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147471

TEST REPORT

DYNAMIC MICROPHONES M-87/AIC AND M-101/AIC
AND EARPHONE H-143/AIC

Job Order 11-209

(NASA-CR-147471) DYNAMIC MICROPHONES M-87/AIC AND M-101/AIC AND EARPHONE H-143/AIC (Lockheed Electronics Co.) 302 p HC $9.75 CSCL 17B N76-18298 Unclas G3/32 09623

Prepared By

Lockheed Electronics Company, Inc.
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Houston, Texas

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For

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TRACKING AND COMMUNICATIONS DEVELOPMENT DIVISION

National Aeronautics and Space Administration

LYNDON B. JOHNSON SPACE CENTER

Houston, Texas

May 1975

LEC-5733
SHUTTLE

TECHNICAL REPORT INDEX/ABSTRACT
(See instructions on reverse side.)

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13. ABSTRACT

The electrical characteristics of the M-87/AIC and M-101/AIC dynamic microphone and H-143 earphones were recently tested for the purpose of establishing the relative performance levels of units supplied by four vendors: Carter Engineering Company, Astrocom, Electrovoice, and Roanwell.

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ABBREVIATIONS, ACRONYMS, AND SYMBOLS

B&K	Bruel and Kjaer
dB	Decibel
ft	Feet
Hz	Hertz
SN	Serial Number
SPL	Sound Pressure Level
σ	Standard Deviation

1.0 SUMMARY

The electrical characteristics of the M-87/AIC and M-101/AIC dynamic microphone and H-143 earphones were recently tested for the purpose of establishing the relative performance levels of units supplied by four vendors: Carter Engineering Company, Astrocom, Electro-voice, and Roanwell. A total of 70 microphones and 30 earphones were tested for frequency response, sensitivity, linearity, impedance and noise cancellation. Some of these tests were performed at a simulated altitude of 25,000 feet (ft).

From a careful evaluation of the test data, the following conclusions can be drawn:

- The H-143 earphones supplied by Astrocom and Carter are functionally equivalent.
- The M-101 microphone supplied by the three vendors (Astrocom, Carter, Electrovoice) are also equivalent units.
- The M-87 microphones supplied by Roanwell were found to be lower in sensitivity and impedance than the M-87 microphones supplied by Electrovoice, Carter, and Astrocom.

2.0 INTRODUCTION

This document contains the results of recent tests performed on the M-87/AIC and M-101/AIC microphones, as well as the H-143/AIC earphone. The M-87 and M-101 microphones are dynamic, noise cancelling units designed for use at altitudes of up to 35,000 ft and are subject to the extreme noise conditions often encountered in military aircraft. The M-87 microphone is designed for conventional boom mounting or may be used with a pressure helmet. The M-101 is designed for use in an oxygen mask and is about twice as sensitive as the M-87.

The H-143/AIC is a lightweight, moving coil earphone designed for serviceability in military aircraft with constant sensitivity at altitudes ranging from sea level to 70,000 ft. Forty M-87 microphones, thirty M-101 microphones and thirty H-143 earphones were tested which were supplied by four different vendors as follows:

M-87/AIC:	Carter	SN-41 to SN-50
	Astrocom	SN-31 to SN-40
	Electrovoice	SN-51 to SN-60
	Roanwell	SN-1 to SN-10
M-101/AIC:	Carter	SN-1 to SN-10
	Astrocom	SN-11 to SN-20
	Electrovoice	SN-21 to SN-30
H-143/AIC:	Astrocom	SN-61 to SN-69 SN-71 to SN-73 SN-77 SN-78 SN-80

Carter	SN-82 SN-83 SN-86 SN-87 SN-89 to SN-93 SN-95 to SN-100

Although the Carter, Astrocom, and Electrovoice microphones all bear different vendor's names, these units are all manufactured by Electrovoice.

The microphones were tested for frequency response, sensitivity and linearity at sea level and at a simulated altitude of 25,000 ft. Microphone impedance was tested at sea level only.

In addition to the above near field tests, the frequency response of 10 microphones was tested at a sound pressure level (SPL) of 110 decibels (dB) (referred to .0002 dynes per square centimeter) with the sound source 6 ft from the normal talking part of the microphone. The results of these tests are documented in appendix D.

The earphones were tested at sea level ambient atmospheric pressure only; the parameters measured were frequency response, linearity, sensitivity, and impedance.

The purpose of these tests is to establish the relative performance levels of the units manufactured by each vendor.

3.0 M-87/AIC TEST

3.1 M-87/AIC TEST PROCEDURE

For all M-87 near field tests, the normal talking part was held 1/4" from a No. 4215 Bruel and Kjaer (B&K) artificial voice, driven by a B&K model 1014 oscillator. The microphone output was measured across 5 ohms using a Ballantine model 300 H voltmeter. The sound pressure level input to the test microphone was monitored using a B&K one inch condensor microphone and a B&K No. 2604 microphone amplifier. The frequency response data was obtained with a constant sound pressure level input of 110 dB SPL. The linearity data was obtained using sound pressure inputs of 124 dB, 115 dB, 110 dB, to 105 dB at the frequencies noted on the data sheets. The impedance was measured by applying a 0.2 volt 1000 Hz signal to the test microphone; the microphone was then removed from the power source and replaced with a Leeds and Northrup No. 4755 ac/dc decade resistance substitution box. The resistance was then adjusted to match the voltage measured across the microphone terminals. The microphone impedance was then read from the substitution box.

The far field tests were conducted in an anechoic chamber with the microphone separated from the sound source by 6 ft. The reference sound pressure level was monitored as described in the previous section with a one-inch B&K condensor microphone. The sound pressure level was maintained at a constant 110 dB at the test microphone.

3.2 GROUND LEVEL M-87 TEST DATA

All of the test data of this section was obtained at sea level ambient atmospheric pressure.

3.2.1 M-87 Frequency Response Test Data

The M-87 frequency response graphs were prepared in accordance with Mil-M-26542A with the response in decibels referred to the 1000 Hz response. An average response graph was prepared for each of the four vendors and are included in this section. The individual microphone response graphs may be found in appendix A.

RESPONSE FREQUENCY CHARACTERISTIC TO A CLOSE SOUND SOURCE

TABLE I. – CARTER M-87 GROUND LEVEL FREQUENCY RESPONSE

INPUT: 110 dB SPL

FREQUENCY	OUTPUT LEVEL (µV)											
200	45	45	40	31	36	41	38	37	36	46	48.4	4.0
300	60	64	53	39	47	58	54	55	38	62	53	9.1
400	98	98	84	64	77	89	80	82	78	100	85	11.4
600	120	113	100	94	100	130	109	115	135	90	110.6	14.9
800	118	92	82	75	78	105	105	92	115	82	94.7	15.3
1000	98	84	76	98	76	98	90	94	80	97	89.1	9.3
2000	96	96	100	86	96	106	98	105	95	134	101	12.8
3000	220	240	225	235	220	270	195	220	280	270	237	27.5
4000	95	82	86	84	84	84	90	103	78	98	88.4	7.9
5000	74	65	57	62	58	62	58	59	58	71	62.4	5.9
6000	72	64	70	55	61	52	65	71	65	60	63.5	6.7
MICROPHONE SERIAL NUMBER	41	42	43	44	45	46	47	48	49	50	AVE	σ

MANUFACTURER: Carter Engineering CE/87/AIC

RESPONSE FREQUENCY CHARACTERISTIC TO A CLOSE SOUND SOURCE

TABLE II. – ASTROCOM M-87 GROUND LEVEL FREQUENCY RESPONSE

INPUT: 110 dB SPL

FREQUENCY	OUTPUT LEVEL (µV)											
200	38	---	34	34	---	---	---	32	36	32	34.3	2.3
300	55	32	43	40	38	34	38	45	46	47	41.8	6.8
400	83	54	72	70	55	58	57	69	80	72	67	10.4
600	110	84	119	115	124	100	127	125	120	112	113	13.2
800	89	78	93	94	127	78	130	100	95	83	96.7	18.3
1000	89	86	75	82	92	78	93	83	96	74	84.8	7.7
2000	84	92	87	88	104	81	110	78	86	100	91	10.4
3000	200	235	210	260	240	230	220	168	215	240	222	25.7
4000	82	78	82	78	80	65	79	73	110	76	80.3	11.6
5000	61	60	62	55	61	47	60	56	79	64	60.5	8.1
6000	53	49	74	58	55	58	57	72	84	60	62	10.9
MICROPHONE SERIAL NUMBER	31	32	33	34	35	36	37	38	39	40	AVE	σ

MANUFACTURER: Astrocom M-87/AIC

RESPONSE FREQUENCY CHARACTERISTIC TO A CLOSE SOUND SOURCE

TABLE III. – ELECTROVOICE M-87 GROUND LEVEL FREQUENCY RESPONSE

INPUT: 110 dB SPL

FREQUENCY	OUTPUT LEVEL (μV)											
200	30	35	34	35	32	37	---	---	30	30	32.8	2.7
300	37	47	43	36	36	48	37	35	43	42	40.4	4.8
400	66	76	70	59	56	78	60	56	68	66	65.5	7.8
600	111	120	105	94	114	135	92	100	110	105	109	13
800	94	88	82	78	106	105	76	80	92	84	88.5	10.6
1000	88	69	86	82	98	94	64	76	85	82	82.4	10.5
2000	74	111	91	82	57	108	74	60	68	76	80.1	18.3
3000	190	220	235	220	257	205	150	200	175	195	205	30.4
4000	96	86	80	69	78	82	92	78	84	52	63.7	33.7
5000	65	63	66	51	58	57	58	52	66	50	58.6	6.2
6000	65	59	46	58	57	60	63	53	57	47	51.5	16.8
MICROPHONE SERIAL NUMBER	51	52	53	54	55	56	57	58	59	60	AVE	σ

MANUFACTURER: Electrovoice M-87/AIC

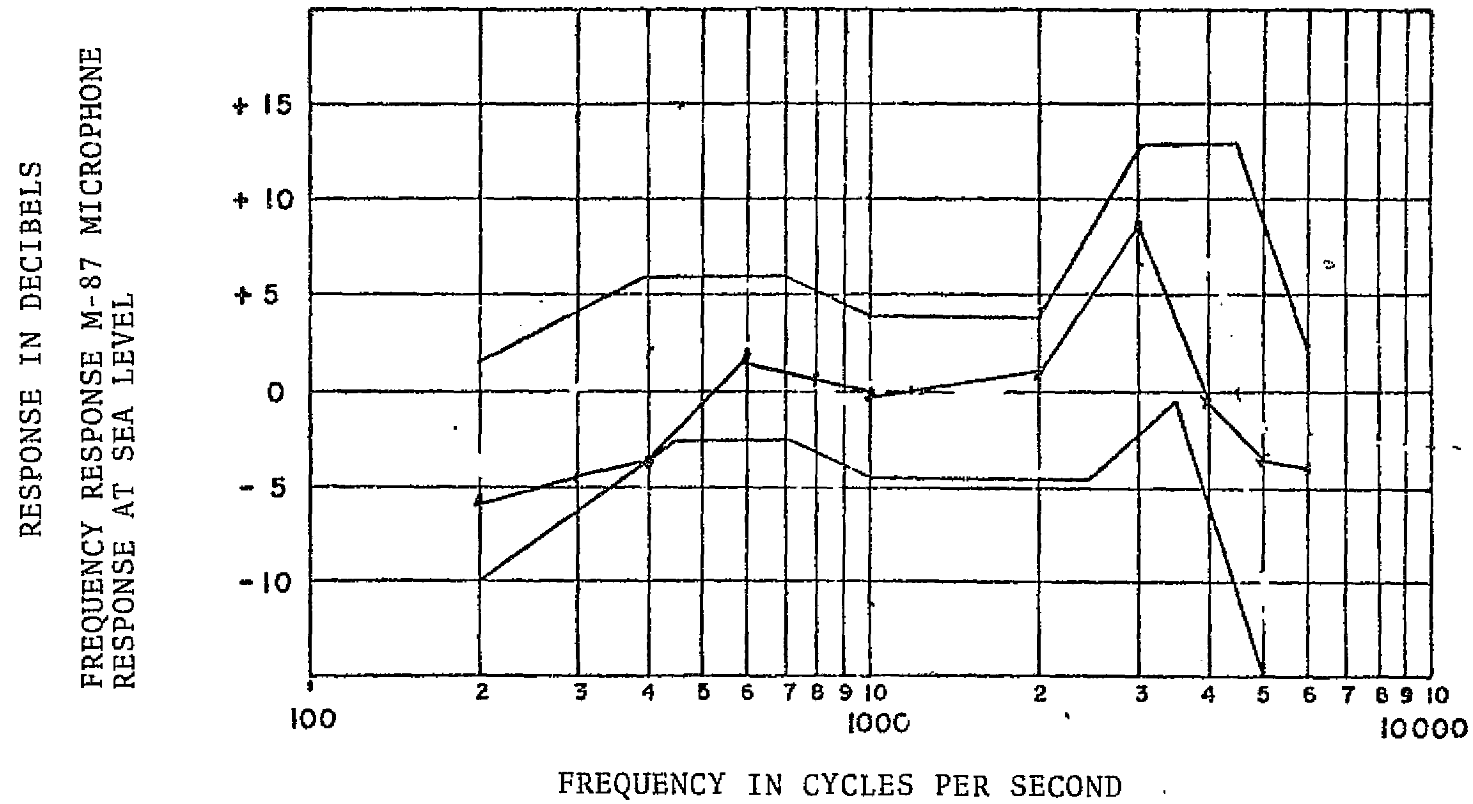
RESPONSE FREQUENCY CHARACTERISTIC TO A CLOSE SOUND SOURCE

TABLE IV. — ROANWELL M-87 GROUND LEVEL FREQUENCY RESPONSE

INPUT: 110 dB SPL Close Atm.

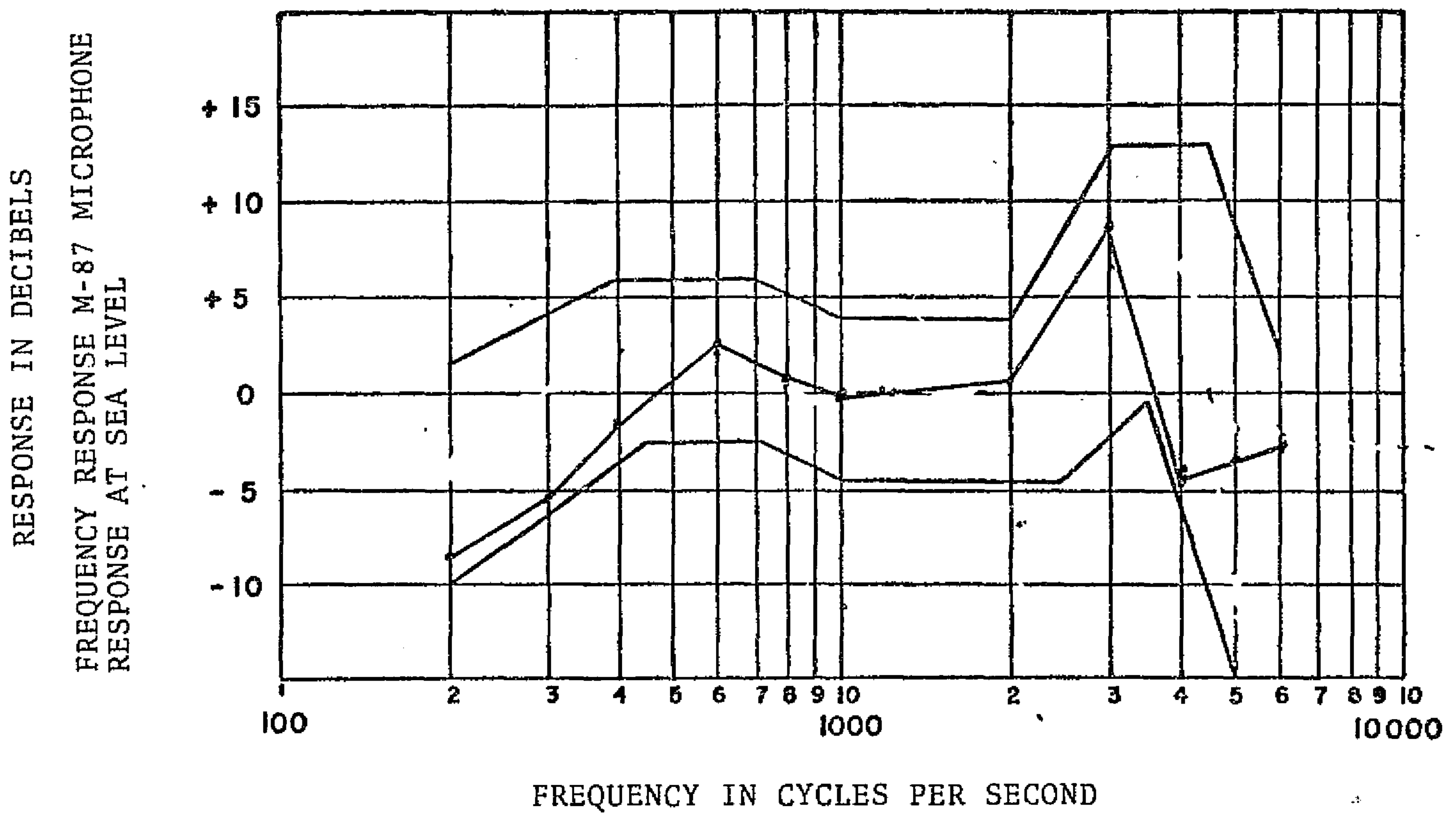
FREQUENCY	OUTPUT LEVEL (μV)											
200	37	42	40	30	48	43	45	N/R	33	33	39	6
300	49	56	52	37	64	60	63	35	46	45	51	10.2
400	67	76	72	51	82	80	90	57	64	64	70	12
600	69	78	82	50	86	88	98	92	76	73	79	14
800	65	68	86	42	80	86	78	94	80	66	75	15
1000	47	64	83	38	74	84	47	84	76	56	65	17
2000	58	73	84	55	78	78	66	80	35	36	64	18
3000	140	195	170	145	200	155	270	85	135	142	164	50
4000	290	320	265	270	370	380	285	N/R	320	270	307	43
5000	55	68	56	50	70	90	54	49	58	86	63.6	14.6
6000	N/R	30	N/R	N/R	32	42	N/R	N/R	N/N	36	35	5.3
MICROPHONE SERIAL NUMBER	1	2	3	4	5	6	7	8	9	10	AVE	σ

MANUFACTURER: Roanwell M-87/AIC



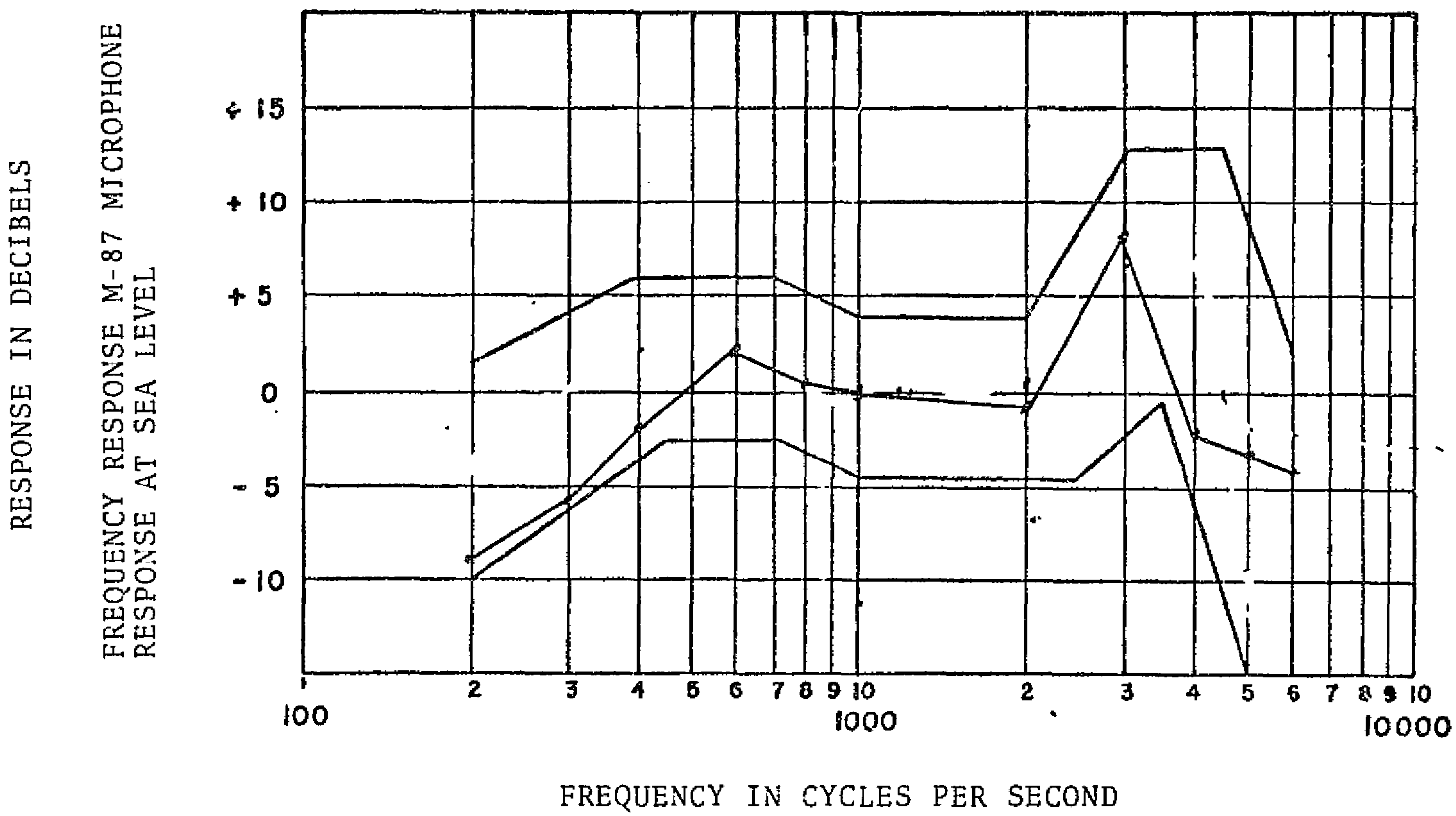
Dip is allowed; within the 1100 to 1700 CPS Range to extend below the limits of the envelope. The portion of the dip which occurs outside of the envelope may be no greater than 150 CPS wide.

Figure 3-1. — Carter M-87 ground level average frequency response.



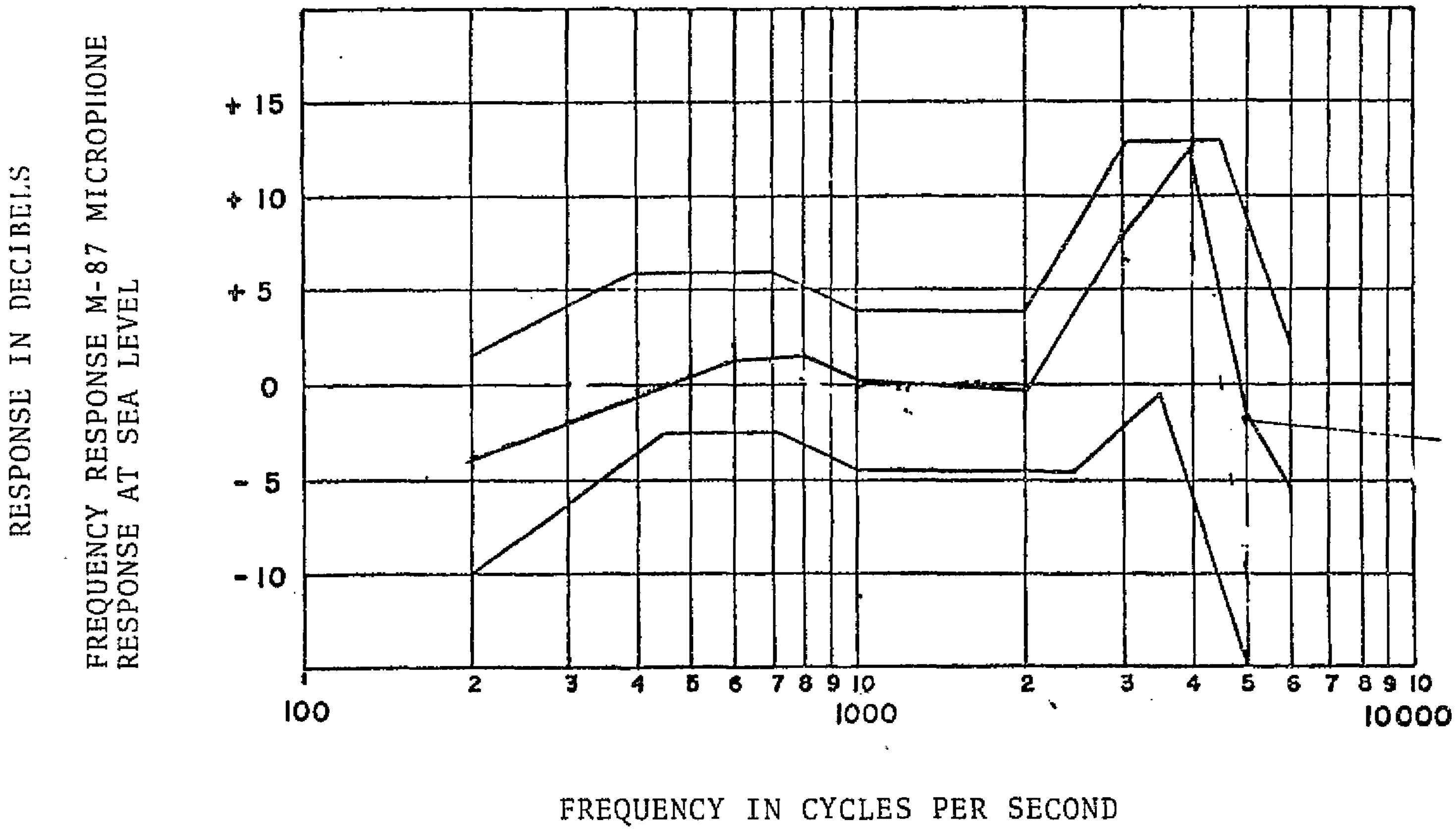
Dip is allowed; within the 1100 to 1700 CPS Range to extend below the limits of the envelope. The portion of the dip which occurs outside of the envelope may be no greater than 150 CPS wide.

Figure 3-2. — Astrocom M-87 ground level average frequency response.



Dip is allowed; within the 1100 to 1700 CPS Range
to extend below the limits of the envelope.
The portion of the dip which occurs outside of
the envelope may be no greater than 150 CPS wide.

Figure 3-3. — Electrovoice M-87 ground level average frequency response.



Dip is allowed; within the 1100 to 1700 CPS Range
to extend below the limits of the envelope.
The portion of the dip which occurs outside of
the envelope may be no greater than 150 CPS wide.

Figure 3-4. — Roanwell M-87 ground level average frequency response.

3.2.2 M-87/AIC Linearity

The average linearity for each vendor was graphed (figures 3-5, 3-6, 3-7, 3-8) with the microphone output expressed in decibels referred to the microphone output when a 105 dB SPL sine wave is input to the microphone.

TABLE V. — CARTER ENGINEERING CO. M-87 GROUND LEVEL LINEARITY

MICROPHONE SERIAL NUMBER	SPL	105 dB					110 dB					115 dB					124 dB				
	FREQ	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000
41		---	60	54	54	53	45	118	98	96	95	100	185	170	175	165	---	520	480	500	460
42		---	50	46	52	46	45	92	84	96	82	94	160	148	165	146	---	510	440	460	400
43		---	46	41	55	48	40	82	76	100	86	75	145	130	174	155	---	340	360	450	420
44		---	41	54	48	47	31	75	98	86	84	62	133	170	150	150	---	340	450	425	450
45		---	43	42	55	46	36	78	76	96	84	72	135	135	167	148	---	340	380	470	430
46		---	58	54	60	46	41	105	98	106	85	85	180	171	190	150	---	590	520	520	440
47		---	59	50	53	51	38	105	90	94	92	74	186	158	165	160	---	580	460	440	500
48		---	54	50	60	57	37	92	94	105	103	74	170	160	134	180	---	540	440	520	500
49		---	63	45	53	44	36	115	80	95	78	74	200	145	168	139	---	620	450	470	400
50		---	46	54	74	55	46	82	97	134	98	90	144	172	235	170	---	330	540	680	540
AVERAGE		---	52	49	56	49	40	94	89	101	89	80	164	156	172	156	---	471	452	494	454
STANDARD DEVIATION		---	6.8	5.1	7.1	4.4	4.8	16	9.3	1.3	7.9	11	25	16	27	12	---	119	55	73	46

All entries in μV.

TABLE VI. — ASTROCOM M-87 GROUND LEVEL LINEARITY

MICROPHONE SERIAL NUMBER	SPL	105 dB					110 dB					115 dB					124 dB				
	FREQ	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000
31		---	50	47	46	46	38	89	89	84	82	78	156	155	145	141	---	490	440	430	400
32		---	39	48	50	42	---	78	86	92	78	57	122	150	160	135	---	310	440	450	380
33		---	52	40	48	44	34	93	75	87	82	70	163	130	153	145	---	400	375	425	410
34		---	52	45	48	43	34	94	82	88	78	73	164	145	150	136	---	380	410	435	380
35		---	70	50	58	45	---	127	92	104	80	77	220	160	183	142	---	645	480	510	430
36		---	43	43	45	38	---	78	78	81	65	71	136	135	141	119	---	340	400	400	340
37		---	72	52	61	45	---	130	93	110	79	76	225	164	194	143	---	660	475	540	430
38		---	56	45	44	40	32	100	83	78	73	80	180	145	138	128	---	540	440	395	380
39		---	53	52	46	61	36	95	96	86	110	84	166	165	155	190	---	440	470	450	540
40		---	47	41	56	43	32	83	74	100	76	78	146	131	176	135	---	470	380	480	390
AVERAGE		---	53.4	46	50	48	34	97	85	91	80	74	167	148	159	141	---	468	431	452	408
STANDARD DEVIATION		---	11	4.3	6.0	6.2	2.3	18	7.7	10	12	7.4	33	13	19	19	---	119	38	46	53

All entries in μV.

TABLE VII. – ELECTROVOICE M-87 GROUND LEVEL LINEARITY

MICROPHONE SERIAL NUMBER / SPL	105 dB					110 dB					115 dB					124 dB				
FREQ	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000
51	---	49	47	39	52	30	94	88	74	96	72	143	140	114	165	---	450	450	355	460
52	---	49	39	60	48	35	88	69	111	86	140	135	125	185	155	---	510	360	520	460
53	---	46	47	51	44	34	82	86	91	80	62	145	150	155	140	---	380	460	450	330
54	---	44	45	45	38	35	78	82	82	69	80	135	140	142	120	---	460	440	380	310
55	---	60	54	32	43	32	106	98	57	78	64	190	160	100	140	---	470	510	300	370
56	---	57	53	60	47	37	105	94	108	82	82	180	165	190	145	---	500	490	560	420
57	---	40	35	42	51	---	76	64	74	92	60	145	110	130	160	---	430	330	360	450
58	---	44	42	35	42	---	80	76	60	78	63	141	135	116	135	---	440	390	300	390
59	---	50	48	39	46	30	92	85	68	84	89	160	145	120	150	---	490	450	345	410
60	---	48	44	43	30	30	84	82	76	52	69	150	140	134	94	---	450	410	350	270
AVERAGE	---	49	45	45	44	33	89	82	80	80	78	152	141	139	140	---	458	429	395	387
STANDARD DEVIATION	---	6	5.8	9.6	6.5	2.7	11	11	18	12	24	19	16	30	21	---	38	56	88	66

All entries in µV.

TABLE VIII. – ROANWELL M-87 GROUND LEVEL LINEARITY

MICROPHONE SERIAL NUMBER	SPL	105 dB					110 dB					115 dB					124 dB				
	FREQ	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000
1		N/R	37	N/R	33	165	36	65	49	58	300	76	112	86	100	510	TE	300	230	280	1400
2		N/R	37	37	42	185	42	66	64	73	320	72	115	111	125	550	TE	320	320	500	1500
3		N/R	49	47	48	150	39	88	82	84	265	69	150	150	150	460	TE	430	420	430	1300
4		N/R	N/R	N/R	32	152	30	42	38	55	270	52	72	68	94	470	TE	200	190	270	1500
5		N/R	46	43	44	210	48	80	74	78	370	86	140	130	138	650	TE	400	370	380	1800
6		N/R	49	49	46	215	43	86	84	78	380	76	150	147	140	660	TE	400	420	400	1825
7		N/R	44	N/R	39	165	45	78	47	66	285	80	135	82	115	480	TE	360	240	340	1450
8		N/R	54	49	46	N/R	N/R	94	84	80	N/R	52	165	150	140	36	TE	460	420	400	80
9		N/R	46	45	N/R	180	33	80	76	35	320	60	145	138	72	570	TE	390	400	260	1500
10		N/R	37	32	N/R	155	33	66	56	36	270	60	115	97	64	500	TE	320	270	180	1300
AVERAGE		---	44	43	41	175	38	75	65	64	309	68	129	115	114	489	---	358	328	344	1348
STANDARD DEVIATION		---	6	6.4	6	24	6.2	15	17	18	43	12	27	31	30	17	---	75	90	95	49

All entries in μV.

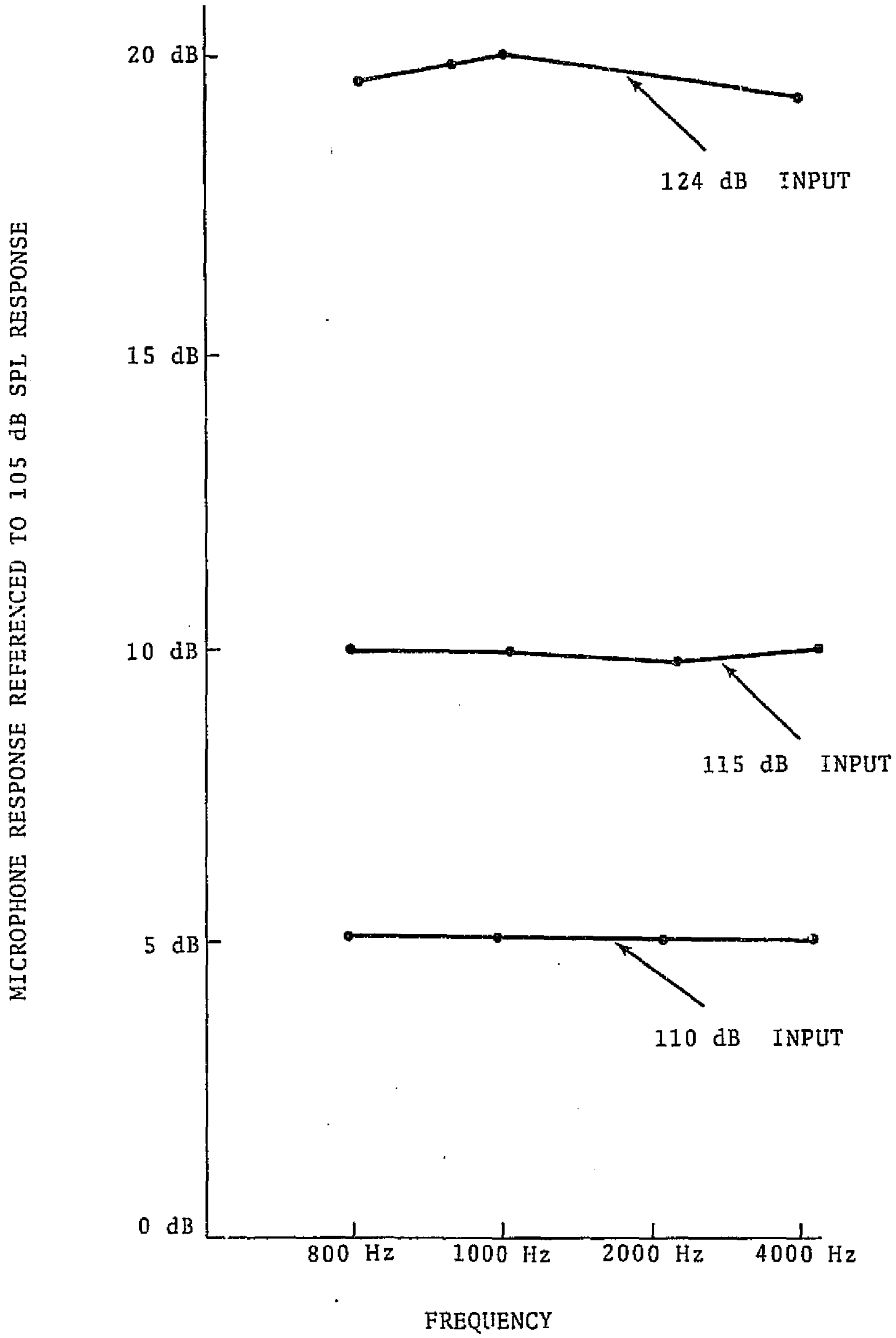


Figure 3-5. – Carter M-87 ground level linearity.

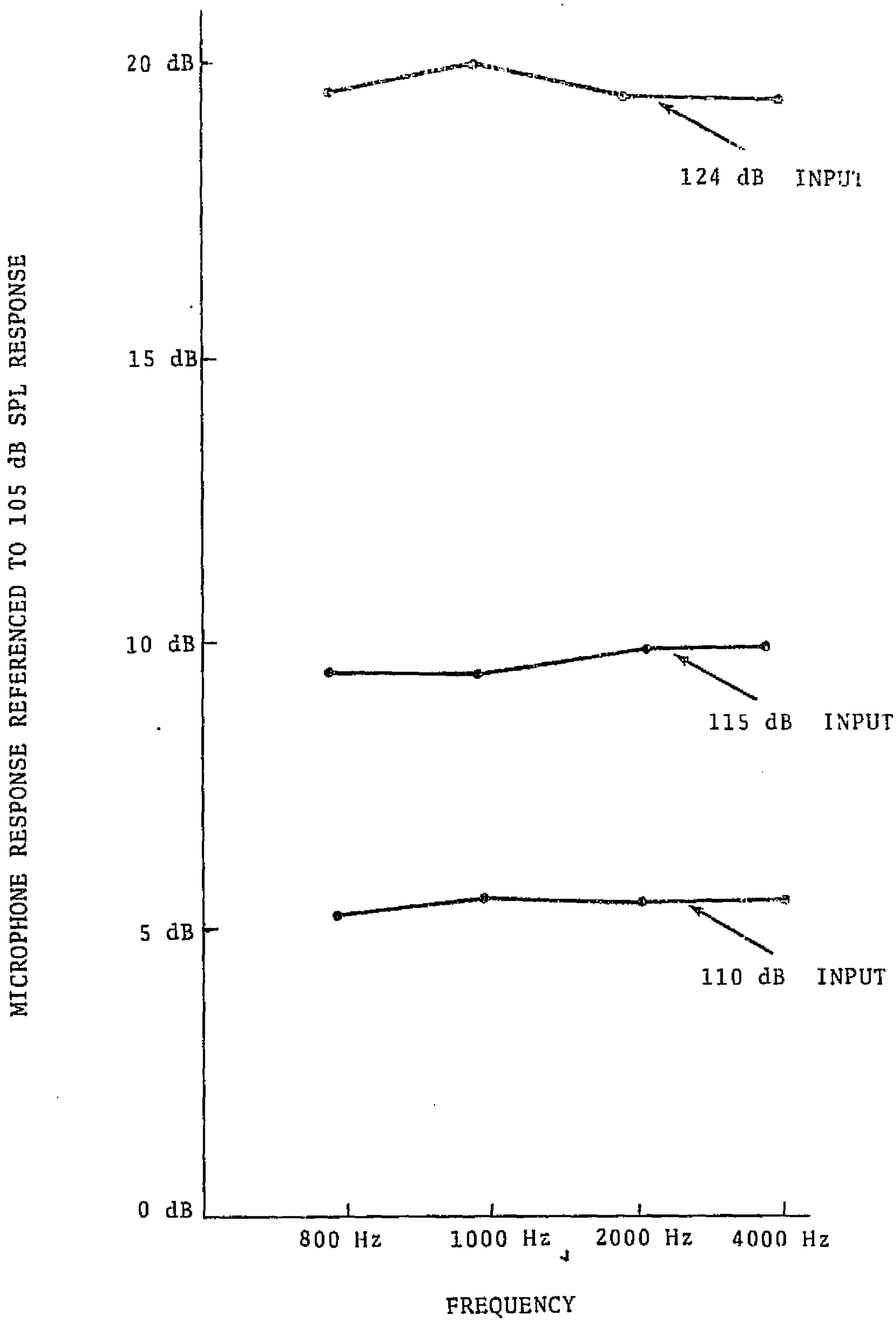


Figure 3-6. – Astrocom M-87 ground level average linearity.

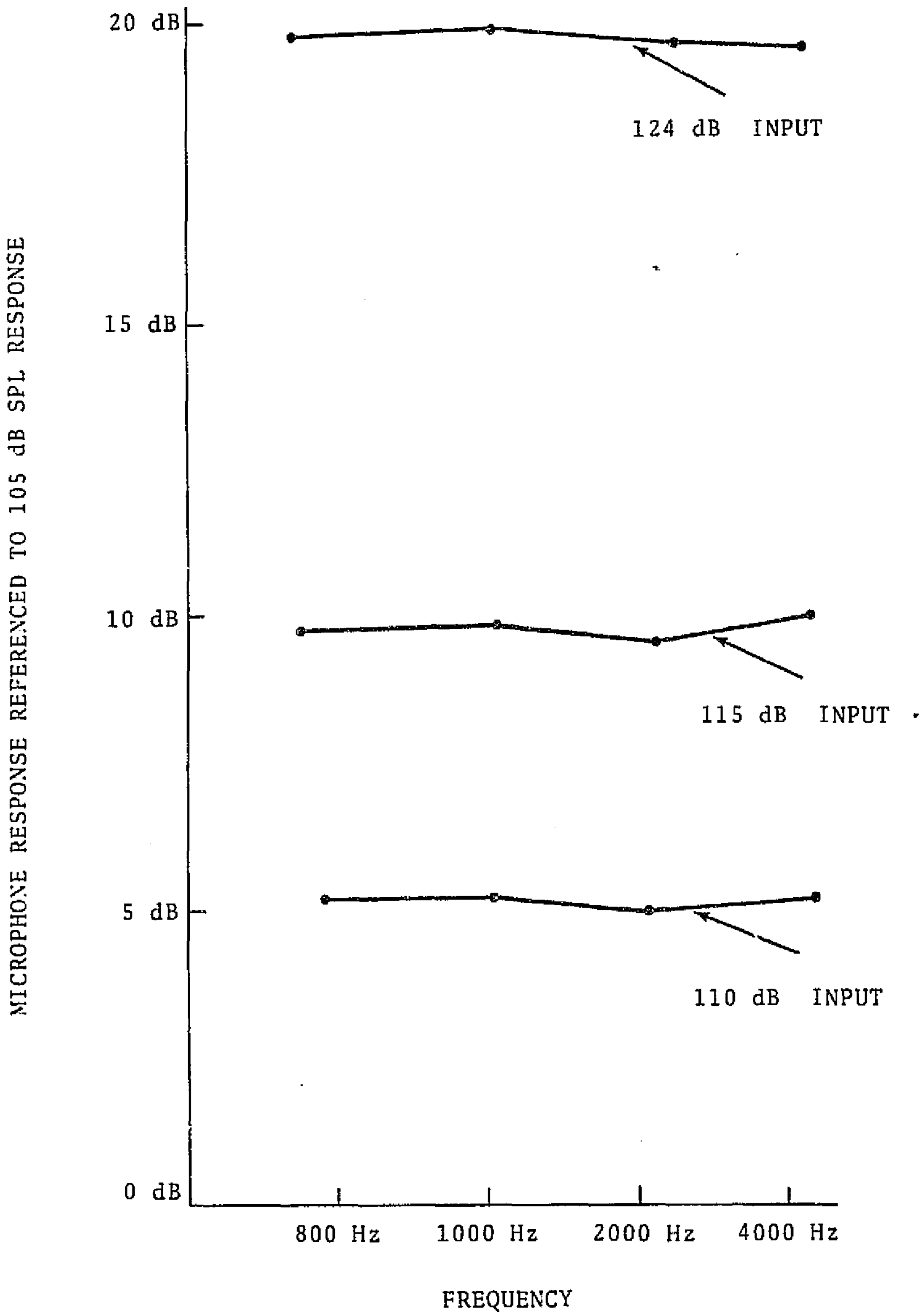


Figure 3-7. – Electrovoice M-87 ground level average linearity.

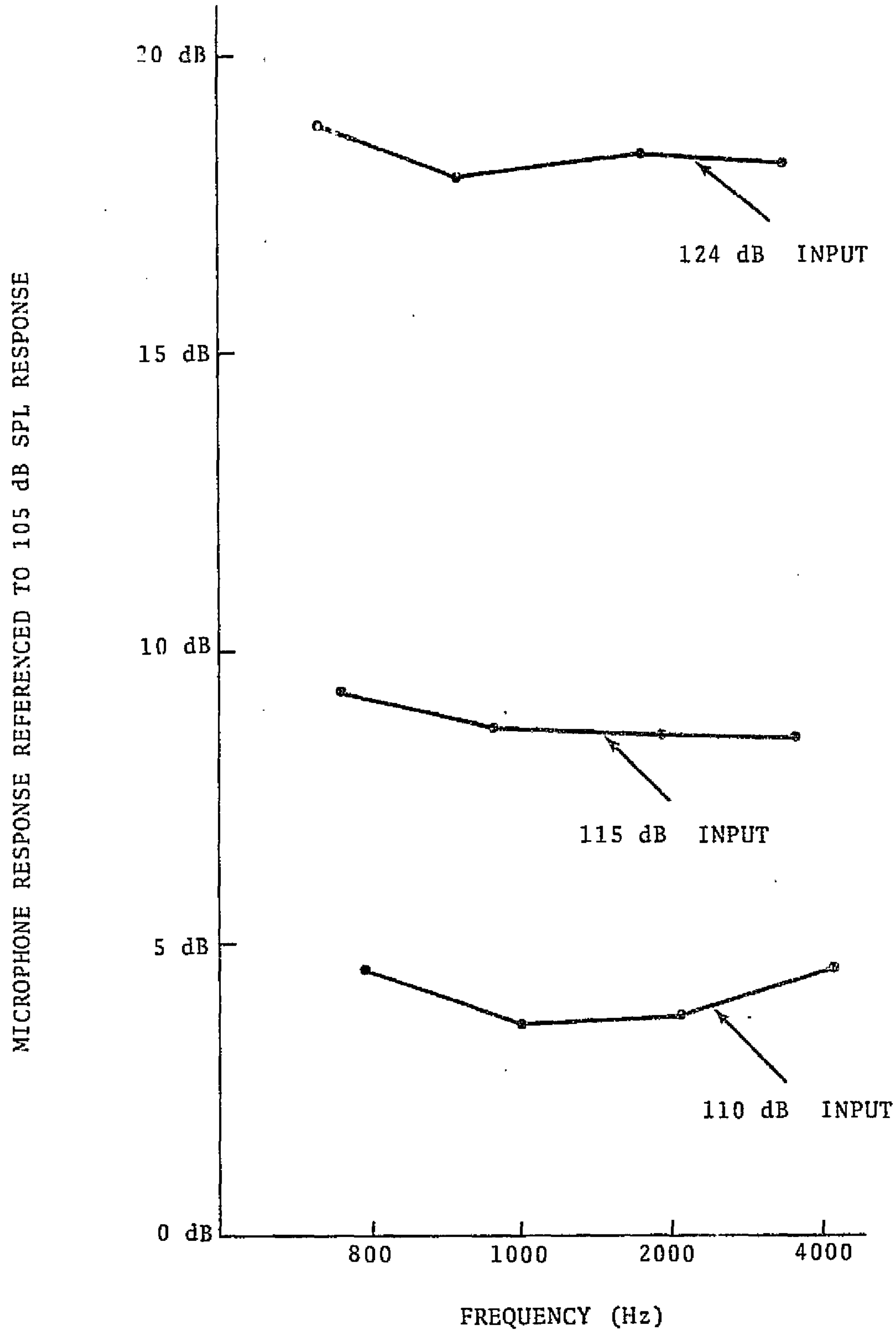


Figure 3-8. – Roanwell M-87 ground level average linearity.

3.2.3 M-87/AIC Impedance

TABLE IX. — CARTER M-87 IMPEDANCE

S/N	FREQ-HZ									PEAK FREQUENCY
	200	400	600	800	1000	2000	4000	6000	7000	
41	5.0	5.1	5.2	5.2	5.2	5.2	5.2	5.5	5.5	5.7 3250
42	5.4	5.4	5.4	5.4	5.4	5.4	5.5	5.5	5.4	5.8 3100
43	5.0	5.0	5.3	5.3	5.3	5.3	5.2	5.2	5.2	5.6 3200
44	5.1	5.1	5.1	5.1	5.2	5.1	5.2	5.2	5.3	5.6 3250
45	5.2	5.2	5.2	5.2	5.2	5.2	5.3	5.5	5.5	5.6 3300
46	5.0	5.1	5.2	5.2	5.2	5.2	5.2	5.2	5.5	5.8 3100
47	5.0	5.0	5.1	5.1	5.1	5.1	5.3	5.5	5.5	5.6 3200
48	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.4	5.4	5.7 3250
49	5.0	5.0	5.1	5.1	5.1	5.1	5.2	5.3	5.4	5.7 3100
50	5.1	5.2	5.2	5.2	5.2	5.2	5.2	5.3	5.4	5.8 3250

IMPEDANCE MEASUREMENT: Ohms.
MANUFACTURER: Carter Engineering Co.
MODEL: M-87/AIC.

TABLE X. — ASTROCOM M-87 IMPEDANCE

S/N	FREQ-HZ									PEAK FREQUENCY
	200	400	600	800	1000	2000	4000	6000	7000	
31	4.8	4.9	4.9	4.9	4.9	4.9	5.0	5.1	5.2	5.4 3100
32	4.8	4.8	4.8	4.8	4.9	4.9	5.0	5.1	5.1	5.4 3200
33	4.9	4.9	4.9	4.9	4.9	5.0	5.2	5.2	5.2	5.4 3250
34	4.8	4.8	4.8	4.8	4.8	4.8	4.9	4.9	5.0	5.3 3150
35	4.8	4.8	5.0	5.0	5.0	5.0	5.0	5.2	5.2	5.4 3150
36	4.9	5.0	5.1	5.1	5.1	5.1	5.1	5.3	5.3	5.5 3150
37	4.8	4.8	4.9	4.9	4.9	4.9	4.9	5.1	5.1	5.4 3200
38	4.9	5.0	5.3	5.3	5.3	5.3	5.2	5.3	5.3	5.5 3050
39	4.8	4.9	5.0	5.0	5.0	5.0	5.1	5.2	5.2	5.5 3300
40	4.7	4.7	4.8	4.8	4.8	4.9	4.9	5.0	5.0	5.3 3200

MANUFACTURER: Astrocom.

MODEL: M-87/AIC.

All entries in ohms.

TABLE XI. — ELECTROVOICE M-87 IMPEDANCE

S/N	FREQ-HZ									PEAK FREQUENCY	
	200	400	600	800	1000	2000	4000	6000	7000		
51	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.2	5.2	5.3	3200
52	4.9	4.9	5.0	5.0	5.0	5.0	5.1	5.2	5.2	5.4	3250
53	5.3	5.3	5.4	5.4	5.4	5.4	5.4	5.7	5.7	6.0	3100
54	4.9	4.9	5.0	5.0	5.0	5.0	5.0	5.1	5.1	5.4	3100
55	5.1	5.1	5.3	5.3	5.3	5.3	5.4	5.5	5.5	5.7	3050
56	5.2	5.2	5.4	5.4	5.4	5.4	5.5	5.7	5.8	5.8	3150
57	4.9	4.9	5.0	5.0	5.0	5.0	5.1	5.3	5.3	5.5	3300
58	4.9	4.9	5.0	5.0	5.0	5.0	5.1	5.1	5.2	5.4	3100
59	4.9	5.0	5.0	5.0	5.0	5.0	5.1	5.2	5.3	5.3	3300
60	5.0	5.0	5.0	5.0	5.0	5.0	5.1	5.2	5.3	5.4	3000

MANUFACTURER: Electrovoice.
MODEL: M-87/AIC.
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All entries in ohms.

TABLE XII. — ROANWELL M-87 IMPEDANCE

S/N	FREQ-HZ									PEAK FREQUENCY
	200	400	600	800	1000	2000	4000	6000	7000	
1	3.2	3.2	3.2	3.2	3.2	3.3	4.0	3.5	3.6	4.0 4000
2	3.0	3.1	3.1	3.1	3.1	3.2	3.6	3.4	3.5	3.8 3700
3	3.0	3.0	3.1	3.1	3.1	3.2	3.5	3.4	3.5	3.8 3650
4	3.3	3.3	3.3	3.3	3.3	3.3	3.8	3.5	3.6	4.0 3700
5	3.1	3.2	3.2	3.2	3.2	3.3	3.9	3.5	3.6	3.9 3800
6	3.1	3.2	3.2	3.2	3.2	3.3	3.8	3.5	3.6	3.8 4000
7	3.0	3.1	3.1	3.1	3.1	3.2	3.6	3.4	3.4	3.8 3200
8	2.9	3.0	3.1	3.1	3.1	3.2	3.2	3.4	3.5	4.1 4600
9	3.1	3.1	3.2	3.2	3.2	3.3	3.9	3.5	3.6	3.9 4000
10	3.2	3.2	3.2	3.2	3.2	3.2	3.8	3.4	3.6	4.0 4250

MANUFACTURER: Roanwell.

MODEL: M-87/AIC.

All entries in ohms.

3.3 M-87 25,000 FT SIMULATED ALTITUDE TEST DATA

3.3.1 Frequency Response

The frequency response averages for each vendor was graphed in accordance with Mil-M-26542A. The response in decibels was referred to the 1000 Hz ground level microphone output.

RESPONSE FREQUENCY CHARACTERISTIC TO A CLOSE SOUND SOURCE

TABLE XIII. – CARTER M-87 FREQUENCY RESPONSE AT 25,000 FT

INPUT: 110 dB SPL - 25,000 ft

FREQUENCY	OUTPUT LEVEL (μV)											
200	72	62	51	42	55	76	55	50	48	59	57	11
300	45	49	38	31	40	43	40	37	36	46	41	5.4
400	52	62	47	32	54	50	47	46	41	56	49	8.3
600	95	105	80	56	90	88	76	78	74	95	84	14
800	150	155	125	100	133	145	120	128	125	142	132	17
1000	185	165	145	135	146	170	140	150	150	160	155	15
2000	280	255	210	220	225	250	205	225	250	260	238	24.4
3000	110	120	115	115	112	135	125	137	121	140	123	10.9
4000	72	61	56	58	50	52	64	67	67	75	62.2	8.3
5000	62	63	43	46	50	50	42	49	50	50	50.5	7.0
6000	50	47	64	47	45	79	57	74	60	61	58	11.6
MICROPHONE SERIAL NUMBER	41	42	43	44	45	46	47	48	49	50	AVE	σ

MANUFACTURER: Carter Engineering Co. M-87/AIC

RESPONSE FREQUENCY CHARACTERISTIC TO A CLOSE SOUND SOURCE

TABLE XIV. – ASTROCOM M-87 FREQUENCY RESPONSE AT 25,000 FT

INPUT: 110 dB SPL - 25,000 ft

FREQUENCY	OUTPUT LEVEL (μV)											
200	56	50	49	56	53	50	42	49	54	53	51	4.2
300	38	35	34	43	40	37	34	40	42	39	38	4.8
400	44	38	44	50	45	41	36	43	46	47	43	4.2
600	78	60	84	78	74	64	58	66	66	70	70	8.5
800	120	100	130	120	125	104	100	108	105	110	112	11
1000	141	145	150	145	160	135	130	120	130	130	139	12
2000	200	260	195	240	210	200	215	200	251	219	219	23
3000	107	98	110	126	126	107	133	66	120	117	111	19
4000	76	68	58	58	52	58	58	50	64	63	61	7.6
5000	57	64	50	51	54	52	42	62	75	56	56	10.9
6000	37	36	43	35	49	54	55	51	46	52	46	7.6
MICROPHONE SERIAL NUMBER	31	32	33	34	35	36	37	38	39	40	AVE	σ

MANUFACTURER: M-87-AIC-Astrocom

RESPONSE FREQUENCY CHARACTERISTIC TO A CLOSE SOUND SOURCE

TABLE XV. — ELECTROVOICE M-87 FREQUENCY RESPONSE AT 25,000 FT

INPUT: 110 dB SPL 25,000 ft

FREQUENCY	OUTPUT LEVEL (μV)										
200	52	56	55	61	56	56	49	47	49	48	49	13
300	38	43	42	47	40	43	35	31	38	33	39	5.0
400	41	48	50	53	42	45	44	38	42	42	45	4.6
600	62	75	73	85	64	74	67	54	62	63	68	8.9
800	103	117	109	131	107	120	101	87	100	97	107	13
1000	130	135	125	150	143	150	125	106	120	113	110	52
2000	215	230	214	209	248	258	218	210	201	218	222	18
3000	84	96	107	92	76	103	110	70	90	87	92	13
4000	62	66	80	60	82	62	66	61	70	50	59	23
5000	64	59	68	57	79	47	53	57	40	44	57	12
6000	38	31	34	33	45	41	37	/	/	40	37	46
MICROPHONE SERIAL NUMBER	51	52	53	54	55	56	57	58	59	60	AVE	σ

MANUFACTURER: M-87/AIC - Electrovoice

RESPONSE FREQUENCY CHARACTERISTIC TO A CLOSE SOUND SOURCE

TABLE XVI. — ROANWELL M-87 FREQUENCY RESPONSE AT 25,000 FT

INPUT: 110 dB SPL @ 25,000 ft

FREQUENCY	OUTPUT LEVEL (μV)											
200	33	48	52	30	58	55	43	46	44	35	44	9.4
300	35	36	46	30	51	45	40	33	37	33	39	6.7
400	44	54	60	36	61	57	54	42	45	40	49	8.9
600	45	64	78	38	75	74	64	57	56	43	59	14
800	49	76	95	49	80	98	82	86	76	55	75	18
1000	34	74	103	38	92	104	60	90	82	49	73	26
2000	60	135	130	N/R	115	137	76	160	30	36	98	4.8
3000	70	165	165	170	190	160	145	72	120	200	146	45
4000	72	92	95	105	90	110	105	N/R	145	75	99	22
5000	30	31	38	N/R	40	42	40	43	46	40	39	5.3
6000	37	33	N/R	N/R	40	35	N/R	N/R	30	35	35	3.4
MICROPHONE SERIAL NUMBER	1	2	3	4	5	6	7	8	9	10	AVE	σ

MANUFACTURER: Roanwell M-87/AIC

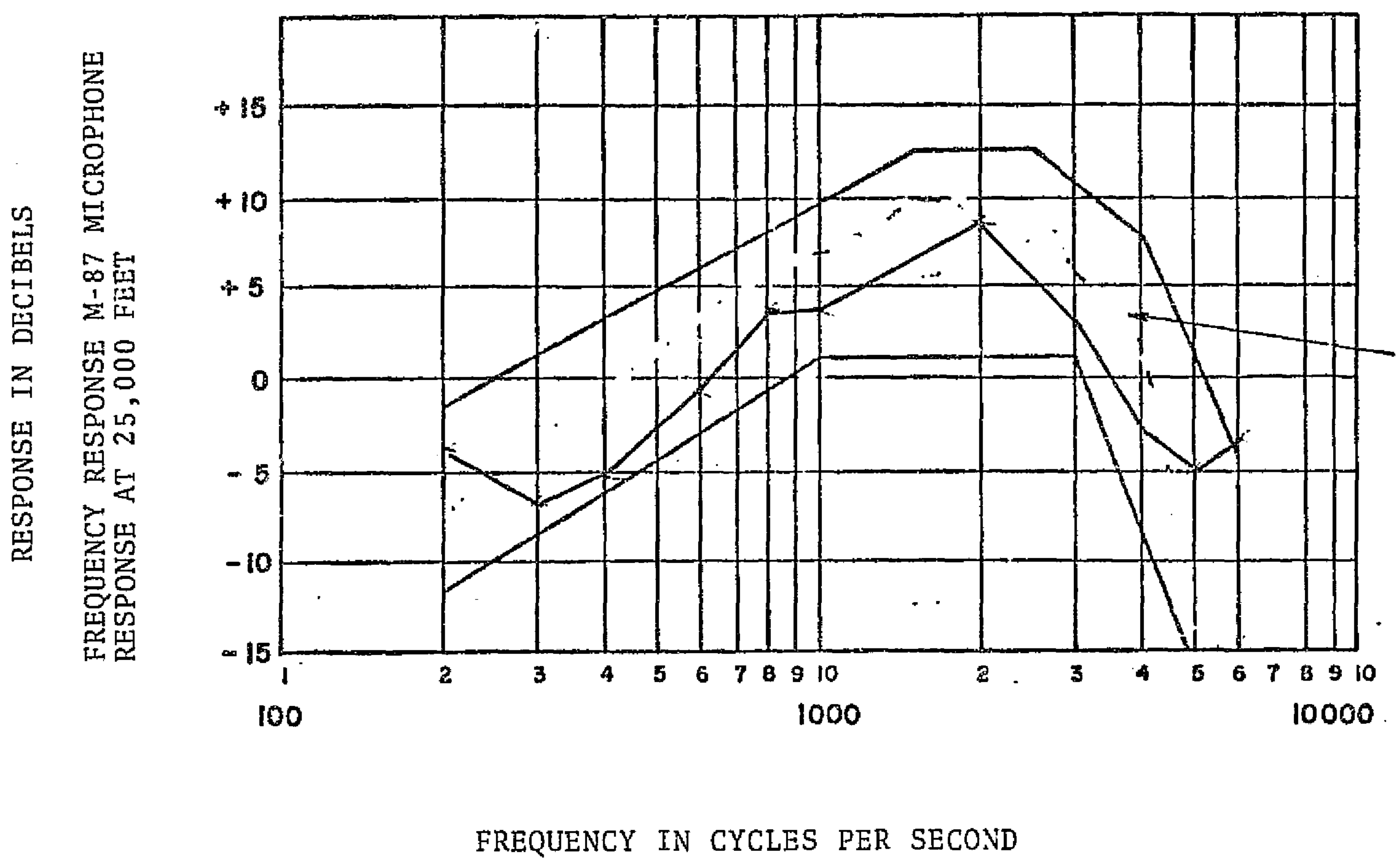


Figure 3-9. – Carter M-87 average frequency response at 25,000 ft.

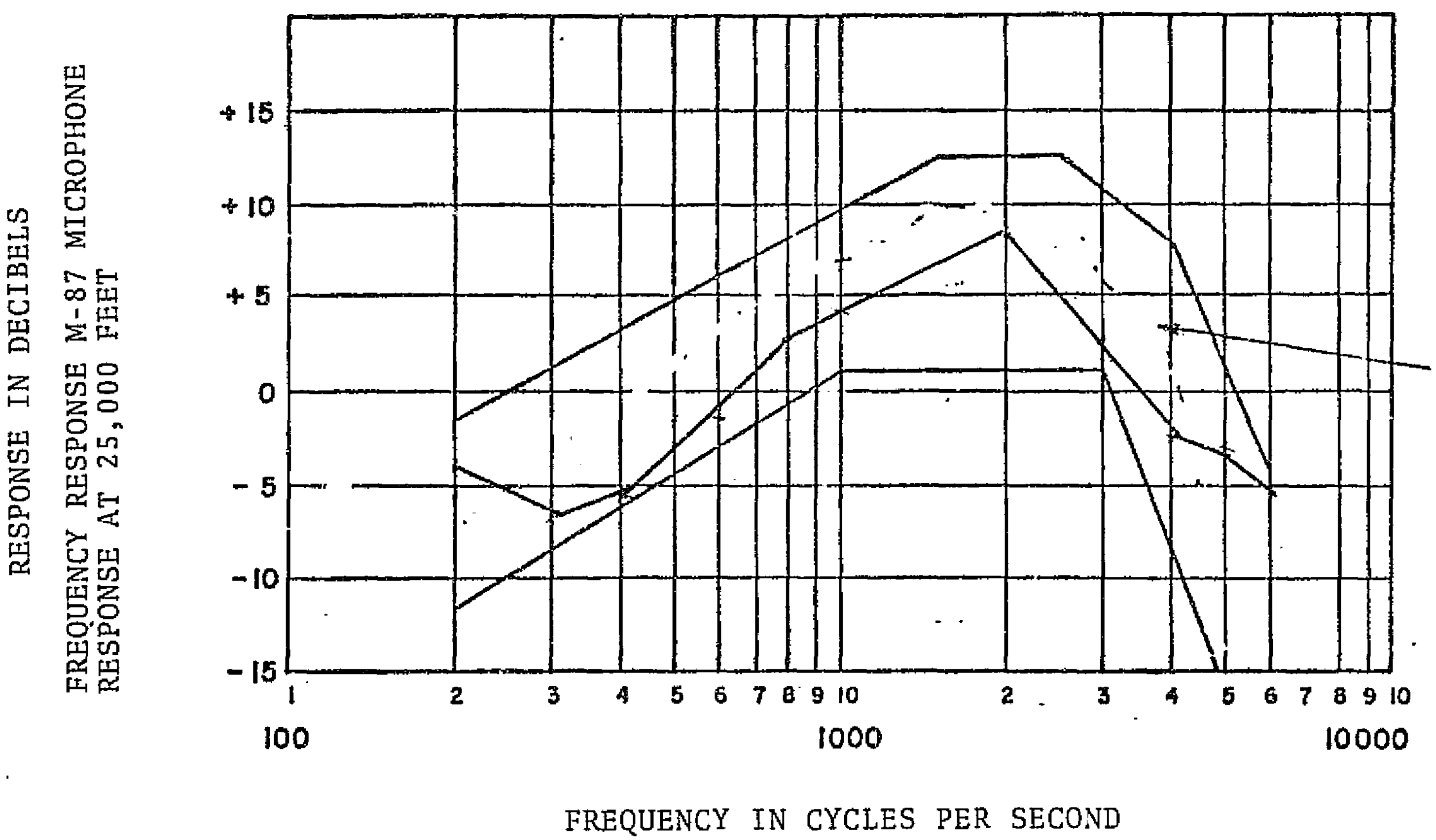


Figure 3-10. — Astrocom M-87 average frequency response at 25,000 ft.

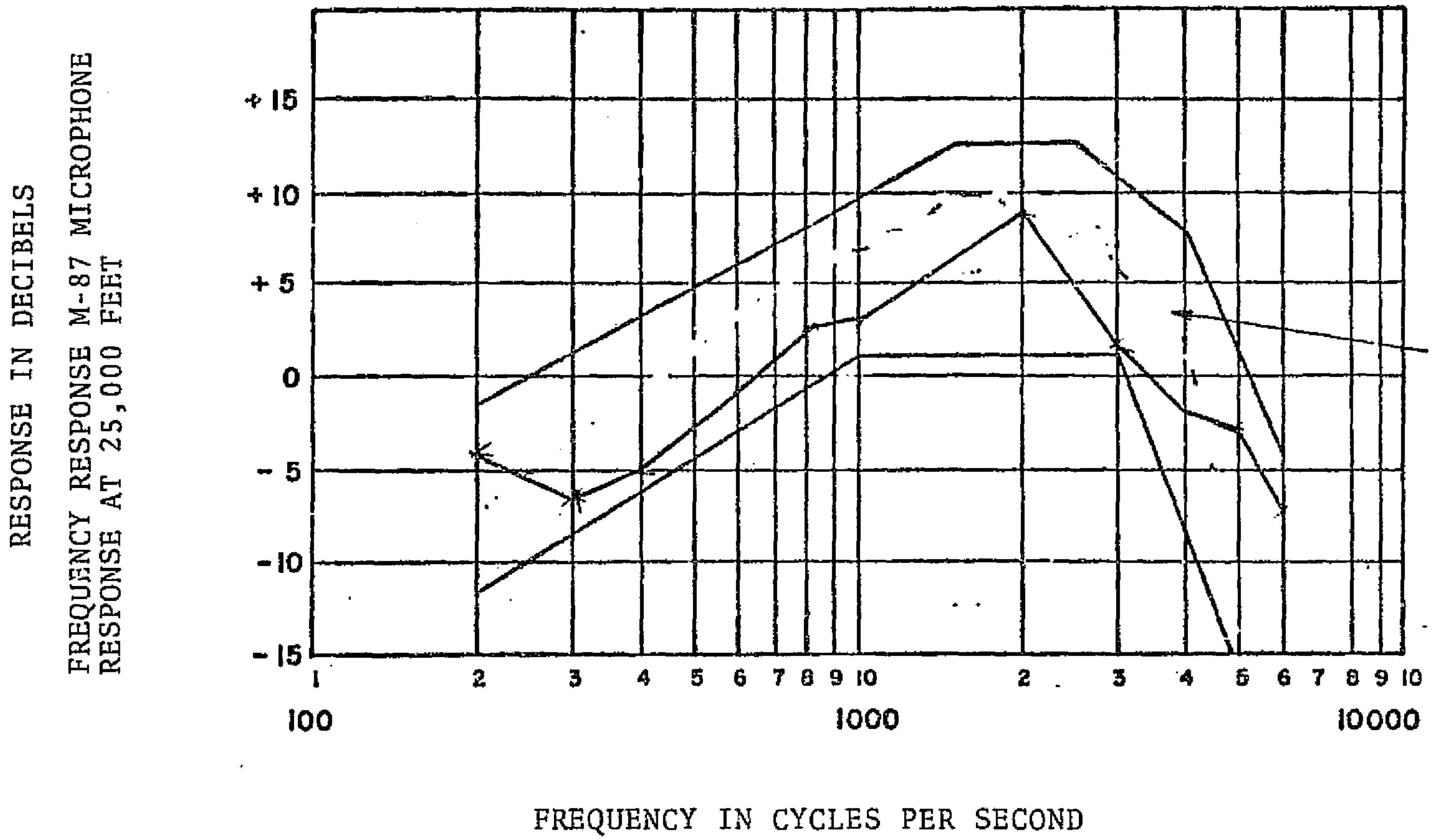


Figure 3-11. — Electrovoice M-87 average frequency response at 25,000 ft.

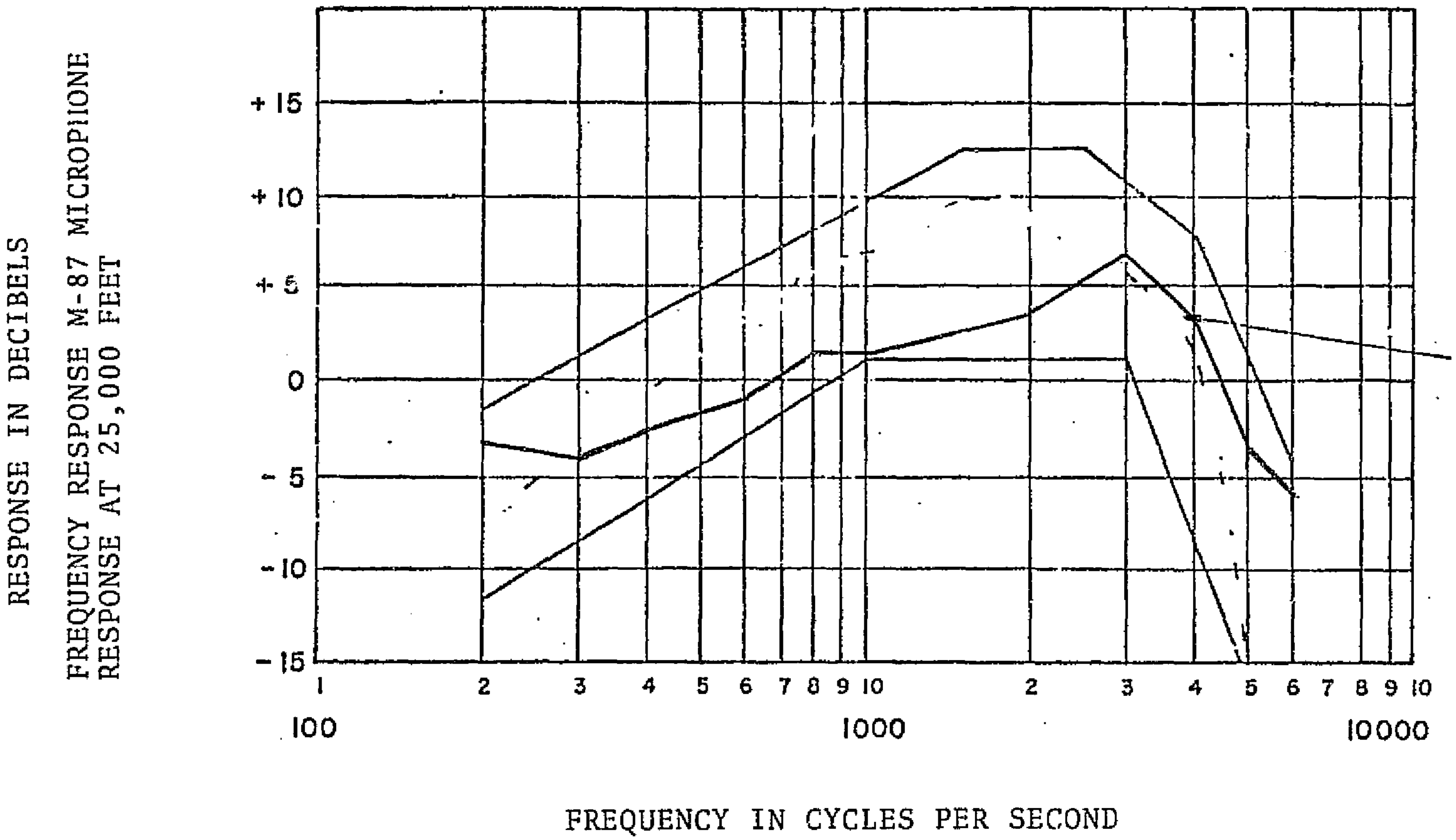


Figure 3-12. — Roanwell M-87 average frequency response at 25,000 ft.

3.3.2 Linearity At 25,000 Ft

The M-87 linearity was averaged and graphed for each vendor as described in section 3.2.2.

TABLE XVII. – CARTER M-87 LINEARITY AT 25,000 FT

MICROPHONE SERIAL NUMBER	SPL	105 dB					110 dB					115 dB					124 dB				
	FREQ	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000
41		36	90	110	140	44	72	150	185	280	72	150	265	320	430	93	---	660	860	1200	---
42		31	88	98	150	37	62	155	165	255	61	145	265	290	450	105	---	720	790	1250	---
43		30	72	85	121	35	51	125	145	210	56	120	218	250	380	92	---	600	700	1050	---
44		---	58	80	125	35	42	100	135	220	58	100	171	235	380	88	---	540	650	1070	---
45		30	76	85	125	30	55	133	146	225	45	135	232	259	400	86	---	660	710	1110	---
46		35	82	100	145	36	76	145	170	250	52	145	250	300	450	85	---	670	820	1250	---
47		40	70	83	125	44	55	120	140	205	64	125	210	241	365	100	---	580	670	1020	---
48		---	72	86	130	39	50	128	150	225	67	130	235	270	400	102	---	660	740	1100	---
49		---	72	88	145	38	48	125	150	250	67	125	215	262	450	90	---	590	700	1250	---
50		31	82	92	150	47	59	142	160	260	75	145	250	280	470	94	---	700	780	1300	---
AVERAGE		33	76	90.7	136	38.5	57	132	155	238	62	132	231	271	418	94	---	638	742	1160	---
STANDARD DEVIATION		3.8	9.5	9.3	12	5.1	11	16	15	24	9.2	15	29	27	37	6.8	---	58	68	101	---

All entries in μV.

TABLE XVIII. — ASTROCOM M-87 LINEARITY 25,000 FT

MICROPHONE SERIAL NUMBER	105 dB					110 dB					115 dB					124 dB				
SPL / FREQ	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000
31	---	70	82	102	47	56	120	141	200	76	125	210	249	330	124	---	580	650	940	---
32	---	58	84	145	37	50	100	145	260	68	115	175	255	460	96	---	600	700	1250	---
33	---	74	86	113	33	49	130	150	195	58	130	225	260	340	96	---	560	700	950	---
34	---	68	82	139	33	56	120	145	240	58	120	210	250	435	100	---	580	660	1175	---
35	---	72	92	120	30	53	125	160	210	52	115	215	278	375	92	---	570	730	1050	---
36	---	59	78	115	34	50	104	135	200	58	100	180	232	350	98	---	520	650	960	---
37	---	60	76	125	44	42	100	150	215	58	100	170	225	375	101	---	540	600	1050	---
38	---	63	70	115	33	49	108	120	200	50	110	187	210	360	80	---	500	560	940	---
39	---	61	75	140	42	54	105	130	251	64	110	180	228	440	90	---	570	625	1250	---
40	---	64	78	125	41	53	110	130	219	63	105	180	225	390	84	---	510	610	1050	---
AVERAGE	---	65	80	124	37	51	112	139	219	61	113	193	241	386	96	---	552	648	1062	---
STANDARD DEVIATION	---	5.7	6.3	14	5.7	4.2	11	12	23	7.6	10	20	21	45	12	---	33	52	123	---

All entries in μV.

TABLE XIX. – ELECTROVOICE M-87 LINEARITY 25,000 FT

MICROPHONE SERIAL NUMBER	SPL	105 dB					110 dB					115 dB					124 dB				
	FREQ	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000
51		---	60	75	175	37	52	103	130	215	62	100	179	222	390	105	---	500	620	1100	---
52		30	68	79	132	39	56	117	135	230	66	126	200	235	400	102	---	520	640	1100	---
53		33	62	72	120	48	55	109	125	214	80	116	190	210	375	102	---	620	700	1140	---
54		32	75	86	120	35	61	131	150	209	60	125	230	260	360	100	---	600	700	960	--
55		31	62	84	141	50	56	107	143	248	78	115	190	250	440	100	---	580	690	1220	---
56		31	70	86	145	37	56	120	150	258	62	120	210	260	450	114	---	600	720	1250	---
57		---	58	72	124	38	49	101	125	218	66	108	175	218	380	115	---	480	600	1090	---
58		---	50	62	120	36	47	87	106	210	61	96	150	187	370	100	---	470	520	1040	---
59		---	59	70	115	40	49	100	120	201	70	104	172	210	370	120	---	540	580	1000	---
60		---	56	66	123	32	48	97	113	218	50	105	165	195	385	88	---	480	540	1080	---
AVERAGE		31	62	75	125	36	53	107	130	222	66	111	186	225	392	104	---	489	631	1100	---
STANDARD DEVIATION		1.1	7.3	8.3	10	12	4.5	13	15	18	8.8	10	23	26	30	9.3	---	17	71	89	---

All entries in μV.

TABLE XX. — ROANWELL M-87 LINEARITY AT 25,000 FT

MICROPHONE SERIAL NUMBER	SPL	105 dB					110 dB					115 dB					124 dB				
	FREQ	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000
1		N/R	49	N/R	35	39	33	49	34	60	72	62	86	59	86	125	TE	240	165	235	TE
2		N/R	42	43	79	52	48	76	74	135	92	86	135	130	230	165	TE	380	360	660	TE
3		N/R	54	58	74	56	52	95	103	130	95	106	165	180	230	165	TE	470	500	660	TE
4		N/R	30	N/R	N/R	66	30	49	38	N/R	98	55	86	63	N/R	TE	TE	235	180	72	TE
5		30	47	54	60	49	58	80	92	115	90	100	132	160	208	150	TE	410	450	560	TE
6		30	56	60	76	64	55	98	104	137	110	105	167	183	230	190	TE	470	520	615	TE
7		N/R	46	34	36	60	43	82	60	76	106	92	141	103	115	175	TE	400	280	280	TE
8		N/R	48	52	93	N/R	46	86	90	160	N/R	94	150	160	280	35	TE	440	450	770	TE
9		N/R	43	47	N/R	91	44	76	82	30	145	86	135	145	105	215	TE	380	410	520	TE
10		---	31	N/R	N/R	44	35	55	49	36	75	73	96	86	51	135	TE	270	230	175	TE
AVERAGE		---	45	50	65	57	44	74	73	98	98	86	129	127	171	151	---	370	354	454	---
STANDARD DEVIATION		---	8.6	9.1	22	15	9.4	18	26	48	21	18	30	46	81	51	---	90	132	242	---

All entries in μV.

