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TEST OF MODELS TBY-1 and TBY-2 RADIO TRANSMITTING EQUIPMENTS

By
M. F. Hodges

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NAVY DEPARTMENT

Report on Test of Models TBY-1 and TBY-2 Radio Transmitting Equipments

Contractors:
Westinghouse Electric and Manufacturing Co.
Colonial Radio Co.

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D. C.

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AUTHORIZATION

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

Reference:
(a) BuShips ltr. C-NOs 80643(480H) of 1 October 1942. (Problem T54C, Priority AA)
(b) BuShips ltr. C-Nxs 4303(480H) of 1 October 1942. (Problem M50C, Priority AA)
(c) Electronics Laboratories, Inc. ltr. Ref. S67/21(480-H) of 9 November 1942 to BuShips.
(d) BuShips ltr. C-NXs-4303(480H) of 17 November 1942,
(e) BuShips ltr. C-NXs-4303(926) of 10 December 1942.
(f) Specifications RE 13A 535B for Ultra Portable Radio Transmitting Receiving Equipment.
(g) Specifications RE 13A 535C for Ultra Portable Radio Transmitting Receiving Equipment.
(h) Second Marine Brigade ltr. of 20 May 1942 to Signal Depot Quartermaster, San Francisco, California, and enclosures.

OBJECT OF TESTS

2. The objectives of the tests were:

(a) To examine the equipment to determine its ability to withstand the rigors of Naval Service.

(b) To determine the performance when subjected to various conditions likely to be encountered in Naval Service.

(c) To ascertain what modifications are necessary to insure satisfactory operation under Naval Service conditions.

(d) To ascertain if the equipment meets contractual specifications.

(e) To obtain data to facilitate the preparation of specifications necessary for the purchase of new equipment.

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ABSTRACT OF TESTS

3. The tests herein reported were conducted to determine the performance of the equipment under operating conditions experienced in the Marine Corps and on shipboard. Inspection and tests were conducted as follows:

(a) Determination of ability to withstand the rigors of Naval Service.

(1) Vibration and shock tests were conducted.
(2) Operation of the equipment at high and low temperatures and relative humidities was investigated.
(3) The ability of the equipment to withstand transportation as a pack load and as cargo was considered.
(4) The operation of protective devices was investigated.
(5) Operation tests of the equipment while being transported as a pack load were conducted.

(b) Performance Characteristics.

(1) Measurements were made to determine the power output into a dummy antenna.
(2) The frequency range and overlap of the equipment was determined.
(3) The useful operating life of the battery supplies and power requirements were determined.
(4) The effects of temperature and humidity on power output and frequency were measured.
(5) Frequency stability under conditions of shock and vibration were determined.
(6) The operational characteristics of the crystal calibrator were investigated.
(7) Tests to determine the frequency characteristics and modulation capabilities of the audio system were conducted.
(8) The effects of reduced battery voltages were noted.
(9) The effect on output frequency of changing tubes was recorded.
(10) The effect of backlash, torque lash and lost motion on output frequency was investigated.
(11) The accuracy with which the transmitter could be reset to a given frequency was measured.
(12) The effect of dial locks on frequency was investigated.
(13) The amount of carrier hum and ripple introduced by the vibrapack-storage battery supply was measured.

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(o) The equipments were examined to ascertain the suitability of design and compliance with contractual specifications as follows:

(1) Dimensions and weights.
(2) Controls, meters and nameplates provided.
(3) Check of protective devices.
(4) Check of mechanical and physical construction and assembly, general workmanship, materials used, corrosion resisting measures taken, and the adequacy of the electrical circuits for operation under Naval Service conditions.

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CONCLUSIONS

(1) The Model TBY-1 and TBY-2 equipments were intended for ultra portable ultra-high-frequency transmission and reception. The TBY-1 series equipments were manufactured in accordance with usual practice for standard Naval equipment, whereas the Model TBY-2 series equipments were manufactured on a mass production basis. Performance tests show negligible differences in the two series.

(2) The power output requirements of Specification RE 13A 535C cannot be fulfilled by the TBY equipments if the oscillator tubes are operated within the tube manufacturer's recommendations.

(3) Reliable communication between two TBY equipments will depend largely on the skill and judgment of the operating personnel in choosing the optimum frequency and location for the transmitters.

(4) Tests indicate the desirability of using a storage battery vibrator power supply to replace the dry batteries originally used with this equipment. Suitable modification of the Type CLG 20145 vibrator power pack must be effected to provide a higher plate voltage than is available with the present design.

(5) The performance of the TBY equipments together with the vibrator power supplies under severe conditions of shock vibration, temperature and humidity indicates that it will withstand the conditions encountered in field service provided modifications discussed in this report are made.

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RECOMMENDATIONS.

To insure reliable operation of the Models TBY-1 and TBY-2 equipments under Naval Service conditions, and to comply with the requirements of governing specifications, it is recommended:

(1) That improved methods of packing the equipment be used to preclude damage from mold and moisture condensation within the shipping chest. (Paragraph 7)

(2) That a spare milliammeter be furnished for the equipment as required by the specifications. (Paragraph 16)

(3) That transmitter tube replacement sockets and instructions for installation be furnished as basic spare equipment. (Paragraph 17g)

(4) That a tube from the Army-Navy approved type list be used instead of the Type 30. (Paragraph 17h)

(5) That the tube manufacturer's specifications for mounting the Type 958-A tubes be followed. (Paragraph 17h)

(6) That consideration be given to redesigning the audio system using approved types of miniature tubes. (Paragraph 17h)

(7) That the use of plated steel in minor applications be approved. (Paragraph 21)

(8) That the use of electrolytic filter capacitors in the Type CLG-20144 vibrator power unit be approved. (Paragraph 24)

(9) That the design of inductance L-12 be improved for humidity protection. (Paragraph 26)

(10) That inductances in the radio frequency and audio frequency circuits of the TBY equipment not hermetically sealed be heavily waxed. (Paragraph 26)

(11) That reactors and transformers in the Type CLG 20144 vibrator power unit be heavily waxed.

(12) That the vernier dials be pinned to their respective drive shafts. (Paragraph 38)

(13) That permanent, legible markings be placed on the equipment chassis adjacent to the components to facilitate servicing. (Paragraph 42)

(14) That greater accessibility to components underneath the transmitter chassis be afforded. (Paragraph 43)

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(15) That letter designations for panel controls be provided. (Paragraph 47)

(16) That cabling of wires leading to the transfer relay, K-1, be eliminated. (Paragraph 48)

(17) That necessary provision be made to exclude water from the TBY equipment. (Paragraph 51(2))

(18) That provision be made to illuminate the dial calibration booklet. (Paragraph 53)

(19) That a heavier gauge of metal be used in the cover snap fastener (Paragraph 55a)

(20) That the external charger-plug input socket on the Type CLG-20144 vibrator power unit be provided with a waterproof cover. (Paragraph 55c)

(21) That the design of the spill-proof vent incorporated in the Type CLG-19029 storage battery be improved. (Paragraph 55c(b2))

(22) That the method of mounting inductances and filter capacitors in the type CLG 20194 vibrator power unit be changed. (Paragraph 55c(b3))

(23) That hook-up wire having better insulation be used in the Type CLG-20144 vibrator power unit. (Paragraph 55c(b3))

(24) That the illumination afforded by the panel lamps be reduced. (Paragraph 55e)

(25) That a lubricant less affected by low temperatures be used on all control shaft bearing surfaces instead of that now used. (Paragraph 55h)

(26) That a suitable waterproof membrane be provided to protect the microphone in rainy weather. (Paragraph 59)

(27) That a clip be provided for attaching the telegraph key to an operator's belt or pocket. (Paragraph 60)

(28) That a flexible spring at the base of the antenna be provided to permit 90° flexing through a 360° arc of rotation. (Paragraph 67)

(29) That antenna segments of the same size be made interchangeable between different antennas. (Paragraph 68)

(30) That the design of the canvas carrying case be approved. (Paragraph 69 to 76)

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(31) That the location of the nameplates on the shipping chest be changed to conform with the specifications. (Paragraph 77b)

(32) That suitable phenolic nameplates be furnished on the shipping chests. (Paragraph 77b)

(33) That a secure method of retaining spare vacuum tubes in their compartment be incorporated in the shipping chest. (Paragraph 77f)

(34) That the Bureau of Ships determine the operating time desired for the Model TBY equipment combined with a type CLG-20144 vibrator power unit and Type CLG-19029 storage battery based on field requirements. (Paragraph 79b)

(35) That the current delivery capacity of the type 19018-A dry battery be increased. (Paragraph 79c)

(36) That the "Off" position of the filament control rheostats be eliminated. (Paragraph 82)

(37) That the ground terminal of the calibrator crystal and socket be permanently marked. (Paragraph 86)

(38) That rubber less affected by low temperatures be used for the telegraph key covering. (Paragraph 93)

(39) That the frequency stability of the Model TBY equipment under voltage variations be improved. (Paragraph 95)

(40) That consideration be given to incorporating in the TBY equipment a means of indication that the transmitter is oscillating. (Paragraph 97d)

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MATERIAL UNDER TEST

4. The material under test consisted of the following:

2 - Model TBY-1 Transmitter-Receivers, Type CAY-43007, Westinghouse Electric and Manufacturing Co., Serial numbers 642 and 646. Frequency range 28 to 80 megacycles.

2 - Model TBY-2 Transmitter-Receivers, Type CKI 43007, Colonial Radio Corporation, Serial numbers 124 and 200. Frequency range 28 to 80 megacycles.

2 - Type CWA 66025 antennas.

2 - Type CWN 66025 antennas.

1 - Complete set of vacuum tubes for each of the above equipments, including three spare tubes carried in the units.

1 - Additional complete set of spare vacuum tubes for each of the above equipments.

2 - Type CAY 10038 shipping chests each containing spare hardware, the above listed tubes, and 3 Type CGD 19018 dry batteries.

2 - Type CRH 10038 shipping chests each containing the same number of tubes and hardware, and 3 Type CNC 19018-A dry batteries.

4 - Canvas carrying cases, Type CSS 10039, for Model TBY equipment.

8 - Headphone-microphone combinations: Headphone Type CTE 49016; Microphone Type CTE 51004-B.

4 - Telegraph key-send receive switch combinations: Type CAY 26013.

1 - Instruction book for Model TBY and TBY-1 equipments.

2 - Instruction books for Model TBY-2 equipments.

5. Plates 25 to 41 inclusive are views showing the construction of the Model TBY equipment. Various aspects of operation are also illustrated. The photographs include views of the Type CLG 19029 and CLG 20144 storage battery and vibrator power supply attached to the Model TBY equipment in normal operating position. Operation of these units with the TBY equipment is described in this report, and a more detailed report will be contained in a supplementary letter report to

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be written by the Laboratory.

6. The serial numbers 124 and 200 TBY-2 equipments were received at the Naval Research Laboratory September 15, 1942. The number 642 equipment was received October 29, 1942, and the number 646 equipment was received November 16, 1942.

METHOD OF TEST

7. The TBY equipments were carefully unpacked and examined for damage received in transit. No damage to any equipment which could have been incurred in transit was evident. The number 646 equipment, however, when unpacked from the Type CRH 10038 shipping chest had mold growths on the canvas carrying case (Type CSS 10039) on the bakelite dial-driving gears in the transmitter-receiver unit, on the headphone-microphone units, and on the front panel of the transmitter-receiver unit. The rubber earpieces on one headphone unit was also slightly sticky as a result of this mold growth. Investigation revealed no damage to the equipment resulted from this mold, but the condition indicates that an improved method of storing and packing this equipment must be devised if it is to be successfully used in the tropics.

8. The general construction of the transmitter and modulator of each equipment was examined and the components were inspected as completely as possible.

9. The transmitters were adjusted in accordance with the directions contained in the instruction books furnished. Measurements of the power output from each unit were made by the photometer substitution method using dummy antennas which simulated as closely as possible the characteristics of the Type CWN and CWA 66025 whip antennas furnished as part of the TBY equipment. Tables covering the various power output tests include a description of the antenna used in the measurement.

10. A Model TBY-1 and TBY-2 equipment were placed in a test chamber and subjected to controlled variations in ambient temperature and relative humidity. Periodic readings of frequency, temperature, relative humidity, power output and other important data were made at regular intervals and recorded. Each equipment was operated only during the period readings were being taken and remained turned off for the balance of the interval. The transmitter output frequency was measured by means of a General Radio Type 620-A Heterodyne Frequency Meter. During these tests the ambient temperature was varied between the limits of -40°C and +60°C with the relative humidity held to a low level. Then the relative humidity was varied between the limits of approximately 20% and 90% at a constant temperature of 40°C. The ability of the equipments to start after an idle period at temperatures

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between -40° and zero degrees centigrade was brought out by this test, as well as their ability to start and operate after subjection to high humidity and temperatures.

11. The ability of the equipment to withstand vibration and shock was determined by mounting the equipments on a test platform capable of producing these effects in controllable amounts. The output frequency was monitored on both a standard Navy Type RBG superheterodyne receiver, and the superregenerative receiver in the TBY equipment. Voice signals were transmitted and the intelligibility of the signal in the two types of receivers was determined.

12. A field test was made to determine, insofar as possible, the peculiarities of operation of this type of equipment. Operation was with the Type 19018 dry battery as the source of power. This test is described further in paragraph 97.

13. Tests of modulation and distortion were made by means of an RCA Model 69-C distortion meter, and a cathode-ray oscillograph. Frequency range, overlap and end tolerances were determined by means of a General Radio Model 620-A Heterodyne Frequency Meter.

14. The transmitters were operated with a storage battery-vibrapack power supply, and variations in operating characteristics from those normally obtained were noted.

15. Specifications RE 13A 535B and RE 13A 535C are directly applicable to the Model TBY equipments and tests were conducted to determine the extent of compliance with these specifications. The succeeding paragraph notations in this report refer directly to these specifications.

Section I INTRODUCTORY

16. Par. 1-1 to 1-3. The general construction and design of the Model TBY-1 and TBY-2 equipment conform with the introductory section of the specifications. The equipment is complete in itself and covers the frequency range of 28 to 80 megacycles adequately. Satisfactory operation may be expected over the frequency range depending on atmospheric conditions and the experience of operating personnel. The complete TBY equipment can conveniently be transported as a pack load by one man. The equipment is supplied complete with tubes, headphones, microphones, batteries, and basic spares all contained in a steel shipping chest. However, no spare meter was furnished with the station spares, and it is recommended that a replacement meter be supplied for the equipment. Two-way communication using either voice or MCW between two Model TBY equipments

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is possible and operation may be satisfactorily maintained while being transported as a pack load, Simplicity of operation and adjustment has been attained by reducing the number of controls to a minimum.

Section II GENERAL

17. Par. 2-2. The components used in the equipments were examined and the following comments result from this investigation:

(a) Indicating Instruments. A single meter has been provided in the equipment to read filament voltages in both audio and radio frequency stages of the transmitter and receiver and to read the transmitter plate current. This meter is a 2 1/2 inch Navy standard type Model NX-33 manufactured by Westinghouse, has a non-glare glass front, and requires 5 milliamperes for full scale deflection. There is a single calibration point midway of the dial. No calibration of this meter was attempted, but mid-scale deflection of the pointer occurrs when 2.5 milliamperes passes through the meter. Under operating conditions, this mid-scale deflection point is the criterion of normal operation of the equipment. The dial marker is approximately 1/8 inch wide. The deflection of the pointer at the low edge of this marker represents 15.5 ma. plate current, 1.8 volts audio filament voltage, or 1.28 volts radio frequency filament voltage. At the high edge of the marker the deflection represents 18.5 ma. plate current, 2.2 volts audio filament voltage, or 1.48 volts radio frequency filament voltage. These readings represent respectively an 8 per cent, a 10 per cent, and a 7 per cent variation from the exact mid-scale reading.

(b) Capacitors. Molded bakelite cased mica capacitors have been employed in the construction of the TBY equipment. All are manufactured by Cornell Dubilier and are standard commercial types. The variable capacitors used in the equipments are manufactured by Hammarlund. Insulation on all variable capacitors is ceramic. Only one paper-dielectric metal-cased capacitor has been used, and it is located where it can conveniently be replaced if necessary. No electrolytic type capacitors have been used.

(c) Resistors. Composition resistors of the half-watt size were used in the construction of the TBY equipments. All are supplied with pigtail leads which serve for electrical connections and mechanical support. Two wire wound rheostats are used

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in the filament circuits of the equipment to adjust the voltage applied to the tube filaments. Two potentiometer type resistors used as regeneration and volume controls in the receiver have carbon elements. None of these resistors has a Navy type number.

(d) Head Telephones. The head telephones furnished with the TBY equipments were Telephonics Corporation's Type TH37 and bear the Navy Type number CTE 49016. A Navy Type CTE 51004-B microphone has been combined with these headphones to form a single unit which has the Navy Type number CTE 51022.

(e) Nameplates. All nameplates of the TBY equipments are photo-etched on the front panel of the equipment. Nameplate data are shown in Table 2.

(f) Insulation. Ceramic and phenolic materials were used as insulation in the model TBY equipments. Ceramic material has been used for tube sockets, variable capacitor insulation, coil forms and mounting supports, transformer terminal insulation, and feed-through and stand-off insulators. Polystyrene insulation is used on the transmitter and receiver coils to give rigidity to the coils. Phenolic material has been used as capacitor cases, tube sockets, switch cases, control shafts, gears, crystal holder, meter case, and microphone and telegraph key connector plugs. The type of insulation material, in general, has been suitably chosen for the application in which it is used.

(g) Tube Sockets. The tube sockets in the audio portion of the equipment are of the replacement type made of black phenolic material and are secured to the chassis by a split metal ring surrounding the socket itself. The same type of socket of ceramic material is used for the crystal calibrator tube, and for the socket of the crystal. The transmitting tubes are horizontally mounted and are held in place by "acorn" tube clips secured to a metal plate and a ceramic bar. Mica insulation is used under the positive filament clip holding the tube in place on the metal plate; two additional clips for the negative pins of the tube are mounted directly on this metal plate without insulation. Two such clips mounted on a ceramic bar provide grid and plate connections and mechanical support. Small metal fingers on each side of the tube

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socket serve as tube clamps by furnishing a moderate spring action when the tube is inserted in the socket. No provision for clamping the audio tubes or the crystal oscillator other than that afforded by the sockets has been provided, but no difficulty on this account was experienced during the tests. The audio tube sockets are accessible for servicing or replacement, but the transmitter tube clips cannot be replaced without special tools or extensive disassembly of the frame on which they are mounted. There is the possibility, however, of renewing the sockets by replacing the entire ceramic bar on which the clips have been previously mounted by the manufacturer.

(h) Vacuum Tubes. The TBY equipments employ a total of seven tubes in the combined transmitter-receiver. Two RCA Type 958-A tubes are used in a push-pull Hartley oscillator circuit in the radio frequency portion of the transmitter. One RCA Type 959 is used as a radio-frequency amplifier in the receiver portion of the equipment and a third RCA Type 958-A tube is used in the receiver as a superregenerative detector. One Type 30 tube is used in the combined speech-amplifier-modulator unit as an audio voltage amplifier and audio tone-oscillator. A second Type 30 is used as a crystal oscillator to provide a calibration frequency and a harmonic check point for each band of the transmitter and receiver. One Type 1E7G is used as a power amplifier modulator tube in the speech-amplifier-modulator portion of the equipment. The Type 30 and 1E7G tubes are not on the Army-Navy preferred list of vacuum tubes. It is recommended that a type be chosen from this list to replace the type 30 presently used. There is no approved substitute for the Type 1E7G, a dual pentode. Two failures of 1E7G tubes occurred during the tests; the first was due to low emission in one pentode section which caused severe audio distortion in the output; the second failure was due to a grid plate short in one pentode section. Additional tube failures occurred during the power output tests in the No. 124 and No. 646 transmitters when two pair of 958-A tubes in the oscillators failed due to low emission. In reference (h) are reported failures of this type tube in field service due to excess plate voltage causing arc-over from plate to grid. In this connection it is felt that the method of mounting these tubes may have more significance than the excessive plate voltage. The tube manufacturer's data permits horizontal

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mounting of the Type 958-A tubes in somewhat the same manner as is used in these equipments, but recommends that the plane of the tube elements be kept vertical. This recommendation has not been observed in the Models TBY-1 and TBY-2 equipments. It is probable that filament and grid sag due to heating, and the fact that the plane of the elements is horizontal were the chief causes of the arc-over experienced in the field. No failures of this nature occurred during the laboratory tests. It is recommended that the manufacturer's specifications for mounting these tubes be followed in the TBY equipments. In the interest of conserving space and reducing weight, it is also recommended that consideration be given to redesigning the audio system of this equipment using miniature type tubes from the Army-Navy list of tubes.

(i) Switches used in the transmitter are listed in Table 1. The power, crystal calibrator, and Send-Receive switches have the following ratings:

Power and Crystal Calibrator Switches	6A	125 V.a.c.
Send-Receive Switch	3A	125 V.a.c.
Dial Lamp Momentary and Interlock Switches each	0.75A	125 V.a.c.

The band switches in both transmitter and receiver are a four position-type on which the coils for the four operating bands are mounted. These switch assemblies were apparently specially manufactured for the TBY equipments and appear mechanically suitable for the purpose.

(j) A hand telegraph key bearing Navy Type number CRH 26013 was furnished with the TBY equipment. The key is so designed that it can be attached to the TBY case, or carried in one hand while being operated.

(k) The design of the equipment, with the exception of the receiver and transmitter coil turret switches, is such that component units commercially available are used. The vacuum tubes used are available from more than one manufacturer.

(l) The antenna connection is provided on the left side of the transmitter-receiver case as shown in Plate 28. The bottom feed-through insulator is connected internally to the coupling circuit

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of the transmitter by a short length of flexible wire. The feed-through insulator at the top edge of the case acts merely as a guide and support for the antenna. The operating potential of the antenna connection is so low that no danger to personnel is involved if it is touched while the transmitter is operating.

(m) No indicator lamps were furnished in this equipment, other than momentarily operated dial lights. This permits saving considerable battery power. Indication of operation sufficient to obviate the necessity for indicator lamps is provided by the filament voltmeter incorporated in the equipment.

18. Par. 2-3. The equipment is ruggedly constructed of aluminum alloy for lightness and mechanical strength. Suitable bracing or other reinforcement has been provided where necessary to support or mount component units in the equipment.

19. Par. 2-4. All surfaces exposed during operation of the equipment when removed from the carrying case, including plated surfaces of plugs and switches, have a dull finish.

20. Par. 2-5. The components of the TBY equipments appear suitably protected from possible damage by salt spray. Contact between the aluminum alloy chassis and dissimilar metals has been avoided insofar as possible, and such other metals as have been used are plated. No exposed brass, bronze or copper surfaces not protected by a suitable plating or enamel were revealed by an examination of the equipment.

21. Par. 2-6. Plated steel has been used to a limited extent in the construction of the TBY equipments. Nuts on the microphone and key connector plugs and the mounting plate of the transfer relay K-1 are of cadmium plated steel and are the only places in the equipment proper that magnetic material has been used where another material might have been substituted. The cases of the Type CNC 19018 dry battery, and the Type CLG 19029 storage battery and Type CLG 20144 vibrator unit associated with the TBY equipment are of sheet steel. The Type CNC 19018 case is protected by olive green enamel, and the Type CLG 19029 storage battery and Type CLG 20144 vibrator units are finished in olive-green wrinkle enamel on the outside, and smooth grey enamel inside. These applications are such that efficient operation of the equipment would not be adversely affected if the parts mentioned should eventually rust. No corrosion of these parts was evident at the conclusion of the humidity tests conducted at the Laboratory.

22. Par. 2-1. The equipments tested under temperature and humidity variations performed acceptably. Minor difficulties and the general operation during these tests will be discussed further in paragraphs 93 and 94.

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23. Par. 2-8. The design of the electrical circuits is adequate to protect any part which might be subjected to an overload. No fuses were provided in the equipment, however. Controls, although small, are of ample size to permit the use of heavy gloves by personnel in the field.

24. Par. 2-9. No electrolytic capacitors were used in the TBY transmitter-receiver units. In order to obtain the necessary filtering of the output of the vibrator in the Type CLG-20144 vibrator power unit, high capacity electrolytic capacitors have been used. Paper capacitors of comparable rating would be prohibitively large, and it is recommended that the use of electrolytic types be authorized for this purpose.

25. Par. 2-10. One foil-paper capacitor was used in the TBY transmitter. No trouble was experienced with this capacitor during the tests.

26. Par. 2-11. Transformers and the foil-paper capacitor are hermetically sealed in metal containers. The transformers are cadmium plated; tin plating was used on the capacitor case. Choke coils used are in radio frequency circuits, with the exception of L-12, and are solenoid wound on ceramic forms. L-12 is an audio plate choke and is not hermetically sealed. Since it has been reported this choke has failed in service due to moisture and corrosion, it is recommended that an hermetically sealed choke of equivalent characteristics be used in its place, or that by suitable waxing, it be protected from the effects of humidity. In the Type CLG 20144 vibrator power equipment, the filter chokes are open type units and are not hermetically sealed but are protected by a heavy coat of varnish. Transformer T101 is similarly protected. It is recommended that all reactors and radio frequency choke coils be additionally protected by a heavy wax coating as a means of resisting the effects of fungus growth on these components. Electrolytic capacitors in the type 20144 vibrator power unit are sealed, and their cases protected by zinc chromate paint.

27. Par. 2-14. No material in the TBY equipment flowed at temperatures up to 65°C, the limiting temperature attained during the tests. No material cracked at temperatures as low as -39°C.

28. Par. 2-15. Insulation used in tank circuit inductances is polystyrene. Contacts on the transfer relay K-1 carrying r.f. are suitably insulated by styrene material. Variable capacitors, switch components, and tube sockets are ceramic. Capacitor plates are silver plated, are adequately secured to their mountings, and were not adversely affected by shock and vibration.

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29. Par. 2-17. No wood was used in any component of the TBY equipment.

30. Par. 2-18. The TBY-1 No. 646 and TBY-2 No. 124 equipments were operated with a Type 19018 dry battery in the various positions described in Table 42. No great difference in operation was noted between the two equipments, and transmission and reception appeared normal on both. The equipments were dismantled, transported and set up numerous times incidental to various tests and no damage resulted.

31. Par. 2-19. Machine screws and nuts are secured by the use of external tooth lock washers. Ceramic antenna insulation bushings have cork strain-reducing washers. Ceramic tube sockets, capacitor insulation, coil forms, and other stand off insulators which are not subjected to strain are not protected, however. Wiring has been secured to terminals by non-corrosive soldered connections. Vacuum tubes are mounted in a manner to remain unaffected by vibration or rough handling. Tube shields, where used, have been properly secured to prevent jarring loose.

32. Par. 2-20. The transmitter oscillator tube sockets are not a single-unit type. See Par. 17g of this report.

33. Par. 2-21. The design of the basic equipment permits satisfactory operation using vacuum tubes whose characteristics are within Navy standard specifications. The measured operating voltages and currents of each tube in the No. 646 equipment are recorded in Table 19. Comparison of these values with the maximum limits imposed by applicable Navy specifications and the manufacturer's ratings reveals that filament voltages are from 2 to 5 per cent greater than the recommended values for most of the tubes. This excess is due to the calibration of voltmeter M-1, inasmuch as these voltages are individually adjustable by means of rheostats. The filament voltage of the crystal calibrator is intentionally low to decrease the power obtained from the oscillator. The only data available on the 958-A tube as a radio frequency oscillator were in the form of a tentative specification which indicates that the plate power input to these tubes in the TBY-1 is 9 per cent greater than the recommended maximum. This will be reduced after a comparatively short operating time as the battery voltage decreases. Only data for Class B operation of the Type 30 tubes were available. Assuming an operating efficiency of 60 per cent, the dissipation per tube in Class B operation under the typical operating conditions is 0.7 watts. The measured input to this tube as an oscillator is 0.6 watts, and an operating efficiency of 30 per cent as an oscillator may be safely assumed. Thus, the input to the Type 30 tube is

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within the manufacturers rating. (See Paragraph 17h for a discussion of tube failures.)

34. Par. 2-22. The equipment is electrically shielded and all external parts are at d.c, ground potential. Hand and body effects are nevertheless pronounced due to the proximity of the operator to the antenna and the frequencies used. These effects, however, cannot be avoided and can be minimized only by intelligent operating technique during service operation.

35. Par. 2-23. Design and control of the circuits were made adequately simple to permit operation by relatively inexperienced personnel. Cognizance must be taken of the fact, however, that operating conditions over which no control may be had will complicate actual service operation of any equipment in the frequency range of the TBY series.

36. Par. 2-24. The basic equipment is capable of being adjusted and operated at any frequency within its range by means of a minimum number of controls, all of which are on the front panel.

37. Par. 2-25. All controls have been arranged so that the clockwise rotation of the control knob results in an increase in the final controlled effect.

38. Par. 2-26. Control shafts and associated fittings are adequate for the purpose intended. It is recommended, however, that the vernier dial be pinned to its drive shaft to avoid the possibility of accidental movement on the shaft and the consequent necessity for recalibration.

39. Par. 2-27. Major units of the TBY equipments were designed to facilitate and permit interchangeability.

40. Par. 2-28. The spare parts furnished with the Model TBY-1 and TBY-2 equipments are interchangeable with similar parts employed in the construction of the equipment. Only basic field spares were furnished the Laboratory for the tests. Navy type numbers did not appear on any spare except the vacuum tubes and dry batteries.

41. Par. 2-29. Design tolerances were sufficient to accommodate replacement components having the limiting dimensions and characteristics permitted by applicable specifications.

42. Par. 2-30. No identifying markings were provided in the TBY units. The Type CLG-20144 storage battery vibrator power supply has such identification affixed to the

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components wherever practicable, but not to the chassis near the component. Tube sockets in the TBY are not marked to indicate the type tube used. It is recommended that permanently legible markings be placed near the various component units to facilitate locating a defective part in servicing.

43. Par. 2-31. For the most part, components have been so placed that they are accessible for servicing or replacing. An exception, however, is a terminal strip, shown in Plate 32 on which are mounted a number of resistors. As a test, an attempt was made to replace one of these resistors, and it was found necessary to remove several other nearby components in order to get clearance sufficient for a soldering iron to be used. It is recommended that longer leads be used to and from this terminal strip to permit its being partially withdrawn for servicing. The leads are so short that even if the adjoining components are moved, the bottom edge of the strip cannot be easily reached, and the number of wires connected to the terminals make servicing difficult. No rivets were used in the TBY equipments to mount parts likely to become defective.

44. Par. 2-32. Safe operation and satisfactory performance within the limits discussed elsewhere in this report may be expected under service conditions.

45. Par. 2-33. An interlock in the high voltage supply removes all potential in excess of 25 volts from any point in the equipment where accidental contact might be made while tubes were being changed.

46. Par. 2-34. Appropriate nameplates have been affixed to all major units of the TBY equipment, including the vibrator power unit and storage battery.

47. Par. 2-35. Front panel controls are marked with descriptive words or phrases indicative of the purpose of the control. Additional letter designation required by RE 13A 535C were not provided. The markings are of a permanent nature and of a size easily readable at a distance of 24 inches under normal operating conditions.

48. Par. 2-36. The wiring in both TBY-1 and TBY-2 is suitable for the applications in which it is used. Waxed, cotton-covered stranded wire is used in all d-c supply circuits, and No. 14 bare tinned wire is used for r.f. leads. The radio-frequency coils in both receiver and transmitter were wound with silver wire protected by an insulating enamel coating. Stranded cotton-covered wire shielded by tinned copper braid has been used where necessary to keep r.f. out of the d.c. supply circuits and to reduce pick-up in the audio circuits. The wires have been cabled in both Models TBY-1 and TBY-2, is unaffected by vibration, and did

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not move during operation of the equipment. The wiring in the Model TBY-1 appears somewhat neater than that in the TBY-2, but both are of suitably high-quality workmanship and material for Naval Service. In both equipments, the wires from the contacts of the transfer relay, K-1, have been cabled by means of cotton tape for a length of three inches between the contacts and a soft rubber grommet through the chassis. This bit of cabling is considered undesirable inasmuch as the short lengths of leads available at this point will make servicing these contacts extremely difficult. It is recommended that this particular bit of cabling be eliminated.

49. Par. 2-40. External aluminum surfaces are protected by olive drab wrinkle finish enamel to resist the effects of corrosion.

50. Par. 2-41. Exterior screw heads which must be removed for major servicing of the TBY equipment have been painted olive drab to match the equipment. Interior aluminum surfaces have been chemically treated to resist the effects of corrosion.

51. Par. 2-42(1). Connecting cords are made of stranded wire protected by a heavy black rubber coating over the separately insulated individual wires. The color of this rubber faded at 65°C during the temperature tests, but this did not affect the serviceability of the headphone units. Color coding was used to facilitate circuit checking. Cable lengths are shown in Table 3.

Par. 2-42(2). Plug receptacles and connection plugs, as assemblies, are not submergence proof. However, the construction of the equipment is such that it is completely drip-proof, when assembled for field service as a pack load. As a test, a Model TBY-1 equipment was subjected to an intense spray of water continuously for fifteen minutes. During this period, both the receiver and the transmitter operated normally. No trouble was experienced with either component. Examination of the equipment at the end of this test revealed only a small amount of water inside the headphone compartment, and inside the main compartment of the type CSS 10039 canvas carrying case. The water had apparently entered around the openings where the headphone and telegraph key cables were brought outside the carrying case. These openings were left in the zipper closures, and it was then observed that provision has been made in the design of the Type CSS 10039 case to permit the cover flap to be completely closed and still allow the cables to be brought out. The TBY-1 equipment was next removed from the Type CSS 10039 carrying case and subjected to the same spray test for another 15 minutes unprotected by the carrying case. The equipment appeared as in Plate 30 except that the rubber protector cap

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for the telegraph key was securely in place over the key instead of folded back as shown. After ten minutes, the receiver became noisy when no signal was being received, but the noise was reduced considerably when a signal sufficient to override the super-regenerative hiss was received. This noise was not evident on the transmitter carrier when monitored on another receiver, and can be attributed only to leakage across the antenna terminals. A small amount of water inside the microphone and telegraph-key connector plugs was discovered during the inspection at the end of the 15 minute test period. There was also a small amount of water inside the TBY-1 which had entered around the transmitter and receiver tuning controls. The performance of the equipment under the conditions of this test is considered satisfactory, but it is recommended that provision be made to preclude the entrance of moisture through shaft openings and into microphone connector plugs to assure trouble-free operation during protracted periods of exposure to rainfall.

Par. 2-42(3). The microphone and key connection plugs are of a construction which will withstand service use. The body of the plug withstood a pressure of 200 pounds without damage or distortion. The unsupported knurled locking ring was deformed but was readily restored to operating condition. Non-ferrous metal heavily plated to resist corrosion was used for these plugs and receptacles.

52. Par. 2-43. The exterior surfaces of the TBY equipment, including vibrapack and storage battery, are finished in a color and texture substantially that prescribed. The front panel is of the same color in a smooth finish.

53. Par. 2-44. and as modified by Spec. RE 13A 535. The Model TBY-1 tuning chart conforms to the original requirement of an etched metal plate. The Model TBY-2 equipment has been provided with a loose-leaf ring-bound booklet for the same purpose in accordance with the modified specification. The pages of the booklet are of a plastic material with space provided for the recalibrated dial readings to be added. No provision was made for illuminating the pages of this booklet for night operation. Inasmuch as the frequency control dials are lighted and the calibration booklet for these controls is not, the usefulness of the panel lamps is questionable. By mounting the panel lamps inside the TBY case, as discussed in paragraph 55e, an opening could be cut in the cover to provide illumination of a portion of the booklet. The leaves of the booklet are translucent, and the markings thereon were readable when tested in this fashion. It is desirable that some form of illumination of the calibration booklet be supplied to facilitate effective operation of the TBY equipment at night.

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54. Par. 2-45(1). The complete equipment assembled for field service with a Type-19018 dry battery weighed 32 pounds. With a -19029 battery and -20144 vibrator power unit it weighed 38 pounds. Other dimensions are shown in Table 3.

Par. 2-45(2). The approximate volume of the TBY equipment is 975 cubic inches. Maximum dimension limits have not been exceeded.

Par. 2-45(3). Reduction of the size of the equipment to a minimum has been accomplished.

55(a) Par. 3-1(1). The transmitter and receiver units have been constructed on a common chassis of 1/32 inch aluminum. The front panel of the equipment is also of this same material, securely joined to the chassis by screws, lock washers and nuts. The chassis front panel assembly can be completely withdrawn from the case, which is of 1/16 inch aluminum. A riveted metal hinge extends the full width of the cover which can be lifted up and back to permit replacement of tubes and inspection of the interior. Two baggage-type ring fasteners secure the cover when in the closed position. The case has been reinforced by symmetric indentations pressed into the metal of the sides and rear, which have been made from one continuous piece of aluminum. The construction of the fasteners securing the cover appears rather light, and it is recommended that a more substantially designed fastener be incorporated in this equipment. A webbed canvas carrying handle is attached to the top cover to enable the equipment to be carried when removed from the canvas carrying case. Antenna mounting supports are waterproof. Attachment buttons for securing the telegraph key are provided on thecover of the TBY.

55(b) Par. 3-1(2). The chassis and front panel are so arranged that they form one unit which may be withdrawn from the case easily and without damage to any part. Positive electrical contact between chassis and cabinet is made by means of screws, nuts and lock washers.

55(c) Par. 3-1(3). A block battery was originally supplied for use as a power source in the TBY equipment. Connection to it is made by pressing down with the transmitter cabinet on the battery to engage the two parts of the connector socket and plug. The cabinet overhang prevented entrance of moisture during the splash test conducted at the Laboratory and should provide reasonable protection in normal service. The Type-19029 storage battery and 20144 vibrator unit are similarly protected. An external charging plug on the 20144 vibrator unit, however, should be protected from moisture by some form of cover. (See Plate 27) Operation of either type unit in 2 inches of sea water is possible.

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Batteries are secured to the cabinet by two webbed canvas straps. Photographs of the Type CLG 20144 vibrator power unit and the Type CLG 19029 storage battery are shown in Plates 38 to 41 inclusive.

(a) The Type 19018-A dry battery contained in a single case the various batteries necessary to operate the Model TBY equipment. Connection between the battery and the TBY equipment was made through a 5 prong wafer type socket placed in the top of the battery. The proper potentials for operation of the TBY equipment were obtained by connecting internally 1 inch or 3/4 inch cylindrical dry cells in series and parallel. These individual cells were grouped inside a thin sheet steel case and secured in place by a pitch compound. The battery case was protected by flat green enamel which matched the finish of the Model TBY equipment.

(b)(1) The Type CLG 20144 vibrator power unit and CLG 19029 storage battery were designed to replace, electrically and mechanically, the Type 19018-A dry battery. Mechanically, the interchange is satisfactory; no alteration of the electrical connections of the TBY or change in the method of carrying the battery was necessary.

(b)(2) The CLG 19029 storage battery is a lead-acid type consisting of two cells which give a nominal output of 4 volts, 40 amperes, at a 16 hour rate. Various tests conducted on the vibrapack and dry batteries independently of those made in conjunction with the TBY equipment are described in a separate letter report prepared by this Laboratory. Plates 38 and 39 show composite and breakdown views of the battery and vibrator units. Two recessed lead terminals are provided for contact between the battery and the Type 20144 vibrator power unit. The battery case is a clear plastic protected by an outer case of enamelled sheet steel. Precautions were taken in designing the battery to make it spill proof. The vent holes have a built-in liquid trap which minimizes leakage but under certain conditions a drop or two of electrolyte will come through. Since severe corrosion will occur in case of leakage it is recommended that the performance of the vents be improved.

(b)(3) Plates 40 and 41 are close-up views of the Type 20144 vibrator power unit. Banana plugs provide the necessary connection to the Type 19029 storage battery. The vibrator, transformer, control relays,

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dropping resistors and rectifier tube necessary to give output voltages approximately equivalent to those of the dry battery have been compressed into the small space available in this unit. This makes servicing or replacing components difficult, and improvement in this respect is desirable. Chokes L-101 and L-102, as well as several filter capacitors, are secured to the chassis by metal tabs. Inasmuch as the inductances must be removed to replace adjacent components, this method of mounting is unsatisfactory and screw and nut fastenings should be provided instead. Further redesign of this unit using plug-in type components would considerably facilitate repairs. Wiring of this unit is not up to the usual standards of Naval equipment. Ordinary push-back hook-up wire has been used extensively, and this is not considered acceptable; a more durable type of insulation should be used.

55(d) Par. 3-1(4). All operating controls, receptacles and instruments are mounted on the front panel from which all manipulations and adjustments will be made. Single control tuning of transmitter and receiver frequencies has been provided; a minimum number of controls are involved.

55(e) Par. 3-1(5). A momentary contact push-button switch was provided to operate two panel lamps. Some provision should be made so that the amount of illumination from these panel lamps is reduced to a minimum. The shading afforded in the present design by extended flanges on the cover is insufficient to prevent the bulb being seen. Attempts were made at the Laboratory to "black out" a major portion of the dial lights to reduce the illumination of the equipment, but the method was not entirely satisfactory. A considerable light area was visible and the bulb itself could be seen if observed from an angle. The dial lights were then placed wholly inside the TBY case in such a position that the light was shed over the dial scales only. This appeared much more desirable. It is felt that this would facilitate night operation with the equipment, and effectively reduce the hazard of a light target offered by the equipment as originally designed.

55(f) Par. 3-1-(6). The combination head telephone receiver-microphone assembly is connected to the front panel by means of an Amphenol Type MC4M male receptacle on the bottom of the panel. The telegraph key is similarly connected, and each terminal is appropriately marked. Alternate operation and control from any of these units is possible, as well as keying and voice modulation of the carrier.

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55(g) Par. 3-1(7). One spare tube of each type used in the equipment (except the Type 30) is carried in a small rack attached to the under side of the cover. The crystal calibrator tube, which is not in constant use under normal circumstances, may be used as a spare audio amplifier tube, inasmuch as it is also a Type 30. For this reason, no provision was made to carry a spare tube of this type. All tubes in the transmitter portion of the TBY equipments are accessible for replacing when the cover of the cabinet is opened.

55(h) Par. 3-1(8). The front panel controls pertaining to the transmitter are listed in Table 1. The various adjustments turn easily and smoothly without excessive lost motion, binding, scraping or cutting at 20°C. Whether or not a lubricant had been used on all bearing surfaces could not be definitely ascertained, but a small amount of oil was noted on the transmitter and receiver antenna loading controls. It was found that when the equipment was left several hours at -30°C these antenna controls froze and it was impossible for an operator wearing heavy gloves to manipulate them. When the gloves were removed, sufficient force could be exerted to move the control, and when thus freed, operation was restored to normal. After the idle period mentioned above, the audio and radio-frequency filament rheostats and the receiver regeneration and volume controls were sluggish and tended to make poor contact until rotated quickly a few times and until they had been heated slightly by the operating current. It is recommended that a lubricant less affected by low temperatures be used on the various control shaft bearings in the TBY equipment to permit operating personnel to wear heavy gloves if necessary.

55(i) Par. 3-1(9). All dials and the meter were constructed in a manner to afford visibility with any point source lighting at any incidence up to 60 degrees from the normal to the unit. Special or internal lighting of the units is unnecessary during daytime operation.

55(j) Par. 3-1(10). Scale markings are in aluminum non-glare finish against a black background. Markings appeared to be of a durable nature, not susceptible to ordinary scratching or aging.

55(k) Par. 3-1(11). The tuning verniers are split-type aluminum gears, easy running, without appreciable backlash.

55(l) Par. 3-1(12). Friction and pressure contacts have been kept to a minimum.

55(m) Par. 3-1(13a). No contact trouble developed during the tests as a result of aging. Minor troubles experienced

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at -30°C were possibly due to slight "frosting" of the contacts and were not caused by repeated operation of the switch.

Par. 3-1(13b). All switches are a positive self-positioning type; contacts on the band change switch are a self-cleaning type

Par. 3-1(13c). Pressure and movable contacts in the radio frequency coil turret are silver-faced. Rotor contacts in the receiver variable capacitors are cadmium plated.

56. Par. 3-1(14). Variable resistors of 50,000 ohms or less are wire wound.

57. Par. 3-1(15). The controls and other panel mounted units have been symmetrically arranged and so proportioned that an attractive appearance results as can be seen in Plate 30. All control knobs of the equipment are black.

58. Par. 3-1(16). No binding posts have been used in the equipments to which repeated connections and disconnections must be made.

59. Par. 3-2(1). The requirements with respect to the headphone-microphone assembly have been fulfilled. As protection against rain it is recommended that a suitable waterproof membrane be provided to cover the front openings in the bakelite shell of the microphone.

60. Par. 3-2(2). The requirements for a telegraph key have been fulfilled except that no clip was provided for attaching the key assembly to the operator's belt or pocket.

61. Par. 3-3(1). The antenna is self-supporting jointed tubing. One threaded connection in the base section has a sufficiently coarse thread to permit rapid attachment and easy cleaning.

Par. 3-3(2). Stainless steel, finished in durable olive-drab wrinkle enamel, was used for the antenna.

62. Par. 3-3(3). The maximum assembled length of the antenna is 110 inches, and the minimum length used in actual operation of the TBY equipment is 69 inches. The maximum individual length of a section is 13.5 inches, which is within the requirements.

63. Par. 3-3(4). The antenna is secured to the cabinet by a ceramic feed-through insulator and bushing. No tools are required in either assembling or disassembling the antenna.

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64. Par. 3-3(5). The antenna is less than 13 feet long when assembled.

65. Par. 3-3(6). The proper antenna length for each frequency band is indicated in the tuning chart.

66. Par. 3-3(7). The sectional joints are suitably color-coded to facilitate rapid erection.

67. Par. 3-3(8). Two types of antennas were furnished with the TBY equipment: Type CWA 66025 with Model TBY-1, and Type CWN 66025 with Model TBY-2. Type CWA 66025 is not tapered, but is divided into section of uniform diameter as follows:

2 sections	0.383 inches
4 sections	0.288 inches
1 section	0.227 inches
2 sections	0.167 inches
1 section	0.105 inches

These measurements were taken over the enamel finish on the antenna sections. The reported mechanical failure of the whip-type antenna in service may be attributable to the stiffness and non-uniform flexing resulting from this method of construction, because bending the antenna through an arc of 5 degrees per section resulted in a permanent bending of the last two or three sections. By contrast, the Type CWN 66025 antenna is continuously tapered through each of its ten sections and a uniform flexing and return to normal occurs when the antenna is bent through the above mentioned arc and released. The color coding provided on both types of antenna facilitate rapid erection of the antenna. The use of such coding on the Type CWA 66025 antenna is somewhat superfluous in view of the duplication of section diameters. A comparison of this type antenna and a modification incorporating a coil spring in the base section has been made in NRL ltr. C-S67/43(380:CBD) of 31 December 1942 to Bureau of Ships. The spring base antenna appears better suited for the requirements of field operation than either the CWA or CWN Model 66025 antennas, inasmuch as it can be bent 90° from vertical through a continuous arc of 360°. This then will not restrict sideways or reverse movements of operating personnel in heavily wooded country as the latter types will. It is recommended that a spring base antenna be furnished with the TBY equipment to permit unrestricted directional flexing in field service. Of the two types of antenna furnished with the TBY equipment, the Type CWN 66025 appears the more suitable mechanically; there is no material difference electrically.

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68. Par. 3-3(9). The antenna, with the exception of the tip section of one particular antenna did not become unjointed or unmounted as a result of vibration or of field transportation as a pack load. Ferrule diameters varied between the different sample antennas which permitted a loose fit between the next-to-last and last sections. This condition should be eliminated.

69(a) Par. 3-4. Plates 36 and 37 show the Model TBY equipment assembled as a pack load for one man.

69(b) Par. 3-4(1). The carrying case is hard texture cotton duck with adequate provision for carrying all units of the basic equipment.

70. Par. 3-4(2). The compartments and pockets provide sufficient space for the various components necessary in the field and are so arranged that the equipment balances well on a man's back. Such a design should permit it to be carried for long periods without undue fatigue.

71. Par. 3-4(3). Zipper type slide fasteners are used as closures on the main cover flap and the headphone compartment. Supplementary "Dot" type snap fasteners have also been used. (See Plate 29).

72. Par. 3-4(4). That portion of the case which rests against a man's back is of double thickness, quilted construction with a layer of padding.

73. Par. 3-4(5). Army haversack-type carrying suspenders are securely attached to the carrying case.

74. Par. 3-4(6). Operation was satisfactorily effected while the equipment was being carried by an operator.

75. Par. 3-4(7). Rivets and leather reinforcements of the case have not been used. Supplementary canvas reinforcements, however, are sewed to the bottom outside corners of the carrying case. Major seams have been double stitched and appear strong and secure.

