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REPORT NO. R-1617

DATE 15 May 1940

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SUBJECT

Test of Model XTBW Radio Receiving Equipment

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NRL Report No. R-1617
Report on Test of Model XTBW
Radio Receiving Equipment

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NAVY DEPARTMENT

Report on

Test of Model XTBW Radio Receiving Equipment

DECLASSIFIED

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D. C.

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Date of Test: 23 October 1939 to 15 March 1940.

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jlh

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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 (z), inclusive.

Reference:
(a) BuEng. ltr. F42-1 (9-18-R6) of 19 September 1939 to Director, NRL, Anacostia, D. C.
(b) BuEng. Specifications RE 13A 552B.
(c) Contract NOs-65690 of 16 March 1939.
(d) BuEng. ltr. C-2-500-714 (2-13-R5) of 21 February 1939 to BuS&A.
(e) BuEng. ltr. C-NOs-65690 (3-23-R1) of 18 April 1939 to RINM, WEMCo., Baltimore, Maryland.
(f) BuEng. ltr. C-NOs-65690 (3-23-R1) of 20 April 1939 to BuS&A.
(g) BuEng. ltr. C-NOs-65690 (4-3-R1) of 21 April 1939 to RINM, WEMCo., Baltimore, Maryland.
(h) BuEng. ltr. C-NOs-65690 (4-3-R1) of 27 April 1939 to RINM, WEMCo., Baltimore, Maryland.
(i) BuEng. ltr. C-NOs-65690 (5-11-R1) of 19 May 1939 to RINM, WEMCo., Baltimore, Maryland.
(j) BuEng. ltr. C-NOs-65690 (5-4-R1) of 19 May 1939 to RINM, WEMCo., Baltimore, Maryland.
(k) BuEng. ltr. C-NOs-65690 (5-23-R1) of 24 May 1939 to RINM, WEMCo., Baltimore, Maryland.
(l) BuEng. ltr. C-NOs-58115 (5-18-R6) of 29 May 1939 to RINM, WEMCo., Baltimore, Maryland.
(m) RINM, WEMCo., Baltimore, Maryland, ltr. L4-3/65690 (31) of 12 June 1939 to BuEng.
(n) RINM, WEMCo., Baltimore, Maryland, ltr. L4-3/65690 (28) of 16 June 1939 to Chief of BuEng.
(o) BuEng. ltr. C-NOs-65690 (6-7-R1) of 16 June 1939 to BuS&A.
(p) BuS&A ltr. NOs-65690 (SPM) of 19 June 1939 to WEMCo. via RINM, WEMCo., Baltimore, Maryland.
(q) BuEng. ltr. C-NOs-65690 (5-17-R1) of 19 June 1939 to RINM, WEMCo., Baltimore, Maryland.
(r) BuEng. ltr. C-NOs-65690 (5-11-R1) of 23 June 1939 to RINM, WEMCo., Baltimore, Maryland.
(s) BuS&A ltr. C-NOs-65690 (SPM) of 6 July 1939 to WEMCo. via RINM, WEMCo., Baltimore, Maryland.
(t) BuEng. ltr. C-NOs-65690 (7-11-R6) of 14 July 1939 to RINM, WEMCo., Baltimore, Maryland.
(u) BuEng. ltr. C-NOs-65690 (7-7-R1) of 24 July 1939 to RINM, WEMCo., Baltimore, Maryland.
(v) BuEng. ltr. C-NOs-65690 (6-12-R1) of 26 July 1939 to RINM, WEMCo., Baltimore, Maryland.
(w) RINM, WEMCo., Baltimore, Maryland, ltr. L4-3/65690 (58) of 19 October 1939 to Chief of BuEng.
(x) BuEng. ltr. C-NOs-65690 (10-19-R1) of 25 October 1939 to Director, NRL, Anacostia, D. C.
(y) BuEng. ltr. C-NOs-65690 (11-16-DR1) of 17 November 1939 to Director, NRL, Anacostia, D. C.
(z) BuEng. ltr. C-NOs-65690 (11-27-DR1) of 18 December 1939 to RINM, WEMCo., Baltimore, Maryland.

[redacted]

OBJECT OF TEST

2. The object of the tests was to determine first, the extent to which the Model XTBW Radio Receiving Equipment complies with the requirements of the governing specifications, reference (b), and its amendments as included under reference (c); second, the presence of desirable features over and above the specific requirements of the specifications; and third, any objectionable features in this equipment which should either be corrected or avoided. Tests on the companion Model XTBW Radio Transmitting Equipment, authorized under reference (a), are covered under a separate report. A secondary objective of the tests, as authorized under reference (a), was that of determining the degree of compliance of the subject equipment with the applicable Bureau of Engineering receiver specifications for shipboard equipments. These tests will be conducted after final disposition of the primary objective tests, and will be covered under a separate report.

ABSTRACT OF TESTS

3. The Model XTBW Radio Receiving Equipment was set up in the Laboratory and given a general inspection of mechanical construction and wiring. The electrical tests conducted to determine compliance with references (b) and (c) were as follows:

(a) Accuracy of main tuning dial calibration, and band overlap.

*(b) CW and MCW sensitivity - dynamotor and a-c power unit operation.

*(c) CW and MCW sensitivity with replacement vacuum tube complements.

*(d) Tests for determining the ratios of unmodulated to modulated receiver output voltages - dynamotor and a-c power unit operation.

*(e) Maximum noise level, with receivers adjusted for cw and mcw reception, and operated from dynamotor and a-c power units.

*(f) Selectivity, at optimum and reduced gain.

*(g) Overall audio fidelity.

*(h) Image selectivity.

*(i) Intermediate frequency rejection.

(j) CW and MCW resonant overload.

(k) AVC characteristics, cw and mcw operation.

*(l) Increase of noise level with change from MVC to AVC.

(m) Range and linearity of sensitivity control.

(n) Range and linearity of volume control.

(o) Variation of audio output with load resistance.

(p) Accuracy of resettability of main tuning control.

(q) Frequency stability with change of supply voltage.

(r) Frequency stability with change of toggle switch settings.

(s) Frequency stability with increase of input signal intensity.

(t) Frequency stability with change of sensitivity (or volume) control settings.

(u) Frequency variation with change of converter tube.

(v) Audio distortion.

(w) Time constants of automatic volume control circuits.

(x) Frequency variation, (1) constant ambient temperature, (2) change of ambient temperature.

(y) Vibration tests.

(z) Acceleration tests.

(aa) Immersion tests.

(bb) Regulation of dynamotor and a-c power units.

4. The itemized tests preceded by an asterisk (*) were repeated for the Type CAY 46077 High Frequency Receiver Unit when employing narrow band intermediate frequency transformers in lieu of the normal band intermediate frequency transformers.

[redacted]

Conclusions

(a) The Model XTBW Radio Receiving Equipment does not comply with all of the requirements of its governing specifications, reference (b), as amended by the contract, reference (c). It possesses certain defects in its construction and deficiencies in performance which render it unacceptable for its intended purpose. The workmanship on the model equipment is not up to the usual standards expected of equipment of its character.

(b) The chassis-front panel construction of the receiver units is not rugged. Handling of the receiver units from their front panels results in the warpage of their chassis, which in turn results in excessive strains being applied on the ganged tuning capacitors and coil assemblies. The method of mounting the shield cans for the radio frequency transformer and high frequency oscillator assemblies subjects the coil forms to such severe strains as to cause their breakage. The general construction of the receiver units, owing to its lack of ruggedness and rigidity, is such that permanent adjustment of circuit alignment under all service conditions cannot be assured.

(c) The component parts of the receiver units are exceedingly inaccessible. The construction of the radio frequency transformer and high frequency oscillator assemblies is such as to preclude any possible means for cleaning the band switch contacts; and the replacement of the coils or band switches cannot be effected without considerable disarrangement of the wiring and possible damage to other components. The method of mounting fixed resistors and capacitors is such that their replacement is extremely difficult without damage to the insulation on the wiring, breakage of soldering lugs, or possible injury to other components. The replacement or servicing of certain components cannot be effected without the removal of other components or of partitions.

(d) The electrical performance of the receiver units does not provide the specified selectivity or fidelity required by the contract, nor does it provide for optimum signal to noise ratios. The antenna trimmer capacitors are ineffective and the input circuits are considered to be of poor design. The frequency stability of the receiver units under conditions of variations in temperature, manipulation of the volume controls on MVC, and variation of signal intensity, when receivers are adjusted for reception of cw signals on MVC, is poor. The performance of the converter tubes in the presence of strong r-f input signals is exceedingly poor. The frequency of the oscillator section is pulled out of step with the receiver tracking, as the input signal is increased, and the mixer circuit creates innumerable spurious responses.

[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 226. Recommendations for their correction are listed below under heading "A." Under this heading, recommendations are given for the modification or correction of existing deficiencies to effect compliance with the spirit and/or intent of references (b) and (c). Other deficiencies noted throughout the report and under paragraph 227 are those which do not comply with existing Naval General Specifications, which, however, are not necessarily applicable under reference (c). Under heading "B" below are recommended changes that should be made, in addition to those under "A," if this equipment is to comply with these specifications so as to extend its usefulness to shipboard service.

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

(1) That the circuit constants associated with the Type 38568K triode hexode converter tube be modified to overcome the adverse influences which this tube has on the overall performance of the receiver units. This recommendation is predicated on the assumption that the Type 38568K vacuum tube is approved for use in Navy equipment.

(2) That the 25-ohm resistors employed in the receiver units be of the type for which specific approval has been given under reference (j).

(3) That the construction of the receiver chassis, front panels, and panel supporting brackets be of more rugged design and possess the necessary rigidity to permit handling of the chassis from their front panels without distortion or warpage of the chassis from the weight of the components which they carry.

(4) That all shield cans be of such design as to provide for their direct and entire support from the chassis, and that their mountings shall provide for permanent and satisfactory bonding with the chassis.

(5) That the i-f and cw oscillator shield cans be constructed from heavier gauge material; that the side openings in the i-f shield cans, for coil coupling adjustment, be enclosed with permanently attached snap type cover plates; and that side holes for the passage of leads be fitted with protecting grommets.

(6) That the vacuum tube shields be notched to permit their complete seating on their bases with the type of base mounting screws provided.

[redacted]

(7) That aluminum brackets, employed for supporting phenolic insulating panels, and partition shields be of rigid design or be provided with additional bracing to preclude their movement under conditions of vibration.

(8) That spade bolts, if employed for shield can mounting, be of the design which provides for double rivet mounting, and that they be of stainless steel or of nickel plated brass.

(9) That the r-f transformer and high frequency oscillator coil assemblies be redesigned to provide for greater accessibility to their internal components and for external lead connections; and that the components be arranged for improved internal bus wiring.

(10) That inserts provided in cast aluminum alloy base plates be of such design as to preclude their possible rotation or loosening under conditions of vibration or on tightening or loosening the mounting screws.

(11) That the coil form and trimmer capacitor assemblies be redesigned to effect the following improvements:

(a) That coil forms for layer wound or space turn windings be suitably threaded to maintain the desired spacings of the turns; and that threads for primary windings, which are interwound between the turns of the secondary windings, be of sufficient depth to provide the necessary clearance between windings to preclude insulation breakdown from high d-c potentials.

(b) That each coil form be provided with soldering lug terminals for all of its coil leads.

(c) That the coil forms be provided with suitably spaced holes for anchoring the leads adjacent to the windings and to permit passage of the leads up through the center of the coil forms for connection to the soldering lugs, so as to preclude placing the leads of any coil in intimate contact with other coils.

(d) That greater clearances be provided between the soldering lug terminals of the coil forms and the metallic parts of the air dielectric trimmer capacitors.

[redacted]

(e) That separate mounting brackets or other suitable means be provided for supporting the air dielectric trimmer capacitors, so as to preclude their dependence upon the coil forms for support, or the subjection of the coil forms to adverse strains when adjusting the trimmer capacitor rotors.

(f) That the mounting of the trimmer capacitors be by means of screws threaded into inserts attached to their ceramic insulating plates, in lieu of nuts threaded on studs protruding from these same inserts. The present design does not provide sufficient clearance to permit loosening or tightening the securing nuts by means of a spin type socket wrench.

(g) That the lock nuts for the trimmer capacitor rotors be sealed with Glyptol after the final alignment of the receiver units to preclude their loosening under conditions of vibration.

(h) That enamel insulation on all coils employing such insulation be free of any breaks; that the ends of the leads where the enamel has been removed for soldering be completely tinned.

(i) That fixed mica trimmer capacitors be so mounted as to preclude any undue strains at the entrance of the leads into their molded phenolic cases.

(j) That the treatment provided for the coils be suitable to permit operation of the equipment within the range of ambient temperatures specified under reference (b), without cracking at cold temperatures or melting and dripping at high temperatures; and, if the contractor intends to use polystyrene impregnation, that he produce satisfactory evidence as to its temperature and moisture resisting properties.

(12) That the ganged tuning capacitors be of more rugged design; that they employ plates of heavier gauge material and wider spacings between plates; and that they be so mounted as to be independent of any distortion of the receiver chassis.

(13) That the wiper contacts in the ganged tuning capacitors and the spring wipers and rotor hubs of the trimmer capacitors be heavily silver plated. The plating thickness should not be less than .005" to assure that contact difficulties will not be experienced within the two-year guarantee period.

(14) That the main tuning drives of the ganged capacitors be redesigned to provide for greater ease of operation; more rapid traversing of the dial scale; to preclude backlash between the tuning knobs and the capacitor shafts; that all gears be machined from brass; and that the bearings for the drive shafts be provided either with ball bearings or suitable means for maintaining the lubrication of such bearings as they are afforded.

(15) That the mounting of the ganged tuning capacitors be modified to provide for greater accessibility for connection of the leads from the high frequency coil compartments.

(16) That the silver plating on the contacts of the band switch wafers be not less than .005" in thickness, and that the switch shafts be supported at both ends by means of suitable bearings which shall also incorporate facilities for maintaining their lubrication.

(17) That the dial mask mechanism be redesigned to eliminate the degree of backlash that is present in the model equipment.

(18) That the design of the i-f transformers be considerably improved to the extent of eliminating the objectionable method of mounting the dual tuning capacitors; the objectionable method in which the grid leads are brought out through the sides of the shield cans; to provide for the adjustment of the coupling between their coils without necessitating the complete removal of the transformer assemblies from the chassis; and that their construction be such as to permit rapid interchangeability between the wide and narrow band transformers in the high frequency receiver unit, without the use of tools.

(19) That the internal assembly of the cw oscillator and tuning inductors be dependent entirely upon the receiver chassis for their support; that access be provided for the adjustment of their tuning capacitors without the removal of the outer shield cans; and that these units be provided with terminal panels, for external lead connections, and rigid internal wiring.

[redacted]

(20) That the bottom edges of the receiver chassis be modified to preclude their damaging the phenolic angles in the interior of the common receiver cabinet, and that the cabinet be provided with guide tracks so as to properly align the receiver chassis, upon their insertion, to preclude damage to the panel finishes.

(21) That the dynamotor unit be redesigned or modified to permit its operation in the presence of driving rain, dust, and insect infestations, in compliance with the specification requirements.

(22) That the chassis of the a-c power unit be provided with additional bracing to preclude damage to the chassis under conditions of rough handling.

(23) That the workmanship on the receiver units be considerably improved for the production equipments.

(24) That the wiring of the receiver units be effected in a more neat and workmanlike manner; that the arrangement of the wiring be such as to preclude any possibility of lead breakage or of damage to the lead insulation under conditions of vibration; and that leads passing through shields and partitions be suitably protected by means of grommets.

(25) That greater effort be made to maintain the cleanliness of the chassis of the separate units of the equipment.

(26) That the welding workmanship be considerably improved over that displayed in the model equipment.

(27) That the use of steel for the mounting brackets of the audio output transformers and the grid connectors of the converter tubes be avoided; and that the steel studs for the chain supporting brackets and the steel chains be made non-corrosive by means of suitable plating.

(28) That suitable provision be made to protect the exposed metal parts of the antenna lead connectors and connecting posts as a precaution against possible shock from r-f potentials to the operating personnel; and that a conspicuously placed warning nameplate be provided to warn the operating personnel of the shock hazard encountered when removing the power cables with full power applied to the receiver units.

(29) That cable ferrules for the battery and charging cables be of the sizes suitable for the diameters of these cables; that the retaining nuts for all ferrules be staked to preclude their loosening under conditions of vibration;

[redacted]

and that the rubber sleeving for the cable plugs be of such quality as to withstand service in the tropics.

(30) That the metallic parts of toggle switches, jacks and dial light receptacles, be provided with a dull finish in lieu of bright polished finishes.

(31) That the ends of the antenna connection leads be provided with suitable protective means to obviate the danger of rain or spray rendering the equipment inoperative or in reducing its overall efficiency.

(32) That the color coding of the leads of the dynamotor, power transformer or filter reactors of the power units be consistent with the color coding of the wires of the circuits to which they are connected; and that the color coding of rubber insulated wires be of permanent character without any tendency towards fading under the operating conditions stipulated under reference (b) for this equipment.

(33) That, unless greater accessibility is provided in the production equipments for the component parts on the under side of the receiver chassis, the vacuum tube sockets be of the type fitted with mounting plates which will permit their attachment to the receiver chassis by means of the securing screws of the tube shield bases.

(34) That the design of the equipment be such that the voltages arriving at the receiver tube sockets comply with the limitations of reference (r) with the receiver units operating either from the dynamotor or a-c power unit.

(35) That all component parts employed in the equipment be identified by the manufacturer's type numbers, as required by the governing specifications.

(36) That the nameplate data be revised in line with paragraph 71 of this report.

(37) That anti-sieze compound be employed for all applications where its use is required under the specifications.

(38) That the shock mount assembly be such as to assure that its limit of effectiveness be not exceeded by such vibration and shock as may be expected under service conditions.

(39) That all ceramic, micalex and phenolic insulating material and phenolic insulating panels be wax impregnated prior to their use; that greater clearances be provided between terminals and between terminals and ground to effect compliance with the specification requirements.

[redacted]

(40) That all iron cored transformers and filter reactors be hermetically sealed in metallic cases, and be provided with terminal panels for external lead connections.

(41) That the receiver units be redesigned to provide for greater accessibility of the component parts mounted under their chassis to provide the degree of serviceability that is usually expected of Navy receivers. This redesign should provide for the ready replacement of fixed foil paper by-pass capacitors, molded mica dielectric capacitors and resistors without subjecting the terminal lugs to breakage or the wiring to damage from hot soldering irons. It is further recommended that, unless a major design change can be effected in the design of the r-f transformer and high frequency oscillator coil assemblies to provide for greater accessibility of their component parts, one of each of these assemblies be provided among the equipment spare parts in lieu of spare components.

(42) That special wrenches for operation of the Bristol type set screws employed in parts of the equipment where disassembly is required for servicing be furnished as a part of the equipment in such a manner as to make it readily available when needed. It should be attached to one of the units, preferably the receiver unit, in a manner that will obviate its loss.

(43) That circuit symbols be provided on the tops of all coil shield cans and adjacent to the trimmer capacitors to identify the circuit functions of these capacitors for alignment purposes.

(44) That transparent cellulose material employed for enclosing the dial apertures and for displaying the fiducial marks for the receiver dials be of non-inflammable material, as required by the specifications; and that the design of the receiver units be modified so as to provide for the ready replacement of these items in the event of their warpage or their having become permanently damaged from scratches, fogging, or punctures.

(45) That soft washers be employed as required by the governing specifications for all mounting screws or eyelets bearing against ceramic insulators.

(46) That the design of the equipment be so modified as to make the use of special tools unnecessary except for Bristol set screw wrenches and trimmer capacitor adjustment tools; and that the contractor furnish among the tools a set of small socket wrenches, pliers, side cutters and screwdrivers, as normally required for servicing receivers.

[redacted]

(47) That the design of the fixtures provided for supporting the cover of the receiver transportation case, when employed as an operating table, be modified to overcome the weaknesses of the present design; and that the supporting chains be provided with a protective covering to prevent their damaging the receiver panel and transportation case finishes.

(48) That more suitable means be provided in the production equipment than has been afforded the model equipment for protecting the receiver and dynamotor units when set up for operation in a driving rainstorm; that these provisions shall assure the non-exposure of any of the component parts of either of these two units to moisture, and that if canvas covers are furnished they be so designed as to permit the viewing of the calibrated dials through transparent devices.

(49) That the thumb screws for securing the covers of the transportation cases be redesigned to permit their operation by means of a special tool; that the new design include screwdriver slots and that the cases provide some means for securing the operating tools, when not in use, in such a manner as to preclude their possible loss during transportation.

(50) That the covers of the transportation cases for the receiver and dynamotor units be fitted with schematic and actual wiring diagrams, as required, and that these diagrams be constructed from such materials that will be unaffected by wide variations of temperature and humidity or from their direct exposure to rain or sun rays. Also that the instruction book be suitably bound to withstand rough handling, and that the paper employed shall be such that the pages will show no tendency towards adhering to each other in tropical climates; and, further, that the instruction book shall be stored within the transportation case for the receiver units.

(51) That the front panels of the receiver units be provided with single chassis withdrawal handles in lieu of two, as provided on the models, and so positioned as to cause no interference with each other or with the operating controls.

(52) That the dynamotor chassis be provided with a withdrawal handle or equivalent device to permit its removal from the transportation case without subjecting the component parts to strain.

(53) That the cw oscillator tubes in the receiver units and the rectifier vacuum tube and pilot lamp in the a-c power unit be replaceable without the use of tools.

(54) That a more satisfactory method be employed for securing the receiver cabinet within its transportation case, and that in this regard consideration be given to the use of "Dzus" fasteners or snap slides, in lieu of thumb screws.

(55) That the dynamotor chassis be secured within its transportation case by means which will overcome the inherent defects of the method employed for the model unit, and that thumb screws be not employed, if possible.

(56) That the chassis construction of the dynamotor and a-c power units provide means, in the same manner as for the receiver units, which will permit their being placed on their backs for servicing without damage to their component units.

(57) That the front panels of the receiver units be secured to their common cabinet by more suitable means than has been employed for the model units; and that if thumb screws are employed they shall be of such design as to be self-aligning, free from damage from heavy shock, and shall be constructed from stainless steel so as to require no plating.

(58) That the retaining blocks for the panel thumb screws be so constructed as to withstand repeated engaging or disengaging with the thumb screws without danger of their threads being stripped. The thumb screw design shall be such that when tightened they will cause no perceptible distortion of the receiver panels.

(59) That, contrary to the specification requirements, the Rajah type connectors be not employed, since they are not considered as being suitable for their intended purpose, as discussed under paragraph 127 of this report.

(60) That rear connection of the antenna and power cables be provided in lieu of front panel connections, unless a more suitable arrangement can be provided on the front panels to avoid the disadvantages attended by their arrangements as provided on the model receiver units.

(61) That the panel lights be of such design as to provide for more direct illumination of the tuning dials and less illumination of the operating controls than has been provided for the model receiver units; and that the domes be so constructed as to provide for their positive locking, with the pilot lamp fixtures, so as to preclude their loosening under conditions of vibration.

(62) That the finishes on the pilot lamps and the tuning dial escutcheon plates be consistent with the flat black finishes of the receiver panels so as to render these parts less conspicuous than for the model equipment.

[redacted]

(63) That the operating controls on the receiver panels be rearranged to avoid the existing interference between the band switch and the antenna trimmer capacitor and AVC and CW toggle switches; interference between the manual volume control and the phone plugs; and to make the phone plugs more accessible for removal.

(64) That shielded wiring be positively bonded, by means of metallic clamps, to supporting brackets, etc., and that pressure contact as provided in the model equipment be reduced by incorporating in the production equipments the recommended design changes for coil shield cans, trimmer capacitors, and ganged tuning condenser assemblies, as presented above.

(65) That interference from the oscillators of the receivers be eliminated through the use of more adequate shielding in the construction of the receiver units.

(66) That the input circuits of the receiver units be so designed that the antenna trimmer capacitor will be effective at all frequencies within the ranges of the two receivers and to effect complete compensation for variations in the constants of the antennas with which the equipment may be expected to operate.

(67) That the degree of coupling afforded between the beat frequency oscillator and the second detector of the I. F. Receiver Unit be modified so as to effect an improvement in cw sensitivity, at any frequency within the range of the I. F. Receiver Unit, so that the ratios between mcw and cw sensitivities will be commensurate with those normally expected.

(68) That the audio output transformers of the receiver units be redesigned for operation into a 425-ohm load, as required under reference (b); and that their secondary windings be electrostatically shielded and electromagnetically balanced with respect to ground.

(69) That the sensitivity of both receiver units when adjusted for the reception of either cw or mcw signals be improved to effect compliance with the specification requirements with a reasonable margin of safety, through the use of improved antenna input circuits and the inclusion of a low pass filter between the second detector and the first audio frequency amplifier to effect better signal to noise ratios; that the converter circuits be redesigned so as to make the receiver units less sensitive to tube replacements; and that suitable precautions be taken to preclude the rapid aging of circuit components resulting from the operation of the receivers under conditions of wide variations of ambient temperature and humidity.

(70) That the circuit constants and circuit design of the receiver units be modified so that the contract limits for selectivity may be met at all specified inputs; that the selectivities be not affected by variations in the sensitivity control settings; and that the necessary precautions be taken to avoid permanent changes in the selectivities of the receivers from their operation under conditions of wide variations of ambient temperature and humidity.

(71) That the receiver units employ low pass filters as recommended under paragraph 69 above to effect compliance with the contract limits for overall audio fidelity.

(72) That the High Frequency Receiver Unit employ a separate high frequency oscillator tube and a separate mixer tube as a means for providing for greater high frequency oscillator stability under conditions of wide variations of r-f input, variations in sensitivity control, variations of supply voltage, etc., so as to reduce, to practical limits, the need for retuning the receiver when adjusted for reception of cw signals and subjected to the influences of these variables.

(73) That the graduations on the dial scales of the receiver units be redesigned to emphasize the calibrated divisions from the intermediate divisions, and that the dial indexes be made more prominent so as to provide for greater readability of the dial scales at distances up to 24 inches, under all lighting conditions.

(74) That the taper of the potentiometer employed in the I. F. Receiver Unit for controlling receiver sensitivity on MVC be such as to effect compliance with the requirements of paragraph 4-73(1) of reference (b).

(75) That the automatic volume control circuits and constants of the receiver units be modified to effect compliance with the specification requirements for its action, as given under paragraph 4-77 of reference (b), with optimum sensitivity being assumed as the reference input level for determining specification compliance.

(76) That the necessary circuit changes be incorporated in the H. F. Receiver Unit to render its sensitivity less responsive to temperature changes; and that the specification limit for frequency stability be changed to be consistent with the limits specified under paragraph 4-81 of reference (b).

(77) That the following improvements be provided in the design and construction of the storage batteries to effect their compliance with the requirements of their applicable specifications.

(a) That the covers and cases be more carefully constructed so as to render the storage batteries watertight.

(b) That the terminal boxes be redesigned so as to be watertight, and that suitable means be provided for enclosing the knockout openings on the removal of the battery cables in preparation of the storage batteries for transportation.

(c) That the terminal box retaining screws be of the design specified under Bureau of Aeronautics Specification B-38a.

(d) That the clamping area between the wing nuts and the battery hold down strap be increased.

(e) That the carrying handles for the storage batteries be of such design as to preclude their possible movement, loosening, or detachment during the normal handling of the storage batteries.

(f) That the steel hardware employed for the battery terminals be more heavily plated with lead to preclude corrosion.

(78) That the receiver units be provided with means for turning the power to the a-c power unit "on" or "off."

(79) That the canvas slip covers furnished with the receiver and dynamotor units, for their protection when operated in driving rain, be of such design as to effect complete compliance with the requirements of reference (b). The flaps which are fastened by means of zippers shall be of such design as to provide for free access to the operating controls and at the same time be not subject to blowing about when opened. The canvas cover for the receiver unit should also permit viewing the tuning dials when the control openings are closed.

(80) That sample resistors, capacitors, transformers, reactors, insulating materials, etc., be furnished for test to determine their compliance with their applicable specifications.

B. That the equipment may comply with Naval specifications which are generally applicable to shipboard radio receiving equipment, the following recommended changes or modifications are in addition to those under "A" above.

(1) That separate high frequency oscillator and mixer tubes be employed in the receiver units; and that dual purpose tubes be not employed for any purpose except AVC circuits.

(2) That the receiver chassis and front panel and panel supporting brackets and shield cans be of heavier gauge material.

(3) That the r-f transformer and high frequency oscillator shield enclosures be of such design as to provide complete shielding on all sides, and full surface bonding, of one of their sides, with the receiver chassis.

(4) That the rotor and stator plates of the ganged tuning capacitors be of brass, solder bonded to brass supporting members; that both the rotor and stator assemblies be completely silver plated; that the rotor hubs be provided with coin silver facings, and be secured to a common stainless steel shaft by means of suitably arranged set screws; and that the wiper fingers be fitted with coin silver button contacts which shall, when contacting the coin silver facings on the rotor hubs, provide self-cleaning action.

(5) That the band switches be of more rugged design; that they be provided with coin silver facings on their fixed and movable contacts; and that the band switch wafers be designed to provide for their self-alignment when ganged to a common drive shaft.

(6) That all toggle switches be of the dry packed type with silver plated contacts, and that their toggles and mounting hardware be dull black nickel plated.

(7) That the front edges of the common receiver cabinet be flanged to provide additional bonding with the front panels of the receiver units to provide for greater shielding.

(8) That the a-c power unit be redesigned to provide for the extension of its usefulness for shipboard service.

(9) That some means be provided for shielding the antenna posts on the receiver units, and to provide for transmission line connection.

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(10) That bus wiring, where employed, be color coded by means of colored lacquer spotted at the ends of the wires to facilitate servicing; and that the colors employed be consistent with the color coding of the associated circuit wiring.

(11) That access be provided for the replacement of all component parts mounted to the under sides of the receiver chassis without necessitating the removal of other components, and without subjecting the terminal lugs or wiring to partial or permanent damage.

(12) That photo-etched nameplates bearing the circuit symbols of the air dielectric trimmer capacitors be mounted adjacent to the capacitor rotor shafts, and on the shield cans through which these shafts protrude, to provide for their permanent identification for circuit alignment.

(13) That the frequency overlap between the ends of the bands and the respective mean frequencies be equalized for the production receiver units; that this be effected either through a revision of the coil designs or through the selection of a new set of mean frequencies; and that the RINM inspect and test each production receiver unit for band overlap.

(14) That the receiver units be provided with separate manual sensitivity and audio output level controls and that the panel marking for these controls be descriptive of their functions.

(15) That the resistance elements of the sensitivity and/or audio output level controls be wire wound, unless subsequent tests prove that it is possible to produce satisfactory composition units.

(16) That the spurious responses be considerably reduced through more adequate shielding and suitable circuit constants.

MATERIAL UNDER TEST

5. The material under test consisted of one Model XTBW Radio Receiving Equipment complete with the following units or items.

(a) One - Type CAY 46078 Receiver Assembly, complete with transportation case, and,

One - Type CAY 46076 Intermediate Frequency Receiver Unit with complete complement of vacuum tubes.

One - Type CAY 46077 High Frequency Receiver Unit with complete complement of vacuum tubes.

(b) One - Type CAY 21387 Dynamotor Unit complete with transportation case.

(c) One - Type CAY 20085 A. C. Power Unit complete with rectifier vacuum tube, and line cable and plug.

(d) One - Type CAY 10034 Mobile Spare Parts Box, less spare parts.

(e) Two - Type CAY 19017, Special, Class S-34 Storage Batteries.

(f) One set - Interconnecting Cables consisting of

One - I. F. Receiver power cable.
One - H. F. Receiver power cable.
One - Battery cable to dynamotor unit.
One - Battery charging cable.
One - Battery interconnecting cable.
One - I. F. Receiver antenna cable.
One - H. F. Receiver antenna cable.

(g) One - Canvas cover for Type CAY 46078 Receiver Assembly.

(h) One set - Narrow Band I. F. Transformers for Type CAY 46077 Receiver Unit.

(i) One Copy - Test data.

(j) Two copies - Preliminary Instruction Book.

6. The subject equipment was manufactured by the Westinghouse Electric and Manufacturing Company of Baltimore, Maryland, under contract, reference (c), and was delivered to the Laboratory for type approval tests on 19 October 1939.

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METHOD OF TEST

7. 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. 383.

(d) Wave Analyzer, General Radio Company, Type 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. 37.

(g) Output Meter, NRL No. 2505.

(h) Output Meter, Daven Company, Type D180, Serial No. 1454.

(i) Vacuum Tube Voltmeter, Weston Company, Model 669.

(j) Audio Frequency Microvolter, General Radio Company, Type 546A, Serial No. 119.

8. The equipment was inspected after its unpacking for damaged or loosened components. It was then set up in a screened booth for test. The tests described herein were made on each receiver taken individually, and unless otherwise specified apply equally as well to one receiver as to the other. The tests conducted on the High Frequency Receiver Unit were made with the receiver employing wide band i-f transformers, except as noted throughout the report, in the tables, and on the plates, where duplicate tests were made with the narrow band i-f transformers replacing the others. Tests were conducted with the receivers operated from both types of power supply. The choice of power supply is indicated on the tables and plates. Prior to each test the line or battery voltages were measured to assure their being of the values required by the governing specifications.

9. The output of the standard signal generator was connected to the input terminals of the receiver under test through a standard dummy antenna, whose characteristics comply with the latest I.R.E. specifications. Stray coupling was reduced to a minimum at all frequencies through the use of short, shielded, r-f input leads and suitable grounding of the apparatus for minimum stray signal reception, with the step attenuator of the standard signal generator set for a high output level and with the

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slide wire attenuator set at zero. A beat frequency oscillator was employed for modulating the r-f carrier inputs and was connected to the standard signal generator. The percentage of modulation was regulated by means of a control, provided for this purpose, on the front panel of the standard signal generator. The output of the receiver was connected to two parallel connected output meters, one being provided for indicating low output voltages, the other provided for indicating high output voltages. The receiver output load was adjusted to 425 ohms and the meter connections were such as to provide no additional loading across the receiver load. A brief description of each of the tests for which the above test set-up was employed is as follows:

(a) Sensitivity. Sensitivity measurements for both cw and mcw inputs were conducted in accordance with conventional methods. These measurements were predicated on the receiver being adjusted for MVC, and with the receiver gain adjusted for a standard noise level of 400 microwatts, with no applied input signal. When the maximum receiver noise level, under these conditions, was less than standard, the sensitivity was determined for the maximum gain setting. Standard output was 10 milliwatts across a 425-ohm load. Standard output frequency, for cw inputs, was 1,000 cycles. Where modulated signals were applied to the receiver input, the r-f carrier was modulated 30 per cent at 400 cycles per second. Sensitivity measurements were made for both cw and modulated inputs at five frequency settings, including the overlap frequencies, for each band of the receiver under test.

(b) Ratios of Unmodulated to Modulated Output Voltages. The ratios of unmodulated to modulated output voltages were determined in accordance with the procedure outlined under paragraph 174 of this report.

(c) Maximum Noise Level. The maximum noise level appearing at the output of the receiver with no applied input signal, but with the receiver remaining connected to the standard signal generator, was measured at the same frequency settings as for sensitivity. Noise voltage measurements were made with the receiver adjusted for both MVC and AVC, with their respective volume controls adjusted first, for standard noise level on MVC, and then for maximum gain setting on both MVC and AVC.

(d) Sensitivity with Replacement Vacuum Tube Complements. Tests to determine the effect of tube replacement on receiver sensitivity were conducted in the same manner as that under paragraph (a) above, but with the original tube complement replaced by (1), a complete set of vacuum tubes having lower mutual conductances, and (2), a complete set of vacuum tubes having higher mutual conductances, than the original tubes.

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(e) Selectivity. Selectivity measurements were made at three frequency settings in each band of the receiver with the receiver adjusted as for sensitivity and for modulated input signals. Certain of the selectivity measurements were measured with the sensitivity control adjusted so as to reduce the overall receiver gain by a ratio of 10 to 1. The procedure employed for determining receiver selectivity was in accordance with conventional standards.

(f) Image Selectivity. Measurements for image selectivity were made at several frequency settings in the complete frequency range of the receiver, as indicated on the plates, with the receiver adjusted for optimum conditions, and with the signal from the standard signal generator modulated 30 per cent at 400 cycles per second. The test procedure was to tune the receiver to a given frequency and to determine its sensitivity at that frequency. The standard signal generator was then adjusted to the image frequency corresponding to the resonant frequency of the receiver, and the r-f input adjusted to produce standard output, without disturbing the receiver adjustments. The ratio of the sensitivity at the image frequency, with respect to the resonant frequency of the receiver, is the image selectivity of the receiver at the particular test frequency.

(g) Intermediate Frequency Rejection. The degree to which the preselector circuits of the receiver attenuates the direct reception of the intermediate frequency was determined in the same method as described under paragraph (f) above, except that the signal generator was tuned to the intermediate frequency of the receiver instead of to the image frequency for each frequency to which the receiver was tuned.

(h) Resonant Overload. With the receiver adjusted for standard conditions, as for sensitivity, the resonant overload of the receiver was determined for cw and mcw inputs by increasing the input voltages in small increments and noting the corresponding output voltages. For cw inputs, the receiver was adjusted for a 1000 cycle beat note, except where it was necessary to adjust the receiver beat note to such a frequency as was necessary to compensate for the drift of the high frequency oscillator, resulting from the application of strong input signals.

(i) AVC Characteristics. These characteristics were determined in the same manner as described under paragraph (h), above, for both cw and mcw inputs, except that the AVC-MVC switch was thrown to AVC. Measurements were made under several test conditions, as noted on the applicable plates, and described under paragraph 183 of this report. As for the resonant overload characteristics, the beat note for cw

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inputs was adjusted to compensate for the drift of the high frequency oscillator, resulting from strong input signals.

(j) Range and Linearity in Sensitivity Control. With the receiver again adjusted on MVC as for the sensitivity measurements, the range and linearity of the sensitivity control were determined by varying the angular rotation of the control and increasing the r-f input so as to maintain standard output. These measurements were made for small incremental changes in the angular rotation of the control .

(k) Range and Linearity of Volume Control. The range and linearity of the volume control were determined for the receiver, when adjusted for standard conditions, and with a fixed r-f input applied to the receiver input terminals. The volume control was then varied and the corresponding output voltage for each incremental change in the angular rotation of the control was noted.

10. The test set-up which was employed for determining audio frequency performance data was essentially the same as described under paragraph 9, except that a General Radio Wave Analyzer was connected across the receiver output load. When so connected, it was employed as a vacuum tube voltmeter for indicating output voltages at their fundamental audio frequencies.

(a) Overall Audio Fidelity. The overall audio fidelity was measured at three frequency settings within the range of the receiver. The r-f input to the receiver was modulated 30 per cent at the various audio frequencies at which measurements were made. This input was applied to the receiver in the same manner as for the sensitivity measurements and adjusted to produce standard output, across the receiver load, at the specification sensitivity value and for a modulation frequency of 1,000 cycles, with the receiver gain adjusted accordingly. These tests were repeated with the modulated input increased to 100 microvolts and with the receiver gain control adjusted for 10 volts output, across the receiver load, at 1,000 cycles. Overall audio fidelity was measured for incremental changes in audio frequency from 30 to 5,000 cycles per second.

(b) Effect of Load Resistance on Audio Output. A 1,000 cycle signal, from the beat frequency oscillator, was fed to the grid of the second detector through an audio microvolter. The voltage of this signal was adjusted to produce standard output across the 425-ohm load at the receiver output. This load consisted of a decade box which was varied in steps from 100 to 1,000 ohms and the output voltage, as indicated on the wave analyzer, noted for each step. This test was repeated with the input adjusted for an audio output of 10 volts across 425 ohms (235 milliwatts).

(c) Audio Distortion. With the receiver and test apparatus connected as described under paragraph 10 above, the audio distortion, resulting from the modulated carrier input applied to the receiver input and adjusted to produce an audio output of 300 milliwatts across the receiver load, was determined at the overlap frequency settings for each band of the receiver. The amplitudes of the 400-cycle signal, as well as for its separate harmonics, were observed on the wave analyzer, and from these observations the percentage of distortion with respect to the 400-cycle signal was calculated.

11. The tests which follow, and which are of a character which requires a precise measurement of frequency, were conducted with the following test set-up and general procedure. The output of the General Radio Heterodyne Calibrator was coupled to the receiver input or to the circuit of the receiver under investigation, as indicated below. The output of the receiver was connected to the input of the General Radio Interpolation Oscillator, parallel connected across the receiver output load. The heterodyne calibrator was employed as a primary standard of frequency, while the interpolation oscillator was employed as a reference indicator. The general procedure was to measure the frequency to which the receiver, or circuit under test, was tuned before and after each test. This was accomplished by adjusting the signal from the heterodyne calibrator to such frequency as to provide a 1,000 cycle receiver output. This output was then beat against the interpolation oscillator so adjusted as to give a zero beat. Variation of receiver output frequency was determined by the difference frequency between the receiver output frequency and the interpolation oscillator frequency. In certain of the tests, frequency variations were determined by readjusting the interpolation oscillator to maintain a constant zero beat in the headphones, and noting the dial settings, of the interpolation oscillator, before and after each test. In other tests the frequency drift was determined by readjusting the heterodyne calibrator tuning to maintain a zero beat at the receiver output, with the interpolation oscillator set for a 1,000 cycle adjustment. Sufficient time was allowed at the start and finish of each test to permit oscillator stabilization to take place.

(a) Accuracy of the Main Tuning Dial Calibration and Band Overlap. The accuracy of the tuning dial calibration for each band of each receiver unit was determined by measuring the actual frequencies for each of the calibrated settings indicated on the dials. Similar measurements were made to determine the extreme tunable frequencies for each band of the receivers, for purposes of determining the percentage of overlap between adjacent

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bands. These measurements were made by adjusting the heterodyne calibrator for zero beat at the receiver output with the 1,000 cycle note from the interpolation oscillator. In making these measurements, the direction of rotation of the tuning dials from one frequency to the next was always in the same direction, and the adjustment of the heterodyne calibrator was always for the beat note on the high side of receiver resonance.

(b) Accuracy of Resettability of Main Tuning Control. The initial adjustments of the receiver at any given test frequency were the same as for (a) above. The tuning dial was then returned to the same setting in a clockwise direction and then in a counter-clockwise direction with the heterodyne oscillator readjusted for zero beat for each resetting of the dial. The frequency of the input signal was recorded for each setting.

(c) Frequency Stability with Change of Converter Tube. The effect of replacing the converter tube with other tubes of the same type but differing in mutual conductances, was determined in the same manner as for dial calibrations. Tests were conducted on both receiver units.

(d) Frequency Stability with Change of Supply Voltage. The effect of variation in supply voltage as noted herein was measured in the same manner as described under (a) above, except these measurements were made with constant r-f inputs from the heterodyne calibrator and variation of the frequency noted by means of the interpolation oscillator which was readjusted, before and after each test, for zero beat with the output signal from the receiver.

(e) Frequency Stability with Change of Toggle Switch Settings. This test was conducted the same as for (d), and the effect of turning the MVC-AVC switch from MVC to AVC, and of turning the second receiver "on" or "off" upon the frequency stability of the receiver under test was measured. Measurements were made at several frequency settings within the ranges of the two receivers.

(f) Frequency Stability with Change of Input Signal Intensity. Measurements for the overall frequency variation of the receivers were made at several frequency settings within their respective ranges. The receiver output was adjusted for a zero beat with the 1,000 cycle signal of the interpolation oscillator by tuning the heterodyne calibrator to maintain this condition as the frequency varied, due to an increase in the r-f input of such values as to vary the receiver output from a barely audible signal to maximum output.

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(g) Frequency Stability with Change of Sensitivity and/or Volume Control Signals. At any given frequency setting of the two receiver units at which measurements were made, the initial adjustments of the receiver and measuring equipment were the same as for (f) above. The output signal from the heterodyne calibrator was coupled to the receiver so as to produce maximum output at the test frequency. Measurements of frequency variation were made with the manual volume control adjusted, on both MVC and AVC, from their initial settings to such settings where the receiver output became barely perceptible. As the controls were varied, the overall frequency variation as well as any irregularities in this variation was noted.

(h) Frequency Stability - Constant Ambient Temperature. Refer to paragraph 186 of this report.

(i) Frequency Stability - Variable Ambient Temperature. Refer to paragraph 188 of this report.

12. Vibration Tests. The receiver units were secured within their common cabinet, which in turn was secured in the receiver transportation case. Likewise, the dynamotor chassis was secured in its transportation case. Both units were firmly clamped to the vibration table in the Transmitter House. Power was applied to the receivers through the A. C. Power Unit. The tests were conducted on the two units under test, in the manner described under paragraph 4-71 of reference (b).

13. Acceleration Tests. The receiver and dynamotor units were secured to a table of an accelerometer which was adjusted to accelerate the equipment at the rate of 8 g. Tests were conducted as prescribed under paragraph 2-12 of reference (b).

14. Immersion Tests. The component units of the subject equipment with the exception of the A. C. Power Unit were subjected to an immersion test as specified under paragraph 3-2 of reference (b).

15. Regulation of Dynamotor and A. C. Power Units. The regulation of the Dynamotor and A. C. Power Units was measured by conventional methods for variations in supply voltages, as specified under reference (b). Data were obtained for both power units when supplying only one receiver unit, then both receiver units, and finally with both receiver units and a Model LM crystal frequency indicator.

16. Time Constants. The time constants of each receiver unit for operation or release of the AVC control, when an r-f signal having an amplitude of 5 volts was suddenly impressed or removed from the receiver input terminals, were measured by means of an oscilloscope and photographic recordings. The r-f input was obtained from a high power radio frequency driver.

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DATA RECORDED DURING TESTS

17. Complete data were recorded for all tests conducted and this information is contained in Tables 1 to 34, inclusive, and Plates 1 to 76, inclusive.

PROBABLE ERRORS IN RESULTS

18. 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 had been operated for sufficient time to permit stabilization to take place prior to test, and include the advertised errors for the instruments employed. Included also are errors resulting from line voltage fluctuations, radio frequency leakage, and the errors due to resetting of instrument and/or receiver controls. The latter errors were reduced to a minimum by frequent checking of the line (or battery) voltages, the location of the ground connection for maximum reduction of stray field influences, and extreme care in the adjustment of all instruments and/or receiver controls.

Name of Test	Estimated Overall Accuracy
Band calibration and band overlap.	± 0.005%
Sensitivity, 200 to 7500 kc.	± 10%
Sensitivity, 7500 to 18,100 kc.	± 25%
Ratios of unmodulated to modulated output voltages.	± 10%
Maximum noise level.	± 10%
Selectivity, 200 to 7500 kcs.	
(Sensitivity, off resonance.)	± 10%
(Frequency setting, off resonance.)	± .02%
Selectivity, 7500 to 18,100 kcs.	
(Sensitivity, off resonance.)	± 25%
(Frequency setting, off resonance.)	± .02%
Overall audio fidelity.	± 0.5 db
Image selectivity ratios.	
(200 to 7500 kcs.)	± 10%
(7500 to 18,100 kcs.)	± 25%
I. F. rejection ratios.	± 10%
Resonant overload, input voltage.	
(200 to 4000 kcs.)	± 10%
(4000 to 18,100 kcs.)	± 25%

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Name of Test	Estimated Overall Accuracy
AVC characteristics, input voltage.	
(200 to 4000 kcs.)	± 10%
(4000 to 18,100 kcs.)	± 25%
Increase of noise level with change from MVC to AVC.	± 10%
Range and linearity of sensitivity control.	
(200 to 4000 kcs.)	± 10%
(4000 to 18,100 kcs.)	± 25%
Range and linearity of volume control.	
(200 to 4000 kcs.)	± 10%
(4000 to 18,100 kcs.)	± 25%
Variation in audio output with load resistance.	± 0.5 db
Resettability of main tuning control.	± 0.005%
Frequency stability with change of supply voltages.	± 0.005%
Frequency stability with change of toggle switch settings.	± 0.005%
Frequency stability with change of input signal intensity.	± 0.01%
Frequency stability with change of sensitivity or volume control settings.	± 0.01%
Frequency variation with change of converter tube.	± 0.01%
Audio distortion.	± 1%
Time constants.	± 0.005 sec.
Frequency variation at constant ambient temperature.	± 0.005%
Frequency variation with change of ambient temperature.	± 0.005%
Power supply regulation.	± 0.1%

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RESULTS OF TESTS

19. General Description of Receiving Equipment.

A. Type CAY 46078 Receiver Unit. This unit consists of two separate and distinct radio receivers, namely, a Type CAY 46076 Intermediate Frequency Receiver, and a Type CAY 46077 High Frequency Receiver housed in a common cabinet. Each of these two receivers employs a superheterodyne circuit of conventional design which consists of a two-stage radio frequency preamplifier preceding a combined first detector and high frequency (heterodyne) oscillator, two stages of intermediate frequency amplification, a combined second detector and first audio frequency amplifier, a second audio frequency amplifier designed for connection with head telephones, a separate amplified automatic volume control, and a beat frequency oscillator. The two receivers may be operated either separately or jointly from either of the two types of power units listed below. Separate controls are provided on the front panels of the receivers to permit the application of power to, or its removal from, either receiver independently of the other.

B. Type CAY 21387 Dynamotor Unit. The dynamotor unit is intended primarily for field service and provides the high voltage d-c power necessary for the plates and screens of the receiver vacuum tubes. It is designed for operation from the Type CAY 19017, Class S34, Storage Batteries, which also furnish, through transfer circuits within the dynamotor unit, the low voltage d-c power required for the heaters and/or filaments of the receiver vacuum tubes and panel lamps. The dynamotor unit contains, within its base, all necessary filters as well as cable receptacles for interconnection with other units of the complete Model XTBW Transmitting and Receiving Equipments.

C. Type CAY 20085, 115 Volt, A. C. Power Unit. This unit is intended for use in lieu of the batteries and dynamotor unit in locations where a 115 volt, 60 cycle, a-c source of power is available. It contains, in addition to the cable receptacles necessary for the connection with the receiver units, a conventional vacuum tube full wave rectifier and associated filter circuit for the high voltage d-c supply. A low voltage winding is provided in the power transformer for supplying a-c power to the heaters and/or filaments of the receiver vacuum tubes and panel lamps.

D. Type CAY 19017 Storage Batteries, Class S34. Two batteries of this classification are furnished for operation of the Model XTBW Receiving Equipment in the field. They are of special design characterized by compact construction, a degree of watertightness, and non-spillable features.

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E. Cables. A complete set of cables is furnished for interconnection between the various units of the combined Model XTBW Equipment. Separate cables are also furnished for connecting the antenna posts, mounted on the front panels of the receiver units, to the break-in relays on their corresponding transmitter units.

20. Frequency Range. The Type CAY 46078 Receiver Unit covers a frequency range of from 200 to 18,100 kilocycles. This frequency spectrum is divided between the two integral receiver units, namely, the Type CAY 46076 Receiver Unit which covers the frequency range from 200 to 2,000 kilocycles; and the Type CAY 46077 Receiver Unit which covers the frequency range from 2000 to 18,100 kilocycles. The Type CAY 46076 Receiver Unit covers its frequency range in three bands, while the Type CAY 46077 Receiver Unit employs four bands to cover its assigned frequency range.

21. Vacuum Tube Complement. The vacuum tube complement is identical for each of the Types CAY 46076 and CAY 46077 Receiver Units and is as follows:

Navy Type No.	Function
38646	First r-f amplifier.
38646	Second r-f amplifier.
38568K	First detector - High Frequency Oscillator.
38646	First i-f amplifier.
38646	Second i-f amplifier.
38667	Second detector - First a-f amplifier.
38041	Second audio amplifier.
38667	AVC amplifier - AVC rectifier.
38646	Beat frequency oscillator.

A Navy Type 38593 vacuum tube serves as the rectifier in the Type CAY 20085 A. C. Power Unit.

22. Type CAY 46078 Receiver Unit - Circuit Elements. The schematic diagrams for the Types CAY 46076 and CAY 46077 Receiver Units, comprising this unit, are shown on Plates 77 and 78, respectively. As will be noted from these diagrams the receiver circuits are essentially identical -- differing only in the number of their frequency bands and, of course, their circuit constants. Consequently, the following descriptions of the circuit elements will, for the sake of convenience, be based on the schematic diagram shown on Plate 77. In order to conveniently identify the components entering into the discussions of the circuit elements, as presented below, reference will be made to the circuit symbols as shown on the schematic diagrams of Plates 77 and 78. Equivalent symbols for the Type CAY 46077 Receiver Unit will be noted in brackets as, for example, the first r-f amplifier tube will be represented by V-402 (V-502) for the Types CAY 46076 and CAY 46077 Receiver Units, respectively.

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A. Antenna Circuit. Radio frequency energy from the break-in relay of the transmitter unit corresponding to the receiver unit in question enters the receiver through the antenna post J404 (J504) which connects to the primary of transformer T401, T402, or T403 (T501, T502, T503 or T504) as selected by the ganged band switch S401 (S501) through a fixed coupling capacitor C461. Direct connection is provided through S501, in the Type CAY 46077 Receiver Unit, between the antenna post and the primary windings of the r-f input transformers. The low potential ends of the primary windings of these transformers are connected to ground potential. All unused windings are shorted to ground through the media of shorting vaneson switch S401 (S501).

B. First Tuned Circuit. The secondary winding of the input transformer T401, T402 or T403 (T501, T502, T503 or T504) as selected by switch S401 (S501) together with one section of the ganged air dielectric tuning capacitor C405 (C506) constitutes the first tuned circuit. Each secondary winding of the transformers is shunted by an air dielectric trimmer capacitor C401, C402, or C403 (C501, C502, C503, or C504) and as in the case of T403 by an additional fixed mica dielectric capacitor C476; and likewise, in the cases of T502, T503 and T504, by a fixed mica dielectric capacitor C579, C580 and C581, respectively, for the Type CAY 46077 Receiver Unit. Capacity coupling is provided between the primary and secondary windings of transformers T401 and T402 by means of fixed mica dielectric capacitors, C474 and C475, respectively. No similar or corresponding capacity coupling is provided for the first r-f transformers of the Type CAY 46077 Receiver Unit. An adjustable antenna air dielectric trimmer capacitor C457 (C563) is provided on the front panel of the receiver for lining up the first tuned circuit with the type and length of antenna employed at installation. The low potential ends of the secondaries of the subject transformers connect to the AVC bus through a decoupling resistor R401 (R501), by-passed to ground through capacitor C404 (C505). Unused secondary windings are shorted to a common low potential termination through switch S401 (S501). A neon tube V401 (V501) is connected directly across C405 (C506) in order to protect the first tuned circuit and the first r-f amplifier tube V402 (V502), in the event the receiver is tuned to a very strong local signal such as might be emitted from a transmitter operating adjacent to the receiver.

C. First Radio Frequency Amplifier Tube. This vacuum tube, V402 (V502), is a remote cut-off triple grid r-f pentode. Its control grid connects to the first tuned circuit through the selector switch S401 (S501). The suppressor is connected directly to the cathode. Initial grid bias is obtained by means of a cathode resistor R402 (R502), by-passed to ground by capacitor C406 (C507), and inserted between the cathode of the vacuum tube and the MVC bus which terminates at the MVC-AVC switch S402 (S502). The screen is connected through a decoupling resistor R403 (R503) to the screen d-c

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supply bus terminating at the high voltage d-c bleeder network. Capacitor C407 forms the capacitive element of the screen decoupling filter and is connected between the screen and cathode of the vacuum tube. In the case of the Type CAY 46077 Receiver Unit, the corresponding screen by-pass capacitor, C508, terminates between the screen of V502 and ground. The plate connects to the main high voltage d-c bus through the primary of the second r-f transformer T404, T405 or T406 (T505, T506, T507, or T508) as selected by the ganged band switch S401 (S501); and a decoupling filter consisting of resistor R404 (R504), and by-pass capacitor, C408 (C509) which terminates at the cathode of V402 in the Type CAY 46076 Receiver Unit and to ground in the Type CAY 46077 Receiver Unit. All unused primary windings are shorted to the common junction, through S401 (S501), with R404 (R504) and C408 (C509) and the low potential ends of these windings. The primary windings of T404 and T405 are shunted by fixed mica dielectric capacitors C478 and C479, respectively. No similar shunting is employed for any of the primaries of the second r-f transformers of the Type CAY 46077 Receiver Unit.

D. Second Tuned Circuit. The secondary winding of the second r-f transformer T404, T405 or T406, (T505, T506, T507 or T508), as selected by a section of the ganged band switch S401 (S501), forms, in conjunction with the second section of the ganged air dielectric tuning capacitor C405 (C506), the second tuned circuit. The secondary windings are provided with fixed mica dielectric trimmer capacitors C471, C472 and C473, and air dielectric trimmer capacitors C409, C410 and C411. Capacity coupling between the primary and secondary windings of the second r-f transformers T404 and T405 is provided through fixed mica dielectric capacitors C477 and C480, respectively. In a similar manner, the secondary windings of the second r-f transformers of the Type CAY 46077 Receiver Unit are provided with variable air dielectric trimmer capacitors C510, C511, C512 and C513, and fixed mica dielectric trimmer capacitors C576, C577, and C578 for transformers T506, T507 and T508, respectively. No capacity coupling is provided between primary and secondary windings of these transformers except that which is unavoidable. The unused secondary windings are shorted through switch S401 (S501) to a common low potential junction, formed by the decoupling network consisting of resistor R405 (R505), terminating at the AVC bus, and by-pass capacitor C412 (C514) to ground.

E. Second Radio Frequency Amplifier Tube. Coupling between the second and third sets of r-f transformers is provided through vacuum tube V403 (V503), which is identical to V402 (V502) and similarly connected. The control grid bias is obtained by means of cathode resistor R406 (R506) by-passed to ground by capacitor C413 (C515), and terminating at the MVC bus. The suppressor is directly connected to the cathode. The screen obtains its d-c supply from the high voltage screen bus, and is provided with a decoupling filter composed of resistor R407 (R507), and capacitor C414 (C516) connected as for V402 (V502). The plate connects to the main high voltage d-c bus through the primary of the third r-f transformer T407, T408 or T409 (T509, T510, T511, or T512), as selected by switch S401 (S501), and the decoupling filter formed by resistor R408 (R508), by-passed by capacitor C415 (C517) connected as for V402 (V502). Unused primary windings are shorted to the common junction between the plate supply decoupling filter and the low potential ends of these windings in the same manner as for the second r-f transformers. Transformers T407 and T408 have their primary windings shunted by fixed mica dielectric capacitors C482 and C483, respectively. No such devices are employed with any of the third r-f transformers of the Type CAY 46077 Receiver Unit.

F. Third Tuned Circuit. The secondary windings of the third r-f transformer T407, T408 or T409 (T509, T510, T511, or T512), as selected by a section of the ganged band switch S401 (S501), together with the third section of the main ganged air dielectric tuning capacitor C405 (C506) constitute the third tuned circuit. Capacity coupling is provided between the secondary windings of transformers T407 and T408 through fixed mica dielectric capacitors C481 and C484, respectively. The secondary windings are shunted with fixed mica dielectric capacitors C468, C469, and C470, and variable air dielectric trimmer capacitors C416, C417 and C418. Transformers T509, T510, T511, and T512 of the Type CAY 46077 Receiver Unit have their secondaries shunted by fixed air dielectric trimmer capacitors C518, C519, C520, and C521, respectively. The secondary windings of T510, T511, and T512 are also shunted by fixed mica dielectric capacitors C573, C574 and C575, respectively. Unused secondary windings are shorted and terminated through the band switch to the decoupling filter resistor R409 (R509), and capacitor C419 (C522) in the same manner as for the second r-f transformer. Likewise resistor R409 (R509) terminates at the AVC bus.

G. Combined First Detector and High Frequency Oscillator Tube. The vacuum tube V404 (V504), employed for the dual function of first detector (or mixer) and high frequency (or heterodyne) oscillator, is an r-f triode and pentode combined in one envelope. The triode section is employed as the heterodyne oscillator while the pentode section functions as the frequency converter. The control grid (No. 3) is connected to the third tuned circuit selected by a section of the ganged band switch S401 (S501). Initial grid bias is obtained through the cathode resistor R410 (R510), terminated at the MVC bus, and by-passed with capacitor C420 (C523). The screen connects to the d-c screen supply bus through a decoupling filter composed of resistor R411 (R511), and by-pass capacitor C421 (C524). The triode grid connects to the heterodyne oscillator tuned circuit composed of the secondary of one of the transformers

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T410, T411, or T412 (T513, T514, T515, or T516), as selected by the band switch S401 (S501), and the fourth section of the ganged tuning capacitor C405 (C506) through a mica dielectric coupling capacitor C422 (C525), and grid leak resistor R412 (R512) terminated at the cathode. The triode plate connects to a tap on the d-c voltage divider, through the primary of the selected oscillator transformer and a decoupling filter composed of resistor R413 (R513) and by-pass capacitor C429 (C534).

H. Heterodyne Oscillator Transformers, Type CAY 46076 Receiver. The heterodyne oscillator transformers T410, T411 and T412 each essentially contain a primary and secondary winding, although it appears that a single tapped winding has been employed in some instances. The low potential ends of the primaries are joined together and connect to the plate decoupling filter. Unused primaries are shorted by the band switch. The secondary windings are shunted by air dielectric trimmer capacitors C424, C426 and C428, and fixed mica dielectric trimmer capacitors C465, C466 and C467. In series with the low potential end of each secondary and ground is a fixed mica dielectric padding capacitor C462, C463 and C464 shunted by variable air dielectric capacitors C423, C425 and C427, respectively. These capacitors permit the tracking of the heterodyne oscillator with the preceding tuned circuits, by providing a nearly constant difference frequency to exist, between the oscillator frequency and the frequency to which the preselector circuits are tuned, over the complete tuning range of each band. The oscillator is adjusted to remain approximately 160 kilocycles higher than the frequency to which the receiver is tuned, and this difference frequency is the intermediate frequency of the receiver. The high potential ends of unused secondaries are grounded through the band switch.

I. Heterodyne Oscillator Transformer, Type CAY 46077 Receiver. The heterodyne oscillator transformers T513, T514, T515 and T516 contain primary and secondary windings with their primary windings connected to the band switch and plate decoupling filter in the same manner as described for the Type CAY 46076 Receiver. The secondary windings of each transformer are shunted by a variable air dielectric trimmer capacitor C527, C529, C531 or C533, and except for T513, also by a fixed mica dielectric capacitor C566, C571 or C572. In series with the low potential end of each secondary and ground is a fixed mica dielectric capacitor C567, C568, C569 or C570, shunted by variable air dielectric capacitors C526, C528, C530 and C532, respectively. Selection of T513, T514 or T516 by the band switch grounds both ends of the secondaries of all other transformers except T515, in which case only the high potential end of its winding is connected to ground. Obviously, the selection of T515 causes both ends of all other unused secondaries to be connected to ground through the band switch. The heterodyne oscillator is tuned to a frequency 1600 kilocycles

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higher than the frequency to which the tuned circuits of the preselector are tuned, and this difference frequency, which is also the intermediate frequency of the receiver, is provided in the adjustment of the aforementioned padding capacitors.

J. <u>First Intermediate Frequency Transformer</u>. The pentode plate of V404 (V504) is coupled to the control grid of the first i-f amplifier tube V405 (V505) through an intermediate frequency transformer T413 in the Type CAY 46076 Receiver Unit, and T517 or T517A in the Type CAY 46077 Receiver Unit. In this latter receiver, the two types of transformers differ from one another in the degree of coupling, afforded between their primary and secondary windings, to yield widely different selectivity characteristics. Transformer T517 is employed only with companion transformers T518 and T519. Likewise, transformer T517A is employed only with transformers T518A and T519A. The first intermediate frequency transformer T413 (T517 or T517A) consists of two inductively coupled identical inductance elements each tuned, by means of a variable air dielectric tuning capacitor, to the intermediate frequency of the receiver. The winding which is connected to the pentode plate of V404 (V504) is the primary winding, while that which connects to the control grid of the first i-f amplifier tube is the secondary winding. The pentode plate circuit of V404 (V504) connects to the main high voltage d-c bus through a decoupling filter consisting of resistor R414 (R514), by-passed to ground through capacitor C430 (C535).

K. <u>First Intermediate Frequency Amplifier Tube</u>. This is a remote cut-off r-f pentode of the same type as employed for the first and second r-f amplifier stages. Its control grid connects to the AVC bus through the secondary of the first i-f transformer, and resistance capacity filter, composed of R415 (R515), and by-pass capacitor C431 (C536). Initial grid bias is obtained by means of cathode resistor R416 (R516), connected to the MVC bus, and by-passed to ground by means of capacitor C432 (C537). The suppressor grid is directly connected to the cathode, while the screen is connected to the high voltage d-c screen bus through resistor R417 (R517), by-passed to ground by means of capacitor C433 (C538).

L. <u>Second Intermediate Frequency Transformer</u>. This transformer, T414 (T518 or T518A), is identical with its companion first i-f transformer. It serves to couple the plate of the first i-f amplifier tube, V405 (V505) to the grid of the second i-f amplifier tube V406 (V506). The plate circuit of the former tube is completed through the primary winding of this transformer and resistance capacity filter R418, C435 (R518, C539) to the main high voltage d-c bus. The secondary winding connects to the control grid of the second i-f amplifier tube and to the AVC bus through resistor R419 (R519), by-passed to ground through capacitor C435 (C541).

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M. Second Intermediate Frequency Amplifier Tube. This tube, V406 (V506), is identical with the first i-f amplifier tube V405 (V505) and is similarly connected. Associated with this tube is cathode resistor R420 (R520) which connects with the MVC bus, and which is by-passed to ground through capacitor C437 (C542), and, screen supply coupling filter R421, C438 (R521, C543).

N. Third Intermediate Frequency Amplifier Transformer. This transformer, T415 (T519 or T519A), is electrically similar to its companion first and second i-f transformers -- its electrical characteristics being modified to function properly with a diode second detector. It serves to couple the plate of the second i-f amplifier tube to the joined triode grid and plate (acting jointly as a diode) of V407 (V507). The plate circuit of the second i-f amplifier tube is completed through the primary winding of this transformer and resistance-capacity filter R422, C439 (R522, C544), to the main high voltage d-c bus. The diode circuit of the second detector, formed by joining the triode grid and plate of V407 (V507) together is completed to the cathode of this tube through the secondary of this transformer and the volume control potentiometer.

O. Combined Second Detector and First A. F. Amplifier Tube. Dual function of second detector and first a-f amplifier is accomplished through the use of a triode-pentode, V407 (V507) combined in one envelope. The triode grid and plate are connected together to form the second detector diode. Bias is provided for this diode and pentode grid through cathode resistor R425 (R525) terminated at ground, and by-passed to ground by capacitor C445 (C547). The pentode screen is returned to the main d-c screen bus through resistance-capacity filter R427, C442 (R527, C548).

P. First Audio Frequency Amplifier. The audio frequency portion of the received signal, in the case of mcw reception, or the audio beat note in the case of cw reception, appears across resistor R424 (R524), which is a variable potentiometer which acts as the level control, when AVC is being employed. The grid of the pentode portion of V407 (V507) is connected to the arm of R424 (R524) through coupling capacitor C441 (C546) and the MVC-AVC switch S402 (S502). It is effectively connected to ground through load resistor R426 (R526), and resistance-capacity filter R446, C445 (R546, C562). The pentode plate is resistance-capacity coupled to the control grid of the second a-f amplifier tube V408 (V508), and connects to the main high voltage d-c bus, through plate load resistor R428 (R528), and grid blocking capacitor C443 (C549).

Q. Second Audio Frequency Amplifier Tube. This is a power amplifier pentode. Its control grid connects with the grid coupling capacitor C443 (C549), and grid load resistor R429 (R529) termination. From R429 (R529) the decoupling resistor R430 (R530) is connected to ground and by-passed to the cathode with capacitor C444 (C550).

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The screen connects to the main high voltage d-c bus. Grid bias is provided through the cathode resistor R431 (R531), terminated at ground, and by-passed through C444 (C550).

R. Output Circuit. The output circuit consists of a step-down impedance matching transformer T417 (T521), the primary winding of which is shunted with capacitor C460 (C565). This winding is connected between the plate of V408 (V508) and the main high voltage d-c bus. The secondary connects to two parallel connected telephone jacks J401, J402 (J501, J502), one of which receives the head telephone set, while the other receives the side tone plug from the associated transmitter. One side of the transformer secondary is at ground potential. The Type CAY 46077 Receiver is provided with a switch S507 which places the output circuits of both receivers in parallel so that one operator may operate both receivers simultaneously and monitor either or both transmitters. When this switch is off, the receiver outputs and their respective side tone circuits are separated so that two operators may operate the two receivers simultaneously and independently of each other.

S. Manual Volume Control Circuit. The cathodes of the two radio frequency amplifier stages, the first detector, and the two intermediate frequency stages are connected through their respective cathode resistors to the variable contact on potentiometer R445 (R545). The receiver sensitivity is controlled, when switch S402 (S502) is in the MVC position, by increasing the potential between the cathodes and control grids of the amplifier tubes through the manipulation of R445 (R545). Also when switch S402 is in the MVC position the a-f input to the grid of the pentode portion of V407 (V507) is obtained from the high potential end of potentiometer R424 (R524). The automatic volume control remains in the circuit when S402 (S502) is in the MVC position, but it is not effective except for strong input signals where, it is claimed by the manufacturer, it serves as a means for preventing receiver blocking upon reception of very strong signals.

T. Automatic Volume Control Circuit. The automatic volume control circuit is of the amplified type in which intermediate frequency is coupled from transformer T414 (T518 or T518A), through a small mica dielectric capacitor C436 (C540) to the grid of the pentode portion of vacuum tube V410 (V510). This tube is a triode-pentode of the same type as employed for V407 (V507). The intermediate frequency energy is amplified through the pentode portion of this tube and is coupled to the triode portion, operating as a diode, through intermediate frequency transformer T413 (T520). The d-c voltage obtained by rectification of the amplified i-f energy appears across resistors R438 and R439 (R538 and R539). The full voltage appearing across both resistors in series is applied to the control grids of both radio frequency

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amplifier tubes, the first detector, and both intermediate frequency amplifier tubes, so as to reduce the gain of the tubes as the signal input is increased. With automatic control of the receiver sensitivity the cathodes of the controlled tubes are connected to ground through their respective bias resistors. The pentode plate of V410 (V510) is connected to the main high voltage d-c bus, through the tuned primary winding of T416 (T520), and resistance-capacity filter R436, C4560 (R536, C556). The triode grid and plate are tied together to form a diode which connects to the diode load resistors R438, R439 (R538, R539) through the tuned secondary winding of T416 (T520). The series diode load resistors are shunted by capacitors C452 and C453 (C557 and C558). Cathode bias is obtained by cathode resistor R440 (R540), which is by-passed by capacitor C454 (C559), and which connects to switch S402 (S502). When this switch is in the MVC position, the sensitivity control affects the gain of the AVC amplifier simultaneously and in the same manner as for the other controlled amplifier tubes. However, with this switch in the AVC position the gain of the AVC amplifier is limited by R437 and R440 in the Type CAY 46076 Receiver Unit, and by R450 alone in the Type CAY 46077 Receiver Unit.

U. Beat Frequency Oscillator Circuit. The beat frequency oscillator, employed for cw reception, is of the electron coupled type. It employs a remote cut-off r-f pentode vacuum tube V409 (V509). The control grid is connected to the cathode, through a grid resistor R434 (R534), and to the high potential end of the oscillator tuned circuit through blocking capacitor C448 (C554). The low potential end of the tuned circuit is at ground potential. The cathode connects to the suppressor and to a tap on the inductance element of the tuned circuit. The screen is connected to the end of a voltage divider consisting of resistors R433 and R448 (R533 and R548) and by-passed to ground with capacitor C449 (C553). The plate connects to the junction of R433 and R448 (R553 and R548) through a load resistor R432 (R532). The junction of R432 (R532) and R448 (R548) is by-passed to ground by capacitor C447 (C552). The voltage divider connects to a tap on the main voltage divider through switch S403 (S503). The plate of the beat oscillator tube is coupled into the second detector diode through a mica dielectric capacitor C446 (C561) and the tuned secondary of transformer T415 (T519).

V. Main Voltage Divider. The receiver includes its own high voltage d-c bleeder and voltage divider network consisting of fixed resistors R442, R443, R444, sensitivity control potentiometer R445, and fixed resistor R437, (R542, R543, R544, and potentiometer R545). This network is connected between ground and the high voltage terminal of the power receptacle J403 (J503) through

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switch S404 (S504). By-pass capacitors C456 and C459 (C551 and C564) are provided at the connections of the plate and screen supply buses to the voltage divider.

W. Heater and/or Filament Circuits. Series parallel connection of the heaters of the vacuum tubes is employed so as to permit operation of the heaters from a 12-volt a-c or d-c supply. Since the receiver employs nine tubes, the heater of one of the tubes is connected in series with a voltage dropping resistor R447 (R547) so that normal voltage will be applied to its heater. The filaments of the panel lamps are connected in parallel since they are designed for operation from a 12-volt supply. Switch S405 (S505) controls the heater supply to all vacuum tubes, while switch S406 (S506) controls the filament supply to the panel lamps. These switches operate independently of each other.

23. Circuit Description of Type CAY 21387 Dynamotor Unit. On Plate 79 is shown the circuit diagram of the Type CAY 21387 Dynamotor Unit. This unit serves not only as a source of high voltage d-c power, but also as a junction box for the interconnection of all parts of the Model XTBW Receiving Equipment. Power from the Type CAY 19017 Storage Batteries enters the dynamotor unit through receptacle J604 parallel connected with receptacle J605, which connects to the charging circuit of the gasoline or motor driven generator. The negative side of the low voltage battery line is grounded to the chassis. The positive side of this line connects to contact 50 on receptacles J601 and J602, and contact 30 on J603 after passing through r-f choke L601, by-passed to ground through capacitor C601, and fuses F602, F604 and F606. Receptacles J601, J602 and J603 connect to the Types CAY 46077 and CAY 46076 Receiver Units and Frequency Indicator Unit, respectively. The positive low voltage potential is applied to the dynamotor unit, when the power on-off switches of receiver units are closed, via the receiver power interconnecting cables and contacts 42 on receptacles J601 and J602. These contacts connect with the low voltage input of dynamotor D601 through r-f choke L602, by-passed to ground at the dynamotor through capacitor C606. The filters composed of L601, C601 and L602, C606, are provided in the low potential circuit to eliminate radio frequency interference, caused by the commutator of dynamotor D601, which might enter the receivers through the low voltage leads. The negative brush of the high voltage d-c output of the dynamotor is connected to ground, while the positive brush connects to by-pass capacitors C605 and C607, and r-f choke L603, which in turn connects to the inputs of two a-f filters. One of the a-f filters consists of filter reactor L605 and filter capacitor C602. The output of this filter connects through fuse F601 to contact 51 on receptacle J601. The second a-f filter, consisting of filter reactor L604 and input and output filter capacitors C604 and C603, respectively, connects through fuses F603 and F605 to contact 51 on receptacle J602 and contact 29 on receptacle J603. Contacts 49 on receptacles J601 and J602 are connected together and provide means whereby the phone output of the Type CAY 46076 Receiver Unit may be mixed with that of the Type CAY 46077 Receiver Unit.

24. <u>Circuit Description of Type CAY 20085 A. C. Power Unit.</u> A complete schematic diagram of the Type CAY 20085 A. C. Power Unit is shown on Plate 80. Like the Type CAY 21387 Dynamotor Unit, this unit serves also as a junction box for interconnection of the several units of the Model XTBW Receiving Equipment, in addition to supplying low voltage a-c power and high voltage d-c power to the vacuum tubes of the receiver units. Line power is applied to the primary of the power transformer, T901, through an on-off toggle switch S901, and fuses F901 and F902, one of which is inserted in each side of the line. Each side of the line is by-passed to ground through capacitors C903 and C904. The power transformer contains three secondary windings; namely, a high voltage plate winding, which connects to the plates of the rectifier tube V901, a low voltage filament winding which supplies power to the filament of the rectifier tube, and a low voltage winding for supplying power to the heaters and/or filaments of the vacuum tubes and pilot lamps of the several units of the equipment. The rectifier tube V901 is a full wave high vacuum rectifier tube, and the connections to its elements are conventional. The low voltage winding which supplies power to the heaters and/or filaments of the receiver vacuum tubes connects between ground and contacts 50 on receptacles J901 and J902 and to contact 30 on receptacle J903. Receptacles J901, J902 and J903 supply low voltage a-c and high voltage d-c power to the Types CAY 46077 and CAY 46076 Receiver Units and Frequency Indicator Unit, respectively, through their associated interconnecting cables. The center tap of the high voltage winding of T901 connects to the chassis and to ground through contacts 52 on J901 and J902, and contact 28 on J903. The positive high voltage d-c circuit enters an a-f filter reactor L903 which feeds the inputs of two separate single stage a-f filters. The first of these filters consists of filter reactor L901 shunted by capacitor C905, and having its input and output by-passed to ground through filter capacitors C907 and C901, respectively. The positive d-c output from this filter connects to contact 51 on receptacle J901. The second a-f filter consists of filter reactor L902, shunted by capacitor C906, and having its input and output by-passed to ground through filter reactors C907 and C902 respectively. The positive d-c output from this filter connects to contact 51 on receptacle J902 and contact 29 on J903. A pilot light I901 is provided in this power unit and is controlled by switch S901. Contacts 49 of receptacles J901 and J902, which are joined together, provide means whereby the phone output of the Type CAY 46076 Receiver Unit may be mixed with that of the Type CAY 46077 Receiver Unit.

25. <u>Par. 1-1.</u> The Model XTBW Radio Transmitting and Receiving Equipment is designed primarily for use in establishing a complete advance base radio station. The several and separate units complementing this equipment are such as to extend the application of the equipment to semi-permanent or permanent shore station installations. This report will deal only with those units associated with the Receiving Equipment, since the Transmitting Equipment is treated under a separate report.

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26. Par. 1-2. The Receiving Equipment, hereinafter identified as the Type CAY 46078 Receiving Equipment, consists of the following separate units:

(a) One - Type CAY 46076 Intermediate Frequency Receiver.
(b) One - Type CAY 46077 High Frequency Receiver.
(c) One - Type CAY 21387 Dynamotor Unit, or
(d) One - Type CAY 20085 A. C. Power Unit.
(e) Two - Type CAY 19017 Storage Batteries, and
(f) One - Type CAY 10034 Mobile Spare Parts Box.
(g) One - Set of Interconnecting Cables.

The Type 46076 Intermediate Frequency Receiver Unit covers a frequency range from 200 to 2000 kilocycles in three bands, as indicated under Table 1, while the Type 46077 High Frequency Receiver Unit covers a frequency range from 2000 to 18,100 kilocycles in four bands, as indicated under Table 18. Both receiver units are designed for cw and mcw telephone and telegraph communication. Since the mechanical design and electrical performance of the Model XTBW Receiving Equipment do not effect compliance with the governing specifications, reference (b), as amended by the contract, reference (c), this equipment cannot be considered as suitable or satisfactory for use in the Naval communication system, where the paramount requirement for such equipment is that it provide satisfactory communication with similar equipments or other units of the system with precision and reliability, without the necessity for preliminary calling, or without causing interference to communication in other channels, when functioning on antennas specified under reference (b) over the frequency ranges of its integral receiver units.

27. Par. 1-3. A discussion of the subject equipment with respect to the specific requirements as outlined under this paragraph reference of the governing specifications follows. These topics will be treated only in a general sense, at this stage, and in greater detail in other portions of this report where they are specifically referred to under reference (b).

(1) The Model XTBW Receiving Equipment, when considered in a general sense, is not rugged, but is compact and reasonably light in weight. However, the construction of some of the component units detracts from the general ruggedness of the equipment to the extent that reliable operation of the equipment under conditions of rough handling, repeated assembly and disassembly, and prolonged periods of operation or storage in tropical climates cannot be assured. Specific details concerning design defects which will affect the serviceability of this equipment will be found in other portions of this report. The equipment is not considered as being especially rain and spray-proof when set up for operation. The separate units of the model equipment, as submitted to the Laboratory, were definitely not waterproof when enclosed in their transportation cases.

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(2) The equipment is considered suitable for convenient storage and transportation in airplanes, of the patrol and transport type, except as noted herein.

(3) The equipment is considered capable of being readily loaded into a small boat, in compliance with this specification requirement.

(4) The model equipment, as submitted to the Laboratory, is not suited for use under the conditions where the ambient temperature ranges from -15° C. to +50° C. and the relative humidity varies from low values to saturation. This statement applies particularly to the Type CAY 46077 High Frequency Receiver Unit which appears to be very sensitive to changes of both temperature and humidity. Refer to paragraph 186 of this report.

(5) It is not believed that a crew of six men, suitably trained and entirely familiar with this equipment, can readily set up the entire Transmitting and Receiving Equipment for operation ashore as a complete radio station within the allotted time. The method employed for securing the covers to the carrying cases will cause considerable delay in the removal of these covers if they have been previously closed so as to assure their watertightness integrity.

(6) Operation of the subject equipment over long periods of time, or immediately after long periods of storage, cannot be expected without more than usual adjustment and/or repair.

(7) The equipment is not considered as being suitably designed to permit its repeated assembly for operation or disassembly for transportation and/or storage. The mechanical design of certain of its parts as discussed in other portions of this report, is such that their failure will result under these conditions.

(8) The weight of the equipment is discussed in detail in the report covering the Transmitting Equipment. The weights of the component units are given under paragraph 30 of this report.

(9) Dimensions of the several units of the equipment as arranged for transportation are as follows:

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Name of Unit	Length	Width	Depth
Type CAY 46078 Receiver Unit	25.3"	13.8"	16.8"
Type CAY 21387 Dynamotor Unit	11.25"	8.8"	8.5"
Type CAY 10034 Mobile Spare Parts Box	20.1"	13.25"	11.38"
Type CAY 19017 Storage Battery (1 Unit)	11.75"	8.75"	12.0"

The Type CAY 20085 A. C. Power Unit is not designed for transportation in aircraft, and therefore is not considered as being subject to the requirements of this paragraph reference of reference (b).

(10) The Type CAY 46078 Receiving Equipment is so designed that its two receiver units, namely, the Type CAY 46076 Intermediate Frequency Receiver Unit and the Type CAY 46077 High Frequency Transmitter Receiver Unit, may be operated independently of each other.

28. Par. 1-4. The equipment is furnished complete with vacuum tubes and all accessories necessary for its packing for transportation by airplane, or for its installation, except for such items as will be furnished by the Navy, in accordance with the information contained by this paragraph reference of reference (b). Other details of this paragraph reference are discussed under the separate report covering the Transmitter Unit.

29. Par. 1-5. In so far as this paragraph reference applies to the subject equipment, the following statements are in order:

(a) No spare parts of any kind were supplied with the model equipment.

(b) No slip covers were furnished to protect the finish on the carrying cases as required. A face cover was furnished for attachment to the receiver transportation case. None was supplied for the dynamotor transportation case.

(c) A Type CAY 20085 A. C. Power Unit was furnished, as required by reference (b), for operation of the equipment from 115 volt, 60 cycle, single phase, commercial power supply.

30. Par. 1-6. The weights of the separate units of the equipment covered in the report are as follows:

Description of Unit	Weight
(a) Type CAY 46078 Receiver Unit, complete with Type CAY 46076 I. F. Receiver Unit, Type CAY 46077 H. F. Receiver Unit, vacuum tubes, transportation case and supporting legs. . . .	80.5 lbs.

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Description of Unit	Weight
(b) Type CAY 21387 Dynamotor Unit, complete with transportation case.	15.8 lbs.
(c) Type CAY 10034 Mobile Spare Parts Box, exclusive of spare parts.	17.0 lbs.
(d) Type CAY 19017 Storage Batteries (Two Units).	81.0 lbs.
(e) Type CAY 20085 A. C. Power Unit complete with rectifier vacuum tube.	24.0 lbs.
(f) Complete set of Interconnecting Cables. . .	7.5 lbs.

31. Par. 1-7, 1-8 and 1-9. These paragraph references of reference (b) do not concern the Naval Research Laboratory; hence, no comments will be made.

32. Par. 2-1. The subject equipment, in its entirety, was inspected by the Laboratory with due consideration given to the requirements of the General Specifications for the Inspection of Material, issued by the Navy Department, and applying specifically to the contract, reference (c).

33. Par. 2-2. (1) General considerations of component parts, as specifically covered by the referenced detailed specifications listed under reference (b), are as follows:

(a) Ceramics. Ceramic insulating material, or its equivalent, is employed for the vacuum tube sockets, i-f transformer sockets, and plug bases, insulating supporting blocks for the stators of the ganged tuning capacitors, terminal panels of the r-f transformer and h-f oscillator coil assemblies, mounting plates of air dielectric trimmer capacitors, contact wafers and rotors of the ganged band switches, coil forms for all r-f coils including those employed in the i-f transformers and cw oscillator inductors, and exclusive of primary coils employed on the second and third r-f transformer assemblies of the I. F. Receiver Unit. It is also employed for the insulating washers for the antenna connector posts and terminal panels of the a-f output transformers. No samples were submitted for test to determine their compliance with referenced specification RE 13A 317F for loss factor. Although this specification reference requires that Navy type numbers be marked on all ceramics, it is felt that since these ceramics are assembly parts, the appearance of such numbers would confuse the association of other Navy type numbers, required by reference (b), with the component parts they are intended to identify. Refer to paragraph 77 of this report for additional comments.

(b) Micalex Insulation. Micalex insulation is employed in the construction of the i-f transformer and cw oscillator inductor assemblies, and for the low voltage power receptacle bases in the dynamotor unit. Refer also to paragraph 95 of this report.

(c) Molded Phenolic Insulation. Molded phenolic insulation is employed for the insulating sleeves of the Rajah clip-type antenna connectors, the insulating cases of the panel operated toggle switches, panel light socket mountings, cable plugs and companion receptacle bases, potentiometer resistance element mountings, mica dielectric fixed capacitors, fuse receptacles, fixed metalized filament type resistors, and panel control knobs. No tests were conducted to determine compliance of these items with reference specification 17-P-4.

(d) Laminated Paper Base Phenolic Insulation. Laminated paper base phenolic insulation is employed for the receiver chassis insulating guide angles, angle type brackets and coil forms for the primary coils of the first and second r-f transformer assemblies of the I. F. Receiver Unit, end plugs of all r-f and h-f oscillator coil forms, insulating washers of the telephone jacks, mounting plates for the adjusting devices employed in the construction of the i-f transformers, resistor and fixed mica dielectric capacitor terminal panels, and winding forms for the r-f chokes of the dynamotor unit. No tests were conducted to determine compliance of these items with reference specification 17-P-5. Refer also to paragraph 77.

(e) Vacuum Tubes. The vacuum tubes, employed in the Types CAY 46076 and CAY 46077 Receiver Units, as listed under paragraph 21, and the rectifier vacuum tube employed in the Type CAY 20085 A. C. Power Unit have been assigned Navy type numbers. These assignments indicate Naval approval for their use in Naval equipment. The Laboratory is of the opinion that the use of the tube which combines the two functions of high frequency oscillator and first detector in one envelope is responsible for the failure of some of the performance characteristics of the receiver units in meeting the specification requirements.

(f) Fixed Composition Resistors. Fixed composition resistors are employed only in the Types CAY 46076 and CAY 46077 Receiver Units. Except for one heater supply voltage dropping resistor in each receiver, all of the fixed composition resistors are of the metallized filament type

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sealed in molded phenolic insulating cases. With two exceptions, for each receiver, these resistors are the Type BT-1/2, 1/2 watt resistors as produced by the International Resistance Company. The excepted items are the Type BT-1, 1 watt resistors, of the same manufacture, employed in the high voltage bleeder networks. While the Types BT-1/2 and BT-1 resistors do not fall under the types of resistors covered in reference Specification RE 13A 372G, they are of the types which have received Naval approval for use in other Naval equipments, of the same or similar character, as for the equipment reported herein. The fixed composition resistor employed in the low voltage heater circuit of each receiver is of a type which is covered by the above reference specification and employs an enamel outer coating. This type of resistor is not the type for which specific approval has been given under reference (j) for this particular circuit function, and its type is not generally satisfactory owing to the variation of electrical resistance with aging.

(g) <u>Fixed Wire Wound Resistors</u>. Each receiver unit employs a Type DG, 8-watt wire-wound resistor with its wire-wound element sealed in cement composition. These resistors are manufactured by the International Resistance Company and appear to be in compliance with reference Specification RE 13A 372J -- but, no tests were conducted by the Laboratory to determine complete specification compliance owing to the lack of test samples.

(h) <u>Fixed Mica Dielectric Capacitors</u>. The fixed mica dielectric capacitors employed in the Types CAY 46076 and CAY 46077 Receiver Units are sealed in molded bakelite cases. Type XM262 low loss bakelite has been generally employed. All capacitors are provided with pigtail leads. These capacitors are of the types which have received Naval approval for use in other Naval radio equipments.

(i) <u>Fixed Foil-Paper Capacitors</u>. Fixed foil-paper capacitors, employed in the several units of this equipment for r-f or a-f by-passing and filtering, are of the single and multiple section types. All of these capacitors are hermetically sealed in metal cases, and except for the two 5-microfarad filter capacitors employed in each of the Types CAY 21387 Dynamotor Unit and CAY 20085 A. C. Power Unit, are of the types listed under reference Specification RE 13A 488. The 5-microfarad capacitors are provided with screw type terminals in lieu of soldering lug terminals, as provided on the other capacitors. Their design and construction appears to be entirely suitable and satisfactory for their intended purposes. No tests were conducted on any of the fixed foil-paper dielectric capacitors to determine their compliance with applicable specifications, as no samples were submitted for test.

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(j) Nameplates. Reversed etched aluminum alloy nameplates are provided for the Type CAY 46078 Receiver Unit, Type CAY 21387 Dynamotor Unit, Type CAY 20085 A. C. Power Unit, and Type CAY 10034 Mobile Spare Parts Box. The nameplates for the Types CAY 46076 and CAY 46077 Receiver Units are photo-etched on their respective front panels. Refer to Plate 92 for a photograph of the separable nameplates, and to paragraph 71 of this report for a discussion as to the suitability of the data shown on the nameplates.

(k) The cables furnished are not listed on NAF Drawing 47024.

(l) Aluminum Alloys. The framework for supporting the tuning drive and band switch mechanisms, and the bases for the r-f and high frequency oscillator coil assemblies of both receiver units are of cast aluminum alloy. These castings are presumably in compliance with the requirements of reference Specification 46-A-1d. However, confirmation tests are entirely outside of the scope of the tests covered by this report. Likewise, it was not feasible to conduct the tests necessary to determine whether the aluminum alloy sheet or plate employed in the construction of the subject equipment complies with reference Specification 46-A-11.

(m) Other specification references included under this heading of reference (b) either cover materials or parts not employed in the equipments, or accessories furnished by the Navy. Comments on these specifications are therefore unnecessary.

(2) In general, the component parts, such as resistors, capacitors, etc., used in this equipment are commercially standard parts, and are readily obtainable in the open market. All r-f transformers, audio transformers, a-f filter reactors, tuning capacitors, and the a-c power transformer are of special design, and therefore obtainable only from the contractor.

34. Par. 2-3. In general, the construction of the Type CAY 46078 Radio Receiving Equipment, including its auxiliary units, cannot be considered as being of rugged design. While certain components, employed in its construction, are rugged and possess qualities which make them suitable for their particular application, the equipment possesses other design features which detract from its general ruggedness to the extent that the suitability of this equipment for the type of service for which it is intended is destroyed. Reliable operation of this equipment cannot be assured under the adverse operating conditions which this equipment can normally be expected to encounter in the Service. In many instances, the materials employed are less suitable for the purposes intended than would usually be considered acceptable for use in Naval radio receiving equipment. Constructional details of this equipment which are not specifically covered by the governing specifications, reference (b), are as follows:

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A. Types CAY 46076 and/or CAY 46077 Receiver Units.

1. Chassis Construction. The receiver chassis is of one piece inverted box type construction, with folded sides, back, and recessed front edge. The front surface is folded for added rigidity, but is recessed with respect to the chassis side walls, to clear the panel mounted controls. The corners of the chassis are secured together by means of 1/16" thick aluminum corner angle brackets spot welded to the chassis. The corner angles at the rear of the chassis permit resting the chassis on its back, or sides, for servicing. The front panel, which is secured to the front corner angle brackets by means of machine screws and nuts, is of 3/32" thick aluminum plate. A partition, which is provided for mounting several by-pass capacitors, extends from the front panel to the rear of the chassis and is secured in place with machine screws and nuts. The design and construction of the chassis are not considered as being satisfactory. The front panel construction is not sufficiently rigid in itself to support the chassis without warpage. The chassis is of too light construction to support the unevenly distributed weights of the component parts of the receiver without twisting, sagging, or otherwise being distorted from its original shape when handled; and the partition member offers little additional stiffening to the chassis because of the inherent weakness of its design. The use of heavier gauge material, additional bracing, or a complete redesign of the chassis is clearly implied to effect compliance with the governing specifications, reference (b).

(a) Fabricated Shield Cans. Enclosure shields for the coil assemblies of the preselector and high frequency (heterodyne) oscillator circuits, and for the filter circuits, vacuum tube and tuned inductor of the beat frequency oscillator, are fabricated from 1/32" thick sheet aluminum. All are of similar design and construction. Each shield can is of three piece spot welded construction. Suitable holes for mounting purposes and clearance holes for the rotors of the trimmer capacitors, where required, are provided. The shield cans employed for the beat frequency oscillator filter circuits, and for enclosing its vacuum tube and shielded tuned inductor fit over flanged base plates which are secured to the receiver chassis with machine screws and nuts. The construction of the base plates is such that their flanged sides do not make positive contact with their

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respective shield cans. Their construction and fit with their associated shield cans, as displayed in the Model Equipment, make their usefulness of questionable value. The fabricated shield cans, as employed in the receiver units, are not of satisfactory design or construction. The gauge of aluminum employed in their construction does not appear to be adequate for good shielding; it does not provide them with the degree of rigidity or ruggedness that is usually expected for their particular applications; and it does not preclude the possibility of the metal around the mounting holes being torn away or otherwise damaged when the mounting screws or nuts are tightened against their associated external tooth shakeproof lockwashers. Edge contact is provided between the open ends of the shield cans and the chassis. In certain instances, point contact may exist between the side walls of the shield cans and the fabricated or cast coil mounting bases. The degree of bonding to the chassis as provided by the shield cans is not considered sufficiently permanent when such contact is so depended upon for completing the shield enclosures, under adverse operating conditions, or conditions of prolonged exposure to the equipment to humid, saline atmospheres.

(b) Drawn Shield Cans. Drawn and punched shield cans of soft aluminum and having a wall thickness of approximately .025 inch are employed for the i-f transformer and beat frequency oscillator tuned inductor assemblies. The shield cans for the i-f transformers are each provided with two angle type mounting brackets spot welded in place. The tops of these cans are suitably punched to provide mounting holes for securing the cans to their internal coil assemblies, and clearance holes for the rotors of their tuning capacitors. One side of each of these cans is provided with a slot, covered by a removable plate, to provide access to the adjustment screws used for varying the coupling between the transformer coils. The open end of each shield can is closed by a base plate which supports the internal coil assembly and ceramic plug, similar to a metal vacuum tube base, which permits the insertion of transformers in standard octal tube sockets. The shield can for the beat frequency oscillator tuned inductor is of similar design except that the side opening is omitted, as

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is the plug base; and spade bolts, riveted in place, are provided for mounting purposes in lieu of spot welded brackets. These shield cans are not considered satisfactory. They are of too fragile construction to be suitable for use in the subject equipment, as they are easily dented or misshapen if subjected to strain or rough handling. The cover plates over the openings for the coil coupling adjustment screws are not considered as appropriate, for their purpose, as sliding vanes, or plates, which would be permanently attached to the shield cans and provide a snap fit into the openings when closed. The spot welded mounting feet will bend easily and consequently do not offer adequate support for the relatively heavy transformer assemblies when the equipment is subjected to severe shock. The spade bolt mounting rivets will, in all probability, become loosened, if not actually pulled through the soft aluminum sides of the shield can of the beat frequency oscillator tuned inductor assembly if subjected to severe shock or vibration, or if their spade bolt securing nuts are tightened too tightly.

(c) Tube Shields. The tube shields are of very satisfactory design. The shields have fluted sides to permit their firmly gripping the tubes, and in addition, each shield is provided with a spun ring near its base. Protuberances, on opposite sides of the tube shield bases, ride in these rings when the tube shields are seated to prevent the shields from becoming loose under conditions of severe shock or vibration. Although the heads of the mounting screws for the tube shield bases prevent complete seating of the tube shields to their bases, they do not interfere with the locking feature of the tube shield design. Full advantage of the locking action, however, cannot be realized without complete seating. Consequently, the tube shields employed in the production equipments should have their base ends notched in several places to clear the mounting screw heads, and, at the same time, to permit their orientation, within practical limits, to any desired position. The tube shields are apparently designed for use with riveted mountings. Those furnished in the model receiver units are without caps for shielding the control grid connections to the tubes. These caps, or equivalent shielding,

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are necessary for the successful reduction of spurious responses which are very evident in the two receiver units.

(d) Mounting Brackets and Partition Shields. Mounting brackets for resistor panels, and the like, are of 1/16" thick aluminum and, in general, are of unsatisfactory design. They are formed from flat aluminum stock with a 90° bend to form an "L." Their design is inherently weak and non-rigid, and the manner in which they are mounted makes them subject to breakage at their bends when subjected to prolonged vibration. Their free movement subjects certain leads to possible breakage, and in some instances, certain electrical components may become grounded or shorted should the fish paper strips provided to protect these components from such dangers become loosened or worn. The use of fish paper insulation as employed in the model equipment is definitely not acceptable. Mechanically rigid mounting brackets must be employed if compliance with the governing specifications is to be met. The partition shields employed in the I. F. Receiver Unit for shielding the r-f control grid leads, and mounted to the ganged tuning capacitor, are fabricated from 1/32" thick sheet aluminum. Their construction is fragile and their method of mounting makes them unsuitable for their intended usage under conditions of vibration.

