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N. Eng. 70-C

REPORT NO. R-1457

DATE 14 July 1938

FR-1457

SUBJECT

Test on Preliminary Model XGQ Equipments
Manufactured by Radio Research Company

UNCLASSIFIED

[redacted]

DECLASSIFIED by NRL Contract
Declassification Team
Date: 4 MAY 2016
Reviewer's name(s): H. Do, P. HANNA

Declassification authority: NAVY DECLASS MANUAL, 11 DEC 2012, 02 SERIES

DECLASSIFIED: By authority of 5000A Dated: Jan 1958

Entered By: E. Bliss Code 2027

BY

NAVAL RESEARCH LABORATORY

BELLEVUE, D. C.

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CONFIDENTIAL
NRL Report No. R-1457
Test on Preliminary Model XGQ Equipments
Manufactured by the Radio Research Co.

14 July 1938

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BuEng. Prob. A1-12

FR-1457

NAVY DEPARTMENT

BUREAU OF ENGINEERING

Report of Test

on

Preliminary Model XGQ Equipments

Manufactured by

Radio Research Company, Inc.

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D.C.

Number of Pages:	Text - 11 Tables - 51 Plates - 21
Authorization:	BuEng. let. C-NOs-55696(10-6-W8) of 8 October 1937.
Date of Tests:	12 January 1938 to 25 June 1938.

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Distribution:
BuEng. (5)

bms

[redacted] DECLASSIFIED

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APPENDIX I

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Conclusions

The tests of the Model XGQ Equipment were conducted on two preliminary models.

(a) The material used and the workmanship are excellent and the equipment should give long and dependable service.

(b) The equipment does not entirely meet the size and weight requirements of reference (c).

(c) The equipment does not meet the electrical requirements of reference (c) on the following:

Transmitter
- Power Output
- Humidity Conditions
- Frequency Range

Receiver
- Calibration Accuracy
- Selectivity
- Audio Fidelity
- Image Response
- Humidity Conditions
- Automatic Sensitivity Control

(d) In all other respects the equipment meets the requirements of reference (c).

(e) The receiver, not being designed for the reception of CW signals, is not suitable for homing on broadcasting stations. It is entirely suitable for homing on a steady modulated signal. The other points wherein the receiver does not meet the requirements of the specifications of reference (c) are of a minor nature and will not detract seriously from its suitability for the use for which it is intended.

(f) The transmitter in its present condition is not satisfactory. There are several mechanical features which should be modified. Electrically, it will not tune into the smaller antennae now standard on some types of planes and the tuning range is not complete from 3000 to 7000 kilocycles.

(g) Power input necessary to operate the transmitter at full rating is not available in Navy planes.

(h) In cases where the equipment does not meet the requirements of the specifications, the difference between the specified performance and actual performance is not of great magnitude being in most cases only slightly outside the probable error of measurement.

[redacted]

Recommendations

It is recommended that the contractor be instructed to make modifications on the equipment as follows:

A. Transmitter

1. Improve action of crystal oscillator locking device.
2. Improve band selector switch of crystal oscillator and indicate range of bands.
3. Arrange cable to removable tube chassis to avoid chafing against frame.
4. Provide for better protection against corrosion on the crystal holders.
5. Change the engraving on switch panel from W,X,Y,Z to 1,2,3,4, - 1 corresponding to Z, 2 to Y, 3 to X and 4 to W.
6. Improve the frequency switching system.

B. Receiver

1. Correct wiring diagram.
2. Exercise care in mounting shells of plug receptacles to insure plugs locking in place.
3. Provide means to safely wire slide fasteners on bottom of case.
4. Provide more clearance for the audio amplifier tube labeled V 107.
5. Improve the accuracy of the calibration chart. Distinguish the frequency and dial setting with red and black marking respectively. Furnish additional chart showing Band and Dial settings for all range beacon and control tower frequencies in the following manner:

   Frequency   Band   Dial Setting   Call Letters

   Call letter column will be left blank and additional columns as space is available will be provided.

C. Receiver Remote Control

1. Increase size of lettering showing band limits.
2. Provide more suitable mechanical linkage.
3. Improve visibility of tuning dial.
4. Provide larger knurled crank handle on tuning control and band selector dials. Increase size of dials if practicable.
5. Provide outlet for two headphones.

D. Cables

1. Provide internal shielded (rubber covered) cables.
2. Mark plugs and receptacles with corresponding numbers.
3. Provide right angle plug for receiver end of side tone cable. All others to be straight plugs.

In addition to the above, other modifications were recommended at a

[redacted]

conference at the Bureau of Engineering attended by representatives of the Navy and the contractor. These modifications, some of which require a change in contract, are listed in references (e) and (f). It is recommended that these modifications be incorporated in the model and production equipment.

Provided the above modifications are made in a satisfactory manner, it is recommended that the equipment be considered satisfactory for use in the Naval service.

[redacted]

EQUIPMENT UNDER TEST

7. The Model XGQ equipment under test, manufactured by the Radio Research Company, Inc., consists of two preliminary models, each of which is comprised of a transmitter unit, receiver unit, transmitter control box, receiver control box, transmitter dynamotor, receiver dynamotor, and connection cables and linkage to permit complete remote control.

8. The transmitter is crystal controlled and consists of a type 807 tube as a crystal oscillator, two type 807 tubes in parallel as a power amplifier, two type 807 tubes as a modulator and one type 42 tube connected as a triode as a speech amplifier.

9. The transmitter contains four identical channels with a tuning range of from 3000 to 7000 kilocycles, any one of which may be selected at will by means of an electrically operated switch. The frequency is determined by the crystal associated with each channel.

10. The receiver is the conventional superheterodyne type, capable of collecting modulated continuous wave and radio telephone signals within the ranges of 150 to 1500 kilocycles and 1800 to 15,000 kilocycles. It employs a type 6K7G tube as a radio frequency amplifier, a type 6K7G tube as an oscillator, a type 6L7G tube as a converter, a type 6K7G tube as a first intermediate amplifier, a type 6K7G tube as a second intermediate amplifier, a type 6R7G tube as a detector and first audio amplifier and a type 6K6G tube as a second audio amplifier.

11. The frequency range of the receiver is covered by six bands, three of which cover the range of 150 to 1500 kilocycles and three the range of 1800 to 15,000 kilocycles.

12. The receiver is designed for use of a homing loop which permits for homing over a frequency range of 150 to 1500 kilocycles.

13. The ship's 12-volt storage battery supplies all the power for the equipment, direct for the heaters and to a separate dynamotor each for the transmitter and receiver which supplies the plate voltage.

METHOD OF TEST

14. A description of the methods used in conducting the tests follows:

15. The equipment was checked for size, weight and mechanical construction. It was then assembled and tested to determine its compliance with the electrical requirements of the specifications, reference (c).

16. The power output of the transmitter was determined using the artificial antenna as described in reference (c) with an r.f. ammeter in the ground side of the circuit. The output was determined as the product of I^2R. This test was conducted on other antennas in service use with characteristics not covered by reference (c).

17. The humidity test was made by saturating the transmitter with 100 percent humidity at 50° C. for 18 hours. The output was measured and recorded before and after saturation.

[redacted]

18. The temperature test of the transmitter was made by installing the equipment in a temperature controlled chamber varying the temperature over the range specified by reference (c) and measuring the frequency at various points with the use of a Model LM-1 crystal frequency indicator.

19. The modulation characteristics of the transmitter were determined with the use of audio analyzer equipment from which percentage of modulation, carrier noise level, and percentage of audio harmonic distortion can be read directly.

20. The total drain of the receiver equipment on the primary power supply (the ship's 12-volt battery) was determined with the use of a precision ammeter.

21. The frequency range and overlap of the receiver was determined with the use of a crystal frequency indicator except for frequencies below 200 kilocycles in which case a standard signal generator was used.

22. The calibration accuracy was determined with the use of a crystal frequency indicator, the receiver being set on frequencies according to the calibration chart furnished with the equipment.

23. The sensitivity was determined with the use of a standard signal generator. The receiver was adjusted for not over 12.5 milliwatts noise output with no modulation. Then with modulation on the carrier, the input was adjusted until 50 milliwatts output was obtained. The output was measured with a power output meter.

24. The loop sensitivity was determined the same as above. The loop was connected in series with the receiver across the standard signal generator output.

25. The selectivity of the receiver was determined with the use of a standard signal generator and a power output meter. The output was adjusted for 50 milliwatts in the same manner as for the sensitivity test; then the standard signal generator was adjusted for this same output at six, twenty, forty, and sixty decibels, respectively, above and below resonance. The selectivity was determined as the band spread in kilocycles between equivalent points above and below resonance.

26. The audio fidelity was determined with the use of a beat frequency oscillator and a power output meter. The output of the receiver was adjusted for 100 milliwatts, modulated 30 percent at 400 cycles. With all other controls remaining fixed the beat frequency oscillator was adjusted to various frequencies from 100 cycles to 3000 cycles and the output recorded. The audio fidelity was determined as the power ratio in decibels of the power output at the various frequencies with reference to 100 milliwatts at 400 cycles.

27. The image ratio was determined with the use of a standard signal generator and an output meter. The receiver was adjusted for 100 milliwatts output with 5 microvolts input. The receiver controls remaining fixed, the standard signal generator was adjusted to the image frequency and the input increased until 100 milliwatts output was again obtained. The image ratio was determined as the ratio of the input of the image frequency and the 5 microvolts input of the base frequency.

[redacted]

28. The frequency change due to temperature change was determined with the use of a temperature controlled chamber, a crystal frequency indicator and a power output meter. The receiving equipment was installed in a temperature controlled chamber with a range of from -20° C. to +50° C. The receiver was adjusted for 100 milliwatts output with the volume control set at a position to insure low noise level. The temperature was varied over the above range and the frequency and output measured at regular intervals. These tests were made at approximately the middle of each of the six bands of the receiver.

29. The frequency change due to humidity was made with the same apparatus as above with the addition of a hygrometer to measure the percentage of humidity. The percentage of humidity was varied from a low value to 100 percent. The frequency and output was measured at regular intervals.

30. The frequency change due to manipulating the sensitivity control from maximum to minimum was determined with the use of a standard signal generator and an output meter. The receiver was tuned to a frequency at approximately the middle of each band with the sensitivity control at the maximum position. This frequency was measured and with all other controls remaining fixed the sensitivity was adjusted to minimum and the frequency again measured. The minimum position was not at zero but as near thereto as possible and have a measurable signal.

31. The undistorted power output was determined with the use of a beat frequency oscillator, a wave analyzer, a standard signal generator, and a power output meter. The receiver was adjusted for 500 milliwatts output modulated 30 percent at 400 cycles. The sensitivity control was adjusted to reduce the noise level to a low value (below 12.5 mw). The output was coupled into a wave analyzer. With all other controls remaining fixed the wave analyzer was adjusted to successive harmonics of the modulation frequency and the output in millivolts recorded. The percentage of distortion was determined from these values.

32. Reset measurements were made with the use of a standard signal generator and power output meter. The receiver was adjusted to predetermined frequencies and the dial setting recorded. The receiver was then detuned and returned to the original recorded setting without regard to maximum reading of the output meter. This was done from both clockwise and counter-clockwise directions. The input frequency was readjusted for maximum reading of the output meter. The resettability was determined from the difference between these and the original frequencies.

33. The automatic sensitivity control action was determined with the use of a standard signal generator and a power output meter. The receiver was adjusted for 50 milliwatts output in the AVC position and the input then increased by steps up to 10,000 times the original input and the output recorded.

<u>DATA RECORDED DURING TEST</u>

34. Data recorded during the tests in the form of tables, charts and photographs are appended to this report. These data which are listed below and other data are discussed in "Results."

35. Transmitter data were recorded on the following:

(a) Weights and dimensions.
(b) Power output.
(c) Humidity test.
(d) Temperature test.
(e) Modulation characteristics.

36. Receiver data were recorded on the following:

(a) Weights and dimensions.
(b) Drain on primary power source.
(c) Frequency range and overlap.
(d) Calibration accuracy.
(e) Sensitivity.
(f) Selectivity.
(g) Audio fidelity.
(h) Image response.
(i) Temperature test.
(j) Humidity test.
(k) Manipulation of sensitivity control.
(l) Audio distortion.
(m) Reset.
(n) Automatic sensitivity control.
(o) I.F. rejection.

37. Photographs were made of the complete equipment.

DISCUSSION OF PROBABLE ERRORS

38. Following is a list of apparatus used with the margin of error according to the manufacturer's guarantee: (a) Weston d.c. voltmeter, Model 45, Ser. #41660, ± 0.5%; (b) Weston d.c. ammeter, Model 370, Ser. #4576, ±0.25%; (c) Weston r.f. ammeter, Model 425, Ser. #28117, ± 2.0%; (d) Weston r.f. ammeter, Model 425, Ser. #37401, ± 2.0%; (e) General Radio power output meter, Type 583A, Ser. #63, ± 5.0%; (f) General Radio standard signal generator, Model LC-A, Ser. #2, ± 10.0%; (g) General Radio beat frequency oscillator, Model 713-A, Ser. #209, ± 2.5%; (h) General Radio wave analyzer, type 636-A, Ser. #318, ± 2.5%; (i) Radio Research Company crystal frequency indicator, Model LM-1, Ser. #5, ± 0.001%; (j) Radio Research Company, audio wave analyzer, Model OB, Ser. #1, modulation 0-100%, ± 2.5%.
Carrier noise level to 60 db, below 100% modulation, ± 5.0%.
Audio harmonic distortion .2 to 1.0%, ± 15.0%.
Audio harmonic distortion 1.0 to 30%, ± 5.0%.
(k) Sargent hair hygrometer, Ser. #42795, ± 15.0%; (l) Frigidaire refrigerator; (m) Centigrade thermometer -30° to $+50^{\circ}$, 1.0%.

RESULTS

39. The tests of the subject equipment were made with the two preliminary models as submitted by the contractor. Complete tests were not made on both models. However, they were made on sufficient points to indicate that the performance of both models was practically identical.

40. The results of these tests will be discussed in the order of the paragraphs of reference (c) in which they appear. The numbers of the following subparagraphs are in agreement with the numbers of the paragraphs of the specifications.

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Sections I and II

1-1 to 1-6 and 2-1 to 2-51, inclusive, are introductory and general and apply largely to material and parts used in the equipment. Those points that apply to these tests are covered in detail in the following discussion.

2-7. The equipment operated satisfactorily up to 17,000 feet above sea level. Equipment was not available to conduct tests of acceleration in any direction up to 5 g. or orientation in any plane up to 180 degrees. However, except for vibration of the relay contacts discussed later, the equipment performed satisfactorily through numerous take-offs and landings of aircraft. The performance under variable temperature conditions is shown on Table 6 appended to this report.

2-41. The equipment does not meet the humidity requirements of this paragraph. The result of this test is shown on Table 5 appended to this report.

III. Mechanical and Electrical Requirements

3-1. The equipment in its present condition does not entirely meet the requirements of this paragraph either mechanically or electrically. It is designed to mount in planes mocked up for Model GP equipment, but those planes mocked up only for Model GF equipment will need special brackets. Electrically, the transmitter will not resonate into all types of antennas now standard in the Naval Service.

3-2. The equipment does not meet all the requirements of this paragraph. The transmitter is 1-3/4 inches oversize in width, 5-1/8 inches oversize in length and 8 pounds overweight. The transmitter control box is oversize 7/8 inches in width and 1/16 inch in length. The transmitter dynamotor is 2-1/4 inches oversize in height and 2 pounds and 7 ounces overweight. The receiver is 1 pound overweight. The receiver dynamotor is 1/4 pound overweight and 7/8 inch oversize in length. The connection cables and control linkage are 27 pounds and 8 ounces overweight. The receiver dynamotor is 1/8 inch oversize in width, 7/8 inch oversize in length and 4 ounces overweight. The homing loop is 1/8 inch oversize in width across the face. A complete list of actual and specified weights and dimensions are shown on Table 1 appended to this report.

3-3. The dynamotor submitted with the equipment was designed to supply 460 volts with a terminal input of 13.4 volts. With the equipment installed in a plane and using the plane's battery for the primary source, the terminal voltage at the dynamotor was low. This resulted in lower plate voltage and consequently less power output. Tables showing the results of tests made with an NEA-2 generator and a D-1a generator are in the Naval Air Station report, Appendix II, of this report.

3-4. The power output of the transmitter does not meet all the requirements of this paragraph. The output is less than required in some cases and the transmitter does not resonate with the smaller type of antennas which is standard for some types of planes having a capacity of 65 micro-microfarads at 3000 kilocycles. The power output measurements are shown on Tables 2, 3, and 4, appended to this report.

3-5. The equipment does not meet the requirements of this paragraph in that the two bands in the crystal oscillator circuit do not overlap.

[redacted]

3-6. Frequency selection is effected by remote electrical control.

3-7. Due to mechanical defects the frequency selecting mechanism failed to function properly at all times. Misalignment of switch blade and contacts and unnecessary indents were mainly responsible for this condition. The torque developed by the switching motor appeared to be weak under the lowest voltage condition encountered in normal service. A switch is incorporated to disengage the electrical control and permit local manual control.

3-8. The equipment meets all of the requirements of this paragraph except that the contact springs of the relay are not strong enough to maintain good contact in the receive position under vibration. This causes undesirable noise in the receiver.

3-9. The crystals supplied with the equipment performed satisfactorily. The protective coating of the crystal holders was not satisfactory. Several of the holders showed indications of rust.

3-10. Crystals were provided covering the frequencies specified.

3-11. There is no interlocking or other harmful effect between channels when set up on the same or different frequencies.

3-12. The overall audio response of the transmitter meets the requirements. Measurements were made at 100 percent modulation. The result of this test is shown on Table 7.

3-13. The audio frequency distortion measurements which are within the requirements is shown on Table 7.

3-14. The equipment is capable of 100 percent modulation when using a standard Navy microphone of the aircraft type.

3-15. The carrier noise level meets the requirements. The result of this test is shown on Table 7.

3-16. The time required for changing from one pre-tuned frequency to another is within the 5 seconds allowed.

3-17. The type of shock mountings used meet the requirements.

3-18. The performance of the receiver under severe temperature and humidity conditions is discussed in following paragraphs. The receiver operated satisfactorily at an altitude up to 17,000 feet above sea level. Equipment was not available to conduct tests of acceleration in any direction up to 5g. or orientation in any plane up to 180 degrees. However, the receiver was subjected to the shock of numerous take-offs and landings and orientation encountered in test flights and performed satisfactorily except for vibration of the relay contacts previously discussed.

3-19. The receiving equipment appears to be well protected against corrosion and continuous exposure to unfavorable climatic conditions.

3-20. The drain on the primary power source at any voltage within the range of 12 to 16 volts was less than the specified allowance. The result of this test is shown on Table 8.

3-21. The frequency range and overlap which is shown on Table 9 is satisfactory.

3-22. The conventional superhetrodyne circuit is employed.

3-23. The equipment is arranged for remote control up to 15 feet.

3-24. A loop coupled to the receiver through a transmission line is provided for homing purposes. Satisfactory homing can be accomplished on a steady signal but as the receiver is not designed for the reception of CW signals, it is not satisfactory for homing on broadcast stations since the carrier cannot be used.

3-25. The audio transformers and chokes are of such construction as to satisfactorily meet the requirements of the specifications.

3-26. The equipment is arranged to operate with head telephones having an impedance of 600 ohms. One single circuit jack is located in the operator's control box. The equipment meets the requirements of this paragraph. Paragraph 1-5(3) requires operation with one or <u>two</u> pairs of headphones.

3-27. The calibration chart furnished with the equipment does not meet the accuracy required by the specifications as shown in Table 10.

3-28. The sensitivity meets the requirements as shown on Tables 11 to 16, inclusive, for antenna reception and Tables 17 to 19 for loop reception.

3-29. The equipment does not entirely meet the selectivity requirements as shown on Tables 20 to 25 inclusive.

3-30. The fidelity characteristic does not meet the requirements at all frequencies. Table 26 shows the result of this test.

3-31. The image response ratio meets the requirements at all except the high frequencies. This is shown on Table 27.

3-32. (1) The frequency change due to change of temperature was within the requirements. The results of these tests are shown on Tables 28 to 39 and Plates 1 to 6, inclusive.

3-32. (2) The equipment did not meet the humidity requirements the results of which are shown on Tables 40 to 45 and Plates 7 to 12 inclusive.

(3) Frequency change due to voltage variation ± 15 percent was so slight as to be unmeasurable.

(4) The vibration encountered in flight had no deleterious effect except from the relay contacts as stated above.

(5) The effect resulting from manipulating the sensitivity control from maximum to minimum is satisfactory as shown on Table 46.

3-33. The undistorted power output meets the requirements as is shown on Table 47.

[redacted]

3-34. The remote control feature using mechanical linkage is satisfactory for 15 feet installation. On small planes where it becomes necessary to coil up the surplus length of linkage it is difficult to make a fine adjustment.

3-35. The reset requirements are met. The result is shown on Table 49.

3-36. The calibration of the indicating dials while readable at a 70 degree angle with good light would be difficult to read under poor light conditions. The engraving on the plate indicating the frequency range of the bands should be larger.

3-37. The manual sensitivity control meets the requirements of this paragraph but the automatic sensitivity control falls somewhat short. The result of this test is shown on Table 50.

3-38. All controls necessary to operate the receiver are located on the front panel of the operator's control box.

3-39. The loop is designed to cover the range from 150 to 1500 kcs and is tuned by means of a condenser within the receiver and ganged with the receiver tuning condenser.

3-40. The loop and 15 feet of transmission line allow for homing on a steady signal but is not satisfactory as broadcast stations. This condition is discussed above.

3-41. The loop, transmission line and mounting meet the requirements of the paragraph.

3-42. Homing is accomplished in the usual manner known as bilateral direction finding and is satisfactory except for homing on broadcasting stations as discussed before.

3-43. Satisfactory homing operation is obtained when the loop is mounted under the hood on back of the head rest on airplanes incorporating those structural features.

3-44. Time did not permit a 300 hour test of the dynamotors but those furnished were used throughout the factory test, laboratory tests and flight tests and performed satisfactorily and with no apparent deleterious effect. They are identical with units previously furnished by other contractors and have given satisfactory performance in service.

3-45. The jack receptacle for the microphone accommodates a Navy type 49007 plug and the jack receptacle for the head phones accommodates a Navy type 49006 plug.

3-46. All tuning and trimming capacitors are of the air dielectric type.

3-47. Provision is made for the quick detachment of each unit with the use of pliers only for removal of safety wire. All units may be readily safety wired except the receiver which can easily be modified to allow for same.

[redacted]

3-48. The only tool, a screw-driver, necessary for adjustment of the equipment has been furnished.

3-49. Provision has been made for the operator to hear his own transmission.

3-50. When operating on any antenna within the specified limits tuning is accomplished without change in antenna length.

3-51. Pure fundamental frequency output with reasonable reduction of harmonics, clicks, lilt or other objectionable radiated energy has been accomplished. This was not true in the first model due to self oscillations in the amplifier.

3-52. Suitable means has been provided in the receiver for automatically maintaining the alignment of the antenna circuit with the amplifier circuits.

3-53. The output circuit of the receiver is such as to remove all d.c. potential and substantially all radio frequency potential from the telephone cords.

3-54. The receiver under any normal operating condition is free from self oscillation.

3-55. There is no appreciable time lag in transferring the equipment from "Receive" to "Transmit" and vice versa.

[redacted]

CONCLUSIONS

41. The tests of the Model XGQ equipment were conducted on two preliminary models.

42. The material used and the workmanship are excellent and the equipment should give long and dependable service.

43. The equipment does not entirely meet the size and weight requirements of reference (c).

44. The equipment does not meet the electrical requirements of reference (c) on the following:

<u>Transmitter</u>
- Power Output
- Humidity Conditions
- Frequency Range

<u>Receiver</u>
- Calibration Accuracy
- Selectivity
- Audio Fidelity
- Image Response
- Humidity Conditions
- Automatic Sensitivity Control

45. In all other respects the equipment meets the requirements of reference (c).

46. The receiver, not being designed for the reception of CW signals, is not suitable for homing on broadcasting stations. It is entirely suitable for homing on a steady modulated signal. The other points wherein the receiver does not meet the requirements of the specifications of reference (c) are of a minor nature and will not detract seriously from its suitability for the use for which it is intended.

47. The transmitter in its present condition is not satisfactory. There are several mechanical features which should be modified. Electrically, it will not tune into the smaller antennae now standard on some types of planes and the tuning range is not complete from 3000 to 7000 kilocycles.

48. Power input necessary to operate the transmitter at full rating is not available in Navy planes.

49. In cases where the equipment does not meet the requirements of the specifications, the difference between the specified performance and actual performance is not of great magnitude, being in most cases only slightly outside the probable error of measurement.

