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AIRBORNE RADIO DIVISION - ENGINEERING TEST SECTION

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Results of Engineeing Tests of Model AN/ARC-13 (XN-1), Serial #1, UHF Communications Transmitter and Receiver

by
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- Report R-2966

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Problem S-2122T-R

ABSTRACT

This report covers the results of engineering tests on experimental Model AN/ARC-13(XN-1), Serial #1:COL., aircraft communications transmitting and receiving equipment manufactured by the Collins Radio Company, Cedar Rapids, Iowa. The equipment performance is compared with specification requirements and suitability for Naval use is evaluated. The subject equipment is not considered acceptable in its present form chiefly because of poor receiver sensitivity and poor receiver and transmitter operation under service conditions.

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INTRODUCTION

1. Engineering tests of Model AN/ARC-13(XN-1) UHF aircraft transmitter-receiver were authorized by the Bureau of Ships letter establishing Problem S-2122T-R, reference (a). One unit, Serial No. 1, complete with controls, shock mount and cabling, was submitted by the manufacturer, Collins Radio Company, Cedar Rapids, Iowa, for test by the Laboratory for compliance with the problem directive reference (a) and with specification reference (b). The subject equipment covers the frequency range of 100 to 400 megacycles and is to be used as an interim equipment in both the 100 - 156 mc and the 200 - 400 mc communication bands during the transition to the latter frequency band. This equipment eliminates the necessity of carrying two equipments in each aircraft, one for each frequency band, during the transition period. The subject developmental equipment while not suitable in its present form for use in Naval aircraft is considered to have many features which are desirable and with some modifications can be made to operate satisfactorily. Complete tests were not made on this equipment, particularly on the receiver section, as it was known that it did not meet specifications and is undergoing redesign by the contractor. Another developmental model employing these new designs will be submitted for test at some later date. Where the equipment operation borders on the specified limits, consideration should be given to the inaccuracies of present day instrumentation at these frequencies and allowances made therefore.

GENERAL DESCRIPTION

2. Model AN/ARC-13 is a transmitter-receiver combination designed for installation in all types of Naval aircraft. It provides preset, multichannel, voice, amplitude modulated, pilot or radio operator controlled, two-way radio communication between aircraft and ship, shore, or other aircraft. It covers the frequency range from 100 to 400 megacycles per second. There are nine channels, which may be preset to any nine frequencies within the range of the equipment, and a guard channel which is fixed tuned. The guard channel frequency is 140.58 mc or 280.2 mc depending upon which of two units are installed. There are three antenna posts; one, designated as "low", is used with a VHF antenna for transmitting or receiving at frequencies below 200 mc; a second, designated as "high" is used with a broad-band type antenna for operation above 200 mc, and a third for connection to the AN/ARR-2 homing receiver. A master oscillator which is crystal controlled is the basic controlling factor in the transmitter output frequency and also in determining the injection frequency into the mixer of the receiver. In order to make the transmitter output frequency differ from the injection frequency by 19.8 mc (the intermediate frequency) there is a second crystal controlled oscillator called the sidestep oscillator of I.F. oscillator. This oscillator operates in such a way as to increase or decrease the transmitter output frequency, depending upon the channel being used, by the correct amount. In the frequency range from 100 to 146 mc the driver stage does not multiply; from 146 to 262 mc the driver acts as a doubler and from 262 to 400 mc the driver stage acts as a tripler. Both the driver stage and the final amplifier

are modulated. The modulation amplifer has a pressure operated gain control which increases the gain at high altitudes to compensate for the reduced efficiency at the microphone. The receiver is a conventional supherheterodyne. The audio section of the receiver incorporates a noise peak limiter and an audio compressor. The transmitter-receiver is housed in a 1 1/2 ATR unit and is shock mounted. Weight of the unit and shock mount is approximately 72 pounds. For more detailed description see the "Handbook for Maintenance Instructions for Model AN/ARC-13, Aircraft Radio Equipment".

RESULTS OF TESTS

3. Except as indicated in the following paragraphs, results of the tests indicate that the performance of the AN/ARC-13 equipment meets the requirements set forth in the specification, reference (b). Paragraph numbers shown in parenthesis in the following pages correspond to those of the specification.

SENSITIVITY (E-7b)

(a) Sensitivity measurements were made under both standard and service conditions with the results as shown in Tables 1, 2, and 3.

(1) Sensitivity of the main receiver under standard conditions was outside specification limit of five microvolts on all of the nine channels spaced throughout the frequency range of the equipment. Best sensitivity was 5.3 microvolts which was at a frequency of 217.2 megacycles and the worst condition was a sensitivity of 67.5 microvolts at a frequency of 164.84 megacycles. The sensitivity of the high guard channel measured 36.5 microvolts which does not meet specification requirements. Sensitivity of the low guard channel was three microvolts which is satisfactory.

(2) Under service conditions, sensitivity was checked over the range of temperatures from -30° to +50°C and during a humidity run of 48 hours at +50°C and 95% relative humidity. During the temperature run sensitivities were checked on channel 4 of the main receiver and the low guard channel at temperatures of -30°, 0°, +20° and +50° with results as shown in Table 2. Sensitivity of the main receiver on channel 4 varied from 10 microvolts at +20°C to 15.5 microvolts at 0°C. Sensitivity of the low guard channel varied from 6.5 microvolts at -30°C, 0°C and +50°C to 7.2 microvolts at +20°C. While none of these readings meet specification requirements, it will be noted that the change in sensitivity over the temperature range is not great and that the failure to meet specifications is not due to any temperature effects. Under conditions of +50°C and 95% relative humidity the sensitivity of the main receiver on channel 5 (230.6 mc) changed from 28.5 microvolts at room temperature to more than 60 millivolts at the end of the 48 hour run. Recovery was satisfactory; sensitivity at the end of 75 minutes continuous operation, after shutting off humidity, was 65

microvolts and after 72 hours was 30 microvolts. Sensitivity of the low guard channel changed from 6.5 microvolts at room temperature to 145 microvolts at the end of 48 hours. At the end of a period of 75 minutes continuous operation, after shutting off the humidity, the sensitivity was 8.5 microvolts and after 72 hours the sensitivity was 4.0 microvolts. See Table 3 for complete results of sensitivity versus humidity. Noise output of the receiver, with the antenna post shorted to ground through 50 ohms resistance, was measured on each channel with results as shown in Table 4.

AVC CHARACTERISTICS (E-7c)

(b) AVC characteristics were measured at one frequency on the main receiver and on both guard channels with results as given in Tables 5, 6, and 7, and Plates 1, 2 and 3. On the channel of the main receiver on which tests were made, AVC characteristics were within the required limits of the specification except at the low end where, due to poor sensitivity, the output with ten microvolts input was more than two decibels below the output with one millivolt input. On the low guard channel receiver blocking occurred at a signal input of six millivolts and again at sixty millivolts. On the high guard channel AVC action was satisfactory at signal inputs of one hundred microvolts and above, but due to poor sensitivity, the outputs at ten and fifty microvolt inputs are more than two decibels below the one millivolt input level. There being no signal generator available with outputs of two volts, it was impossible to determine whether or not blocking occurs beyond about sixty millivolts.

(c) The AVC action as described in paragraph (b) above is not entirely due to the effect of AVC voltages used to change the bias on the intermediate frequency amplifiers, but includes the effect of the audio compressor which operates from the audio output to control the gain of the first audio amplifier. Table 8 and Plate 4 shows a comparison of audio outputs with and without the audio compressor action. To determine the effect of AVC alone a check of voltages at the cathode of the AVC rectifier and at the plate of the AVC amplifier was made and the results show that considerable AVC action is due to the audio compressor. See Table 9 and Plate 5.

SELECTIVITY (E-7d)

(d) Measurements of selectivity were made on the main receiver on channel 4 (217.2 mc) and on the low guard channel. IF selectivity was also measured. Results of these measurements are shown in Plates 6, 7 and 8, and Table 10. Resonance was taken as the point of maximum audio output from the receiver. In general, the total bandwidth at the 6 db point is less than the specified limits, while at the 20 db, 40 db and 60 db points the total bandwidth exceeds the specified limits. The curves are unsymmetrical, being wider below resonance on channel 4 (230.6 mc) and at the intermediate frequency and wider above resonance on the low guard channel.

These results are consistent as on channel 4 the injection frequency is 19.8 megacycles above the receiver frequency and on the low guard channel the injection frequency is below the receiver frequency.

IMAGE REJECTION (E-7e)

(e) Image rejection was measured on two channels (1 and 9) of the main receiver and on both high and low guard channels. Results are tabulated in Table 11. In general the results were satisfactory on low and high guard channels. On channel 1 (109.8 mc) it was found that attenuation of a signal at approximately 70 mc/s was only 51.4 db, and to a signal at approximately 160 mc/s it was 59.4 db. Both of these fall slightly short of the 60 db attenuation required below 310 mc/s. On channel 9 (378 mc) the attenuation to a signal at approximately 339 mc was 34 db, to a signal at approximately 139.4 mc was 31.4 db, and to a signal at approximately 139.4 mc was 31.4 db, and to a signal at approximately 100.2 mc was 32 db, all of which fail to meet the requirement of 40 db attenuation when the receiver is tuned to a frequency above 310 mc.

IF REJECTION (E-7f)

(f) IF rejection was measured on channels 1 (109.8 mc) and 9 (378 mc) and on both high and low guard channels and was found to be unsatisfactory in all four cases, ranging from 37.8 db to 57.1 db as compared to a specification requirement of 80 db. See Table 12 for tabulation of data.

REGENERATION (E-7g)

(g) No evidence of oscillations, instability or excessive regeneration was apparent when, under conditions set forth in paragraph (E-7g) of the specification reference (b), the voltage was varied from 24 to 30 volts.

NOISE PEAK LIMITER (E-7h)

(h) There is clipping of the audio output at modulation levels of sixty percent and above. This is evident from observation of the output voltage on the oscilloscope. Also the audio output as measured on the output meter drops off when the modulation level exceeds sixty percent. This is considered to fail to meet the requirements of the specifications, reference (b).

AUDIO CHARACTERISTICS (E-7i)

(i) Audio characteristics of the receiver output circuit were measured under standard conditions with the following results:

(1) (E-7i(1)) Power output and distortion. With an input signal of 50 millivolts modulated 30% at 1000 CPS, the audio output is 520 milliwatts with a total harmonic content of 30%. This measurement was made on channel 4 (217 mc). While this does not meet the requirement of 3 watts output given in paragraph (E-7i(1)) of the specifications, it should be noted that this paragraph conflicts with the requirements set down in paragraph (E-7c) which states that the audio output, with an input of 1 millivolt 30% modulated, shall be 500 milliwatts

(-10%, +20%) and shall not vary more than 2 db, from the 1 millivolt level, over a range of input signal from 10 microvolts to 100,000 microvolts. In view of this conflict of requirements, it is recommended that the specifications be modified and that the 520 milliwatt output be considered satisfactory. The 30% distortion is excessive and fails to meet the requirement of not more than 15% distortion. Table 13 shows results of measurement of distortion and audio output on channels 1 through 5. Table 14 and Plate 9 show audio output and percent distortion versus percent modulation. Table 15 and Plate 10 show audio output and percent distortion versus signal input at both 30% and 60% modulation. Table 16 and Plate 11 show audio output and percent distortion versus output impedance. While there is some variation from one set of data to another, all are within the limits of accuracy of measurements and no measurement of percent distortion approached the 15% limit allowed in the specifications.

(2) (E-7i(2)) Overall fidelity. The audio response does not vary more than 3 db relative to the response at 1000 CPS for modulation frequencies of 300 to 4000 CPS. Attenuation above 4000 CPS is very good. While the attenuation below 300 CPS is not so rapid, it is considered satisfactory. Distortion levels were measured over the frequency range of 100 to 10,000 CPS and were found to range from 25% to 32%. This is not considered satisfactory in view of the requirement of paragraph (E-7i(1)). See Table 17 and Plate 12 for complete data on overall fidelity.

RF GAIN CONTROL CHARACTERISTICS (E-7j)

(j) RF gain control characteristics were measured on the main receiver (channel 4) and on the high and low guard channels. In each instance it was noted that the setting of the gain control affected the tuning. This effect was much worse on the main receiver. In changing the gain control setting from maximum to minimum, the resonant point was found to have shifted downward approximately 185 kilocycles. This causes quite a difference in the measurement of variation in overall gain depending on whether the range is measured from minimum to maximum or from maximum to minimum. Three measurements were made as follows: (1) The change from maximum to minimum setting, without retuning the signal generator, was 27.3 db; (2) The change from maximum to minimum, returning the signal generator from maximum receiver output, was 22.4 db; (3) The change from minimum to maximum, without retuning, was 18.1 db. The operation of the gain control would be satisfactory if the shift in frequency was minimized. While the frequency shift in the high and low guard channels is not as great, 21.8 kilocycles in the former and 19 kilocycles in the latter, it is sufficient to cause quite a difference in measurement of variation in gain control characteristics. In the high guard channel, the variation in gain from minimum to maximum (not retuned) was 19 db. In the low guard channel, the change in gain from maximum to

to minimum position was 23.6 db. Squelch operation on channel 4 (217 mc) of the main receiver was measured by checking audio output versus signal input. The receiver sensitivity being poor, a five microvolt signal would not produce a 100 milliwatt output and it could not be determined whether the receiver met the requirement of effectively suppressing signals below three microvolts. Examination of the data in Table 18 and Plate 13 shows that from an input of 19 microvolts to 25 microvolts the output changes from 36 milliwatts to 240 milliwatts. This is a change of 2.4 db in signal input to produce a change of 9.7 db in audio output, which is not within the rate of change specified. The specifications, reference (b), states that a change of approximately one db in RF input shall produce a change of 10 db in audio output.

RF POWER OUTPUT (E-7k)

(k) Power output was measured under both standard and service conditions. Table 19 and Plate 14 show the results of measurements under standard conditions. These measurements were made with a bolometer. Three measurements were made at each frequency and the average value take. Power output failed to meet specification requirements on channels 2 (128.0 mc), 3 (164.8 mc), 5 (230.6 mc), 6 (277.8 mc) and 9 (378.0 mc). Table 20 and Plate 15 show results of measurements of power output versus supply voltage. The transmitter was operated for one hour continuously in the "keyed" condition and power output measured at various intervals. The results are show in Table 21 and Plate 16. Under service conditions measurements were made as follows: (1) Into a 20 ohm load and into a 125 ohm load; (2) Over the range of temperatures from -30°C to +50°C; (3) Under conditions of +50°C temperature and 95% relative humidity for 48 hours. Results of measurements into 20 ohms and into 125 ohms were made on channels 5 (230.6 mc) and 8 (351.3 mc) with results shown in Table 22. All these results meet requirements of the specifications except into a 20 ohm load on channel 5 where the power output was 9.7 watts instead of the 10 watts required. It should be pointed out that the requirements of the specifications now call for antenna resistances of 25 ohms instead of 20 and 125. Time limitations prevented the taking of measurements using these loads, but in view of results of earlier tests it seems safe to assume satisfactory outputs into these loads at these frequencies. Results of power output measurements over the range of temperatures from -30°C to +30°C on channels 7 (328 mc) and 2 (128.0 mc) are shown in Table 23. All results on channel 7 are satisfactory and, while the results on channel 2 do not meet the requirement of 10 watts given in the specifications, there is little change over the range of temperatures and results would be satisfactory if the power output under standard conditions were satisfactory. Under conditions of high temperature and high relative humidity the power output went from 8.9 watts at room temperature (7.2 watts at +50°C) to a low of 2.0 watts at the end of 48 hours. Recovery was rather rapid however, power output being 4.6 watts after two hours continuous operation (75 minutes after ceasing humidity) and 6.0 watts after 72 hours drying out. Results in each case were taken at the end of fifteen minutes operation. See Table 24.

MODULATION CHARACTERISTICS (E-71)

(l) Measurements were made under both standard and service conditions with the following results:

(1) (E-71(1)) Modulation capability. The modulation amplifier has a pressure operated gain control which increases the gain at approximately 20,000 feet and again at approximately 35,000 feet. Measurements were made to determine the audio input necessary for 85% modulation (negative peaks) of the carrier at each of the three levels. See Table 25 for results. At about 20,000 feet, the gain is increased by 7.4 db, and at about 35,000 feet by an additional 6.9 db (14.3 db total). Under service conditions of temperatures ranging from -30°C to +50°C, tests run on channels 2 and 7 show very little change of audio input voltage required for 30% negative peak modulation. See Table 26.

(2) (E-71(2)) Fidelity. Using an input voltage equal to that required for 100% negative peak modulation, measurements of modulation level were made over the frequency range from 150 CPS to 6000 CPS. At frequencies in the range 300 to approximately 2800 CPS, the modulation level exceeded the required 60%. At 3000 CPS the modulation level was 57% and at 3500 CPS it was 47% and it fell off rapidly above 4000 CPS. Percent distortion measurements were made and were found to be satisfactory (below 15%). See Table 27 and Plate 17.