2. R. F. Transformer and H. F. Oscillator Coil Assemblies. The circuit components, exclusive of filter components and the main tuning capacitor, for each stage of the r-f preselector and high frequency oscillator are assembled as separate and complete sub-assembly units. Each unit is complete with its own shield enclosure, and ceramic terminal panel for supply lead connections, and is capable of being removed, as a unit for servicing, without disturbing the other units. The removal of any unit can be effected only after first withdrawing the band switch shaft, and exercising extreme care, tempered with patience, in unsoldering the supply leads and the grid leads from the ganged tuning capacitor so as not to permanently damage the wiring or other components. All of the sub-assemblies are of the same general design with the high frequency oscillator coil assembly being larger than the others. An interior view of one of the radio frequency sub-assemblies and of one of the high frequency oscillator sub-assemblies are shown photographically on Plate 93.

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(a) Base Plates. The base plates are of cast aluminum alloy, of rectangular shape with flanged sides, and self-contained band switch mounting brackets and band switch shaft guides. The external base surfaces are finished to present a smooth flat surface for mounting against the chassis. The interior surfaces are recessed for securing the coil forms, and the bosses on the band switch mounting brackets are machined for mounting the band switch wafers. Tapped aluminum inserts are pressed into holes, drilled in the bases, and staked in place for receiving the chassis securing screws. One end of each base plate is recessed, and tapped, for mounting the ceramic terminal block. The bases are also provided with holes for passage of the leads to the ganged tuning capacitors. These holes are fitted with rubber grommets. The design of the aluminum inserts is unsatisfactory in that it does not appear to preclude their loosening under conditions of prolonged and severe vibration, nor does it preclude the possibility of their turning when the chassis mounting screws are being loosened should the screws "freeze" as the result of corrosion of the treaded contacting surfaces. The staking provided is not considered as sufficient protection against the occurrence of these contingencies. The use of cast aluminum alloy base plates is entirely satisfactory only if they have been properly aged before being used. The construction of the r-f transformer and high frequency oscillator assemblies are such that any warpage of their cast base plates will adversely affect the performance and operation of the subject equipment.

(b) Coil Form and Trimmer Capacitor Assemblies. The coil forms are all of identical construction, and are of unglazed ceramic, with smooth walls. Each coil form is provided with two holes spaced 180° apart at its base, and four holes spaced 90° apart at its top. The holes at the base are provided for the mounting screws which secure a phenolic disc in the end of the form. The phenolic disc, in turn, is provided with tapped holes for receiving its securing screws and a coaxial tapped hole for receiving the mounting screw which secures the coil form to the base plate. Soldering lugs for the leads of the primary winding are secured to two of the top holes with unplated brass eyelets. The remaining holes are used for

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securing the nickel plated brass mounting brackets for the air dielectric trimmer capacitor. The air dielectric trimmer capacitor, in turn, is secured to its supporting brackets with nuts which are tightened against external tooth shakeproof lockwashers on treaded brass studs, screwed into the mounting blocks in the ceramic mounting plate of the capacitor. These studs also serve to secure the shield can. The capacitor stator studs, and rotor soldering lug, serve as terminations for the leads of the secondary winding.

These assemblies are of inferior and unsatisfactory design. The use of unplated brass eyelets is in violation of General Naval Specifications. The clearances provided between the capacitor plates and the soldering lugs for the primary coil leads are entirely inadequate to assure uninterrupted operation of the subject equipment under the conditions of humidity, temperature and vibration as stipulated in the governing specifications, since all active primary windings are operated at full d-c plate potential. In many instances, in the model equipment, the capacitor plates barely clear these soldering lugs. The capacitor mounting brackets are not shaped to conform with the curvature of the coil forms to which they are riveted. Since the capacitor mounting studs also serve to secure the shield can for the main sub-assembly, the points of riveting of the capacitor mounting brackets are subjected to severe strains when the shield can securing units, or lock nuts for the capacitor rotors, are tightened. The direct result of these strains, being applied to the coil forms through improperly designed capacitor supporting brackets, has been that several of the coil forms have cracked during the Laboratory's tests. The use of the trimmer capacitor soldering lugs for secondary winding lead terminations is not satisfactory, particularly where heavy wire has been employed for the windings. With such construction, the replacement or the removal of the trimmer capacitor, for any reason, will result in the destruction of the winding as its anchorage and adjustment are dependent on its attachment to the capacitor remaining undisturbed. The capacity values of the trimmer capacitors which are under their associated coil forms, when the receiver units are set up for operation, are subject to

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changes resulting from the wax of the coils flowing in between the capacitor plates when the subject equipment is operated under conditions of high ambient temperatures. Such a condition developed during the tests as discussed under paragraph 186 of this report. Their is insufficient clearance provided between the shield can securing nuts and the lock nut for the capacitor rotor to permit the former being loosened with a socket wrench.

(c) R. F. Transformer and H. F. Oscillator Windings. The arrangements and the types of windings employed for the r-f transformers and high frequency oscillator coils of the two receiver units are shown under the following tabulation.

Type CAY 46076 I. F. Receiver Unit

Band No.	Coil Sub-Assembly	Type of Primary Winding	Type of Secondary Winding	Arrangement of Primary and Secondary
1	1st R.F.	Universal	Universal	Coaxial and spaced.
	2nd & 3rd R.F.	Universal	Universal	Separate forms at 90° coupling.
2	1st R.F.	Universal	Universal	Coaxial and spaced.
	2nd & 3rd R.F.	Universal	Universal	Separate forms at 90° coupling.
3	1st R.F.	Universal	Close layer	Coaxial and spaced.
	2nd & 3rd R.F.	Universal	Close layer	Coaxial and spaced.
1	H. F. Osc.	Universal	--	Center tapped.
2	H. F. Osc.	Universal	--	Center tapped.
3	H. F. Osc.	Close layer	--	Center tapped.

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Type CAY 46077 H. F. Receiver Unit

Band No.	Coil Sub-Assembly	Type of Primary Winding	Type of Secondary Winding	Arrangement of Primary and Secondary
1	1st R.F.	Universal	Close layer	
	2nd & 3rd R.F.	Universal	Close layer	
2	1st R.F.	Universal	Close layer	
	2nd & 3rd R.F.	Universal	Close layer	Coaxial and spaced on same form.
3	1st R.F.	Close layer	Spaced layer	
	2nd & 3rd R.F.	Universal	Spaced layer	
4	1st R.F.	Close layer	Spaced layer	
	2nd & 3rd R.F.	Close layer	Spaced layer	
1	H. F. Osc.	Close layer	--	Center tapped.
2	H. F. Osc.	Spaced layer	Spaced layer	Concentric.
3	H. F. Osc.	Spaced layer	Spaced layer	Concentric.
4	H. F. Osc.	Close layer	Spaced layer	Coaxial and spaced.

The construction of the r-f transformers and high frequency oscillator coils is not of the character that is generally considered acceptable for use in naval receiving equipment. The use of treated fabric sleeving of spaghetti tubing is not acceptable for use in radio frequency circuits. In general, the insulation provided between the primary leads operating at high d-c potential, and lying against their associated secondary windings, is inadequate to preclude insulation breakdown between windings. Concentrically wound coils consisting of one winding of fine wire with enamel insulation interwound between spaced turns of a second winding of heavy wire, also with enameled insulation, is not acceptable when, as in the case of the model equipment, the turns of the two windings are in intimate contact, and where one of the windings operates at high d-c potential. Such construction does not provide for dependable and trouble-free equipment operation and performance, as required by the governing specifications, under adverse operating conditions. The coil forms are not considered suitable for use with windings of heavy wire and/or spaced turns because they do not provide satisfactory means for maintaining

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the spacing of the turns, or the anchorage of the windings under conditions of wide variations of ambient temperatures or of vibration. Also, as mentioned above, the method employed for terminating the secondary winding leads is unsatisfactory. Incidently, the highest frequency coil in the H. F. Receiver Unit is the farthest away from the band switch. The wax impregnation employed for the coils proved to be unsuitable since it melts and flows at high ambient temperatures. The contractor has proposed polystyrene coil impregnation to overcome this fault. However, the contractor should be required to produce satisfactory evidence as to the suitability of polystyrene for this purpose. The Laboratory has found, from test samples submitted by the contractor, that polystyrene does not possess good adhesive properties and can therefore be expected to peel from enamel wire insulation as it does from ceramics. It has been found, also, that temperature variations result in the development of minute fractures of the polystyrene surface. Moreover, the surface is full of small craters which resulted from the evaporation of the solvent. There is some question, therefore, as to the ability of this material to remain impervious to moisture over long periods of time, when subjected to repeated and wide variations of temperature and humidity, as stipulated under reference (b).

(d) General. The band switch wafers are secured to their supporting brackets on the base plates (paragraph "a" above) by means of screws and nickel plated brass spacers. The method employed for mounting these switch wafers is such that their replacement is extremely difficult to accomplish without considerable disarrangement of the wiring and possible damage to other components. Fixed mica trimmer capacitors are suspended by their leads between air dielectric trimmer capacitor terminals or from the bus wiring. Fixed mica dielectric padding capacitors employed in the high frequency oscillator coil assemblies are secured to ceramic insulating plates with machine screws and nuts. These plates are located under the aluminum bracket supporting the adjustable air dielectric trimmer capacitors employed in these assemblies. The connection of the band switch leads to the ganged tuning capacitors is accomplished in an extremely unsatisfactory manner. They are

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soldered, not to terminal lugs provided for this purpose on the capacitors -- for these are inaccessible -- but to the soldered connections between the stator plates and the screw supports in the ceramic insulating blocks. This practice is unsatisfactory, since, as in the case of the H. F. Receiver Unit where each section of the ganged capacitor is split, any attempt to remove a band switch lead results in the maladjustment of the spacing between the rotor and stator plates of the capacitor section from which the lead is removed.

3. Ganged Tuning Capacitors. Each receiver employs a four-section, ganged air dielectric variable tuning capacitor of open frame construction. While the separate sections of either one of the ganged tuning capacitors are of identical construction and capacity range, they differ in these respects for each receiver. The ganged sections of the tuning capacitor for the H. F. Receiver Unit employs split stators which are spaced, and insulated, from each other and so connected to the ganged band switch that one of the intermediate sections is effective only for the two lower frequency bands of the receiver. The rotor and stator plates, end plates, partition shields, spacer members and mounting brackets are of aluminum. The rotor shaft is of stainless steel and is mounted and supported between the two end plates of the assembly by a ball bearing in the front end plate and an adjustable bearing in the rear end plate. Each section of the ganged capacitor is provided with a silver plated phosphor-bronze wiper which straddles and contacts recesses in the rotor shaft. The wiper fingers are secured to the partition shields and/or end plates with cadmium plated brass eyelets. Ceramic blocks are employed for supporting and insulating the stator sections and are, in turn, provided with soldering lug terminals for lead connections.

(a) Rotor Construction. The rotor plates are pressed into recesses in the rotor shaft without benefit of staking or swedging. The ends of the plates are swedged to cadmium plated brass straps. The end plates of the rotor assemblies are notched to permit capacity matching between capacitor sections of the ganged assembly.

(b) Stator Construction. The stator plates are swedged to two cadmium plated brass straps, so positioned as to permit their being attached to mounting screws in the ceramic blocks. These plates are secured to their respective mounting screws with solder.

The design and construction of the ganged tuning capacitors are such that the capacitors would not generally be considered

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suitable for use in Naval radio equipment. The rotor and stator plates are of too thin material and the plate spacings are too small to preclude their movement and possible shorting under conditions of vibration or wide temperature variation. The mounting of the ganged capacitors precludes any satisfactory means for attaching the grid leads from the radio frequency transformer or high frequency oscillator coil assemblies. The entire assembly is dependent upon swedging or friction for contact between the various elements which make up its assembly. The design of the rotor and stator assemblies is such that their ability to withstand long exposure in saline atmospheres is questionable and can only be proven by accelerated salt spray tests. The silver plating on the wiper contactors is of insufficient thickness to be satisfactory and has completely worn through in the model receiver units. The method employed for obtaining contact to the rotors is considered in violation of the requirements of the governing specifications, and full compliance with these specifications can be effected only through the use of coin silver button contacts on the wiper fingers and coin silver facings on the rotor hubs; and with the wiper contactors possessing self-cleaning characteristics. While this type of construction is expensive, it is the only type of construction which has proven to be satisfactory under adverse operating conditions.

4. <u>Main Tuning Drive</u>. The main tuning drive for the ganged tuning capacitor of either receiver unit consists of a panel operated control knob which drives the condenser shaft by means of worm and helical gearing. Movement of the control knob shaft is transmitted to the worm gear drive for the condenser shaft through helical gears having a one to one ratio. The worm gear is of the split type provided with spring take-up to reduce backlash. The tuning ratio is 25 to 1 for 180° rotation of the ganged tuning capacitor. The calibrated tuning dial is directly connected to the capacitor rotor shaft. All gears are of cadmium plated brass except the split worm gears, which appear to be of die cast alloy, and pinned to their respective shafts. The bearings for the drive shafts are pressed into a cast aluminum alloy frame which supports one end of the ganged capacitor and is mounted to the receiver chassis. No provisions have been made for compensating for bearing wear. Mechanical stops are provided to limit the rotation of the ganged tuning capacitor rotors in such a manner that the drive mechanism receives all of the strain. The calibrated dial is an aluminum disc with one side reversed photo-etched and the other side fitted with a nickel plated brass hub for securing the dial to the capacitor shaft. Mounted to the tuning dial frame is a transparent cellulose plate which carries the fiducial mark for the tuning dial. While the tuning dial mechanism is mechanically rugged, it does not possess the ease of operation that is usually expected

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of such drives. The force which must be applied to the control knob in the operation of the drive is relatively high and constant operation is fatiguing to the operator. The control provides too slow a traverse from one end of the tuning range to the other for any one band, and therefore cannot be considered as a satisfactory tuning arrangement. The drive mechanism does not preclude backlash between the tuning knob and the condenser shaft. This is a major disadvantage, in the case of the H. F. Receiver Unit, where this backlash makes it extremely difficult to tune the receiver, in spite of the fact that the tuning dial is directly attached to the capacitor rotor shaft and hence provides for relatively permanent calibration for the dial.

5. Band Switches and Band Switch Drives. The band switches employed in the receiver units are of the wafer type employing silver plated phosphor-bronze or beryllium-copper contacts mounted on ceramic insulation. The silver plating on the contacts has completely worn through during the tests. The results of the tests conducted at the Laboratory have proven that the band switch design is entirely unsatisfactory for use in the subject equipment. Contact troubles were the cause for constant annoyance throughout the test and resulted in complete failure of receiver operation when the receiver units were subjected to vibration as required by the governing specifications. These switches cannot be considered as suitable for use in Naval radio equipment, particularly of the character of the equipment reported herein, where the operating conditions may be extremely adverse and where the equipment may be stored over long periods of time in tropical climates. Under these conditions, corrosion may be expected to develop between or on the contacts of the band switches during long periods of their inactivity. Complete compliance with the specification requirements will necessitate the use of coin silver button type contacts, having self-cleaning properties, in the construction of the band switches. The method of mounting of the band switch wafers is such that their alignment is entirely dependent upon the accurate alignment of the r-f transformer and high frequency oscillator coil assemblies with the mounting holes provided in the receiver chassis. The band switch drive mechanism consists of a panel operated control attached to a shaft which extends through the rotors of the band switch sections and is capable of being withdrawn through the front panel, upon the removal of a cotter pin and the loosening of two set screws in the hub of one of the dial mask gears, which is directly connected to the switch shaft. Operation of the band switch actuates a dial mask which is gear driven and is provided with a pawl which falls into recesses in the rim of the mask for locking it in the intermediate switch positions. Mechanical stops are provided on the gear attached to the switch shaft which strikes against a boss on the switch mounting frame at the extreme positions of the band switch rotation. The

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dial mask is essentially an aluminum disc with one side reversed photo-etched and provided with slits for exposing the dial scales as selected. The dial mask pawl acts as a clicker for the band switch itself. It does not preclude the complete shift from one set of contacts to another on the band switches without completing the corresponding movement of the dial mask. When such a condition arises, it is necessary to reset the band switch to properly position the dial mask. The dial mask drive mechanism possesses too great a degree of backlash for its satisfactory operation in the subject equipment. The band switch shafts are equipped with only a single end bearing. The ends of the relatively long shafts are therefore free to flex during its movement, thus causing a lag in the movement of the rear switch rotors with respect to the others.

6. <u>I. F. Transformers</u>. The i-f transformers employed for the two receiver units are shown photographically on Plate 94 and are as follows, reading from left to right: (a) 160 kilocycle i-f transformer employed in the I. F. Receiver Unit; (b) 1600 kilocycle wide band i-f transformer employed for the H. F. Receiver Unit, and (c) the 1600 kilocycle narrow band i-f transformer employed for the same receiver. These transformers are constructed as complete sub-assemblies and are designed to be plugged into octal type sockets mounted in the receiver chassis. The windings are wound on solid ceramic forms and mounted coaxially. One of the coils is mounted to a micalex spacer member which supports the dual air dielectric trimmer capacitors. The companion coil is mounted on an aluminum bracket which, in turn, is secured to a phenolic block supported by the vertical aluminum corner posts and arranged to permit adjustment of the magnetic coupling between the coils. The transformers are provided with aluminum base plates on which are mounted four-prong ceramic plugs, whose construction is similar to that employed for conventional metal tube bases, and provided for insertion in the chassis sockets. The shielded enclosures for the transformers are secured to the vertical corner posts of the transformer assemblies and to the top mounting studs for the trimmer capacitors. The grid leads (not shown in the photograph) for connection to the control grids of their associated vacuum tubes are brought out through holes in the sides of the shield cans. These holes are not protected with grommets to prevent the cutting of the lead insulation by the sharp edges of the holes. Refer to paragraph 1(a) above for comments on the shield can construction. The internal assemblies of the i-f transformers are of rugged construction. The placement of the grid leads, however, is unsatisfactory since the internal structures cannot be easily removed from their shielded enclosures without damaging the lead insulation. The method employed for mounting the dual tuning capacitors requires the use of special studs with no suitable provision

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for locking them in place. Consequently, when attempting to loosen the nuts which secure the top of the shield can to these studs, the studs are apt to turn with the nut, making it extremely difficult to effect the removal of the shield cans, without possible injury either to the can, or to the internal assembly. The need for the heavy micalex spacer is not readily apparent. The arrangements of the internal bus wiring are such that when the brackets for the movable coils are adjusted for circuit alignment they contact one of the high potential leads.

7. CW Oscillator Inductor Assembly. The construction of the internal assembly of the cw oscillator inductor is very similar to that employed for the i-f transformers, except that it is not provided with a plug base, and derives its entire support from the top of the shield can enclosure. It employs a modified tuning capacitor of the type employed for the i-f transformers except one capacitor section has been removed. The oscillator coil is wound on a solid ceramic tube form and mounted to a micalex plate as for the i-f transformers. The type of construction is entirely unsatisfactory in that the internal assembly does not derive its entire support from the receiver chassis, and no terminal panel is provided for the external lead connection. Leads in frequency determining circuits should, in every case, be rigidly anchored so as to preclude their movement under conditions of vibration.

8. Toggle Switches. The toggle switches are not of the dry-packed type with silver plated contacts. The types of toggle switches employed have been known to give trouble in service and are therefore generally unsatisfactory for use in Naval radio equipment.

9. Receiver Cabinet. The receiver cabinet is of three piece, spot welded, construction fabricated from 1/16" thick aluminum alloy. It consists of a "U" shaped piece which forms the top, bottom and back edges, and two end pieces with folded sides, inserted in the open ends and spot welded in place. A flanged partition shield is spot welded to the inside of the box so as to divide the enclosure into equal compartments. Phenolic angles are riveted to the inside bottom edges to serve as insulating guide tracks for the receiver chassis. Aluminum angles, spot welded to top and bottom of the cabinet, are parallel to the front edges of the cabinet and spaced so as to straddle the Lord shock mountings. They are provided for added rigidity of the cabinet. A Lord shock mount is secured to each of the four top and bottom corners of the cabinet by means of machine screws and nuts. Stainless steel straps of channel design are mounted to the Lord shock mounts by means of special stainless steel screws and nuts provided for securing the cabinet within its transportation case. Two such

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straps are mounted at the top and bottom of the cabinet and arranged parallel to each other and at right angles to the front of the cabinet. The aluminum alloy angles along the top front edges of the cabinet are fitted with 1/16" blocks riveted in place. Tapped holes are provided through these angles and the aluminum blocks for receiving the panel securing thumb screws. The cabinet construction is considered as being of rugged design and is suitable for its intended purpose. In the model equipment the phenolic angles suffered some damage which was the result of the sharp edges of the receiver chassis digging into the material so as to leave heavy grooves after repeated insertions or withdrawals of the chassis from the cabinet. This difficulty could be easily overcome by smoothing the bottom edges of the receiver chassis. The tapped holes for receiving panel thumb screws are not suitable since the threads are easily stripped, as has been the case with the model equipment. Brass inserts with tapped holes assembled to the aluminum angles would be preferable to tapping the aluminum. The front edges of the cabinet do not provide sufficient bonding with the receiver panel to preclude the reception of undesired signals or noise. The present design would easily permit the use of flanged edges along the top and bottom of the cabinet to contact the front panels of the receivers. The cabinet design does not provide for self-alignment of the receiver chassis to preclude damage to the panel finishes upon their insertion.

B. <u>Type CAY 21387 Dynamotor Unit</u>. External views of the dynamotor unit, when withdrawn from its transportation case, are shown photographically on Plates 88 and 89. An internal view of its chassis is shown on Plate 90. The chassis is of one piece construction, with folded sides and spot welded corners, and fabricated from 1/16" thick aluminum plate. A 1/16" thick aluminum angle type bracket is spot welded lengthwise to the inside top surface of the chassis for added rigidity and to serve as a support for the r-f filter chokes. Aluminum angle brackets, spot welded to the two sides of the chassis, serve to support the chassis in the transportation case. The rear ends of these brackets are designed to slide in clamping shoes in the rear of the transportation case and to bond the chassis to the case. The forward ends of the side brackets are fitted with two nickel plated brass thumb screws with knurled and slotted heads. The thumb screws engage with nickel plated brass blocks to which they are permanently attached since the ends of their threaded studs are peaned to prevent their complete removal from the blocks, when loosened. The dynamotor and filter reactors are mounted on the top side of the chassis by means of machine screws and nuts. The top of the chassis is provided with rectangular holes for clearing the reactor windings. Along the front side of the chassis are mounted the cable plug receptacles and receptacle rings, fuses and photo-etched nameplate for fuse identification. The retaining rings for the cable plugs are engraved with circuit symbol numbers to direct the correct cable connections. All

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other component parts are mounted inside of the chassis. The dynamotor unit is ruggedly constructed and its dimensions are well proportioned, but its mechanical design renders it unsuitable for its intended purpose. The method provided for securing the chassis in its transportation case is awkward and inconvenient. The design does not provide for its satisfactory operation in the presence of driving rain, dust, or insect infestations, in compliance with the requirements of the governing specifications.

C. Type CAY 20085 A. C. Power Unit. This unit is shown photographically on Plates 88, 89 and 90. It consists of a chassis fabricated from 1/16" aluminum plate. It is of one piece construction with folded sides, flanged mounting feet, and spot welded corners. The power transformer, filter reactors, high voltage filter capacitors and rectifier tube socket are mounted on top of the chassis. The chassis is suitably punched to clear the windings of the transformer and reactors, and the terminals of the tube socket and filter capacitors. The line power cable enters through a hole in the side of the chassis and is protected by a rubber grommet. A reverse etched panel covers the front side of the chassis to which are mounted the cable plug receptacles and receptacle rings, "on-off" toggle power switch, indicator lamp, and fuse receptacles. These components are suitably identified by appropriate letters or figures on the etched panel. All other components are mounted on the under side of the chassis. The bottom of the chassis is closed by a cover plate which is secured to the chassis by means of six screws. The top components are protected by a box type enclosure which is secured to the sides and back of the chassis with screws. The top structure is of two piece, spot welded, construction, and fabricated from 1/32" thick aluminum plate, and is punched with ventilating holes. The gauge of material employed for the chassis is not suitable for the load which the chassis bears. The use of additional bracing is clearly implied to satisfy the specification requirements. The replacement of the rectifier tube or pilot lamp is not convenient owing to the number of screws which must be removed to effect this end.

Other parts, entering into the construction of the subject equipment, which are not discussed under the foregoing paragraphs, will be considered under other paragraphs of this report which specifically refer to the applicable paragraph references of reference (b).

35. Par. 2-4. An evaluation of the workmanship on the several units of this equipment, reported herein, must necessarily take into consideration the fact that this equipment is a preliminary model. It cannot be expected to possess the quality of workmanship that would be demanded of production equipments. The contractor has demonstrated, on past contracts, his ability to produce good workmanship in his products. However, there are certain construction features of this equipment which warrant some comment, and cannot, therefore, be overlooked. These are as follows:

(a) The radio frequency coils employed for the preselector transformers, high frequency oscillator inductors, i-f transformers and cw oscillator inductor do not employ good workmanship in their construction. The leads in general and the heavy wire leads, in particular, are not suitably anchored since their anchorage depends solely on the adhesive properties of wax or cement. The coil forms are not provided with holes, or suitably positioned terminals, for lead anchorage, or threads for maintaining the spacing of "space turn" windings. In many instances the primary coil leads of the r-f transformers lie across their associated secondary windings without adequate protection to preclude insulation breakdown between the contacting wires due to the high d-c voltage on the primary windings. Careless workmanship has been displayed in the inductance adjustment of the secondary coils of the r-f transformers employing spaced and layer wound turns of enameled insulated copper wire. The affected turns have been badly distorted by the use of a sharp instrument which broke through the enamel insulation and left fractures in the surface of the copper wire wherever it was applied. Discontinuity of lead or coil insulation, except where it is removed for soldering, cannot be tolerated. In general, the construction and workmanship as displayed for the above-named coils do not create any confidence in the permanence of the coil adjustments or that their failure will not result when the subject equipment is operated under the adverse operating conditions which are normally encountered in the Service.

(b) The workmanship displayed in the preselector transformer and high frequency oscillator coil assemblies demonstrates the difficulties that may be expected to be encountered in production. The arrangement of the component parts in each of these assemblies makes the placement of the bus wiring, in a neat and orderly manner, somewhat difficult owing to the inaccessibility of some of the soldering lugs and the lack of sufficient clearance for the wiring. The use of spaghetti tubing or varnish impregnated fabric sleeving for wire insulation is not acceptable in radio frequency circuits. In general, fixed mica trimmer capacitors are suspended by their pigtail leads from the bus wiring and in many instances the pigtail leads are sharply bent at their points of entrance into the molded phenolic capacitor cases. They are not neatly arranged so as to present a pleasing appearance in the completed assemblies. The soldering workmanship is not up to the standards usually expected in Naval equipment. Ground return leads, where such leads are terminated on the cast aluminum alloy bases, are not solder bonded to their securing screws. The advisability of so doing is questionable, however, from servicing

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consideration. The mounting studs in the air dielectric trimmer capacitors, employed for securing the coil shield cans, have been cut off with the result that the base brass metal is exposed and the ends of the studs are left in an unfinished and unsatisfactory condition.

(c) The i-f transformer and cw oscillator coil assemblies do not present a finished appearance, and the general workmanship is poor. The grid leads which are brought out of the shield cans are not suitably protected against insulation breakage, which might result from their rubbing against the sharp edges of the holes through which they pass under conditions of vibration. Some of the i-f coils examined had aluminum filings embedded in their waxed surfaces.

(d) The wiring of the receiver units has not been effected in as neat a manner as is usually expected for equipments of their character. The general inaccessibility of the component parts precludes a neat arrangement of the wiring. In many instances there are long leads which are not suitably anchored to prevent their breakage at their soldered connections. In other instances leads have been permitted to lie across sharp edges of partitions, soldering lugs, etc., in such a manner that the lead insulation may become fractured or worn under conditions of vibration. The antenna leads entering the r-f shield cans are wedged against the band switch shafts, and also, are so placed as to be rubbed by the dial mask drive gears. The soldering workmanship is not good and its inferior quality is undoubtedly due to the general inaccessibility of the soldering lugs and/or terminals. While superior workmanship has been displayed in the wiring of the dynamotor and a-c power units, specification compliance has not been effected, owing to the fact that grouped leads are not suitably cabled, and long leads have not been satisfactorily anchored to preclude their breakage at their soldered connections under conditions of vibration. The soldering workmanship displayed in these two units is entirely satisfactory.

(e) Greater care should be exercised, in the manufacture of the production units, to assure the cleanliness of the chassis and in the stamping of the circuit symbols. The receiver chassis of the model equipment, as received by the Laboratory, were dirty and discolored and the marking of the circuit symbols was not accomplished in a neat and orderly manner. As previously mentioned, the Laboratory appreciates the fact that this equipment, being a model, has been subjected to considerable handling in its development. This criticism, therefore, is not especially directed against these units, but is made to emphasize the fact that the receiver units, in particular, will be subjected to an unusual amount of handling in production due to the relative inaccessibility of the component parts, which makes their assembly and wiring difficult. The circuit symbols should be protected against their possible obliteration during the normal handling of the separate units of this equipment.

(f) The workmanship displayed in the spot welding of the transportation cases has resulted in certain welds having been burned completely through the metal to the extent of leaving small holes through which water may leak, thus destroying the watertightness of their designs. The spot welding of the shoes for securing the legs for the receiver transportation case has not been done in a workmanlike manner, and this statement applies equally well to the welding of the seams of all transportation cases. Closer supervision and inspection should be applied to the welding of the transportation cases for the production equipments than apparently has been provided for the model equipment.

36. Par. 2-5. All items entering into the construction of the equipment have, in general, been protected against the corrosive action of a moist sea atmosphere. Aluminum, as employed for fabricated parts, has been treated to be corrosion resistant. Brass parts have been cadmium or nickel plated. The thickness of the plating or protective coating provided for the metallic parts, employed in the model equipment, the degree of adherence provided by these coatings, or their ability to withstand service conditions cannot be ascertained by this Laboratory without subjecting the equipment to possible destruction. It is suggested, therefore, that if tests are desired to determine specification compliance, that sample plates containing these protective coatings be submitted to the Laboratory for test. Such items as do not comply with the requirements of this specification reference (b) are as follows:

(a) Brass has been employed for the spacer straps in the construction of the rotor and stator assemblies for the ganged air dielectric tuning capacitors. The use of this material is contrary to specification requirements, in that it has been employed to support aluminum capacitor plates.

(b) The silver plating provided on all wiper contacts is of insufficient thickness to preclude the corrosion of the base metal upon its exposure to moist sea atmosphere after rather limited use.

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(c) The power transformer and filter reactors employed in the power units are not suitably constructed, or protected, to provide satisfactory operation, without interruption, under the operating conditions stipulated in the governing specifications. The plating on the cases of the fixed oil-paper capacitors has become discolored, during the tests, and therefore, there is some question as to whether it is capable of withstanding the usual salt water spray test.

37. Par. 2-7. All control knobs on the receiver units, with the exception of the antenna trimmer capacitor control knobs, are engraved with letters to facilitate the logging of calibration data, in compliance with this specification reference. The engraved letters are filled with a white paint.

38. Par. 2-8. The use of iron or steel, except where specifically required for electromagnetic purposes, has not been minimized, in compliance with this paragraph reference, since steel has been employed for the mounting brackets of the audio output transformers, for the grid connectors for the converter tubes, and for the chains and chain supporting studs for the receiver transportation cover support, when employed as an operating table. While steel cases have been employed for some of the fixed foil paper capacitors, their use is permitted under reference specification RE 13A 488, provided that they are suitably protected by a non-corrosive metal plating.

39. Par. 2-9. All circuits of the subject equipment, which are likely to carry a heavy electrical overload due to any cause, are suitably fused. The antenna circuits are protected by neon tubes to prevent damage to the input circuits resulting from high radio frequency potentials being applied directly to the antennas.

40. Par. 2-6 and 2-10. The power units are provided with all necessary ventilation and cooling to preclude damage to any of the component parts under conditions of continuous operation in the range of ambient temperatures specified under reference (b). The receiver units, however, will not withstand continuous operation at the high temperature required by the governing specifications due to the low melting point of the wax employed on the coil assemblies, as evidenced by the temperature tests reported upon elsewhere in this report.

41. Par. 2-11. Refer to paragraph 34 of this report.

42. Par. 2-12. The design of the equipment and of its component units is such that no damage resulted when the equipment was subjected to a maximum acceleration of 8 g, applied in any direction.

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43. Par. 2-13. Satisfactory provision has been made to permit the removal or replacement of vacuum tubes and fuses without danger of shock. Adequate provision has not been made, in the design of the antenna lead connectors, to preclude the possibility of the operating personnel accidentally coming in contact with high radio frequency potentials in the event that the break-in relays in the transmitter units should fail to close normally. The operator may be subjected to electrical shock when disconnecting the receiver power cables if, in the process of removing the power plug either from the receiver or from the power supply unit, the negative B and/or ground connection is broken, before the high potential positive d-c contact is broken, and the operator has one hand on the receiver cabinet. The equipment fails to comply with the requirements of this paragraph reference, since it specifically stipulates accidental contact. The "on-off" power switches cannot therefore be viewed as a means for precluding accidental contact with high voltages, since these switches may be left on through carelessness.

44. Par. 2-14. Refer to paragraph 34.

45. Par. 2-15. This specification reference applies only to the Transmitting Equipment.

46. Par. 2-16. The dimensions and weights of the separate units comprising the subject equipment are given under paragraphs 27 and 30 above.

47. Par. 2-17. Individual units of the equipment, including the mobile spare parts box, as arranged for transportation are capable of passage through a hatch 18" x 24" in compliance with the requirements of this specification reference.

48. Par. 2-18. The Type CAY 46078 Receiver Unit and Type CAY 21387 Dynamotor Unit are housed in metal transportation cases. The external surfaces of these cases and the Type CAY 10034 Mobile Spare Parts Box have an olive drab wrinkle finish. The interiors of these boxes have been treated to resist corrosion by the Westinghouse "Nasat" finish. This latter finish has also been applied to all aluminum and aluminum alloy surfaces and parts employed in the fabrication of the several units of the equipment. No finish has been applied to the plates of the ganged tuning capacitors since the specification considers that these plates are inherently protected against corrosion. The external surfaces of the receiver cabinet, dynamotor and dynamotor chassis, cover and chassis of the power unit have a black wrinkle finish. The front panels of the Types CAY 46076 and CAY 46077 Receiver Units are reversed photo-etched with black background. No tests were conducted by the Laboratory to determine the corrosion resisting properties of the various types of finishes, employed for this equipment.

49. Par. 2-19. The cable attachment plugs are provided with natural aluminum metallic shells and cast aluminum alloy elbows, where used. Ferrules, washers, retaining nuts, (except for the aluminum re-

taining nuts on elbows), and all securing screws and lockwashers are of nickel plated brass. The aluminum parts were left in the natural state for electrical reasons. All shielded cables are provided with a rubber covering over the metallic shielding. The shielding is solder bonded, in each case, to the brass ferrules of the attachment plugs. The cable ferrules for the attachment plugs of the battery and charging cables are of incorrect size to be suitable for the size of cables employed. No tests were made to determine the degree to which the rubber insulation on the cables will withstand electrical and mechanical stresses, or of its aging properties. The cable plugs are of types which have been employed for other types of Naval equipment, particularly aircraft equipment, and have given satisfactory service. The rubber cable is of the Simplex "Tirex" type which appears to be very satisfactory for the intended purpose and it is similar to other cables listed under NAF Drawing 47024. While the basic dimensions of the cables supplied do not agree with any one cable as listed on this drawing, their construction, size of conductors, etc., are considered satisfactory. The shells of the cable plugs are fitted with rubber sleeves. While the rubber sleeve design is satisfactory, the quality of rubber is not uniform for all sleeves.

50. <u>Par. 2-20</u>. The separate units of the equipment are shielded within their cabinets and all parts external to them, with the exception of the antenna posts, operate at ground potential. The degree of shielding provided for the receiver units is not extraordinary.

51. <u>Par. 2-21</u>. All panel markings, or nameplate markings, are of natural aluminum color against dull black backgrounds, and provide good readability in compliance with this specification reference. Bright finishes have been employed for all panel thumb screws, toggle switches, phone jacks, panel lamp retaining rings and several panel mounted securing screws, as employed for the receiver and/or power units. Bright finishes are not permitted for these parts under reference (b). However, reference (e) permits their use on toggle switches, jacks, and light receptacles when such material meets, in full, the applicable specification requirements. The Laboratory is of the opinion that it would be to the advantage of the operator if these parts be not highly polished, and if provided with some finish other than a dull black, that, at least, they be of the dull nickel finish. The use of polished nickel retaining rings for the receiver panel lights is not considered satisfactory, in any event, because their use detracts from the general appearance of the panels and draws attention from more important controls and/or devices.

52. <u>Par. 2-22</u>. All thumb screws, screw heads and nuts which are manipulated or removed in the normal process of installation and/or servicing have a dull nickel finish as required under reference (b).

53. <u>Par. 2-23</u>. The equipment is not considered as being suitably designed to permit its operation under adverse conditions of rain, spray, humidity and changing temperatures accompanied by condensation and moisture. The external fixtures associated with the antenna systems are not satisfactorily arranged as to obviate the danger of rain and spray rendering

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the equipment inoperative. The cable plugs may be removed by an operator wearing heavy gloves. Refer to the report covering the Transmitting Equipment for comments on the provisions made for protecting the external connections provided for the antenna transfer and break-in relays against the danger of collecting water.

54. Par. 2-24. All cables supplied with this equipment are capable of being bent to a radius of less than 3 inches and appear to be suitable for operation continuously in service, when so bent, without damage to the covering, shielding, attachment plugs, or plug receptacles. The cables furnished are not listed on NAF Drawing 47023 but appear to be entirely suitable for their intended purposes.

55. Par. 2-25. The cable attachment plugs furnished with the model equipment are of the shielded type with their jacks suitably arranged in such a manner that each plug will fit in only one position. The design of the plugs, and the method employed for mounting the jacks, are such as to preclude the possibility of shocks or short circuits should the plugs be placed in contact with a flat metal surface. All power cables are of the metallically shielded type, with the shielding suitably solder bonded to the retaining ferrules of the plugs, and provided with a rubber outer covering over the cable shielding. The retaining ferrules are bonded to the shells of their respective plugs by means of securing nuts and washers. These nuts were not staked on the model cables and became loosened when subjected to vibration. All leads in the cables are suitably color coded and terminate at terminals, which are identified by numbers to facilitate servicing. A ground wire is provided in the receiver power cables to connect the plug housings and the cable shields to ground. No separate conductor is provided in the battery or charging cables for ground connection, this connection being provided by the cable shielding. The receiver power cable employs five conductors, whereas all other cables employ two conductors. The lengths, number of conductors and conductor color coding are given below for the cables furnished with the model equipment. No marking bands have been employed for any cables for their identification.

Cable Description	Length	No. of Conductors	Color Coding
Battery Interconnecting Cable	37"	2	Black - White
Battery to Dynamotor Cable	118.5"	2	Black - White
Battery Charging Cable	118.5"	2	Black - White
I. F. Receiver to Dynamotor Cable	82.25"	5)	Black - Brown
H. F. Receiver to Dynamotor Cable	82.25"	5)	White, Green, Red
I. F. Receiver to Antenna Cable	72"	1	Black
H. F. Receiver to Antenna Cable	72"	1	Black

56. Par. 2-26. (1) All connections within the separate units of this equipment, as supplied for field installations, are not suitably supported to minimize changes in frequency or output, or to prevent breakage due to severe vibration under flight conditions. This statement applied

particularly to the leads for the cw oscillator and to leads which pass through the chassis partitions of the receiver units, without benefit of protecting rubber grommets; and to long leads in all the units which are neither laced in groups, nor anchored by clamps.

(2) All wire used in the wiring of the receiver and power units is of stranded soft, annealed copper, except where bus wire is employed in radio frequency circuits, and appears to be of ample cross section for safe current carrying capacity and mechanical strength.

(3) All insulated wire employed in all units is rubber insulated, except for leads from the dynamotor, power transformer, and filter reactor of the power units. These latter wires are insulated with rubber and a treated fabric outer covering.

57. <u>Par. 2-27</u>. All wiring, except bus wire employed in the radio frequency circuits, is color coded to facilitate testing and the location of faults. The leads from the dynamotor, power transformer or filter reactors of the power units are not, in every case, color coded, and, where color coding is employed, the colors do not agree with the coding of the wires of the circuits to which they are connected. The color coding on the rubber insulated wiring is unsatisfactory, in that it has faded, in almost every instance, to the extent that all wires are approaching white in color.

58. <u>Par. 2-28</u>. Samples of the wires employed in the wiring of the separate units of the subject equipment were not submitted for test to determine compliance with the requirements of this specification reference.

59. <u>Par. 2-29</u>. No asbestos covered wires or leads have been employed in either of the two types of power units furnished with the model equipment. The heat dissipation of either of these units does not warrant the use of asbestos insulated wire.

60. <u>Par. 2-30</u>. No special provision has been made for shockproofing the individual sockets for the vacuum tubes employed in this equipment. The cabinet of the Type CAY 46078 Receiver Unit is provided with shock mounts for the purpose of protecting the entire unit, including vacuum tubes, from damage due to shock or vibration. No provision has been made for shockproofing the vacuum tube of the Type CAY 20085 A. C. Power Unit against damage due to shocks or vibration, as it is not anticipated that this unit will be subjected to such operating conditions.

61. <u>Par. 2-31</u>. All vacuum tubes are provided with individual sockets, These sockets are all of the Amphenol ceramic type which employ cadmium plated phosphor-bronze spring retaining rings for securing them to the chassis. These sockets, while being satisfactory in themselves, are not particularly suited for use in the receiver units where little or no access is provided for the removal of their retaining rings should replacement of one or more of the sockets become necessary. It is believed

that if a similar type of socket, obtainable from the same supplier, but provided with a mounting plate, were employed, the mounting plates could then be secured to the chassis with the same mounting screws as employed for the tube shield bases. The replacement of any of the sockets would then be greatly facilitated, since it appears that securing screws would be more accessible than the retaining rings furnished.

62. Par. 2-32. The design of the equipment is such that the operation of the I. F. Receiver Unit is only slightly affected when using vacuum tubes whose characteristics vary within the limits set by the Navy Standard Specifications for the particular tubes involved. The H. F. Receiver Unit, however, is adversely affected both in frequency calibration sensitivity, under similar conditions, and particularly if the converter tube is replaced. Complete data showing the effect of tube replacement on sensitivity are shown on Tables 3 and 20, and on Tables 16 and 33 for the effect of tube replacements on frequency stability.

63. Par. 2-33. The design of the equipment is such that with the receiver units operating from the dynamotor power unit, fed from a 12-volt battery supply, or the a-c power unit, when fed from a 115-volt line, the heater and/or filament supply voltages at the tube sockets are less than the normal rating required for the tubes. These voltage variations do not comply with the limits specified under reference (r).

64. Par. 2-34. No electrical indicating instruments are employed with the Model XTBW Radio Receiving Equipment.

65. Par. 2-35. The equipment complies with the specification requirement for simplicity of operation. The operating controls and/or devices are suitably identified to permit the installation and operation of the equipment by relatively inexperienced personnel. Rugged mechanical stops are provided to limit the rotation of the main tuning controls and band switches of the receiver units. The band switches are also provided with mechanical "clickers" to indicate their intermediate selective positions. The mechanical stops provided on the receiver volume controls, while less rugged than those on other controls, are satisfactory for the purpose and are the best that can be obtained with commercially available components of their character. These controls can, however, be permanently damaged if good judgment is not exercised in their operation since their mechanical stops can be easily broken with the application of abnormal force. No mechanical stops are provided for the antenna trimmer capacitor of the receiver units, hence, their adjustment might be confusing to a relatively inexperienced operator.

66. Par. 2-36. Refer to paragraph 64, above, concerning electrical indicating instruments. The main tuning dial scales are identified by the word "FREQUENCY," photo-etched on the front panel of each receiver unit, and located directly above dial apertures. In addition, the dial mask on each receiver indicates, by photo-etched figures and letters, the frequency range and kilocycles covered by each dial scale division, for each particular calibrated dial scale, as it is brought into view by the band selector switch.

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67. Par. 2-37. Clockwise rotation is provided, for all panel operated controls of the two receiver units, for final controlled effect. In the case of the main tuning controls, a clockwise rotation of the tuning knob causes an increase in frequency setting although the dial scale calibration is actually in a counter-clockwise direction. Operation of the band switches in the clockwise direction causes a numerical increase in the band selection. The rotations of the volume controls are indicated by arrows. All toggle switches are mounted for up and down operation of the toggles, and in the case of power switches "on" is in the up position, with "off" in the down position. The toggle of the cw-mcw switch is up for "cw" and down for "mcw." Likewise, the toggle for the AVC-MVC switch is up for "AVC" and down for "MVC." No indication is provided to show the direction of rotation for the antenna trimmer capacitors. Except for the antenna trimmer capacitors, the two receiver units are considered as being in compliance with the requirements of this specification reference of reference (b).

68. Par. 2-38. The main tuning dials of each of the receiver units are provided with calibrated scales for each band of their respective frequency ranges. The calibrated scales for the I. F. Receiver Unit are in kilocycles and in megacycles for the H. F. Receiver Unit. The dial apertures are of such size as to permit three divisions to be visible at all times. Divisions on the dial scales are not evenly spaced since the ganged tuning capacitors provide for "midline" capacity variation. The spacing between dial scale divisions is greater than .05 inch, as required by the governing specifications.

69. Par. 2-39. All control shafts and control bushings (including toggle switches and phone jacks) are grounded to the front panels of their respective receiver units. Rotatable controls are provided with molded phenolic control knobs. The antenna clip type connector on the ends of the antenna leads, which attach to the antenna posts of the receivers, is not considered as being sufficiently protected to preclude the possibility of unpleasant shocks or burns, when touched, due to the possible existence of stray high frequency fields. The molded phenolic sleeves on these connectors may be easily broken if stepped on.

70. Par. 2-40. The parts employed in the Model XTBW Receiving Equipment are, in general, identified by circuit symbols but not with the manufacturer's type numbers. The exceptions to this statement are the fixed paper dielectric capacitors, wire-wound resistors and the dynamotor. Navy type numbers for the vacuum tubes appear on the chassis of the receiver units. Major parts, employed in one receiver, are interchangeable with similar parts in the other receiver, wherever possible. The specification requirement concerning the assignment of Navy type numbers to the component parts is not within the scope of this report and therefore no comments can be made.

71. Par. 2-41. Nameplates, as furnished with the model equipment, are shown photographically on Plate 83 for the I. F. and H. F. Receiver Units and on Plate 92 for all other nameplates. The Laboratory is of the opinion that the equipment nameplate should include a listing of all units

[redacted]

comprising this receiving equipment. In other words, Type No. CAY 46078 should apply to the entire receiving equipment rather than simply to the unit comprising the I. F. and H. F. Receivers. Such a provision would greatly facilitate the identification of the separate units and eliminate the obvious confusion which arises when attempting to refer to the equipment, as a whole, when the existing nameplate lists only the receiver units. A suggested arrangement of the nameplate data is as follows:

RADIO RECEIVING EQUIPMENT

TYPE CAY 46078

WEIGHT SERIAL

A UNIT OF MODEL TBW EQUIPMENT

CONSISTING OF

1 TYPE CAY 46076 I. F. RECEIVER
1 TYPE CAY 46077 H. F. RECEIVER
1 TYPE CAY 21387 DYNAMOTOR
1 TYPE CAY 10034 MOBILE SPARE PARTS BOX
2 TYPE CAY 19017 STORAGE BATTERIES

MANUFACTURED FOR
NAVY DEPARTMENT - BU. OF ENGINEERING
BY
WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
BALTIMORE, MD.
CONTRACT NOs. 65690 DATE 16 Mar. 1939

72. Par. 2-42. The construction of the equipment is not free from damage and faulty operation resulting from vibration and shock, as is pointed out in other portions of this report.

(1) All machine screws and nuts are secured by the use of nickel plated phosphor-bronze lockwashers. The lockwashers are of the external tooth shakeproof type. Split type spring lockwashers have been employed to secure the screws employed in the construction of the ganged tuning condenser assemblies. These lockwashers are of nickel plated phosphor-bronze. The panel securing nuts for the toggle switches and phone jacks are staked in an approved manner. The locking nuts for the trimmer capacitors employed for the r-f and high frequency oscillator coil assemblies and the tuning capacitors employed for the i-f transformers and cw oscillator assemblies depend upon tapered threads for their locking action. This method of locking did not prove satisfactory when the equipment was subjected to a vibration test, since in many instances, the nuts became loosened to the extent of being easily turned with one's fingers.

[redacted]

(2) All wires connected to terminals, etc., are securely fastened by crimping and do not depend upon solder for mechanical strength, in compliance with the specification requirements.

(3) Solder connections have not been employed for all circuits operating at a radio frequency to effect specification compliance as interpreted by this Laboratory. This statement applies particularly to the soldering lugs on the ganged tuning capacitor to which are attached the control grid leads. These connections depend upon pressure contact afforded between the soldering lugs and the capacitor stator mounting screws; the soldering lug, carrying the ground lead of the antenna trimmer capacitor, which depends upon pressure contact between its securing lockwasher nut and mounting screw for its bonding to the front panel; and the soldering lug for the antenna lead which depends upon similar pressure contact for circuit continuity to the antenna connector post. Soldered connections in r-f circuits have not been coated with red lacquer as required.

73. Par. 2-43. All bolts, studs, screws, nuts, etc., used in the model equipment comply with the requirements of this specification reference for type and size of threads, and in their application. No aluminum alloy screws have been employed. Anti-sieze compound has not been employed, as required, where aluminum alloy parts are assembled by threading and where it is necessary to take them apart for servicing.

74. Par. 2-44. The receiver cabinet housing the Types CAY 46076 and CAY 46077 Receiver Units is provided with eight Lord shock mounts arranged at the top and bottom corners of the cabinet. These shock mounts do not possess sufficient damping to preclude possible damage to the receiver units when subjected to the natural period of vibration of the combined assembly. This unit therefore cannot be considered as being suitably designed to permit its transportation without damage. The Type CAY 21387 Dynamotor Unit is not provided with any form of shock mounting as required under references (c) and (d). However, it is believed that the design and construction of the model dynamotor unit are satisfactory to permit its transportation without damage.

75. Par. 2-45. Tests were not conducted to determine the inflammability of the insulating material, waxes, etc., which were employed in the construction of the subject equipment. Such tests would have resulted in the possible permanent damage to the equipment, and it is believed that the Bureau should request that samples of these materials be submitted to the Laboratory for test to determine specification compliance.

76. Par. 2-46. No wood has been employed in the construction of the model receiving equipment, as submitted for type approval test.

77. Par. 2-47. Ceramic insulating material has been employed for all circuits operating at radio frequency except where micalex is employed as will be noted under paragraph 33. Laminated paper base phenolic sheet has been employed for mounting panels for mounting resistors and small mica dielectric capacitors operating in audio frequency or d-c power circuits. Molded laminated paper base phenolic angles have been employed as mounting brackets for the primary windings of the second and third r-f coils as employed in the I. F. Receiver Unit and as runners in the receiver cabinet. Solid laminated paper base phenolic rods are employed for the radio frequency chokes employed in the dynamotor unit and for the abovementioned primary coils. The fuse housings employed in the dynamotor unit are of molded phenolic insulating material. Except for the vacuum tube sockets, neither the ceramic nor the phenolic insulating materials are considered as having been satisfactorily employed to comply with the requirements of this paragraph reference. The terminal spacings and the clearances provided between some of these terminals and ground are such that voltage breakdown between the terminals and ground can be expected if the equipment is operated under the conditions stipulated under this paragraph reference. Where metallic shields are in close proximity with resistor and/or capacitor mounting panels, these surfaces have been coated with a layer of fish paper cemented in place. The use of this fish paper, as applied, is entirely unsatisfactory in that the fish paper is not non-hydroscopic and has a tendency to curl and loosen when exposed to heat. In the model equipment, the fish paper strips have already begun to curl, and in due time, may be expected to become complately loosened.

78. Par. 2-48. The sealing compound employed in the paper dielectric fixed capacitors appears to be satisfactory. These capacitors are hermetically sealed in metal containers and are of a type of design which has given satisfactory performance in other equipment.

79. Par. 2-49. All trimmer capacitors employed in the subject equipment are of the air dielectric variable type and employ nickel plated brass plates and rotors and ceramic insulation.

80. Par. 2-50. No electrolytic capacitors have been employed in any unit of the Model XTBW Radio Receiving Equipment.

81. Par. 2-51. Foil paper capacitors as used in the subject equipment are of the type covered by Specifications RE 13A 488C. No tests have been conducted to determine their compliance with this specification reference, and it is suggested that the Bureau request that the contractor furnish the Laboratory with samples to determine their suitability for use.

82. Par. 2-52. The equipment complies with the requirements of this paragraph reference of reference (b).

83. Par. 2-53 and 2-54. The audio frequency output transformer employed in each receiver unit is sealed in a metallic container and is provided with a ceramic terminal panel. The power transformer and filter

[redacted]

reactors of the Type CAY 20085 A. C. Power Unit and the Type CAY 21387 Dynamotor Unit are of the open-core, exposed-winding, type of construction. These assemblies are completely varnish impregnated. It is conceivable that the specification requirements may be construed to imply that such construction is satisfactory. Since the basic requirements of the governing specifications are that the equipment give satisfactory and uninterrupted service under all operating conditions, this type of construction is entirely unsatisfactory. The power transformer and the filter reactors as used in the power supplies of the subject equipment can be expected to fail as the result of entrance of moisture through the insulation of their exposed leads, from "wick" action. They are without any protection from the damaging effects of dust storms, driving rain storms or insects, which are encountered in the tropics.

84. <u>Par. 2-55</u>. No tests were made on the audio frequency output transformers to determine their compliance with the requirements of this paragraph reference. The contractor should be requested to provide samples to the Laboratory for test.

85. <u>Par. 2-56</u>. Refer to paragraph 137.

86. <u>Par. 2-57</u>. In general, the component parts of the receiver units are inaccessible for servicing or replacement to a much greater degree than in accepted Naval practice. The removal of the r-f transformer or high frequency oscillator coil assemblies can be effected only upon the removal of the mounting screws for securing the supporting brackets of the centrally located resistor and capacitor terminal panel, or through the use of a soldering iron equipped with special angle tips. Their removal is further hampered by the inaccessibility of the leads which pass through the chassis and soldered to the under-sides of the tuning capacitors. The use of Bristol set screws in any part of the equipment where disassembly may be required for servicing is not satisfactory unless provision is made to assure that the special wrenches required for their operation are available as a part of the equipment, and further, that this provision be such that loss will be unlikely. One of the mounting screws for an i-f transformer is inaccessible unless a long bit screwdriver is available. As it is apparent that the i-f transformers may have to be exchanged to take advantage of the broad and sharp units it is believed that an improvement in mounting should be effected to facilitate such exchange.

87. The arrangements of the i-f transformers are such that the adjustment of the coupling of their coils cannot be effected without removing the complete units.

88. Access to the cw oscillator coil assemblies for tuning purposes, and for the replacement of oscillator vacuum tubes necessitates the removal of the shield cans enclosing these items. The removal of the cw oscillator coil assemblies for replacement, or servicing, necessitates the removal of the shield cans enclosing the filter components. The construction of the receiver units provides no convenient access to the

[redacted]

securing nuts of the cw oscillator inductor assemblies for wrench application, without subjecting the filter components to possible damage or permanent destruction.

89. The cellulose coverings for the dial windows are difficult to replace in the event their surfaces become scratched while in service, owing to the use of escutcheon pins for their mounting. The by-pass capacitors mounted on the chassis partitions and which may be expected to fail in service cannot be replaced without the removal of several screws or other components and the partial if not complete disarrangement of a good share of the wiring, in order to provide access to their mounting screws for wrench or screwdriver application. Practically all the resistors and molded mica dielectric capacitors are inaccessible for their replacement. It is not believed that any one of these items can be replaced without subjecting the wiring to damage or without the possible breakage of the soldering lug terminals to which they are attached.

90. Servicing of the r-f transformer high frequency oscillator coil assemblies or the replacement of any of their component parts is so difficult that it is felt that complete assemblies should be included among the spare parts furnished for the equipment rather than their separate components. It has been estimated by competent enlisted personnel trained for servicing Naval radio equipment that the replacement of a band switch wafer in any one of these assemblies would place the equipment out of commission for approximately eight hours. If complete coil assemblies, including band switches, were made available as spares, the time required to restore the receiver to operable condition after failure of any of the components would be greatly reduced.

91. The crowded arrangement of the wiring and of the component parts on the under-side of the receiver chassis is generally unsatisfactory, since it does not provide for the degree of serviceability required of equipment of this character. When it is considered that this equipment is to be employed primarily in field service, a degree of accessibility that will not require special tools and equipment for service adjustments is of paramount importance.

92. The power units associated with this equipment are considered as being suitably designed to provide for the necessary accessibility of component parts required by this specification reference.

93. Par. 2-58. This paragraph reference applies only to the Transmitting Equipment and therefore no comments will be made here.

94. Par. 2-59. Circuit symbols have been applied as required. However, no identification marks are shown on top of the r-f transformer, heterodyne oscillator, i-f transformer, or cw oscillator inductor shield cans to identify the trimmer capacitors for alignment purposes.

95. Par. 2-60. Micalex insulation, as employed in the construction of the i-f transformer and cw oscillator inductor assemblies of both

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receiver units, does not possess either glazed or ground surface finishes to effect compliance with the requirements of this paragraph reference of reference (b). The use of micalex insulation is approved under reference (e) only if it meets all of the requirements of reference (b).

96. Par. 2-61. The transparent cellulose material employed for enclosing the dial apertures and for displaying the dial fiducial marks for the receiver units is inflammable. Slivers of this material when held by a pair of tweezers and ignited by a match continued to burn until they were completely destroyed. The use of this material as employed in the model equipment is, therefore, in violation of the requirements of the governing specifications and contract.

97. Par. 2-62. No special provisions are made for lubricating the bearings of any of the panel operated controls of the receiver units. The bearings for the band switch and tuning control mechanisms consist of inserts pressed into the cast aluminum alloy frame which supports the tuning drive and band switch mechanisms. The material employed for the bearings cannot be determined because they are either obscured or plated. Ball bearings have not been employed. It is evident from the construction of the tuning and band switch mechanisms that the maximum degree of lubrication which they might receive would be possibly from the application of machine oil applied at the bearings and on the gears. The design of these mechanisms is not considered as being particularly suitable for the type of service for which the equipment is intended. In order to preclude freezing of the shafts in their bearings from the accumulation of corrosion resulting from prolonged inactivity of movable parts while in storage in humid salt atmospheres, some provision must be made for packing the gears and the bearings with grease. Such grease must necessarily be capable of retaining its lubricating properties, without loss of viscosity, at high operating temperatures or without appreciable increase in viscosity at low operating temperatures. Greases which satisfy these demands are commercially available.

98. Par. 2-63 and 2-64. No coupling joints or adjustable couplings are employed in the Model XTBW Radio Receiving Equipment.

99. Par. 2-65. Lead washers have not been adequately employed for the mounting screws or eyelets on ceramic insulators, as required by this paragraph reference.

100. Par. 3-1. The design and construction of the equipment are such as to permit its transportation by aircraft. The overall dimensions and weights of the separate units are given in previous paragraphs of this report and are considered as being of reasonable values. As mentioned elsewhere under other headings of this report, the equipment will not fully withstand the vibration tests as applied, which did not include rough handling as stipulated in the governing specifications.

101. Par. 3-2. The Types CAY 46076 and CAY 46077 Receiver Units are housed in a common cabinet which, in turn, is mounted by means of shock

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mounts and attachment brackets inside of another box, which serves as its transportation case. The transportation case is provided with a cover which is secured to the case by means of thumb screws. The transportation case and its cover are fabricated from aluminum with all corners and seams welded. The front edge of the box is provided with an aluminum flange which surrounds the outside front edge of the box and is provided with tapped holes for receiving the cover securing thumb screws. Brackets or "shoes" are spot welded to the two sides and rear of the box and are designed for receiving and securing the supporting legs for the cabinet when the equipment is set up for field operation. The Type CAY 21387 Dynamotor Unit employs a similarly constructed transportation case which houses its chassis. It is fabricated from aluminum and has fully welded seams. Lugs are provided on the outside front edges of the box for receiving the cover securing thumb screws and are spot welded in place. An aluminum foot is spot welded to the rear of the box so as to permit its resting in a level position when placed on a flat surface. The construction of the Type CAY 10034 Mobile Spare Parts Box is similar to that employed for the receiver units except that it is smaller in size. It employs an identical arrangement for securing its top cover in place. No separate transportation cases are provided for the Type CAY 19017 Storage Batteries, since it was the intent of their design that they would, in themselves, be watertight. They are, however, fitted with carrying handles secured to the batteries by means of webbed straps. Refer to paragraph 200 of this report. Other details of design and construction of the transportation cases mentioned above will be covered under the succeeding paragraphs. The transportation cases of the receiver and dynamotor units, the mobile spare parts box, and the storage batteries were subjected to immersion in salt water for ten minutes to such depth that all parts were covered by at least one inch of water, as required by this specification reference. The cases for the receiver and dynamotor units and the mobile spare parts box leaked water through flaws in the spot welds employed in their construction. There was no evidence of water having leaked around the gaskets of their covers. Water leaked into the top cavity of the storage batteries as the result of an imperfect fit between the battery cover and its retaining box. As mentioned elsewhere in this report, the terminal compartments for the batteries are not watertight. It should be mentioned, also, that the water which leaked into the top cavity of the battery also leaked between the outer box and the battery electrolyte container. This leakage occurred around the rubber gaskets separating these two containers.

102. Par. 3-3. Refer to paragraph 101 above.

103. Par. 3-4. Refer to paragraph 27 of this report.

104. Par. 3-5. The tools specified under this specification reference are not particularly applicable when setting up the receiver equipment or taking it down. Small tools, satisfactory for making internal adjustments, compensator capacitor adjustments, etc., as may become necessary

[redacted]

in the maintenance of this equipment, have not been furnished. The contractor has not presented information as to the character and quantity of tools which he proposes to furnish. The design of the model equipment is such that an abnormal number of special tools will be necessary to facilitate servicing of this equipment in the field.

105. Par. 3-6. The design and construction of the transportation case for the Type CAY 46078 Receiver Unit provide means whereby the cover may be employed as an operating table, when the unit is set up on its legs for operation. The cover, when so employed, is supported from the bottom edge of the case by means of suitable fixtures. Link chains are provided for bracing the front edge of the cover from the top side walls of the case. The mounting fixtures consist of cast brass angles to which are attached threaded studs, suitably machined, for attachment to the transportation case. The link chains serve a secondary purpose of tying the mounting fixtures together so as to prevent their separation, or loss, when removed from the case for packing. The design of the fixtures is not entirely suitable in that the machined ends of the threaded studs, to which the ends of the chain are attached, are too weak for the type of service for which they are employed. They may be easily bent or broken if excessive pressure is applied to the top of the operating table. The machined studs and the link chains are of steel without any plating to protect them from rust. The link chains are not provided with a sleeving to preclude their damaging the finish on the transportation case or the front panels of the receiver units. Refer to Plates 81 and 82.

106. Par. 3-7. The maximum overall dimensions of each unit, as arranged for transportation, are given under paragraph 27 of this report. The weights of the separate units are well within specification requirements and are tabulated under paragraph 30 of this report.

107. Par. 3-8 to 3-11, inclusive. These specification references apply only to the Transmitting Equipment.

108. Par. 3-12. Refer to paragraph 101 of this report.

109. Par. 3-13. The transportation cases of the separate units of this equipment are so designed that, when closed for transportation, they serve as complete protection to the units. All corners and edges are rounded and their construction is sufficiently strong to withstand handling, without derangement, or damage to any part of the units which they house. This statement should not be construed as implying that rough handling of the transportation cases will not result in damage or derangements of component parts of the separate units which are improperly designed or unsuitably constructed to withstand such handling. It is the intent of this statement to convey the thought that the construction of the transportation cases will not damage the parts, by virtue of its becoming distorted when handled, to the extent of subjecting the internal equipment to abnormal strain.

110. Par. 3-14. Refer to paragraphs 121 and 122 of this report.

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111. Par. 3-15. Refer to paragraph 74.

112. Par. 3-16. The transportation cases are of fabricated and welded construction. Their sides are ribbed to provide the required strength and rigidity. They comply, in all respects, with the requirements of this specification reference.

113. Par. 3-17. The transportation cases comply with the requirements of this specification reference.

114. Par. 3-18. The thumb screws, employed in the construction of the covers for the transportation cases, and provided for securing their covers to their respective cases, protrude from the covers. While these thumb screws do not interfere with the convenient handling of the transportation cases, they may become caught or bumped by interfering obstacles, while being packed for transportation in aircraft. Their construction is such that it is not believed they would be damaged under normal conditions of handling. The design of the covers is such that their retaining thumb screws cannot be loosened without tools if they have been properly tightened, beforehand, to preclude the entrance of water into the cases.

115. Par. 3-19. Rubber gaskets are provided on the covers of the transportation cases and are cemented between aluminum angles, spot welded to the covers. The gaskets appear to have been cut from sheet rubber stock and this, together with the fact that they are cemented in place, complies with the specification requirements for their easy replacement. The rubber gaskets appear to be entirely satisfactory and suitable for their intended purposes. The transportation cases, when immersed in water, showed no evidence of leakage of water around the gaskets. However, the thumb screws for the covers cannot be tightened by hand to arrive at this end, and must necessarily then be tightened with gas pliers or an equivalent tool. This procedure will ultimately destroy the knurling on the thumb screws and might result in their possible breakage. This condition could be remedied through the use of slotted thumb screws and a special wrench, with a screwdriver tip, for tightening or loosening the thumb screws. Such a wrench should be permanently mounted to each of the transportation cases, in such a manner as to preclude their possible damage or loss during the transportation of the equipment.

116. Par. 3-20. The covers of the transportation cases for the receiver and dynamotor units were not fitted with schematic and actual wiring diagrams of their associated apparatus. The contractor has not furnished any information as to what means he intends to employ for mounting such diagrams, or for their protection against rain or moisture, in compliance with the requirements of this specification reference. Also, the contractor has not furnished information to show the manner in which he intends to pack and protect the instruction book, as required.

117. Par. 3-21. The transportation cases are provided with suitable handles to facilitate their movement. These handles are well designed and

are mounted in such a manner that, when not in use, they are held against the sides of the cases by means of retaining springs.

118. Par. 3-22. The transportation cases, if carefully constructed so as to avoid the development of holes around the spot welds, would completely protect the equipment from damage resulting from external causes, (except vibration -- see paragraph 109), during transportation. The transportation case of the receiver unit and the mobile spare parts box are of the same height, but differ in the other two dimensions. The transportation case for the dynamotor unit is considerably smaller than the other cases in all of its dimensions.

119. Par. 3-23. The intent of this specification reference is considered as having been met.

120. Par. 3-24. The design and construction of the separate units of the subject equipment do not fully comply with the requirements of this specification reference. The Types CAY 46076 and CAY 46077 Receiver Units are provided with two handles mounted on either side of their front panels to assist in the removal of their chassis from their common cabinet, after loosening their panel retaining thumb screws. Removal of their chassis permits the replacement of the vacuum tubes and the alignment of the tuned circuits. The withdrawal handles are unsuitably arranged on the front panels, in that the two inner handles subject one's fingers to possible injury, due to their interference with each other, as the result of insufficient spacing. The use of a single handle on each panel and mounted at the top or bottom of the panel would facilitate the removal of the chassis. The chassis of the Type CAY 21387 Dynamotor Unit is not provided with a handle or similar device to permit its removal from its transportation case without subjecting its component parts to strain. Convenient access is not provided for the replacement of the rectifier vacuum tube or the pilot lamp in the Type CAY 20085 A. C. Power Unit, as required by this specification reference. The replacement of these components necessitates the removal of several screws and their replacement, therefore, cannot be effected without the use of tools. This applies also to the cw oscillator tubes in the receiver units where their replacement necessitates the removal of shield cans and their securing screws. The general accessibility of the component parts of the receiver units is very poor, and their replacement or servicing would be very difficult to accomplish in the present design of the model equipment. Refer to paragraph 86 above for further comments on accessibility of parts.

121. Par. 3-25. Type CAY 46078 Receiving Equipment. The main cabinet housing the Types CAY 46076 and CAY 46077 Receiver Units is provided with four stainless steel runners, two mounted at the top and two at the base of the cabinet, which serve the dual purpose of guides when sliding the cabinet into its transportation case, and means for securing the cabinet within its transportation case. These stainless steel guides are secured to the receiver cabinet through Lord shock mountings. When the receiver cabinet is fitted into its transportation case, the stainless steel guide strips slide under stainless steel straps mounted at the ends

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of the guide runways, and which serve as stops and securing means for the back ends of the guide strips. The front ends of the guide strips are secured to the transportation cases by means of nickel plated brass thumb screws. These thumb screws are permanently attached to their respective guide straps by means of beaded chains. The method employed for attaching these chains to the thumb screws is highly unsatisfactory, since the chains may be easily pulled loose or broken, thus subjecting the thumb screws to possible loss. The ends of the chains are secured by means of their insertion in holes, drilled into the tops of the thumb screws, and into aluminum blocks fastened to the inside of the transportation case, and the material then peened around the chain ends. The replacement of the chains, if broken, is therefore not readily made possible. While the thumb screws are nickel plated, they insert into aluminum blocks. The repeated usage of the thumb screws will ultimately result in the plating on the threads wearing away, thus placing dissimilar base metals in intimate contact, in violation of this specification reference. The design of the shock mounting guide strips and guide tracks is considered to be rugged and entirely satisfactory for their purpose, except for the fact that the Lord shock mounts do not have sufficient damping action to protect the receiver units from damage due to vibration at the natural period of the assembly. When the receiver cabinet thumb screws are in place, it is impossible to remove either of the two receiver chassis because of the obstruction offered by the beaded chains. The clearances provided around the thumb screws are such as to make tightening or loosening of the thumb screws somewhat difficult.

122. The chassis of the Type CAY 21387 Dynamotor Unit is secured within its transportation case by means of two nickel plated knurled and slotted thumb screws mounted on the side angle brackets of the chassis. These thumb screws engage with nickel plated brass blocks, with their threaded ends peened over, so as to preclude their becoming detached from their retaining blocks when completely loosened. The securing action of the thumb screws is to clamp the side mounting brackets, spot welded to the inner sides of the transportation case, between the thumb screw retaining block and the mounting brackets to which the thumb screws are attached. The design of the thumb screw retaining blocks is such that they may partially rotate and thus interfere with the free insertion of the chassis within its transportation case. In this connection, attention is invited to the fact that even though the retaining blocks do turn, the chassis may be completely inserted in the transportation case, but under these conditions the mounting brackets on the sides of the dynamotor are subjected to abnormal strain. The positions of the thumb screws do not permit their tightening, without the use of tools, to the degree necessary to prevent their loosening under conditions of vibration such as may be encountered during transportation. Such tools as will normally be carried would be unsatisfactory for this purpose and only a screwdriver of special design would be suitable.

123. Par. 3-26. The construction of each chassis of the Types CAY 46076 and CAY 46077 Receiver Units is such that, by virtue of the rear corner upright supports, it may be placed on a flat surface on its base, sides or back for servicing, without damage to or derangement of the

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component parts. The chassis construction of the Type CAY 21387 Dynamotor Unit or of the CAY 20085 A. C. Power Unit limits their being placed only on their sides on a flat surface for servicing. Placing the dynamotor on its back will result in probable damage to the exposed windings of the filter reactors, which employ open core construction. Likewise, placing the a-c power unit on its back will result in probable damage to the exposed windingsof the power transformer and filter reactors, which also employ open core construction, and excessive strain being placed on the vacuum tube rectifier socket, if the tube is left in place.

124. <u>Par. 3-27</u>. The Types CAY 46076 and CAY 46077 Receiver Units are secured in their common cabinet by means of knurled thumb screws arranged at each of the four corners of the receiver panels. The thumb screws are of one piece nickel plated brass construction. The thumb screw shanks are supported at right angles, with respect to the panel, by means of "U" shaped aluminum brackets, riveted to the panel, and provided with holes through which the thumb screw shanks pass. The thumb screws are retained with the panels, when loosened, by means of nickel plated brass cotter pins. The method of securing the receiver chassis within their common cabinet is not satisfactory. The nickel plating on the thumb screws is easily worn off with repeated usage (as was actually the case with the model receivers). The material employed for the cotter pins is so hard that bending the ends of the pins causes the material to become fractured at the points of bending. The design of the thumb screws does not provide for self-aligning features. The aluminum angle supports for the thumb screws may be easily distorted from their normal shape if the thumb screws should accidentally become hit, when loosened. The panel thickness is such that misalignment of the thumb screws results in the bowing of the panel when the thumb screws are tightened. The thumb screws engage with threaded holes in 1/16" thick aluminum angles fastened to the top and bottom of the cabinet. This is unsatisfactory, since the threads may become easily stripped, as they have in the case of the model units, upon tightening of the thumb screws. The nickel plating on the threaded ends of the thumb screws is easily worn through and hence will result in the base brass coming in intimate contact with the aluminum retaining angles, in violation of the governing specifications.

125. <u>Par. 3-28</u>. Refer to paragraph 74 of this report, for comments as to the suitability of the construction of the subject equipment for withstanding vibration.

126. <u>Par. 3-29</u>. This paragraph reference applies to the Transmitter Equipment and is covered in a separate report.

127. <u>Par. 3-30</u>. Antenna connections to the receiver units are effected by means of clip type terminals of the Rajah type, and suitable terminal posts. The terminal posts are insulated from the front panels of the receiver units by means of Isolantite bushings and are secured in place with nuts and lockwashers. The ceramic insulation is protected from possible damaging strains by the use of lead washers inserted between the bushings and the panels. The clip type Rajah connectors are provided with

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molded bakelite insulation attached to the ends of packard cable leads for connection to the break-in relays of the Transmitter Units. In spite of specification compliance, these antenna connectors are of such design that no provision is made for soldering the cable wires to the conducting elements of the connectors. The present design provides only a pressure contact between the cable wires and the metallic connectors, with no provision for locking the metallic connector in place. Movement of the relatively stiff cable will result in loss of contact between the cable and the antenna post. Normal handling of the cables results in the cable connectors, which are mounted at each end of the antenna cables, becoming loosened to the extent that they fall from the cables and therefore may become lost. Such was actually the case with one of the cable connectors furnished with the model equipment.

128. Par. 3-31. The antenna connection post and the power cable receptacle for each receiver unit are mounted on its front panel. No ground binding post is provided, ground connection being dependent upon continuity between the receiver and the source of power through the interconnecting cables. Neither the antenna posts or the power cable receptacle are conveniently located on either receiver. Connection of the antenna lead results in the operator's view of the panel control being obstructed. The connection of the power cables can be effected only by draping them in front of the receivers in such a manner that they detract from the usefulness of the operating table. The method for attaching the power cables is such that their removal is necessary, when withdrawing either of the two receiver chassis from their cabinet. The arrangement provided for antenna and power cable connection for the receivers is contrary to the requirements of the governing specifications, and to the contractor's descriptive specifications, which require that these connections be located in the rear of the unit so as to afford the maximum protection to the operating personnel. It is the opinion of the Laboratory that the specification requirement, for rear connections, is preferable to the methods employed in the model equipment. The power cable plugs entering the receiver units and the antenna connectors are not suitably protected against the entrance of moisture.

129. Par. 3-32. Each of the two receiver units is provided with two panel lights which project from the front panel and serve to illuminate the operating controls and dials.

130. Par. 3-33. The panel lights for each receiver unit are controlled by a panel operated on-off switch. The design of the panel lights is not considered appropriate for their intended purpose, in that they offer greater illumination for the panel controls than is necessary for their successful manipulation, and less than the required amount of illumination for the tuning dials to permit easy readability of the dials under conditions of night operation. The bright finishes on the toggle switches, phone jacks and antenna connectors, as well as the polished surface of the transparent dial covering, offer objectionable reflections from the dial lighting to the extent of being tiring to the operator's eyes. Under certain conditions of illumination, the glare from the dial aperture covering diminishes the readability of the tuning dial.

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131. Par. 3-34. The panel light fixtures discussed under the above paragraphs are constructed of brass and employ black wrinkle finish on all parts except their panel retaining rings, which are nickel plated and polished. The method employed for securing of dial light domes is entirely unsatisfactory, in that the domes are not adequately locked in place so as to preclude their loosening under conditions of prolonged and severe vibration or shock. The black wrinkle finish employed for the domes and the polished nickel finish employed for the retaining rings of the panel lights are considered unsuitable. The black wrinkle finish, in contrast with the photo-etched panel, renders the panel lamps conspicuously prominent and so detracts from the general appearance of the receiver panel. The polished nickel finish contributes to the light reflections which are considered as being excessive.

132. Par. 3-35. The lamps employed for the panel lights of the two receiver units are of the 12 to 16-volt bayonet base type, employing the Type T-4-1/2 bulb and Type C filament. The normal current rating for these lamps is 400 milliamperes.

133. Par. 3-36. The front panels of the receiver units are completely photo-etched with dull black background. The external surfaces of the cabinet for the Type CAY 46078 Receiver Unit, the external surfaces of the chassis of the Type CAY 21387 Dynamotor Unit, and the external surfaces of the chassis and cover of the Type CAY 20085 A. C. Power Unit are finished with the Navy standard black wrinkle finish. The interior surfaces of the front panels and chassis of the Types CAY 46076 and CAY 46077 Receiver Units, as well as the aforenamed items, have a satin finish resulting from the "Nasat" process, developed by the contractor, for protecting aluminum against corrosion. The exterior surfaces of the transportation cases for the receiver and dynamotor units and for the spare parts have an olive drab finish, their interior surfaces having the same satin finish as just described.

134. Par. 3-37. All controls and/or devices required for the operation of either receiver unit are located on the front panels, in identical arrangements. Symmetry has been attained in the arrangement of these controls and/or devices, but their arrangement does not provide easy and rapid operating conditions owing to the following interferences:

(a) The antenna leads when connected to their respective antenna posts obstruct the operator's view of the main tuning dials, and may cause interference with his free access to the control knobs of the main tuning capacitors and band switches.

(b) Operation of the controls by the operator, when wearing heavy gloves, will result in the accidental upsetting of the antenna trimmer capacitor settings, or the switching of the MCW-CW or MVC-AVC toggle switches, when operating the band switches.

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(c) There is insufficient clearance provided between the manual volume control knobs and the telephone cable plugs to permit quick and easy adjustment of these controls by an operator when wearing heavy gloves. This interference is greatest in the regions of their rotation, where they will usually be adjusted.

(d) The clearance provided between the phone jack and the monitor jack is such that the easy removal of either plug is hampered. In all probability, the operator will tend to withdraw the plugs by pulling on their cords.

The main tuning control is not designed to provide for quick traversing of the tuning ranges. The design of the control knob is unsatisfactory in that operation of the tuning control, by its use, is tiring.

135. <u>Par. 3-38 and 3-39</u>. All markings for operating controls on the front panels of either receiver unit are permanently photo-etched on the panels, and are of such size as to be easily readable at a distance of 24 inches under normal operating conditions. The panel markings for the controls are as shown on Plate 83.

136. <u>Par. 3-40</u>. Individual photo-etched nameplates have been employed. They are shown on Plate 92.

137. <u>Par. 3-41</u>. The number of friction or pressure contacts has not been kept to a minimum, and in many instances are not suitably designed to prevent erratic operation due to the effect of vibration, shock or exposure to moist sea atmosphere. Instances where compliance with this paragraph reference of the governing specifications fails are as follows:

(a) The shield cans for the r-f coil assemblies depend upon friction contact between the shield cans and the cast coil mounting bases for bonding to the receiver chassis. Owing to the light gauge material employed in the construction of the coil shield cans and their inherent loose fit, such contact as is provided is rather dubious and not permanent in character.

(b) The partition shields provided in the I. F. Receiver Unit for shielding the control grid leads of the first and second r-f amplifier tubes, and mounted to the ganged tuning capacitor, are constructed of light gauge aluminum. Their construction is such that they are free to vibrate, and when vibrated, they rub on the bottom spacer members of the ganged tuning capacitor, and therefore will result in noisy operation of the receiver.

(c) Where shielded wire has been employed, it has not been sufficiently anchored to prevent its movement, with consequent rubbing on metallic surfaces under conditions of

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vibration. Such anchoring as has been employed consists of waxed cord applied in such a manner that it cannot be permanently depended upon to secure these wires in place. In a few isolated instances, particularly for short shielded wire connectors, soldering lug terminals have been employed for securing these leads and have, in turn, been secured to the chassis by screws and nuts.

(d) Bonding of the rotor of the antenna trimmer capacitor to the front panel is dependent upon the pressure provided between a soldering lug and the securing nut and lock-washer for one of the panel mounting screws.

138. Par. 3-42 and 3-43. The requirements of these paragraph references have been covered under paragraph 34 of this report.

139. Par. 3-44. All rotatable devices, including control knobs, are secured to their respective shafts by suitable and satisfactory means, commensurate with the load to be driven. The rotors of the trimmer capacitors are provided with locking nuts for maintaining their adjustment under conditions of vibration. Their locking action proved to be ineffective when the equipment was subjected to the vibration test. The lock nuts, therefore, are not considered as being entirely suitable for their intended purpose.

140. Par. 3-45. Vacuum tube replacement of either of the two types of receiver units may be effected upon the removal of their receiver chassis from their common cabinet. While complete chassis removal is necessary, the Laboratory feels that the receiver units comply with the spirit and intent of the requirements of this paragraph reference of reference (b). The removal of the vacuum tube rectifier from the Type CAY 20085 A. C. Power Unit necessitates the removal of the cover, which, in turn, can be effected only upon the removal of six screws. Refer also to paragraph 120.

141. Par. 3-46. When the equipment is operated from the Type CAY 19017 Storage Batteries, and Type CAY 21387 Dynamotor Unit, the vacuum tube filaments and/or heaters derive their power from the storage battery supply. The vacuum tube heaters and/or filaments derive their power from a winding on a power transformer in the Type CAY 20085 A. C. Power Unit when the equipment is operated from this supply. This winding does not employ a center-tap, as required by this paragraph reference of reference (b), but its omission is permitted under reference (h). The operating voltages arriving at the heaters and/or filaments of the receiver vacuum tubes are less than the nominal rated values when operated from either type of power supply, the storage batteries at 12 volts, or the a-c power unit operated from 115-volt line.

142. Par. 3-47. The power transformer employed in the a-c power unit operates without excessive over-heating. It is of compact construction and air-cooled, but its construction is such that continuous operation under adverse operating conditions normally encountered in the

Naval service cannot be expected. Refer also to paragraph 83.

143. Par. 3-48. No provision is made for adjusting or controlling the filament and/or heater potentials under conditions of variation in supply voltage or frequency or in changing operation to H. F. from I. F. Receiver Unit or vice versa. While the specifications require such a control, the Laboratory is of the opinion that it is not necessary for the types of tubes employed.

144. Par. 3-49 to 3-53, inclusive. These paragraph references of reference (b) apply only to the Transmitting Equipment and therefore no comments will be made.

145. Par. 3-54. The receivers are so designed as to permit their simultaneous operation on their respective channels without interference, except as follows:

(a) The high frequency oscillator of the I. F. Receiver Unit when adjusted for operation on Band 3 will cause interference with the High Frequency Receiver Unit when operated on Band 1 and the I. F. Receiver is tuned from 1840 to 2000 kilocycles. Interference will be noticeable on the High Frequency Receiver between 2000 and 2160 kilocycles. This interference will be the direct reception of the high frequency oscillator of the I. F. Receiver Unit.

(b) Interference resulting from the direct reception of cw oscillator of the H. F. Receiver Unit will result when the I. F. Receiver Unit is tuned to its frequency.

(c) Direct reception of the second and third harmonics, by each receiver unit, of its own cw oscillator causes noticeable interference when the receivers are tuned to these harmonic frequencies.

146. Par. 3-55. A toggle switch mounted on the front panel of the Type CAY 46077 Receiver Unit permits the outputs of the two receivers to be mixed so as to enable one operator to monitor the outputs at both receivers. Separate headphone jacks are provided on the front panels of the two receiver units to permit two operators to cover two channels, one in each receiver, simultaneously and independently of each other.

147. Par. 3-56. Regulation curves for the Types CAY 21387 Dynamotor Unit and CAY 20085 A. C. Power Unit are shown on Plates 75 and 76, respectively. It will be observed that turning one receiver unit off results in considerable change in plate and filament voltages that are applied to the other receiver when operated from the A. C. Power Unit. The effect of this increase in supply voltages on the frequency stability of the receiver, as compared with the receiver when operated, under similar conditions, from the dynamotor unit, is shown by the data tabulated under Tables 10 and 11 for the Type CAY 46076 Receiver Unit, and under Tables 27 and 28 for the Type CAY 46077 Receiver Unit.

148. Par. 3-57. The subject equipment is designed to operate with an LM series frequency indicating unit, as covered by Specifications RE 13A 489D. Both the a-c and dynamotor power units are provided with a suitable plug-in receptacle for connection of the power cable of the crystal frequency indicator.

149. Par. 3-58. The requirements of this paragraph reference are covered under paragraph 105 of this report.

150. Par. 3-59. The receiving equipment, covered in this report, is not considered as being suitably designed for continuous operation under all conditions of operation to which this character of equipment may be subjected in the service. Detailed comments in this regard are given under other portions of this report.

151. Par. 3-60. This paragraph reference applies to the Transmitting Equipment, and the only comment that is necessary here is that there is provided on the front panel of each receiver unit a telephone jack for receiving the plug of the sidetone cable from the associated transmitter unit.

152. Par. 4-1 to 4-48, inclusive. These specification references apply only to the Transmitting Equipment and are covered under a separate report.

153. Par. 4-49. The Model XTBW Radio Receiving Equipment covers a frequency range from 200 to 18,100 kilocycles, without hiatus, through the use of two separate receiver units, mounted side by side in a common cabinet, and operated from a common power supply. The receiver units are designed for operation from separate antenna systems of unlike mechanical construction and electrical characteristics. A panel operated antenna trimmer capacitor, of the air dielectric type, is provided on the front panel of each receiver unit for compensating the alignment of the first tuned circuit for variations in the constants of the associated antenna system. In view of the fact that the constants of the antenna systems are subject to wide variation, since it is not probable that they will be exactly duplicated from one installation to another, due to limitations which might be imposed by the installation site, the antenna trimmer capacitors are not considered as possessing sufficient range for their intended purposes. Refer to paragraph 161 of this report for additional comments relative to these capacitors. Each receiver unit may be operated independently of the other. However, simultaneous operation of the two receiver units is not totally free of interaction or inter-receiver interference. The effects produced when one receiver is turned "on" or "off" while the other receiver is being operated, and the degree to which the oscillators of the two receivers cause interference are discussed elsewhere in this report.

154. Par. 4-50. The frequency range covered by the subject equipment is divided between two receiver units, namely, the Type CAY 46076 Intermediate Frequency Receiver Unit and the Type CAY 46077 High Frequency

Receiver Unit as follows:

Receiver Unit	Rated Frequency Range
Type CAY 46076	200 to 2000 kilocycles
Type CAY 46077	2000 to 18,100 kilocycles

Three bands are employed by the I. F. Receiver Unit and four bands by the H. F. Receiver Unit for covering their respective frequency ranges, as follows:

Type CAY 46076		Type CAY 46077	
Band No.	Rated Frequency Range - Kilocycles	Band No.	Rated Frequency Range - Kilocycles
1	200 to 435	1	2000 to 4000
2	435 to 960	2	4000 to 7300
3	960 to 2000	3	7300 to 11,600
		4	11,600 to 18,100

Tables 1 and 18 show the actual end frequencies, frequency coverage, and band ratio for each band of the Types CAY 46076 and CAY 46077 Receiver Units, respectively. It will be noted from Table 18 that the band ratios for Bands 1 and 2 of the H. F. Receiver Unit exceed those for Bands 3 and 4. The increase in the band ratio for each of Bands 1 and 2 is effected through the use of additional plates for each section of the ganged tuning capacitor, which are paralleled with the main plates by the ganged band switch. The percentages of frequency overlap between adjacent bands of the receiver units and/or between the high frequency end of the I. F. Receiver Unit and the low frequency end of the H. F. Receiver Unit are given under Tables 2 and 19, and are in compliance with the requirements of reference (b). However, attention is invited to Table 19, where it will be noted that there is very little overlap between the low frequency end of any band of the H. F. Receiver Unit and its corresponding mean frequency. It is believed that adequate low frequency overlap for the several bands of this receiver unit will be difficult to attain in production, without abnormal control of coil manufacture, with the same mean frequencies as were arbitrarily selected by the manufacturer for the model. The reverse situation exists for the I. F. Receiver Unit, but this deficiency can be corrected without resorting to coil redesign.

155. Par. 4-51. Each receiver unit is tunable to all frequencies, without hiatus, within its respective frequency range. Tuning of each receiver unit is accomplished through the use of a single tuning control, which actuates a ganged tuning capacitor, through a geared tuning drive. A directly driven ganged band switch is provided for each receiver for band selection.

156. Par. 4-52. The Types CAY 46076 and CAY 46077 Receiver Units are arranged for either manual or automatic control of sensitivity. Manual control of sensitivity of each receiver unit is effected through the use of a potentiometer which regulates the cathode bias voltages applied to

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the r-f amplifier, converter, and i-f amplifier tubes, when the panel operated "MVC-AVC" toggle switch is in the "MVC" position. The automatic sensitivity control is a carrier operated device which rectifies an amplified carrier voltage, at the intermediate frequency, for controlling the gain of the same tubes as are controllable by the manual sensitivity control. This control functions when the "MVC-AVC" toggle switch is in the "AVC" position, and is effective for cw, mcw or voice reception; and for strong input signals when the receiver is adjusted for MVC.

157. Par. 4-53. Adjustment of each of the two receiver units for manual or automatic control of sensitivity is accomplished by the manipulation of a toggle switch mounted on the front panel of the receiver. The panel markings for this switch are "AVC," for automatic sensitivity control; and "MVC" for manual sensitivity control, with the toggle switch in the up position for the former control and down for the latter control. The panel markings, while differing from those specified under this paragraph reference of reference (b), are considered as being equally suitable, and as meeting the spirit of the specification.

158. Par. 4-54. A single control labeled "VOLUME" consisting of two potentiometers mounted, in tandem, on a common shaft and employing a common control knob, is mounted on the front panel of each receiver unit. This control functions as follows:

(a) When the "MVC-AVC" toggle switch is thrown to the "MVC" position, one of the potentiometers controls receiver sensitivity for both cw and modulated signals by regulation of the cathode bias voltage applied to the r-f, converter, and i-f amplifier tubes. The second potentiometer is connected as a grid input resistance for the first a-f amplifier tube and is inoperative as an output level control. This circuit detail is amplified under paragraph 22(S) of this report.

(b) When the "MVC-AVC" toggle switch is thrown to the "AVC" position, the cathodes of the controlled tubes are returned to ground potential through their respective biasing resistors in the case of the H. F. Receiver Unit, and to ground through a fixed resistor in the case of the I. F. Receiver Unit. The potentiometer which functions as the sensitivity control on "MVC" is rendered inoperative as a gain control. This results in approximately full r-f gain being applied to diode of the second detector before AVC action becomes effective. The second potentiometer acts as a control of the a-f voltage being applied to the control grid of the first a-f amplifier tube for both cw and modulated signals. In effect then, the dual control may be considered as a sensitivity control when the receiver is adjusted for "MVC" and as a volume control when it is adjusted for "AVC." Consequently, the marking of this control is considered inappropriate since it does not accurately indicate the functions of the control.

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159. Par. 4-55. Adjustment of each receiver unit for cw, mcw and voice is effected by means of a panel operated toggle switch, with the up position of the toggle switch marked "CW," and "MCW" for the down position. This marking is contrary to the requirements of this reference paragraph of the governing specifications, reference (b), but is considered as being in keeping with the spirit and intent of the specifications. Switching this toggle switch to the "CW" position causes plate and screen power to be applied to the beat frequency oscillator tube. Power is applied to the heater of this tube at all times that the receiver is "on."

160. Par. 4-56. An "on-off" toggle switch labeled "REC. MON., ON-OFF" is mounted on the front panel of the H. F. Receiver Unit for mixing the audio outputs of both receiver units in parallel to permit one operator to monitor both receivers simultaneously. The audio output of the I. F. Receiver Unit is conveyed to the phone jack of the H. F. Receiver Unit through the interconnecting power cables of the two receiver units and the Type CAY 21387 Dynamotor and/or Type CAY 20085 A. C. Power Unit, (whichever is employed), which acts as a junction box. Control of the audio output from each receiver unit can be effected only through the individual receiver volume controls, no separate mixing control being supplied or required.

161. Par. 4-57. Each of the two receiver units is provided with a panel operated antenna trimmer capacitor of the variable air dielectric type. This capacitor is connected across the first section of the ganged tuning capacitor, which tunes the first tuned circuit. Hence, it operates regardless of the position of the ganged band switch. Its function is to compensate the alignment of the antenna circuit with the r-f amplifier tuned circuits for variations of antenna capacities which may occur from one installation to another. This trimmer capacitor was not found to be very effective, during the tests, when the input of the receiver unit was connected to a Model LC-1 Standard Signal Generator, through a standard dummy antenna, whose constants conformed with the latest I.R.E. standards. That the antenna trimmer capacitor was ineffective under these conditions is not entirely conclusive of its value, since the specifications do not state either the constants, or type, of dummy antenna to be employed for determining receiver performance. As will be noted from study of the sensitivity curves appended hereto, the receiver sensitivity was but very slightly improved by the optimum adjustment of the antenna trimmer capacitor. Also, the range of the antenna trimmer capacitor was not adequate to effect input resonance at all frequency settings with the type of dummy antenna employed.

162. Par. 4-58. A beat frequency oscillator is included in each receiver unit to permit the reception of cw signals. It is coupled to the secondary of the intermediate frequency transformer, feeding the diode second detector through a small coupling capacitor. Hence, the amplitude of the coupled voltage from the oscillator, which is tuned to a fixed frequency, is unaffected by receiver tuning. The beat frequency oscillator is controlled by the panel operated "CW-MCW" toggle switch. The tuning of the oscillator is approximately 1200 cycles higher than the frequency of the intermediate frequency amplifier of the Type

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CAY 46076 Receiver Unit and approximately 1500 cycles higher than the frequency of the intermediate frequency amplifier of the Type CAY 46077 Receiver Unit. The difference frequency produced between the i-f carrier frequency and oscillator frequency is, for each receiver unit, the beat note appearing at the output of the receiver. Turning the beat frequency oscillator "on" results in an increase of the receiver noise level. This increase of noise level in the case of the I. F. Receiver Unit results in cw sensitivities that are generally poorer than their corresponding mcw sensitivities, when both are measured with respect to a 400 microwatt noise level, with no signal input. The increase in noise level due to the beat frequency oscillator is less detrimental to the cw sensitivity of the H. F. Receiver Unit. The sensitivity of this receiver, when adjusted for cw reception, is better than when adjusted for the reception of 30 per cent modulated signals. An examination of the sensitivity curves submitted with this report will show the degree to which the above statements apply at any frequency to which either receiver unit may be tuned.

163. Par. 4-59. The air dielectric variable trimmer capacitor provided on the front panel of each receiver unit and discussed under paragraph 161 above, is not considered as being suitable for the purpose for which it was intended. Its capacity range is not believed to be adequate for maintaining the alignment of the antenna circuit with the amplifier circuits when the antenna capacity is subject to as wide variation as may be encountered in the type of service for which the subject receiving equipment is intended. No mechanical stops are provided on the capacitor to limit the rotation of the rotor to 180° adjustment. While the pointer of the control knob on this capacitor is intended to indicate the setting of the capacitor, there is no assurance that this indication will always be reliable as the knob may become loosened and retightened in a wrong position. The receiver units do not comply with the intent of the specifications in that the operation of the antenna trimmer capacitor does not materially affect the overall gain, as would normally be expected for a well designed input circuit. Such a circuit would provide for a high degree of antenna input selectivity and high input gain. These features would then make for higher signal to noise ratios than would otherwise obtain.

164. Par. 4-60. Each receiver unit is provided with an audio frequency output transformer apparently hermetically sealed in a metallic enclosure. Two parallel connected telephone jacks are provided on the front panel of each unit and connected across the secondary winding of the output transformer. One of these jacks, marked "OUTPUT," is provided for receiving the operator's head telephone plug, while the second jack, marked "SIDETONE," is provided for receiving the sidetone plug from the receiver's companion transmitter unit. A toggle switch, marked "REC. MON. - ON-OFF," and mounted on the front panel of the H. F. Receiver Unit permits mixing of the outputs of the two receivers by connecting their output jacks in parallel. One side of the secondary winding is at ground potential. The primary winding of the output transformer is connected between the plate of the second a-f amplifier tube and the high voltage d-c bus. Plates 34 and 74 show the variation of audio output with load resistance for the

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Types CAY 46076 and CAY 46077 Receivers, respectively. It will be noted that the specified load value of 425 ohms is not the optimum value for either receiver unit. Maximum audio output is obtained when the load resistance is of the order of 1000 ohms. Hence, specification compliance with regard to output load impedance is not met by either receiver unit.