[redacted]

TABLE 1

MODEL XGQ EQUIPMENT
WEIGHTS AND DIMENSIONS

WEIGHTS

Unit	Actual Lbs.	Actual Ozs.	Specified Lbs.	Specified Ozs.
Transmitter	41	0	33	0
Transmitter Control Box	1	0	2	4
Transmitter Dynamotor	24	7	22	0
Receiver	24	0	23	0
Receiver Control Box	2	4	3	0
Receiver Dynamotor	9	12	9	8
Homing Loop	4	0	4	0
Mechanical Linkage	6	0	- -	- -
Set of Cables	29	8	8	0

DIMENSIONS

Unit	Actual Height	Actual Width	Actual Length	Specified Height	Specified Width	Specified Length
Transmitter	10-1/4"	11-3/4"	19-1/8"	10-1/2"	10"	14"
Transmitter Control Box	3-7/8"	2-7/8"	5-1/16"	4"	2"	5"
Transmitter Dynamotor	9-1/4"	6-1/8"	9-3/4"	7"	8"	10"
Receiver	7-5/8"	9-1/4"	14-3/4"	9"	10"	15-1/2'
Receiver Control Box	4-5/8"	3-5/16"	6-1/4"	4"	3"	5"
Receiver Dynamotor	7-1/2"	4-3/8"	7-3/8"	7-5/8"	4-1/2"	6-1/2'
Homing Loop	17-1/4"	4-5/8"	O.D.12-3/8"	- -	4-1/2"	O.D. 12-1/2'
Homing Loop			I.D.11"			I.D.11'

TABLE 2

MODEL XGQ TRANSMITTER
POWER OUTPUT
Ep Adjusted for 460 Volts

Freq. Kcs.	Ant. Resistance (Ohms)	Equiv. Reactance (Ohms)	Output Watts	Specification Requirements
3000	1.1	586 Cap.	7.4	
3000	1.1	525 "	7.4	
3000	1.1	282 "	15.1	16 Watts
3000	1.1	181 "	18.0	
3000	11.7	256 "	42.2	
3105	1.1	656 "	6.3	
3105	1.1	290 "	15.9	16 Watts
3105	1.1	187 "	19.4	
3750	1.1	714 "	5.8	
3750	1.1	260 "	.16.7	16 Watts
3750	1.1	145 "	20.3	

[redacted]

TABLE 3

MODEL XGQ TRANSMITTER
POWER OUTPUT

Ep Adjusted for 460 Volts

Freq. Kcs.	Ant. Resistance (Ohms)	Equiv. Reactance (Ohms)	Output Watts	Specification Requirements
4220	1.1	95 Cap.	22.3	
4220	1.1	171 "	16.7	
4220	1.1	468 "	6.3	
4220	2.2	380 "	14.2	
4220	2.2	630 "	8.8	17 Watts
4220	2.2	252 "	18.5	
4220	2.2	0	30.1	
4220	2.2	30 "	31.8	
4220	11.7	204 "	37.9	
5200	1.1	380 "	7.7	
5200	2.2	24 "	28.5	
5200	2.2	0	30.1	
5200	2.2	510 "	9.3	19 Watts
5200	2.2	303 "	16.0	
5200	11.7	166 "	37.9	
5200	11.7	33 IND.	46.8	
5200	11.7	196 "	42.0	
5200	11.7	1040 "	9.5	

TABLE 4

MODEL XGQ TRANSMITTER
POWER OUTPUT
Ep Adjusted for 460 Volts

Freq. Kcs.	Ant. Resistance (Ohms)	Equiv. Reactance (Ohms)	Output Watts	Specification Requirements
6210	1.1	316 Cap.	7.7	
6210	2.2	426 "	9.7	
6210	2.2	256 "	16.7	
6210	2.2	171 "	23.3	
6210	2.2	20 "	21.1	22 Watts
6210	2.2	0	21.1	
6210	11.7	138 "	37.9	
6210	11.7	144 IND.	33.8	
6210	11.7	1280 "	2.4	
6210	4.1	156 "	30.0	
7000	2.2	380 Cap.	8.8	
7000	2.2	227 "	13.8	
7000	2.2	151 "	21.1	
7000	2.2	18 "	18.7	
7000	2.2	0	19.8	30 Watts
7000	11.7	44 IND.	22.9	
7000	11.7	352 "	22.9	
7000	11.7	440 "	19.8	
7000	11.7	528 "	16.8	

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TABLE 5
MODEL XGQ TRANSMITTER
HUMIDITY TEST

Freq. Kcs.	Power Output in Watts			
	Before Test	After Test	Two Days After Test	Five Days After Test
3000	12.2	8.0	Failed	10.3
4220	13.5	9.7	Failed	11.2
5200	13.2	9.7	11.6	12.0
7000	12.9	8.4	9.7	10.5

NOTE: Transmitter was saturated with 100% humidity at 50° C. for 18 hours.

TABLE 6
TEMPERATURE TEST

Base Freq. Kcs.	Measured Frequency in Kcs. at				
	-17° C.	0° C.	+21° C.	+40° C.	+ 50° C.
3000	2998.62	2998.57	2998.57	2998.32	2998.27
4220	4220.35	4220.35	4220.25	4220.15	4220.10
5200	5200.35	5200.3	5200.3	5200.3	5200.25
7000	7000.22	7000.17	7000.32	7000.37	7000.22

TABLE 7
MODEL XGQ TRANSMITTER
MODULATION CHARACTERISTICS
100% MODULATION

Audio Frequency	Input Volts	Sidetone Output MW.
150	.48	140
250	.50	200
500	.50	350
750	.48	450
1000	.50	500
1500	.50	575
2000	.50	600
2500	.48	600
3000	.52	650
3500	.54	680
5000	.64	800
10,000	.58	800

Carrier shift negligible. Audio distortion between 5 and 6%.
Carrier noise 30 to 38 db., below 100% modulated carrier depending upon whether NEA-1 generator was operating.

[redacted]

TABLE 8

MODEL XGQ RECEIVER
DRAIN ON POWER SOURCE

Power Source Varied 15% Above and Below 14 Volts

Power Supply	Current Drain
11.9 volts	3.8 Amps
14.0 "	4.3 "
16.1 "	4.8 "

Specification Requirements - 6 Amps or less.

TABLE 9

MODEL XGQ RECEIVER
FREQUENCY RANGE AND OVERLAP

Band	Frequency in Kcs. Min.	Max.	Overlap Kcs.	Average Kcs.	Percent Overlap
I	147.5	316.25	2.5	150.0	1.66
II	309.85	684.8	6.4	313.0	2.05
III	680.2	1518.2	4.6	682.5	.66
			18.2	1,500.0	1.21
IV	1790.25	3748.2	9.75	1800.0	.5
V	3657.0	7574.0	91.2	3702.6	2.46
VI	7380.0	15168.0	194.0	7477.0	2.6
			168.0	15000.0	1.12

TABLE 10

MODEL XGQ RECEIVER
CALIBRATION ACCURACY

Freq. Kcs.	Freq. Setting By Chart Kcs	Kcs. Off	Percent Off
200	200.095	.095	.04
300	301.05	1.05	.34
400	401.19	1.19	.29
600	600	0	0
800	800.88	.88	.11
1400	1401.67	1.67	.12
2000	2000	0	0
3500	3503.12	3.12	.09
4200	4207.6	7.6	.18
7000	7004.06	4.06	.06
8500	8502.2	2.2	.025
14,500	14,502.85	2.85	.02

Specification Requirements - .25% at 23° C.

[redacted]

TABLE 11
MODEL XGQ RECEIVER
SENSITIVITY

Modulated 30% at 1000 Cycles
Output - 50 Milliwatts

Band I

Rec. Dial Setting	Frequency Kcs.	Noise Milliwatts	Input Microvolts
00	147.5	12.5	3.0
500	158.5	12.5	3.0
1000	173.5	12.5	3.7
1500	188.0	12.5	3.5
2000	205.0	12.5	3.3
2500	223.5	12.5	3.3
3000	242.5	12.5	3.2
3500	264.0	12.5	3.0
4000	286.5	12.5	3.0
4500	312.0	12.5	3.0
5000	320.5	12.5	3.0

Specification Requirement - 5 Microvolts.

TABLE 12
MODEL XGQ RECEIVER
SENSITIVITY

Modulated 30% at 1000 Cycles
Output - 50 Milliwatts

BAND II

Rec. Dial Setting	Frequency Kcs.	Noise Milliwatts	Input Microvolts
00	313.5	12.5	2.35
500	335.5	12.5	2.55
1000	363.0	12.5	2.65
1500	395.0	12.5	2.45
2000	430.0	12.5	2.3
2500	470.0	12.5	2.6
3000	515.0	12.5	2.5
3500	560.0	12.5	2.5
4000	612.0	12.5	2.4
4500	667.0	12.5	2.4
5000	685.0	12.5	2.6

Specification Requirement - 5 Microvolts

TABLE 13
MODEL XGQ RECEIVER
SENSITIVITY

Modulated 30% at 1000 Cycles
Output - 50 Milliwatts

Band III

Rec. Dial Setting	Frequency Kcs.	Noise Milliwatts	Input Microvolts
00	672	12.5	1.75
500	718	12.5	1.9
1000	778	12.5	2.55
1500	850	12.5	2.0
2000	930	12.5	2.3
2500	1025	12.5	2.1
3000	1125	12.5	2.2
3500	1230	12.5	2.35
4000	1345	12.5	2.35
4500	1478	12.5	2.65
5000	1520	12.5	2.65

Specification Requirement- 5 Microvolts

TABLE 14
MODEL XGQ RECEIVER
SENSITIVITY

Modulated 30% at 1000 Cycles
Output - 50 Milliwatts

Band IV

Rec. Dial Setting	Frequency Kcs.	Noise Milliwatts	Input Microvolts
00	1790	12.5	1.15
500	1905	12.5	1.15
1000	2055	12.5	1.2
1500	2230	12.5	1.2
2000	2430	12.5	1.25
2500	2650	12.5	1.15
3000	2865	12.5	.9
3500	3100	12.5	.825
4000	3360	12.5	.8
4500	3640	12.5	.7
5000	3725	12.5	.8

Specification Requirement - 5 Microvolts

[redacted]

TABLE 15
MODEL XGQ RECEIVER
SENSITIVITY

Modulated 30% at 1000 Cycles
Output - 50 Milliwatts

Band V

Rec. Dial Setting	Frequency Kcs.	Noise Milliwatts	Input Micro-volts
00	3600	5.0	2.4
500	3860	5.0	2.4
1000	4175	4.5	2.4
1500	4515	4.0	2.35
2000	4950	4.0	2.2
2500	5375	4.0	2.0
3000	5820	3.5	2.0
3500	6280	4.0	2.0
4000	6765	4.0	1.9
4500	7325	4.0	1.3
5000	7525	4.0	1.2

Specification Requirement -
5 Microvolts

TABLE 16
MODEL XGQ RECEIVER
SENSITIVITY

Modulated 30% at 1000 Cycles
Output - 50 Milliwatts

Band VI

Rec. Dial Setting	Frequency Kcs.	Noise Milliwatts	Input Micro-volts
00	7400	2.0	3.5
500	7900	2.5	4.0
1000	8525	2.5	3.95
1500	9250	2.0	3.8
2000	10,050	2.0	3.55
2500	10,920	2.0	4.9
3000	11,800	1.0	4.4
3500	12,700	0	3.95
4000	13,675	0	3.4
4500	14,700	0	2.8
5000	15,025	0	3.1

Specification Requirement -
5 Microvolts

TABLE 17
MODEL XGQ RECEIVER
LOOP SENSITIVITY

Modulated 30% at 1000 Cycles
Output - 50 Milliwatts

Band I

Rec. Dial Setting	Frequency Kcs.	Input Microvolts Large Cable	Small Cable
00	143	.35	.3
500	153.5	.3	.25
1000	166.5	.25	.2
1500	182.0	.25	.25
2000	199.0	.2	.2
2500	218.0	.2	.2
3000	238.0	.2	.25
3500	258.5	.2	.25
4000	281.5	.2	.25
4500	307.0	.2	.25
5000	316.0	.2	.25

Specification Requirement -
5 Microvolts

TABLE 18
MODEL XGQ RECEIVER
LOOP SENSITIVITY

Modulated 30% at 1000 Cycles
Output - 50 Milliwatts

Band II

Rec. Dial Setting	Frequency Kcs.	Input Microvolts Large Cable	Small Cable
00	311	.22	.25
500	334	.22	.25
1000	361.5	.22	.27
1500	380.0	.27	.27
2000	415.0	.27	.3
2500	455.0	.27	.3
3000	500.0	.27	.3
3500	545.0	.27	.3
4000	597.0	.27	.32
4500	655.0,	.3	.35
5000	670.0	.35	.5

Specification Requirement -
5 Microvolts

[redacted]

TABLE 19
MODEL XGQ RECEIVER
LOOP SENSITIVITY

Modulated 30% at 1000 Cycles   Output - 50 Milliwatts

Band III

Receiver Dial Setting	Frequency Kcs.	Input Microvolts Large Cable	Input Microvolts Small Cable
00	660	.75	.75
500	708	.75	.75
1000	772	.75	.75
1500	845	.8	.88
2000	925	.8	.88
2500	1015	.8	.95
3000	1070	.95	1.0
3500	1180	.95	1.01
4000	1295	1.05	1.1
4500	1425	1.2	1.23
5000	1515	1.4	1.6

Specification Requirement - 5 Microvolts

TABLE 20
MODEL XGQ RECEIVER
SELECTIVITY

Modulated 30% at 1000 Cycles   Output - 50 Milliwatts

Band I

Frequency Kcs	Attenuation DB	Band Width Kcs	Specification Requirements Kcs
157	6	3.94	2
	20	6.86	4
	40	11.3	11
	60	16.77	18
221	6	4.34	2
	20	7.7	4
	40	12.77	11
	60	18.35	18
310	6	5.15	2
	20	9.48	4
	40	14.83	11
	60	21.0	18

[redacted]

TABLE 21
MODEL XGQ RECEIVER
SELECTIVITY

Modulated 30% at 1000 Cycles — Output - 50 Milliwatts

Band II

Frequency Kcs.	Attenuation DB	Band Width Kcs.	Specification Requirements Kcs.
336	6	3.87	2
	20	7.86	4
	40	13.36	11
	60	19.4	18
470	6	5.05	3.5
	20	9.44	8.0
	40	15.16	14.0
	60	21.55	24.0
668	6	6.5	3.5
	20	12.67	8.0
	40	19.17	14.0
	60	26.63	24.0

TABLE 22
MODEL XGQ RECEIVER
SELECTIVITY

Modulated 30% at 1000 Cycles — Output - 50 Milliwatts

Band III

Frequency Kcs.	Attenuation DB	Band Width Kcs.	Specification Requirements Kcs.
720	6	6.2	3.5
	20	12.4	8.0
	40	20.7	14.0
	60	28.5	24.0
932	6	6.11	3.5
	20	12.55	8.0
	40	20.9	14.0
	60	29.6	24.0
1475	6	7.2	5.5
	20	14.4	11.0
	40	22.5	20.0
	60	31.5	30.0

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TABLE 23
MODEL XGQ RECEIVER
SELECTIVITY

Modulated 30% at 1000 Cycles

Output - 50 Milliwatts

Band IV

Frequency Kcs.	Attenuation DB	Band Width Kcs.	Specification Requirements Kcs
1910	6	8.4	5.5
	20	15.12	14.0
	40	23.5	28.0
	60	34.5	42.0
2440	6	7.04	5.5
	20	15.8	14.0
	40	24.65	28.0
	60	37.0	42.0
3635	6	7.08	5.5
	20	11.8	14.0
	40	21.25	28.0
	60	33.0	42.0

TABLE 24
MODEL XGQ RECEIVER
SELECTIVITY

Modulated 30% at 1000 Cycles

Output - 50 Milliwatts

Band V

Frequency Kcs.	Attenuation DB	Band Width Kcs.	Specification Requirements Kcs.
3900	6	7.05	5.5
	20	14.1	14.0
	40	22.32	28.0
	60	32.9	42.0
5400	6	4.4	5.5
	20	12.1	14.0
	40	19.8	28.0
	60	29.7	42.0
7325	6	3.4	5.5
	20	10.21	14.0
	40	17.02	28.0
	60	27.24	42.0

[redacted]

TABLE 25
MODEL XGQ RECEIVER
SELECTIVITY

Modulation 30% at 1000 Cycles

Output - 50 Milliwatts

Band VI

Frequency Kcs	Attenuation DB	Band Width Kcs	Specification Requirements Kcs.
7900	6	6.45	5.5
	20	12.9	14.0
	40	25.8	28.0
	60	38.7	42.0
10,925	6	6.65	5.5
	20	13.3	14.0
	40	21.6	28.0
	60	34.9	42.0
14,700	6	5.68	5.5
	20	9.94	14.0
	40	17.05	28.0
	60	24.15	42.0

TABLE 26
MODEL XGQ RECEIVER
AUDIO FIDELITY

Output Adjusted for 100 Milliwatts - Modulated 30% at 400 Cycles.

Output Level in D.B.

Freq. Kcs.	100~	200~	300~	400~	500~	1000~	2000~	2500~	3000~
159	-5.2	-2.2	- .9	0	+ .4	- .9	- .6	-8.2	-8.2
310	-4.9	-2.6	- .9	0	+ .7	+1.4	-2.2	-4.5	-6.9
335	-4.5	-2.2	- .9	0	+ .4	0	-5.2	-6.9	-7.4
668	-4.9	-2.6	-1.2	0	+ .6	+1.4	- .4	-2.6	-4.5
717	-4.1	-2.2	-1.2	0	+ .4	+1.4	-1.2	-3.7	-5.2
1480	-4.9	-2.6	- .9	0	+ .7	+1.7	+ .7	- .9	-3.0
1905	-4.9	-2.6	-1.2	0	+ .7	+1.7	0	-2.2	-4.5
3640	-5.2	-2.6	-1.2	0	+ .7	+1.7	- .9	-3.0	-4.9
3885	-5.5	-3.0	-1.2	0	+ .7	+2.0	- .4	-3.4	-5.8
7340	-5.5	-2.6	- .9	0	+ .7	+1.7	-1.5	-3.9	-5.8
7900	-6.0	-3.0	-1.2	0	+ .7	+1.1	-3.9	-6.5	-9.2
14,725	-5.8	-2.6	- .9	0	+ .7	+1.4	- .7	-3.4	-6.0

Specification Requirements - 200 to 2500 Cycles ± 5 DB

Output Adjusted for 100 Milliwatts - Modulated 30% at 1000 Cycles.

Freq. Kcs.	Output Milliwatts 1000~	2500~	Power Ratio	D.B.
159	100	15	6.66	-8.2
310	100	25	4.0	-6.0
470	100	22	4.55	-6.5

Specification Requirements - 20 DB Down at 2500 Cycles with Reference to 1000 Cycles.

TABLE 27
MODEL XGQ RECEIVER
IMAGE RESPONSE

Freq. Kcs.	Base Freq. Input MCV	Base Freq. Output MW	Image Input MCV	Image Output MW	Image Freq. Kcs.	Image Ratio	Specification Requirements Ratio
221	5	100	500,000	2	3350	100,000+	50,000
925	5	100	500,000	10	4050	100,000+	50,000
1425	5	100	300,000	100	4600	60,000	50,000
3500	5	100	70,000	100	6750	14,000	4,000
7215	5	100	38,000	100	10,300	7,600	3,000
14,500	5	100	4,800	100	17,750	960	2,000

TABLE 28
MODEL XGQ RECEIVER
VARIABLE TEMPERATURE

<u>Band I</u> <u>200 Kcs</u>

DECREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	+19	200.000
5	+12	199.804
15	+8	199.724
25	+4	199.804
35	-1	199.887
45	-5	199.970
55	-8	200.012
65	-10	200.054
75	-12	200.095
100	-16	200.137
135	-21	200.179
150	-22	200.200
180	-23.75	200.220
240	-26.5	200.262
330	-27.5	200.345

Greatest Change Over 20°
+8° to -12° .371 Kcs = .185%
Specification Allowance .5%

INCREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	-27.5	200.345
15	-24	200.345
30	-20	200.304
45	-17	200.262
75	-12	200,220
105	-4	200.054
120	+10	200.012
135	+15	200.0

Greatest Change Over 20°,
-24° to -4° .291 Kcs = .145%
Specification Allowance - .5%

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[redacted]

TABLE 29
MODEL XGQ RECEIVER
VARIABLE TEMPERATURE

Band I 200 Kcs

INCREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	+17	199.928
15	+25	199.888
30	+30	199.868
45	+38	199.848
60	+44	199.828
75	+48.5	199.808
90	+50	199.808

Greatest Change Over 20°
+17 to +37° .08 Kcs. = .04%
Specification Allowance .5%

DECREASING TEMPERATURE

Time Min .	Temp. °C.	Freq. Kcs.
0	+50	199.808
15	+41	199.828
30	+37	199.848
45	+32	199.868
60	+28	199.888
75	+24	199.928
90	+20	199.972
105	+15	200.000

Greatest Change Over 20°
+50° to +30° .291 Kcs = .096%
Specification Allowance .5%

TABLE 30
MODEL XGQ RECEIVER
VARIABLE TEMPERATURE

Band II 450 Kcs.

DECREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	+20	450.000
15	+12	450.100
30	+ 4	450.150
45	- 3	450.250
60	-7	450.300
75	-11	450.400
90	-14	450.500
105	-16.5	450.600
120	-18	450.670
135	-19.5	450.740
150	-21	450.790
165	-22	450.890
180	-23	450.990
195	-24	450.990
210	-25	450.990

Greatest Change Over 20°
-3° to -23° .74 Kcs = .165%
Specification Allowance .5%

INCREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	-25	450.990
15	-18.5	450.990
30	-16	450.940
45	-12	450.890
60	-8	450.790
75	-3	450.690
90	+6	450.500
105	+12	450.400
120	+18	450.300
135	+23	450.100

Greatest Change Over 20°
+3° to +23° .500 Kcs = .111%
Specification Allowance .5%

[redacted]

TABLE 31
MODEL XGQ RECEIVER
VARIABLE TEMPERATURE

Band II   450 Kcs

INCREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	+15	450.000
15	+21	449.950
30	+28	449.900
45	+33	449.850
60	+38	449.800
75	+46	449.700
90	+50	449.600

Greatest Change Over 20°
+30° to +50° .32 Kcs. = .071%
Specification Allowance .5%

DECREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	+50	449.600
15	+40	449.650
30	+30	449.750
45	+23	449.850
60	+15	449.900
75	+11	450.000

Greatest Change Over 20°
+31° to +11° .24 Kcs = .053%
Specification Allowance .5%

TABLE 32
MODEL XGQ RECEIVER
VARIABLE TEMPERATURE

Band III 1000 Kcs

DECREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	+19	1000.000
15	+10	1000.100
30	+ 2	1000.200
45	- 4	1000.540
60	- 9	1000.900
75	-12	1001.120
90	-15	1001.380
105	-16.5	1001.520
120	-18	1001.680
135	-19.5	1001.980
150	-20.5	1002.180
165	-21.5	1002.280
180	-22.5	1002.380
195	-23	1002.480
210	-24	1002.480

Greatest Change Over 20°
-4° to -24° 1.9 Kcs = .194%
Specification Allowance .5%

INCREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	-24	1002.480
15	-18	1002.480
30	-16	1002.380
45	-14	1002.180
60	-12	1001.980
75	- 7	1001.780
90	- 2	1001.480
105	+ 3	1001.180
120	+10	1000.900
135	+17	1000.400
150	+23	1000.000

Greatest Change Over 20°
-17° to +3° 1.25 Kcs. = .125%
Specification Allowance .5%

[redacted]

TABLE 33
MODEL XGQ RECEIVER
VARIABLE TEMPERATURE

Band III 1000 Kcs

INCREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	+26	1000.000
15	+40	999.800
30	+47.5	999.400
45	+48.5	999.350
60	+49	999.300

Greatest Change Over 20°
+29° to +49° .658 Kcs. = .065%
Specification Allowance .5%

DECREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	+49	999.300
15	+45	999.300
30	+41	999.400
45	+36	999.500
60	+26.5	999.700
75	+22	1000.000
90	+21	1000.100

Greatest Change Over 20°
+41° to +21° .7 Kcs = .07%
Specification Allowance .5%

TABLE 34
MODEL XGQ RECEIVER
VARIABLE TEMPERATURE

Band IV 2500 Kcs.

DECREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	+7	2500.000
15	0	2499.900
30	-6	2499.750
45	-9	2500.150
60	- 12	2500.550
75	-15	2501.050
90	-17.5	2501.550
135	-20	2503.050
215	-22.5	2503.850
335	-24	2504.000

Greatest Change Over 20°
-4° to -24° 4.2 Kcs = .167%
Specification Allowance .25%

INCREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	-24	2504.000
15	-20	2503.850
30	-16	2503.800
45	- 6	2503.050
60	+ 3	2502.300
75	+12	2500.250
90	+20	2498.500
105	+24	2497.750

Greatest Change Over 20°
+4° to +24° 4.55 Kcs = .182%
Specification Allowance .25%

[redacted]

TABLE 35
MODEL XGQ RECEIVER
VARIABLE TEMPERATURE

Band IV 2500 Kcs

INCREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	+19	2500.000
15	+33	2499.300
30	+42	2498.750
45	+47	2497.950
60	+48.5	2497.700
75	+49	2497.400
90	+50	2497.400

Greatest Change Over 20°
+30° to +50° 2.0 Kcs. = .08%
Specification Allowance .25%

DECREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	+50	2497.400
15	+37.5	2497.450
30	+21.5	2497.850
45	+14	2498.450
60	+ 5	2499.250

Greatest Change Over 20°
+25° to +5° 1.5 Kcs = .06%
Specification Allowance .25%

TABLE 36
MODEL XGQ RECEIVER
VARIABLE TEMPERATURE

Band V 5500 Kcs

DECREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	+24	5500.000
15	+13	5500.300
30	+ 5	5501.000
45	0	5502.300
60	- 5	5503.800
75	-10	5505.300
90	-12	5505.800
105	-14	5506.600
120	-16	5507.700
135	-17	5508.200
150	-18.5	5508.700
210	-20	5509.300
240	-22	5510.100
285	-24	5511.000

Greatest Change Over 20°
-4° to -24° 7.5 Kcs = .136%
Specification Allowance .25%

INCREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	-24	5511.000
15	-19	5510.800
30	-12	5510.600
45	- 7	5509.300
60	0	5508.100
75	+ 7	5506.000
90	+14	5504.200
105	+21.5	5502.400
120	+25	5501.200
135	+27	5500.100

Greatest Change Over 20°
+7° to +27° 5.9 Kcs = .107%
Specification Allowance .25%

[redacted]

TABLE 37
MODEL XGQ RECEIVER
VARIABLE TEMPERATURE

Band V 5500 Kcs.

INCREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	+25	5500.000
15	+31	5499.700
30	+38	5499.100
45	+43	5498.900
60	+48	5498.400
75	+49	5498.400

Greatest Change Over 20°
+29° to +49° 1.4 Kcs = .026%
Specification Allowance .25%

DECREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	+49	5498.400
15	+45	5498.900
30	+38	5499.300
45	+33	5499.700
60	+28	5499.900
75	+20	5500.100

Greatest Change Over 20°
+49° to +29° 1.5 Kcs = .027%
Specification Allowance .25%

TABLE 38
MODEL XGQ RECEIVER
VARIABLE TEMPERATURE

Band VI 11,000 Kcs.

DECREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	+20	11,000.000
15	+14	11,000.400
30	+8	11,001.800
45	+4	11,002.600
60	0	11,004.000
75	-4	11,005.400
90	-6	11,007.400
105	-8	11,008.000
120	-10	11,009.200
135	-12	11,010.200
165	-15	11,012.000
180	-16.5	11,012.600
210	-19	11,013.400
240	-21.5	11,013.600
285	-24	11,013.600

Greatest Change Over 20°
+4° to -16° 10.0 Kcs = .09%
Specification Allowance .25%

INCREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	-24	11,013.600
15	-19	11,013.400
30	-15	11,012.000
45	-7.5	11,011.000
60	0	11,009.200
75	+6	11,008.000
90	+12	11,006.400
105	+18	11,003.600
120	+24	11,001.000

Greatest Change Over 20°
+4° to +24° 7.8 Kcs = .09%
Specification Allowance .25%

[redacted]

TABLE 39
MODEL XGQ RECEIVER
VARIABLE TEMPERATURE

Band VI 11,000 Kcs

INCREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	+19	11,000.000
15	+30	10,998.800
30	+38	10,996.600
45	+45	10,993.800
60	+48.5	10,990.000
105	+49	10,988.600

Greatest Change Over 20°
+29° to +49° 10.3 Kcs. = .093%
Specification Allowance = .25%

DECREASING TEMPERATURE

Time Min.	Temp. °C.	Freq. Kcs.
0	+49	10,988.600
15	+41	10,989.600
30	+33	10,991.400
45	+26	10,993.200
60	+22	10,994.800
75	+18	10,996.800
105	+17.5	10,998.600

Greatest Change Over 20°
+37.5° to 17.5° 8.6 Kcs = .078%
Specification Allowance .25%

TABLE 40
MODEL XGQ RECEIVER
VARIABLE HUMIDITY

Band I

Time Min.	Temperature °C.	Percent Humidity	Frequency Kcs.
0	22	63	224.6
10	24	69	224.5
20	30	83	224.45
30	35	85	224.4
40	39	86.5	224.3
50	43	88	224.25
60	48	90	224.15
70	50	90	224.05
80	55	90	224.0
90	53	91	223.9
100	51	94	223.85
110	51	95	223.75
120	52	93	223.8

Room Temperature Constant at 22°C.
Maximum Frequency Change .85 Kcs.
Percent Change .378 Allowed .5 Percent

[redacted]

TABLE 41
MODEL XGQ RECEIVER
VARIABLE HUMIDITY

Band II

Time Min.	Temperature °C.	Percent Humidity	Frequency Kcs.
0	23	62	450.0
10	30	69	449.9
20	36	81	449.8
30	39	83	449.6
40	43	85	449.4
50	47	87	449.2
60	51	89	449.0
70	52	90	448.6
80	50	93	448.5
90	51	92	448.4
100	51	94	448.4
110	50	95	448.5
120	50	96	448.6

Room Temperature Constant at 23°C.
Maximum Frequency Change 1.6 Kcs
Percent Change .355 Allowed .5 Percent

TABLE 42
MODEL XGQ RECEIVER
VARIABLE HUMIDITY

Band III

Time Min.	Temperature °C.	Percent Humidity	Frequency Kcs.
0	26	59	1000
10	33	64	999.8
20	38	82	999.4
30	41	86	999.2
40	46	92	998.8
50	50	93	998.0
60	51	94	997.4
70	51	94	997.2
80	51	94	996.8
90	51	94	997.2
100	51	95	997.4
110	51	96	997.6
120	51	94	997.6

Room Temperature Constant at 26°C.
Maximum Frequency Change 3.2 Kcs.
Percent Change .32 Allowed .5 Percent

[redacted]

TABLE 47
MODEL XGQ RECEIVER
AUDIO DISTORTION

Adjusted for 500 MW Output   Modulated 30% at 400 Cycles

Harmonics	Output Millivolts	Pct. of Fund	X^2	RMS
223 Kcs.				
Fund	20,500			
2	1800	8.8	77.4	
3	600	2.93	8.59	
4	140	.683	.466	
5	30	.146	.021	
			86.477	9.3
470 Kcs.				
Fund	20,500			
2	1760	8.6	74.0	
3	700	3.4	11.56	
4	165	.805	.648	
5	40	.195	.038	
			86.246	9.3
1130 Kcs.				
Fund	20,500			
2	1700	8.3	68.9	
3	675	2.73	7.45	
4	135	.66	.435	
5	50	.244	.0595	
			76.8445	8.77

[redacted]

TABLE 48
MODEL XGQ RECEIVER
AUDIO DISTORTION

Adjusted for 500 MW Output — Modulated 30% at 400 Cycles

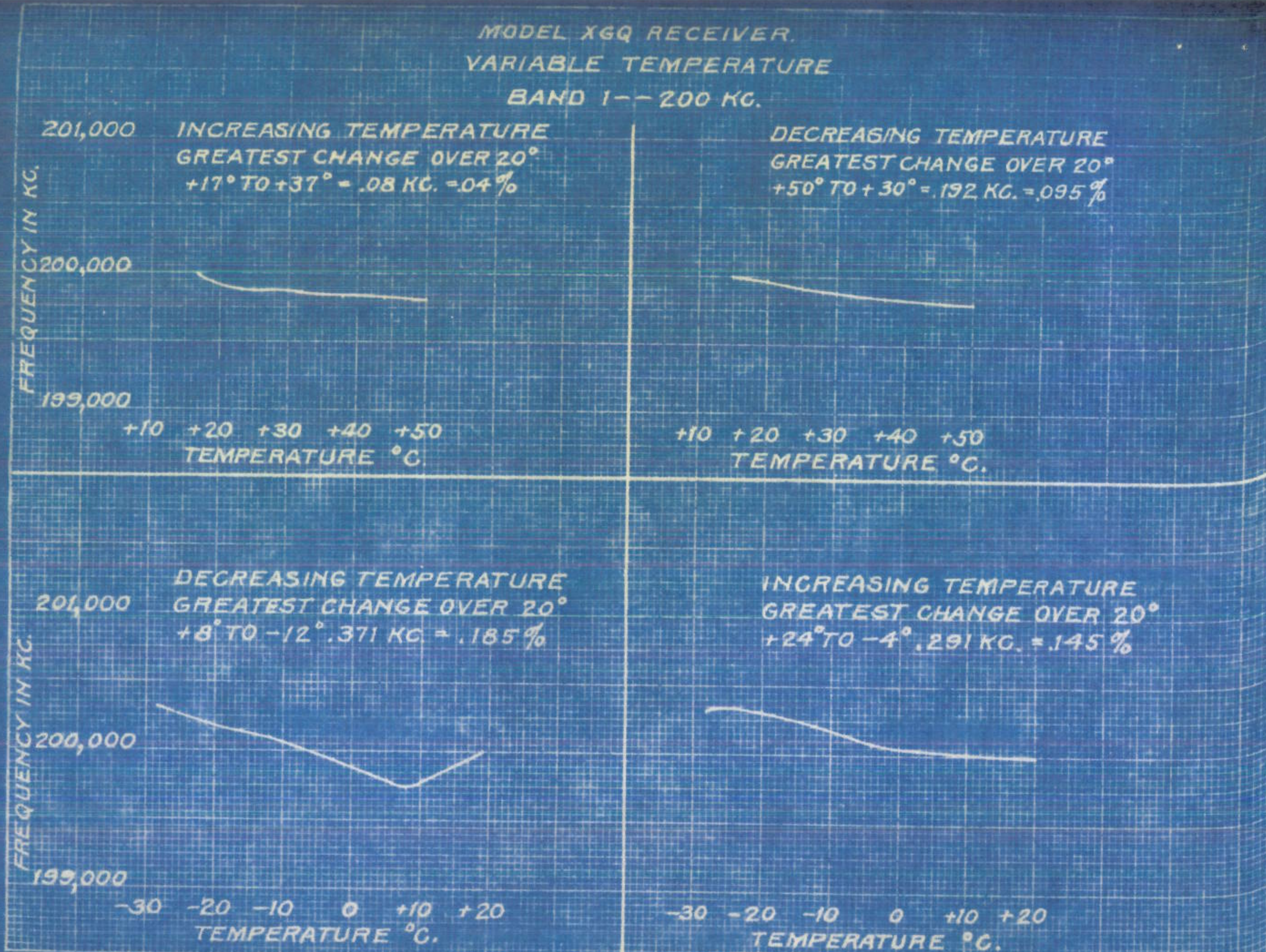
Harmonics	Output Millivolts	Pct. of Fund	X^2	RMS
2430 Kcs.				
Fund	20,500			
2	1600	7.8	60.85	
3	650	3.17	10.05	
4	130	.634	.402	
5	25	.122	.015	
			71.317	8.45
5380 Kcs.				
Fund	20,500			
2	1600	7.8	60.85	
3	700	3.42	11.7	
4	160	.78	.608	
5	40	.195	.038	
			73.196	8.55
10,920 Kcs.				
Fund	20,000			
2	1360	6.8	46.25	
3	680	3.4	11.56	
4	120	.6	.36	
5	35	.175	.03	
			58.20	7.63

TABLE 49
MODEL XGQ RECEIVER
RESET

Original Freq. Kcs.	Reset Freq. Diff.	Pct. Off Original Freq.
221	0	0
455	0	0
925	.32	.034
2390	.89	.037
5260	2.2	.04
10,575	3.32	.031

Specification Requirements – .1%

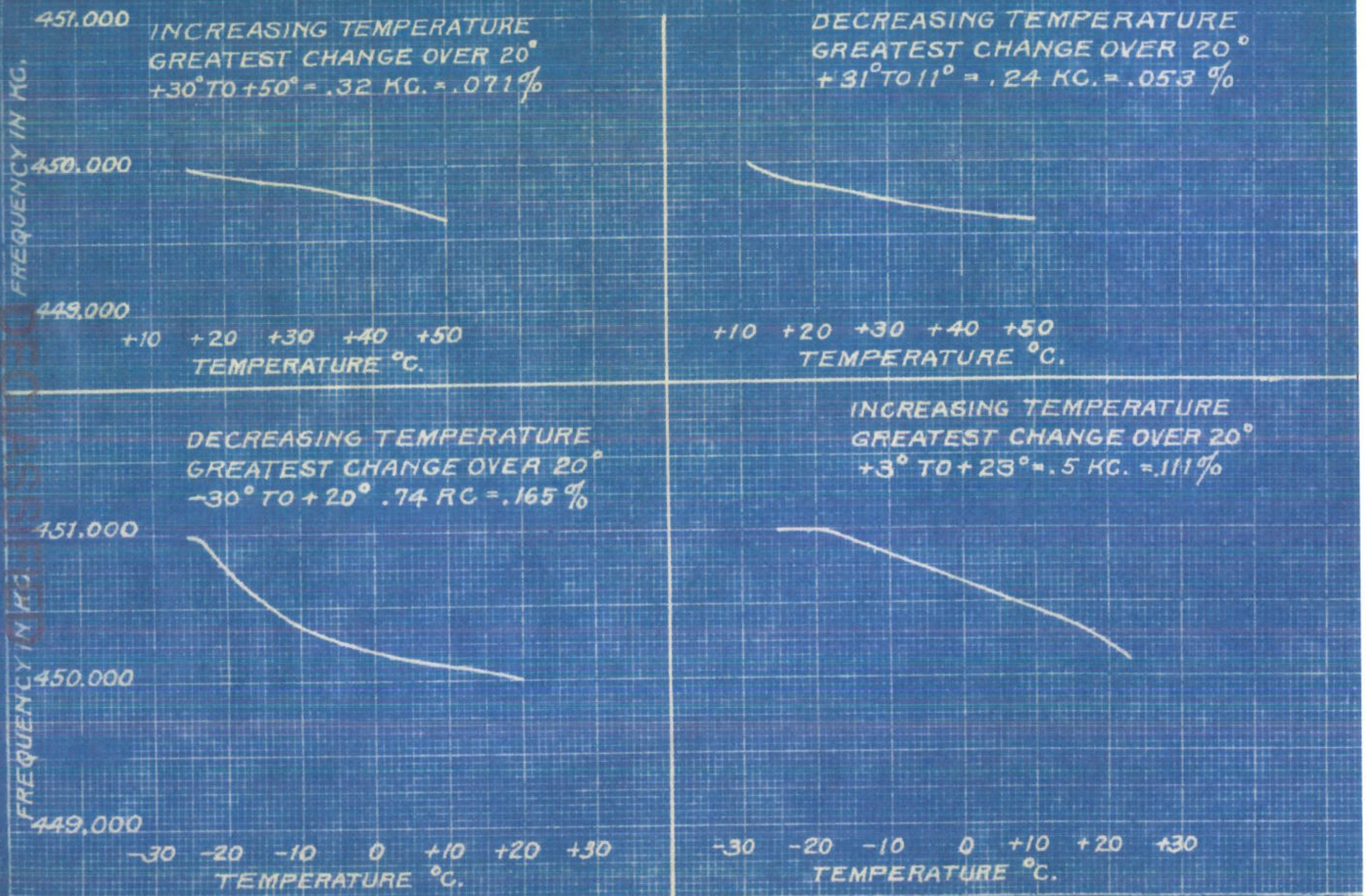
[redacted]



SHEET

PLATE 1

MODEL XGQ RECEIVER
VARIABLE TEMPERATURE
BAND 2--450 KC.



SHEET

PLATE 2

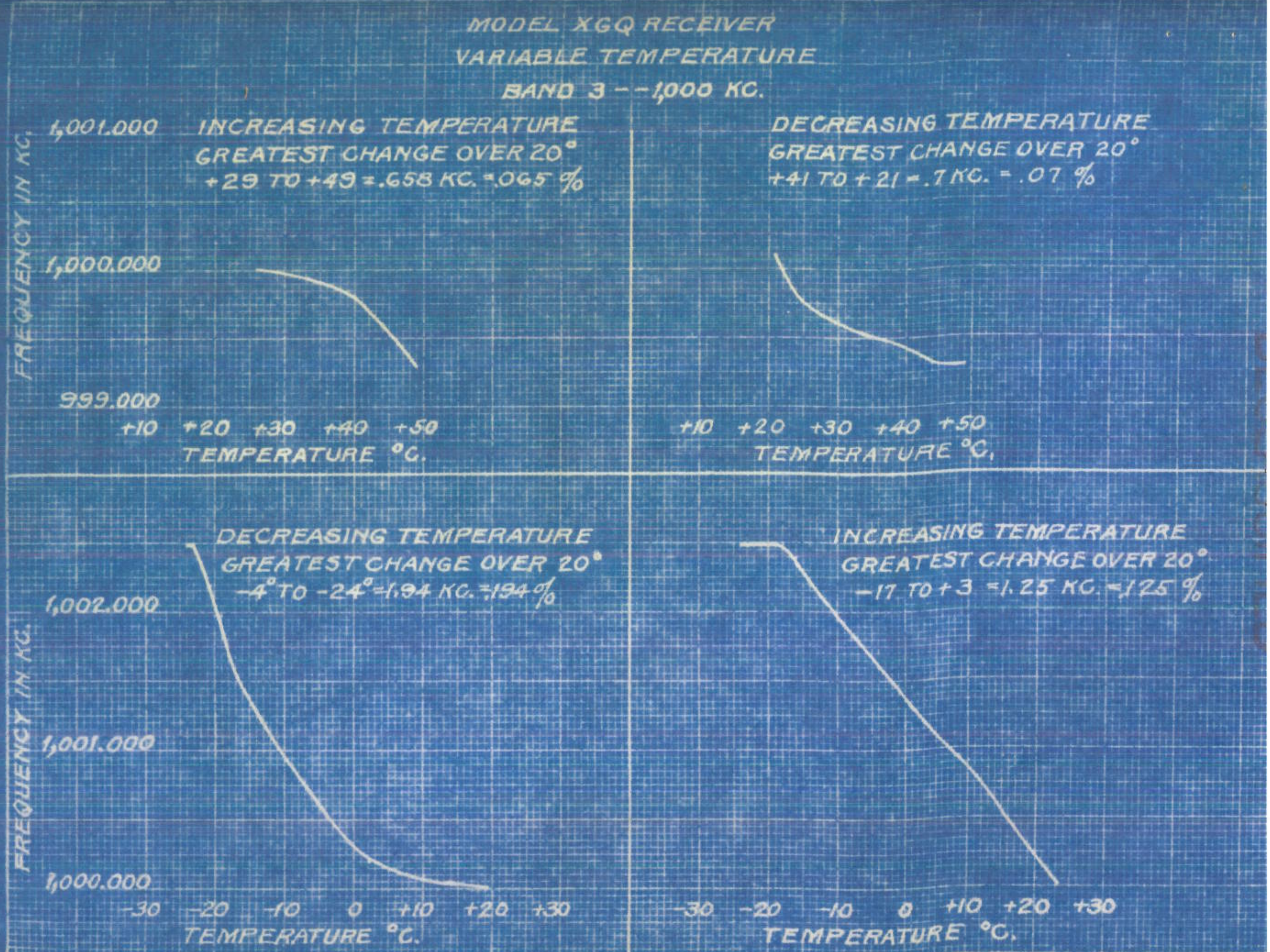
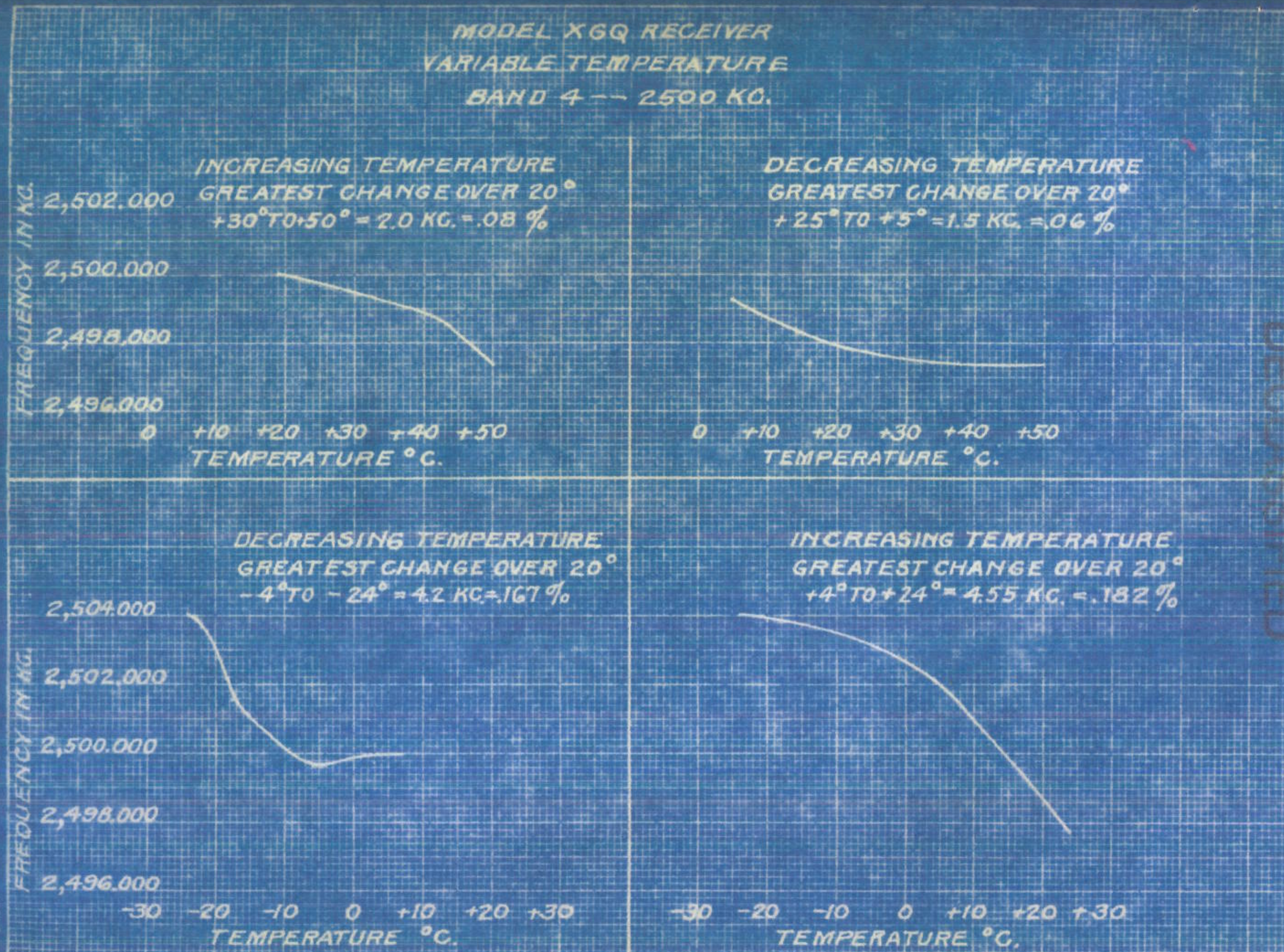
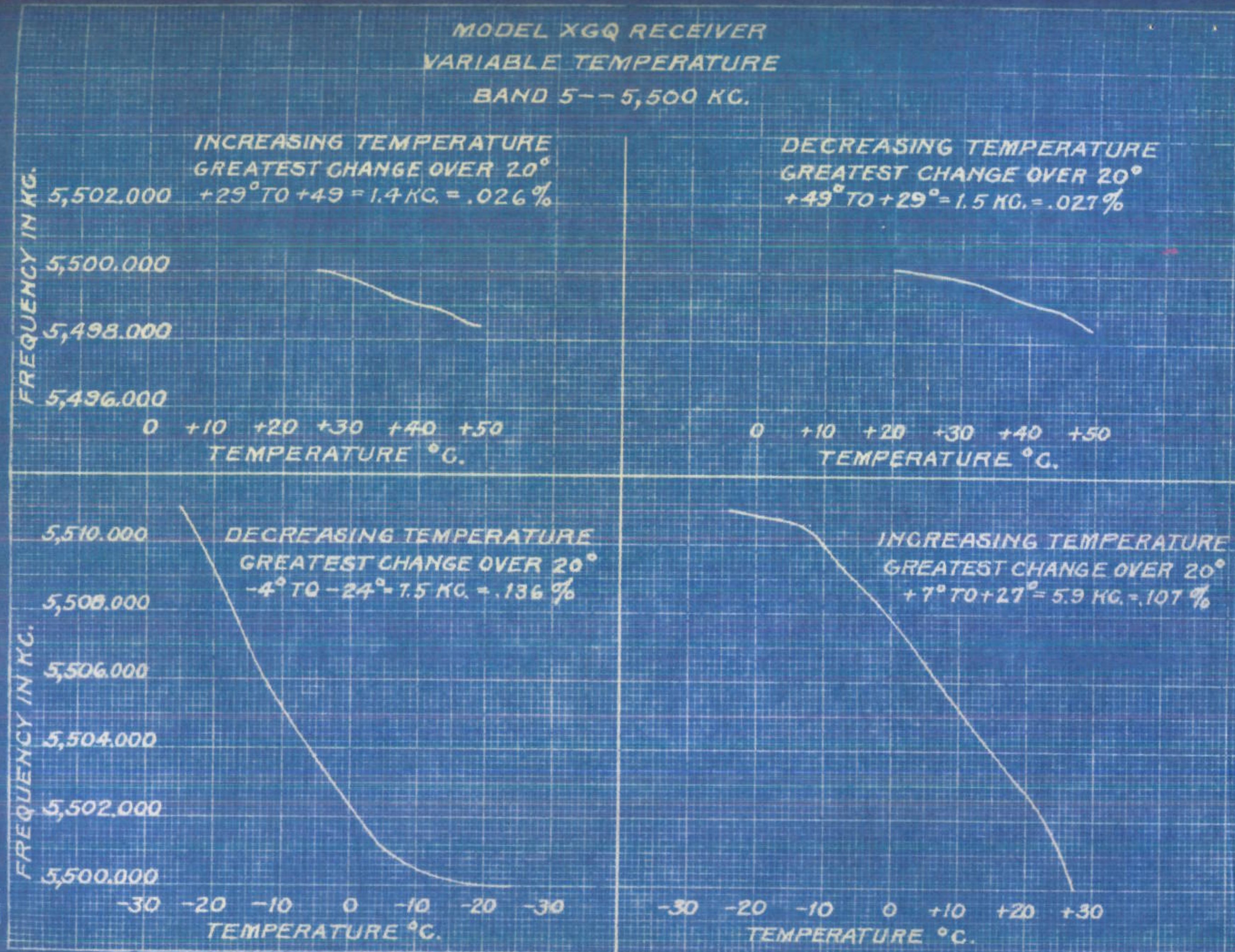

MODEL XGQ RECEIVER
VARIABLE TEMPERATURE
BAND 3 - - 1,000 KC.
INCREASING TEMPERATURE
GREATEST CHANGE OVER 20°
+29 TO +49 = .658 KC. = .065 %
DECREASING TEMPERATURE
GREATEST CHANGE OVER 20°
+41 TO +21 = .7 KC. = .07 %
1,001.000
1,000.000
999.000
FREQUENCY IN KC.
+10 +20 +30 +40 +50
TEMPERATURE °C.
DECREASING TEMPERATURE
GREATEST CHANGE OVER 20°
-4° TO -24° = 1.94 KC. = .194 %
INCREASING TEMPERATURE
GREATEST CHANGE OVER 20°
-17 TO +3 = 1.25 KC. = .125 %
1,002.000
1,001.000
1,000.000
-30 -20 -10 0 +10 +20 +30
TEMPERATURE °C.