76. Par. 3-4(9). The type number of the carrying case is stencilled in black waterproof ink on the cover flap.

77(a) Par. 3-5(1). The shipping chest contains the complete equipment listed in Paragraph 1-2 as well as two spare dry batteries with the exception of the spare meter.

77(b) Par. 3-5(2). Paper nameplates were furnished both inside and outside of the shipping chest; each is glued to the chest, and is protected by a sheet of celluloid, secured by bolts and nuts. Nameplates on the outside of the

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chest are affixed to the cover instead of to the right end of the chest as required. Nameplates inside the chest have been affixed to the cover also. It is recommended that nameplates of a phenolic material be substituted for those now used in the shipping chest.

77(c) Par. 3-5(4). A hasp and staple suitable for a Navy Type 1-A padlock has been provided.

77(d) Par. 3-5(5). Inside and outside surfaces of the sheet steel shipping chest have been painted with olive drab enamel.

77(e) Par. 3-5(6f). Two metal chest handles which permit only 90° rotation are secured to the metal chest.

77(f) Par. 3-5(6i). A compartment is provided on the cover for stowing the spare vacuum tubes. No permanent cover has been incorporated to retain the tubes in this compartment, and the tubes will be jarred out of it during rough handling. A low retaining wall is used to keep the spare batteries from shifting during transit. No padding of any kind was built into the chest.

OPERATIONAL DATA AND TESTS

78(a) Par. 4-1(1) and (5). The frequency range and overlap of Model TBY-1 No. 642 and TBY-2 No. 124 appear in Tables 9 and 10, respectively. Adequate overlap has been provided in each case.

78(b) Par. 4-1(2). The equipments are capable of alternate transmission and reception on the same frequency.

78(c) Par. 4-1(3). The audio amplifier comprises two tubes and is common to both receiver and transmitter. The crystal calibrator employs one tube and is used with either receiver or transmitter.

79. Par. 4-1(4)(a). In Table 30 are data indicative of the current and voltage requirements of the TBY equipment as supplied from the various sources in the Type 19018-A battery pack. These source voltages were simulated by substitution of other supplies to assure better regulation and control of operating conditions during the measurements than was possible with the dry battery. A maximum of 10 watts of power must be supplied from the plate voltage supply; approximately 0.7 watts from the 2-volt supply; and approximately 0.3 watts each from the 1.5 and -6.75-volt sources.

Par. 4-1(4)(b). Tests were conducted to determine the number of hours of operation possible with the Type

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CNC 19018-A and CLG 19029 battery supplies, and the data, recorded intermittently throughout the tests, appears in Tables 31 and 32. Means were provided to automatically transfer operation of the equipment from receive to MCW transmission at fifteen minute intervals, and a timer clock was operated during the transmission periods by a relay controlled by the oscillator grid current. Thus, when grid current in the oscillator failed to flow from any cause when the transmitter was turned on, the total elapsed transmitting time was recorded on the timer clock. The total operating time for the equipment was, therefore, twice the recorded time under these conditions. With the storage battery equipment, the total operating time was 14.8 hours. The equipment ceased to operate at a time when it was not under observation and it was therefore impossible to obtain data of conditions immediately before it stopped. After 7.8 hours of operation the power output had dropped 9.3 per cent from that obtained at the start of the test. During the period the equipment was under observation, the filament voltages of audio and radio frequency tubes were maintained at the proper value by the adjustments provided in the equipment. Table 32 shows data obtained during operation of a TBY-1 equipment with a Type 19018 dry battery. A comparison of the operation of the two types of supply after approximately the same elapsed operating time is decidedly in favor of the storage battery, inasmuch as the power output with the dry battery had decreased 20 per cent as contrasted with 9.3 per cent for the storage battery. The difference is undoubtedly due to polarization effects in the dry battery. The conditions of operation were maintained the same as for the storage battery test insofar as possible. Cessation of transmitter operation with the dry battery supply occurred when the voltage from the 3 volt source dropped to a value of 1.16 volts, which was insufficient to operate the transfer relay K-1 in the TBY equipment. The voltages still available in the dry battery were sufficient to operate the receiver and a signal from a nearby transmitter was readily picked up. The Type 19018-A dry battery fulfilled the requirements with regard to 30 hours' operating time, but the Type 19029 battery and Type 20144 vibrator supply did not. Power output requirements of paragraph 4-1(15) were not met with either type of supply for the TBY equipment under the test conditions. Application of the specification requirements of 30 hours' operation to the combination of a Type 19029 storage battery and a Type 20144 vibrator power unit does not seem entirely justified because the storage battery can, of course, be recharged and used again whereas the Type 19018 dry battery cannot be renewed. It is impracticable for the Laboratory to make a definite recommendation for this, but the 14 hours of operation obtainable with the equipment should safely provide sufficient reserve for field

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patrols of an extended nature before the necessity for replacing the storage battery will arise. The maximum operating time requirements for one day's service in the field should determine the specifications for this particular equipment. This time can be most easily ascertained by the Bureau, and it is recommended that the operating time thus determined be designated as the minimum acceptable for the Type 19029 storage battery and Type 20144 vibrator power unit in lieu of the thirty hours applicable to the Type 19018-A dry battery.

Par. 4-1(4)(c). During continued tests of the characteristics of the TBY audio system, difficulty was experienced in obtaining consistent data on power output and percentage of modulation when a Type 19018-A dry battery was used as a source of power. Investigation showed that, while the plate voltage on the transmitter tubes remained constant after approximately twenty minutes operating time, the radio frequency filament voltage would have to be readjusted or erroneous results would be obtained. The condition was not as severe with the 3 volt supply. It is apparent from this that polarization takes place more rapidly in the filament supplies than in the high voltage supply, because a considerably greater current is drawn from the low voltage batteries. It is recommended that additional current delivering capacity be provided in the 1.5 volt and 3 volt batteries to permit longer sustained operating periods without the necessity for adjusting filament voltages, inasmuch as the transmitter power output is adversely affected by low filament voltages.

80. Par. 4-1(6). Table 8 is a calibration of the Number 124 TBY-2 oscillator dial. The transmitter was operated into a Type 66025 antenna of the recommended length for each frequency band during the calibration. The change in frequency per dial division appears in Plate 24 as a function of incremental dial settings of 100 divisions. The frequency change per division is not linear over the whole range of each band, as shown in this plate, but is reasonably so over the portions of the dial in use in each band. The portions of the curves in Plate 24 between the points marked with an "X" indicate the part of the dial scale in use in that particular band.

81. Par. 4-1(7). A positive clicker action switch has been provided for the transmitter and receiver coil turrets.

82. Par. 4-1(8). A wire wound low resistance rheostat has been provided in each filament supply circuit to permit adjustment of voltage. These rheostats are so connected in the circuit that slightly below the useful minimum resistance

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position the filament circuit opens and no voltage is applied to the tube. It is probable that elimination of the off-position of the rheostats will permit a few hours additional operation by utilizing the last bit of available power in the battery.

83. Par. 4-1(9). A transfer relay effects complete change-over from transmit to receive. Deenergized, this relay is in receive position. No other adjustments are necessary.

84. Par. 4-1(10). Only one crystal check point is provided in Band 1. The remaining bands have two or more crystal check points. In Table 43 are data obtained when using the crystal calibrator to set the transmitter frequency. Individual deviations vary between 0.203 megacycles below and 0.976 mcs above the desired operating frequency. The average percentage deviation for the eleven trial frequency settings is 0.147 percent, which is considered acceptable.

85. Par. 4-1(11). The setting of the transmitter and receiver tuning dial is corrected by direct comparison with the crystal calibrator. The difference between the true setting and the calibrated setting for a given crystal check point is added algebraically to the calibrated setting for a new channel and the tuning dial adjusted accordingly.

86. Par. 4-1(12). The absolute frequencies of the crystals furnished in each of the equipments were measured at 19.5°C with the following results:

Equipment	Crystal Number	Measured Frequency	Percent Frequency Deviation
TBY-1 No. 646	H-9371	5000.450 kc.	0.009
TBY-1 No. 642	H-9515	5000.937 kc.	0.019
TBY-2 No. 200	C-1189	5000.138 kc.	0.003
TBY-2 No. 124	C-1119	5000.928 kc.	0.019

These deviations are within the limits of ±0.02%. The crystals supplied in the equipments were Type CF-5, manufactured by Hipower, They are encased in a cylindrical phenolic holder with a metal top plate on which the crystal frequency and other pertinent data appeared. Two metal prongs provide electrical contact. A rubber gasket under the cover plate seals the crystal away from dust and dirt. No adjustment of the crystal frequency is possible. Permanent markings on the crystal holder to indicate the ground side of the crystal were not provided. The method of marking now used easily rubs off with ordinary handling.

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Instead of the ink-stamp marking now used, it is recommended that such markings be either stamped or molded into the holder near the appropriate connector prong. The crystals furnished are interchangeable in the TBY-1 and TBY-2 equipments.

87. Par. 4-1(13). In Table 33 and Plate 1 are found data resulting from frequency measurements made on Crystal C 1119, nominal frequency 5000 kilocycles included in the calibrator of Model TBY-2 No. 124, at temperatures from -39° to 0°C. At these temperatures, when operating in the TBY-2 equipment , the temperature coefficient of this crystal is less than the specified 5 parts per million per degree Centigrade. Similar characteristics may be expected in the remaining crystals. The crystals evinced no tendency toward erratic operation at any time during the test period.

88. Par. 4-1(14). A switch has been provided to start and stop the crystal calibrator.

89. Par. 4-1(15)(a). Measurements of the power output of four different equipments were made as outlined in paragraph 9 and the results are shown in Tables 4 to 7. The data recorded as CW power were made for unmodulated carrier conditions, which were obtained by placing the Send-Receive switch in the "send" position. The maximum power obtainable from each equipment under both CW and MCW conditions was as follows:

Equipment	Serial Number	Maximum Power in Watts CW	MCW
TBY-1	642	1.170	1.64
"	646	0.906	1.72
TBY-2	124	0.975	1.72
"	200	0.847	1.52

Data on phone operation of Model TBY-1 No. 646 are representative of the remainder of the equipments. It will be noted that the increase in output power for MCW operation is usually greater than 50 per cent of the CW power. This condition was carefully investigated and appeared consistently throughout the tests, and indicates greater than 100 per cent modulation. Operating efficiencies are in the order of 32 to 42 per cent for the Serial Numbers 124, 200, and 646, while those of No. 642 range from 42 to 53 per cent. This may possibly have been due to an exceptionally good pair of tubes in this particular equipment. It will be noted that, with the exception of No. 646 equipment at a few frequencies, the specification requirements as modified by RE 13A 535C are not fulfilled by these equipments. The power output capability of the 958-A tubes, operated within the manufacturer's recommendations, is not great enough to assure a

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minimum of 1 watt over the specified frequency range.

Par. 4-1(15)(b). The characteristics of the Type CWA or CWN 66025 antennas could not be determined with sufficient accuracy at the operating frequencies to permit calculation of power delivered to them by the transmitter. However, the operation of each equipment was observed with the antennas, and normal oscillator plate and grid currents as determined by the power output tests into a dummy antenna, were obtained with these antennas throughout the frequency range of the equipment.

Par. 4-1(15)(c). The power output obtained under MCW conditions is also shown in Tables 4 through 7, and for each equipment in excess of 1 watt.

Par. 4-1(15)(d). Keying tests on this equipment were not conducted, other than to ascertain that the equipment was capable of being keyed by hand at moderate speeds. Keying is possible only in transmitting position, and only the modulating tone is keyed. No relays are used in keying and high speed automatic keying would be practicable if desired.

90. Par. 4-1(16). Tables 24 and 25 and Plates 14 to 17, inclusive, show the distortion introduced by the audio amplifier of the TBY-1 and TBY-2 equipments, as a function of modulating frequency. The maximum distortion measured in the Model TBY-1 equipment No. 642 occurred at 200 cycles in Band 4 and amounted to 13.5 per cent. The increase in input voltage necessary to produce 70 per cent modulation indicates that the response of the amplifier is low at this frequency; the data also show that the response begins to fall off at approximately 600 and 3000 cycles in both equipments. The maximum distortion in the No. 124 equipment appears in Band 4 at 5000 cycles modulating frequency and amounted to 15 per cent, although the percentage distortion is also high at 200 cycles. The distortion in these equipments is not sufficient to make speech unintelligible, and is within the limits imposed by the specifications.

91(a) Par. 4-1(17). The fidelity of the Model TBY-1 No. 642 transmitter was determined and the data appear in Table 26. Similar measurements on Model TBY-2 No. 124 appear in Table 27. Graphical representation of these data appear in Plates 2 to 9, inclusive. In the Model TBY-1 equipment, the maximum deviation from the audio output at 1000 cycles occurred in Bands 2 and 3 and amounted to -1.5 db. That of the TBY-2 occurred in Band 3 at 200 cycles and amounted to -1.3 db. These deviations are within the specification limits of 4 db.

91(b) Par. 4-1(17). Tables 28 and 29, and Plates 10 to

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13, inclusive, contain data showing the percentage modulation obtainable for various input voltages at 1000 cycles. This percentage appears somewhat dependent on the carrier frequency since it will be observed that the degree of modulation remained unchanged above inputs of 1 volt in Band 1 of the TBY-1, while it continued to increase in Band 4 up to 1.2 volts, the limit of which the signal generator used was capable. The Model TBY-2 equipment did not show this tendency in either band.

92. Par. 4-1(18). Table 23 shows the percentage of modulation of TBY-2 No. 124 obtained for 400 cycles modulating frequency at one point in each transmitting band, and for MCW conditions at the same carrier frequencies. The MCW tone frequency is approximately 800 cycles, which can be changed plus or minus 60 or 70 cycles by varying the receiver regeneration control. The degree of modulation during MCW operation is greater than 100 percent, and cannot be altered by means of any control in the equipment. The specification requirements have been met in all equipments tested.

93. Par. 4-1(19a). The effect of changes in ambient temperature on the emitted frequency is shown in Tables 34 and 35 and is also presented graphically in Plates 18 and 19. The Model TBY-1 equipment was operated from a Type CLG 19029 storage battery with a Type CLG 20144 vibrator. The TBY-2 was operated from a Type CNC 19018-A dry battery. A summary of the frequency variations is included with each table. Both equipments failed to start after having been idle in the temperature chest at an ambient temperature continuously below -30°C for more than eight hours. The storage battery-vibrator unit recovered sooner than the dry battery, however, and data on the performance of both units from the time they started functioning appears in the tables. The transmitter and receiver antenna tuning controls of both equipments were inoperative, having become frozen. The receiver volume and regeneration controls operated sluggishly at -40°C. Poor contact in the filament rheostats at this temperature was corrected by rapidly operating the control a few times. The rubber covering on the telegraph key assembly of the TBY-1 became so stiff at -40°C that it was difficult to operate the send-receive switch in that assembly with the protective cover in place. The rubber on the headphones, however, remained soft and pliable at this temperature. It is recommended that a grade of rubber with less tendency toward stiffening at low temperatures be used for the telegraph key covering. That of the TBY-2 unit was less affected by the low temperatures than the cover of the TBY-1 telegraph key, and the material seems better suited for operation at this temperature. At 60°C the color of the rubber covering on the cord of the headphone assembly faded, but the color of the TBY-1 key covering

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was unaffected. Apparently the two materials are of different chemical composition.

94. Par. 4-1(19b). The data for frequency changes observed during humidity variations appear in Tables 36 and 37 and Plates 20 to 23, inclusive. Frequency changes were measured in two bands of each transmitter. The maximum frequency change was 0.036 megacycles in the TBY-1 and 0.051 megacycles in the TBY-2 which amounted to 0.12 per cent and 0.12 per cent and 0.17 per cent, respectively, in the low frequency channels. In the high frequency channels, the maximum frequency change was 0.084 megacycles in the TBY-1 and 0.104 megacycles in the TBY-2, amounting to 0.12 per cent and 0.14 per cent, respectively. These variations are within the specification limits. At no time did the equipments fail to start when turned on for the measurements appearing in these tables, and no erratic operational characteristics attributable to the high humidity were noticed.

95. Par. 4-1(19c). The effect of reducing the input voltages to the No. 642 and No. 124 equipments appears in Tables 20, 21, and 22. Data in Tables 20 and 21 are for frequency changes as a result of reducing the filament and plate voltage of the transmitters in steps of 5 per cent of the initial voltage. The maximum frequency deviation of 2.3 per cent occurred in Band 4 of No. 642 at 15 per cent reduction of the input voltages, but this is not representative of the true frequency variation, inasmuch as it was necessary to retune the dummy antenna used in this test, and also the antenna loading control, in order to make the transmitter oscillate. Tuning either of these caused the oscillator frequency to change. The maximum frequency change for a 5 per cent reduction of input voltages in this equipment was 0.229 per cent, which exceeds the limits of the specifications by 0.029 per cent; the No. 124 equipment exceeded this limit by 0.013 per cent and 0.127 per cent in Bands 3 and 4, respectively. It is recommended that the frequency stability of these equipments under voltage variations be improved to comply with the specification requirements. The input voltages to the No. 642 equipment in another test were reduced in 5 per cent steps to a maximum of 25 per cent for the data on output power appearing in Table 22. Oscillation ceased at 112 volts on the plates of the tubes, a reduction of 25 per cent. For a reduction of 20 per cent in input voltage, the output power was reduced 80 per cent.

96. Par. 4-1(19d)(a). The numbers 646 and 124 TBY equipments were secured to the vibration platform by placing a U-shaped steel clamp over each equipment and bolting this firmly to the platform. Padding was provided between the top of the equipment and the clamp, and wooden

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blocks were used wherever necessary to keep sideways motion to a minimum. It was impracticable to record a continuous frequency drift curve during the vibration and subsequent shock tests. The signals of each transmitter were monitored on the adjacent TBY receiver and also on a Navy Type RBG Receiver. The frequencies shown in Tables 38 and 39 are the approximate operating frequencies of the transmitter as determined from the calibration of the RBG receiver dial. The quality of the signal appeared slightly better on the TBY-1 than on the TBY-2 when both the monitoring receiver and the transmitter were vibrating simultaneously; no noticeable wavering was observed in the received signal when monitored on the TBY superregenerative receiver, although it was of sufficient magnitude to make it difficult to monitor on the more sharply tuned RBG receiver. Intelligible signals were received on both types of receiving equipment while the transmitters were vibrating. There appeared so little frequency shift in either equipment that it was thought desirable to determine the operation of the equipment under vibration with the Type 66025 antenna. Aside from a small change in frequency occasioned by this transfer of antennas, there was no difference in operation of either equipment compared to operation with the dummy antenna.

Par. 4-1(19d)(b). The equipments were next subjected to accelerations in excess of 300 G by means of a pneumatic shocking device. The same mounting as described in paragraph 96 was used during this test. The equipments were operated alternately and the transmitted signal was monitored on a Navy Type RBG Receiver. After shock number 8, the frequency of the TBY-2 equipment when turned on again had changed approximately one megacycle, necessitating retuning the RBG receiver. At the completion of the series of shocks, the equipments were thoroughly examined and no damage to components was discovered. The spare 958-A and 959 tubes in the cover of the TBY-1 equipment had slipped partially free of the retaining clips, but had not been completely dislodged. Those in the TBY-2 were unaffected by the shocks and remained in place. The performance of these equipments under the conditions of this test is considered satisfactory.

Par. 4-1(19d)(c). Detuning of Circuits.
It proved impracticable to attempt to determine the effect of detuning circuits on the operation of the equipment, inasmuch as the effect of the operator's body was inseparable from the effects which were to be measured and which were of comparable magnitude.

Par. 4-1(19d)(d). Change of Tubes.
A group of five pairs of Type 958-A tubes were substituted for the original oscillator tubes in the No. 642 and No. 124 equipments. The data for these tests

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appear in Tables 17 and 18. The maximum average frequency deviation for the No. 642 was 0.555 per cent at approximately 65 megacycles; that of No. 124 was 0.200 per cent at approximately 80 megacycles.

Par. 4-1(19a)(e). Back Lash, Torque Lash and Lost Motion. The amount of back-lash present in the transmitter tuning dials of Model TBY-1 and TBY-2 equipments was investigated with the results shown in Tables 11 and 12. The dial mechanism of the TBY-1, although the same design as that of the TBY-2, caused less frequency deviation due to back-lash. The deviation in the TBY-2 transmitter frequency, however, was not sufficient to require a different dial setting in the superregenerative receiver of the TBY equipment, and the benefit to be derived from closer manufacturing tolerances in the TBY-2 dials would be negligible.

Par. 4-1(19a)(f). Accuracy of Reset to Previously Calibrated Frequencies. In Tables 13 and 14 are data covering the investigation of the degree of accuracy to which the tuning controls of the equipments could be reset at a given frequency. In each case, the dial setting was approached in a clockwise direction. In the TBY-1, the maximum frequency deviation from this cause was 0.0099 per cent; in the TBY-2 this deviation amounted to 0.187 per cent.

Par. 4-1(19d)(g). Effect of Dial Locks. The frequency deviations of the TBY-1 and TBY-2 equipments due to use of the dial locks appear in Tables 15 and 16, respectively. The dial lock had appreciably more effect on the TBY-2 equipment than it did in the TBY-1.

Par. 4-1(19d)(h). Carrier Hum and Ripple. Model TBY-1 No. 642 and Model TBY-2 No. 124 equipments were operated with a Type CLG 20144 vibrator power unit and a Type CLG 19029 storage battery unit and the carrier hum introduced by this source was measured. The ripple measured in the radio-frequency output of the No. 642 was 0.074 per cent of the carrier voltage, and 0.047 per cent in the No. 124 carrier. Both transmitters were operated at the same frequency and the measurements were made only in one band.

97. Par. 4-2(1)(2). Field Tests.

(a). Three field tests were conducted to acquire data on the operational characteristics and capabilities of the equipment. In the first test, a Model TBY-2 equipment was operated with a Type CBA 66066 antenna mounted on top of a mast placed on the roof of a building. The antenna was approximately

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25 feet above the ground in this position, and 8 feet above the roof. Twenty-seven feet of Type CASSF-50-1 flexible transmission line were used between the antenna and transmitter through which the transmitter power was delivered to the antenna. A TBY-1 equipment was carried by an operator various distances away from the location of this antenna, and communication between the two equipments was established. As has been reported in service, shadow effects caused by buildings and other obstructions in the transmission path between the transmitting and receiving antennas frequently interfered with communication. The Type COA 66066 antenna permitted only 72.5 megacycle operation during this test. If the operator moved his body as little as a foot or two, it frequently sufficed to establish communication with the fixed station at what at first appeared to be a "dead spot". Occasionally, orienting the antenna by rotation to the left or right increased the intensity of a faint signal in the receiver. The greatest transmitting distance in this test was 2500 feet.

(b) In a second test, attempts were made to compare operation of the TBY-1 and TBY-2 equipments with dry battery and storage battery vibrator supplies under adverse weather conditions. It was raining heavily during this test and no protection was applied to the equipment other than that afforded by the Type CSS 10039 canvas carrying case. The operating frequency in this test was 28 mcs. and communication was established and maintained for approximately one hour between two points 1 1/2 miles apart. One equipment was located behind trees on a hill top, and the other was in open level country, and the two operators were not visible to each other. A third equipment was available for this test and communication was established between all three units. There was no apparent difference in the operation of the equipments using the Type 19018-A dry batteries and the one using the Type CLG 19029 storage battery with the Type CLG 20144 vibrator power unit. At one time the Type 20144 vibrator power unit unaccountably failed so that the TBY equipment went dead, but tapping the vibrator unit a few times caused it to resume operation and no further trouble of this nature was experienced. It was found that even if initially tuned to the same frequency when the receivers were close to the transmitter, they each required retuning when removed to a distance from the transmitter. The frequency of the transmitter likewise changed

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somewhat, which increased the detuning effect. It found on a third field test (to be described subsequently) that consistent use of the crystal calibrator eliminates this difficulty and no trouble in this respect was experienced in maintaining communication between all three equipments on the third test. After completion of the test the equipments were carefully examined for evidences of damage from the rain to which they had been subjected. There was approximately a gill of water in the bottoms of each of the carrying cases caused by leakage into them through openings around the antenna and cover flap. This amount is not considered excessive under the severe conditions experienced during the test. There was an appreciable amount of water inside the carbon button compartment of the microphone of each equipment which had entered through the holes in the bakelite case. A small amount of water had penetrated into the switch compartment of one microphone also. Although no damage resulted from this water, it is felt that the waterproof membrane recommended in paragraph 59 will prolong the useful life of these microphones.

(c) The weather during the third field test was clear and mild. A frequency of 80 megacycles was used and communication was established between two points approximately 1 1/4 miles apart. One equipment was operated from a Type CLG 20144 vibrator power unit and Type CLG 19029 storage battery, and the remaining two equipments were operated from dry battery packs (Type 19018A). It was found that with the vibrator power unit, it was necessary at 80 mcs. to couple the transmitter very tightly to the antenna in order to obtain the normal load current as indicated by the meter in the TBY equipment. When the equipment was removed from the operator's back and placed on the ground, it was impossible to transmit voice signals in this position although MCW signals were satisfactorily emitted. Plate current, filament voltages and mechanical connections all appeared normal. It was subsequently found that stray capacity effects are appreciable at this frequency, and that because the vibrator plate voltage output is lower than that of the dry batteries, the transmitter operates very near a critical coupling point below which oscillation ceases. Changing the position of the operator's body will often cause the transmitter to go out of oscillation. This condition is more pronounced with tubes which have been in use for an appreciable

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time and in which emission has been reduced than it is in new tubes. There is no visible indication on the plate current meter that the equipment is not oscillating. The fact that the transmitted signal could be received when it was MCW and not when it was voice modulated is understandable when it is recalled that the MCW signal effectively increases the plate voltage to double normal voltage on the positive peaks. This voltage is sufficient to restore an oscillating condition in the transmitter and the equipment operates normally. The modulating voltage available with voice modulation is not sufficient, at most voice frequencies to effect the necessary increase in plate voltage for restoring oscillation. No other difficulties in maintaining communication between the three equipments were encountered during this test.

(d) Investigation of the coupling problem subsequent to these field tests revealed that the difficulty of definitely ascertaining that oscillations are occurring in the transmitter is independent of frequency and depends rather on such variables as battery voltage, and tube emission. With new batteries and tubes, operating plate currents as high as 17 or 18 ma may be used without causing oscillation to stop, whereas with old tubes, and low plate voltage (such as that obtained from the vibrator power unit, for example) any plate current in excess of 15.5 ma will cause the oscillations to cease and voice modulation will not be accomplished. Inasmuch as these plate currents are not definitely indicated by the plate current meter, it is impossible for an operator to determine whether or not the transmitter is oscillating under these conditions, other than by monitoring on a separate receiver. It is highly desirable that some means of indicating oscillation be incorporated in the TBY equipment. Both terminals of a small neon lamp of 1/25 watt rating were connected to the plate of one oscillator tube and capacitively coupled to ground. The operation of this bulb was compared with a grid meter as a means of determining oscillation and its operation compares favorably with a grid meter especially when proper tuning procedure is followed with the TBY. Although the plate current meter could be adapted to be used as a grid current meter to indicate oscillation, it is felt that the neon bulb will be equally satisfactory and more simply incorporated in production of the equipment than the grid meter would be. The small amount of power consumed by the lamp will have no noticeable affect

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on output power.

(e) From these tests it cannot be concluded that reliable communication can be maintained between TBY equipments under all operating conditions because the tests which were conducted were too limited in scope. Observations would of necessity have to extend over a period of time and be made for a large number of the frequencies available in the TBY equipment before a truly representative idea of the operating possibilities and limitations of the equipment could be obtained. However, it may be concluded that the effectiveness and reliability of the equipment will depend on operating technique in the choice of frequency and location rather than on electrical and mechanical limitations imposed by the Model TBY equipment itself.

98. Par. 5. Instruction books furnished with the Model TBY-1 and TBY-2 equipment have been compiled in accordance with the instructions set forth in this paragraph for Final Instruction Books. Directions and circuit diagrams are clear and descriptive enough to assure correct operation and facilitate trouble-shooting. Photographs of the equipment show the majority of components well, and the parts are appropriately identified. A few minor discrepancies and errors in schematic diagrams were noted. It is recommended that the manufacturer correct these in future copies.

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Table 1

Models TBY-1 and TBY-2

LIST OF CONTROLS AND METERS

1. Meters:

One of Westinghouse manufacture - with anti-glare glass.

Nameplate marking: TRANS PLATE MA

Range 0 - 5 ma. d.c.

Type NX-33

This meter has no scale reading numbers on its face. It has a radium painted square at midscale.

2. Controls (No control letters):

Control Marking	Dial Marking	Direction for Increase of the Controlled Effect
TRANS BAND	1 - 4	clockwise
TRANS TUNING	0 - 1200	"
TRANS ANT LOADING	9 markings	"
RECEIVER BAND	1 - 4	"
RECEIVER TUNING	0 - 1200	"
REC ANT TUNING	9 markings	"
VOLUME		"
REGEN.		"
R.F.FIL. RHEOSTAT		"
AUDIO FIL. RHEOSTAT		"

Power Switch (toggle type);
Down: Off
Up: On

Crystal Oscillator Calibration Switch (toggle type):
Down: Off
Up: On

Meter Switch: 3-position rotary switch

Light Switch: Push-button type.

Locks; Dial locks, screw operated pressure type.

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Table 1 (Cont'd)

Headphone and Microphone Connector Sockets:
Amphenol type.

Key Connector Socket: Amphenol type.

3. External Control Equipment.

MCW Control Unit:
1. D.P.S.T. toggle type switch - 3 amps. at 125 volts.
2. Key, push button momentary type with standard key knob.

Headphone and Microphone Assembly:
Transmitter-microphone switch, push button type.

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Table 2

Models TBY-1 and TBY-2

NAMEPLATE DATA

Transmitter Receiver:

TYPE CRI-43007
TRANSMITTER-RECEIVER
FREQUENCY RANGE 28 TO 80 MC

INPUT	(VOLTS	7.5	1.5	3.0	156
	(AMP. MAX	0.02	0.20	0.375	0.03

32 POUNDS SERIAL 124
A UNIT OF MODEL TBY-2 RADIO EQUIPMENT
MANUFACTURED FOR
NAVY DEPARTMENT - BUREAU OF SHIPS
BY COLONIAL RADIO CORPORATION
CONTRACTOR
WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.
BALTIMORE, MARYLAND
CONTRACT NUMBER NOs. 80643 CONTRACT DATE January 8, 1941

(SIZE - 2" C 1 5/16")

DRY BATTERY:

NAVY TYPE CNC 19018A
CONTRACT NO. 80645
CONTRACT DATE 1-8-41
DATE OF MANUFACTURE 6-10-42

(Letters are embossed into metal battery container)

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Table 2 (Cont'd).

STORAGE BATTERY:

TYPE CLG-19029
STORAGE BATTERY
4 VOLTS 40 AMPERE HOURS AT 16 HOUR RATE
12.5 POUNDS SERIAL .0004
FOR USE WITH MODEL TBY SERIES RADIO EQUIPMENT
MANUFACTURED FOR
NAVY DEPARTMENT - BUREAU OF SHIPS
BY CONTRACTOR
ELECTRONIC LABORATORIES, INC.
INDIANAPOLIS, INDIANA
CONTRACT NUMBER CONTRACT DATE
NXs. 4383 April 27, 1942

(SIZE 3 1/16" X 2" on top of battery cover)

READ CAREFULLY

1. Add distilled water only when battery is fully charged.
2. Fill to water level line only -- do not overfill.
3. Tilt battery to observe condition of charge.
4. All balls floating indicates full charge; green ball sinks at 75%, white at 50%, and red at 25% of full charge.
5. Do not permit battery to remain in discharged condition. Recharge as soon as possible after discharged.
6. Charge battery once every 30 days when not in use.
7. Refer to instruction manual for complete information.

(Size 3 1/16 X 2" on side of battery case)

ANTENNA:

TYPE CWN - 66025
ASSY 10 SECTIONS

(Placed on one section of antenna)

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VIBRATOR UNIT:

TYPE CLG-20144
VIBRATOR POWER UNIT

INPUT:	4 VOLTS D.C.	2.5 AMPERES		10 WATTS	
OUTPUT:	(VOLTS D.C.	-7.5	1.5	3.0	156
	(AMPS MAX:	0.03	0.19	0.36	0.035

6.5 POUNDS SERIAL 0003
FOR USE WITH MODEL TBY SERIES RADIO EQUIPMENT
MANUFACTURED FOR
NAVY DEPARTMENT - BUREAU OF SHIPS
BY CONTRACTOR
ELECTRONIC LABORATORIES, INC.
INDIANAPOLIS, INDIANA

CONTRACT NUMBER	CONTRACT DATE
NXs 4303	April 27, 1942

(SIZE 3 1/16 X 2 on side of case)

SHIPPING CHEST:

TYPE CRH-10038
SHIPPING CHEST
82 POUNDS SERIAL 124
A UNIT OF MODEL TBY-2 RADIO EQUIPMENT
MANUFACTURED FOR
NAVY DEPARTMENT - BUREAU OF SHIPS
BY A.E. RITTENHOUSE CO.
CONTRACTOR
WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.
BALTIMORE, MARYLAND

CONTRACT NUMBER	CONTRACT DATE
NOs 80643	January 8, 1941

(SIZE 3 1/16 X 2" on top of chest)

[redacted]

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Table 3

Models TBY-1 and TBY-2

EQUIPMENT DIMENSIONS AND WEIGHTS

Transmitter Receiver, Type CRI-43007 (overall dimensions):

Height	8 1/2"
Width	10 3/4"
Depth	7 1/4"
Weight	11 1/2 lbs.

Dry Battery, Type CNC 19018A:

Height	4 1/4"
Width	9 7/16"
Depth	6 9/16"
Weight	13 lbs.

Storage Battery, Type CLG-19029:

Height	4 3/8"
Width	5 15/16"
Depth	6 5/8"
Weight	12 1/2 lbs.

Vibrator Unit, Type CLG-20144:

Height	4 7/16"
Width	4 1/4"
Depth	6 5/8"
Weight	6 1/2 lbs.

Shipping Chest, Type CAH-10038:

Height	11"
Width	20"
Length	16 3/4"
Weight(empty)	20 1/4 lbs.

Antenna, Type CWN-66025:

Ten pieces	
Total length	9 3/4 ft.
Weight	3 oz.

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Table 3 (Cont'd)

Canvas carrying Case, Type OSS-10039:	
Height (complete with equipment)	17 1/2"
Width (" " ")	13 1/2"
Depth (" " ")	9"
Weight (case only)	3 lbs.
Weight (complete equipment with Type CNC 19018 battery)	32 lbs
Weight (complete equipment with Type CLG 19029 battery and Type CLG 20144 vibra-pack)	38 lbs.
Headphone weight	12 oz.
Cord length	7 ft.
Key weight	7 oz.
Cord length	4 ft.

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Table 4

Model TBY-2, Serial No. 200

POWER OUTPUT MEASUREMENTS

TEST AS PER PAR. 4-1(15) OF SPECIFICATIONS RE 13A 535B

AND MODIFICATIONS RE 13A 535C

Band	Frequency (Mc)	Plate Current (Ma)	Plate Voltage	Grid Current (Ma)	Power Output (Watts)	Emission
1	28	16.5	138	4.38	0.847	CW
1	30	16.3	138	4.4	0.788	CW
1	32.4	16.1	138	4.3	0.730	CW
1	28	17.2	138	4.98	1.523	MCW
1	30	17.0	138	5.1	1.383	MCW
1	32.4	17.1	138	5.1	1.365	MCW
2	32.8	15.5	139	4.5	0.802	CW
2	39.6	16.2	138	4.5	0.815	CW
2	47.2	16.5	138	4.9	0.682	CW
2	32.8	17.0	138	5.3	1.513	MCW
2	39.6	17.1	138	5.0	1.435	MCW
2	47.2	17.5	138	5.9	1.275	MCW
3	47.6	16.5	139	3.1	0.814	CW
3	55.6	16.1	140	3.0	0.710	CW
3	65.2	16.1	139	3.4	0.768	CW
3	47.6	17.5	138	3.7	1.500	MCW
3	55.6	17.5	138	3.7	1.320	MCW
3	65.2	17.8	138	4.1	1.430	MCW
4	65.6	16.5	138	1.7	0.738	CW
4	72.8	16.2	138	1.6	0.653	CW
4	80	16.5	138	1.8	0.508	CW
4	65.6	17.6	137	2.0	1.39	MCW
4	72.8	17.5	137	2.4	1.27	MCW
4	80	17.6	138	2.5	1.01	MCW

Antenna Resistance: 33 ohms (lamp load)
Specification Requirements: 1 watt

[redacted]

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Table 5

Model TBY-2, Serial No. 124

POWER OUTPUT MEASUREMENT

TEST AS PER PAR. 4-1(15) OF SPECIFICATIONS RE 13A 535B

AND MODIFICATIONS RE 13A 535C

Band	Frequency (Mc)	Plate Current (Ma)	Plate Voltage	Grid Current (Ma)	Power Output (Watts)	Emission
1	28	16.5	140	5.3	0.975	CW
1	30	16.4	140	5.5	0.960	CW
1	32.4	16.2	140	5.95	0.923	CW
1	28	17.5	140	5.95	1.720	MCW
1	30	17.3	140	6.10	1.700	MCW
1	32.4	17.1	140	6.45	1.643	MCW
2	32.8	16.6	140	5.10	0.960	CW
2	39.6	16.2	140	4.90	0.923	CW
2	47.2	16.0	140	5.20	0.860	CW
2	32.8	17.5	140	5.80	1.700	MCW
2	39.6	17.0	140	5.70	1.587	MCW
2	47.2	16.6	140	6.25	1.489	MCW
3	47.6	16.5	140	3.40	0.854	CW
3	55.6	16.5	140	3.50	0.740	CW
3	65.2	16.5	140	3.60	0.854	CW
3	47.6	17.6	139	4.30	1.601	MCW
3	55.6	17.0	140	4.50	1.313	MCW
3	65.2	18.1	139	4.40	1.656	MCW
4	65.6	16.4	140	2.00	0.740	CW
4	72.8	16.4	140	2.10	0.740	CW
4	80	16.5	140	2.30	0.672	CW
4	65.6	17.5	139	2.60	1.397	MCW
4	72.8	17.5	139	2.70	1.372	MCW
4	80	17.5	139	3.00	1.296	MCW

Antenna Resistance: 33 ohms (lamp load)
Specification Requirements: 1 watt

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Table 6

Model TBY-1, Serial No. 646

POWER OUTPUT MEASUREMENTS

TEST AS PER PAR. 4-1(15) OF SPECIFICATIONS RE 13A 535B

AND MODIFICATIONS RE 13A 535C

Band	Freq. (Mc)	Plate Current (Ma)	Plate Voltage	Grid Current (Ma)	Power Output (Watts)	Emission	Mod. (%)
1	28	16	138	5.4	0.774	CW	
1	30	16	140	5.4	0.730	CW	
1	32.4	16	139	5.7	0.640	CW	
1	28	17.5	137	6.6	1.460	MCW	
1	30	17.4	137	6.5	1.410	MCW	
1	32.4	17	137	6.7	1.190	MCW	
1	28	16.5	138	5.9	1.010	Phone	67.7
1	30	16.4	139	6.1	0.935	Phone	68.7
1	32.4	16.4	138	6.2	0.845	Phone	66.6
2	32.8	16	139	4.6	0.906	CW	
2	39.6	16	139	4.3	0.900	CW	
2	47.2	16	139	4.9	0.786	CW	
2	32.8	17.5	137	5.8	1,720	MCW	
2	39.6	17.0	137	5.8	1.655	MCW	
2	47.2	16.3	137	6.4	1.375	MCW	
2	32.8	16.5	138	5.2	1.210	Phone	66.6
2	39.6	16.2	138	5.3	1.160	Phone	66.6
2	47.2	16.1	138	5.7	1.040	Phone	68.0
3	47.6	16	138	3.2	0.754	CW	
3	55.6	16	138	2.7	0.893	CW	
3	65.2	16	138	2.3	0.800	CW	
3	47.6	16.8	137	3.6	1.390	MCW	
3	55.6	16.8	137	3.4	1.630	MCW	
3	65.2	17	137	3.3	1.490	MCW	
3	47.6	16.5	138	3.40	1.060	Phone	67
3	55.6	16.1	138	2.90	1.175	Phone	67
3	65.2	16.2	138	2.70	1.060	Phone	67

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Table 6 (Cont'd)

Band	Freq. (Mc)	Plate Current (Ma)	Plate Voltage	Grid Current (Ma)	Power Output (Watts)	Emission	Mod. (%)
4	65.6	16	138	2.20	0.838	CW	
4	72.8	16	138	1.90	0.774	CW	
4	80.0	16	138	1.90	0.750	CW	
4	65.6	17.1	137	2.20	1.440	MCW	
4	72.8	17.1	137	2.30	1.390	MCW	
4	80.0	17.1	137	2.10	1.330	MCW	
4	65.6	16.5	138	2.10	1.050	Phone	68
4	72.8	16.5	138	2.00	1.010	Phone	67
4	80.0	16.6	138	1.95	0.907	Phone	65

Antenna Resistance: 33 ohms (lamp load)
Specification Requirements: 1 watt.

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Table 8

Model TBY-2, Serial No. 124

CALIBRATION OF OSCILLATOR DIAL USING TYPE CWN66025 ANTENNA

TEST AS PER PAR. 4-1(6) OF SPECIFICATIONS RE 13A 535B

BAND 1

Oscillator Dial Setting	Output Freq. (Mcs)	Kilocycles per 100 Dial Divisions	Kilocycles per Division
000	24.574		
100	24.792	218	2.18
200	25.326	534	5.34
300	25.932	606	6.06
400	26.624	692	6.92
500	27.376	752	7.52
600	28.270	894	8.94
700	29.312	1042	10.42
800	30.706	1394	13.94
900	32.512	1705	17.05
1000	33.500	988	9.88
1100	35.562	2062	20.62
1200	36.918	1356	13.56

Only the portion of the dial between 500 and 900 is normally used in Band 1.

BAND 2

000	30.996		
100	31.314	318	3.18
200	32.148	834	8.34
300	33.123	975	9.75
400	34.221	1098	10.98
500	35.484	1263	12.63
600	36.984	1500	15.00
700	38.412	1428	14.28
800	39.966	1554	15.54
900	41.844	1878	18.78
1000	43.806	1962	19.62
1100	46.119	2313	23.13
1200	47.856	1737	17.37

Only the portion of the dial between 200 and 1100 is normally used in Band 2.

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Table 8 (Cont'd)

BAND 3

Oscillator Dial Setting	Output Freq. (Mcs)	Kilocycles per 100 Dial Divisions	Kilocycles Per Division
000	44.178		
100	44.634	456	4.56
200	45.612	978	9.78
300	46.782	1170	11.70
400	48.210	1428	14.28
500	49.830	1620	16.20
600	51.663	1833	18.33
700	53.775	2112	21.12
800	56.175	2400	24.00
900	59.208	3033	30.33
1000	62.728	3520	35.20
1100	66.416	3688	36.88
1200	69.120	2704	27.04

Only the portion of the dial between 300 and 1100 is normally used in Band 3.

BAND 4

000	58.336		
100	58.992	656	6.56
200	60.572	1580	15.80
300	62.288	1716	17.16
400	64.292	2004	20.04
500	66.560	2268	22.68
600	69.144	2584	25.84
700	71.980	2836	28.36
800	75.376	3396	33.96
900	79.516	4140	41.40
1000	84.230	4714	47.14
1100	89.515	5285	52.85
1200	93.445	3930	39.30

Only the portion of the dial between 400 and 900 is normally used in Band 4.
Frequencies measured with a General Radio Type 620-A Heterodyne Frequency Meter.

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Table 9

Model TBY-1, Serial No. 642

FREQUENCY RANGE AND OVERLAP TRANSMITTER

TEST AS PER PARAS. 4-1(1) AND 4-1(5) OF

SPECIFICATIONS RE 13A 535B

Band	Tuning Dial	Freq. (Mc)	Mean Freq.	Overlap (Mc)	Per Cent Overlap Measured	Per Cent Overlap Specifications
		28.000				
1	0	24.754	26.377	3.246	12.3	3
	1200	34.024				
2	0	31.306	32.665	2.718	8.3	3
	1200	48.836				
3	0	43.899	46.367	4.937	10.6	3
	1200	68.720				
4	-0	56.988	62.854	11.732	18.7	3
	1200	90.125				
		80.000	85.063	10.125	11.9	3

Frequency measured with General Radio Type 620-A Heterodyne Frequency Meter.

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Table 10

Model TBY-2, Serial No. 124

FREQUENCY RANGE AND OVERLAP OF TRANSMITTER

TEST AS PER PARAS. 4-1(1) AND 4-1(5) OF

SPECIFICATIONS RE 13A 535B

Band	Transmitter Tuning Dial	Freq. (Mc)	Mean Freq. (Mc)	Overlap (Mc.)	Per Cent Overlap Measured	Per Cent Overlap Specs.
		28.000				
1	000	24.436	26.212	3.564	13.6	3
	1200	36.610				
2	000	31.323	33.9665	5.287	15.6	3
	1200	48.332				
3	000	43.916	46.124	4.316	9.4	3
	1200	70.075				
4	000	58.204	64.1395	11.871	18.5	3
	1200	94.780				
		80.000	87.390	14.780	16.9	3

Note: Measurements made with General Radio Type 620-A Heterodyne Frequency Meter.

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Table 11

Model TBY-1, Serial No. 642

CHECK FOR LOST MOTION, BACK LASH,

AND TORQUE LASH TRANSMITTER

BAND 1

Trial No.	Osc. Dial	Output Frequency (Mc) Clockwise Direction	Output Frequency (Mc) Counter-clockwise Direction	Deviation (Mc)	Deviation (%)
0	300	26.364	26.364	0.000	0.0000
1	300	26.364	26.366	0.002	0.0076
2	300	26.364	26.364	0.000	0.0000
3	300	26.366	26.366	0.000	0.0000
4	300	26.366	26.366	0.000	0.0000
5	300	26.364	26.366	0.002	0.0076
0	1000	32.838	32.840	0.002	0.006
1	1000	32.838	32.840	0.002	0.006
2	1000	32.838	32.840	0.002	0.006
3	1000	32.840	32.842	0.002	0.006
4	1000	32.838	32.842	0.004	0.012
5	1000	32.838	32.842	0.004	0.012

Frequency measurements made with General Radio Type 620-A Heterodyne Frequency Meter.

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Table 12

Model TBY-2, Serial No. 124

CHECK FOR LOST MOTION, BACKLASH

AND TORQUE LASH OF TRANSMITTER

BAND 1

Trial No.	Osc. Dial	Output Frequency (Mc) Clockwise Direction	Output Frequency (Mc) Counter-Clockwise Direction	Deviation (Mc)	Deviation (%)
0	300	25.984	25.958	0.026	0.100
1	300	25.988	25.952	0.036	0.139
2	300	25.988	25.950	0.038	0.146
3	300	25.992	25.948	0.044	0.170
4	300	25.990	25.958	0.032	0.124
5	300	25.978	25.952	0.026	0.100
0	1000	32.958	32.979	0.021	0.064
1	1000	32.955	32.976	0.021	0.064
2	1000	32.964	32.982	0.018	0.055
3	1000	32.958	32.976	0.018	0.055
4	1000	32.958	32.979	0.021	0.064
5	1000	32.958	32.973	0.015	0.0456

Frequency measurements made with General Radio Type 620-A Heterodyne Frequency Meter.