165. Par. 4-61. The manufacturer's descriptive specifications which became a part of the contract, reference (c), stated that the output transformers would employ a balanced construction for the elimination of all r-f potentials from the output leads. No evidence has been presented that such construction has been employed or that electrostatic shielding of the secondary windings has been incorporated in the output transformers furnished in the model receivers. The secondary windings, and hence the telephone jacks, are free of all d-c potentials, but not r-f potentials. The r-f potentials appearing on the phone cord of a pair of head telephones, plugged into the output phone jack, are at the frequency of the receiver's intermediate frequency amplifier and/or the fundamental and harmonic frequencies of the receiver's beat frequency oscillator, when used. The intermediate frequency amplifier precludes the appearance of all other r-f potentials on the head telephone cord. The r-f potentials on the head telephone cord cause no receiver instability even when the head telephone cord is in close proximity with the antenna terminal of its own receiver unit. The second harmonic of the beat frequency oscillator of either receiver unit produces an audible beat note when the preselector of that unit is tuned to the frequency of this second harmonic. This interference is equivalent to approximately one microvolt.

166. Par. 4-62. Sensitivity measurements were made at five frequency settings for each band of each receiver unit. These frequency settings included the mean overlap frequency settings for each band. All sensitivity measurements were made with the receiver units adjusted for manual volume control, with the r-f input voltages from a Standard Signal Generator applied to the input of the receiver unit, under test, through a Standard Dummy Antenna whose constants comply with the latest I.R.E. Standards, and with the receiver output voltages measured across a 425-ohm load.

(1) The mcw sensitivity at any frequency of either receiver unit, as defined herein, is the number of microvolts of r-f input, modulated 30 per cent at 400 cycles per second, applied at the receiver input, through a Standard Dummy Antenna, from a Standard Signal Generator, to produce an audio output of 10 milliwatts across a receiver output load of 425 ohms, when the receiver is adjusted for resonance with the frequency of the applied signal voltage. This definition is predicated upon an initial adjustment of the manual sensitivity control of the receiver for a 400-microwatt noise level across the receiver load with no applied r-f input signal. Where the noise level with

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the manual sensitivity control set for maximum receiver sensitivity (or gain) is less than 400 microwatts, the sensitivity of the receiver was measured at the maximum gain setting.

A. Type CAY 46076 I. F. Receiver Unit.

(a) MCW sensitivity curves are shown on Plate 3 for this receiver when operated either from the Type CAY 21387 Dynamotor Unit or Type CAY 20085 A. C. Power Unit. The sensitivity at any frequency over the complete range of this receiver unit complies with the requirements of this specification reference of reference (b). It will be evident, from an inspection of the sensitivity curves, that adjustment of the antenna trimmer capacitor for maximum output response at each frequency setting offers little improvement in the sensitivity than results where the antenna trimmer is adjusted only at 2000 kilocycles and left at this setting for all other frequencies. The sensitivities are in general slightly better when the receiver is operated from the dynamotor unit than from the a-c power unit, due to the lower noise level resulting from the use of the former power supply.

(b) Maximum noise level curves are shown on Plate 6 for each band of the receiver unit when adjusted for mcw reception on MVC or AVC and operated from the two types of power supply. These curves show the maximum noise level at each frequency setting, with no r-f input signal applied, and with the variable gain control set for maximum for both MVC or AVC. These curves show that under these conditions the overall gain with the receiver adjusted for AVC is greater than for when it is adjusted for MVC at any frequency within its range. The difference between the two gains is practically constant. This is due to the fact that with the receiver adjusted for MVC the minimum resistance of the sensitivity control is not zero, and hence, a somewhat higher initial bias is applied to the controlled tubes than for the AVC condition.

(c) The sensitivity of this receiver unit, over its complete frequency range, is not appreciably affected by tube replacements. Sensitivity data

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under Table 3 show the variation in sensitivity which results when employing complete tube complements whose mutual conductances are given under Table 3A.

B. <u>Type CAY 46077 H. F. Receiver Unit with Wide Band I. F. Amplifier.</u>

(a) MCW sensitivity curves are shown on Plate 36 for each band of this receiver unit when employing wide band i-f transformers, and operating from the Type CAY 21387 Dynamotor Unit. Data for these curves were taken prior to the subjection of the receiver to a temperature test which resulted in the maladjustment of the receiver alignment, as reported under paragraph 186. Similar sensitivity curves, shown on Plate 38 with the receiver unit operated from the Type CAY 21387 Dynamotor Unit and Type CAY 20085 A. C. Power Unit, were plotted from data taken after the receiver was restored to normal operation by the manufacturer's representative. Realignment of the receiver unit improved the sensitivities of Bands 1 and 2 over their original values, (dynamotor operation), but the sensitivities of Bands 3 and 4 were generally poorer. Poorer sensitivities resulted when the receiver was operated from the a-c power unit, than from the dynamotor unit, as will be apparent from a comparison of the two sets of curves shown on Plate 38. Attention is invited to the fact that at approximately 3400 kilocycles on Band 1 there is a sharp decrease in sensitivity which appears to be due to resonance absorption by some other circuit. Adjustment of the antenna trimmer capacitor for maximum output response at each frequency setting offers little improvement in the sensitivity, at that frequency, than obtains when it is adjusted at 18,100 kilocycles and left at this setting for all other frequencies. This receiver unit, when employing wide band i-f transformers and operated from either the dynamotor or a-c power units, does not comply with the specification limits for mcw sensitivity at the middle frequency range covered by Band 2, or the low and high frequency ends of Band 4. The sensitivity at any frequency of Band 4 is outside of the specification limit when the receiver is operated from the a-c power unit and the antenna trimmer is adjusted for maximum response only at 18,100 kilocycles.

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(b) Maximum noise level curves are shown on Plate 43 for each band of the receiver unit when adjusted for the reception of modulated signals. These curves were plotted from data obtained after the realignment of the receiver unit, and show the maximum output noise voltages occurring across the receiver load as the tuning of the receiver is varied over its complete range, with no applied r-f input signal, and with the variable gain control associated with manual or automatic control of receiver gain adjusted for maximum gain. Under these conditions, the overall receiver gain is greater with the AVC "on" than when it is "off," and this increase in gain varies with frequency. However, the apparent difference in the overall gain with AVC "on" and "off," as the receiver tuning is varied, is due to the fact that the minimum resistance of the sensitivity control varied with repeated settings, and this variation increased with frequency. This difficulty was due to a peculiar phenomenon which manifested itself upon the manipulation of the manual sensitivity control and which is discussed under paragraph 173 of this report. It will be noted from an inspection of the two sets of curves on Plate 43 that the maximum noise level is, with few exceptions, less than 400 microwatts when the receiver is adjusted for MVC. It follows then, that the receiver is without any reserve gain, and since the model receiver unit fails to comply with the specification requirements for mcw sensitivity considerable improvement must be made in the receiver design to effect specification compliance in production.

(c) The sensitivity of this receiver is critical to tube replacements and hence will require circuit realignment. Sensitivity data under Table 20 show the variation in sensitivity which results when employing complete tube complements whose mutual conductances are given under Table 20A. Replacement of the converter tube causes the greatest change in sensitivity.

C. <u>Type CAY 46077 H. F. Receiver Unit with Narrow Band I. F. Amplifier.</u>

(a) MCW sensitivity curves are shown on Plate 39 for each band of this receiver unit when employing narrow band i-f transformers, and operated from the Type CAY 20085 A. C. Power Unit. Data for

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these curves were obtained after exposure of the receiver unit to two temperature cycles. For comparison, similar curves are plotted from data observed with the receiver unit operating from the Type CAY 21387 Dynamotor Unit shortly after the equipment was submitted for test. The data for the two sets of curves cover an interval of several weeks. The initial sensitivity at any frequency, within the frequency range of the receiver unit, was considerably better when employing narrow band in lieu of wide band i-f transformers. This is to be expected, since the use of the narrow band i-f transformers provides for improved signal to noise ratios. The initial sensitivity curves should be compared with those shown on Plate 36, obtained under similar operating conditions, but with wide band i-f transformers. The sensitivities obtained after the temperature cycles approach those shown on Plate 36. The loss of sensitivity over the complete frequency range of the receiver unit can be attributed, in part, to the increase of noise level resulting from the use of the a-c power unit as compared with that obtained when using the dynamotor unit, and, in part, to the adverse effect of temperature variation on the receiver. Temperature variation caused permanent changes in the receiver characteristics. Aging of certain components appears to be more rapid than would normally be expected.

(b) Maximum noise level curves are shown on Plate 44 for each band of the receiver unit when adjusted for mcw reception with the volume control set for maximum gain on MVC and AVC, and operated from the Type CAY 20085 A. C. Power Unit. Data for these curves were obtained after the completion of the temperature tests. Comparative noise level curves, also obtained after these tests, are shown with the receiver adjusted for MVC and operated from the Type CAY 21387 Dynamotor Unit. It will be noted that for any frequency setting of the main tuning control, the maximum noise level is less when the receiver is operated from the dynamotor unit than from the a-c power unit. These curves will show to what extent the latter power unit contributes to the differences in the sensitivity curves shown on the lower half of Plate 39.

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(2) The cw sensitivity at any frequency of either receiver unit, as defined herein, is the number of microvolts of r-f carrier input applied at the receiver input through a Standard Dummy Antenna from a Standard Signal Generator to produce a 10 milliwatt output, at an audio frequency of 1000 cycles, across a receiver output load of 425 ohms, when the receiver is adjusted for resonance with the frequency of the applied carrier frequency. The definition is predicated upon an initial adjustment of the manual sensitivity control of the receiver for a 400 microwatt noise level across the receiver load with no applied input signal, and with the beat frequency oscillator "on." Where the noise level, with the manual sensitivity control set for maximum receiver sensitivity (or gain), is less than 400 microwatts, the sensitivity of the receiver was measured at maximum gain setting.

A. <u>Type CAY 46076 I. F. Receiver Unit.</u>

(a) CW sensitivity curves are shown on Plate 2 for each band of this receiver when operated from the two types of power supply. The curves are shown for two conditions of antenna trimmer capacitor adjustment as indicated on the Plate. Specification compliance is met at all frequencies, except at the high frequency end of Band 3, when the receiver is operated from the Type CAY 21387 Dynamotor Unit; and except at the upper half of the frequency range of Band 1, and high frequency end of Band 3 when operated from the Type CAY 20087 A. C. Power Unit. Adjustment of the antenna trimmer capacitor at each frequency setting offers no great improvement in the sensitivity than obtains from a fixed setting of this capacitor.

(b) Maximum noise level curves are shown on Plate 5 for this receiver unit when adjusted for cw reception. It will be noted from a study of these curves that, in general, higher maximum noise levels result from a-c operation than from battery operation of this receiver unit.

(c) The sensitivity of this receiver unit when adjusted for the reception of cw signals is appreciably affected by tube replacements, particularly if it becomes necessary to replace the converter tube. Sensitivity data are given under Table 3 to show the variation in the cw sensitivity of the receiver with complete tube replacements. The change in the frequency of the heterodyne oscillator with replacement of

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the converter tube is given under Table 16. The loss in sensitivity is due largely to the shift of the frequency of the high frequency oscillator which upsets its tracking with the preselector circuits. Hence circuit realignment will be necessary when one or more of the tubes of these circuits are replaced, if optimum receiver performance is to be obtained.

B. <u>Type CAY 46077 H. F. Receiver Unit with Wide Band I. F. Amplifier.</u>

(a) CW sensitivity curves are shown on Plate 36 for each band of the receiver unit whem employing wide band i-f transformers and operating from the Type CAY 21387 Dynamotor Unit. Data for these curves were obtained prior to the subjection of the receiver unit to a temperature cycle and subsequent modification by the manufacturer's representative. Similar cw sensitivity curves shown on Plate 37 with the receiver operating from the Type CAY 21387 Dynamotor Unit, and the Type CAY 20085 A. C. Power Unit, were plotted from data taken after the receiver was restored to normal operation following the temperature test. Except for the first half of the frequency range covered by Band 2 when the receiver is operated from the a-c power unit, specification requirements for cw sensitivity are met at all frequencies throughout the range of this receiver. It will be noted from the curves that the sensitivity of the receiver at any frequency is not appreciably affected by the adjustment of the antenna trimmer capacitor.

(b) Maximum noise level curves are shown on Plate 42 and obtained under operating conditions similar to those previously discussed. Since these curves are similar to other curves discussed in the foregoing paragraphs, no further comments regarding them are necessary.

(c) The sensitivity of this receiver when adjusted for the reception of cw signals is adversely affected by tube replacements, particularly the replacement of the converter tube. Under Table 20 are shown sensitivities resulting from replacement of the original tube complement by two other sets of tubes having mutual conductances

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shown under Table 20A. As in the case of the i-f receiver unit, replacement of the converter tube causes a shift in frequency of the high frequency oscillator, to the extent of causing mistracking between this oscillator and the preselector circuits, as indicated under Table 33. This mistracking impairs the sensitivity of the receiver to the extent shown under Table 20, and consequently circuit realignment will be necessary with the replacement of one or more of the tubes in the r-f circuits if optimum receiver performance is to be obtained. Replacement of the tubes resulted in no evidence of instability.

C. Type CAY 46077 H. F. Receiver Unit with Narrow Band I. F. Amplifier.

(a) CW sensitivity curves shown on Plate 39 were obtained after the receiver unit had been subjected to two complete temperature cycles. Operation from the a-c power unit when employing narrow band i-f transformers following the temperature tests resulted in sensitivities which were outside of the specification limits between the frequency range of 3,000 to 6,000 kilocycles and 15,500 to 18,100 kilocycles. Corresponding maximum noise voltage curves are shown on Plate 44.

167. Par. 4-63. The selectivity of each receiver unit was measured with the receiver adjusted as for sensitivity and with the applied r-f carrier voltage from the Standard Signal Generator modulated 30 per cent at 400 cycles per second. Selectivity measurements were made at several frequency settings of both receivers, as indicated on the plates appended hereto, with the manual sensitivity control adjusted for optimum and reduced gain.

A. Type CAY 46076 I. F. Receiver Unit. Selectivity curves are shown on Plates 7 to 9, inclusive, for three frequency settings in each of the three bands of the receiver, with the manual sensitivity control adjusted for optimum gain. Similar curves are shown on Plates 10 to 12, inclusive, for one frequency setting in each of the three bands, with the manual sensitivity control adjusted for optimum and reduced gain at each of these frequency settings. Under Tables 4 and 5 are tabulated the band widths at the specified input levels. The contract limit for the 6 db input level is not met at any of the frequencies in which measurements were made, except 435-kilocycle setting on Band 1, and the 960-kilocycle setting on Band 3.

The effect of the temperature cycle on the selectivity characteristics of this receiver was to broaden the selectivity below the 6 db input level for Band 1 and to sharpen the selectivity characteristics below this input level for Bands 2 and 3. Reduction of the manual sensitivity control causes a sharpening of the selectivity characteristics below the 6 db input level and a broadening of these characteristics for increasing input levels from 6 to 60 db.

B. Type CAY 46077 H. F. Receiver Unit. Selectivity curves shown on Plates 45 to 48, inclusive, apply to this receiver unit when employing wide band i-f transformers and with the manual sensitivity control adjusted for optimum gain. Measurements of selectivity were made at three frequency settings of each of the four bands of the receiver prior to the subjection of the receiver to a temperature cycle and subsequent modification by the manufacturer's representative. Plates 49 and 50 show selectivity curves observed at 3,000 and 15,000 kilocycles, after the temperature test, and with the manual sensitivity control adjusted for optimum and reduced gain. Corresponding selectivity curves are shown on Plates 51 to 56, inclusive, measured under similar conditions but with the receiver unit employing narrow band i-f transformers. Table 21 gives a resumé of the band widths at the input levels specified under reference (b). Except for the middle half of the frequency range covered by Band 4, the initial selectivities failed to comply with the requirements of the contract, reference (c). The effect of the temperature test, as determined at the 3,000 and 15,000-kilocycle settings, was to alter the selectivities at these frequency settings. Reduction of the sensitivity reduces the selectivity at 3,000 kilocycles at all input levels, and broadens the selectivity at 15,000 kilocycles at all input levels except at the 20 db level. Corresponding band width data are shown under Table 22 for the receiver unit when employing narrow band i-f transformers. It will be noted from these data, that with but few exceptions, the contract limits are not met at any frequency within the range of this equipment or for any input level as specified under reference (c), except at the 6 db input level. The effect of reducing the receiver sensitivity is clearly indicated on Plates 55 and 56. The irregular shapes on the selectivity curves for the higher frequencies of this receiver unit and characterized by a general spreading, or bowing, of their sides are due to oscillator pulling or receiver overloading. There is a strong tendency of the oscillator to pull when subjected to strong input signals. This fault would probably be overcome through the use of a separate h-f oscillator tube and a separate first detector tube in lieu of the pentagrid converter type of tube, employed in the model, for these functions.

168. Par. 4-64. Overall audio fidelity characteristics are shown on Plates 13, 14 and 15 for three frequency settings within the tuning range of the Type CAY 46076 I. F. Receiver Unit. Similar characteristics are shown on Plates 57 and 58 for the 2000 and 18,100 kilocycle settings of the Type CAY 46077 H. F. Receiver Unit, when employing wide band i-f transformers, and on Plate 59 for the same frequency settings when employing narrow band i-f transformers. Measurement of overall audio fidelity was accomplished by applying an r-f carrier from a Standard Signal Generator, modulated 30 per cent at several audio frequencies from 30 to 5000 cycles per second, to the input of the receiver unit under test through a Standard Dummy Antenna. The audio output voltages, appearing across the 425-ohm receiver load, were measured with a General Radio Wave Analyzer employed as a vacuum tube voltmeter. The curves shown on all but Plate 59 are for two r-f input levels, one being the microvolts permitted by reference (b) to produce a 10 milliwatt output across the receiver load, with the manual sensitivity control adjusted accordingly; and the other being 100 microvolts with the manual sensitivity control adjusted for 10 volts (235 milliwatts) output across the same load. All adjustments were made for a 1000 cycle modulation frequency, and the variation of audio output with modulation frequency is, therefore, expressed in terms of decibels variation with respect to the response at this frequency taken as the zero decibel reference level. The input level for the curves shown on Plate 59 was the microvolts permitted in reference (b) to produce, at each frequency, a 10 milliwatt output across the receiver load with suitable receiver adjustments.

169. Neither of the two receiver units comply with the contract requirements for overall audio fidelity at any frequency within their respective tuning ranges. The I. F. Receiver Unit, however, approaches specification compliance at 200 and 600 kilocycles. The overall audio fidelity characteristics of either receiver unit, when adjusted for a 1000 cycle output of 10 volts, as produced by a 100 microvolt modulated carrier input, shows less attenuation of the audio frequencies above and below 1000 cycles than it does when the receiver is operated at lower input and output levels. Hence, the non-compliance with the specification requirements is aggravated as the receiver output level is increased. The irregularity of the curve, shown on Plate 14 for the 100 microvolt input level, which takes place between 1000 and 3000 cycles per second is the result of the presence of a slight degree of regeneration.

170. Par. 4-65. The audio distortion at any frequency of either receiver unit does not exceed 7 per cent combined r-m-s harmonics for outputs varying between 1.0 milliwatt and 300 milliwatts, and for r-f carrier inputs modulated 30 per cent at 400 cycles per second, in compliance with the paragraph reference of reference (b).

171. Par. 4-66. The image selectivity, at any frequency throughout the respective tuning ranges of the two receiver units, is well within the limits specified under this paragraph reference of reference (b). Image selectivity curves are shown on Plate 16 for each band of the Type CAY 46076 I. F. Receiver Unit, and on Plate 60 for each band of the Type CAY 46077 H. F. Receiver Unit, when employing wide and narrow band i-f trans-

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formers. Data for these curves were obtained with both receivers operated from the Type CAY 20085 A. C. Power Unit.

172. The specifications do not specifically cover tests for determining the degree of rejection which the preselector circuits of the two types of receivers offer to their respective intermediate frequencies. However, tests for i-f rejection were made and the results are given under Table 6 for the Type CAY 46076 I. F. Receiver Unit; and under Table 23 for the Type CAY 46077 H. F. Receiver Unit, when employing wide or narrow band i-f transformers. The i-f rejection ratio at any frequency is the ratio of the input microvolts at the intermediate frequency to the input microvolts at the resonant frequency required to produce standard output. The degree of rejection offered by either receiver unit to its intermediate frequency at any frequency setting within its frequency range is considered satisfactory, except for the 200-kilocycle setting of the i-f receiver unit. At this frequency the i-f rejection ratio is only 900. This represents an input of 620 microvolts at the intermediate frequency. Spurious response sensitivities, including the direct reception of the intermediate frequency, as afforded by the two receiver units, are not generally satisfactory for Naval receiving equipment.

173. <u>Par. 4-67</u>. A. <u>Type CAY 46076 I. F. Receiver Unit</u>.

(a) Resonant overload characteristics, as measured at the low and high frequency ends of each band of the receiver, are shown on Plates 17 to 22, inclusive. These measurements were made with the receiver adjusted for cw operation at optimum gain, and for a 1000 cycle beat note at resonance. Similar curves, shown on Plates 23 to 28, inclusive, were obtained under similar test conditions except that the receiver was adjusted for mcw reception. The receiver shows no evidence of blocking, at any frequency within its range, from strong r-f inputs, either modulated or unmodulated. Receiver blocking is prevented by the fact that for high values of r-f inputs, the automatic volume control becomes operative when the receiver is adjusted for manual volume control. The variation in the beat note frequency, resulting from strong r-f inputs, is shown under Table 14 for the frequency settings at which measurements were made. The frequency variation, at any frequency, falls within the specification limit, assumed to be applicable in these instances, and derived from paragraph 4-73 of reference (b).

(b) Maximum audio output and the audio output at resonant overload, as measured for cw inputs at the overlap frequency settings of each band of the receiver, are shown under Table 7. Similar data are given under Table 8 for outputs resulting from r-f inputs, modulated 30 per cent at 400 cycles, at the same frequency settings. Maximum undistorted output is assumed to be that output which obtains at resonant overload. Under this assumption,

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specification compliance is met at all frequency settings except for at the high frequency end of Band 1 and the low frequency end of Band 2 for modulated input signals. However, since the audio distortion, at any frequency setting, is within the specification limit for audio outputs up to 300 milliwatts, this receiver unit can be considered as complying with the specification requirements for maximum undistorted output. It is to be noted that resonant overload occurs for inputs approximately one order greater than corresponding inputs necessary to produce standard output.

B. Type CAY 46077 H. F. Receiver Unit.

(a) Resonant overload characteristics are shown on Plates 61 to 64, inclusive, for the high frequency ends of each band of this receiver when adjusted for cw operation, and on Plates 65 to 68, inclusive, for the same frequency settings with the receiver adjusted for mcw operation. These measurements were made with the receiver employing the wide band i-f transformers and adjusted for standard conditions. As will be noted from the cw resonant overload curves, the beat note for cw operation of the receiver must be higher than 1,000 cycles to prevent receiver blocking. Receiver blocking results from the pulling of the high frequency oscillator on the application of strong input signals. As the amplitude of the r-f input is increased up to a certain critical level, this level differing with frequency, the output beat note frequency is decreased. Further increases in the input amplitude results in the beat note frequency returning to normal. It is to be emphasized that at no frequency at which measurements were made did the beat note go through zero beat. This phenomenon of frequency reversal appears to be independent of the frequency to which the receiver may be tuned. If the receiver is adjusted for a high enough beat note on cw so that the shift in beat note frequency will remain within the flat portion of the overall fidelity characteristic, the output level will remain substantially constant for inputs greater than that necessary to produce resonant overload. There is no evidence of receiver blocking at any frequency within the range of this equipment. The loss of output, as shown on the plates, is the result of the shift in the beat note frequency to such values that are not amplified by the audio system of the receiver. The degree of shift in the beat note frequency, from strong input signals, is shown for the end frequency settings of each band under Table 31. The behavior of this receiver, when adjusted for the reception of cw signals, is not considered satis-

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factory since the beat note which must be maintained in order to prevent loss of output signal is higher than that which is normally considered suitable for copying. There is no evidence of receiver blocking when adjusted for mcw operation. The same devices are employed in this receiver unit as for its companion unit to preclude receiver blocking when subjected to strong input signals.

(b) Maximum audio output, at any frequency within the range of this receiver, is greater than 600 milliwatts for cw inputs. Maximum undistorted output, as derived from the cw resonant overload curves, is greater than 300 milliwatts. Resonant overload at any frequency occurs at approximately one order of input greater than required to produce standard output. Complete data are given under Table 24. The maximum audio output, with the receiver adjusted for mcw reception, is greater than 600 milliwatts, and the maximum undistorted output, as derived from the resonant overload characteristics, is greater than 300 milliwatts at all but the highest frequency setting of the receiver, where it is only 132 milliwatts. Resonant overload for modulated inputs occurs at inputs which vary between three to four times that required to produce standard output. Refer to Table 25.

174. Par. 4-68. The noise output of each receiver unit, when adjusted to an mcw sensitivity not less than the maximum required by paragraph 4-62(1) of the governing specifications, and when receiving a pure cw input signal is shown, in terms of ratios of carrier plus noise voltage to tone modulated carrier plus noise voltage, on Plate 4 for the Type CAY 46076 I. F. Receiver Unit; on Plate 40 for the Type CAY 46077 H.F. Receiver Unit, when employing wide band i-f transformers; and on Plate 41 for this same receiver unit when employing narrow band i-f transformers. Specification compliance is met by the former receiver unit. Band 2 of the latter receiver unit fails to comply with the specification limit over the first half of its frequency range. Somewhat better ratios are obtained for either receiver unit when operated from the Type CAY 21387 Dynamotor Unit. The method employed for obtaining these data was to apply an r-f carrier, modulated 30 per cent at 400 cycles per second, at such amplitude as is permitted by specification for the test frequency to the input of the receiver. The manual sensitivity control was then adjusted for a 10 milliwatt output, as produced by the applied input signal. Modulation was then removed and the voltage resulting from the carrier noted. The ratio was then calculated from this voltage divided by standard output voltage produced by the modulated carrier input.

175. Par. 4-69. The main tuning dials on the two receiver units are provided with individual frequency calibrations for each of their respective bands. These calibrations are in terms of kilocycles for the

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I. F. Receiver Unit, and megacycles for the H. F. Receiver Unit. A dial mask, operated from the ganged band switch, is provided for concealing unused calibrations on the tuning dial so that only one dial calibration is exposed. Under Table 17 are shown the calibrated frequencies for each band of the I. F. Receiver Unit. A similar tabulation is shown for each band of the H. F. Receiver Unit under Table 34. The number of kilocycles covered per division of each dial scale for each receiver unit is shown under the following tabulation:

Type CAY 46076 I. F. Receiver Unit

Band No.	Rated Freq. Range - Kc	Kc per Div.
1	200 - 435	5
2	435 - 960	10
3	960 - 2000	20

Type CAY 46077 H. F. Receiver Unit

Band No.	Rated Freq. Range - Kc	Kc per Div.
1	2000 - 4000	50
2	4000 - 7300	100
3	7300 - 11600	100
4	11600 - 18100	100

The marking of the dial scales is contrary to the specification requirements and to the manufacturer's descriptive specifications which became a part of the contract, reference (c). The dial scales are not considered as satisfactory as linear dial scales for use on Naval receiving equipment. Dial scales are reverse etched but the individual graduations are not easily distinguished, particularly at the high frequency ends of the scales where the markings become crowded. The dial index is not sufficiently prominent, for either receiver unit, to permit readability of the dial settings, at distances up to 24 inches, under certain lighting conditions which are apt to cause reflections from the transparent material employed for covering the dial apertures.

176. Par. 4-70. The common cabinet housing the two receiver units is supported from the transportation case by means of Lord shock mounts. These Lord shock mounts do not possess sufficient stiffness to preclude possible damage to the receiver units when subjected to a vibration frequency equal to the natural period of the combined assembly. Vibration tests conducted on this equipment show that when this frequency was reached, the amplitude of vibration of the receiver cabinet within its case exceeded the range over which the shock mounts were effective, thus permitting the cabinet to strike the retaining channels within the case. At other frequencies, the limits within which the mounts were effective were not exceeded. No measurements could be made of any microphonics resulting from the vacuum tubes because, if they were present, they were over-shadowed by other noises which appeared at the receiver output during the vibration. The origin of these noises could not be definitely determined. However, there is sufficient evidence, as noted throughout this report, to lead to the conclusions that they are due to faulty contacts occurring in the band switch, between the shield cans and chassis, etc. The Lord shock mounts are replaceable upon removal of the cabinet from the transportation case and the removal of the receiver chassis. The locking device provided on the tube shields, together with the friction afforded between the tubes and the tube shields, preclude any possibility of the tubes' striking each

other or any part of the equipment when subjected to violent shock. It is believed that the shockproofing, as such, is adequate for all conditions except such violent shock or persistent vibration as would not be likely to occur in service. It is not adequate, however, to prevent receiver noises with the receiver construction provided, and it is believed that if the receivers are designed to function with the mounts provided it will more nearly meet service requirements than to alter the mounts.

177. Par. 4-71. Operation of the two receiver units, under conditions of vibration, as specified in this specification reference was unsatisfactory. The increase in noise level exceeded the specification limits as the frequency of the vibration was increased from 5 to 30 cycles per second. The operation of the I. F. Receiver Unit, when receiving a cw signal, was such that while the shift of beat note did not exceed the maximum limit permitted by the specifications, the signal intensity became so reduced at certain vibration frequencies as to be completely obscured by the noise level. This loss in signal intensity apparently was due to the development of faulty contacts occurring in one or more of the band switch sections when the vibration frequency was adjusted to be equal to the natural period of the receiver assembly. The operation of the H. F. Receiver Unit under similar conditions of vibration was such that, even at low vibration frequencies, the beat note was immediately rendered inaudible, regardless of the signal frequency. When the vibration frequency was increased to 15 cycles per second the receiver became completely inoperative, and remained so, even when the vibration was removed. Switching of the band switch, however, restored the receiver to normal operating conditions. In view of these tests it is evident that the band switches employed in both receiver units are entirely unsatisfactory for use in Naval equipment. After a one-half hour vibration of the two receiver units at such a frequency as to be equal to the natural period of the receiver assembly as mounted in its transportation case, it was found that screws in the cable plug assemblies had become loosened and in some instances had become lost. Also the majority of the lock nuts on the trimmer capacitors, which had been previously tightened, became loosened to the extent that they were easily turned with one's fingers. A few mounting screws, in isolated places, became loosened and dropped inside of the cabinet. There was no evidence of any wires having become broken or damaged. All tubes remained seated in their sockets and panel mounted controls remained tightly secured in place. The dynamotor unit, which was also subjected to the same vibration test, when mounted in its transportation case, showed no ill effects.

178. Par. 4-72. A dual volume control, provided on the front panel of each receiver unit, and operated by a single control knob, serves the dual function of controlling the gain of the r-f circuits when the receiver is set for manual volume control; and the audio output level when the receiver is set for automatic volume control. The range and linearity of this control when employed for the control of receiver sensitivity are shown on Plates 30 to 32, inclusive, for each band of the Type CAY 46076 I. F. Receiver Unit when adjusted for cw or mcw reception. On Plate 33

are shown range and linearity curves of that section of the dual control which regulates the audio output level on AVC. The range of the sensitivity control on MVC exceeds the specification minimum of 80 db at any frequency within the range of the equipment. The volume control, acting in conjunction with AVC, is capable of varying the audio output from zero to the maximum available output of the receiver, and as this control is in the a-f circuit, its action is independent of the frequency to which the receiver may be tuned. Similar curves showing the range and linearity of the sensitivity control of the Type CAY 46077 H. F. Receiver Unit are shown on Plates 71 and 72, with the receiver adjusted for mcw and cw operation. The range and linearity of the volume control which functions on AVC are shown on Plate 73 for these same frequency settings. The a-f gain control like that for the I. F. Receiver Unit is capable of varying the audio output from zero to the maximum available from the receiver. The sensitivity control of this receiver unit complies with the specification requirements for range.

179. Par. 4-73(1). Operation of the automatic volume control of either receiver unit produces no appreciable reduction in selectivity or frequency shift of the heterodyne oscillator in excess of the specification limits. Operation of the manual volume control at any frequency within the frequency range of either receiver unit reduces its selectivity, and causes a shift in the high frequency oscillator which exceeds the specification limits. The effect of change of the setting of the manual sensitivity control upon the overall frequency stability is shown under Table 15 for the Type CAY 46076 Receiver Unit and under Table 32 for the Type CAY 46077 Receiver Unit. The sensitivity and/or volume control of either receiver unit functions over its operable range with no evidence of receiver blocking at any frequency setting of its respective receiver units. The reduction of receiver sensitivity with angular rotation of the manual sensitivity control of the I. F. Receiver Unit does not comply with the specification requirements. In this respect, the manual sensitivity control does not afford substantially logarithmic reduction of sensitivity with its angular displacement. The output level control for the I. F. Receiver Unit affords substantial logarithmic control of audio output with its angular displacement from zero output up to such levels where overload begins to take effect. The output level control of the H. F. Receiver Unit provides for linear control of audio output with its angular displacement from zero up to approximately two-thirds of its angular displacement and logarithmic control of audio output for the remaining portion of its range.

(2) Neither of the two potentiometers which comprise the dual volume control of either receiver employ wire-wound construction. They are the carbon type and function without introducing extraneous noises in the audio output when the "MVC-AVC" switch is set at either of its two positions. From past experience with composition element potentiometers, neither of these controls can be considered suitable for their intended purposes, because similar potentiometers have not given satisfactory operation after prolonged exposure in high humid saline atmospheres. Since the subject equipment may remain in storage over long periods of time, during which the equipment may be subjected to wide variations in temperature and humidity, the effect of these climatic conditions on the poten-

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tiometers when left in an inactive state may be adverse. Experience has shown that only wire-wound potentiometers are suitable for the type of service for which the subject equipment is intended. It is realized that considerable improvement in composition units has been effected in recent years, and it would appear advisable that samples of this and other similar types of more recently developed potentiometers be tested for type approval.

180. Par. 4-74. Tests were conducted on the two receiver units to determine their respective capabilities to recover from the application and removal of a five volt r-f signal, applied across the receiver input terminals and with the receiver tuned to the frequency of the applied signal. Tests were conducted in the following manner.

Test A. A five-volt signal, of a given frequency from a high power driver, was applied across the input of the receiver tuned to the same frequency and operating with AVC "on." The signal was instantly removed and the time required for the receiver to recover normal operation measured photographically.

Test B. This test was conducted in the reverse order with respect to Test A; that is, the time required for AVC action was determined after the instant application of the five-volt signal.

Test C. With the five-volt signal applied to the receiver input the AVC-MVC toggle switch was switched from AVC to MVC and the recovery time measured.

Test D. Again, with the five-volt signal applied to the receiver input the AVC-MVC toggle switch was switched from MVC to AVC.

The measured time constants, as determined for two test frequencies for each receiver, are as given in the following tabulation.

		Time Constant - Seconds			
Receiver Unit	Frequency Kilocycles	Test A	Test B	Test C	Test D
I.F.	1000	0.11	0.010	0.25	0.06
I.F.	2100	0.08	0.010	0.17	0.06
H.F.	2100	0.071	0.010	0.20	0.02
H.F.	10500	0.27	0.085	0.145	0.10

Except at the 10,500-kilocycle setting on the H. F. Receiver Unit, the equipment complies with the requirements of this specification reference. However, it will be noted that relatively high time constants obtain under the conditions as outlined under Test C. Also, the application of the five-volt r-f signal, as for Test B, results in an instantaneous surge of

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the output signal. This surge is equivalent to an increase of approximately 25 per cent of the output signal.

181. Par. 4-75. The equipment is considered as complying with the spirit and/or intent of this specification reference.

182. Par. 4-76. The equipment, as furnished to the Laboratory, is capable of continuous operation without damage to or deterioration of any integral part with the exception of normal life deterioration of vacuum tubes and wear of dynamotor brushes, provided it is not subjected to high ambient temperatures or severe vibration.

183. Par. 4-77 and 4-78. 1. Type CAY 46076 Receiver Unit.

A. Automatic volume control characteristics are shown on Plates 17 to 22, inclusive, for the overlap frequencies of each band of this receiver when adjusted for cw reception. Similar curves, obtained for r-f input signals, modulated 30 per cent at 400 cycles per second, are shown on Plates 23 to 28, inclusive. These characteristic curves were plotted from data obtained under four test conditions, namely;

(a) The noise level was adjusted for 400 microwatts with the receiver set for manual volume control, and with no signal applied to the receiver input. The receiver was then set for operation with automatic volume control, and the output voltages recorded as the input signal was progressively increased in steps.

(b) The second test was made in the same manner as for (a), but with the noise level adjusted for 400 microwatts, with no input signal, and with the AVC "on."

(c) The third test was conducted as described under (b) above, except that the manual volume control was retarded so that standard output obtained with AVC "on," and with the r-f input voltage as specified for cw and/or mcw sensitivity, for the test frequency, under reference (b).

(d) The fourth test was a repetition of the third test except that the manual volume control was retarded, with AVC "on," until standard output resulted for an input signal of 100 microvolts.

B. The results of the test, described under (A)(a) above, resulted in the following effects; namely;

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(a) With the receiver adjusted for either cw or mcw reception, and with no r-f input applied, switching from MVC to AVC resulted in a large increase in the receiver output noise level, and vice-versa. The increase in noise level at each of the five frequency settings for each band of the receiver is shown on Plate 29. It will be noted that this noise increase is as large as 23 times the initial noise level on MVC.

(b) It follows then, that if the receiver is adjusted for standard conditions, (i.e., 10 milliwatts output and 400 microwatts noise level), switching from MVC to AVC results in an increase of audio output which exceeds the specification requirements, as stipulated under paragraph 4-78 of reference (b). This holds at any frequency within the range of the equipment, and for cw or mcw signals. Moreover, the output will be largely noise, and the specified signal to noise voltage ratio is not reached, except for stronger input signals which will cause automatic volume control action. The useful sensitivity, with AVC, for any frequency setting, therefore, is approximately one order higher than the corresponding sensitivity with MVC for the same volume control setting. On Plates 23 to 28, inclusive, the point at which a 5 to 1 signal to noise voltage ratio obtains is shown on the curves labeled "B." These points are derived from the curves labeled "F," which show approximately when AVC action takes effect.

(c) Under the test conditions as described under (A)(a) above, the requirements of paragraph 4-77 of reference (b) are not met at any frequency within the range of the receiver. The allowable voltage variation of audio output is 4 to 1 above standard output voltage for an increase of r-f input of 10,000 to 1 above that necessary to produce standard output. It will be noted from the "B" curves on the plates that the increase of audio output voltage is approximately 10 times that for standard output for both cw and mcw inputs within the specified input voltage ranges.

C. The automatic volume control characteristics, as measured under the test conditions described under (A)(b) above, are represented by the curves labeled "C." Under these conditions the receiver fails to comply with the requirements of paragraph 4-77 of reference (b) at the following frequency settings and inputs.

[redacted]

Band No.	Freq. Kc	Type of Input	Reason for Non-Compliance
1	435	MCW	Standard output not obtainable.
3	2000	MCW	Variation of output voltage greater than 4 to 1.
1	435	CW	Standard output not obtainable.

It will be noted from these curves that, in general, the sensitivity of the receiver is materially reduced if the adjustment for standard noise is made for either cw or mcw reception with AVC "on." Also, under these same test conditions, compliance with the requirements of paragraph 4-78 of reference (b) is not met at any frequency for either cw or mcw inputs. This is due to the fact that, regardless of which one of the gain controls is adjusted, switching of the MVC-AVC switch will result in a large increase in gain if switched from MVC to AVC; and the converse effect, if switched from AVC to MVC. This statement applies also to the curves labeled "D" and "E" on the plates.

D. Automatic volume control characteristics labeled "D" on the plates were measured under the conditions described under (A)(c) above, in the light of a possible interpretation of paragraph 4-77, reference (b). Under these test conditions, the requirements of the paragraph reference are met, at any frequency setting within the range of the receiver, and for cw or mcw inputs. However, in several instances the receiver output noise level, with no applied input signal, exceeds standard noise level. This is contrary to the requirements of paragraph 4-62 of reference (b). In these instances, specification compliance cannot be considered as having been met. Therefore, the interpretation of paragraph 4-77 of reference (b) upon which the test procedure under (c) above is predicated, can be viewed only as a means to an end, namely, that of effecting compliance with this specification reference.

E. The curves labeled "E" on the plates are self-explanatory. It will be noted from these curves that at certain frequencies the no signal noise level exceeds 400 microwatts even after the volume control, on AVC, has been reduced to provide for standard output with a 100 microvolt input signal.

2. Type CAY 46077 Receiver Unit.

A. Automatic volume control characteristics are shown on Plates 61 to 64, inclusive, for the high frequency ends of each band of this receiver, when adjusted for cw

[redacted]

reception. Similar curves, obtained for r-f inputs modulated 30 per cent at 400 cycles per second, are shown on Plates 65 to 68, inclusive. An analysis of these curves is similar to that given above for the Type CAY 46076 Receiver Unit, except as follows:

(a) Compliance with the requirements of paragraph 4-77 is effected only under the condition when the audio gain control, which functions when AVC is "on," is retarded (a-f gain reduced) so that standard output obtains with an r-f input of the value as permitted under reference (b) for sensitivity at the measurement frequency, or for higher r-f inputs. This holds for both cw or mcw inputs, provided that the receiver tuning is adjusted, for cw inputs, to a beat note frequency which will not cause a break to occur in the continuity of the characteristic curve.

(b) Compliance with the requirements of paragraph 4-78 is met only at such frequency settings where the noise level at maximum gain, on MVC, is less than standard. Or in other words, only when the manual volume control is at or near its maximum gain setting for both MVC and AVC adjustments. This holds for both cw and mcw inputs. Any reduction in the overall gain of the receiver will destroy the receiver's compliance with the requirements of the specification reference. The increase in noise level resulting from switching the MVC-AVC switch from MVC to AVC is shown for each of five frequency settings of each band of the receiver on Plates 69 and 70. Curves are shown for both cw and mcw operation, with the receiver operated from both types of power supply, and with the initial noise levels being those which obtain on MVC.

(c) Operation of this receiver on AVC with cw inputs is complicated by the fact that constant retuning of the receiver is necessary, particularly at the higher frequencies, to maintain a constant beat note frequency. As the signal increases in intensity, it varies the frequency of the beat note. The breaks in the AVC characteristics shown on Plates 61 to 64, inclusive, are not the result of overloading, but are the result of the beat note, initially adjusted for 1000 cycles,

[redacted]

decreasing in frequency with increasing input voltage to such low values as to be greatly attenuated by the audio amplifier of the receiver. Further increases of input voltage result in a reversal of the beat note frequency drift. The same phenomena were observed on MVC. The circuit design of the receiver is such that the breaks in the AVC curves cannot be avoided except by adjusting the initial frequency of the beat note to some high frequency, so that the total frequency drift will be along the flat portion of the receiver's fidelity characteristic at the test frequency. In this event the initial frequency of the beat note will be too high to permit ease of code reception and copying. It is believed that the pentagrid converter tube is the main contributing factor causing the phenomena which are peculiar with this receiver unit when operated either on MVC or AVC and adjusted for cw reception.

184. In general, neither receiver unit complies with the requirements of paragraphs 4-77 and 4-78 of reference (b). The requirements of the latter specification reference conflict with those of paragraph 4-54 of the governing specifications. The contractor has provided, on each receiver unit, a dual volume control for adjusting radio frequency gain or audio frequency level in the manner as prescribed in the governing specifications. Such an arrangement automatically precludes any practical solution for effecting compliance with the requirements of paragraph 4-78. In the light of the performance data resulting from the use of the dual volume control, there is some question as to its advantage for the type of service for which the receivers are intended, as compared with the results which would obtain were the radio frequency and audio frequency gain independently controlled. A study of Plates 23 to 28, inclusive, which include Curves A, B and F, will show that weak signals in the range below the point where the AVC system becomes effective can be received with a better signal to noise ratio in the MVC than in AVC condition. Curve A is plotted for the condition that a 400 microwatt noise exists for the adjustment of the sensitivity control when in the MCW condition. It will be observed that the curve passes through the standard output level of 10 milliwatts (with a 5 to 1 voltage ratio) for signal plus noise to noise ratio, for an r-f input ranging from .1 to .2 times that required for the same signal plus noise to noise ratio, when the AVC condition is employed. (Obtain this ratio for the AVC condition by reference to Curves "B" and "F.") The reason for this loss of useful sensitivity for weak signals when shifting from the MVC to the AVC condition is that when in the AVC condition, full gain in all gain controlled circuits ahead of the detector exists for input signal levels below the level when the AVC starts to function. In the no signal condition, or weak signal condition, the noise alone approaches the maximum output that the receiver is capable of giving which is entirely too much output to be bearable to an operator wearing phones. The noise level

[redacted]

can be reduced only by adjustment of the volume control which is in effect an attenuator ahead of the audio amplifier. This adjustment does not appreciably improve the signal to noise ratio, as evidenced by the fact that the "B," "C," "D," and "E" curves are not appreciably changed in shape as the volume control is adjusted for the output levels indicated. Thus in practice, the useful sensitivity for the AVC condition is from one-half to one order poorer than for the MVC condition of operation. This was demonstrated by practical tests, in which it was found possible to make solid copy of code signals in the MVC condition when they were unheard in the AVC condition.

185. <u>Par. 4-79</u>. The receiver unit operates without evidence of regeneration when the supply voltage for battery operation is varied from 11 to 15 volts, and from 95 to 125 volts for a-c operation. The frequency of the heterodyne oscillator is appreciably affected by changes of supply voltage in the following manner:

(a) <u>Type CAY 46076 Receiver Unit</u>. The effect of battery voltage variation on the overall frequency stability of this receiver is shown under Table 10. Data are shown for a supply voltage variation from 11 to 15 volts, and from 15 to 11 volts. The data shown represent the total change in frequency at the end of these changes. Sufficient time was allowed to elapse at the start and finish of each test to permit receiver stabilization to take place. The variation at any frequency within the range of this receiver does not exceed the specification limits, as set forth under paragraph 4-80, which are assumed to be applicable in this instance. Similar data are tabulated under Table 11 for progressive changes in line voltage from 115 to 95 volts, from 95 to 125 volts, and from 125 to 115 volts. It will be noted that the frequency of the heterodyne oscillator returned to its initial value at the end of the test cycle. While in two instances the frequency variation is just outside of the assumed specification limits, specification compliance is essentially met. In Table 12 are shown the effects on the overall frequency stability of this receiver resulting from switching the MVC-AVC toggle switch from MVC to AVC; and from switching the high frequency receiver "on" and then "off." The receiver was operated from the dynamotor unit. Sufficient time was allowed to elapse to permit stabilization to take effect at the start and finish of each test. Table 12 is self-explanatory and no further comment need be made. Similar data, shown under Table 13, were measured under similar conditions, except that the receiver was operated from the a-c power unit. It will be noted that turning the high frequency receiver unit "on" or "off" produces larger variations in the output beat note than indicated under Table 12. This is due to the fact that with the receiver operated from the a-c power unit, the additional load offered by the high frequency receiver results in a variation in both the heater and plate

[redacted]

supply voltages to a greater extent than when the receiver under test is operated from the dynamotor unit. In this latter instance, the change in heater voltage is only that due to the increase in voltage drop in the battery supply cable, as will be noted from Plates 75 and 76. The heater and plate supply voltages arriving at the vacuum tubes of the receiver under test are affected to a greater extent with the second receiver turned "on" when the first receiver is operated from the a-c power unit than from the dynamotor unit.

(b) Type CAY 46077 Receiver Unit. The results of the tests, obtained in a similar manner as for the I. F. Receiver Unit, to determine the effect of variation of battery voltage and line voltage on the overall frequency stability of this receiver unit are shown under Tables 27 and 28. These tables are self-explanatory. It will be noted, however, that the overall frequency stability of this receiver unit is more sensitive to supply voltage variations than for the I. F. Receiver Unit. Specification compliance is not met at all frequency settings within the range of the equipment. These statements apply equally well to the data shown under Tables 29 and 30, which show the effect of turning the I. F. Receiver Unit "on" and "off," and turning the MVC-AVC toggle switch on the receiver under test from MVC to AVC, on the overall frequency stability of the H. F. Receiver Unit.

186. Par. 4-80. An unsuccessful attempt was made to measure the variation in the frequency of the high frequency oscillator of each receiver, when subjected to variations of temperature ranging from -15° C. to +50° C. These measurements were conducted in accordance with the specification requirements wherein the receiver under test was adjusted to receive a fixed frequency and the temperature was maintained at a constant value for a sufficient length of time to permit stabilization to take place. Measurements were conducted at each of several temperatures with the frequency drift recorded, at each temperature, at the end of a 10-minute warm-up period and then again at the end of the next 50-minute period of operation at the selected temperature. The data thus obtained became worthless owing to the fact that the wax on the coils melted to such a degree that in the high frequency unit it ran in between the plates of the air dielectric trimmer capacitors. The receivers were later modified by the manufacturer's representative to the extent of removing the excess wax from their coils and air dielectric trimmer capacitors. They were then realigned. It was found that the first temperature test had very little effect upon the alignment or the overall sensitivity of the I. F. Receiver Unit. However, the selectivity was slightly affected, and it was necessary to readjust the coupling of the i-f transformers to reestablish the original band widths. Measurements for frequency stability under conditions of constant ambient temperature were repeated as follows:

[redacted]

(a) Type CAY 46076 I. F. Receiver Unit. This unit was set up in the Laboratory and tests for frequency stability were conducted at room temperature. Measurements of the stability of the high frequency oscillator were determined at the 400 and 880 kilocycle settings by coupling the output of a General Radio Heterodyne Calibrator to the high frequency oscillator circuit of the receiver, and adjusting the heterodyne calibrator for zero beat with the signal from the high frequency oscillator of the receiver. Measurements were taken at the end of the 10-minute warm-up period and again at the end of the next 50-minute period of operation. These data are as follows:

High Frequency Oscillator Stability - Constant Ambient Temperature

		Frequency Variation - C.P.S.			
		10 Min. Run		50 Min. Run	
Band No.	Freq. Kcs.	Actual	Allowed	Actual	Allowed
1	400	-87	250	+399	250
2	880	-108	440	+593	250

Similar data were taken at the 880 kilocycle setting of the receiver, but with the cw oscillator on, so that the measured drift was the overall drift of the two oscillators. This measurement was made with the heterodyne calibrator coupled to the input of the receiver and adjusted for a zero beat at the receiver output as obtained by beating the receiver output with a thousand cycle signal from a General Radio Interpolation Oscillator. The overall frequency variation at the end of the 10-minute warm-up period and at the end of the next 50 minutes of operation was as follows:

Overall Frequency Stability - Constant Ambient Temperature

	Frequency Variation - C.P.S.	
Period of Test	Actual	Allowed
10 minutes	+153	440
50 minutes	+121	250

Measurement of the drift due to the cw oscillator alone was determined by coupling the output of the heterodyne calibrator to the cw oscillator circuit and adjusting the calibrator for zero beat with the oscillator frequency. This oscillator is a fixed frequency device, and its frequency stability will be independent of any frequency to which the receiver may be tuned. The frequency stability

[redacted]

of the cw oscillator under the specified conditions of measurement was as follows:

Frequency Stability of CW Oscillator - Constant Ambient Temperature

Period of Test	Frequency Variation - C.P.S. Actual	Allowed
10 minutes	+10	250
50 minutes	+285	250

(b) Type CAY 46077 H. F. Receiver Unit. Tests conducted at room temperature employing the same procedures as described above for the I. F. Receiver Unit were made to determine the frequency stability of the high frequency oscillator at the 4,000 and 11,400 kilocycle settings of the receiver. These data are as follows:

High Frequency Oscillator Stability - Constant Ambient Temperature

		Frequency Variation - C.P.S.			
		10 Min. Run		50 Min. Run	
Band No.	Freq. Kcs.	Actual	Allowed	Actual	Allowed
1	4000	-1470	2000	-6820	800
3	11,400	-4200	5700	+7700	2280

The results of the tests conducted to determine the stability of the cw oscillator are as follows:

Frequency Stability of CW Oscillator - Constant Ambient Temperature

Period of Test	Frequency Variation - C.P.S. Actual	Allowed
10 minutes	-110	800
50 minutes	+1270	320

The equipment was set up in a temperature box and the overall stability of the receiver measured at various temperatures in accordance with the procedure described by the specifications and as presented in the foregoing. These tests were conducted with the receiver adjusted to receive a signal at a frequency of 7300 kilocycles with both of its oscillators functioning and with the variation in frequency measured by means of a General Radio Heterodyne Calibrator, adjusted to maintain zero beat at the receiver output when coupled to an interpolation oscillator adjusted for 1,000 cycle output. The results of these tests are as follows:

[redacted]

Overall Frequency Stability -
Constant Ambient Temperature

Temp. °C.	Frequency Variation - C.P.S.			
	10 Min. Run		50 Min. Run	
	Actual	Allowed	Actual	Allowed
295	-1960	2250	-4880	1460
-15.0	-2160	2250	-5660	1460
+50.0	-3200	2250	-4120	1460
+21.5	-2240	2250	-2940	1460

187. The I. F. Receiver Unit complies with the governing specifications, only if these specifications can be interpreted as applying to the overall drift of the receiver, and not to the drift of the high frequency oscillator. Specification compliance is met by the High Frequency Receiver Unit during the 10-minute warm-up period, but not during the succeeding 50-minute period of operation. Attention is invited to the fact that during the tests on the High Frequency Receiver Unit when this receiver was operated at fixed temperatures within the range specified under reference (b) the sensitivity was adversely affected, particularly at the lower temperatures. When the temperature was reduced to -15° C. the sensitivity was so reduced that the output signal was barely audible for an r-f input of 1/10 volt. This can be attributed to the possible shorting of the plates of one or more of the ganged tuning capacitors, for, an inspection of these capacitors shows but very little clearance between the plates where they have been adjusted for capacity matching. Operation of the equipment at cold temperatures did not materially affect the action of the operating controls. The action of the toggle switches and the volume controls, while somewhat sluggish, was nevertheless satisfactory.

188. Par. 4-81. In view of the fact that satisfactory operation of either receiver did not obtain during the tests conducted in accordance with paragraph 4-80, no tests were conducted to determine the frequency stability of either equipment when subjected to a variation in ambient temperature of -15° C. to +50° C., in accordance with the requirements of this specification reference. It was felt that the results that would be obtained would not justify the time that would necessarily have to be expended and the risk involved by the possibility of further melting of the coil wax to the extent of again upsetting the circuit alignment of the receivers. This latter possibility was none too remote, since it would be necessary to conduct tests to determine not only the overall frequency stability under the specified conditions, but also the effect of temperature variation on the high frequency oscillator and cw oscillator of each receiver.

189. Par. 4-82. The receiver tuning dials are directly calibrated in frequency. These calibrations are provided on reverse etched dials attached to the shafts of the tuning capacitors. The letters, figures, and graduations are of natural aluminum finish against a black background.

The calibration accuracy is shown on Plates 1 and 35 for the Types CAY 46076 and CAY 46077 Receiver Units, respectively. The maximum error exceeds the one per cent limit, allowed by the contract, for the middle range of frequencies covered by Band 1 of the I. F. Receiver Unit. The calibration data, from which the curves shown on the two plates were drawn, were obtained at room temperature. The use of calibrated dials is, by all means, preferable to calibration charts. Calibrated dials can be associated only with rugged construction, and the use of stable circuits. While the contractor is to be complimented in his desire to furnish calibrated dials, it is questionable whether the present construction and circuit instability of the model equipment will permit economical duplication of dial calibrations, within the specified degree of accuracy, for the production equipments. The Laboratory has found that the equipment is extremely sensitive to variations of temperature, supply voltage and adjustment of the sensitivity control. This statement applies particularly to the High Frequency Receiver Unit where the effects due to these changes are the more pronounced.

190. Par. 4-83. The crystal frequency indicator, to which reference is made under this paragraph reference, will be furnished by the Navy and no comment, therefore, is required.

191. Complete data showing the accuracy of resettability of the main tuning controls of the receiver units are given under Table 9 for the Type CAY 46076 Receiver Unit, and under Table 26 for the Type CAY 46077 Receiver Unit. The frequency deviations are for clockwise and counterclockwise rotation of the tuning dials and were measured with respect to the initial settings of the tuning dials as adjusted for the calibration measurements. The accuracy of resettability is governed largely by the ability of the operator to reset the main tuning dial by eye to the same dial setting. Since the tuning dials are directly connected to the shafts of the ganged tuning capacitors, the accuracy of resettability is independent of the backlash of the tuning drives. However, as has been previously mentioned in other parts of this report, the backlash of the tuning drives is excessive to the extent of depreciating their ease of adjustment. This is particularly true in the case of the High Frequency Receiver Unit, where tuning is unusually difficult and of such character that would not normally be expected for the type of drive provided.

192. Par. 5-1. The power units required under references (b) and (c) and furnished with the model equipment are as follows:

(1) One - Type CAY 21387 Dynamotor Unit
(2) Two - Type CAY 19017 Class S34 Storage Batteries
(3) One - Type CAY 20085 A. C. Power Unit

Items (1) and (2) are furnished for field operation of the receiving equipment, while Item (3) is furnished to permit base station operation where 60 cycle, 115-volt, single phase, commercial power is available.

193. Par. 5-2. The equipment was set up in the field and given a practical operating test to determine the suitability of two types of gas engine driven generators, and two types of motor driven generators for use with the subject equipment. The types of generators furnished by the contractor for test were as follows:

(a) Onan, gasoline engine driven generator
(b) Briggs & Stratton, gasoline engine driven generator
(c) Onan, motor driven generator
(d) Continental, motor driven generator

The report covering the Transmitting Equipment gives a complete discussion as to the suitability of these types of generators for use with the Model XTBW Transmitting and Receiving Equipment. The discussion presented herein is confined entirely to the merits of these generators from the standpoint of radio frequency interference due to ignition or commutators. Tests were conducted at approximately the low and high frequency settings over the complete frequency ranges of the two receiver units. At each frequency setting, the equipment was adjusted to receive a cw signal with the receiver sensitivity adjusted for approximately standard noise level with no input signal and with the generators not running. The generators were then started one at a time, and the increase in noise level was noted for each generator. A signal generator was then connected to the antenna input through a dummy antenna and the equivalent microvolts which would produce the same increase in output, as obtained with the generator under test, were measured. It was found that of the two gas engine driven generators the Onan unit was the better, since it produced less radio interference at all frequencies. It was also found that the Onan unit was the better of the two types of the motor driven generator units at all frequency settings of the receiver units. There was no evidence of any noise arriving at the receiver units through the dynamotor power supply, when the dynamotor unit was connected to any one of the generator units for battery charging. Practically all the interference was radiated interference which was picked up by the antennas. The noise emitted by the generators due to their rotating parts did not preclude the satisfactory reception of weak signals while they were running.

194. Par. 5-3 to 5-10, inclusive. These paragraph references of reference (b) are discussed in a separate report covering the Model XTBW Transmitting Equipment.

195. Par. 5-11. The Type CAY 21387 Dynamotor Unit is considered as being capable of continuous and intermittent operation for a total period of at least 500 hours without requiring any attention other than occasional lubrication. This statement, however, applies only where the operating conditions are especially favorable. The dynamotor unit is not considered suitably constructed for continuous or intermittent operation under adverse operating conditions as may be encountered in the Service. The unit is not adequately protected against the entrance of moisture when operated in a driving rain storm. The construction of filter reactors is such that their failure may be expected with their prolonged exposure to

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humid saline atmospheres, as encountered in the tropics, as no provision has been made for precluding entrance of moisture into the windings through "wick" action. The varnish coating on the reactors does not provide complete coverage of all metallic parts, and hence the exposed, unplated hardware is subject to corrosion.

196. Par. 5-12. The Type CAY 21387 Dynamotor Unit is designed for operation from the two, 12-volt, Type CAY 19017 Storage Batteries connected in parallel. It provides satisfactory performance, for its intended purpose, when operated from the storage batteries alone, from the storage batteries when floating across the charging windings of the gasoline engine or motor driven generators, or when directly connected to these windings. The output of the dynamotor varies, of course, as the input voltages are varied under these methods of operation. However, the regulation of the gasoline or motor driven generators furnished with the Model XTBW Transmitting Equipment, is such as not to materially detract from the normal performance of the subject receiving equipment.

197. Par. 5-13. The Type CAY 21387 Dynamotor Unit consists of a completely enclosed and electrically shielded rotating machine mounted on an aluminum chassis containing filter components, fuses, and cable receptacles. The dynamotor derives its input power from the primary storage batteries which also provide low voltage d-c power for the filaments and/or heaters of the receiver vacuum tubes and panel lights, and convert the low voltage d-c to high voltage d-c for the plates and screens of the vacuum tubes of the receiver units and of the frequency measuring unit. The filter reactors are mounted on top of the chassis with the leads projected through the chassis for connection to other components. All filter capacitors and r-f chokes are mounted on the under side of the chassis. Fuse mountings and cable receptacles are arranged along the front edge of the chassis and suitably marked by an etched nameplate. No voltage divider is provided since reference (d) permits the use of individual voltage dividers in the receiver units. The chassis assembly is housed in a transportation case and secured in place with thumb screws, as previously described.

198. Par. 5-14. No tests were made to determine the extent to which the dynamotor complies with the requirements of the paragraph reference of reference (b). The dynamotor furnished is a Model DM416, manufactured by the Continental Electric Company, Incorporated. It is completely enclosed so as to exclude dust and dirt. Dynamotors of this type are commonly employed with aircraft radio receiving equipment, and are reputed to give satisfactory performance, over long periods of service, without attention.

199. Par. 5-15 to 5-19, inclusive. It is not possible to completely discuss all items covered by these paragraph references of reference (b), without the complete disassembly of the dynamotor unit. It can be said, however, that the dynamotor operates in a reasonably quiet manner; the armature appears to be adequately balanced, since no abnormal vibration is set up; and at no time during the tests did any evidence

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develop to show failure of either the brushes or brush holders. The dynamotor unit withstood two complete cycles of temperature variation over the range specified under reference (b), the acceleration test and vibration test, without damage to or deterioration of any of its parts.

200. Par. 5-20(1). The Type CAY 19017 Storage Batteries are suitable for operating the Types CAY 46076 and CAY 46077 Receiver Units for a period of 8 hours continuously from a fully charged condition at zero degrees centigrade in compliance with the specification requirement.

(2) These batteries are modified Class S34 batteries designed in compliance with Bureau of Aeronautics Specification B-38a.

(3) The Type CAY 19017 Storage Batteries are not satisfactory for their intended purpose, and do not comply with the requirements of this specification reference of reference (b). Constructional defects of the batteries are as follows:

(a) Watertight construction has not been provided. Submersion of one of the batteries in water for a period of one minute to a depth of one inch below the water surface resulted in the collection of approximately a half cupful of water in the top internal cavity of the battery, and the complete flooding of the terminal compartment. Inspection of the battery, after its submersion, revealed that the gasket in the top cover plate is not completely compressed so as to preclude the entrance of water when the cover plate is tightly secured in place.

(b) Rubber gaskets have not been suitably employed around the terminal studs, terminal box knockouts, either as required under Bureau of Aeronautics Specification B-38a or as specifically required by the governing specifications to render the terminal box watertight.

(c) No provision has been made for enclosing the knockout openings, after the removal of the battery cables, to reestablish the watertightness integrity of the battery when prepared for transportation.

(d) The terminal box retaining screws are not in compliance with the type specified in Bureau of Aeronautics Specification B-38a.

(e) There is insufficient area provided between the wing nuts and the battery hold down straps to afford the necessary pressure of the cover on the box to preclude the entrance of water when the batteries are submerged in water.

(f) The carrying handles are secured to the battery with woven straps in an unsatisfactory manner, as no devices are employed to prevent the straps from slipping off of the bottom of the battery case. This presents a hazard in the handling of the battery as their slippage may result in damage to the battery or injury to the personnel handling it. This danger is especially apparent when handling the battery above head level.

(g) The carrying handles and the top cover plates of the batteries must be removed for checking specific gravity or level of the electrolyte.

(h) The lead plating on the steel battery terminal hardware has worn away during the small amount of handling to which they were subjected during the tests.

The construction of the Type CAY 19017 Storage Batteries is such that they are spillproof and may be placed on any side without loss of electrolyte.

(4) The storage batteries furnished with the Model XTBW Receiving Equipment were delivered to the Laboratory in a dry charge condition, as required by reference (b). Acid for the batteries was delivered in a glass container packed in a wooden box with a protective filler.

201. Par. 5-21. The Type CAY 21387 Dynamotor Unit is unsuitable for use in the field where it will be expected to give satisfactory service operation despite blowing sand, dust, and rain. As mentioned in other parts of this report, this unit is poorly protected against the ravages of blowing sand, dust, and rain, when set up for operation. The open core construction of its filter reactors is especially vulnerable to damage from these sources.

202. Par. 5-22. A Type CAY 20085 A. C. Power Unit is furnished for operating the complete Model XTBW Radio Receiving Equipment, when used for semi-permanent installations, where commercial power supplies are available. It is designed for operation from a 115-volt ± 10 per cent, 60 cycle, single phase line. It provides all low and high voltage energy, as required, for the operation of the complete receiving equipment, and the frequency indicator unit. An "on-off" switch and indicator light are furnished with this unit. This unit employs a vacuum tube full wave rectifier and filter circuit of conventional design. No means is provided, however, for turning the line power "on" or "off" from the receiver units. Hence, it will be necessary that this unit be installed within view and reach of the operator to guard against its being left "on" when the receivers are not in service.

203. Par. 5-23. The mechanical design and construction of the Type CAY 20085 A. C. Power Unit are not considered in compliance with the

requirements of this specification reference. The circuit design, however, is considered satisfactory. The size and weight of the unit are reasonable, and continuous operation without overheating can be expected. Defects in mechanical design and construction are as follows:

(a) The vacuum tube rectifier is not readily accessible for replacement, since access to it can be effected only upon the removal of the top cover which necessitates the removal of six screws. Removal of the cover can be effected only if a large overhead clearance is provided or with the complete removal of the unit from its mounting.

(b) The construction of the chassis and cover is not rugged. The gauge of the aluminum employed in this construction does not provide sufficient strength to prevent warpage of the chassis from the load which it bears, or damage to the chassis or cover, when subjected to rough handling, or if dropped.

(c) The open core construction of the power transformer and filter reactors is unsatisfactory and not generally considered acceptable for use in Naval equipment. The construction is such that their failure can be expected when exposed to high humid saline atmospheres, since no means is provided for preventing the entrance of moisture within the windings through the leads from "wick" action on the part of the leads.

The base station receiver power unit is designed for mounting on or under an operating table, as may be desired by the operating personnel, in compliance with reference (b).

204. Par. 6-1 to 6-22, inclusive. These paragraph references of reference (b) cover the design and construction of the antenna and counterpoise systems to be furnished with the Model XTBW Radio Transmitting and Receiving Equipment. They are discussed under a separate report covering the Transmitting Equipment.

205. Par. 7-1. The Model XTBW Radio Receiving Equipment was delivered to the Laboratory complete with all accessories, except those which are to be furnished by the Navy, which are required for the operation of the equipment in accordance with the governing specifications. Space is provided in the Type CAY 10034 Mobile Spare Parts Box for packing all accessories except the legs for the receiver transportation case which are packed with the antenna gear, and the Model LM series Crystal Frequency Indicator Unit furnished by the Navy. This latter item will be furnished in a suitable carrying case.

206. Par. 7-2. Two pairs of head telephones with cords and plugs will be included among the accessories furnished by the Navy.

[redacted]

207. Par. 7-3. Electrical connections between the several units of the Model XTBW Receiving Equipment are effected by means of cables and plugs, descriptions of which are given in other portions of this report. The equipment is suitable for installation with relation to the Transmitting Equipment in compliance with the requirements of this specification reference.

208. Par. 7-4. Interconnecting cables, necessary for the proper operation of the receiving equipment, were furnished by the contractor. The dynamotor unit employed for field installations and the a-c power unit employed for base station installations serve as junction boxes for interconnection between the several units of the equipment.

209. Par. 7-5. Refer to report on Transmitting Equipment.

210. Par. 7-6. The Type CAY 20085 A. C. Power Unit is provided with a rubber covered two-conductor cable permanently attached to the unit and provided with a conventional receptacle for a-c power connection.

211. Par. 7-7. Refer to the report on the Transmitting Unit.

212. Par. 7-8. The tools and accessories, as listed in the specifications, are not considered as being entirely suitable or complete to permit servicing of the several units of the receiving equipment in the field. The list of tools should include small side-cutting pliers, long-nose pliers, small wrenches, small screwdrivers, socket wrenches from #2 to #10, and small tips for the soldering iron. The designs of the component units of the receiving equipment are such that servicing can be effected only with the use of small tools. The receiver units as designed do require the special tools as indicated above for disassembly, etc.

213. Par. 7-9. A canvas slip-cover was furnished for the Type CAY 46078 Receiver Unit, but none was furnished for the Type CAY 21387 Dynamotor Unit. The canvas slip-cover is designed to enclose the front opening of the receiver transportation box when the equipment is set up for operation in the field. It is provided with a flap,which is fastened at each of its two sides with zippers, so that when opened it affords access to the tuning controls of the receiving units. A drawstring is provided for fastening the cover to the rim of the receiver transportation box. The design of this cover is not considered as being particularly suitable for the intended purpose. Access to the operating control results in the bottom edge of the flap being completely loosened when the zippers are opened so that it becomes free to flap about when the equipment is operated in the presence of high winds. Hence, its effectiveness for precluding the entrance of moisture when the equipment is operated in a driving rain is diminished.

214. Par. 7-10. This specification reference does not apply to any of the units of the receiving equipment as furnished for field service, since they are all provided with their own transportation cases.

215. Par. 7-11. The Type CAY 20085 A. C. Power Unit complies with the requirements of this specification reference.

216. Par. 7-12 and 7-13. Refer to the report on the Transmitting Equipment.

217. Par. 8-1 to 8-7, inclusive. No spare parts were furnished with the Model Receiving Equipment, and therefore no comment can be made on these paragraph references of the governing specifications. The spare parts were not required by the contract for the model equipment.

218. Par. 9-1. Two preliminary instruction books which included schematic diagrams of each component unit, and an interconnection diagram for the equipment, were furnished. Other requirements of this specification reference apply in particular to the first production model, as approved by the Navy, and therefore no comment concerning them can be made at this time.

219. Par. 10-1. The manufacturer's descriptive specifications which became a part of the contract comply with all the requirements of this specification reference. Certain changes from the proposed design have been made and these changes have in many instances received Bureau approval by subsequent correspondence.

220. Par. 11-1. The preliminary model, as submitted to the Laboratory for type approval tests, was accompanied with a copy of the test data as witnessed and approved by the Resident Inspector of Naval Material.

221. Par. 11-2. No component parts were submitted for test as required in Section II of the governing specifications.

222. Par. 11-3 to 11-5, inclusive. These paragraph references do not apply to the preliminary model of the subject equipment.

223. Par. 11-6. A description of the tests conducted by the Laboratory is presented under the section devoted to Methods of Test of this report for determining the degree of compliance of this equipment with the requirements of the governing specifications, reference (b), as amended by the contract, reference (c).

224. Par. 11-7 and 11-8. These paragraph references apply to the production equipments and hence no comments are necessary.

225. Par. 11-9. Such other tests as were necessary to demonstrate the degree of compliance of the subject equipment with the governing specifications, and its suitability for Naval use, were conducted by the Laboratory.

226. A summary of the defects noted, and such items as do not comply with the governing specifications, reference (b), as amended by the contract, reference (c), are as follows:

[redacted]

(1) Par. 2-2(e). The Type 38568K triode-hexode converter vacuum tube is not listed under specifications RE 13A 134B. This tube, as employed, is apparently responsible for the failure of the receiver units to comply with some of the specification requirements for performance.

(2) Par. 2-2(f). The 25-ohm composition resistors, employed in the receiver units, are not of the type for which approval has been given under reference (j).

(3) Par. 2-3(A)(1). The chassis, front panels and panel supporting brackets of the receiver units are not of rugged construction, nor do they possess the necessary rigidity to preclude their warpage or twisting from their respective leads. Other defects under this paragraph reference are:

(a) Fabricated and drawn shield cans, partition shields, and insulating panel supporting brackets do not possess sufficient rigidity for their intended purposes.

(b) The method of mounting the fabricated shield cans does not provide for their satisfactory or permanent bonding with the chassis, nor for their direct and entire support from the chassis.

(c) The cover plates for the side openings of the i-f transformer shield cans are not of suitable design. The mounting brackets for the shield cans are of non-rigid design.

(d) The spade bolt mountings for the cw oscillator inductor shield cans are unsatisfactory in their present form and application.

(e) The design of the vacuum tube shields does not provide for their complete seating on their bases with the type of screws provided for mounting the bases to the chassis.

(f) Fish paper insulation is not an acceptable means for protecting components against shorts or grounds resulting from the free movement of non-rigid supporting brackets for insulating panels bearing electrical components attached to soldering lug terminals.

(4) Par. 2-3(A)(2). The r-f transformer and high frequency oscillator coil assemblies are of unsatisfactory design

[redacted]

and construction owing to the following defects:

(a) Connection of the r-f leads from the band switches to the ganged tuning capacitors has been made in a very unsatisfactory manner. The other external lead connections are not sufficiently accessible.

(b) The design of the aluminum inserts in the cast base plates does not appear to preclude their loosening under conditions of severe vibration, or their turning when attempting to loosen the mounting screws which they retain, in the event of the screws having become "frozen" by corrosion.

(c) The coil form and trimmer capacitor assemblies are of unsatisfactory design and construction in that separate terminals are not provided on the coil forms for all winding leads; insufficient clearances have been provided between the primary coil lead terminals and the plates of the trimmer capacitors; the mounting brackets for the trimmer capacitors are not shaped to conform with the curvature of the coil forms; and the mounting and support provided for the trimmer capacitors are such that the coil forms are subject to adverse strains which result in their cracking.

(d) The construction of the r-f transformer and high frequency oscillator windings is generally unsatisfactory. The coil forms for layer and spaced turn windings are not threaded to assure permanence in turn spacings; no suitable and independent means have been provided for secondary winding lead terminations; concentric windings have not been satisfactorily insulated from one another; and coil leads of windings operating at high d-c potentials are secured to other windings without adequate insulation barriers.

(e) The trimmer capacitors are so positioned that the excess coil wax, if melted due to high ambient temperature, will flow between their plates, as in the case with the model equipment.

(f) The band switch wafers in each assembly are inaccessible for replacement or servicing without considerable disarrangement of the wiring and possible damage to other components.

[redacted]

(g) No lacquer has been employed on the soldered connections as required by the governing specifications. This feature, however, is appreciated in model equipment in that it permits better inspection of the soldering.

(5) Par. 2-3(A)(3). The design and construction of the ganged tuning capacitors are such that they would not generally be considered suitable for use in Naval equipment. The use of thin rotor and stator plates, and narrow spacings, makes them subject to possible shorting under conditions of vibration and wide variations of temperature. Their method of mounting precludes any satisfactory means for connection of the leads from their associated coil assemblies. The entire assembly is dependent upon swedging or friction for contact between the various elements which make up the assembly. This construction may loosen with time due to strains resulting from temperature and vibration exposure, thus resulting in poor electrical and mechanical contact. Cadmium plated spacer bars have been employed in violation of the specifications. The silver plating on the wipers is of insufficient thickness and has worn away after relatively little service.

(6) Par. 2-3(A)(4). The main tuning drives do not provide for rapid traverse of the dial scales; they do not provide ease of operation; their design does not preclude backlash between the tuning knobs and capacitor shafts; and the use of die-cast worm gears may be expected to aggravate tuning difficulties.

(7) Par. 2-3(A)(5). The band switches cannot be considered as entirely suitable for use in this equipment. Contact troubles were a source of constant annoyance throughout the tests. The silver plating on the contacts was worn away after relatively few cycles of operation. The band switch shafts are equipped with but a single bearing, so that their extreme ends are free to flex during the switching operation to the extent of causing a lag in the movement of the rear switch rotors with respect to the others. The amount of backlash between the band switch knobs and the dial masks is excessive.

(8) Par. 2-3(A)(6). The placement of the grid leads, which are brought out of the sides of the i-f transformer assemblies, is unsatisfactory, since the internal structures of these transformers cannot be removed from their shield enclosures without damaging the lead insulation. The method employed for mounting the dual tuning capacitors requires the use of special studs with no suitable provision for locking them in place. The arrangement of the internal bus wiring is such that when the mounting brackets for the removable coils are

[redacted]

adjusted for circuit alignment they contact one of the high potential leads.

(9) Par. 2-3(A)(7). The design and construction of the cw oscillator inductor assemblies are not satisfactory, in that their internal assemblies do not derive their entire support from the receiver chassis, and no terminal panels are provided for external lead connections. Flexible wire has been employed for connection to these inductors in an unsatisfactory manner.

(10) Par. 2-3(A)(9). The phenolic angles in the receiver cabinet were damaged from the sharp edges of the receiver chassis. The cabinet design does not provide for self-alignment of the receiver chassis to preclude damage to the panel finishes upon their insertion. The tapped holes for the panel securing thumb screws are easily stripped when the thumb screws are tightened.

(11) Par. 2-3(B). The dynamotor unit cannot be considered suitable for its intended purpose, since it does not provide adequate protection to permit its operation in the presence of driving rain, dust, or insect infestations, in compliance with the specification requirements. The method for securing the chassis in its transportation case is awkward and inconvenient.

(12) Par. 2-3(C). The gauge of material employed in the construction of the chassis and cover of the a-c power unit does not provide the necessary ruggedness to permit this unit to withstand rough handling. The design does not provide facilities for replacing the rectifier vacuum tube or pilot lamp without the use of tools.

(13) Par. 2-4. The workmanship in general, and on the receiver units in particular, is not up to the standard quality usually expected for Navy equipment. Instances of faulty or careless workmanship are as follows:

(a) The workmanship displayed for the radio frequency coils shows evidence of carelessness, particularly in the manner in which the end turns of layer wound coils have been adjusted for an inductance trimming. In many instances, the enamel insulation has been broken and the surface of the copper wire has been fractured. The end turns of all coils are not suitably anchored, since their anchorage depends, in general, on the adhesive properties of wax or cement.

[redacted]

(b) Spaghetti tubing or varnish impregnated sleeving has been employed for wire insulation in radio frequency circuits contrary to accepted standards of construction.

(c) Fixed mica trimmer capacitors are suspended by their pigtail leads from the bus wiring in the preselector and high frequency oscillator assemblies in a manner that is not neat or which presents a pleasing appearance. Pigtail leads of these capacitors have in many instances been sharply bent at their points of entrance into their molded phenolic cases. The mounting studs in the air dielectric trimmer capacitors, employed for securing the coil shield cans, have been cut off with the result that the ends of the studs are left in an unfinished and unsatisfactory manner. The soldering workmanship is generally poor.

(d) The i-f transformer and cw oscillator coil assemblies do not present a finished appearance. The holes in the sides of their shield cans through which the grid leads pass are not suitably protected by grommets. Some of the i-f transformer coils had aluminum filings embedded in their waxed surfaces.

(e) The wiring of the receiver units has not been effected in a neat and workmanlike manner. In many instances long leads are not suitably anchored to prevent their breakage at their soldered connections. In other instances, leads are not suitably protected to preclude damage to their insulation from sharp edges of partitions, soldering lugs, etc., under conditions of vibration. The soldering workmanship is not good and its inferior quality is undoubtedly due to the general inaccessibility of the soldering lugs and/or terminals. The antenna leads entering the first r-f shield cans are wedged against band switch shafts and are also placed so as to be rubbed by the dial mask drive gears.

(f) The receiver chassis does not present a clean appearance, and the stamping of the circuit symbols has not been done in a neat and orderly manner.

(g) The welding workmanship on the transportation cases is of inferior quality. In certain instances, spot welds have burned through the metal to the extent of leaving small holes so as to destroy the watertightness integrity of the transportation cases.

[redacted]

(14) Par. 2-5. The equipment failed to comply with the requirements of this specification reference in the following premises:

(a) Dissimilar metals have been employed in the construction of the ganged air dielectric tuning capacitors.

(b) The silver plating provided on all wiper contacts is of insufficient thickness to preclude corrosion of the base metal after exposure to moist sea atmosphere and rather limited use.

(c) The power transformer and filter reactors employed with the power units are not designed to provide for continuous operation over long periods of time under the specified operation conditions.

(15) Par. 2-8. Steel has been employed for the mounting brackets of the audio output transformers; for the grid connectors of the converter tubes employed in the receiver units; and for the chains and chain supporting studs for the receiver transportation cover supports, in violation of the requirements of this specification reference.

(16) Par. 2-10. The receiver units will not withstand continuous operation at high ambient temperatures, as required by the governing specifications, due to the low melting point of the wax employed on the coil assemblies.

(17) Par. 2-13. Adequate provision has not been made, in the design of the antenna lead connectors, to preclude the possibility of the operating personnel accidentally coming in contact with high radio frequency potentials in the event of break-in relay failures. The operator may be subjected to electrical shock when disconnecting the receiver power cables.

(18) Par. 2-19. The cable ferrules for the two-conductor battery and charging cables are too large for use with these cables.

(19) Par. 2-21. The use of bright finishes is not satisfactory, particularly where, in the case of the model equipment, they result in light reflections which are tiring to the operator's eyes. The front panels of the receiver unit are equipped with so many items having polished nickel finishes that not only is the general appearance of the panels impaired, but the effectiveness of the panel illumination , as provided, is greatly reduced for nighttime operation of the equipment.

[redacted]

The bright finishes have a bad psychological effect in that they draw attention away from more important controls and/or devices.

(20) Par. 2-23. The external fixtures associated with the antenna systems are not satisfactorily arranged to obviate the danger of rain and spray rendering the equipment inoperative.

(21) Par. 2-25. The retaining nuts for the ferrules associated with the cable plugs were not staked and became loosened when subjected to vibration.

(22) Par. 2-26. All connections within the separate units, as supplied for field installations, are not suitably supported to minimize changes in frequency or output, or to prevent lead breakage, due to severe vibration under flight conditions.

(23) Par. 2-27. No color coding has been employed for the bus wiring of the receiver units; color coding of the leads from the dynamotor, power transformer or filter reactors of the power units does not agree with the color coding of the wires of the circuits to which they are connected; color coding on the rubber insulated wire is unsatisfactory, since it has displayed a considerable degree of fading.

(24) Par. 2-31. The vacuum tube sockets employed in the receiver units are not considered as being of satisfactory design for use in these units where very limited accessibility is provided for the removal of their retaining rings.

(25) Par. 2-32. The high frequency receiver unit is adversely affected, both in frequency stability and sensitivity, by tube replacements, particularly by the replacement of the converter tube.

(26) Par. 2-33. The heater and/or filament supply voltages impressed across for the vacuum tubes of the receiver units are less than the nominal value required for these tubes. The variation in these voltages with change of input voltage, as specified under reference (b) for either type of power unit, exceeds the limits specified under reference (r).

(27) Par. 2-35. No mechanical stops are provided for the antenna trimmer capacitor of either receiver unit.

(28) Par. 2-37. No indication is provided to show the direction of rotation or the setting of the antenna trimmer capacitors.

(29) Par. 2-38. The dial scales do not provide for even spacing of its graduations in compliance with the requirements of this

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specification reference.

(30) Par. 2-39. Refer to (17) above.

(31) Par. 2-40. The component parts employed in the equipment with the exception of fixed paper dielectric capacitors, wire-wound resistors and the dynamotor have not been marked with the manufacturer's type numbers, as required.

(32) Par. 2-41. The data on the nameplates lead to confusion as to the proper identity of the component units and do not adequately indicate the units which make up the combined equipment.

(33) Par. 2-42. The lock nuts provided for the trimmer capacitors employed for all radio frequency circuits do not possess positive locking action to the extent of precluding their loosening under conditions of vibration. Soldered connections for radio frequency circuits have not been coated with red lacquer.

(34) Par. 2-43. Anti-sieze compound has not been employed, as required, where aluminum alloy parts are assembled by threading and where it is necessary to take them apart for servicing.

(35) Par. 2-44. The Lord shock mounts employed for the Type CAY 46078 Receiver Unit do not provide the degree of damping necessary to preclude possible damage to the unit when subjected to vibration at its natural period.

(36) Par. 2-47. Ceramic insulating material has not been uniformly glazed as required. Phenolic insulating material has not been treated to preclude insulation breakdown in the presence of moisture under the conditions stipulated in the specifications. Terminal spacings on phenolic insulating panels and their clearances to ground are not adequate to effect their compliance with the governing specifications.

(37) Par. 2-54. The power transformer and filter reactors used in the power supplies of the equipment are not designed to preclude the entrance of moisture into their windings through the insulation of their exposed leads from "wick" action. Their construction renders them unsuitable for use under adverse operating conditions.

(38) Par. 2-57. In general, the component parts of the receiver units are inaccessible for servicing or replacement to a much greater degree than in accepted Naval practice. The principal items under this classification are as follows:

[redacted]

(a) The r-f transformer and high frequency oscillator coil assemblies cannot be removed without loosening the centrally located resistor and capacitor terminal panel to provide access to the external soldered connections. Their removal is further hampered by the inaccessibility of the leads which pass through the chassis and are soldered to the under sides of the tuning capacitors.

(b) The use of Bristol set screws in any part of the equipment where disassembly may be required for servicing is not satisfactory unless the special wrenches, required for their operation, are made a part of the equipment.

(c) The method of mounting the i-f transformers does not provide for quick interchangeability between the narrow and broad band transformers for the High Frequency Receiver Unit. The positions of the i-f transformers are such that they must be completely removed for adjustment of the coupling of their coils.

(d) The tuning of the cw oscillator inductor or the removal of the oscillator vacuum tube necessitates the removal of the shield can enclosing these items. The removal of the cw oscillator inductor for replacement or servicing requires the removal of all external shield cans associated with the cw oscillator circuit. The securing nuts for the inductors are inaccessible owing to interferences caused by the placement of other electrical components.

(e) The cellulose coverings for the dial windows are difficult to replace owing to the use of escutcheon pins for their mounting.

(f) The fixed foil paper dielectric capacitors, molded mica dielectric capacitors, and resistors are practically all inaccessible for servicing or replacement without subjecting the wiring to damage, without the possible breakage of soldering lug terminals, or without possible damage to other components.

(g) The replacement of the band switch wafers in the r-f and high frequency oscillator coil compartments is so difficult as to make it advisable to include complete compartment assemblies among the equipment spare parts in lieu of component parts. It is estimated that, with the present design of these compartments, the replacement of a single band switch wafer would place the affected receiver unit out of commission for a period of approximately 8 hours.

(h) The crowded arrangement of the wiring and of the component parts on the under side of the receiver chassis is generally unsatisfactory, since it does not provide for the degree of serviceability required of equipment of this character.

(39) Par. 2-59. No circuit symbols or other means of identification have been provided on the tops of the r-f transformer, high frequency oscillator, i-f transformer or cw oscillator inductor shield cans to indicate, for purposes of circuit alignment, the functions of their trimmer capacitors.

(40) Par. 2-60. Micalex insulation, where employed, does not possess either glazed or ground surface finishes as required.

(41) Par. 2-61. The transparent cellulose material employed for enclosing the dial apertures for displaying the dial fiducial marks is inflammable. Its use, therefore, is contrary to the governing specifications.

(42) Par. 2-62. The design and construction of the bearings of the band switch and tuning control mechanisms are not considered as being particularly suitable for the type of service for which the equipment is intended. No satisfactory provision has been made for lubricating the bearings or in maintaining their lubrication.

(43) Par. 2-65. Lead washers have not been adequately employed for the mounting of screws or eyelets on ceramic insulators, as required by reference (b).

(44) Par. 3-2. The transportation cases supplied with the equipment are not watertight to the degree required under reference (b), owing to leaks resulting from defective welds employed in their construction. The storage batteries are not watertight owing to an imperfect fit between the battery cover and the retaining boxes.

(45) Par. 3-5. The design of the equipment is such as to require an abnormal number of special tools to facilitate its servicing. The contractor has not indicated the quantity or character of the special tools which he intends to furnish with the equipment.

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(46) Par. 3-6. The design of the fixtures provided for supporting the cover of the receiver transportation case when used as an operating table is not entirely suitable for their intended purpose. The machined ends of the threaded studs which form a part of these fixtures are of weak design and may be easily bent or broken if subjected to excessive strains. The machined studs and associated link chains are of steel without any protective plating to preclude the formation of rust. The link chains are not provided with a protective sleeving to preclude their damaging the finish on the transportation case or the front panels of the receiver units.

(47) Par. 3-17 and 3-18. The design of the thumb screws employed for the covers of the transportation cases is unsuitable, in that they cannot be tightened to the degree necessary to preclude the entrance of moisture or water into the transportation cases without the use of tools. Their design precludes the use of any tool for their tightening or loosening which would not permanently damage the knurled surfaces.

(48) Par. 3-20. The covers of the transportation cases for the receiver and dynamotor units are not fitted with schematic and actual wiring diagrams as required. No information has been received as to the means to be employed for packing and protecting the instruction book.

(49) Par. 3-24. The chassis withdrawal handles on the receiver units are unsatisfactorily arranged on the front panels of their respective receivers and result in subjecting one's fingers to possible injury. The chassis of the dynamotor unit is not provided with a handle or similar device to permit its removal from the transportation case without subjecting its component parts to strain. The replacement of the cw oscillator tubes in the receiver units and of the rectifier vacuum tube and pilot lamp in the a-c power unit cannot be effected without the use of tools, contrary to standard practice.

(50) Par. 3-25. The thumb screw design for securing the receiver cabinet in its transportation case is generally unsatisfactory. The beaded chains for securing the thumb screws to the transportation case are easily broken, and if broken their replacement is extremely difficult. The use of nickel plated brass thumb screws and aluminum retaining blocks is not satisfactory and their positions are such as to make their tightening or loosening somewhat difficult. The receiver cabinet thumb screws when in place obstruct the removal of either of the two receiver chassis because of the interference offered by the beaded retaining chains. The Lord shock mounts do not

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provide sufficient damping action to protect the receiver units from vibration at their natural period of the assembly. The design of the thumb screws and thumb screw retaining blocks for the dynamotor unit is not satisfactory, in that the thumb screws are not easily tightened without the use of special tools and the retaining blocks restrict the free and easy insertion of the chassis in the transportation case.

(51) Par. 3-26. The chassis construction for the dynamotor and a-c power units does not permit their being placed on their backs for servicing without damage to their component parts, as required under reference (b).

(52) Par. 3-27. The method employed for securing the receiver units in their common cabinet is unsatisfactory, owing to the following design differences:

(a) The panel retaining thumb screws are not self-aligning.

(b) The nickel plating on the thumb screws is easily worn away, leaving the base brass metal exposed.

(c) The cotter pins for retaining the thumb screws when loosened are too brittle to be satisfactory for their intended purpose.

(d) The aluminum angle supports for the thumb screws are easily distorted, and such distortion results in the misalignment of the thumb screws with the threaded holes of their retaining angles on the cabinet.

(e) Tightening of the thumb screws results in the stripping of the threads in the aforementioned retaining angles.

(53) Par. 3-31. Front connection in lieu of rear connection of the antenna and power cables to the receiver units is not in accordance with the preferred arrangement specified. The provided arrangement of the cables does not permit the maximum of convenience or protection to the operating personnel.

(54) Par. 3-33. The panel lights are not considered of suitable design in that they do not offer the proper distribution of illumination. The polished surfaces of the dial coverings offer objectionable reflections to the extent of diminishing the readability of the tuning dials under certain conditions of external lighting.

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(55) Par. 3-34. The dial light domes are not rigidly locked in place and the finishes employed for the dial lamp fixtures make them conspicuously prominent when contrasted with the panel finish.

(56) Par. 3-37. The arrangement of the operating controls on the receiver units does not provide for easy and rapid operating conditions owing to the following interferences. The antenna leads obstruct the operator's view of the main tuning dials and can cause interference of the free access to the main tuning and band switch control knobs. Operation of the controls by an operator wearing heavy gloves will result in the accidental missetting of the antenna trimmer capacitors and switching of toggle switches. The restricted spacing between the manual volume control knob and the telephone cable plugs precludes the easy adjustment of these controls by an operator wearing heavy gloves. The clearance provided between the phone jack and the monitor jack does not preclude the probability of the operator withdrawing the plugs by pulling on their cords. The operation of the main tuning control does not provide for quick traversing of the tuning ranges and its action is tiring.

(57) Par. 3-41. The number of friction and pressure contacts has not been kept to a minimum and in many instances are not suitably designed to prevent erratic operation under conditions of vibration, shock, or exposure to sea atmosphere. Specification compliance is not met in the following instances:

(a) The bonding of the shield cans of the r-f coil assemblies with the receiver chassis is not permanent.

(b) The partition shields provided in the I. F. Receiver Unit and mounted on the ganged tuning capacitor is of such light construction they are free to vibrate so as to cause noisy operation of the receiver due to their rubbing on the framework of the ganged tuning capacitors.

(c) Shielded wire has been anchored to metallic surfaces by means of waxed cord in an unsatisfactory manner.

(d) Bonding of the antenna trimmer capacitor to the front panel is dependent upon the pressure provided between the soldering lug and the securing nut and lockwasher for one of the panel mounting screws.

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(58) Par. 3-44. The locking action of the lock nuts for the rotors of the trimmer capacitors proved to be ineffective when the equipment was subjected to the vibration test.

(59) Par. 3-46. The operating voltages arriving at the heaters and/or filaments of the receiver vacuum tubes are less than their nominal rated values when the storage batteries are at 12 volts, or the a-c power unit is operated from 115-volt line.

(60) Par. 3-54. Simultaneous operation of the receivers on their respective channels is not effected without interference as noted in the report.

(61) Par. 4-57 and 4-59. The antenna trimmer capacitors of the receiver units are not marked to indicate either their directions of rotation or settings. They appear to be unsuitable for their intended purpose owing to their relative ineffectiveness as compensating devices.

(62) Par. 4-58. Operation of the beat frequency oscillator results in an increase of noise level, at any frequency within the range of the I. F. Receiver Unit, to such an extent as to adversely affect the receiver sensitivity when adjusted for the reception of cw signals.

(63) Par. 4-60. The optimum output load for either receiver unit is not in compliance with the specification requirements.

(64) Par. 4-61. The output transformers of the receiver units do not employ electromagnetically balanced secondary windings, as required by the contract. No electrostatic shielding has been employed in the construction of these transformers.

(65) Par. 4-62. The Type CAY 46076 I. F. Receiver Unit does not comply with the specification requirements for cw sensitivity at all frequencies within its tuning range. The sensitivity of the receiver, when adjusted for the reception of cw signals, is adversely affected by variations of ambient temperature and by tube replacements, particularly by the replacement of the converter tube. The loss in sensitivity is largely due to the frequency change of the high frequency oscillator from variation of ambient temperature and tube replacements. The cw sensitivities are generally poorer than would be normally expected from a receiver having mcw sensitivities of the same order as for this receiver. The Type CAY 46077 H. F. Receiver Unit does not comply with the specification requirements for either mcw or cw sensitivity, at all

frequencies within its tunable range, when employing wide or narrow band i-f transformers. This receiver unit is adversely affected by variations of ambient temperature and tube replacements. The loss in sensitivity due to both of these changes is the result of frequency variations of the high frequency oscillator. The sensitivity of this receiver is permanently reduced after its operation under conditions of high ambient temperatures. The receiver appears to age much more rapidly than would be considered satisfactory for Naval receivers. There is evidence of resonance absorption when the receiver is operated on Band 1 which adversely affects the receiver sensitivity at the frequency at which this absorption takes place.

(66) Par. 4-63. Neither receiver unit complies with the contract limits for selectivity. The high frequency oscillator of both receiver units, and particularly the High Frequency Receiver Unit, shows tendencies towards pulling upon the application of strong input signals. The selectivities of both receiver units are affected by variations in the sensitivity control settings. The temperature tests resulted in a permanent loss of selectivity for the H. F. Receiver Unit.

(67) Par. 4-64. Neither receiver unit complies with the contract limits for overall audio fidelity at any frequency within their respective frequency ranges. In the case of the High Frequency Receiver Unit, there is evidence of a slight degree of regeneration when a 100 microvolt r-f input signal is applied at the receiver input, the manual volume control is adjusted for a 10-volt output, and the modulation frequency is varied between 1000 to 2000 cycles per second.

(68) Par. 4-67. Variation of r-f input voltage applied to the High Frequency Receiver Unit, when adjusted for the reception of cw signals, from low values up to such values as will produce maximum audio output results in a frequency variation of the high frequency oscillator to such a degree as to cause a loss in audio output. Increasing the input level to higher values results in the reversal of the drift of the high frequency oscillator, so that the loss in audio output is regained. The output beat note does not pass through zero beat as the r-f input is varied. As the result of the variation in the frequency of the high frequency oscillator, the receiver must be retuned in order to maintain the audio output level and beat note frequency.

[redacted]

(69) Par. 4-68. The specification limit for the ratios of audio outputs with the r-f input carrier modulated and unmodulated is not met at all frequency settings of the H. F. Receiver Unit.

(70) Par. 4-69. The marking of the dial scales of the two receiver units is contrary to the specification requirements and to the manufacturer's descriptive specifications. The graduations are not readily distinguished, particularly at the high frequency ends of the scales where the markings become crowded. The dial indexes are not sufficiently prominent to permit readability of the dial settings at distances up to 24 inches under all lighting conditions.