(3) (E-71(3)) Microphone current. The microphone current as measured was found to be 43 milliamperes which is slightly below the minimum of 45 milliamperes given in the specifications.

FREQUENCY STABILITY (E-7o)

(m) Frequency stability was calculated by measuring the drifts of the oscillator involved and calculating the change occurring in the transmitter output frequency or receiver frequency. These measurements were made under both standard and service conditions. Results are shown in Table 28 and Plate 18 through 25. Frequency deviation exceeds the 0.007% limit in the following cases: (1) Warm-up drift of low guard channel at room temperature; (2) Low guard channel at +50°C; (3) Channel 5 at +50°C (receiver only).

SIDETONE (E-7p)

(n) Output of the sidetone circuit was too low for satisfactory measurement, being only 15 milliwatts (8 milliwatts noise) when the transmitter was modulated 30% (negative peaks) at 1000 CPS. Considerable time was spent in trying to raise the output level. No trouble was found in the sidetone rectifier and by increasing the pickup it was possible to get as much as 300 milliwatts output when the transmitter was modulated 100%. The trouble appears to be insufficient coupling.

INPUT POWER (E-7r)

(o) Table 29 and Plate 26 show input power requirements under both transmit and receive conditions. Autotune drain on the power supply is also shown. All are satisfactory.

CHANNEL CHANGING CYCLE (E-7s)

(p) The time required to change channels was measured at room temperature and over the range of temperatures from -30°C to +50°C. Measurements made as indicated in Paragraph (E-7s) of the specifications showed the channel changing time to be 7.12 seconds at -30°C and 6.34 seconds at 0°C, both of which are greater than the 5 second limit.

allowed. These figures are averages of ten trials at each temperature. See Table 30.

FREQUENCY MODULATION (E-7u)

(q) A check for frequency modulation of the transmitter was made using the type RBW-3 Panoramic Adaptor. With the carrier modulated 80% at frequencies of from 100 CPS to 10,000 CPS no evidence of frequency modulation could be discerned by observing the presentation on the oscilloscope.

FAILURES DURING TESTS

(r) The following failures occurred:

(1) During power output measurements unusual loading of the dynamotor was observed. It was found to be due to arcing in one of the 2C39's in the driver stage. The transmit-receiver relay K-1602 would close momentarily and then reopen, drawing an arc which burned the contacts so badly it was necessary to replace the relay.

(2) During the visit of Messrs. Hubbard and Anderson of the Collins Radio Company, they undertook to improve the tracking of the driver stage and the final amplifier. In so doing it was discovered that the grid of V-502, one of the drivers, was drawing current even when the transmitter was not keyed. The cause of this proved to be a partially shorted by-pass condenser which made the DC resistance to ground 2000 ohms. This formed a voltage divider arrangement to the +26.5 volts and made the grid positive causing grid current to flow. It was necessary to replace the faulty condenser. It is considered quite likely that this was the cause of the tube failure and consequent relay failure reported in (1) above .

(3) During the temperature run on channel 7, the equipment failed to operate at -30°C. Examination showed filaments to be lighted but the dynamotor would not operate. The trouble was found to be due to the power lead to L-1321 being open. Apparently contraction due to exposure at low temperatures had caused a poor solder joint to break. Normal operation was resumed after resoldering the connection.

(4) Four tube failures, all 2C39's, occurred during these tests.

MECHANICAL FEATURES

(s) In general the equipment is considered to be well engineered and most sub-assemblies and components are readily accessable for replacement or repairs. However, several minor mechanical difficulties have occurred and are listed below:

(1) Dzuz fasteners not securely locking the dust cover to the chassis.

(2) Crushing of ground springs around chassis plug and around front panel.
(3) Audio unit plug not fastened to chassis.
(4) Inaccessability of main receiver RF amplifier components and first RF amplifier tube.

WEIGHTS AND DIMENSIONS

(t) The equipment is housed in a one and one-half unit ATR rack and weighs approximately 72 lbs., less shock mount, cables and central box. See Table 31 for complete weights and dimensions.

CONCLUSIONS

4. Model AN/ARC-13 Serial No. 1, COL, in its present form, is considered unsatisfactory for use in Naval aircraft due to the failures, enumerated below, to meet the requirements of the specifications, reference (b):

(a) On all nine channels of the main receiver the sensitivity was not within the 5 microvolt requirement, varying from 5.3 microvolts to 67.5 microvolts. On the high guard channel the sensitivity was 36.5 microvolts. Under service conditions, especially humidity, the sensitivity became much poorer, going to more than 60 millivolts on channel 5 (230.6 mc) and to 145 microvolts on the low guard channel. The poor showing under high humidity would seem to be due in a large measure to surface moisture since recovery was rather rapid.

(b) On channel 4 of the main receiver and on the high guard channel, AVC action is unsatisfactory at signal inputs of 50 microvolts and below. This is due to poor sensitivity rather than failure of AVC circuits but still is a failure to meet the requirements of the specifications. On the low guard channel blocking occurs at signal inputs of six millivolts and sixty millivolts.

(c) On channels 4 and the low guard channel, the total bandwidth of the receiver at the 6 db points is less than the required 114 kilocycles. On channel 4 and at the intermediate frequency the total bandwidth at 20 db points is greater than the 220 kilocycle limit. On channels 4 and the low guard and at the intermediate frequency, the total bandwidth at the 40 db points exceed the 284 kilocycle limit and at the 60 db points exceeds the 450 kilocycle limits.

(d) Image rejection fails to reach the 60 db limit at two frequencies on channel 1 (109.8 mc) being only 51.4 db to a 70 mc signal and 59.4 db to a 1460 mc signal. On

channel 9 (378 mc) there are three frequencies at which the image rejection falls below the 40 db required, being 34.0 db to a 339 mc signal, 31.4 db to a 139.4 mc signal and 32.0 db to a 100.2 mc signal.

(e) IF rejection fails to meet the 80 db requirement on all of the four channels, 1 (109.8 mc) and 9 (378 mc) of the main receiver and both high and low guard channels, on which measurements were made. Results range from 37.8 db to 57.1 db.

(f) Audio power output of the receiver fails to reach the 3 watts level required in paragraph (E-7i(1)) of reference (b), but does meet the requirements of paragraph (E-7c) of the same reference. Since these two paragraphs give conflicting requirements, it is considered that the power output is sufficient. The audio distortion level is excessive varying from 25 to 32%. While overall fidelity is satisfactory, distortion of the output varies from 25 to 32% over the audio frequency range from 100 CPS to 10,000 CPS.

(g) The RF gain control causes considerable shift in the resonant frequency of the receiver.

(h) Squelch operation is somewhat below the specifications requirements since it takes a change of 2.4 db of the signal input to cause a change of 9.7 db in the audio output.

(i) Transmitter power output is below requirements of the specifications on channels 2, 3, 5, 6, and 9 under standard conditions. On channel 5 under service conditions of high temperature and humidity, the transmitter power output went from 8.9 watts to 2 watts. Recovery was rapid and satisfactory after ceasing humidity which seems to indicate that surface moisture accounts for most of the loss of power output.

(j) Modulation fidelity does not meet specification requirements at frequencies of 3000 and 3500 CPS. Microphone current was only 43 milliamperes.

(k) Frequency deviation exceeded the 0.007% limit in the following cases; (1) Warm-up drift of low guard channel at room temperature; (2) Low guard channel at +50°C; (3) Channel 5 at +50°C (receiver only).

(l) The output of the sidetone circuit was only 15 milliwatts (8 milliwatts noise) when the transmitter was modulated 30% at 1000 CPS.

(m) The antenna output metering circuit does not provide ample indication of maximum power output.

RECOMMENDATIONS

5. Model AN/ARC-13 Serial No. 1 COL transmitter-receiver is considered, in its present form, to be unsatisfactory for use in Naval aircraft. The following changes and modifications are recommended:

(a) The sensitivity of the main receiver and of the high guard channel be increased to comply with the 5 microvolt requirement.
(b) The cause of blocking in the low guard channel be determined and eliminated.
(c) The bandwidth be decreased so as to comply with the limits specified in reference (b).
(d) Image rejection and IF rejection be improved to comply with the specifications.
(e) The cause of reduction of gain of the receiver when the input signal is modulated 60% or more be investigated to determine if the noise peak limiter is at fault and steps taken to improve this condition.
(f) The receiver audio distortion level be reduced to below 15%.
(g) The effect of the RF gain control on the receiver frequency be minimized and the range be made to comply with the requirement of 20 to 40 db variation in gain.
(h) Transmitter power output be increased to comply with specifications.
(i) Frequency response of the modulation system be improved so that the 3000 and 3500 CPS frequencies will not be attenuated more than permitted by the specifications.
(j) The frequency stability of the sidestep oscillator and the guard channel exciters be improved.
(k) The coupling from which the sidetone system picks up the transmitter output be increased so that the output of the sidetone system is within the specified limits. This will also improve the reliability of transmitter tuning on position 6 of the metering switch.
(l) It is further recommended that the specifications, reference (b), be clarified as to what audio output is desired and to remove conflicting requirements of paragraphs (E-7c) and (E-7i(1)).

REFERENCES

(a) BuShips ltr. Sec. 944DA-Ser 3554 944ZA of 29 December 1945 to Director NRL authorizing Problem S-2122T-R.

(b) BuShips Specifications RE 13A 996A.

Data recorded in NRL Log Book No. 6194.

TABLE 1

Model AN/ARC-13 Serial No. 1 COL
Receiver Sensitivity

Standard conditions, RF input modulated 30% at 1000 CPS input through 50 ohm dummy antenna and 10 ft. of RG-8/u transmission line, sensitivity is the voltage input to the receiver antenna post.

CHANNEL	FREQUENCY (mc)	OUTPUT-MILLIWATTS Audio	Noise	SIGNAL/NOISE RATIO	SENSITIVITY MICROVOLTS
1	109.8	320	80	6	9.8
2	128.0	100	20	7.0	36.5
3	164.84	120	30	6	67.5
4	217.2	100	25	6	5.3
5	230.6	100	25	6	8.0
6	277.8	100	9	10.4	34.5
7	328.2	100	17	7.7	32.0
8	351.3	100	18	7.5	21.5
9	378.0	100	16	8.0	28.0
LOW GUARD	140.58	240	60	6	3.0
HIGH GUARD	280.2	100	16	8.0	36.5

[redacted]

TABLE 2

Model AN/ARC-13 Serial No. 1 COL
Receiver Sensitivity vs
Temperature

Sensitivity taken as the voltage input to the receiver antenna post.

TEMPERATURE CONDITIONS	MAIN RECEIVER CHANNEL 4			LOW GUARD CHANNEL		
	Sens. Micro-volts	Output Milli-watts	Noise Milli-watts	Sens. Micro-volts	Output Milli-watts	Noise Milli-watts
Room	10.5	100	12	7.0	100	25
-30°C	15.0	360	90	6.5	280	70
0°C	15.5	280	70	6.5	260	65
+ 20°C	10.0	220	55	7.2	220	55
+ 50°C	10.5	100	15	6.5	120	30

[redacted]

TABLE 3

Model AN/ARC-13 Serial No. 1 COL
Receiver Sensitivity vs. Humidity

Sensitivity taken as the voltage input to the receiver antenna post.

Temperature Conditions	MAIN RECEIVER CHANNEL 5			LOW GUARD CHANNEL		
	Sens. Micro-volts	Output Milli-watts	Noise Milli-watts	Sens. Micro-volts	Output Milli-watts	Noise Milli-watts
Room Temp.	28.5	240	60	6.5	200	50
+50°C Low Humidity	30.0	100	20	6.5	100	25
24 hours Humidity	145	100	6	14.5	100	8
48 hours Humidity	60000	45	1	145	100	0.5
2 hours Recovery	65	100	15	8.5	100	17
72 hours Recovery	30.0	100	20	4.0	160	40

[redacted]

TABLE 4

Model AN/ARC-13 Serial No. 1 COL
Audio Noise Output

Antenna post connected to ground through 50 ohms resistance. Switch on control box in main T/R position except on Channel 10 where Guard position was used.

CHANNEL	NOISE OUTPUT (Milliwatts)
1	32
2	12
3	10
4	15
5	12
6	9
7	13
8	12
9	10
10	12

[redacted]

TABLE 5

Model AN/ARC-13 Serial No. 1 COL
AVC Characteristics Channel 4 -217.2
Megacycles

INPUT Microvolts	OUTPUT Milliwatts	DECIBELS FROM ONE MILLIVOLT Output Level
1	20	- 14.2
2	27	- 12.9
3	40	- 11.1
4	70	- 8.7
5	85	- 7.9
10	170	- 4.9
50	450	- 0.6
100	490	- 0.3
500	520	0
1000	520	0
5000	520	0
10000	520	0
50000	520	0

[redacted]

TABLE 6

Model AN/ARC-13 Serial No. 1 COL
AVC CHAPACTERISTIC
Low Guard Channel

INPUT Microvolts	OUTPUT Milliwatts	DECIBELS FROM ONE MILLIVOLT Output Level
1	140	-5.4
2	230	-3.3
5	370	-1.2
10	410	-0.8
20	440	-0.5
50	460	-0.3
100	470	-0.2
200	470	-0.2
500	475	-0.1
1000	490	0
2000	485	0
3000	460	-0.3
4000	400	-0.9
5000	290	-2.3
6000	210	-3.7
7000	275	-2.5
8000	400	-0.9
9000	425	-0.6
10000	425	-0.6
12000	390	-0.9
15000	335	-1.6
20000	265	-2.7
25000	220	-3.5
30000	195	-4.0
40000	175	-4.5
50000	160	-4.9
60000	135	-5.6

TABLE 7

Model AN/ARC-13 Serial No. 1 COL
AVC Characteristics
High Guard Channel

INPUT Microvolts	OUTPUT Milliwatts	DECIBELS FROM ONE MILLIVOLT Output Level
10	30	-11.1
50	130	- 4.8
100	290	- 1.8
500	365	- 0.3
1000	390	0
5000	420	+ 0.3
10000	430	+ 0.4
50000	450	+ 0.6

[redacted]

TABLE 8

Model AN/ARC-13 Serial No. 1 COL
Operation of Audio Compressor

COMPRESSOR IN			COMPRESSOR OUT	
INPUT Microvolts	OUTPUT Milliwatts	DB FROM ONE Millivolt level	OUTPUT Microvolts	DB FROM ONE Millivolt (Compressor in) level
10	60	-8.7	90	-7.0
15			190	-3.8
20			380	-0.7
25	190	-3.7	600	+1.3
30			850	+2.8
35			1050	+3.7
40			1100	+3.9
45			1200	+4.3
50	330	-1.3	1300	+4.6
100	410	-0.4	1650	+5.6
500	450	0	2050	+6.6
1000	450	0	2150	+6.8
5000	460	+0.1	2300	+7.1
10000	470	+0.2	2500	+7.5
50000	470	+0.2	2650	+7.7

[redacted]

TABLE 9

Model AN/ARC-13 Serial No. 1 COL
AVC Characteristics
Voltages at the Cathode of AVC Rectifier (V1201) and at Plate of AVC Amplifier (V1202)

INPUT Microvolts	CATHODE OF V1201 Volts	PLATE OF V1202 Volts
10	+1.5	+27.0
50	+3.9	+27.0
100	+4.4	+26.5
500	+4.7	+24.7
1000	+4.8	+23.5
5000	+4.9	+23.2
10000	+5.0	+22.5
50000	+5.0	+21.7

[redacted]

TABLE 10

Model AN/ARC-13 Serial No. 1 COL
Overall Selectivity
(In Kilocycles)

DB DOWN	SPECIFICATION LIMITS			CHANNEL A			LOW GUARD			IF		
	High Side	Low Side	Total	High Side	Low Side	Total	High Side	Low Side	Total	High Side	Low Side	Total
6	57 to 85	57 to 85	114 to 170	* 29.2	72.6	*101.8	* 25.5	*30.7	*56.2	* 29.7	88.1	117.9
20	57 to 110	57 to 110	114 to 220	83.7	*139.2	*222.9	*120.4	84.9	205.3	91.1	*130.7	*221.8
40	57 to 142	57 to 142	114 to 284	137.9	*208.6	*346.5	*199.2	135.1	*334.3	*163.4	*182.2	*345.6
60	57 to 225	57 to 225	114 to 450	190.0	*274.2	*464.2	*261.3	182.1	443.4	*234.6	*236.6	*471.2

NOTE: Points marked * do not meet requirements of the specification. Resonance taken as point of maximum output.

