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AIRBORNE RADIO DIVISION - ENGINEERING TEST SECTION

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AIRBORNE RADIO - RESULTS OF TESTS OF AN/ARC-1 MODIFIED EQUIPMENT

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- Report R-2605 -

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ABSTRACT

As requested in reference (a) and further amplified by references (c) and (d) the model AN/ARC-1 equipment serial #3494 submitted was tested for performance in order to determine the effects of certain modifications listed in reference (a). Included in this report are the results of engineering performance tests on the receiver and transmitter under room and service conditions and the results of radiation measurements and dynamotor input cable noise measurements. From the results obtained, it was concluded that all of the modifications incorporated resulted in improved performance and it is recommended that they be accepted.

As requested in reference (d), the frequency stability measurements on the equipment were not performed.

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INTRODUCTION

1. The model AN/ARC-1, Serial #3494, is a ten channel VHF communication transmitting and receiving equipment for use in Naval aircraft which was modified as outlined in reference (a). The purpose of this problem was to determine whether the modifications improved or adversely affected the characteristics and operation of the equipment. Laboratory tests were conducted on the receiver and transmitter with particular emphasis on the magnitude of R.F. noise radiated by the power cables and external radiation from the crystal oscillators. Operational measurements were made under service conditions of temperature, humidity and vibration. The results of these tests are herein reported.

RESULTS OF TESTS - RECEIVER

2. All receiver measurements were made using a Ferris Model 40-A signal generator. Standard output of 50 milliwatts across 300 ohms was used.

(a) The sensitivity of the receiver over the frequency range, when using a 50 ohm dummy antenna varied from 0.23 to 0.75 microvolts for 50 milliwatts output across a 300 ohm load. The signal to noise ratio was measured with 5 microvolts input to the receiver, as required by reference (b) and varied from 8.6 to 16.7 db over the frequency range. The guard channel sensitivity was within 6 db of any main channels. See Table 1. The sensitivity of the receiver when using a 125 ohm dummy antenna varied between 1.1 and 2.4 microvolts over the frequency range for 50 milliwatts output across a 300 ohm load. With 5 microvolts input, the signal to noise ratio varied from 11.0 to 17.0 db over the frequency range when using the 125 ohm dummy antenna. The guard channel sensitivity was within 5.6 db of any main channel. See Table 2 and Plate 1. All sensitivity measurements were made using 30% modulation at 1,000 cycles.

(b) The variation in sensitivity of the receiver with a 50 ohm dummy antenna and changes in primary voltage from 23 to 30 volts is shown on Plate 2. An 11 db variation was measured on the guard channel and a 9.4 db variation on channel 9.

(c) The resettability of the receiver was measured in terms of change in sensitivity for 50 milliwatts output. Each channel was checked with 5 resets per channel. The maximum change in sensitivity on any channel due to reset inaccuracy was 1.52 db. See Table 3.

(d) The overall selectivity was measured on channel 9 and the guard channel. The bandwidth at the 6 db points on channel 9 was 110 Kc and 101 Kc on the guard channel. See Table 4 and Plates 3 and 4 for comparative bandwidth data. Selectivity measurements were made with 1,000 cycle 30% modulation of the signal generator.

(e) The effectiveness and operation of the sensitivity control and the squelch circuit in the receiver were checked. The amount of signal input necessary to open the squelch circuit with the sensitivity control set at maximum was 2.1 microvolts on channel 9 and 0.55 microvolts on the guard channel. With the sensitivity control in the minimum position it required 70 microvolts to open the squelch circuit on channel 9 and 65 microvolts on the guard channel. These measurements were made with 1000 cycle 30% modulation of the signal generator. See Table 5. Data on current drain under several conditions of operation are contained in Table 6.

(f) The audio fidelity of the receiver was measured on channel 9 and the guard channel. The audio output on channel 9 varied a maximum of 5.5 db between 300 and 3,000 cycles. The audio output on the guard channel varied a maximum of 6 db between 300 and 3,000 cycles. See Plate 5.

(g) The percent total harmonic distortion of the receiver was measured on channel 9 and the guard channel and the results are shown on Plates 6 and 7. On the guard channel the percent total harmonic distortion varied from 8% to 27% over the audio frequency range. On channel 9 the percent total harmonic distortion varied from 3.5% to 21%. The audio fidelity and distortion measurements were made with 1000 microvolts input to the receiver, a 300 ohm output load and 30% modulation of the signal generator.

(h) Plate 8 shows the variation in audio output and percent total harmonic distortion at 1000 cycles as the percent modulation of the input signal is varied from 10 to 100%. These measurements were taken with 1000 microvolts input from the signal generator.

(i) Table 7 shows the audio output of each channel with a 1000 microvolt, 100% modulated input signal. The audio output on all channels under these conditions was better than 1100 milliwatts.

(j) The resonant overload characteristics of the receiver were checked on channel 9 and on the guard channel. The audio output on channel 9 increases 7.5 db as the signal input is varied from 1 to 50,000 microvolts. The audio output on the guard channel increases 6.8 db as the input signal is varied from 1 to 50,000 microvolts. (See Plates 9 and 10.)

(k) Measurements were made of receiver rejection to the image and IF frequencies and spurious responses. The image rejection and spurious responses were found to be 50 db or better. This is slightly below the specification limit of 55 db, reference (b) paragraph E-7e. The IF rejection was better than 60 db on all channels except channel 9 where it was 41.5 db. This does not comply with the 60 db requirement of the above noted paragraph. See Table 8.

(l) The coupling factor and noise rejection factor of the receiver were measured with signal input to the power cable and to the audio cable respectively. The coupling factor measured varied from 0.000256 to 0.000025. The noise rejection factor measured varied from 2,500 microvolts to 7,500 microvolts. See Table 9.

(m) The equipment was subjected to temperature variation from -30°C to +50°C after being installed in a temperature controlled chamber. Channels 1, 9 and the guard channel were checked during this test. The maximum variation in sensitivity noted on any channel during the temperature test was 17.5 db on the guard channel. The sensitivity on these channels was within specifications at all times during the temperature test. See Plate 11,

(n) Immediately following the temperature run, humidity was introduced into the chamber so that at +50°C, 95% relative humidity was attained. After the equipment had been subjected to 95% humidity at +50°C for 24 hours, it was checked. When the equipment was operated, no power output was obtained from the transmitter and the receiver was inoperative. It was found that the field coil of K101 had opened and that K104 was in the transmit position. The receiver and transmitter operated satisfactorily after the antenna changeover relay was repaired. The equipment was then subjected to another humidity test for 48 hours and operated satisfactorily during this test. The maximum change in sensitivity noted during the second humidity test was 6.6 db on the guard channel. See Table 10 for humidity test data.

(o) The equipment was then turned over to the Shock and Vibration Division where it was secured to a vibration table and subjected to vibration tests. Project engineers made observations of the electrical performance of the equipment during the vibration tests. The greatest change in receiver sensitivity noted on any channel was 7.2 db on channel 9 during the vertical vibration test. The greatest change in transmitter power output noted was 1.4 db on channel 9 while vibration was applied perpendicular to the front of the equipment. See Table 11. The results of the mechnnical performance of the equipment during the vibration test with conclusions and comments are presented by the Shock and Vibration Division in a memo appended to this report.

RESULTS OF TESTS - TRANSMITTERS

3. The results of tests on Model AN/ARC-1 Serial #3494 transmitter are as follows:

(a) The transmitter power output into a 50 ohm dummy antenna at the end of 10 feet of PT-5 cable varied from 9.4 to 14.8 watts and the power output was within 0.8 db of the inital value in four resets for all R.F. channels. See Table 12. A 28 volt power source was used. Measurements made on channel 9 show a power output variation from 9.4 watts with a supply voltage of 23 volts to 14.8 watts with a supply voltage 30 volts. See Plate 12. These values are within the specifications of paragraph E-7k of reference (b).

(b) The microphone circuit current was measured using a standard 82 ohm phantom microphone circuit and found to be 50 milliamperes.

(c) With the transmitter operating on 146.16 Mc/s at rated RF load, the audio input voltage to the phantom microphone circuit was varied and measurements were made of percent modulation and distortion. These measurements were made using a 28 volt power supply and 1000 cycles modulation. The percent distortion varied from 4% to 14.8% over the range of 25% to 100% modulation. At 1000 cycles, the input audio voltage required varied from 0.13 volts for 10% modulation to 1.04 volts for 100% modulation. See Plate 13. It should be noted that the specification, reference (b), states that 1.9 volts should be required for 95% modulation. This would indicate that over-modulation would occur when the speech input is obtained from a microphone. Tests were made using several microphones to modulate the transmitter. None of the microphones used produced over modulation; however they were not checked for audio voltage output when working into a standard load.

(d) Overall audio fidelity and percent distortion were measured and plotted on Plate 14 for modulating audio frequencies between 300 c.p.s. and 3000 c.p.s. operating on channel 9 (146.16 mc/s), with a constant microphone voltage of 0.85 volts, and a power supply voltage of 28 volts. In the 300 to 3000 c.p.s. range the maximum and minimum modulation percentages differed by 6 db as permitted in paragraph E-7(o) of reference (b). The total harmonic distortion was 14.3% which is within the 15% required in that paragraph. This 14.3% distortion was measured with the rated carrier modulated 82% at 1000 c.p.s. and using the rectified envelope. In the 300 c.p.s. to 2000 c.p.s. modulating frequency range the total harmonic distortion varied from 6.0% to 15%.

(e) The frequency channel shifting time of the autotune system at room temperature varied from 4.0 seconds with 24 volts input to 2.7 seconds with 30 volts input. The autotune mechanism did not operate properly at 23 volts input. See Table 13.

(f) The current drain from the power supply varied from 7.9 amperes at 24 volts to 9.5 amperes at 30 volts. The power drain varied from 189.5 watts at 24 volts to 285 watts at 30 volts. The current drain with the autotune operating varied from 11.5 amperes with 24 volts power supply input voltage to 15.0 amperes at 30 volts. See Tables 13 and 14. These values of current drain are within those specified in paragraph E-7q of reference (b).

(g) The R.F. power output was measured on channel 9 (146.16 Mc) as the primary voltage was increased from 24 to 30 volts. With a 24 volt supply, the R.F. power output was 9.45 watts; increasing the primary voltage to 30 volts increased the R.F. power output to 14.8 watts or 1.95 db. See Plate 15.

(h) Sidetone output varied from a maximum of 950 milliwatts to a minimum of 700 milliwatts in the modulation frequency range of 200 c.p.s. to 1000 c.p.s. and to a minimum of 350 milliwatts in the range 200 c.p.s. to 3000 c.p.s. using 100% modulation. See curve 1, Plate 16. Paragraph E-7(f) of reference (b) requires 400 milliwatts sidetone output between 300 c.p.s. to 1000 c.p.s. with a 100% modulation. The voltage necessary across the microphone jack to produce 100% modulation varied from 2.05 volts to 1.04 volts in the 300 c.p.s. to 3000 c.p.s. range. See curve 2, Plate 16. The total harmonic distortion of the of the sidetone amplifier varied from 5% to 25% in the audio frequency range 300 c.p.s. to 3000 c.p.s. See curve 3, Plate 16.

(i) The model AN/ARC-1 equipment was subjected to temperature in the range of -30°C to +50°C. Its operation in the transmit condition was satisfactory. The R.F. power output for channel 1 (116.15 Mc/s) varied from 14.8 watts at 15°C to 8.3 watts at +50°C or 2.52 db. The R.F. power output for channel 9 (146.16 Mc/s) varied from 14.2 watts at -15°C to 11.7 watts at +50°C representing a 0.84 db power change. See Plate 17. These values are well above the 3 watts power output required under service conditions in paragraph E-7k of reference (b). Frequency shifting time was 3.0 seconds or less throughout the exposure to temperatures between -30°C to +50°C which is within the limits of paragraph E-7r of reference (b).

(j) The model AN/ARC-1 equipment was subjected to 95% relative humidity at a temperature of 50°C for a 48 hour period. At the end of this period measurements were made and the R.F. power output had decreased from 6.9 watts to 5.3 watts (1.16 db reduction) on channel 1, from 10.25 watts to 7.9 watts (1.13 db reduction) on channel 9, and from 8.3 watts to 6.6 watts (1.0 db reduction) on the guard channel. See Table 10. However these values are above the 3 watt minimum allowed under adverse conditions in paragraph E-7k of reference (b).

(k) It should be noted that after approximately 50 hours of intermittent operation, the IF crystal holder was found to be broken. The cause was traced to a drop of solder which had become lodged at the end of the female receptacle. Thus when the crystal was inserted in the holder the drop of solder limited the depth of insertion and when the crystal holder was forced in it resulted in breakage of the holder. The I.F. crystal oscillator tube (6C4) was found to be defective after approximately 50 hours of intermittent operation.

RESULTS OF RADIATION MEASUREMENTS

4. Comparative measurements were made of the modified and unmodified equipments to determine the reduction in radiation from the main channel crystals effected by the new front cover and the additional bonding. These measurements were made in a shielded room with the equipment mounted on a metal-top bench. A Ferris model 32-B noise and field strength meter was set-up with the antenna approximately one foot directly in front of the front cover

for one comparative measurement and approximately one foot from the right side of the equipment near the front cover for another comparative measurement. Measurements of field strength were made at each crystal fundamental frequency and at the second harmonic. No harmonics above the second were noticeable. The data taken were tabulated and appear in Tables 15 and 16. The reduction in radiation at the fundamental frequencies effected varied from 4.7 to 9.2 db depending on crystal frequency when measured in the position directly in front of the cover and from 3.7 to 11.7 db when in the position to the right of the cover.