(71) Par. 4-70. The equipment does not fully comply with the specification requirements for operation under conditions of vibration. It is believed that the shockproofing provided for the receiver unit is satisfactory for the type of service for which it is intended. It is not satisfactory if the equipment is subjected to violent shock or persistent vibration at the natural period of the receiver unit.

(72) Par. 4-71. The receiver will not give satisfactory operation in compliance with the specification requirement under the conditions of vibration specified under reference (b), owing to the very high increase in the noise output level and intermittent failure of the band switches to maintain contact. Normal band switch operation obtains on the cessation of vibration. Lock nuts on air dielectric trimmer capacitors and miscellaneous screws and nuts became loosened as a result of the vibration tests.

(73) Par. 4-73. Operation of the manual volume control at any frequency within the frequency range of either receiver unit reduces its selectivity and causes a shift in the high frequency oscillator in excess of the specification limits. The reduction of receiver sensitivity with angular rotation of the manual sensitivity control of the I. F. Receiver Unit does not comply with the specification requirements.

(74) Par. 4-77 and 4-78. The requirements of these paragraph references of reference (b) are not completely met at any frequency within the range of either receiver unit. Compliance with the requirements of reference paragraph 4-78 is not met at all frequencies, regardless of the interpretation placed upon this paragraph reference. The requirements of paragraph 4-78 cannot be met if compliance with reference paragraph 4-54 is met. Refer to the text for a complete, detailed, discussion.

[redacted]

(75) Par. 4-79. Type CAY 46077 Receiver Unit does not comply with the specification limits for frequency stability under conditions of variation of input power at all frequency settings within its range.

(76) Par. 4-80. The I. F. Receiver Unit does not comply with this specification reference unless the requirements can be interpreted to apply to overall frequency stability under the specified conditions. The H. F. Receiver Unit does not comply with the specification requirements during the 50-minute operation period for either interpretation of the specification limits.

(77) Par. 5-11. Refer to (37) above.

(78) Par. 5-20(3). The storage batteries are not in compliance with their applicable specifications owing to the following deficiencies in their design and construction.

(a) The battery cases are not watertight due to the poor fit between the covers and cases.

(b) Rubber gaskets have not been adequately employed to render the terminal boxes watertight.

(c) No provision has been made for enclosing the knockout openings after the removal of the battery cables.

(d) The terminal box retaining screws do not comply with Bureau of Aeronautics Specification B-38a.

(e) The carrying handles are not secured to the battery cases in a manner which will preclude their slipping off during the normal handling or transportation of the batteries.

(f) The carrying handles and top cover plates of the batteries must be removed for checking specific gravity or the level of the electrolyte.

(g) The lead plating of the steel battery terminal hardware has worn away after a relatively short period of service.

(79) Par. 5-21. Refer to (37) and (77) above.

(80) Par. 5-22. The equipment, when operating from the a-c power unit, is not provided with means for turning the power to the power unit "on" or "off" from the receiver units.

(81) Par. 5-23. Refer to (12), (37), and (49) above.

(82) Par. 7-8. The tools and accessories as listed in reference (b) are not adequate for servicing the receiver units in their present form, as special tools will be required. Refer also to (45) above.

(83) Par. 7-9. The canvas slip cover furnished for the Type CAY 46078 Receiver Unit is not especially suited for its intended purpose, in that it does not provide the necessary protection during the manipulation of the receiver operating controls.

(84) No sample fixed resistors, capacitors, transformers, insulation materials, etc., were furnished for test to determine their compliance with their applicable specifications.

227. A summary of defects and such items as do not comply with Naval Specifications which are generally applicable to shipboard radio receiving equipment are as follows:

(1) Par. 2-2. The use of vacuum tubes for dual functions, particularly in high frequency circuits, is not generally acceptable for Navy receivers.

(2) Par. 2-3(A)(1). The materials employed in the construction of the receiver chassis, front panels, panel supporting brackets, and shield enclosures are of too light gauge to provide for satisfactory ruggedness and rigidity. The shield enclosures for the preselector and high frequency oscillator tuned circuits are not complete, in themselves, since their covers depend upon the chassis rather than their base plates for grounding.

(3) Par. 2-3(A)(3). The plates of the rotors and stators of the ganged tuning capacitors are not soldered bonded to their supporting members. The rotor hubs are not provided with coin silver facings, and the wiper fingers for these rotors are not fitted with coin silver button contacts, as required for well designed tuning capacitors.

(4) Par. 2-3(A)(5). The band switches are not equipped with coin silver facings on their movable or fixed contacts, and their wafers are not so designed as to be self-aligning when ganged on a common drive shaft.

(5) Par. 2-3(A)(8). The toggle switches employed in the equipment do not appear to be of the dry packed type with silver plated contacts.

[redacted]

(6) Par. 2-3(A)(9). The front edges of the receiver cabinet do not provide sufficient bonding with the front panels of the receiver units to permit operation of the equipment in the presence of high power local transmitters.

(7) Par. 2-3(c). The construction of the a-c power unit is not sufficiently rugged for shipboard service.

(8) Par. 2-20. No satisfactory means has been provided to shield the antenna posts on the front panel of the receiver units, nor are the input circuits designed for transmission line feed.

(9) Par. 2-27. No satisfactory means has been afforded for identifying the circuit functions of bus wiring.

(10) The component parts mounted to the under sides of the receiver chassis are not accessible to the degree required for Naval receivers.

(11) No suitable or permanent means have been provided for identifying the circuit function of air dielectric trimmer capacitors for convenience of circuit alignment.

(12) The methods employed for securing the receiver chassis in their common cabinet or in securing the dynamotor unit within its transportation case are not satisfactory.

(13) Par. 4-50. The frequency overlaps, afforded for either receiver unit, between the high frequency end of any band and the low frequency end of the succeeding band and their common mean frequency (arbitrarily chosen by the contractor) are not very well equalized. In the case of the H. F. Receiver Unit, this non-equalization may lead to difficulties in production when attempting to provide the required overlap between the ends of the bands and their respective mean frequencies.

(14) Par. 4-54. The panel markings for the manual volume controls of the receiver units do not accurately indicate the functions of these controls.

(15) Par. 4-56. The spurious responses of the receiver units, including the direct reception of their respective intermediate frequencies, are not attenuated to the degree normally expected of Navy receivers.

(16) Par. 4-70 and 4-71. The construction of the equipment will not permit its use on shipboard where it will be subjected to severe and prolonged vibration, and to the shock of gunfire.

[redacted]

(17) Par. 4-73. Wire-wound resistance elements are not provided in the construction of the manual volume control potentiometers, as usually required.

(18) Par. 4-78. Separate sensitivity and audio gain (or level) controls are not provided for either receiver unit.

[redacted]

CONCLUSIONS

228. The Model XTBW Radio Receiving Equipment does not comply with all of the requirements of its governing specifications, reference (b), as amended by the contract, reference (c). It possesses certain defects in its construction and deficiencies in performance which render it unacceptable for its intended purpose. The workmanship on the model equipment is not up to the usual standards expected of equipment of its character.

229. The chassis-front panel construction of the receiver units is not rugged. Handling of the receiver units from their front panels results in the warpage of their chassis, which in turn results in excessive strains being applied on the ganged tuning capacitors and coil assemblies. The method of mounting the shield cans for the radio frequency transformer and high frequency oscillator assemblies subjects the coil forms to such severe strains as to cause their breakage. The general construction of the receiver units, owing to its lack of ruggedness and rigidity, is such that permanent adjustment of circuit alignment under all service conditions cannot be assured.

230. The component parts of the receiver units are exceedingly inaccessible. The construction of the radio frequency transformer and high frequency oscillator assemblies is such as to preclude any possible means for cleaning the band switch contacts; and the replacement of the coils or band switches cannot be effected without considerable disarrangement of the wiring and possible damage to other components. The method of mounting fixed resistors and capacitors is such that their replacement is extremely difficult without damage to the insulation on the wiring, breakage of soldering lugs, or possible injury to other components. The replacement or servicing of certain components cannot be effected without the removal of other components or of partitions.

231. The electrical performance of the receiver units does not provide the specified selectivity or fidelity required by the contract, nor does it provide for optimum signal to noise ratios. The antenna trimmer capacitors are ineffective and the input circuits are considered to be of poor design. The frequency stability of the receiver units under conditions of variations in temperature, manipulation of the volume controls on MVC, and variation of signal intensity, when receivers are adjusted for reception of cw signals on MVC, is poor. The performance of the converter tubes in the presence of strong r-f input signals is exceedingly poor. The frequency of the oscillator section is pulled out of step with the receiver tracking, as the input signal is increased, and the mixer circuit creates innumerable spurious responses.

TABLE 1

FREQUENCY RANGE AND BAND RATIO
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46076

Band No.	Tuning Dial Setting	Frequency Kilocycles	Frequency Coverage Kilocycles	Band Ratio
1	Minimum	193.38		
	Maximum	438.70	245.32	2.27 to 1
2	Minimum	425.37		
	Maximum	968.41	543.04	2.28 to 1
3	Minimum	943.25		
	Maximum	2077.31	1134.06	2.20 to 1

TABLE 2

BAND OVERLAP
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46076

Band	Frequency Range (Min. to Max.)	Overlap Frequency		L.F. Overlap		H.F. Overlap		Total Overlap*	
No.	Kilocycles	Bands	Kcs	Kc	%	Kc	%	Kc	%
1	193.38 - 438.70	L.F.End Band 1.	200	6.62	3.32	3.70	0.850		3.32
		1 and 2	435					13.33	3.06
2	425.37 - 968.41			9.63	2.21	8.41	0.876		
		2 and 3	960					25.16	2.62
3	943.25 - 2077.31	H.F. End Band 3.	2000	16.75	1.74	77.31	3.87		3.87

*Specification Minimum Limit - 2%.

[redacted]

TABLE 3

CW AND MCW SENSITIVITY WITH ORIGINAL AND REPLACEMENT TUBES
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46076

		CW Sensitivity - Microvolts			MCW Sensitivity - Microvolts		
		Tube Complement			Tube Complement		
Band No.	Freq. Kc	Original	Replacement No. 1	Replacement No. 2	Original	Replacement No. 1	Replacement No. 2
1	200	1.30	1.25	1.25	0.71	0.72	0.75
	295	1.97	1.95	1.81	1.25	1.32	1.43
	435	2.20	2.24	2.61*	1.55	1.62	1.60
2	435	1.24	1.10	2.72*	0.61	0.61	1.24
	650	1.37	1.30	1.95	0.90	0.80	1.08
	960	1.89	1.80	2.57*	1.19	1.13	1.42
3	960	1.45	1.38	2.85*	0.85	0.75	1.32
	1400	1.82	1.78	2.90*	1.05	1.06	1.33
	2000	3.05*	3.02*	4.20*	1.48	1.55	1.65

*Outside of specification limit.
Note: Receiver operated from 115 volt, A.C. Power Unit

TABLE 3A

MUTUAL CONDUCTANCE AND FUNCTION OF VACUUM TUBES
AS USED FOR SENSITIVITY DATA UNDER TABLE 3
TYPE CAY 46076

		Mutual Conductance - Micromhos		
Tube Navy Type No.	Circuit Function	Original Tube Complement	Replacement Tube Complement No. 1	Replacement Tube Complement No.2
38646	1st R.F.	1590	1590	1760
38646	2nd R.F.	1570	1610	1730
38568K	1st Det. & 1st Osc.	1430**	1290**	1458**
38646	1st I.F.	1720	1570	1730
38646	2nd I.F.	1680	1580	1790
		415*	415*	580*
38667	2nd Det. & 1st A.F.	1100**	1150**	1000**
		440*	415*	560*
38667	AVC	1190**	1100**	1060**
38646	CW Osc.	1690	1600	1730
38041	2nd A.F.	1815	1815	2220

*Triode section only.
**Pentode section only.

TABLE 4 [redacted]

SELECTIVITY - BAND WIDTHS (REFER TO NOTE BELOW)
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46076

Band No.	Frequency Kilocycles	Sensitivity Setting	Band Widths At Contract Limits	6 db Down 6 Kc Min.	20 db Down 9 Kc Max.	40 db Down 13 Kc Max.	60 db Down 16 Kc Max.
1	200	Optimum		2.66*	6.10	9.25	11.61
	315	"		4.19*	8.22	10.87	13.54
	435	"		6.28	9.17*	11.72	14.85
2	435	Optimum		5.27*	8.49	11.37	14.79
	600	"		4.71*	8.45	10.97	13.87
			Contract Limits	7.5 Kc Min.	11 Kc Max.	15 Kc Max.	20 Kc Max.
	960	"		7.35*	9.33	12.24	15.91
3	960	Optimum		7.67	9.63	12.86	16.85
	1500	"		7.37*	9.78	12.88	17.77
			Contract Limits	10 Kc Min.	15 Kc Max.	21 Kc Max.	28 Kc Max.
	2000	"		6.73*	9.6	13.02	16.8

*Outside of contract limits.

NOTE: The above data were obtained during the early part of the tests, and before subjection of receiver to temperature cycle.

TABLE 5

SELECTIVITY - BAND WIDTHS (REFER TO NOTE BELOW)
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46076

Band No.	Frequency Kilocycles	Sensitivity Setting	Band Widths at Contract Limits	6 db Down 6 Kc Min.	20 db Down 9 Kc Max.	40 db Down 13 Kc Max.	60 db Down 16 kc Max.
1	315	Optimum		5.34*	8.65	11.21	13.96
	315	Reduced		5.26*	8.77	11.37	14.20
2	600	Optimum		3.90*	8.01	10.88	13.60
	600	Reduced		3.73*	8.12	10.94	13.78
			Contract Limits	7.5 Kc Min.	11 Kc Max.	15 Kc Max.	20 Kc Max.
3	1500	Optimum		5.15*	9.77	12.97	17.76
	1500	Reduced		4.45*	9.77	13.25	17.77

*Outside of contract limits.

NOTE: The above data were obtained during the latter part of the tests and after the receiver unit had been subjected to a temperature cycle.

TABLE 6

INTERMEDIATE FREQUENCY REJECTION RATIO
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46076

Band No.	Frequency Kilocycles	I.F. Rejection Ratio
1	200	900
	245	4030
	295	7740
	375	11550
	435	20800
2	435-960	Input at I.F. Freq. greater than 500,000 microvolts.
3	960-2000	Input at I.F. Freq. greater than 500,000 microvolts.

[redacted]

TABLE 7

RESONANT OVERLOAD AND MAXIMUM OUTPUT - CW OPERATION
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46076

Band No.	Freq. Kc	uV Input for 10 MW Output	Resonant Overload uV Input	Resonant Overload MW Output	Maximum Output Milliwatts
1	200	1.2	16.0	680	1400
	435	1.9	28.0	625	1265
2	435	1.1	13.0	530	1290
	960	1.6	30.0	942	1520
3	960	1.5	20.0	602	1450
	2000	3.2	40.0	665	1470

Note: All outputs measured with AVC off and sensitivity control adjusted for 400 microwatt noise level with no input signal.

TABLE 8

RESONANT OVERLOAD AND MAXIMUM OUTPUT MCW OPERATION
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46076

Band No.	Freq. Kc	uV Input for 10 MW Output	Resonant Overload uV Input	Resonant Overload MW Output	Maximum Output Milliwatts
1	200	0.62	6.2	345	1140
	435	1.15	10.0	260*	785
2	435	0.55	4.7	275*	905
	960	1.00	13.0	515	1000
3	960	0.62	7.0	380	940
	2000	1.15	10.0	350	1160

Note: All outputs measured with AVC off and sensitivity control adjusted for 400 microwatt noise level with no input signal.

*Outside of specification minimum limit of 300 MW.

[redacted]

TABLE 9

RESETTABILITY OF MAIN TUNING CONTROL
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46076

Band No.	Dial Setting Kilocycles	Dial Reset Clockwise Freq. Deviation	Dial Reset Counter Clockwise Freq. Deviation
1	200	+30.1 Cycles	-157.0 Cycles
	225	-81.7 Cycles	-49.1 Cycles
	275	-177.8 Cycles	-115.8 Cycles
	325	+162.5 Cycles	+ 33.3 Cycles
	375	-425.0 Cycles	-125.0 Cycles
	425	+71.4 Cycles	- 71.4 Cycles
2	450	0 Cycles	-333.0 Cycles
	500	+136.2 Cycles	-373.0 Cycles
	600	+17.7 Cycles	+351.0 Cycles
	700	-234.0 Cycles	- 60.6 Cycles
	800	-219.0 Cycles	+142.0 Cycles
	900	-255.3 Cycles	+241.2 Cycles
3	1000	+444.5 Cycles	-252.0 Cycles
	1100	+289.0 Cycles	-227.0 Cycles
	1300	+273.0 Cycles	+418.0 Cycles
	1500	-419.0 Cycles	-110.0 Cycles
	1700	+930.0 Cycles	-279.0 Cycles
	1900	+597.0 Cycles	-149.2 Cycles

TABLE 10

FREQUENCY STABILITY WITH CHANGE OF BATTERY VOLTAGE
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT OPERATED FROM DYNAMOTOR UNIT
TYPE CAY 46076

Band No.	Frequency Kilocycles	Frequency Stability with Change of Battery Voltage from 11 to 15 Volts Cycles	15 to 11 Volts Cycles	Spec. Limit Cycles
1	200	+114	-105	250
	435	+165	-142	250
2	435	+143	-147	250
	960	+240	-242	250
3	960	+141	-146	250
	2000	+343	-331	400

[redacted]

TABLE 11

FREQUENCY STABILITY WITH CHANGE OF LINE VOLTAGE
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT OPERATED FROM A.C. POWER UNIT
TYPE CAY 46076

		Frequency Stability With Change of Line Voltage From			
Band No.	Freq. Kc.	115 to 95 Volts Cycles	95 to 125 Volts Cycles	125 to 115 Volts Cycles	Implied Spec.Limit Cycles
1	200	-87.8	+119.8	-31.9	250
	435	-104.6	+130.8	-32.7	250
2	435	-85.0	+163.5	-52.3	250
	960	-173.8	+275.3*	-101.5	250
3	960	-116.0	+144.8	-28.8	250
	2000	-312.5	+437.5*	-156.3	400

*Outside of specification limit.

TABLE 12

FREQUENCY STABILITY WITH CHANGE OF TOGGLE SWITCH SETTINGS
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT OPERATED FROM DYNAMOTOR UNIT*
TYPE CAY 46076

		Freq. Stability with Toggle Switch Changes from			
			H.F. Receiver		
Band No.	Freq. Kc	MVC to AVC Cycles	OFF to ON Cycles	ON to OFF Cycles	Implied Spec. Limits
1	200	0	+25	-24	250
	435	+79.0	-50	+50	250
2	435	+ 4.0	-31	+31	250
	960	+30.0	-79	+87	250
3	960	- 2.0	-35	+33	250
	2000	-90.0	-114	+119	400

*Battery voltage 12.0 volts.

[redacted]

TABLE 13

FREQUENCY STABILITY WITH CHANGE OF TOGGLE SWITCH SETTINGS
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT OPERATED FROM A.C. POWER UNIT*
TYPE CAY 46076

		Freq. Stability with Toggle Switch Changes From	H.F. Receiver		
Band No.	Freq. Kc	MVC to AVC Cycles	OFF to ON Cycles	ON to OFF Cycles	Implied Spec. Limit
1	200	-1.0	+37	-39	250
	435	-85.0	+77	-90	250
2	435	+14.0	-42	+44	250
	960	-36.0	+132	-130	250
3	960	+5.0	-59	+57	250
	2000	-88.0	-201	+220	400

*Line voltage - 115.0 volts.

TABLE 14

FREQUENCY STABILITY WITH INCREASE OF INPUT SIGNAL INTENSITY
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46076

		Frequency Deviation		
Band No.	Frequency Kilocycles	MVC Cycles	AVC Cycles	Spec. Limit
1	200	+16	+26	250
	435	+22	+29	250
2	435	+19	+35	250
	960	+105	+180	250
3	960	+30	+50	250
	2000	+293	+360	400

[redacted]

TABLE 15

FREQUENCY STABILITY WITH CHANGE OF SENSITIVITY (OR VOLUME) CONTROL SETTING
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46076

Band No.	Frequency Kilocycles	Frequency Deviation MVC Cycles	Frequency Deviation AVC Cycles	Spec. Limit
1	200	-125	0	250
	435	-615*	0	250
2	435	-155	0	250
	960	-850*	0	250
3	960	-190	0	250
	2000	-800*	0	400

*Outside of specification limit.

TABLE 16

FREQUENCY VARIATION WITH CHANGE OF CONVERTER TUBE
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46076

Converter Tube Change From Original to	Mutual Conductance Micromhos*		Frequency Change			
			Band 1 - 200 Kc		Band 3 - 2000 Kc	
	Original Tube	Replacement Tube	Cycles	%	Cycles	%
Replacement #1	1430	1290	-50	.025	+2560	0.1280
Replacement #2	1430	1458	+20	.010	+ 550	0.0275

*Pentode section only.

[redacted]

TABLE 17

DIAL SCALE CALIBRATIONS
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46076

Calibrated Frequencies - Kilocycles

Band 1	Band 2	Band 3
200	450	1000
210	470	1040
225	500	1100
250	550	1200
275	600	1300
300	650	1400
325	700	1500
350	750	1600
400	800	1700
425	850	1800
	900	1900
	950	2000

[redacted]

TABLE 18

FREQUENCY RANGE AND BAND RATIO
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46077

Band No.	Tuning Dial Setting	Frequency Kilocycles	Frequency Coverage Kilocycles	Band Ratio
1	Minimum	1930.40		
	Maximum	4090.13	2159.73	2.12 to 1
2	Minimum	3973.68		
	Maximum	7473.00	3499.32	1.88 to 1
3	Minimum	7248.20		
	Maximum	11905.60	4657.40	1.64 to 1
4	Minimum	11517.75		
	Maximum	18696.90	7179.15	1.62 to 1

TABLE 19

BAND OVERLAP
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46077

Band	Frequency Range (Min. to Max.)	Overlap Frequency		L.F. Overlap		H.F. Overlap		Total Overlap*	
No.	Kilocycles	Bands	Kcs	Kc	%	Kc	%	Kc	%
1	1930.40 - 4090.13	L.F.End Band 1.	2000	69.60	3.48	90.13	2.25		3.48
		1 and 2	4000					116.45	2.91
2	3973.68 - 7473.00			26.32	0.65	173.00	2.37		
		2 and 3	7300					224.80	3.08
3	7248.20 - 11905.60			51.80	0.71	305.60	2.63		
		3 and 4	11600					387.85	3.34
4	11517.75-18696.90	H.F.End Band 4	18100	82.25	0.71	596.90	3.30		3.30

*Specification Minimum Limit - 2%.

[redacted]

TABLE 20

CW AND MCW SENSITIVITY WITH ORIGINAL AND REPLACEMENT TUBES
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46077

Band No.	Freq. Kcs	CW Sensitivity - Microvolts, Tube Complement: Original	Replacement No. 1	Replacement No. 2	MCW Sensitivity - Microvolts, Tube Complement: Original	Replacement No. 1	Replacement No. 2
1	2000	2.00	2.60*	3.20*	1.32	3.16	3.60
	2800	2.05	1.88	3.00*	1.95	3.35	4.35
	4000	2.70*	2.02	3.30*	2.32	2.82	3.90
2	4000	2.95*	3.20*	6.10*	3.82	6.10*	7.20*
	5400	2.58*	2.42	4.90*	3.41	6.00*	6.80*
	7300	2.52	2.55	4.50	4.84	9.50	11.60*
3	7300	2.80	2.81	6.70*	4.74	8.50	8.00
	9200	2.50	2.60	6.30*	5.80	10.50*	11.90*
	11600	1.50	1.49	3.60	4.88	11.00*	9.20
4	11600	2.82	2.60	7.20*	10.00	17.50*	19.10*
	14500	2.50	2.90	7.00	8.40	13.10	17.00*
	18100	3.64	5.50	7.20	13.50	22.50*	24.00*

*Outside of specification limits.

TABLE 20A

MUTUAL CONDUCTANCE AND FUNCTION OF VACUUM TUBES
AS USED FOR SENSITIVITY DATA UNDER TABLE 20
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46077

Tube Navy Type No.	Circuit Function	Mutual Conductance Micromhos: Original Tube Complement	Replacement Tube Complement No. 1	Replacement Tube Complement No. 2
38646	1st R.F.	1630	1590	1760
38646	2nd R.F.	1610	1610	1730
38568K	1st Det.&1st Osc.	1458**	1290**	1458**
38646	1st I.F.	1730	1570	1730
38646	2nd I.F.	1790	1580	1790
		460*	415*	580*
38667	2nd Det.&1st A.F.	1180**	1150**	1000**
		415*	415*	560*
38667	A.V.C.	1150**	1100**	1060**
38646	CW Osc.	1580	1600	1730
38041	2nd A.F.	2080	1815	2220

*Triode Section only.
**Pentode Section only.

[redacted]

TABLE 21

SELECTIVITY - BAND WIDTHS
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
WITH WIDE BAND I.F. AMPLIFIER
TYPE CAY 46077

Band No.	Frequency Kilocycles	Sensitivity Setting	Band Width At Contract Limits	6 db Down 30 Kc Min.	20 db Down 60 Kc Max.	40 db Down 90 Kc Max.	60 db Down 150 Kc Max.
1	2000	Optimum		16.7*	36.2	58.8	77.2
	3000	"		25.9*	48.4	70.6	92.2
	4050	"		24.1*	43.2	67.2	90.9
2	4050	"		26.5*	47.1	69.5	94.9
	5500	"		26.9*	48.2	74.3	99.1
	7300	"		28.7*	52.5	82.5	107.5
3	7300	"		28.9*	58.8	85.0	112.0
	9500	"		23.3*	46.6	73.2	103.2
	11600	"		29.7*	59.4	85.8	113.6
4	11600	"		28.4*	51.4	79.2	112.2
	15000	"		33.5	53.0	75.3	97.7
	18100	"		26.4	57.9	81.7	110.0

The following data were obtained after receiver modification by WEMCo.

Band No.	Frequency Kilocycles	Sensitivity Setting	Band Width At Contract Limits	6 db Down 30 Kc Min.	20 db Down 60 Kc Max.	40 db Down 90 Kc Max.	60 db Down 150 Kc Max.
1	3000	Optimum		19.5*	43.3	66.1	87.5
		Reduced		24.5*	43.9	66.5	88.7
4	15000	Optimum		38.6	70.3*	89.4	122.8
		Reduced		39.1	68.7*	89.6	129.5

*Outside of contract limits.

[redacted]

TABLE 22

SELECTIVITY BAND WIDTHS
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
WITH NARROW BAND I.F. AMPLIFIER
TYPE CAY 46077

Band No.	Frequency Kilocycles	Sensitivity Setting	Band Width At Contract Limits	6 db Down 8.5 Kc Min.	20 db Down 15 Kc Max.	40 db Down 22.5 Kc Max.	60 db Down 40 Kc Max.
1	2000	Optimum		12.1	25.2*	36.5*	48.3*
	3000	"		11.8	24.5*	38.8*	52.8*
	4050	"		9.9	16.6*	27.6*	47.6*
2	4050	"		9.2	20.3*	36.1*	49.4*
	5500	"		10.8	20.7*	31.5*	42.8*
	7300	"		10.0	22.5*	37.5*	55.0*
3	7300	"		10.0	18.0*	30.7*	47.5*
	9500	"		13.3	20.0*	33.3*	53.3*
	11600	"		6.6*	19.8*	39.6*	59.6*
4	11600	"		9.9	23.1*	33.0*	46.2*
	15000	"		8.4*	17.8*	35.1	50.2*
	18100	"		14.4	24.0*	42.2*	64.0*

The following data were obtained after receiver modifications by WEMCo.

1	3000	Optimum		13.6	27.7*	41.1*	54.9*
		Reduced		13.4	28.9*	41.5*	45.3*
4	15000	Optimum		11.7	29.0*	44.6*	65.9*
		Reduced		6.7*	20.0*	36.3*	50.2*

*Outside of contract limits.

[redacted]

TABLE 23

INTERMEDIATE FREQUENCY REJECTION RATIO
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46077

Band No.	Frequency Kilocycles	Wide Band I.F. I.F. Rejection Ratio	Narrow Band I.F. I.F. Rejection Ratio
1	2000	3380	2210
	2350	10250	4500
	2800	17300	13900
	3350	9470	12100
	4000	39400	30150
2	4000	61600	62900
	4600	73700	65300
	5400	64500	66600
	6300	62500	74600
	7300	48100	54400
3	7300	92500	90300
	8200	100000	97500
	9200	(Input at I.F. Freq.)	114000
	10300	(Greater Than 500,000)	115000
	11600	(Microvolts.)	119000
4	11600	(Input at I.F. Freq.)	71500
	13000	(Greater Than 500,000)	61600
	14500	(Microvolts.)	52600
	16200	( )	162000
	18100	( )	131000

TABLE 24

RESONANT OVERLOAD AND MAXIMUM OUTPUT - CW OPERATION
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT WITH WIDE BAND I.F. AMPLIFIER
TYPE CAY 46077

		10 MW Output		Resonant Overload		Maximum Output
Band No.	Freq. Kcs	uV Input	Beat Note Freq. - C.P.S.	uV Input	MW Output	Milliwatts
1	4000	1.8	1000	24.0	618	655
	4000	1.8	1500	24.0	618	795
2	7300	1.85	1000	24.0	602	602
	7300	2.0	2000	23.0	495	895
3	11600	2.6	1000	20.0	447	558
	11600	3.0	2500	23.4	495	785
4	18100	3.0	1000	37.0	495	557
	18100	4.1	4000	42.0	362	822

[redacted]

TABLE 25

RESONANT OVERLOAD AND MAXIMUM OUTPUT - MCW OPERATION
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT WITH WIDE BAND I.F. AMPLIFIER
TYPE CAY 46077

Band No.	Freq. Kcs	uV Input for 10 MW Output	Resonant Overload uV Input	Resonant Overload MW Output	Maximum Output Milliwatts
1	4000	1.4	8.0	410	868
2	7300	4.7	22.0	385	1040
3	11600	6.5	25.0	312	923
4	18100	13.8	36.0	132*	640

*Outside of specification minimum limit of 300 MW.

TABLE 26

RESETTABILITY OF MAIN TUNING CONTROL
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
TYPE CAY 46077

Band No.	Dial Setting Kilocycles	Dial Reset Clockwise Freq. Deviation	Dial Reset Counter Clockwise Freq. Deviation
1	2000	+303 Cycles	+697 Cycles
	2500	-114 Cycles	-1660 Cycles
	3500	-1700 Cycles	-2300 Cycles
	4000	+1220 Cycles	+2440 Cycles
2	4500	+438 Cycles	-2380 Cycles
	5500	-2350 Cycles	-3680 Cycles
	6500	-1365 Cycles	-195 Cycles
	7000	+3120 Cycles	-1170 Cycles
3	7500	+500 Cycles	-1000 Cycles
	8500	-243 Cycles	-6060 Cycles
	9500	+2750 Cycles	-1875 Cycles
	10500	+1650 Cycles	-5250 Cycles
	11500	-4540 Cycles	-1317 Cycles
4	12000	+3660 Cycles	+2930 Cycles
	13000	+1875 Cycles	+6380 Cycles
	14000	-7850 Cycles	-6000 Cycles
	15000	+2815 Cycles	-1312 Cycles
	16000	-1250 Cycles	-2500 Cycles
	17000	+4130 Cycles	0
	18000	+5820 Cycles	+4130 Cycles

[redacted]

TABLE 27

FREQUENCY STABILITY WITH CHANGE OF BATTERY VOLTAGE
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT OPERATED FROM DYNAMOTOR UNIT
TYPE CAY 46077

		Frequency Stability with Change of Battery Voltage from 11 to 15 Volts			
Band No.	Freq. Kcs	Immediate Drift Cycles	Drift During 10 min. Stabilization Cycles	Final Drift After Stabilization Cycles	Spec. Limit Cycles
1	2000	+215	-450	-235	400
	4000	+1515	-905	+610	800
2	7300	+1950	-975	+975	1460
3	11600	+5022	-1395	+3627*	2320
4	11600	+2790	-1814	+976	2320
	18100	+8560	-1860	+6700*	3620

*Outside of specification limit.

TABLE 28

FREQUENCY STABILITY WITH CHANGE OF LINE VOLTAGE
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT OPERATED FROM A.C. POWER UNIT
TYPE CAY 46077

		Frequency Stability with Change of Line Voltage from			
Band No.	Freq. Kcs	115 to 95 Volts Cycles	95 to 125 Volts Cycles	125 to 115 Volts Cycles	Implied Spec. Limit Cycles
1	2000	-123.0	+215.3	-92.3	400
	4000	-909.0	+1273.0*	-364.0	800
2	4000	-212.8	+383.0	-170.2	800
	7300	-1172.0	+1854.0*	-682.0	1460
3	7300	-1000.0	+1300.0	-300.0	1460
	11600	-3628.0*	+4605.0*	-977.0	2320
4	11600	-1116.0	+1395.0	-279.0	2320
	18100	-7770.0*	+11540.0*	-3770.0*	3620

*Outside of implied specification limits.

[redacted]

TABLE 29

FREQUENCY STABILITY WITH CHANGE OF TOGGLE SWITCH SETTINGS
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT OPERATED FROM DYNAMOTOR UNIT*
TYPE CAY 46077

Band No.	Freq. Kcs	Freq. Stability - With Toggle Switch Changes From MVC to AVC Cycles	I. F. Receiver OFF to ON Cycles	I. F. Receiver ON to OFF Cycles	Implied Spec. Limit Cycles
1	2000	+92.3	-92.3	+61.6	400
	4000	+181.8	-363.5	+363.5	800
2	4000	+139.6	-139.6	+139.6	800
	7300	+390.5	-488.0	+488.0	1460
3	7300	+195.0	-195.0	+195.0	1460
	11600	+1255.0	-1116.0	+1116.0	2320
4	11600	+139.5	-418.5	+418.5	2320
	18100	+744.0	-3060.0	+2350.0	3620

*Battery voltage = 12.0 volts.

TABLE 30

FREQUENCY STABILITY WITH CHANGE OF TOGGLE SWITCH SETTINGS
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT OPERATED FROM A.C. POWER UNIT*
TYPE CAY 46077

Band No.	Freq. Kcs.	Freq. Stability with Toggle Switch Changes From MVC to AVC Cycles	I. F. Receiver OFF to ON Cycles	I. F. Receiver ON to OFF Cycles	Implied Spec. Limit Cycles
1	2000	+90.0	-66.0	+73.0	400
	4000	+195.0	-727.0	+773.0	800
2	4000	+139.6	-186.2	+93.1	800
	7300	+390.5	-975.0	+1073.0	1460
3	7300	+195.0	-487.5	+585.0	1460
	11600	+697.0	-2372.0**	+2372.0**	2320
4	11600	+279.0	-697.0	+558.0	2320
	18100	+941.0	-4940.0**	+5180.0**	3620

*Line voltage = 115 volts.
**Outside of implied specification limits.

[redacted]

TABLE 31

FREQUENCY STABILITY WITH INCREASE OF INPUT SIGNAL INTENSITY
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
WITH WIDE BAND I.F. AMPLIFIER
TYPE CAY 46077

		Frequency Deviation - Cycles				
		MVC		AVC		
Band No.	Frequency Kilocycles	Initial Change	Change After Reversal	Initial Change	Change After Reversal	Spec. Limit
1	2000	-850*	+600*	-860*	+650*	400
	4000	-500	+870*	-455	+825*	800
2	7300	-120	+590	-800	+1120	1460
3	11600	-70	+1470	-140	+1340	2320
4	11600	-345	+745	-465	+615	2320
	18100	-300	+3100	-1400	+3400	3620

*Outside of specification limits.

TABLE 32

FREQUENCY STABILITY WITH CHANGE OF SENSITIVITY (OR VOLUME) CONTROL SETTING
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
WITH WIDE BAND I.F. AMPLIFIER
TYPE CAY 46077

		Frequency Deviation		
Band No.	Frequency Kilocycles	MVC Cycles	AVC Cycles	Spec. Limit
1	2000	-400	0	400
	4000	-4000*	0	800
2	7300	-5000*	0	1460
3	11600	-16000*	0	2320
4	11600	-1600	0	2320
	18100	-20000*	0	3620

*Outside of specification limit.

[redacted]

TABLE 33

FREQUENCY VARIATION WITH CHANGE OF CONVERTER TUBE H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT TYPE CAY 46077

Converter Tube Change From Original to	Mutual Conductance Micromhos*		Frequency Change			
	Original Tube	Replacement Tube	Band 1 - 2000 Kc		Band 4 - 18100 Kc	
			Kc	%	Kc	%
Replacement No. 1	1458	1290	+1.10	0.055	-23.0	0.127
Replacement No. 2	1458	1430	+0.20	0.010	+10.0	0.055

*Pentode section only.

TABLE 34

DIAL SCALE CALIBRATIONS H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT TYPE CAY 46077

Calibrated Frequencies - Megacycles

Band 1	Band 2	Band 3	Band 4
2.0	4.0	7.5	12.0
2.2	4.5	8.0	12.5
2.5	5.0	8.5	13.0
3.0	5.5	9.0	13.5
3.5	6.0	9.5	14.0
4.0	6.5	10.0	14.5
	7.0	10.5	15.0
		11.0	15.5
		11.5	16.0
			16.5
			17.0
			17.5
			18.0

[redacted]

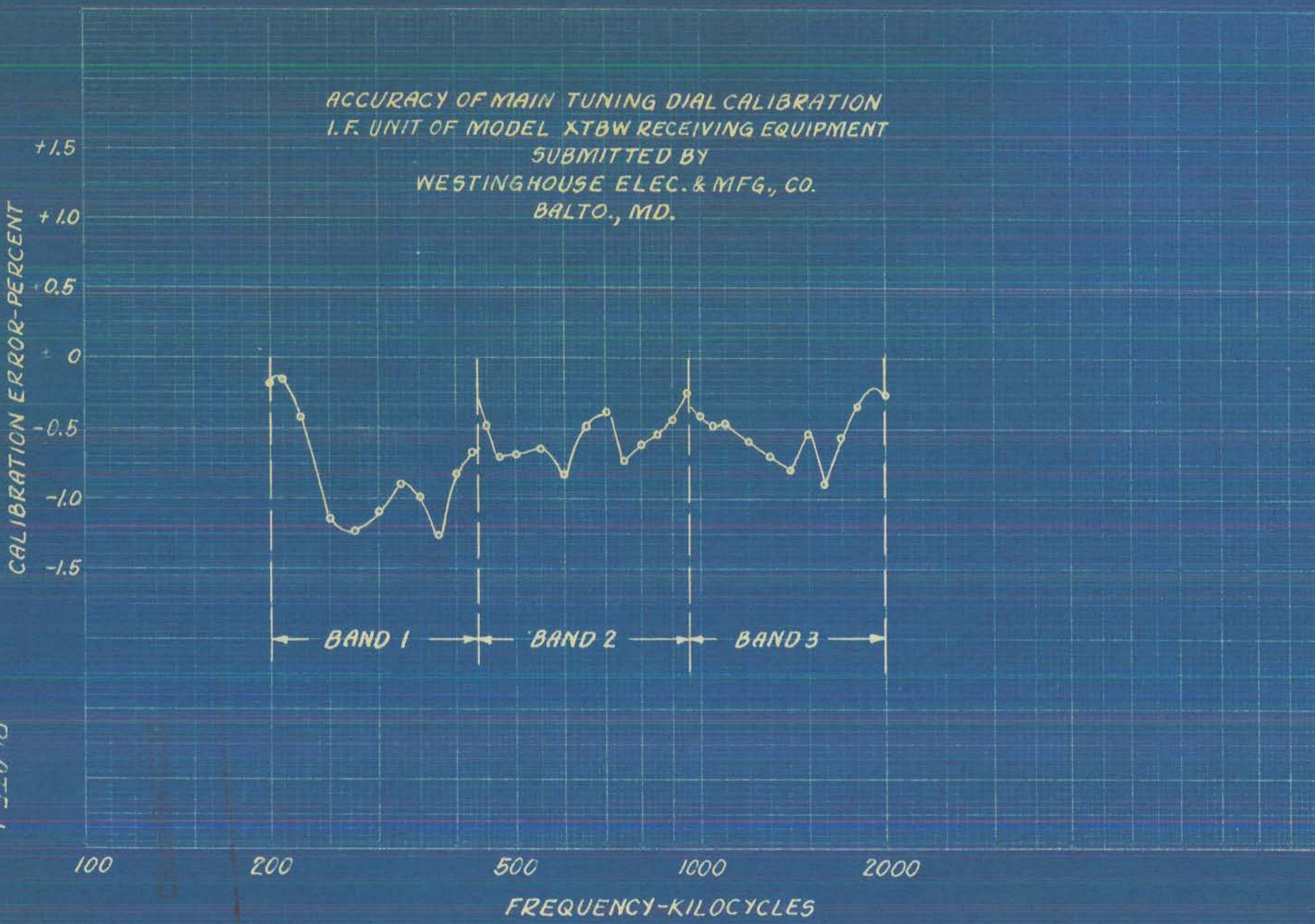
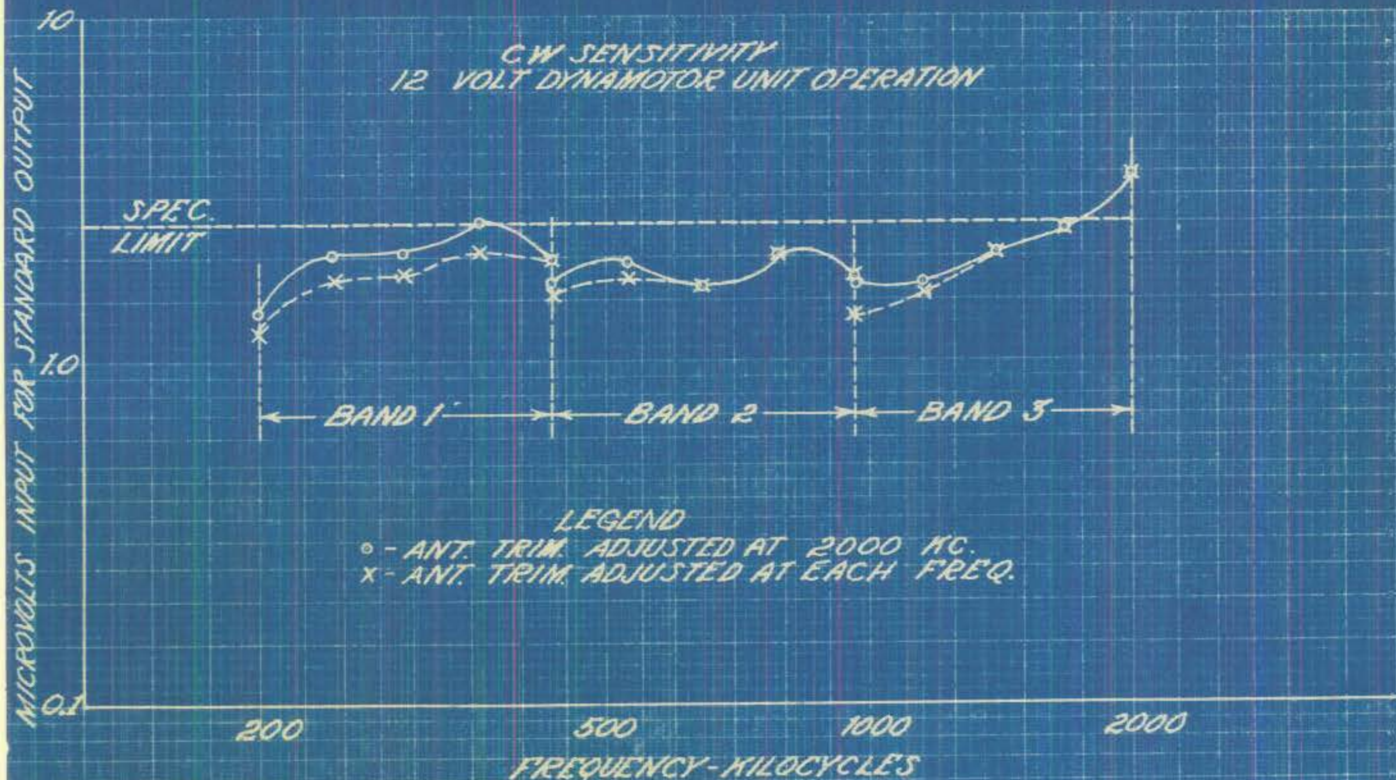
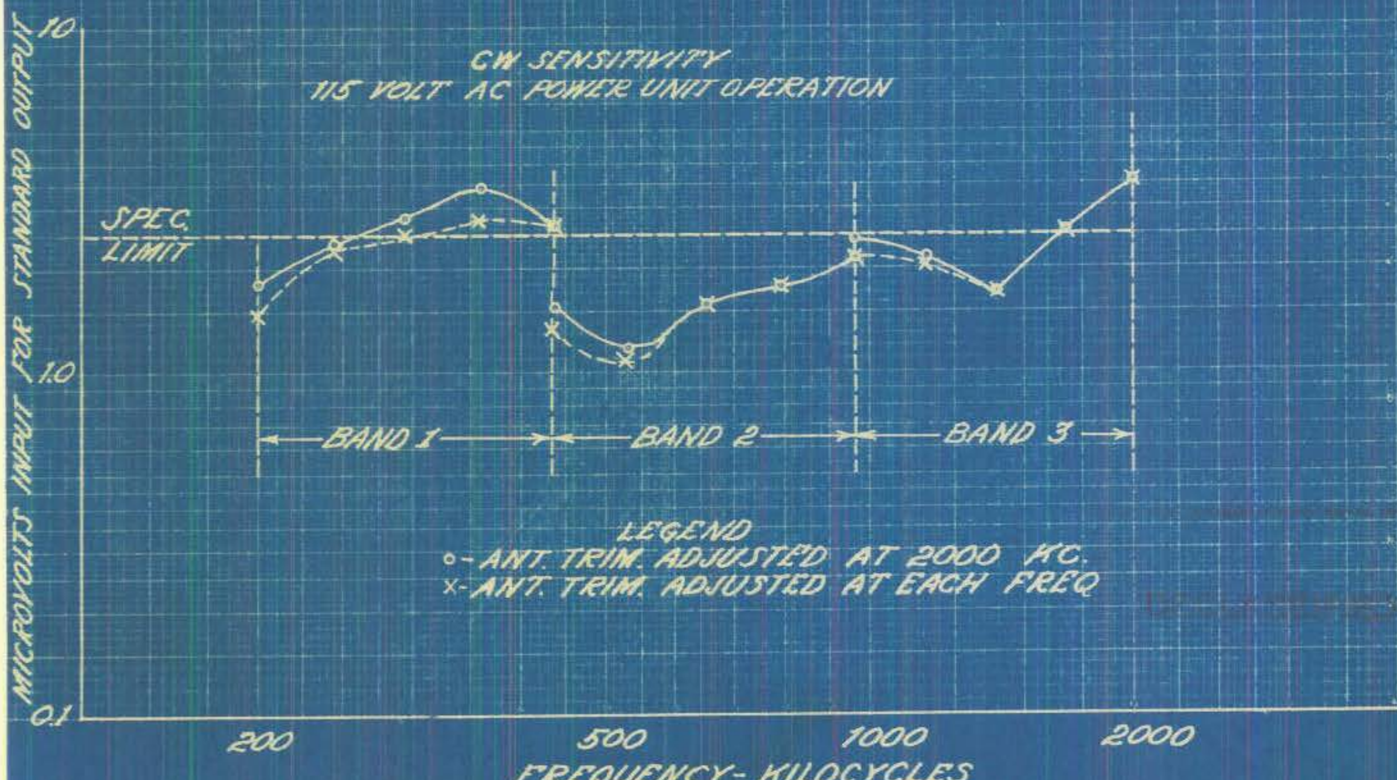
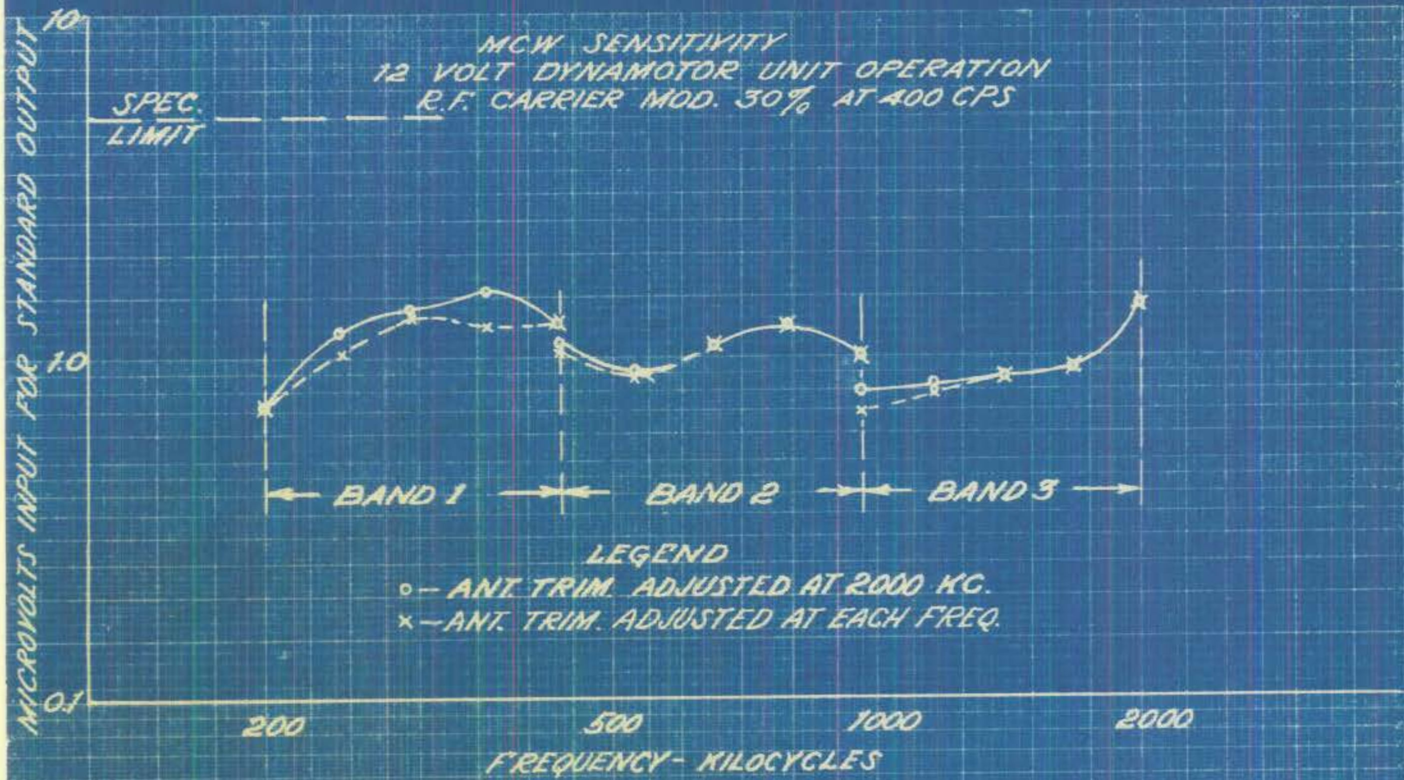

ACCURACY OF MAIN TUNING DIAL CALIBRATION
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG., CO.
BALTO., MD.
CALIBRATION ERROR-PERCENT
+1.5
+1.0
+0.5
0
-0.5
-1.0
-1.5
BAND 1
BAND 2
BAND 3
100
200
500
1000
2000
FREQUENCY-KILOCYCLES

PLATE I



I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC & MFG. CO
BALTO. MD.





I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.

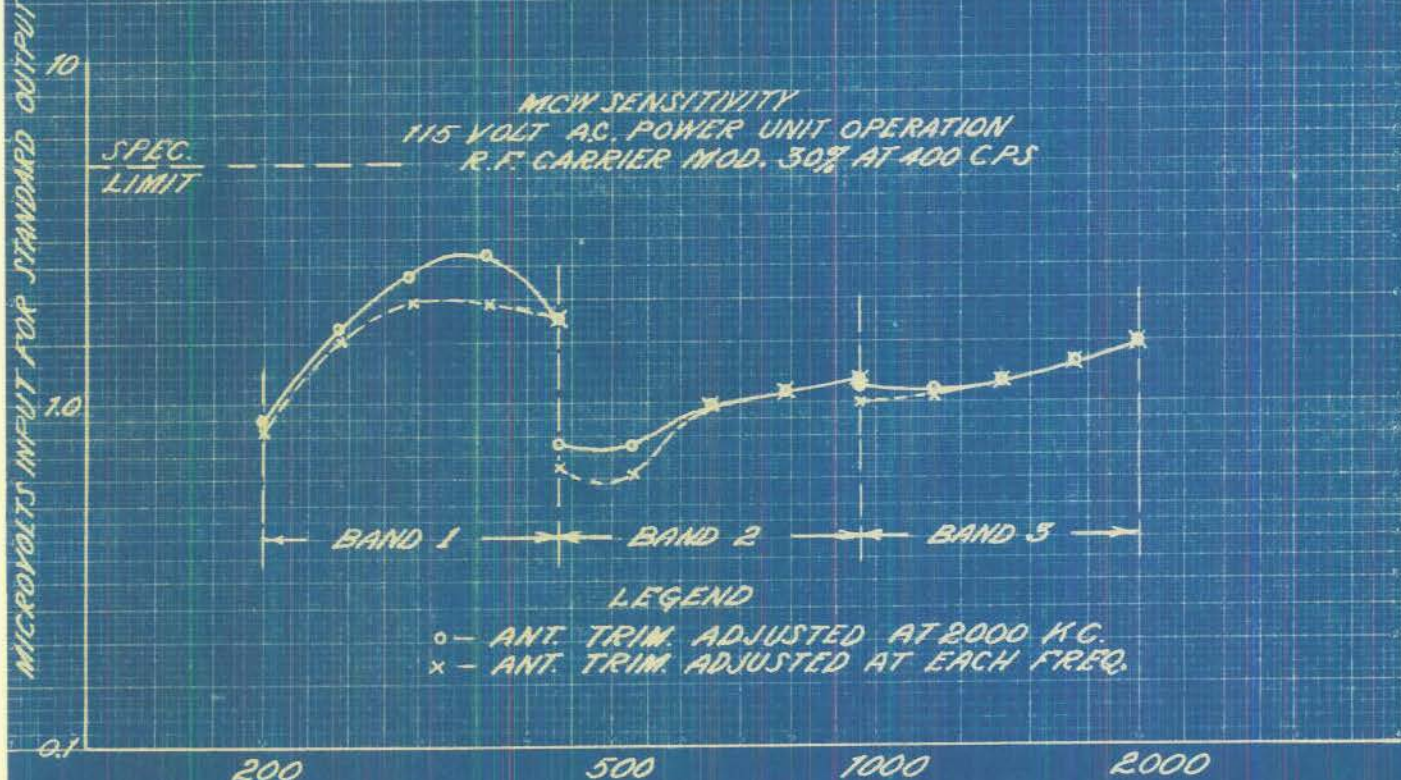
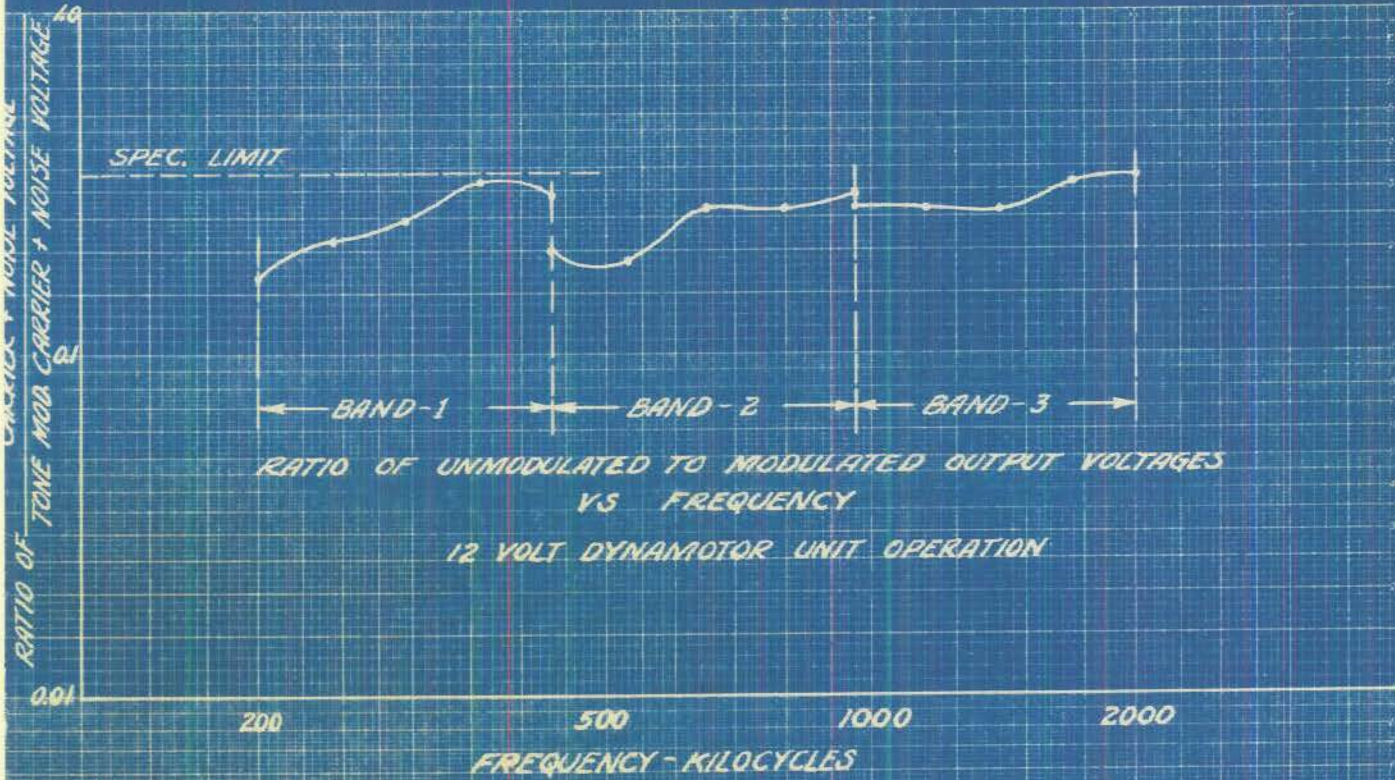


PLATE 3

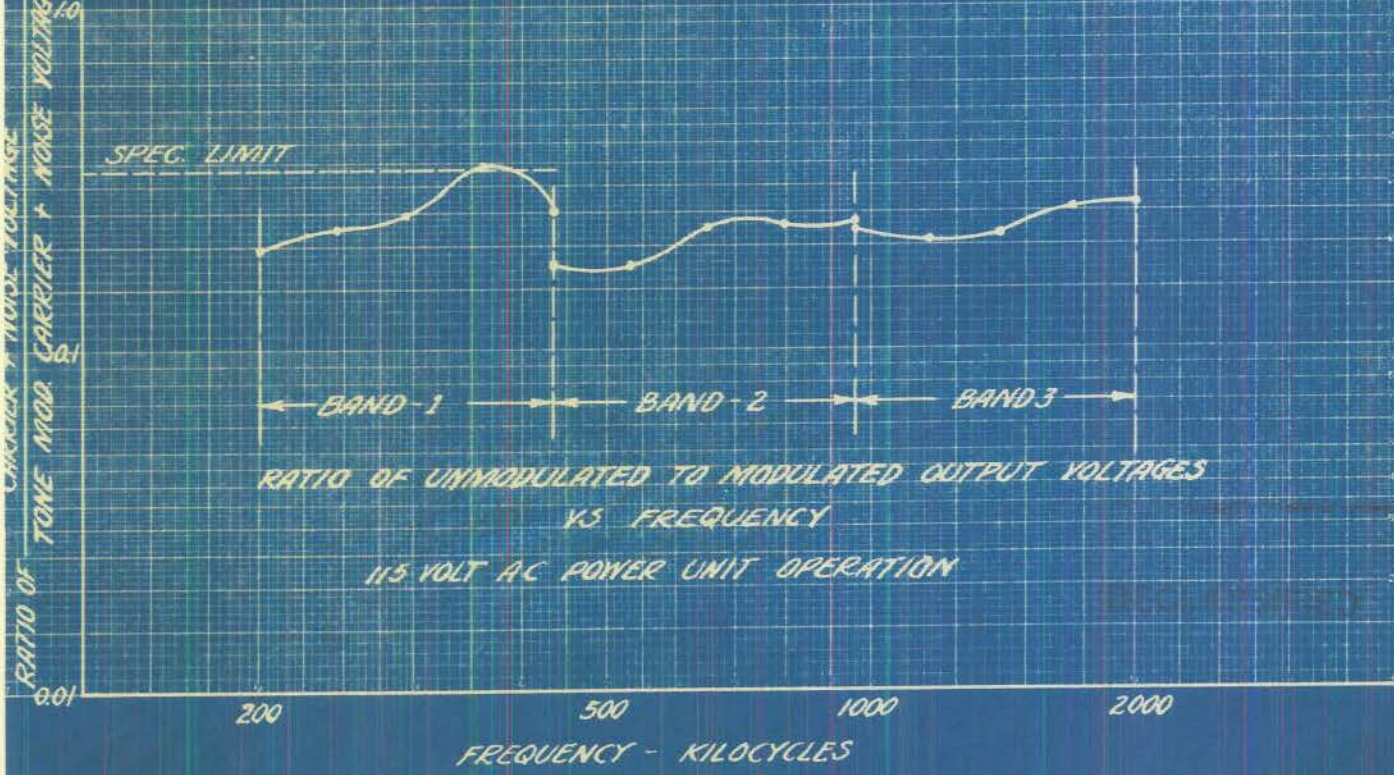


I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT

SUBMITTED BY

WESTINGHOUSE ELECTRIC & MFG. CO.

BALTIMORE, MARYLAND



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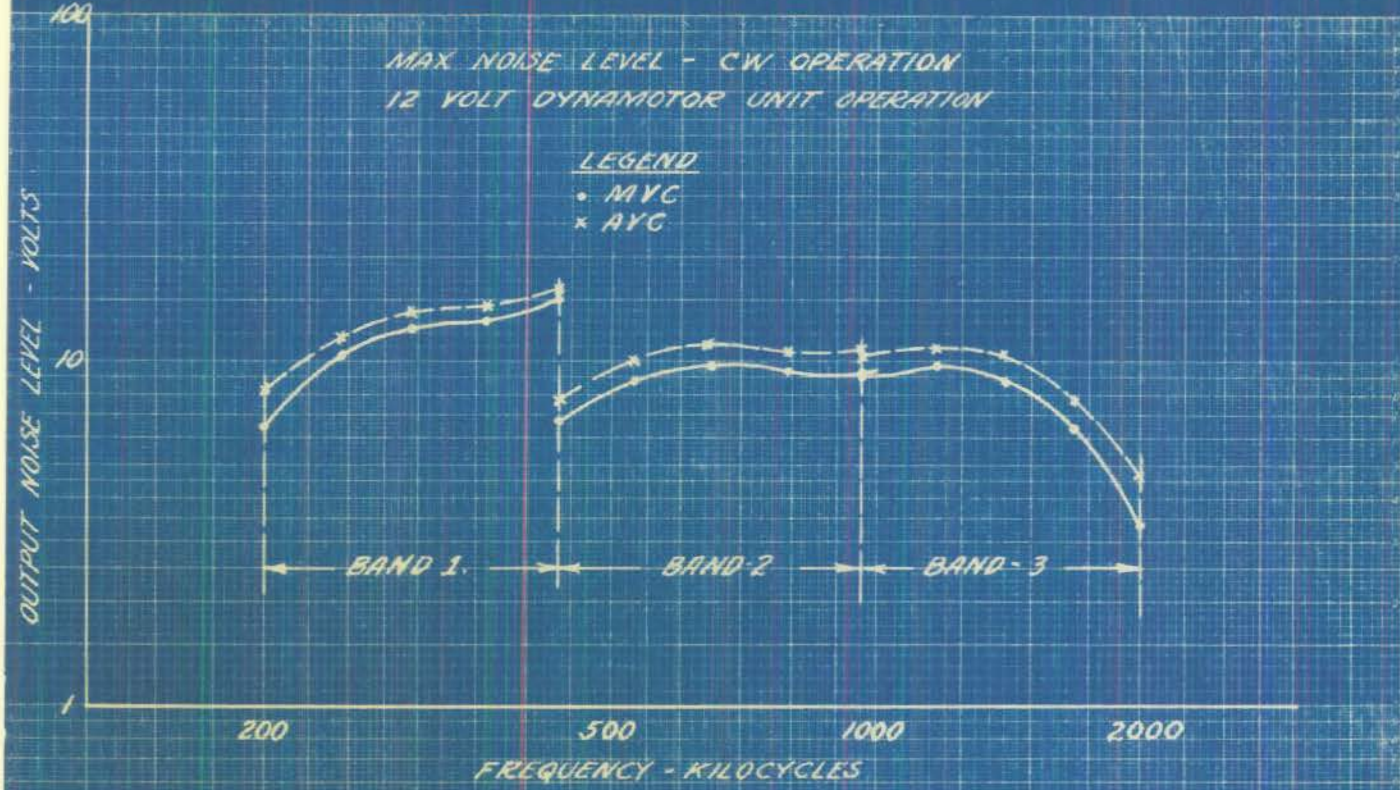


I. F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT

SUBMITTED BY
WESTINGHOUSE ELECTRIC & MFG. CO.
BALTIMORE, MD.

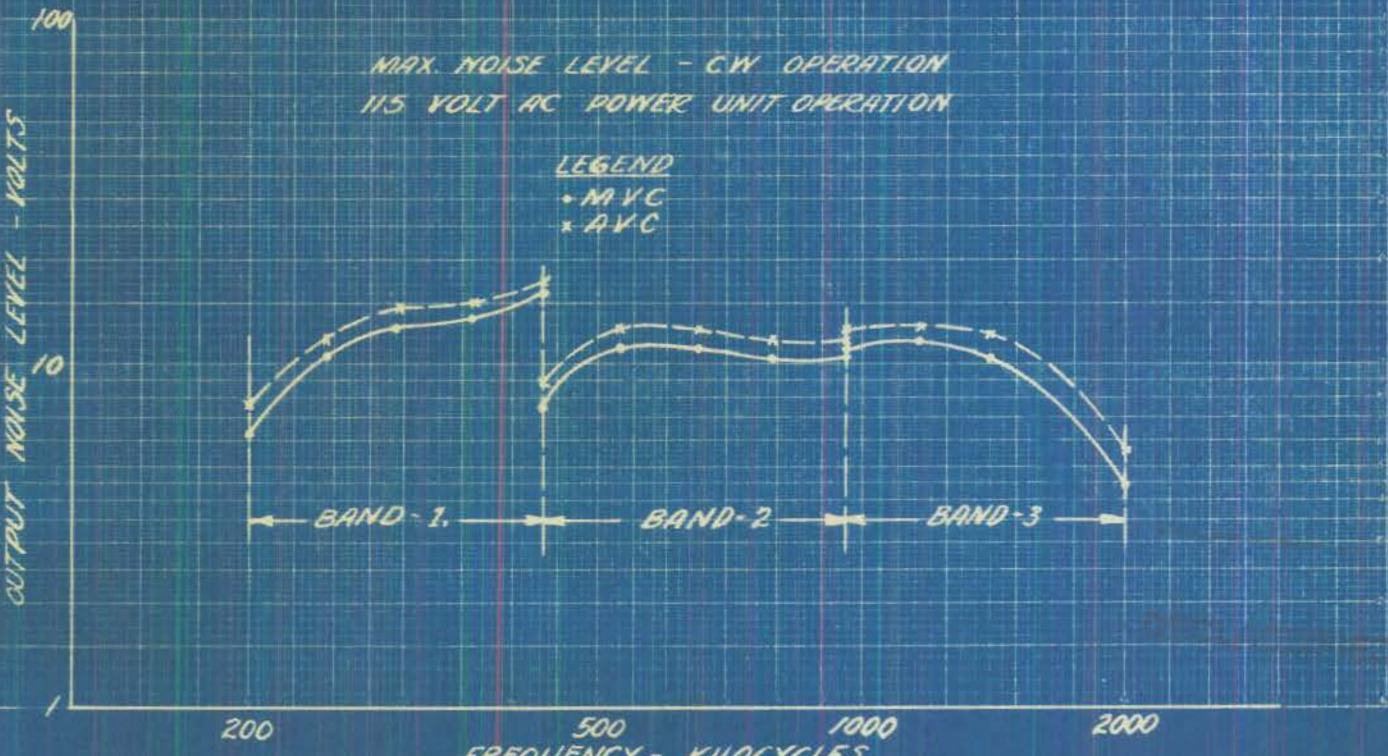
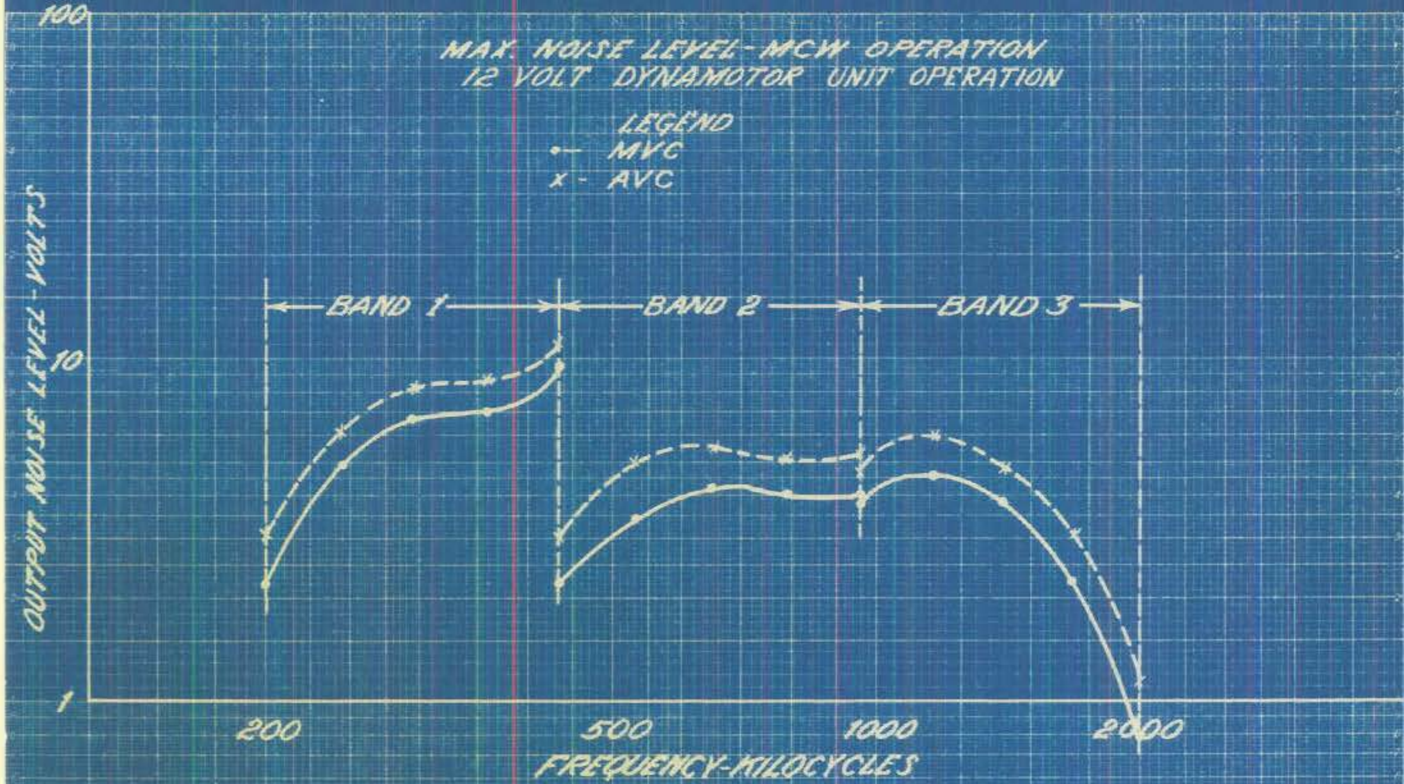


PLATE 5.



I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG CO.
BALTO. MD.

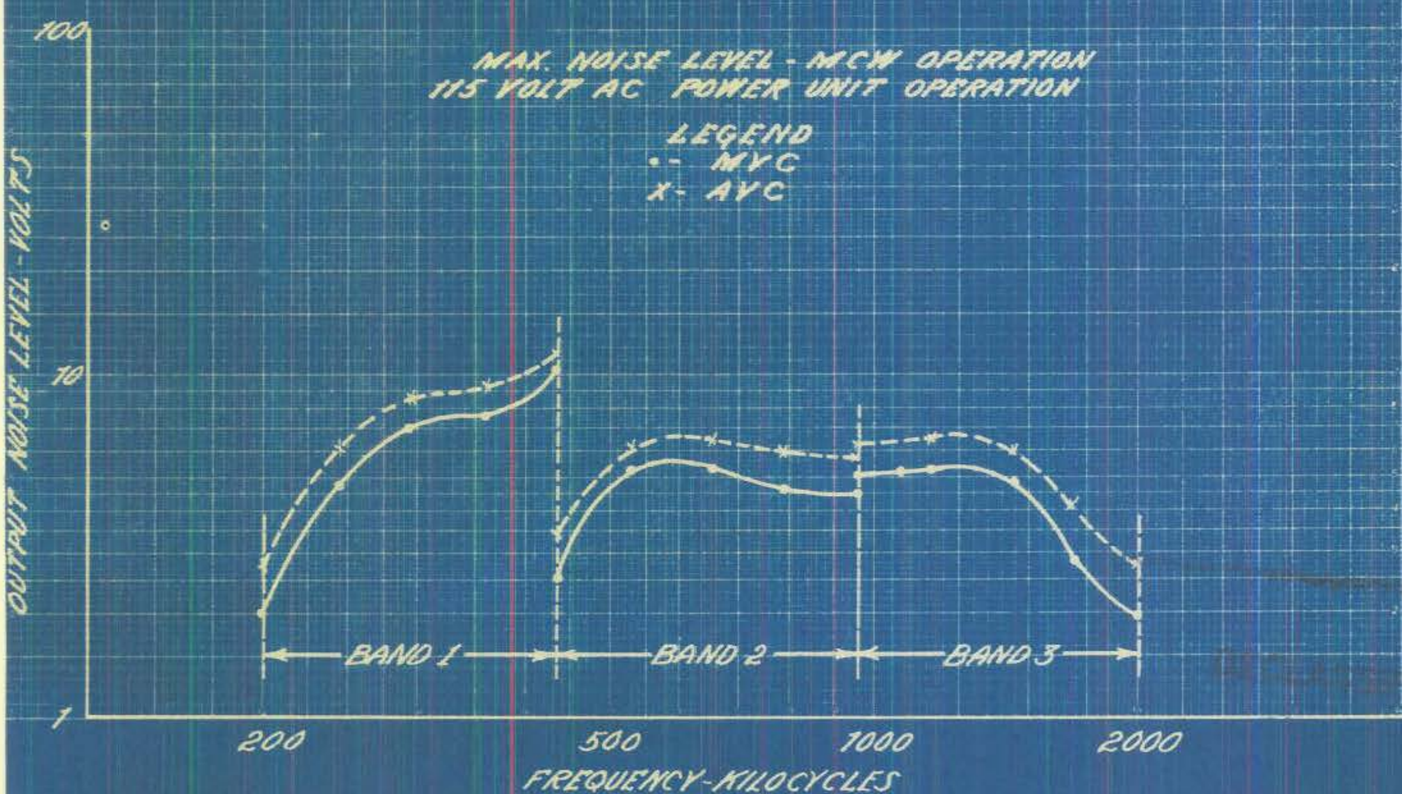


PLATE 6

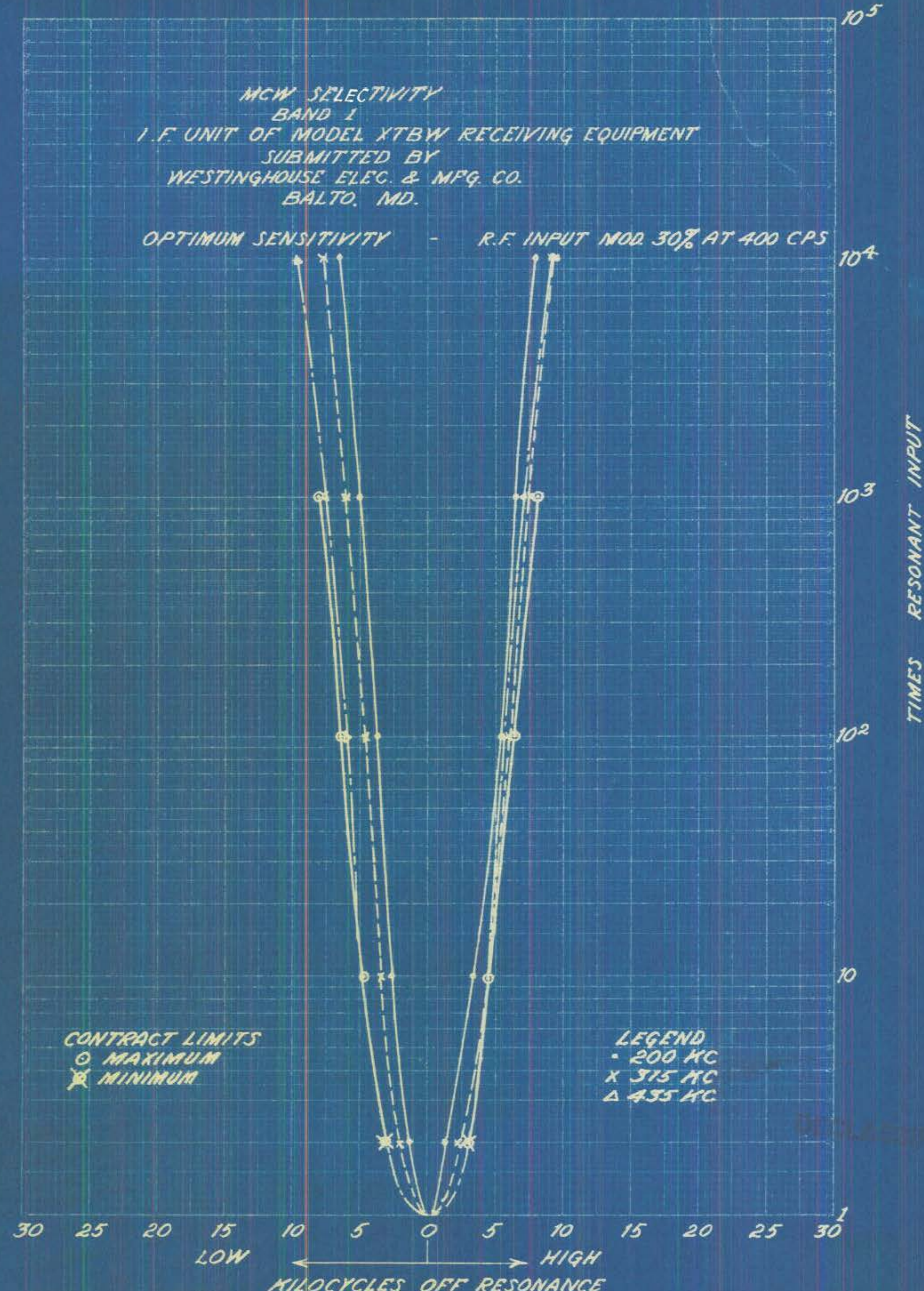

MCW SELECTIVITY
BAND 1
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
OPTIMUM SENSITIVITY - R.F. INPUT MOD. 30% AT 400 CPS
TIMES RESONANT INPUT
10^5
10^4
10^3
10^2
10
1
CONTRACT LIMITS
⊙ MAXIMUM
MINIMUM
LEGEND
• 200 KC
x 315 KC
△ 435 KC
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE 7

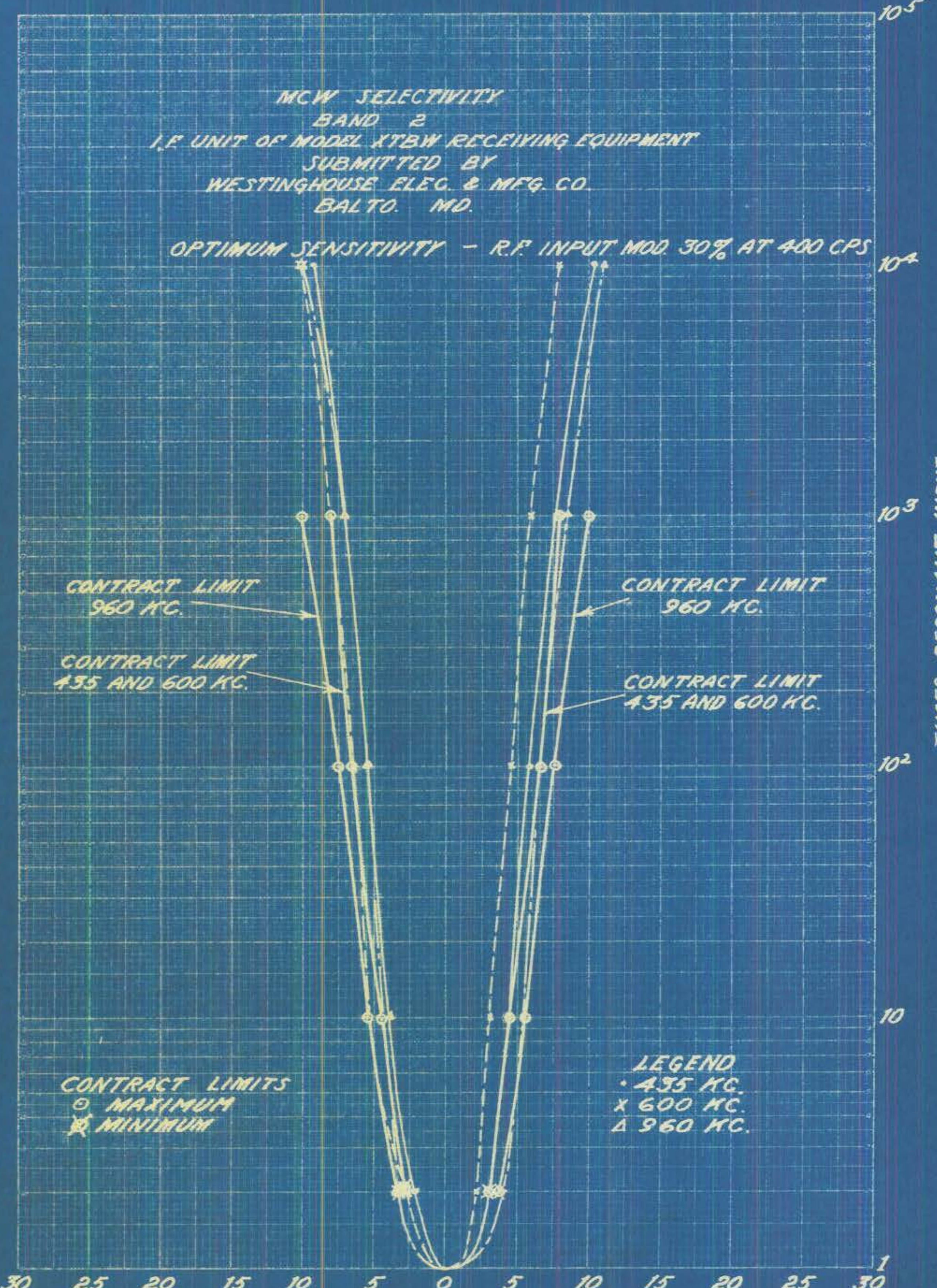

MCW SELECTIVITY
BAND 2
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
OPTIMUM SENSITIVITY - R.F. INPUT MOD. 30% AT 400 CPS
CONTRACT LIMIT 960 KC.
CONTRACT LIMIT 435 AND 600 KC.
CONTRACT LIMIT 960 KC.
CONTRACT LIMIT 435 AND 600 KC.
CONTRACT LIMITS
⊖ MAXIMUM
MINIMUM
LEGEND
· 435 KC.
x 600 KC.
Δ 960 KC.
TIMES RESONANT INPUT
10^5
10^4
10^3
10^2
10
1
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE 8

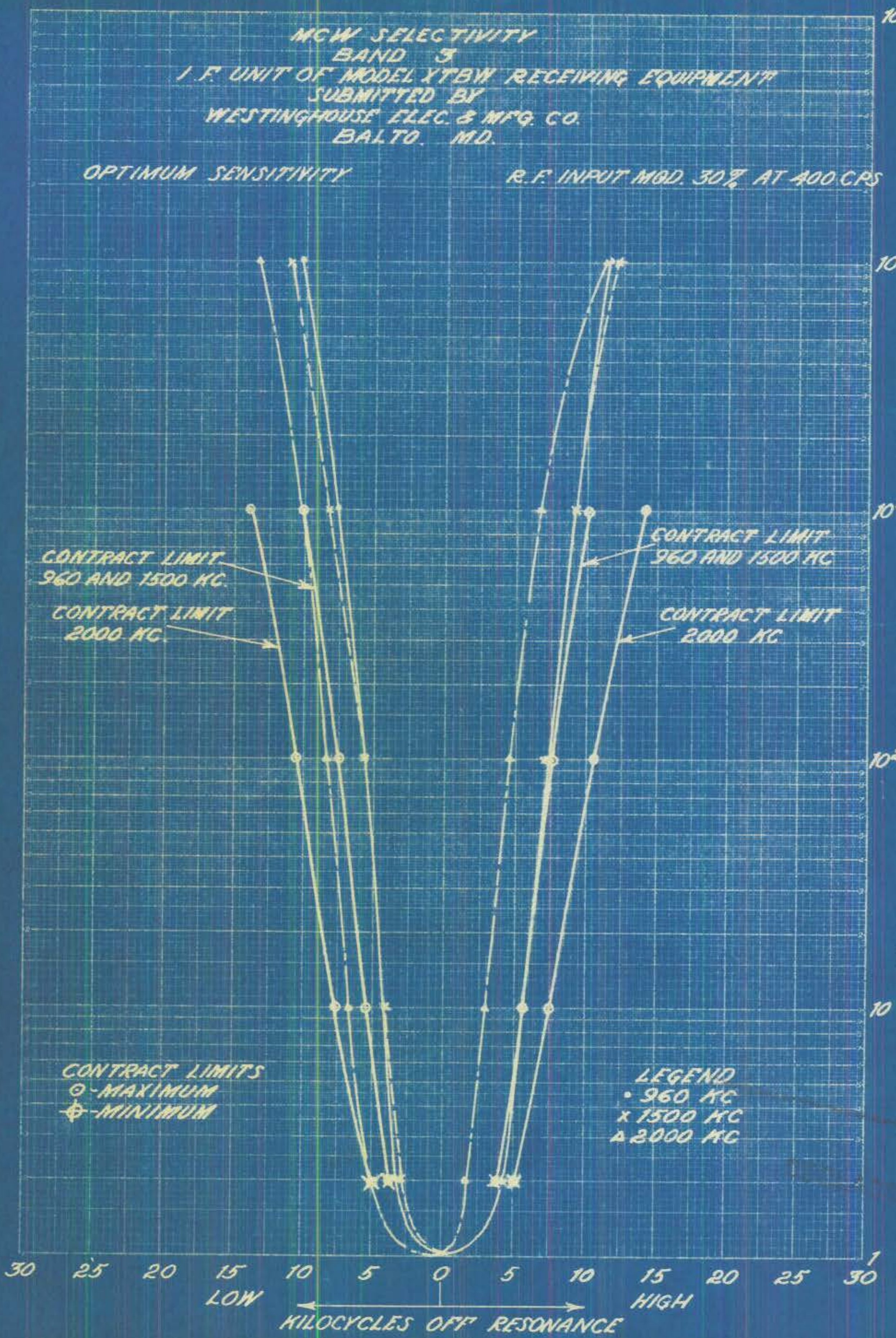
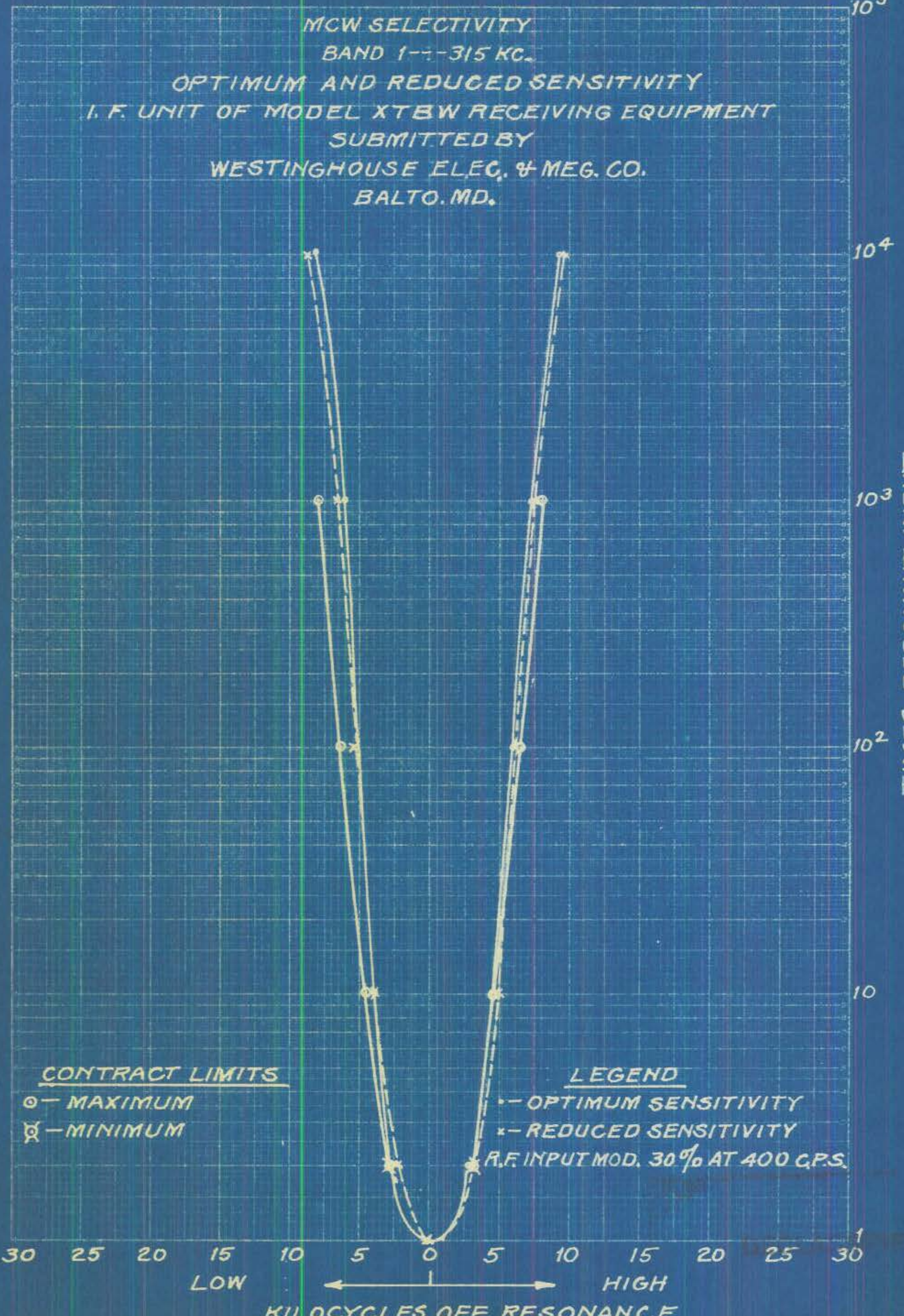

MCW SELECTIVITY
BAND 3
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
OPTIMUM SENSITIVITY
R.F. INPUT MOD. 30% AT 400 CPS
CONTRACT LIMIT 960 AND 1500 KC.
CONTRACT LIMIT 2000 KC.
CONTRACT LIMIT 960 AND 1500 KC
CONTRACT LIMIT 2000 KC
CONTRACT LIMITS
⊖-MAXIMUM
⊕-MINIMUM
LEGEND
• 960 KC
x 1500 KC
▲ 2000 KC
TIMES RESONANT INPUT
10^5
10^4
10^3
10^2
10
1
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE 9


MCW SELECTIVITY
BAND 1---315 KC.
OPTIMUM AND REDUCED SENSITIVITY
I. F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
10^5
10^4
10^3
10^2
10
1
TIMES RESONANT INPUT
CONTRACT LIMITS
⊙ – MAXIMUM
⊗ – MINIMUM
LEGEND
• – OPTIMUM SENSITIVITY
× – REDUCED SENSITIVITY
R.F. INPUT MOD. 30% AT 400 C.P.S.
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE
PLATE 10

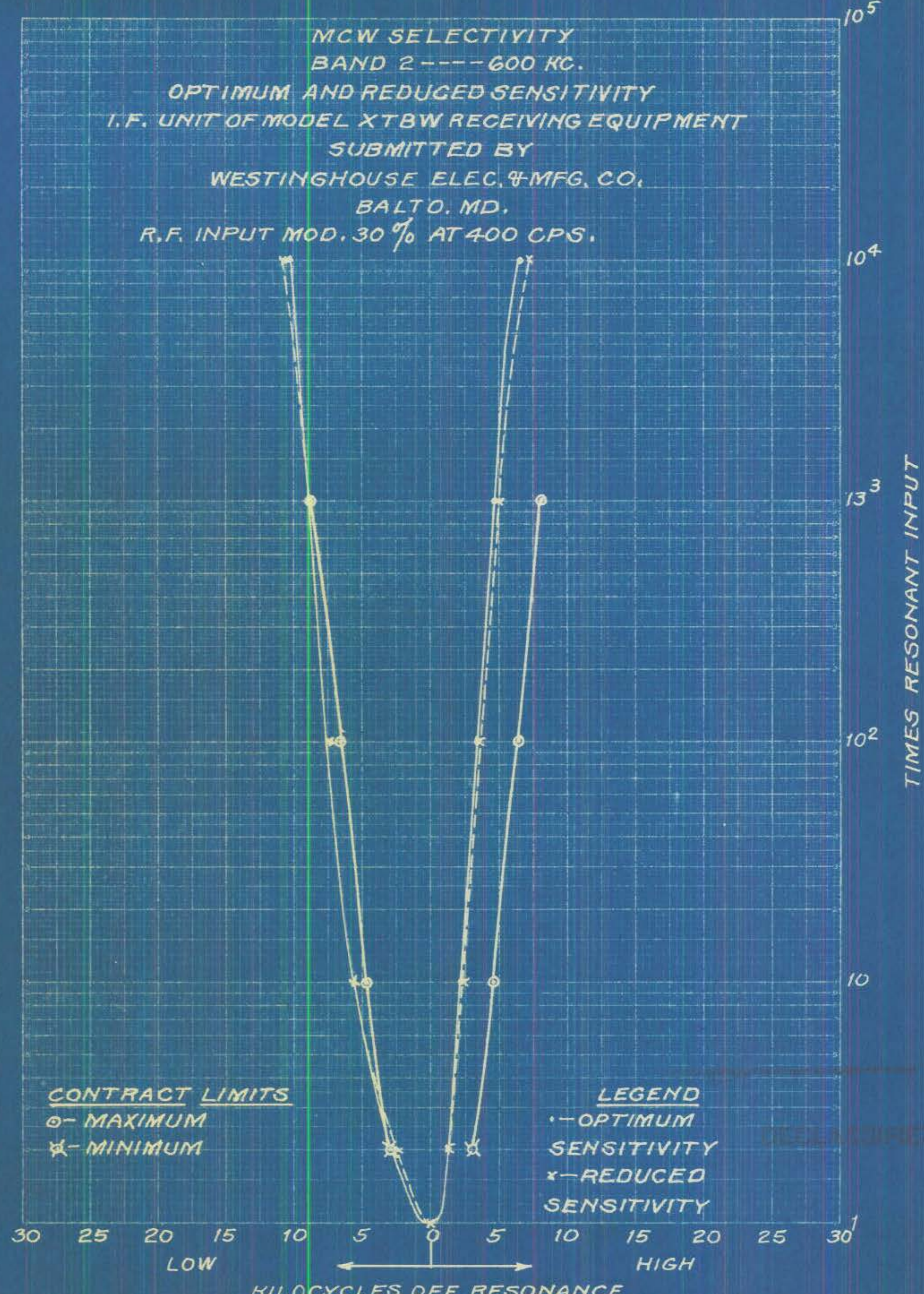
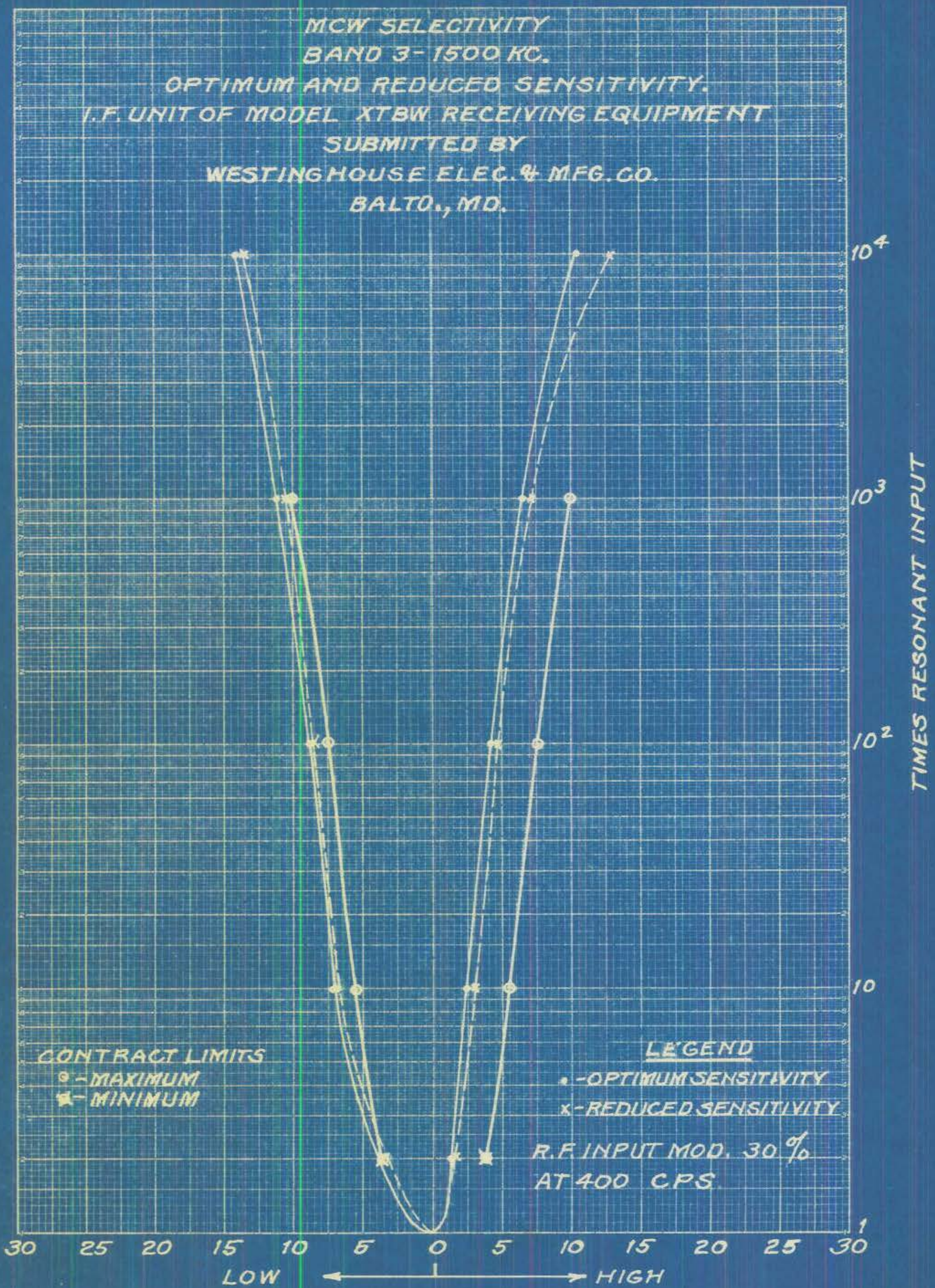