TABLE 11

Model AN/ARC-13 Serial No. 1 COL
Image Rejection

Only points are shown which are not satisfactory.

MAIN RECEIVER, CHANNEL 1
(109.8 mc)

Frequency Megacycles	Input Microvolts	Sensitivity (200 milliwatts)	DB Image Rejection
70	2800	7.5	51.4
160	7000	7.5	59.4

MAIN RECEIVER, CHANNEL 9
(378 mc)
(100 milliwatts)

339	1750	35	34.0
139.4	1300	35	31.4
100.2	1400	35	32.0

[redacted]

TABLE 12

Model AN/ARC-13 Serial No. 1 COL
IF Rejection

Channel	Frequency Megacycles	Sensitivity Microvolts	IF Signal Microvolts	Decibels Ratio	Sig/Noise Milliwatts	DB S/N
1	109.8	9.5	3750	51.9	240/60	6
9	378.0	24	3000	41.9	100/15	8.2
ow Guard	140.58	3	2150	57.1	240/60	6
igh Guard	280.2	34	2650	37.8	100/15	8.2

[redacted]

TABLE 13

Model AN/ARC-13 Serial No. 1 COL
Audio Output and Per Cent Distortion vs. Frequency

Input 1000 Microvolts Modulated 30% 1000 CPS

Channel	Frequency Megacycles	Output Milliwatts	Per Cent Distortion
1	109.8	520	30
2	128.0	460	26
3	164.8	470	28
4	217.0	520	32
5	230.6	440	27

[redacted]

TABLE 14

Model AN/ARC-13 Serial No. 1 COL
Audio Output and Distortion vs Per Cent Modulation

Channel 5 (230.6 mc), input signal 1 millivolt modulated at 1000 CPS

Per Cent Modulation	Audio Output (Milliwatts)	Per Cent Distortion
10	320	28.0
20	330	24.0
30	440	28.0
40	480	28.5
50	480	28.0
60	465	26.5
70	455	25.5
80	430	25.0
90	415	25.5
100	420	25.5

TABLE 16

Model AN/ARC-13 Serial No. 1 COL
Audio Output and Distortion vs. Signal Input

Channel 5 (230.6 mc), signal input modulated 30% and 60% at 1000 CPS, reference level is output with 1 millivolt input signal modulated 30%.

Signal Input	30% Modulation			60% Modulation		
	Output		Per Cent	Output		Per Cent
Microvolts	MW	DB	Distortion	MW	DB	Distortion
10	45	-9.5	80	95	-6.3	48
50	250	-2.1	27	360	-0.5	24.5
100	335	-0.8	24	435	+0.3	29.5
500	385	-0.2	25.5	480	+0.7	29.5
1000	405	0	28	490	+0.8	33
5000	410	+0.05	28	500	+0.9	34
10000	400	-0.05	32	510	+1.0	34
50000	410	+0.05	32	480	+0.7	32

TABLE 16

Model AN/ARC-13 Serial No. 1 COL
Audio Output and Distortion vs. Output Impedance

Channel 5 (230.6 mc), signal input one millivolt modulated 30% at 1000 CPS

Output Impedance Ohms	Output Milliwatts	Decibels From 300 Ohm Level	Per Cent Distortion
50	550	+ 1.4	18
100	550	+ 1.4	21
150	500	+ 1.0	22
200	450	+ 0.5	23
300	400	0	25
600	275	- 1.6	28
1000	200	- 3.0	30
2000	120	- 5.2	33
5000	45	- 9.5	33
10000	20	-13.0	44

[redacted]

TABLE 17

Model AN/ARC-13 Serial No. 1 COL
Receiver Fidelity

Channel 5 (230.6 mc), input signal 1 millivolt modulated, 30% at 1000 CPS

AUDIO FREQUENCY CPS	OUTPUT MILLIWATTS	DECIBELS FROM 1,000 CPS LEVEL	PER CENT DISTORTION
100	180	-3.9	28
150	240	-2.6	26.5
200	280	-2.0	25
250	310	-1.5	26
300	330	-1.2	25
400	375	-0.7	28
500	410	-0.3	28
600	425	-0.2	28
750	435	-0.1	27.5
1000	440	0	28
1500	400	-0.4	25
2000	350	-1.0	27.5
2500	310	-1.5	28.5
3000	265	-2.2	28
4000	230	-2.8	27.5
5000	185	-3.8	31
6000	160	-4.4	31
7500	140	-5.0	30
10000	100	-6.4	32

[redacted]

TABLE 18

Model AN/ARC-13 Serial No. 1 COL
Squelch Operation

Channel 5 (230.6 mc), input signal modulated 30% at 1000 CPS

INPUT Microvolts	OUTPUT Milliwatts
5	0.1
7.5	0.3
10	0.8
12.5	1.7
15	5.0
17.5	15.0
19	26
20	48
21	75
22	90
23	120
24	160
25	240
30	270
35	300

[redacted]

TABLE 19

Model AN/ARC-13 Serial No. 1 COL
Transmitter Power Output

Three trials at each frequency. Measured with Bolometer

Channel	Frequency Megacycles	Standing Wave Ratio				Phase Angle			Power Output (Watts)			
		1	2	3	Av.	1	2	3	1	2	3	Av.
1	109.8	.96	.945	.945	.95	-1.25	-1.7	-1.55	20.0	20.3	19.5	19.9
2	12[illegible].8	[illegible].4	.862	.862	.85	+8.0	+6.0	+6.2	10.5	10.6	10.6	10.6
3	164.84	.955	.94	.95	.95	+0.5	+0.05	+0.7	6.5	6.8	7.5	6.9
4	217.2	.942	.90	.916	.92	-1.6	-5.0	4.0	15.98	15.98	16.55	16.2
5	230.6	.878	.898	1.0	.93	+7.5	+6.1	0	11.7	10.9	11.2	11.3
6	277.8	.87	.813	.89	.86	+6.0	+6.8	+4.5	14.44	13.6	13.9	14.0
7	328.0	.97	.965	.957	.96	+0.75	+1.45	+1.3	9.9	9.4	9.2	9.5
8	351.3	.91	.912	.912	.91	+3.2	-2.7	-3.9	8.2	7.8	8.4	8.1
9	378.0	.935	.875	.815	.88	-3.5	-5.9	-8.4	0.60	0.59	0.82	0.67
10	280.2	.94	.948	.922	.94	+0.8	+0.75	+2.3	16.3	16.8	16.7	16.6

Table 20

Model AN/ARC-13 Serial No. 1 COL
Transmitter Power output vs. Supply Voltage

Channel 5 (230.6 mc), standing wave ratio 0.928.

Supply Voltage	Transmitter Power Output Watts
24	7.6
25	8.8
26	9.6
26.5	10.5
27	10.8
28	11.6
29	12.4

[redacted]

Table 21

Model AN/ARC-13 Serial No. 1 COL
Transmitter Power Output vs Time.

Channel 5 (230.6 mc), Standing Wave ratio 0.933, equipment on 1 minute before being keyed, time is given in minutes from time transmitter is keyed.

Time (Minutes)	Power Output (Watts)
1	13.9
2	13.7
5	12.85
10	12.4
15	11.8
20	11.2
27	10.7
35	10.3
40	10.0
45	9.9
50	9.55
60	9.55

TABLE 22

Model AN/ARG -13 Serial No. 1 COL

Power Output into Various Loads

Channel	Trail	20 Ohn Load			50 Ohn Load			125 Ohn Load		
		Power Output	S.W.R.	Phase Angle	Power Output	S.W.R.	Phase Angle	Output	S.W.R.	Phase Angle
5	(1	8.55	2.37	+ 7°	11.7	.878	+7.5°	11.3	2.45	+12°
	(2	10.7	2.54	+12°	10.9	.898	+6.1°	10.14	2.49	+17°
	(3	9.85	2.61	+12°	11.2	1.0	0°	10.15	2.47	+ 9°
	(Av.	9.7			11.26			10.53		
8	(1	6.1	2.26	-11°	8.2	-.91	+3.2	10.5	2.36	-2°
	(2	5.9	2.31	-14°	7.8	.912	-2.7°	11.3	2.19	+2°
	(3	5.1	2.31	-11°	8.4	.912	-3.9°			
	(Av.	5.7			8.13			10.9		

TABLE 23

Model AN/ARC-13 Serial No. 1 COL
Transmitter Power Output vs. Temperature

Readings taken at the end of 20 minutes operation of the transmitter, 50 ohm load.

Temperature Conditions	Channel 2 (128.0 mc) Power Output (Watts)	Channel 7 (328.2 mc) Power Output (Watts)
Room Temperature	---	11.6
-30°C	7.9	10.5
0°C	7.35	9.6
+20°C	7.35	8.8
+50°C	7.4	6.6
Room Temperature After run	---	7.8

Table 24

Model AN/ARC-13 Serial No. 1 COL.
Transmitter Power Output vs. Humidity

Channel 5 (230.6 mc), Readings taken after 15 minutes operation of transmitter, 50 ohm load.

Time or Cond.	Power Output (Watts)
RM. Temp	8.9
+50°C. (No Humidity)	7.2
After 24 hr. Humidity	4.2
After 48 hr. humidity	2.0
2 hr. Recovery	4.6
72 hr. Recovery	6.0

[redacted]

TABLE 25

Model AN/ARC-13 Serial No. 1 COL
Modulation Characteristics - Capability

Channel 4 (217.2 mc), modulation of negative peaks measured by means of modulation meter built by Test Investigation Section, Airborne Radio Division of the Naval Research Laboratory. Measurements under standard conditions.

Altitude (Approximate Feet)	Volts for 85% Modulation	Decibels Gain	Volts for 100% Modulation
Below 20,000	0.73	--	0.80
20,000 to 35,000	0.31	7.4	0.36
Above 35,000	0.14	6.9	0.15

[redacted]

TABLE 26

Model AN/ARC-13 Serial No. 1 COL
Modulation Characteristics - Capability

Measurements under service conditions: (1) Temperatures ranging from -30°C to +50°C taken on channels 2 and 7; (2) +50°C and 95% humidity taken on channel 5.

Temperature Conditions	VOLTS INPUT FOR 30% Modulation Channel 2	Channel 7
Room Temperature		0.32V
-30°C	0.30V.	0.24V
0°C	0.36V	0.26V
+20°C	0.38V	0.24V
+50°C	0.39V	0.27V
Room Temperature		0.24V

(2):

	Channel 5
Room Temperature	0.32V
+50°C (no humidity)	0.31V
24 hours Humidity	0.32V
48 hours Humidity	0.38
*2 hours Recovery	0.26
72 hours Recovery	0.28

ote: * Two hours continuous operation.

TABLE 27

Model AN/ARC-13 Serial No. 1 COL
Modulation Characteristics - Fidelity

Channel 4 (217.2 mc), negative peak modulation made by means of modulation meter under standard conditions.

Audio Frequency	Per Cent Modulation*	Volts for 100% Modulation	Decibel Ratio to 1000 CPS Volts	Per Cent Distortion
150	14	2.65	10.1	17.0
200	30	1.85	7.3	8.0
300	79	1.05	2.4	11.0
400	81	0.87	0.7	10.5
600	93	0.84	0.4	10.0
800	94	0.81	0.1	10.0
1000	100	0.80	0	11.5
1500	86	0.86	0.6	10.0
2000	80	0.91	1.1	12.0
3000	57	1.17	3.3	11.5
3500	47	1.43	5.0	13.5
4000	36	1.85	7.3	10.5
6000	10	1.90	7.5	9.0

Note: * Audio input constant 0.8 volts.

TABLE 28

Model AN/ARC-13 Serial No. 1 COL
Frequency Stability

Condition	Channel	Per Cent Off Frequency Transmitter	Receiver
Warm-up Drift 455 minutes +23°C	Low Guard	--	.0195
+50°C	Low Guard	--	.0131
Warm-up Drift +23°C	High Guard	--	.0023
Warm-up Drift +23°C	4 (217.2 mc)	.000012	.00126
+50°C	7 (328.2 mc)	.0065	.0066
-30°C	2 (128.0 mc)	.000062	.0023
+50°C	5 (230.6 mc)	.007	.0076

[redacted]

Table 29

Model AN/ARC-13 Serial No. 1 COL
Input Power Requirements

Supply Volts	Receive (Normal) Amps.	Watts	Receive (Autotune) Amps	Volts	Watts	Transmit Amps.	Watts
24	8.2	197	12.6	21.5	271	12.1	290
25	8.5	213	13.1	23.0	301	12.8	320
26	8.8	229	13.6	24.5	334	13.2	343
26.5	8.9	236	13.9	25.2	350	13.5	358
27	9.0	243	13.8	25.5	352	13.7	370
28	9.2	258	14.1	26.5	374	14.1	393
29	9.5	276	14.6	28.0	409	14.6	423

Table 30

Model AN/ARC-13 Serial No. 1 COL
Channel Changing Time

Trial	Room Temp.	-30°C.	0°C.	+20°C.	+ 50°C.
1	5.9	7.4	6.6	6.2	6.1
2	4.3	7.6	6.2	6.0	6.0
3	4.5	8.0	6.2	6.0	6.0
4	5.3	7.2	6.6	6.0	6.0
5	4.7	7.0	6.4	6.0	6.1
6	5.3	7.0	6.2	6.0	6.0
7	5.9	7.0	6.6	5.8	6.0
8	4.5	7.0	6.4	5.8	6.0
9	4.3	6.6	6.2	5.6	5.9
10	5.7	6.4	6.0	5.8	5.8
AV.	5.04	7.12	6.34	5.92	5.99

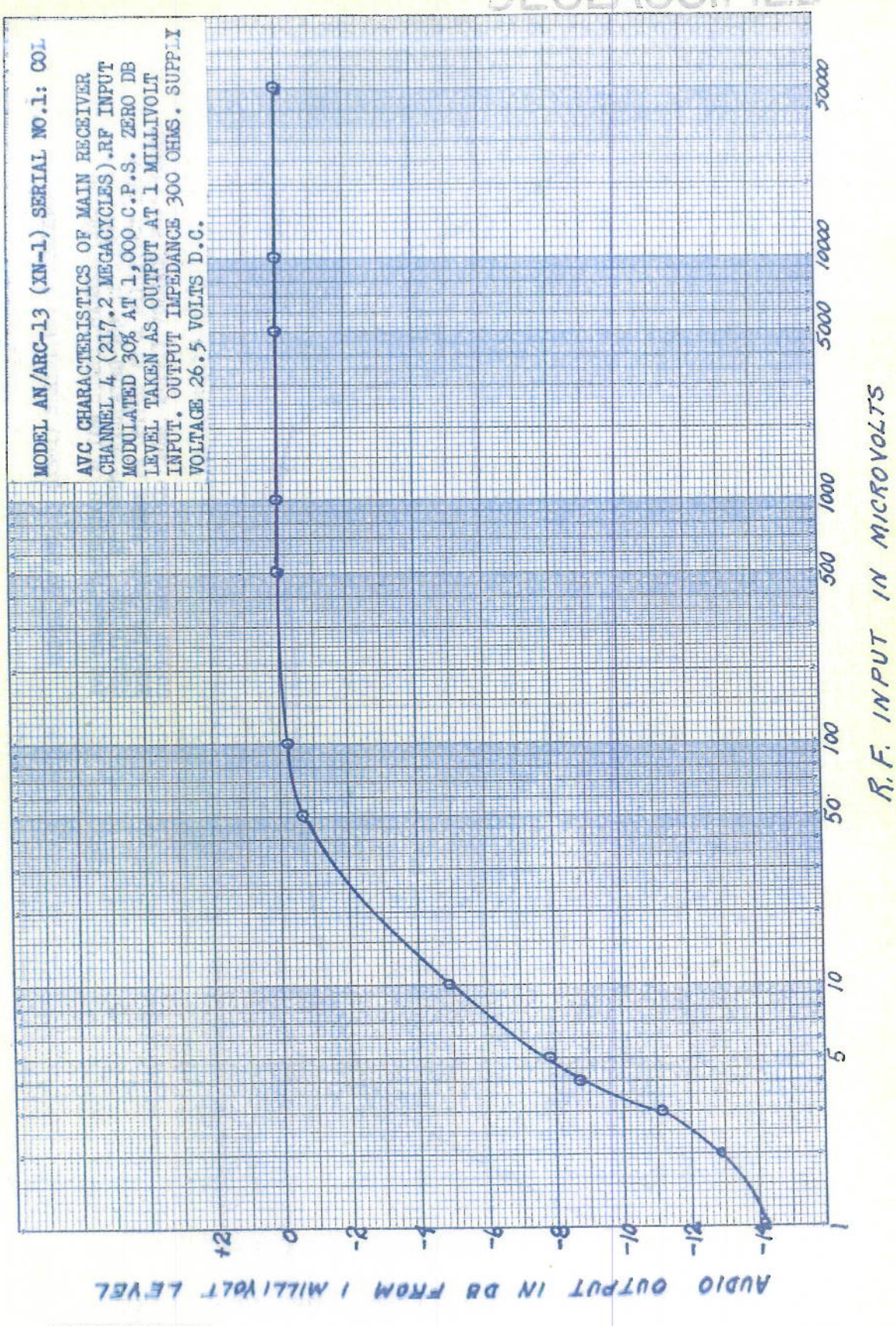
[redacted]

TABLE 31

Model AN/ARC-13 Serial No. 1 COL
Weights and Dimensions

Unit	Weight (Pounds)
AN/ARC-13 (less cables and shock mounting)	72.4
Guard Channel (extra unit)	2.0

Unit	Length	Width	Height
AN/ARC-13 (overall dimensions of equipment not mounted on shock mounting)	21 1/2"	15 5/8"	7 7/8"



MODEL AN/ARC-13 (XN-1) SERIAL No. 1 COLLINS.