RESULTS OF NOISE MEASUREMENTS

5. In order to determine the effect of the additional filtering incorporated in the equipment submitted for test in regard to conducted noise through the power cables, the following set-up was made. The AN/ARC-1 equipment was set up in a shielded room on a metal bench top. The power cable negative lead was grounded near the power plug to the metal bench. The positive lead was 12 inches long and fed through a 2.8 millihenry iron core choke and thence to the battery. A Ferris model 32-B noise and field strength meter was then coupled to the high potential side of the choke and ground. Comparative measurements were then made of conducted noise on the power cable (unshielded) of the unmodified AN/ARC-1 equipment, Serial #3420, and the modified AN/ARC-1, Serial #3494. Measurements were made of conducted noise through the range from 0.1 Mc to 20 Mc. These data are plotted on Plate 18 in decibels above one microvolt. Plate 19 is plotted in decibels and shows the reduction in conducted noise produced by the additional filtering in the modified equipment, Serial #3494. A 40 decibel reduction in noise level is obtained at some frequencies in the range checked.

CONCLUSIONS

6. Based on the results of these tests the following conclusions are presented:

(a) The sensitivity, resettability, effect of sensitivity control and operation under adverse conditions of temperature and humidity characteristics of the receiver were essentially unaffected in the modified equipment.

(b) The overall bandwidth of the receiver at the 6 db point is increased 10% to 15% by the modifications. However, the selectivity characteristics are still within specifications.

(c) The coupling factor and noise rejection factor show improvement.

(d) The IF and spurious response rejection of the receiver was slightly lower than that permitted by the specifications, reference (b).

(e) The operating characteristics of the modified transmitter were satisfactory and in compliance with the specifications, reference (b).

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(f) Comparative measurements between the modified and unmodified equipments in regard to RF radiation indicated a decrease of between 4.7 to 9.2 db, depending on the crystal frequency.

(g) The fasteners provided on the modified front cover are not considered entirely satisfactory with respect to ease and simplicity of removal.

(h) The additional filtering incorporated in the modified equipment resulted in considerable reduction of conducted dynamotor noise on the power cable.

RECOMMENDATIONS

7. Based on the results of tests herein reported the following recommendations are submitted:

(a) It is recommended that the circuit modifications and the additional filtering be approved for use in production.

(b) A simpler and more positive method of securing the front panel cover be used such as the use of Dzus fasteners.

(c) It is further recommended that the antenna relay coil be impregnated to protect it from the effects of humidity.

(d) Efforts should be made to improve the IF rejection and the spurious response rejection of the receiver.

REFERENCES

(a) BuShips ltr to NRL dated 28 December 1944, Sec. 949CF Ser. 5650.

(b) BuShips Specifications RE-13A-734C.

(c) BuShips ltr to NRL dated 10 March 1945 Sec. 949 CA Ser. 2486 (clarification).

(d) BuShips ltr to NRL dated 24 March 1945 Sec. 913 BH Ser. 2573 913 BZ. (clarification)

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APPENDIX 1
13 June 1945.

From: Shock & Vibration Division, Code 870

To: Aircraft Section, Code 310

Subj: RT-18/ARC-1 Equipment - Vibration Test of - Report on.

Ref: (a) BuShips Specifications 13A-8250 dated 4 May 1944.
(b) BuShips Specification 16V1(RE)

Encl: (HW)
(A) Graph showing transmissibility of mounts.

INTRODUCTION

1. As requested by Code 310, vibration tests were conducted on a RT18/ARC-1 Equipment during the period from 10 May 1945 to 11 May 1945 in accordance with reference (a). This report presents the data obtained and observations made of the mechanical performance of the equipment during the tests. The electrical performance was observed by representatives of the Aircraft Section.

VIBRATION TESTS

2. The equipment, supported on a MT-100/ARC-1 mount was secured to the platform of the direct drive vibration machine. Its weight was 47 pounds.

3. The equipment was subjected to vibration in a vertical plane at an amplitude of approximately 0.03" (total excursion approximately 0.06"). The transmissibility (ratio of unit displacement to table displacement was measured between 10 and 55 cps and is plotted in enclosure (A). Resonance was observed at 10, 20 and 25 cps. The frequency was slowly changed from 10 to 55 cps and returned to 10 cps in one minute. This test was continued for 30 minutes. Following this, the equipment was vibrated for 15 minutes at each of the three resonant frequencies. When vibrated at 10 and 20 cps the amplitude was 0.03". When vibrated at 10 cps, the amplitude was reduced to 0.015". No damage was observed.

4. The equipment was then subjected to vibration in a horizontal plane in a direction parallel to its front. Resonance in a rocking mode was

observed at 14 cps. The same procedure described in paragraph 3 was followed. The equipment was vibrated for 15 minutes at 14 cps with the amplitude at approximately 0.015". No damage was observed.

5. The equipment was subjected to vibration in a horizontal plane in a direction perpendicular to its front following the procedure described in paragraph 3. No resonance above 10 cps was observed.

COMMENTS

6. Resonance of the mounts in a vertical plane was observed at 10, 20 and 25 cps. Reference (a) does not state limiting resonant frequencies allowable. However, reference (b) states that resonance in each direction specified shall be 15 cps or less. It is the opinion of this Division that mounts which comply with reference (b) should be employed on the subject equipment.

CONCLUSION

7. Judging from observations which could be made during the vibration tests, the equipment performed satisfactorily throughout the tests and complies with the conditions specified in reference (a). However, the equipment does not comply with the conditions of reference (b) because resonance occurred at frequencies above 15 cps.

Approved

C. E. Crede

Report prepared by

D. H. Eschen

TABLE 1

Model AN/ARC-1 Serial #3494

SENSITIVITY AND SIGNAL/NOISE

Ratio vs. Frequency
(50 ohm dummy ant.) (Primary supply 28V.)

Channel	Frequency in Megacycles	Sensitivity in Microvolts For 50 MW output	Signal to Noise Ratio in db.
1	116.1	0.39	16.7
2	124.38	0.40	15.0
3	126.38	0.25	16.4
4	128.7	0.23	16.0
5	142.32	0.35	14.3
6	142.56	0.39	14.2
7	142.74	0.5	13.8
8	144.36	0.7	13.6
9	146.16	0.75	12.8
10	140.58	0.5	14.0
G.C.	140.58	0.46	8.56

TABLE 2

Model AN/ARC-1 Serial #3494

SENSITIVITY AND SIGNAL/NOISE

Ratio vs. Frequency
(125 Ohm dummy ant.) (Primary supply 28V.)

Channel	Frequency in Megacycles	Sensitivity in Microvolts For 50 MW output	Signal/Noise Ratio in db
1	116.1	1.2	16.5
2	124.38	2.4	16.0
3	126.38	1.1	16.6
4	128.7	1.25	17.0
5	142.32	1.6	15.0
6	142.56	1.95	15.5
7	142.74	1.75	15.5
8	144.36	2.1	15.5
9	146.16	2.3	15.5
10	140.58	2.4	14.5
G.C.	140.58	2.1	11.0

TABLE 3

SENSITIVITY VS. RESETTABILITY

Squelch out - 300 ohm load
Primary voltage 28 volts.

Channel	Frequency in Megacycles	Sensitivity vs. Reset (Microvolts for 50 MW) 0	1	2	3	4	5	Max. db change/ channel
1	116.1	0.504	0.550	0.550	0.551	0.551	0.60	1.52
2	124.38	0.60	0.60	0.60	0.60	0.60	0.60	0
3	126.38	0.380	0.385	0.385	0.385	0.385	0.385	0.12
4	128.7	0.385	0.385	0.390	0.390	0.390	0.390	0.10
5	142.32	1.25	1.25	1.25	1.30	1.30	1.30	0.34
6	142.56	1.50	1.55	1.55	1.55	1.55	1.55	0.24
7	142.74	0.725	0.725	0.750	0.750	0.750	0.750	0.30
8	144.36	0.95	1.00	1.00	1.00	1.00	1.00	0.44
9	144.16	1.75	1.75	1.75	1.55	1.60	1.60	1.04
10 - G.C.	140.58	0.95	0.90	0.95	0.95	0.95	0.95	.48

TABLE 4

OVERALL BANDWIDTH DATA

Bandwidth in Kc.

db down From Resonance	RE 13A 734C Specifications	Channel #9	Guard Channel
0	----	----	----
6	100 - 150	110	101
20	240 Max.	176	163
40	370 Max.	254	237
60	500 Max.	346	315
80	----	439	402

TABLE 5

Effect of R.F. Gain Control and Squelch Upon Sensitivity of Aircraft Radio Model AN/ARC-1 Serial 3494

Channel	Signal in Microvolts necessary to produce 20 milliwatts output with Squelch disabled and 1000 cycle 30% modulation of the signal Generator.	Signal in Microvolts necessary to operate squelch. with R.F. Control at Maximum Sensitivity	Signal in Microvolts necessary to operate squelch. with R.F. Control at Minimum Sens.
9	1.25	2.1	70
Guard	.335	.55	65

TABLE 6

Primary Power Drain in the Receive Condition for the Aircraft Radio Model AN/ARC-1 Serial 3494 with Frequency Selector in Position 9, No Signal being received and 28 volts D.C. Power Supply Voltage.

Condition	Current Drain in Amperes	Power Drain in Watts
In ordinary operation	6.5	182.
At start of Autotune	15.	420.
During ordinary running of Autotune	12.	336

TABLE 7

AUDIO OUTPUT WITH 100% MODULATION AT
1000 CYCLES
Primary Voltage = 28V.

Channel	Frequency in Megacycles	Audio Output Milliwatts 300 ohm load
1	116.1	1300
2	124.38	1280
3	126.38	1300
4	128.7	1300
5	142.32	1200
6	142.56	1200
7	142.74	1200
8	144.36	1200
9	146.16	1200
10	140.58	1200
G.C.	140.58	1100

TABLE 8

I.F. REJECTION DATA

Model AN/ARC-1
Serial #3494
I.F. Frequency = 9.72 Mc.
30% 1000 cycle Modulation of Ferris
18-D signal generator
Main-both-guard SW. in "Both"
Position.
300 ohm load.

Channel	Microvolts Input for 50 MW output At Fundamental Frequency	Microvolts Input at I.F. Frequency (9.72 Mc.) for 50 MW. Output	I.F. Rejection in db.
1	0.5	1900	71.6
9	1.6	1900	41.5
G.C.	.95	1900	66

TABLE 9

Coupling Factor and Noise Rejection of Aircraft Radio Model AN/ARC-1 Serial 3494 with the Squelch out and a constant 50 milli-watts output during Coupling Factor Measurements.

R.F. Signal Input:	Channel	Sensitivity in Microvolts	Signal in Microvolts for 50 Milli-watts output	Coup-ling Factor	Noise Level in Milli-watts	Noise Rejection in Microvolts
to Power cable	1	0.5	15,000	.000033	8.0	6,500
	9	1.6	22,500	.000071	7.0	7,500
	Guard	0.95	12,500	.000076	7.5	4,000
to Audio Output Jack	1	0.5	20,000	.000025	7.0	7,500
	9	1.6	6,250	.000256	5.0	2,500
	Guard	0.95	17,500	.000054	5.0	5,750

[redacted]

TABLE 10

AN/ARC-1 RECEIVER CHARACTERISTICS
WITH HUMIDITY

Primary Voltage 28V.
Receiver Output Load - 300 Ω
Receiver Input Load - 50 Ω
Transmitter Output Load - 50 Ohm
Transmission Line to Equipment was
10 feet of 50 Ω coaxial cable.

INITIAL MEASUREMENTS

Channels	Temperature	Humidity	Sens. for 50 MW. Output	db change Sens.	Power Output watts	db change Power Output
1	+50°C	50%	1.05	0	6.9	0
9	+50°C	50%	1.4	0	10.25	0
G.C.	+50°C	50%	0.7	0	8.3	0
			AFTER 24 HOURS			
1	+50°C	95%	1.5	3.1	5.9	0.69
9	+50°C	95%	2.35	4.5	8.7	0.71
G.C.	+50°C	95%	1.1	3.9	7.2	0.61
			AFTER 48 HOURS			
1	+50°C	95%	2.0	5.6	5.3	1.15
9	+50°C	95%	3.0	6.6	7.9	1.13
G.C.	+50°C	95%	1.4	6.0	6.6	1.0

TABLE 11

AN/ARC-1

SENSITIVITY OF RECEIVER
and
POWER OUTPUT OF TRANSMITTER VS. VIBRATION

Ferris Model 18D Signal Generator
Output impedance of receiver -300
Receiver and Transmitter Fed Thru
10 Feet of 50 coaxial cable.
Receiver Dummy Antenna 50 Trans. Dummy Antenna 50 ohms

Condition	Channel	Sens. in Micro-volts for 50 MW output	Power Output Watts	db change in Sens.	db change in Power Output
		VIBRATION VERTICAL			
Start of Test	9	2.6	11.1		
"	G.C.	2.0	10.7		
End of Test	9	6.0	10.3	7.2	0.33
"	G.C.	3.4	9.05	4.6	0.73
		VIBRATION _ TO SIDES OF EQUIPMENT			
Start of Test	9	2.6	10.7		
"	G.C.	2.5	9.4		
End of Test	9	2.9	8.3	0.96	1.1
"	G.C.	2.0	9.05	1.94	0.16
		VIBRATION _ TO FRONT OF EQUIPMENT			
Start of Test	9	2.9	8.3		
"	G.C.	2.0	9.05		
End of Test	9	3.0	11.5	0.3	1.41
"	G.C.	2.2	10.3	0.82	0.54

TABLE 12

Transmitter Resettability of Model AN/ARC-1
Serial No. 3494 using 50 Ohm Dummy Load
at the End 10 Ft. of PT-5 Cable and
a 28 Volt Supply Voltage.