MCW SELECTIVITY
BAND 2 ---- 600 KC.
OPTIMUM AND REDUCED SENSITIVITY
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
R.F. INPUT MOD. 30 % AT 400 CPS.
10^5
10^4
10^3
10^2
10
1
TIMES RESONANT INPUT
CONTRACT LIMITS
⊙- MAXIMUM
⊠- MINIMUM
LEGEND
•—OPTIMUM SENSITIVITY
×—REDUCED SENSITIVITY
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE II



MCW SELECTIVITY
BAND 3 - 1500 KC.
OPTIMUM AND REDUCED SENSITIVITY.
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO., MD.
TIMES RESONANT INPUT
10^4
10^3
10^2
10
1
CONTRACT LIMITS
⊕ - MAXIMUM
⊠ - MINIMUM
LEGEND
• - OPTIMUM SENSITIVITY
x - REDUCED SENSITIVITY
R.F. INPUT MOD. 30 %
AT 400 CPS.
30 25 20 15 10 5 0 5 10 15 20 25 30
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE 12

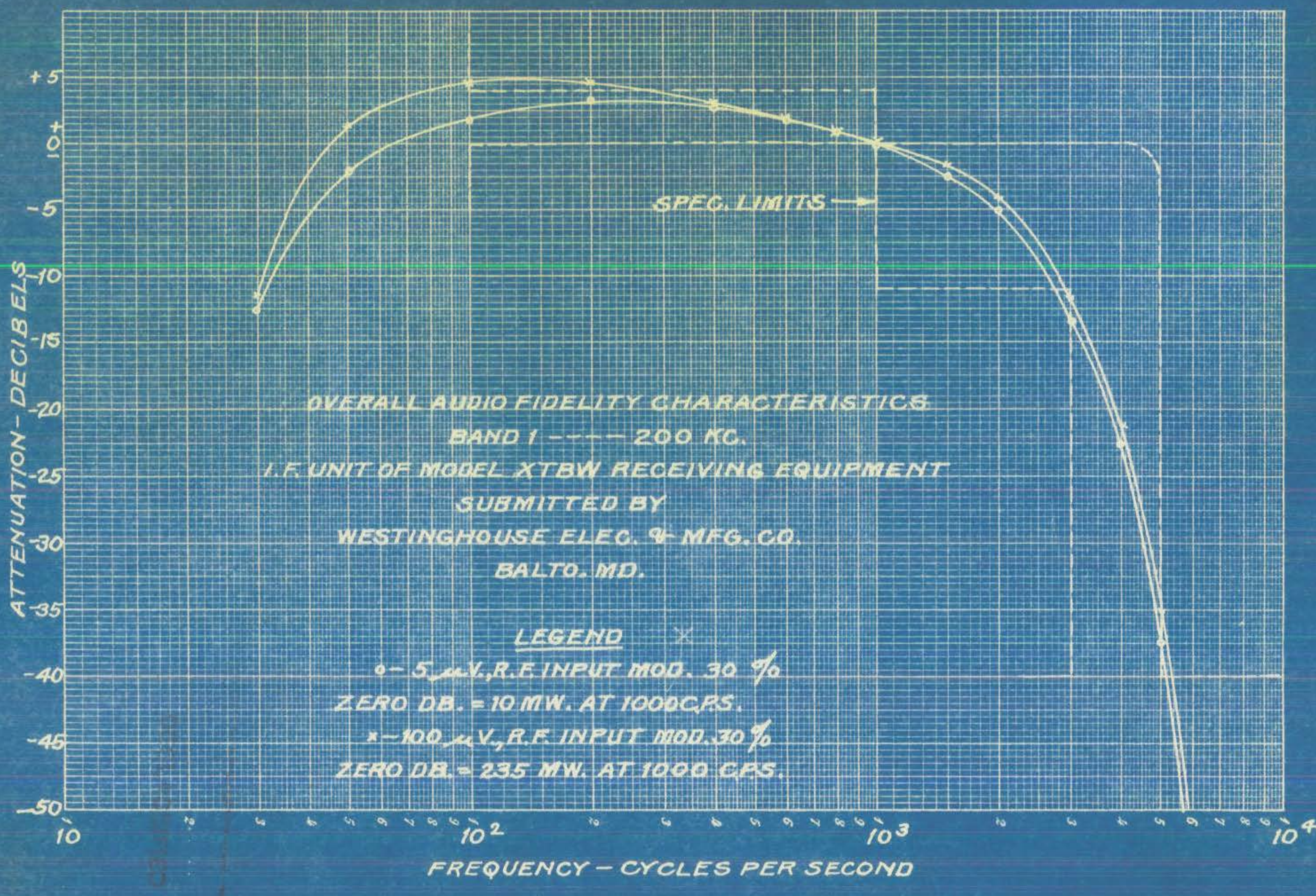

OVERALL AUDIO FIDELITY CHARACTERISTICS
BAND 1 ----- 200 KC.
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
LEGEND
o – 5 μV., R.F. INPUT MOD. 30 %
ZERO DB. = 10 MW. AT 1000 C.P.S.
x – 100 μV., R.F. INPUT MOD. 30 %
ZERO DB. = 235 MW. AT 1000 C.P.S.
SPEC. LIMITS
ATTENUATION - DECIBELS
FREQUENCY - CYCLES PER SECOND

PLATE 13

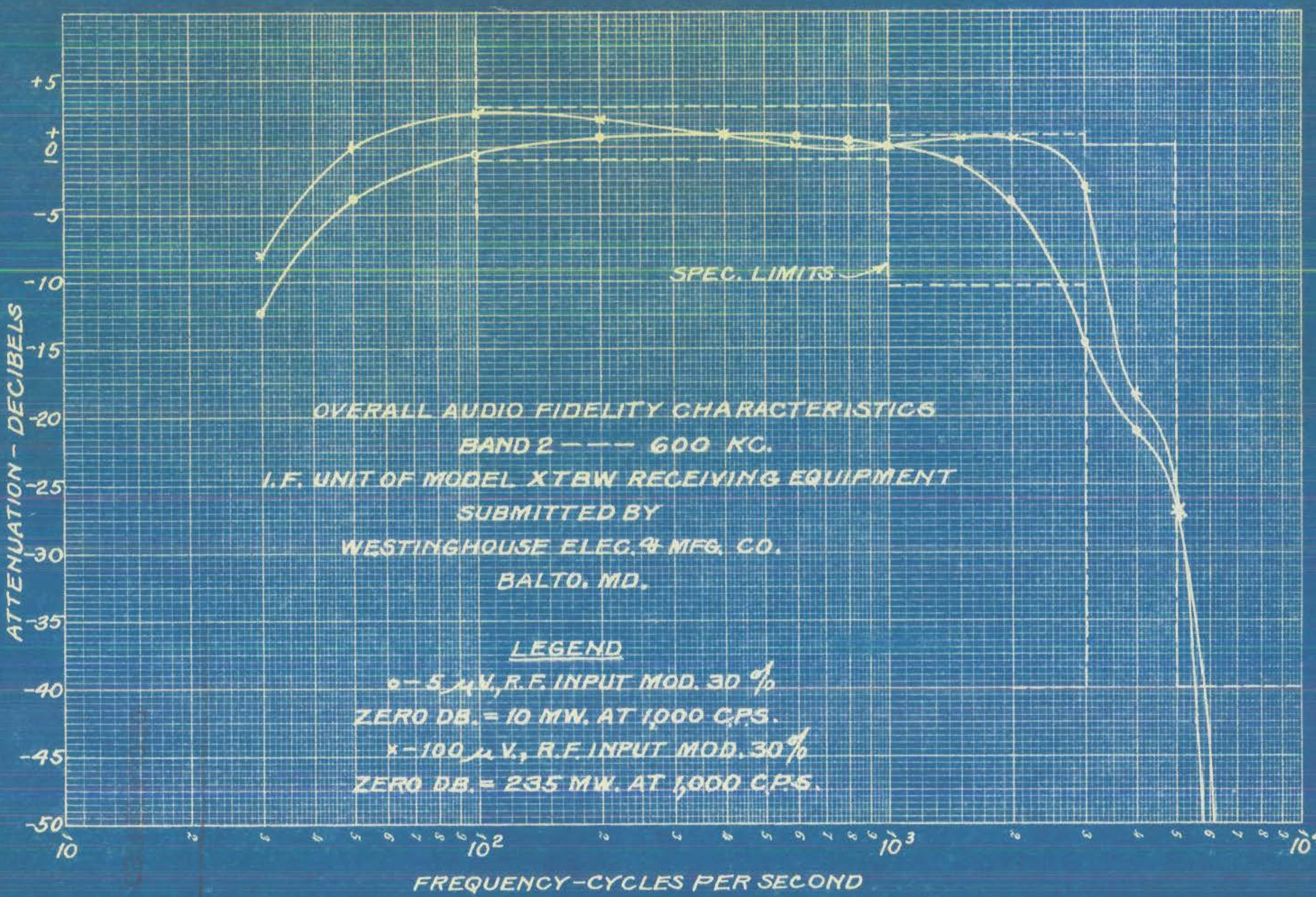
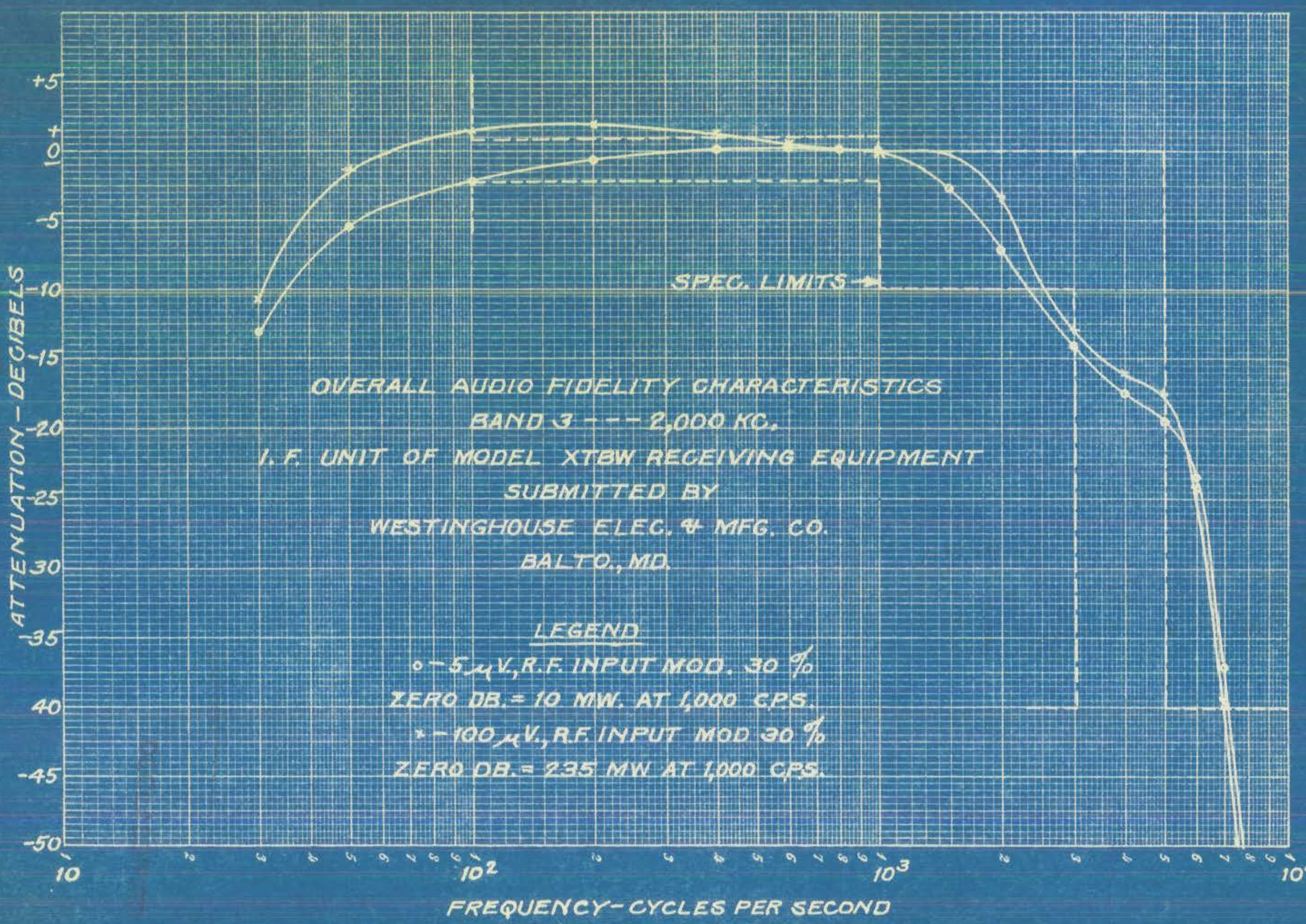

OVERALL AUDIO FIDELITY CHARACTERISTICS
BAND 2 ---- 600 KC.
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
LEGEND
o - 5 μV, R.F. INPUT MOD. 30 %
ZERO DB. = 10 MW. AT 1,000 C.P.S.
x - 100 μV., R.F. INPUT MOD. 30 %
ZERO DB. = 235 MW. AT 1,000 C.P.S.
SPEC. LIMITS
ATTENUATION - DECIBELS
FREQUENCY-CYCLES PER SECOND

PLATE 14



OVERALL AUDIO FIDELITY CHARACTERISTICS
BAND 3 - - - 2,000 KC.
I. F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO., MD.
LEGEND
o - 5 μV, R.F. INPUT MOD. 30 %
ZERO DB. = 10 MW. AT 1,000 CPS.
x - 100 μV., R.F. INPUT MOD 30 %
ZERO DB. = 235 MW AT 1,000 CPS.
SPEC. LIMITS
ATTENUATION - DECIBELS
+5
+
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
10
10²
10³
10⁴
FREQUENCY - CYCLES PER SECOND

PLATE 15

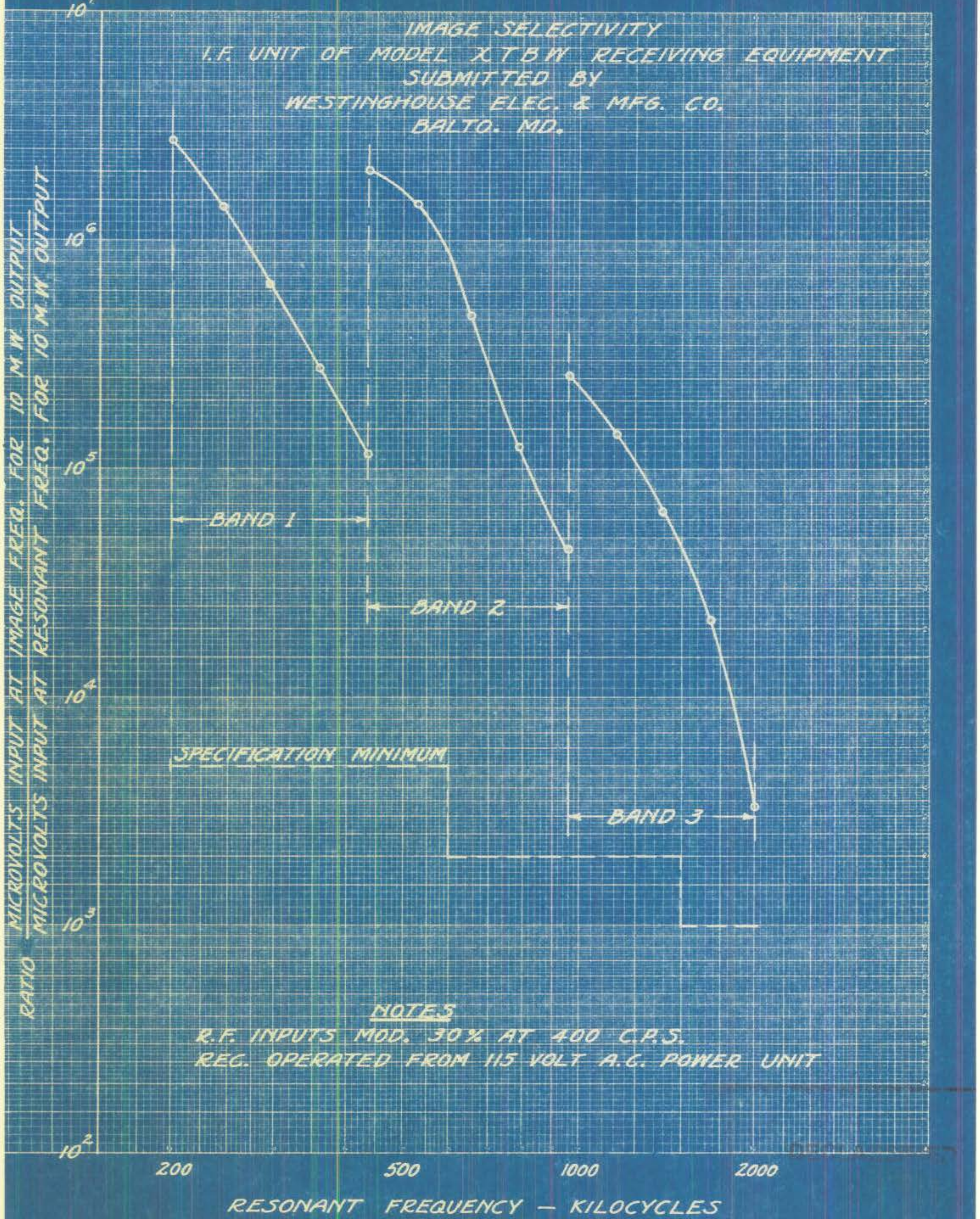
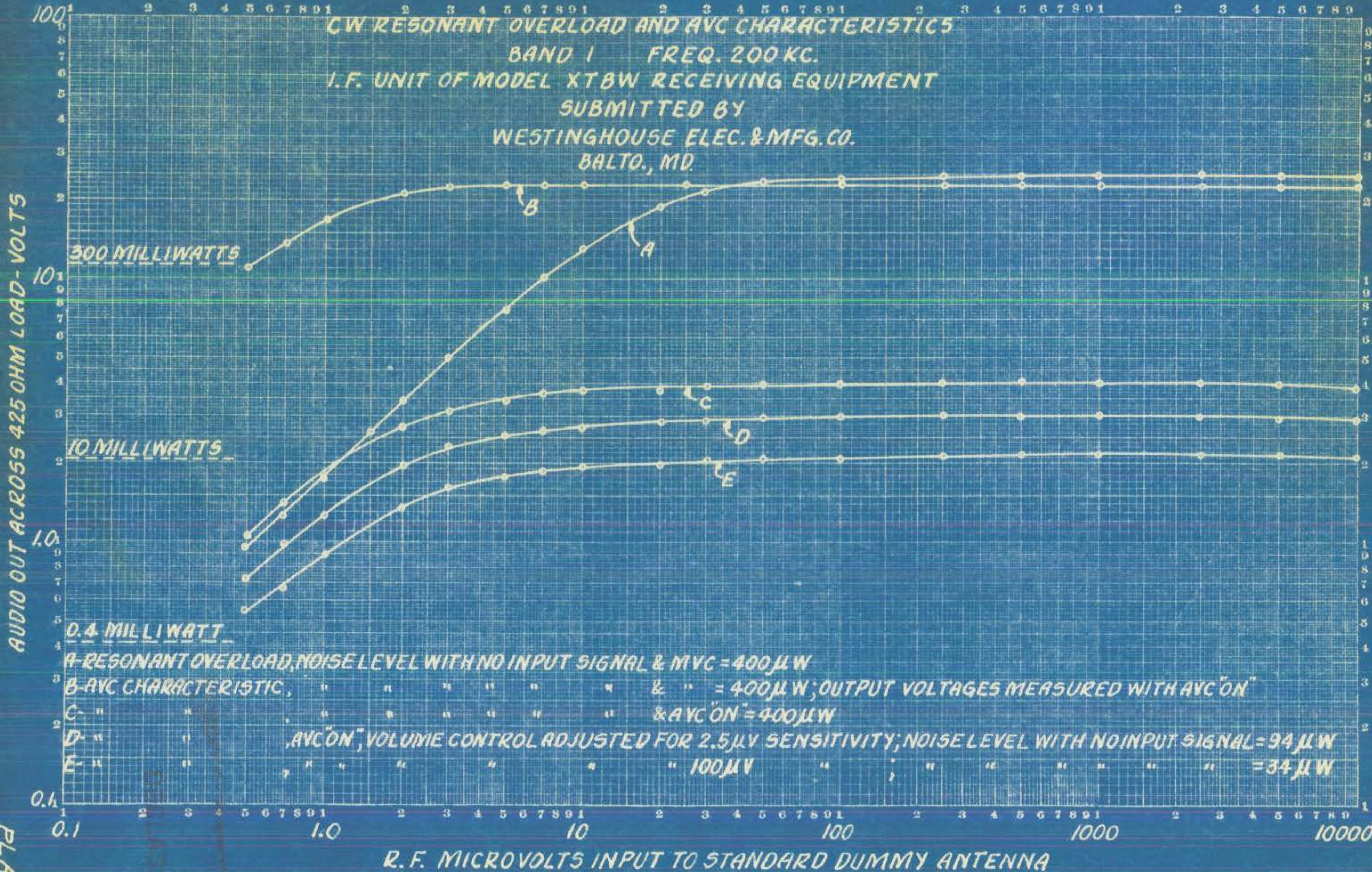


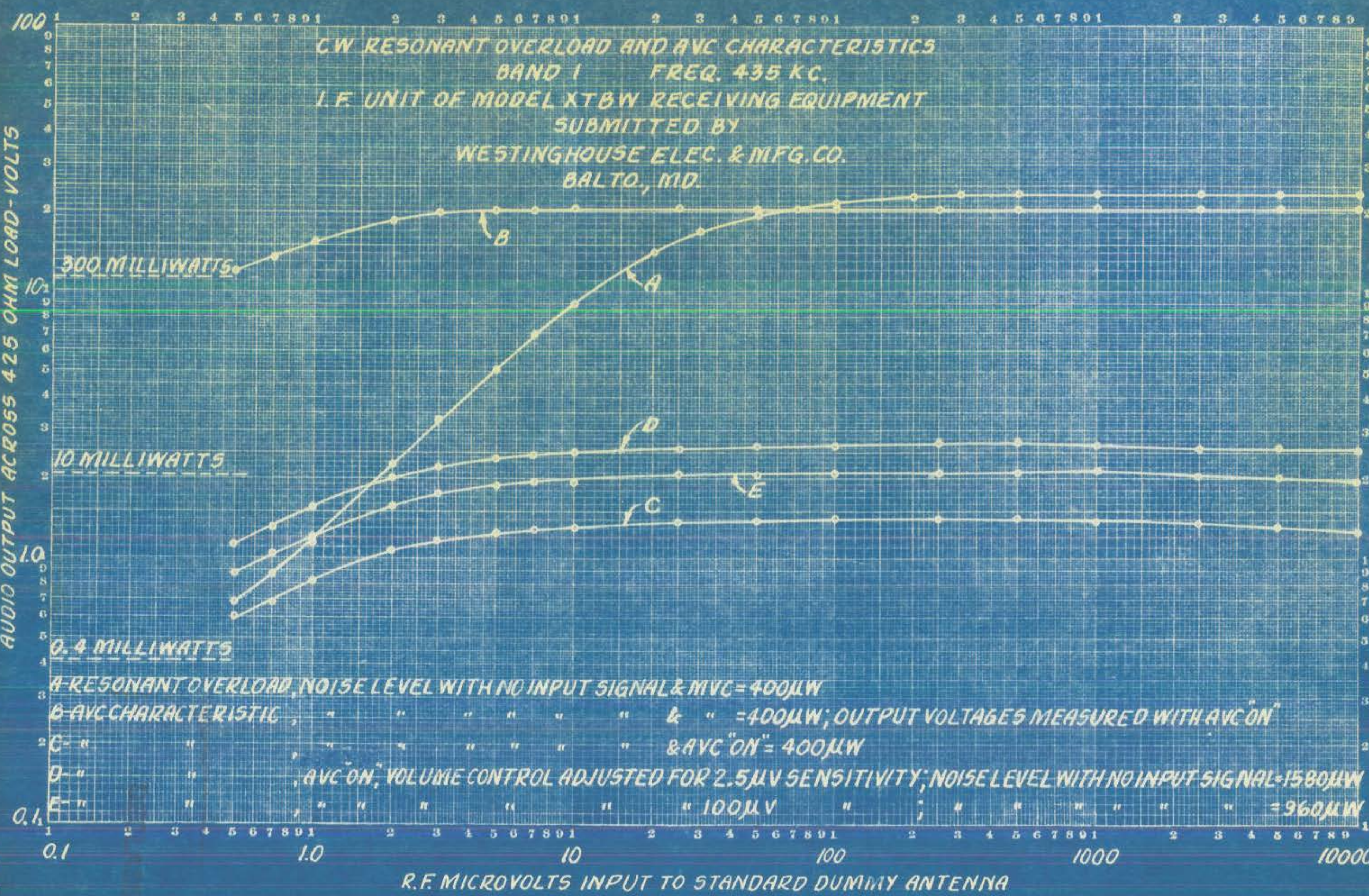
IMAGE SELECTIVITY
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
RATIO MICROVOLTS INPUT AT IMAGE FREQ. FOR 10 M.W. OUTPUT / MICROVOLTS INPUT AT RESONANT FREQ. FOR 10 M.W. OUTPUT
10^7
10^6
10^5
10^4
10^3
10^2
BAND 1
BAND 2
BAND 3
SPECIFICATION MINIMUM
NOTES
R.F. INPUTS MOD. 30% AT 400 C.P.S.
REC. OPERATED FROM 115 VOLT A.C. POWER UNIT
200
500
1000
2000
RESONANT FREQUENCY — KILOCYCLES

PLATE 16



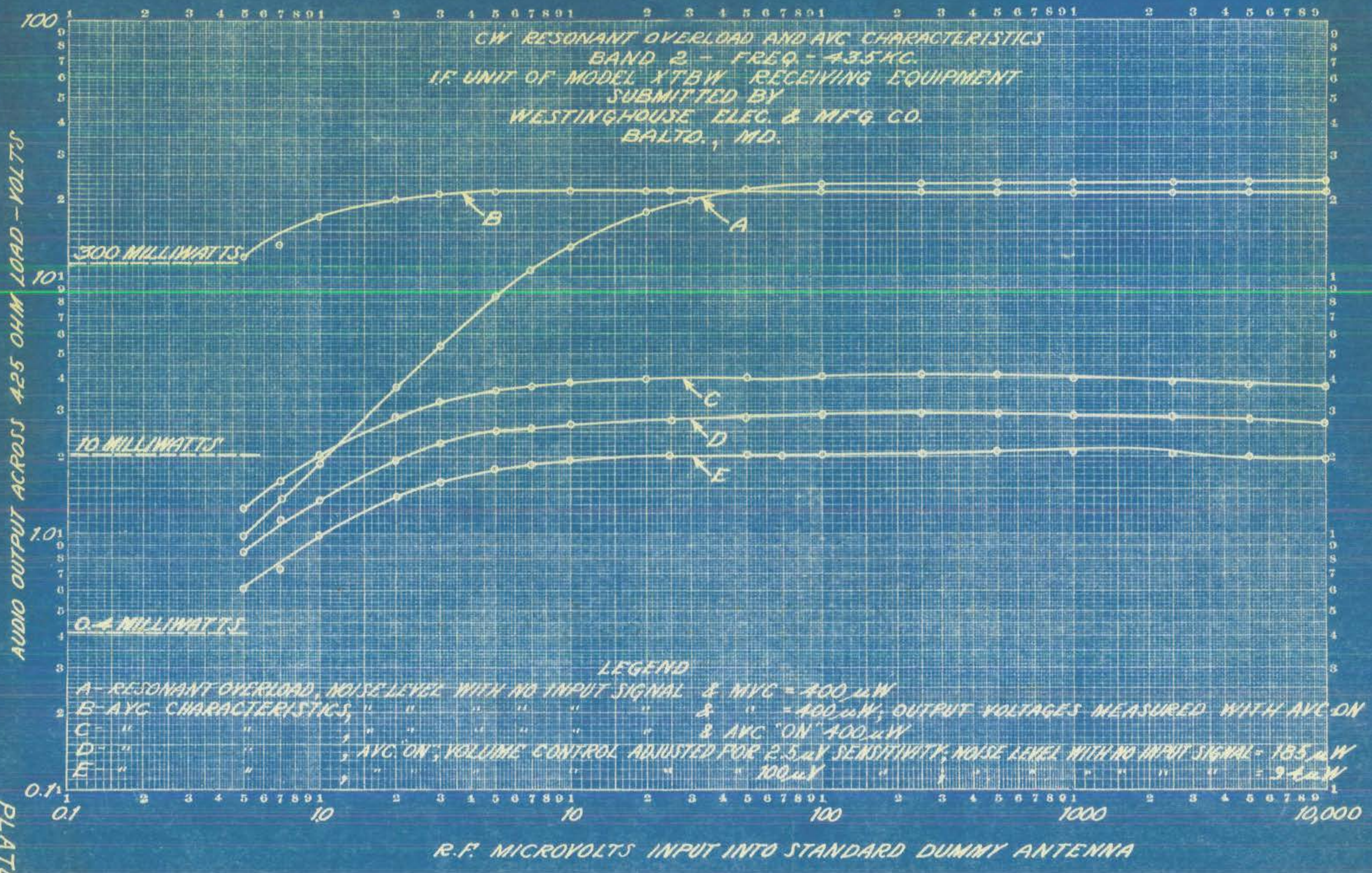
CW RESONANT OVERLOAD AND AVC CHARACTERISTICS
BAND I FREQ. 200 KC.
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO., MD.
300 MILLIWATTS
10 MILLIWATTS
0.4 MILLIWATT
A
B
C
D
E
A-RESONANT OVERLOAD, NOISE LEVEL WITH NO INPUT SIGNAL & MVC = 400 µW
B-AVC CHARACTERISTIC, " " " " " " & " = 400 µW; OUTPUT VOLTAGES MEASURED WITH AVC "ON"
C- " " " " " " " " & AVC "ON" = 400 µW
D- " " , AVC "ON", VOLUME CONTROL ADJUSTED FOR 2.5 µV SENSITIVITY; NOISE LEVEL WITH NO INPUT SIGNAL = 94 µW
E- " " " " " " " " " 100 µV " ; " " " " " " = 34 µW
AUDIO OUT ACROSS 425 OHM LOAD - VOLTS
100
10
1.0
0.1
0.1
1.0
10
100
1000
10000
R.F. MICROVOLTS INPUT TO STANDARD DUMMY ANTENNA

PLATE 17



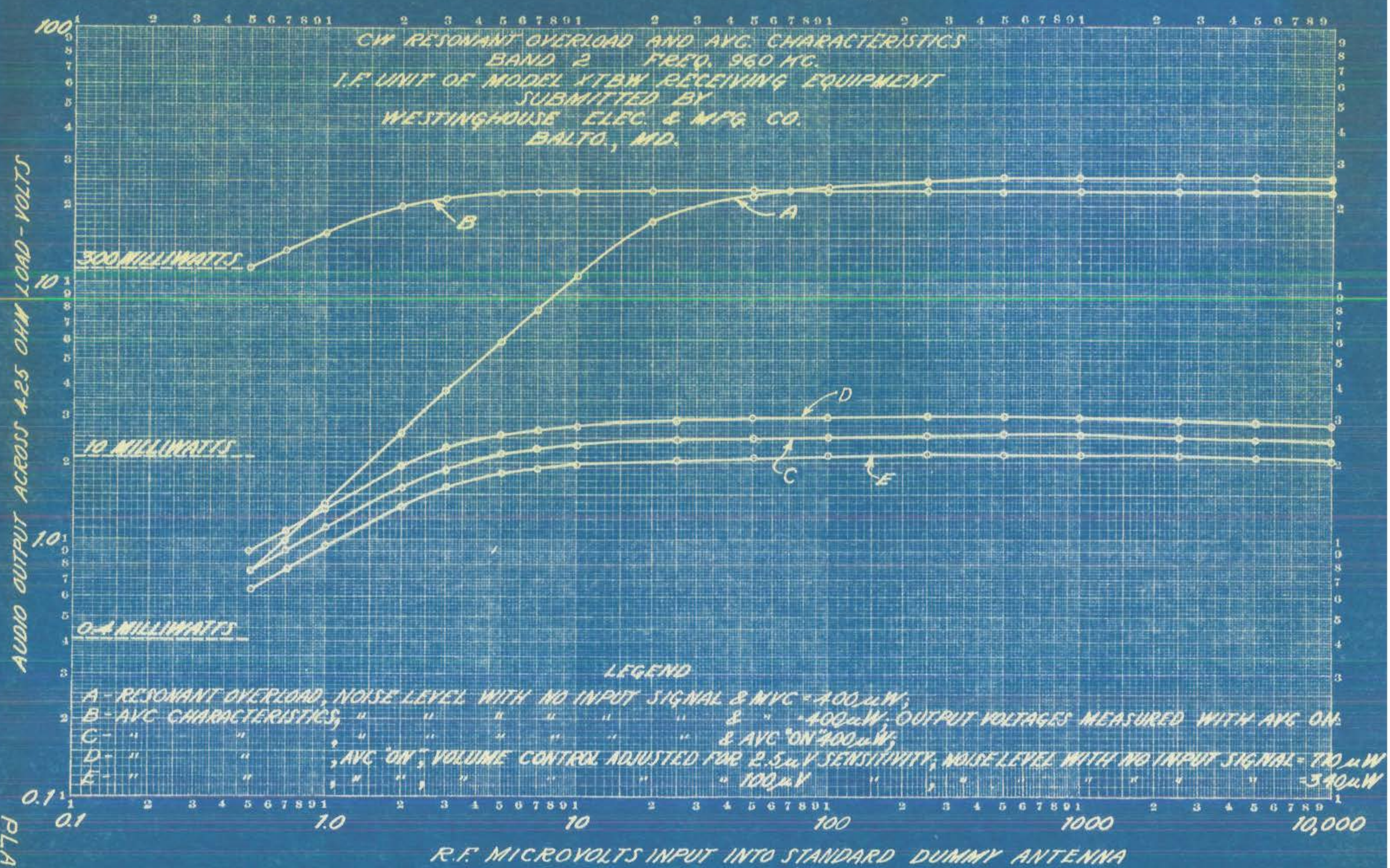
CW RESONANT OVERLOAD AND AVC CHARACTERISTICS
BAND I FREQ. 435 KC.
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO., MD.
AUDIO OUTPUT ACROSS 425 OHM LOAD-VOLTS
100
10
1.0
0.1
300 MILLIWATTS
10 MILLIWATTS
0.4 MILLIWATTS
A
B
C
D
E
A-RESONANT OVERLOAD, NOISE LEVEL WITH NO INPUT SIGNAL & MVC = 400μW
B-AVC CHARACTERISTIC, " " " " " " & " =400μW; OUTPUT VOLTAGES MEASURED WITH AVC "ON"
C- " " , " " " " " " &AVC "ON" = 400μW
D- " " , AVC "ON", VOLUME CONTROL ADJUSTED FOR 2.5μV SENSITIVITY; NOISE LEVEL WITH NO INPUT SIGNAL = 1580μW
E- " " , " " " " " " 100μV " ; " " " " " " =960μW
0.1
1.0
10
100
1000
10000
R.F. MICROVOLTS INPUT TO STANDARD DUMMY ANTENNA

PLATE 18



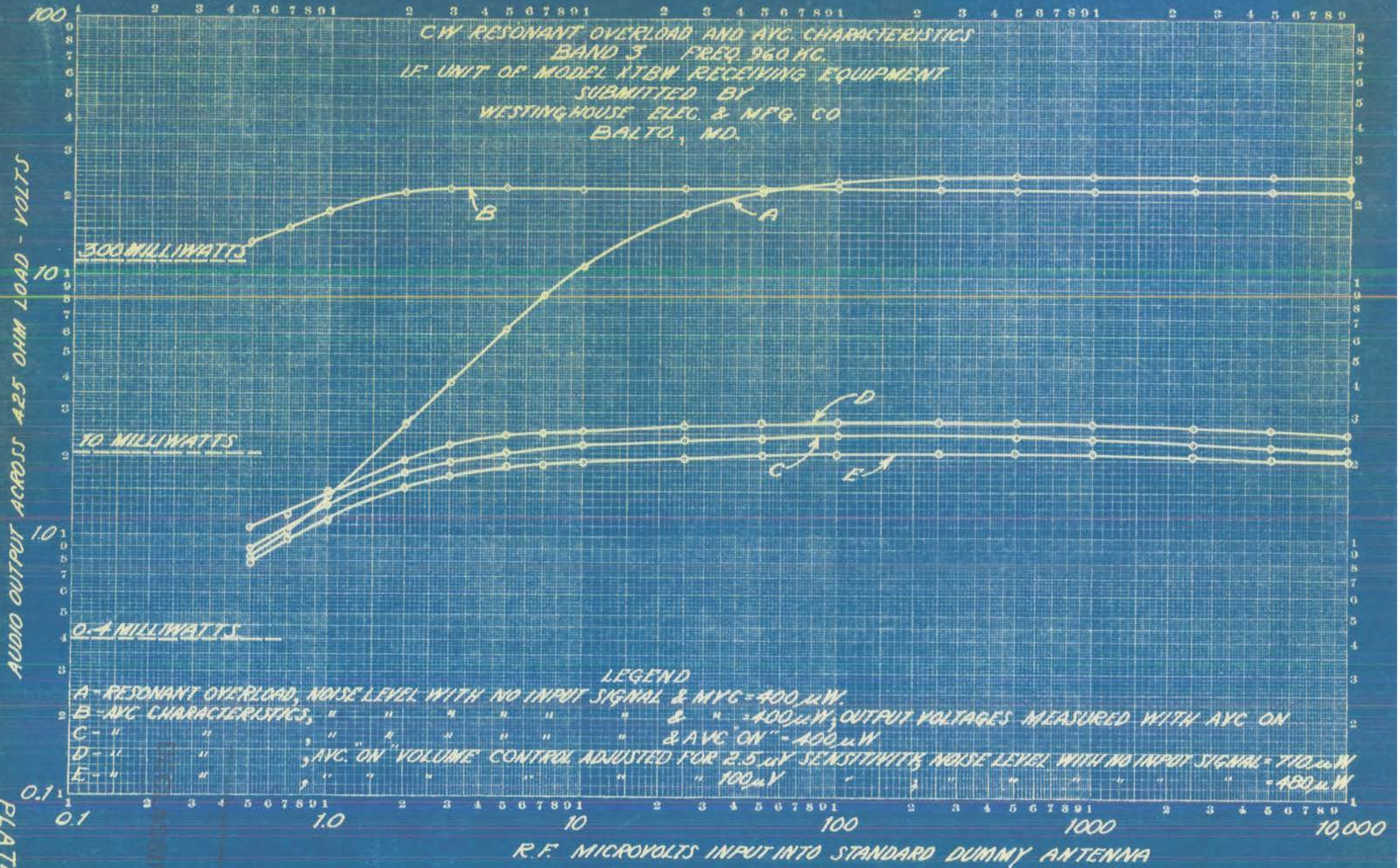
CW RESONANT OVERLOAD AND AVC CHARACTERISTICS
BAND 2 - FREQ. - 435 KC.
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO., MD.
300 MILLIWATTS
10 MILLIWATTS
0.4 MILLIWATTS
A
B
C
D
E
LEGEND
A - RESONANT OVERLOAD, NOISE LEVEL WITH NO INPUT SIGNAL & MVC = 400 μW
B - AVC CHARACTERISTICS, " " " " " " & " = 400 μW; OUTPUT VOLTAGES MEASURED WITH AVC ON
C - " " " " " " " & AVC "ON" 400 μW
D - " " ; AVC "ON"; VOLUME CONTROL ADJUSTED FOR 2.5 μV SENSITIVITY; NOISE LEVEL WITH NO INPUT SIGNAL = 185 μW
E - " " " " " 100 μV " " " " " " " = 94 μW
AUDIO OUTPUT ACROSS 425 OHM LOAD - VOLTS
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA
100
10
1.0
0.1
0.1
1.0
10
100
1000
10,000

PLATE 19



CW RESONANT OVERLOAD AND AVC. CHARACTERISTICS
BAND 2 FREQ. 960 KC.
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO., MD.
300 MILLIWATTS
10 MILLIWATTS
0.4 MILLIWATTS
A
B
C
D
E
LEGEND
A - RESONANT OVERLOAD, NOISE LEVEL WITH NO INPUT SIGNAL & MVC = 400 µW;
B - AVC CHARACTERISTICS, " " " " " " & " = 400 µW; OUTPUT VOLTAGES MEASURED WITH AVC ON.
C - " " " " " " " & AVC "ON" 400 µW;
D - " " , AVC "ON", VOLUME CONTROL ADJUSTED FOR 2.5 µV SENSITIVITY, NOISE LEVEL WITH NO INPUT SIGNAL = 770 µW
E - " " " " " " " 100 µV " " " " " " = 340 µW
100
10
1.0
0.1
0.1
1.0
10
100
1000
10,000
AUDIO OUTPUT ACROSS 425 OHM LOAD - VOLTS
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA

PLATE 20


CW RESONANT OVERLOAD AND AVC. CHARACTERISTICS
BAND 3 FREQ. 960 KC.
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO
BALTO., MD.
AUDIO OUTPUT ACROSS 425 OHM LOAD - VOLTS
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA
300 MILLIWATTS
10 MILLIWATTS
0.4 MILLIWATTS
A
B
C
D
E
100
10
1.0
0.1
1.0
100
1000
10,000
LEGEND
A - RESONANT OVERLOAD, NOISE LEVEL WITH NO INPUT SIGNAL & MVC = 400 μW.
B - AVC CHARACTERISTICS, " " " " " " & " = 400 μW; OUTPUT VOLTAGES MEASURED WITH AVC ON
C - " " , " " " " " & AVC "ON" - 400 μW
D - " " , AVC. "ON" VOLUME CONTROL ADJUSTED FOR 2.5 μV SENSITIVITY; NOISE LEVEL WITH NO INPUT SIGNAL = 710 μW
E - " " , " " " " " " 100 μV " " " " " " " " = 480 μW
PLATE 21

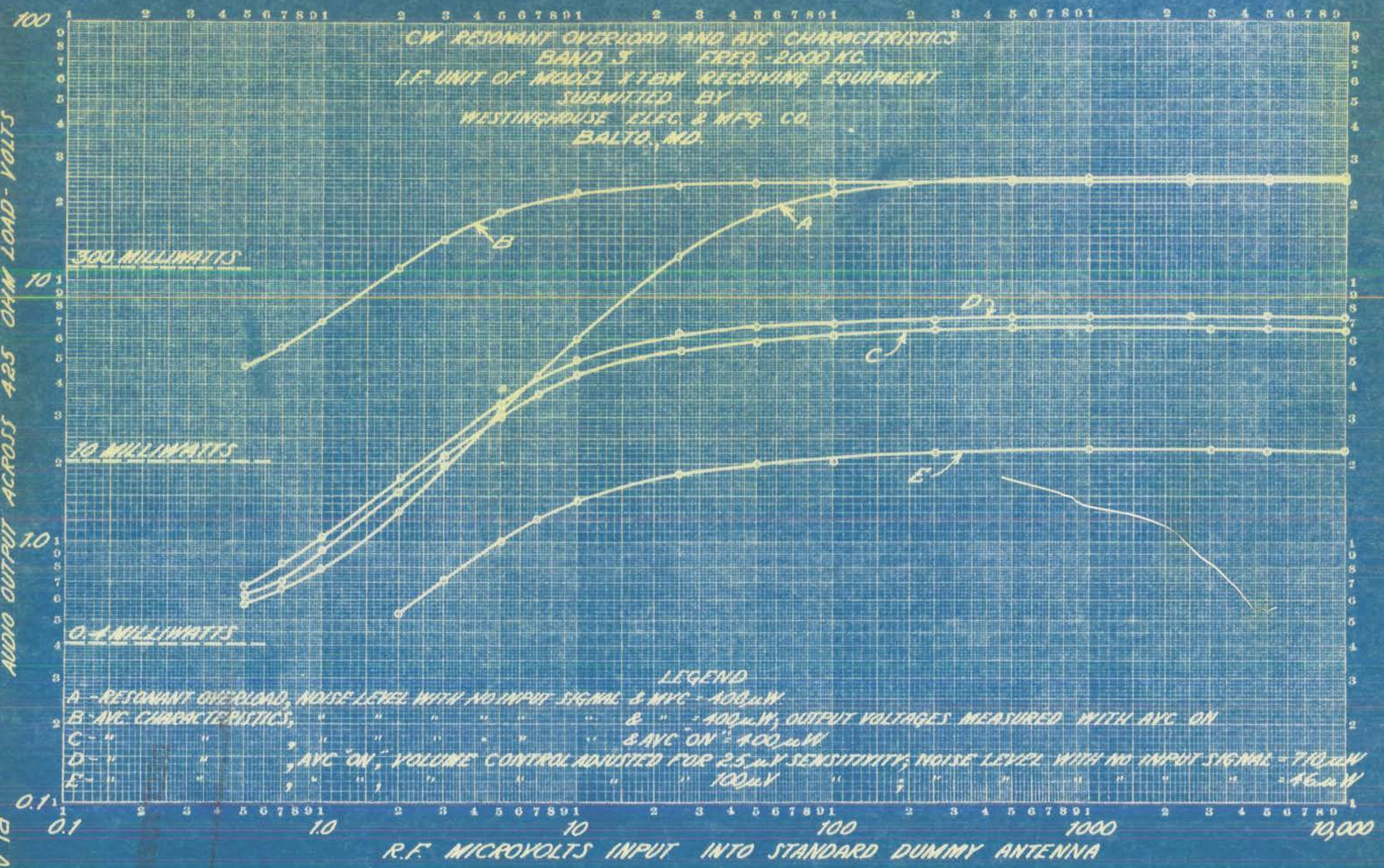

CW RESONANT OVERLOAD AND AVC CHARACTERISTICS
BAND 3 FREQ.-2000 KC.
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO., MD.
300 MILLIWATTS
10 MILLIWATTS
0.4 MILLIWATTS
A
B
C
D
E
LEGEND
A - RESONANT OVERLOAD, NOISE LEVEL WITH NO INPUT SIGNAL & AVC - 400 μW
B - AVC CHARACTERISTICS, " " " " " & " - 400 μW; OUTPUT VOLTAGES MEASURED WITH AVC ON
C - " " " " " " & AVC "ON" - 400 μW
D - " " , AVC "ON", VOLUME CONTROL ADJUSTED FOR 2.5 μV SENSITIVITY; NOISE LEVEL WITH NO INPUT SIGNAL - 710 μW
E - " " , " " " " 100 μV " ; " " " " " - 46 μW
AUDIO OUTPUT ACROSS 425 OHM LOAD - VOLTS
100
10
1.0
0.1
0.1
1.0
10
100
1000
10,000
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA

PLATE 22

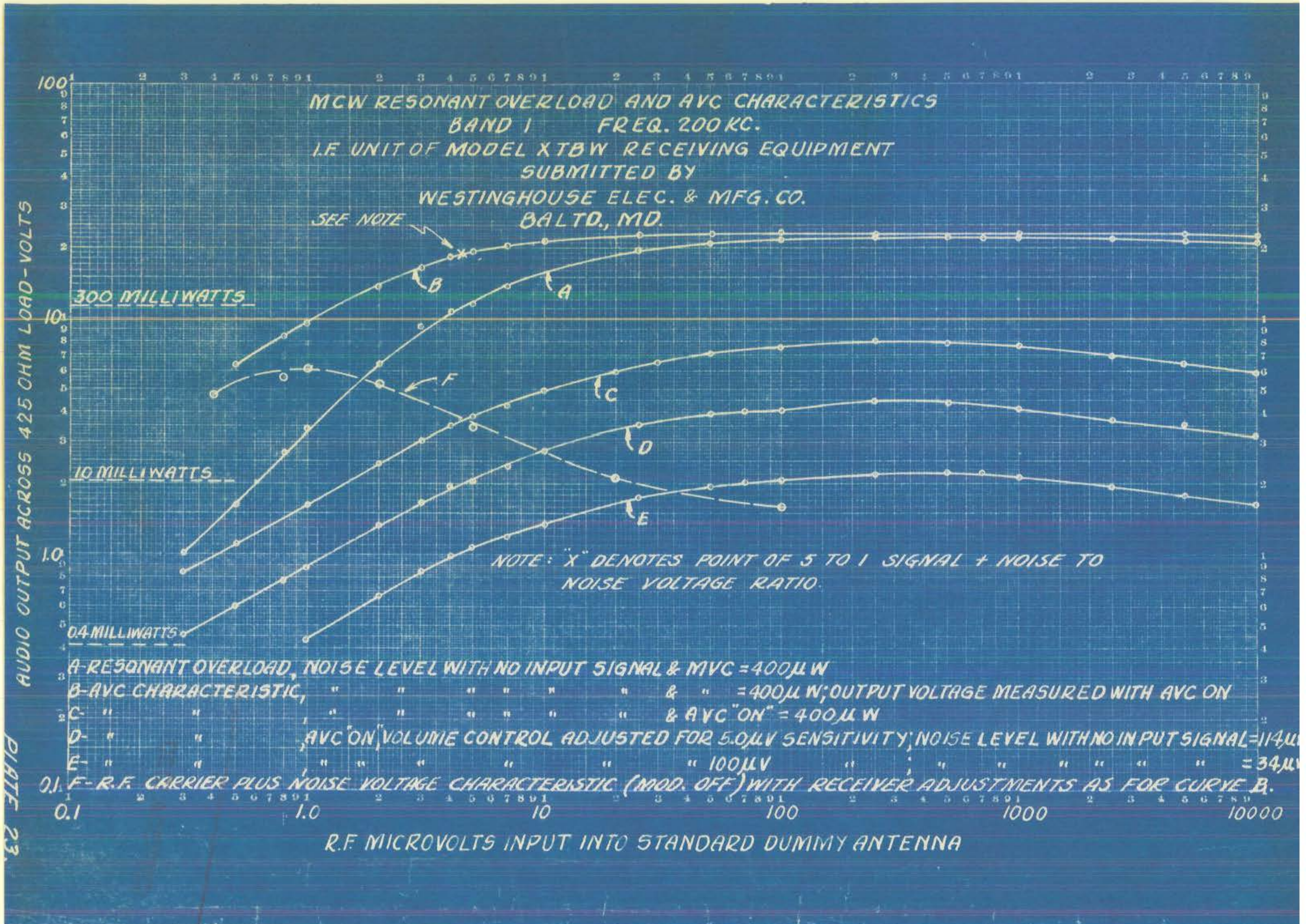
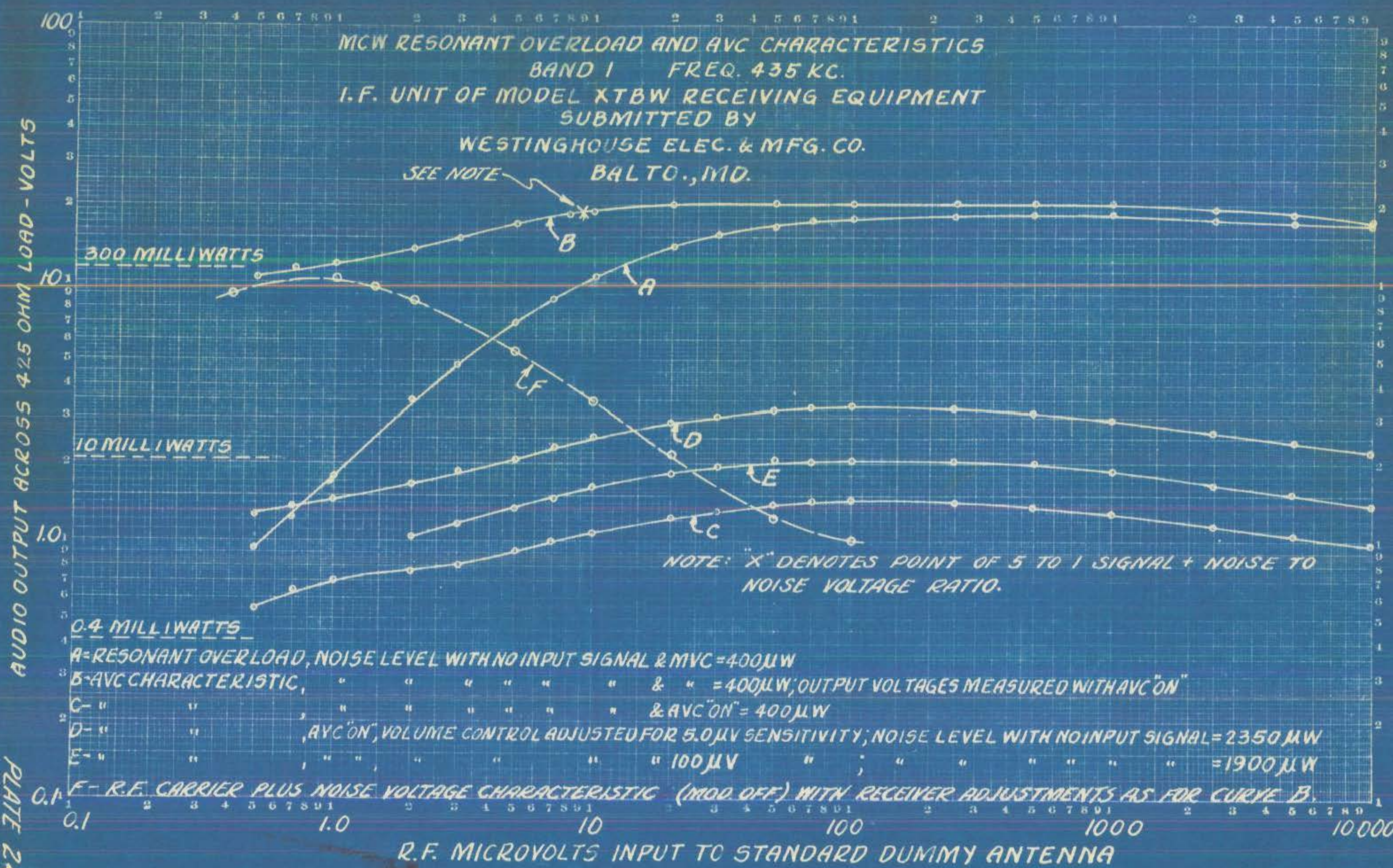

MCW RESONANT OVERLOAD AND AVC CHARACTERISTICS
BAND I FREQ. 200 KC.
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO., MD.
SEE NOTE
300 MILLIWATTS
10 MILLIWATTS
0.4 MILLIWATTS
A
B
C
D
E
F
NOTE: "X" DENOTES POINT OF 5 TO 1 SIGNAL + NOISE TO NOISE VOLTAGE RATIO.
A-RESONANT OVERLOAD, NOISE LEVEL WITH NO INPUT SIGNAL & MVC = 400μW
B-AVC CHARACTERISTIC, " " " " " " & " = 400μW; OUTPUT VOLTAGE MEASURED WITH AVC ON
C- " " " " " " " " & AVC "ON" = 400μW
D- " " , AVC "ON", VOLUME CONTROL ADJUSTED FOR 5.0μV SENSITIVITY; NOISE LEVEL WITH NO INPUT SIGNAL = 114μ
E- " " " " " " " " 100μV " ; " " " " " " = 34μ
F-R.F. CARRIER PLUS NOISE VOLTAGE CHARACTERISTIC (MOD. OFF) WITH RECEIVER ADJUSTMENTS AS FOR CURVE B.
AUDIO OUTPUT ACROSS 425 OHM LOAD-VOLTS
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA
100
10
1.0
0.1
0.1
1.0
10
100
1000
10000

PLATE 23.



MCW RESONANT OVERLOAD AND AVC CHARACTERISTICS
BAND I FREQ. 435 KC.
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO., MD.
SEE NOTE
300 MILLIWATTS
10 MILLIWATTS
0.4 MILLIWATTS
A
B
C
D
E
F
NOTE: "X" DENOTES POINT OF 5 TO 1 SIGNAL + NOISE TO NOISE VOLTAGE RATIO.
A=RESONANT OVERLOAD, NOISE LEVEL WITH NO INPUT SIGNAL & MVC=400μW
B-AVC CHARACTERISTIC, " " " " " " & " =400μW; OUTPUT VOLTAGES MEASURED WITH AVC "ON"
C- " " , " " " " " " & AVC "ON" = 400μW
D- " " ,AVC "ON", VOLUME CONTROL ADJUSTED FOR 5.0μV SENSITIVITY; NOISE LEVEL WITH NO INPUT SIGNAL=2350μW
E- " " , " " , " " " " 100μV " ; " " " " " " =1900μW
F- R.F. CARRIER PLUS NOISE VOLTAGE CHARACTERISTIC (MOD OFF) WITH RECEIVER ADJUSTMENTS AS FOR CURVE B.
AUDIO OUTPUT ACROSS 425 OHM LOAD - VOLTS
100
10
1.0
0.1
0.1
1.0
10
100
1000
10000
R.F. MICROVOLTS INPUT TO STANDARD DUMMY ANTENNA

PLATE 24.

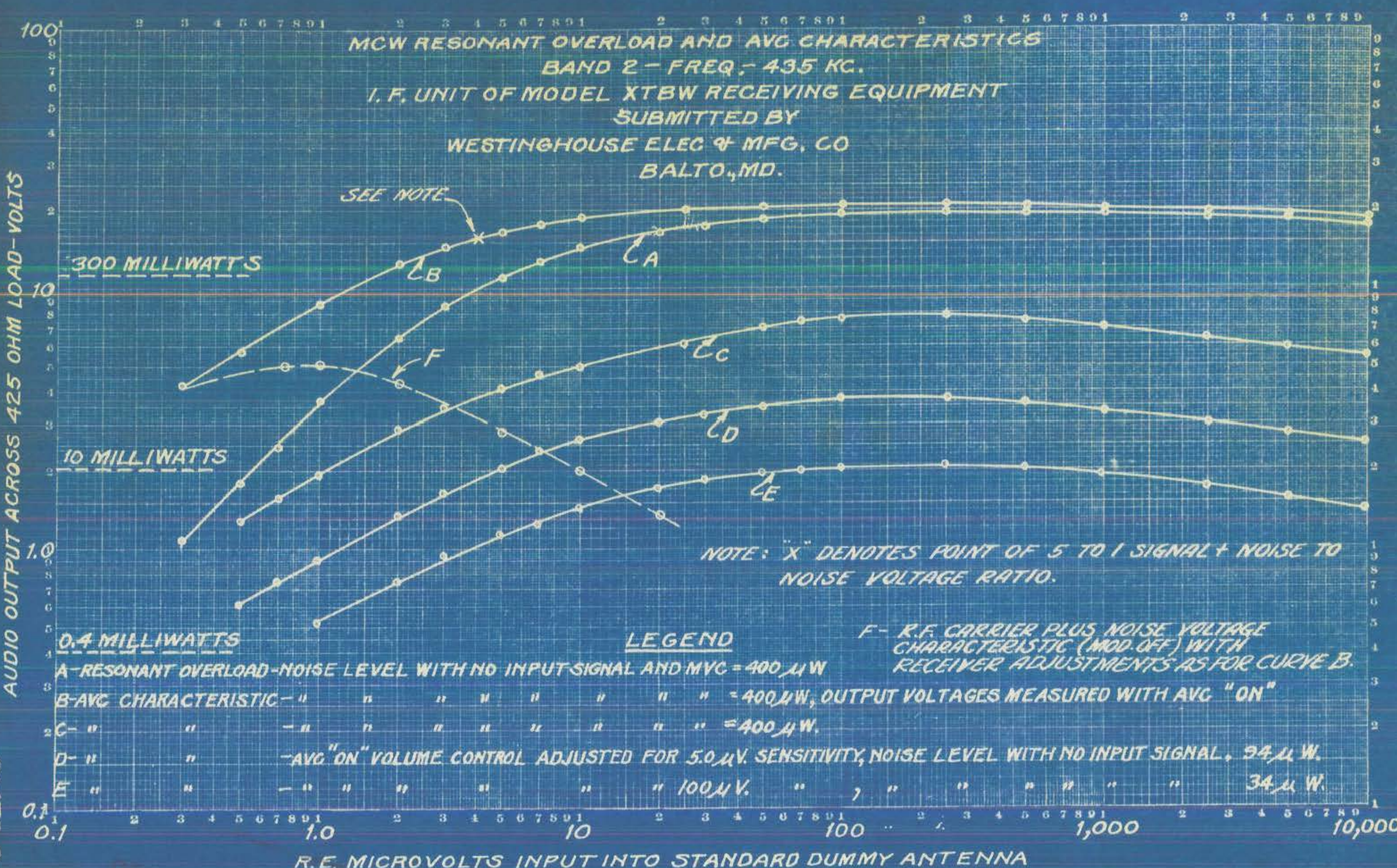

MCW RESONANT OVERLOAD AND AVC CHARACTERISTICS
BAND 2 - FREQ.- 435 KC.
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC & MFG. CO
BALTO., MD.
SEE NOTE
300 MILLIWATTS
10 MILLIWATTS
0.4 MILLIWATTS
AUDIO OUTPUT ACROSS 425 OHM LOAD-VOLTS
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA
NOTE: "X" DENOTES POINT OF 5 TO 1 SIGNAL + NOISE TO NOISE VOLTAGE RATIO.
LEGEND
A-RESONANT OVERLOAD-NOISE LEVEL WITH NO INPUT SIGNAL AND MVC = 400 μW
B-AVC CHARACTERISTIC - " " " " " " " " = 400 μW, OUTPUT VOLTAGES MEASURED WITH AVC "ON"
C- " " - " " " " " " " " = 400 μW.
D- " " -AVC "ON" VOLUME CONTROL ADJUSTED FOR 5.0 μV. SENSITIVITY, NOISE LEVEL WITH NO INPUT SIGNAL. 94 μW.
E " " - " " " " " " 100 μV. " , " " " " " " 34 μW.
F- R.F. CARRIER PLUS NOISE VOLTAGE CHARACTERISTIC (MOD. OFF) WITH RECEIVER ADJUSTMENTS AS FOR CURVE B.
100
10
1.0
0.1
1.0
10
100
1,000
10,000

PLATE 25.

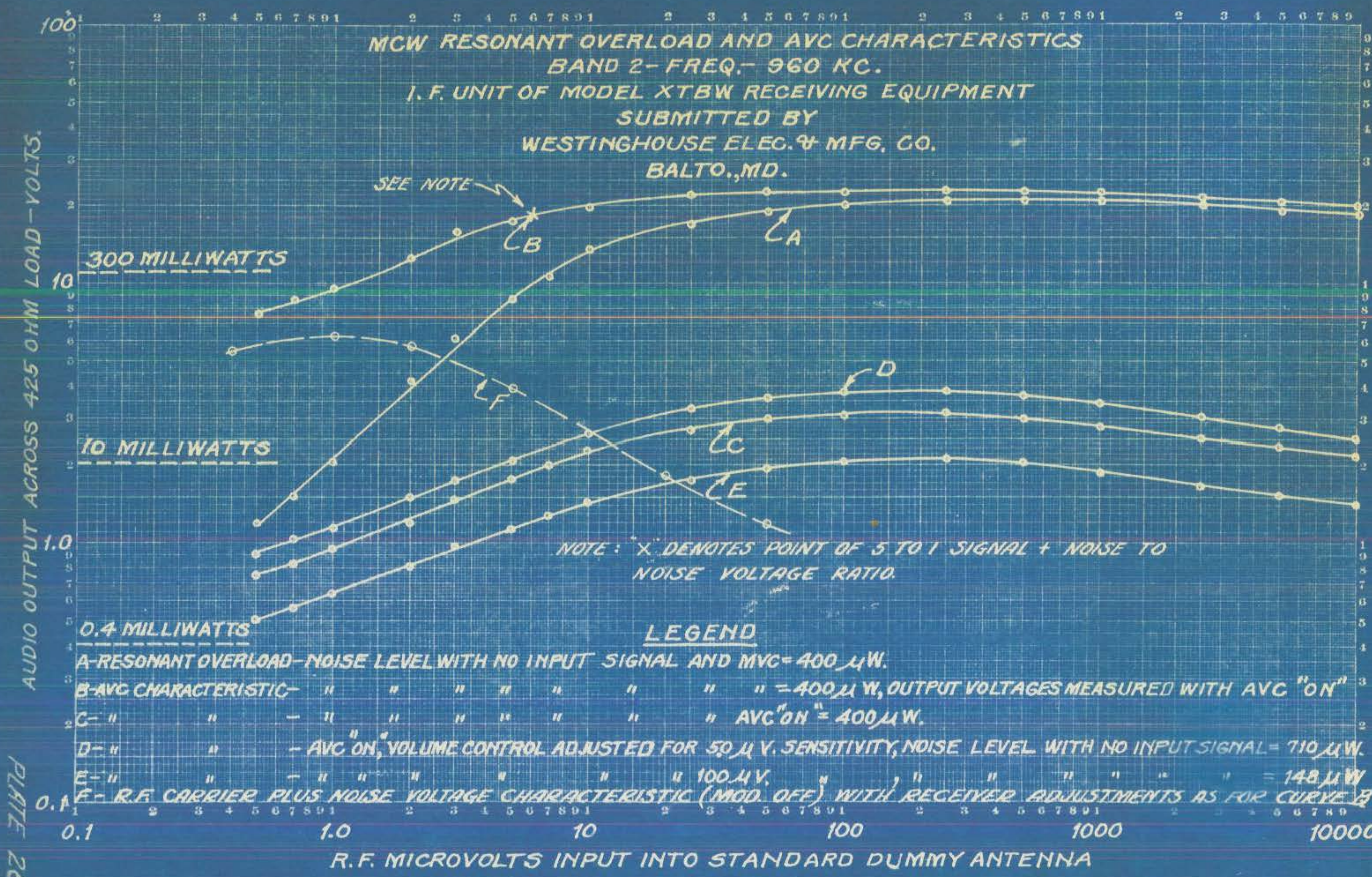
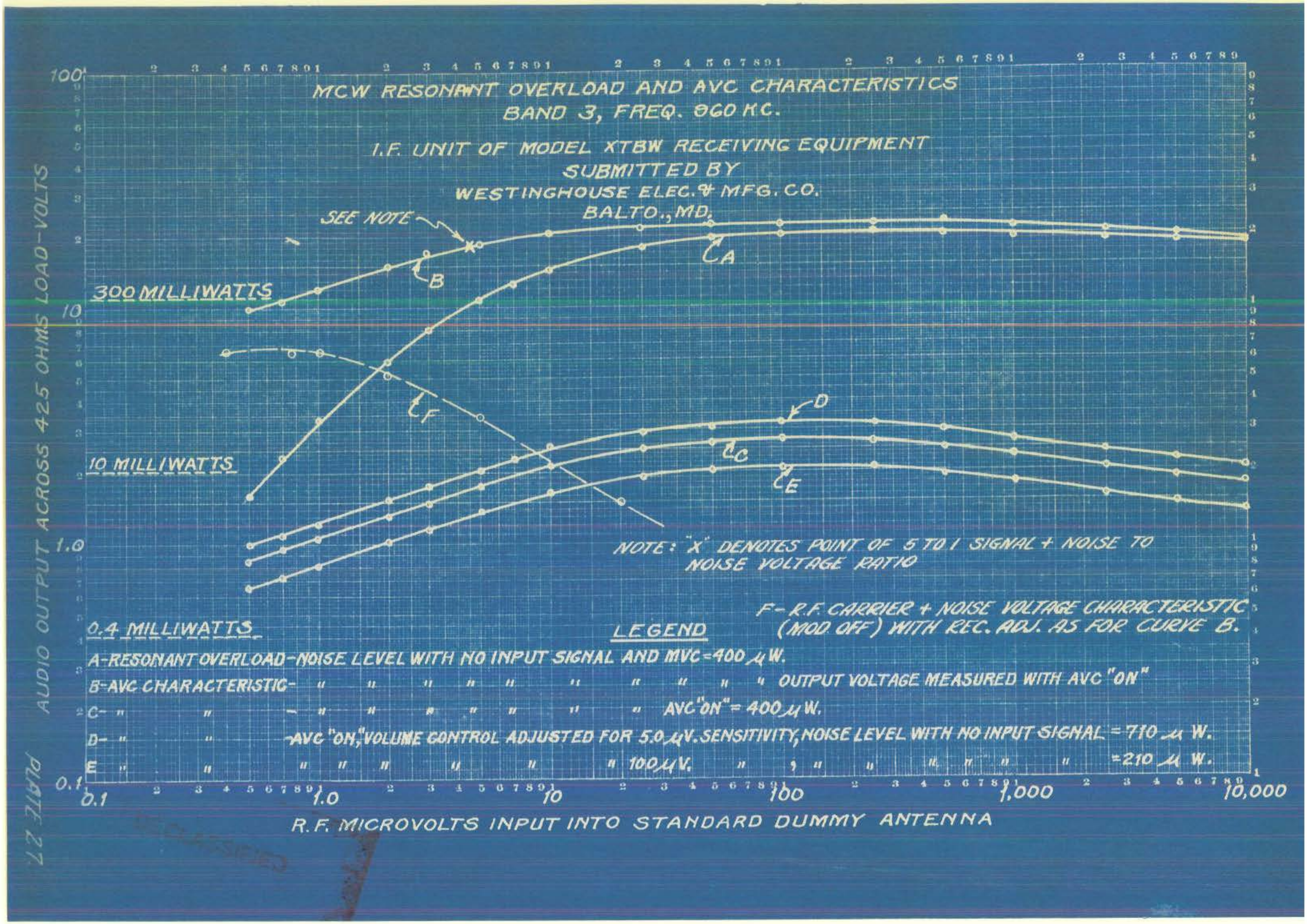

MCW RESONANT OVERLOAD AND AVC CHARACTERISTICS
BAND 2 - FREQ.- 960 KC.
I. F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO., MD.
SEE NOTE
A
B
C
D
E
F
300 MILLIWATTS
10 MILLIWATTS
0.4 MILLIWATTS
NOTE: "X" DENOTES POINT OF 5 TO 1 SIGNAL + NOISE TO NOISE VOLTAGE RATIO.
LEGEND
A-RESONANT OVERLOAD-NOISE LEVEL WITH NO INPUT SIGNAL AND MVC= 400 μW.
B-AVC CHARACTERISTIC- " " " " " " " " =400 μW, OUTPUT VOLTAGES MEASURED WITH AVC "ON"
C- " " - " " " " " " " AVC "ON" = 400 μW.
D- " " - AVC "ON", VOLUME CONTROL ADJUSTED FOR 50 μV. SENSITIVITY, NOISE LEVEL WITH NO INPUT SIGNAL = 710 μW.
E- " " - " " " " " " 100 μV. " , " " " " " " = 148 μW
F- R.F. CARRIER PLUS NOISE VOLTAGE CHARACTERISTIC (MOD. OFF) WITH RECEIVER ADJUSTMENTS AS FOR CURVE B
AUDIO OUTPUT ACROSS 425 OHM LOAD - VOLTS.
100
10
1.0
0.1
1.0
10
100
1000
10000
R. F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA

PLATE 26.


MCW RESONANT OVERLOAD AND AVC CHARACTERISTICS
BAND 3, FREQ. 860 KC.
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO., MD.
SEE NOTE
300 MILLIWATTS
10 MILLIWATTS
0.4 MILLIWATTS
NOTE: "X" DENOTES POINT OF 5 TO 1 SIGNAL + NOISE TO NOISE VOLTAGE RATIO
F- R.F. CARRIER + NOISE VOLTAGE CHARACTERISTIC (MOD OFF) WITH REC. ADJ. AS FOR CURVE B.
LEGEND
A-RESONANT OVERLOAD-NOISE LEVEL WITH NO INPUT SIGNAL AND MVC=400 µW.
B-AVC CHARACTERISTIC- " " " " " " " " " " OUTPUT VOLTAGE MEASURED WITH AVC "ON"
C- " " — " " " " " " " AVC "ON" = 400 µW.
D- " " AVC "ON," VOLUME CONTROL ADJUSTED FOR 5.0 µV. SENSITIVITY, NOISE LEVEL WITH NO INPUT SIGNAL = 710 µ W.
E " " " " " " " " 100 µV. " " " " " " " " = 210 µ W.
AUDIO OUTPUT ACROSS 425 OHMS LOAD-VOLTS
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA
0.1
1.0
10
100
1,000
10,000
PLATE 27

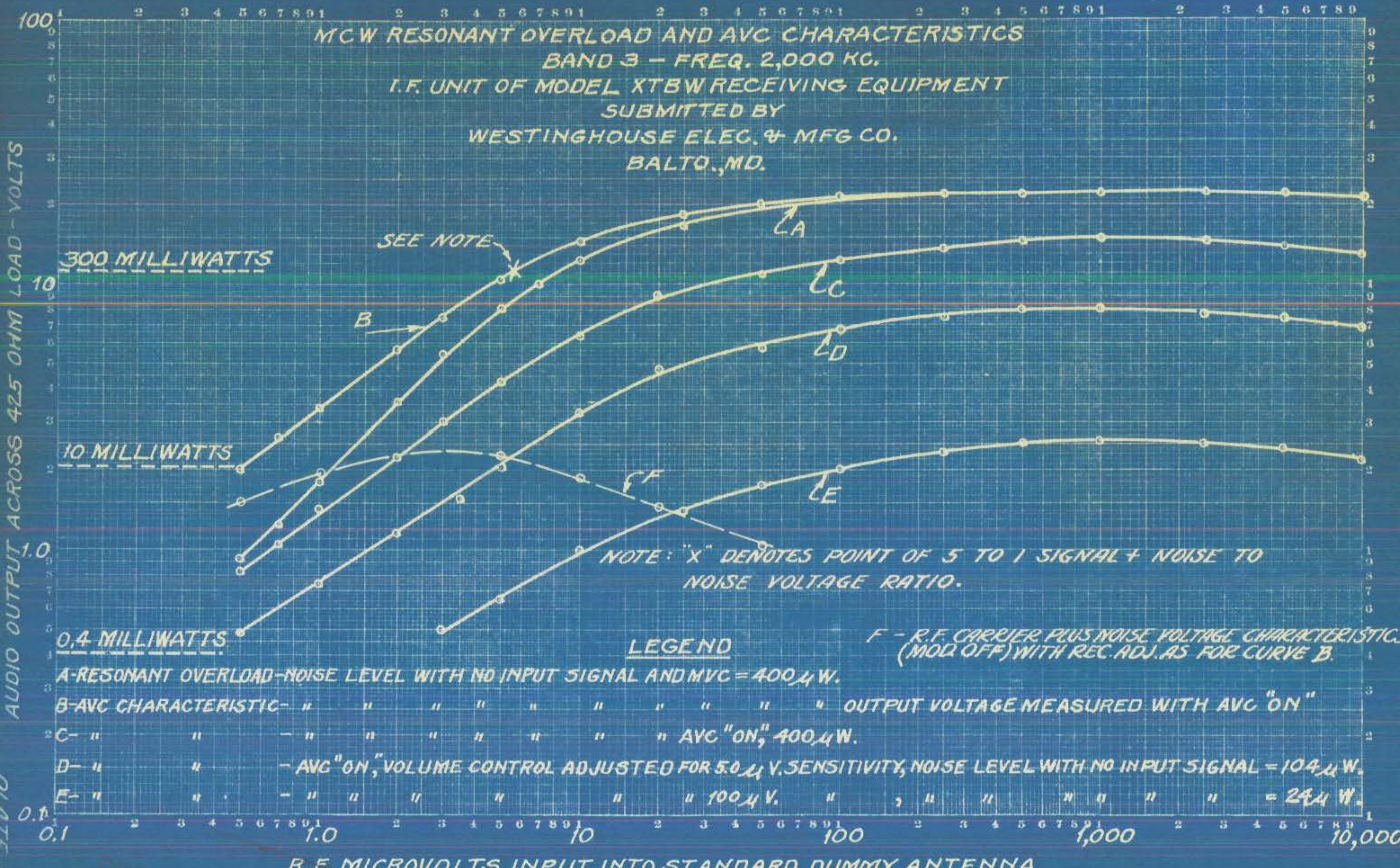

MCW RESONANT OVERLOAD AND AVC CHARACTERISTICS
BAND 3 – FREQ. 2,000 KC.
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG CO.
BALTO., MD.
AUDIO OUTPUT ACROSS 425 OHM LOAD - VOLTS
100
10
1.0
0.1
300 MILLIWATTS
10 MILLIWATTS
0.4 MILLIWATTS
SEE NOTE
B
A
C
D
E
F
NOTE: "X" DENOTES POINT OF 5 TO 1 SIGNAL + NOISE TO NOISE VOLTAGE RATIO.
LEGEND
A-RESONANT OVERLOAD-NOISE LEVEL WITH NO INPUT SIGNAL AND MVC = 400 μW.
B-AVC CHARACTERISTIC- " " " " " " " " " " OUTPUT VOLTAGE MEASURED WITH AVC "ON"
C- " " - " " " " " " " AVC "ON," 400 μW.
D- " " - AVC "ON," VOLUME CONTROL ADJUSTED FOR 5.0 μV. SENSITIVITY, NOISE LEVEL WITH NO INPUT SIGNAL = 104 μW.
E- " " - " " " " " " 100 μV. " " " " " " " = 24 μW.
F - R.F. CARRIER PLUS NOISE VOLTAGE CHARACTERISTICS (MOD. OFF) WITH REC. ADJ. AS FOR CURVE B.
0.1
1.0
10
100
1,000
10,000
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA

PLATE 28.

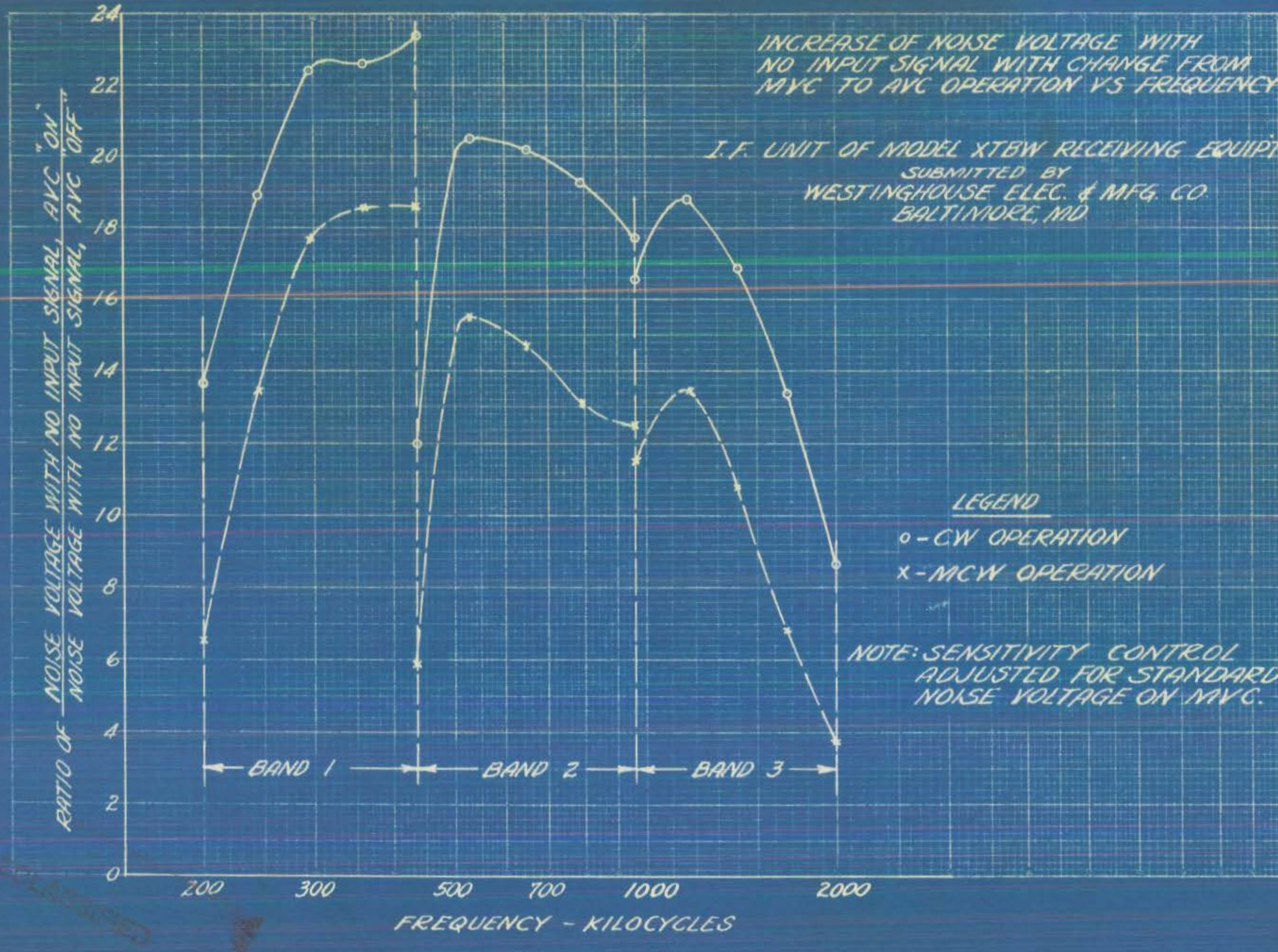
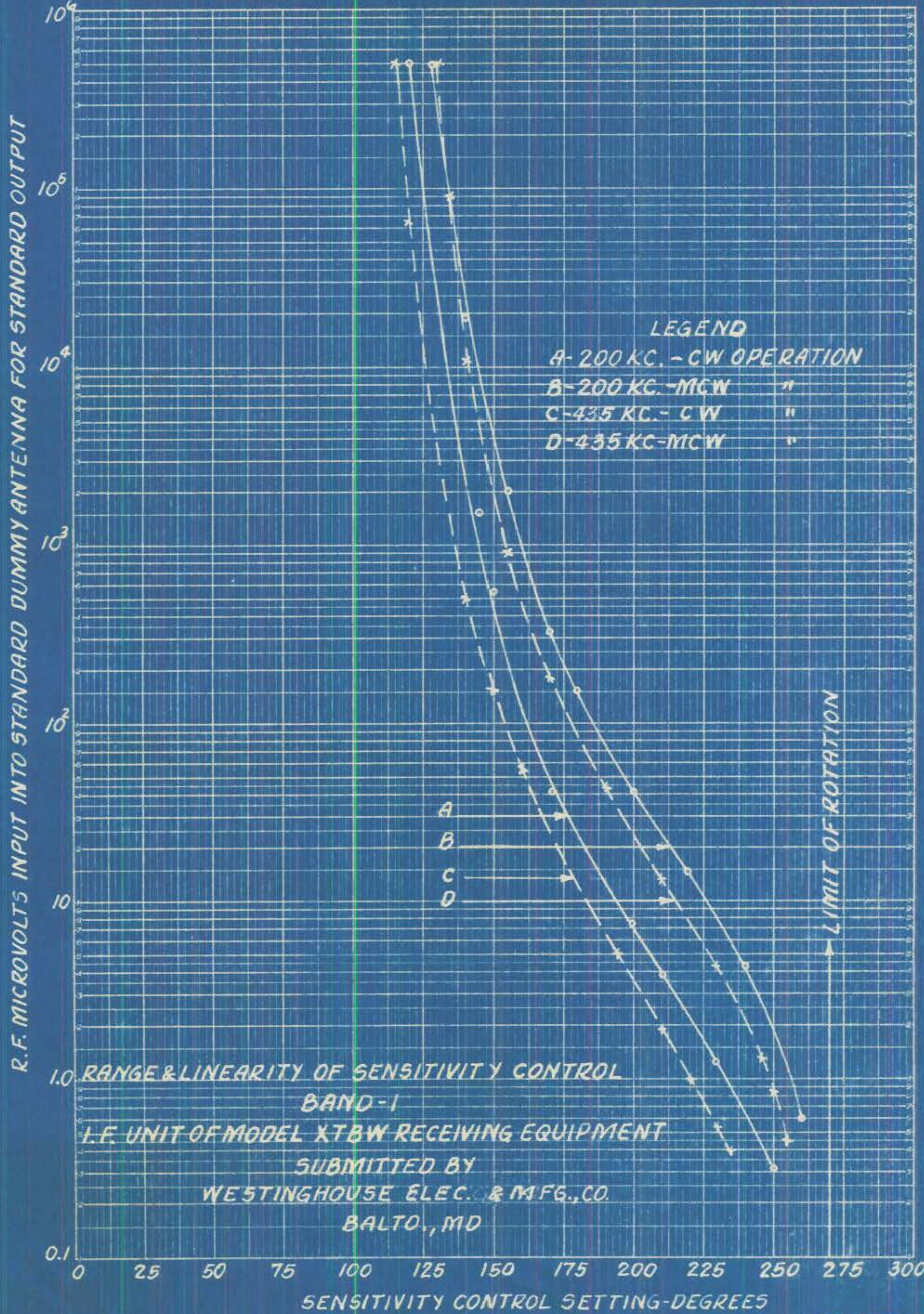

INCREASE OF NOISE VOLTAGE WITH NO INPUT SIGNAL WITH CHANGE FROM MVC TO AVC OPERATION VS FREQUENCY
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTIMORE, MD
LEGEND
o - CW OPERATION
x - MCW OPERATION
NOTE: SENSITIVITY CONTROL ADJUSTED FOR STANDARD NOISE VOLTAGE ON MVC.
RATIO OF NOISE VOLTAGE WITH NO INPUT SIGNAL, AVC "ON" / NOISE VOLTAGE WITH NO INPUT SIGNAL, AVC "OFF"
0
2
4
6
8
10
12
14
16
18
20
22
24
BAND 1
BAND 2
BAND 3
200
300
500
700
1000
2000
FREQUENCY - KILOCYCLES

PLATE 29



LEGEND
A-200 KC. - CW OPERATION
B-200 KC. -MCW "
C-435 KC. - CW "
D-435 KC-MCW "
A
B
C
D
LIMIT OF ROTATION
RANGE & LINEARITY OF SENSITIVITY CONTROL
BAND-1
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG., CO.
BALTO., MD
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA FOR STANDARD OUTPUT
SENSITIVITY CONTROL SETTING-DEGREES
0 25 50 75 100 125 150 175 200 225 250 275 300
0.1
1.0
10
10²
10³
10⁴
10⁵
10⁶

PLATE 30

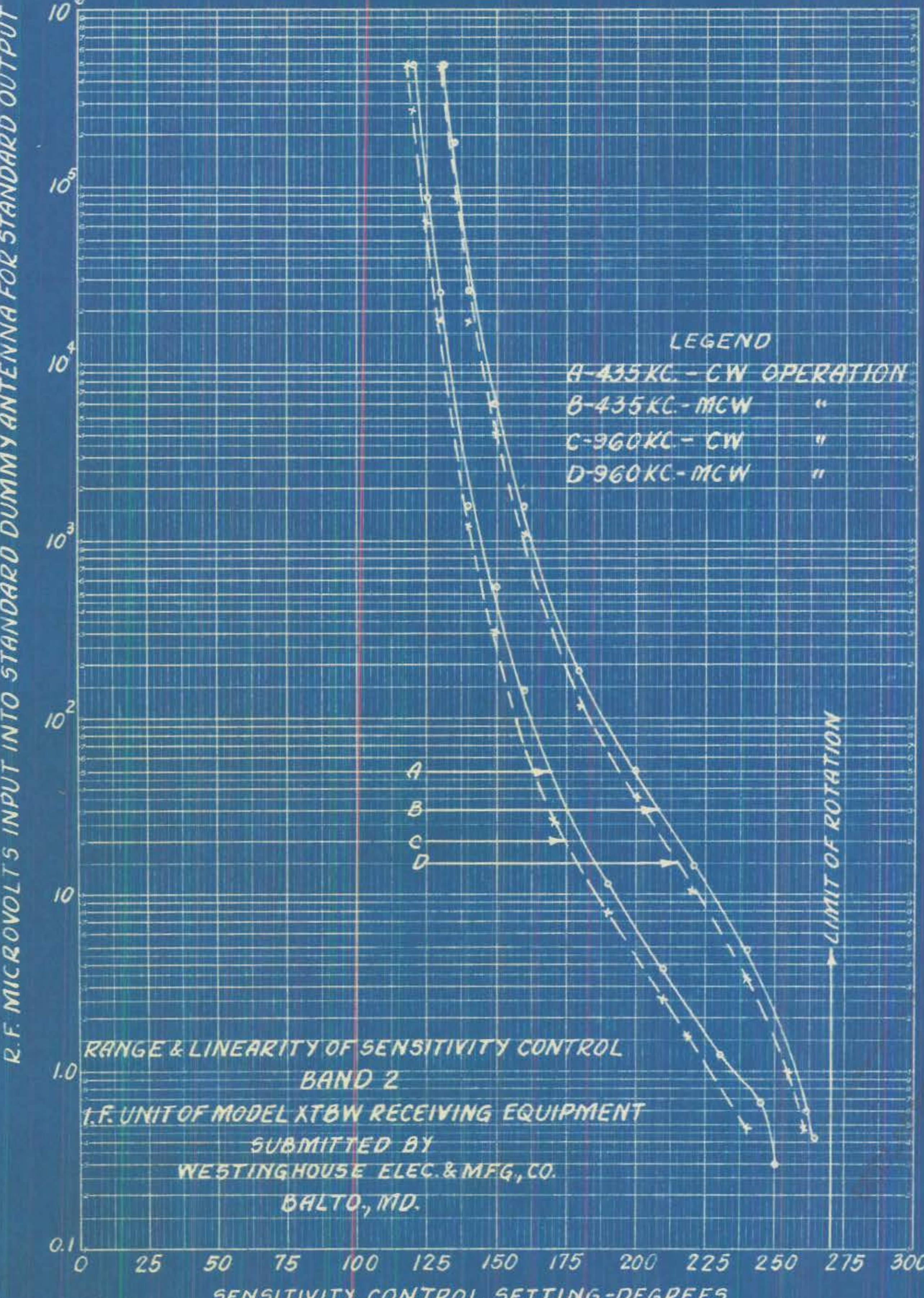
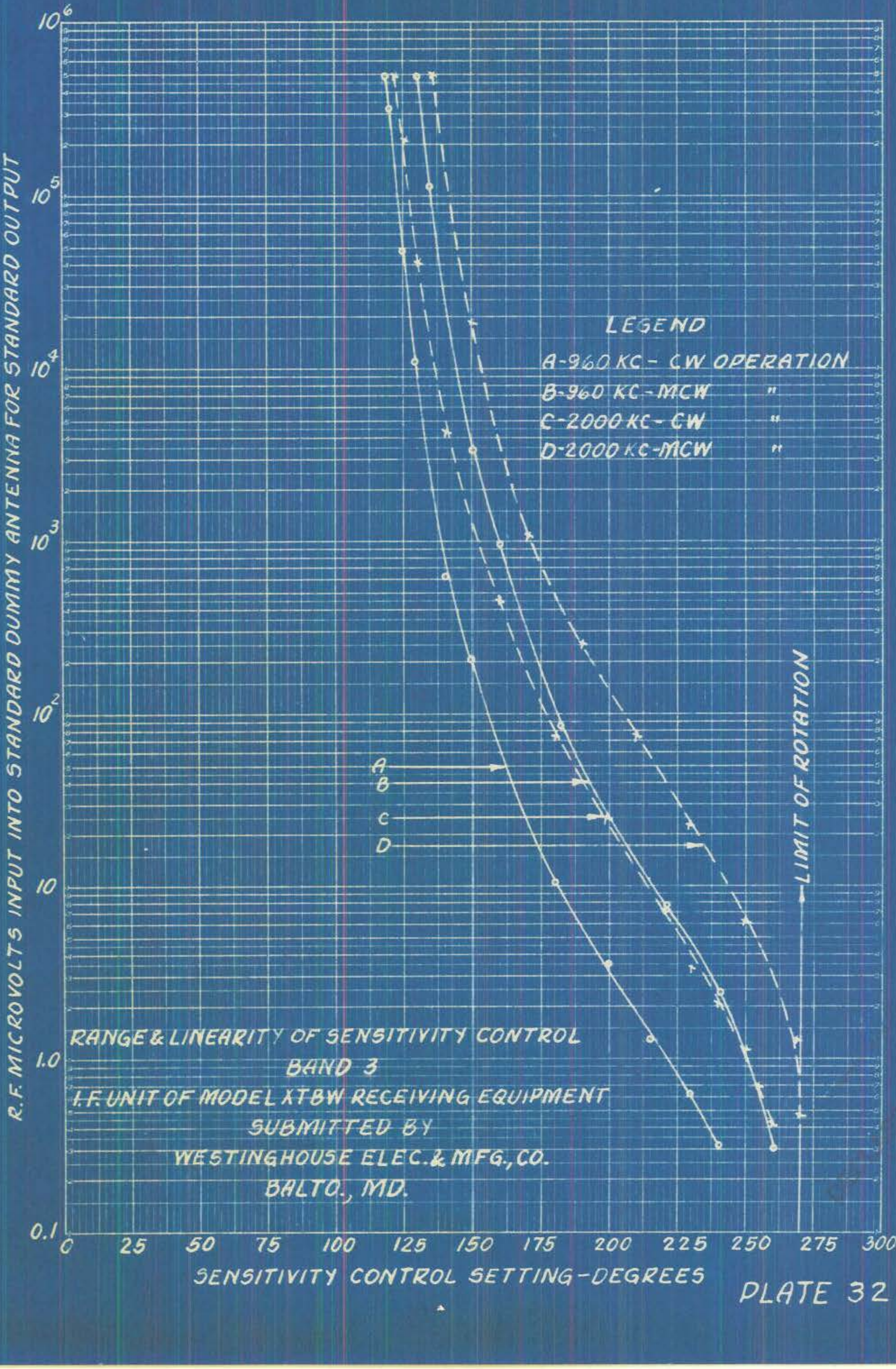
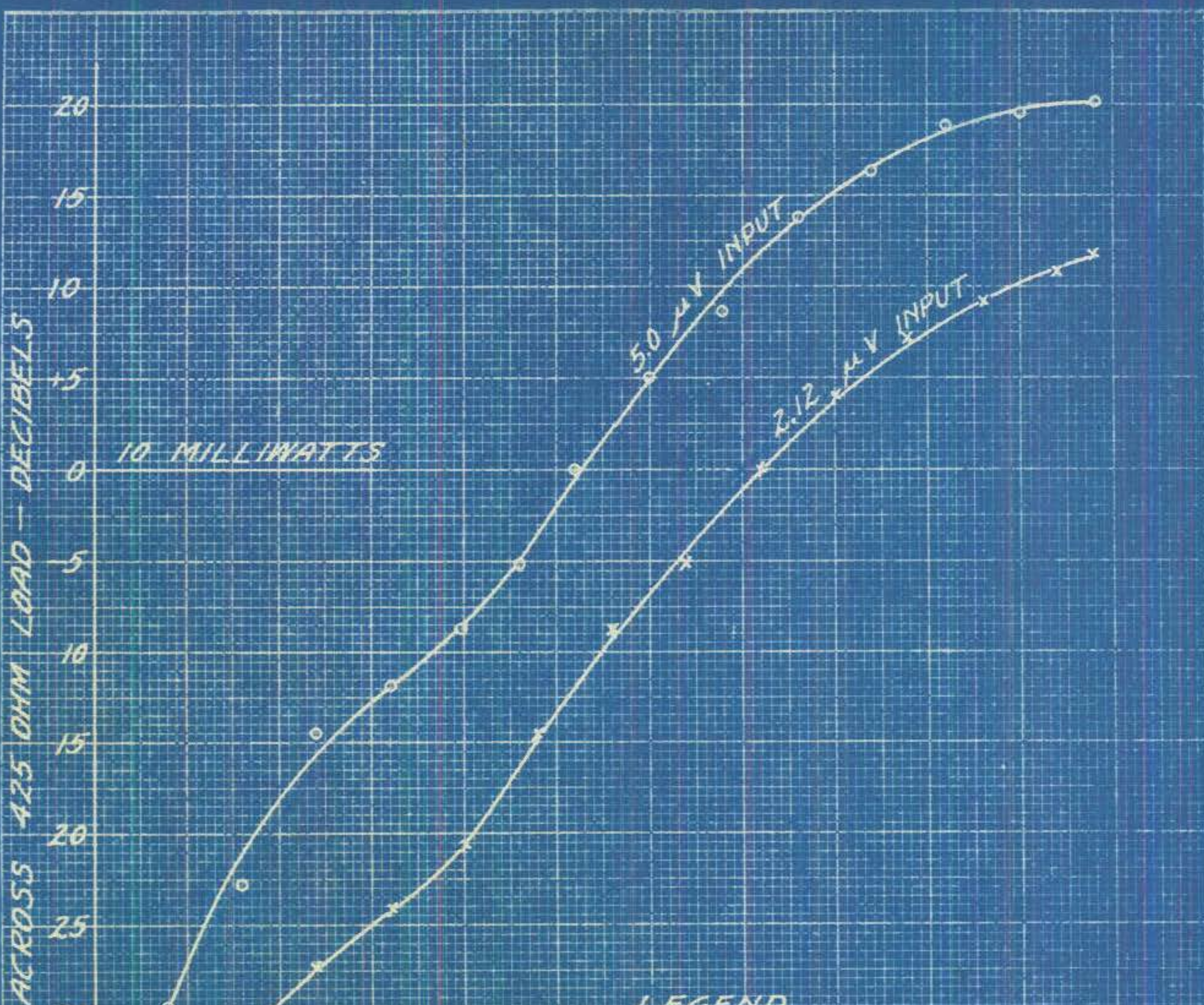

