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REPORT NO. R-1546

DATE 24 July 1939

SUBJECT

Tests of Two RAG-1 Receiving Equipments,

Serial No. 1 and Serial No. 18.

BY

NAVAL RESEARCH LABORATORY

BELLEVUE, D. C.

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BuEng. Prob. R1-7R

NAVY DEPARTMENT

BUREAU OF ENGINEERING

Report

on

Tests of Two RAG-1 Receiving Equipments, Serial No. 1 and Serial No. 18.

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D.C.

Number of Pages: Text - 9 Tables - 1 Plates - 43

Authorization: BuEng. ltr. C-S67/46 (5-22-R6) of 25 May 1939.

Date of Tests: 1 June to 19 June 1939.

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Approved by: H. M. Cooley, Captain, USN, Director.

Distribution: BuEng. (10)

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Appendices

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AUTHORIZATION

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

Reference: (a) BuEng.ltr. C-S67/46 (5-22-R6) of 25 May 1939.
(b) BuEng. Specifications RE 13A 466C.
(c) Instruction Book for Models RAG and RAH Receivers.
(d) BuEng. Specifications RE 13A 466B.
(e) BuEng. Specifications RE 13A 571A.
(f) NRL Report No. R-1178.
(g) NRL Report No. R-1093.
(h) NRL conf.ltr. C-S67/46 of 6 July 1939.

OBJECT OF TEST

2. The objects of this test were first, to determine the suitability of the Type RAG equipment for reorder; second, to determine the deterioration in operating characteristics due to service use; third, to detect such conditions in the specifications, design, or operation of the equipment as might be improved with advantage.

ABSTRACT OF TEST

3. The two Type RAG-1 receiving equipments, serial numbers 1 and 18, were received from the Fleet and subjected to tests in accordance with references (a) and (b). Tests were first conducted using the receivers and tubes as they arrived from the Fleet, with no internal adjustments. Next, the receivers were realigned using the original tubes and tested for sensitivity. Then the receivers were supplied with a new complement of tubes, the same set of tubes being used with both receivers, and the complete test repeated. Tests were conducted to determine:

(a) Calibration.
(b) CW sensitivity.
(c) Noise level.
(d) Selectivity - optimum gain.
(e) Sensitivity control range.
(f) Audio filter characteristics.
(g) Overall fidelity at 600 kilocycles.
(h) Resonant overload.
(i) Limiter action.
(j) Frequency overlap.

CONCLUSIONS

(a) The results of the tests indicate that these RAG-1 receivers, after such actual service as they may have had to date, did not meet the requirements of reference (b), neither as received from the Fleet nor after careful alignment and adjustment according to reference (c).

(b) The receivers were found to have drifted only slightly out of alignment since last adjusted, which may have been at the point of manufacture.

(c) The sensitivity of both receivers was unsatisfactory in Bands 1 and 2, both before and after realignment with new tubes.

(d) The selectivity of both receivers was unsatisfactory in Band 1, both before and after realignment with new tubes. It should be noted that the selectivity curves shown in reference (c) were taken on cw with the beat oscillator in operation, and thus are a measure of only the audio filter selectivity, while the curves included in this report indicate very nearly the true r-f selectivity.

(e) The sensitivity and selectivity of both receivers appeared to have deteriorated in all bands, and could not be improved sufficiently by normal adjustments so as to equal the values previously reported on the original test model. It is felt that this deterioration is largely due to a reduction in circuit Q as the result of aging of the inductances.

(f) The antenna trimmer was found unsatisfactory in that it required adjustment for each frequency in all bands.

(g) The lock nuts on some of the coil unit trimmer condensers were inoperative.

(h) The band-pass audio filter may be considered as meeting the specifications if a frequency of 1000 cycles is used as the reference point. No difficulty should be encountered in meeting much more rigid requirements, as is indicated by the Models RAA and RAB receivers.

(i) The peak audio filters were found to be unsatisfactory at the low and high ends of their range, and at some of the intermediate points.

(j) Harmonics, generated in the detector, were found to produce undesirable fidelity characteristics.

(k) The maximum noise level of one receiver exceeds 300 microwatts in one band. Both receivers fall far below 300 microwatts in some bands, a natural result of the limitation of noise to such a low level. A further result of this limitation is a lack of reserve gain, it being necessary to operate the receivers at maximum gain over most of the frequency range in order to make sensitivity measurements.

(l) Resonant overload occurs in some cases at less than 250 milliwatts, but is considered to be satisfactory in general.

(m) The manual gain control has a range of more than 100 decibels in both receivers and is satisfactory.

(n) The output limiter action is satisfactory.

(o) The useful sensitivity at some points in the range of the receiver could be improved by the simple expedient of reducing the effective bias on the r.f. tubes, as the present full gain position of this bias control does not give full standard noise level throughout the range. Such a change would not, however, bring the sensitivity within specification limits at the points where standard noise level is obtainable with existing gain and the specification limit is not met. It is believed that specification limits will be met only after improved selectivity is realized.

RECOMMENDATIONS

(a) After a careful study of the above test results and in the light of modern practice, it is believed that better performance than demonstrated can be expected in new receivers for the low frequency part of the spectrum. Improvement in sensitivity, overall selectivity, audio selectivity and greater reserve gain can be reasonably expected. With this in mind, the following recommendations are submitted for consideration.

(b) That the performance specifications as given in RE 13A 466C apply to the purchase of new equipment with certain exceptions as listed below and that the inferior performance of the units tested not be considered as acceptable.

(c) That the prospective contractor be not only permitted, but urged, to consider a different coupling system in the r-f amplifier stages than used in the model. It is not apparent that a maximum selectivity, and hence sensitivity, can be realized in an amplifier covering the range of 15 to 600 kilocycles, employing the same choke coil, as a plate load, for all frequencies in this band.

(d) That the maximum noise level be not limited to 300 microwatts as specified but that a maximum of 100 milliwatts be permitted to provide reserve gain to compensate for general depreciation of tubes, components, and alignment, resulting from aging.

(e) That the band-pass filter specified under paragraph 2-1(21) of reference (b) be required to be effective at all times, but in addition thereto, and available by means of switching, there be provided a sharp band-pass filter similar to that provided in the Model RAA receiver, its object being to separate the very low frequency channels which are but 200 cycles apart. The variable frequency attenuators described in paragraph 2-1(25) to (32) inclusive of reference (b)are considered very useful under many circumstances, and due to their relatively small space requirement are worthy of retainment. The present design should not be copied, however, as it has been found to be mechanically weak and appears to depreciate electrically, as indicated by the tests. The band-pass filter in the present models has air core coils of apparently rather poor efficiency and the entire unit is unnecessarily large. It is probable that the two band-pass filters suggested above, if properly designed, will occupy no more space than the present one.

(f) That provision be made in the detector plate circuit for insertion of a d-c meter to be employed for r-f selectivity measurements, and that such jack or terminals as provided be properly by-passed to assure that normal receiver performance will prevail when such a meter is used.

(g) That provision of a cw (oscillator) "on and off" switch be considered.

(h) That the receiver input circuit be so designed that specification sensitivity will prevail throughout any one band after the antenna trimmer adjustment has once been made for any point within the band.

(i) That the coil unit trimmer condensers be equipped with reliable locking devices which will continue to function throughout the life of the receiver.

(j) That the power cable between the receiver and the power unit be completely covered with a conducting braid so tightly woven as to leave no apparent spacing between the individual wires of the braid and that these braid coverings be connected through such coupling means as to assure no appreciable electrical discontinuity between the braid and the box walls at the point of entry of either box. The cables should also have a sturdy outer rubber covering to provide physical protection for the braid shield.

(k) That the antenna and power supply leads be brought into the receiver in such a manner as to reduce the electrical coupling to a minimum. Bringing them into the receiver parallel and adjacent to each other, as in the model, is unsatisfactory.

(l) That provision be made to assure that the contact areas of all component parts such as box aperture edges, panel backs, covers and chassis components, which depend upon pressure contact for electrical continuity or shielding integrity, maintain good conductivity throughout the life of the equipment unless intentionally open circuited by disassembly for repairs or adjustments; and also be assured of regaining good electrical conductivity and shielding after reassembly by the reverse procedure to that of disassembly. The bolting or screw-locking of pressure contacts as between the panel back and the receiver case, where such contacts are anodized and/or lacquered as in the model, is unacceptable.

(m) That all receiver cases be made the equivalent of one piece construction so far as electrical continuity is concerned. The use of riveted lap seams with anodized or lacquered material where such seams admit light for over 90 per cent of their length, as in the model, is not acceptable.

(n) That the receiver be required to operate in a field strength of 10 volts per meter at any frequency within its range with the antenna input binding post shielded so as not to contribute to the receiver input, giving an output under standard gain conditions not exceeding 6 milliwatts. Items 47 - 50 are believed to be necessary as means of accomplishing the requirements of (51).

MATERIAL UNDER TEST

4. The material under test consisted of two radio receiving equipments, Type RAG-1, Serial No. 1 and Serial No. 18. These equipments were manufactured by the Hygrade Sylvania Corporation, Clifton, New Jersey, and had been in service for some time.

5. The Type RAG-1 equipment covers a rated frequency range of 15 to 600 kilocycles in four bands, by means of tuning condensers and a coil switching mechanism. It consists of the following units:

(a) One Navy Type CHS-46042 receiver.
(b) One Navy Type CHS-20032 power unit.
(c) One set of interconnecting cables.

TEST INSTRUMENTS

6. The following instruments were employed in these tests:

(a) General Radio signal generator, Model LC-1, Serial No. 18.
(b) Naval Research Laboratory 600 ohm output volt-power meter.
(c) General Radio dummy antenna, Type 418G.
(d) Ballantine VT voltmeter, Type 300, Serial No. 14.
(e) General Radio beat frequency oscillator, Type 713A, Serial No. 141.
(f) Weston tube analyzer, Model OD-A, Serial No. 395 (corrected for error).
(g) General Radio wave analyzer, Type 636A, Serial No. 102.

METHOD OF TEST

7. Tests were conducted in accordance with references (a) and (b).

8. For radio frequency tests the signal generator was coupled to the receiver input terminals through the dummy antenna, the a-f output being measured across a 600 ohm resistive load by means of the output meter or the Ballantine voltmeter as desired.

9. Sensitivity measurements were made using a 1000 cycle cw beat note in the output, with a signal plus noise output of 6 milliwatts, 20 decibels above the noise level.

10. Selectivity measurements were made with the cw beat oscillator inoperative, and the input signal modulated 40 per cent at 100 cycles for Bands 1, 2 and 3 to avoid side-band cutting, and modulated 40 per cent at 400 cycles for Band 4. Due to attenuation in the audio filter, it was necessary to operate at a low output level to avoid detector overloading. The system is not recommended unless provision is made for cutting out the audio filter, but was employed as an alternative instead of the detector plate current-change method for which there also was no provision.

11. Noise level measurements were made at maximum gain with optimum antenna trimmer settings for each point.

12. The audio filter characteristics were measured by removing the detector tube and feeding the audio signal into the detector output circuit through a series resistance and capacity of 25,000 ohms and 2 microfarads. The input voltage was maintained constant, while the frequency was varied and the receiver output measured.

13. The overall fidelity at 600 kilocycles was measured by externally modulating the signal generator in the normal manner with a beat frequency oscillator of low harmonic content, maintaining a constant input voltage to the receiver, and measuring its output.

14. Resonant overload was measured by recording the receiver output voltage for inputs ranging from 1 microvolt to 1/2 volt, with the receiver adjusted for standard sensitivity.

DATA RECORDED DURING TEST

15. The data recorded during these tests are contained in Table 1 and Plates 1 to 43, inclusive.

PROBABLE ERRORS IN RESULTS

16. The equipment under test and all measuring instruments incorporating vacuum tubes were allowed a warm-up period of at least fifteen minutes before each test.

17. The signal generator output calibration was corrected by measurement with the Ballantine voltmeter, this voltmeter then being used to measure receiver output.

18. The audio beat frequency oscillator and the wave analyzer were calibrated periodically to assure reliable results.

19. The estimated overall error for the various tests is given below:

Test	Maximum Error
Sensitivity	± 10%
Selectivity	± 10% (input voltage)
Maximum noise level	± 5%
Resonant overload	± 5%
A-F characteristics	± .3 decibels
Limiter action	± .3 decibels

RESULTS OF TEST

20. No defective vacuum tubes were found, although the values for S_m were decreased from the rated values. The measured values are recorded in Table 1.

21. In accordance with reference (a), paragraph 8(a), both receivers were tested as they arrived from the Fleet, making no internal adjustments. The results were as follows:

21-1. Calibration. The calibration for RAG-1, Serial No. 18, is shown on Plate 1, and covers the specified range. The calibration for Serial No. 1 is shown on Plate 22, and covers the specified range.

21-2. Antenna Trimmer. Antenna trimmer settings for Serial No. 18 were plotted on Plate 2, failing to reach optimum values in Bands 2 and 3. Antenna trimmer settings for Serial No. 1 were plotted on Plate 23, and resonated satisfactorily.

21-3. Sensitivity. Reference (b), paragraph 2-1(1). Sensitivity curves for Serial No. 18 are shown on Plate 3, and for Serial No. 1 on Plate 24. With the antenna trimmer adjusted only once in each band, both receivers failed seriously to meet the sensitivity requirements in all four bands. With the antenna trimmer adjusted for each point of measurement in each band, both receivers still failed to meet the sensitivity requirements except at a few points in Bands 3 and 4.

21-4. Selectivity. Reference (b), paragraph 2-1(2). Receiver No. 18 failed to meet the selectivity requirements throughout Band 1, and at one end of Band 2, but met the requirements at all points in Bands 3 and 4. Receiver No. 1 failed to meet the selectivity requirements at some points in Bands 1, 3 and 4. The deviation from the requirements was not large for either receiver however. Selectivity curves for Serial No. 18 are shown on Plates 4 to 7, and for Serial No. 1 on Plates 25 to 28, inclusive.

21-5. Band-pass Filter. Reference (b), paragraph 2-1(21). The band-pass filter characteristics are shown on Plate 8 for receiver No. 18 and Plate 29 for receiver No. 1. The filters of both receivers are centered within ± 10 per cent of 800 cycles. If the 1000 cycle output is taken as the reference level, both receivers meet the band-pass requirements, contrary to the statement of reference (h), paragraph 4e. If the 800 cycle output is taken as the reference level, both receivers fail to meet the requirements at the -6 decibel level, concurring in the statement of reference (h), paragraph 4e. Receiver No. 18 showed a pronounced peak at 280 cycles as indicated on the curve.

21-6. Peak Filter. Reference (b), paragraph 2-1(26). Since there was no provision in these receivers for disconnecting the band-pass filter during operation, the peak-filter curves on Plates 8 and 29 were taken with the band-pass in operation. The curves for the lowest and highest peak frequencies are very broad and highly attenuated, failing to meet the requirements.

21-7. Reference (b), paragraph 2-1(29). Both receivers failed to meet the peak filter band-width requirements.

21-8. Reference (b), paragraph 2-1(30). Both receivers failed to meet the peak filter attenuation requirements at the lowest and highest peak audio frequencies, showing a high insertion loss. The intermediate frequencies were satisfactory, however.

21-9. Fidelity. Fidelity curves are shown on Plates 9 and 10 for receiver No. 18, and Plates 30 and 31 for receiver No. 1. These curves, taken at 600 kilocycles, show the true response of the receiver to an incoming signal, regardless of whether the audio frequency is obtained from a modulated signal or from beating a cw signal with the local heterodyne oscillator. A study of the receiver by means of the harmonic analyzer indicated that the detector was responsible for the generation of harmonics which appear on the curves as spurious responses.

22. In accordance with reference (a), paragraph 8(b), both receivers were realigned and the sensitivity curves repeated. The lock nuts on the trimmer condensers were found to be unreliable. On several coil units the lock nuts were stuck tightly to the trimmer shafts and rotated with them.

22-1. Sensitivity. Reference (b), paragraph 2-1(1). Sensitivity curves are shown on Plates 11 and 32 for the receivers after realignment with the original tubes. Although somewhat improved over the curves of Plates 3 and 24, both receivers failed to meet the sensitivity requirements in some portions of all bands.

23. A set of new RCA tubes with values of S_m slightly better than average was next installed, the same tubes being used in both receivers. Table 1 gives the values of S_m for these tubes. Receiver No. 1 was found to have one mounting screw missing, and the other one very loose at the forward end of the tuning condenser, providing a poor ground and resulting in oscillations with the new tubes. The defect was remedied and the spurious oscillations ceased. Both receivers were then realigned and measurements made of sensitivity, selectivity, maximum noise level, manual gain control, resonant overload, and output limiter.

23-1. Calibration. The calibration curves are shown on Plate 13 for receiver No. 18 and on Plate 33 for receiver No. 1.

23-2. Antenna Trimmer. Antenna trimmer settings are plotted on Plates 13 and 34. The curves for Serial No. 18 indicate a failure to reach resonance in Bands 2 and 3. This could be corrected by aligning the receiver at about 920 on the tuning dial instead of 900 as instructed in reference (c). That procedure was followed in aligning receiver No. 1, with more favorable antenna trimmer curves, as shown on Plate 34.

23-3. Sensitivity. Reference (b), paragraph 2-1(1). The sensitivity control settings used with optimum antenna trimmer settings are shown on Plates 13 and 34. The sensitivity curves are shown on Plates 14 and 35. With the antenna trimmer adjusted at one point in each band, both receivers failed to meet the sensitivity requirements except at a few points in Bands 3 and 4. With the antenna trimmer adjusted at each point in each band, receiver No. 18 met the sensitivity requirements in Bands 3 and 4, but failed in Bands 1 and 2. Receiver No. 1 met the requirements in Band 3 and a portion of Band 4, but failed in Bands 1, 2, and a portion of 4. This paragraph supersedes that of reference (h), paragraph 6b, with which it is not in entire agreement.

23-4. Maximum Noise Level. Reference (b), paragraph 2-1(3). Curves of maximum noise level for both receivers are shown on Plates 15 and 36. Receiver No. 18 exceeded 300 microwatts, the specification maximum, in Band 3, reaching a maximum of 1010 microwatts at 195 kilocycles. Receiver No. 1 did not reach a noise level of 300 microwatts at any frequency. The noise level of both receivers was extremely low in Bands 1, 2 and 4, which may be explained by insufficient gain.

23-5. Manual Gain Control. Reference (b), paragraph 2-1 (33, 34, 36, 37, 38, 39). The manual gain (sensitivity) controls on both receivers complied with the specifications. Curves are shown on Plates 16 and 37.

23-6. Selectivity. Reference (b), paragraph 2-1(2). Selectivity curves are shown for receiver No. 18 on Plates 17 to 20, and for receiver No. 1 on Plates 38 to 41. Both receivers failed to meet the selectivity requirements at some points in Bands 1, 2 and 3, the deviation being small in Bands 2 and 3. In general, the selectivity of both receivers was unsatisfactory in Band 1, and satisfactory in Bands 2, 3, and 4.

23-7. Resonant Overload. Reference (b), paragraph 2-1(4). Resonant overload curves are shown on Plates 21 and 42. The curves for receiver No. 18 show that at a frequency of 15 kilocycles, overload occurred at 11.8 volts or 232 milliwatts output. At the other frequencies tested, overload occurred above 250 milliwatts output. Receiver No. 1 overloaded below 250 milliwatts at all five test frequencies as follows:

		Overload Point	
Frequency Kilocycles	Input Microvolts	Output Volts	Output Milliwatts
15	73	10.1	170
38	160	11.4	217
95	46	11.1	205
240	32	12	240
600	23	11	202

The maximum output obtained was approximately 375 milliwatts for each receiver, and decreased to 60 milliwatts in Band 2 for a signal input of 1/2 volt.

23-8. Output Limiter. Reference (b), paragraph 2-1 (41-46). The output limiter action for receiver No. 1 is shown on Plate 43. The variation in output is within the specified limit of 2 to 1 in voltage (6 decibels) for changes in input of 10 to 1 for all inputs above 10 microvolts with the limiter control set at 10 or 5, and for all inputs above 20 microvolts with the limiter control set at 0. The limiter introduces an insertion loss of 1.8 decibels at the 6 milliwatt standard sensitivity level. No tolerance is given in the specification. The limiter action of receiver No. 18 was not measured.

CONCLUSIONS

24. The results of the tests indicate that these RAG-1 receivers, after such actual service as they may have had to date, did not meet the requirements of reference (b), neither as received from the Fleet nor after careful alignment and adjustment according to reference (c).

25. The receivers were found to have drifted only slightly out of alignment since last adjusted, which may have been at the point of manufacture.

26. The sensitivity of both receivers was unsatisfactory in Bands 1 and 2, both before and after realignment with new tubes.

27. The selectivity of both receivers was unsatisfactory in Band 1, both before and after realignment with new tubes. It should be noted that the selectivity curves shown in reference (c) were taken on cw with the beat oscillator in operation, and thus are a measure of only the audio filter selectivity, while the curves included in this report indicate very nearly the true r-f selectivity.

28. The sensitivity and selectivity of both receivers appeared to have deteriorated in all bands, and could not be improved sufficiently by normal adjustments so as to equal the values previously reported on the original test model. It is felt that this deterioration is largely due to a reduction in circuit Q as the result of aging of the inductances.

29. The antenna trimmer was found unsatisfactory in that it required adjustment for each frequency in all bands.

30. The lock nuts on some of the coil unit trimmer condensers were inoperative.

31. The band-pass audio filter may be considered as meeting the specifications if a frequency of 1000 cycles is used as the reference point. No difficulty should be encountered in meeting much more rigid requirements, as is indicated by the Models RAA and RAB receivers.

32. The peak audio filters were found to be unsatisfactory at the low and high ends of their range, and at some of the intermediate points.

33. Harmonics, generated in the detector, were found to produce undesirable fidelity characteristics.

34. The maximum noise level of one receiver exceeds 300 microwatts in one band. Both receivers fall far below 300 microwatts in some bands, a natural result of the limitation of noise to such a low level. A further result of this limitation is a lack of reserve gain, it being necessary to operate the receivers at maximum gain over most of the frequency range in order to make sensitivity measurements.