	R.F. Power in Watts in 50 Ohm Load					Maximum db change
Channel	Initial Set	1st Reset	2nd Reset	3rd Reset	4th Reset	Per Channel
1	12.4	12.4	12.4	12.4	12.4	0.00
2	13.3	13.8	13.8	13.8	13.8	0.32
3	11.5	11.5	11.5	12.0	11.5	0.36
4	13.8	13.8	14.3	14.3	13.8	0.30
5	9.4	9.8	9.8	9.8	10.3	0.80
6	11.5	11.5	11.1	11.5	11.5	0.30
7	13.3	13.3	13.3	13.3	13.3	0.00
8	14.8	14.8	14.8	14.8	14.8	0.00
9	13.3	13.3	13.3	13.3	13.3	0.00
Guard	12.9	12.9	12.9	12.9	12.9	0.00

TABLE 13

D.C. Current Input with Autotune Running and Autotune Time vs. D. C. Voltage Input to Aircraft Radio Model AN/ARC-1 Serial 3494

D. C. Volts from Power Supply	D. C. Current Input In Amperes with Autotune Running	Autotune Time in Seconds
24	11.5	4.0
25	12.0	4.0
26	13.0	3.5
27	13.5	3.0
28.6	14.5	3.0
30	15.0	2.7

TABLE 14

Model AN/ARC-1 Serial #3494

Power Requirements and Auto-tune Time in Transmit Position

Primary Voltage (D.C.)	Input Current (Amp.)	Input Power (Watts)	Input Current Auto-tune Running (Amp.)	Input Power Auto-tune Runnir (Watts)
30	9.5	285	15.	450
28.6	9.2	263	14.5	415
27	8.7	235	13.5	364
26	8.4	218.4	13.	338
25	8.0	200	12.0	300
24	7.9	189.5	11.5	276
23	7.5	172.5	* See Note	---

* Note: Auto-tune failed to complete cycle.

TABLE 15

Model AN/ARC-1

CRYSTAL RADIATION

27 V. Supply
Ferris Model 32-B Field Strength Meter #192
Measuring Antenna 1 ft. from front of receiver

		AN/ARC-1 #3420		AN/ARC-1 #3494		db Reduction in Fundamental Radiation from Modified Gear
Channel	Xtal Freq. (Kc.)	Fundamental Radiation (μV)/meter	2nd Harmonic Radiation (μV)/meter	Fundamental Radiation (μV)/meter	2nd Harmonic Radiation (μV)/meter	
1	5910	22	2.7	7.6	1.5	9.2
2	6370	26	2.0	13.0	---	6
3	6470	24	18.0	13.0	---	5.3
4	6610	30	17.0	15.0	---	6
5	7350	30	11.0	15.0	---	6
6	7380	21.0	11.0	11.0	---	5.6
7	7390	24	9.0	14.0	---	4.7
8	7480	26	9.0	15	---	4.7
9	7580	30	8.0	15	---	6
10	7270	26	12.0	12	---	6.7
G.C.	7270	5.0	----	1.5	---	----

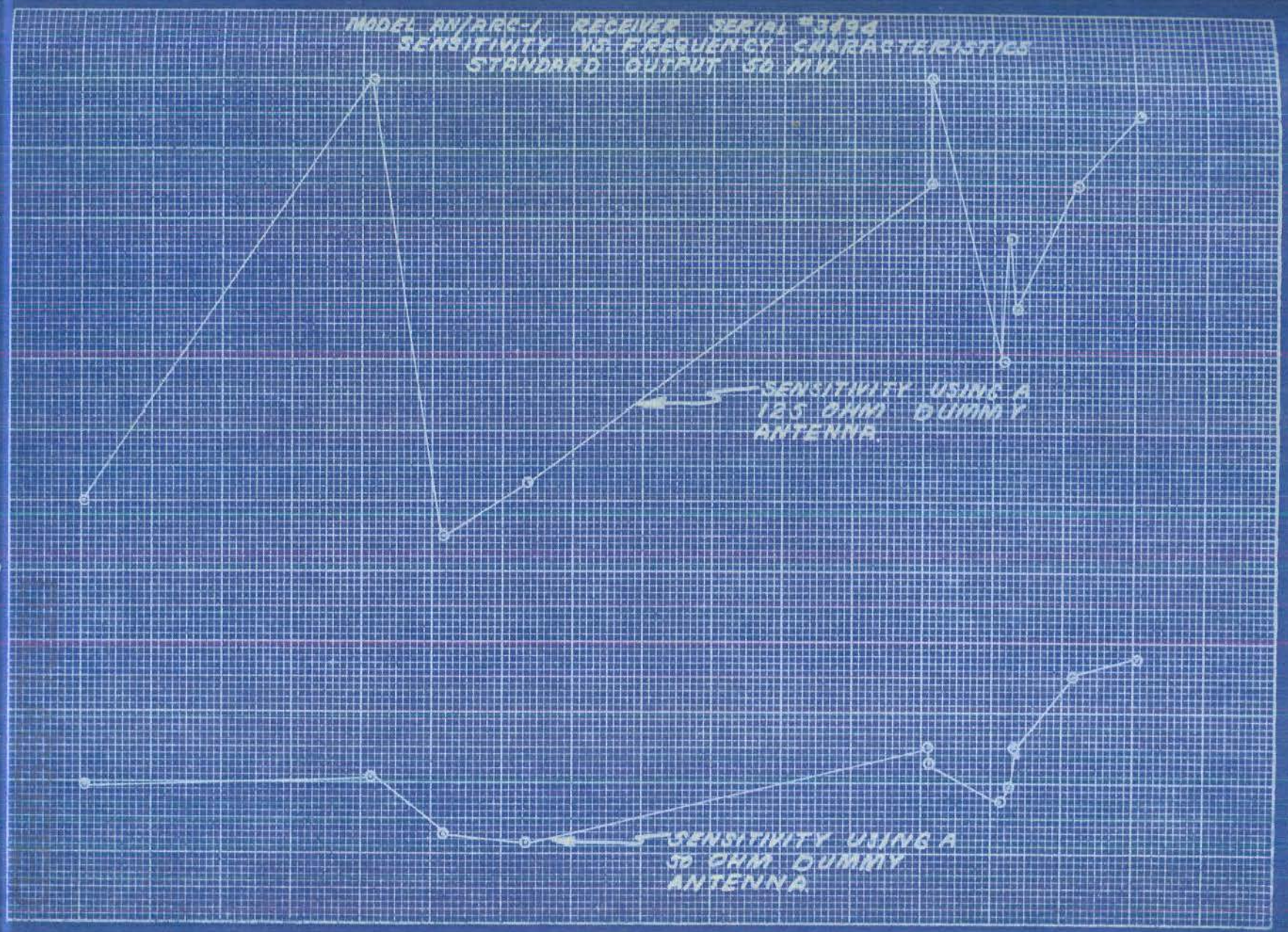
TABLE 16

Model AN/ARC-1

CRYSTAL RADIATION

28 V. Supply
Ferris Model 32-B
Field Strength Meter 1 ft. from right side of Equipment near front cover.

Channel	Xtal Freq. in Kc.	AN/ARC-1 #3420 Fundamental Radiation in μV/meter	AN/ARC-1 #3494 Fundamental Radiation in μV/meter	db reduction in Radiation from modified Gear
1	5910	38	20	5.5
2	6370	44	24	5.3
3	6470	40	24	4.4
4	6610	40	26	3.7
5	7350	40	22	5.2
6	7380	56	22	8.1
7	7390	70	24	9.3
8	7480	90	25	11.2
9	7580	100	26	11.7



INPUT IN MICROVOLTS

PLATE 1

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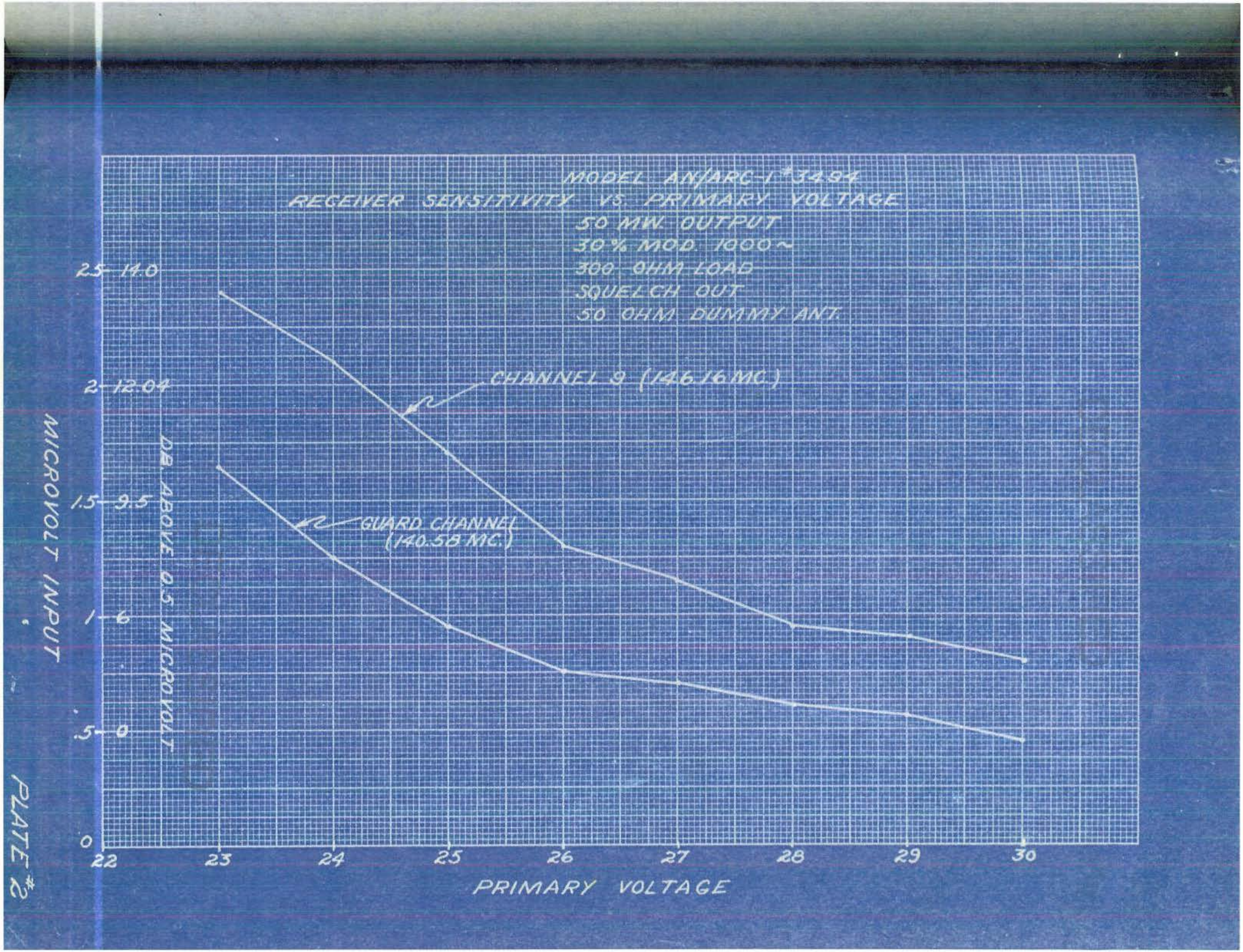
MODEL AN/ARC-1 34-94
RECEIVER SENSITIVITY VS. PRIMARY VOLTAGE
50 MW. OUTPUT
30% MOD. 1000~
300 OHM LOAD
SQUELCH OUT
50 OHM DUMMY ANT.
CHANNEL 9 (146.16 MC.)
GUARD CHANNEL (140.58 MC.)
DB ABOVE 0.5 MICROVOLT
MICROVOLT INPUT
2.5 14.0
2 12.04
1.5 9.5
1 6
.5 0
0
22
23
24
25
26
27
28
29
30
PRIMARY VOLTAGE
PLATE 2

MODEL AN/ARC-1
SERIAL # 3494
OVERALL SELECTIVITY
300 OHM LOAD
50 MW. OUTPUT
SQUELCH OUT
GUARD CHANNEL (140.58 MC.)
INPUT AT RESONANCE OR
0 DB = 0.95 MICROVOLTS
PRIMARY VOLTAGE 28 V.