R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA FOR STANDARD OUTPUT
LEGEND
A-435 KC. - CW OPERATION
B-435 KC. - MCW "
C-960 KC. - CW "
D-960 KC. - MCW "
LIMIT OF ROTATION
A
B
C
D
RANGE & LINEARITY OF SENSITIVITY CONTROL
BAND 2
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG., CO.
BALTO., MD.
0 25 50 75 100 125 150 175 200 225 250 275 300
SENSITIVITY CONTROL SETTING-DEGREES

PLATE 31



LEGEND
A-960 KC - CW OPERATION
B-960 KC - MCW "
C-2000 KC - CW "
D-2000 KC-MCW "
A
B
C
D
LIMIT OF ROTATION
RANGE & LINEARITY OF SENSITIVITY CONTROL
BAND 3
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG., CO.
BALTO., MD.
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA FOR STANDARD OUTPUT
10^6
10^5
10^4
10^3
10^2
10
1.0
0.1
0
25
50
75
100
125
150
175
200
225
250
275
300
SENSITIVITY CONTROL SETTING-DEGREES

PLATE 32


20
15
10
+5
0
-5
10
15
20
25
30
35
40
45
50
AUDIO OUTPUT ACROSS 425 OHM LOAD - DECIBELS
10 MILLIWATTS
5.0 μV INPUT
2.12 μV INPUT
LEGEND
o - BAND 1 - 435 K.C.
x - BAND 3 - 2000 K.C.
RANGE AND LINEARITY OF VOLUME CONTROL
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
0
25
50
75
100
125
150
175
200
225
250
275
VOLUME-CONTROL SETTING - DEGREES

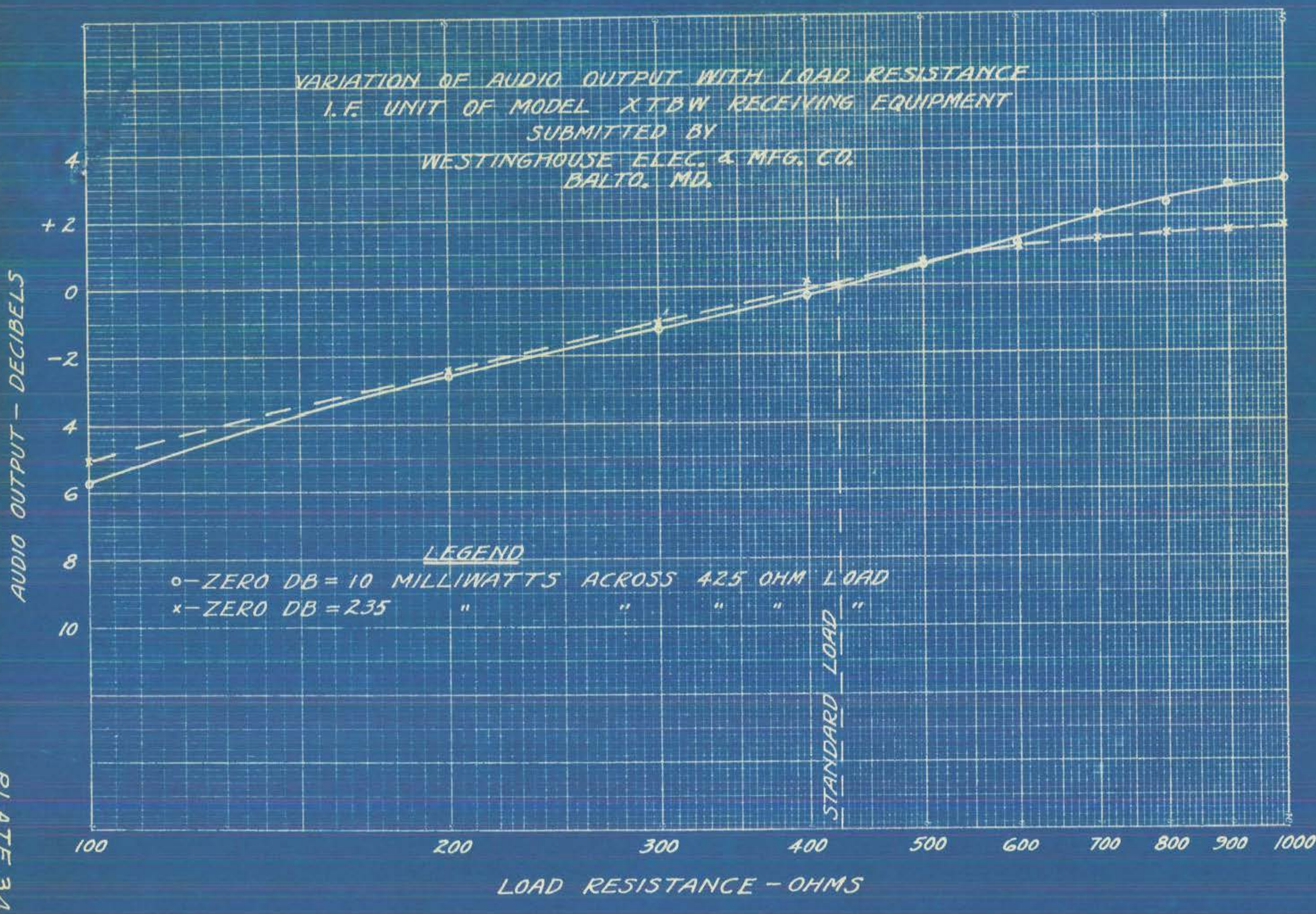
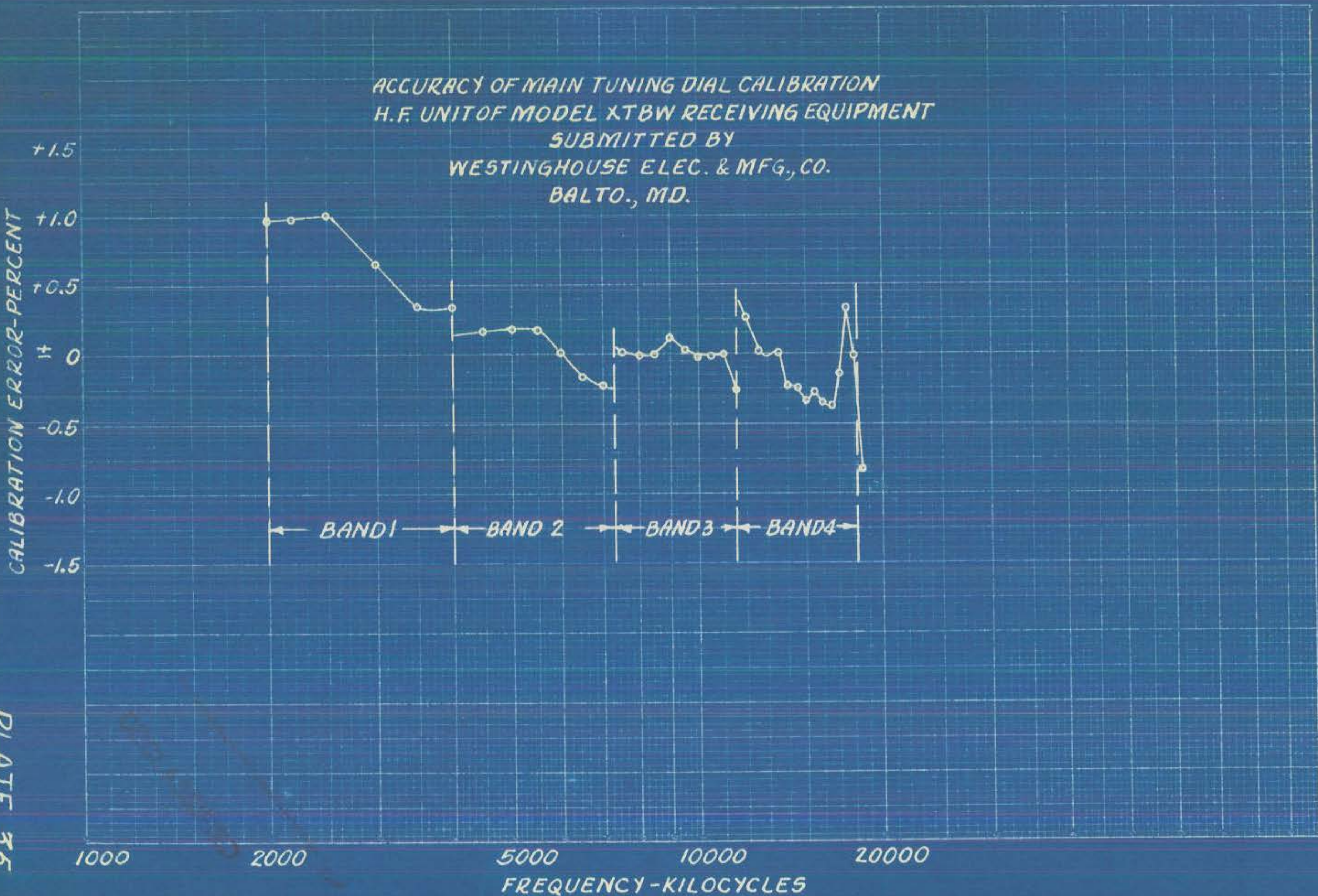
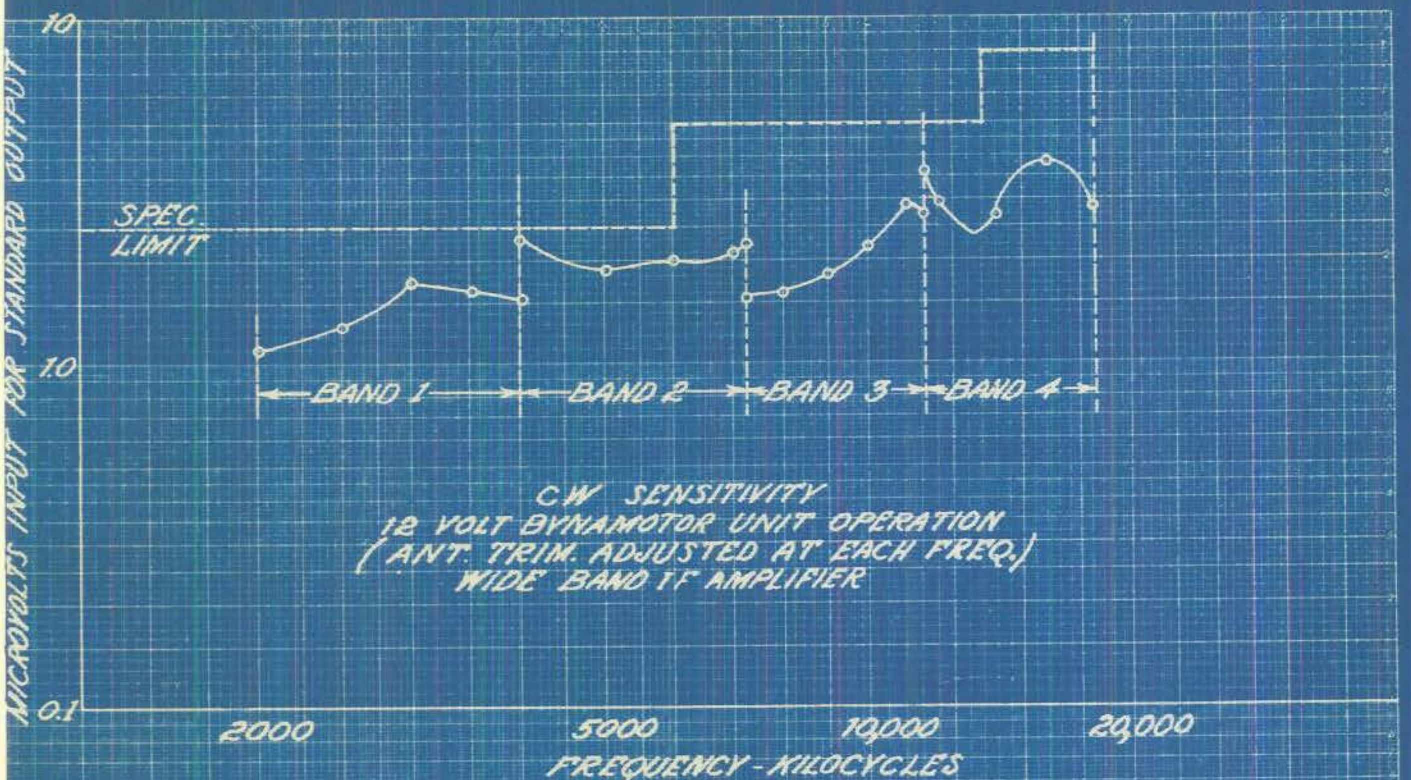

VARIATION OF AUDIO OUTPUT WITH LOAD RESISTANCE
I.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
LEGEND
o–ZERO DB = 10 MILLIWATTS ACROSS 425 OHM LOAD
x–ZERO DB = 235 " " " " "
STANDARD LOAD
AUDIO OUTPUT – DECIBELS
4
+2
0
-2
4
6
8
10
100
200
300
400
500
600
700
800
900
1000
LOAD RESISTANCE – OHMS

PLATE 34

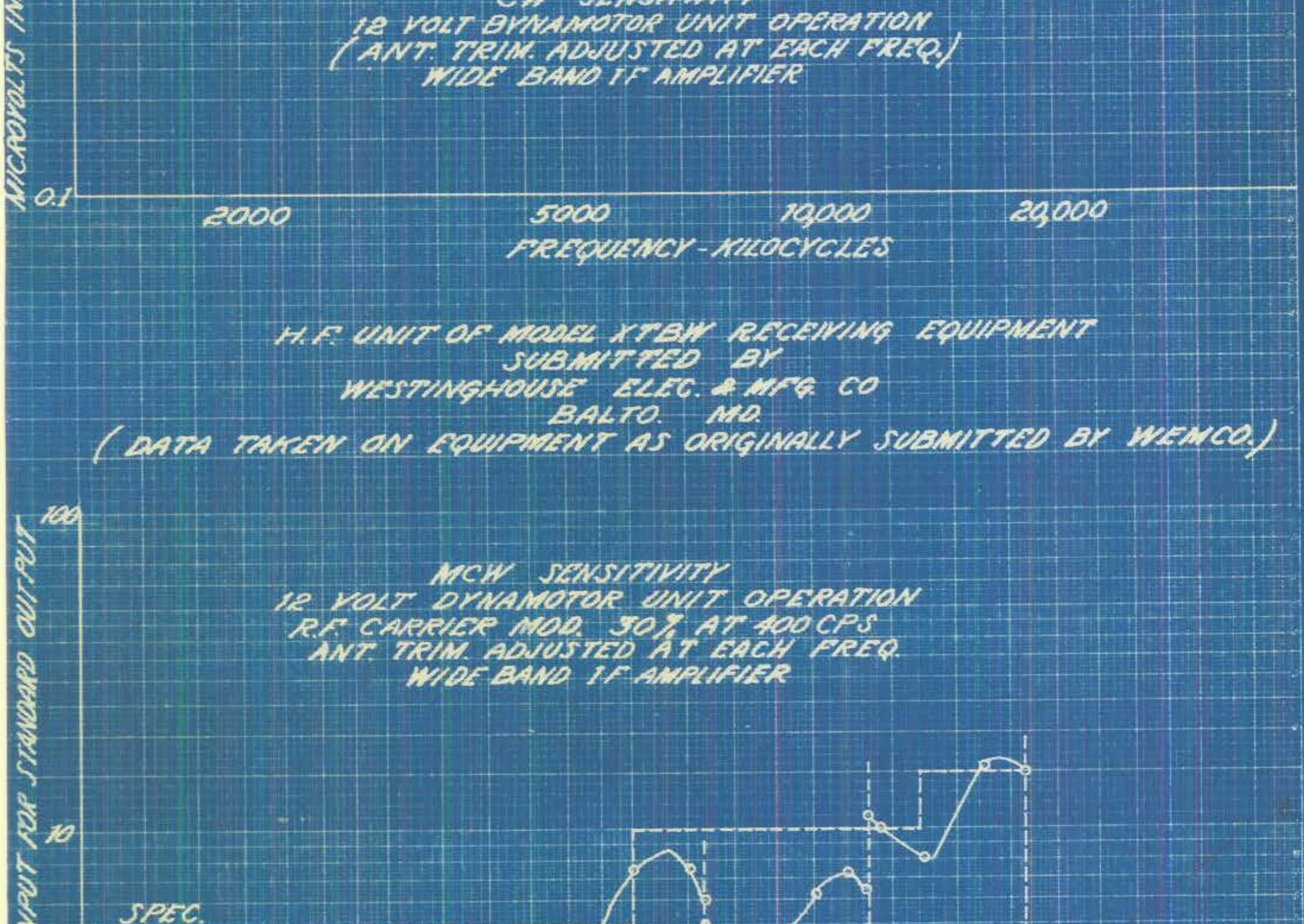


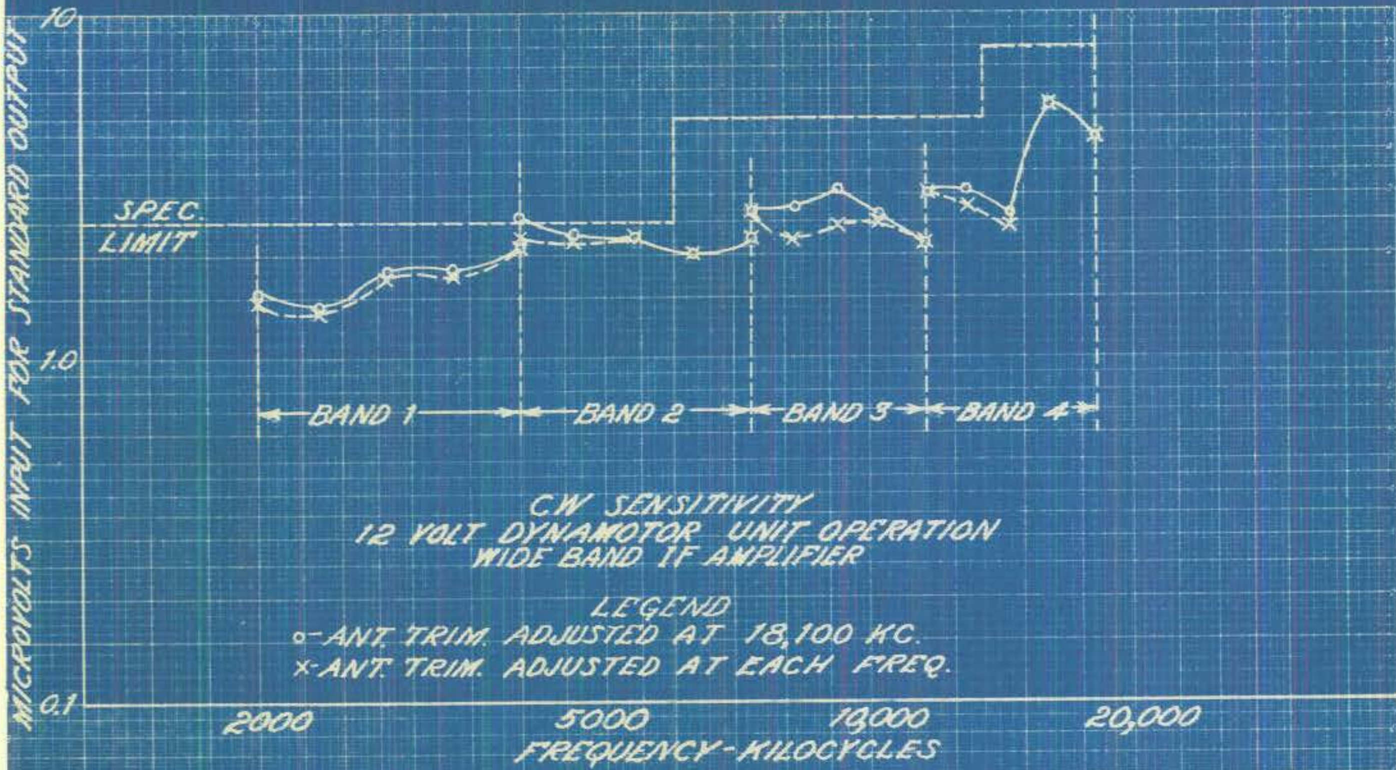
ACCURACY OF MAIN TUNING DIAL CALIBRATION
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG., CO.
BALTO., MD.
CALIBRATION ERROR-PERCENT
+1.5
+1.0
+0.5
± 0
-0.5
-1.0
-1.5
BAND 1
BAND 2
BAND 3
BAND 4
1000
2000
5000
10000
20000
FREQUENCY-KILOCYCLES

PLATE 35



H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO
BALTO. MD.
(DATA TAKEN ON EQUIPMENT AS ORIGINALLY SUBMITTED BY WEMCO.)





H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALT. MD.
(DATA TAKEN AFTER RECEIVER MODIFICATIONS BY WEMCO.)

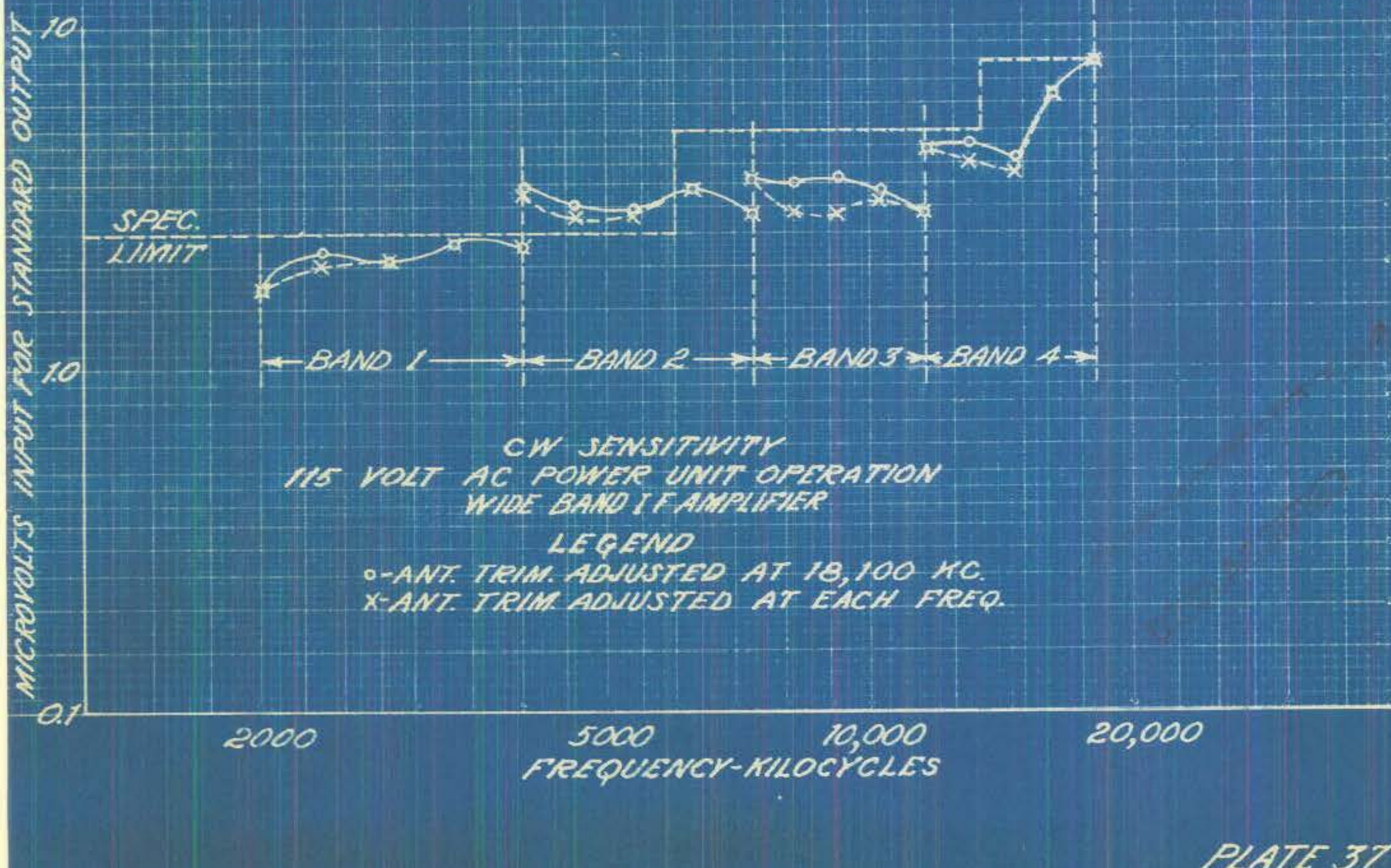
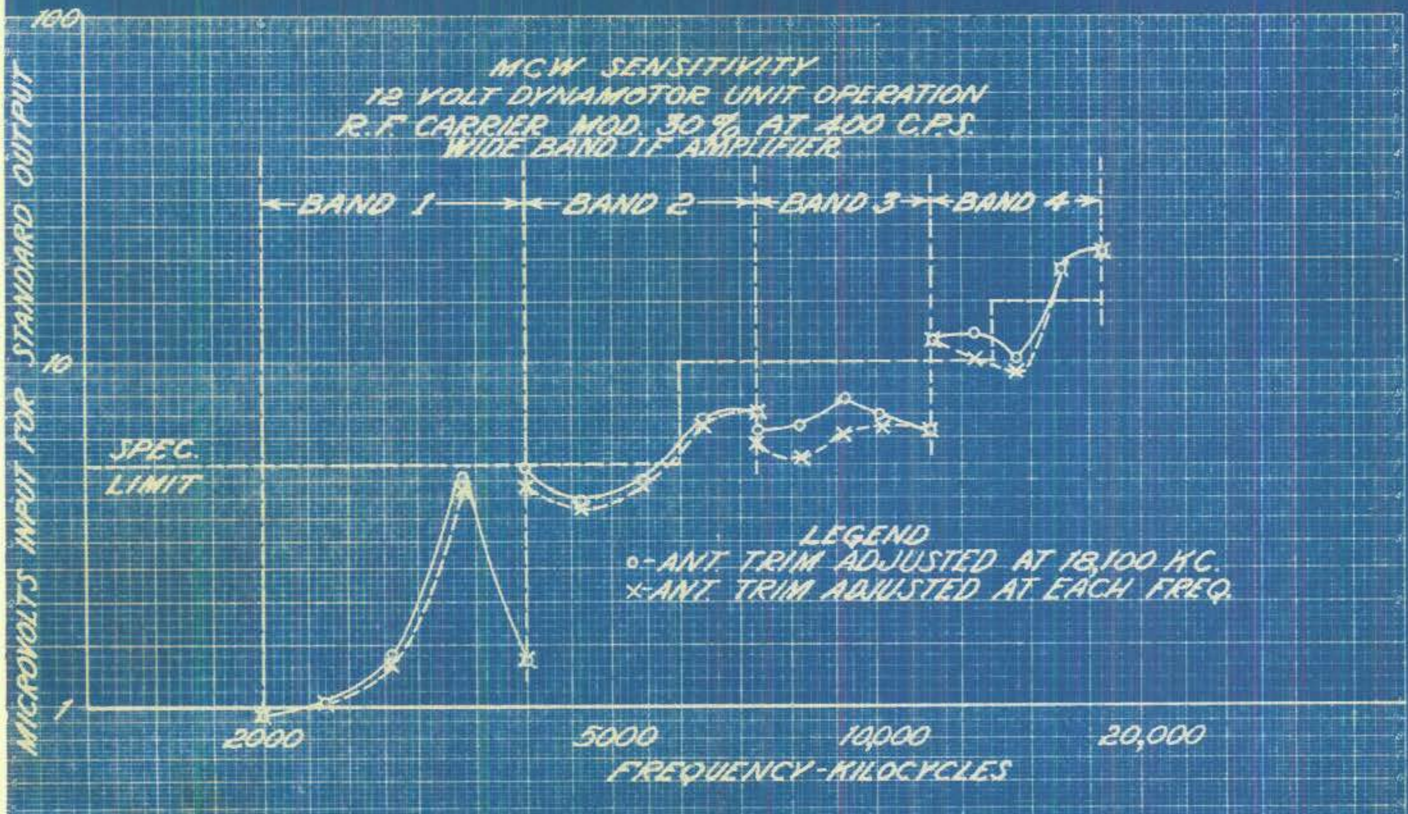


PLATE 37



H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
(DATA TAKEN AFTER RECEIVER MODIFICATIONS BY WEMCO)

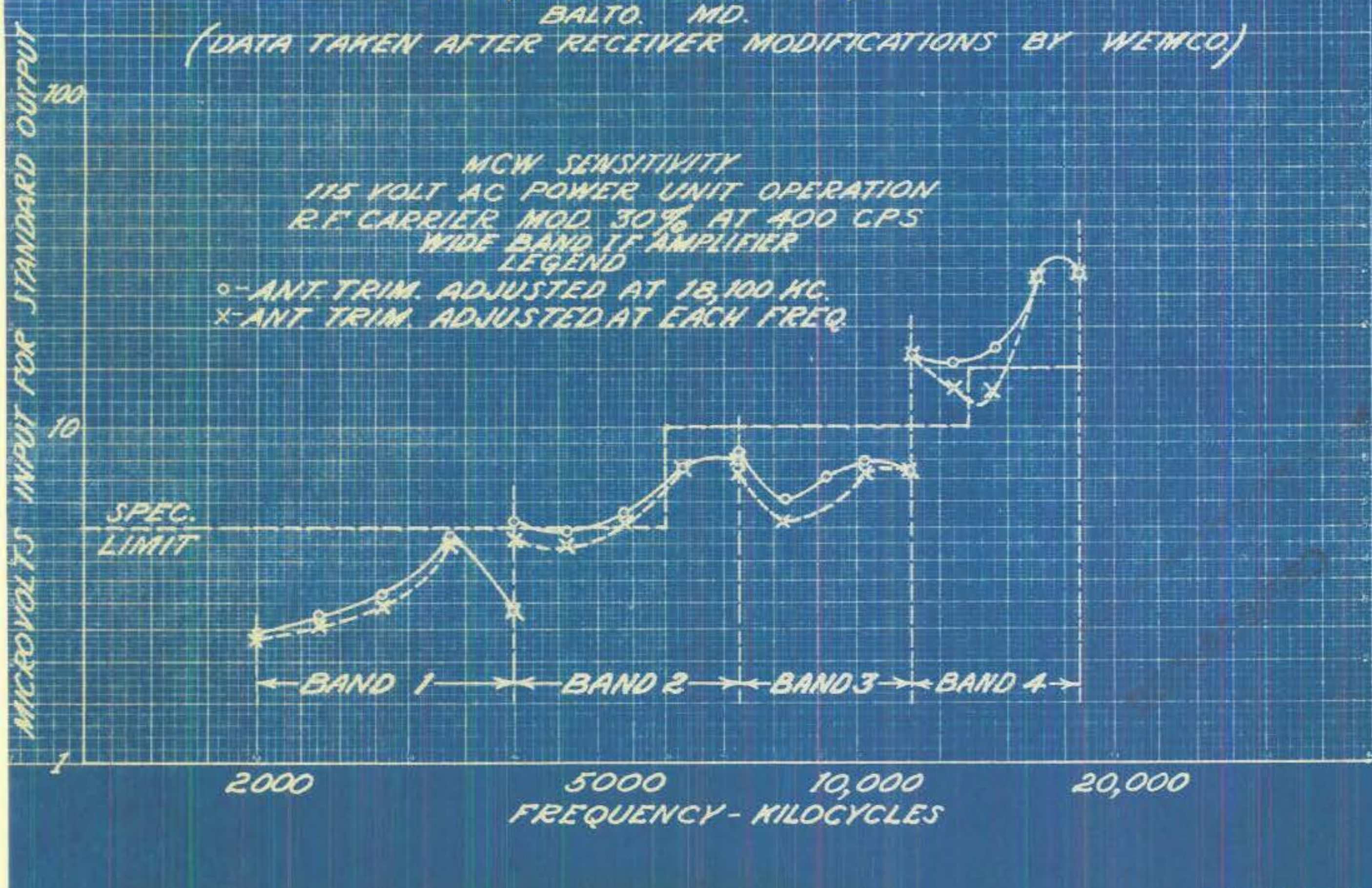


PLATE 38

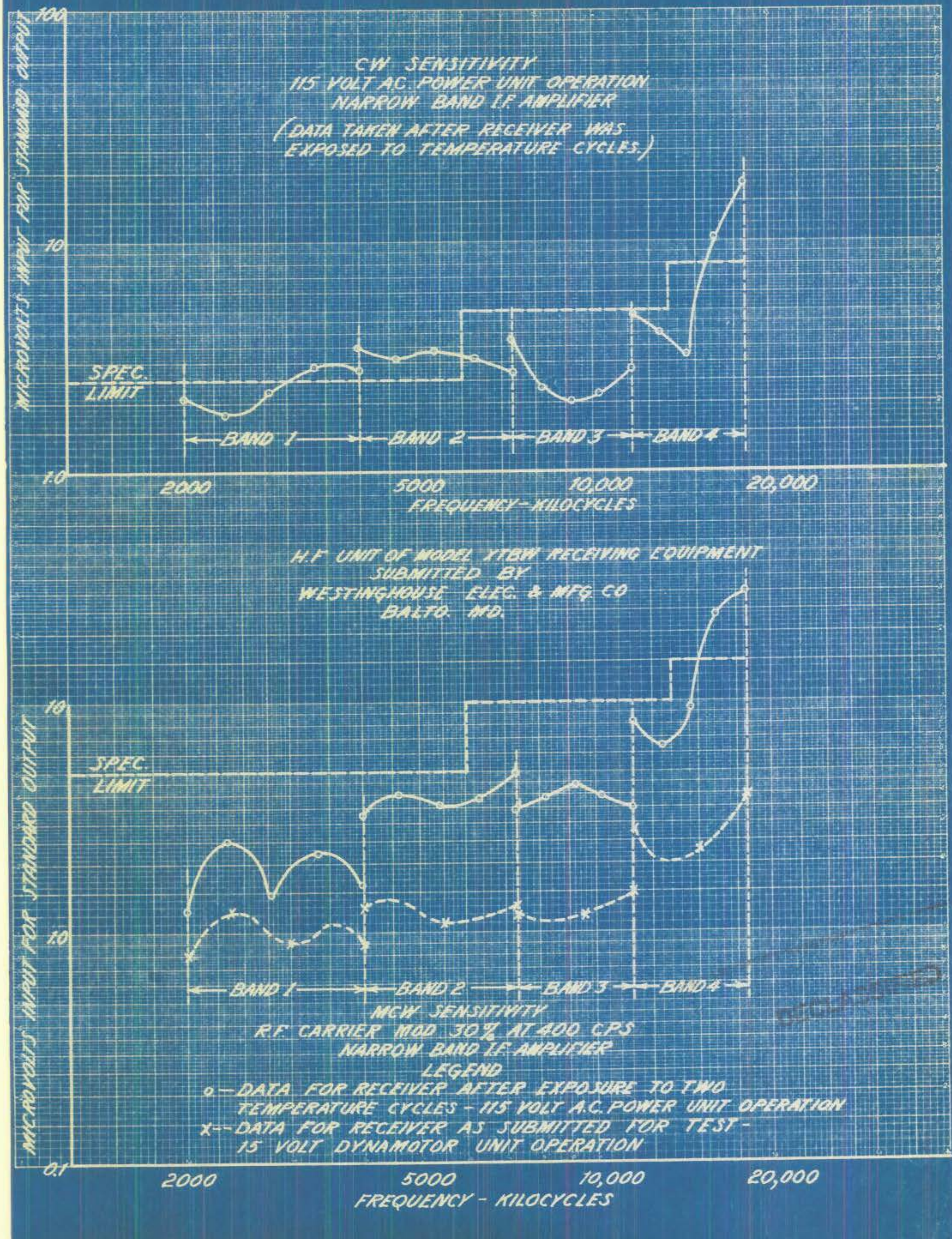
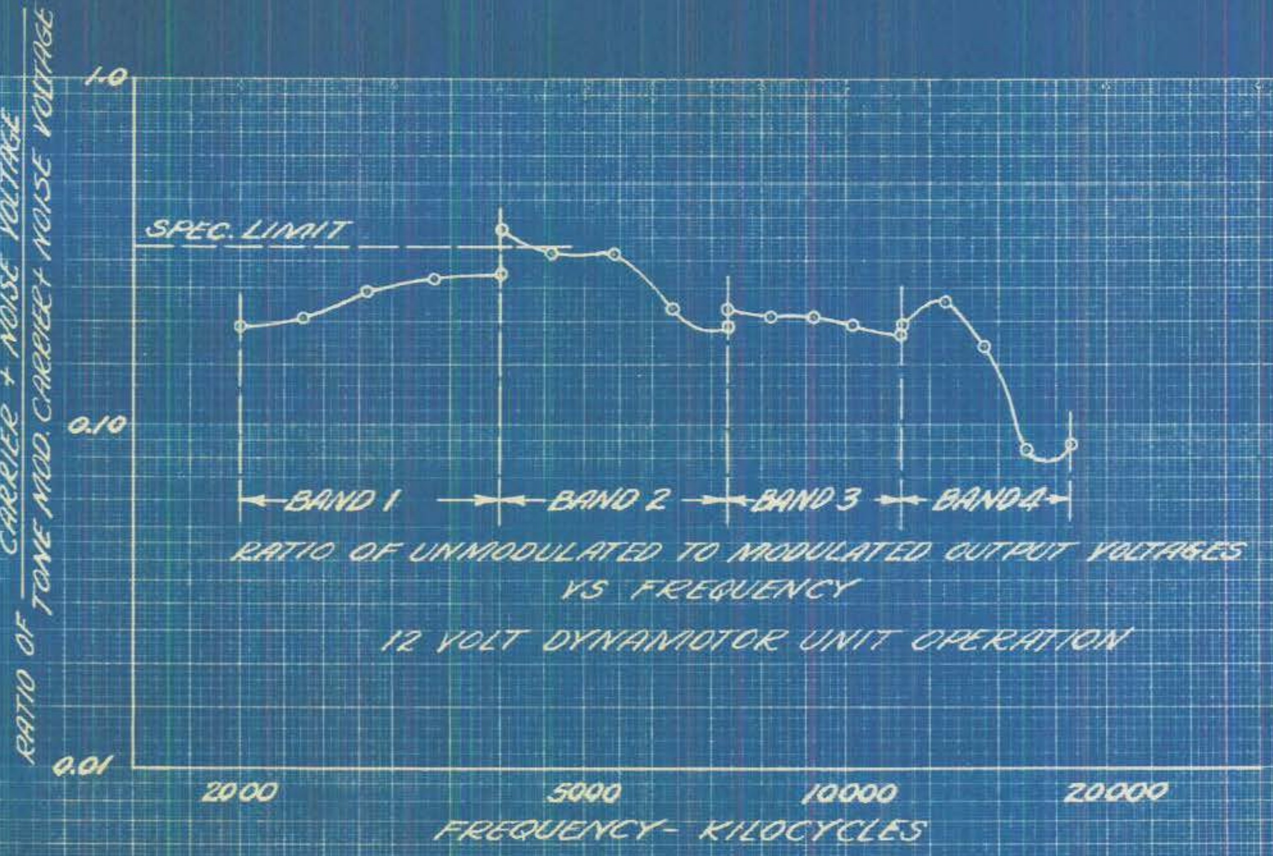
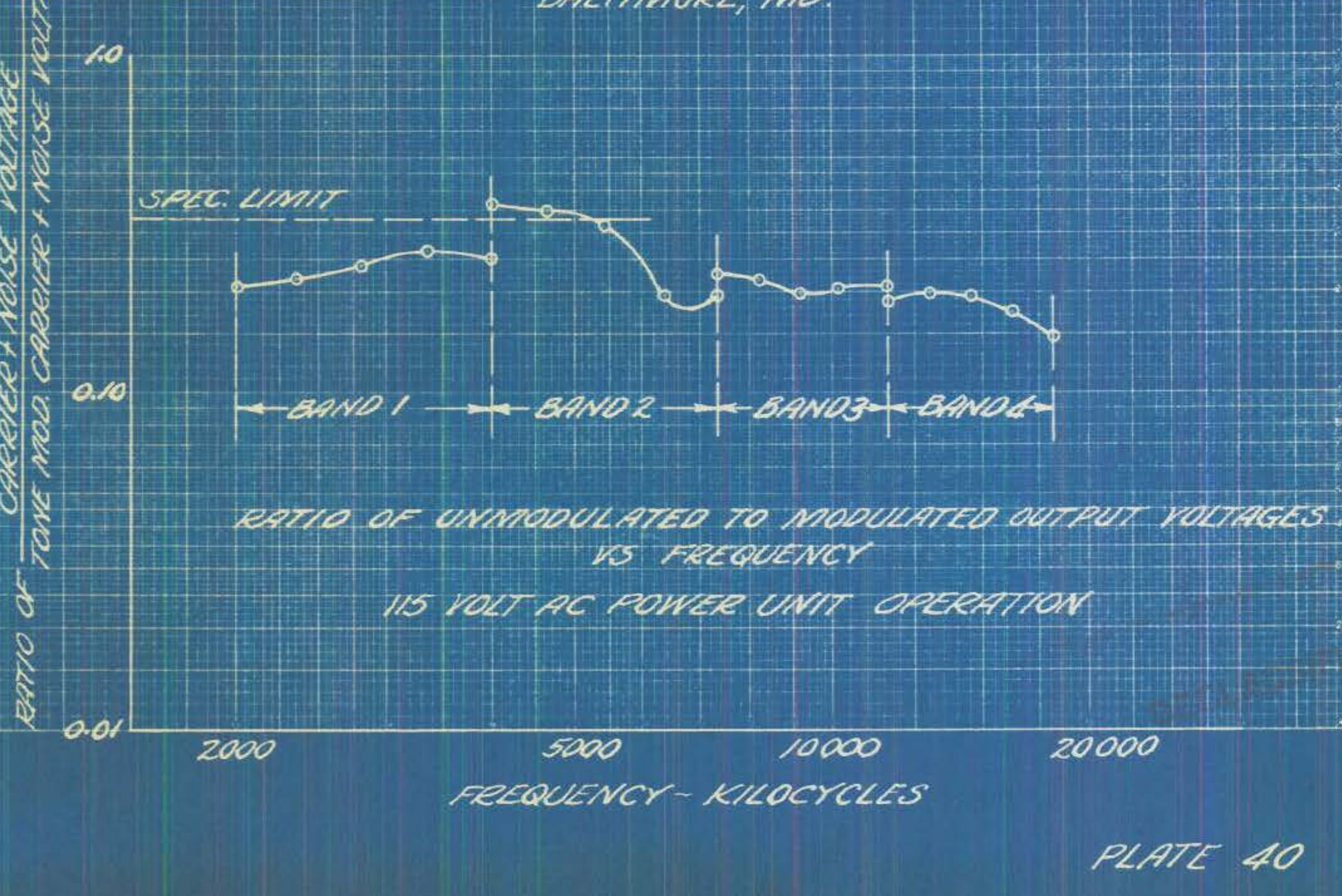

CW SENSITIVITY
115 VOLT AC. POWER UNIT OPERATION
NARROW BAND I.F. AMPLIFIER
(DATA TAKEN AFTER RECEIVER WAS EXPOSED TO TEMPERATURE CYCLES.)
MICROVOLTS INPUT FOR STANDARD OUTPUT
100
10
1.0
SPEC. LIMIT
BAND 1
BAND 2
BAND 3
BAND 4
2000
5000
10,000
20,000
FREQUENCY - KILOCYCLES
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO
BALTO. MD.
MICROVOLTS INPUT FOR STANDARD OUTPUT
10
1.0
0.1
SPEC. LIMIT
BAND 1
BAND 2
BAND 3
BAND 4
MCW SENSITIVITY
R.F. CARRIER MOD 30% AT 400 CPS
NARROW BAND I.F. AMPLIFIER
LEGEND
o - DATA FOR RECEIVER AFTER EXPOSURE TO TWO TEMPERATURE CYCLES - 115 VOLT A.C. POWER UNIT OPERATION
x - DATA FOR RECEIVER AS SUBMITTED FOR TEST - 15 VOLT DYNAMOTOR UNIT OPERATION
2000
5000
10,000
20,000
FREQUENCY - KILOCYCLES

PLATE 39



H. F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
WIDE BAND I. F. AMPLIFIER

SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTIMORE, MD.



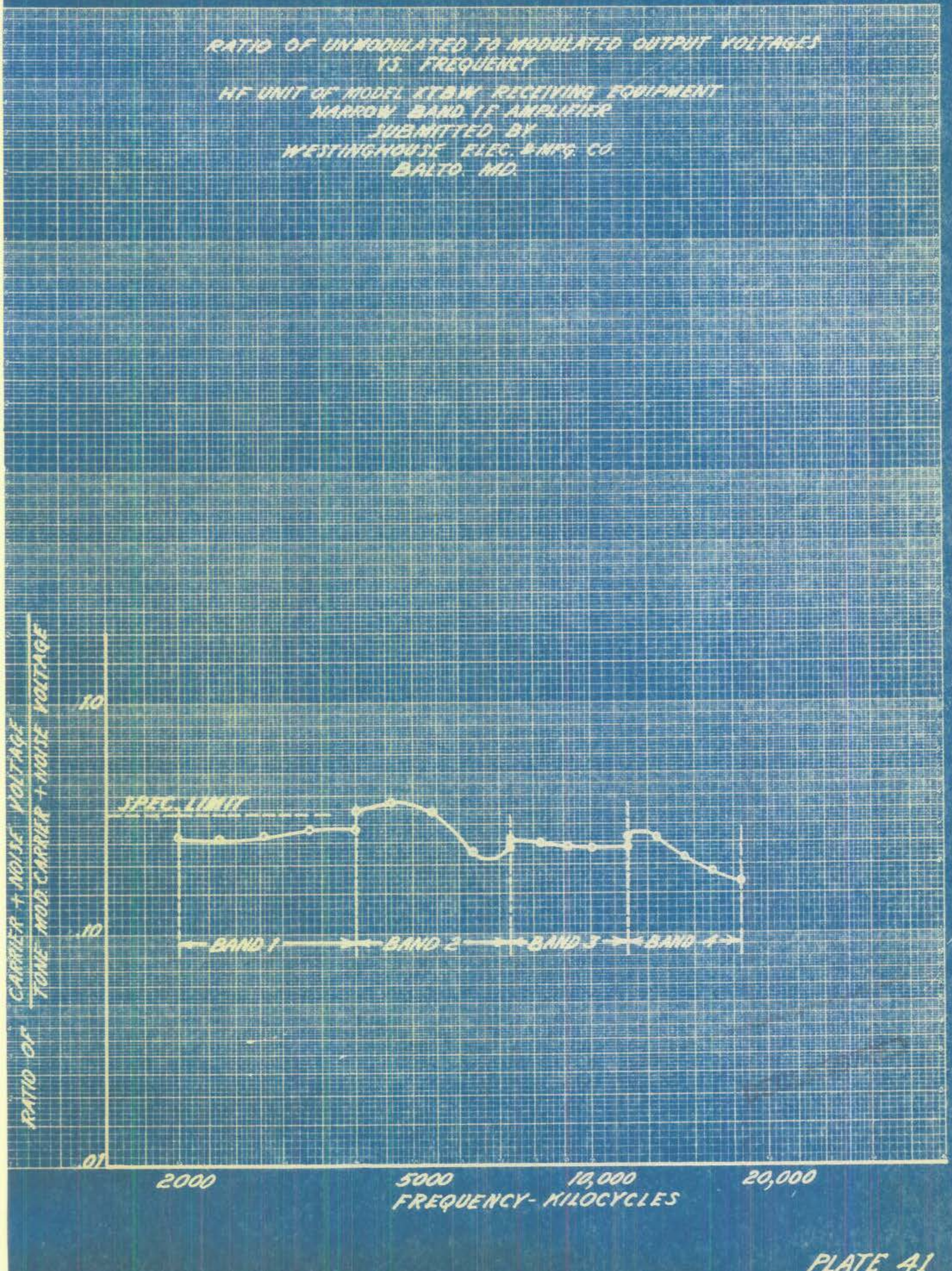
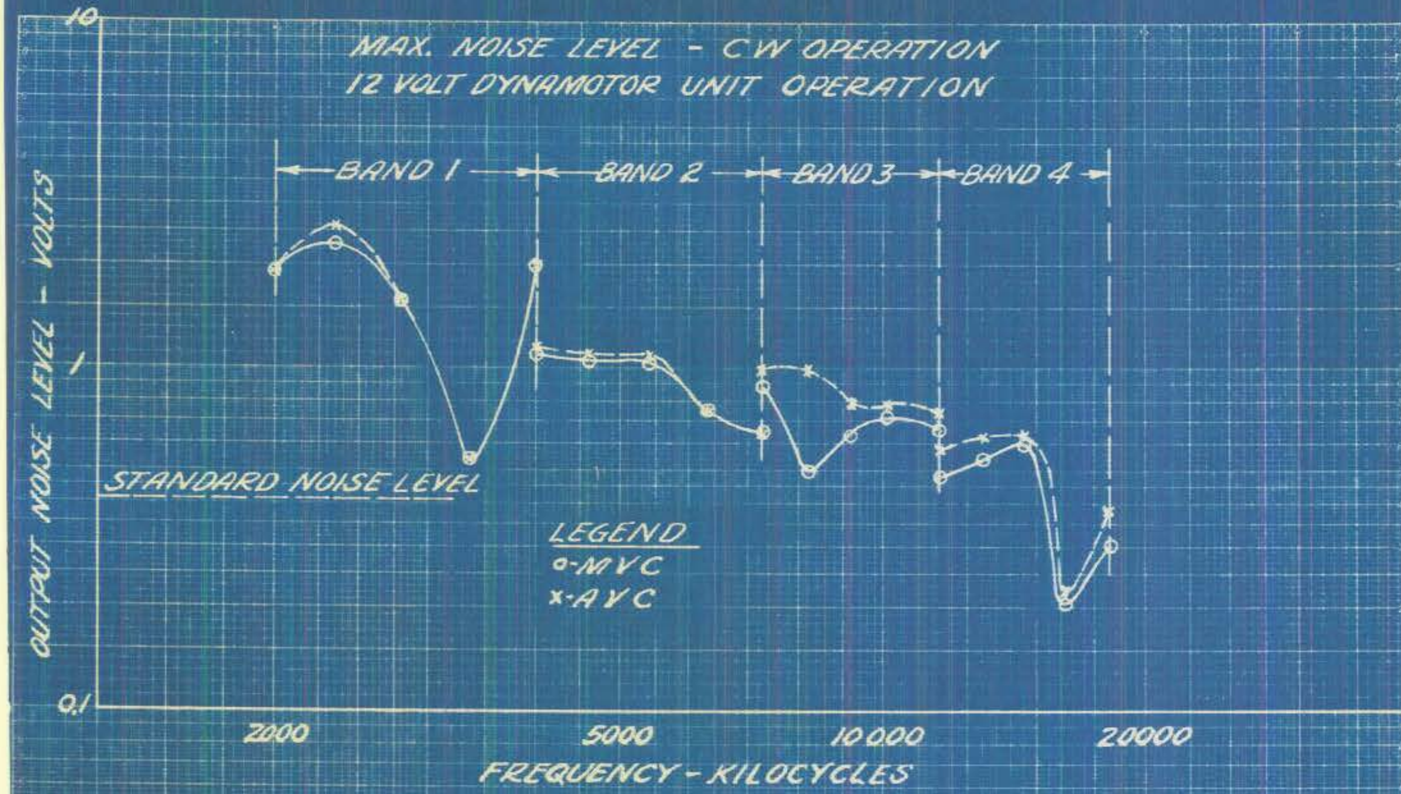

RATIO OF UNMODULATED TO MODULATED OUTPUT VOLTAGES
VS. FREQUENCY
HF UNIT OF MODEL XTBW RECEIVING EQUIPMENT
NARROW BAND I.F. AMPLIFIER
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
RATIO OF CARRIER + NOISE VOLTAGE / TONE MOD CARRIER + NOISE VOLTAGE
1.0
SPEC. LIMIT
.10
BAND 1
BAND 2
BAND 3
BAND 4
.01
2000
5000
10,000
20,000
FREQUENCY - KILOCYCLES

PLATE 41



H. F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
WIDE BAND I.F. AMPLIFIER
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTIMORE, MD.

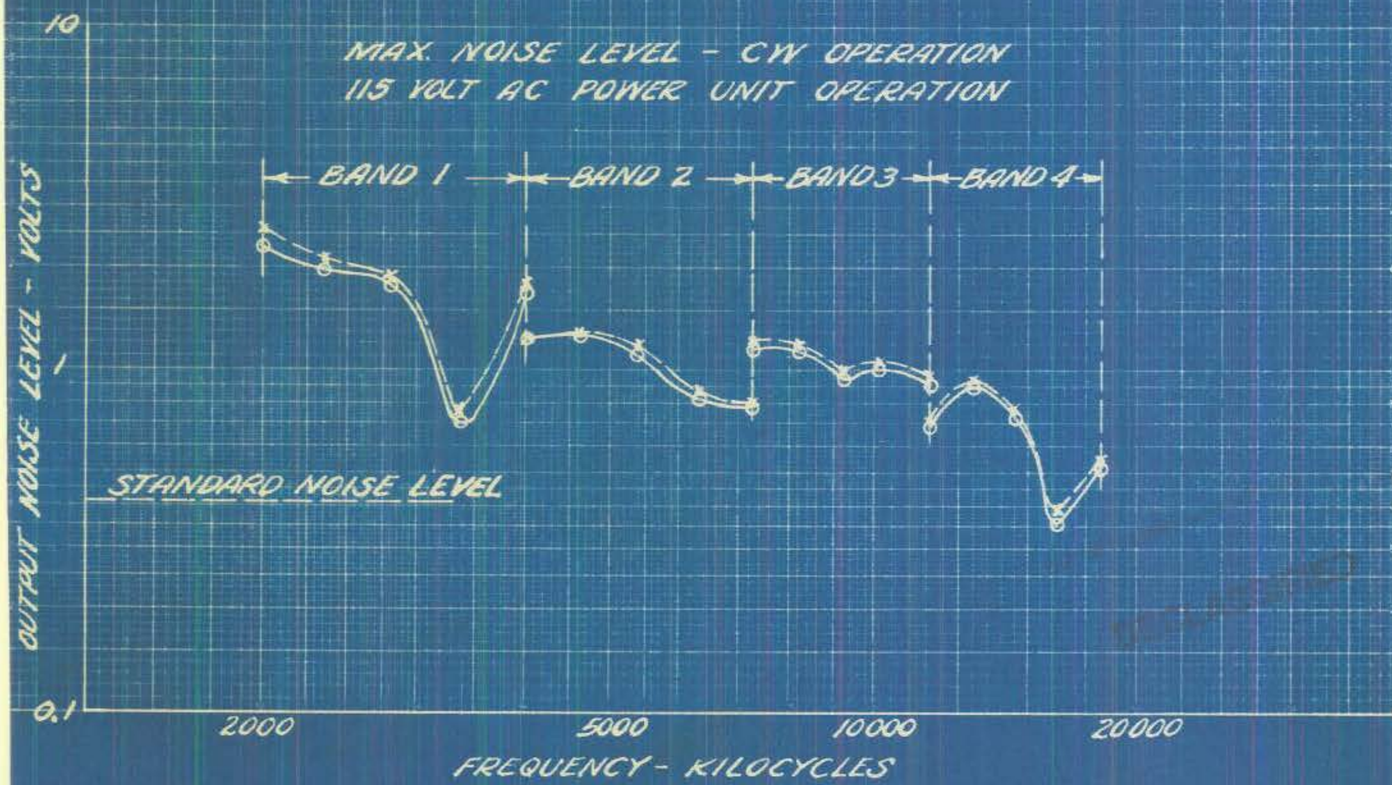
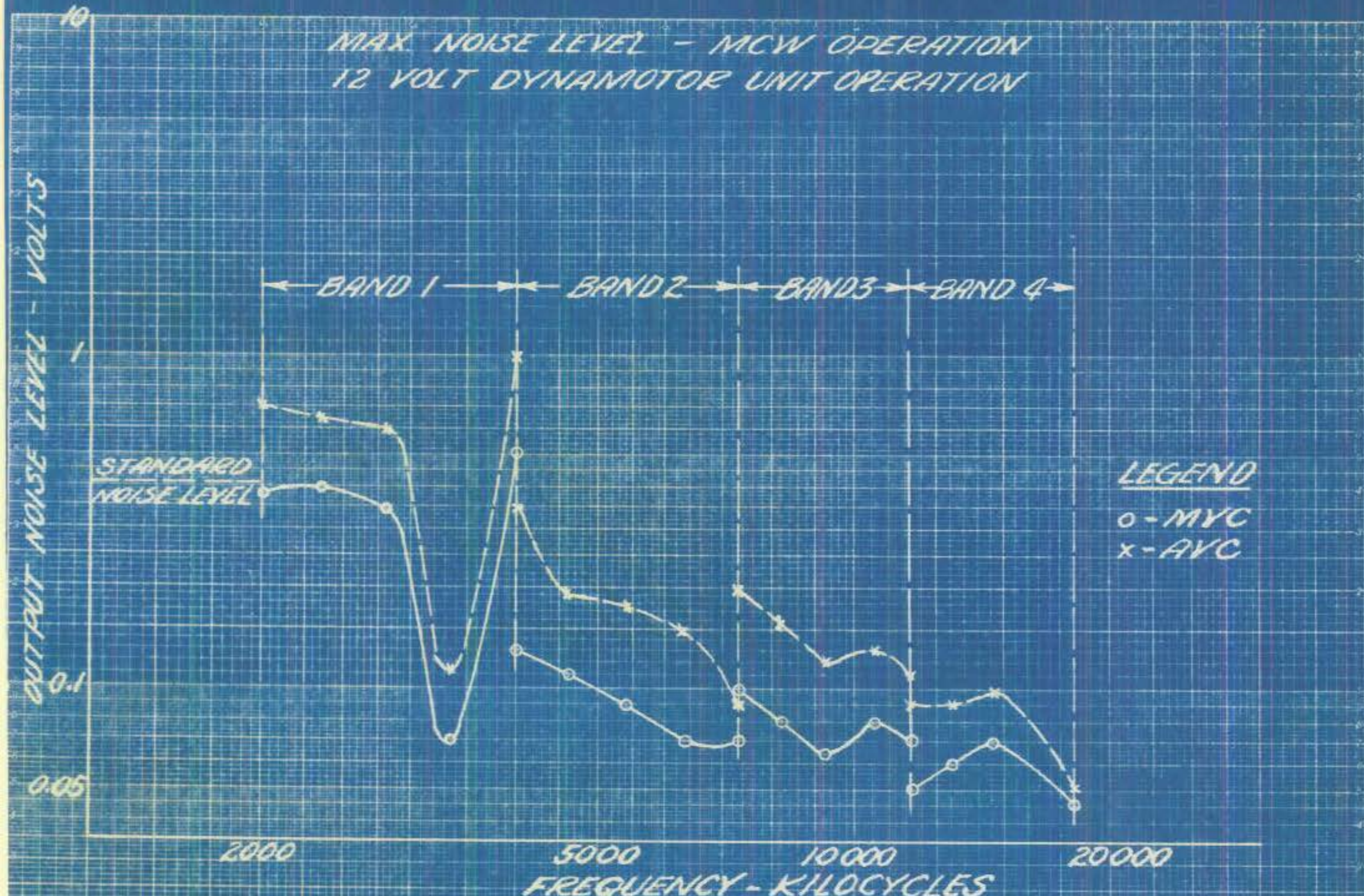


PLATE 42



H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
WIDE BAND I.F AMPLIFIER
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTIMORE, MD.

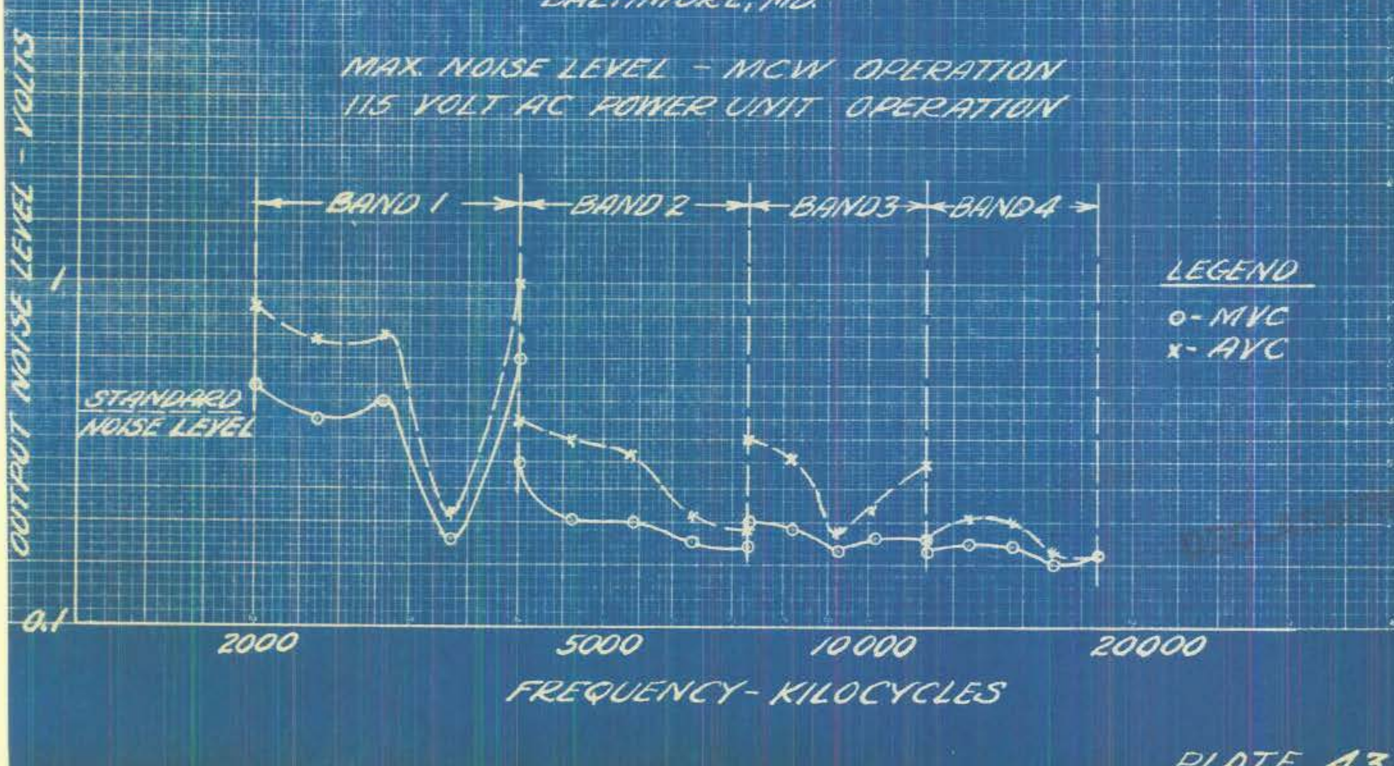
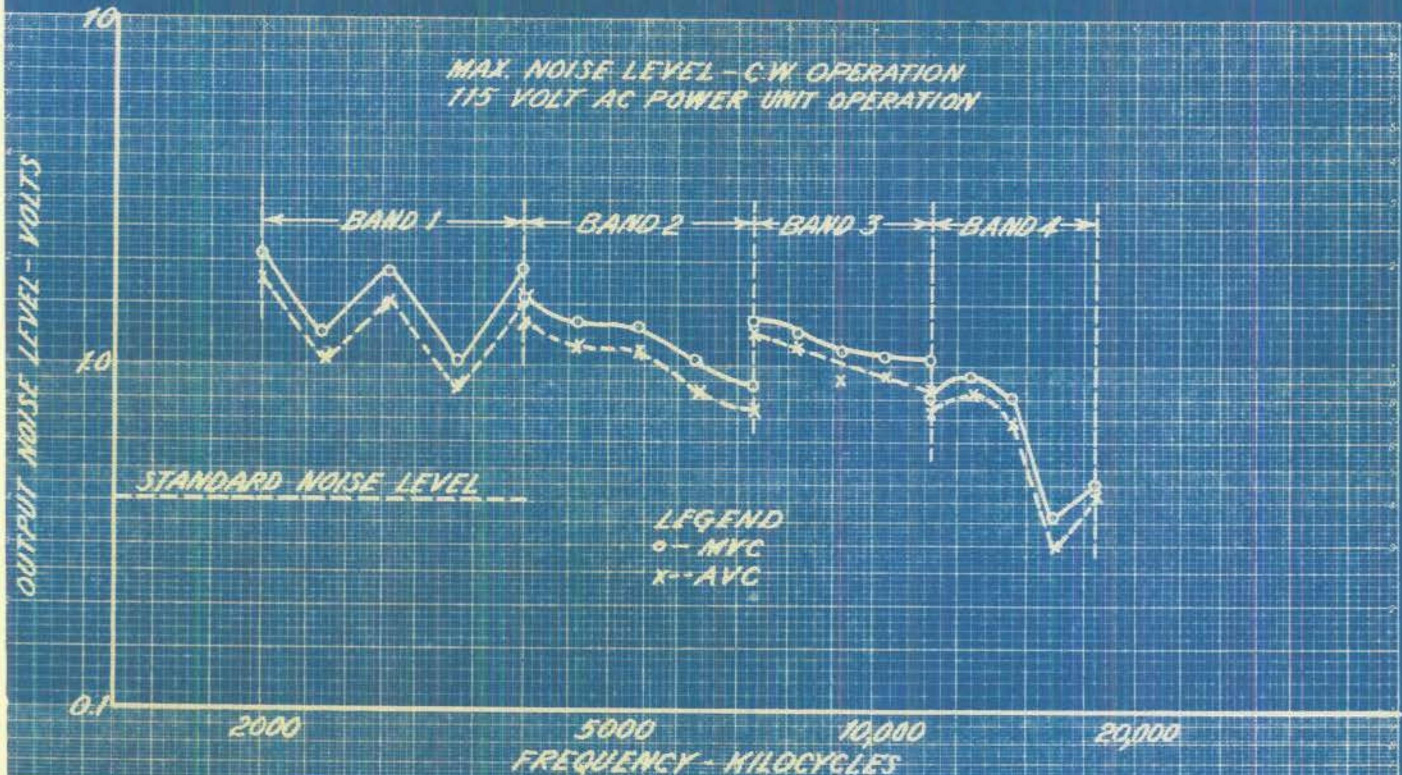


PLATE 43.



HF UNIT OF MODEL XTBW RECEIVING EQUIPMENT
NARROW BAND IF AMPLIFIER
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD

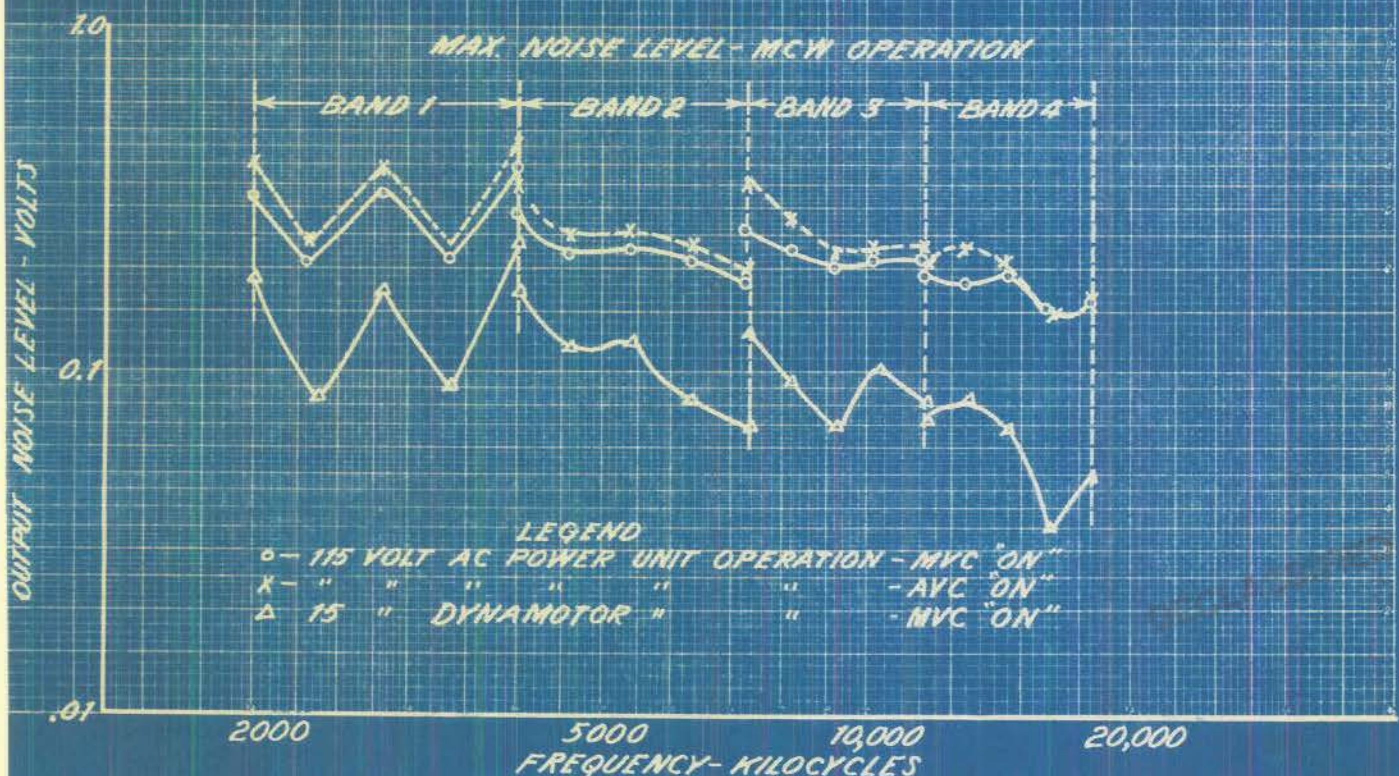
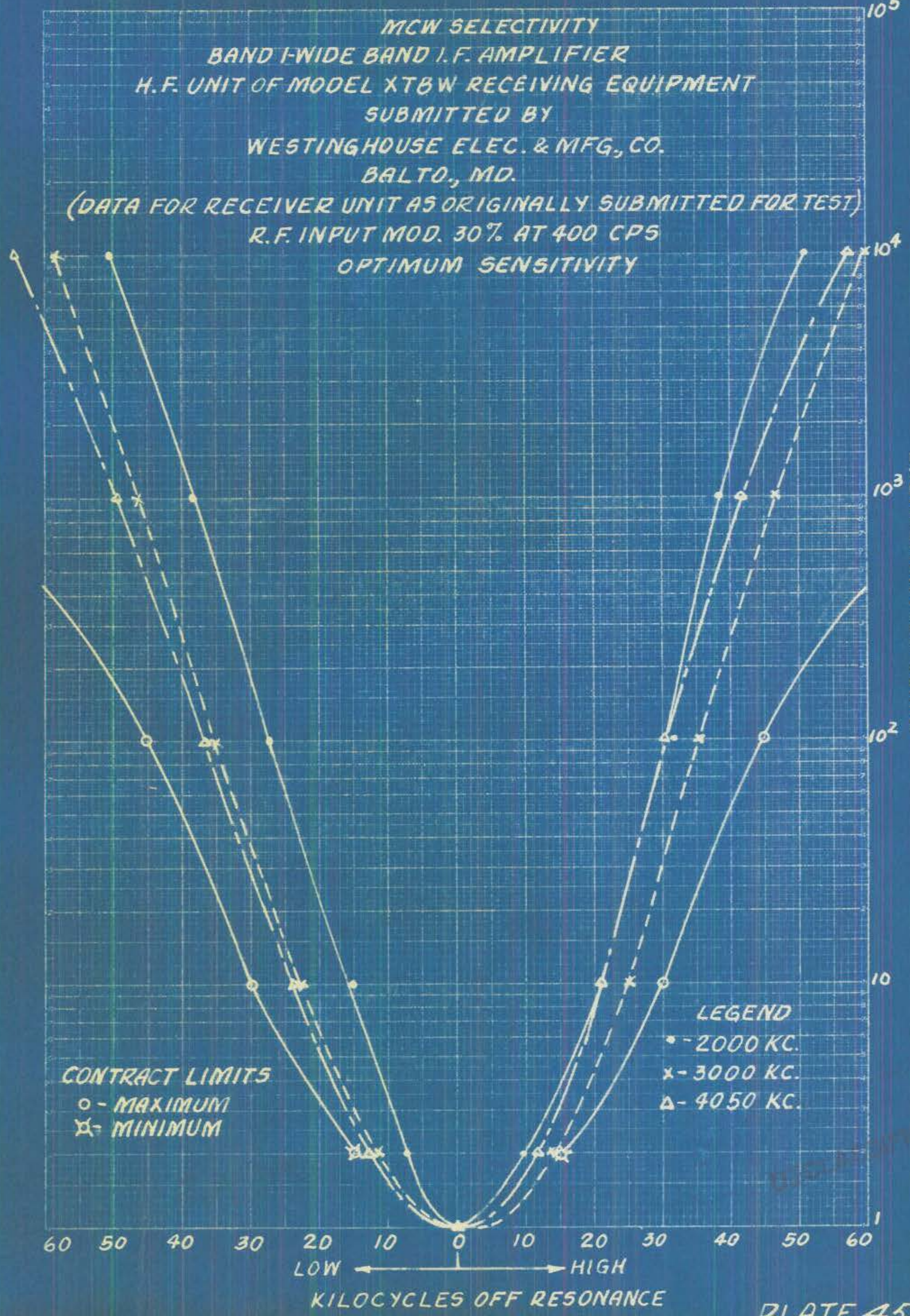


PLATE 44



MCW SELECTIVITY
BAND I-WIDE BAND I.F. AMPLIFIER
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG., CO.
BALTO., MD.
(DATA FOR RECEIVER UNIT AS ORIGINALLY SUBMITTED FOR TEST)
R.F. INPUT MOD. 30% AT 400 CPS
OPTIMUM SENSITIVITY
CONTRACT LIMITS
o - MAXIMUM
MINIMUM
LEGEND
• - 2000 KC.
x - 3000 KC.
Δ - 4050 KC.
TIMES RESONANT INPUT
10^5
10^4
10^3
10^2
10
1
60 50 40 30 20 10 0 10 20 30 40 50 60
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE 45

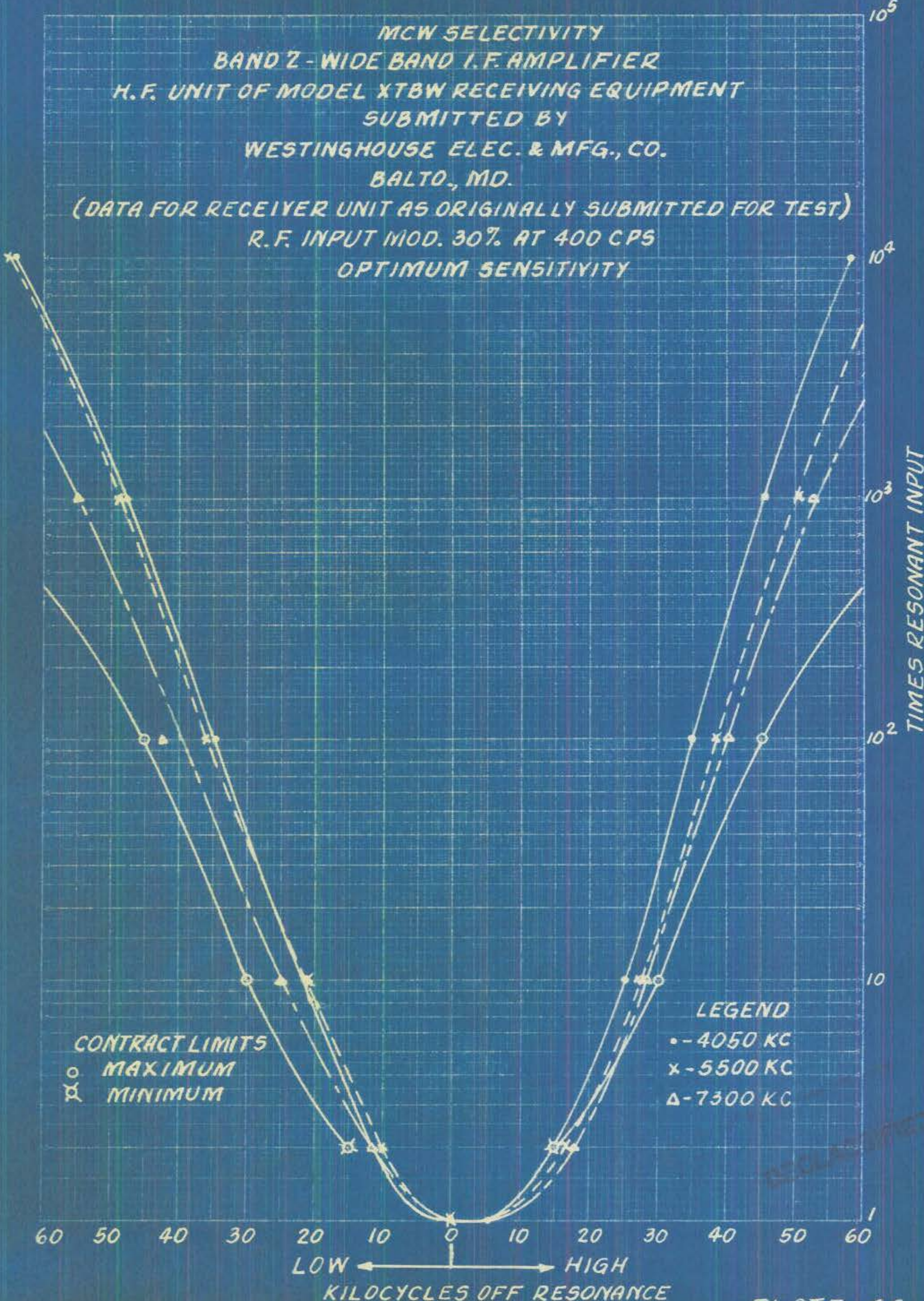

MCW SELECTIVITY
BAND 2 - WIDE BAND I.F. AMPLIFIER
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG., CO.
BALTO., MD.
(DATA FOR RECEIVER UNIT AS ORIGINALLY SUBMITTED FOR TEST)
R.F. INPUT MOD. 30% AT 400 CPS
OPTIMUM SENSITIVITY
CONTRACT LIMITS
o MAXIMUM
MINIMUM
LEGEND
• - 4050 KC
x - 5500 KC
Δ - 7300 KC
TIMES RESONANT INPUT
KILOCYCLES OFF RESONANCE
LOW
HIGH

PLATE 46

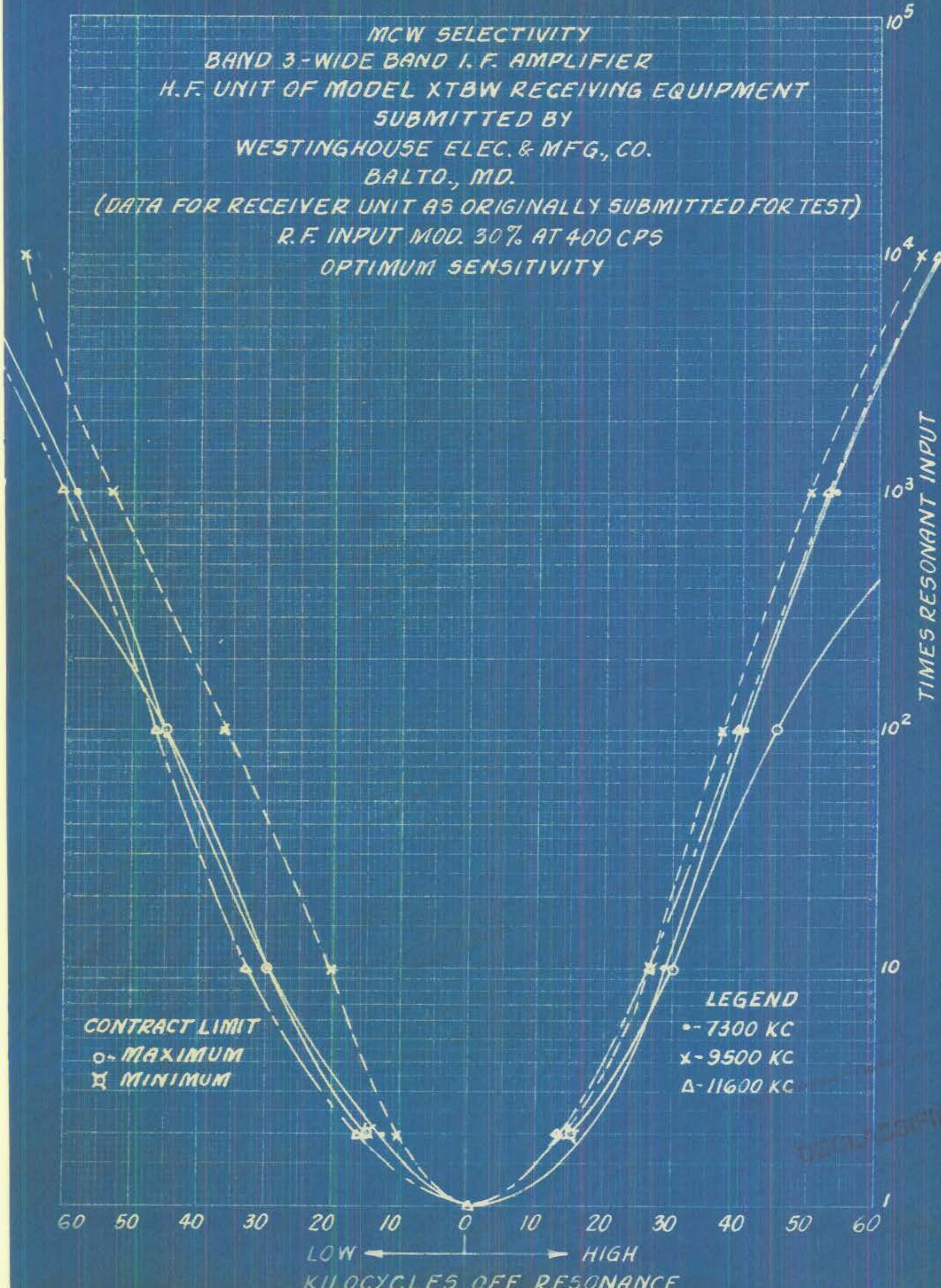
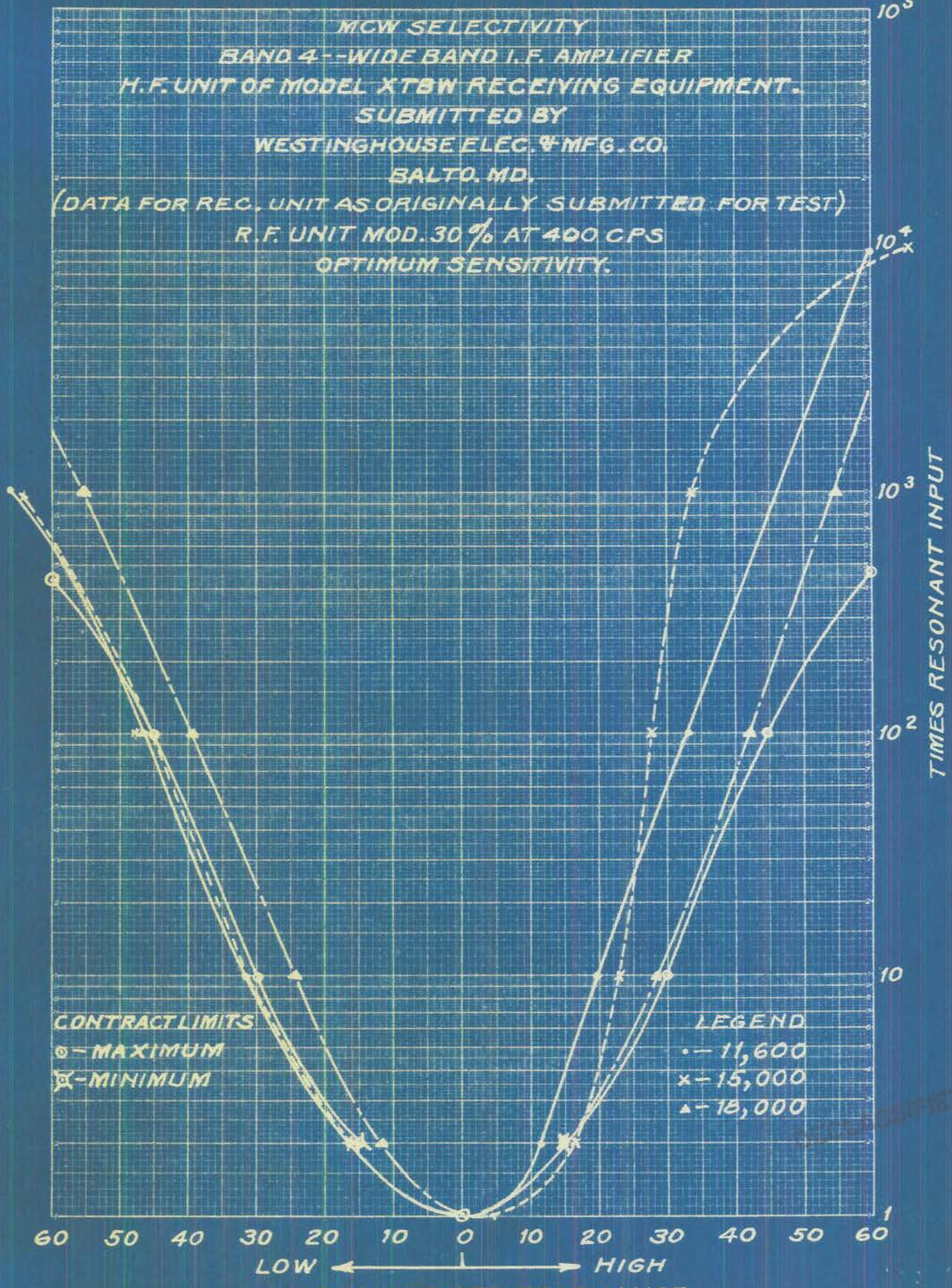

MCW SELECTIVITY
BAND 3 - WIDE BAND I. F. AMPLIFIER
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG., CO.
BALTO., MD.
(DATA FOR RECEIVER UNIT AS ORIGINALLY SUBMITTED FOR TEST)
R.F. INPUT MOD. 30% AT 400 CPS
OPTIMUM SENSITIVITY
CONTRACT LIMIT
o - MAXIMUM
MINIMUM
LEGEND
• - 7300 KC
x - 9500 KC
Δ - 11600 KC
TIMES RESONANT INPUT
10^5
10^4
10^3
10^2
10
1
60 50 40 30 20 10 0 10 20 30 40 50 60
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE 47



MCW SELECTIVITY
BAND 4--WIDE BAND I.F. AMPLIFIER
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT.
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
(DATA FOR REC. UNIT AS ORIGINALLY SUBMITTED FOR TEST)
R.F. UNIT MOD. 30 % AT 400 CPS
OPTIMUM SENSITIVITY.
CONTRACT LIMITS
⊙-MAXIMUM
⊠-MINIMUM
LEGEND
•-11,600
×-15,000
▲-18,000
10^5
10^4
10^3
10^2
10
1
TIMES RESONANT INPUT
60 50 40 30 20 10 0 10 20 30 40 50 60
LOW ← → HIGH
KILOCYCLES OFF RESONANCE

PLATE 48

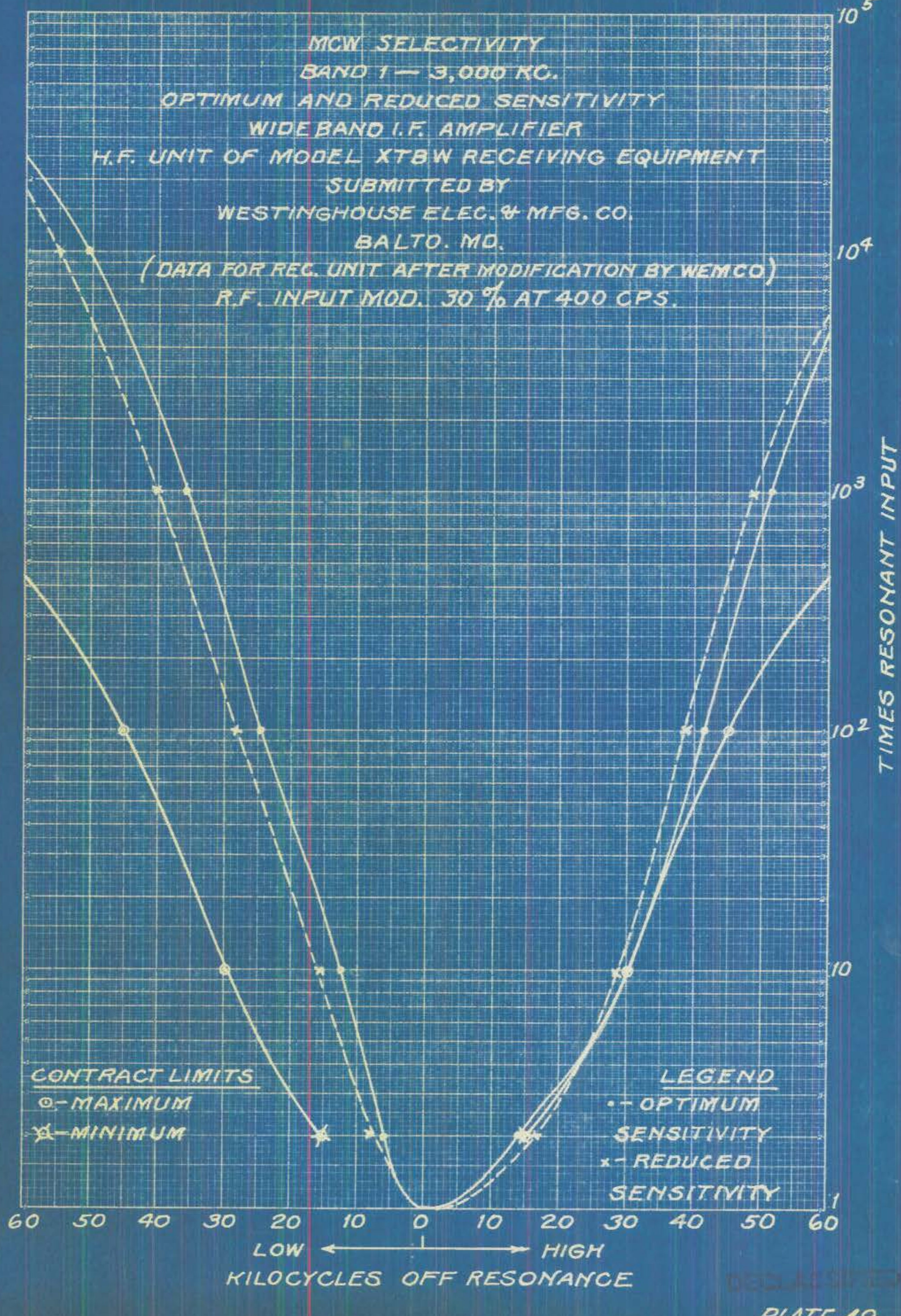

MCW SELECTIVITY
BAND 1 — 3,000 KC.
OPTIMUM AND REDUCED SENSITIVITY
WIDE BAND I.F. AMPLIFIER
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
(DATA FOR REC. UNIT AFTER MODIFICATION BY WEMCO)
R.F. INPUT MOD. 30 % AT 400 CPS.
CONTRACT LIMITS
⊙ - MAXIMUM
⊗ - MINIMUM
LEGEND
• - OPTIMUM SENSITIVITY
x - REDUCED SENSITIVITY
TIMES RESONANT INPUT
10^5
10^4
10^3
10^2
10
1
60 50 40 30 20 10 0 10 20 30 40 50 60
LOW ← → HIGH
KILOCYCLES OFF RESONANCE

PLATE 49

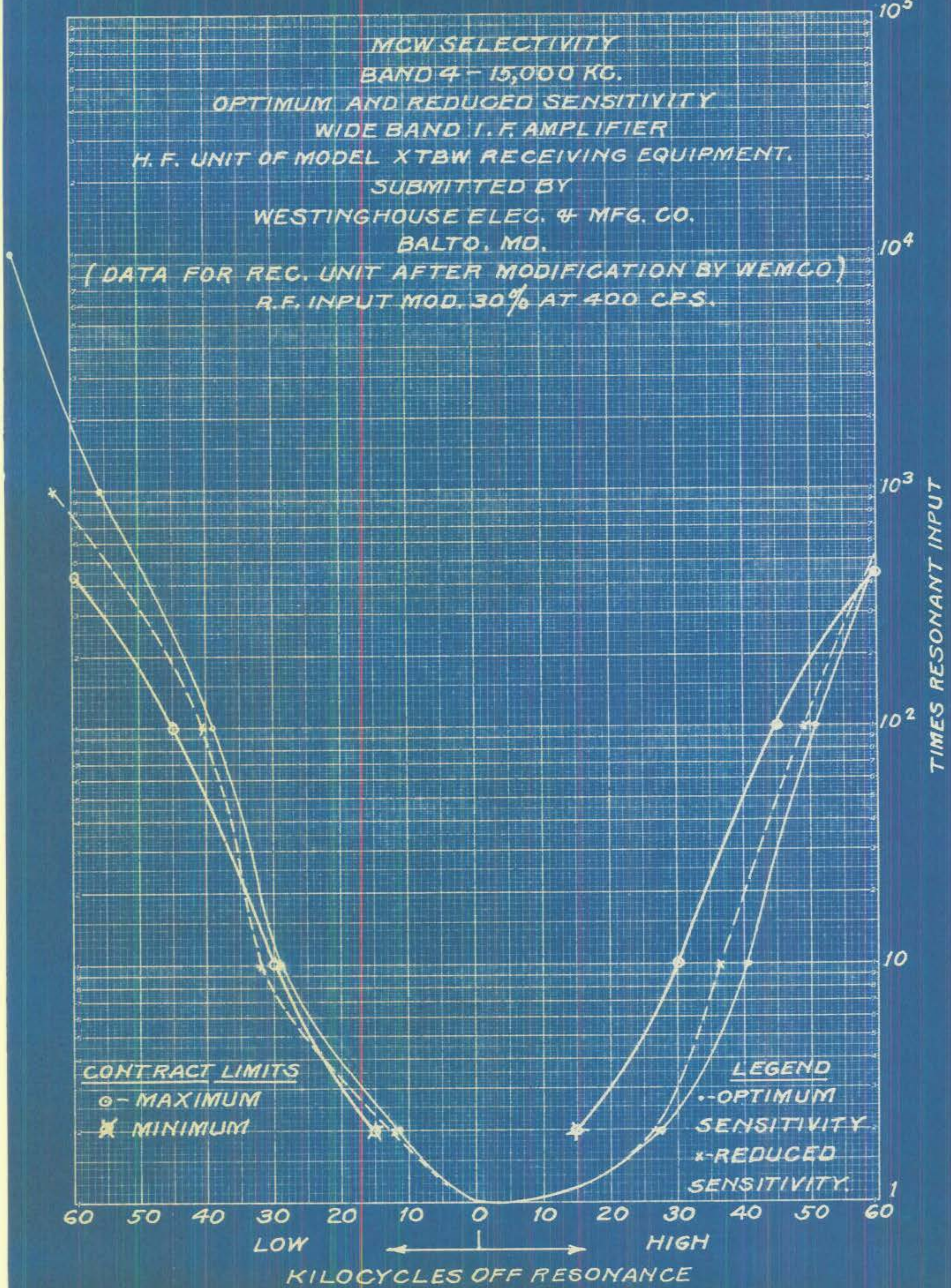

MCW SELECTIVITY
BAND 4 - 15,000 KC.
OPTIMUM AND REDUCED SENSITIVITY
WIDE BAND I. F. AMPLIFIER
H. F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT.
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
(DATA FOR REC. UNIT AFTER MODIFICATION BY WEMCO)
R.F. INPUT MOD. 30% AT 400 CPS.
CONTRACT LIMITS
⊙ - MAXIMUM
✕ MINIMUM
LEGEND
•-OPTIMUM SENSITIVITY
x-REDUCED SENSITIVITY.
TIMES RESONANT INPUT
10^5
10^4
10^3
10^2
10
1
60 50 40 30 20 10 0 10 20 30 40 50 60
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE 50