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Table 13

Model TBY-1, Serial No. 642

ACCURACY OF RESET TO PREVIOUSLY CALIBRATED FREQUENCIES

Band 1

Trial No.	Osc. Dial	Output Freq. (Mc)	Deviation (Mc)	Deviation (%)	Time of Reset (Sec)
0	600	28.730			
1	600	28.730	0	0	4
2	600	28.728	0.002	0.00697	6
3	600	28.728	0.002	0.00697	5.3
4	600	28.730	0.000	0.00000	5.6
5	600	28.728	0.002	0.00697	5.5
0	900	31.848			
1	900	31.845	0.003	0.00953	5.6
2	900	31.848	0.000	0	5.9
3	900	31.848	0.000	0	4.5
4	900	31.848	0.000	0	5.4
5	900	31.848	0.000	0	5.8

Band 2

0	300	33.735			
1	300	33.735	0.000	0	7.5
2	300	33.735	0.000	0	3.5
3	300	33.738	0.003	0.0089	5.0
4	300	33.735	0.000	0	4.0
5	300	33.735	0.000	0	3.1
0	1000	45.212			
1	1000	45.216	0.004	0.00884	7
2	1000	45.212	0.000	0	3.8
3	1000	45.212	0.000	0	5.7
4	1000	45.216	0.004	0.00884	6.6
5	1000	45.216	0.004	0.00884	6.1

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Table 13 (Cont'd)

Band 3

Trial No.	Osc. Dial	Output Freq. (Mc)	Deviation (Mc)	Deviation (%)	Time of Reset (Sec)
0	450	50.455			
1	450	50.450	0.005	0.0099	5.5
2	450	50.460	0.005	0.0099	5.0
3	450	50.455	0.000	0	6.1
4	450	50.455	0.000	0	5.5
5	450	50.450	0.005	0.0099	3.7
0	1000	64.056			
1	1000	64.044	0.012	0.018	7.3
2	1000	64.056	0.000	0	7.5
3	1000	64.020	0.036	0.0562	7.0
4	1000	64.020	0.036	0.0562	6.4
5	1000	64.016	0.040	0.0625	7.2

Band 4

0	500	66.388			
1	500	66.388	0.000	0	4
2	500	66.392	0.004	0.00603	3.2
3	500	66.388	0.000	0	3
4	500	66.388	0.000	0	3.6
5	500	66.392	0.004	0.00603	5.0
0	900	79.250			
1	900	79.245	0.005	0.00631	4.0
2	900	79.255	0.005	0.00631	4.0
3	900	79.250	0.000	0	3.6
4	900	79.250	0.000	0	4.2
5	900	79.255	0.005	0.00631	3.8

Frequency measurements made by means of General Radio Type 620-A Heterodyne Frequency Meter.

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Table 14

Model TBY-2, Serial No. 124

ACCURACY OF RESET TO PREVIOUSLY CALIBRATED FREQUENCIES

Band 1

Trial No.	Osc. Dial	Output Freq. (Mc)	Deviation (Mc)	Deviation (%)	Time of Reset (Sec)
0	600	28.246			
1	600	28.248	0.002	0.00714	11
2	600	28.238	0.008	0.0286	10
3	600	28.252	0.006	0.0214	15
4	600	28.234	0.012	0.0428	11
5	600	28.232	0.014	0.0500	12
0	900	31.875			
1	900	31.860	0.015	0.0470	8
2	900	31.863	0.012	0.0380	10
3	900	31.848	0.027	0.0850	14
4	900	31.824	0.051	0.1600	12
5	900	31.878	0.003	0.0095	13

Band 2

0	300	32.754			
1	300	32.772	0.018	0.0550	11
2	300	32.811	0.057	0.1740	12
3	300	32.760	0.006	0.0184	10
4	300	32.772	0.018	0.0550	9
5	300	32.757	0.003	0.0092	11
0	1000	44.592			
1	1000	44.600	0.008	0.0179	12
2	1000	44.552	0.040	0.0900	16
3	1000	44.592	0.000	0.0000	18
4	1000	44.596	0.004	0.0090	20
5	1000	44.600	0.008	0.0179	15

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Table 14 (Cont'd)

Trial No.	Osc. Dial	Output Freq. (Mc)	Band 3 (Mc)	(%)	Time of Reset (Sec)
0	450	49.388			
1	450	49.416	0.028	0.0571	10
2	450	49.380	0.008	0.0162	20
3	450	49.480	0.092	0.1865	13
4	450	49.420	0.032	0.0648	12
5	450	49.376	0.012	0.0245	14
0	1000	63.185			
1	1000	63.185	0.000	0.0000	12
2	1000	63.155	0.030	0.04770	15
3	1000	63.180	0.005	0.00794	12
4	1000	63.150	0.035	0.0556	11
5	1000	63.170	0.015	0.0238	16
			Band 4		
0	500	67.345			
1	500	67.340	0.005	0.00744	11
2	500	67.360	0.015	0.0224	10
3	500	67.305	0.040	0.0595	15
4	500	67.320	0.025	0.0373	13
5	500	67.300	0.045	0.0672	11
0	900	80.515			
1	900	80.510	0.005	0.0062	12
2	900	80.485	0.030	0.0373	12
3	900	80.540	0.025	0.0311	8
4	900	80.480	0.035	0.0435	8
5	900	80.475	0.040	0.0497	10

Frequency measurements made by means of General Radio Type 620-A Heterodyne Frequency Meter.

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Table 15

Model TBY-1, Serial No. 642

EFFECT OF DIAL LOCK ON FREQUENCY OF TRANSMITTER

Direction of Approach	Frequency in Mc		Deviation	
	Unlocked	Locked	(Mc)	(%)
CW	27.956	27.954	0.002	0.00717
CCW	27.954	27.952	0.002	0.00717
CW	32.732	32.730	0.002	0.00612
CCW	32.734	32.732	0.002	0.00612
CW	66.820	66.824	0.004	0.0060
CCW	66.828	66.824	0.004	0.0060
CW	80.485	80.490	0.005	0.00621
CCW	80.485	80.480	0.005	0.00621

Frequency measurements made by means of General Radio Type 620-A Heterodyne Frequency Meter.

CW = clockwise
CCW = counterclockwise

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Table 16

Model TBY-2, Serial No. 124

EFFECT OF DIAL LOCK ON FREQUENCY OF TRANSMITTER

Direction of Approach	Frequency in Mc.		Deviation	
	Unlocked	Locked	(Mc)	(%)
CW	28.176	28.170	0.006	0.0212
CCW	28.112	28.092	0.020	0.0715
CW	31.844	31.848	0.004	0.0126
CCW	31.878	31.864	0.014	0.044
CW	66.632	66.580	0.052	0.0782
CCW	66.508	66.496	0.012	0.0180
CW	79.945	79.955	0.01	0.0125
CCW	80.095	80.055	0.04	0.0500

Frequency measurements made with General Radio Type 620-A Heterodyne Frequency Meter.

CW = clockwise
CCW = counterclockwise

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Table 17

Model TBY-1, Serial No. 642

FREQUENCY VARIATION WITH CHANGE OF TUBES

IN THE OSCILLATOR

Tube Pair No.	Frequency (Mc)	Deviation from mean freq. (Mc)	(%)	
Orig.	28.100			
1	28.262	0.162	0.574	
2	28.224	0.124	0.440	
3	28.200	0.100	0.356	
4	28.198	0.098	0.350	
5	28.196	0.096	0.342	
Orig.	28.102	0.002	0.071	
	28.183 mean;	0.047	0.167	average
Orig.	32.190			
1	32.334	0.144	0.450	
2	32.320	0.130	0.403	
3	32.286	0.096	0.298	
4	32.260	0.070	0.217	
5	32.258	0.068	0.210	
Orig.	32.162	0.028	0.087	
	32.259 mean;	0.047	0.146	average
Orig.	64.916			
1	65.520	0.604	0.920	
2	65.348	0.432	0.664	
3	65.524	0.608	0.940	
4	65.232	0.316	0.485	
5	65.124	0.208	0.320	
Orig.	64.644	0.272	0.420	
	64.901 mean;	0.3593	0.555	average

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Table 17 (Cont'd)

Tube Pair No.	Frequency (Mc)	Deviation from mean Freq. (Mc)	(%)
Orig.	80.455		
1	81.065	0.610	0.760
2	80.920	0.465	0.580
3	81.040	0.585	0.727
4	80.770	0.315	0.391
5	80.905	0.450	0.558
Orig.	80.465	0.010	0.124
	80.817 mean;	0.2033	0.251 average

Frequency measurements made by means of General Radio Type 620-A Heterodyne Frequency Meter.

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Table 18

Model TBY-2, Serial No. 124

FREQUENCY VARIATION WITH CHANGE OF TUBES

IN THE OSCILLATOR

Tube Pair No.	Frequency (Mc)	Deviation from mean frequency (Mc)	(%)
Orig.	28.402		
1	28.406	0.004	0.014
2	28.382	0.020	0.070
3	28.328	0.074	0.260
4	28.268	0.134	0.474
5	28.270	0.132	0.464
Orig.	28.368	0.034	0.121
	28.346 mean;	0.048	0.17 average
Orig.	32.090		
1	32.042	0.048	0.149
2	32.120	0.030	0.0935
3	32.090	0.000	0.000
4	32.346	0.256	0.797
5	32.270	0.180	0.560
Orig.	32.096	0.006	0.0187
	32.151 mean;	0.109	0.340 average
Orig.	66.524		
1	66.308	0.216	0.325
2	66.336	0.188	0.284
3	66.288	0.236	0.355
4	66.084	0.440	0.662
5	66.184	0.340	0.511
Orig.	66.520	0.004	0.006
	66.321 mean;	0.118	0.178 average

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Table 18 (Cont'd)

Tube Pair No.	Frequency (Mc)	Deviation from mean freq. (Mc)	(%)
Orig.	80.100		
1	79.835	0.265	0.332
2	80.090	0.010	0.0125
3	79.705	0.395	0.495
4	79.600	0.500	0.625
5	79.725	0.375	0.470
Orig.	80.185	0.085	0.106
	79.891 mean;	0.200	0.250 Average

Frequency measured by means of General Radio Type 620-A Heterodyne Frequency Meter.

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Table 19

Model TBY-1, Serial No. 642

TUBE VOLTAGES AND CURRENTS -29 MC

Tube	Purpose and Designation	Fil. Volts	Plate Volts	Plate Cur. (Ma)	Grid Volts	Grid Cur. (Ma)	Screen Volts	Screen (Ma)	Condition
1E7G	Audio Modulator, V-7	2	145	4.5	-8.2	0	145	2.75	CW
		2	140	8.5	-8.2	0.18	150	4.25	MCW
		2.1	145	4.8	-8.2	0	150	2.8	Receive
	Twin Pentode	2	145	4.5	-8.2	0	145	2.75	CW
		2	140	8.5	-8.2	0.20	150	4.25	MCW
		2.1	145	4.5	-8.2	0	150	2.80	Receive
30	Audio Oscillator, V-6	2.05	145	4.1	6.2	0			MCW
		2.05	147	4.3	2.2	0			Receive
30	Crystal Calibrator, V-5	1.85	65	4.4			Calibrate		Send
		1.85	62	4.4					Receive
958A	Transmitter Oscillator, V-4	1.3	140	16		4.2			CW
		1.3	138	17.5		6.0			MCW
958A	Transmitter Oscillator, V-3	1.3	140	16		4.2			CW
		1.3	138	17.5		6.0			MCW
958A	Receiver Detector, V-2	1.3	102	0.625	-27				Receive
959	R.F. Amp. in Receiver	1.3	141	0.43	-3		60	0.1	Receive

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Table 20

Model TBY-1, Serial No. 642

EFFECT OF VARIATION OF SUPPLY VOLTAGE

TEST AS PER PAR. 4-1(19) OF SPECIFICATIONS RE 13A 535B

AND MODIFICATIONS RE 13A 535C

Band 1

Fil. (Volts)	Plate Supply (Volts)	Plate Cur. (Ma)	Grid Cur. (Ma)	Freq. (Mc)	Deviation (Mc)	Deviation (%)	
1.50	150	16	5.9	28.044			
1.42	142	16	4.5	28.014	0.030	0.107	
1.35	135	16	3.5	27.990	0.054	0.193	
1.27	127.5	16	2.7	27.948	0.096	0.343	
			Band 2				
1.50	150	16	4.4	33.474			
1.42	142	16	3.3	33.438	0.036	0.107	
1.35	135	16	2.5	33.402	0.072	0.215	
1.27	127.5	13.6	1.4	33.762	0.288	0.860	
			Band 3				
1.50	150	16	3.6	49.004			
1.42	142	16	2.2	48.892	0.112	0.229*	
1.35	135	16	1.8	49.984	0.980	2.00	
1.27	127.5	14	1.2	49.948	0.944	1.93	
			Band 4				
1.50	150	16	3.3	65.445			
1.42	142	16	2.3	65.365	0.080	0.122	
1.35	135	16	1.5	65.255	0.190	0.290	
1.27	127.5	13.5	1.3	66.990	1.545	2.300	Note 1

Note 1. Necessary to retune antenna and antenna coupling to obtain oscillation.

Specification Requirements: That the frequency vary not more than 0.2% for a 5% reduction in battery operating voltages.

* Specifications exceeded.

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Table 21

Model TBY-2, Serial No. 124

EFFECT OF VARIATION OF SUPPLY VOLTAGE

TEST AS PER PAR. 4-1(19) OF SPECIFICATIONS RE 13A 535B

AND MODIFICATIONS RE 13A 535C

Band 1

Fil. (Volts)	Plate Supply (Volts)	Plate Cur. (Ma)	Grid Cur. (Ma)	Freq. (Mc)	Deviation (Mc)	Deviation (%)
1.50	150	16.5	4.9	28.444		
1.42	142	16.5	4.1	28.414	0.030	0.106
1.35	135	16.5	2.8	28.374	0.070	0.247
1.27	127.5	16.5	1.8	28.346	0.098	0.345

Band 2

1.50	150	16.5	4.7	33.393		
1.42	142	16.5	3.4	33.345	0.048	0.144
1.35	135	16.5	2.5	33.312	0.081	0.242
1.27	127.5	16.5	1.7	33.279	0.114	0.341

Band 3

1.50	150	16.5	3.6	48.752		
1.42	142	16.5	2.2	48.648	0.104	0.213*
1.35	135	16.5	1.5	48.564	0.188	0.386
1.27	127.5	16.0	1.2	48.472	0.280	0.575

Band 4

1.50	150	16.5	2.0	65.845		
1.42	142	16.5	1.3	65.630	0.215	0.327*
1.35	135	16.5	0.8	65.705	0.140	0.213
1.27	127.5	13.0	0.5	65.855	0.010	0.0152

Specification Requirements: That the frequency vary not more than 0.2% for a 5% reduction in battery operating voltages.

* Specifications exceeded.

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Table 22

Model TBY-1, Serial No. 642

VARIATION OF SUPPLY VOLTAGE

Reduction (%)	Fil. (Volt)	Plate Voltage	Grid Current (Ma)	Plate Current (Ma)	R.F. (Ma)	Power (Watts)	Power (%)
0	1.50	150	1.5	16	177	0.845	100.0
- 5	1.42	142	1.4	16.2	173	0.808	95.8
-10	1.35	135	1.2	13.2	148	0.591	70.0
-15	1.27	127	0.9	10.6	122	0.402	47.8
-20	1.20	120	0.7	7.5	79	0.168	19.8
-25	1.12	112	0	6.6	0	0	00.0

Antenna: 27-ohm resistor in series with a variable condenser.

Band No. 4 frequency approximately 72.5 mcs. used during these measurements.

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Table 23

Model TBY-2, Serial No. 124

MCW PERCENTAGE MODULATION

TEST AS PER PAR. 4-1(18) OF SPECIFICATIONS RE 13A 535B

Output Freq. (Mc)	Mod. Freq.	Input (Volts)	Mod. (%)	Plate Current (Ma)	Grid Current (Ma)	Band	Osc. Dial
30	400	1.5	61.5	17.0	6.2	1	760.0
45	400	1.5	58.4	16.6	5.9	2	1032.5
60	400	1.5	60.0	16.1	3.9	3	896.5
80	400	1.5	55.5	17.0	2.4	4	905.0
30	MCW	---	92.4	16.8	6.5	1	760.0
45	MCW	---	90.5	16.0	6.1	2	1032.5
60	MCW	---	90.5	17.0	4.0	3	896.5
80	MCW	---	98.0	17.1	2.3	4	905.0

Specification Requirements: That in the case of MCW, the percentage of modulation shall not be less than 90.

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Table 23

Model TBY-2, Serial No. 124

MCW PERCENTAGE MODULATION

TEST AS PER PAR. 4-1(38) OF SPECIFICATIONS RE 13A 535B

Output Freq. (Mc)	Mod. Freq.	Input (Volts)	Mod. (%)	Plate Current (Ma)	Grid Current (Ma)	Band	Osc. Dial
30	400	1.5	61.5	17.0	6.2	1	760.0
45	400	1.5	58.4	16.6	5.9	2	1032.5
60	400	1.5	60.0	16.1	3.9	3	896.5
80	400	1.5	55.5	17.0	2.4	4	905.0
30	MCW	---	92.4	16.8	6.5	1	760.0
45	MCW	---	90.5	16.0	6.1	2	1032.5
60	MCW	---	90.5	17.0	4.0	3	896.5
80	MCW	---	98.0	17.1	2.3	4	905.0

Specification Requirements: That in the case of MCW, the percentage of modulation shall not be less than 90.

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Table 24

Model TBY-1, Serial No. 642

DISTORTION VERSUS AUDIO FREQUENCY

(70% MODULATION)

DUMMY ANTENNA RESISTANCE 27 OHM

Band 1

Audio Freq. (Cps)	Audio Input Volts	Per Cent Distortion	Plate Current (Ma)	Grid Current (Ma)	Antenna Current (Ma)
200	1.70	10.0	16.0	4.8	175
300	1.50	9.4	16.3	4.9	175
400	1.26	6.8	16.1	4.8	175
500	1.07	5.5	16.1	4.8	175
600	0.94	5.4	16.1	4.8	175
750	0.81	4.7	16.1	4.8	175
1000	0.79	4.3	16.0	4.8	175
1500	0.81	4.3	16.0	4.7	174
2000	0.87	3.0	16.0	4.6	175
2500	0.92	3.0	16.0	4.7	175
3000	0.96	3.0	16.0	4.7	175
4000	1.01	5.7	16.0	4.8	175
5000	1.05	10.0	16.0	4.6	175

Band 4

200	1.74	12.5	16.0	1.1	189
300	1.55	10.0	16.3	1.1	189
400	1.28	6.5	16.0	1.1	189
500	1.09	5.7	16.0	1.1	189
600	0.95	5.5	16.0	1.1	189
750	0.84	5.3	16.0	1.1	189
1000	0.79	5.0	16.0	1.1	186
1500	0.80	5.2	16.0	1.0	182
2000	0.85	5.3	16.0	1.0	182
2500	0.90	6.0	16.0	1.0	184
3000	0.94	6.2	16.0	1.0	183
4000	0.96	6.2	16.0	1.0	182
5000	1.01	11.0	15.8	1.0	181

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Table 25

Model TBY-2, Serial No. 124

DISTORTION VERSUS AUDIO FREQUENCY

(70% MODULATION)

DUMMY ANTENNA RESISTANCE 27 OHM

Band 1

Audio Freq. (Cps)	Audio Input Volts	Per Cent Distortion	Plate Current (Ma)	Grid Current (Ma)	Antenna Current (Ma)
200	1.85	12.0	16	5.65	180
300	1.65	9.8	"	5.70	180
400	1.34	8.0	"	5.60	179
500	1.15	7.7	"	5.15	181
600	0.98	7.3	"	5.80	180
750	0.82	7.0	"	5.80	179
1000	0.70	6.3	"	6.20	179
1500	0.72	5.7	"	6.20	179
2000	0.77	6.3	"	6.20	179
2500	0.83	6.3	"	6.20	180
3000	0.85	7.0	"	6.20	180
4000	0.92	7.1	"	6.20	180
5000	0.98	11.0	"	6.20	180

Band 4

200	1.85	11	16	1.9	200
300	1.70	9.4	"	1.9	201
400	1.40	6.8	"	1.9	199
500	1.14	6.0	"	1.9	198
600	1.00	5.8	"	1.9	200
750	0.82	5.5	"	1.9	199
1000	0.77	5.0	"	2.1	202
1500	0.84	5.2	"	1.9	200
2000	0.90	5.5	"	1.9	201
2500	0.94	6.6	"	1.9	200
3000	0.97	7.9	"	1.9	199
4000	1.09	8.5	"	1.9	203
5000	1 14	15.0	"	1.9	200

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Table 26

Model TBY-1, Serial 642

AUDIO FREQUENCY RESPONSE

DUMMY ANTENNA RESISTANCE 27 OHMS

Mod. Freq. (CPS)	Input Volts (A.C)	Mod. (%)	Db Relative to 70% Mod. at 1000 cycles	R-F Output (Ma)
		Band 1		
1000	0.9	70	0	125
200	0.9	61	-1.2	123
300	0.9	66.5	-0.4	124
400	0.9	67	-0.35	124
500	0.9	67.1	-0.3	124
750	0.9	68	-0.2	124
1000	0.9	69.3	-0.1	125
1500	0.9	69.3	-0.1	124
2000	0.9	69.3	-0.1	125
2500	0.9	69.3	-0.1	124
5000	0.9	66.5	-0.4	125
		Band 2		
1000	1.14	70	0	80
200	1.14	59.5	-1.5	79
300	1.14	65	-0.66	79
400	1.14	65.7	-0.6	79
500	1.14	66.5	-0.5	79
750	1.14	68	-0.25	79
1000	1.14	69.3	-0.1	79
1500	1.14	69.3	-0.1	79
2000	1.14	69.3	-0.1	79
2500	1.14	68.5	-0.15	79
5000	1.00*	58.7	-1.5	79

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Table 26 (Cont'd)

Mod. Freq. (CPS)	Input Volts (A.C)	Mod. (%)	Db Relative to 70% Mod. at 1000 cycles	R-F Output (Ma.)
		Band 3		
1000	0.92	70	0	85
200	0.92	59.5	-1.5	85
300	0.92	63.5	-0.8	85
400	0.92	66	-0.6	85
500	0.92	66	-0.6	85
750	0.92	67	-0.4	85
1000	0.92	69.2	-0.1	85
1500	0.92	70	0	86
2000	0.92	70	0	86
2500	0.92	70	0	86
5000	0.92	67	-0.4	86
		Band 4		
1000	0.96	70	0	75
200	0.96	60	-1.25	75
300	0.96	63	-0.9	76
400	0.96	64.3	-0.8	76
500	0.96	65	-0.7	76
750	0.96	66.5	-0.4	76
1000	0.96	69.3	0	76
1500	0.96	70	0	76
2000	0.96	70	0	76
2500	0.96	70	0	76
5000	0.96	69.3	0	76

* Impossible to get greater input voltage with the circuit arrangement employed.

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Table 27

Model TBY-2, Serial No. 124

AUDIO FREQUENCY RESPONSE

DUMMY ANTENNA RESISTANCE 27 OHMS

Band 1

Mod. Freq. (CPS)	Input Volts (A.C)	Mod. (%)	Output Volts (A.C)	Db Relative to 70% Mod. at 1000 cycles	R-F Output (Ma)
1000	0.91	70	3.35	0.0	351
200	0.91	55	2.50	- 2.1	335
300	0.91	60	3.00	- 1.3	345
400	0.91	65.6	3.20	- 0.55	348
500	0.91	67.4	3.35	- 0.3	352
600	0.91	68.7	3.48	- 0.15	353
750	0.91	68.7	3.50	- 0.15	353
1000	0.91	68.7	3.50	- 0.15	352
1500	0.91	68.7	3.40	- 0.15	352
2000	0.91	68.7	3.40	- 0.15	351
2500	0.91	68.0	3.25	- 0.2	350
5000	0.91	64.0	2.90	- 0.8	344
7500	0.91	56.8	2.20	- 1.8	332

Band 2

1000	1.08	70.8	2.0	+ 0.0	250
200	1.08	59	1.6	- 1.5	242
300	1.08	63.2	1.88	- 0.9	242
400	1.08	66.7	2.0	- 0.4	242
500	1.08	66.7	2.1	- 0.4	242
600	1.08	66.7	2.08	- 0.4	245
750	1.08	71.4	2.32	+ 0.2	252
1000	1.08	72.3	2.32	+ 0.3	252
1500	1.08	71.6	2.28	+ 0.2	254
2000	1.08	71.4	2.20	+ 0.2	255
2500	1.08	71.1	2.00	+ 0.1	240
5000	1.08	68.9	2.04	- 0.1	235
7500	1.08	60.8	1.80	- 1.2	235

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Table 27 (Cont'd)

Band 3

Mod. Freq. (CPS)	Input Volts (A.C)	Mod. (%)	Output Volts (A.C)	Db Relative to 70% Mod. at 1000 cycles	R-F Output (Ma)
1000	0.91	70.	12.3	0	390
200	0.91	60	9.1	- 1.3	358
300	0.91	61.1	10.3	- 1.15	370
400	0.91	64.4	11.0	- 0.7	378
500	0.91	67.1	11.4	- 0.35	380
750	0.91	70.0	12.1	0	383
1000	0.91	71.0	11.8	+ 0.15	382
1500	0.91	69.5	11.8	- 0.05	380
2000	0.91	69.5	11.5	- 0.05	380
2500	0.91	66.2	11.2	- 0.45	380
5000	0.91	63.4	10.2	- 0.8	372
7500	0.91	60.0	8.9	- 1.3	365

Band 4

1000	0.89	70.0	5.5	0	279
200	0.89	64.7	4.75	- 0.7	235
300	0.89	70.0	5.20	0	250
400	0.89	70.5	5.35	+ 0.1	255
500	0.89	70.0	6.05	0	275
750	0.89	70.0	6.25	0	278
1000	0.89	70.0	6.25	0	279
1500	0.89	70.0	6.00	0	275
2000	0.89	69.5	5.65	- 0.05	272
2500	0.89	64.0	5.55	- 0.75	269
5000	0.89	64.0	5.55	- 0.75	272
7500	0.89	57.0	4.20	- 1.8	245

Antenna Resistance: 27 ohms

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Table 28

Model TBY-1, Serial No. 642

PERCENT MODULATION VERSUS AUDIO

INPUT VOLTS (1000 CPS)

DUMMY ANTENNA RESISTANCE 27 OHMS

Input Volts	Mod. (%)	Plate Current (Ma)	Grid Current (Ma)	Plate Volts	Grid Volts	R-F Current (Ma)
			Band 1			
0	0	16.0	3.3	139	6	245
0.1	16.1	16.0	3.4	140	6	248
0.2	27.4	16.0	3.4	140	6	250
0.3	35.6	16.0	3.5	140	6	255
0.4	43.0	16.0	3.6	140	6	251
0.5	51.7	16.0	3.7	140	6	258
0.6	58.2	16.0	3.9	140	6	273
0.7	62.5	16.0	4.2	138	6	270
0.8	72.5	16.0	4.4	138	6	271
0.9	77.5	16.0	4.45	138	6	278
1.0	80.0	16.0	4.5	138	6	279
1.1	80.0	16.0	4.8	138	6	282
			Band 4			
0	0	16.0	1.0	140	6	360
0.1	18.1	16.0	1.0	140	6	361
0.2	23.6	16.0	1.0	140	6	371
0.3	42.0	16.5	1.1	140	6	380
0.4	50.0	16.5	1.1	140	6	380
0.5	57.2	16.0	1.2	140	6	390
0.6	63.6	16.0	1.3	140	6	400
0.7	71.5	16.0	1.4	138	6	408
0.8	74.5	16.1	1.4	138	6	420
0.9	78.5	16.1	1.45	138	6	428
1.0	82.5	16.0	1.5	137	6	429
1.1	86.2	16.0	1.5	137	6	432
1.2	87.9	16.0	1.5	136	6	432

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Table 29

Model TBY-2, Serial No. 124

PERCENT MODULATION VERSUS AUDIO

INPUT VOLTS (1000 CYCLES)

DUMMY ANTENNA RESISTANCE 27 OHMS

Band 1

Input Volts	Mod. (%)	Plate Current (Ma)	Grid Current (Ma)	Plate Volts	Grid Volts	R-F Current (Ma)
0	0	16	4.1	138	6.0	200
0.1	14.0	16	4.0	138	6.0	198
0.2	26.4	16	4.1	138	6.0	195
0.3	37.5	16	4.3	138	6.0	200
0.4	45.1	16	4.4	137	6.0	205
0.5	54.7	16	4.8	137	6.0	206
0.6	61.5	16	5.0	137	6.0	215
0.7	65.5	16	5.1	137	6.0	220
0.8	71.2	16	5.3	137	6.0	220
0.9	73.6	16	5.3	137	6.0	228
1.0	76.8	16	5.4	137	6.0	225
1.1	78.7	16	5.4	136	6.0	226
1.2	80.6	16	5.5	137	6.0	229

Band 4

0	0	16	1.30	138	6.0	278
0.1	16.0	15.8	1.20	138	6.0	276
0.2	27.3	16.0	1.20	138	6.0	285
0.3	39.2	16	1.15	137	6.0	285
0.4	42.0	16	1.25	136	6.0	295
0.5	53.0	16	1.20	136	6.0	300
0.6	62.7	16	1.50	136	6.0	310
0.7	69.6	16	1.40	135	6.0	315
0.8	75.7	16.3	1.55	137	6.0	323
0.9	79.0	16	1.55	136	6.0	325
1.0	82.8	16	1.60	137	6.0	330
1.1	85.4	16	1.60	136	6.0	334

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Table 30

Model TBY-2, Serial No. 124

CURRENT DRAIN FROM POWER SUPPLY

(ALL SOURCES)

Condition	Source Voltage	Total Current (Ma)	Watts	Osc. Plate Volts	Osc. Plate Current (Ma)	Osc. Grid Current (Ma)
Carrier only	156	45	7.02	156	16.5	4.5
	2.0	345	0.69	156	16.5	4.5
	1.5	206	0.31	156	16.5	4.5
	-6.75	0	0.00	156	16.5	4.5
MCW (Key down)	156	65	10.14	156	17	6.9
	2.0	340	0.68	156	17	6.9
	1.5	201	0.30	156	17	6.9
	-6.75	0	0.00	156	17	6.9
Phone (70% Mod. at 1000 cps)	156	49	7.65	150	16.5	5.8
	2.0	345	0.69	150	16.5	5.8
	1.5	204	0.31	150	16.5	5.8
	-6.75	40	0.27	150	16.5	5.8
Receive	156	30	4.68	Not measured		
	2.0	290	0.58	0	0	0
	1.5	220	0.33	0	0	0
	-6.75	0	0.00	0	0	0

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Table 31

OPERATION OF MODEL TBY-1 EQUIPMENT DURING

LIFE TEST OF VIBRATOR-STORAGE BATTERY POWER SUPPLY

(TYPE CLG 19029 AND VIBRATOR UNIT TYPE CLG 20144)

TEST AS PER PAR. 4-1(4) OF SPECIFICATIONS RE 13A 535B

Condition	Battery Voltage	Plate Supply Voltage	Plate Cur. (Ma)	Grid Cur. (Ma)	Fil. Volts	Antenna Current	Time Hours
Trans.	3.9	125	16.0	4.4	1.51	209	2047.60
Receive	3.9	141	--	--	--	--	2047.83
Trans.	3.9	122	15.5	4.1	1.45	202	2047.83
Receive	3.9	141	--	--	--	--	2048.11
Trans.	3.9	121	15.4	4.1	1.45	200	2048.11
Trans.	3.9	121	16.0	4.1	1.44	202	2048.49
Trans.	3.9	120	16.0	4.0	1.40	202	2048.89
Trans.	3.85	119	16.0	3.8	1.40	202	2049.19
Trans.	3.83	117	16.0	3.6	1.38	200	2050.40
Trans.	3.80	116	16.0	3.6	1.38	200	2050.80
Trans.	3.79	116	16.0	3.5	1.38	199	2051.16
Trans.	3.75	114	16.0	3.5	1.39	199	2051.50
Trans.	1.6	0	0	0	0.2	0	2055.00

Antenna: 27 ohms 100 μμf
Clock operated only during transmitting time.
Elapsed transmitting time: 7.40 hours.
Total operating time: 14.80 hours.

Initial power output 1.18 watts
Power output after 7.8 hours operation 1.07 watts
Decrease in output power 9.3 percent
Decrease in battery voltage 3.8 percent
Decrease in plate voltage 8.8 percent

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Table 32

OPERATION OF MODEL TBY-1 EQUIPMENT DURING

DRY BATTERY LIFE TEST (BATTERY TEST CNC 19018)

TEST AS PER PAR. 4-1(4) OF SPECIFICATIONS RE 13A 535B

Plate Volts	Plate Current (Ma)	Grid Current (Ma)	Antenna Current (Ma)	Fil. Volts	Time
134	16.5	5.8	204	1.40	2062.32
120	15.0	4.3	182	1.28	2066.61
107	15.0	2.6	174	1.22	2073.71
107	15.0	2.4	171	1.21	2076.12
109	14.6	2.2	167	1.21	2077.89
108	10	2.4	130	1.21	2078.89
107	0	0	0	1.14	2083.48

Antenna: 27 ohms 100 μμf

Clock operated only during transmitting time.
Elapsed transmitting time: 21.16 hours.
Total operating time: 42.32 hours.

Initial power output 1.12 watts.
Power at end of 8.6 hours operation 0.894 watts.
Power at end of 30 hours operation 0.790 watts.
Decrease in output at 8.6 hours 20.2 perdent.
Decrease in plate voltage at 8.6 hours 10.4 percent.

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Table 33

FREQUENCY CHANGE PER DEGREE CENTIGRADE

TBY-2 CRYSTAL CALIBRATOR

HI-POWER CRYSTAL TYPE CF-5, SERIAL No. 1119

Time	Temp. (°C)	Calibrator Frequency (Kc)	Change Per Degree C. (Kc)	(%)
1115	-39	5000.200		
1130	-39	.199		
1145	-39	.199		
1200	-39	.199		
1210	-30	.205		
1225	-30	.285		
1240	-30	.337		
1255	-30	.364		
1310	-30	.369	.0186	.000372
	Mean of last two readings	.366		
1325	-20	.409		
1340	-20	.478		
1355	-20	.514		
1410	-20	.532		
1425	-20	.539		
	Mean of last two readings	.536	.0170	.000340
1435	0	.568		
1455	0	.677		
1510	0	.731		
1525	0	.761		
1540	0	.774		
1550	0	.784		
1610	0	.788		
	Mean of last two readings	.786	.0125	.000250

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Table 34

Model TBY-1

VARIATION OF TEMPERATURE

TEST AS PER PAR. 4-1(19) OF SPECIFICATIONS RE 13A 535B

AND MODIFICATION RE 13A 535C

Time	Temp. (°C)	Rel. Hum. (%)	Plate Volts	Plate Current (Ma)	R-F Output (Ma)	Freq. (Mc)
			0	0	0	0
820	-37		116	16.1	220	29.925
830	-39		114	15.8	220	.931
840	-39		116	15.5	220	.931
850	-39		116	15.8	220	.931
900	-39		115.5	15.4	220	.934
910	-39		112	15.0	220	.931
920	-39		112	15.5	220	.931
930	-39		112	15.5	220	.931
940	-10		112	15.5	180	.931
945	0		112	15.5	175	.928
955	0		116	15.5	190	.928
1005	- 1		116	15.5	190	.928
1015	- 1		116	16.0	190	.928
1025	0		114	15.4	190	.928
1035	1		116	15.9	190	.931
1045	4		118	16.0	180	.931
1050	21	22	118	16.1	175	.934
1100	21	12	120	16.5	175	.925
1110	21	10	121	16.5	150	.931
1120	21	10	121	16.6	150	.934
1130	18	31	120	16.5	170	.928
1140	21	10	120	16.5	170	.931
1150	20.5	8	122	16.9	180	.928
1200	20.5	10	122	16.9	160	.931
1210	38.2	4	124	17.0	170	.934
1215	42	4	125	17.0	170	.934
1225	39	5	122	17.0	170	.934
1235	40.5	5	126	17.1	170	.937
1245	40.5	5				

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Table 35

Model TBY-2

VARIATION OF TEMPERATURE

TEST AS PER PAR. 4-1(19) OF SPECIFICATIONS RE 13A 535B

AND MODIFICATION RE 13A 535C

Time	Temp. (°C)	Rel. Hum. (%)	Plate Volts	Plate Cur. (Ma)	R-F Output (Ma)	Freq. (Mc)	
820	-37						
830	-39						
840	-39						Note 1
955	-39						
1005	0						
1035	1						Note 2
1100	21	22	128	15.1	170	30.084	
1110	21	22	129	15	165	30.078	
1120	21	10	131	15	168	30.072	
1130	18	31	132	15.4	170	30.072	
1140	21	10	131	15.3	172	30.075	
1150	20.5	8	132	15.5	173	30.072	
1200	20.5	10	132	15.4	170	30.069	
1210	38.2	4	132	15.5	180	30.084	
1215	42	4	132	15.5	168	30.075	
1225	39	4	132	15.5	165	30.066	
1235	40.5	4	132	15.5	169	30.060	
1245	40.5	4	133	15.6	171	30.048	
1255	53	5	132	15.5	168	30.048	
1305	60	6	134	15.6	164	30.042	
1315	61.5	6	132	15.8	166	30.024	
1325	59.5	6	133	16.2	170	30.030	
1335	60	6	134	16.5	173	30.029	
1345	60	6	135	16.5	173	29.991	
1355	60	6	136	16.6	175	29.991	
1405	60	6	136	16.6	175	29.988	
1415	60	10	136	16.8	172	29.988	
1425	60	10	136	16.9	175	29.982	
1435	60	10	136	16.8	175	29.982	
1445	60	10	137	16.8	175	29.982	
1455	60	10	138	17	177	29.982	

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Table 35 (Cont'd)

Summary

Temperature Change Degrees C.	Megacycles Change Per 10°C	Percent Change Per One Degree C.
20 to 40	0.0105	0.0035
40 to 60	0.0330	0.0110

Dry battery type CNC 19018-A used as power source in this test.

Note 1.
Battery first started to function at this point as evinced by the r-f tube filaments beginning to draw current.

Note 2.
Plate voltage sufficient to produce radio frequency power output in the transmitter first available from the dry battery at this time.

Maximum frequency deviation from original frequency 0.102 Mc, 0.34%.

Specification requirements: Stability within 0.3 percent between -20°C and +50°C.

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Table 36

Model TBY-1, Serial No. 646

VARIATION OF HUMIDITY

TEST AS PER PAR. 4-1(19) OF SPECIFICATIONS RE 13A 535B

AND MODIFICATIONS RE 13A 535C

Time	Temp. (°C)	Rel. Hum. (%)	Ant. Cur. (Ma)	Freq. (Mc)	Plate Voltage	Plate Cur. (Ma)
			Low Frequency Channel			
0835	40	18	150	30.117	126	16.1
0845	40	25	150	.117	126	16.0
0855	40.5	20	150	.117	126	16.0
0905	40	21	150	.117	126	16.1
0915	40.5	63	150	.111	126	16.1
0925	40	80	150	.105	125	16.0
0935	40	87	155	.099	126	16.1
0945	40	90	140	.099	126	16.1
0955	41	90	150	.096	126	16.5
1005	40	90	150	.093	126	16.5
1015	41	90	150	.090	126	16.4
1025	41	90	150	.087	127	16.5
1035	41.5	90	150	.087	126	16.6
1045	40	90	150	.087	125	16.6
1055	40	90	140	.087	128	16.8
1105	40	90	145	.084	127	16.9
1115	40	90	145	.084	124	16.8
1125	40	95	145	.081	126	17.0
1135	40.5	93	145	.081	126	17.0
1145	36.5	23	150	.096	126	17.0
1155	40	20	150	.105	126	17.1
1205	40	25	150	.108	127	17.0
1215	40	20	155	.108	124	16.1
1225	40	25	165	.108	128	16.5
1235	40	30	165	.108	127	16.1
1245	40	20	160	.108	128	16.5

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Table 36 (Cont'd)

Time	Temp. (°C)	Rel. Hum. (%)	Ant. Cur. (Ma)	Freq. (Mc)	Plate Voltage	Plate Cur. (Ma)
			High Frequency Channel			
1335	40	30	185	72.500	127	16.9
1345	40	21	180	.540	126	16.5
1355	40.5	22	180	.540	126	16.5
1405	40.5	21	185	.540	126	16.5
1415	40.5	60	180	.528	126	16.5
1425	40.5	84	185	.512	126	17.0
1435	40.5	90	185	.496	126	17.0
1445	40.5	90	180	.472	124	16.9
1455	40.5	90	160	.468	124	17.0
1505	40.5	90	160	.464	126	17.2
1515	41.0	90	170	.456	125	17.5
1525	40.5	90	180	.456	126	17.8
1535	39.5	23	190	.460	125	16.5
1545	39.5	30	190	.500	126	15.6
1555	40.0	20	160	.516	126	15.1
1605	39.5	20	180	.532	126	15.0

Specification Requirements: 0.2% between the limits of 30% and 90% humidity.

Low Frequency Channel

Frequency at end of initial 30 minute low humidity period: 30.117 mcs.
Frequency at end of high humidity period: 30.081 mcs.
Frequency change 0.036 mcs, 0.12 percent.

High Frequency Channel

Frequency at end of initial 30 minute low humidity period: 72.540 mcs.
Frequency at end of high humidity period: 72.456 mcs.
Frequency change 0.084 mcs, 0.12 percent.

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Table 37

Model TBY-2, Serial No. 124

VARIATION OF HUMIDITY

TEST AS PER PAR. 4-1(19) OF SPECIFICATIONS RE 13A 535B

AND MODIFICATIONS RE 13A 535C

Time	Temp. (°C)	Rel. Hum. (%)	Ant. Cur. (Ma)	Freq. (Mc)	Plate Voltage	Plate Cur. (Ma)
			Low Frequency Channel			
835	39	22	188	30.036	140	17.1
845	40	25	183	30.024	140	17.0
855	40.5	20	182	30.018	140	16.9
905	40	21	181	30.012	140	16.9
915	40.5	63	179	30.003	140	16.9
925	40	80	178	29.991	139	17.1
935	40	87	178	29.985	138	17.2
945	40	90	178	----	138	17.2
955	40.5	90	178	29.976	138	17.4
1005	40	90	175	29.970	138	17.6
1015	41	90	175	29.964	138	17.7
1025	41.5	90	177	29.964	138	18.0
1035	40.5	90	175	29.964	138	18.0
1045	40	90	175	29.958	138	17.7
1055	40	90	175	29.961	138	17.9
1105	40	90	177	29.964	138	18.1
1115	40	90	176	29.958	138	18.0
1125	40	95	176	29.958	138	18.0
1135	40.5	93	175	29.961	138	18.1
1145	36.5	23	179	29.982	138	17.4
1155	40	20	178	29.988	138	17.2
1205	40	25	179	29.997	139	17.0
1215	40	20	179	29.994	140	17.0
1225	40	25	180	30.000	140	17.0
1235	40	30	180	30.000	140	17.0
1245	40	20	180	30.000	140	17.0

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Table 37 (Cont'd)

Time	Temp. (°C)	Rel. Hum. (%)	Ant. Cur. (Ma)	Freq. (Mc)	Plate Voltage	Plate Cur. (Ma)
			High Frequency Channel			
1335	40	30	167	72.500	127	17.3
1345	40	21	167	.492	126	17.3
1355	40.5	22	170	.500	126	17.5
1405	40.5	21	172	.508	126	17.3
1415	40.5	60	172	.496	126	17.5
1425	40.5	84	172	.484	126	17.5
1435	40.5	90	170	.464	126	18.0
1445	40.5	90	172	.436	124	18.0
1455	40.5	90	168	.448	124	18.0
1505	40.5	90	146	.400	126	16.5
1515	41	90	150	.404	125	17.0
1525	40.5	90	150	.404	126	17.5
1535	39.5	23	172	.496	125	17.5
1545	39.5	30	172	.500	126	17.5
1555	40	20	173	.508	126	17.5
1605	39.5	20	174	.512	126	17.5

Specification Requirements: 0.2% between the limits of 30% and 90% humidity.

Low Frequency Channel

Frequency at end of initial 30 minute low humidity period: 30.012 mc.
Frequency at end of high humidity period: 29.961 mcs.
Frequency change 0.051 mc., 0.17 percent.

High Frequency Channel

Frequency at end of initial 30 minute low humidity period: 72.508 mc.
Frequency at end of high humidity period: 72.404 mc.
Frequency change 0.104 mc., 0.14 percent.

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Table 38

Model TBY-1, Serial No. 646

VIBRATION TEST

Time	Vibrations Per Minute	Grid Current (Ma)	Plate Current (Ma)	Approx. Freq. (Mc)	R-F Output (Ma)
1400	0	4.6	16.5	30.45	180
1410	600	4.6	16.5	30.45	170
1440	600	4.4	16.8	30.45	175
*1441	See Note			30.50	
1510	1100	5.4	14.4	30.50	

Signal monitored on a Navy Type RBG receiver.

* Replaced dummy antenna with regular whip antenna at this point in test.

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Table 39

Model TBY-2, Serial No. 124

VIBRATION TEST

Time	Vibrations Per Minute	Grid Current (Ma)	Plate Current (Ma)	Approx. Freq. (Mc)	R-F Output (Ma)
1400	0	4.6	16.3	28.95	177
1410	600	4.7	16.0	28.95	175
1440	600	4.3	15.5	28.95	171
*1441	See Note			30.80	
1510	1100	5.2	10.8	30.80	

Signal monitored on a Navy Type RBG receiver.

* Replaced dummy antenna with regular 9-foot whip antenna at this point in test,

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Table 40

Model TBY-1, Serial No. 646

SHOCK TEST

Shock No.		Acceleration (G's)	Plate Current (Ma)	Grid Current (Ma)	R-F Output (Ma)
		Shock Applied From Left Side Of Equipment			
1	Before	0	16.2	5.3	150
	After	300	Equipment off.		
2	Before	0	Equipment off.		
	After	300	16.8	4.8	160
3	Before	0	Equipment off.		
	After	300	Equipment off.		
4	Before	0	16.6	4.6	155
	After	300	17.0	4.9	155
5	Before	0	Equipment off.		
	After	300	Equipment off.		
6	Before	0	16.0	5.1	150
	After	300	16.5	5.0	155

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Table 40 (Cont'd)

Shock No.		Acceleration (G's)	Plate Current (Ma)	Grid Current (Ma)	R-F Output (Ma)
		Shock Applied From Rear of Equipment			
7	Before	0	16.2	5.6	150
	After	300	Equipment Off.		
8	Before	0	16.0	5.0	140
	After	300	16.5	5.4	155
9	Before	0	Equipment Off.		
	After	300	Equipment Off.		
10	Before	0	16.0	5.2	170
	After	300	16.1	5.3	170
11	Before	0	Equipment Off.		
	After	300	Equipment Off.		
12	Before	0	15.8	5.2	170
	After	300	16.5	5.0	170

During the test the spare tube types 958 and 959 in the TBY-1 started to slip out of their carrying sockets.

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Table 41

Model TBY-2, Serial No. 124

SHOCK TEST

Shock No.		Acceleration (G's)	Plate Current (Ma)	Grid Current (Ma)	R-F Output (Ma)
		Shock Applied From Left Side of Equipment			
1	Before	0	16.0	4.9	185
	After	300	16.6	4.6	188
2	Before	0	Equipment Off.		
	After	300	Equipment Off.		
3	Before	0	16.0	4.2	180
	After	300	16.0	4.8	185
4	Before	0	Equipment Off.		
	After	300	Equipment Off.		
5	Before		15.8	4.6	180
	After	300	16.0	4.8	183
6	Before	0	Equipment Off.		
	After	300	Equipment Off.		

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Table 41 (Cont'd)

Shock No.		Acceleration (G's)	Plate Current (Ma)	Grid Current (Ma)	R-F Output (Ma)
		Shock Applied From Rear Of Equipment.			
7	Before	0	16.5	4.7	180
	After	300	16.6	4.6	187
8	Before	0	Equipment Off.		
	After	300	Equipment Off.		
9	Before	0	16.3	4.6	185
	After	300	16.0	4.4	181
10	Before	0	Equipment Off.		
	After	300	Equipment Off.		
11	Before	0	16.0	3.8	180
	After	300	16.0	4.1	180
12	Before	0	Equipment Off.		
	After	300	Equipment Off.		

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Table 42

Model TBY-1, Serial No. 646

OPERATION IN VARIOUS POSITIONS

BATTERY: NAVY TYPE 19018 DRY CELL PACK

Position	Plate Current (Ma)	Grid Current (Ma)
Normal	17	1.2
Right Side Down	11	3.3
Upside Down	16.8	1.6
Left Side Down	14	2.0
Face Down	13	2.3
Back Down	13	2.4
Model TBY-2, Serial No. 124		
Normal	16.2	2.4
Right Side Down	11.0	3.5
Upside Down	20.0	1.5
Left Side Down	14.0	2.8
Face Down	12.0	3.2
Back Down	12.0	3.2

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Table 43

Model TBY-2, Serial No. 200

ACCURACY OF FREQUENCY SETTING

USING CRYSTAL CALIBRATOR

Band	Crystal Cal. Freq.	Crystal Cal. Dial Set.	Test Freq. Dial	Test Freq. Freq. (Mc)	Het. Freq. (Mc)	Freq. Deviation (Mc)	Deviation (%)
1	30	772.5	933.5	31.6	31.791	+.131	0.414
2	35	431.0	586	36.8	36.930	+.130	0.353
2	40	778.0	868	41.6	41.397	-.203	0.488
2	45	988.0	1090	47.2	47.721	+.521	1.100
3	50	432.0	539	52.0	51.999	-.001	0.001
3	55	692.0	771	56.8	57.025	+.225	0.396
3	60	903.0	962	61.6	61.120	-.480	0.779
3	65	1086	1027	63.2	64.176	+.976	1.540
4	70	567	640	72.0	72.168	+.168	0.234
4	75	716	777	77.2	77.070	-.130	0.168
4	80	905	866	78.4	78.685	+.285	0.364

Average deviation +0.147 percent.
Frequency measured on G.R. Type 620A Heterodyne Frequency Meter.

