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REPORT NO. R-1366

DATE 20 May 1937

SUBJECT

Test of Preliminary Models

of

Model XTBR-1 Receiving Equipment

FR-1366

[redacted]

BY

NAVAL RESEARCH LABORATORY

BELLEVUE, D. C.

[redacted]

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Appendices

AUTHORIZATION

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

Reference: (a) BuEng let.C-NOs-48078(12-1-W8) of 7 December 1936.
(b) BuEng Specifications RE 13A 500B.
(c) Contract NOs-48078 dated 28 April 1936 with contract notes.
(d) Contractor's descriptive specifications AS-P20714-B (issued 2 March 1936 by RCA Mfg. Co. through contractor)
(e) NRL Report No. R-1140
(f) INM Philadelphia let.L4-3/41370 of 20 Nov. 1936 to BuEng.
(g) BuS&A let.NOs-48078(SPM) of 17 July 1936 to General Electric Company.
(h) BuEng let.C-NOs-48078(7-2-W7) of 16 July 1936 to BuS&A.
(i) INM Schenectady let. C-48078 of 29 Oct.1936 to General Electric Company.

OBJECT OF TEST

2. The object of the test was to determine compliance with specifications, reference (b), of one Type CRV-46053 receiver and one Type CRV-20053 receiver power unit, as a complete receiving equipment and a part of the Model XTBR-1 equipment as a whole.

ABSTRACT OF TEST

3. The equipment was given the usual general inspection of mechanical construction, parts and wiring. The electrical tests for compliance with specifications, reference (b), are listed below:

(a) Sensitivity,a.c. and d.c. operation.
(b) Selectivity, optimum and reduced gain.
(c) Maximum noise level.
(d) Resonant overload.
(e) Audio frequency characteristics.
(f) Automatic volume control.
(g) Manual volume control.
(h) Frequency stability.
(i) Time constants.
(j) Load impedance characteristics.
(k) Effect of moving platform and vibration.
(l) Measurement of variable capacitors.
(m) Frequency wobbler range.
(n) Resettability.
(o) Overload selectivity.
(p) Operation during ambient temperature variation.
(q) 72-hour humidity test.
(r) Dynamotor heating.

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Conclusions

The subject receiver is essentially a Model RAL receiver with modifications to adapt it to the Model XTBR-1 equipments. The modifications consist essentially of the provision of a protective panel cover for the receiver with a rubber gasket between the panel and case, and dynamotors in the power unit for d.c. operation.

The cover furnished, however, affords mechanical protection only, the only special provision for spray proofing being the gasket between the panel and case of the receiver. The panel controls are not protected from spray, and eleven of the controls enter the panel with a slip fit, which would probably protect the inside of the receiver from occasional applications of spray, but not from any considerable amount of water. The power unit is definitely not spray proof, due to the perforations in the case for ventilation.

Construction throughout is mostly similar to the Model RAL, and the workmanship is good with slight exceptions which are commented on by the manufacturers, who state that it is not up to the degree of excellence which may be expected in production. Some improvement in the accessibility of parts is noted over the Model RAL.

In electrical performance, all specification requirements are met with but one possible minor exception as regards attenuation characteristics, which may or may not be considered a defect, depending upon the interpretation of the specifications. It is, in general, very similar to the Model RAL.

Failure of the receiver to operate after the 72-hour humidity test is believed to be due to breakdown of the rubber insulation on the high frequency leads, satisfactory operation being obtained after the second 72-hour test, when these leads were cleared.

There is some question as to the degree of water proofing required for this equipment. It is probable that with suitable canvas covers it can be considered spray proof. With the covers removed, it definitely could not be exposed to rain or spray without injury.

[redacted]

Recommendations

It is recommended:

(a) That future specifications covering similar equipment require that receiver blocking not occur with less than 1.0 volt input at the antenna terminals.

(b) That the receiver and power unit not be considered rain or spray proof with the protective cover removed and that the power unit not be considered spray proof under any conditions unless some form of complete covering is furnished.

(c) That the proposed canvas covers be submitted for inspection and test to determine their suitability for the purpose intended.

(d) That means be provided in the power unit to prevent injury of the ballast lamp from such vibration and shock as may be expected from transportation.

(e) That in view of the reported ineffectiveness of the taper pin method of securing tuning condenser rotor plate assemblies to the drive shaft, the manufacturer be instructed to supplement the pins with set screws as proposed by the Inspector of Naval Material, Philadelphia, but in view of the thin wall into which these set screws fit, extra vigilance should be exercised by the inspector to assure that the screws are tight and that the threads are not stripped.

(f) That the flat springs which contact the rotor assemblies of the main tuning condenser be of bi-metal construction as proposed by the manufacturer's representative and that the contacting face be of silver not less than .015" thick.

(g) That the gasket between the panel and cabinet be redesigned to give greater resiliency and compression and that the method of securing this gasket be improved so that it will not interfere with its effectiveness.

(h) That a higher standard of workmanship as regards soldering and wiring be required in production equipment.

(i) That the detector coil for bands 1, 2, and 3 be more thoroughly wax coated in production equipments.

(j) That the sheet metal parts of the chassis be free from plugged holes such as displayed by the model and indicate remodeling and patching.

(k) That the calibrated indicator dials on the main tuning control be provided with suitable clearance so as to assure that chafing will not occur to the extent that the calibration will be injured from continued operation.

[redacted]

(l) That the shield cans covering the coils be so designed that there be ample clearance between the two threaded parts so removal and replacement can be accomplished without such friction as will damage the plating on the threaded area; and that the contact obtained by bottoming the can on its receptacle or the chassis be depended upon for electrical conductivity instead of contact on the threaded area.

(m) That the several magnetic parts used in the construction of the main tuning condenser as mentioned in par. 4-6 be made of non-corrosive metal.

(n) That all parts be marked with Navy and/or manufacturer's type numbers in accordance with the governing specifications.

(o) That all tube sockets be properly and permanently marked to indicate the type of tube required for operation.

(p) That lock washers be furnished on all nuts in accordance with par. 4-16 of the governing specifications.

(q) That the rubber sleeving used on the bus wires running from the band change switch to the coil terminals be considered as unsatisfactory and that samples of the proposed substitute be forwarded to the Naval Research Laboratory for test and approval before use in production.

(r) That attention be given to the band switch, particularly on the higher frequency bands to assure precise positioning both by the clicker and of the contacts themselves for each engraved position.

(s) That anti-glare glass be furnished on the main tuning indicator window.

(t) That in view of the fact that this receiver, and its predecessor, the Model RAL, employ trimmer condensers depending upon bearing contact, the Bureau pass judgment as to the reliability of such contacts based upon reports from the Service on the performance of the Model RAL.

(u) That a more reliable method be employed for securing the ceramic insulated antenna binding posts to the panel to assure that they will not become loosened from ordinary service use.

(v) That consideration be given to the fact that the type P-72014-G 501 capacitors and the type CDH 63184 resistors failed on the salt water immersion tests. (Replacement units have been submitted and are now being tested.)

(w) That the Bureau furnish an interpretation with regard to the specifications (par. 6-48) as regards the required characteristics of the audio attenuators. (See par. 6-48 and Plate 33.)

(x) That a protective projection be placed adjacent to the toggle switches on the power unit to prevent injury during transportation when covered by the proposed canvas cover.

[redacted]

(y) That, except for any defects that may develop as a result of the tests not yet completed, this equipment be considered as satisfactory for Naval use after the recommendations as given herein have been accomplished in a manner satisfactory to the Bureau of Engineering.

[redacted]

MATERIAL UNDER TEST

4. The material under test consists of one Model XTBR-1 receiving equipment, serial number 37, and includes the following units:

One Type CRV-46053 Receiver
One Type CRV-20053 Power Unit

The receiver covers a frequency range of 300 kilocycles to 23,000 kilocycles and the equipment is manufactured by the RCA Manufacturing Company, Inc., Camden, New Jersey, sub-contractor of the General Electric Company, Schenectady, New York. The subject equipment was received at the Laboratory on 9 December 1936.

METHOD OF TEST

5. Radio frequency voltages were supplied by a Model LN signal generator, serial number 42 and a Model LC-2 signal generator, serial number 8.

6. Audio frequency voltages were supplied by a General Radio audio oscillator Type 713-A, serial number 141, used in conjunction with a General Radio microvolter Type 546A, serial number 119.

7. Outputs were measured with a rectifier type meter of laboratory construction, serial number 2505; also a General Radio power output meter Type 583A, serial number 16.

8. Capacitances were measured by the use of a General Radio "Q" meter, Type 100-A, serial 177.

9. Sensitivity, selectivity, maximum noise level, and resonant overload were measured using the procedure as outlined in paragraphs 7-7 to 7-10 inclusive of the specifications, reference (b). Overload selectivity was measured in accordance with procedure outlined in par. 7-11 of specifications, ref.(b). Audio characteristics were measured by removing the detector tube and applying audio frequency voltage across the plate terminal to ground through a blocking condenser and resistor of a value equivalent to the plate resistance of the tube.

10. Measurements were made with the low pass filter in and out; also of the variable frequency attenuator, as required by par. 8-6 of specifications, ref.(b).

11. Manual and automatic volume control characteristics were measured as outlined in pars. 6-53 to 6-69 inclusive of specifications, ref.(b).

12. Frequency stability was measured under various conditions as outlined in pars. 6-31 to 6-37 inclusive of specifications, ref.(b).

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13. Time constants were determined by applying impacts having a maximum amplitude of 5 volts through an electronic relay, to the input of the receiver, in parallel with a radio frequency input from a standard signal generator, the output impedance of the signal generator being suitably isolated from the impact voltage by resistance and capacity coupling. The output of the receiver was viewed on the screen of a cathode ray oscillograph, and the duration of the impact noted as compared with the length of the image produced by the 30 cycle sweep voltage.

14. Load impedance characteristics were measured with a General Radio power output meter.

15. A General Radio interpolation oscillator, Type 617A, serial number 30, was used to measure all frequency variations in the receiver audio outputs.

16. The effect of vibration was determined by mounting the equipment on a stand capable of producing controlled vibrations of various frequencies. Temperature variation tests were made in a thermostatically controlled temperature chamber for temperatures from -30° to +50° C. 72 hour humidity tests were made in the Laboratory test chamber which is equipped for controlling both temperature and percentage of relative humidity over the ranges required by specifications.

DATA RECORDED

17. The data recorded during the test are contained in Tables 1 to 16 inclusive and Plates 1 to 44 inclusive, appended hereto.

PROBABLE ERROR IN RESULTS

18. The estimated overall accuracy for the various tests made is as given below:

Sensitivity	± 10%
Selectivity	± 10% input voltage
"	± .01% frequency variation
Maximum Noise Level	± 10%
Resonant Overload	± 5%
Audio Fidelity	± 0.5 decibel
Frequency Stability	± 5% in cycles
Frequency Overlap	± 0.1%
Reset	± 10%
Frequency Wobbler Range	± 2%
Sensitivity Control	± 10%
Output Impedance	± 10%
Time Constant	± 10%

In estimating the overall accuracy of the results obtained, consideration is given to the manufacturer's rating of probable errors in the instruments used; also the factors entering into the measurements involved. In all tests, great care was exercised in the manipulation of controls of the equipment under test; also the measuring equipment and every effort was made to reduce errors in observations to a minimum.

[redacted]

RESULTS OF TESTS

19. The specifications governing the manufacture of the subject equipment, reference (b), include those specifications under which the Class IIA, Model RAL equipments were manufactured, the latter specifications having been modified or extended by reference (b) to meet the Model TBR requirements.

20. Inasmuch as the constructional details are in most cases similar to those in the Model RAL equipments reported on in reference (e), and by the same manufacturer, no comment will be made under paragraphs of the general or constructional specifications where the items are identical with those reported on in reference (e) unless the specification requirements have not been fully met.

21. The circuit elements of the subject receiver differ from the Model RAL in that a low pass filter has been provided instead of a band pass filter and duplicate dynamotors have been added to the power unit for providing B voltages from a six volt battery source for d.c. operation.

1-2. The subject equipment is of the general service type and suitable for satisfactory operation over a wide frequency range on vessels of the U.S.Navy, at Naval radio shore stations or in portable service, except as may be noted in detailed comment in the paragraphs following.

1-3. Subject equipment is suitable for independent operation as a portable receiving equipment. No tests have been made to determine its performance when used in conjunction with the transmitter or its auxiliary equipment due to the fact that the transmitter was not available during the time that these tests were made. Tests will be made to cover this type of operation as soon as the transmitter is available and results will be submitted when completed.

1-4. The actual frequency range of the subject receiver is 284 to 24,500 kilocycles.

1-7(c). The subject receiver is not considered as having a high degree of protection against strong local signals such as to permit duplex operation aboard Naval vessels, since the receiver blocks at the high frequency end of all bands with a signal input of from 100 to 200 microvolts.

(f). At the threaded end of shield cans, the plating has come off due to excessive friction resulting from too tight a fit. The exposed copper will probably corrode in salt atmospheres and thus prevent removal.

1-8. The receiver housing is provided with a metal cover, which however, is not spray proof. The cover is of the same height and width as the panel and stands out from the panel on four posts. The securing screws go through the center of these posts to a threaded fitting in the panel. The face of the cover is 2-1/8 inches from face of panel, and the sides and ends are bent back 1-1/8 inches toward the panel, leaving an opening of 1 inch all around. This

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provides the mechanical protection of the receiver controls, as required in reference (g). The receiver case would be spray proof with the protective cover in place except for control shaft openings in panel and with a better gasket behind the panel. At present, this gasket is a strip of soft rubber packing 1/32" x 9/16" and is hard at the corners, due to the cement used. The material does not appear to have the required flexibility in its present form to assure spray tightness and it is not probable that the material will become more flexible with age. At present, no protection from spray is provided for the receiver controls on the front of the panel. The shafts for the various controls which enter holes in the panel, are a close fit and are considered watertight for intermittent application of spray, but are not submergence proof. The power unit has no spray proof gasket on the panel, and is entirely unprotected where perforated for ventilating, making the entire unit definitely not spray proof. No canvas cover was furnished with this equipment. The contract, reference (c), states however that receiver is to be spray proof without the use of canvas cover.

2-22. The power unit is equipped to permit operation from a source of 115 volts 60 cycle, single phase a.c. or from a 6 volt (rated) storage battery through suitable dynamotors.

2-24 and 2-25. The equipment consists of one receiver and one power unit complete with all vacuum tubes and cables necessary to permit operation from a source of either a.c. or battery voltage.

4-2. In connection with the main tuning capacitor, it is noted that the recommendation of the Inspector of Naval Material in paragraph 6 of reference (f) has not been complied with, i.e., to provide set screws to supplement the pins to secure the rotor to the shaft. Threaded holes have been provided on each rotor for the insertion of set screws, as has previously been done, but the screws have been omitted. This Laboratory has no knowledge of the need for the proposed set screws to supplement the pins. The efficacy of the screws is questionable due to the thin wall of the sleeve through which they pass, which would provide very little threaded area to withstand the required locking pressure. It is believed that if the present manner of securing with pins is determined to be inadequate, a more rugged device than the set screws should be provided. The plated spring brush contacts which contact with the collars on the rotors of the ganged condenser may have limited life due to the possibility of the plating wearing off. The manufacturer's representative states however that a bi-metallic spring having a solid silver face will be used in production.

4-3. The materials used are generally of excellent quality. No tests were made on phenolic material as no sample material was submitted from which to make the necessary test specimens. As described under par.1-8, the gasket material does not appear to have the required flexibility in its present form. The ceramic insulation with lead washers on antenna binding posts are satisfactory, but the fact that they so frequently become loosened with use is objectionable. Some spring take-up, as a spring washer should be made a part of the assembly so that as the lead washers compress, the spring washer will take up the slack. The type 38276 ballast tube in the power

unit has a socket with a flexible mounting, which allows the tube to slap against the sides of the shielded compartment with the normal vibration caused during transportation in a truck. The lamp socket is mounted on two flat springs so bent as to be effective in shock proofing the tube from vibration of small magnitude, but during such vibration and shock as may be expected during transportation the lamp and socket assembly mechanically oscillate without sufficient damping as to prevent lamp destruction. Transportation on a rubber tired hand truck between buildings at this Laboratory caused slapping to the extent that the truck had to be moved slowly to prevent breakage of the tube.

4-4. The soldering and wiring in the subject receiver are not particularly neat. However, the manufacturers are cognizant of this, as stated in par.4-4 of reference (d), due to development work having been carried on after assembly. It is also stated that for this reason it has been impossible to maintain the degree of excellence in workmanship that is to be anticipated with production equipment.

There is insufficient wax impregnation on the detector coil assembly for the low frequency bands 1, 2, and 3. Eight paper tags on strings were left on this coil, which however were removed for humidity tests.

There are several holes in the chassis plugged with lead or other soft metal which discolors to give evidence of a patched job.

The cement used on the gasket on the back of the panel was permitted to cover the gasket face at the corners, thus hardening the gasket and reducing its effectiveness.

The slow tuning dial was mounted so that a considerable portion of the white paint on its face was removed by chafing during tests.

4-5. The plating on the threaded portion of the copper coil shields and their receptacles is worn off by such little use as they have had to date. The exposed copper will undoubtedly corrode to prevent removal, as the cans were found very difficult to remove in their present condition. See par. 6-22 which describes the condition of the transformers, filter, and condenser cases upon receipt, which the manufacturers claim have been put through the required cycle of salt water tests.

4-6. Magnetic material is employed for condenser, transformer, and filter cases, variable potentiometer covers; main condenser shaft, counter weight and coupling flange to worm wheel; tapered pins securing rotor condenser plates to shaft, contact collar to shaft, coupling flange to shaft, counter weight to shaft, thrust collars to worm shaft, and worm to drive shaft.

The use of magnetic material in units which are of inductive nature such as transformers and filters is justified. The use of steel for the various main condenser parts and controls as men-

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tioned above is desirable to assure ruggedness, but this material should be of the "stainless" variety. No tests have been made to determine if this material is "stainless" and no corrosion is in evidence. All items mentioned above are however very magnetic.

4-7. Plates 43 and 44 show the operation of the receiver with change in ambient temperature between the limits of 30° Fahrenheit and 125° Fahrenheit. Governing specifications do not limit the frequency stability with change in temperature, and satisfactory operation in other respects is obtained over the temperature range specified.

4-8. Line fuses are provided in the power unit, on both sides of the a.c. line, and on the positive side of the battery line.

4-9. The top and bottom of the power unit case are perforated for ventilation. The individual cases enclosing the dynamotors are not perforated and during a continuous run for 7-1/2 hours, a rise of 19° C. above ambient temperature was noted within these cases.

4-10. No information as to the ability of the equipments to withstand continuous operation is available other than that equipment operated satisfactorily for the duration of the tests except for the factor of rubber insulation, as described in par. 4-27 and 6-21. It should be expected, however, that the wire wound potentiometers and paper condensers have a limited life.

4-11. Satisfactory operation was obtained on a moving platform when inclining up to 45° from the vertical in any direction.

4-12. When vibrating at frequencies up to 2,000 per minute, no appreciable change was noted in the output level, or frequency of beat note at the lower frequencies, and there was not enough change in beat note to pass out of audibility at the higher frequencies.

4-13. The interchangeability of parts appears to be satisfactory, but only the filters are marked with Navy type numbers. The small capacitors and sockets have the manufacturer's identification marks, but other parts are not marked with Navy type numbers or manufacturer's numbers.

4-14. The name plates are in accordance with specifications except as to size, which is 3" by 1-3/4".

Name plate for the receiver unit reads:

Receiver Unit
Type CRV 46053
Frequency 0.3 to 23 mc
Weight 77 Serial 37
A Unit of Model XTBR-1
Mfd for, etc

[redacted]

Name plate for the power unit reads:

Power Unit
Type CRV 20053
115 volts 60 cycles 200-60 watts
or
6 volts D.C. 6 amperes
Weight 77 Serial 37
A Unit of Model XTBR-1
Mfd for, etc.

The manufacturer's name on each plate being given as RCA Mfg.Co.Inc. The plates are of non-magnetic material.

4-16. The requirement of approved lock washers or their approved equivalent is generally complied with. There are, however, several nuts not locked, notably the antenna binding posts. All radio frequency leads are securely soldered and there are no signs of corrosive flux.

4-20. Vernier scales have 100 divisions, marked every 10 divisions on a 50 - 0 - 50 basis.

4-22. Solid bus wire is used for radio frequency leads and is color coded.

4-25. The results of the first humidity tests indicate that the rubber sleeving over the high potential radio frequency bus leads running from the band change switch to the coil terminals is of inferior quality. It was found that when leads, so covered, were rearranged to prevent physical contact of the rubber covering with the chassis or with other leads, the detector would oscillate on bands 7, 8, and 9; whereas previous to this rearrangement and after humidity submersion for 72 hours, the detector could not be made to oscillate on these bands. A second humidity immersion did not affect detector oscillation when these leads were in the rearranged positions. It is believed that this material has a poor power factor but no tests were made due to lack of sample material. The rubber appeared to lack resiliency and would not stretch appreciably without breaking.

4-26, 4-27, and 4-28. No samples of wire were submitted for test. The wire appears to be of the same construction as used in the Model RAL.

5-5. The measurements of the receiver unit are as follows:

Height	14-1/8"
Length	19-1/4" including handles
Depth	17-3/8" over panel controls - 18-5/8" over securing screws for panel control cover.
Weight	77-1/4 lbs. including panel control cover.

[redacted]

5-6. Satisfactory operation was obtained with a line source of 115 volts, 60 cycle, single phase a.c., with either side of line grounded, also from a 6 volt battery source.

5-7. The measurements of the power unit are as follows:

Height	13-1/8"
Length	14" without handles, 15-1/4" with handles.
Depth	15-1/4" over panel controls
Weight	77 lbs.

5-9, 5-10. One interconnecting cable is provided between receiver and power unit, 8 ft. in length, and one cable between power unit and battery, 10 ft. in length.

A plug only is provided for the a.c, line to power unit. Cables are rubber covered and battery cable has clips at battery end.

5-15. The controls on the front of the receiver panel are as in the Model RAL. The power unit panel has an additional switch and plug receptacle for d.c. operation. However, these are placed symmetrically and present a pleasing appearance.

5-16. The marking adjacent to each control is also similar to the Model RAL on the receiver unit. The power unit has marking for the added controls to conform with that on the original controls as in the Model RAL.

5-18. Photo etched name plates have been supplied, as in the Model RAL.

5-19. The tube complement is as below, which is in accordance with specifications and is also the same as in the Model RAL.

Receiver		Power Unit	
1st r.f.	38646	Ballast lamp	38276
2nd r.f.	38646	Rectifier	38180
DET	38646	Voltage regulator	38274
1st Audio	38646		
Output	38041		
AVC	38041		

5-20. The band change switch is similar in construction to the Model RAL. It is also noted that an apparently satisfactory job has been done in riveting the rotor contact points to the support springs. When returning to position 9 on the band change switch, the beat note may be changed as much as 3,000 cycles from that obtained from a former positioning of the switch. This indicates inconsistent positioning of the switch as governed by the clicker. The mechanical variation is not sufficient to be readily detected. The fact that the position of the regeneration control for start of oscillation does not vary with switch operation indicates that the contact resistance remains normal.

5-21. The positioning devices provided appear to be mechanically positive but as stated in par. 5-20 above, there appears to be a noticeable lack of reproducibility on band 9 when considered from the electrical point of view.

5-22. Silver faced contacts have been provided on the radio frequency band change switches. It is assumed that this requirement of the specifications does not apply to power, decibel, and audio attenuator switches, which are not silver faced.

5-23. A decimal system of marking is employed on all dials, as contradistinct to actual degree markings.

5-25. None of the dials or indicating devices depend on any internal or special lighting of the dial and are the same as in the Model RAL. Markings are visible in accordance with specifications. However, it is noted that the use of anti-glare glass on the meters permits them to be more easily read than the tuning dials which are apparently covered with ordinary glass.

5-28. All verniers are as in the Model RAL and are capable of being reset to within approximately 0.5%.

5-30. Panel operated verniers are provided for each radio frequency circuit, also the detector circuit in accordance with specifications.

5-33. Capacity verniers are calibrated with zero center in accordance with specifications.

5-34. The various units are apparently electrically and mechanically interchangeable with the Model RAL, but a Model RAL equipment is not available at this time for direct comparison.

5-35. Friction and pressure contacts are at a reasonable minimum, as in the Model RAL. It is noted, however, that the shield can for the detector coil, bands 4, 5, and 6 is a very tight fit, and it is difficult to screw the cover in place without jamming. If not properly screwed on, as was the case when first removed for inspection, noises are apt to develop. It is also noted that the trimmers in radio frequency and detector circuits depend upon bearing contact.

5-36. The integral parts of the units are unusually accessible, and so mounted that replacements may be effected with a minimum of disassembling. The objectionable features criticized in the Model RAL have been eliminated.

5-38. The linearity of the main tuning condenser calibration is shown on Plate 1.

5-39. The output transformer is claimed by manufacturers in reference (d) to be electrostatically shielded. No overall feed back is noted in the receiver.

[redacted]

5-48. The receiver is provided with "on-off" switch for opening the tube heater and other circuits normally drawing current when in the off position. This switch functions with links "open" as for battery operation, otherwise the links short circuit this switch.

5-49. Short circuiting links are provided for the switch mentioned in the preceding paragraph for a.c. operation, and the mounting block is stenciled to indicate their function.

5-52. Antenna-ground terminals are located on the front of panel, in accordance with contract notes, reference (c). These are at the upper left hand corner of the receiver panel.

6-1. The sensitivity is shown on Plate 2 for a.c. operation and on Plate 3 for d.c. operation, and is within specification limits throughout all bands for both types of operation.

6-2. The selectivity is shown on Plates 4 to 12 inclusive at standard gain, and on Plates 13 to 21 inclusive at reduced gain, the resonant input being increased ten times, and the gain reduced to maintain the same output. In taking these selectivities, some secondary peaks were observed at the lower frequencies, all of which however are within the specification limits, and are not recorded.

6-3. Maximum noise level for all bands is shown on Plate 22. The maximum variation through the working range of any frequency band is less than 12 decibels and is within specification limits.

6-4. Resonant overload is shown on Plates 23 to 31 inclusive and does not occur under 300 milliwatts.

It will be noted that blocking occurs with an input of from 100 to 200 microvolts at the high frequency end of all bands, indicating a comparatively narrow range of input voltages over which overall receiver response may be obtained.

6-5. Overload selectivity is shown on Plates 41 and 42, and is within specification limits.

6-6. The receiver is of the tuned radio frequency type as in the Model RAL.

6-7. Three resonant (tuned) circuits are provided, as in the Model RAL.

6-8. CW reception is accomplished by the autodyne method.

6-9. Tuning is accomplished by one main tuning control.

6-10. Panel operated verniers require setting but once for each frequency band, this procedure having been followed in taking sensitivity measurements which were all within specification limits. The full scale capacity of the trimmer capacitors is found to be as in the Model RAL, and within specification requirements.

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6-11. Two separate antenna binding posts are provided. The one marked "Antenna" connects directly to the input transformer, while the one marked "Common" feeds through a series condenser to the transformer. This series condenser increases the receiver input impedance to permit multiple reception without undue loading of the antenna. These posts are not suitably secured to prevent loosening when subjected to normal usage. The input impedance for both conditions is shown on Table 11.

6-12. The subject receiver is found to be capable of operating in accordance with the governing specifications when the power unit is connected to either a 115 volt, 60 cycle, single phase a.c. line, or to a 6 volt (rated) storage battery.

6-13. No "C" batteries are used or required.

6-14. "B" potentials for battery operation are obtained from the maximum dynamotor output, thus requiring but two leads from the dynamotor output to the receiver.

6-15. With a.c. operation, the total supply line consumption is 197 watts. With d.c. operation, the total current consumption is 5.5 amperes at 6 volts.

6-16. With a.c. operation, the equipment is found to operate in accordance with governing specifications at any line frequency from 58 to 62 cycles.

6-17. The regeneration control operates in a smooth and noiseless manner with entire absence of clicks or squeals.

6-18. With the receiver adjusted for optimum gain, and with the low pass filter and audio tuning "out" using the cathode ray oscillograph method as described under METHOD OF TEST, sharp impulses of CW signals, with a maximum amplitude of 5 volts, do not cause a reduction in sensitivity which persists longer than .0037 seconds.

6-19, 6-20. As only one receiver was available, no cross talk tests were made and it is assumed that the same results would obtain as for the Models RAK, RAL receivers.

6-21. The receiver in an inoperative condition was placed in a temperature and humidity controlled chamber for 72 hours. Table 13 gives the record of temperatures and relative humidity throughout this test. Table 15 shows the sensitivities taken immediately prior to test, also for bands 1, 2, and 3, ten minutes after completion of test; for bands 4, 5, and 6, two hours and forty-five minutes after completion of test; bands 7, 8, and 9 being inoperative after completion of test. At ten minutes after completion of test and during the next two and one-half hours, bands 4, 5, and 6 were excessively noisy which noise was not controllable with the sensitivity control. With the sensitivity control set at zero the minimum noise obtainable was from 2 to 6 volts across the 600 ohm output load.