AVC CHARACTERISTICS OF LOW GUARD CHANNEL (140.58 MEGACYCLES). RF INPUT MODULATED 30% AT 1,000 C.P.S. ZERO DB LEVEL TAKEN AS OUTPUT AT 1 MILLIVOLT INPUT. OUTPUT IMPEDANCE 300 OHMS. SUPPLY VOLTAGE 26.5 VOLTS.

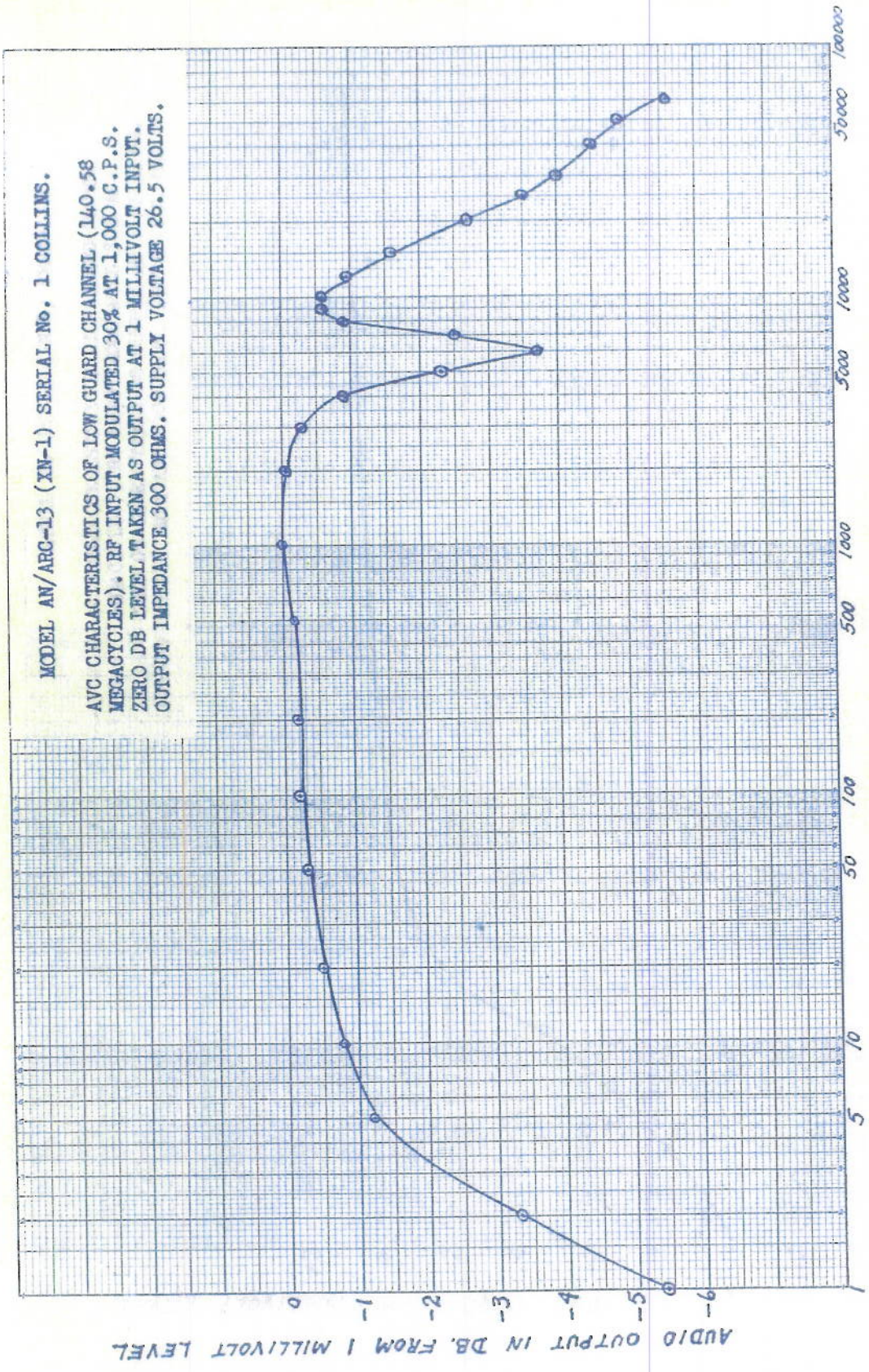


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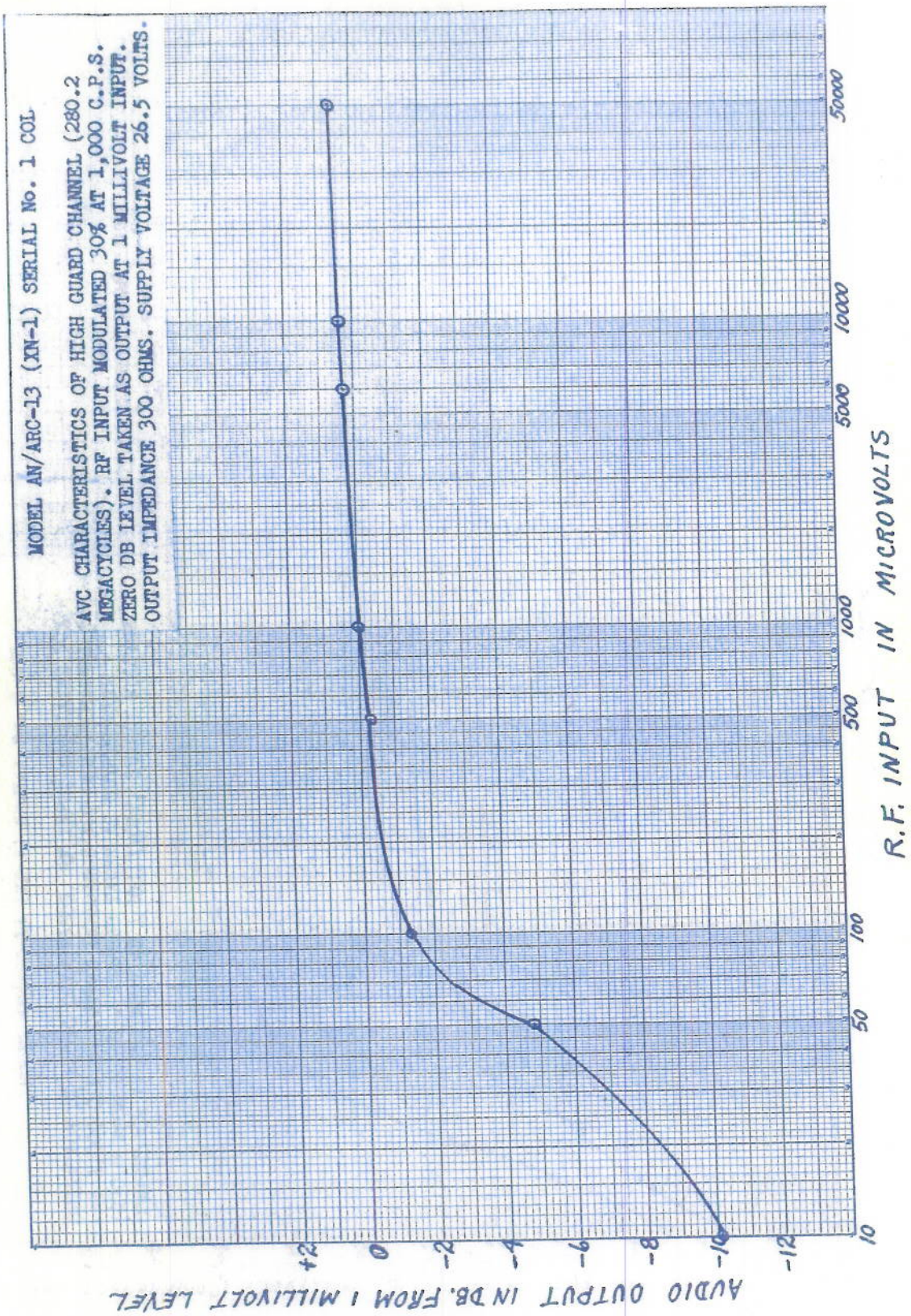
PLATE 2



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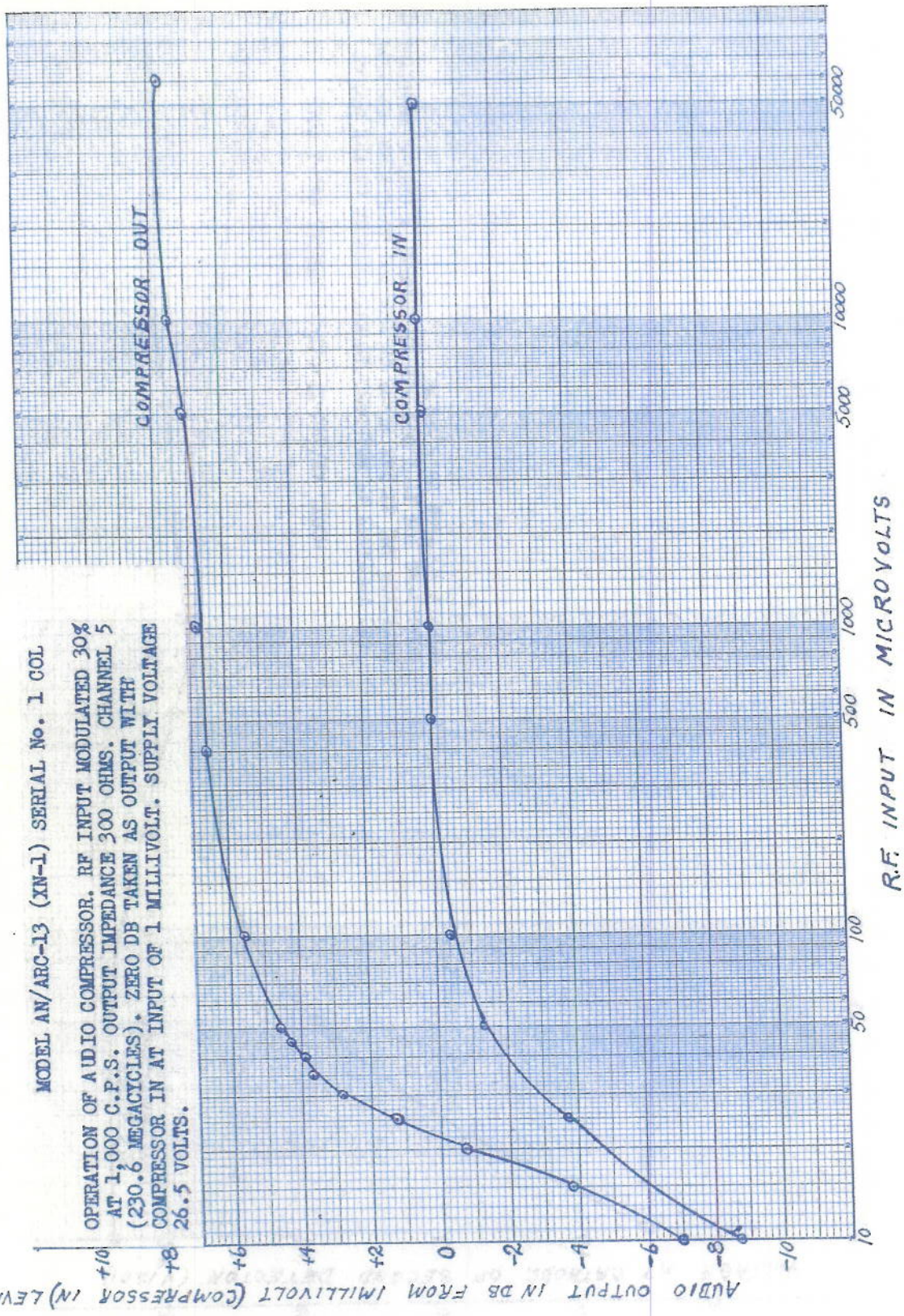

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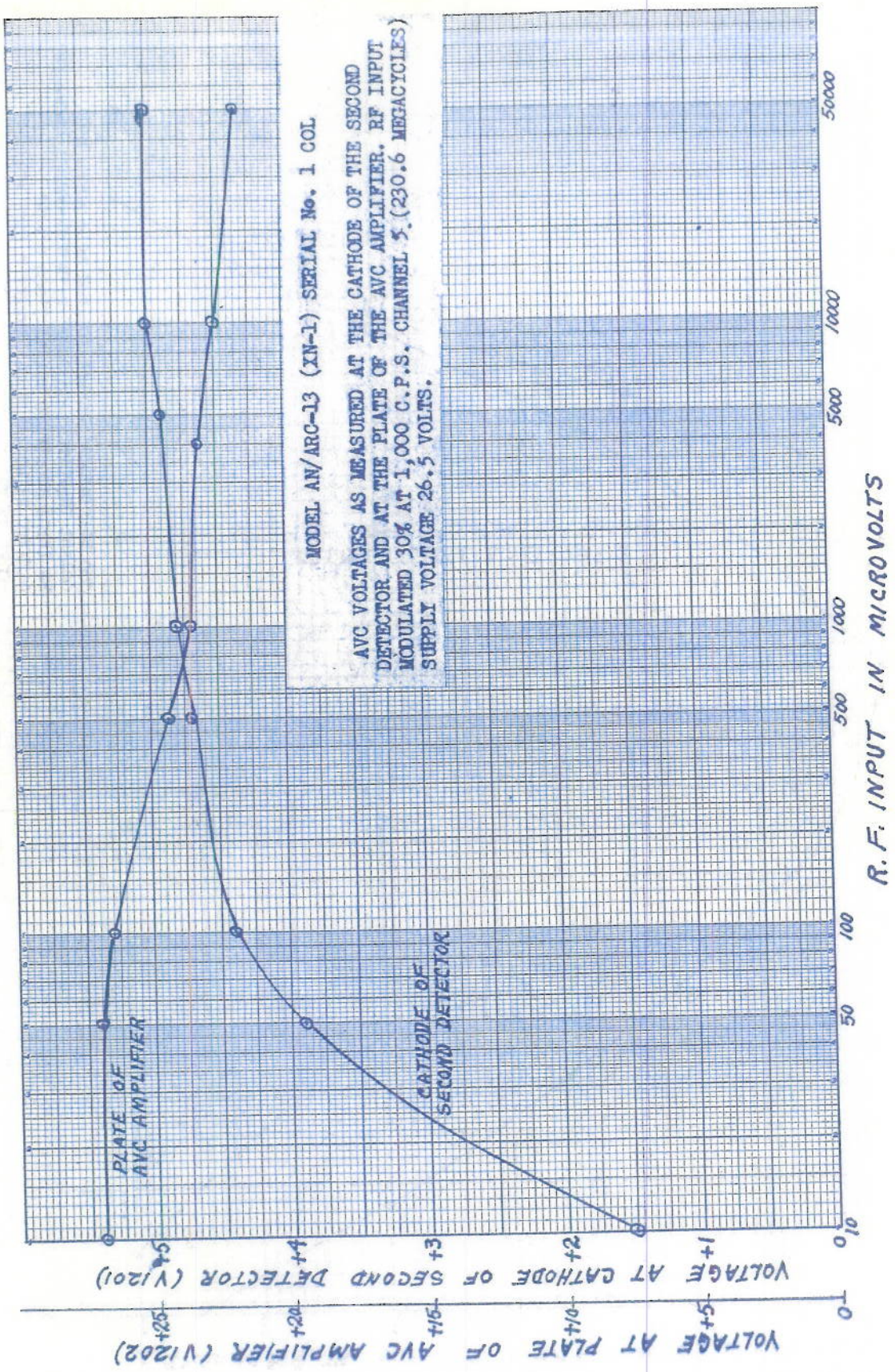
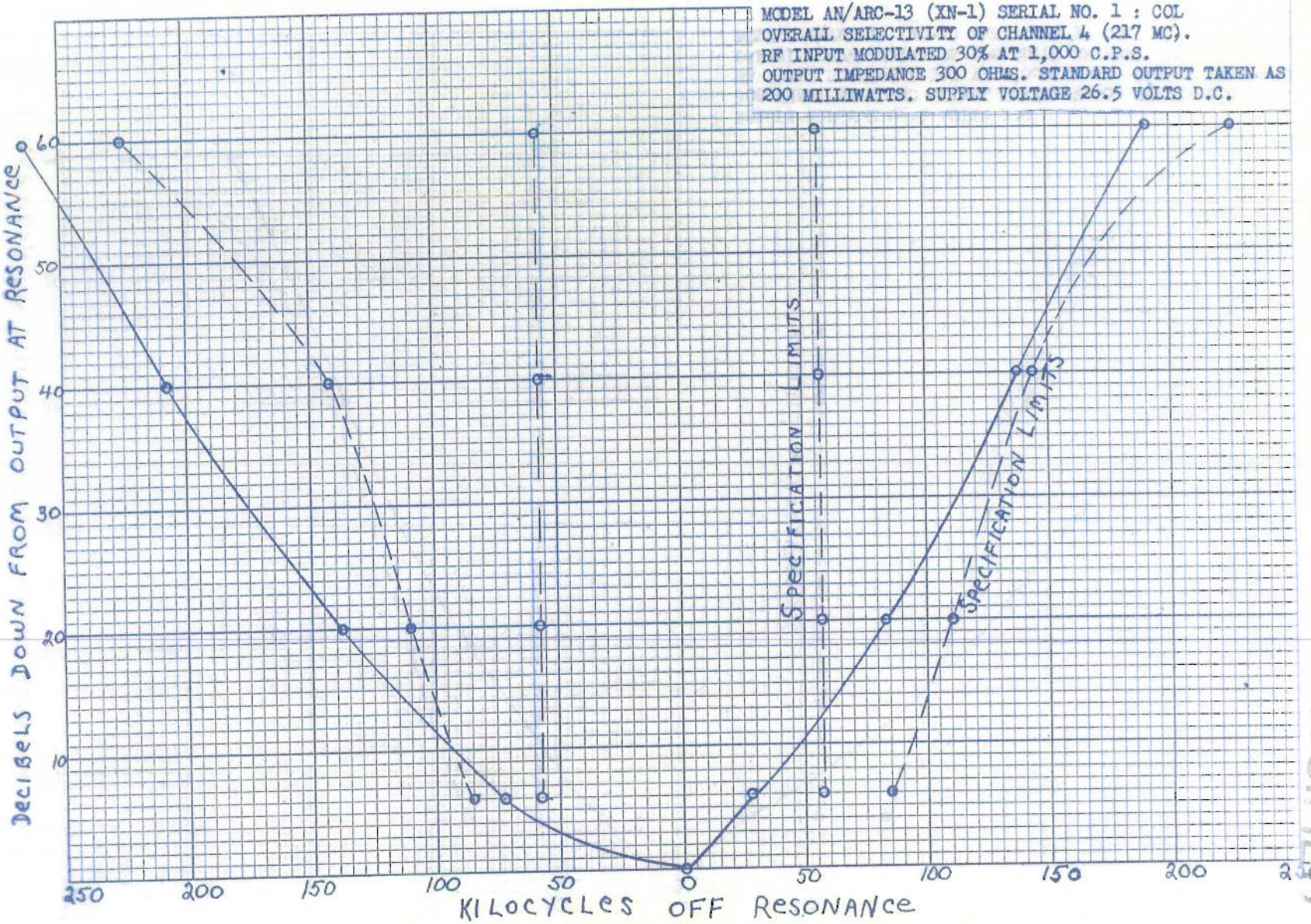
PLATE 4