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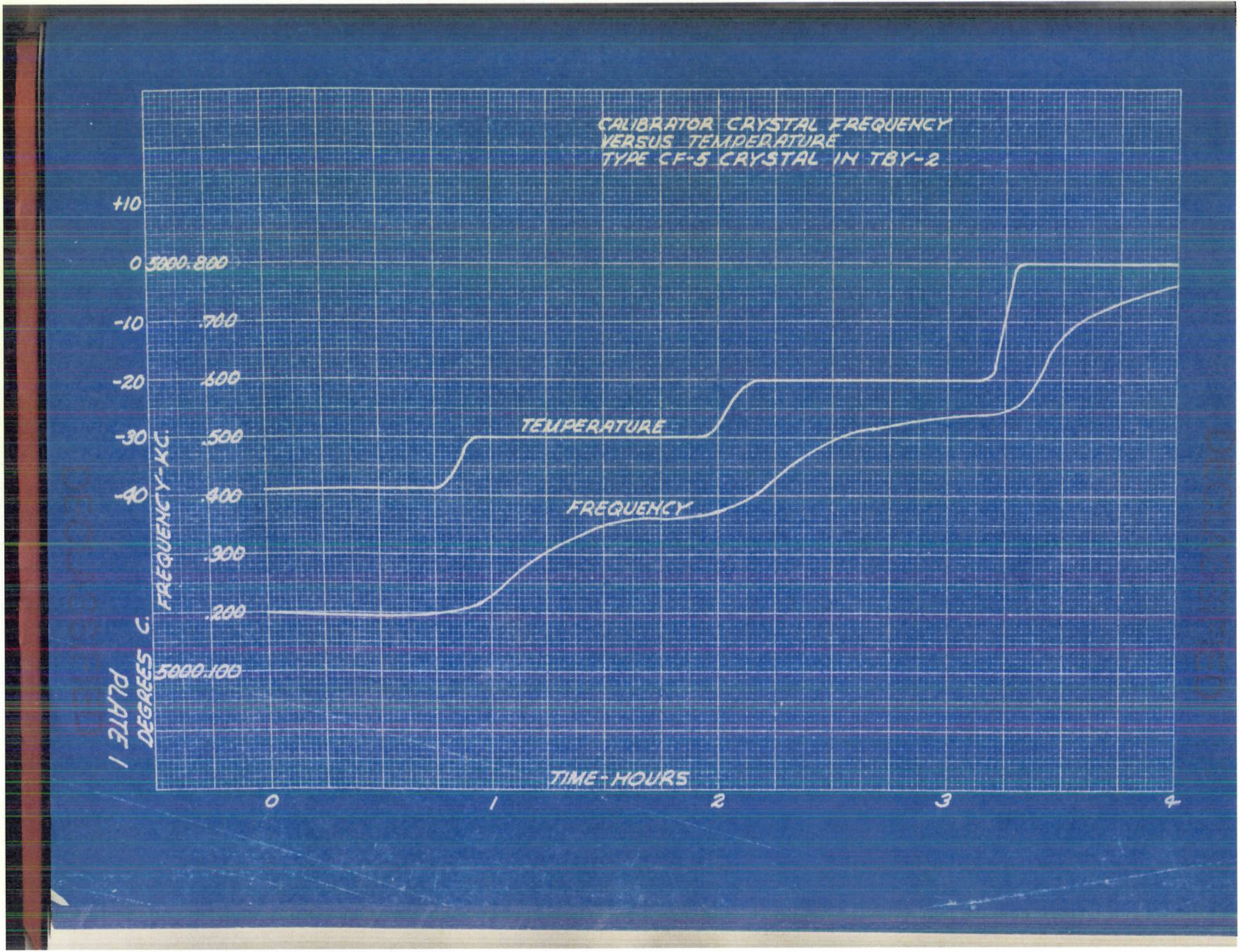
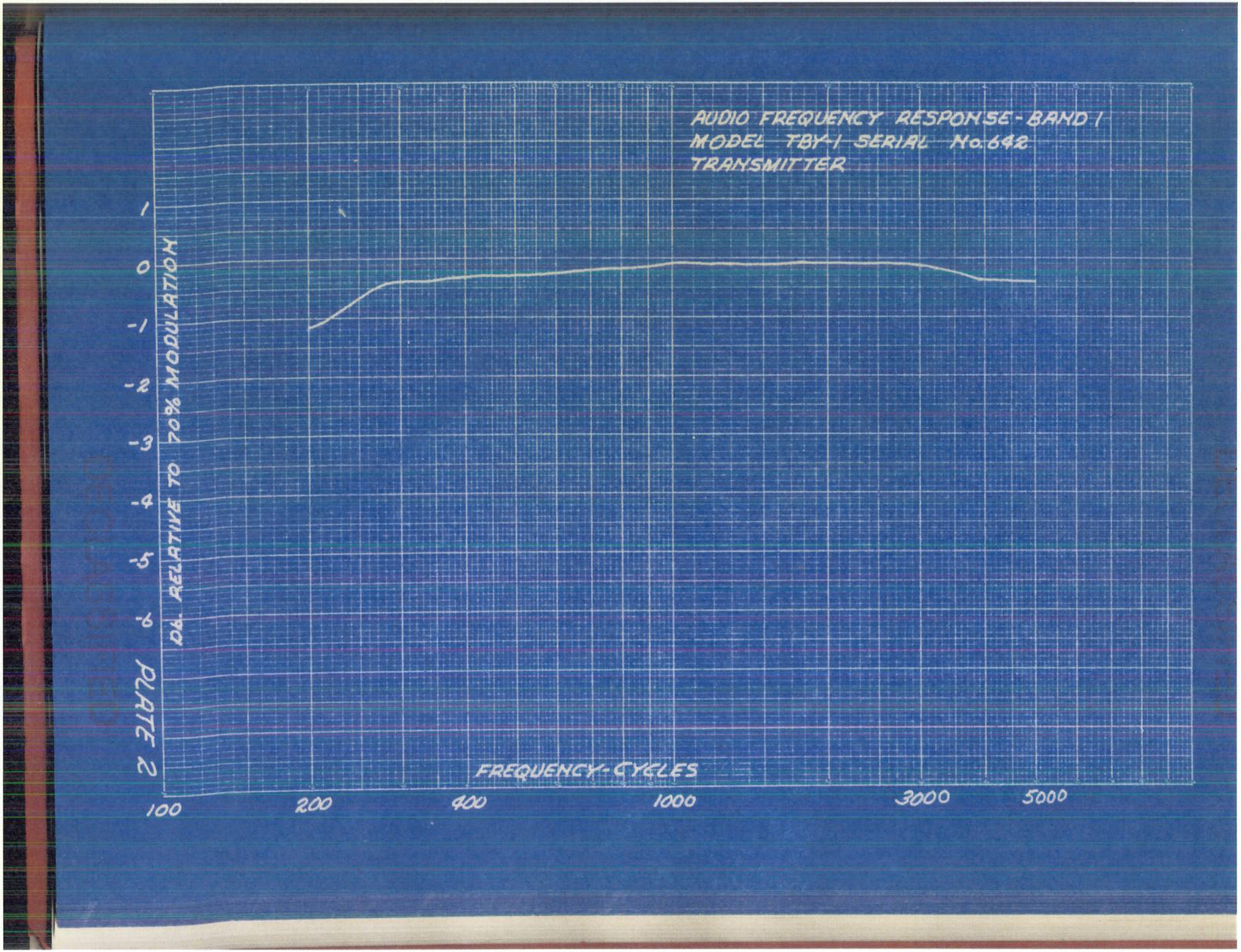
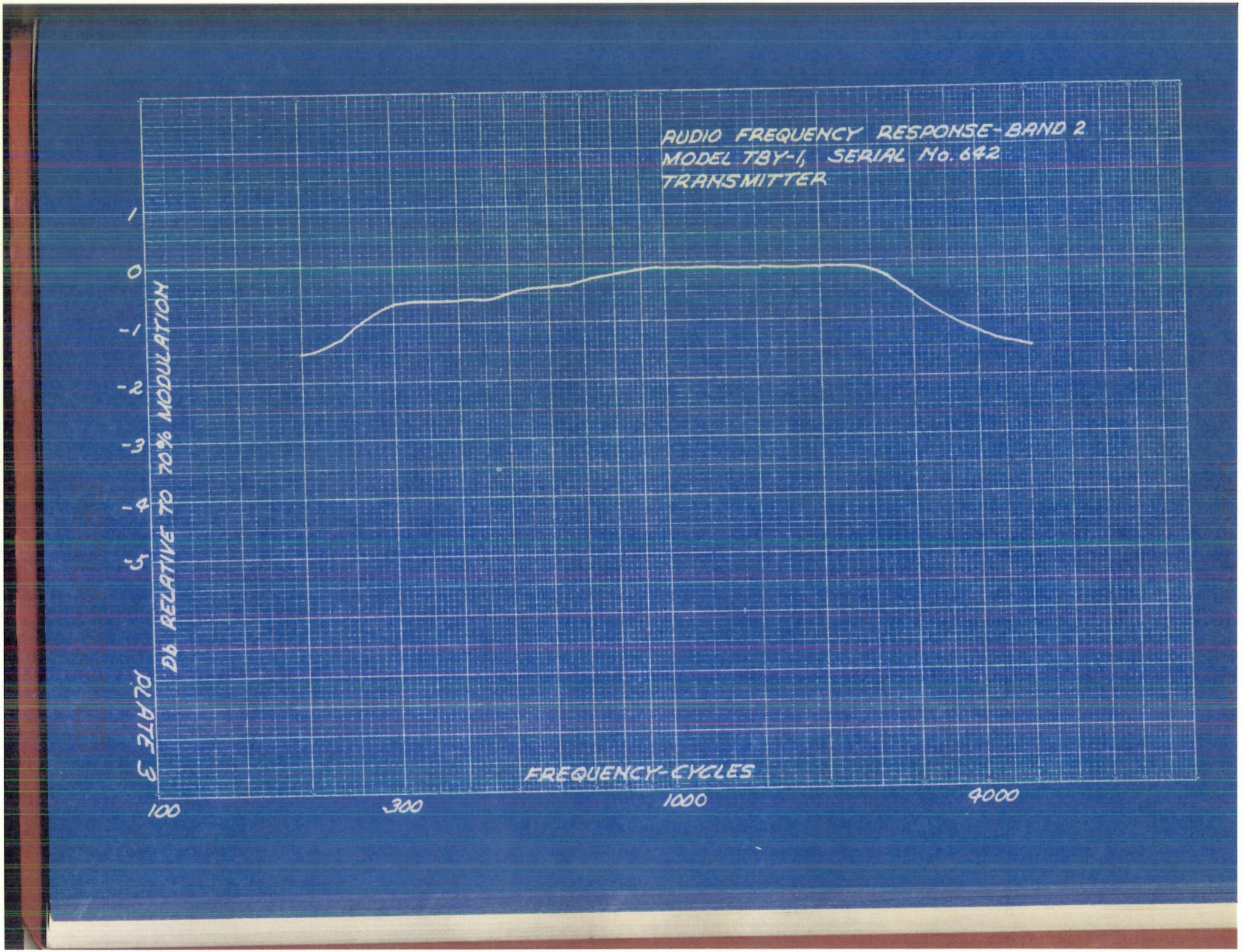
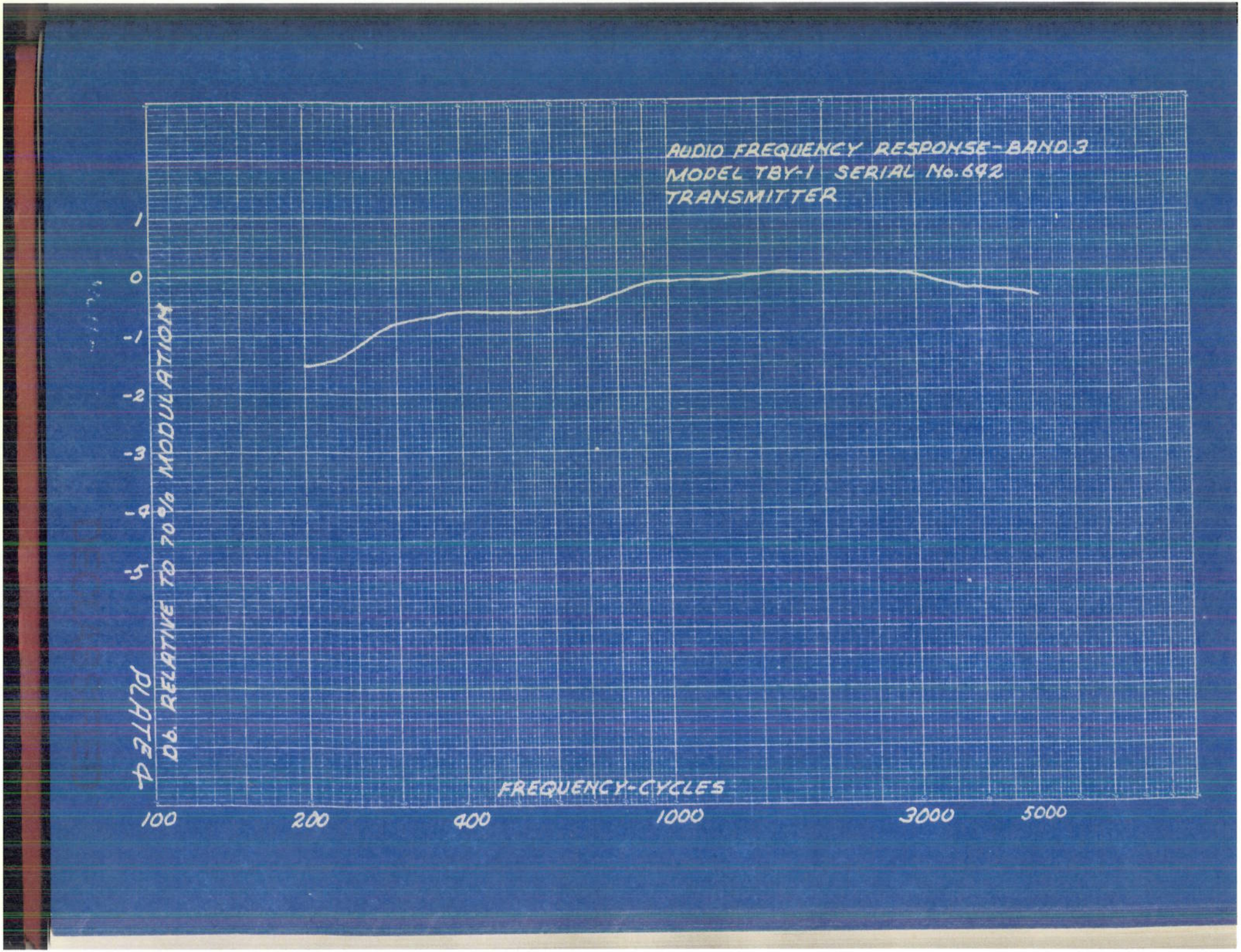
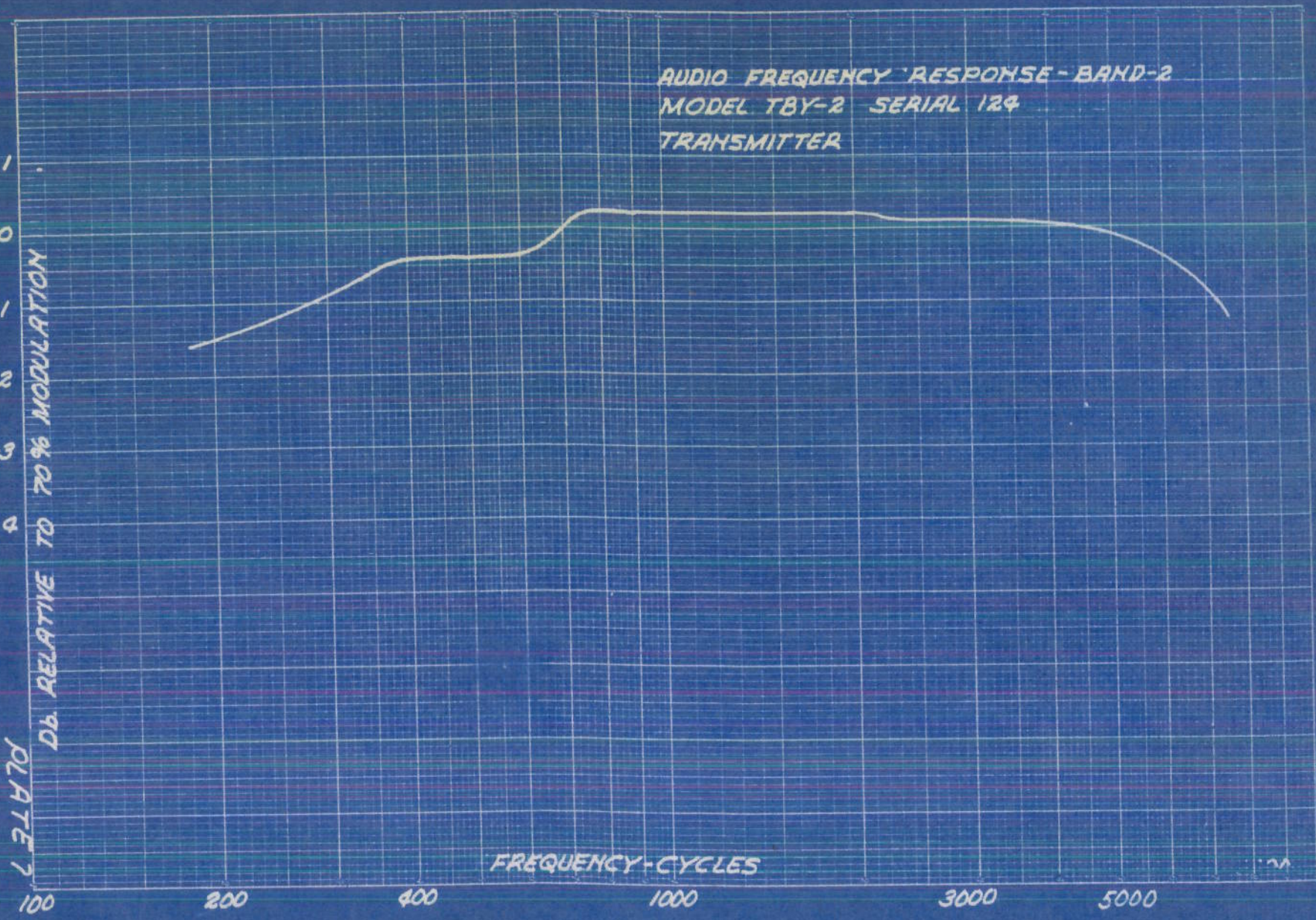
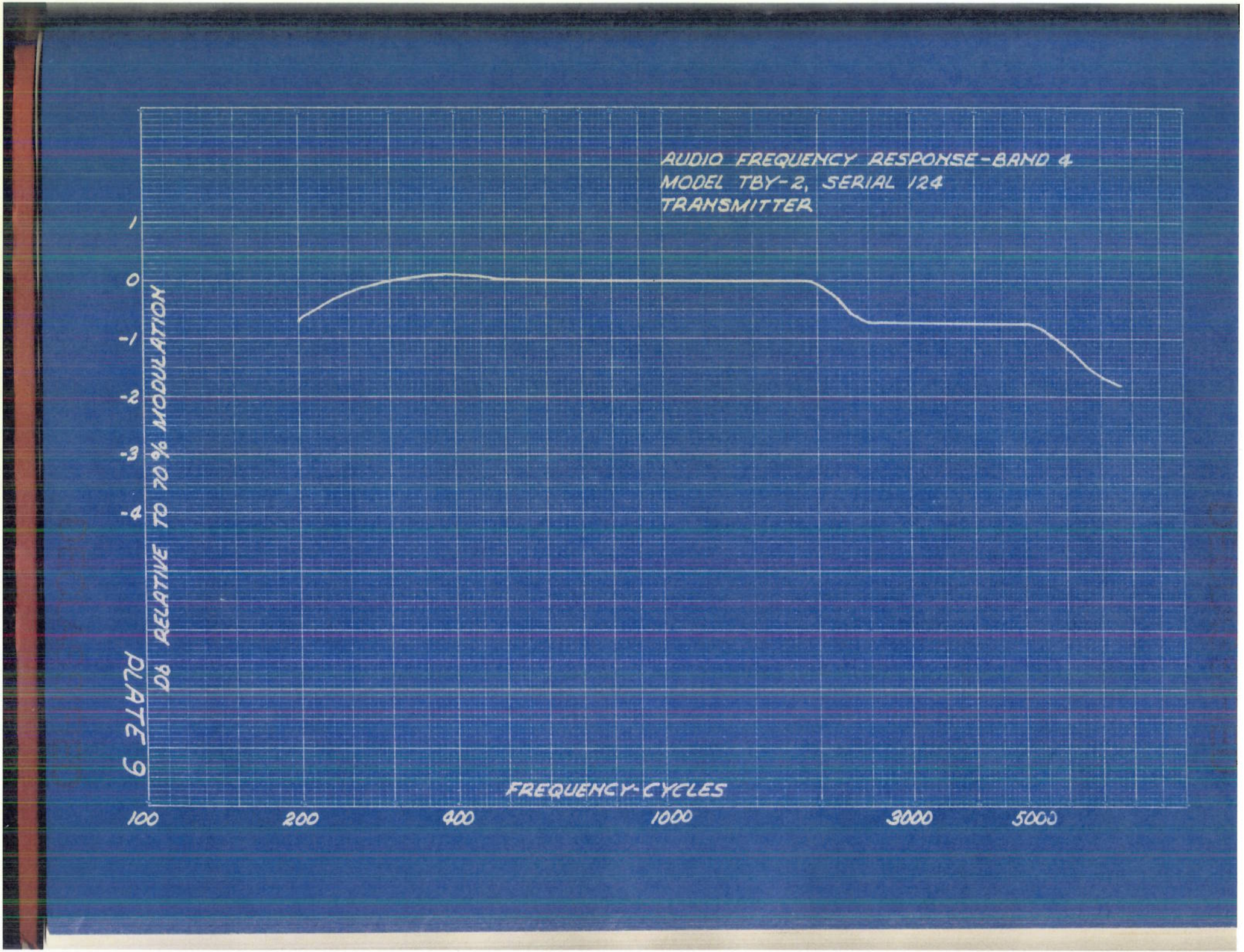

CALIBRATOR CRYSTAL FREQUENCY
VERSUS TEMPERATURE
TYPE CF-5 CRYSTAL IN TBY-2
+10
0
-10
-20
-30
-40
DEGREES C.
5000.800
.700
.600
.500
.400
.300
.200
5000.100
FREQUENCY-KC.
TEMPERATURE
FREQUENCY
TIME-HOURS
0
1
2
3
4
PLATE 1


AUDIO FREQUENCY RESPONSE - BAND I
MODEL TBY-1 SERIAL No. 642
TRANSMITTER
DB RELATIVE TO 70% MODULATION
2
1
0
-1
-2
-3
-4
-5
-6
FREQUENCY - CYCLES
100
200
400
1000
3000
5000


AUDIO FREQUENCY RESPONSE-BAND 2
MODEL TBY-1, SERIAL No. 642
TRANSMITTER
DB RELATIVE TO 70% MODULATION
+1
0
-1
-2
-3
-4
PLATE 3
FREQUENCY-CYCLES
100
300
1000
4000


AUDIO FREQUENCY RESPONSE - BAND 3
MODEL TBY-1 SERIAL No. 692
TRANSMITTER
DB. RELATIVE TO 70% MODULATION
PLATE 4
1
0
-1
-2
-3
-4
-5
FREQUENCY-CYCLES
100
200
400
1000
3000
5000


AUDIO FREQUENCY RESPONSE - BAND-2
MODEL TBY-2 SERIAL 124
TRANSMITTER
PLATE 7
Db. RELATIVE TO 70% MODULATION
+1
0
-1
-2
-3
-4
FREQUENCY-CYCLES
100
200
400
1000
3000
5000


AUDIO FREQUENCY RESPONSE - BAND 4
MODEL TBY-2, SERIAL 124
TRANSMITTER
PLATE 9
DB RELATIVE TO 70% MODULATION
1
0
-1
-2
-3
-4
FREQUENCY-CYCLES
100
200
400
1000
3000
5000

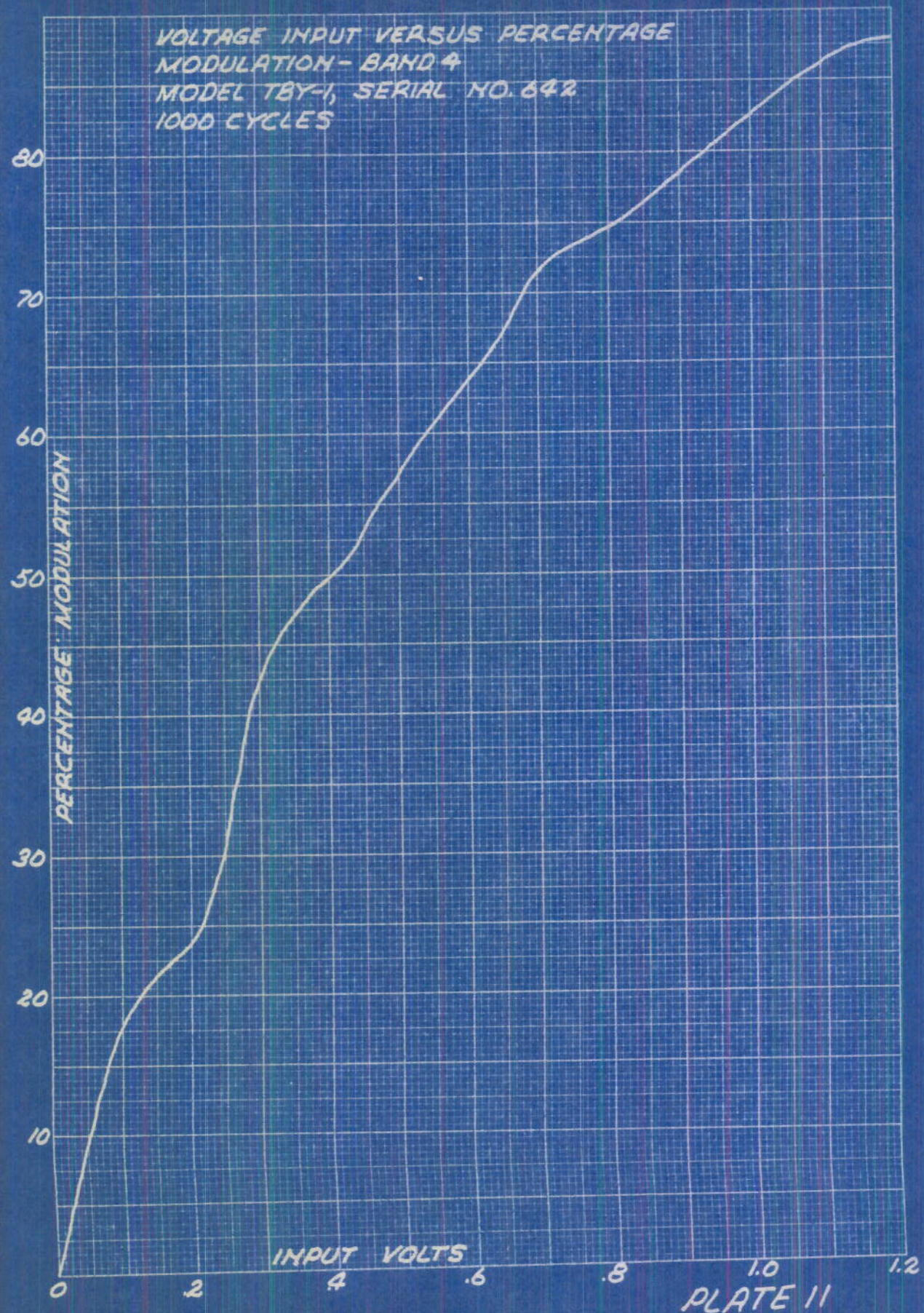

VOLTAGE INPUT VERSUS PERCENTAGE MODULATION - BAND 4
MODEL TBY-1, SERIAL NO. 642
1000 CYCLES
PERCENTAGE MODULATION
80
70
60
50
40
30
20
10
0
.2
.4
.6
.8
1.0
1.2
INPUT VOLTS

PLATE 11

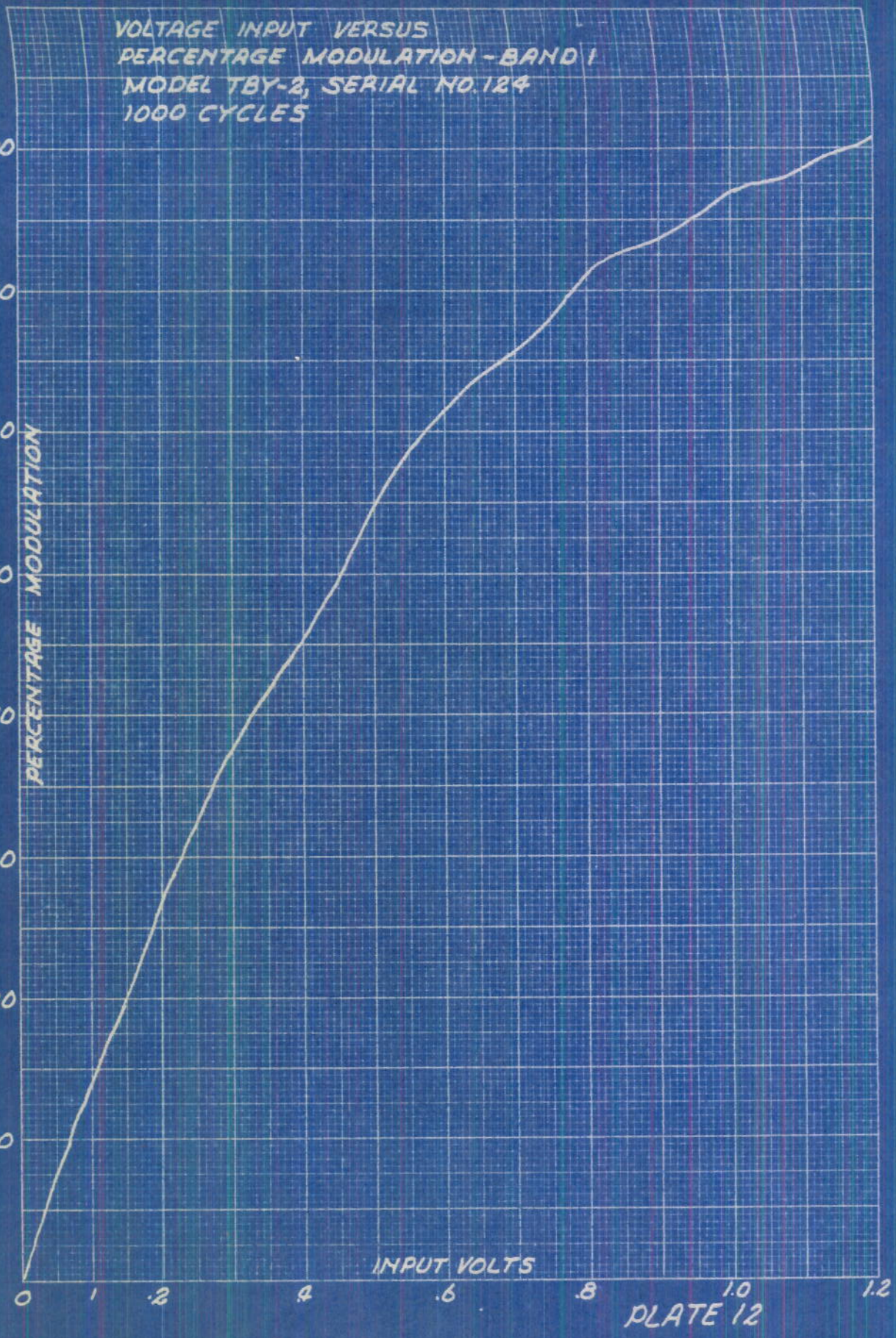

VOLTAGE INPUT VERSUS
PERCENTAGE MODULATION - BAND 1
MODEL TBY-2, SERIAL NO. 124
1000 CYCLES
80
70
60
50
40
30
20
10
PERCENTAGE MODULATION
INPUT VOLTS
0
.1
.2
.4
.6
.8
1.0
1.2

PLATE 12

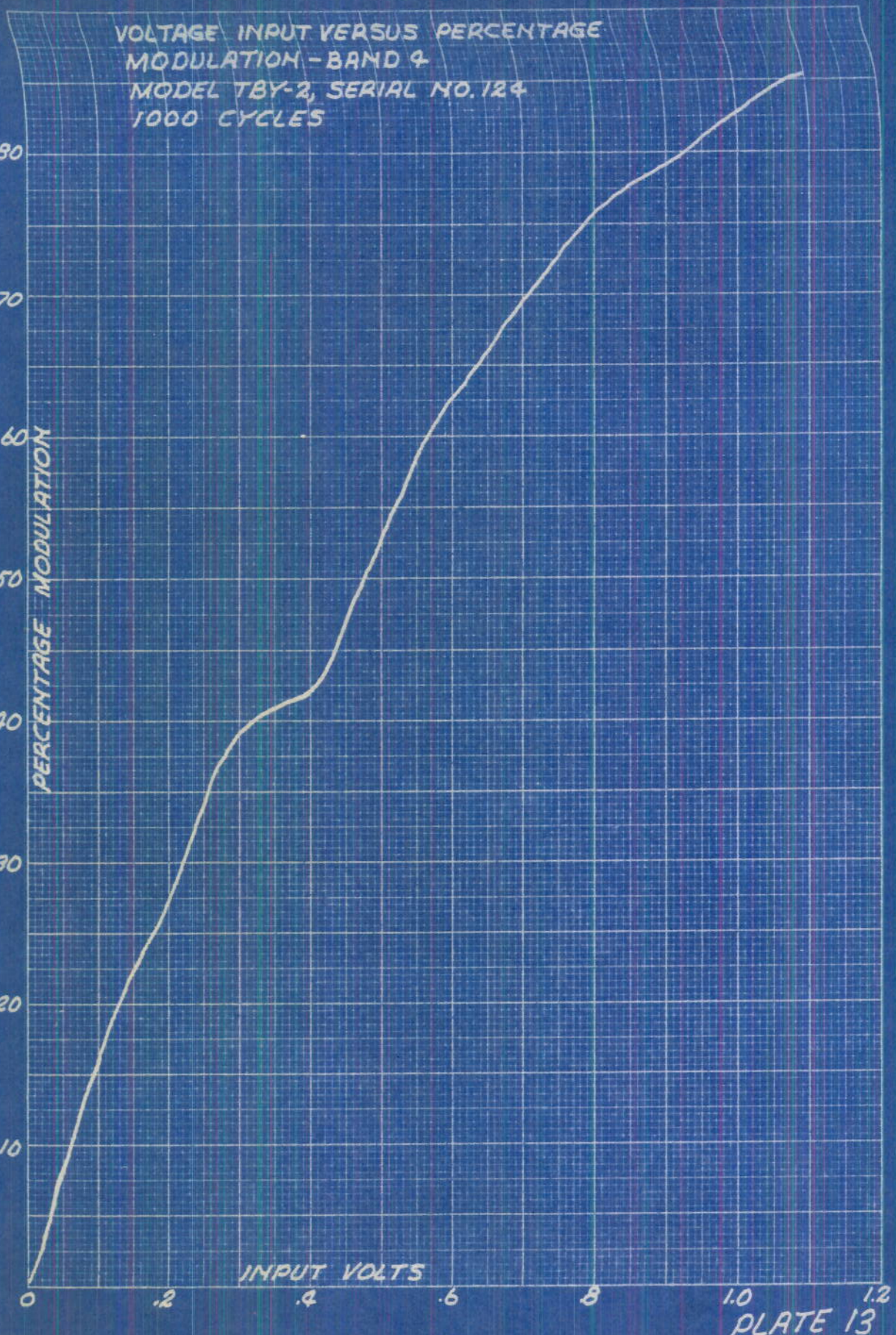

VOLTAGE INPUT VERSUS PERCENTAGE MODULATION - BAND 4
MODEL TBY-2, SERIAL NO. 124
1000 CYCLES
PERCENTAGE MODULATION
80
70
60
50
40
30
20
10
INPUT VOLTS
0
.2
.4
.6
.8
1.0
1.2

PLATE 13

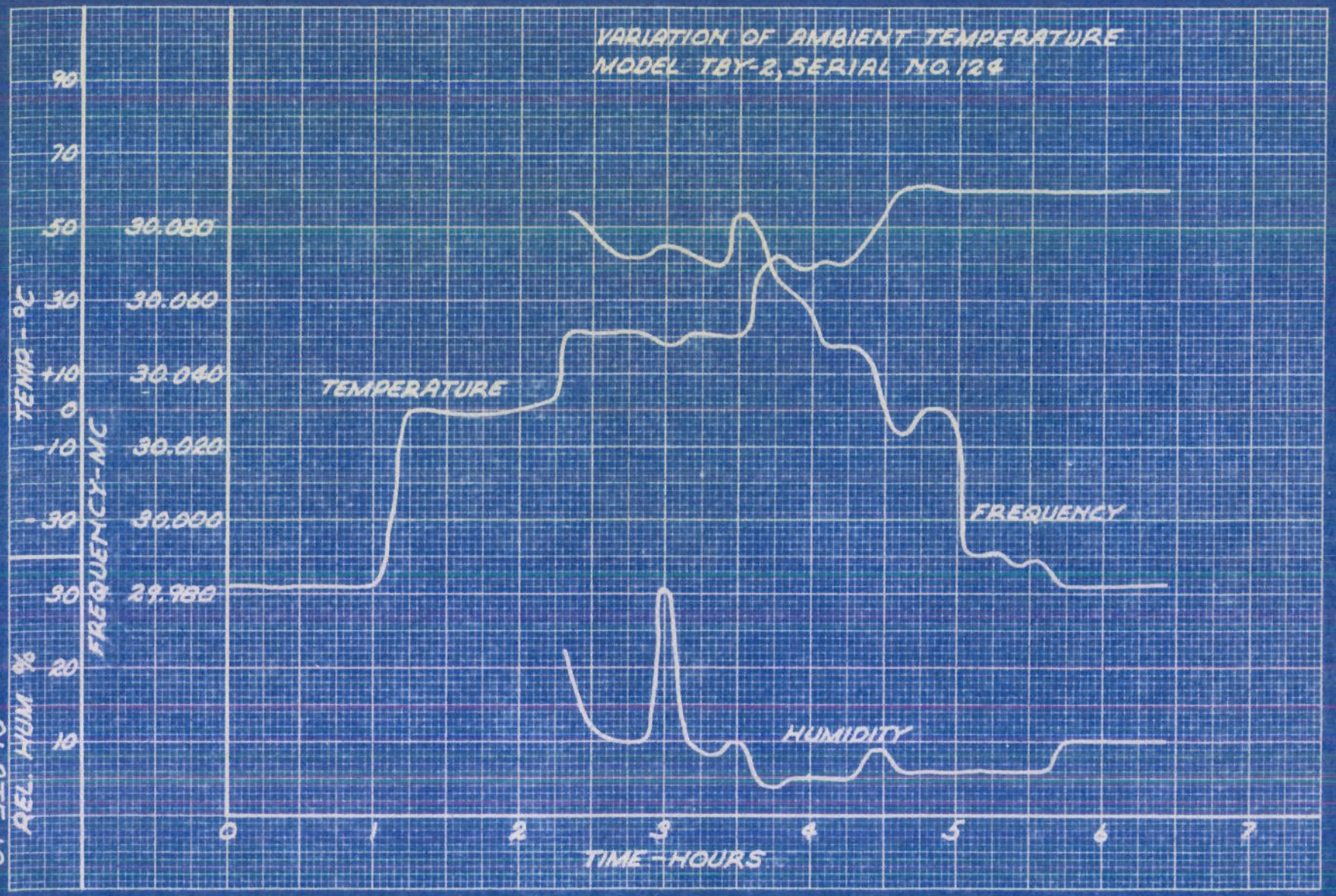

VARIATION OF AMBIENT TEMPERATURE
MODEL TBY-2, SERIAL NO. 124
TEMP. - °C
FREQUENCY - MC
REL. HUM. %
90
70
50
30
+10
0
-10
-30
30
20
10
30.080
30.060
30.040
30.020
30.000
29.980
TEMPERATURE
FREQUENCY
HUMIDITY
0
1
2
3
4
5
6
7
TIME - HOURS

PLATE 19

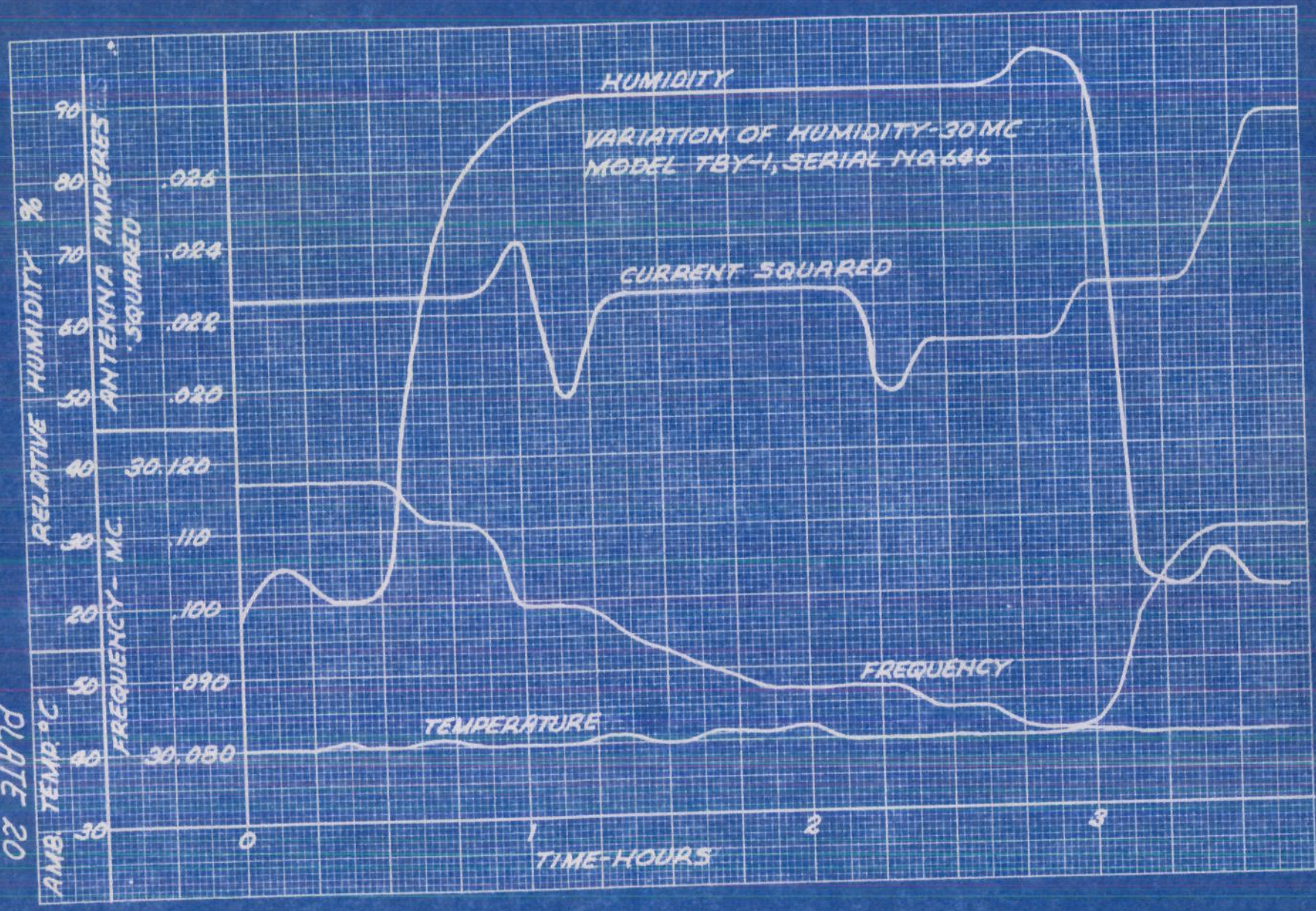

VARIATION OF HUMIDITY-30 MC
MODEL TBY-1, SERIAL NO. 646
HUMIDITY
CURRENT SQUARED
FREQUENCY
TEMPERATURE
RELATIVE HUMIDITY %
AMB. TEMP. °C
FREQUENCY - MC.
ANTENNA AMPERES SQUARED
90
80
70
60
50
40
30
20
10
40
30
20
10
0
30.120
.110
.100
.090
30.080
.026
.024
.022
.020
0
1
2
3
TIME-HOURS

PLATE 20

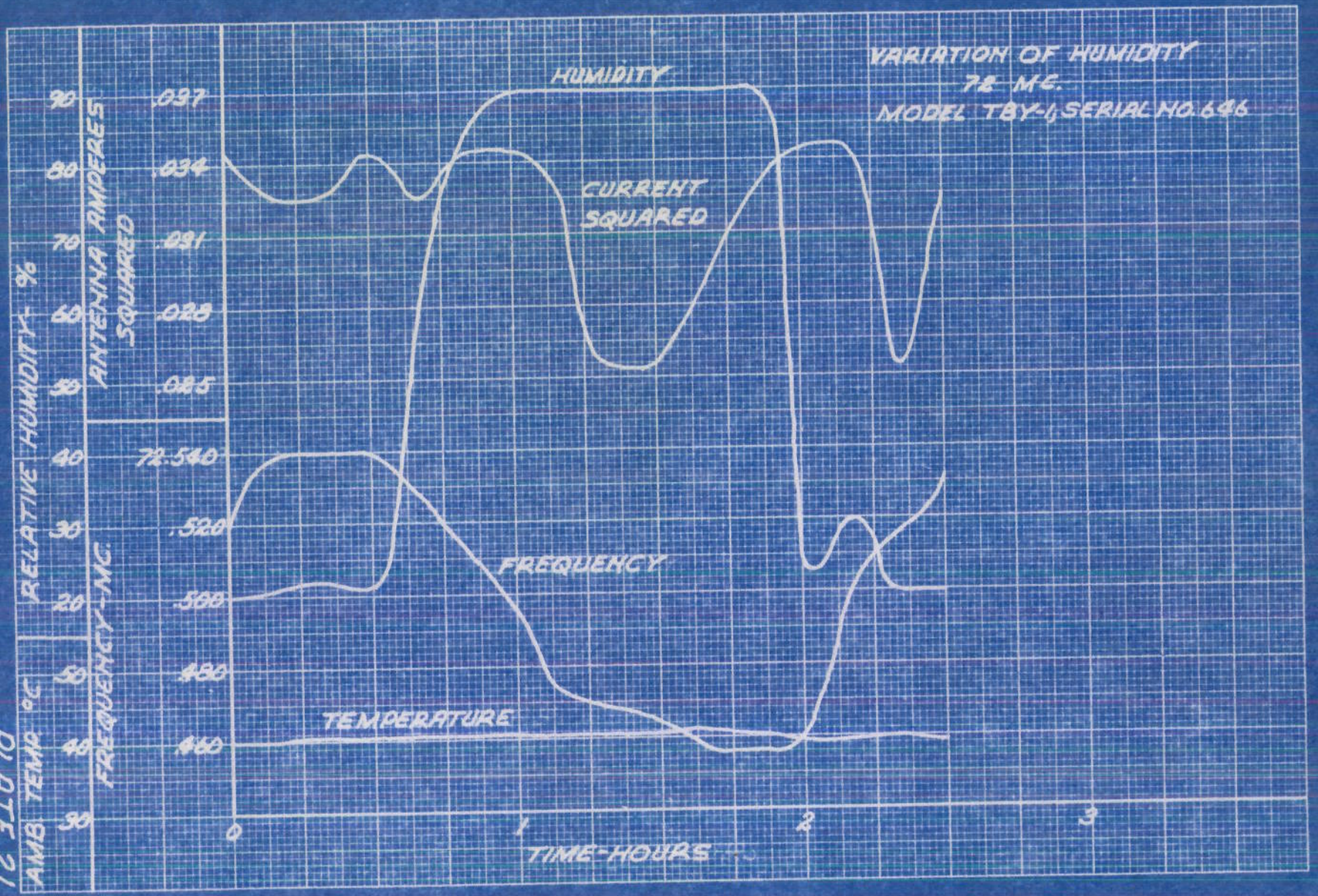

VARIATION OF HUMIDITY
78 M.C.
MODEL TBY-4, SERIAL NO. 646
HUMIDITY
CURRENT SQUARED
FREQUENCY
TEMPERATURE
RELATIVE HUMIDITY %
AMB. TEMP. °C
ANTENNA AMPERES SQUARED
FREQUENCY-MC.
.037
.034
.031
.028
.025
72.540
.520
.500
.480
.460
90
80
70
60
50
40
30
20
10
0
1
2
3
TIME-HOURS

PLATE 21

Table 7

Model TBY-1, Serial No. 642

POWER OUTPUT MEASUREMENTS

TEST AS PER PAR. 4-.(15) OF SPECIFICATIONS RE 13A 535B

AND MODIFICATIONS RE 13A 535C

and	Freq. (Mc)	Plate Current (Ma)	Plate Voltage	Grid Current (Ma)	Power Output (Watts)	Emission
1	28	15.7	138	6.8	0.960	CW
1	30	15.7	138	6.7	0.944	CW
1	32.4	15.8	138	7.0	0.916	CW
1	28	16.5	138	7.1	1.41	MCW
1	30	16.6	138	7.0	1.38	MCW
1	32.4	16.6	138	7.2	1.32	MCW
2	32.8	15.9	138	5.5	1.17	CW
2	39.6	15.8	138	5.6	1.11	CW
2	47.2	15.6	138	6.0	1.00	CW
2	32.8	16.4	138	5.8	1.64	MCW
2	39.6	15.9	138	6.0	1.55	MCW
2	47.2	16.4	138	6.3	1.50	MCW
3	47.6	16.0	138	3.7	1.05	CW
3	55.6	16.0	138	3.8	0.925	CW
3	65.2	16.0	138	3.6	0.925	CW
3	47.6	16.1	138	4.3	1.54	MCW
3	55.6	16.8	138	4.0	1.46	MCW
3	65.2	17.2	138	4.0	1.49	MCW
4	65.6	16.0	138	2.2	0.94	CW
4	72.8	16.0	138	2.1	0.913	CW
4	80.0	16.0	138	2.2	0.804	CW
4	65.6	17.5	138	2.2	1.44	MCW
4	72.8	17.0	138	2.2	1.42	MCW
4	80.0	17.0	138	2.4	1.225	MCW

Antenna Resistance: 33 ohms (lamp load).
Specification Requirements: 1 watt.