In bands 7, 8, and 9, oscillations could not be obtained with the regeneration control. Tests were made to locate the cause of failure in bands 7, 8, and 9, and the trouble was determined to be in the detector coils. Not desiring to disturb these coils without the consent of the manufacturers, the matter was reported to the Bureau of Engineering, who in turn arranged for an inspection by a manufacturer's representative. This representative found the trouble to be in the rubber insulated leads to the detector coils, the rubber having become softened and cracked where these leads were bent around the edge of an opening in the shielded compartment, causing a partially grounded circuit. The leads in question in bands 7, 8, and 9 were cleared from contact with the shielding, after which the receiver functioned normally in these bands. Similar leads to the detector coils for bands 4, 5, and 6 were separated from the shielding, although no contacts appeared to be made at the time. Without further changes in the insulation the receiver was subjected to a second 72 hour test. Table 14 gives the record of temperatures and relative humidity during this second test, and Table 16 shows the sensitivities taken immediately before the test, and ten minutes after completion. The sensitivities after completion were found to be well within specification limits, the maximum change in any band being 4.81 decibels. This indicated that the cause of failure in the first test was due to the breakdown of insulation of the leads to the detector coils, which were made up of solid wire covered with soft rubber tubing.

6-22, 6-23. The following separate component units were received with the receiving equipment under test for use in the immersion tests. These parts had already been subjected to one cycle of tests by the manufacturer, and their condition when received is also noted.

(a)	3 Filters	P 72402-G 502	(CRV 53032)
(b)	4 Capacitors	P 72014-G 501	
(c)	15 Capacitors	P 72025-G 501	(CRV 48555)
(d)	6 Resistors	K 806810 - P 2	(CHD 63184)
*(e)	4 Transformers	M 80158-0501	(CRV 30242)
*(f)	1 Transformer		(CRV 30244)

The condition when received was as follows:

(a) Cases dulled by exposure to salt water.
(b) Cases dulled, slight rust, salt in cracks of cases.
(c) Cases fairly bright.
(d) Enamel white clouded, apparently from salt.
(e) Cases bright.
(f) Case very rusty.

*One of (e) was smaller than the others, in same size case as (f) but marked CRV 30242 instead of CRV 30244.

The condition after immersion test was as follows:

(a) Same as before tests, no failures.

(b) Two sections of a three section unit failed on leakage after first immersion. Other three capacitors same as before tests.
(c) One capacitor failed on leakage, also leaked oil at the end of third immersion.
(d) One resistor was broken before immersion, two failed mechanically at end of first immersion (ceramic insulation cracked).
(e) Same as before tests, no failures.
(f) Same as before tests, no failures.

Eleven each of items (b) and (d) type CRV-48540 and CAO 63184 resistors were received on May 4, 1937, for retest. Results of this retest will be submitted as soon as completed.

6-24. Table 1 shows the frequency range of all bands, and the percentage of overlap between bands, which is well within specification limits.

6-25. The accuracy of resettability is shown on Table 2 and is within specification limits.

6-26. The range of the frequency wobbler is given for all bands in Table 3 and is within specification limits.

6-27. The frequency wobbler is provided with a zero center dial and the trimming of the oscillator is effective at zero wobbler setting. All sensitivity measurements were made with the wobbler set at zero and all sensitivities were within specification limits.

6-28. The effect of varying the output load resistance is shown on Plate 32, as compared with a zero level with 600 ohms output load, at 1000 cycles.

6-29. The secondary of the output transformer has a grounded center, thus making the opposite sides of the lines at the same instantaneous potential with respect to ground.

6-30. The durability of the plating on the phosphor bronze springs, which slide on the silver rings for the main tuning condenser contacts is not known, but it is believed this plating will wear off with continuous use. (See par. 4-2) The wire wound potentiometers also have a limited life. Other construction appears to be rugged enough to withstand continuous use without damage.

6-31. Frequency stability with change in line voltage, also with change in battery voltage is shown on Table 4, and is within specification limits.

6-32. Frequency stability with variation of regeneration control from optimum to standard is shown on Table 5 and is within specification limits.

[redacted]

6-33. Frequency stability with variation of panel operated trimmer capacitors from any point to any other point within their limits is shown on Table 6. Change in frequency is negligible with variation of the antenna trimmer, and is well within specification limits for the radio frequency trimmer.

6-34. When vibrating at frequencies up to 2,000 per minute, no change greater than 100 cycles was noted in the output frequency of beat note.

6-35. Frequency stability with change in input from .5 microvolt to such values as to produce maximum output is shown on Table 7 and is within specification requirements.

6-36. Frequency stability with variation of manual volume control from maximum output with full gain down to a point where signal is just audible, is shown on Table 8, and is within specification limits.

6-37. See paragraphs 6-33 to 6-36 inclusive.

6-38. A low pass filter has been provided as required.

6-39. Characteristics of the low pass filter are shown on Plate 33 and meet specification requirements.

6-40. An "on-off" switch is provided on front of panel for the low pass filter.

6-41. At the frequency of minimum attenuation and in fact at all frequencies under 1,000 cycles, the use of the low pass filter does not cause an attenuation in audio amplification greater than 3 decibels, and is well within specification limits, as shown on Plate 33.

6-42. The low pass filter is placed between the detector and first audio tube.

6-43. The limits of the low pass filter characteristics are not abrogated at an output level of 300 milliwatts as shown on Plate 34.

6-44. A variable frequency attenuator is provided in the audio amplifier.

6-45. The above attenuator is capable of being adjusted to accept any frequency from 445 to 1450 cycles.

6-46. The adjustments are by means of controls located on the front panel.

6-47. The frequency range is variable by a band switch with 10 taps, this switch being thrown ~~from band 1 to~~ band 2 by a separate toggle switch. The peak frequencies for each tap are

shown on Table 9, and the attenuation between taps is less than 3 decibels. This is determined by assuming the same slope in the attenuation curve for taps 2, 3, 4, 6, 7, 8, and 9 as for taps 1, 5, and 10 which were measured. The attenuation of the audio output of the same frequency is shown for each tap.

6-48. The characteristics of the audio attenuators for taps 1, 5, and 10 of bands 1 and 2 are shown on Plate 33. Specification requirements are not met at +150% of peak frequency with taps 1 and 5 in band 1, when interpreted as attenuation from the 1,000 cycle zero level with no attenuator in circuit. If interpreted as attenuation due to the attenuator alone, eliminating the effect of the sloping audio characteristic, the attenuators are all within specification limits. In all other respects, the characteristics are within specification requirements.

6-49. The use of the attenuators does not incur an attenuation in the audio amplifier of more than 8 decibels at any peak frequency as shown in Table 9.

6-50. The adjustable attenuator is disconnected by an "on-off" switch on the front of the panel.

6-51. The characteristic limits of the variable frequency attenuators are not abrogated at any radio frequency within the limits of the equipment, or at a 300 milliwatt output level. See Plate 34.

6-52. The attenuators are placed between the detector and first audio amplifier tube.

6-53. A manual volume control is provided, operating from the front of the panel.

6-54. The range of the volume control is shown on Plate 35, with a maximum attenuation of 80 decibels with 30,000 microvolts applied, standard output being taken as the output obtained with 3 microvolts input, to permit an increase of four orders in the input without exceeding 30,000 microvolts.

6-56. Selectivities were taken with as much reduction in gain as was permissible in order to obtain complete curves, without falling below the requirements of these specifications.

6-57. The linearity of the volume control, with a constant input for a 300 milliwatt output at optimum gain, is shown on Plate 36, indicating compliance with specification requirements.

6-58. The variation in output is continuous.

6-59. The volume control operates in such a manner that the noise level is substantially reduced in direct proportion to a CW signal as is shown on Plates 37 and 38.

[redacted]

6-60. Smooth operation is obtained without extraneous noise in the output during operation.

6-61. The manual volume control is separate from the automatic volume control.

6-62. Examination of the interior construction of the potentiometer used for the manual volume control cannot be made without damaging it for further use. The manufacturer states in ref.(d) that it is of wire wound construction.

6-63. The receiver is provided with an automatic volume control with level adjustments operating from the front of the panel.

6-64. The automatic volume control is disconnected by an "on-off" switch on the front of the panel.

6-66, 6-67. Automatic volume control characteristics are shown on Plates 39 and 40 and regulate the output for specification compliance from .5 milliwatts to 27 milliwatts.

6-68. The time of complete recovery after the application of a 5 volt impact, as in the test for time constant of the receiver without automatic volume control, par.6-18, is .0064 seconds.

6-69. The potentiometer used as a part of the automatic volume control is wire wound.

22. The following sub-paragraph numbers correspond with those in the addenda to specifications, reference (b), listing "additional requirements."

47. The power unit contains two dynamotors, either of which is capable of supplying all necessary high voltages for operation of the subject receiver in accordance with specifications, from a 6 volt (rated) storage battery. (Dynamotor output 202 V. for 5.5 V. supply.)

48. The integral parts of the power unit used for both a.c. and d.c. operation are the multiple plug, which connects receiver cable either to the a.c. rectifier, or one of the dynamotors, and the low frequency filter which is connected directly to the plug.

49. Change over from a.c. to battery operation is accomplished by changing the plug, which is attached to a short lead within the power unit, from the a.c. receptacle to one of the dynamotor receptacles.

50. Two panel controlled toggle switches are provided to place the receiver in an operative, or inoperative condition, one for a.c. and one for d.c. These switches are operative only as the plug within the power unit is placed either in the a.c. or a d.c. receptacle.

51. The dynamotors are mounted in separate metal cases at the back of the a.c. compartment, each case measuring 6-1/4" wide, 7-1/2" high and 4-11/16" deep. The back of the case and the sides constitute a cover removable with two thumb screws, and the plug receptacle is accessible through an opening in the top of the case. The entire case is removable from the power unit chassis with four screws, without rendering the remaining dynamotor, or the a.c. unit inoperative.

52. The dynamotors are of the conventional design, the frame being 6" in length, and 4" in diameter. The armature has a core 1-7/8" in diameter. The keyway in each lamination of the core is progressively advanced, so that the slots do not run parallel with the shaft, the last lamination being rotated in angular degrees with respect to the first about twice the width of the slot. Operation during these tests indicates sparkless commutation, but the brush contacts cannot be seen when the dynamotor is assembled.

53. The armature rotates on ball bearings of a design which permits operation at any angle up to 45° without loss of lubricant, or slapping, the play in the bearing being negligible, and the ball bearings being held in position by a washer which acts both as a retainer to provide uniform spacing of the balls and to prevent the grease from running out.

54. Inspection of the commutators indicates a workmanlike job and durable construction, but the manner of retaining the segments to prevent relative displacement cannot be determined without disassembly. There are 15 segments in the low voltage commutator, and 30 segments in the high voltage commutator. Measurement of the thickness of the segments plus the insulation over the hub shows it to be approximately 3/32" which would permit a reduction in diameter of 1/8", but the strength or durability is not known at this reduced thickness.

55. The 3000 hour continuous run test to determine compliance with the requirements of this paragraph has not been completed at the time of making this report.

56. Table 12 shows the heating of dynamotor at temperatures above the maximum ambient temperature of 40° C to be 24° C with a maximum dynamotor temperature of 65° C. This is well within specification limits.

57. The dynamotor efficiency at full working load is shown on Table 10 and is within specification limits.

SUMMARY OF DEFECTS

23. The following is a summary of defects noted, and items wherein specification requirements are not met.

[redacted]

1-7c. Subject receiver does not have a high degree of protection against strong local signals to permit duplex operation, as blocking occurs with comparatively low signal inputs.

1-8. The metal cover provided is not spray proof. No canvas cover was furnished for either receiver or power unit. The ballast tube is not sufficiently supported to prevent self-destruction due to mechanical oscillation under conditions of transportation. The Power Unit cannot be considered as spray proof. The only means of securing main condenser rotor to shaft is that of pinning, as in the Model RAL.

4-2. Plated spring brush contacts which contact with the collars on the rotors of the ganged condenser are not considered sufficiently durable. However, manufacturer's representative states these will be of bi-metal construction in production.

4-3. Gasket material for spray proofing receiver housing does not have the required flexibility.

4-4. The soldering and wiring are below standard in neatness. There is insufficient wax impregnation on the detector coil assembly for the low frequency bands 1, 2, and 3. Holes in the chassis plugged with lead or other soft metal are not considered good workmanship. Cement used on the gasket on the back of panel is permitted to cover the gasket face, thus hardening the gasket. The slow tuning dial was mounted so that chafing occurred, damaging the face of the dial.

4-5. The plating on the threaded portion of the copper coil shields is worn off making them subject to corrosion.

4-6. Several of the parts of the main tuning condenser are of magnetic material, which is not considered as a defect unless they are corrosive.

4-13. Major parts are not marked, either with manufacturer's type number of Navy type numbers.

4-14. Name plates are not of specified size, but the plates submitted have been approved by the Bureau in reference (i).

4-16. Lock washers are not provided for all nuts.

4-25. The rubber sleeving used over the bus wire running from the band change switch to the coil terminals is of inferior quality.

5-20. Repositioning of the band change switch on band 9 has the effect of changing inductance to result in a change of beat note of as much as 3000 cycles.

5-35. Pressure contact of coil shield cans is subject to jamming by reason of being too tight fitting.

Trimmers in r.f. and detector circuits depend upon bearing contact.

6-4. Blocking occurs with an input of from 100 to 200 microvolts, giving a comparatively narrow range of input voltages over which normal receiver gain may be realized.

6-11. The antenna binding posts have a tendency to become loosened in the panel holes with ordinary service use.

6-21. The receiver failed to pass the 72 hour humidity test, due to poor insulation. (See par. 4-25.)

6-22, 6-23. Two capacitors failed on leakage, and two resistors failed mechanically during immersion tests.

6-48. Audio attenuator does not meet the specification requirements as to attenuation at +150% and -60% of peak frequency on taps 1 and 5 of band 1 only. This may or may not be considered as a defect, depending upon the interpretation of the specifications. (See par. 6-48.)

CONCLUSIONS

24. The subject receiver is essentially a Model RAL receiver with modifications to adapt it to the Model XTBR-1 equipments. The modifications consist essentially of the provision of a protective panel cover for the receiver with a rubber gasket between the panel and case, and dynamotors in the power unit for d.c. operation.

25. The cover furnished, however, affords mechanical protection only, the only special provision for spray proofing being the gasket between the panel and case of the receiver. The panel controls are not protected from spray, and eleven of the controls enter the panel with a slip fit, which would probably protect the inside of the receiver from occasional applications of spray, but not from any considerable amount of water. The power unit is definitely not spray proof, due to the perforations in the case for ventilation.

26. Construction throughout is mostly similar to the Model RAL and the workmanship is good with slight exceptions which are commented on by the manufacturers, who state that it is not up to the degree of excellence which may be expected in production. Some improvement in the accessibility of parts is noted over the Model RAL.

27. In electrical performance, all specification requirements are met with but one possible minor exception as regards attenuation characteristics, which may or may not be considered a defect, depending upon the interpretation of the specifications. It is, in general, very similar to the Model RAL.

28. Failure of the receiver to operate after the 72 hour humidity test is believed to be due to breakdown of the rubber insulation on the high frequency leads, satisfactory operation being obtained after the second 72 hour test, when these leads were cleared.

29. There is some question as to the degree of water proofing required for this equipment. It is probable that with suitable canvas covers it can be considered spray proof. With the covers removed it definitely could not be exposed to rain or spray without injury.

[redacted]

Table 1

Frequency Overlap
Par. 6-24

Bands	Frequency Kilocycles	% Overlap between Bands
1	284	
	517	
		12.3
2	457	
	850	
		12.1
3	753	
	1395	
		9.76
4	1265	
	2235	
		11.1
5	2000	
	3600	
		10.8
6	3230	
	5840	
		9.1
7	5330	
	9300	
		9.8
8	8430	
	14950	
		10.3
9	13475	
	24500	

Specification limit not less than 5%

[redacted]

Table 2

Accuracy of Resettability
Par. 6-25

Band	Frequency Kcs.	Cycles Change	%
1	300	20	.006
	490	60	.012
2	490	60	.012
	800	40	.005
3	800	40	.005
	1340	250	.0186
4	1340	30	.0022
	2090	30	.0014
5	2090	620	.029
	3420	440	.012
6	3420	330	.0096
	5530	770	.013
7	5530	1280	.023
	8830	900	.01
8	8830	1500	.017
	14300	300	.0021
9	14300	730	.0051
	23000	800	.0034

Specification limit 0.1%

[redacted]

Table 3

Frequency Wobbler Range
Par.6-26

Band	Frequency Kcs.	Total Cycles 50-0-50	%
1	300	265	.088
	490	1156	.236
2	490	450	.092
	800	1954	.244
3	800	744	.098
	1340	3385	.252
4	1340	1135	.085
	2090	4310	.206
5	2090	1770	.085
	3420	8010	.234
6	3420	2971	.087
	5530	12415	.224
7	5530	4870	.088
	8830	20520	.232
8	8830	9460	.107
	14300	35500	.248
9	14300	13200	.092
	23000	52880	.23

Specification limit not less than .05%
not more than .35%

[redacted]

Table 4

Frequency Stability with Change in Line Voltage, also Change in Battery Voltage.
Par.6-31

Freq. Kcs.	Cycles Change 115 V - 10%	% Change	Cycles Change 115 V. + 10%	% Change
490	10	.002	10	.002
800	25	.0031	27	.0033
1340	15	.0012	20	.0014
2090	70	.0033	30	.0014
3420	53	.0015	25	.0007
5530	34	.0006	36	.00065
8830	95	.001	75	.00085
14300	75	.0005	30	.00021
23000	400	.0017	300	.0013

Specification limit .01%

Freq. Kcs.	Cycles Change 6.2 V. to 5.58 V. d.c.	% Change	Cycles Change 5.022 V. to 5.58V	% Change
490	120	.024	90	.018
800	200	.025	150	.018
1340	357	.026	250	.017
2090	432	.02	410	.019
3420	848	.024	780	.022
5530	1437	.026	1350	.024
8830	1820	.02	1500	.017
14300	3702	.025	3150	.022
23000	4713	.02	5500	.024

Specification limit for d.c. .05%

Table 5

Frequency Stability with Variation of Regeneration Control from Optimum to Standard.
Par.6-32

Freq. Kcs.	Variation in Cycles	%
490	123	.025
800	168	.021
1340	242	.018
2090	550	.026
3420	810	.023
5530	750	.013
8830	715	.008
14300	562	.0039
23000	285	.001

Specification limit .03%

[redacted]

Table 6

Frequency Stability with Variation of Panel Operated Trimmer Capacitors from Any Point to Any Other Point within Their Limits.
Par.6-33

Freq.	Ant. Trimmer Cycles Change	% Change	R.F. Trimmer Cycles Change	% Change
490	-	-	-	-
800	-	-	-	-
1340	-	-	-	-
2090	-	-	-	-
3420	-	-	-	-
5530	-	-	-	-
8830	-	-	15	.00017
14300	-	-	100	.0007
23000	-	-	3025	.013

Specification limit
200 to 8000 kcs .05%
8000 to 23000 kcs .025%

Table 7

Frequency Stability with Change in Input from 0.5 microvolts to Such Values as to produce maximum output.
Par.6-35

Frequency	Change in Cycles
490	25
800	20
1340	34
2090	-
3420	94
5530	270
8830	65
14300	60
23000	270

Specification limit 300 cycles

[redacted]

Table 8

Frequency Stability with Variation of Manual Volume Control from Maximum Output with Full Gain, down to a Point Where Signal is Just Audible.

Frequency	Change in Cycles	%
490	10	.002
800	25	.0031
1340	40	.0029
2090	45	.0021
3420	50	.0014
5530	139	.0025
8830	143	.0016
14300	180	.0012
23000	440	.0019

Specification limit

200 to 8000 kcs .05%

8000 to 23000 kcs .025%

Table 9

Variable Frequency Audio Attenuator
Peak Frequencies for Each Tap
Par.6-47,6-49

Band	Tap	Freq.Cycles	Decibels attenuation at resonance due to attenuator
1	1	445	4.8
	2	470	3.40
	3	510	3.34
	4	540	3.10
	5	585	3.30
	6	630	2.92
	7	670	2.41
	8	730	2.79
	9	770	2.34
	10	830	2.70
2	1	770	4.7
	2	820	3.69
	3	890	3.34
	4	960	3.40
	5	1010	3.22
	6	1100	3.16
	7	1160	2.98
	8	1260	3.04
	9	1370	2.92
	10	1450	2.60

[redacted]

Table 10

Dynamotor Efficiency
Par. 57 of Addenda

Input			Output			
V	A	W	V	A	W	% Efficiency
5.5	3.5	19.25	202	.0425	8.585	44.5

Specification minimum 40%

Table 11

Input Impedance
Par.6-11

Frequency Kcs.	Ant. Z-ohms	Common Ant. Z-ohms
490	150	1100
800	200	400
1340	250	275
2090	350	350
3420	950	950
5530	775	775
8830	700	700
14300	400	400
23000	350	350

Table 12

Dynamotor Heating
Par. 56

Time	Frequency	Ambient Temp.°C	Temp.C at Dynamotor
0930	20,000	27.5	27.5
1345		45	65
1400		41	65
1500		41	65

[redacted]

Table 13

First 72-hour Humidity Test
Par.6-21

Date	Time	Temp.° F. Wet Bulb	Temp.° F. Dry Bulb	% Relative Humidity
12 April	1000	98	104	80
	1030	100.5	104	88.5
	1630	101	104	90
	2000	95	104	71
13 April	0000	93	104	66
	0400	92	104	63
	0800	92	104	63
	0830	101	104	90
	1200	101	104	90
	1630	101	104	90
	2000	106	110	87
14 April	0000	107	112	84
	0400	108	115	79
	0800	110	117	79
	0845	101	104	90
	1200	101	104	90
	1630	101	104	90
	2000	105	107	93
15 April	0000	105	108	90
	0400	105.5	108.5	90
	0800	106	109	90
	0845	101	104	90
	1000	101	104	90

[redacted]

Table 14

Second 72-hour Humidity Test
Par.6-21

Date	Time	Temp.° F. Wet Bulb	Temp.° F. Dry Bulb	% Relative Humidity
20 April	1300	91	104	55.5
	1345	101	104	90
	1630	101	104	90
	2000	101	104	90
21 April	0000	101	104	90
	0400	100.5	104	88.5
	0800	100	104	87
	0820	101.5	104	91.5
	1200	101	104	90
	1630	101	104	90
	2000	103	106	90
22 April	0000	103	106.5	88.5
	0400	103	107	87
	0800	104	107.5	88.5
	0805	102	104	93
	0830	101	104	90
	1200	101	104	90
	1630	101	104	90
	2000	103.5	107	88.5
23 April	0000	104	108	87
	0400	104	108.5	85.5
	0800	104.5	109	85.5
	0815	101	104	90
	1245	101	104	90

Table 15

First Test Sensitivity Before and After 72-hour Humidity Test
Par.6-21

Frequency Kcs.	Before Microvolts Input	After Microvolts Input*
300	2	2.32
385	2.1	2.9
490	2.05	3.32
490	2.4	2.4
630	2.4	2.7
800	2.45	3
800	2.05	2.2
1035	2.25	3.28
1340	1.95	3

* Sensitivity measured 10 minutes after removal from humidity chamber.

[redacted]

Table 15 (continued)

Frequency Kcs.	Before Microvolts Input	After Microvolts Input*
1340	1.9	2
1675	1.7	1.75
2090	1.8	1.85
2090	2	2
2670	1.88	1.85
3420	1.95	2
3420	2.5	2.5
4350	2.5	2.9
5530	2.52	2.45
5530	2.8	
6980	2.96	
8830	3.46	
8830	4.4	
11220	5.1	
14300	5.05	
14300	9.6	
18120	9.3	
23000	10	

*Sensitivity measured 2 hours and 45 minutes after removal from humidity chamber.

[redacted]

Table 16

Second Test Sensitivity Before and After 72-hour Humidity Test
Par.6-21

Frequency Kcs.	Before Microvolts Input	After Microvolts Input
300	2.2	2.1
385	2.9	2.75
490	3.0	2.9
490	2.6	2.75
630	2.9	2.86
800	2.7	3.8
800	2.35	4.1
1035	3.0	3.45
1340	2.95	2.4
1340	2.8	1.9
1675	2.6	1.86
2090	2.1	1.97
2090	2.1	1.97
2670	2.6	1.85
3420	2.8	1.8
3420	3	2.66
4350	2.8	2.58
5530	3	2.69
5530	3.7	3.03
6980	3.4	2.72
8830	3.5	3.5
8830	4.9	4.5
11220	5.2	4.52
14300	7.2	6.48
14300	7.2	8.4
18120	8.3	7.6
23000	10	10

4.81 decibels maximum change

12 decibels specification limit

[redacted]

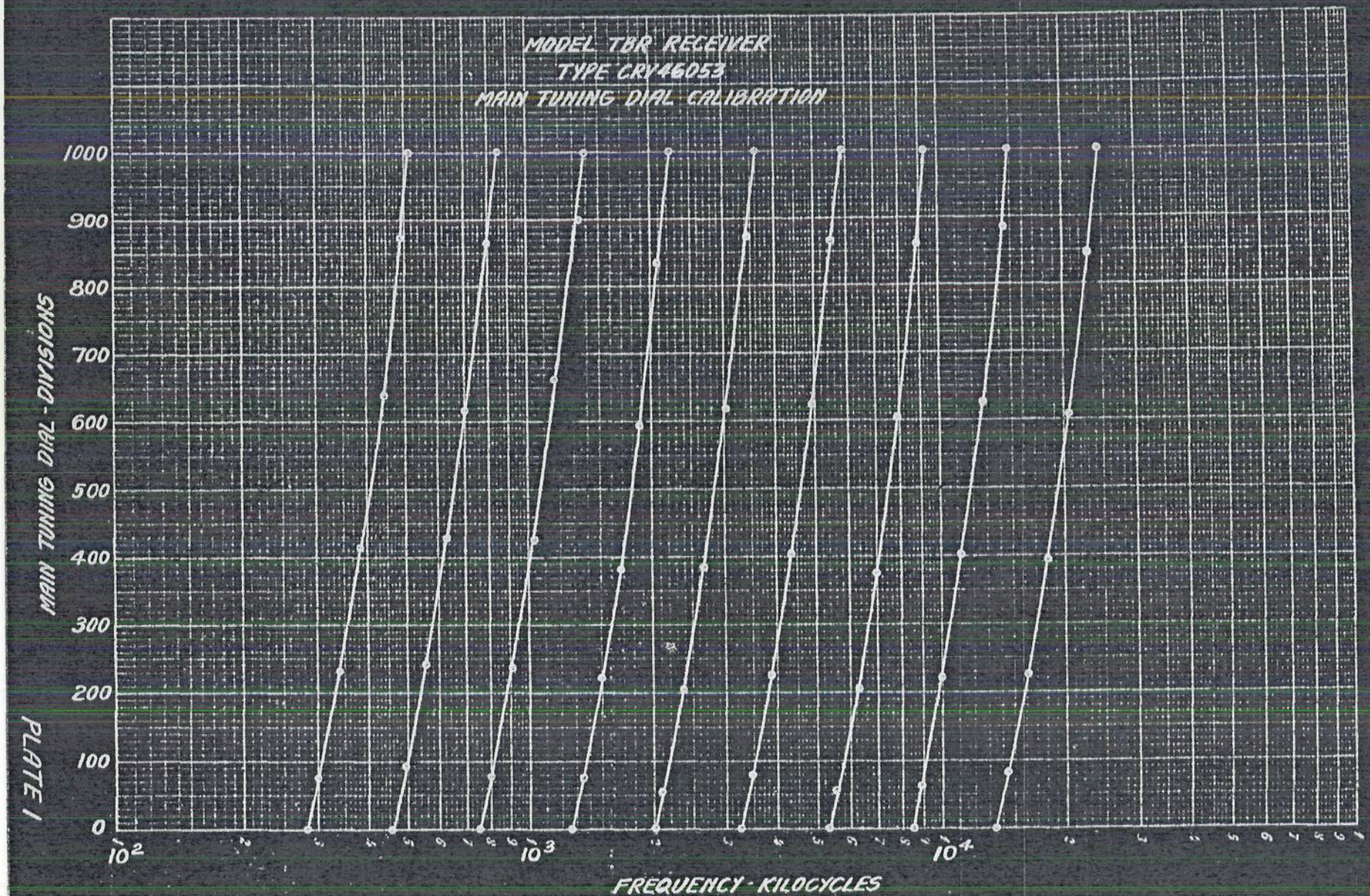
MODEL TBR RECEIVER
TYPE CRY46053
MAIN TUNING DIAL CALIBRATION
MAIN TUNING DIAL - DIVISIONS
1000
900
800
700
600
500
400
300
200
100
0
10^2
10^3
10^4
FREQUENCY - KILOCYCLES