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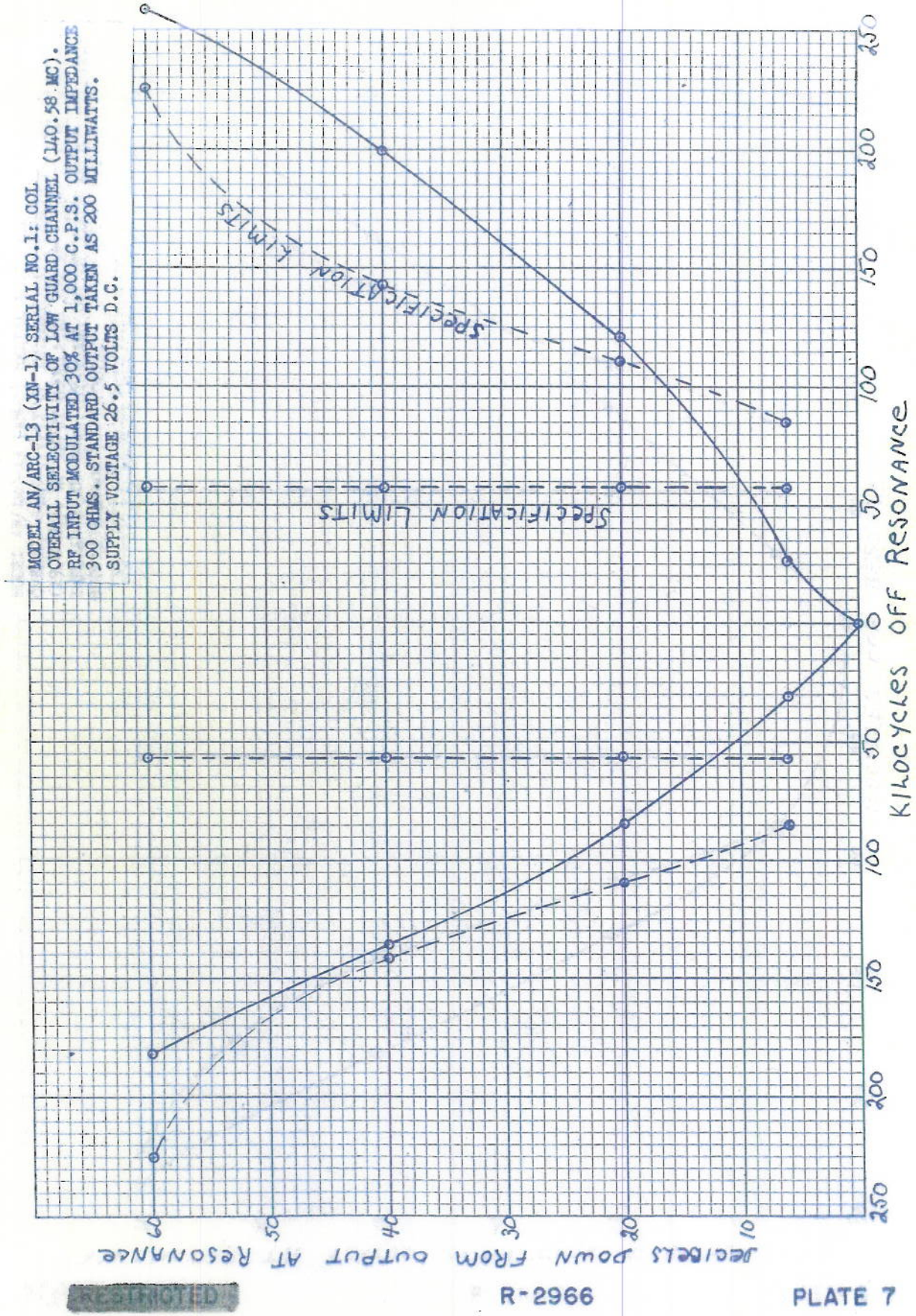

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PLATE 7

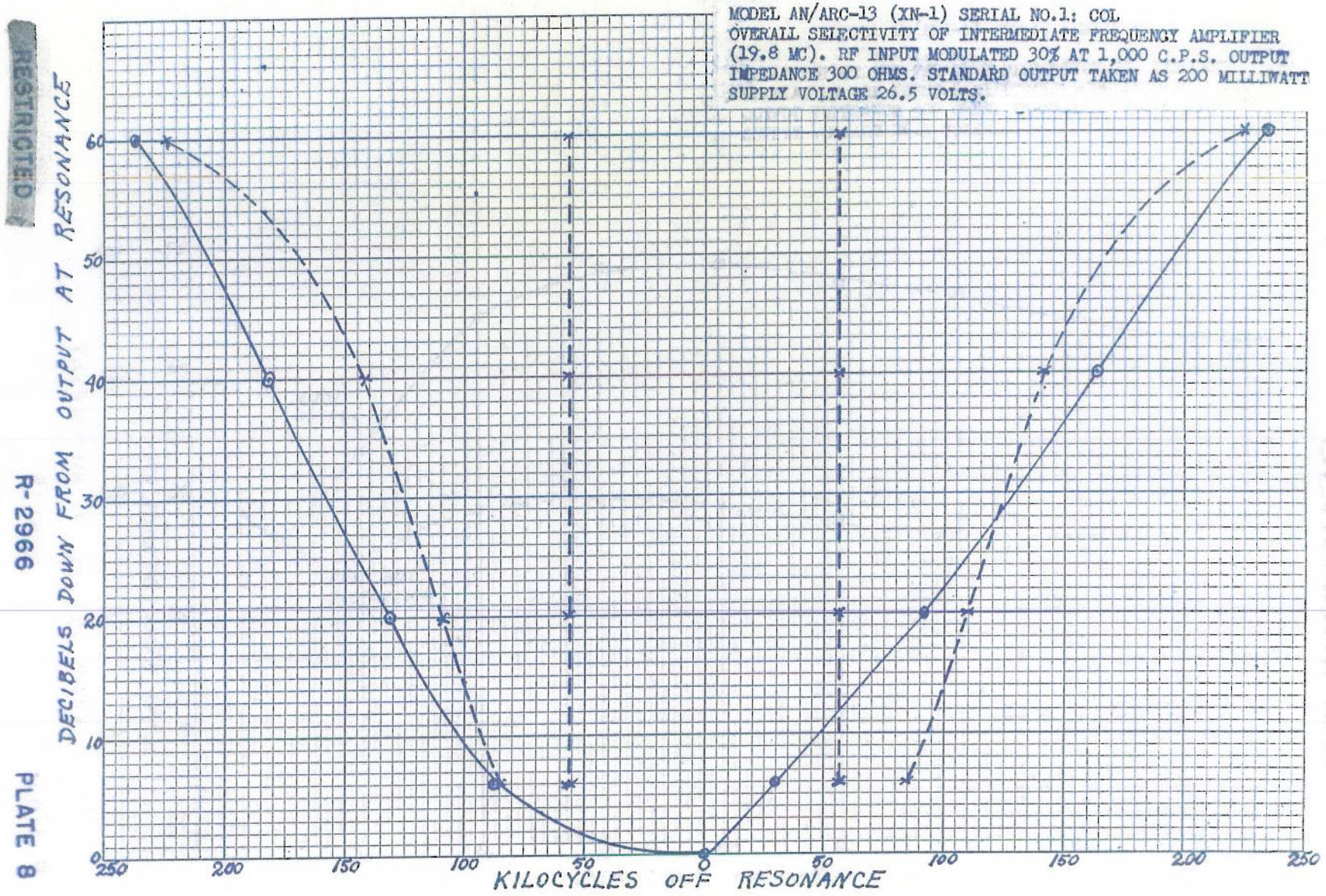

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PLATE 8

MODEL AN/ARC-13 (XN-1) SERIAL No. 1 COL

AUDIO OUTPUT AND PER CENT DISTORTION VS. PER CENT MODULATION. RF INPUT 1 MILLIVOLT MODULATED AT 1,000 C.P.S. OUTPUT IMPEDANCE 300 OHMS. CHANNEL 5 (230.6 MEGACYCLES). SUPPLY VOLTAGE 26.5 VOLTS.