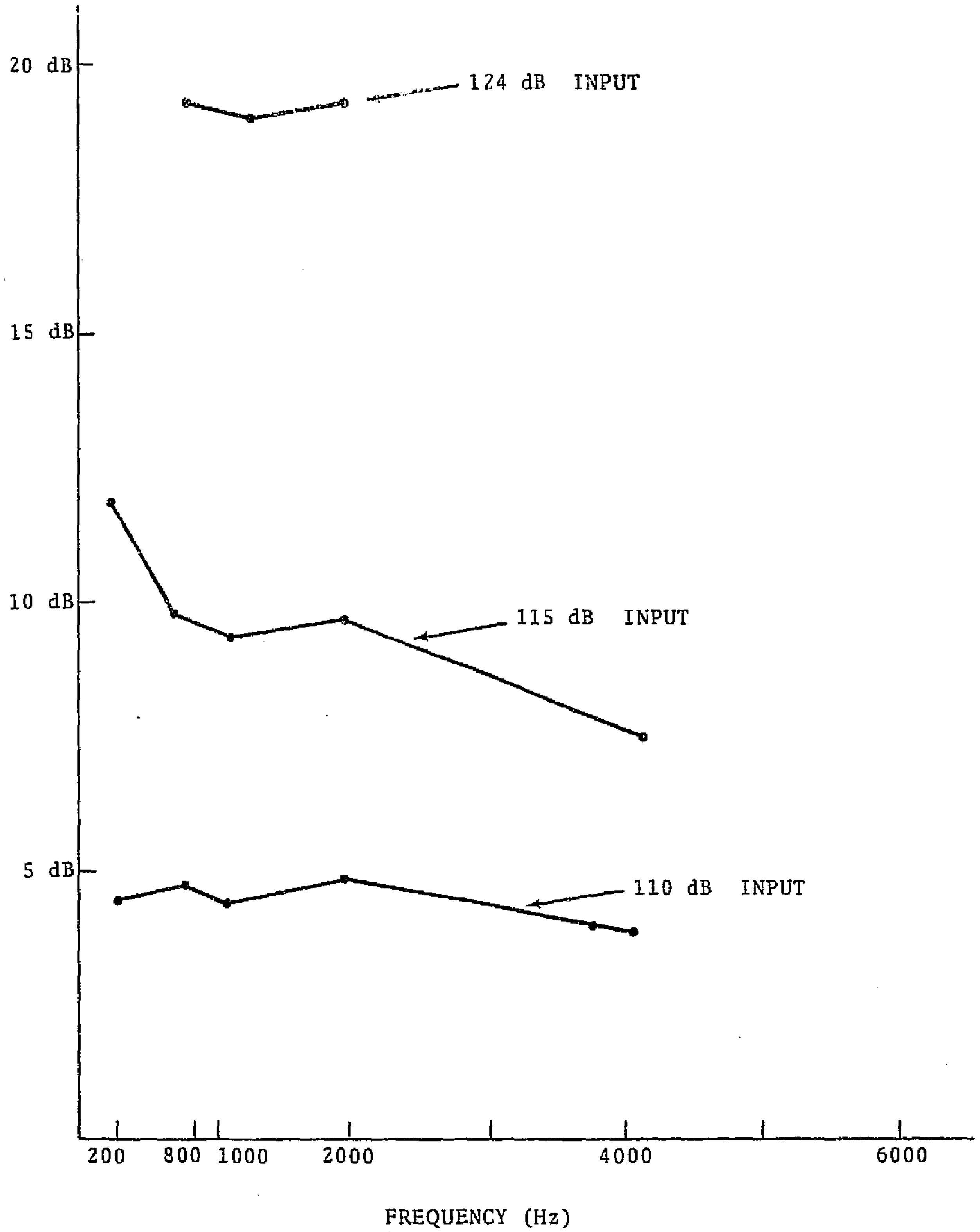


Figure 3-13. – Carter M-87 linearity at 25,000 ft.

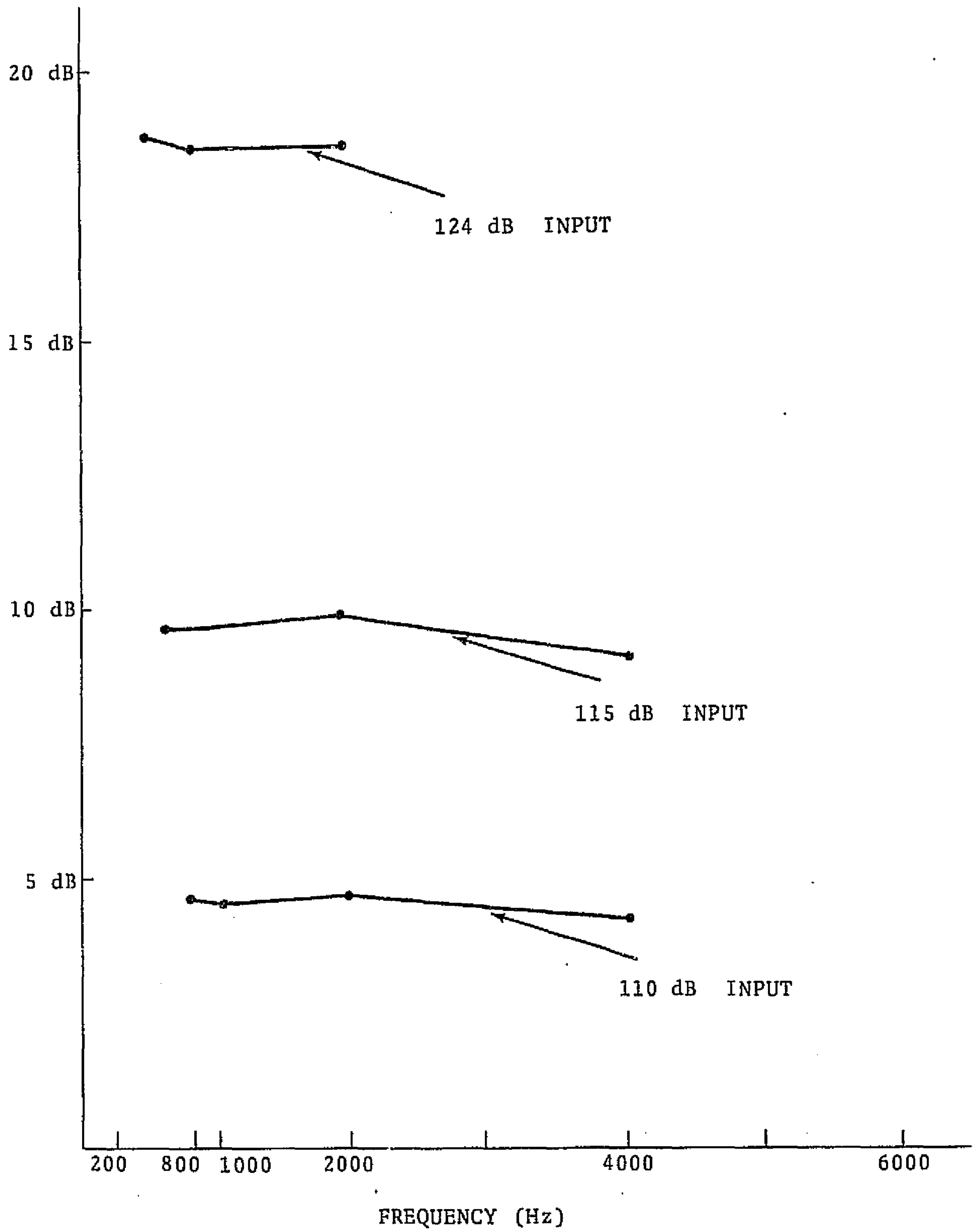


Figure 3-14. — Astrocom M-87 linearity at 25,000 ft.

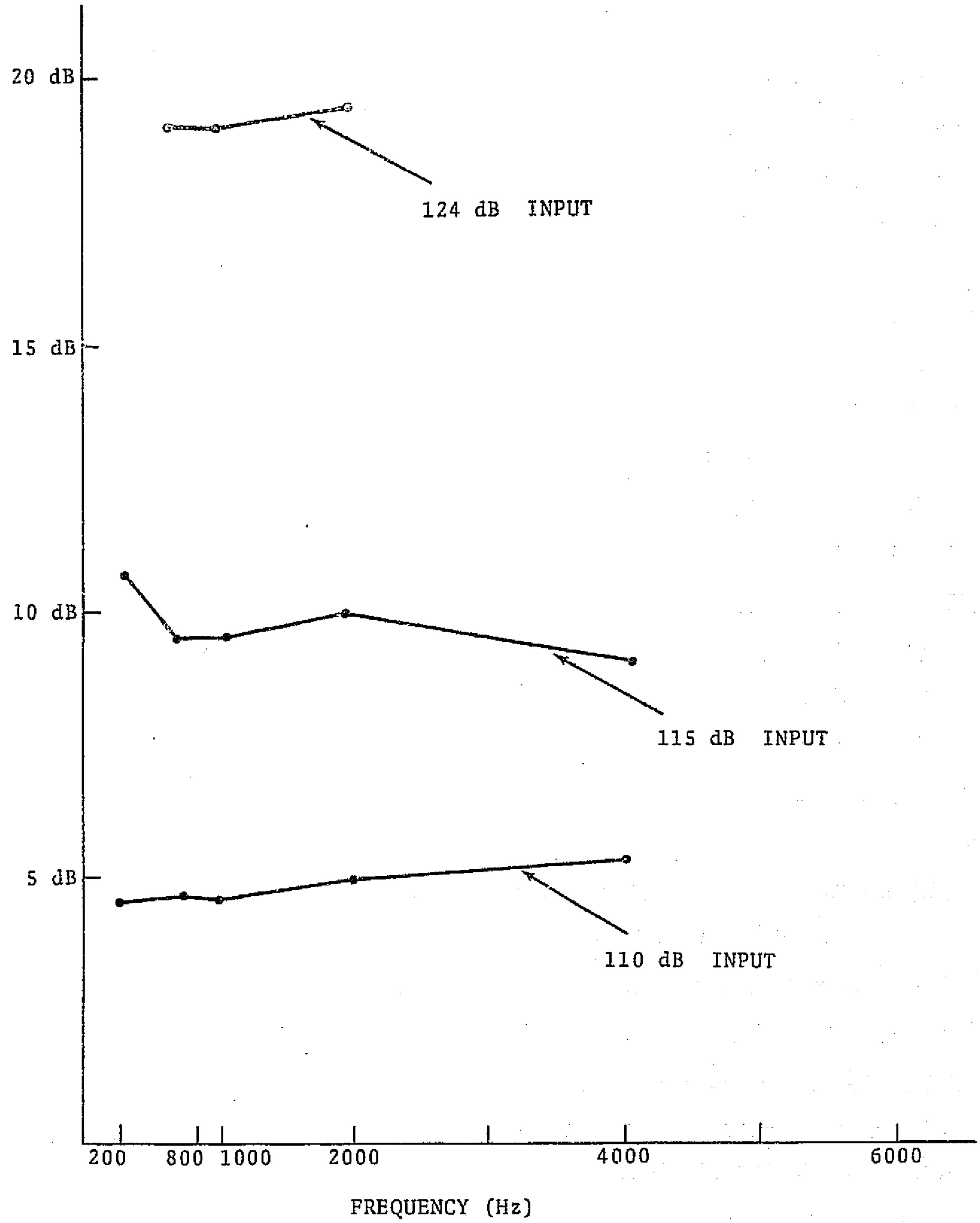


Figure 3-15. — Electrovoice M-87 linearity at 25,000 ft.

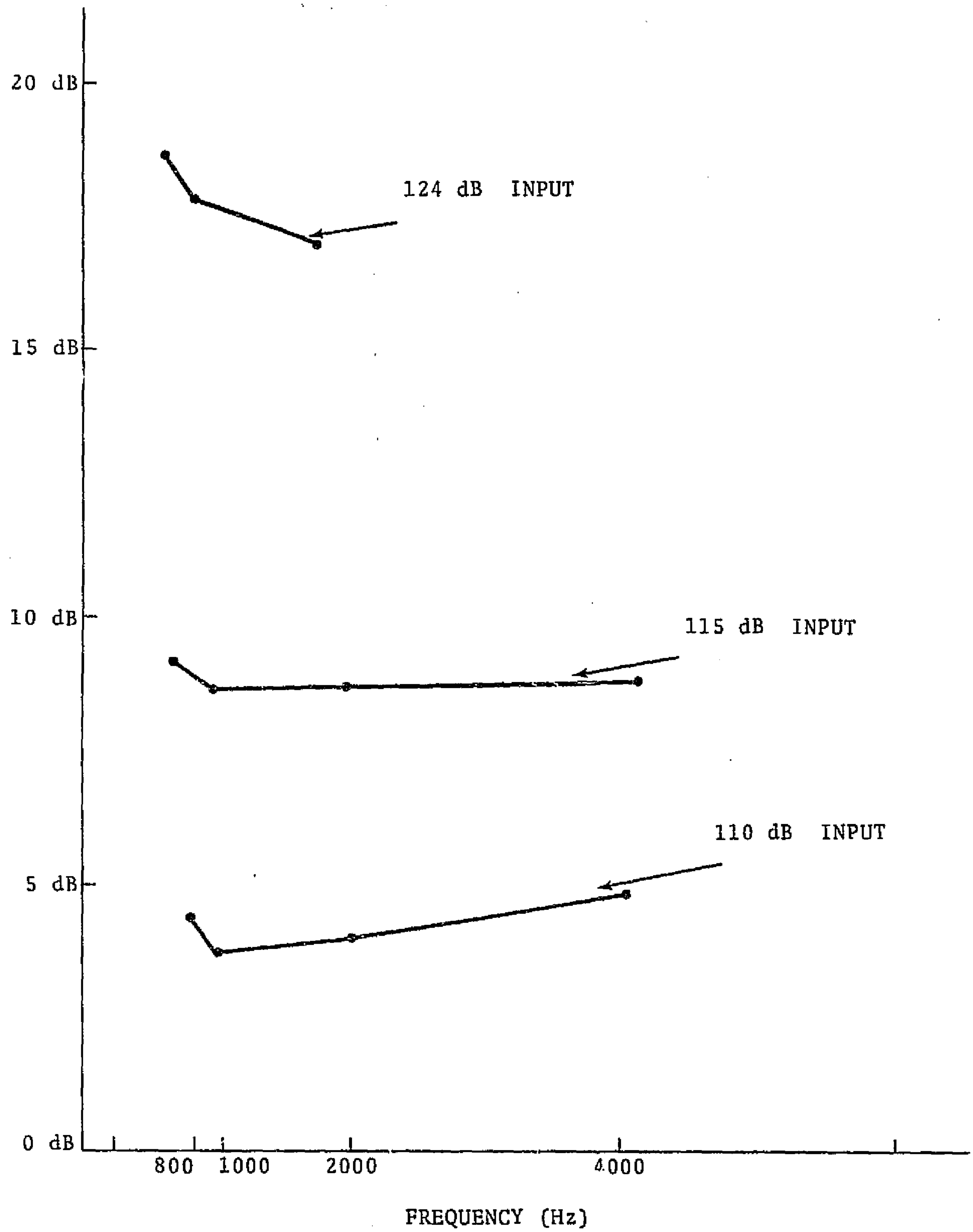


Figure 3-16. – Roanwell M-87 linearity at 25,000 ft.

4.0 M-101/AIC TEST

All test procedures for the M-101/AIC microphone were identical to the procedures used for the M-87/AIC microphone as documented in section 3.1. The linearity and frequency response graph were drawn similarly to the graphs of the M-87 test data. The graphs for individual microphones may be found in appendix B.

4.1 GROUND LEVEL TEST DATA

4.1.1 Frequency Response

RESPONSE FREQUENCY CHARACTERISTIC TO A CLOSE SOUND SOURCE

TABLE XXI. — CARTER M-101 GROUND LEVEL FREQUENCY RESPONSE

INPUT: 110 dB SPL

FREQUENCY	OUTPUT LEVEL (μV)											
200	66	93	100	84	60	100	115	110	50	47	83	25
300	82	115	125	110	74	130	130	117	68	65	101	26
400	105	140	145	135	100	150	150	145	93	87	125	26
600	140	170	170	175	137	160	180	180	131	114	156	23
800	155	180	180	200	160	160	200	190	150	145	172	21
1000	175	210	205	220	185	180	210	215	195	180	197	17
2000	270	300	320	340	300	320	320	300	250	230	295	35
3000	255	330	340	420	300	400	300	380	220	240	319	68
4000	240	320	340	300	280	330	330	340	190	180	285	61
5000	225	230	300	180	255	260	190	320	145	125	223	64
6000	125	200	180	130	145	180	140	225	82	82	149	48
MICROPHONE SERIAL NUMBER	11	12	13	14	15	16	17	18	19	20	AVE	σ

MANUFACTURER: M-101/AIC Carter Engineering Co.

RESPONSE FREQUENCY CHARACTERISTIC TO A CLOSE SOUND SOURCE

TABLE XXII. – ASTROCOM M-101 GROUND LEVEL FREQUENCY RESPONSE

INPUT: 110 dB SPL

FREQUENCY	OUTPUT LEVEL (μV)											
200	100	84	82	80	70	83	84	60	58	80	78	12
300	125	105	100	100	88	100	105	80	72	98	97	15
400	150	120	120	112	105	112	125	100	86	120	115	17
600	180	135	135	125	120	132	145	130	105	135	133	20
800	175	142	135	125	125	130	150	140	115	130	137	17
1000	190	155	150	145	145	138	165	160	130	150	153	17
2000	240	230	210	205	220	230	230	240	190	270	227	22
3000	250	220	240	210	230	240	230	230	200	300	235	27
4000	215	195	240	185	185	195	210	190	165	280	196	55
5000	150	148	140	141	142	155	175	130	130	280	159	44
6000	110	100	95	115	90	125	123	58	105	200	112	36
MICROPHONE SERIAL NUMBER	1	2	3	4	5	6	7	8	9	10	AVE	σ

MANUFACTURER: Astrocom M-101/AIC

RESPONSE FREQUENCY CHARACTERISTIC TO A CLOSE SOUND SOURCE

TABLE XXIII. – ELECTROVOICE M-101 GROUND LEVEL FREQUENCY RESPONSE

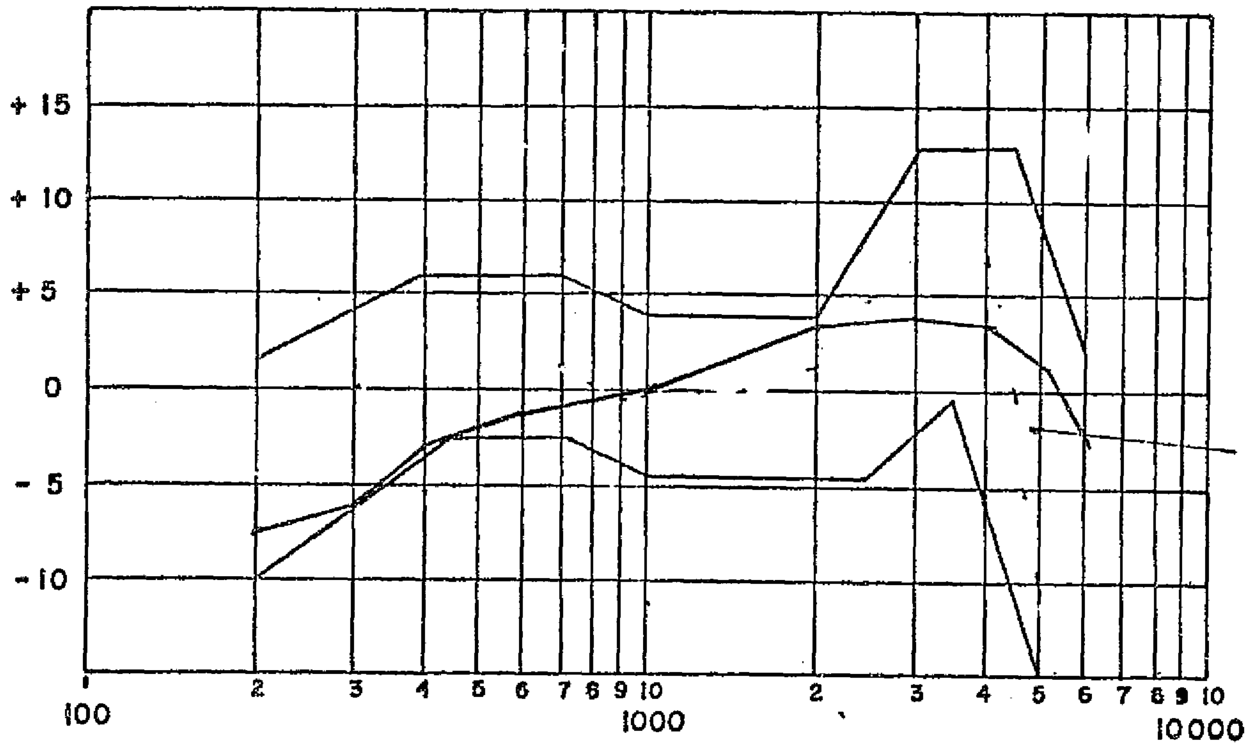
INPUT: 110 dB

FREQUENCY	OUTPUT LEVEL (μV)											
200	96	94	90	107	130	125	120	112	104	118	110	14
300	115	115	95	110	107	127	145	115	100	120	115	14
400	140	135	118	140	140	150	160	135	125	145	139	12
600	161	160	145	165	175	160	180	160	137	170	161	13
800	165	160	150	165	190	165	180	161	145	170	165	13
1000	175	185	165	180	210	180	190	170	160	190	181	14
2000	240	250	240	250	280	240	260	230	220	250	226	67
3000	265	250	280	270	280	280	270	250	250	260	245	69
4000	250	210	240	275	250	180	265	220	200	210	220	31
5000	120	110	105	92	142	98	167	115	120	125	119	21
6000	88	86	73	62	93	72	119	85	74	85	837	16
MICROPHONE SERIAL NUMBER	21	22	23	24	25	26	27	28	29	30	AVE	σ

MANUFACTURER: M-101/AIC - Electrovoice

RESPONSE IN DECIBELS

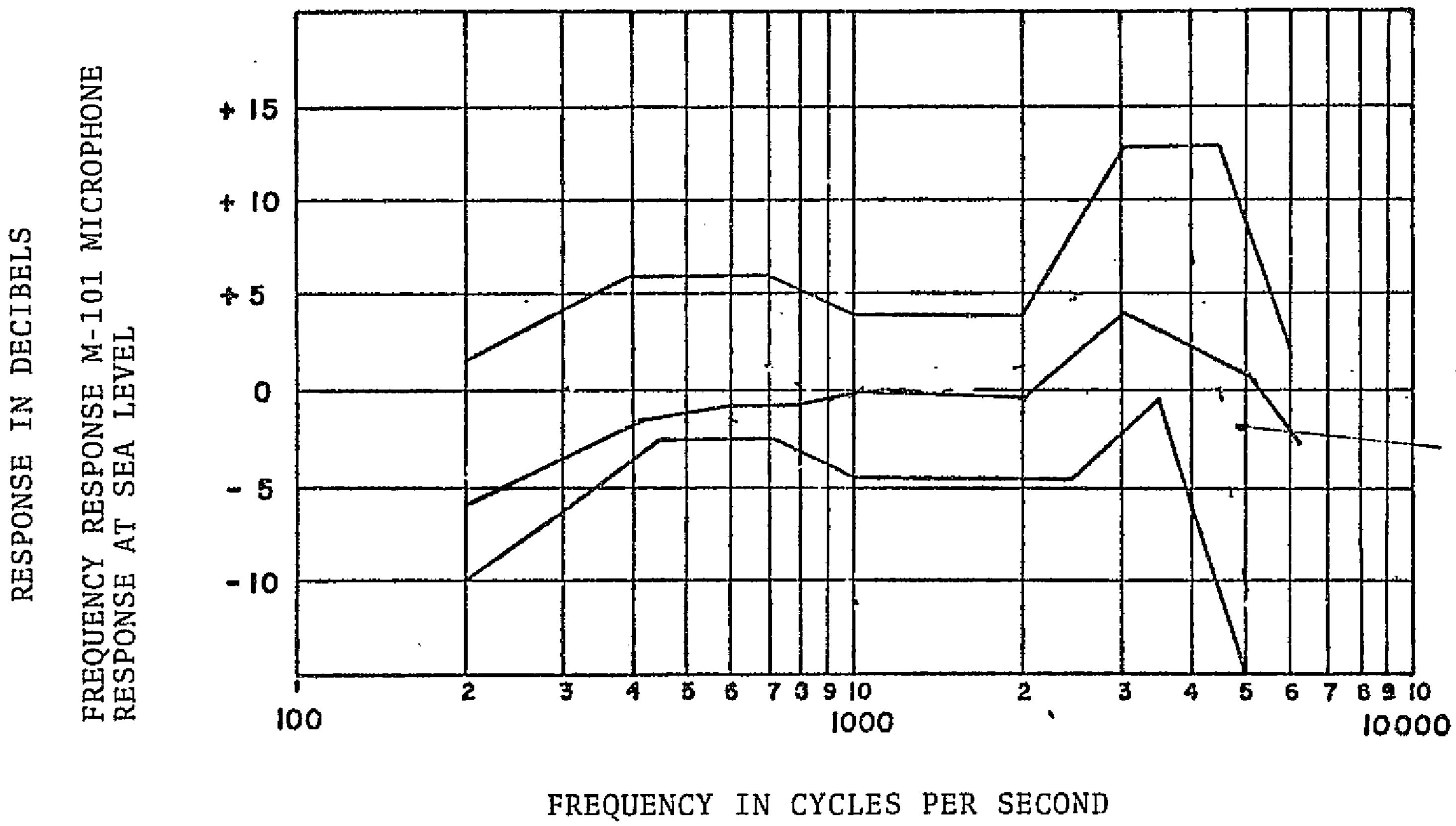
FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



FREQUENCY IN CYCLES PER SECOND

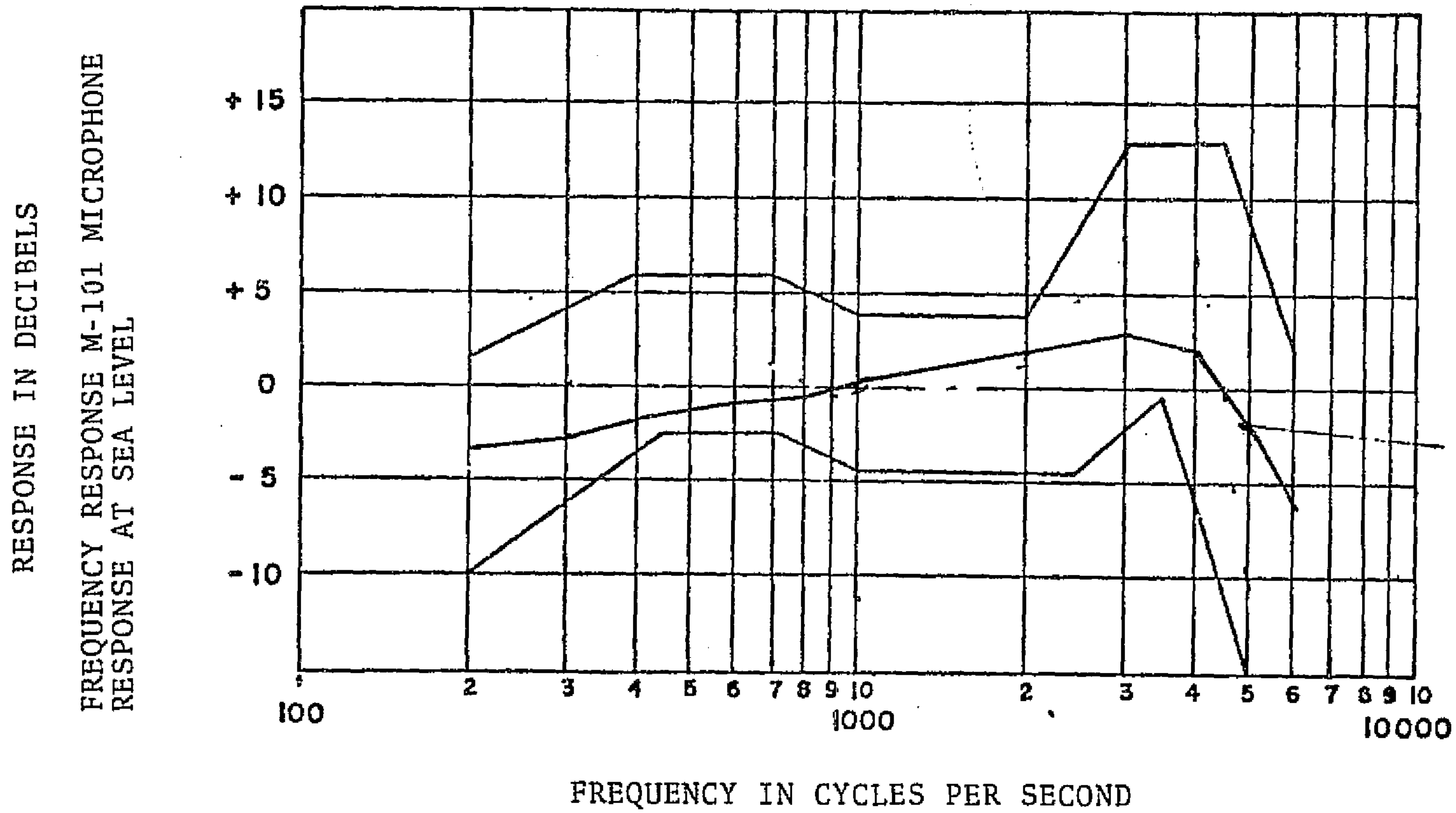
Dip is allowed; within the 1100 to 1700 CPS Range to extend below the limits of the envelope. The portion of the dip which occurs outside of the envelope may be no greater than 150 CPS wide.

Figure 4-1. – Carter ground level average frequency response.



Dip is allowed; within the 1100 to 1700 CPS Range
to extend below the limits of the envelope.
The portion of the dip which occurs outside of
the envelope may be no greater than 150 CPS wide.

Figure 4-2. — Astrocomm ground level average frequency response.



Dip is allowed; within the 1100 to 1700 CPS Range to extend below the limits of the envelope. The portion of the dip which occurs outside of the envelope may be no greater than 150 CPS wide.

Figure 4-3. — Electrovoice ground level average frequency response.

4.1.2 Linearity

TABLE XXIV. – CARTER M-101 GROUND LEVEL LINEARITY

MICROPHONE SERIAL NUMBER	SPL	105 dB					110 dB					115 dB					124 dB				
	FREQ	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000
11		40	90	107	160	140	66	155	175	270	240	135	260	300	460	410	---	740	1125	1275	1150
12		56	105	120	175	180	93	180	210	300	320	170	320	370	540	540	---	1000	1100	1650	1600
13		56	100	115	175	175	100	180	205	320	340	165	320	370	525	570	---	860	1000	1500	1650
14		47	115	122	185	160	84	200	220	340	300	160	360	400	580	520	---	1000	1000	1600	1450
15		38	95	115	180	165	60	160	185	300	280	140	300	380	560	500	---	760	900	1400	1400
16		60	88	100	180	175	100	160	180	320	330	185	285	310	560	580	---	860	900	1500	1550
17		56	105	115	175	185	115	200	210	320	330	225	330	370	550	560	---	960	1050	1700	1500
18		50	105	112	170	180	110	190	215	300	340	220	340	375	540	590	---	960	1000	1450	1550
19		34	83	105	140	105	50	150	195	250	190	95	270	340	450	320	---	800	950	1275	930
20		---	80	95	128	100	47	145	180	230	180	86	260	310	410	315	---	760	900	1250	860
STANDARD DEVIATION		17	11	8.7	19	33	25	21	17	35	61	46	35	35	57	105	---	103	82	161	283
AVERAGE		45	97	111	167	149	83	172	198	295	285	158	305	353	518	491	---	870	993	1460	1364

All entries in μV.

TABLE XV. – ASTROCOM M-101 GROUND LEVEL LINEARITY

MICROPHONE SERIAL NUMBER	SPL	105 dB					110 dB					115 dB					124 dB				
	FREQ	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000
1		54	92	100	135	120	100	175	190	240	215	170	300	320	425	375	---	840	900	1200	1050
2		48	80	88	130	105	84	142	155	230	195	145	250	275	420	330	---	680	780	1125	940
3		45	70	78	110	110	82	135	150	210	240	135	230	255	370	340	---	570	700	1050	920
4		45	69	80	115	96	80	125	145	205	185	140	230	220	380	330	---	695	705	1000	900
5		40	72	83	113	105	70	125	145	220	185	120	225	250	400	340	---	600	715	1200	940
6		45	70	78	125	105	83	130	138	230	195	140	230	250	420	350	---	600	700	1175	960
7		48	84	92	130	117	84	150	165	230	210	140	220	300	410	370	---	780	820	1100	1050
8		34	78	86	130	100	60	140	160	240	190	110	245	270	400	340	---	740	780	1175	940
9		33	65	77	115	98	58	115	130	190	165	98	195	240	340	300	---	580	615	1000	840
10		36	72	80	150	156	80	130	150	270	280	175	230	250	470	500	---	720	780	1400	1400
AVERAGE		43	75	84	125	111	78	136	153	227	206	137	235	263	404	358	---	680	750	1143	994
STANDARD DEVIATION		6.8	8.2	7.4	12	18	12	1.7	17	22	33	24	27	29	35	54	---	92	79	118	156

All entries in μV.

TABLE XXVI. — ELECTROVOICE M-101 GROUND LEVEL LINEARITY

MICROPHONE SERIAL NUMBER	SPL	105 dB					110 dB					115 dB					124 dB				
	FREQ	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000
21		49	90	96	135	130	96	165	175	240	250	200	285	300	440	420	---	800	840	1200	1100
22		50	87	100	140	120	94	160	185	250	210	200	275	320	440	370	---	800	890	1250	1000
23		38	83	92	135	135	90	150	165	240	240	185	260	295	420	400	---	760	800	1175	1100
24		52	98	100	140	95	107	165	180	250	175	222	300	320	430	300	---	860	1000	1220	800
25		45	107	115	155	140	130	190	210	280	250	220	340	370	490	440	---	960	1000	1400	1200
26		58	93	98	135	100	125	165	180	240	180	230	290	315	440	320	---	840	810	1225	900
27		62	98	105	142	150	120	180	190	260	265	250	310	350	460	470	---	840	920	1250	1300
28		52	88	92	127	120	112	161	170	230	220	220	285	290	410	400	---	850	825	1150	1050
29		49	80	88	120	112	104	145	160	220	200	185	250	271	390	360	---	750	790	1075	950
30		56	95	105	138	120	118	170	190	250	210	230	300	340	440	380	---	895	920	1225	1000
AVERAGE		51	93	7.5	137	122	110	169	166	246	220	214	290	317	436	386	---	835	896	1217	1040
STANDARD DEVIATION		6.8	8.7	100	9.4	17.0	14	13	13	16	31	21	26	30	27	52	---	63	93	83	145

All entries in μV.

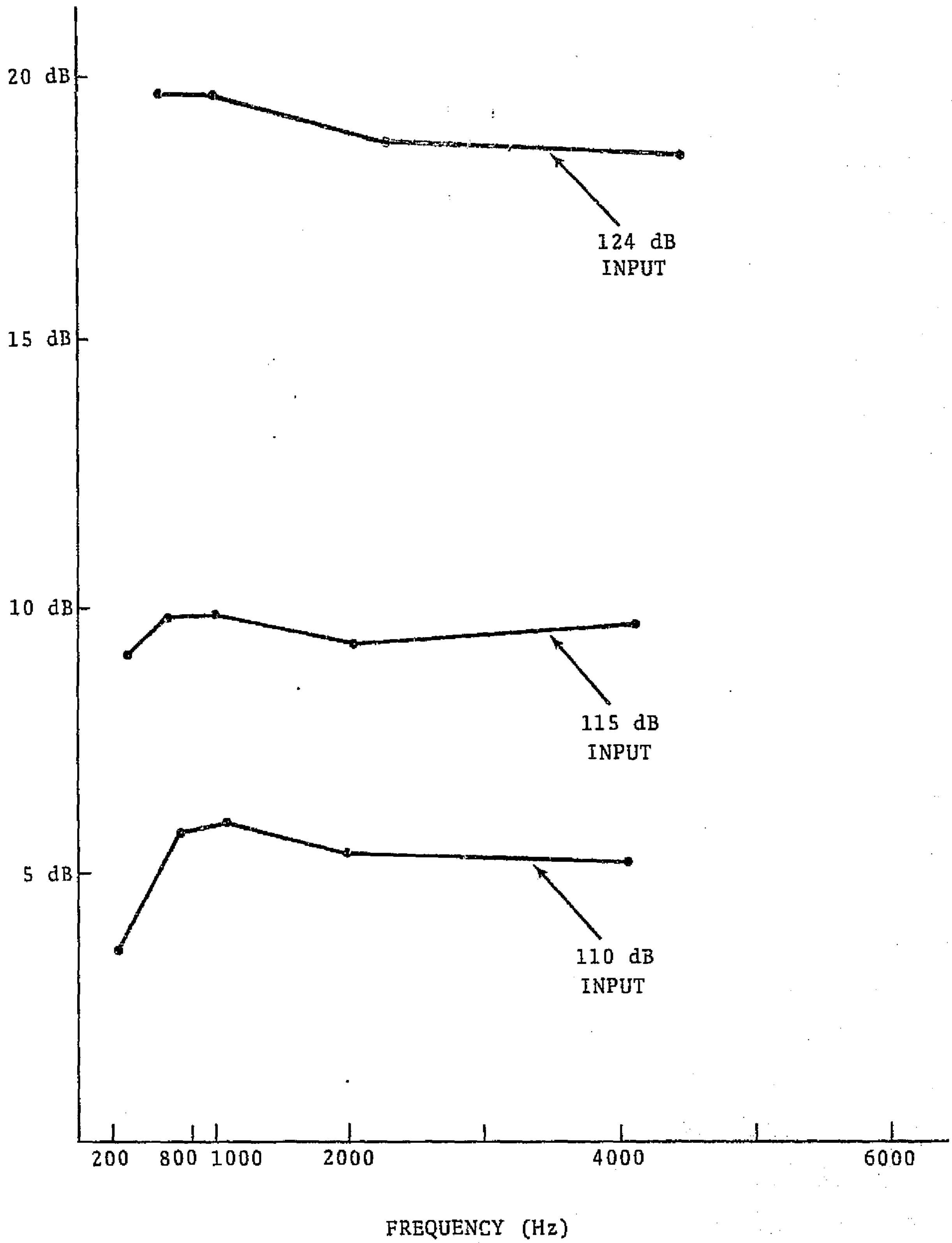


Figure 4-4.— Carter M-101 ground level linearity.

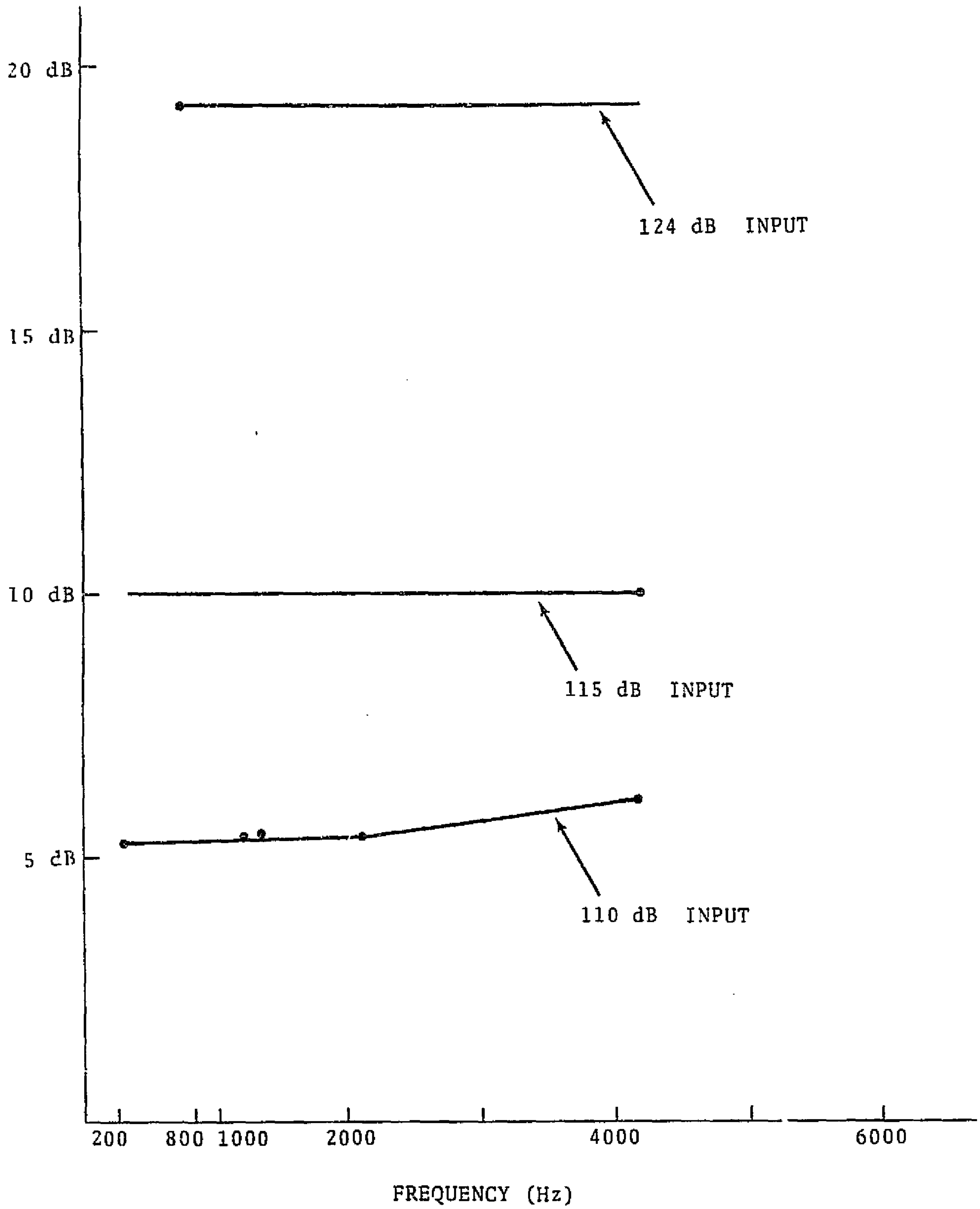


Figure 4-5. – Astrocom M-101 ground level linearity.

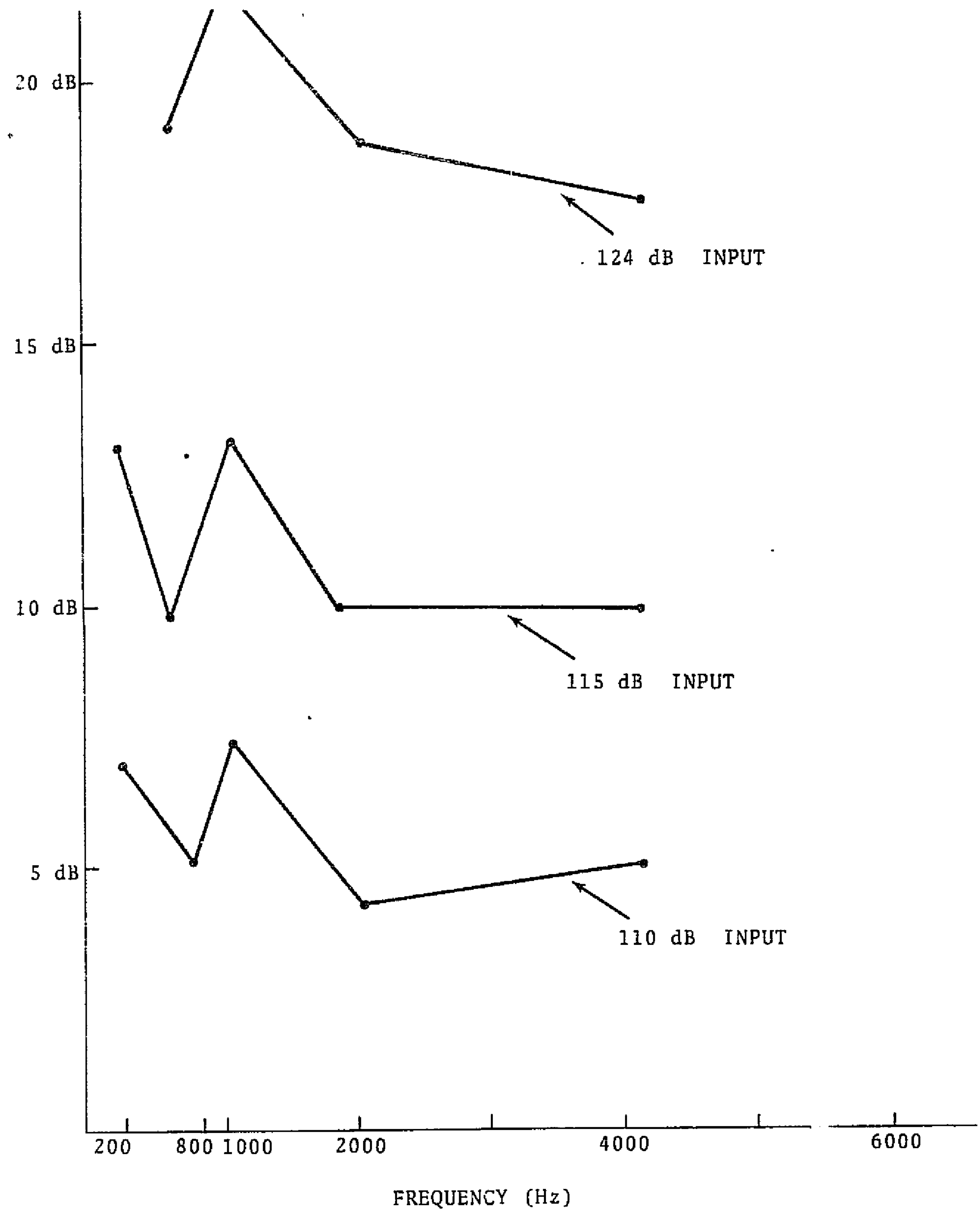


Figure 4-6. – Electrovoice ground level linearity.

4.1.3 Impedance

TABLE XXVII. — CARTER M-101 IMPEDANCE

S/N	FREQ-HZ									PEAK FREQUENCY Ohms/Hz
	200	400	600	800	1000	2000	4000	6000	7000	
11	5.3	5.4	5.4	5.4	5.4	5.5	5.5	5.7	5.7	5.5 3000
12	5.3	5.3	5.3	5.3	5.3	5.4	5.4	5.5	5.6	5.3 3400
13	5.1	5.1	5.1	5.1	5.3	5.3	5.3	5.4	5.5	5.5 3350
14	5.3	5.3	5.3	5.3	5.3	5.4	5.4	5.5	5.5	5.3 3200
15	5.5	5.5	5.5	5.5	5.6	5.6	5.6	5.7	5.8	5.5 3300
16	5.2	5.2	5.3	5.3	5.3	5.4	5.4	5.6	5.6	5.7 3050
17	5.1	5.2	5.1	5.1	5.2	5.3	5.4	5.4	5.4	5.3 3300
18	5.5	5.5	5.6	5.6	5.6	5.7	5.7	5.9	5.9	NONE ----
19	5.3	5.3	5.3	5.4	5.4	5.4	5.4	5.5	5.6	NONE ----
20	5.2	5.2	5.3	5.3	5.3	5.5	5.4	5.4	5.4	NONE ----

MANUFACTURER: Carter Engineering Co.

MODEL: M-101/AIC.

All entries in ohms.

TABLE XXVIII. – ASTROCOM M-101 IMPEDANCE

S/N	FREQ-HZ									PEAK FREQUENCY Ohms/Hz
	200	400	600	800	1000	2000	4000	6000	7000	
1	[illegible]	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.5 2250
2	5.2	5.2	5.2	5.2	5.2	5.2	5.3	5.4	5.5	5.4 3200
3	5.2	5.2	5.2	5.3	5.3	5.3	5.4	5.5	5.5	5.6 3000
4	5.1	5.1	5.1	5.1	5.1	5.3	5.3	5.3	5.5	5.4 3250
5	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.3	5.5	5.3 3350
6	5.0	5.0	5.1	5.1	5.1	5.1	5.2	5.2	5.4	5.1 3000
7	5.1	5.1	5.1	5.1	5.1	5.2	5.3	5.4	5.5	5.5 7000
8	5.0	5.1	5.1	5.1	5.2	5.3	5.3	5.5	5.5	5.5 2950
9	5.1	5.1	5.1	5.1	5.1	5.2	5.3	5.4	5.5	5.5 3000
10	4.9	4.9	4.9	4.9	5.0	5.1	5.1	5.2	5.3	5.0 3500

MANUFACTURER: Astrocom.

MODEL: M-101/AIC.

All entries in ohms.

TABLE XXIX. — ELECTROVOICE M-101 IMPEDANCE

S/N	FREQ-HZ									PEAK FREQUENCY Ohms/Hz
	200	400	600	800	1000	2000	4000	6000	7000	
21	5.4	5.4	5.4	5.4	5.4	5.5	5.6	5.7	5.8	NONE ----
22	5.4	5.5	5.5	5.6	5.6	5.6	5.8	5.8	5.8	NONE ----
23	5.5	5.6	5.6	5.6	5.6	5.7	5.8	5.8	5.9	5.9 3550
24	5.1	5.1	5.2	5.2	5.2	5.2	5.2	5.3	5.4	5.2 3500
25	5.4	5.4	5.5	5.5	5.5	5.5	5.5	5.7	5.7	NONE ----
26	5.3	5.4	5.4	5.4	5.4	5.4	5.5	5.6	5.6	NONE ----
27	5.6	5.6	5.6	5.6	5.6	5.7	5.8	5.9	5.9	5.8 3600
28	5.4	5.4	5.4	5.4	5.4	5.4	5.6	5.6	5.7	NONE ----
29	5.3	5.3	5.4	5.4	5.4	5.4	5.5	5.6	5.7	NONE ----
30	5.4	5.5	5.5	5.5	5.5	5.6	5.7	5.8	5.8	NONE ----

MANUFACTURER: Electrovoice.

MODEL: M-101/AIC.

All entries in ohms.

4.2 25,000 FT SIMULATED ALTITUDE TEST DATA

4.2.1 Frequency Response

RESPONSE FREQUENCY CHARACTERISTIC TO A CLOSE SOUND SOURCE

TABLE XXX. – CARTER M-101 FREQUENCY RESPONSE AT 25,000 FT

INPUT: 110 dB SPL 25,000 ft

FREQUENCY	OUTPUT LEVEL (μV)											
200	82	110	112	105	89	105	100	110	84	76	97	13
300	74	100	110	91	70	108	85	100	70	68	90	17
400	84	117	120	110	86	120	112	110	80	75	101	18
600	114	150	151	140	115	140	148	135	107	98	130	19.5
800	159	200	195	200	155	175	190	175	150	139	174	22
1000	190	230	220	240	192	200	221	205	200	172	207	20.6
2000	230	275	270	285	275	270	260	270	275	222	263	20.[illegible]
3000	132	171	167	160	150	152	155	145	150	135	151	12.5
4000	96	125	122	97	105	105	115	105	104	88	106	11.6
5000	78	98	112	76	84	93	84	87	88	63	86	13
6000	72	78	112	80	68	85	67	80	76	69	79	13
MICROPHONE SERIAL NUMBER	11	12	13	14	15	16	17	18	19	20	AVE	σ

MANUFACTURER: Carter Engineering Co. M-101/AIC

RESPONSE FREQUENCY CHARACTERISTIC TO A CLOSE SOUND SOURCE

TABLE XXXI. – ASTROCOM M-101 FREQUENCY RESPONSE AT 25,000 FT

INPUT: 110 dB SPL 25,000 ft

FREQUENCY	OUTPUT LEVEL (μV)										
200	170	105	107	110	100	100	117	93	88	100	109	23
300	150	90	105	105	92	96	117	79	79	100	101	20.7
400	172	112	117	117	110	112	130	98	93	112	117	21.7
600	220	140	145	140	137	130	155	131	117	130	145	28.4
800	280	118	180	180	170	162	200	165	149	162	176	42
1000	300	210	205	219	200	182	220	218	175	172	210	36.4
2000	325	250	272	250	250	251	255	270	240	270	263	24.1
3000	185	140	140	152	130	130	157	131	120	150	143	18.6
4000	115	90	88	102	87	90	94	110	76	100	105	32
5000	80	74	57	80	70	75	90	77	56	86	75	11
6000	68	77	58	70	61	74	74	53	53	77	67	9.5
MICROPHONE SERIAL NUMBER	1	2	3	4	5	6	7	8	9	10	AVE	σ

MANUFACTURER: M-101/AIC Astrocom

RESPONSE FREQUENCY CHARACTERISTIC TO A CLOSE SOUND SOURCE

TABLE XXXII. - ELECTROVOICE M-101 FREQUENCY RESPONSE AT 25,000 FT

INPUT: 110 dB SPC 25,000 ft

FREQUENCY	OUTPUT LEVEL (μV)										
200	120	110	94	112	112	125	120	110	101	120	112	9.5
300	115	105	84	105	98	122	115	115	102	120	108	12.0
400	125	120	102	120	114	140	132	117	105	127	120	11.6
600	150	151	132	155	148	161	162	140	120	155	147	13.0
800	195	195	170	205	205	200	210	175	160	205	192	17.3
1000	226	220	200	235	245	225	230	195	190	230	219	18.0
2000	255	250	267	250	271	250	280	240	230	245	253	15.0
3000	145	135	165	140	165	135	175	130	120	145	146	17.5
4000	90	95	94	86	113	79	122	88	78	88	93	14.0
5000	80	66	74	69	94	80	97	74	74	74	78	10.1
6000	75	71	70	86	90	88	77	61	78	77	77	8.9
MICROPHONE SERIAL NUMBER	21	22	23	24	25	26	27	28	29	30	AVE	σ

MANUFACTURER: Electrovoice M-101/AIC

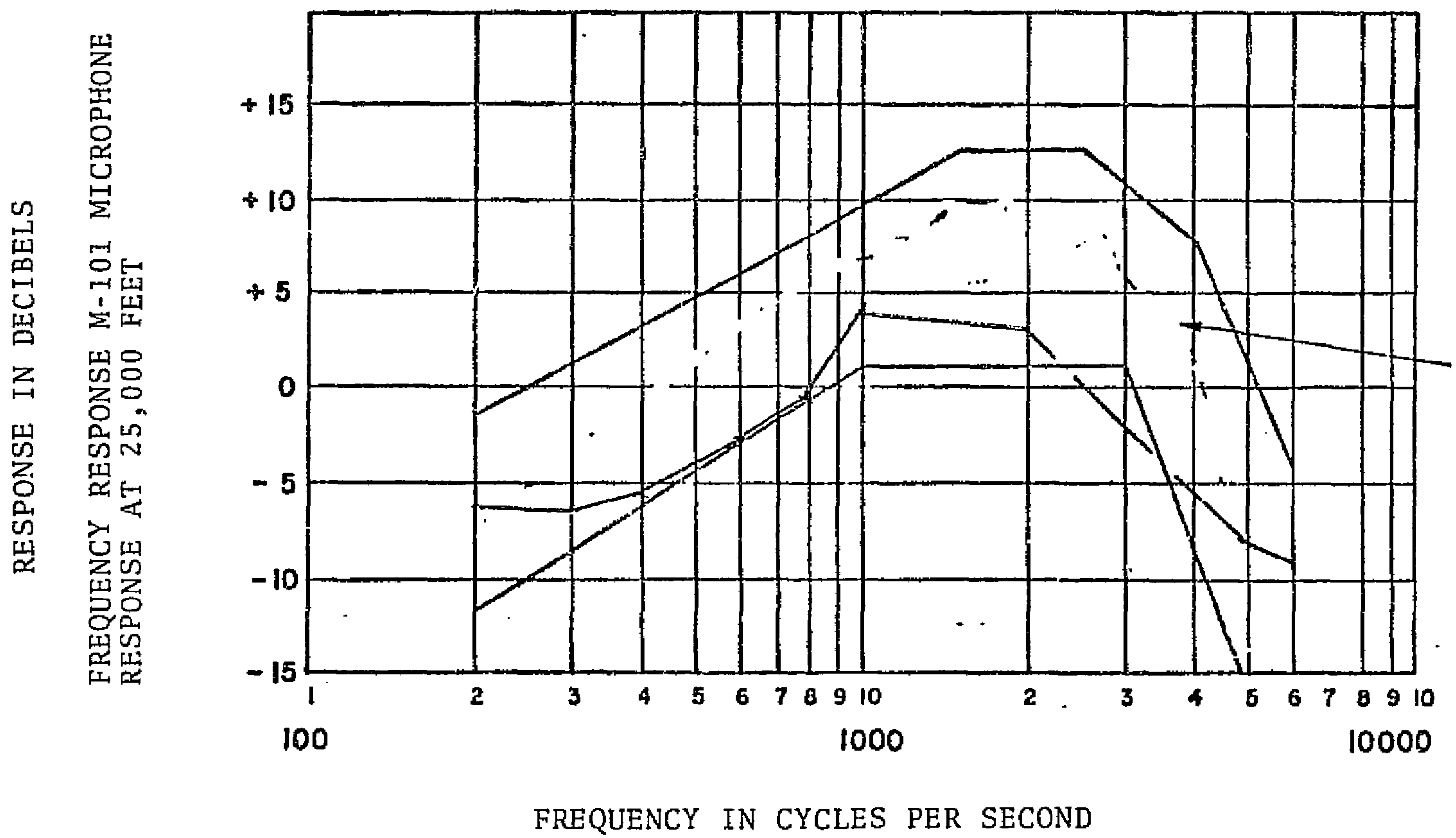


Figure 4-7. – Carter average frequency response at 25,000 ft.

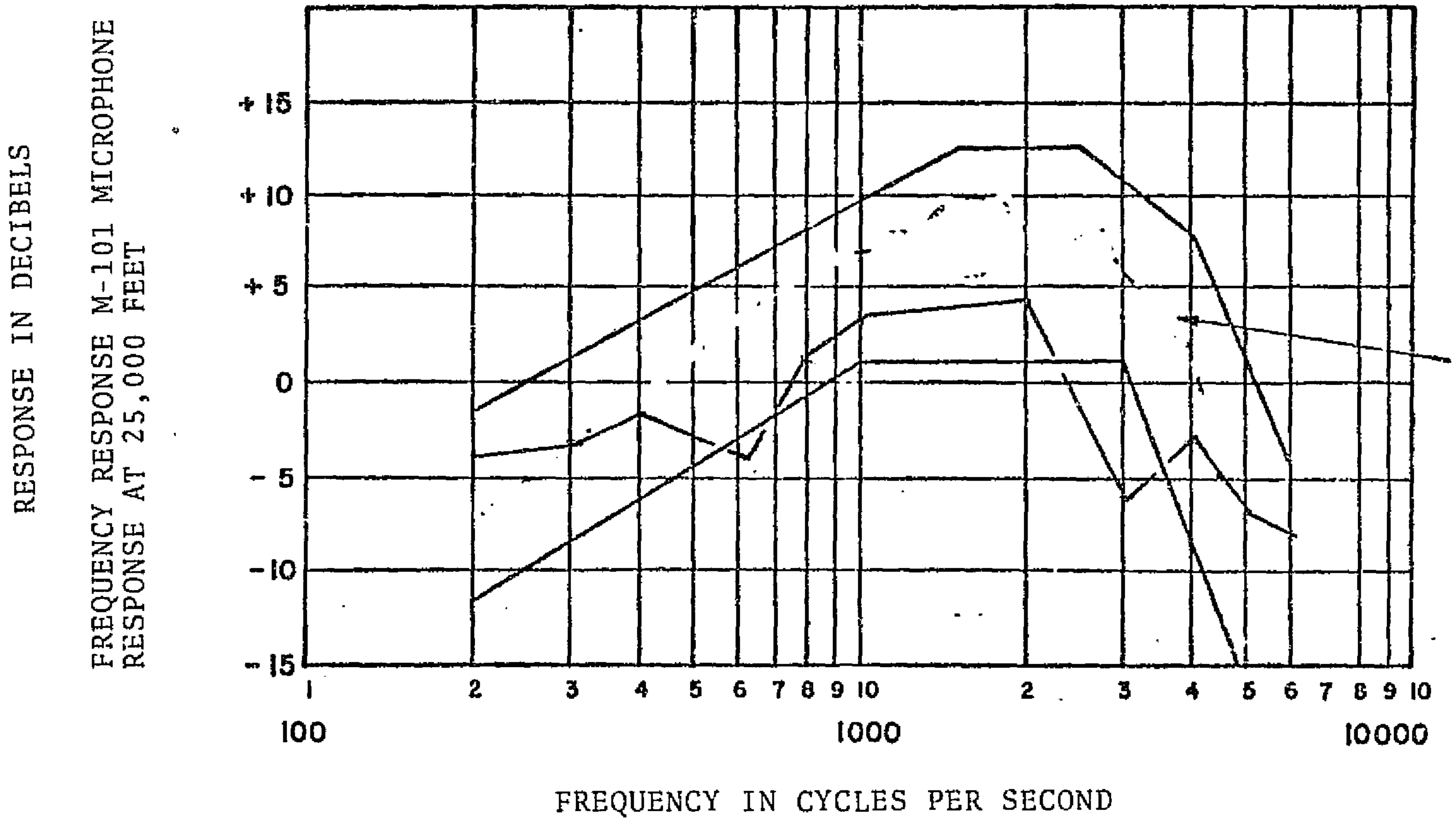


Figure 4-8. – Astrocom average frequency response at 25,000 ft.

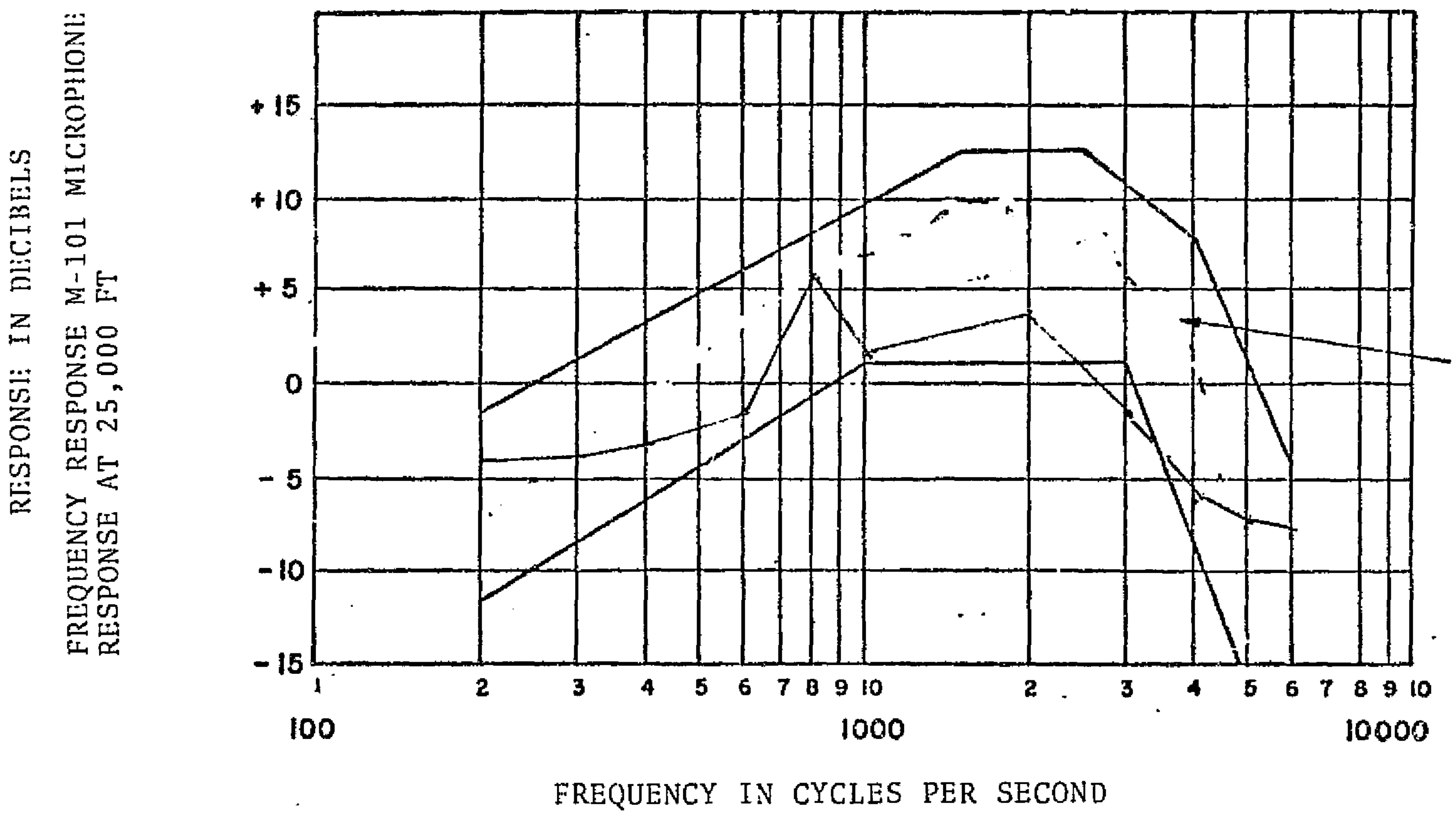


Figure 4-9. – Electrovoice average frequency response at 25,000 ft.

4.2.2 Linearity

TABLE XXXIII. – CARTER M-101 LINEARITY AT 25,000 FT

MICROPHONE SERIAL NUMBER	SPL: 105 dB					110 dB					115 dB					124 dB				
FREQ	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000
11	40	90	110	135	53	82	159	190	230	96	165	275	350	420	167	---	810	945	1150	---
12	56	112	130	155	70	110	200	230	275	125	215	350	410	490	200	---	1000	1150	1350	---
13	58	110	125	155	72	112	195	220	270	1[illegible]2	220	340	390	470	210	---	1000	1070	1320	---
14	52	115	137	165	56	105	200	240	285	160	210	360	420	500	165	---	1020	1175	1400	---
15	42	89	110	157	59	89	155	192	275	105	172	270	350	490	165	---	860	940	1350	---
16	58	102	115	155	62	105	175	200	270	104	205	310	350	470	175	---	920	980	1340	---
17	47	106	125	146	60	100	190	221	260	115	210	330	395	460	200	---	960	1100	1250	---
18	60	100	120	155	58	110	175	205	270	105	200	310	360	480	140	---	865	1050	1300	---
19	46	85	112	155	60	84	150	200	275	104	170	265	350	475	150	---	800	1000	1325	---
20	44	78	100	129	51	76	139	172	222	88	160	240	301	390	156	---	780	900	1075	---
AVERAGE	45	99	118	151	55	97	173	197	243	112	194	305	368	465	173	---	902	1031	1291	---
STANDARD DEVIATION	15	13	11	11	17	13	22	41	62	20	22	40	36	34	23	---	90	93	104	---

All entries in μV.

TABLE XXXIV. – ASTROCOM M-101 LINEARITY AT 25,000 FT

MICROPHONE SERIAL NUMBER	SPL 105 dB					110 dB					115 dB					124 dB				
FREQ	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000
1	80	160	180	180	69	170	280	300	325	115	295	480	520	540	---	---	1200	1350	1520	---
2	53	105	110	140	49	105	118	210	250	90	220	340	380	450	155	---	1175	1200	1250	---
3	52	102	122	150	49	107	180	205	272	88	200	310	360	460	150	---	900	940	1300	---
4	52	100	115	140	52	110	180	219	250	102	200	315	380	420	170	---	920	1020	1200	---
5	52	98	115	147	46	100	92	170	200	87	195	300	370	460	150	---	890	1000	1215	---
6	51	90	101	146	50	100	162	182	251	90	185	280	315	460	150	---	840	900	1250	---
7	59	110	120	140	62	117	200	220	255	94	220	350	390	470	175	---	1050	1100	1300	---
8	46	95	118	155	54	93	165	218	270	110	185	290	355	480	150	---	780	980	1320	---
9	44	84	100	138	44	88	149	175	240	76	168	270	305	425	135	---	780	860	1170	---
10	52	92	100	150	56	100	162	172	270	100	179	285	305	465	165	---	889	910	1250	---
AVERAGE	54	104	118	149	53	109	169	207	258	95	205	322	338	423	144	---	942	927	1277	---
STANDARD DEVIATION	10	21	23	12	7.6	23	50	38	31	12	36	61	115	143	42	---	150	323	97	---

All entries in µV.

TABLE XXXV. – ELECTROVOICE M-101 LINEARITY AT 25,000 FT

MICROPHONE SERIAL NUMBER	SPL	105 dB					110 dB					115 dB					124 dB				
	FREQ	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000	200	800	1000	2000	4000
21		63	112	130	146	53	120	195	226	255	90	219	350	400	450	154	---	960	1100	1250	---
22		54	112	127	146	55	110	195	220	250	95	230	370	410	480	140	---	1000	1600	1350	---
23		45	96	112	157	52	94	170	200	267	94	185	300	360	490	150	---	825	980	1250	---
24		52	115	135	148	51	112	205	235	250	86	225	355	410	450	160	---	1000	1150	1250	---
25		55	115	140	155	65	112	205	245	271	113	220	370	440	480	174	---	1000	1200	1320	---
26		64	110	130	145	47	125	200	225	250	79	225	352	400	450	145	---	980	1100	1250	---
27		62	120	131	155	70	120	210	230	280	122	220	380	410	480	215	---	1050	1150	1370	---
28		60	98	112	136	50	110	175	195	240	88	190	300	350	420	155	---	880	960	1170	---
29		58	92	110	137	47	101	160	190	230	78	177	280	340	400	140	---	840	940	1120	---
30		63	115	134	140	50	120	205	230	245	88	210	375	425	450	155	---	1000	1150	1200	---
AVERAGE		57	109	126	146	54	112	172	221	254	86	210	343	355	415	150	---	954	1119	1253	---
STANDARD DEVIATION		6	10	11	7.4	7.6	10	61	19	15	30	19	36	125	117	33	---	77	195	78	---

All entries in μV.

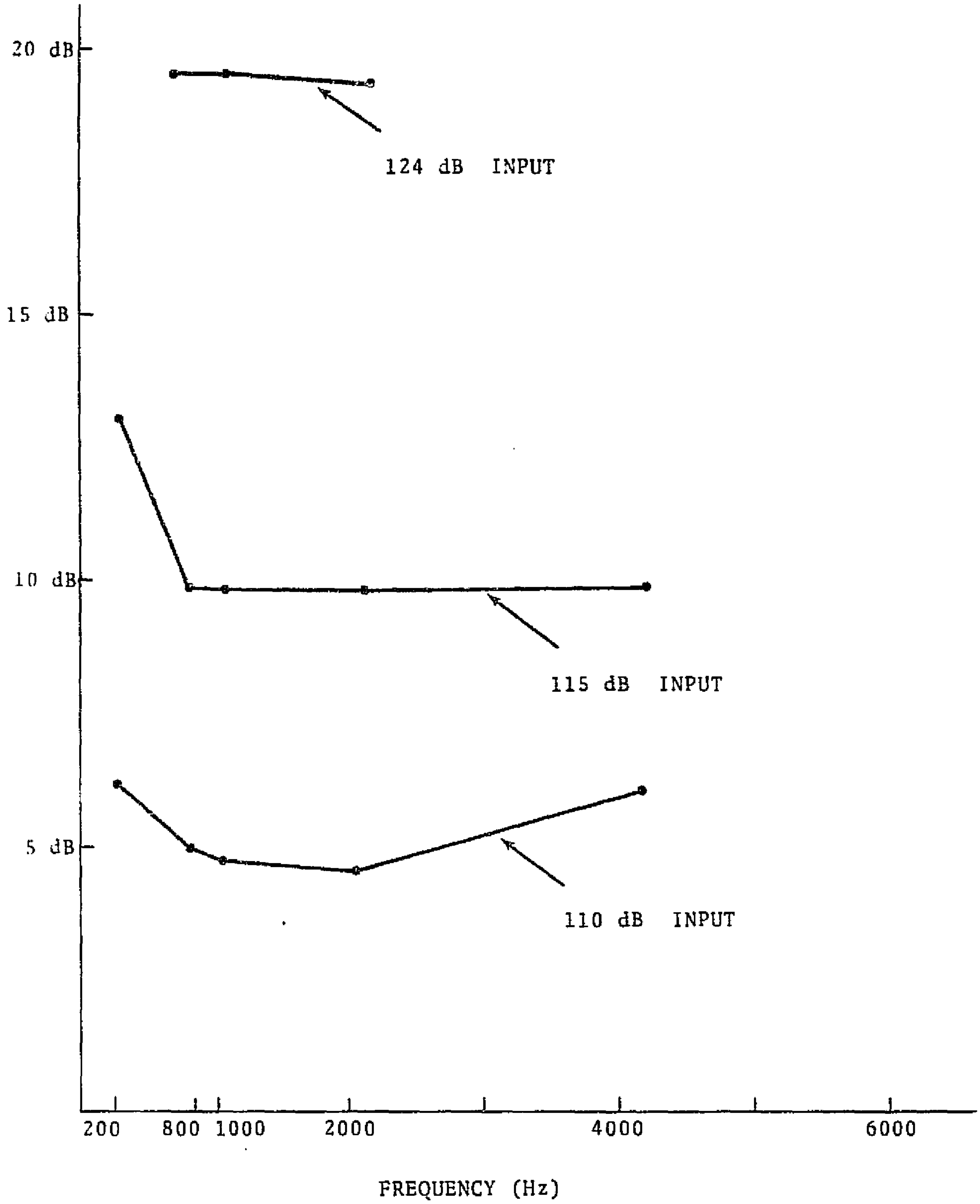


Figure 4-10. – Carter average linearity at 25,000 ft.

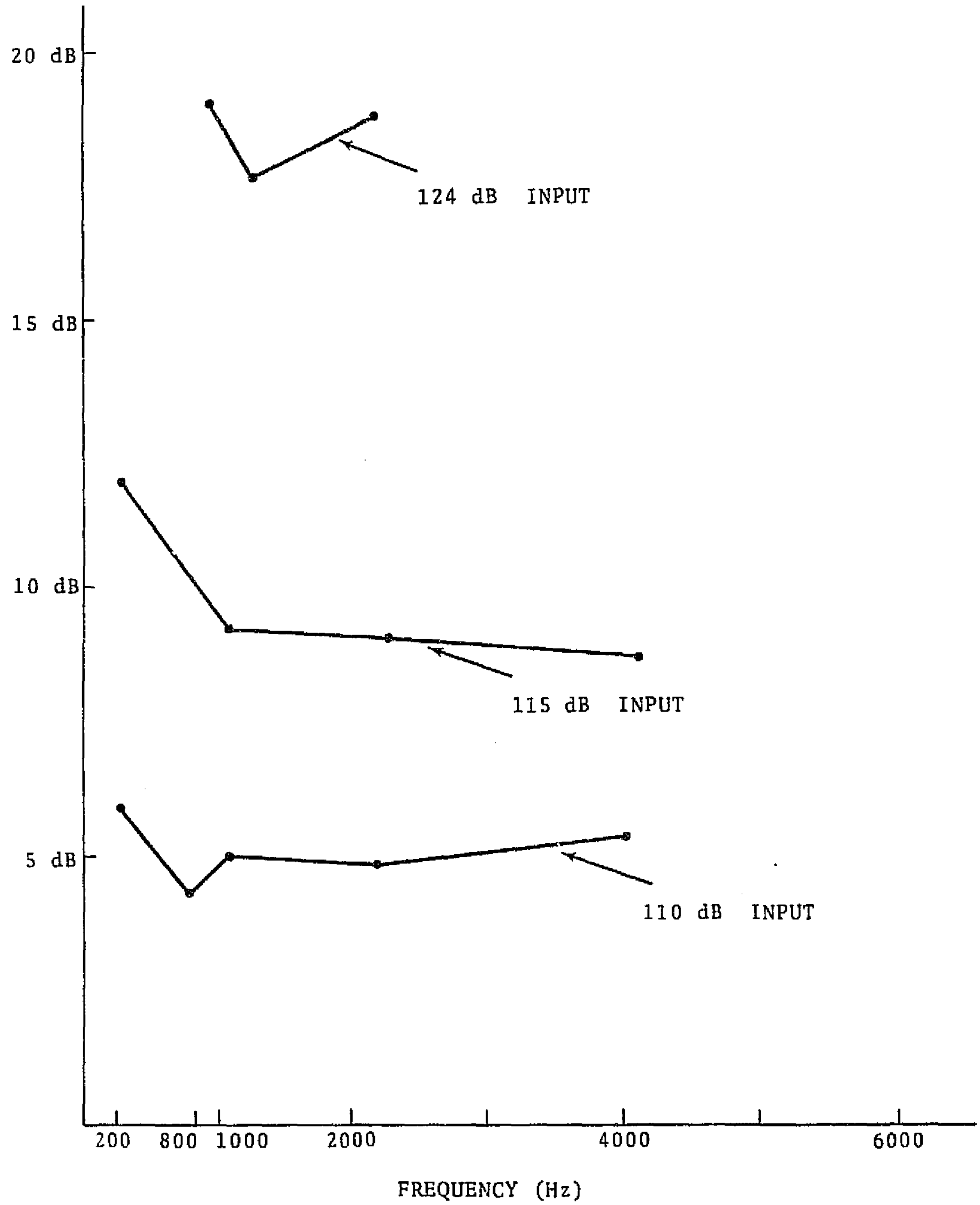


Figure 4-11. – Astrocom average linearity at 25,000 ft.

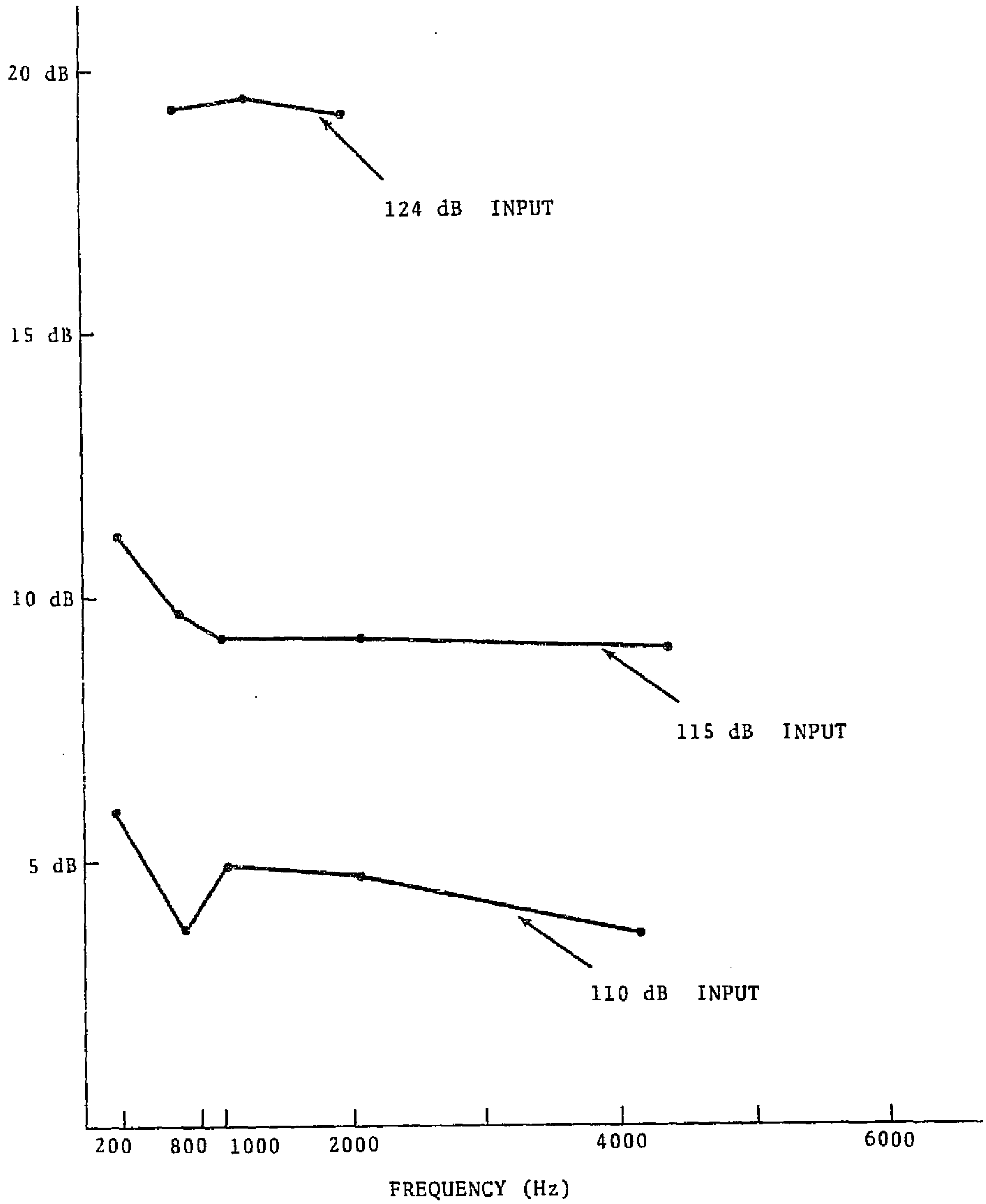


Figure 4-12. – Electrovoice average linearity at 25,000 ft.

5.0 H-143/AIC EARPHONE TEST

5.1 TEST PROCEDURE

The linearity and frequency response of the H-143 earphones were measured by coupling the earphone audio output to a one-inch B&K condenser microphone via a 40 cubic centimeter resonant cavity. The microphone output was connected to a General Radio No. 1521B graphic level recorder. The H-143 earphone was driven from a General Radio beat frequency oscillator (BFO). The recording rate of the level recorder was controlled automatically by the BFO via mechanical coupling.

Using the above equipment, a frequency response graph was drawn for each of the following drive levels:

0.14 volts rms
0.28 volts rms
0.56 volts rms
1.12 volts rms

The earphone impedance was measured by connecting the earphone to a Hewlett-Packard 204B oscillator and adjusting the oscillator to 1000 Hz at 77 millivolts rms. The earphone was subsequently disconnected and replaced by a resistance substitution box. The resistance of the substitution box was then adjusted to obtain 77 millivolts. The earphone impedance was then read from the substitution box.

5.2 TEST DATA

5.2.1 Frequency Response

The frequency response and linearity test data graphs for each earphone may be found in appendix C. Frequency response data were extracted from these graphs, tabulated (tables XXXVI and XXXVII) and averaged.

TABLE XXXVI. — CARTER H-143 AVERAGE OUTPUT

	FREQUENCY				
	200	300	1000	2000	3000
AVE	95.6	94.2	93.1	89.8	93.1
σ	0.6	0.7	0.9	1.6	2.0

dB. SPL

TABLE XXXVII. — ASTROCOM H-143 AVERAGE OUTPUT

	FREQUENCY				
	200	300	1000	2000	3000
AVE	95.1	93.4	91.7	88.4	93.6
σ	0.5	0.6	1.0	1.7	1.9

dB. SPL

5.2.2 Impedance

TABLE XXXVIII. — CARTER H-143 IMPEDANCE

S/N	FREQ-HZ 200	400	600	800	1000	2000	4000	6000	7000	PEAK FREQUENCY Ohms/Hz	
95	18.8	18.8	18.8	18.8	18.8	19.4	19.7	20.1	20.4	21.6	3150
91	17.8	17.9	18.0	18.2	18.2	18.4	19.0	19.2	19.5	20.8	3650
63	17.9	17.9	18.1	18.1	18.3	18.6	19.3	19.5	19.7	21.0	2950
97	18.5	18.8	18.8	18.9	19.0	19.4	20.0	20.1	20.3	21.6	3150
92	17.7	17.7	17.8	18.0	18.1	18.5	19.3	19.3	19.7	21.0	3150
82	18.5	18.5	18.5	18.7	18.9	19.2	19.9	19.9	20.3	21.7	3650
72	17.3	17.5	17.5	17.8	18.0	18.2	18.8	19.0	19.4	20.6	3150
61	17.6	17.8	17.8	18.0	18.0	18.3	18.9	19.1	19.5	20.7	3150
81	18.3	18.5	18.5	18.7	18.7	18.3	19.7	19.7	20.0	21.3	3450
83	17.4	17.5	17.6	17.7	18.0	18.1	18.7	18.8	19.1	20.3	3650

MANUFACTURER: Carter.

