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NRL Report No. R-1347-A
Addenda to Report of Test of Models DP-4, DP-5, DP-6, and DQ-1
Direction Finder Receivers as given in NRL Report No. R-1347

REPORT NO. R-1347-A

DATE 19 March 1937

SUBJECT

FR-1347-A

Addenda to
Report of Test of
Models DP-4, DP-5, DP-6, and DQ-1
Direction Finder Receivers
as given in NRL Report No. R-1347

BY

NAVAL RESEARCH LABORATORY

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19 March 1937

NRL Report No. R-1347-A
BuEng. Problem D1-9

Charged to W B Burgess

NAVY DEPARTMENT

BUREAU OF ENGINEERING

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Addenda to Report of Test of Models DP-4, DP-5, DP-6, and DQ-1 Direction Finder Receivers as given in NRL Report No. R-1347

(NEW CONSTRUCTION)

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Date of Test: February 10 to March 15, 1937

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Appendices

Addenda to Naval Research Laboratory Report No. R-1347
on the Tests of the Models DP-4, DP-5, DP-6, and DQ-1
Radio Direction Finders as submitted by
the RCA Manufacturing Company.

1. This addenda covers such additional tests as were made necessary by the changes incorporated in the model by the manufacturer subsequent to the tests reported in NRL Report No. R-1347 and beginning February 10, 1937.

Reference: (a) NRL Report No. R-1347 on Test of Models DP-4, DP-5, DP-6 and DQ-1 Direction Finder.
(b) BuEng conf.let.C-NOs-45843(2-9-W8-27) of 19 Feb.1937.
(c) NRL Preliminary Report on Tests of Models DP-4, DP-5, DP-6, and DQ-1 Radio Direction Finders of 14 December 1936.
(d) BuEng conf.let.C-NOs-45843(12-17-W8)
(e) BuEng specifications [illegible]
(i) NRL Report on Test of Model DO Equipment, Report No. R-1134.
(j) NRL let.S67/69 of 18 Jan. 1937 to BuEng.

AUTHORIZATION

2. The basic authorization as included in the report to which this is an addenda applies. Further authorization for additional tests is included in references (b) and (f).

OBJECT OF TEST

3. The additional tests covered by the addenda were made to determine the degree to which the subject equipment complies with the governing contract, including the basic specifications, ref.(h), and specifically to determine to what degree the defects in the original model have been corrected. Other tests were made where it was believed that the modifications made would change the characteristics of the equipment from those reported upon in the previous report.

ABSTRACT OF TEST

4. The equipment was given a general mechanical inspection with particular reference to the parts modified since the tests of the previous model. The following electrical tests were also made to determine the characteristics which were believed to have been affected by the modifications.

(A) (a) Sensitivity with loop excitation for Models DP-5 and DP-6.
(b) Selectivity with loop excitation for Models DP-5 and DP-6.
(c) Image selectivity with loop excitation for Models DP-5 and DP-6.
(d) Range and linearity of sensitivity control with loop excitation.
(e) Resonant overload characteristics with loop excitation.
(f) Variation of audio output with angular rotation of sensitivity control and with constant input.
(g) Variation in output beat note frequency with change in signal intensity at optimum gain.
(h) Variation in beat note frequency with change of sensitivity control setting and with constant input of high level.
(i) Time constants from first tube grid-cathode to phones.
(j) Audio frequency characteristic of audio system.
(k) Load characteristic of audio output transformer.

(B) (a) Watertight integrity of loop and pedestal assembly.
(b) Responsiveness and damping factor of output meter.

(C) Additional tests not specifically covered by ref.(h).
(a) Intermediate frequency selectivity.
(b) Overload characteristics of audio system.

(D) Tests for general performance.
(a) General direction finder performance.
(b) Ease and accuracy of sense determination.

Conclusions

(a) The Models DP-4, DP-5, DP-6, and DQ-1 equipments are, in general, ruggedly constructed, present a pleasing appearance and the workmanship is, in general, of a very high quality. The band selector switch is a marked improvement over band change switches previously used in direction finder equipment.

(b) The watertight integrity of the loop and pedestal construction has been improved over previous similar equipment. Tests show that, as delivered from the factory, both units are watertight to submergence. It is believed that this integrity will be preserved if occasional and reasonable attention is given to gasket and grease replacement.

(c) The provision of adjustable resistors in the antenna circuit permit the obtainment of a more nearly ideal coupling for sense operation than in previous equipments. The modifications in the receiver, which includes the addition of a carrier operated automatic volume control and a diode detector, have made it practically impossible to obtain a reversal of sense which is a decided improvement over the first model submitted. In general, a sense bearing can be taken without a reduction in gain below that required for bilateral operation.

(d) The balancer sensitivity is considerably less than in the Model DO equipments in the low frequency band. The Laboratory does not possess sufficient data to permit a recommendation as to whether this sensitivity is ample for satisfactory operation under the wide variation of actual service installations.

(e) Aside from the lower balancer sensitivity, this equipment is an excellent direction finder and is superior to the Model DO series which precedes it.

Recommendations

It is recommended:

(a) That in lieu of the proposed aluminite finish on knobs, which the manufacturer states cannot be applied to the material used, as fine (as contrasted with coarse) a wrinkle finish as can be practically applied, be furnished. (See par. 2-8)

(b) That the colored lacquer as shown on sample submitted be accepted if applied over a sand blast finish. (See par. 2-10)

(c) That the silver contact shoes furnished on the loop collector brushes of the model be considered as acceptable. (See par. 2-11)

(d) That better inspection be made of component parts with particular reference to meter range switches to assure that mechanical imperfections do not exist. (See par. 2-15)

(e) That tapped bushings, if properly secured to the chassis, be considered as a satisfactory means of mounting the parts which are now difficult to remove or replace. (See par. 2-16)

(f) That the two leads running to the band switch, which are so close as possibly to short from vibration, be better spaced in production equipment. (See par. 2-20)

(g) That the color coding of the bus wires as proposed by the manufacturer be considered as acceptable and that proper reference to this system be incorporated in the instruction books. (See par. 2-33)

(h) That isolantite bushings in the chassis to prevent grounding of leads passing through conducting material as proposed by the manufacturer be considered satisfactory provided that they are properly secured. (See par. 2-37)

(i) That better inspection of transformer, choke, and filter construction be enforced to assure that no hygroscopic materials are employed. (See par. 2-47)

(j) That the combination of automatic volume control and diode detection be considered as a very great improvement in the equipment as a means of preventing blocking and that it be considered that its performance meets specification requirements as regards the effect of blocking on sense determinations. (See par. 2-47)

(k) That the performance of the subject equipment, with respect to bearing shifts due to control variations, be approved. (See par.3-8)

(l) That the loop structure be considered as watertight. This assumes that a gasket be provided to fit under the screw head furnished in the insulator at the top of the assembly to assure watertightness and to increase the insulation path which is now short by virtue of the

presence of the screw head which has a diameter nearly as great as the insulator thickness. (See par. 4-7)

(m) That the aperture fitting over the collector rings and brushes be considered as watertight as originally assembled at the factory. (See par. 4-10)

(n) That consideration be given to the possibility of having to remove the adapter and collector ring brush assembly upon installation and if believed necessary that extra gaskets and cement be furnished. (See par. 4-10)

(o) That a better grade of felt be furnished in the junction between the pedestal head and body. (See par. 4-10)

(p) That consideration be given to the requirement that the manufacturer tag the pedestal assembly with instructions to refill the pedestal head with the proper grade of grease prior to installation when such installations are made in an inverted position. (See par. 4-10)

(q) That consideration be given to a type of packing between the pedestal and its brush contact fittings which will not decompose from the presence of oil. (See par. 4-10)

(r) That in future equipment, consideration be given to a design which will provide a petticoat arrangement that can be inverted as necessary upon installation, to shed water whether installed in the normal or an inverted position. (See par. 4-10)

(s) That consideration be given to the probability that the primer, employed on the loop and pedestal assembly, will soften and blister or peel on the interiors under conditions of condensation; and to the necessity of a protective coating over all similar primed surfaces prior to exposure to moisture. (See par. 4-61)

(t) That the 3/16" tapped vent hole screw plug be furnished with a gasket under its head to assure watertightness and to increase the length of the insulation path at this point. (See par. 4-61)

(u) That consideration be given to leaving the primer coat off of the loop shaft exterior and the coupling interior until final assembly is made at time of installation. (See par. 4-61)

(v) That consideration be given to the added length requirements for installation of the receiver which amounts to an increase of 4". (See par. 5-3)

(w) That consideration be given in the design of the right hand rear servicing bracket to assure that it will not interfere with azimuth lamp leads which will run from the stuffing tube in the right hand box wall to the plugs mounted on the back box wall. (See pars. 5-3 and 5-8)

(x) That inasmuch as the toggle switches have been purchased and that the governing specifications do not make it mandatory to supply a greaseless switch; consideration be given to the acceptance of the switches purchased, but that future specifications require the greaseless type. (See par. 5-14)

(y) That no variation in the specification requirements as regards tuning linearity from 0 to 800 divisions on the tuning dial be allowed. That from 800 and the normal part of overlap between frequency bands, or the point of the highest required frequencies of the receiver for any 10 divisions of the dial shall not be less than 75% nor more than 190% of the reference value. (See par. 5-37)

(z) That as the decibel meter characteristics are well within the limits given in par. 5-59 of ref.(d), it be considered as satisfactory. (See par. 5-59)

(aa) That inasmuch as the contractor has stated that tubes possessing the "spurious oscillation" characteristics are the exception instead of the rule in production, it be required that tubes furnished on this contract be taken from production lots in which a test of 10% of the total number of tubes furnished shows that none have these characteristics. (See par. 5-72)

(bb) That the instruction books for these equipments state the approximate microamperes that can be expected in the diode circuit (where arrangements for a meter have been provided) for both the CW and MCW conditions, with no signal voltage applied and with such signal inputs as would be practical for service measurements. (See par. 5-81)

(cc) That the Bureau of Engineering by reference to shipboard direction finder calibrations, determine the advisability of approving the low balance sensitivity of the Model DP-4 and DQ-1 direction finders as reported herewith. (See par. 5-98(1).

(dd) That the next direction finder specifications be so written as to eliminate the apparent contradictions of par. 5-98 of the present governing specifications. Assuming that the present ratios are to be specified, the following wording is suggested: "With the equipment properly tuned to any given frequency within its range, with loop set for maximum bilateral signal and with standard balance anatenna, the theoretical field strength in microvolts per meter applied to the antenna alone to produce standard output shall lie between 0.167 and 3.33 times the similar field strength applied to the loop alone for standard output. The ratios shall be computed from the measured absolute microvolts required through a dummy standard balance antenna and the absolute microvolts required at the loop center, each for standard output, and each reduced to microvolts per meter by use of the assumed effective height of the balance antenna and the calculated effective height of the loop for the given frequency.

(ee) That the sense button contact springs be so anchored as to prevent rotation even though their securing screws become loosened. (See par. 5-102)

(ff) That consideration be given to the additional 5-1/2" in length which is required at installation of the power unit due to rearrangement of the power cable connections to the box for compliance with the suggestions of ref.(d). (See par. 6-5)

(gg) That at least 3/8" of the back skirt of the power unit chassis be cut away for a distance of not less than 1", as near the corners as practicable, for clearance of cabinet mounting bolts. (See par. 6-6)

(hh) That the third screw for holding the two parts of the power cable plug shells be furnished as proposed by the manufacturer. (See par. 6-19)

(ii) That inasmuch as the sensitivity is so near to specification limits in the high frequency band and further that the obtainment of a passing sensitivity is so dependent upon the setting of the tuning dial at the time of alignment, the proper tuning condenser setting for alignment be included in the instruction books. (See par. 7-2)

(jj) That in future specifications the conditions for selectivity measurements be either limited to CW operation or that if MCW selectivity is desired, the precise method of measurement be defined with allowance for the increased width due to the presence of side bands. (See par. 7-3)

(kk) That the frequency variation with change in volume control as demonstrated by the model be considered satisfactory, and that the need for additional regulation from a grid glow tube is not justified. (See par. 7-18)

DESCRIPTION OF MATERIAL UNDER TEST

5. The equipment is essentially the same as described in the basic report with the following exceptions. The loop and pedestal structure have been modified to assure better watertight integrity. The band around the periphery of the loop has been clamped over a rubber gasket cemented to this band instead of using a non-compressible bakelite gasket as formerly. The top insulator has been made in the form of a complete rectangle instead of a "U"-shape. The rubber gaskets between this insulator and the ends of the loop housing are also of rectangular shape and when the two ends of the loop casting are clamped together with the bolts provided, these gaskets, forming a complete ring, are compressed to give a watertight seal without the probability of leakage as was the case when a "U"-shaped gasket was used which depended upon proper butting of the gasket ends for a seal. The clamping members around this insulator have been strengthened, which is a decided improvement over the previous design. A tapped hole 1/4" - 20 with a cap screw seal is provided at the loop top which is drilled through the insulator. It is understood that this is provided for air hose connection in order that the loop housing may be dried out, should it become necessary as a result of condensation. (See photograph, Plate 28, for exterior view.) The loop was not disassembled as external inspection indicated that the questionable parts had been modified and it was understood from the manufacturer's representative that the interior loop construction was the same as previously submitted. Disassembly of this loop, it is understood, would destroy the rubber gaskets as they are cemented to the metal parts and cannot be removed without destruction.

6. The loop pedestal head was changed in accordance with drawings which, it is understood, have been submitted to the Bureau. This change consists essentially of the use of a larger felt gasket which overlaps the space between the head and body of the pedestal. This gasket, when saturated with and backed by a heavy grease, is expected to prevent the entrance of water from rain or spray. The gasket material is not as homogeneous as would seem necessary, as the binder appears to have become ineffective as a result of oil saturation resulting in a lack of adhesion of its constituent parts. The brush assembly has been modified to have silver contacts brazed on to the spring fingers. This brush assembly is now mounted on a flat cast plate which in turn secures to a second casting with nine screws. This second casting has been made to fit in place of the curved sheet brass plate that was of questionable rigidity in the former model. It fits over the cylindrical surface of the pedestal body and is clamped in position by a "U" bolt of stainless steel. This second casting provides an adapter which permits the use of a flat plate for brush mounting as mentioned above. Soft rubber gaskets are used between these castings and the casting and pedestal body. (See Plate 29.)

7. The changes in the receiver consist of the addition of an automatic volume control on the two i.f. stages, the use of a "76" tube for a detector, connected as a diode, the addition of an extra audio stage employing a "6C6", and more sharply tuned i.f. transformers which also have a higher Q. The automatic volume control system depends upon the

IR drop in a resistor placed in the grid circuit of the second i.f. stage to control the effective bias on the first i.f. stage as well as its own bias. This is not effective until after a six milliwatt phone output has been obtained as there is not sufficient grid current drawn below this level to materially change the bias of either tube from normal. The diode type of detector has been provided as it will not overload within its range of operation. The 606 tube previously used as a detector has been used in a resistor coupled audio amplifier stage to compensate for the less sensitive detector employed. This adds one tube to the complement given for the previous model, but does not add any new type of tube. The sharper i.f. stages were required in order that selectivity requirements could be met.

METHOD OF TEST

8. The methods employed for the several tests were as described in the basic report except as follows. The letters refer to the tests as given under ABSTRACT OF TESTS. The test set-up differed from the one used on previous tests in that the loop and receiver were placed in a separate screened booth from the signal generator on all tests.

9. Test A(i) was made with the impact and desired signal applied directly to the first tube grid and cathode instead of feeding through the loop as was previously done. This method permitted the use of available equipment which did not have sufficient power output to give a 5 volt impulse across low enough impedance at the loop center to permit the loop to function normally.

10. Test A(j). The input voltage to the audio system was fed across the 1 megohm diode resistor for the measurement of audio frequency characteristic.

11. Test B(a). The loop Q was measured with several values of shunt capacitance and then secured in place on its pedestal. The loop and pedestal assembly was placed in a tank of water in an inverted position. The water was of sufficient depth to completely cover the loop and the rotating pedestal head so that the felt gasketed joint between the head and the pedestal base was under water. After 40 hours the assembly was removed, the loop Q again measured and visual inspection was made for leaks.

12. Test B(b). The decibel meter was tested for its responsiveness and damping factor at its "0" decibel graduation with a 1,000 cycle input. The meter and a stop watch, the hand of which rotated a complete revolution in 3 seconds, were placed side by side and for several cycles of voltage application, sufficient to give a "0" decibel deflection, when the needle had come to rest, they were photographed by a moving picture camera with 64 frames per second. The time required for a complete excursion of the needle or any part thereof was obtained from a study of the films.

DATA RECORDED

13. The data recorded are shown in Plates 1 to 27 inclusive.

PROBABLE ERRORS IN RESULTS

14. The same allowance for errors should be made as listed in the basic report for such measurements as those figures are applicable.

Test	Maximum Probable Error	
Decibel Meter Test	Degrees	1.0
	Milliseconds	10.0

RESULTS OF TESTS

15. The tests reported upon herein are those made since the preparation of ref.(a) to which this is an addenda. These tests were made on the resubmitted model which was modified to overcome certain failures in specification compliance as given in ref.(d). Some of the modifications asked for in ref.(d) have not been made but the manufacturer, in lieu thereof, has submitted proposed remedies in ref.(e). The proposals of the manufacturer as outlined in this reference as well as the tests made covering the incorporated modifications will be discussed under the paragraph headings as appear in ref.(e). Certain other tests which were considered essential to determine to what degree the incorporated modifications change other characteristics not listed in ref.(e), will be discussed under the appropriate paragraph headings as appear in ref.(h).

16. 2-2. Does not require Laboratory action.

17. 2-8. No improved knob samples were submitted. The use of wrinkle finish on all of the major control knobs will not provide as good appearance as would knobs having a polished surface. The added ruggedness of the proposed all metal knobs is desirable and if a smooth and durable finish cannot be provided and the wrinkle finish is accepted, it is recommended that attempt be made to provide as fine a wrinkle (as contrasted with coarse) as possible.

18. 2-10. The lacquered finish as displayed by the sample, over a sand blast finish, appears to be satisfactory. The lacquer on the smooth surface does not appear to adhere to the metal so that it is easily peeled off from such abrasion as might be expected from the handling incidental to servicing.

19. 2-11. The coin silver shoes provided on the loop collector ring brushes are satisfactory.

20. 2-15. The meter range switch has been made to operate in a smooth and satisfactory manner. From the fundamental design of the switch it would not appear that it should depend to any great extent on lubrication for proper action provided that it is properly adjusted mechanically.

If it does depend upon lubrication to the degree implied by ref.(e), it cannot be expected that factory lubrication will assure continued satisfactory operation.

21. 2-16. The manufacturer's plan to provide tapped bushings in the chassis for mounting the by-pass condensers which were difficult of replacement in the previous model would appear to be acceptable.

22. 2-20. The rearrangement of the bus wire leads in the antenna tuning compartment has provided better rigidity. These changes together with those proposed in ref.(e) should, with one exception, provide satisfactory rigidity and protection from possible short circuit. The exception refers to the close proximity of two right angle bent leads on adjacent contact blocks of the band change switch. These contact blocks are designed to permit thrust motion and with such motion as might result from severe vibration, these leads could short circuit. A slightly different bend of these leads will provide the necessary safety. The use of a chemically neutral lacquer at the soldered joints and over the exposed portions of the fine wire windings together with a general shortening of these leads to prevent movement from vibration would appear to satisfy the criticism as made in ref.(c).

23. 2-33. The proposed color coding of bus wires with enamel or lacquer, as in the Model RAK-RAL equipment, with descriptive reference to same in the instruction books, should satisfy the criticism as given in ref.(c).

24. 2-37. The use of isolantite bushings to prevent grounding of leads passing through shields should be satisfactory if properly secured in place. No samples were submitted.

25. 2-47. The reason for the failure of the Type RT-426 transformer is given by the manufacturer in ref.(e). No new samples were submitted. Apparently the manufacturer feels that his design is satisfactory, but that inspection was not, in this particular instance. The Laboratory agrees with the manufacturer which means that much closer inspection will be required if specification performance is to be assured.