PLATE 3



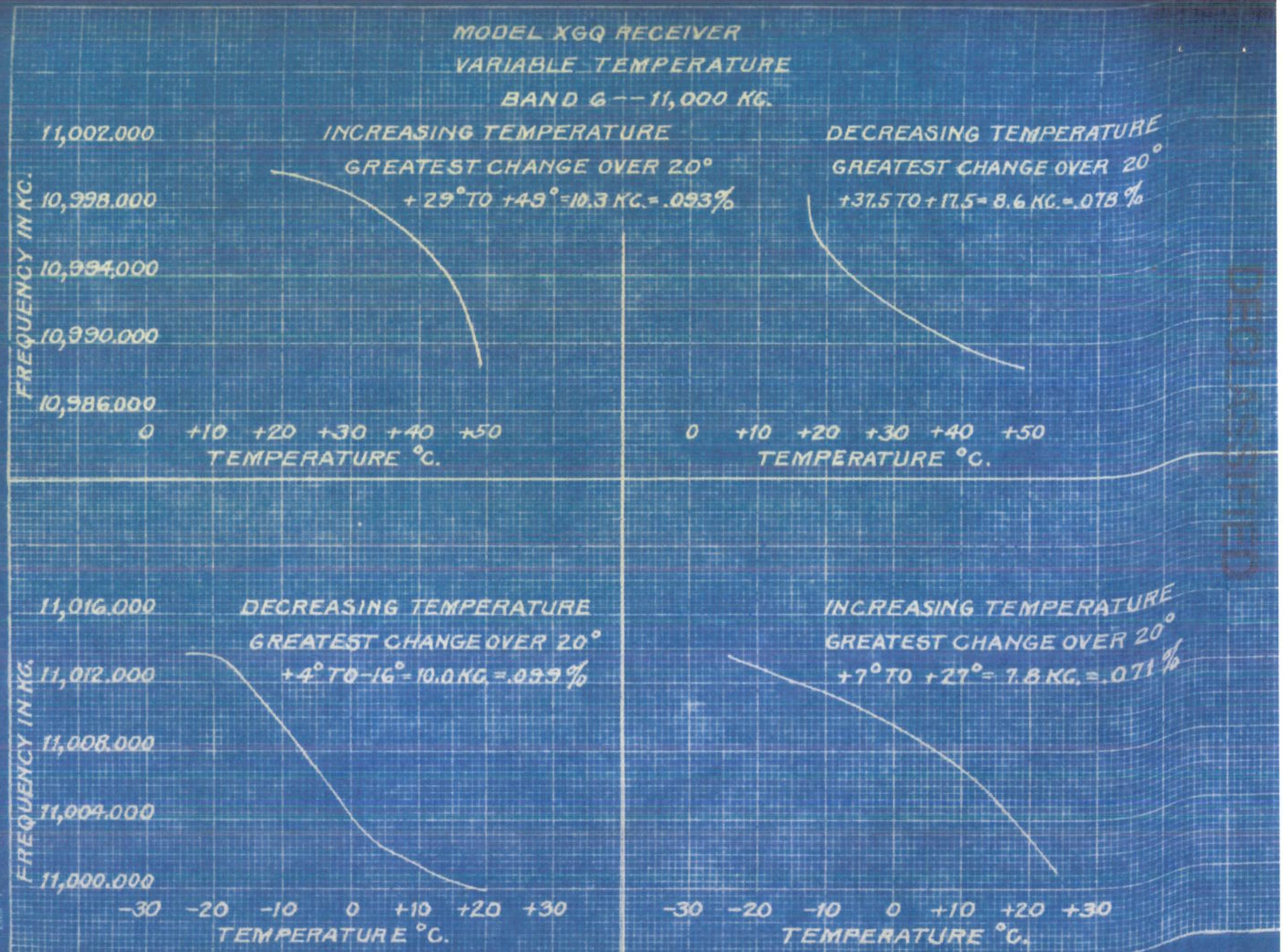
SHEET

PLATE 4



SHEET

PLATE 5



SHEET

PLATE 6

DECLASSIFIED

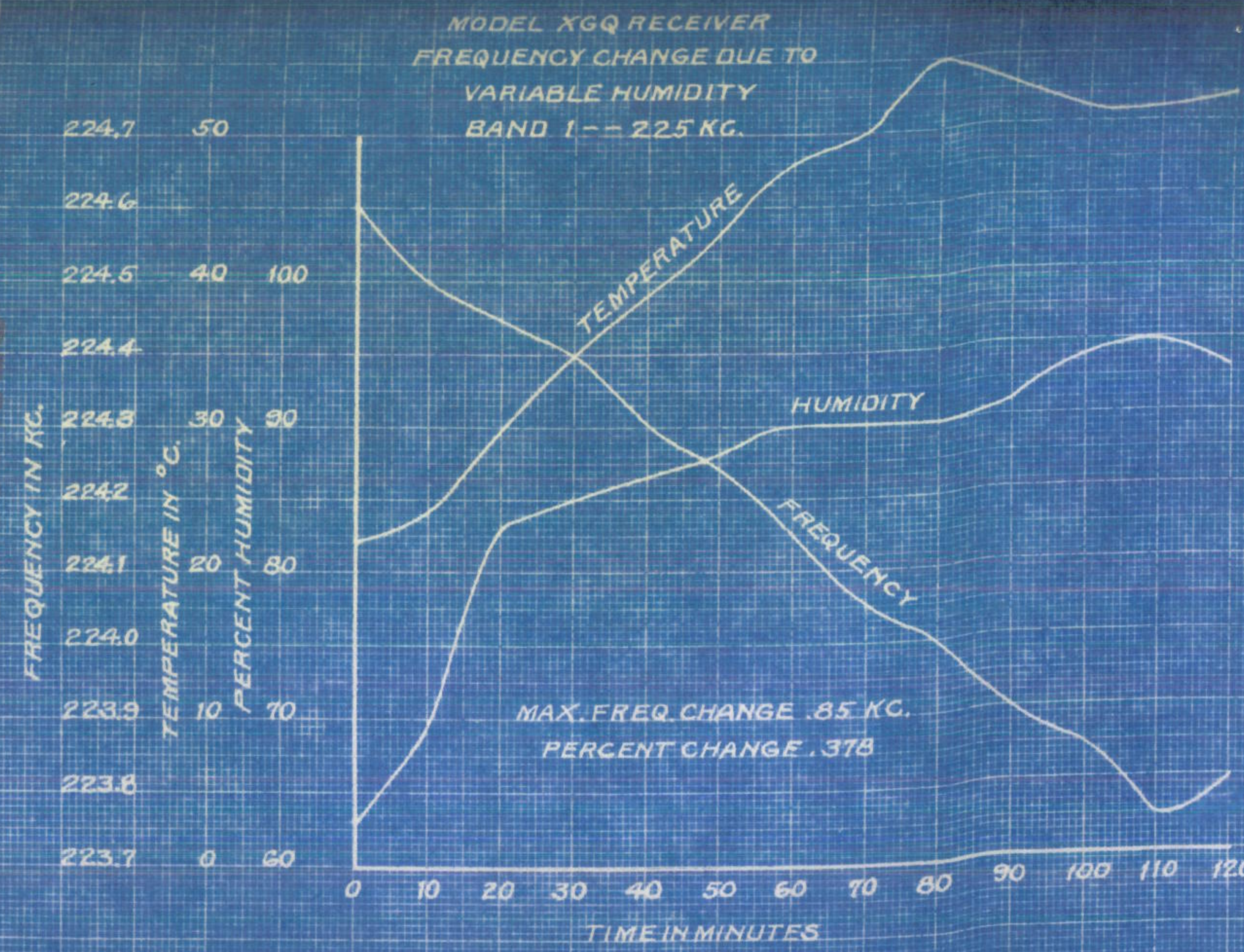
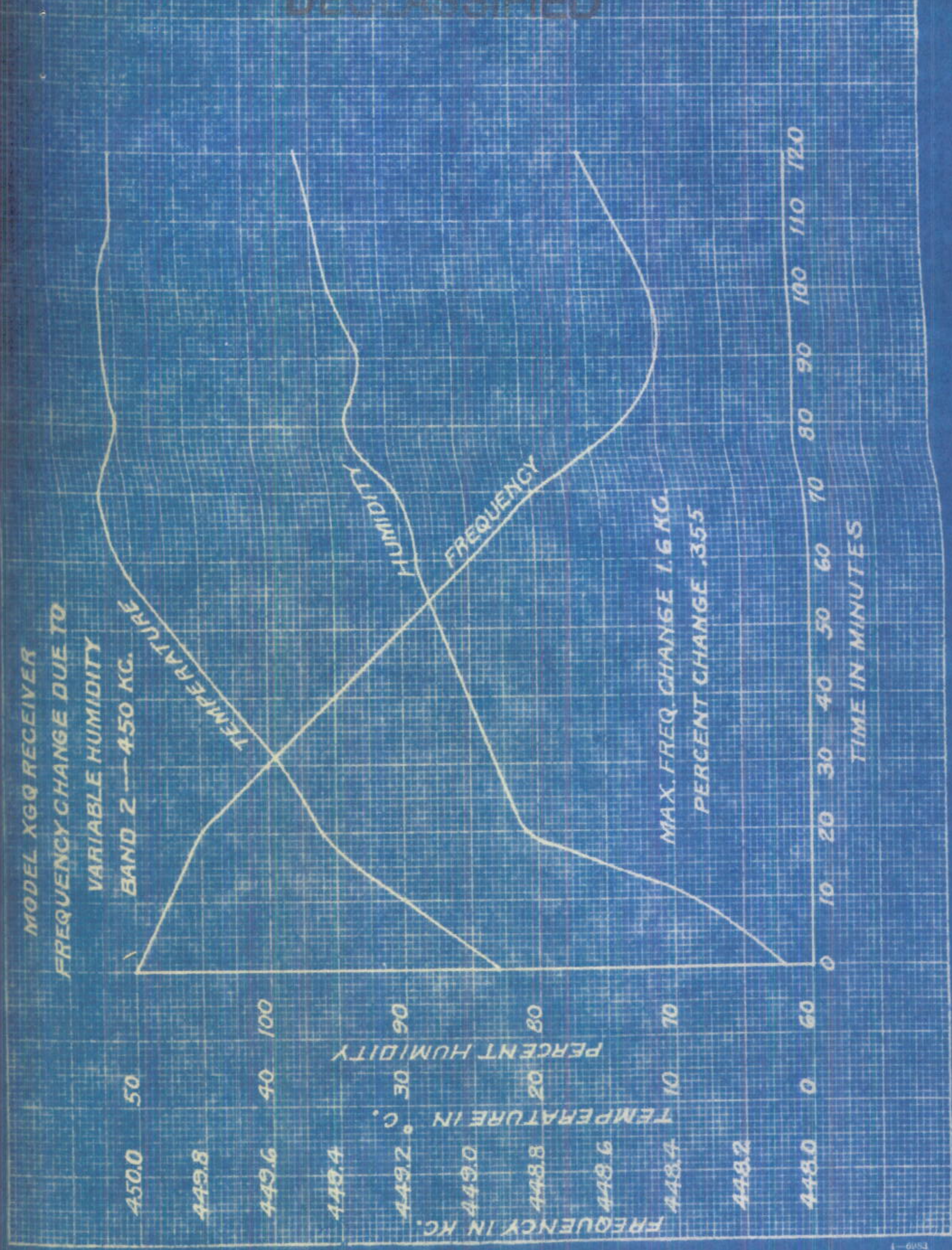

MODEL XGQ RECEIVER
FREQUENCY CHANGE DUE TO
VARIABLE HUMIDITY
BAND 1 -- 225 KC.
FREQUENCY IN KC.
TEMPERATURE IN °C.
PERCENT HUMIDITY
224.7 50
224.6
224.5 40 100
224.4
224.3 30 90
224.2
224.1 20 80
224.0
223.9 10 70
223.8
223.7 0 60
TEMPERATURE
HUMIDITY
FREQUENCY
MAX. FREQ. CHANGE .85 KC.
PERCENT CHANGE .378
0 10 20 30 40 50 60 70 80 90 100 110 120
TIME IN MINUTES

PLATE 7



DECLASSIFIED SHEET

PLATE 8

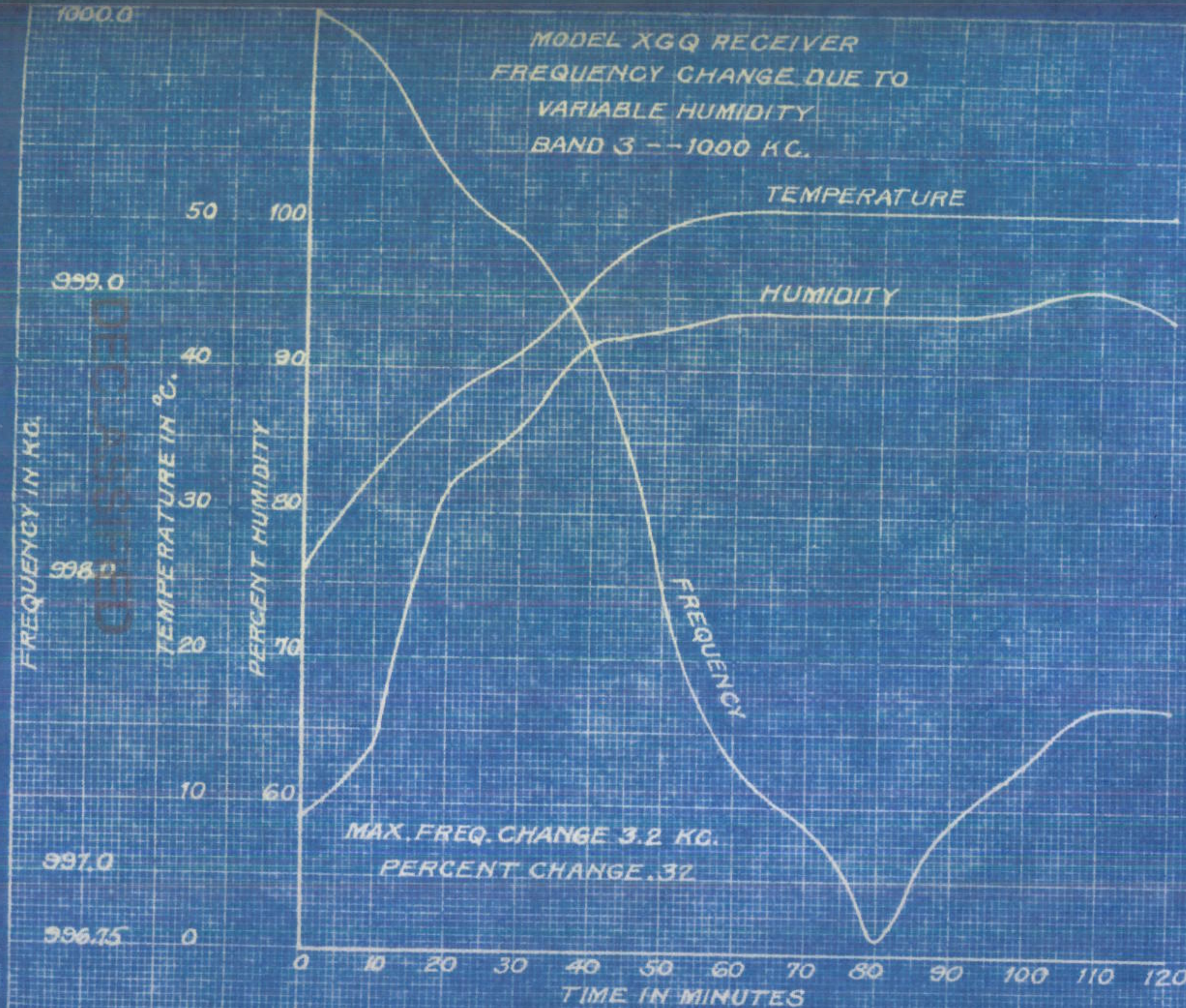


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PLATE 9

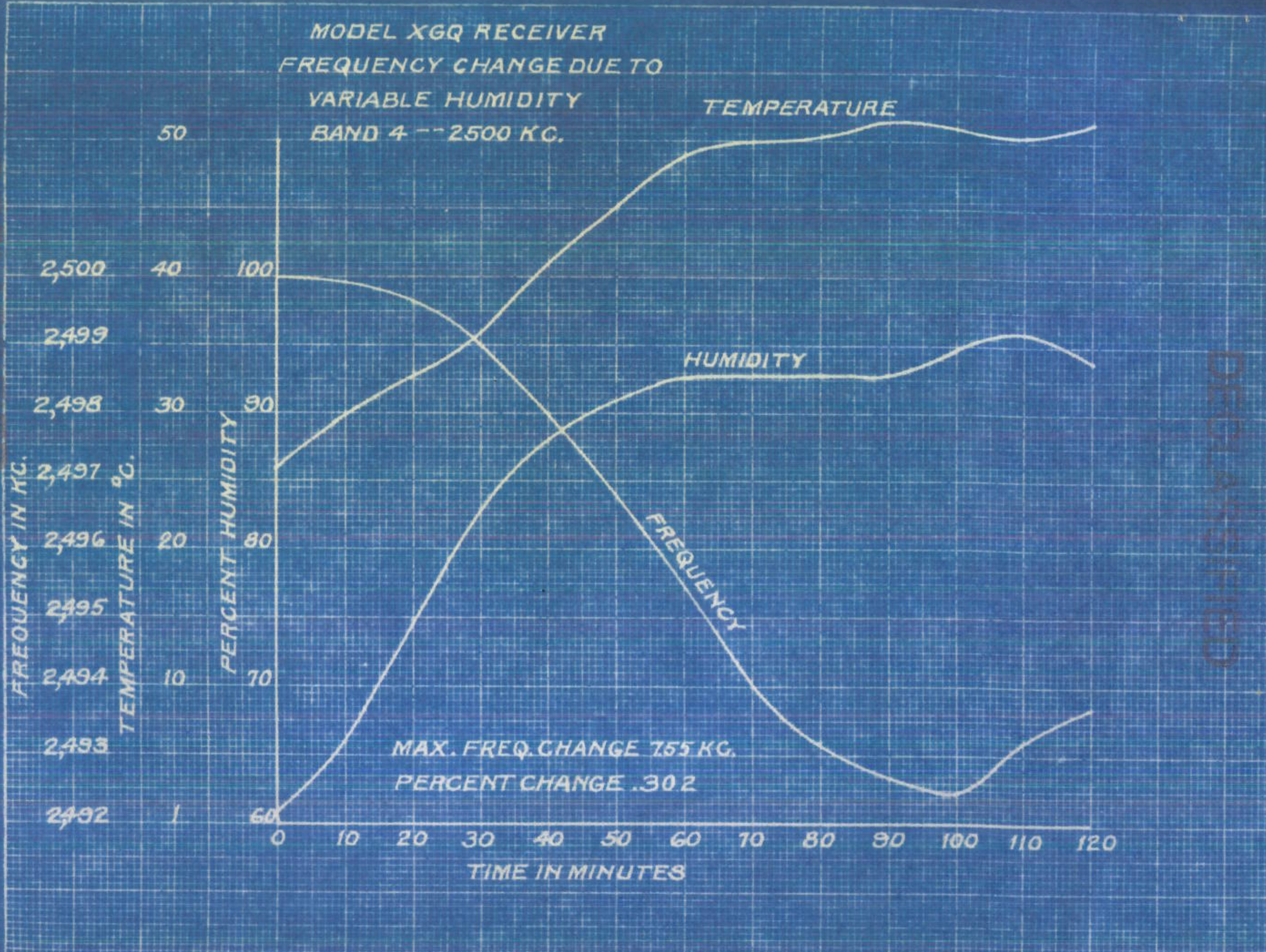
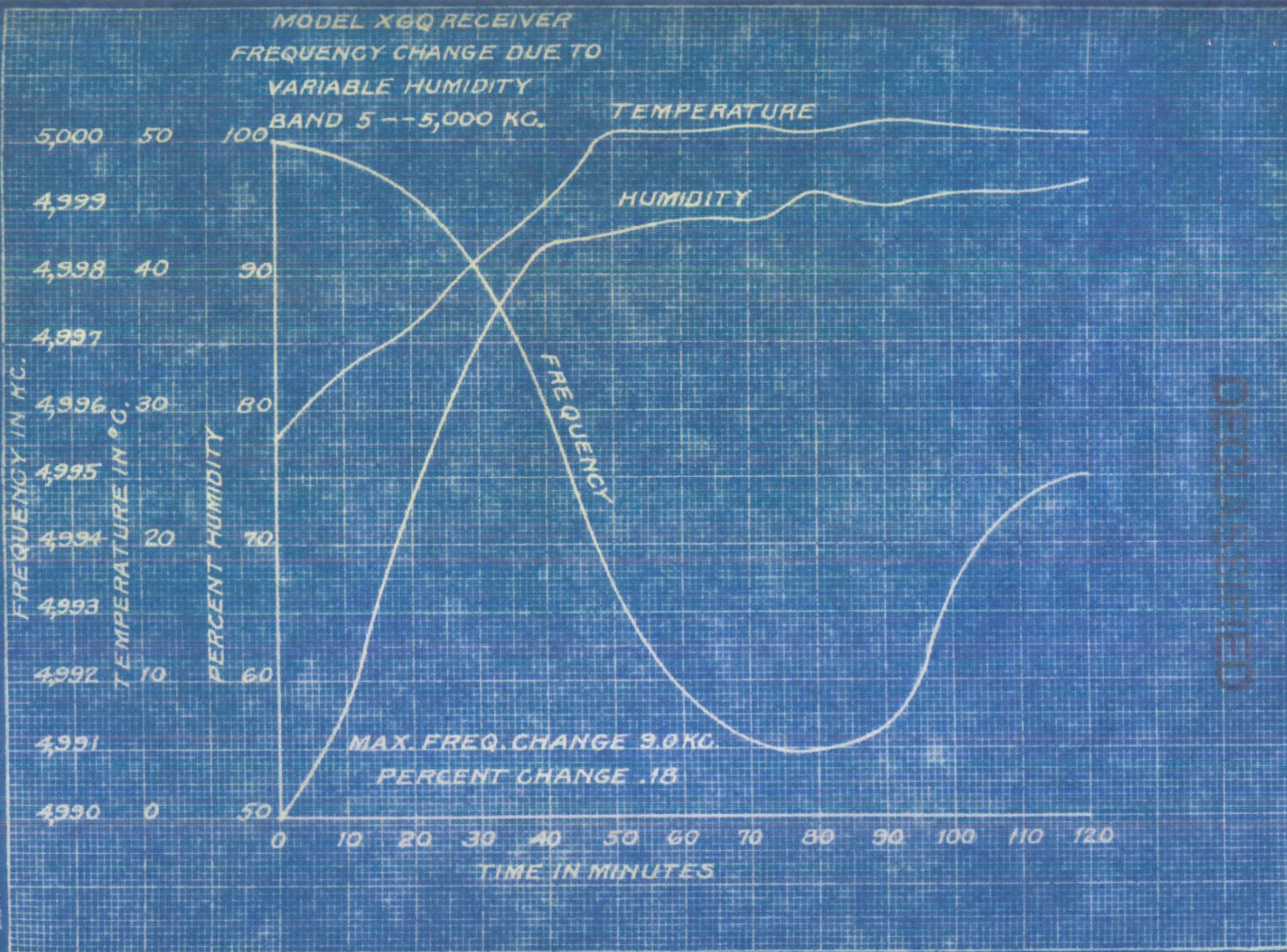
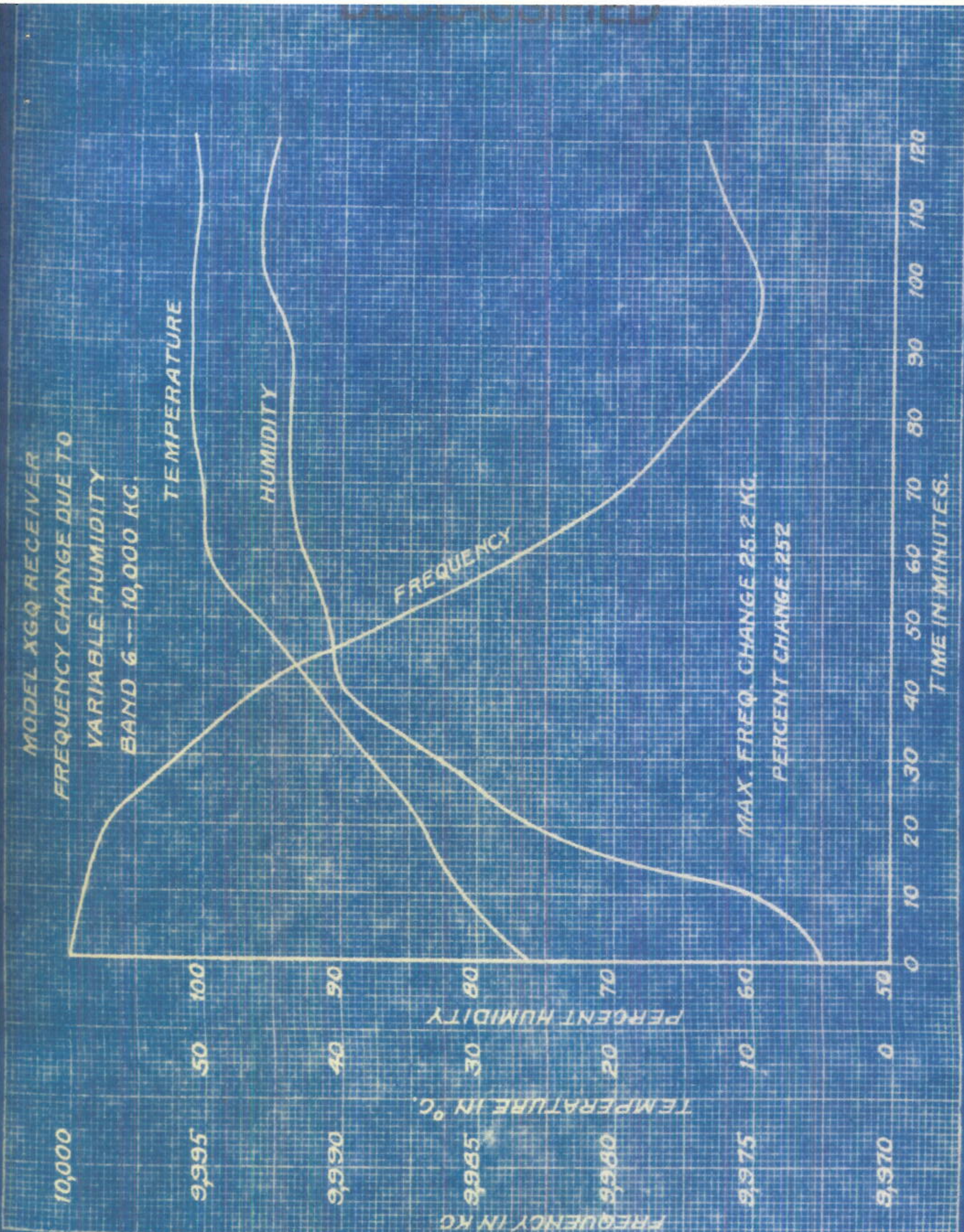