MODEL: H-143/AIC.

All entries in ohms.

TABLE XXXIX. - CARTER H-143 IMPEDANCE

S/N	FREQ-HZ									PEAK FREQUENCY Ohms/Hz	
	200	400	600	800	1000	2000	4000	6000	7000		
88	17.7	17.7	17.8	17.8	18.2	18.4	19.1	19.1	19.2	19.0	3450
87	18.1	18.2	18.5	18.6	18.7	19.2	19.7	19.9	19.9	20.7	3150
86	17.4	17.4	17.4	17.4	17.4	18.3	18.8	18.9	18.9	27.1	3850
93	18.4	18.4	18.4	18.7	18.8	19.2	19.9	19.1	19.1	16.2	3150
99	17.8	17.8	17.8	17.9	17.9	18.6	19.0	19.3	19.5	110.6	4450

MANUFACTURER: Carter.
MODEL: H-143/AIC.

All entries in ohms.

TABLE XL. — CARTER H-143 IMPEDANCE

S/N	FREQ-HZ									PEAK FREQUENCY Ohms/Hz	
	200	400	600	800	1000	2000	4000	6000	7000		
96	19.4	19.6	19.7	19.7	19.8	20.4	21.1	21.1	21.6	21.9	3150
89	18.0	18.2	18.4	18.6	18.7	18.9	19.8	19.9	20.1	21.3	2950
98	18.5	18.7	18.7	18.8	19.3	19.9	20.2	20.2	20.6	21.6	3250
90	18.7	18.7	18.7	19.0	19.0	19.0	19.9	19.9	20.2	21.5	3250
94	17.5	17.5	17.5	17.9	18.0	18.3	18.7	18.9	19.1	20.2	3150
84	18.7	18.8	18.8	19.1	19.1	19.5	20.3	20.3	20.6	21.9	3450
100	18.8	18.8	18.9	18.9	19.1	19.5	19.5	19.7	20.0	21.3	3150

MANUFACTURER: Carter.
MODEL: H-143/AIC.

All entries in ohms.

TABLE XLI. — ASTROCOM H-143 IMPEDANCE

S/N	FREQ-HZ									PEAK FREQUENCY Ohms/Hz	
	200	400	600	800	1000	2000	4000	6000	7000		
71	18.1	18.1	18.1	18.1	18.3	18.7	19.5	19.7	19.8	21.1	3150
80	17.5	17.5	17.5	17.7	17.7	18.2	18.9	19.2	19.2	20.5	3150
77	18.5	18.5	18.7	18.7	18.7	19.1	19.9	20.1	20.2	21.5	3645
64	10.0	10.0	10.0	10.0	10.0	10.0	10.2	10.2	10.2	10.8	----
66	17.8	17.8	17.8	17.9	18.0	18.4	19.1	19.2	19.5	28.1	3150

MANUFACTURER: Astrocom.

MODEL: H-143/AIC.

All entries in ohms.

C.2

TABLE XLII. — ASTROCOM H-143 IMPEDANCE

S/N	FREQ-HZ									PEAK FREQUENCY Ohms/Hz	
	200	400	600	800	1000	2000	4000	6000	7000		
68	17.5	17.6	17.6	17.8	17.9	18.3	19.0	19.2	19.6	20.8	3150
62	17.3	17.4	17.5	17.6	17.8	18.2	18.8	19.1	19.4	20.6	2950
65	18.3	18.3	18.5	18.5	18.7	19.0	20.0	20.0	20.6	21.9	3150
69	17.6	17.6	17.5	17.7	17.7	18.0	19.0	19.0	19.4	20.6	2950
78	18.0	18.0	18.0	18.2	18.2	18.7	19.4	19.6	19.8	21.1	3150
67	17.5	17.6	17.7	17.9	17.9	18.4	19.2	19.5	19.8	21.0	2950
73	18.1	18.3	18.3	18.3	18.7	19.1	19.8	20.0	20.4	21.6	3250

MANUFACTURER: Astrocom.
MODEL: H-143/AIC.

All entries in ohms.

6.0 TEST DATA EVALUATION SUMMARY

The following list details the areas of significant differences in microphone performance found for the various vendors. Data categories not listed were judged to not have significant variations from one vendor to another.

6.1 M-87/AIC SENSITIVITY

The average sensitivities at 1000 Hz of the M-87 microphones for the four vendors are listed below (in microvolts per dyne per square centimeter).

	SEA LEVEL	25,000 FT
Carter	1.41 ± 0.15	2.45 ± 0.24
Astrocom	1.33 ± 0.12	2.20 ± 0.19
Electrovoice	1.29 ± 0.16	1.74 ± 0.87
Roanwell	1.02 ± 0.26	1.15 ± 0.41

Each datum is listed plus or minus one standard deviation.

6.2 M-87/AIC IMPEDANCE

The average impedances of the M-87 microphone at 1000 Hz are listed below for the four vendors:

Carter	5.21 ± .08
Astrocom	4.96 ± .15
Electrovoice	5.11 ± .18
Roanwell	3.17 ± .06

Each impedance is listed plus or minus one standard deviation.

7.0 CONCLUSIONS

A careful evaluation of the test data yields the following conclusions:

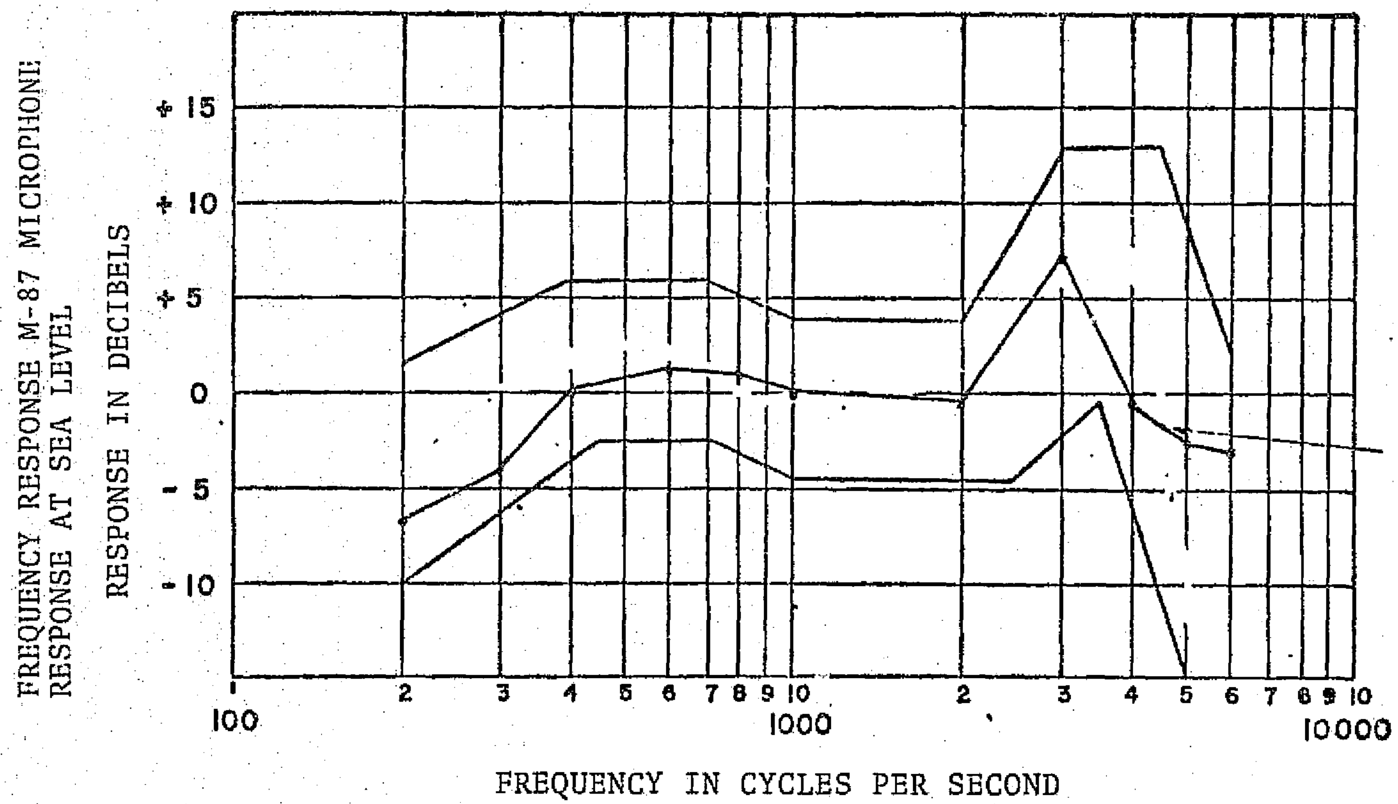
- The H-143 earphones supplied by Astrocom and Carter are functionally equivalent, i.e., no significant differences in earphone performance were noted.
- The M-87 microphones supplied by four different vendors revealed two areas of significant parameter variation. The Roanwell M-87 microphones yielded an average impedance of 3 ohms at 1000 Hz. The impedance of the microphones supplied by the other three vendors averaged 5 ohms. In addition, the Roanwell microphones averaged much lower in sensitivity than did the other vendors' units.
- No important performance variations were found for the M-101 microphones supplied by the three vendors (Astrocom, Electrovoice, and Carter).

APPENDIX A

M-87/AIC FREQUENCY RESPONSE GRAPHS

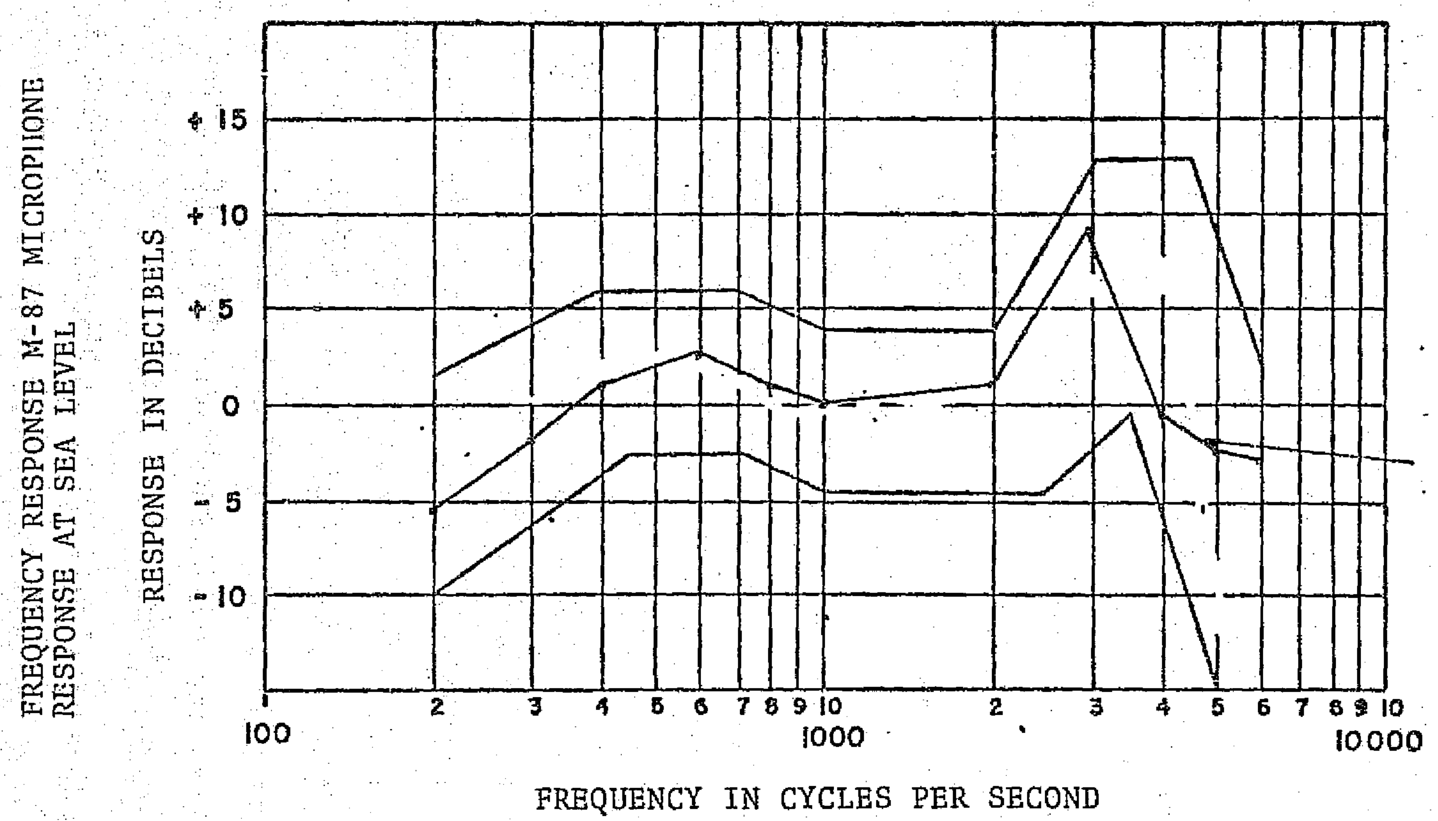
FIGURES

Figure		Page



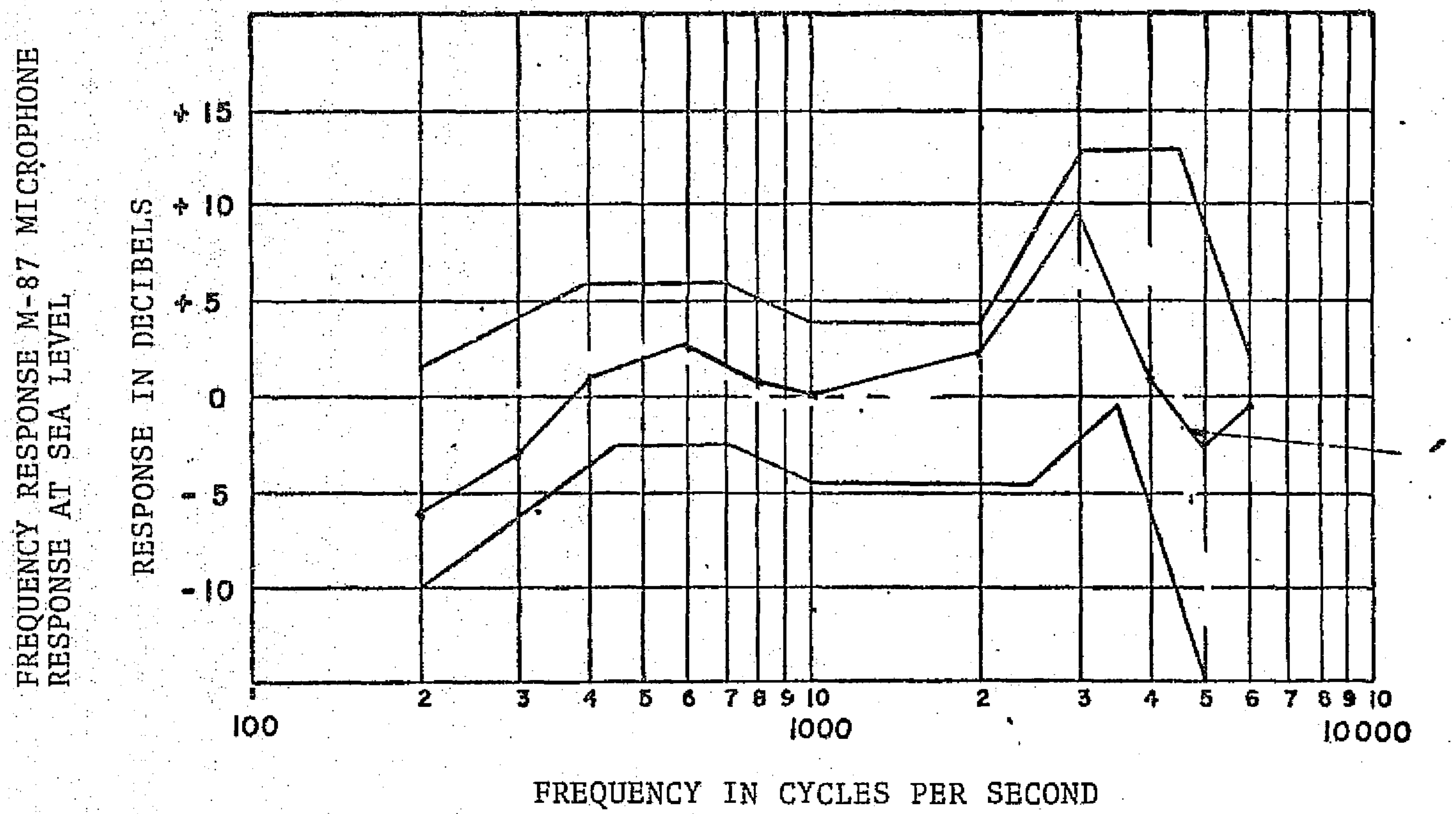
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-1.– Carter M-87 ground level frequency response SN-41.



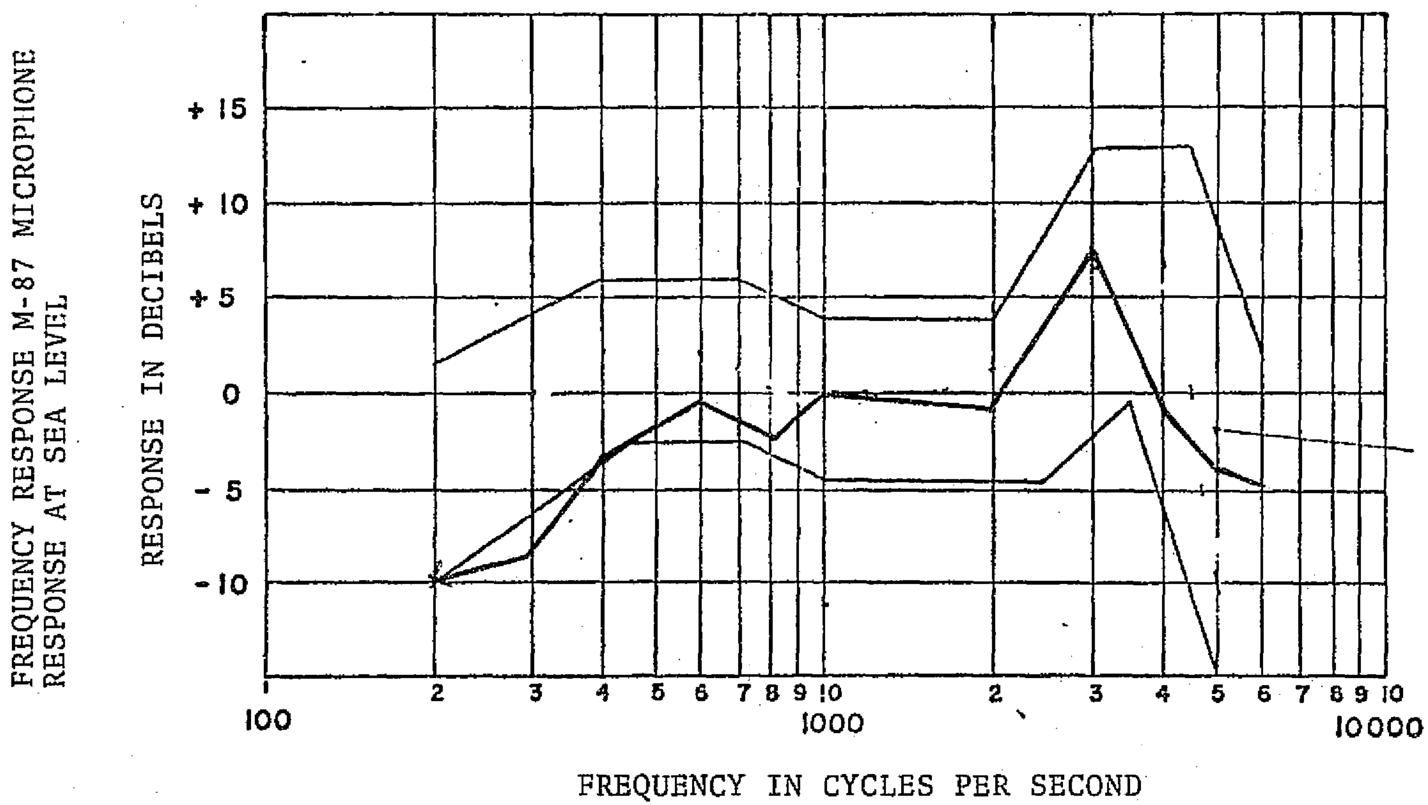
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-2.— Carter M-87 ground level frequency response SN-42.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

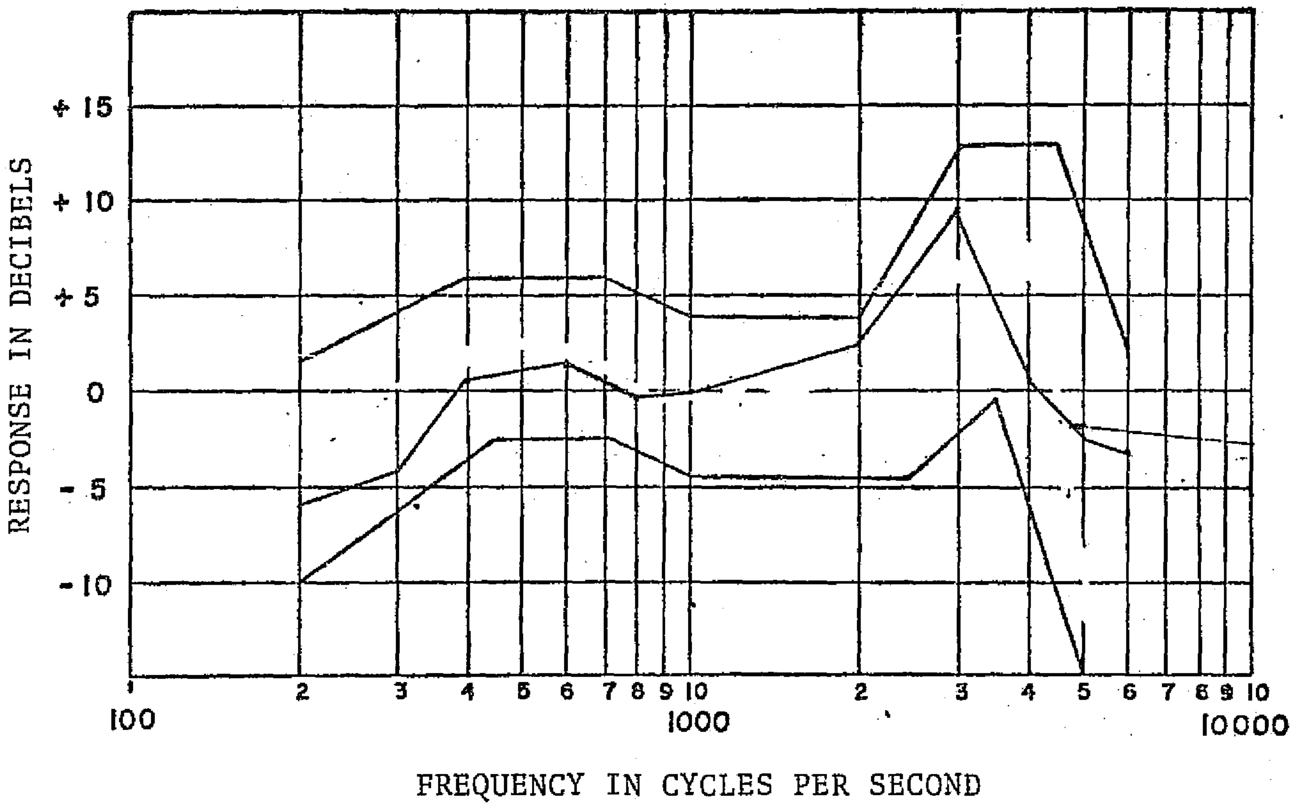
Figure A-3.— Carter M-87 ground level frequency response SN-43.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-4.– Carter M-87 ground level frequency response SN-44.

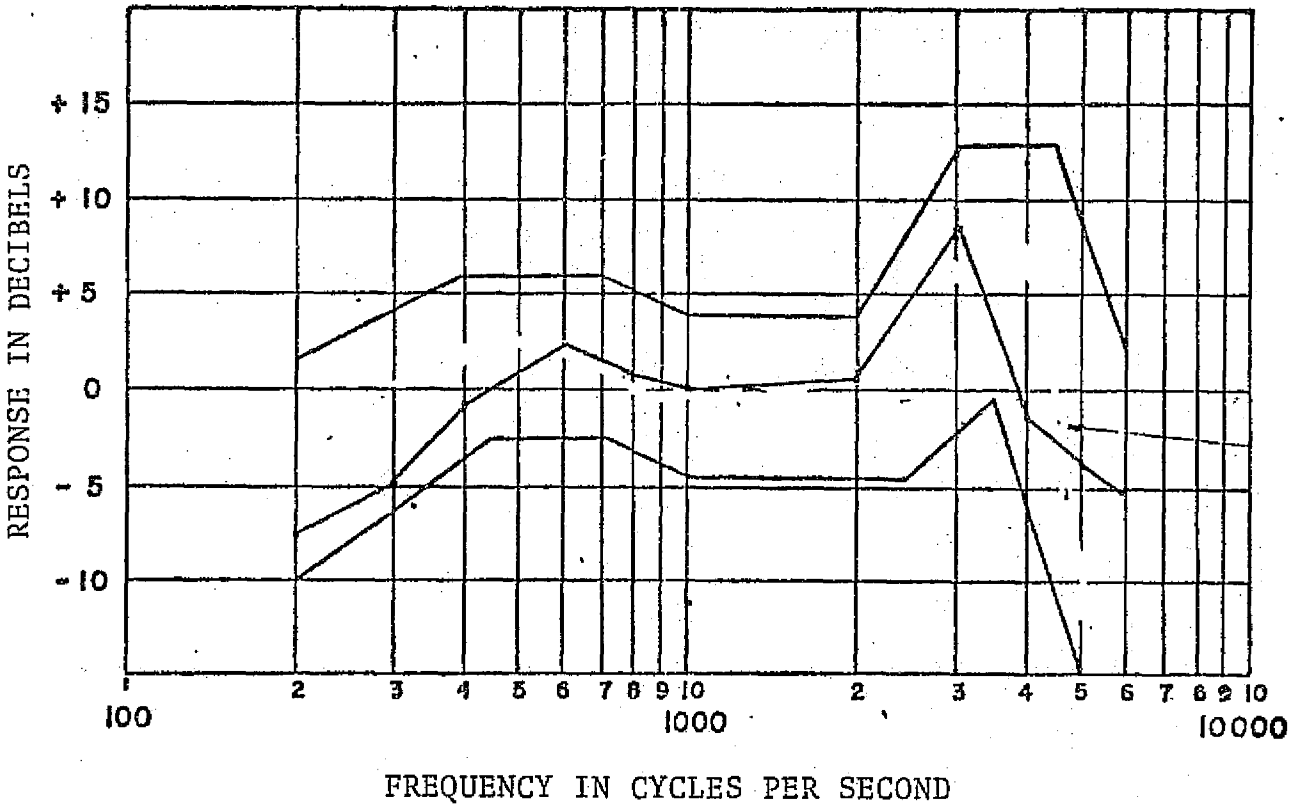
FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

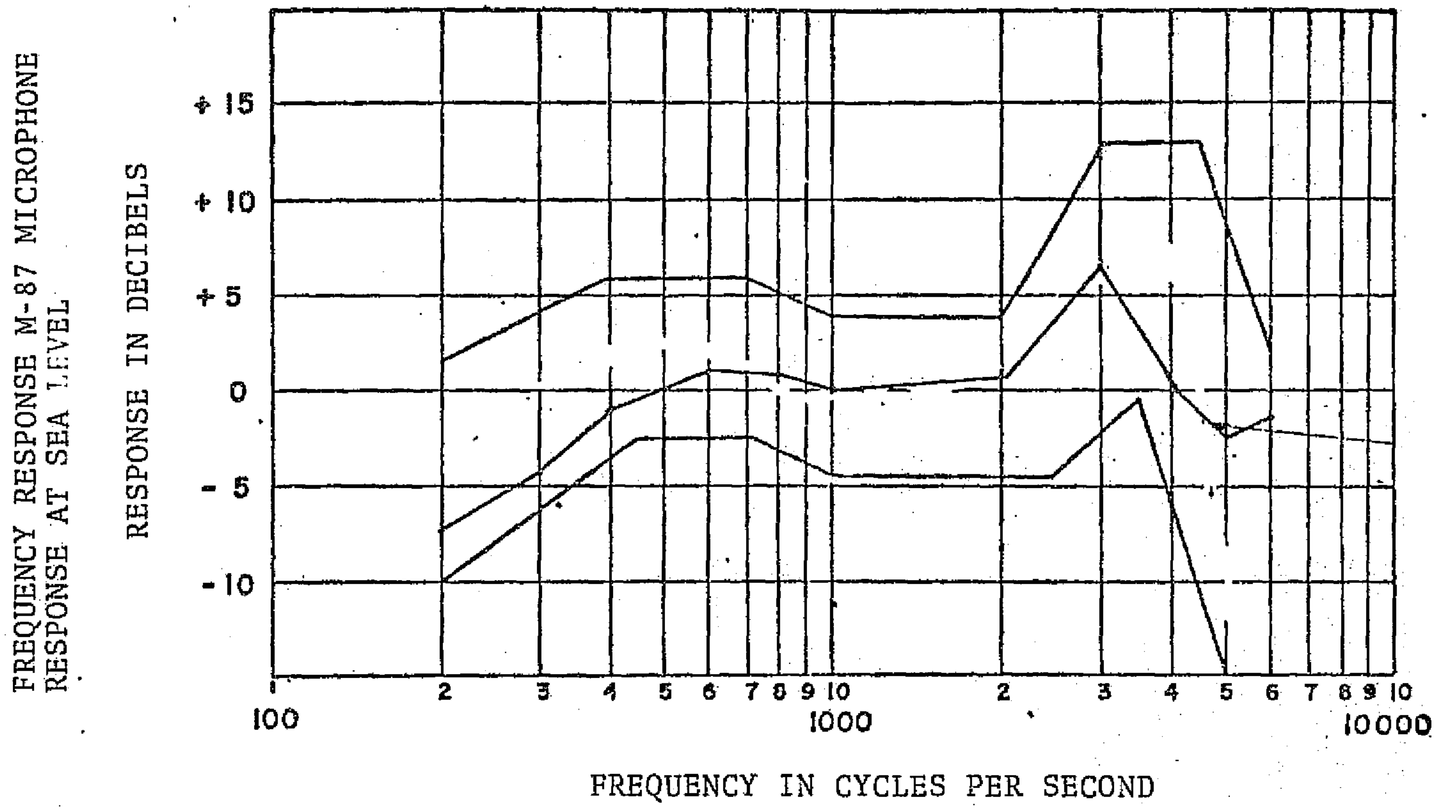
Figure A-5.— Carter M-87 ground level frequency response SN-45.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

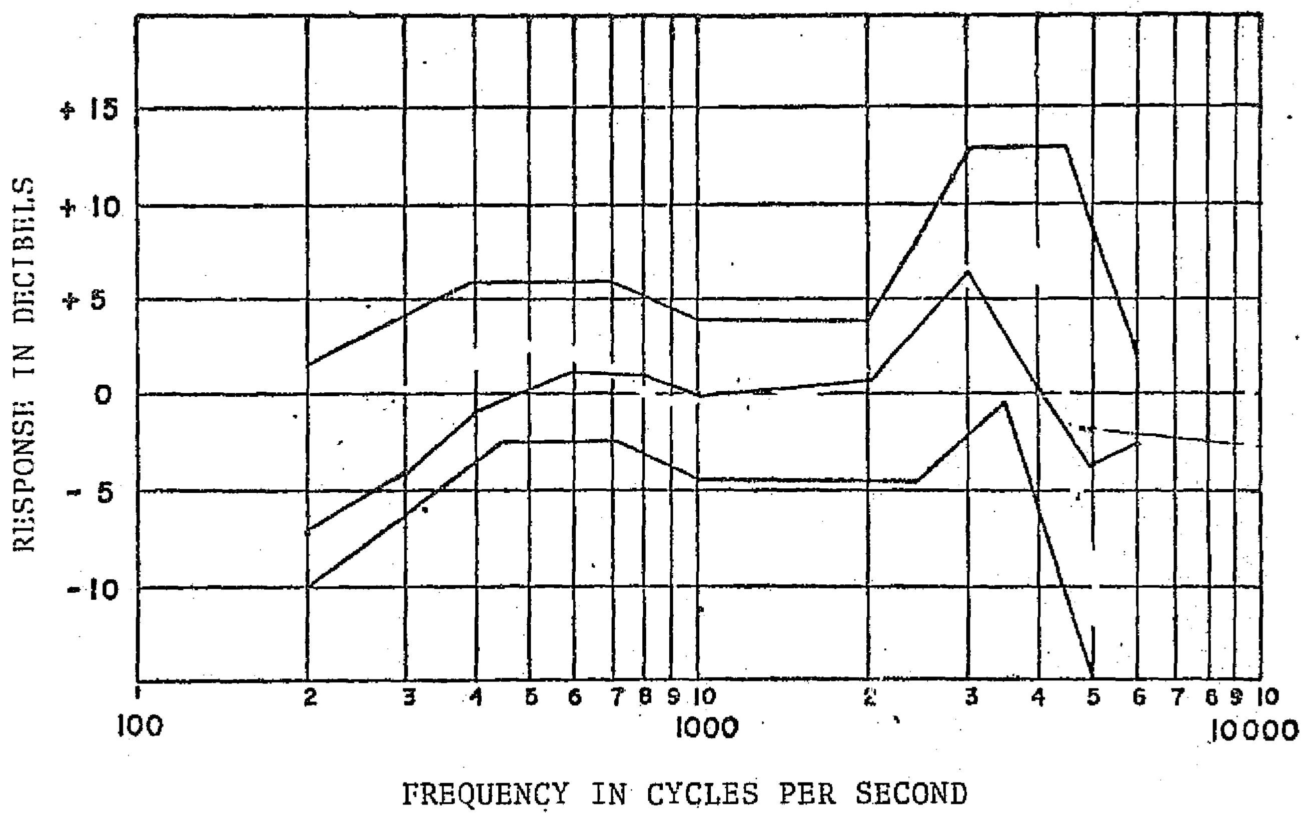
Figure A-6.– Carter M-87 ground level frequency response SN-46.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

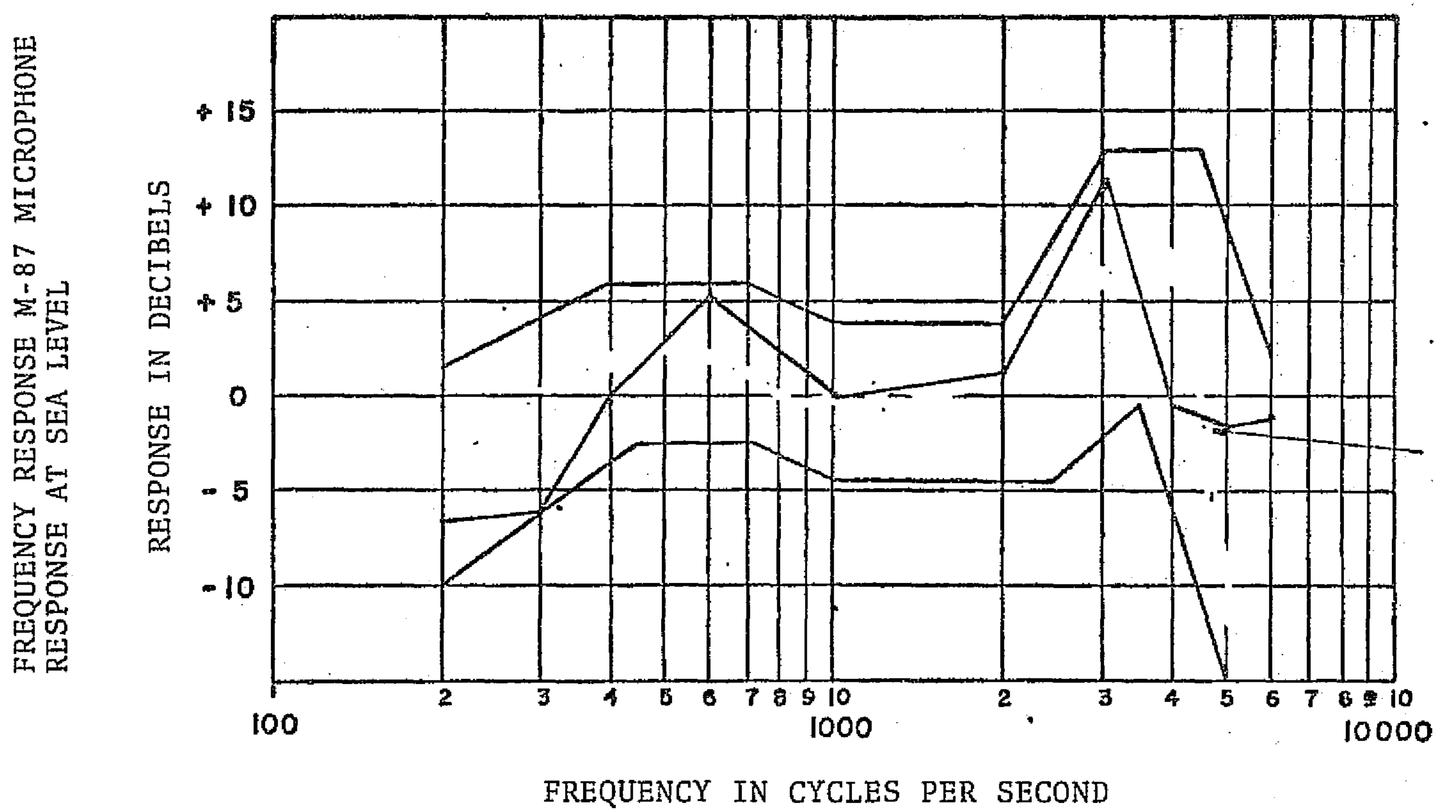
Figure A-7.– Carter M-87 ground level frequency response SN-47.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

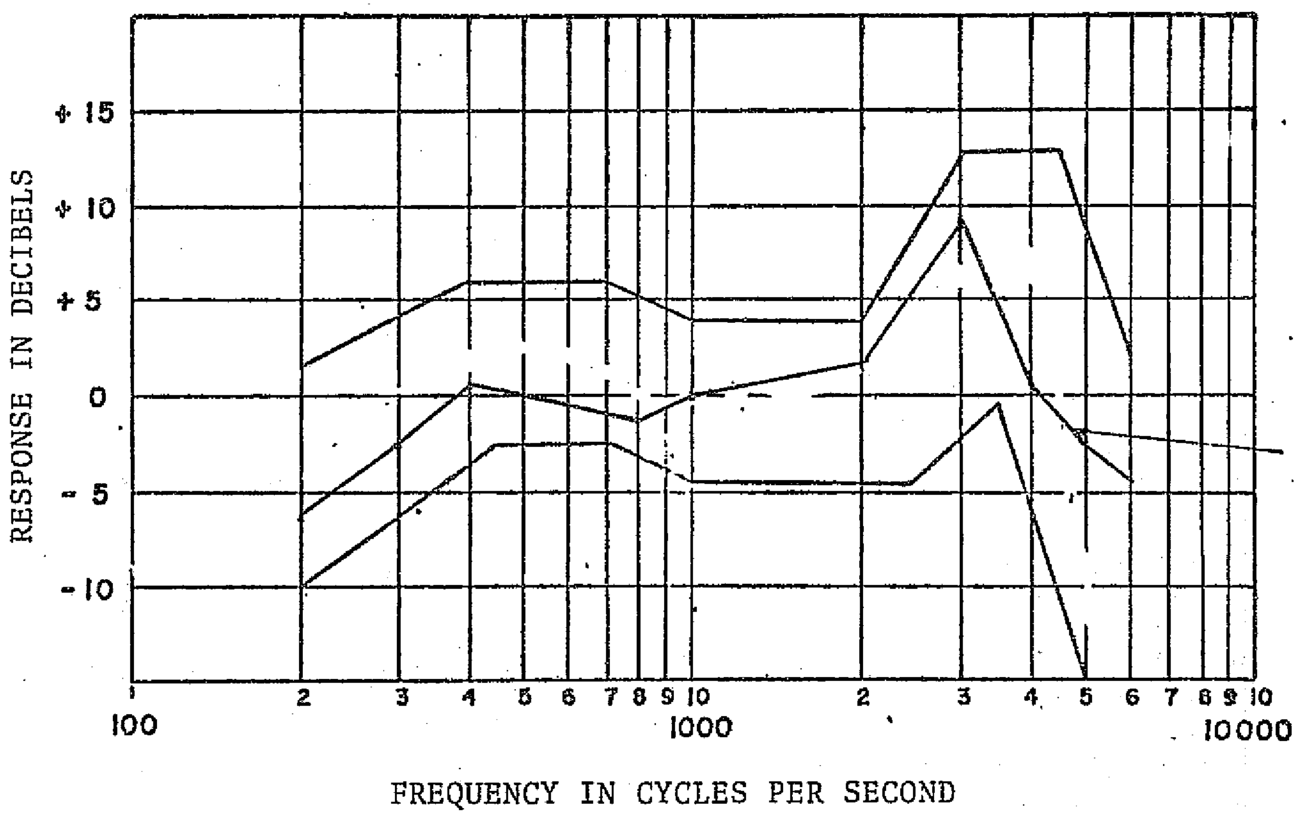
Figure A-8.— Carter M-87 ground level frequency response SN-48.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-9.— Carter M-87 ground level frequency response SN-49.

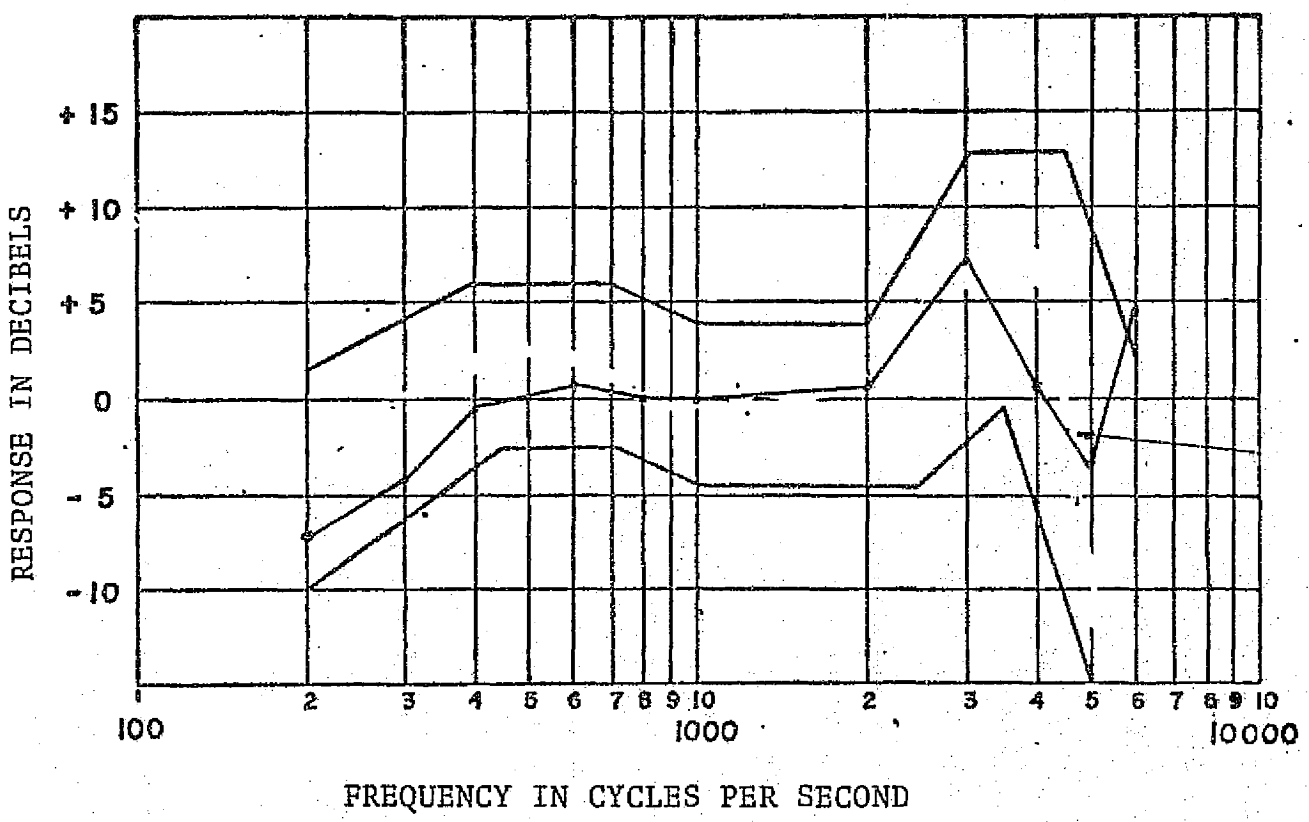
FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

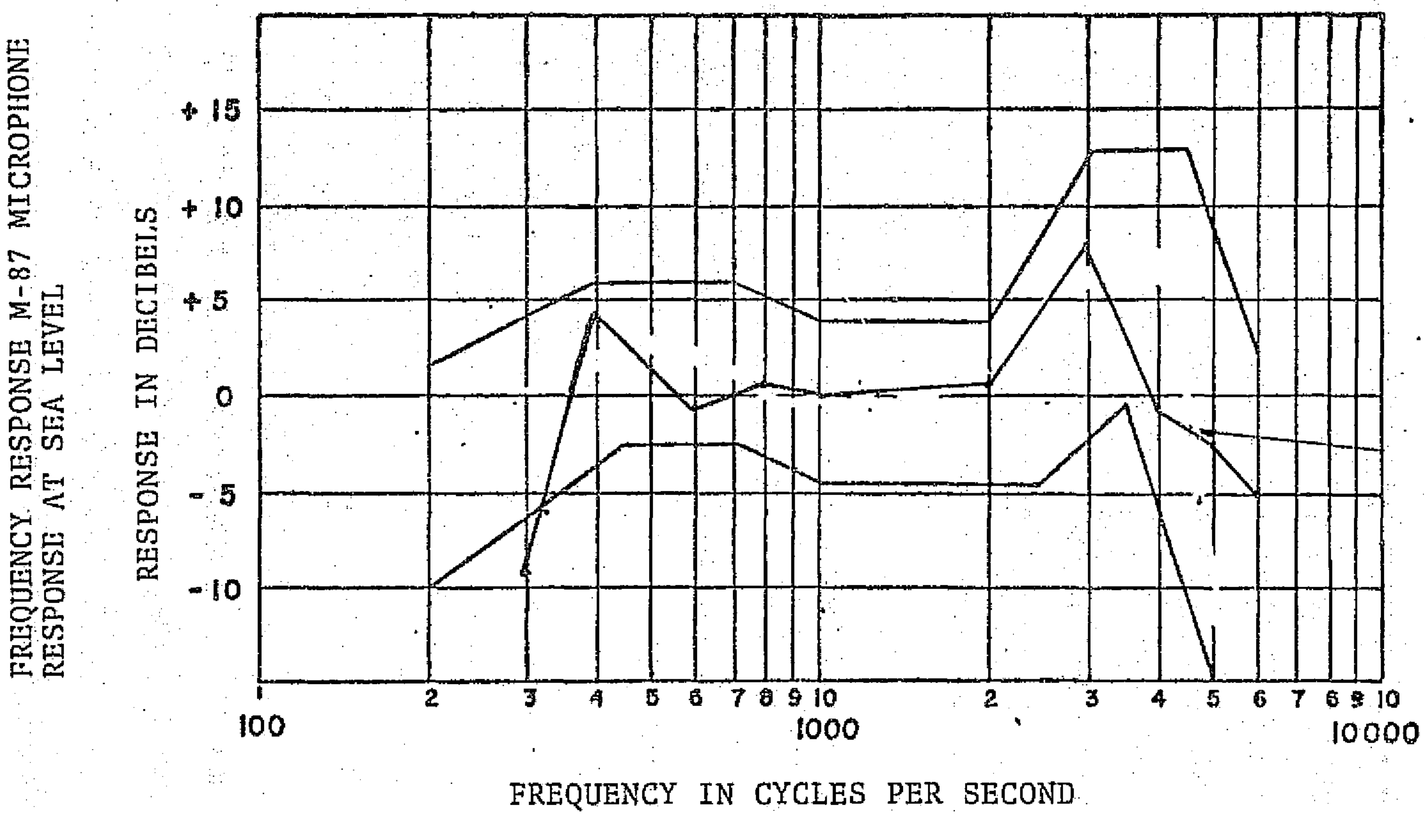
Figure A-10.– Carter M-87 ground level frequency response SN-50.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT SEA LEVEL



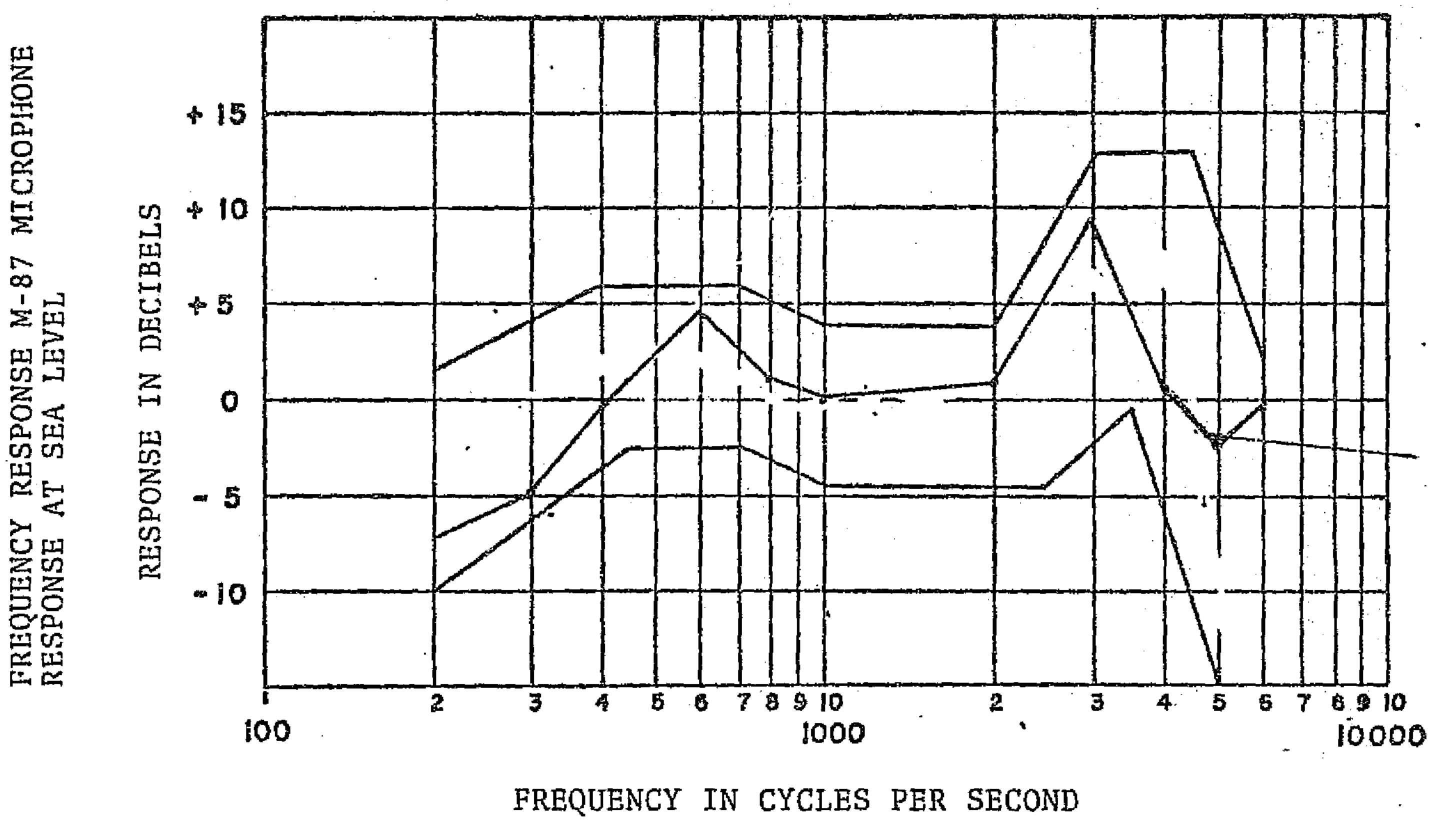
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-11.— Astrocom M-87 ground level frequency response SN-31.



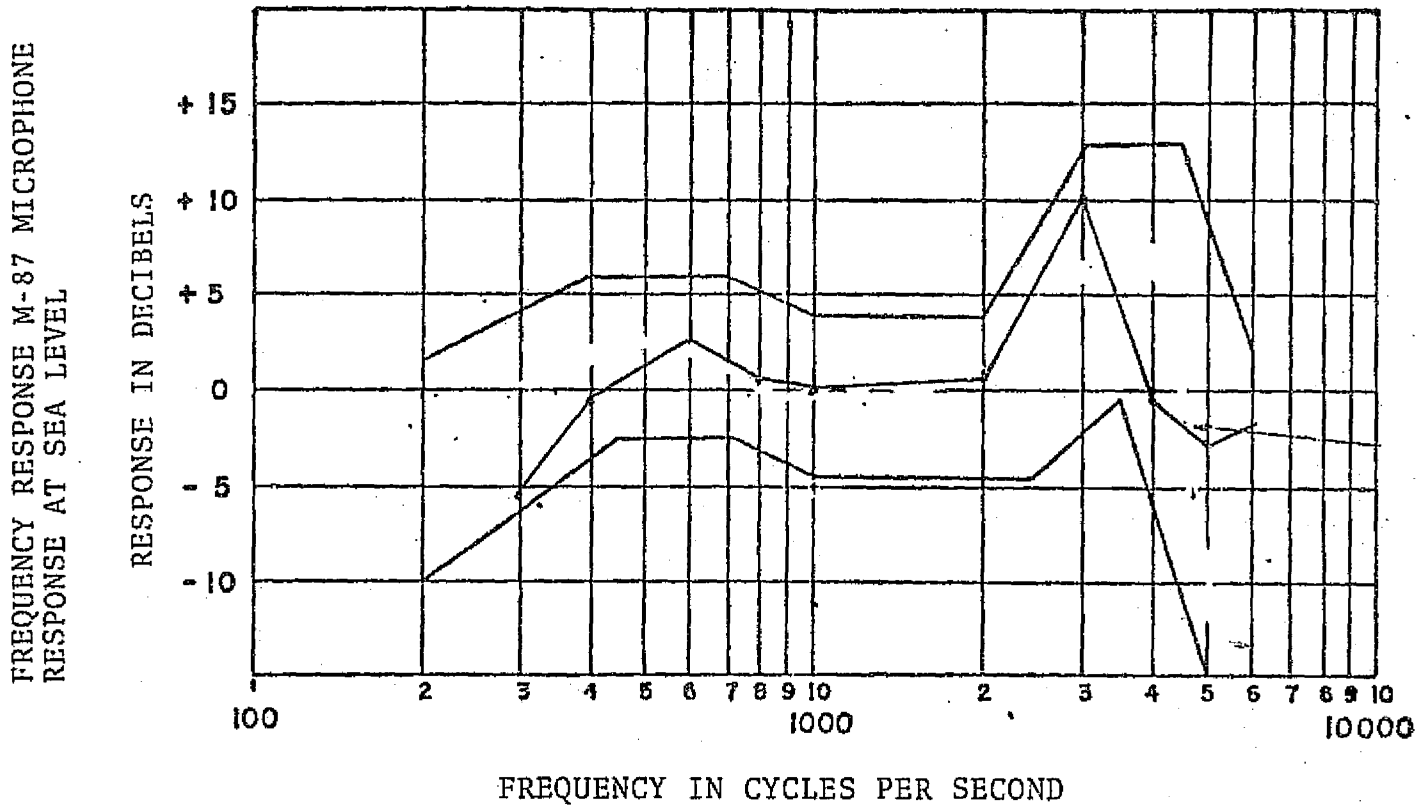
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-12.– Astrocom M-87 ground level frequency response SN-32.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

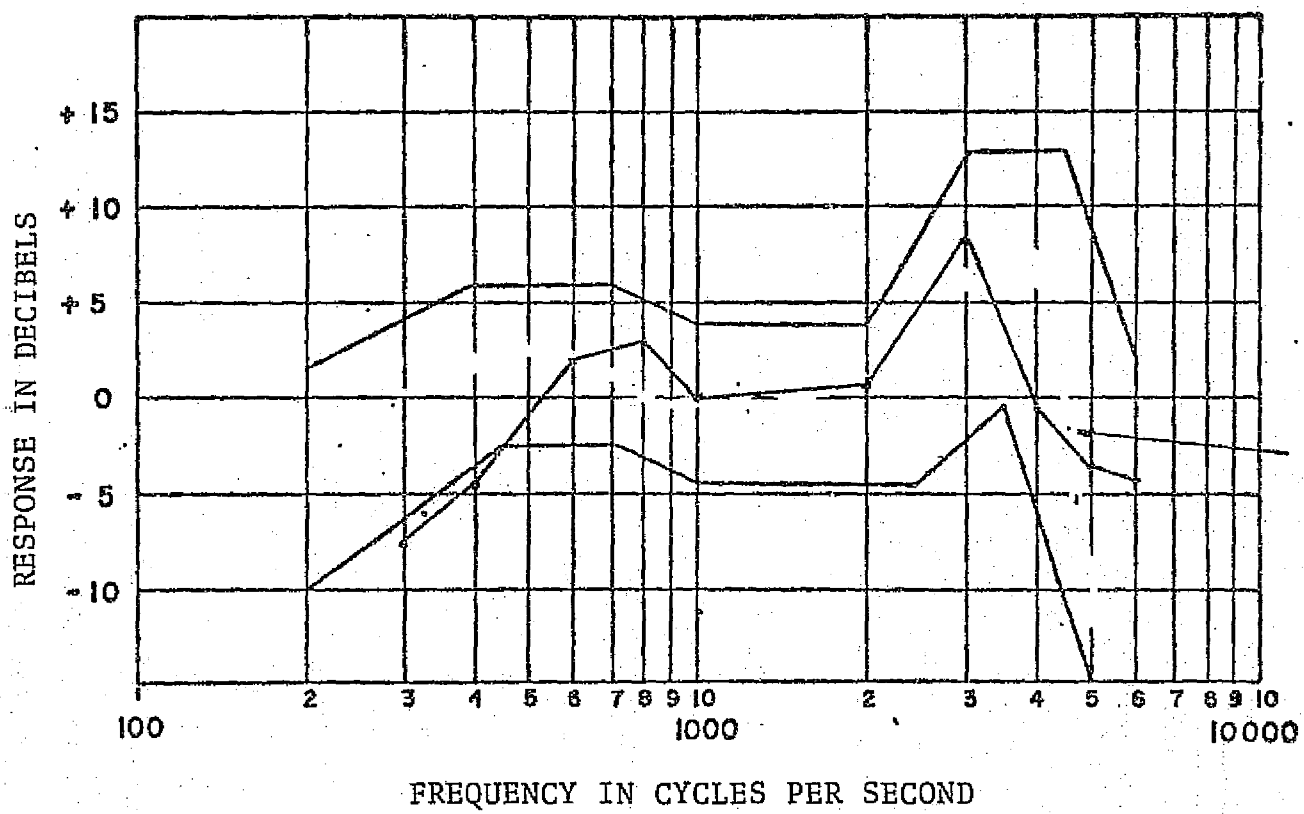
Figure A-13.— Astrocom M-87 ground level frequency response SN-33.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

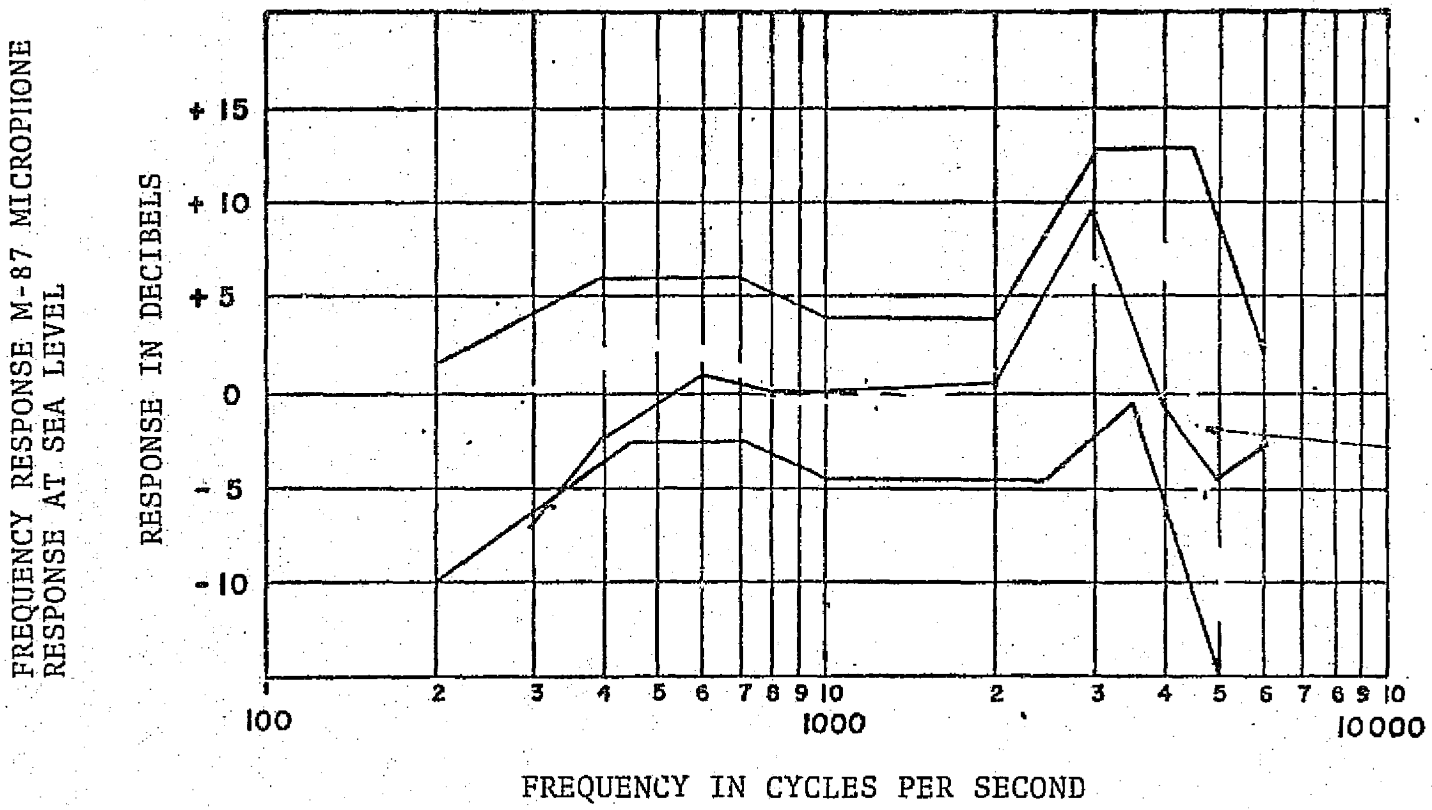
Figure A-14.— Astrocom M-87 ground level frequency response SN-34.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT SEA LEVEL



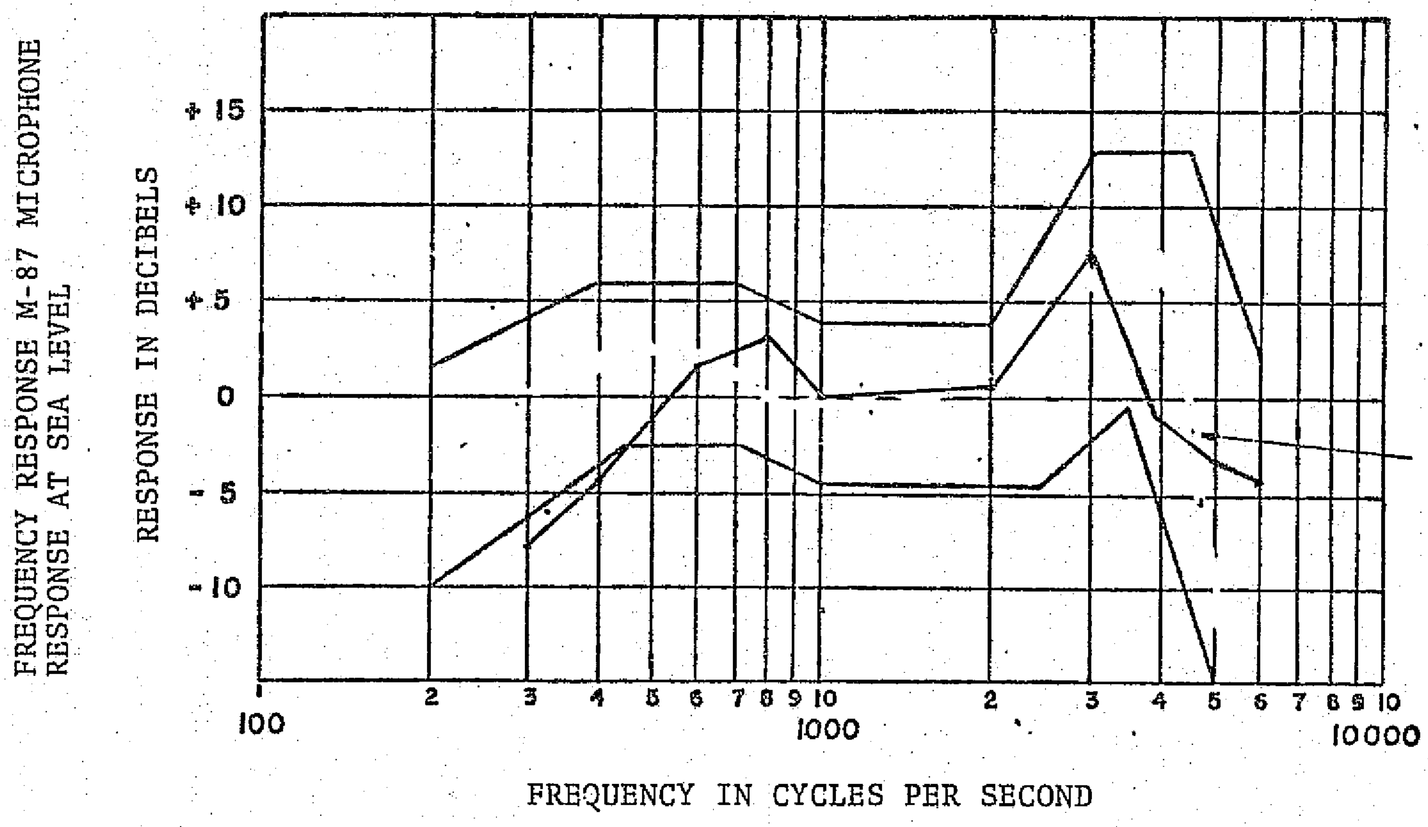
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-15.– Astrocom M-87 ground level frequency response SN-35.



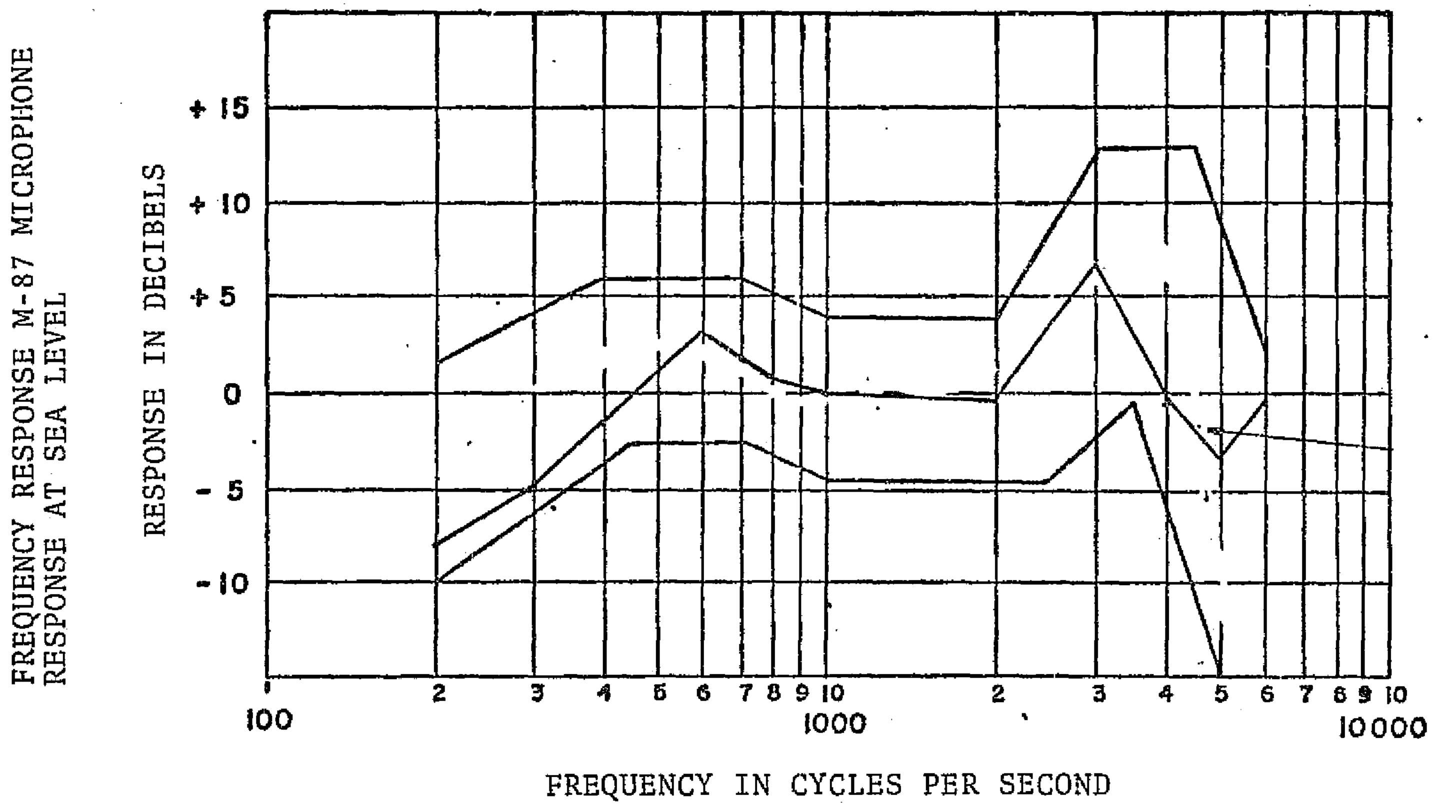
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-16.— Astrocom M-87 ground level frequency response SN-36.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

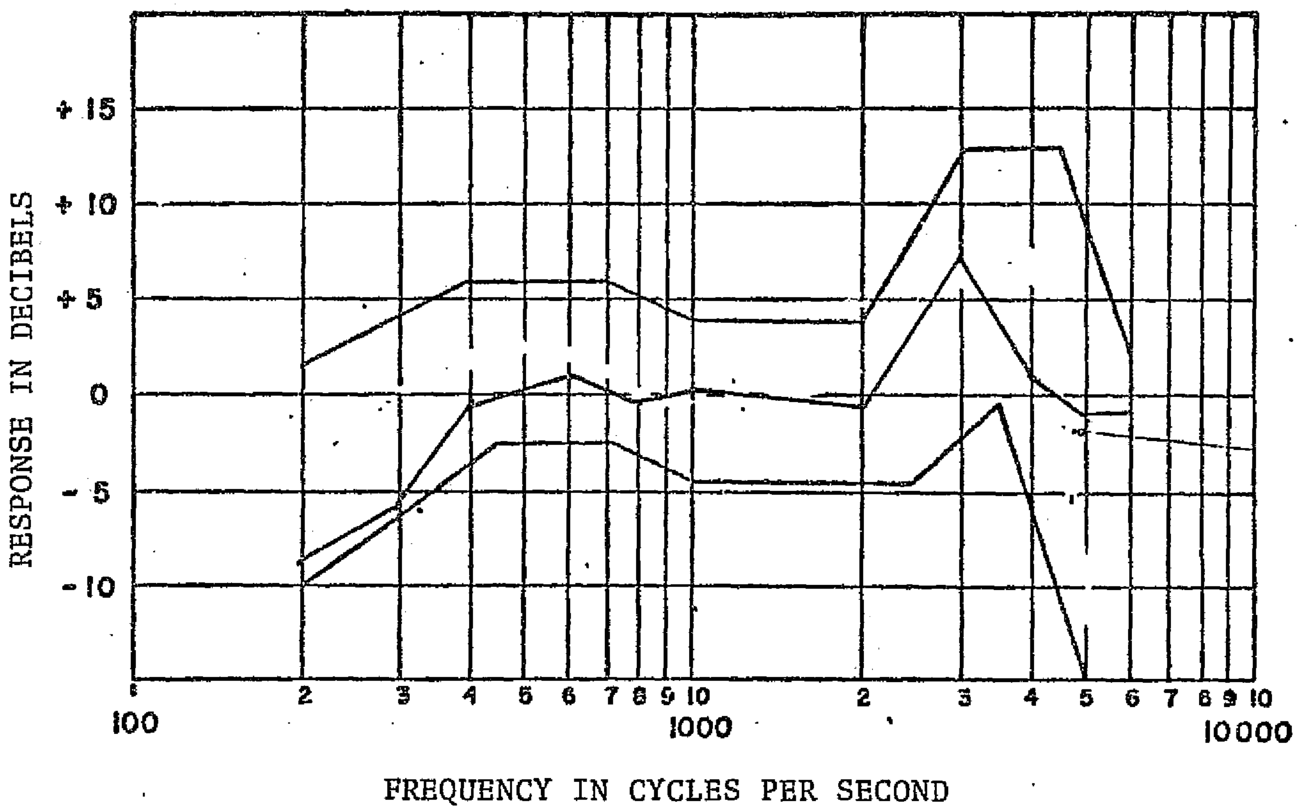
Figure A-17.— Astrocom M-87 ground level frequency response SN-37.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

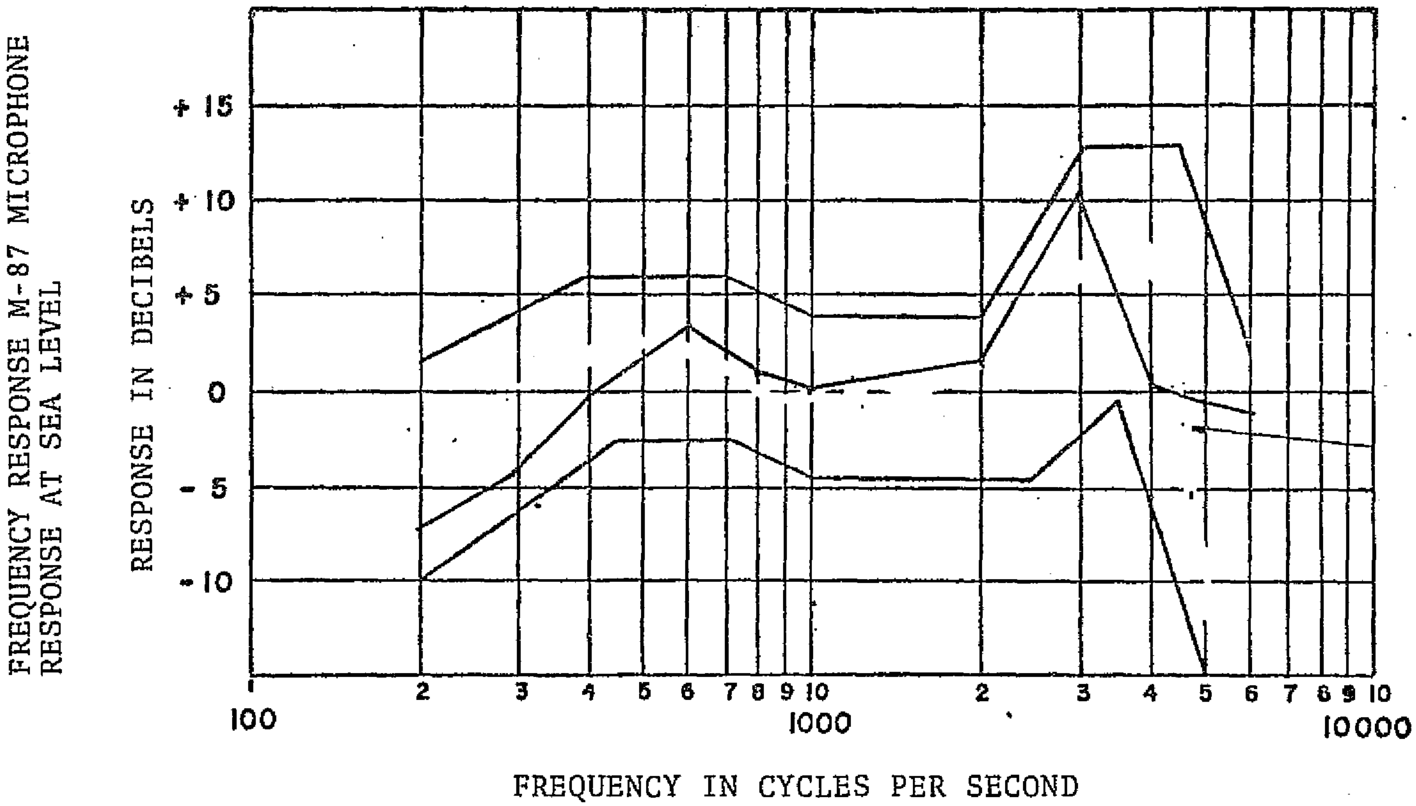
Figure A-18.— Astrocom M-87 ground level frequency response SN-38.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

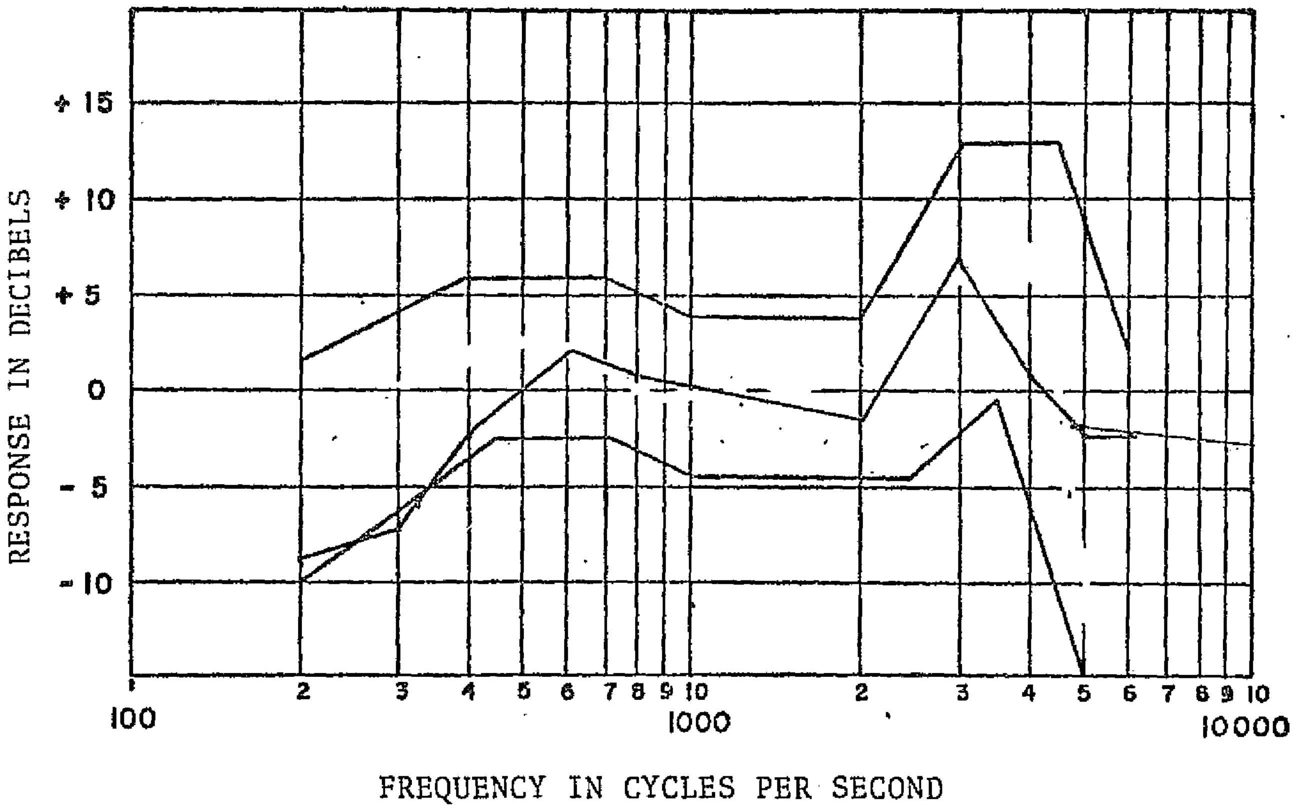
Figure A-19.— Astrocom M-87 ground level frequency response SN-39.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-20.– Astrocom M-87 ground level frequency response SN-40.