35. Resonant overload occurs in some cases at less than 250 milliwatts, but is considered to be satisfactory in general.

36. The manual gain control has a range of more than 100 decibels in both receivers and is satisfactory.

37. The output limiter action is satisfactory.

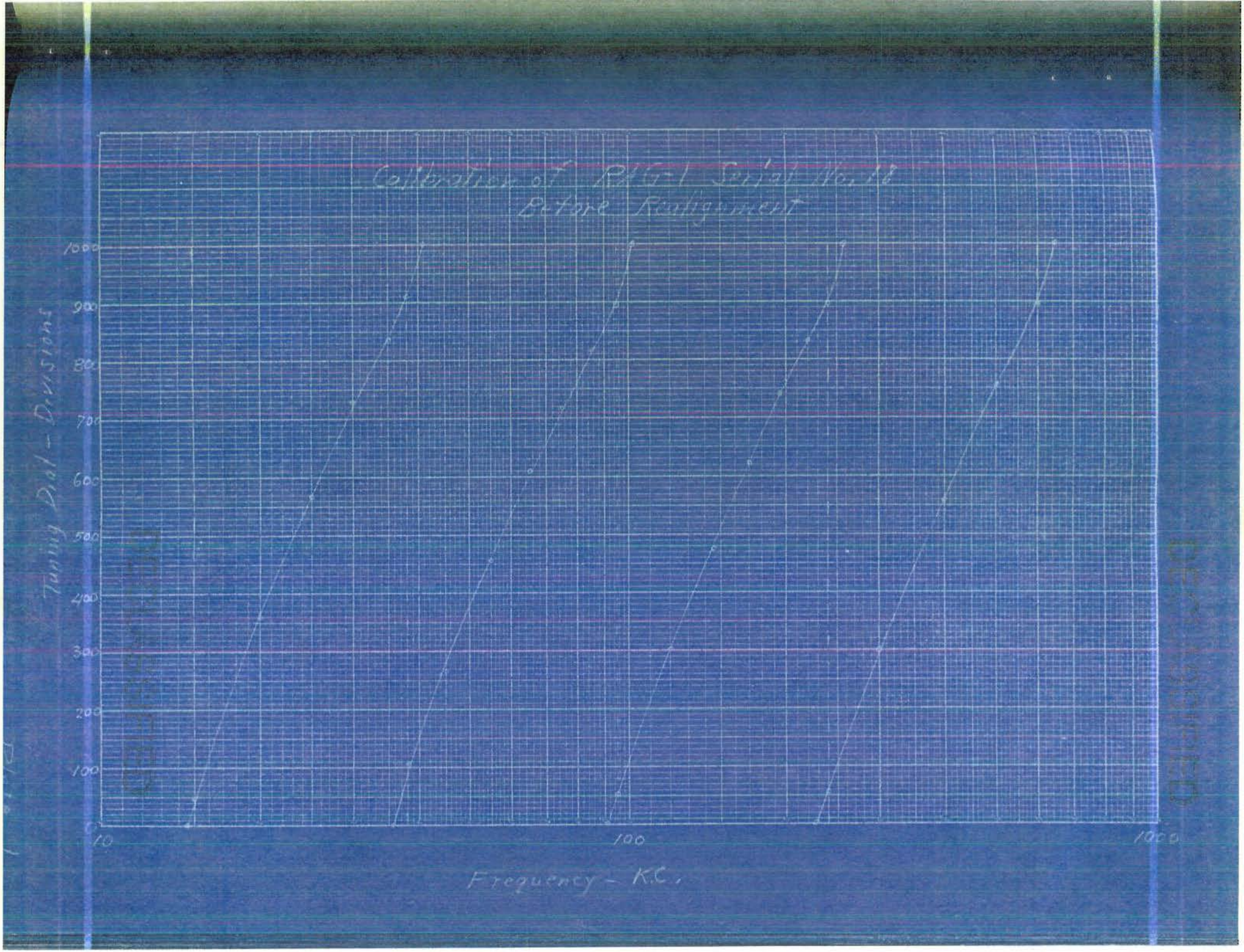
38. The useful sensitivity at some points in the range of the receiver could be improved by the simple expedient of reducing the effective bias on the r.f. tubes, as the present full gain position of this bias control does not give full standard noise level throughout the range. Such a change would not, however, bring the sensitivity within specification limits at the points where standard noise level is obtainable with existing gain and the specification limit is not met. It is believed that specification limits will be met only after improved selectivity is realized.

TABLE 1

Mutual Conductance of Tubes Used in Tests of RAG-1 Receiving Equipment, Serial No. 18 and Serial No. 1.

Position of Tube	Navy Type No.	Mutual Conductance		
		Original Sylvania Tubes		New RCA Tubes
		Ser.No. 18	Ser.No. 1	For both Receivers
1st R.F.	CHS-38646	1760	1670	1760
2nd R.F.	CHS-38646	1640	1640	1780
3rd R.F.	CHS-38646	1560	1670	1760
Oscillator	CHS-38646	1690	1630	1790
Detector	CHS-38076	1200	1320	1530
1st A.F.	CHS-38076	1260	1120	1520
Output	CHS-38041	1920	2200	2470

Measurements made with E_p of 250 volts, and corresponding screen and bias potentials.


Calibration of R&G-1 Serial No. 18
Before Realignment
Tuning Dial - Divisions
1000
900
800
700
600
500
400
300
200
100
0
10
100
1000
Frequency - K.C.

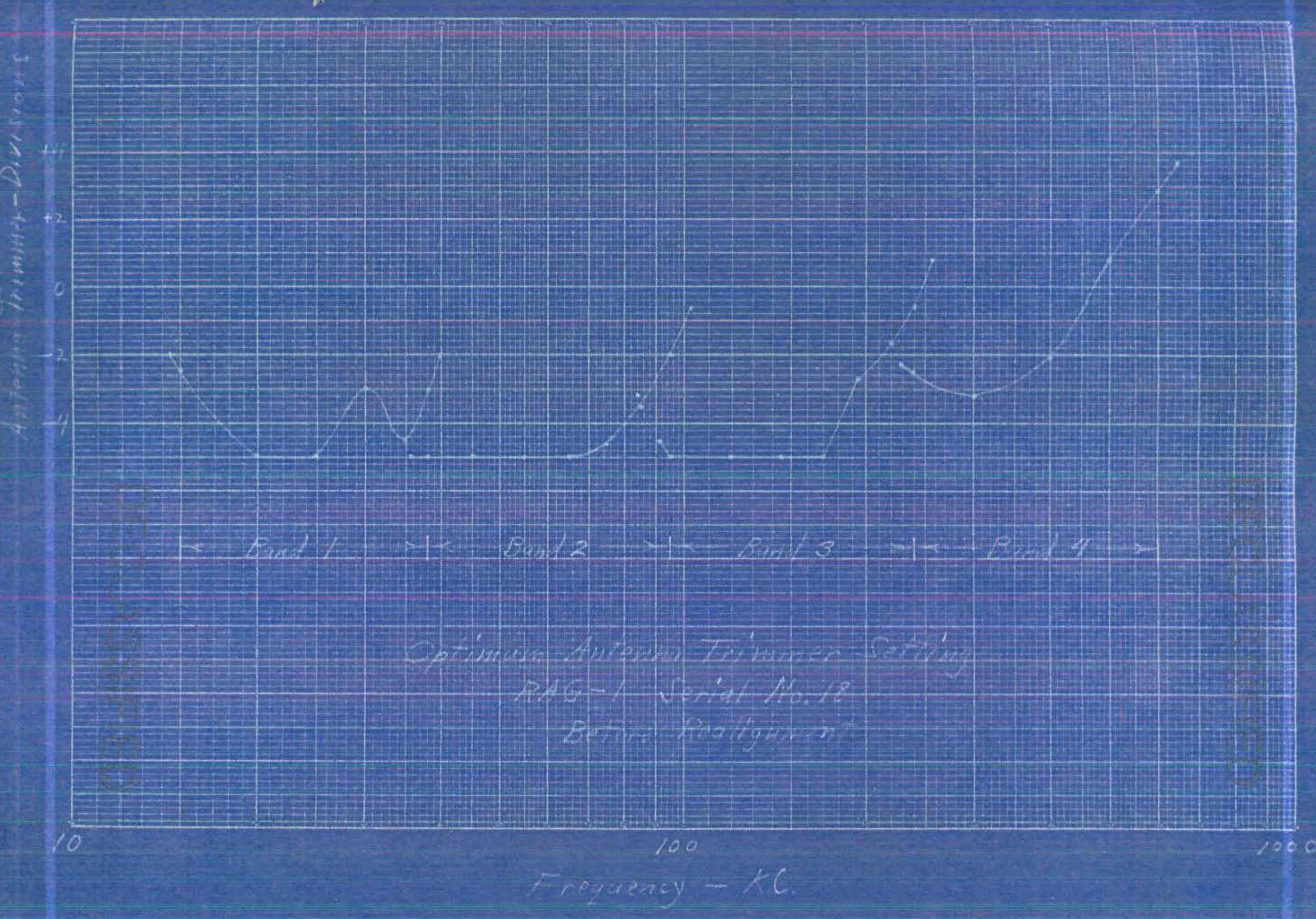


Plate 2

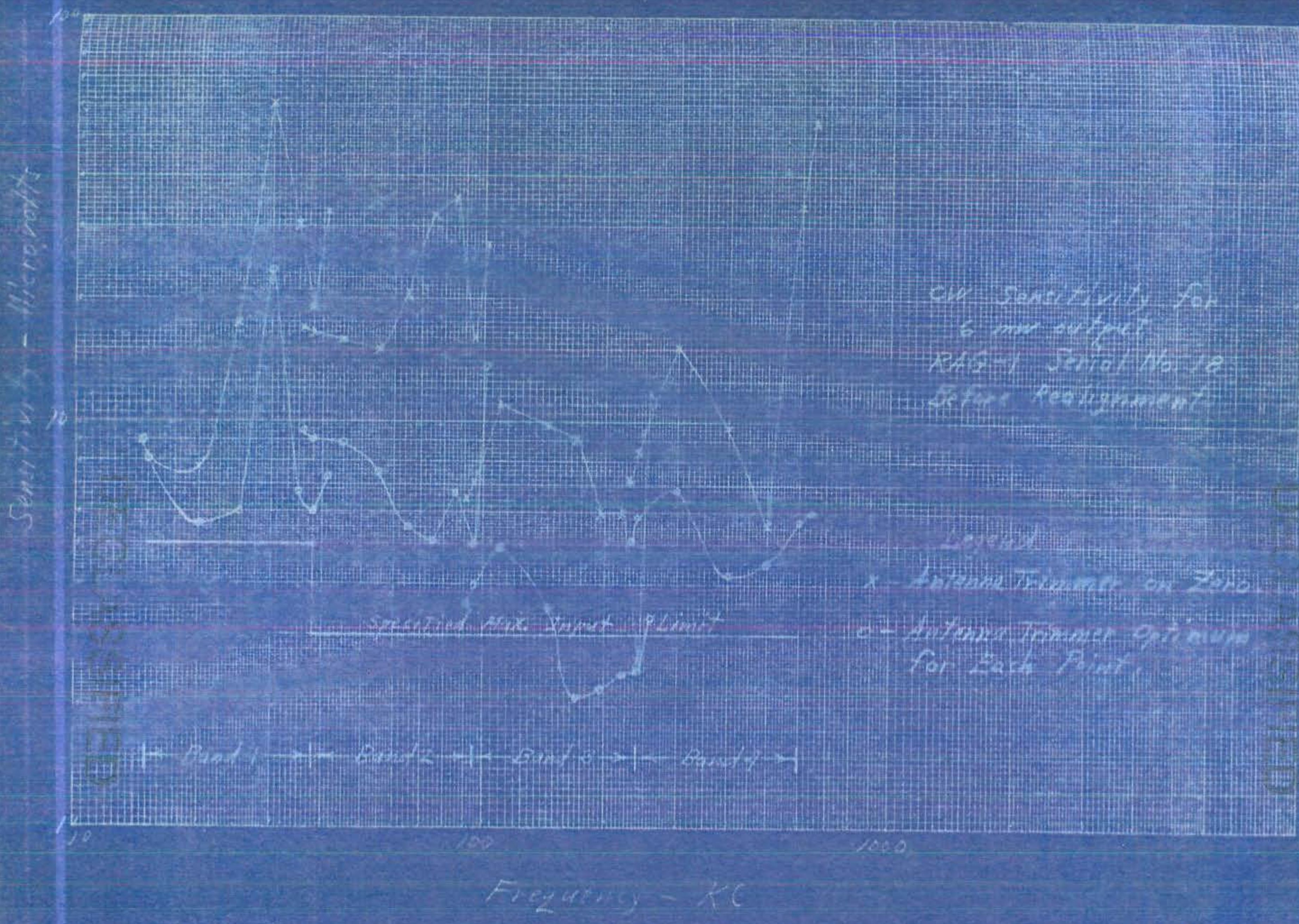


Plate 3

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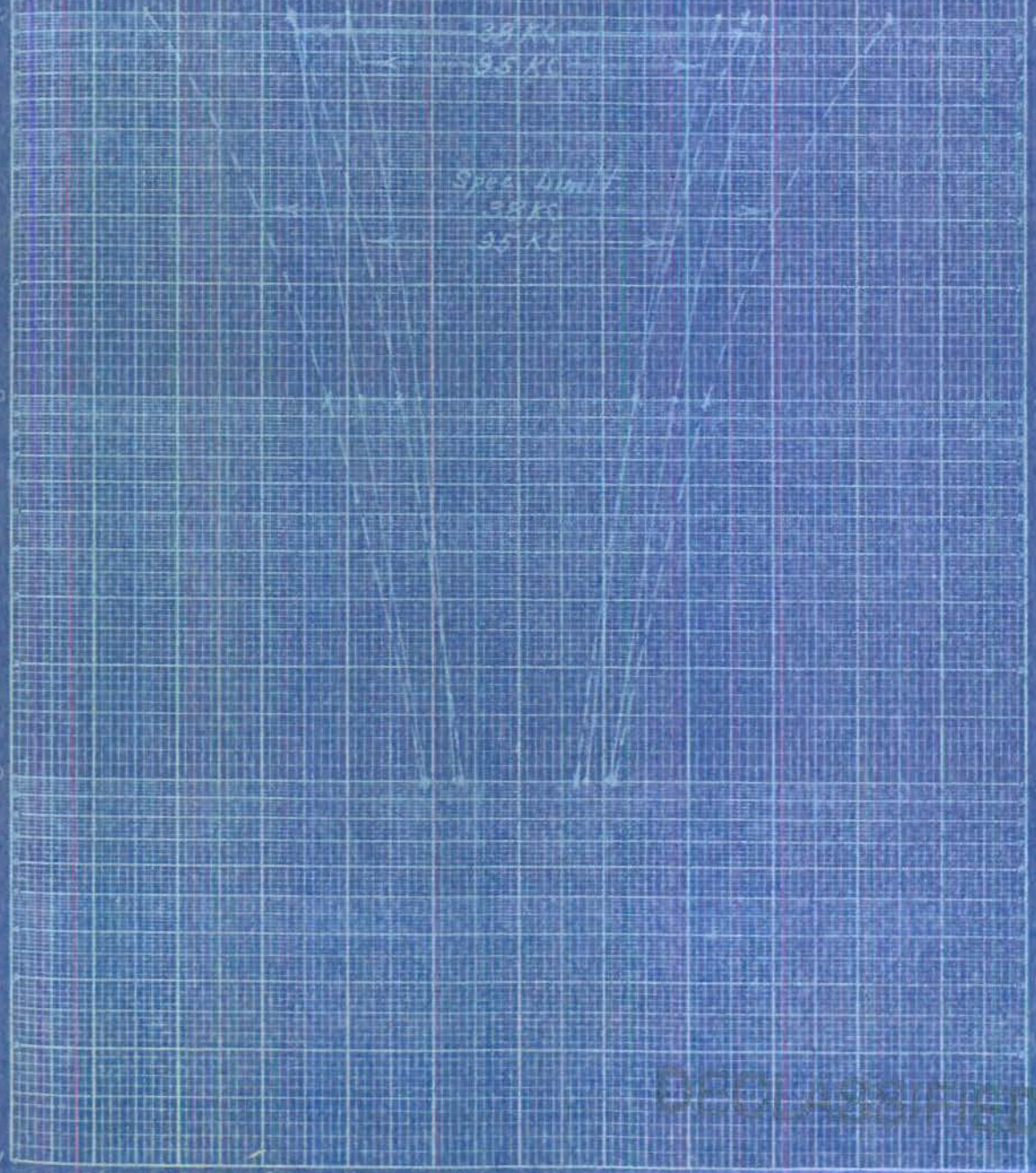
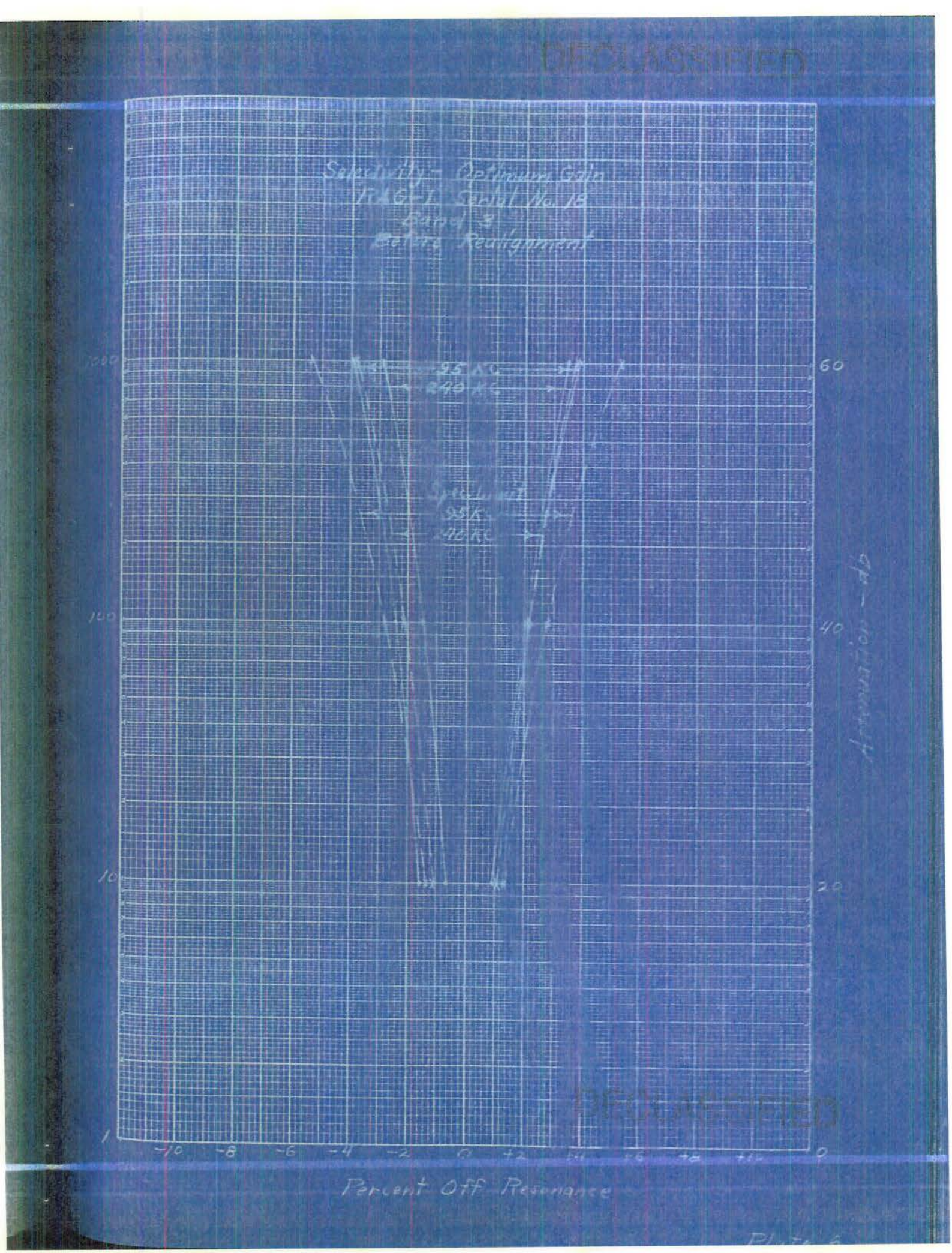
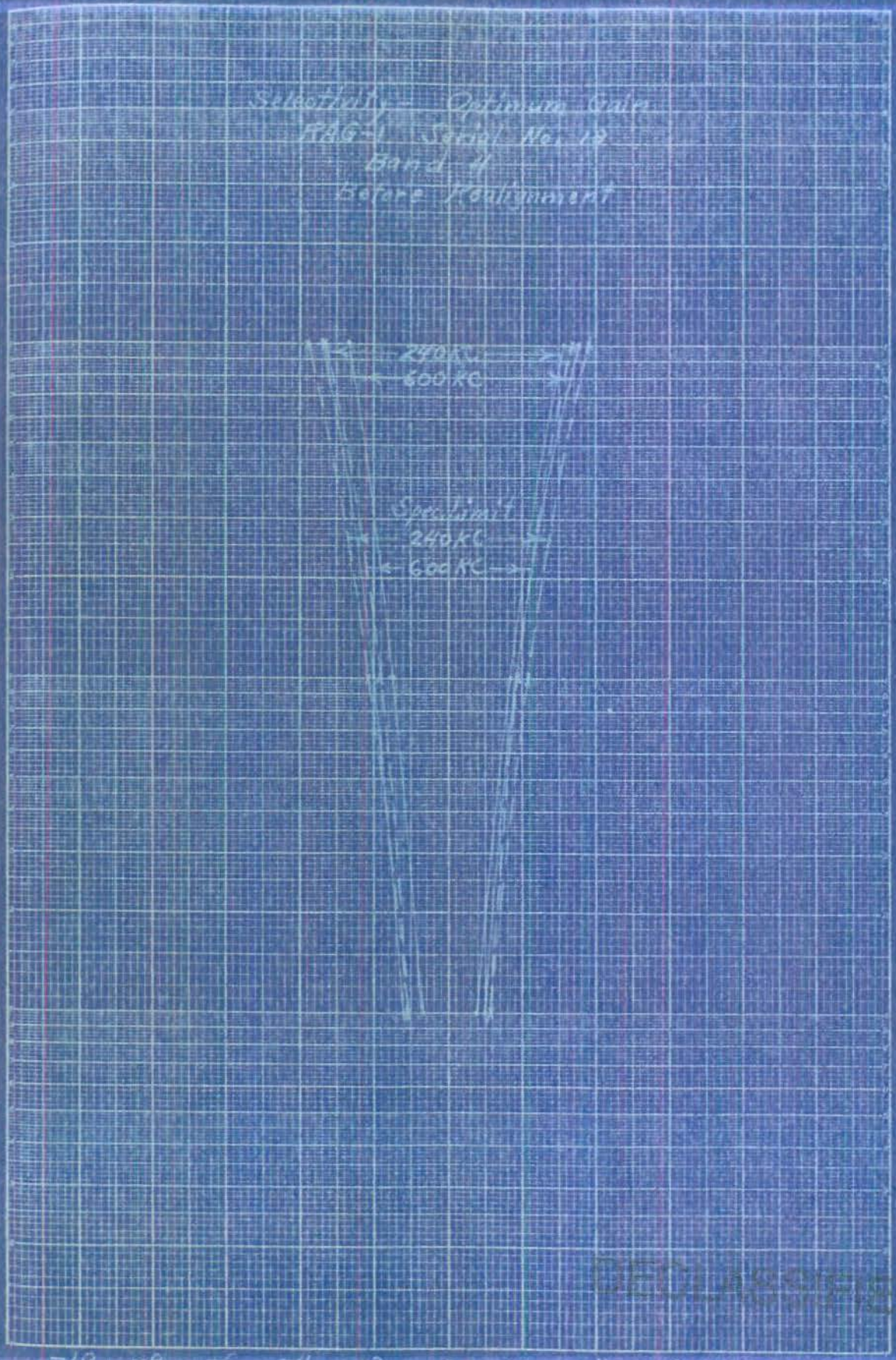
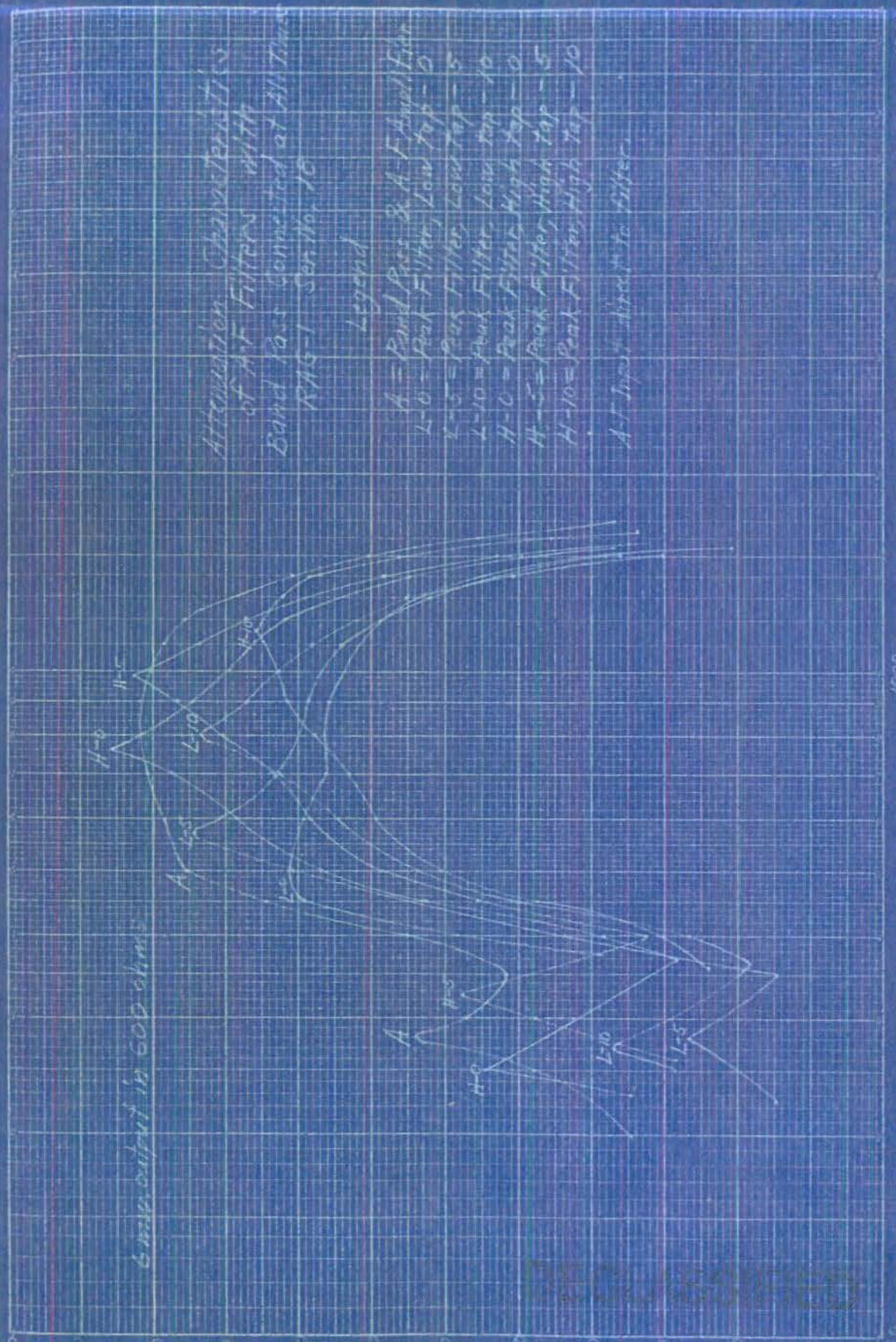
Plate 4