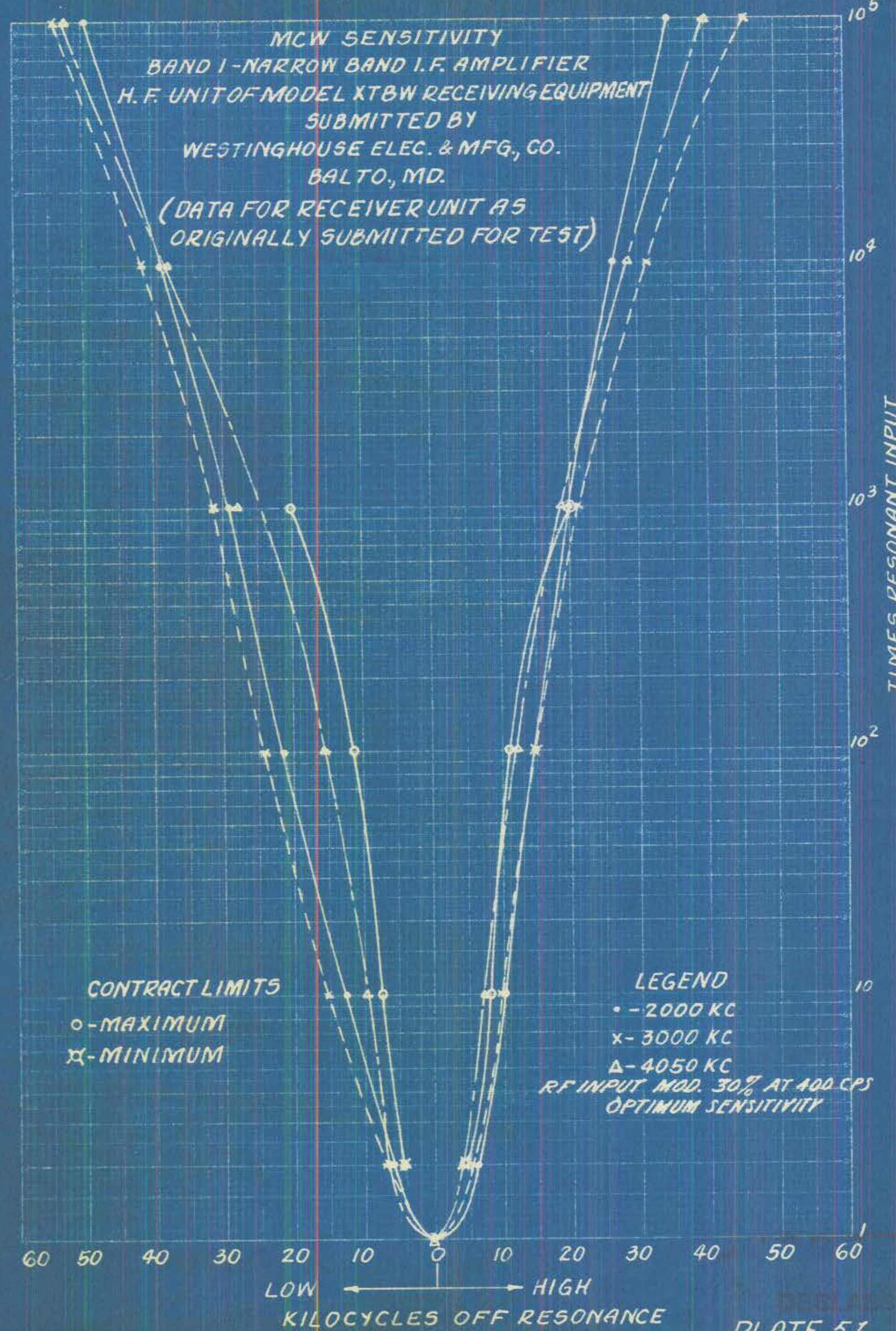

MCW SENSITIVITY
BAND I - NARROW BAND I.F. AMPLIFIER
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG., CO.
BALTO., MD.
(DATA FOR RECEIVER UNIT AS
ORIGINALLY SUBMITTED FOR TEST)
CONTRACT LIMITS
o - MAXIMUM
¤ - MINIMUM
LEGEND
• - 2000 KC
x - 3000 KC
Δ - 4050 KC
RF INPUT MOD. 30% AT 400 CPS
OPTIMUM SENSITIVITY
TIMES RESONANT INPUT
10^5
10^4
10^3
10^2
10
1
60 50 40 30 20 10 0 10 20 30 40 50 60
LOW ← → HIGH
KILOCYCLES OFF RESONANCE

PLATE 51

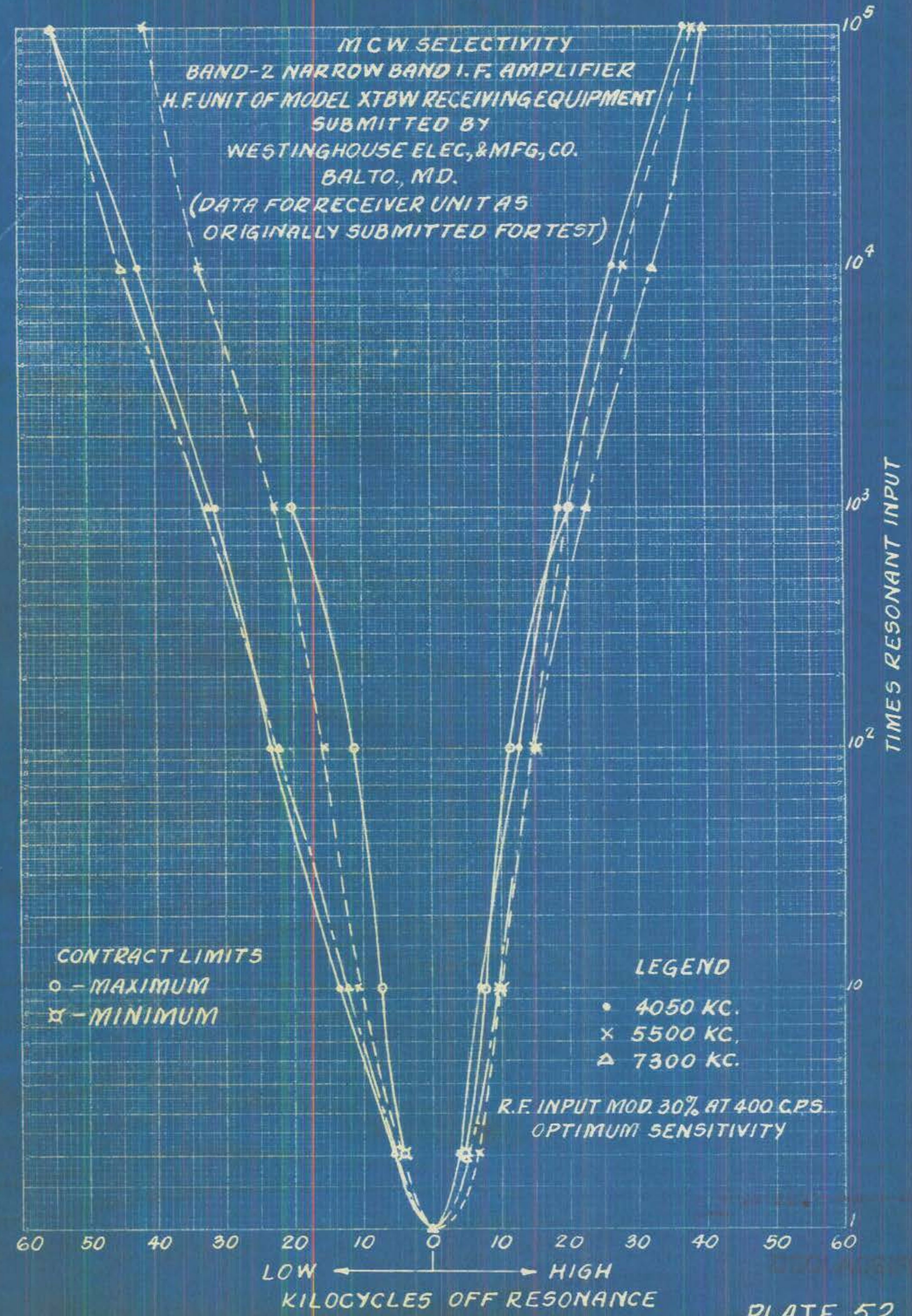
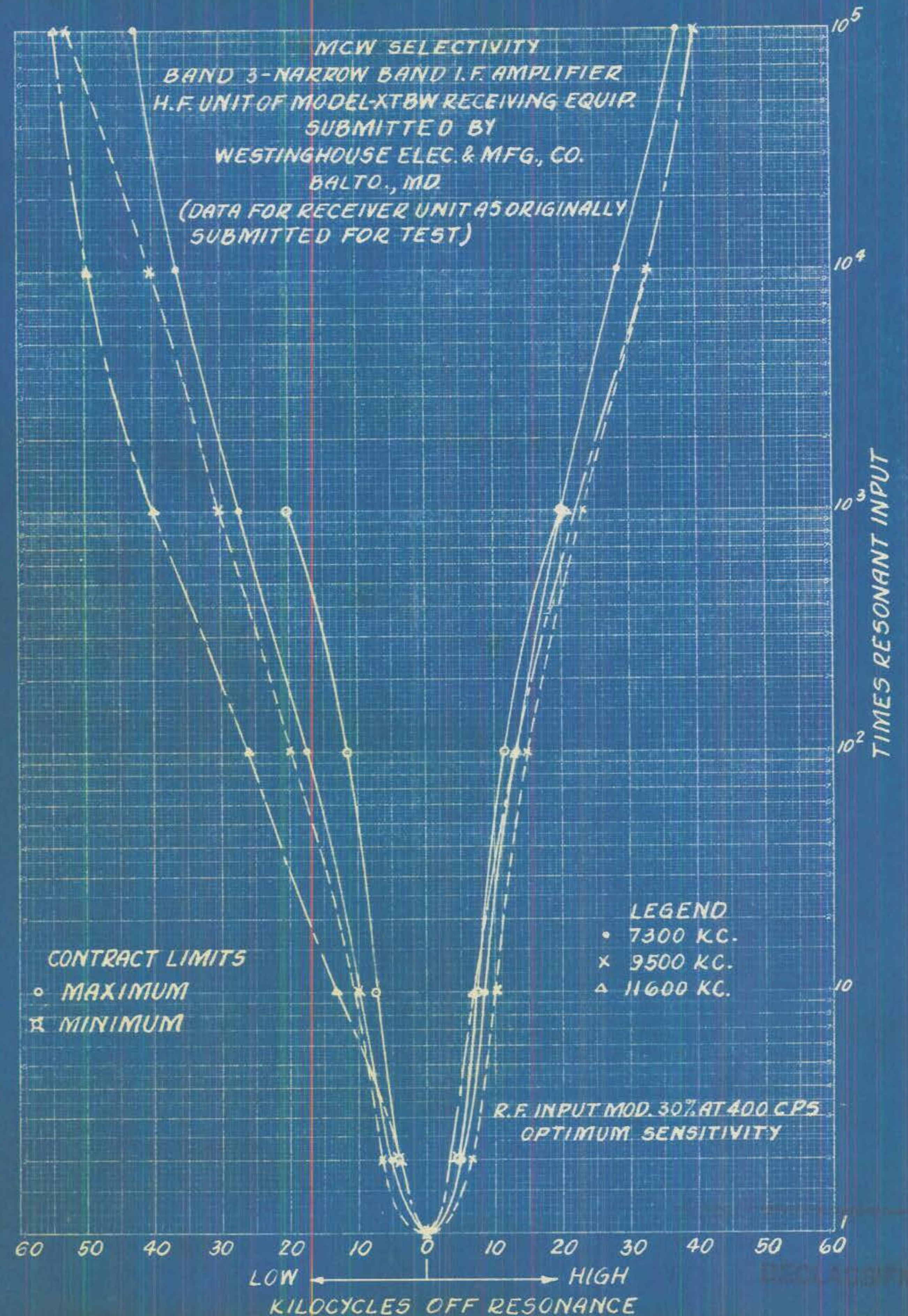

MCW SELECTIVITY
BAND-2 NARROW BAND I.F. AMPLIFIER
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC, & MFG, CO.
BALTO., MD.
(DATA FOR RECEIVER UNIT AS
ORIGINALLY SUBMITTED FOR TEST)
CONTRACT LIMITS
○ - MAXIMUM
☆ - MINIMUM
LEGEND
• 4050 KC.
× 5500 KC.
△ 7300 KC.
R.F. INPUT MOD. 30% AT 400 C.P.S.
OPTIMUM SENSITIVITY
TIMES RESONANT INPUT
10⁵
10⁴
10³
10²
10
1
60 50 40 30 20 10 0 10 20 30 40 50 60
LOW ← → HIGH
KILOCYCLES OFF RESONANCE

PLATE 52



MCW SELECTIVITY
BAND 3-NARROW BAND I.F. AMPLIFIER
H.F. UNIT OF MODEL-XTBW RECEIVING EQUIP.
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG., CO.
BALTO., MD.
(DATA FOR RECEIVER UNIT AS ORIGINALLY
SUBMITTED FOR TEST)
LEGEND
• 7300 KC.
× 9500 KC.
△ 11600 KC.
CONTRACT LIMITS
○ MAXIMUM
⌑ MINIMUM
R.F. INPUT MOD. 30% AT 400 CPS
OPTIMUM SENSITIVITY
TIMES RESONANT INPUT
10^5
10^4
10^3
10^2
10
1
60 50 40 30 20 10 0 10 20 30 40 50 60
LOW ← → HIGH
KILOCYCLES OFF RESONANCE

PLATE 53

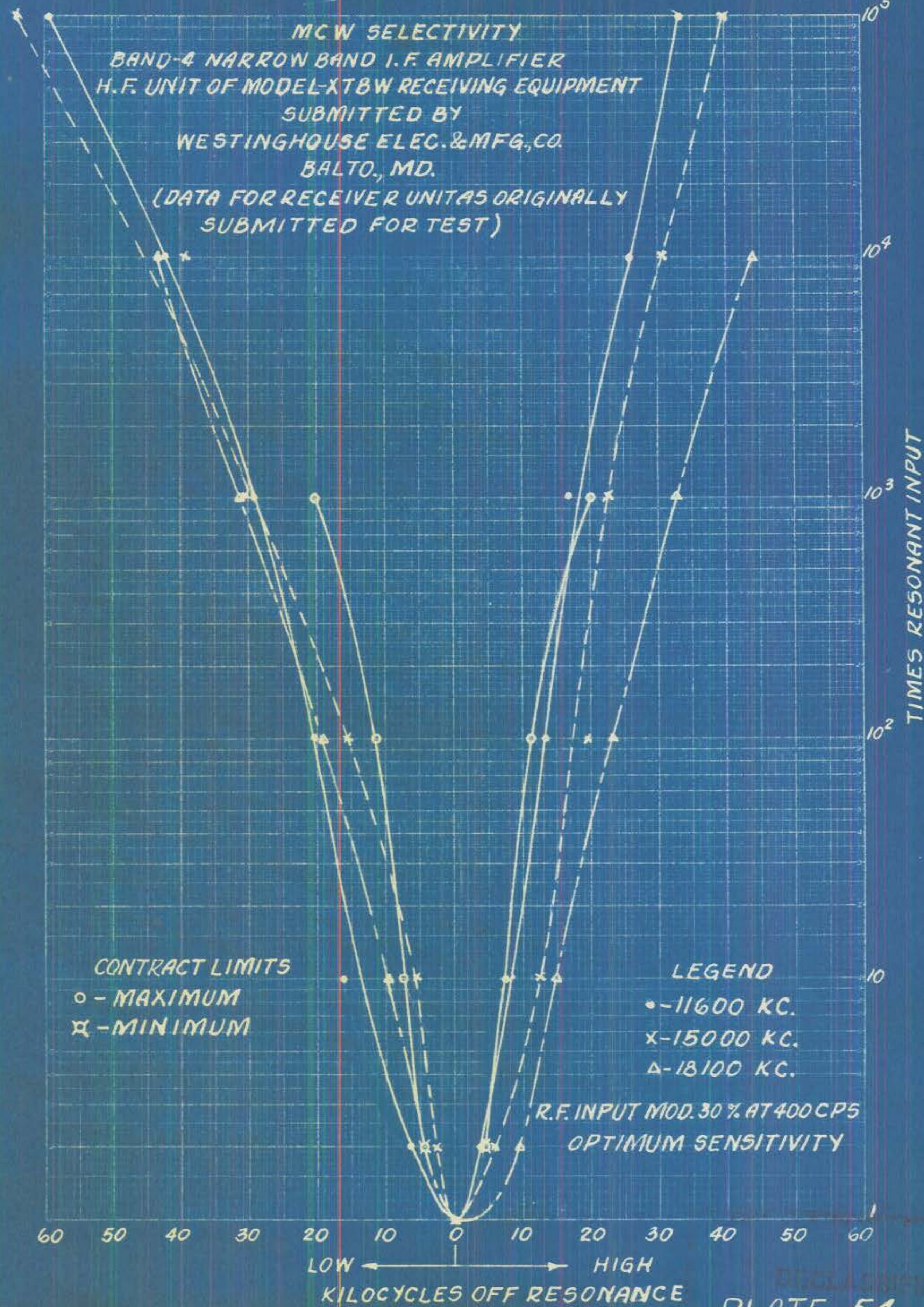

MCW SELECTIVITY
BAND-4 NARROW BAND I.F. AMPLIFIER
H.F. UNIT OF MODEL-XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO., MD.
(DATA FOR RECEIVER UNIT AS ORIGINALLY
SUBMITTED FOR TEST)
CONTRACT LIMITS
o - MAXIMUM
¤ - MINIMUM
LEGEND
• - 11600 KC.
x - 15000 KC.
Δ - 18100 KC.
R.F. INPUT MOD. 30 % AT 400 CPS
OPTIMUM SENSITIVITY
TIMES RESONANT INPUT
10^5
10^4
10^3
10^2
10
60 50 40 30 20 10 0 10 20 30 40 50 60
LOW
HIGH
KILOCYCLES OFF RESONANCE

PLATE 54

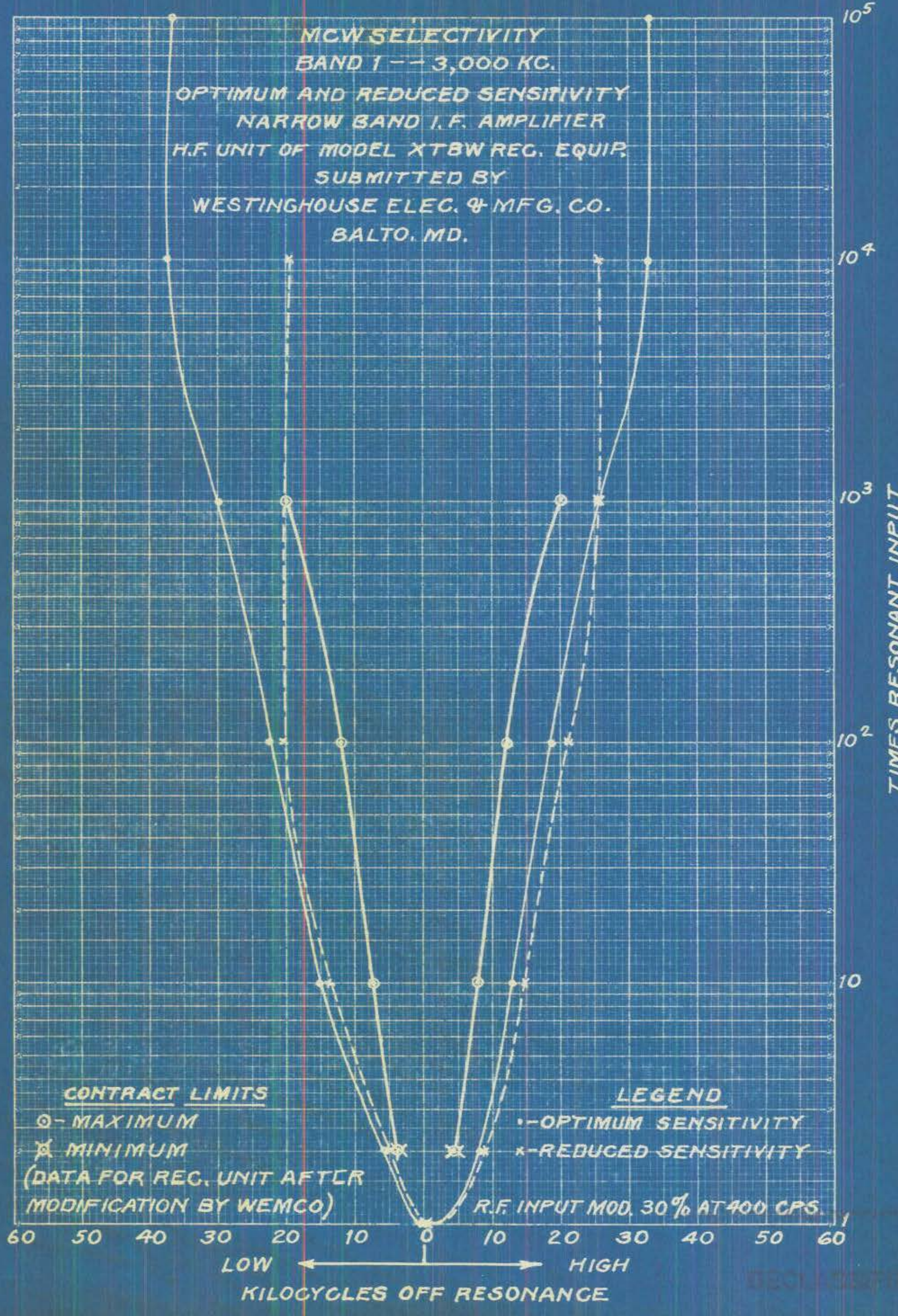

MCW SELECTIVITY
BAND 1 -- 3,000 KC.
OPTIMUM AND REDUCED SENSITIVITY
NARROW BAND I.F. AMPLIFIER
H.F. UNIT OF MODEL XTBW REC. EQUIP.
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
CONTRACT LIMITS
⊙- MAXIMUM
⊠ MINIMUM
(DATA FOR REC. UNIT AFTER
MODIFICATION BY WEMCO)
LEGEND
•-OPTIMUM SENSITIVITY
×-REDUCED SENSITIVITY
R.F. INPUT MOD. 30% AT 400 CPS.
60 50 40 30 20 10 0 10 20 30 40 50 60
LOW
HIGH
KILOCYCLES OFF RESONANCE
1
10
10²
10³
10⁴
10⁵
TIMES RESONANT INPUT

PLATE 55

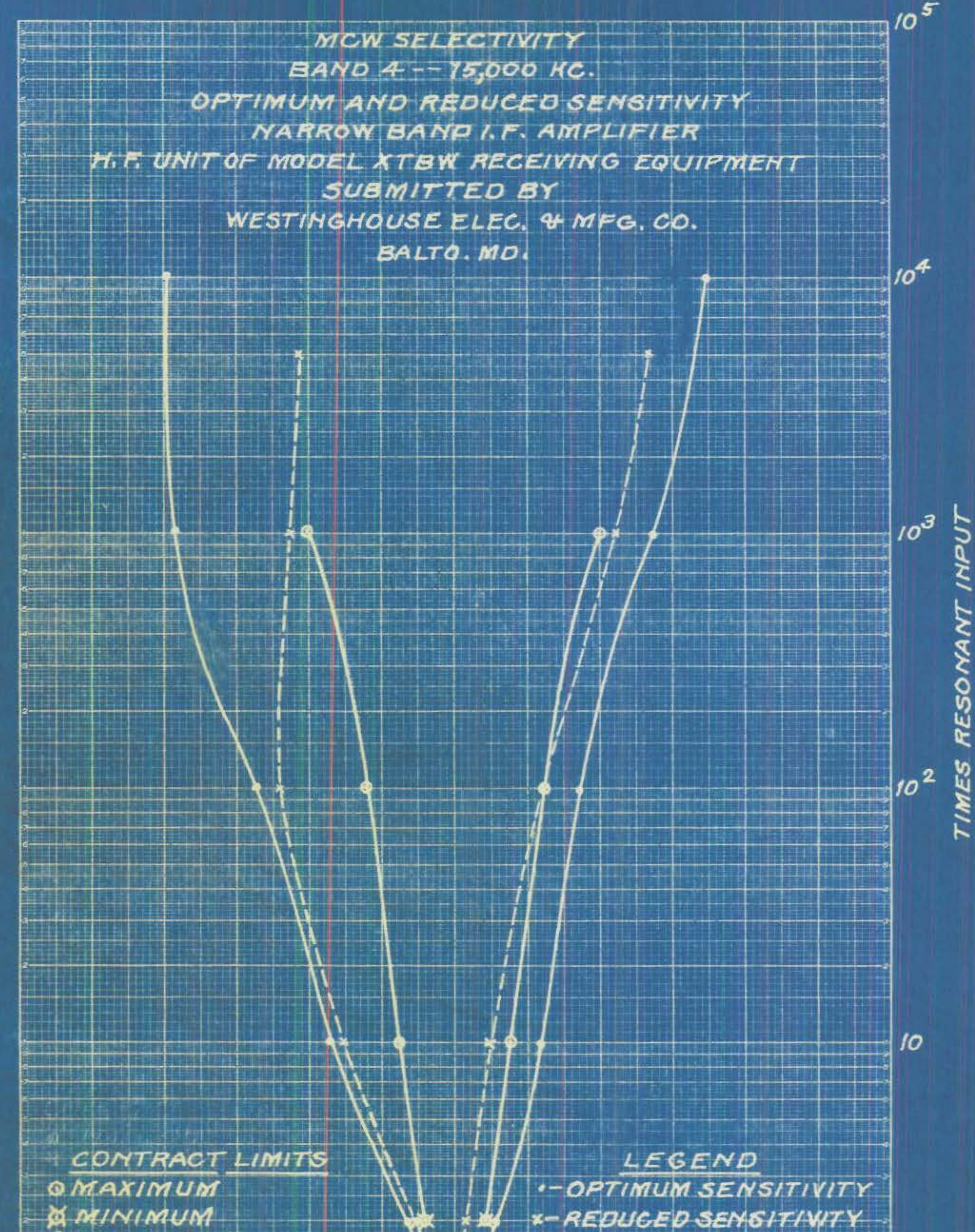

MCW SELECTIVITY
BAND 4 -- 15,000 KC.
OPTIMUM AND REDUCED SENSITIVITY
NARROW BAND I.F. AMPLIFIER
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
CONTRACT LIMITS
MAXIMUM
MINIMUM
(DATA FOR REC. UNIT AFTER
MODIFICATION BY WEMCO)
LEGEND
•- OPTIMUM SENSITIVITY
x- REDUCED SENSITIVITY
R.F. INPUT MOD. 30% AT 400 CPS.
60 50 40 30 20 10 0 10 20 30 40 50 60
LOW
HIGH
KILOCYCLES OFF RESONANCE
TIMES RESONANT INPUT
1
10
10^2
10^3
10^4
10^5

PLATE 56

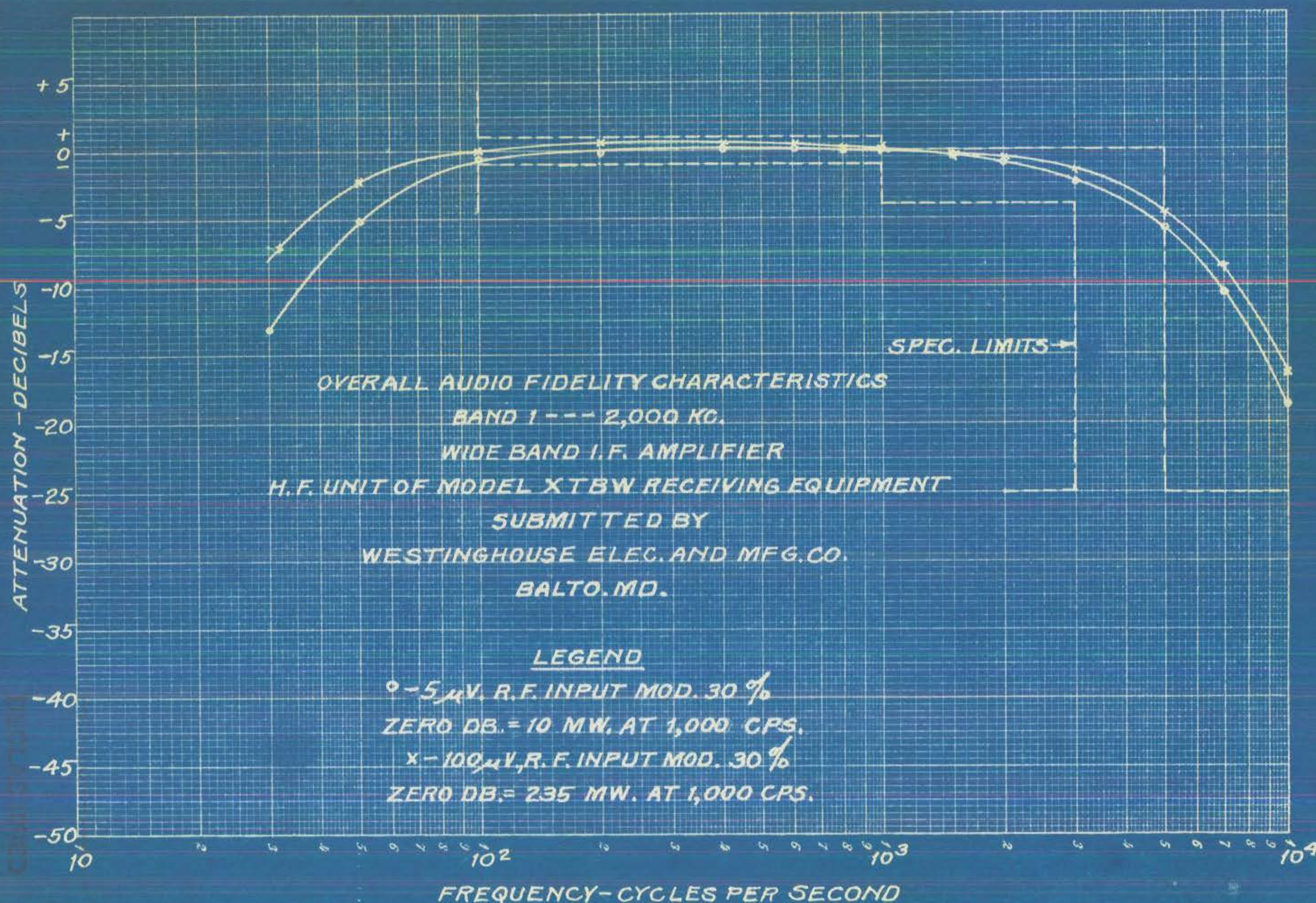
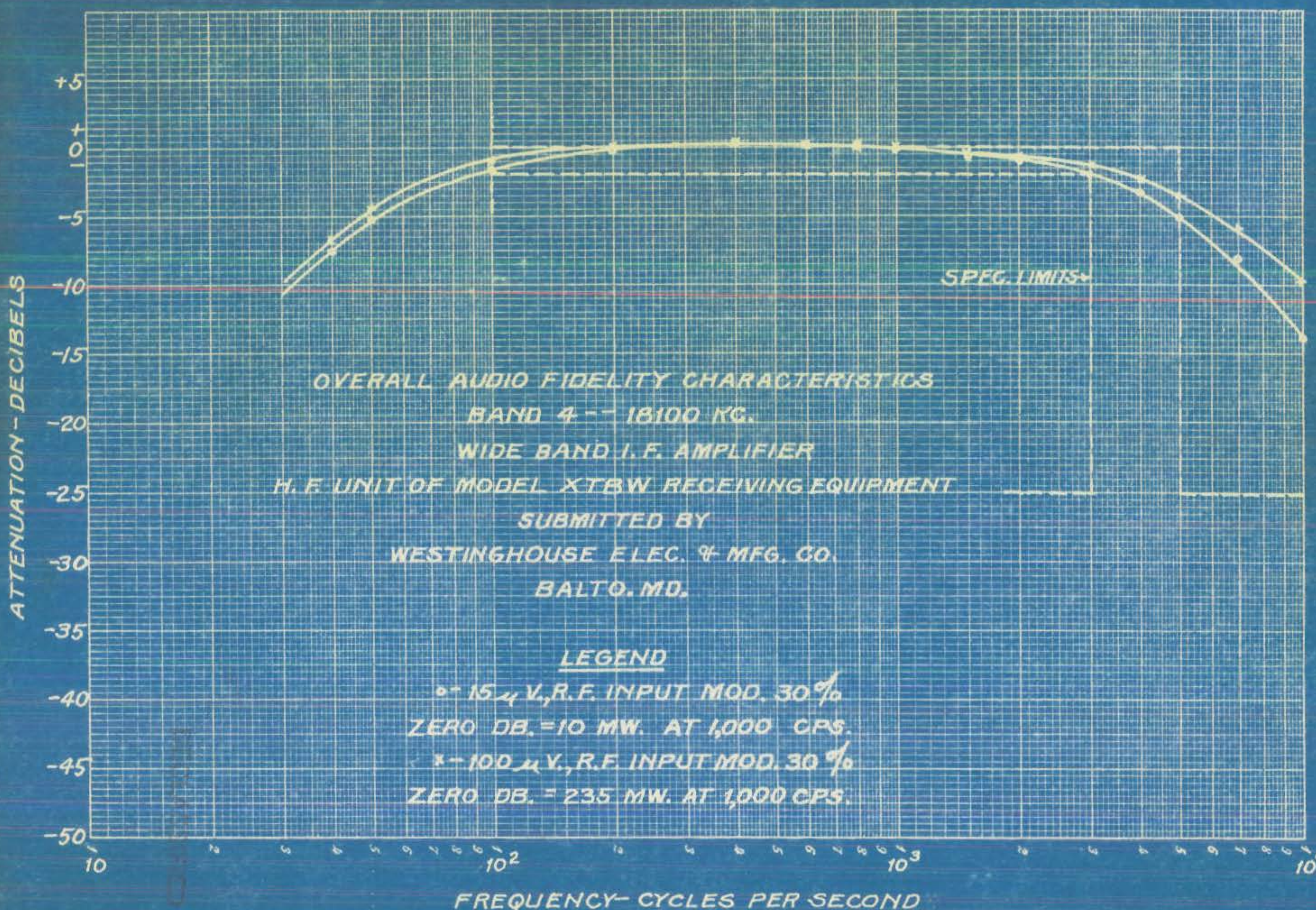

OVERALL AUDIO FIDELITY CHARACTERISTICS
BAND 1 --- 2,000 KC.
WIDE BAND I.F. AMPLIFIER
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. AND MFG. CO.
BALTO. MD.
LEGEND
o - 5 μV. R.F. INPUT MOD. 30 %
ZERO DB. = 10 MW. AT 1,000 CPS.
x - 100 μV, R.F. INPUT MOD. 30 %
ZERO DB. = 235 MW. AT 1,000 CPS.
SPEC. LIMITS
ATTENUATION - DECIBELS
+5
+0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
10
10^2
10^3
10^4
FREQUENCY - CYCLES PER SECOND

PLATE 57



OVERALL AUDIO FIDELITY CHARACTERISTICS
BAND 4 -- 18100 KC.
WIDE BAND I. F. AMPLIFIER
H. F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
LEGEND
o - 15 μV., R.F. INPUT MOD. 30 %
ZERO DB. = 10 MW. AT 1,000 CPS.
x - 100 μV., R.F. INPUT MOD. 30 %
ZERO DB. = 235 MW. AT 1,000 CPS.
SPEC. LIMITS
ATTENUATION - DECIBELS
+5
+
0
-
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
10
10^2
10^3
10^4
FREQUENCY- CYCLES PER SECOND

PLATE 58

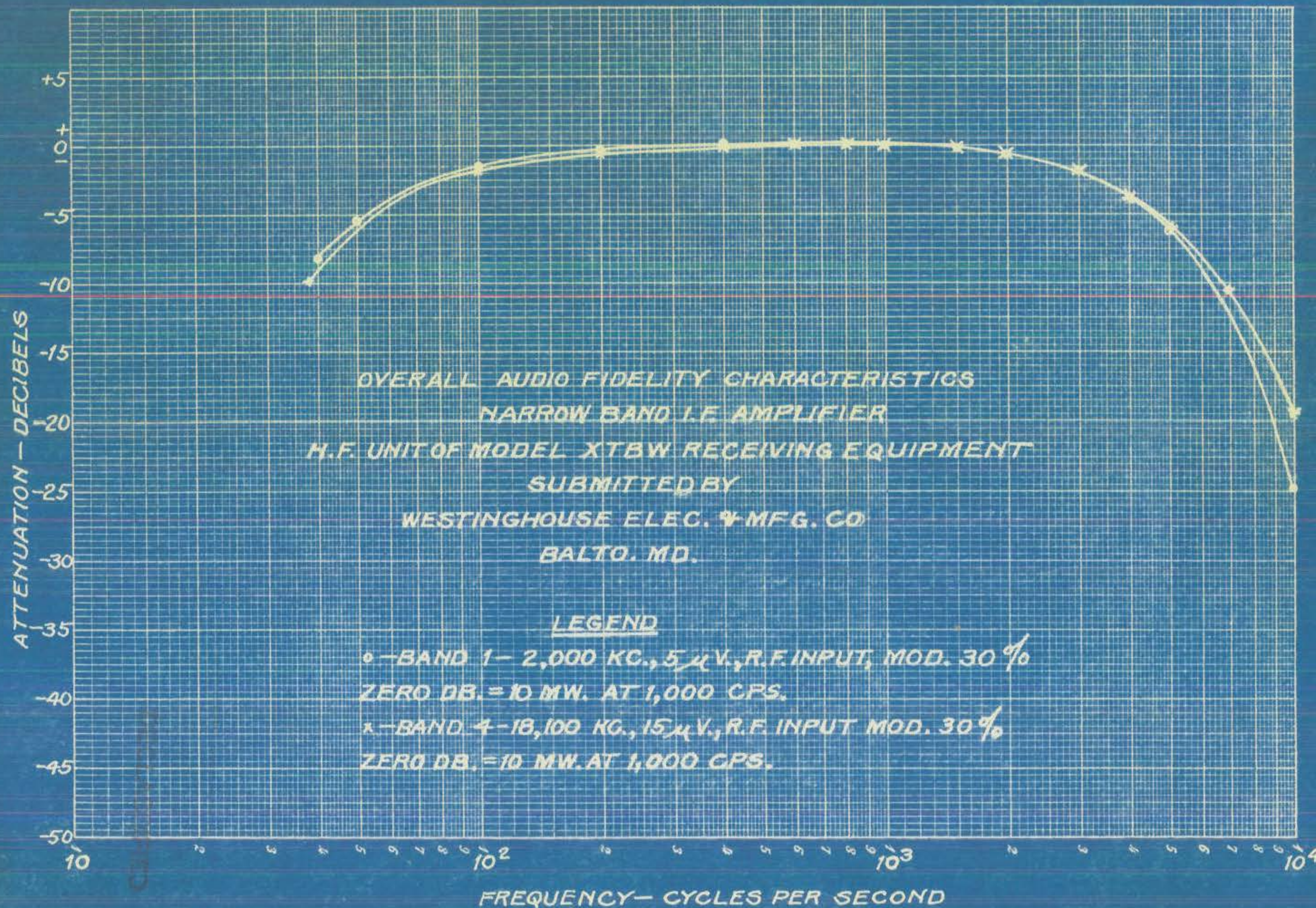

OVERALL AUDIO FIDELITY CHARACTERISTICS
NARROW BAND I.F. AMPLIFIER
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO
BALTO. MD.
LEGEND
o – BAND 1 – 2,000 KC., 5 μV., R.F. INPUT, MOD. 30 %
ZERO DB. = 10 MW. AT 1,000 CPS.
x – BAND 4 – 18,100 KC., 15 μV., R.F. INPUT MOD. 30 %
ZERO DB. = 10 MW. AT 1,000 CPS.
ATTENUATION – DECIBELS
+5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
10
10^2
10^3
10^4
FREQUENCY – CYCLES PER SECOND

PLATE 59

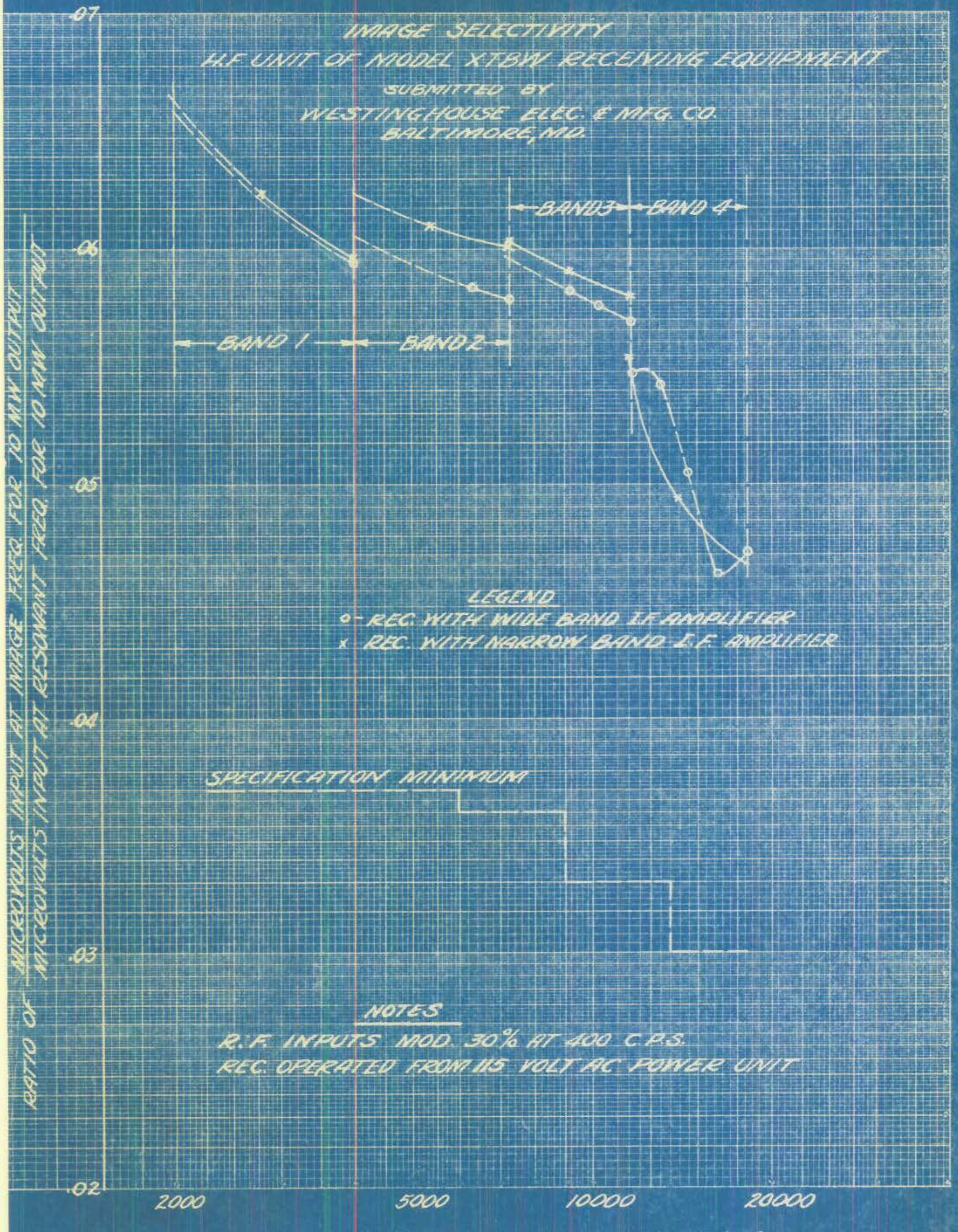


IMAGE SELECTIVITY
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTIMORE, MD.
BAND 1
BAND 2
BAND 3
BAND 4
LEGEND
o - REC. WITH WIDE BAND I.F. AMPLIFIER
x REC. WITH NARROW BAND I.F. AMPLIFIER
SPECIFICATION MINIMUM
NOTES
R.F. INPUTS MOD. 30% AT 400 C.P.S.
REC. OPERATED FROM 115 VOLT AC POWER UNIT
.07
.06
.05
.04
.03
.02
RATIO OF MICROVOLTS INPUT AT IMAGE FREQ. FOR 10 MW OUTPUT / MICROVOLTS INPUT AT RESONANT FREQ. FOR 10 MW OUTPUT
2000
5000
10000
20000
RESONANT FREQUENCY - KILOCYCLES

PLATE 69.

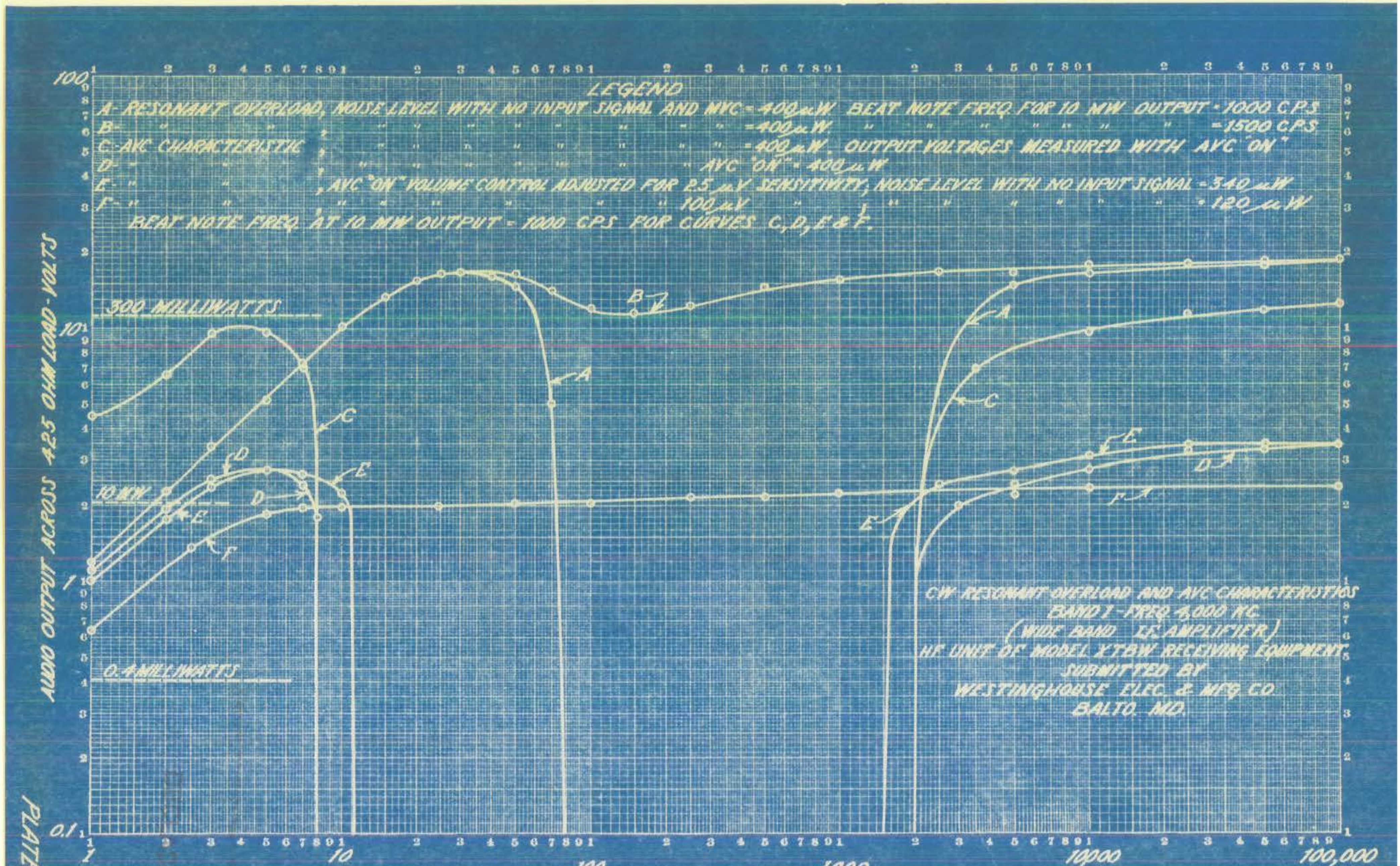

LEGEND
A- RESONANT OVERLOAD, NOISE LEVEL WITH NO INPUT SIGNAL AND MVC = 400 μW BEAT NOTE FREQ. FOR 10 MW OUTPUT = 1000 C.P.S.
B- " " " " " " " " " " = 400 μW " " " " " " " = 1500 C.P.S.
C- AVC CHARACTERISTIC ; " " " " " " " " = 400 μW. OUTPUT VOLTAGES MEASURED WITH AVC "ON"
D- " " ; " " " " " " " AVC "ON" = 400 μW
E- " " ; AVC "ON" VOLUME CONTROL ADJUSTED FOR 2.5 μV SENSITIVITY, NOISE LEVEL WITH NO INPUT SIGNAL = 340 μW
F- " " " " " " " " " 100 μV " " " " " " " = 120 μW
BEAT NOTE FREQ. AT 10 MW OUTPUT = 1000 CPS FOR CURVES C, D, E & F.
300 MILLIWATTS
10 MW
0.4 MILLIWATTS
CW RESONANT OVERLOAD AND AVC CHARACTERISTICS
BAND I - FREQ. 4,000 KC.
(WIDE BAND I.F. AMPLIFIER)
HF UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
AUDIO OUTPUT ACROSS 425 OHM LOAD - VOLTS
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA

PLATE 61

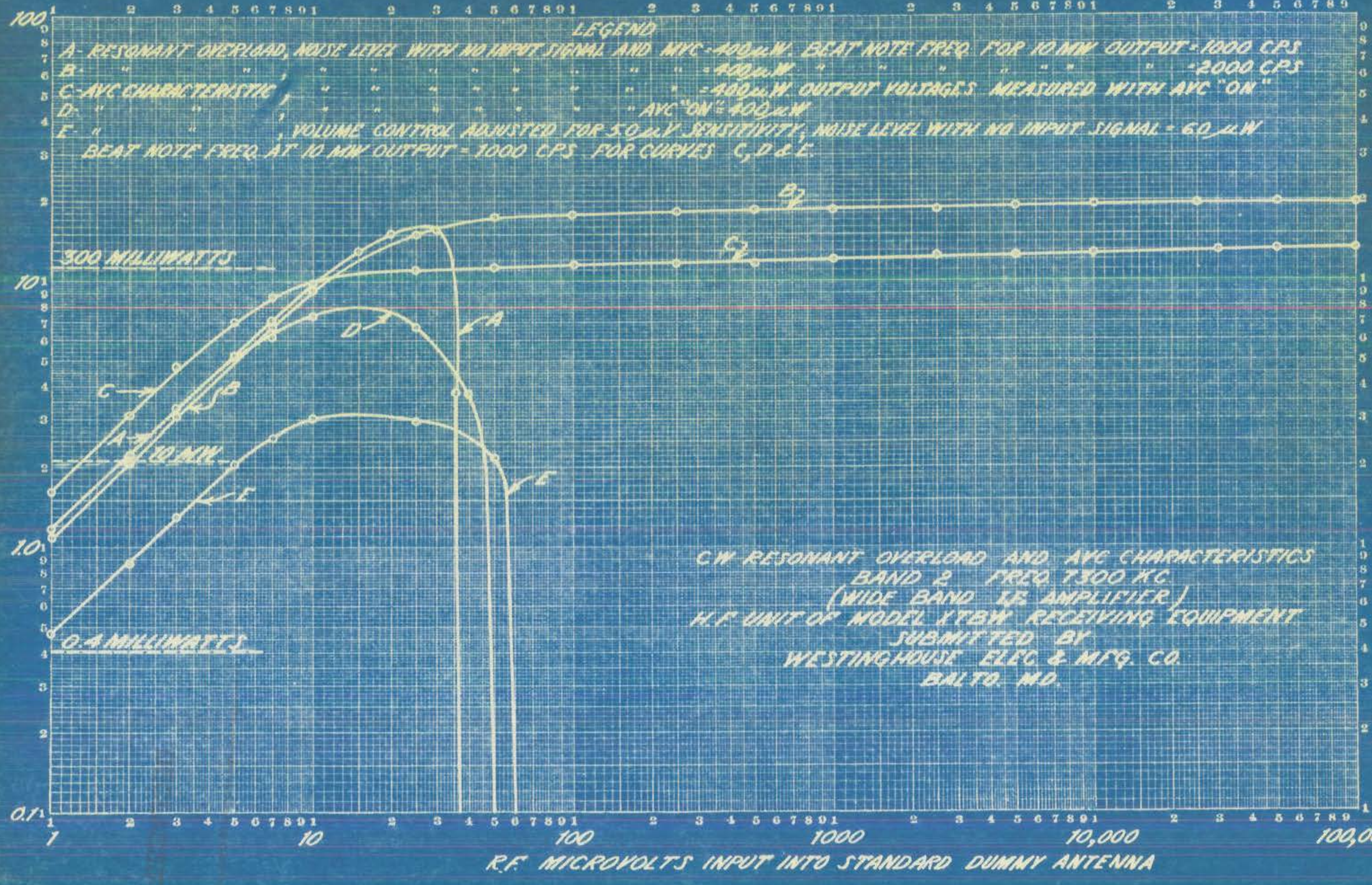
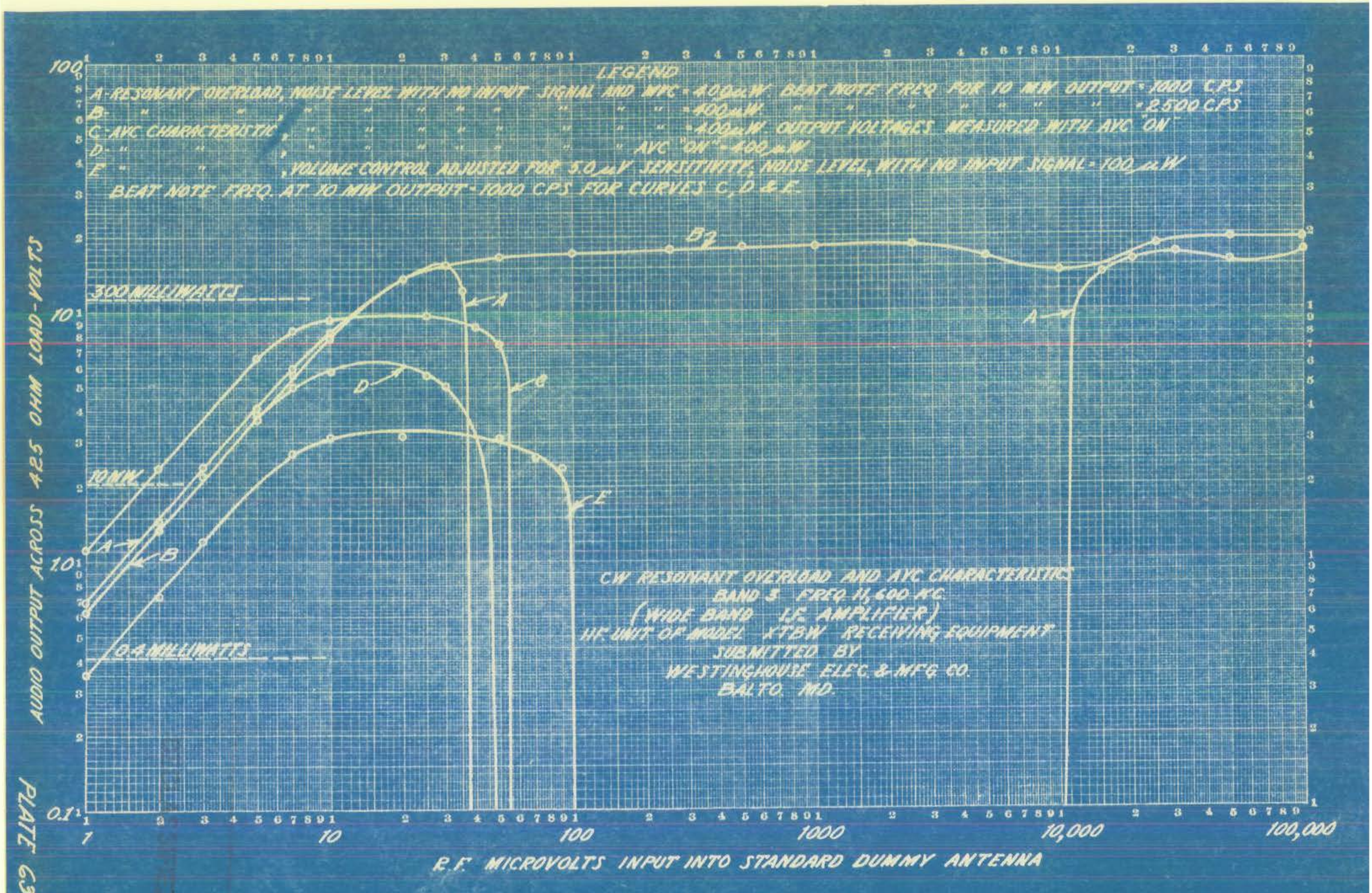
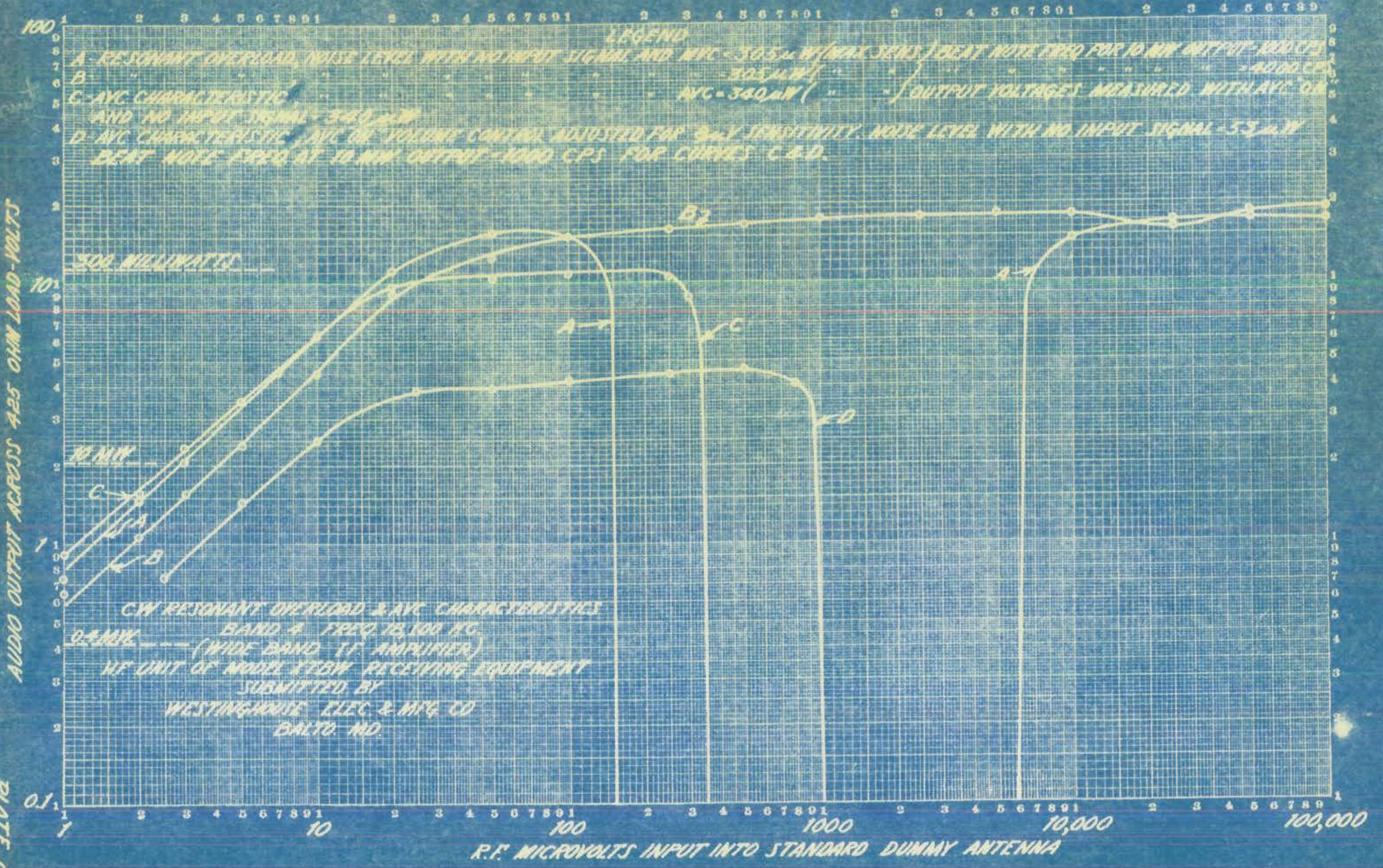

LEGEND
A- RESONANT OVERLOAD, NOISE LEVEL WITH NO INPUT SIGNAL AND MVC = 400 μW. BEAT NOTE FREQ. FOR 10 MW OUTPUT = 1000 CPS
B- " " " " " " " " " = 400 μW " " " " " " = 2000 CPS
C- AVC CHARACTERISTIC, " " " " " " " " = 400 μW OUTPUT VOLTAGES MEASURED WITH AVC "ON"
D- " " , " " " " " " " AVC "ON" = 400 μW
E- " " , VOLUME CONTROL ADJUSTED FOR 5.0 μV SENSITIVITY, NOISE LEVEL WITH NO INPUT SIGNAL = 6.0 μW
BEAT NOTE FREQ. AT 10 MW OUTPUT = 1000 CPS FOR CURVES C, D & E.
300 MILLIWATTS
10 MW
0.4 MILLIWATTS
A
B
C
D
E
CW RESONANT OVERLOAD AND AVC CHARACTERISTICS
BAND 2 FREQ. 7300 KC
(WIDE BAND IF AMPLIFIER)
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
AUDIO OUTPUT ACROSS 425 OHM LOAD - VOLTS
100
10
1.0
0.1
1
10
100
1000
10,000
100,000
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA

PLATE 62



LEGEND
A-RESONANT OVERLOAD, NOISE LEVEL WITH NO INPUT SIGNAL AND AVC = 4.0 μW BEAT NOTE FREQ FOR 10 MW OUTPUT = 1000 CPS
B- " " " " " " " " " " = 400 μW " " " " " " = 2500 CPS
C-AVC CHARACTERISTIC, " " " " " " " " = 4.0 μW OUTPUT VOLTAGES MEASURED WITH AVC "ON"
D- " " " " " " " " AVC "ON" = 400 μW
E " " , VOLUME CONTROL ADJUSTED FOR 5.0 μV SENSITIVITY, NOISE LEVEL, WITH NO INPUT SIGNAL = 100 μW
BEAT NOTE FREQ. AT 10 MW OUTPUT = 1000 CPS FOR CURVES C, D & E.
300 MILLIWATTS
10 MW
0.4 MILLIWATTS
A
B
C
D
E
CW RESONANT OVERLOAD AND AVC CHARACTERISTIC
BAND 3 FREQ 11,600 KC
(WIDE BAND I.F. AMPLIFIER)
HF UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
AUDIO OUTPUT ACROSS 425 OHM LOAD-VOLTS
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA
1
10
100
1000
10,000
100,000
0.1
1.0
10
100

PLATE 63



LEGEND
A- RESONANT OVERLOAD, NOISE LEVEL WITH NO INPUT SIGNAL AND AVC - 30.5 μW (MAX. SENS.) BEAT NOTE FREQ FOR 10 MW OUTPUT - 1000 CPS
B " " " " " " " " 30.5 μW " " " " " " - 4000 CPS
C- AVC CHARACTERISTIC " " " " AVC = 340 μW " " OUTPUT VOLTAGES MEASURED WITH AVC ON
AND NO INPUT SIGNAL - 340 μW
D- AVC CHARACTERISTIC, AVC ON VOLUME CONTROL ADJUSTED FOR 3 μV SENSITIVITY. NOISE LEVEL WITH NO INPUT SIGNAL - 53 μW
BEAT NOTE FREQ AT 10 MW OUTPUT - 1000 CPS FOR CURVES C & D.
300 MILLIWATTS
10 MW
0.4 MW
CW RESONANT OVERLOAD & AVC CHARACTERISTICS
BAND 4 FREQ 18,100 KC
(WIDE BAND I.F. AMPLIFIER)
HF UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC & MFG CO
BALTO. MD.
AUDIO OUTPUT ACROSS 425 OHM LOAD-VOLTS
R.F. MICROVOLTS INPUT INTO STANDARD DUMMY ANTENNA

PLATE 64

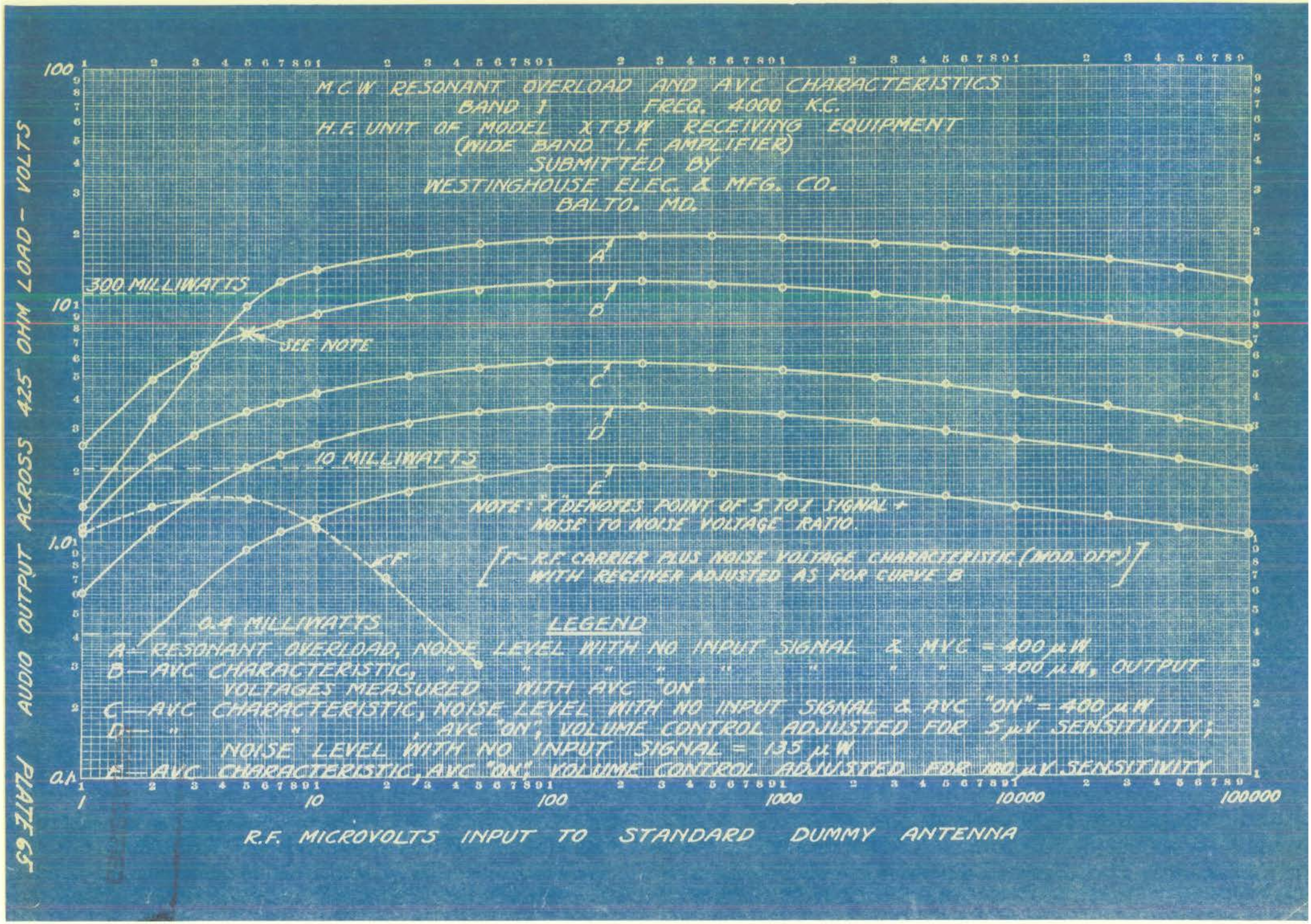
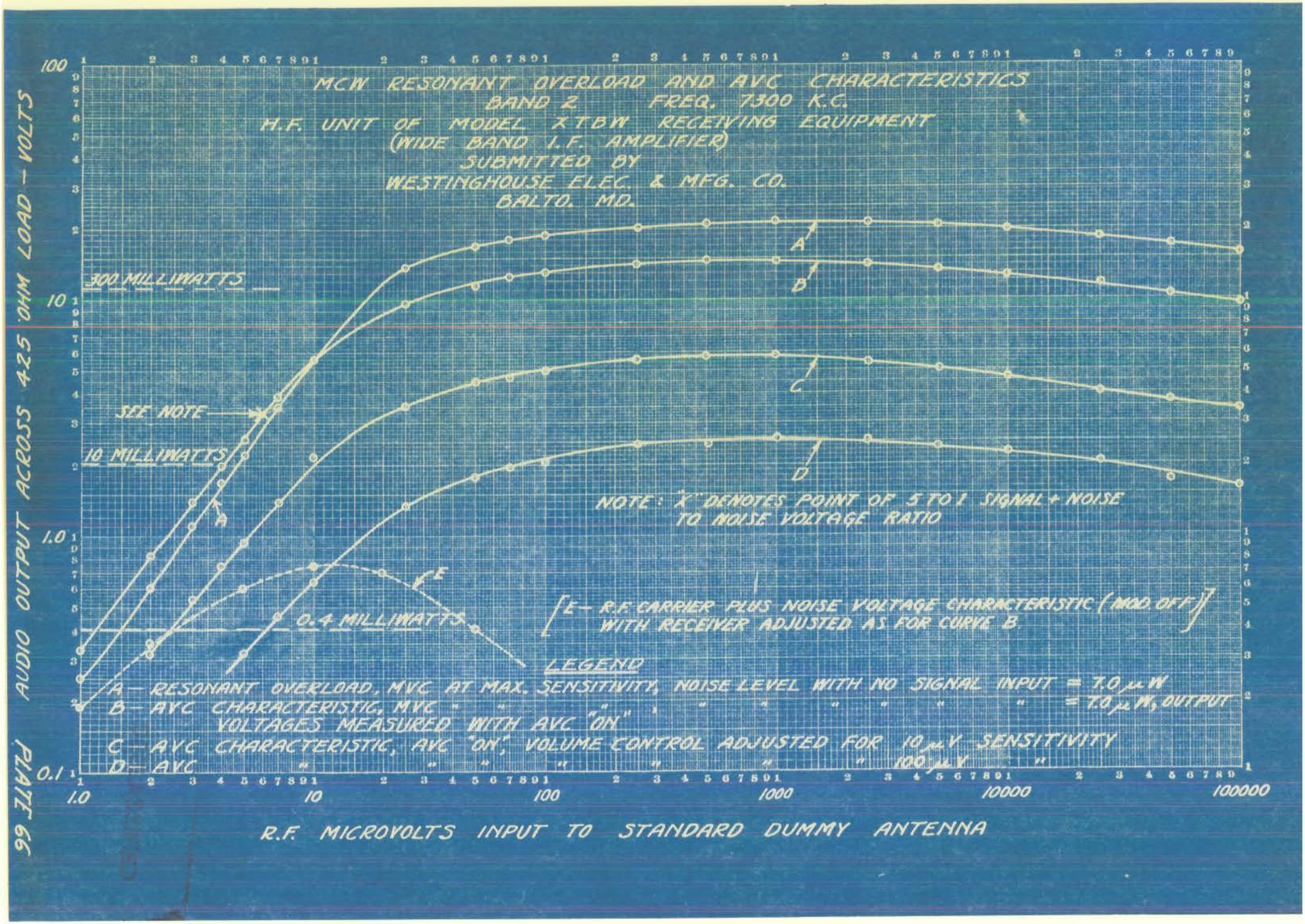
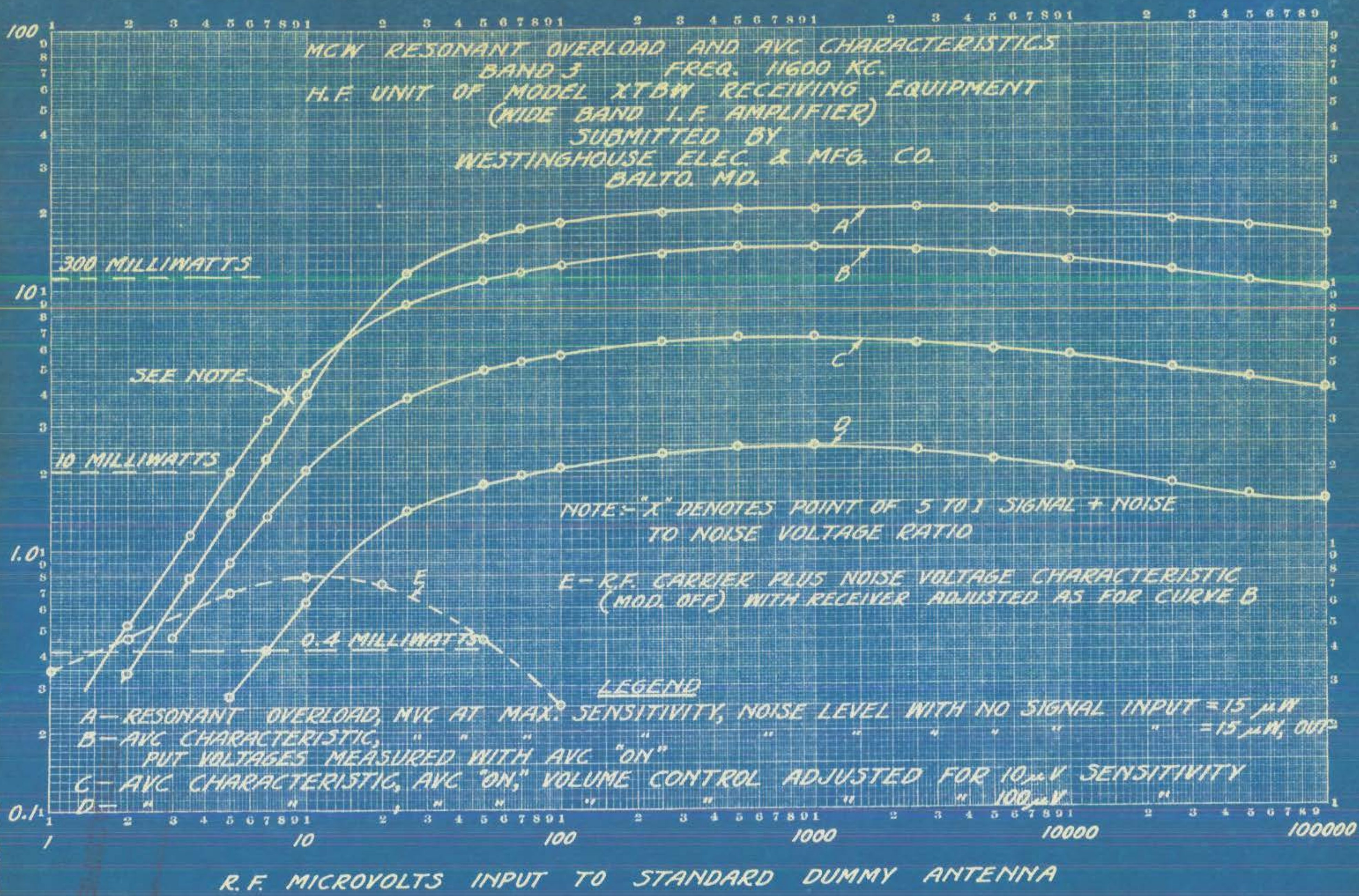

M.C.W. RESONANT OVERLOAD AND A.V.C. CHARACTERISTICS
BAND 1 FREQ. 4000 K.C.
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
(WIDE BAND I.F. AMPLIFIER)
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
300 MILLIWATTS
SEE NOTE
10 MILLIWATTS
0.4 MILLIWATTS
A
B
C
D
E
F
NOTE: "X" DENOTES POINT OF 5 TO 1 SIGNAL + NOISE TO NOISE VOLTAGE RATIO.
[F — R.F. CARRIER PLUS NOISE VOLTAGE CHARACTERISTIC (MOD. OFF) WITH RECEIVER ADJUSTED AS FOR CURVE B]
LEGEND
A — RESONANT OVERLOAD, NOISE LEVEL WITH NO INPUT SIGNAL & MVC = 400 μW
B — AVC CHARACTERISTIC, " " " " " " " = 400 μW, OUTPUT VOLTAGES MEASURED WITH AVC "ON"
C — AVC CHARACTERISTIC, NOISE LEVEL WITH NO INPUT SIGNAL & AVC "ON" = 400 μW
D — " " , AVC "ON", VOLUME CONTROL ADJUSTED FOR 5 μV SENSITIVITY; NOISE LEVEL WITH NO INPUT SIGNAL = 135 μW
E — AVC CHARACTERISTIC, AVC "ON", VOLUME CONTROL ADJUSTED FOR 100 μV SENSITIVITY
100
10
1.0
0.1
1
10
100
1000
10000
100000
AUDIO OUTPUT ACROSS 425 OHM LOAD - VOLTS
R.F. MICROVOLTS INPUT TO STANDARD DUMMY ANTENNA

PLATE 65



MCW RESONANT OVERLOAD AND AVC CHARACTERISTICS
BAND 2 FREQ. 7300 K.C.
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
(WIDE BAND I.F. AMPLIFIER)
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
300 MILLIWATTS
SEE NOTE
10 MILLIWATTS
0.4 MILLIWATTS
A
B
C
D
E
NOTE: "X" DENOTES POINT OF 5 TO 1 SIGNAL + NOISE TO NOISE VOLTAGE RATIO
[E - R.F. CARRIER PLUS NOISE VOLTAGE CHARACTERISTIC (MOD. OFF) WITH RECEIVER ADJUSTED AS FOR CURVE B.]
LEGEND
A - RESONANT OVERLOAD, MVC AT MAX. SENSITIVITY, NOISE LEVEL WITH NO SIGNAL INPUT = 7.0 μW
B - AVC CHARACTERISTIC, MVC " " " " " " " " = 7.0 μW, OUTPUT
VOLTAGES MEASURED WITH AVC "ON"
C - AVC CHARACTERISTIC, AVC "ON", VOLUME CONTROL ADJUSTED FOR 10 μV SENSITIVITY
D - AVC " " " " " " 100 μV "
100
10
1.0
0.1
1.0
10
100
1000
10000
100000
AUDIO OUTPUT ACROSS 425 OHM LOAD - VOLTS
R.F. MICROVOLTS INPUT TO STANDARD DUMMY ANTENNA

PLATE 66



MCW RESONANT OVERLOAD AND AVC CHARACTERISTICS
BAND 3 FREQ. 11600 KC.
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
(WIDE BAND I.F. AMPLIFIER)
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
300 MILLIWATTS
10 MILLIWATTS
0.4 MILLIWATTS
SEE NOTE
A
B
C
D
E
NOTE:- "X" DENOTES POINT OF 5 TO 1 SIGNAL + NOISE TO NOISE VOLTAGE RATIO
E - R.F. CARRIER PLUS NOISE VOLTAGE CHARACTERISTIC (MOD. OFF) WITH RECEIVER ADJUSTED AS FOR CURVE B
LEGEND
A - RESONANT OVERLOAD, MVC AT MAX. SENSITIVITY, NOISE LEVEL WITH NO SIGNAL INPUT = 15 μW
B - AVC CHARACTERISTIC, " " " " " " " " " " = 15 μW, OUTPUT VOLTAGES MEASURED WITH AVC "ON"
C - AVC CHARACTERISTIC, AVC "ON," VOLUME CONTROL ADJUSTED FOR 10 μV SENSITIVITY
D - " " " " " " " " 100 μV "
AUDIO OUTPUT ACROSS 425 OHM LOAD VOLTS
100
10
1.0
0.1
1
10
100
1000
10000
100000
R.F. MICROVOLTS INPUT TO STANDARD DUMMY ANTENNA

PLATE 67

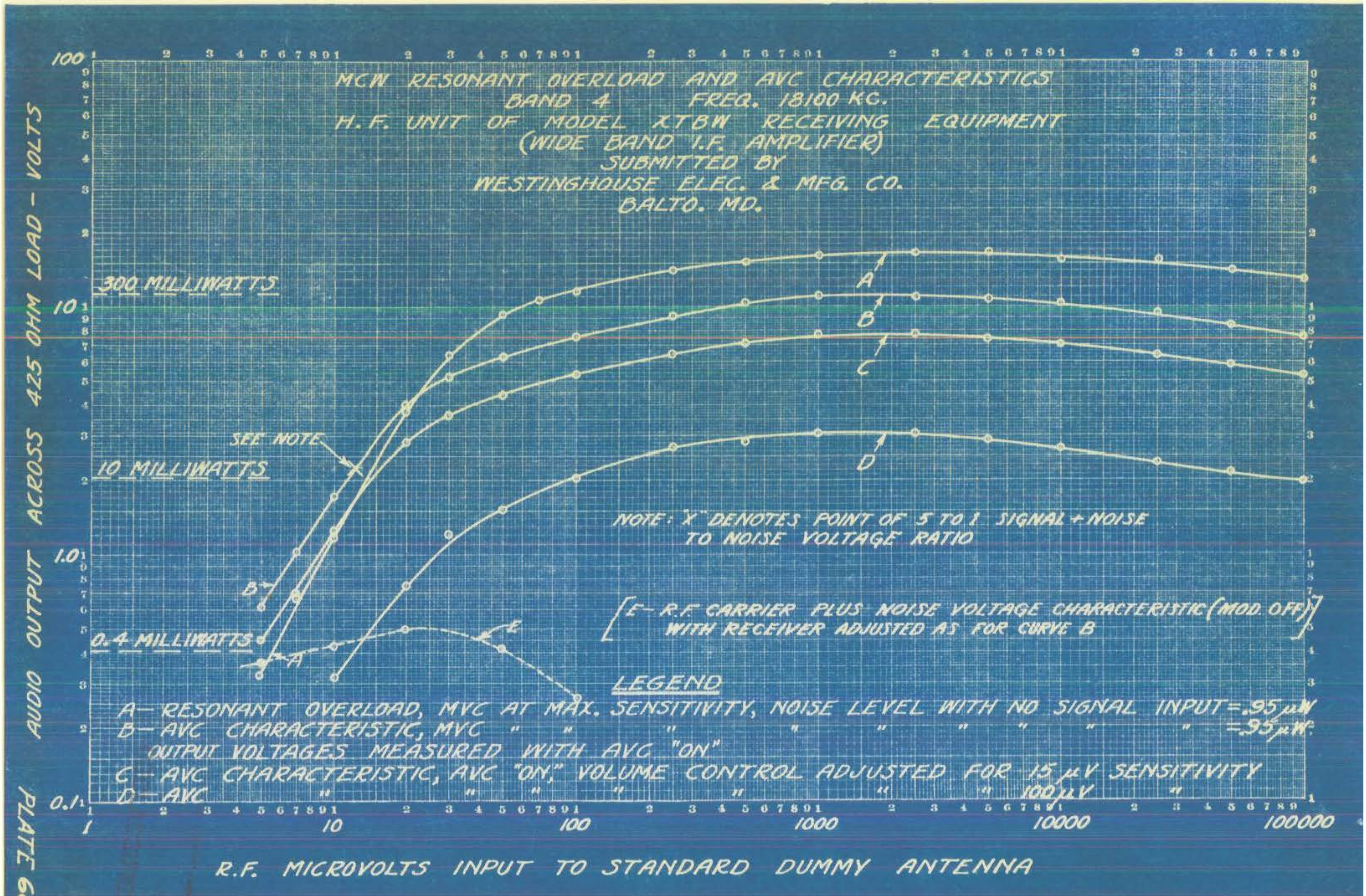
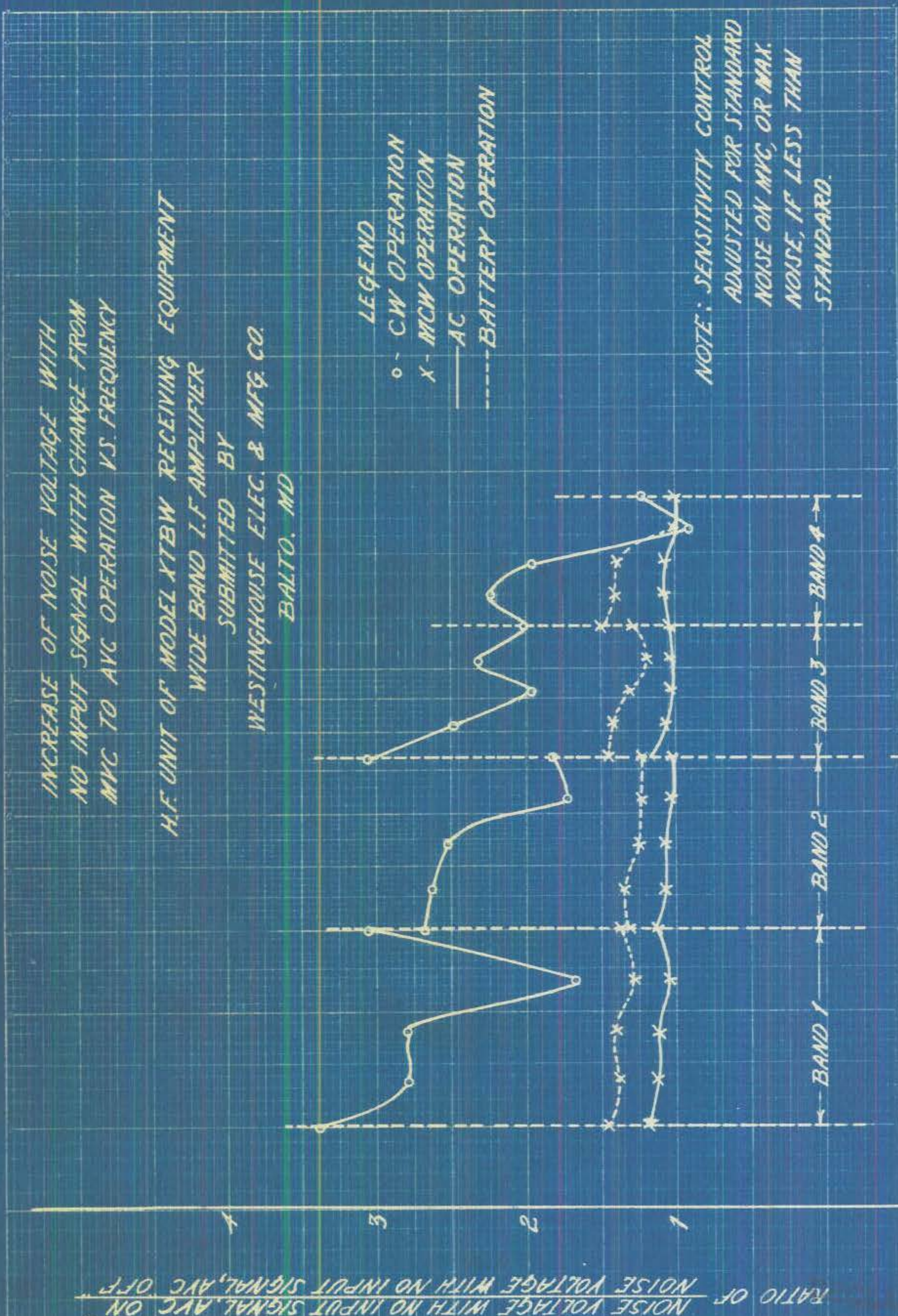
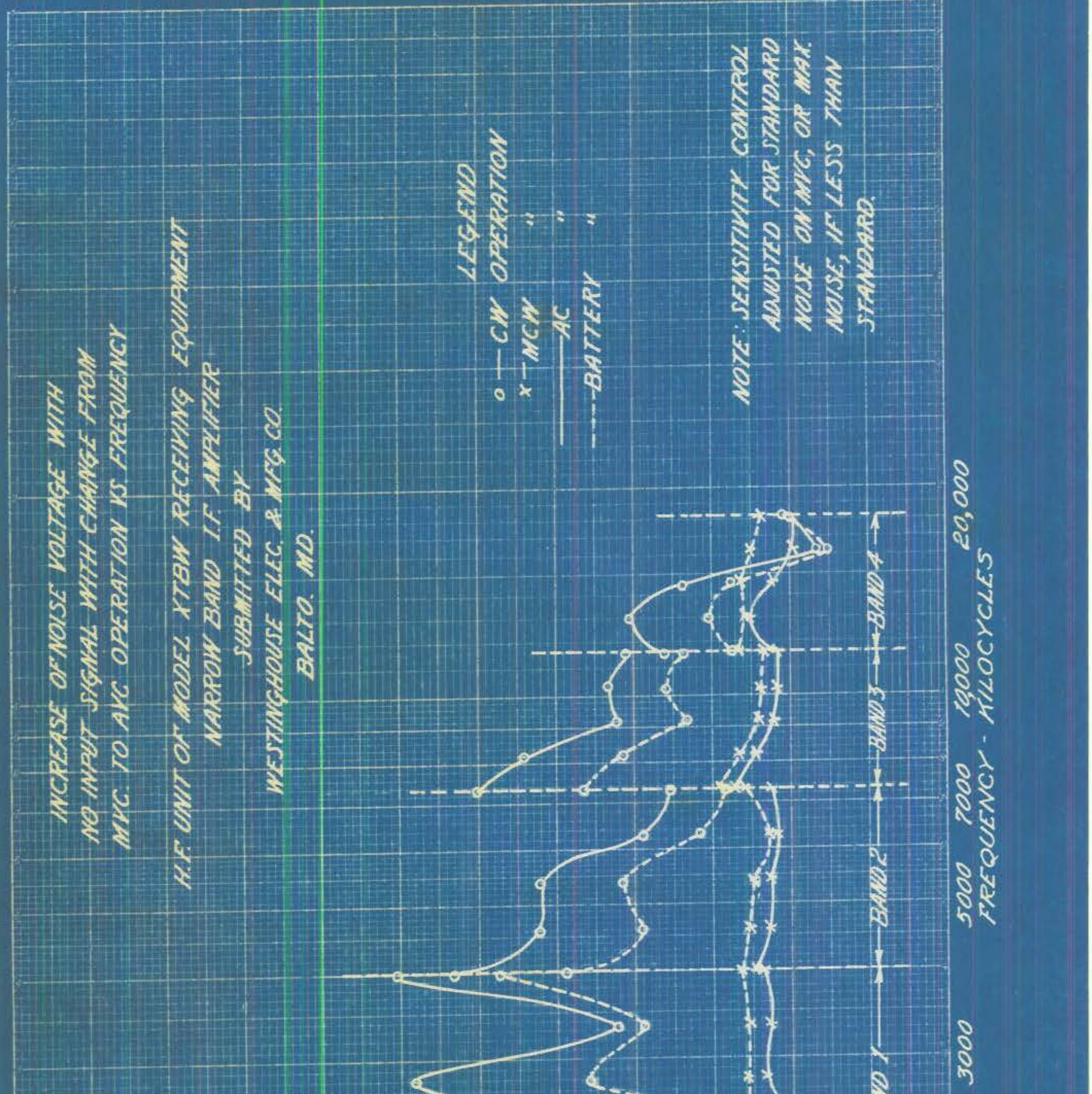

MCW RESONANT OVERLOAD AND AVC CHARACTERISTICS
BAND 4 FREQ. 18100 KC.
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
(WIDE BAND I.F. AMPLIFIER)
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
AUDIO OUTPUT ACROSS 425 OHM LOAD - VOLTS
100
10
1.0
0.1
300 MILLIWATTS
10 MILLIWATTS
0.4 MILLIWATTS
SEE NOTE
A
B
C
D
E
NOTE: "X" DENOTES POINT OF 5 TO 1 SIGNAL + NOISE TO NOISE VOLTAGE RATIO
[E - R.F. CARRIER PLUS NOISE VOLTAGE CHARACTERISTIC (MOD. OFF) WITH RECEIVER ADJUSTED AS FOR CURVE B]
LEGEND
A - RESONANT OVERLOAD, MVC AT MAX. SENSITIVITY, NOISE LEVEL WITH NO SIGNAL INPUT = .95 µW
B - AVC CHARACTERISTIC, MVC " " " " " " " " " = .95 µW
OUTPUT VOLTAGES MEASURED WITH AVC "ON"
C - AVC CHARACTERISTIC, AVC "ON," VOLUME CONTROL ADJUSTED FOR 15 µV SENSITIVITY
D - AVC " " " " " " " 100 µV "
1
10
100
1000
10000
100000
R.F. MICROVOLTS INPUT TO STANDARD DUMMY ANTENNA

PLATE 68

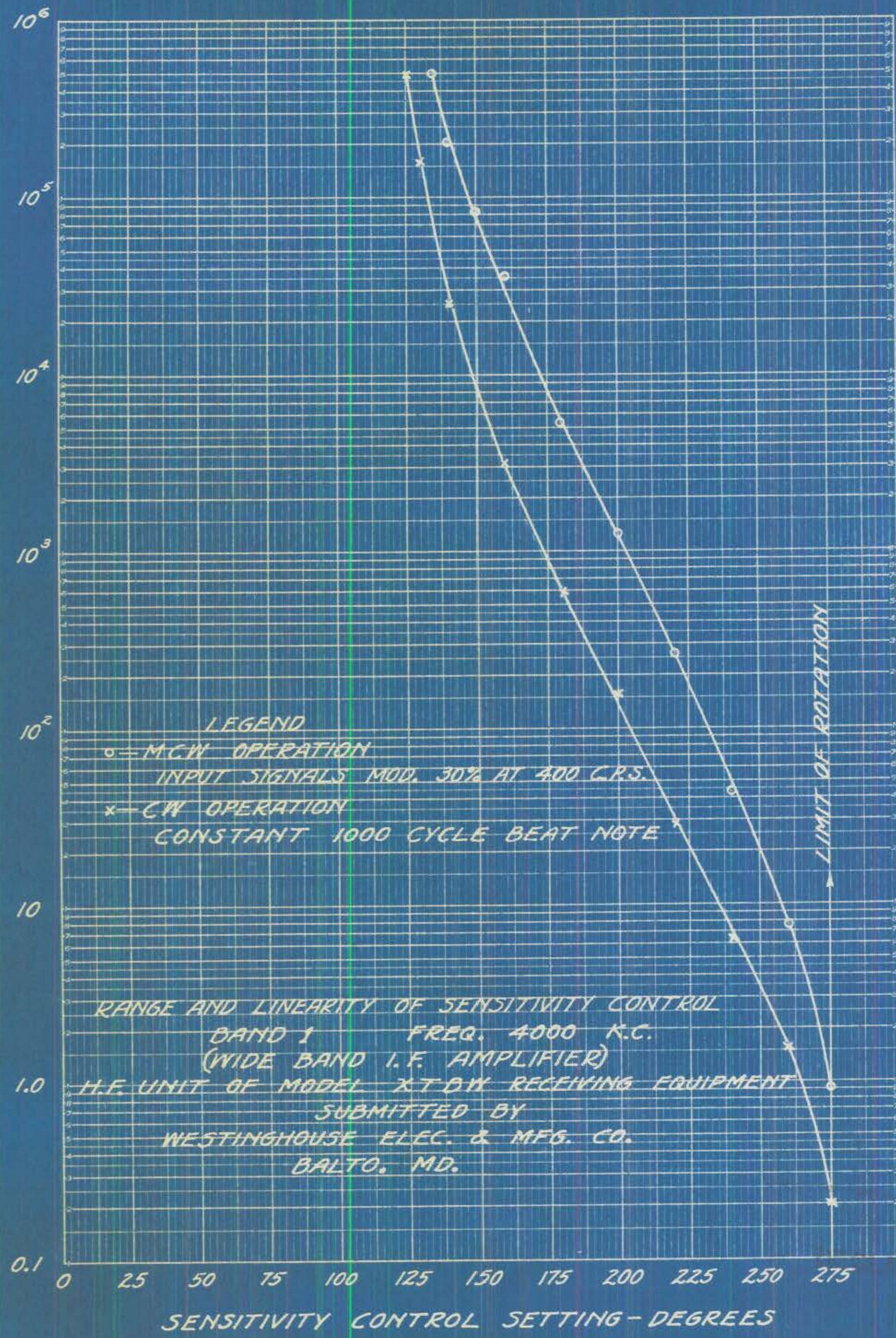


INCREASE OF NOISE VOLTAGE WITH
NO INPUT SIGNAL WITH CHANGE FROM
MVC TO AVC OPERATION VS. FREQUENCY
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
WIDE BAND I.F. AMPLIFIER
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD
LEGEND
o - CW OPERATION
X - MCW OPERATION
— AC OPERATION
--- BATTERY OPERATION
NOTE: SENSITIVITY CONTROL
ADJUSTED FOR STANDARD
NOISE ON MVC, OR MAX.
NOISE, IF LESS THAN
STANDARD.
BAND 1
BAND 2
BAND 3
BAND 4
2,000
3000
5000
10,000
20,000
FREQUENCY - KILOCYCLES
1
2
3
4
RATIO OF NOISE VOLTAGE WITH NO INPUT SIGNAL, AVC "ON"
NOISE VOLTAGE WITH NO INPUT SIGNAL, AVC OFF