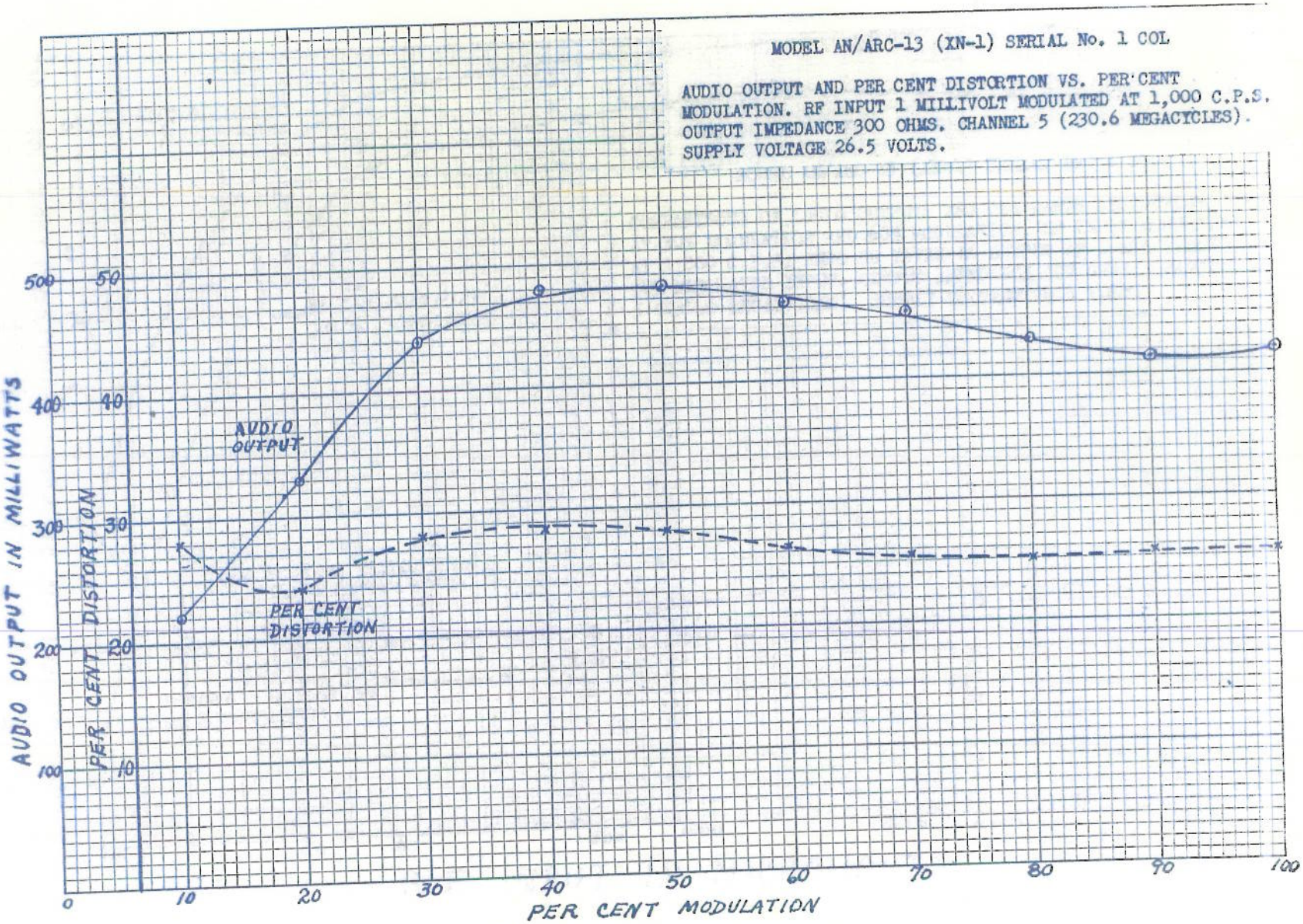

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PLATE 9

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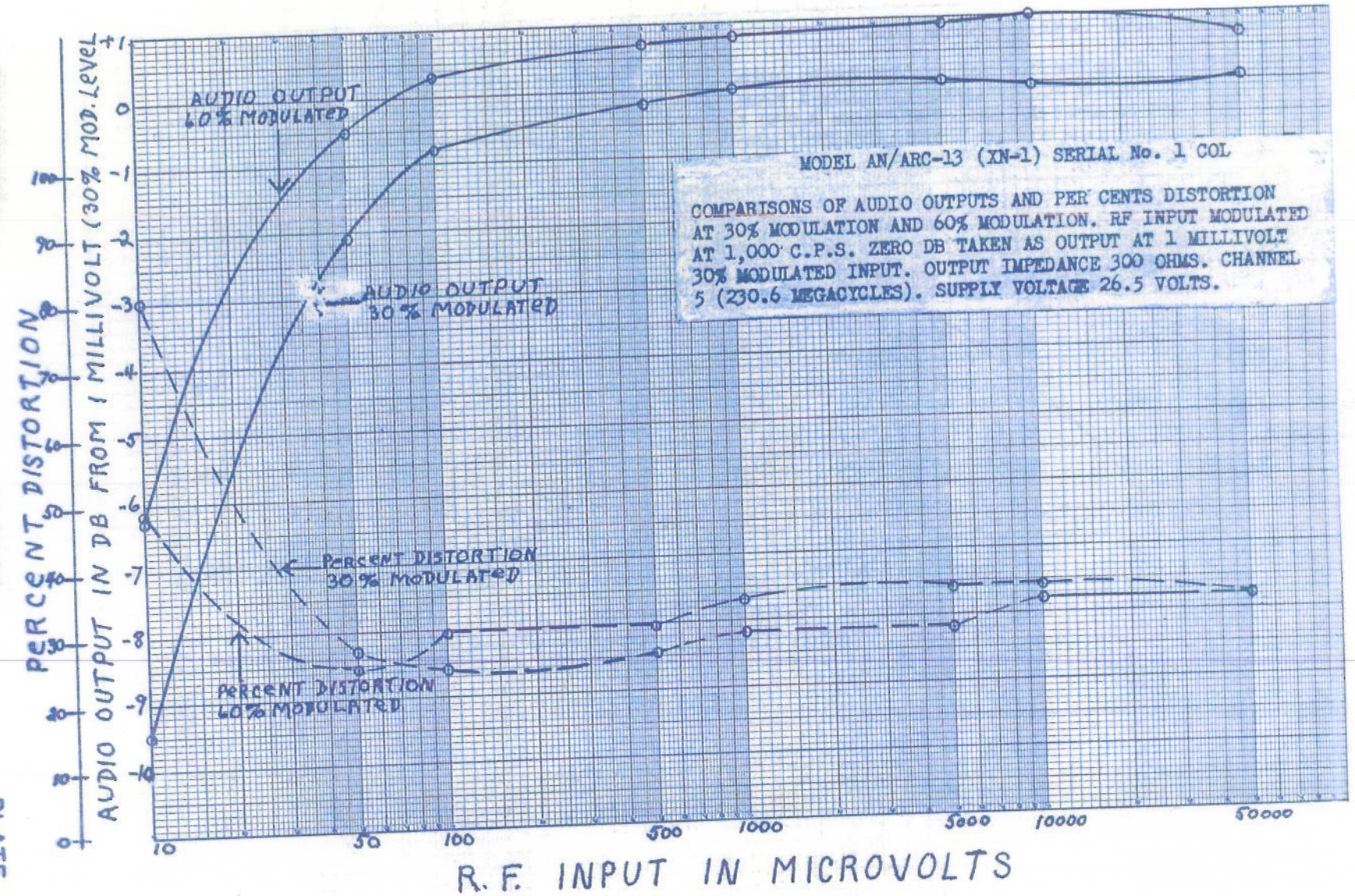

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PLATE 10

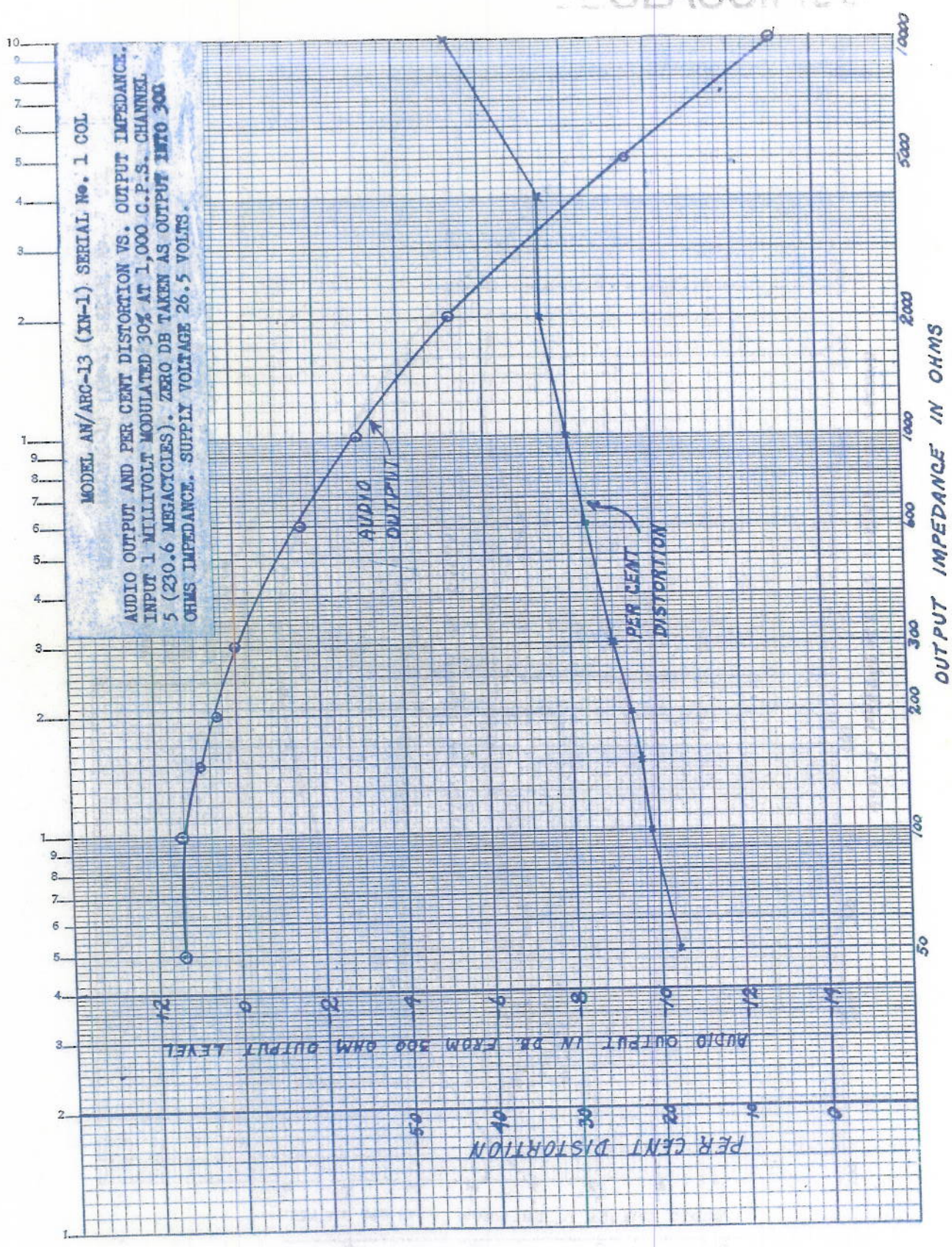

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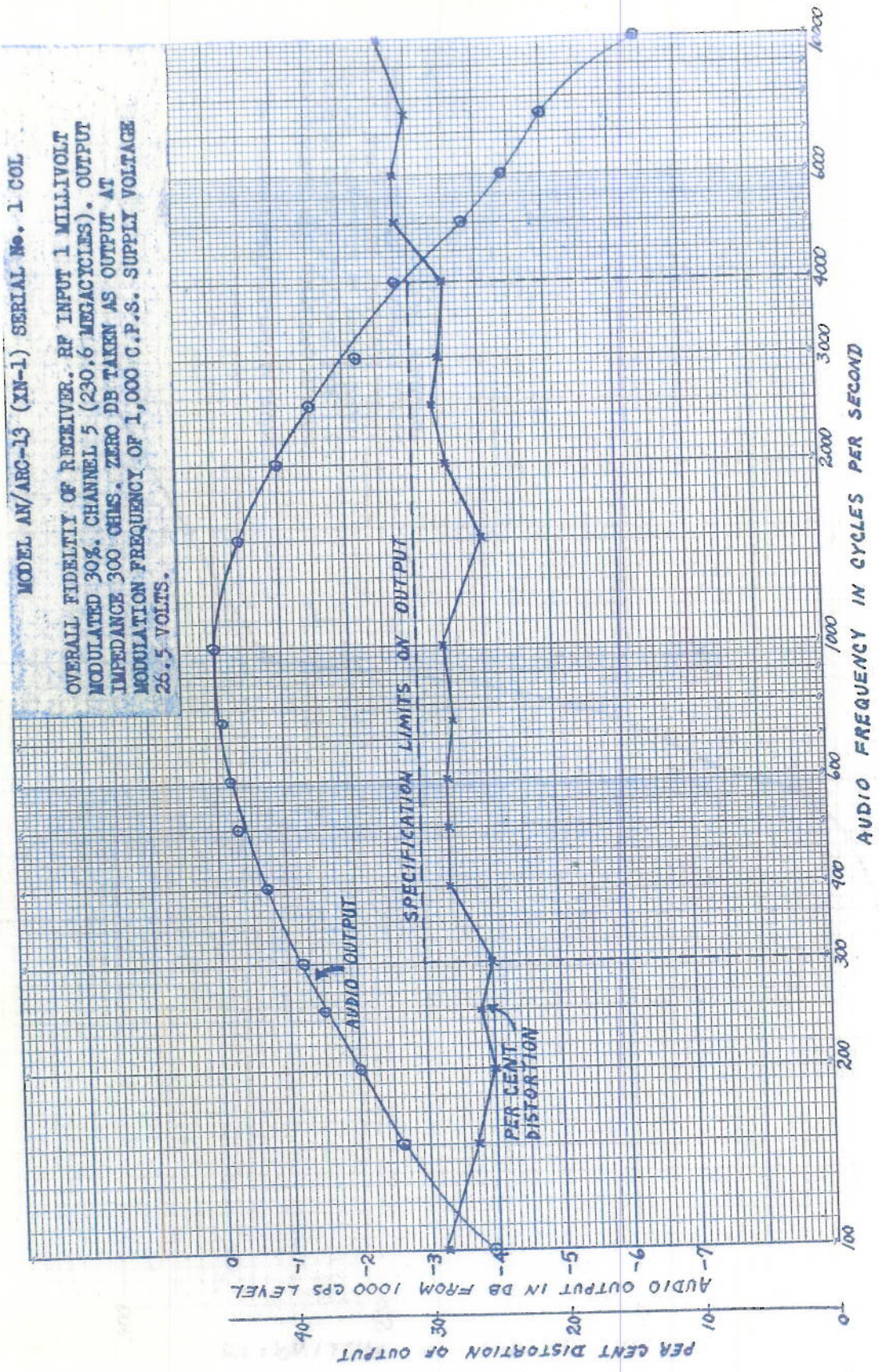
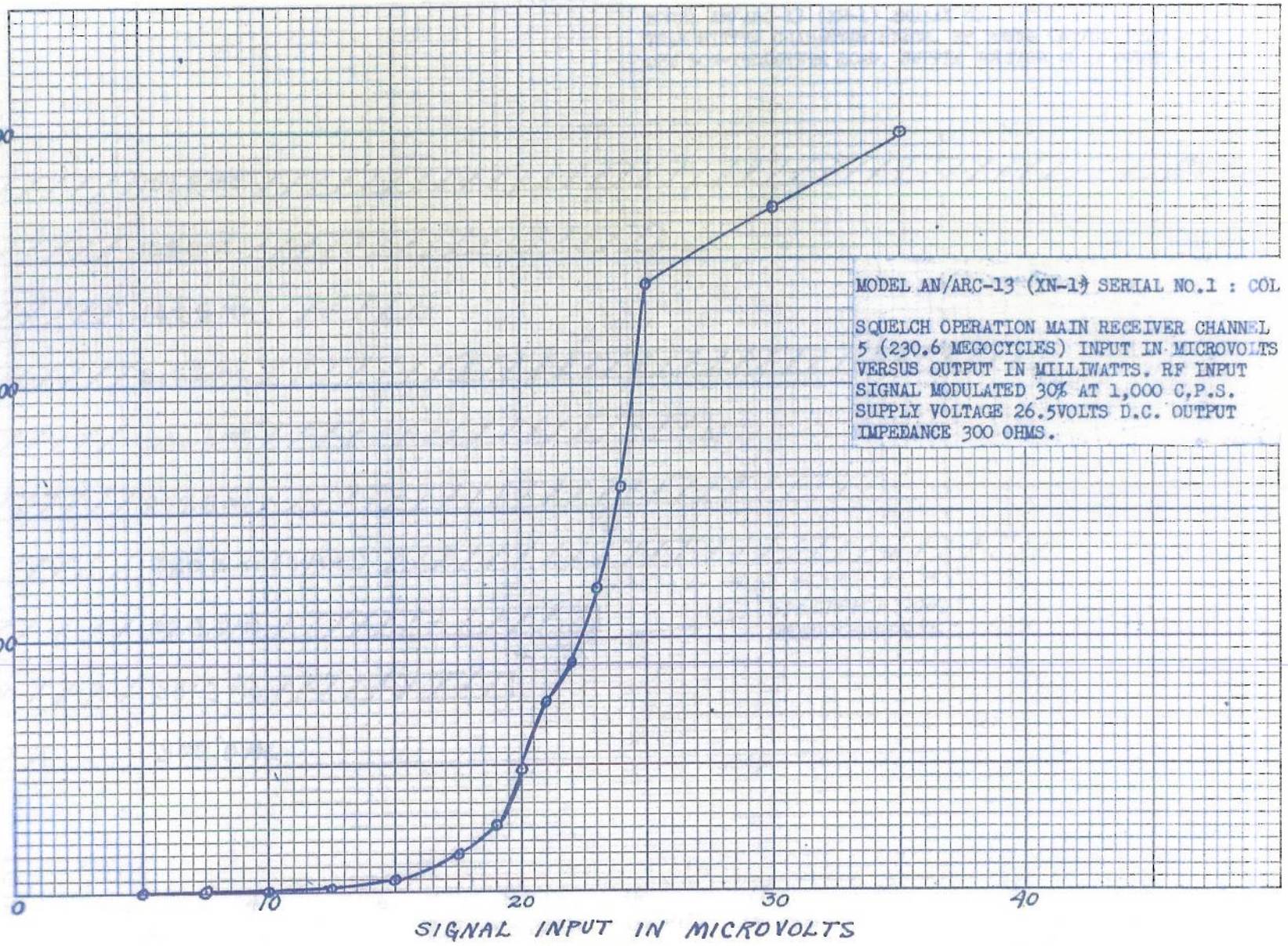
PLATE II





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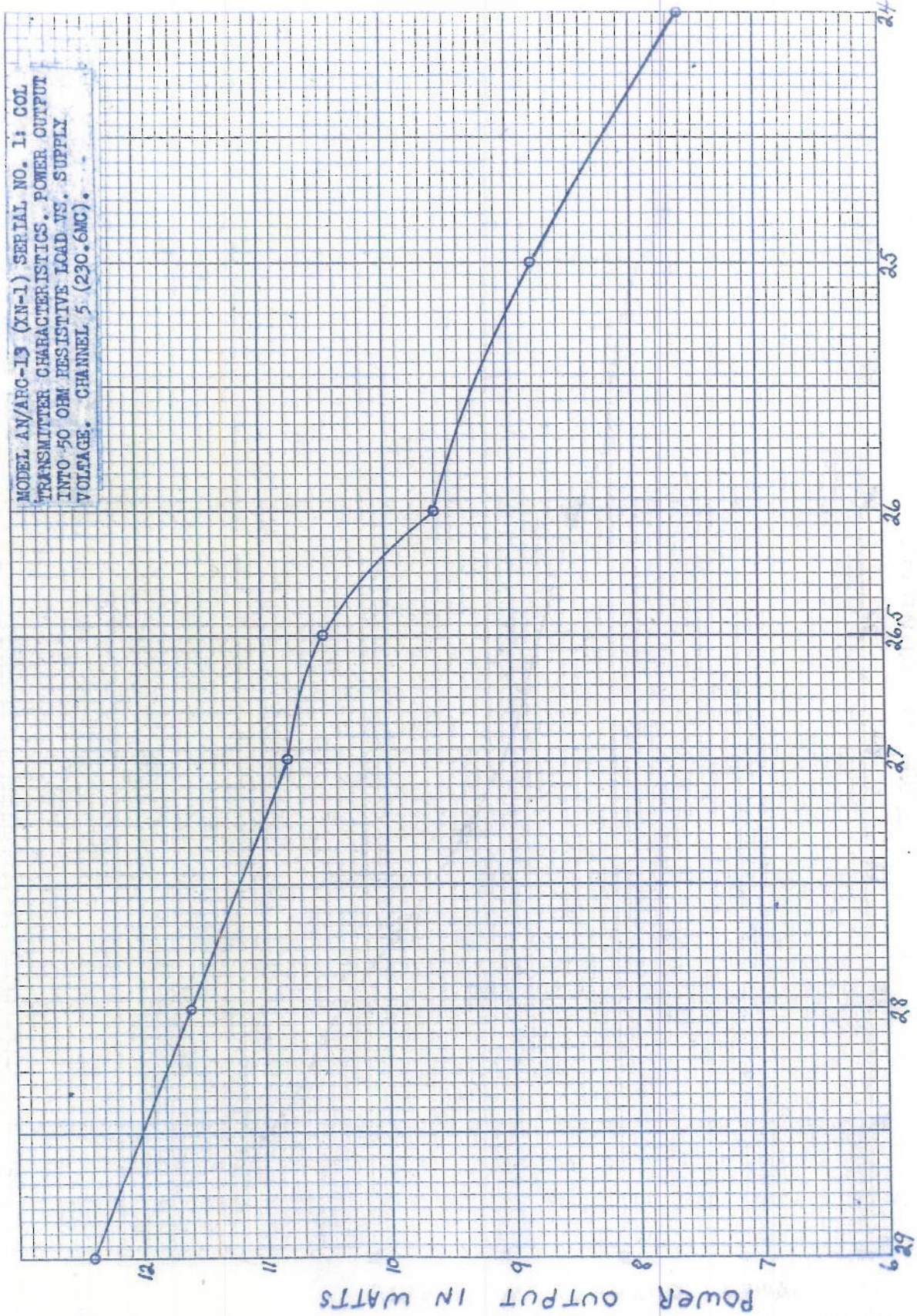
DECLASSIFIED