26. 3-8. Ref.(c) reported shifts of 5 or more degrees due to maladjustment of the balance. The measured constants of the balance antenna were reported in Table 13 of ref.(c). These data showed no unusual tendencies. No points were taken on the exact test frequencies used because of the interference with readings caused by received energy from the stations used for tests. Ref.(e) states the manufacturer's belief that the minimum shifts reported were due to the test conditions. This had been considered at the Laboratory. The test position, on the roof of Building 12, was that used for the Model DO tests. Its characteristics over the subject frequency band were considered well known and more favorable than many shipboard locations. It was preferred as providing a better test than an "ideal" site, because such a site does not require balance variations and would not be a test for some of the subject specifications. Tests were immediately made on an available Model DO equip-

ment under duplicate conditions. The results were substantially similar to those obtained with the subject equipments. Brief comment on these results is contained in ref.(j). When the sample equipment was resubmitted, it was again tested in the presence of the manufacturer's representative. The receiver was tested with the Model DO loop and pedestal, which are electrically similar to those of the sample. At the lower frequencies, bilateral results were excellent as before. Specific test data taken on local broadcasters are plotted on Plates 24, 25, and 26. Abscissae represent loop azimuth scale readings with partial scales for both direct and reciprocal bearings. Zero displacement of the bilateral bearings is indicated by both minima on the same vertical line. Ordinates are the balancer settings used. The observations consisted in arbitrarily setting the balancer at -50, 40, etc. to +50 and taking the four scale readings for which the signal rose 1 decibel above each of the minimum values. In addition, each minimum was recorded, with proper balance for sharpness. The curves plot the width of the minimum for any balancer setting. Zero width indicates a perfect minimum. It will be obvious from Plate 24 that at 630 kilocycles the minima are closely opposite and that the center of a poorly balanced minimum does not shift right or left materially, even for minima as much as 50° wide. Plate 25, however, shows no sharp minima obtainable on either side over the balancer range. The minimum assumed to be the "direct," although it is not known to be so, shifted from 247° to about 310°, while the other side showed a similar tendency. No useful bearings could be taken on this frequency. This was not the case during the original DO tests, the first tests on the subject equipment, or the recent special tests with Model DO equipment. Plate 25 shows still another condition. Here, sharp minima were observed at 359.3 and 180.2°, roughly a degree displaced from opposite. (All three transmitters observed bear nearly due north of the Laboratory.) In this case, although excellent bearings are obtainable, there is a marked tendency to drag minima around the scale as the balancer varies, from a bearing of 10° at +50 balance to 305° at -20 balance. No minimum could be observed on either side when the balancer was forced beyond 30 on the wrong side. It is significant of each of these three plates that the minima for symmetrical balancer settings are closely opposite, and in each case the observations made with neutral balancer setting (actual zero coupling) could be repeated with the antenna disconnected. In addition, for Plates 25 and 26, where shifts are shown, the use of the same balancer setting for both minima induces serious displacements from opposite except at zero balance. This shows wrong phasing of the antenna circuit. The displacements are obviously due to balancer coupling. However, since Plate 100 of ref.(a) shows balance detuning between 20 and 30% over the whole high frequency band with a dummy antenna, any in phase component in the balance effect must be due to influences outside the equipment proper. This third series of tests having been the first to show such radical conditions on 950 kilocycles and inspection having failed to show any reason for such a change, a portable direction finder was employed for test. It was found that when this portable equipment was wheeled toward and around the west tower of Building 12 (supporting the far end of the balance antenna) that all bearings on 950 kilocycles seemed to point to the tower itself. This tower supports several antennae, none of which appeared likely to be the cause of the apparent resonance. This particular frequency has previously shown a high deviation, but otherwise has permitted good per-

formance. It appears that conditions have appreciably changed since the measurements were made on the sense-balance antenna. While received power prevented observations on these exact frequencies, there was no indication at the frequencies tested of coupling to resonant circuits. The changes since measurement have made accurate observations on 950 kilocycles impossible and on 1310 kilocycles much less reliable. The curves presented in Plates 24, 25, and 26 are typical of others at hand, and further work is not being done because it is not chargeable to the subject equipment. Much could be learned by further study, if the Bureau should see fit to authorize it, to assist analysis of shipboard difficulties. The effect of resonant or nearly resonant circuits in the field of the balance antenna is known to produce radical troubles in direction finders. Partial resonance external to the receiver could definitely alter the phase, or the effective center of pick-up may be sufficiently displaced to materially affect the phase through coupling to another circuit. The sample equipment is considered equal to previous models and satisfactory for Naval service within the requirements of specification 3-8.

27. 3-9. The receiver has been modified to incorporate an automatic volume control which prevents objectionable overloading. This system is effective when the signal amplitude is great enough that the second i.f. grid draws a current in excess of that which would normally exist for receiver outputs up to 6 milliwatts. The IR drop in a resistor placed in this grid circuit is effective to increase the bias on the grids of both i.f. stages. This system has low enough time constant so that the overall time of recovery from impacts, as required by the governing specifications, is not exceeded. The detector has been changed from a pentode type 38636 to a type 38076 connected as a diode to prevent detector overloading or blocking. The type 38636 formerly employed as a detector has been connected into an extra audio stage to compensate for the loss in the diode detector. This adds one type 38076 to the tube complement. See Plates 8 to 13 inclusive which show the action of the automatic volume control. It will be observed that blocking does not occur within four orders of standard output. Practical tests on strong local signals indicate that this feature has greatly improved the equipment for sense operation as there is no possibility of sense reversal as a result of overloading for inputs two orders greater than was required for complete receiver blocking in the previous model. Sense operation should be entirely reliable under all conditions if the sensitivity control is adjusted so that the receiver output is within the range of the output meter.

28. 4-6. Requires no Laboratory action.

29. 4-7. The loop has been redesigned to provide better watertight integrity. For description see paragraph 5 of this report, par.4-7 of ref.(e), and photographs which are a part of this report. The loop Q without pedestal was measured upon receipt as follows:

Kilocycles	Q	Capacity across Loop
2380	62	40 uufd
1795	91	100
1225	102	250
947	98	400

The loop and pedestal were assembled and placed in a tank of water in an inverted position. The water depth was sufficient to cover the entire loop, its junction with the pedestal, and the junction of the pedestal head with its base. It remained submerged for 40 hours when it was removed and the loop Q again measured with the following results:

Kilocycles	Q	Capacity across Loop
2380	52	40 uufd
1795	78	100
1225	94	250
947	93	450

The room temperature at start of test was 76.5° F. This temperature varied during the test as the heat was turned off after working hours. The water temperature was 67.5 at start of test and varied but little during the test. Such inspection as could be made through the hole in the top of the loop indicated that no water had entered the assembly. The plug and jack junction box was found to be dry and there was no evidence of leakage at the pedestal head and base junction. The reduction in Q was apparently due to condensation as tests made the following day showed that it had returned to normal.

30. 4-10. An adapter has been provided to fit around the collector ring aperture to permit the use of a flat plate upon which to mount the brush contacts. The adapter is a casting which fits over the raised boss on the pedestal, where the curved cover plate formerly furnished, was secured. The adapter is secured in place with a "U" bolt, which clamps around the pedestal body. The junction between the pedestal body and adapter as well as the one between the adapter and the flat brush plate is fitted with rubber gaskets cemented in place. Tests indicate that this construction will provide watertight integrity as originally assembled. It is apparent, however, that the projection from the side of the pedestal caused by this adapter, when in place, will require its removal if installation is made in a hole approaching the pedestal body diameter. Its removal will probably destroy the gasket if cemented upon factory assembly. It is therefore recommended that assembly be either made without cement or that extra gaskets be provided. In either case a tube of cement should be provided and the parts should be tagged to indicate the necessity of cement at the time of installation. The felt seal between the pedestal and its head stood a submergence test without leakage. This was undoubtedly due to the fact that the pedestal head is filled with grease, and so long as the felt gasket is backed by grease, it is probable that it will be sufficiently watertight to withstand service conditions. It is possible, however, that the grease backing will not be present at the time of installation if

the pedestals as furnished from the factory are stored in an unusually warm place in a position that will permit the grease to flow from the pedestal head. If the pedestal is installed in an inverted position (head down) it is important that the grease be present and in sufficient quantity and position as to back up the felt gasket. This could be assured if installation instructions require that the head be filled with the proper type of grease through the filler hole provided, at the time of installation. If installed in the normal position (head up) the need for a grease backing is not so evident and it would be unreasonable to assume that it would remain in the desired position in extremely hot weather. The Laboratory does not have the drawings for this assembly and bases the above upon verbal description of the pedestal interior by the manufacturer's representative and memory of details as observed by Laboratory personnel on drawings in the Bureau. The bulk of the grease does not flow at 125° F but there is, however, a seepage of oil, due to separation, through the felt packing at this temperature. The bearing in the collector ring end of the pedestal is likewise packed in grease which has the same tendency to separate at above 100° F. This oil seepage would, if the assembly were mounted in an inverted position, eventually get at the rubber gaskets furnished around the collector ring aperture and as these gaskets have no fabric binder, it is probable that they would eventually disintegrate and require replacement. In future designs it would appear that the pedestals could be made so that a rather tight fitting petticoat arrangement be provided that could be mounted at the time of installation in such position as to shed water depending upon whether the loop is mounted in a normal or inverted position.

31. 4-14. The angle of the boss against which the wing nuts tighten has been modified so that the washers under the wing nuts do not have the tendency of sliding off the boss as in the previous model.

32. 4-15. Securing holes have been provided in the wing nuts.

33. 4-54. The manufacturer states in ref.(e) that the 3/16" holes in the transformer case will be eliminated in production.

34. 4-55. The manufacturer states in ref.(e) that all screws which extend through the cases of the transformers will be made watertight by means of white lead or cement.

35. 4-60. No Laboratory action required.

36. 4-61. A 3/8" hole has been provided in the loop housing for signal generator connections. This hole is threaded and normally closed with a square head pipe plug which if assembled with white lead should be watertight. A yellow zinc chromate primer has been applied to the loop and pedestal. This primer does not appear to be as durable as the iron oxide previously used, as it softens with immersion in water. It should not be exposed to the weather without a protective coating. It is believed that this will be of little value on the pedestal interior if condensation produces sweating. The specifications have been complied with as regards

coating, but it would appear undesirable to coat the shaft coupling bore until after assembly due to the desired neat fit at this point which might become too tight for assembly without force, if painted. The top of the loop has been provided with a 3/16" tapped hole with screw plug for air connection in drying out loop interior. The screw has a fillister head under which a gasket should be provided to assure watertightness. Such a gasket would add to the dielectric path which is now rather short due to the fact that the screw head diameter is nearly as great as the thickness of the insulator into which the screw fits.

37. 4-63. The same provision for connection of a signal generator to the loop center is provided as before except that access may be had through the hole in the loop housing as mentioned in par. 4-61 above.

38. 5-3. The power cable plug and azimuth scale lamp wiring gland, removal details, as proposed by the manufacturer are shown on their drawing T-60159&, enclosure (A) of ref.(b). It has been proposed that these outlets be moved from the receiver back to the rear right hand end of the receiver cabinet. The drawings show the power cable plug to be centered 2-3/8" from the back of the cabinet end 3-7/8" from the bottom. In this position the plug will extend approximately 2" from the box wall and will require another 2" for cable clearance and plug removal thus adding 4" in the overall length requirement. The azimuth wire packing gland has been removed from the back of the cabinet to the right hand end and is centered 1-3/8" from the back of the cabinet and 6-1/2" from the bottom. Its length is 1-1/2" and an additional 3/4" should be allowed for cable clearance which is less than for the power plug and cable. It is assumed that the servicing bracket will be so formed that it will not prevent running wires from this packing gland to the jack terminals which are still shown at the back of the box in their original position. It is proposed that the box wall be indented about 3/8" to permit a hand hold on the large diameter of the power cable plug, for removal and replacement of same. This arrangement appears to satisfy the Bureau's comment as given in ref.(d), provided that the additional allowance of overall length is acceptable.

39. 5-8. The manufacturer proposed in ref.(e), to provide protecting angles on the back of the chassis tall enough to permit placing the receiver on its top for servicing without injury to any of its component parts. See par.5-3 above where attention is invited to a possible interference of the right hand angle with azimuth leads running to their respective jacks in the back of the box.

40. 5-14. Sample toggle switches and descriptive drawings have been furnished as enclosures of ref.(b). These samples appear to comply with Bureau drawing RE 24AA 118A in all respects except that the parts are lubricated with a coating of heavy grease. The contractor states in ref.(e) that it is proposed to furnish switches as per sample, as greaseless switches are not mandatory on the contract and further that these switches have already been purchased. As stated in ref.(d), a greaseless switch is desirable. This is particularly true in cases where low voltage and low current

is handled. In this particular instance, the only switch that could be expected to give trouble would be the "CW", "on-off" switch and although this handles relatively low current, the voltage is reasonably high and it is probable that the presence of grease will not be as objectionable as in most cases where similar switches have been found unsatisfactory.

41. 5-19. The manufacturer proposes to use a switch knob on the sensitivity control and meter range control similar to that employed on the band change switch. These are believed to be satisfactory as is the photo-etched sample reference scale for use with the sensitivity control which was furnished as an enclosure to ref.(b).

42. 5-34. The manufacturer promises in ref.(e) that the backlash in the main tuning control will be reduced to comply with the specifications.

43. 5-37. Par. 3 of ref.(b) requests information as to what revision is necessary in the specification requirements to permit necessary engineering tolerance. Ref.(a) indicates that no change in specifications is necessary from 0 to 800 divisions on the dial and that a maximum variation of 175% of the reference level is required to permit the model to pass. Assuming that the handmade plates are a fair example of the rate of frequency variation with condenser rotation for a condenser of reasonably conventional design, without sacrifice in rigidity or of undue size, it would appear that if the 110% value be increased to 190% for that part of the range above 800, and within the required overlap range as well as the maximum frequencies required by the receiver, the manufacturer should have no difficulty in compliance.

44. 5-39. No Laboratory comment required.

45. 5-50. The stability of the receiver has been greatly improved under conditions of volume control variation as reported in ref.(c). It is now satisfactory in this respect. See Plates 14 to 16 inclusive for range of volume control in the modified equipment.

46. 5-53. See Plates 14 to 16 inclusive for curves showing linearity of the volume control which complies with the governing specifications.

47. 5-59. The manufacturer submitted a sample decibel meter for test. The results of a preliminary test were reported in ref.(g). The meter has since been tested with the following results:

Meter Deflection	Meter Resistance approx.	Volts across Meter	Calculated microamperes
-10 db	8000 ohms	.19	23.7
0	4800	.6	125
+ 5	5200	1.06	204

The manufacturer gives the following table of characteristics in circuits of resistance approximating practice.

DB at "0" on scale	DB Overswing	Damping Factor at "0"	Circuit Resistance approx.
0	0.25	22.0	120 ohms
5	0.60	9.3	4000
10	0.90	6.2	11300
15	1.00	5.6	23300

The manufacturer also gives the following data as descriptive of this instrument:

Resistance at "0" db, 5400 ohms
Damped period on "0" db range, 0.43 seconds
Scale angle at "0" db, 42°
Scale angle at 1 db, 49.5°
Sensitivity at the "0" point, 111 microamperes
Voltage at the "0" point, .6 volts

The scale angles as measured on the subject meter were as follows:

Decibels	Degrees ± 1°
	0
-10	6.5
- 8	10
- 6	15
- 4	21.3
- 2	31
0	42.8
+ 1	50.9
+ 2	59
+ 3	67.7
+ 4	79.4
+ 5	90.8

The damping factor, calculated in accordance with the governing specifications, from the data on Plate 21 is 20.9, and its responsiveness is 5.0. The overswing is approximately 0.33 decibel. The time required for one complete swing from a state of rest to "0" level is approximately 0.2 second. These measurements were made with a 122 ohm shunt across the meter.

48. 5-61. The requirements of ref.(d) have been complied with. See Plate 30 for meter face markings.

49. 5-65. The power cable receptacles have been moved from the back to the right hand end in compliance with ref.(d).

50. 5-66. See par. 5-65 above.

51. 5-72. The manufacturer states in ref.(e) that it is proposed to test 10% of the tubes supplied on the contract for so-called "spurious" oscillations and if found that more than 10% of this obtain "spurious" oscillations, another lot will be subjected to similar tests. This is interpreted to mean that if 10% or less of the tubes tested show "spurious" oscillations it is planned to furnish tubes from the lot tested without further test. The manufacturer also implies that no tubes have been found in production for the past year that have "spurious" oscillations. It would seem that if the presence of "spurious" oscillations is the exception instead of the rule that it would be fair to expect that the rule governing acceptance would bar the exception.

52. 5-81. The terminals for meter insertion in making selectivity measurements have been provided in the lead from cathode to ground and have been suitably by-passed. In making selectivity measurements, it was observed that change in the deflection of the meter used for this purpose was less than 0.1 microampere for resonance when a standard output obtains. The steady current in this circuit with no signal applied under standard conditions for sensitivity measurements is slightly less than 1 microampere for MCW and slightly less than 2 microamperes for the CW condition. Measurements were made for selectivity using an increase of deflection of 0.2 microampere for a resonance indication with a 6 microampere full scale instrument. These measurements were readily duplicated showing that the system is practical if a sensitive enough instrument is available. Measurements were also made with greater detector cathode currents to ascertain if a less sensitive meter could be relied upon for alignment purposes. It was found that as against a 273 microvolt input to the i.f. system for a 1 microampere deflection for MCW, a 7400 microvolt input was required for a 10 microampere deflection and for a 100 microampere deflection, 100,000 microvolts was required. In all three cases resonance was easily detected with sufficient sharpness to permit alignment. The selectivity obtained with a 10 microampere diode current was identical with the one obtained with the 1.0 microampere deflection. The small current present in the diode circuit does not permit the taking of selectivity measurements with signal generators having but .5 volt maximum output unless a microammeter having a sensitivity of less than 10 microamperes is available.

53. 5-96. The manufacturer agrees that the alignment between the balancer coil and its pointer will, in production, comply with the governing specifications in ref.(e).

54. 5-98(1). In ref.(e) the manufacturer states that the balance-sense circuit has been modified from that of previous models, condenser tuning replacing variometer tuning. The Laboratory believes that this is an improvement in the tuning method. The resubmitted sample has not been altered, since its first submission, in this respect. The balance circuit of the Model DP-4 equipment does not meet this specification in the low frequency band, as shown in Plates 10 and 11 (ref.(a)) as the balance sensitivity in microvolts per meter rises to a maximum of 1180% of the loop sensitivity instead of the 330% permitted. This specification is very definite in requiring that a given field strength produce a maximum

loop circuit quadrature voltage between 30 and 600% of the maximum loop circuit in phase voltage. It is best measured, however, in terms of the input absolute microvolts through either antenna and loop for standard receiver output, with suitable reduction of inputs to equivalent field intensities. It is especially necessary to guard against confusion due to the apparent contradiction of the test methods of this specification. Plates 10, 11, and 13 of ref.(a) and ref.(c) correctly report the sensitivities of the subject equipments. Unfortunately, however, Plates 28, 29, and 30 of ref.(a) and ref.(c) are in error. They show percentage ratios of quadrature to in-phase sensitivity, not voltage from equivalent field strengths. The voltage ratios are inversely proportional to the sensitivity ratios. Therefore, the curves of the above Plates 28, 29, and 30 of refs.(a) and (c) would have been correct with the ordinates labelled "Percentage ratio of quadrature to in-phase field strength sensitivity" and the upper and lower limit lines at 333 and 16.7% respectively. Two of the above incorrect plates for CW inputs are corrected and presented herewith as Plates 22 and 23. In these curves, a high percentage ratio means that for a given loop circuit voltage, the balance antenna requires a higher field strength; or, for a given field strength, the quadrature voltage is relatively low. It should be borne in mind that the effective center of the balance antenna, in general, is somewhat removed from the loop, and may pick its energy from a field materially different in strength. There are, probably, no data existing on this point. In ref.(e) the manufacturer states that the balance-sense circuit has been modified from that of previous models, condenser tuning having replaced variometer tuning. The Laboratory believes that this circuit will track more accurately for sense purposes. Accurate tracking is not required for balance purposes. The resubmitted sample has not been altered in this respect since its original submission. The balance circuit of the Model DP-4 and DQ-1 equipments does not meet this specification from 100 to 250 kilocycles, 470 to 550 kilocycles, and from 1000 to 1500 kilocycles. Similarly the Model DP-5 and DP-6 equipments are deficient from 100 to 130 kilocycles and from 175 to 250 kilocycles. The maximum discrepancy is for the Model DP-4 or DQ-1 equipment at 150 kilocycles, where the sensitivity ratio reaches a maximum of 1180%, with a maximum of 300% permitted. By way of comparison, at 100 kilocycles, the Model DP-4 equipment has about one-fifth of the balancing power of the Model DO-1 equipment, or a maximum balancing power roughly equal to that of the DO-1 at 25 on the balancer scale. The Laboratory has no information regarding the balance sensitivity necessary at various frequencies aboard various types of vessels. These data should be available to the Bureau from the calibration curves submitted by various vessels. It is possible that the subject equipments would show adequate balance sensitivity in the low frequency band for most Naval applications. In ref.(e) the manufacturer shows that the errors of Plates 28, 29, and 30 of ref.(c) caused no misunderstanding. He states in effect that a low ratio of quadrature to in-phase voltage exists in the low frequency band, and that it is impracticable to raise this ratio without impairing performance at other frequencies.