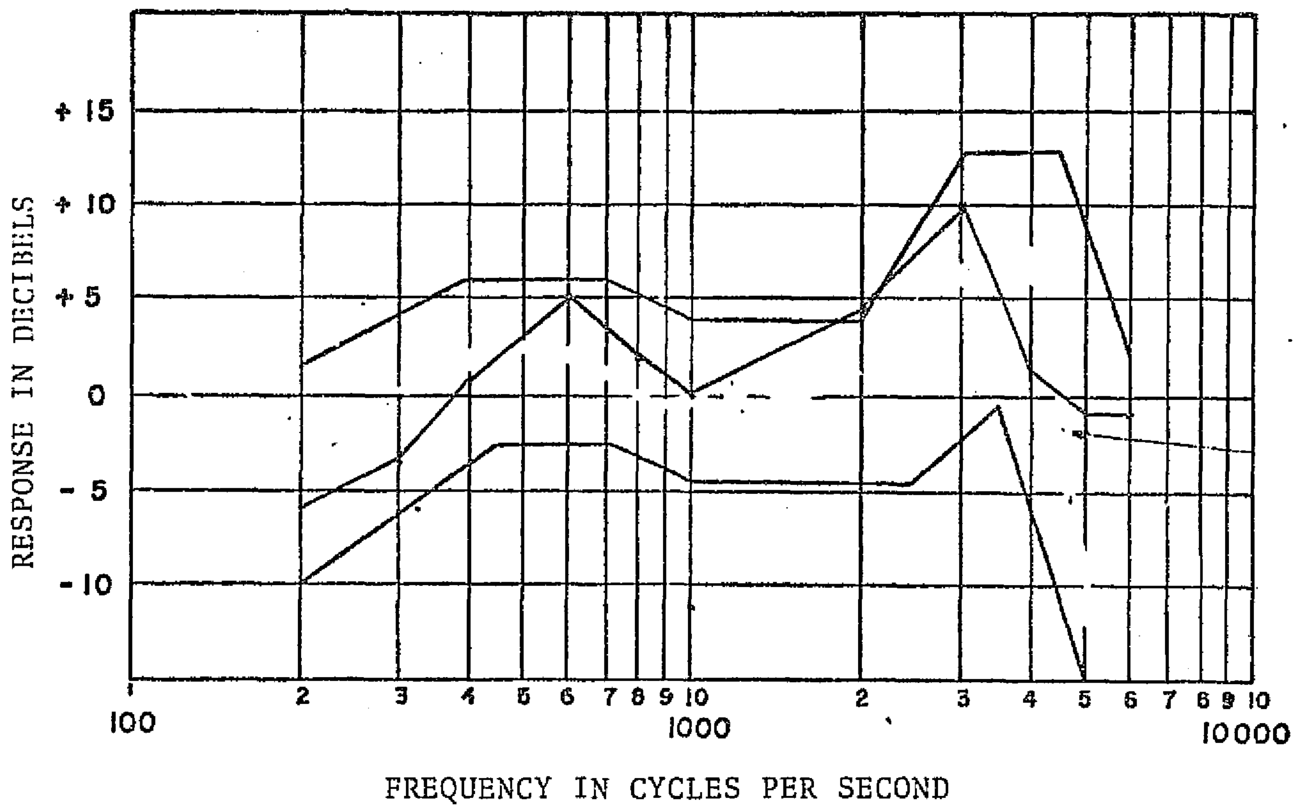
FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

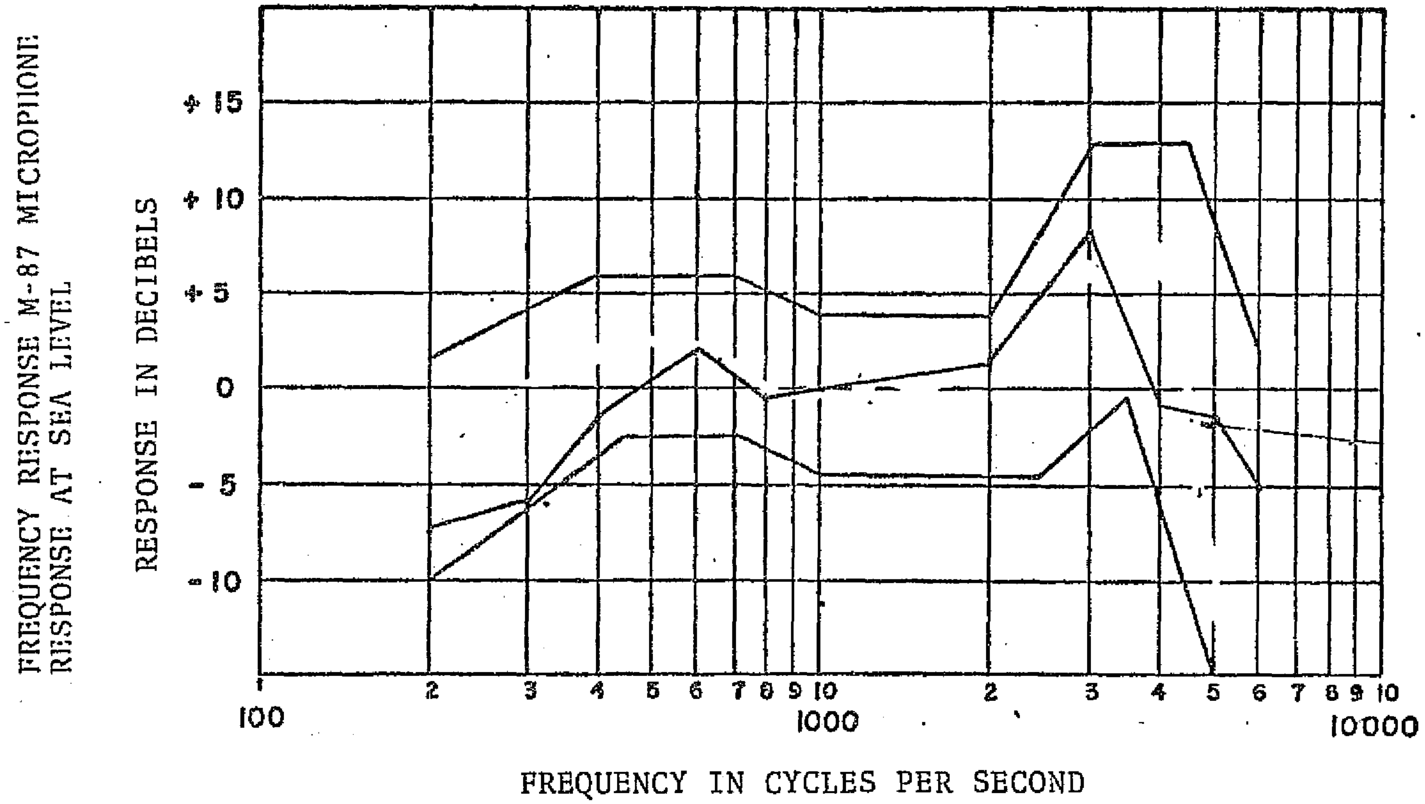
Figure A-21.— Electrovoice M-87 ground level frequency response SN-51.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT SEA LEVEL



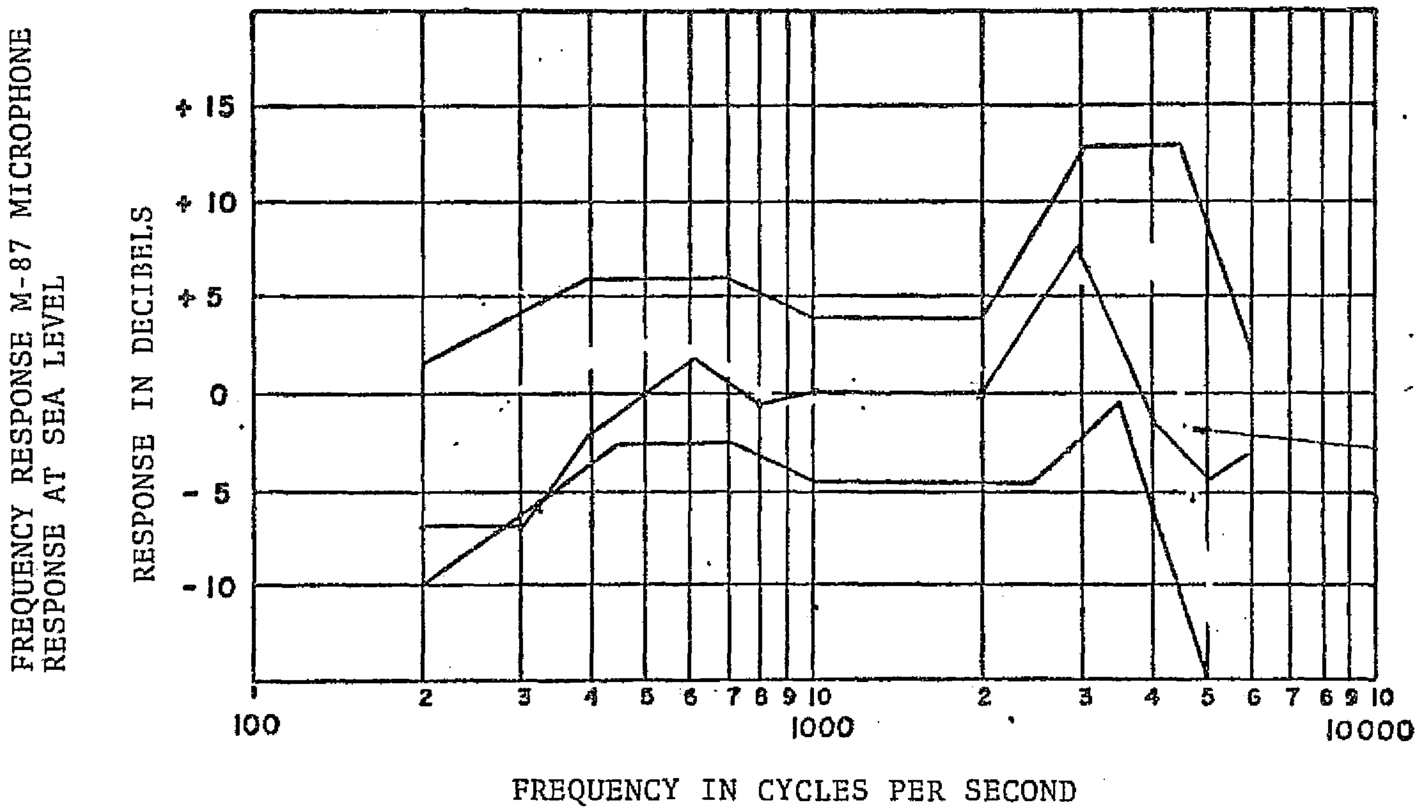
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-22.– Electrovoice M-87 ground level frequency response SN-52.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

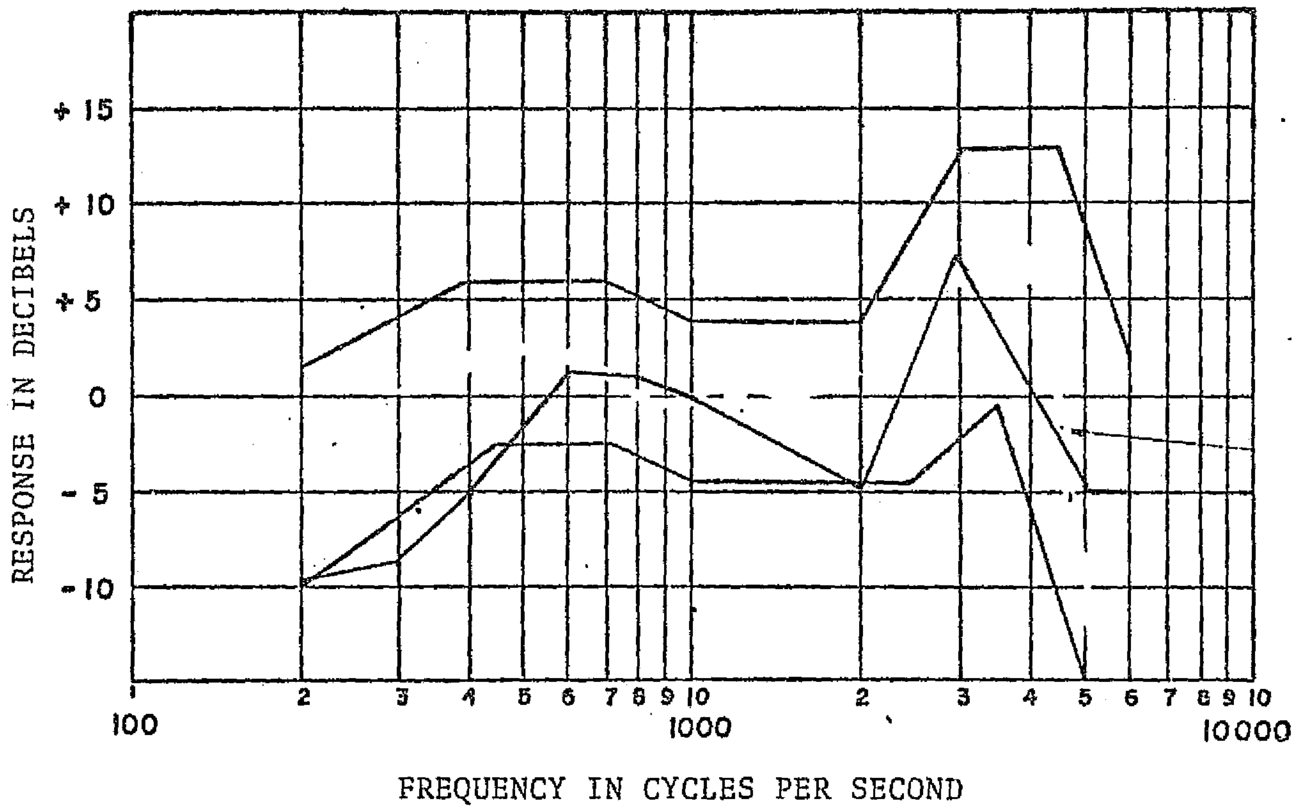
Figure A-23.– Electrovoice M-87 ground level frequency response SN-53.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

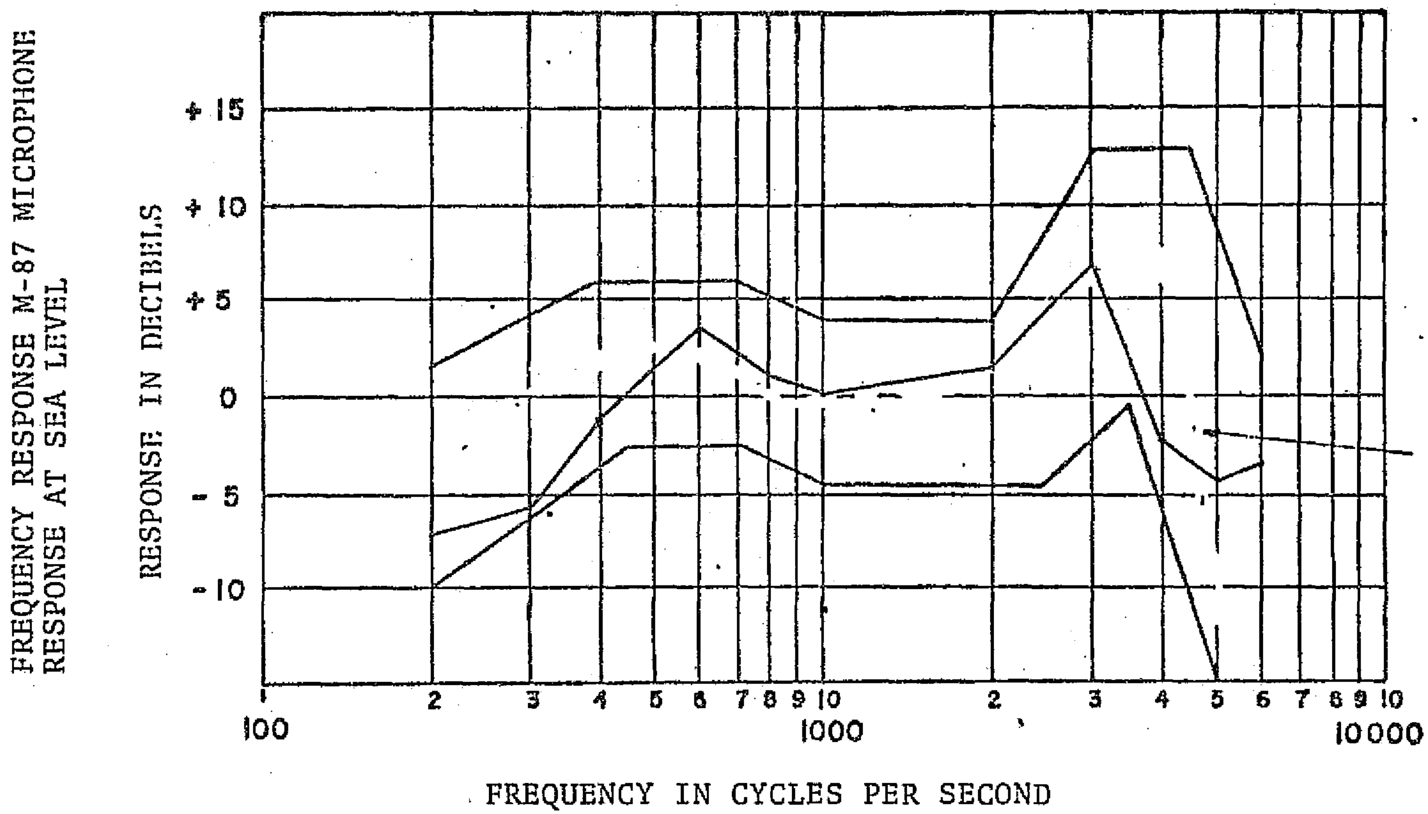
Figure A-24.– Electrovoice M-87 ground level frequency response SN-54.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT SEA LEVEL



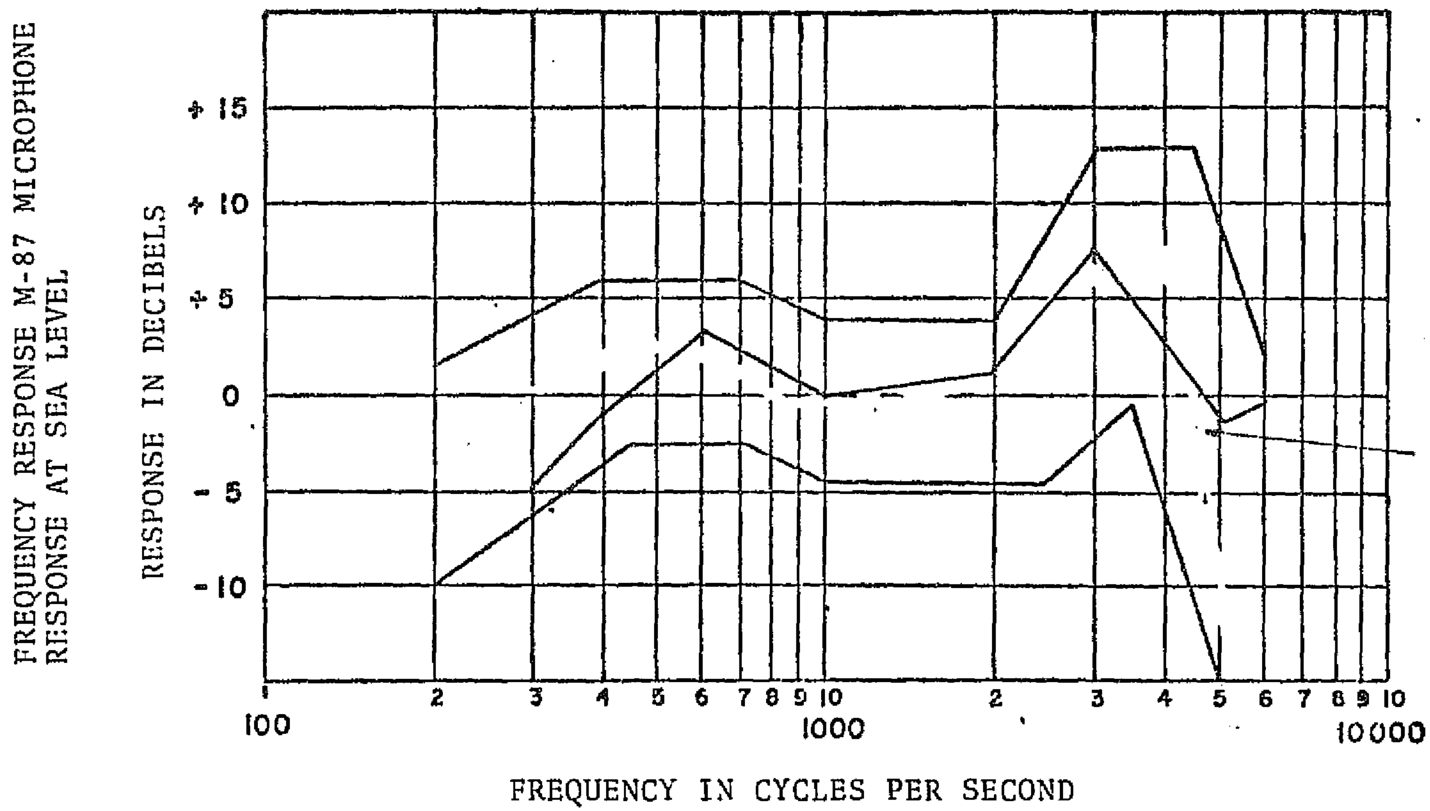
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-25.– Electrovoice M-87 ground level frequency response SN-55.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

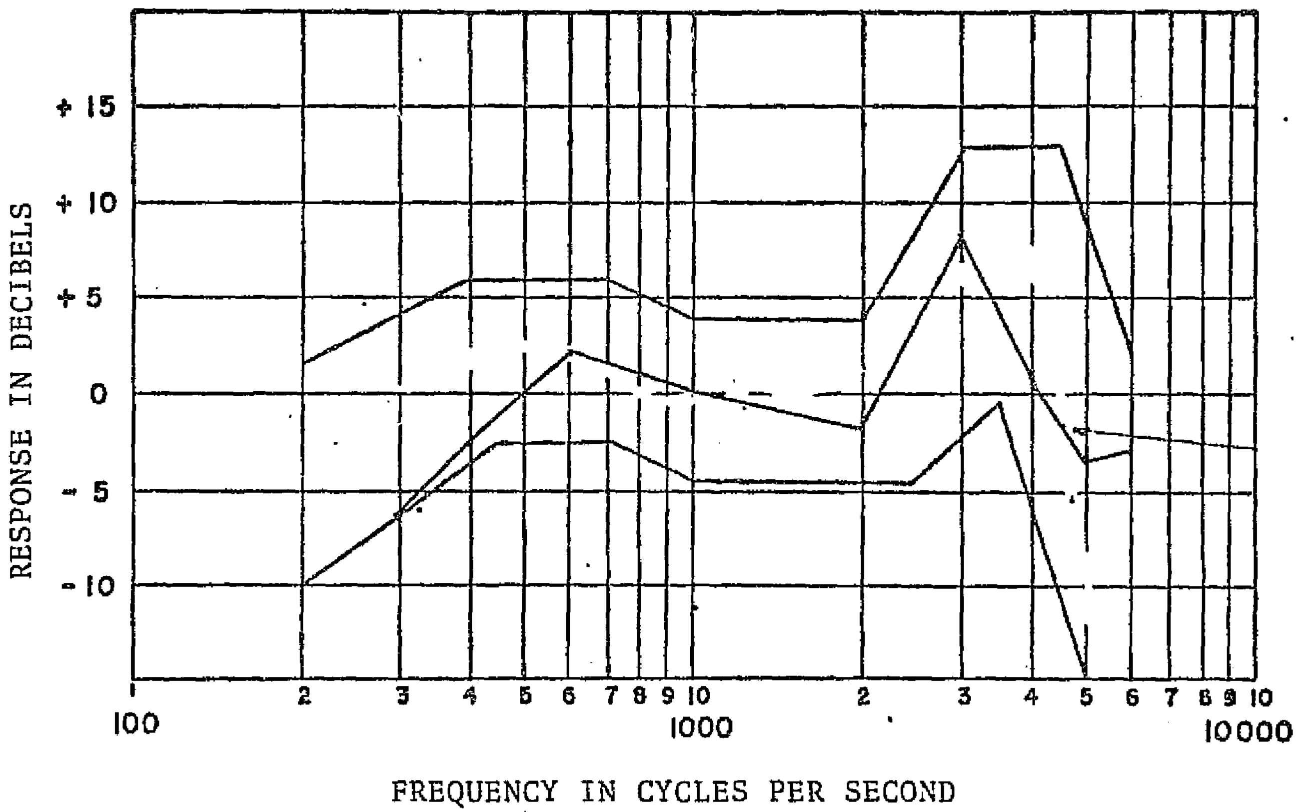
Figure A-26.– Electrovoice M-87 ground level frequency response SN-56.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

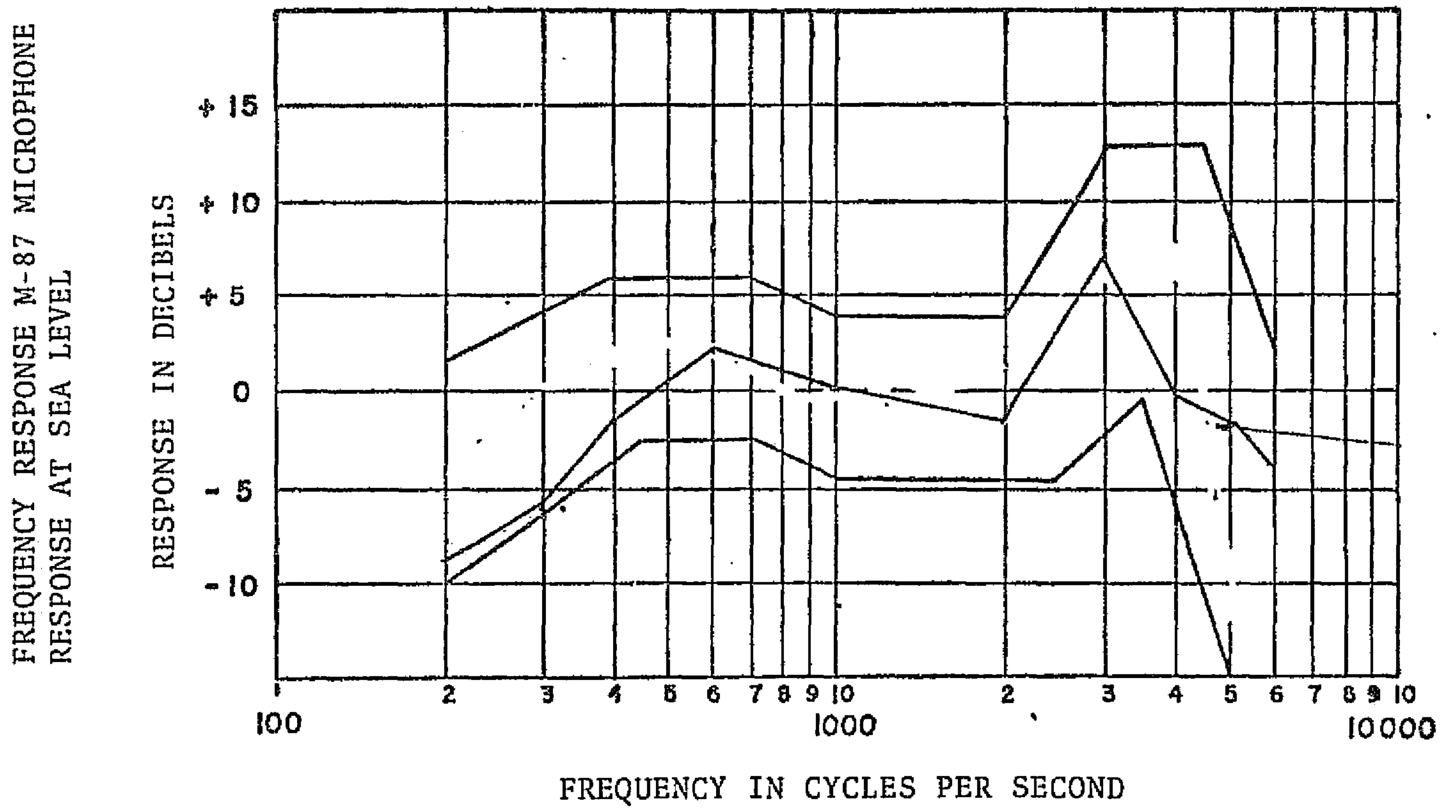
Figure A-27.– Electrovoice M-87 ground level frequency response SN-57.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT SEA LEVEL



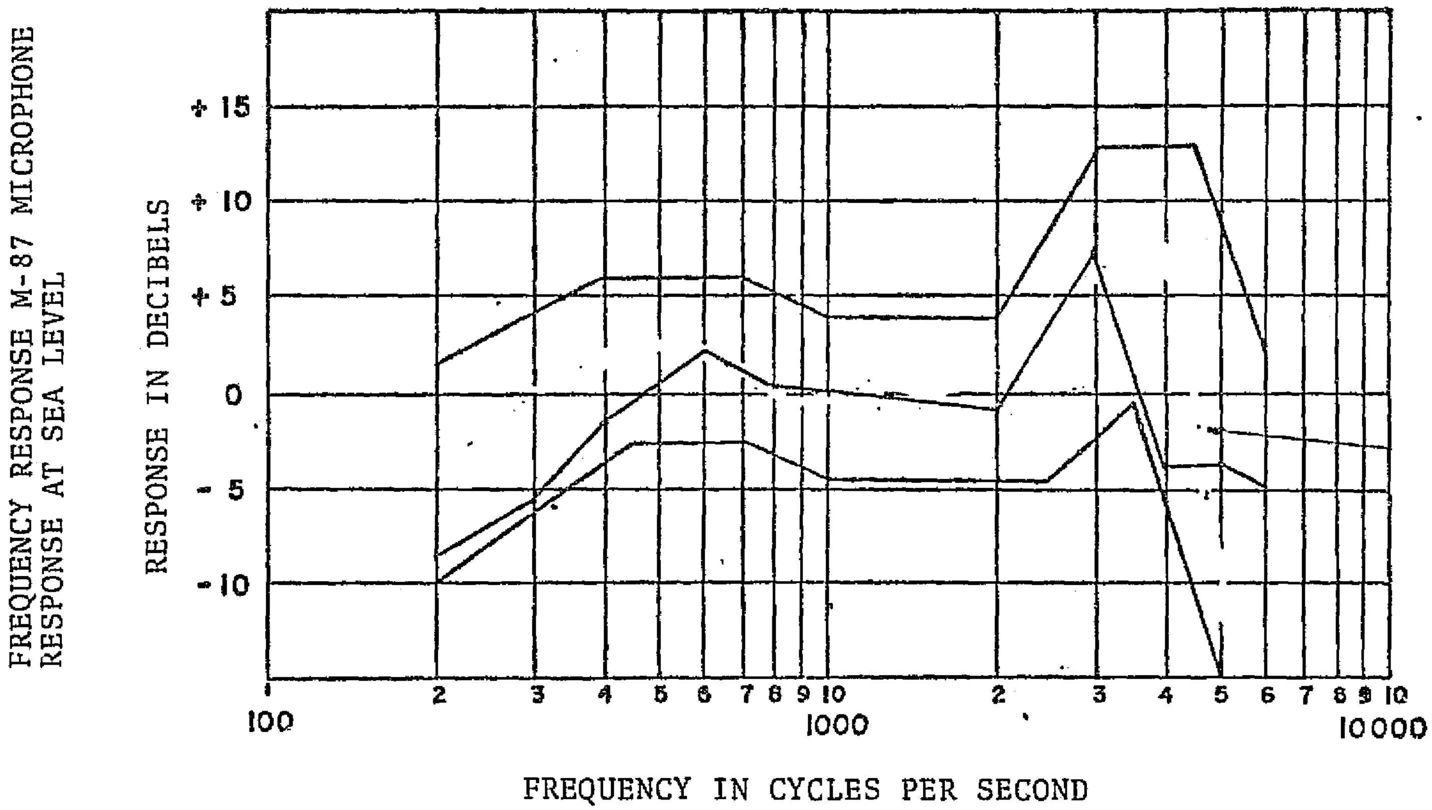
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-28.– Electrovoice M-87 ground level frequency response SN-58.



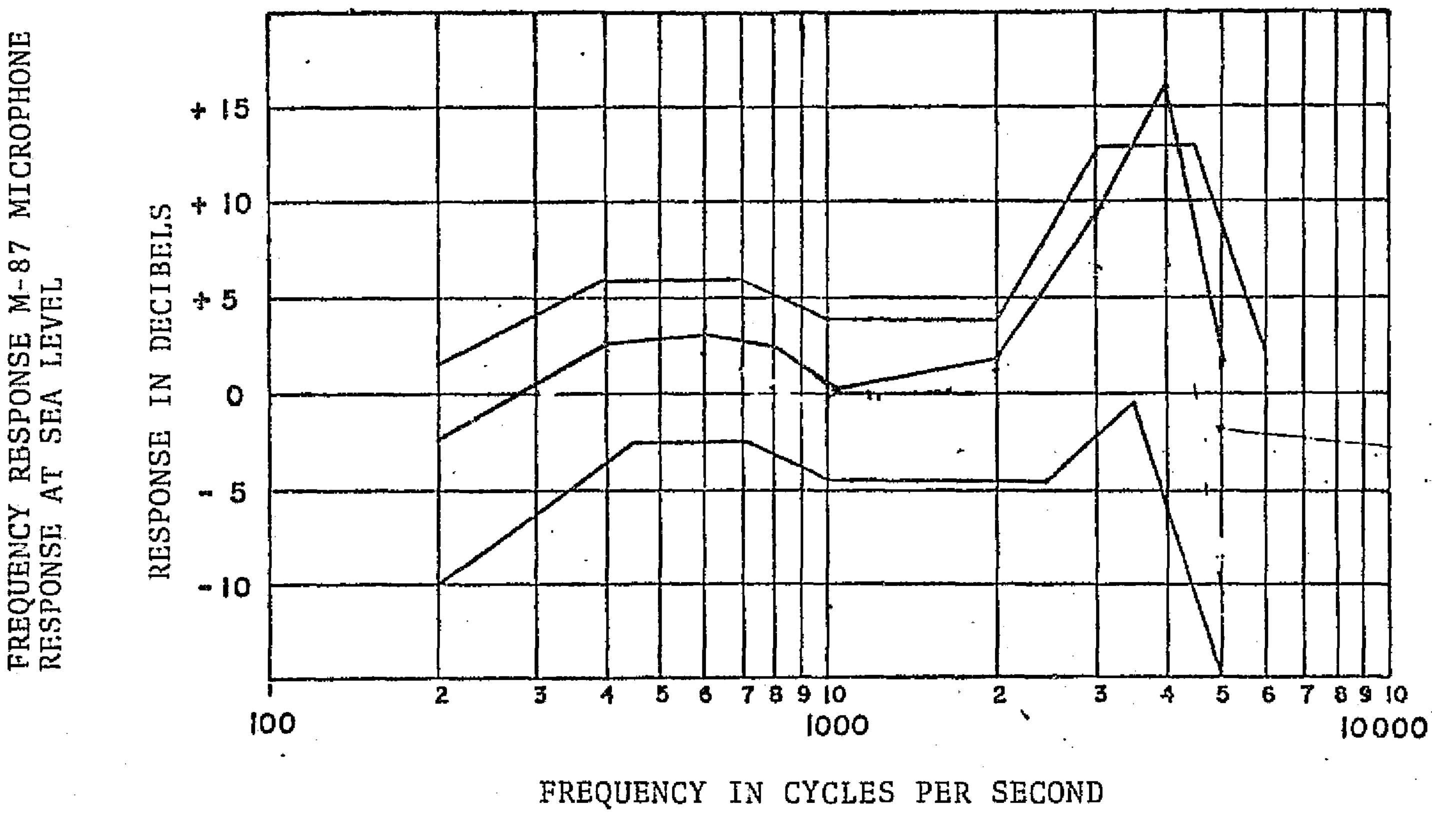
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-29.— Electrovoice M-87 ground level frequency response SN-59.



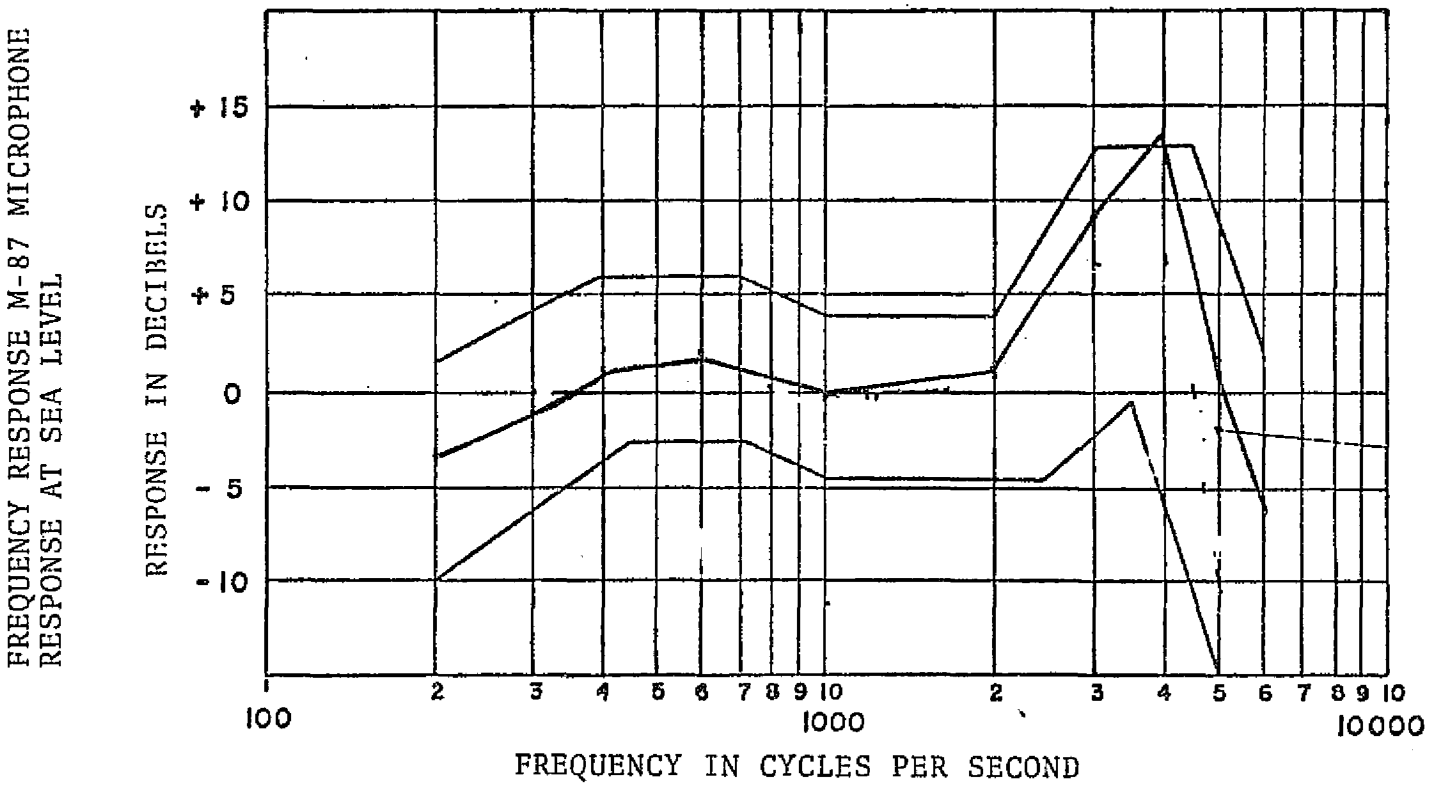
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-30.– Electrovoice M-87 ground level frequency response SN-60.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

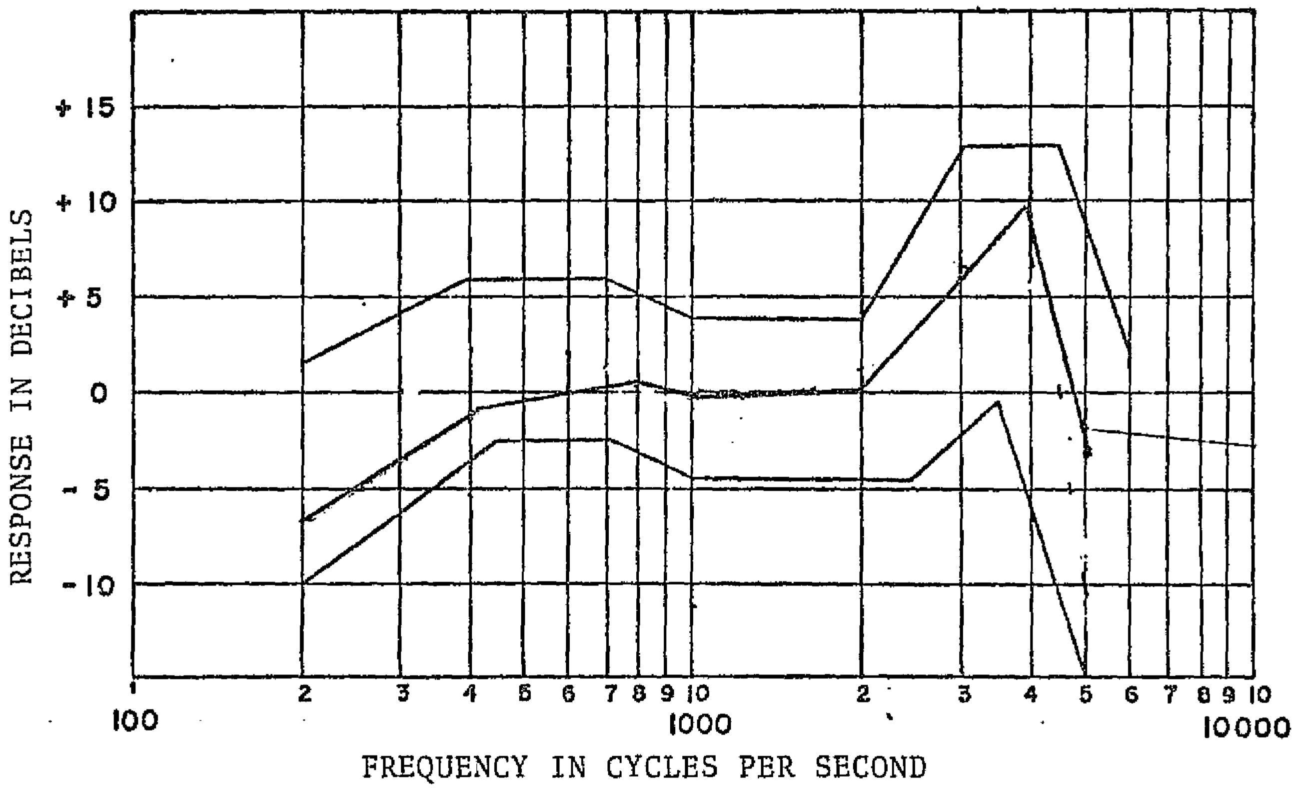
Figure A-31.– Roanwell M-87 ground level frequency response SN-1.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-32.– Roanwell M-87 ground level frequency response SN-2.

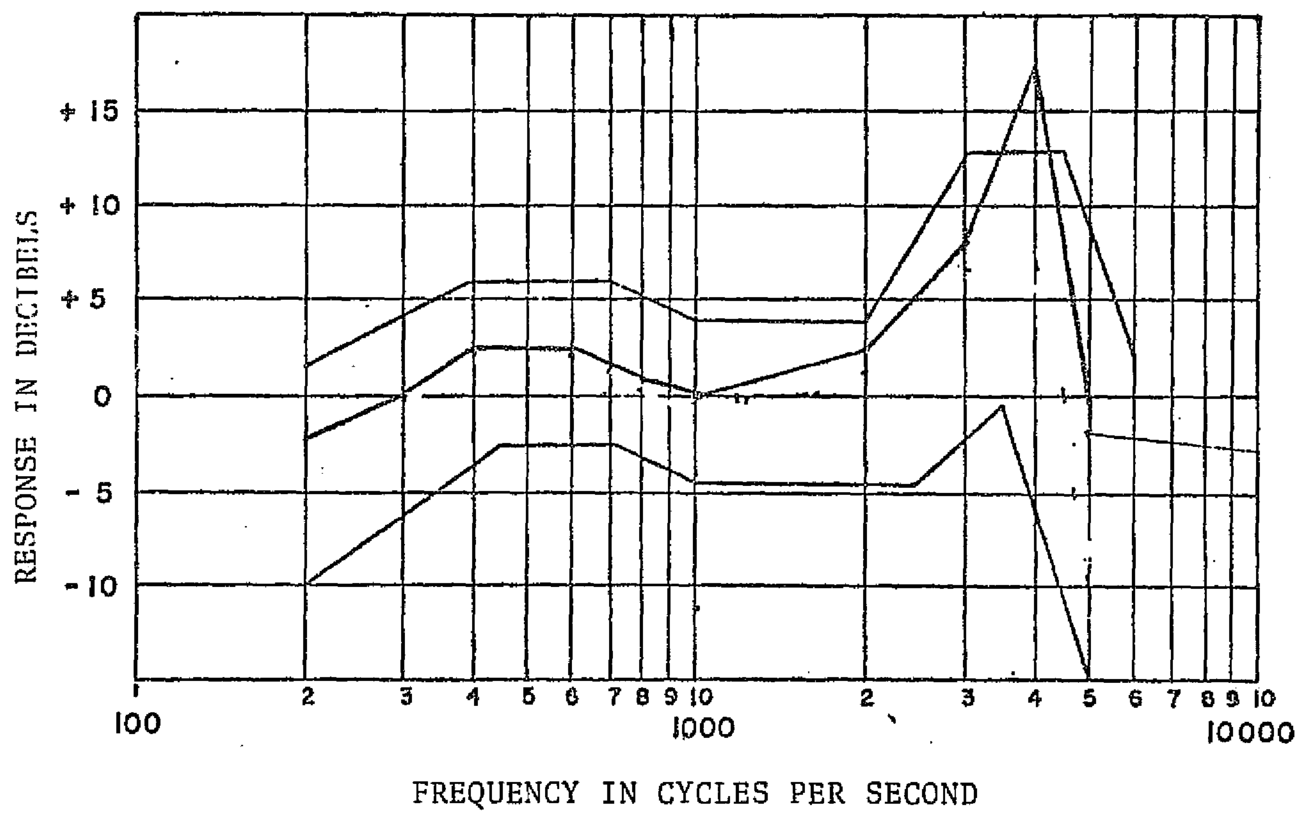
FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

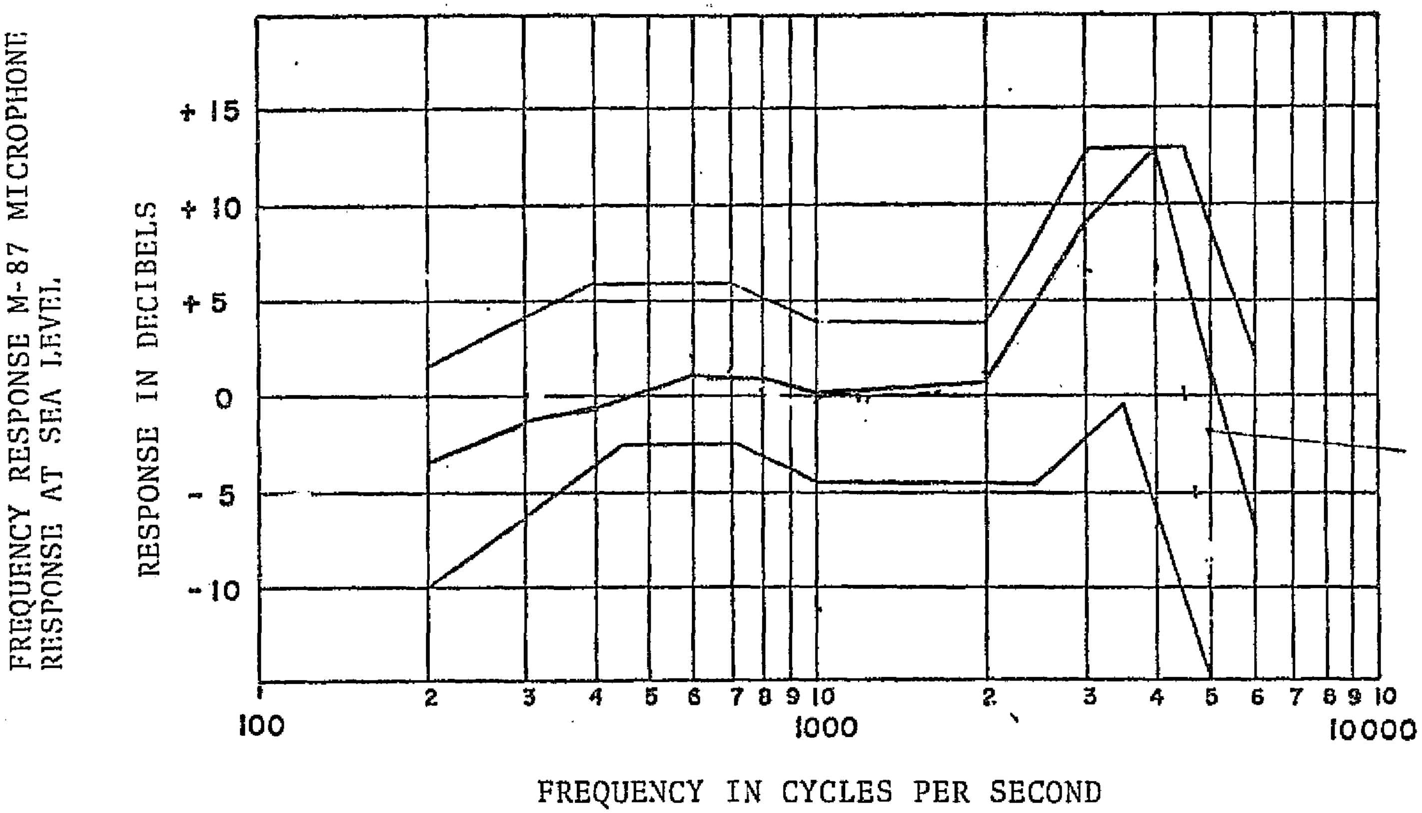
Figure A-33.– Roanwell M-87 ground level frequency response SN-3.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT SEA LEVEL



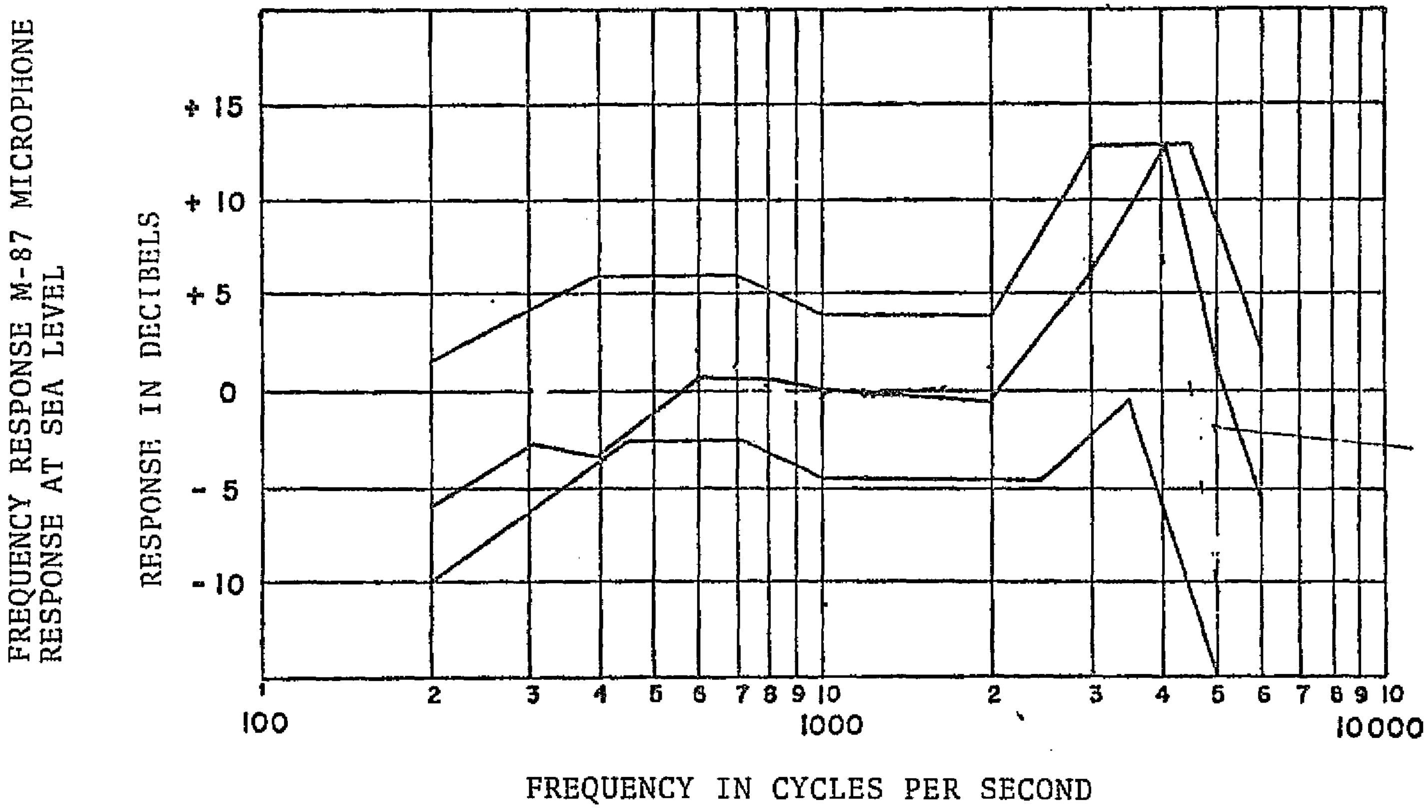
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-34.— Roanwell M-87 ground level frequency response SN-4.



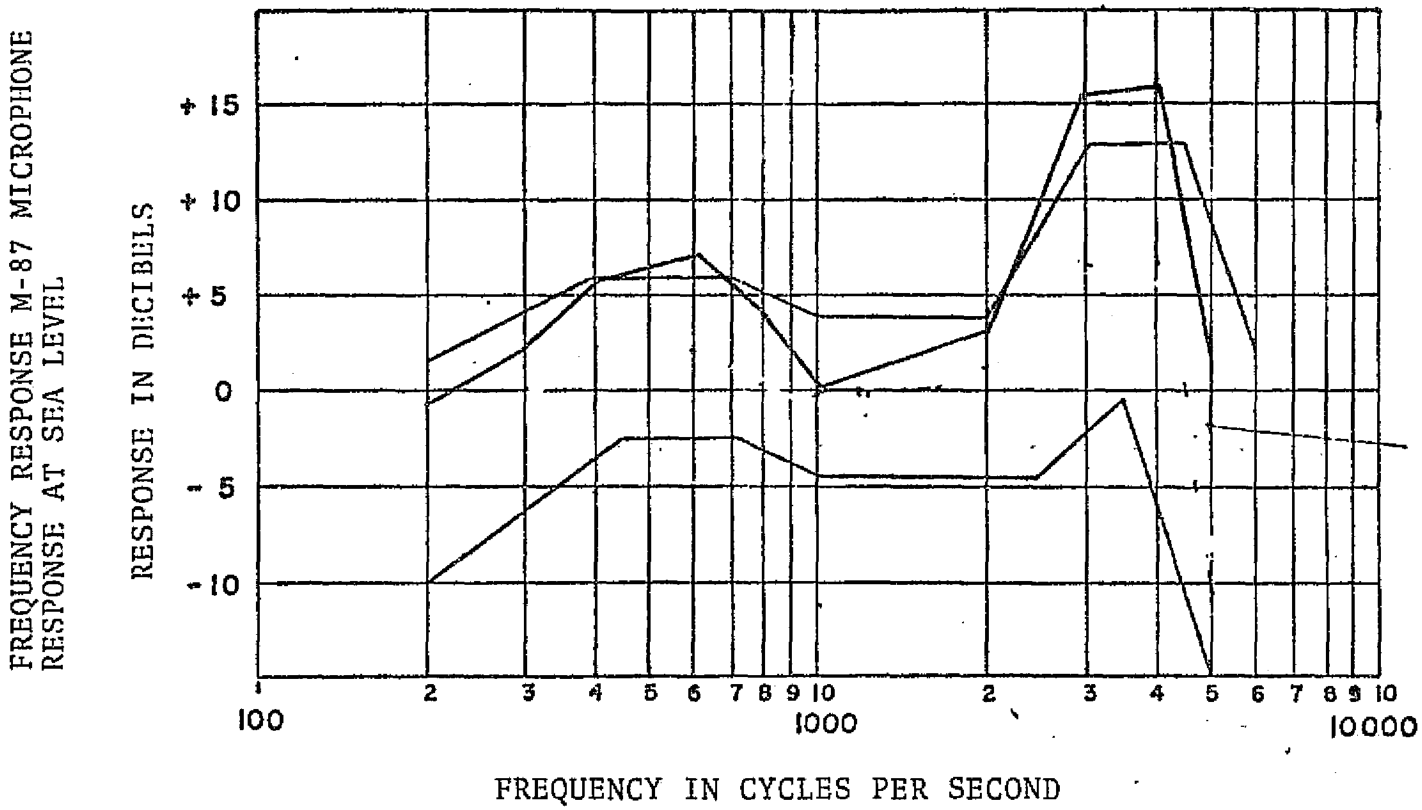
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-35.– Roanwell M-87 ground level frequency response SN-5.



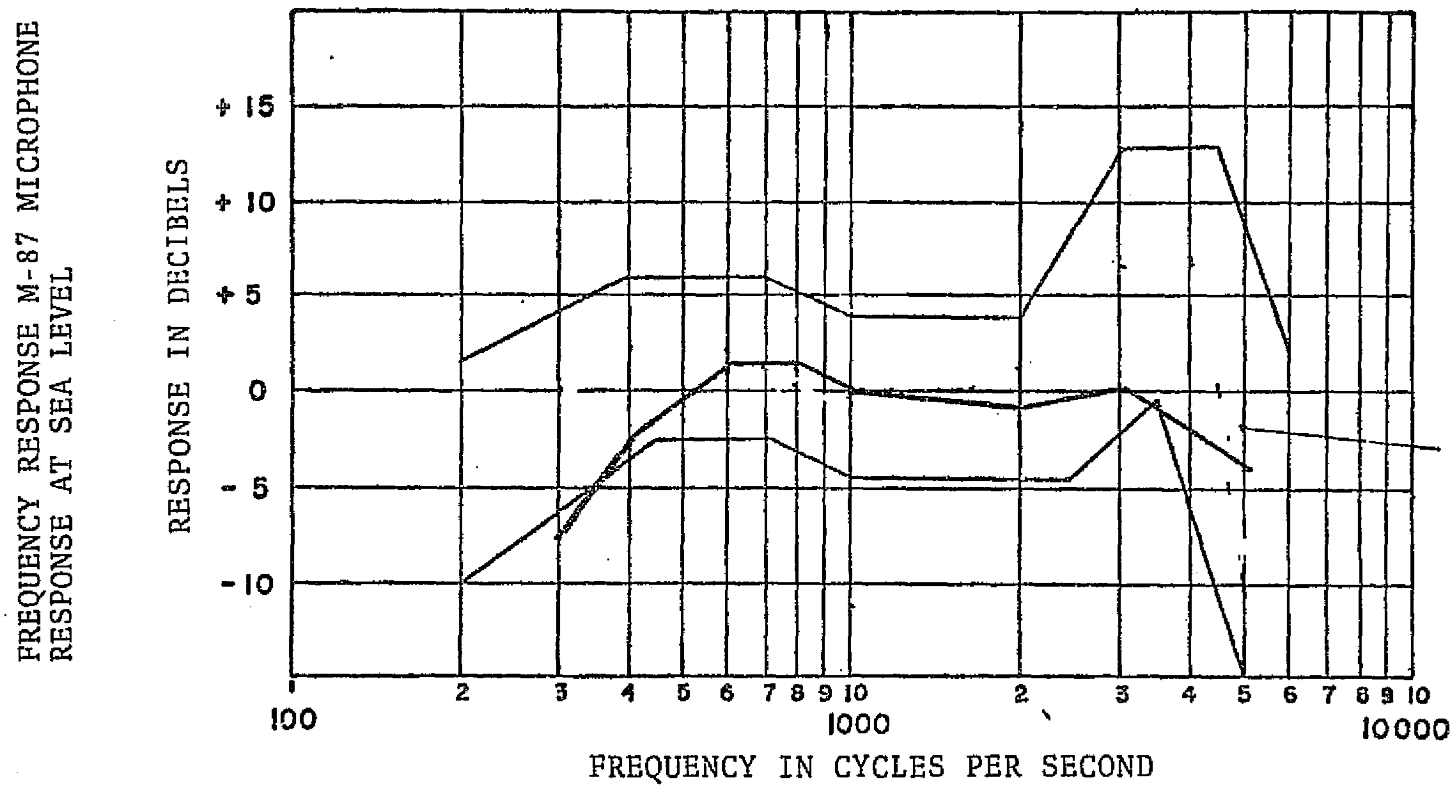
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-36.– Roanwell M-87 ground level frequency response SN-6.



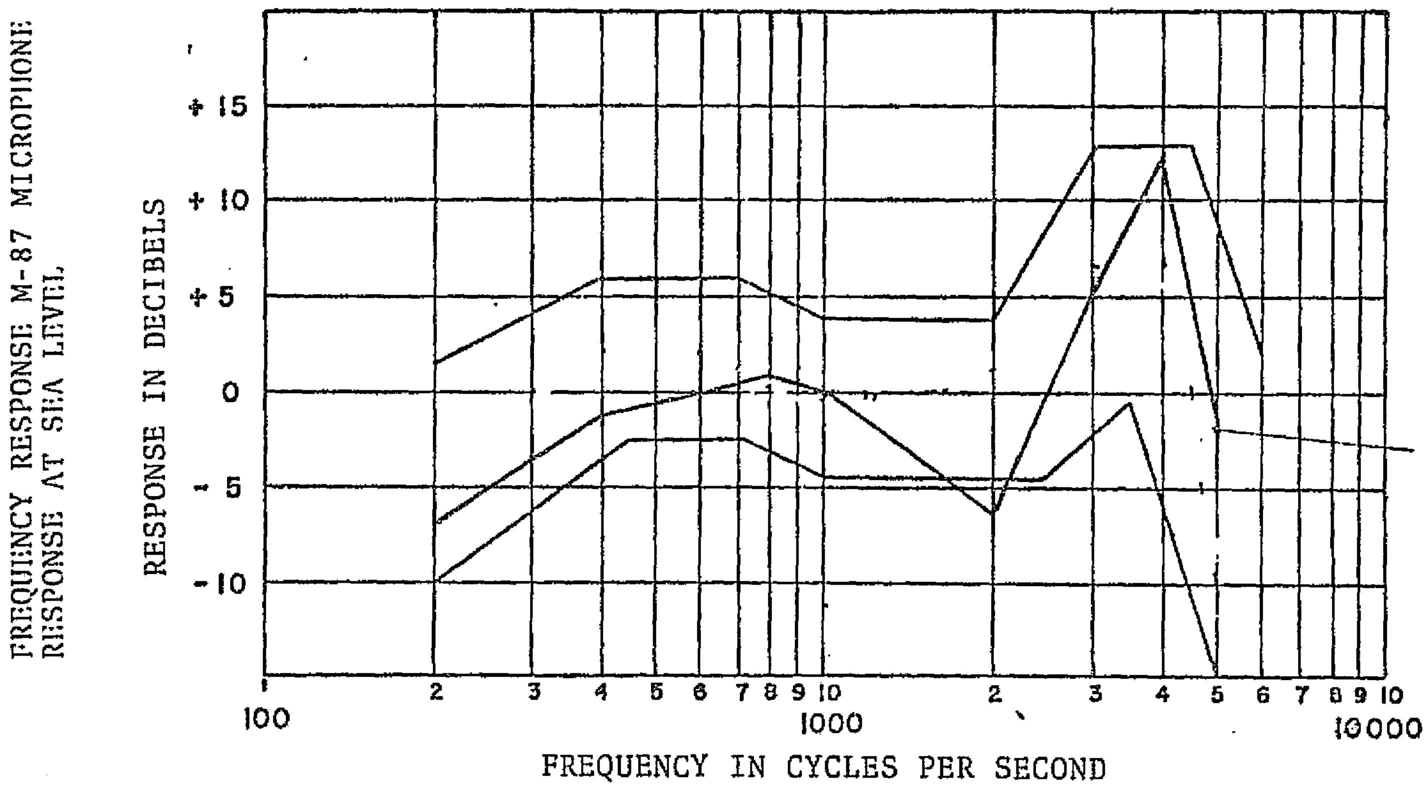
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-37.— Roanwell M-87 ground level frequency response SN-7.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

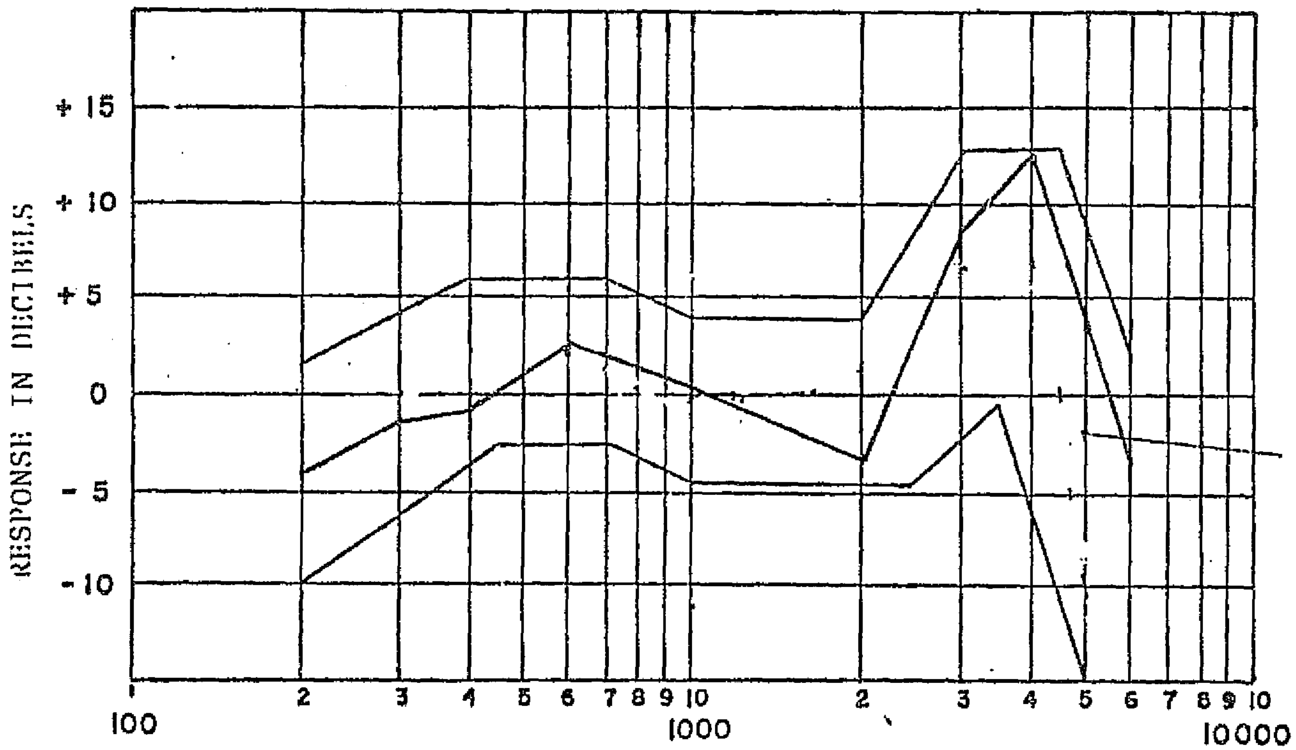
Figure A-38.– Roanwell M-87 ground level frequency response SN-8.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-39.– Roanwell M-87 ground level frequency response SN-9.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT SEA LEVEL



FREQUENCY IN CYCLES PER SECOND

Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure A-40.– Roanwell M-87 ground level frequency response SN-10.

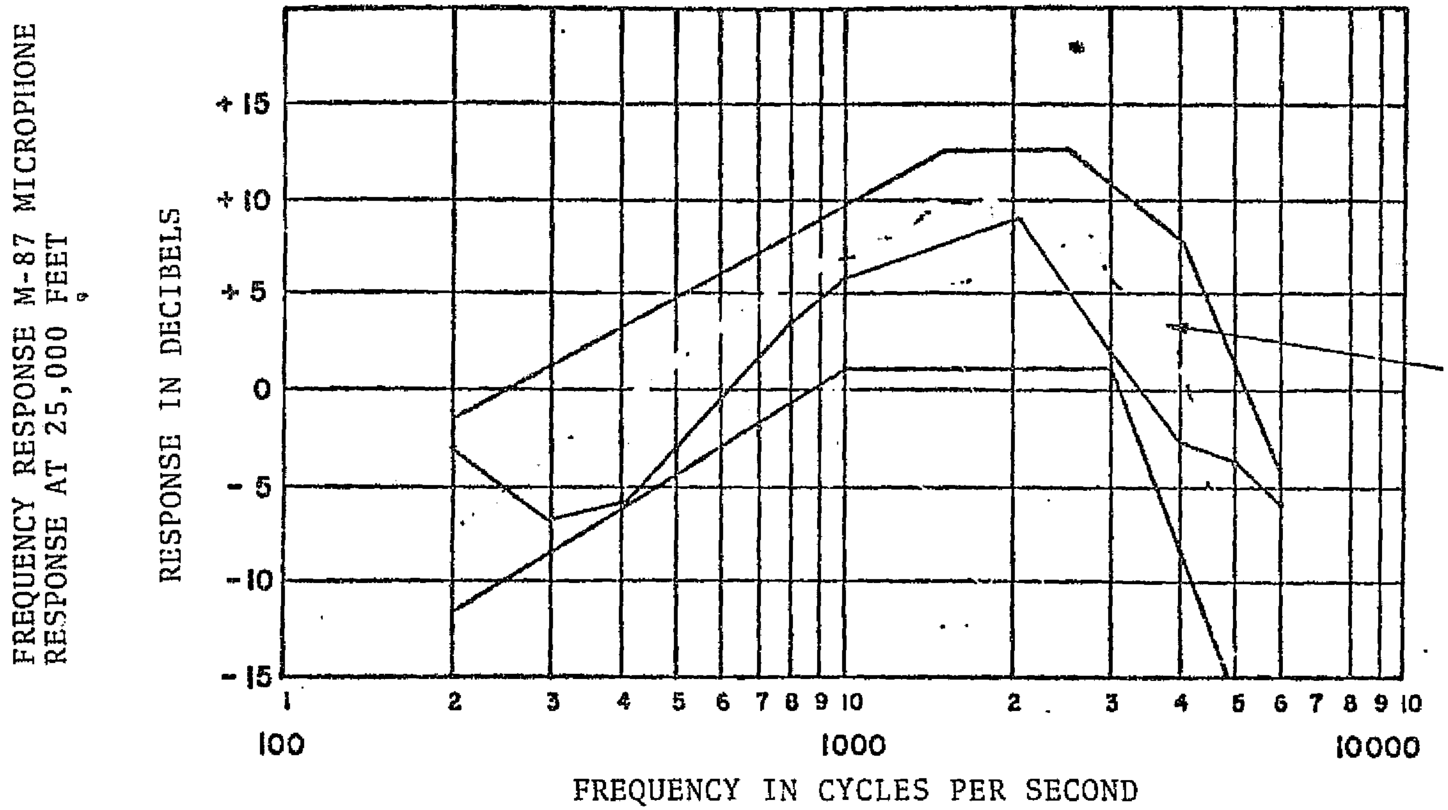


Figure A-41.— Carter M-87 frequency response at 25,000 ft SN-41.

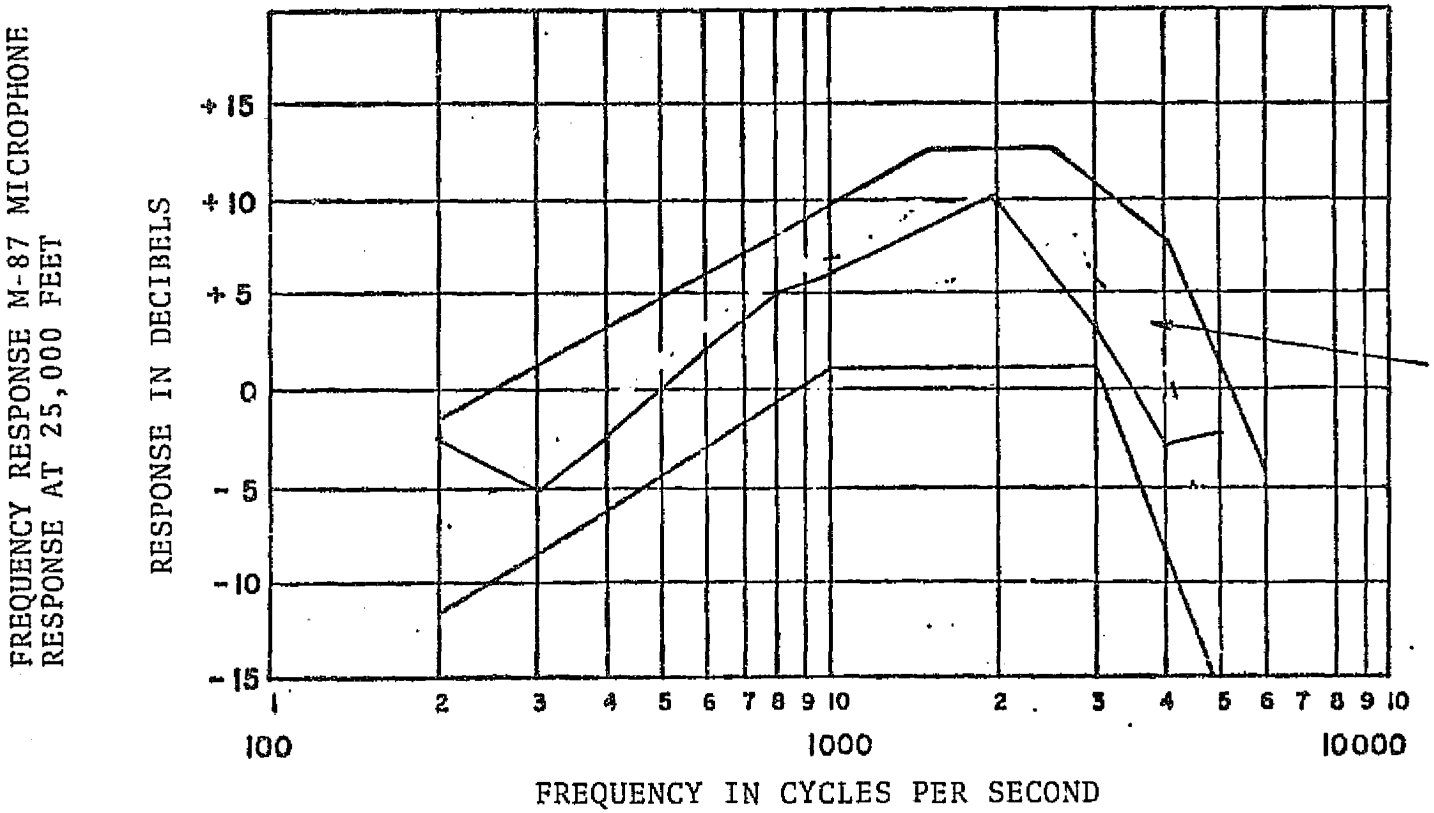


Figure A-42.— Carter M-87 grequency response at 25,000 ft SN-42.

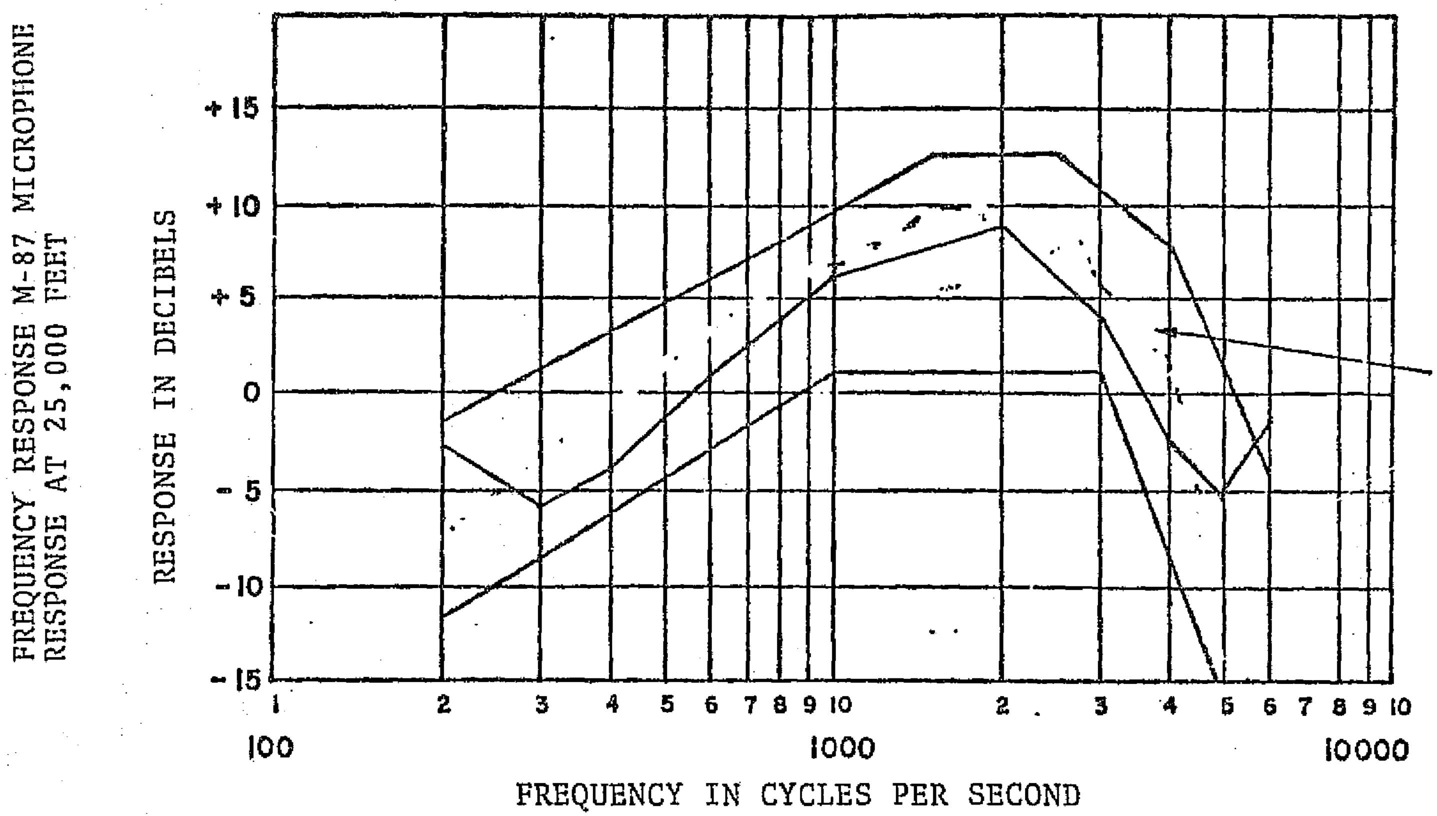


Figure A-43.– Carter M-87 frequency response at 25,000 ft SN-43.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT 25,000 FEET

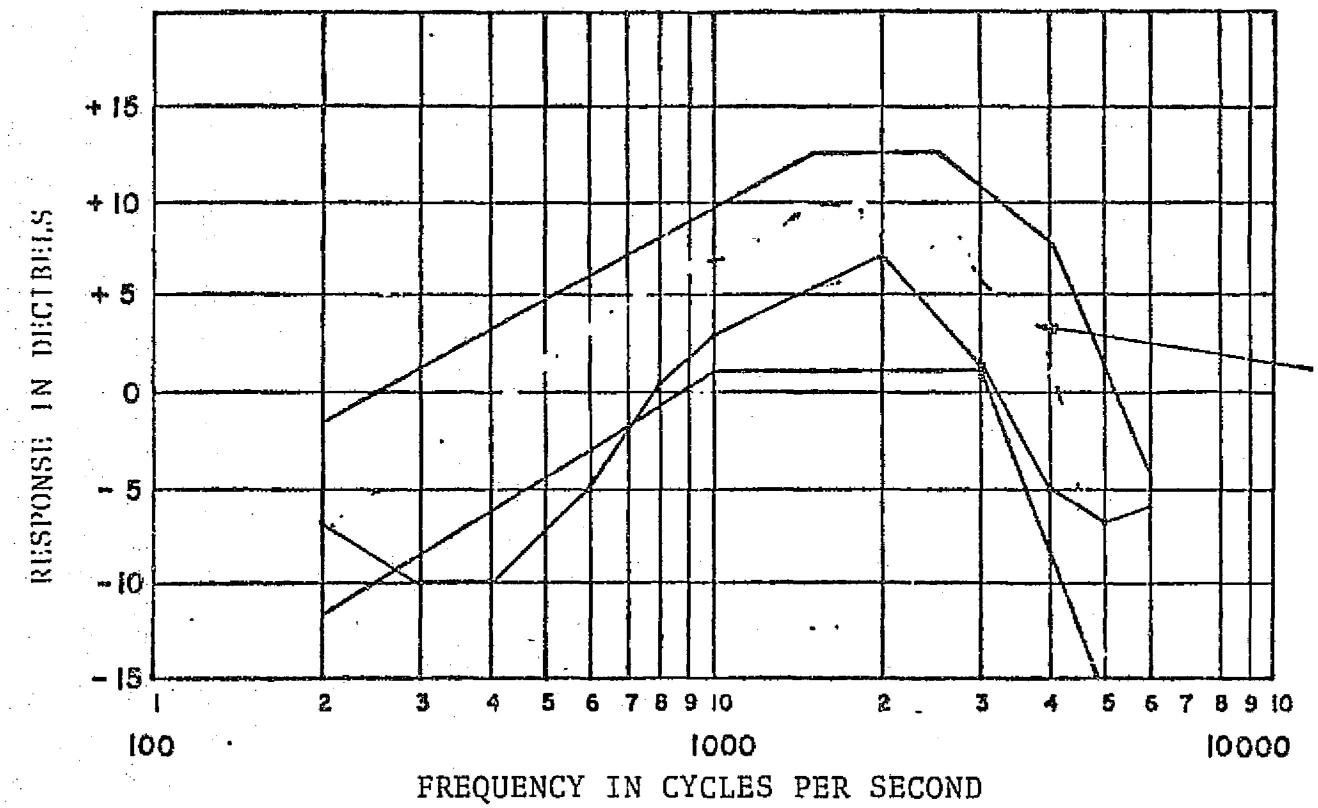


Figure A-44.— Carter M-87 frequency response at 25,000 ft SN-44.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT 25,000 FEET

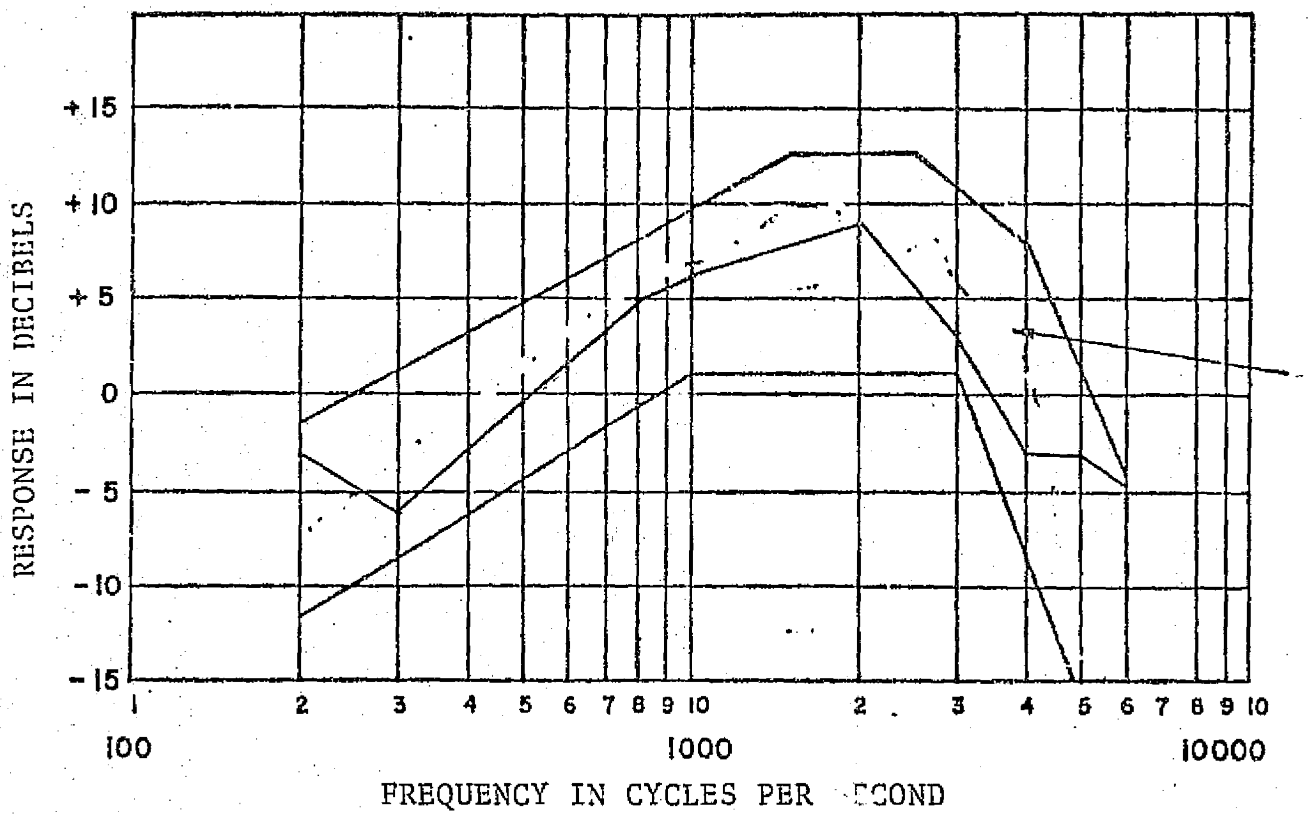


Figure A-45.– Carter M-87 frequency response at 25,000 ft SN-45.