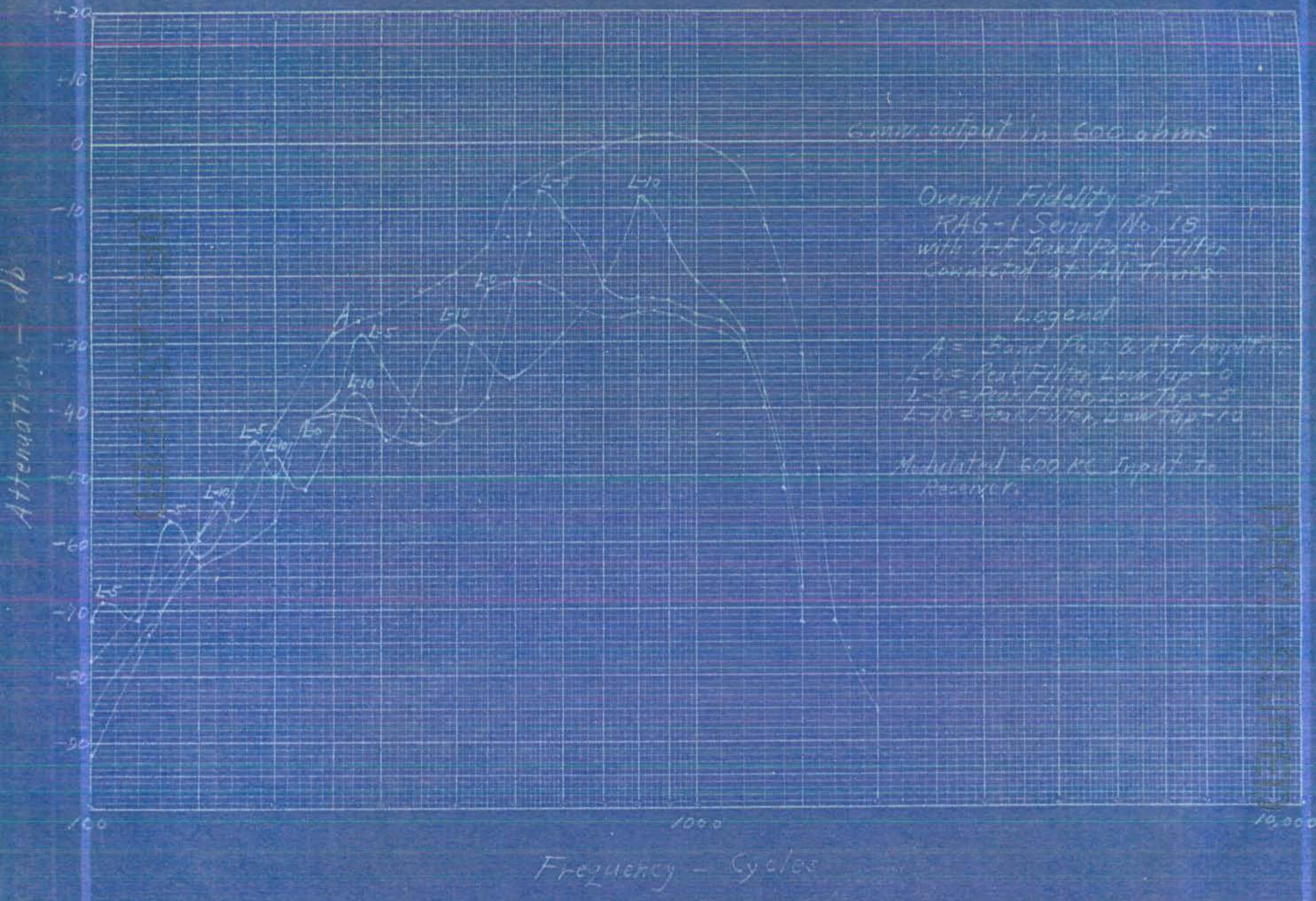
Selectivity — Optimum Gain
RAS-1 Serial No. 16
Band 7
Before Realignment










6 mw. output in 600 ohms
Overall Fidelity of
RAG-1 Serial No. 15
with A-F Band Pass Filter
connected at All Times
Legend
A = Band Pass & A-F Amplifier
L-0 = Peak Filter Low Tap - 0
L-5 = Peak Filter Low Tap - 5
L-10 = Peak Filter Low Tap - 10
Modulated 600 KC Input to Receiver.
A
L-0
L-5
L-10
+20
+10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
100
1000
10,000
Attenuation - db
Frequency - Cycles

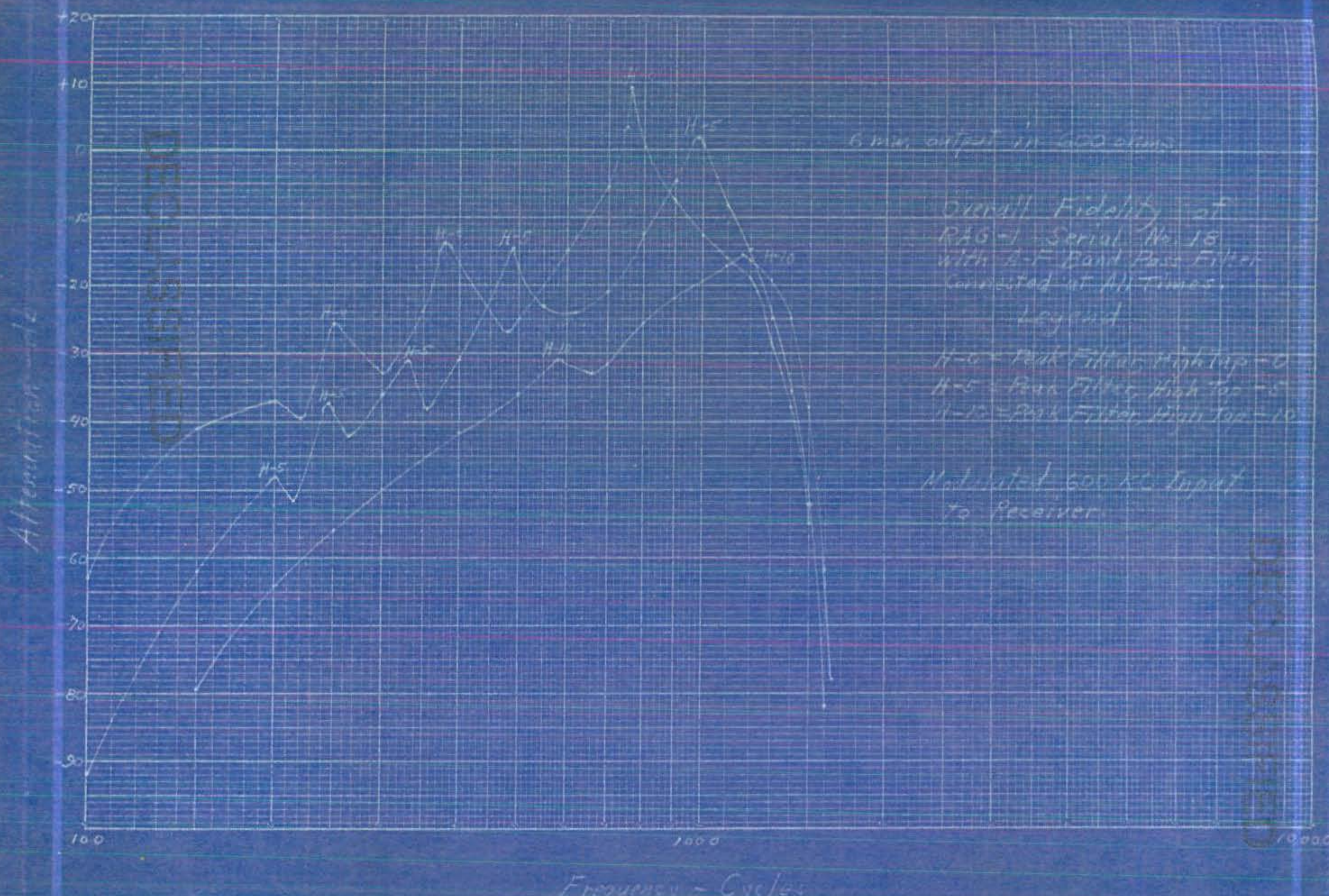
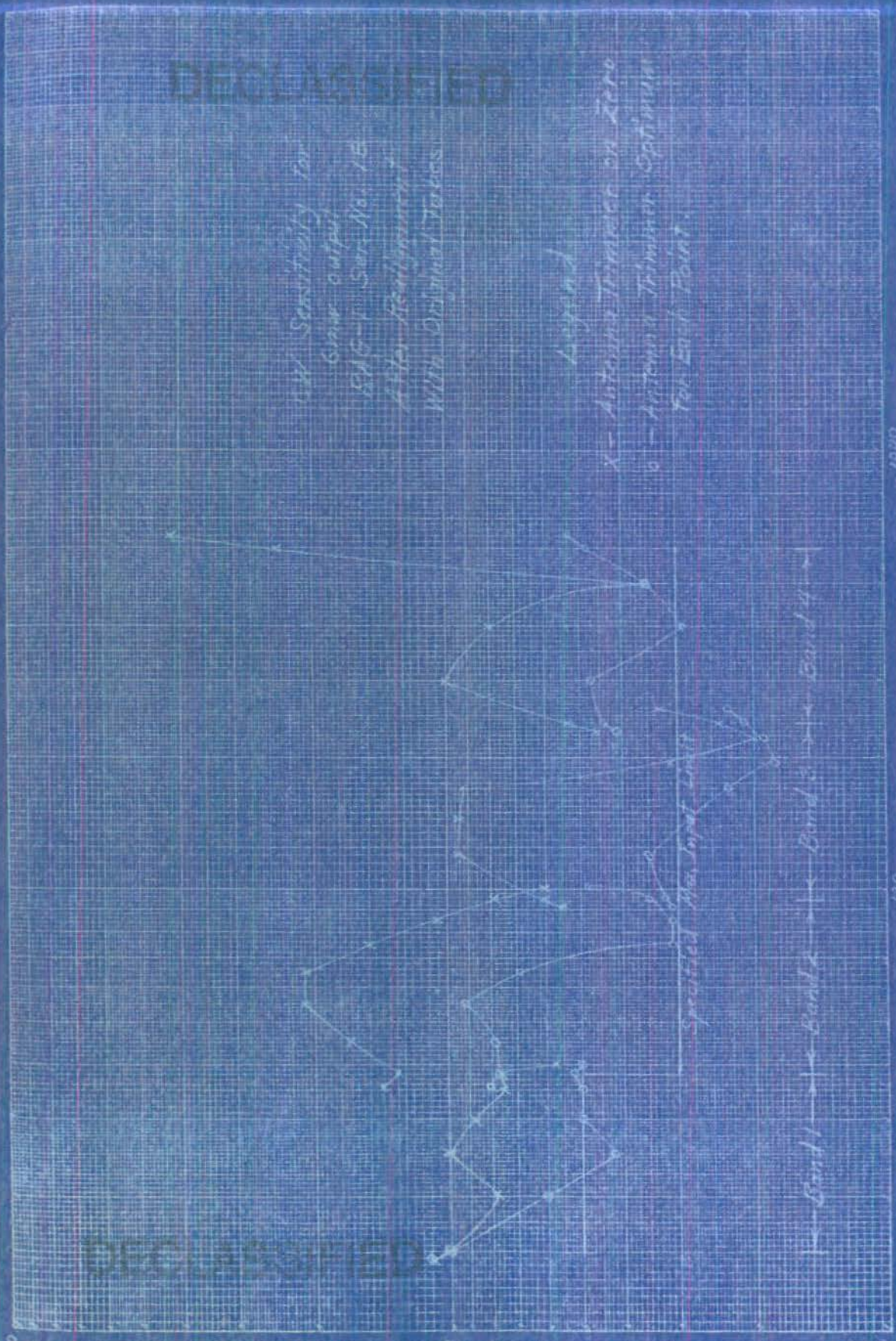
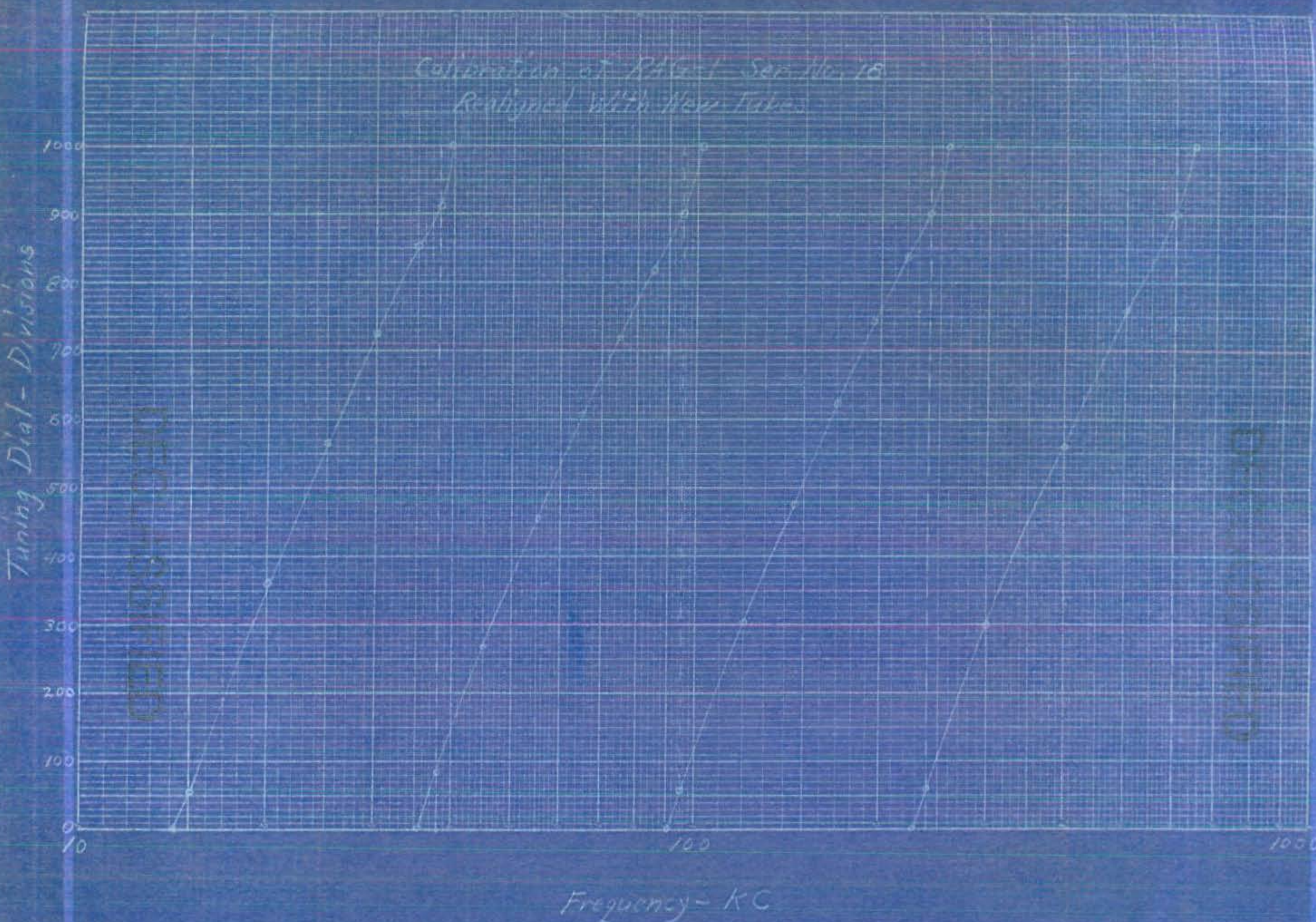


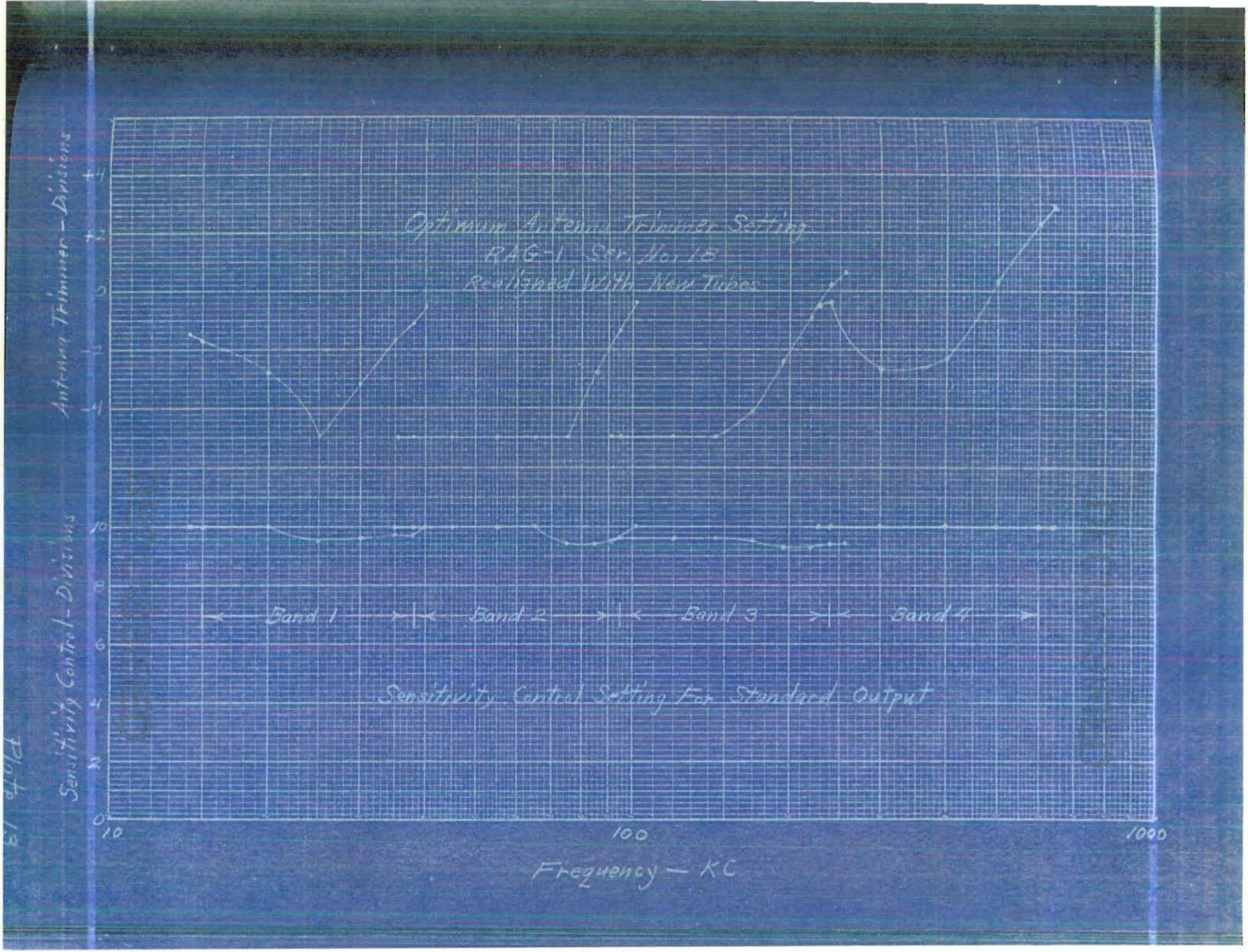
Plate 70



Sensitivity - Microvolts

Plate 11




Optimum Antenna Trimmer Setting
RAG-1 Ser. Nos. 18
Realigned With New Tubes
Band 1
Band 2
Band 3
Band 4
Sensitivity Control Setting For Standard Output
Sensitivity Control - Divisions
Antenna Trimmer - Divisions
+4
+2
0
-1
-2
10
8
6
4
2
0
10
100
1000
Frequency - KC