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Table 8

Model TBY-2, Serial No. 124

'LIBRATION OF OSCILLATOR DIAL USING TYPE CWN66025 ANTENNA

TEST AS PER PAR. 4-1(6) OF SPECIFICATIONS RE 13A 535B

BAND 1

llator l ting	Output Freq. (Mcs)	Kilocycles per 100 Dial Divisions	Kilocycles per Division
00	24.574		
00	24.792	218	2.18
00	25.326	534	5.34
30	25.932	606	6.06
400	26.624	692	6.92
500	27.376	752	7.52
600	28.270	894	8.94
700	29.312	1042	10.42
800	30.706	1394	13.94
900	32.512	1705	17.05
000	33.500	988	9.88
100	35.562	2062	20.62
200	36.918	1356	13.56

y the portion of the dial between 500 and 900 is normally
d in Band 1.

BAND 2

000	30.996		
100	31.314	318	3.18
200	32.148	834	8.34
300	33.123	975	9.75
400	34.221	1098	10.98
500	35.484	1263	12.63
600	36.984	1500	15.00
700	38.412	1428	14.28
800	39.966	1554	15.54
900	41.844	1878	18.78
1000	43.806	1962	19.62
1100	46.119	2313	23.13
1200	47.856	1737	17.37

ly the portion of the dial between 200 and 1100 is normally
sed in Band 2.

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Table 8 (Cont'd)

BAND 3

Oscillator Dial Setting	Output Freq. (Mcs)	Kilocycles per 100 Dial Divisions	Kilocycles Per Division
000	44.178		
100	44.634	456	4.56
200	45.612	978	9.78
300	46.782	1170	11.70
400	48.210	1428	14.28
500	49.830	1620	16.20
600	51.663	1833	18.33
700	53.775	2112	21.12
800	56.175	2400	24.00
900	59.208	3033	30.33
1000	62.728	3520	35.20
1100	66.416	3688	36.88
1200	69.120	2704	27.04

Only the portion of the dial between 300 and 1100 is normally used in Band 3.

BAND 4

000	58.336		
100	58.992	656	6.56
200	60.572	1580	15.80
300	62.288	1716	17.16
400	64.292	2004	20.04
500	66.560	2268	22.68
600	69.144	2584	25.84
700	71.980	2836	28.36
800	75.376	3396	33.96
900	79.516	4140	41.40
1000	84.230	4714	47.14
1100	89.515	5285	52.85
1200	93.445	3930	39.30

Only the portion of the dial between 400 and 900 is normally used in Band 4.

Frequencies measured with a General Radio Type 620-A Heterodyne Frequency Meter.

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Table 9

Model TBY-1, Serial No. 642

FREQUENCY RANGE AND OVERLAP TRANSMITTER

TEST AS PER PARAS. 4-1(1) AND 4-1(5) OF

SPECIFICATIONS RE 13A 535B

ind	Tuning Dial	Freq. (Mc)	Mean Freq.	Overlap (Mc)	Per Cent Overlap Measured	Per Cent Overlap Specifications
		28.000				
1	0	24.754	26.377	3.246	12.3	3
	1200	34.024				
2	0	31.306	32.665	2.718	8.3	3
	1200	48.836				
3	0	43.899	46.367	4.937	10.6	3
	1200	68.720				
4	0	56.988	62.854	11.732	18.7	3
	1200	90.125				
		80.000	85.063	10.125	11.9	3

Frequency measured with General Radio Type 620-A Heterodyne Frequency Meter.

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Table 10

Model TBY-2, Serial No. 124

FREQUENCY RANGE AND OVERLAP OF TRANSMITTER

TEST AS PER PARAS. 4-1(1) AND 4-1(5) OF

SPECIFICATIONS RE 13A 535B

Transmitter Tuning Dial	Freq. (Mc)	Mean Freq. (Mc)	Overlap (Mc.)	Per Cent Overlap Measured	Specs.
	28.000				
000	24.436	26.212	3.564	13.6	3
1200	36.610				
000	31.323	33.9665	5.287	15.6	3
1200	48.332				
000	43.916	46.124	4.316	9.4	3
1200	70.075				
000	58.204	64.1395	11.871	18.5	3
1200	94.780				
	80.000	87.390	14.780	16.9	3

e: Measurements made with General Radio Type 620-A Heterodyne Frequency Meter.

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Table 11

Model TBY-1, Serial No. 642

CHECK FOR LOST MOTION, BACK LASH,

AND TORQUE LASH TRANSMITTER

BAND 1

Osc. Dial	Output Frequency (Mc) Clockwise Direction	Output Frequency (Mc) Counter-clockwise Direction	Deviation (Mc)	Deviation (%)
300	26.364	26.364	0.000	0.0000
300	26.364	26.366	0.002	0.0076
300	26.364	26.364	0.000	0.0000
300	26.366	26.366	0.000	0.0000
300	26.366	26.366	0.000	0.0000
300	26.364	26.366	0.002	0.0076
1000	32.838	32.840	0.002	0.006
1000	32.838	32.840	0.002	0.006
1000	32.838	32.840	0.002	0.006
1000	32.840	32.842	0.002	0.006
1000	32.838	32.842	0.004	0.012
1000	32.838	32.842	0.004	0.012

Frequency measurements made with General Radio Type 620-A Heterodyne Frequency Meter.

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Table 12

Model TBY-2, Serial No. 124

CHECK FOR LOST MOTION, BACKLASH

AND TORQUE LASH OF TRANSMITTER

BAND 1

Osc. Dial	Output Frequency (Mc) Clockwise Direction	Counter-Clockwise Direction	Deviation (Mc)	Deviation (%)
300	25.984	25.958	0.026	0.100
300	25.988	25.952	0.036	0.139
300	25.988	25.950	0.038	0.146
300	25.992	25.948	0.044	0.170
300	25.990	25.958	0.032	0.124
300	25.978	25.952	0.026	0.100
1000	32.958	32.979	0.021	0.064
1000	32.955	32.976	0.021	0.064
1000	32.964	32.982	0.018	0.055
1000	32.958	32.976	0.018	0.055
1000	32.958	32.979	0.021	0.064
1000	32.958	32.973	0.015	0.0456

quency measurements made with General Radio Type 620-A
rodyne Frequency Meter.

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Table 13

Model TBY-1, Serial No. 642

CURACY OF RESET TO PREVIOUSLY CALIBRATED FREQUENCIES

Band 1

Osc. Dial	Output Freq. (Mc)	Deviation (Mc)	Deviation (%)	Time of Reset (Sec)
600	28.730			
600	28.730	0	0	4
600	28.728	0.002	0.00697	6
600	28.728	0.002	0.00697	5.3
600	28.730	0.000	0.00000	5.6
600	28.728	0.002	0.00697	5.5
900	31.848			
900	31.845	0.003	0.00953	5.6
900	31.848	0.000	0	5.9
900	31.848	0.000	0	4.5
900	31.848	0.000	0	5.4
900	31.848	0.000	0	5.8

Band 2

300	33.735			
300	33.735	0.000	0	7.5
300	33.735	0.000	0	3.5
300	33.738	0.003	0.0089	5.0
300	33.735	0.000	0	4.0
300	33.735	0.000	0	3.1
1000	45.212			
1000	45.216	0.004	0.00884	7
1000	45.212	0.000	0	3.8
1000	45.212	0.000	0	5.7
1000	45.216	0.004	0.00884	6.6
1000	45.216	0.004	0.00884	6.1

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Table 13 (Cont'd)

Band 3

Osc. Dial	Output Freq. (Mc)	Deviation (Mc)	Deviation (%)	Time of Reset (Sec)
450	50.455			
450	50.450	0.005	0.0099	5.5
450	50.460	0.005	0.0099	5.0
450	50.455	0.000	0	6.1
450	50.455	0.000	0	5.5
450	50.450	0.005	0.0099	3.7
1000	64.056			
1000	64.044	0.012	0.018	7.3
1000	64.056	0.000	0	7.5
1000	64.020	0.036	0.0562	7.0
1000	64.020	0.036	0.0562	6.4
1000	64.016	0.040	0.0625	7.2

Band 4

500	66.388			
500	66.388	0.000	0	4
500	66.392	0.004	0.00603	3.2
500	66.388	0.000	0	3
500	66.388	0.000	0	3.6
500	66.392	0.004	0.00603	5.0
900	79.250			
900	79.245	0.005	0.00631	4.0
900	79.255	0.005	0.00631	4.0
900	79.250	0.000	0	3.6
900	79.250	0.000	0	4.2
900	79.255	0.005	0.00631	3.8

ency measurements made by means of General Radio Type Heterodyne Frequency Meter.

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Table 14

Model TBY-2, Serial No. 124

ACCURACY OF RESET TO PREVIOUSLY CALIBRATED FREQUENCIES

Band 1

Trial No.	Osc. Dial	Output Freq. (Mc)	Deviation (Mc)	Deviation (%)	Time of Reset (Sec)
0	600	28.246			
1	600	28.248	0.002	0.00714	11
2	600	28.238	0.008	0.0286	10
3	600	28.252	0.006	0.0214	15
4	600	28.234	0.012	0.0428	11
5	600	28.232	0.014	0.0500	12
0	900	31.875			
1	900	31.860	0.015	0.0470	8
2	900	31.863	0.012	0.0380	10
3	900	31.848	0.027	0.0850	14
4	900	31.824	0.051	0.1600	12
5	900	31.878	0.003	0.0095	13

Band 2

0	300	32.754			
1	300	32.772	0.018	0.0550	11
2	300	32.811	0.057	0.1740	12
3	300	32.760	0.006	0.0184	10
4	300	32.772	0.018	0.0550	9
5	300	32.757	0.003	0.0092	11
0	1000	44.592			
1	1000	44.600	0.008	0.0179	12
2	1000	44.552	0.040	0.0900	16
3	1000	44.592	0.000	0.0000	18
4	1000	44.596	0.004	0.0090	20
5	1000	44.600	0.008	0.0179	15

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Table 14 (Cont'd)

Osc. Dial	Output Freq. (Mc)	Band 3 (Mc)	(%)	Time of Reset (Sec)
450	49.388			
450	49.416	0.028	0.0571	10
450	49.380	0.008	0.0162	20
450	49.480	0.092	0.1865	13
450	49.420	0.032	0.0648	12
450	49.376	0.012	0.0245	14
1000	63.185			
1000	63.185	0.000	0.0000	12
1000	63.155	0.030	0.04770	15
1000	63.180	0.005	0.00794	12
1000	63.150	0.035	0.0556	11
1000	63.170	0.015	0.0238	16
		Band 4		
500	67.345			
500	67.340	0.005	0.00744	11
500	67.360	0.015	0.0224	10
500	67.305	0.040	0.0595	15
500	67.320	0.025	0.0373	13
500	67.300	0.045	0.0672	11
900	80.515			
900	80.510	0.005	0.0062	12
900	80.485	0.030	0.0373	12
900	80.540	0.025	0.0311	8
900	80.480	0.035	0.0435	8
900	80.475	0.040	0.0497	10

Frequency measurements made by means of General Radio Type 620-A Heterodyne Frequency Meter.

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Table 15

Model TBY-1, Serial No. 642

EFFECT OF DIAL LOCK ON FREQUENCY OF TRANSMITTER

on	Frequency in Mc		Deviation	
1	Unlocked	Locked	(Mc)	(%)
	27.956	27.954	0.002	0.00717
	27.954	27.952	0.002	0.00717
	32.732	32.730	0.002	0.00612
	32.734	32.732	0.002	0.00612
	66.820	66.824	0.004	0.0060
	66.828	66.824	0.004	0.0060
	80.485	80.490	0.005	0.00621
	80.485	80.480	0.005	0.00621

ncy measurements made by means of General Radio Type
Heterodyne Frequency Meter.

clockwise
counterclockwise

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Table 16

Model TBY-2, Serial No. 124

EFFECT OF DIAL LOCK ON FREQUENCY OF TRANSMITTER

ion ch	Frequency in Mc.		Deviation	
	Unlocked	Locked	(Mc)	(%)
	28.176	28.170	0.006	0.0212
	28.112	28.092	0.020	0.0715
	31.844	31.848	0.004	0.0126
	31.878	31.864	0.014	0.044
	66.632	66.580	0.052	0.0782
	66.508	66.496	0.012	0.0180
	79.945	79.955	0.01	0.0125
	80.095	80.055	0.04	0.0500

uency measurements made with General Radio Type 620-A
rodyne Frequency Meter.

= clockwise
= counterclockwise

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Table 17

Model TBY-1, Serial No. 642

FREQUENCY VARIATION WITH CHANGE OF TUBES

IN THE OSCILLATOR

	Frequency (Mc)	Deviation from mean freq. (Mc)	(%)
ig.	28.100	0.162	0.574
	28.262	0.124	0.440
	28.224	0.100	0.356
	28.200	0.098	0.350
	28.198	0.096	0.342
	28.196	0.002	0.071
ig.	28.102		
	28.183 mean;	0.047	0.167 average
rig.	32.190	0.144	0.450
1	32.334	0.130	0.403
2	32.320	0.096	0.298
3	32.286	0.070	0.217
4	32.260	0.068	0.210
5	32.258	0.028	0.087
Orig.	32.162		
	32.259 mean;	0.047	0.146 average
Orig.	64.916	0.604	0.920
1	65.520	0.432	0.664
2	65.348	0.608	0.940
3	65.524	0.316	0.485
4	65.232	0.208	0.320
5	65.124	0.272	0.420
Orig.	64.644		
	64.901 mean;	0.3593	0.555 average

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Table 17 (Cont'd)

Frequency (Mc)	Deviation from mean Freq. (Mc)	(%)
80.455	0.610	0.760
81.065	0.465	0.580
80.920	0.585	0.727
81.040	0.315	0.391
80.770	0.450	0.558
80.905	0.010	0.124
80.465		
80.817 mean;	0.2033	0.251 average

Frequency measurements made by means of General Radio Type 620-A Heterodyne Frequency Meter.

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Table 18

Model TBY-2, Serial No. 124

FREQUENCY VARIATION WITH CHANGE OF TUBES

IN THE OSCILLATOR

Tube Pair No.	Frequency (Mc)	Deviation from mean frequency (Mc)	(%)
Orig.	28.402		
1	28.406	0.004	0.014
2	28.382	0.020	0.070
3	28.328	0.074	0.260
4	28.268	0.134	0.474
5	28.270	0.132	0.464
Orig.	28.368	0.034	0.121
	28.346 mean;	0.048	0.17 average
Orig.	32.090		
1	32.042	0.048	0.149
2	32.120	0.030	0.0935
3	32.090	0.000	0.000
4	32.346	0.256	0.797
5	32.270	0.180	0.560
Orig.	32.096	0.006	0.0187
	32.151 mean;	0.109	0.340 average
Orig.	66.524		
1	66.308	0.216	0.325
2	66.336	0.188	0.284
3	66.288	0.236	0.355
4	66.084	0.440	0.662
5	66.184	0.340	0.511
Orig.	66.520	0.004	0.006
	66.321 mean;	0.118	0.178 average

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Table 18 (Cont'd)

Tube Pair No.	Frequency (Mc)	Deviation from mean freq. (Mc)	(%)
Orig.	80.100		
1	79.835	0.265	0.332
2	80.090	0.010	0.0125
3	79.705	0.395	0.495
4	79.600	0.500	0.625
5	79.725	0.375	0.470
Orig.	80.185	0.085	0.106
	79.891 mean;	0.200	0.250 Average

Frequency measured by means of General Radio Type 620-A Heterodyne Frequency Meter.

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Table 19

Model TBY-1, Serial No. 642

TUBE VOLTAGES AND CURRENTS -29 MC

ose and gnation	Fil. Volts	Plate Volts	Plate Cur. (Ma)	Grid Volts	Grid Cur. (Ma)	Screen Volts	Screen (Ma)	Condition
	2	145	4.5	-8.2	0	145	2.75	CW
	2	140	8.5	-8.2	0.18	150	4.25	MCW
tor, V-7	2.1	145	4.8	-8.2	0	150	2.8	Receive
	2	145	4.5	-8.2	0	145	2.75	CW
Pentode	2	140	8.5	-8.2	0.20	150	4.25	MCW
	2.1	145	4.5	-8.2	0	150	2.80	Receive
	2.05	145	4.1	6.2	0			MCW
lator, V-6	2.05	147	4.3	2.2	0			Receive
tal	1.85	65	4.4			Calibrate		Send
brator, V-5	1.85	62	4.4					Receive
smitter	1.3	140	16		4.2			CW
llator, V-4	1.3	138	17.5		6.0			MCW
smitter	1.3	140	16		4.2			CW
llator, V-3	1.3	138	17.5		6.0			MCW
iver ctor, V-2	1.3	102	0.625	-27				Receive
. Amp. Receiver	1.3	141	0.43	-3		60	0.1	Receive

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Table 20

Model TBY-1, Serial No. 642

EFFECT OF VARIATION OF SUPPLY VOLTAGE

TEST AS PER PAR. 4-1(19) OF SPECIFICATIONS RE 13A 535B

AND MODIFICATIONS RE 13A 535C

Band 1

l. lts)	Plate Supply (Volts)	Plate Cur. (Ma)	Grid Cur. (Ma)	Freq. (Mc)	Deviation (Mc)	Deviation (%)	
.50	150	16	5.9	28.044			
.42	142	16	4.5	28.014	0.030	0.107	
.35	135	16	3.5	27.990	0.054	0.193	
1.27	127.5	16	2.7	27.948	0.096	0.343	

Band 2

1.50	150	16	4.4	33.474			
1.42	142	16	3.3	33.438	0.036	0.107	
1.35	135	16	2.5	33.402	0.072	0.215	
1.27	127.5	13.6	1.4	33.762	0.288	0.860	

Band 3

1.50	150	16	3.6	49.004			
1.42	142	16	2.2	48.892	0.112	0.229*	
1.35	135	16	1.8	49.984	0.980	2.00	
1.27	127.5	14	1.2	49.948	0.944	1.93	

Band 4

1.50	150	16	3.3	65.445			
1.42	142	16	2.3	65.365	0.080	0.122	
1.35	135	16	1.5	65.255	0.190	0.290	
1.27	127.5	13.5	1.3	66.990	1.545	2.300	Note 1

ote 1. Necessary to retune antenna and antenna coupling to obtain oscillation.

pecification Requirements: That the frequency vary not more than 0.2% for a 5% reduction in battery operating voltages.

Specifications exceeded.

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Table 21

Model TBY-2, Serial No. 124

EFFECT OF VARIATION OF SUPPLY VOLTAGE

:T AS PER PAR. 4-1(19) OF SPECIFICATIONS RE 13A 535B

AND MODIFICATIONS RE 13A 535C

Band 1

s)	Plate Supply (Volts)	Plate Cur. (Ma)	Grid Cur. (Ma)	Freq. (Mc)	Deviation (Mc)	Deviation (%)
)	150	16.5	4.9	28.444		
2	142	16.5	4.1	28.414	0.030	0.106
5	135	16.5	2.8	28.374	0.070	0.247
7	127.5	16.5	1.8	28.346	0.098	0.345

Band 2

50	150	16.5	4.7	33.393		
42	142	16.5	3.4	33.345	0.048	0.144
35	135	16.5	2.5	33.312	0.081	0.242
27	127.5	16.5	1.7	33.279	0.114	0.341

Band 3

50	150	16.5	3.6	48.752		
.42	142	16.5	2.2	48.648	0.104	0.213*
.35	135	16.5	1.5	48.564	0.188	0.386
.27	127.5	16.0	1.2	48.472	0.280	0.575

Band 4

.50	150	16.5	2.0	65.845		
.42	142	16.5	1.3	65.630	0.215	0.327*
.35	135	16.5	0.8	65.705	0.140	0.213
.27	127.5	13.0	0.5	65.855	0.010	0.0152

pecification Requirements: That the frequency vary not more than 0.2% for a 5% reduction in battery operating voltages.

Specifications exceeded.

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Table 22

Model TBY-1, Serial No. 642

VARIATION OF SUPPLY VOLTAGE

n	Fil. (Volt)	Plate Voltage	Grid Current (Ma)	Plate Current (Ma)	R.F. (Ma)	Power (Watts)	Power (%)
	1.50	150	1.5	16	177	0.845	100.0
	1.42	142	1.4	16.2	173	0.808	95.8
	1.35	135	1.2	13.2	148	0.591	70.0
	1.27	127	0.9	10.6	122	0.402	47.8
	1.20	120	0.7	7.5	79	0.168	19.8
	1.12	112	0	6.6	0	0	00.0

a: 27-ohm resistor in series with a variable condenser.

b. 4 frequency approximately 72.5 mcs. used during measurements.

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Table 23

Model TBY-2, Serial No. 124

MCW PERCENTAGE MODULATION

TEST AS PER PAR. 4-1(18) OF SPECIFICATIONS RE 13A 535B

Input Freq. (Mc)	Mod. Freq.	Input (Volts)	Mod. (%)	Plate Current (Ma)	Grid Current (Ma)	Band	Osc. Dial
30	400	1.5	61.5	17.0	6.2	1	760.0
45	400	1.5	58.4	16.6	5.9	2	1032.5
60	400	1.5	60.0	16.1	5.9	3	896.5
80	400	1.5	55.5	17.0	2.4	4	905.0
30	MCW	---	92.4	16.8	6.5	1	760.0
45	MCW	---	90.5	16.0	6.1	2	1032.5
60	MCW	---	90.5	17.0	4.0	3	896.5
30	MCW	---	98.0	17.1	2.3	4	905.0

Specification Requirements: That in the case of MCW, the percentage of modulation shall not be less than 90.

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Table 24

Model TBY-1, Serial No. 642

DISTORTION VERSUS AUDIO FREQUENCY

(70% MODULATION)

DUMMY ANTENNA RESISTANCE 27 OHM

Band 1

Audio Input Volts	Per Cent Distortion	Plate Current (Ma)	Grid Current (Ma)	Antenna Current (Ma)
1.70	10.0	16.0	4.8	175
1.50	9.4	16.3	4.9	175
1.26	6.8	16.1	4.8	175
1.07	5.5	16.1	4.8	175
0.94	5.4	16.1	4.8	175
0.81	4.7	16.1	4.8	175
0.79	4.3	16.0	4.8	175
0.81	4.3	16.0	4.7	174
0.87	3.0	16.0	4.6	175
0.92	3.0	16.0	4.7	175
0.96	3.0	16.0	4.7	175
1.01	5.7	16.0	4.8	175
1.05	10.0	16.0	4.6	

Band 4

1.74	12.5	16.0	1.1	189
1.55	10.0	16.3	1.1	189
1.28	6.4	16.0	1.1	189
1.09	5.7	16.0	1.1	189
0.95	5.5	16.0	1.1	189
0.84	5.3	16.0	1.1	186
0.79	5.0	16.0	1.1	182
0.80	5.2	16.0	1.0	182
0.85	5.3	16.0	1.0	184
0.90	6.0	16.0	1.0	183
0.94	6.2	16.0	1.0	182
0.96	6.2	16.0	1.0	181
1.01	11.0	15.8	1.0	

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Table 25

Model TBY-2, Serial No. 124

DISTORTION VERSUS AUDIO FREQUENCY

(70% MODULATION)

DUMMY ANTENNA RESISTANCE 27 OHM

Band 1

dio eq. ps)	Audio Input Volts	Per Cent Distortion	Plate Current (Ma)	Grid Current (Ma)	Antenna Current (Ma)
00	1.85	12.0	16	5.65	180
00	1.65	9.8	"	5.70	180
00	1.34	8.0	"	5.60	179
00	1.15	7.7	"	5.15	181
00	0.98	7.3	"	5.80	180
50	0.82	7.0	"	5.80	179
00	0.70	6.3	"	6.20	179
00	0.72	5.7	"	6.20	179
00	0.77	6.3	"	6.20	179
00	0.83	6.3	"	6.20	180
00	0.85	7.0	"	6.20	180
00	0.92	7.1	"	6.20	180
00	0.98	11.0	"	6.20	180

Band 4

00	1.85	11	16	1.9	200
00	1.70	9.4	"	1.9	201
00	1.40	6.8	"	1.9	199
00	1.14	6.0	"	1.9	198
00	1.00	5.8	"	1.9	200
50	0.82	5.5	"	1.9	199
00	0.77	5.0	"	2.1	202
00	0.84	5.2	"	1.9	200
00	0.90	5.5	"	1.9	201
00	0.94	6.6	"	1.9	200
00	0.97	7.9	"	1.9	199
00	1.09	8.5	"	1.9	203
00	1 14	15.0	"	1.9	200

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Table 26

Model TBY-1, Serial 642

AUDIO FREQUENCY RESPONSE

DUMMY ANTENNA RESISTANCE 27 OHMS

...q. ...S)	Input Volts (A.C)	Mod. (%)	Db Relative to 70% Mod. at 1000 cycles	R-F Output (Ma)
		Band 1		
...0	0.9	70	0	125
...0	0.9	61	-1.2	123
...0	0.9	66.5	-0.4	124
...0	0.9	67	-0.35	124
...0	0.9	67.1	-0.3	124
...0	0.9	68	-0.2	124
...50	0.9	69.3	-0.1	125
...00	0.9	69.3	-0.1	124
...00	0.9	69.3	-0.1	125
...00	0.9	69.3	-0.1	124
...00	0.9	66.5	-0.4	125
		Band 2		
...000	1.14	70	0	80
...200	1.14	59.5	-1.5	79
...300	1.14	65	-0.66	79
...400	1.14	65.7	-0.6	79
...500	1.14	66.5	-0.5	79
...750	1.14	68	-0.25	79
...000	1.14	69.3	-0.1	79
...500	1.14	69.3	-0.1	79
...2000	1.14	69.3	-0.1	79
...500	1.14	68.5	-0.15	79
...5000	1.00*	58.7	-1.5	

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Table 26 (Cont'd)

Input Volts (A.C)	Mod. (%)	Db Relative to 70% Mod. at 1000 cycles	R-F Output (Ma)
		Band 3	
0.92	70	0	85
0.92	59.5	-1.5	85
0.92	63.5	-0.8	85
0.92	66	-0.6	85
0.92	66	-0.6	85
0.92	67	-0.4	85
0.92	69.2	-0.1	85
0.92	70	0	86
0.92	70	0	86
0.92	70	0	86
0.92	67	-0.4	86
		Band 4	
0.96	70	0	75
0.96	60	-1.25	75
0.96	63	-0.9	76
0.96	64.3	-0.8	76
0.96	65	-0.7	76
0.96	66.5	-0.4	76
0.96	69.3	0	76
0.96	70	0	76
0.96	70	0	76
0.96	70	0	76
0.96	69.3	0	76

impossible to get greater input voltage with the circuit arrangement employed.

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Table 27

Model TBY-2, Serial No. 124

AUDIO FREQUENCY RESPONSE

DUMMY ANTENNA RESISTANCE 27 OHMS

Band 1

Input Volts (A.C)	Mod. (%)	Output Volts (A.C)	Db Relative to 70% Mod. at 1000 cycles	R-F Output (Ma)
0.91	70	3.35	0.0	351
0.91	55	2.50	- 2.1	335
0.91	60	3.00	- 1.3	345
0.91	65.6	3.20	- 0.55	348
0.91	67.4	3.35	- 0.3	352
0.91	68.7	3.48	- 0.15	353
0.91	68.7	3.50	- 0.15	353
0.91	68.7	3.50	- 0.15	352
0.91	68.7	3.40	- 0.15	352
0.91	68.7	3.40	- 0.15	351
0.91	68.0	3.25	- 0.2	350
0.91	64.0	2.90	- 0.8	344
0.91	56.8	2.20	- 1.8	332

Band 2

1.08	70.8	2.0	+ 0.0	250
1.08	59	1.6	- 1.5	242
1.08	63.2	1.88	- 0.9	242
1.08	66.7	2.0	- 0.4	242
1.08	66.7	2.1	- 0.4	242
1.08	66.7	2.08	- 0.4	245
1.08	71.4	2.32	+ 0.2	252
1.08	72.3	2.32	+ 0.3	252
1.08	71.6	2.28	+ 0.2	254
1.08	71.4	2.20	+ 0.2	255
1.08	71.1	2.00	+ 0.1	240
1.08	68.9	2.04	- 0.1	235
1.08	60.8	1.80	- 1.2	235

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Table 27 (Cont'd)

Band 3

Mod. Freq. (CPS)	Input Volts (A.C)	Mod. (%)	Output Volts (A.C)	Db Relative to 70% Mod. at 1000 cycles	R-F Output (Ma)
1000	0.91	70.	12.3	0	390
200	0.91	60	9.1	- 1.3	358
300	0.91	61.1	10.3	- 1.15	370
400	0.91	64.4	11.0	- 0.7	378
500	0.91	67.1	11.4	- 0.35	380
750	0.91	70.0	12.1	0	383
1000	0.91	71.0	11.8	+ 0.15	382
1500	0.91	69.5	11.8	- 0.05	380
2000	0.91	69.5	11.5	- 0.05	380
2500	0.91	66.2	11.2	- 0.45	380
5000	0.91	63.4	10.2	- 0.8	372
7500	0.91	60.0	8.9	- 1.3	365

Band 4

1000	0.89	70.0	5.5	0	279
200	0.89	64.7	4.75	- 0.7	235
300	0.89	70.0	5.20	0	250
400	0.89	70.5	5.35	+ 0.1	255
500	0.89	70.0	6.05	0	275
750	0.89	70.0	6.25	0	278
1000	0.89	70.0	6.25	0	279
1500	0.89	70.0	6.00	0	275
2000	0.89	69.5	5.65	- 0.05	272
2500	0.89	64.0	5.55	- 0.75	269
5000	0.89	64.0	5.55	- 0.75	272
7500	0.89	57.0	4.20	- 1.8	245

Antenna Resistance: 27 ohms

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Table 28

Model TBY-1, Serial No. 642

PERCENT MODULATION VERSUS AUDIO

INPUT VOLTS (1000 CPS)

DUMMY ANTENNA RESISTANCE 27 OHMS

...ut ...lts	Mod. (%)	Plate Current (Ma)	Grid Current (Ma)	Plate Volts	Grid Volts	R-F Current (Ma)
			Band 1			
	0	16.0	3.3	139	6	245
.1	16.1	16.0	3.4	140	6	248
.2	27.4	16.0	3.4	140	6	250
.3	35.6	16.0	3.5	140	6	255
.4	43.0	16.0	3.6	140	6	251
.5	51.7	16.0	3.7	140	6	258
.6	58.2	16.0	3.9	140	6	273
.7	62.5	16.0	4.2	138	6	270
.8	72.5	16.0	4.4	138	6	271
.9	77.5	16.0	4.45	138	6	278
.0	80.0	16.0	4.5	138	6	279
.1	80.0	16.0	4.8	138	6	282
			Band 4			
	0	16.0	1.0	140	6	360
.1	18.1	16.0	1.0	140	6	361
.2	23.6	16.0	1.0	140	6	371
.3	42.0	16.5	1.1	140	6	380
.4	50.0	16.5	1.1	140	6	380
.5	57.2	16.0	1.2	140	6	390
.6	63.6	16.0	1.3	140	6	400
.7	71.5	16.0	1.4	138	6	408
.8	74.5	16.1	1.4	138	6	420
.9	78.5	16.1	1.45	138	6	428
.0	82.5	16.0	1.5	137	6	429
.1	86.2	16.0	1.5	137	6	432
.2	87.9	16.0	1.5	136	6	432

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Table 29

Model TBY-2, Serial No. 124

PERCENT MODULATION VERSUS AUDIO

INPUT VOLTS (1000 CYCLES)

DUMMY ANTENNA RESISTANCE 27 OHMS

Band 1

Mod. (%)	Plate Current (Ma)	Grid Current (Ma)	Plate Volts	Grid Volts	R-F Current (Ma)
0	16	4.1	138	6.0	200
14.0	16	4.0	138	6.0	198
26.4	16	4.1	138	6.0	195
37.5	16	4.3	138	6.0	200
45.1	16	4.4	137	6.0	205
54.7	16	4.8	137	6.0	206
61.5	16	5.0	137	6.0	215
65.5	16	5.1	137	6.0	220
71.2	16	5.3	137	6.0	220
73.6	16	5.3	137	6.0	228
76.8	16	5.4	137	6.0	225
78.7	16	5.4	136	6.0	226
80.6	16	5.5	137	6.0	229

Band 4

0	16	1.30	138	6.0	278
16.0	15.8	1.20	138	6.0	276
27.3	16.0	1.20	138	6.0	285
39.2	16	1.15	137	6.0	285
42.0	16	1.25	136	6.0	295
53.0	16	1.20	136	6.0	300
62.7	16	1.50	136	6.0	310
69.6	16	1.40	135	6.0	315
75.7	16.3	1.55	137	6.0	323
79.0	16	1.55	136	6.0	325
82.8	16	1.60	137	6.0	330
85.4	16	1.60	136	6.0	334

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Table 30

Model TBY-2, Serial No. 124

CURRENT DRAIN FROM POWER SUPPLY

(ALL SOURCES)

ndition	Source Voltage	Total Current (Ma)	Watts	Osc. Plate Volts	Osc. Plate Current (Ma)	Osc. Grid Current (Ma)
rrier only	156	45	7.02	156	16.5	4.5
	2.0	345	0.69	156	16.5	4.5
	1.5	206	0.31	156	16.5	4.5
	-6.75	0	0.00	156	16.5	4.5
W (Key down)	156	65	10.14	156	17	6.9
	2.0	340	0.68	156	17	6.9
	1.5	201	0.30	156	17	6.9
	-6.75	0	0.00	156	17	6.9
none	156	49	7.65	150	16.5	5.8
70% Mod. at	2.0	345	0.69	150	16.5	5.8
000 cps)	1.5	204	0.31	150	16.5	5.8
	-6.75	40	0.27	150	16.5	5.8
eceive	156	30	4.68	Not measured		
	2.0	290	0.58	0	0	0
	1.5	220	0.33	0	0	0
	-6.75	0	0.00	0	0	0

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Table 31

OPERATION OF MODEL TBY-1 EQUIPMENT DURING

LIFE TEST OF VIBRATOR-STORAGE BATTERY POWER SUPPLY

(TYPE CLG 19029 AND VIBRATOR UNIT TYPE CLG 20144)

ST AS PER PAR. 4-1(4) OF SPECIFICATIONS RE 13A 535B

ndition	Battery Voltage	Plate Supply Voltage	Plate Cur. (Ma)	Grid Cur. (Ma)	Fil. Volts	Antenna Current	Time Hours
ans.	3.9	125	16.0	4.4	1.51	209	2047.60
ceive	3.9	141	--	--	--	--	2047.83
ans.	3.9	122	15.5	4.1	1.45	202	2047.83
ceive	3.9	141	--	--	--	--	2048.11
ans.	3.9	121	15.4	4.1	1.45	200	2048.11
ans.	3.9	121	16.0	4.1	1.44	202	2048.49
ans.	3.9	120	16.0	4.0	1.40	202	2048.89
ans.	3.85	119	16.0	3.8	1.40	202	2049.19
ans.	3.83	117	16.0	3.6	1.38	200	2050.40
ans.	3.80	116	16.0	3.6	1.38	200	2050.80
ans.	3.79	116	16.0	3.5	1.38	199	2051.16
ans.	3.75	114	16.0	3.5	1.39	199	2051.50
ans.	1.6	0	0	0	0.2	0	2055.00

tenna: 27 ohms 100 μμf
ock operated only during transmitting time.
apsed transmitting time: 7.40 hours.
tal operating time: 14.80 hours.

itial power output 1.18 watts
wer output after 7.8 hours operation 1.07 watts
crease in output power 9.3 percent
crease in battery voltage 3.8 percent
crease in plate voltage 8.8 percent

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Table 32

OPERATION OF MODEL TBY-1 EQUIPMENT DURING

DRY BATTERY LIFE TEST (BATTERY TEST CNC 19018)

TEST AS PER PAR. 4-1(4) OF SPECIFICATIONS RE 13A 535B

Plate Volts	Plate Current (Ma)	Grid Current (Ma)	Antenna Current (Ma)	Fil. Volts	Time
134	16.5	5.8	204	1.40	2062.32
120	15.0	4.3	182	1.28	2066.61
107	15.0	2.6	174	1.22	2073.71
107	15.0	2.4	171	1.21	2076.12
109	14.6	2.2	167	1.21	2077.89
108	10	2.4	130	1.21	2078.89
107	0	0	0	1.14	2083.48

Antenna: 27 ohms 100 μμf

Clock operated only during transmitting time.
Elapsed transmitting time: 21.16 hours.
Total operating time: 42.32 hours.

Initial power output 1.12 watts.
Power at end of 8.6 hours operation 0.894 watts.
Power at end of 30 hours operation 0.790 watts.
Decrease in output at 8.6 hours 20.2 percent.
Decrease in plate voltage at 8.6 hours 10.4 percent.

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Table 33

FREQUENCY CHANGE PER DEGREE CENTIGRADE

TBY-2 CRYSTAL CALIBRATOR

HI-POWER CRYSTAL TYPE CF-5, SERIAL No. 1119

Temp. (°C)	Calibrator Frequency (Kc)	Change Per Degree C. (Kc)	(%)
-39	5000.200		
-39	.199		
-39	.199		
-39	.199		
-30	.205		
-30	.285		
-30	.337		
-30	.364		
-30	.369	.0186	.000372
Mean of last two readings	.366		
-20	.409		
-20	.478		
-20	.514		
-20	.532		
-20	.539		
Mean of last two readings	.536	.0170	.000340
0	.568		
0	.677		
0	.731		
0	.761		
0	.774		
0	.784		
0	.788		
Mean of last two readings	.786	.0125	.000250

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Table 34

Model TBY-1

VARIATION OF TEMPERATURE

T AS PER PAR. 4-1(19) OF SPECIFICATIONS RE 13A 535B

AND MODIFICATION RE 13A 535C

e	Temp. (°C)	Rel. Hum. (%)	Plate Volts	Plate Current (Ma)	R-F Output (Ma)	Freq. (Mc)
			0	0	0	0
0	-37		116	16.1	220	29.925
0	-39		114	15.8	220	.931
.0	-39		116	15.5	220	.931
50	-39		116	15.8	220	.931
00	-39		115.5	15.4	220	.934
10	-39		112	15.0	220	.931
20	-39		112	15.5	220	.931
30	-39		112	15.5	220	.931
40	-10		112	15.5	180	.931
45	0		112	15.5	175	.928
55	0		116	15.5	190	.928
05	- 1		116	15.5	190	.928
15	- 1		116	16.0	190	.928
25	0		114	15.4	190	.928
35	1		116	15.9	190	.931
45	4		118	16.0	180	.931
050	21	22	118	16.1	175	.934
100	21	12	120	16.5	175	.925
110	21	10	121	16.5	150	.931
120	21	10	121	16.6	150	.934
130	18	31	120	16.5	170	.928
140	21	10	120	16.5	170	.931
150	20.5	8	122	16.9	180	.928
200	20.5	10	122	16.9	160	.931
210	38.2	4	124	17.0	170	.934
215	42	4	125	17.0	170	.934
225	39	5	122	17.0	170	.934
1235	40.5	5	126	17.1	170	.937
1245	40.5	5				

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Table 34 (Cont'd)

Temp. (°C)	Rel. Hum. (%)	Plate Volts	Plate Current (Ma)	R-F Output (Ma)	Freq. (Mc)
50	9	124	17.1	180	29.952
60	6	126	17.1	170	.931
61.5	6	126	17.2	140	.931
60	6	124	16.9	150	.928
60	6	124	17.0	150	.937
60	6	124	17.0	170	.937
60	6	124	17.0	170	.940
60	6	124	17.0	180	.940
60	10	126	17.1	170	.940
60	10	124	17.0	180	.940
60	10	125	17.3	150	.940
60	10	124	17.1	160	.940
60	10	125	17.0	160	.940

Summary

perature Change Degrees C.	Megacycles Change Per 10°C	Percent Change Per One Degree C
-39.9 to 0	0.0000	0.000
0 to 20	0.0015	0.0005
20 to 40	0.0045	0.0015
40 to 60	0.0015	0.0005

pe CLG 19019 storage battery with a Type CLG 20144 vibra-
ck used as power source in this test

ximum frequency deviation from initial frequency 0.027 mc;
09%.

ecification requirements: Stability within 0.3% between
0° and +50°C.

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Table 35

Model TBY-2

VARIATION OF TEMPERATURE

AS PER PAR. 4-1(19) OF SPECIFICATIONS RE 13A 535B

AND MODIFICATION RE 13A 535C

Temp. (°C)	Rel. Hum. (%)	Plate Volts	Plate Cur. (Ma)	R-F Output (Ma)	Freq. (Mc)	
-37						
-39						Note 1
-39						
-39						
0						Note 2
1		128	15.1	170	30.084	
21	22	129	15	165	30.078	
21	22	131	15	168	30.072	
21	10	132	15.4	170	30.072	
18	31	131	15.3	172	30.075	
21	10	132	15.5	173	30.072	
20.5	8	132	15.4	170	30.069	
20.5	10	132	15.5	180	30.084	
38.2	4	132	15.5	168	30.075	
42	4	132	15.5	165	30.066	
39	4	132	15.5	169	30.060	
40.5	4	133	15.6	171	30.048	
40.5	4	132	15.5	168	30.048	
53	5	134	15.6	164	30.042	
60	6	132	15.8	166	30.024	
61.5	6	133	16.2	170	30.030	
59.5	6	134	16.5	173	30.029	
60	6	135	16.5	173	29.991	
60	6	136	16.6	175	29.991	
60	6	136	16.6	175	29.988	
60	6	136	16.8	172	29.988	
60	10	136	16.9	175	29.982	
60	10	136	16.8	175	29.982	
60	10	137	16.8	175	29.982	
60	10	138	17	177	29.982	

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Table 35 (Cont'd)

Summary

erature Change egrees C.	Megacycles Change Per 10°C	Percent Change Per One Degree C.
20 to 40	0.0105	0.0035
40 to 60	0.0330	0.0110

battery type CNC 19018-A used as power source in this

e 1.
attery first started to function at this point as evinced
y the r-f tube filaments beginning to draw current.

e 2.
late voltage sufficient to produce radio frequency power
utput in the transmitter first available from the dry
attery at this time.

timum frequency deviation from original frequency 0.102 Mc,
34%.

ecification requirements: Stability within 0.3 percent
tween -20°C and +50°C.

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Table 36

Model TBY-1, Serial No. 646

VARIATION OF HUMIDITY

AS PER PAR. 4-1(19) OF SPECIFICATIONS RE 13A 535B

AND MODIFICATIONS RE 13A 535C

Temp. (°C)	Rel. Hum. (%)	Ant. Cur. (Ma)	Freq. (Mc)	Plate Voltage	Plate Cur. (Ma)
		Low Frequency Channel			
40	18	150	30.117	126	16.1
40	25	150	.117	126	16.0
40.5	20	150	.117	126	16.0
40	21	150	.117	126	16.1
40.5	63	150	.111	126	16.1
40	80	150	.105	125	16.0
40	87	155	.099	126	16.1
40	90	140	.099	126	16.1
41	90	150	.096	126	16.5
40	90	150	.093	126	16.5
41	90	150	.090	126	16.4
41	90	150	.087	127	16.5
41.5	90	150	.087	126	16.6
40	90	150	.087	125	16.6
40	90	140	.087	128	16.8
40	90	145	.084	127	16.9
40	90	145	.084	124	16.8
40	95	145	.081	126	17.0
40.5	93	145	.081	126	17.0
36.5	23	150	.096	126	17.0
40	20	150	.105	126	17.1
40	25	150	.108	127	17.0
40	20	155	.108	124	16.1
40	25	165	.108	128	16.5
40	30	165	.108	127	16.1
40	20	160	.108	128	16.5

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Table 36 (Cont'd)

e	Temp. (°C)	Rel. Hum. (%)	Ant. Cur. (Ma)	Freq. (Mc)	Plate Voltage	Plate Cur. (Ma)
			High Frequency Channel			
35	40	30	185	72.500	127	16.9
45	40	21	180	.540	126	16.5
55	40.5	22	180	.540	126	16.5
05	40.5	21	185	.540	126	16.5
15	40.5	60	180	.528	126	16.5
25	40.5	84	185	.512	126	17.0
35	40.5	90	185	.496	126	17.0
45	40.5	90	180	.472	124	16.9
55	40.5	90	160	.468	124	17.0
05	40.5	90	160	.464	126	17.2
15	41.0	90	170	.456	125	17.5
25	40.5	90	180	.456	126	17.8
35	39.5	23	190	.460	125	16.5
45	39.5	30	190	.500	126	15.6
55	40.0	20	160	.516	126	15.1
05	39.5	20	180	.532	126	15.0

pecification Requirements: 0.2% between the limits of 30% and 90% humidity.

Low Frequency Channel

requency at end of initial 30 minute low humidity period: 30.117 mcs.
requency at end of high humidity period: 30.081 mcs.
Frequency change 0.036 mcs, 0.12 percent.

High Frequency Channel

requency at end of initial 30 minute low humidity period: 72.540 mcs.
requency at end of high humidity period: 72.456 mcs.
Frequency change 0.084 mcs, 0.12 percent.