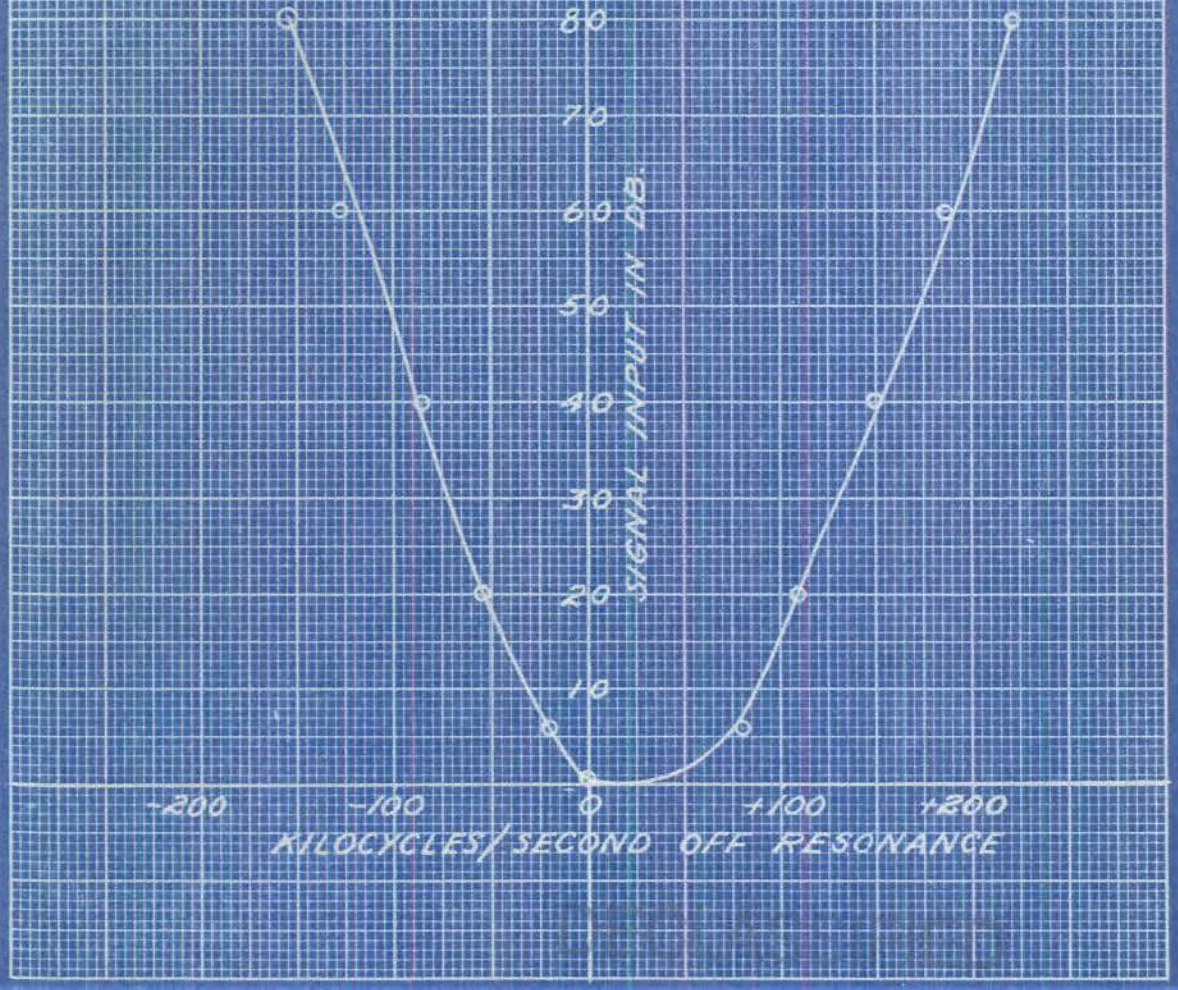

PLATE #3

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DATE

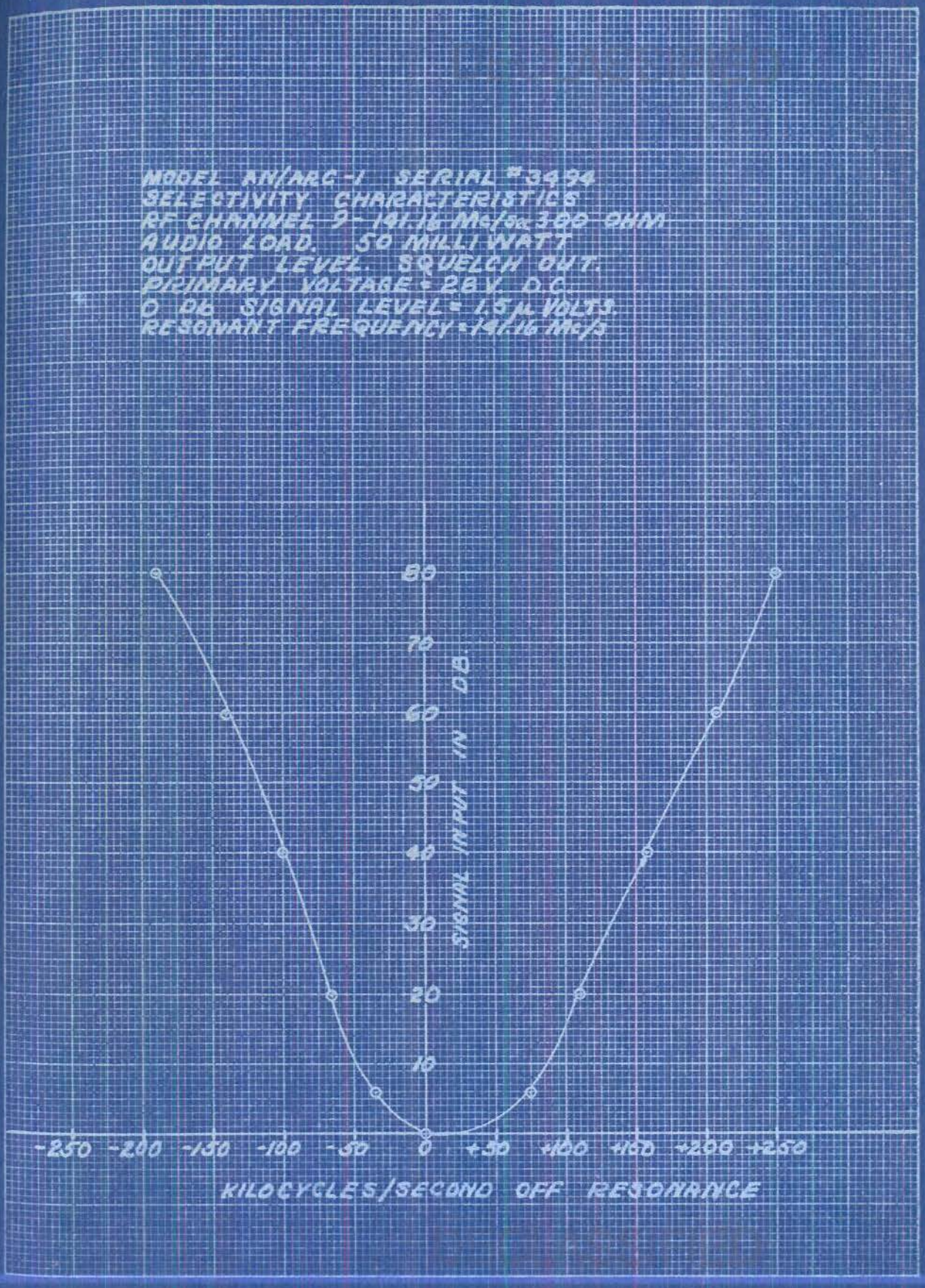


PLATE 4

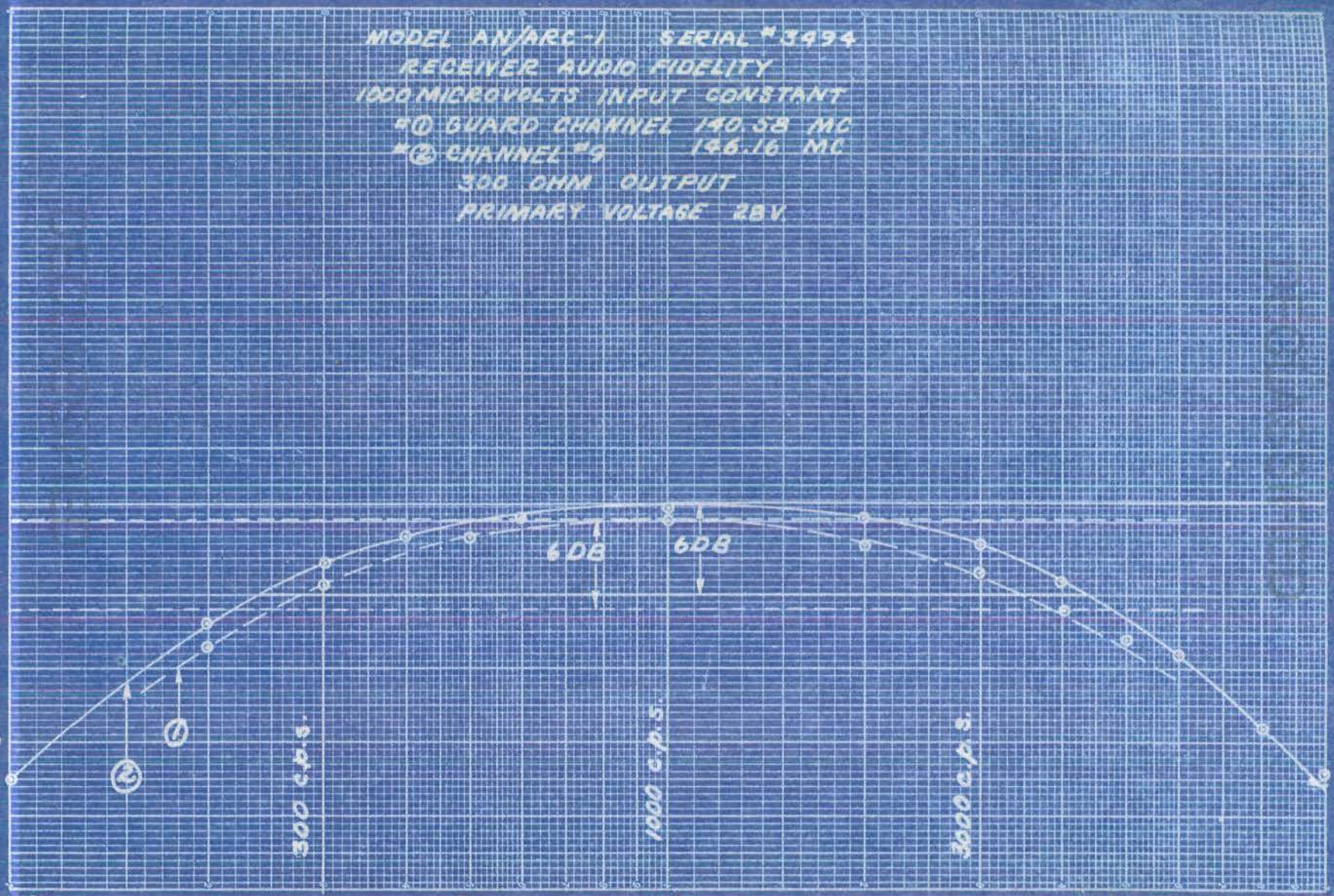

MODEL AN/ARC-1 SERIAL #3494
RECEIVER AUDIO FIDELITY
1000 MICROVOLTS INPUT CONSTANT
*① GUARD CHANNEL 140.58 MC
*② CHANNEL #9 146.16 MC
300 OHM OUTPUT
PRIMARY VOLTAGE 28 V.
6 DB
6 DB
300 C.P.S.
1000 C.P.S.
3000 C.P.S.
RECEIVER AUDIO OUTPUT IN DB ABOVE 1 MILLIWATT
0
10
20
30
40
100
500
1000
5000
10,000
AUDIO FREQUENCY IN C.P.S.

PLATE 5

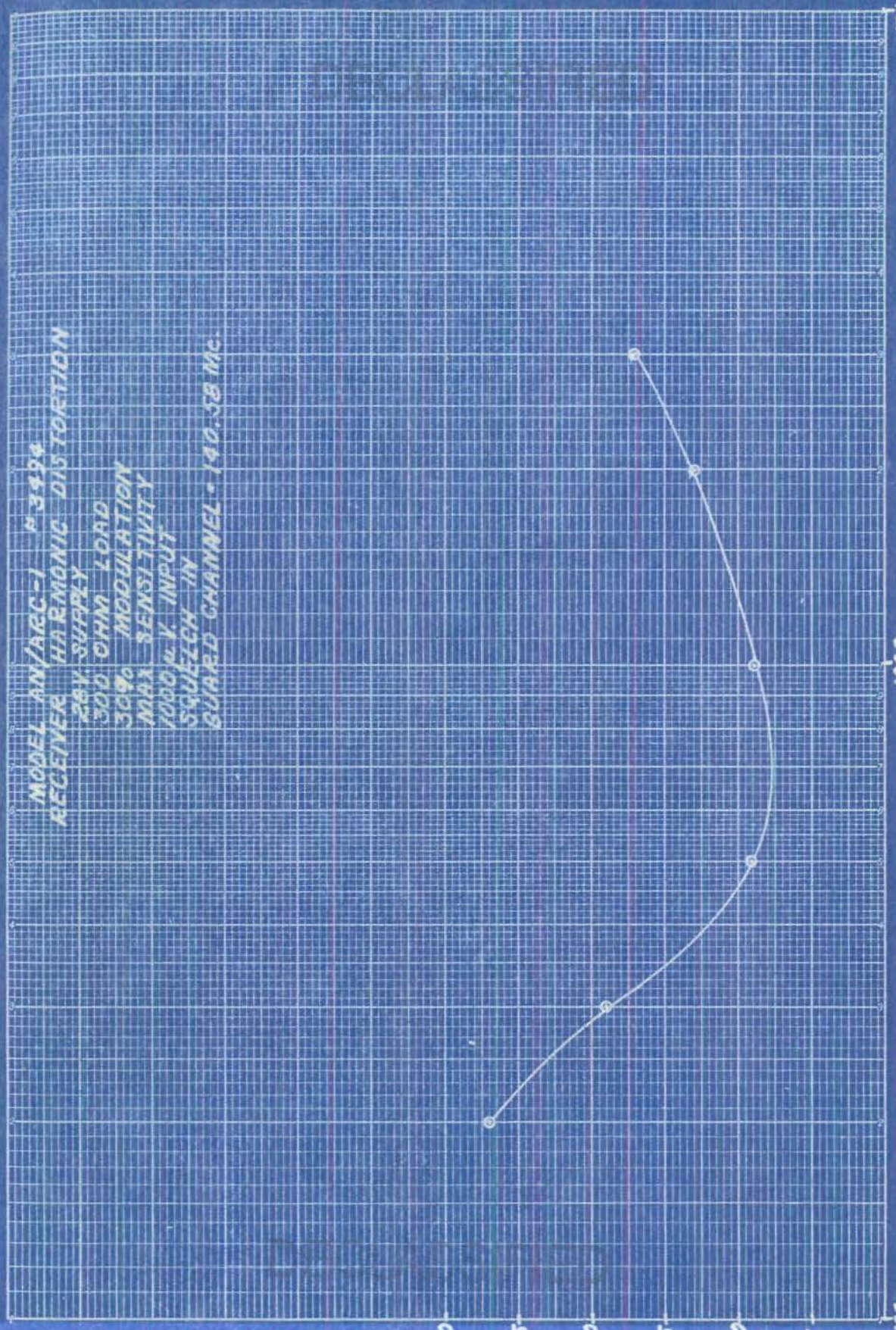

MODEL AN/ARC-1 P-3494
RECEIVER HARMONIC DISTORTION
28V SUPPLY
500 OHM LOAD
30% MODULATION
MAX SENSITIVITY
1000 V. IN/OUT
SQUELCH IN
GUARD CHANNEL - 140.58 Mc.
10K
1000
100
FREQUENCY (c.p.s.)
30
25
20
15
10
5
PER CENT TOTAL HARMONIC DISTORTION