MODEL XGQ RECEIVER
FREQUENCY CHANGE DUE TO
VARIABLE HUMIDITY
BAND 4 -- 2500 KC.
TEMPERATURE
HUMIDITY
FREQUENCY
MAX. FREQ. CHANGE 7.55 KC.
PERCENT CHANGE .302
FREQUENCY IN KC.
2,500
2,499
2,498
2,497
2,496
2,495
2,494
2,493
2,492
TEMPERATURE IN °C.
50
40
30
20
10
1
PERCENT HUMIDITY
100
90
80
70
60
0
10
20
30
40
50
60
70
80
90
100
110
120
TIME IN MINUTES

PLATE 10



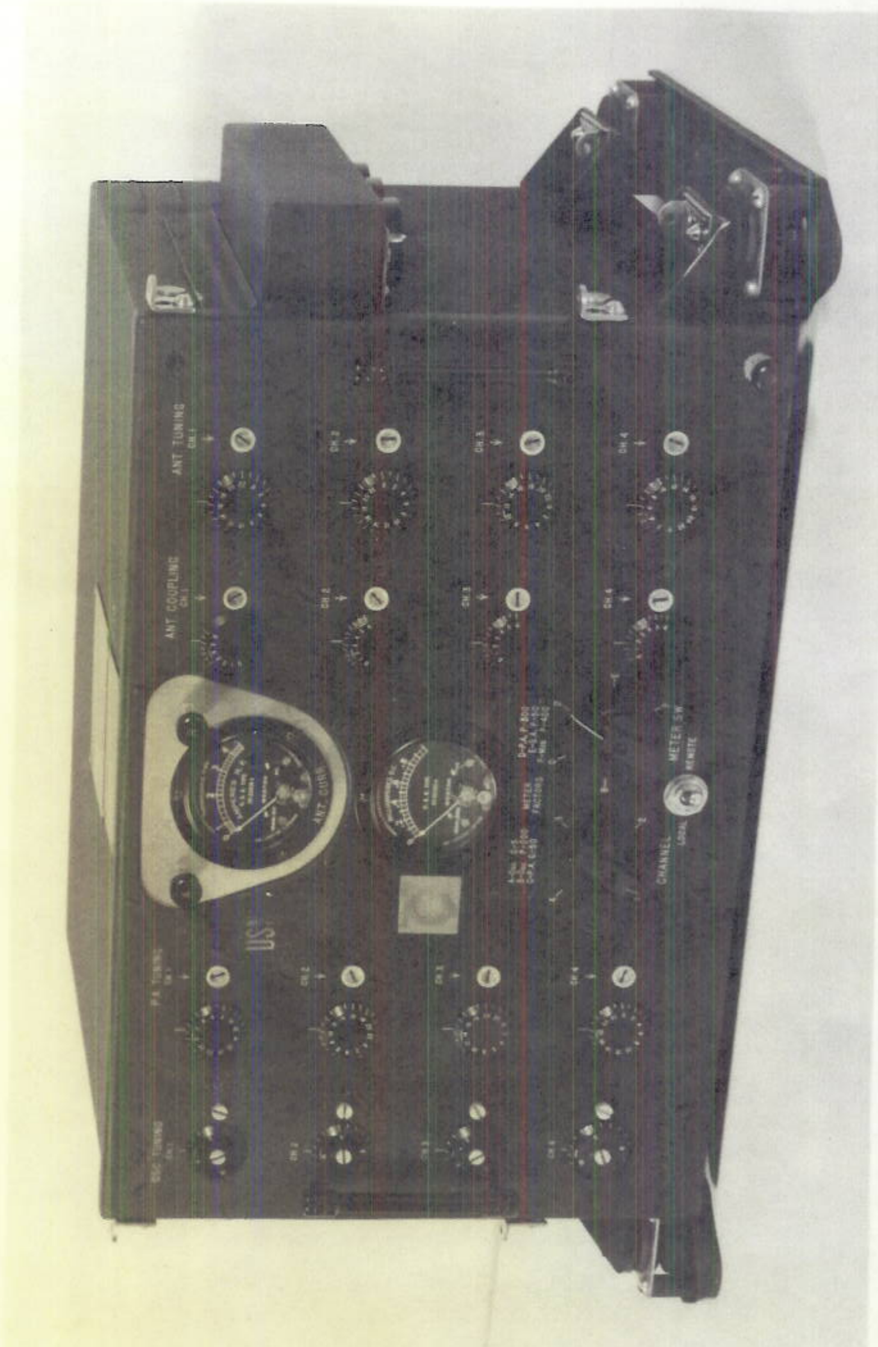
SHEET

PLATE 11



 SHEET

PLATE 12



Transmitter

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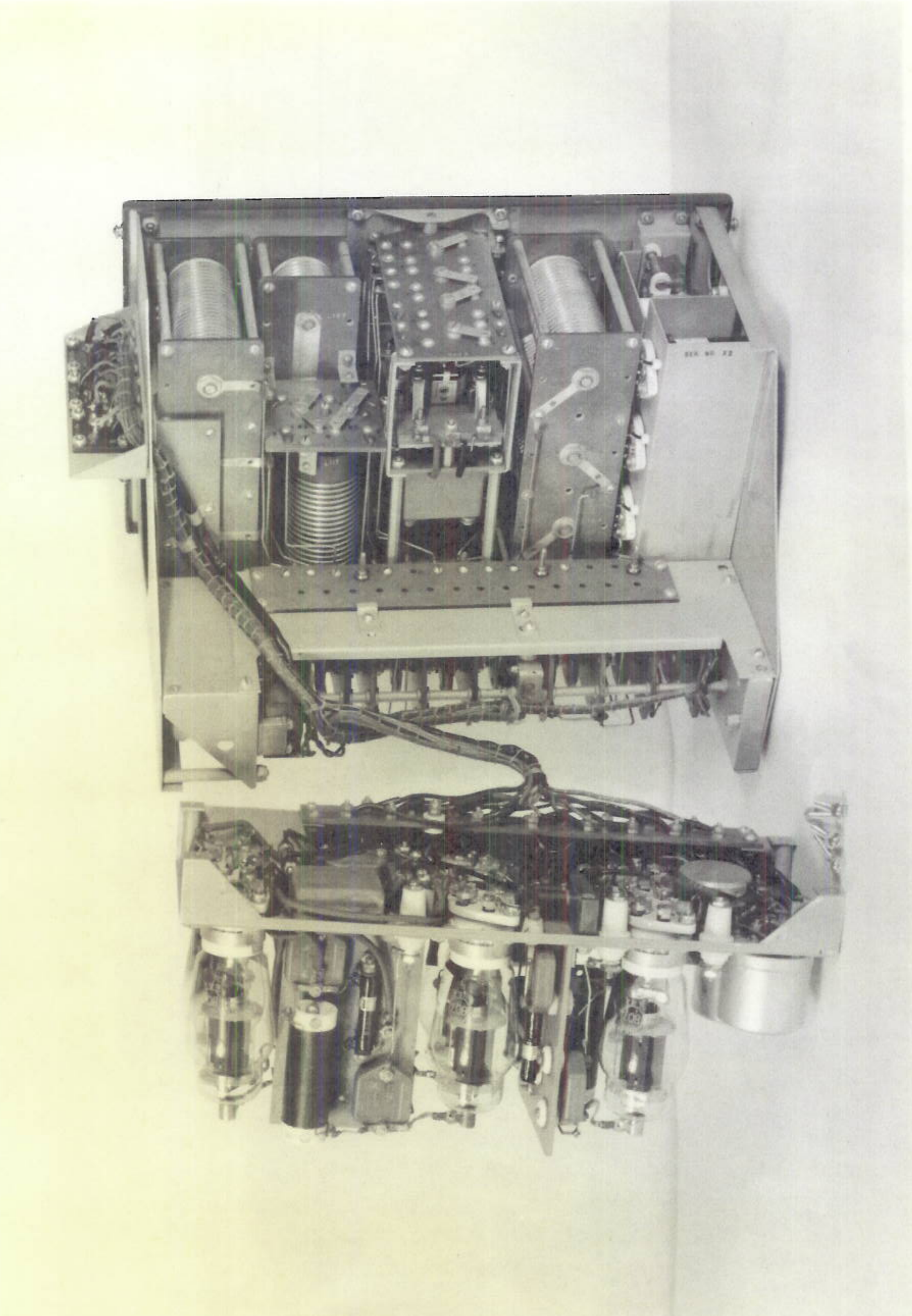
Plate 13



Transmitter

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Plate 14

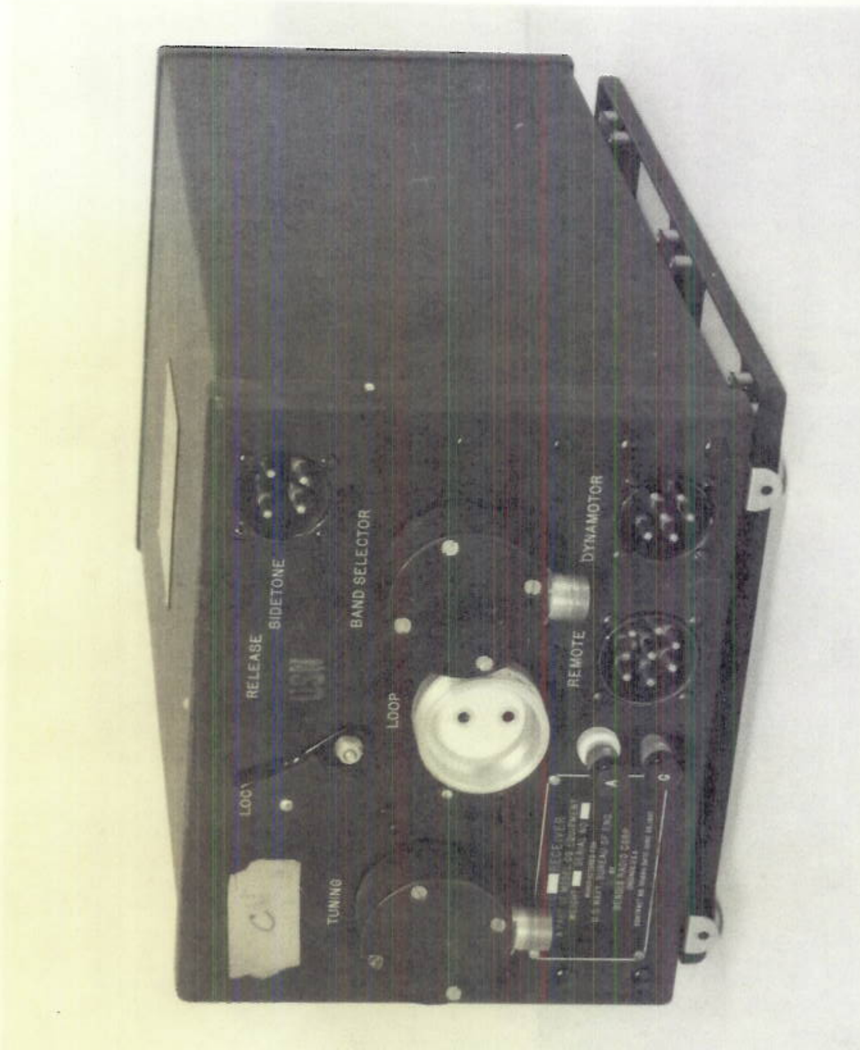

RELEASE
SIDETONE
BAND SELECTOR
USN
LOOP
TUNING
REMOTE
DYNAMOTOR

Plate 15

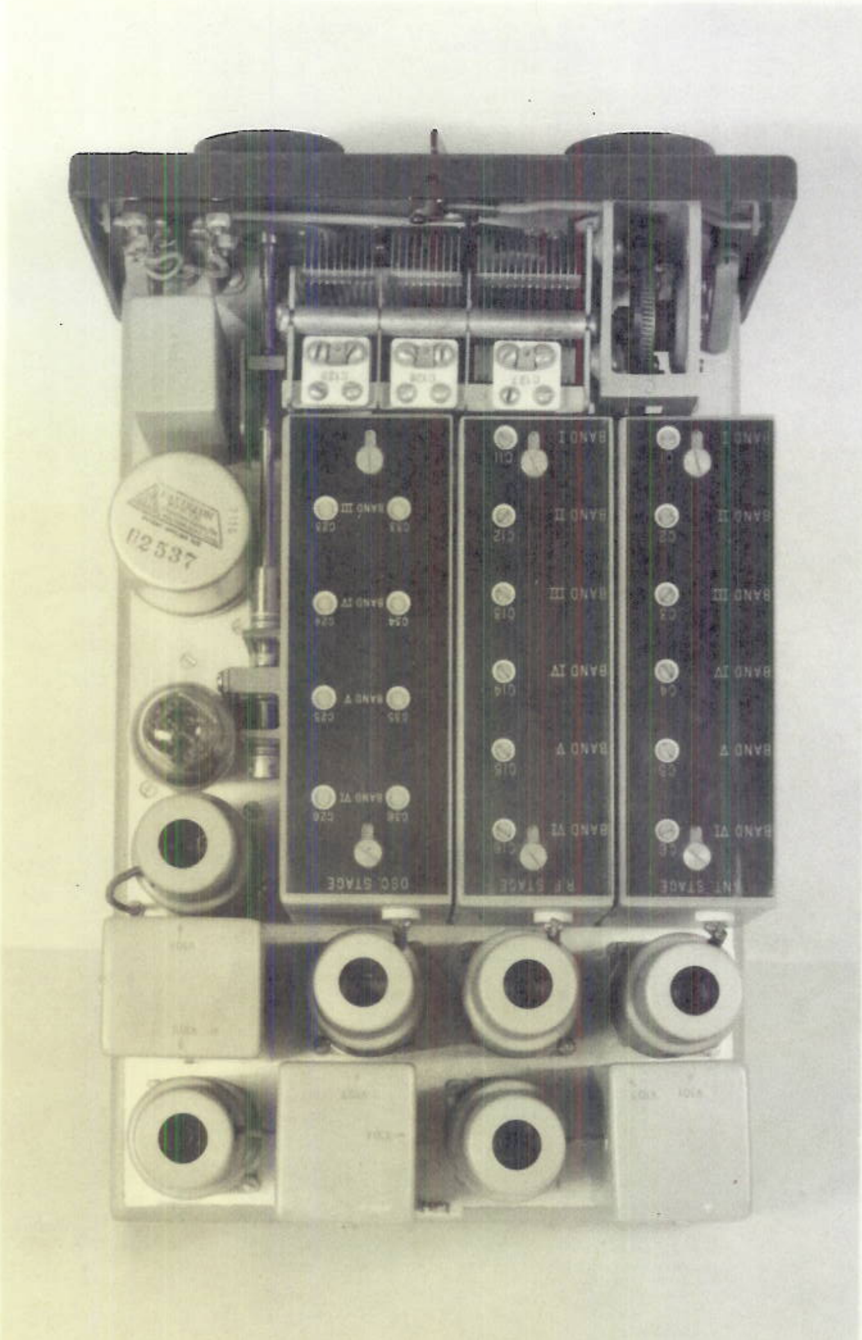
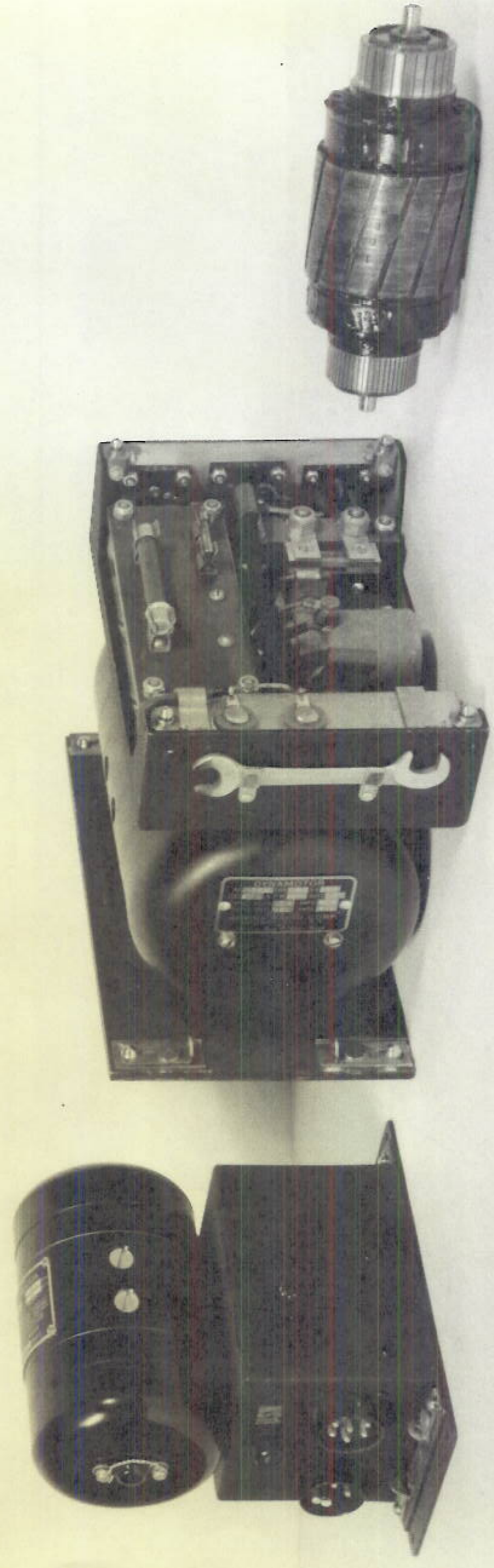
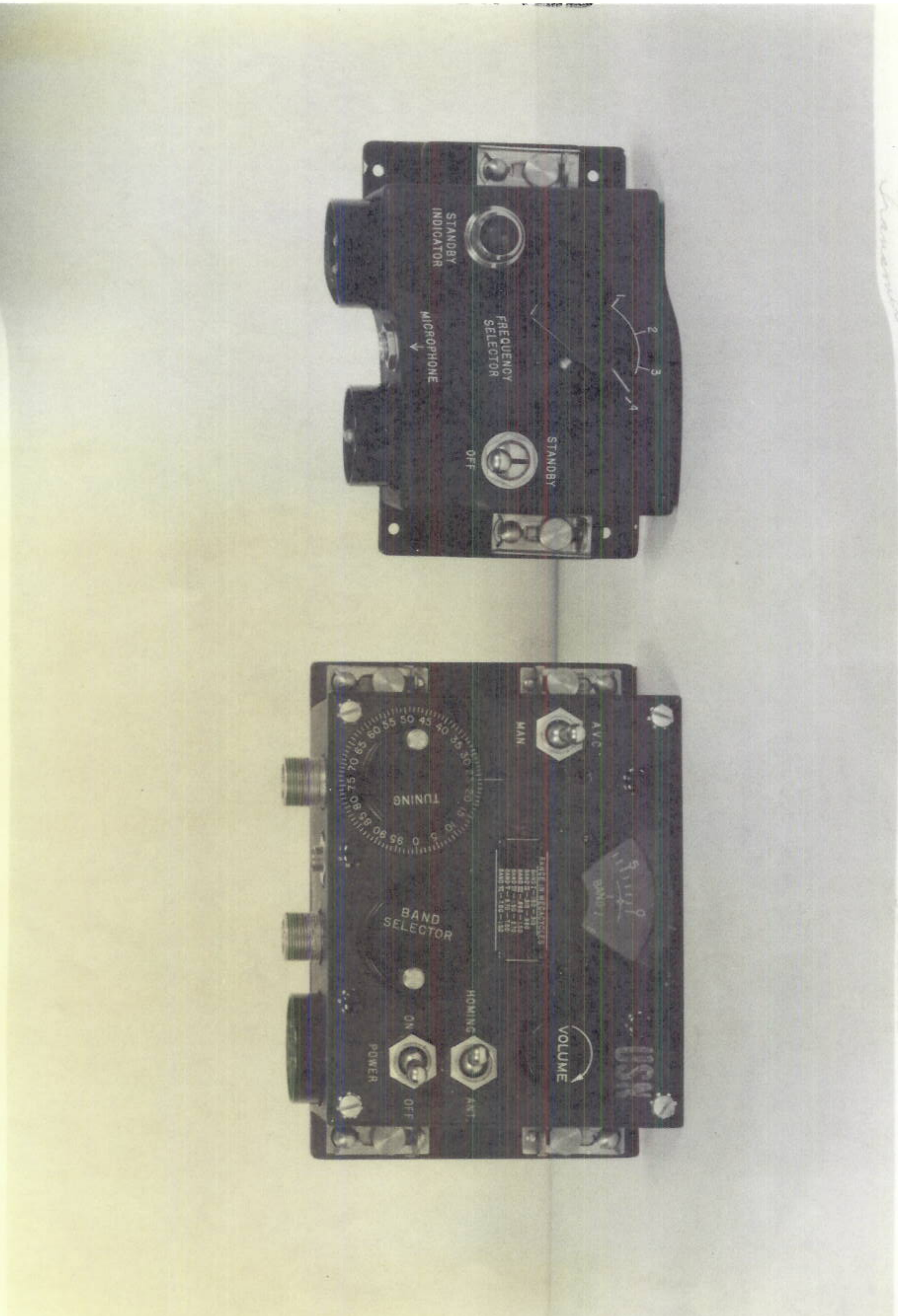