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Table 37

Model TBY-2, Serial No. 124

VARIATION OF HUMIDITY

TEST AS PER PAR. 4-1(19) OF SPECIFICATIONS RE 13A 535B

AND MODIFICATIONS RE 13A 535C

Time	Temp. (°C)	Rel. Hum. (%)	Ant. Cur. (Ma)	Freq. (Mc)	Plate Voltage	Plate Cur. (Ma)
			Low Frequency Channel			
5	39	22	188	30.036	140	17.1
5	40	25	183	30.024	140	17.0
5	40.5	20	182	30.018	140	16.9
5	40	21	181	30.012	140	16.9
.5	40.5	63	179	30.003	140	16.9
25	40	80	178	29.991	139	17.1
15	40	87	178	29.985	138	17.2
45	40	90	178	----	138	17.2
55	40.5	90	178	29.976	138	17.4
05	40	90	175	29.970	138	17.6
15	41	90	175	29.964	138	17.7
25	41.5	90	177	29.964	138	18.0
35	40.5	90	175	29.964	138	18.0
45	40	90	175	29.958	138	17.7
55	40	90	175	29.961	138	17.9
05	40	90	177	29.964	138	18.1
15	40	90	176	29.958	138	18.0
25	40	95	176	29.958	138	18.0
35	40.5	93	175	29.961	138	18.1
45	36.5	23	179	29.982	138	17.4
55	40	20	178	29.988	138	17.2
05	40	25	179	29.997	139	17.0
15	40	20	179	29.994	140	17.0
25	40	25	180	30.000	140	17.0
35	40	30	180	30.000	140	17.0
45	40	20	180	30.000	140	17.0

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Table 37 (Cont'd)

Temp. (°C)	Rel. Hum. (%)	Ant. Cur. (Ma)	Freq. (Mc)	Plate Voltage	Plate Cur. (Ma)
		High Frequency Channel			
40	30	167	72.500	127	17.3
40	21	167	.492	126	17.3
40.5	22	170	.500	126	17.5
40.5	21	172	.508	126	17.3
40.5	60	172	.496	126	17.5
40.5	84	172	.484	126	17.5
40.5	90	170	.464	126	18.0
40.5	90	172	.436	124	18.0
40.5	90	168	.448	124	18.0
40.5	90	146	.400	126	16.5
41	90	150	.404	125	17.0
40.5	90	150	.404	126	17.5
39.5	23	172	.496	125	17.5
39.5	30	172	.500	126	17.5
40	20	173	.508	126	17.5
39.5	20	174	.512	126	17.5

fication Requirements: 0.2% between the limits of 30% 90% humidity.

Low Frequency Channel

ency at end of initial 30 minute low humidity period: 2 mc.

ency at end of high humidity period: 29.961 mcs.

ency change 0.051 mc., 0.17 percent.

High Frequency Channel

ency at end of initial 30 minute low humidity period: 08 mc.

ency at end of high humidity period: 72.404 mc.

ency change 0.104 mc., 0.14 percent.

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Table 38

Model TBY-1, Serial No. 646

VIBRATION TEST

e	Vibrations Per Minute	Grid Current (Ma)	Plate Current (Ma)	Approx. Freq. (Mc)	R-F Output (Ma)
0	0	4.6	16.5	30.45	180
0	600	4.6	16.5	30.45	170
0	600	4.4	16.8	30.45	175
1	See Note			30.50	
0	1100	5.4	14.4	30.50	

gnal monitored on a Navy Type RBG receiver.

Replaced dummy antenna with regular whip antenna at this point in test.

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Table 39

Model TBY-2, Serial No. 124

VIBRATION TEST

Vibrations Per Minute	Grid Current (Ma)	Plate Current (Ma)	Approx. Freq. (Mc)	R-F Output (Ma)
0	4.6	16.3	28.95	177
600	4.7	16.0	28.95	175
600	4.3	15.5	28.95	171
See Note			30.80	
1100	5.2	10.8	30.80	

nal monitored on a Navy Type RBG receiver.

eplaced dummy antenna with regular 9-foot whip antenna
t this point in test,

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Table 40

Model TBY-1, Serial No. 646

SHOCK TEST

ck		Acceleration (G's)	Plate Current (Ma)	Grid Current (Ma)	R-F Output (Ma)
	Shock Applied From Left Side Of Equipment				
1	Before	0	16.2	5.3	150
	After	300	Equipment off.		
2	Before	0	Equipment off.		
	After	300	16.8	4.8	160
3	Before	0	Equipment off.		
	After	300	Equipment off.		
4	Before	0	16.6	4.6	155
	After	300	17.0	4.9	155
5	Before	0	Equipment off.		
	After	300	Equipment off.		
6	Before	0	16.0	5.1	150
	After	300	16.5	5.0	155

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Table 40 (Cont'd)

Shock No.		Acceleration (G's)	Plate Current (Ma)	Grid Current (Ma)	R-F Output (Ma)
	Shock Applied From Rear of Equipment				
7	Before	0	16.2	5.6	150
	After	300	Equipment Off.		
8	Before	0	16.0	5.0	140
	After	300	16.5	5.4	155
9	Before	0	Equipment Off.		
	After	300	Equipment Off.		
10	Before	0	16.0	5.2	170
	After	300	16.1	5.3	170
11	Before	0	Equipment Off.		
	After	300	Equipment Off.		
12	Before	0	15.8	5.2	170
	After	300	16.5	5.0	170

During the test the spare tube types 958 and 959 in the TBY-1 started to slip out of their carrying sockets.

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Table 41

Model TBY-2, Serial No. 124

SHOCK TEST

Shock No.		Acceleration (G's)	Plate Current (Ma)	Grid Current (Ma)	R-F Output (Ma)
	Shock Applied From Left Side of Equipment				
1	Before	0	16.0	4.9	185
	After	300	16.6	4.6	188
2	Before	0	Equipment Off.		
	After	300	Equipment Off.		
3	Before	0	16.0	4.2	180
	After	300	16.0	4.8	185
4	Before	0	Equipment Off.		
	After	300	Equipment Off.		
5	Before		15.8	4.6	180
	After	300	16.0	4.8	183
6	Before	0	Equipment Off.		
	After	300	Equipment Off.		

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Table 41 (Cont'd)

	Acceleration (G's)	Plate Current (Ma)	Grid Current (Ma)	R-F Output (Ma)
Shock Applied From Rear Of Equipment.				
Before	0	16.5	4.7	180
After	300	16.6	4.6	187
Before	0	Equipment Off.		
After	300	Equipment Off.		
Before	0	16.3	4.6	185
After	300	16.0	4.4	181
Before	0	Equipment Off.		
After	300	Equipment Off.		
Before	0	16.0	3.8	180
After	300	16.0	4.1	180
Before	0	Equipment Off.		
After	300	Equipment Off.		

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Table 42

Model TBY-1, Serial No. 646

OPERATION IN VARIOUS POSITIONS

BATTERY: NAVY TYPE 19018 DRY CELL PACK

Position	Plate Current (Ma)	Grid Current (Ma)
Normal	17	1.2
Right Side Down	11	3.3
Upside Down	16.8	1.6
Left Side Down	14	2.0
Face Down	13	2.3
Back Down	13	2.4
Model TBY-2, Serial No. 124		
Normal	16.2	2.4
Right Side Down	11.0	3.5
Upside Down	20.0	1.5
Left Side Down	14.0	2.8
Face Down	12.0	3.2
Back Down	12.0	3.2

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Table 43

Model TBY-2, Serial No. 200

ACCURACY OF FREQUENCY SETTING

USING CRYSTAL CALIBRATOR

and	Crystal Cal. Freq.	Dial Set.	Test Dial	Freq. Freq. (Mc)	Het. Freq. (Mc)	Freq. (Mc)	Deviation (%)
1	30	772.5	933.5	31.6	31.791	+.131	0.414
2	35	431.0	586	36.8	36.930	+.130	0.353
2	40	778.0	868	41.6	41.397	-.203	0.488
2	45	988.0	1090	47.2	47.721	+.521	1.100
3	50	432.0	539	52.0	51.999	-.001	0.001
3	55	692.0	771	56.8	57.025	+.225	0.396
3	60	903.0	962	61.6	61.120	-.480	0.779
3	65	1086	1027	63.2	64.176	+.976	1.540
4	70	567	640	72.0	72.168	+.168	0.234
4	75	716	777	77.2	77.070	-.130	0.168
4	80	905	866	78.4	78.685	+.285	0.364

erage deviation +0.147 percent.
equency measured on G.R. Type 620A Heterodyne Frequency
ter.

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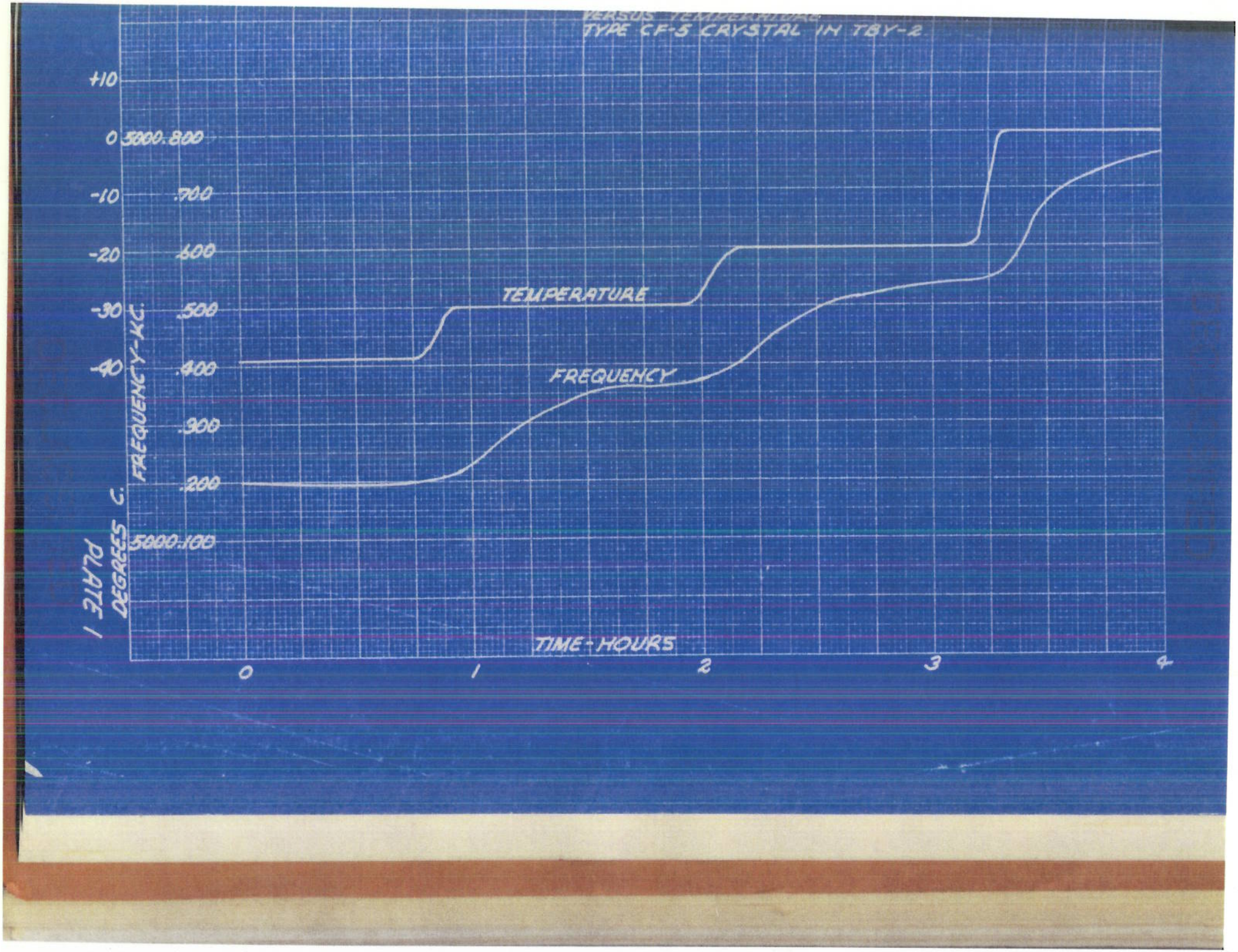
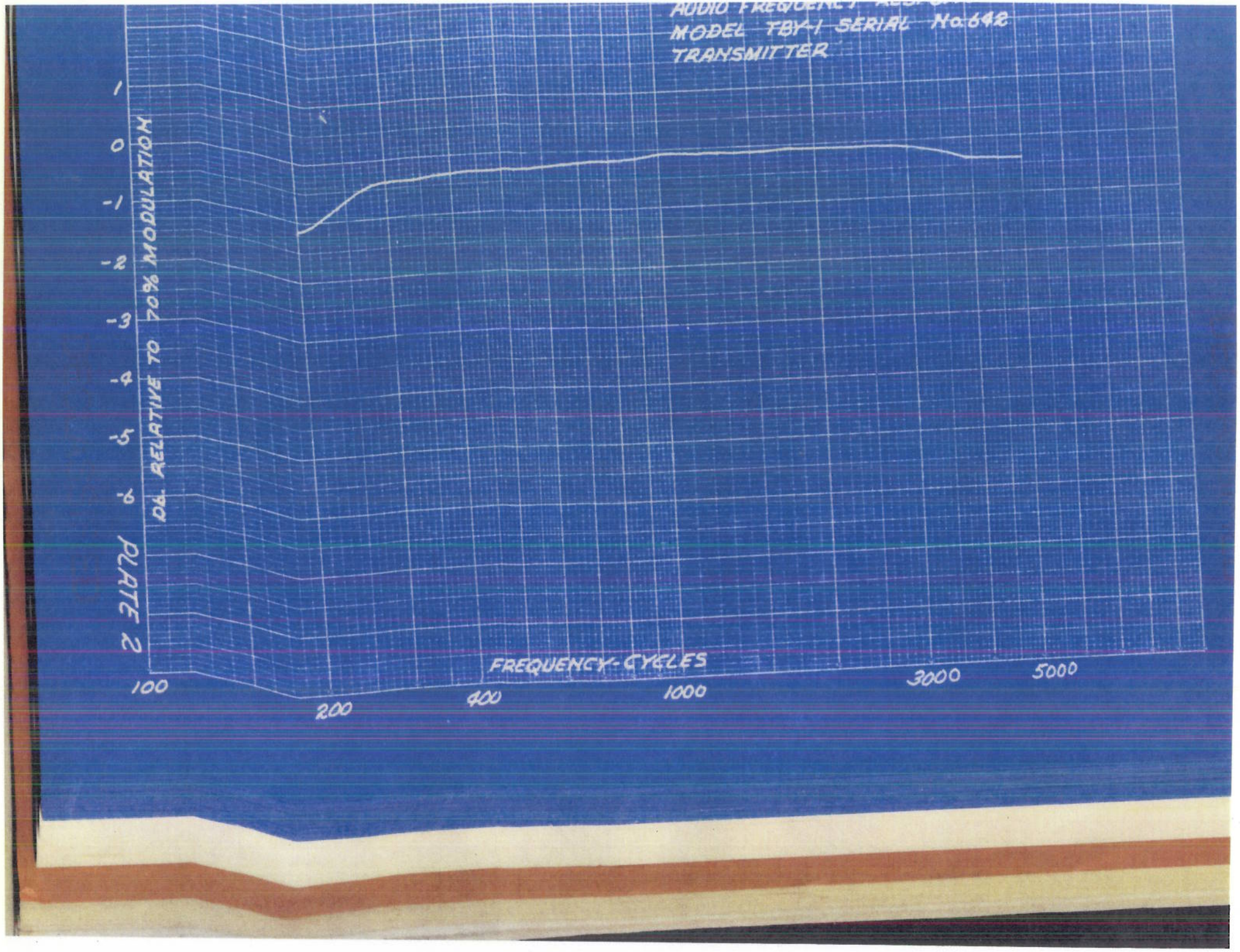
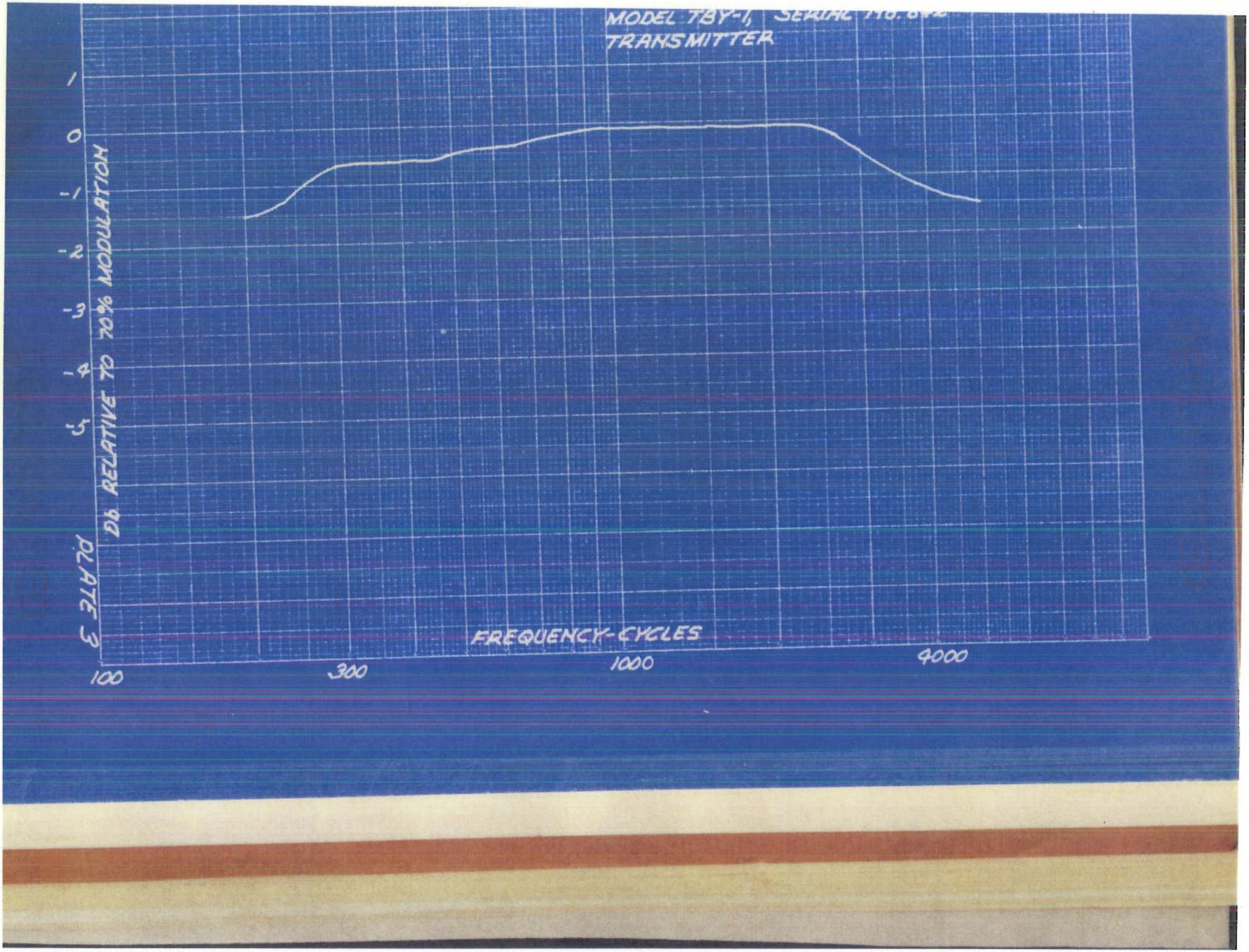
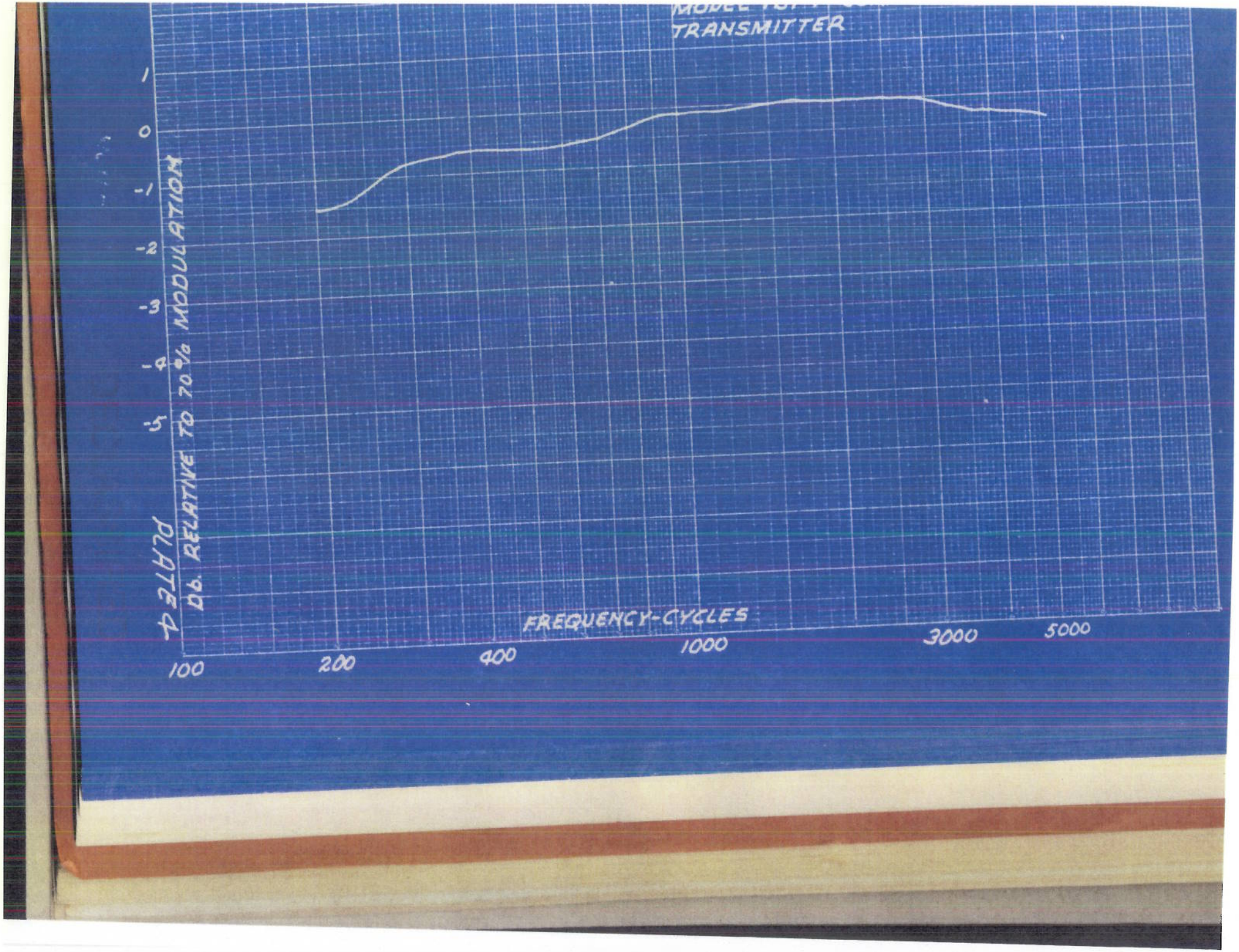
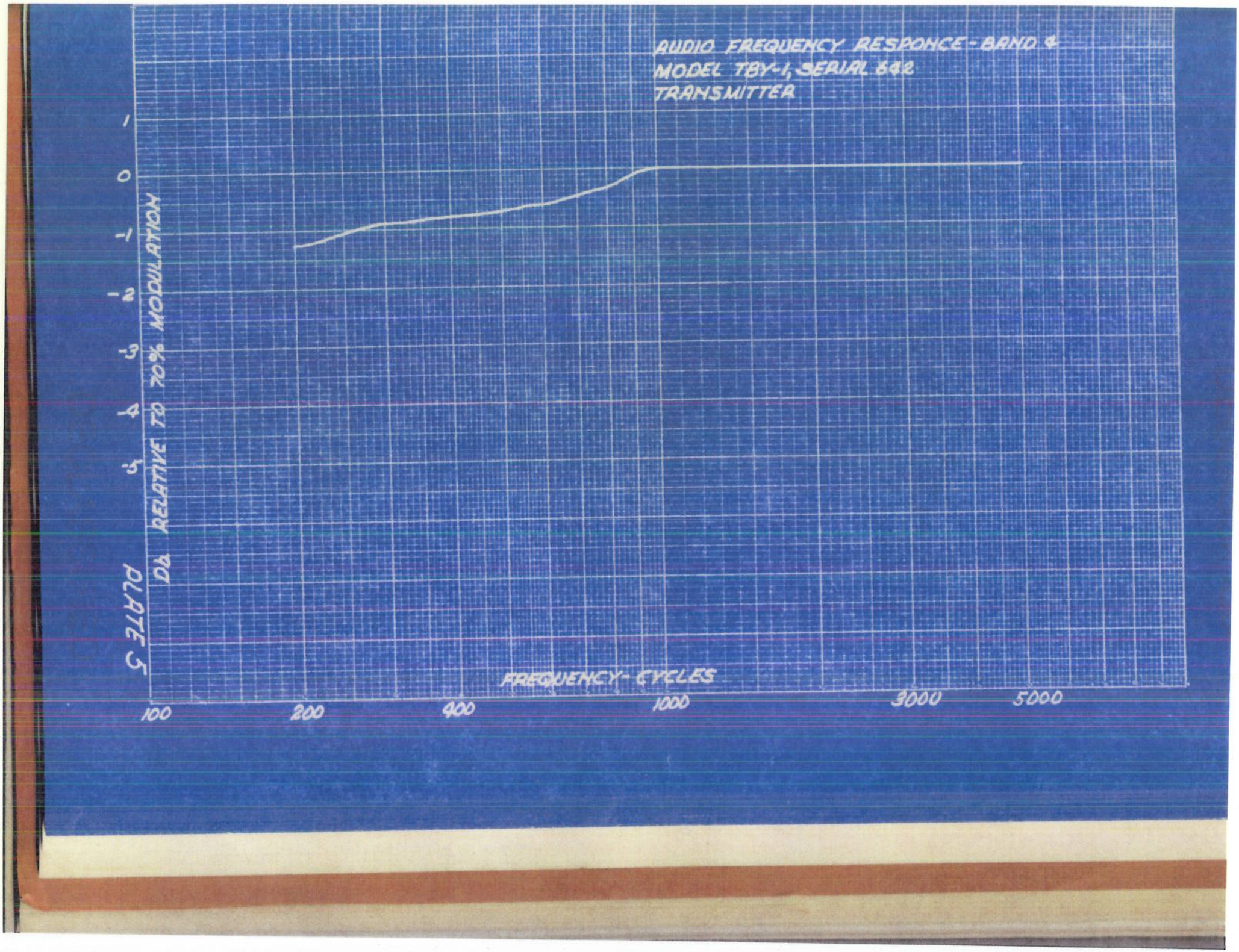
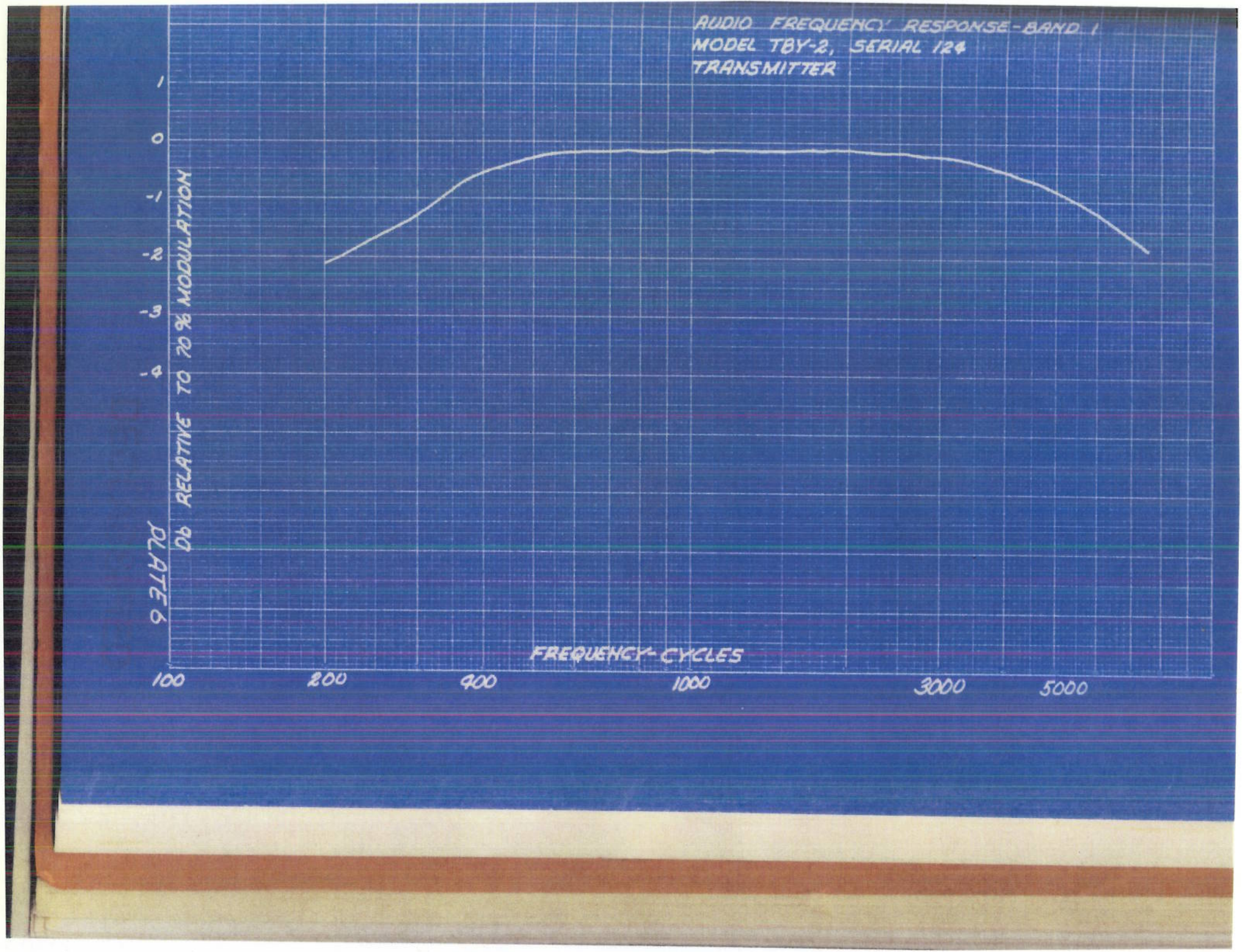

VERSUS TEMPERATURE
TYPE CF-5 CRYSTAL IN TBY-2
+10
0
-10
-20
-30
-40
5000.800
.700
.600
.500
.400
.300
.200
5000.100
TEMPERATURE
FREQUENCY
PLATE I
DEGREES C.
FREQUENCY-KC.
TIME-HOURS
0
1
2
3
4

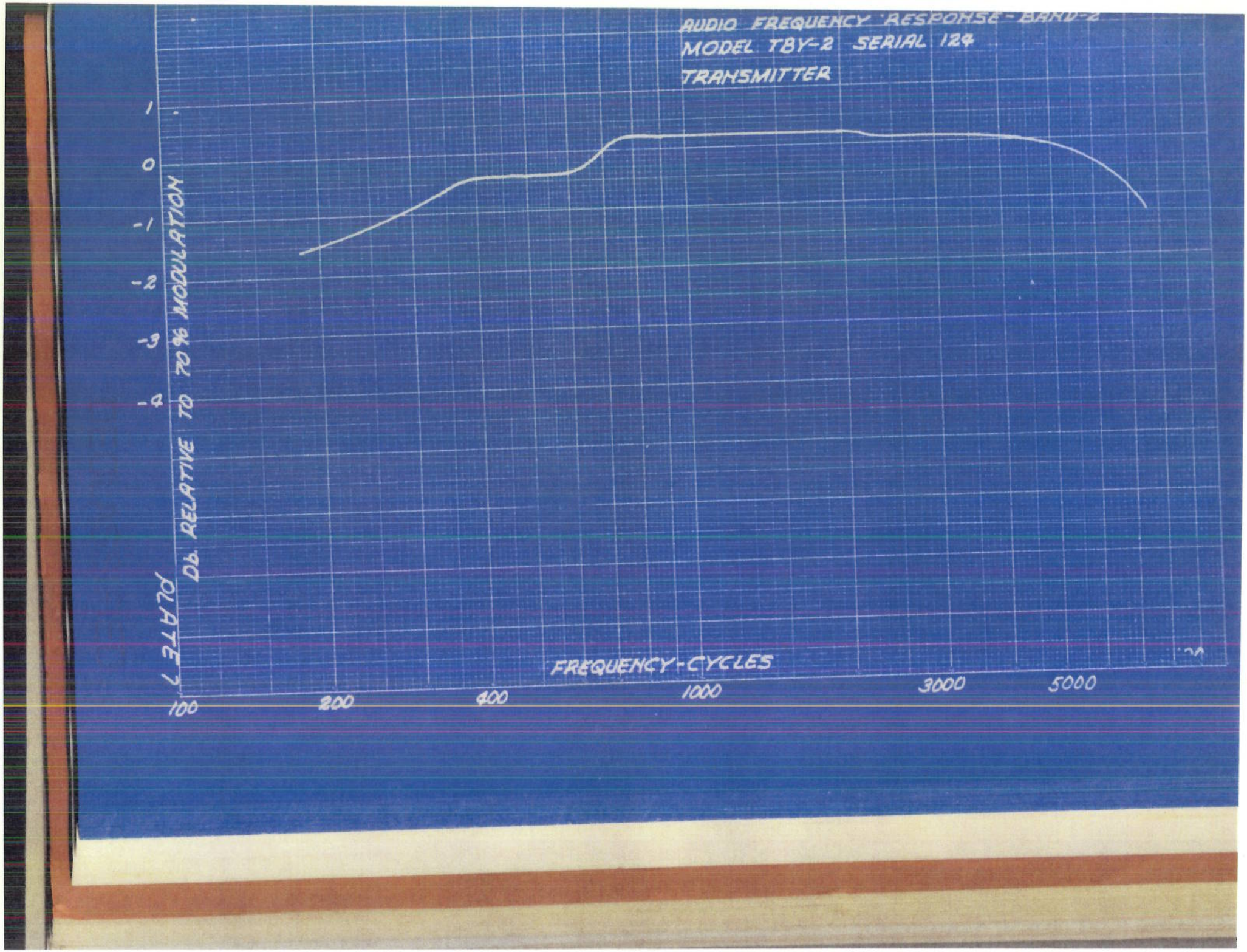

AUDIO FREQUENCY
MODEL TBY-1 SERIAL No. 642
TRANSMITTER
PLATE 2
DB. RELATIVE TO 70% MODULATION
1
0
-1
-2
-3
-4
-5
-6
FREQUENCY-CYCLES
100
200
400
1000
3000
5000

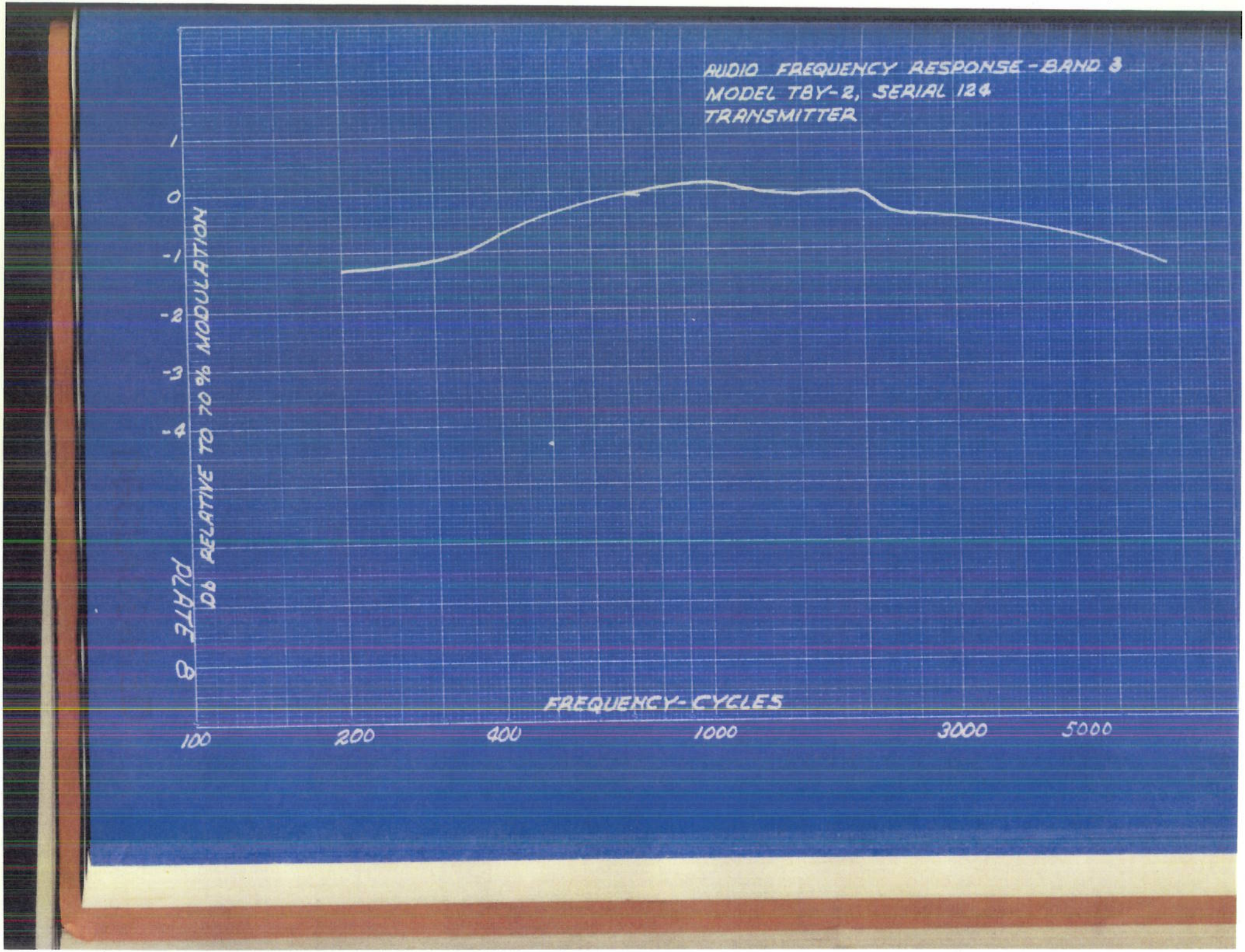

MODEL TBY-1, SERIAL NO. 8
TRANSMITTER
DB RELATIVE TO 70% MODULATION
+1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
FREQUENCY-CYCLES
100
300
1000
9000

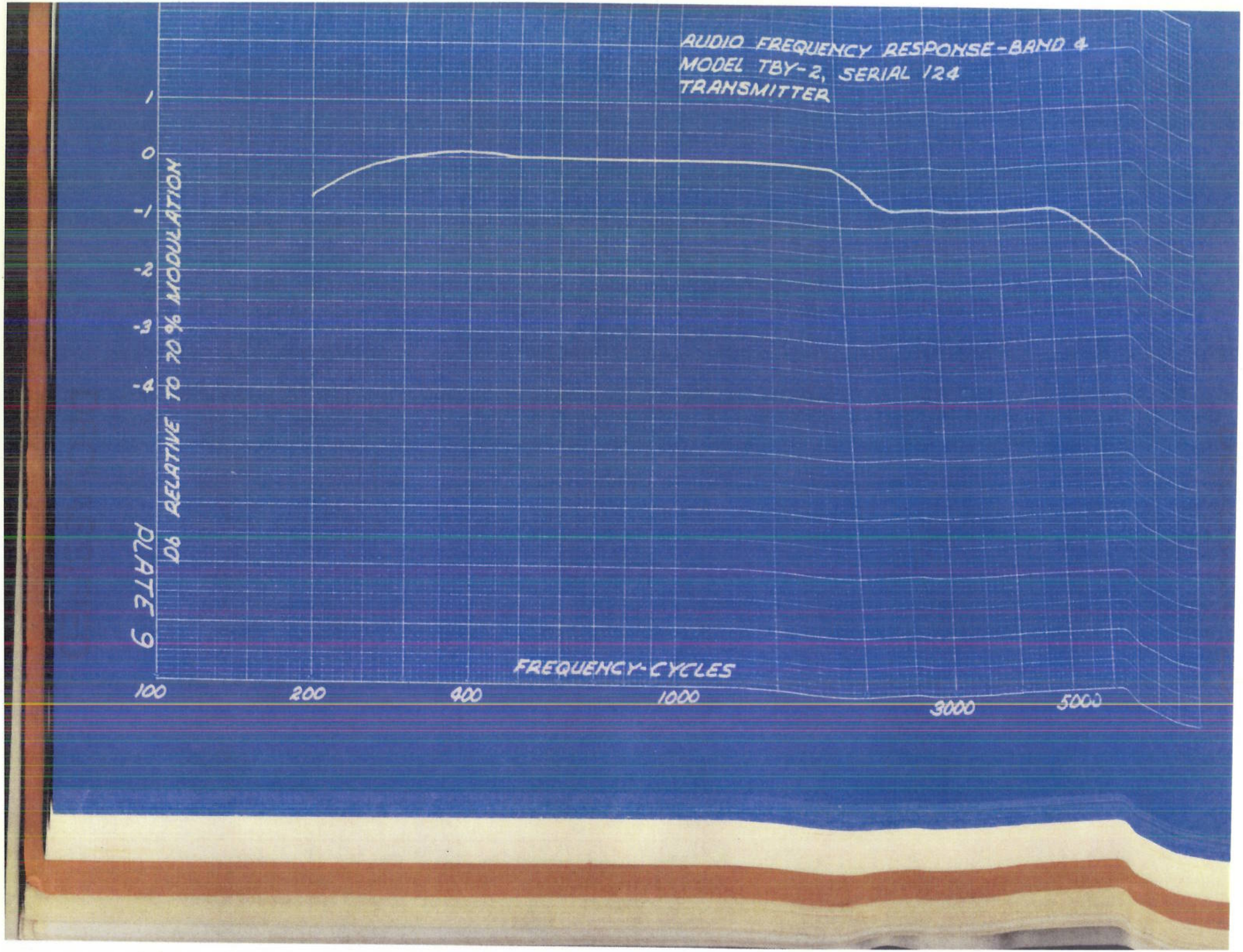

TRANSMITTER
DB. RELATIVE TO 70% MODULATION
+1
0
-1
-2
-3
-4
FREQUENCY-CYCLES
100
200
400
1000
3000
5000

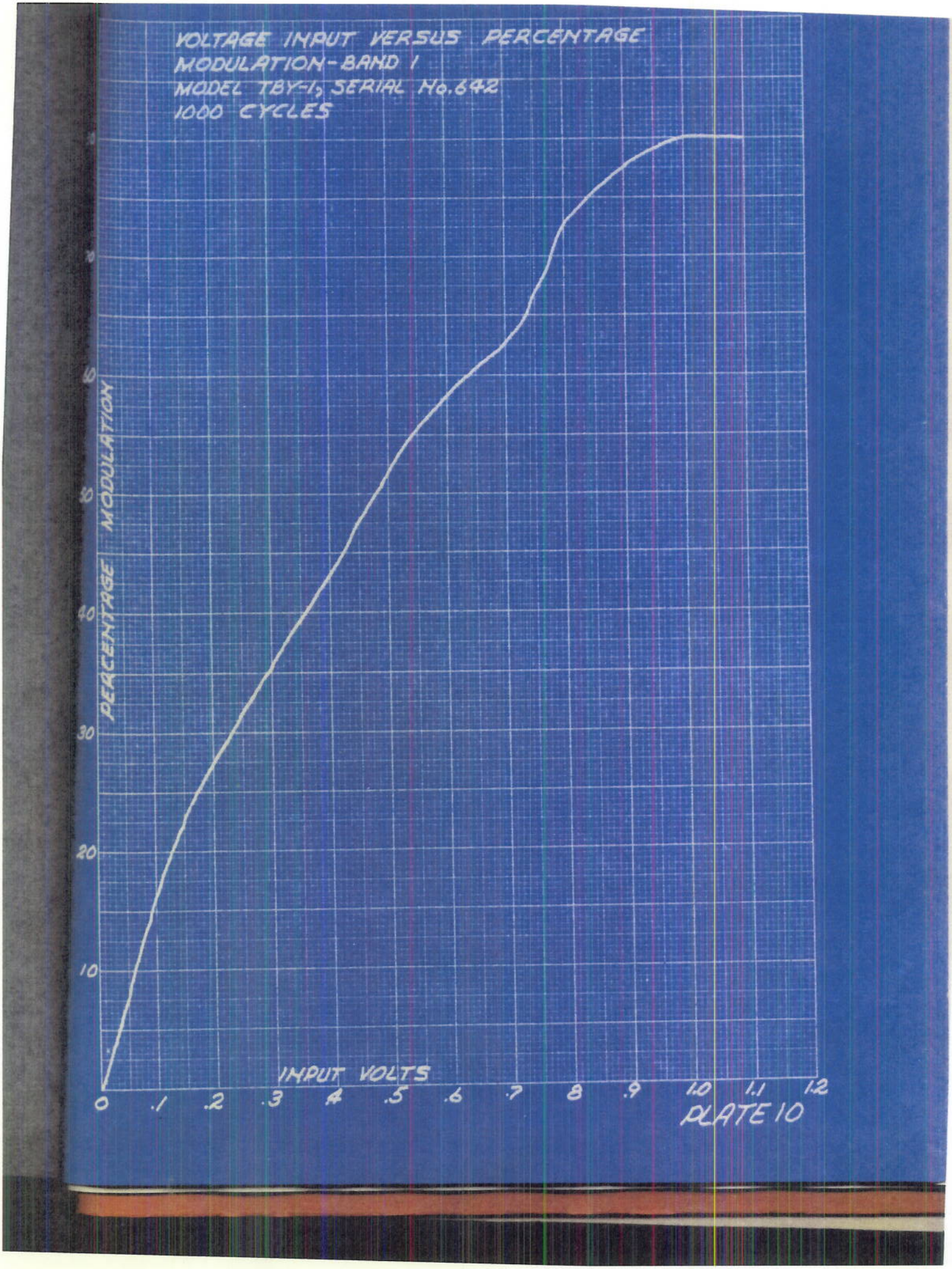

AUDIO FREQUENCY RESPONCE - BAND 4
MODEL TBY-1, SERIAL 642
TRANSMITTER
PLATE 5
DB RELATIVE TO 70% MODULATION
1
0
-1
-2
-3
-4
-5
FREQUENCY - CYCLES
100
200
400
1000
3000
5000


AUDIO FREQUENCY RESPONSE - BAND 1
MODEL TBY-2, SERIAL 124
TRANSMITTER
DATE 6
DB RELATIVE TO 70% MODULATION
1
0
-1
-2
-3
-4
FREQUENCY - CYCLES
100
200
400
1000
3000
5000


AUDIO FREQUENCY RESPONSE - BARD-2
MODEL TBY-2 SERIAL 124
TRANSMITTER
DB. RELATIVE TO 70% MODULATION
1
0
-1
-2
-3
-4
FREQUENCY-CYCLES
100
200
400
1000
3000
5000


AUDIO FREQUENCY RESPONSE - BAND 3
MODEL TBY-2, SERIAL 124
TRANSMITTER
DB RELATIVE TO 70% MODULATION
+1
0
-1
-2
-3
-4
FREQUENCY - CYCLES
100
200
400
1000
3000
5000


AUDIO FREQUENCY RESPONSE-BAND 4
MODEL TBY-2, SERIAL 124
TRANSMITTER
PLATE 9
DB RELATIVE TO 70% MODULATION
1
0
-1
-2
-3
-4
FREQUENCY-CYCLES
100
200
400
1000
3000
5000


VOLTAGE INPUT VERSUS PERCENTAGE MODULATION - BAND 1
MODEL TBY-1, SERIAL No. 642
1000 CYCLES
PERCENTAGE MODULATION
60
50
40
30
20
10
INPUT VOLTS
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
PLATE 10