PLATE 6

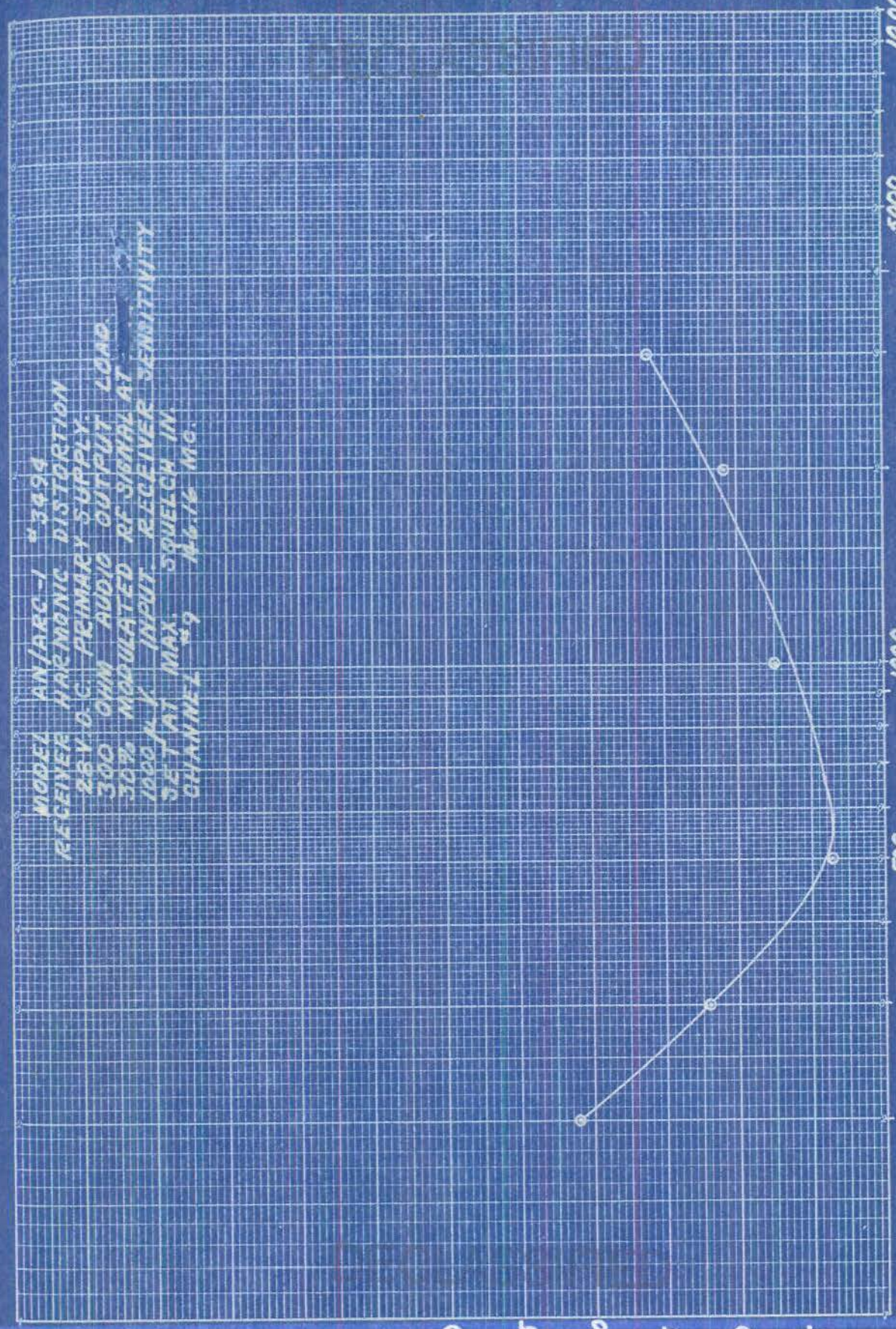

MODEL AN/ARC-1 #3494
RECEIVER HARMONIC DISTORTION
225 TO 400 MC PRIMARY SUPPLY
3000 OHM AUDIO OUTPUT LOAD
30% MODULATED RF SIGNAL AT SENSITIVITY
INPUT SQUELCH IN
MAX. MIN.
10000
5000
1000
500
100
30
25
20
15
10
5
FREQUENCY IN C.P.S.
TOTAL HARMONIC DISTORTION IN PER CENT

PLATE 7

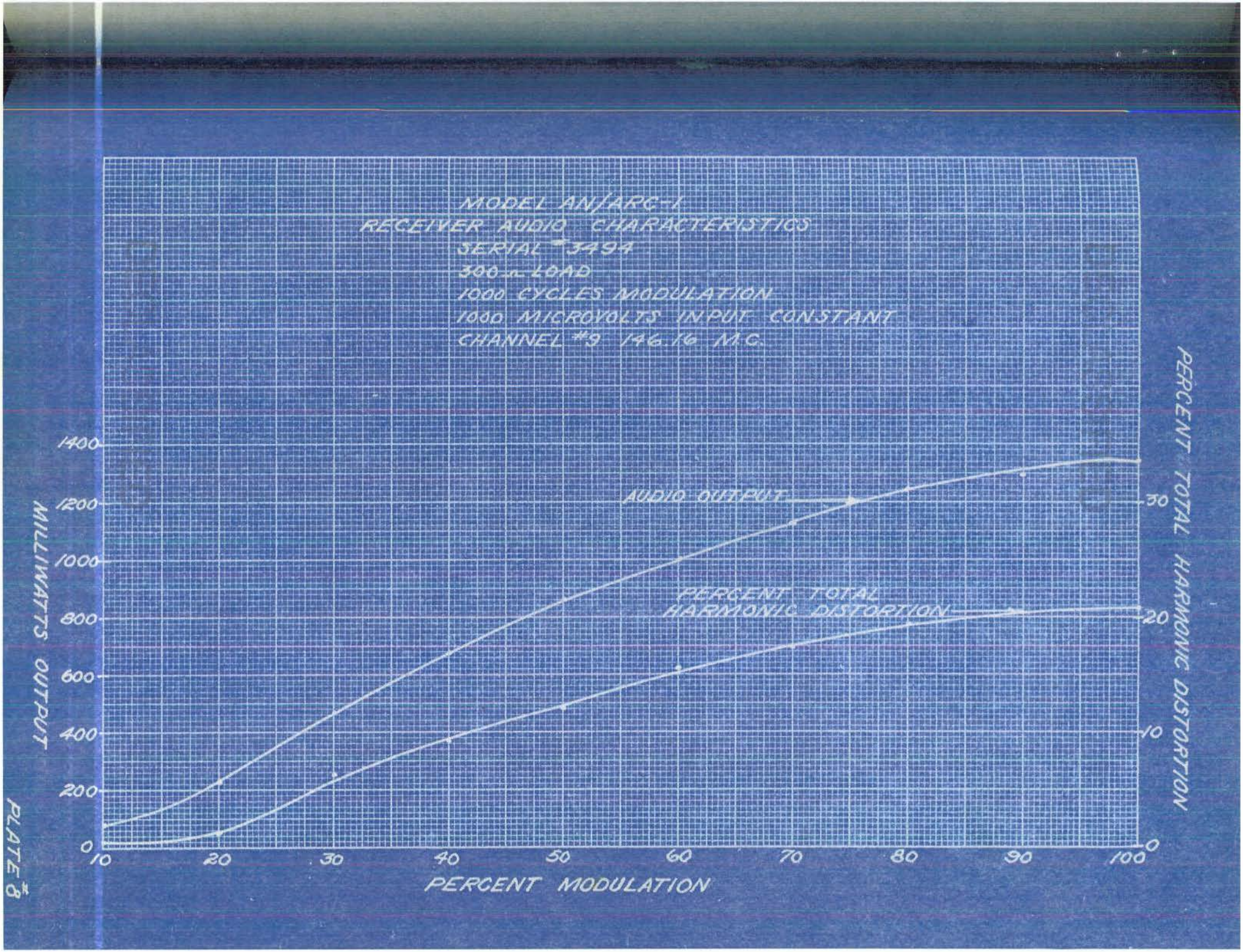

MODEL AN/ARC-1
RECEIVER AUDIO CHARACTERISTICS
SERIAL # 3494
300 Ω LOAD
1000 CYCLES MODULATION
1000 MICROVOLTS INPUT CONSTANT
CHANNEL #9 146.16 M.C.
AUDIO OUTPUT
PERCENT TOTAL HARMONIC DISTORTION
MILLIWATTS OUTPUT
PERCENT TOTAL HARMONIC DISTORTION
PERCENT MODULATION
0
200
400
600
800
1000
1200
1400
10
20
30
40
50
60
70
80
90
100

PLATE 8

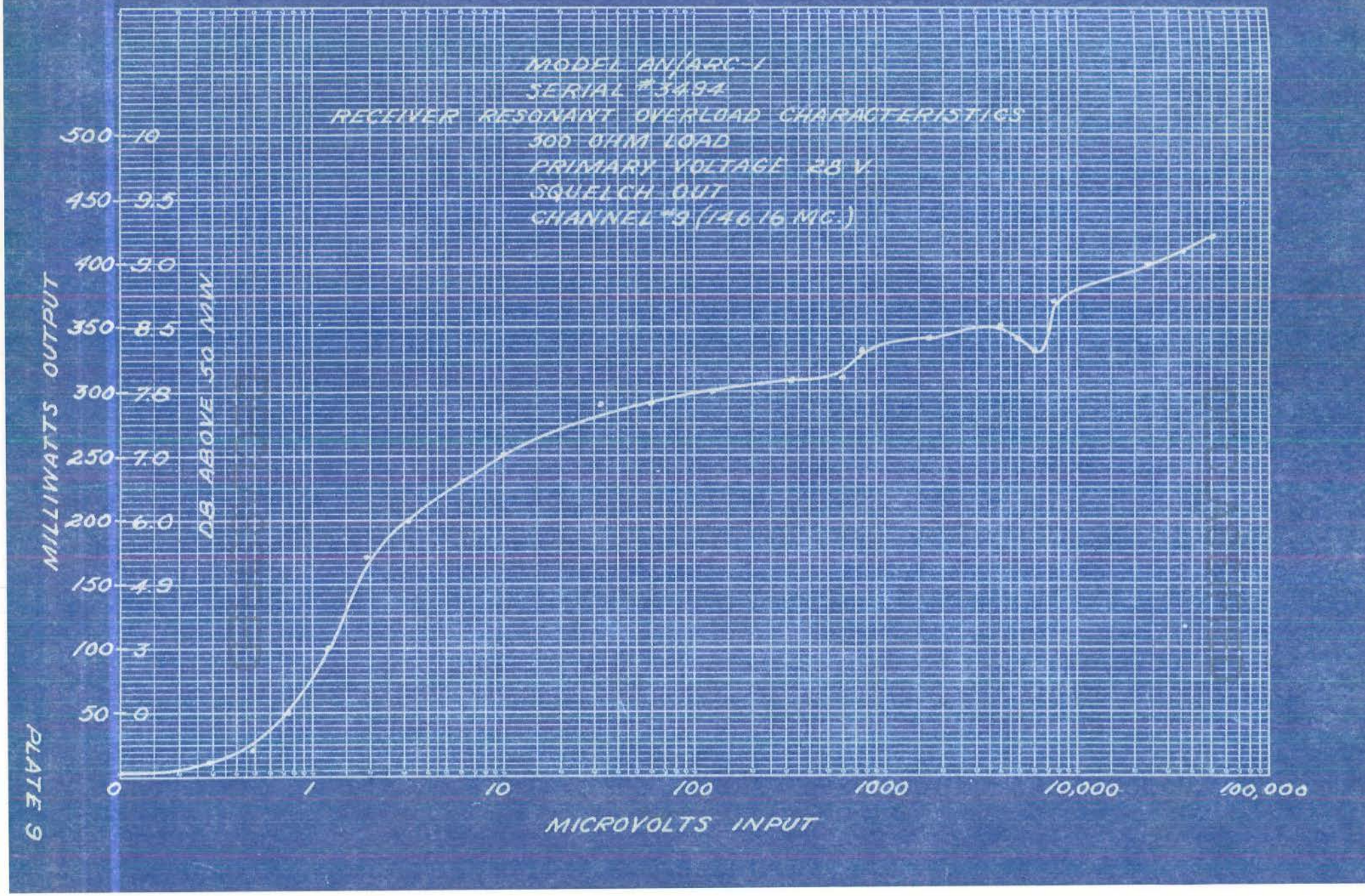
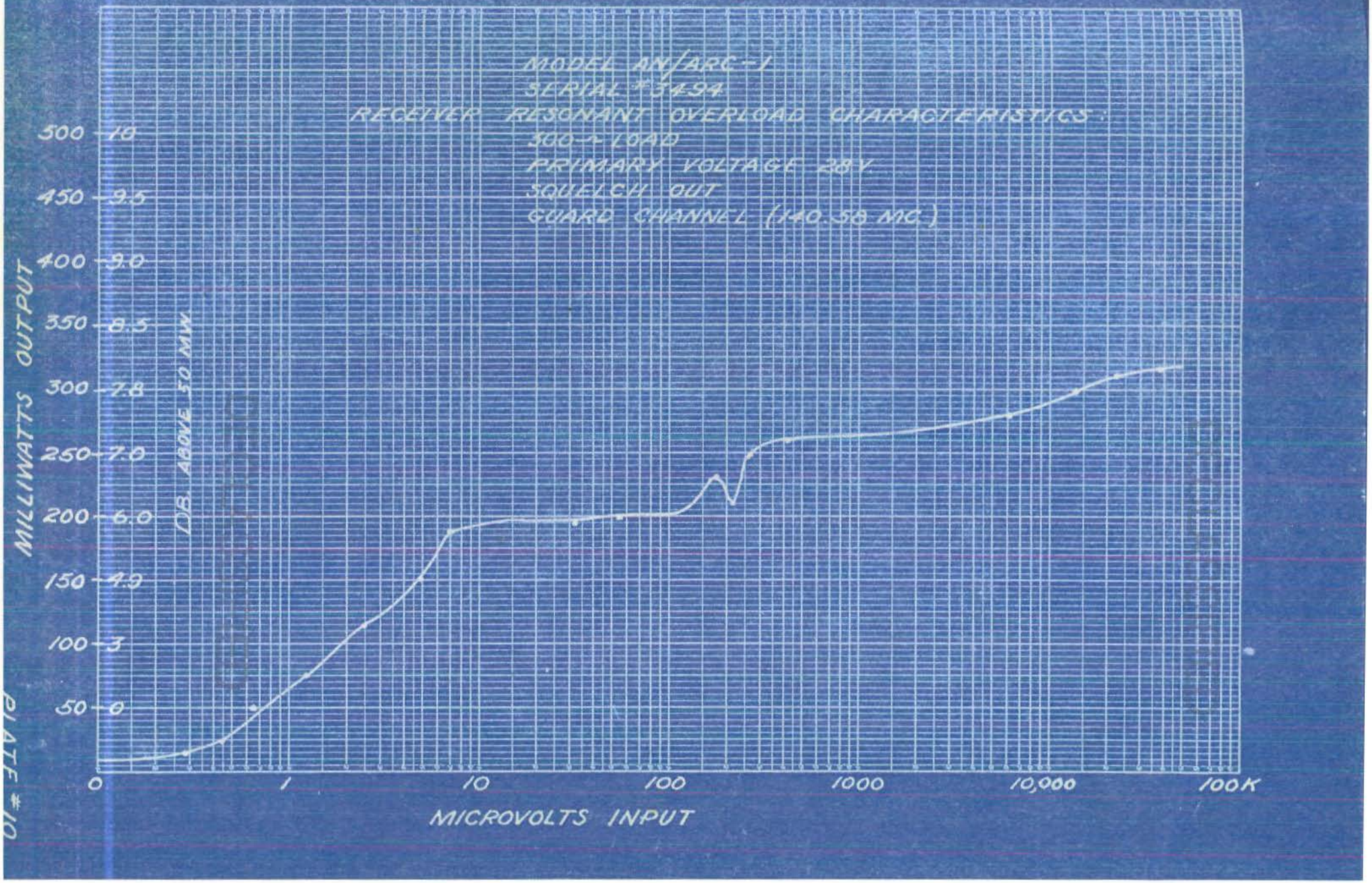

