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REPORT NO. R-1581

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SUBJECT

Test of Model XRAS Radio Receiving Equipment

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BY

NAVAL RESEARCH LABORATORY

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NRL Report No. R-1581
Test of Model XRAS Radio Receiving Equipment

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NRL Report No. R-1581
BuEng. Problem R5-36C

NAVY DEPARTMENT

Report on

Test of Model XRAS Radio Receiving Equipment

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D. C.

[redacted]

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Authorization: BuEng let.C-NOs-66920(6-29-R6) of 5 July 1939.

Date of Test: 12 July to 15 September 1939.

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Appendices

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AUTHORIZATION OF TEST

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

Reference:
(a) BuEng let.C-NOs-66920 (6-29-R6) of 5 July 1939.
(b) Specification RE 13A 565A.
(c) Contract NOs-66920 (Restricted).
(d) G.E.Supply Corp. Descriptive Specifications dated 4 April 1939.
(e) G.E.Supply Corp. letter dated 10 July 1939 to NRL.

OBJECT OF TEST

2. The object of the tests was to determine first, compliance with the requirements of the governing specification, reference (b), and its amendments, as included under reference (c); second, the presence of desirable features over and above the specific requirements of the specification; and third, any objectionable features in this equipment which should either be corrected or avoided. A secondary feature of the tests authorized under reference (a); namely, that of determining the desirability of changing the coupling of the intermediate frequency transformers as to provide "nose width" selectivity commensurate with that provided in the standard commercial type "HRO" receiver, was not included in the tests covered in this report. These additional tests were omitted due to the fact that it was not considered advisable to disturb the initial adjustments of the intermediate frequency transformers in the model equipment until after it has been shown that this equipment, in its present status, complies in all respects to the requirements of references (b) and (c).

ABSTRACT OF TEST

3. The Model XRAS Radio Receiving Equipment was set up in the Laboratory and given a general inspection for mechanical construction and wiring. The electrical tests conducted to determine compliance with references (b) and (c) are given below.

(a) Calibration and band overlap.
(b) Sensitivity - MCW and CW operation.
(c) Maximum noise level - MCW and CW operation.
(d) Selectivity - MCW operation.
(e) Image selectivity - MCW and CW operation.
(f) Spurious response sensitivity - MCW operation.
(g) Overall electric fidelity.
(h) Resonant overload characteristics - MCW and CW operation.
(i) Electric undistorted power output - MCW and CW operation.
(j) Audio output with change in load impedance - phone and loud speaker outputs.
(k) AVC characteristics - MCW operation.
(l) Time constants for AVC operation.
(m) Output hum level.
(n) Range and linearity of r-f gain control - MCW and CW operation.

(o) Frequency stability with change in r-f gain control rating.
(p) Frequency stability with change in line voltage.
(q) R-F output from heterodyne oscillator.
(r) Variation in frequency with change in condenser dial rotation.
(s) Input impedance.

Conclusions

(a) The Model XRAS Radio Receiving Equipment is not demonstrative of strict compliance with the governing specifications, reference (b), as amended under reference (c). It displays certain defects in construction which are not generally considered acceptable for Naval Service. It possesses a quality of workmanship that is considered inferior to that normally expected of Naval equipment; and its overall performance is such as to definitely restrict its usefulness to the Service.

(b) The lack of ruggedness evident in its construction and the commercial practices employed in the construction and mounting of its components limit the use of the equipment to locations that are remote from gunfire shock, devoid of prolonged and severe vibration, where temperature variation is slight, and where failure of operation resulting from the corrosive action of humid saline atmospheres will not be of major importance. The workmanship is of commercial quality and is totally lacking of the refinements which are essential for trouble-free and reliable performance under adverse operating conditions frequently encountered in the Naval Service. The electrical performance is such that receiver blocking will occur for cw input signals of the same order as required for maximum output. This characteristic does not permit beat note reception of close-by stations with the same adjustments as for distant stations. In addition, the inferior quality of the shielding provided in the equipment adversely affects the operation, without overloading, in the presence of nearby transmitters which might be in operation.

(c) The Laboratory has covered in the summary of defects, as presented herein, those defects in design, construction, and performance which are not considered in compliance with the strict interpretation of the governing specifications and its contractual modifications, or in compliance with existing specifications normally applicable to Naval receiving equipments. However, in preparing its recommendations, the Laboratory has recognized the fact that the specifications, reference (b), were written with the intent of permitting acceptance of a modified commercial receiver. The Laboratory has therefore stressed in the first part of its recommendations, those items which are in need of improvement to assure reasonably satisfactory service for limited applications.

(d) This equipment, if modified to include the changes as noted under section "A" of the Recommendations, should be very satisfactory for the limited application as indicated above. It can then be employed to give creditable performance at shore stations, when not required to function in strong r.f. fields resulting from nearby transmitters and where power supply line voltage variation and vibration are not excessive. In general, it may be said that the subject equipment, with the recommended modifications, can be expected to give superior performance, from the service standpoint, to any of the commercially available receiving equipments, exclusive of those specifically designed for Naval specification compliance and available only at considerably greater cost.

[redacted]

(e) The Laboratory desires to emphasize that by comparison with the more recent types of receiving equipments now in the Naval Service and specifically designed for compliance with the usual Naval specifications for such equipment, the subject equipment, like any other commercially available receiving equipment designed for the amateur trade, is far less rugged, distinctly less reliable under adverse operating conditions, and is lacking in many of the refinements or features which years of experience and development have proven to be essential for satisfactory overall receiver performance. These design limitations consequently not only limit its usefulness in the Naval Service, but also preclude its use on shipboard where it will not give reliable performance when subjected to the shock of gun fire or vibration inherent with certain types of ships or speed of propulsion. The shielding integrity of the receiver is such that the receiver will be rendered useless when operated near high powered transmitting equipments. The use of plug-in coils as employed in the subject receiver is no longer recommended for receiving equipments designed for shore station or shipboard installations owing to their inherent disadvantages as compared with the present day development of band switching which has been proven to be more reliable and which permits the use of self-contained coil systems which will maintain their alignment over longer periods of time, and where their possible damage is relatively remote.

[redacted]

Recommendations

Numerous deficiencies in design, construction, workmanship, and performance, as noted in the preliminary model of the subject equipment, are cited throughout the report, and specifically under paragraph 149. Recommendations for their correction are listed below under headings "A" and "B." Under "A" will be found recommendations for the modification or correction of existing deficiencies to effect compliance with the spirit and/or intent of the governing specifications, it being apparent that they were drawn up to permit acceptance of a modified commercial product. The modifications and corrections recommended under "B" together with the recommendations under "A" are considered necessary if the subject equipment is to comply with existing Navy general specifications, which, however, are not necessarily applicable under reference (c).

A. That the subject equipment may comply with the spirit and/or intent of the governing specifications, reference (b), amended under reference (c), it is recommended:

(a) That the design of the equipment be modified to permit its installation adjacent to or between equipments of identical or similar construction. Refer to paragraphs 42(A)(2) and 65(2).

(b) That by-pass capacitors of the tubular type, and fixed resistors of relatively large mass, be secured to the chassis by means of clamps and not depend entirely on their pigtail leads for support. Refer to paragraph 43(A)(1)(b).

(c) That component parts be so mounted as to preclude straddling of components and to permit the replacement of any component independent of other components. Refer to paragraphs 43(A)(1), 43(A)(2), and 43(A)(3).

(d) That all chassis mounted components be secured in place with machine screws and nuts, or spade bolts and nuts in lieu of rivets and welds. Refer to paragraphs 42(B)(1), 43(A)(2), 43(A)(3), and 43(A)(6).

(e) That self tapping screws be not employed for any item normally subject to replacement or opening for normal servicing. Refer to paragraphs 43(F) and 65.

(f) That corrosion resisting steel lock washers be employed under all nuts or heads of all screws screwed into tapped holes.

(g) That the power transformer and filter reactor in the Power Unit, head phone output transformer in the Receiver Unit, and coupling transformer for the Loud Speaker Units be potted in metallic enclosures fitted with terminal panels with soldering lug type terminals to facilitate wiring. The enclosures should be complete and the soldering of the coil leads to the soldering lugs should be such as to preclude entrance of moisture into their windings through the lead insulation from "wick" action. Refer to paragraphs 42(B)(1) and 62.

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(h) That the attachment of the pin terminals of the speaker input cables be such as to be supported by the lead insulation and not solely by the stranded wire of the leads to which they are soldered. Refer to paragraph 43(C)(1).

(i) That the soldering workmanship be considerably improved, with particular attention being paid to the amount of solder applied, and to the wrapping of the leads around the soldering lugs prior to the application of the solder. The soldering workmanship in the production equipments should be comparable with that normally considered acceptable for Naval equipments. Refer to paragraph 45.

(j) That the use of steel as employed in the model equipment for panels, chassis, dust covers, etc., be accepted in view of the permitted and actual use of steel for the mounting rack. Refer to paragraph 47.

(k) That metal clad, hermetically sealed, tubular type capacitors be employed in lieu of the cardboard clad, wax filled, capacitors as employed in the model equipment. Refer to paragraph 51.

(l) That Navy type numbers be marked on all parts, including vacuum tubes (but excluding small fixed resistors and molded mica capacitors, which should be color coded), in compliance with references (b) and (c). Refer to paragraph 54.

(m) That all joints in the wiring of radio frequency circuits and where such wiring connects to component items be thoroughly soldered, except where connections to steel or aluminum are involved; that in these instances, suitable lugs be employed and be secured to the members with screws, and/or nuts and lock washers: this recommendation excepts swedged joints such as are employed in variable capacitors. Refer to paragraph 56.

(n) That insulating grommets be employed where any wiring passes through metal shields, partitions, shield cans, etc.

(o) That color coded wire be employed in the wiring of the Receiver and Power Units, and that this coding be consistent with RMA standards. Refer to paragraph 59.

(p) That only flexible wire with rubber or asbestos insulation be employed in the Power Unit. Refer to paragraph 60.

(q) That ceramic tube sockets be employed for all tubes in radio frequency circuits, including i-f circuits, in compliance with the governing specifications. Refer to paragraph 61.

(r) That the lacquer or enamel finish employed for the rear surfaces of panels, internal and external surfaces of the dust cover, etc., be consistent in gloss and texture; that the finish applied to the components and chassis of the Power Unit be consistent with the gray finish employed for the Receiver Unit; that steel panels, chassis, dust covers, etc., be copper plated prior to the application of the final finish. Refer to paragraph 64.

(s) That spade bolts having dual mounting holes be employed for securing the dust covers of the Receiver and Power Units to their respective front panels. Refer to paragraph 65.

(t) That the use of four in lieu of five-sided dust shields be considered satisfactory where the fifth side,and complete enclosure, is is provided by the chassis of the unit involved. Refer to paragraph 65.

(u) That the existing dimensions and weights of the component units of this equipment be approved, as their reduction will adversely affect the mechanics and appearance of the equipment. Refer to paragraphs 67 to 71, inclusive.

(v) That the hand grips provided on the front panel of the Receiver Unit be redesigned to permit full hand gripping, and be so mounted as to provide for more uniform balance for handling the receiver. Refer to paragraph 74.

(w) That clamping "dogs" be provided on the front panel on either side of the plug-in coil aperture in the front panel of the Receiver Unit to secure the plug-in coil sets, after their insertion, and preclude their movement under conditions of severe vibration. Refer to paragraph 74.

(x) That the "OFF" positions of all panel-operated toggle switches be consistent with RMA standards. Refer to paragraph 75.

(y) That the use of one stage of audio amplification be approved. Refer to paragraph 76.

(z) That the "B" power supply consumption of 260 volts at 70 milliamperes be considered satisfactory for an a-c supply voltage of 115 volts applied to the input of the Power Unit, in view of the specification requirements for overall performance. Refer to paragraphs 78 and 112.

(aa) That the low voltage supply for filament and/or heater circuits be increased to provide 6.3 volts at the tube sockets, under conditions of full load, for an a-c supply voltage of 115 volts applied to the input of the Power Unit, in compliance with the contract. Refer to paragraph 78.

(bb) That the low frequency end of Band 1 cover 190 kilocycles with a nominal safety factor. Refer to paragraphs 40 and 79.

(cc) That the contact buttons on the plug-in coil assemblies and the spring wiper fingers in the receiver, with which they mate, be provided with silver facings with a finished thickness of not less than .015 inch. Refer to paragraph 81.

(dd) That nameplates be provided on the face plates of the plug-in coil assemblies which shall contain, in addition to Navy type numbers, and in reasonably large characters, the working frequency ranges and the plug-in coil set numbers. It is further recommended that the numbering of the coil sets should be progressively from 1 to 7, with Band 1 being that one covering the lowest frequency range. Refer to paragraph 82.

(ee) That a maximum frequency ratio per band of 2.5 to 1 be accepted in view of the effective length of tuning scale provided in the subject equipment. However, it is not recommended that the specification reference be changed for future equipments, since increasing the allowable band ratio may result in the acceptance of equipments providing less ease in channel separation than is provided in the subject equipment. Refer to paragraph 84.

(ff) That consideration be given to the acceptance of the commercial type 6F8G and 6V6G vacuum tubes in lieu of commercial types 6B7 and 42 vacuum tubes, respectively, in view of their superior characteristics for their particular applications in the model receiver. Refer to paragraph 92.

(gg) That the input impedances of the model receiver be considered as satisfactory in view of the arbitrary grouping of the bands for impedance limits, without regard to frequency, as set forth in the specifications; and to the fact that those impedances which do not comply with the specification limits are not very far outside the limiting values in spite of their approximations. Refer to paragraph 95.

(hh) That radio frequency coils be supported on ceramic, low loss phenolic or polystyrene forms; that all universal wound coils be hot and cold wax dipped, and that all layer wound coils be coated with polystyrene or equivalent. Refer to paragraph 93.

(ii) That the input impedance of the loud speaker input transformer, which substantially matches the output tube employed, be considered as satisfactory. Refer to paragraph 99.

(jj) That the magnitude of the plate current flowing through the primary winding of the output transformers be considered as satisfactory, in view of the recommended use of the commercial type 6V6G output tube, and the fact that excessive heating of the transformers is not incurred. Refer to paragraph 99.

(kk) That the line fuses in the Power Unit be so mounted as to permit their replacement without the removal of the rectifier tube, and without danger of shock, when the power ON-OFF switch is in the OFF position. Refer to paragraph 117.

(ll) That the construction of the Coil Rack Unit be such as to cause no interference in the free insertion or removal of the plug-in coil sets; that it positively secure the coil sets in place; that its cover be provided with more rugged hinges and a more positive catch; and that some means be incorporated to hold the cover open while the coils are being removed or replaced. Refer to paragraphs 119 and 120.

(mm) That the panel type Loud Speaker Unit be provided with a metal grill over the diaphragm opening as required by the governing specifications. Refer to paragraph 125.

(nn) That the clamping of the loud speaker interconnecting cable be such as to preclude the possibility of the terminal lugs on the coupling transformer, to which it is attached, being subjected to strain. Refer to paragraph 126.

[redacted]

(oo) That, in view of the fact that atmospheric conditions limit the useful sensitivity of any receiver operating in the frequency region of 200 kilocycles, an mcw sensitivity of 10 microvolts be considered satisfactory for Band 1. Refer to paragraph 131.

(pp) That the cw sensitivities be considerably improved to the extent of being at least equal to or better than their corresponding mcw sensitivities. Refer to paragraph 132.

(qq) That the band widths of the selectivity characteristics as demonstrated by the model equipment at the 6 decibel input levels be considered satisfactory, since they are as good as can be expected for this character of equipment with due consideration of all factors involved. The contract permits the limits of acceptance for band widths at 6 decibel levels to be based upon the actual band widths of the model receiver if their measured values prove to be satisfactory. However, it is further recommended that unsymmetrical selectivity characteristics resulting from "pulling" of the high frequency oscillator be made to approach approximate symmetry through appropriate changes in circuit constants. Refer to paragraph 133.

(rr) That, in view of the contractual change of intermediate frequency, consideration be given to the acceptance of image selectivities greater than 70 decibels for Bands 1, 2, and 3. Refer to paragraph 134.

(ss) That the production equipments comply with the specification requirements for spurious response sensitivities including direct reception of the intermediate frequency, harmonics of the cw oscillator, and harmonics of the signal frequency generated within overloaded r-f amplifier and/or first detector tubes; and that spurious responses resulting from the direct reception of harmonics of the input signal, as differentiated from the input signal harmonics, generated within the receiver, need not be considered. Refer to paragraphs 135 and 136.

(tt) That the overall electric fidelity for the higher audio frequencies, based on the response at 1,000 cycles, be considered satisfactory if attenuated 6 decibels at not less than 1500 cycles and 20 decibels at not less than 2500 cycles. These figures, while differing from those shown in the governing specifications, are commensurate with the recommended selectivity limits as presented under paragraph (qq) above. Refer to paragraph 137.

(uu) That the maximum undistorted power output figures of the governing specifications be made applicable to 100 per cent modulated signal as measured at the input terminals of the loud speaker transformer. Refer to paragraph 138.

(vv) That consideration be given to the acceptance of a time constant for automatic volume control not in excess of 0.3 second. While this figure is in excess of the specification figure, it is believed that the changes that would be necessary in the AVC circuit constants to effect specification compliance would adversely affect the filtering of the controlled r-f and i-f stages. Refer to paragraph 142.

(ww) That the specification limit for change in heterodyne oscillator frequency under conditions specified under paragraph 9-10 and 9-11 of the governing specifications be changed from .015 per cent to .075 per cent. The original limit is considered too exacting for a commercial receiving equipment operating without a voltage regulator to provide constant plate and screen voltage to the heterodyne oscillator tube. Refer to paragraphs 144 and 145.

(xx) That the r-f output from the first oscillator be reduced as much as possible, within practical limits, but that in no instance shall it exceed a value (for any frequency) as shown by a straight line plot on log/log paper with ordinates and abscissas the same as on Sheet 31A of reference (b) drawn between a value of 100,000 microvolts at 30 megacycles and 150 microvolts at 200 kilocycles. Refer to paragraph 146.

B. That the equipment may comply with specifications which are generally applicable to radio receiving equipment to Naval service, it is recommended, in addition to the above recommended modifications, that:

(a) That aluminum or aluminum alloy be employed in lieu of steel in the construction of the panels, chassis, dust covers (and/or equivalent enclosures), shield partitions and mounting brackets for the several units of the subject equipment.

(b) That the Receiver Unit be of more rugged construction than displayed by the model through the use of heavy gauge material for the chassis and through the use of additional bracing between the chassis and front panel. The chassis should derive its entire support from the front panel and be independent of the receiver dust cover for the necessary rigidity to preclude its warpage where subjected to severe shock or rough handling.

(c) That the dust covers for the Receiver and Power Units be of more rigid construction through the use of heavier gauge material, that their front edges be flanged for contact with their respective front panels, and that the flanged edges be provided with threaded blocks to receive front panel thumb screws.

(d) That the front panels of Receiver and Power Units be fitted with thumb screws of the captive type to engage with the threaded blocks in the flanges of their respective dust covers, and to remain with the panels when loosened.

(e) That the thumb screws employed for securing the tube aperture cover plate on the front panel of the Power Unit be of the captive type and arranged to be retained with the separable cover plate when loosened.

(f) That the small panel mounted controls and/or devices employed with the Receiver and Power Units be constructed from materials which conform with the requirements of existing applicable Naval specifications; and, further, that they employ uniform finishes on their exposed metallic parts and/or mounting hardware.

[redacted]

(g) That the shafts for all control knobs be flattened or spot drilled for the control knob set screws, and that where flattening or spot drilling is impracticable, the knobs be secured with two set screws arranged 90° apart.

(h) That the i-f and cw oscillator transformer assemblies employ aluminum shield cans of greater thickness than employed for the model receiver; that their internal assemblies derive their main support from the receiver chassis, with their shield cans supporting their top structures; that their bases be provided with terminal panels of high grade insulating material, fitted with soldering terminals to facilitate wiring, and to provide for rigid bus wire connections between the internal circuit components and the soldering lugs; and that the tops of the shield cans be fitted with sliding cover plates for closing the screw driver openings for the trimmer capacitor rotors.

(i) That the construction of the plug-in coil assemblies be modified and improved to include coil shield cans of greater thickness to withstand rough usage; grounding jacks riveted to their respective shield cans with dural rivets and with the rivet heads staked to the shield cans; cadmium or nickel plated brass in lieu of steel for the shield can clamping straps; the ends of the shield can mounting screws staked to prevent their complete removal from the clamping straps, when loosened; aluminum, in lieu of steel, hand grips, and finally means for providing complete edge surface contact between the face plate and the edges of the plug-in coil compartment of the receiver chassis to effectively shield the front panel aperture.

(j) That the internal assemblies of the r-f and heterodyne and d-c transformers be redesigned to derive their entire support from the face plate of the plug-in coil sets (rather than from the shield cans) with the shield cans supporting only the contact panel; that they remain with the face plates when their shield cans are removed for inspection or servicing, that access to the trimmer capacitors be through the face plates to permit circuit alignment without removing the receiver from the rack, and that the trimmer capacitor apertures be closed by suitable means when not in use.

(k) That long leads of fine wire be avoided in the construction of the r-f transformer and heterodyne oscillator inductor assemblies through the use of terminal lugs on the coil forms, and the use of rigid bus wire connections between these terminals and their associated button contactors for external circuit connection; that the use of the coil leads for inductance trimming be avoided where the rigidity of the leads will not maintain permanent adjustment under conditions of vibration.

(l) That fixed mica capacitors employed in the r-f transformer and heterodyne oscillator inductor assemblies employ high grade insulating cases, such as XM262 low loss bakelite, and that they be so supported as to preclude their movement or possible flexing of their leads under conditions of vibration.

(m) That the calibration and station logging charts on the plug-in coil assemblies be provided with brass or aluminum frames in lieu of steel frames, and that the charts be protected by non-glare, non-inflammable transparent coverings.

(n) That the air dielectric trimmer capacitors be of all brass construction with the rotor and stator plates soldered to their respective rotor shaft and stator spacer rods; that the brass parts be nickel plated, and that in addition, the rotor bushing, shaft, and rotor contacting parts be heavily silver plated, and that the mounting of the trimmer capacitors be independent of the mounting of other components and/or parts to the extent that destruction or damage to the capacitor mounting will not incur replacement of other components. This statement applies to the mounting of the trimmer capacitors in the r-f transformer units in the model receiver, where replacement of the trimmer capacitors might result in breakage of the coil-capacitor mounting plate.

(o) That all brass construction be employed for the main ganged tuning capacitors; that the rotor and stator plates be soldered to their respective rotor shafts and spacer members, that all brass parts be heavily nickel or silver plated, that the rotor hubs be provided with coin silver facings for contact with the spring wiper fingers, that the spring wiper fingers be provided with coin silver button contacts so designed as to be self cleaning; that the spring wiper fingers be so mounted as to preclude any radial movement, and that the rotor shafts be of stainless steel.

(p) That the main ganged tuning capacitors be enclosed in a metallic housing complete with shield partitions, and fabricated from aluminum alloy to effect better interstage shielding, and to preclude the entrance of dust and dirt between the plates of the tuning capacitors.

(q) That the antenna post be provided with a cast aluminum housing to effectively shield this post from external signals or noise pick-up other than what enters via the antenna connections.

(r) That small fixed resistors, tubular capacitors, and molded mica capacitors be systemmatically mounted on panels of high grade insulating material, provided with soldering lugs, spaced to receive the pigtail leads of these components; that the mounting plates be wax impregnated to preclude the accumulation of moisture between the soldering terminals; and that no more than three connections, including wiring leads, be made at any one soldering terminal.

(s) That the wiring employed in both the Receiver and Power Units be considerably improved to the extent of reducing long leads to a minimum; anchoring unavoidably long leads to prevent their breakage from crystallization at their soldered connections under conditions of vibration; and the elimination of crisscrossed leads. Group leads should be laced together, flexible leads employed in frequency determining circuits should be anchored throughout their lengths.

(t) That in no instance shall spaghetti tubing or varnished or wax impregnated fabric sleeving be employed for coil or circuit leads.

(u) That ceramic insulating plates or strips employ soft washers under their mounting screws for protection against breakage under conditions of wide temperature variation, and severe vibration and/or shock.

[redacted]

(v) That the coupling capacitor employed for the cw oscillator be improved in design to maintain permanent adjustment under conditions of wide temperature and humidity variation; that its construction be such that its capacitance value may be easily duplicated; and that it be so mounted as to preclude self coupling or coupling of its associated leads with the r-f amplifier circuits.

(w) That all components be identified by circuit symbols, stenciled, stamped, or engraved adjacent to the components and on the chassis or component mounting plates, for circuit identification in compliance with existing Naval standards.

(x) That control knob inserts, and miscellaneous mounting straps or brackets employing tapped holes be not less than 1/16 inch in thickness.

(y) That dural inserts be provided in the Receiver and Power Unit chassis for receiving the retaining screws for their respective dust covers.

(z) That brass inserts employed in molded phenolic plates be nickel or cadmium plated.

(aa) That partition shields and mounting brackets be of aluminum or aluminum alloy and be of such design as to provide rigid support for any load that they might carry without danger of breakage or loosening under conditions of severe vibration.

(bb) That stainless steel set screws be employed for all set screw applications.

(cc) That the steel parts employed for the reproducer of the Loud Speaker Unit be provided with a non-corrosive primer prior to the application of the aluminum paint.

(dd) That the line input cable and receiver power cable consist of tinned stranded copper conductors, with rubber insulation, and employ, in addition, braided copper shields with outer rubber coverings.

(ee) That all components except small components provided with pigtail leads be secured with nickel plated brass, machine screws and nuts. Shield cans may be secured with nickel plated brass spade bolts and nuts. All screws and nuts should be suitably locked in place by approved means. Nuts on screws or studs carrying radio frequency currents should be soldered. The use of internal tooth shakeproof soldering lug is not considered as an acceptable lock washer substitute. The use of self-tapping screws likewise is not acceptable in lieu of a machine screw and associated nut or insert.

(ff) That all ground return terminations be substantially at unipotential, be independent of the mounting of components, and be positively protected against corrosion.

(gg) That all aluminum or aluminum alloy parts including tube shields, coil shields, etc., employed in the construction of the subject equipment to protect against corrosion by an anodic treatment (or equivalent), and that this protective coating be removed from contacting surfaces.

(hh) That full surface bonding be provided between all contacting metallic parts, where effective shielding or elimination of corrosion from electrolytic action is dependent upon such bonding; and that where the use of dissimilar metal in intimate contact cannot be avoided, their contacting surfaces be protected by a continuous film of non-corrosive plating.

MATERIAL UNDER TEST

4. The material under test consisted of one Model XRAS Radio Receiving Equipment complete with the following units.

(a) Receiver Unit complete with seven sets of plug-in coils.
(b) A.C. Power Supply Unit.
(c) Panel type Loud Speaker Unit.
(d) Coil Storage Rack.
(e) Relay Rack.
(f) Cabinet type Loud Speaker Unit.

Items (a) to (d) inclusive are designed for relay rack mounting.

5. The subject equipment was manufactured by the National Company of Malden, Massachusetts, and supplied by the General Electric Supply Corporation of Washington, D.C., under contract, reference (c). It was delivered to the Laboratory for type approval tests on 5 July 1939.

METHOD OF TEST

6. The following instruments or apparatus were employed in conducting the tests described herein.

(a) Standard Signal Generator, General Radio Company Model LC-1, Serial No. 18.
(b) Standard Dummy Antenna, General Radio Company Type 418G.
(c) Beat Frequency Oscillator, General Radio Company Type 713A, Serial No. 141.
(d) Wave Analyzer, General Radio Company 736A, Serial No. 118.
(e) Heterodyne Calibrator, General Radio Company Model LD-2, Serial No. 1.
(f) Interpolation Oscillator, General Radio Company Type 617A, Serial No. 30.
(g) Output Meter, NRL No. 2505.
(h) Output Meter, General Radio Company Type 483F, Serial No. 552.
(i) Crystal Frequency Indicator, Bendix Radio Corporation Model LM-2, Serial No. 1.

7. The subject equipment was inspected after its unpacking for damaged or loosened components, and to make certain that all vacuum tubes were firmly seated in their sockets. It was then set up in a screened booth for test. The antenna and ground terminals of the Receiver Unit were connected to the output of a General Radio Model LC-1 Standard Signal Generator through a General Radio Type 418G Standard Dummy Antenna, with the common ground circuit bonded to the screening of the booth. The phone output of the receiver was connected to a General Radio Type 483F Output Meter and an NRL #2505 Output Meter connected in parallel. The former instrument was employed for the measurement of maximum noise voltages, and audio output voltages obtained under the resonant overload tests; while the latter instrument was employed for indicating low signal and/or noise voltages, and to provide a 600 ohm load for the phone output. The General Radio Type 713A Beat Frequency Oscillator was employed for modulation of the carrier from the Standard Signal Generator for selectivity and overall electric fidelity measurements. Output voltages for the overall electric fidelity tests and hum

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voltages were measured with a General Radio Type 736A Wave Analyzer. The calibration of the receiver was checked against a General Radio Model LD-2 Crystal Controlled Heterodyne Calibrator. Frequency drift was measured by the "zero beat" method with the use of a General Radio Type 617A Interpolation Oscillator. The line voltage to the Power Unit was maintained at 115 volts, corrections for normal line voltage variations being accomplished through the use of a General Radio Variac.

8. CW and MCW sensitivity measurements were made in accordance with par.10-1 to 10-3 and 10-6 to 10-9, both inclusive, of the governing specifications. Selectivity measurements were conducted at three frequency settings for each band, with the carrier input signals 30% modulated at 400 cycles per second, and with the receiver adjustments the same as for the sensitivity measurements. Selectivity measurements were also made for a 10 to 1 reduction in the radio frequency gain of the receiver, with the same character of applied input signals at the center frequency setting for each band. Overall electricity fidelity measurements were made for 30% modulated signals applied to the receiver input. All other performance characteristics, listed under paragraph 3 above, were measured in accordance with conventional procedure for laboratory receiver tests. Specific features of the test procedures employed will be given under the applicable paragraph references of this report, where further elaborations are considered essential for the correct interpretation of the test data.

DATA RECORDED DURING TEST

9. Complete data were recorded for all tests conducted, and this information is contained in Tables 1 to 11 inclusive and Plates 1 to 50 inclusive.

PROBABLE ERRORS IN RESULTS

10. Estimates of the probable errors in the results of the tests are given under the following tabulation. These estimates are based on the assumption that the equipment has been operated for sufficient time to permit stabilization to take place prior to test, and include the advertized errors for the instruments employed. Included also are errors resulting from line voltage fluctuation, radio frequency leakage, and errors due to resetting of instrument and/or receiver controls. The latter errors were reduced to a minimum by frequent checking of line voltage, precalibration of the Standard Signal Generator and Output Meters, the location of the ground connection for maximum reduction of stray field influences, and extreme care in the adjustment of all instrument and/or receiver controls.

Name of Test	Estimated Overall Accuracy
Band Calibration & Band Overlap	± 0.5%
Sensitivity, 190 to 7500 kc	± 10%
Sensitivity, 7500 to 30,000 kc.	± 25%
Maximum Level Noise	± 10%
Selectivity, 190 to 7500 kc (Sensitivity, off resonance	± 10%
(Freq. setting, " "	± 0.02%
Selectivity, 7500 to 30,000 kc (Sensitivity, off resonance	± 25%
(Freq. setting " "	± 0.02%

Name of Test	Estimated Overall Accuracy
Image Selectivity, (Ratio) 190 to 7500 kc	± 10%
" " " 7500 to 30,000 kc	± 25%
Resonant Overload, 190 to 7500 kc	± 10%
Resonant Overload, 7500 to 30,000 kc input voltage	± 25%
AVC Characteristics, 190 to 7500 kc " "	± 10%
AVC Characteristics, 7500 to 30,000 kc " "	± 25%
Spurious Response Sensitivity, 190 to 7500 kc input voltage	± 10%
Spurious Response Sensitivity, 7500 to 30,000 kc input voltage	± 25%
Overall Electric Fidelity (100 to 2000 c.p.s.	± 0.5 db
(2000 to 10,000 c.p.s.	± 1.0 db
Output hum level	± 5%
Output impedance	± 5%
Input impedance	(approximated)
Manual Volume Control Characteristics, 190 to 7500 kc	± 10%
" " " " 7500 to 30,000 kc	± 25%
R-F Output from Heterodyne Oscillator, 190 to 7500 kc	± 10%
" " " " " 7500 to 30,000 kc	± 25%
Time Constant with AVC Control	± 0.005 sec.
Frequency Stability with Change to Line Voltage	± 0.001%
Frequency Stability with Change in R-F Gain Control	± 0.005%

RESULTS OF TESTS

11. The Model XRAS Radio Receiving Equipment consists of four separate and distinct units; namely, the Receiver Unit, Power Supply Unit, Loud Speaker Unit, and Coil Rack Unit, with this latter unit serving as a storage compartment for the plug-in coil sets for the Receiver Unit. The several units are designed for mounting, one above the other on a relay rack (furnished as a part of the equipment) of conventional design.

12. The Receiver Unit employs a superheterodyne circuit consisting of two stages of tuned radio frequency amplification preceding the first detector (or mixer), a heterodyne oscillator, two stages of intermediate frequency amplification, combined second detector and automatic volume control, beat frequency (or cw) oscillator, and one stage of audio frequency amplification arranged for head telephone or loud speaker signal reproduction. Power for operating the receiver unit is obtained from an a-c operated Power Unit of conventional design, which operates from 110/120 volt, 50-60 cycle line.

13. The Receiver Unit has a rated frequency range of from 190 to 30,000 kilocycles, without hiatus, covered through the use of seven plug-in coil sets whose respective frequency ranges are as follows:

Band	Frequency Range
1	190 - 456 kc
2	435 - 950 kc
3	0.90 - 2.05 mc
4	1.7 - 4.0 mc
5	3.5 - 7.3 mc
6	7.0 - 14.4 mc
7	14.0 - 30.0 mc

[redacted]

14. The circuit elements are as follows, noted in order from the input, and as indicated in the schematic diagram shown on Plate 50.

(a) Antenna circuit.
(b) First tuned circuit.
(c) First radio frequency amplifier tube.
(d) Radio frequency transformer and second tuned circuit.
(e) Second radio frequency amplifier tube.
(f) Radio frequency transformer and third tuned circuit.
(g) First detector tube.
(h) High frequency (or heterodyne) oscillator tube.
(i) High frequency oscillator tuned circuit.
(j) First intermediate frequency transformer.
(k) First intermediate frequency amplifier tube.
(l) Second intermediate frequency transformer.
(m) Second intermediate frequency amplifier tube.
(n) Third intermediate frequency transformer.
(o) Second detector and AVC tube.
(p) Beat frequency oscillator tube.
(q) Beat frequency oscillator tuned circuit.
(r) First audio frequency amplifier tube.
(s) Output circuits.
(t) Power supply.

15. Inasmuch as the plug-in coil sets are fundamentally identical, differing from one another only in their circuit constants and mechanical construction, the following discussion of the coupling transformers and/or tuned circuits contained therein, will be general in character and will apply equally well for one plug-in coil set as for another.

16. <u>Antenna Circuit</u>. The antenna circuit is the primary winding of the input transformer. Although neither side is grounded, a jumper connection is provided for grounding one side of the winding when desired. This arrangement permits operation of the receiver on either a balanced feed line or single antenna-ground connection.

17. <u>First Tuned Circuit</u>. The secondary winding of the input transformer together with one section of the ganged tuning capacitor constitutes the first tuned circuit. The inductance element is shunted with an air dielectric capacitor for purposes of circuit alignment. The high potential end of the tuned circuit is coupled directly to the control grid of the first r-f amplifier tube, while the low potential end is returned to the chassis ground through a by-pass capacitor, and to the AVC control circuit through a decoupling filter resistor.

18. <u>First Radio Frequency Amplifier Tube</u>. This is a commercial type 6D6 pentode with its suppressor tied to the cathode. Grid bias is obtained by means of a cathode resistor which is grounded to the chassis. The cathode resistor is shunted with a by-pass capacitor. AVC is simultaneously effected on the control grid of this tube, as well as that of the second r-f amplifier tube and 1st and 2nd i-f amplifier tubes. Bias voltage for AVC control is obtained from the load resistor in the plate circuit of one of the triode sections of the twin triode tube employed as the 2nd detector and automatic volume control. The screen is provided with a by-pass capacitor to ground and obtains its voltage from

the plate supply bleeder circuit. This voltage is varied somewhat by the operation of the r-f gain control since this control varies the cathode bias and hence alters the current flowing through the bleeder circuit.

19. Radio Frequency Transformer and Second Tuned Circuit. The plate circuit of the first r-f amplifier tube is completed through the primary winding of this transformer to the main high voltage d-c bus. The low potential end of this winding is by-passed to ground through a paper dielectric by-pass capacitor. The secondary winding, shunted with an air dielectric trimmer capacitor, forms in conjunction with the second section of the ganged tuning capacitor, the second tuned circuit. This tuned circuit is coupled to the control grid of the second r-f amplifier tube and to the automatic volume control bus through a decoupling filter resistor, by-passed to the chassis ground, as for the first tuned circuit.

20. Second Radio Frequency Amplifier Tube. This tube is the same type as the first r-f amplifier tube and serves a similar function. Minimum cathode bias is obtained by means of a fixed cathode resistor, by-passed to the chassis through a by-pass capacitor, and connected to the r-f gain control bus. Variation of the gain of this tube is simultaneously regulated with that of the 1st and 2nd i-f amplifier tubes by the r-f gain potentiometer, the arm of which is at ground potential, and one side of whose resistance element is connected to the high voltage d-c voltage divider. The screen obtains its voltage from this latter divider.

21. Radio Frequency Transformer and Third Tuned Circuit. The plate circuit of the second r-f amplifier tube is completed through the primary winding of this transformer to the main high voltage d-c bus, and capacity by-pass to the chassis ground. The secondary winding, shunted by an air dielectric trimmer capacitor, forms in conjunction with the third section of the ganged tuning capacitor, the third tuned circuit. The high potential end of this tuned circuit connects to the control grid of the first detector, while the low potential end is returned to the chassis.

22. First Detector Tube. This tube is a commercial type 6C6 pentode. Grid bias is obtained by means of a fixed cathode resistor which is retuned to the chassis and is shunted by a by-pass capacitor. The suppressor grid is tied to the cathode. The cathode of the heterodyne oscillator tube is capacity coupled to the screen of the first detector tube. Screen grid voltage is obtained from a voltage divider employed in conjunction with the plate circuit of the heterodyne oscillator tube.

23. Heterodyne Oscillator Tube. The high frequency oscillator tube is a commercial type 6C6 pentode, employing a Hartley electron coupled circuit. The plate is directly connected to the high voltage d-c bus. The suppressor grid is tied to the cathode, while the screen grid is retuned to ground through a fixed capacitor.

24. Heterodyne Oscillator Tuned Circuit. This circuit consists of a tapped inductance element shunted with an air dielectric trimmer capacitor. The fourth section of the ganged tuning capacitor is connected in shunt with the inductance element through a fixed series padding capacitor (differing in capacitance value for each oscillator circuit) to form the tuned circuit. This circuit is tuned to a higher

frequency than the resonant frequency of the previously described tuned circuits to produce a difference frequency of 175 kilocycles, which is the intermediate frequency employed for the subject receiver. The high potential end of this tuned circuit is coupled to the control grid of the heterodyne oscillator tube through a grid capacitor shunted by a grid leak, while the low potential end is grounded to the receiver chassis. The tap on the inductance element is connected for the cathode of this same tube.

25. First Intermediate Frequency Transformer. The plate of the first detector tube is coupled to the control grid of the first i-f amplifier tube through an intermediate frequency transformer. This transformer consists of two identical inductance elements tuned, by means of air dielectric capacitors, to the intermediate frequency. The winding connected to the plate of the detector tube is the primary winding, while the secondary winding is that which is connected to the control grid of the first r-f amplifier tube. The plate circuit of the first detector tube is retuned to the main high voltage d-c bus through a resistance-capacity filter.

26. First Intermediate Frequency Amplifier Tube. This tube is a commercial type 6D6 pentode. The control grid connects to the AVC bus through the secondary winding of the 1st intermediate frequency transformer and a resistance-capacity filter. Minimum bias is obtained by means of a cathode resistor connected to the r-f gain control bus as described under paragraph 20 above. The cathode is provided with a by-pass capacitor to the chassis ground. The suppressor grid is tied to the cathode, while the screen grid is connected to the high voltage d-c voltage divider and is provided with a capacity by-pass filter to the chassis.

27. Second Intermediate Frequency Transformer. This transformer is identical with the first intermediate frequency transformer. The plate of the 1st i-f amplifier tube is connected to the high voltage d-c bus through the primary winding of this transformer, and a resistance-capacity filter network, the resistance element of which is common to the plate circuit of the second i-f amplifier tube. The secondary winding of the transformer connects to the control grid of the second i-f amplifier tube and to the AVC bus through a resistance-capacity filter.

28. Second Intermediate Frequency Amplifier Tube. This tube is also a commercial type 6D6 having its suppressor grid tied to the cathode. Cathode bias and screen grid voltage are obtained in the same manner as for the preceding i-f amplifier tube.

29. Third Intermediate Frequency Transformer. This transformer is identical with the first and second intermediate frequency transformers. The plate circuit of the 2nd i-f amplifier tube is completed through the primary winding of this transformer to the high voltage d-c bus through the resistance-capacity filter common to the preceding tube. The secondary winding connects to the control grid of the triode section of the twin triode tube which acts as the second detector, and has its low potential end grounded to the receiver chassis.

30. Second Detector and AVC Tube. A commercial type 6F8G twin triode tube is used to serve the dual function of second detector and

automatic volume control. The 1st triode section is employed for AVC with the second triode section acting as a biased second detector. Detector grid bias is furnished by a fixed cathode resistor connected to the chassis and shunted by an electrolytic by-pass capacitor. The cathode of the AVC triode section is also provided with a fixed cathode resistor connected to the chassis and shunted by a by-pass capacitor. The control grid of the AVC triode are capacitively coupled to the control grid of the second detector triode, and to its own cathode through a grid leak and resistance-capacity filter. The junction of this grid leak and filter resistor is connected to the minus "B" terminal of the power supply. The load resistor in the AVC plate circuit is arranged for providing d-c voltage for AVC operation, this voltage being regulated by the carrier voltage acting on the two control grid elements of this tube. The AVC switch, when in the "Off" position, grounds the AVC bus, thus connecting the grid return circuits of the controlled tubes to ground.

31. <u>Beat Frequency Osçillator Tube</u>. The beat frequency oscillator tube is a commercial type 6C6 pentode and is used in conjunction with a Hartley, electron coupled, oscillator circuit. The suppressor grid is connected to the chassis; the plate is connected to the high voltage d-c bus through a voltage dropping resistor and an "On-Off" switch, and the the screen grid is connected to the plate circuit voltage divider. The plate is capacitively coupled to the control grid of the 2nd detector tube to effect cw reception.

32. <u>Beat Frequency Oscillator Tuned Circuit</u>. This circuit consists of a tapped inductance element shunted with an air dielectric tuning capacitor and a panel operated air dielectric tuning capacitor,also shunt connected, and provided for beat note frequency adjustment. The high potential end of this tuned circuit is connected to the control grid of the beat frequency oscillator tube through a fixed coupling capacitor shunted by a grid leak resistor. The low potential end of the inductance element is grounded to the chassis, while the tap is connected to the cathode of the beat frequency oscillator tube. The cathode is connected to the chassis through a small air dielectric capacitor whose adjustment remains fixed once it has been ascertained.

33. <u>A-F Amplifier Tube</u>. This tube is a commercial type 6V6G beam power amplifier tube, triode connected. It is resistance-capacity coupled to the plate of the 2nd detector tube. The plate circuit of this latter tube is returned to the high voltage d-c bus through an r-f filter network, plate load resistor and resistance capacity filter in consecutive order. A blocking capacitor is connected between the plate load resistor and the audio gain potentiometer which acts as the grid return load, and whose arm is connected to the control grid of the a-f amplifier tube. Grid bias is obtained through a fixed cathode resistor, shunted with an electrolytic by-pass capacitor and connected, together with the low potential end of the audio potentiometer, to the minus "B" terminal of the power supply.

34. <u>Output Circuit</u>. The plate of the a-f amplifier tube is connected to the primary winding of the head telephone coupling transformer when the telephone plug is inserted in the phone jack, and to the primary of the loud speaker coupling transformer when it is removed. D-C voltage

to the plate of this tube from the main high voltage d-c bus is completed through the coupling transformer primaries.

35. Power Supply. The power supply is of conventional design employing a commercial type 5Z3 full wave rectifier tube, a power transformer having in addition to the plate supply winding, separate low voltage windings for the heater of the rectifier tube and the parallel connected heaters of the receiver tubes, and an inductance-capacitor filter unit. It includes also the line power ON-OFF switch and protective fuses.

36. Par.1-1. The Model XRAS Radio Receiving Equipment does not comply with all of the requirements of Specification RE 13A 565A, reference (b), as amended, by the provisions of the contract, reference (c), and therefore cannot be considered as being entirely satisfactory for use at Naval Radio Shore Stations or aboard Naval vessels.

37. Par. 1-2. The model equipment is designed for the reception of radio telephone or telegraph signals (either cw or mcw) by either headphone or loud speaker methods.

38. Par. 1-3. The design of the equipment is such that all units are supported on a relay rack of conventional design suitable for table mounting.

39. Par. 1-4. The model equipment is designed for operation from 110/120 volt, 50 - 60 cycle a-c line, as provided under reference (c).

40. Par. 1-5. The Receiver Unit has a rated frequency range of from 190 to 30,000 kilocycles. However, the lowest frequency covered by the model is 190.67 kilocycles. With this exception, the complete frequency range as specified under reference (c) is covered, without hiatus, through the use of seven plug-in coil sets having respective frequency ranges as indicated under Table 1.

41. Par. 1-6. The Model XRAS Radio Receiving Equipment as submitted to the Laboratory for test consisted of the following items:

(a) One Receiver Unit, complete with all necessary vacuum tubes, interconnecting power cable, and seven plug-in coil sets, one of which was housed in the Receiver Unit with the remaining six housed in the Coil Rack Unit, listed below.

(b) One Power Unit, complete with rectifier type vacuum tube and detachable line power cable.

(c) One Loud Speaker Unit, complete with matching transformer.

(d) One Coil Rack Unit.

(e) One Relay Rack, complete with mounting feet, "trim" channels and necessary hardware for mounting items (a) to (d), inclusive, thereon.

[redacted]

(f) One loud Speaker Unit, complete with matching transformer and cabinet designed for wall or table mounting.

No spare parts or instruction books were furnished as they were not required under the terms of the contract, reference (c).

42. Par. 2-1. The construction of the Model XRAS Radio Receiving Equipment can be considered as being better than average for receiving equipments produced for the amateur and commercial trades; but its construction is far less rugged, and in many respects the materials employed are less suitable for the purposes intended than would be considered acceptable by a strict interpretation of the specification reference. Constructional details and materials which are not considered as being in compliance with the requirements of the governing specifications are as follows:

(A) <u>Receiver Unit</u>

(1) The receiver chassis is of the inverted box type and of one piece construction, fabricated from 3/64 inch thick sheet steel. Its corners are lapped and spot welded. It is provided with 3/64 inch thick steel angle brackets, spot welded to the chassis for front panel support and attachment of the bottom cover plate. The bottom cover plate is also of 3/64 inch thick sheet steel with its longer sides turned up for added rigidity. A mounting pedestal for the ganged tuning capacitor assembly is of four sided, one piece, open ended construction with mounting flanges. It is also constructed from 3/64 inch thick sheet steel and spot welded to the chassis. The plug-in coil enclosure which surrounds the plug-in coil aperature on the front side of the chassis is constructed from 3/64 inch thick sheet steel. It is of one piece, three sided construction with its sides flanged for spot welding to the under side of the chassis. Spot welding of this compartment is to the top and front side of the chassis. The compartment is fitted three 1/32 inch thick steel partitions spot welded in place. The front side of the chassis is bolted to the receiver front panel with four screws, secured with nuts and external tooth shakeproof lock washers. There is no support between the front panel and the rear of the chassis except as is provided by the dust cover when it is in place. The support offered to the chassis by the front panel and dust cover is not considered sufficient to prevent warping of the chassis, resulting from the load which it bears, under conditions of severe vibration, when the Receiver Unit is supported from the relay rack. The gauge of the steel used in the construction of the chassis and dust cover does not provide sufficient ruggedness to the receiver as to permit its universal application in Naval Service. Refer to paragraph 47.