55. 5-102. The sense button provided appears to have one fault. In other respects it is exceptionally rugged and well constructed. The fault lies in the fact that the contact springs are secured with but a single

screw and that with constant use they loosen enough that the springs rotate away from the isolantite collar through which force for their movement is conveyed, thus making the switch inoperative. There are six contact springs similarly mounted on the tops of 1/4" diameter posts. The mounting screw passes through the single hole in the flat spring, the center of the cylindrical post and through the isolantite switch base upon which the complete assembly is mounted. This screw is fitted with a nut and lock washer on the under side of the base plate. It is probable that the shorter or fixed contact springs can be sufficiently supported from rotation by providing a sharper bend on the terminal ends of the springs that will cause the springs to rest against the edge of the isolantite base. In the case of the longer or movable springs which receive the force for operation and which are coupled to the push button proper only at one edge which fits into a 1/16" deep peripheral slot in a doughnut shaped isolantite insulator, it is most important that no rotation away from this slot be permitted. Some means should be provided that will prevent rotation of these two springs even though the clamping screw becomes loosened.

56. 5-104. The receiver has been equipped with an automatic volume control and a diode detector combination which prevents noticeable overloading or blocking for inputs up to and somewhat greater than 10 millivolts, at the loop center. This has resulted in a decided improvement over previous equipment in that sense determinations are not likely to be reversed by overloading under reasonable operating conditions.

57. 6-5. The manufacturer proposes to rearrange the power unit to bring the power cable out of the right hand side of the cabinet at a position centered 1-3/4" from the bottom and 2-7/8" from the back as shown on drawing T-601584, an enclosure of ref.(b). The power plug will extend about 2-1/4" from the box wall and an additional 2" will be required for cable clearance and plug removal. The cabinet wall is indented about 3/8" to permit a grip to be had on the plug at its greatest diameter for removal purposes. The 60 cycle power supply fitting extends about 1/2" from the box wall at the left hand end and will require about 3/4" for cable clearance. The additional length required for installation of this unit over the original is 5-1/2" to allow for these power input and output connections.

58. 6-6. In ref.(e) the manufacturer proposes to cut away the rear skirt of the chassis to clear mounting bolt heads should the unit be mounted on its base. It is recommended that at least 3/8" be cut away for a distance of not less than 1" as near to the corners as practicable, with symmetry. The manufacturer also states that it is expected that the installation force will provide the necessary holes and bolts.

59. 6-19. No change has been made in the model but in ref.(e) the manufacturer proposes to furnish a third screw to prevent rocking of the two parts of the plug, which he believes to be responsible for the objectionable loosening of the two screws previously furnished.

60. 6-21. The manufacturer proposes in ref.(e) to lower the fuse block in the power unit 7/32" to prevent possible contact of conducting parts with receiver case. This should be satisfactory.

61. 7-2. The sensitivity falls within the specified limits. See Plate 1. It will be observed that there is but little excess sensitivity in the high frequency band to allow for production variations. These measurements were made with transformers and transmission line as for the DP-5 and DP-6 combinations. Alignment was made for a dial setting of 900 or 1442 kilocycles for the high frequency band. Alignment at 950 divisions, 1535 kilocycles did not result in sufficient sensitivity to comply with the specifications.

62. 7-3. The selectivity is within the limits of the specifications for either CW or MCW (1000 cycles) if measured by a meter in the cathode circuit of the diode detector. See Plates 5 to 7 inclusive. It is natural that the apparent selectivity as shown by the curves should be less for MCW than for CW due to the presence of side bands. It will be observed that the subject receiver barely passes at 250 kilocycles with MCW. It is interpreted by the manufacturer that the specifications permit the option of the use of CW or MCW in selectivity tests, but if the Laboratory takes the same interpretation it is probable that the more strenuous test will be made, using MCW. Tests have therefore been made both ways and are submitted for the Bureau's information. The Laboratory agrees with the manufacturer that the MCW selectivity as obtained from an overall measurement may be very different than if measured at the final detector. Such a measurement does not give any real information unless the wave form of the carrier and modulation voltages are known and then the result will not indicate the ability of the receiver to discriminate against any one frequency for the point of measurement, but for the band of frequencies included in the complex wave which includes the carrier with its side bands. It is evident that the audio system will not pass the carrier and that the only useful output energy of a receiver must be derived from the modulation frequency which is in the side bands and if the receiver selectivity is such as to attenuate these bands, the output from a receiver tuned to carrier resonance will be less than when the receiver is tuned to some point between carrier resonance and the side band frequency. Under these conditions the conventional "times resonance" selectivity curves are of little value unless the receiver is designed specifically to work on, or discriminate against, the exact wave form used in the test; and then the "two signal generator" method of test would be preferable.

63. 7-4. The image response is shown on Plate 3 and is within the specification limitation. These measurements as well as all others reported upon in this report, requiring signal generator excitation, were made with the loop and receiver in a separate screened booth from that containing the signal generator.

64. 7-5. In view of the modifications incorporated in this model to prevent overloading at low input voltages resonant overload data was taken for all bands and is shown on Plates 8 to 13 inclusive. The present model complies with specification requirements.

65. 7-6. The resonant overload curves show that the automatic volume control system is not effective below 6 milliwatts and maximum audio output is well above this value.

66. 7-8. The audio hum level is well below the 0.1 microwatts specified and was so low as to be immeasurable with the equipment available.

67. 7-9. The receiver was tested to determine the time required for restoration to a normal overall gain condition from subjection to sharp impact voltages simulating static. At 1500 kilocycles with 26 volts peak of applied impact the receiver recovered to normal sensitivity in 4.4 milliseconds. At 100 kilocycles with 15 volts applied it recovered in 8.3 milliseconds.

68. 7-12. The manufacturer states in ref.(e) that it is expected that better selectivity and sensitivity will result from improved tracking of the uncontrolled r.f. circuits in production due to the use of punched condenser plates.

69. 7-16. As the audio system has been changed to include an extra stage since the previous tests, it has been again tested and its gain characteristic is shown on Plate 18. It was found to be well within specification limits.

70. 7-18. The manufacturer has in ref.(e) raised the question as to the fairness of the test for frequency shift with volume control variation from the "MAXIMUM OUTPUT" condition. This point is well taken as a study of the resonant overload curves as of Plates 8 to 13 inclusive will show that MAXIMUM OUTPUT as called MAXIMUM AVAILABLE by the manufacturer, may be several orders above STANDARD OUTPUT. The anti-blocking characteristics as incorporated in this model makes it possible to obtain a satisfactory degree of frequency stability for volume control variation over a much greater range of inputs than in the previous model and, in fact, this model does come just within the specification limits of 100 cycles variation at the worst point, 1500 kilocycles. This test was made with a 5,000 microvolt input at the loop center or the maximum available from the Laboratory generators using the 100:1 pad as used for loop excitation. The frequency variation when similarly tested at 100 kilocycles was less than 1 cycle. The need for a grid glow tube for better regulation does not appear to be justified in this equipment.

71. A summary of the defects noted which do not comply with the governing specifications follows:

(a) The felt gasket material used between the pedestal base and pedestal head appears to disintegrate due to the presence of oil.

(b) The soft rubber gaskets employed around the collector ring aperture appear to disintegrate due to the presence of oil.

(c) Two bus wire leads connecting to the band change switch are so close that it is possible that they may short with vibration. See par. 2-20.

(d) The two longer contact springs on the sense switch are not sufficiently secured to prevent rotation which may result in disengagement with the driving collar thus making the switch inoperative. See par. 5-102.

(e) None of the subject equipments completely meet the governing specifications as regards balancer sensitivity. The maximum discrepancy is approximately 4 to 1. See par. 5-98(1) and Plates 22 and 23.

CONCLUSIONS

72. The Models DP-4, DP-5, DP-6, and DQ-1 equipments are in general ruggedly constructed, present a pleasing appearance and the workmanship is in general of a very high quality. The band selector switch is a marked improvement over band change switches previously used in direction finder equipment.

73. The watertight integrity of the loop and pedestal construction has been improved over previous similar equipment. Tests show that, as delivered from the factory, both units are watertight to submergence. It is believed that this integrity will be preserved if occasional and reasonable attention is given to gasket and grease replacement.

74. The provision of adjustable resistors in the antenna circuit permit the obtainment of a more nearly ideal coupling for sense operation than in previous equipments. The modifications in the receiver, which includes the addition of a carrier operated automatic volume control and a diode detector, have made it practically impossible to obtain a reversal of sense which is a decided improvement over the first model submitted. In general, a sense bearing can be taken without a reduction in gain below that required for bilateral operation.

75. The balancer sensitivity is considerably less than in the Model DO equipments, in the low frequency band. The Laboratory does not possess sufficient data to permit a recommendation as to whether this sensitivity is ample for satisfactory operation under the wide variation of actual service installations.

76. Aside from the lower balancer sensitivity, this equipment is an excellent direction finder and is superior to the Model DO series which precedes it.

LOOP SENSITIVITY
CW CARRIER INPUT
MODELS DP-5 & DP-6 - RADIO DIRECTION FINDER EQUIPTS.
MFD. BY R.C.A. MFG. CO.

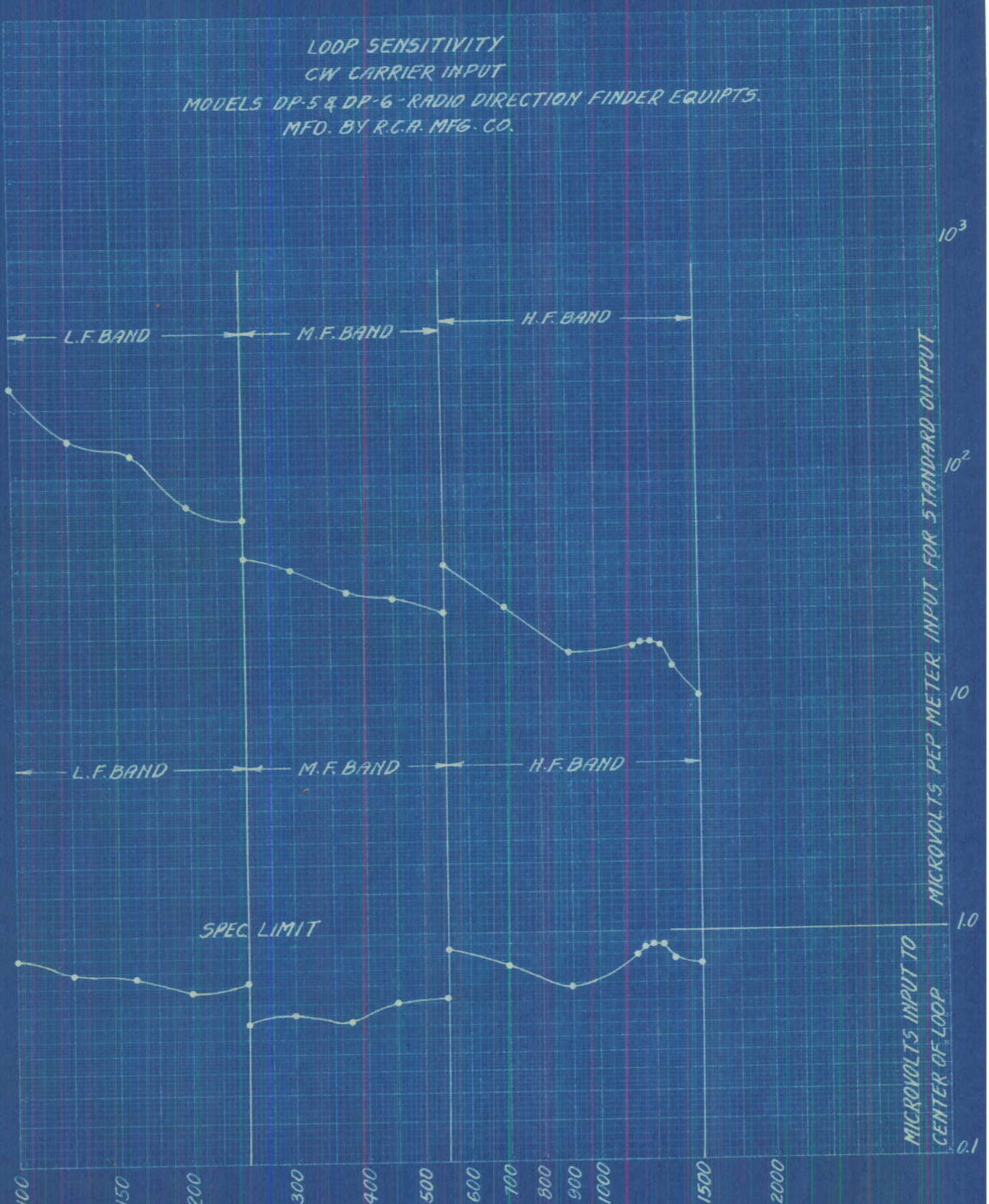


PLATE I
(R-1347A)

MAXIMUM NOISE LEVEL VS. FREQUENCY
CW CARRIER OPERATION
MODELS DP-5 & DP-6 - RADIO DIRECTION FINDER EQUIPTS.
MFD. BY R.C.A. MFG. CO.

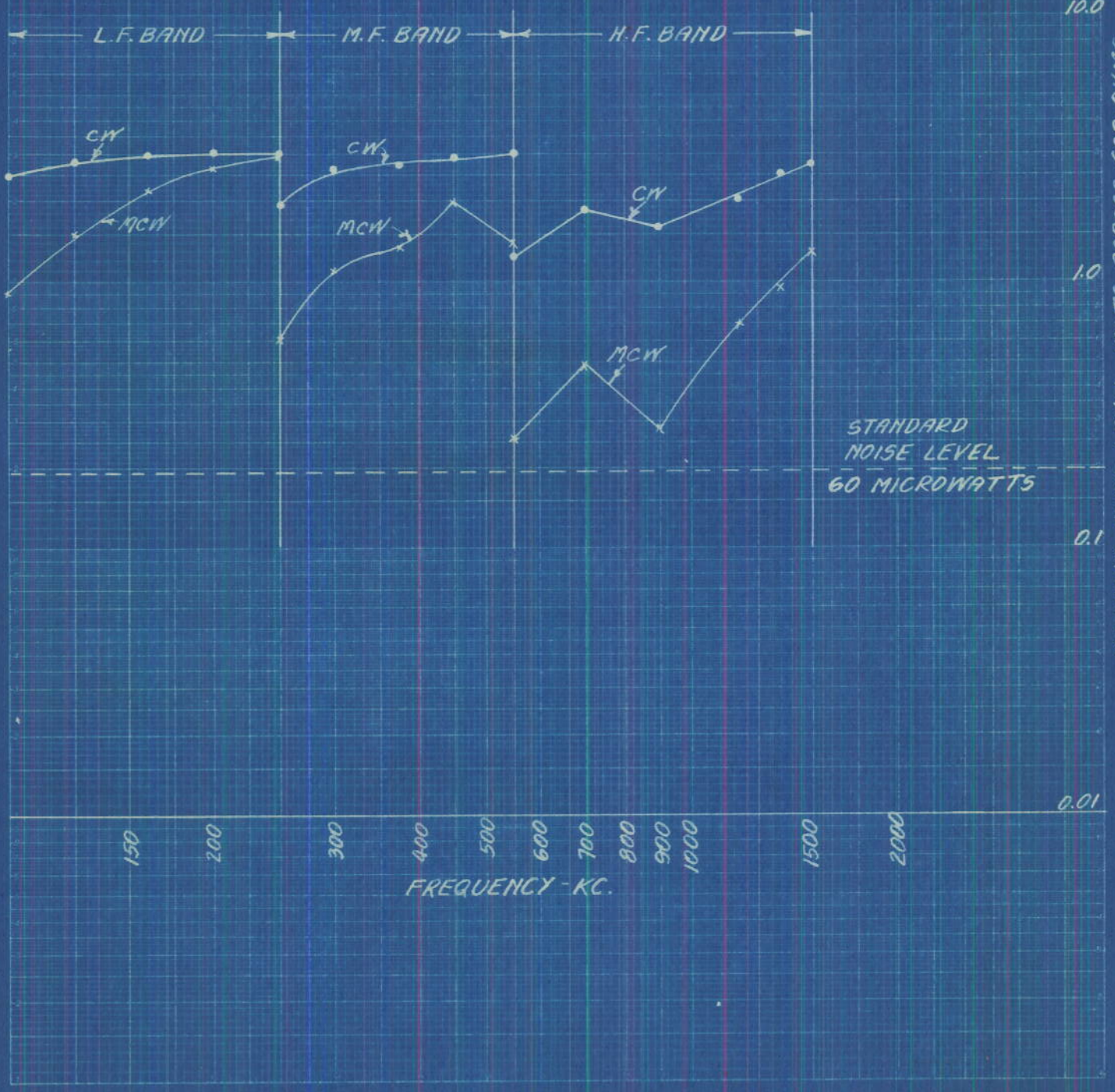


PLATE 2
(R-1347a)

IMAGE SELECTIVITY
CW INPUT
MODELS DP-5 & DP-6 - RADIO DIRECTION FINDER EQUIPTS.
MFD. BY R.C.A. MFG. CO.