PLATE I

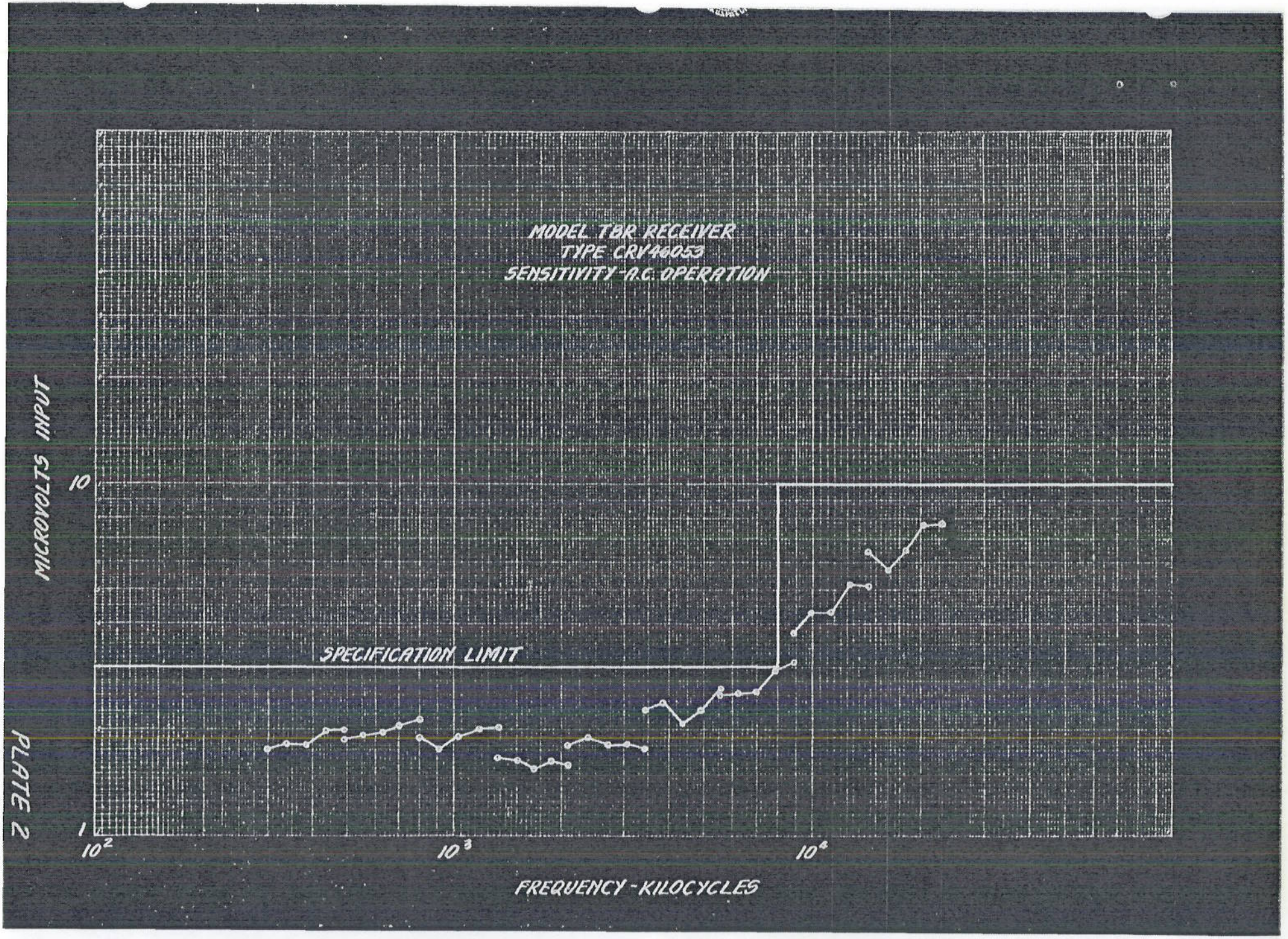
MODEL TBR RECEIVER
TYPE CRV46053
SENSITIVITY-A.C. OPERATION
MICROVOLTS INPUT
10
1
SPECIFICATION LIMIT
10^2
10^3
10^4
FREQUENCY-KILOCYCLES

PLATE 2

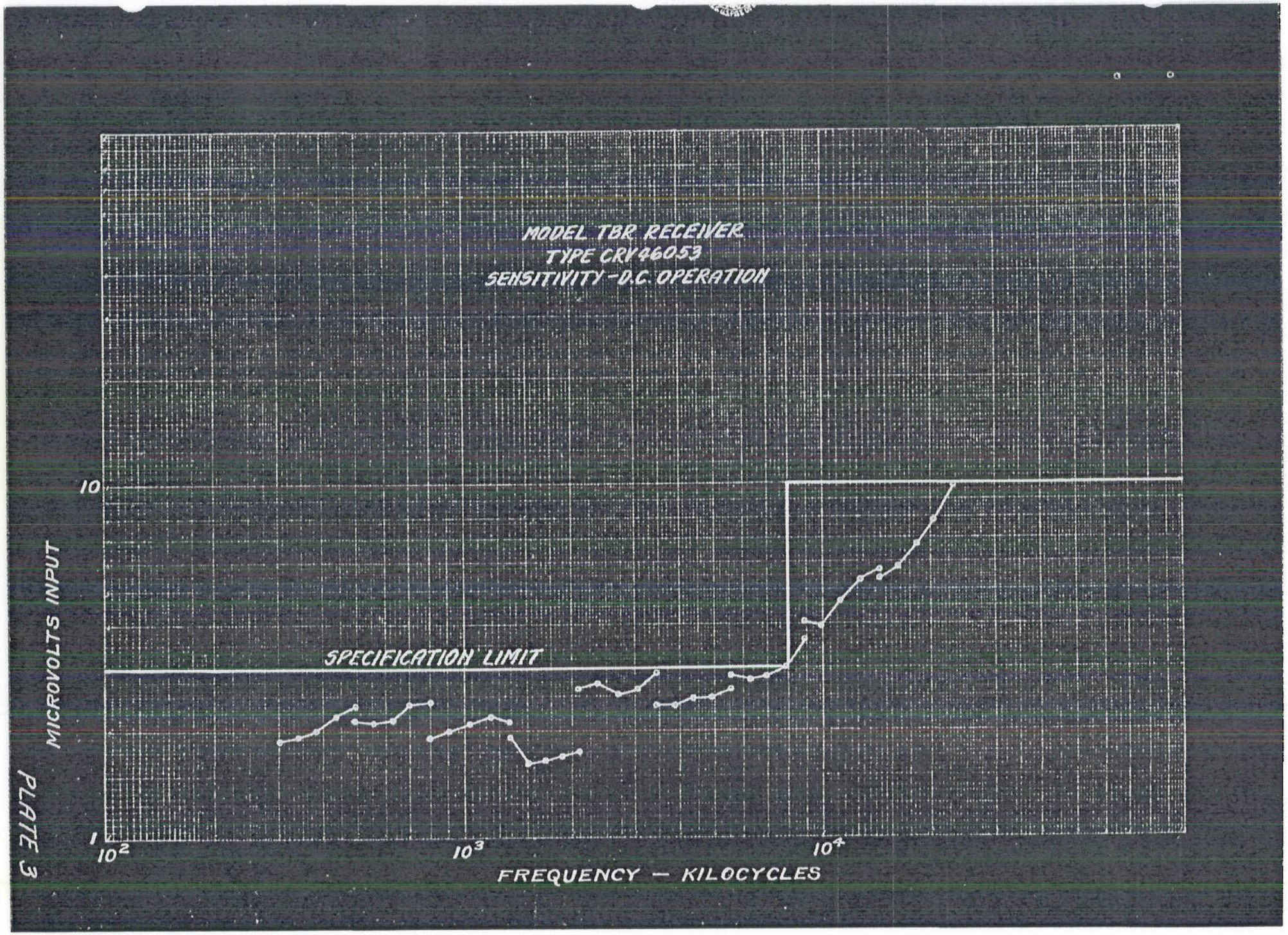
MODEL TBR RECEIVER
TYPE CRV46053
SENSITIVITY - D.C. OPERATION
SPECIFICATION LIMIT
MICROVOLTS INPUT
10
1
10^2
10^3
10^4
FREQUENCY — KILOCYCLES

PLATE 3

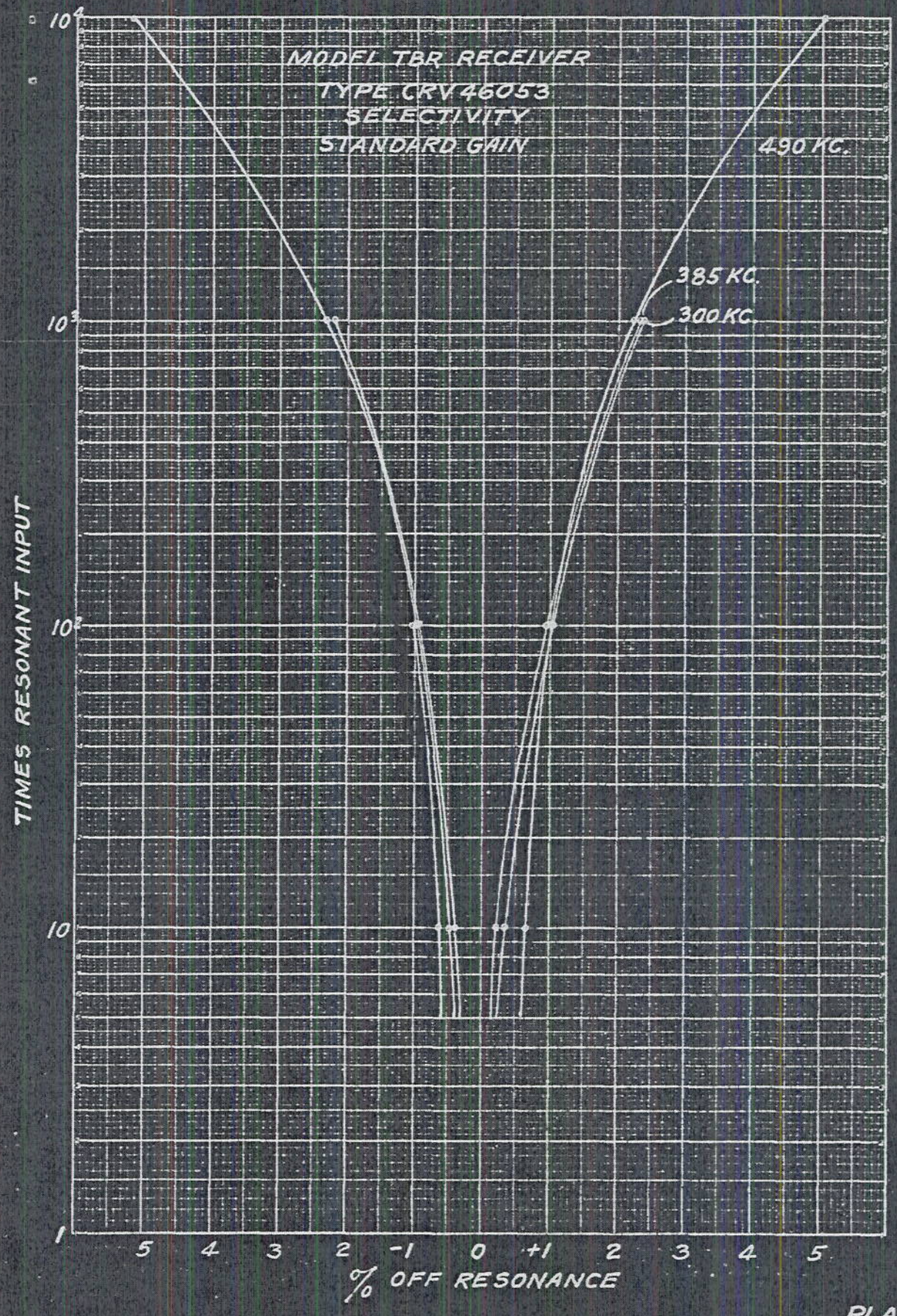
MODEL TBR RECEIVER
TYPE CRV46053
SELECTIVITY
STANDARD GAIN
490 KC.
385 KC.
300 KC.
10^4
10^3
10^2
10
1
TIMES RESONANT INPUT
5 4 3 2 -1 0 +1 2 3 4 5
% OFF RESONANCE

PLATE 4

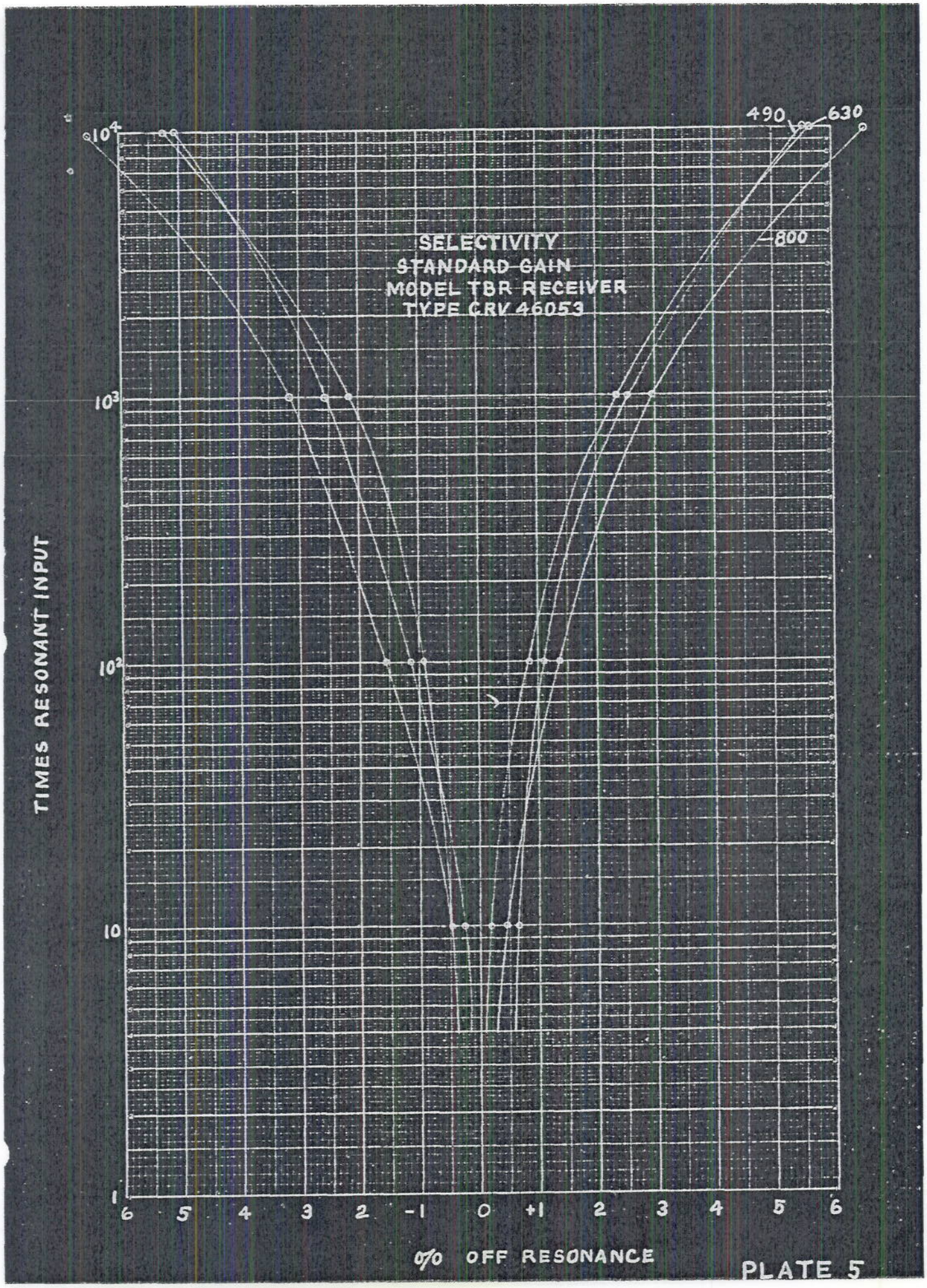
SELECTIVITY
STANDARD GAIN
MODEL TBR RECEIVER
TYPE CRV 46053
490
630
800
10^4
10^3
10^2
10
1
TIMES RESONANT INPUT
6 5 4 3 2 -1 0 +1 2 3 4 5 6
% OFF RESONANCE

PLATE 5

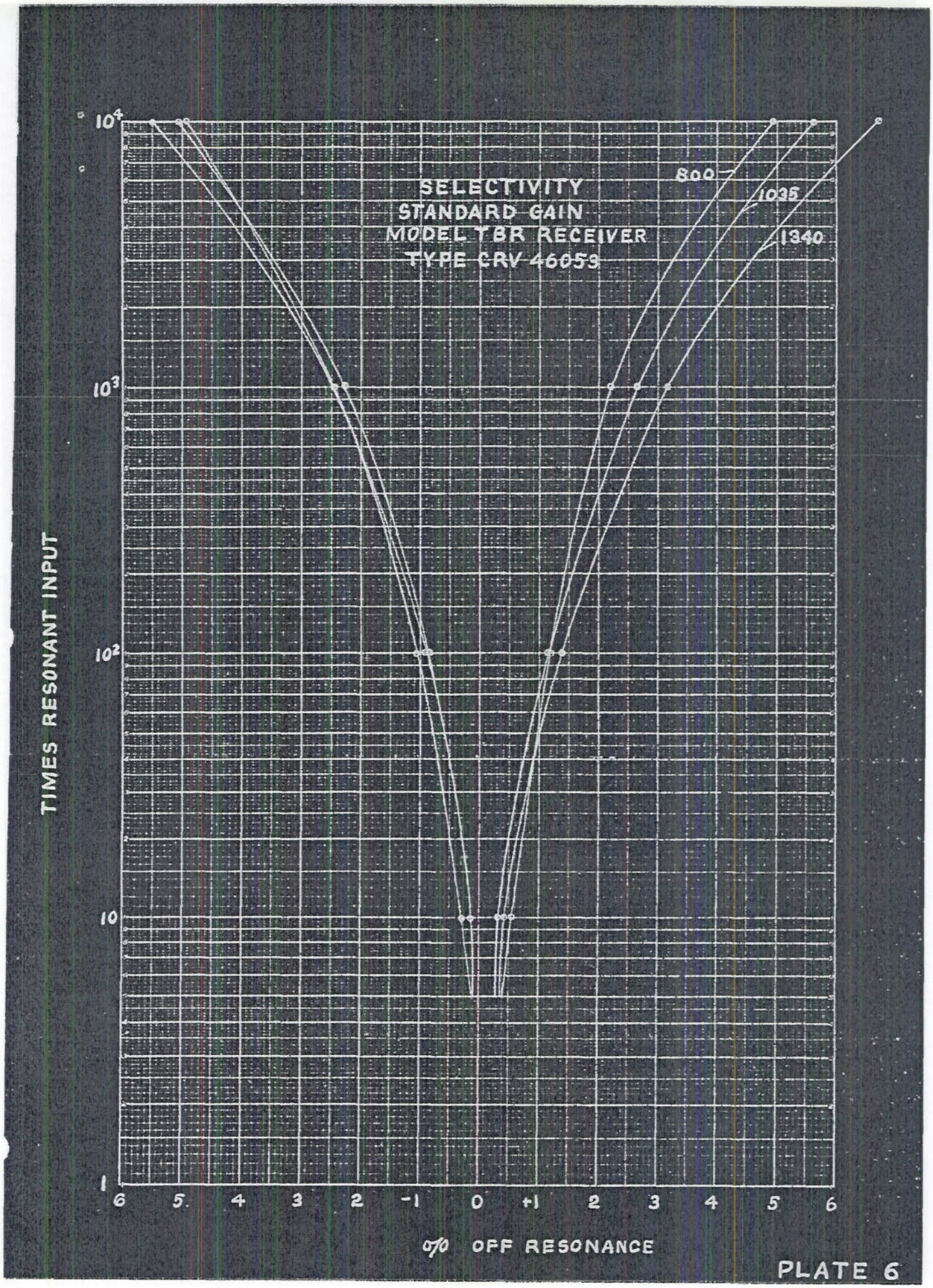
SELECTIVITY
STANDARD GAIN
MODEL TBR RECEIVER
TYPE CRV 46053
800
1035
1340
10^4
10^3
10^2
10
1
TIMES RESONANT INPUT
6
5
4
3
2
-1
0
+1
2
3
4
5
6
% OFF RESONANCE

PLATE 6

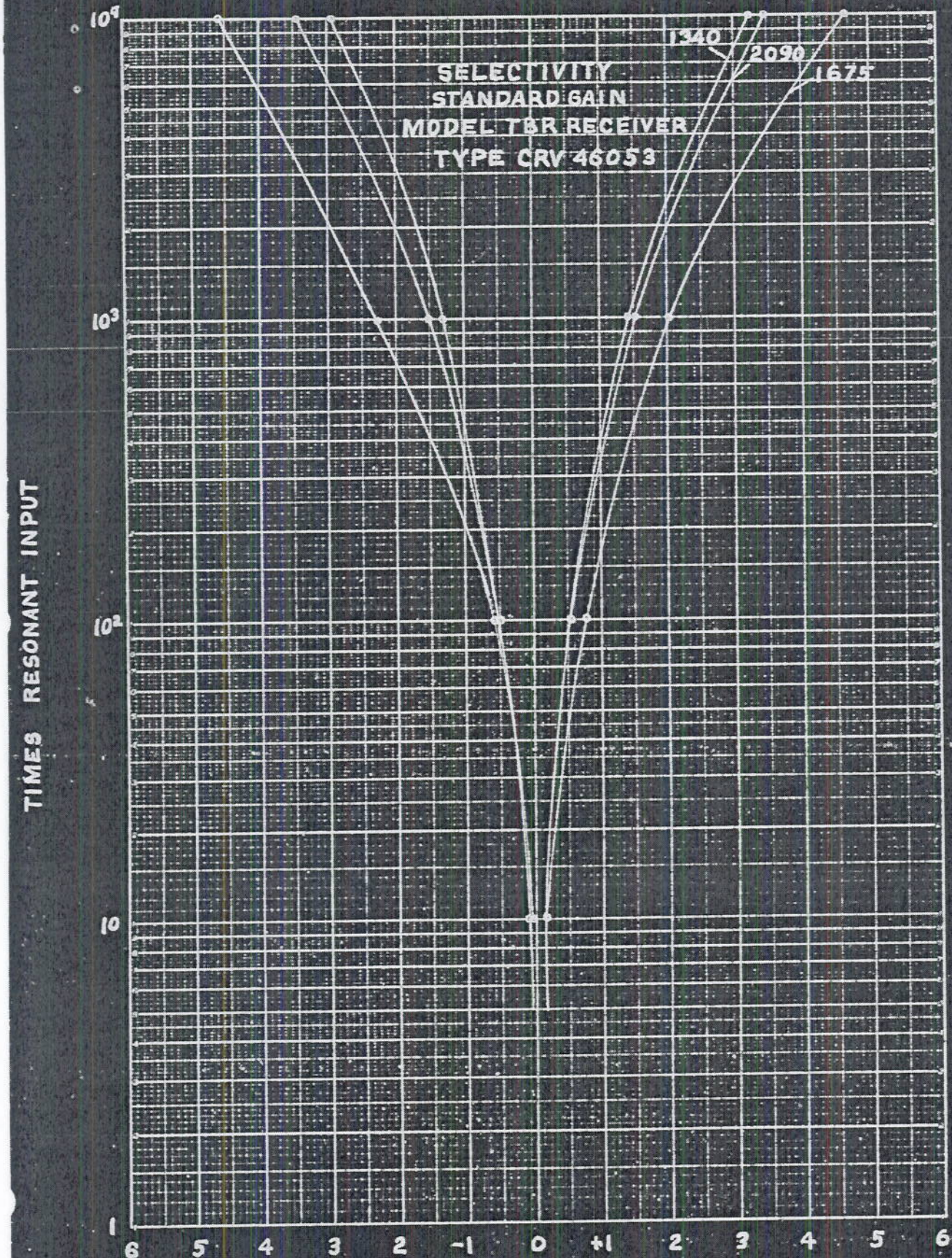
SELECTIVITY
STANDARD GAIN
MODEL T&R RECEIVER
TYPE CRV 46053
1340
2090
1675
TIMES RESONANT INPUT
10⁴
10³
10²
10
1
6 5 4 3 2 -1 0 +1 2 3 4 5 6
% OFF RESONANCE

PLATE 7

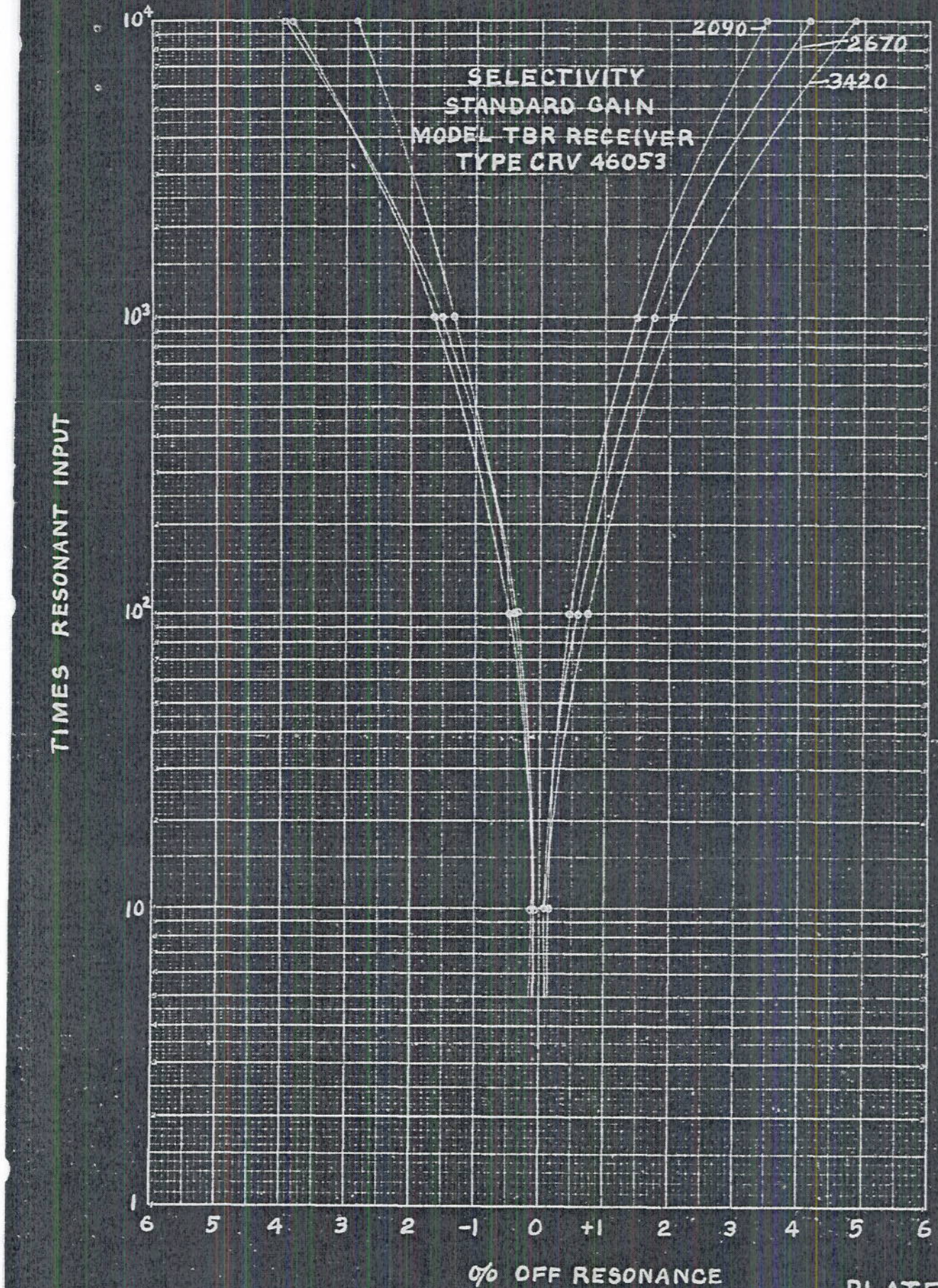
SELECTIVITY
STANDARD GAIN
MODEL TBR RECEIVER
TYPE CRV 46053
2090
2670
3420
10^4
10^3
10^2
10
1
TIMES RESONANT INPUT
6 5 4 3 2 -1 0 +1 2 3 4 5 6
% OFF RESONANCE