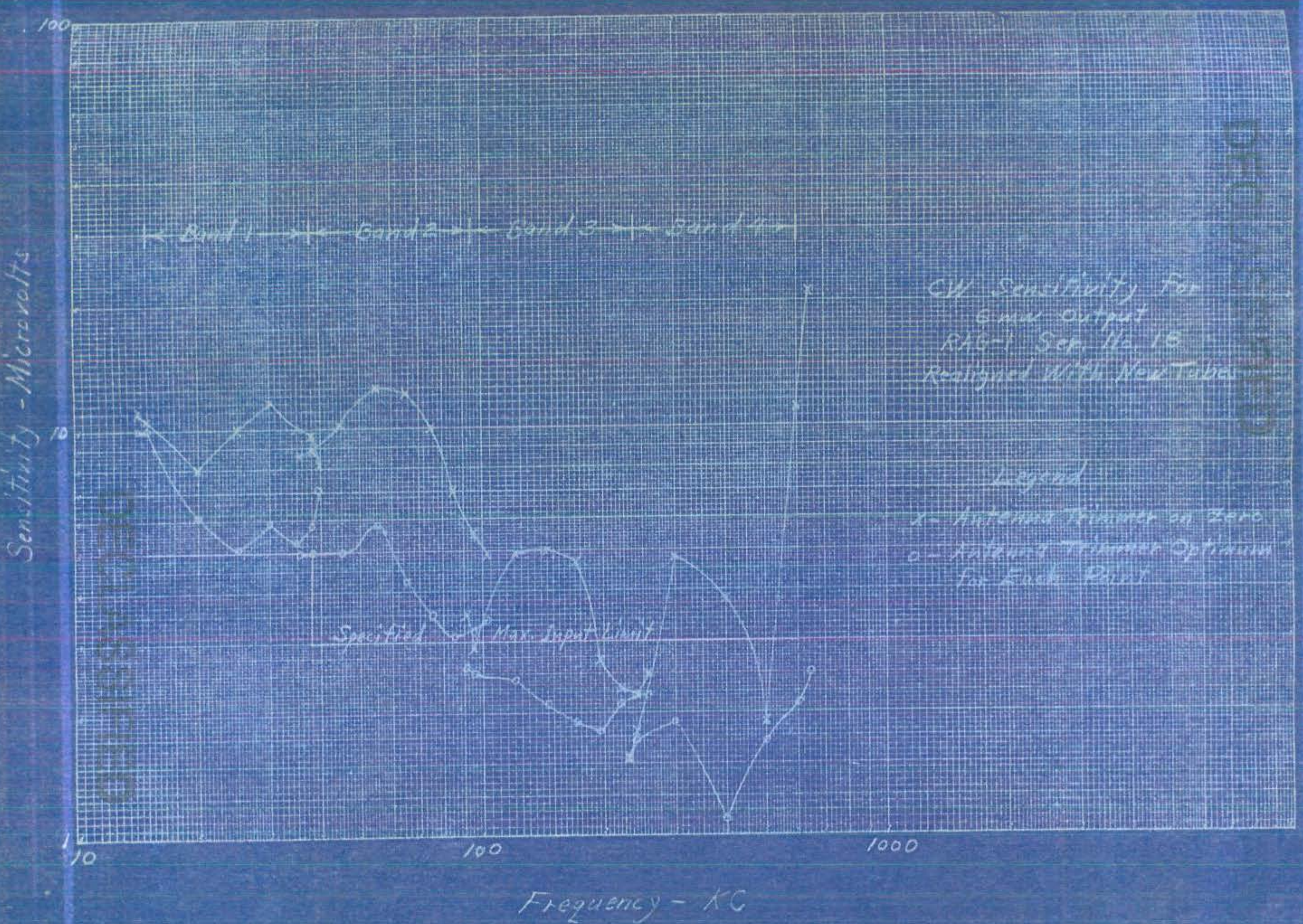
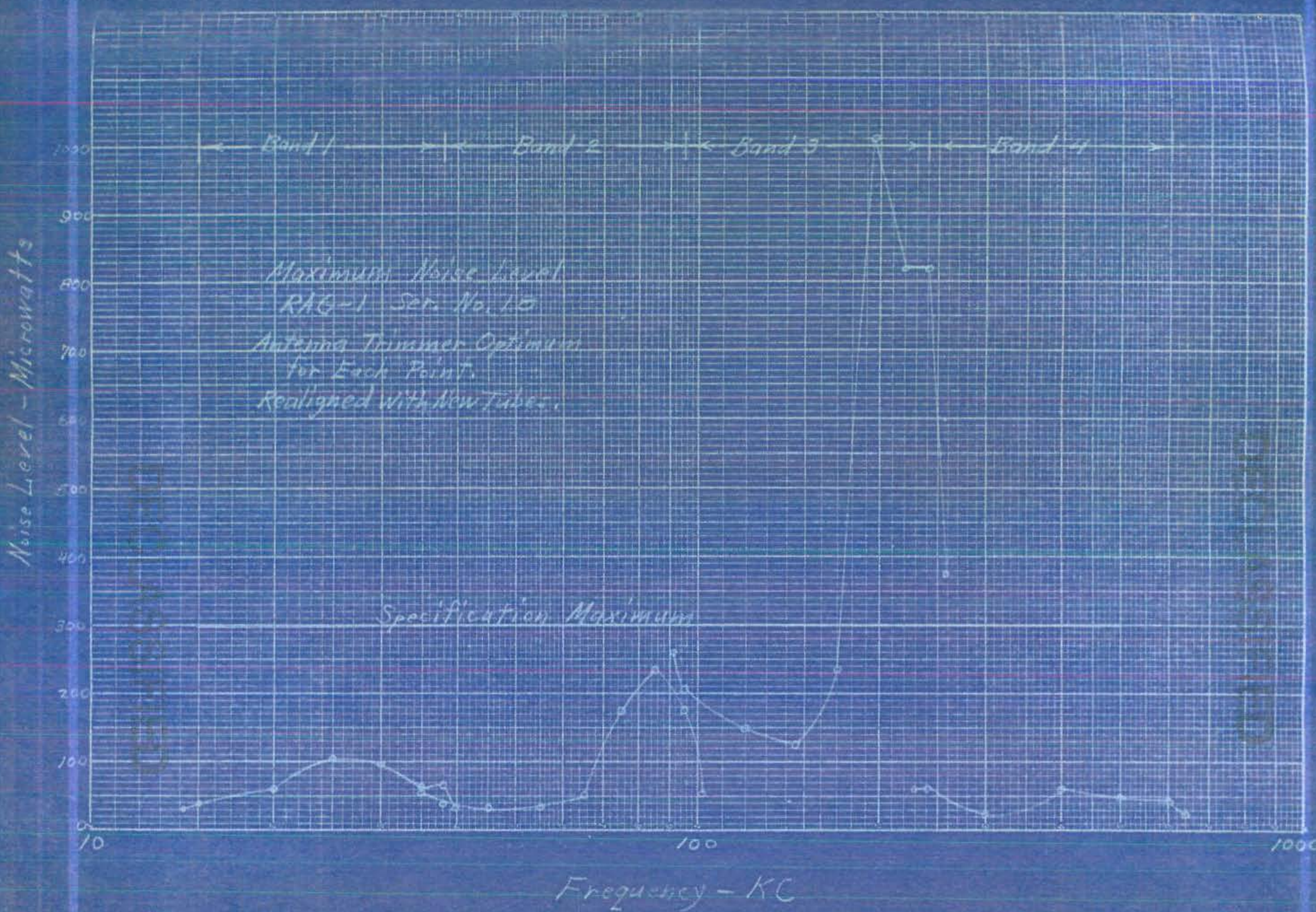


Plate 14



DECLASSIFIED
Band 1
Band 2
Band 3
Band 4
Maximum Noise Level
RAG-1 Ser. No. 15
Antenna Trimmer Optimum
for Each Point.
Realigned With New Tubes.
Specification Maximum
Noise Level - Microwatts
Frequency - KC
10
100
1000
0
100
200
300
400
500
600
700
800
900
1000
DECLASSIFIED

Plate 15

NAVAL RESEARCH LABORATORY
BELLEVUE, D. C.

DATE

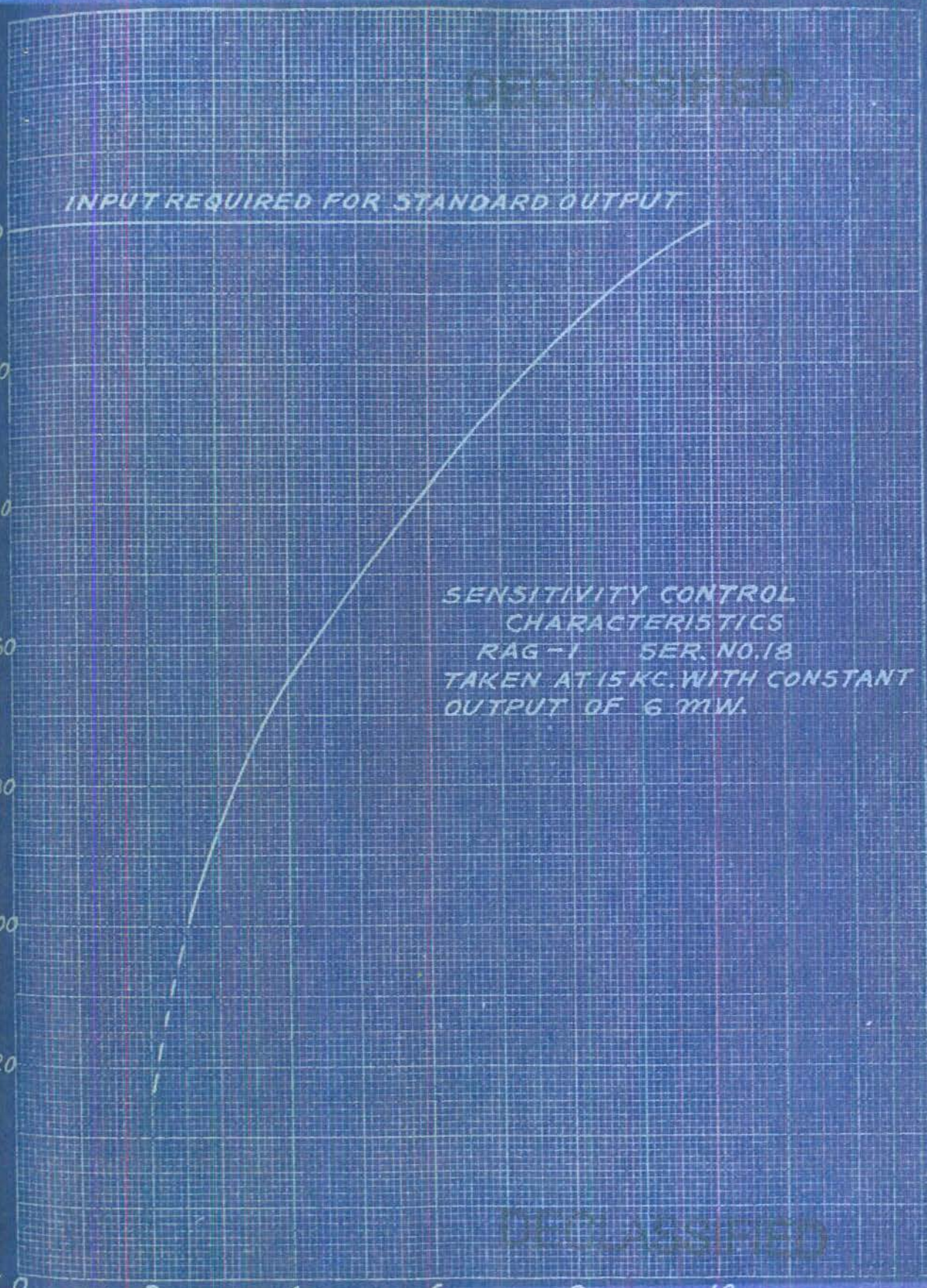
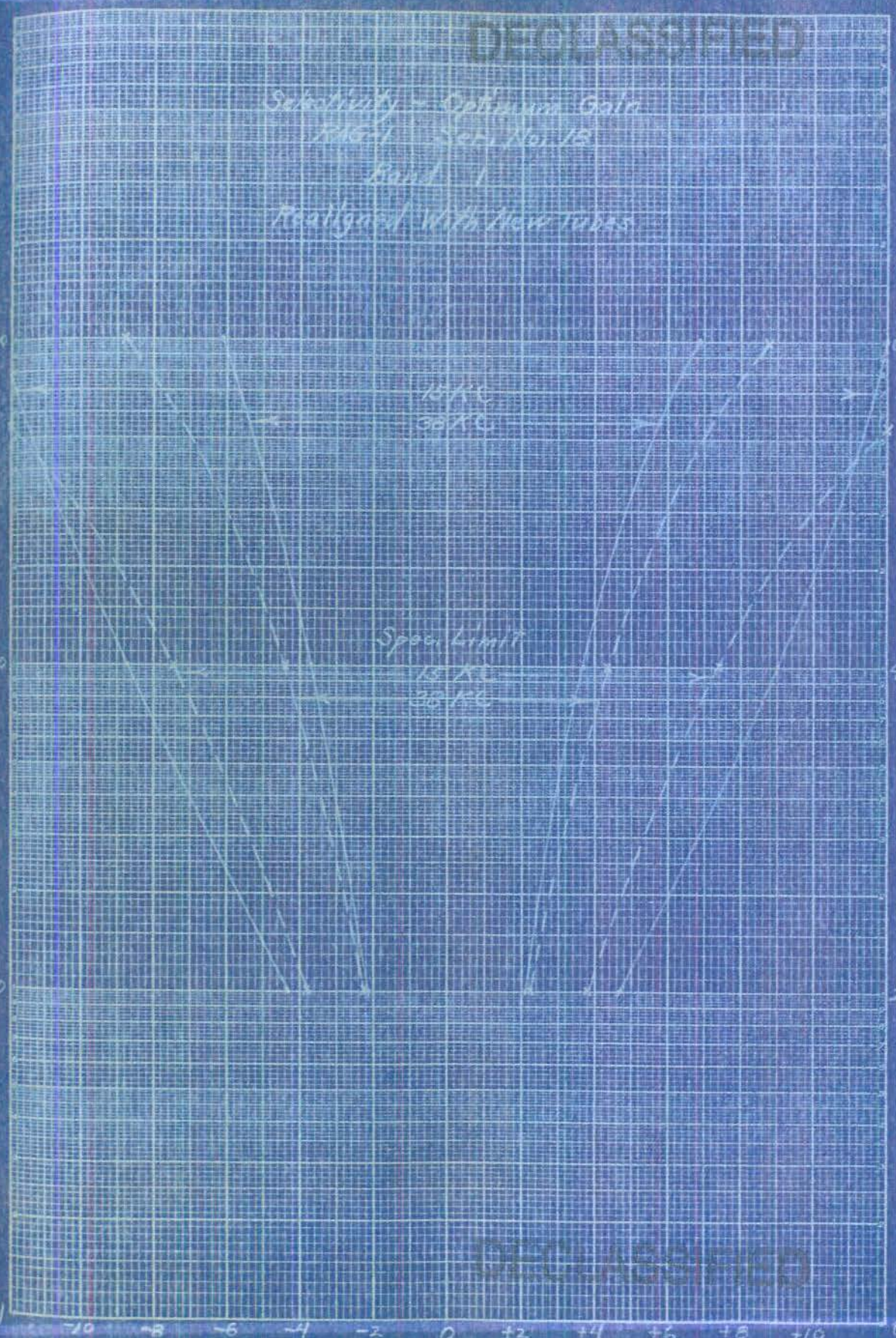


PLATE 16



Selectivity - Optimum Gain
RAG-1 Ser. No. 10
Band 2
Realigned with New Tubes

38 KC
94 KC

Spectrum
38 KC
93 KC

1000
100
10
1

60
40
20
0

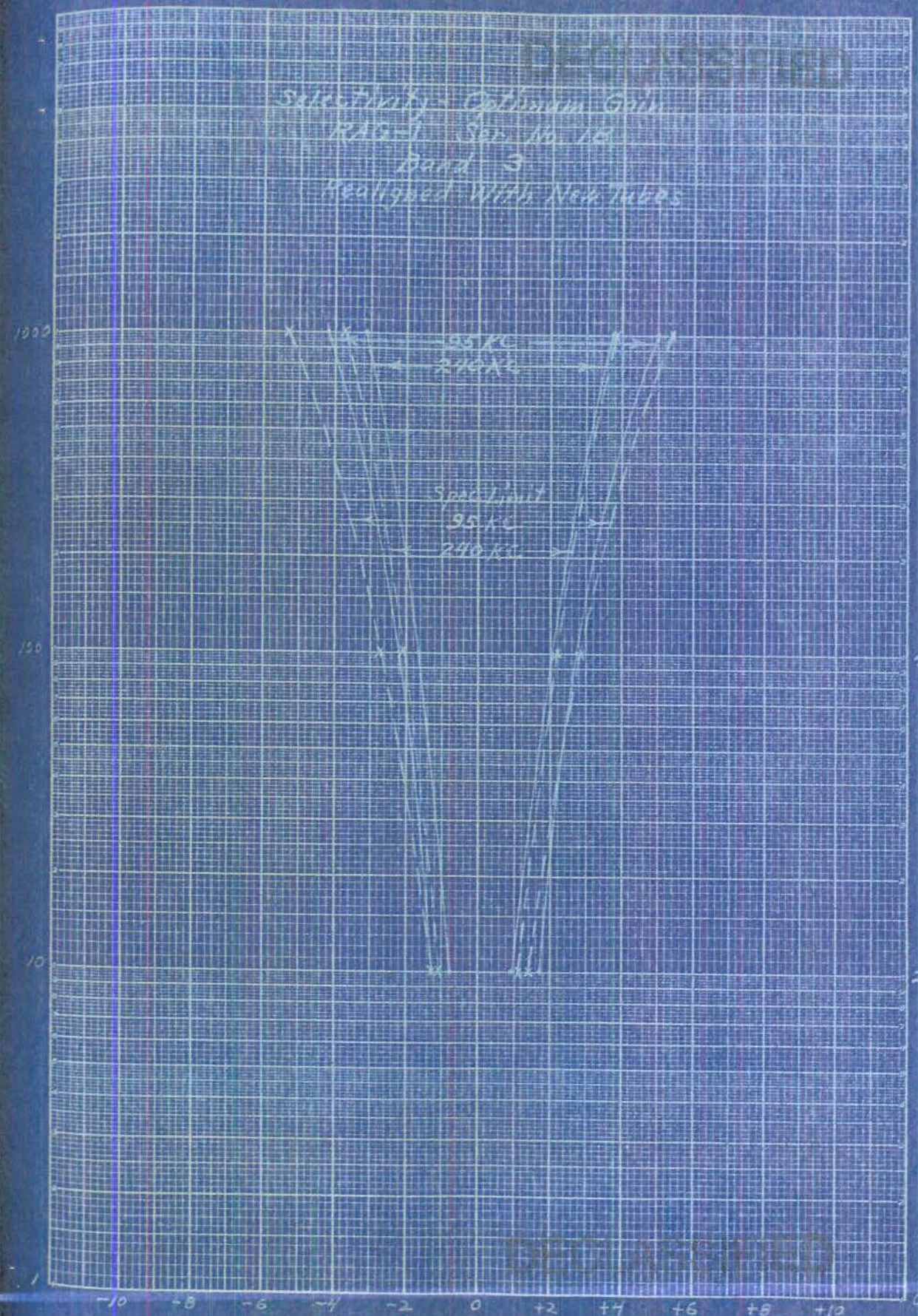
Insertion Loss - db

Attenuation - db

-10 -8 -6 -4 -2 0 +2 +4 +6 +8 +10

Percent Off Resonance

Plate 18


DECLASSIFIED
Sikorsky - Optimum Gain
RAC-1 Ser. No. 18
Part 3
Realigned With New Tubes
1000
100
10
1
93 KC
240 KC
Spec Limit
95 KC
240 KC
60
40
20
0
-10 -8 -6 -4 -2 0 +2 +4 +6 +8 +10
Percent Off Resonance
Attenuation - db
DECLASSIFIED