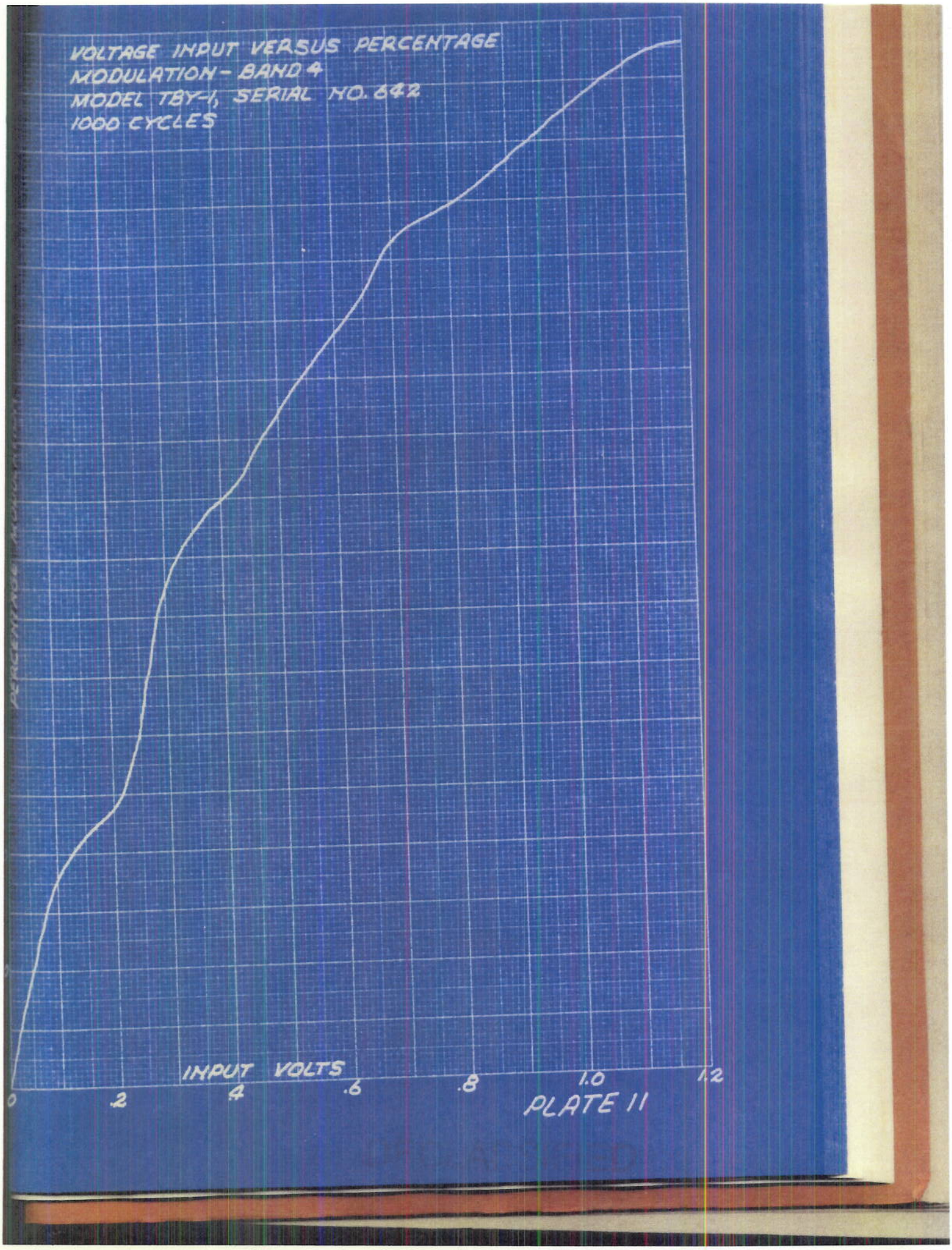

VOLTAGE INPUT VERSUS PERCENTAGE
MODULATION - BAND 4
MODEL TBY-1, SERIAL NO. 642
1000 CYCLES
PERCENTAGE MODULATION
INPUT VOLTS
0
.2
.4
.6
.8
1.0
1.2

PLATE 11

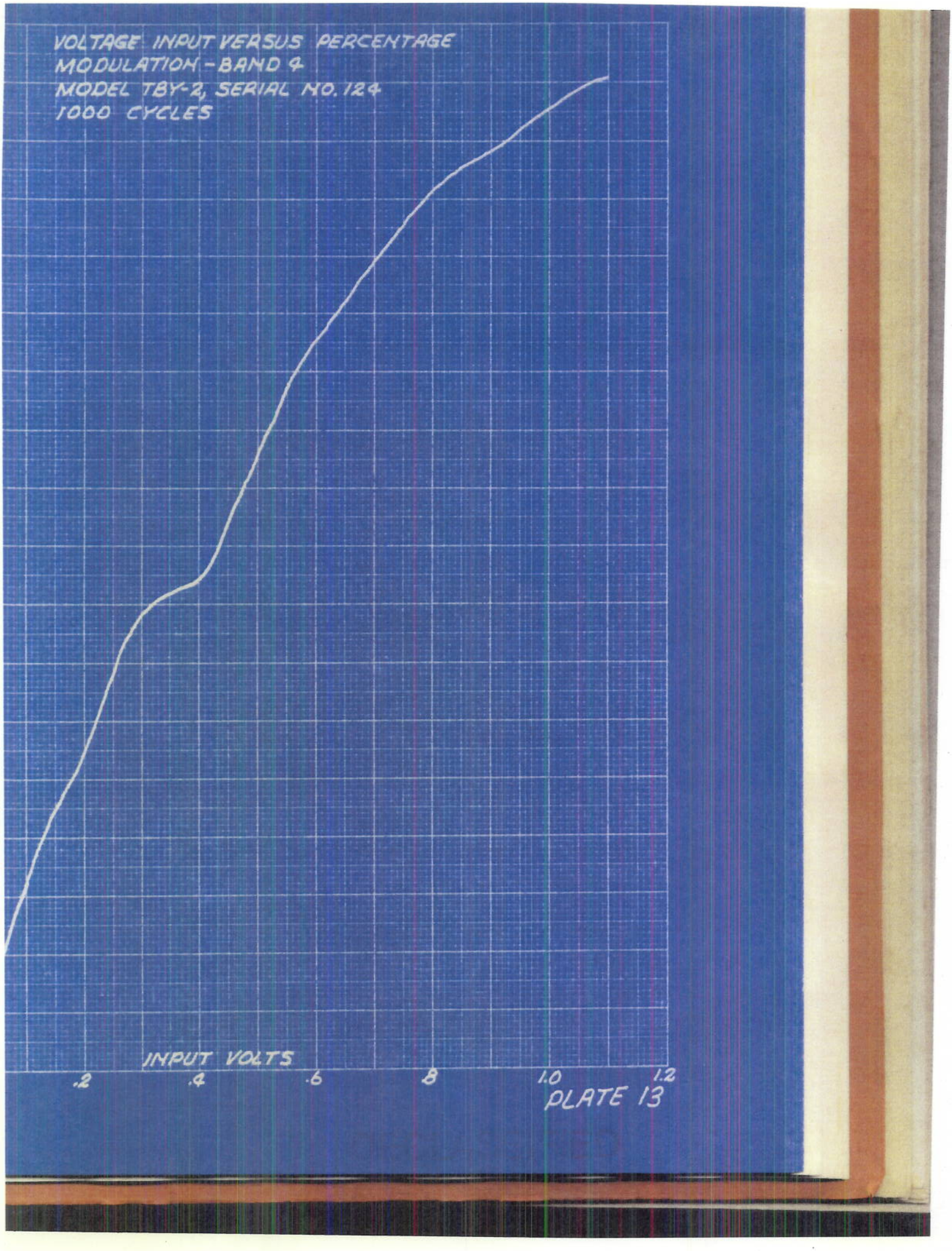
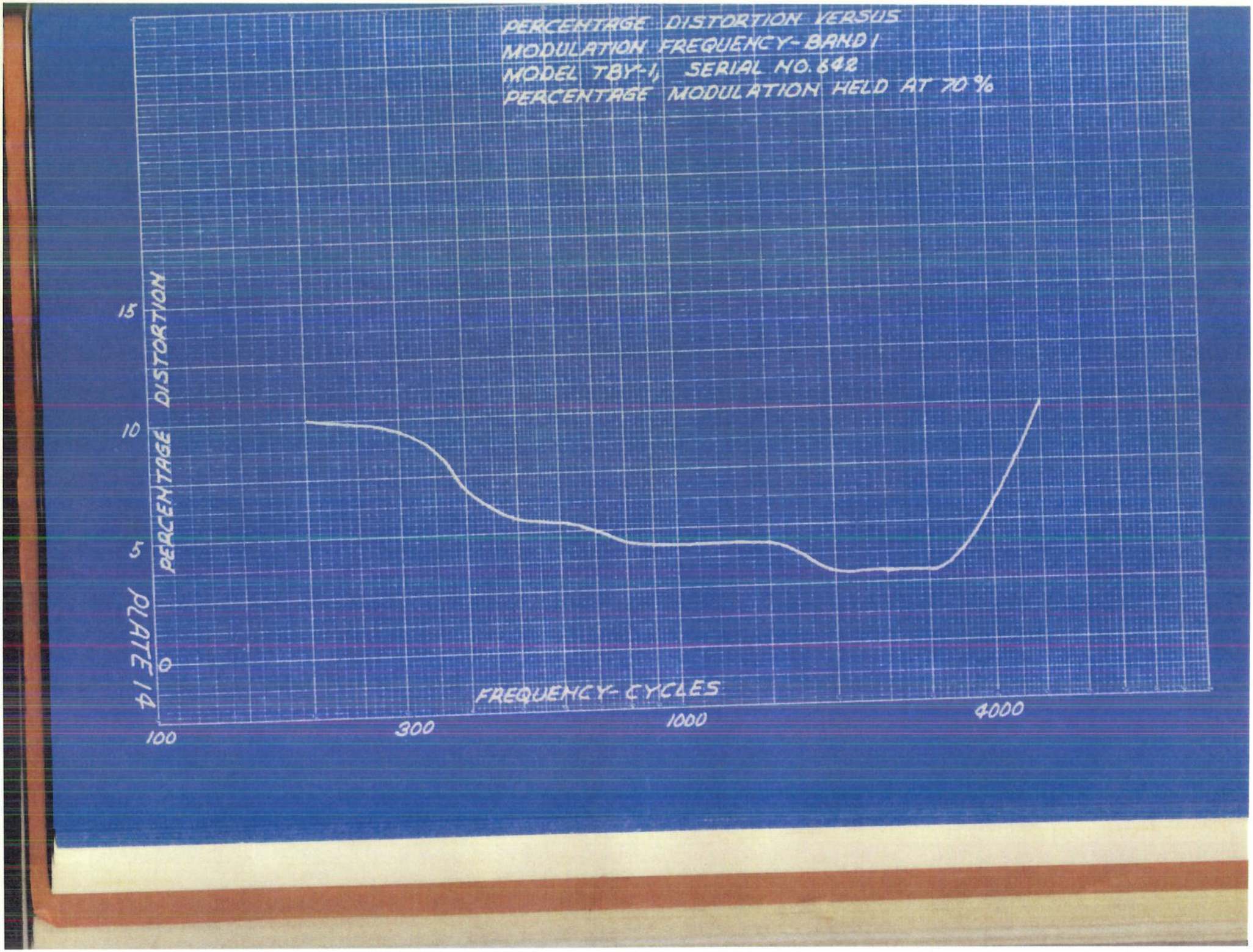
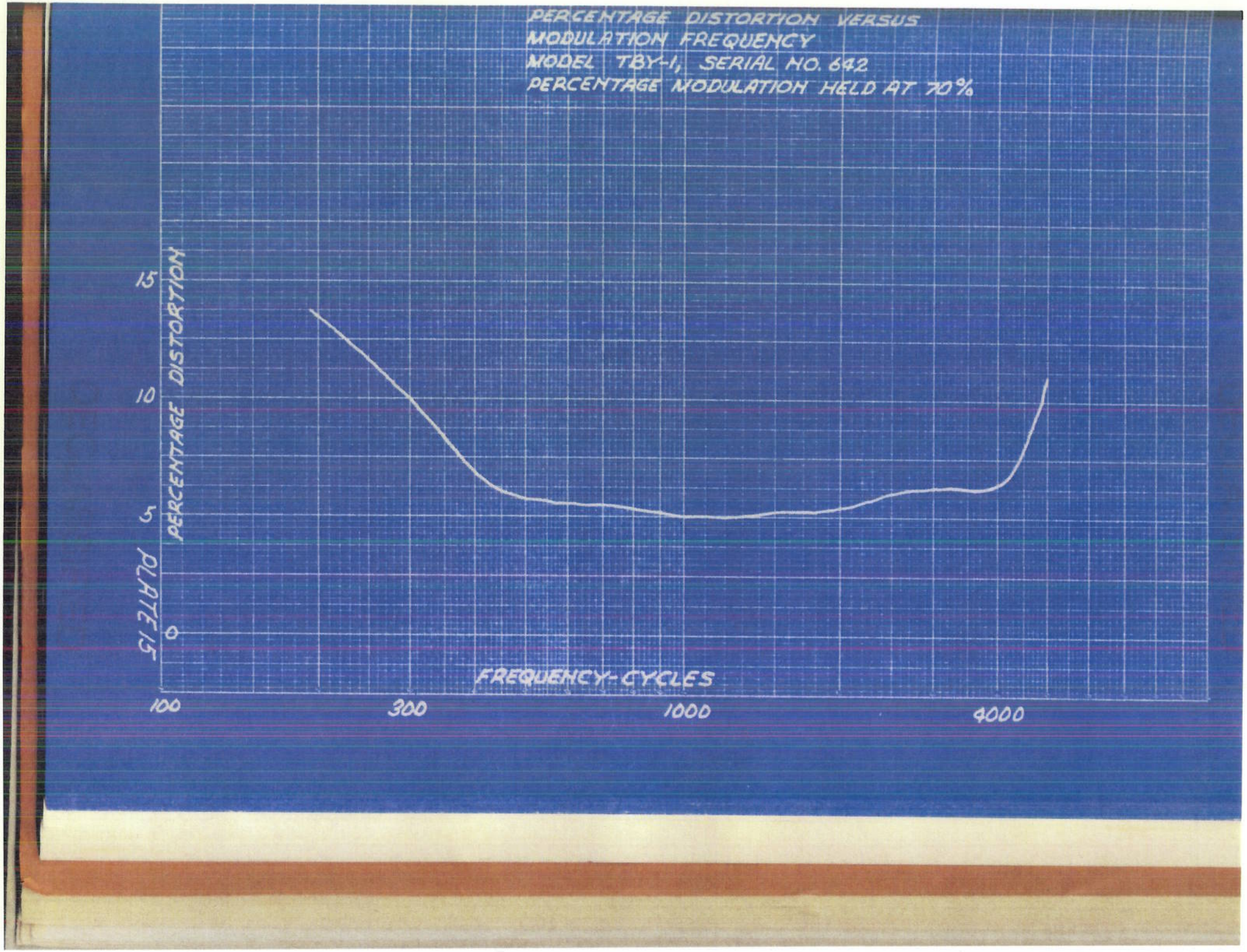
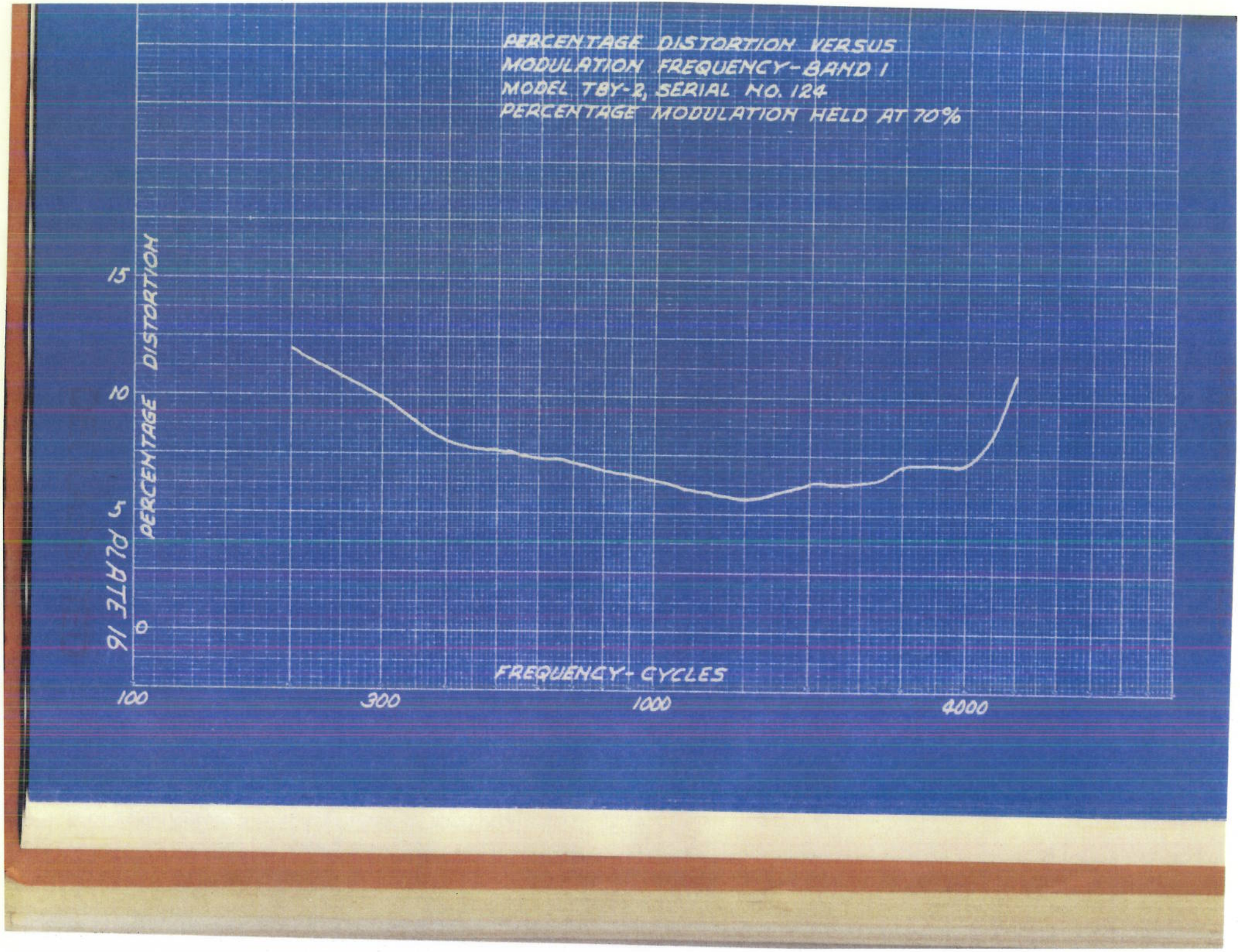

VOLTAGE INPUT VERSUS PERCENTAGE
MODULATION - BAND 4
MODEL TBY-2, SERIAL NO. 124
1000 CYCLES
INPUT VOLTS
.2
.4
.6
.8
1.0
1.2

PLATE 13


PERCENTAGE DISTORTION VERSUS
MODULATION FREQUENCY- BAND I
MODEL TBY-1, SERIAL NO. 642
PERCENTAGE MODULATION HELD AT 70 %
PERCENTAGE DISTORTION
15
10
5
0
FREQUENCY- CYCLES
100
300
1000
4000
PLATE 14


PERCENTAGE DISTORTION VERSUS
MODULATION FREQUENCY
MODEL TBY-1, SERIAL NO. 642
PERCENTAGE MODULATION HELD AT 70%
PERCENTAGE DISTORTION
15
10
5
0
DECIBELS
FREQUENCY-CYCLES
100
300
1000
4000


PERCENTAGE DISTORTION VERSUS
MODULATION FREQUENCY - BAND 1
MODEL T8Y-2, SERIAL NO. 124
PERCENTAGE MODULATION HELD AT 70%
PLATE 16
PERCENTAGE DISTORTION
15
10
5
0
FREQUENCY - CYCLES
100
300
1000
4000

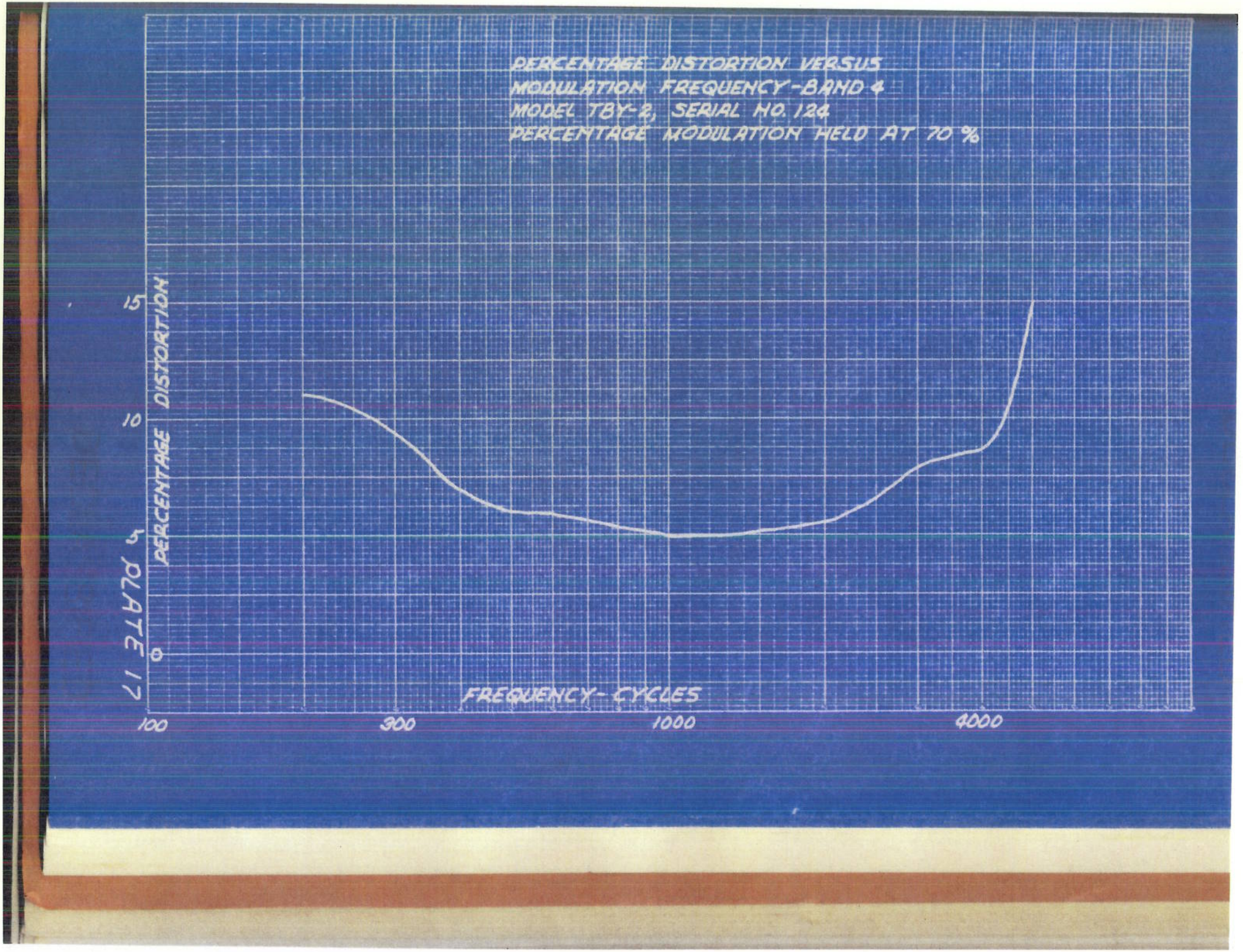

PERCENTAGE DISTORTION VERSUS
MODULATION FREQUENCY - BAND 4
MODEL TBY-2, SERIAL NO. 124
PERCENTAGE MODULATION HELD AT 70 %
PERCENTAGE DISTORTION
15
10
5
0
FREQUENCY - CYCLES
100
300
1000
4000

PLATE 17

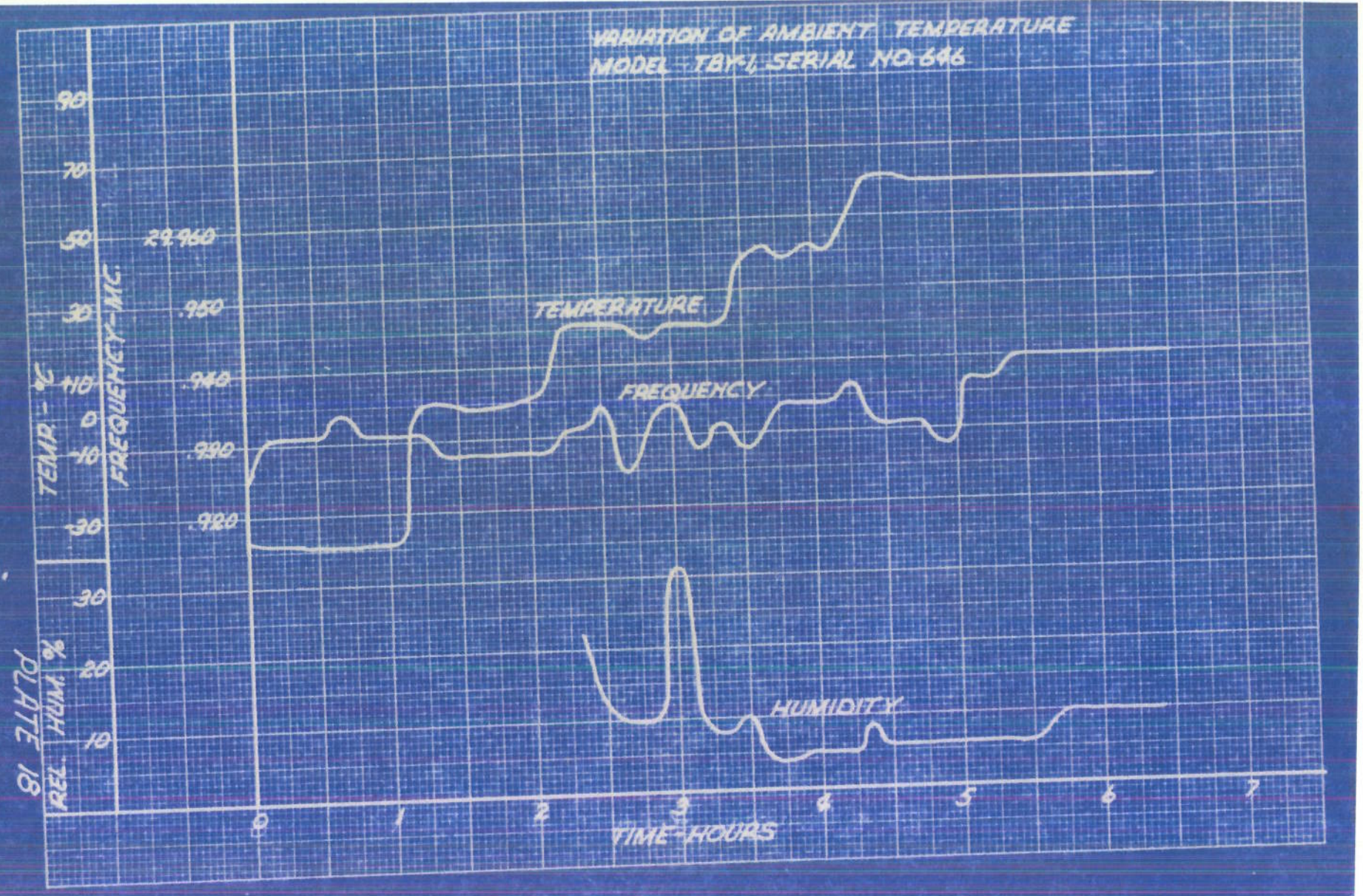

VARIATION OF AMBIENT TEMPERATURE
MODEL - TBY-4, SERIAL NO. 646
TEMPERATURE
FREQUENCY
HUMIDITY
TEMP. - °C
FREQUENCY - MC.
REL. HUM. %
TIME - HOURS
90
70
50
30
10
0
-10
-30
29.960
.950
.940
.930
.920
30
20
10
0
1
2
3
4
5
6
7

PLATE 18

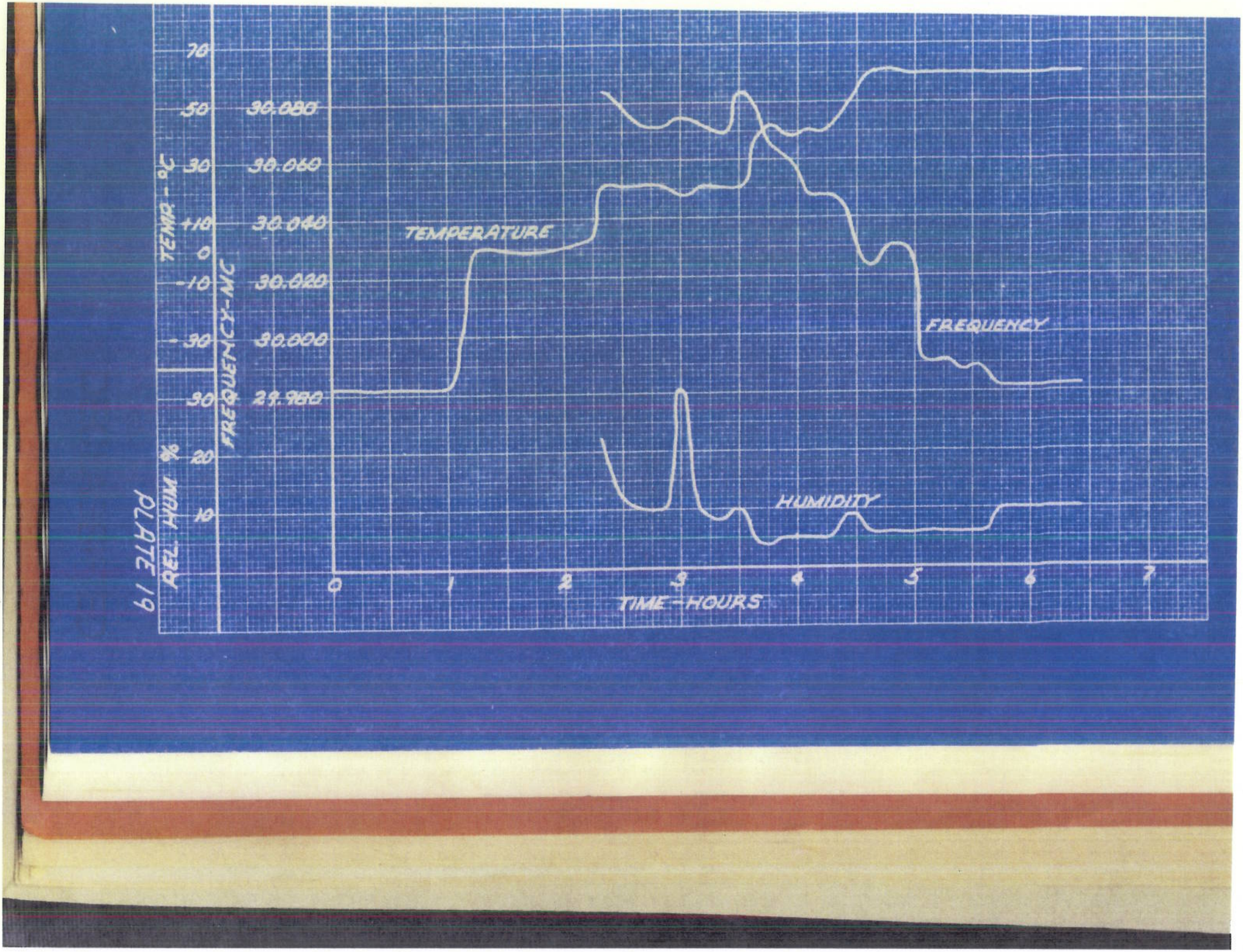
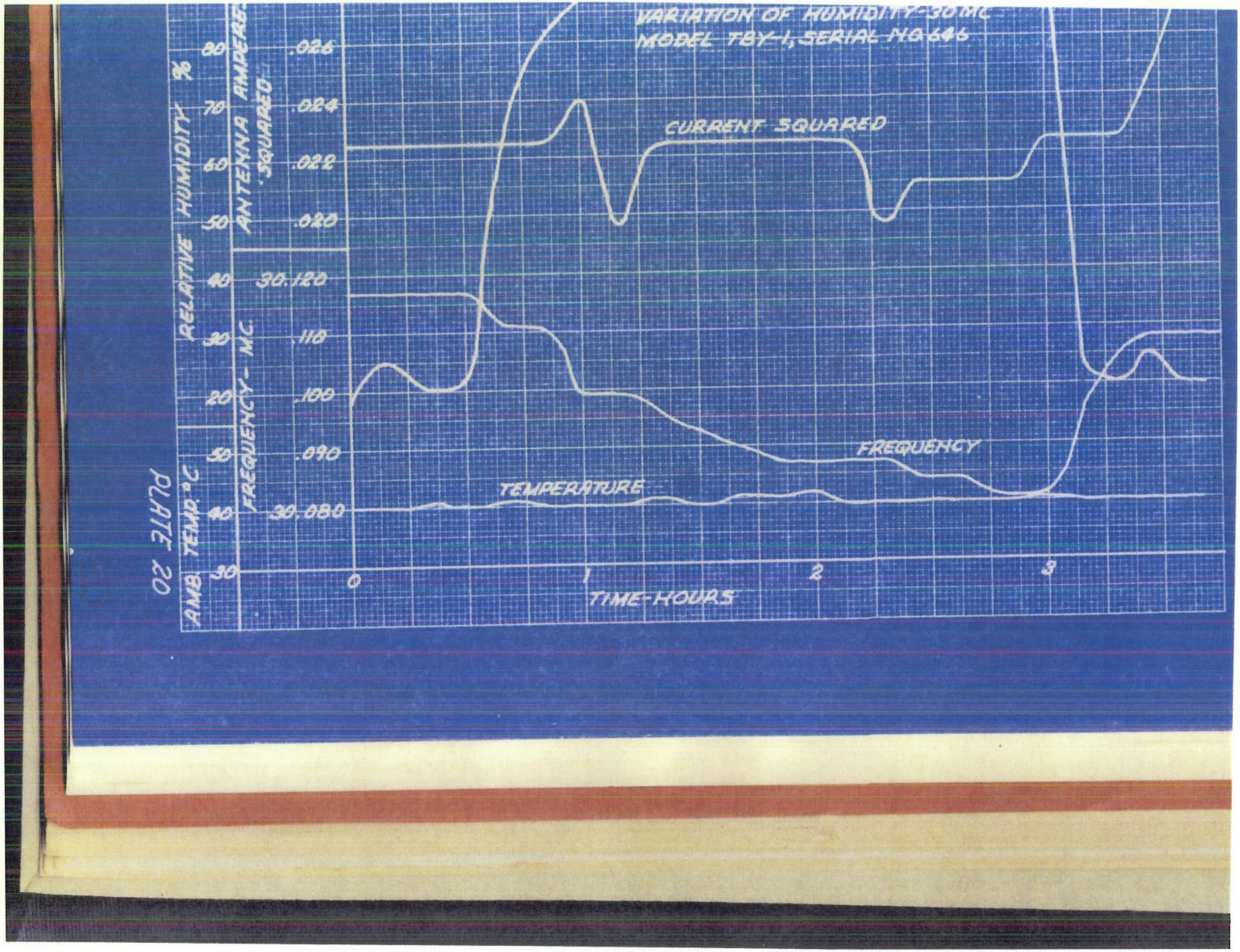
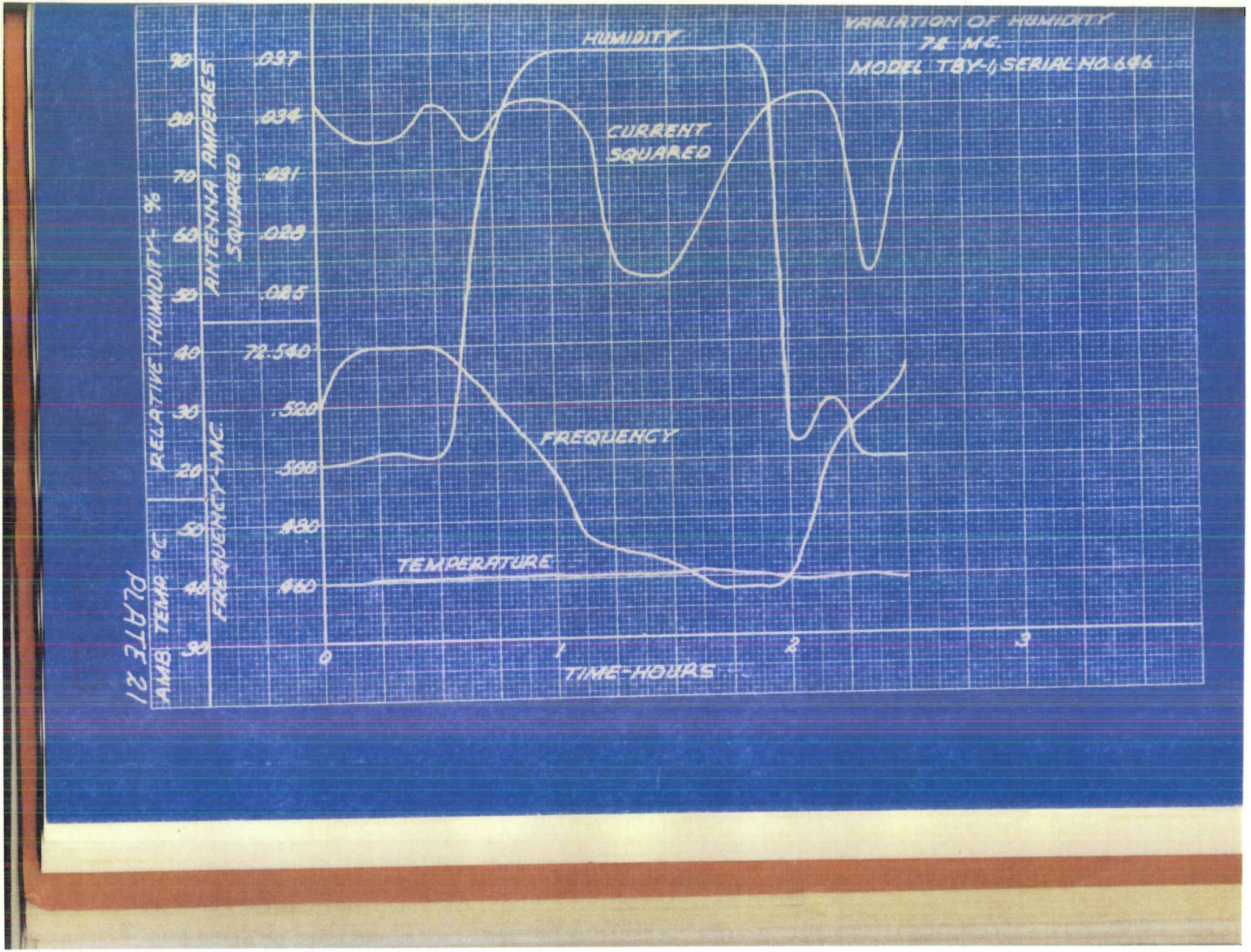


PLATE 19
REL. HUM. %
TEMP. - °C
FREQUENCY-MC
70
50
30
+10
0
-10
-30
30
20
10
30.080
30.060
30.040
30.020
30.000
29.980
TEMPERATURE
FREQUENCY
HUMIDITY
0
1
2
3
4
5
6
7
TIME-HOURS


VARIATION OF HUMIDITY-30 MC
MODEL TBY-1, SERIAL NO. 646
CURRENT SQUARED
FREQUENCY
TEMPERATURE
TIME-HOURS
AMB. TEMP. °C
RELATIVE HUMIDITY %
FREQUENCY - M.C.
ANTENNA AMPERAGE SQUARED
PLATE 20


VARIATION OF HUMIDITY
72 MC.
MODEL TBY-1, SERIAL NO. 646
HUMIDITY
CURRENT SQUARED
FREQUENCY
TEMPERATURE
TIME-HOURS
RELATIVE HUMIDITY %
AMB. TEMP. °C
ANTENNA AMPERES SQUARED
FREQUENCY-MC.
PLATE 21

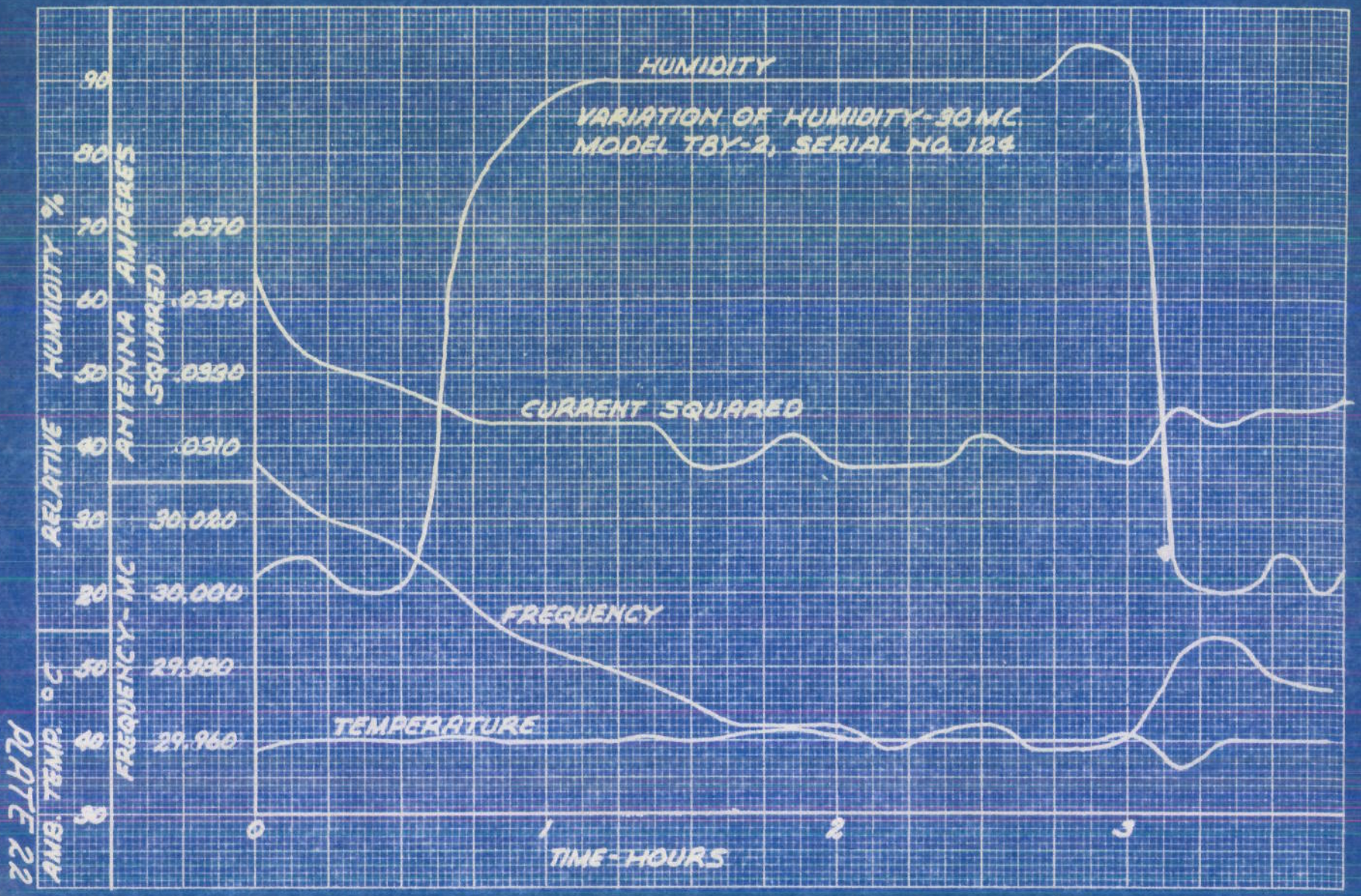
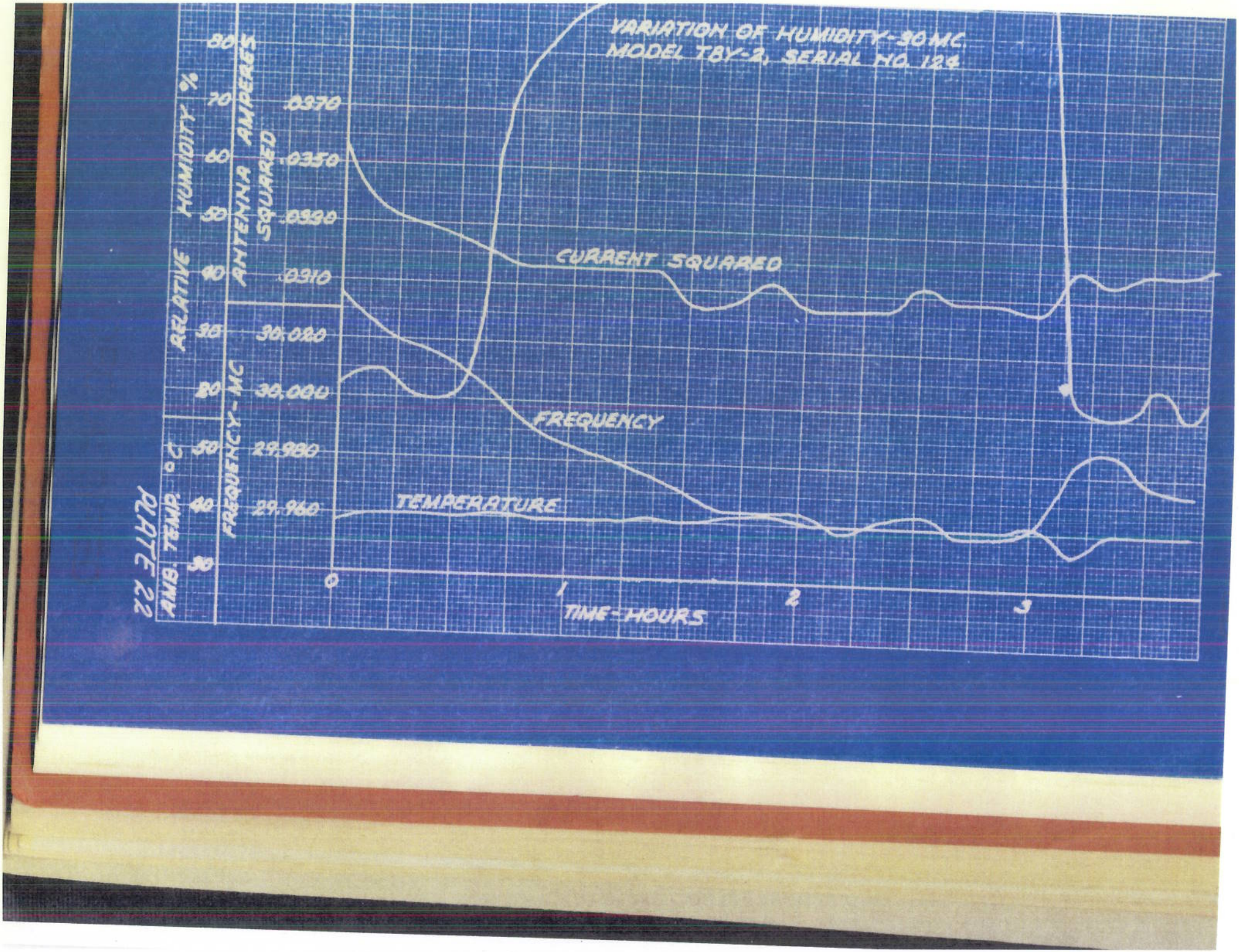
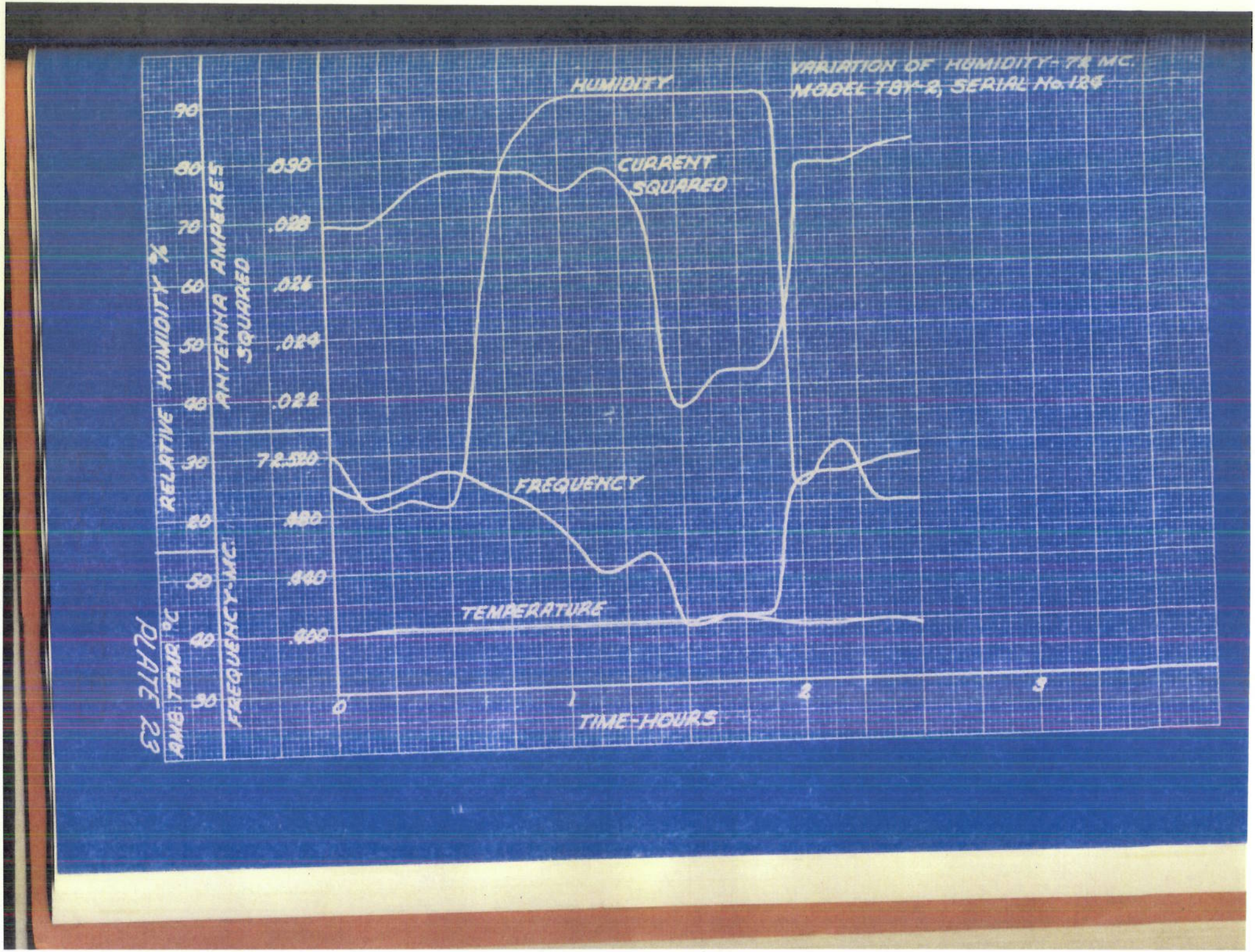