PLATE 8

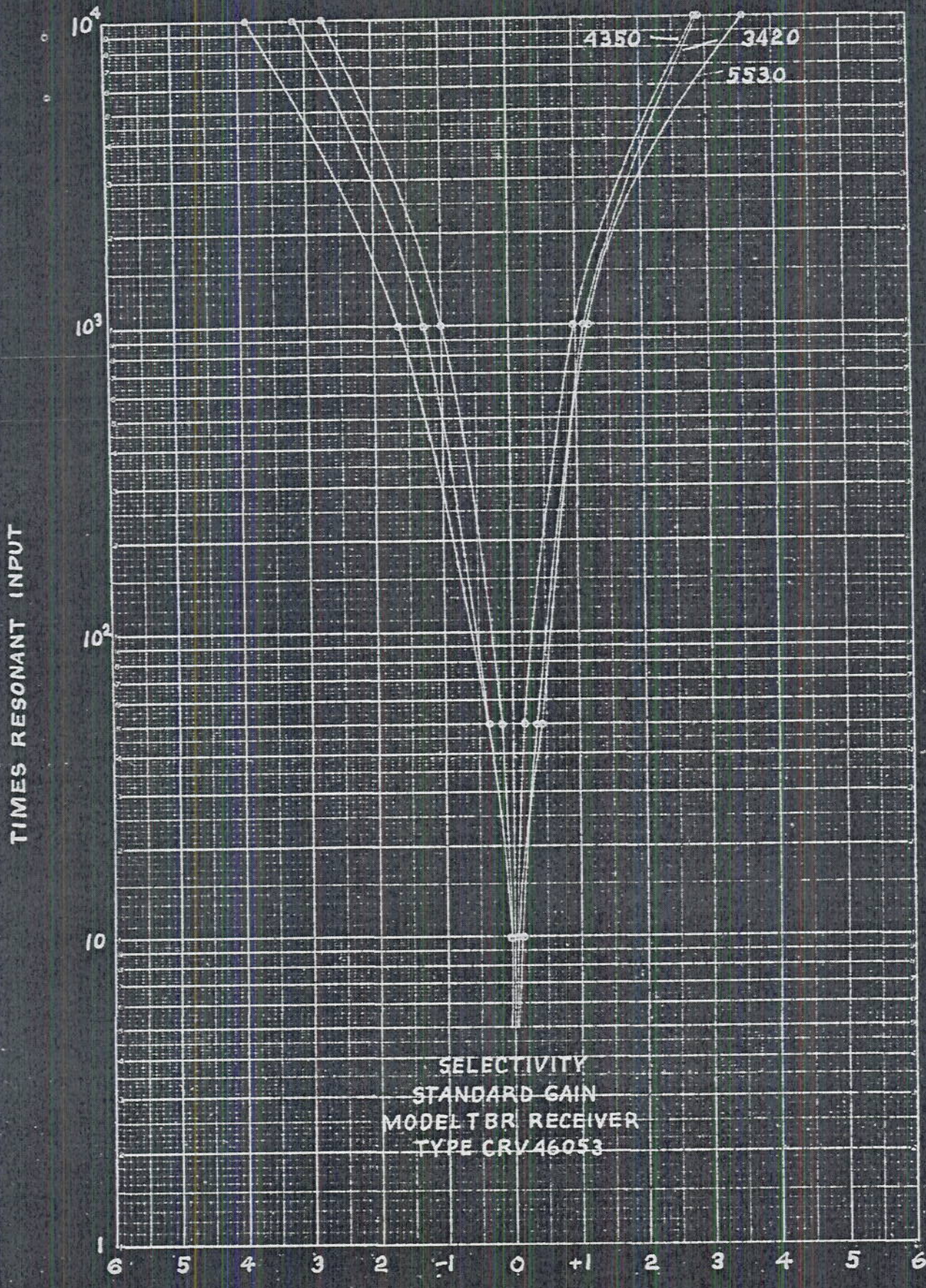
4350
3420
5530
10^4
10^3
10^2
10
1
TIMES RESONANT INPUT
6 5 4 3 2 -1 0 +1 2 3 4 5 6
% OFF RESONANCE
SELECTIVITY
STANDARD GAIN
MODEL T BR RECEIVER
TYPE CRV 46053

PLATE 9

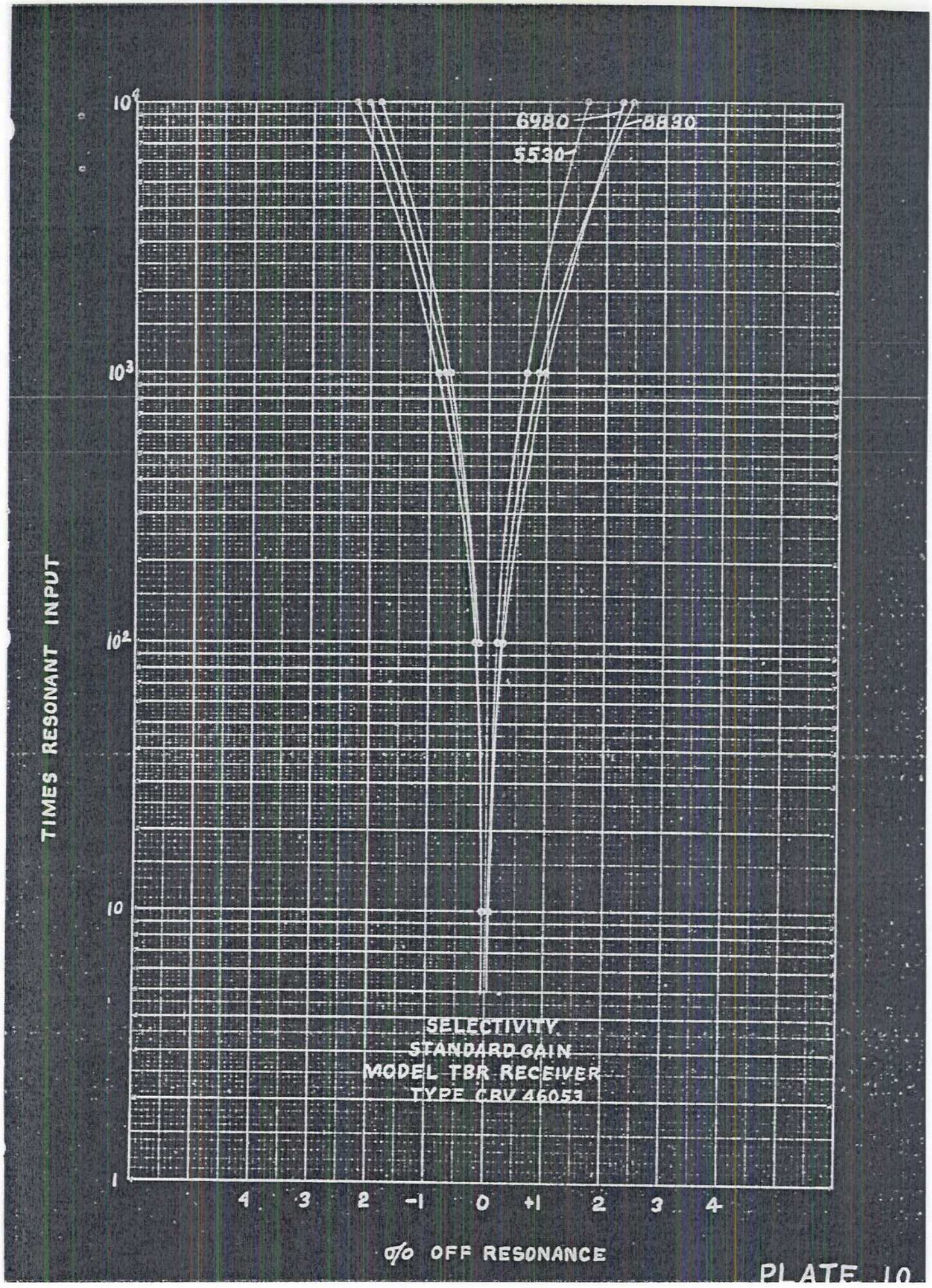
10⁴
10³
10²
10
1
TIMES RESONANT INPUT
6980
8830
5530
SELECTIVITY
STANDARD GAIN
MODEL TBR RECEIVER
TYPE CRV 46053
4 3 2 -1 0 +1 2 3 4
% OFF RESONANCE

PLATE 10

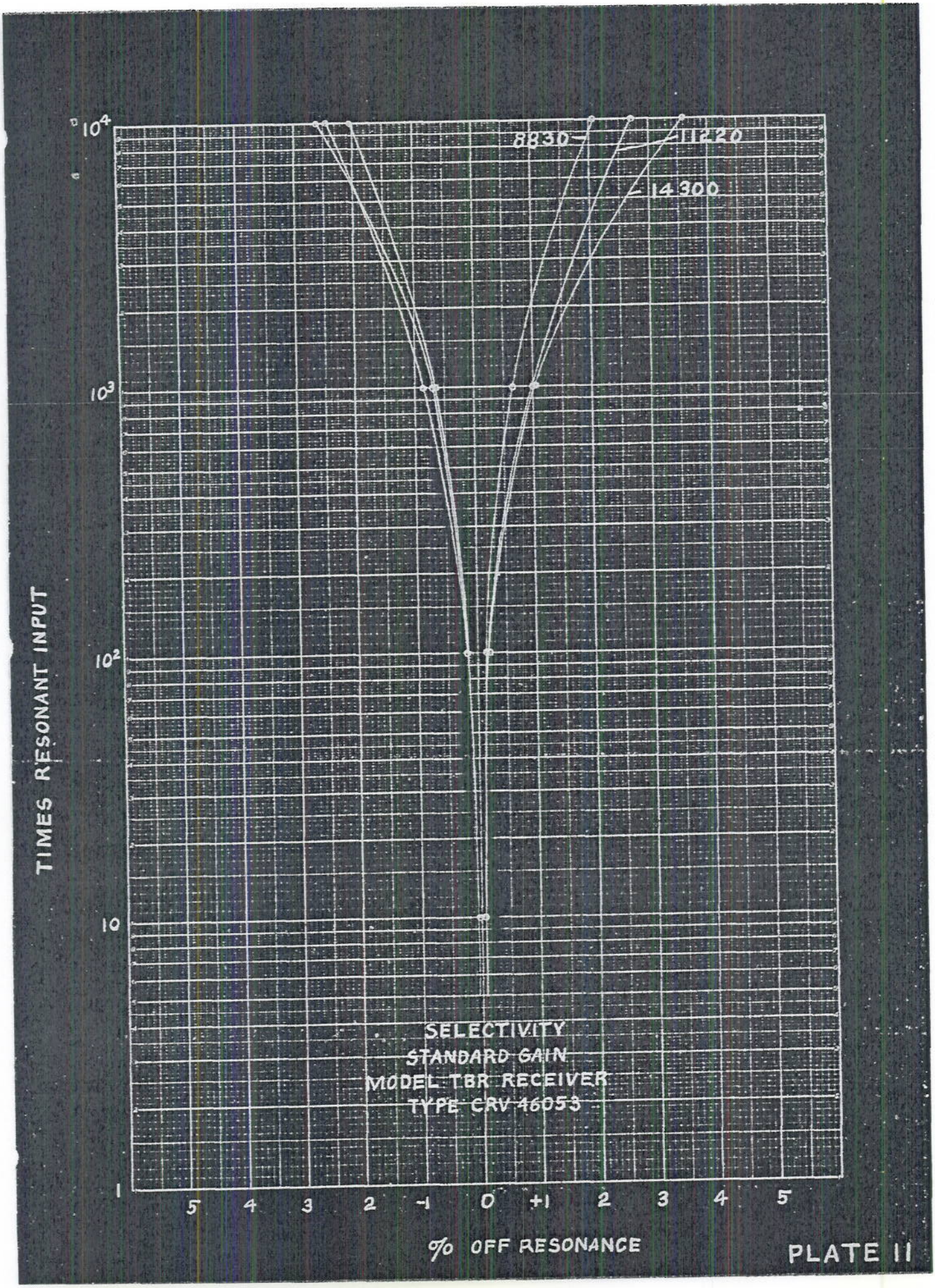
10⁴
10³
10²
10
1
TIMES RESONANT INPUT
8830
11220
14300
SELECTIVITY
STANDARD GAIN
MODEL TBR RECEIVER
TYPE CRV 46053
5 4 3 2 -1 0 +1 2 3 4 5
% OFF RESONANCE

PLATE II

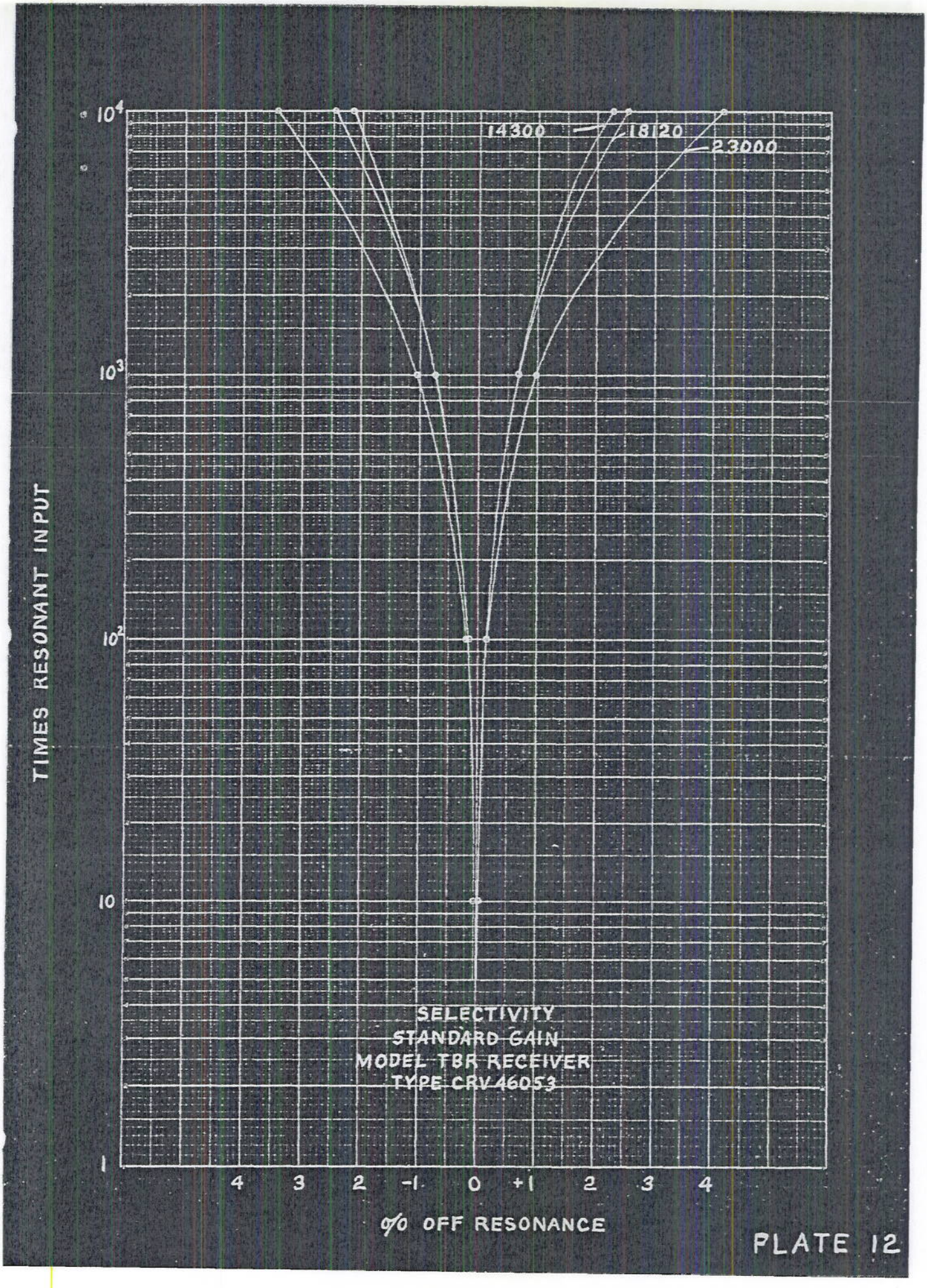
14300
18120
23000
10^4
10^3
10^2
10
1
TIMES RESONANT INPUT
SELECTIVITY
STANDARD GAIN
MODEL TBR RECEIVER
TYPE CRV 46053
4 3 2 -1 0 +1 2 3 4
% OFF RESONANCE

PLATE 12

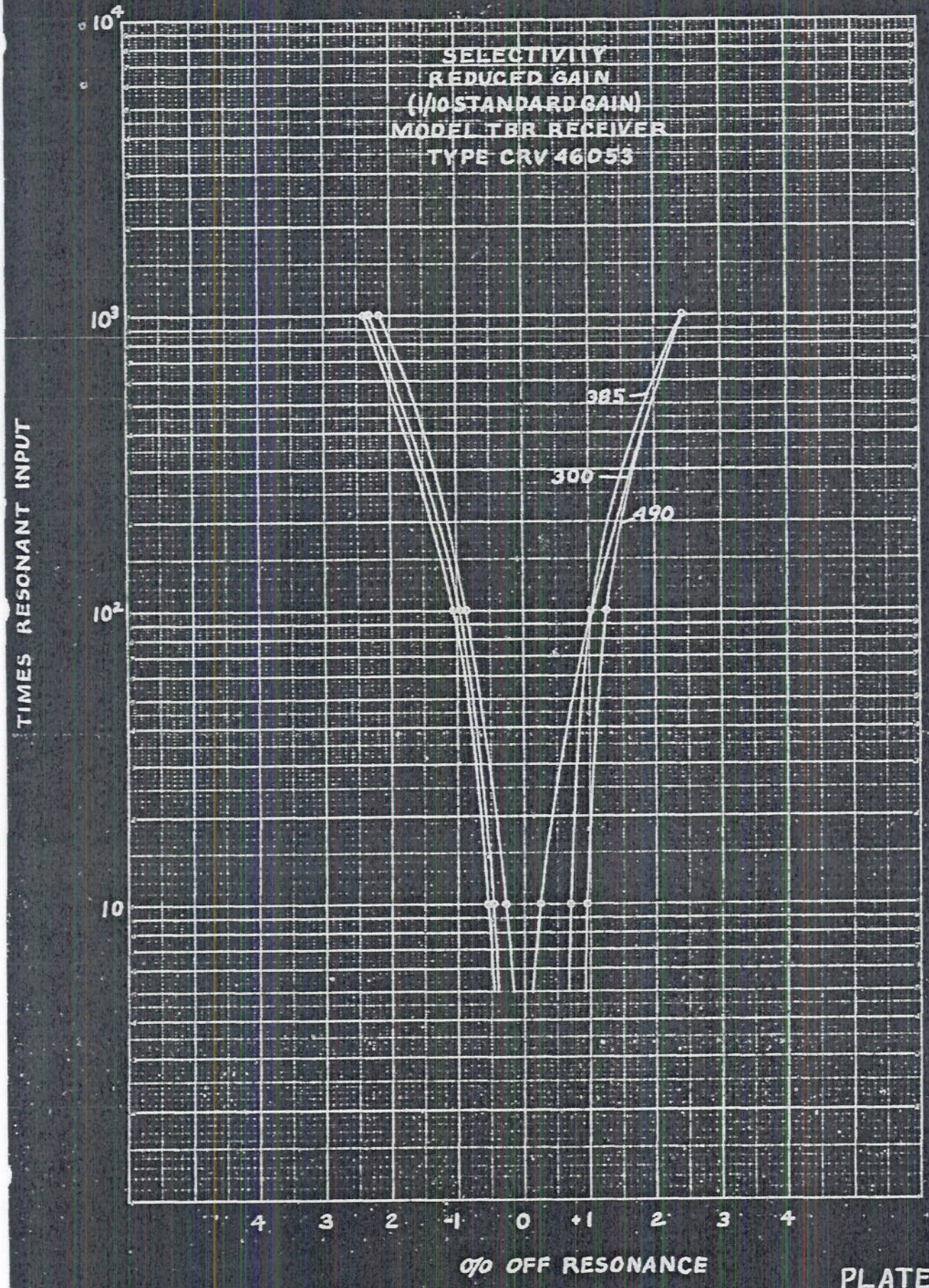
SELECTIVITY
REDUCED GAIN
(1/10 STANDARD GAIN)
MODEL TBR RECEIVER
TYPE CRV 46053
10^4
10^3
10^2
10
385
300
490
TIMES RESONANT INPUT
4
3
2
1
0
+1
2
3
4
% OFF RESONANCE

PLATE 13

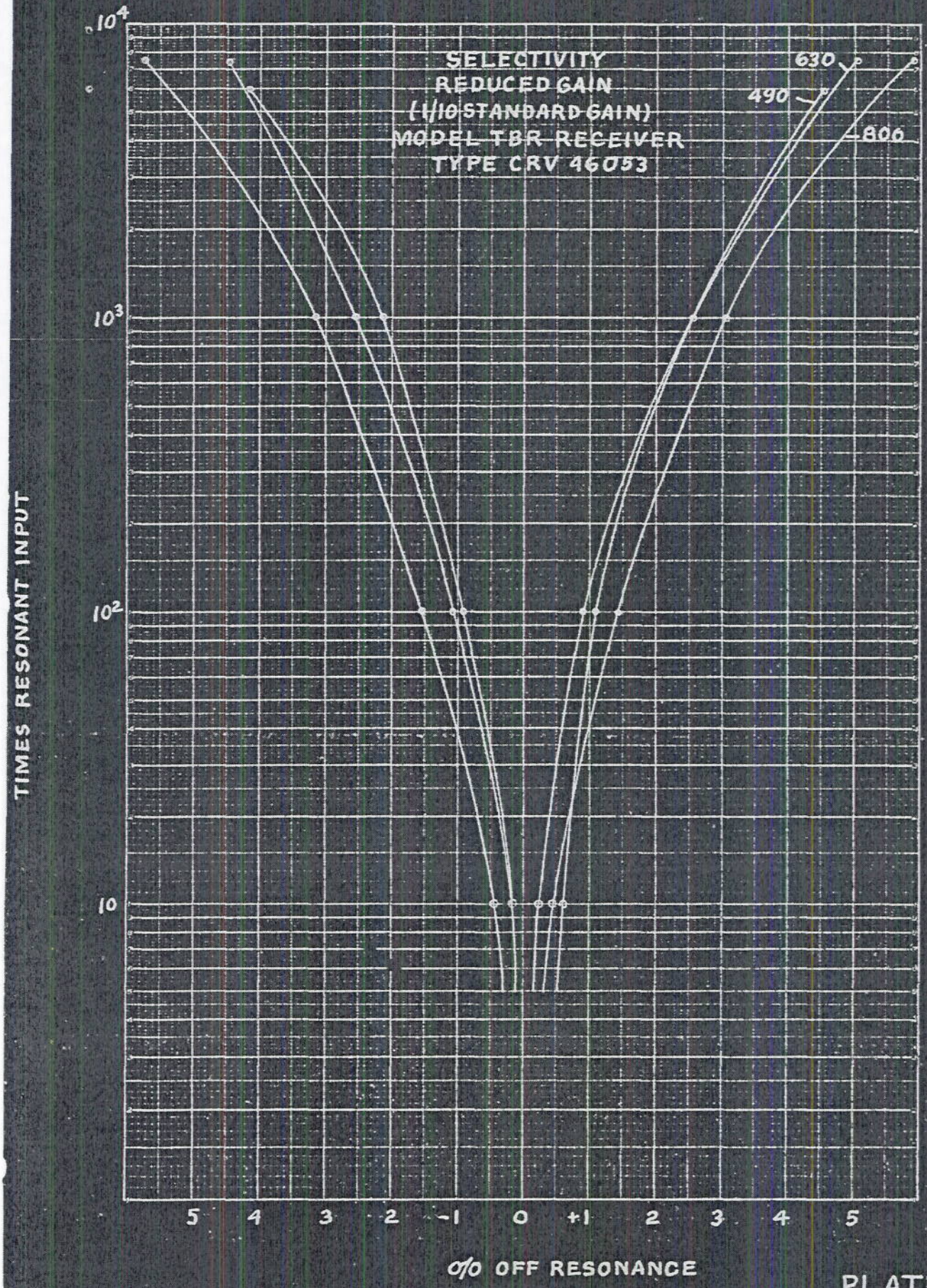
SELECTIVITY
REDUCED GAIN
(1/10 STANDARD GAIN)
MODEL TBR RECEIVER
TYPE CRV 46053
630
490
806
10^4
10^3
10^2
10
TIMES RESONANT INPUT
5 4 3 2 1 0 +1 2 3 4 5
% OFF RESONANCE

PLATE 14

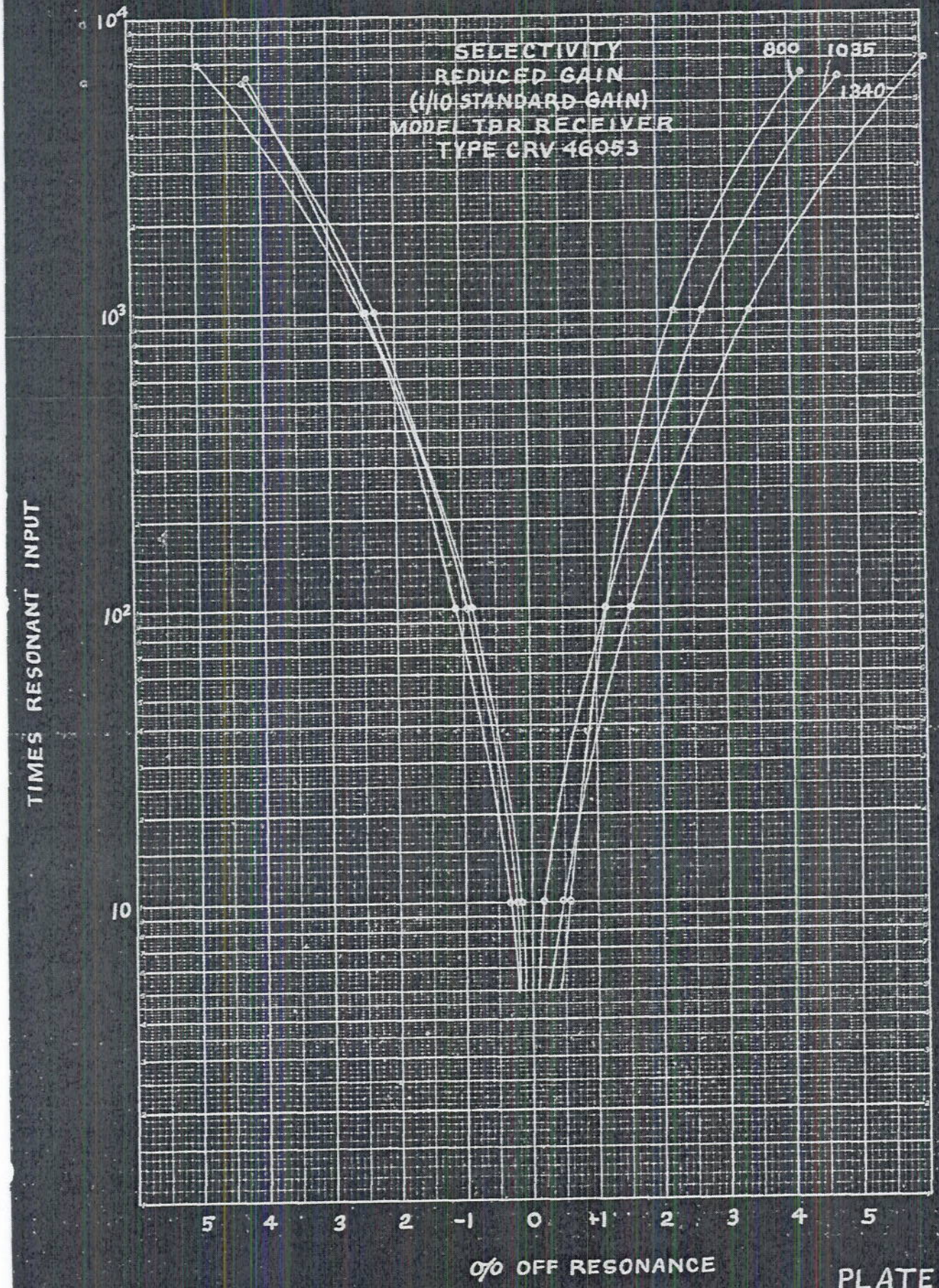
SELECTIVITY
REDUCED GAIN
(1/10 STANDARD GAIN)
MODEL TBR RECEIVER
TYPE CRV 46053
800
1035
1340
10^4
10^3
10^2
10
TIMES RESONANT INPUT
5
4
3
2
-1
0
+1
2
3
4
5
% OFF RESONANCE

PLATE 15

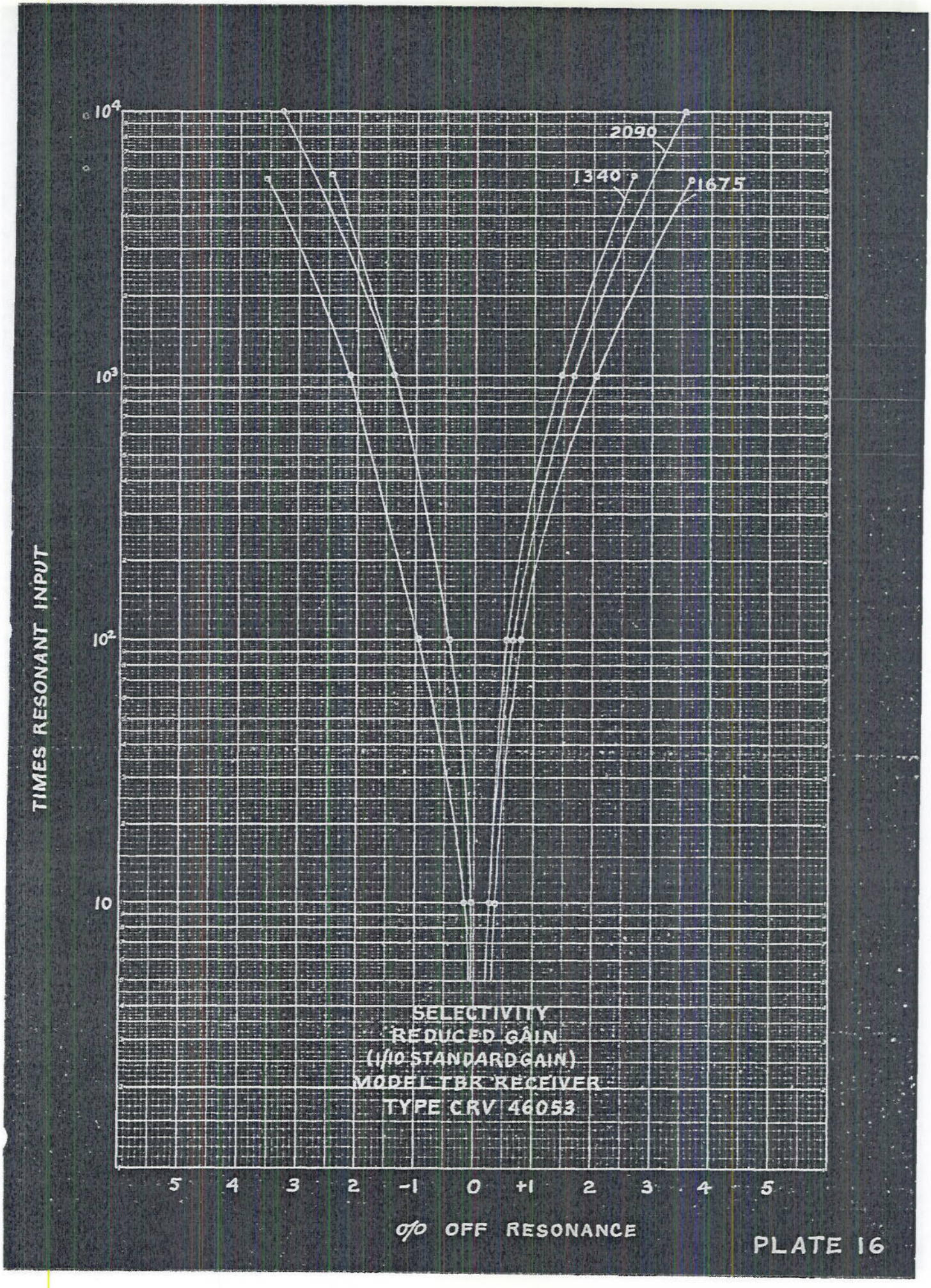
TIMES RESONANT INPUT
10^4
10^3
10^2
10
2090
1340
1675
SELECTIVITY
REDUCED GAIN
(1/10 STANDARD GAIN)
MODEL TBR RECEIVER
TYPE CRV 46053
5 4 3 2 -1 0 +1 2 3 4 5
% OFF RESONANCE