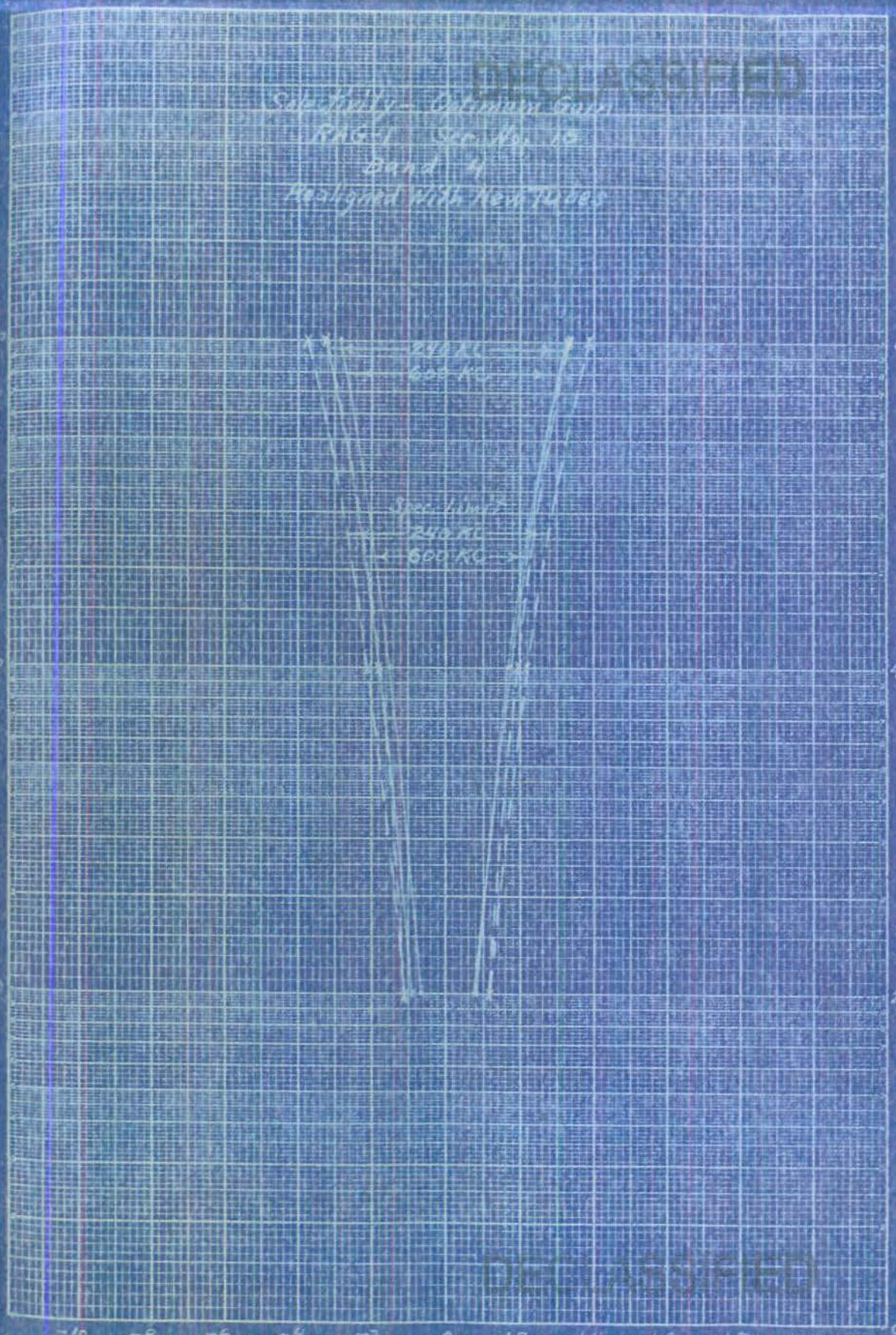
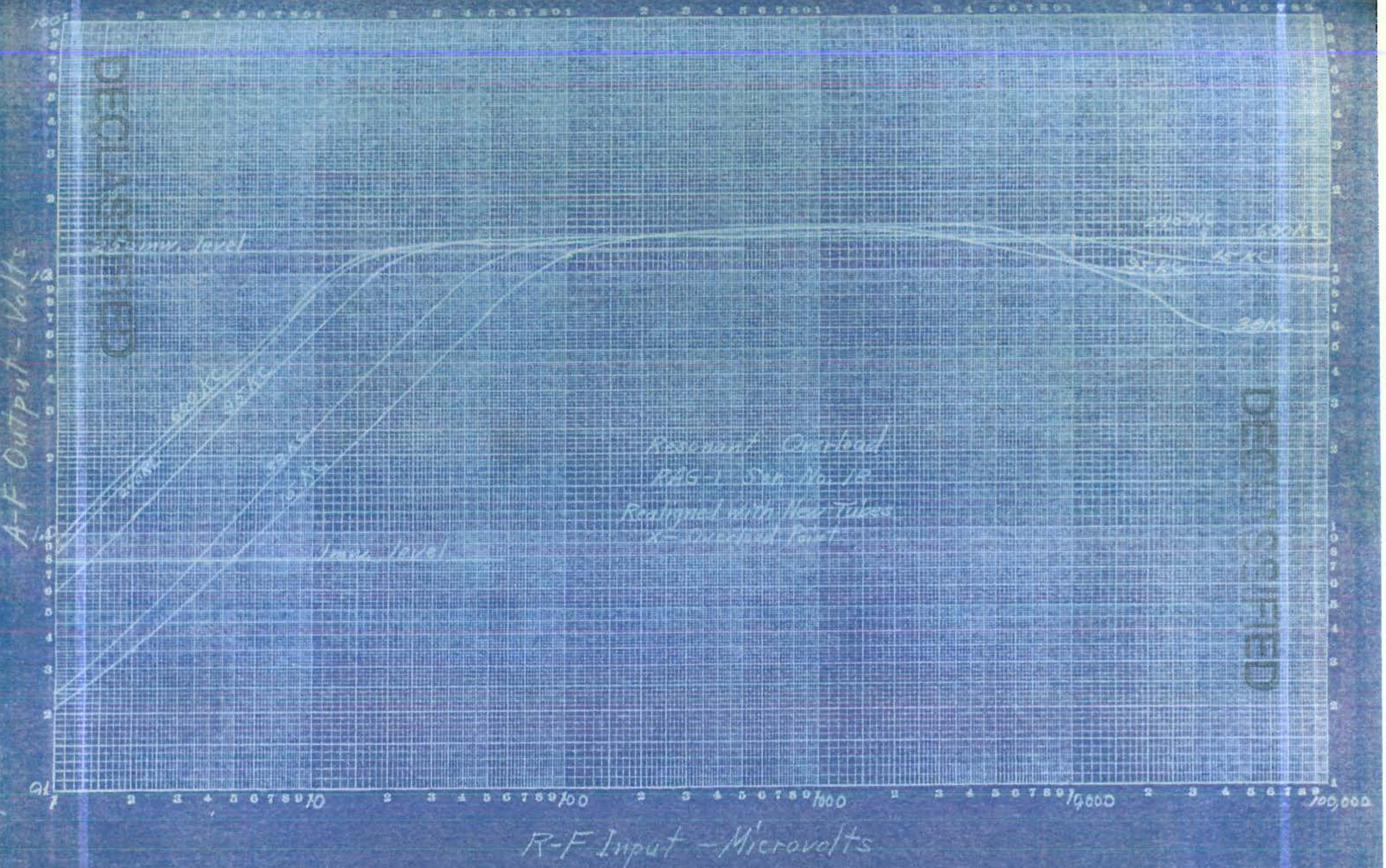


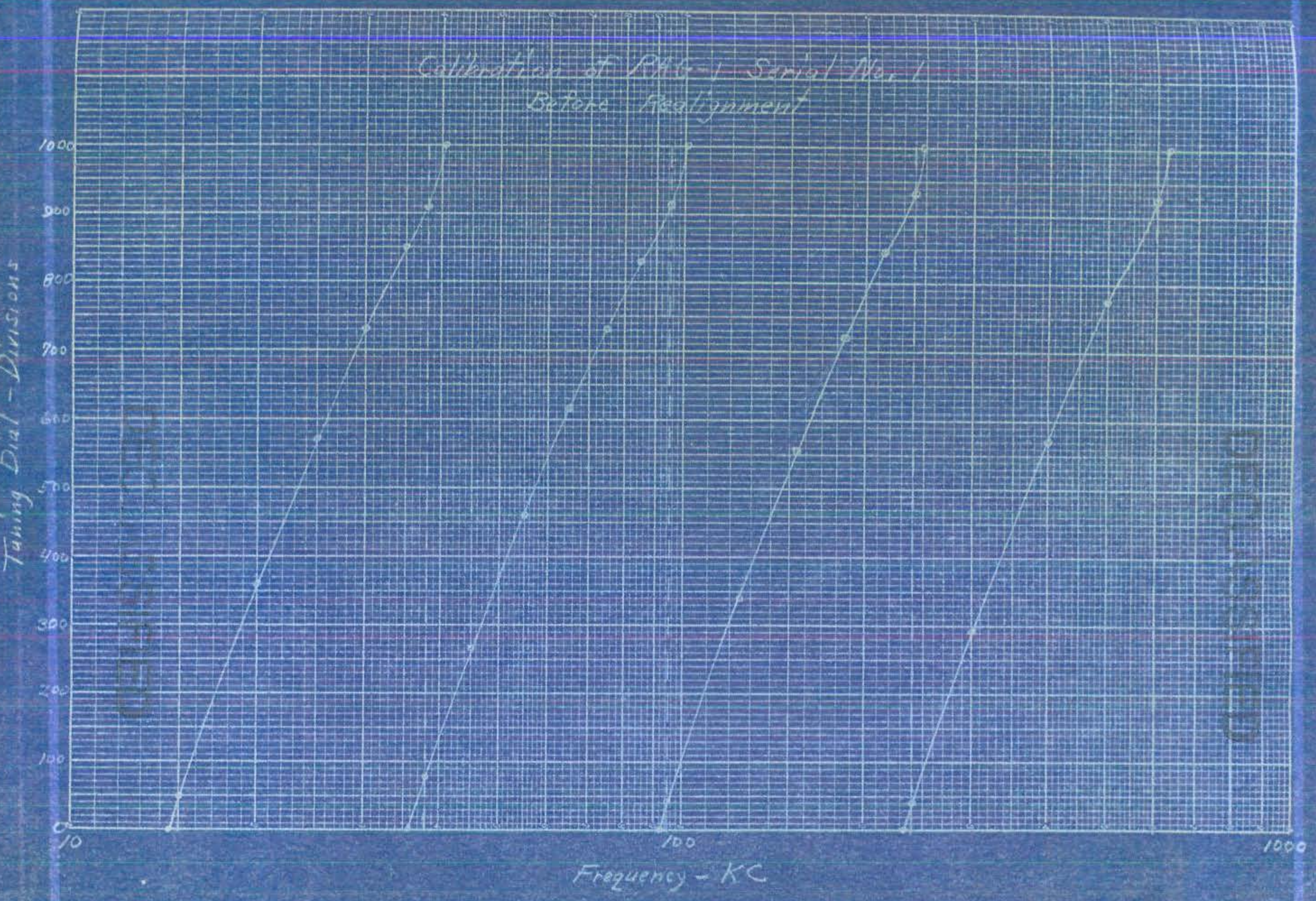
Plate 20

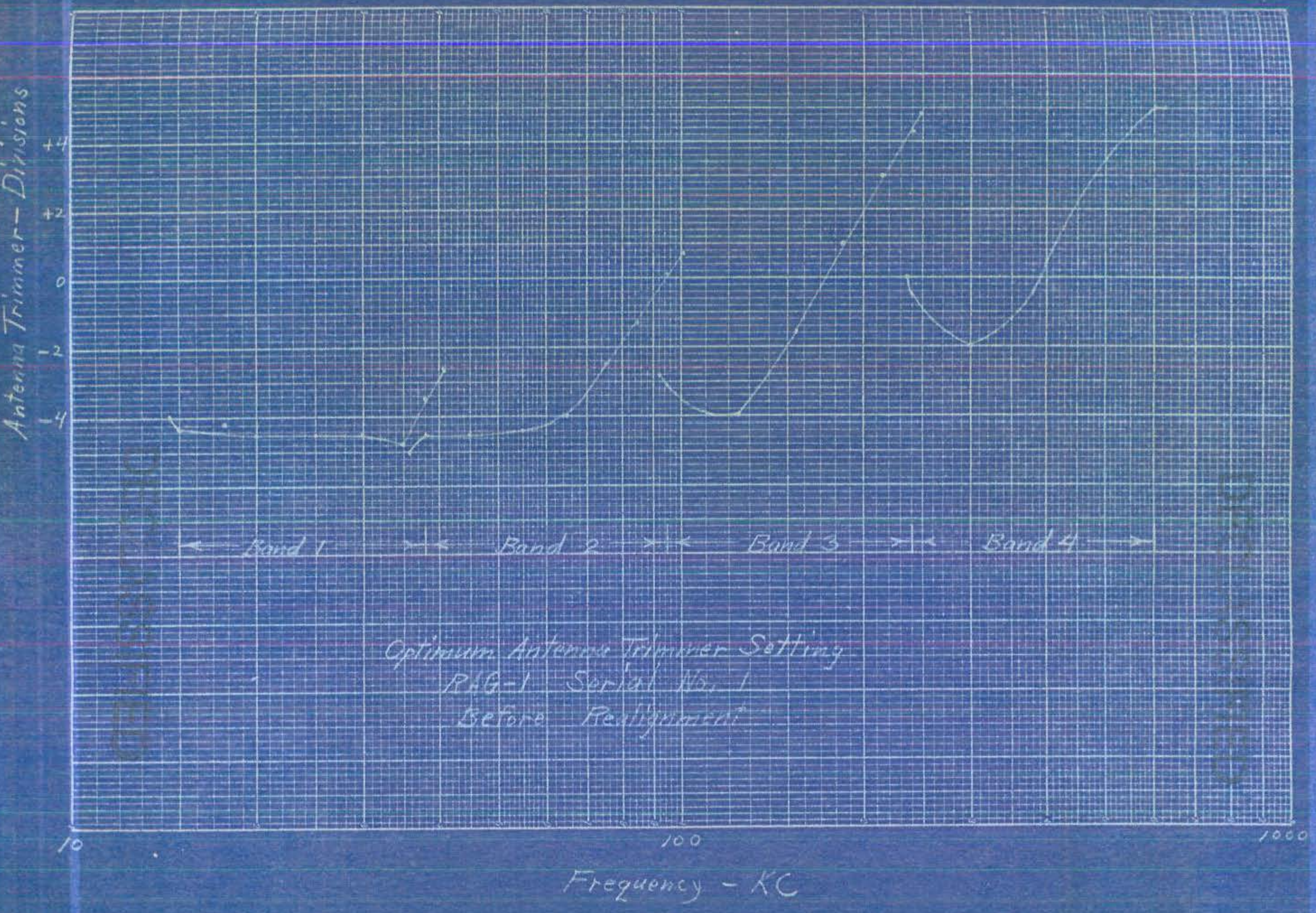


DECLASSIFIED

DECLASSIFIED

Plate 21





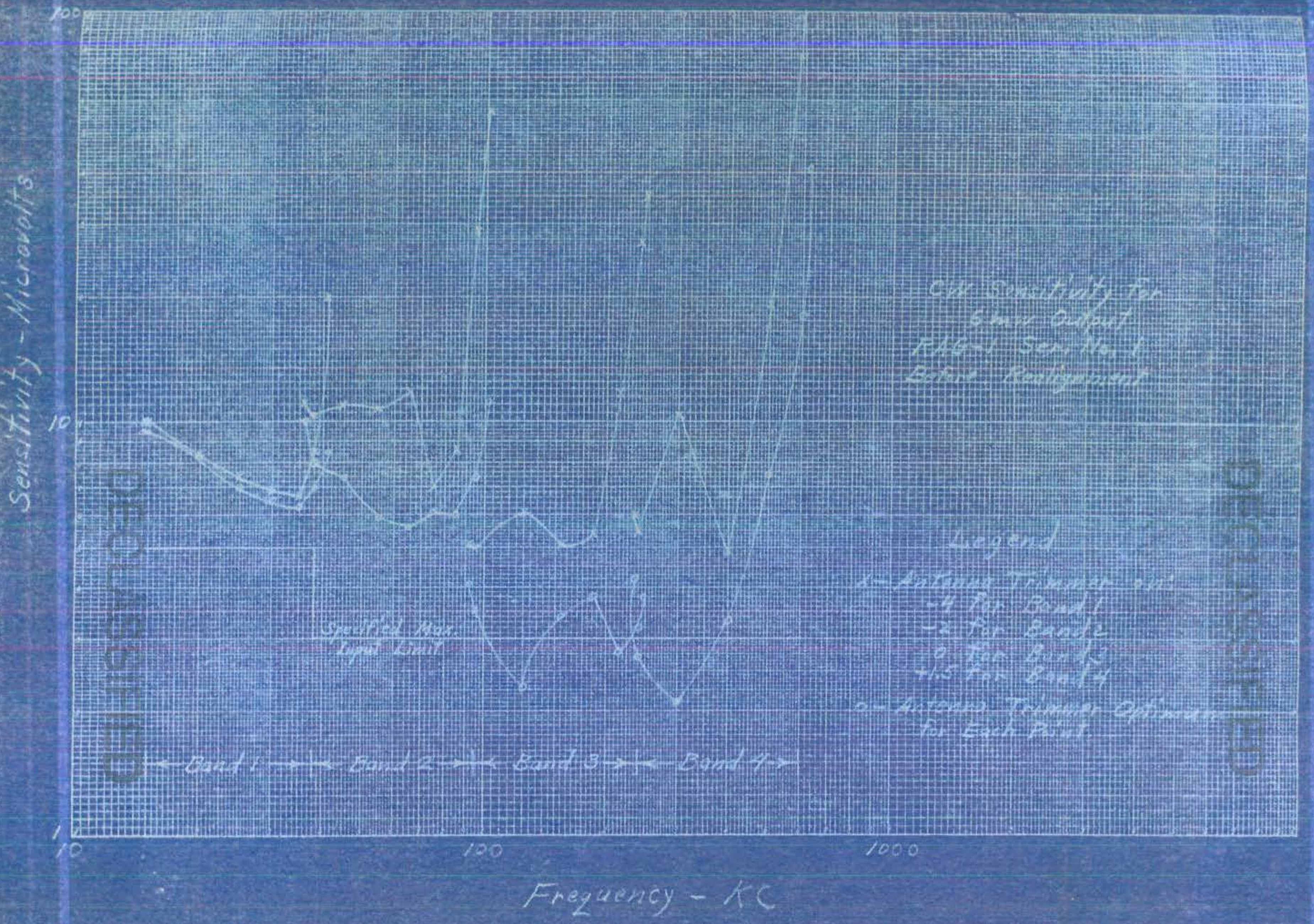
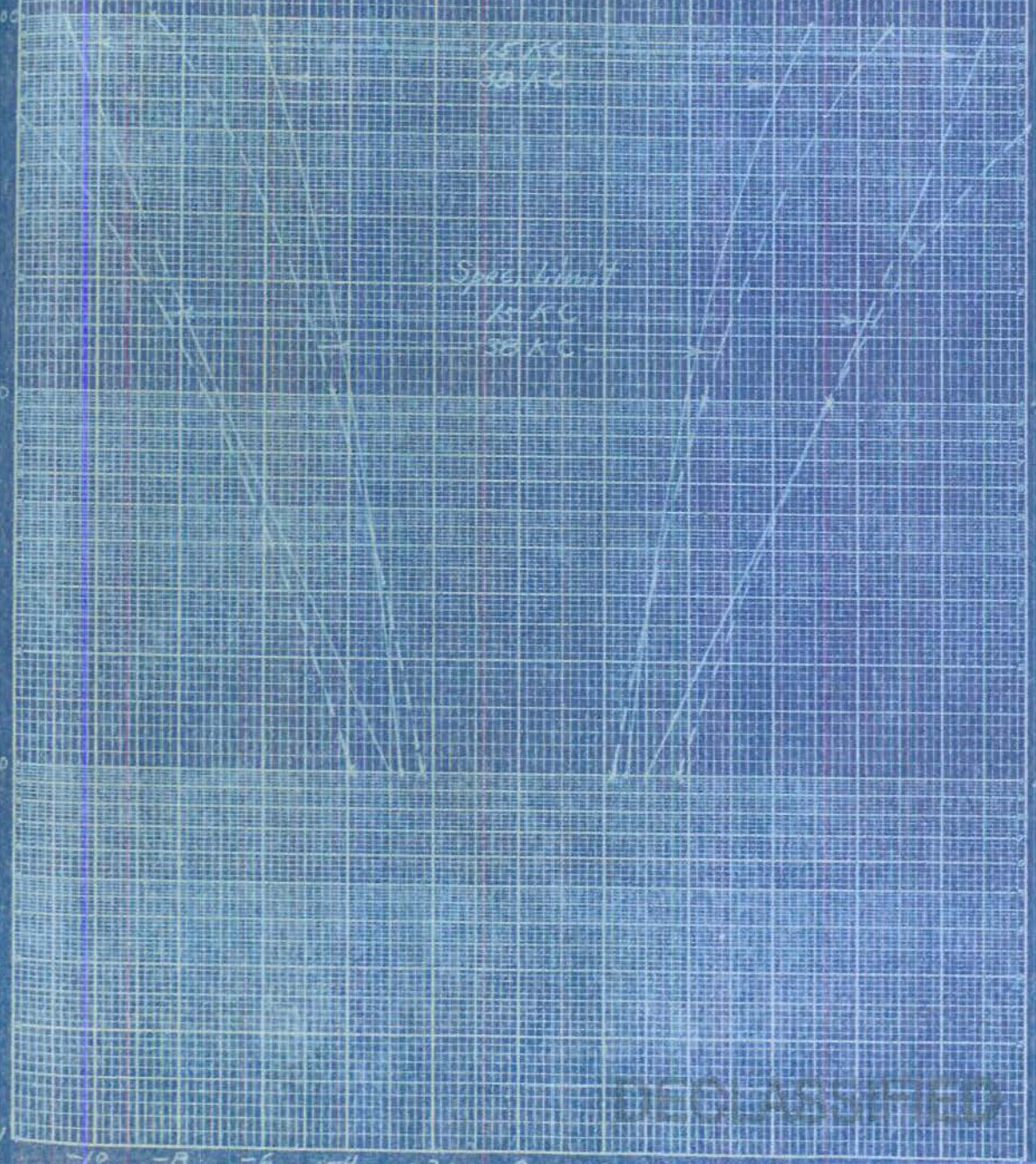
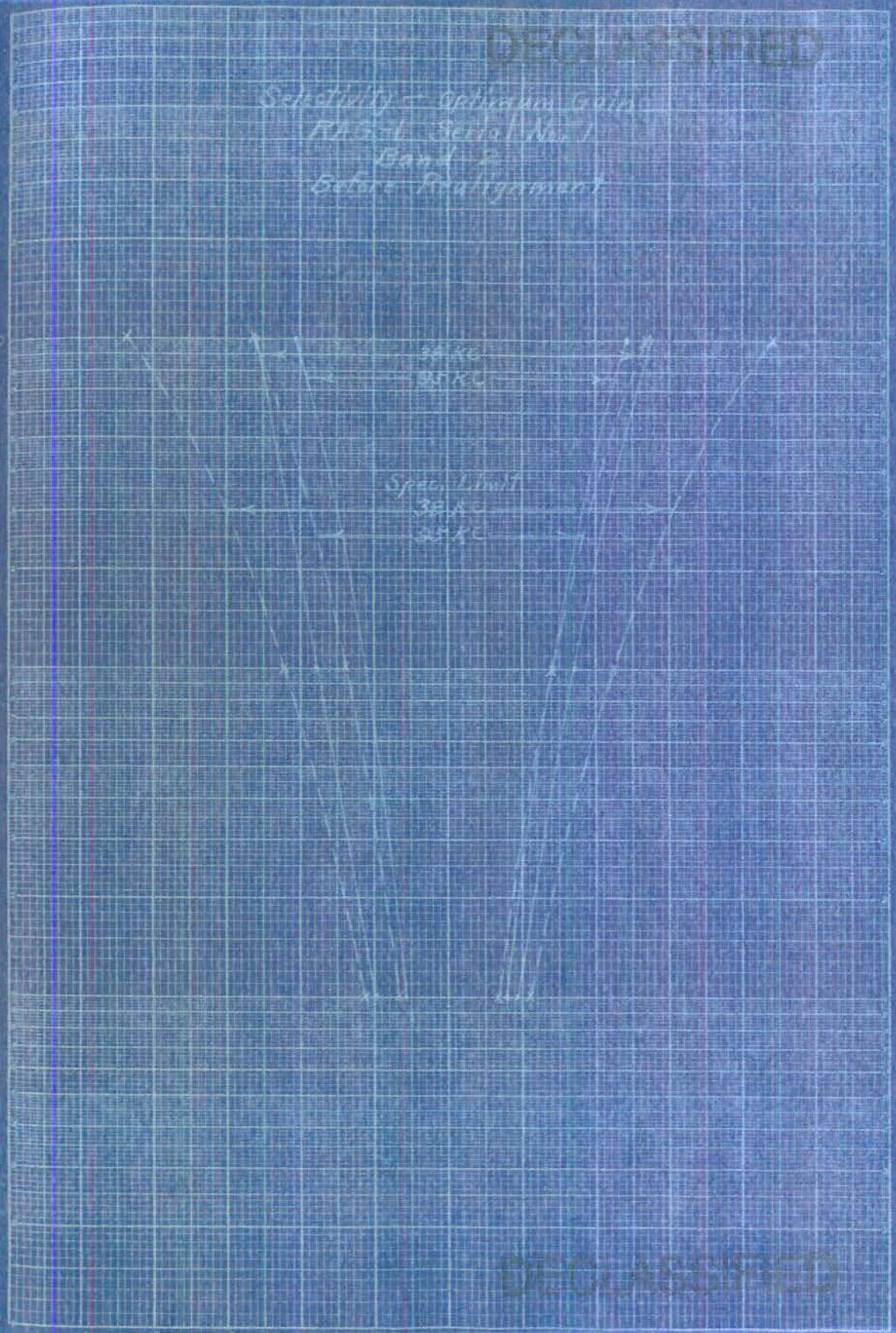