VARIATION OF HUMIDITY-30 MC.
MODEL TBY-2, SERIAL NO. 124
HUMIDITY
CURRENT SQUARED
FREQUENCY
TEMPERATURE
RELATIVE HUMIDITY %
ANTENNA AMPERES SQUARED
FREQUENCY - MC
AMB. TEMP. °C
90
80
70
60
50
40
30
20
50
40
30
.0370
.0350
.0330
.0310
30.020
30.000
29.980
29.960
0
1
2
3
TIME - HOURS

PLATE 22


VARIATION OF HUMIDITY-30 MC.
MODEL TBY-2, SERIAL NO. 124
RELATIVE HUMIDITY %
80
70
60
50
40
ANTENNA AMPERES SQUARED
.0370
.0350
.0330
.0310
FREQUENCY-MC
30.020
30.000
29.980
29.960
AMB. TEMP. °C
50
40
30
CURRENT SQUARED
FREQUENCY
TEMPERATURE
0
1
2
3
TIME-HOURS
PLATE 22


VARIATION OF HUMIDITY- 72 MC.
MODEL TBY-2, SERIAL No. 126
HUMIDITY
CURRENT SQUARED
FREQUENCY
TEMPERATURE
RELATIVE HUMIDITY %
ANTENNA AMPERES SQUARED
FREQUENCY-MC.
AMB. TEMP. °C
TIME-HOURS
PLATE 23

KILOCYCLES CHANGE PER DIAL DIVISION
VERSUS
INCREMENTAL DIAL SETTING
TRANSMITTER-MODEL TBY-2, SERIAL NO. 124

X'S INDICATE PORTION OF DIAL IN USE
DURING NORMAL OPERATION

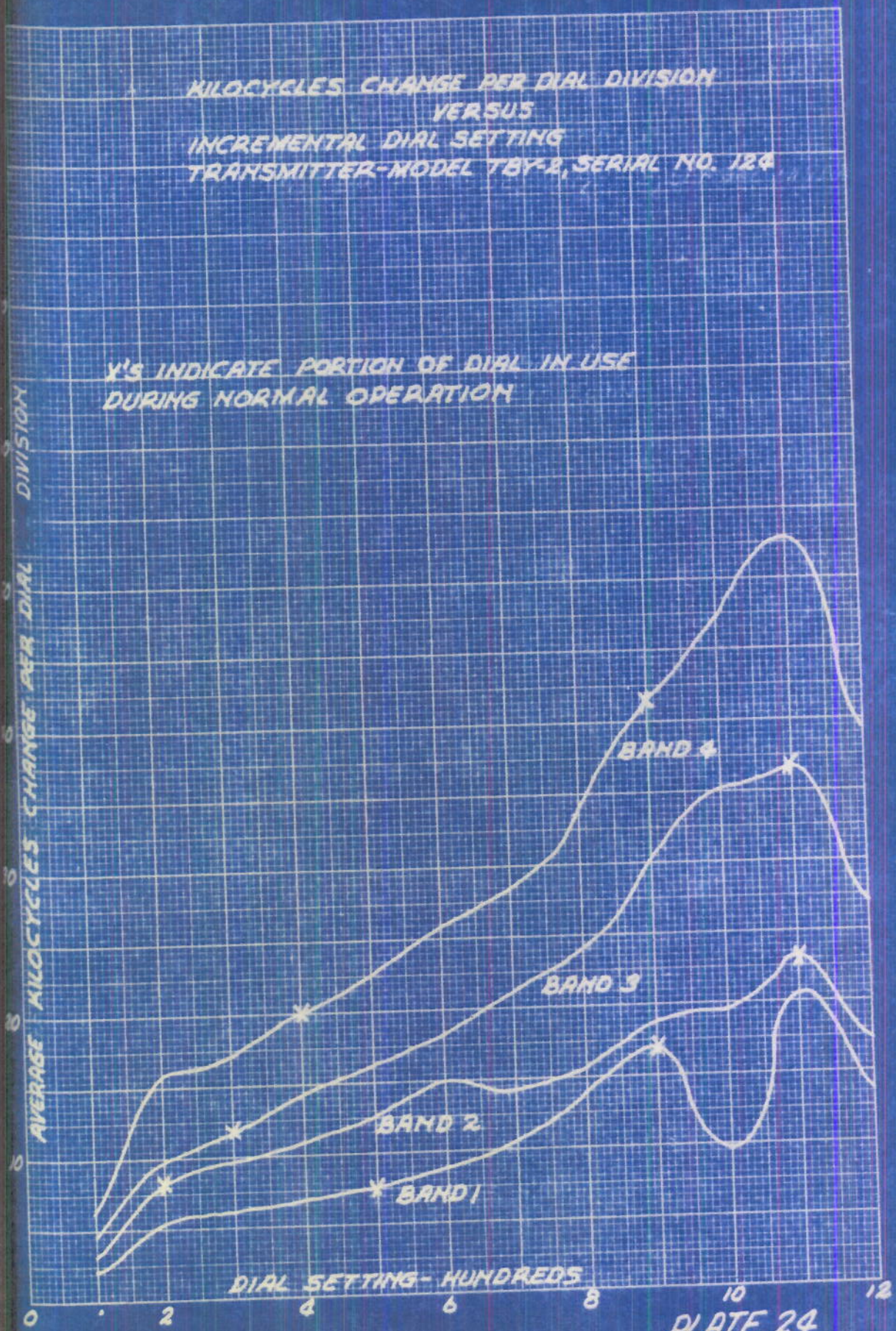


PLATE 24

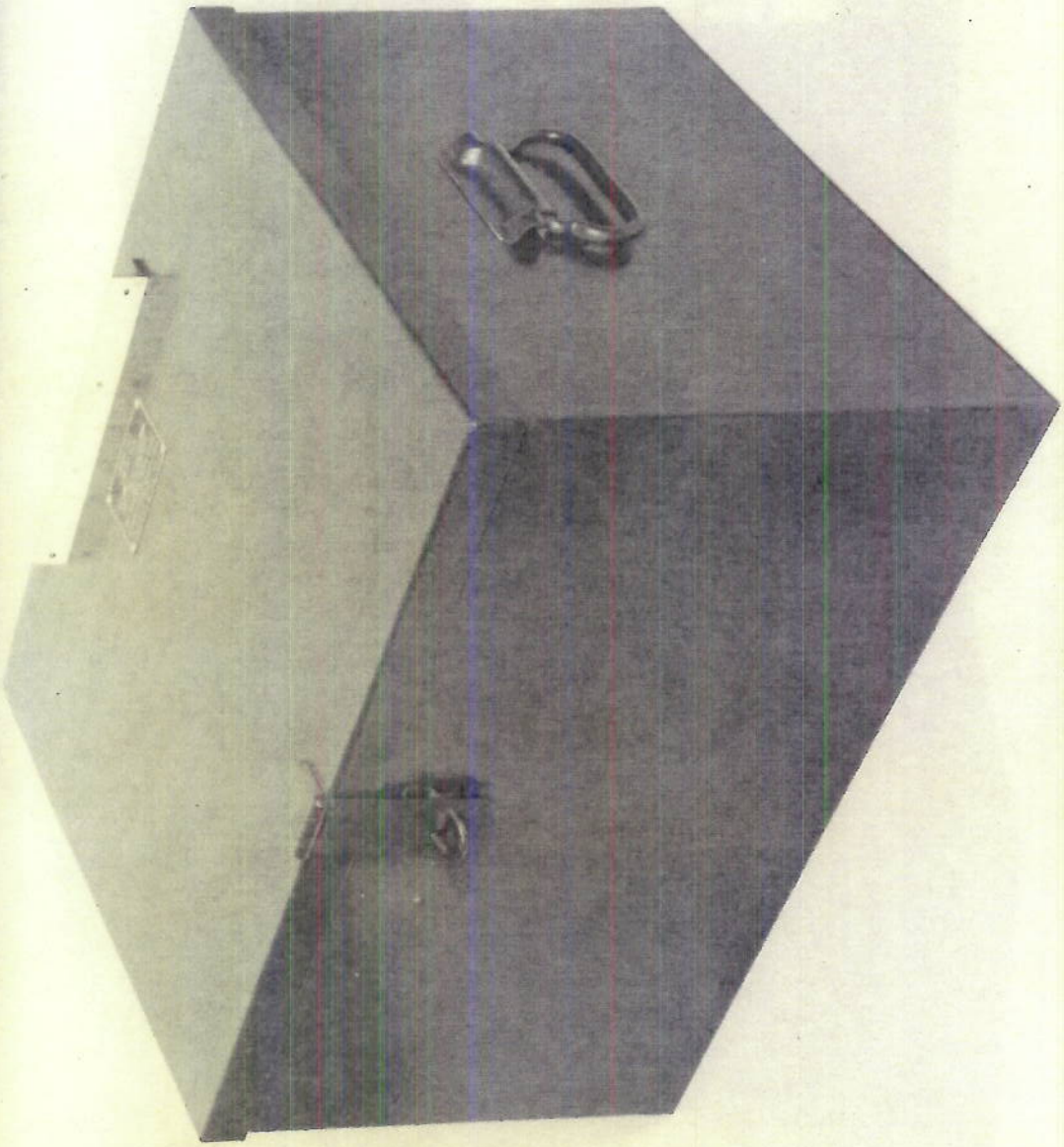


PLATE 25

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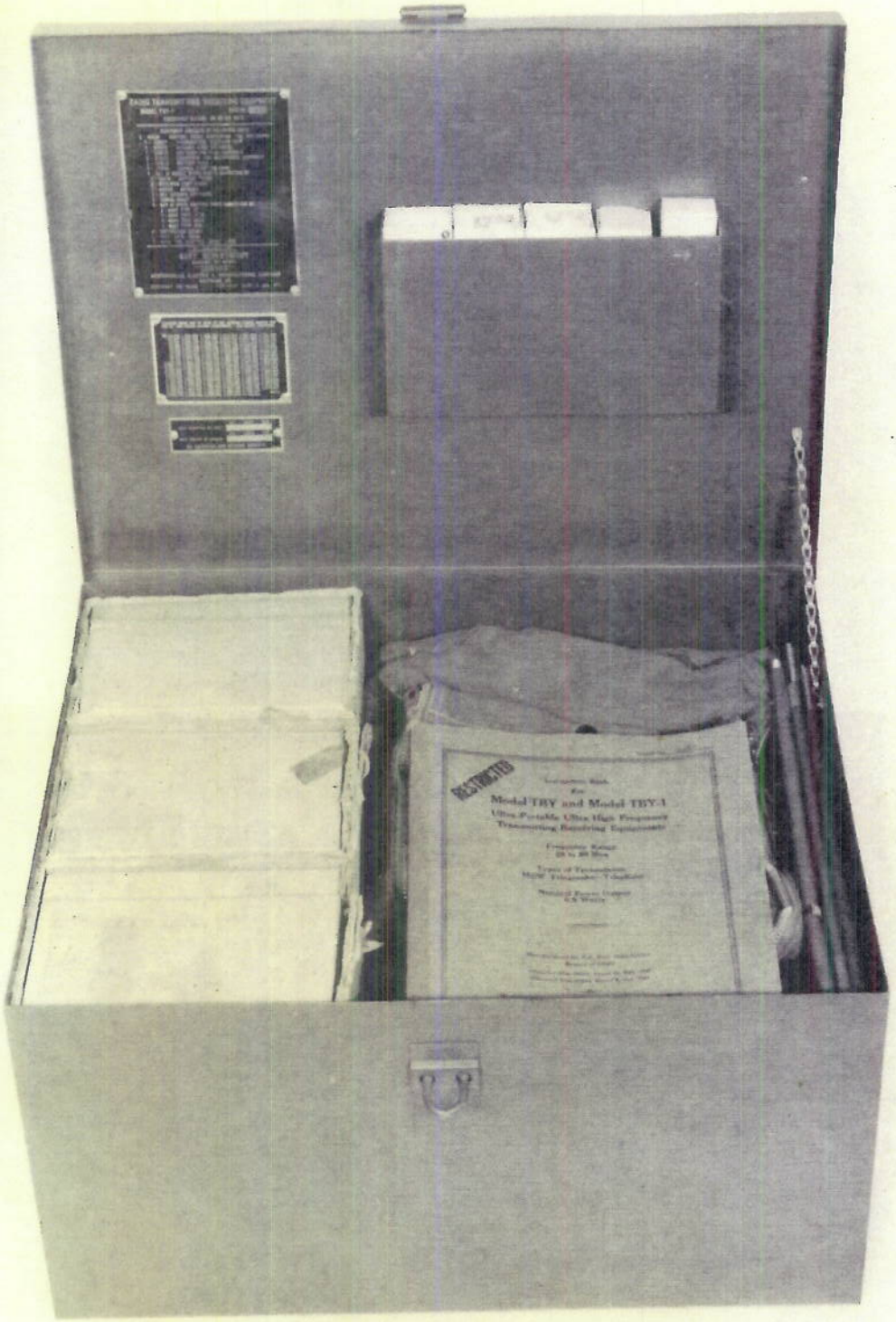

PLATE 26

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DECLASSIFIED

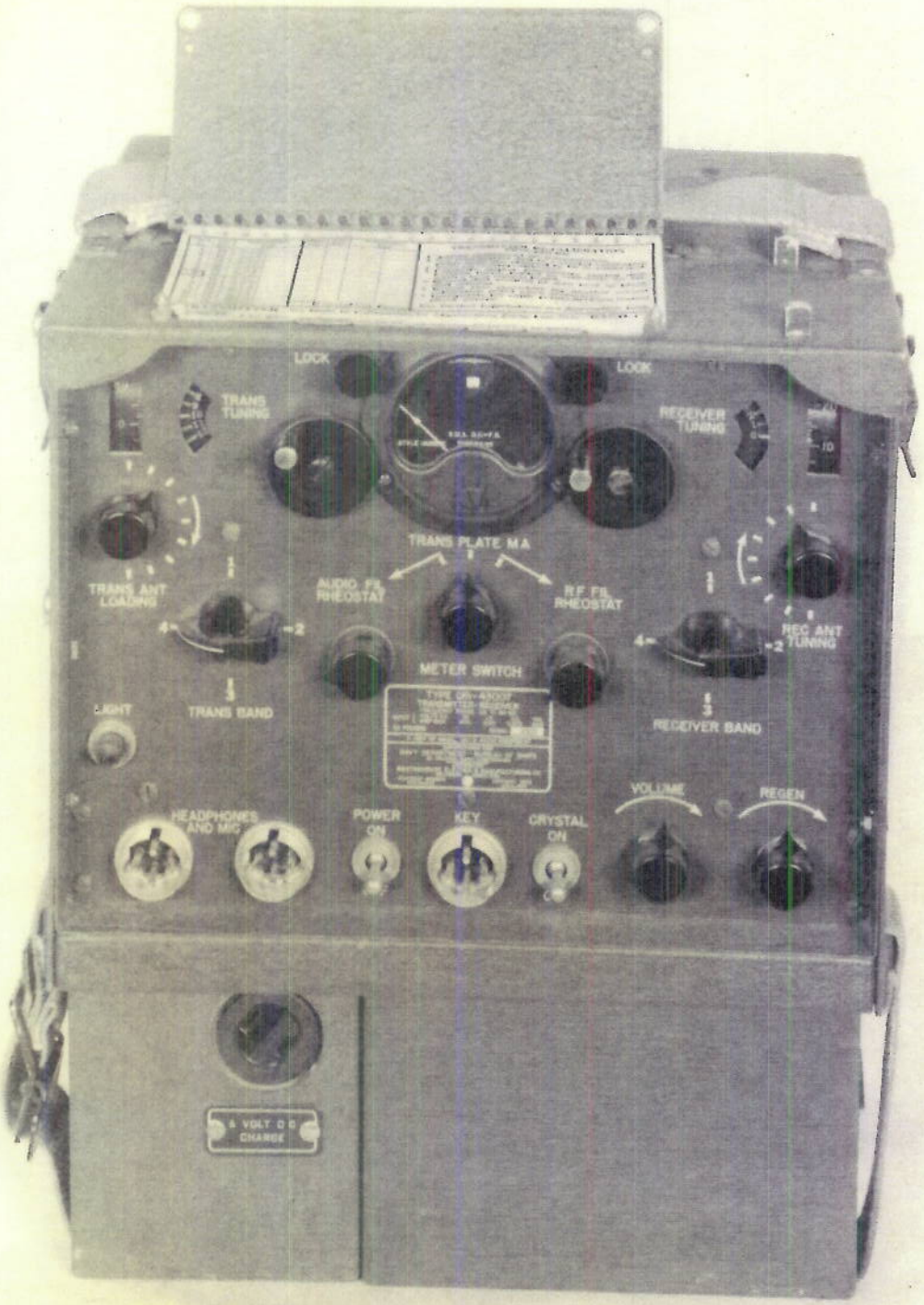

PLATE 27

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DECLASSIFIED

PLATE 28

DECLASSIFIED

PLATE 29

DECLASSIFIED

PLATE 30

DECLASSIFIED

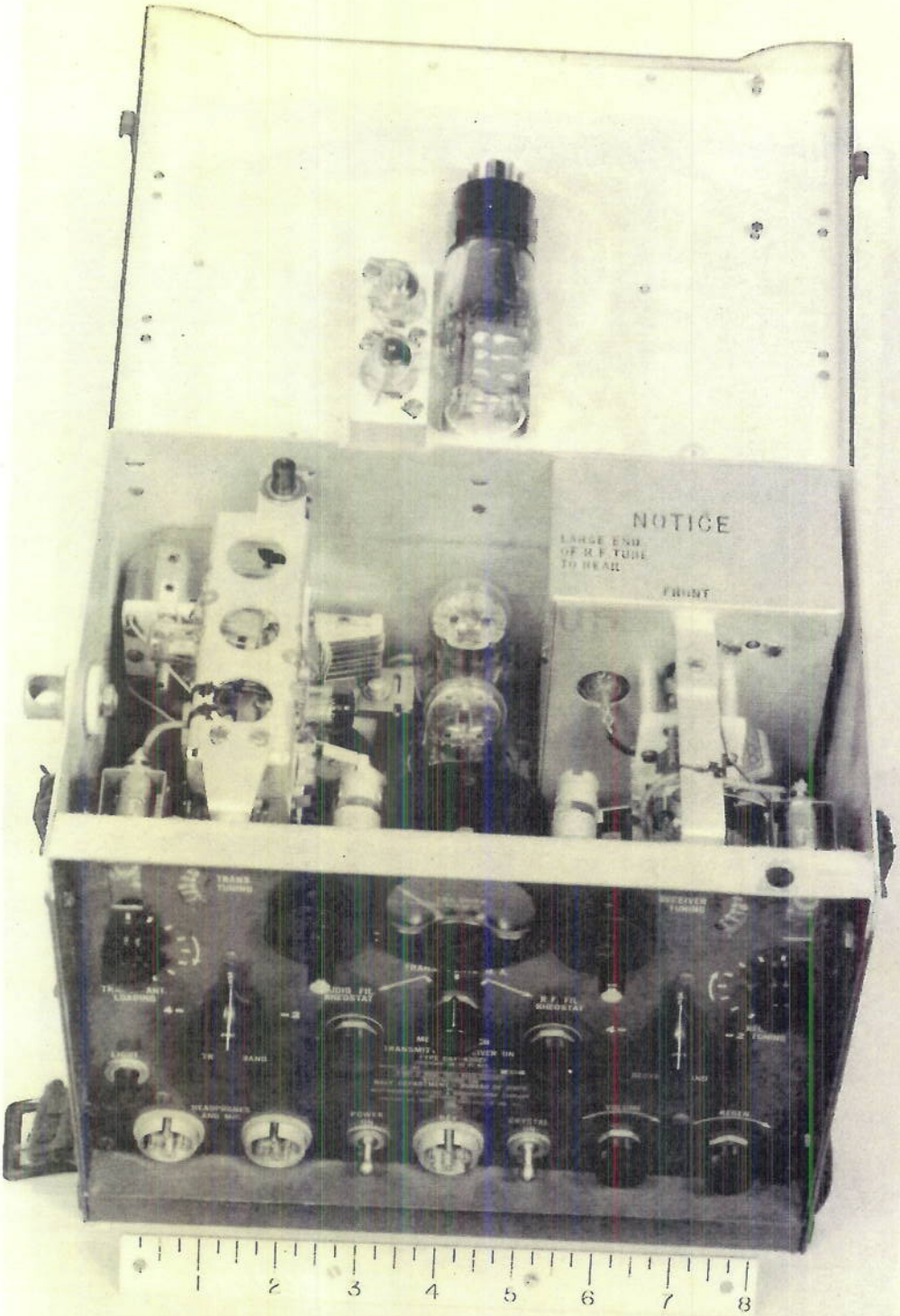

PLATE 31

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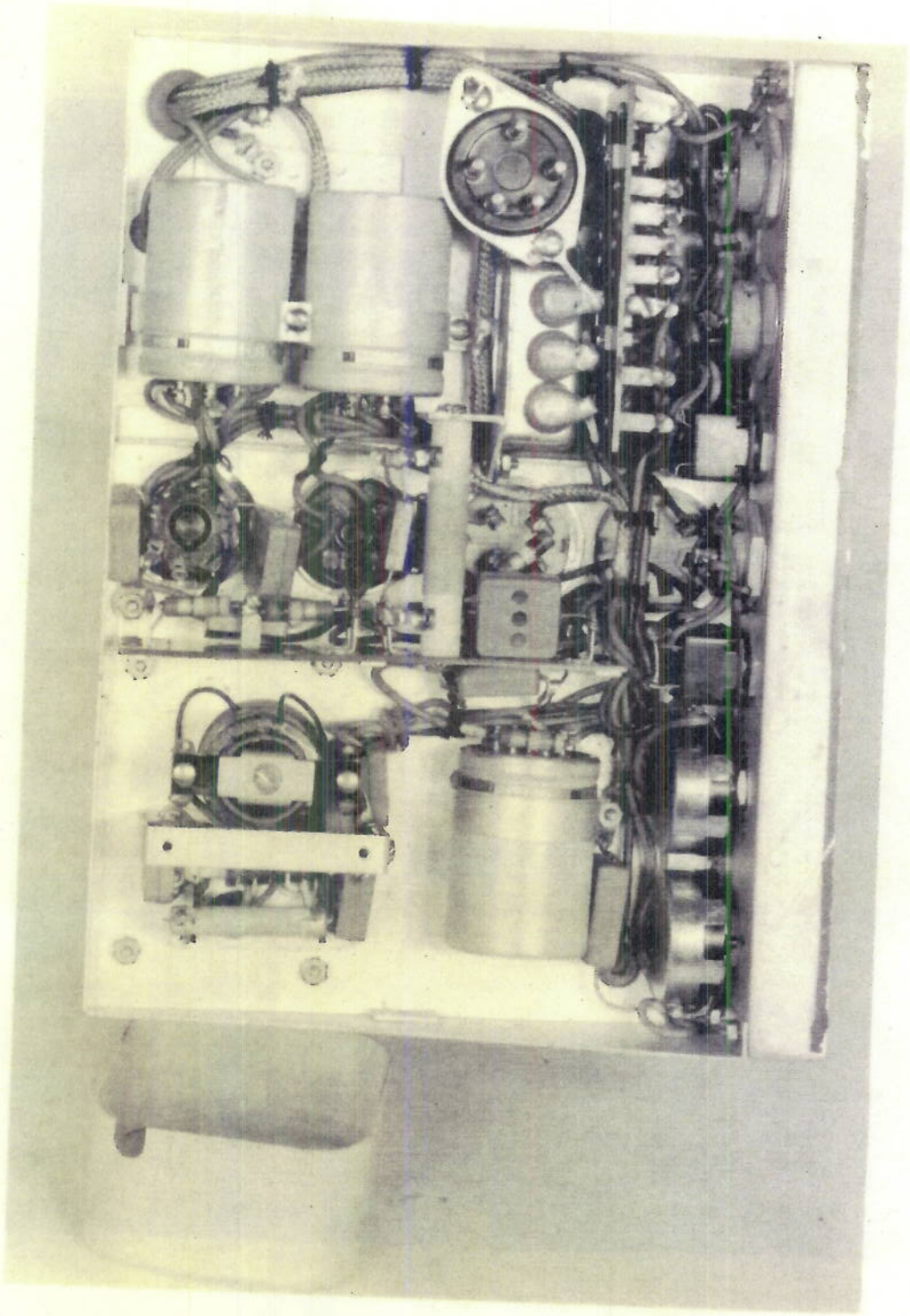

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PLATE 32

DECLASSIFIED

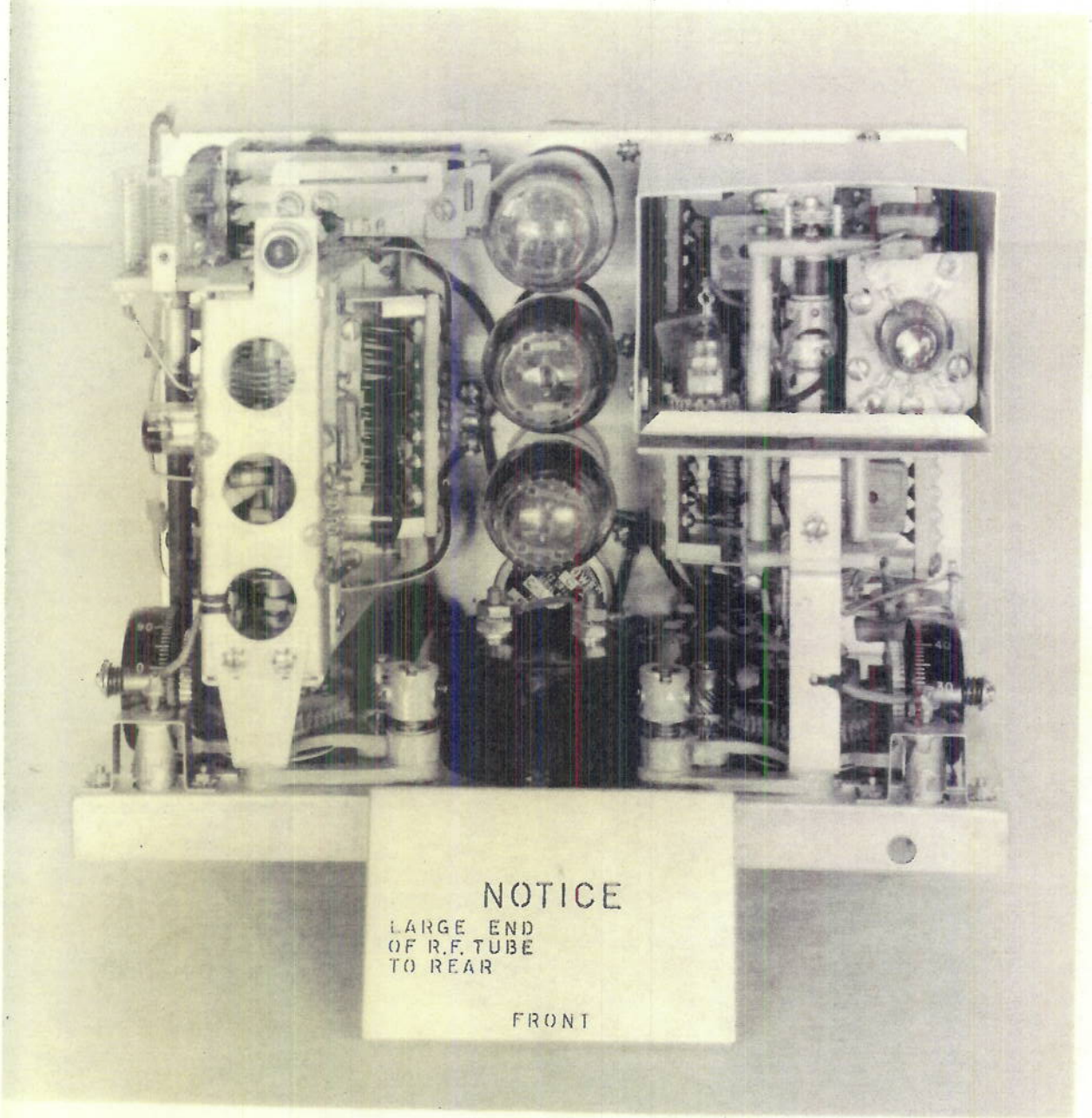

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PLATE 33

DECLASSIFIED

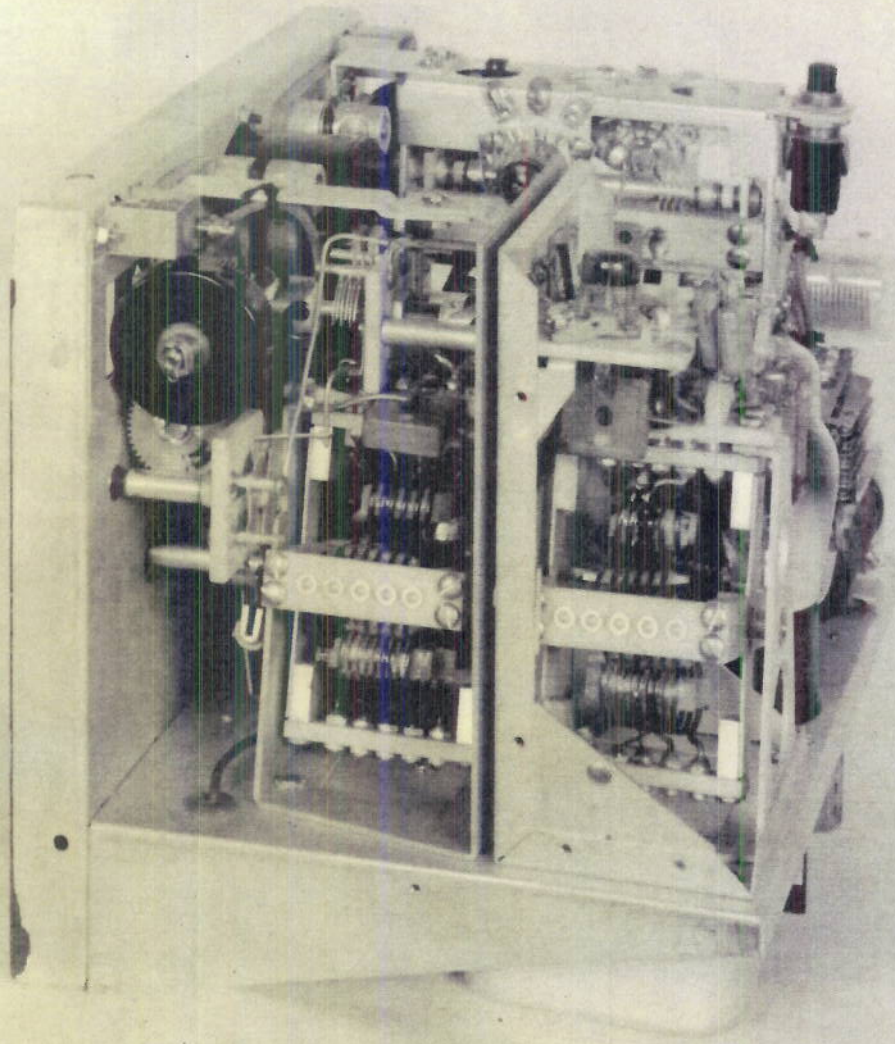

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PLATE 34

DECLASSIFIED

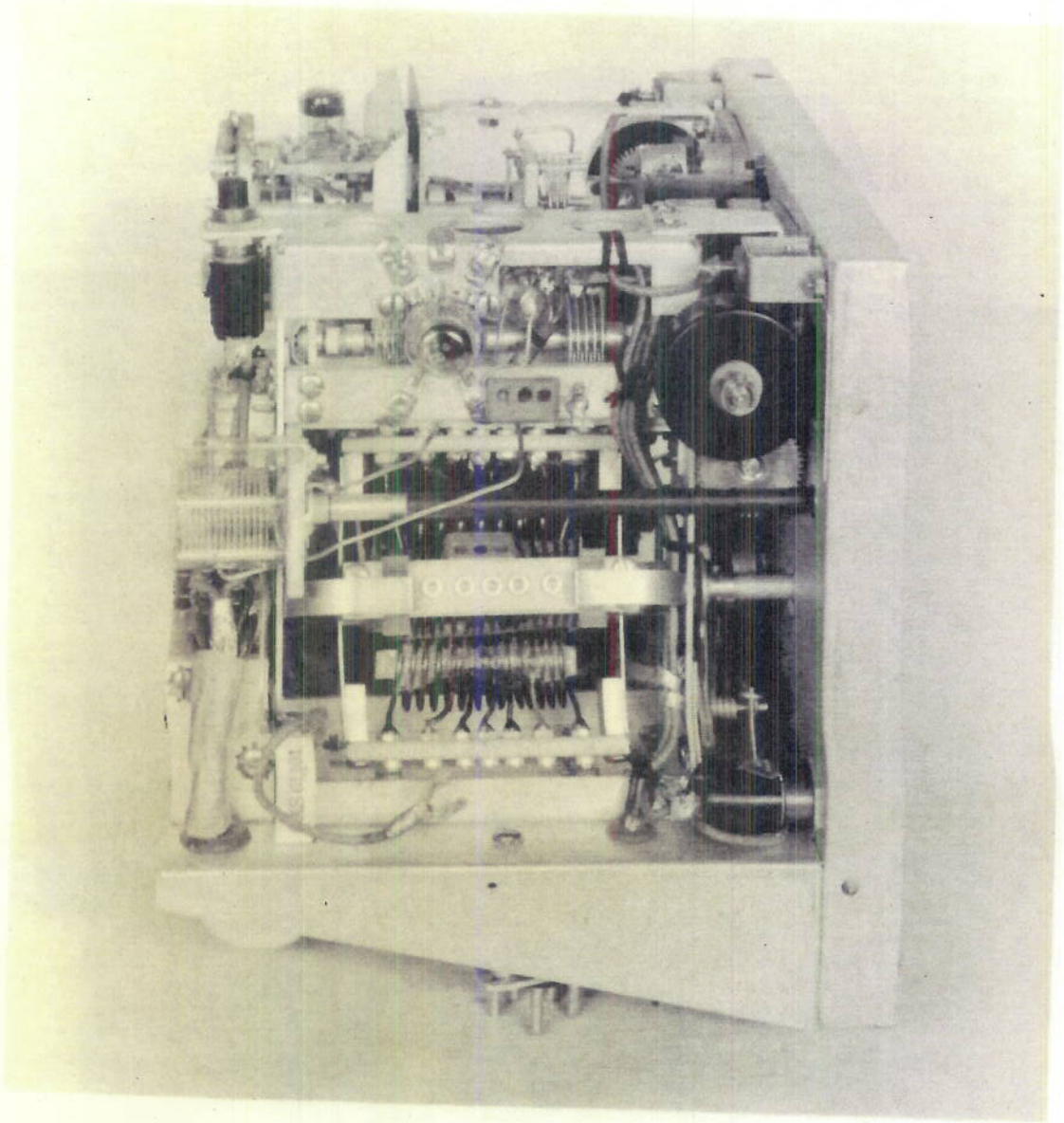

PLATE 35

DECLASSIFIED

DECLASSIFIED

DECLASSIFIED

PLATE 36

DECLASSIFIED

PLATE 37

DECLASSIFIED

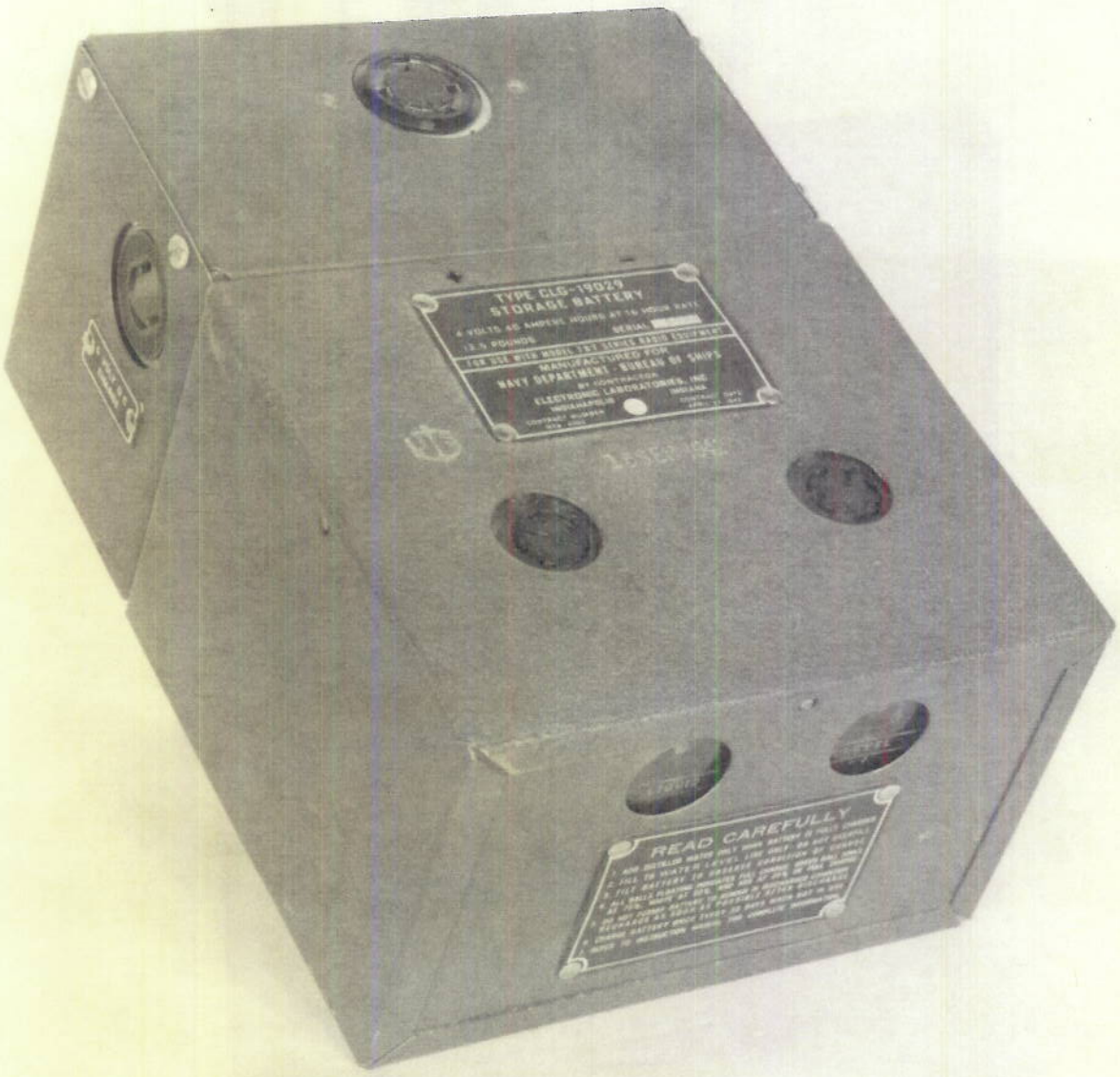

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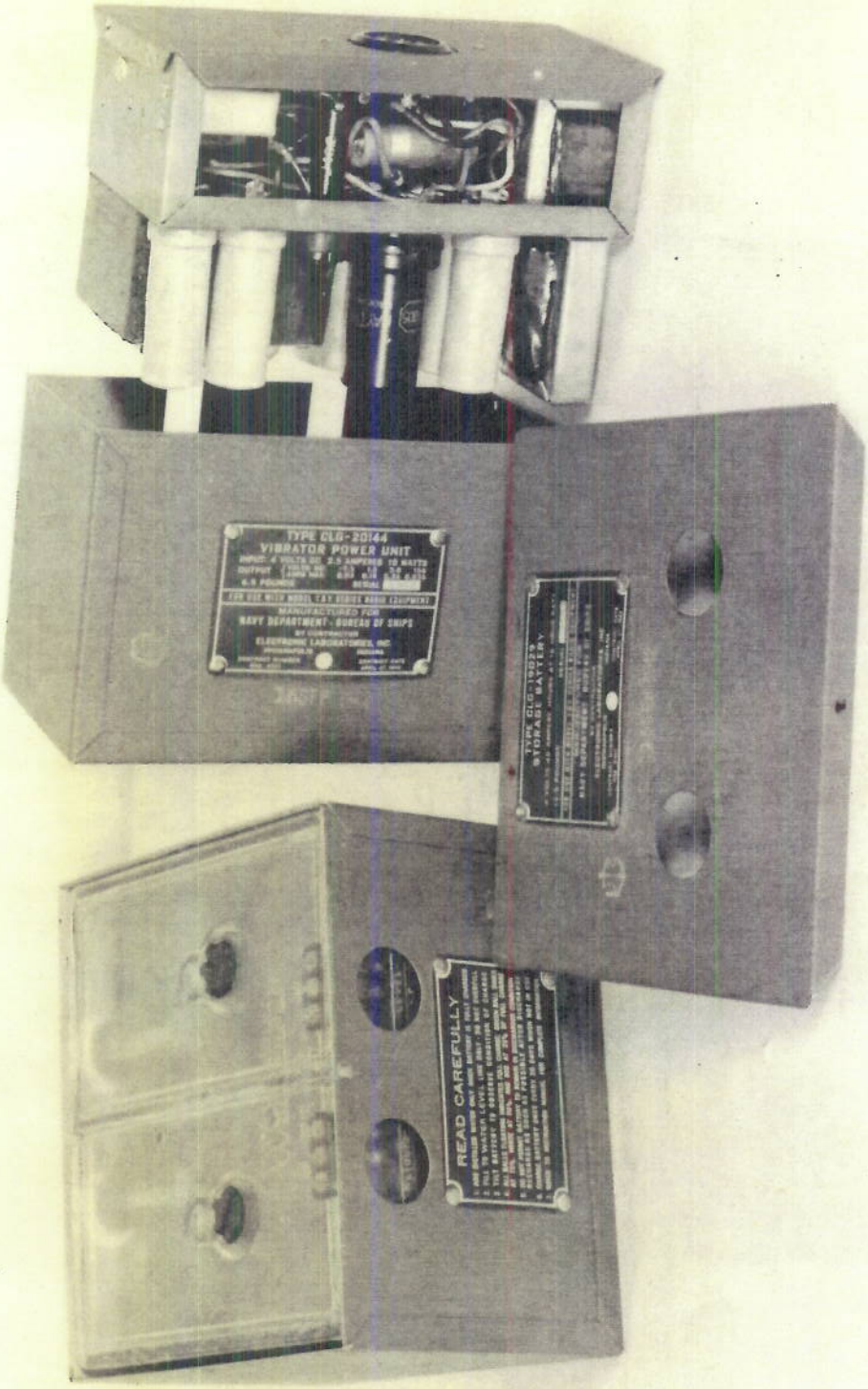
PLATE 38

DECLASSIFIED



DECLASSIFIED
LIBRARY
NAVAL RESEARCH LABORATORY

PLATE 39

DECLASSIFIED

DECLASSIFIED

PLATE 40

DECLASSIFIED

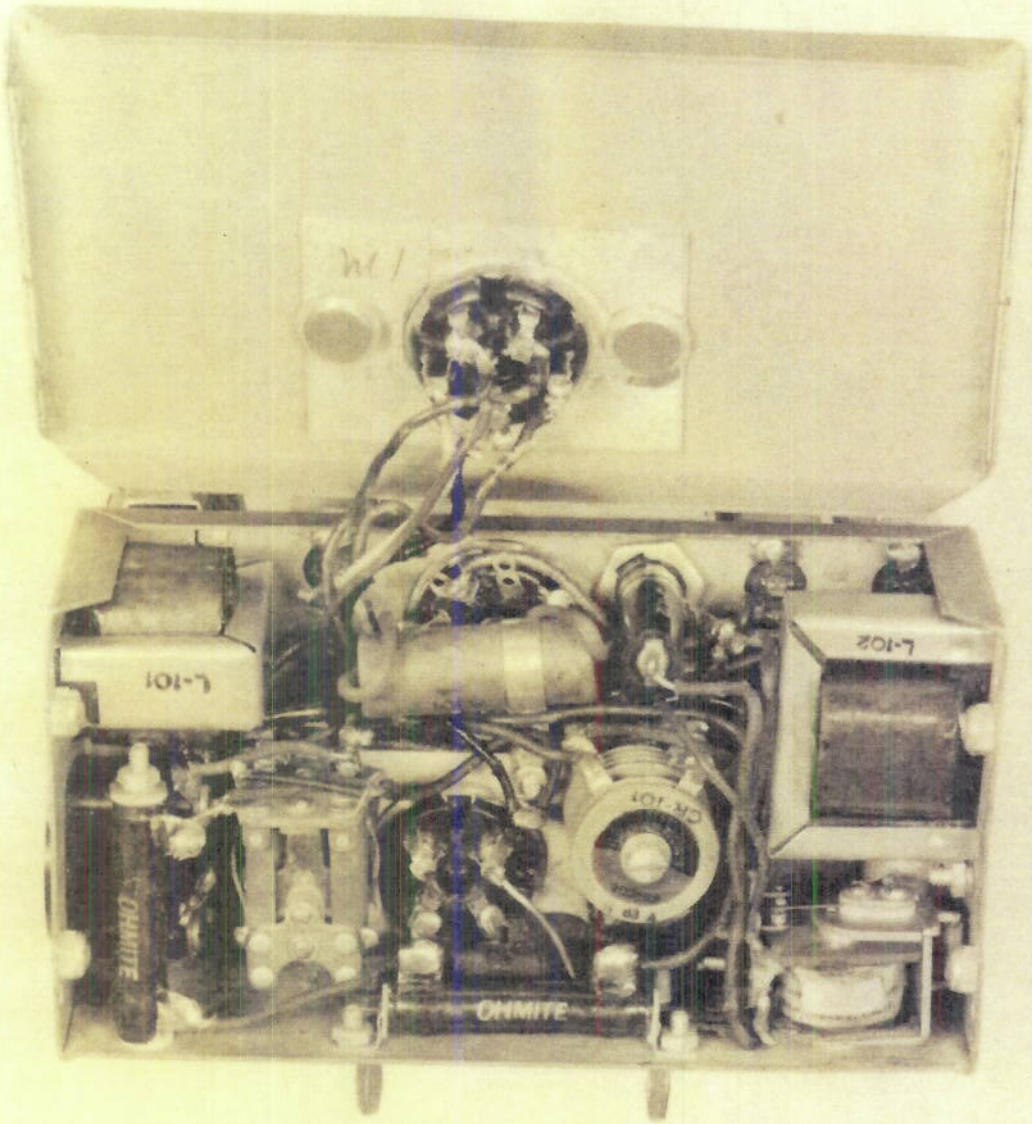


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PLATE 41