Plate 16



Transmitter & Receiver Dynamotor

Plate 17



Transmitter Control Boxes Receiver

Plate 18

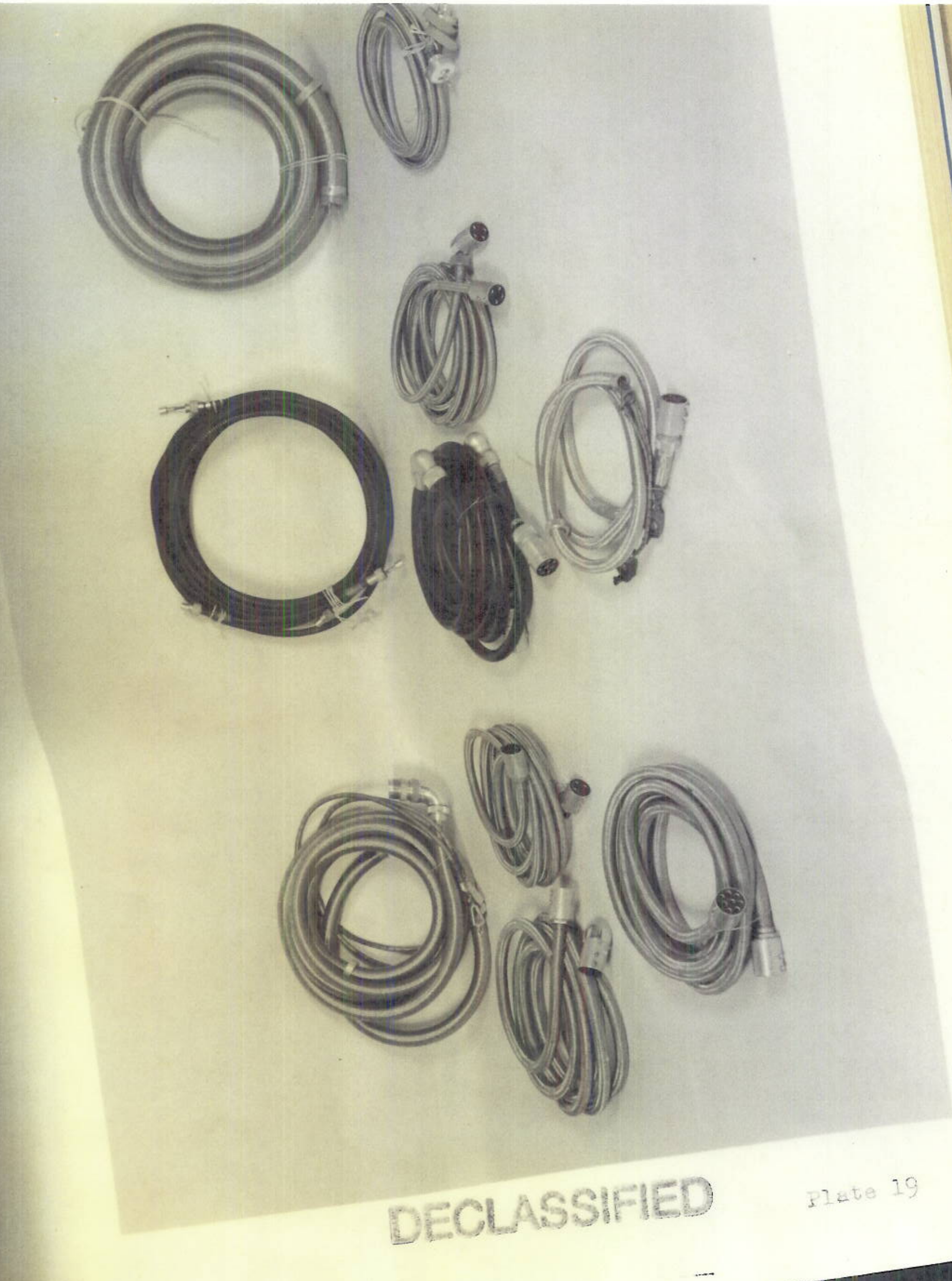


Plate 19

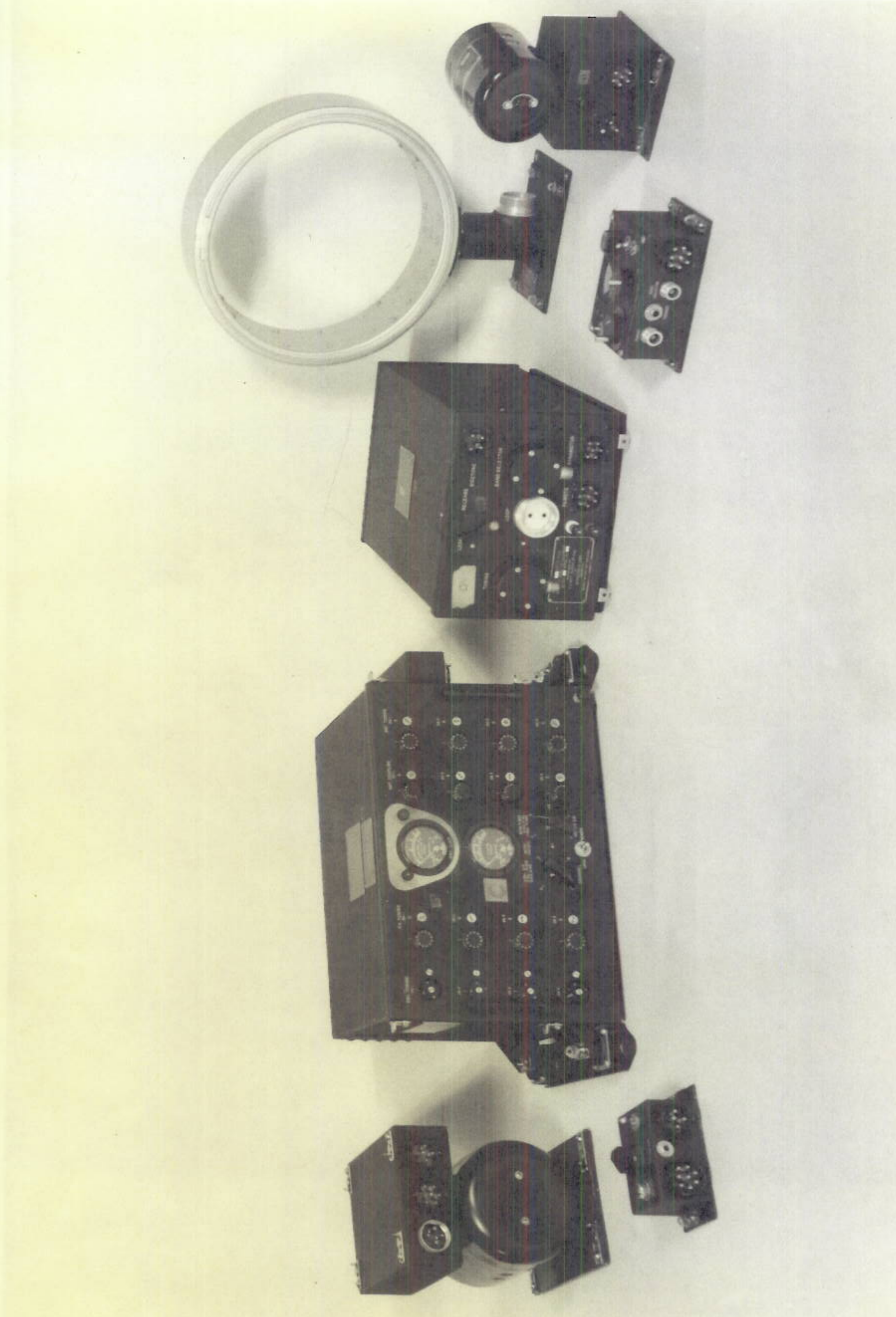


Plate 20

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U.S. NAVAL AIR STATION
ANACOSTIA, D. C.

F42-1/46-52/NA6
(500)Serial #38074

June 10, 1938

From: Commanding Officer.
To: Director, Naval Research Laboratory,
Bellevue, Anacostia, D.C.

SUBJECT: Aircraft Radio - Preliminary Model XGQ Equipment -
- Report on Tests of.

Reference: (a) BuEng. ltr. F42-1 (11-8-W3) of 17 November 1934.
(b) C.O. NAS Anacostia, ltr. F42-1/46-52 F42-1/21 (NA6) (459) of 4 May 1938.
(c) C.O. NAS Anacostia, ltr. F42-1/46-52/NA6 (473) Serial #38067 of 13 May 1938.
(d) BuEng. Specification RE 13A 541A.

Enclosure: (A) Antenna characteristics Full Vee, SU-2 Airplane #9104 (on ground).
(B) Antenna characteristics Full Vee, SU-2 Airplane #9104 (in flight).
(C) Antenna characteristics Half Vee, SU-2 Airplane #9104 (on ground).
(D) Antenna characteristics Half Vee, SU-2 Airplane #9104 (in flight).
(E) Photograph AN-51619 - Model XGQ Equipment. Top view of receiver, transmitter dynamotor, and receiver dynamotor. Rear Cockpit Installation SU-2 #9104 Airplane.
(F) Photograph AN51618. Model XGQ Equipment. Homing Loop, transmitter, transmitter control box, and receiver control box in rear cockpit installation SU-2 #9104 Airplane.
(G) Photograph AN-51691. Full Vee Antenna SU-2 #9104 Airplane.
(H) Photograph AN-51682. Model XGQ Equipment. Schematic Wiring Diagram of Transmitter.
(I) Photograph AN-51683. Model XGQ Equipment. Schematic Wiring Diagram of Receiver.

1. This letter reports upon tests performed at this station on the model XGQ equipment in conformity with reference (d).

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F42-1/46-52/NA6
(500)Serial #38074

SUBJECT: Aircraft Radio - Preliminary Model XGQ Equipment - Report on Tests of.

- -

2. Description of Equipment.

Model XGQ equipment consists of a transmitter, a receiver, and a homing loop which is intended to provide two way voice communication and homing loop operation for ferrying Navy planes. It is designed to operate from the plane's D.C. voltage supply thus making it operable in all planes while still being able to deliver substantial power output into fixed antennas. The transmitter can be pre-tuned for four crystal controlled frequencies and selection of the desired frequency is accomplished by a four point tap switch through the medium of a switching motor incorporated in the transmitter proper. The range of the transmitting equipment extends from 3 to 7 megacycles and any channel can be tuned to any frequency in the range or all channels can be tuned to the same frequency provided suitable crystals are available. Plate power for the transmitter is converted from the plane's 12 volt D.C. supply by a special dynamotor which operates only when the microphone button is depressed. The tube filaments are connected in series parallel and are energized directly from the plane's 12 volt D.C. supply.

The receiver is of the superheterodyne type and extends over the frequency ranges 150 to 1500 kilocycles in three bands and 1800 to 15000 kilocycles in three more bands. The conversion frequency of the receiver is 1650 kilocycles and no reception is possible within 150 kilocycles of this point. No provision is made for the reception of CW signals and no plug-in coils are used. Control of the receiver is accomplished exclusively at a remote point by means of the receiver remote control box and associated linkages and cables. Power for the receiver with the exception of the filaments is applied by a separate dynamotor. The homing loop is of the bilateral type which is operable with the receiver from 150 to 1500 kilocycles.

3. Tube Lineup.

Transmitter

Tube	Number	Function
42	1	Speech amplifier
807	2	Modulators
807	1	Crystal oscillator
807	2	R.F. amplifier

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F42-1/46-52/NA6
(500)Serial #38074

SUBJECT: Aircraft Radio - Preliminary Model XGQ Equipment - Report on Tests of.

Receiver

Tube	Number	Function
6K7G	1	R.F. amplifier
6K7G	1	Oscillator
6L7G	1	Converter
6K7G	1	I.F. amplifier
6K7G	1	I.F. amplifier
6R7G	1	Detector & audio amplifier
6K6G	1	Output tube

4. Dimensions. RE 13A 541 3-2

	Submitted Model			Specification		
	Height	Width	Length	Height	Width	Length
Transmitter	10-1/4"	11-3/4"	19-1/8"	10-1/2"	10"	14"
Transmitter Control Box	3-7/8"	2-7/8"	5-1/16"	4"	2"	5"
Transmitter Dynamotor	9-1/4"	6-1/8"	9-3/4"	7"	8"	10"
Receiver	7-3/4"	9-3/8"	15"	9"	10"	15-1/2"
Receiver Control Box	4-3/4"	2-7/8"	5-1/4"	4"	3"	5"
Receiver Dynamotor	7-1/2"	4-3/8"	7-3/8"	7-5/8"	4-1/2"	6-1/2"
Loop	17-3/16"	4-5/8"	12-11/16"	- - -	4-1/2"	12-1/2"

Width dimension of receiver control box was measured after removing lips from each side; length of transmitter control box was cut down 3/16" by reducing mounting lips to the dimension recorded above.

5. Weight. RE 13A 541A. 3-2

	Model		Specification	
	lbs.	ozs.	lbs.	ozs.
Transmitter	41	0	33	0
Transmitter Control Box	1	0	2	4
Transmitter Dynamotor	24	7	22	0
Receiver	24	2	23	0
Receiver Control Box	2	6	3	0
Receiver Dynamotor	9	14	9	8
Loop	4	2	4	0
Total (No cables or linkages)	106	15	96	12
Mechanical Linkages	5	14	--	--
Set of cables using short Loop cable	29	8	8	0
Total	142	5	104	12

F42-1/46-52/NA6
(500)Serial #38074

SUBJECT: Aircraft Radio - Preliminary Model XGQ Equipment - Report on Tests of.

- -

Cables at present are longer than necessary in some cases and the estimated weight of a complete set of cables and linkages for a production equipment for an average installation is twenty pounds.

6. History of Tests.

1 April, Friday.	Model XGQ equipment arrived at this station.
4 April.	Flight #1, 30 minutes. Supply voltage low; self oscillation present at 4220 kc.
5 April.	Measured supply voltage available for XGQ on SOC-2, J2F-1 and F3F-1.
6-8 April.	Bench tests on power supplies.
11-26 April.	Data collected on installation requirements of various type planes and further work on power supplies.
26 April.	New dynamotor to operate from 11.4 volt source checked on bench.
27 April.	XGQ installed in SU-2.
28 April.	Flight #4 and flight #5. New dynamotor operated satisfactorily but line currents are considered excessive.
29 April.	Flight #6 to Philadelphia. Bendix representative as observer. Communication nearly whole distance on 5200.
2 May.	Flight #7. Checked loop operation. Operation poor on broadcast stations. Slider contacts giving trouble.
4 May.	Measurements on XGQ loop on bench.
5 May.	SU-2 to Norfolk. Operation of receiver checked.
9 May.	Forward cockpit installation of controls. SU-2 to Baltimore. Communication good; homing unsatisfactory.
10 May.	Operation with 1/2 Vee antenna. Slider contacts giving trouble in all channels.
16 May.	Revised XGQ arrived from Bellevue.
17 May.	Flight #11 and flight #12. Intelligibility test in morning and harmonic content in afternoon. Self oscillations observed.
18-19 May.	Bad weather. Set up XGQ on bench. Cure for self oscillation found. Operation of crystal oscillator improved.
20 May.	Flight #13. Altitude; operation satisfactory.
21 May.	Flight #14 to Norfolk.
23 May.	Flight #15 to Philadelphia. Flight #16. XGQ used with flight test of special microphones.
24-25 May.	Antenna overlap studied.

7. Installation Facility. Specification RE 13A 541 1-1 3-1.

Maximum convenience of installing in Navy planes as required by

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paragraph 3-1 of the governing specifications has not been accomplished by the model XGQ equipment. The basic difficulty lies in the fact that the model XGQ has been designed to be inter-changeable with the model GP series so far as mounting is concerned but is required to operate in planes which are mocked up only for model GF series equipment. The physical space necessary for the equipment is available in the planes but special brackets are necessary for numerous purposes and installation may frequently require two men to work for two days. Some minor modifications of the equipment were made at this station and a list of minor defects was furnished the contractor for the purpose of improving installation facility of the equipment. Disadvantages of the individual component units are as follows:

A. Transmitter.
Transmitter is designed to fit the inner row of mounting holes of the model GP. However the design is such that the mounting brackets are not symmetrical and consequently the equipments will have a right-hand and a left-hand mounting bracket. Stamping the brackets as right front and left front will be required. Mounting of the transmitter in planes mocked up for model GF transmitter requires building of complete new mounting table.

B. Receiver.
Receiver dimensions are such that it will fit in the space normally required by a model RU series receiver operating with a dual coil provided the space required for removing the dual coil is taken into consideration. However several difficulties are encountered in the receiver mounting. First of all the mounting holes do not correspond to the RU mounting holes and an adapter plate is necessary. Secondly, there are numerous instances where some member of the plane structure interferes with the upper right corner of the model XGQ receiver even though the space is adequate for mounting the model RU receiver with its dual coil and in these cases the receiver will normally have to be moved to the model LM frequency meter mount and another special adapter plate will be required. Finally, the usual mockups on Navy planes have a 3/4" lip turned up at the edges and it is necessary to have suitable spacers which will raise the model XGQ receiver above these lips.

C. Loop.
Loop was moved one inch to the right on its base plate mounting to give it the same offset as the RDF-1A. Dimensions with the exception of depth correspond closely to RDF-1A and no trouble is anticipated in mounting although the clearance between the hoods on the plane and the loop is extremely small. Installation of the loop in planes carrying headrest loops is not feasible.

D, Transmitter Dynamotor.

Contractor has been requested to modify mounting to fit GF-2 dynamotor mockup and in addition be able to shift base plate so that dynamotor can be mounted on either side as well as upright. Since the height dimension of the dynamotor is greater than that of the model GF it often happens that the necessary clearance is not available with the dynamotor filter mounted on the top side. Ability to shift the base plate 90° provides the added possibility of using some GF mockups where clearance could not be obtained otherwise.

E. XGQ Receiver Dynamotor.

Fits RU receiver dynamotor or RU receiver junction box mounting.

F. Transmitter Control Box.

Transmitter control box has been trimmed down to same width dimension as RU receiver switch box. This will necessitate using smaller but thoroughly suitable snap slides.

G. Receiver Control Box.

Receiver control box was intended to fit model GP pilot's control box but the lips provided on the side for mounting the unit increased its dimensions so that the control box would no longer fit the model GP mockup of the recessed type. The entire mounting plate has been discarded and the lips removed from the unit proper; mounting is now accomplished in exactly the same fashion as is used for model GP pilot's control box. In addition to the mounting difficulties of the receiver control box there is the additional objection that the visibility of the calibrated dial is not suitable. The control box normally mounts on the contour of the fuselage at a level of about two to three feet below the level of the pilot's eyes. The fuselage slopes in such a fashion at the point of control box mounting that the pilot looks at the dial from a 90° angle and has no chance of reading the calibration. Still further trouble was encountered in getting sufficient torque from the band selector and the remote tuning control to operate the receiver properly at the end of fifteen feet of mechanical linkage. A new design of control box was submitted by the contractor which provided greater radius on the controls and a 4 to 1 gear ratio on the band selector instead of a 2-1/2 to 1. The desigh appeared to be better but no actual flight tests were made due to the fact that the gears in the receiver must be changed in a corresponding manner to make the new design operable. Mechanical linkage of an improved design is desirable. The linkage submitted does not travel smoothly and this becomes a serious objection in view of the fact that the length of mechanical linkages in all XGQ installations will be approximately twelve feet.

8. Mockup Notes.

Flight tests were made in the SU-2 #9104 but the installation was

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not typical due to the fact that the control boxes were installed in the rear cockpit for test purposes. However the equipment was tried in other planes as indicated by the following table:

Plane	Trans.	Trans. Dyn.	Trans. Control Box	Receiver	Receiver Dyn.	Receiver Control Box	Loop
SB2U-1	GP Mount OK	GF-2 Dyn. Mount	RU Switch Box OK	LM Position * OK	RU Junc. Box Mtg. OK	GP EXt. cont. box OK	RDF mtg. OK
SOC-3	GP Mount OK	GP spare coil mount *	RU Sw. Box OK	RU rec. Mount OK * If XGQ raised 3/4"	RU Junc. Box.mtg. OK	Special* mount necessary	RDF mtg. OK
F3F-1	Fore & Aft in RU* Rec. mtg.	GF-2 Dyn. mtg OK if XGQ dyn is laid on side	RU Sw. Box OK	IN GF * Trans. mtg.	Athwart-ships just fwd rec. *	RU SW. Box OK	Has loop
J2F-1	GP Mount OK	Fore & Aft in LM mtg. *	Bulkhead aft rec. control box	RU rec. mtg. OK *	Aft. Trans. Dyn.*	GP Ext. Cont. Box OK	RDF mtg. OK
XF2A-1	In RU* rec.mtg.	OK	RU rec. Sw. box OK	GF Trans. mtg.*	Between Trans. & Rec.	GF cont. Box	Has loop
TBD-1	GP Mount OK	GP Spare Coil *	Just aft GP Ext.* Cont.Box	RU rec. mtg.	OK	GP Ext. Control Box	RDF mtg OK
XSBC-4	GP Mount OK	Fore-Aft to right Trans.	RU Rec. Sw. Box	RU Rec.* Position	RU Dyn. Mount	GP Ext. Box	RDF mtg OK
SBU-2	GP Mount OK	RU Rec.* mtg.	Aft.Rec. * Remote Control	LM Freq. Meter Pos.*	RU Dyn. Mount	GP Ext. Box	RDF mtg OK

The information in the preceding table is typical of what may be expected throughout the service. Asterisks indicate mountings that will require special brackets or adapter plates. No condition has been encountered where the necessary physical space was not available except the NJ-1 but ease of installation is not one of the characteristics of the model XGQ equipment.

10. Cable Lengths.

Cable lengths will probably be determined by the longest length required for any probable installation and with this in view the measurements were taken on the same 8 planes used for the basis of paragraph 7. The results:

CABLE LENGTHS	SB2U-1	SOC-3	F3F-1	J2F-1	XF2A-1	TBD	XSBC-4	SBU-2	Maximum Length
Trans.Dyn-Battery	36"	60"	24"	36"	30"	30"	24"	30"	60"
Trans.Dyn-Trans.	40"	72"	54"	36"	48"	36"	24"	50"	72"
Trans.Dyn-Remote Cont.	102"	84"	48"	48"	66"	168"	72"	108"	168"
Trans.Rem.C.-Trans.	120"	66"	84"	36"	66"	144"	60"	80"	144"
Trans.-Receiver	36"	30"	30"	30"	36"	36"	30"	36"	36"
Rec.Dyn.-Battery	36"	36"	36"	42"	36"	24"	42"	40"	42"
Rec.Dyn. - Receiver	36"	60"	30"	46"	24"	36"	36"	40"	60"
Rec.-Rec.Remote Cont	120"	66"	72"	50"	80"	144"	80"	78"	144"
Band Selector Linkage	96"	72"	72"	50"	80"	144"	80"	78"	144"
Tuning Linkage	96"	72"	72"	50"	80"	144"	80"	78"	144"
Homing Loop - Receiver	40"	36"	40"	42"	30"	40"	40"	70"	70"

11. Power Supply Capabilities - Specification paragraphs 1-5(1) and 3-3.

Due to insufficient output of the model GQ transmitter dynamotor on the first flight test measurements of the supply voltage were made on the SU-2 and other ships which happened to be available. For ships other than the SU-2 a 0.5 ohm resistance was used as a load to simulate the model AGQ transmitter. Voltage was measured at the radio power junction box. The results:

Type of Plane	Generator	Load	Volts
J2F-1	NEA-2	None	14.5
J2F-1	NEA-2	0.5 ohm	10.5
SOC-2	NEA-2	Battery	14.5
SOC-2	NEA-2	Battery with 0.5 ohm in parallel.	11.25
F3F-1	D-1	None	14.6
F3F-1	D-1	Battery with 0.5 ohm in parallel.	11.8
SU-2 (flight)	NEA-2	None	14.0
SU-2 (flight)	NEA-2	GQ transmitter	11.2

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Measurements on the SU-2 were made in flight. Other measurements were made with the plane on the ground turning up sufficiently to drive the NEA-2 at 2400 r.p.m. On the basis of the preceding information, the contractor was asked to furnish a new dynamotor which would operate from a supply voltage over the range of 10.5 to 12.5 volts instead of the specified 12-16 volts. In view of the higher line currents to be encountered in the new design dynamotor some bench tests were made on the generator characteristics of both the NEA-2 and the D-1A generators to determine whether adequate D.C. power was available for operating the new dynamotor. Two different adjustments of the voltage regulator were used for each generator, one adjustment giving no load output at 14.5 volts and the other at 14.0 volts. These two values represent the extremes normally found in service. The results:

NEA-2 Generator.

Load Amperes	Voltage at Generator	Voltage at Junction Box	Battery Current
0	14.5	14.5	0
0	14.25	13.8	+10.0
20	13.75	12.75	+ 2.0
25	13.60	12.50	- 2.0
30	13.60	12.30	- 3.0
35	13.55	12.15	- 4.0
40	13.50	12.00	- 6.0
0	14.0	14.0	0
0	13.75	13.5	+ 8
20	13.2	12.3	- 2
25	13.1	12.2	- 3
30	13.1	12.0	- 5
35	13.0	11.8	- 7
40	13.0	11.6	- 9

D-1A Generator Ser. No. 877

Load Amperes	Voltage at Generator	Voltage at Junction Box	Battery Current
0	14.5	14.5	0
0	14.4	14.1	+12
20	14.3	13.4	+ 7
25	14.25	13.25	+ 6
30	14.25	13.0	+ 5
35	14.2	12.85	+ 4
40	14.1	12.75	+ 2.5

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Load Amperes	Voltage at Generator	Voltage at Junction Box	Battery Current
0	14.0	14.0	0
0	14.0	13.75	+ 8
20	13.9	13.1	+ 5
25	13.8	12.95	+ 4
30	13.8	12.75	+ 2
35	13.8	12.60	+ 1
40	13.75	12.50	0

In analyzing the preceding tables of data it should be remembered that the power distribution circuits in the planes are such that the actual supply voltage reaching the dynamotor at 30 to 40 ampere loads is 0.5 volts to 1.0 volt lower than recorded in the preceding bench tests. It will be noted that the D-1A generator, rated at twenty-five amperes performs better than the NEA-2 which is rated at thirty amperes. At no time, even under forty ampere loads with the voltage regulator adjusted to minimum setting (14.0 volts) was the battery required to furnish current when using the D-1A generator but when using the NEA-2 generator with a similar voltage regulator adjustment the battery began to furnish current at twenty ampere loads and at the forty ampere load the battery was supplying nine amperes. This is partly due to the improved action of the voltage regulator on the D-1A generator tested but is largely a result of the fact that the NF-2 voltage regulator used with the D-1A generator does not need a heavy filter choke to filter out the 800 cycles as is the case in the NF-1 voltage regulator which is used with the NEA-2 generator. The NEA-2 and D-1A generators operate consistently overloaded using the low voltage dynamotor and but slightly overloaded using the originally submitted dynamotor.