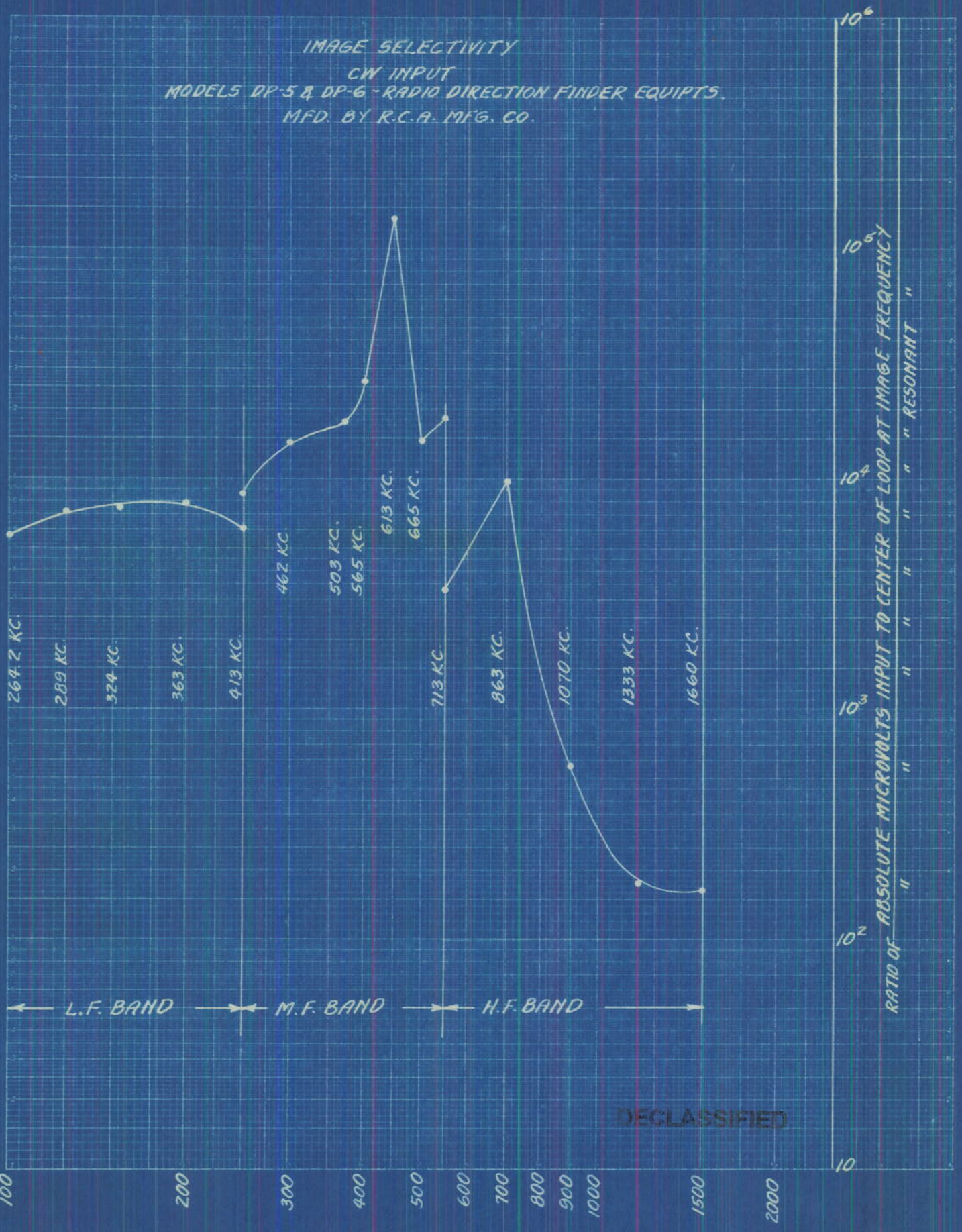
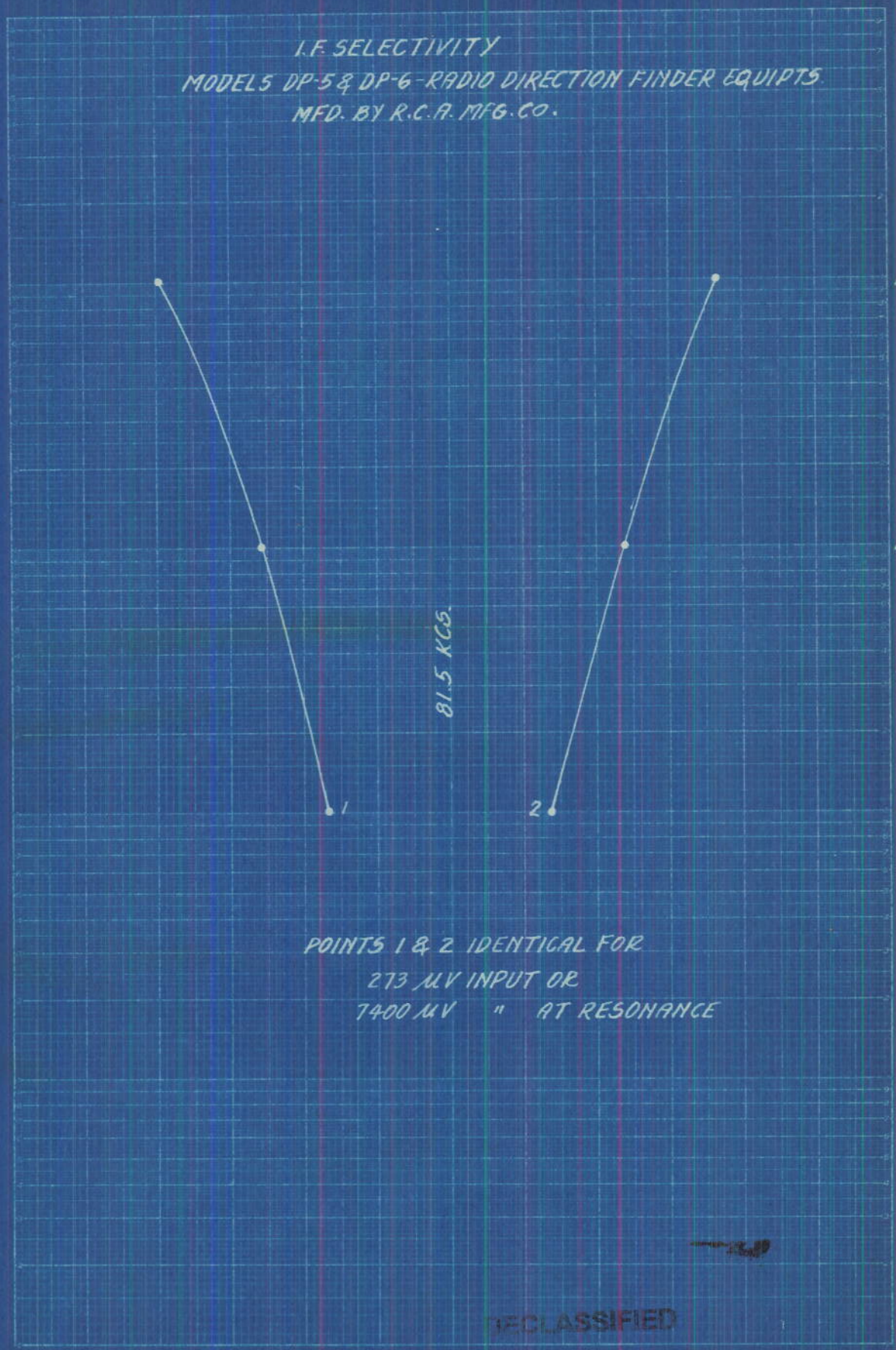


PLATE 3
(R-1347A)

I.F. SELECTIVITY
MODELS DP-5 & DP-6 - RADIO DIRECTION FINDER EQUIPTS
MFD. BY R.C.A. MFG. CO.



POINTS 1 & 2 IDENTICAL FOR
273 μV INPUT OR
7400 μV " AT RESONANCE

PLATE 4
(R-1347A)

SELECTIVITY - LOOP EXCITATION
OPTIMUM GAIN - CW CARRIER INPUT
LOW FREQUENCY BAND
MODELS DP-5 & DP-6 - RADIO DIRECTION FINDER EQUIPTS.
MFD. BY R.C.A. MFG. CO.

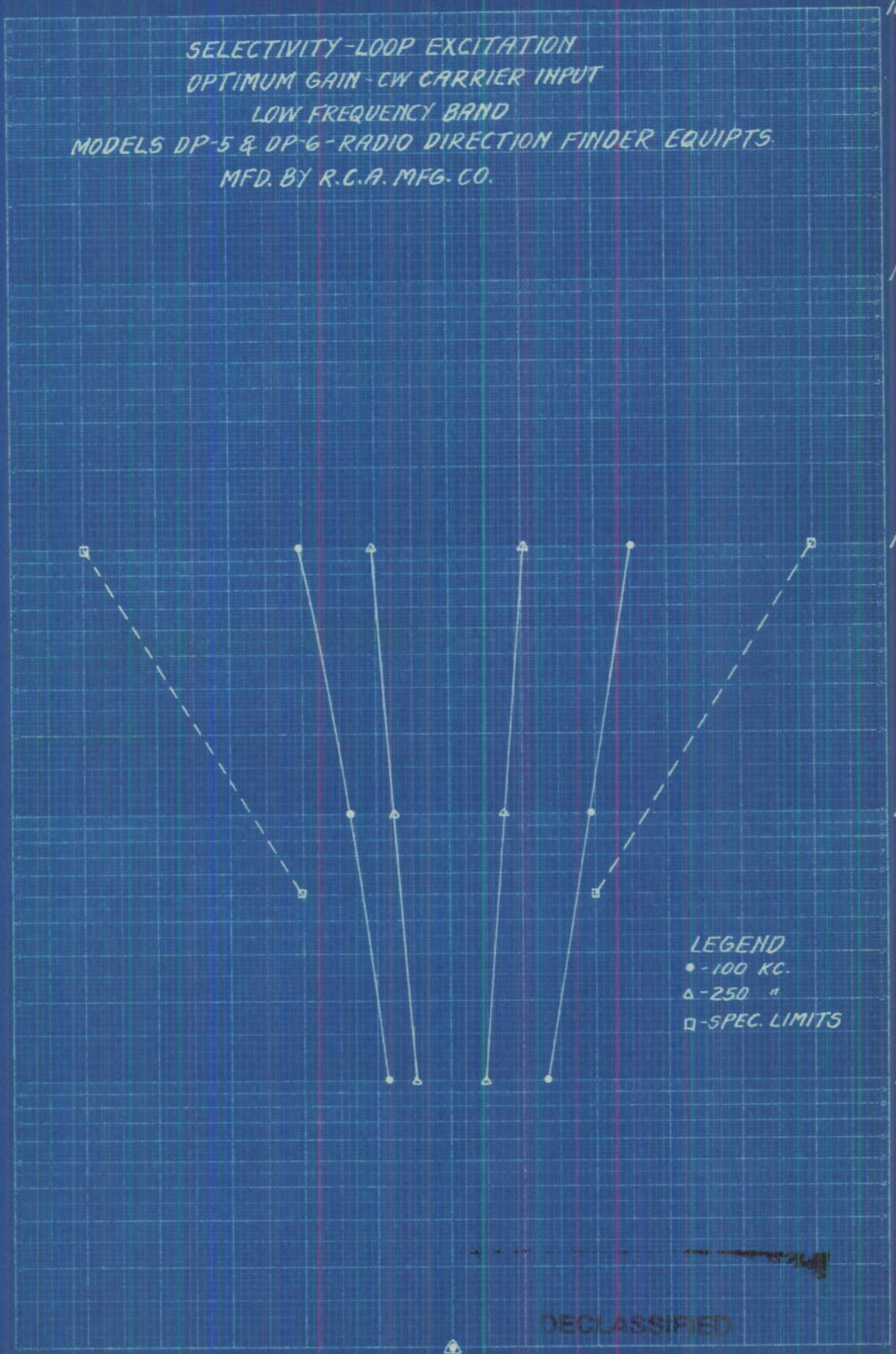


PLATE 5
(R-1347A)

SELECTIVITY - LOOP EXCITATION
OPTIMUM GAIN - CW INPUT
HIGH FREQUENCY BAND
MODELS DP-5 & DP-6 - RADIO DIRECTION FINDER EQUIPTS.
MFD. BY R.C.A. MFG. CO.

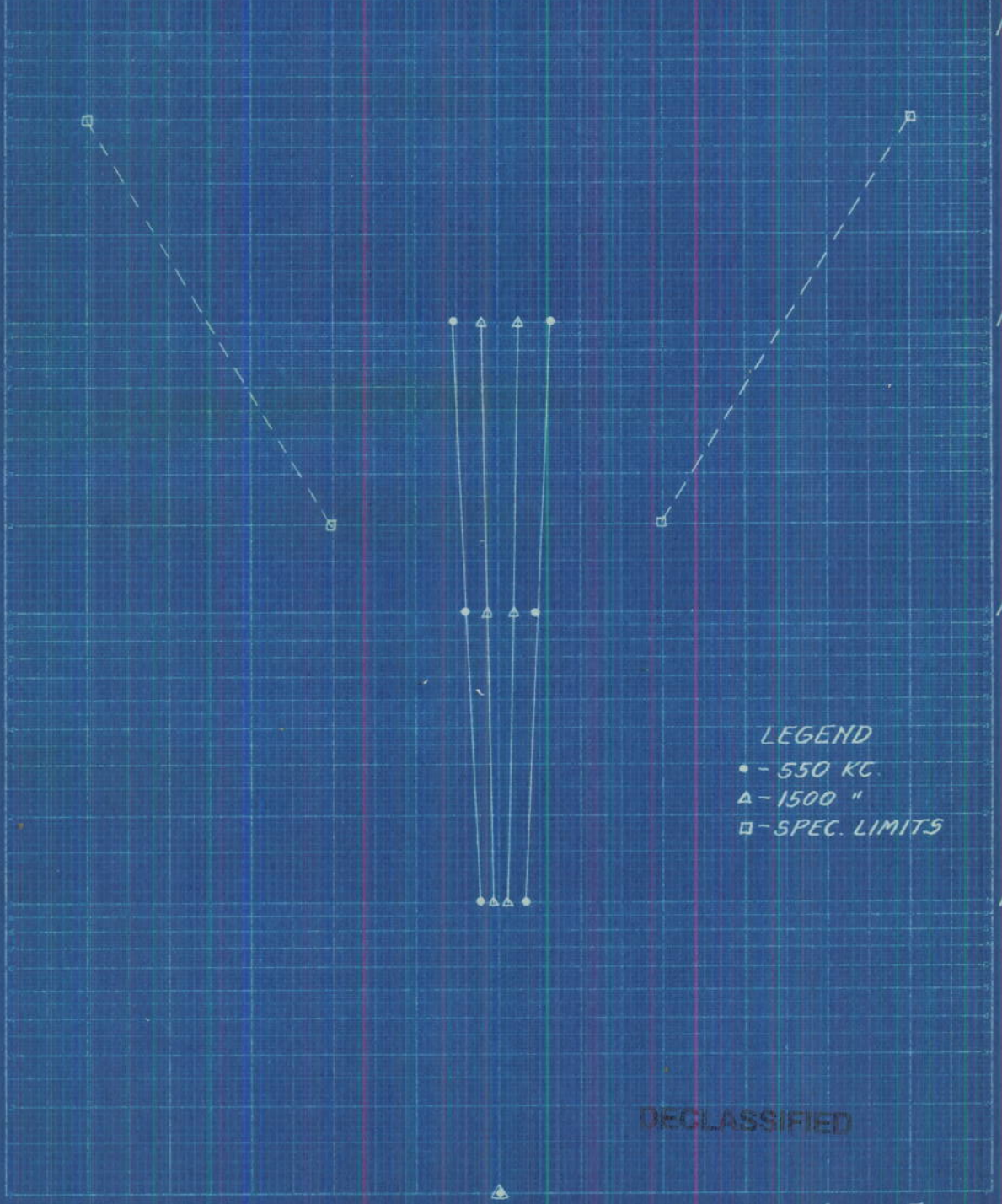


PLATE 6
(R-1347A)

SELECTIVITY - LOOP EXCITATION
OPTIMUM GAIN - MCW INPUT
LOW FREQUENCY BAND
MODELS DP-5 & DP-6 - RADIO DIRECTION FINDER EQUIPTS.
MFD. BY R.C.A. MFG. CO.

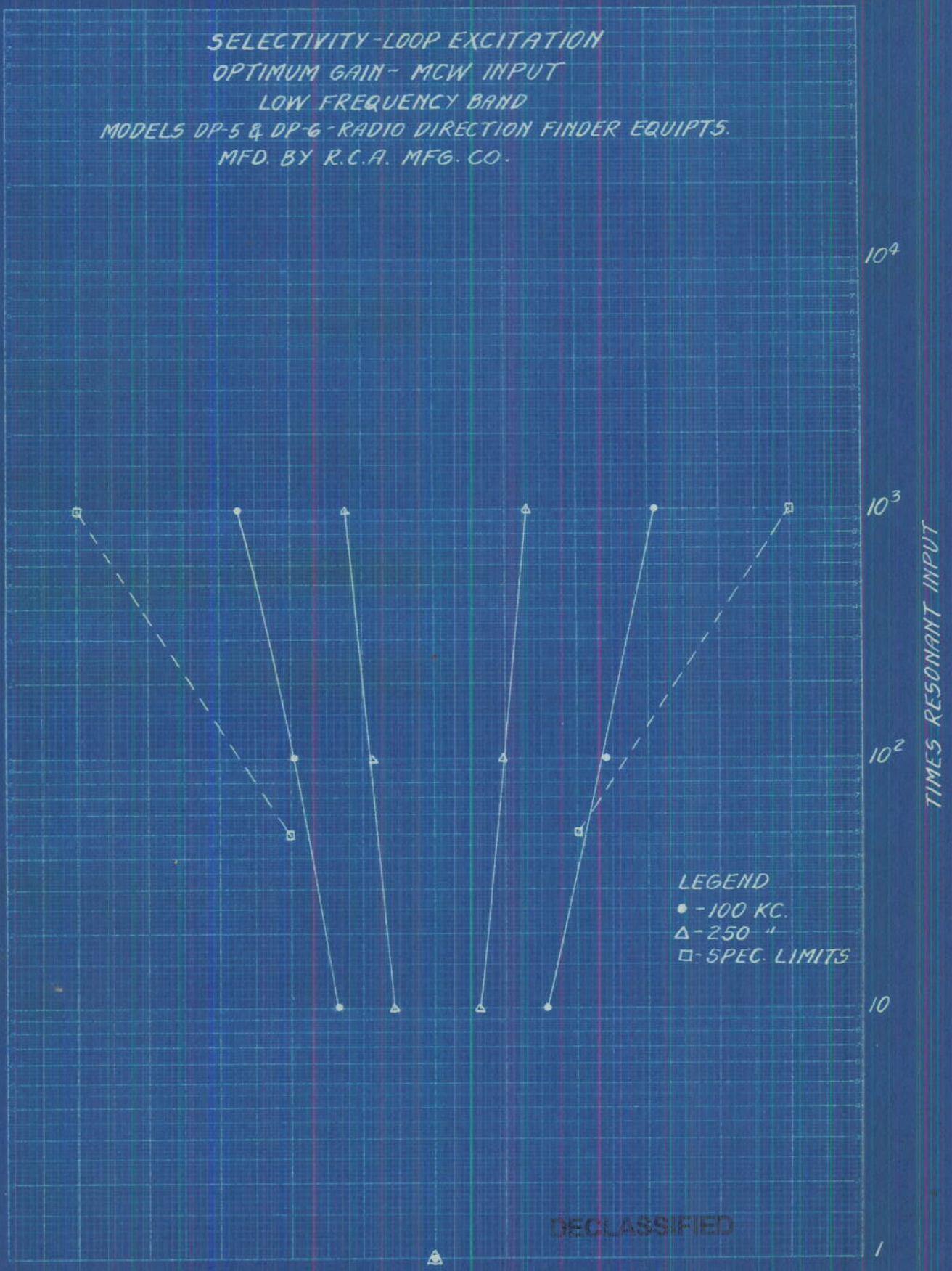


PLATE 7
(R-1347A)

