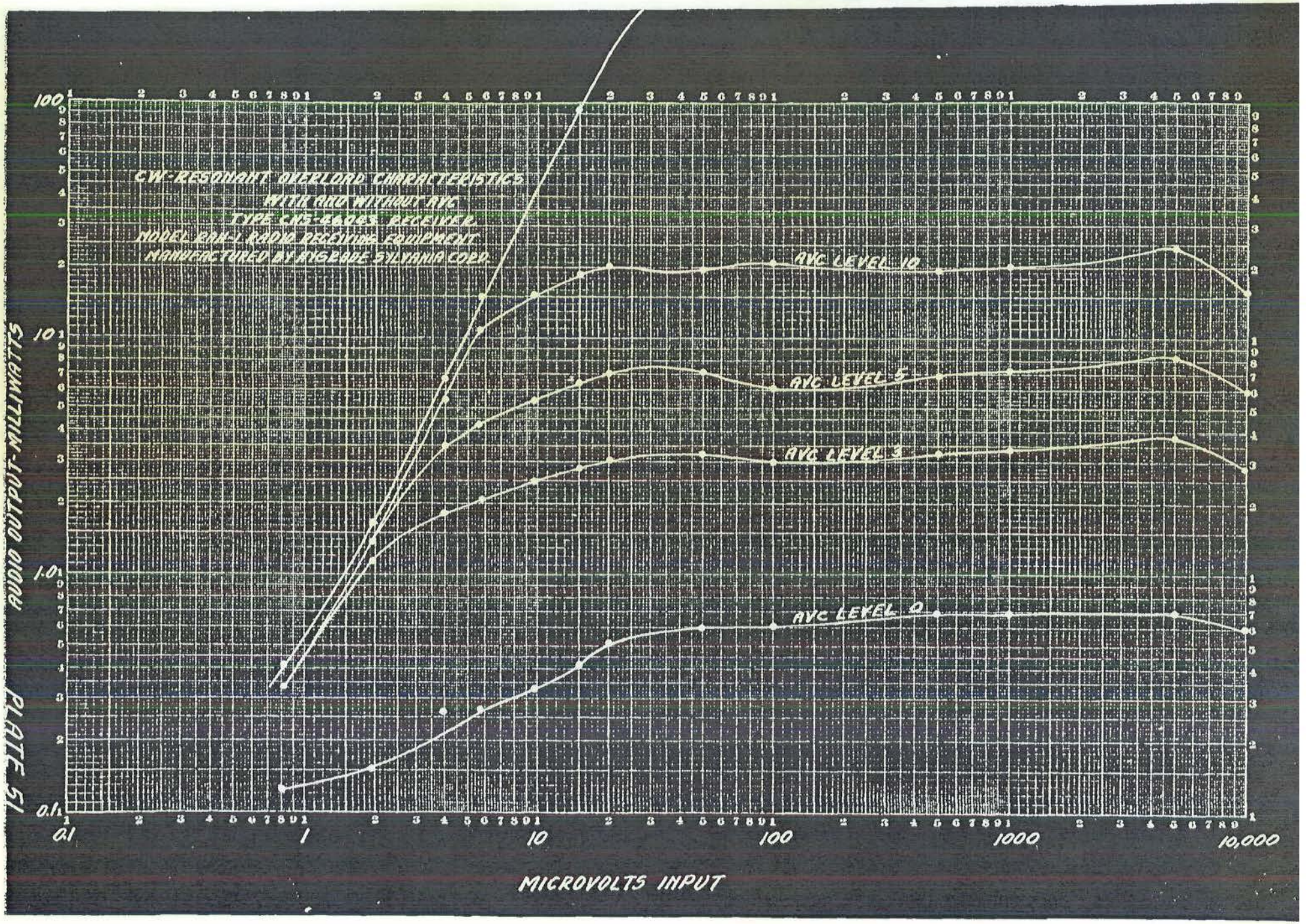


PLATE 50


CW-RESONANT OVERLOAD CHARACTERISTICS
WITH AND WITHOUT AVC
TYPE CNR-4A0CS RECEIVER
MODEL 8001 RADIO DIRECTION EQUIPMENT
MANUFACTURED BY ANSLEY SYLVANIA CORP.
AVC LEVEL 10
AVC LEVEL 5
AVC LEVEL 3
AVC LEVEL 0
AUDIO OUTPUT-MILLIWATTS
PLATE 51
MICROVOLTS INPUT
0.1
1
10
100
1000
10,000