MODEL AN/ARC-1
SERIAL #3494
RECEIVER RESONANT OVERLOAD CHARACTERISTICS
300 OHM LOAD
PRIMARY VOLTAGE 28 V.
SQUELCH OUT
CHANNEL #9 (146.16 MC.)
MILLIWATTS OUTPUT
DB ABOVE 50 MW
500
450
400
350
300
250
200
150
100
50
10
9.5
9.0
8.5
7.8
7.0
6.0
4.9
3
0
0
1
10
100
1000
10,000
100,000
MICROVOLTS INPUT

PLATE 9


MODEL AN/ARC-1
SERIAL # 3494
RECEIVER RESONANT OVERLOAD CHARACTERISTICS:
300 Ω LOAD
PRIMARY VOLTAGE 28 V
SQUELCH OUT
GUARD CHANNEL (140.58 MC.)
500
450
400
350
300
250
200
150
100
50
10
9.5
9.0
8.5
7.8
7.0
6.0
4.9
3
0
DB ABOVE 50 MW
MILLIWATTS OUTPUT
0
1
10
100
1000
10,000
100K
MICROVOLTS INPUT
PLATE #10

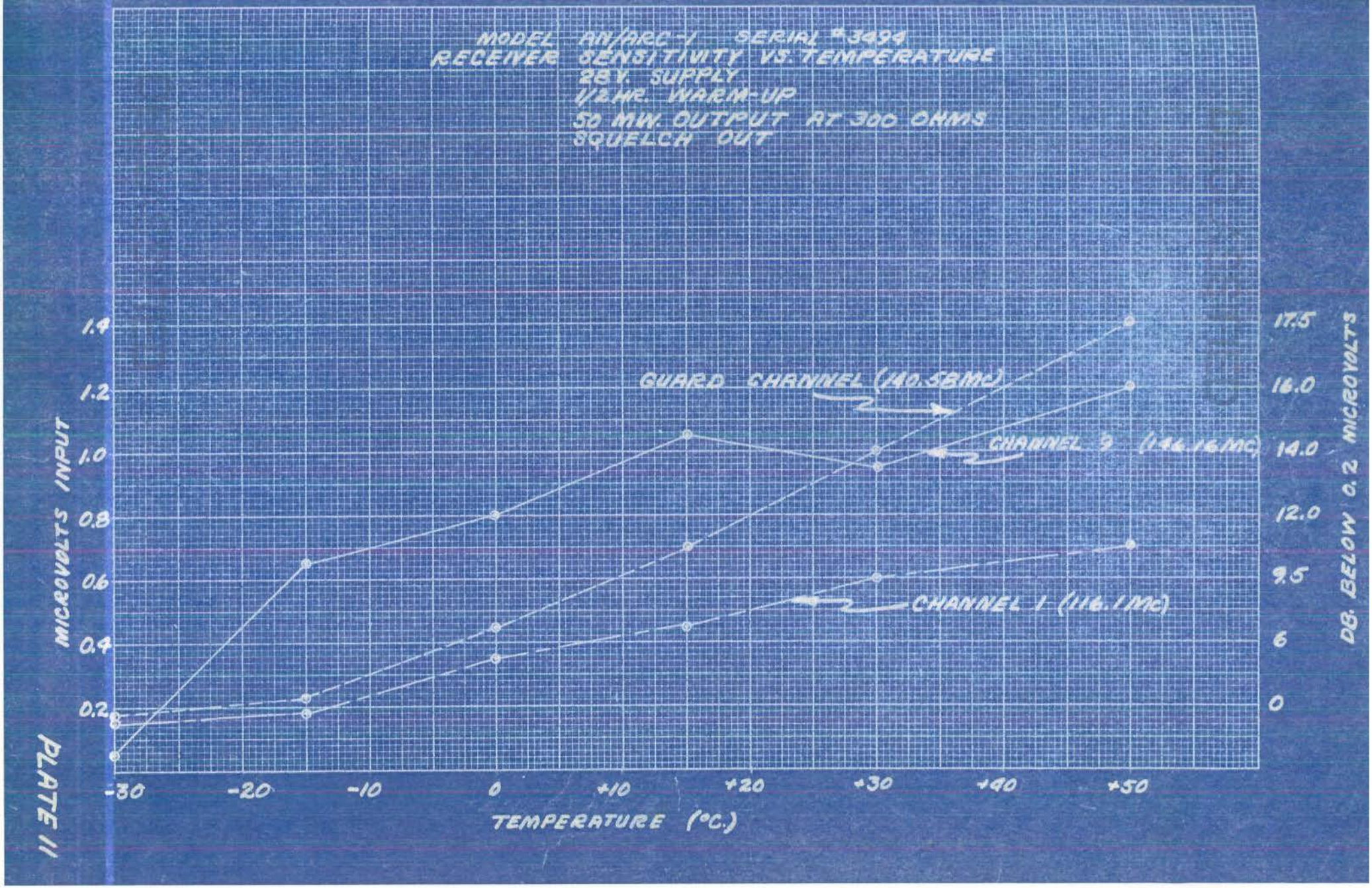

MODEL AN/ARC-1 SERIAL # 3494
RECEIVER SENSITIVITY VS. TEMPERATURE
28 V. SUPPLY
1/2 HR. WARM-UP
50 MW. OUTPUT AT 300 OHMS
SQUELCH OUT
GUARD CHANNEL (140.58MC)
CHANNEL 9 (146.16MC)
CHANNEL 1 (116.1MC)
MICROVOLTS INPUT
DB. BELOW 0.2 MICROVOLTS
TEMPERATURE (°C.)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
17.5
16.0
14.0
12.0
9.5
6
0
-30
-20
-10
0
+10
+20
+30
+40
+50

PLATE 11

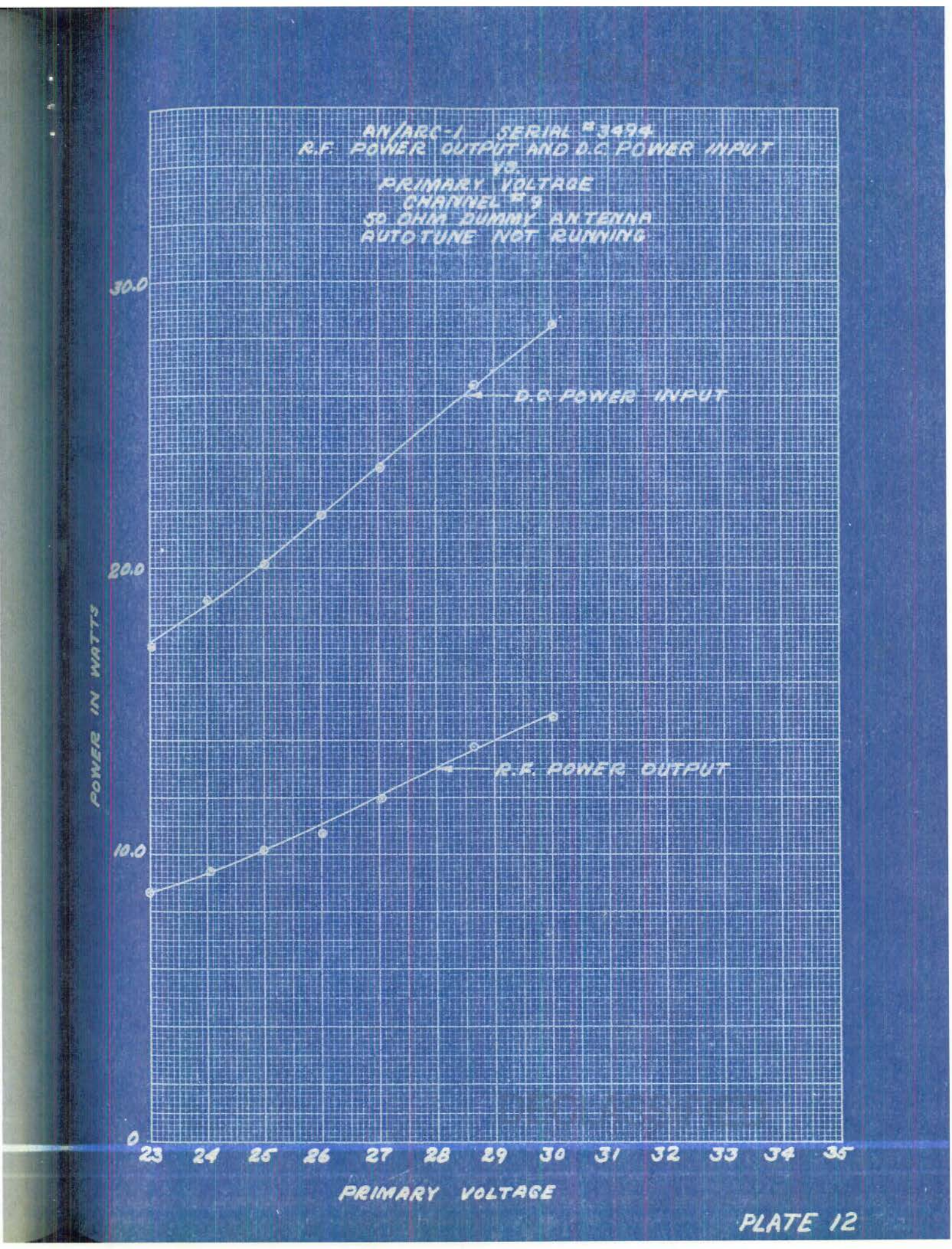

AN/ARC-1 SERIAL # 3494
R.F. POWER OUTPUT AND D.C. POWER INPUT
VS.
PRIMARY VOLTAGE
CHANNEL # 9
50 OHM DUMMY ANTENNA
AUTOTUNE NOT RUNNING
30.0
20.0
10.0
0
D.C. POWER INPUT
R.F. POWER OUTPUT
POWER IN WATTS
23 24 25 26 27 28 29 30 31 32 33 34 35
PRIMARY VOLTAGE