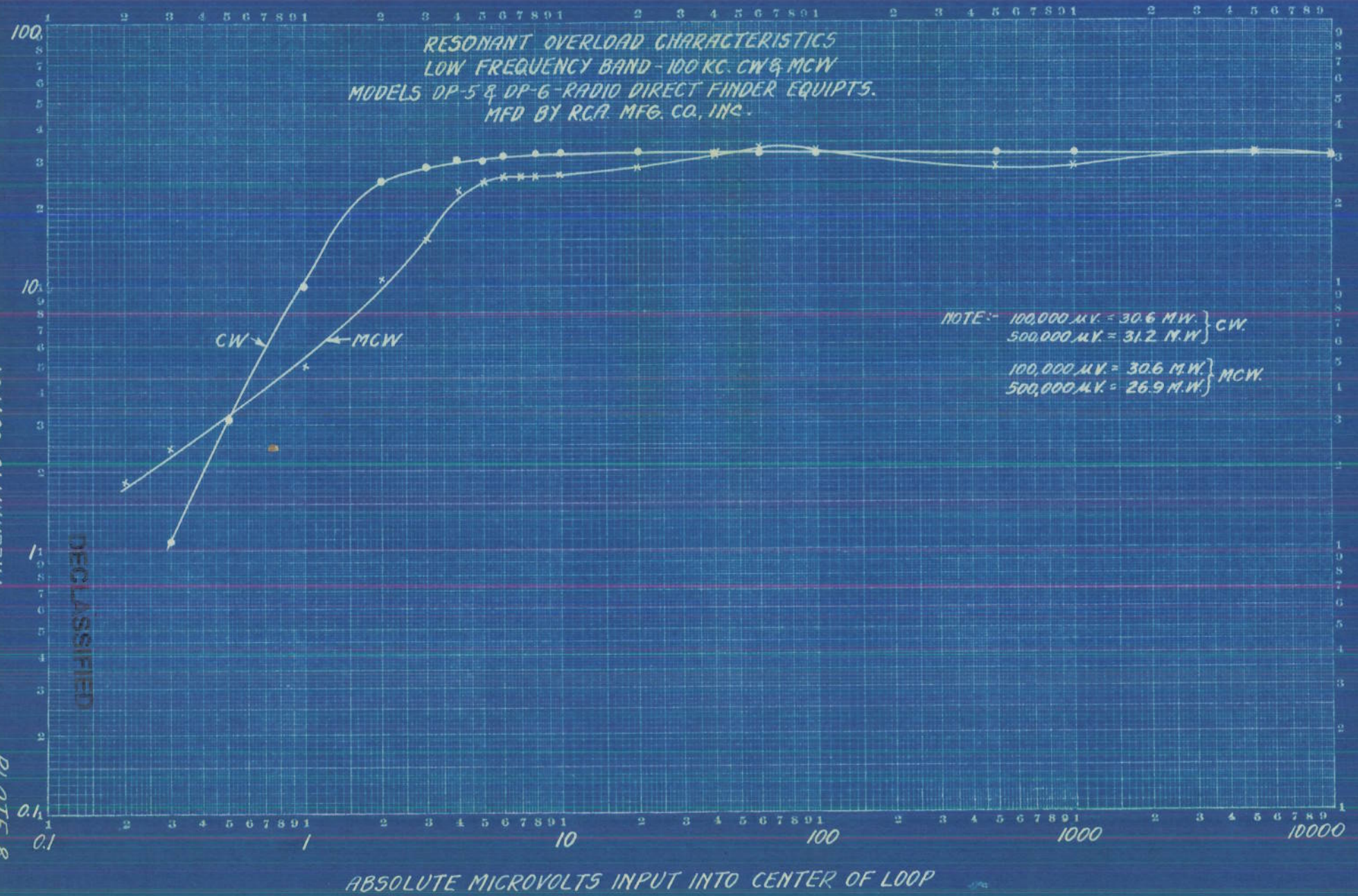


PLATE 8
(R-134-AF)

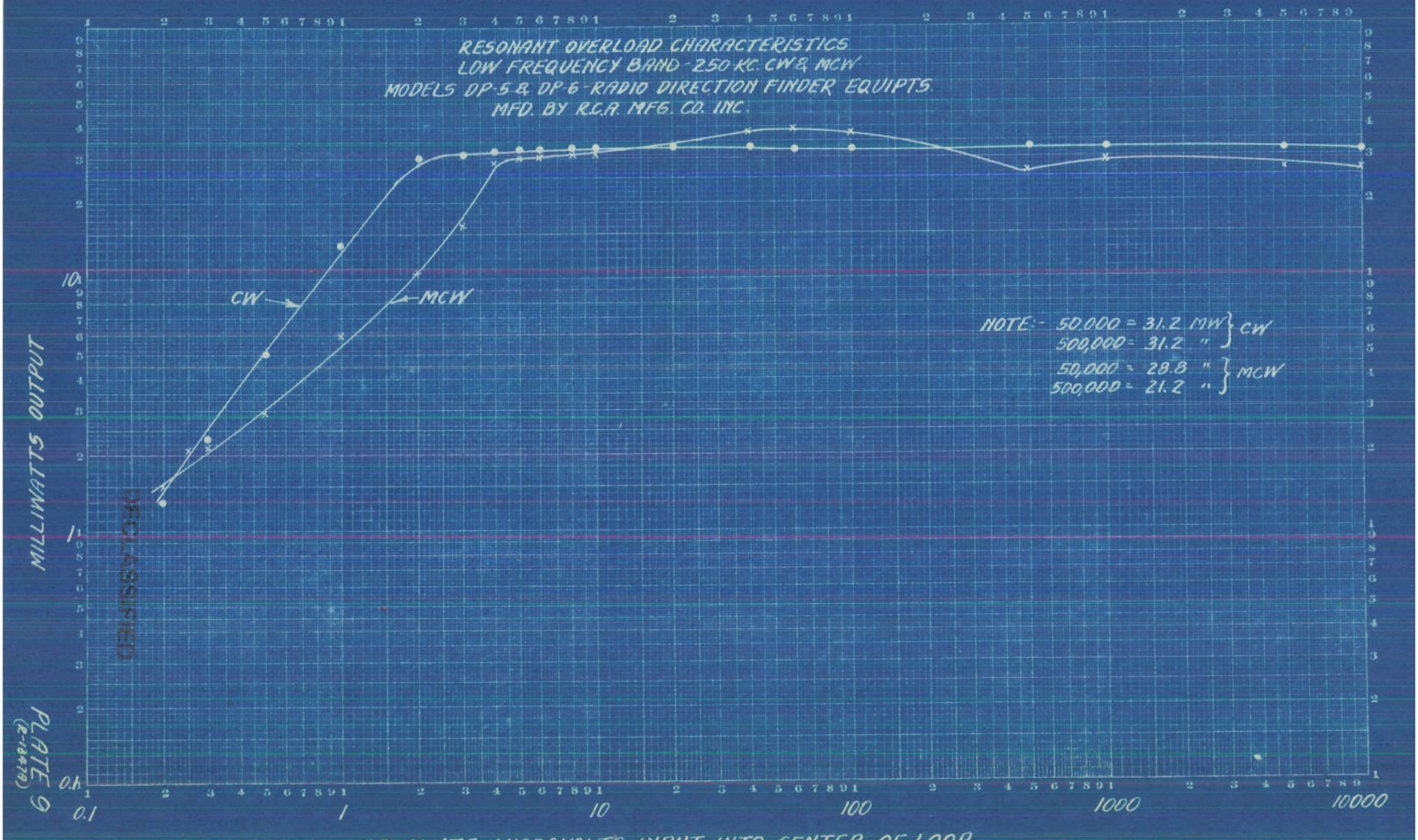
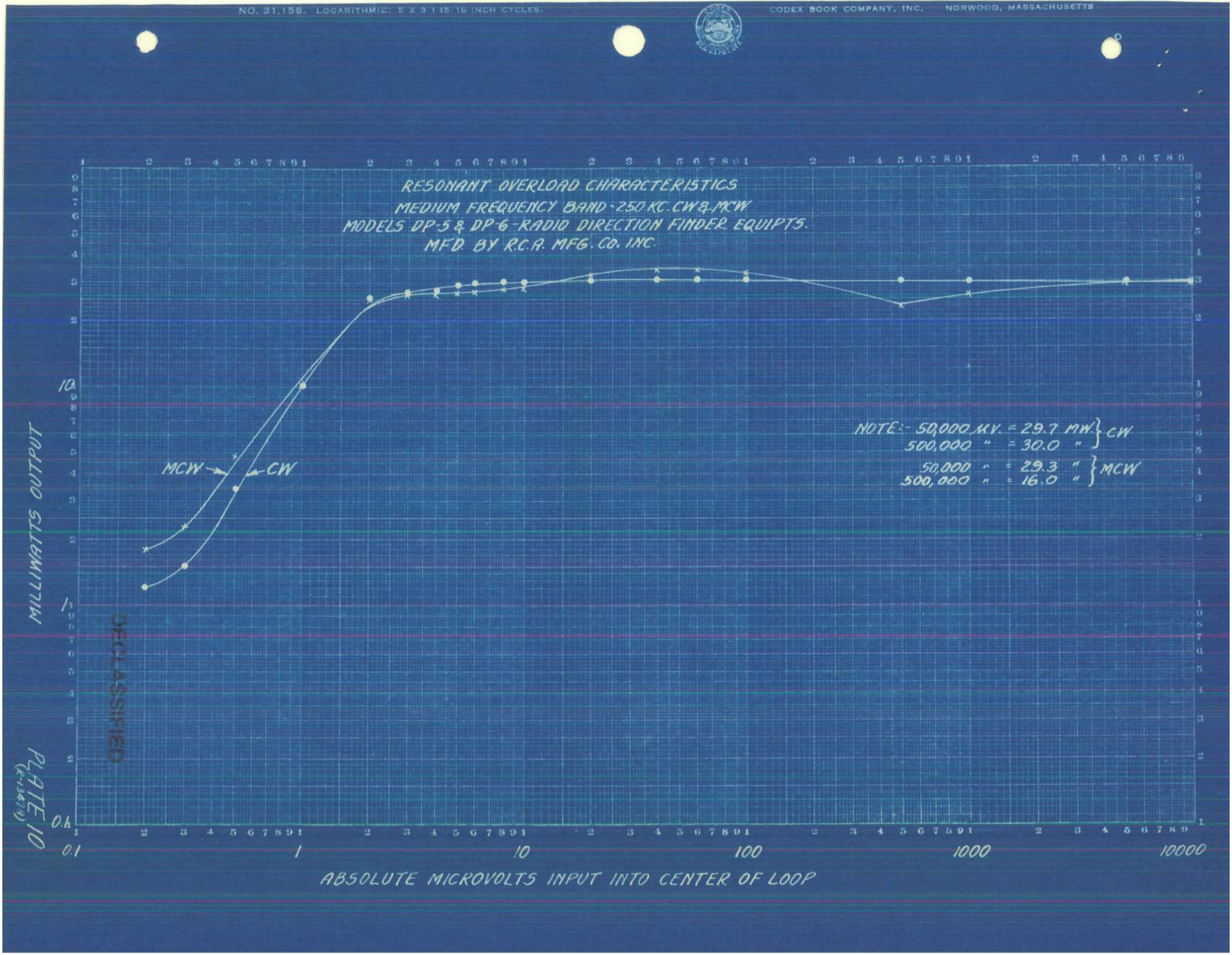


PLATE 9 (E-4470)



RESONANT OVERLOAD CHARACTERISTICS
MEDIUM FREQUENCY BAND-550 KC. CW & MCW
MODELS DP-5 & DP-6-RADIO DIRECTION FINDER EQUIPTS.
MFD. BY R.C.A. MFG. CO. INC.

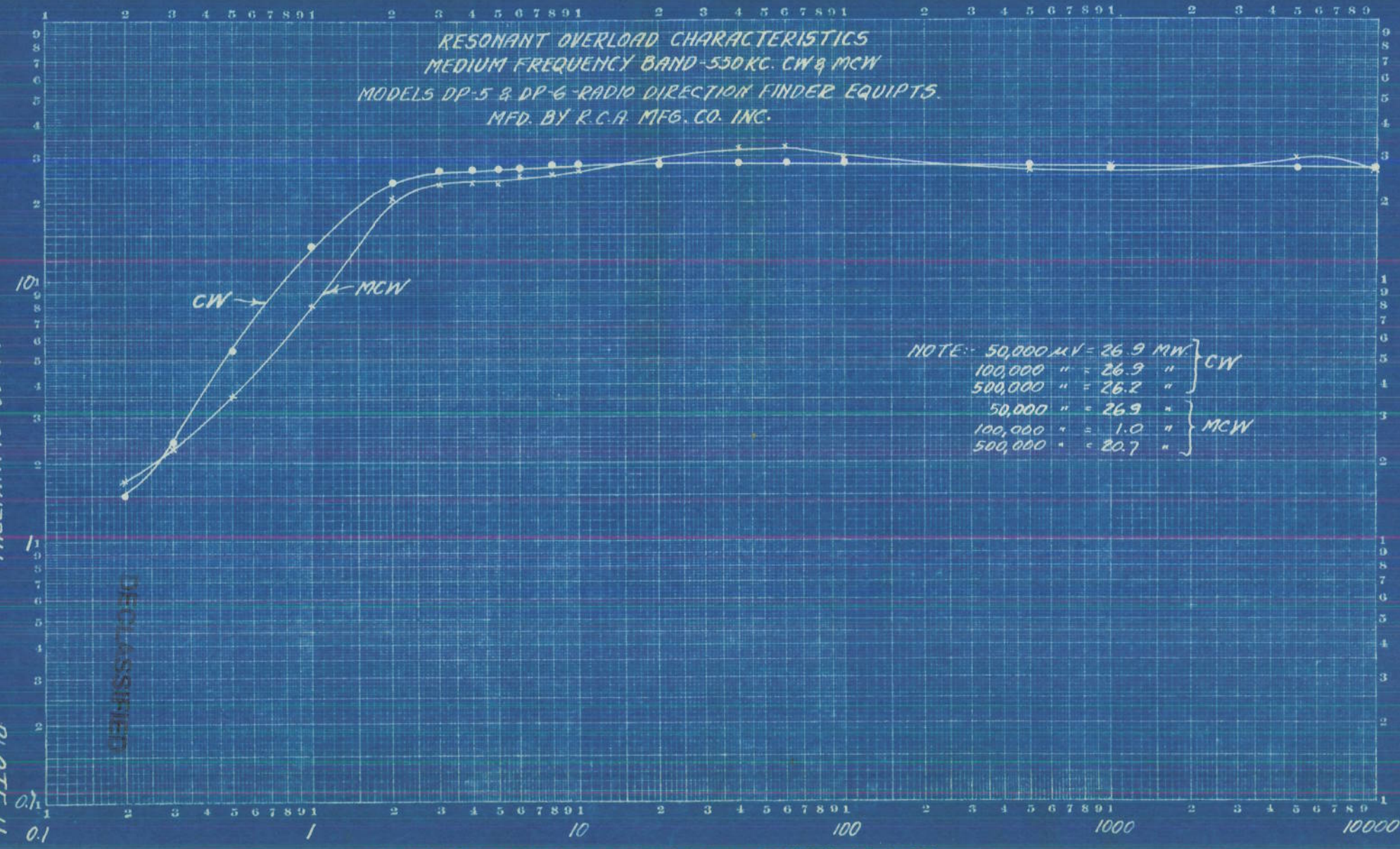
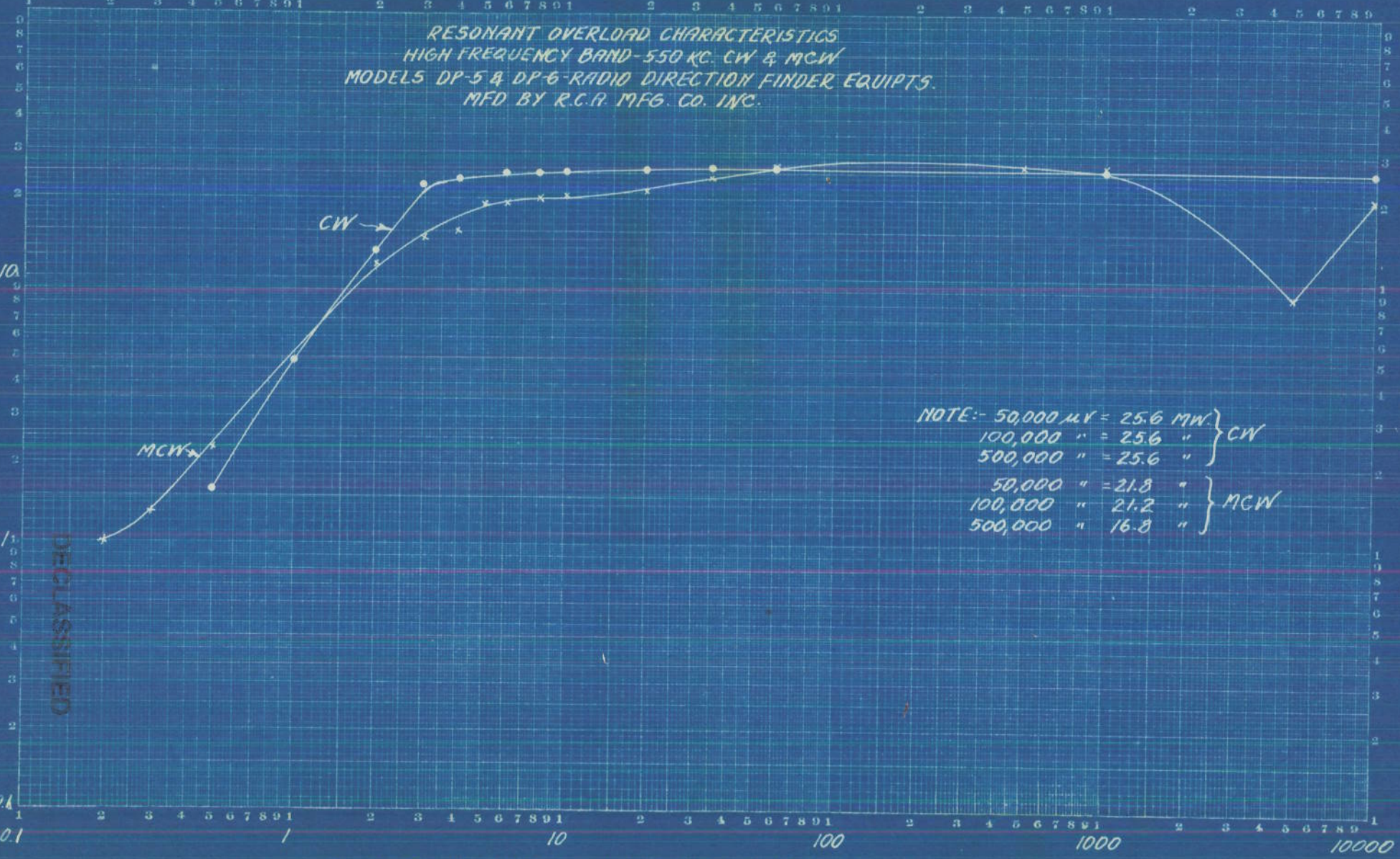


PLATE 11 (R-1#18)

RESONANT OVERLOAD CHARACTERISTICS
HIGH FREQUENCY BAND - 550 KC. CW & MCW
MODELS DP-5 & DP-6 - RADIO DIRECTION FINDER EQUIPTS.
MFD BY R.C.A. MFG. CO. INC.



NOTE:- 50,000 μV = 25.6 MW. } CW
100,000 " = 25.6 "
500,000 " = 25.6 "
50,000 " = 21.8 " } MCW
100,000 " 21.2 "
500,000 " 16.8 "

PLATE 12
(2-5-42 HD)

RESONANT OVERLOAD CHARACTERISTICS
HIGH FREQUENCY BAND 1500 KC. CW & MCW
MODELS DP-5 & DP-6 RADIO DIRECTION FINDER EQUIPTS
MFD. BY R.C.A. MFG. CO. INC.