PLATE 16

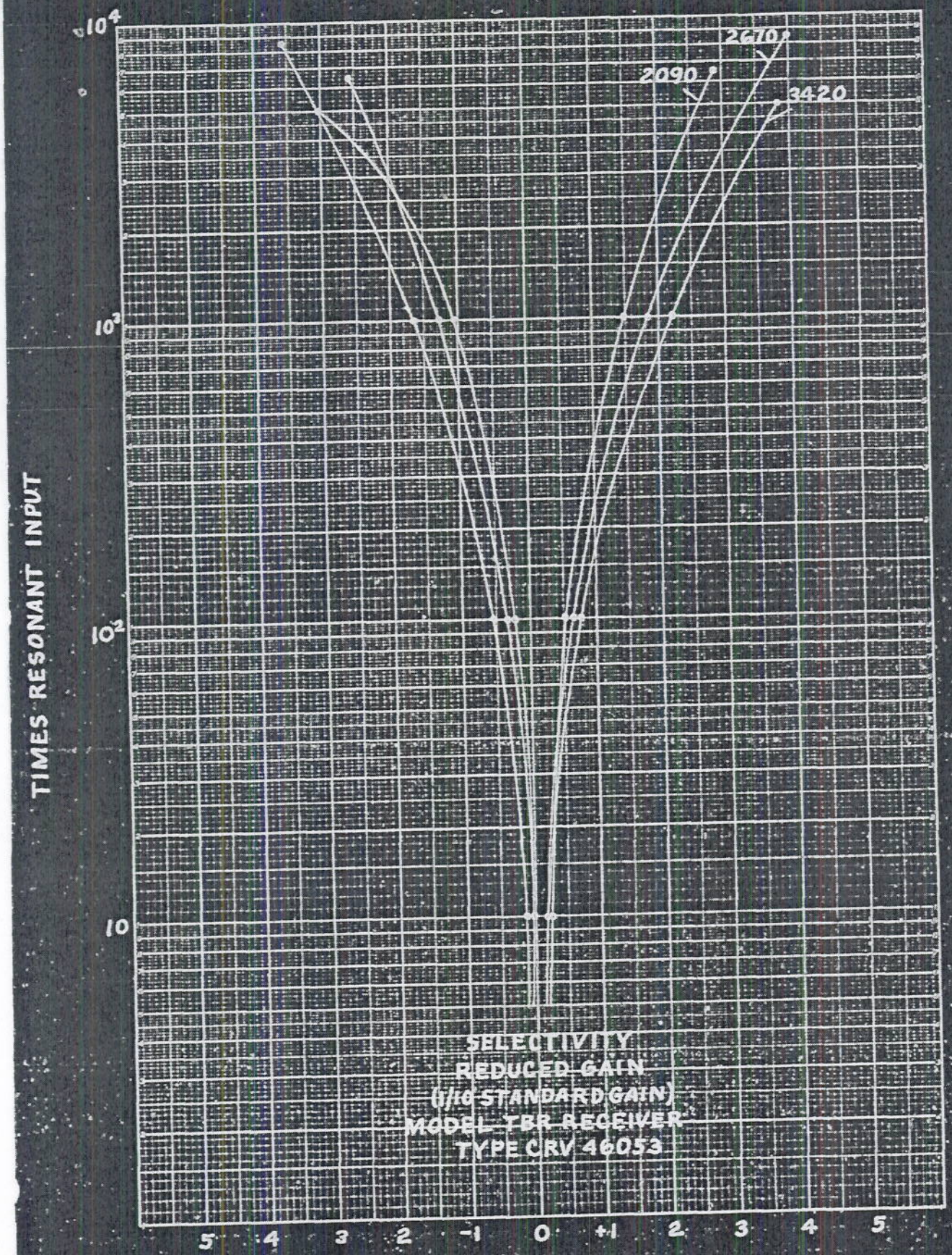
10^4
10^3
10^2
10
TIMES RESONANT INPUT
2670
2090
3420
SELECTIVITY
REDUCED GAIN
(1/10 STANDARD GAIN)
MODEL TBR RECEIVER
TYPE CRV 46053
5 4 3 2 1 0 +1 2 3 4 5
% OFF RESONANCE

PLATE 17

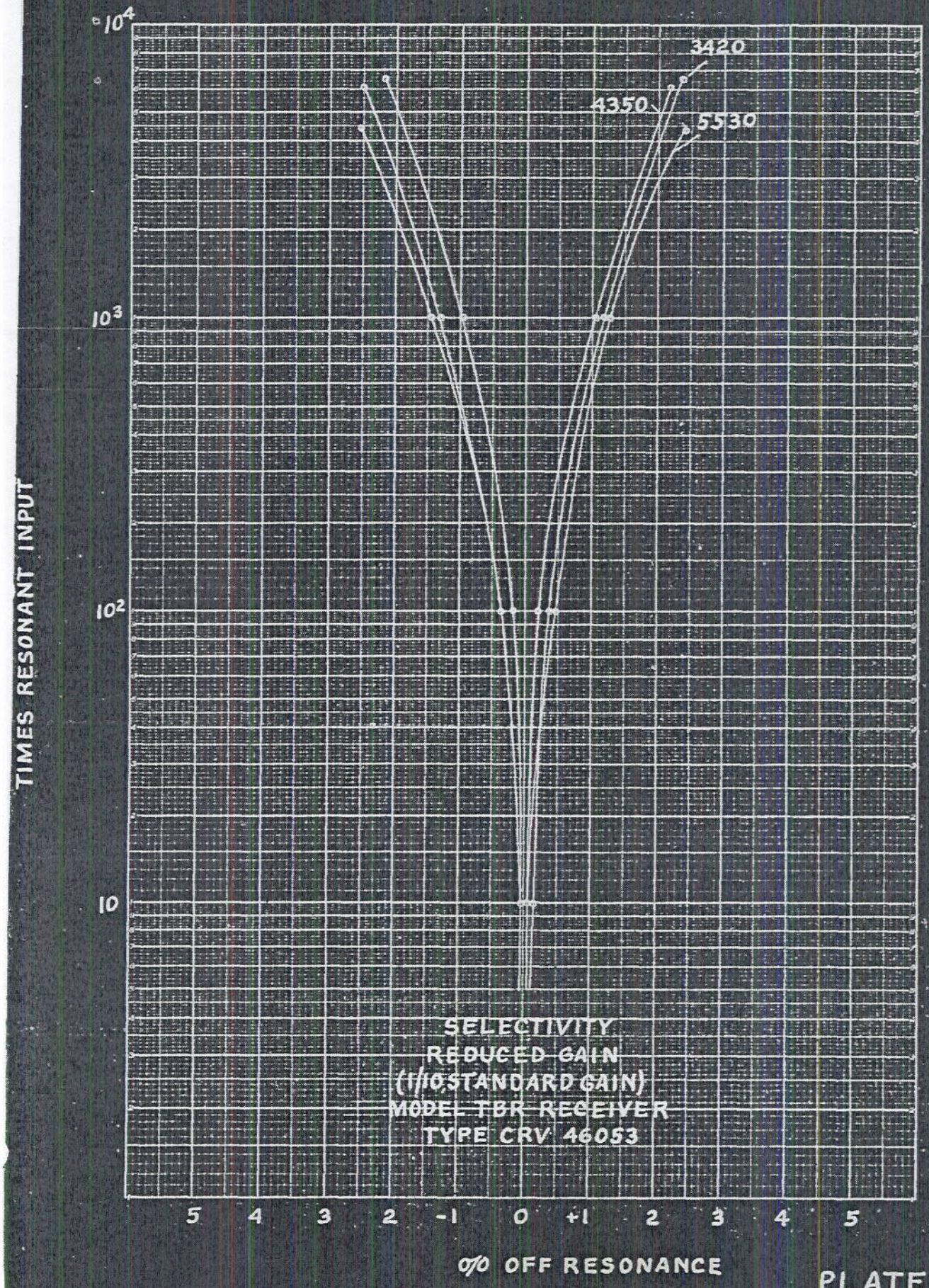
10^4
10^3
10^2
10
TIMES RESONANT INPUT
3420
4350
5530
SELECTIVITY
REDUCED GAIN
(1/10 STANDARD GAIN)
MODEL TBR RECEIVER
TYPE CRV 46053
5 4 3 2 -1 0 +1 2 3 4 5
% OFF RESONANCE

PLATE 18

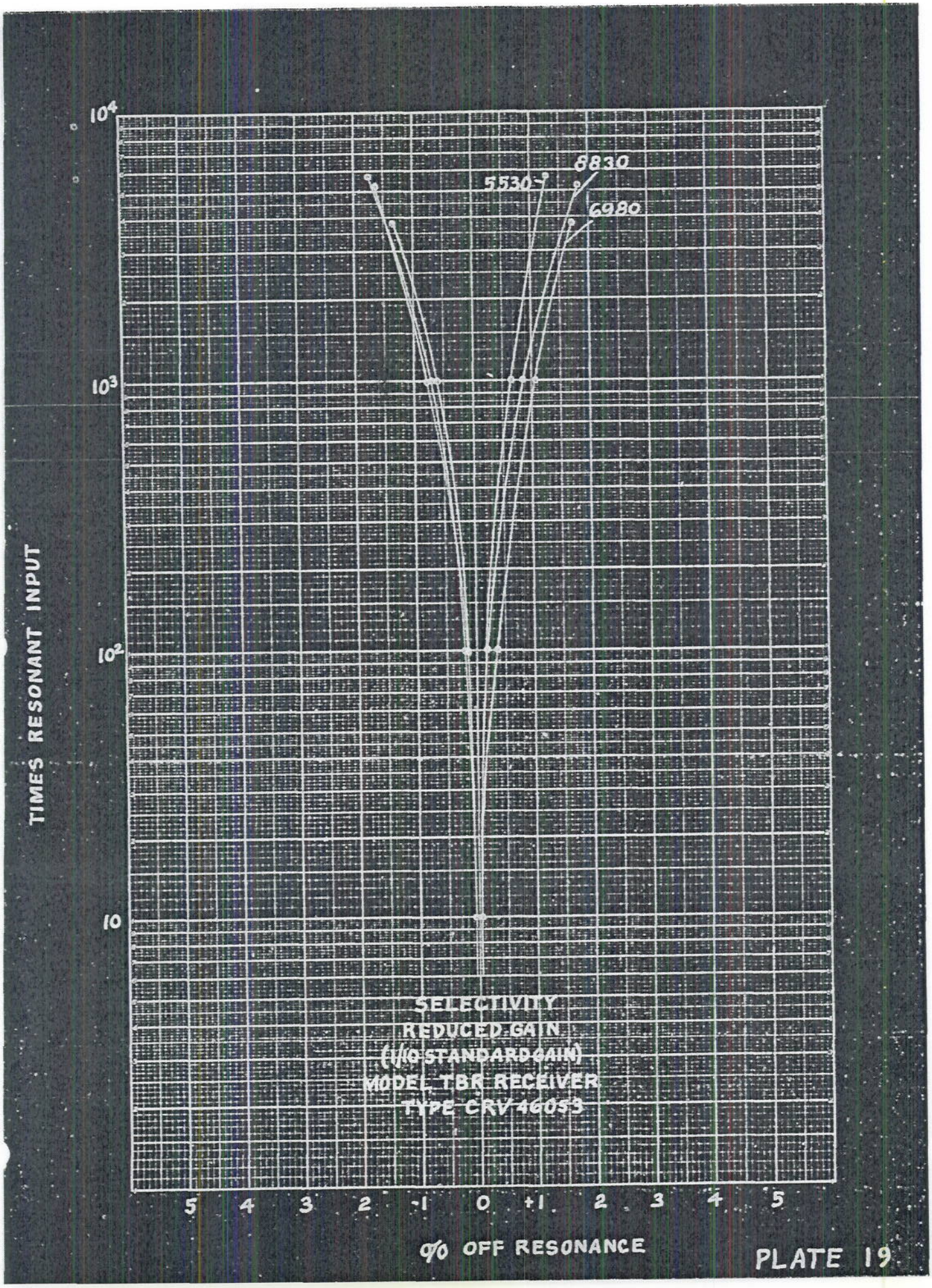
10⁴
10³
10²
10
TIMES RESONANT INPUT
8830
5530
6980
SELECTIVITY
REDUCED GAIN
(1/10 STANDARD GAIN)
MODEL TBR RECEIVER
TYPE CRV 46053
5 4 3 2 -1 0 +1 2 3 4 5
% OFF RESONANCE

PLATE 19

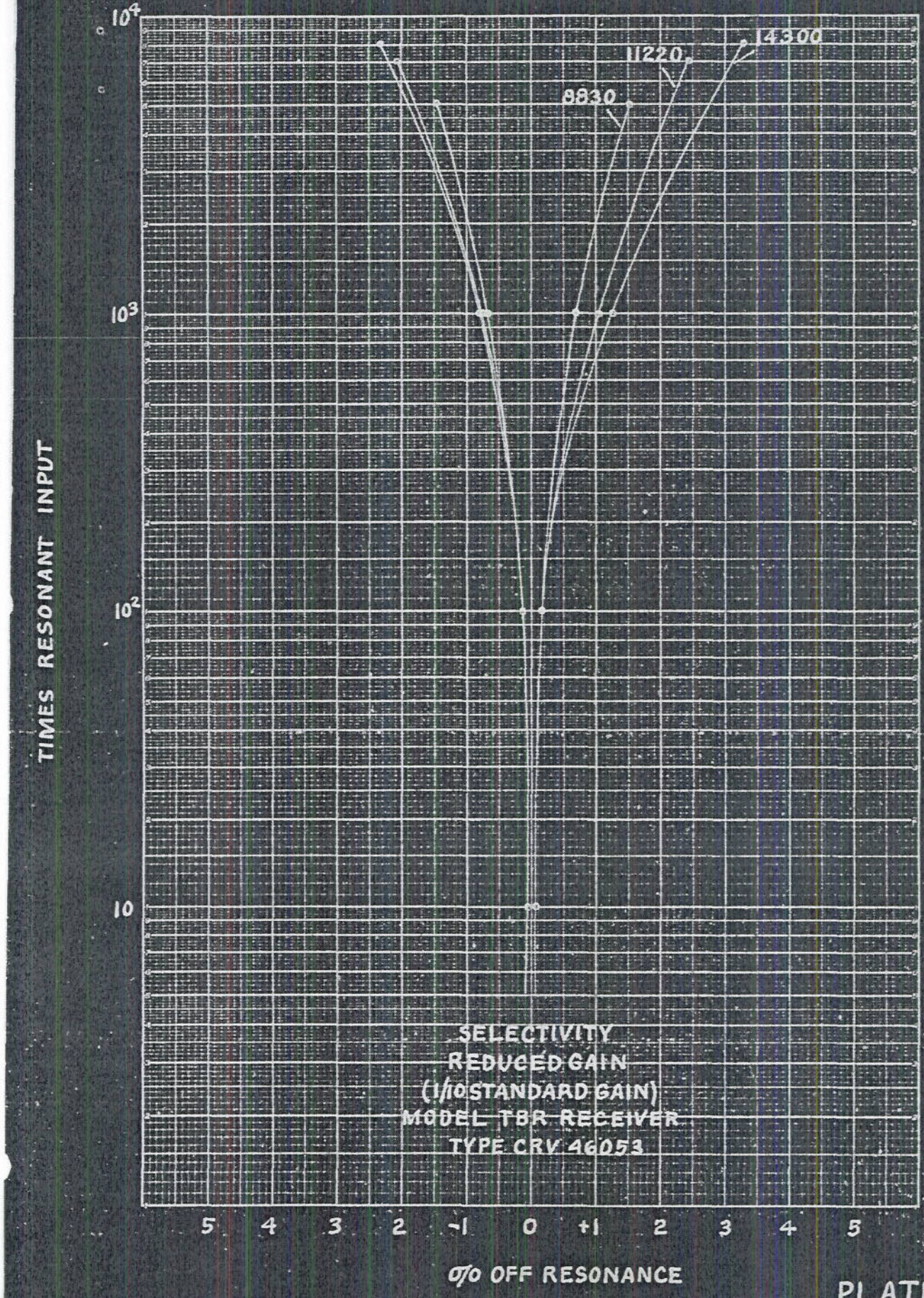
TIMES RESONANT INPUT
10^4
10^3
10^2
10
14300
11220
8830
SELECTIVITY
REDUCED GAIN
(1/10 STANDARD GAIN)
MODEL TBR RECEIVER
TYPE CRV 46053
5 4 3 2 -1 0 +1 2 3 4 5
% OFF RESONANCE

PLATE 20

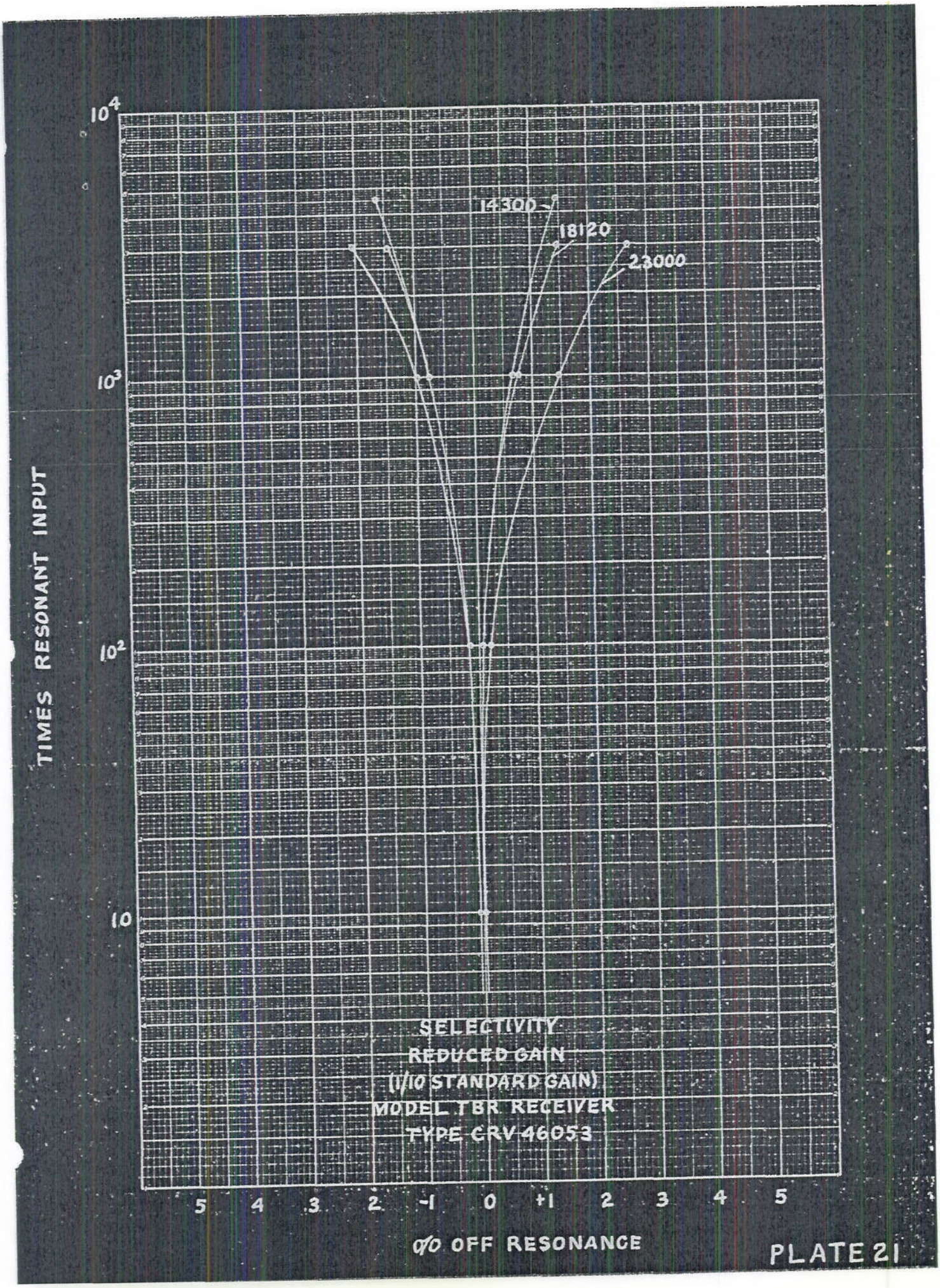
10^4
10^3
10^2
10
TIMES RESONANT INPUT
14300
18120
23000
SELECTIVITY
REDUCED GAIN
(1/10 STANDARD GAIN)
MODEL TBR RECEIVER
TYPE CRV 46053
5 4 3 2 -1 0 +1 2 3 4 5
% OFF RESONANCE

PLATE 21

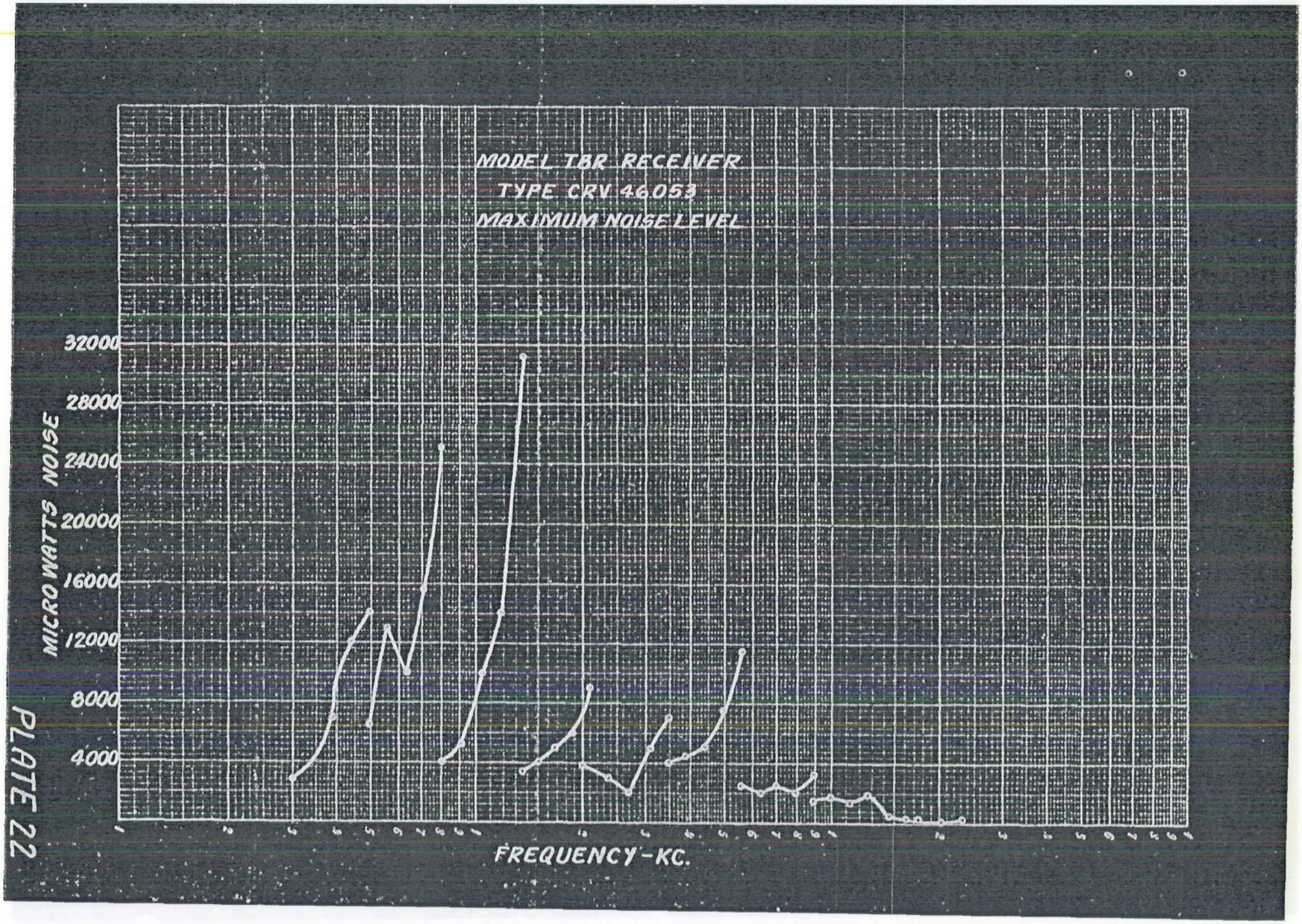
MODEL TBR RECEIVER
TYPE CRV 46053
MAXIMUM NOISE LEVEL
MICRO WATTS NOISE
32000
28000
24000
20000
16000
12000
8000
4000
FREQUENCY - KC.