PLATE 12

U. S. NAVAL RESEARCH LABORATORY
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DATE

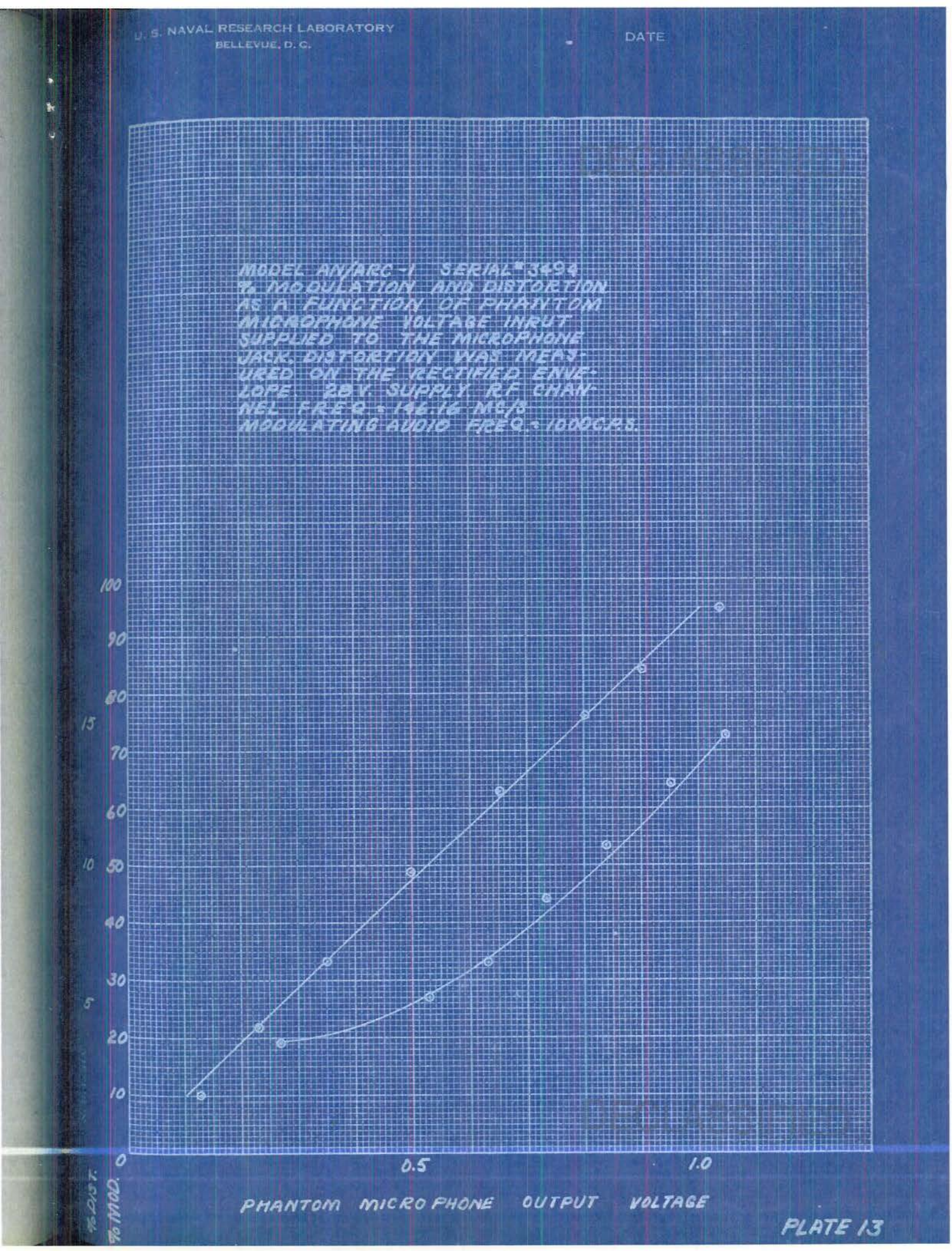


PLATE 13

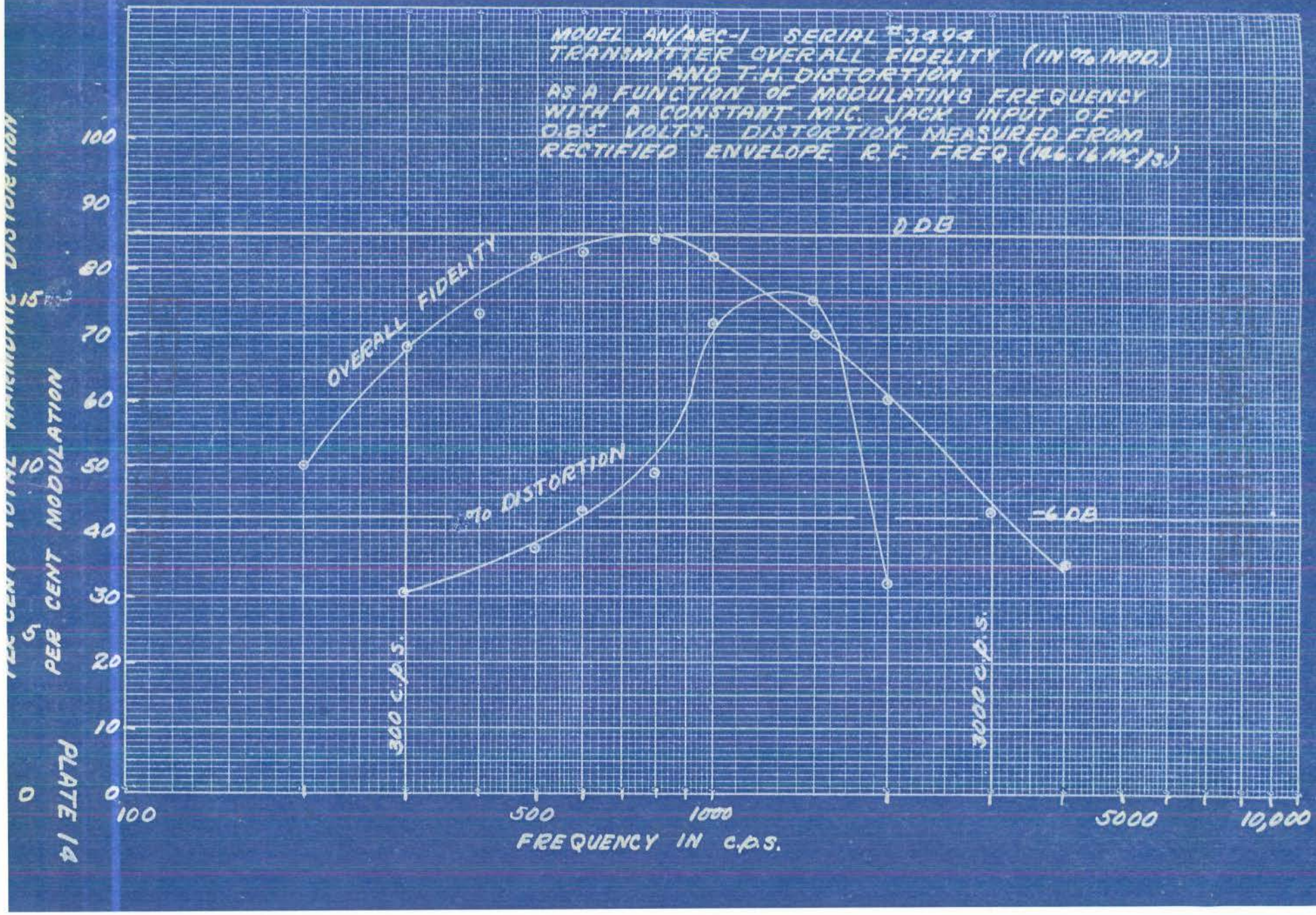

MODEL AN/ARC-1 SERIAL #3494
TRANSMITTER OVERALL FIDELITY (IN % MOD.)
AND T.H. DISTORTION
AS A FUNCTION OF MODULATING FREQUENCY
WITH A CONSTANT MIC. JACK INPUT OF
0.85 VOLTS. DISTORTION MEASURED FROM
RECTIFIED ENVELOPE. R.F. FREQ. (146.16 MC/S.)
0 DB
-6 DB
OVERALL FIDELITY
% DISTORTION
300 C.P.S.
3000 C.P.S.
100
500
1000
5000
10,000
FREQUENCY IN C.P.S.
PER CENT MODULATION
PER CENT TOTAL HARMONIC DISTORTION
0
10
20
30
40
50
60
70
80
90
100

PLATE 14

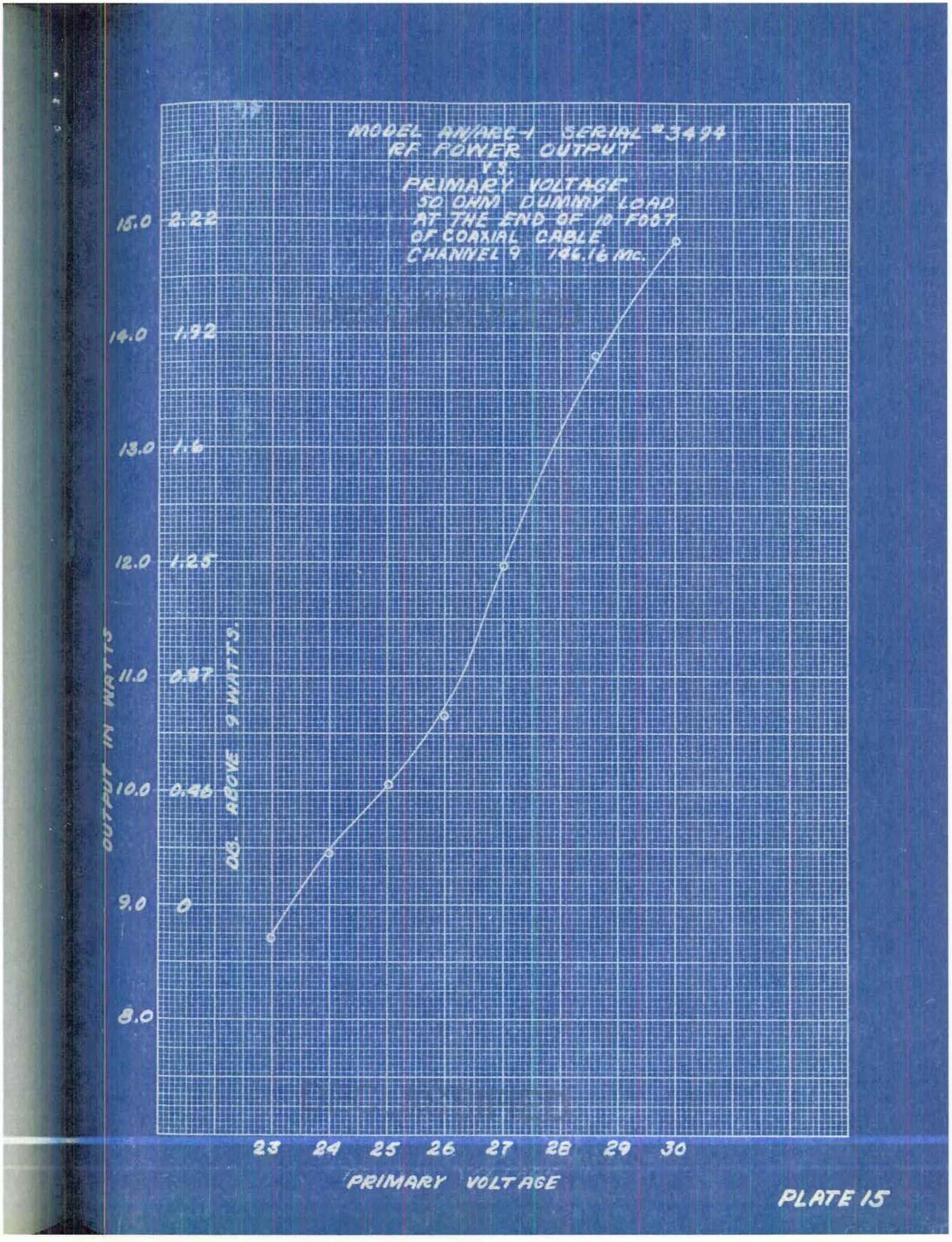

MODEL AN/ARC-1 SERIAL #3494
RF POWER OUTPUT
VS
PRIMARY VOLTAGE
50 OHM DUMMY LOAD
AT THE END OF 10 FOOT
OF COAXIAL CABLE
CHANNEL 9 146.16 Mc.
15.0
2.22
14.0
1.92
13.0
1.6
12.0
1.25
11.0
0.87
10.0
0.46
9.0
0
8.0
DB. ABOVE 9 WATTS.
OUTPUT IN WATTS
23
24
25
26
27
28
29
30
PRIMARY VOLTAGE