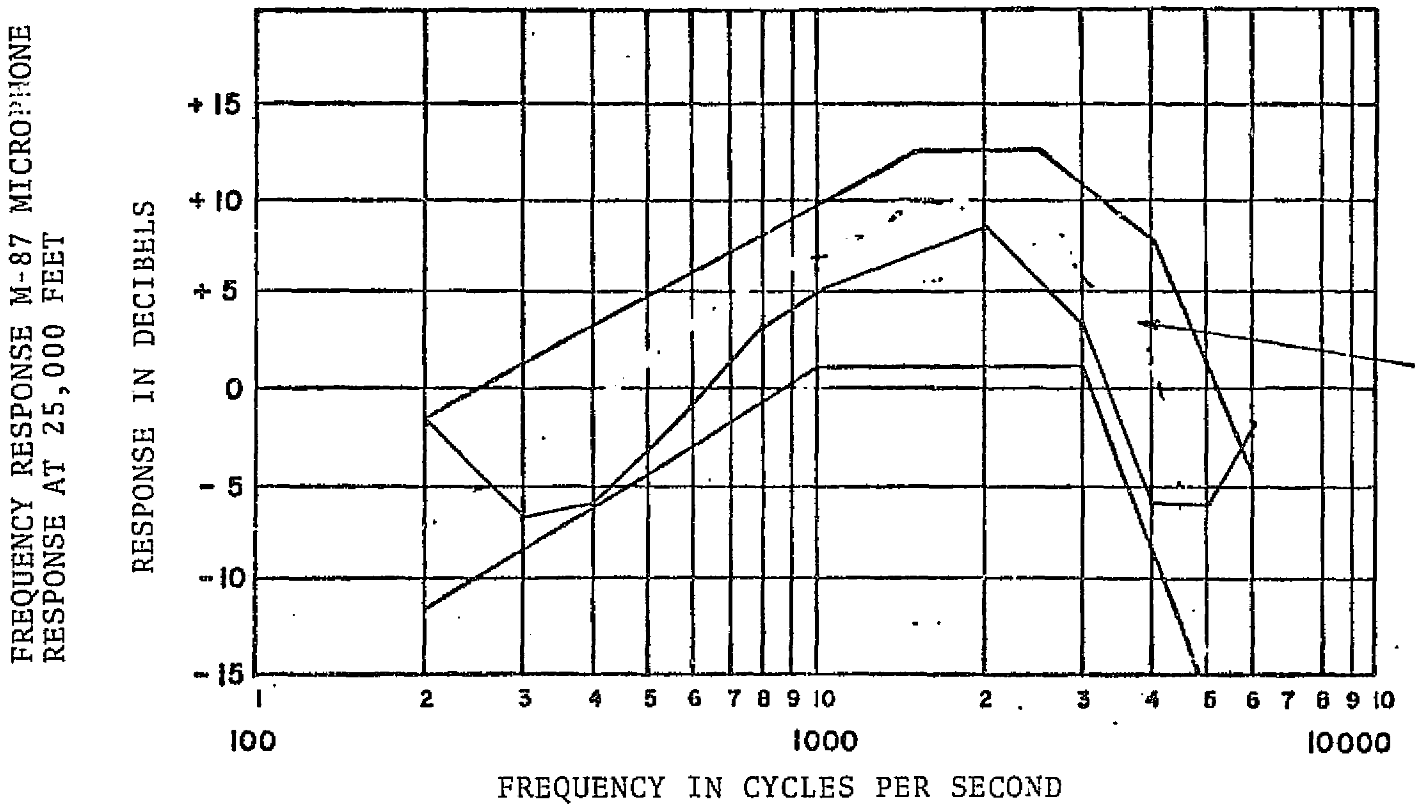


Figure A-46.– Carter M-87 frequency response at 25,000 ft SN-46.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT 25,000 FEET

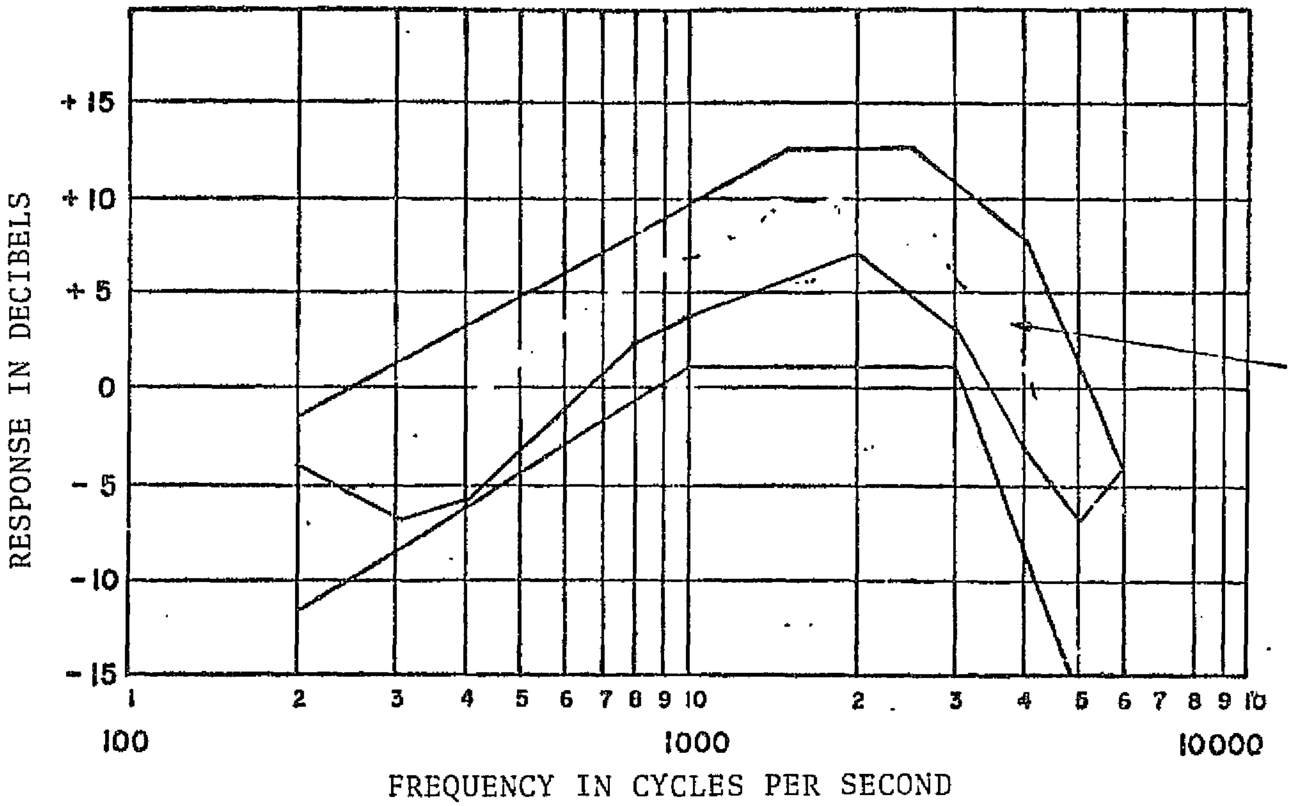


Figure A-47.— Carter M-87 frequency response at 25,000 ft SN-47.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT 25,000 FEET

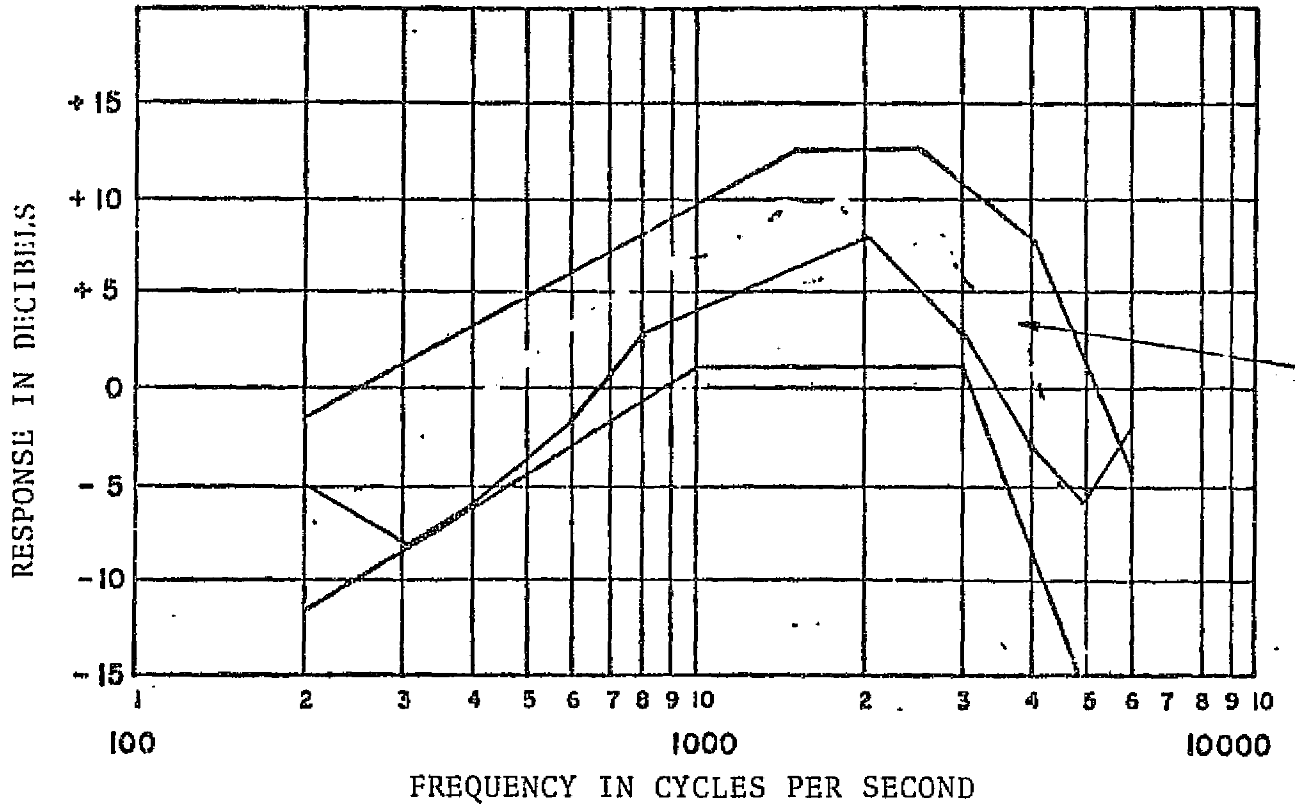


Figure A-48.– Carter M-87 frequency response at 25,000 ft SN-48.

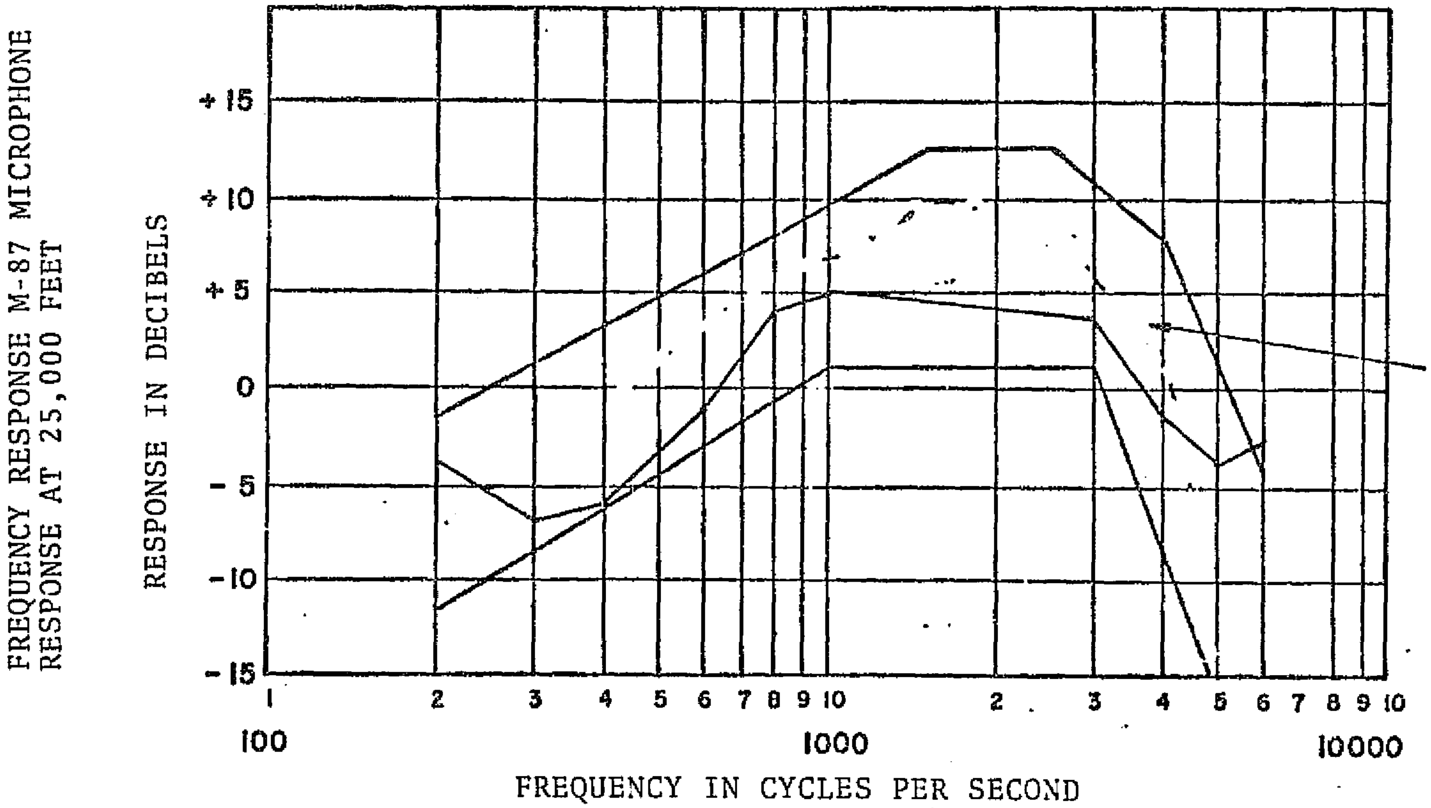


Figure A-49.– Carter M-87 frequency response at 25,000 ft SN-49.

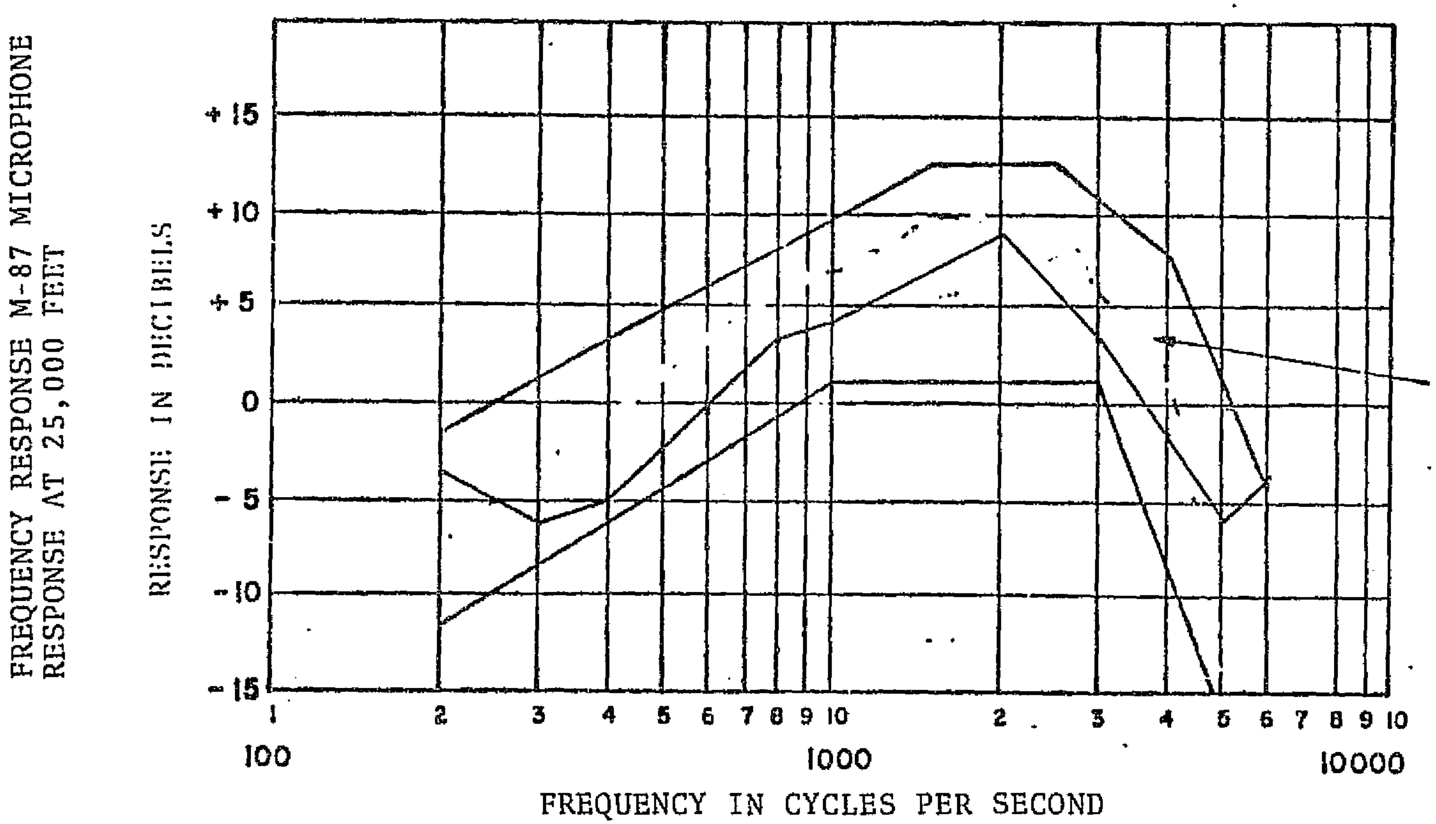


Figure A-50.– Carter M-87 frequency response at 25,000 ft SN-50.

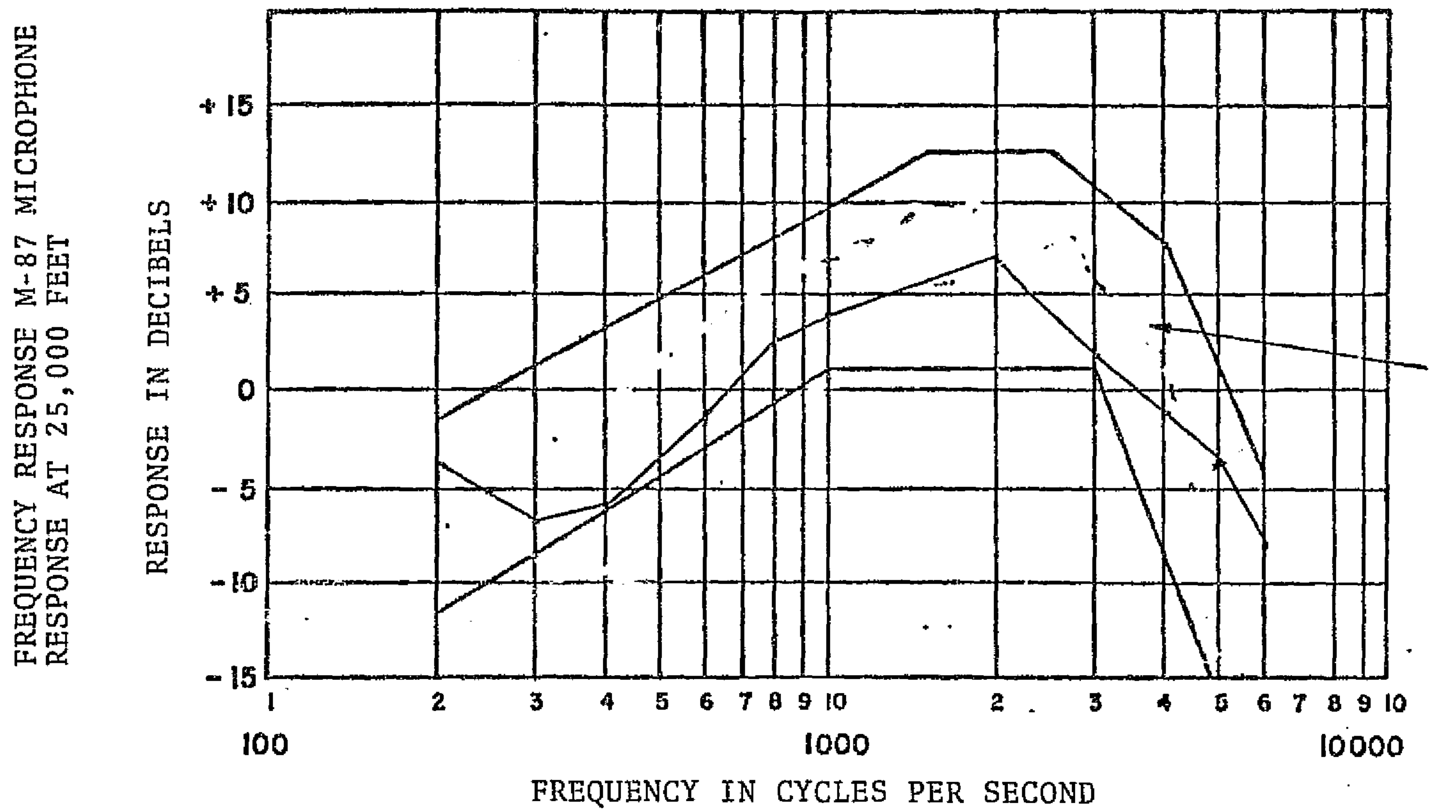


Figure A-51.– Astrocom M-87 frequency response at 25,000 ft SN-31.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT 25,000 FEET

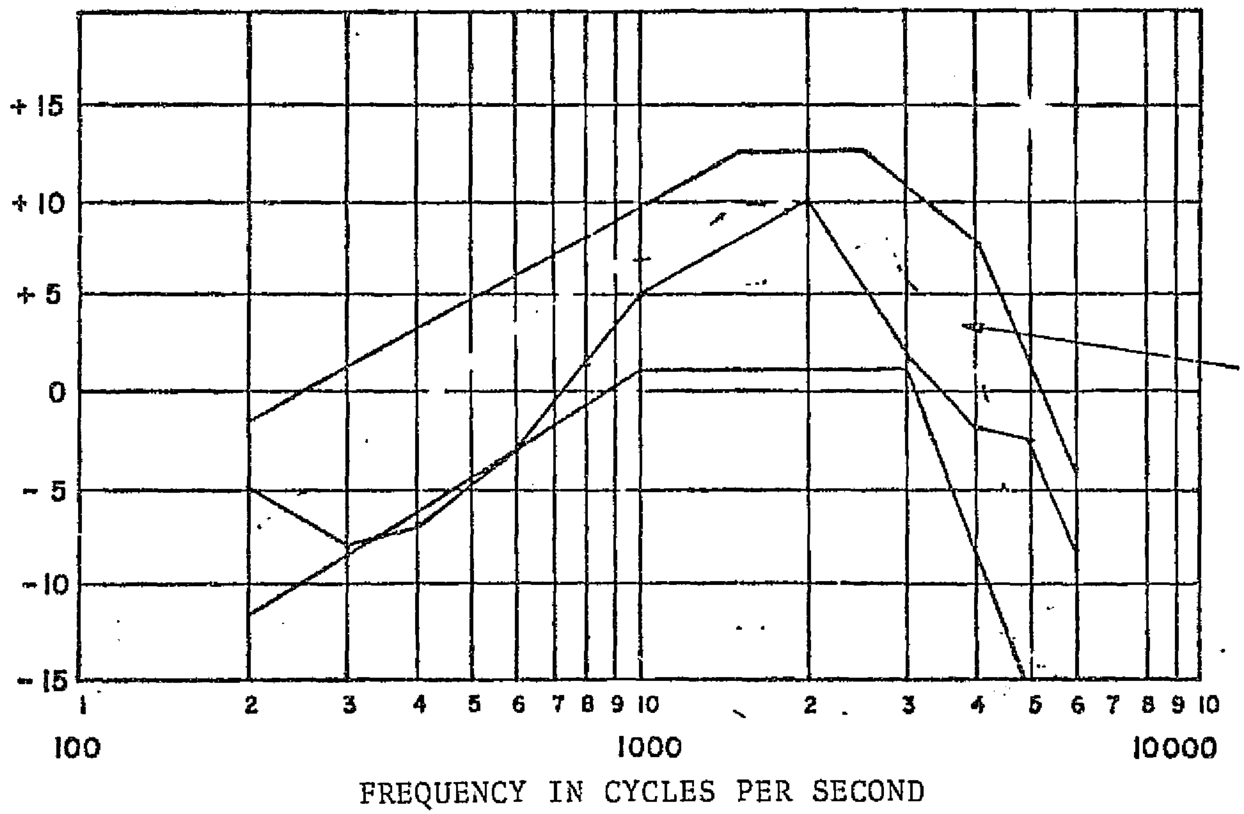


Figure A-52.– Astrocom M-87 frequency response at 25,000 ft SN-32.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT 25,000 FEET

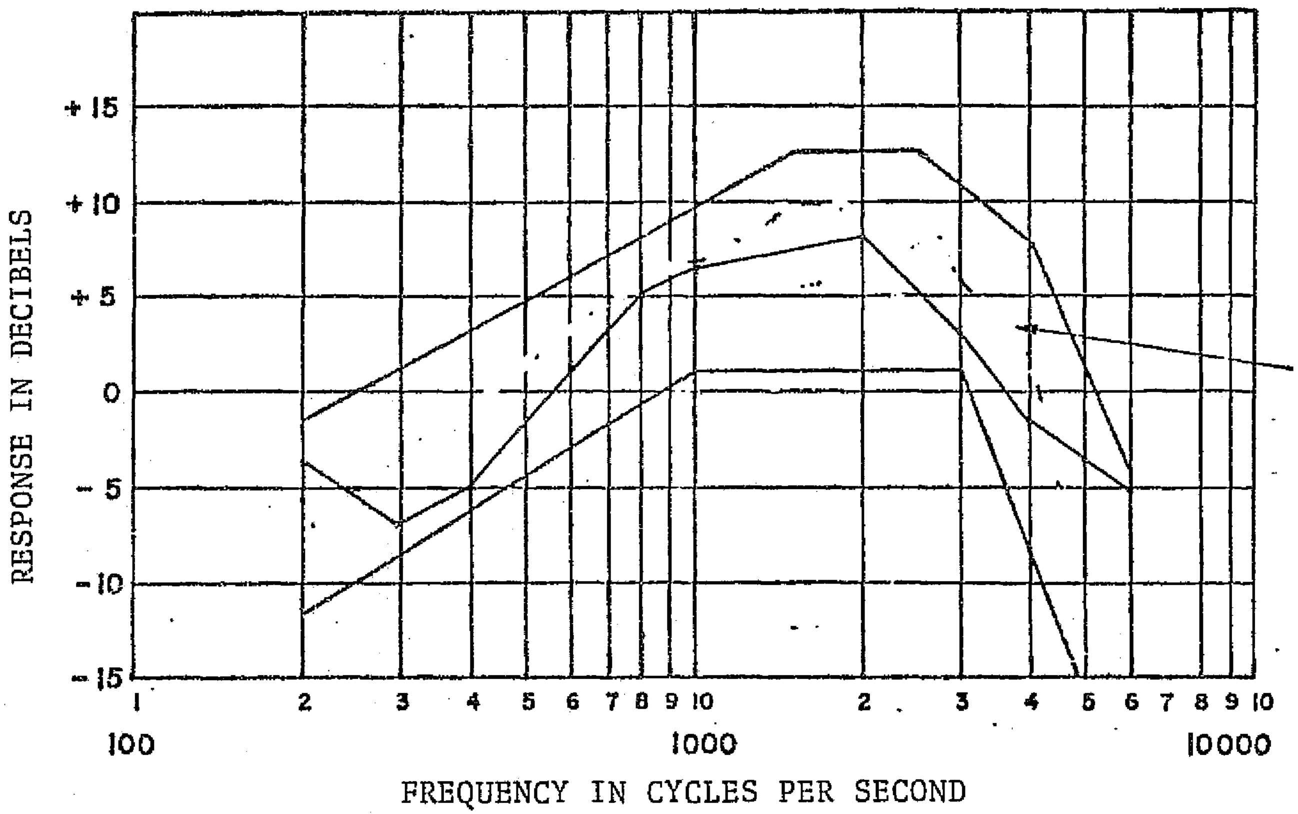


Figure A-53.– Astrocom M-87 frequency response at 25,000 ft SN-33.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT 25,000 FEET

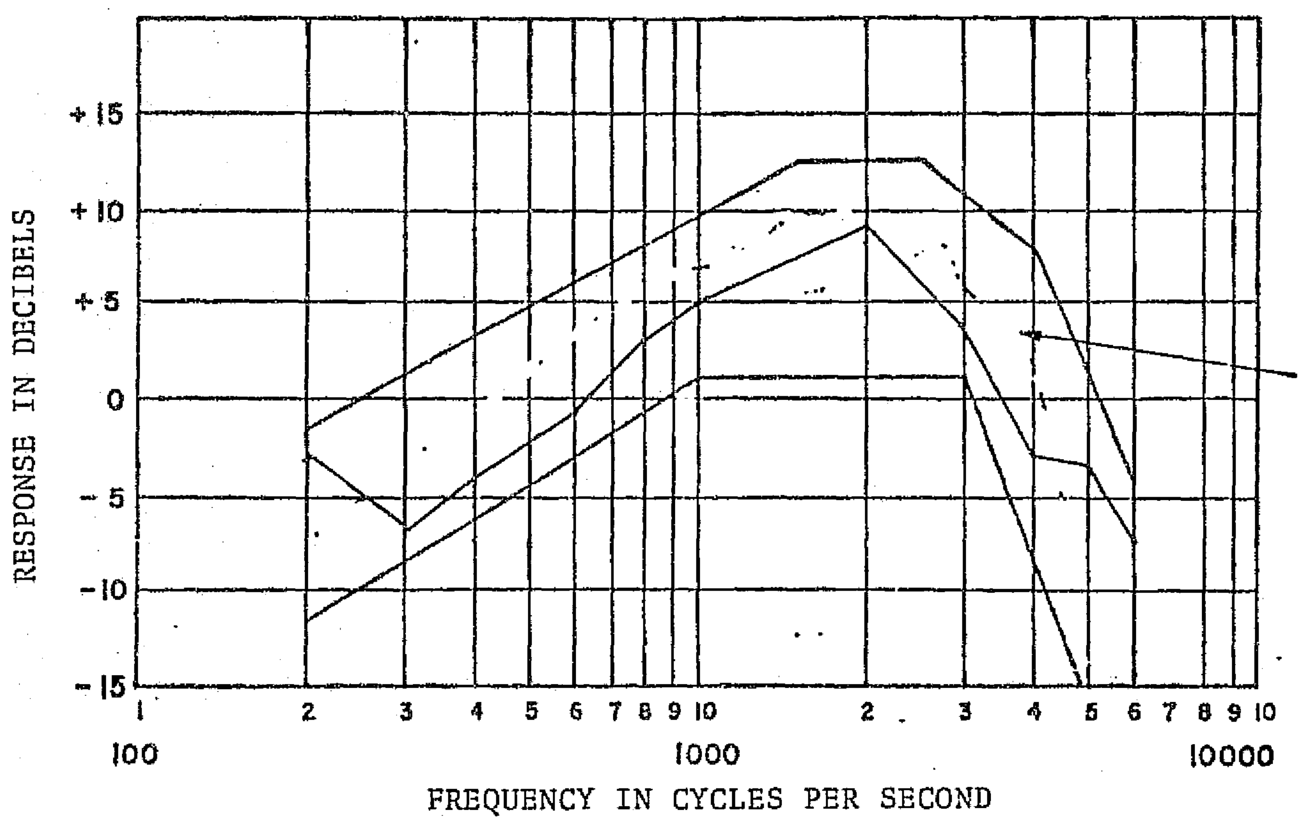


Figure A-54.— Astrocom M-87 frequency response at 25,000 ft SN-34.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT 25,000 FEET

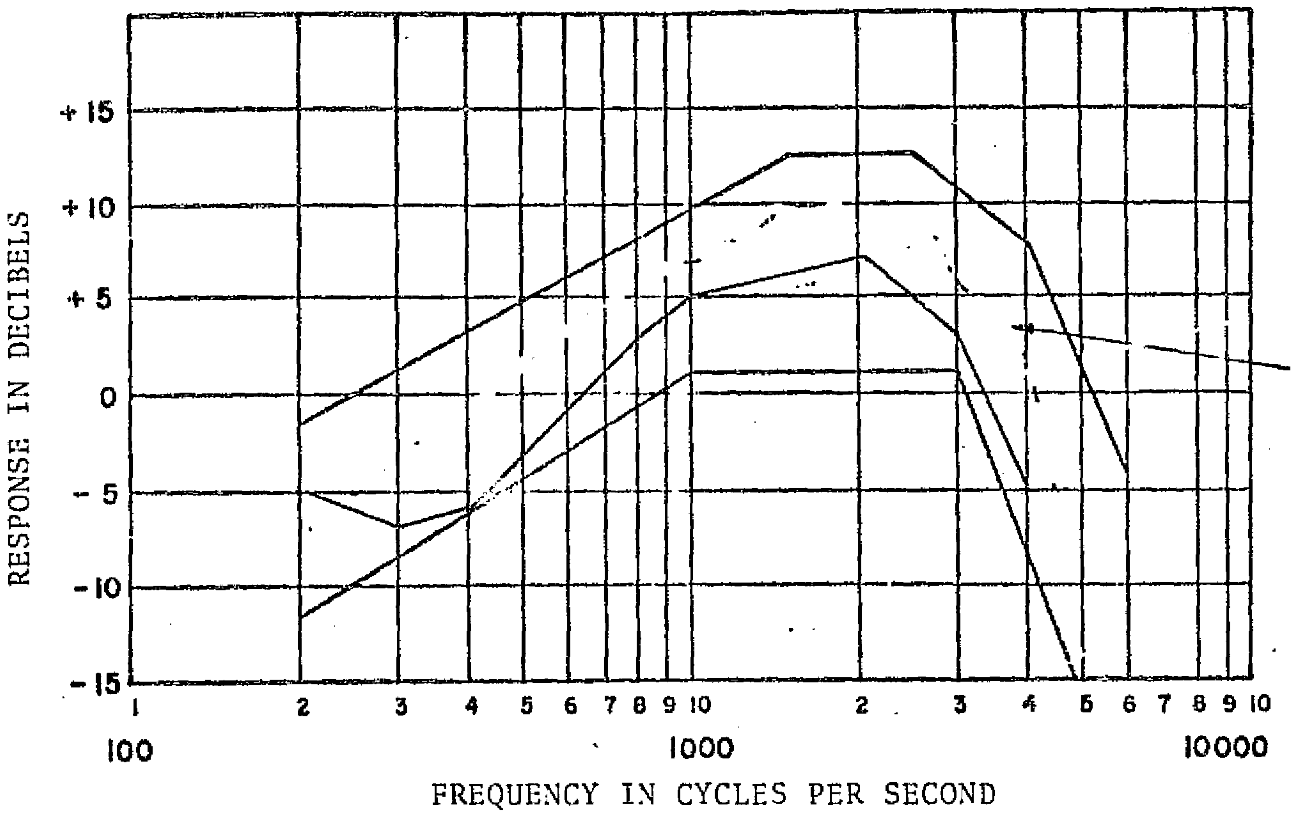


Figure A-55.– Astrocom M-87 frequency response at 25,000 ft SN-35.

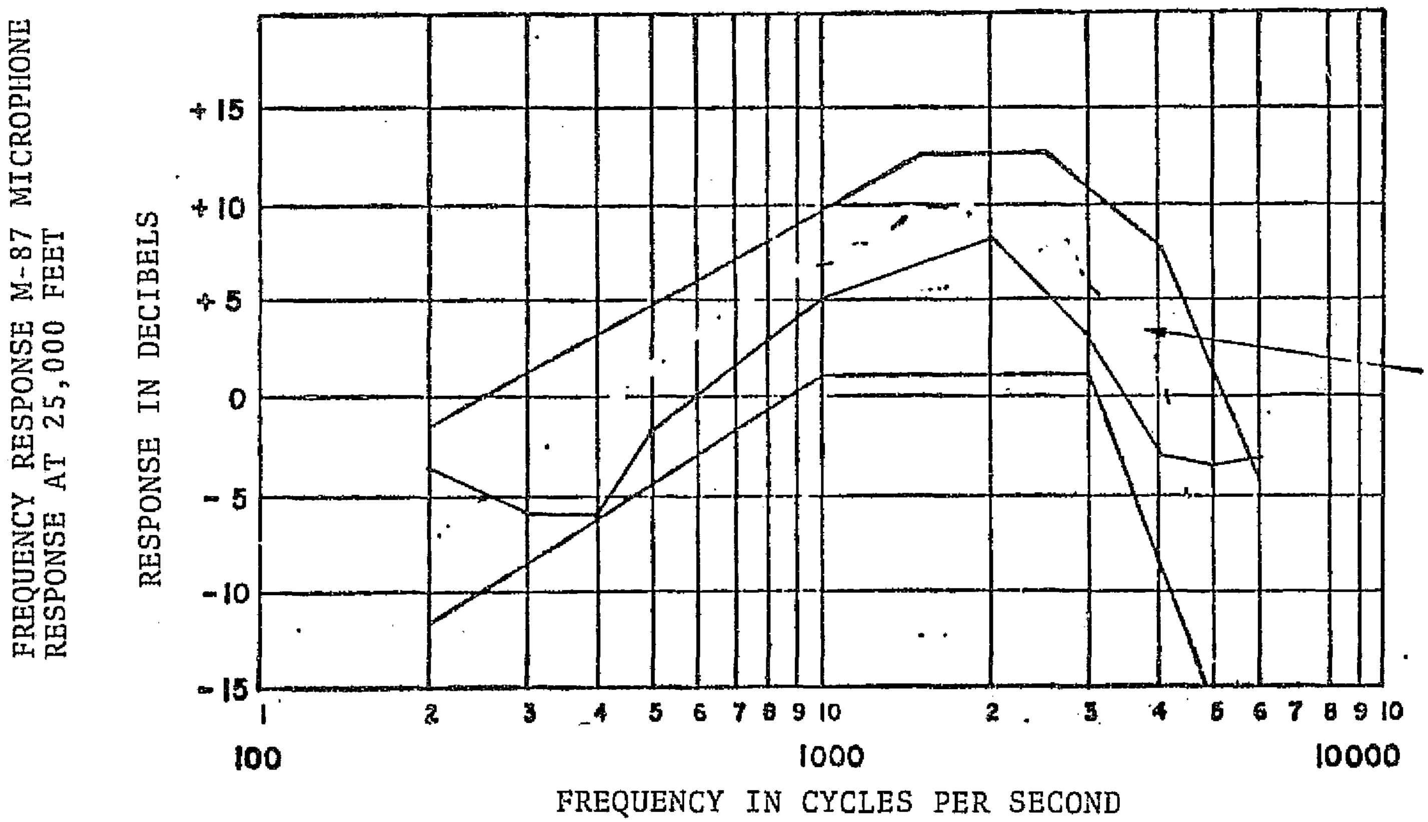


Figure A-56.-- Astrocom M-87 frequency response at 25,000 ft SN-36.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT 25,000 FEET

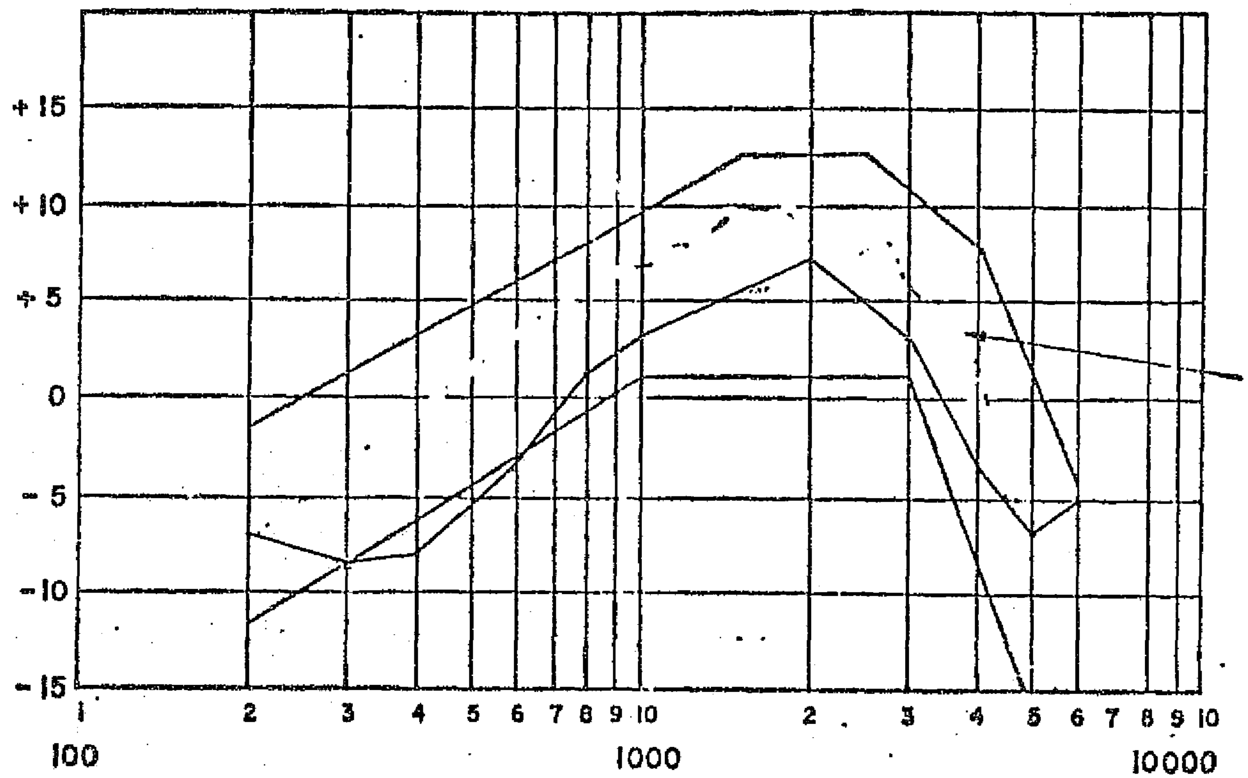


Figure A-57.— Astrocom M-87 frequency response at 25,000 ft SN-37.

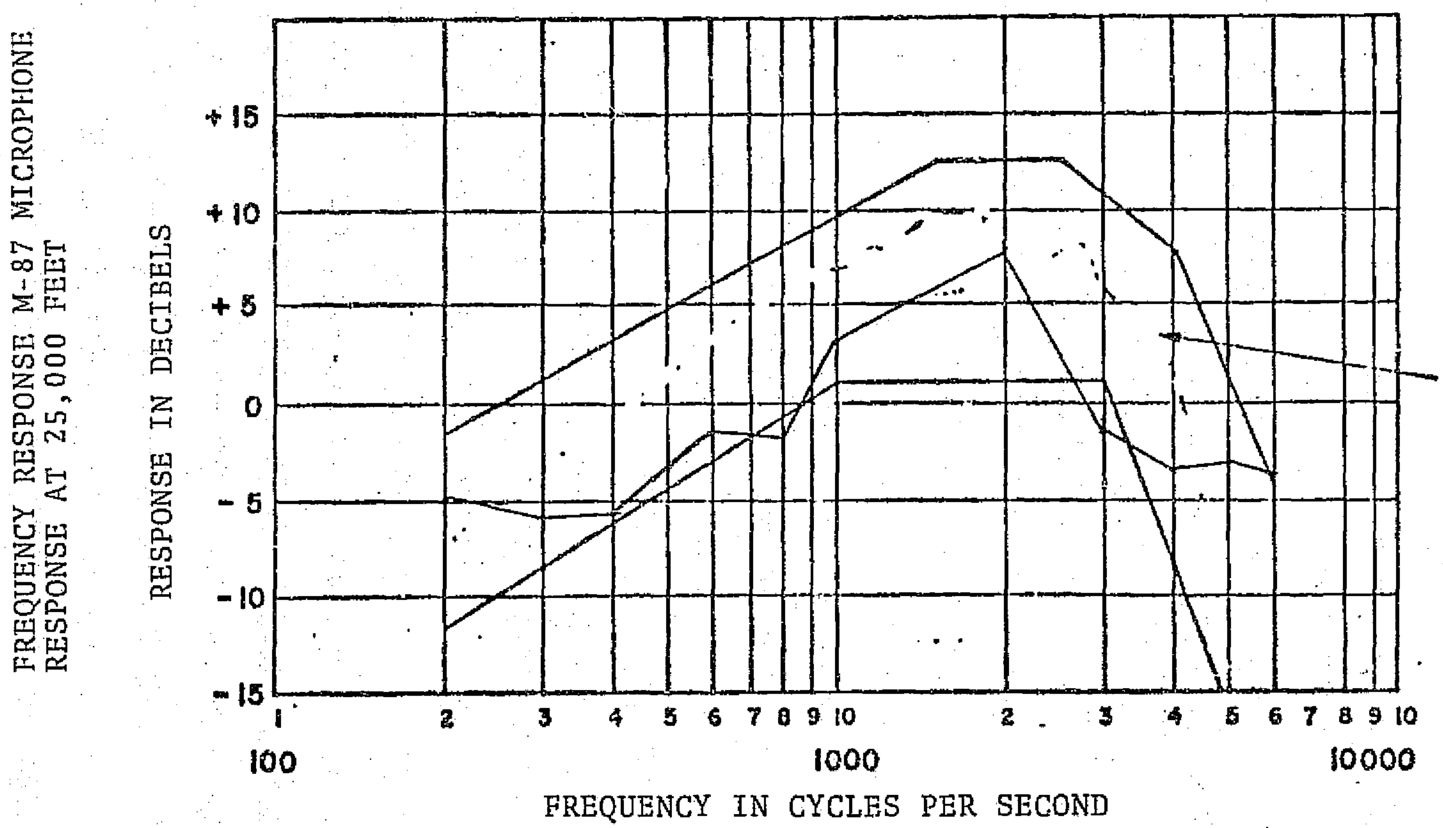


Figure A-58.– Astrocom M-87 frequency response at 25,000 ft SN-38.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT 25,000 FEET

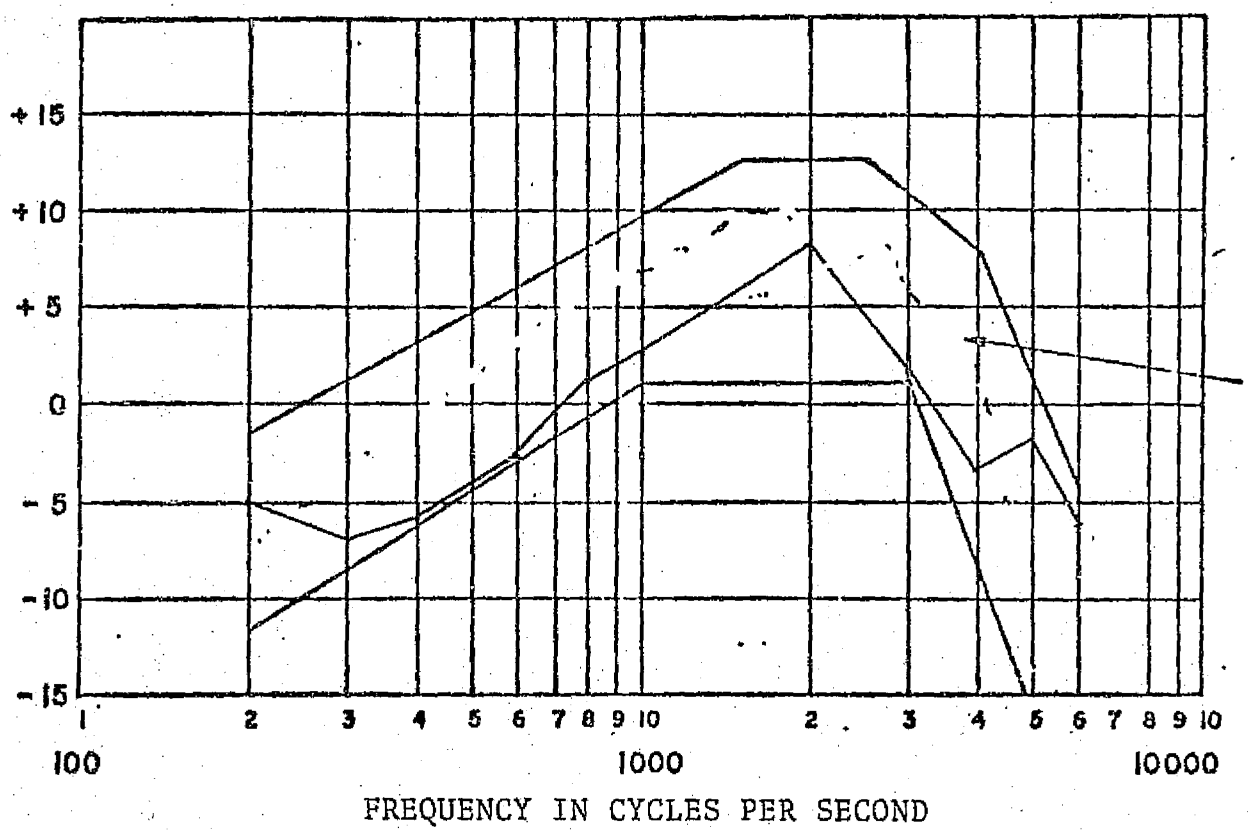


Figure A-59.– Astrocom M-87 frequency response at 25,000 ft SN-39.

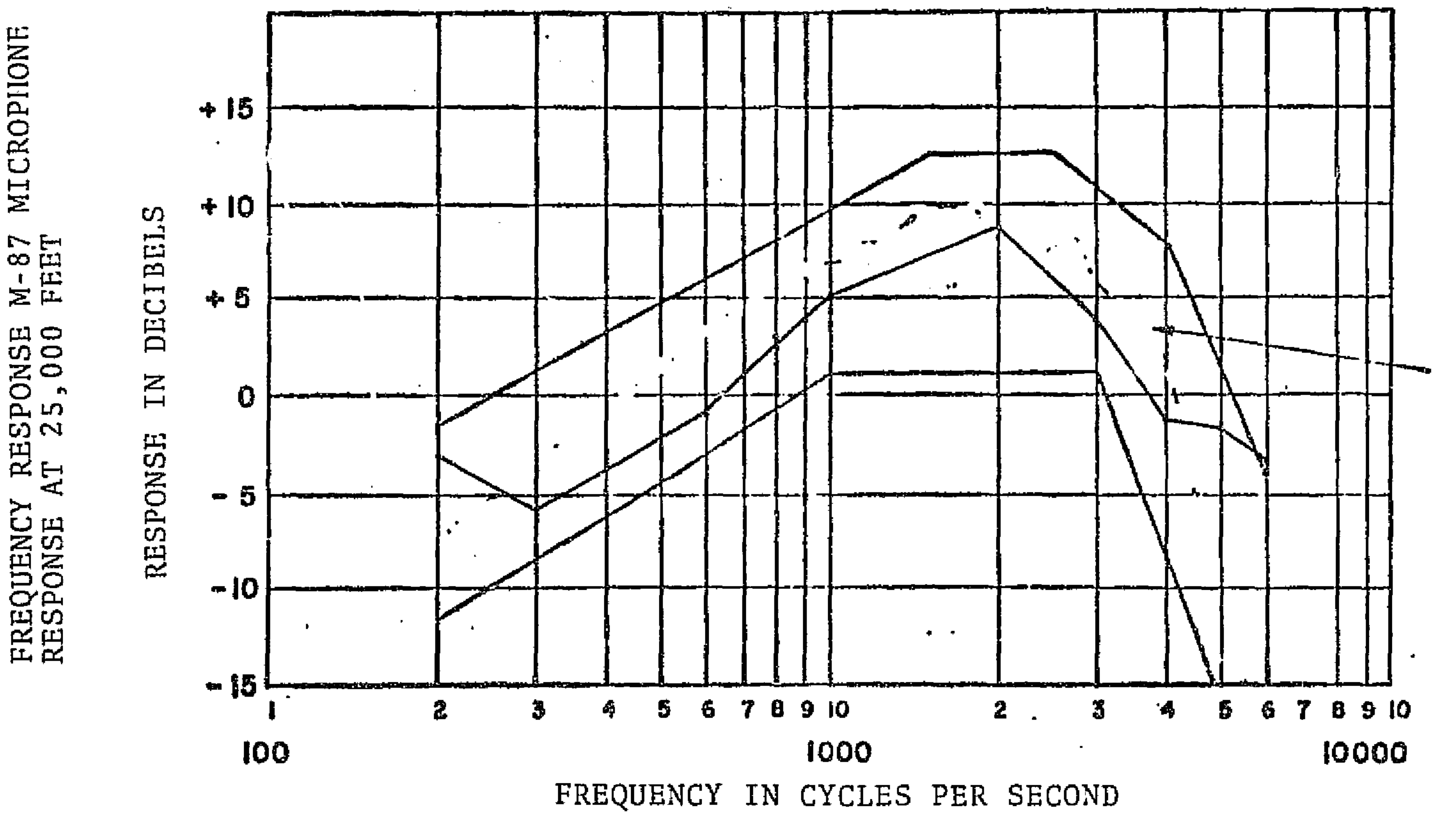


Figure A-60.— Astrocom M-87 frequency response at 25,000 ft SN-40.

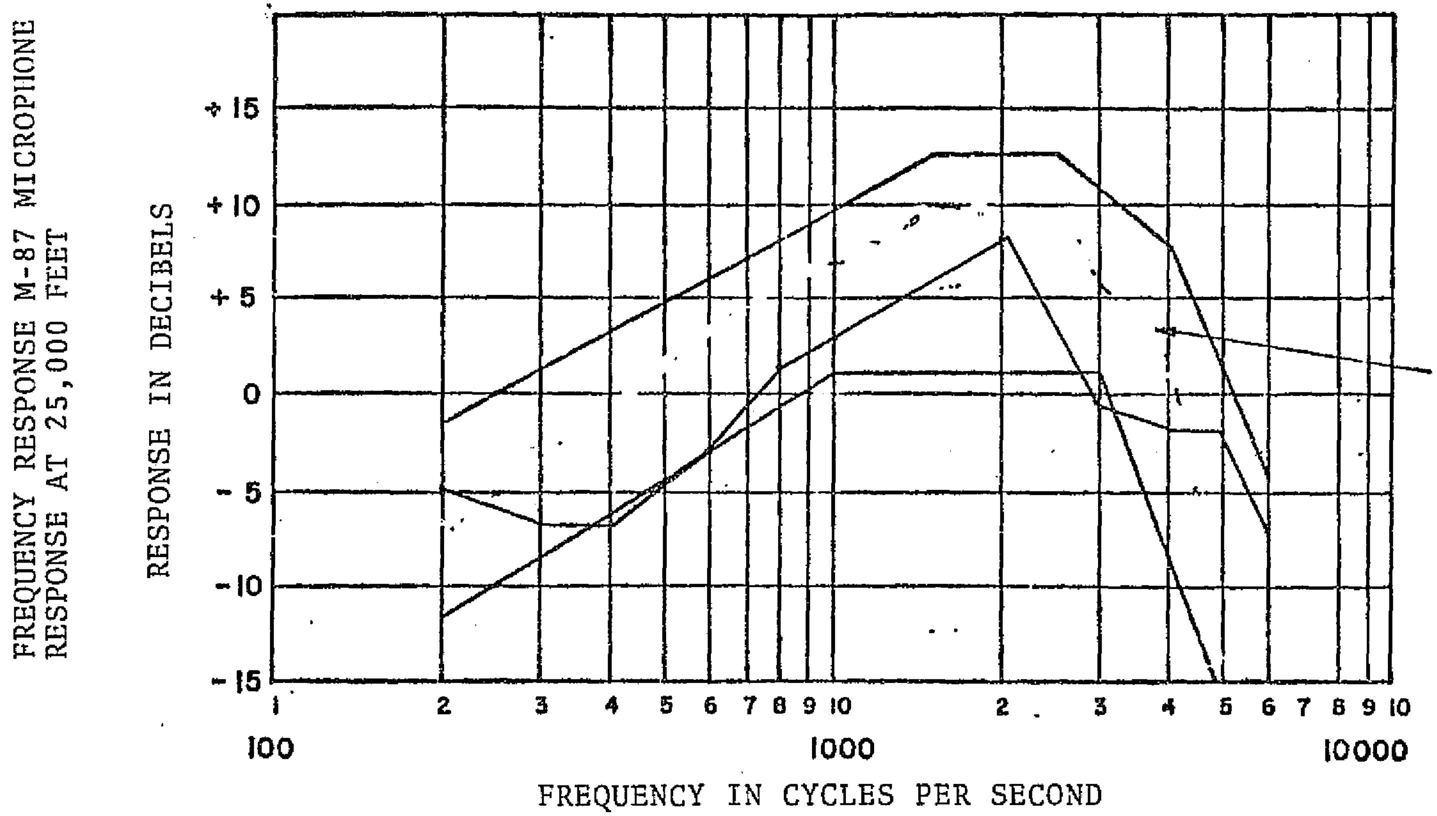


Figure A-61.– Electrovoice M-87 frequency response at 25,000 ft SN-51.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT 25,000 FEET

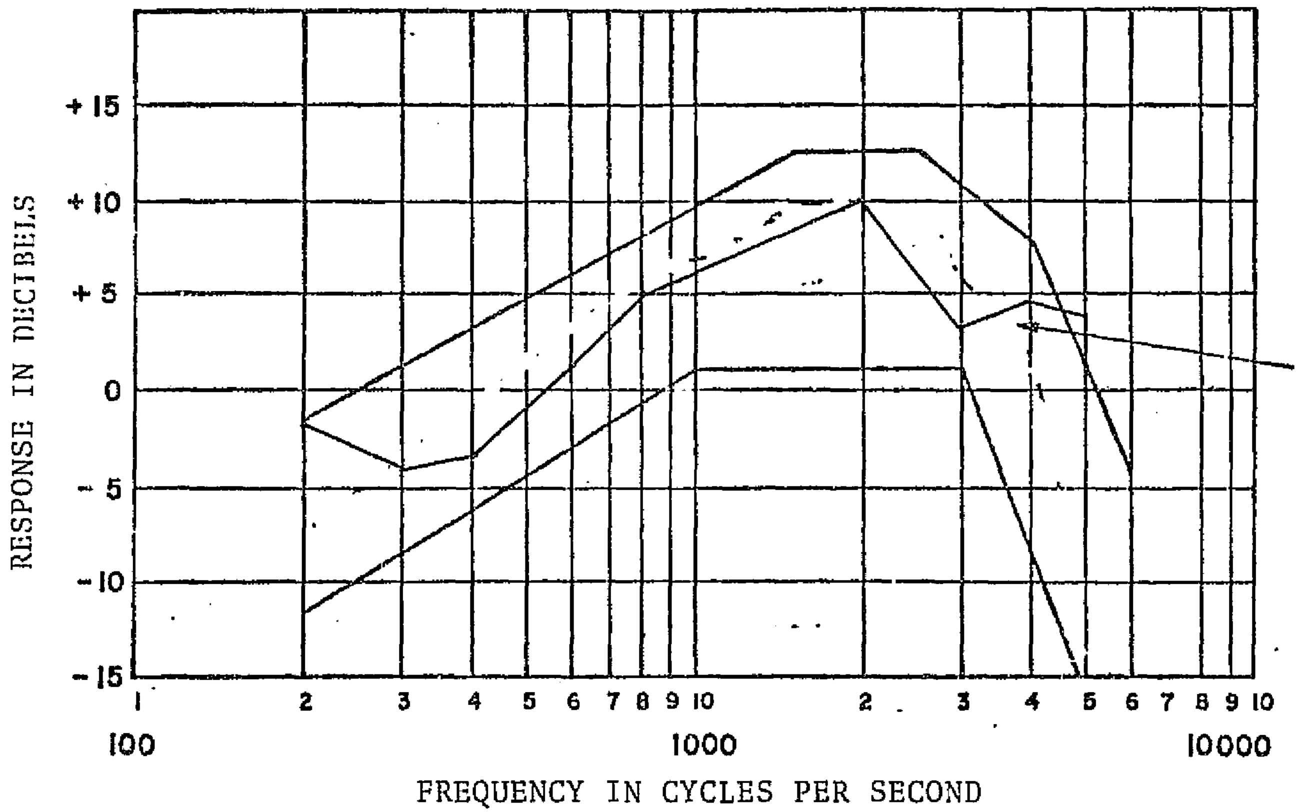


Figure A-62.— Electrovoice M-87 frequency response at 25,000 ft SN-52.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT 25,000 FEET

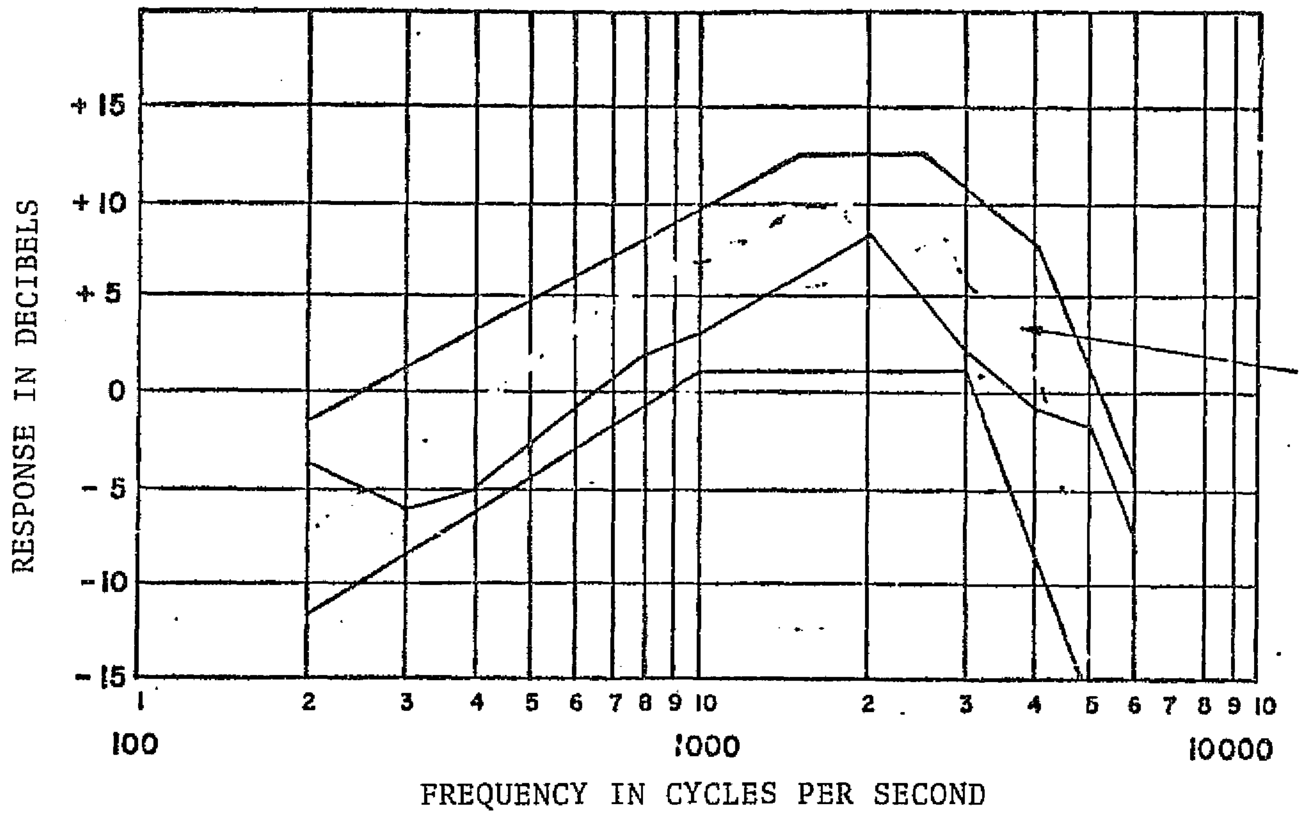


Figure A-63.– Electrovoice M-87 frequency response at 25,000 ft SN-53.

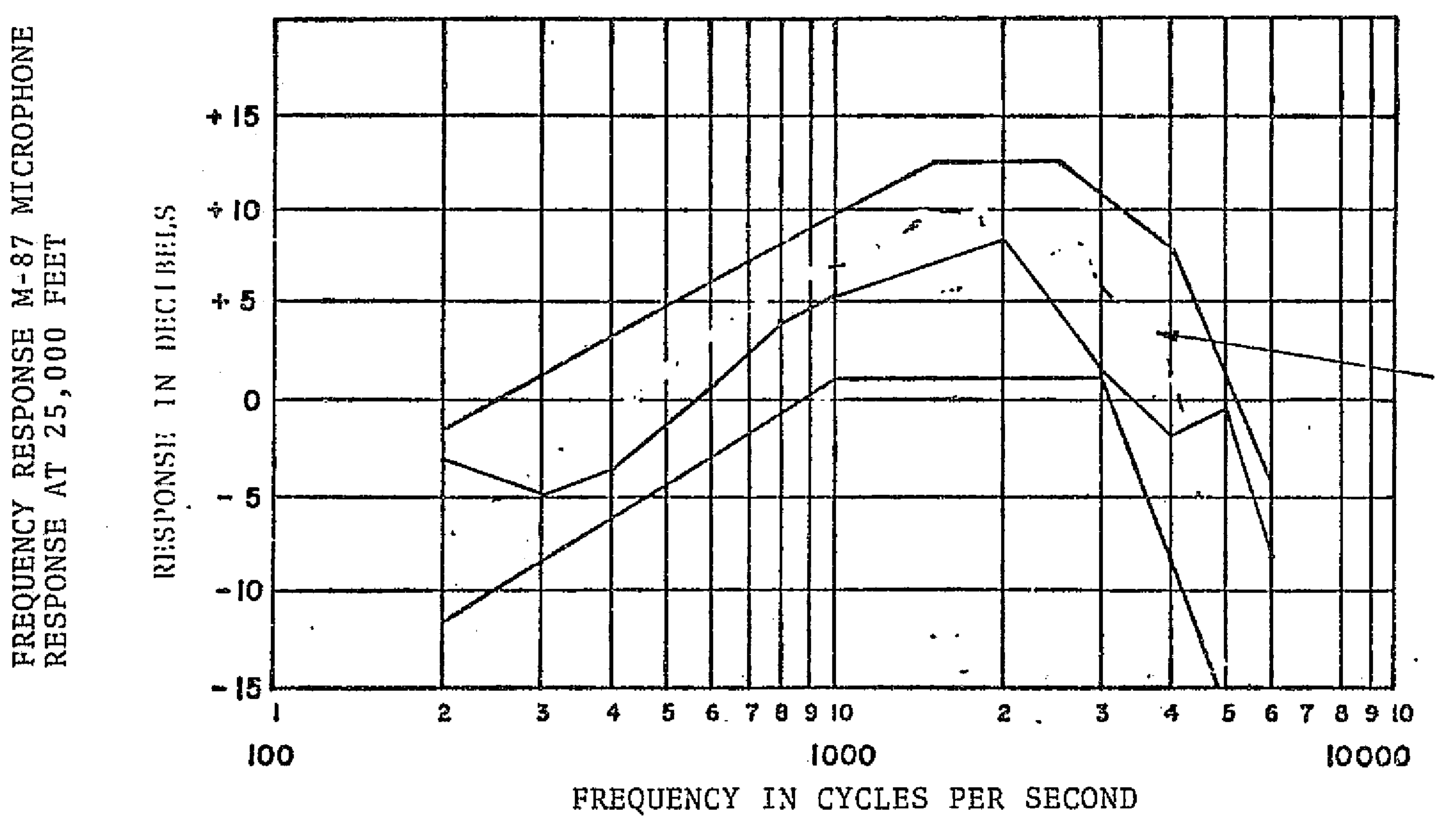


Figure A-64.— Electrovoice M-87 frequency response at 25,000 ft SN-54.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT 25,000 FEET

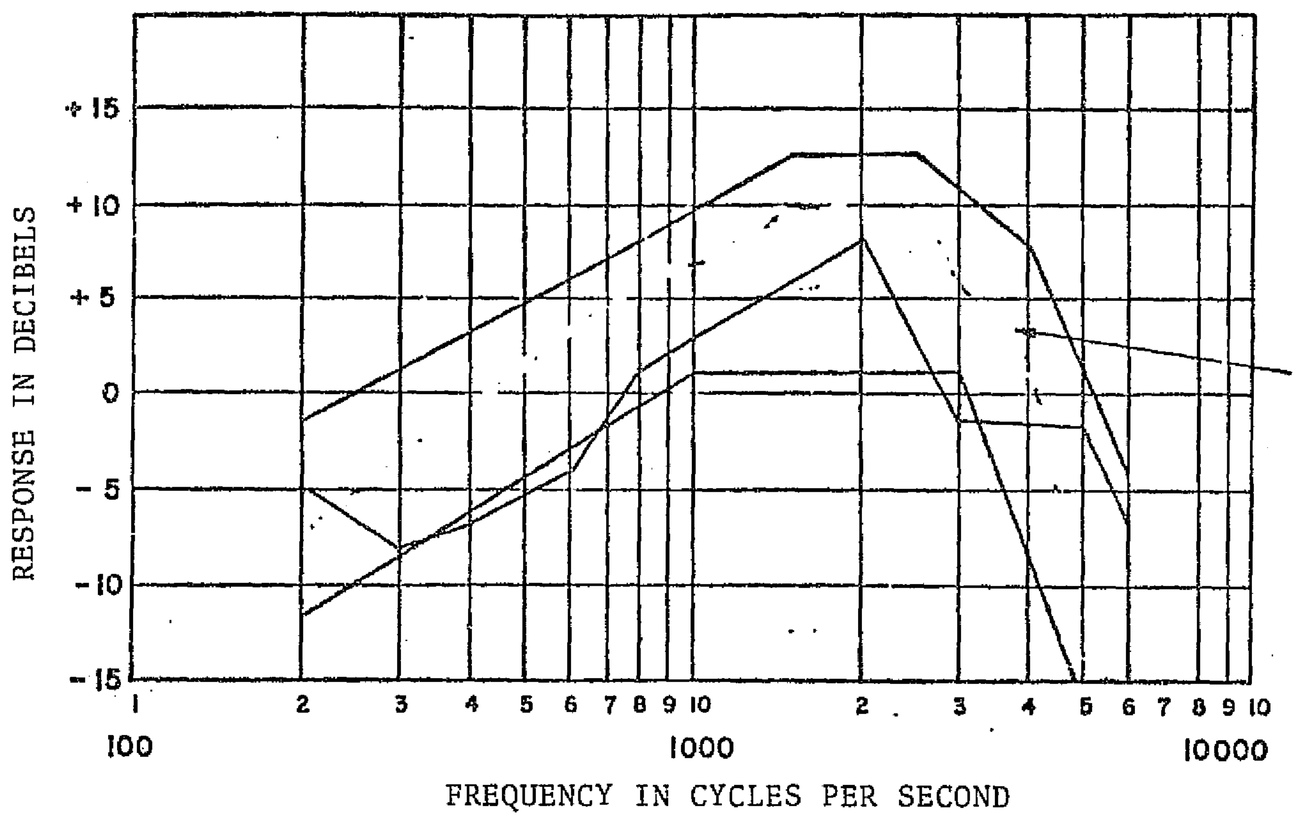


Figure A-65.— Electrovoice M-87 frequency response at 25,000 ft SN-55.

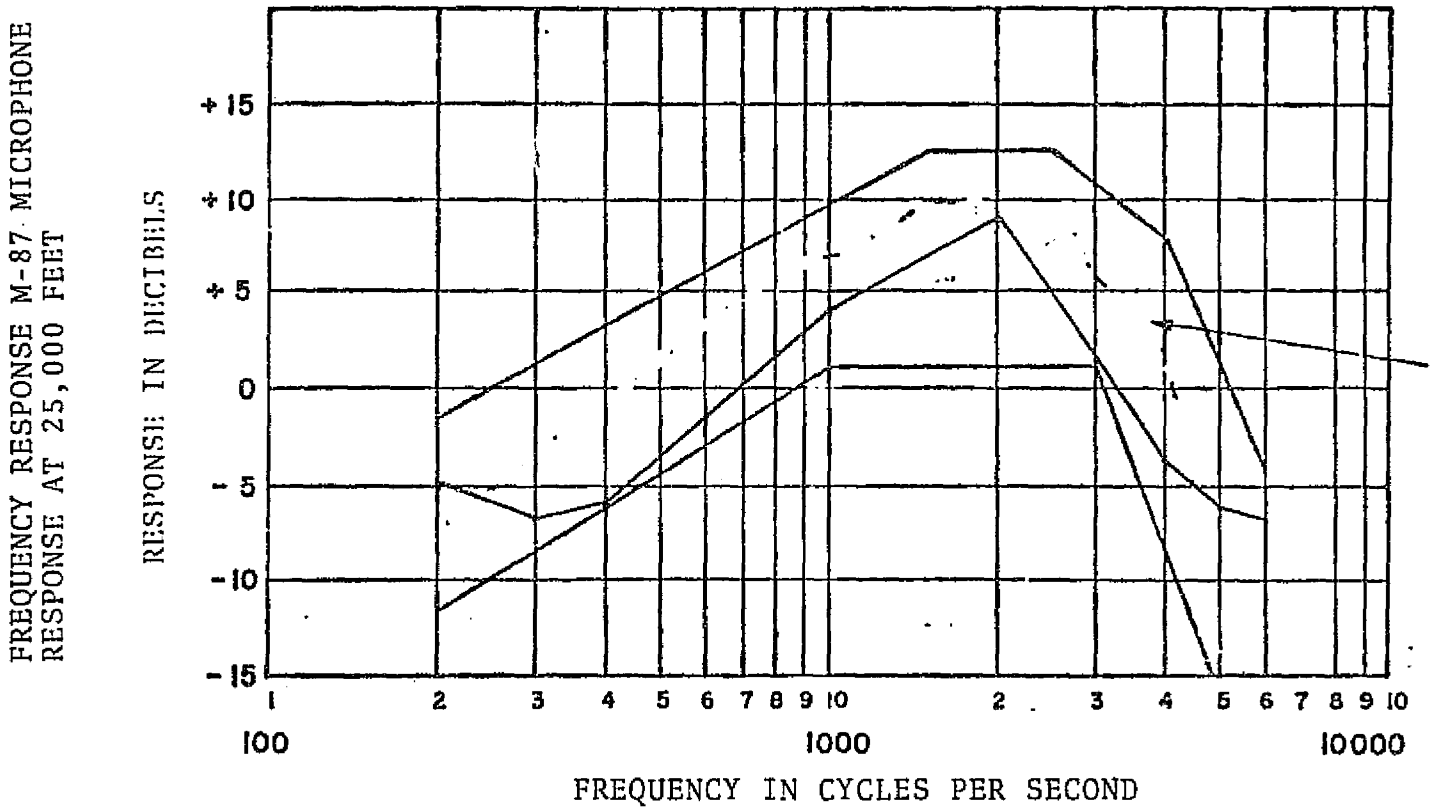


Figure A-66.— Electrovoice M-87 frequency response at 25,000 ft SN-56.

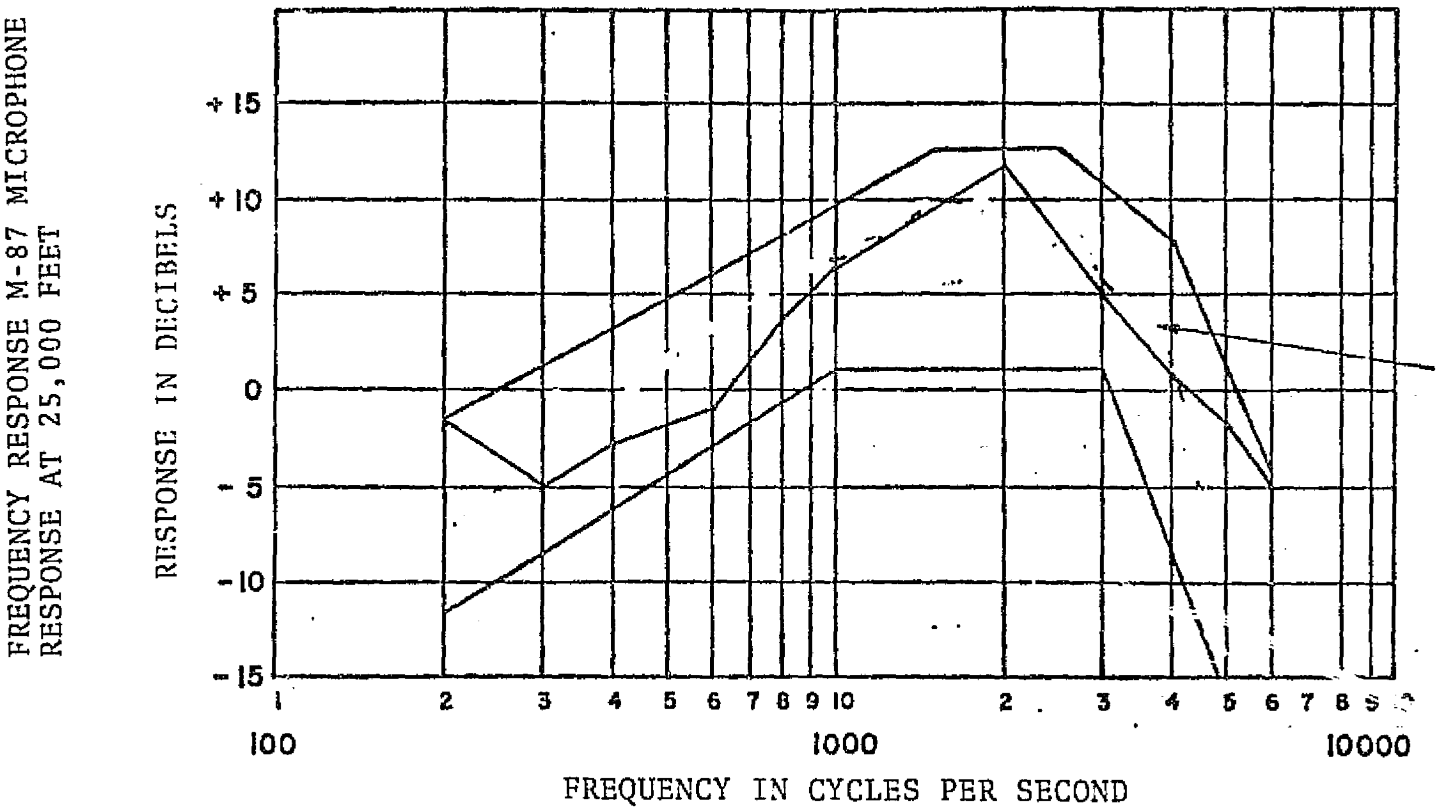


Figure A-67.– Electrovoice M-87 frequency response at 25,000 ft SN-57.