PLATE 22

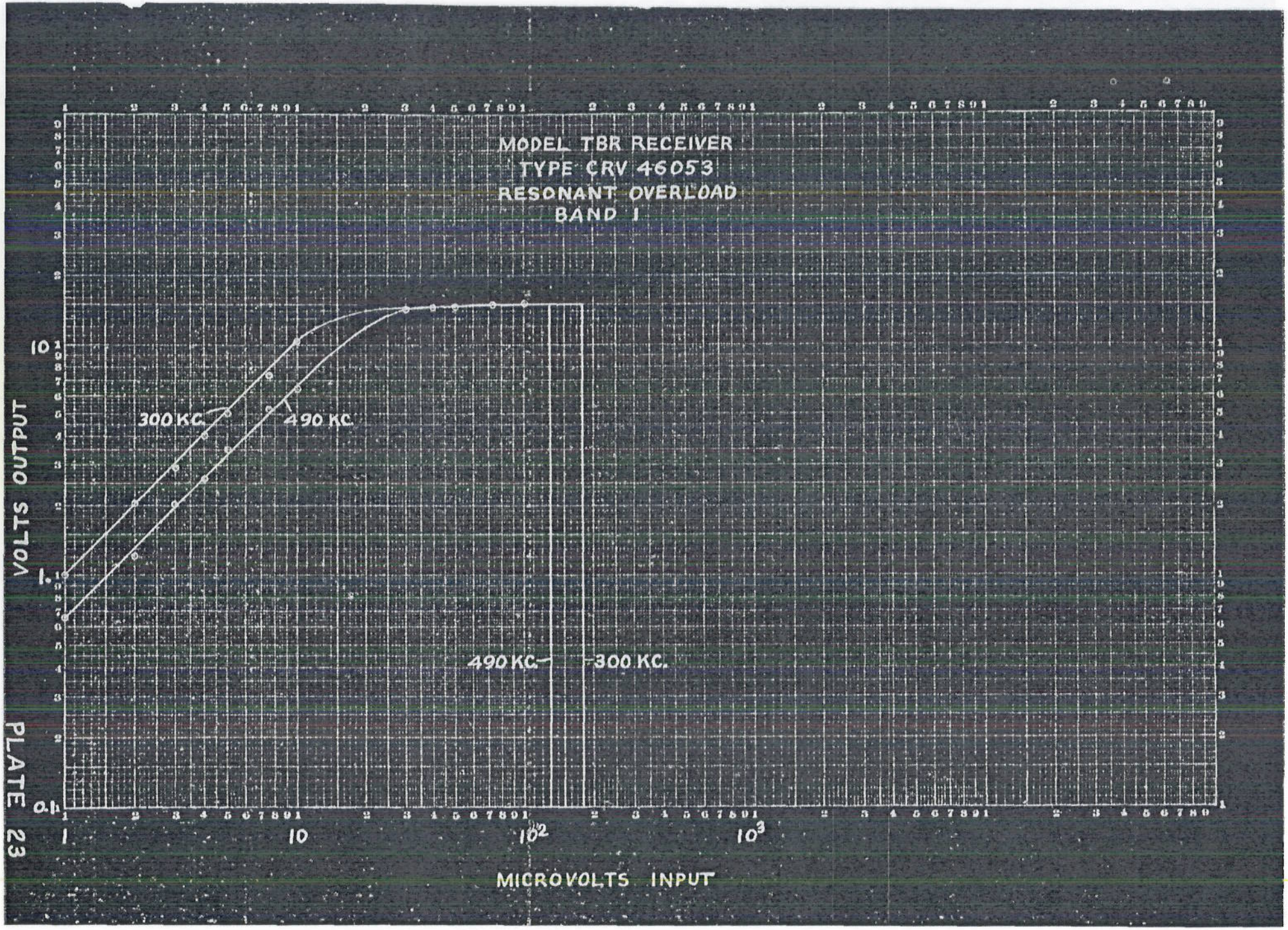
MODEL TBR RECEIVER
TYPE CRV 46053
RESONANT OVERLOAD
BAND I
300 KC.
490 KC.
490 KC.
300 KC.
VOLTS OUTPUT
MICROVOLTS INPUT
10
1.
0.1
1
10
10^2
10^3

PLATE 23

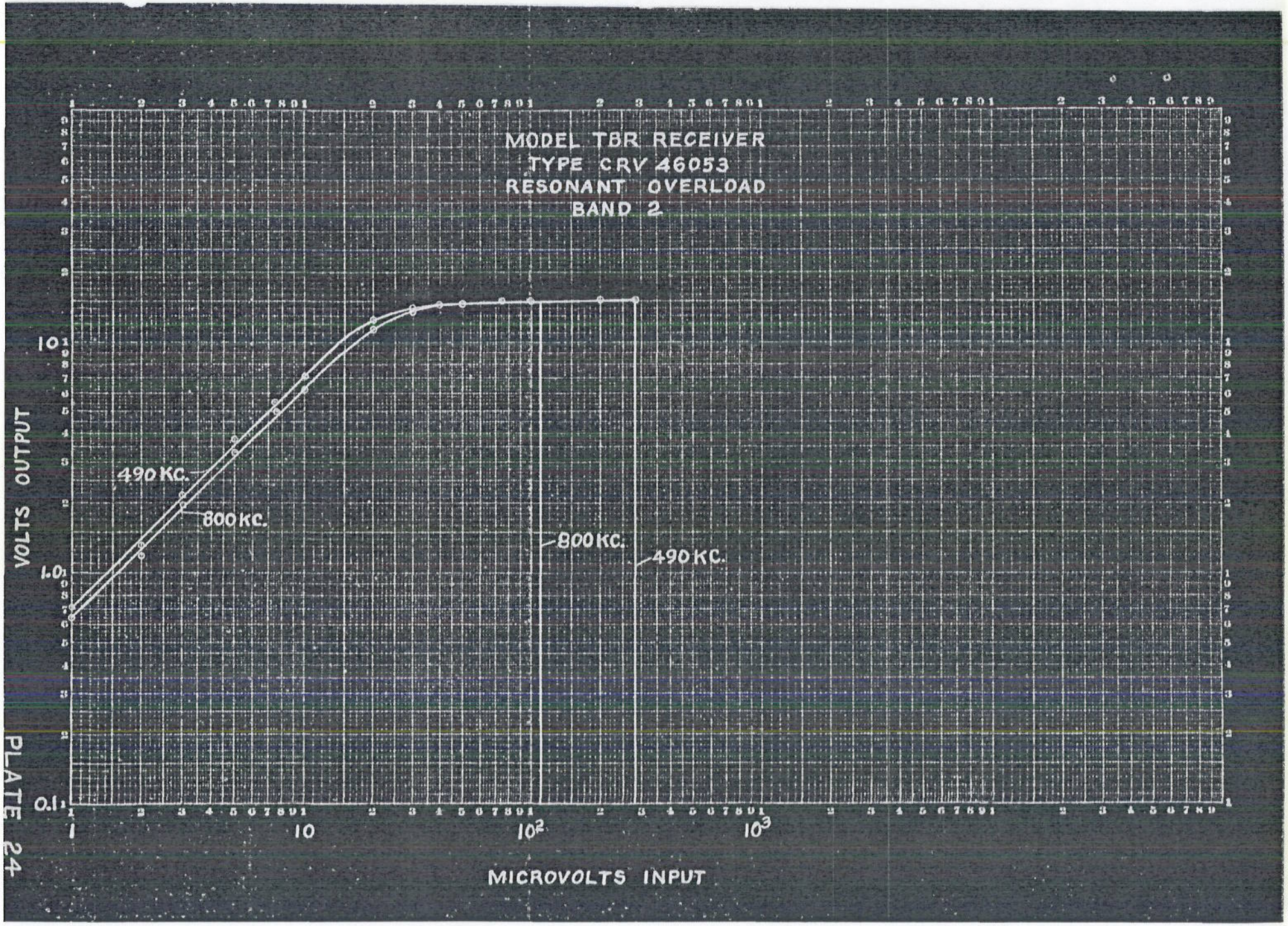
MODEL TBR RECEIVER
TYPE CRV 46053
RESONANT OVERLOAD
BAND 2
490 KC.
800 KC.
800 KC.
490 KC.
VOLTS OUTPUT
10
1.0
0.1
1
10
10^2
10^3
MICROVOLTS INPUT

PLATE 24

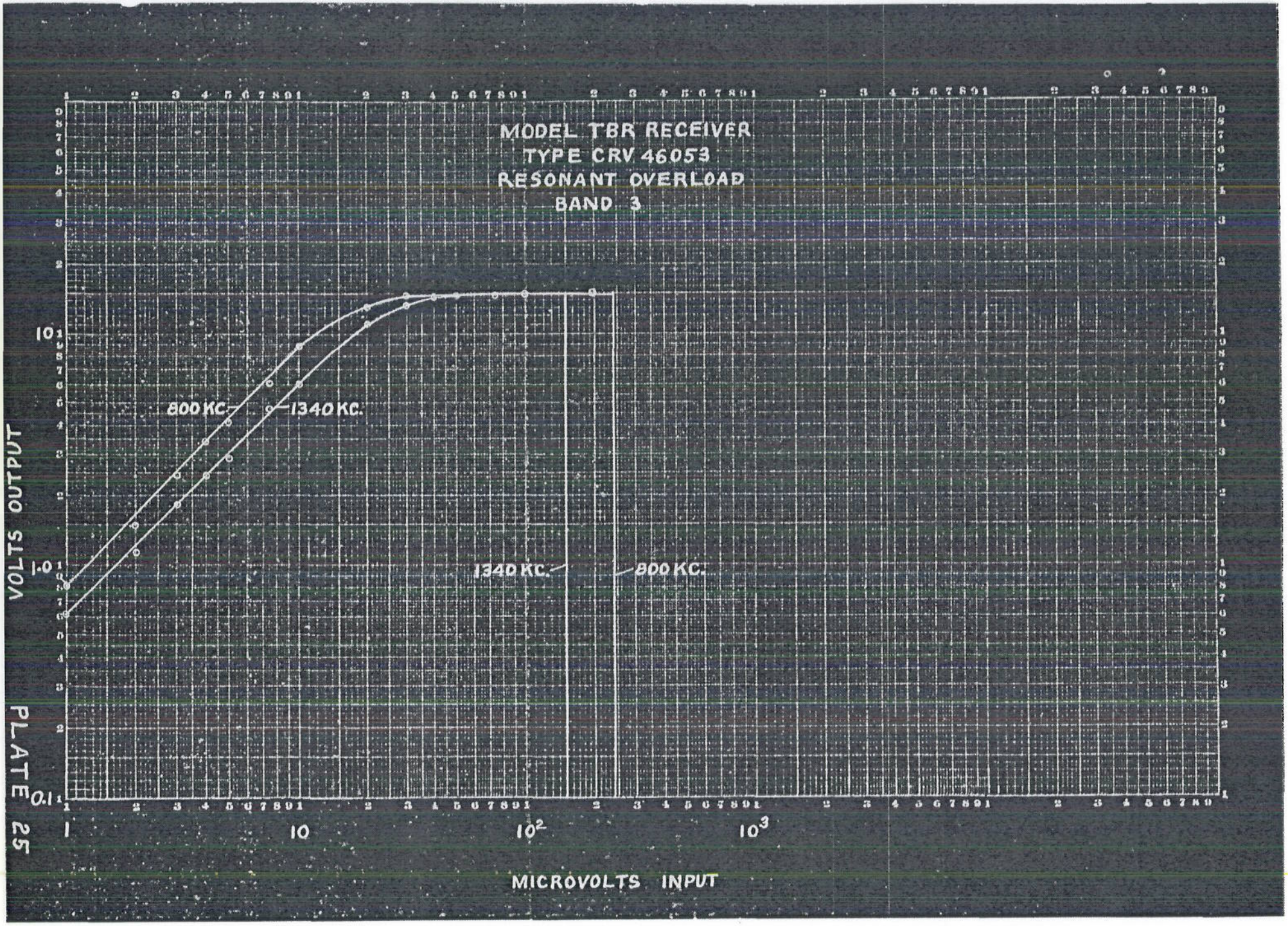
MODEL TBR RECEIVER
TYPE CRV 46053
RESONANT OVERLOAD
BAND 3
800 KC.
1340 KC.
1340 KC.
800 KC.
VOLTS OUTPUT
MICROVOLTS INPUT
10
1.0
0.1
1
10
10^2
10^3

PLATE 25

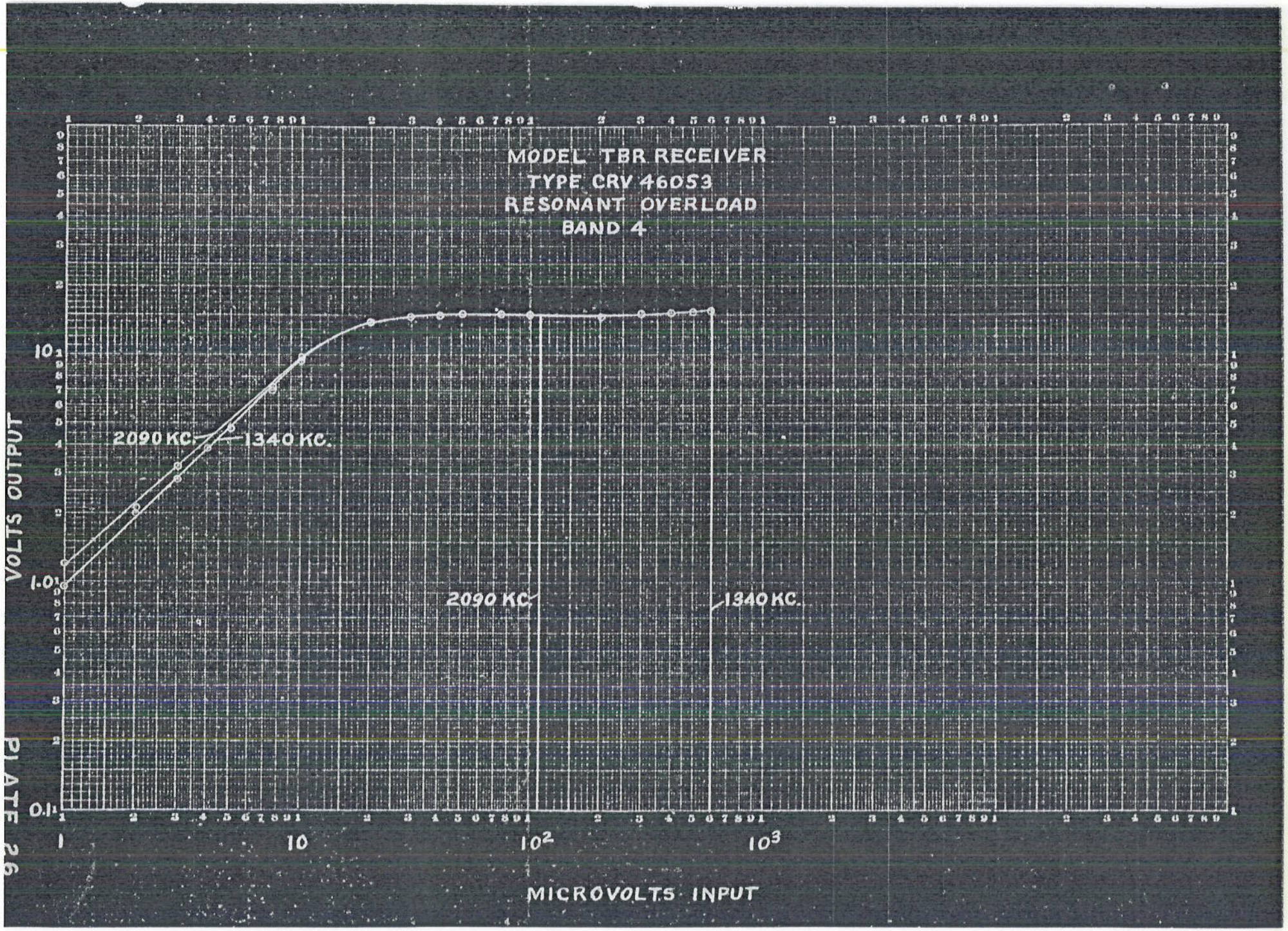
MODEL TBR RECEIVER
TYPE CRV 46053
RESONANT OVERLOAD
BAND 4
2090 KC.
1340 KC.
2090 KC.
1340 KC.
VOLTS OUTPUT
10
1.0
0.1
1
10
10^2
10^3
MICROVOLTS INPUT

PLATE 26

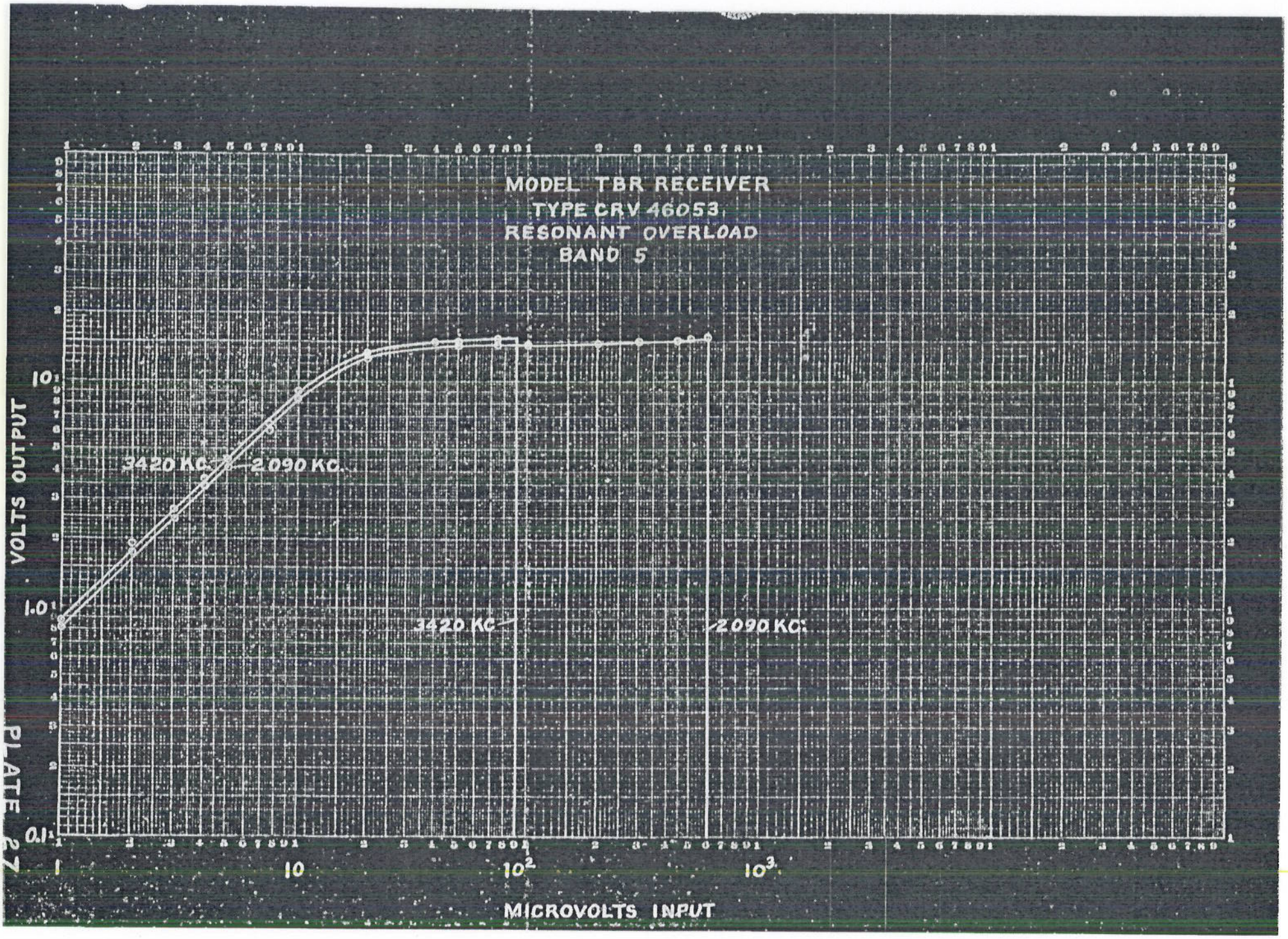
MODEL TBR RECEIVER
TYPE CRV 46053
RESONANT OVERLOAD
BAND 5
3420 KC
2090 KC
3420 KC
2090 KC
VOLTS OUTPUT
10
1.0
0.1
1
10
10^2
10^3
MICROVOLTS INPUT

PLATE 27

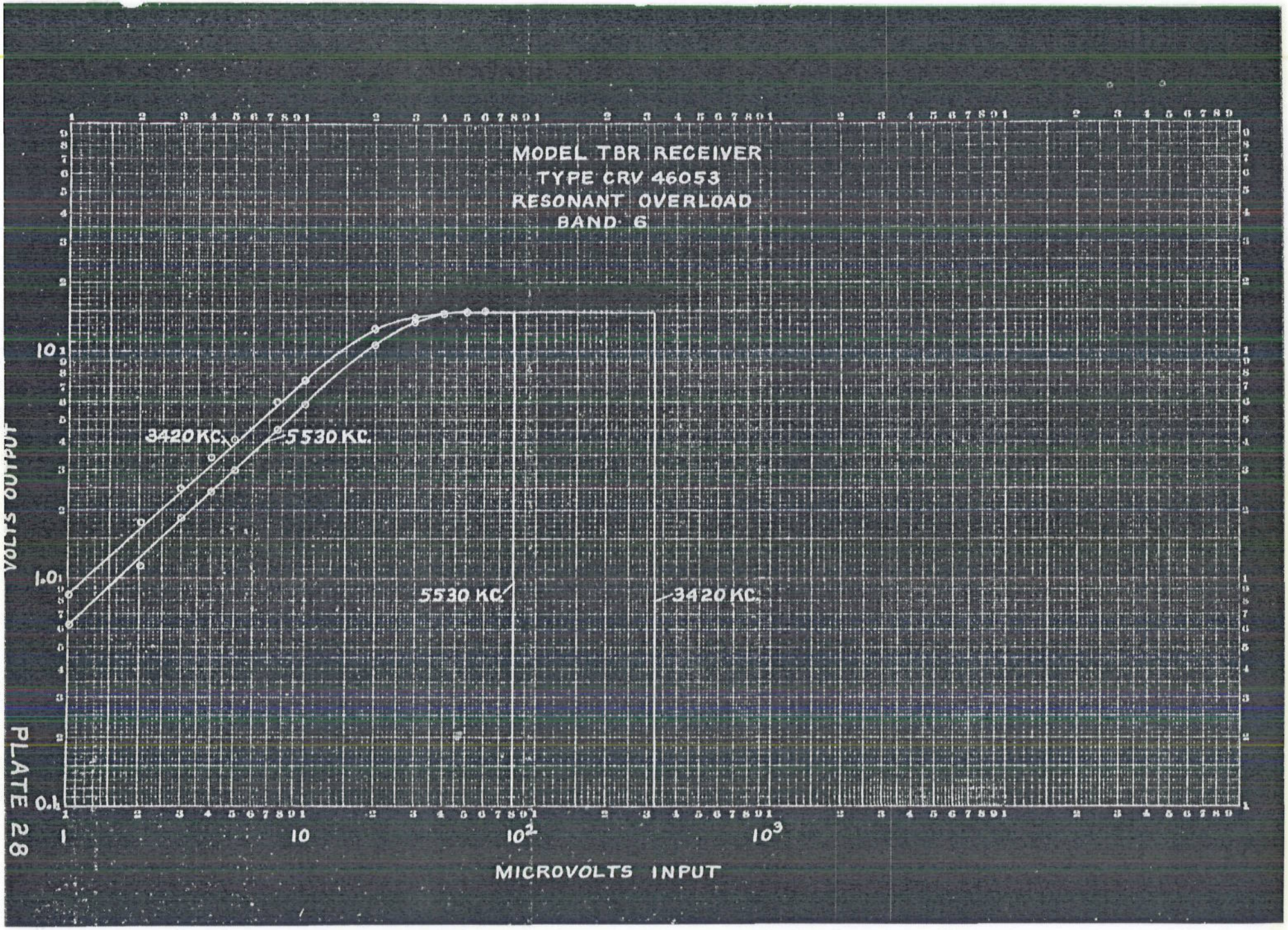
MODEL TBR RECEIVER
TYPE CRV 46053
RESONANT OVERLOAD
BAND 6
3420 KC.
5530 KC.
5530 KC.
3420 KC.
VOLTS OUTPUT
MICROVOLTS INPUT
10
1.0
0.1
1
10
10^2
10^3

PLATE 28

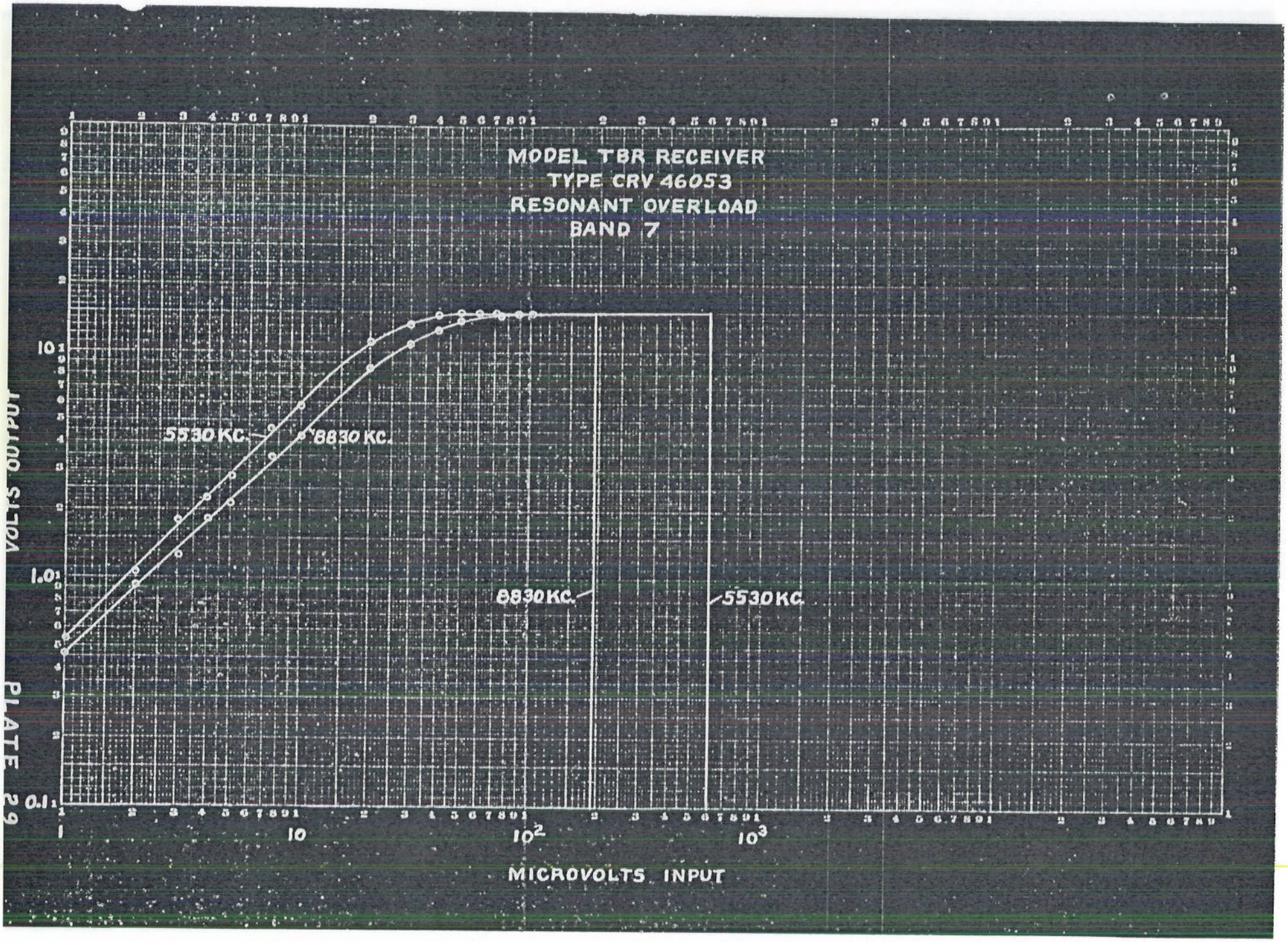
MODEL TBR RECEIVER
TYPE CRV 46053
RESONANT OVERLOAD
BAND 7
5530 KC.
8830 KC.
8830 KC.
5530 KC.
10
1.0
0.1
1
10
10^2
10^3
MICROVOLTS INPUT
VOLTS OUTPUT

PLATE 29

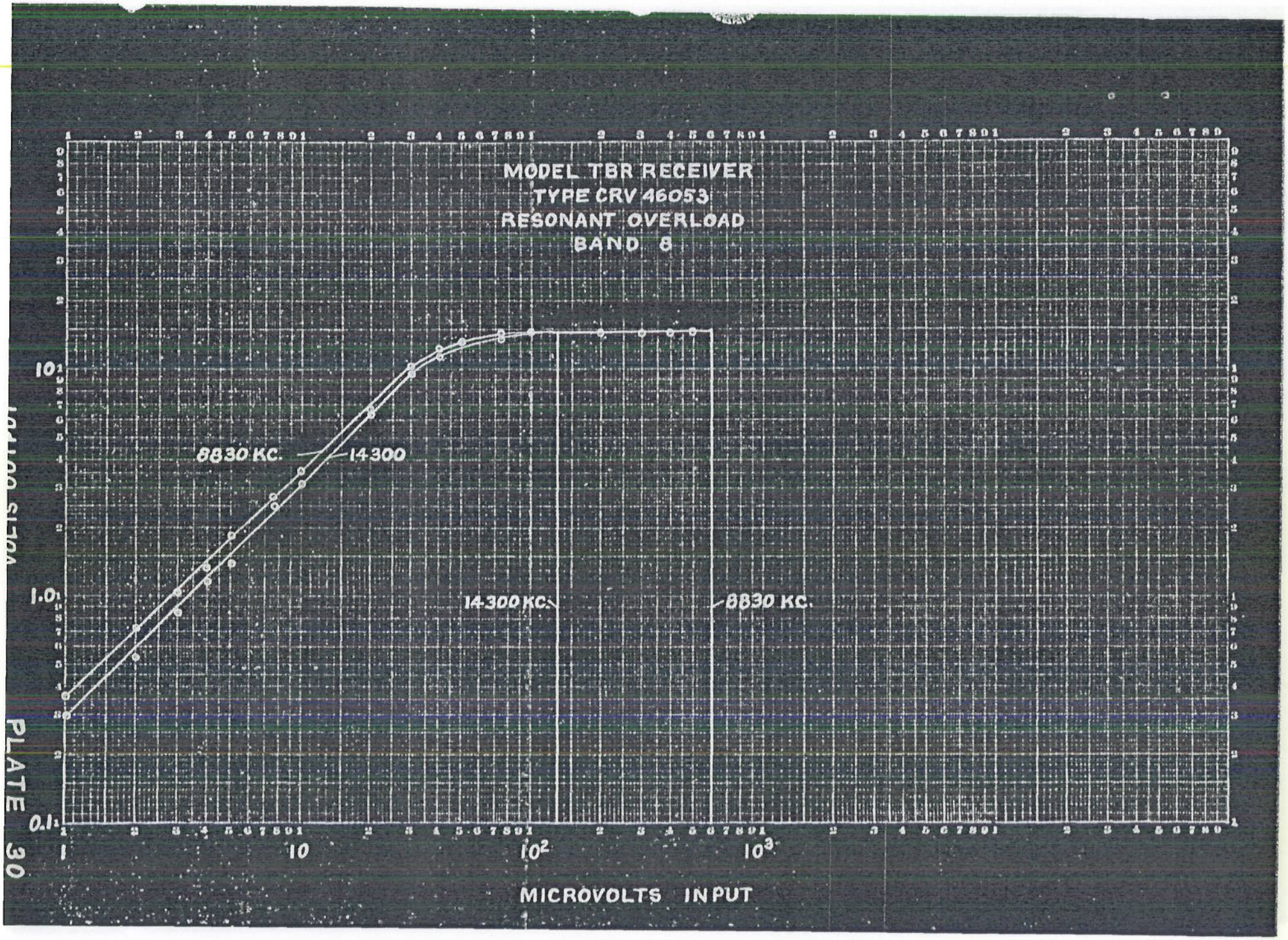
MODEL TBR RECEIVER
TYPE CRV 46053
RESONANT OVERLOAD
BAND 8
8830 KC.
14300
14300 KC.
8830 KC.
10
1.0
0.1
1
10
10^2
10^3
MICROVOLTS INPUT