PLATE 15

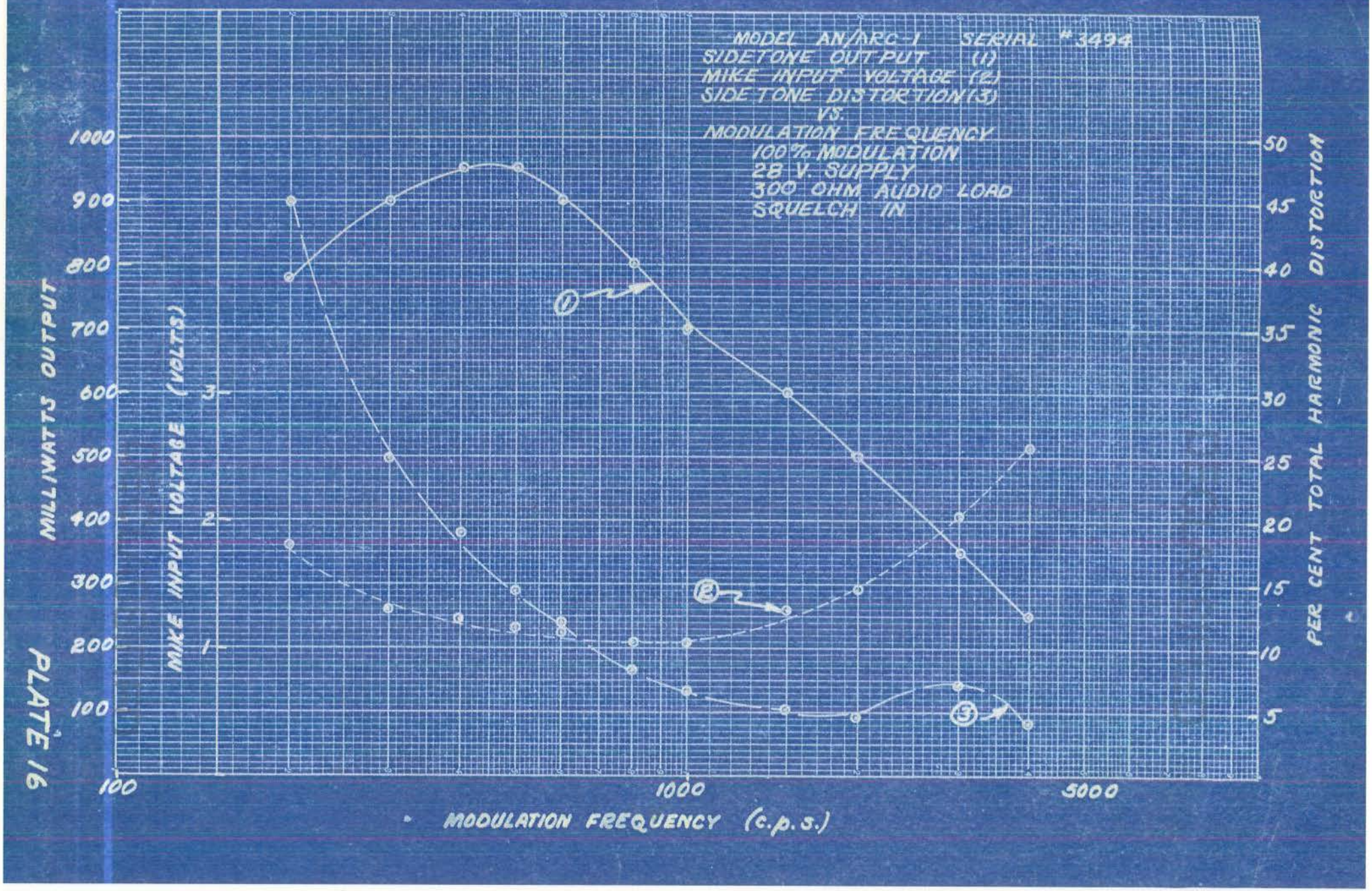
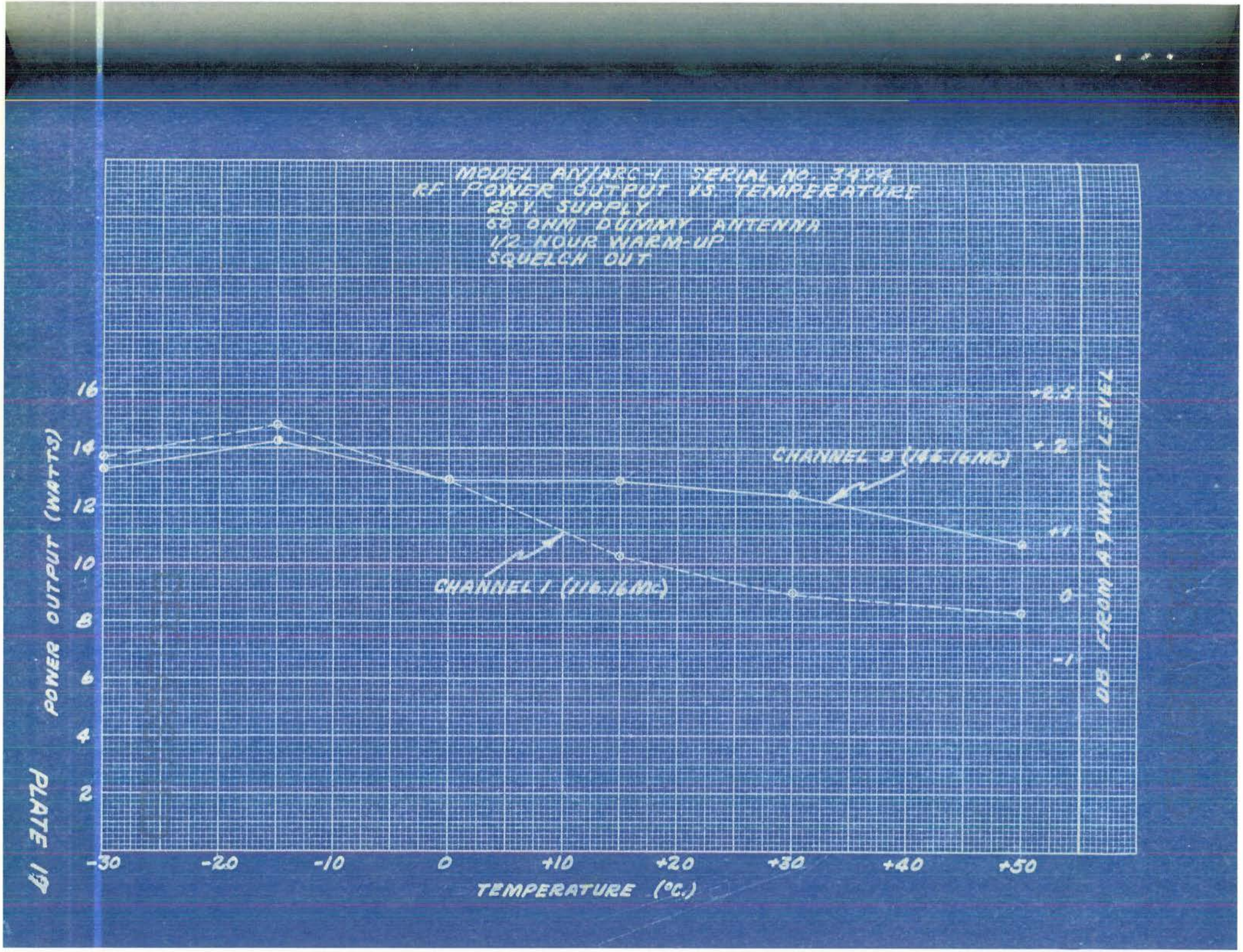

MODEL AN/ARC-1 SERIAL # 3494
SIDETONE OUTPUT (1)
MIKE INPUT VOLTAGE (2)
SIDE TONE DISTORTION (3)
VS.
MODULATION FREQUENCY
100% MODULATION
28 V. SUPPLY
300 OHM AUDIO LOAD
SQUELCH IN
MILLIWATTS OUTPUT
MIKE INPUT VOLTAGE (VOLTS)
PER CENT TOTAL HARMONIC DISTORTION
MODULATION FREQUENCY (c.p.s.)
100
1000
5000
1000
900
800
700
600
500
400
300
200
100
3
2
1
50
45
40
35
30
25
20
15
10
5
1
2
3

PLATE 16


MODEL AN/ARC-1 SERIAL NO. 3424
RF POWER OUTPUT VS. TEMPERATURE
28 V. SUPPLY
50 OHM DUMMY ANTENNA
1/2 HOUR WARM-UP
SQUELCH OUT
CHANNEL 8 (116.16 MC.)
CHANNEL 1 (116.16 MC.)
PLATE 17
POWER OUTPUT (WATTS)
16
14
12
10
8
6
4
2
DB FROM 4.9 WATT LEVEL
+2.5
+2
+1
0
-1
-30
-20
-10
0
+10
+20
+30
+40
+50
TEMPERATURE (°C.)

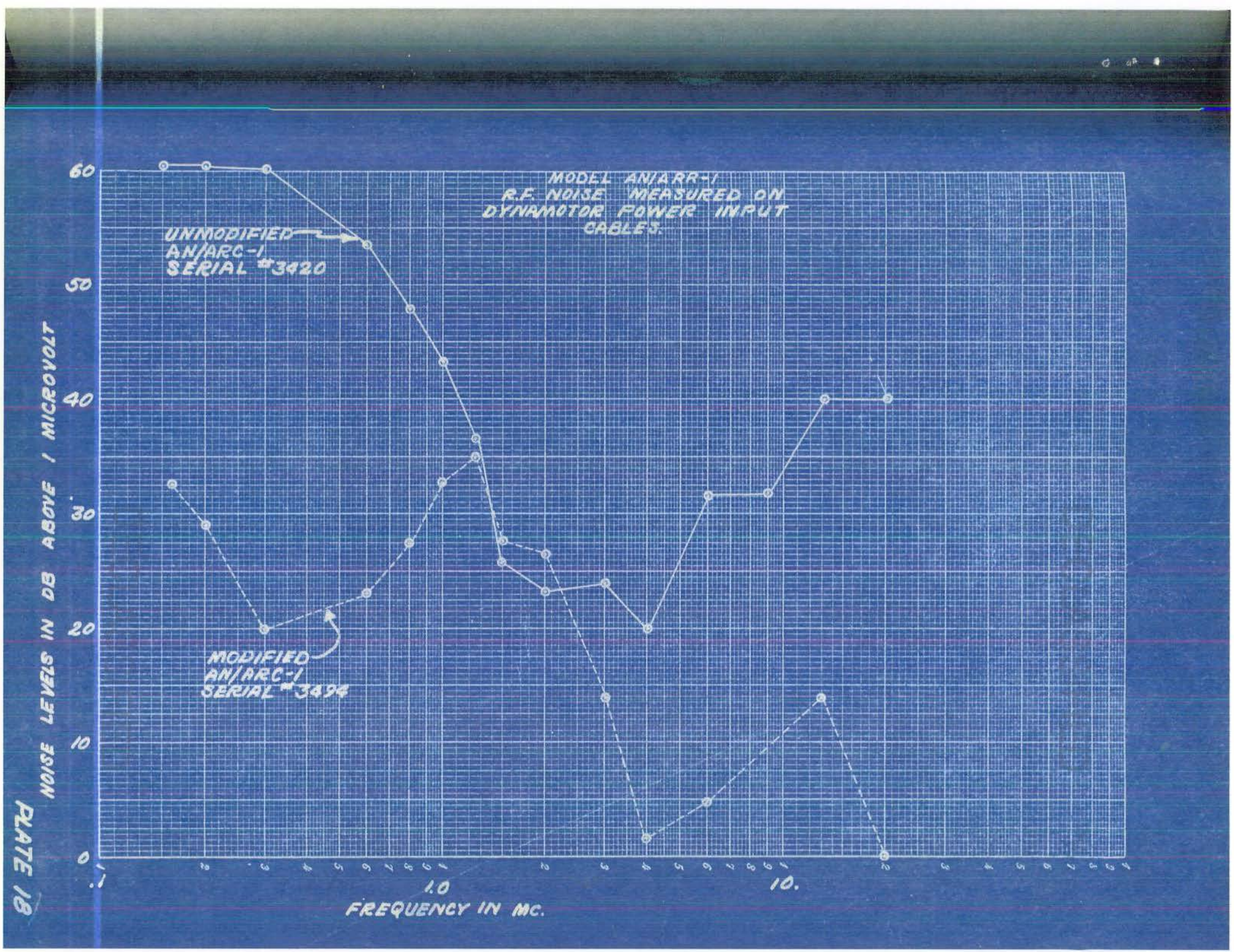

MODEL AN/ARR-1
R.F. NOISE MEASURED ON
DYNAMOTOR POWER INPUT
CABLES.
UNMODIFIED
AN/ARC-1
SERIAL #3420
MODIFIED
AN/ARC-1
SERIAL #3494
NOISE LEVELS IN DB ABOVE 1 MICROVOLT
60
50
40
30
20
10
0
.1
1.0
10.
FREQUENCY IN Mc.

PLATE 18

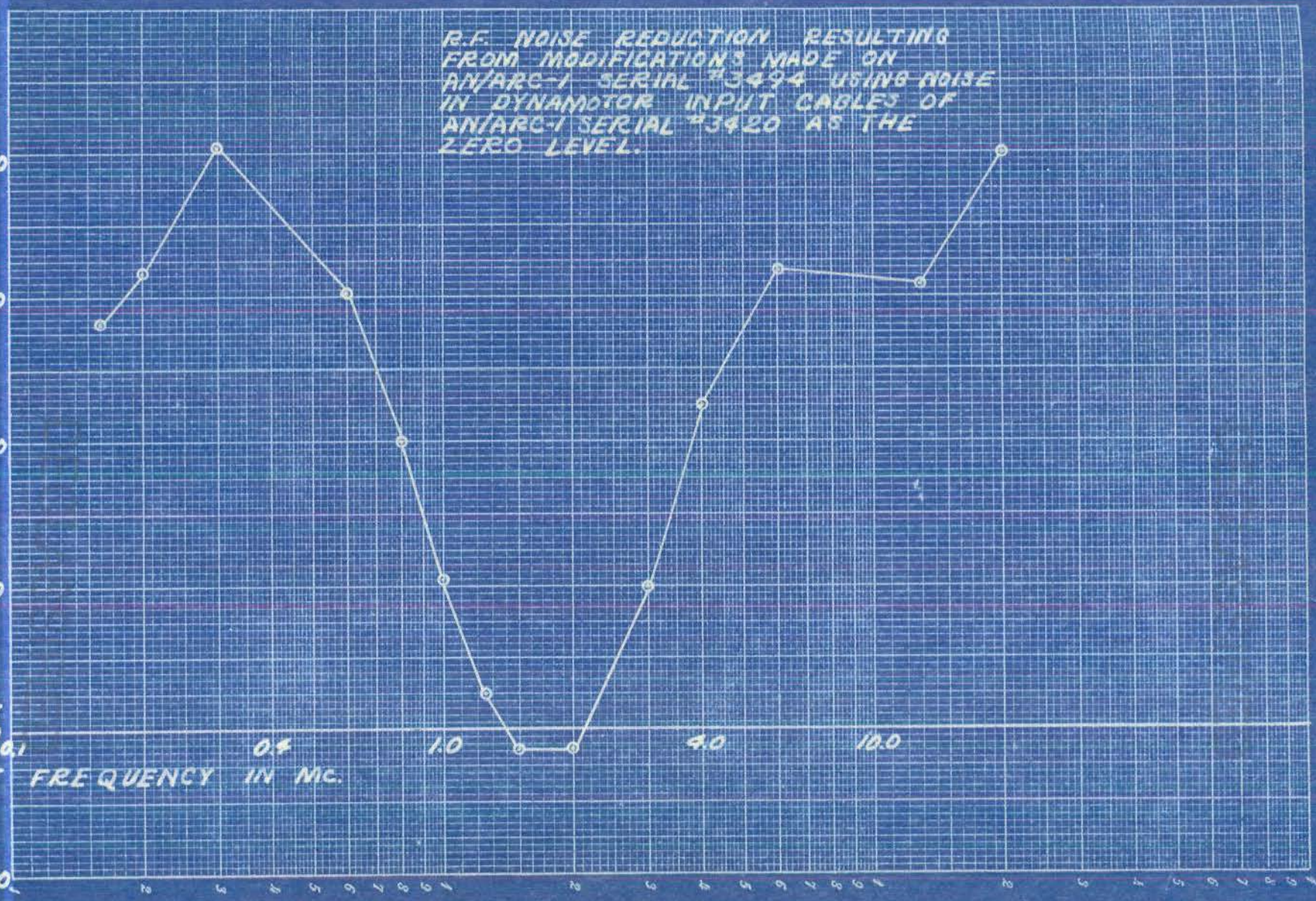

R.F. NOISE REDUCTION RESULTING FROM MODIFICATIONS MADE ON AN/ARC-1 SERIAL #3494 USING NOISE IN DYNAMOTOR INPUT CABLES OF AN/ARC-1 SERIAL #3420 AS THE ZERO LEVEL.
NOISE REDUCTION IN DB
40
30
20
10
0
+
-
10
0.1
0.4
1.0
4.0
10.0
FREQUENCY IN MC.

PLATE 19

DISTRIBUTION LIST

BuShips (10)
BuAer (10)
Jnt. Rdo. Bd. (1)
NAS, Patuxent (1)
NR&SL, San Diego (1)
JEIA (1)