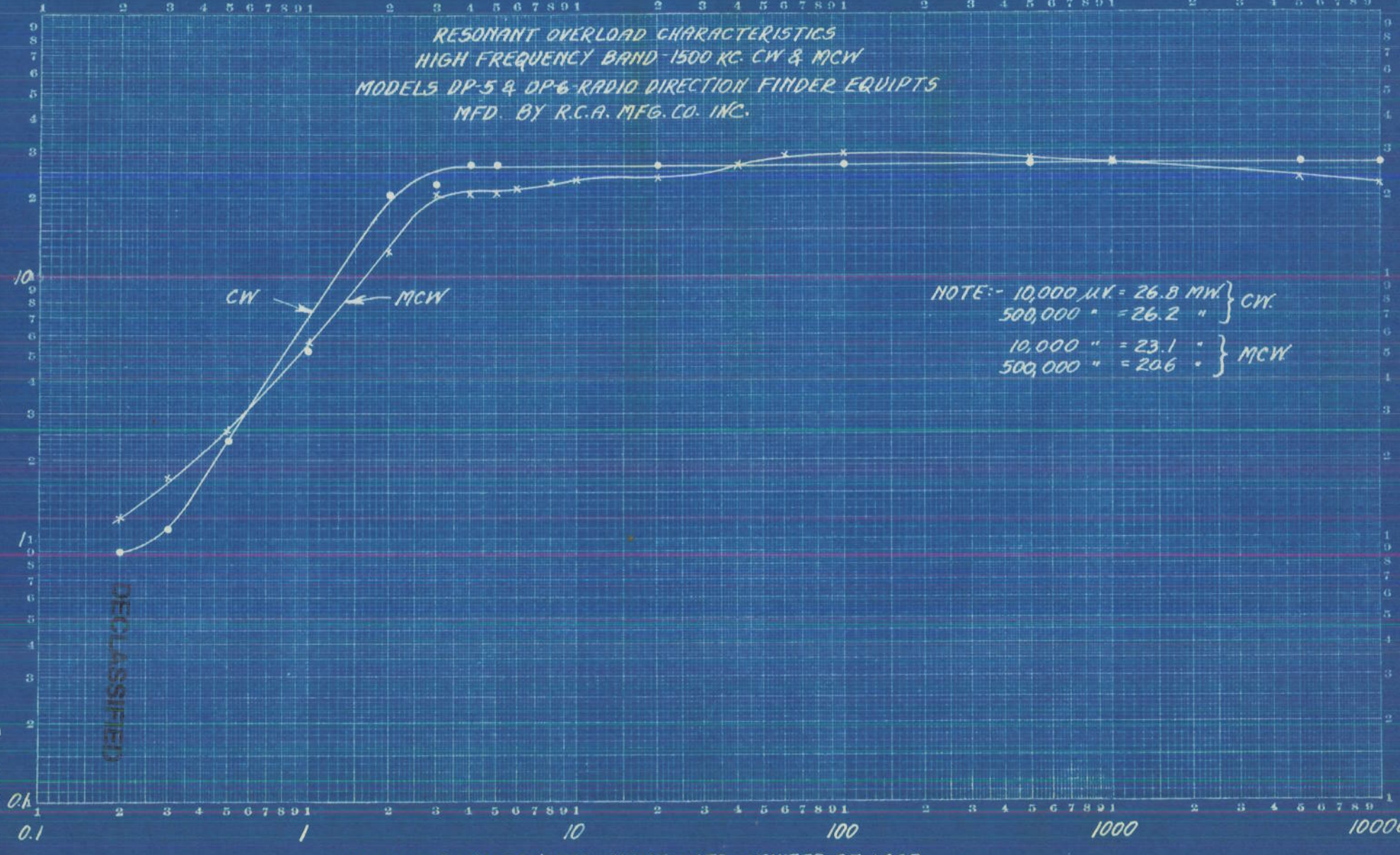


PLATE 13 (R-1844)

DATE

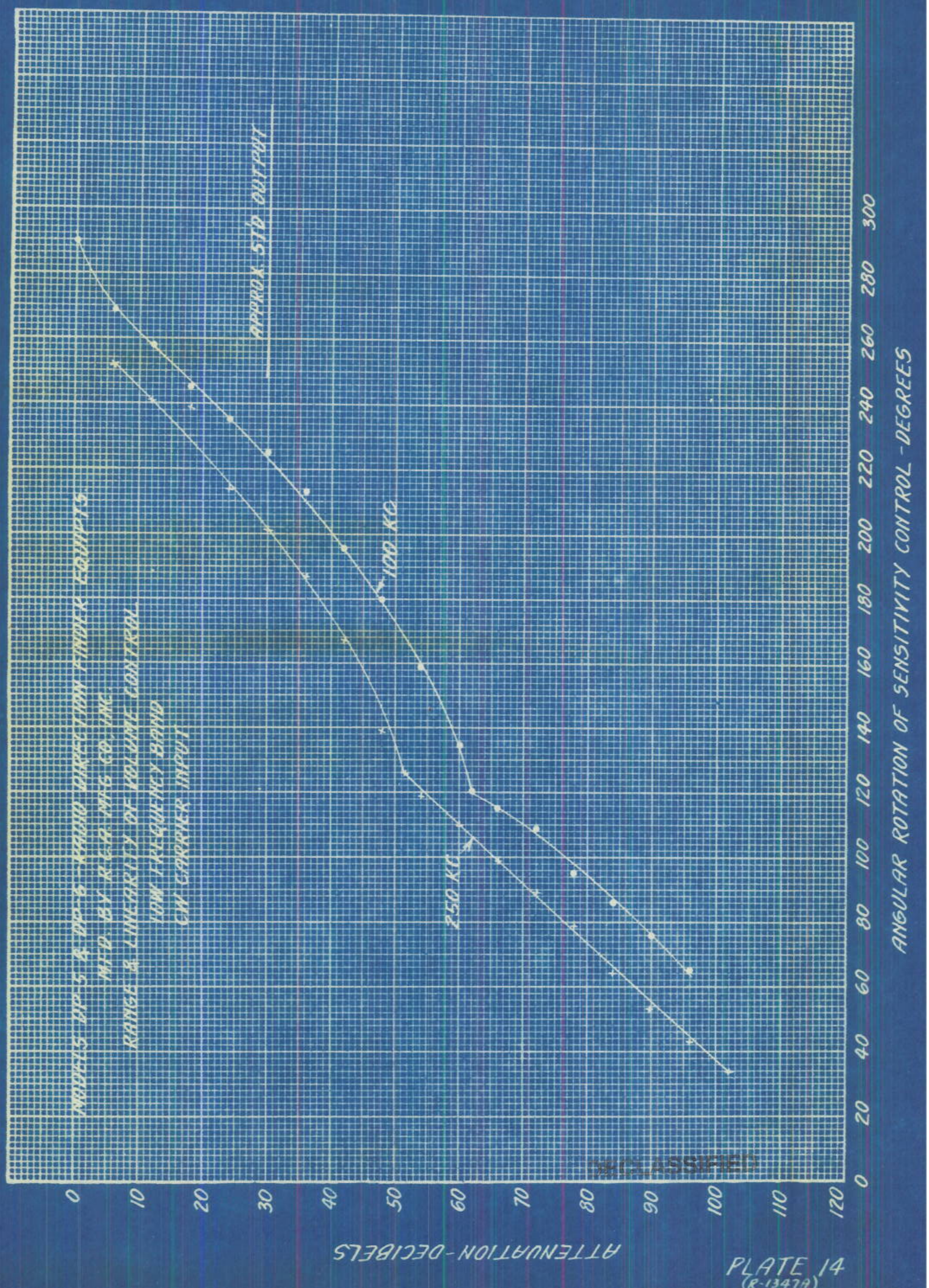


PLATE 14
(R-1347A)

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

DATE

IF SHEET IS READ THIS WAY (HORIZONTALLY) THIS MUST BE TOP. IF SHEET IS READ THE OTHER WAY (VERTICALLY) THIS MUST BE LEFT-HAND SIDE.

N. R. L. 81A

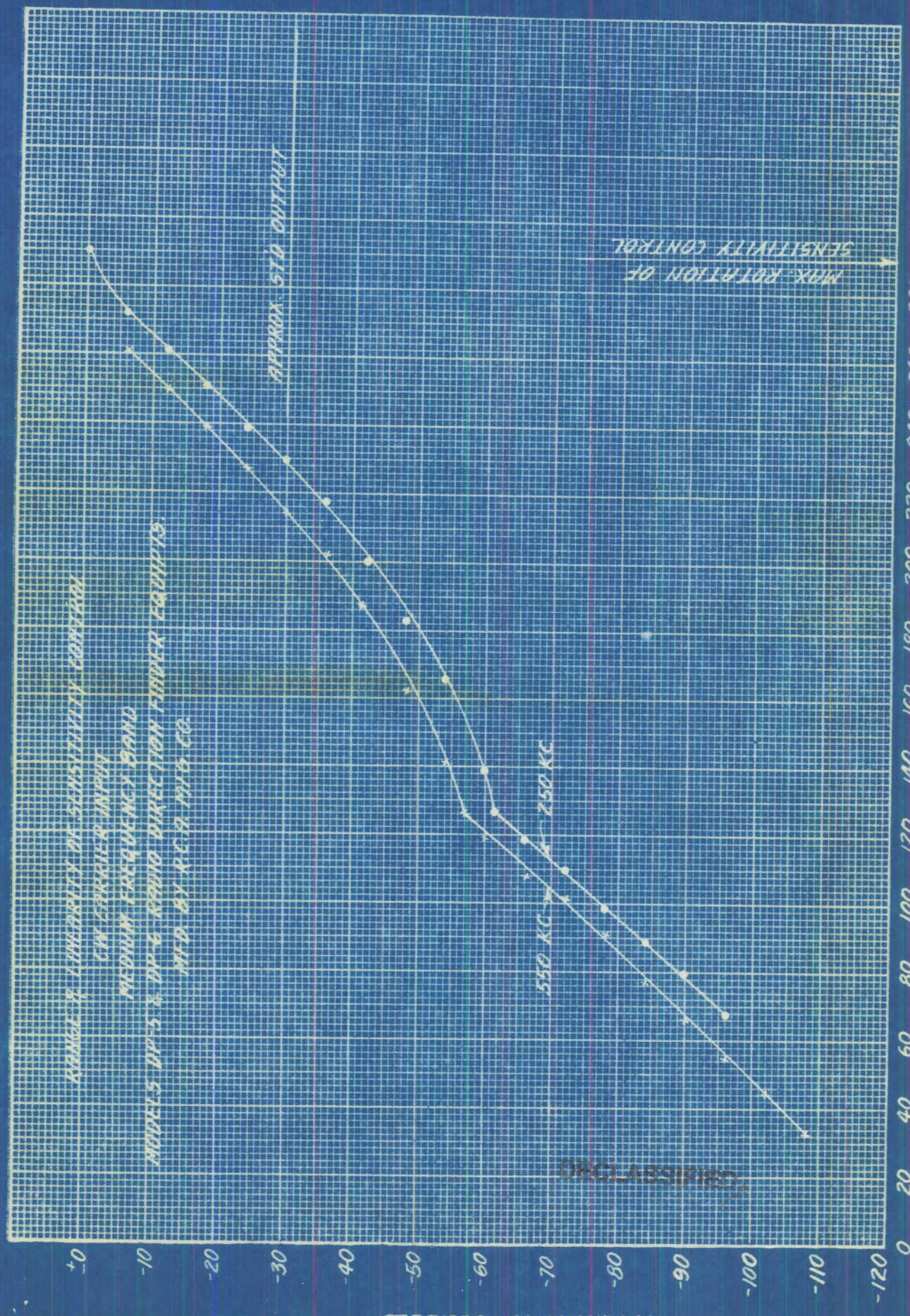


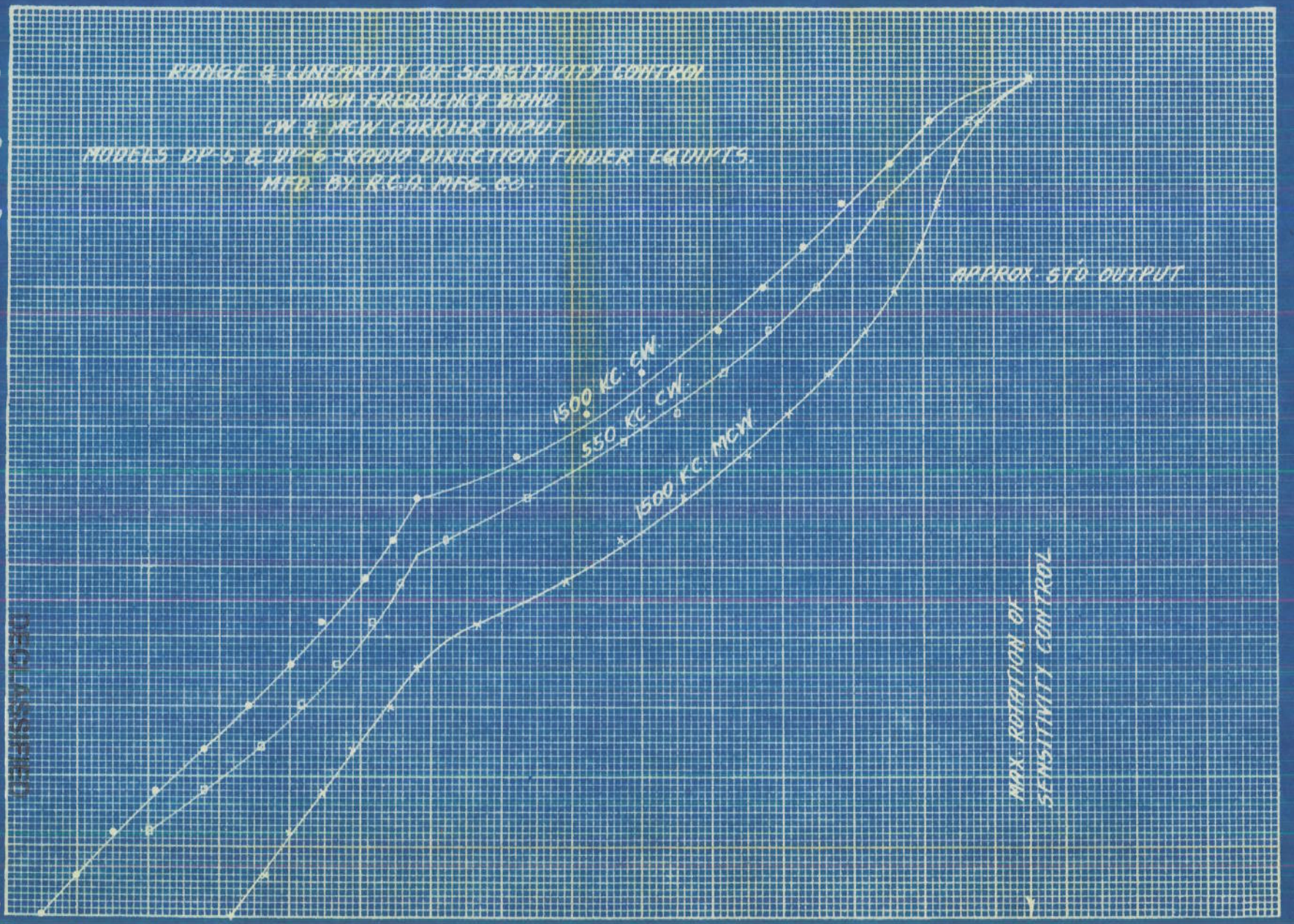
PLATE 15
(R-1347A)

IF SHEET IS READ THIS WAY (HORIZONTALLY) THIS MUST BE TOP. IF SHEET IS READ THE OTHER WAY (VERTICALLY) THIS MUST BE LEFT-HAND SIDE.

N. R. L. 34A

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

DATE



DECLASSIFIED

PLATE 16
(R-1347a)

IF SHEET IS READ THIS WAY (HORIZONTALLY) THIS MUST BE TOP. IF SHEET IS READ THE OTHER WAY (VERTICALLY) THIS MUST BE LEFT-HAND SIDE.

N. R. L. 34A

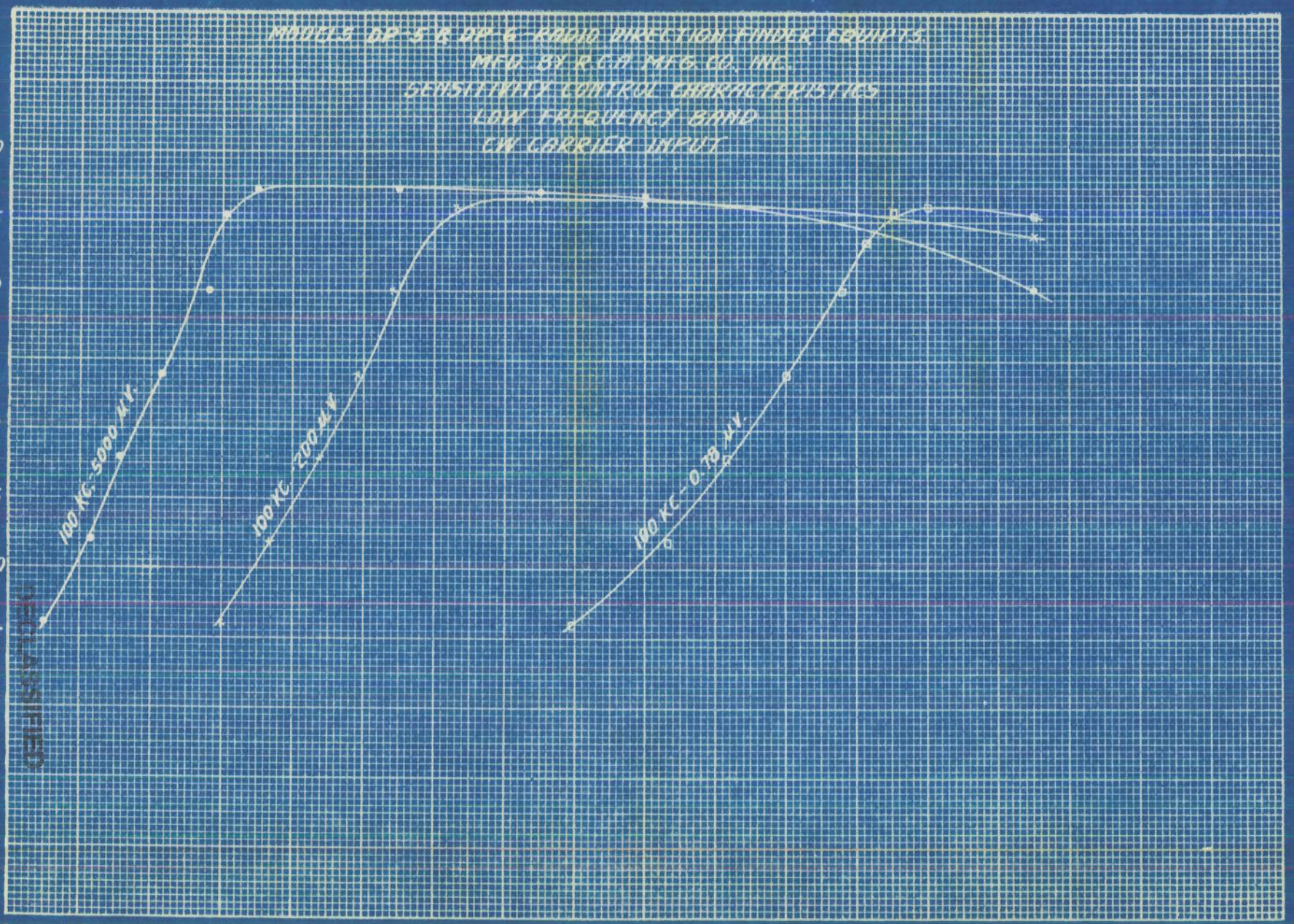
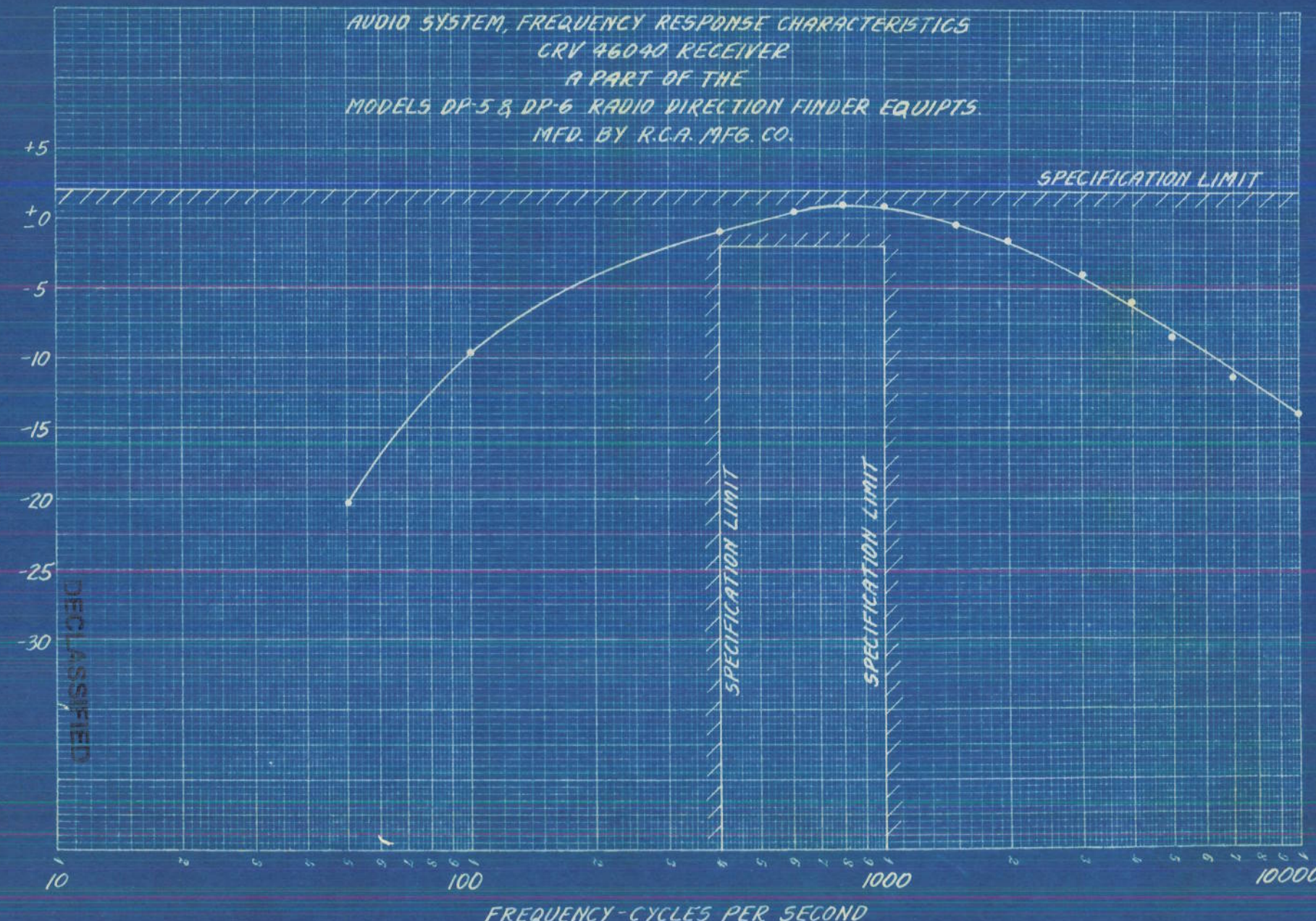


PLATE 17
(R-1494A)

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

DATE

AUDIO SYSTEM, FREQUENCY RESPONSE CHARACTERISTICS
CRV 46040 RECEIVER
A PART OF THE
MODELS DP-5 & DP-6 RADIO DIRECTION FINDER EQUIPTS.
MFD. BY R.C.A. MFG. CO.