(2) One side of the dust cover is provided with a rectangular opening for passage of the antenna and ground leads to their respective binding posts mounted on top and to one side of the receiver chassis. This arrangement makes it necessary to disconnect the antenna and ground leads in order to remove the dust cover, and therefore precludes multiple side by side installation of identical equipments and/or with other types of relay rack mounted equipments.

(3) The use of brass and aluminum in intimate contact with one another in the construction of the main ganged air dielectric tuning capacitors and trimmer capacitors is not generally acceptable. Acceptable construction of these components is predicated on the use of one kind of material for their rotor and stator assemblies. Either brass or aluminum would be suitable for these applications. All brass construction would permit soldering of the plates to their supporting spacer members; while all aluminum construc-struction would permit welding of these parts in addition to swedging.

(4) The aluminum shield cans, employed in the construction of the plug-in coil assemblies have .020 inch thick side walls and .062 inch thick closed ends. They are not considered as being especially rugged as they can be easily dented or otherwise damaged if dropped. Similar shield cans are supplied for the i-f and cw oscillator transformer assemblies, which while less subject to damage from dropping may become distorted should the receiver receive a severe shock, since they are the main support for their internal assemblies.

(5) The toggle switches do not appear to be of the silver plated, dry packed, type commonly employed for Naval receivers. They have brass toggle handles, mounting bushings, and nuts all of which have a black nickel finish.

(6) The panel operated potentiometers employ cadmium plated steel shafts, unplated brass mounting bushings, and nickel plated brass mounting nuts. Prolonged inactivity of the potentiometers may result in the mechanical "freezing" of their shafts in the mounting bushings, which also serve as shaft bearings, owing to corrosion of the bushings and the possible rusting of the shafts. The cadmium plating on the shafts does not appear to be of sufficient thickness to preclude rusting of the shafts after a relatively short period of service.

(7) Cadmium or nickel-plated brass is generally preferred in lieu of cadmium plated steel for the mounting brackets for pilot lights and telephone jacks, employed for Naval receiving equipments. The use of unplated steel set screws in combination with unplated steel inserts is objectionable because of the possibility of "freezing" of the set screws from the accumulation of rust, with their consequent breakage upon their attempted removal.

(B) Power Unit

(1) The Power Unit is of panel-chassis construction employing a 1/16 inch thick shelf type chassis with bent up sides for added rigidity. The rear of the chassis is supported by side straps spot welded to the chassis and bolted to the front panel. The structure of the chassis is considered rugged. The cases of power transformer and filter re-

actor units are spot welded to the bottom of the chassis. Spare transformers and filter reactors are included in the list of spare parts for this equipment. However, the replacement of these items is restricted to one of two methods: the first being to melt out the potting compound of the defective unit and repotting it after the replacement of the core and coil assembly; second, to salvage all component parts other than the power transformer and reactor of the power unit, and then scrapping the chassis and replacing it with a new one containing a new transformer and reactor, and then reassembling and rewiring the Power Unit. The former method presumes that unpotted core and coil assemblies of the power transformer and reactor units are furnished as spares, while the latter method presumes that the spare items be mounted to a replacement chassis. Obviously, neither of these methods are acceptable. Therefore, the production Power Units should be equipped with detachable power transformers and filter reactors secured to the chassis with screws. They should be totally enclosed units, provided with terminal panels, fitted with soldering lug terminals to facilitate wiring.

(2) The dust cover is fabricated from 3/64 inch thick sheet steel with lapped and spot welded corners. It is not considered especially rugged as it may be easily bent if dropped.

(3) The cover plate for the front panel vacuum tube aperture consists of a brass frame,welded to the back of which is a steel grill. The need for two kinds of metals in its construction is not obvious and their composite use is objectionable. The thumb screws for securing the cover plate to the front panel are not of the captive type and hence may be easily lost. A slight design modification would permit pinning these screws in such a manner as to obviate their loss when loosened.

(4) The brass, prong type contacts of the line power receptacle are not plated and their corrosion will result in noisy receiver operation.

(C) Loud Speaker Unit

(1) The reproducer unit of the panel type Loud Speaker Unit is mounted directly on its front panel. The cabinet type Loud Speaker Unit is housed in a steel cabinet considered to be of very rugged construction.

(D) Coil Rack Unit

(1) The Coil Rack Unit consists of an aluminum panel having an opening closed by a hinged door. To the rear of the panel is bolted a box-like enclosure, fabricated from 3/64 inch thick sheet steel and having lapped and spot

welded corners. The base of the enclosure is flanged to permit its mounting against the panel, with screws and nuts. The construction of the Coil Rack is sufficiently rugged for its purpose, but its mechanical design is in need of improvement.

(2) The hinges on the cover are considered too light for the kind of service to which they will be subjected. The catch for the cover is not positive in its action, due mainly to interference caused by paint which was allowed to contact some of the actuating parts.

(E) Mounting Rack

(1) The mounting rack consists of two steel upright channels separated at the top and bottom by steel straps secured in place with screws. The upright channels are bent back at the base to form a footing which is braced by steel crossovers, secured to the uprights with screws. The footings are drilled with holes for mounting to a table or bench. The uprights are provided with a series of tapped holes to receive the panel mounting screws. The spacing between holes permits arrangement of the component units of this equipment in any desired grouping. The construction of the mounting rack is very rugged and well designed.

43. Par. 2-2. The workmanship in the model equipment is of only fair quality as compared with that which is generally considered acceptable for receiving equipments for Naval Service. The component parts, in general, are accessible, but there are instances where the replacement of some of the components is limited due to mechanical restrictions. Design features of this equipment which are not considered in compliance with this specification reference are as follows:

(A) Receiver Unit

(1) The commercial practice of random point to point suspension of fixed resistors, molded mica capacitors, and tubular paper dielectric foil capacitors by their pigtail leads between soldering lugs on tube sockets and small terminal strips has been employed in the model receiver. This method of mounting small components, while satisfactory for commercial and domestic receivers, is not considered satisfactory for receivers for Naval usage where dependable receiver performance is demanded under conditions of prolonged and severe vibrations, wide variations in temperature and humidity and exposure to high saline atmospheres. The method of mounting small components, as applied to the subject receiver, presents certain undesirable features, as follows:

(a) By virtue of the random placement, several of the components cannot be replaced without at least the partial, if not the complete, removal of other components. This is due, in part, to the fact that some of the components straddle other components; and, in part, to the use of common soldering lugs for more than one pigtail connection. It is evident, from an examination of the arrangement of the small components, that the replacement of some components may result in subjecting the interfering components to permanent damage in the process.

(b) Only three of the tubular type, paper carton capacitors are secured in place by means of metal clamps. There are three instances where the capacitors are grouped in pairs and secured together with heavy cord. In other instances, the capacitors are forced against sharp edges of soldering lugs which may, in time, puncture their pasteboard containers, if the equipment is subjected to long periods of vibration. It is considered that the weights of the majority of the tubular type capacitors are too great to permit their suspension by their solid pigtail leads, without additional clamping devices, to prevent lead breakage from crystallization under conditions of vibration. This statement applies also to the two watt carbon resistors, where in some instances, they are free to vibrate.

(2) The replacement of the 1.0 mfd, 400 volt metal clad, paper dielectric, foil capacitor, employed as the screen by-pass capacitor for the first i-f amplifier tube, cannot be effected except by the complete removal of the first i-f transformer, which conceals the head of one of the capacitor mounting screws. This is considered a design defect which could have been avoided by a more judicious location of the capacitor, or in the use of tapped inserts in the chassis for the capacitor mounting screws. In the present arrangement, the adjustment of the i-f transformer would be disturbed upon its removal from the chassis, hence making necessary the realignment of the i-f circuit involved.

(3) The 10 mfd, 50 volt, metal clad, electrolytic cathode by-pass capacitor for the second detector is secured to the chassis by means of a rivet through one end and a nickel plated machine screw through the opposite end of its mounting clamp. Riveting is not an accepted method for securing components in radio equipment. Replacement of this capacitor is further hindered by the fact that the head of the mounting screw is under the second i-f transformer, and access to it can be accomplished only upon the removal of the i-f transformer with the attendant possibility of damaging the leads and throwing the tuned circuits out of alignment. This defect should be corrected either by relocating the capacitor or in providing tapped inserts in the chassis for its mounting screws.

(4) The value of air dielectric trimmer capacitor and/or ceramic coil and capacitor insulation, employed in the construction of the i-f and beat frequency oscillator transformers, is defeated through the use of flexible leads which are brought out through the bottom of the transformer shield cans for circuit connection. This practice is not considered in compliance with good workmanship. Permanence of circuit alignment cannot be expected under all operating conditions where flexible leads, which are free to move, are employed where their movement will affect the circuit constants. Strict compliance with the requirements of reference (b) predicates the use of terminal panels with soldering terminal lugs, and rigid connecting wires, connecting the soldering lugs to the electrical components inside of the transformer shield cans, arranged in such a manner as to preclude their breakage under conditions of vibration.

(5) The practice of running long leads in the open, without any means for their support, so that they are free to sway under conditions of vibration, is not acceptable. This is especially objectionable in the case of leads which carry radio frequency potentials where their movement is apt to affect the electrical performance of the receiver. Of particular reference are the leads running between the panel operated air dielectric capacitor in the beat frequency oscillator circuit to the cathode of the beat frequency oscillator tube, between the plate coupling capacitor of the same tube and the control grid of the second detector tube, and those running to the r-f gain control, +B ON-OFF switch, and CW-ON-OFF switch.

(6) The retaining washer for the octal base ceramic tube socket for the a-f amplifier tube is riveted to the chassis in such a manner as to make replacement of this socket very difficult.

(7) Contact to the rotor hubs of the air dielectric trimmer capacitors employed in the r-f, i-f, and cw oscillator transformer assemblies depends upon the pressure exerted by cup type spring washers inserted between the rotor shaft retaining nuts and their phenolic or ceramic mounting plates. The soldering lug rotor contactors are inserted between the rotor hubs and the opposite sides of the mounting plates from the spring washers. The rotor shaft retaining nuts are soldered in place after their tightening and the shafts and nuts then slotted to permit rotor adjustment by screw driver means. The method employed for securing the rotor assemblies is not entirely satisfactory in that their replacement is difficult without probable damage to their mounting plates. The cup type spring washers employed are not considered as having sufficient area to assure permanent tension, and it is questionable whether they retain their original temper after having been heated during the soldering of the rotor retaining nuts. Trouble-free operation of these capacitors cannot be expected since the rotor contacting surfaces are not protected against corrosion. Refer also to paragraph 58.

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(8) The lead connections from the universal coils in the r-f coil assemblies to their contact buttons are, in general, very unsatisfactory. Long leads are the general rule, and their being of small diameter are subject to breakage from crystallization at their soldered connections, under conditions of vibration. Some of the leads are sleeved with varnish or wax impregnated fabric sleeving which is so rigid as to place the leads under strain. The use of coil leads for inductance trimming should be avoided. Fine wire leads should be short and terminated at soldering lugs close to the coil forms. Interconnecting leads should be of bus wire, or equivalent, so as to maintain permanent circuit alignment under all conditions of receiver operation.

(9) Ceramic insulating plates and strips do not employ soft washers under mounting screws for protection against breakage resulting from wide temperature variations, severe vibration or shock. Accepted standards for good workmanship require the use of cushioning washers of non-hydroscopic composition for this purpose. This statement applies particularly to the ceramic insulating strips for the stator assemblies of the ganged tuning condenser, and the ceramic insulating plates for the i-f and cw oscillator capacitors.

(10) The coupling capacitor between the cw oscillator and the second detector is of very unsatisfactory construction. It consists of two small cadmium plated brass plates riveted to a small phenolic insulating plate. Its construction is such that its capacitance value cannot be maintained at a constant value, and it is doubtful whether its value could be easily duplicated, if replacement of the capacitor should become necessary. It is connected by a long lead to the second detector tube socket. This lead not only is free to sway under conditions of vibration, but can also couple to the circuit leads of the first and second r-f stages.

(11) The wiring is only of commercial quality, and its workmanship is far inferior to that usually expected for Naval receivers. Crisscrossing of wires has not been avoided, grouped leads are not laced together, long leads are not anchored, and rubber grommets have not been sufficiently applied. In many instances, the leads are wedged against sharp metallic projections which in time will wear through their insulation if the receiver is subjected to vibration.

(12) All circuit grounds are made to the chassis through soldering lugs either riveted to the chassis or secured thereon by the mounting screws and nuts common with other components. To insure trouble-free receiver operation, all circuit grounds should be terminated at a

common ground bus solder bonded at but one point on the chassis, or terminated on a plate substantially at uni-potential. These terminations should be permanent, independent of the mounting of other components, and positively protected against corrosion.

(13) The control knobs for the panel operated controls, including the main tuning dial, each depend upon single set screw mounting. The control shafts are neither flattened not spot drilled to prevent turning of the control knobs should their set screws become slightly loosened under conditions of vibration. Control knobs should either be secured by the use of two set screws, or else the shafts to which they are mounted should be flattened or spot drilled, if the design of the control knobs restricts them to the use of single set screws.

(14) The antenna binding post and main ganged tuning capacitor and connections thereto, are not considered effectively shielded against the possibility of strong signals being directly heterodyned without passing through the preselector circuits. This is borne out by the poor showing which this equipment made during the tests for spurious response sensitivities. The antenna ground binding posts should be provided with a metallic shielding enclosure. The ganged tuning capacitor assembly should either be enclosed by a metallic shield or its shield partitions should be increased in size, or otherwise altered in shape, so as to more effectively shield the control grid leads from one another.

(15) No attempt has been made in the construction of the Receiver Unit to completely bond metallic parts whose effectiveness as shields or where elimination of corrosion from electrolytic action is dependent upon such bonding. Contact between painted parts and/or between a plated part and a painted part, which are secured together by screws or rivets, depends only upon such contact through the paint as is afforded by the bitting action caused by the lock washers when they are pressed against the painted surfaces. This type of construction is in complete violation of the basic principles of construction which are accepted for Naval equipment. Complete bonding should be provided between all metallic parts which are secured together, and where the use of dissimilar metals cannot be avoided, their contacting surfaces should be protected by some form of non-corrosive plating. Point to point contact between mounted surfaces is not acceptable, full surface contact being required.

(B) Power Unit

(1) The "ON-OFF" toggle switch mounted on the front panel does not appear to be of the silver plated, dry packed type usually employed for Naval equipment and its finish differs from the finish employed for the panel-operated toggle switches on the Receiver Unit.

(2) The wiring and placement of the wiring is entirely unsatisfactory. Splicing of certain wires has been employed. Certain wires are stretched across the sharp edges of the power transformer and filter reactor cases. Long leads to the input and output receptacles are unsupported and subject to breakage from crystallization at their soldered connections under conditions of vibration.

(3) Internal tooth shake-proof soldering lugs have been employed for securing the terminal nuts for the filter capacitors. These are not considered acceptable for securing nuts.

(4) The tube socket mounting bracket has been spot welded to the sides of the power transformer and filter reactor cases. This is unsatisfactory.

(5) The mounting bracket for the filter capacitors is not properly designed for the character of load it carries.

(6) Bonding of the chassis to the front panel and dust cover to the chassis and front panel is not satisfactory. (Refer to paragraph 43 A (15) for comments on bonding.)

(C) <u>Loud Speaker Unit</u>

(1) The method of attachment used for the pin terminals for the speaker input cables is unsatisfactory in that their sleeves are not supported by the cable leads. The insulation of the leads should extend the full length of the pin terminal sleeves to support them in the manner employed for head telephone cables.

(D) <u>Coil Rack Unit</u>

(1) The design of the Coil Rack Unit demands workmanship to closer tolerances than has been demonstrated for the preliminary model if the requirements of reference (b) are to be fulfilled.

(E) <u>Mounting Racks</u>

(1) The workmanship of the mounting racks is good, and except for the lack of proper bonding of its several parts and lack of a protecting coating under its lacquer finish, is satisfactory.

(F) <u>General</u>

(1) The use of dissimilar materials in intimate contact, except where those parts are separated by an unbroken film of non-corrosive metal, is not acceptable where electrical or magnetic conductivity is dependent upon such contact.

(2) The use of brass nuts on steel screws or vice versa is unsatisfactory.

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(3) Parkerizing is not considered an accepted finish for steel parts.

(4) Self-tapping screws, where employed for securing parts subject to frequent removal, are unsatisfactory. Tapped holes in materials whose thicknesses are less than 1/16 inch are not acceptable for screws or set screws in lieu of nuts or suitable inserts.

44. Par. 2-3. With the exception of the wax impregnated fixed by-pass capacitors, molded mica capacitors, and ceramic clad fixed resistors, practically complete disregard has been shown, in the design of this equipment to the protection of the component parts entering into its construction, against the corrosive action of moist sea atmosphere.

(A) Component parts, subject to corrosion, and which when corroded will adversely affect the electrical performance of the equipment are as follows:

(1) All air dielectric tuning and trimmer capacitors (except the panel operated cw oscillator tuning capacitor) employ aluminum plates swedged to brass spacing members. (Refer to paragraph 42 (A) (3).) Corrosion of the aluminum plates will affect the capacity range of the capacitors, hence their tuning range and/or adjustment. The development of corrosion in the regions of the swedged joints, as the result of electrolytic action from direct contact between dissimilar metals in the presence of moist saline atmosphere, will eventually result in loosening of the capacitor plates, and the development of high contact resistance at the swedged joints. This will result in noisy receiver operation and the reduction of the effective "Q's" of the tuned circuits. The aluminum plates of the trimmer capacitors in one of the i-f transformer assemblies already show evidence of corrosion.

(2) The application of cadmium plated steel spade bolts riveted to aluminum shield cans with nickel plated brass rivets and nickel plated brass nuts for chassis mounting, as employed for the i-f and cw oscillator transformer assemblies is unsatisfactory. Effective grounding of the shield cans to the receiver chassis is dependent upon low contact resistances to the spade bolts. This is not a permanent realization in the subject equipment. The mounting nuts, when tightened, will cut the cadmium plating on the spade bolts, exposing the steel to rust. Rusting of the spade bolts will eventually cause the development of high contact resistance between the shield cans and the chassis. This defect in design can be overcome through the use of nickel plated brass spade bolts riveted to the shield cans with dural rivets.

(3) Coil leads of all r-f transformer assemblies show areas of bare copper exposed adjacent to their soldered connections. This is the result of the removal of the enamel from enameled insulated wire and/or the insulation fraying of cotton and/or silk

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insulated wires. Similar exposure of bare copper exists on the turns adjacent to tapped turns of the heterodyne oscillator coils wound with solid enamel insulated wire. This exposure of copper is due mainly to careless workmanship. Corrosion of the exposed areas on the coil leads will result in lead breakage; and of the exposed areas on the oscillator windings, in shorting of the affected turns to the tap connection. Fraying of lead insulation should be minimized by waxing the ends of the leads and all exposed copper should be suitably protected against corrosion.

(4) The sleeving of bare copper wire leads, either stranded or solid, with varnished impregnated fabric sleeving and/or spaghetti does not offer any protection to the leads from the corrosive action of humid saline atmospheres, and the use of either form of sleeving, particularly for radio frequency circuits, is to be avoided.

(5) The soldered ends of all wires should be tinned or otherwise protected against corrosion.

(6) The dependence of ground return circuits upon the use of dissimilar metals in contact for circuit continuity is unsatisfactory. In the model equipment, ground returns are connected to the steel chassis by means of cadmium plated soldering lugs secured to the chassis with nickel plated brass rivets and/or nuts, and parkerized steel external tooth shake-proof lock washers. This assembly of the soldering lugs is such that the plating on the brass parts is destroyed by the biting action of the lock washers, thus leaving the basic brass in contact with the steel chassis. Corrosion will inevitably occur from electrolytic action between the dissimilar metals in contact, thus adversely affecting the performance of the equipment.

(B) Component parts subject to corrosion and which, when corroded, will affect the mechanics of this equipment, are as follows:

(1) The cadmium plated steel tube socket retaining washers are secured with nickel plated brass screws and nuts (except in one instance, where the washer is riveted in place), to the chassis. The nuts are locked by means of parkerized external tooth shakeproof lock washers which, by virture of their biting action, remove the plating from the plated parts, and place the basic dissimilar metals in contact. Corrosion of the mounting screw threads would not be so serious in this instance, were it not for the fact that they also secure some of the ground return soldering lugs. The use of nickel or cadmium plated brass retaining washers and stainless steel lock washers would eliminate the present undesirable situation.

(2) The brass inserts in the molded phenolic mounting plates of the r-f transformer assemblies are unplated, contrary to accepted standards of workmanship.

(3) The use of brass nuts on steel screws, and of unplated steel set screws is unsatisfactory, even though one or both of the contacting parts are plated. The plating on threaded surfaces is easily worn through and if the contacting parts are of dissimilar materials, fusing of these parts together will result if corrosion sets in, making it difficult to loosen them without their breakage or burring of the screw driver slots. The use of stainless steel set screws will overcome this difficulty.

45. Par. 2-4. The soldering workmanship is of only fair quality. Excess amounts of the solder have been applied for many of the soldered connections, particularly for those of the plug-in coil assemblies. This practice frequently results in "cold" soldered connections which will fail under conditions of vibration (as was true for one of the soldered connections in the receiver power cable plug which failed during the vibration test); or in high resistance contacts due to improper bonding due to the presence of foreign material. In the majority of the soldered connections where wire leads are soldered to soldering lug terminals, the wires were not wrapped around the lugs prior to soldering, but were either simply laid against the lugs or inserted through holes in the lugs. Acceptable practice requires that reasonably good mechanical connection be provided at all wire and terminal junctions prior to soldering and that the solder be provided as a bonding medium. There are also frequent instances where there are splatterings of rosin core residues around the soldered connections which leaves the surroundings in an unsightly condition. There is no evidence of corrosive or acid soldering flux having been employed. Considerable improvement in the soldering workmanship should be demanded of the production equipments, with particular attention paid to avoiding a repetition of the faults existing in the model equipment.

46. Par. 2-5. The aluminum tube shields, i-f and cw transformer shield cans, partition shield for the audio gain control and lead telephone jack, and partition shields for the ganged tuning capacity assembly, and the aluminum parts employed in the plug-in coil assemblies are not protected from the effects of prolonged exposure to high saline humidities. These aluminum parts should at least be coated with a heavy film of clear lacquer except for contacting surfaces which should be left in their natural state. Refer also to paragraph 43 (A) (15) of this report. Brass spacer members for air dielectric capacitor rotors and stators, and the isolated brass units and inserts which are now of natural finish should be plated. The finish applied to the receiver chassis being gray is inconsistent with the black finish of the power unit chassis and internal surfaces of the coil rack unit.

47. Par. 2-6. By strict interpretation of this referenced paragraph of the covering specifications, the use of steel in the construction or fabrication of the following items is contrary to the specification requirements.

(a) Receiver chassis and associated dust cover.
(b) Front panel chassis and dust cover of the power unit.
(c) Rear enclosure of the coil rack.
(d) Cabinet of cabinet type loud speaker unit.
(e) Miscellaneous parts, which include tube socket retaining rings, hand grip handles, brackets for pilot lamps, screws, nuts, and lock washers, etc., discussed elsewhere under various paragraph headings of this report.

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48. Par. 2-7. The model equipment functioned without serious loss of sensitivity when enclosed in a temperature chamber where the ambient temperature was varied from -10° C to +51.5° C. The total change in oscillator frequency resulting from this change in ambient temperature was 0.546% of the resonant frequency to which the receiver was tuned. The receiver was tuned to a frequency of 14.13 megacycles and was allowed to operate for two hours at the start and finish of the run to permit the stabilization of the heterodyne oscillator to become established. The equipment was set up in the temperature chamber with the dust covers in place and adjusted for standard conditions. The frequency drift was measured through the use of a Model LM-2 Crystal Frequency Indicator employed for checking the signal generator frequency by the zero beat method. The only physical effect produced by the temperature variation was the flowing out of oil from the paper carton, tabular by-pass capacitors.

49. Par. 2-8. Fuses are provided in the Power Unit to protect the component parts in the equipment from damage due to electrical overload resulting from the electrical failure of any one of the components or the occurrence of some other form of short circuit. (Refer also to paragraph 117.)

50. Par. 2-9. Ample ventilation appears to have been provided for cooling the Receiver and Power Units.

51. Par. 2-10. All items, with the exception of the foil-paper, wax filled, paper carton, tubular type capacitors employed in the Receiver Units, entering into the construction of the model equipment appear to be capable of withstanding operation, without damage, in any ambient temperature between the limits of -10° C and +51.5° C. The equipment was operated for two hours at each of the extreme temperature limits of the specified temperature range. The equipment, owing to the types of materials employed in its construction, cannot be expected to operate indefinitely without damage to some of its component parts, under conditions of wide temperature variation which might result in condensation of moisture at the lower temperatures. The paper carton, tubular type capacitors are filled with a mixture of oil and wax. The melting point of this mixture is such that it becomes tacky and tends toward dripping even at room temperatures, when the equipment is operated on all-day schedules. At higher temperatures, the pressure built up inside of the capacitors forces the oil out, with the result that excessive dripping occurred. For this reason, these capacitors are not generally considered suitable for use in the Naval Service. They should be replaced with capacitors, hermetically sealed in aluminum containers, with chlorinated diphenol filling, if reliable receiver operation is to be expected under conditions of high temperatures and high humidity.

52. Par. 2-11. The design of the equipment is such that satisfactory operation, without damage, may be expected on a moving platform inclining up to 45° from the vertical in any position, provided that this movement is accomplished without vibration. See also comments under paragraph 53 below.

53. Par. 2-12. The design and construction of this equipment is such that it will not withstand prolonged vibration without damage.

The non-ridged mounting brackets, carrying heavy loads, may be expected to become loosened, and long, unanchored leads may be expected to break if the equipment is subjected to prolonged vibration. Faulty operation will also result, due mainly to the inferior contact design incorporated with the plug-in coil assemblies. Tests conducted at 1000 kilocycles on a vibration table showed that while a copyable signal was obtained, the receiver was rendered inoperative when the vibration ceased. Tests at 14 megacycles, under conditions of vibration, proved the equipment to be useless. Major design changes will be necessary if this equipment is to withstand vibration of such magnitudes as are normally encountered on certain types of Naval vessels.

54. Par. 2-13. No Navy type numbers are required for the components employed in the preliminary model. The manufacturer has failed, however, to include either circuit symbols or other means for identication of component parts except for the fixed by-pass capacitors, fixed resistors, and vacuum tubes, in accordance with the specification requirements. The receiver chassis has its tube sockets identified by commercial tube type numbers, which are other than those applying to the types of tubes furnished with the receiver. The arrangement of the parts on the under side of the receiver chassis is such as to make it difficult to mark the chassis with their circuit symbols in compliance with present day Naval requirements.

55. Par. 2-14. No nameplates are required on the model equipment under the terms of the contract, reference (c). However, it is not apparent from an inspection of the equipment where the manufacturer intends to locate the nameplates on production equipments, in compliance with this specification reference, as no nameplate mounting holes have been provided for the individual units.

56. Par. 2-15. Lock washers, where employed, are not consistent either in type or application. Nickel plated, phosphorous bronze, external tooth shakeproof lock washers and parkerized steel spring type lock washers have been employed for identical applications in the plug-in coil assemblies. In some of the coil mountings, the lock washers have been employed under the mounting screw heads and under the nuts in others. In the receiver chassis, parkerized steel external tooth shakeproof lock washers have been employed for securing nickel plated brass nuts on nickel plated brass screws. The use of the internal tooth shakeproof soldering lug is not considered a satisfactory means for locking nuts on mounting screws because it has been demonstrated that their locking action is not dependable. No lock washers have been employed in the construction of the loud speakers, in the construction of the plug-in coil assemblies, except for coil mounting screws, under the heads of the self tapping screws, or for the locking of mounting nuts of the trimmer capacitor assemblies. In no instance have nuts, employed for securing screws in radio frequency circuits, been soldered in compliance with this paragraph reference of the governing specifications. Pressure contacts, rather than continuous soldered connections, have been the rule in the construction of the model equipment. (Refer also to paragraph 129.)

57. Par. 2-16. Two electrolytic capacitors, each rated for 10 microfarads at 50 volts, d.c., are employed in the Receiver Unit as cathode by-pass capacitors for the second detector and a-f amplifier tubes.

58. Par. 2-17. All air dielectric capacitors used for circuit tuning and/or trimming are of the rotary plate type. Each of the i-f and cw oscillator transformer assemblies employs two identical capacitors mounted on a common ceramic mounting plate. Air dielectric capacitors employed in the r-f transformer assemblies are mounted on the molded low loss phenolic mounting plates common to the coil and contact mountings. Screwdriver slots are provided in the ends of all rotor shafts for capacity adjustment. The method of mounting the rotor shafts is such as to depend upon spring pressure for locking of the rotors in position. The pressure afforded is sufficient to preclude movement of the rotor shafts during transportation, or under conditions of vibration in service usage. Refer also to paragraph 43 (A) (7).

59. Par. 2-18. With three exceptions, the wiring employed in the several units of the model equipment is not color coded as required by this paragraph reference of the governing specifications. The exceptions are the leads from the i-f and cw oscillator transformer assemblies, the conductors of the receiver power cable, and the conductors of the loud speaker coupling cable.

60. Par. 2-19. In general, the wire used in the Receiver and Power Units for interconnection of circuit components is of stranded flexible conductor, employing rubber insulation with a fabric outer braid. This outer braid appears to be of wax impregnated silk. The leads from the head telephone output transformer and high voltage leads from the power transformer are constructed from several strands of bare copper wire of small diameter braided together. They are then sleeved with spaghetti tubing, which extends inside of the transformer enclosures. This construction is entirely unsatisfactory in that it affords no protection against breakage of the fine strands of wire from corrosion or means for the preclusion of moisture entering the transformer mountings from "wick" effect, and ultimately causing internal corrosion from electrolytic action. The low voltage secondary leads from the power transformer are of single strand bare copper wire, sleeved with spaghetti tubing. This construction is unsatisfactory not only because of the probable resultant damage to the windings as well as the leads from corrosion, but also because their use as interconnecting leads to other components is considered as in violation of the requirements for good workmanship. The leads from the filter reactor are of the same quality as for those employed for circuit wiring in the Receiver Unit. The leads from the ON-OFF toggle switch for the Power Unit are spliced to the input leads of the power transformer. Splicing of leads is not acceptable and is in violation of accepted Naval standards for good workmanship and construction.

61. Par. 2-20. The vacuum tube sockets for the first and second i-f amplifier and cw oscillator tubes are of the phenolic wafer type whose use is contrary to the specification requirements of reference (b). Isolantite sockets of the "octal" type are employed for the second detector and a-f amplifier tubes. All other sockets used in radio frequency circuits employ Alsimag insulation.

62. Par. 2-21. The power transformer and filter reactor employed in the Power Unit are not considered as being effectively "potted" to preclude the entrance of moisture. Dripping of moisture can take place

in these units as the result of condensation under their common cover plate. Refer to comments under paragraph 60. The coupling transformer for the reproducer units furnished under reference (c) are of exposed core and winding construction without benefit of protective enclosures or any form of protective sealing compound. Their construction is, therefore, in direct violation of the requirements of this specification reference.

63. Par. 2-22. The front surfaces and edges of the front panels of all units, the cover plate for the tube aperture in the Power Unit, the panels of the plug-in coil assemblies, the grill and cabinet for the cabinet type Loud Speaker Unit and the hinged door of the Coil Rack have a black wrinkle finish, whose texture appears to conform with the Navy standard black wrinkle finish.

64. Par. 2-23. Dull black lacquer finish has been applied to the following items:

(a) Rear surfaces of all panels and/or other items listed under the above paragraph.
(b) Chassis, mounting brackets, and cases for the power transformer and filter reactor of the Power Unit.
(c) Dust cover for the Power Unit.
(d) Interior and exterior surfaces of the coil compartment for the Coil Rack.
(e) Grill guards for both types of Loud Speaker Units.
(f) Angle iron framework and all braces except top and bottom straps of Mounting Rack.

Glossy black lacquer finish has been applied to the following items:

(a) Interior and exterior surfaces of dust cover for Receiver Unit.
(b) Bottom cover plate for chassis of the Receiver Unit.
(c) Top and bottom bracing straps and angle type moldings for Mounting Rack.
(d) Cover plate for power transformer and reactor in Power Unit.

The interior and exterior surfaces of the receiver chassis and all brackets mounted thereon, and the head telephone output transformer are painted with gray enamel. None of the items listed under paragraph 63 or above are provided with any form of anti-corrosion primer as required under reference (b). The use of lacquer on steel parts is definitely not considered a satisfactory protection for steel parts against the formation of rust.

65. Par. 2-24. Dust shields furnished for the Receiver and Power Units are four-sided as described under reference (e) which is not recognized under reference (c). Their application and methods for mounting to their respective units are as follows:

(1) The bottom of the chassis of the Receiver Unit is provided with a detachable cover plate which, together with the dust shield, completes the enclosure of the Unit. The two sides and rear of the dust cover are punched with a series of holes arranged in rows for ventilation purposes. It is secured to the front panel by means of four cadmium plated spade bolts, fitted with thumb nuts, and arranged two along the top and one on each side. The spade bolts are riveted to the dust shields with nickel plated tubular rivets. The types of spade bolts employed and their method of mounting are objectionable. The spade bolts, being of the single hole mounting type, are free to rotate about their rivets, thus making their alignment with their corresponding holes in the front panel difficult, particularly in cramped quarters. The use of spade bolts employing two mounting holes is clearly implied to overcome thie mechanical defect. The use of steel spade bolts in conjunction with nickel plated brass rivets and thumb nuts is not desirable. The plating on the threaded surfaces will ultimately wear through, leaving the two dissimilar base metals in intimate contact and subject to possible corrosion from electrolytic action. Since bonding of the dust shield to the front panel of the receiver is dependent upon good conductivity through the spade bolt, any corrosion which may take place either at the points of riveting or between threaded surfaces of the spade bolts and thumb nuts will be detrimental to the shielding integrity of the Receiver Unit. Better bonding can be effected through the use of brass spade bolts. The dust cover is secured to the rear of the chassis by means of three parkerized steel self tapping screws. It is so mounted that it may be removed without detachment of the Receiver Unit from the Mounting Rack, provided that sufficient clearance is allowed at the rear of the rack for this purpose.

(2) The complete enclosure for the Power Unit is formed by its chassis and dust shield. The dust shield is provided with a series of ventilating louvers punched in its two sides and rear. It is secured to the three sides of the chassis by means of parkerized steel self tapping screws and to the front panel of the Power Unit by means of two #10-32 parkerized steel binder head machine screws. The #10-32 screws employed for securing the dust cover to the front panel are inconsistent with the spade bolts and thumb nuts employed for the Receiver Unit. Spade bolts and thumb nuts are preferable to screws for this application. The dust cover is so mounted as to require clearance on both sides and rear for its removal without removing the Power Unit from the Mounting Rack.

(3) No dust covers are provided for the Loud Speaker Unit or the Coil Rack. The coil compartment for the latter unit serves as its own dust cover and is integral with the unit.

66. Par. 2-25. The panels of all units are provided with slots to permit securing them to the Mounting Rack. All units, except the Coil Rack, have two such slots on each side of their panels, in accordance with specification requirements. The panel for the Coil Rack has four slots in each side, but since its area is approximately twice that of the Power Unit, the use of four slots is considered in order.

67. Par. 3-1. The dimensions and weight of the Receiver Unit, together with their respective limiting values as set forth under references (b) or (c) are as follows:

	Actual	Allowed
Width (over dust shield)	17"	17-3/8"
Panel height	8-3/4"	8-3/4
Panel width	19"	19"
Depth (rear of panel to rear of dust shield)	10-1/8" *	10"
Weight	32.2 lb.	40.0 lb.

* Exceeds allowable limit.

68. Par.3-2. The dimensions and weight of the Power Unit, together with their respective limiting values as set forth under references (b) and (c) are as follows:

	Actual	Allowed
Width (over dust shield)	16-1/4"	17-3/8"
Panel height	5-1/4"	5-1/4"
Panel width	19"	19"
Depth (rear of panel to rear of dust shield)	9-9/16"	12"
Weight	23.4 lb. *	22.0 lb.

* Outside of allowable limit.

69. Par. 3-3. The dimensions and weight of the Loud Speaker Unit together with their respective limiting values as set forth under references (b) and (c) are as follows:

	Actual	Allowed
Panel width	19"	19"
Panel height	8-3/4"	8-3/4"
Depth (rear of panel to rear of speaker)	4"	-
Weight	7.3 lb.	10.0 lb.

70. Par. 3-4. The dimensions and weight of the Coil Rack Unit, together with their respective limiting values as set forth under references (b) and (c) are as follows:

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	Actual	Allowed
Panel width	19"	19"
Panel height	12-1/4"	12-1/4"
Width (over coil cabinet)	15-3/4"	-
Depth (rear of panel to rear of coil cabinet)	5-3/4"	-
Weight (with full complement of coil sets)	24.75 lb.	-
Weight (empty)	12.50 lb.	-

71. Par. 3-5. The dimensions and weight of the Mounting Rack, together with their respective limiting values as set forth under references (b) and (c) are as follows:

	Actual	Allowed
Height	39-3/4" *	37"
Width	20-1/2" *	19"
Footing depth (face to rear)	12-3/16"*	12"
Weight	27 lb. *	25 lb.

* Exceeds allowable limit.

The dimensions and weight of the cabinet type Loud Speaker Unit submitted as an alternate under reference (c) are as follows:

	Actual
Width	10-1/4"
Height	9-1/2"
Depth	7-3/8"
Weight	10.7 lb.

72. Par. 4-1. The Receiver Unit is of panel-chassis construction designed for relay rack mounting. All component parts, with the exception of a few of the panel operated controls and/or devices, are mounted on the chassis. A removable dust shield is provided and is secured to the front panel and the rear of the chassis.

73. Par. 4-2. The following controls and/or devices are symmetrically arranged on the front panel, with the main tuning control centrally located between the sides of the panel and above the plug-in coil set aperture.

(a) Main tuning control.
(b) R-F GAIN control.
(c) AUDIO GAIN control.
(d) CW OSCillator control.
(e) AVC ON-OFF switch.
(f) B+, ON-OFF switch.
(g) Pilot light.
(h) Telephone jack.

[redacted]

The identification markings on the controls and/or devices are indicated by the capitalized letters in the above listing.

74. Par. 4-3. Two hand grips, provided in accordance with the requirements of this referenced paragraph, are mounted on either side of the plug-in coil set aperture in the front panel of the Receiver Unit. They are identical in design with those furnished on the plug-in coil sets, and are made from 3/16 inch diameter steel (or iron) rod bent into the shape of a "U." Their function is presumably twofold; namely, to provide means for handling the receiver chassis, and to furnish leverage pivots for removing the plug-in coil sets. Their design is such as to preclude any possibility for full hand gripping. This, and their situations on the front panel, makes their use in handling the receiver awkward, due to the uneven distribution of the receiver weight around them. Their spacing, with respect to the hand grips on the plug-in coil sets, is such that one's fingers may easily be injured when removing a plug-in coil set. It is the opinion of the Laboratory that the hand grips furnished are unsuitable for their intended purposes owing to the fact that their usefulness is defeated by the disadvantages inherent in their design and their locations on the front panel. Pivot points are unnecessary for removing a plug-in coil set since the front panel is rigidly supported by the relay rack. Hence, the receiver will not be moved by any pull on the plug-in coil set. Hand grips of the drawer pull type, large enough to provide for full hand gripping, mounted near the slotted edges and approximately midway between the top and bottom edges of the front panel would be not only more appropriate, but would meet the requirements of this paragraph reference of the governing specifications. Such a design change would permit a further design improvement to overcome one other defect in the design of the Receiver Unit and that is, that it will permit the mounting of clamping "dogs," or similar devices, to secure the plug-in coil set in place and obviate any tendency for its movement under conditions of vibration. In the present design, the coil set is free to move by an amount sufficient to effect erratic receiver operation due to the non-rigid fit between the ground clips in the ends of the coil shield cans and the ground pins in the rear of the plug-in coil compartment of the receiver chassis.

75. Par. 4-4. All controls and/or devices are symmetrically arranged on the front panel of the receiver unit. The R.F. GAIN, AUDIO GAIN, and C.W. OSCillator controls are provided with etched nickel-silver dials with lacquered surfaces. The descriptive words, indicated by the capitalized letters above, designating their respective functions, are engraved thereon. In addition, the dials are graduated with ten engraved divisions with engraved numbering from 0 to 10, increasing in a clockwise direction for increasing controlled effect. The dials for the R.F. GAIN and AUDIO GAIN controls are engraved for 270° rotation. The dial for C.W. OSCillator control is engraved for 180° rotation, with approximately 45° additional rotation for operating the C.W. ON-OFF switch. The "OFF" position is engraved on the dial. Fiducial marks for these controls are engraved on the panel. The AVC "ON-OFF" and B+ "OFF-ON" toggle switches have their functions, as indicated by the capitalized letters, engraved on the front panel. It is to be noted that the "OFF" positions of the two toggle switches are in opposing directions. The production equipments should have the front panels engraved, and the switches wired and mounted to effect "ON" in a right hand direction when facing the receiver so as to

comply with accepted standards. No descriptive words or phrases are provided to indicate the function of the main tuning dial. However, the function of this control is so obvious that it is not felt that any further identification is necessary.

76. Par. 4-5. The receiver is provided with circuits as listed below. Reference to Plate 50 and paragraphs 14 to 34 inclusive of this report will give additional descriptive information.

- (a) Antenna circuit.
- (b) Preselector, consisting of three tuned circuits.
- (c) First detector (or mixer).
- (d) First oscillator (or heterodyne oscillator).
- (e) I-F amplification, consisting of two transformer coupled stages.
- (f) Second detector and AVC employing a twin triode for the dual function.
- (g) Second oscillator (or cw oscillator).
- (h) Audio amplifier, one stage, with provision for switching from headphone to loud speaker reception.

The governing specifications require the use of two stages of audio amplification, one for headphone reception and the other for loud speaker reception. The circuit design employed in the model receiver employs only one stage of audio amplification. Separate output transformers are incorporated for the two forms of signal reproduction, with switching from one form to the other being effected through the telephone jack. It is believed that the circuit design complies with the spirit of the requirements of this specification reference, if not in the strict interpretation of its wording.

77. Par. 4-6. The Receiver Unit is so designed as to be suitable for battery or a-c power unit operation. It is designed to operate from a 6.3 volt a-c or d-c low voltage supply for filament heating, and 250 volt battery potential or rectified d-c potential for plate and screen supply. The low and high voltage requirements comply with the contract, reference (c).

78. The high voltage d-c power consumption is 76 milliamperes at 260 volts. The low voltage a-c power consumption is approximately 3.15 amperes at 5.95 volts. These figures are based on a line voltage of 115 volts a.c. to the Power Unit. (Refer also to Table 3.) The d-c drain is in excess of the 60.0 milliamperes maximum allowed by the governing specification. The low voltage current consumption complies with the maximum value stated in reference (d), but the voltage is less than the specified value.

79. Par. 4-8. The frequency range of the receiver unit is covered through the use of seven sets of plug-in coil sets whose rated and actual frequency coverages are listed under Table 1. Refer also to paragraph 40 of this report. The calibration of each plug-in coil set was effected through the use of the Model LD-2 Crystal Controlled Heterodyne Calibrator used in conjunction with the Model LC-1 Standard Signal Generator. The limiting frequencies for each band were assumed to be those reached at

the zero and 500 dial settings. Three other frequency settings were also calibrated for each band, these settings being in geometric frequency progression with respect to each other and the end frequencies. Calibration curves are shown on Plate 1.

80. Par. 4-9. The plug-in coil sets are designed for insertion in the Receiver Unit through a suitable aperture, provided for this purpose, in its front panel. Their constructional details are as follows:

(A) General. Each plug-in coil set is of unit assembly, containing four coil shield cans housing the frequency determining circuits for its own particular frequency range; and which, through the use of appropriate handles, may be inserted in or removed from the receiver in one assembly.

(B) Face Plate. The coil sets are provided with face plates of 3/16 inch thick aluminum, fitted with two hand grips. Riveted to the back of each face plate and with a fish paper separator is a 1/16 inch thick aluminum channel to which the four shield cans are attached. The fish paper, presumably, is provided to protect the painted surfaces surrounding the plug-in coil aperture in the front panel of the receiver. However, its effectiveness for this purpose is questionable and in the opinion of the Laboratory is more of a liability than an asset for reasons which are revealed below. Each side member of the aluminum channel is provided with clearance holes, two for each coil assembly, for the coil shield can mounting screws.

(C) Coil Shield Cans. The aluminum coil shield cans are five sided, rectangular in shape, and of one piece drawn construction. (Refer to paragraph 42 (A)(4). With respect to the face plates to which the shield cans are mounted, the two wider parallel sides of each shield can constitute its top and bottom sides, the closed end its back side, and the open end its front side. The top side of each can is provided with a 1-7/8 inch x 1-3/8 inch rectangular aperture for the coil contacts, three clearance holes for 6-32 mounting screws for securing the one piece molded phenolic mounting plate (discussed elsewhere in this report and containing the circuit components and contact buttons); and two 7/16 inch diameter holes near the front end of the can for access to the circuit trimmer capacitors. In the rear of all shield cans are two punched 7/16 inch diameter holes which have no useful function. Also, in the rear of each shield can, except those employed for the heterodyne oscillator circuits is a centrally located clearance hole for the passage of the corresponding ground pin located in the rear of the plug-in coil compartment of the receiver chassis. This pin engages a spring jack or clip riveted to the inside and to the rear face of the shield can. This jack is of the type normally employed for Navy standard tube sockets and is of very satisfactory design. The rivets employed for securing the grounding jacks are of nickel plated brass. The use of nickel plated brass rivets for this application is objectionable because it is not possible to head over such rivets without, at least, the partial destruction of the nickel plating. This precludes permanence in low resistance contact between the ground jack and the aluminum shield can to which it is attached, owing to corrosion which will inevitably take place between the contacting surfaces as the result of electrolytic action when subjected to moist, saline atmospheres. Dural rivets with their heads staked to the coil cans are the only type of rivets that are considered applicable and in keeping with Naval standards for good workmanship and construction.

(D) Shield Can Mounting. The aluminum channel, mounted on the back of the plug-in coil set face plate, is equipped with two cadmium plated steel straps, each containing two tapped holes, for each coil shield can of the coil set. The coil shield can mounting screws pass through the flanges of the aluminum channel and engage with the steel straps. The coil shield cans are mounted against the aluminum channel with their top and bottom sides sandwiched between the channel flanges and the steel straps. This is effected through the use of slots in the front edges of the top and bottom edges of the shield cans to permit their passage around the mounting screws. Tightening of the mounting screws wedges the shield cans between the steel straps and channel flanges. The steel straps have protuberances on their ends which bite into the edges of the shield cans so that the permanence of their attachment will not have to depend solely on friction. The use of the steel in lieu of nickel plated brass for the mounting strap in conjunction with brass screws is not acceptable, in spite of the plating on the two parts. In time, the plating on the treaded surfaces will eventually wear away, leaving brass in intimate contact and therefore subject to "freezing" as the result of corrosion. It would also be advisable to employ 6-40 mounting screws in lieu of 6-32 mounting screws so as to provide more threads in the tapped holes in the mounting straps. The design of the coil sets is such that their servicing by one unfamiliar with their construction may result in one or more of the coils being permanently damaged, because the complete removal of the shield can mounting screws will cause their securing straps to drop into the shield can where they will be free to shake around during handling. Such a condition is unsatisfactory and should be corrected by staking the ends of screws so as to obviate their complete removal from the straps.

(E) Shielding. The shielding integrity of the enclosure formed, when the plug-in coil set is inserted in the coil compartment of the receiver, is only fair. Its inferior quality contributes to the poor showing which the receiver gave when tested for spurious responses. The plug-in coil set, when inserted in the receiver, does not completely

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shield the front panel coil set aperture or coil compartment attached to the receiver chassis. At best, it provides only electrostatic shielding and very little electromagnetic shielding. Grounding of the face plate of the plug-in coil set is effected through ground pins in the rear of coil compartment, and thence through the coil shield cans. There is no metallic bonding provided between the face plate of the plug-in coil set and either the front panel or the outer edges of the opening of the coil compartment. This is due to the fact that the surfaces, which should be in contact for effective shielding, are painted; and in addition, the fish paper insert on the plug-in coil set precludes any accidental contacts. Another contributing factor which detracts from the shielding integrity is that each of the coils in the plug-in coil sets is, in effect, provided with shielding on only three sides of the coil. The individual coil assemblies are so designed that the large opening for the contact assembly in the coil shield can is directly above the coils; and, when the plug-in coil set is inserted in the receiver, this opening is coincident with a similar aperture provided for the spring wiper fingers in the coil compartment.