PLATE 30

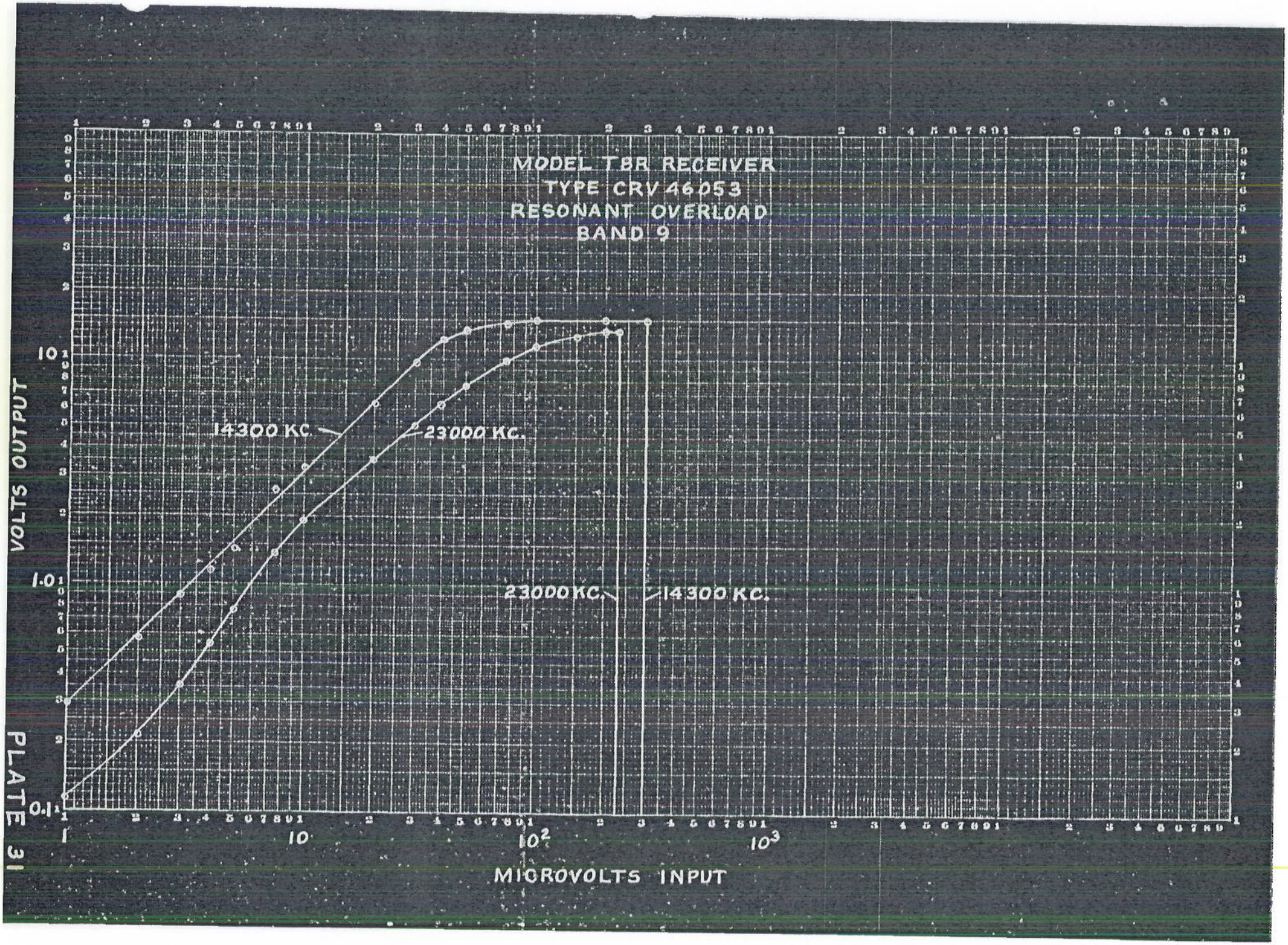
MODEL T8R RECEIVER
TYPE CRV 46053
RESONANT OVERLOAD
BAND 9
14300 KC.
23000 KC.
23000 KC.
14300 KC.
VOLTS OUTPUT
MICROVOLTS INPUT
10
1.0
0.1
1
10
10^2
10^3

PLATE 31

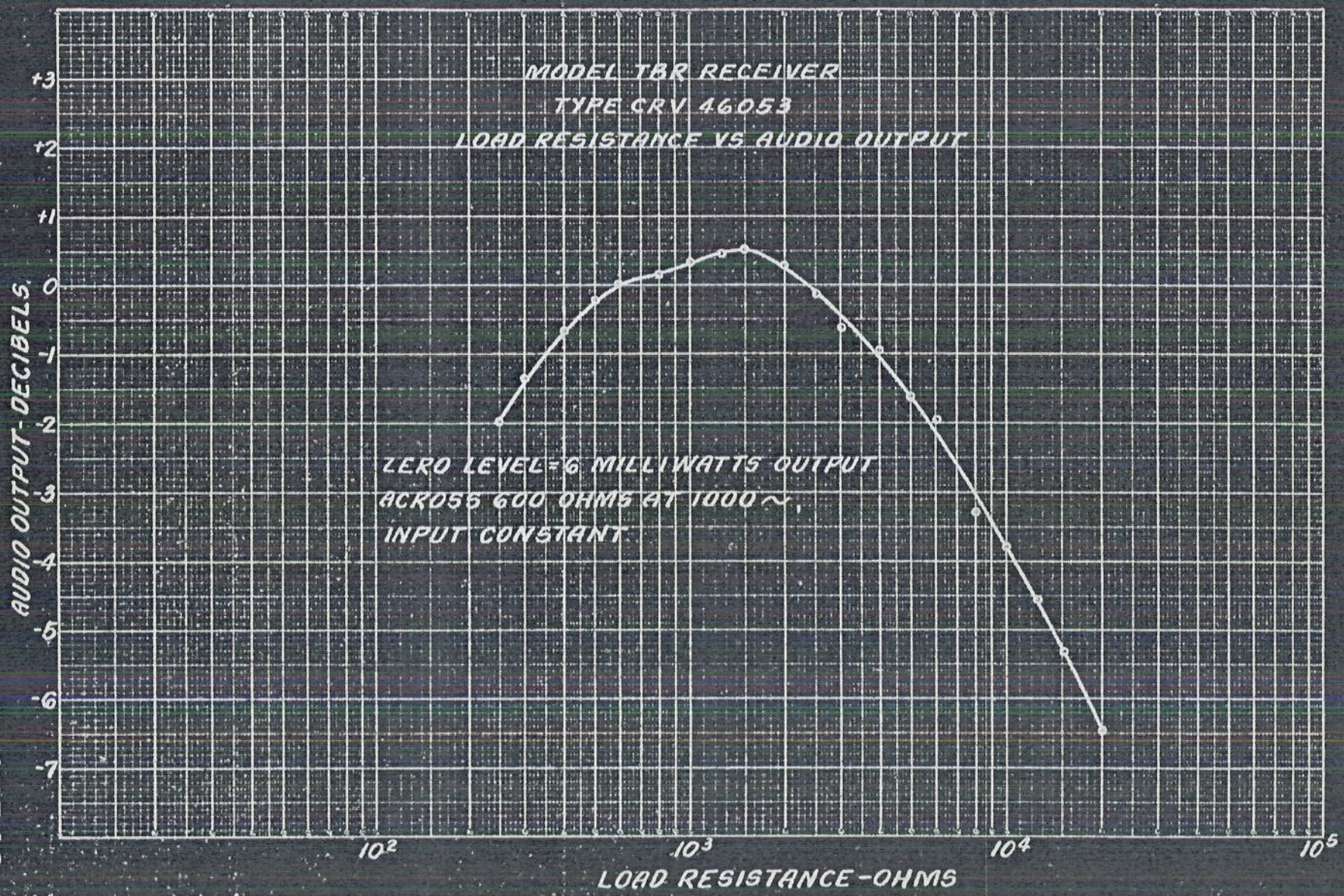
MODEL TBR RECEIVER
TYPE CRV 46053
LOAD RESISTANCE VS AUDIO OUTPUT
ZERO LEVEL=6 MILLIWATTS OUTPUT
ACROSS 600 OHMS AT 1000~,
INPUT CONSTANT
AUDIO OUTPUT-DECIBELS
+3
+2
+1
0
-1
-2
-3
-4
-5
-6
-7
10^2
10^3
10^4
10^5
LOAD RESISTANCE-OHMS

PLATE 32

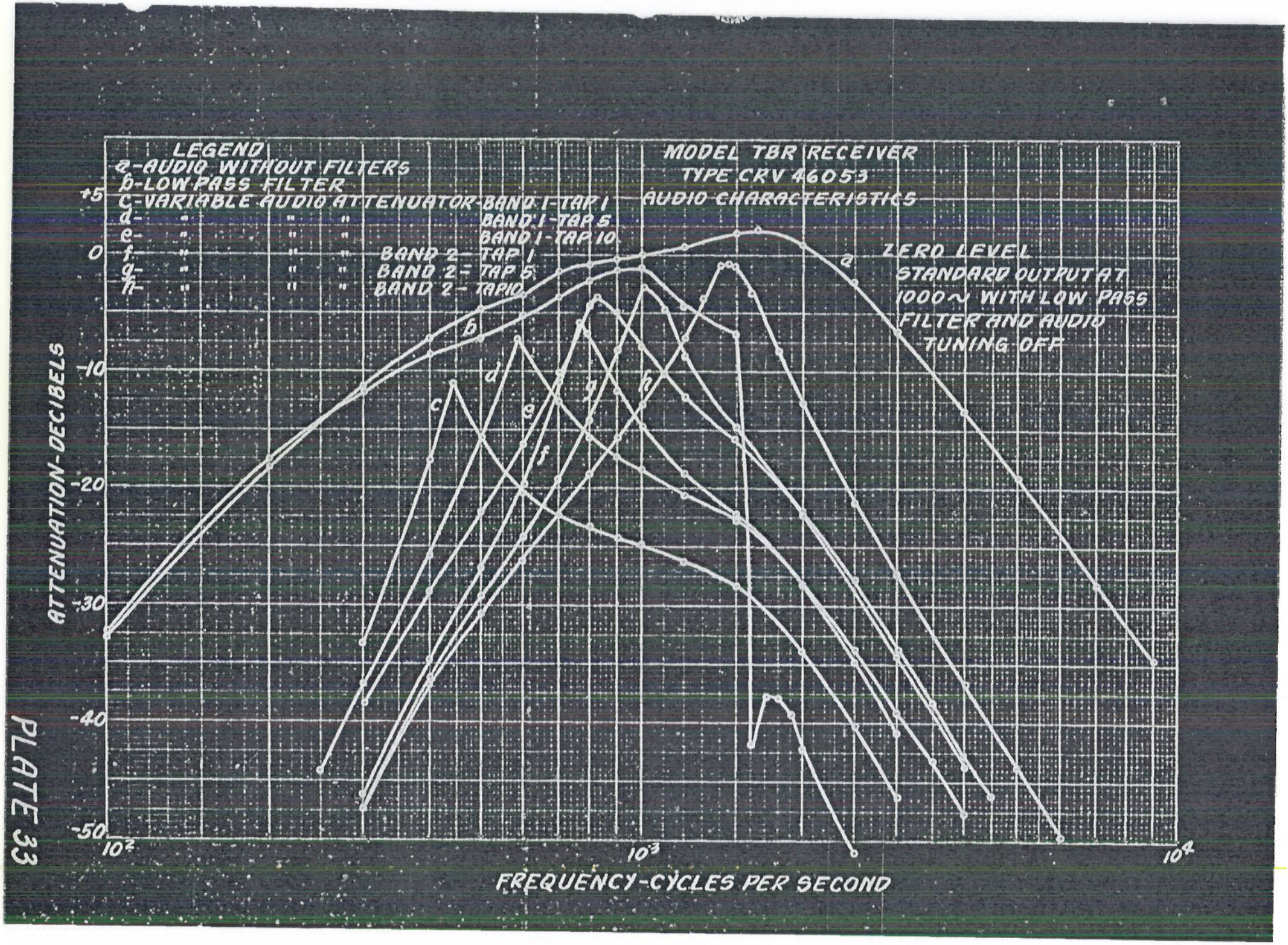
LEGEND
a-AUDIO WITHOUT FILTERS
b-LOW PASS FILTER
c-VARIABLE AUDIO ATTENUATOR-BAND 1-TAP 1
d- " " " BAND 1-TAP 5
e- " " " BAND 1-TAP 10
f- " " " BAND 2-TAP 1
g- " " " BAND 2-TAP 5
h- " " " BAND 2-TAP 10
MODEL TBR RECEIVER
TYPE CRV 46053
AUDIO CHARACTERISTICS
ZERO LEVEL
STANDARD OUTPUT AT
1000~ WITH LOW PASS
FILTER AND AUDIO
TUNING OFF
ATTENUATION-DECIBELS
+5
0
-10
-20
-30
-40
-50
10^2
10^3
10^4
FREQUENCY-CYCLES PER SECOND

PLATE 33

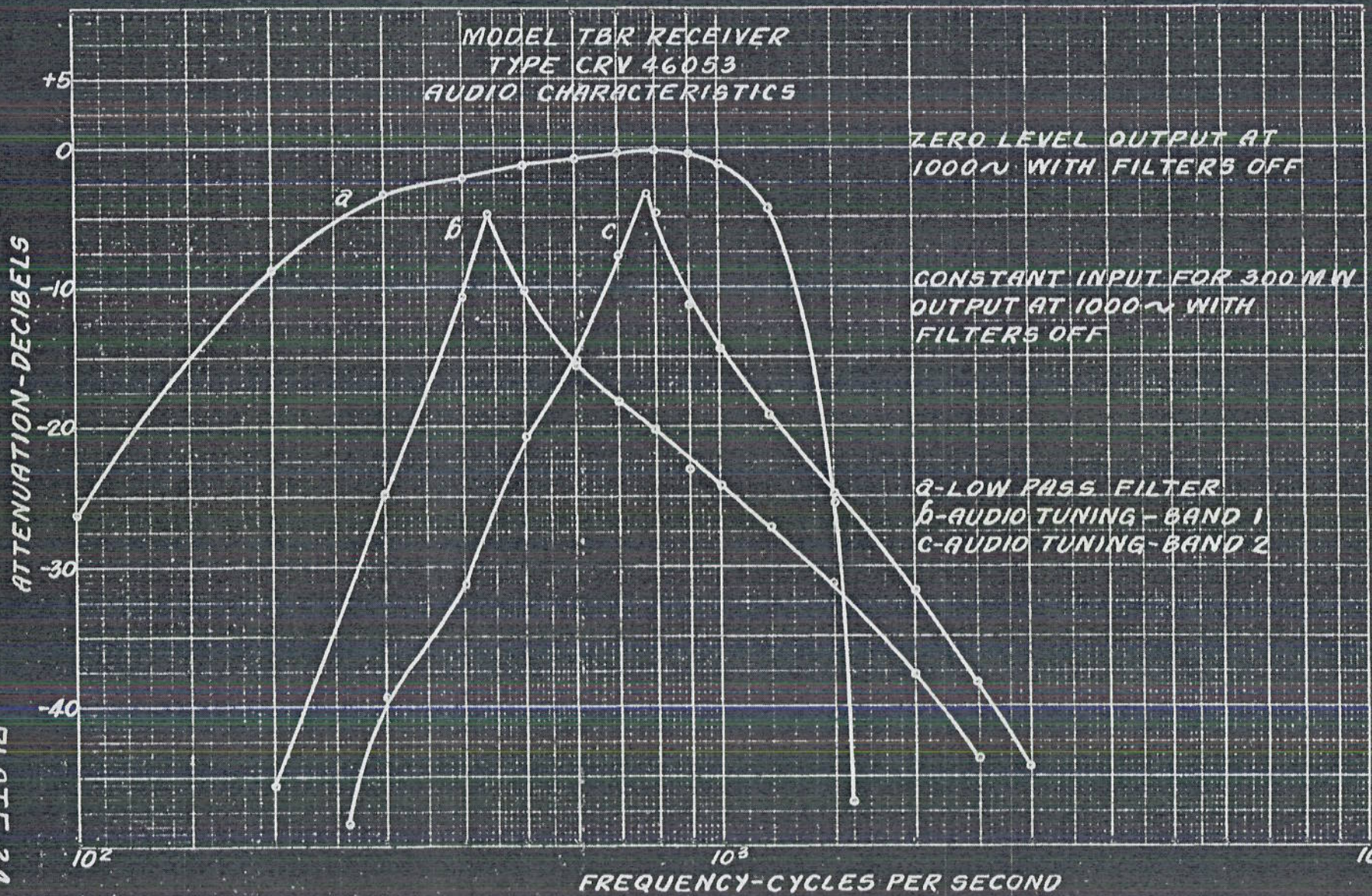
MODEL TBR RECEIVER
TYPE CRV 46053
AUDIO CHARACTERISTICS
ZERO LEVEL OUTPUT AT
1000~ WITH FILTERS OFF
CONSTANT INPUT FOR 300 MW
OUTPUT AT 1000~ WITH
FILTERS OFF
a-LOW PASS FILTER
b-AUDIO TUNING-BAND 1
c-AUDIO TUNING-BAND 2
a
b
c
+5
0
-10
-20
-30
-40
ATTENUATION-DECIBELS
10^2
10^3
10^4
FREQUENCY-CYCLES PER SECOND

PLATE 34

N. R. L. 31A

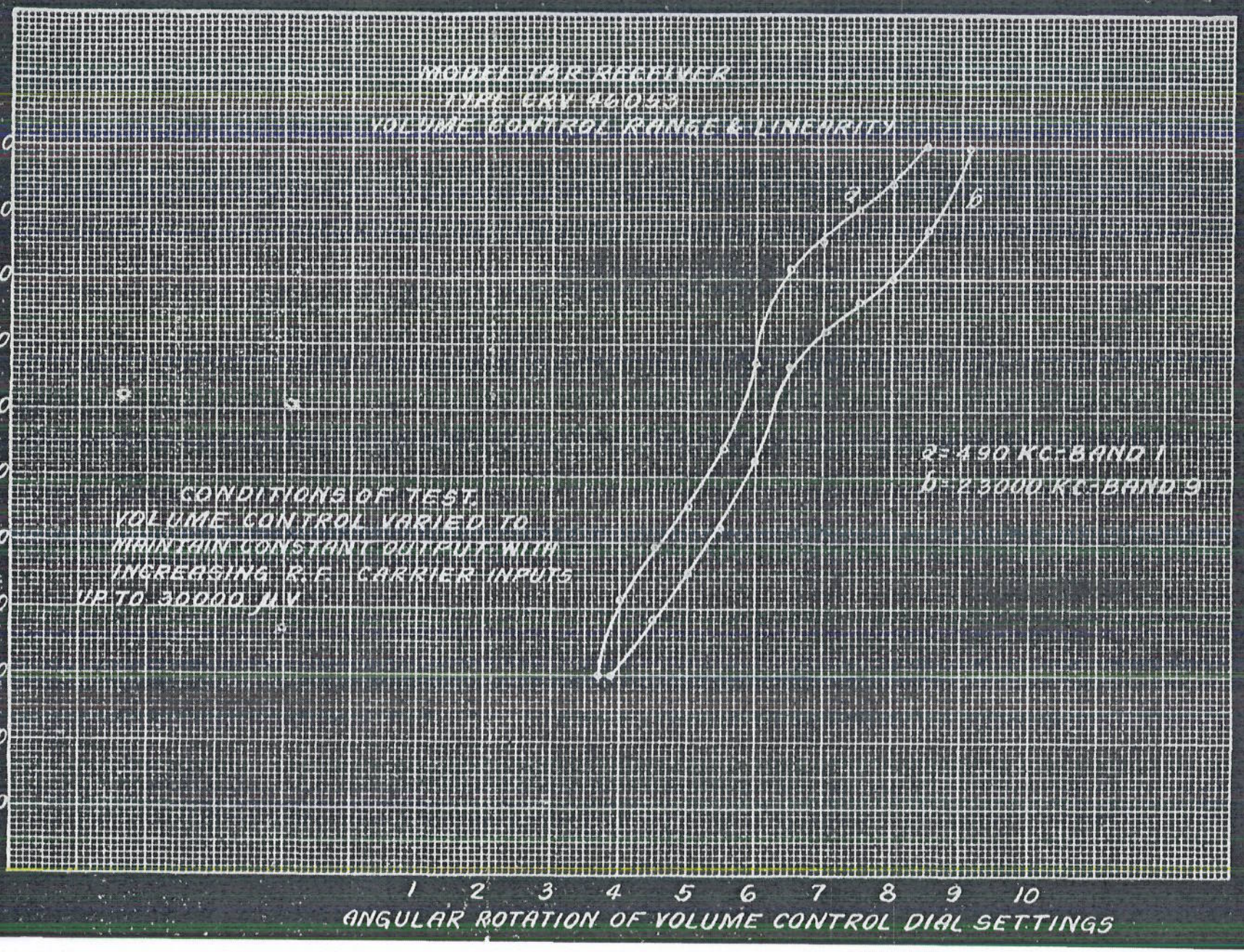

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PLATE 35

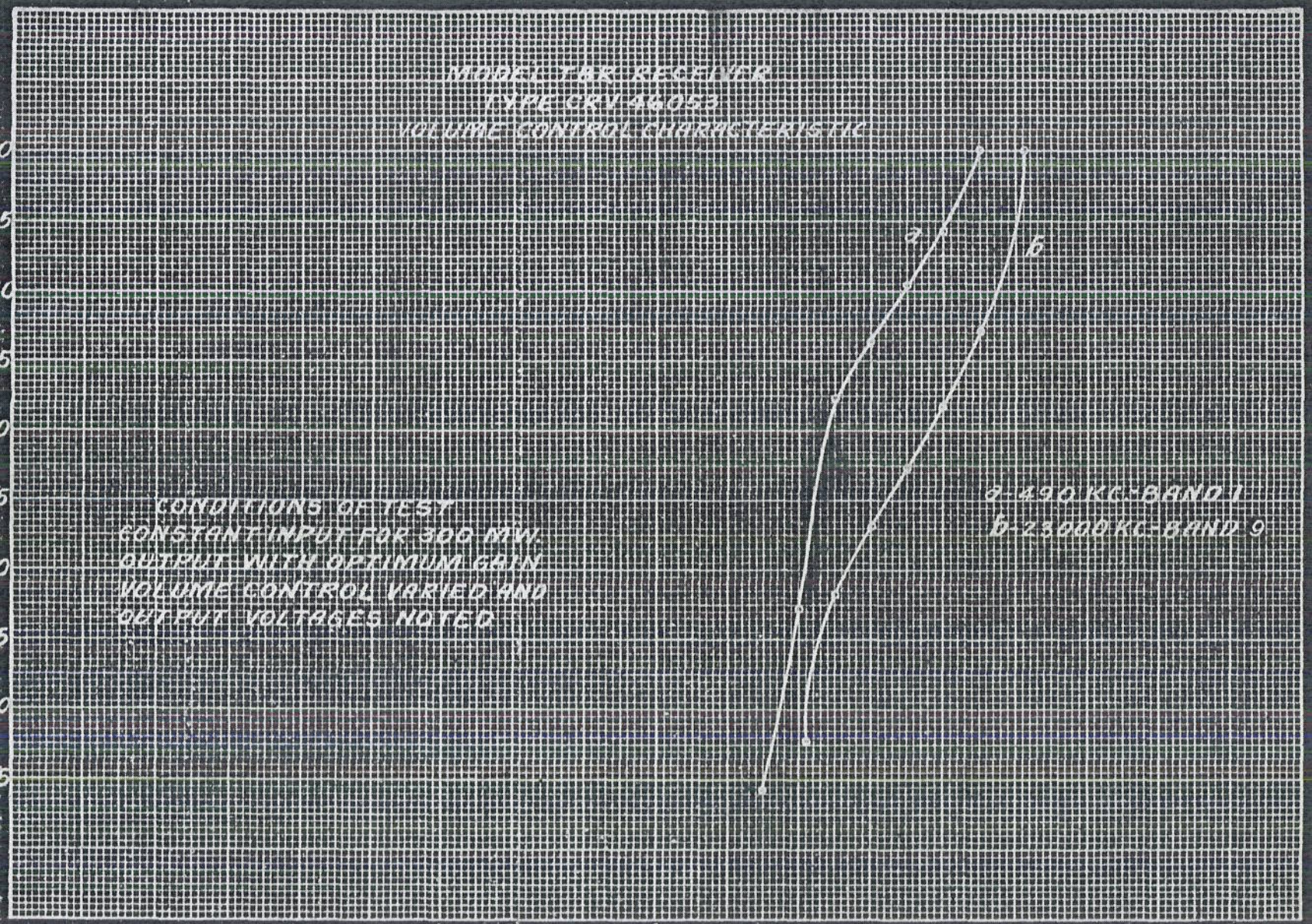

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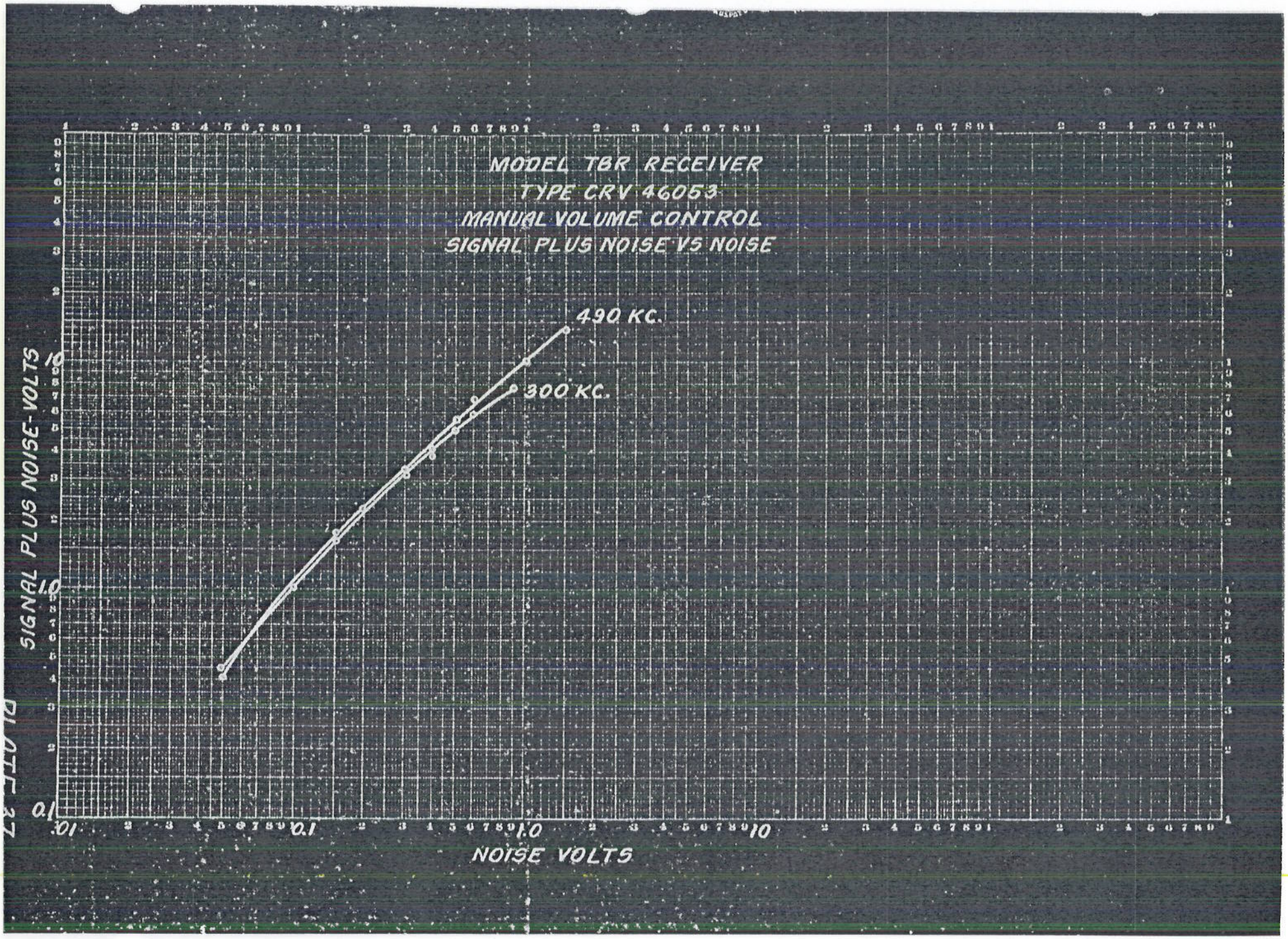
PLATE 36


MODEL TBR RECEIVER
TYPE CRV 46053
MANUAL VOLUME CONTROL
SIGNAL PLUS NOISE VS NOISE
490 KC.
300 KC.
SIGNAL PLUS NOISE-VOLTS
NOISE VOLTS
.01
0.1
1.0
10