12. Operation of Transmitter Dynamotor - Paragraph 3-3 of governing Specification.

Tests were made with two types of transmitter dynamotor, the first of which was the dynamotor originally submitted, designed to operate from a 13.4 volt source and the second from a 11.5 volt source. The power drain for the complete GQ equipment, transmitter and receiver, using the original dynamotor varied from 29 to 32 amperes depending upon the supply voltage. With the dynamotor designed to operate from 11.5 volt source, the total drain varied from 40 to 45 amperes. In either of the above cases the standby current was seven amperes. This represents the power consumed by the receiver and by the transmitter filaments. Three flights were made using the 11.5 volt dynamotor and no failures occurred. On one flight the key was held down almost continuously for about an hour with no apparent ill effect on the NEA-2 generator from the overload (estimated 42 amperes) but the filter choke in the NF-1 voltage regulator became hot enough to vulcanize the small rubber buttons in the lid of

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voltage regulator compartment. The power output of the transmitter was increased approximately 33% by using this dynamotor but the supply voltage at the transmitter had dropped more than anticipated and the filaments of the transmitter were being operated at critically low voltage. Furthermore, it was necessary to readjust the voltage regulator after the first flight in order to keep the supply voltage above ten volts. In view of the fact that the equipment would have to operate in various installations without any special adjustments, it was considered advisable to provide a better margin of safety even at the expanse of reduced power output and consequently the remainder of the tests were made with the original dynamotor.

13. Power Outlets in Planes.

In service installations the power for operating radio equipment is obtained at the radio power junction box. In two place planes this junction box normally has a one-half inch outlet and a three eighths inch outlet while single place planes provide one or occasionally two three-eighths inch outlets. The GQ transmitter supplies a 3/4" fitting for the transmitter power supply cable and a 1/2" fitting for the receiver power supply cable. These fittings should be reduced to 1/2" and 3/8" respectively to facilitate installation in some of the planes. This may require reducing the size of wire in the power supply lead and it is realized that this is undesirable but the short length of power cable to be used makes this slight reduction in wire size unimportant.

14. Modulation Characteristics of Transmitter.

Model XGQ transmitter incorporates the well known "plate modulation" circuit and this is considered the most suitable circuit for service requirements in this particular equipment. Bench tests show that the percentage of modulation varies negligibly when the plate voltage is varied from 360 to 460 volts. A minor change necessary in the modulator system was the incorporation of a network composed of a 750 ohm resistor and a 0.005 microfarad across the secondary of the modulation transformer. This reduced the sensitivity of the system and also eliminated unnecessary high notes. Actual flight tests were made and intelligibility was much improved with the network. The modulation characteristics with and without the network in the circuit was as follows:

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Input Volts	Audio f.	Modulation Percentages No Network	Modulation Percentages 750 ohm 0.005 microfarad network
.8	300	95	95
.8	600	100	95
.8	1000	100	92
.8	2500	98	70
.8	4500	93	40
.8	12000	70	10

15. Power Output in Flight.

The following table gives the power output of the model GQ transmitter in flight into a standard full VEE antenna. The dynamotor which had been designed to operate from a 13.4 volt source was used for this test and it will be observed that the plate voltage was only 385 volts where 460 had been anticipated. Generator volts is the no load voltage and indicates the setting of the voltage regulator; supply volts is the full load voltage measured at the dynamotor brushes; E_p is transmitter plate voltage; I_p is transmitter radio frequency power amplifier plate current; I_A is antenna current measured on a separate external meter and R_A is the antenna resistance of the full Vee antenna used as measured with the Q meter on the ground.

Freq.	Gen. Volts	Supply Volts	E_p (Volts)	I_p (M.A.)	R_A	P.Watts
3105	14.0	11.2	385	126	1.75	6.3
4220	14.0	11.2	380	144	2.2	9.7
5200	14.0	11.3	390	120	3.0	14.5
7000	14.0	11.2	380	150	6.0	29.0

The power figures of the last column are too high due to the fact that the Q meter measurements of antenna resistance made on the ground give higher values than the same measurements made in flight. See enclosures (A), (B), (C), and (D) for the variation of antenna resistances between ground and flight measurements. A new dynamotor armature designed for an 11.5 volt input was submitted for test and the power output of the transmitter was increased about 33% but such heavy line currents were necessary to operate the 11.5 volt dynamotor that it was deemed advisable to use the 13.4 volt dynamotor and sacrifice the increased power output. This means that the dynamotor which is designed for 13.4 volts input operates from 11.5 volt input and consequently provides a reduced D.C. output which in turn energizes the GQ transmitter at only 75% of its

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rated capacity but even under this condition the ratio of antenna watts to power consumption for the GQ is higher than for previous Navy transmitters which are dynamotor operated.

20. Electrical Deficiencies.

The model XGQ incorporates a number of electrical features which are objectionable. They are:

A. Instability of transmitter circuits.
The models originally submitted would self oscillate readily and Serial No. X1 was returned to the contractor's plant for the purpose of eliminating this condition. When Serial No. XI was resubmitted some improvement was noticeable but instability was still present to an extent which would make the equipment unsuitable. Work done at this station indicated that the deficiency might be eliminated by reversing the winding on the crystal oscillator inductance and Serial No. X2 was returned to the contractor's plant to have this modification incorporated.

B. The two bands in the crystal oscillator circuit failed to overlap. This is to be corrected in Serial No. X2.

C. Generally unsatisfactory operation of the crystal oscillator. This includes failure to oscillate when the power amplifier was tuned to a resonance in an unloaded condition and occasionally failure to oscillate under any condition. Crystal action was much improved by putting 5 micromicrofarad coupling condenser between oscillator grid and plate.

D. Poor tuning. An objectionable feature which makes tuning difficult is the failure of maximum radiation and maximum power amplifier plate current to come at the same setting unless a very special procedure is followed in tuning the equipment. This special procedure consists in determining the correct final setting of the coupling adjustment and then resonating the power amplifier with the antenna removed. If this is done the antenna circuits resonate in normal fashion with radiation and power amplifier plate current approaching maximum values at the same time. If this procedure is not followed, the plate current will not give a true indication of resonance and overcoupling will probably result. If the antenna becomes open or grounded with the transmitter improperly tuned, the plate current will rise instead of falling off but no serious trouble is anticipated from this source. In view of the fact that the equipment is for fixed frequency operation and will probably not have to be tuned up frequently the present circuit design is considered usable. A slight improvement in the tuning action is noticeable if the transmitter is operated at full plate voltage.

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E. Considerable trouble was encountered in the sliding contacts used on the rotor coils. These were completely redesigned by the contractor and a very definite improvement observed. However, some difficulty remained due to the sliding contact touching the coil form as well as the coil and providing only intermittent contact during tuning. Sharp edges on the sliding contacts also contribute to unnecessary wear on the coil.

F. Trouble was experienced with the frequency shifting motor. This was partially due to the fact that the switching mechanism did not travel smoothly and also due to unnecessary detents on the local frequency selector switch. Furthermore the switching motor did not appear to develop sufficient torque when operated with the microphone "press to talk" button depressed. This is the condition of lowest line voltage obtainable in normal service.

G. Receiver antenna contact on key relay opened under vibration. Sturdier springs are necessary in key relay to hold it in position properly in the key up position.

21. Range of Antenna Circuits - Paragraph 3-4 of RE 13A 541.

At 3000 kc the antenna coupling circuits of the model XGQ transmitter will resonate antennas having natural periods between 2500 kc and 3050 kc and also antennas with natural periods between 3100 kc and 7000 kc. The discontinuity of the antenna circuit between 3050 kc and 3100 kc (approximate) has definitely been established by careful measurements but it is sufficiently small and occurs at such a point that no trouble is expected in service from this particular deficiency. However it is pointed out that the transmitter cannot be used at 3000 kc with antennas which are smaller than the standard 15 foot full Vee antenna. Half Vee 15 foot antennas and short fore and aft antennas cannot be used at 3000 kc without modification unless additional antenna loading is supplied. At the upper end of the frequency range the transmitter can be resonated with any antenna except those whose natural period comes near one half the output frequency. This means that the upper portion of the frequency range would not operate properly on the large fixed antennas used on patrol boats. The entire frequency range can be tuned to an antenna whose constants are similar to the 15 foot standard full Vee shown in enclosure (A) and it is probable that this type antenna can be provided for ferry work in most instances. Numerous larger antennas can also be resonated but the operation is no longer straightforward and confusion may result in tuning.

22. Operation from battery power supply.

This of course is strictly a function of the condition of the

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battery but during flight tests, using several different batteries chosen at random, it was never possible to operate beyond a very few minutes and in two instances the battery would not carry the load at all. Batteries used in the radio test plane are rated at 10 ampere hours.

23. Loop Operation.

Loop operation on broadcasting stations has proven disappointing chiefly because a minimum point is hard to identify on a received signal where the percentage of modulation fluctuates violently. Furthermore, the receiver does not incorporate a beat oscillator and consequently there is no means of securing a steady signal on a broadcasting station. Better operation is secured on radio range signals where the modulation percentage of the transmitted signal remains constant. The loop is not tuned to the frequency of the incoming signal and the loop trimmer condenser in the receiver has no apparent effect on the loop operation. This appears to be a violation of 3-39 of the governing specifications but the present design will permit the use of head-rest loops with the XGQ receiver and it will not be feasible to mount the XGQ loop in planes which now carry a loop of the head-rest type.

24. Operation at Altitude.

No failures occurred nor were any signs of distress observed when the equipment was operated at 17000 feet into the smallest antennas which antenna circuits would resonate.

25. Receiver Operation.

Generally satisfactory operation was obtained from the receiver with the exception of the trouble with the remote control unit and the mechanical linkages as previously discussed. However there are two features, both within the specifications which are not considered suitable. One is the lack of CW oscillator in the receiver which makes the homing loop practically useless and the other is the incorporation of AVC circuits in the lower three bands where again the operation of the homing loop is adversely affected and, furthermore, confusion may result from the use of a receiver on radio ranges in the AVC position.

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26. Recommendations.

The following action is recommended.

A - Transmitter.

1. (3-51) Contractor shall be required to remove all spurious oscillations.
2. Action of the crystal oscillator shall be improved.
3. Suitable overlap shall be provided in crystal oscillator circuit.
4. (3-7) Frequency switching system shall be improved.
5. Satisfactory sliding contacts shall be provided.
6. Improve meter factor when measuring P.A. grid current.
7. (1-4)(2-31) Ten pound shock mounts with flexible jumpers as provided on re-submitted model shall be required.
8. (2-7) Stiffer springs are required in key relay in key open position.
9. (1-4)(3-1) Stronger mounting angles are necessary on side of case.
10. (1-4)(3-1) Mounting slides shall be marked "Right Front" and "Left Front". Omit notch for cables.
11. Tuning instructions shall be placed on reverse of calibration chart.
12. Operation of tuning indicators shall be improved.
13. (2-30) Engraving on WXYZ panel shall be changed to 1234 with 1 corresponding to Z, 2 to Y, 3 to X, and 4 to W.
14. (2-30) Engraving on antenna tuning indicator shall be reversed so settings increase with frequency.
15. (3-12) Network of 750 ohms, 0.005 microfarads shall be connected across secondary of modulation transformer.
16. Special red warning nameplate is necessary on local frequency selector switch.
17. Clearance should be provided for crystal holder terminals.
18. Panel catches should be secured to case more ruggedly.
19. Sharp corners should be removed on snap slides.
20. (3-4) Present range of antenna coupling circuits shall be considered suitable for 15 foot full Vee antennas. Additional loading is necessary for operation with half Vee antennas at 3000 kc.

B - Transmitter Dynamotor.

1. Dynamotors designed to operate from 13.4 volts should be furnished production equipments.

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2. (1-4)(3-1) Mounting plate should be made to fit GF-3 dynamotor mounting.
3. (1-4)(3-1) Dynamotor base plate should be shortened and mounting channel lengthened to provide necessary ruggedness.
4. (1-4)(3-1) Dynamotor barrel shall be drilled so that mounting channel can be attached for upright mounting, right side mounting or left side mounting.
5. Wrench for changing 100 ampere fuse may be omitted.
6. Consideration should be given to possibility of providing spare fuse mountings for high voltage fuse and control circuit fuse.

C - Transmitter Remote Control Box.

1. (1-4)(3-1) Make dimension correspond to RU receiver switch box exactly. Use smaller snap slides for attaching to mounting plate if necessary. Drill holes in mounting plate with same spacing as at present but symmetrical with respect to edges.
2. Provide suitable standby lights.
3. Provide small calibration chart on right side of unit for logging transmitter frequencies.

D - Receiver.

1. (1-5(3)) Consider addition of beat oscillator for CW reception.
2. (3-22) Eliminate AVC on lower three bands.
3. Consider snapslide design where slides are held in place by receiver being locked in its case.

E - Receiver Dynamotor.

1. Satisfactory.

F - Receiver Remote Control.

1. (2-11) Increase size of lettering showing band limits.
2. (2-11) Provide more suitable mechanical linkage.
3. (3-36) Provide dial which is clearly visible from 40° below the normal to at least 90° above the normal.
4. (2-11) Provide controls with sufficient torque for tuning receiver and selecting desired band.
5. (1-4)(3-1) Eliminate quick detachable mounting plate entirely; also eliminate lips with snap slides. Make contents of unit removable by loosening knurled head screws which extend through front panel. In this way the unit becomes interchangeable with with GP pilot's control box in mounting requirements.

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6. (2-11)(2-27) Provide direct reading calibration for at least that portion of the range extending from 150 to 680 kilocycles.
7. (1-5(3)) Provide outlet for two headphones.
8. Provide small calibration chart on top of unit for recording frequency settings.

G - Cables.

1. Provide internal shielded (rubber covered) cables.
2. (1-4)(3-1) Mark plugs and receptacles with corresponding numbers to facilitate installation.
3. Careful check is necessary to determine whether plugs fit in place properly.
4. Right angled plug is desired for receiver end of sidetone cable. All others are to be straight plugs.
5. Transmitter power cable shall have 1/2" fitting. Receiver cable shall have 3/8" fitting.

H - Nameplates.

1. (2-2) Nameplates shall be reverse etched and made of nickel silver.

I - Subject to the above, it is recommended that the XGQ be released for production.

J - Recommendations for future equipment. General.

1. Receivers shall have calibration dials which read directly in kilocycles.

2. Receivers shall incorporate beat oscillator for reception of CW signals.

3. Receiver calibration dials shall be visible from the normal up to angles of 90°.

4. Cables shall be of the internal shielded type.

5. Range of D.C. voltage output of NEA-2 and comparable generators shall be defined as 11 to 15 volts instead of 12 to 16 volts. For loads of the order of 20 amperes the supply voltage will never exceed 13.0 volts.

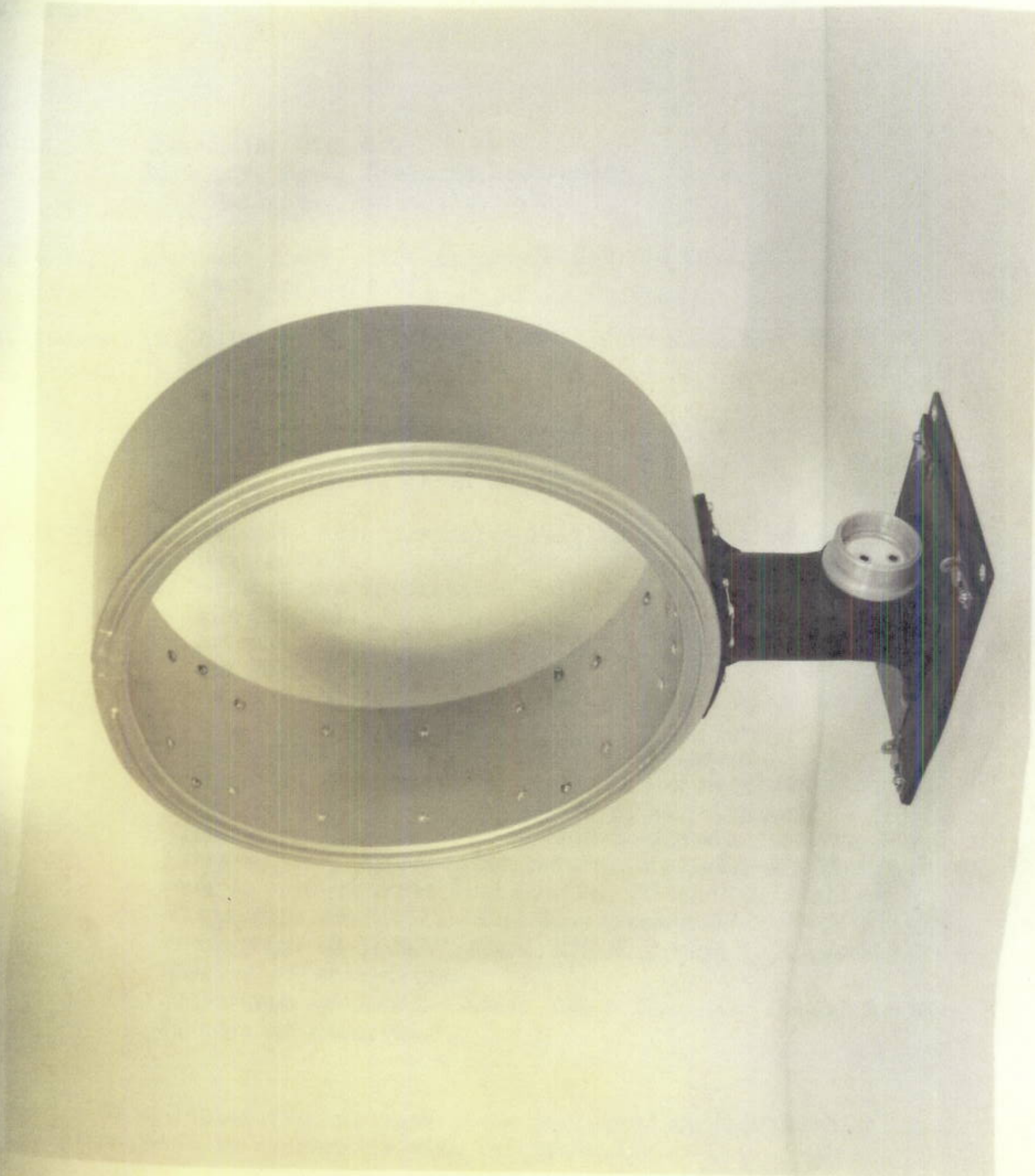
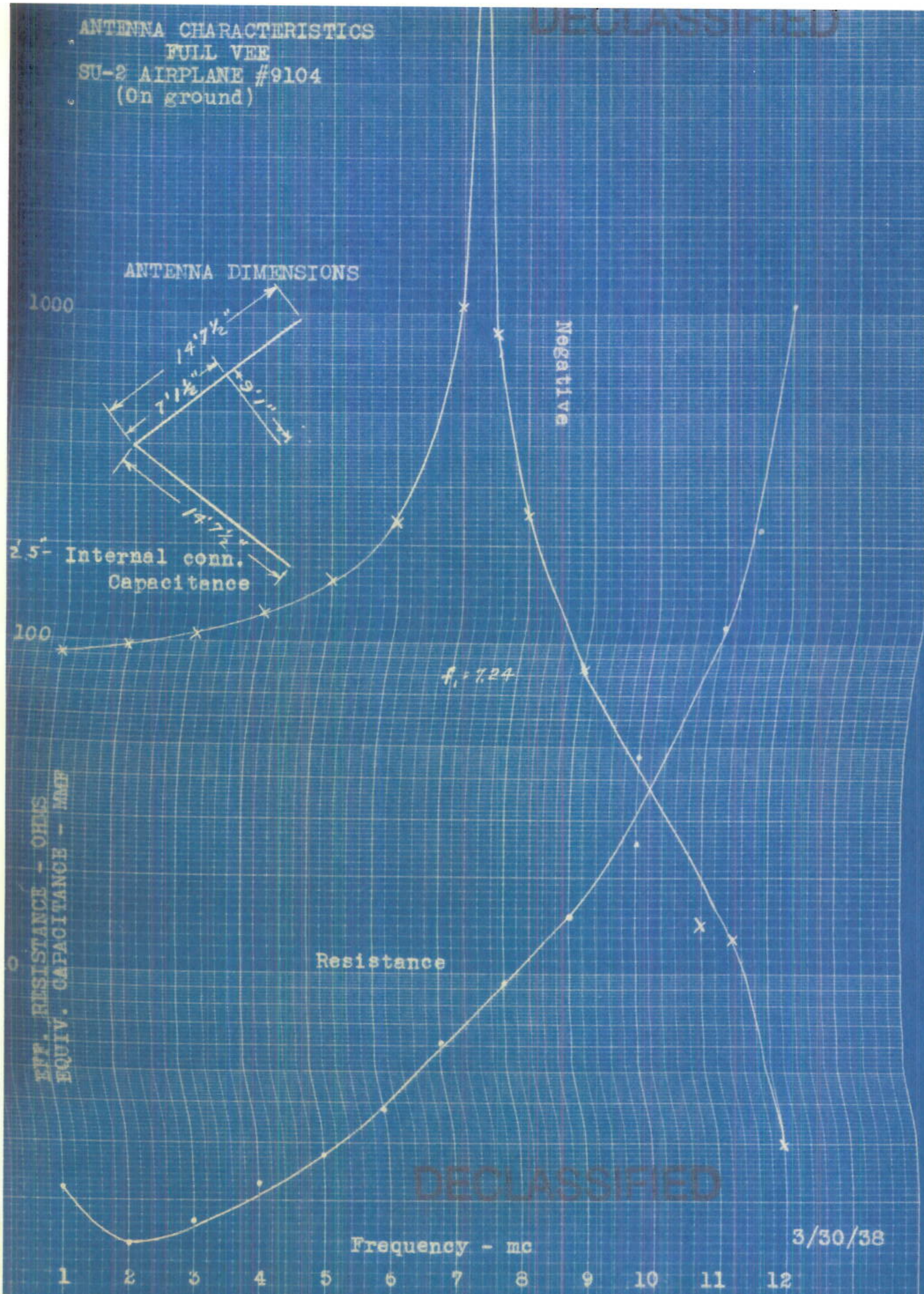
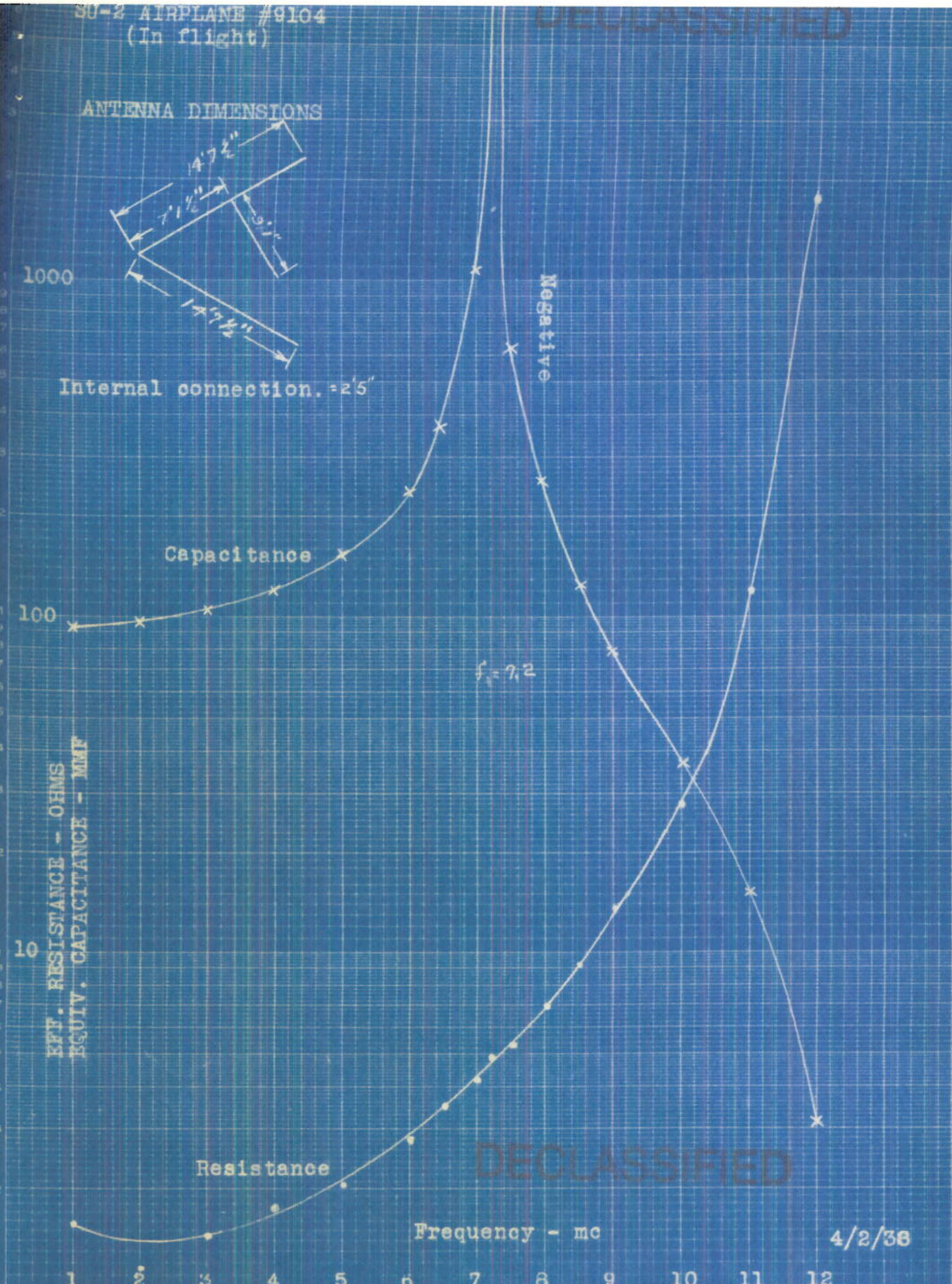