DECLASSIFIED

PLATE 18 (NAVY)

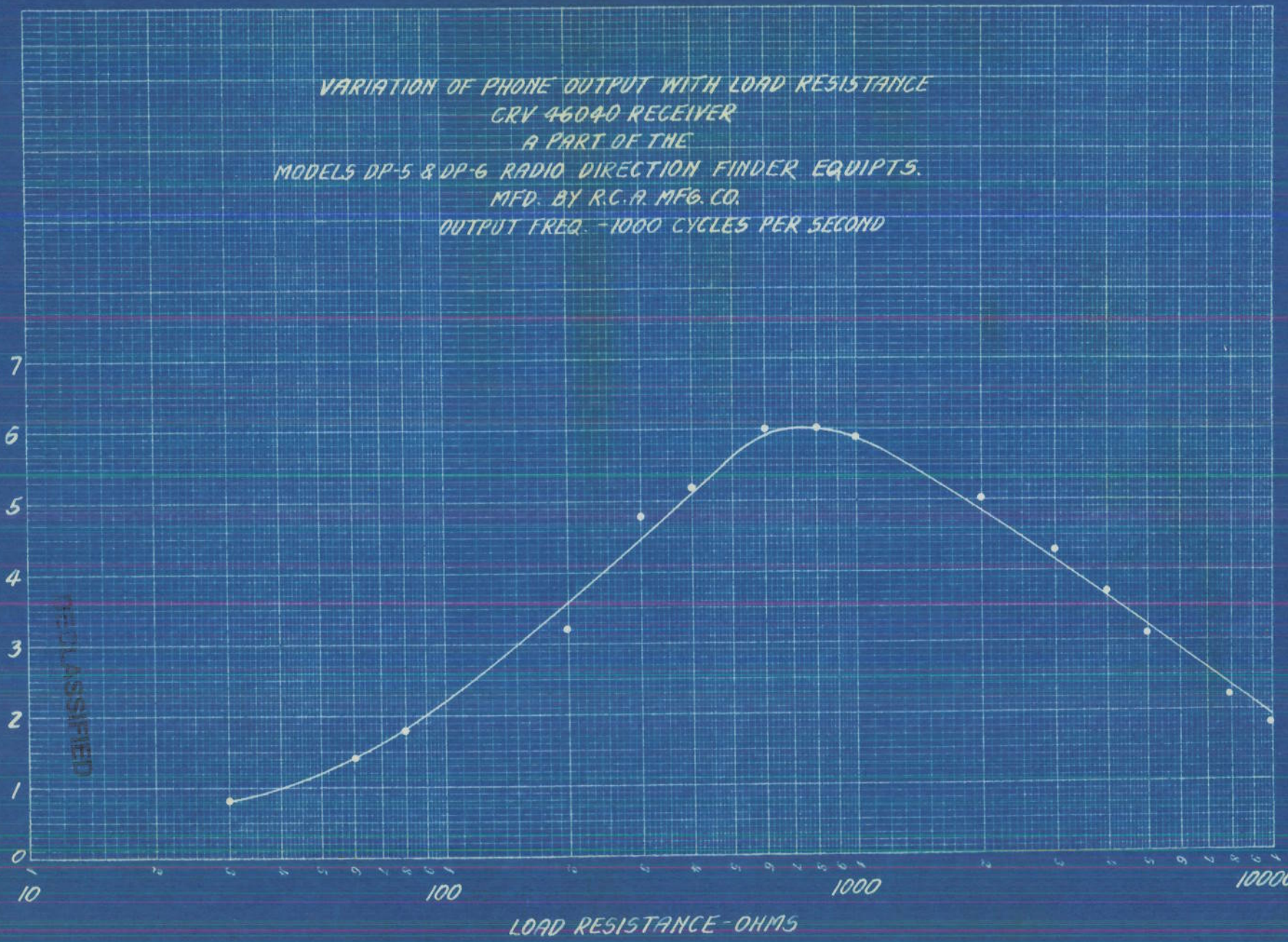


PLATE 19
(R-1818)

OVERLOAD CHARACTERISTICS OF AUDIO SYSTEM
CRV 46040 RECEIVER
A PART OF THE
MODELS DP-5 & DP-6 - RADIO DIRECTION FINDER EQUIPTS.
MFD. BY R.C.A. MFG. CO.
OUTPUT FREQ. - 1000 CYCLES PER SECOND

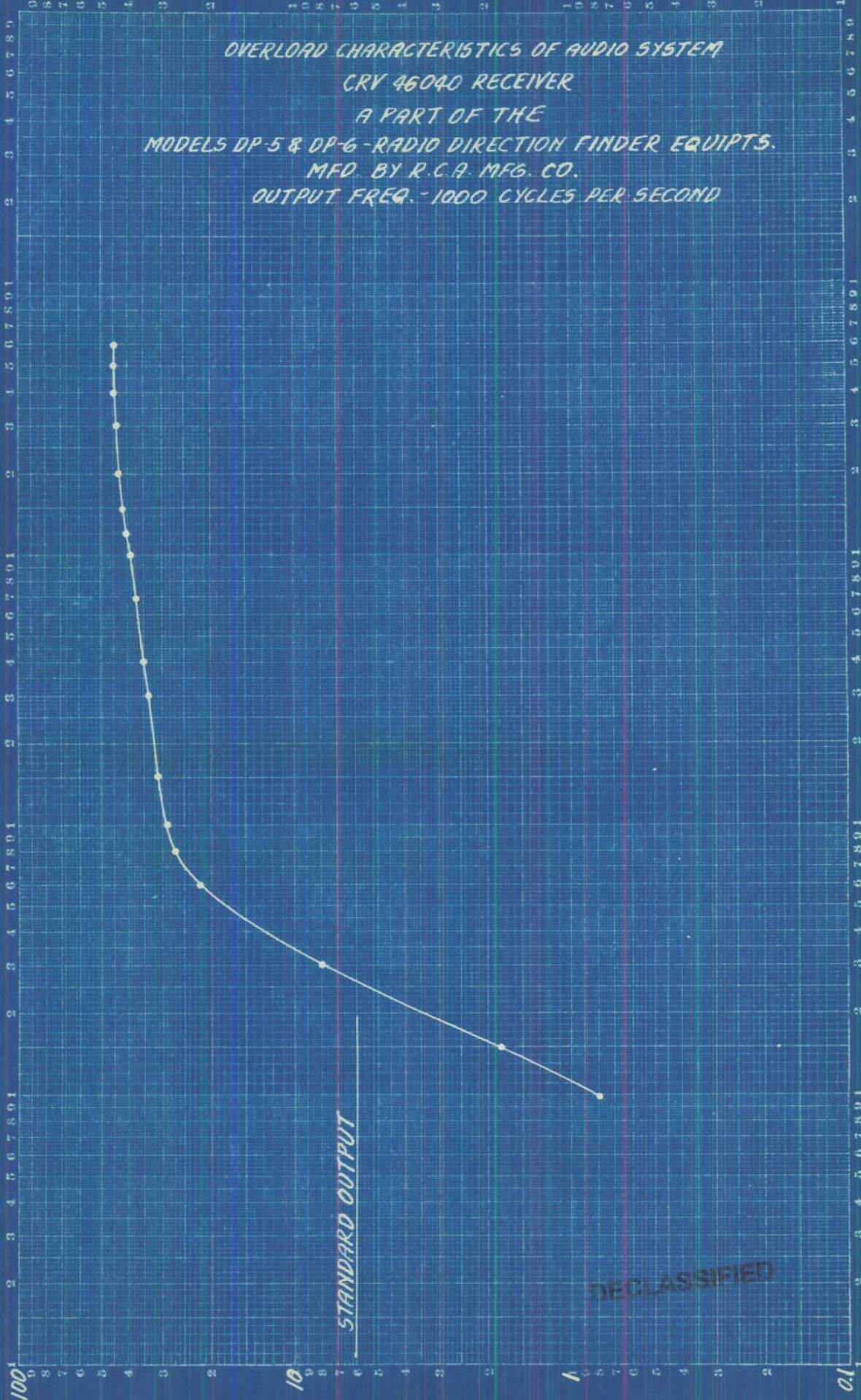


PLATE 20
(R-1347A)

DATE

RESPONSE CURVE AT 1000 CYCLES
FOR
MODELS OP-4, 5, 6 & DO-1 OUTPUT METERS
MFD BY WESTON ELECT. INST. CO.
FURNISHED BY R.C.A. MFG. CO.

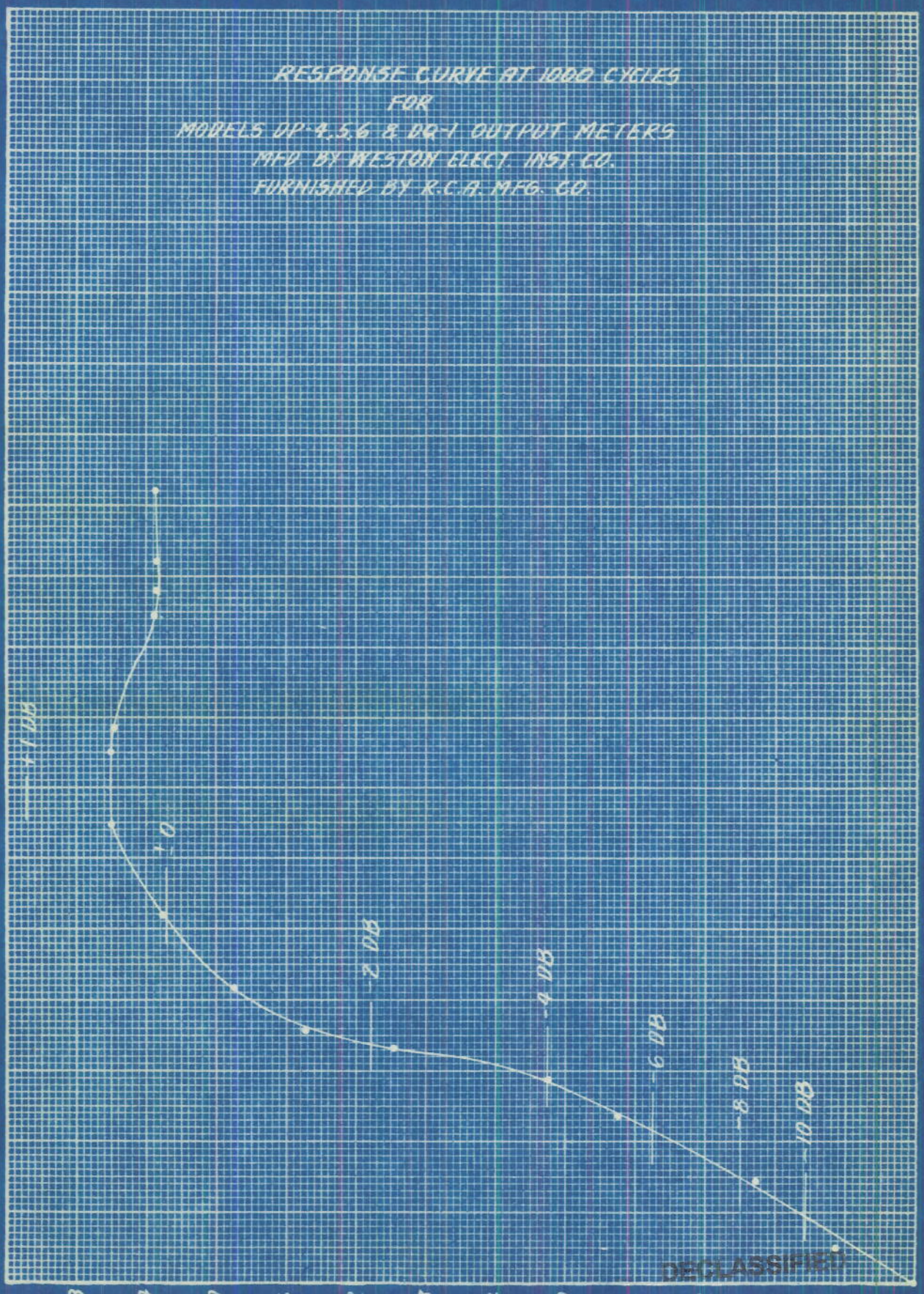
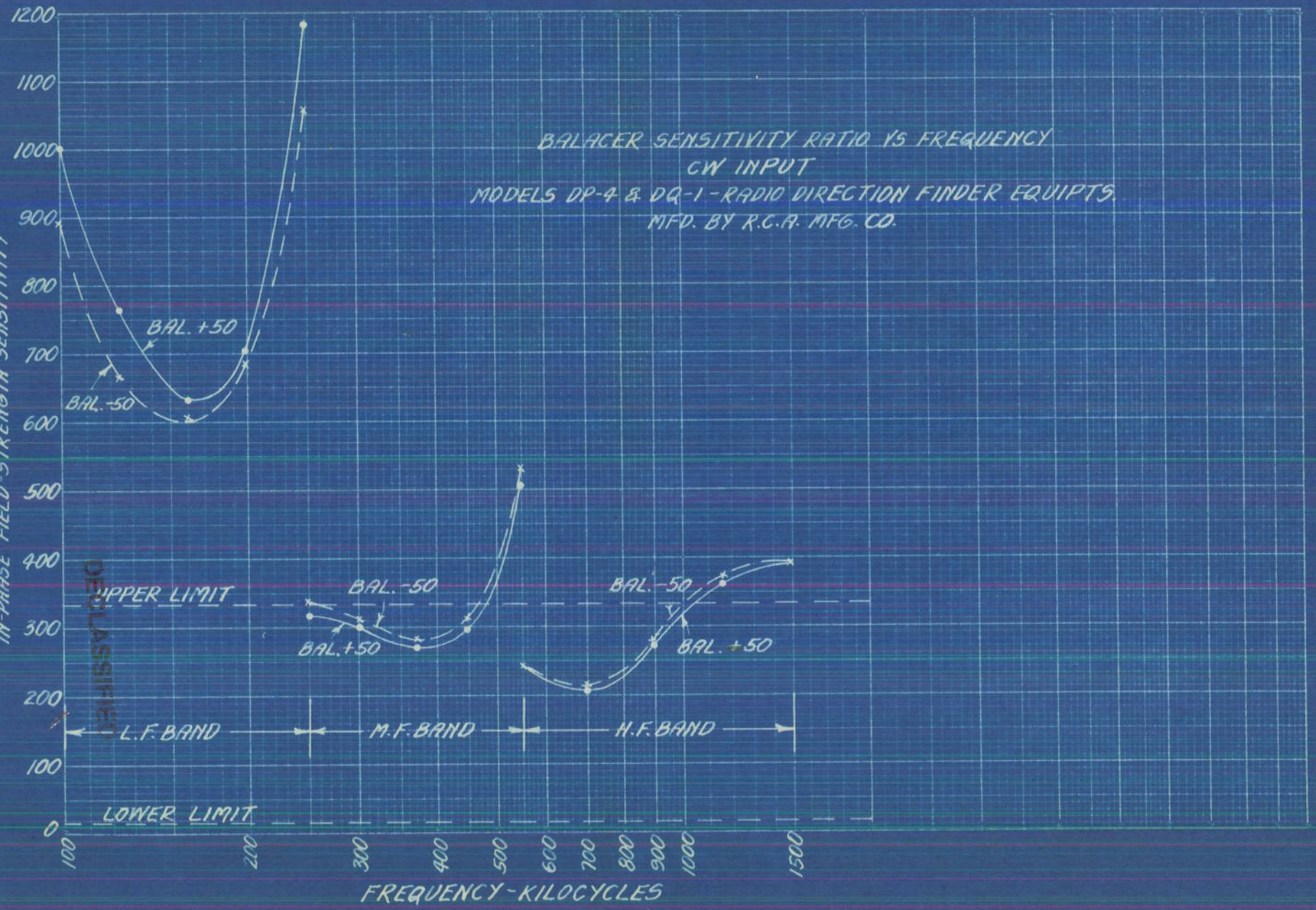
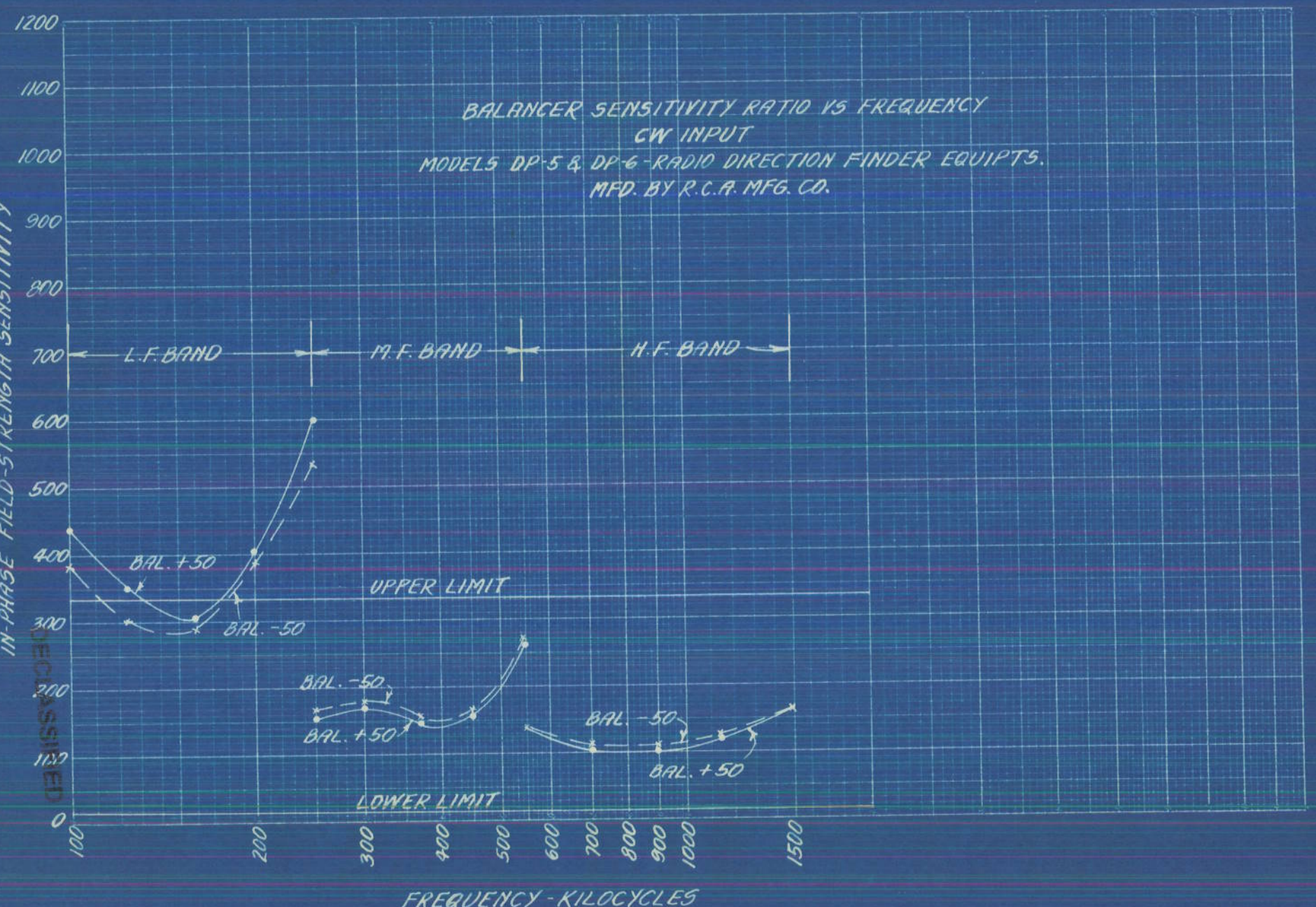