81. Par. 4-10. Each plug-in coil assembly is provided with five button type contacts which make sliding contact with spring wiper fingers mounted on the receiver chassis. Their mechanical design and construction is such as to be entirely unsuited and unsatisfactory for the purpose intended. Their construction consists of silver plated brass rivets which pass through nickel plated collars, thence through the molded phenolic mounting plate where they are riveted against soldering lugs. The leads are connected to the soldering lugs and depend upon pressure for circuit continuity to the button contacts. This form of construction is unsatisfactory because it has been known to develop high resistance contacts in time due to oxidation and/or corrosion. Where such construction is employed, the soldering lug should be soldered to the rivet. In the model coil assemblies, peaning of the rivets destroyed the silver plating on the peaned ends leaving the brass base metal exposed. Moreover, after relatively few cycles of removal and replacement of the plug-in coil sets, the silver plating on the rivet heads wore through to the base metal. A complete redesign of the contact buttons is implied for the production equipments. This new design should employ either coil silver rivets or coin silver facings of not less than .015 inch finished thickness on silver plated brass rivets. The silver plating on the spring wiper contacts also wore through to the base metal. The spring wiper contacts employed in the production equipment should be silver plated to the extent of .015 inch in finished thickness.

82. Par. 4-11. Each plug-in coil set carries on its face plate a chart showing in curve form, frequency versus tuning dial divisions. This is a printed chart. Another chart of similar size, also printed, is provided on the opposite side of the face plate and is ruled and labeled for logging station letters versus tuning dial divisions. Both charts are enclosed in steel frames finished with flat black lacquer. The calibration chart is protected with a transparent covering having a glossy surface which is objectionable for Naval equipment because of

the attendant glare under strong illumination. The second chart is without any protective covering and can be easily smudged from normal handling; particularly, if recordings are penciled. The printed frequency range for each coil set as shown in its calibration chart is in terms of the actual end frequencies instead of the actual working frequencies for the band. The coil sets are not numbered. Each of the coil sets should carry a nameplate bearing, in reasonably large characters, the working frequency range and the coil set number. Numbering of the coil sets should be progressively from 1 to 7, with Band 1 being that one covering the lowest frequency range. The use of steel for the chart frames and its mounting screws is objectionable. The black lacquer finish on the steel frames is not sufficient protection against rust and the consequent discoloration of the charts. It is the opinion that black nickel brass frames and mounting screws should be employed for the production equipments.

83. Par. 4-12. The hand grips provided for the plug-in coil sets are of the same construction as those furnished for the front panel of the receiver. Their mechanical design is satisfactory but the use of steel in their construction is objectionable.

84. Par. 4-13. The frequency ratios for Bands 1, 3, and 4 exceed the specified maximum limit of 2.35 to 1. Complete data are given under Table 2.

85. Par. 4-14. The ganged tuning capacitor assembly consists of two pairs of identical air dielectric capacitors, ganged in line, and mounted on either side of a worm drive assembly. The capacitors are designed for maximum capacitance change through 180° of rotation. The entire ganged assembly is of rugged construction. The capacitors are free running and free from excessive back and torque lash.

86. The rotor and stator plates of the capacitors are of natural aluminum swedged to unplated brass machined supporting members. This construction is undesirable. (Refer to paragraph 42 (A)(3).) Swedging alone does not constitute adequate security against the development of high resistance contacts between the swedged members, with the consequent change in the electrical constants of the capacitors. The composite use of aluminum and brass in the construction of the rotor and stator assemblies definitely limits them to swedging as a practical means for fastening their plates to their supporting members. The capacitor plates and their supporting members should be of like material - either brass or aluminum - so that, in addition to swedging, the plates may be either soldered or welded to their supporting members. These assemblies should then be protected against corrosion through the use of a heavy coating of lacquer for aluminum assemblies, and silver or nickel plating for brass assemblies. Cadmium plating of brass plates for air dielectric capacitors, however, is not acceptable because of its "growing" tendencies.

87. The stator assemblies are supported by means of ceramic straps secured to the end plates which constitute part of the framework for the capacitors. Rotor assemblies are insulated from their drive shafts and are secured to their drive shafts through the use of two cadmium plated steel set screws for each capacitor. The drive shafts are of cadmium

plated steel, where stainless steel would be preferred to prevent "freezing" in its bearings from corrosion resulting from the wearing away of the cadmium plating, thus exposing the basic material to the elements. A two-pronged, silver plated spring wiper contactors which straddles the capacitor shaft is provided for each capacitor rotor and makes contact with the face of the rotor hub. The silver plating on the spring wiper contactors wore through to the basic metal during the tests. These contactors are, therefore, unsatisfactory particularly as employed in the model equipment where they contact unplated brass capacitor rotor hubs. Silver to silver contact, provided through the use of coin silver facings on the rotor hubs and coin silver contact buttons on the wiper contactors, is normally expected for air dielectric tuning capacitors for Naval receivers. Each spring wiper contactor is secured by means of a single rivet to the molded phenolic end plate constituting the framework of its associated capacitor. It is electrically connected to one of the coil spring wiper contactors by means of heavy tinned copper bus wire. In the model receiver, these rotor hub wiper contactors were forced, by the bus wire, against the insulating sleeves of the rotor shafts so as to cause their inner edges to cut into the insulating sleeves, thus preventing positive contact with the rotor hubs and resulting in noisy operation of the ganged tuning capacitor assembly. To mitigate this possibility, two rivet mounting of the rotor hub wiper contactors should be employed to prevent their rotation from their normal positions. Electrical connections to each of the stator assemblies depend upon pressure contact between a soldering lug and the mounting nuts on one of the stator bars. This is unsatisfactory and in the production equipments, the soldering lug should be bonded with solder to both the mounting nuts and associated stator spacing members.

88. In the framework of the ganged capacitor assembly the outermost end plates are of cadmium plated steel; the spacer rods between individual end plates are of cadmium plated steel rod with nickel plated brass sleeving. Adjustment screws are of cadmium plated steel. Lock nuts are of nickel plated brass. Cadmium plated steel set screws, where mechanical strength is of prime importance, are satisfactory provided that the manufacturer can satisfactorily demonstrate that the cadmium plating will withstand a standard 200 hour salt water immersion test. However, the use of steel against brass in the construction of the capacitor frames should be corrected through the substitution of nickel plated brass end plates and spacer rods.

89. Par. 4-15. The mechanical drive assembly for the main ganged tuning capacitors is rugged and well constructed. The drive is free of back lash and torque lash at all parts of the scale to 0.2 division of the dial in compliance with reference (c). The entire drive is free running and is, by virtue of the friction in the gearing, substantially balanced at all points of rotation. The gear housing is totally enclosed and its parts are of die-cast aluminum alloy. The exterior of this housing is painted with gray enamel. The housing employs a separable cover cap in which the control stop is an integral part. The front bearing housing and split worm gears are also of die-cast aluminum alloy. The worm is not visible, but, in any event, provides smooth operation. The worm gears are coated with a lubricating grease and are provided with two very rugged take-up springs. Except for the front bearing housing, which should be painted to protect it from corrosion as for the main housing, the drive should give trouble-free performance.

90. The tuning dial, concentric with the control knob, is 4-1/2 inches in diameter. The fiducial mark is mounted at the top of the dial periphery. The spacing between the dial and its fiducial mark is considered excessive as less spacing would permit more accurate dial readings. The dial is calibrated with 50 divisions, and in turn is provided with a counter integral with the dial so calibrated as to permit reading of the actual number of total divisions from one to five hundred for 180° of capacitor rotation.

91. Par. 4-16. The Receiver Unit employs a total of nine vacuum tubes.

92. Par. 4-17. The tube complement is as follows:

Function	Commercial Tube Type No.
1st R-F Amplifier	6D6
2nd R-F Amplifier	6D6
1st Detector (or mixer)	6C6
1st Oscillator (or heterodyne oscillator)	6C6
1st I-F Amplifier	6D6
2nd I-F Amplifier	6D6
2nd Detector and AVC	6F8G (Dual purpose twin triode)
2nd Oscillator (or cw oscillator)	6C6
A-F Amplifier	6V6G

The types 6F8G and 6V6G vacuum tubes are employed in lieu of the types 6B7 and 42 respectively as required under reference (c).

93. Par. 4-18. Universal coils, employed in the i-f transformers, are wound on ceramic forms. The coils are not wax dipped as required by the specification reference. The manufacturer's representative claims, however, that they are polystyrene impregnated. While this is satisfactory, it is believed that they should be cold wax dipped to provide extra protection against humidity. Universal coils employed in the preselector and heterodyne oscillator assemblies are, in general, wound on what appears to be untreated wooden dowels. The use of wood coil forms is not satisfactory, and substitution,therefore, of ceramic, phenolic, or polystyrene coil forms is in order for compliance with the governing specifications. The universal coils are not wax dipped, as required. Polystyrene impregnation is claimed, however, for these coils. Layer and spaced wound coils are wound on threaded molded coil forms of low loss phenolic material in compliance with specification requirements. The windings are coated with what is claimed to be polystyrene. The coils are mounted by means of aluminum brackets to molded low loss phenolic plates on which are also mounted their associated trimmer capacitors, coupling coils, contact buttons, and other circuit components integral with the particular coil assemblies. The coil forms provide single hole mounting. Universal coils serving as the primary windings for the three lower frequency bands are mounted directly on the phenolic plate by means of a single screw through their coil form. Two methods of inductance trimming are employed for the heterodyne oscillator coils.

One method, applied for universal coils, consists of a single turn of bus wire forming a closed loop and mounted concentrically to the end of the coil form. Inductance trimming is accomplished by adjustment of its position on its cadmium plated brass supporting bracket with respect to the oscillator winding. The other method, employed for layer wound, oscillator coils is through the use of solid brass disk mounted inside of the molded coil form, and which may be moved in or out of the coil form with respect to the end of the winding for inductance trimming. Fixed molded phenolic cased mica capacitors employed for circuit padding are suspended by their pigtail leads between the soldering lugs for the trimmer capacitors and contact buttons. The method of mounting these capacitors is such that their leads are excessively long and are not rigidly supported against movement under conditions of vibration.

94. Par. 4-19. The antenna circuit for each plug-in coil assembly is arranged for either a balanced feed line or simple antenna ground combination through the use of a removable jumper connection to ground.

95. Par. 4-20. The input impedances of the plug-in coil assemblies fail to comply with the limits of this specification reference at the low frequency end of Band 1, and the upper halves of the frequency ranges of Bands 3 and 5. Further data are given under Table 4.

96. Par. 4-21. The output telephone jack mounted on the front panel is of two circuit design arranged for switching the plate of the output tube from the primary of the phone output transformer, when the phone plug is inserted, to the primary of the loud speaker coupling transformer when the phone plug is withdrawn. When the telephone plug is inserted, the loud speaker is rendered inoperable.

97. Par. 4-22. The telephone output circuit is transformer coupled. The transformer primary, fed from the plate of the output tube, is shunted with a 300 ohm resistor to limit the power applied to the head telephones. The secondary circuit is balanced with respect to ground, its midpoint being grounded.

98. Par. 4-23. Maximum audio output across the phone output circuit for a 1,000 cycle output signal occurs for a load impedance of 500 ohms. For a 600 ohm load impedance, as specified under reference (b), the audio output is 1/4 decibel less than that obtained for optimum load impedance. Since the specified value of load impedance is an approximate value, specification compliance is considered to have been met by the model equipment. Refer to Plate 40 for a curve showing the variation of the phone circuit output with change in phone circuit load impedance. All data are based on a 1,000 cycle modulated signal applied at the receiver input from the Model LC-1 Standard Signal Generator adjusted for a signal frequency of 195 kilocycles and with the receiver gain adjusted for standard conditions. Audio output voltages across the test loads were measured with a General Radio Wave Analyzer.

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99. Par. 4-24. The voice coil of the loud speaker is connected to the plate of the a-f output tube, when the telephone plug is removed from the telephone jack, by means of transformer coupling. The primary of the transformer carries the tube plate current and has an impedance of approximately 11,500 ohms. While this impedance is satisfactory for the type of output tube employed, its value exceeds the specification limit of 7,000 ohms, which is based on the use of a commercial type 42 output tube. The d.c. flowing through the primary winding varies from 37 to 41.5 milliamperes for a change in line voltage to the Power Unit from 110 to 120 volts. The specification maximum of 35 milliamperes based on the use of the commercial type 42 tube is therefore exceeded. The variation in audio output across the secondary winding of the loud speaker coupling transformer with change in load impedance is shown in Plate 41. It will be noted that the optimum value of load impedance is 8 ohms. Measurements for optimum load impedance were conducted in a similar manner as described under paragraph 98 and with the same receiver gain adjustments.

100. Par. 4-25. A terminal block, provided with two pin jacks for connecting the two conductor cable from the primary of the loud speaker coupling transformer, is mounted at the rear of the receiver chassis. A screw type connection lug is provided adjacent to this terminal block for connection of the speaker coupling cable shield to the chassis.

101. Par. 4-26. A beat frequency oscillator is provided in the Receiver Unit to permit reception of cw signals. It is provided with a small variable air dielectric capacitor for adjustment of the frequency of the beat note. Circuit details are given under paragraphs 31 and 32.

102. Par. 4-27. The panel operated variable air dielectric capacitor for adjustment of the frequency of the cw beat note employs a tandem mounted cam for operating a single pole, single throw toggle switch, which opens or closes the high voltage d-c plate supply to the cw oscillator vacuum tube. The heater circuit to this tube is energized at all times that power is applied to the Receiver Unit.

103. Par. 4-28. Two panel operated gain controls are provided for controlling the radio frequency and audio frequency gain of the receiver. They are smooth and noiseless in their operation.

104. Par. 4-29. The r-f gain control regulates the gain of the second r-f, first i-f and second i-f amplifier stages by the simultaneous variation of cathode bias to their respective amplifier tubes. This method of control is in compliance with references (c) and (d).

105. Par. 4-30. The a-f gain control regulates the level of signal voltage applied to the grid of the audio frequency output tube.

106. Par. 4-31. The Receiver Unit is provided with an automatic volume control, which is carrier operated, and controls the gain of all r-f and i-f amplifier stages. AVC is effected through the use of a panel operated ON-OFF toggle switch, which grounds the grid return circuits of the controlled stages in the "OFF" position.

107. Par. 4-32. A panel operated ON-OFF toggle switch permits the opening or closing of the +B circuit to the Receiver Unit and is so connected that, when opened, no current will flow. A terminal panel mounted at the rear of the receiver chassis is also provided for the addition of an auxiliary external control switch.

108. Par. 4-33. All resistors appear to be of such size as to operate without damage from overheating.

109. Par. 4-34. All composition resistors have their resistance values indicated by R.M.A. color coding.

110. Par. 4-35. All capacitors whose ratings are visible, without extensive disassembly, have working voltage ratings at least twice their normal d-c operating values.

111. Par. 5-1. The Power Unit is designed for operation from a 110/120 volt, 50/60 cycle alternating current source of supply. During the tests, satisfactory performance was obtained without any apparent damage to any of its components when, for certain tests, the unit was operated under conditions of line voltage variation of from 104 to 127 volts.

112. Par. 5-2. All power for the operation of the Receiver Unit is obtained from this unit. It includes all equipment necessary to convert the a-c voltage to high d-c voltage for plate and screen supply, and low a-c voltage for heater and/or filament supply. A filter circuit is incorporated for filtering the d-c supply. A description of the circuit employed in this unit will be found under paragraph 35. On the basis of 115 volt, a-c line operation, the d-c voltage for the plate and screen supply is 260 volts at 76 milliamperes; the a-c voltage for heater and/or filament heating is 5.95 volts at 3.15 amperes; and the total line power drain is 73 watts. More complete data of this nature are given under Table 3. All voltages were measured at the Power Unit, with the unit operating under conditions of full receiver load. It will be noted that the d-c power drain is in excess of the specification limit. The voltage of the a-c supply for filament heating is less than the 6.3 volts specified under reference (c). Since there is an approximate 0.2 volt drop in the receiver power cable, the voltage at the receiver tube sockets is 5.75 volts for 115 volt line operation of the Power Unit.

113. Par. 5-3. The Power Unit employs a commercial type 5Z3 vacuum tube rectifier.

114. Par. 5-4. The Power Unit is designed for relay rack mounting and employs a four sided dust cover as its enclosure. Input and output power connection is made through the back of the unit. A two contact, recessed receptacle is provided for connection with the plug receptacle on the end of the separable two conductor line power cable. A four contact phenolic wafer socket is provided for receiving the four prong plug on the end of the four conductor receiver power cable. The line power cable is a commercially standard two conductor lamp cord with rubber insulation. It is of the type where the conductors are laid side by side so as to form a flat sided construction. The conductors are of stranded bare copper wire. The cable is provided with a male receptacle plug for insertion in a wall power receptacle.

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115. Par. 5-5. Ventilating louvers are provided in the sides and rear of the dust cover. Ventilating holes are provided in the cover plate for the tube aperture in the front panel. The ventilation facilities appear to be sufficiently ample to permit the continuous operation of the Power Unit, without overheating, at the highest ambient temperature specified under reference (b).

116. Par. 5-6. An ON-OFF toggle switch is provided on the front panel for opening and closing the a-c line circuit.

117. Par. 5-7. Suitable fuses of the "Littelfuse" type are provided in each side of the line and between the line input ON-OFF toggle switch, and therefore are at full line potential regardless of the position of the switch. They are accessible through the tube aperture in the front panel, but their replacement necessitates the removal of the rectifier tube, contrary to the specification requirement. Mounting the fuse block to the left of the rectifier tube would permit replacement of the fuses without removing the rectifier tube. It would be desirable to have the fuses connected between the toggle switch and power transformer so that fuse replacement can be made without danger of electrical shock.

118. Par. 6-1. The Coil Rack is designed for relay rack mounting. It is a completely enclosed unit consisting of an aluminum panel with a hinged, flush mounted aluminum cover and a box-like structure, secured to the front panel with twelve 6-32 nickel plated flat head brass screws and associated nickel plated hexagon brass nuts and phosphorous bronze internal tooth shakeproof lock washers. The composite steel and aluminum construction is objectionable. The coil rack has a capacity of six sets of plug-in coil assemblies. The hinged cover is provided with a felt covered wooden bar secured to the cover with nickel plated round head wood screws to prevent the cover from hitting the coils when closed, and to keep the coil sets from shifting their positions during transportation. The nickel plated screws are not in keeping with the black wrinkle finish on the panel. It is also provided with a spring operated catch. The catch and hinges are of brass and are riveted in place. The catch is finished with black wrinkle which has chipped off, exposing the brass surface. The hinges are nickel plated and black wrinkle finished. Here again, the black wrinkle finish chipped off during the test. The chipping of the black wrinkle is undoubtedly due to the lack of sufficient treatment of the metallic surfaces prior to the application of the black wrinkle lacquer.

119. Par. 6-2. The storage compartment is provided with a beveled ramp on the inside base of the unit to facilitate insertion of the coil sets and guide strips, in the form of channels, are spot welded in place, and mounted inside and at the top and bottom of the storage compartment. These guides are so situated as to cause interference in the free removal or insertion of some of the coil sets, and in some instances, to restrict the seating of a coil set to the extent of preventing the closing of the hinged cover. In some instances the coil sets are not firmly held in place. This difficulty appears to be due mainly to workmanship rather than to design. It is apparent that greater care must be exercised in the production equipments in spot welding the guide strips in place in order to comply with the requirements of this paragraph reference of the

governing specifications. In the model, one of the guide strips was loosened as the direct result of the strains imposed upon it by the coil sets.

120. Par. 6-3. The design of the Coil Rack is such that the panels of the coil sets on which the calibration charts are mounted are fully exposed when the hinged cover is opened. Any one of the coil sets may be removed without disturbing the other sets. However, the Coil Rack is so designed that the cover must be completely opened through an arc of 180° to permit removal of the coil sets. No provision has been made to hold the cover open while a coil set is being removed or replaced, an operation that requires two hands. The design of the cover and for hinges should be such that the coil sets can be removed or replaced with it opened at an angle between 90 and 180°, and in addition, a catch or stop should be provided to hold it in position.

121. Par. 7-1. The reproducer unit employed for the panel type Loud Speaker Unit is of the dynamic cone type mounted on an aluminum panel designed for relay rack mounting. An identical reproducer unit is employed for the cabinet type Loud Speaker Unit furnished as an alternate or auxiliary unit under the terms of reference (c). It is housed in a steel box-like cabinet provided with four rubber mounting feet, a cone diaphragm aperture in one side, and lined on all sides with a fibrous sound absorbing material comparable to an inexpensive form of celotex. Although the requirements of this specification reference do not specifically require a protective enclosure around the reproducer of the panel type Loud Speaker Unit, good engineering design demands that the cone diaphragm be protected, by some means, from possible damage. In the cabinet type Loud Speaker Unit, the cabinet itself affords this protection. The same degree of protection could be provided for the panel type unit by surrounding the reproducer with a four sided open ended enclosure of such depth as to safely shield all openings in the cone diaphragm mounting frame, or through the use of an apron mounted across the top of the panel.

122. Par. 7-2. The reproducer used in both types of Loud Speaker Units employs permanent field magnets.

123. Par. 7-3. The cone diaphragms of the reproducers are 7-1/2 inches in overall diameter.

124. Par. 7-4. The reproducers are of such design and construction as to provide high fidelity reproduction up to at least 5000 c.p.s. with no evidence of rattles or excessive resonance at any level up to an electrical input of two watts. In this respect these units are considered exceptionally good for their size.

125. Par. 7-5. The panel type Loud Speaker Unit is provided with a cloth grill in violation of this specification reference, while a metal grill is provided, in compliance, for the cabinet type Loud Speaker Unit. In both types, the reproducer aperture is finished with a decorative ring with three centrally located vertical slats. These rings are of steel, and serve also as means for securing the reproducer units

to their respective mounting surfaces. Four equally spaced, parkerized, steel, 8-32 mounting studs are welded to the inside surface of the retaining ring. The studs project through the mounting plate and by means of these studs, the reproducer is secured thereon with nickel plated brass hexagon nuts, locked in place with parkerized steel external tooth shakeproof lock washers. As the mounting holes in the reproducer mounting frame are slotted, plain nickel plated lock washers are inserted between the slots and the lock washers. The application of brass nuts and washers in conjunction with steel studs and lock washers is objectionable. In the mounting of the reproducer units, all steel hardward is in order, provided that it is plated or otherwise protected to the degree of withstanding a standard 200 hour salt water spray test. The reproducer mounting frames and field coil housing are finished with aluminum paint, which is not considered sufficient protection for steel parts against corrosion particularly in places where the finish may be scraped off upon tightening a mounting nut.

126. Par. 7-6. The reproducer assemblies are provided with identical input transformers, each designed to operate out of a commercial type 6V6 beam power amplifying tube, and therefore employ primary impedances exceeding the specification limit of 7,000 ohms, and d-c component of 30 milliamperes. The primary impedance of the coupling transformer is approximately 11,000 ohms while the d.c. flowing through the tube is approximately 37 milliamperes. Each coupling transformer is riveted to its mounting bracket, which in turn is bolted to the reproducer mounting frame. Replacement of the transformer must be accompanied by a replacement of the mounting bracket to be satisfactory. No lock washers are employed with any of the screws employed in the assembly of the reproducers. The coupling transformer is of the exposed core and winding type of construction and hence does not comply with the requirements of the governing specifications. Each speaker unit is provided with a shielded twin conductor flexible cable, one end of which is clamped to the coupling transformer mounting frame. The method employed for clamping the cables is not satisfactory in that it does not positively preclude subjection of the terminal lugs to which the cable is connected on the coupling transformer from undue strain.

127. Par. 8-1. The Mounting Rack is fabricated from steel angle and designed with a footing to permit its mounting on an operating table by means of holes in the footing provided for this purpose. It is self-supported and is provided with sufficient bracing to maintain its rigidity and preclude strain on the panels of the units which it supports. Steel moldings are provided for concealing the mounting screws for the several units mounted thereon.

128. Par. 8-2. The vertical members of the Mounting Rack are drilled and tapped for 10-32 screws to permit mounting of the following units in the order named.

(1) Receiver Unit (at bottom)
(2) Coil Rack Unit
(3) Power Unit
(4) Loud Speaker Unit (at top)

The side surfaces of the vertical members are tapped for the 10-24 mounting screws used for securing the steel moldings.

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129. Par. 8-3. The following hardware is furnished for assembling the Mounting Rack and mounting the several units thereto. (Refer also to paragraph 43(F).)

(1) 10-32, parkerized, binder head steel screws, with the heads black enameled, for mounting the top and bottom bracing straps of the mounting rack and for mounting the units.

(2) 10-24, cadmium plated, round head steel screws for mounting the steel moldings to the vertical members of the mounting rack.

(3) 1/4 - 20, nickel plated, flat head, steel screws with black enameled heads, parkerized steel, internal tooth shakeproof lock washers and 1/4 - 20 parkerized, steel hexagon nuts for securing the footing braces.

130. Par. 9-1. Sensitivity measurements were conducted for five frequency settings in geometric progression, including the overlap frequency settings, for each band of the Receiver Unit, in compliance with the procedure prescribed under paragraph 10-9 of reference (b). Sensitiviey, as used herein, designates the number of microvolts from the Standard Signal Generator applied to the Standard Dummy Antenna to produce standard output (6.0 milliwatts) across a 600 ohm resistance load terminated at the phone output of the receiver. For all sensitivity tests, the audio gain control was adjusted for maximum gain, while the r-f gain control was adjusted to produce a 60 microwatt noise level across the phone circuit load, with no input signal applied.

131. MCW sensitivities measured with the radio frequency carrier inputs modulated 30 per cent at 1000 cycles per second are shown on Plate 2. The r-f gain setting for standard noise level (60 microwatts with no applied input signal) is shown for each frequency setting for each band at which mcw sensitivity was measured. Shown also, on Plate 4, are curves depicting the variation of maximum noise level with frequency, due to the amplification of the first circuit noises, resulting from the operation of the receiver at maximum gain, with no applied input signals, but with the receiver input connected to the Standard Signal Generator through the Standard Dummy Antenna. Except for the low frequency end of Band 1, specification compliance, with respect to mcw sensitivity, is met. However, it will be noted from Plate 4 that this compliance is met with but little reserve receiver gain left.

132. CW sensitivities are shown in Plate 3. The corresponding r-f gain settings, cw oscillator settings for 1000 cycle beat note, and maximum noise levels (determined as for mcw operation, except with the cw oscillator "ON") are shown on Plate 4. Specification compliance is met only in the frequency range included between 1175 and 6700 kilocycles, and at the high frequency end of Band 2. It will be noted from Plate 4 that the noise level is very much increased with the introduction of the cw oscillator, which results in a reduction of the useful receiver gain and hence the useful sensitivity. As for mcw operation, very little reserve gain, over and above that necessary for standard conditions, is

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available. For any given band, the adjustment of the cw oscillator control for a 1,000 cycle beat note, with the main tuning control set as for mcw reception, is substantially constant. The cause or causes for the increase in noise level by the cw oscillator is not readily explained. However, one of the probable contributing factors is the method employed for coupling the cw oscillator voltage to the control grid of the second detector. This coupling is effected through the use of a small fixed capacitor, so mounted that its connection to the control grid of the detector is via an excessively long lead. The placement of this lead is such that it can couple with the circuits of the preselector and hence introduce undesired noise voltages which are heterodyned and amplified by the i-f amplifier.

133. Par. 9-2. The resonant selectivities were masured with the input signals modulated 30 per cent at 400 cycles per second modulation frequency. Selectivity curves obtained with the receiver operating at optimum gain are shown for the band overlap frequency settings on Plates 5, 7, 9, 11, 13, 15, and 17. Similar curves obtained with the receiver operating at optimum and one-tenth optimum gain, for the middle frequency setting for each band, are shown on Plates 6, 8, 10, 12, 14, 16, and 18. The band widths for inputs of 6, 20, 40, and 60 decibels above resonant input are shown on Table 5 for each frequency setting at which selectivity was measured. Selectivity specifications have not been complied with at the 6 decibel level at any frequency, or for any frequency within the upper half of Band 7 for any input level. Gaps shown in some of the selectivity curves are due to zero beats resulting from harmonics of the signal frequency and of the heterodyne oscillator combining to form a frequency equal to the applied input frequency. There is no evidence of depressions in the nose of any of the selectivity characteristics. Attention is invited to Plate 5, where it is shown that the receiver's response to the i-f frequency at the lower end of its frequency range affects the selectivity characteristics. The "bowing in" of the selectivity curves is due to receiver overloading, while the "fanning out" of some of the characteristics is due to pulling of the high frequency oscillator frequency by the strong input signals. The effects of spurious responses upon selectivity are also shown on the curves where such responses are in evidence.

134. Par. 9-3. Image selectivity curves for mcw and cw signals are shown on Plates 19 and 20 respectively. Data for these curves were obtained in the same manner as for the sensitivity data, except that sensitivities were measured at both the resonant and corresponding image frequencies. The attenuation at each resonant frequency setting which the receiver offers to the image frequency was calculated in terms of the ratio of the microvolts input at the image frequency to the microvolts input at the resonant frequency. The preselector circuits for Bands 1, 2, and 3 do not offer sufficient attenuation of their image frequency responses to effect complete compliance with the attenuation limits as set forth under reference (c).

135. Par. 9-4. Spurious response sensitivities were measured by applying an r-f carrier signal, modulated 30 per cent at 400 cycles per second, and of high intensity, from the Standard Signal Generator to the

antenna-ground posts of the Receiver Unit through the Standard Dummy Antenna, and tuning the generator slowly over a wide frequency range centering at the frequency to which the receiver was tuned. The response of the receiver to undesired signals was determined in terms of microvolts input for standard output across the phone circuit load and with the receiver adjusted for optimum gain. The response of the receiver to signals resulting from harmonics of the beat frequency oscillator combining with the fundamental frequencies of the high frequency oscillator to produce signals at i-f frequency was determined by noting the receiver output as the receiver tuning was varied over the frequency range of each band, with the Standard Signal Generator off.

136. The sensitivity of the subject equipment to the direct reception of the i-f frequency is shown under Table 6 (A). Specification compliance is not met at the low frequency end of Band 1. No response was noted at any frequency setting for Bands 2 to 7, inclusive, for modulated carrier input at the i-f frequency, of 500,000 microvolts applied as described above. Under Table 6 (B) are shown the outputs produced by the harmonics of the beat frequency oscillator combining with the fundamentals of the high frequency oscillator. It will be noted that these responses are of considerable magnitude, being, in general, greater than Standard Output. Spurious response sensitivities to signals of frequencies other than that to which the receiver is tuned are shown under Table 6 (C). These responses are due to harmonics of the undesired signal frequency, generated within the 2nd r-f amplifier or first detector tubes as the result of overloading, which are then heterodyned, either directly or through leakage, with the fundamental and/or harmonics of the high frequency oscillator to produce signals at the i-f frequency. The composition of these reactions is tabulated under Table 6 (C), and is represented by an equation as follows:

$$(nfx - nfo) = fi$$

where fx = frequency of undesired signal

fo = frequency of heterodyne oscillator

fi = frequency of the i-f amplifier

n = order of harmonic of the interference frequency

2fx = 2nd harmonic of the undesired signal.

Frequency settings of the receiver are indicated by "fr." Spurious response sensitivities which do not comply with the specification requirements are indicated by an asterisk (*). The spurious responses shown under Table 6 are the major responses. Other responses of similar character occur for higher inputs. At certain frequency settings of the receiver, a steadily varying input frequency creates successive beat notes at such regular and frequent intervals as to give the impression of a constant tone.

137. Par. 9-4. Overall electric fidelity characteristics are shown for three frequency settings of the model equipment on Plate 21. The carrier inputs applied to the antenna-ground terminals of the receiver

were modulated 30 per cent for each audio frequency adjustment. The output voltages were measured by means of the General Radio Wave Analyzer across the 600 ohm phone circuit load. The receiver was adjusted for optimum gain for each frequency setting, while the carrier input was adjusted to produce Standard Output for a modulation frequency of 1,000 cycles per second. Similar characteristics obtained by measurement of the audio outputs across a non-inductive load terminating the secondary of the speaker coupling transformer to simulate the voice coil impedance were found to be essentially the same as obtained for the phone output circuit. This clearly demonstrated that the overall fidelity characteristics were primarily governed by the selectivity characteristic of the i-f amplifier. Specification compliance is not met at any frequency for modulation frequencies higher than 1,000 cycles per second. Compliance with the limiting curve as set forth under reference (d) is essentially met at frequencies above 2.6 megacycles. However, this limiting curve is not recognized under reference (c).

138. Par. 9-6. The maximum electric undistorted power output developed across the 600 ohm phone circuit load, at any input frequency throughout the tuning range of the receiver, is greater than 10 milliwatts for either cw or mcw (30 per cent modulated) inputs. Similarly, the maximum electric undistorted power output developed across the primary of the loud speaker coupling transformer is greater than 2 watts. However, at certain input signal frequencies, this power becomes less than 2 watts across the voice coil of the loud speaker due to the losses in the coupling transformer. Complete data for the power output to the headphones and to the loud speaker voice coil are given under Table 7 for mcw inputs, and Table 8 for cw inputs. The power applied across the voice coil is approximately 125 times that across the phone circuit load when the receiver is adjusted for Standard Noise Level, and the r-f input (either cw or 30 per cent mcw) is of such magnitude as to produce Standard Output across the phone load.

139. Par. 9-7. Resonant overload characteristics for cw inputs are shown on Plates 32 to 38, inclusive, for head telephone outputs. Measurements for resonant overload were made at the overlap frequencies of each band, with the receiver adjusted for optimum gain at each frequency setting. Output voltages were measured across the 600 ohm resistive load terminating the phone output circuit. Similar characteristic curves shown on Plate 39 were obtained at one frequency setting for Bands 1, 4, and 7, but with the output voltages measured across an 8 ohm resistive load terminating the secondary (or voice coil) winding of the loud speaker coupling transformer. The power output at resonant overload as defined under paragraph 10-5 of reference (b) is shown under Table 8 for each frequency at which resonant overload measurement was made. Resonant overload at any frequency setting of the receiver is greater than 10 milliwatts for phone outputs in compliance with specification requirements. However, it is less than 2 watts across the voice coil of the loud speaker unit at certain frequencies, but even in these instances the power input to the loud speaker coupling transformer at resonant overload is of the order of 3 watts. Complete resonant overload data are shown under Table 8. It will be noted from the resonant overload curves that receiver output drops appreciably within one and one-half times the input required for standard output. It will also

be noted that complete blocking is not effected, as a constant output of approximately 1 milliwatt prevails for increasing r-f inputs beyond that point at which maximum attenuation of the output signal occurs. Receiver overload apparently occurs as a result of poor regulation of the plate voltage applied to the r-f and 1st oscillator stages; which with the circuit employed, will vary appreciably with the r-f grids having a tendency to draw grid current resulting from high level input voltages. This is demonstrated by the early cut-off, and by the selectivity and spurious response tests. The inferior shielding provided in the receiver permits stray or leakage signals to be heterodyned without passing through the preselector stages. It appears that there is sufficient leakage from the antenna posts to the high frequency oscillator when a strong signal is applied to the receiver to produce voltage across the phone circuit after the r-f amplifier tubes reach saturation. The frequency of the output signal beyond the cut-off region, while of constant value, is of a higher frequency than that obtained for the initial receiver adjustments for standard output.

140. Similar resonant overload characteristics are shown on Plates 22 to 28 inclusive for mcw inputs and phone circuit outputs. Resonant overload characteristics with the outputs measured across an 8 ohm resistive load terminating the secondary winding of the loud speaker coupling transformer are shown on Plates 29 to 31, inclusive. The outputs at resonant overload for the two test conditions are shown on Plate 7. All measurements were made at the center frequency setting for each band. As for the cw resonant overload characteristics, the outputs at resonant overload for the phone circuit occur above 10 milliwatts, and below 2 watts for the loud speaker voice coil circuit. However, these outputs are less than the corresponding outputs for cw inputs. Attention is invited to the fact that all the resonant overload characteristics, for mcw inputs, except that for Band 7 are similar in character. In the latter instance the output remains approximately constant, after resonant overload has been reached due to the pulling of the high frequency oscillator upon the application of input signals of high intensity. This feature is also demonstrated by the selectivity curves.

141. Range and linearity curves for the r-f gain control are shown on Plates 42 to 48, inclusive, for cw and mcw inputs. Data for these curves were obtained by observing the microvolts input required to maintain Standard Output across the phone circuit load as the r-f gain control was retarded from its setting where the noise levels were less than the signals produced by readable settings of the slide wire of the Standard Signal Generator. In making these tests, two phenomena were observed. The first phenomenon was that for either cw or mcw inputs, as the signal intensity was increased above a certain value (depending upon input frequency), no change in audio output occurred except with further retardation of the gain control. The cause of this appears to be the result of direct coupling of the input signal to the first detector, thereby shunting the normal r-f tube action. The second phenomenon is demonstrated for cw inputs at the high frequency ends of Bands 6 and 7, where the high frequency oscillator was "pulled" by the higher intensities of signal input. It may be concluded from this that the reduction in the gain of the second r-f amplifier tube provided by the r-f gain control, when retarded beyond a certain value, is less than

that which is necessary to prevent oscillator pulling, due to strong input signals applied to the grid of the first detector; or that there is sufficient leakage around the controlled tube (second r-f amplifier) to maintain a high potential at the grid of the first detector, which is independent of the reduction in the gain of the second r-f amplifier.

142. Par. 9-8. The automatic volume control maintains a uniform audio output within less than 3 decibels for any variation in mcw input between the limits of 10 and 10^5 microvolts, at any frequency within the range of the equipment, with the receiver adjusted for optimum gain. Automatic volume control characteristics are shown on Plates 22 to 28, inclusive, for headphone outputs. The characteristic curves are shown for two receiver gain adjustments - one for optimum gain and the other for that gain which provides standard output for 100 microvolt input with the automatic volume control "Off." Similar curves are shown on Plates 29 to 31, inclusive, for the loud speaker outputs. The time constant for AVC operation is approximately 0.25 second and approximately 0.08 second for release for an instantaneous signal change between the limits of 10 and 10^5 microvolts. The time constant for AVC operation exceeds the specification limit of 0.1 second.

143. Par. 9-9. With the audio frequency gain control fully advanced, and the r-f gain control fully retarded, the output hum level across the 600 ohm phone circuit load is 0.968 microwatts; and 77.2 microwatts across the primary winding of the loud speaker coupling transformer.

144. Par. 9-10. The frequency stability of the heterodyne oscillator under conditions of variation in the r-f gain control throughout its range with a change of cw input such as to maintain standard output is shown under Table 9 for test frequencies of 445, 3700, and 30,000 kilocycles. Specification compliance is not met at 30 megacycles.

145. Par. 9-11. The frequency stability of the heterodyne oscillator under conditions of a change in line voltage to the Power Unit from 104 to 127 volts is shown under Table 10 for test frequencies of 445, 3700, and 30,000 kilocycles. Specification compliance is not met at 445 or 3700 kilocycles.

146. Par. 9-12. The r-f outputs from the high frequency oscillator, as measured between the antenna and ground terminals of the receiver at five frequency settings for each of its bands are shown on Plate 49. Except for a few isolated instances, specification compliance is not met. Failure to comply with the requirements of the governing specifications is due mainly to the inferior shielding construction employed in the receiver.

147. Par. 9-13. The frequency overlap between adjacent bands computed in compliance with this paragraph reference, is shown under Table 2. Specification compliance is completely met. However, while not specifically covered by this specification reference, the low frequency end of Band 1 does not provide the usual nominal safety factor for tuning the low frequency end of the specified tuning range of the subject equipment. The percentage figures given under Table 2 are based on actual frequency limits as listed under Table 1 and not the manufacturer's rated frequency limits.

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148. Par. 9-14. The frequency variation per division of tuning dial movement, computed on the basis of any ten degrees of movement, does not differ from the average variation per division as computed from the total frequency change for the 500 tuning dial divisions by more than 30 per cent, in compliance with references (c) and (d). Refer to Table 11.

149. A summary of the defects noted and such items as do not comply with the requirements of references (b) and (c) are as follows:

(a) Par. 1-5. The lower limit of the frequency range is 190.67 kilocycles instead of 190.00 kilocycles as required under reference (c).

(b) Par. 2-1. The construction of the equipment can be considered as better than the average for receiving equipments produced for the amateur trade; but its construction is far less rugged and in many instances the materials employed are less suitable for the purposes intended than would be considered acceptable by a strict interpretation of the specification reference for Naval service. The light gauge steel employed for the receiver chassis and dust cover does not offer sufficient rigidity to prevent warping of the chassis under conditions of severe shock or vibration. The aluminum shield cans employed for the r-f transformers will not withstand rough usage. The small panel mounted components do not comply with existing applicable Naval specifications. The construction and mounting of the power transformer and filter reactor in the power unit are unsatisfactory. That they are spot welded to the power unit chassis makes their replacement a major task. The hardware employed for the coil rack is not suitable for the type of service for which it is intended. The selection of the materials employed in the construction of this equipment is not consistant with the requirements of Naval general specifications. The design of the equipment precludes multiple, side by side, installations of identical equipments.

(c) Par. 2-2. The workmanship is of only fair quality as compared with that which is generally considered acceptable for Naval equipment. The replacement of certain components, without subjecting other components to possible damage, is hindered through the use of rivet mountings, the straddling of components over other components, and the use of multiple connections of leads to common soldering lugs. Flexible leads, free to move, are employed in frequency determining circuits and/or in circuits where their movement would affect the receiver alignment. The arrangement of the wiring is not satisfactory in that wires are crisscrossed, grouped wires are not cabled, long unanchored wires have been employed, some wires are wedged against sharp metallic objects, and rubber grommets are not used in all places where their use is applicable. Pressure is depended upon for circuit continuity for all connections to air dielectric trimmer capacitors and for ground connections to the chassis. Soft washers have not been employed under mounting screws for molded phenolic and/or ceramic plates. The design of the cw oscillator coupling capacitor is such that its capacitance value is difficult to maintain or to duplicate. Self tapping screws have been applied for securing parts which are subject to frequent removal. The attachment of the pin terminals to the speaker cables leaves the connections subject to early breakage. The wiring of the r-f coil assemblies employs stiff fabric sleeving, which places the sleeved leads under considerable strain, and long, unsupported fine wire coil leads for interconnections. The shielding integrity of the receiver unit is not good, no provision having been made for shielding the antenna binding post, or to provide metal to metal bonding between all parts and/or devices intended for shielding purposes. The interstage shielding for the preselector stages is not adequate. Direct heterodyning of signals is possible through signal leakage around the preselector circuits to the high frequency oscillator.

(d) Par. 2-3. Practically no attention has been given to protecting the component parts used in this equipment against the corrosive action of moist sea atmosphere. Natural aluminum plates swedged to natural brass supporting members have been employed for all air dielectric capacitors. The ganged tuning capacitor also employs steel in its construction in such a manner that steel to brass contact is possible. Contact between steel, brass, and aluminum exists in the construction and mounting of the i-f and cw oscillator assemblies. Ground connections depend upon contact between dissimilar metals. Dissimilar metals have been employed for mounting hardware; i.e., brass nuts on steel screws, etc. Coil leads show exposed copper near their soldered connections where their insulation has been removed for circuit connection. Turns adjacent to the tapped connections on layer wound coils show exposed copper where their enameled insulation has been carelessly removed in preparation for connecting the tapped leads.

(e) Par. 2-4. The soldering workmanship is not up to the standards usually demanded for Naval equipment. Solder has been employed in excessive amounts and, in some instances, the surrounding surfaces are splattered with rosin residues, particularly in the plug-in coil assemblies. In general, rigid mechanical contact was not provided between the leads and their soldering lugs and/or terminals prior to the application of the solder.

(f) Par. 2-5. The aluminum employed for tube shields, coil shields, partitions and mounting brackets, and brass employed for air dielectric capacitor spacers and for a few isolated nuts and inserts are not protected against the corrosive action resulting from long exposure to tropical salt atmosphere.

(g) Par. 2-6. By strict interpretation of the governing specification, iron or steel has been profusely employed for other than electromagnetic purposes, in violation of the specification requirements.

(h) Par. 2-7. The impregnating compound employed in the tubular, foil-paper dielectric capacitors appears to be a mixture of oil and wax. The melting point of the mixture is such that it becomes tacky and tends toward dripping of oil when the equipment is operated on all-day schedules at room temperature. At higher temperatures the internal pressure built up forces the oil out, with the result that dripping occurs.

(i) Par. 2-10. The equipment, owing to the materials employed in its construction, cannot be expected to operate indefinitely without damage to some of its component parts under conditions of frequent cycling of wide temperature variation. The tubular type capacitors are not suitable for this equipment even for operation at room temperature.

(j) Par. 2-12. The design and construction of this equipment is such that it will not be free from damage or faulty operation resulting from the vibration and shock encountered by transportation and by use on Naval vessels of all types. Non-rigid supporting brackets carrying heavy loads can be expected to become loosened, long unanchored leads may be expected to break, and faulty operation will result from the inferior contact design employed for the plug-in coil assemblies.

(k) Par. 2-13. Circuit symbols have not been marked on the chassis of the receiver and power units. The arrangement of the parts on the under side of the receiver chassis is such that it will be difficult to comply with this requirement.

(l) Par. 2-14. No indication has been made, either by sketch or otherwise, as to the proposed location of the nameplates.

(m) Par. 2-15. Lock washers, where employed, are not consistent either in type or application. The internal tooth shakeproof soldering lug is not an accepted substitute for lock washer application. Parkerized steel lock washers are not considered non-corrosive. No lock washers have been employed for the self tapping screws, trimmer capacitor stator mounting nuts, for the screws employed in the plug-in coil assemblies (except for coil bracket mounting screws), or for screws employed in the loud speakers. Nuts or lugs employed in radio frequency circuits have not been soldered to their respective screws and/or studs.

(n) Par. 2-18. Except for external, interconnecting cable leads, and i-f and cw oscillator transformer leads, the wiring employed in this equipment has not been color coded.

(o) Par. 2-19. The leads of the phone output transformer and high voltage leads of the power transformer consist of several strands of bare copper wire of small diameter, braided together, and sleeved with spaghetti tubing. The low voltage leads from the power transformer are single strand, bare copper wire, sleeved with spaghetti tubing.

(p) Par. 2-20. The vacuum tube sockets for the first and second i-f amplifier and cw oscillator tubes are of the phenolic wafer type instead of the ceramic type required by the specifications.

(q) Par. 2-21. The power transformer and filter reactor in the power unit, and the phone output transformer in the receiver unit are not effectively potted to preclude the entrance of moisture. The speaker coupling transformer is without any form of protective enclosure against moisture.

(r) Par. 2-23. No anti-corrosive primer has been employed, as required for the painted items entering into the construction of this equipment.

(s) Par. 2-24. Five sided dust shields are not provided. The method of mounting employed for the power unit dust shield is not only inconsistent with that employed for the receiver unit, but requires clearance at its two sides and rear for its removal. The steel spade bolts used on the receiver unit dust shield are employed in combination with nickel plated brass rivets and thumb nuts.

(t) Par. 3-1. The depth of the receiver unit exceeds the contract limit by 1/8 inch.

(u) Par. 3-2. The weight of the power unit exceeds the contract limit by 1.4 pounds.

(v) Par. 3-5. The height, width, footing depth, and weight of the mounting rack exceeds the contract limits by 2-3/4 inches, 1-1/2 inches, 3/16 inch, and 2 pounds, respectively.

(w) Par. 4-3. The hand grips on the front panel of the receiver unit do not provide for full hand gripping and their location makes handling of the receiver awkward. Their use as aids for inserting or removing the plug-in coil sets is questionable in view of the rigid mounting of the receiver.

(x) Par. 4-4. The "off" positions of the two panel mounted toggle switches for the receiver unit are in opposing directions.

(y) Par. 4-7. The d-c drain is in excess of the specified maximum of 60 milliamperes. The low voltage supply is less than the 6.3 volts as required under reference (c).

(z) Par. 4-8. Refer to (a) above.

(aa) Par. 4-9. The shield cans employed for the plug-in coil sets are not especially rugged. The mounting of the ground jacks is subject to corrosion. Steel straps are employed for securing the aluminum shield cans in place. The shield can mounting screws are not staked so as to prevent their complete disengagement with the mounting stops, when loosened, and hence the probable damage to the internal coil assemblies. Insertion of a plug-in coil assembly in the receiver does not complete the shielding of the front panel orifice. Moreover, the design of the individual transformer assemblies affects only three-sided shielding for their tuned inductance elements.