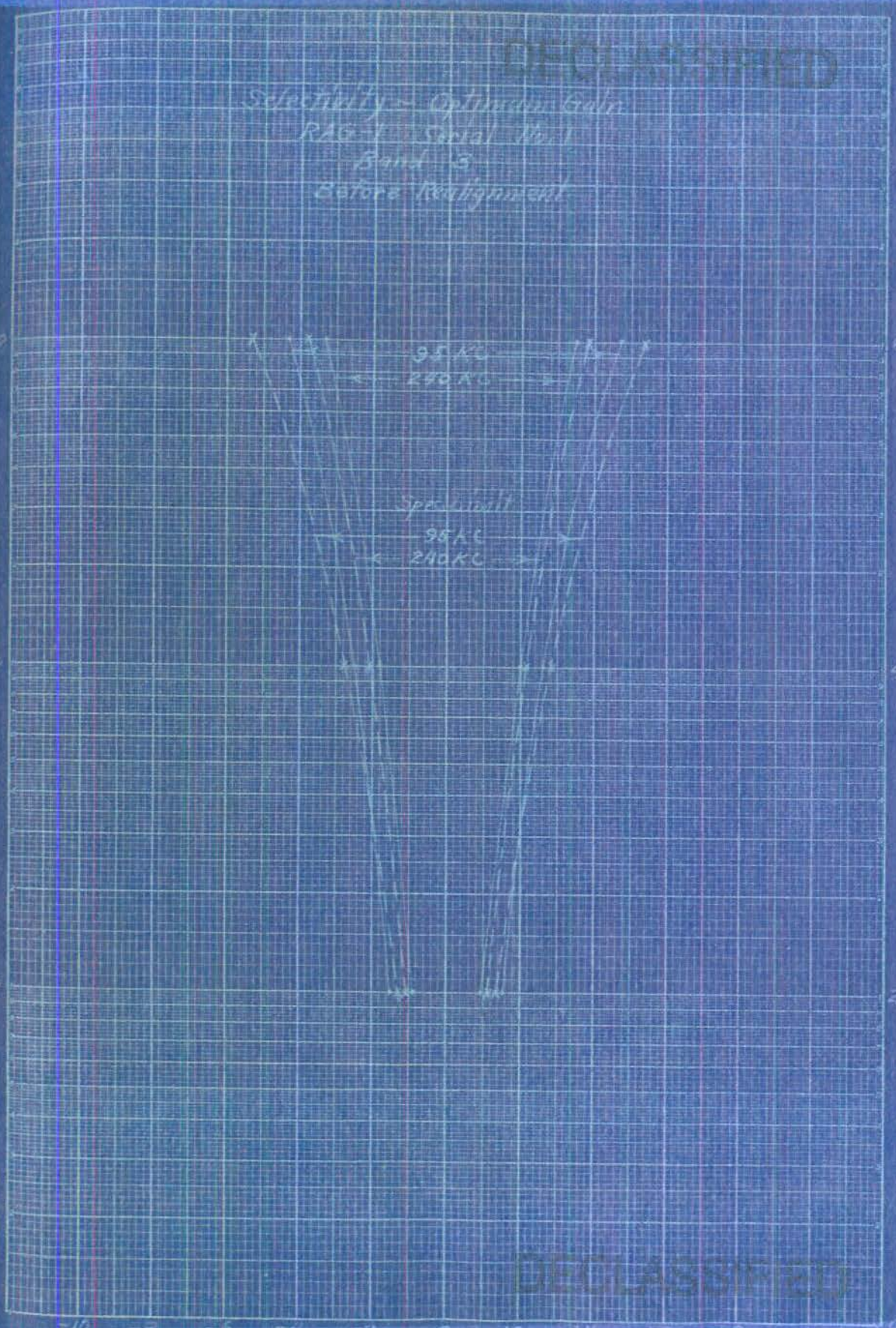
Plate 24

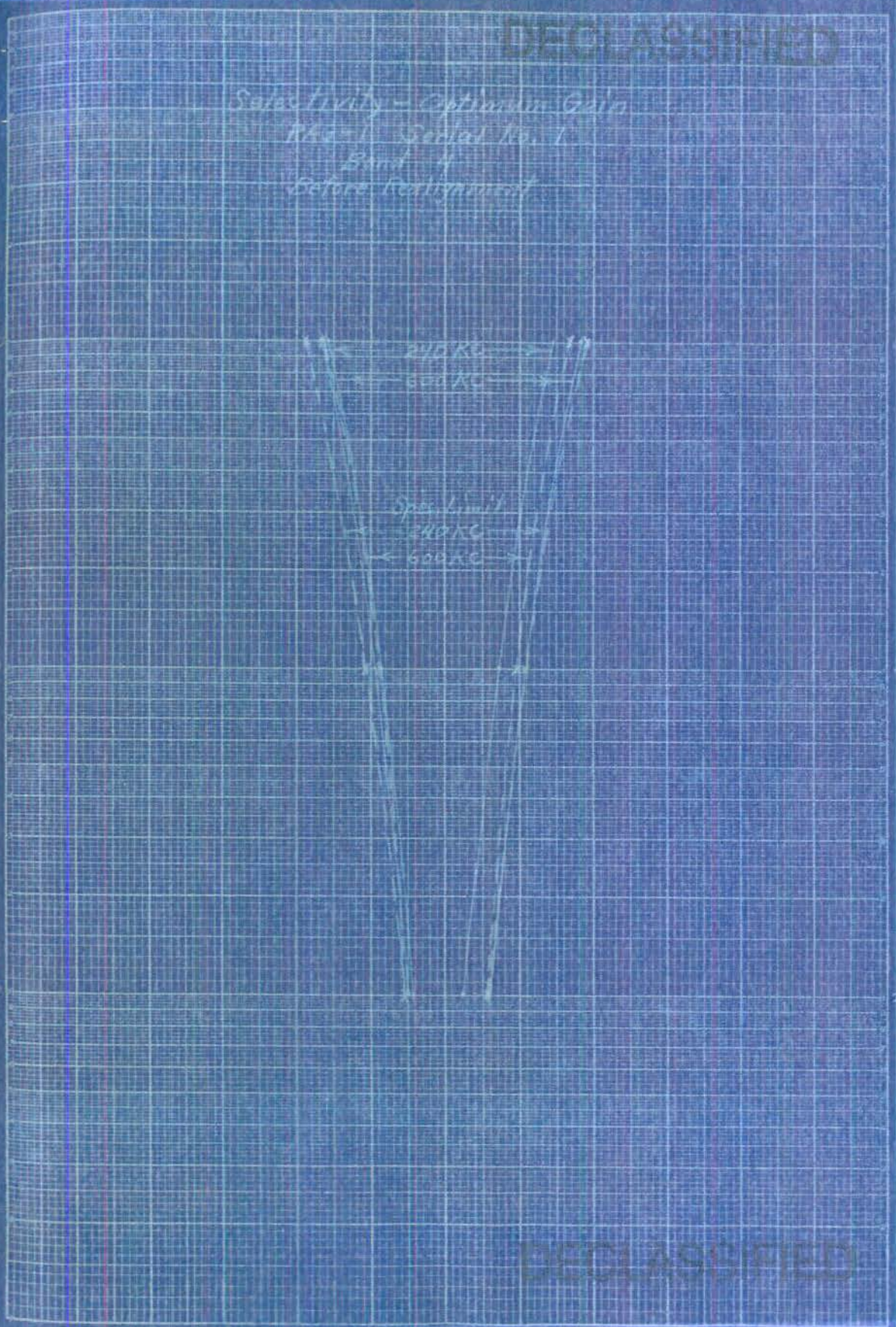
Selectivity — Optimum Gain
AVC-1 Serial No. 1
Band 1
Before Realignment

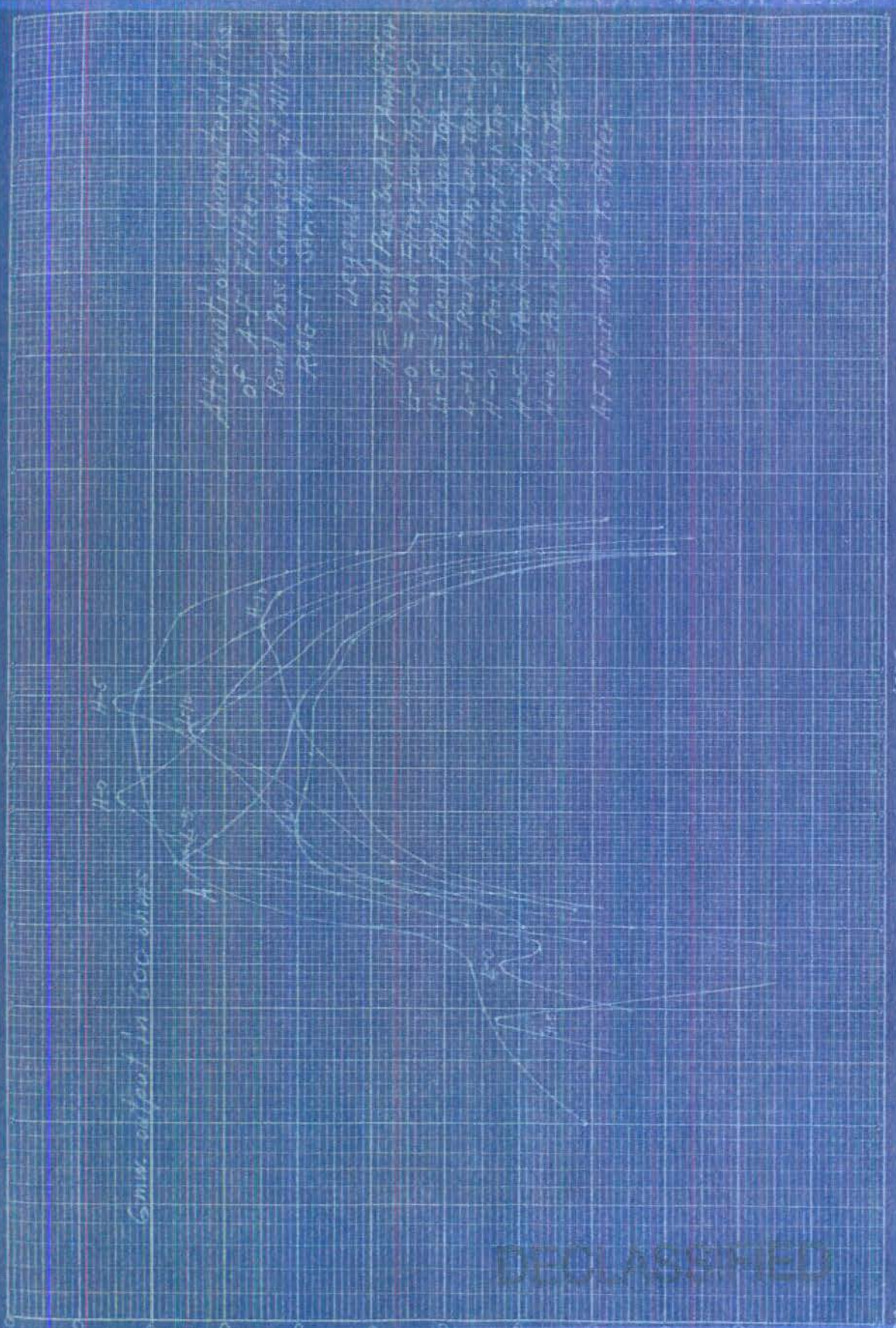


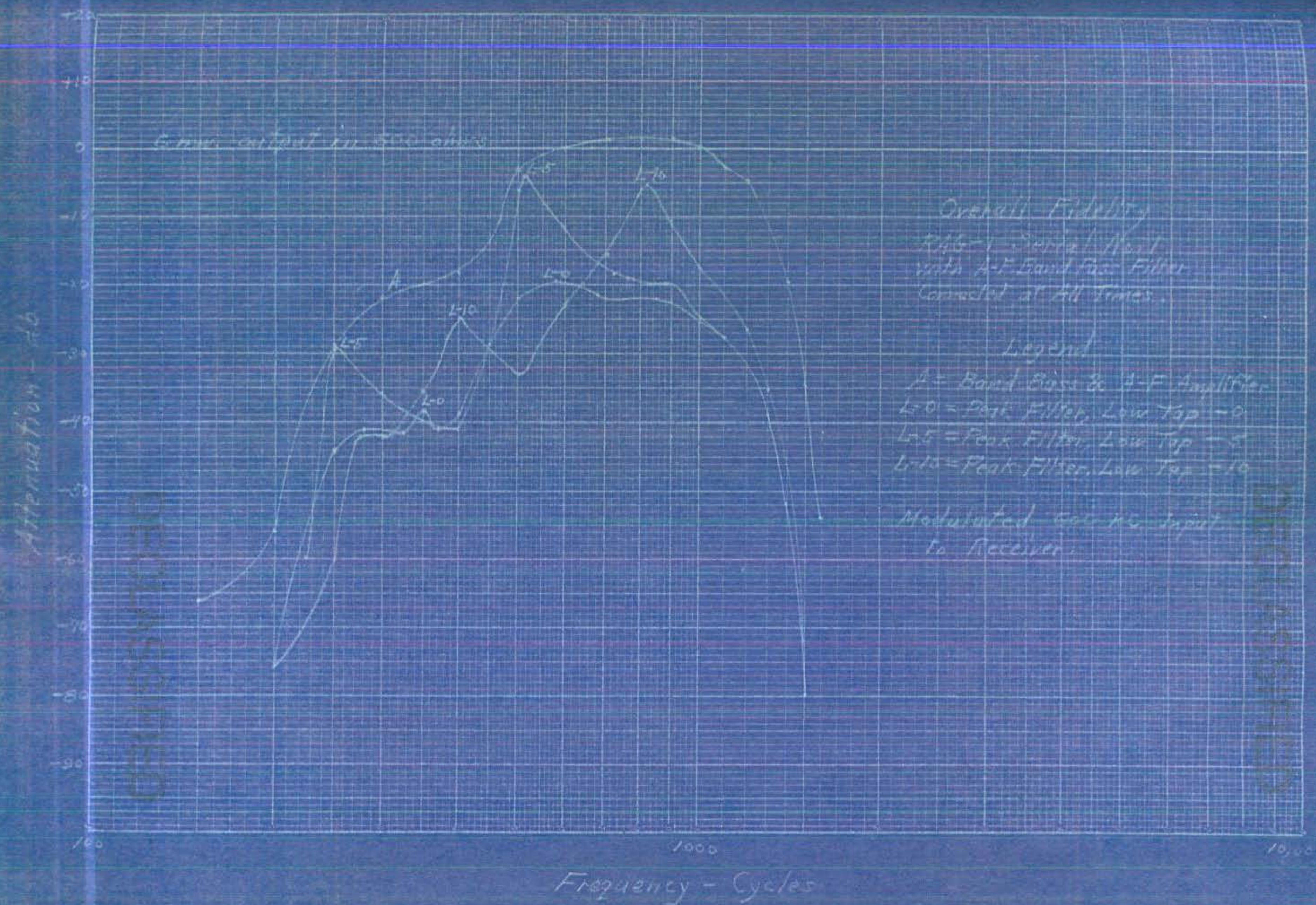


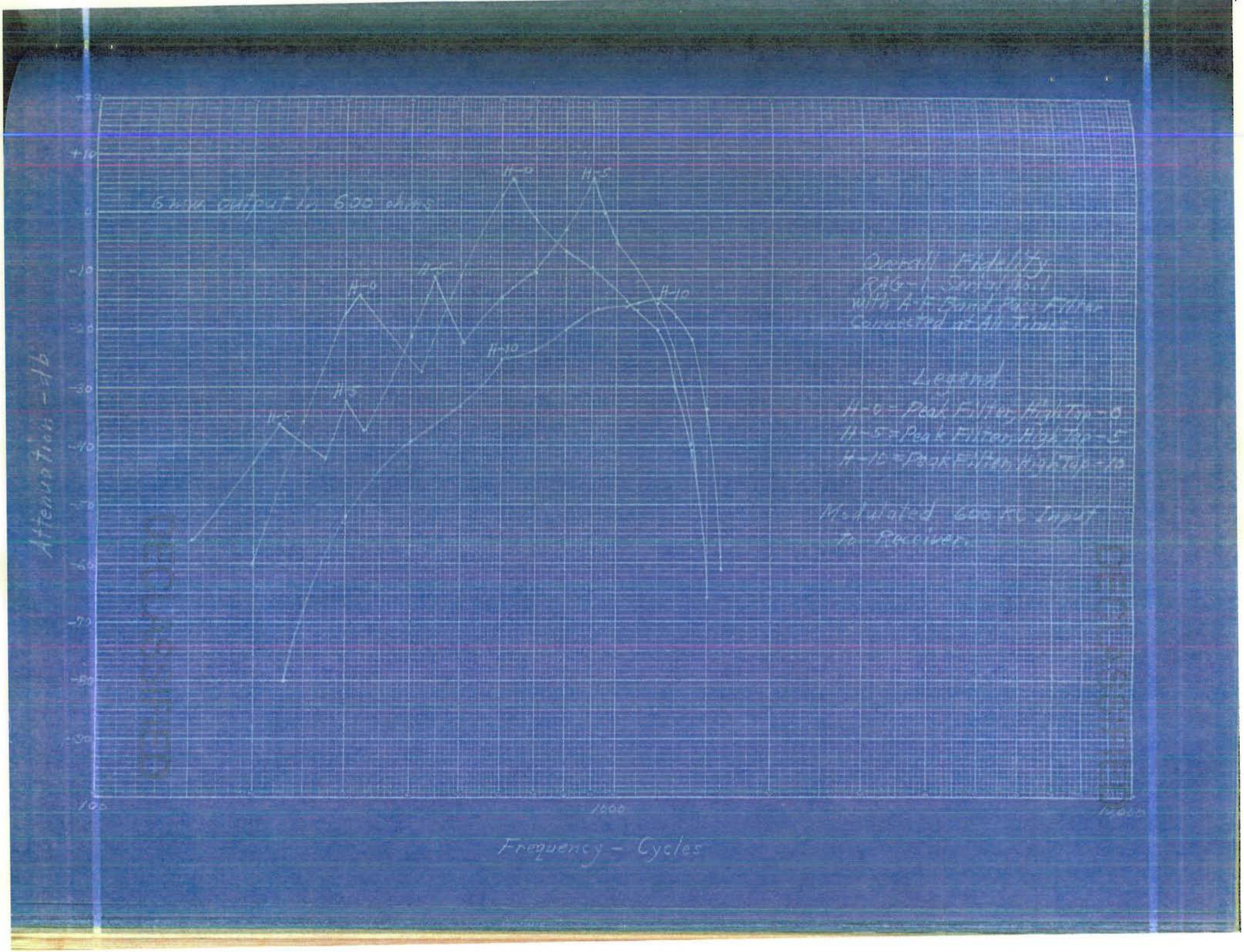
Selectivity - Optimum Gain
RAG-1 Serial No. 1
Band 3
Before Realignment