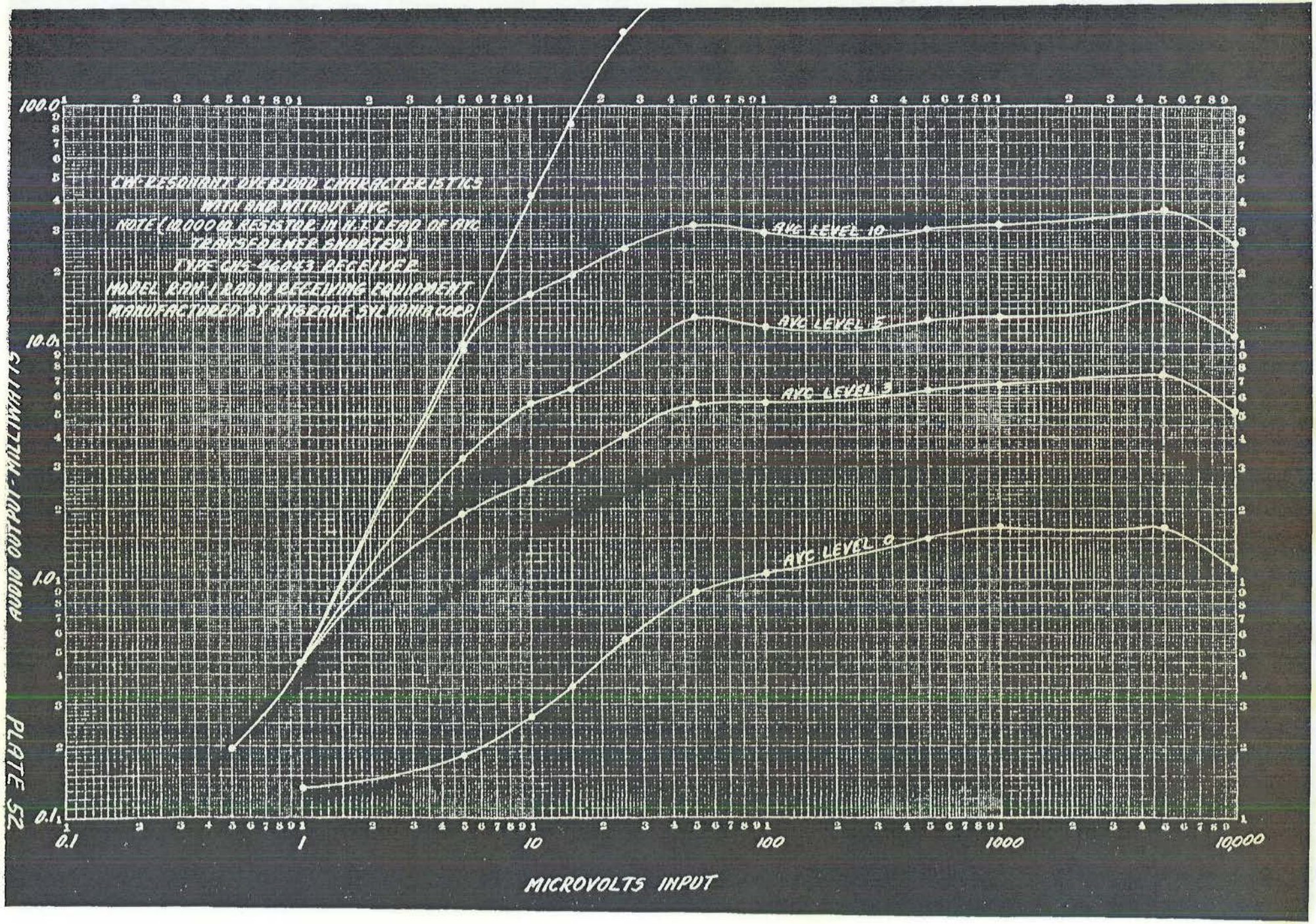

CAC RESONANT CIRCUIT OVERLOAD CHARACTERISTICS
WITH AND WITHOUT AVC
NOTE (10,000Ω RESISTOR IN H.T. LEAD OF AVC TRANSFORMER SHORTED)
TYPE CRS-4 (464) RECEIVER
MODEL RAW-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY ATLANTA, GA.
AVC LEVEL 10
AVC LEVEL 5
AVC LEVEL 3
AVC LEVEL 0
OUTPUT-MILLIWATTS
MICROVOLTS INPUT
0.1
1
10
100
1000
10,000
100.0
10.0
1.0
0.1