(bb) Par. 4-10. The design and construction of the contacts and wiper fingers for the plug-in coil assemblies are entirely unsuited and unsatisfactory for the purpose intended, particularly under conditions of vibration.

(cc) Par. 4-11. The protective covering for the calibration charts for the plug-in coil assemblies is not non-glare. The station logging chart is not designed to avoid smudging. Steel frames have been employed for the two types of charts. The coil sets are not numbered. The frequency range markings are not in terms of working frequencies, as are generally required, nor are their characters sufficiently large to permit their readability with ease.

(dd) Par. 4-12. The use of steel for the hand grips on the plug-in coil sets is objectionable.

(ee) Par. 4-13. The frequency ratios for Bands 1, 3, and 4 exceed the specification limit of 2.35 to 1.

(ff) Par. 4-14. The construction of the ganged tuning capacitors employs natural aluminum rotor and stator plates swedged to natural brass spacer members. The bonding of the plates to their spacer members is not considered permanent. No provision has been made for protecting either the plates or their spacer members against corrosion. The drive shafts are of cadmium plated steel and are subject to rust from the wearing away of the cadmium plating. The spring wiper contactors for the rotors bear on the unplated brass rotor hubs. The method of mounting these spring wiper contactors is such that under certain conditions (as in the case of the model receiver) their internal edges can cut into the insulating tubing on the rotor shafts, thus limiting their spring action and resulting in noisy operation of the ganged capacitor assembly. Circuit continuity to the stator assemblies depends upon pressure contact rather than solder bonding.

(gg) Par. 4-15. The front bearing hub for the tuning drive is not painted or otherwise protected from corrosion. The spacing between the fiducial mark and the main tuning dial limits the accuracy of the dial readings to a lower value than is possible to attain.

(hh) Par. 4-17. Commercial types 6F8G and 6V6G vacuum tubes have been employed in lieu of the types 6B7 and 42 vacuum tubes, respectively, in violation of the contract, reference (c).

(ii) Par. 4-18. None of the universal coils are cold wax dipped as required by reference (b). Wooden coil forms have been employed for the universal coils in the r-f transformer assemblies instead of low loss bakelite, ceramic, or equivalent. The fixed molded mica padding and/or trimmer capacitors employed for the high frequency oscillators are suspended from their pigtail leads in an unsatisfactory manner. No protective coating has been provided for the exposed copper ends of the leads at the soldered connections. The anchoring of the coil leads is, in general, unsatisfactory. This statement applies also to "end turns" which are employed for inductance trimming purposes. Spliced turns, where employed on layer wound coils, are entirely unacceptable.

(jj) Par. 4-20. The input impedances of the subject receiver fail to comply with the governing specifications in the following regions:

- (a) Band 1 - Low frequency end of range.
- (b) Band 3 - Upper half of frequency range.
- (c) Band 5 - Upper half of frequency range.

(kk) Par. 4-24. The plate current flowing through the primary winding of the loud speaker coupling transformer is in excess of the specification limit of 35 milliamperes. The primary impedance of this transformer, while suitable for the type of output tube employed, is in excess of the specification value.

(ll) Par. 5-2. Refer to paragraph (y) above.

(mm) Par. 5-7. The line fuses are at full line potential when the power ON-OFF switch is "OFF." They are not accessible without the removal of the rectifier vacuum tube contrary to the specification requirements.

(nn) Par. 6-1. Steel and aluminum has been employed in intimate contact in the construction of the coil rack. The black wrinkle finish does not adhere to the hinges or catch on the front cover.

(oo) Par. 6-2. The guide strips provided in the coil rack cause interference with the free removal or insertion of some of the coil sets, and in some instances, restrict the seating of the coil sets to the extent of preventing the closing of the hinged cover. In other instances the coil sets are not firmly held in place. One of the guide strips in the model equipment became loosened as the result of strains imposed upon it.

(pp) Par. 6-3. No provision has been made for holding the hinged cover of the coil rack open when removing or inserting a coil set. The mounting of the hinged cover is such that it must be opened a full 180° to permit removal or insertion of the coil sets.

(qq) Par. 7-1. No protective enclosure has been provided for the panel type loud speaker unit to prevent possible damage to the cone diaphragm from external causes.

(rr) Par. 7-5. No metal grill is provided as a part of the panel to protect the cone of the panel type loud speaker unit, as required. Steel parts, employed in the construction of the reproducer unit, are painted with aluminum lacquer with no non-corrosive undercoat.

(ss) Par. 7-6. The open core, open winding, coupling transformer for the loud speaker is riveted to a bracket mounted to the reproducer unit. The clamping of the interconnecting speaker cable to the transformer frame is accomplished in an unsatisfactory manner.

(tt) Par. 9-1. Specification compliance is not met at the low frequency end of Band 1 for mcw sensitivity or at any frequency except the frequency range included between 1175 and 6700 kilocycles, for cw sensitivity.

(uu) Par. 9-2. The band width for inputs of 2 decibels above resonant input does not comply with the contract limits at any frequency within the range of the receiver. The band width for the upper half of Band 7 does not comply with the contract limits for any input above resonant input up to and including 60 decibels.

(vv) Par. 9-3. The image selectivities for Bands 1, 2, and 3 are less than the limiting values allowed by the contract, reference (c).

(ww) Par. 9-4. The direct i-f response sensitivity at the 195 kilocycle setting of the receiver is 1,000 microvolts. Spurious responses whose sensitivities are less than the specification limit occur in Bands 6 and 7.

(xx) Par. 9-5. The overall audio fidelity of the equipment does not comply with the specification limits for modulation frequencies above 1,000 cycles per second.

(yy) Par. 9-6. The maximum electric undistorted output fed into the voice coil of the loud speaker reproducer is less than 2 watts at the low frequency end of the frequency spectrum for cw or mcw inputs to the receiver.

(zz) Par. 9-8. The time constant for AVC operation is 0.25 second instead of 0.1 second as required by the specification.

(aaa) Par. 9-10. The change in the heterodyne oscillator frequency at 30 megacycles resulting from change in r-f gain control setting throughout its range for a change in cw input, such as to maintain Standard Output, exceeds the specification limit of 0.015 per cent.

(bbb) Par. 9-11. The change in the heterodyne oscillator frequency under conditions of change in line voltage to the Power Unit from 104 to 127 volts exceeds the specification limit at 445 and 3700 kilocycles.

(ccc) The r-f output from the high frequency oscillator, as measured between the antenna and ground terminals of the receiver substantially exceeds the specification requirements over the complete frequency range of the receiver.

CONCLUSIONS

150. The Model XRAS Radio Receiving Equipment is not demonstrative of strict compliance with the governing specifications, reference (b), as amended under reference (c). It displays certain defects in construction which are not generally considered acceptable for Naval Service. It possesses a quality of workmanship that is considered inferior to that normally expected of Naval equipment; and its overall performance is such as to definitely restrict its usefulness to the Service.

151. The lack of ruggedness evident in its construction and the commercial practices employed in the construction and mounting of its components limit the use of the equipment to locations that are remote from gunfire shock, devoid of prolonged and severe vibration, where temperature variation is slight, and where failure of operation resulting from the corrosive action of humid saline atmospheres will not be of major importance. The workmanship is of commercial quality and is totally lacking of the refinements which are essential for trouble-free and reliable performance under adverse operating conditions frequently encountered in the Naval Service. The electrical performance is such that receiver blocking will occur for cw input signals of the same order as required for maximum output. This characteristic does not permit

beat note reception of close-by stations with the same adjustments as for distant stations. In addition, the inferior quality of the shielding provided in the equipment adversely affects the operation, without overloading, in the presence of nearby transmitters which might be in operation.

152. The Laboratory has covered in the summary of defects, as presented herein, those defects in design, construction, and performance which are not considered in compliance with the strict interpretation of the governing specifications and its contractual modifications, or in compliance with existing specifications normally applicable to Naval receiving equipments. However, in preparing its recommendations, the Laboratory has recognized the fact that the specifications, reference (b), were written with the intent of permitting acceptance of a modified commercial receiver. The Laboratory has therefore stressed in the first part of its recommendations, those items which are in need of improvement to assure reasonably satisfactory service for limited applications.

153. This equipment, if modified to include the changes as noted under section "A" of the Recommendations, should be very satisfactory for the limited application as indicated above. It can then be employed to give creditable performance at shore stations, when not required to function in strong r-f fields resulting from nearby transmitters and where power supply line voltage variation and vibration are not excessive. In general, it may be said that the subject equipment, with the recommended modifications, can be expected to give superior performance, from the service standpoint, to any of the commercially available receiving equipments, exclusive of those specifically designed for Naval specification compliance and available only at considerably greater cost.

154. The Laboratory desires to emphasize that by comparison with the more recent types of receiving equipments now in the Naval Service and specifically designed for compliance with the usual Naval specifications for such equipment, the subject equipment, like any other commercially available receiving equipment designed for the amateur trade, is far less rugged, distinctly less reliable under adverse operating conditions, and is lacking in many of the refinements or features which years of experience and development have proven to be essential for satisfactory overall receiver performance. These design limitations consequently not only limit its usefulness in the Naval Service, but also preclude its use on shipboard where it will not give reliable performance when subjected to the shock of gun fire or vibration inherent with certain types of ships or speed of propulsion. The shielding integrity of the receiver is such that the receiver will be rendered useless when operated near high powered transmitting equipments. The use of plug-in coils as employed in the subject receiver is no longer recommended for receiving equipments designed for shore station or shipboard installations owing to their inherent disadvantages as compared with the present day development of band switching which has been proven to be more reliable and which permits the use of self-contained coil systems which will maintain their alignment over longer periods of time, and where their possible damage is relatively remote.

Table 1

Frequency Range of Plug-In Coil Sets

Band No.	Rated Frequency Range	Actual Frequency Range
1	190 - 456 kilocycles	190.67 - 460.88 kilocycles
2	435 - 950 "	429.89 - 964.85 "
3	0.90 - 2.05 megacycles	0.883 - 2.081 megacycles
4	1.7 - 4.0 megacycles	1.648 - 4.035 "
5	3.5 - 7.3 "	3.350 - 7.346 "
6	7.0 - 14.4 "	6.734 - 14.558 "
7	14.0 - 30.0 "	13.678 - 30.550 "

Table 2

Band Overlap and Band Ratio

Band Overlap		Band Ratio	
Band No.	Overlap	Band No.	Band Ratio
1 to 2	6.80%	1	2.42 to 1*
2 to 3	8.88%	2	2.24 to 1
3 to 4	23.25%	3	2.36 to 1*
4 to 5	18.50%	4	2.44 to 1*
5 to 6	8.75%	5	2.19 to 1
6 to 7	6.23%	6	2.16 to 1
		7	2.23 to 1

* Outside of specification limit of 2.35 to 1.

Table 3

Line Power, "A" and "B" Supply Voltages and Currents vs Line Voltage

Line Voltage (60 cycles)	Line Power Watts	"A" Supply Volts*	"A" Supply Amps.	"B" Supply Volts	"B" Supply MA
104	59.5	5.38	2.79	237	66.5
110	66.5	5.70	3.07	249	71.5
115	73.0	5.98	3.17	260	76.0
120	79.5	6.25	3.25	270	80.0
127	87.5	6.60	3.36	285	86.0

*Note: Voltage drop in power cable to receiver is approximately 0.2 volt.

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Table 4

Input Impedance

Band No.	Frequency kc	Input Impedance - Ohms (Approximate Indication Only)
1	195	Less than 6000; greater than 5000*
	295	Less than 5000; greater than 4000
	445	Less than 3000; greater than 2000
2	445	Less than 3500; greater than 2500
	640	Less than 2000; greater than 1000
	924	Less than 1000; greater than 800
3	924	Less than 1500; greater than 800
	1310	Less than 450; greater than 350*
	1865	Less than 300; greater than 200*
4	1865	Less than 400; greater than 300
	2600	Less than 500; greater than 400
	3700	Less than 700; greater than 600
5	3700	Less than 800; greater than 700
	5100	Less than 1000; greater than 900*
	7000	Less than 1050; greater than 950*
6	7000	Less than 500; greater than 400
	10000	Less than 350; greater than 300
	14100	Less than 350; greater than 300
7	14100	Less than 600; greater than 500
	21000	Less than 400; greater than 300
	30000	Less than 450; greater than 350

* Outside of specification limits.

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Table 5

Selectivity - Total Band Width

Band No.	Freq. kc	Gain	Total Band Width - Kilocycles x2 (6 db)	x10 (20 db)	x100 (40 db)	x1000 (60 db)
Specification Limit			Not less than 6 kc	Not more than 12 kc	Not more than 20 kc	Not more than 28 kc
1	195	Optimum	3.23*	5.69	8.48	11.36
	295	Optimum	3.24*	5.88	9.28	12.81
	295	Reduced	3.54*	6.32	9.63	13.21
	445	Optimum	3.36*	6.50	10.21	14.68
2	445	Optimum	2.90*	5.41	8.25	11.38
	640	Optimum	2.91*	6.01	9.16	12.70
	640	Reduced	3.42*	6.34	9.61	13.50
	924	Optimum	4.02*	7.17	10.51	14.67
3	924	Optimum	4.16*	7.16	10.65	14.95
	1310	Optimum	3.81*	6.65	10.98	15.56
	1310	Reduced	3.63*	6.97	10.70	15.80
	1865	Optimum	3.55*	7.27	10.92	15.76
4	1865	Optimum	3.46*	6.67	10.22	14.47
	2600	Optimum	2.70*	6.84	10.62	15.39
	2600	Reduced	3.42*	8.19	11.07	14.40
	3700	Optimum	3.76*	6.82	10.58	15.76
5	3700	Optimum	3.75*	6.77	10.57	16.20
	5100	Optimum	3.59*	6.52	10.79	15.74
	5100	Reduced	2.93*	7.88	10.10	15.97
	7000	Optimum	4.08*	6.00	-	16.81
6	7000	Optimum	3.84*	5.52	9.36	14.39
	10000	Optimum	1.84*	6.02	12.06	-
	10000	Reduced	1.84*	6.70	-	13.61
	14100	Optimum	4.50*	8.40	11.40	17.40
7	14100	Optimum	4.80*	8.39	12.60	17.40
	21000	Optimum	4.25*	12.36*	16.46	20.58
	21000	Reduced	4.25*	10.31	14.42	20.54
	30000	Optimum	3.96*	16.56*	22.07*	26.67

* Outside of specification limits.

Table 6

Spurious Response Sensitivities

(A) Direct Reception of Intermediate Frequency

Band	Tuning Dial Setting - kc	Microvolt Input at I.F. for Standard Output
1	195 kc	1,000*
	240 kc	21,800
	295 kc	50,000
	360 kc	112,000
	445 kc	148,000

2 to 7 incl. (Microvolt input at I.F. greater than 500,000 for all frequency settings.)

(B) Spurious Responses due to Beating of Harmonics of First and Second Oscillators.

Band No.	Tuning Dial Setting-kc	CW Oscillator Harmonic	Phone Output MW
1	350	2nd	10.8
2	525	3rd	7.4
2	700	4th	33.8
2	875	5th	23.2
3	1050	6th	0.7

(C) Other Spurious Response Sensitivities.

Band No.	fr kc	fo kc	fx kc	uv Input at fx for Std.Output	Composition	Kc. Off Res.
1	295	470	309.0	212,000	(3 fo-4 fx) = fi	+14
	295	470	322.5	135,000	(2 fx-fo) = fi	+27.5
	445	620	421.3	275,000	(3 fo-4 fx) = fi	+23.7
	445	620	432.7	65,000	(9 fx-6 fo) = fi	-12.3
	445	620	461.0	44,000	(4 fo-5 fx) = fi	+16.0
	445	620	471.8	44,200	(3 fx-2 fo) = fi	+26.8
2	445	620	471.8	350,000	(3 fx-2 fo) = fi	+26.2
	640	815	655.0	95,000	(4 fx-3 fo) = fi	+15.0
	770	945	750.0	150,000	(4 fx-3 fo) = fi	+20.0
	924	1099	886.6	210,000	(5 fo-6 fx) = fi	-37.4
			896.7	131,000	(10 fx-8 fo)= fi	-27.3
			901.3	88,000	(10 fo-12 fx) = fi	-22.7
			904.0	72,000	(16 fx-13 fo) = fi	-20.8
			906.0	65,000	(15 fo-16 fx) = fi	-18.0
			936.2	21,000	(19 fx-16 fo) = fi	+12.2
			940.8	23,000	(13 fo-15 fx) = fi	+16.8
			943.3	46,500	(13 fx-11 fo) = fi	+19.3

Table 6 (continued)

Band No.	fr kc	fo kc	fx kc	uv Input at fx for Std.Output	Composition	Kc Off Res.
2	924	1099	945.0	39,000	(6 fx-5 fo) = fi	+21.0
			950.7	318,000	(14 fo-16 fx) = fi	+26.7
			957.4	250,000	(8 fo-9 fx) = fi	+33.4
			967.0	312,000	(16 fo-18 fx) = fi	+40.0
			1012.5	114,000	(2 fo-2 fx) = fi	+88.5
3	1100	1275	1187.5	350,000	(2 fo-2 fx) = fi	87.5
3	1310	1485	1397.5	111,000	(2 fo-2 fx) = fi	87.5
3	1565	1740	1536.9	170,000	(16 fo-18 fx) = fi	-28.1
			1548.5	28,200	(9 fo-10 fx) = fi	-16.5
			1583.5	42,200	(10 fx-9 fo) = fi	+18.5
			1595.0	128,000	(12 fo-13 fx) = fi	+30.0
			1562.5	52,000	(2 fo - 2 fx) = fi	+87.5
			1681.6	390,000	(3 fo - 3 fx) = fi	+116.6
			1696.0	458,000	(4 fo - 4 fx) = fi	+131.0
3	1865	2040	1837.4	12,200	(19 fo - 21 fx) = fi	-27.6
			1843.7	14,200	(20 fx - 18 fo) = fi	-21.3
			1846.5	14,800	(20 fo - 22 fx) = fi	-18.5
			1881.8	15,000	(13 fo - 14 fo) = fi	+16.8
			1884.6	17,800	(12 fx - 11 fo) = fi	+19.6
			1892.0	31,200	(14 fo - 15 fx) = fi	+27.0
4	1865	2040	1952.5	210,000	(2 fo - 2 fx) = fi	+87.5
4	2200	2375	2288	80,000	(2 fo - 2 fx) = fi	+88
4	2600	2775	2688	32,000	(2 fo - 2 fx) = fi	+88
4	3100	3275	3188	29,000	(2 fo - 2 fx) = fi	88
5	3700	3875	3788	21,000	(2 fo - 2 fx) = fi	+88
			3816	342,000	(3 fo - 3 fx) = fi	+116
5	4400	4575	4488	13,000	(2 fo - 2 fx) = fi	+88
			4516	168,000	(3 fo - 3 fx) = fi	+116
			4663	350,000	(2 fx - 2 fo) = fi	+263

Table 6 (continued)

Band No.	fr kc	fo kc	fx kc	uv Input at fx for Std.Output	Composition	Kc. Off Res.
5	5100	5275	5188	8,200	(2 fo - 2 fx) = fi	+88
			5216	110,000	(3 fo - 3 fx) = fi	+116
			5363	254,000	(2 fx - 2 fo) = fi	+263
5	7000	7175	7088	7,200	(2 fo - 2 fx) = fi	+88
			7116	38,000	(3 fo - 3 fx) = fi	+116
			7131	88,000	(4 fo - 4 fx) = fi	+131
			7233	290,000	(3 fx - 3 fo) = fi	+233
			7263	111,000	(2 fx - 2 fo) = fi	+263
6	7000	7175	7088	3,500	(2 fo - 2 fx) = fi	+88
			7116	50,000	(3 fo - 3 fx) = fi	+116
			7263	102,000	(2 fx - 2 fo) = fi	+263
6	8400	8575	8488	4,000	(2 fo - 2 fx) = fi	+88
			8516	43,000	(3 fo - 3 fx) = fi	+116
			8531	18,500	(4 fo - 4 fx) = fi	+131
			8633	283,000	(3 fx - 3 fo) = fi	+233
			8663	65,000	(2 fx - 2 fo) = fi	+263
6	10,000	10,175	10,088	1,150*	(2 fo - 2 fx) = fi	+88
			10,116	10,000	(3 fo - 3 fx) = fi	+116
			10,131	138,000	(4 fo - 4 fx) = fi	+131
			10,233	72,000	(3 fx - 3 fo) = fi	+233
			10,262	25,800	(2 fx - 2 fo) = fi	+262
6	12,000	12,175	12,088	1,720*	(2 fo - 2 fx) = fi	+88
			12,116	24,800	(3 fo - 3 fx) = fi	+116
			12,133	50,000	(4 fo - 4 fx) = fi	+133
			12,233	78,000	(3 fx - 3 fo) = fi	+233
			12,262	17,200	(2 fx - 2 fo) = fi	+262
6	14,100	14,275	14,188	1,820*	(2 fo - 2 fx) = fi	+88
			14,216	21,000	(3 fo - 3 fx) = fi	+116
			14,231	168,000	(4 fo - 4 fx) = fi	+131
			14,333	50,000	(3 fx - 3 fo) = fi	+233
			14,362	8,000	(2 fx - 2 fo) = fi	+262
7	14,100	14,275	14,188	2,900	(2 fo - 2 fx) = fi	+88
			14,216	22,500	(3 fo - 3 fx) = fi	+116
			14,362	13,200	(2 fx - 2 fo) = fi	+262

Table 6 (continued)

Band No.	fr kc	fo kc	fx kc	uv Input at fx for Std.Output	Composition	Kc. Off Res.
7	17,000	17,175	17,088	2,050*	(2 fo - 2 fx) = fi	+88
			17,118	10,500	(3 fo - 3 fx) = fi	+116
			17,131	34,000	(4 fo - 4 fx) = fi	+131
			17,233	50,000	(3 fx - 3 fo) = fi	+233
			17,262	58,000	(2 fx - 2 fo) = fi	+262
7	21,000	21,175	21,088	1,300*	(2 fo - 2 fx) = fi	+87.5
			21,116	10,500	(3 fo - 3 fx) = fi	+116.0
			21,233	50,000	(3 fx - 3 fo) = fi	+233
			21,262	2,980	(2 fx - 2 fo) = fi	+262
7	25,000	25,175	25,088	1,300*	(2 fo - 2 fx) = fi	+88
			25,120	22,000	(3 fo - 3 fx) = fi	+120
			25,233	28,000	(3 fx - 3 fo) = fi	+233
			25,266	3,000	(2 fx - 2 fo) = fi	+266
7	30,000	30,175	30,088	1,050*	(2 fo - 2 fx) = fi	+88
			30,118	7,200	(3 fo - 3 fx) = fi	+118
			30,263	1,550*	(2 fx - 2 fo) = fi	+63

* Outside of specification limits.

NOTE: fx = frequency of undesired signal

fo = frequency of heterodyne oscillator

fi = frequency of i-f amplifier

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Table 7

Resonant Overload - MCW Inputs

Band No.	Freq kc	Microvolts input for resonant overload	Power output across 600 ohm phone circuit load. milliwatts	Power Output across 8 ohm voice coil load. milliwatts
1	295	15.0	26.7	-
2	640	7.0	16.0	-
3	1,310	5.0	24.0	-
4	2,600	2.9	33.0	-
5	5,100	4.4	26.7	-
6	10,000	6.6	32.2	-
7	21,000	6.6	19.3	-
1	295	13.5	-	1665
4	2,600	2.7	-	1800
7	21,000	7.4	-	3000

Table 8

Resonant Overload - CW Inputs

Band No.	Freq kc	Microvolts input for resonant overload	Power output across 600 ohm phone circuit load. milliwatts	Power output across 8 ohm voice coil load. milliwatts
1	195	47.5	48.6	-
1	445	16.0	52.2	-
2	445	35.0	68.2	-
2	924	9.2	64.0	-
3	924	21.0	64.0	-
3	1,865	5.3	60.0	-
4	1,865	6.6	60.0	-
4	3,700	8.4	60.0	-
5	3,700	11.0	66.0	-
5	7,000	9.5	52.5	-
6	7,000	10.0	42.4	-
6	14,100	20.0	42.7	-
7	14,100	17.0	52.2	-
7	30,000	27.0	58.0	-
1	195	33.0	-	1760
4	2,600	4.0	-	2310
7	21,000	23.0	-	2760

Table 9

Frequency Stability - Total Change in R-F Gain Control Setting

Band No	Frequency Kilocycles	Change in Het.Osc. Frequency	Change in Het. Osc.Freq. % of Input Freq.
1	445	49 cycles	.011
4	3,700	190 cycles	.00513
7	30,000	18.4 kilocycles	.0614*

* Outside of specification limit.

Table 10

Frequency Stability - Change in Line Voltage from 104 to 127 Volts

Band No.	Frequency Kilocycles	Change in Het. Osc. Frequency	Change in Het. Osc.Freq. % of Input Freq.
1	445	303 cycles	.0680*
4	3,700	1012 cycles	.0274*
7	30,000	3.68 kilocycles	.0123

* Outside of specification limits.

Table 11

Frequency Variation per Division per 10° Tuning Capacitor Rotation

Capacitor Rotation - °	Tuning Dial Setting Divisions	$\frac{fo - fx}{fo} \times 100$
0	0	$\pm$ 0
10	27.7	-29.2
20	55.4	-20.0
30	83.1	-13.0
40	110.8	-15.5
50	138.5	-9.2
60	166.2	-10.5
70	193.9	-6.3
80	222.0	+2.5
90	250.0	-3.5
100	277.0	$\pm$ 0
110	305.0	-6.6
120	333.0	+22.7
130	361.0	+6.0
140	388.0	+16.5
150	416.0	+16.5
160	444.0	+29.5
170	472.0	+23.5
180	500.0	-3.8

fo = average kc per division for 500 dial divisions

fx = average kc per division for 10 dial divisions.

NOTE: Data for 195 kc frequency setting.

DECLASSIFIED

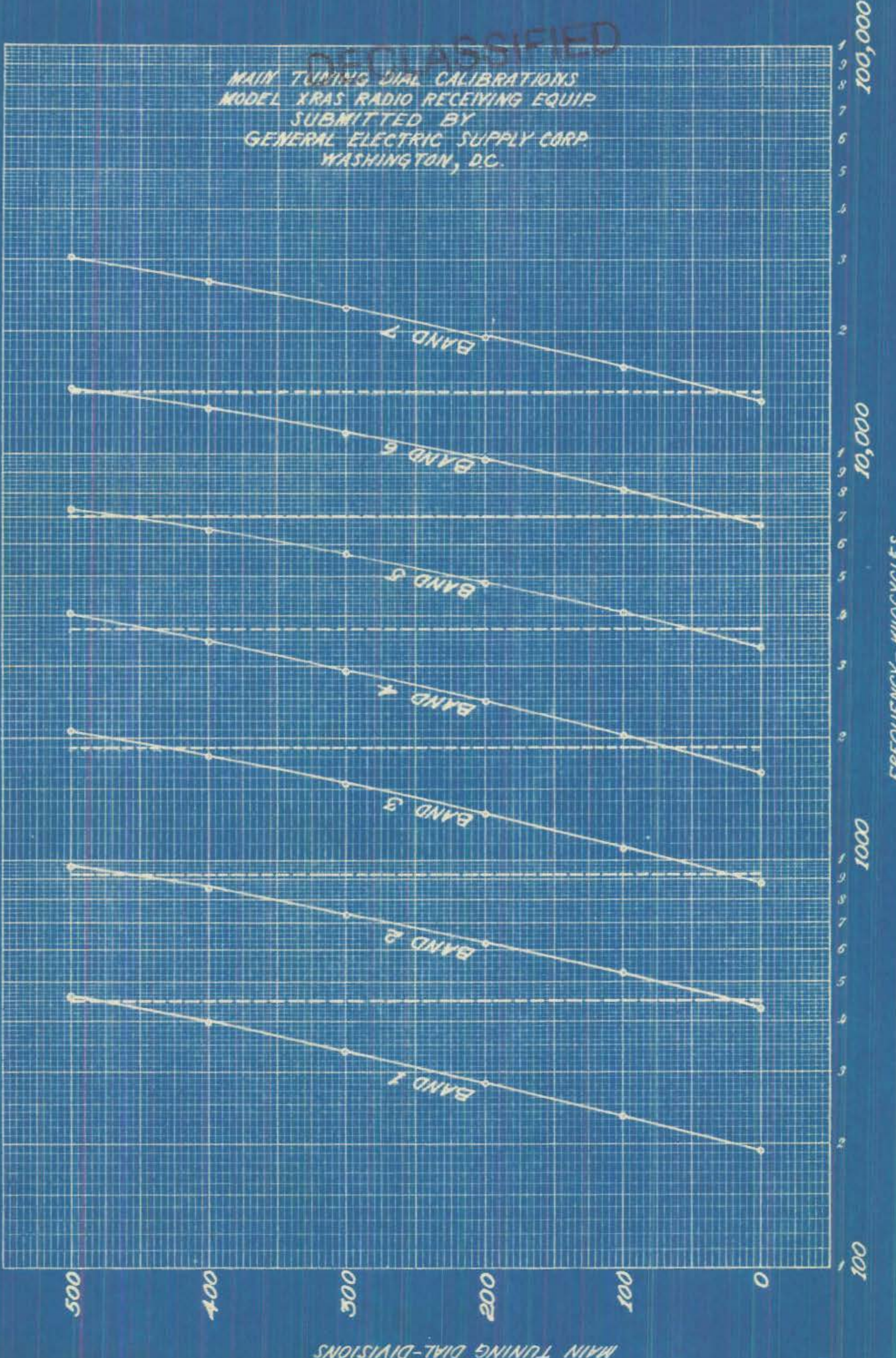
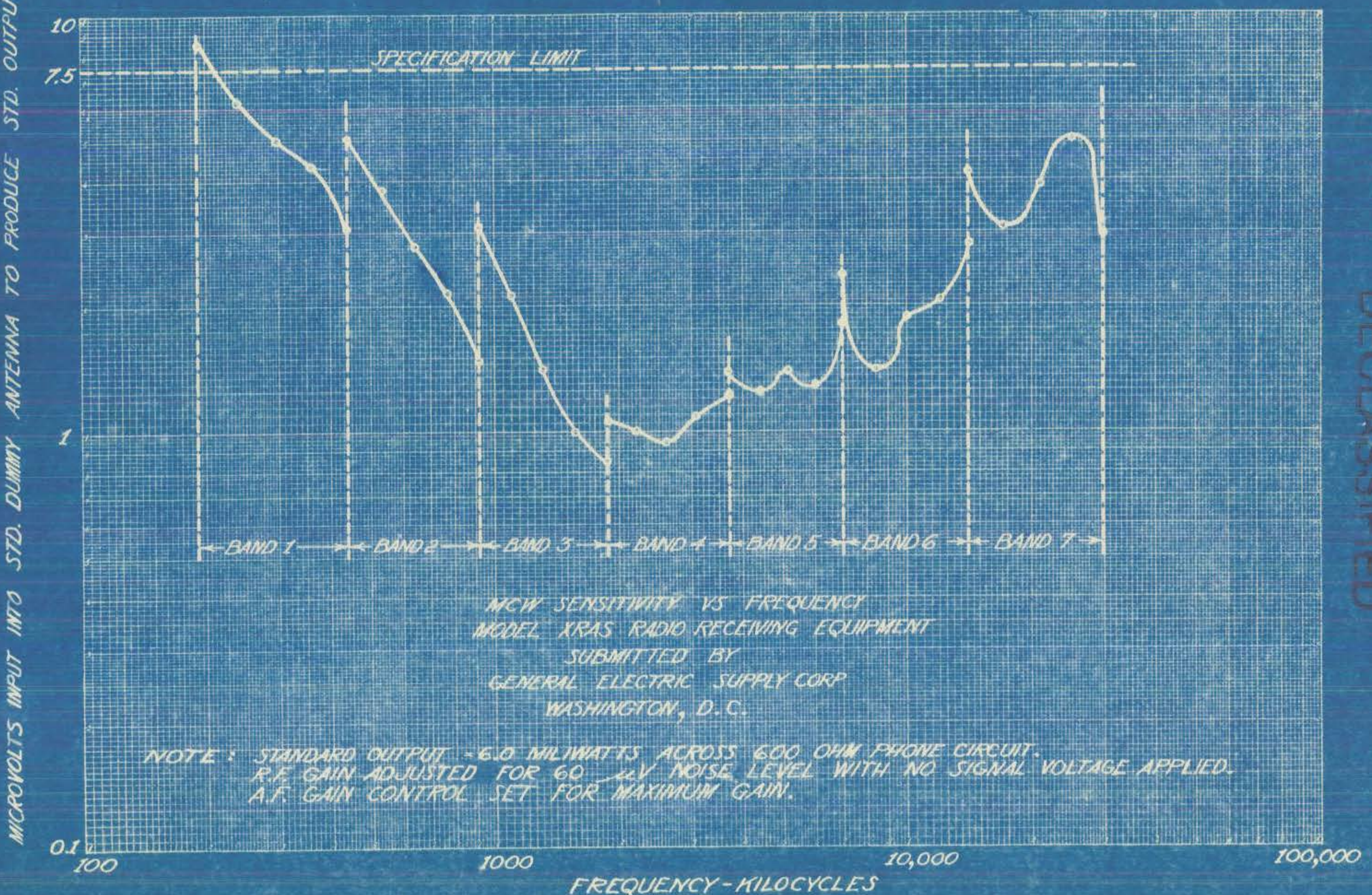
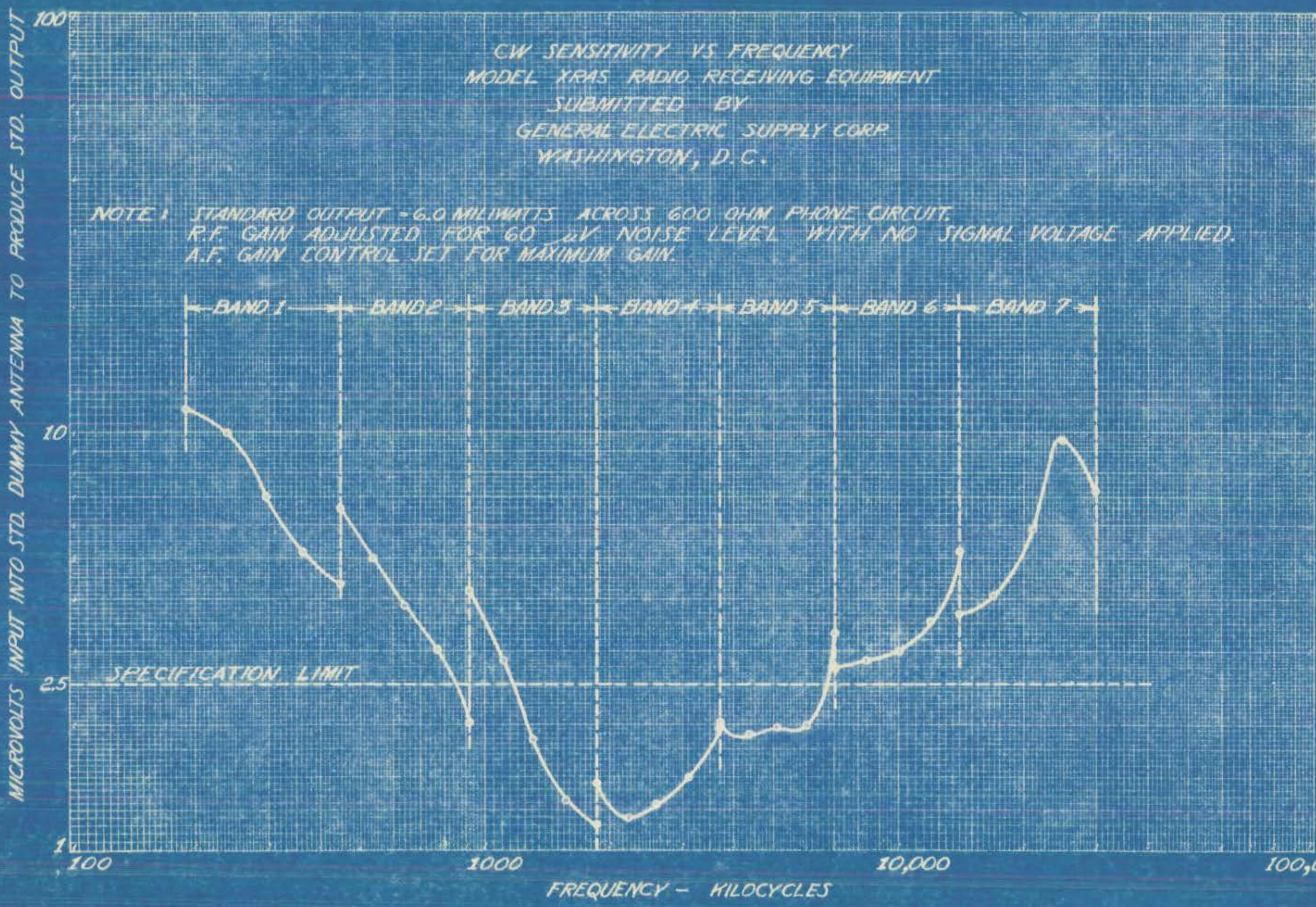


PLATE I



DECLASSIFIED

PLATE 2



CW SENSITIVITY VS FREQUENCY
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
NOTE: STANDARD OUTPUT - 6.0 MILIWATTS ACROSS 600 OHM PHONE CIRCUIT.
R.F. GAIN ADJUSTED FOR 60 μV NOISE LEVEL WITH NO SIGNAL VOLTAGE APPLIED.
A.F. GAIN CONTROL SET FOR MAXIMUM GAIN.
BAND 1
BAND 2
BAND 3
BAND 4
BAND 5
BAND 6
BAND 7
SPECIFICATION LIMIT
100
10
2.5
1
100
1000
10,000
100,000
FREQUENCY - KILOCYCLES
MICROVOLTS INPUT INTO STD. DUMMY ANTENNA TO PRODUCE STD. OUTPUT

PLATE 3

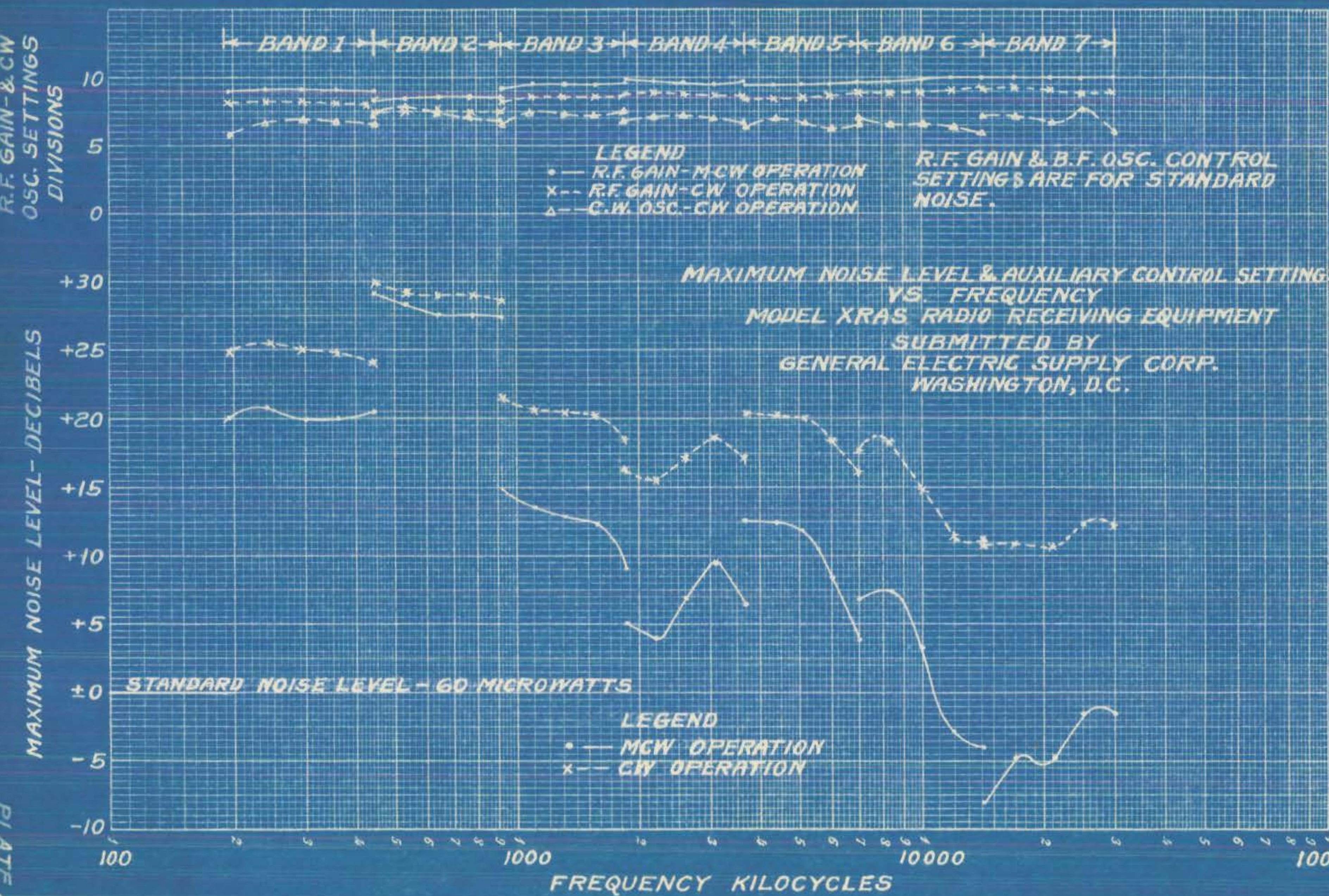

BAND 1
BAND 2
BAND 3
BAND 4
BAND 5
BAND 6
BAND 7
R.F. GAIN-& CW OSC. SETTINGS DIVISIONS
10
5
0
LEGEND
• — R.F. GAIN-MCW OPERATION
X -- R.F. GAIN-CW OPERATION
Δ -- C.W. OSC.-CW OPERATION
R.F. GAIN & B.F. OSC. CONTROL SETTINGS ARE FOR STANDARD NOISE.
MAXIMUM NOISE LEVEL & AUXILIARY CONTROL SETTINGS
VS FREQUENCY
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
MAXIMUM NOISE LEVEL-DECIBELS
+30
+25
+20
+15
+10
+5
±0
-5
-10
STANDARD NOISE LEVEL - 60 MICROWATTS
LEGEND
• — MCW OPERATION
x -- CW OPERATION
100
1000
10000
100000
FREQUENCY KILOCYCLES

PLATE 4

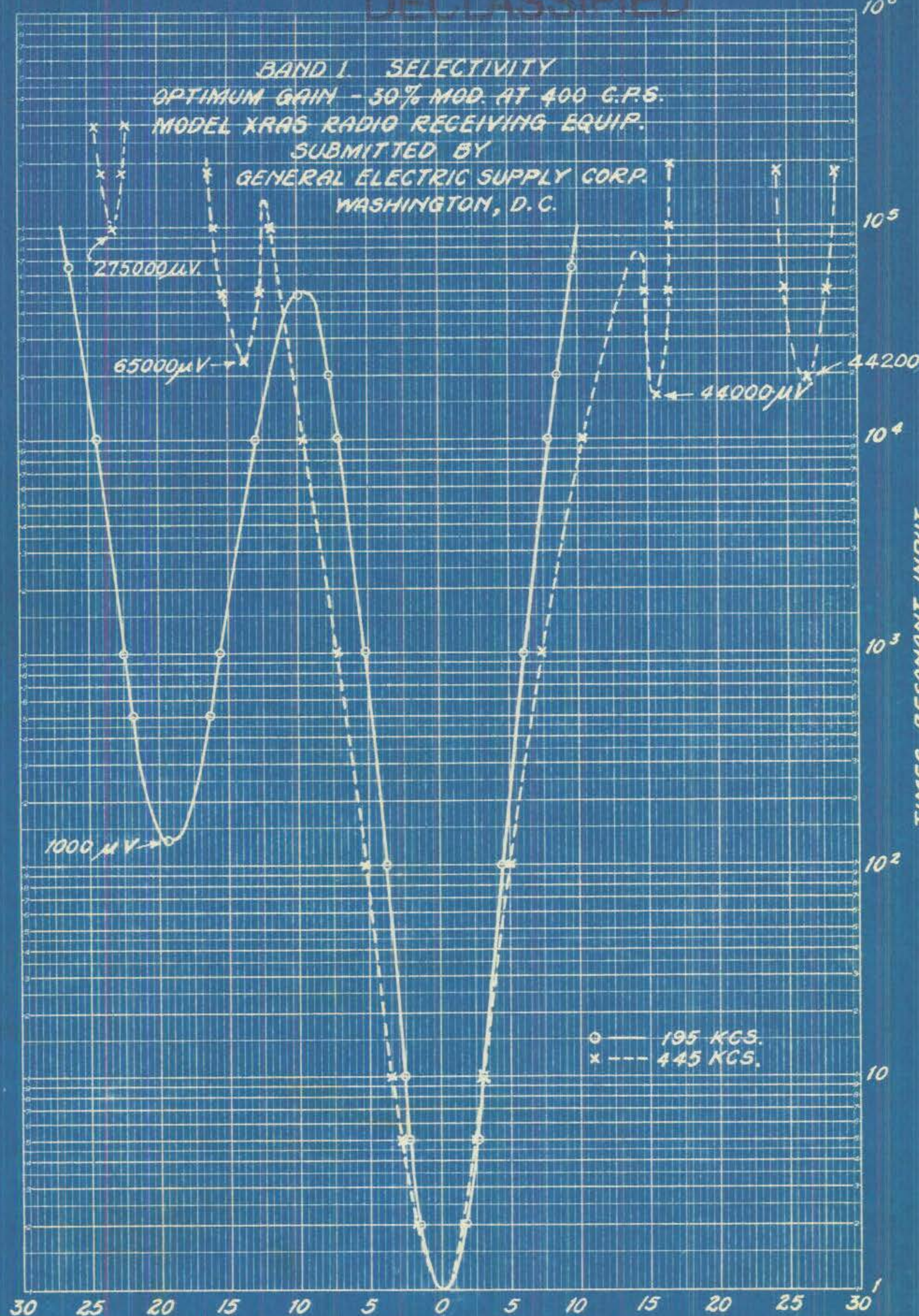

BAND I. SELECTIVITY
OPTIMUM GAIN - 30% MOD. AT 400 C.P.S.
MODEL XRAS RADIO RECEIVING EQUIP.
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
275000µV.
65000µV
1000µV
44000µV
44200µV.
195 KCS.
445 KCS.
10^6
10^5
10^4
10^3
10^2
10
1
TIMES RESONANT INPUT
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE 5