RESTRICTED

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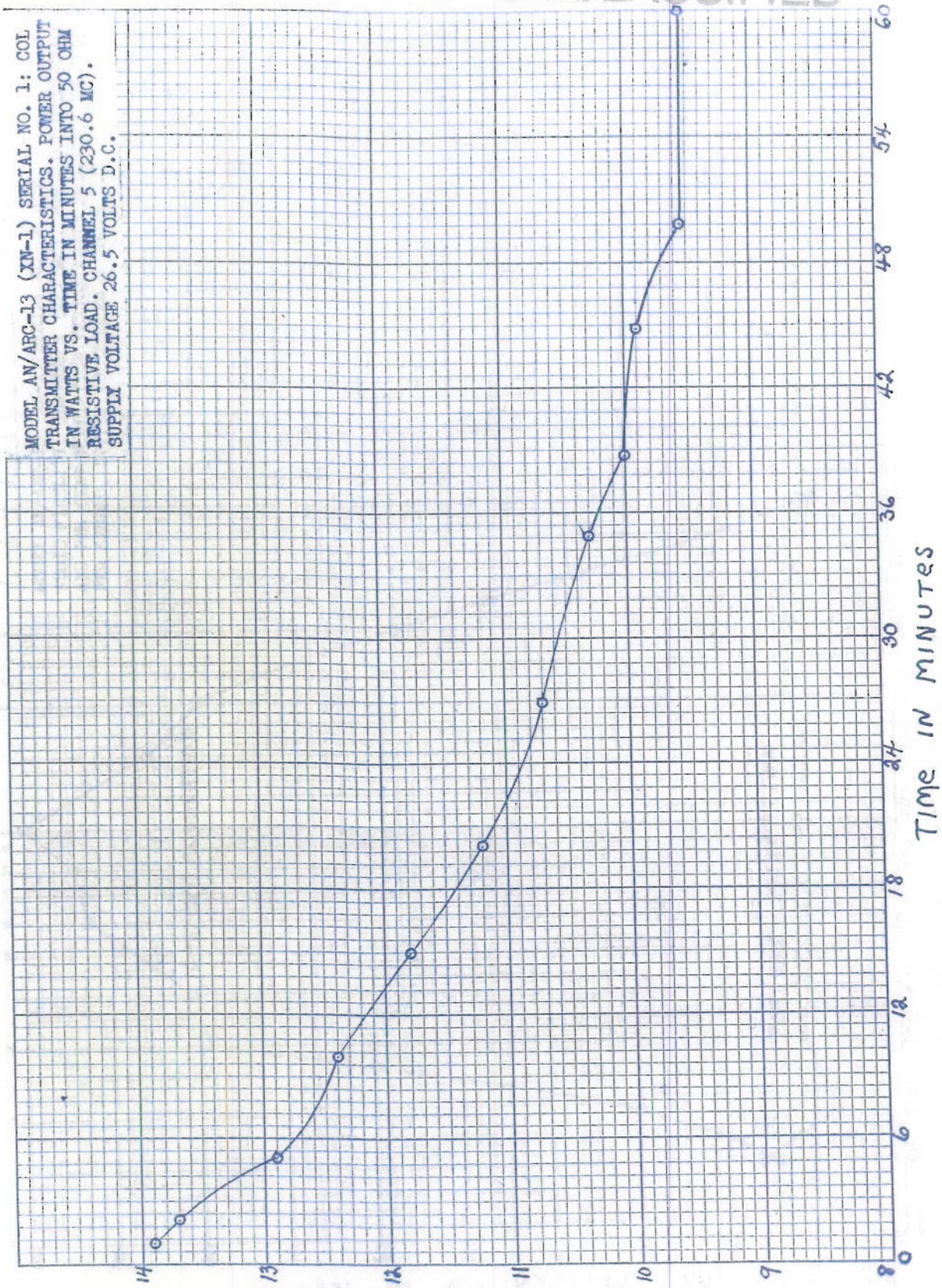
PLATE 15



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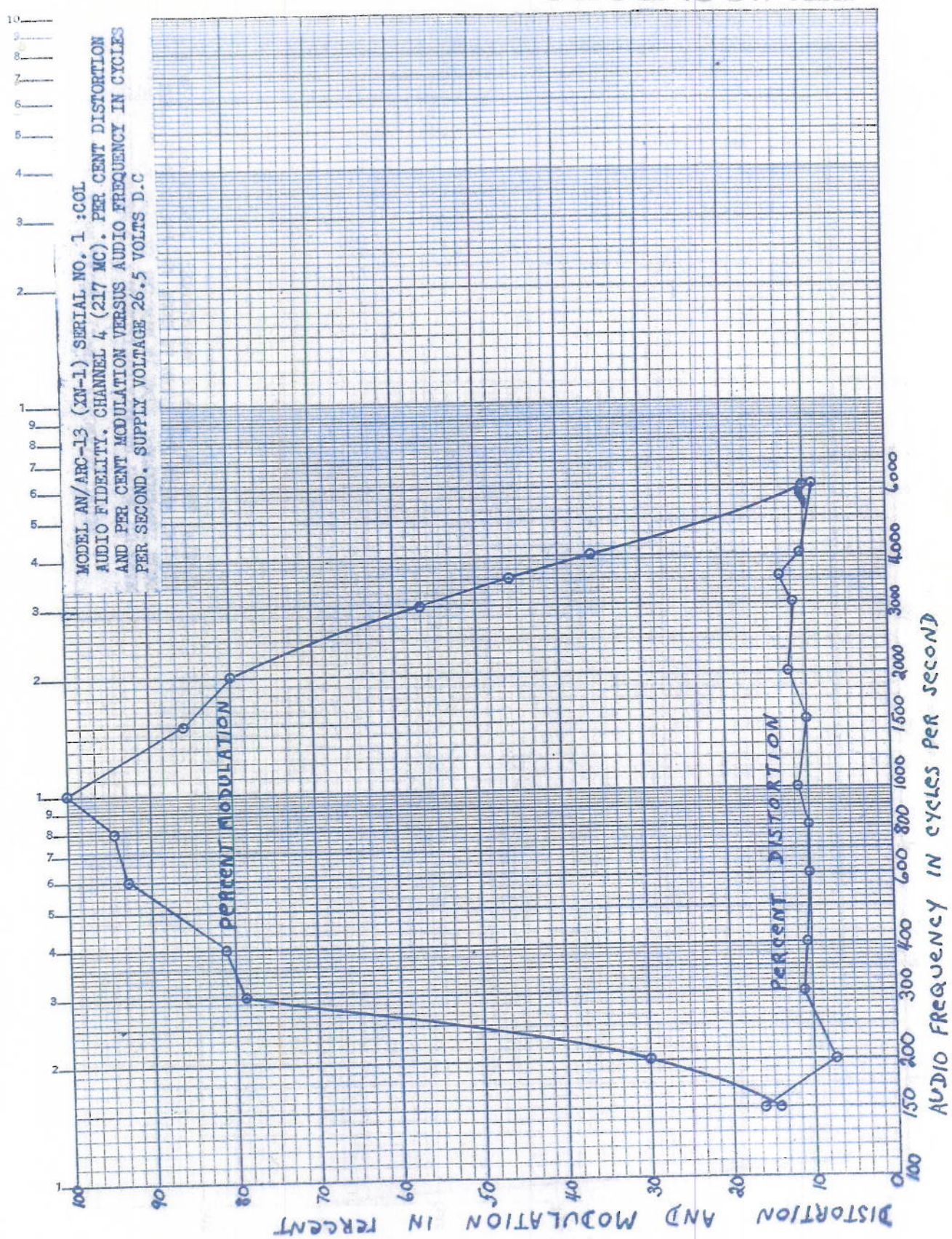

RESTRICTED

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PLATE 17

RESTRICTED

MODEL AN/ARC-13 (XN-1) SERIAL No. 1 COLLINS.

WARM-UP DRIFT OF MAIN OSCILLATOR (7.9 MEGACYCLES) AT ROOM TEMPERATURE. TIME IN MINUTES IS TIME AFTER FIRST READING WHICH WAS TAKEN AS SOON AS PRACTICBALE AFTER TURNING SET ON (WITHIN ONE MINUTE). SUPPLY VOLTAGE 26.5

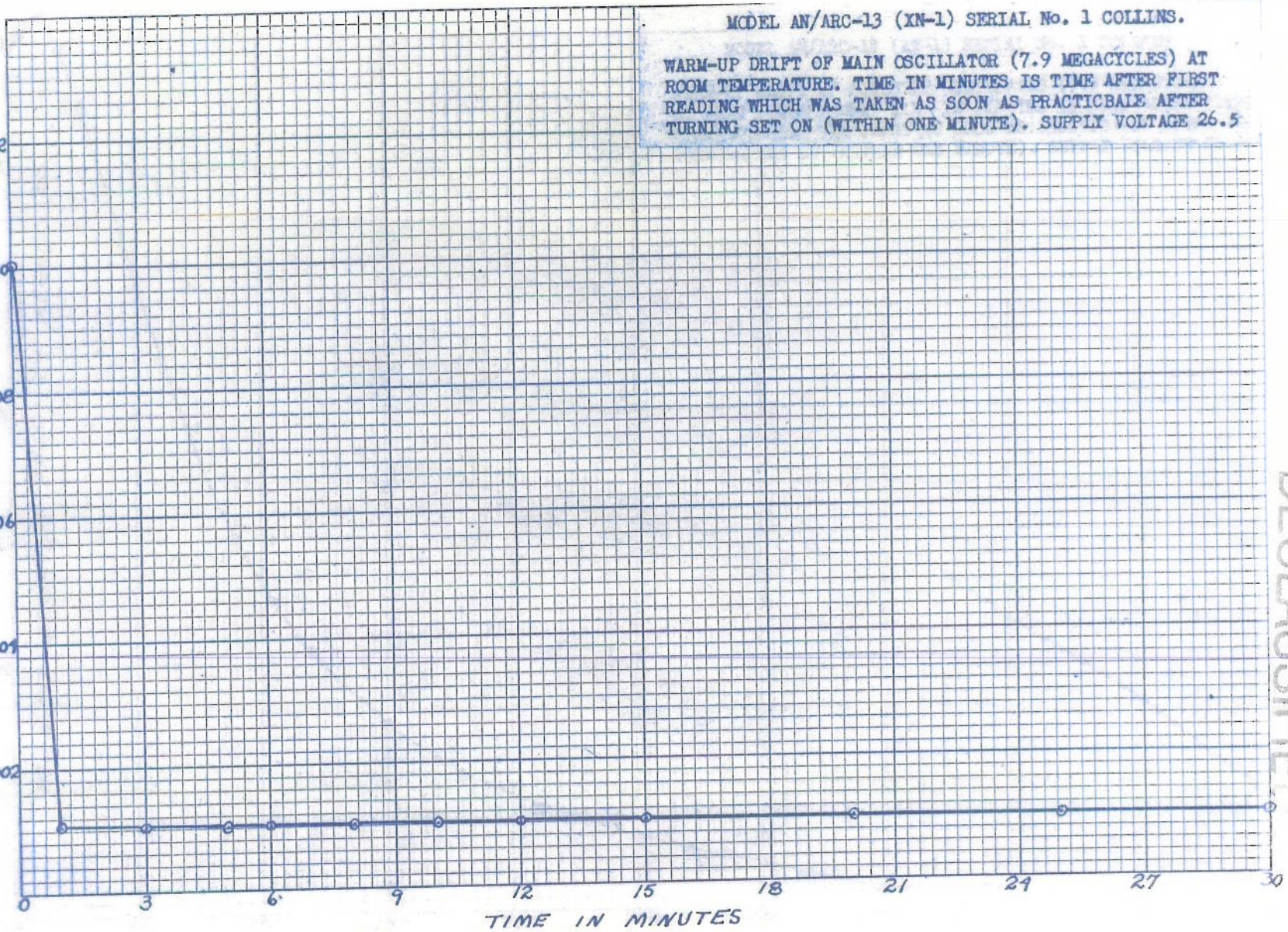

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PLATE 18

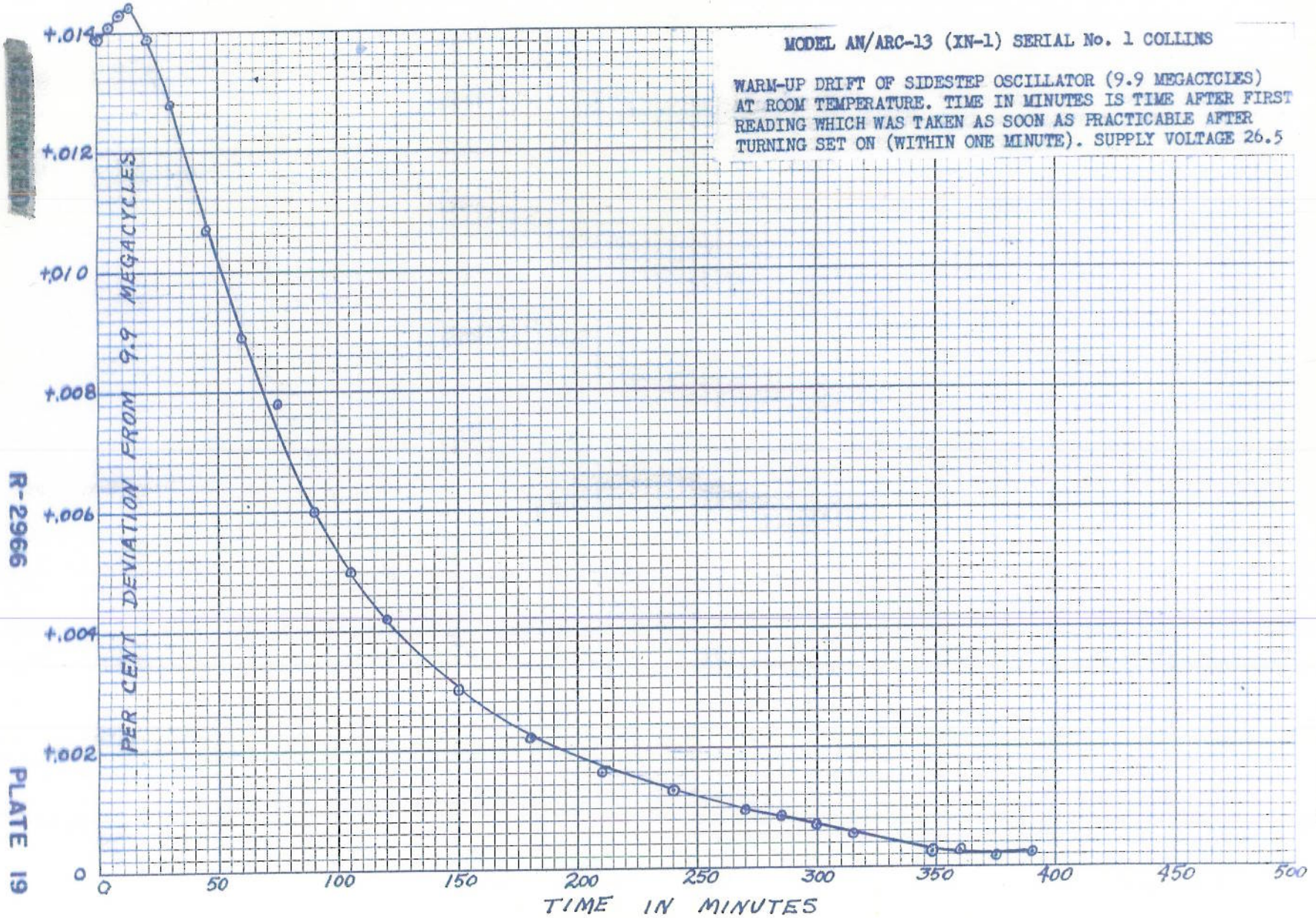

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PLATE 19

MODEL AN/ARC 13 (XN-1) SERIAL No. 1 COLLINS.