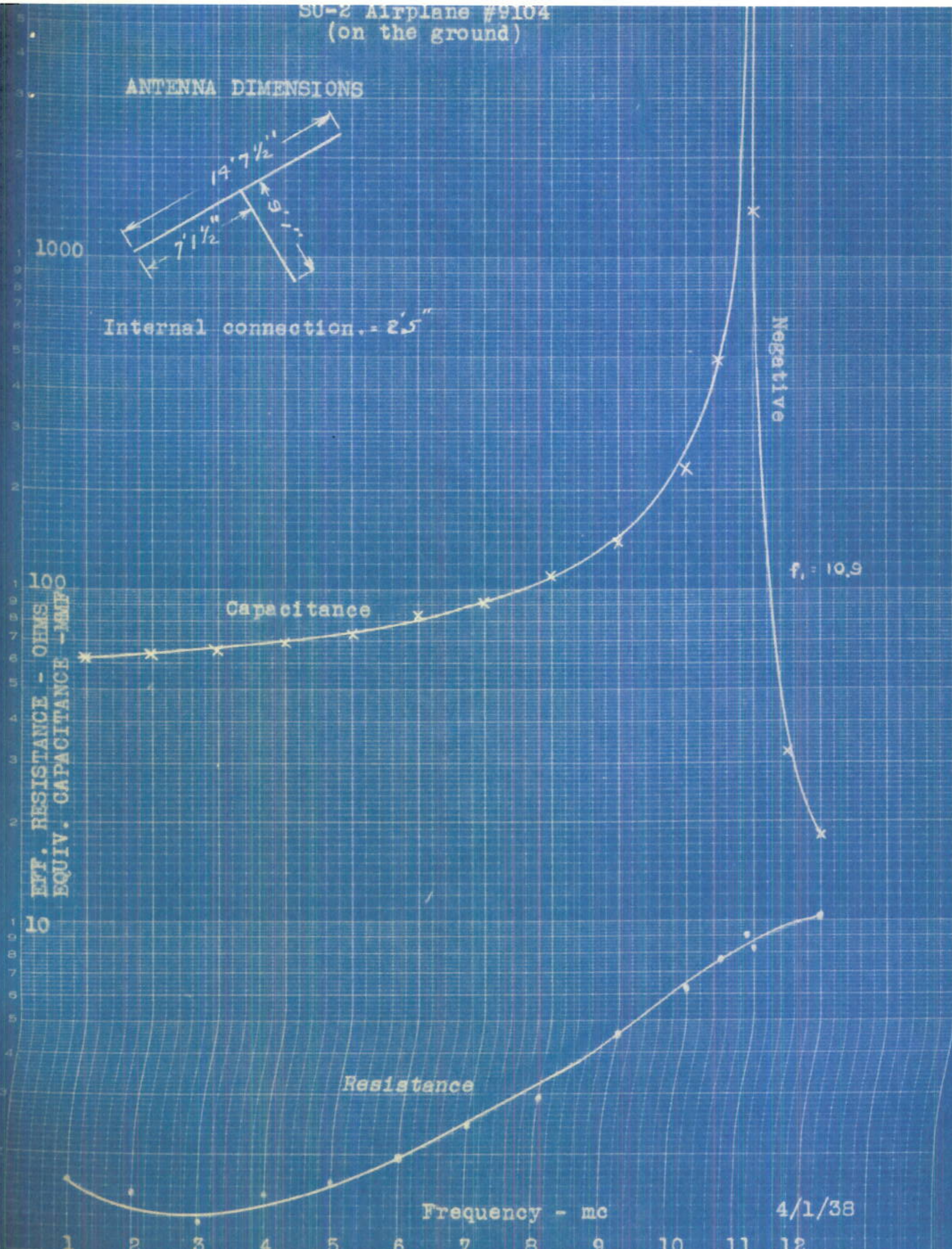
Plate 21


ANTENNA CHARACTERISTICS
FULL VEE
SU-2 AIRPLANE #9104
(On ground)
ANTENNA DIMENSIONS
14'7½"
7'1½"
9'1"
14'7½"
2.5 - Internal conn. Capacitance
Negative
f_1 = 7.24
Resistance
EFF. RESISTANCE - OHMS
EQUIV. CAPACITANCE - MMF
1000
100
10
Frequency - mc
1
2
3
4
5
6
7
8
9
10
11
12
3/30/38
DECLASSIFIED

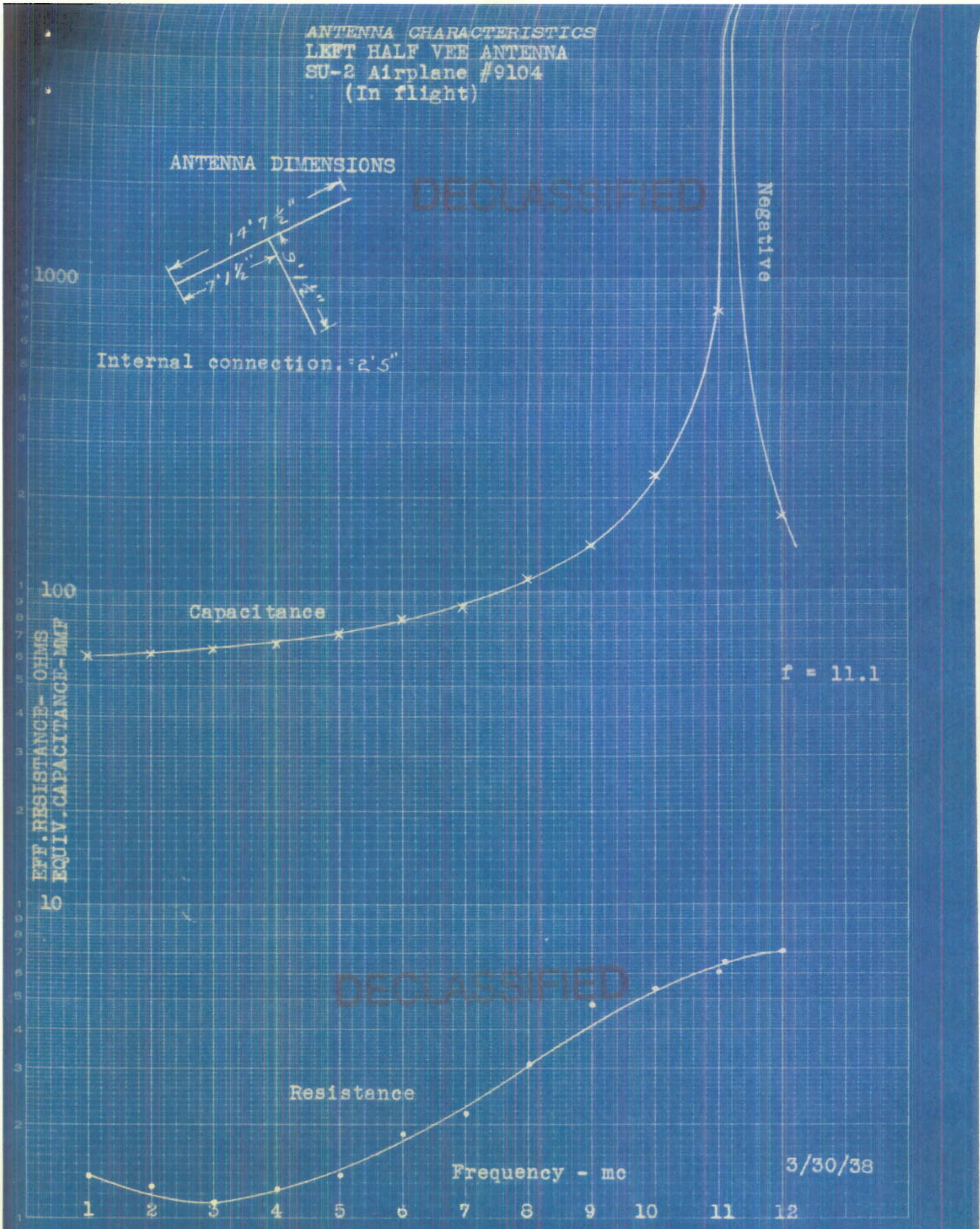
Enclosure (A)


SU-2 AIRPLANE #9104
(In flight)
ANTENNA DIMENSIONS
14'7½"
7'1½"
9½"
14'7½"
Internal connection. = 2'5"
Negative
Capacitance
f_0 = 7.2
Resistance
EFF. RESISTANCE - OHMS
EQUIV. CAPACITANCE - MMF
1000
100
10
1
Frequency - mc
1 2 3 4 5 6 7 8 9 10 11 12
4/2/38

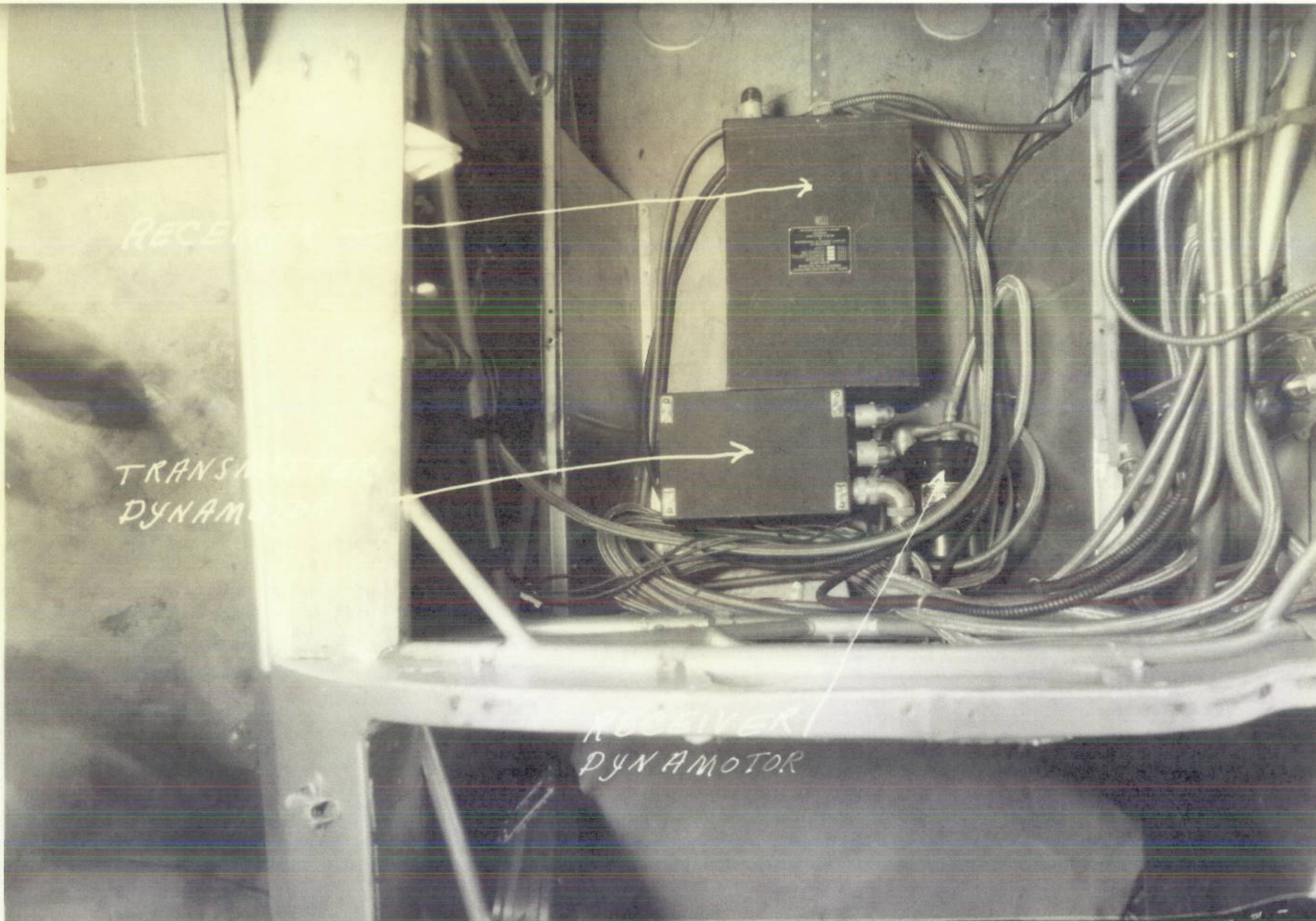
Enclosure (B)


SU-2 Airplane #9104
(on the ground)
ANTENNA DIMENSIONS
14'7½"
7'1½"
9'1"
Internal connection - 2'5"
1000
100
10
Capacitance
Resistance
Negative
f₁ = 10.9
EFF. RESISTANCE - OHMS
EQUIV. CAPACITANCE - MMF
Frequency - mc
4/1/38
1 2 3 4 5 6 7 8 9 10 11 12

Enclosure (C)


ANTENNA CHARACTERISTICS
LEFT HALF VEE ANTENNA
SU-2 Airplane #9104
(In flight)
ANTENNA DIMENSIONS
14'7½"
7'1½"
9'1½"
Internal connection: 2'5"
DECLASSIFIED
Negative
1000
100
10
1
Capacitance
f = 11.1
EFF.RESISTANCE- OHMS
EQUIV.CAPACITANCE-MMF
DECLASSIFIED
Resistance
Frequency - mc
3/30/38
1
2
3
4
5
6
7
8
9
10
11
12

Enclosure (D)



Model XGQ Equipment; Top View of receiver, transmitter dynamotor and receiver dynamotor. Rear cockpit installation SU-2 #9104 airplane.

AN-51619 5/18/38

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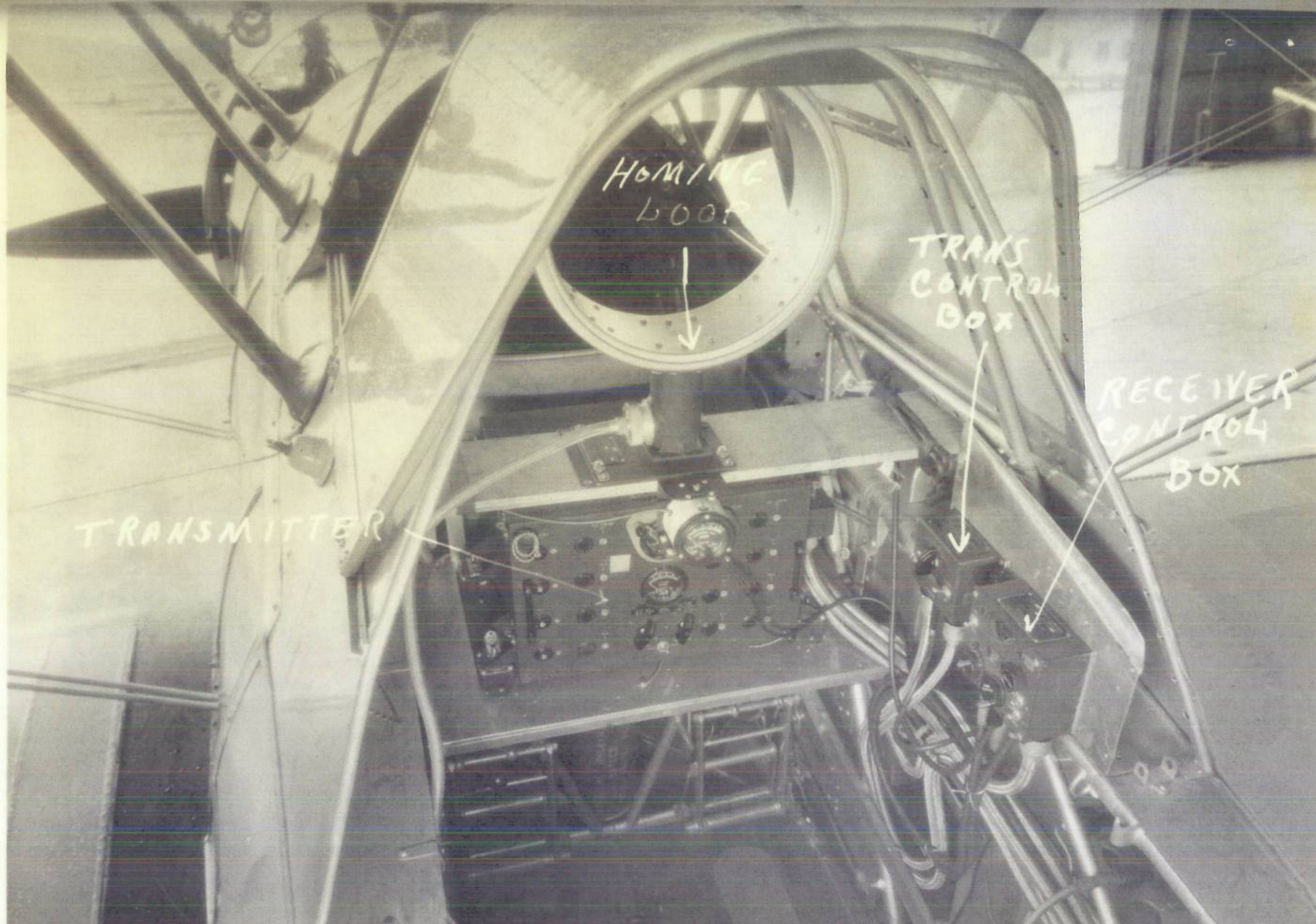
NOT TO BE USED FOR PUBLICATION

(INCLOSURE (E))



Model XGQ Equipment; Homing loop, transmitter, transmitter control box, and receiver control box in rear cockpit installation SU-2 #2104 airplane.

AN-51618 5/18/38

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(ENCLOSURE (F)

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SU-2 Airplane #9104
Full Vee Antenna.

AN-51691 5-31-38

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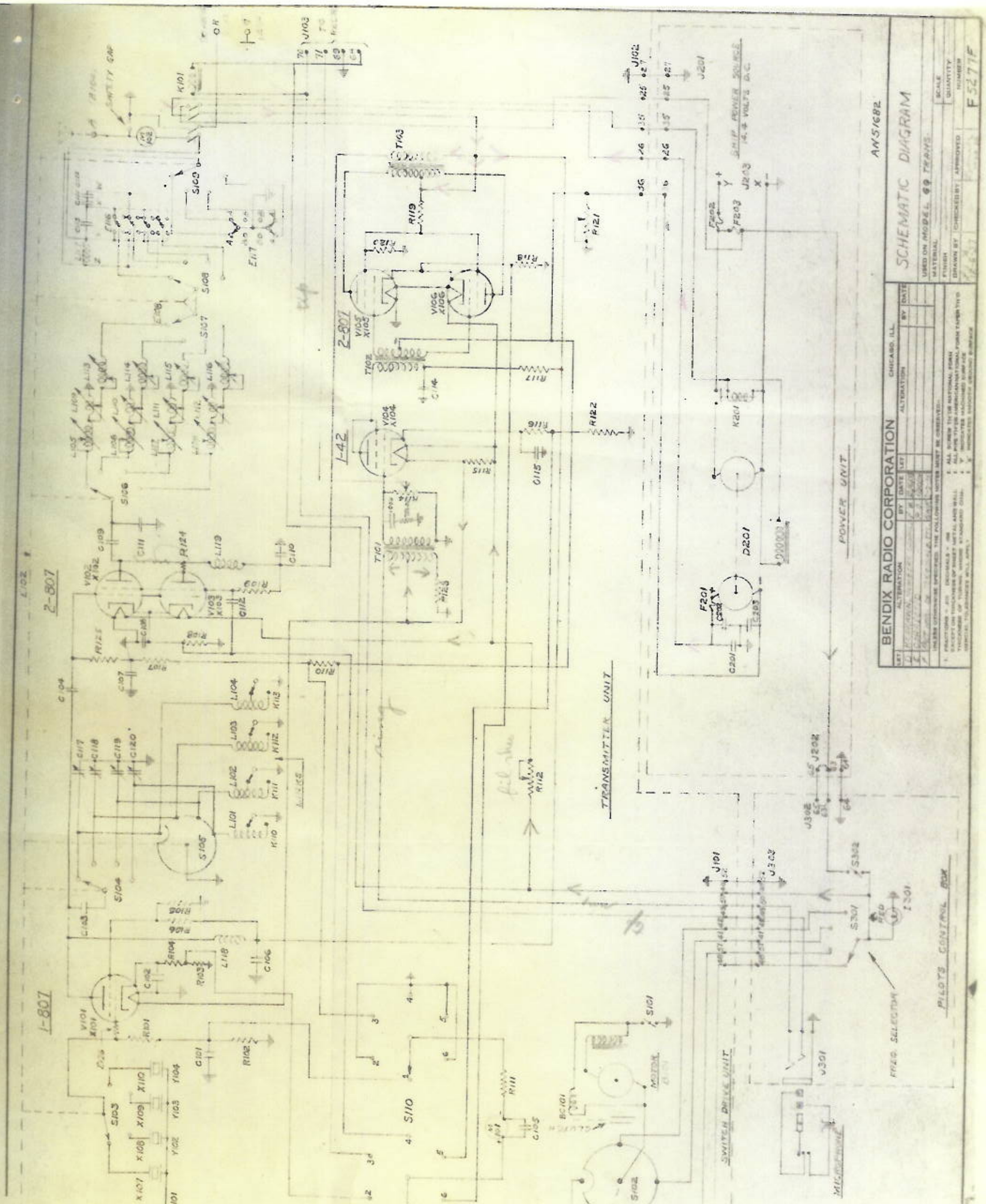
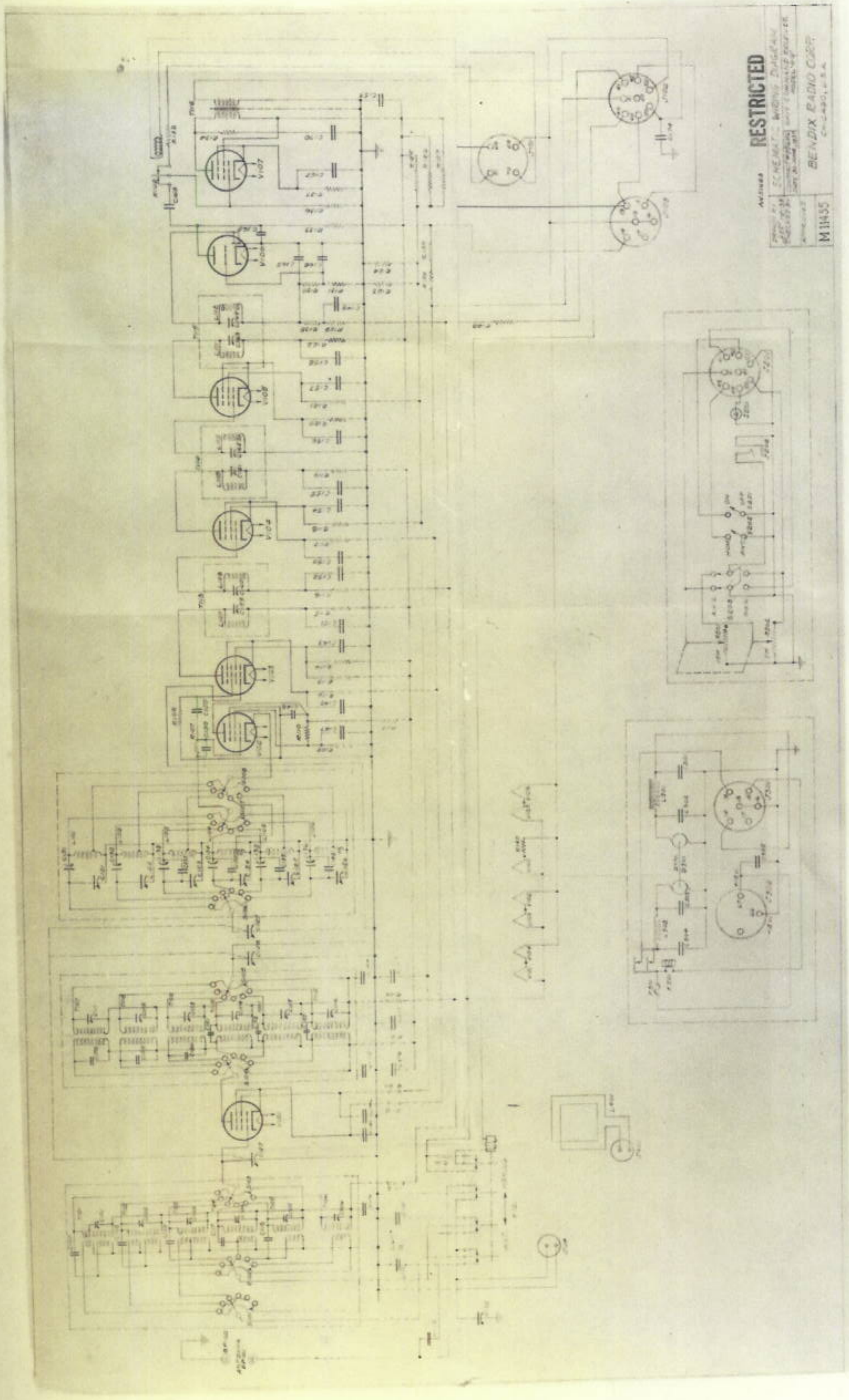
ENCLOSURE (G)

CONFIDENTIAL

RESTRICTED


BENDIX RADIO CORPORATION
CHICAGO, ILL.
SCHEMATIC DIAGRAM
USED ON MODEL 69 TRANS.
E5277F
TRANSMITTER UNIT
POWER UNIT
SWITCH DRIVE UNIT
PILOTS CONTROL BOX
SHIP POWER SOURCE
1-807
2-807
1-42
MICROPHONE
FREQ. SELECTOR
MOTOR

Enclosure (H)



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Enclosure (I)