PLATE 52

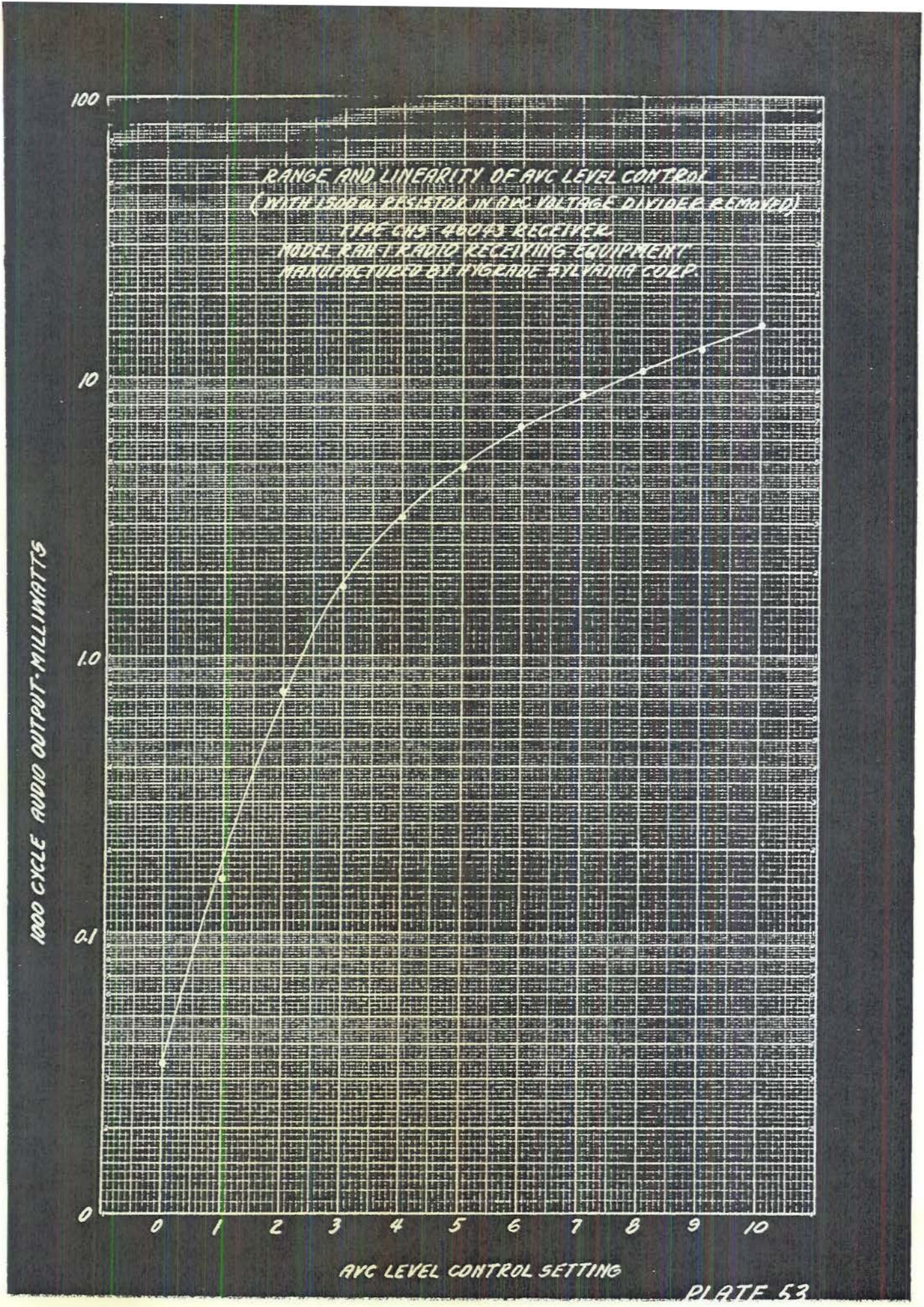

RANGE AND LINEARITY OF AVC LEVEL CONTROL
(WITH 150Ω Ω RESISTOR IN AVC VOLTAGE DIVIDER REMOVED)
TYPE CHS-46043 RECEIVER
MODEL RAK-1 RADIO RECEIVING EQUIPMENT
MANUFACTURED BY SYLVANIA CORP.
100
10
1.0
0.1
0
0 1 2 3 4 5 6 7 8 9 10
1000 CYCLE AUDIO OUTPUT-MILLIWATTS
AVC LEVEL CONTROL SETTING

PLATE 53