WARM UP DRIFT OF LOW GUARD CHANNEL OSCILLATOR (7548.75 KILOCYCLES) AT ROOM TEMPERATURE. TIME IN MINUTES IS TIME AFTER FIRST READING WHICH WAS TAKEN AS SOON AS PRACTICABLE AFTER TURNING SET ON (WITHIN ONE MINUTE). SUPPLY VOLTAGE 26.5 VOLTS.

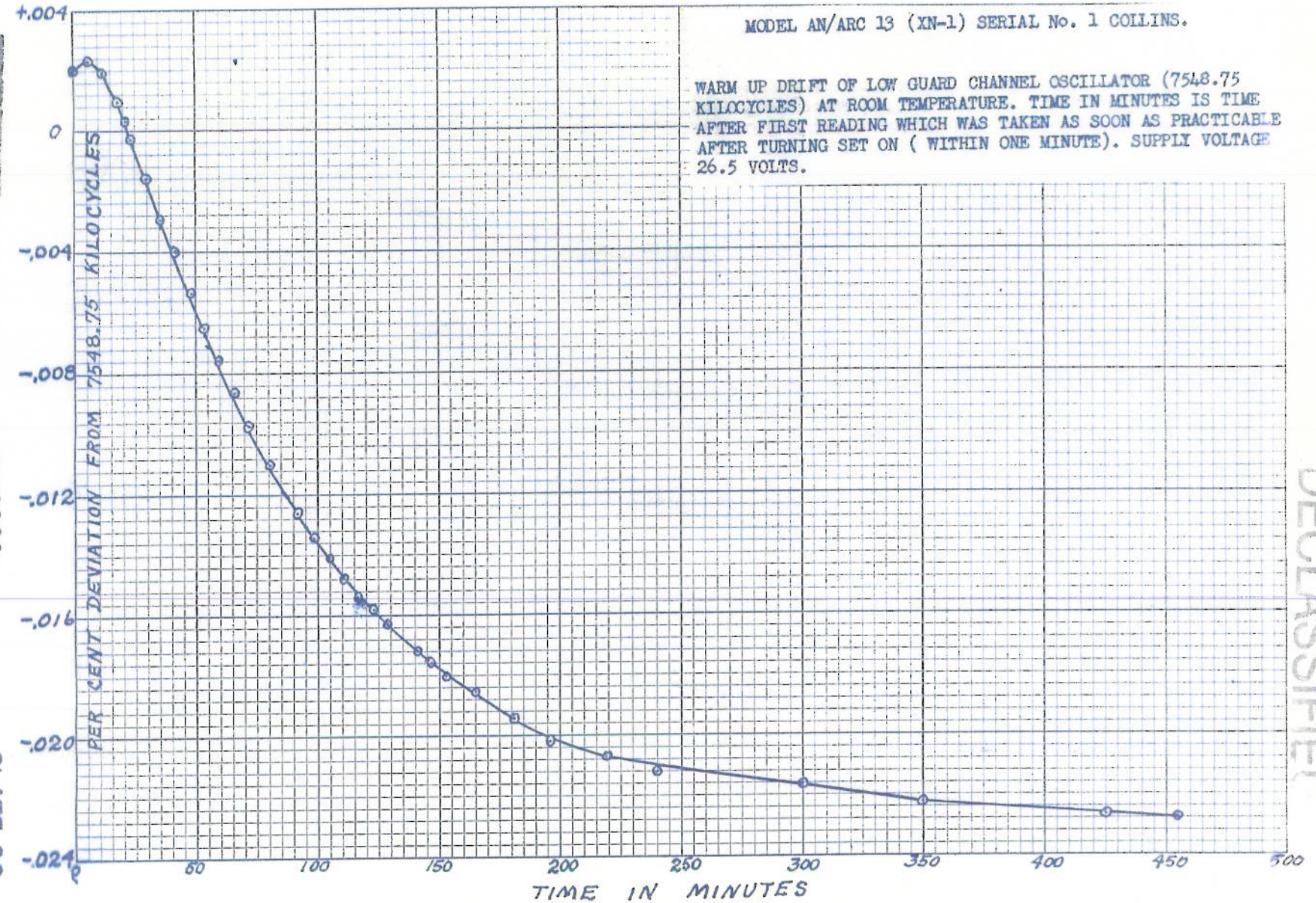

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PLATE 20

MODEL AN/ARC-13 (XN-1) SERIAL No. 1 COLLINS.

WARM-UP DRIFT OF HIGH GUARD CHANNEL OSCILLATOR (7233.33 KILOCYCLES) AT ROOME TEMPERATURE. TIME IN MINUTES IS TIME AFTER FIRST READING WHICH WAS TAKEN AS SOON AS PRACTICABLE AFTER TURNING SET ON (WITHIN ONE MINUTE). SUPPLY VOLTAGE 26.5 VOLTS.

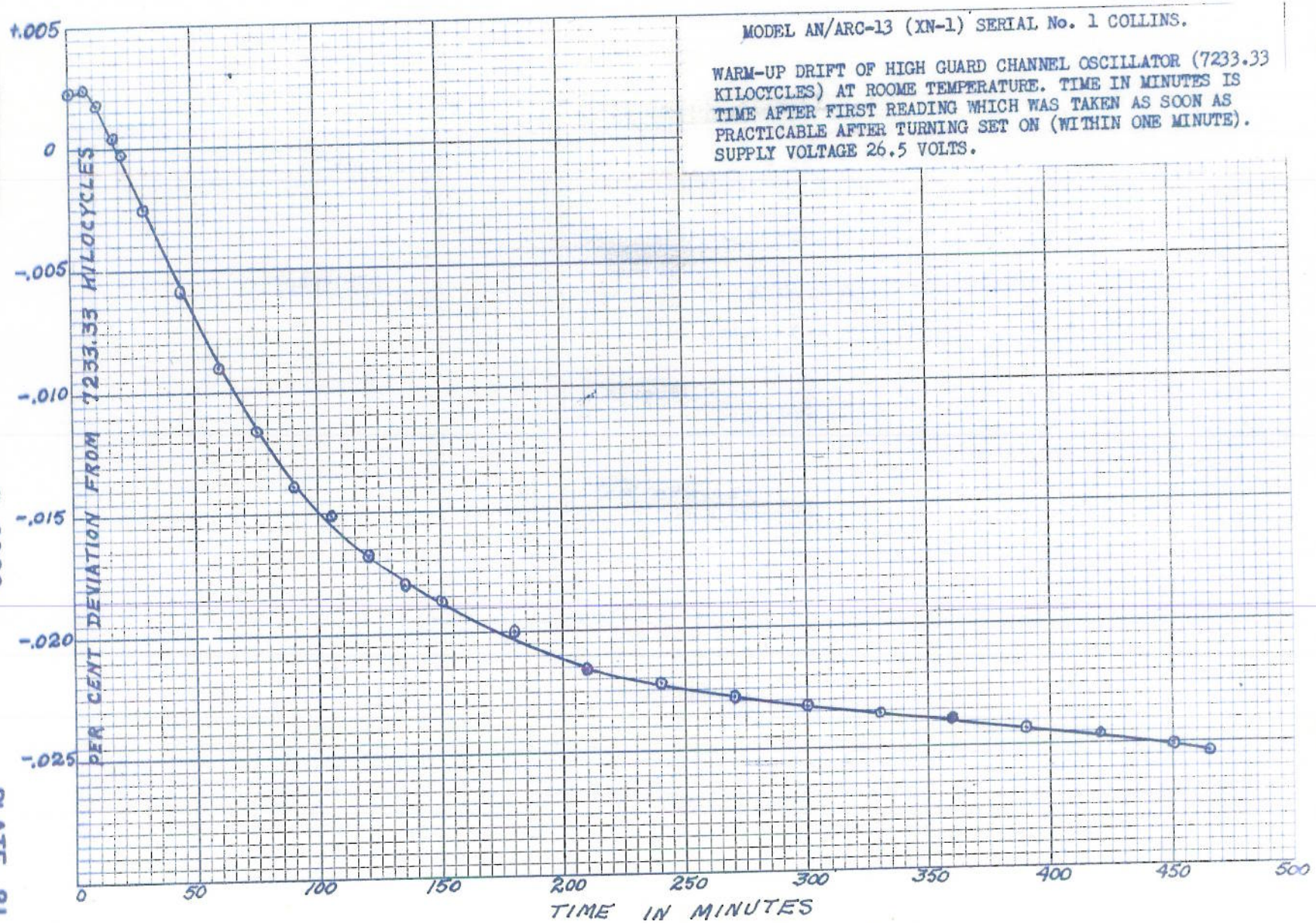

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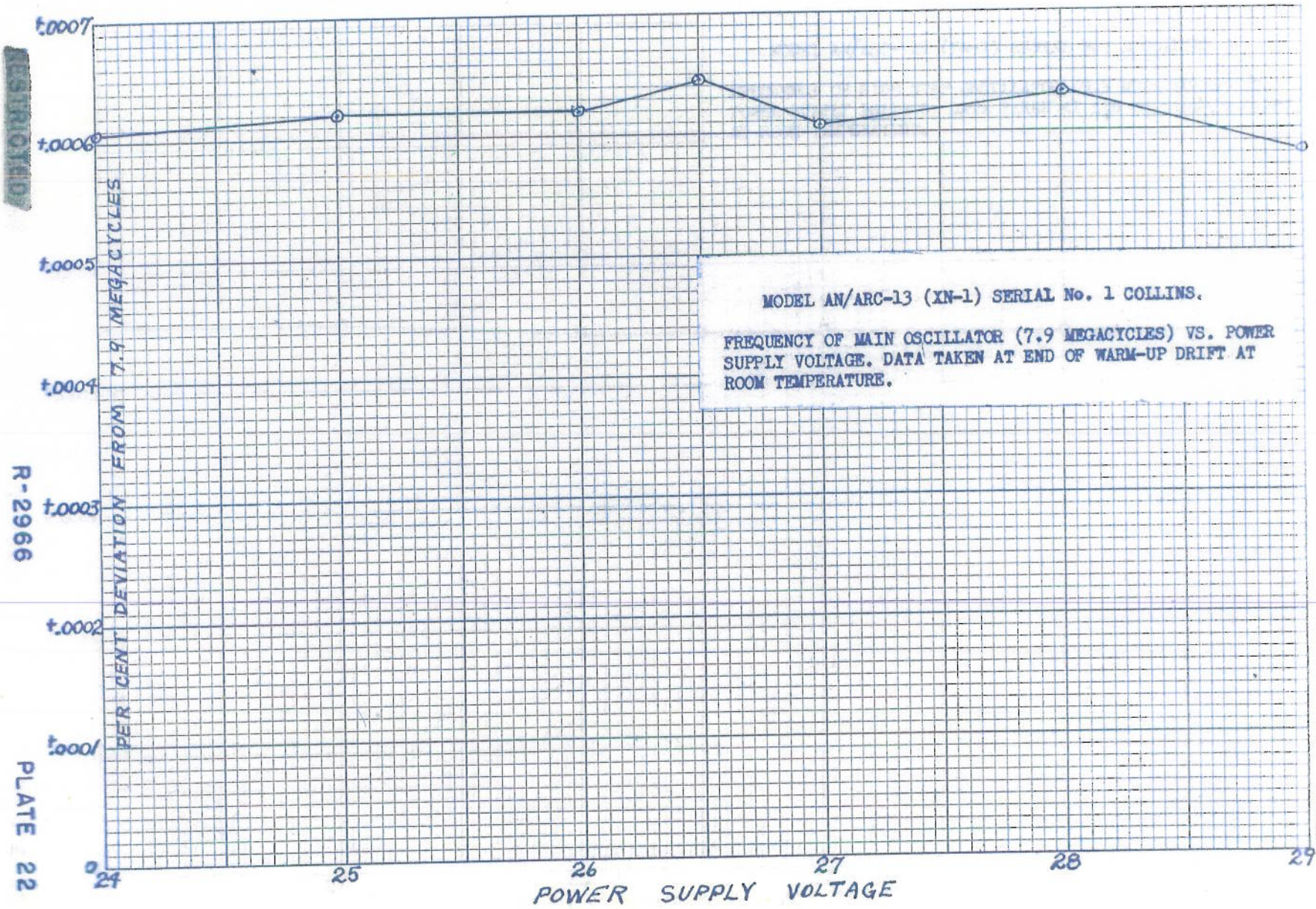
PLATE 21



MODEL AN/ARC-13 (XN-1) SERIAL No. 1 COLLINS.

FREQUENCY OF MAIN OSCILLATOR (7.9 MEGACYCLES) VS. POWER SUPPLY VOLTAGE. DATA TAKEN AT END OF WARM-UP DRIFT AT ROOM TEMPERATURE.

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PLATE 22

DECLASSIFIED

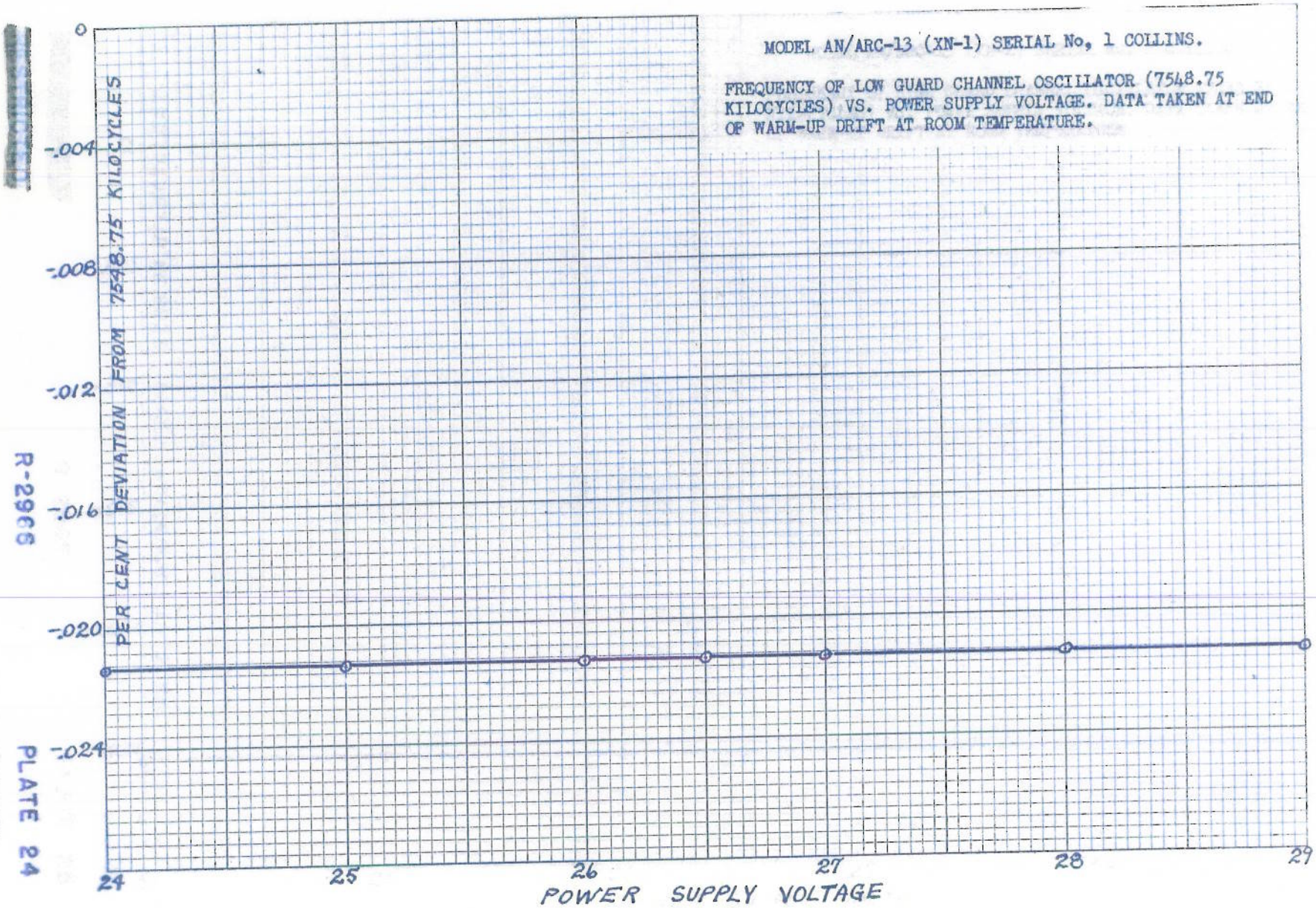

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PLATE 24