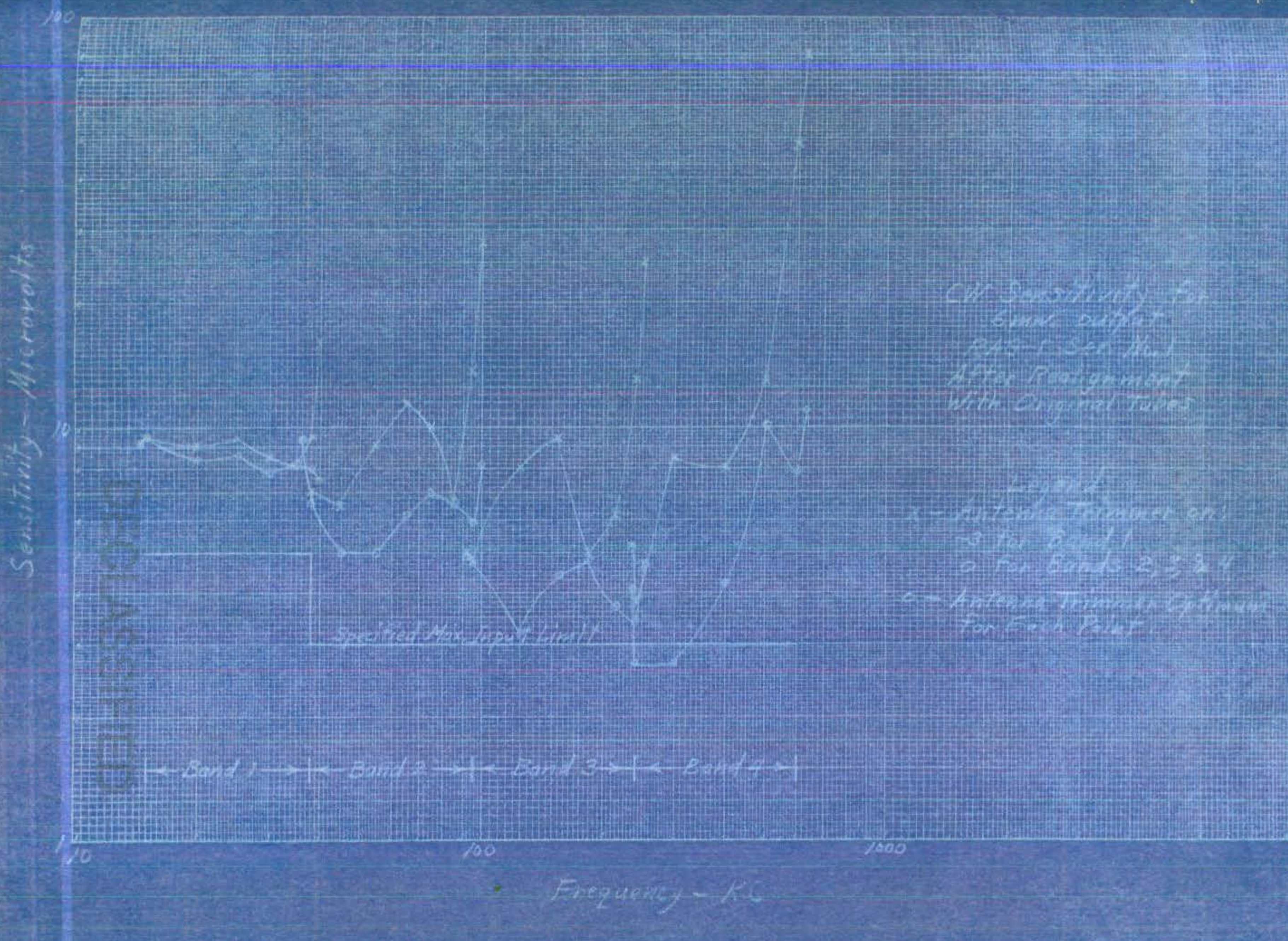






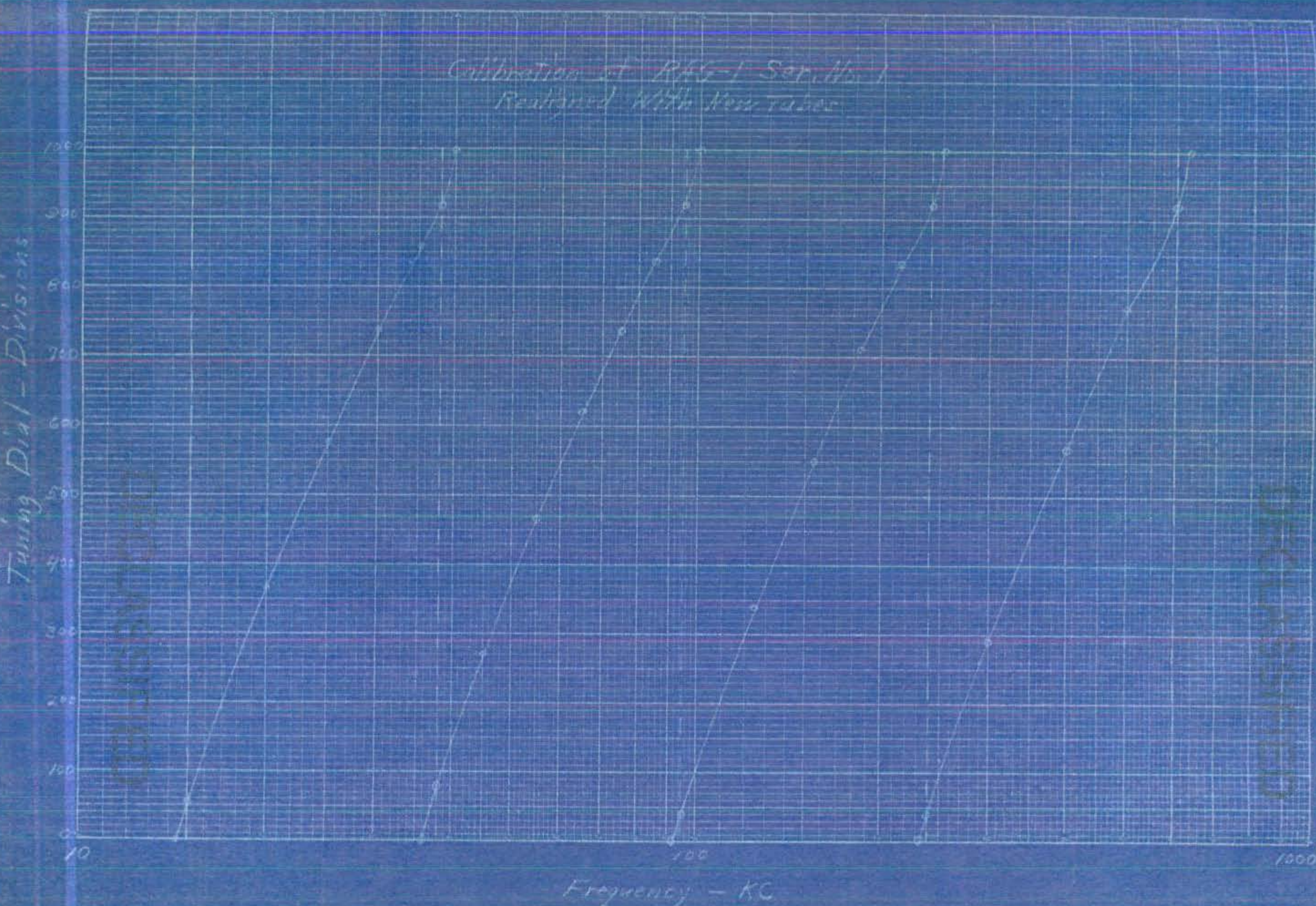

Overall Fidelity
with A-F Band Pass Filter
Connected at All Times.
Legend
A = Band Pass & A-F Amplifier
L-0 = Peak Filter, Low Tap - 0
L-5 = Peak Filter, Low Tap - 5
L-10 = Peak Filter, Low Tap - 10
to Receiver.
A
L-0
L-5
L-10
+20
+10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
100
1000
10,000
Attenuation - db
Frequency - Cycles
DECLASSIFIED
DECLASSIFIED


Attenuation - db
Frequency - Cycles
600 ohm output to 600 ohms
H-0
H-5
H-10
Legend
H-0 = Peak Filter, High Tap - 0
H-5 = Peak Filter, High Tap - 5
H-10 = Peak Filter, High Tap - 10
Modulated 600 ohm input to Receiver.

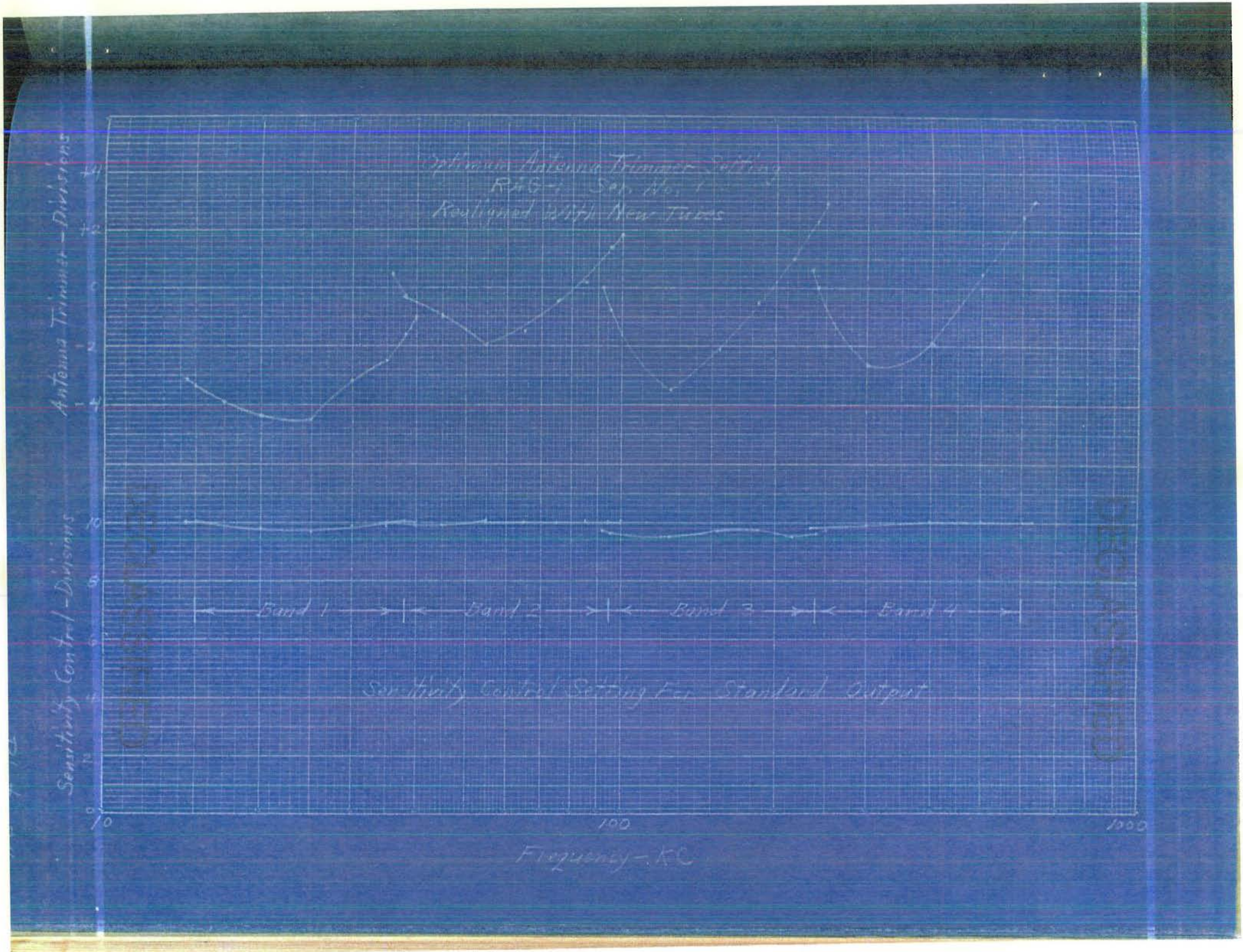


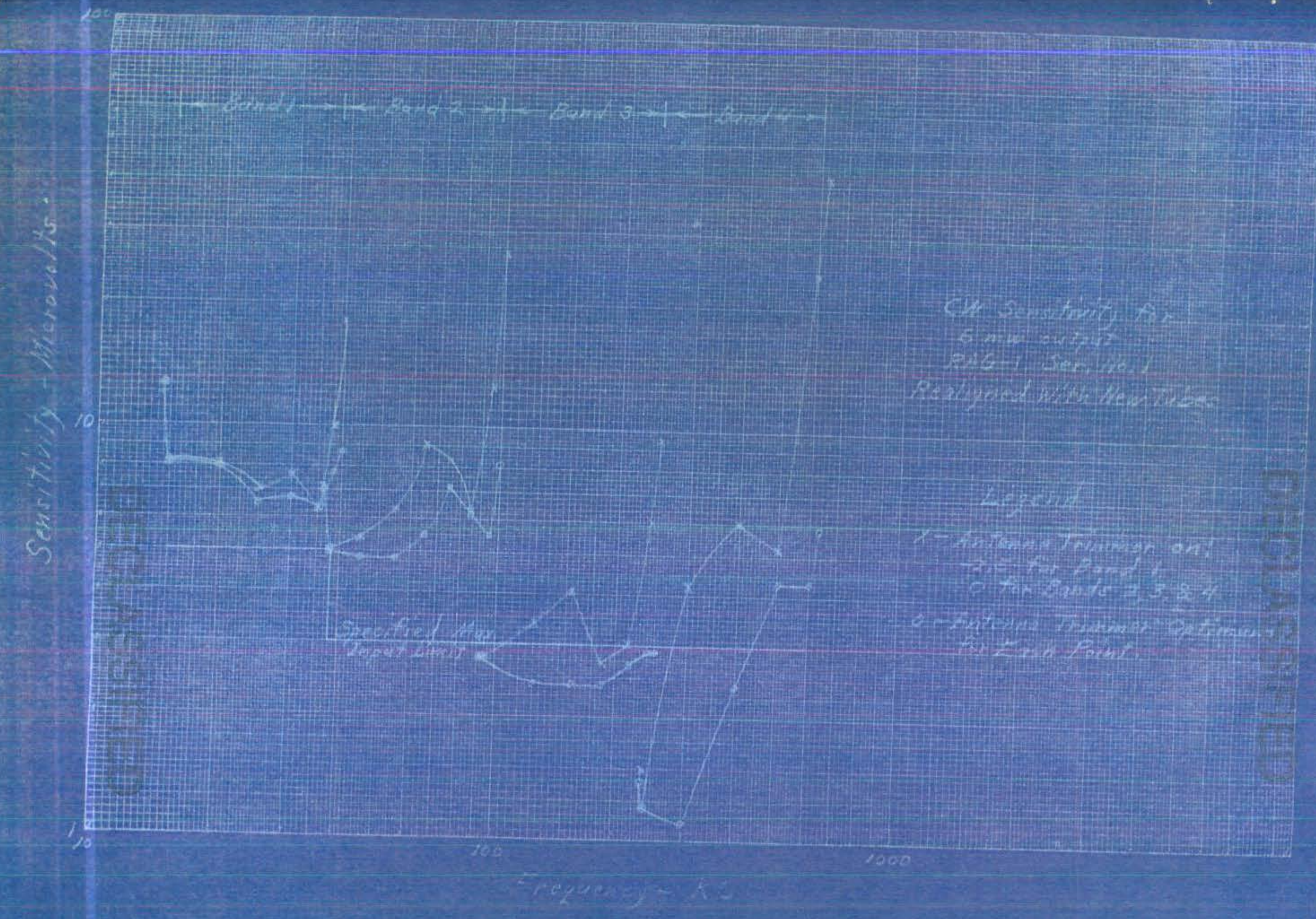
DECLASSIFIED

Plate 32



DECLASSIFIED


Optimum Antenna Trimmer Setting
R&G - Set No. 1
Realigned With New Tubes
+4
+2
0
-2
-4
-10
Band 1
Band 2
Band 3
Band 4
Set Sensitivity Control Setting for Standard Output
10
100
1000
Frequency - KC
Sensitivity Control - Divisions
Antenna Trimmer - Divisions
CONFIDENTIAL
CONFIDENTIAL