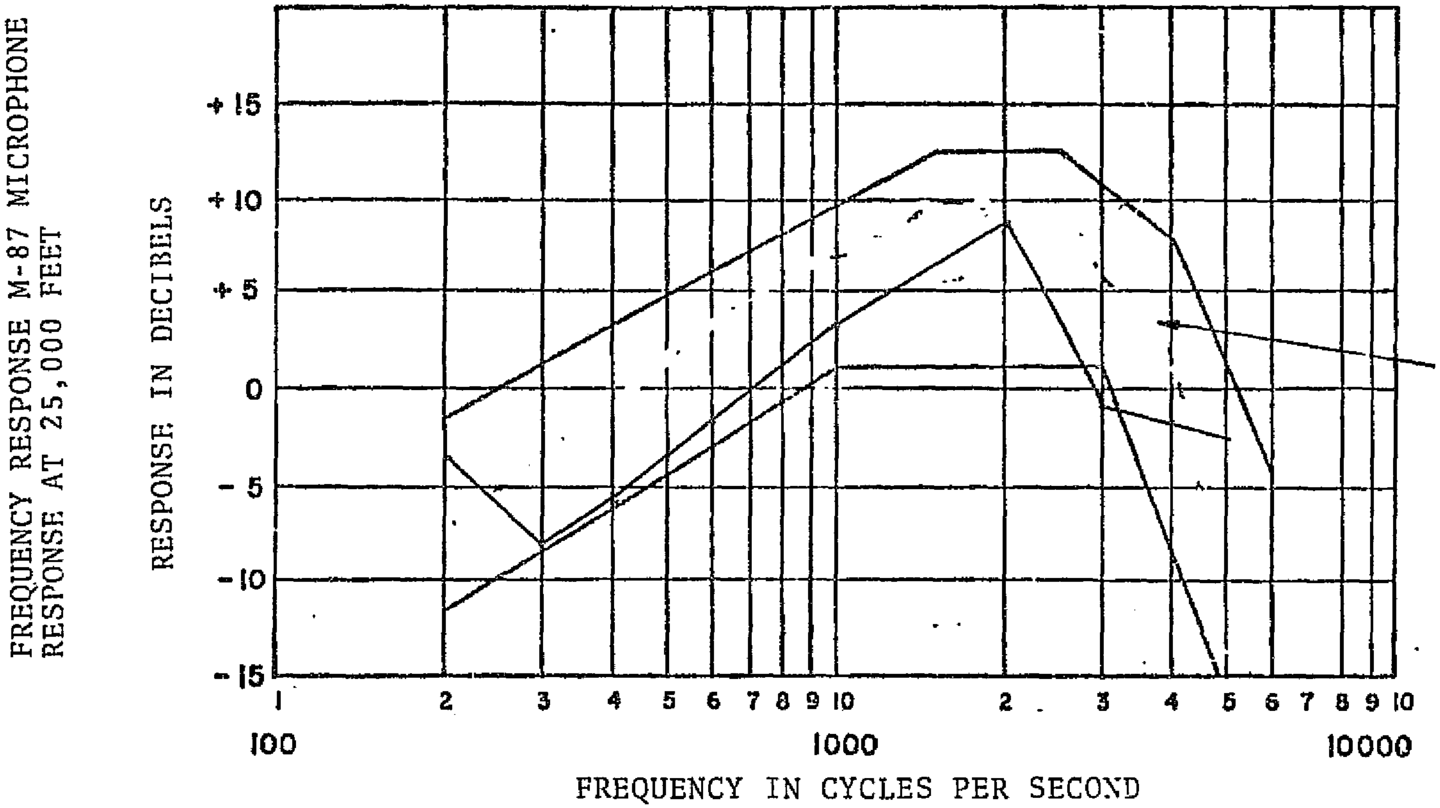


Figure A-68.– Electrovoice M-87 frequency response at 25,000 ft SN-58.

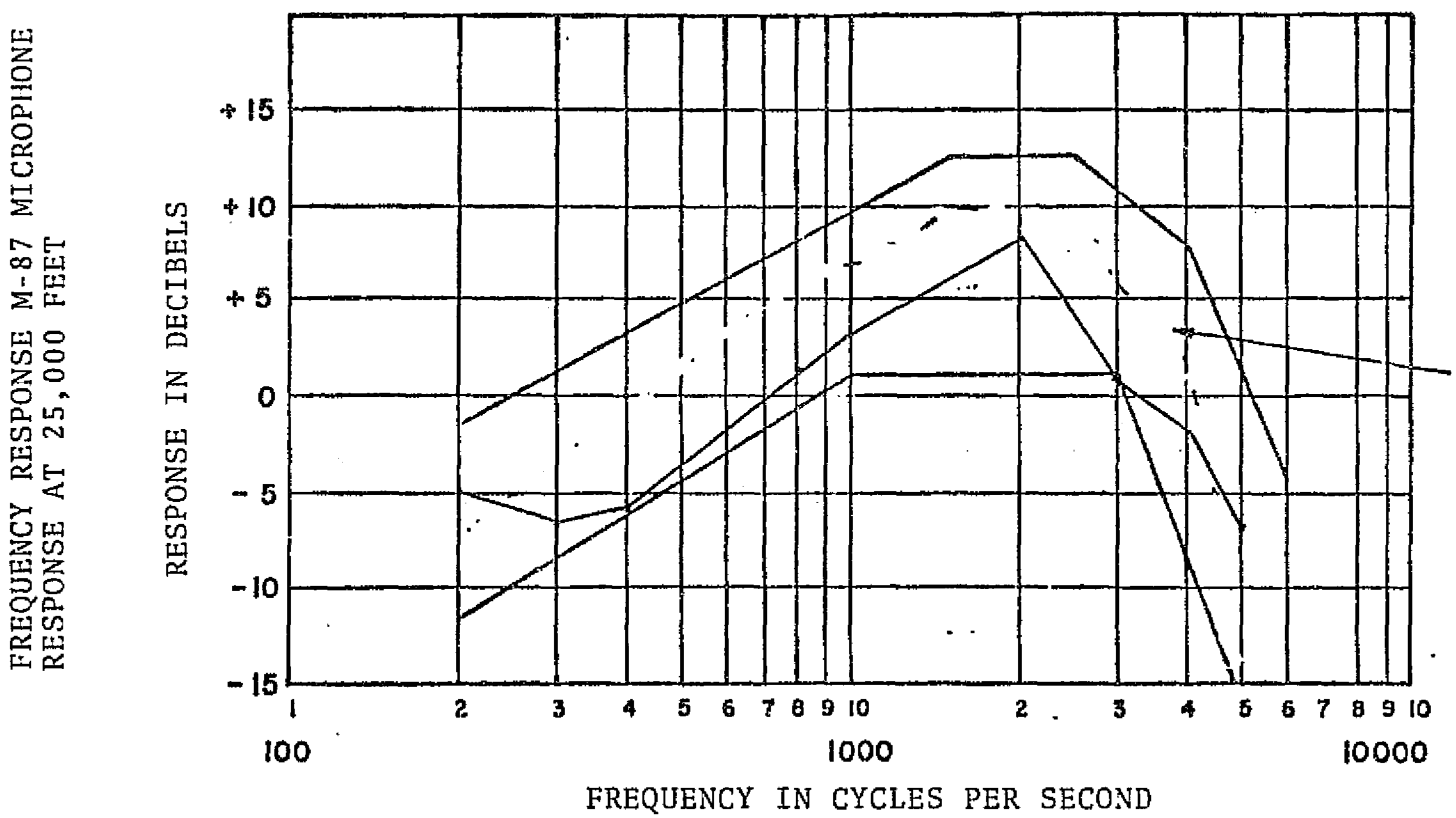


Figure A-69.— Electrovoice M-87 frequency response at 25,000 ft SN-59.

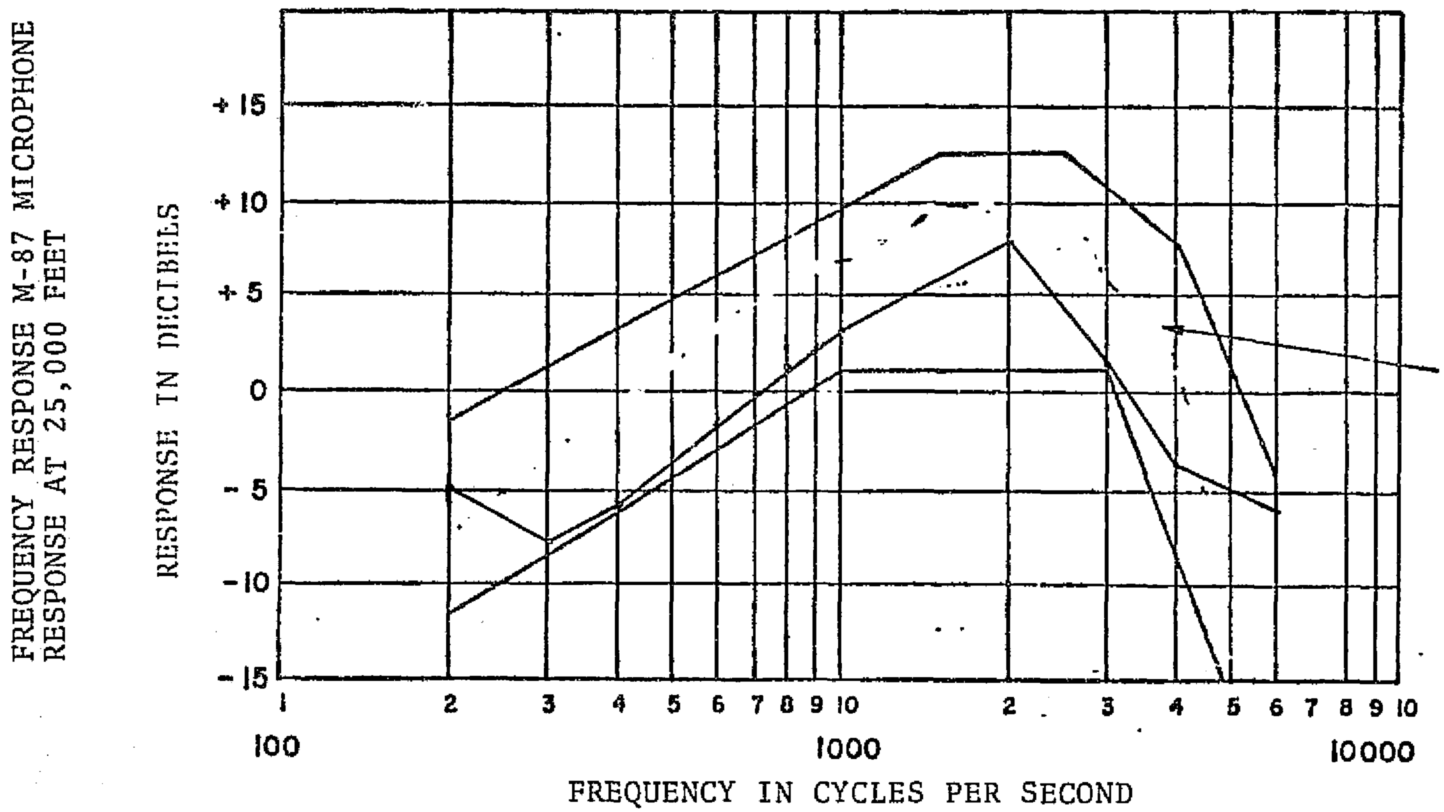


Figure A-70.– Electrovoice M-87 frequency response at 25,000 ft SN-60.

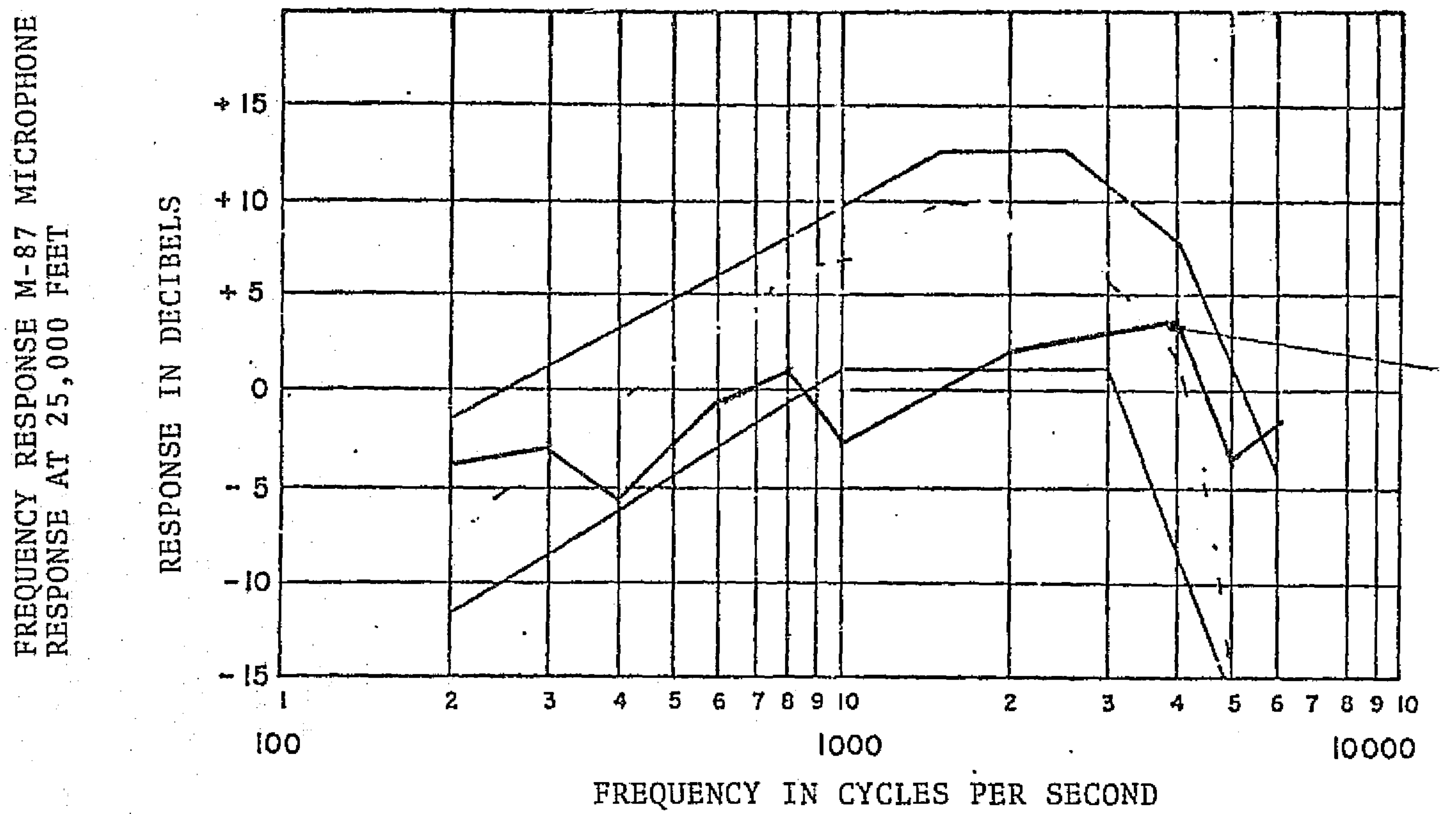


Figure A-71.— Roanwell M-87 frequency response at 25,000 ft SN-1.

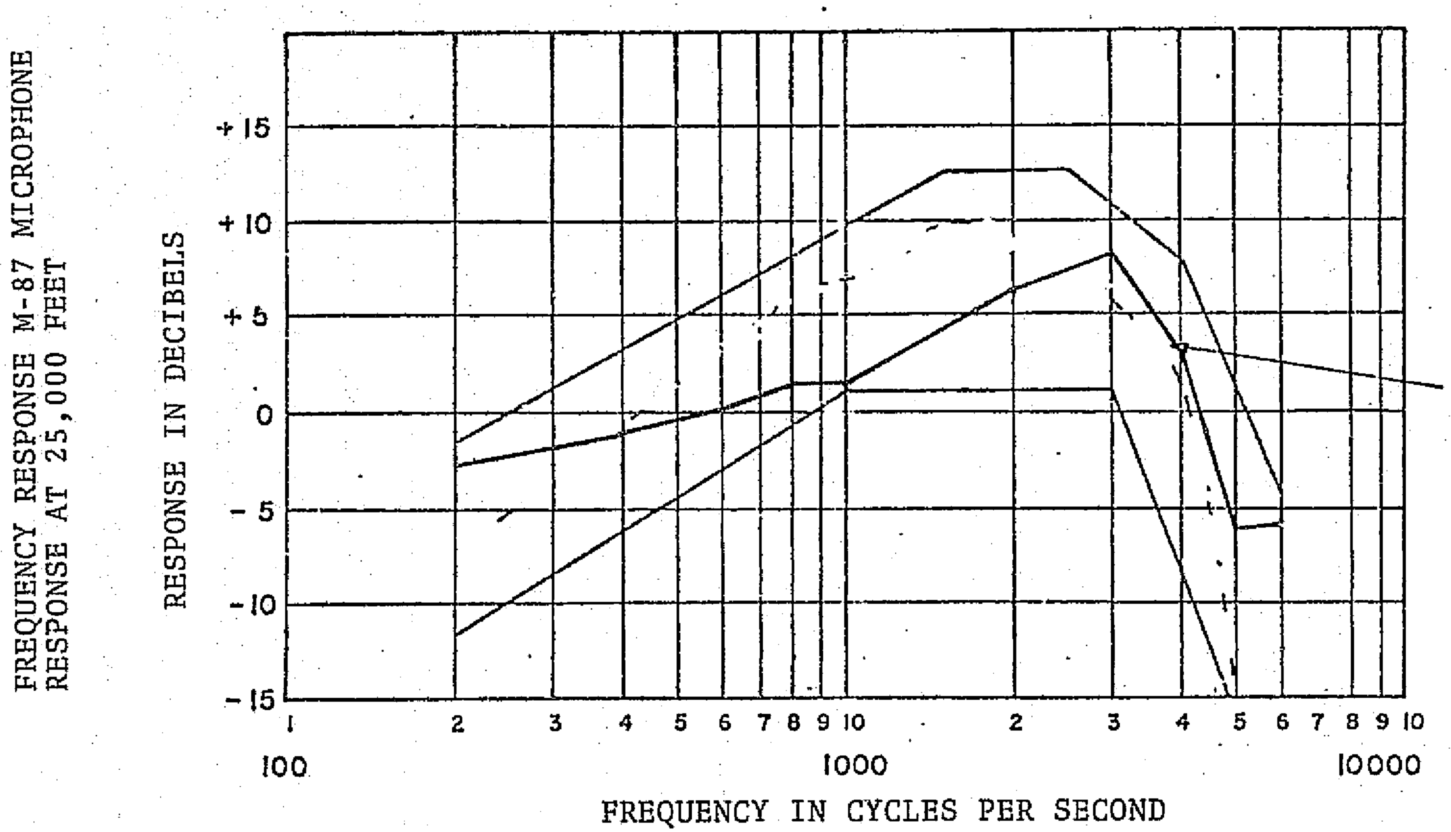


Figure A-72.— Roanwell M-87 frequency response at 25,000 ft SN-2.

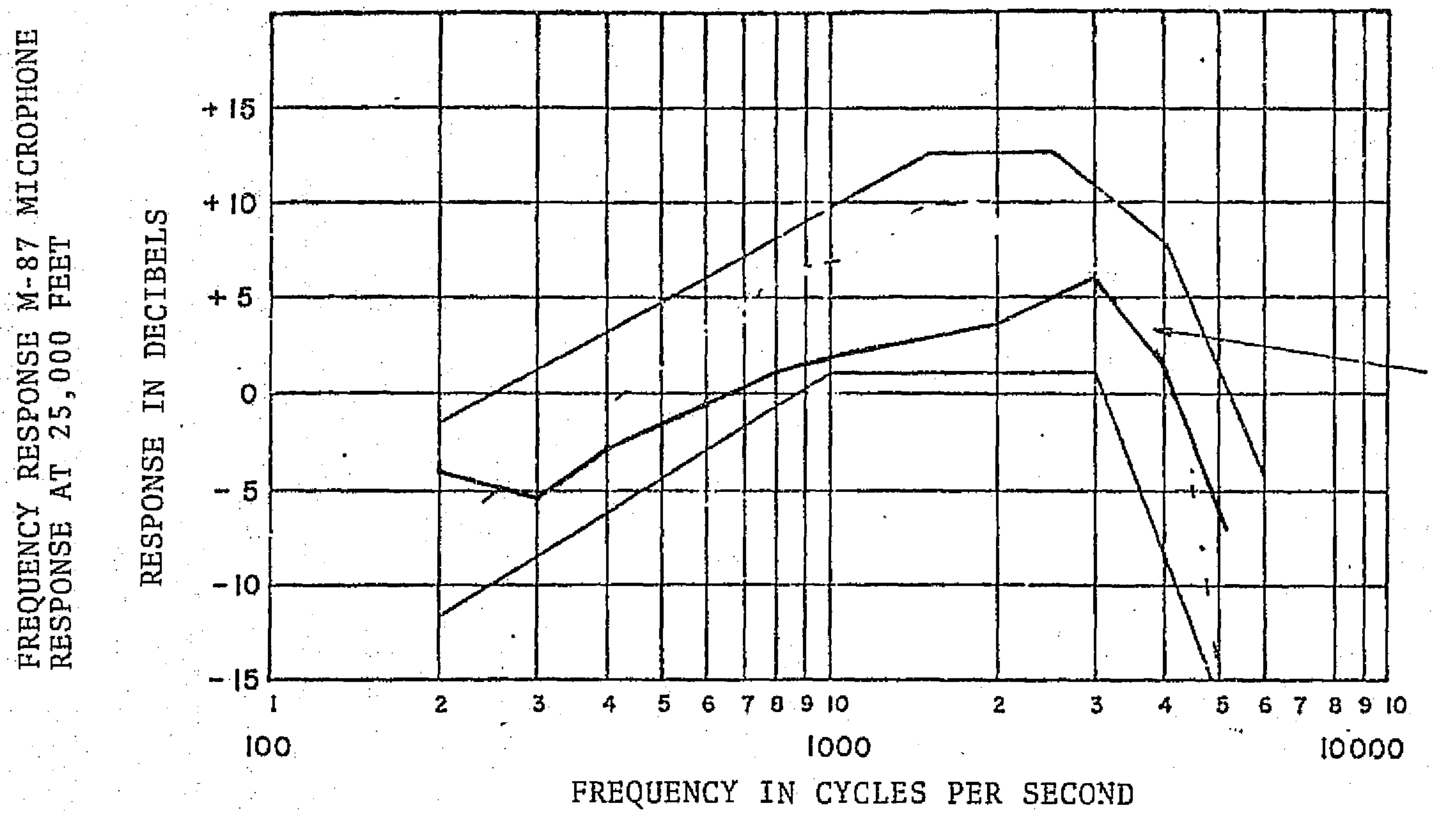


Figure A-73.— Roanwell M-87 frequency response at 25,000 ft SN-3.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT 25,000 FEET

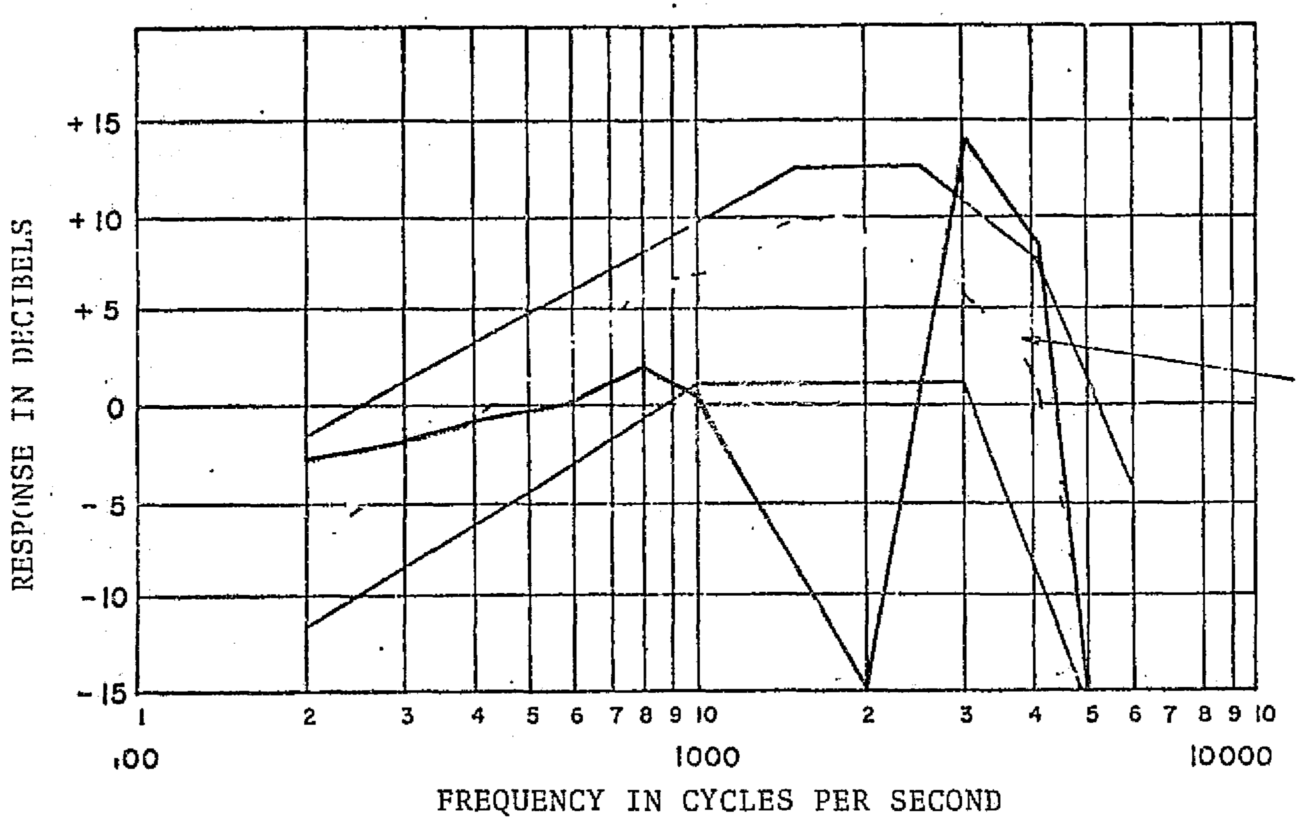


Figure A-74.– Roanwell M-87 frequency response at 25,000 ft SN-4.

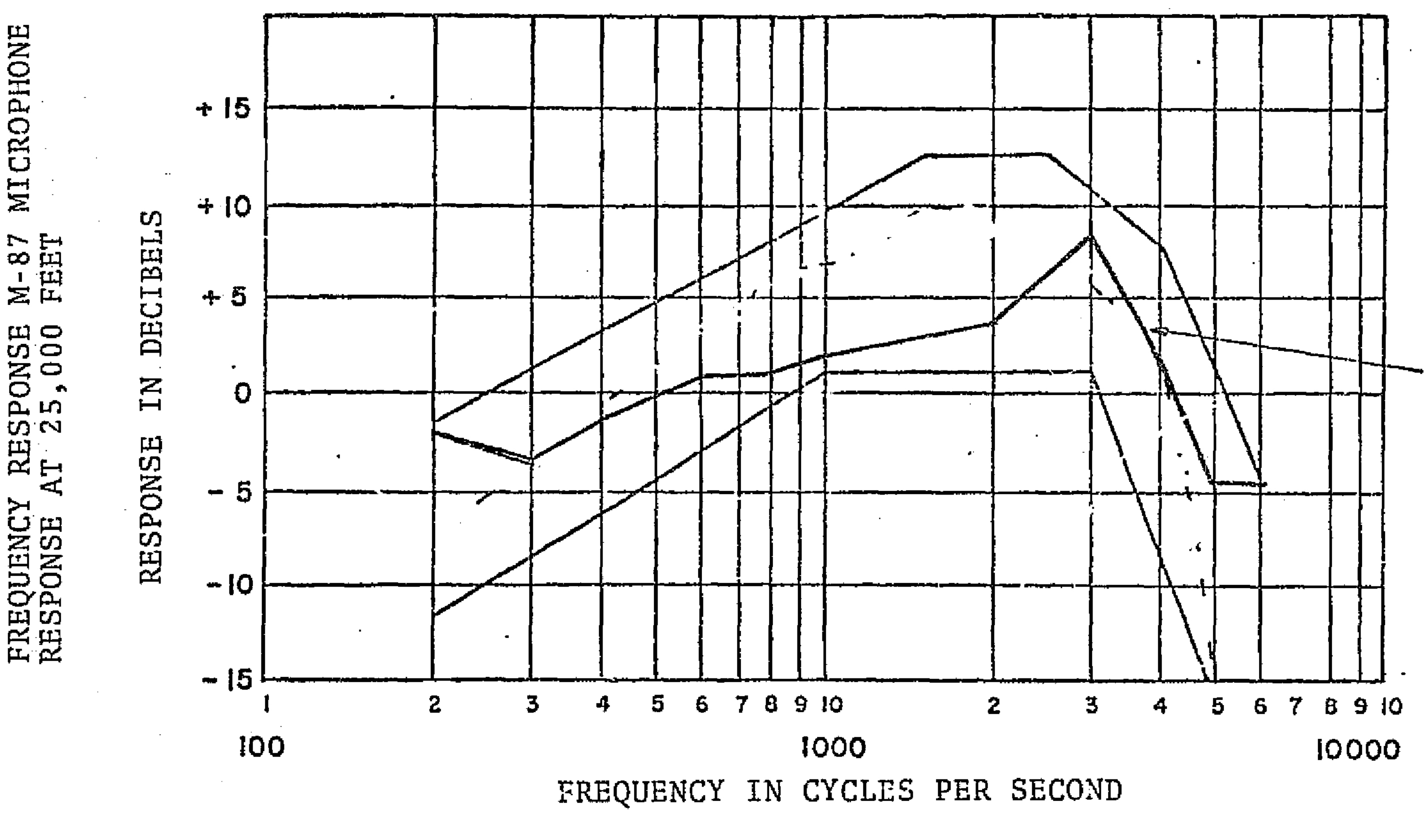


Figure A-75.— Roanwell M-87 frequency response at 25,000 ft SN-5.

FREQUENCY RESPONSE M-87 MICROPHONE
RESPONSE AT 25,000 FEET

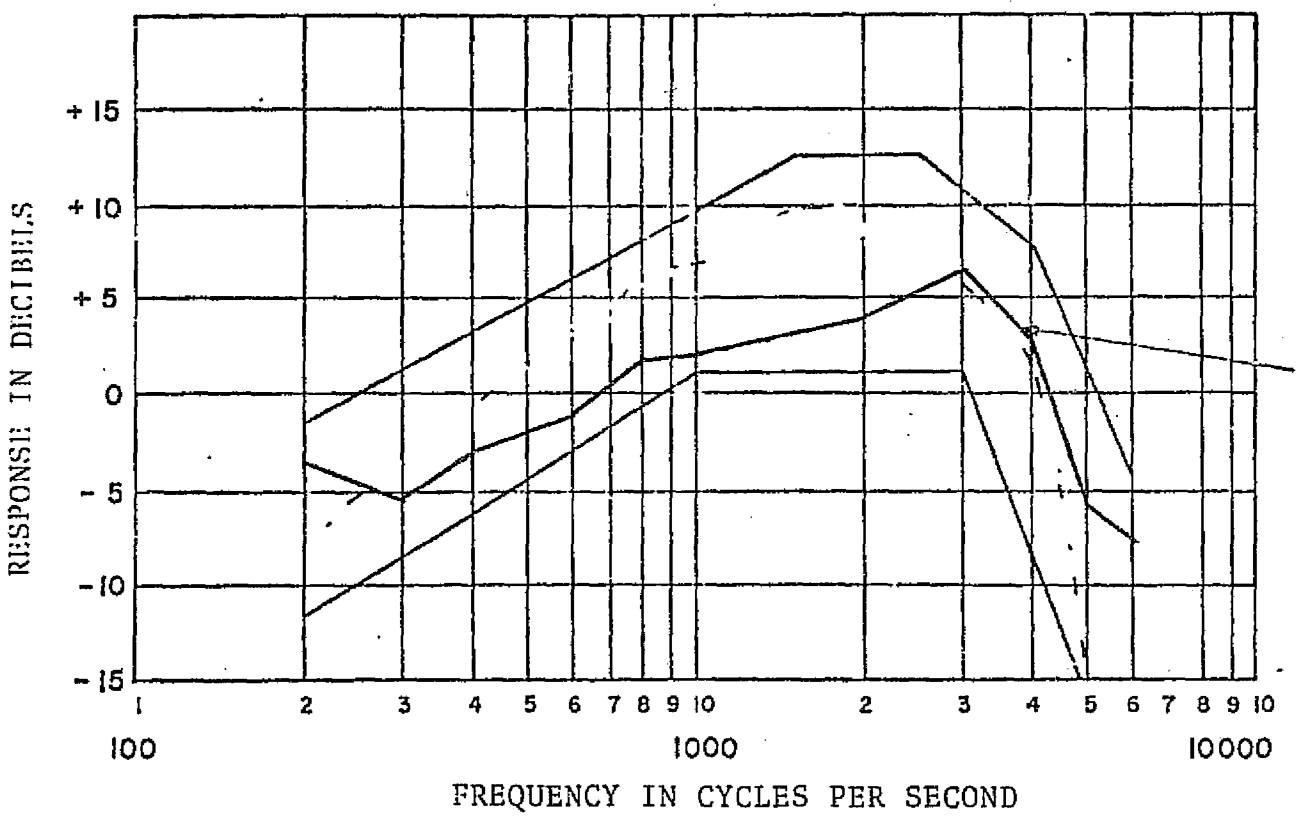


Figure A-76.— Roanwell M-87 frequency response at 25,000 ft SN-6.

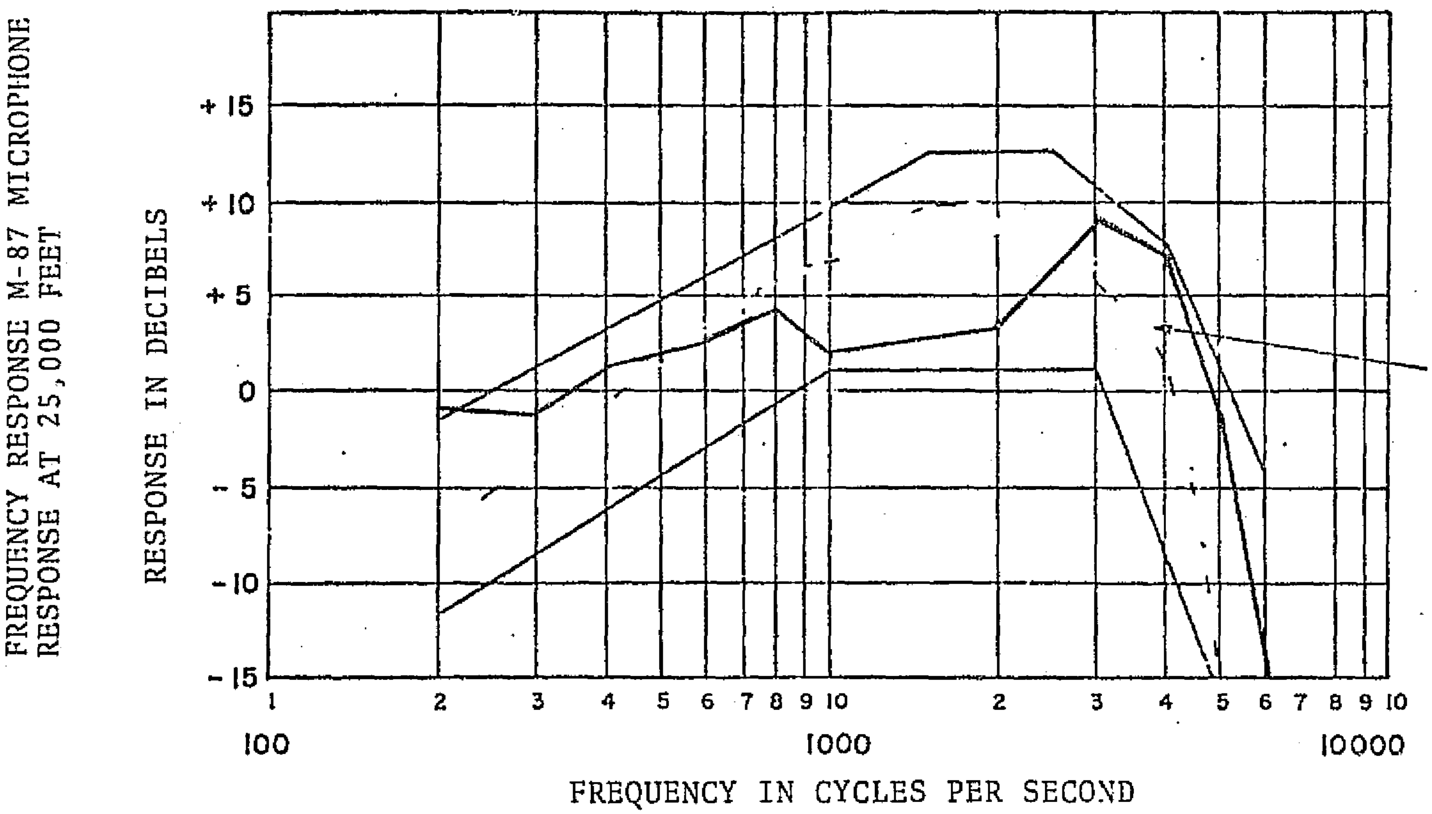


Figure A-77.– Roanwell M-87 frequency response at 25,000 ft SN-7.

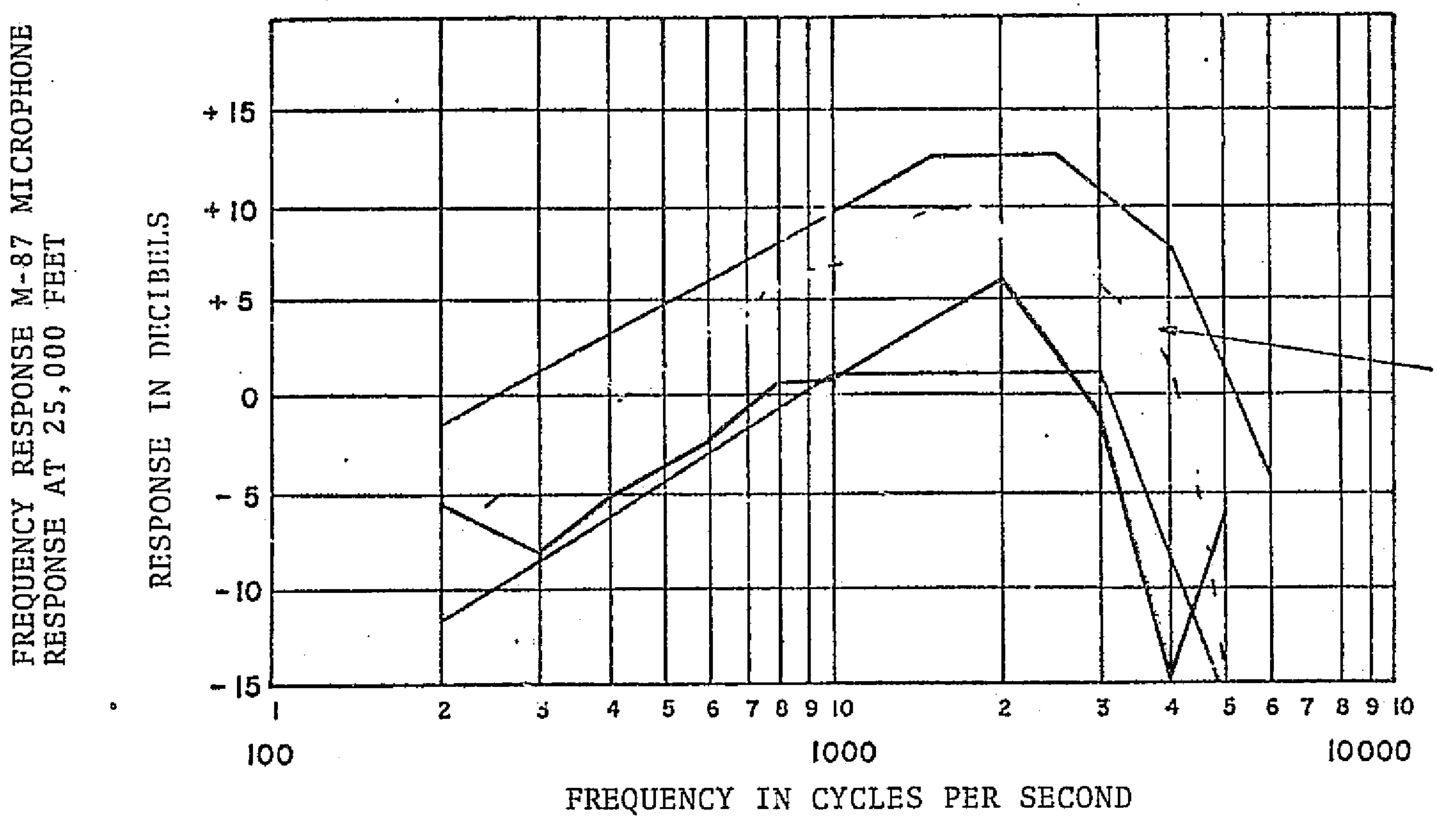


Figure A-78.— Roanwell M-87 frequency response at 25,000 ft SN-8.

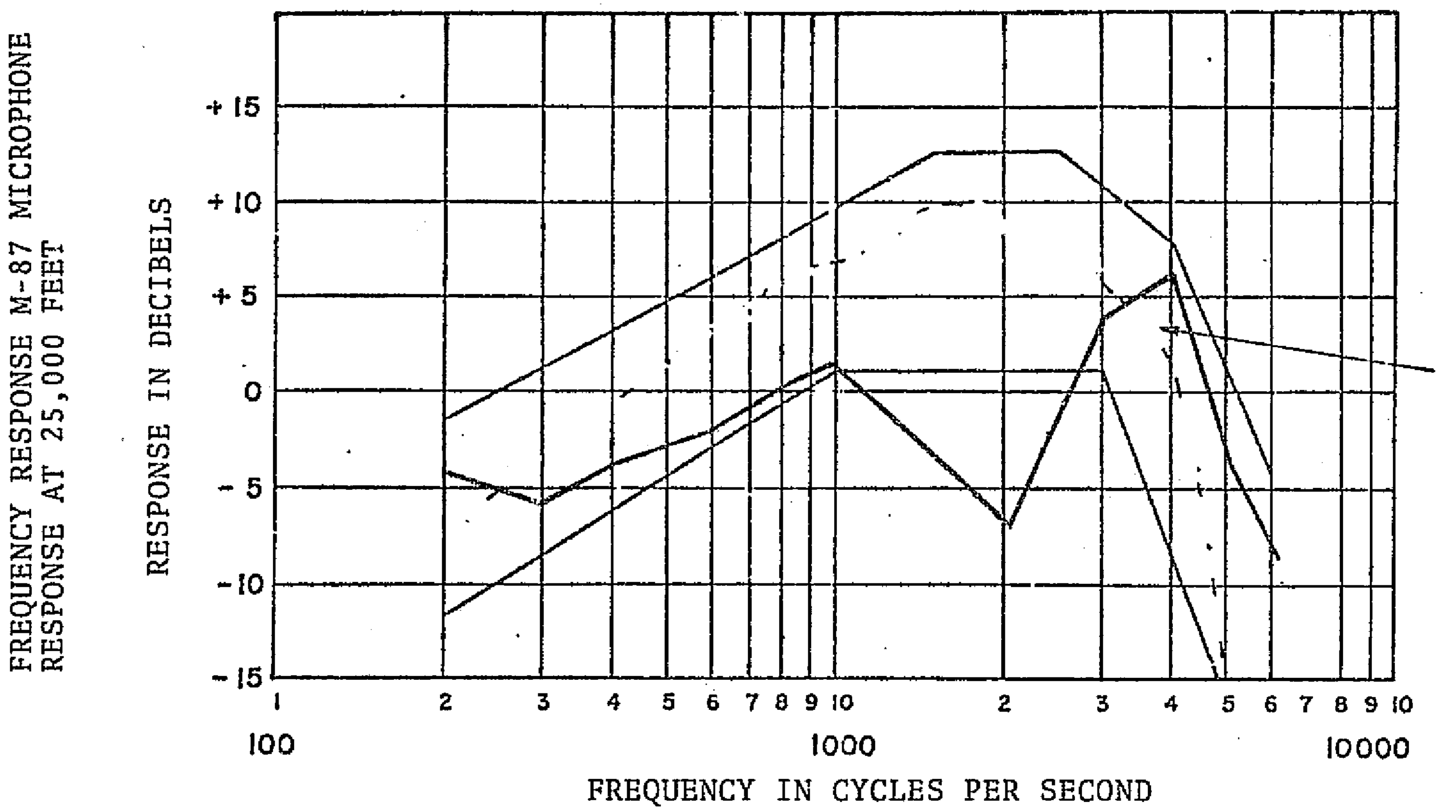


Figure A-79.— Roanwell M-87 frequency response at 25,000 ft SN-9.

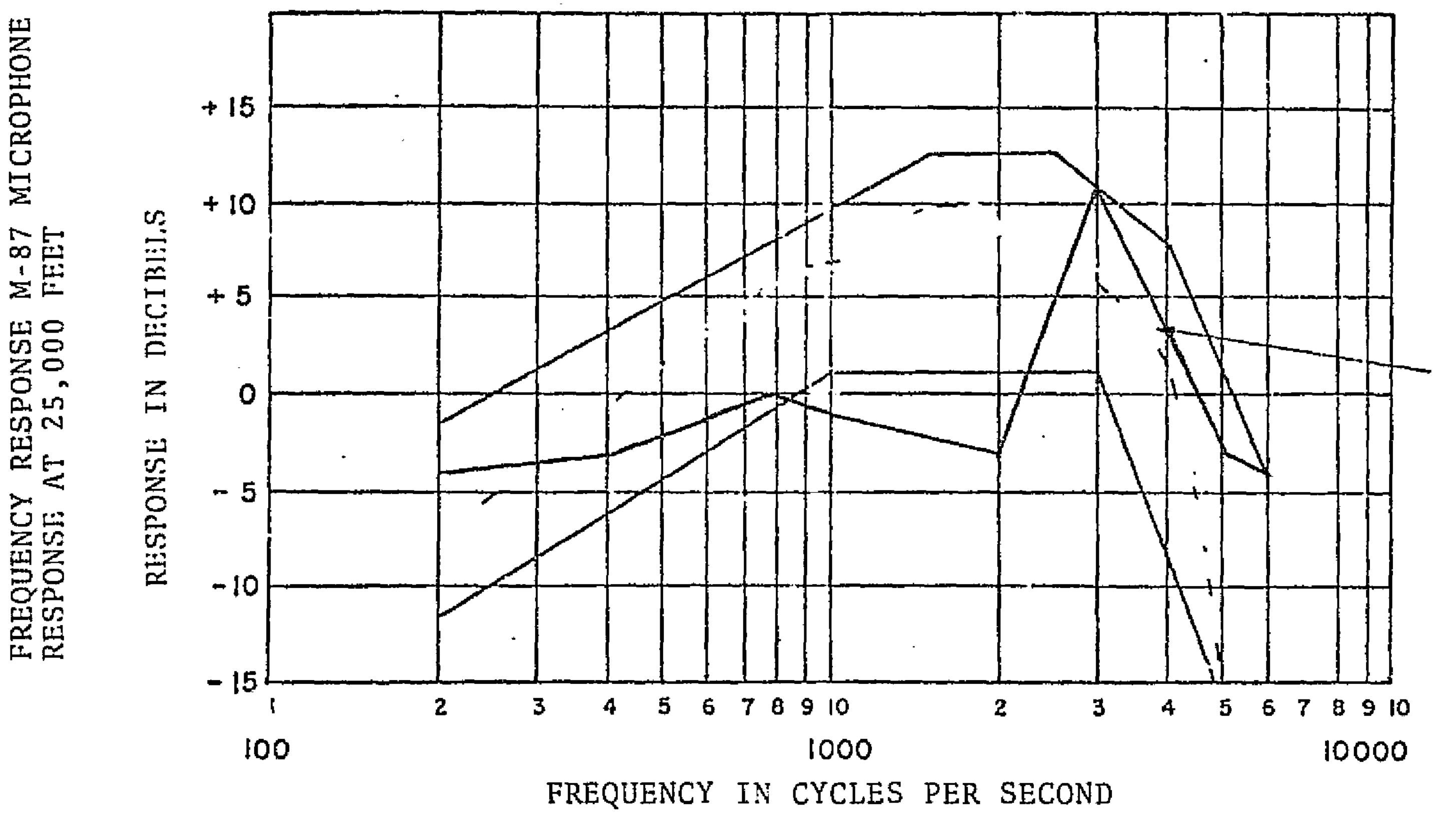


Figure A-80.– Roanwell M-87 frequency response at 25,000 ft SN-10.

APPENDIX B

M-101 FREQUENCY RESPONSE GRAPHS

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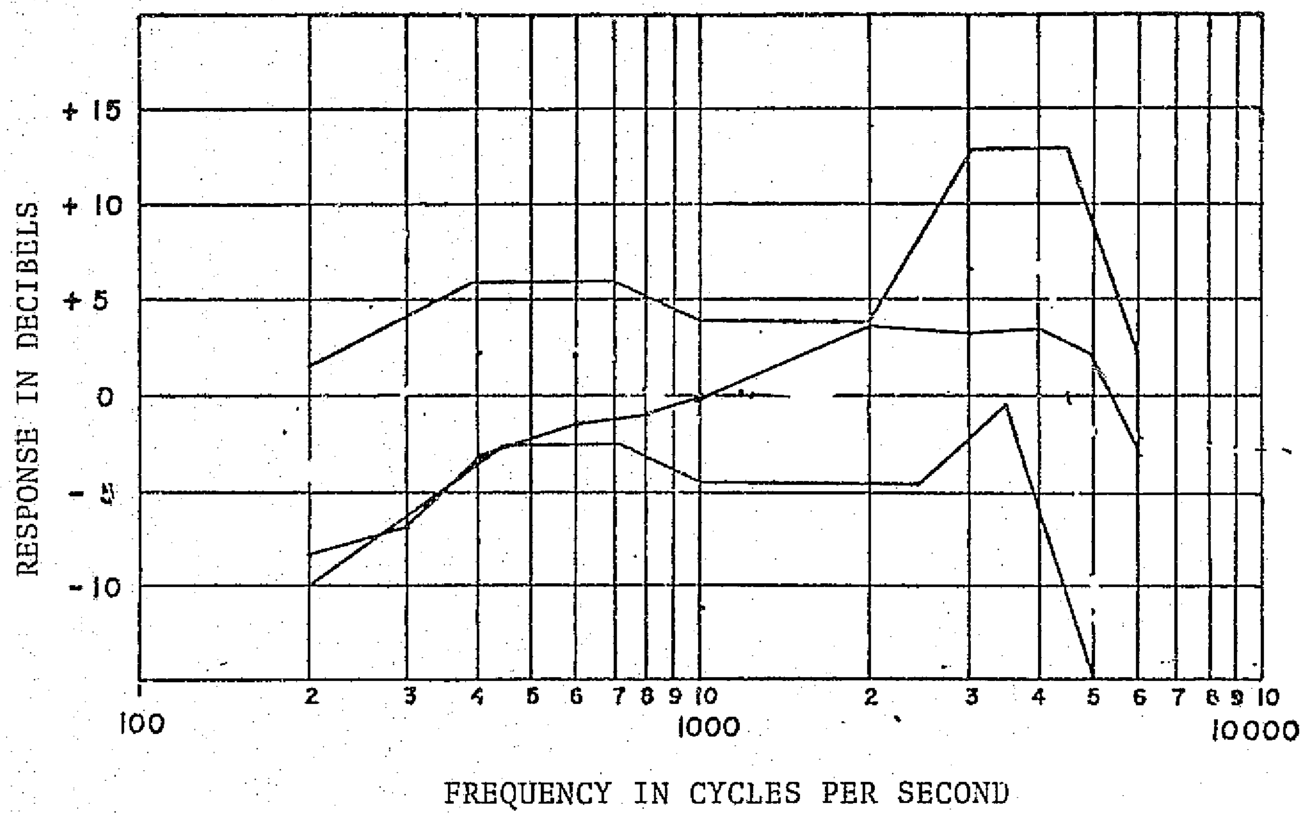
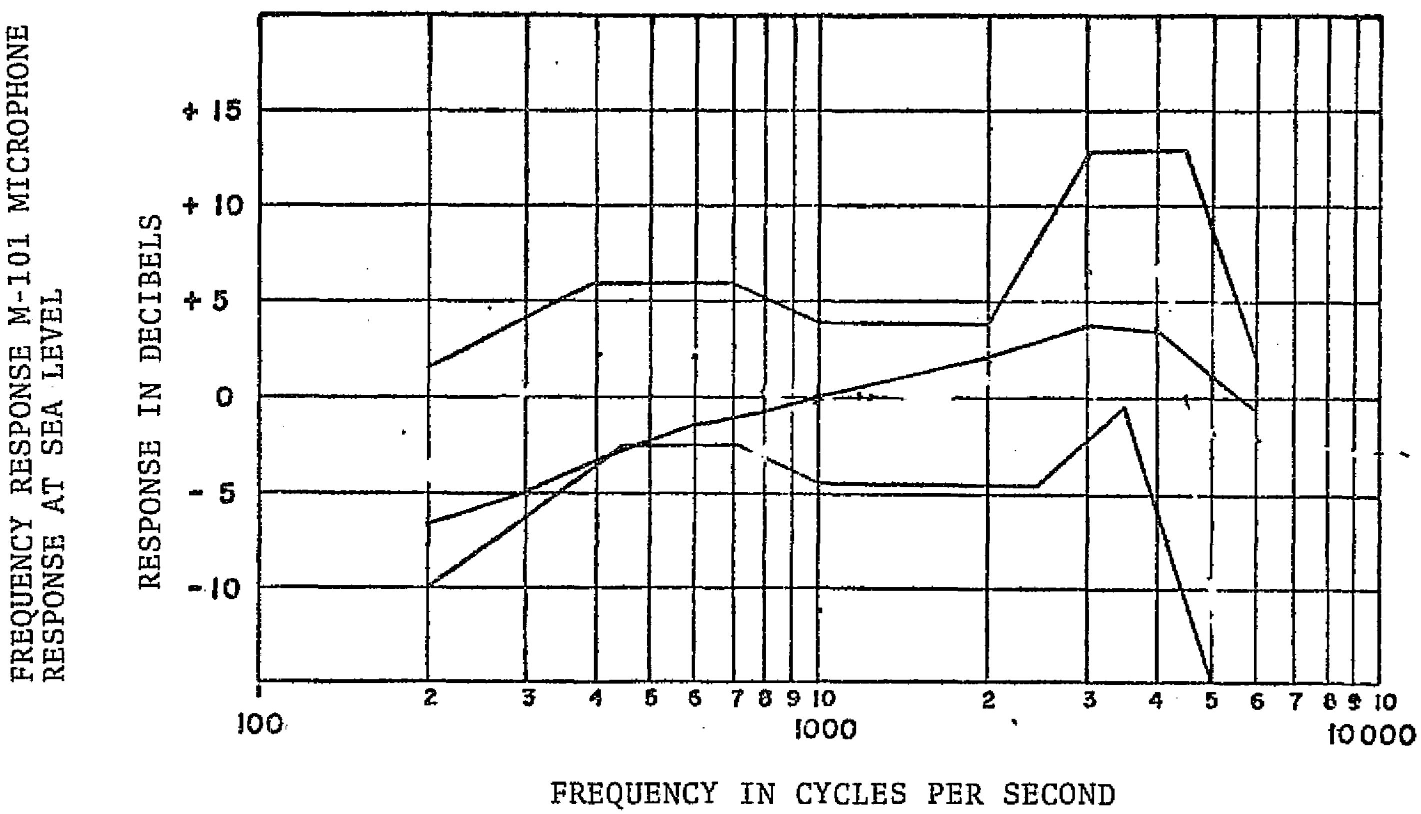
FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



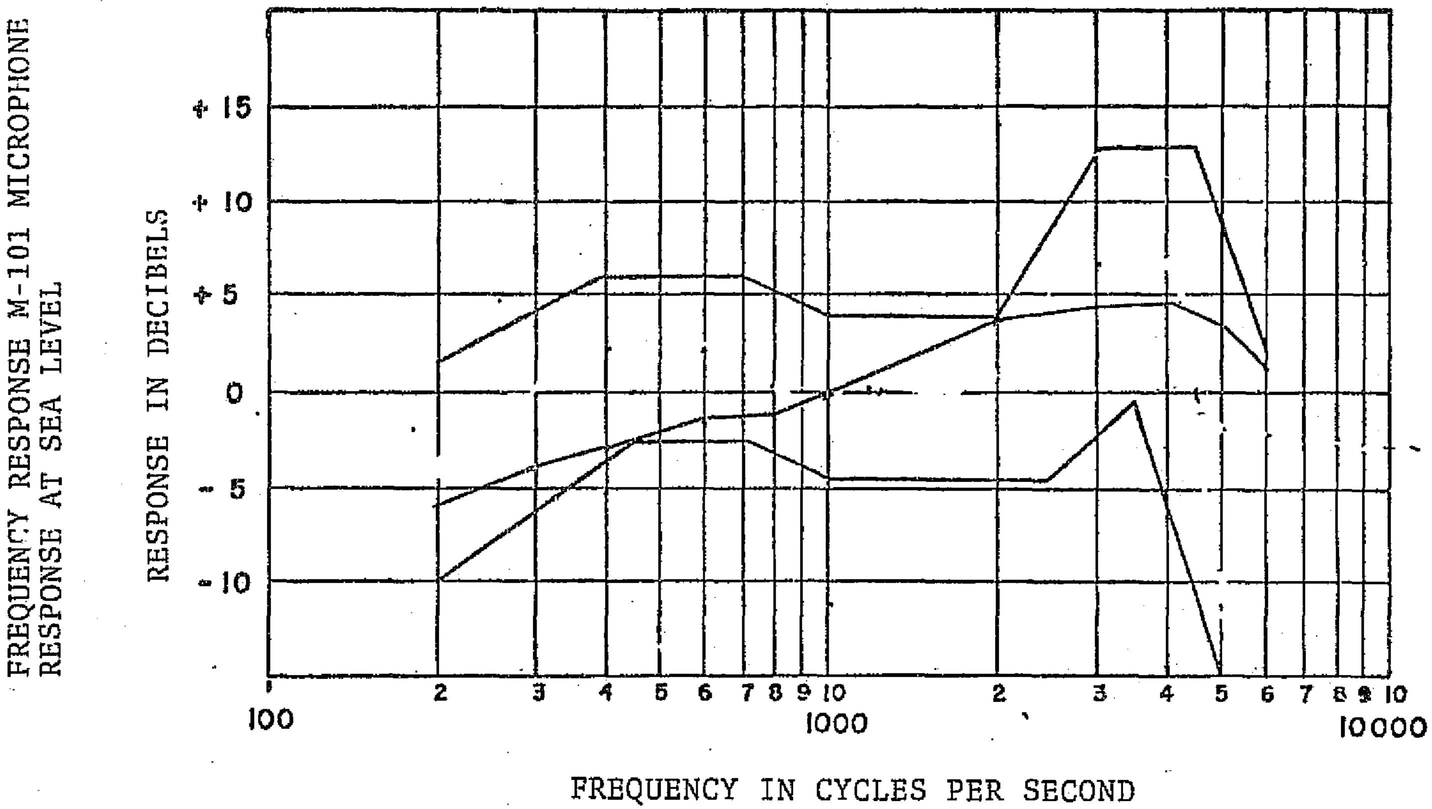
Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure B-1.– Carter M-101 ground level frequency response SN-11.



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

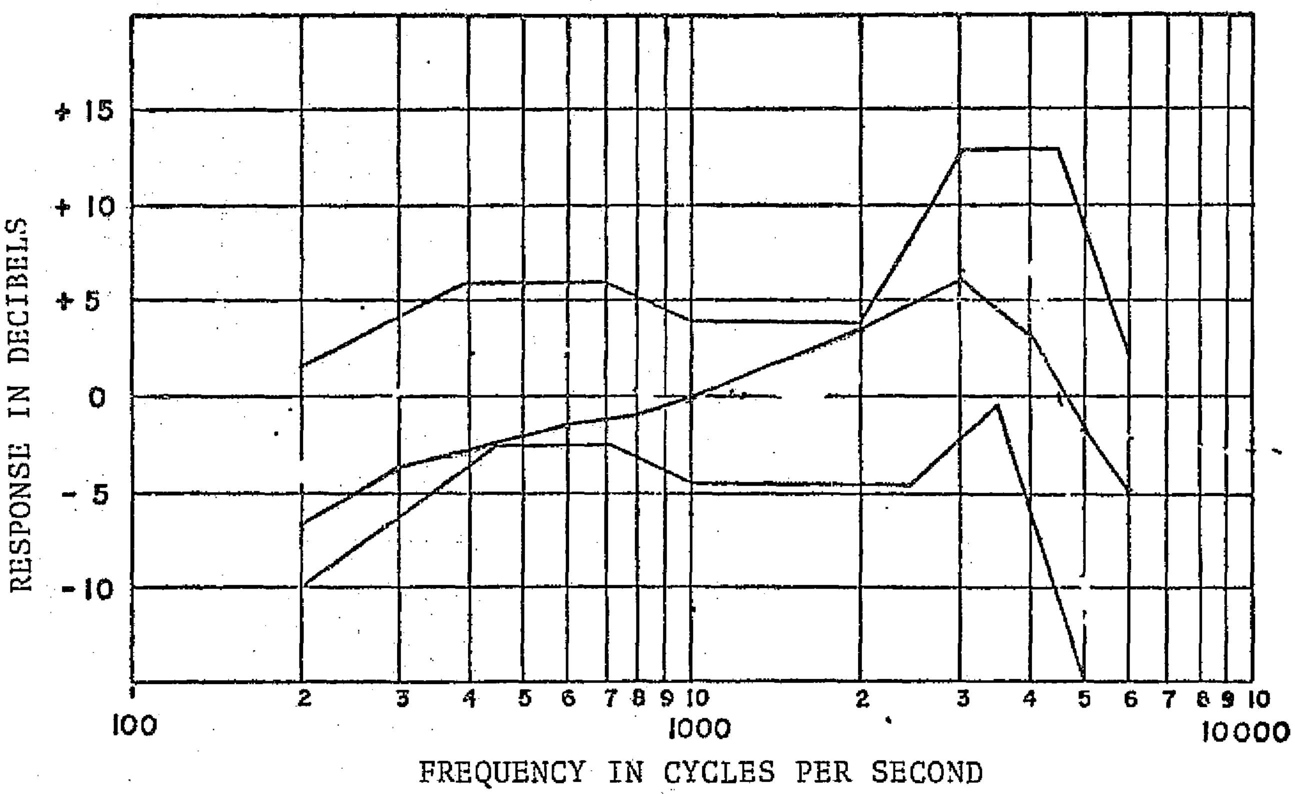
Figure B-2.— Carter M-101 ground level frequency response SN-12.



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure B-3.– Carter M-101 ground level frequency response SN-13.

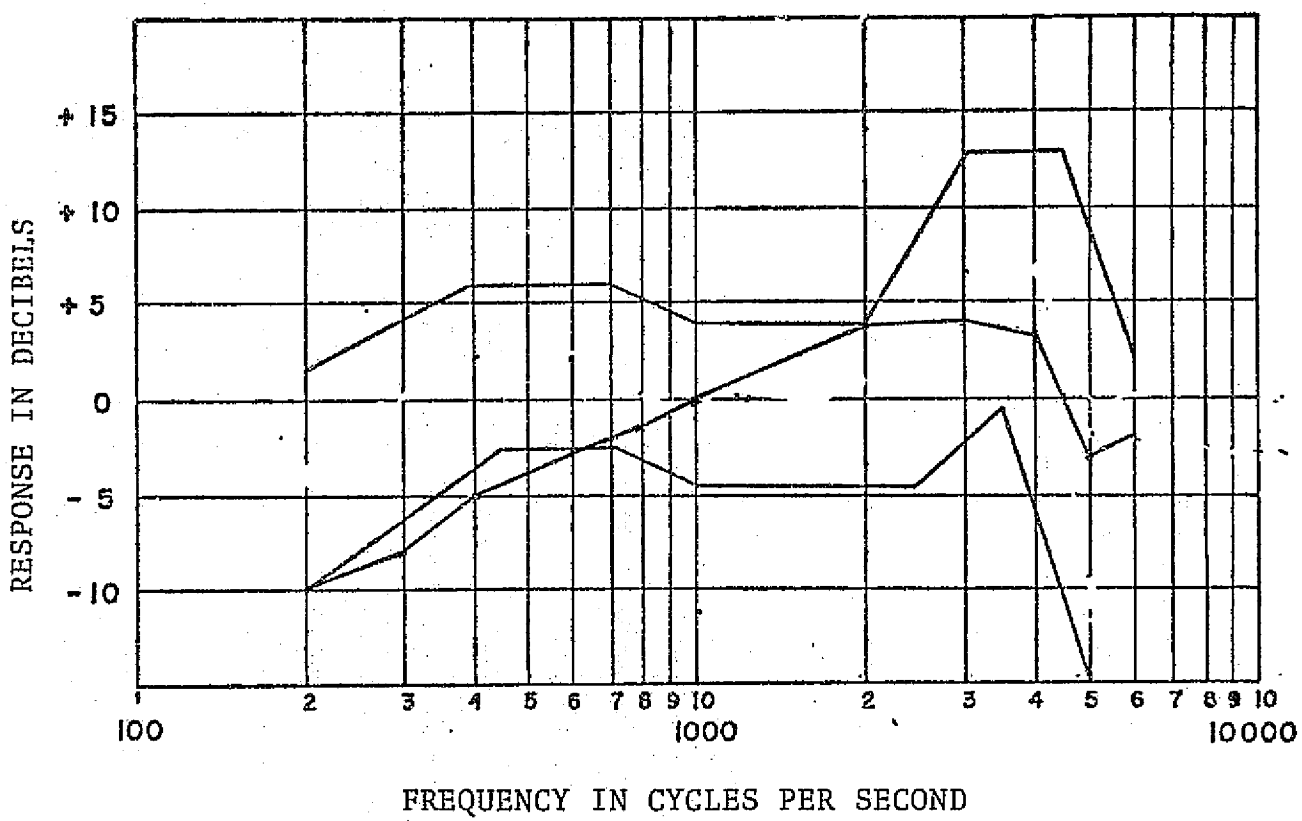
FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

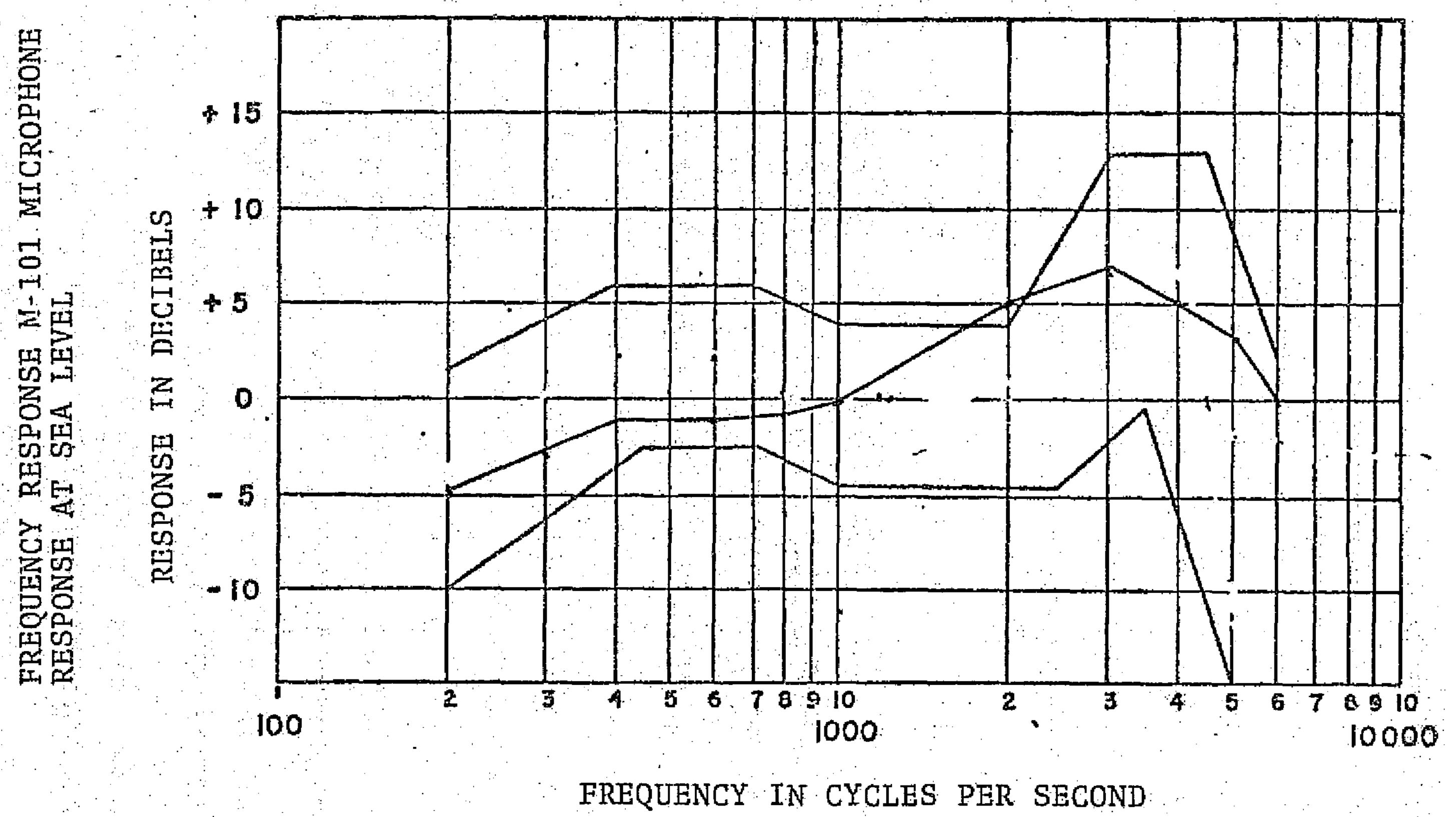
Figure B-4.– Carter M-101 ground level frequency response SN-14.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

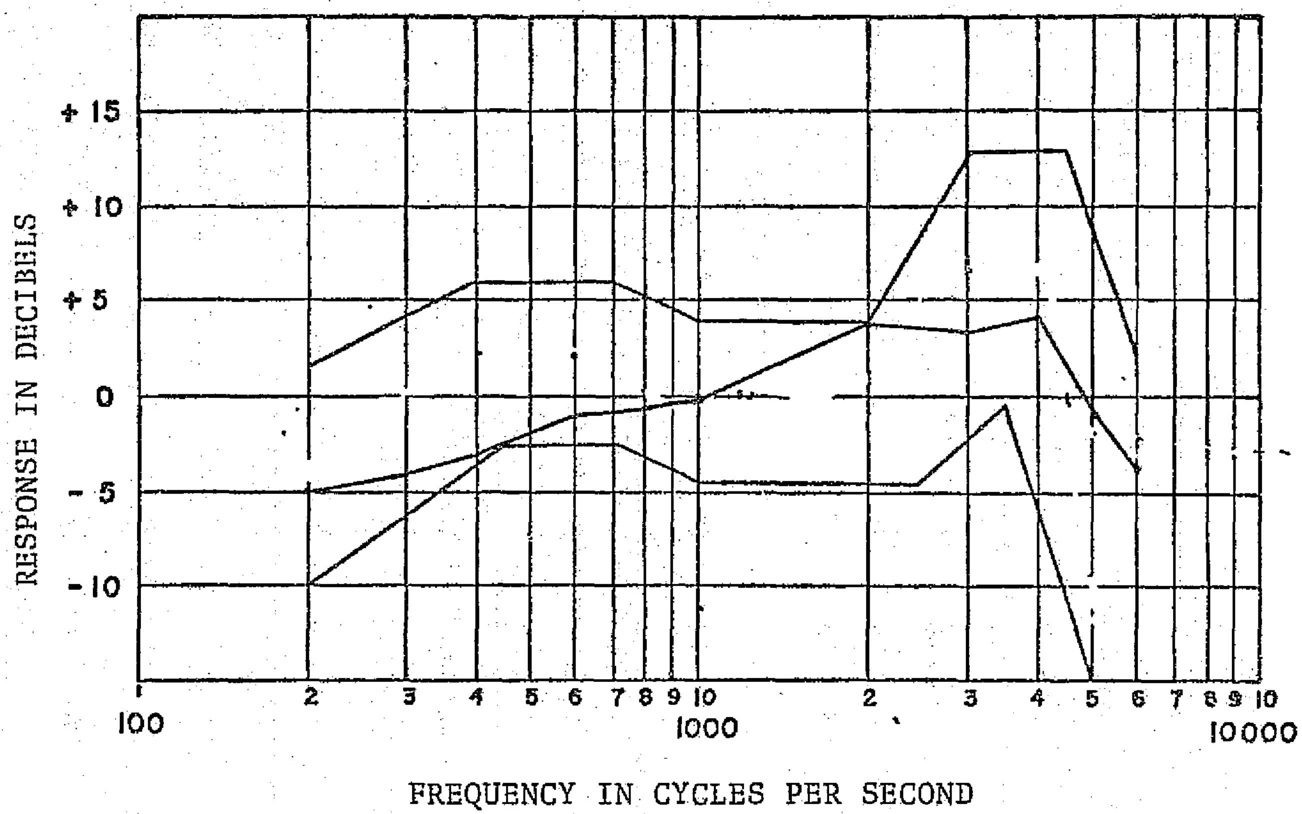
Figure B-5.— Carter M-101 ground level frequency response SN-15.



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

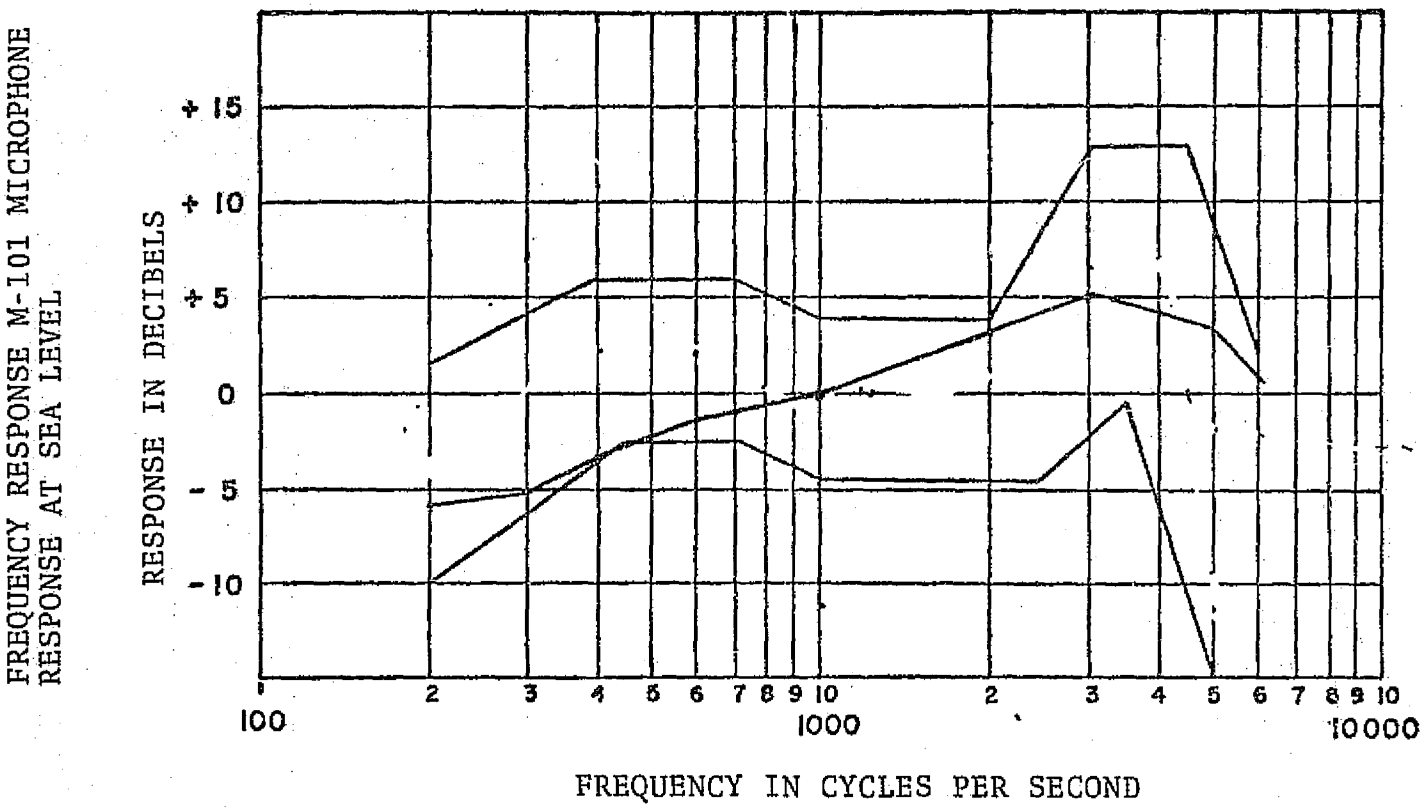
Figure B-6.— Carter M-101 ground level frequency response SN-16.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

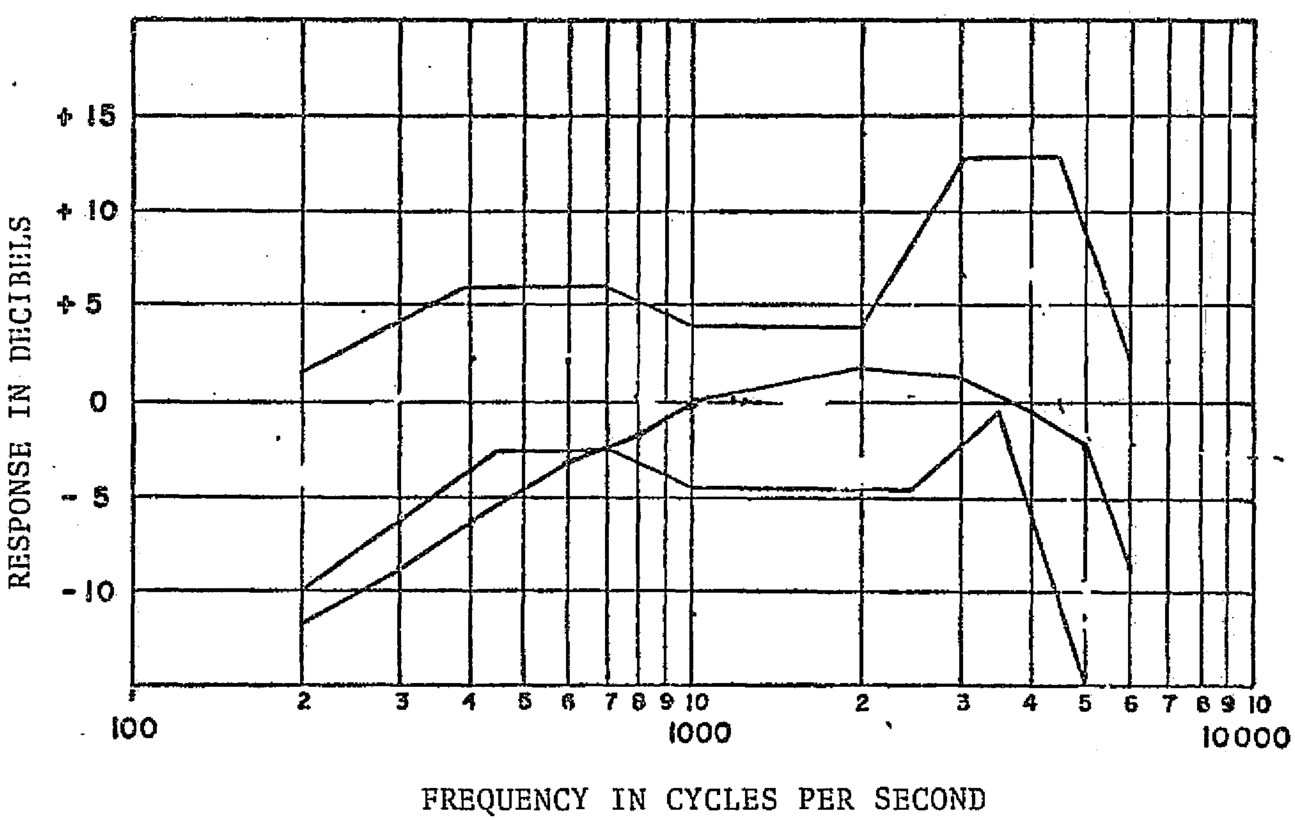
Figure B-7.– Carter M-101 ground level frequency response SN-17.



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure B-8.– Carter M-101 ground level frequency response SN-18.