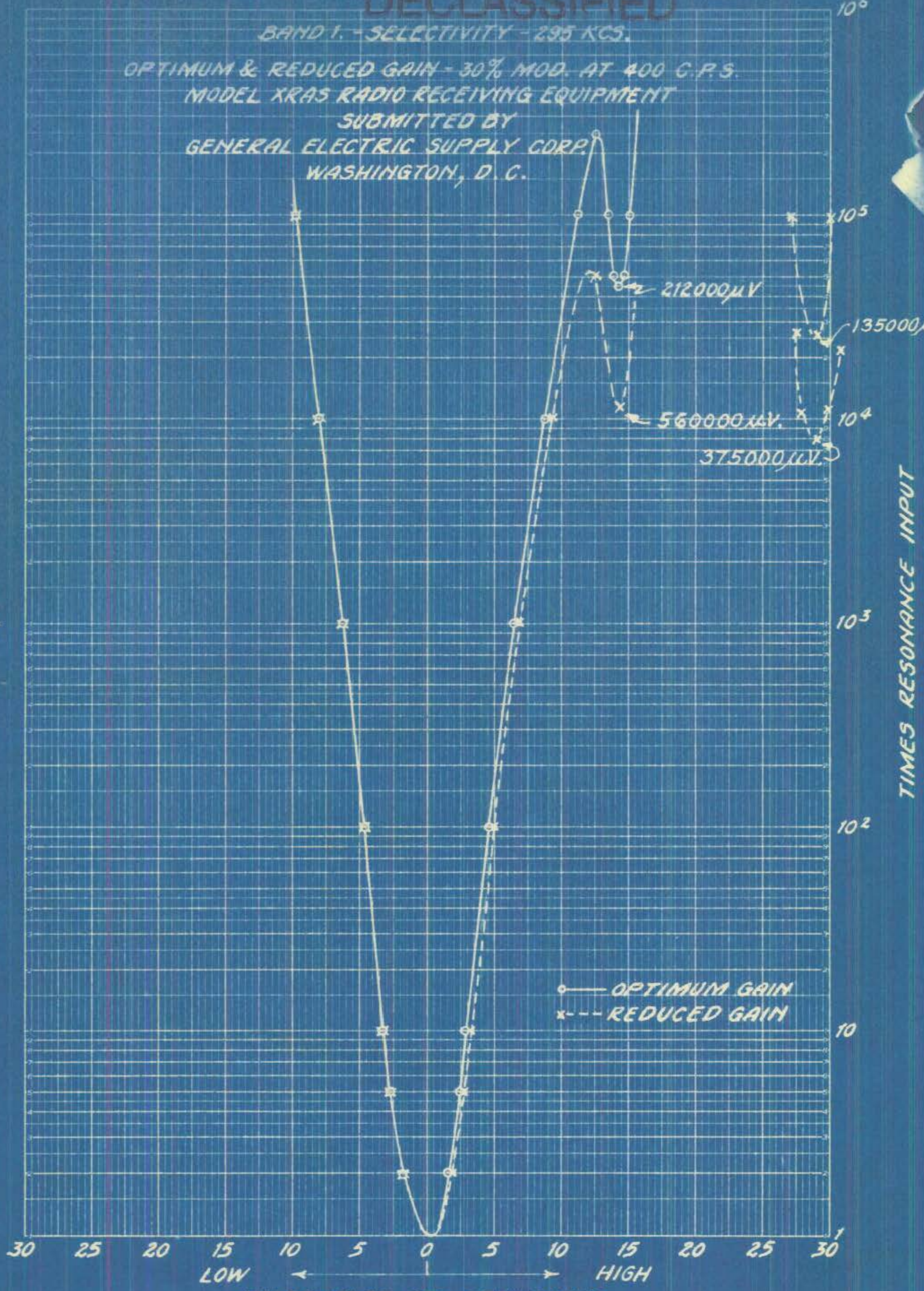

BAND 1. - SELECTIVITY - 295 KCS.
OPTIMUM & REDUCED GAIN - 30% MOD. AT 400 C.P.S.
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
212000μV
135000μV.
560000μV.
375000μV.
OPTIMUM GAIN
REDUCED GAIN
TIMES RESONANCE INPUT
10⁶
10⁵
10⁴
10³
10²
10
1
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE 6

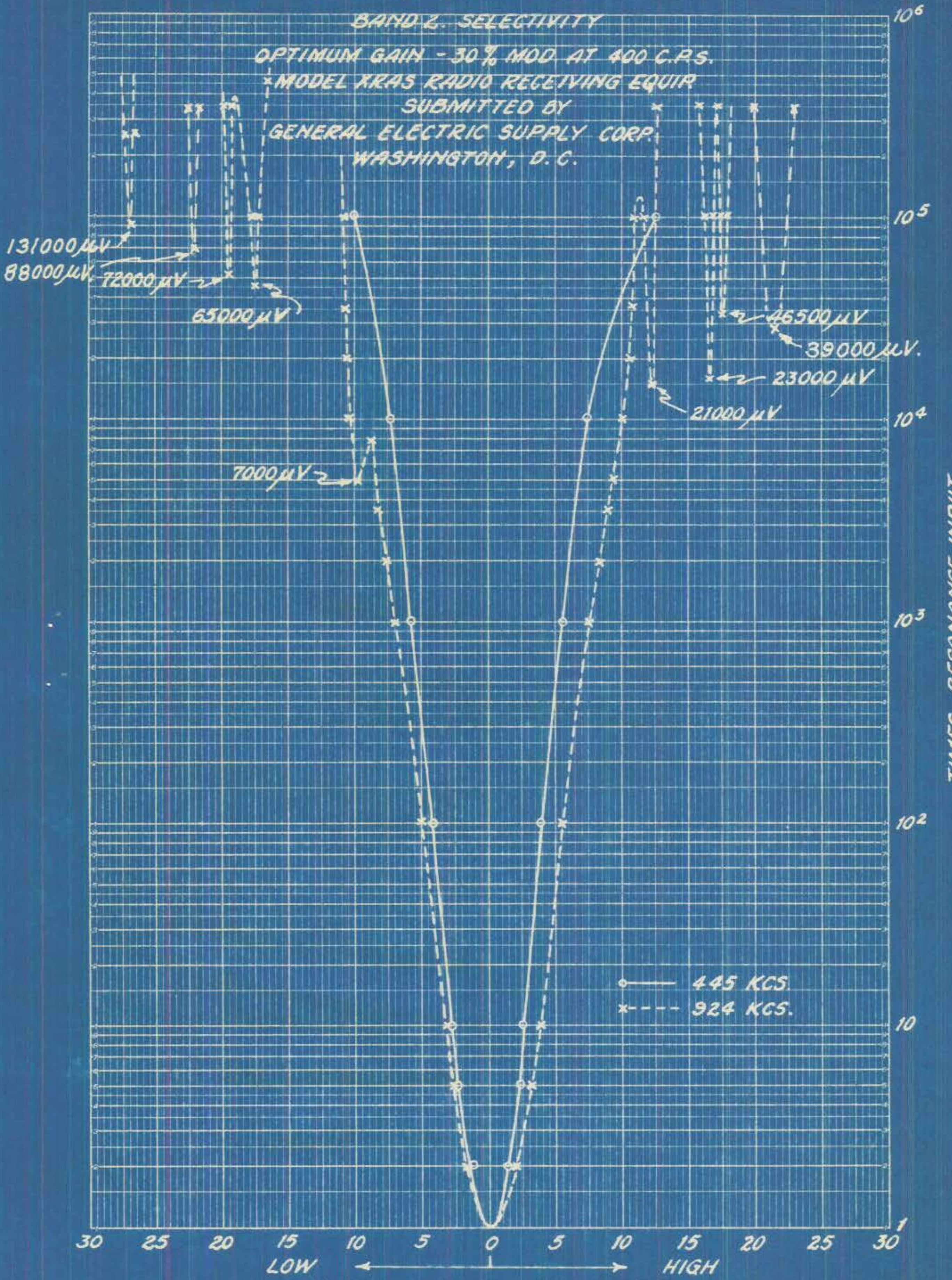

BAND 2. SELECTIVITY
OPTIMUM GAIN - 30% MOD AT 400 C.P.S.
MODEL XRAS RADIO RECEIVING EQUIP.
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
131000µV
88000µV
72000µV
65000µV
7000µV
46500µV
39000µV.
23000µV
21000µV
445 KCS.
924 KCS.
10^6
10^5
10^4
10^3
10^2
10
1
TIMES RESONANCE INPUT
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE 7

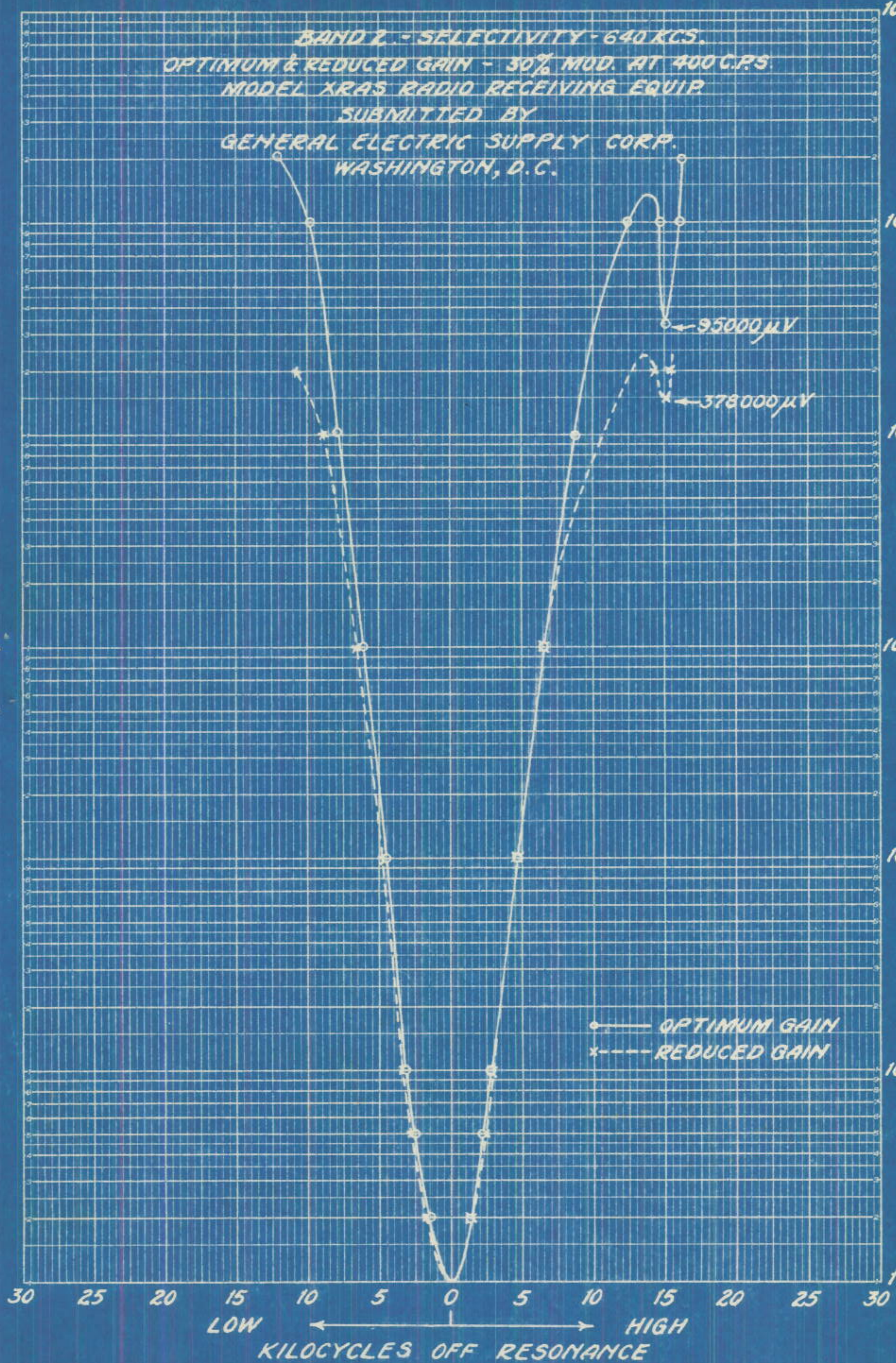

BAND 2 - SELECTIVITY - 640 KCS.
OPTIMUM & REDUCED GAIN - 30% MOD. AT 400 C.P.S.
MODEL XRAS RADIO RECEIVING EQUIP.
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
95000 µV
378000 µV
OPTIMUM GAIN
REDUCED GAIN
10^6
10^5
10^4
10^3
10^2
10
1
TIMES RESONANCE INPUT
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE 8

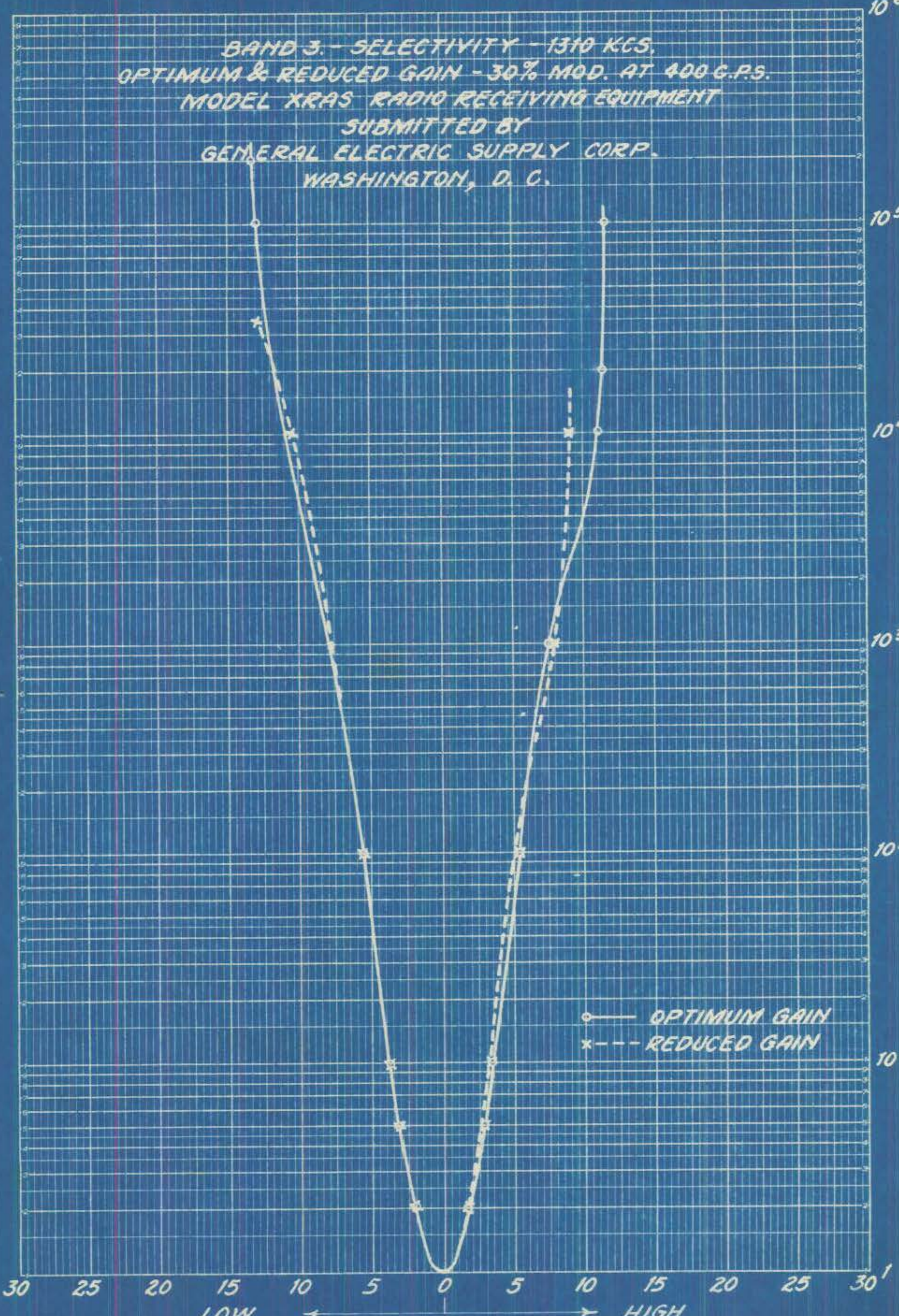
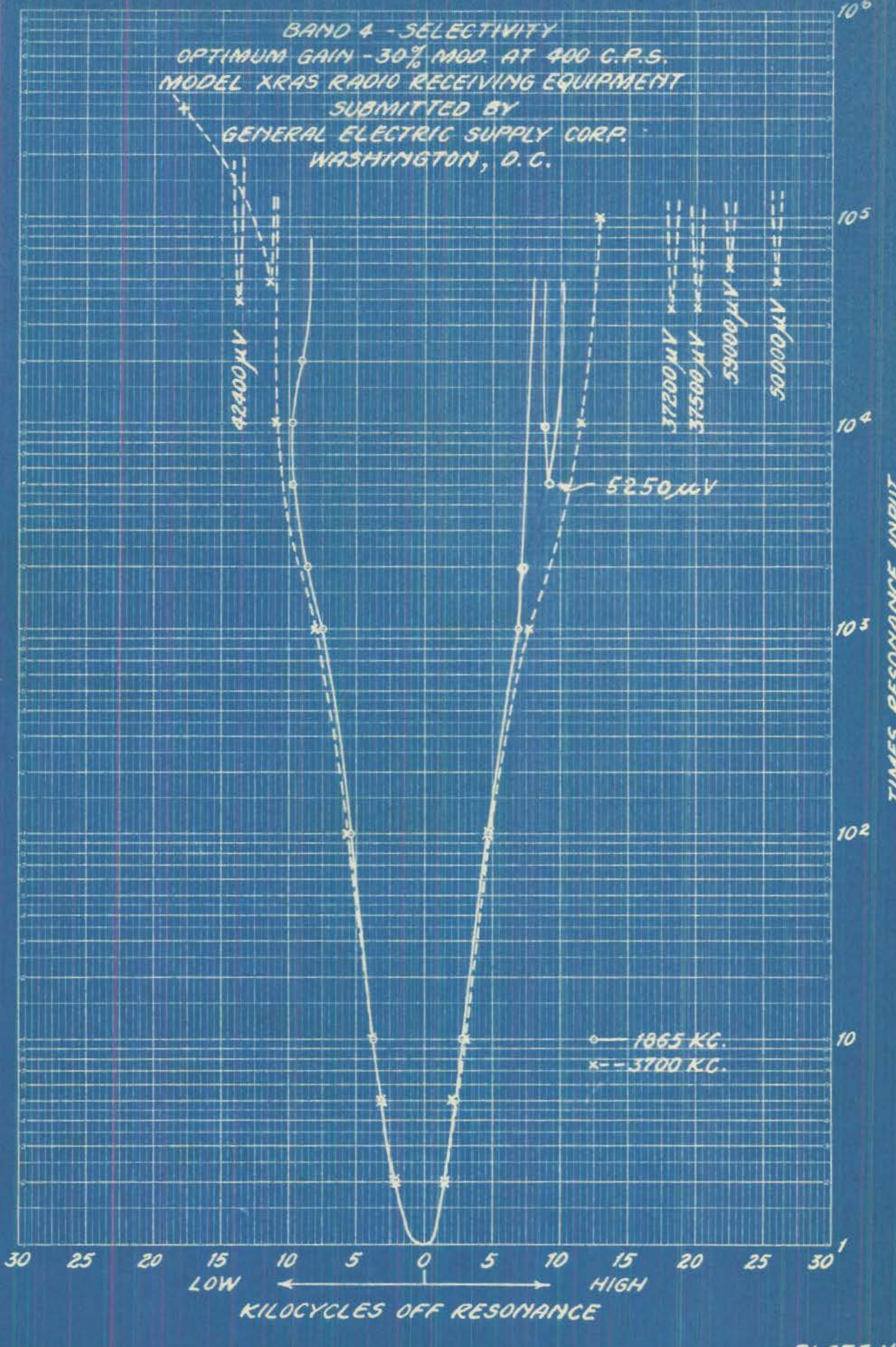

BAND 3. - SELECTIVITY - 1310 KCS.
OPTIMUM & REDUCED GAIN - 30% MOD. AT 400 C.P.S.
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D. C.
OPTIMUM GAIN
REDUCED GAIN
10^6
10^5
10^4
10^3
10^2
10
1
TIMES RESONANCE INPUT
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE 10



BAND 4 - SELECTIVITY
OPTIMUM GAIN - 30% MOD. AT 400 C.P.S.
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
42400 µV
37200 µV
37500 µV
59000 µV
50000 µV
5250 µV
1865 KC.
3700 KC.
10^6
10^5
10^4
10^3
10^2
10
1
TIMES RESONANCE INPUT
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE 11

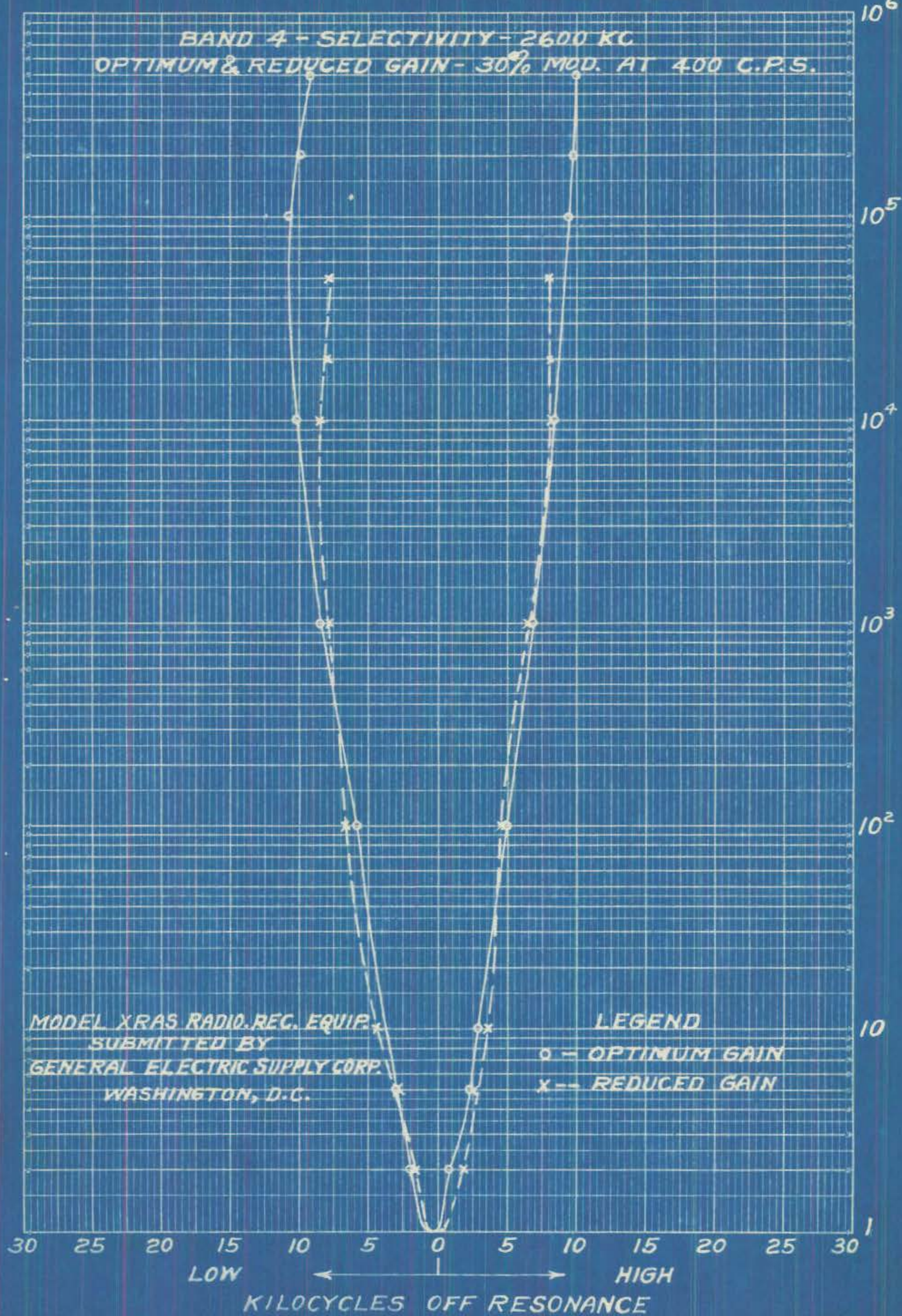

BAND 4 - SELECTIVITY - 2600 KC
OPTIMUM & REDUCED GAIN - 30% MOD. AT 400 C.P.S.
10^6
10^5
10^4
10^3
10^2
10
1
TIMES RESONANCE INPUT
MODEL XRAS RADIO. REC. EQUIP.
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
LEGEND
o - OPTIMUM GAIN
x -- REDUCED GAIN
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE 12

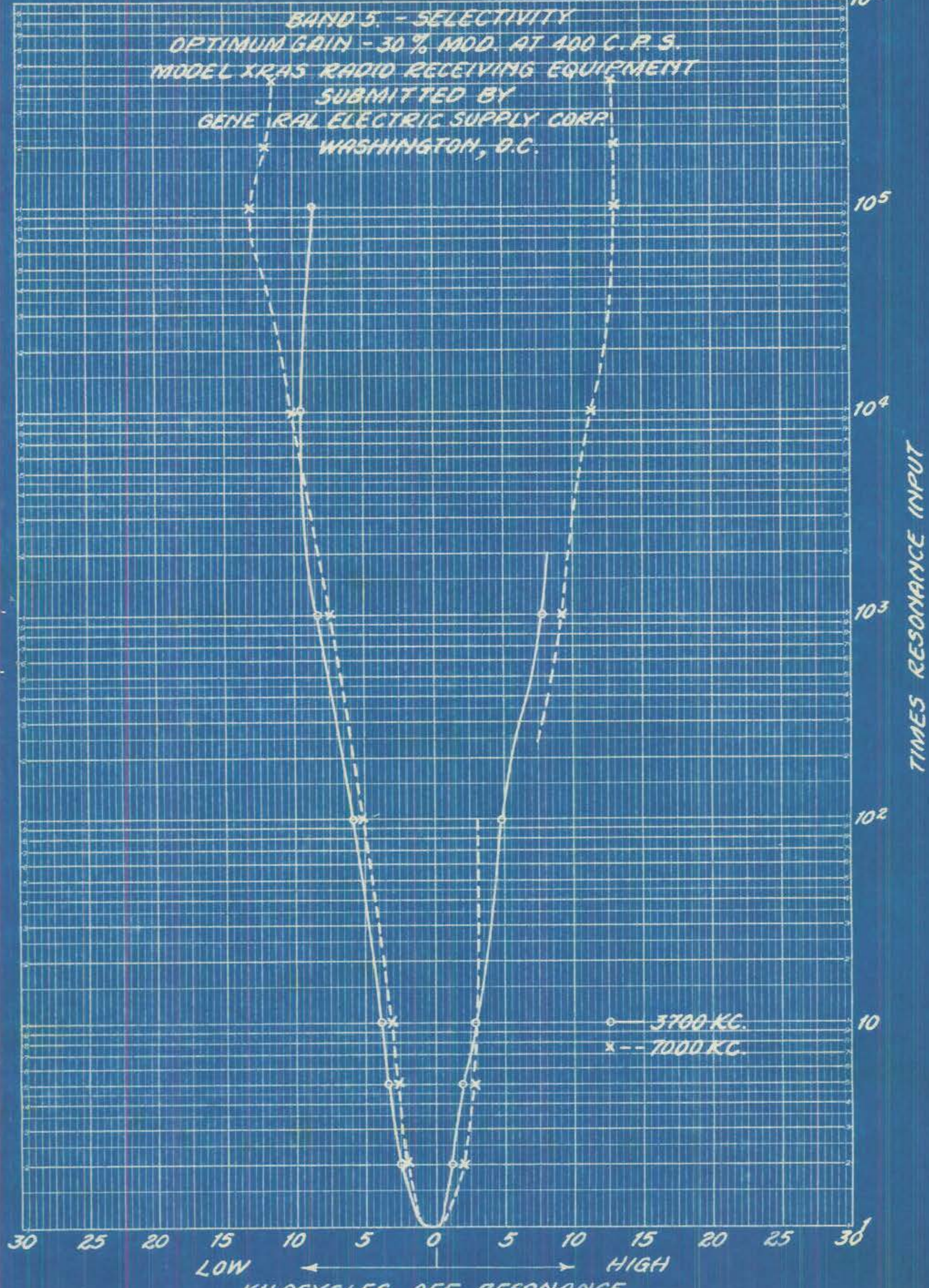

BAND 5. - SELECTIVITY
OPTIMUM GAIN - 30 % MOD. AT 400 C.P.S.
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
10^6
10^5
10^4
10^3
10^2
10
1
TIMES RESONANCE INPUT
3700 KC.
7000 KC.
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE 13

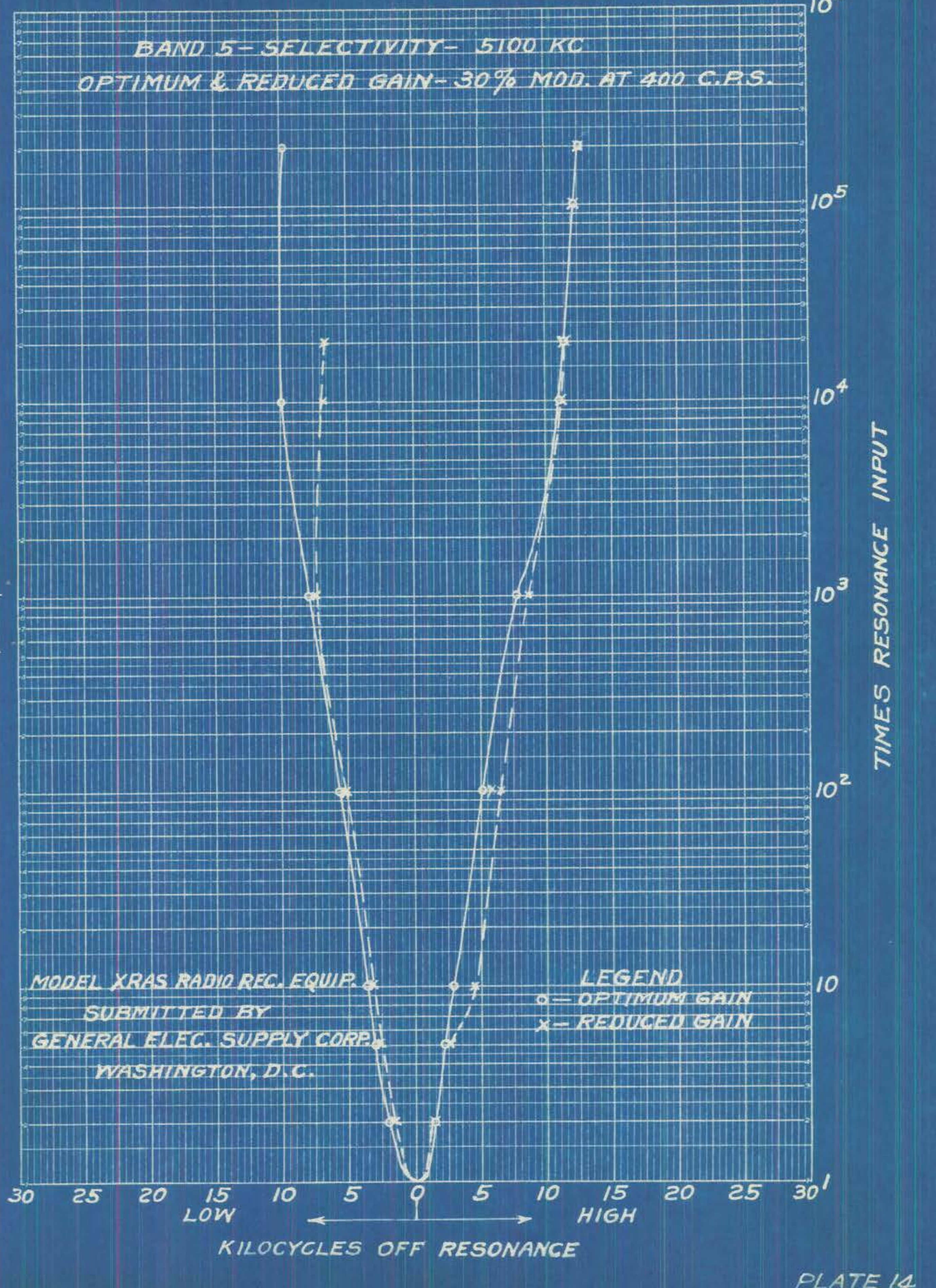

BAND 5 - SELECTIVITY - 5100 KC
OPTIMUM & REDUCED GAIN - 30% MOD. AT 400 C.P.S.
MODEL XRAS RADIO REC. EQUIP.
SUBMITTED BY
GENERAL ELEC. SUPPLY CORP.
WASHINGTON, D.C.
LEGEND
o - OPTIMUM GAIN
x - REDUCED GAIN
10^6
10^5
10^4
10^3
10^2
10
1
TIMES RESONANCE INPUT
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE 14

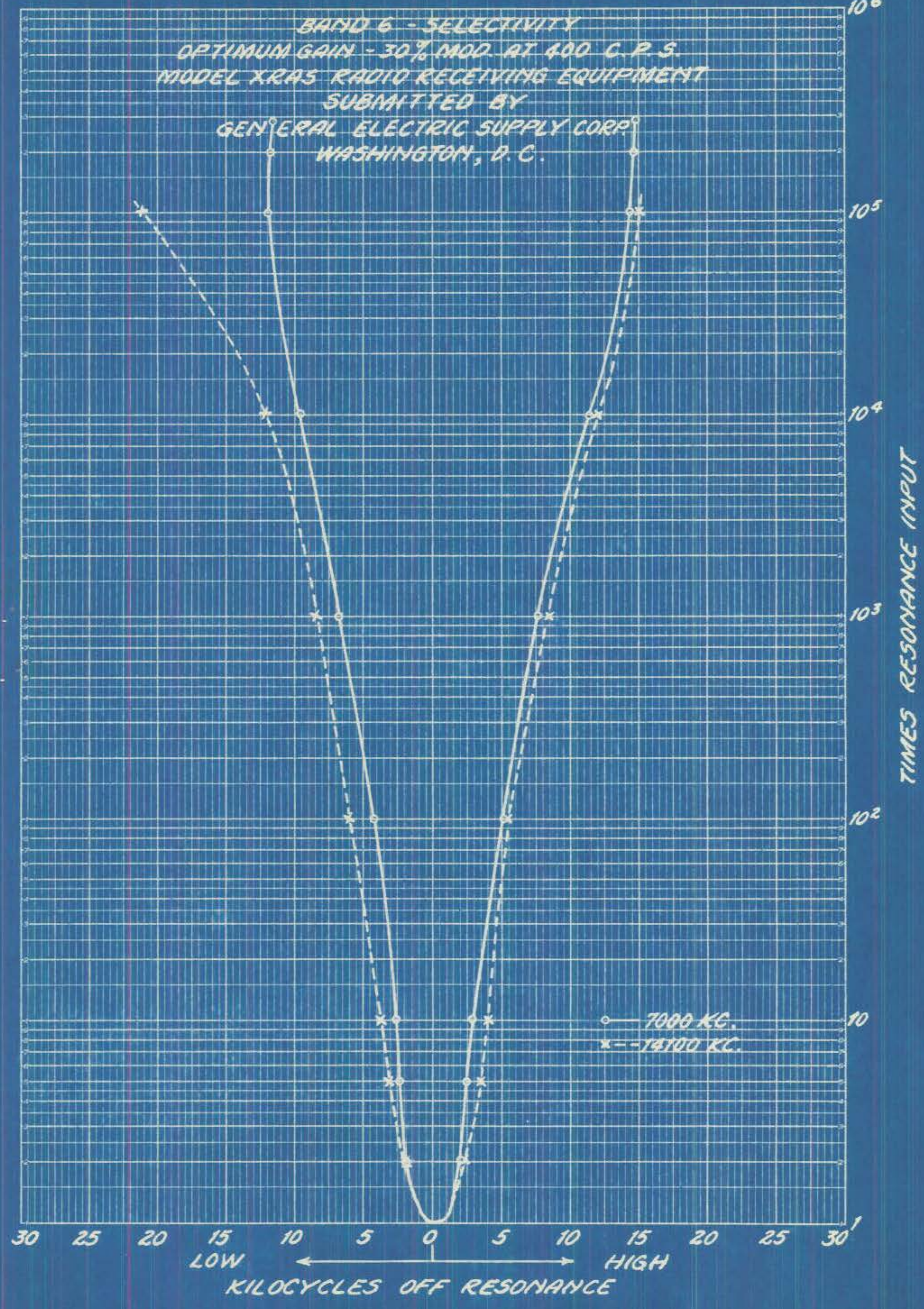

BAND 6 - SELECTIVITY
OPTIMUM GAIN - 30% MOD AT 400 C.P.S.
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
o— 7000 KC.
x - - 14100 KC.
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE
1
10
10²
10³
10⁴
10⁵
10⁶
TIMES RESONANCE INPUT

PLATE 15

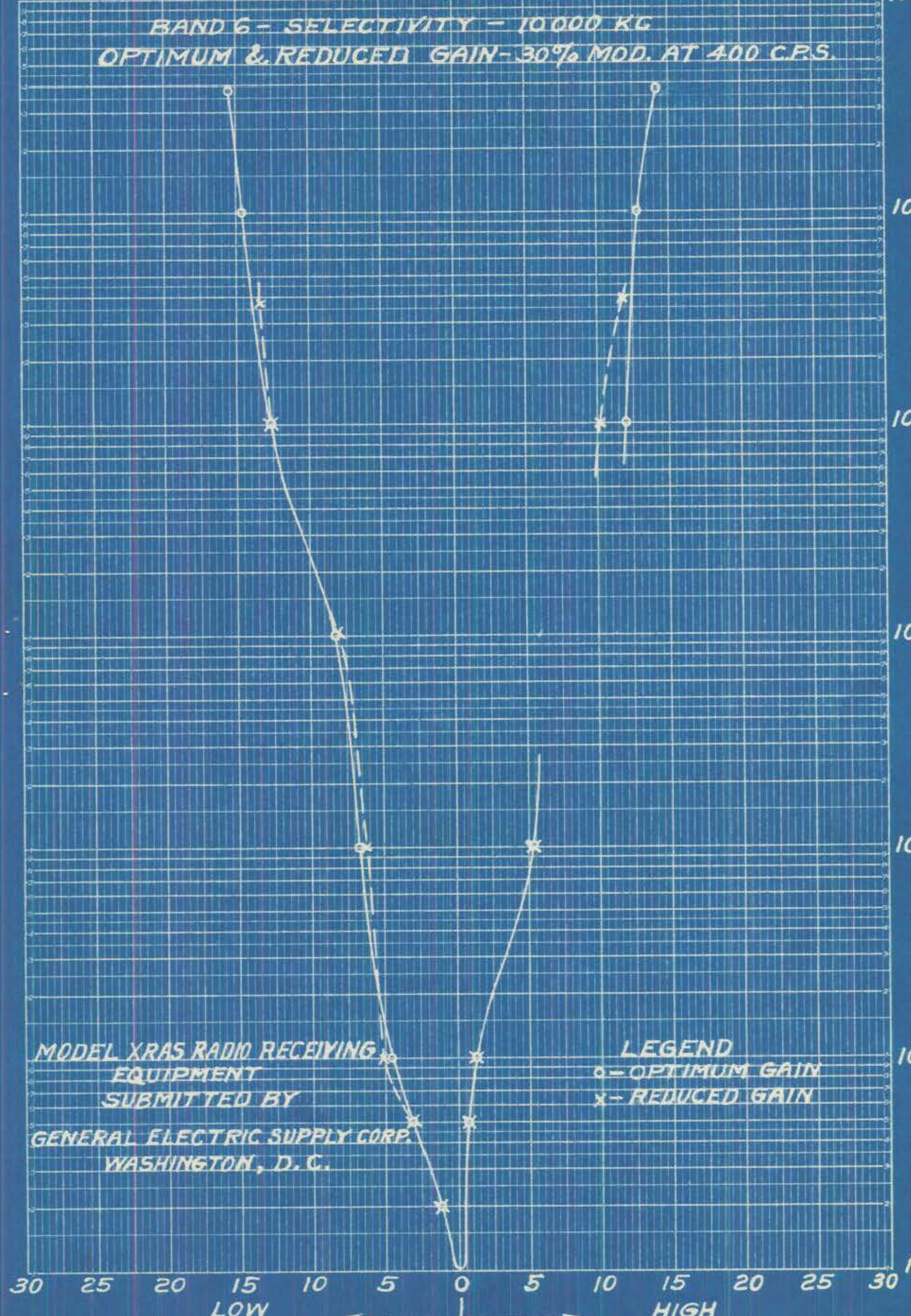

BAND 6 - SELECTIVITY - 10000 KC
OPTIMUM & REDUCED GAIN - 30% MOD. AT 400 C.P.S.
10^6
10^5
10^4
10^3
10^2
10
1
TIMES RESONANCE INPUT
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
LEGEND
o - OPTIMUM GAIN
x - REDUCED GAIN

PLATE 16

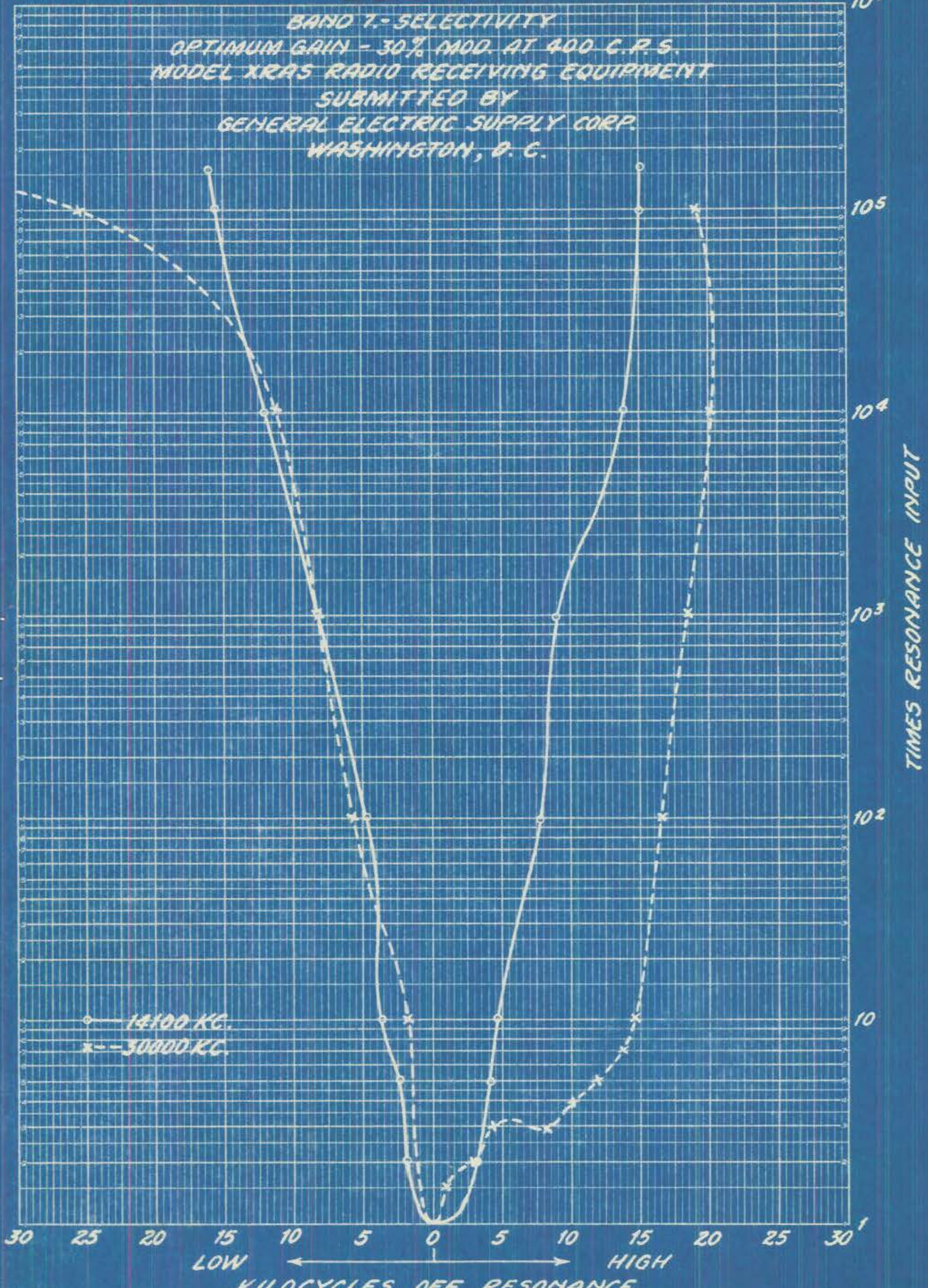

BAND 7.- SELECTIVITY
OPTIMUM GAIN - 30% MOD. AT 400 C.P.S.
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D. C.
14100 KC.
30000 KC.
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE
10^6
10^5
10^4
10^3
10^2
10
1
TIMES RESONANCE INPUT

PLATE 17

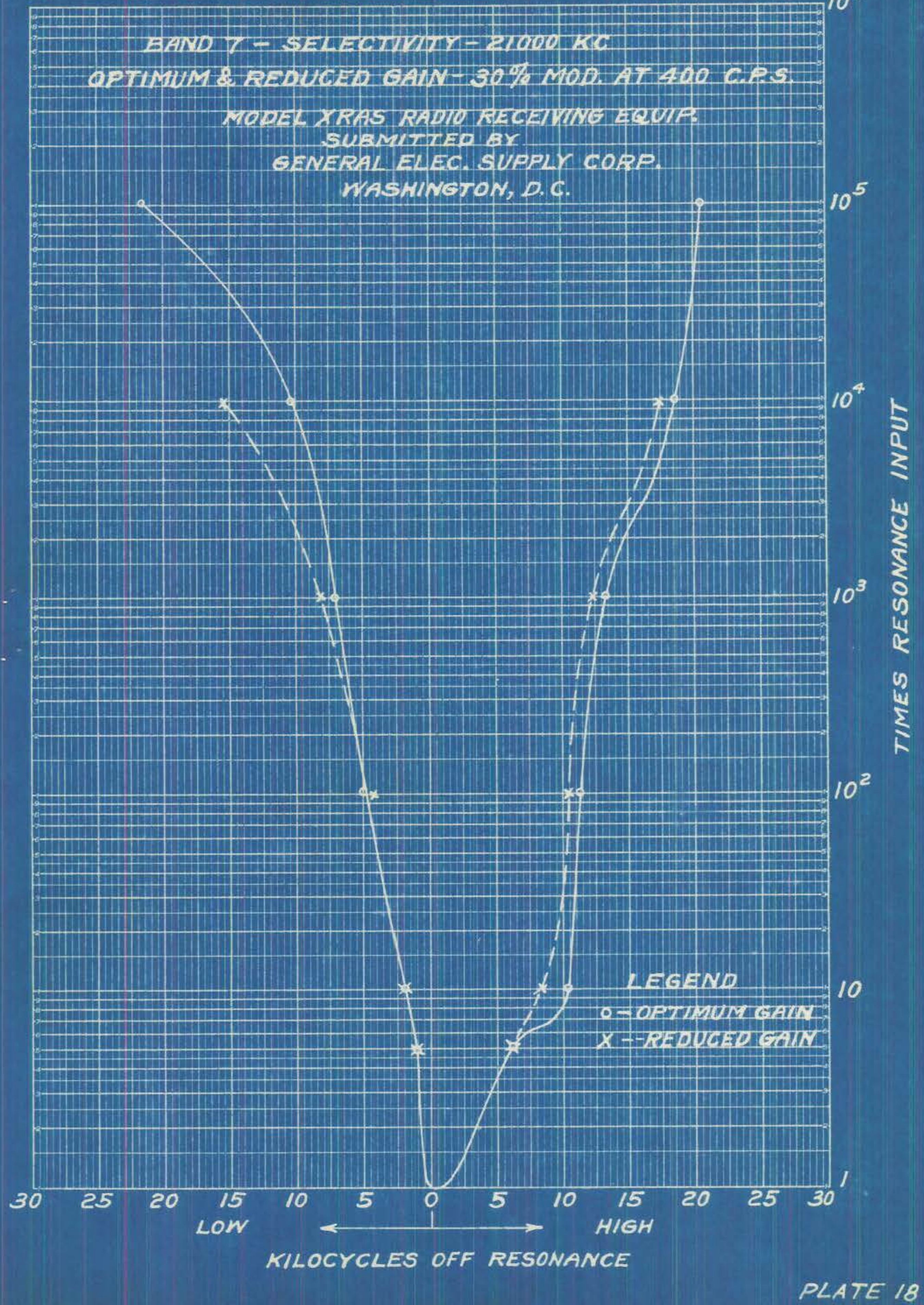

BAND 7 - SELECTIVITY - 21000 KC
OPTIMUM & REDUCED GAIN - 30% MOD. AT 400 C.P.S.
MODEL XRAS RADIO RECEIVING EQUIP.
SUBMITTED BY
GENERAL ELEC. SUPPLY CORP.
WASHINGTON, D.C.
LEGEND
O - OPTIMUM GAIN
X - - REDUCED GAIN
10^6
10^5
10^4
10^3
10^2
10
1
TIMES RESONANCE INPUT
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE 18