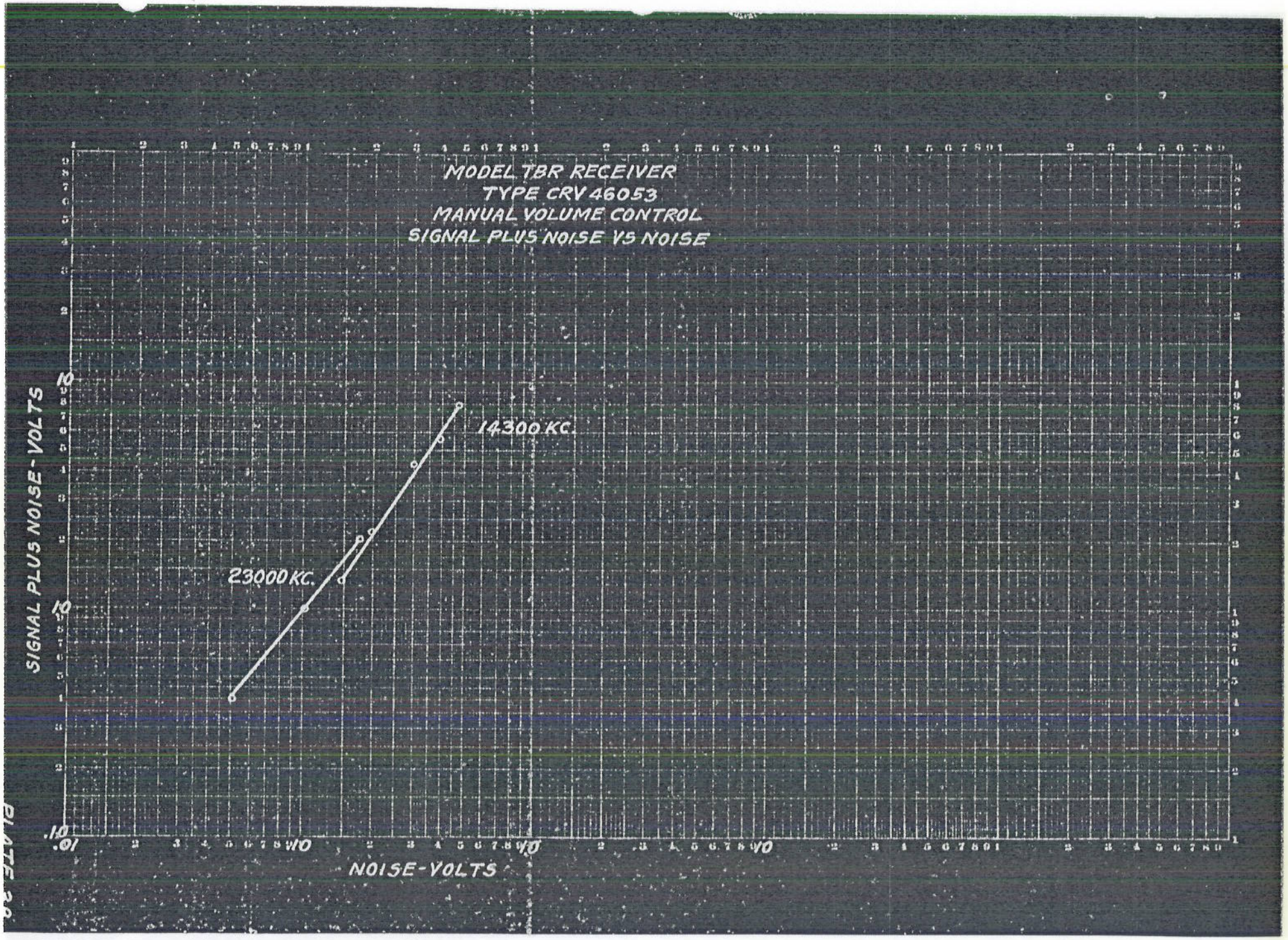

MODEL TBR RECEIVER
TYPE CRV 46053
MANUAL VOLUME CONTROL
SIGNAL PLUS NOISE VS NOISE
14300 KC.
23000 KC.
SIGNAL PLUS NOISE-VOLTS
NOISE-VOLTS
10
1.0
.10
.01

PLATE 30

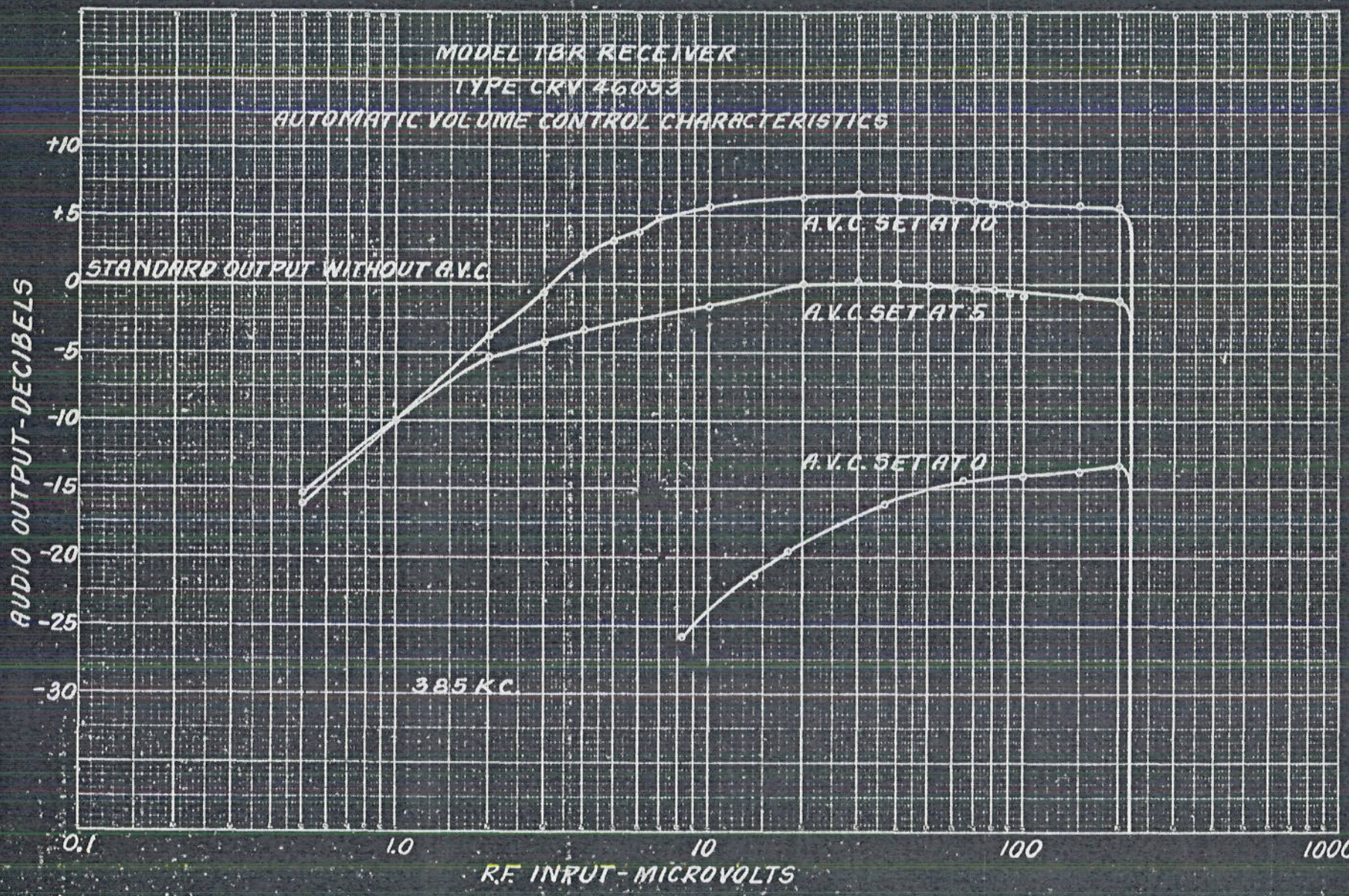

MODEL TBR RECEIVER
TYPE CRV 46053
AUTOMATIC VOLUME CONTROL CHARACTERISTICS
STANDARD OUTPUT WITHOUT A.V.C.
A.V.C. SET AT 10
A.V.C. SET AT 5
A.V.C. SET AT 0
3.85 KC.
AUDIO OUTPUT-DECIBELS
+10
+5
0
-5
-10
-15
-20
-25
-30
0.1
1.0
10
100
1000
R.F. INPUT-MICROVOLTS

PLATE 39

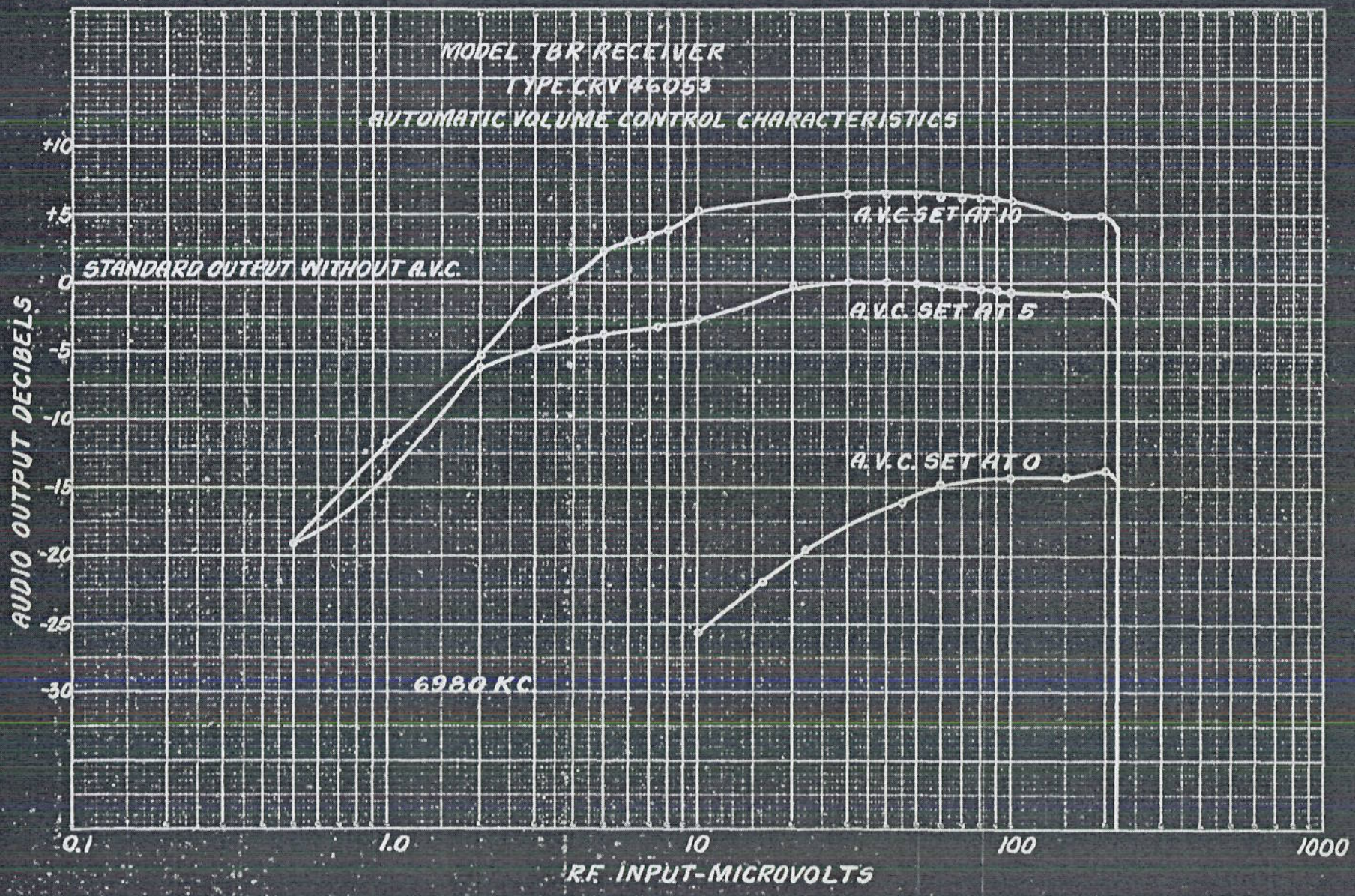

MODEL TBR RECEIVER
TYPE CKV 46053
AUTOMATIC VOLUME CONTROL CHARACTERISTICS
A.V.C. SET AT 10
STANDARD OUTPUT WITHOUT A.V.C.
A.V.C. SET AT 5
A.V.C. SET AT 0
6980 KC
AUDIO OUTPUT DECIBELS
+10
+5
0
-5
-10
-15
-20
-25
-30
0.1
1.0
10
100
1000
R.F. INPUT-MICROVOLTS

PLATE 40

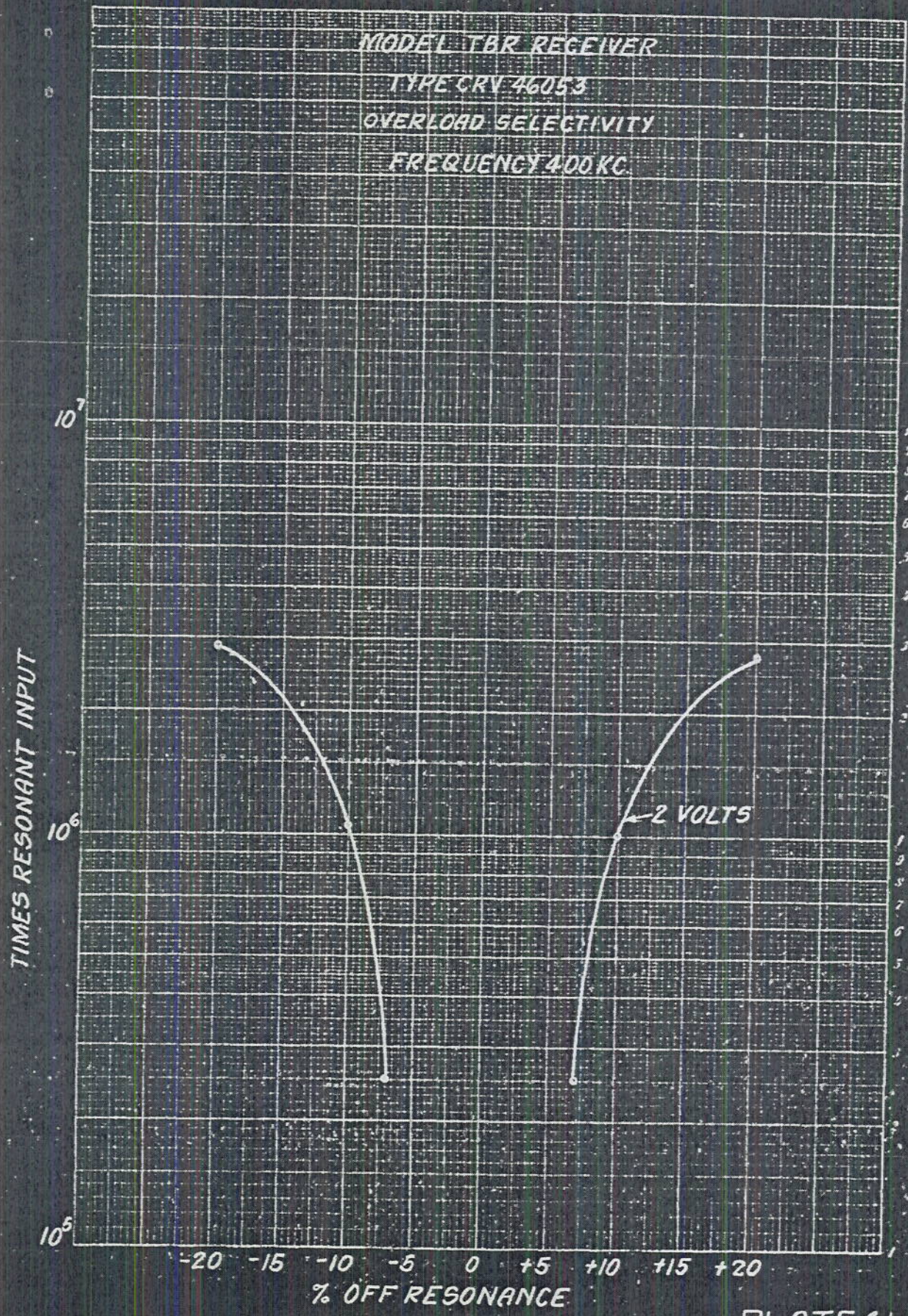

MODEL TBR RECEIVER
TYPE CRV 46053
OVERLOAD SELECTIVITY
FREQUENCY 400 KC
TIMES RESONANT INPUT
10^7
10^6
10^5
-2 VOLTS
-20 -15 -10 -5 0 +5 +10 +15 +20
% OFF RESONANCE

PLATE 41

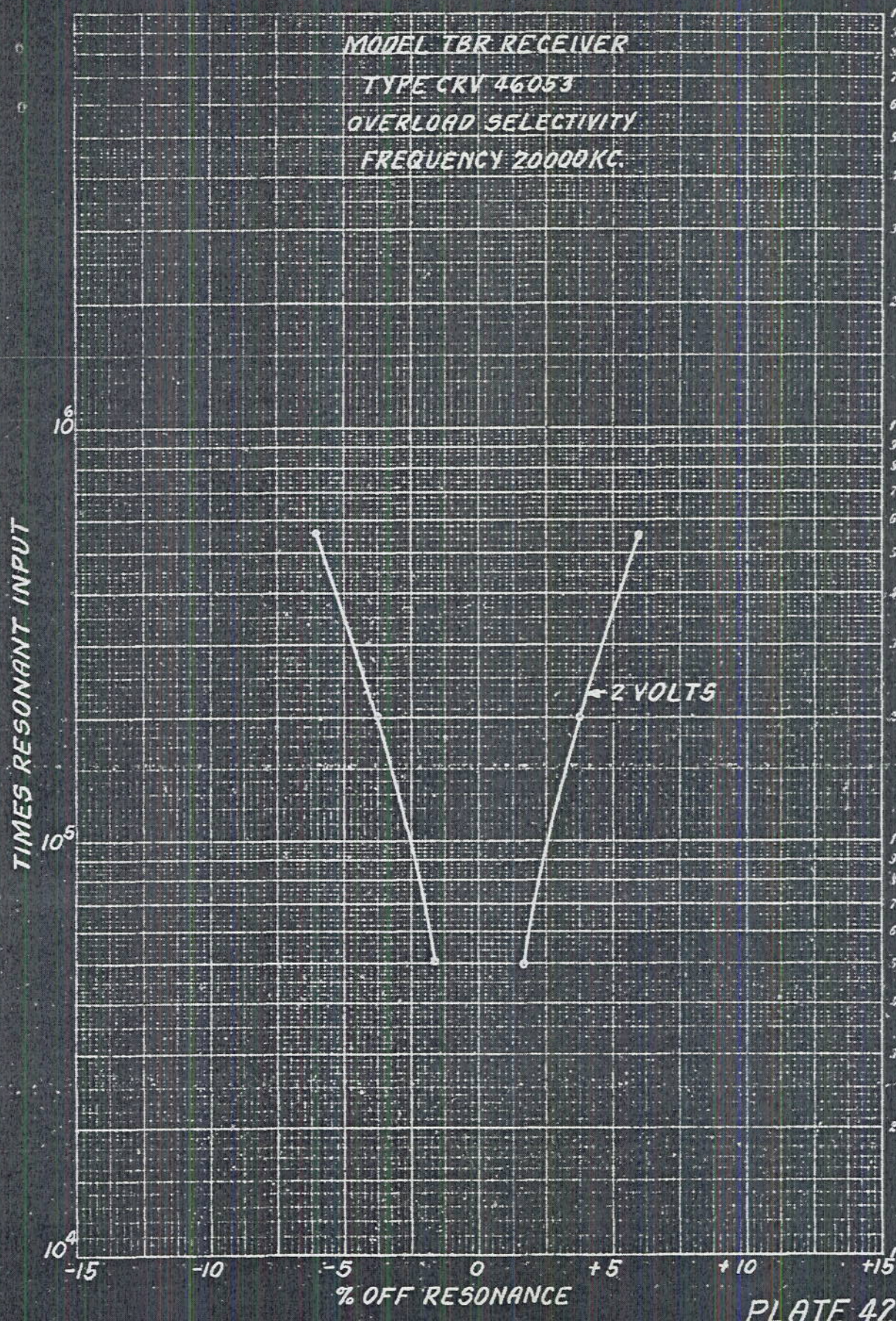

MODEL TBR RECEIVER
TYPE CRV 46053
OVERLOAD SELECTIVITY
FREQUENCY 20000KC.
2 VOLTS
TIMES RESONANT INPUT
10^6
10^5
10^4
-15
-10
-5
0
+5
+10
+15
% OFF RESONANCE

PLATE 42

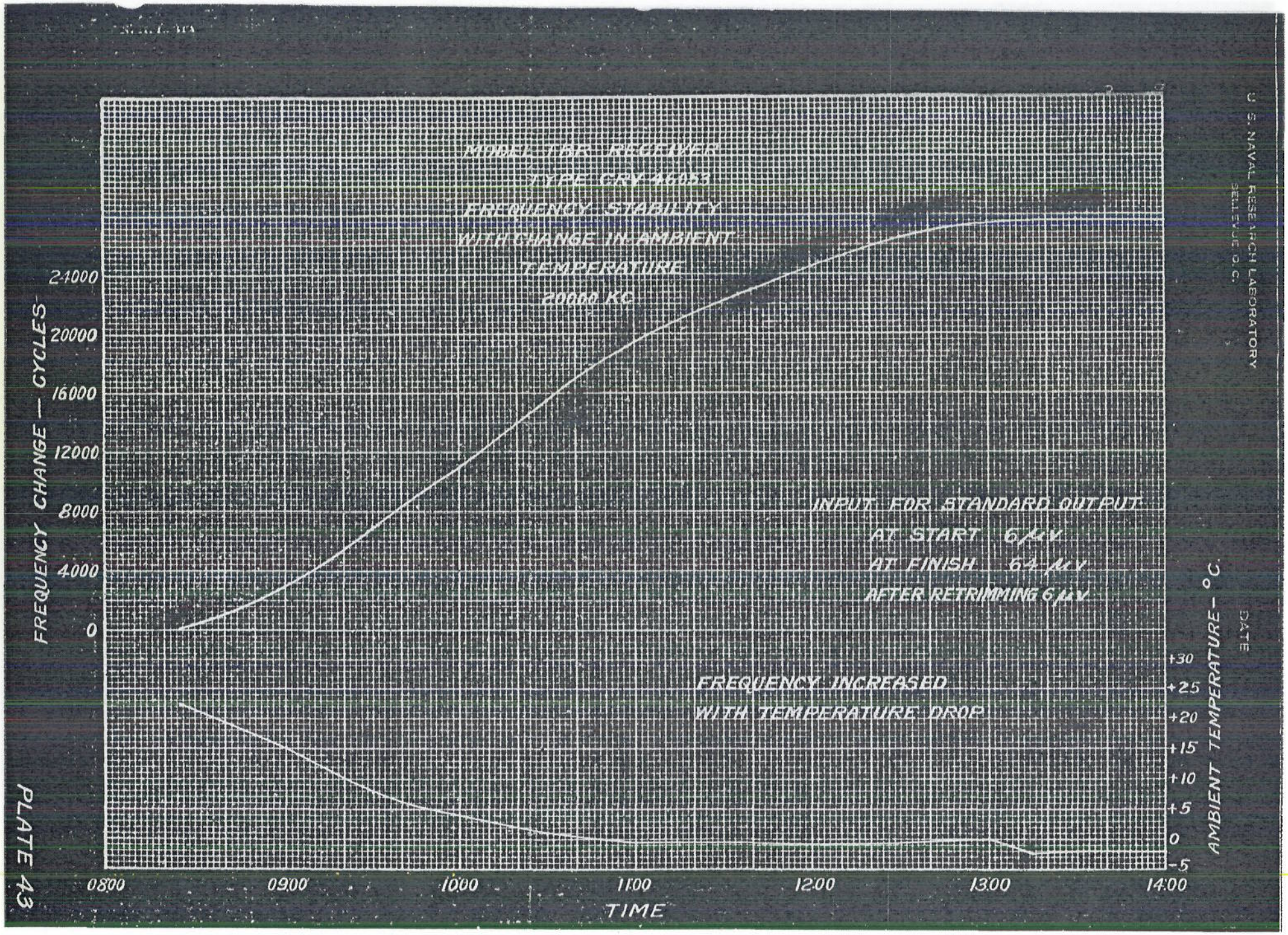

MODEL 1-BR RECEIVER
TYPE CRV 46053
FREQUENCY STABILITY
WITH CHANGE IN AMBIENT
TEMPERATURE
20000 KC.
INPUT FOR STANDARD OUTPUT
AT START 6 μv
AT FINISH 64 μv
AFTER RETRIMMING 6 μv
FREQUENCY INCREASED
WITH TEMPERATURE DROP
FREQUENCY CHANGE — CYCLES
24000
20000
16000
12000
8000
4000
0
AMBIENT TEMPERATURE — °C.
+30
+25
+20
+15
+10
+5
0
-5
08.00
09.00
10.00
11.00
12.00
13.00
14.00
TIME
U. S. NAVAL RESEARCH LABORATORY
BELLEVUE D. C.
DATE

PLATE 43

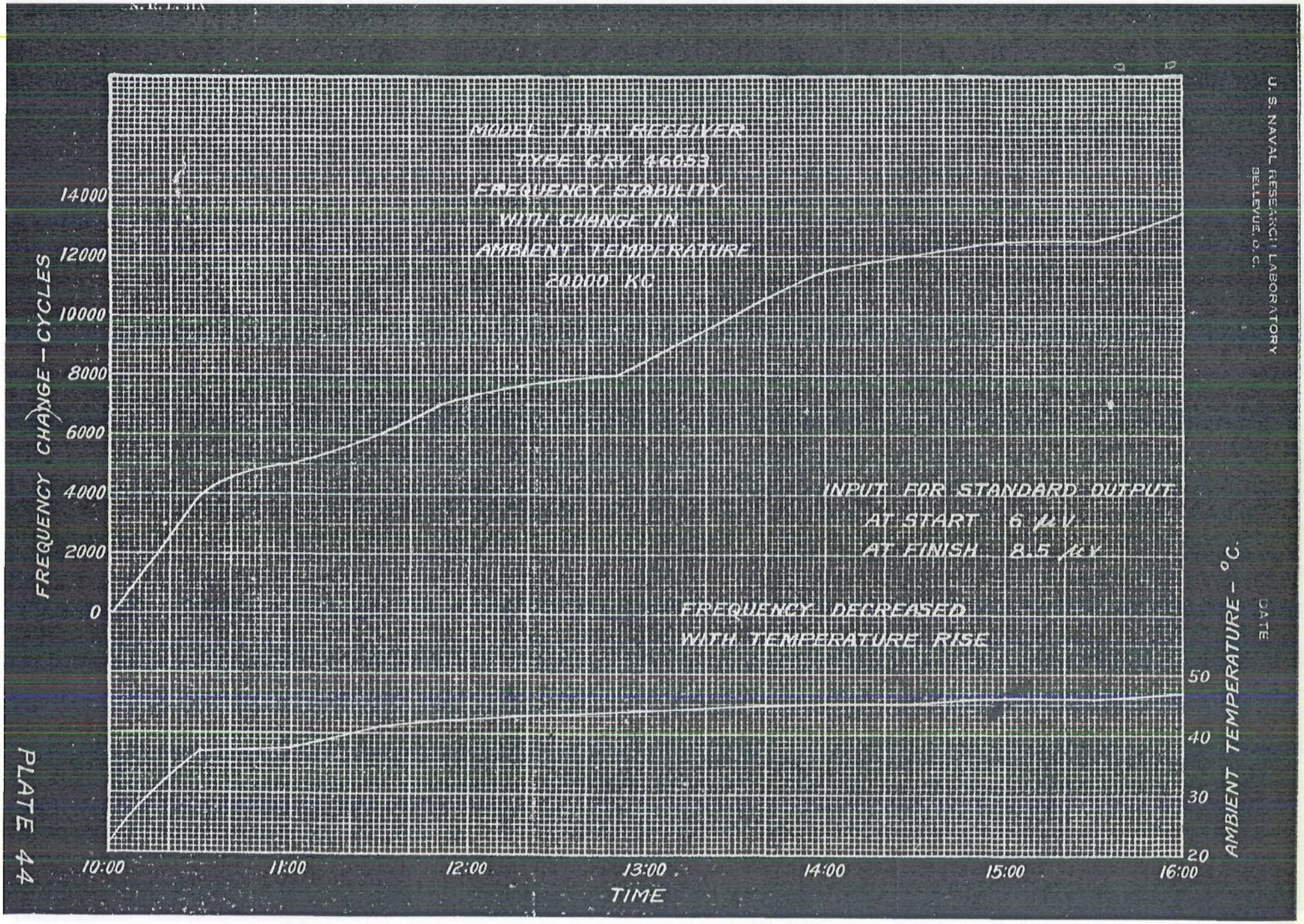

U. S. NAVAL RESEARCH LABORATORY
BELLEVUE, D. C.
DATE
MODEL 1 RR RECEIVER
TYPE CRV 46053
FREQUENCY STABILITY
WITH CHANGE IN
AMBIENT TEMPERATURE
20000 KC
INPUT FOR STANDARD OUTPUT
AT START 6 μV
AT FINISH 8.5 μV
FREQUENCY DECREASED
WITH TEMPERATURE RISE
FREQUENCY CHANGE – CYCLES
14000
12000
10000
8000
6000
4000
2000
0
AMBIENT TEMPERATURE – °C.
50
40
30
20
10:00
11:00
12:00
13:00
14:00
15:00
16:00
TIME

PLATE 44