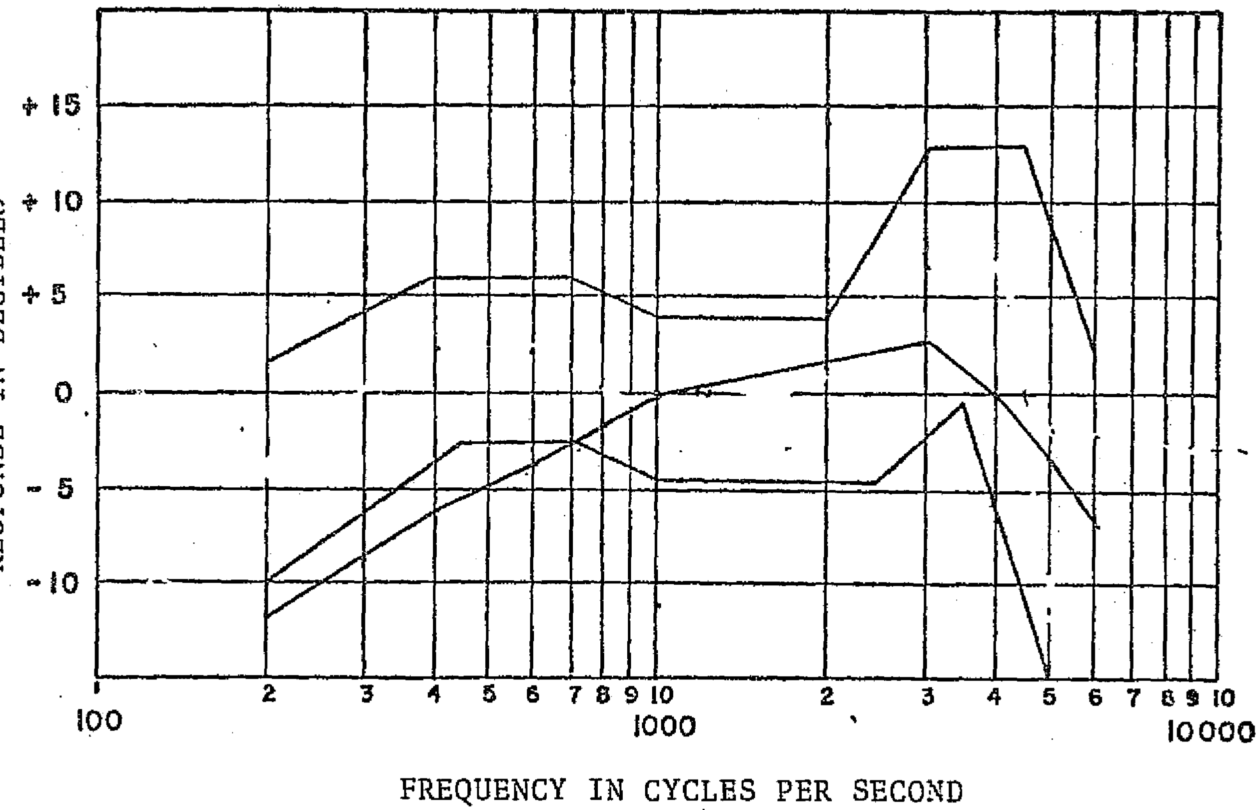
FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure B-9.— Carter M-101 ground level frequency response SN-19.

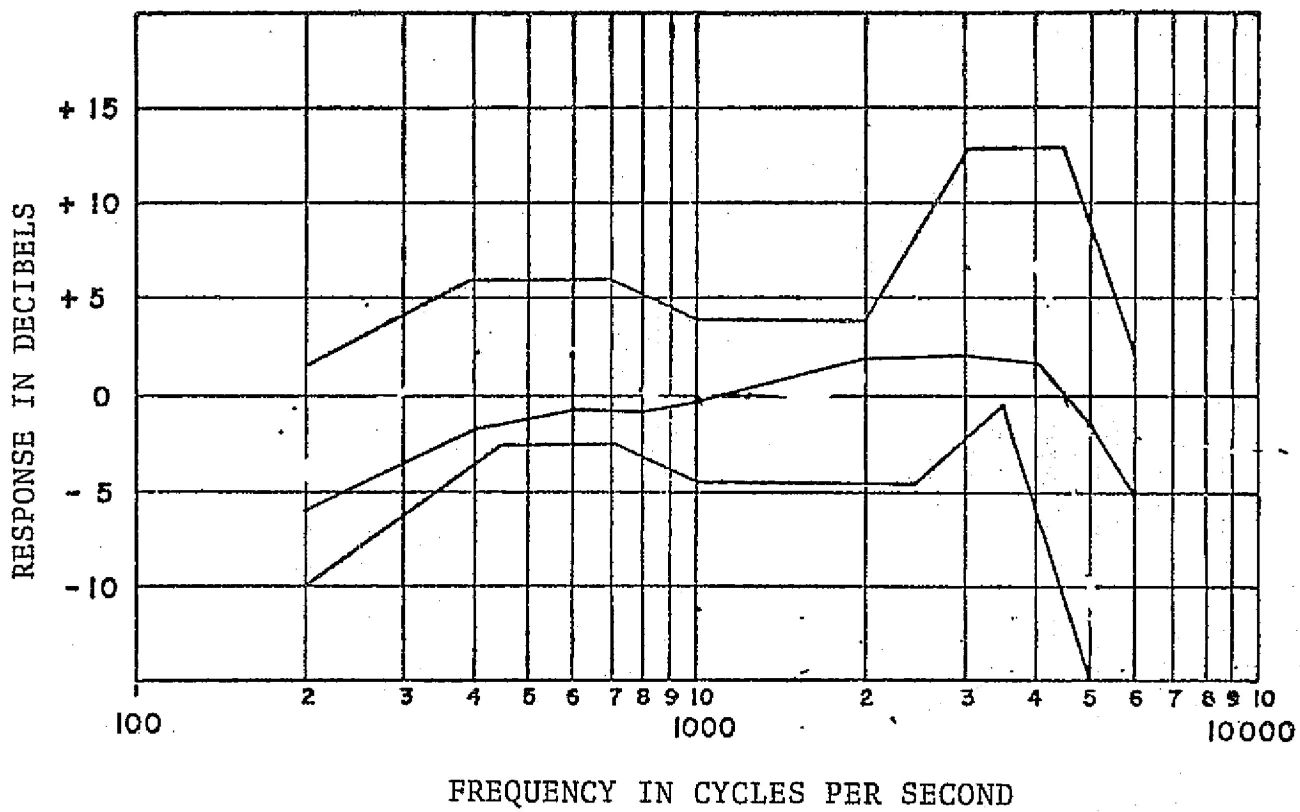
FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure B-10.– Carter M-101 ground level frequency response SN-20.

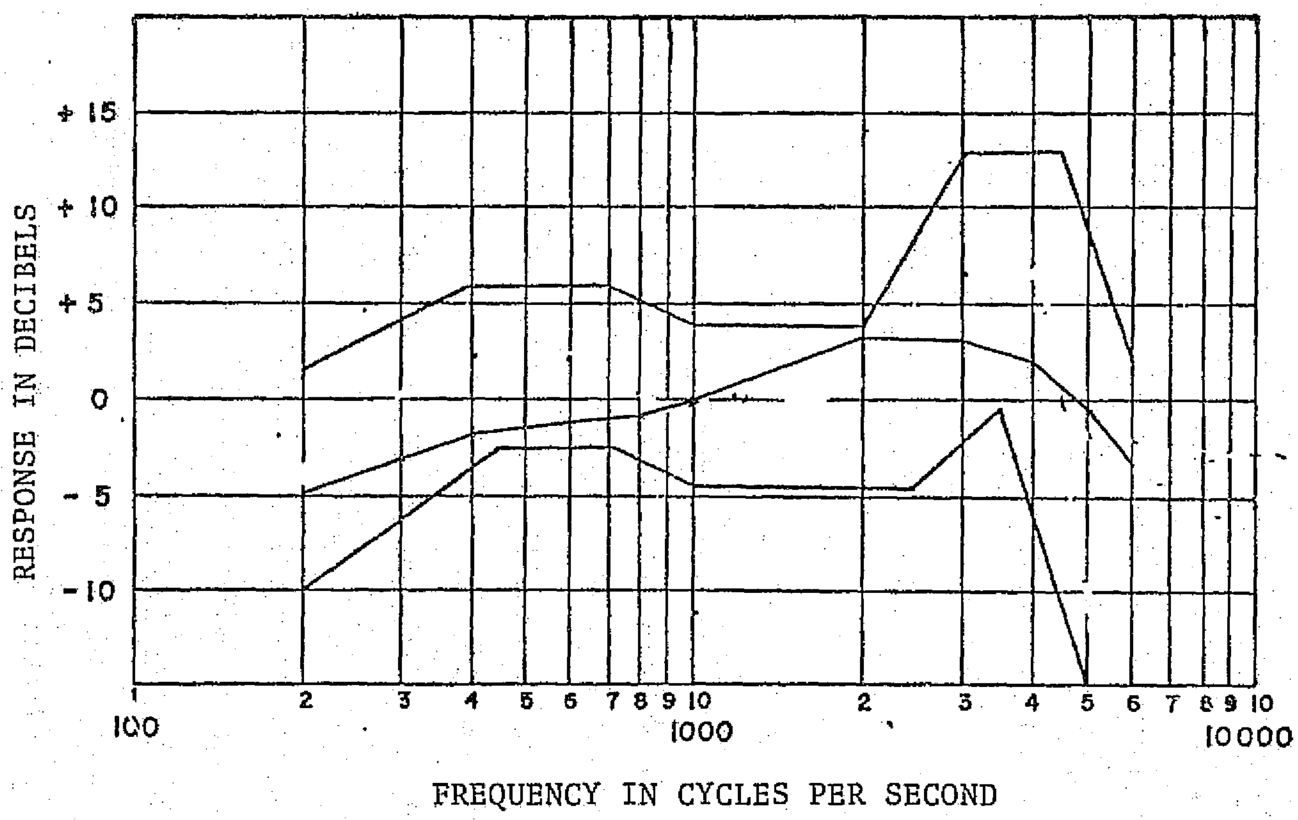
FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure B-11.– Astrocom M-101 ground level frequency response SN-1.

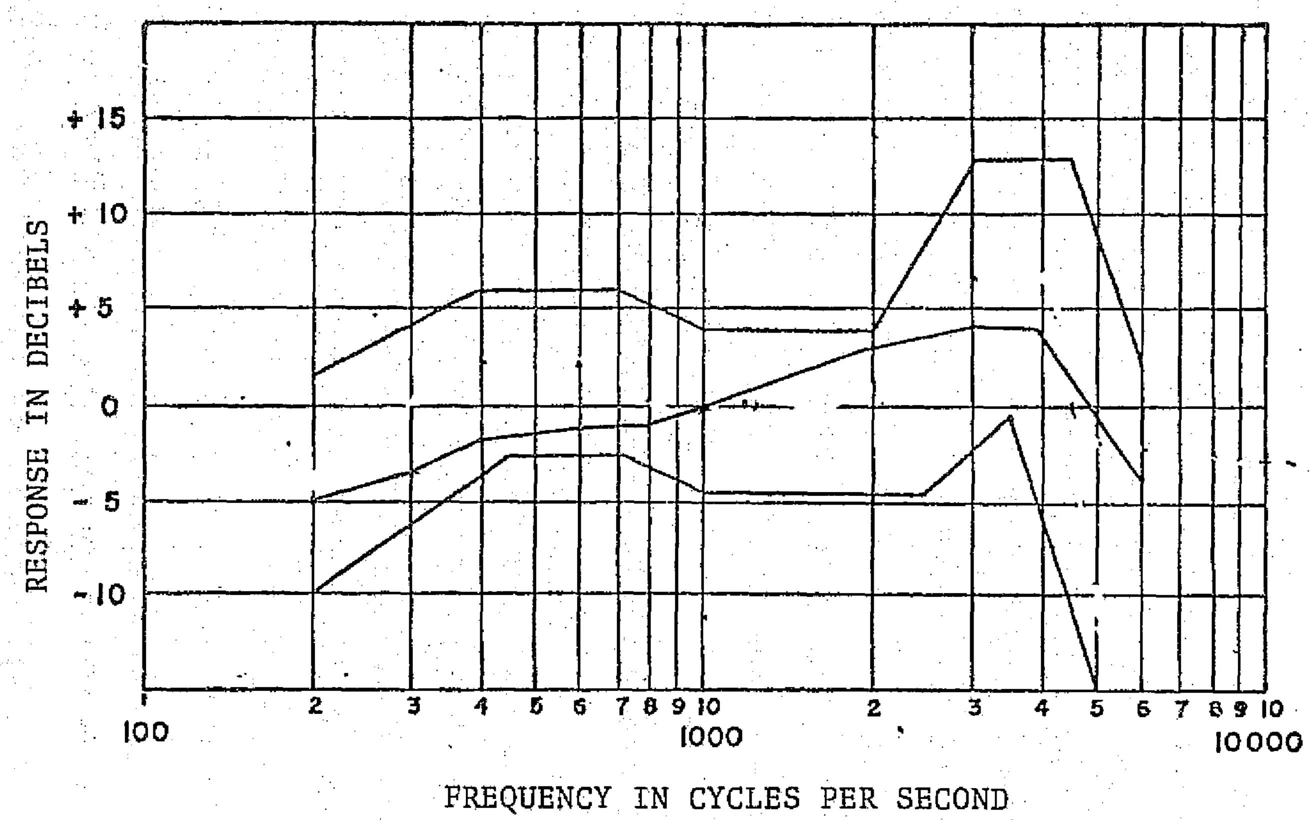
FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

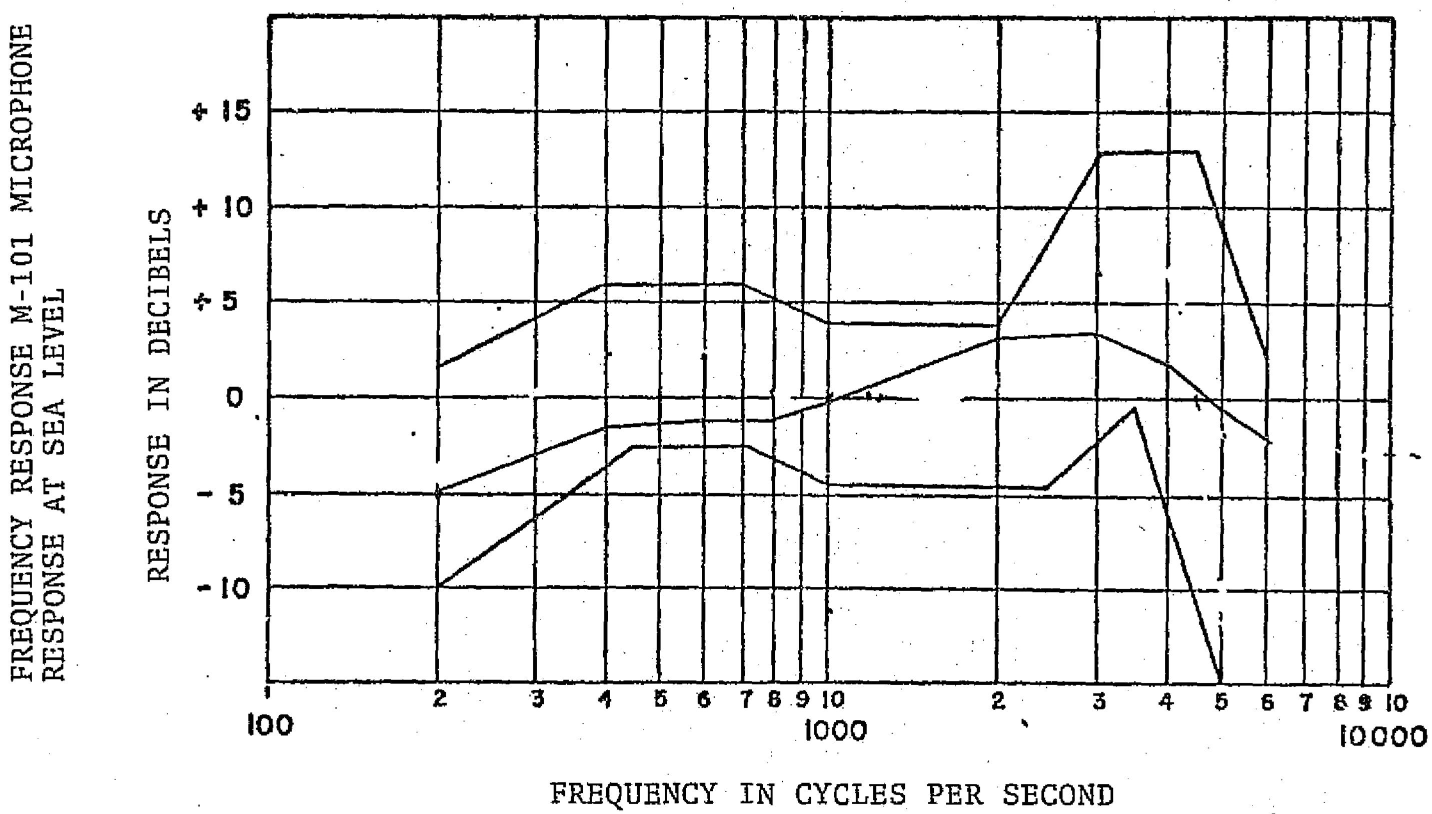
Figure B-12.— Astrocom M-101 ground level frequency response SN-2.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

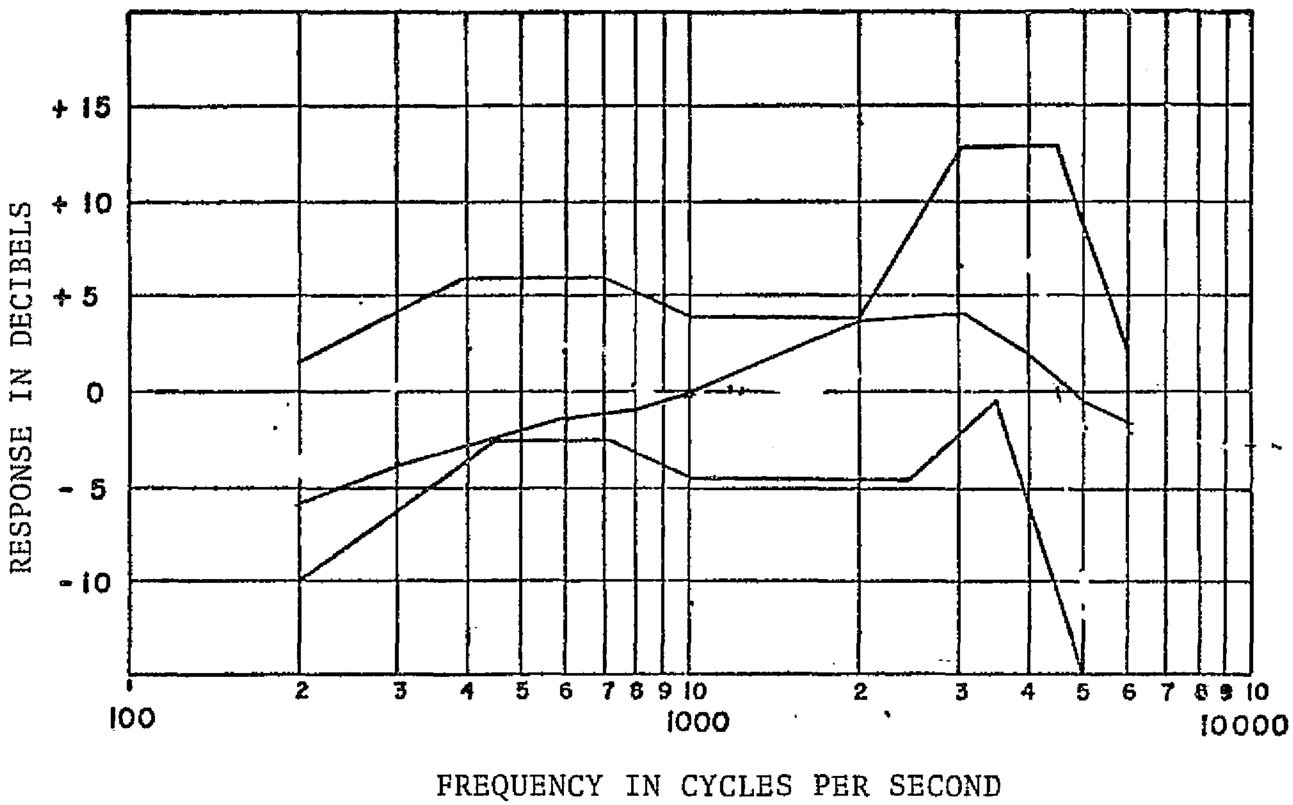
Figure B-13.– Astrocom M-101 ground level frequency response SN-3.



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure B-14.— Astrocom M-101 ground level frequency response SN-4.

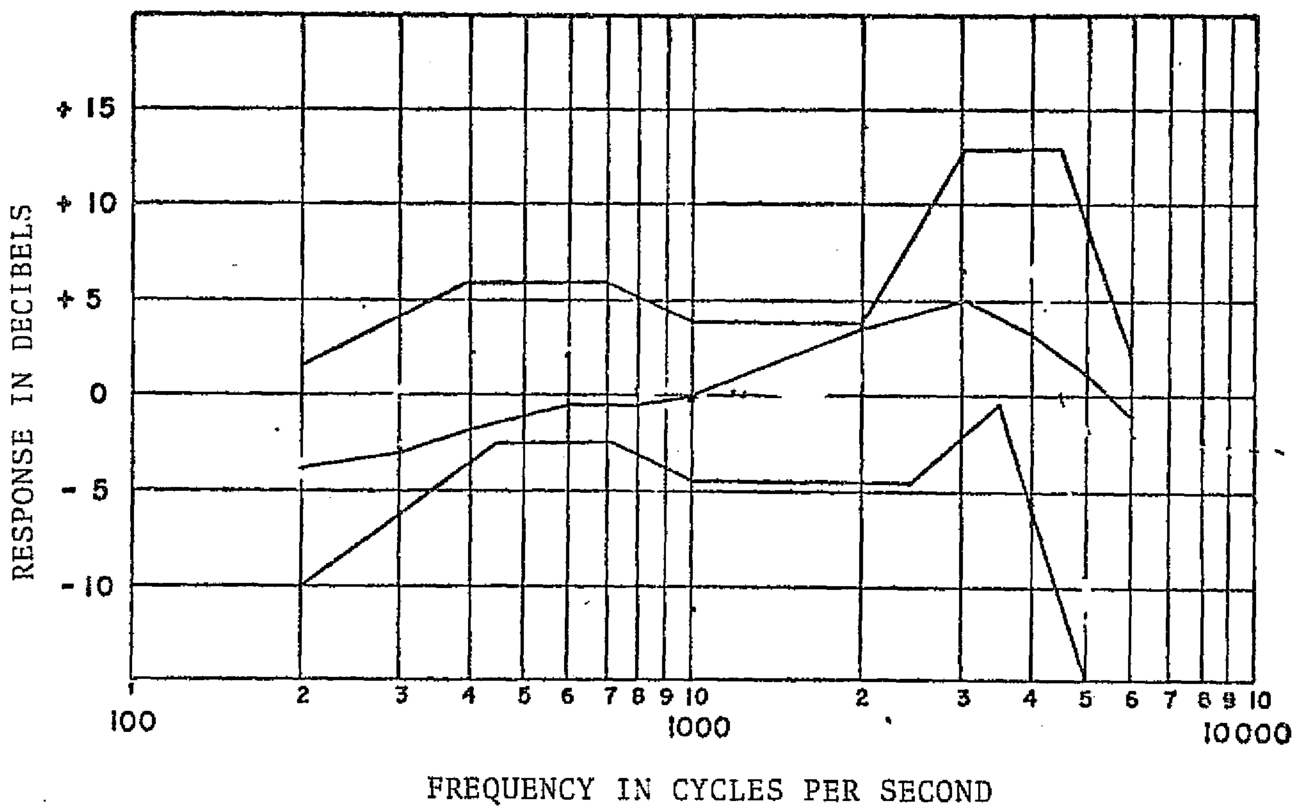
FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure B-15.— Astrocom M-101 ground level frequency response SN-5.

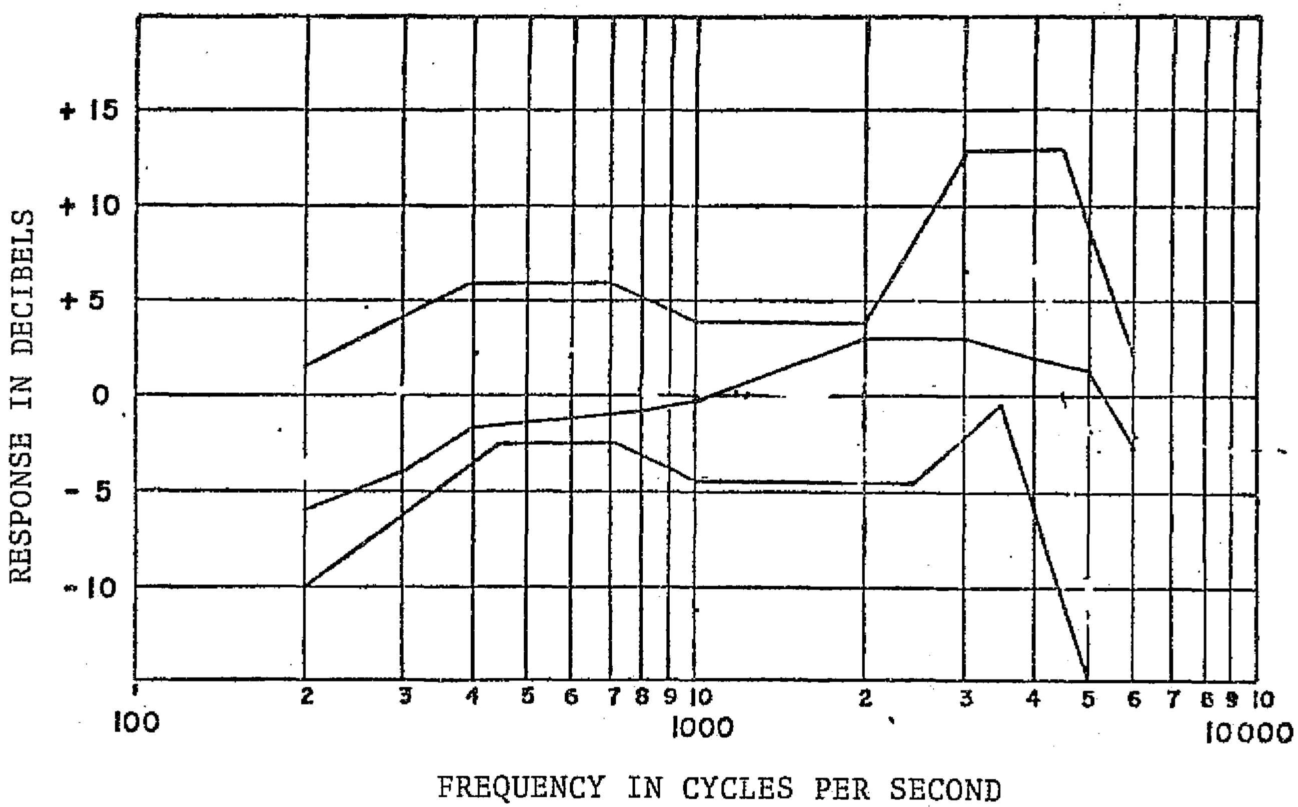
FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

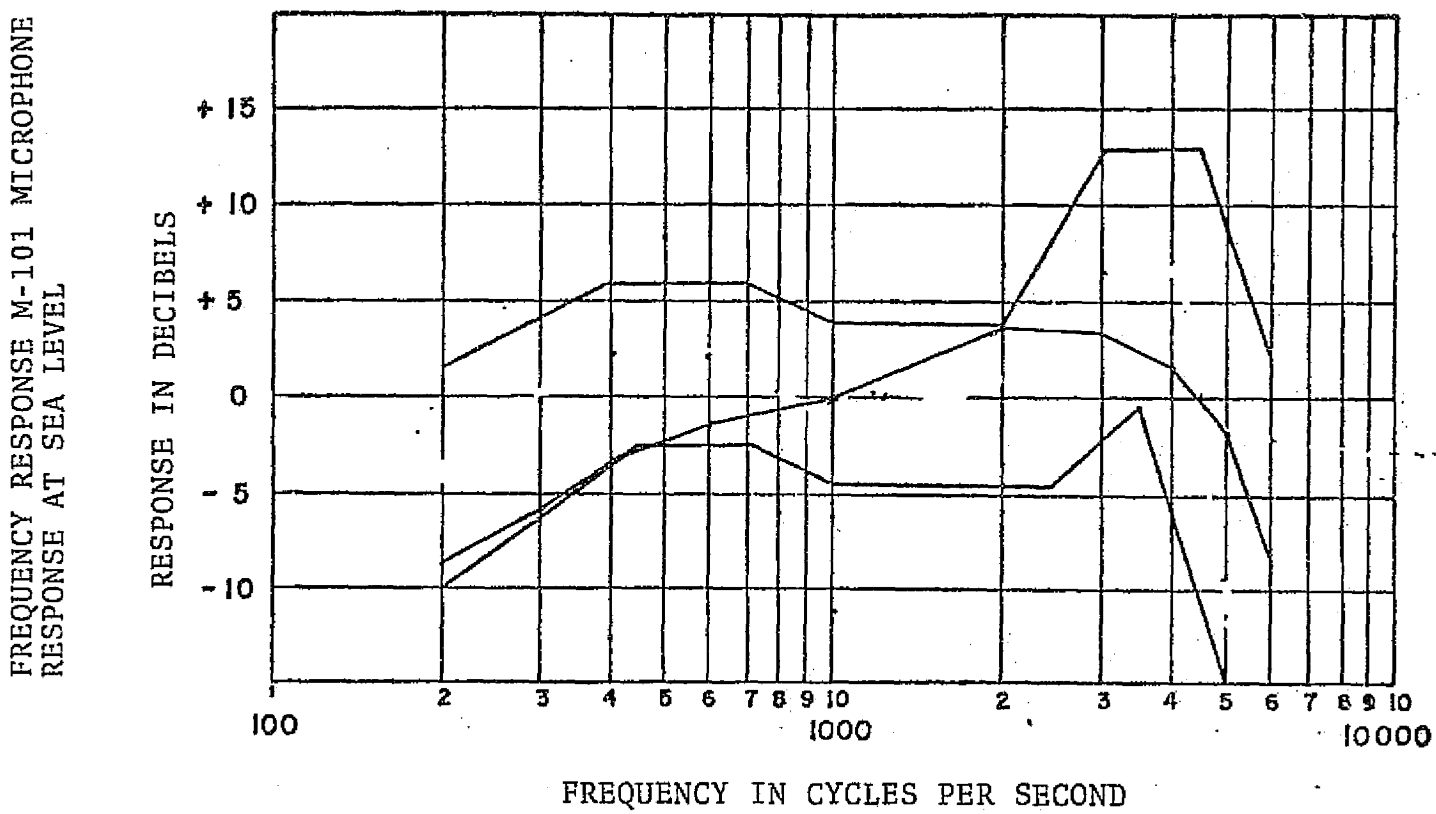
Figure B-16.— Astrocom M-101 ground level frequency response SN-6.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

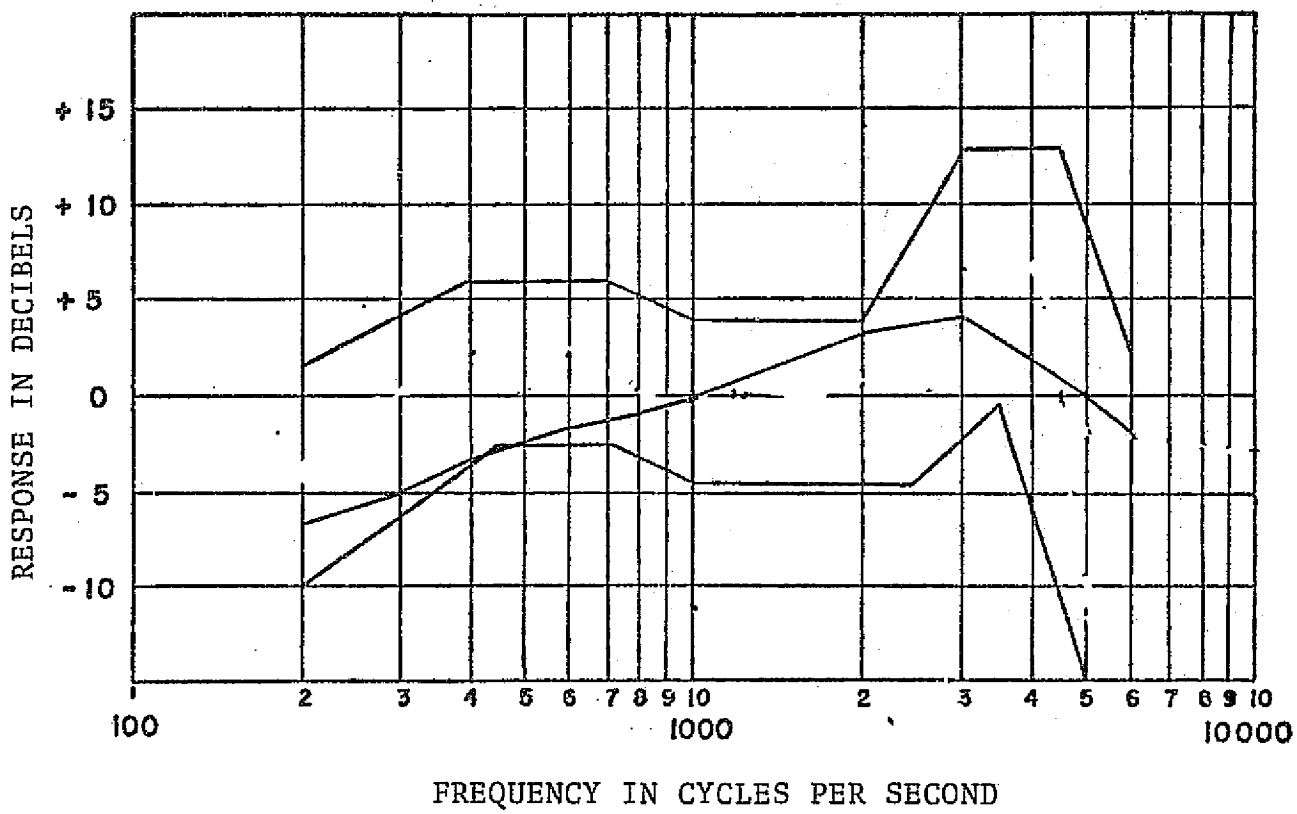
Figure B-17.- Astrocom M-101 ground level frequency response SN-7.



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure B-18.– Astrocom M-101 ground level frequency response SN-8.

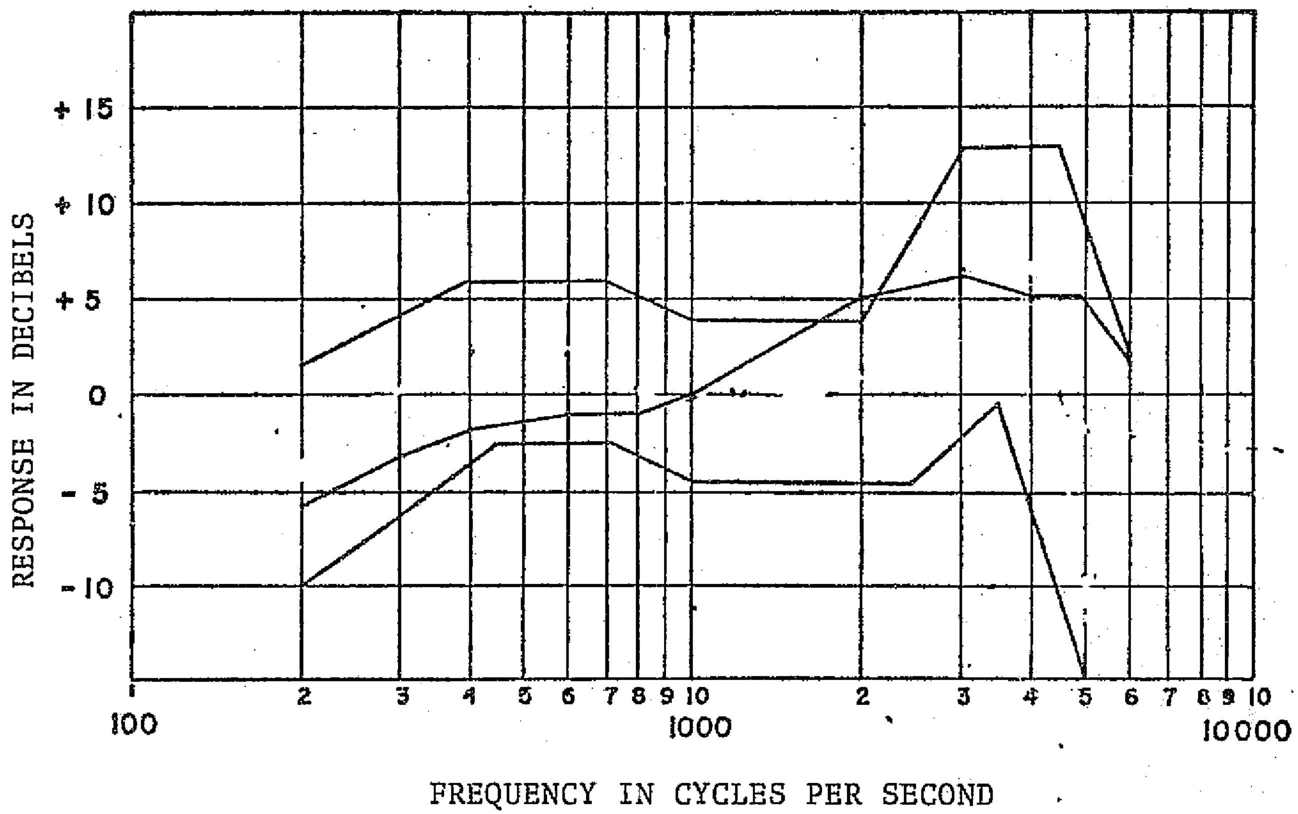
FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

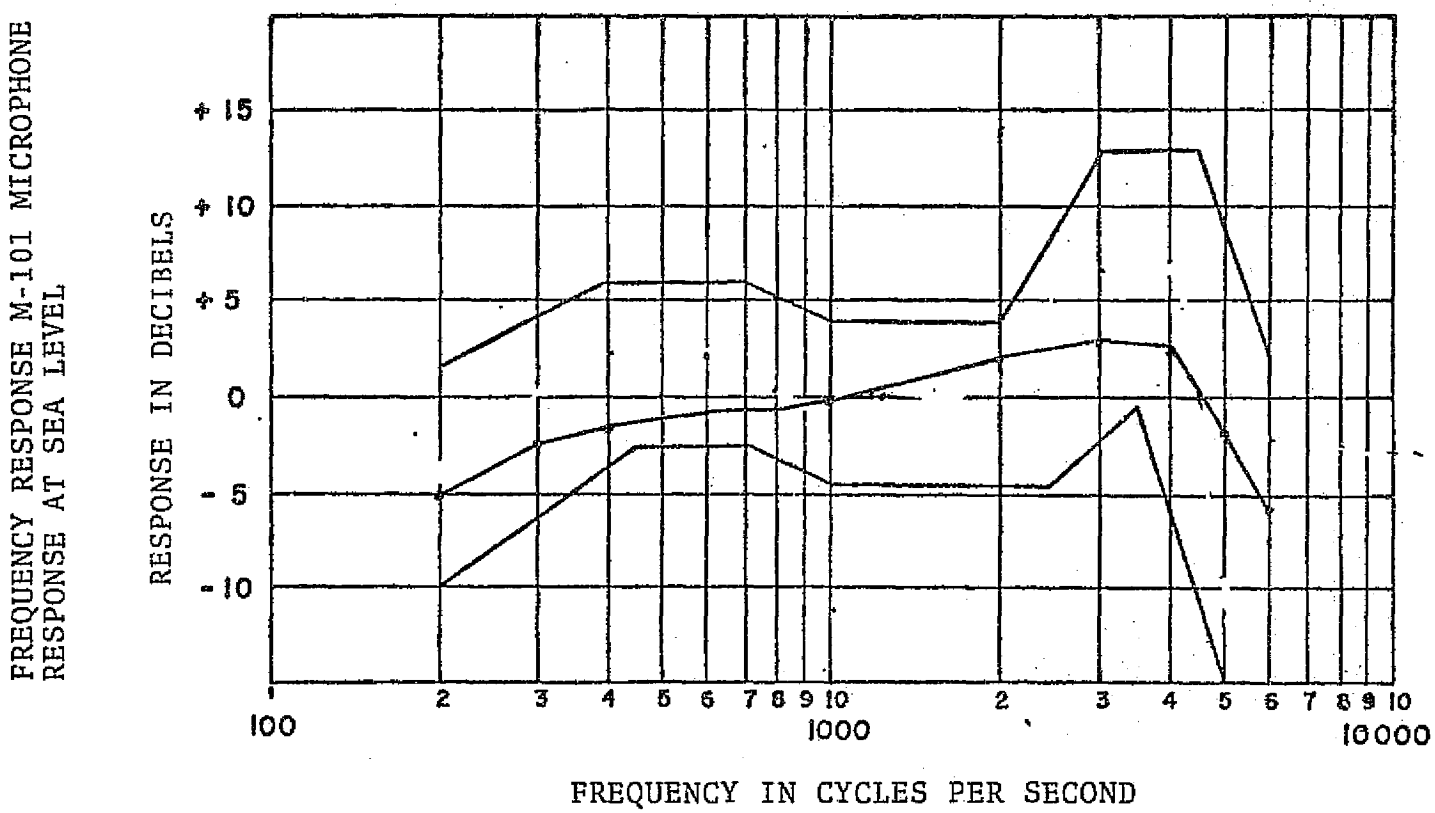
Figure B-19.— Astrocom M-101 ground level frequency response SN-9.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

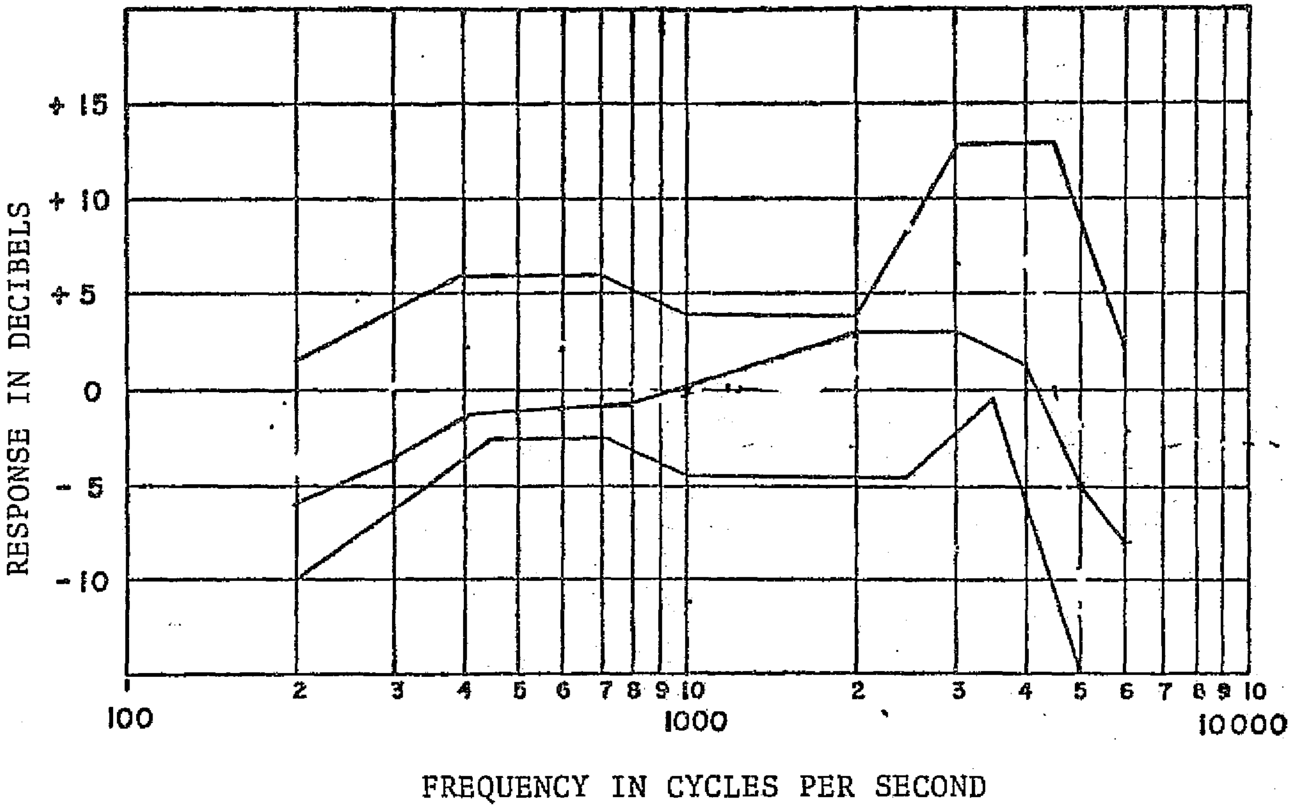
Figure B-20.— Astrocom M-101 ground level frequency response SN-10.



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure B-21.– Electrovoice M-101 ground level frequency response SN-21.

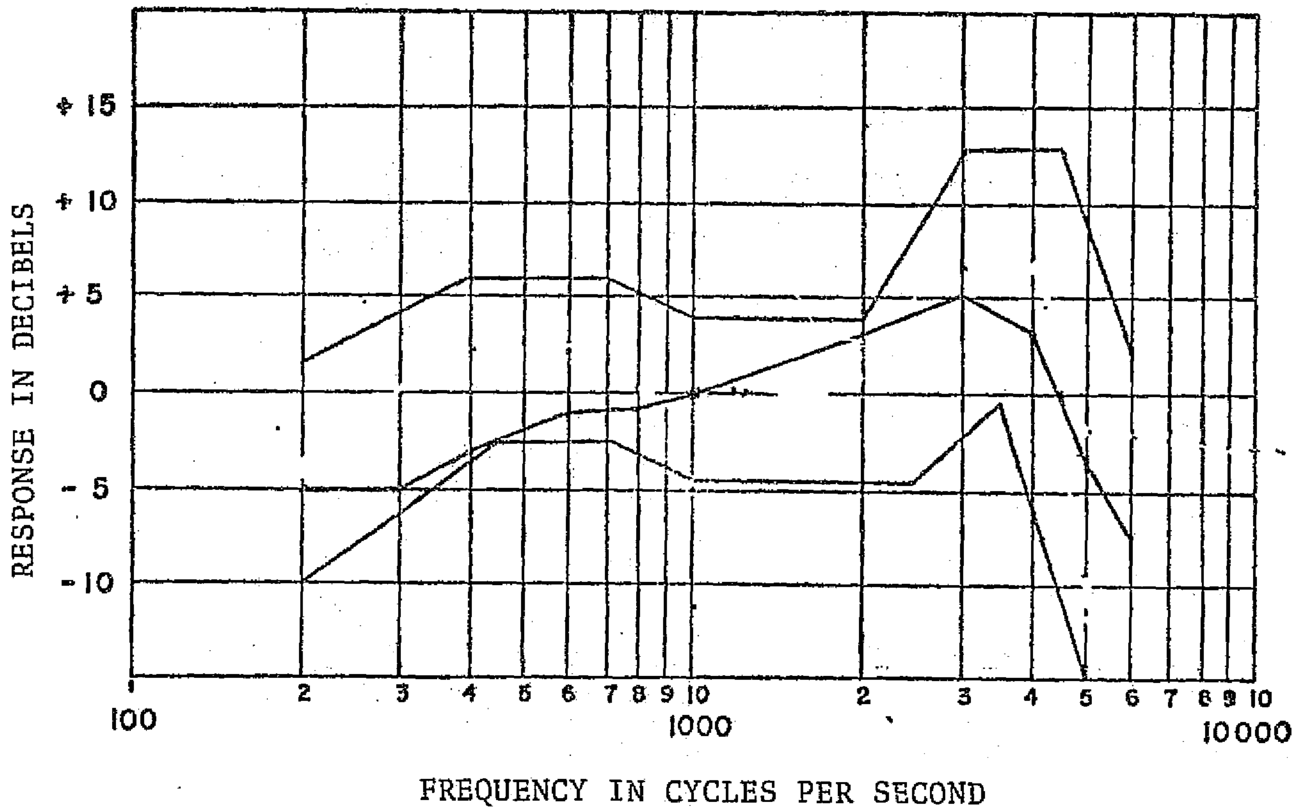
FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

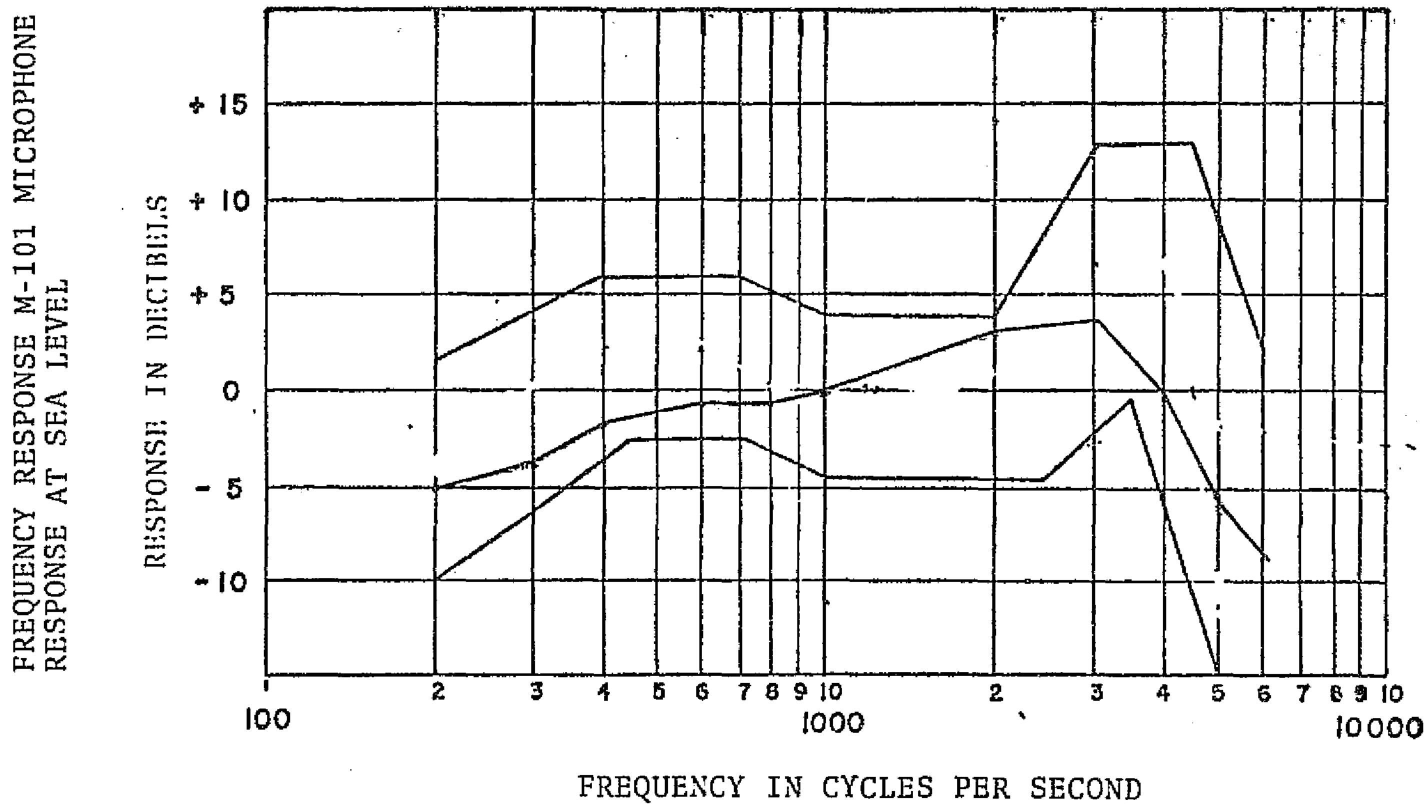
Figure B-22.– Electrovoice M-101 ground level frequency response SN-22.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



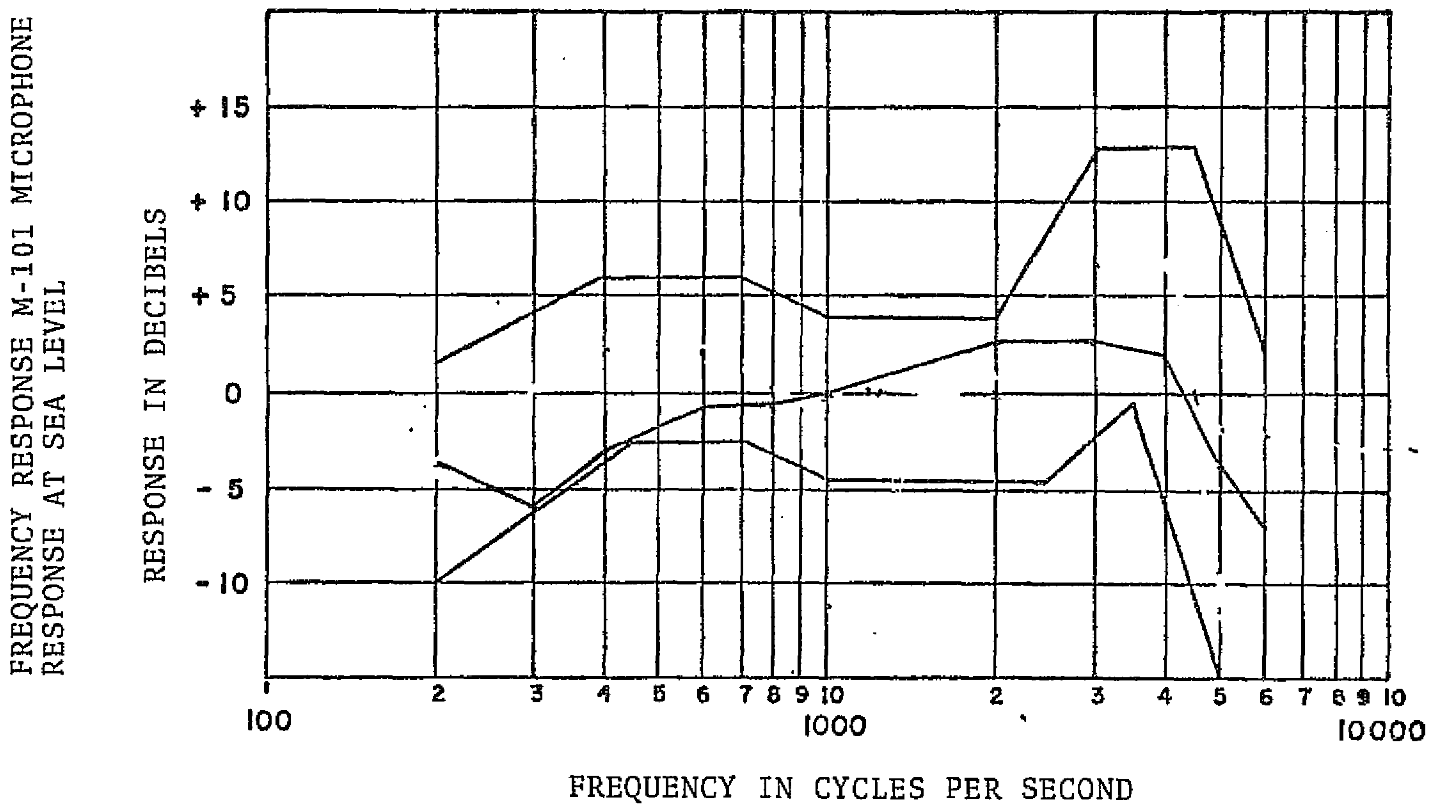
Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure B-23.— Electrovoice M-101 ground level frequency response SN-23.



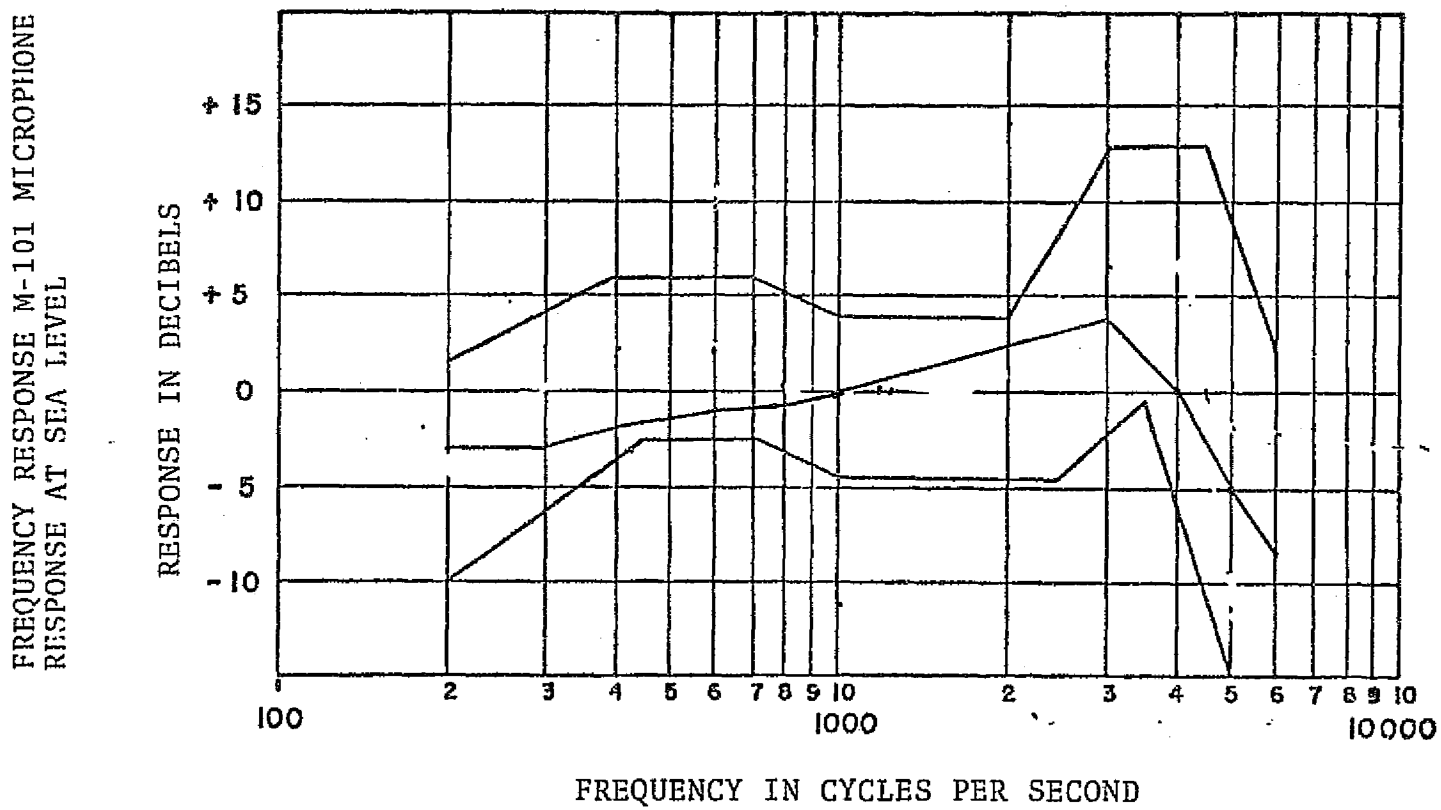
Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure B-24.– Electrovoice M-101 ground level frequency response SN-24.



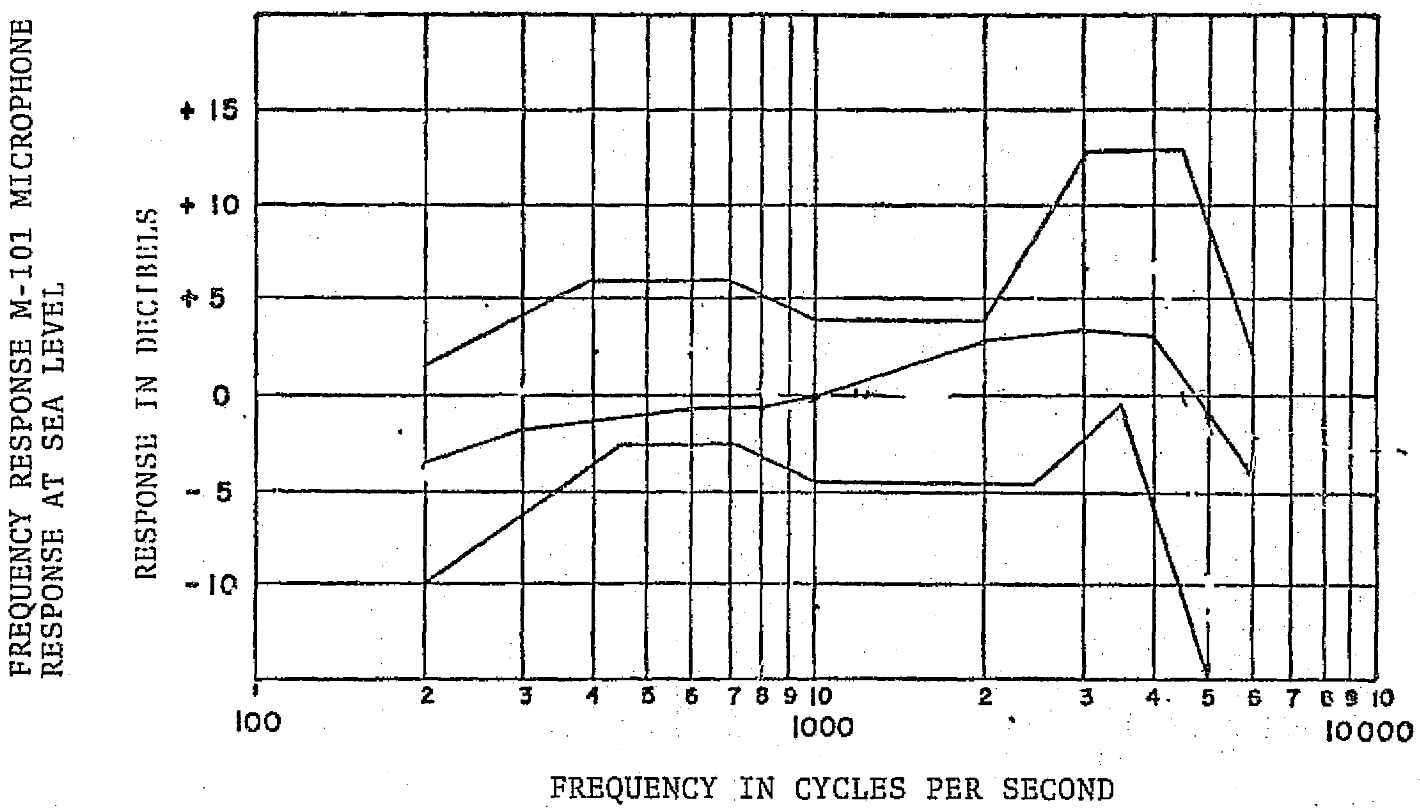
Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure B-25.— Electrovoice M-101 ground level frequency response SN-25.



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

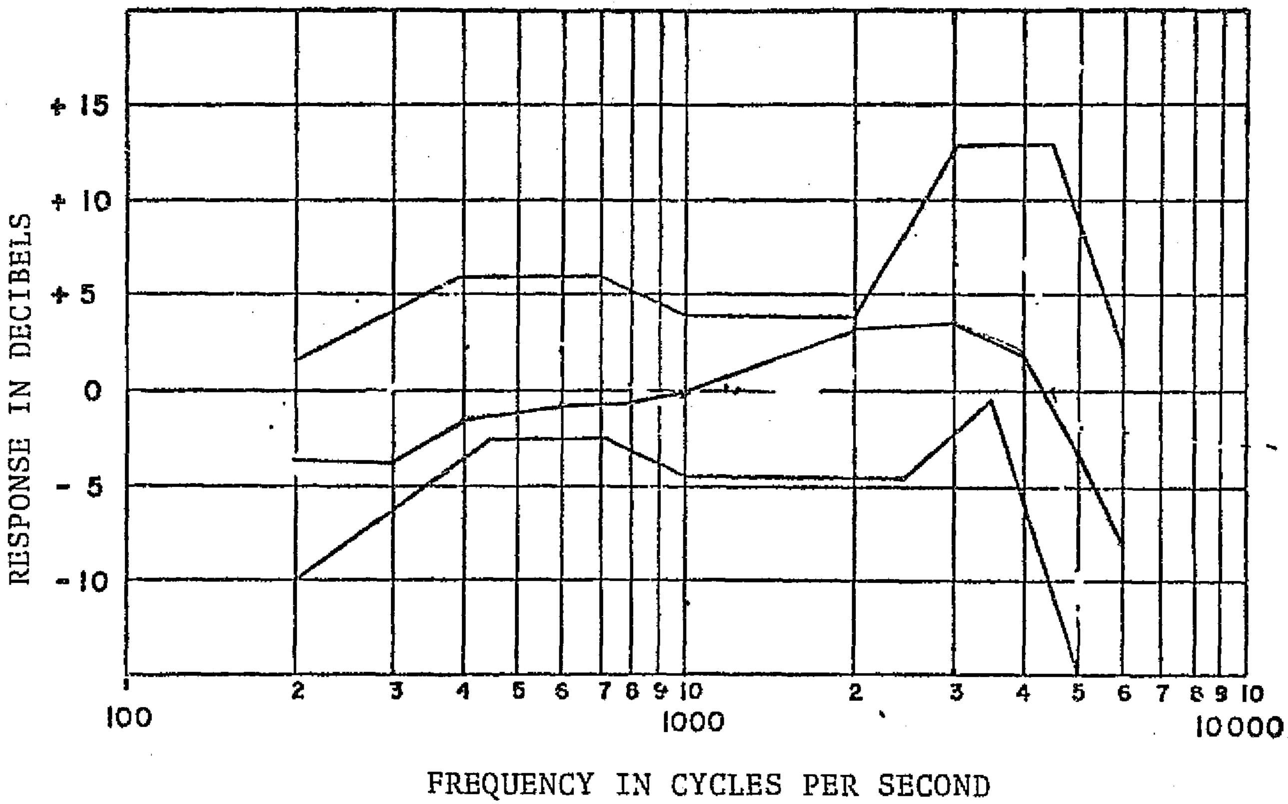
Figure B-26.— Electrovoice M-101 ground level frequency response SN-26.



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure B-27.– Electrovoice M-101 ground level frequency response SN-27.

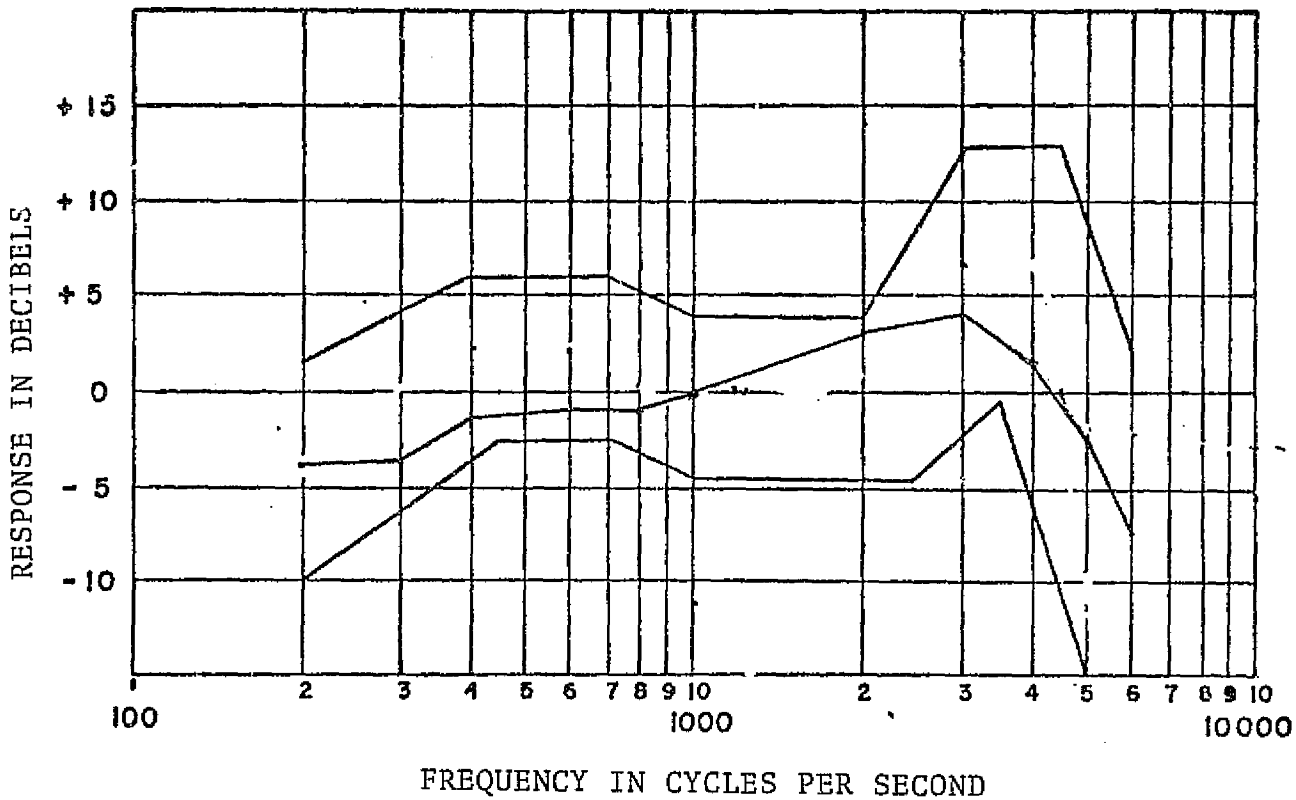
FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

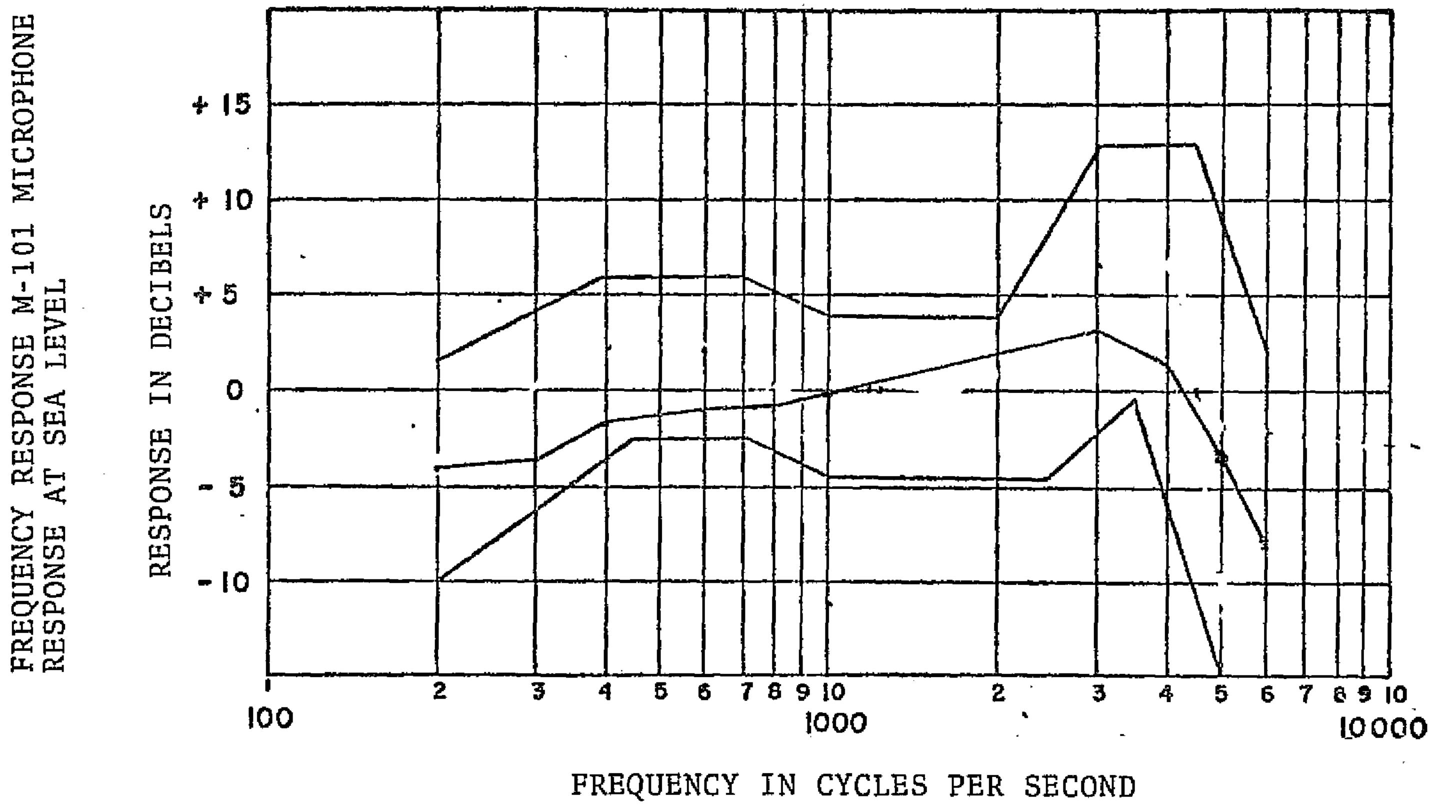
Figure B-28.— Electrovoice M-101 ground level frequency response SN-28.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT SEA LEVEL



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure B-29.– Electrovoice M-101 ground level frequency response SN-29.



Dip is allowed; within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure B-30.– Electrovoice M-101 ground level frequency response SN-30.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

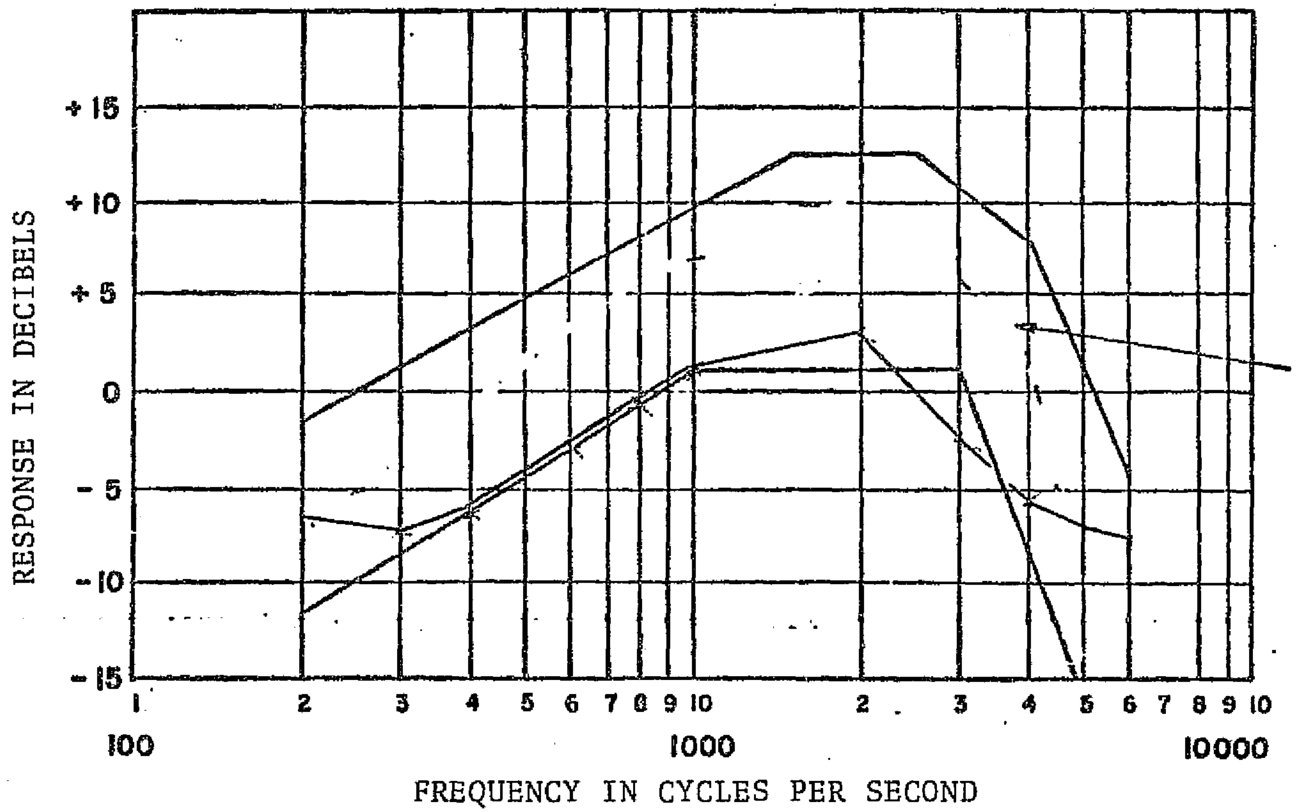


Figure B-31.— Carter M-101 frequency response at 25,000 ft SN-11.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

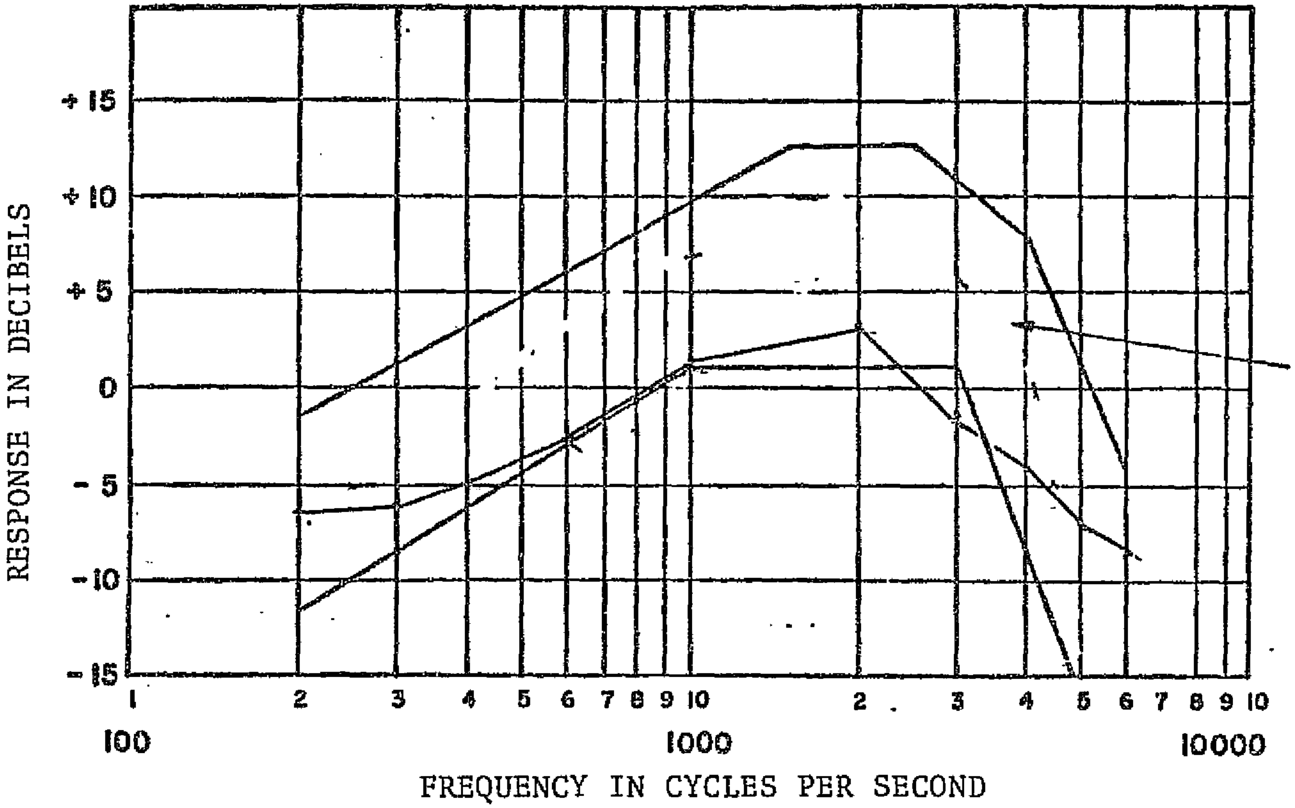


Figure B-32.– Carter M-101 frequency response at 25,000 ft SN-12.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

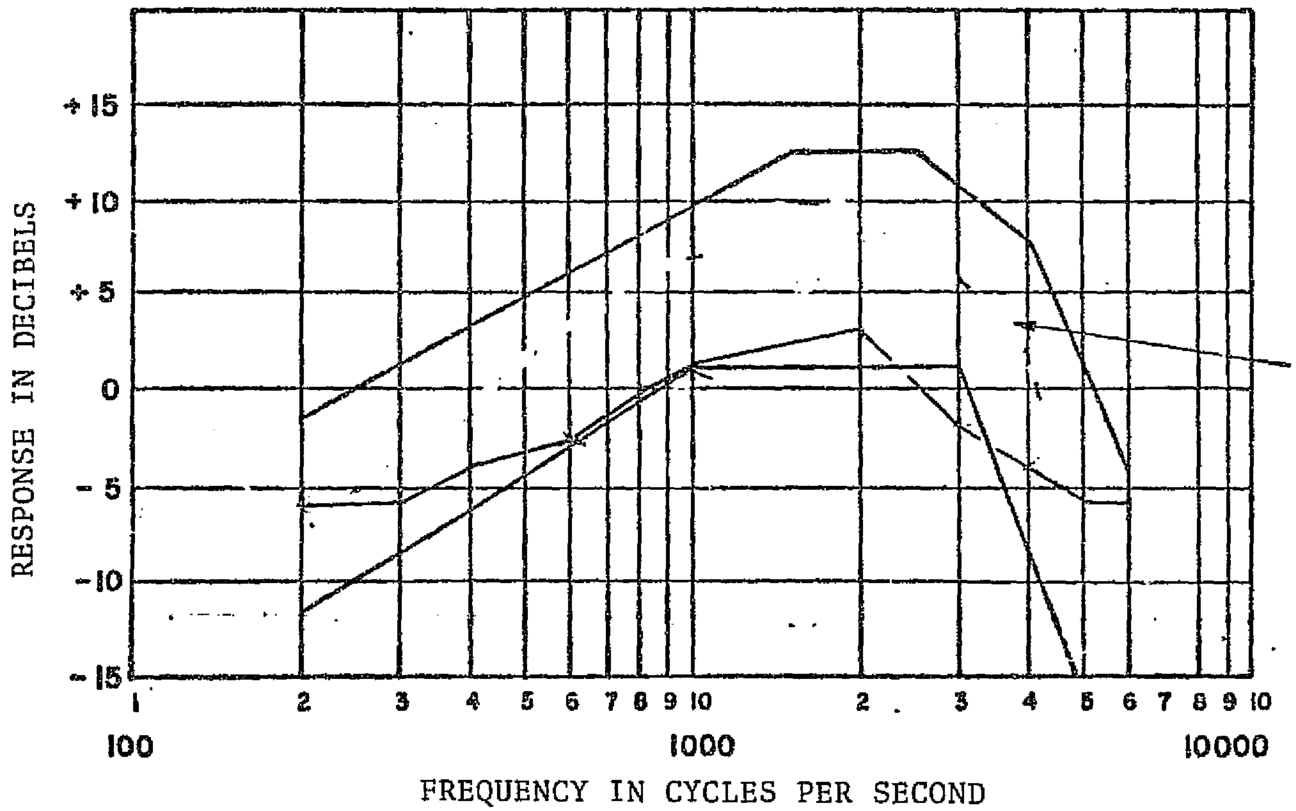


Figure B-33.— Carter M-101 frequency response at 25,000 ft SN-13.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

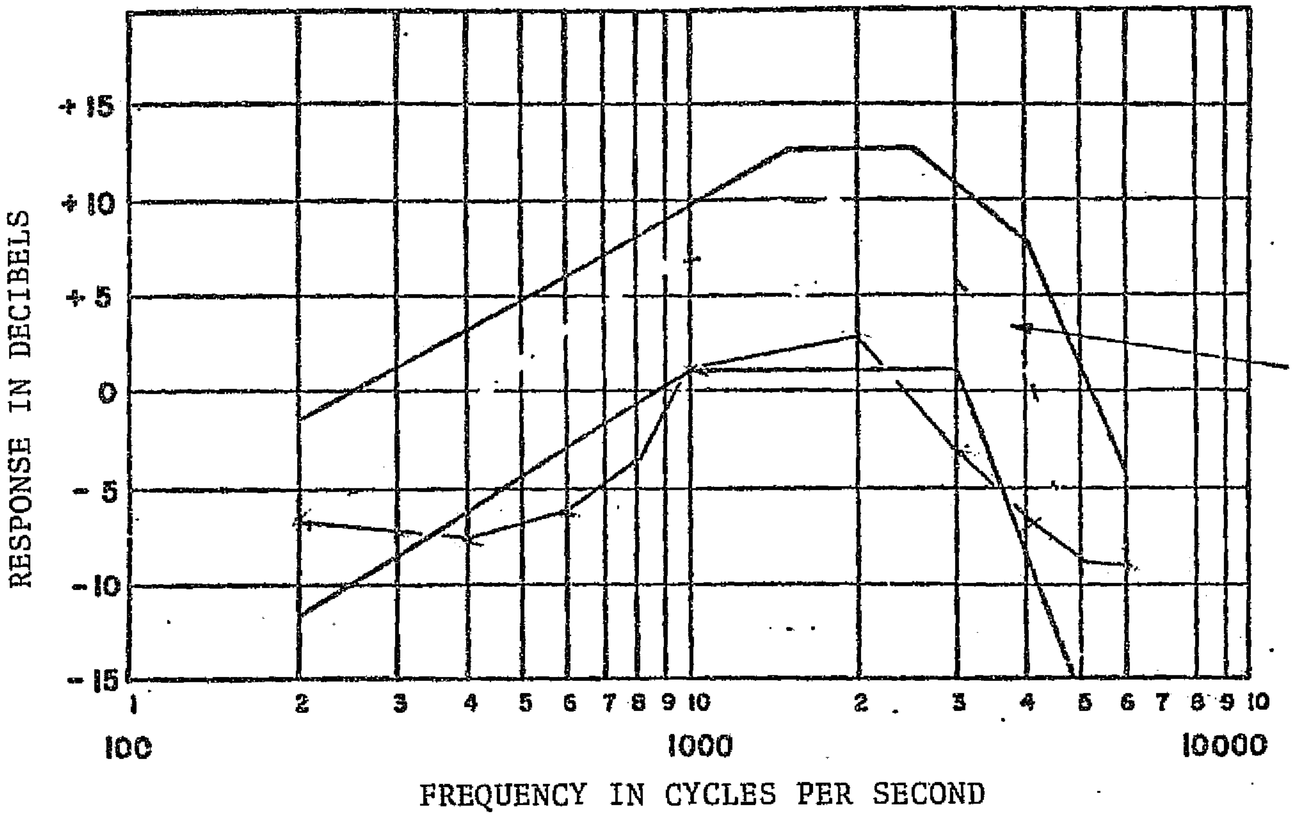


Figure B-34.– Carter M-101 frequency response at 25,000 ft SN-14.