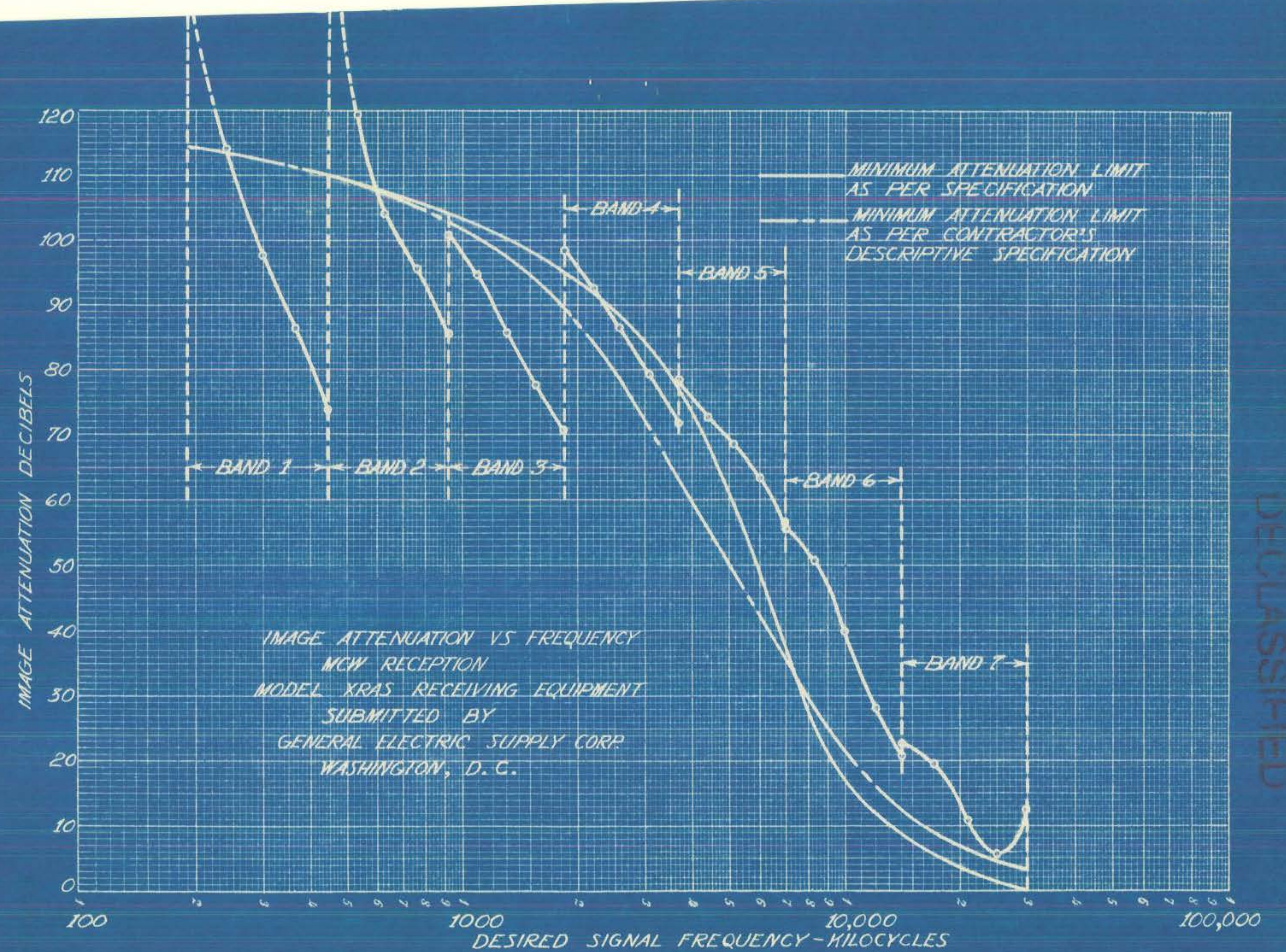
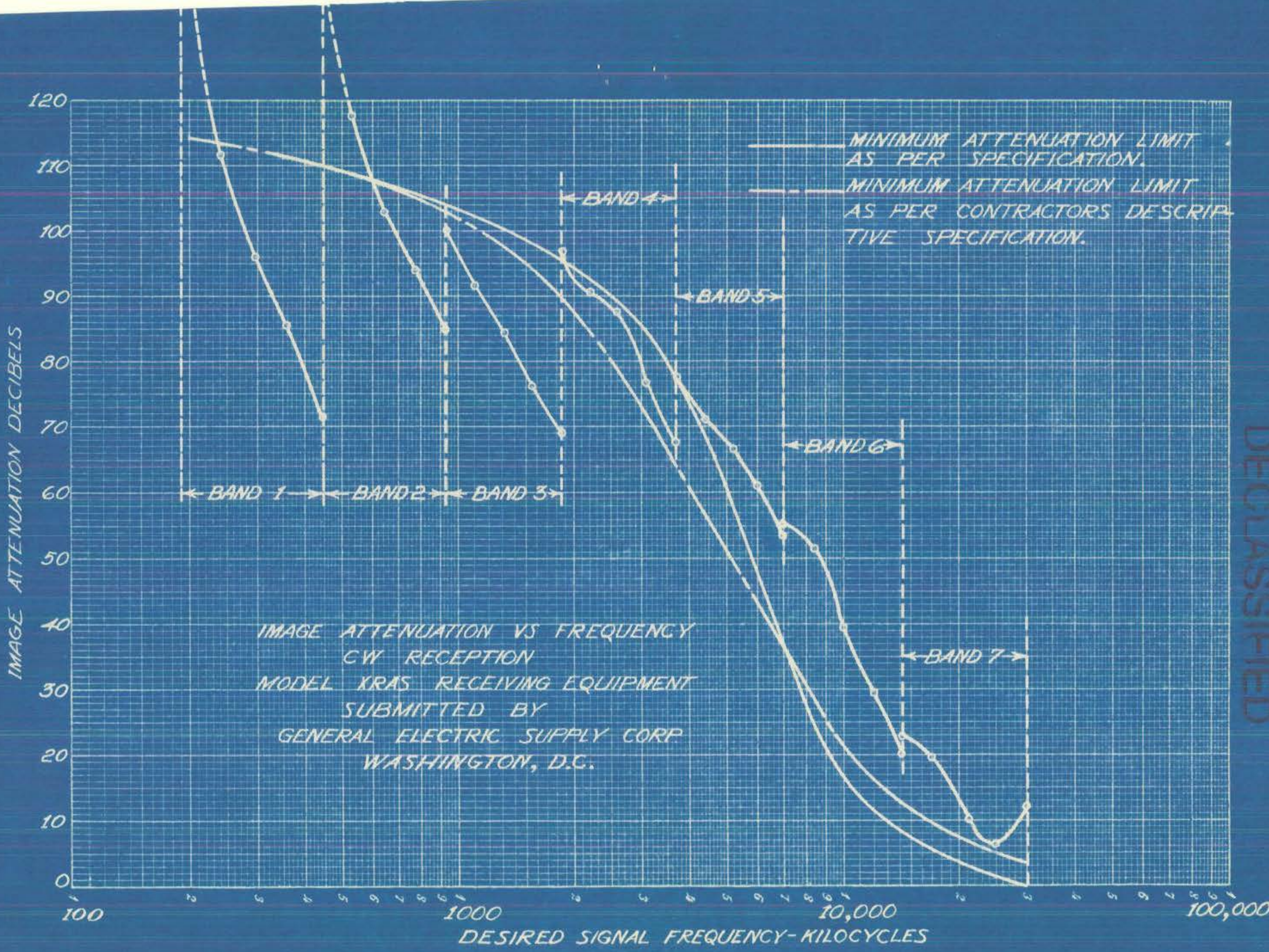
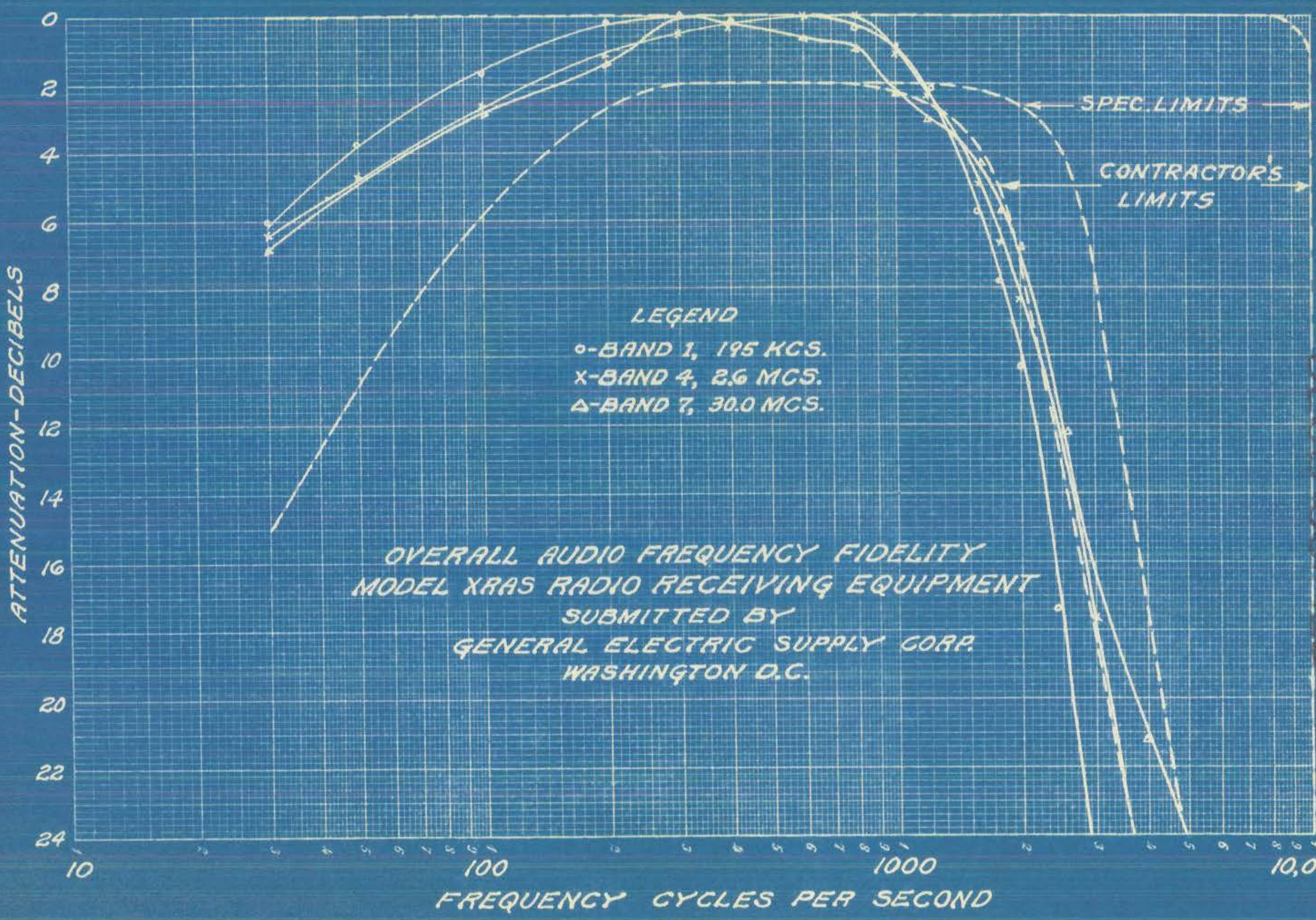

MINIMUM ATTENUATION LIMIT AS PER SPECIFICATION
MINIMUM ATTENUATION LIMIT AS PER CONTRACTOR'S DESCRIPTIVE SPECIFICATION
BAND 1
BAND 2
BAND 3
BAND 4
BAND 5
BAND 6
BAND 7
IMAGE ATTENUATION VS FREQUENCY
MCW RECEPTION
MODEL XRAS RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D. C.
IMAGE ATTENUATION DECIBELS
DESIRED SIGNAL FREQUENCY - KILOCYCLES
100
1000
10,000
100,000
0
10
20
30
40
50
60
70
80
90
100
110
120

PLATE 19



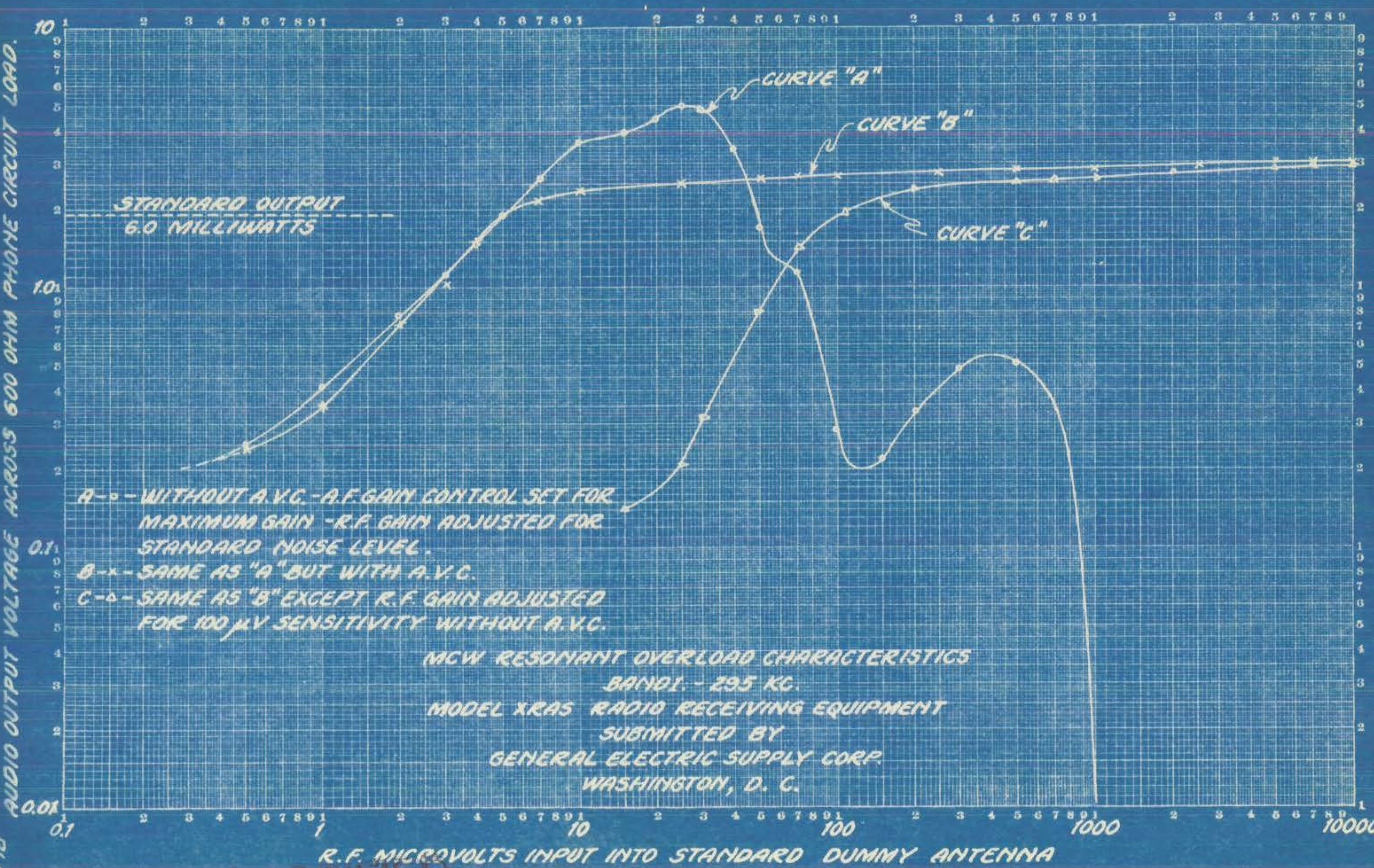
MINIMUM ATTENUATION LIMIT AS PER SPECIFICATION.
MINIMUM ATTENUATION LIMIT AS PER CONTRACTORS DESCRIPTIVE SPECIFICATION.
IMAGE ATTENUATION VS FREQUENCY
CW RECEPTION
MODEL XRAS RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP
WASHINGTON, D.C.
BAND 1
BAND 2
BAND 3
BAND 4
BAND 5
BAND 6
BAND 7
IMAGE ATTENUATION DECIBELS
DESIRED SIGNAL FREQUENCY-KILOCYCLES
120
110
100
90
80
70
60
50
40
30
20
10
0
100
1000
10,000
100,000

PLATE 20



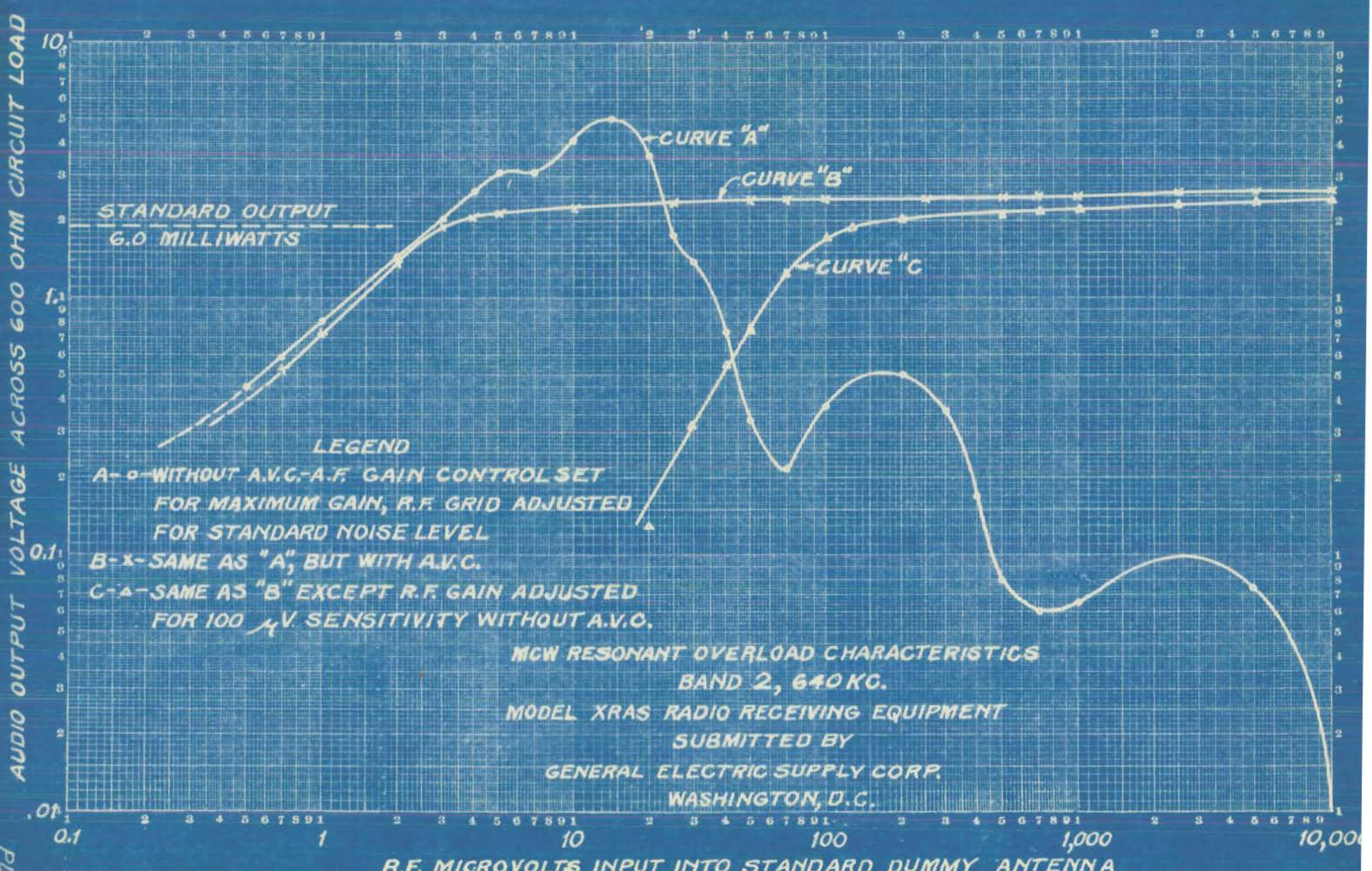
SPEC. LIMITS
CONTRACTOR'S LIMITS
LEGEND
o-BAND 1, 195 KCS.
X-BAND 4, 2.6 MCS.
Δ-BAND 7, 30.0 MCS.
OVERALL AUDIO FREQUENCY FIDELITY
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON D.C.
ATTENUATION-DECIBELS
0
2
4
6
8
10
12
14
16
18
20
22
24
10
100
1000
10,000
FREQUENCY CYCLES PER SECOND

PLATE 21



CURVE "A"
CURVE "B"
CURVE "C"
STANDARD OUTPUT
6.0 MILLIWATTS
A-o-WITHOUT A.V.C.-A.F. GAIN CONTROL SET FOR MAXIMUM GAIN -R.F. GAIN ADJUSTED FOR STANDARD NOISE LEVEL.
B-x-SAME AS "A" BUT WITH A.V.C.
C-Δ-SAME AS "B" EXCEPT R.F. GAIN ADJUSTED FOR 100 μV SENSITIVITY WITHOUT A.V.C.
MCW RESONANT OVERLOAD CHARACTERISTICS
BAND 1. - 295 KC.
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D. C.
AUDIO OUTPUT VOLTAGE ACROSS 600 OHM PHONE CIRCUIT LOAD.
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA
10
1.0
0.1
0.01
0.1
1
10
100
1000
10000

PLATE 22



CURVE "A"
CURVE "B"
CURVE "C
STANDARD OUTPUT
6.0 MILLIWATTS
LEGEND
A-o-WITHOUT A.V.C.-A.F. GAIN CONTROL SET
FOR MAXIMUM GAIN, R.F. GRID ADJUSTED
FOR STANDARD NOISE LEVEL
B-x-SAME AS "A", BUT WITH A.V.C.
C-△-SAME AS "B" EXCEPT R.F. GAIN ADJUSTED
FOR 100 μV SENSITIVITY WITHOUT A.V.C.
MCW RESONANT OVERLOAD CHARACTERISTICS
BAND 2, 640 KC.
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
AUDIO OUTPUT VOLTAGE ACROSS 600 OHM CIRCUIT LOAD
10
1
0.1
.01
0.1
1
10
100
1,000
10,000
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA

PLATE 23

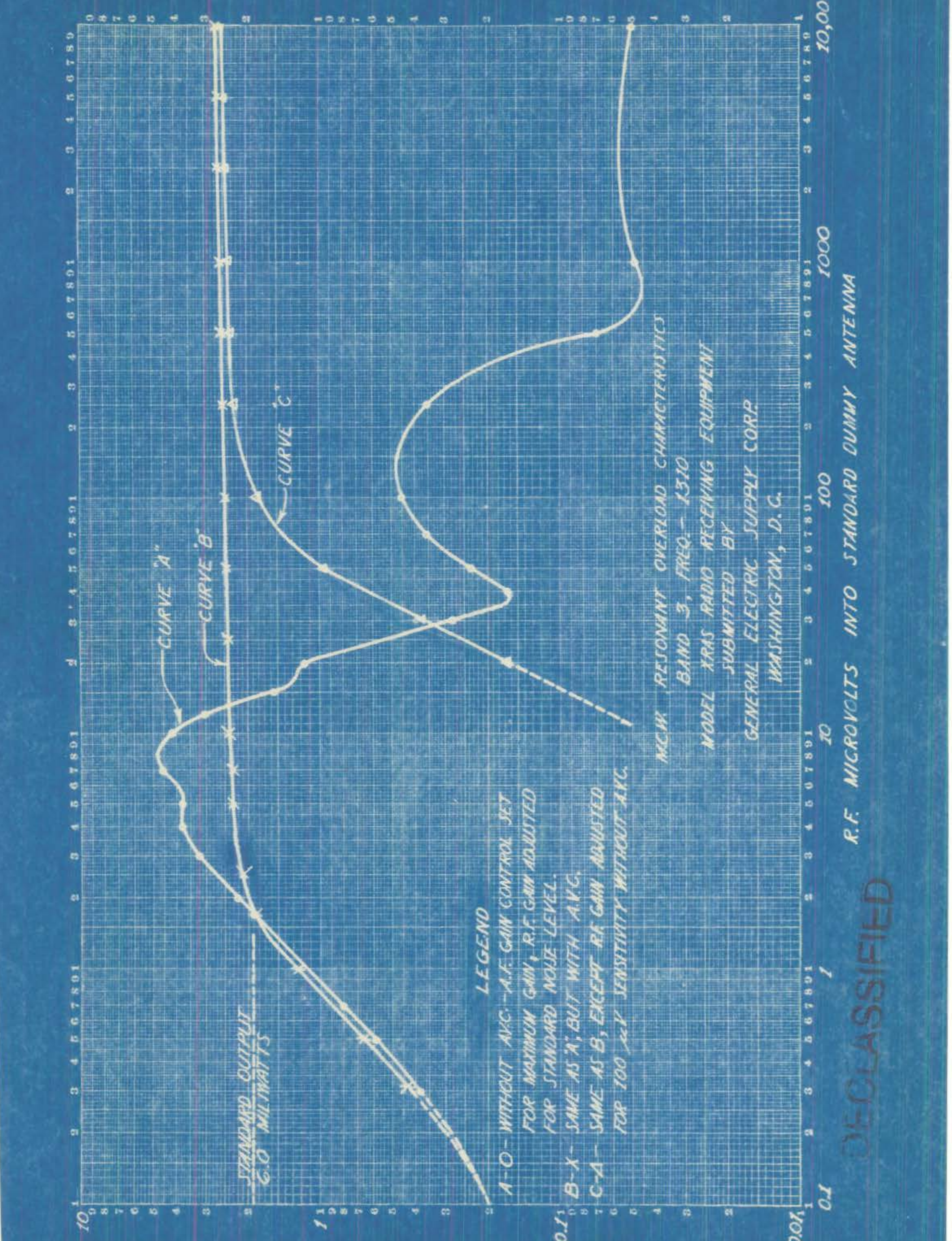

M.C.W. RESONANT OVERLOAD CHARACTERISTICS
BAND 3, FREQ. - 1310
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
LEGEND
A-O- WITHOUT AVC - A.F. GAIN CONTROL SET FOR MAXIMUM GAIN, R.F. GAIN ADJUSTED FOR STANDARD NOISE LEVEL.
B-X- SAME AS 'A', BUT WITH A.V.C.
C-A- SAME AS B, EXCEPT R.F. GAIN ADJUSTED FOR 100 μV SENSITIVITY WITHOUT A.V.C.
STANDARD OUTPUT
6.0 MILLIWATTS
CURVE 'A'
CURVE 'B'
CURVE 'C'
AUDIO OUTPUT VOLTAGE ACROSS 600 OHM PHONE CIRCUIT LOAD
R.F. MICROVOLTS INTO STANDARD DUMMY ANTENNA
0.1
1
10
100
1000
10,000
0.01
0.1
1
10
DECLASSIFIED

PLATE 24

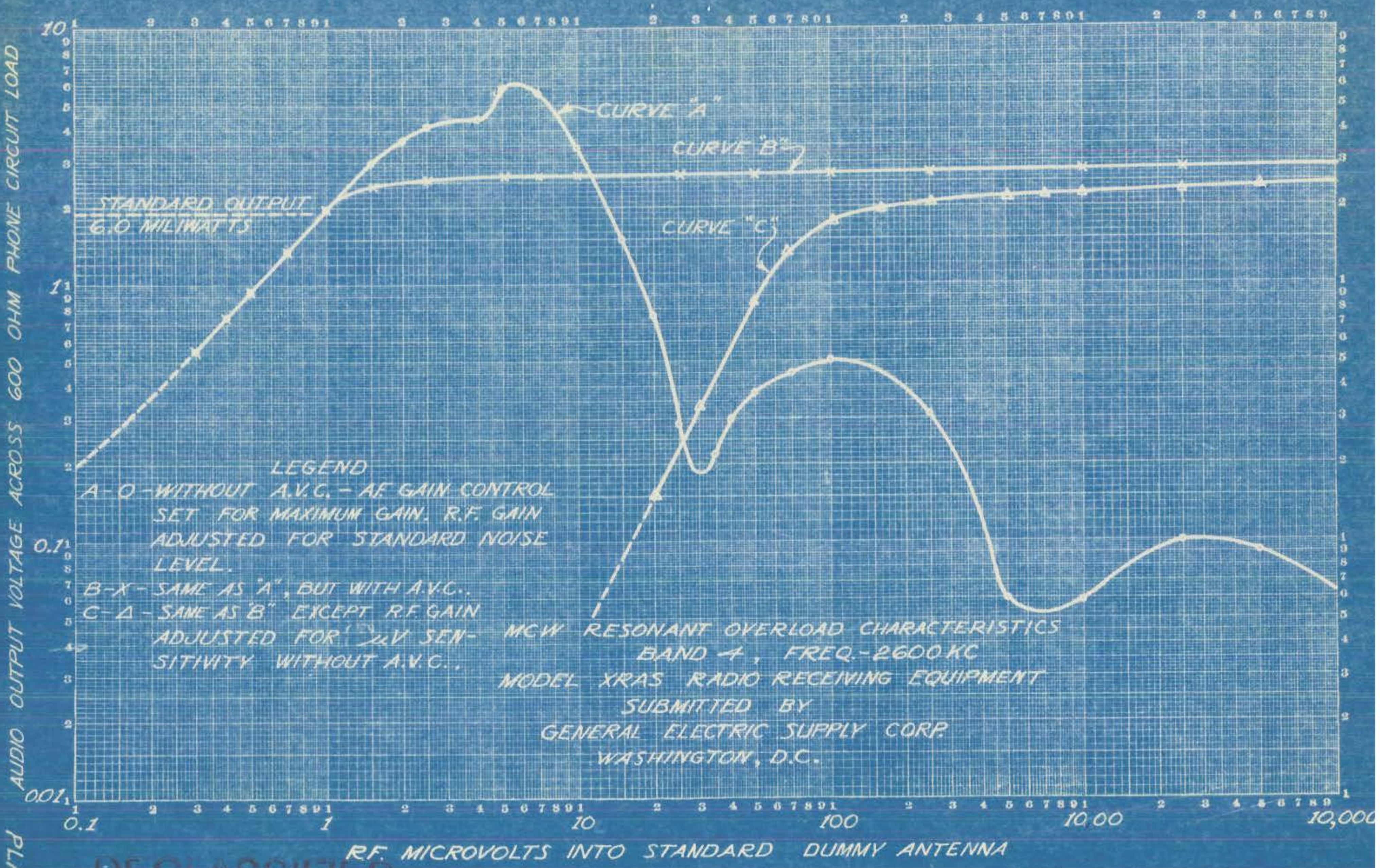


PLATE 25

DECLASSIFIED

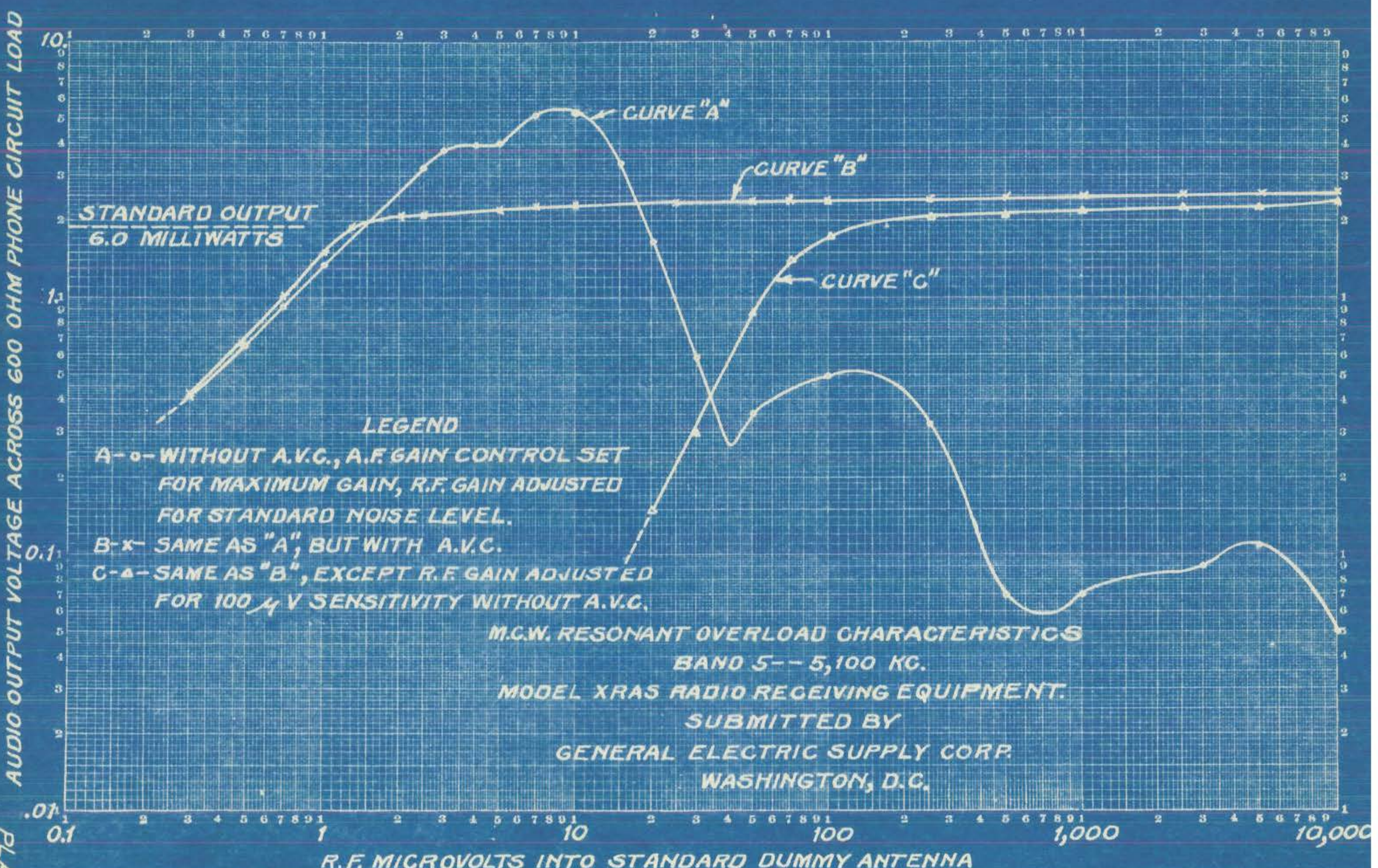


PLATE 26

DECLASSIFIED

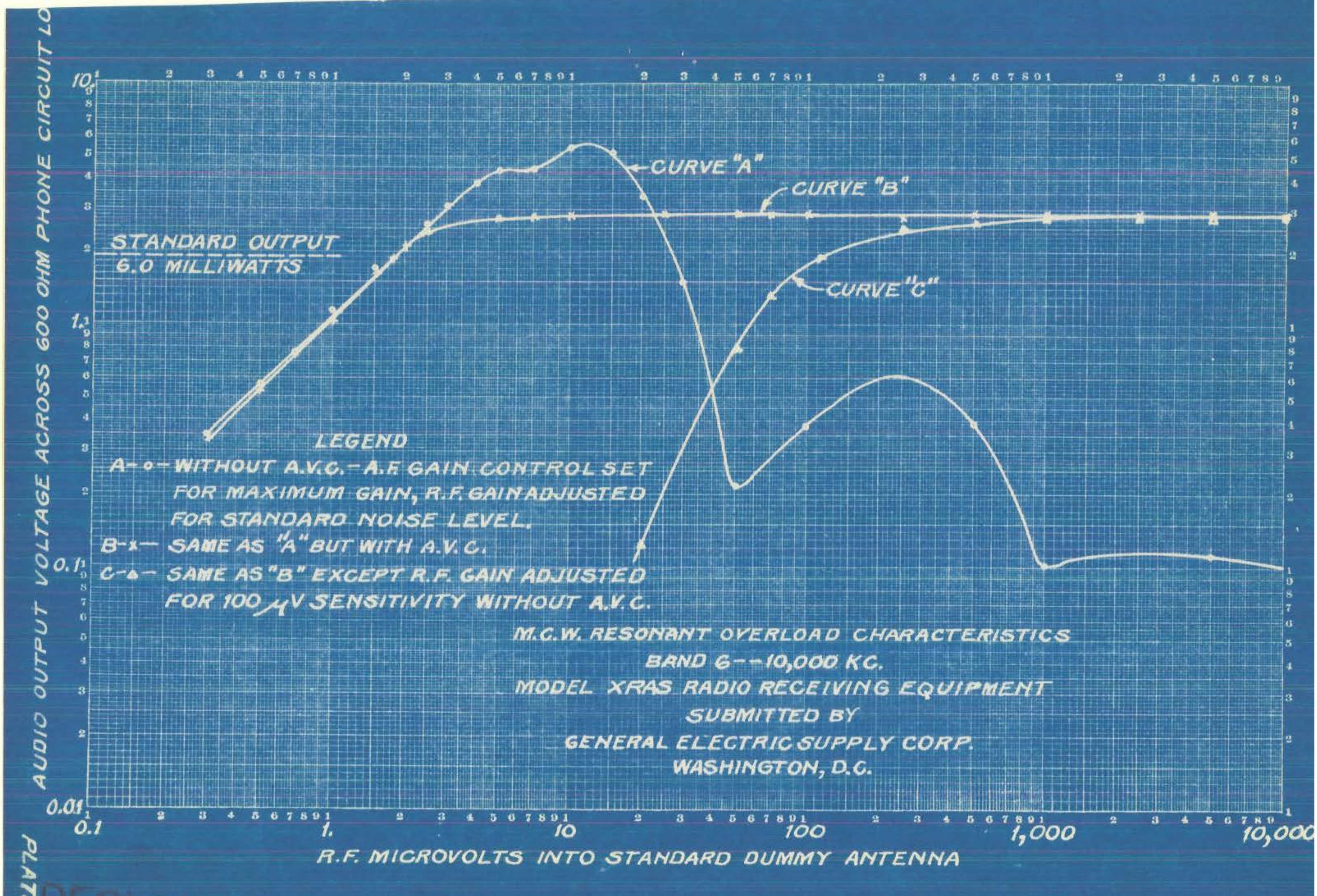

CURVE "A"
CURVE "B"
CURVE "C"
STANDARD OUTPUT
6.0 MILLIWATTS
LEGEND
A-o- WITHOUT A.V.C.-A.F. GAIN CONTROL SET
FOR MAXIMUM GAIN, R.F. GAIN ADJUSTED
FOR STANDARD NOISE LEVEL.
B-x- SAME AS "A" BUT WITH A.V.C.
C-▲- SAME AS "B" EXCEPT R.F. GAIN ADJUSTED
FOR 100 μV SENSITIVITY WITHOUT A.V.C.
M.C.W. RESONANT OVERLOAD CHARACTERISTICS
BAND 6--10,000 KC.
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
AUDIO OUTPUT VOLTAGE ACROSS 600 OHM PHONE CIRCUIT LO
R.F. MICROVOLTS INTO STANDARD DUMMY ANTENNA
10
1
0.1
0.01
0.1
1.
10
100
1,000
10,000

PLATE 27

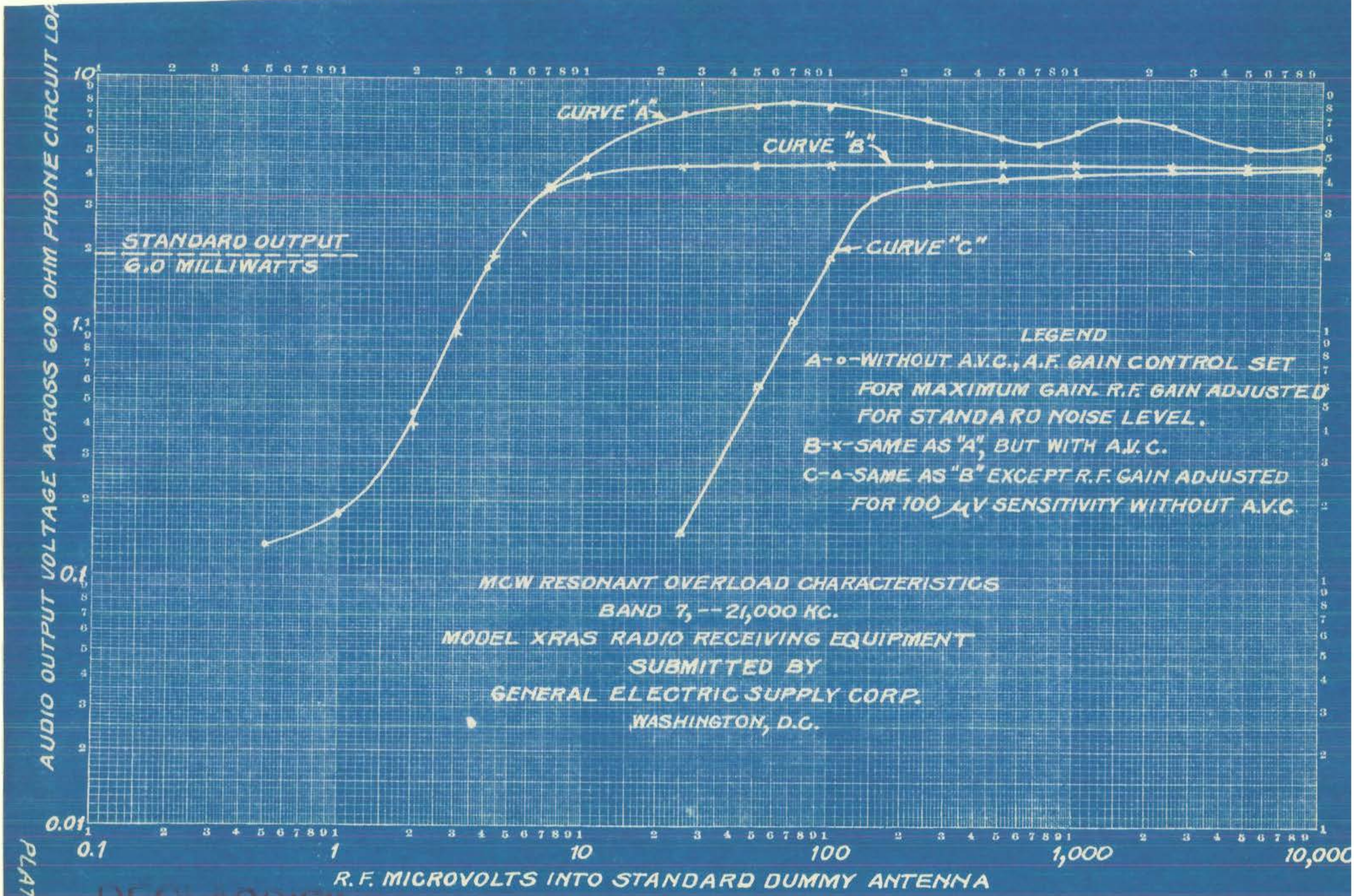
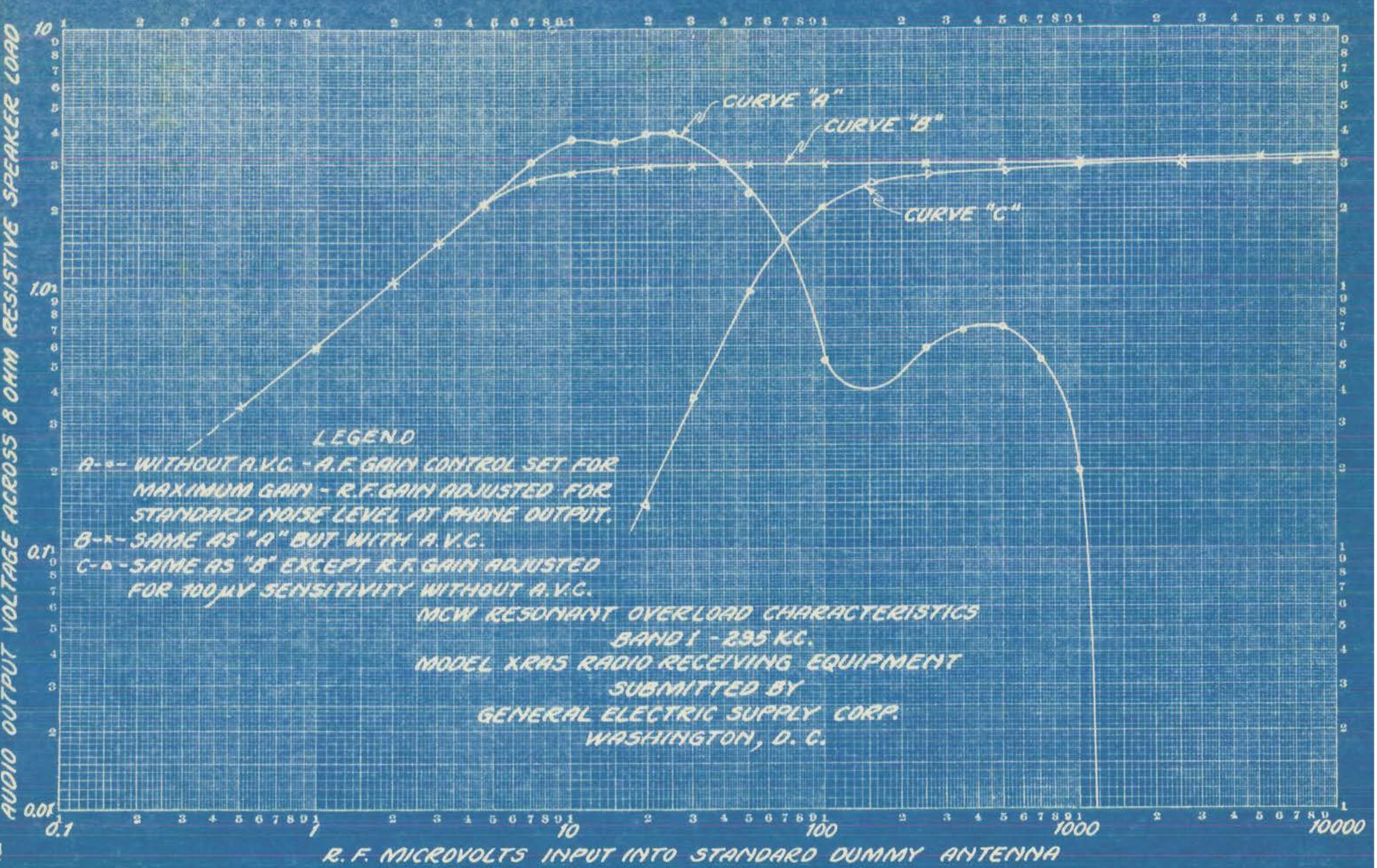
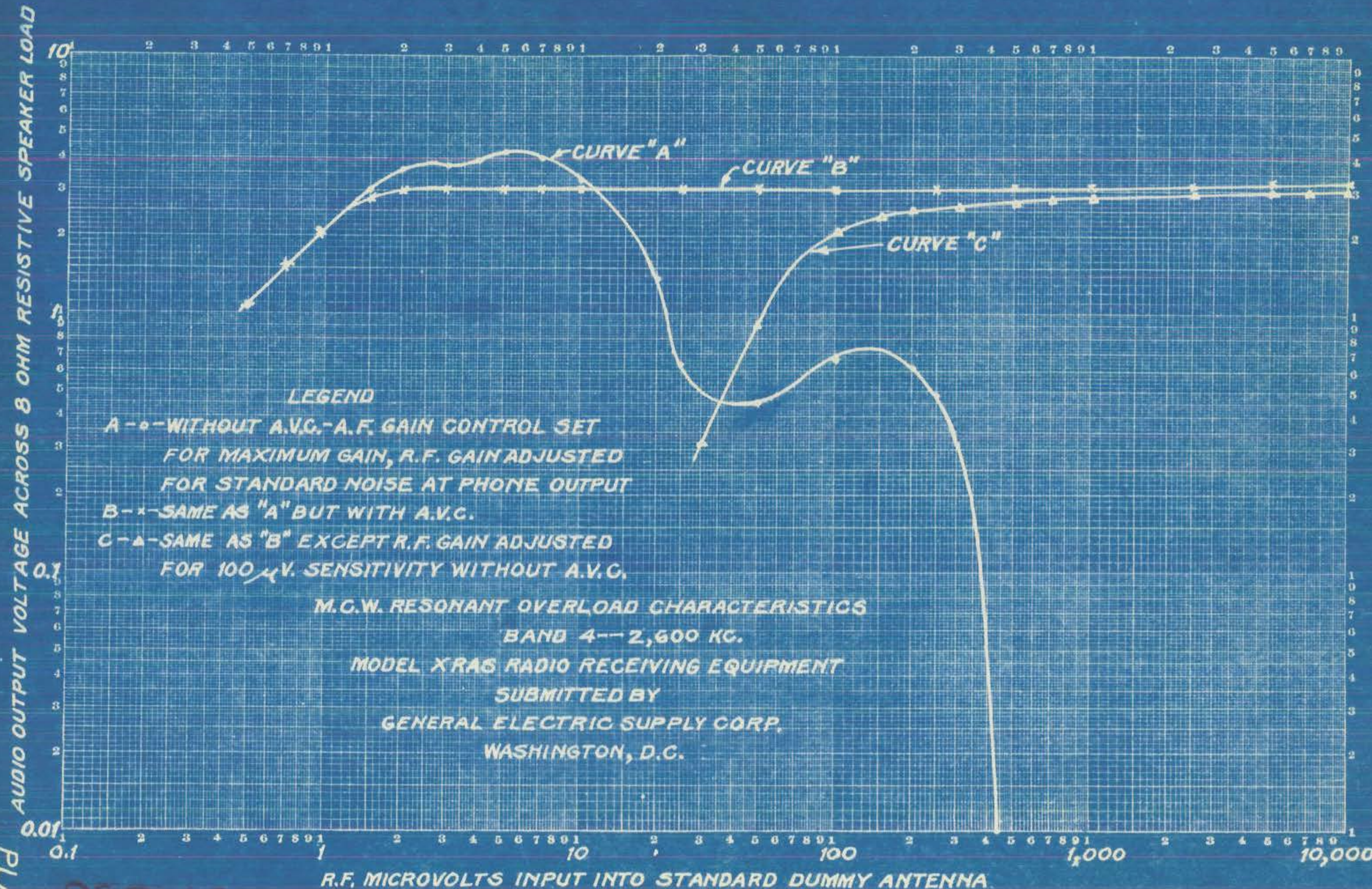