PLATE 69



INCREASE OF NOISE VOLTAGE WITH
NO INPUT SIGNAL WITH CHANGE FROM
MVC. TO AVC OPERATION VS FREQUENCY
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
NARROW BAND I.F. AMPLIFIER
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
LEGEND
o — CW OPERATION
x — MCW "
— AC "
--- BATTERY "
NOTE: SENSITIVITY CONTROL
ADJUSTED FOR STANDARD
NOISE ON MVC, OR MAX.
NOISE, IF LESS THAN
STANDARD.
RATIO OF
NOISE VOLTAGE WITH NO INPUT SIGNAL, AVC "ON"
NOISE VOLTAGE WITH NO INPUT SIGNAL, AVC "OFF"
1
2
3
4
2000
3000
5000
7000
10000
20,000
FREQUENCY - KILOCYCLES
BAND 1
BAND 2
BAND 3
BAND 4



LEGEND
o = MCW OPERATION
INPUT SIGNALS MOD. 30% AT 400 C.P.S.
x — CW OPERATION
CONSTANT 1000 CYCLE BEAT NOTE
LIMIT OF ROTATION
RANGE AND LINEARITY OF SENSITIVITY CONTROL
BAND 1 FREQ. 4000 K.C.
(WIDE BAND I.F. AMPLIFIER)
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
10^6
10^5
10^4
10^3
10^2
10
1.0
0.1
0 25 50 75 100 125 150 175 200 225 250 275
SENSITIVITY CONTROL SETTING - DEGREES

PLATE 71

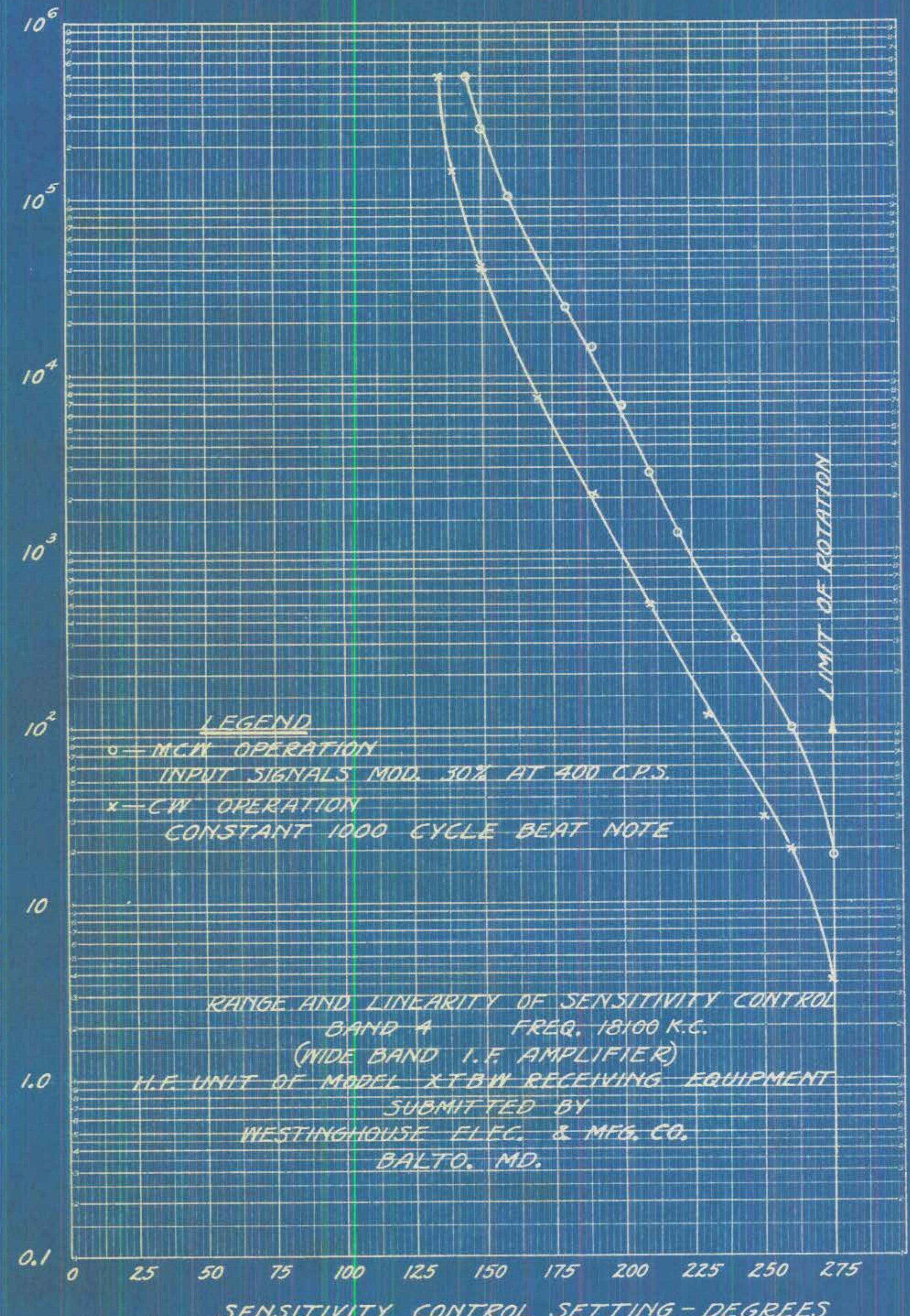

10^6
10^5
10^4
10^3
10^2
10
1.0
0.1
0
25
50
75
100
125
150
175
200
225
250
275
LIMIT OF ROTATION
LEGEND
o — MCW OPERATION
INPUT SIGNALS MOD. 30% AT 400 C.P.S.
x — CW OPERATION
CONSTANT 1000 CYCLE BEAT NOTE
RANGE AND LINEARITY OF SENSITIVITY CONTROL
BAND 4 FREQ. 18100 K.C.
(WIDE BAND I.F. AMPLIFIER)
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
SENSITIVITY CONTROL SETTING - DEGREES

PLATE 72

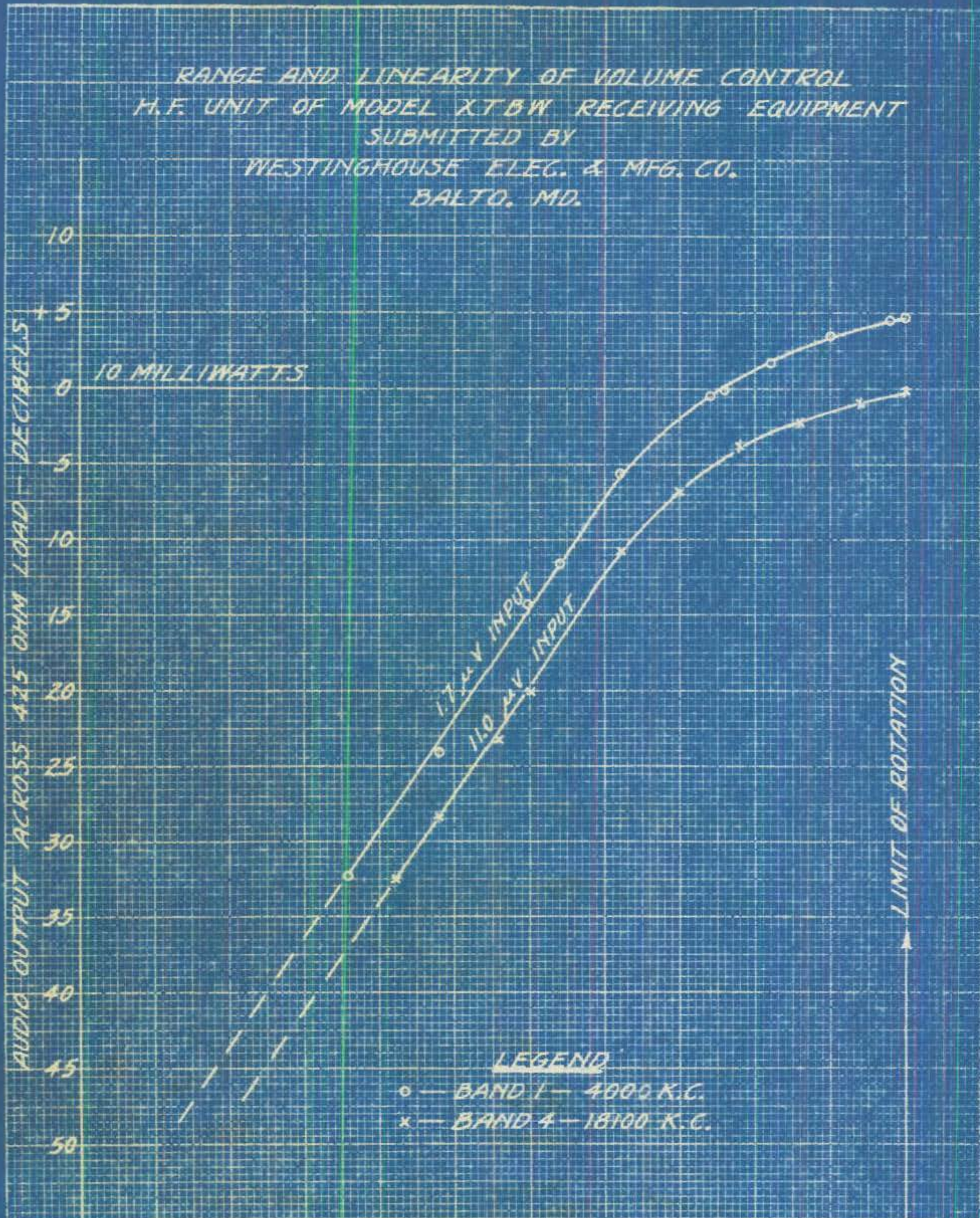
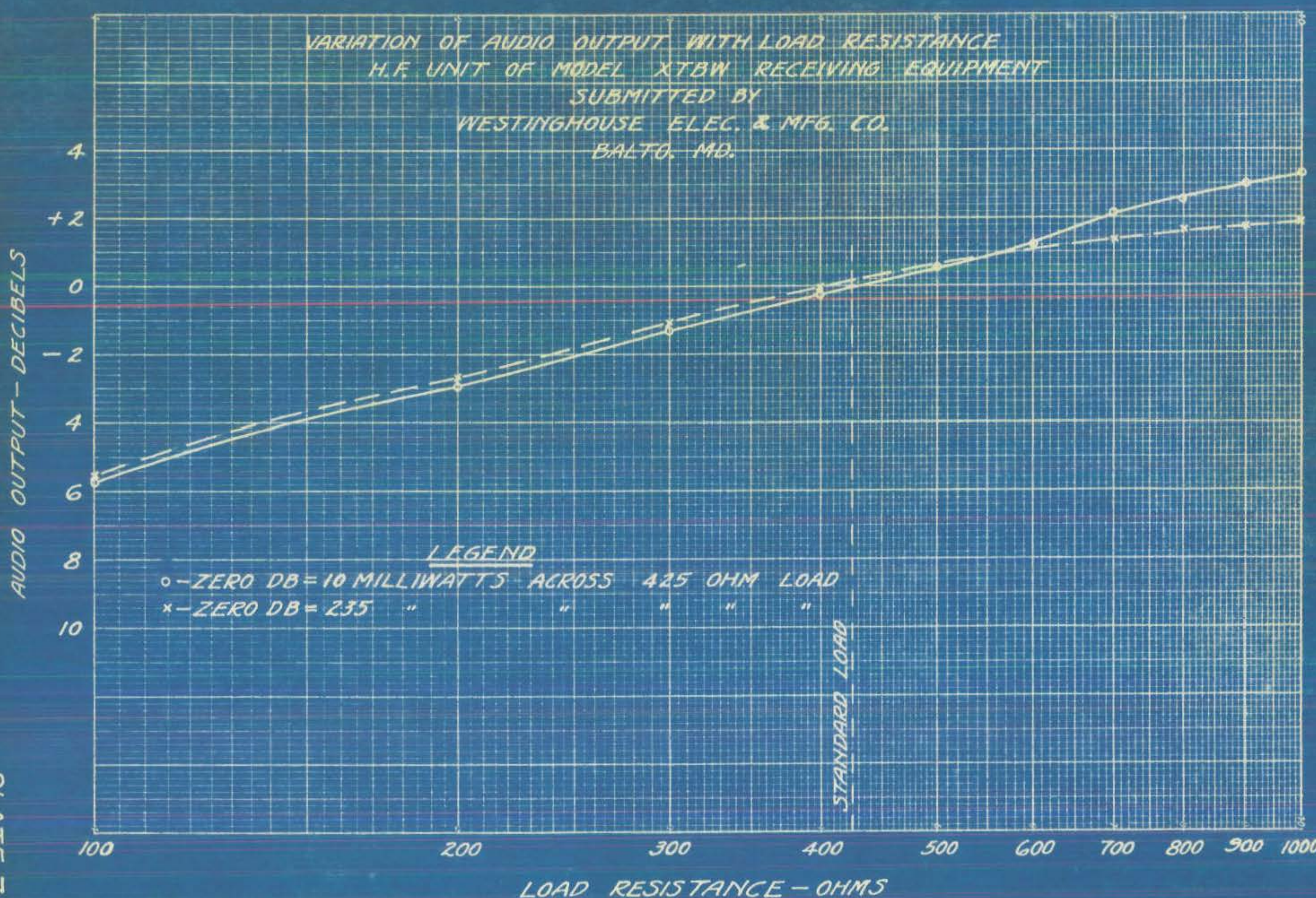

RANGE AND LINEARITY OF VOLUME CONTROL
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
AUDIO OUTPUT ACROSS 425 OHM LOAD - DECIBELS
10
+5
0
5
10
15
20
25
30
35
40
45
50
10 MILLIWATTS
1.7 μV INPUT
11.0 μV INPUT
LIMIT OF ROTATION
LEGEND
o — BAND 1 — 4000 K.C.
x — BAND 4 — 18100 K.C.
0
25
50
75
100
125
150
175
200
225
250
275
VOLUME CONTROL SETTING - DEGREES

PLATE 73



VARIATION OF AUDIO OUTPUT WITH LOAD RESISTANCE
H.F. UNIT OF MODEL XTBW RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
LEGEND
o-ZERO DB=10 MILLIWATTS ACROSS 425 OHM LOAD
x-ZERO DB=235 " " " " "
STANDARD LOAD
AUDIO OUTPUT - DECIBELS
4
+2
0
-2
4
6
8
10
100
200
300
400
500
600
700
800
900
1000
LOAD RESISTANCE - OHMS

PLATE 74

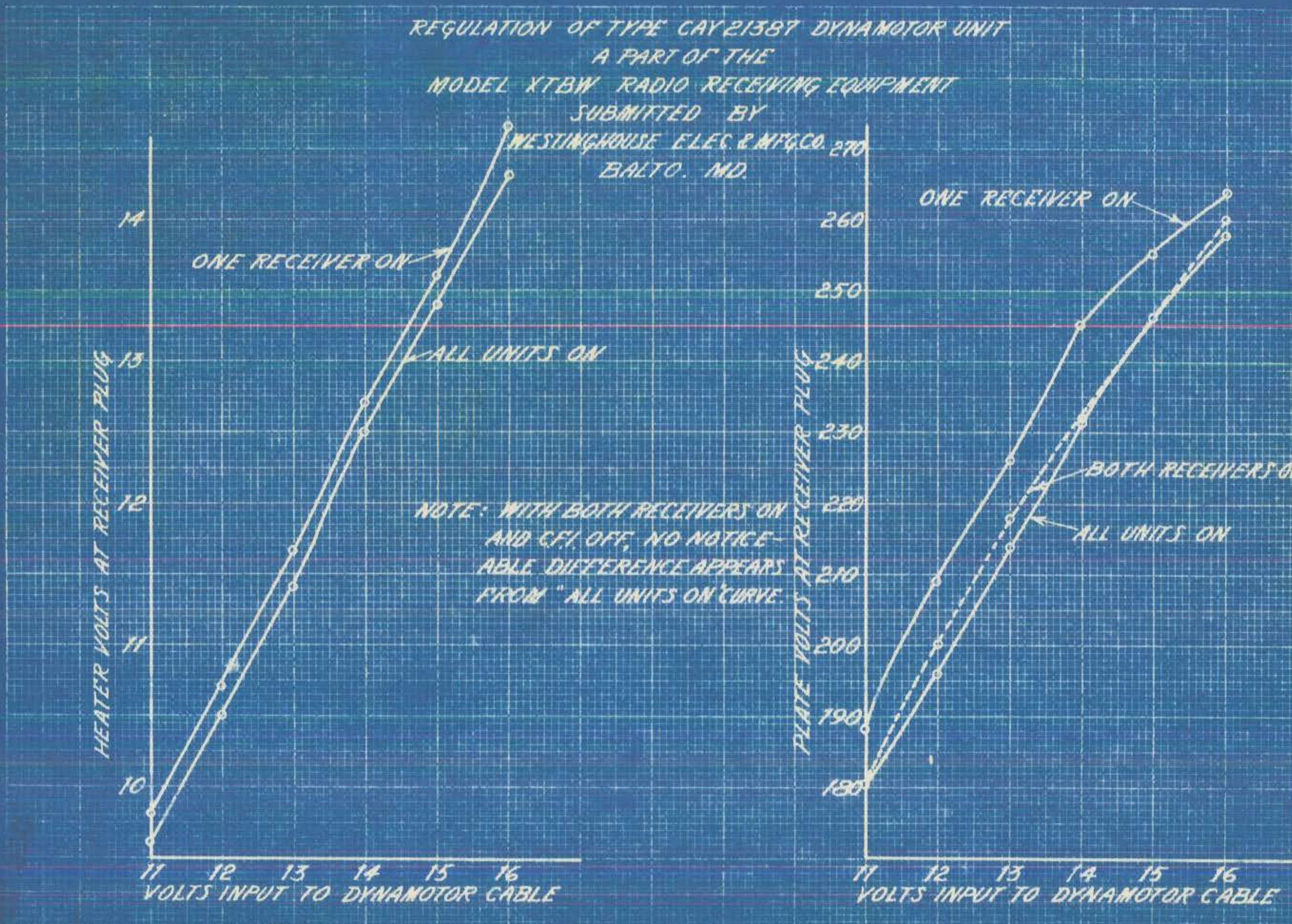
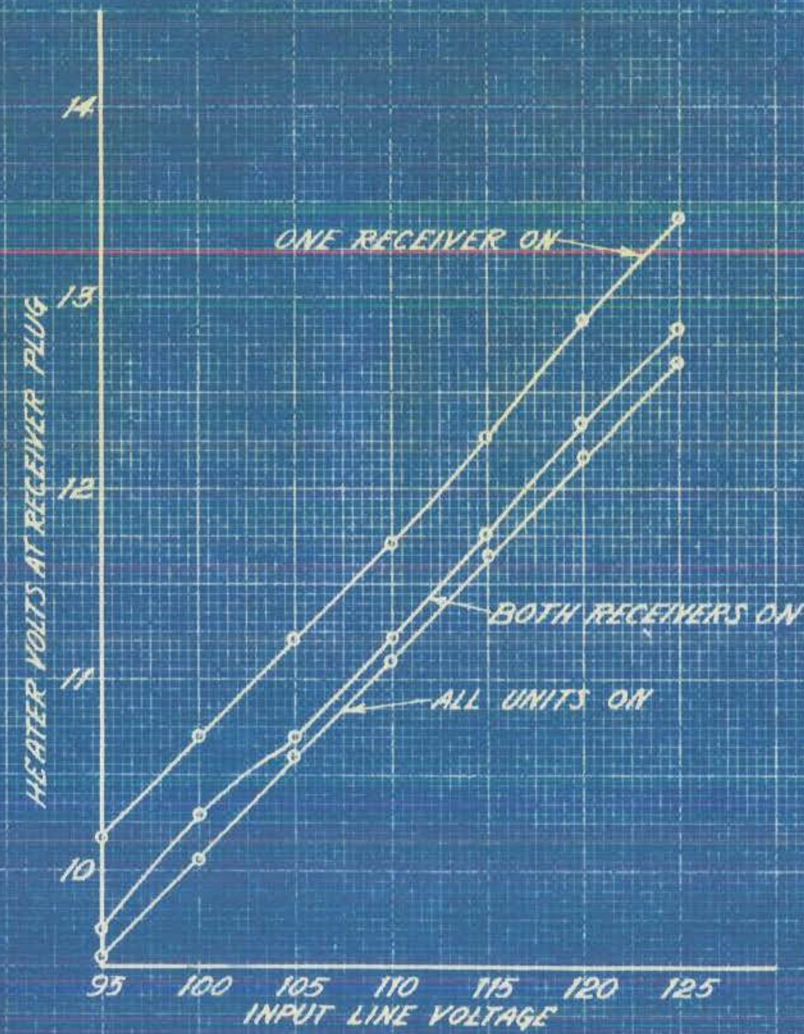
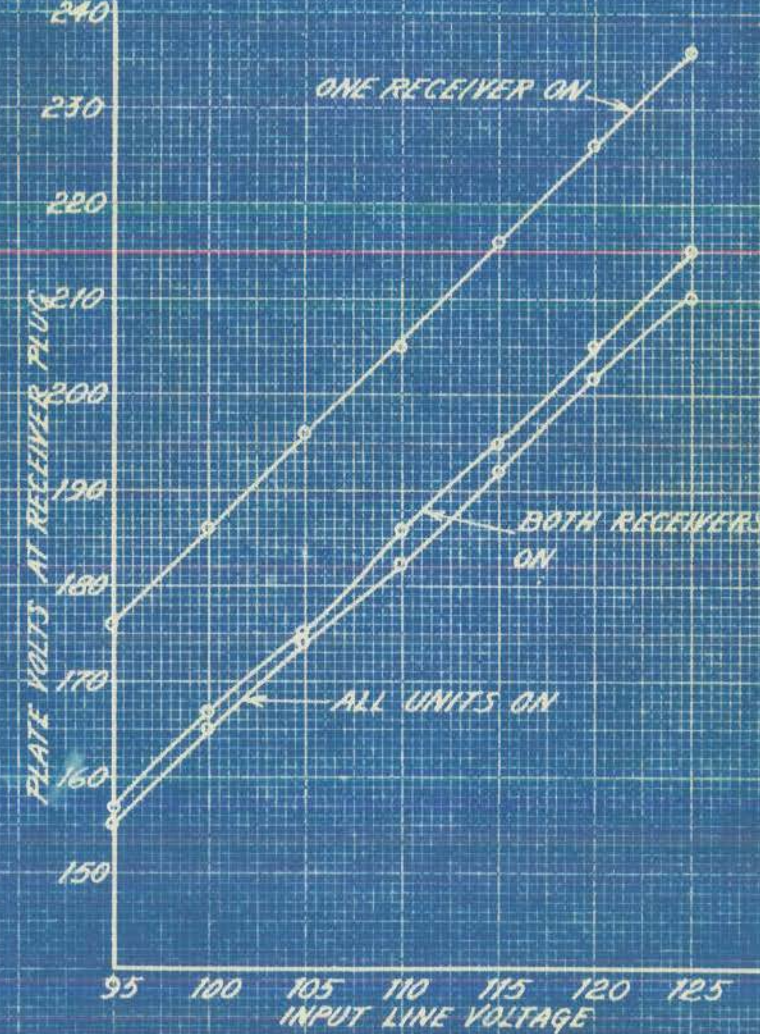

REGULATION OF TYPE CAY21387 DYNAMOTOR UNIT
A PART OF THE
MODEL XTBW RADIO RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.
HEATER VOLTS AT RECEIVER PLUG
10
11
12
13
14
ONE RECEIVER ON
ALL UNITS ON
11 12 13 14 15 16
VOLTS INPUT TO DYNAMOTOR CABLE
NOTE: WITH BOTH RECEIVERS ON
AND C.F.I. OFF, NO NOTICE-
ABLE DIFFERENCE APPEARS
FROM "ALL UNITS ON" CURVE.
PLATE VOLTS AT RECEIVER PLUG
180
190
200
210
220
230
240
250
260
270
ONE RECEIVER ON
BOTH RECEIVERS ON
ALL UNITS ON
11 12 13 14 15 16
VOLTS INPUT TO DYNAMOTOR CABLE

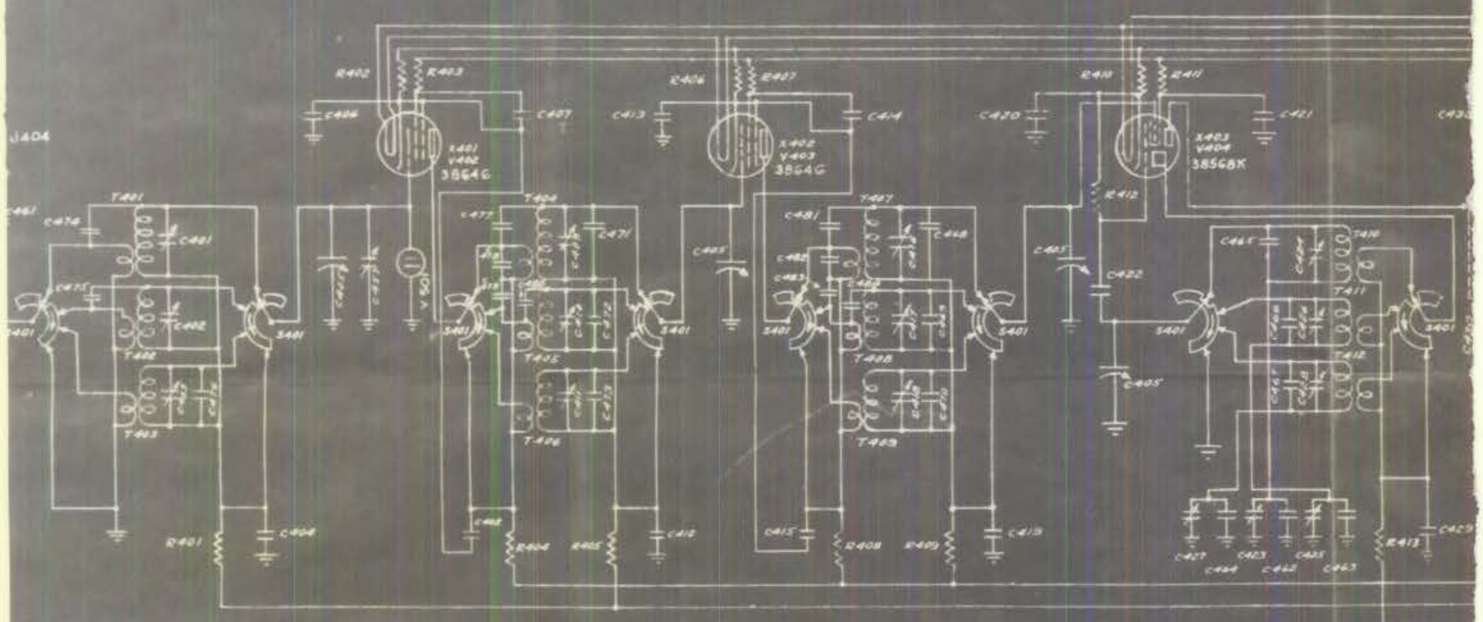
PLATE 75

REGULATION OF TYPE CAY 20085 A.C. POWER UNIT
A PART OF THE
MODEL XTBW RADIO RECEIVING EQUIPMENT
SUBMITTED BY
WESTINGHOUSE ELEC. & MFG. CO.
BALTO. MD.

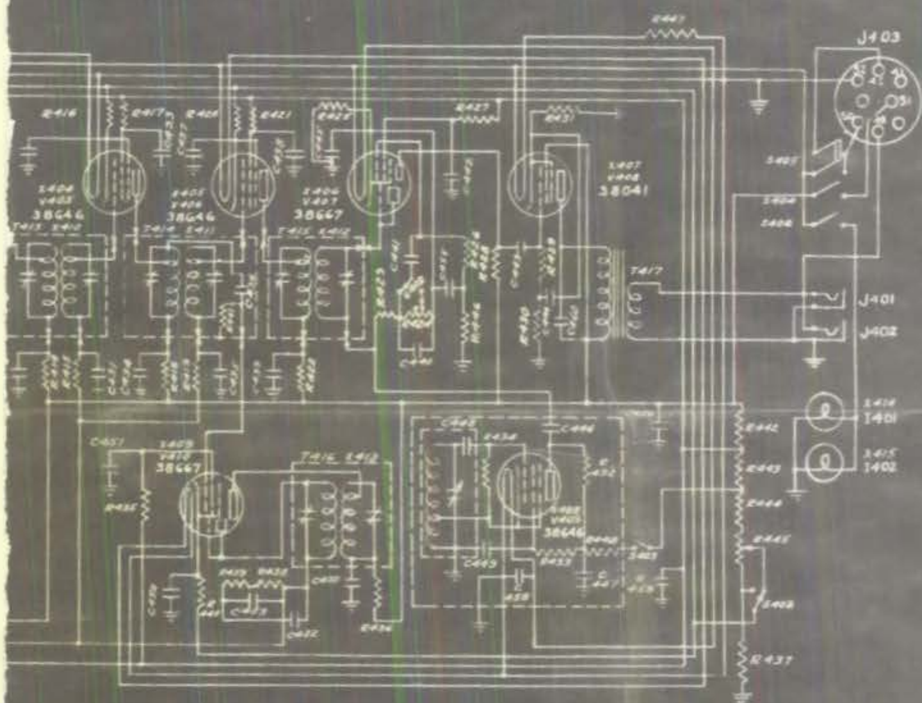




6265



J404
R402
R403
C406
C407
X401
V402
3B64G
R406
R407
C413
C414
X402
V403
3B64G
R410
R411
C420
C421
X403
V404
3B56GK
T401
C474
C481
C475
C402
T402
T403
S401
T404
C477
C471
T405
T406
C485
C481
C448
T407
T408
T409
R412
C422
C405
C465
T410
T411
T412
R401
C404
R404
R405
C412
C415
R408
R409
C419
C427
C423
C425
C464
C462
C463
R413
C429

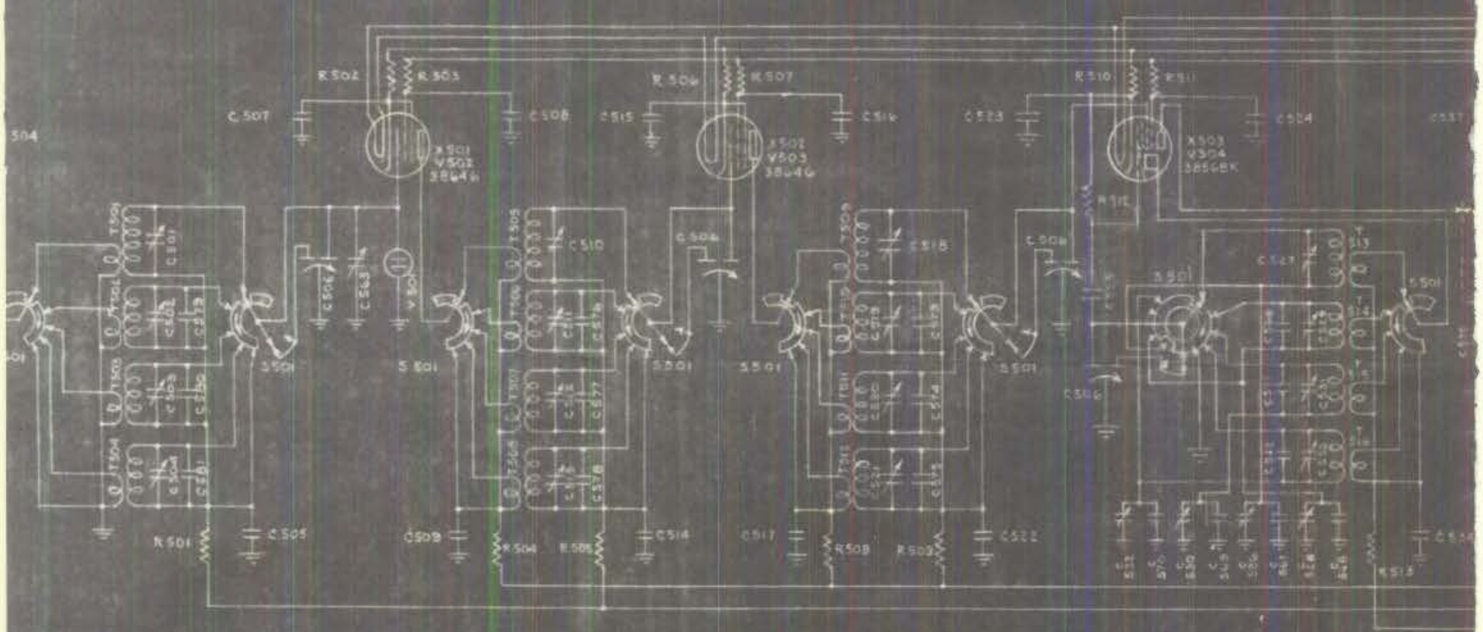


SCHEMATIC DIAGRAM - I.F. REC.

T-7606265

FIRST MADE FOR	SUB D
BEGUN BY / FINISHED BY [illegible] 10-17-37	TRACED BY / INSPECTED [illegible]
WESTINGHOUSE ELECTRIC & MFG. CO., BALTIMORE, MD.	

247


R502
R503
C507
C508
X501
V502
R506
R507
C515
C516
X502
V503
R510
R511
C523
C524
X503
V504
R512
T501
T502
T503
T504
C501
C502
C503
C504
S501
C506
C563
V501
T505
T506
T507
T508
C510
C509
R504
R505
C514
C505
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T509
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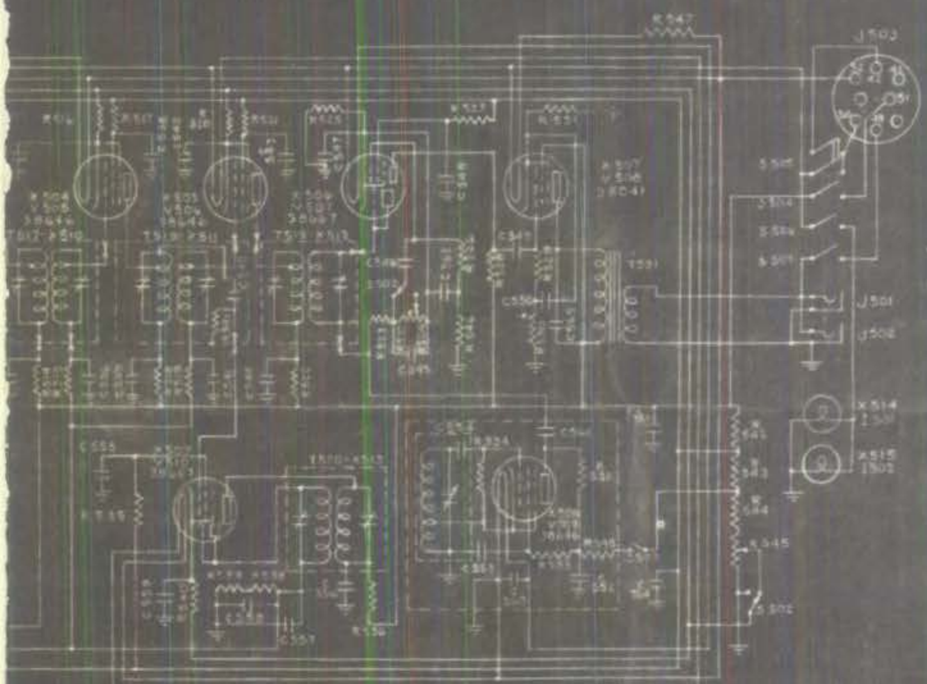
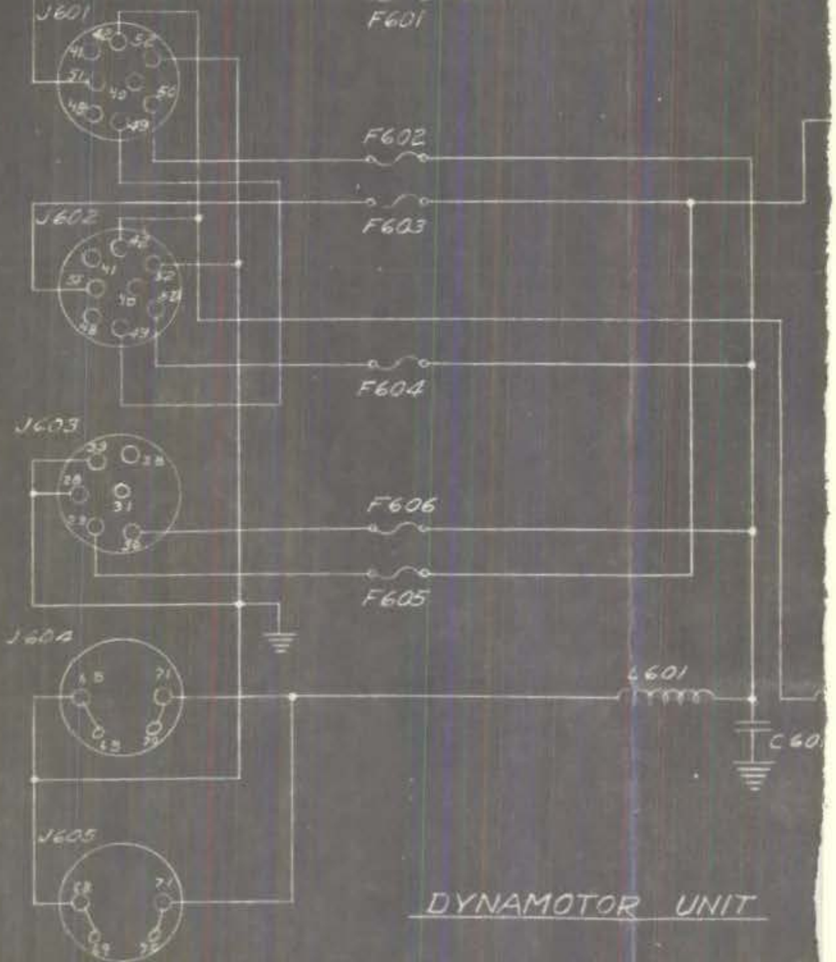
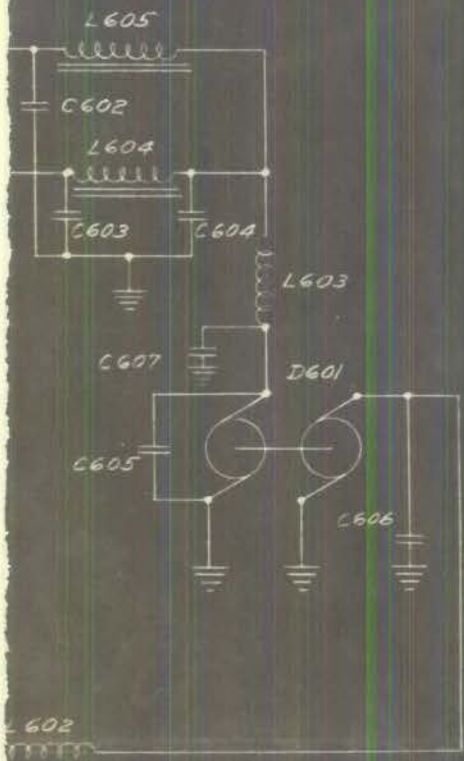
C518
C517
R508
R509
C522
C527
C566
R513



SCHEMATIC DIAGRAM

FIRST MADE FOR WG 28770-1	T 7606247	SUB. 0
BEGUN BY / FINISHED BY	TRACED BY / INSPECTED	
WESTINGHOUSE ELECTRIC & MFG. CO. BALTIMORE, MD.		


J601
F601
F602
F603
J602
F604
J603
F606
F605
J604
L601
C601
J605
DYNAMOTOR UNIT



SCHEMATIC DIAGRAM - DYNAMOTOR

P-7707199

SUB. O

FIRST MADE FOR WG-28770-2

BEGUN BY

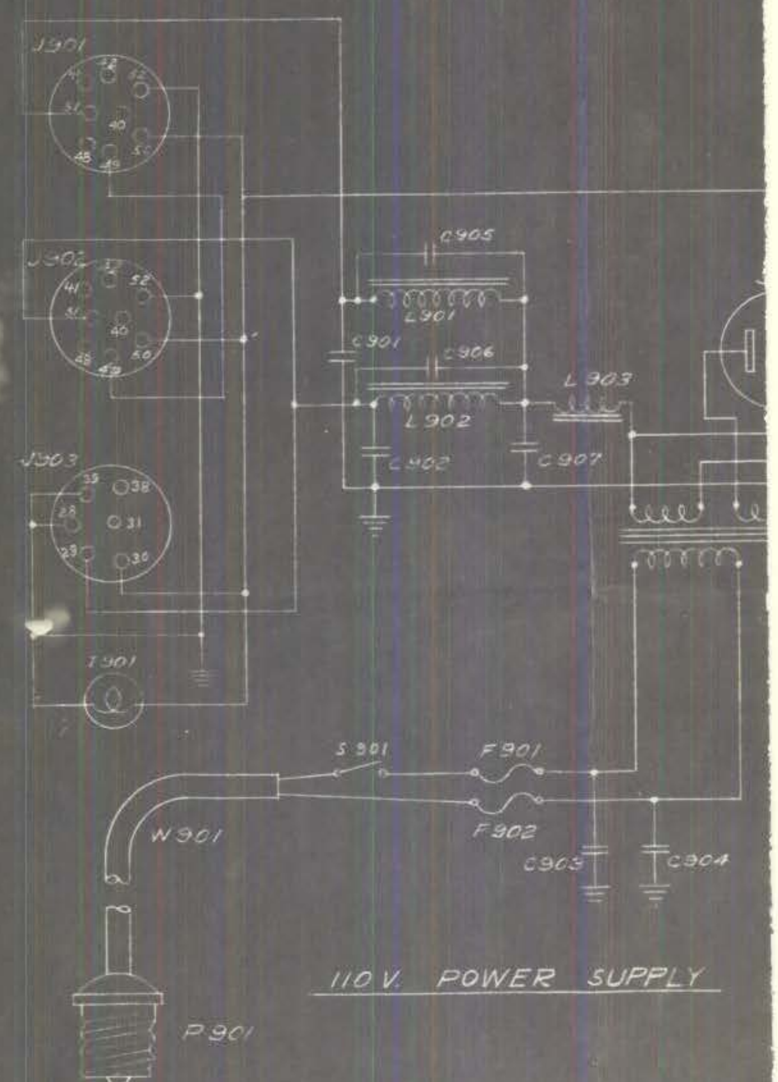
FINISHED BY [illegible]

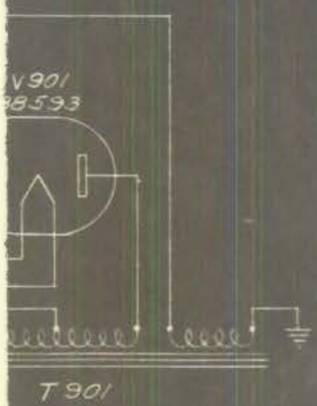
TRACED BY

INSPECTED [illegible]

WESTINGHOUSE ELECTRIC & MFG. CO.
BALTIMORE, MD.

P-7707200


J901
J902
J903
C905
L901
C901
C906
L903
L902
C902
C907
I901
S901
F901
F902
W901
C903
C904
P901
110 V. POWER SUPPLY



SCHEMATIC DIAGRAM 110 V. - 60 CYC. POWER UNIT	
FIRST MADE FOR WG-28770-2	P-7707200 SUB. O
BEGUN BY FINISHED BY	TRACED BY INSPECTED
WESTINGHOUSE ELECTRIC & MFG. CO., BALTIMORE, MD.	Plate 80

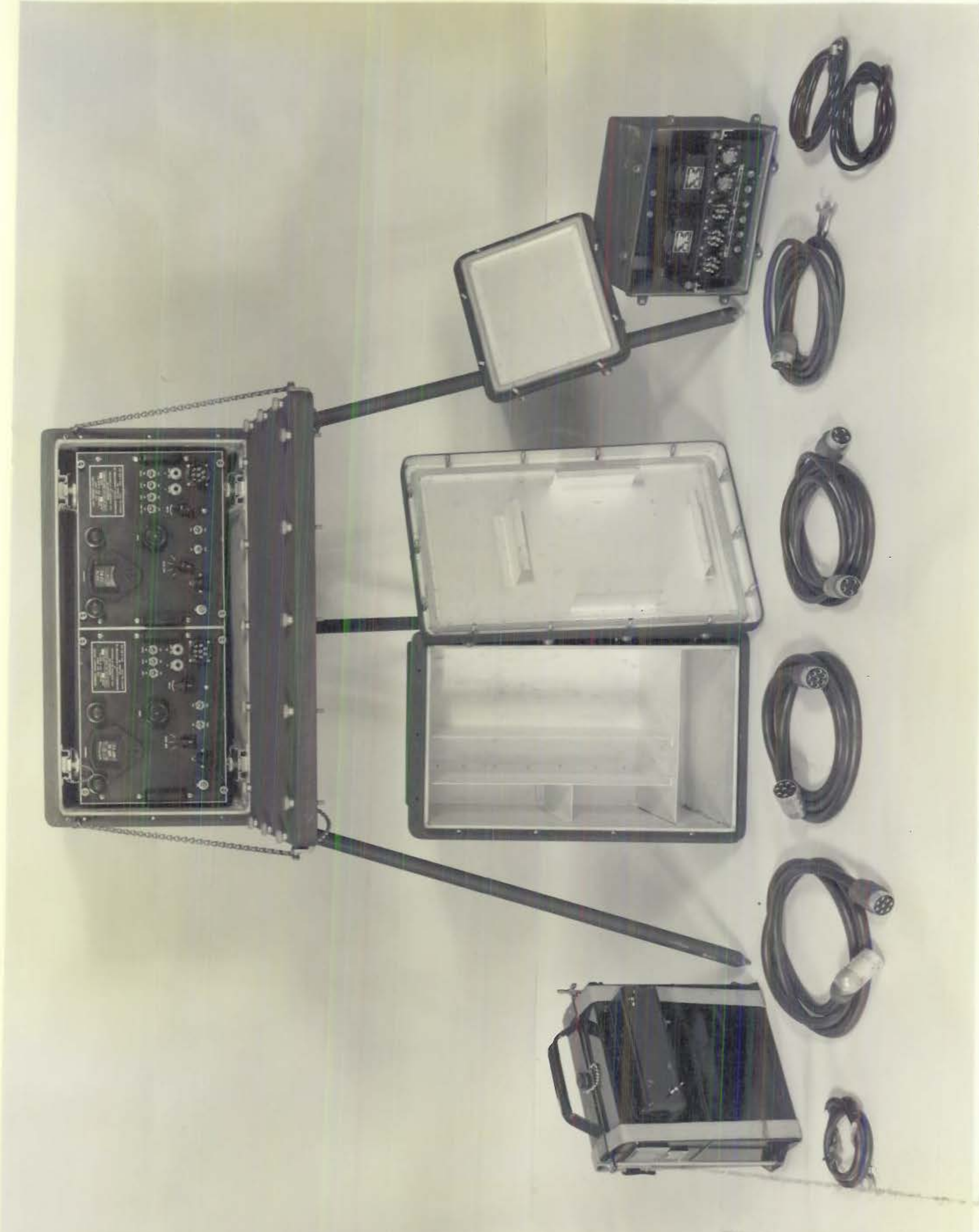


Plate 81

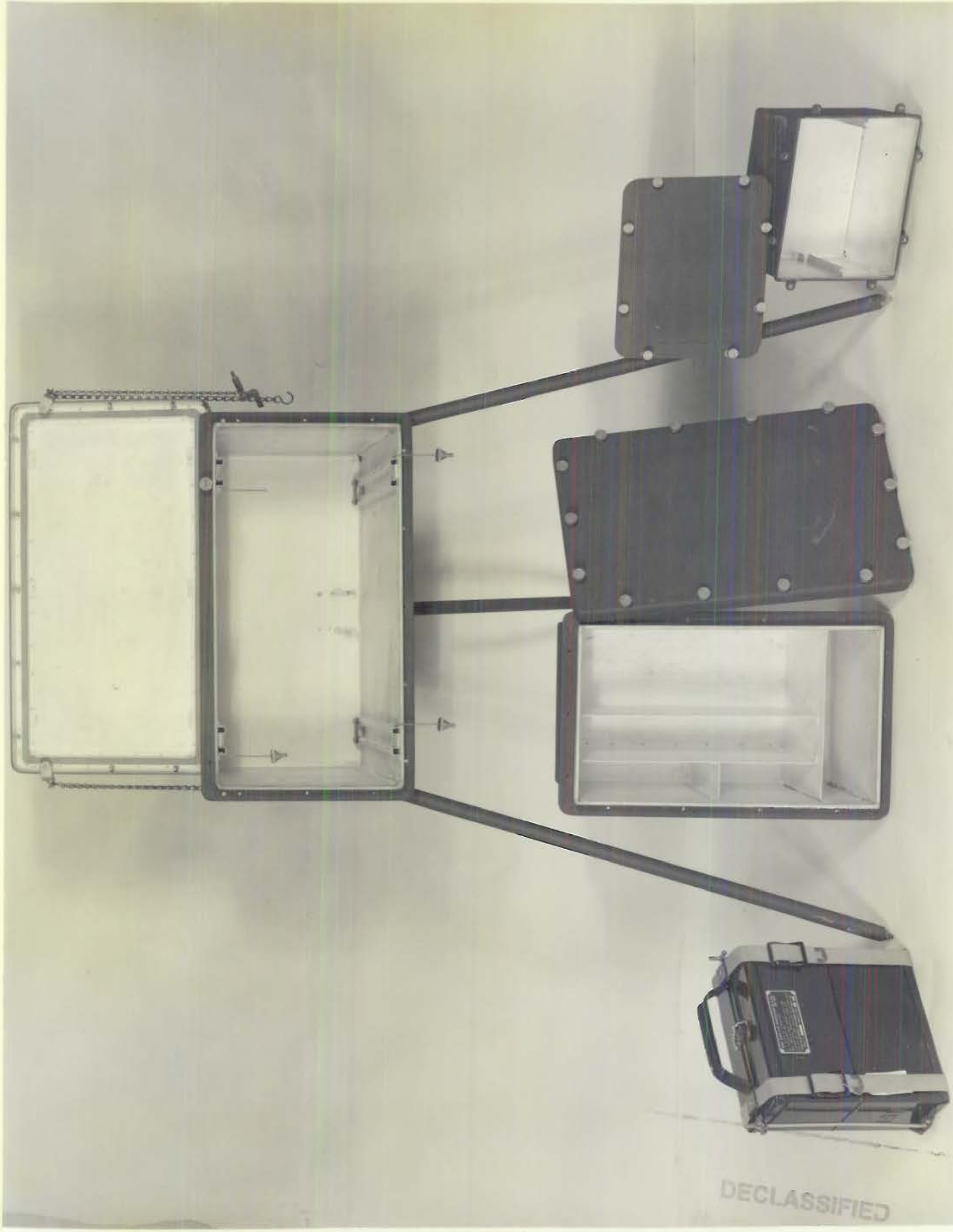


Plate 82

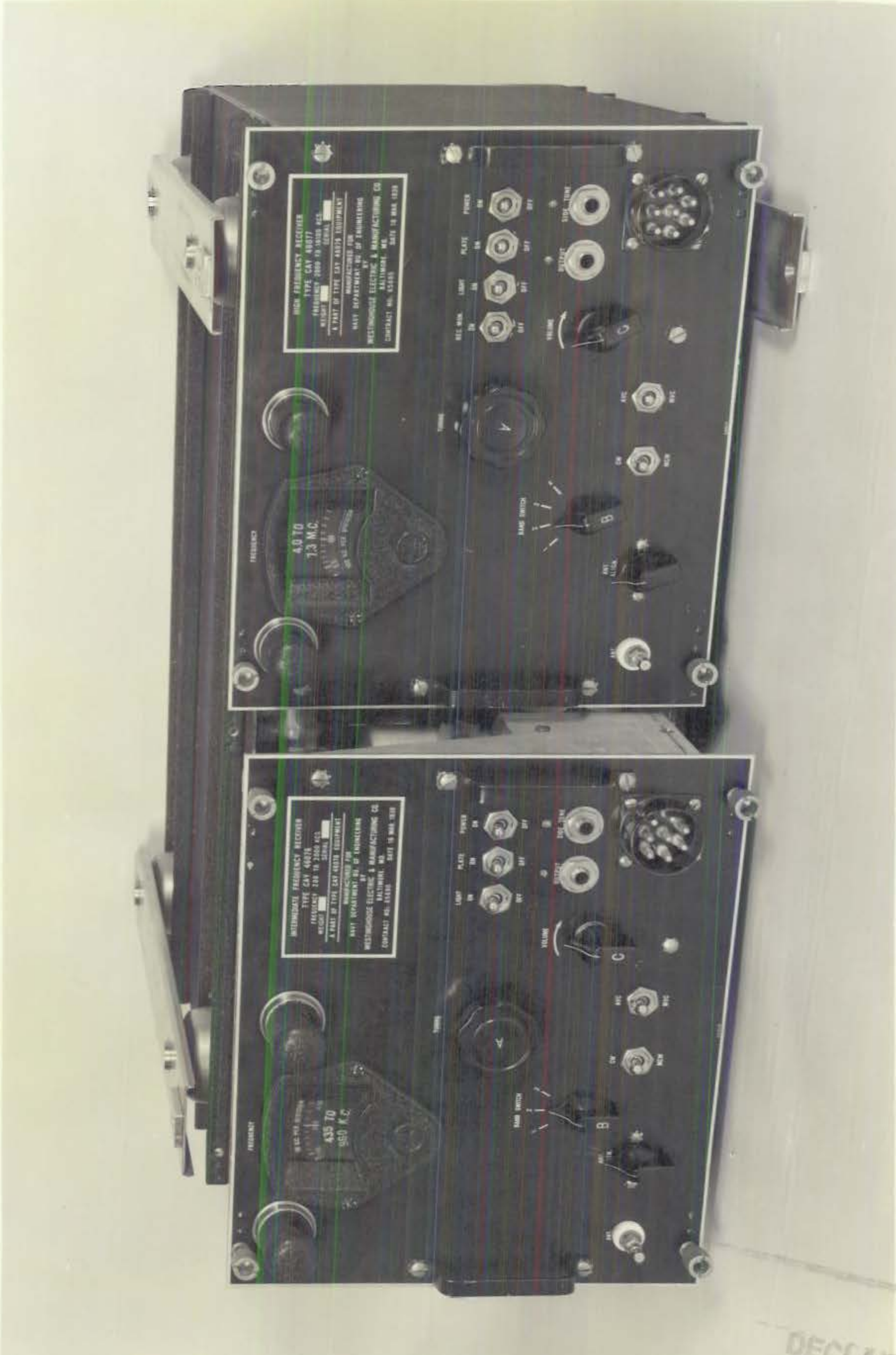


Plate 83

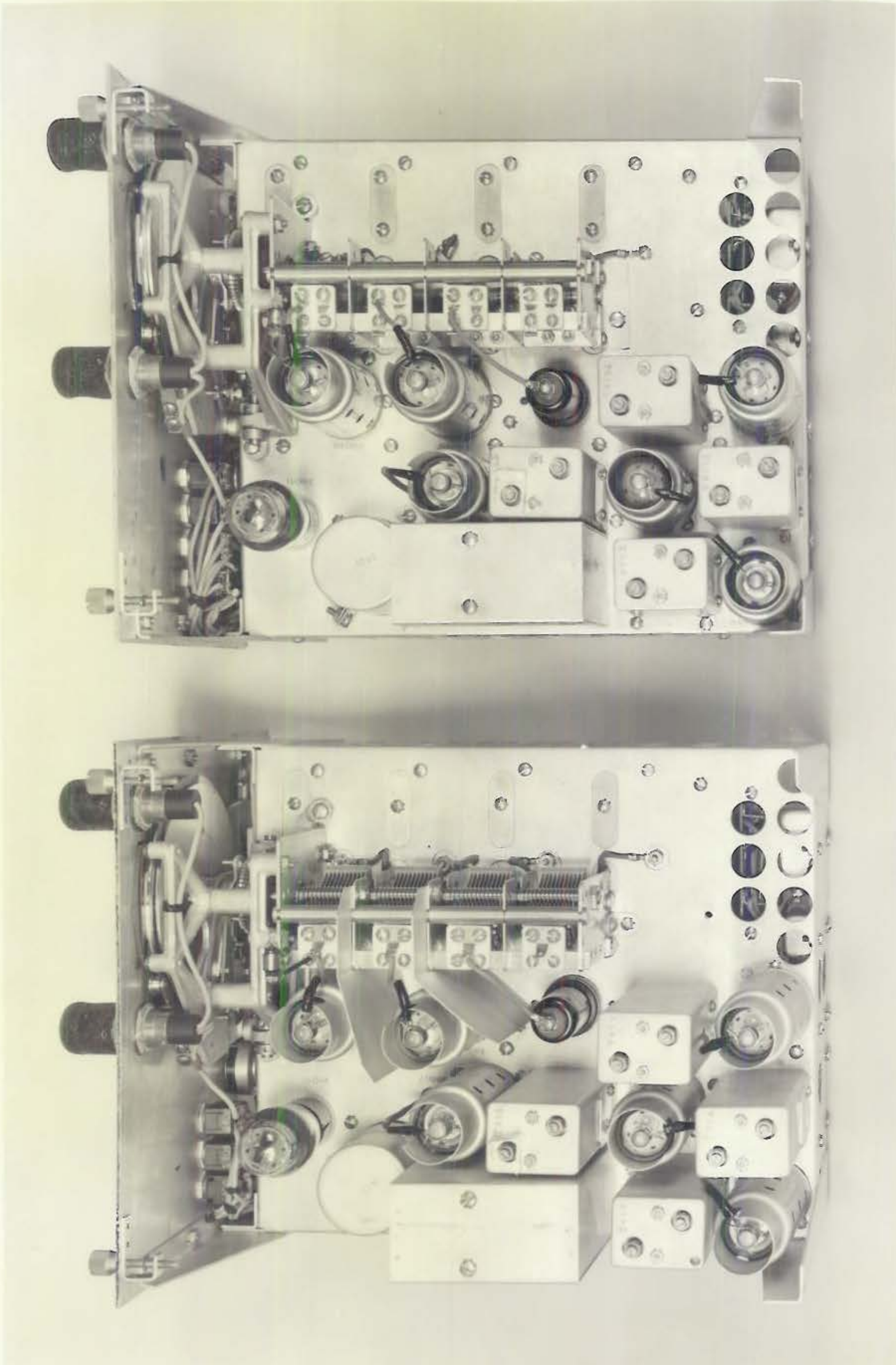


Plate 84

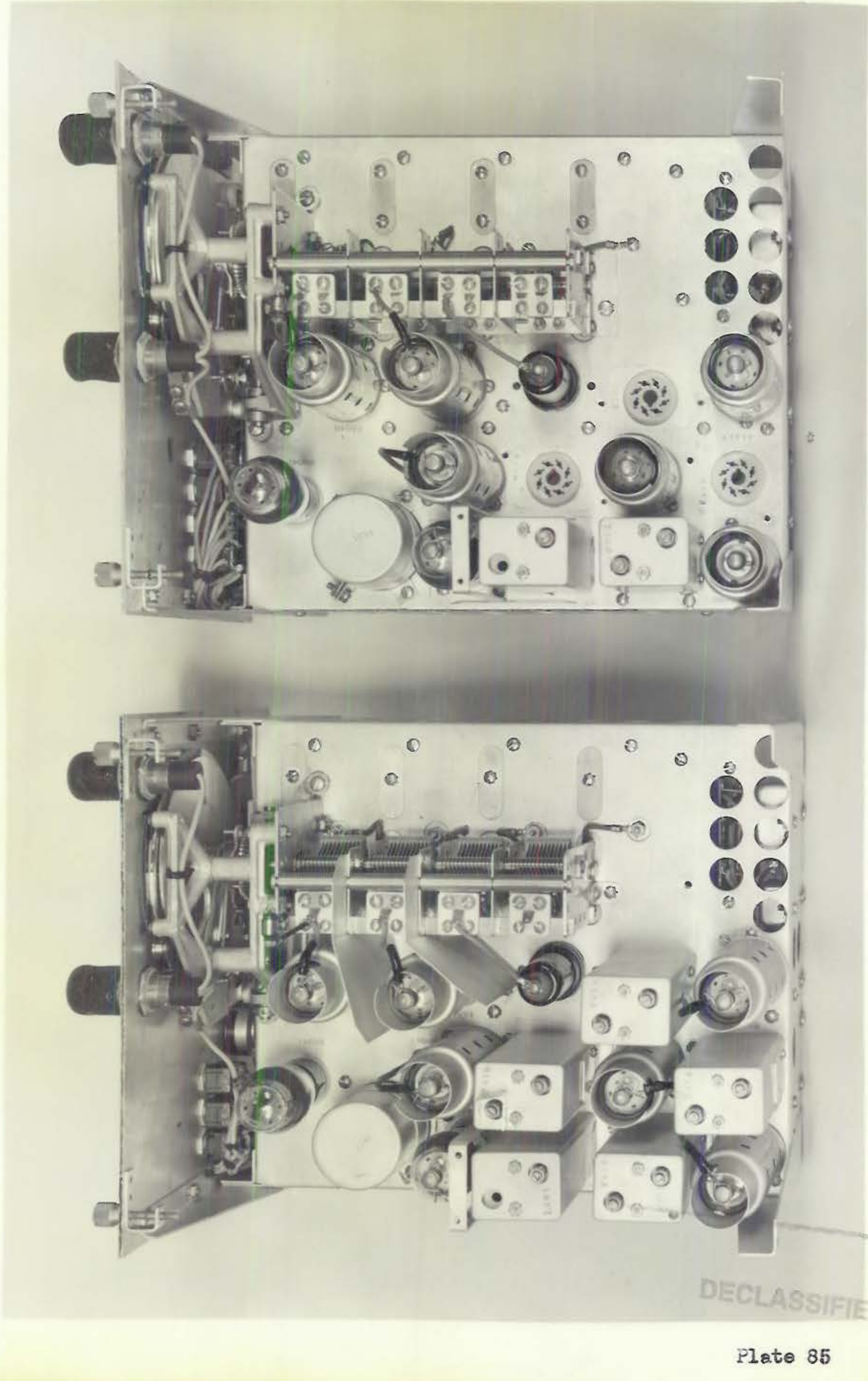


Plate 85

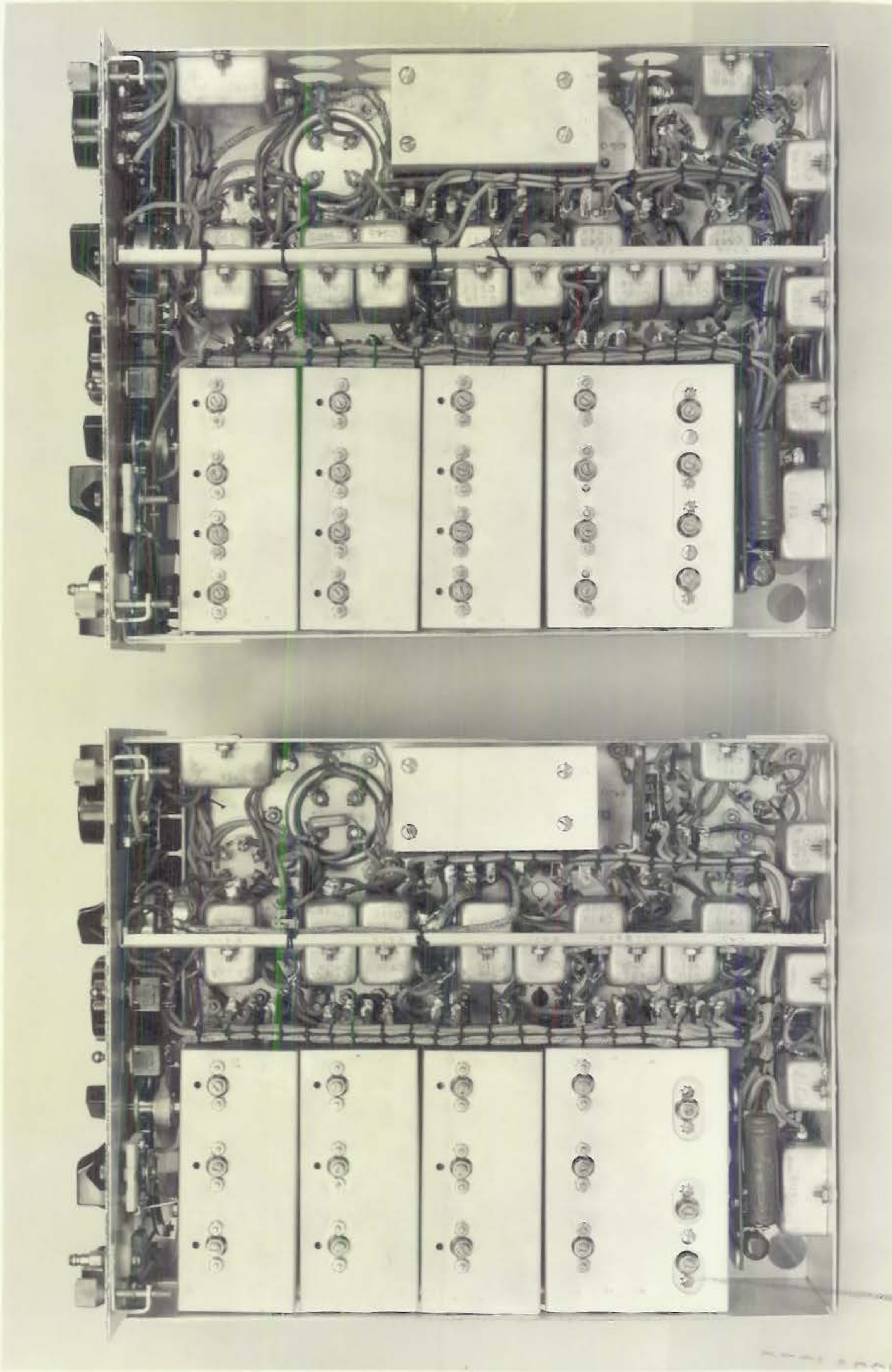


Plate 86

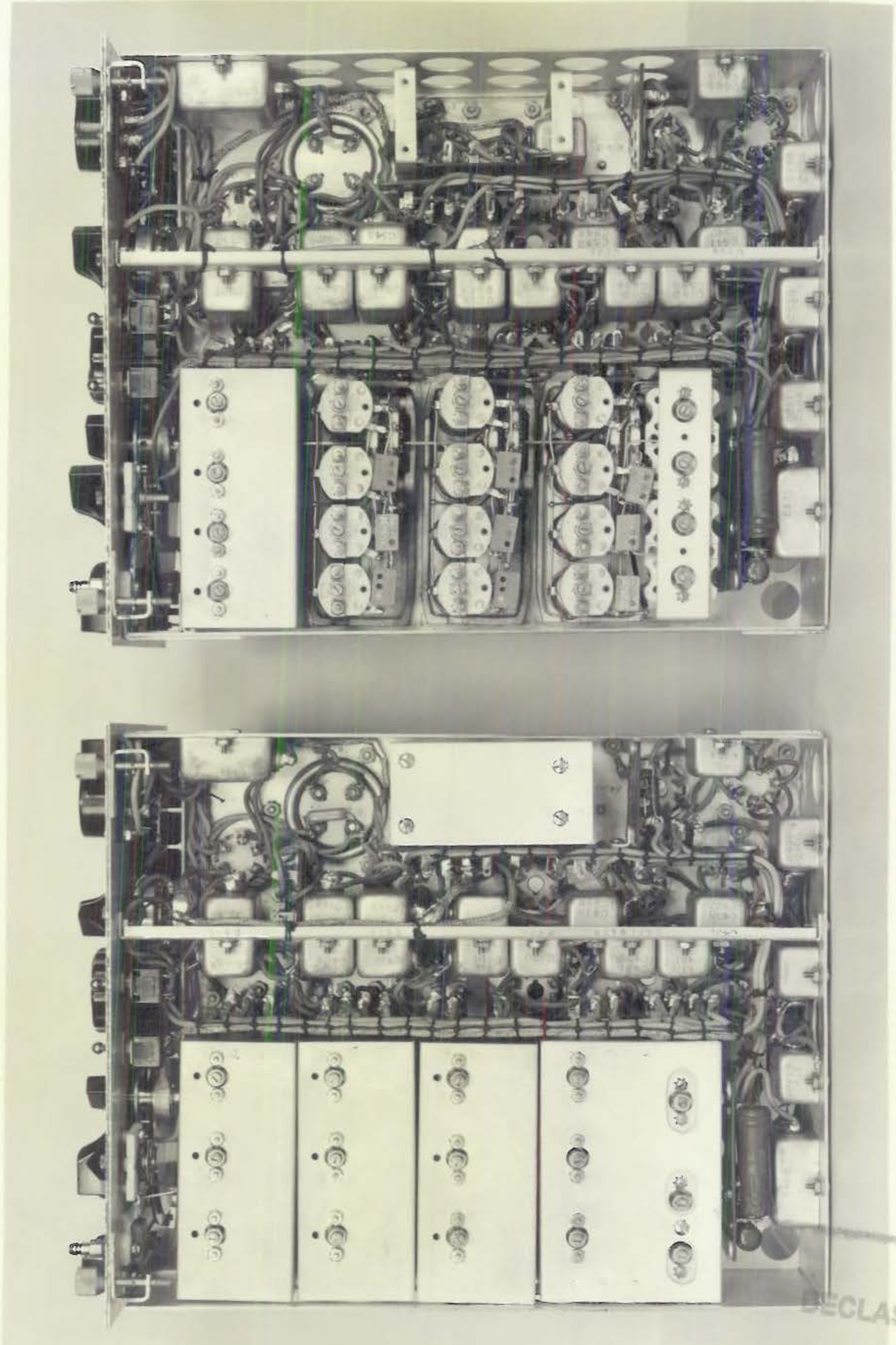


Plate 87

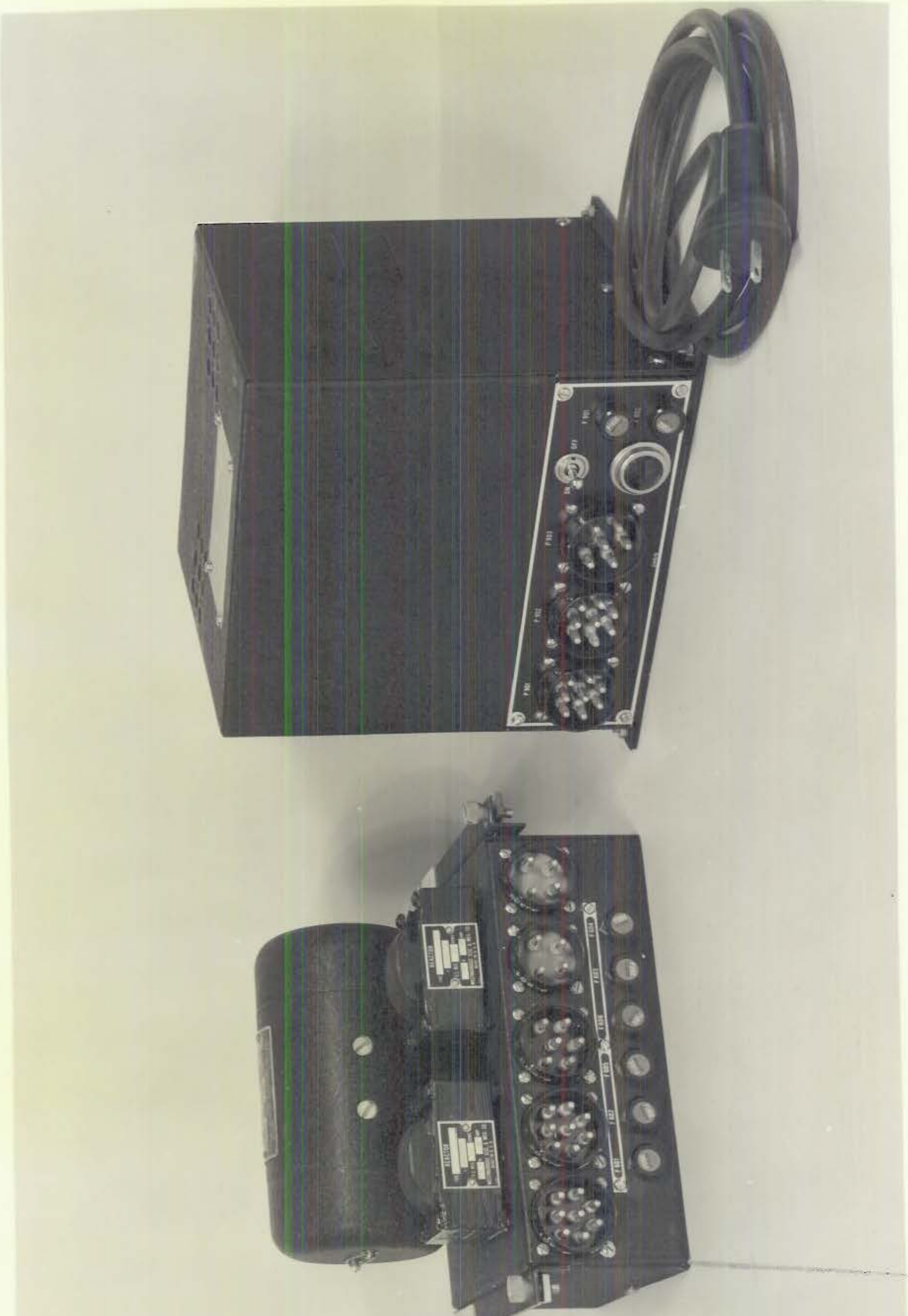


Plate 88

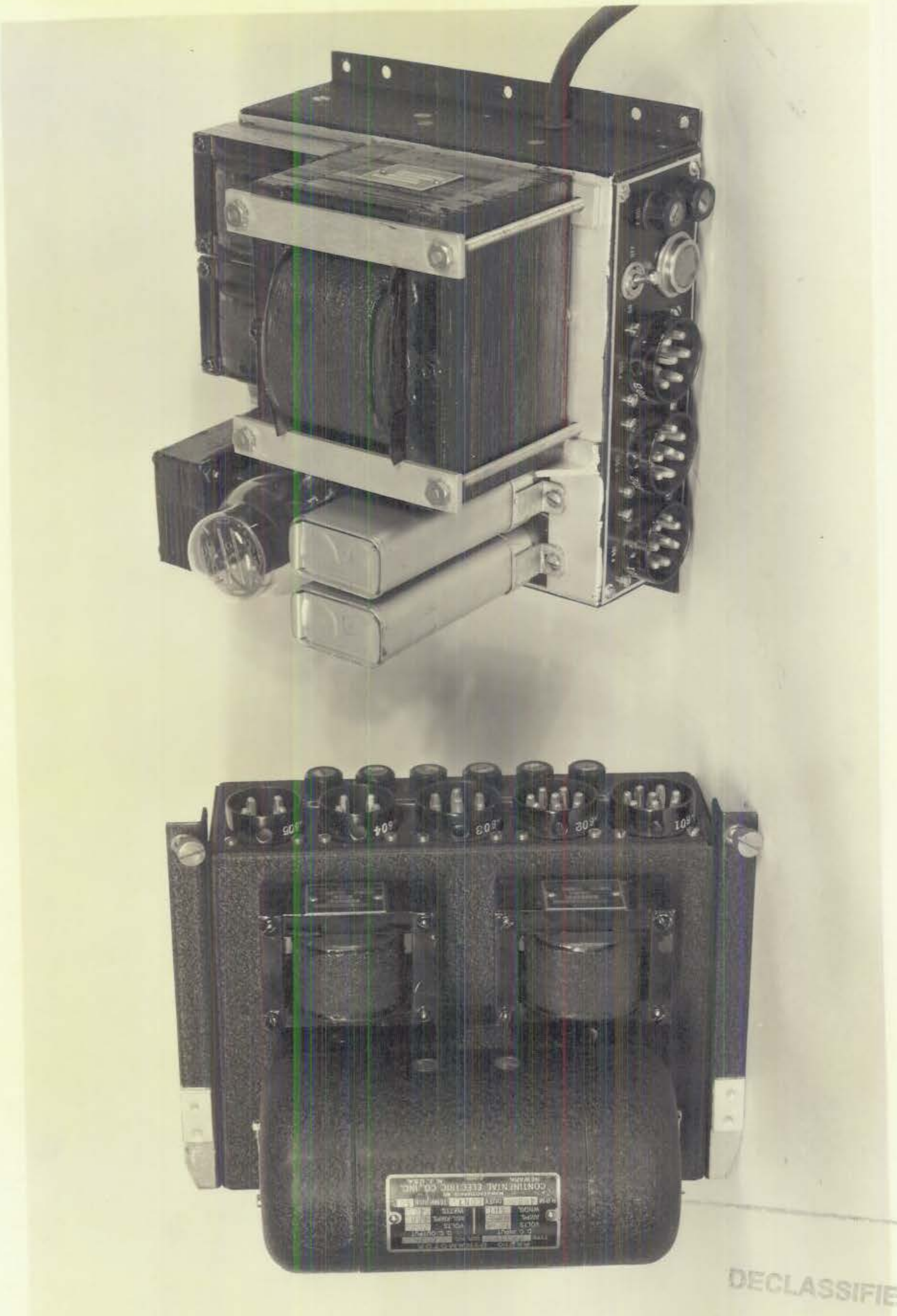


Plate 89

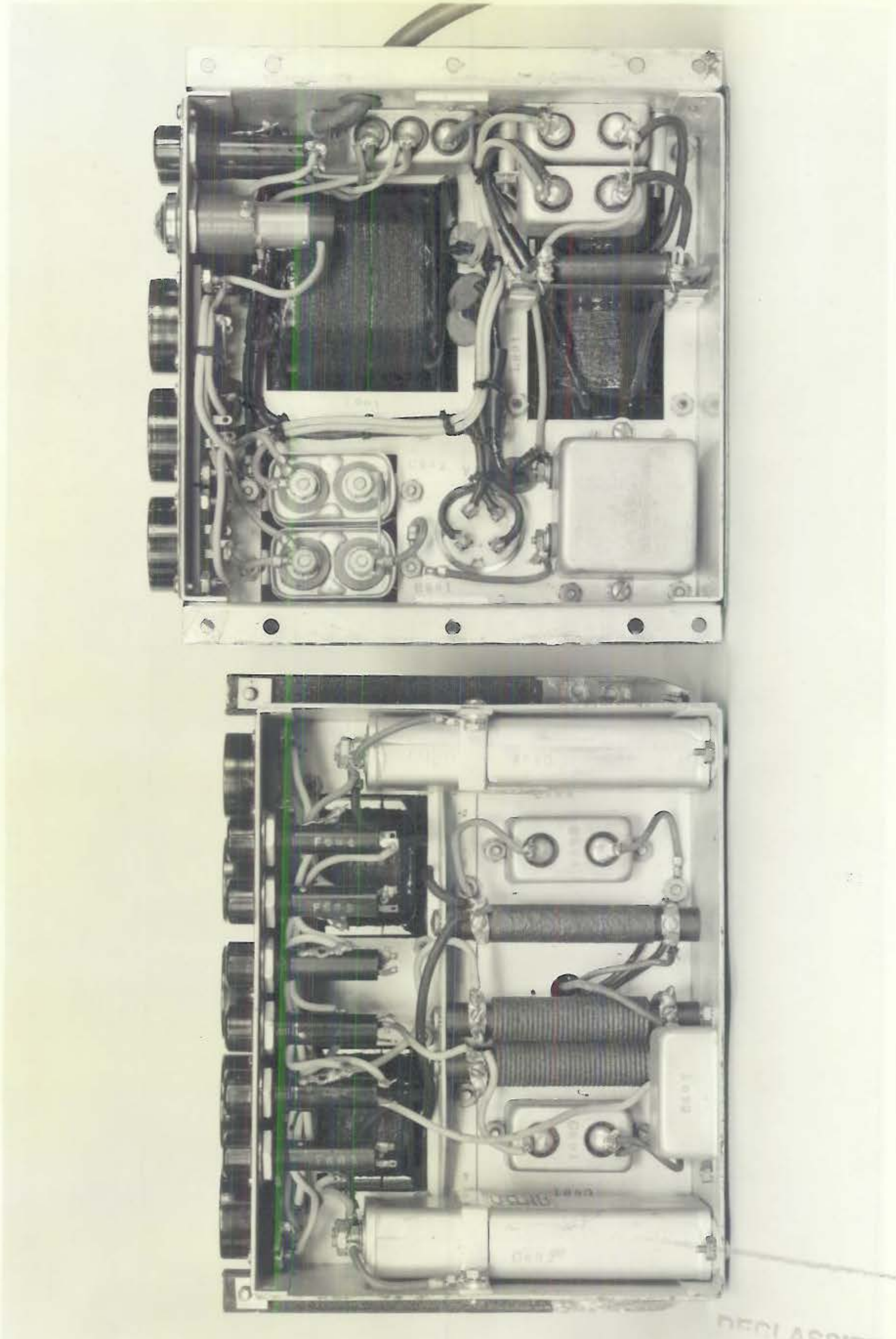


Plate 90

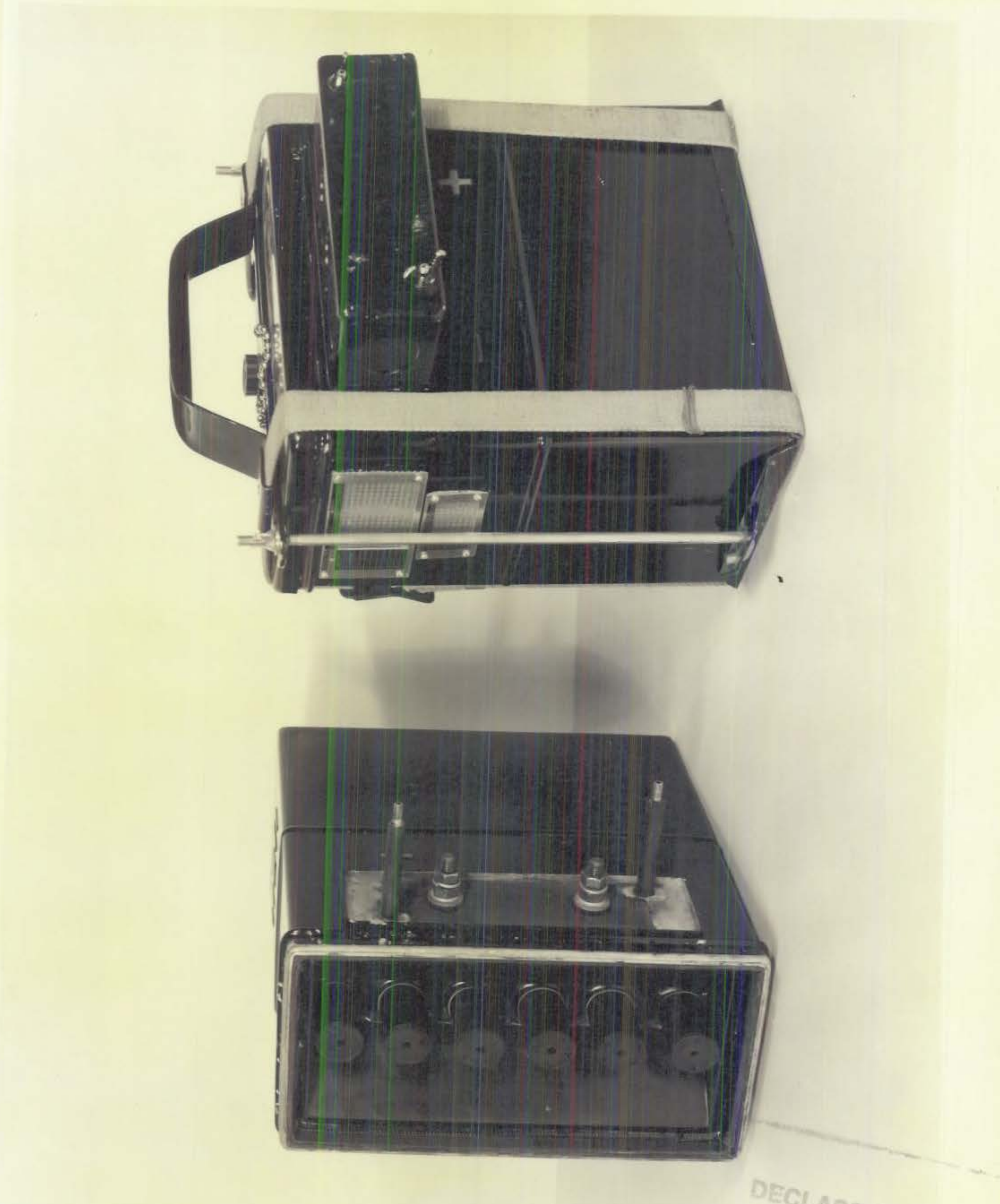
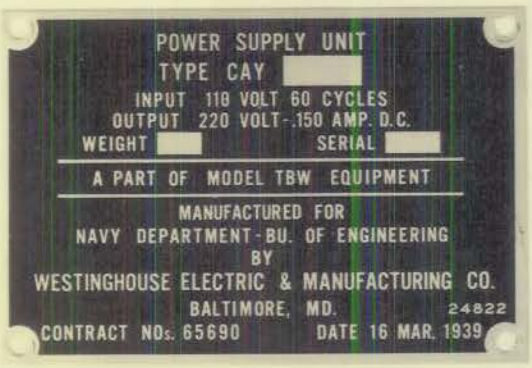
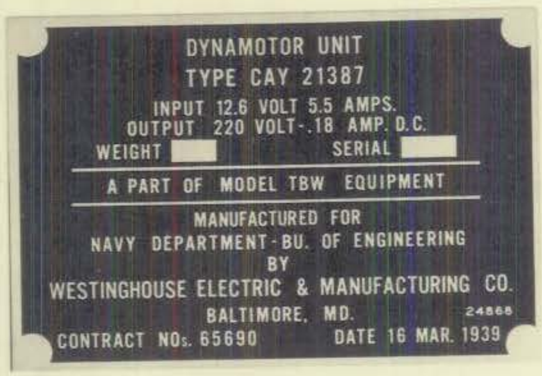
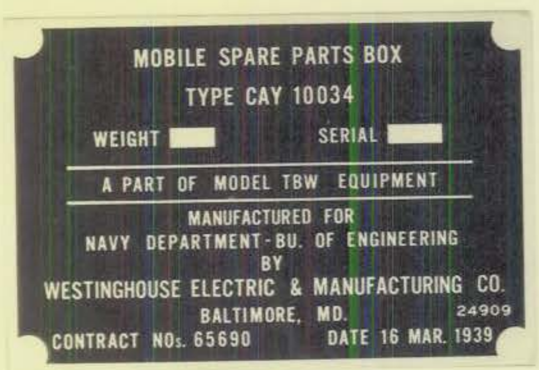


Plate 91


POWER SUPPLY UNIT
TYPE CAY
INPUT 110 VOLT 60 CYCLES
OUTPUT 220 VOLT-.150 AMP. D.C.
WEIGHT SERIAL
A PART OF MODEL TBW EQUIPMENT
MANUFACTURED FOR
NAVY DEPARTMENT-BU. OF ENGINEERING
BY
WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
BALTIMORE, MD. 24822
CONTRACT NOs. 65690 DATE 16 MAR. 1939


DYNAMOTOR UNIT
TYPE CAY 21387
INPUT 12.6 VOLT 5.5 AMPS.
OUTPUT 220 VOLT-.18 AMP. D.C.
WEIGHT SERIAL
A PART OF MODEL TBW EQUIPMENT
MANUFACTURED FOR
NAVY DEPARTMENT-BU. OF ENGINEERING
BY
WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
BALTIMORE, MD. 24868
CONTRACT NOs. 65690 DATE 16 MAR. 1939


MOBILE SPARE PARTS BOX
TYPE CAY 10034
WEIGHT SERIAL
A PART OF MODEL TBW EQUIPMENT
MANUFACTURED FOR
NAVY DEPARTMENT-BU. OF ENGINEERING
BY
WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
BALTIMORE, MD. 24909
CONTRACT NOs. 65690 DATE 16 MAR. 1939

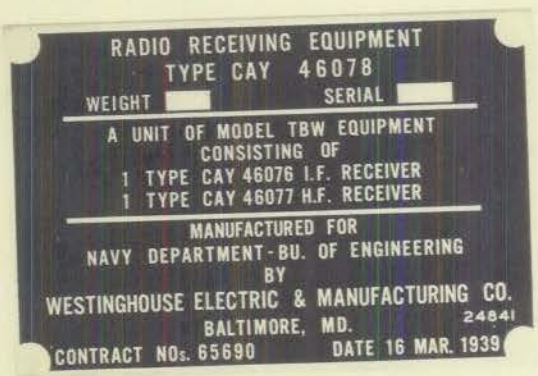

RADIO RECEIVING EQUIPMENT
TYPE CAY 46078
WEIGHT SERIAL
A UNIT OF MODEL TBW EQUIPMENT
CONSISTING OF
1 TYPE CAY 46076 I.F. RECEIVER
1 TYPE CAY 46077 H.F. RECEIVER
MANUFACTURED FOR
NAVY DEPARTMENT-BU. OF ENGINEERING
BY
WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
BALTIMORE, MD. 24841
CONTRACT NOs. 65690 DATE 16 MAR. 1939

Plate 92

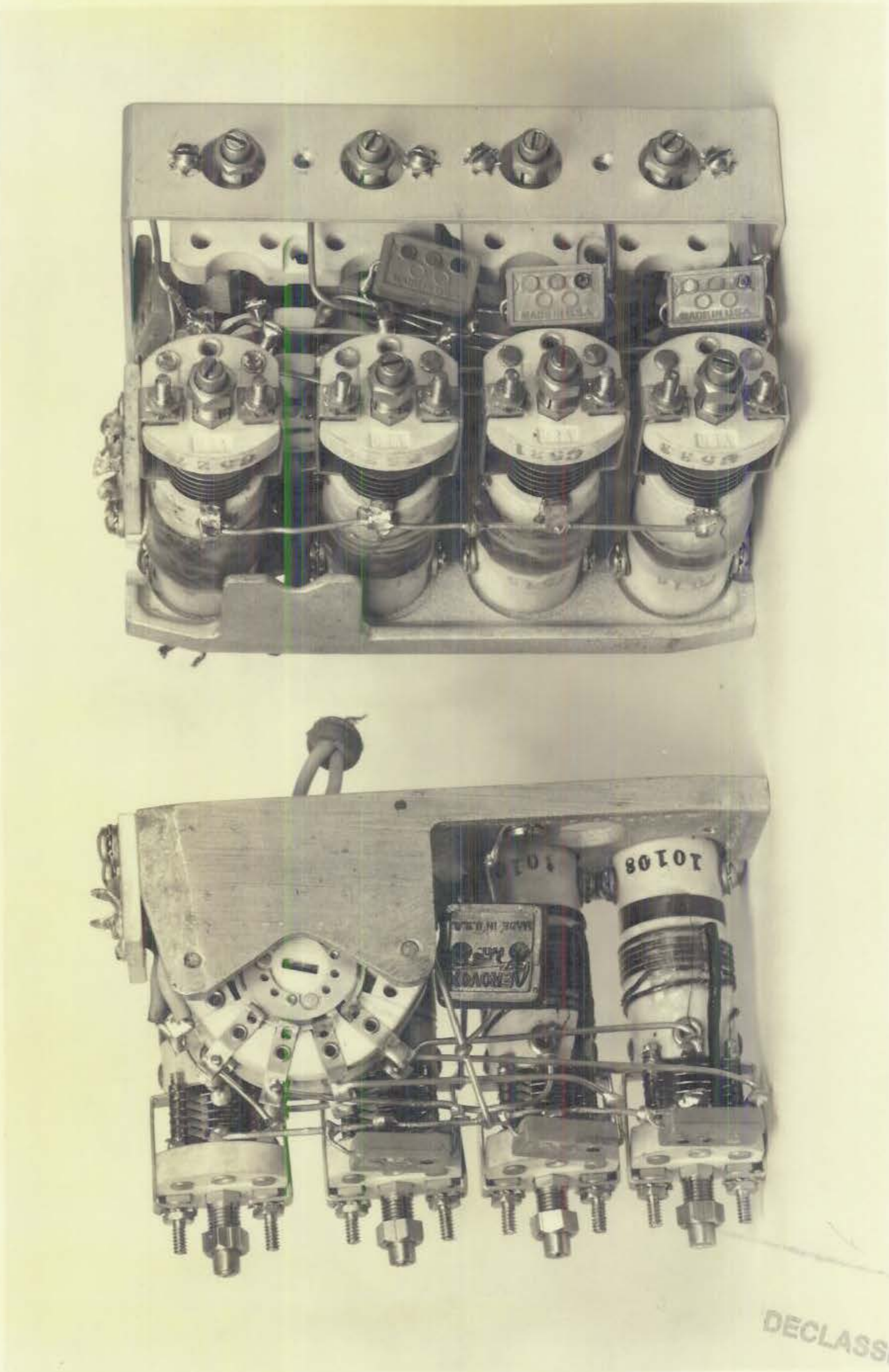


Plate 93

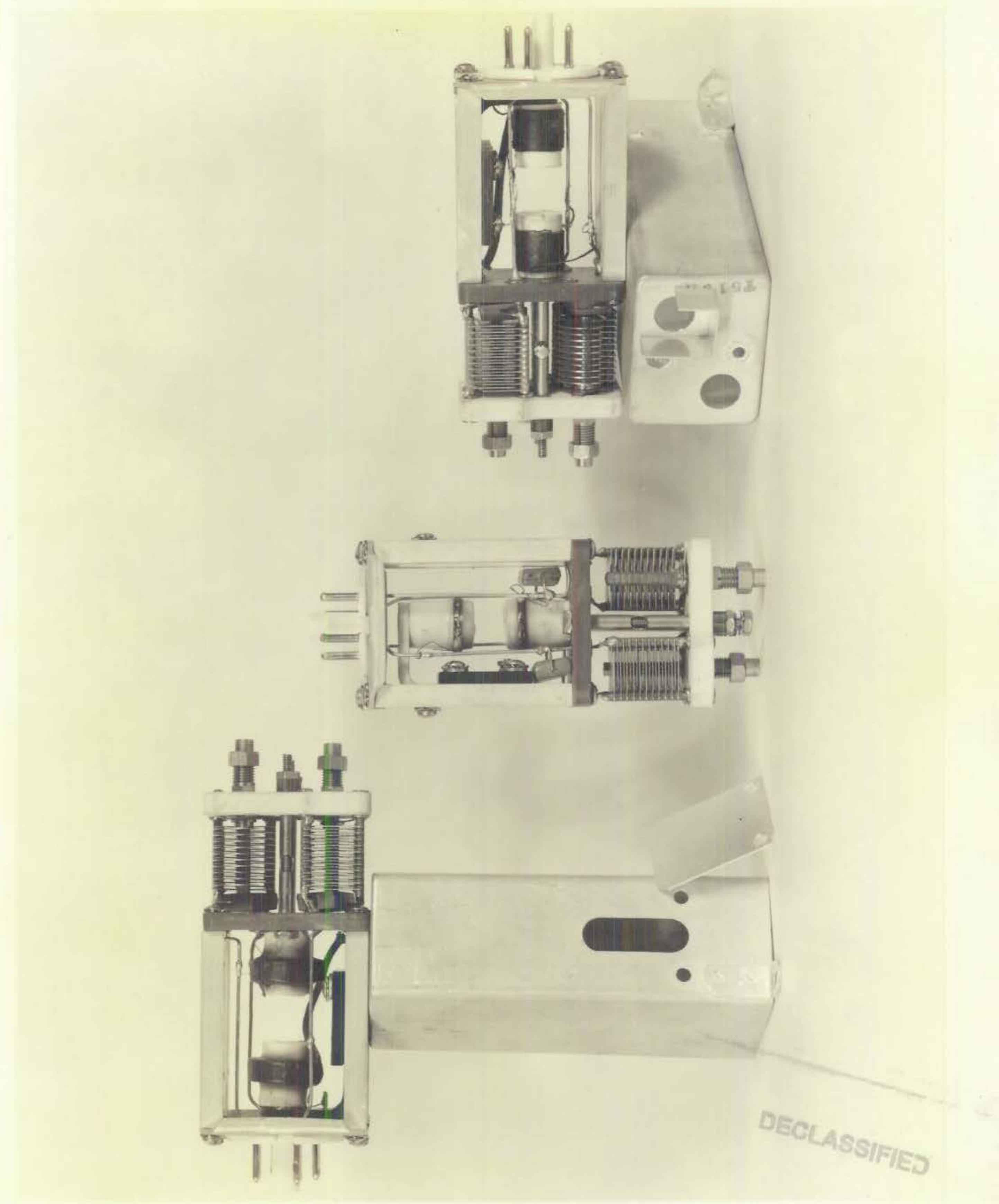


Plate 94