DECLASSIFIED

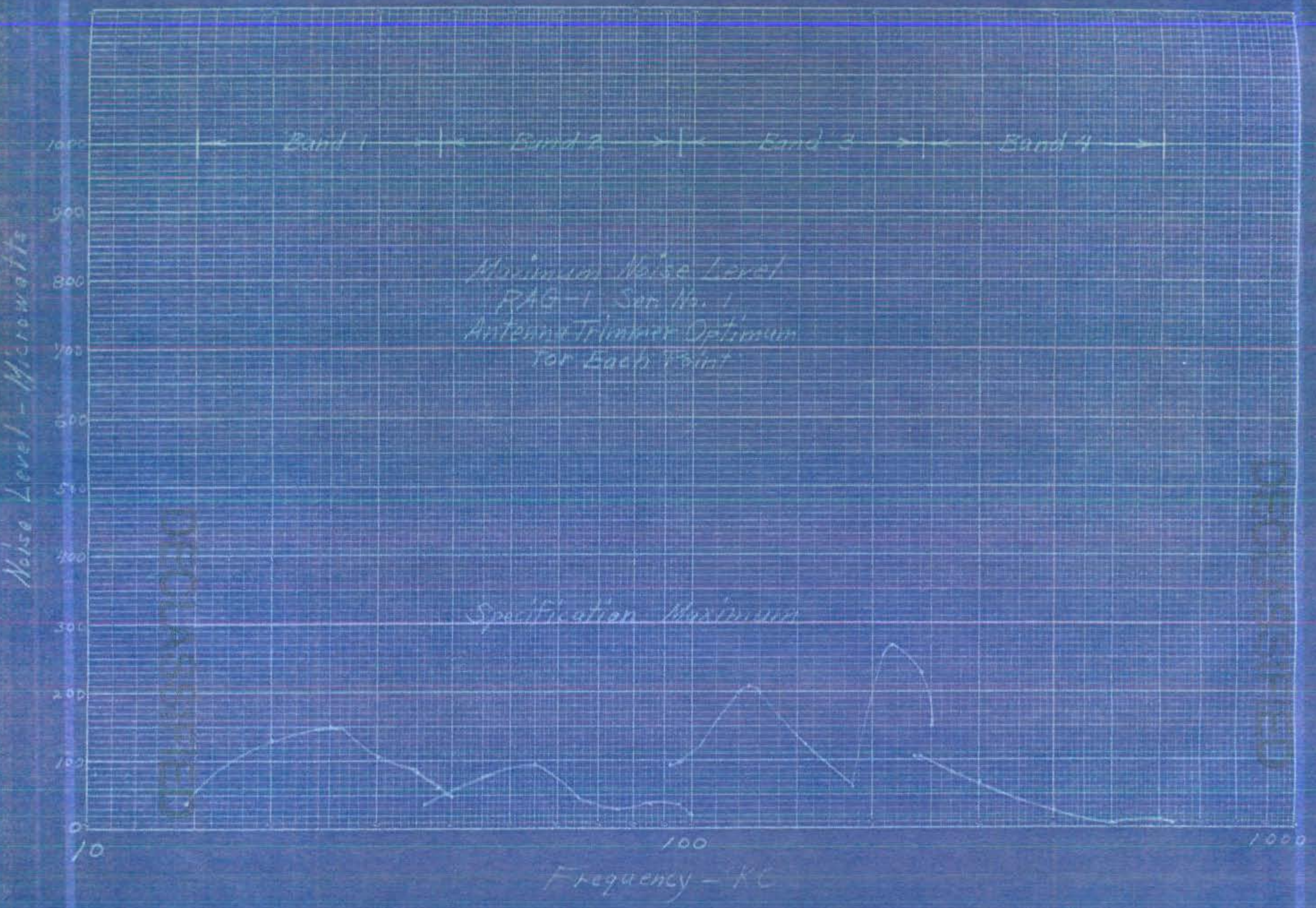


Plate 36

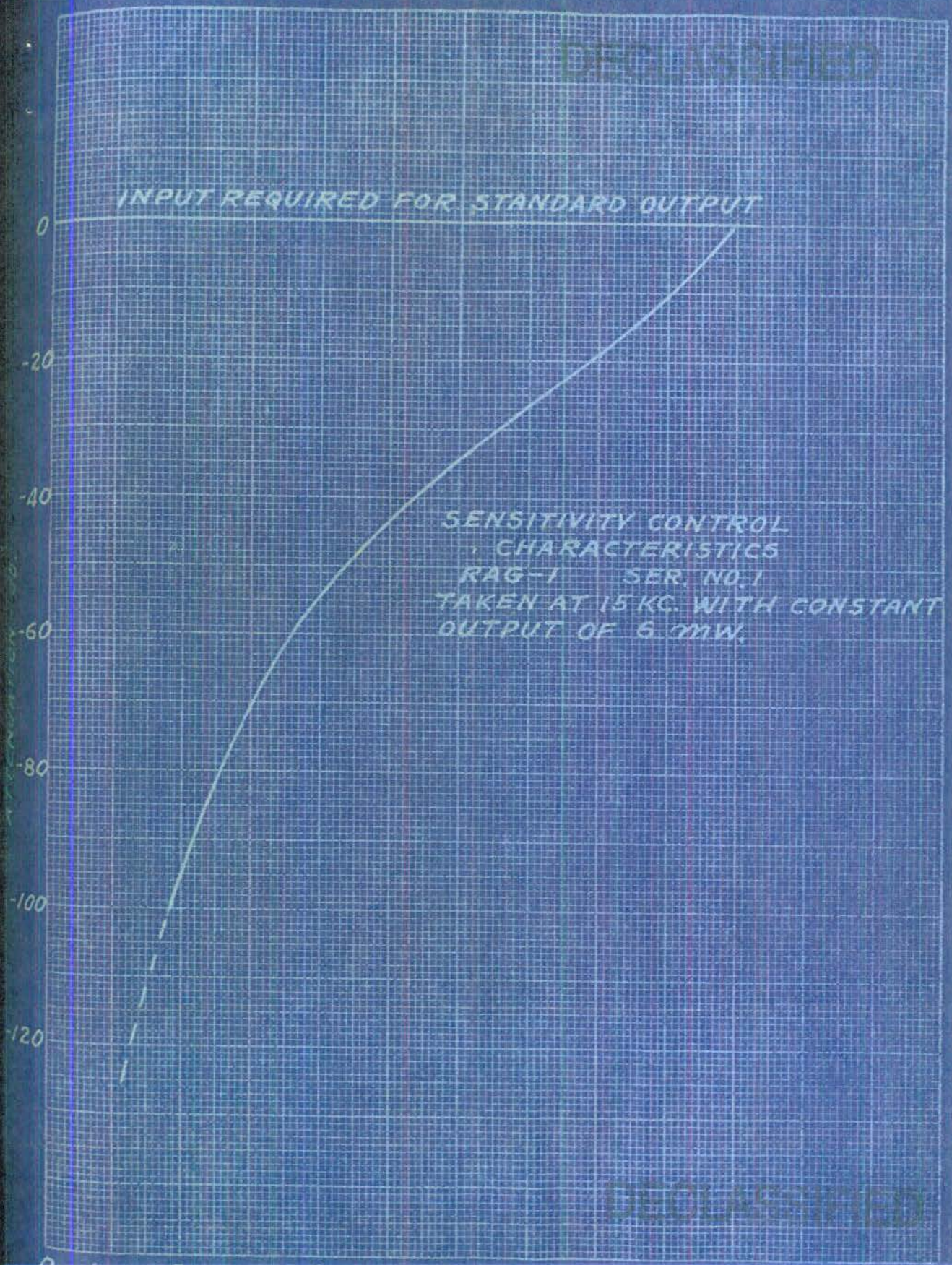
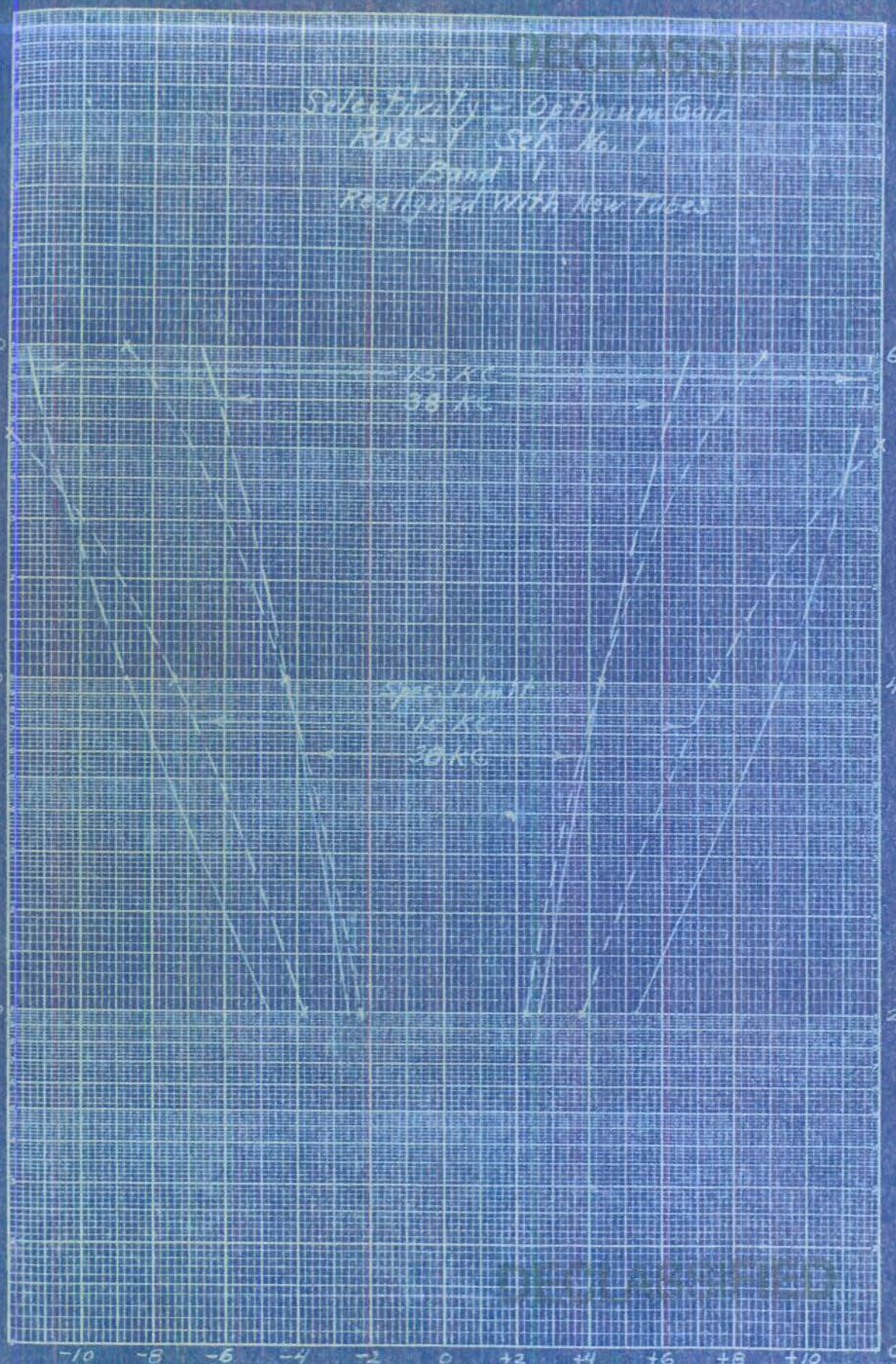


PLATE 32

Selectivity - Optimum Gain
RUG-1 Set No. 1
Band 1
Realigned with New Tubes



Transf. Resonant Input

Attenuation - db

Percent Off Resonance

Plate 38

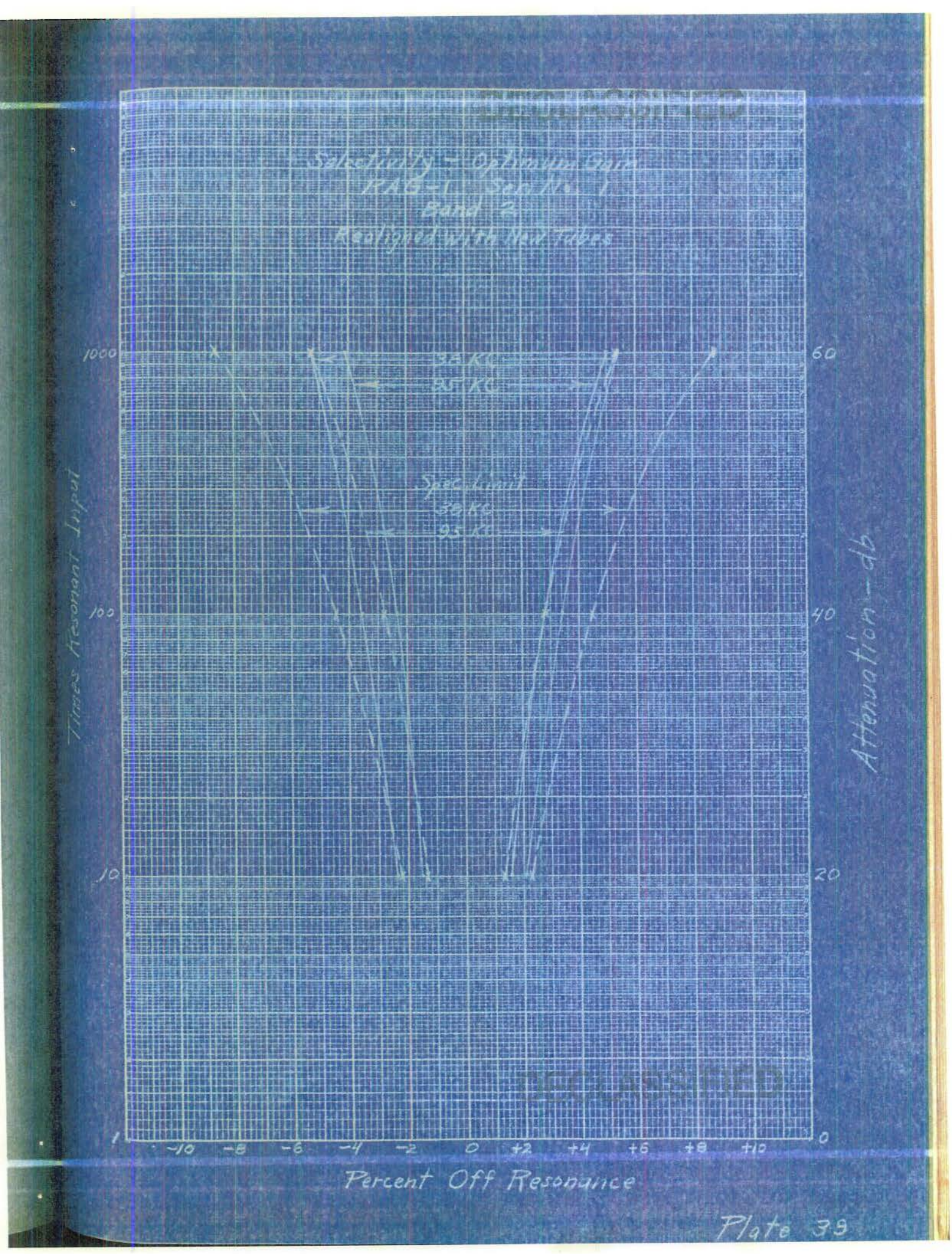

Selectivity – Optimum Gain
RAG-1 Set No. 1
Band 2
Realigned with New Tubes
1000
100
10
1
60
40
20
0
35 KC
85 KC
Spec. Limit
30 KC
9.5 KC
Times Present Input
Attenuation – db
-10 -8 -6 -4 -2 0 +2 +4 +6 +8 +10
Percent Off Resonance
UNCLASSIFIED

Plate 39

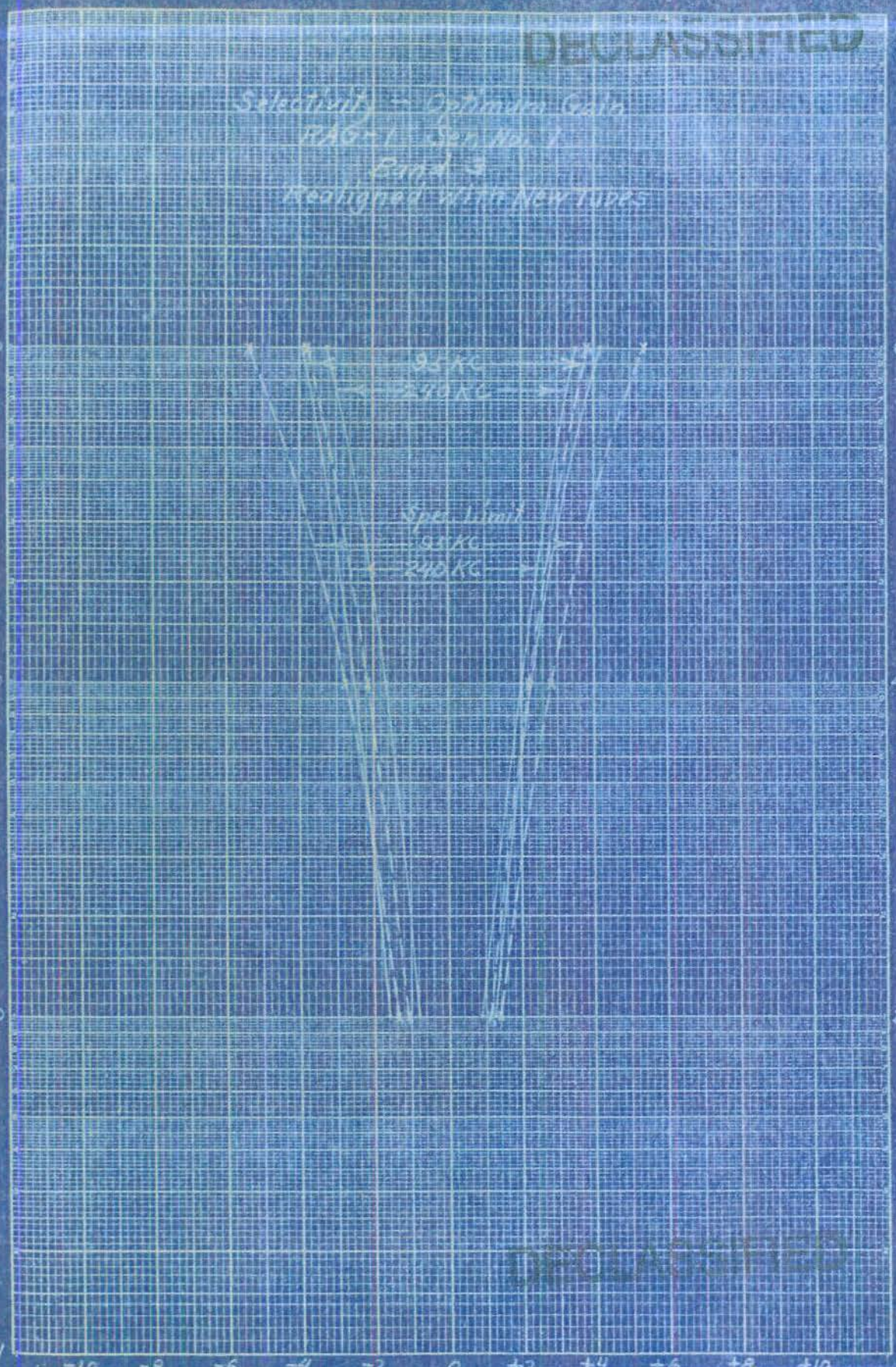
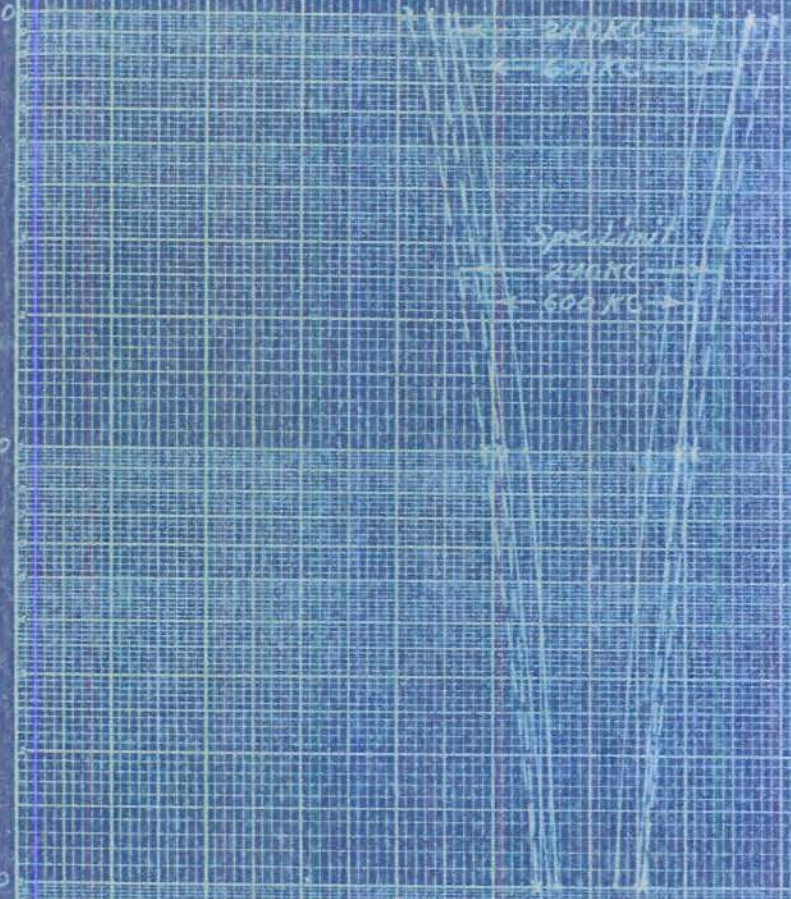


Plate 40

Selectivity - Coherent Gain
RAG 1 - Set No. 1
Plate #4
Realigned with New Tubes



Times Resonant Input

1000
100
10
1

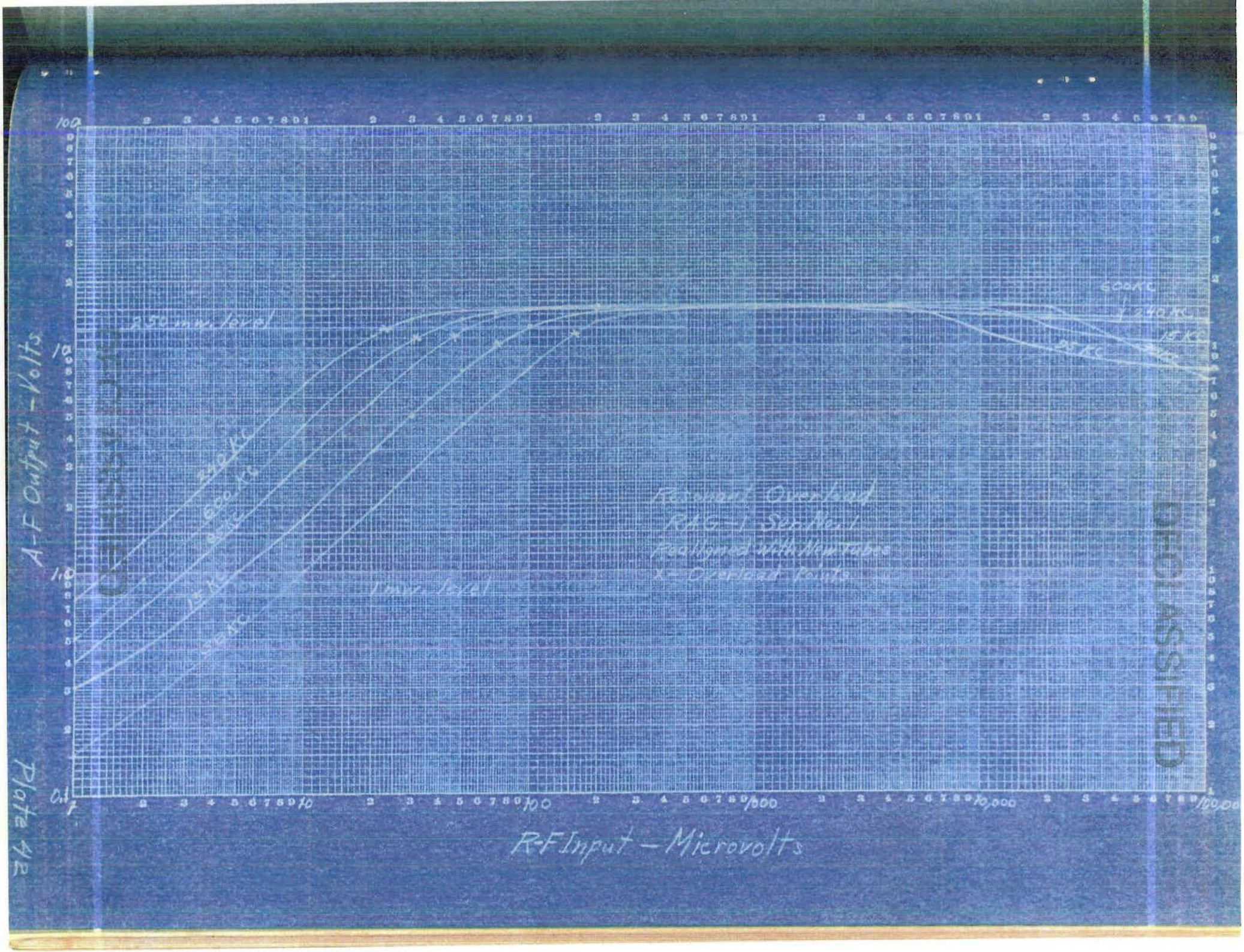
Attenuation - db

60
40
20
0

-10 -8 -6 -4 -2 0 +2 +4 +6 +8 +10

Percent Off Resonance

Plate #4


A-F Output - Volts
R-F Input - Microvolts
Plate 42
Receiver Overload
R&C-1 Sensitivity
Readings with dummy tube
X - Overload points
Normal level
Lower level
CONFIDENTIAL
DECLASSIFIED

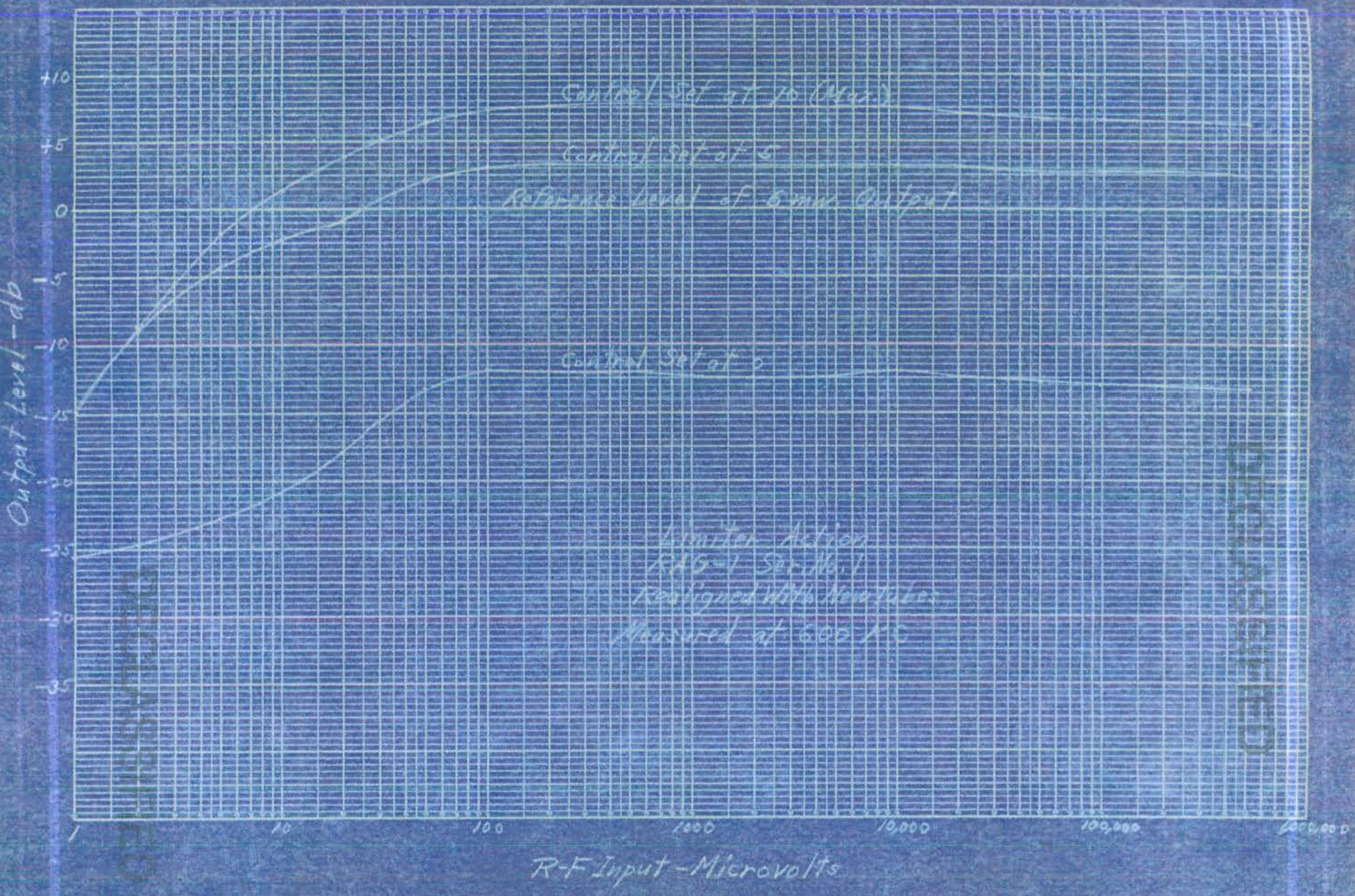


Plate 43