CURVE "A"
CURVE "B"
CURVE "C"
STANDARD OUTPUT
6.0 MILLIWATTS
LEGEND
A-o-WITHOUT A.V.C., A.F. GAIN CONTROL SET
FOR MAXIMUM GAIN. R.F. GAIN ADJUSTED
FOR STANDARD NOISE LEVEL.
B-x-SAME AS "A", BUT WITH A.V.C.
C-Δ-SAME AS "B" EXCEPT R.F. GAIN ADJUSTED
FOR 100 μV SENSITIVITY WITHOUT A.V.C.
MCW RESONANT OVERLOAD CHARACTERISTICS
BAND 7,--21,000 KC.
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
AUDIO OUTPUT VOLTAGE ACROSS 600 OHM PHONE CIRCUIT LO
R.F. MICROVOLTS INTO STANDARD DUMMY ANTENNA
0.1
1
10
100
1,000
10,000
0.01
0.1
1.1
10

PLATE 28



DECLASSIFIED

PLATE 29



DECLASSIFIED

PLATE 30

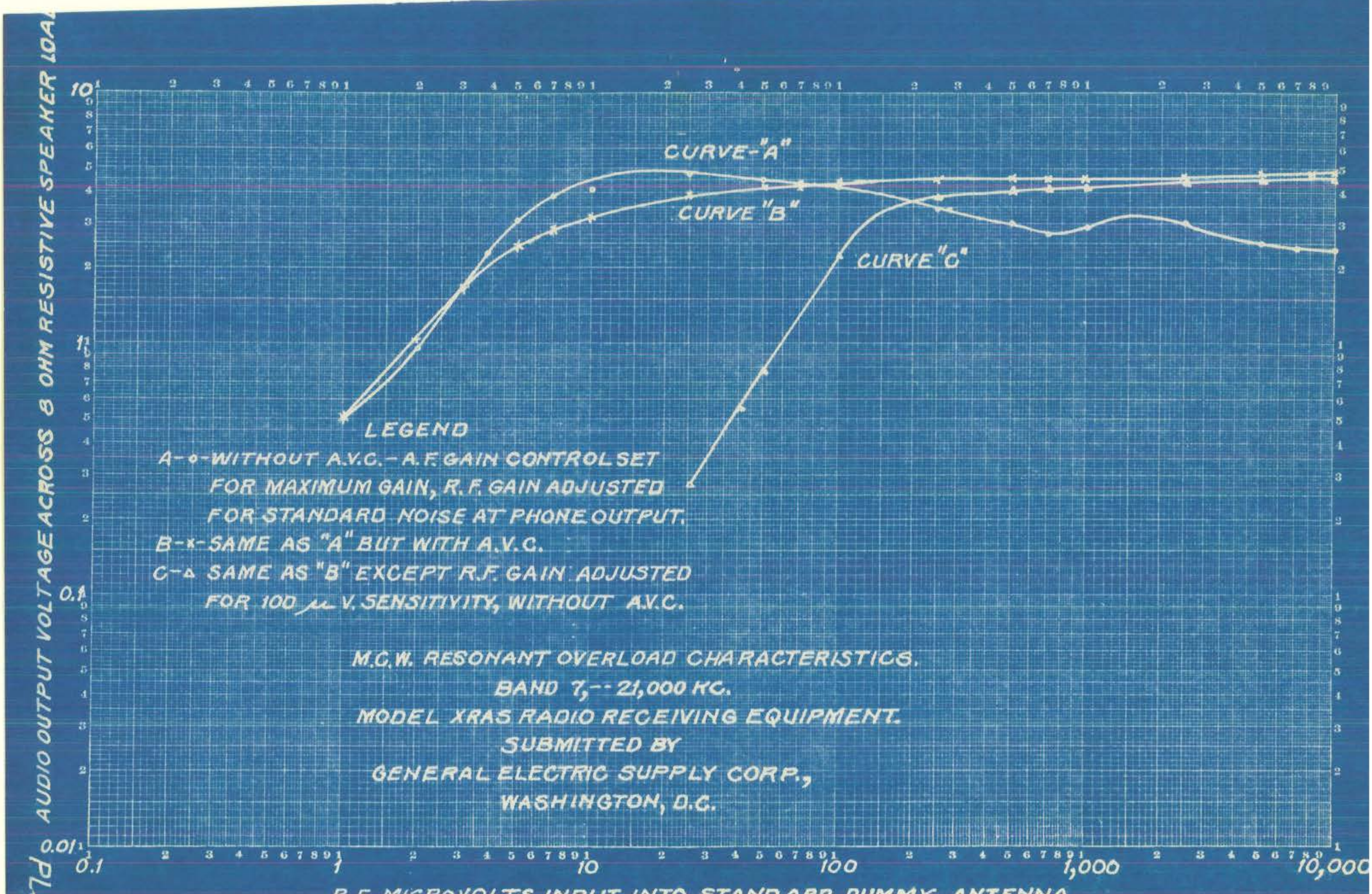
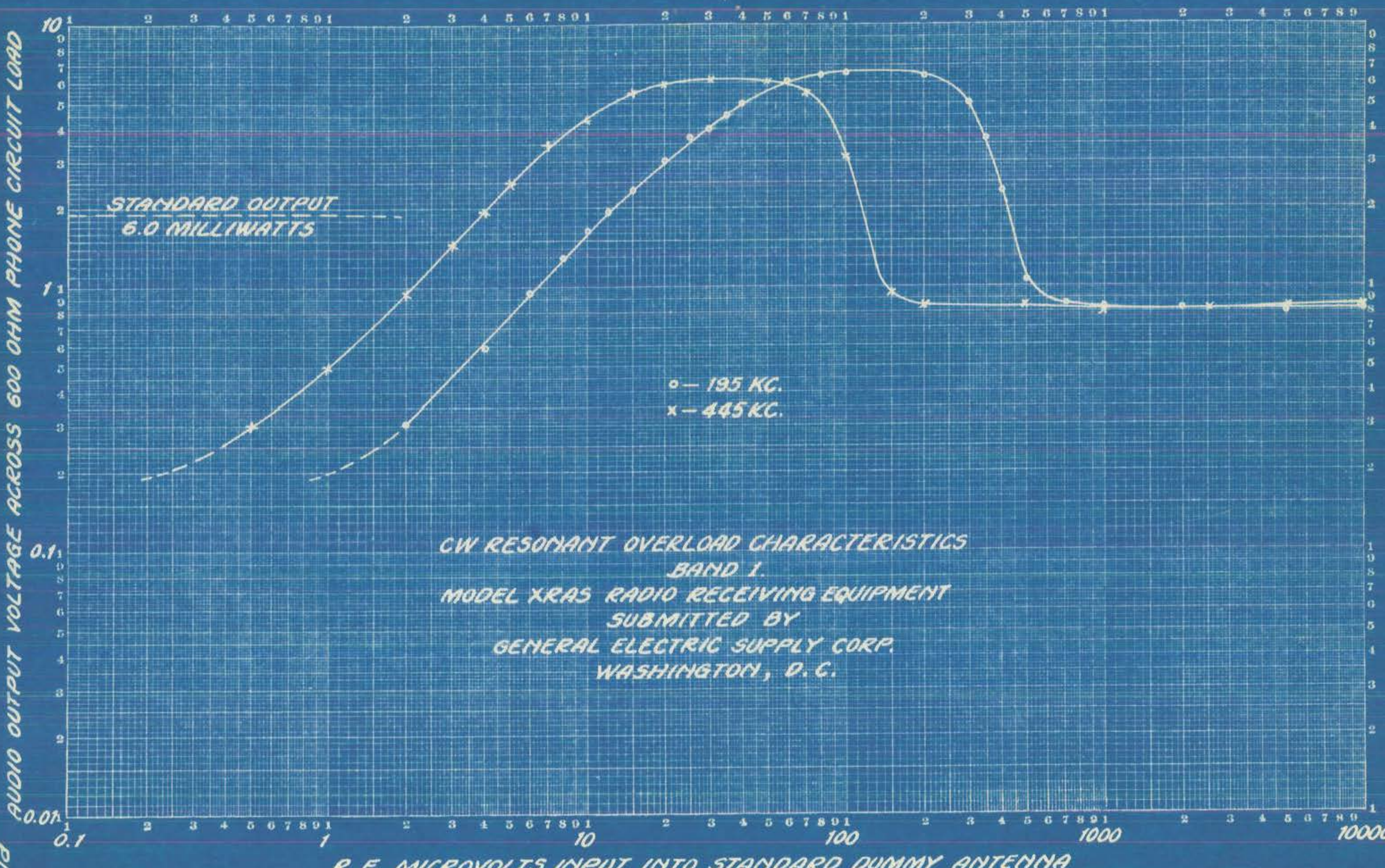


PLATE 31

DECLASSIFIED



DECLASSIFIED

PLATE 32

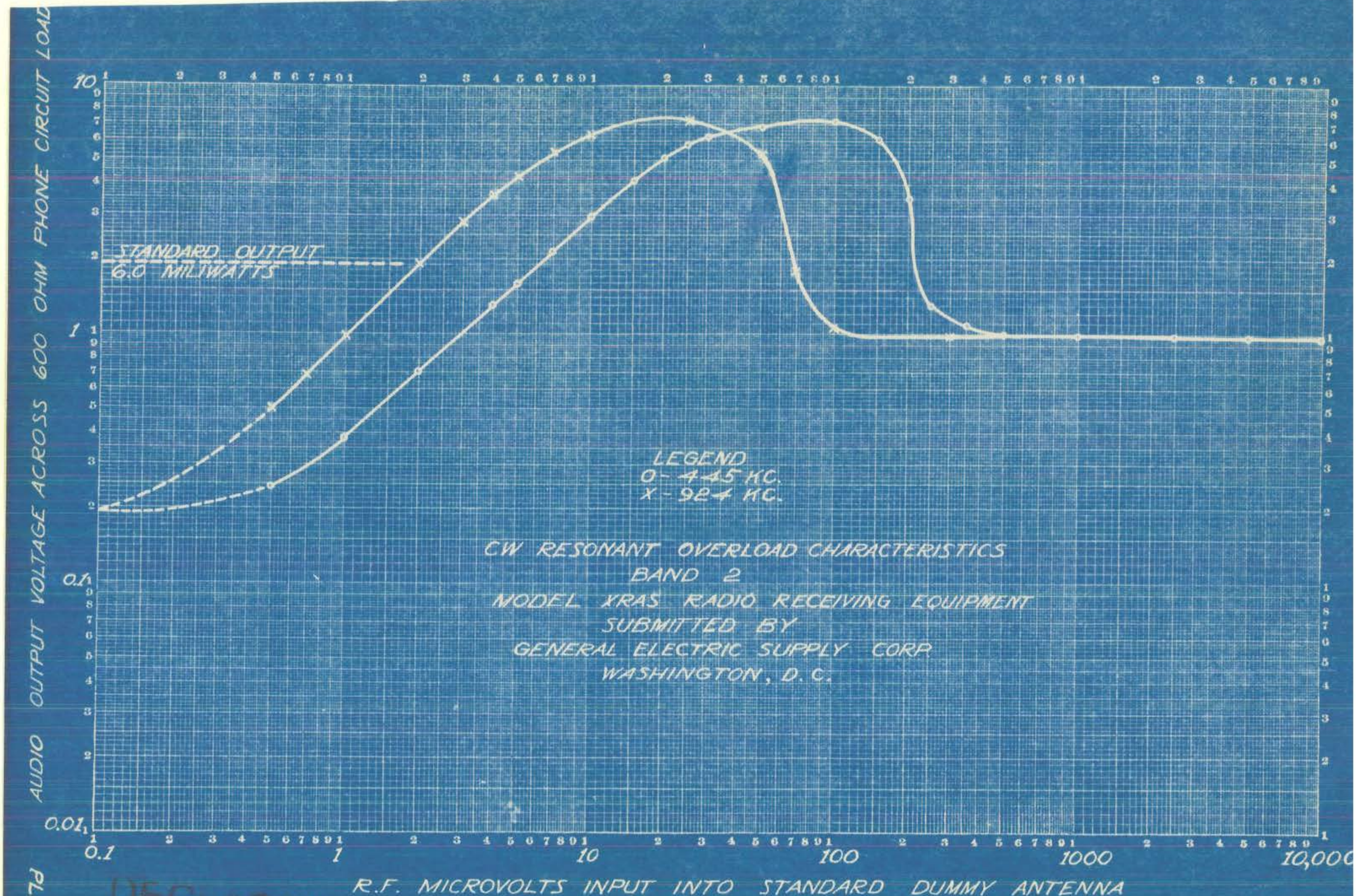
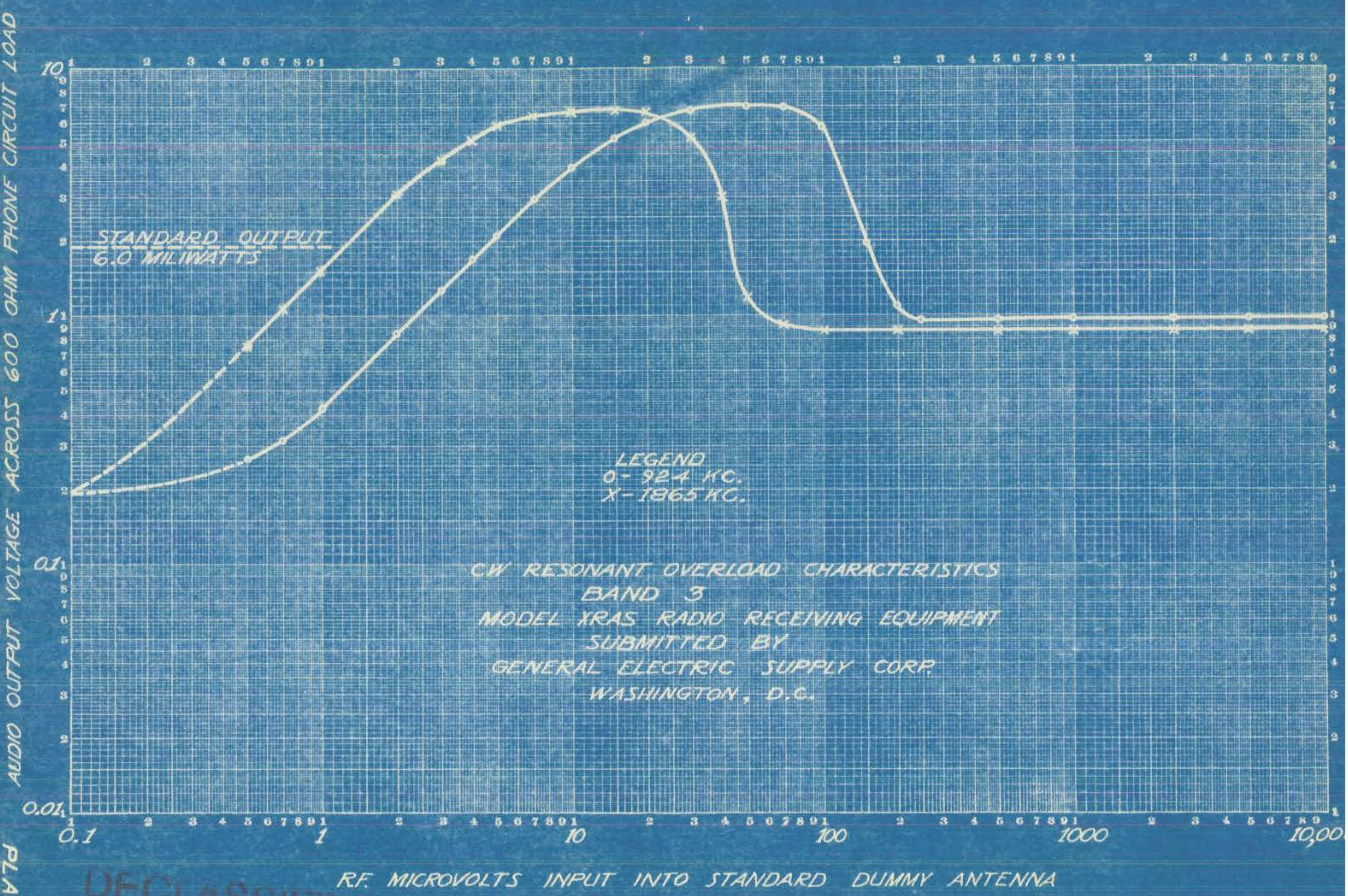
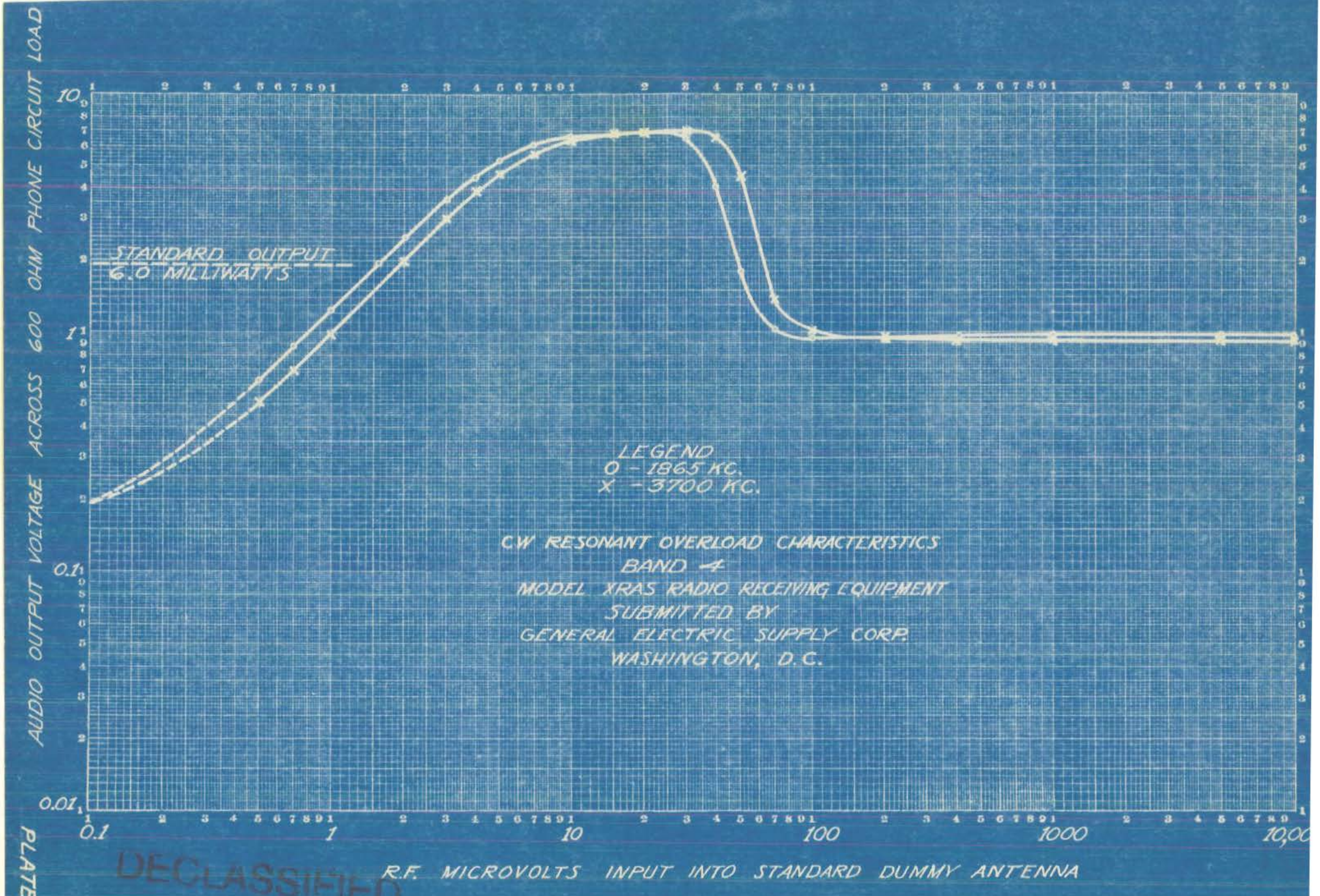

AUDIO OUTPUT VOLTAGE ACROSS 600 OHM PHONE CIRCUIT LOAD
STANDARD OUTPUT
6.0 MILIWATTS
LEGEND
O - 445 KC.
X - 924 KC.
CW RESONANT OVERLOAD CHARACTERISTICS
BAND 2
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA

PLATE 33



DECLASSIFIED

PLATE 34



DECLASSIFIED

PLATE 35

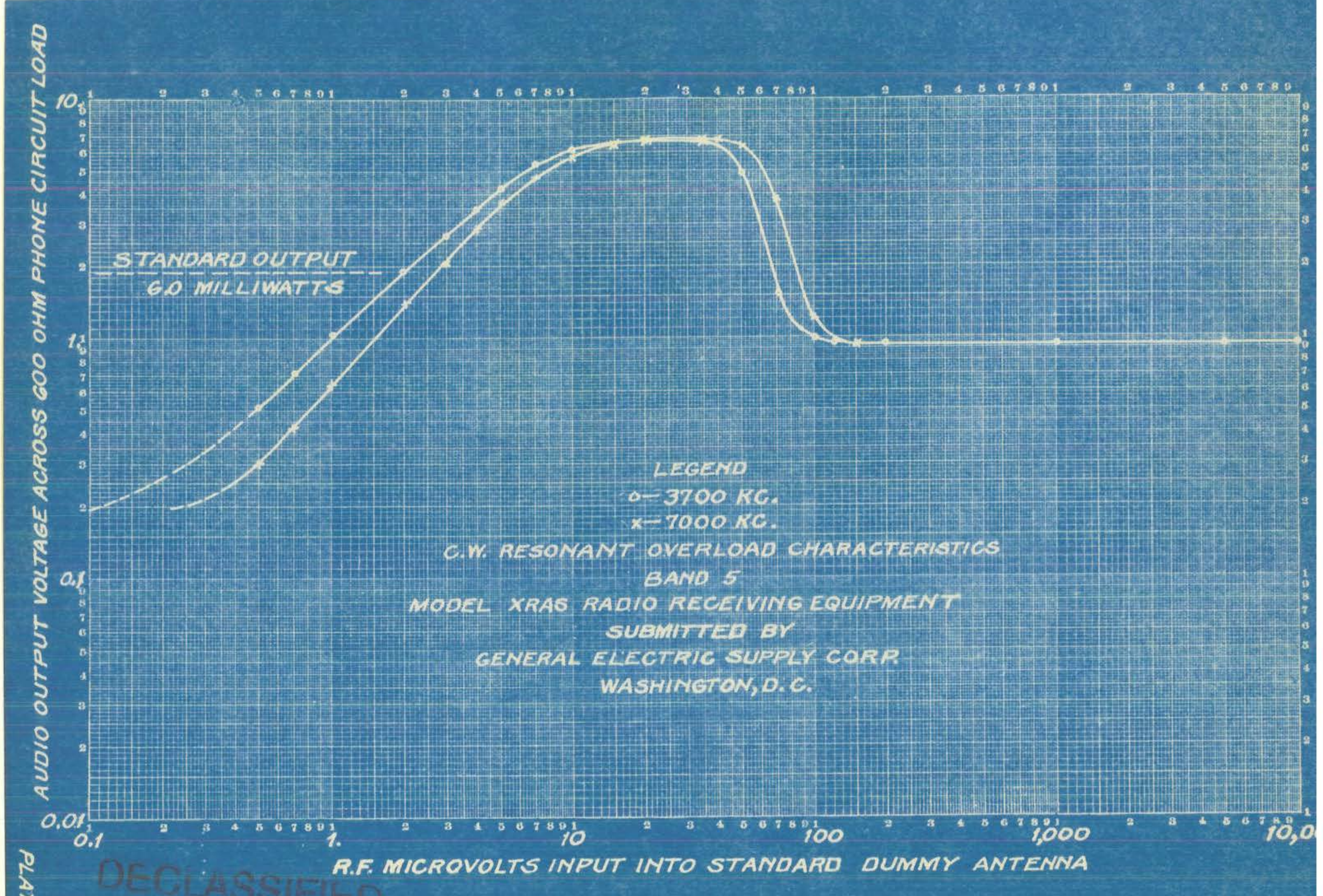
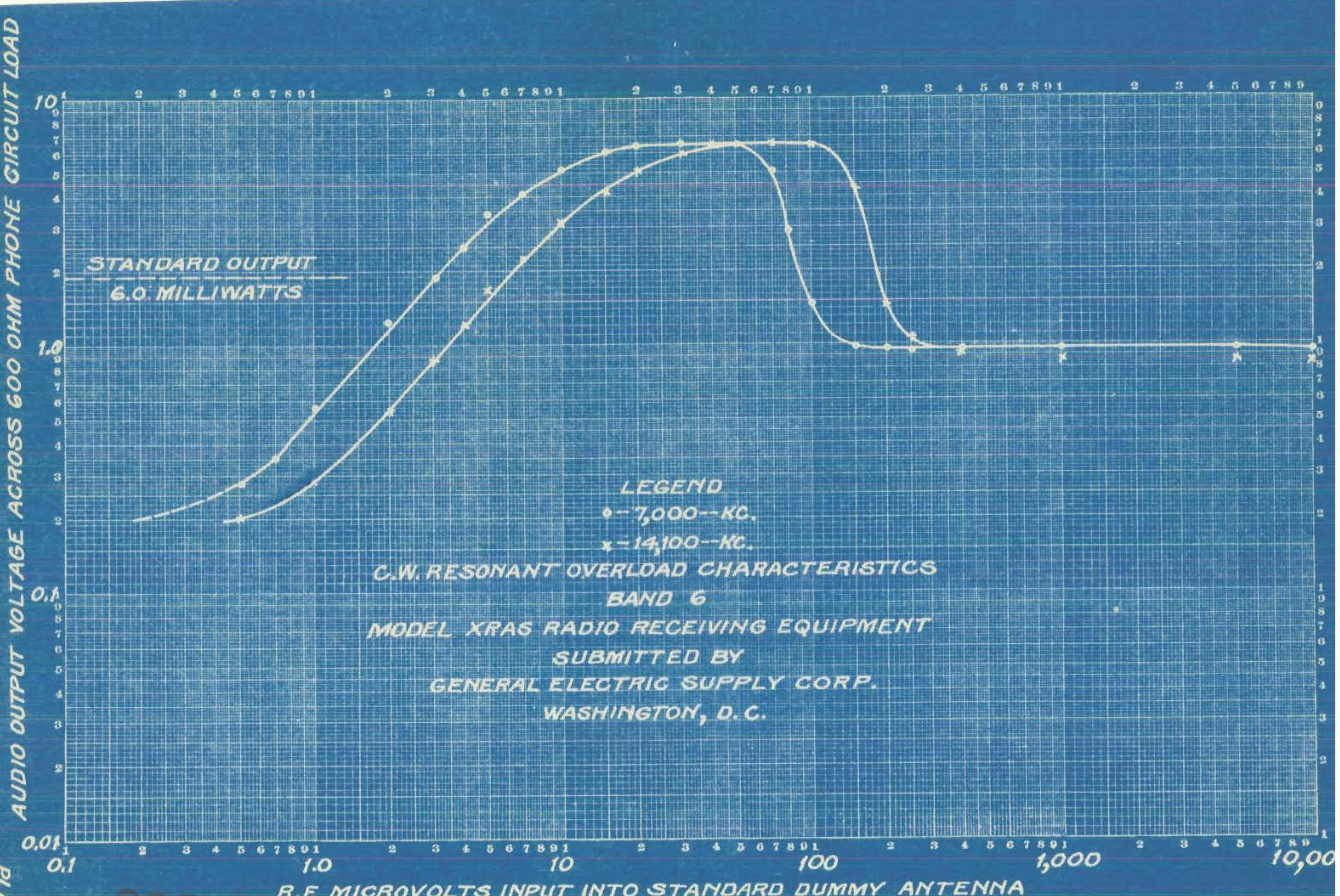
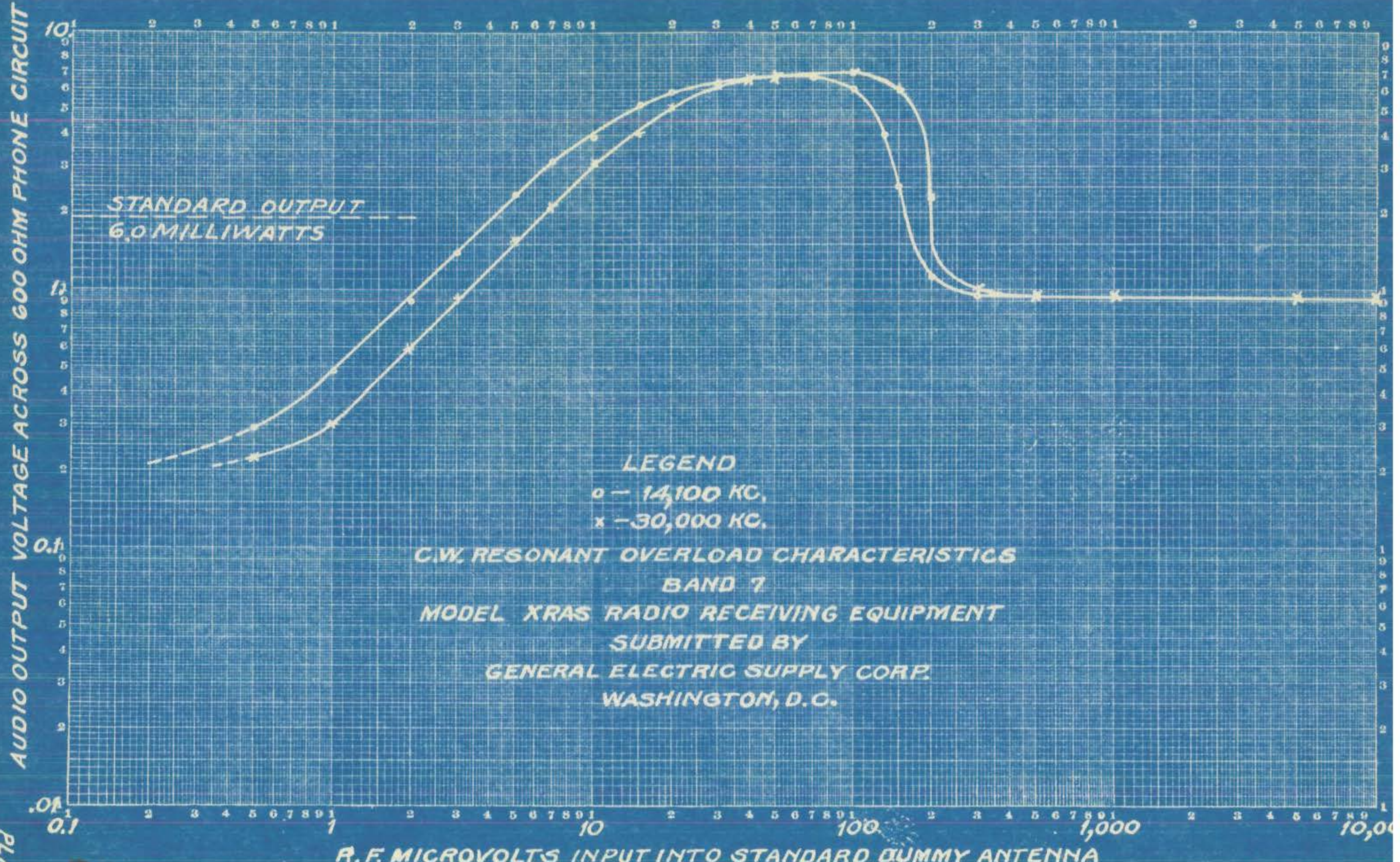

AUDIO OUTPUT VOLTAGE ACROSS 600 OHM PHONE CIRCUIT LOAD
STANDARD OUTPUT
6.0 MILLIWATTS
LEGEND
o—3700 KC.
x—7000 KC.
C.W. RESONANT OVERLOAD CHARACTERISTICS
BAND 5
MODEL XRA6 RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA
DECLASSIFIED

PLATE 36



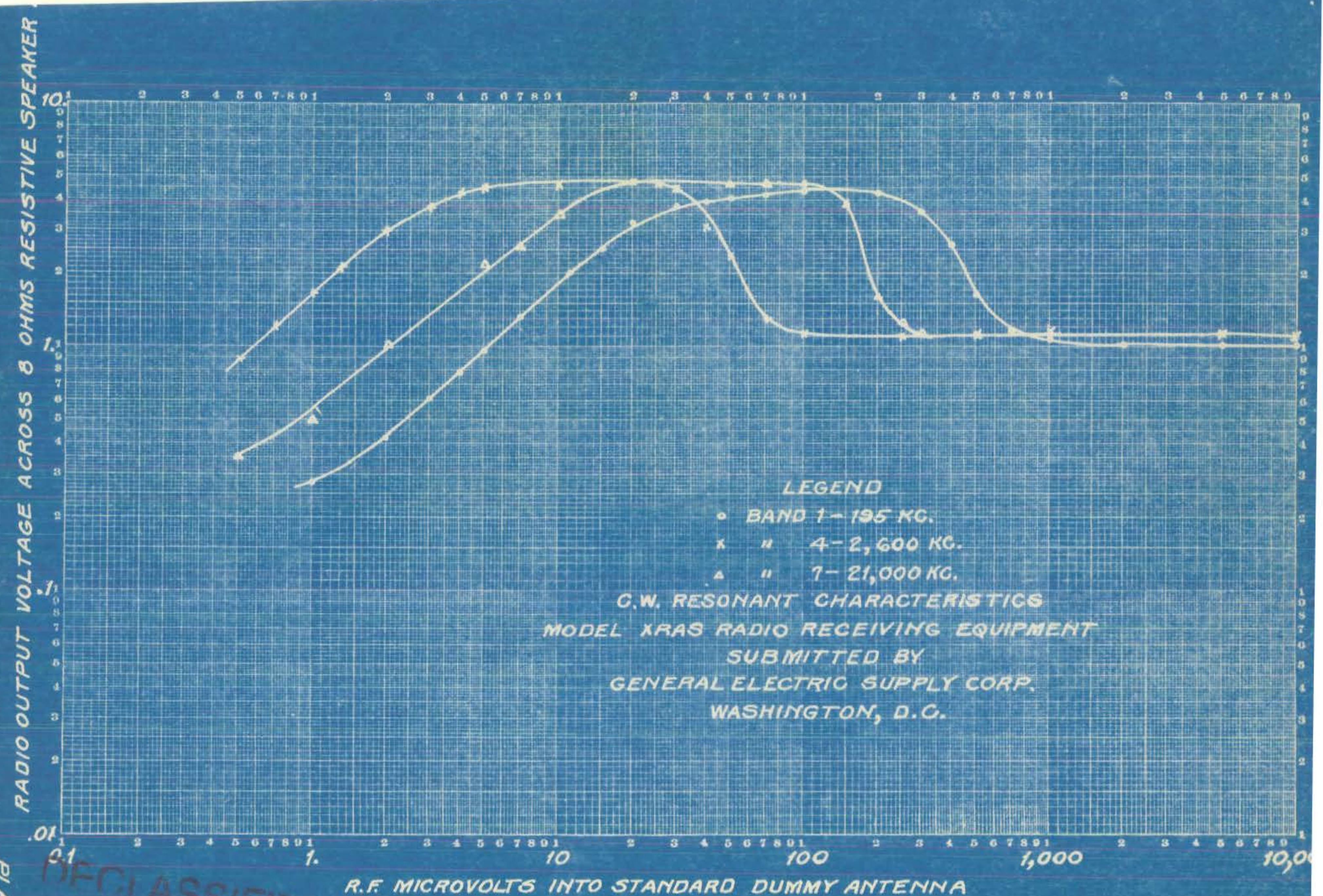
AUDIO OUTPUT VOLTAGE ACROSS 600 OHM PHONE CIRCUIT LOAD
10
1.0
0.1
0.01
STANDARD OUTPUT
6.0 MILLIWATTS
LEGEND
o - 7,000 - - KC.
x - 14,100 - - KC.
C.W. RESONANT OVERLOAD CHARACTERISTICS
BAND 6
MODEL XRA6 RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
0.1
1.0
10
100
1,000
10,00
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA

PLATE 37



AUDIO OUTPUT VOLTAGE ACROSS 600 OHM PHONE CIRCUIT LOA
STANDARD OUTPUT
6.0 MILLIWATTS
LEGEND
o — 14,100 KC.
x — 30,000 KC.
C.W. RESONANT OVERLOAD CHARACTERISTICS
BAND 7
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
10.
1.
0.1
.01
0.1
1
10
100
1,000
10,0
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA

PLATE 38



RADIO OUTPUT VOLTAGE ACROSS 8 OHMS RESISTIVE SPEAKER
10.
1.
.1
.01
.1
1.
10
100
1,000
10,000
R.F. MICROVOLTS INTO STANDARD DUMMY ANTENNA
LEGEND
o BAND 1 – 195 KC.
x " 4 – 2,600 KC.
△ " 7 – 21,000 KC.
C.W. RESONANT CHARACTERISTICS
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.

PLATE 39

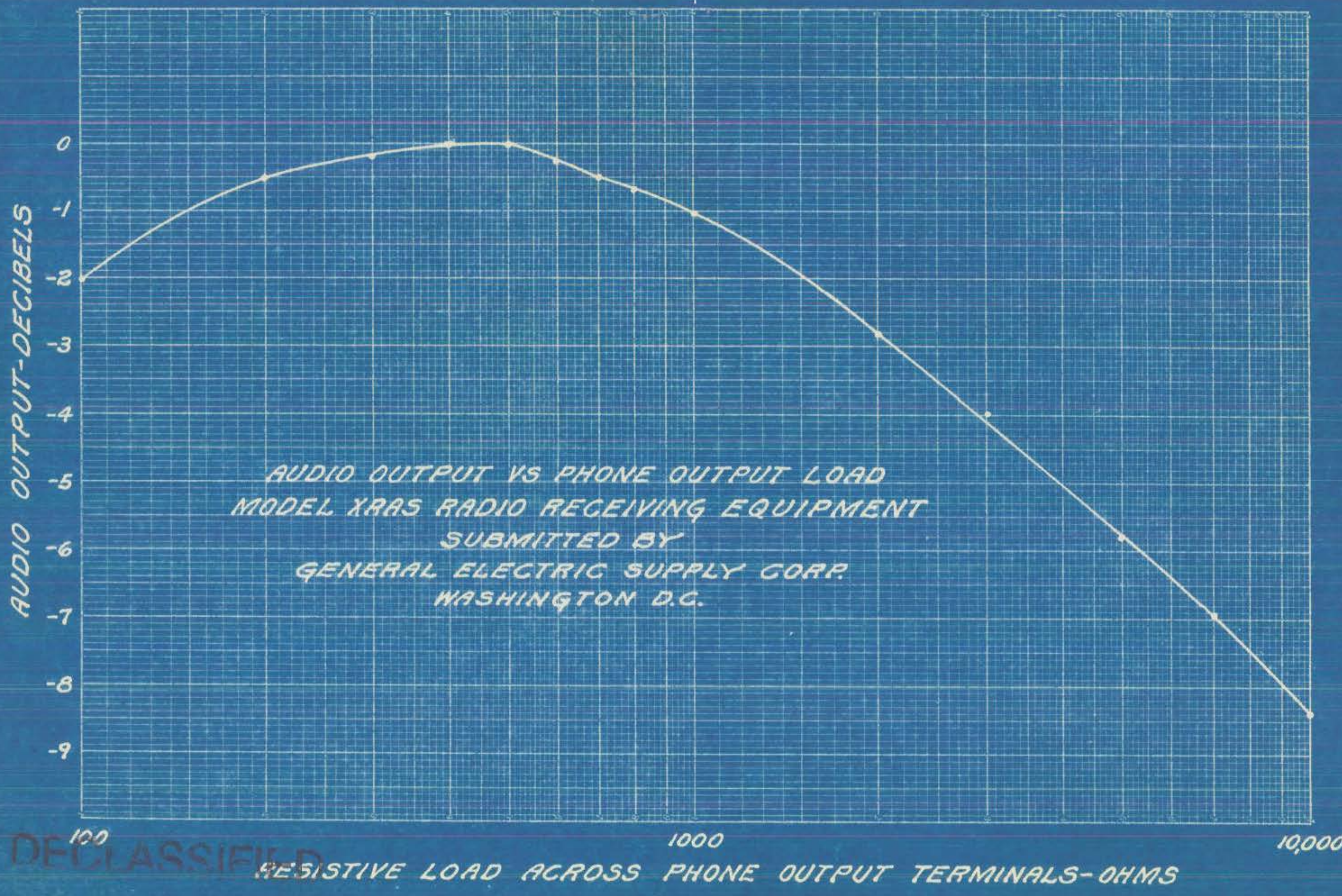

AUDIO OUTPUT VS PHONE OUTPUT LOAD
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON D.C.
AUDIO OUTPUT-DECIBELS
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
100
1000
10,000
RESISTIVE LOAD ACROSS PHONE OUTPUT TERMINALS-OHMS

PLATE 40

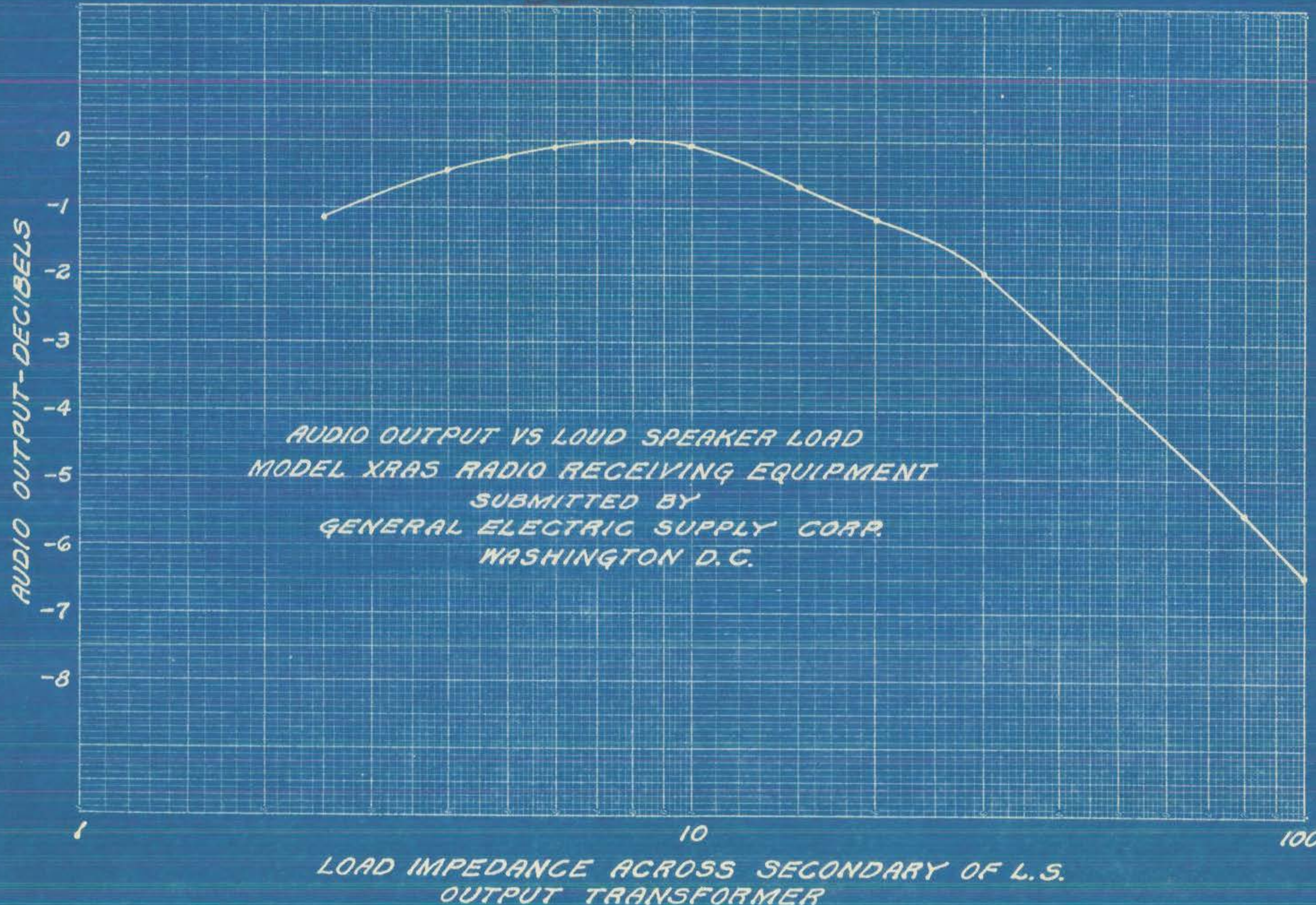
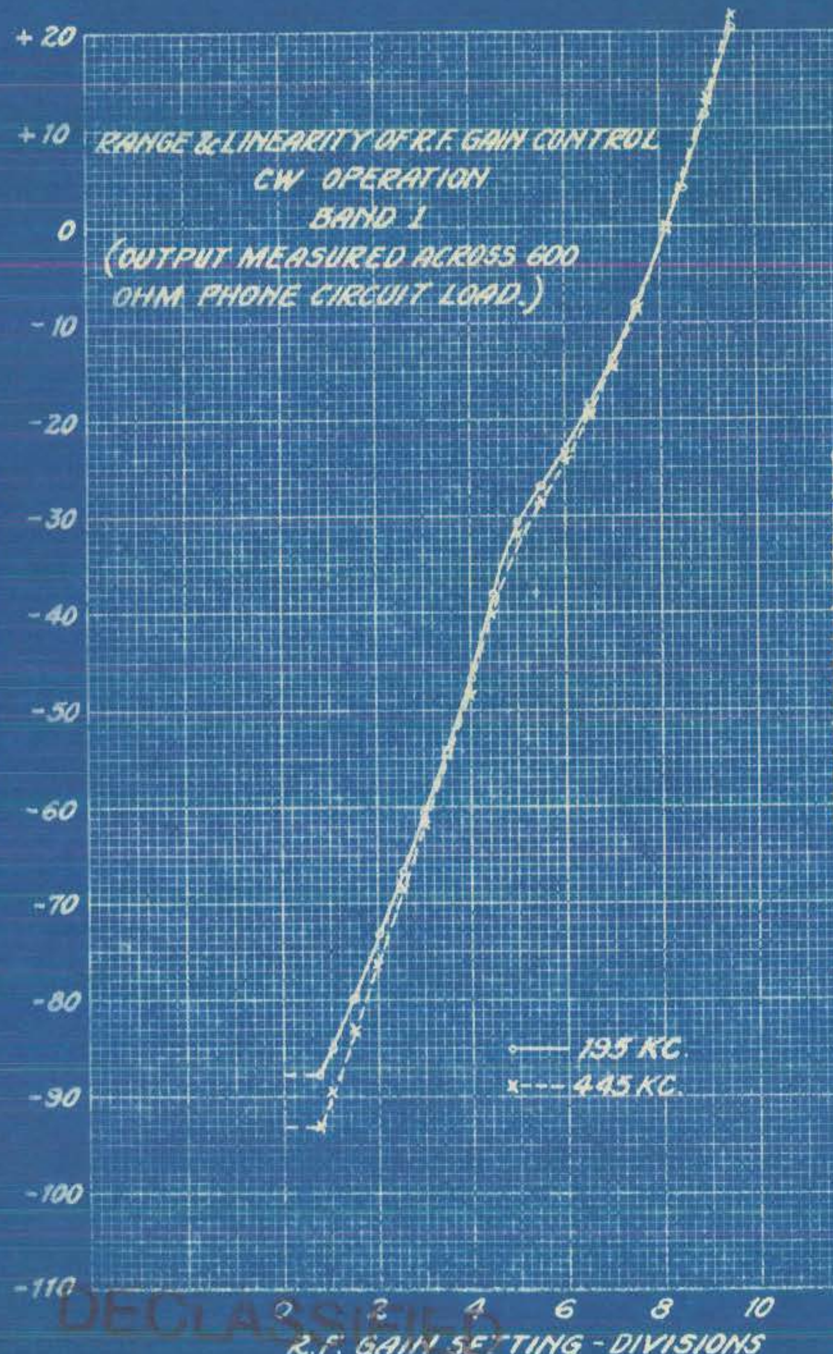

AUDIO OUTPUT VS LOUD SPEAKER LOAD
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON D.C.
AUDIO OUTPUT-DECIBELS
0
-1
-2
-3
-4
-5
-6
-7
-8
1
10
100
LOAD IMPEDANCE ACROSS SECONDARY OF L.S.
OUTPUT TRANSFORMER

PLATE 41


RANGE & LINEARITY OF R.F. GAIN CONTROL
CW OPERATION
BAND 1
(OUTPUT MEASURED ACROSS 600
OHM PHONE CIRCUIT LOAD.)
195 KC.
445 KC.
ATTENUATION-DECIBELS
+20
+10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
0
2
4
6
8
10
R.F. GAIN SETTING - DIVISIONS

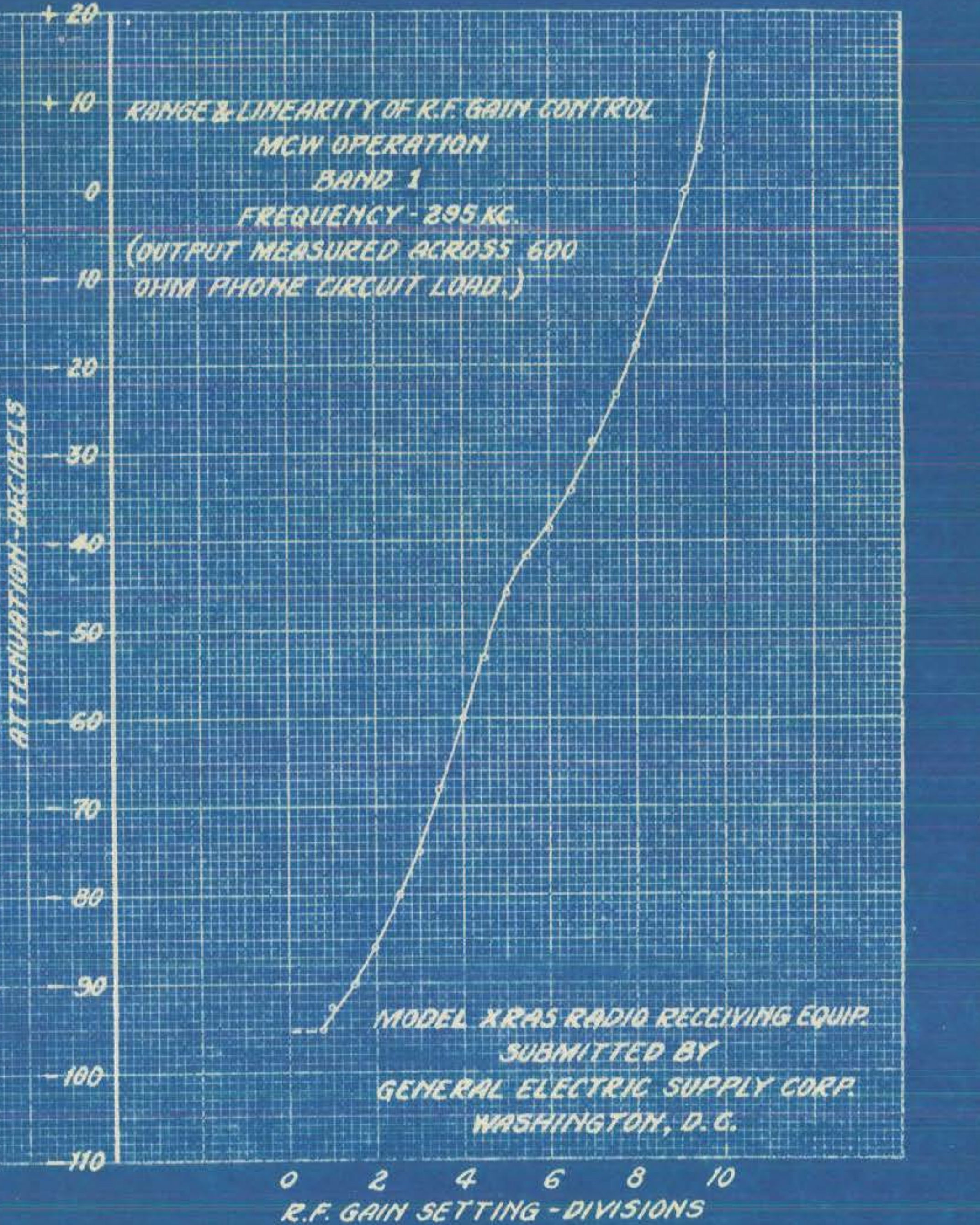

RANGE & LINEARITY OF R.F. GAIN CONTROL
MCW OPERATION
BAND 1
FREQUENCY - 295 KC.
(OUTPUT MEASURED ACROSS 600
OHM PHONE CIRCUIT LOAD.)
ATTENUATION-DECIBELS
+20
+10
0
10
20
30
40
50
60
70
80
90
100
110
0
2
4
6
8
10
R.F. GAIN SETTING - DIVISIONS
MODEL XRAS RADIO RECEIVING EQUIP.
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.