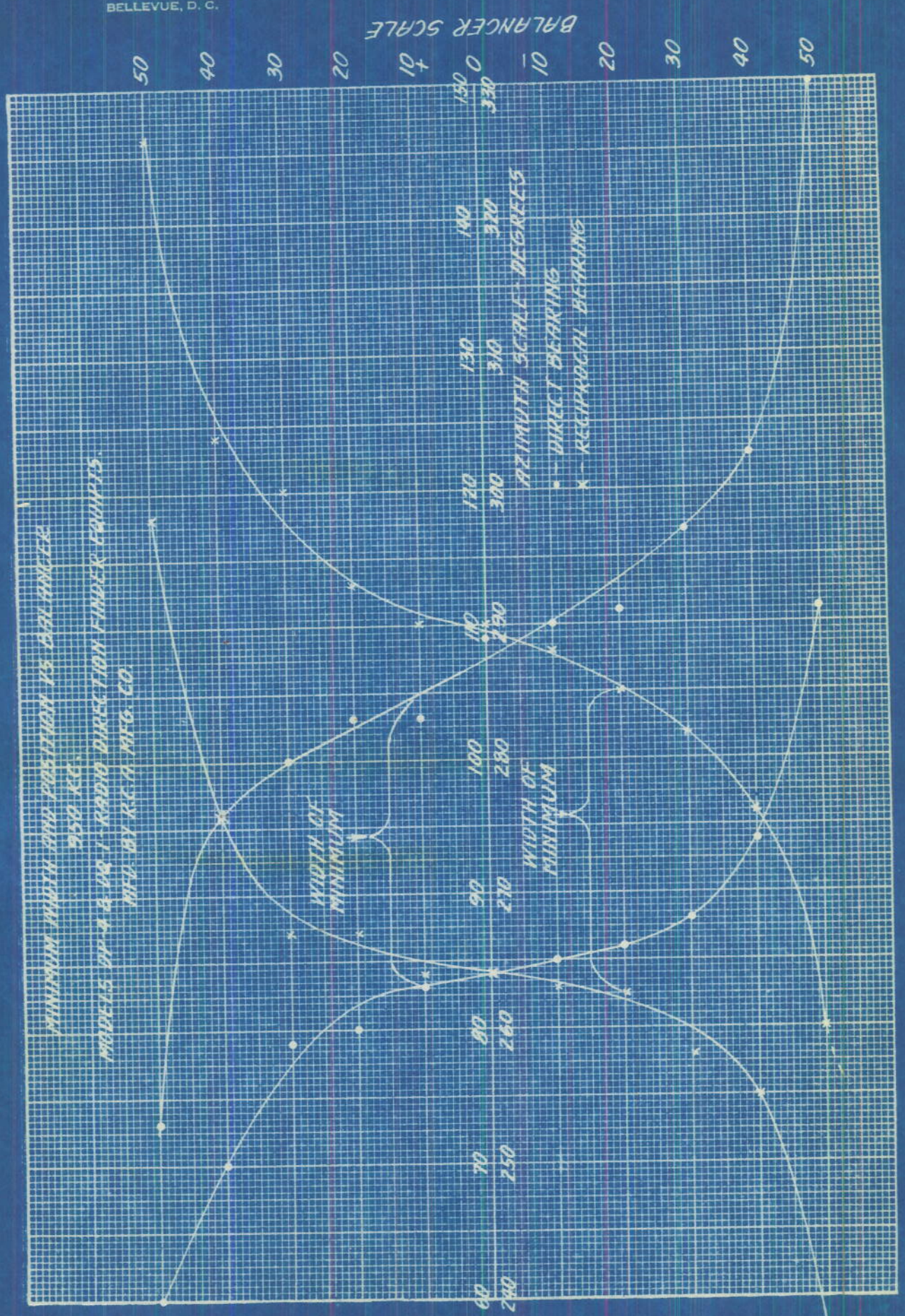
PLATE 21
(R-1347A)





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

DATE



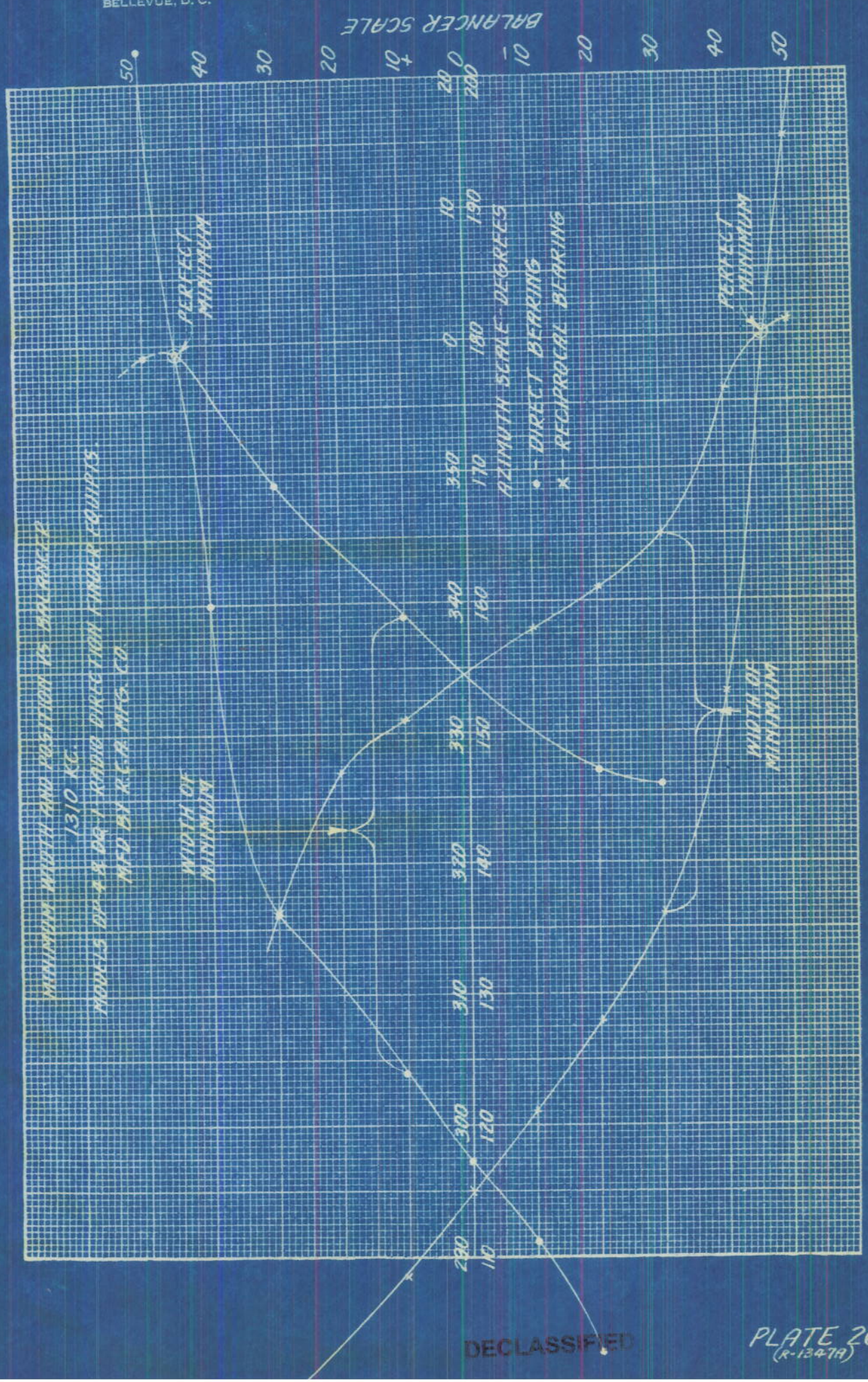
IF SHEET IS READ THIS WAY (HORIZONTALLY) THIS MUST BE TOP. IF SHEET IS READ THE OTHER WAY (VERTICALLY) THIS MUST BE LEFT-HAND SIDE.

N. R. L. 31A

PLATE 25
(R-1347A)

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

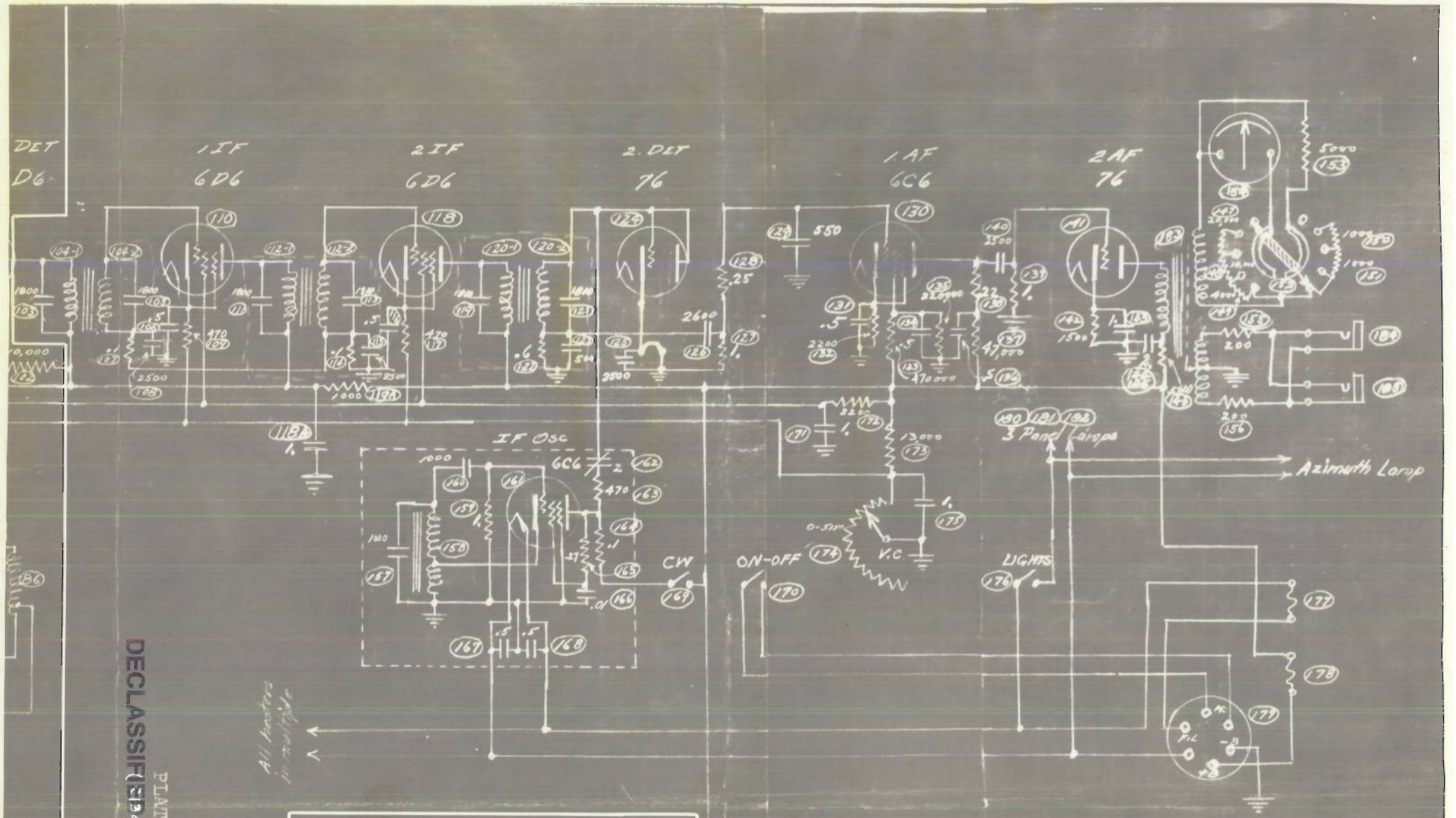
DATE



IF SHEET IS READ THIS WAY (HORIZONTALLY) THIS MUST BE TOP. IF SHEET IS READ THE OTHER WAY (VERTICALLY) THIS MUST BE LEFT-HAND SIDE.

N. R. L. 61A

PLATE 26
(R-1347A)

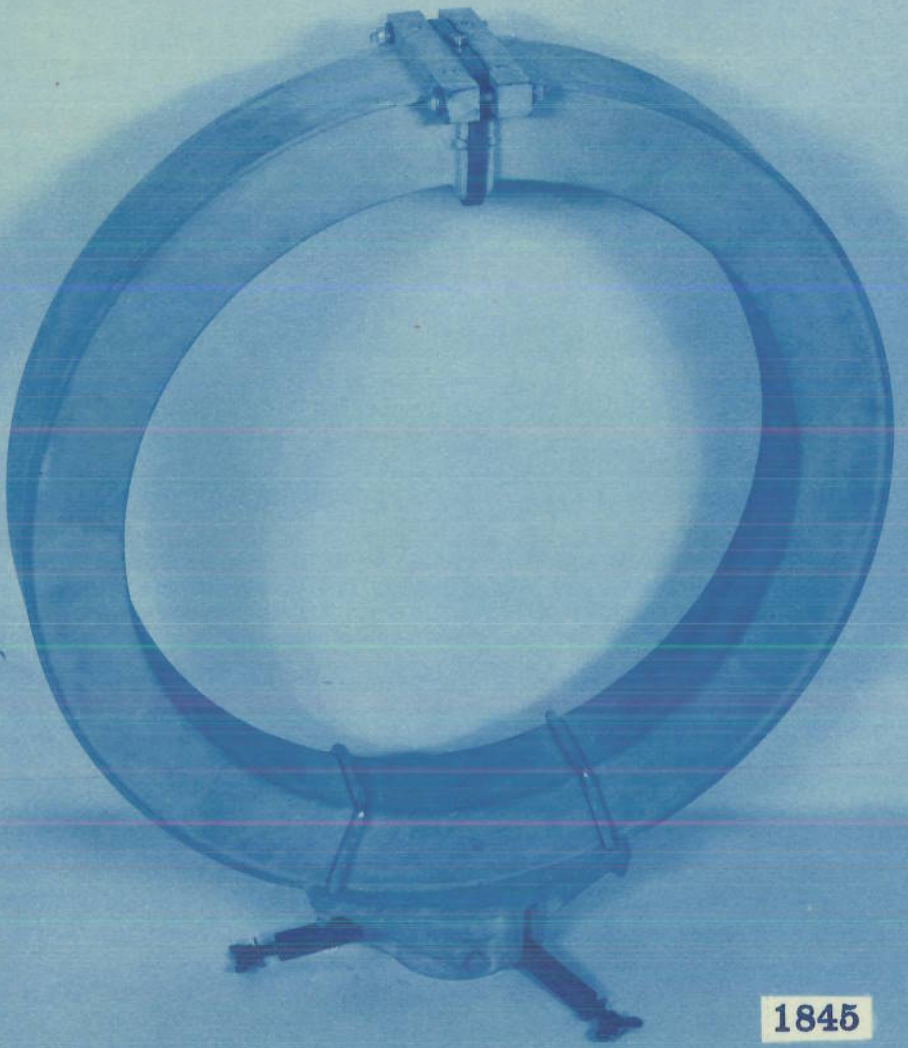


SCHEMATIC DIAGRAM

DIRECTION FINDER DP-4 DP-5 DP-6 DQ-1

RECEIVER

PLATE 27



1845

DECLASSIFIED

Plate 28

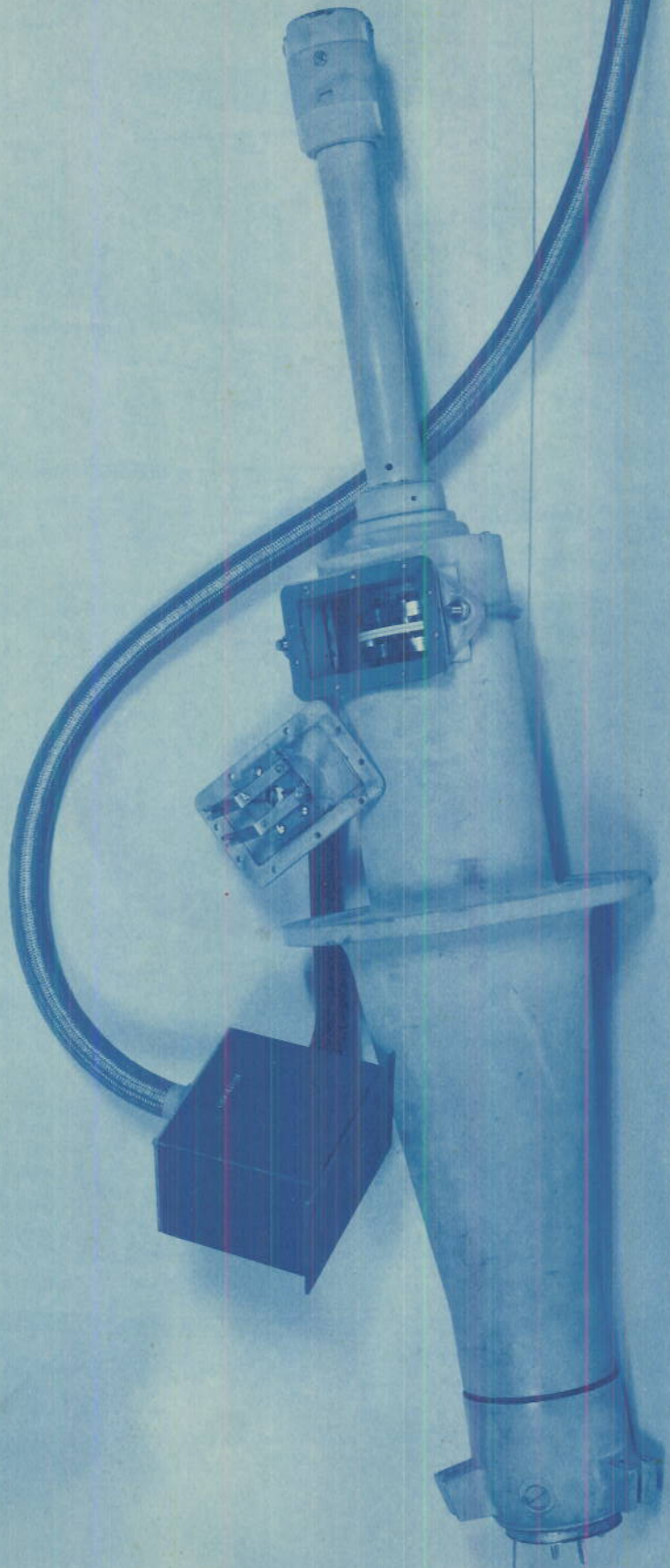


Plate 29