PLATE 42

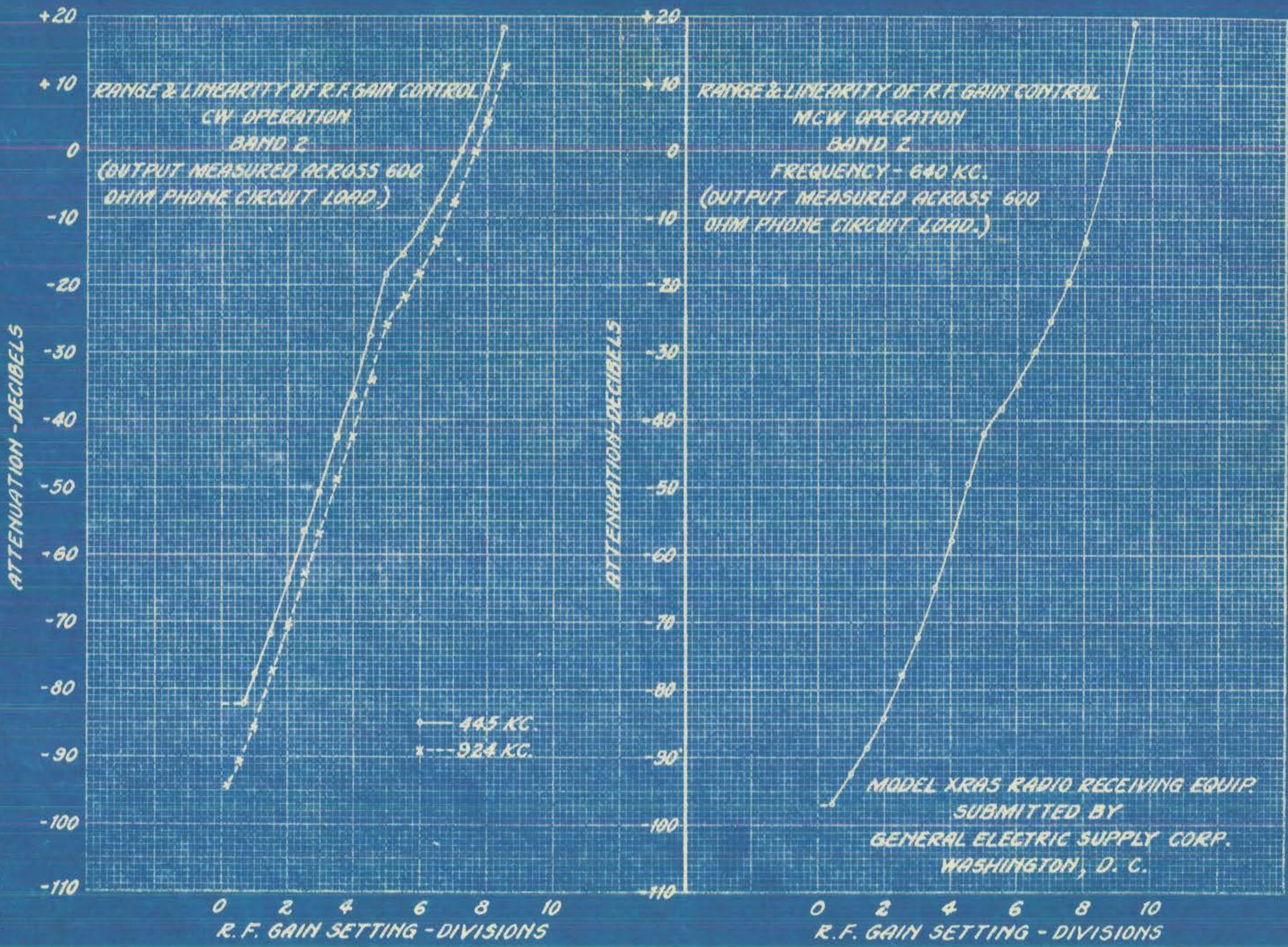
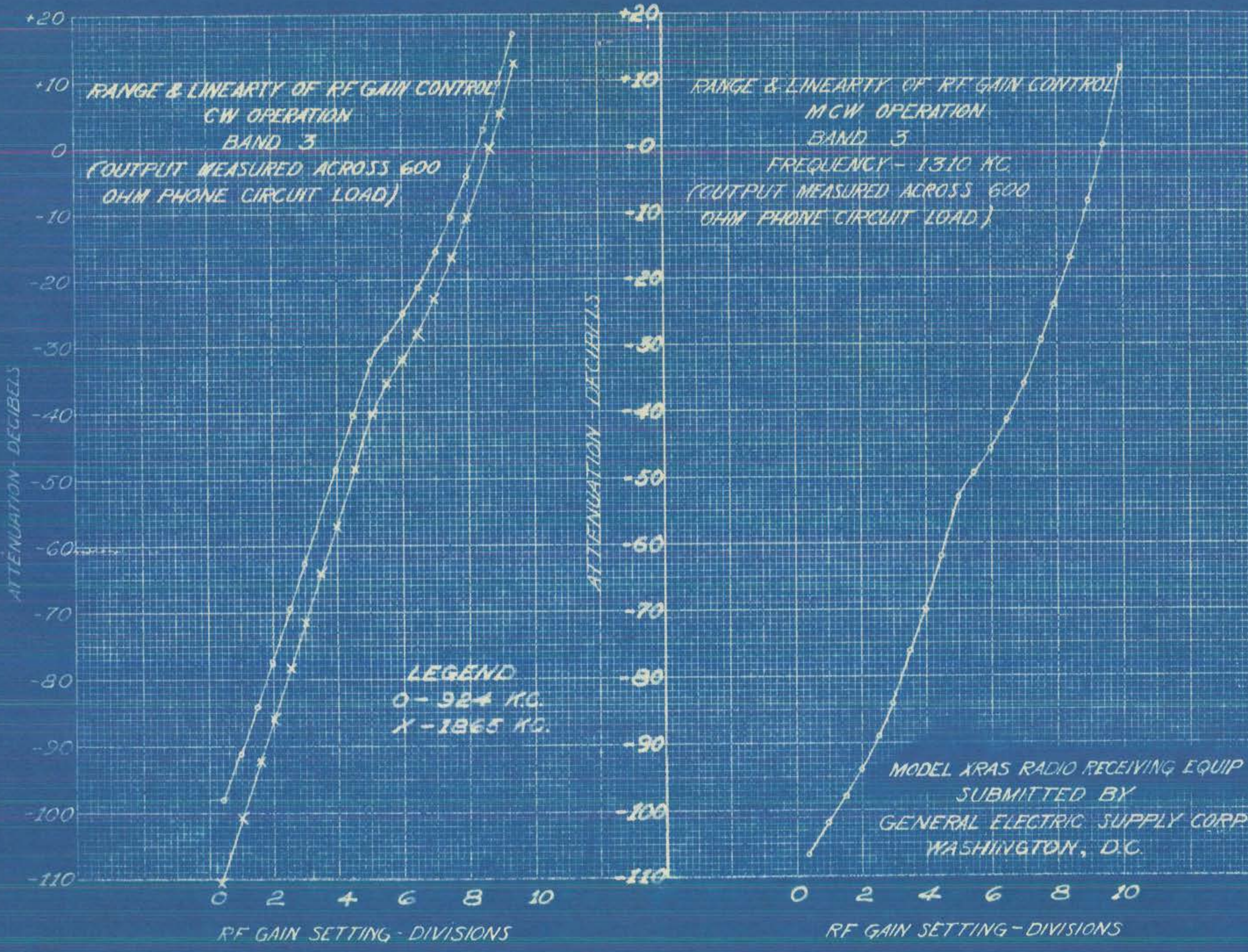
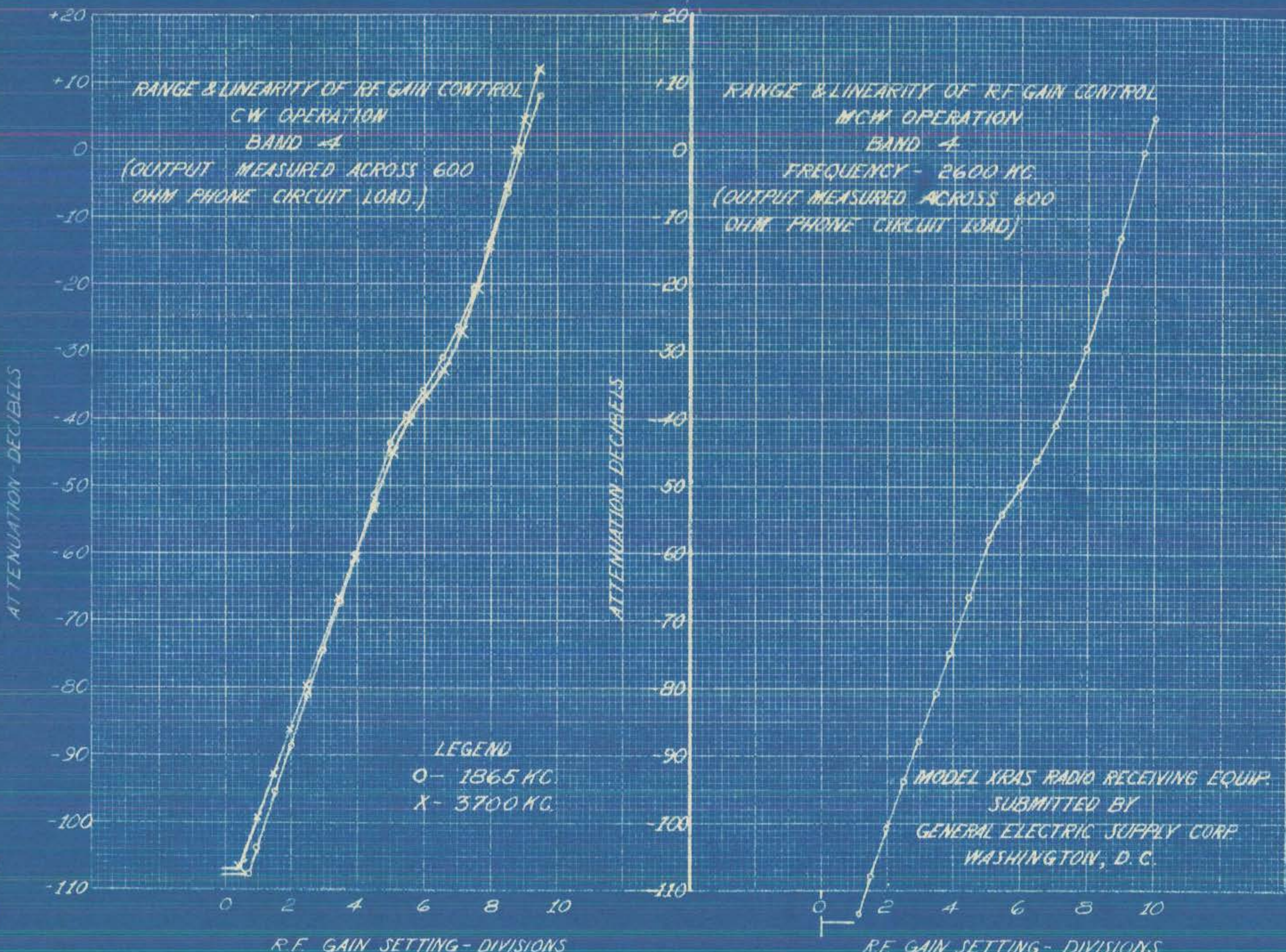


PLATE 43

BELLEVUE, D. C.

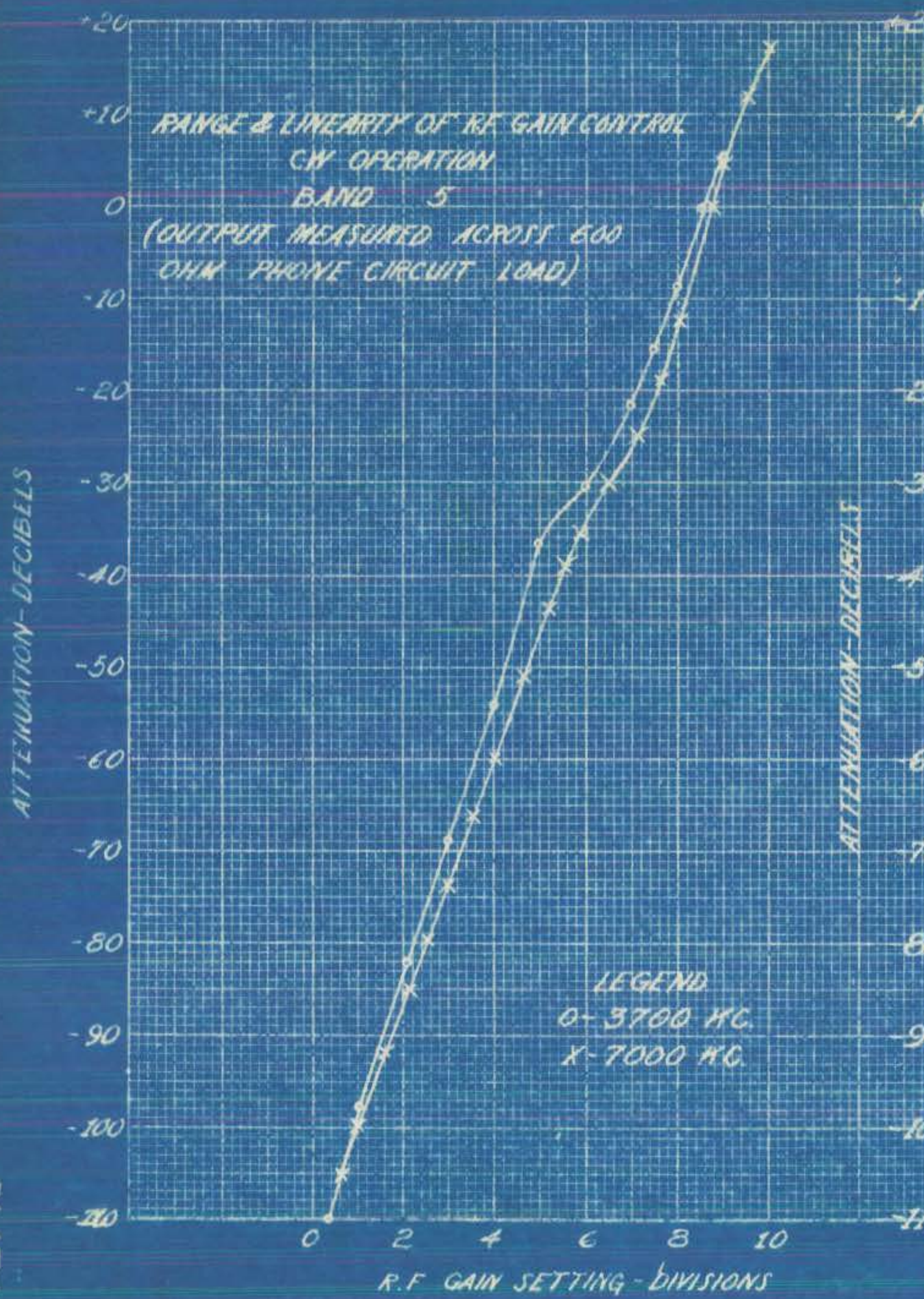
DATE

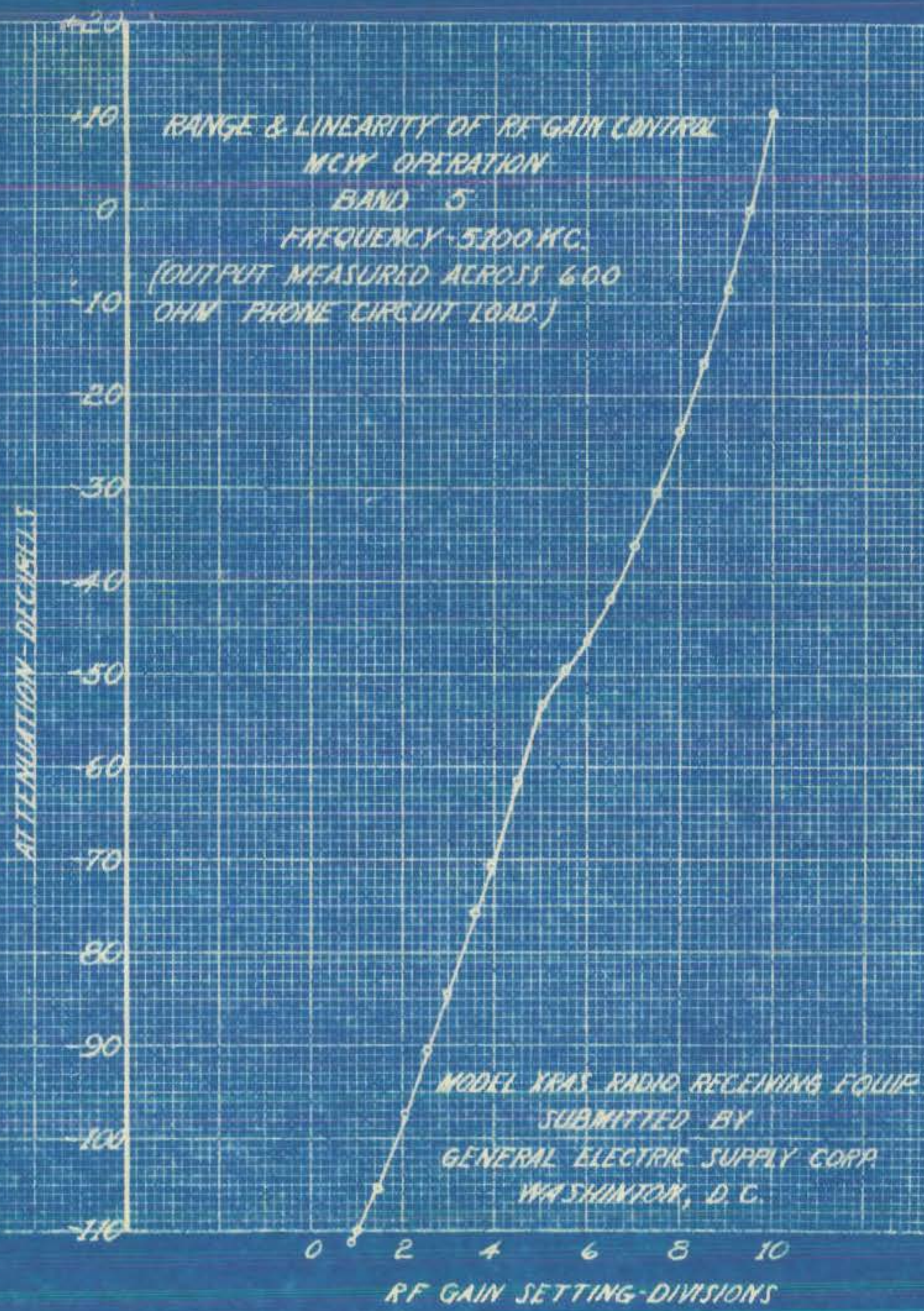

RANGE & LINEARITY OF RF GAIN CONTROL
CW OPERATION
BAND 3
(OUTPUT MEASURED ACROSS 600
OHM PHONE CIRCUIT LOAD)
LEGEND
O - 924 KC.
X - 1865 KC.
ATTENUATION - DECIBELS
+20
+10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
0
2
4
6
8
10
RF GAIN SETTING - DIVISIONS
RANGE & LINEARITY OF RF GAIN CONTROL
MCW OPERATION
BAND 3
FREQUENCY - 1310 KC.
(OUTPUT MEASURED ACROSS 600
OHM PHONE CIRCUIT LOAD)
ATTENUATION - DECIBELS
MODEL XRAS RADIO RECEIVING EQUIP
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP
WASHINGTON, D.C.
RF GAIN SETTING - DIVISIONS



RANGE & LINEARITY OF R.F. GAIN CONTROL
CW OPERATION
BAND 4
(OUTPUT MEASURED ACROSS 600 OHM PHONE CIRCUIT LOAD.)
LEGEND
O - 1865 KC.
X - 3700 KC.
ATTENUATION - DECIBELS
R.F. GAIN SETTING - DIVISIONS
RANGE & LINEARITY OF R.F. GAIN CONTROL
MCW OPERATION
BAND 4
FREQUENCY - 2600 KC.
(OUTPUT MEASURED ACROSS 600 OHM PHONE CIRCUIT LOAD)
ATTENUATION - DECIBELS
R.F. GAIN SETTING - DIVISIONS
MODEL XRAS RADIO RECEIVING EQUIP.
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.

PLATE 45


RANGE & LINEARITY OF RF GAIN CONTROL
CW OPERATION
BAND 5
(OUTPUT MEASURED ACROSS 600
OHM PHONE CIRCUIT LOAD)
LEGEND
O-3700 KC.
X-7000 KC.
ATTENUATION-DECIBELS
+20
+10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
R.F GAIN SETTING-DIVISIONS
0
2
4
6
8
10


RANGE & LINEARITY OF RF GAIN CONTROL
MCW OPERATION
BAND 5
FREQUENCY-5200 KC.
(OUTPUT MEASURED ACROSS 600
OHM PHONE CIRCUIT LOAD.)
MODEL XRAS RADIO RECEIVING EQUIP.
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
ATTENUATION-DECIBELS
+20
+10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
RF GAIN SETTING-DIVISIONS
0
2
4
6
8
10

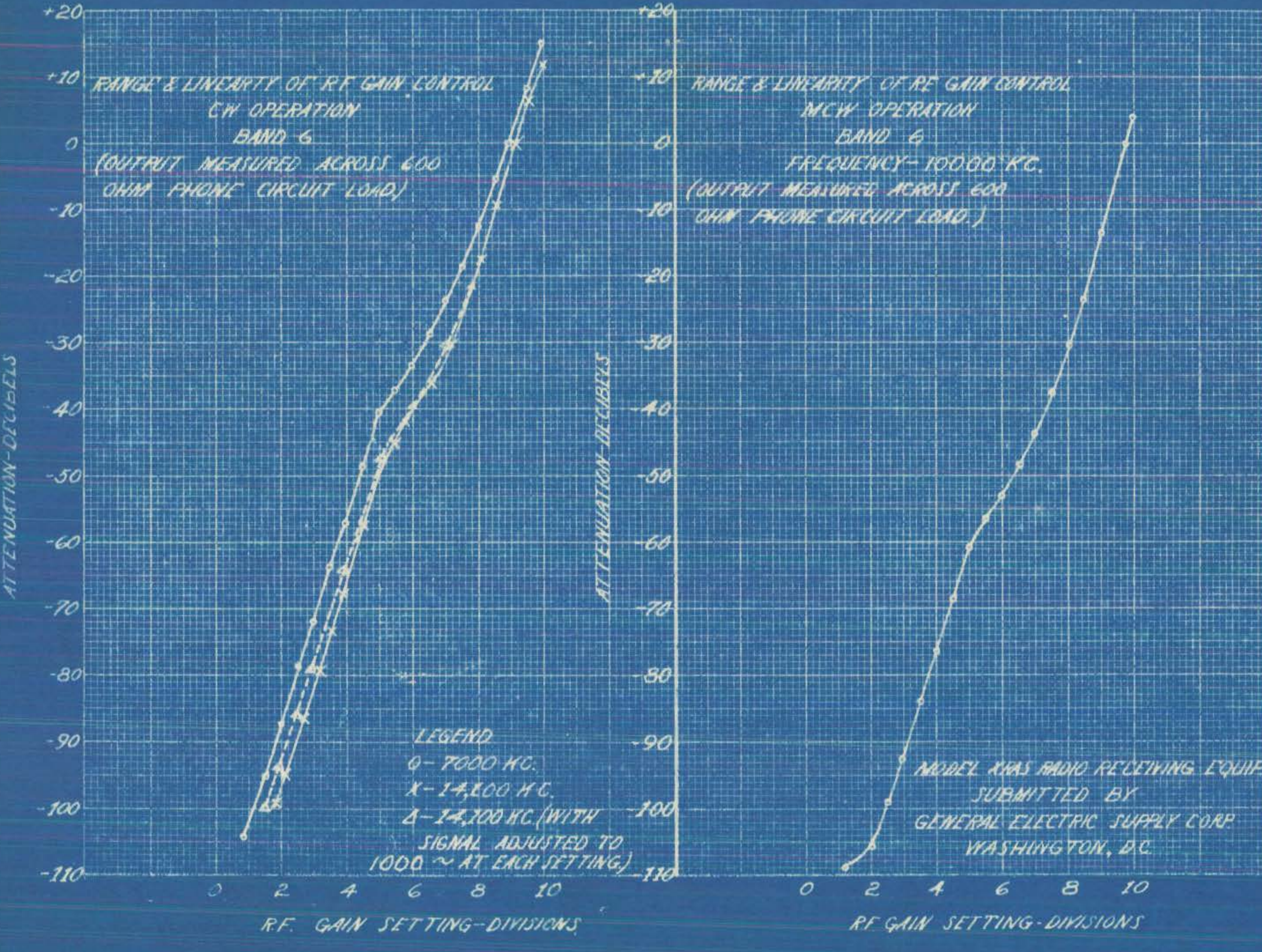
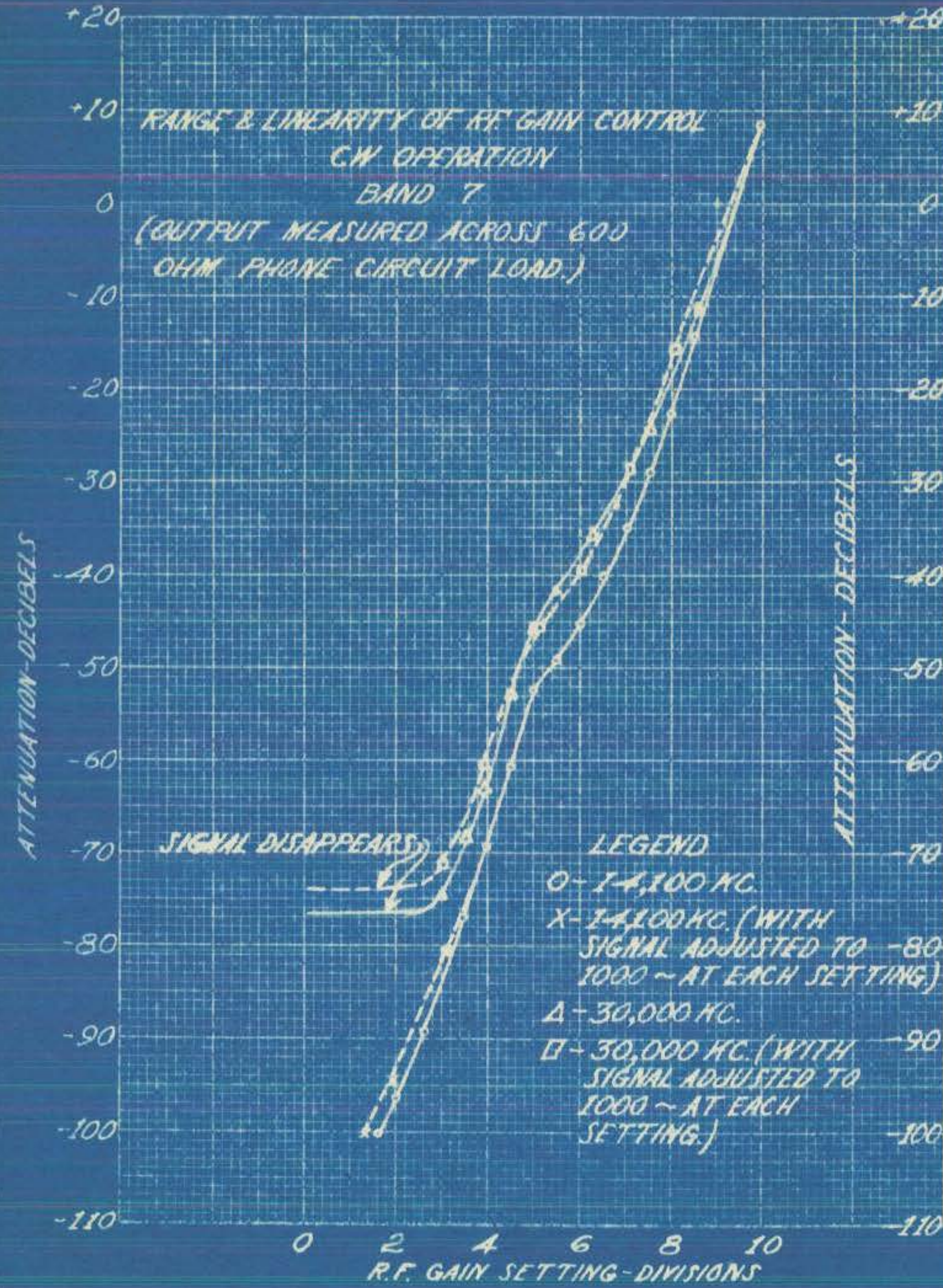

RANGE & LINEARITY OF R.F. GAIN CONTROL
CW OPERATION
BAND 6
(OUTPUT MEASURED ACROSS 600
OHM PHONE CIRCUIT LOAD)
LEGEND
O – 7000 KC.
X – 14,200 KC.
Δ – 14,200 KC. (WITH
SIGNAL ADJUSTED TO
1000 ~ AT EACH SETTING.)
ATTENUATION–DECIBELS
+20
+10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
0
2
4
6
8
10
R.F. GAIN SETTING–DIVISIONS
RANGE & LINEARITY OF RF GAIN CONTROL
MCW OPERATION
BAND 6
FREQUENCY– 10000 KC.
(OUTPUT MEASURED ACROSS 600
OHM PHONE CIRCUIT LOAD.)
ATTENUATION–DECIBELS
MODEL RHAS RADIO RECEIVING EQUIP.
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON, D.C.
RF GAIN SETTING–DIVISIONS

PLATE 47


RANGE & LINEARITY OF RF GAIN CONTROL
CW OPERATION
BAND 7
(OUTPUT MEASURED ACROSS 600
OHM PHONE CIRCUIT LOAD.)
SIGNAL DISAPPEARS
LEGEND
O - 14,100 KC.
X - 14,100 KC. (WITH
SIGNAL ADJUSTED TO
1000 ~ AT EACH SETTING)
Δ - 30,000 KC.
□ - 30,000 KC. (WITH
SIGNAL ADJUSTED TO
1000 ~ AT EACH
SETTING.)
ATTENUATION - DECIBELS
R.F. GAIN SETTING - DIVISIONS

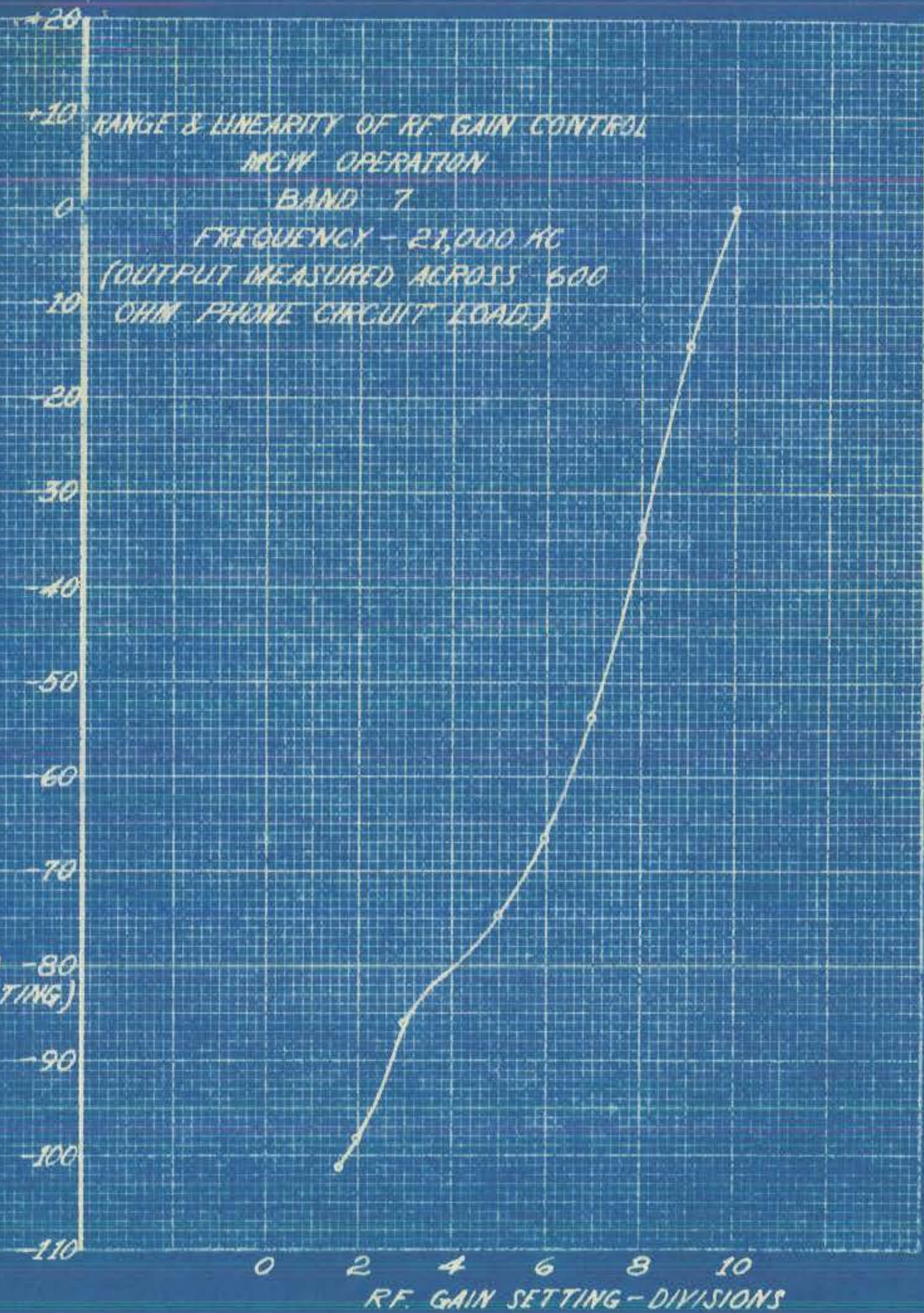

RANGE & LINEARITY OF RF GAIN CONTROL
MCW OPERATION
BAND 7
FREQUENCY - 21,000 KC
(OUTPUT MEASURED ACROSS 600
OHM PHONE CIRCUIT LOAD.)
ATTENUATION - DECIBELS
R.F. GAIN SETTING - DIVISIONS

PLATE 48

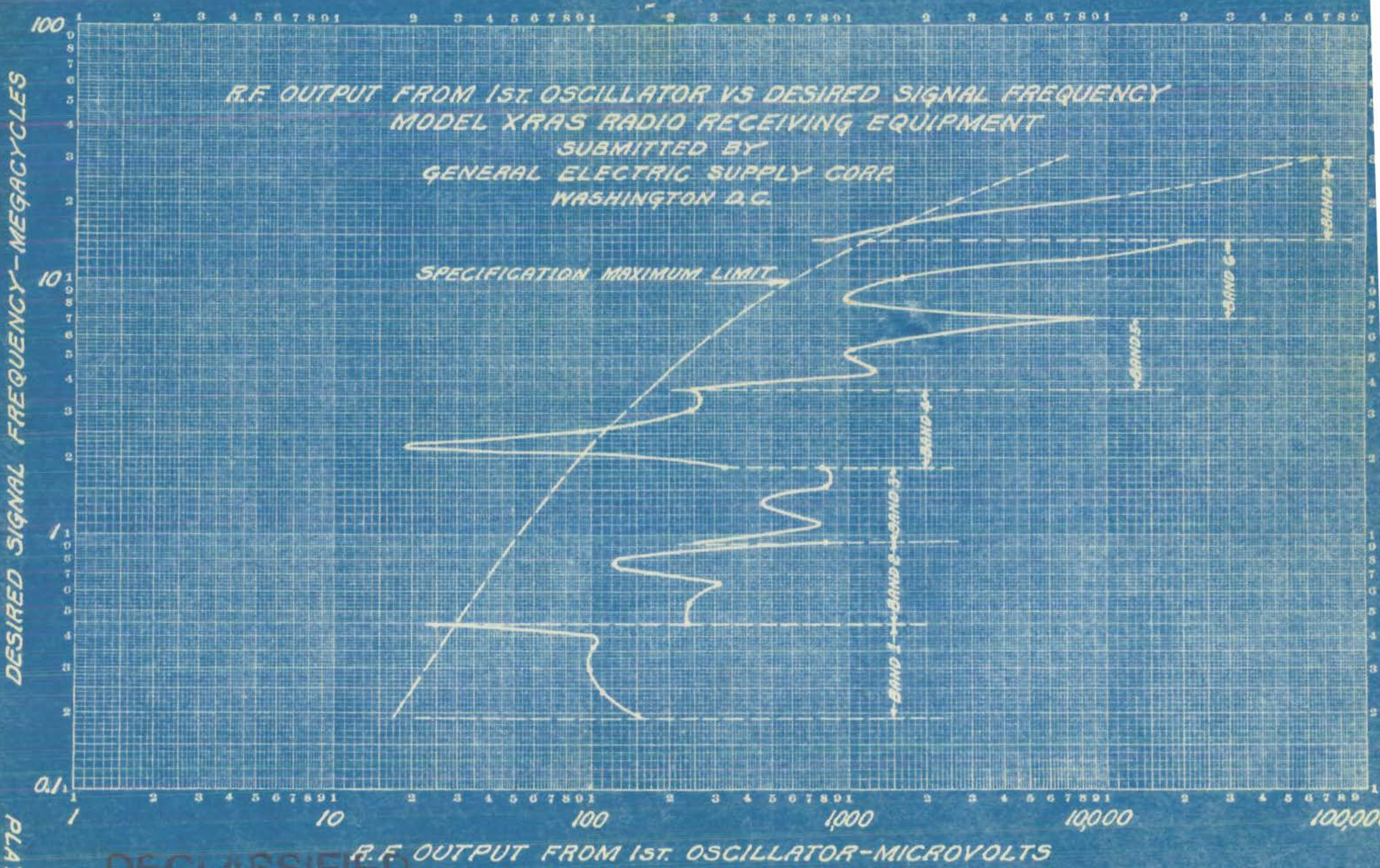

R.F. OUTPUT FROM 1ST. OSCILLATOR VS DESIRED SIGNAL FREQUENCY
MODEL XRAS RADIO RECEIVING EQUIPMENT
SUBMITTED BY
GENERAL ELECTRIC SUPPLY CORP.
WASHINGTON D.C.
SPECIFICATION MAXIMUM LIMIT
BAND 1
BAND 2
BAND 3
BAND 4
BAND 5
BAND 6
BAND 7
DESIRED SIGNAL FREQUENCY-MEGACYCLES
100
10
1
0.1
1
10
100
1,000
10,000
100,000
R.F. OUTPUT FROM 1ST. OSCILLATOR-MICROVOLTS

PLATE 49

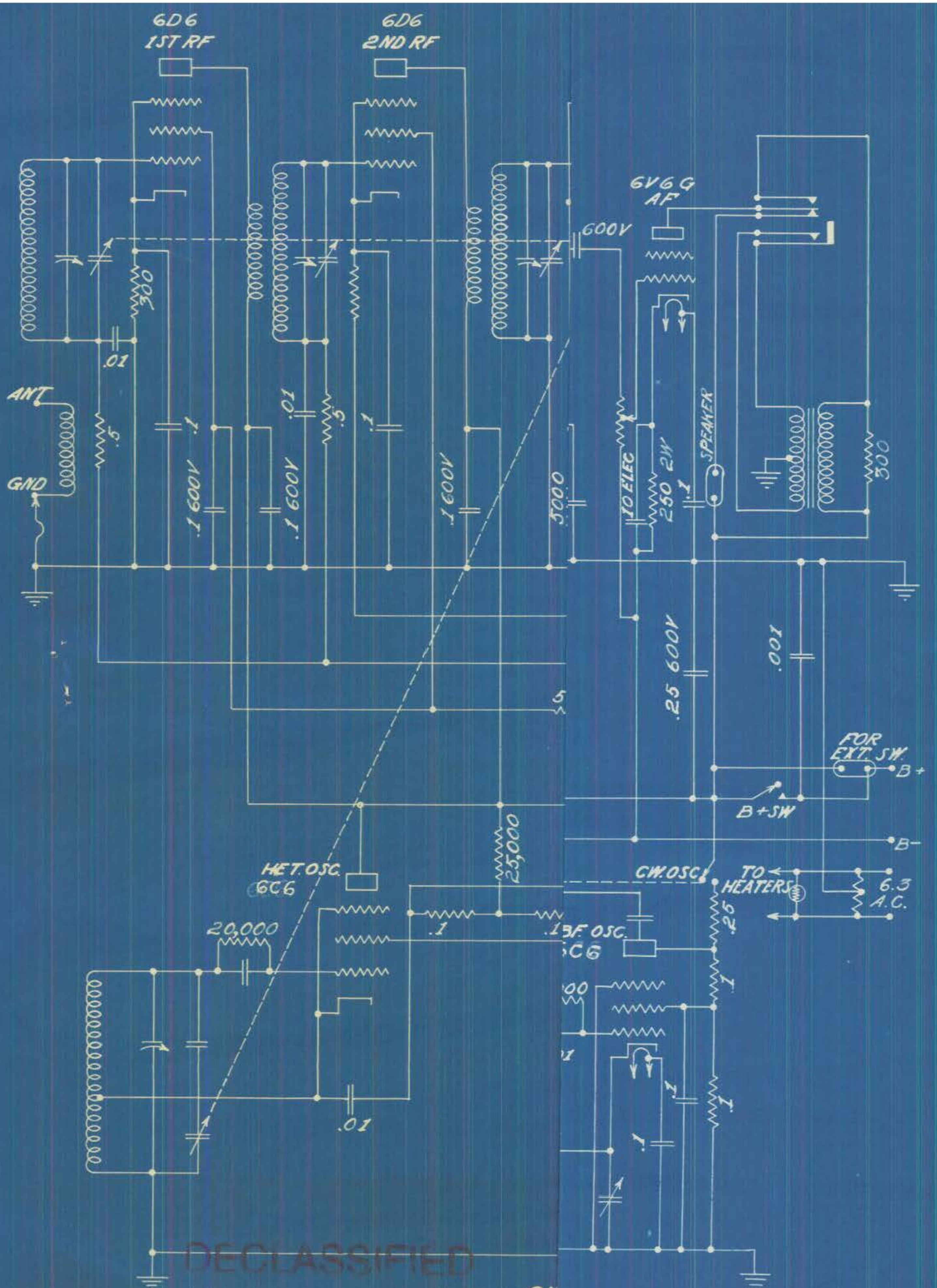

6D6
1ST RF
6D6
2ND RF
6V6G
AF
600V
300
.01
ANT
GND
.5
.1 600V
.01
.5
.1
.1 600V
.1 600V
5000
10 ELEC
250 2W
.1
SPEAKER
300
.25 600V
.001
5
FOR
EXT. SW.
B+
B+SW
B-
25,000
HET. OSC.
6C6
CW. OSC.
TO
HEATERS
6.3
A.C.
.25
20,000
.1
.1
BF. OSC.
6C6
1
.1
1
.01
.1

PLATE 50