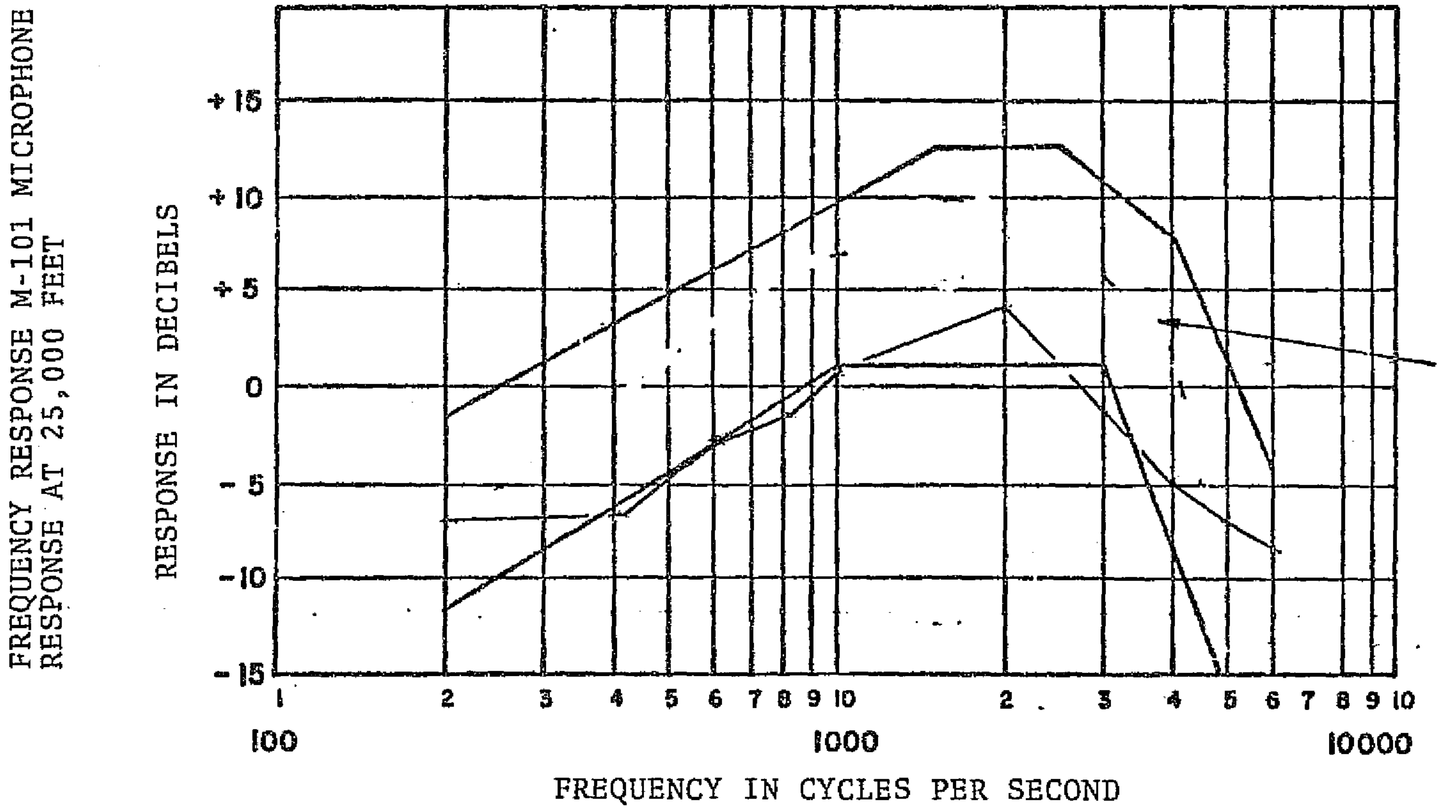


Figure B-35.— Carter M-101 frequency response at 25,000 ft SN-15.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

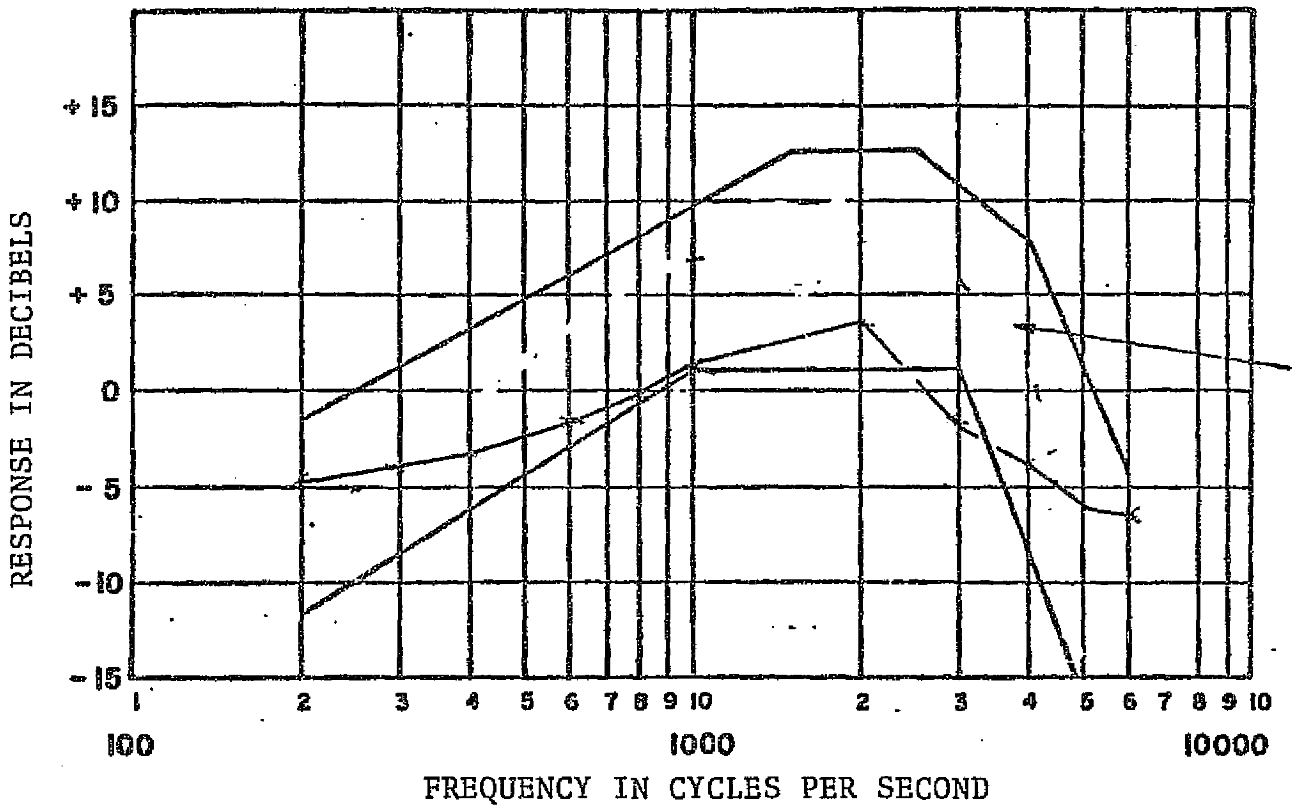


Figure B-36.– Carter M-101 frequency response at 25,000 ft SN-16.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

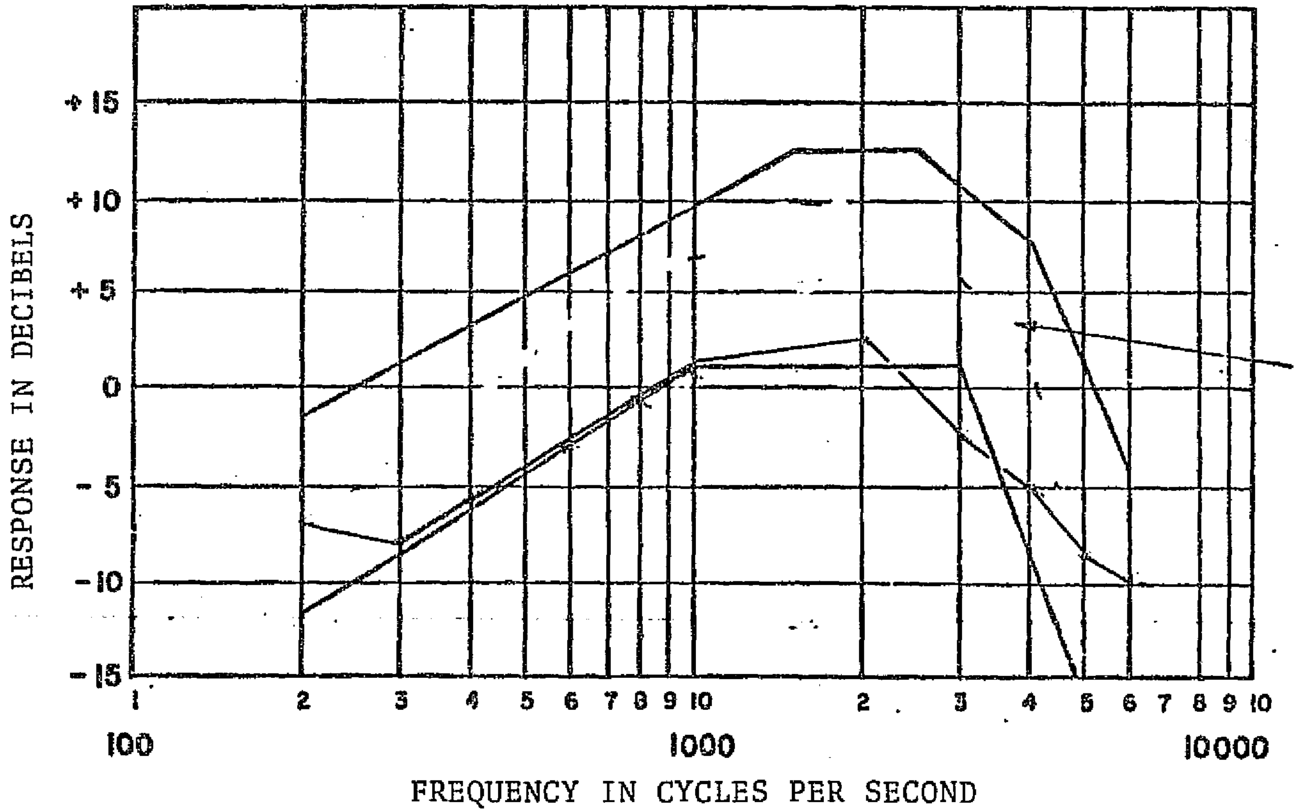


Figure B-37.— Carter M-101 frequency response at 25,000 ft SN-17.

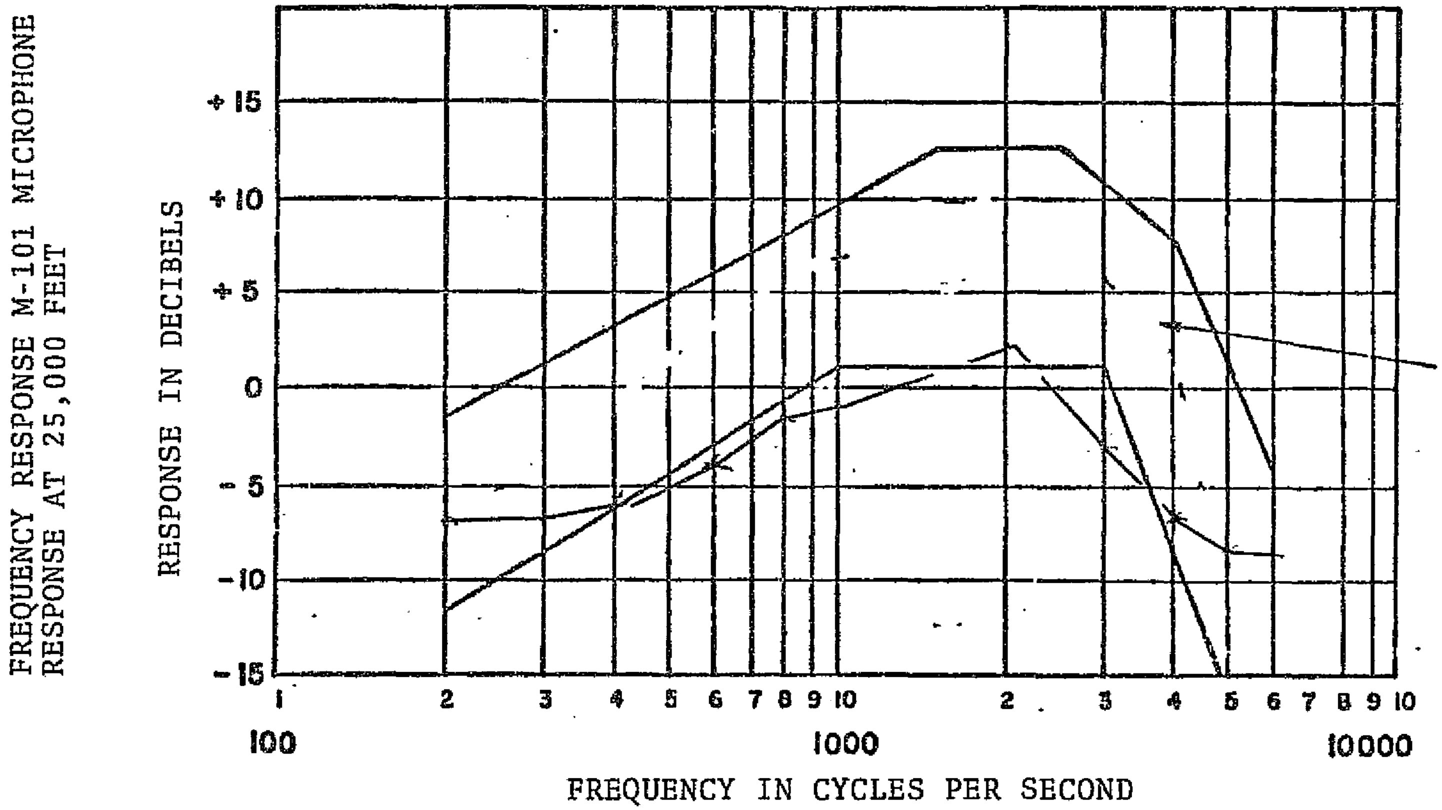


Figure B-38.— Carter M-101 frequency response at 25,000 ft SN-18.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

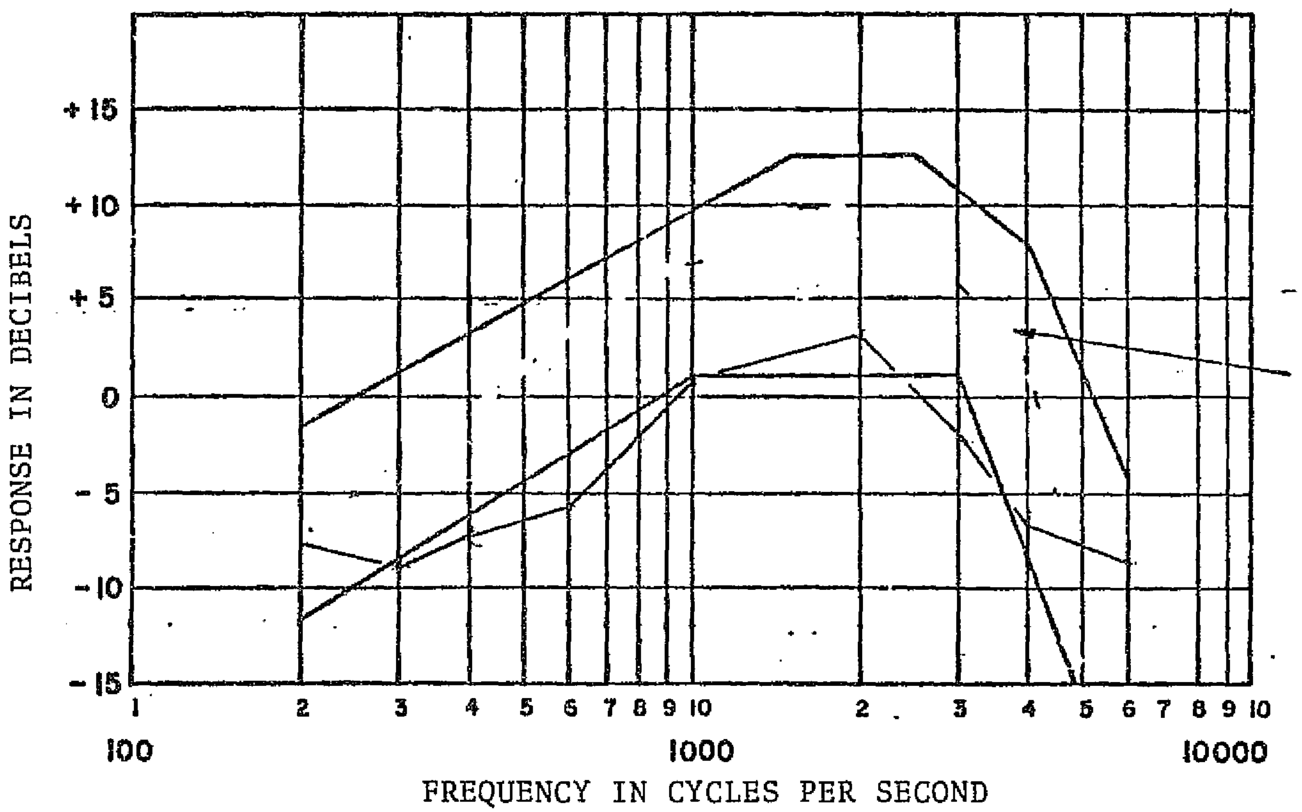


Figure B-39.– Carter M-101 frequency response at 25,000 ft SN-19.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

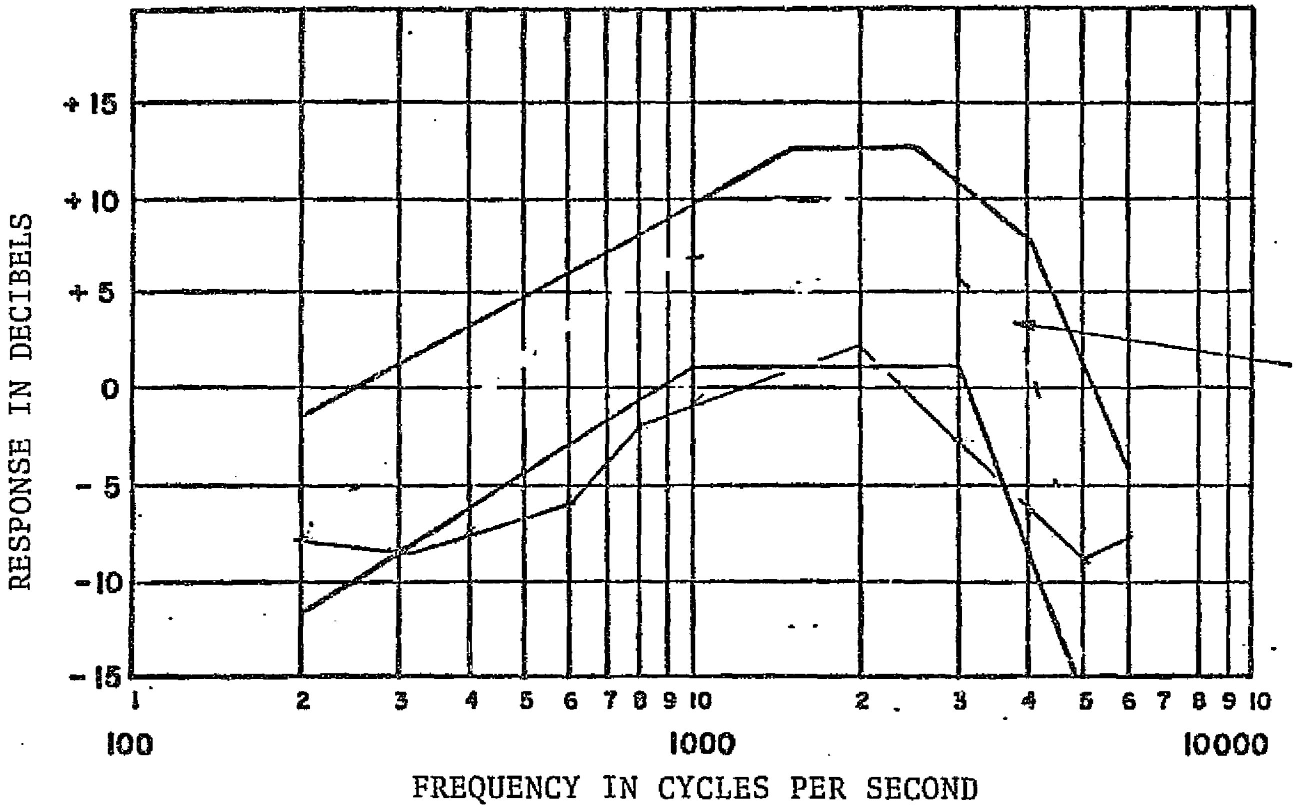


Figure B-40.– Carter M-101 frequency response at 25,000 ft SN-20.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

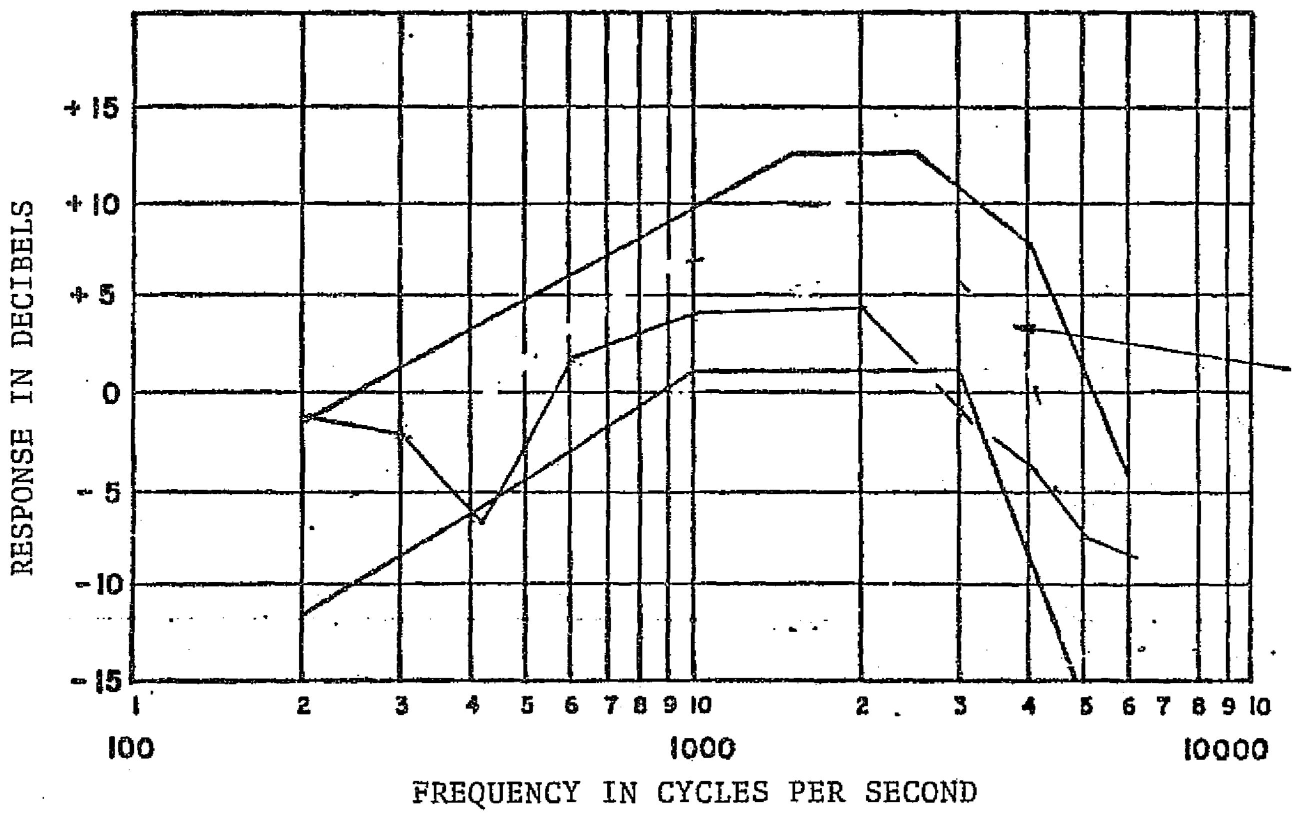


Figure B-41.– Astrocom M-101 frequency response at 25,000 ft SN-1.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

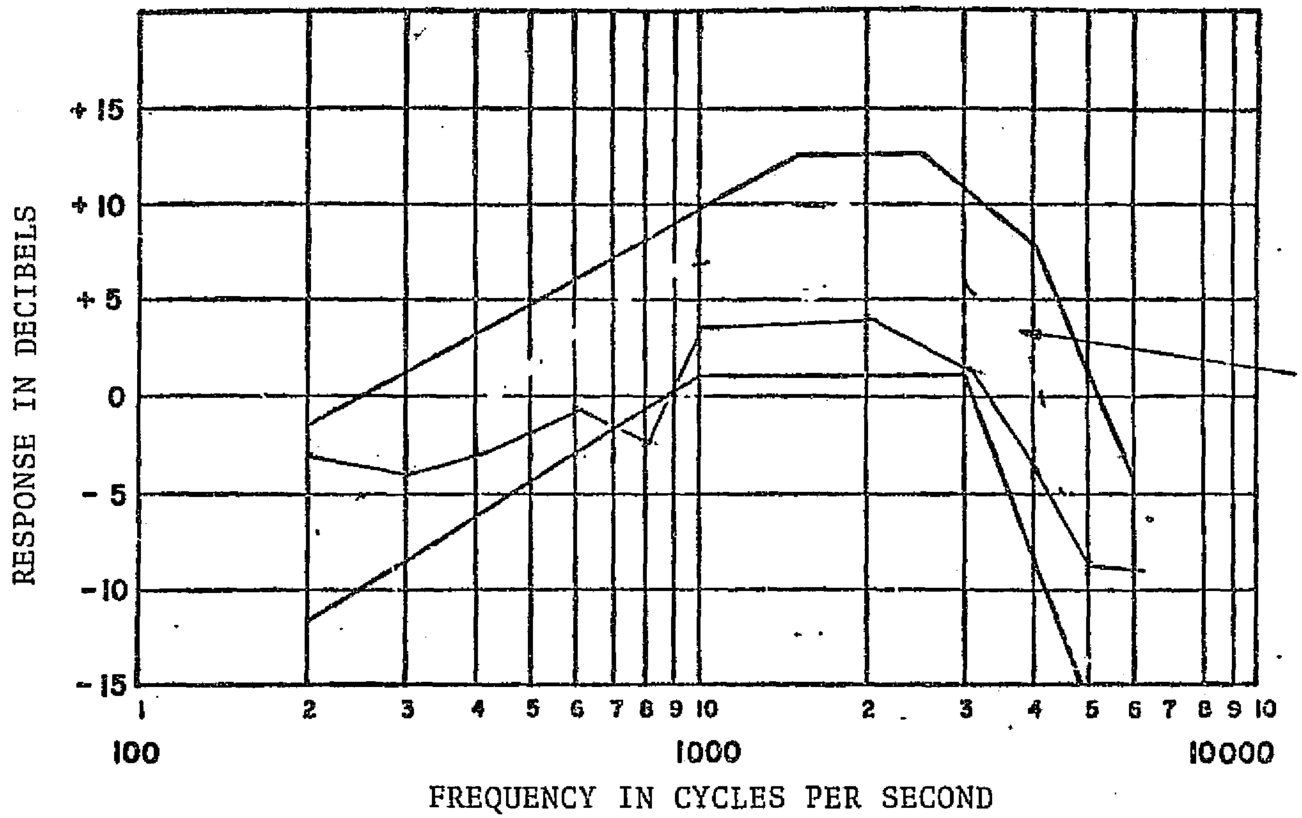


Figure B-42.– Astrocom M-101 frequency response at 25,000 ft SN-2.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

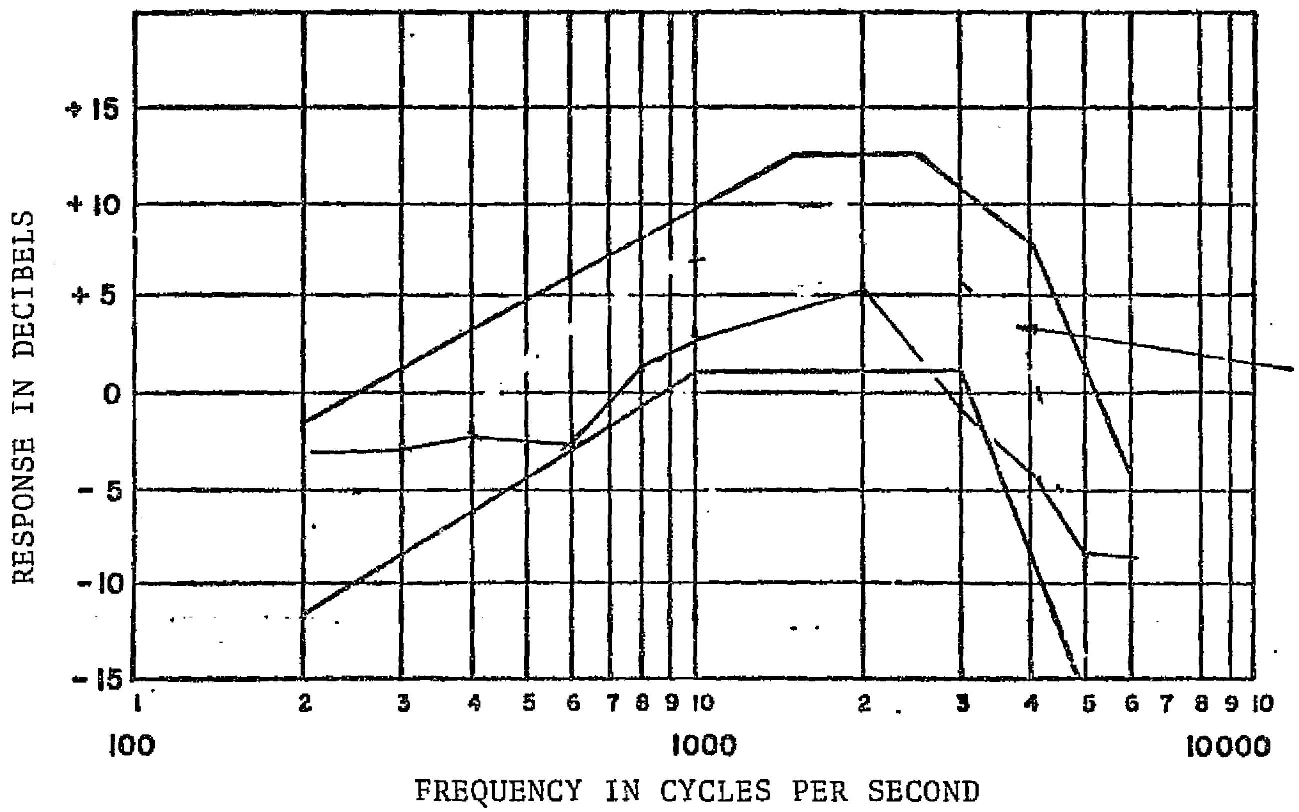


Figure B-43.– Astrocom M-101 frequency response at 25,000 ft SN-3.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

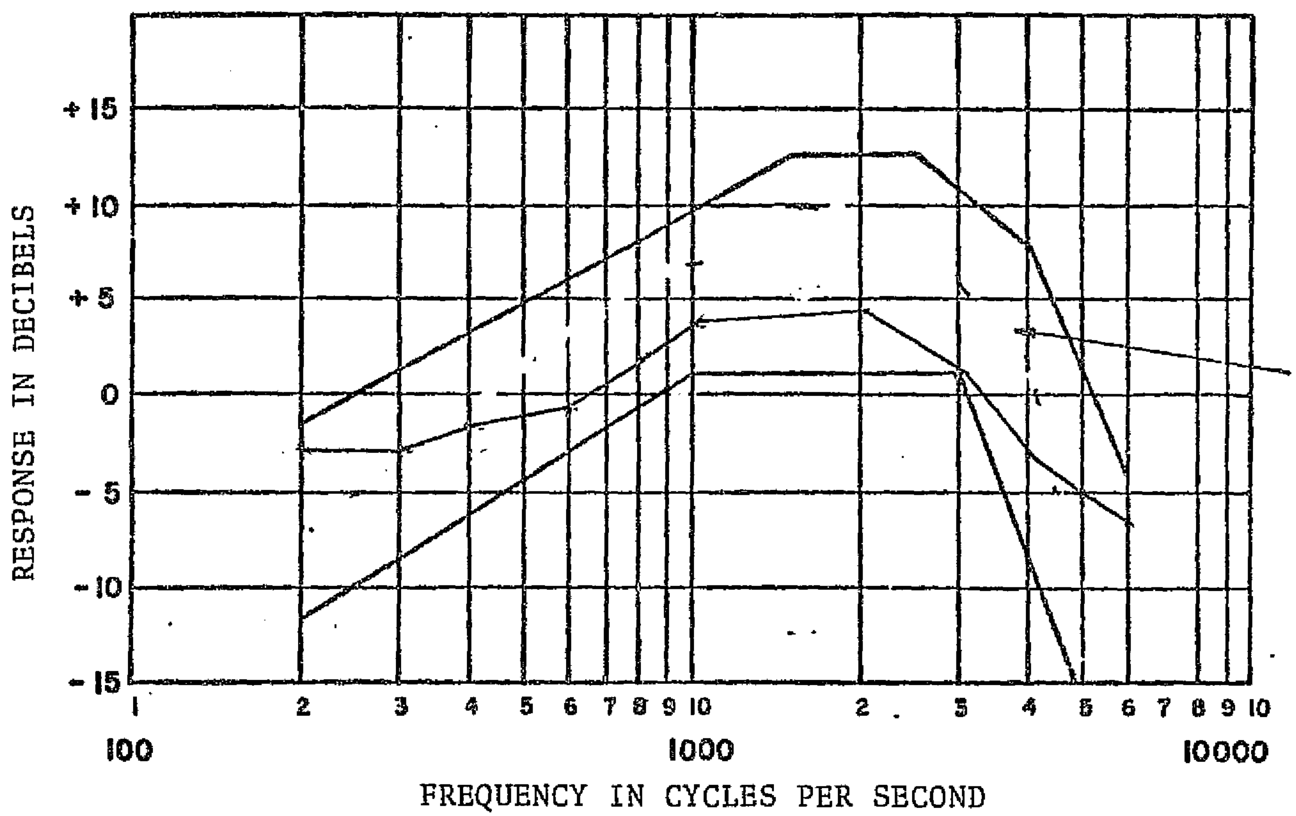


Figure B-44.— Astrocom M-101 frequency response at 25,000 ft SN-4.

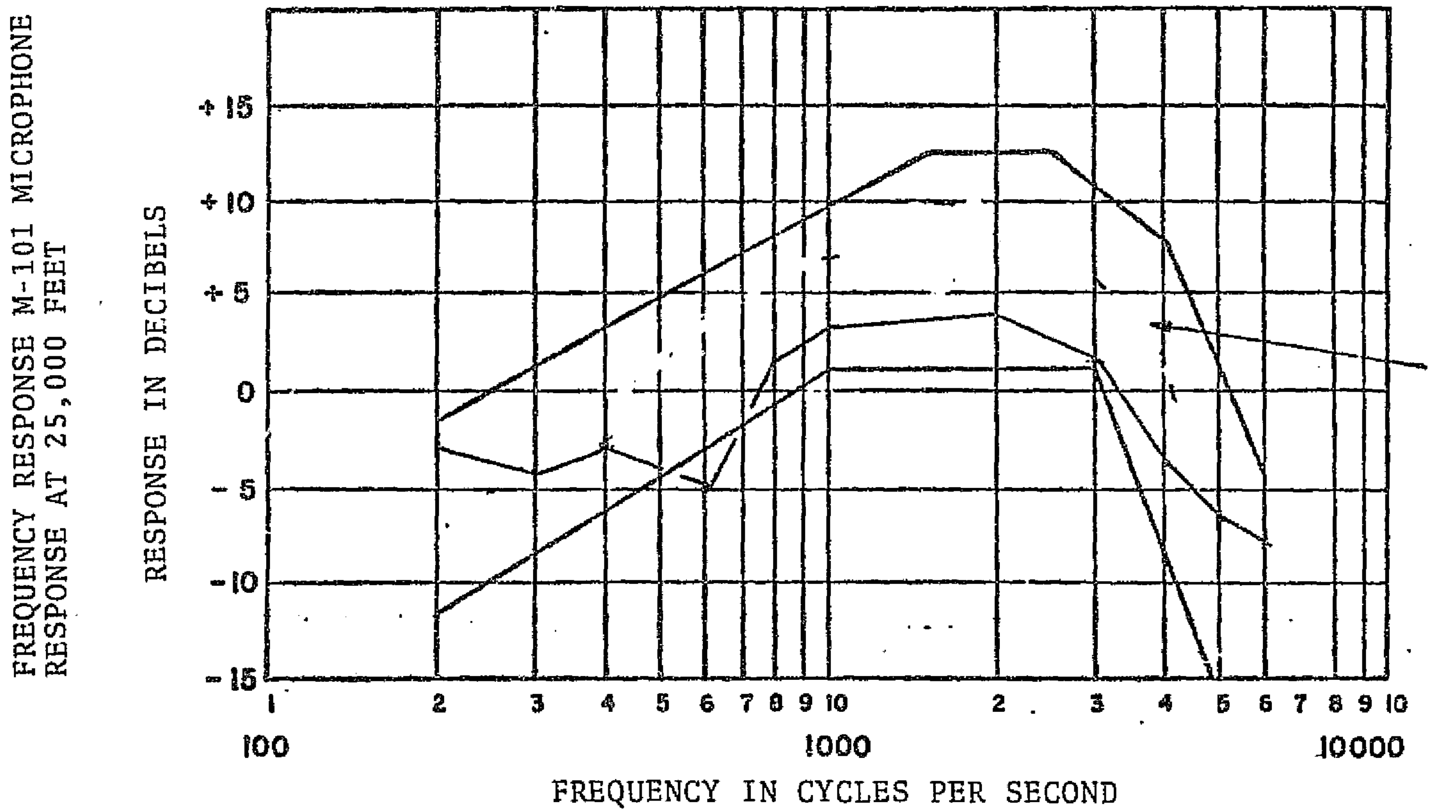


Figure B-45.— Astrocom M-101 frequency response at 25,000 ft SN-5.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

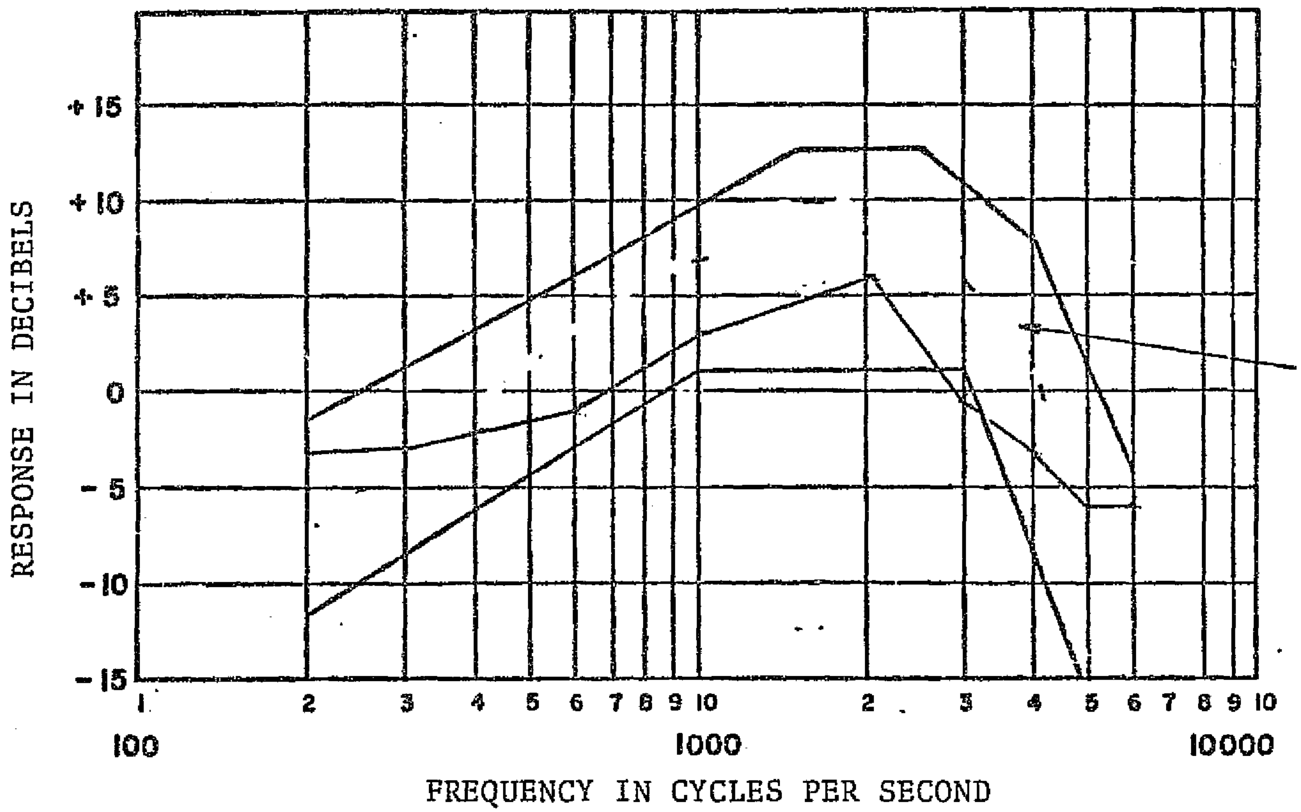


Figure B-46.— Astrocom M-101 frequency response at 25,000 ft SN-6.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

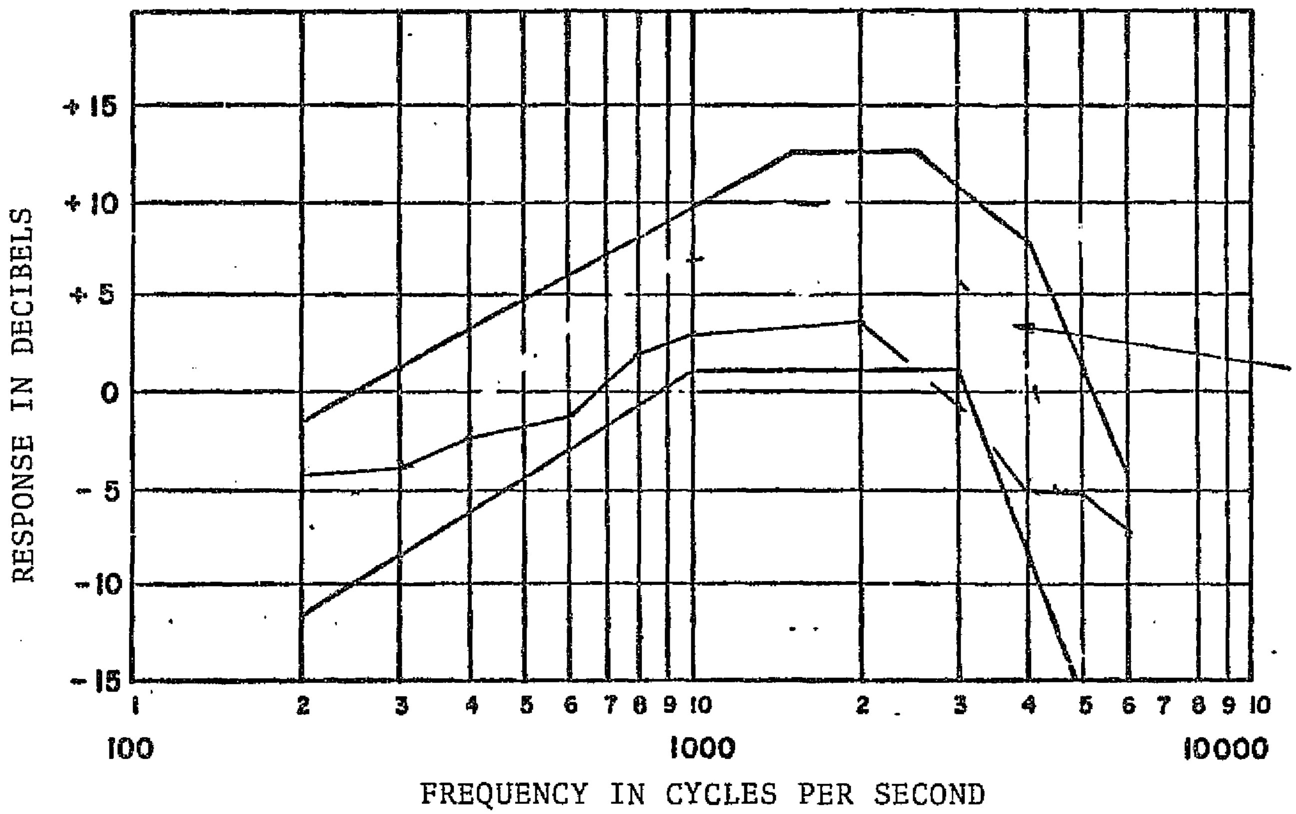


Figure B-47.– Astrocom M-101 frequency response at 25,000 ft SN-7.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

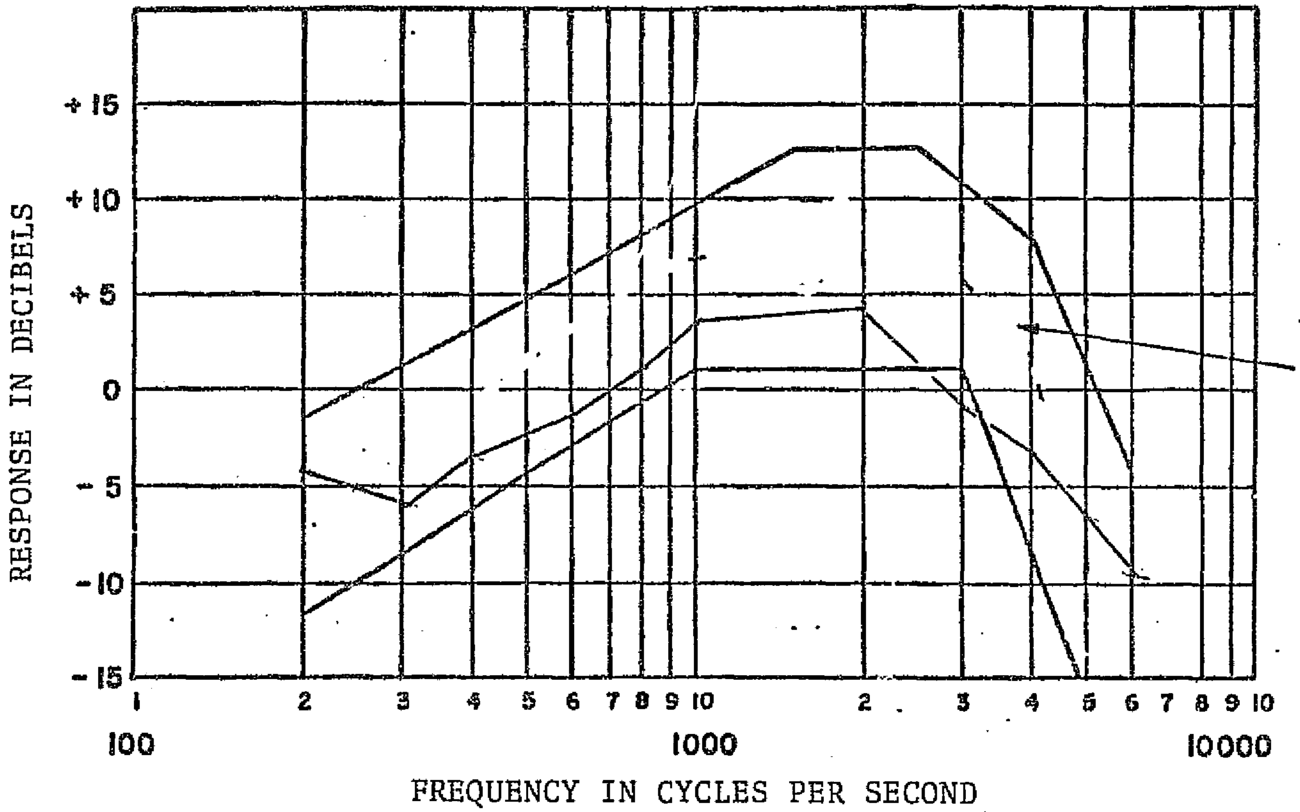


Figure B-48.– Astrocom M-101 frequency response at 25,000 ft SN-8.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

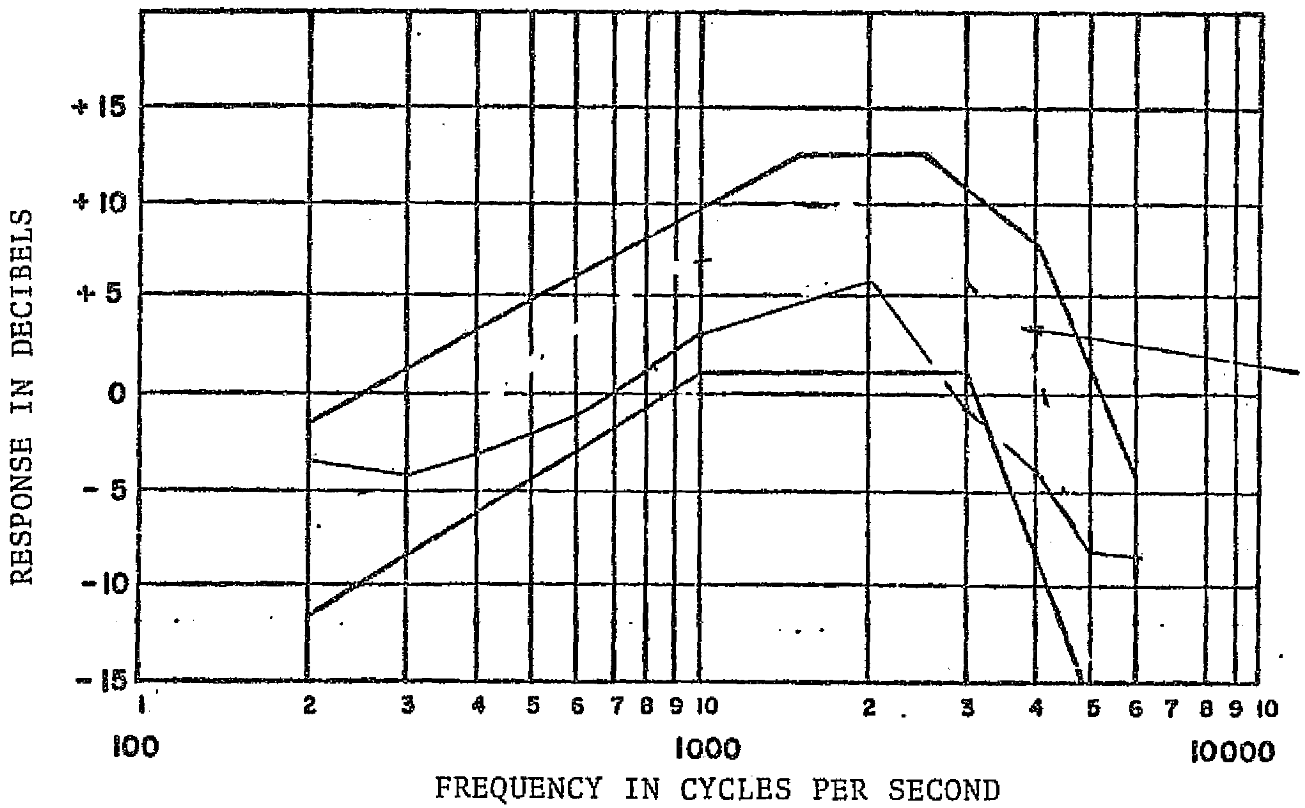


Figure B-49.— Astrocom M-101 frequency response at 25,000 ft SN-9.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

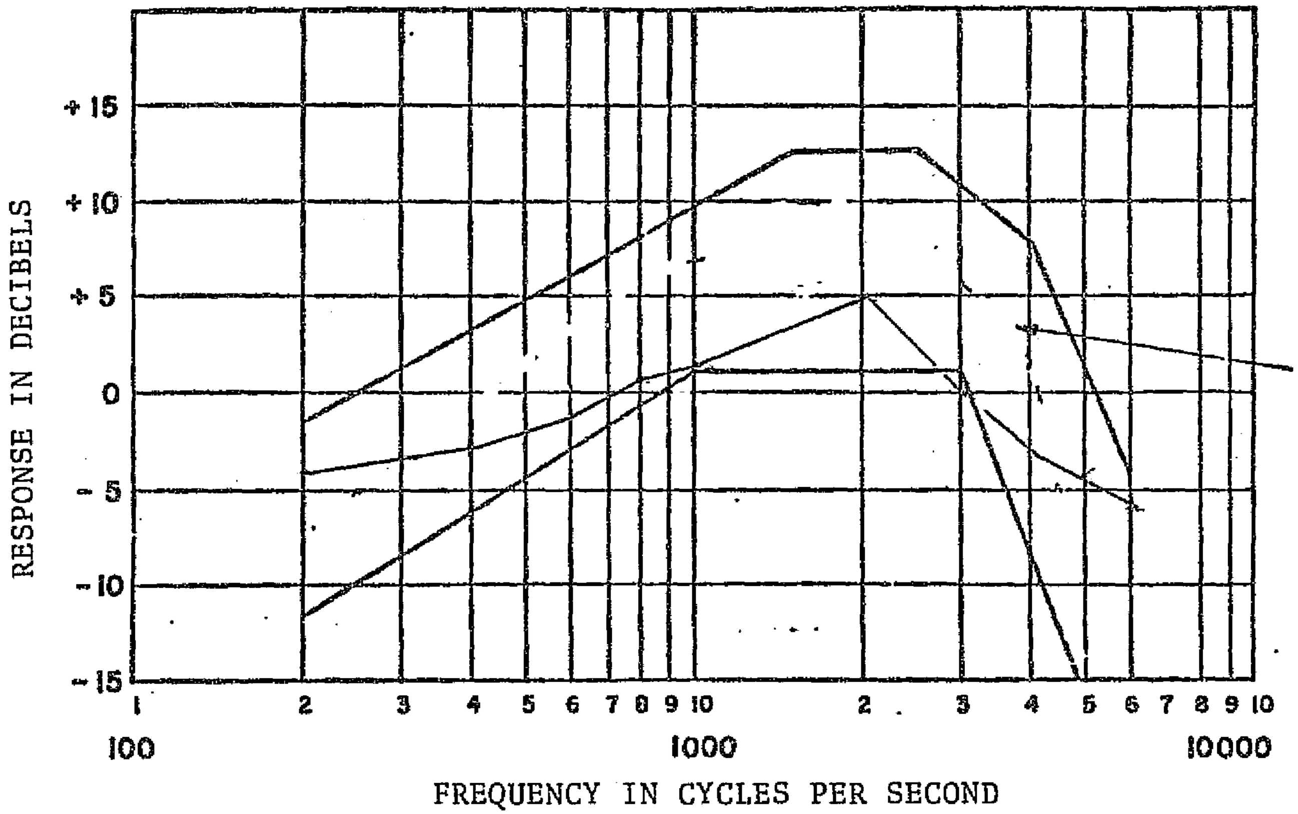


Figure B-50.— Astrocom M-101 frequency response at 25,000 ft SN-10.

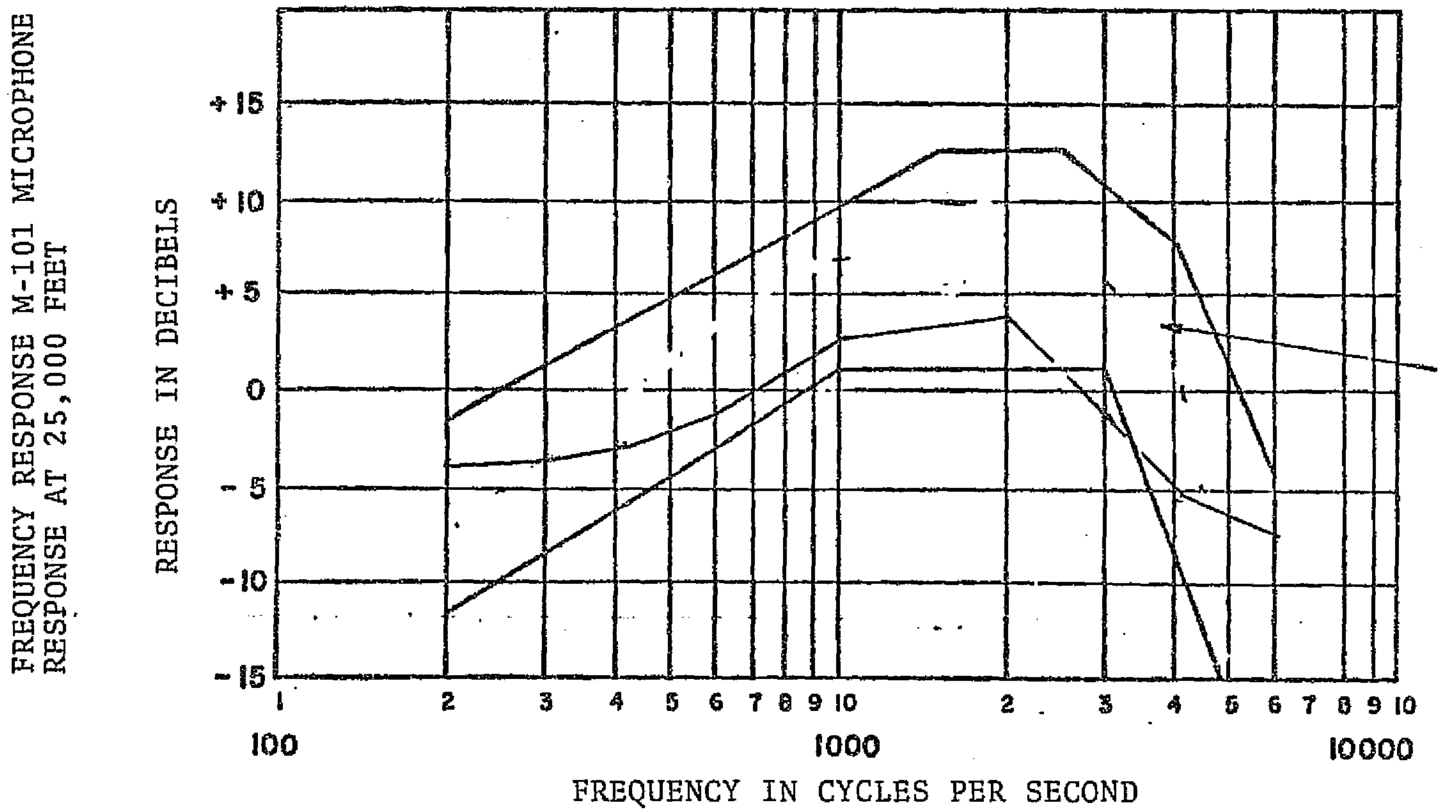


Figure B-51.– Electrovoice M-101 frequency response at 25,000 ft SN-21.

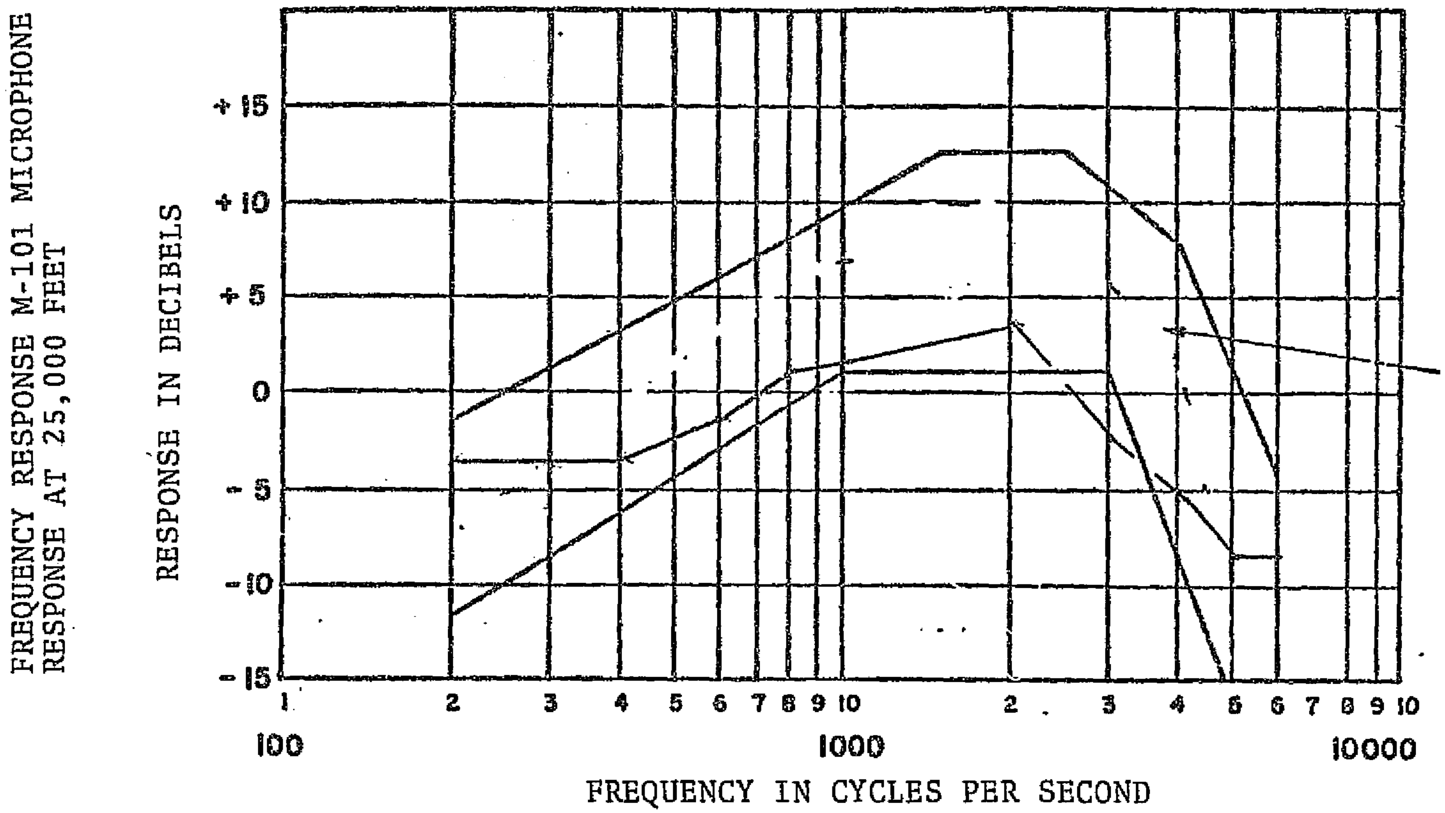


Figure B-52.- Electrovoice M-101 frequency response at 25,000 ft SN-22.

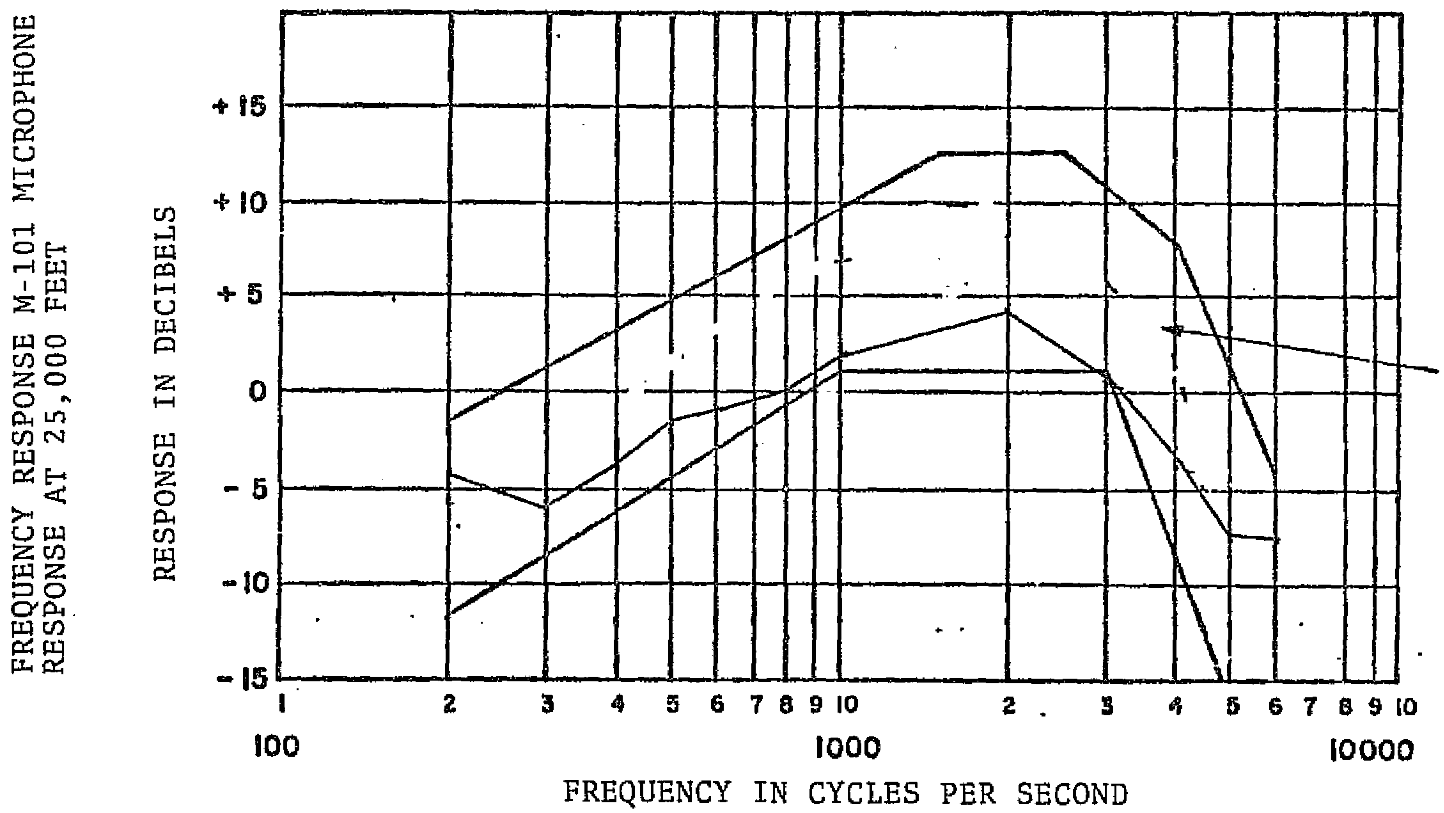


Figure B-53.– Electrovoice M-101 frequency response at 25,000 ft SN-23.

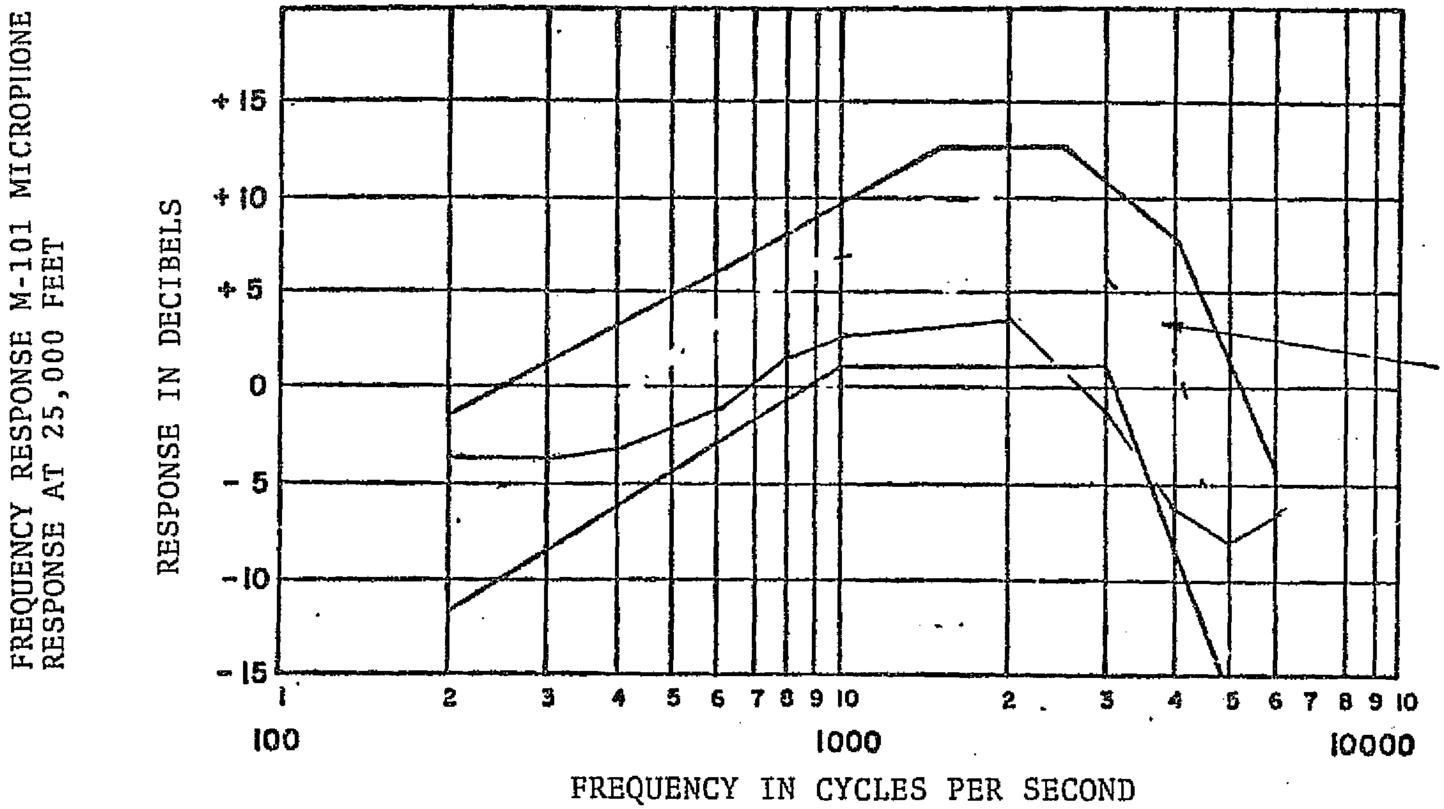


Figure B-54.- Electrovoice M-101 frequency response at 25,000 ft SN-24.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

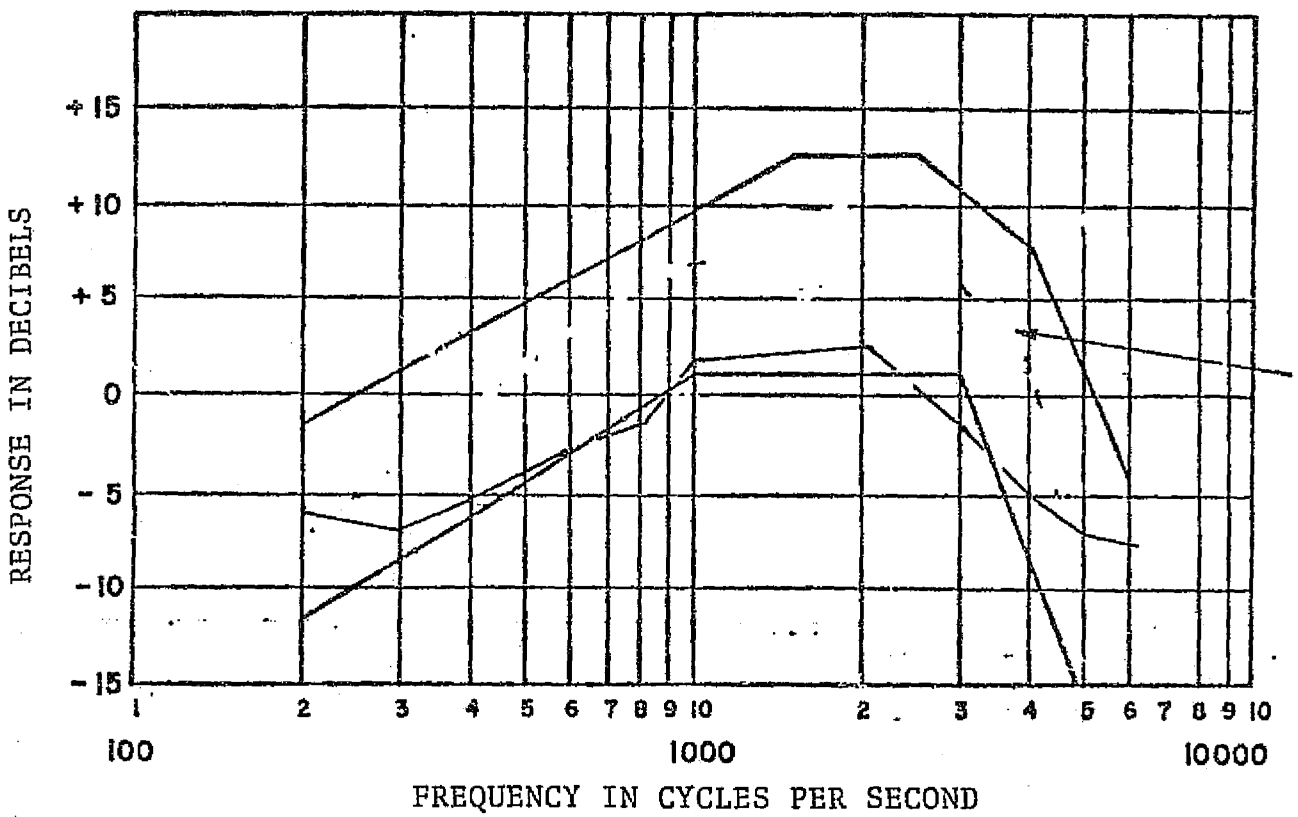


Figure B-55.— Electrovoice M-101 frequency response at 25,000 ft SN-25.

FREQUENCY RESPONSE M-101 MICROPHONE
RESPONSE AT 25,000 FEET

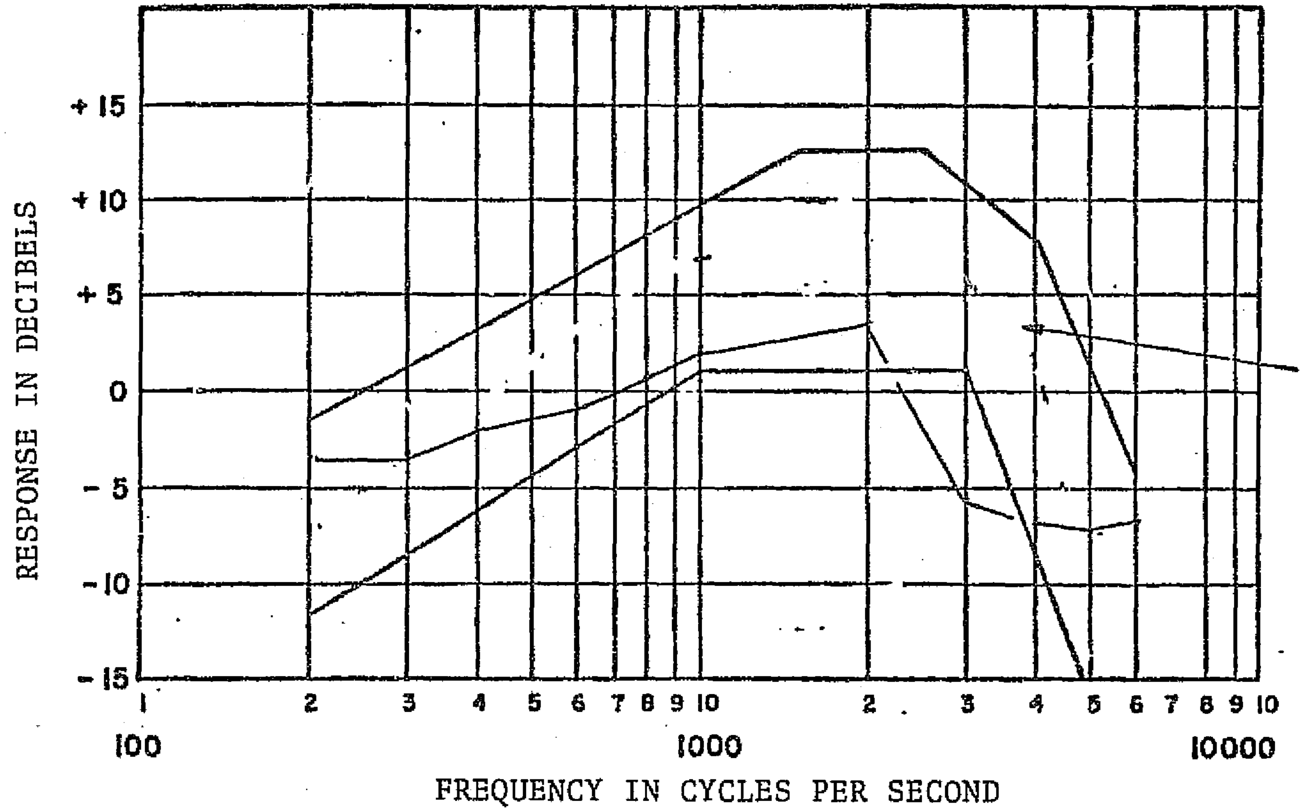


Figure B-56.– Electrovoice M-101 frequency response at 25,000 ft SN-26.

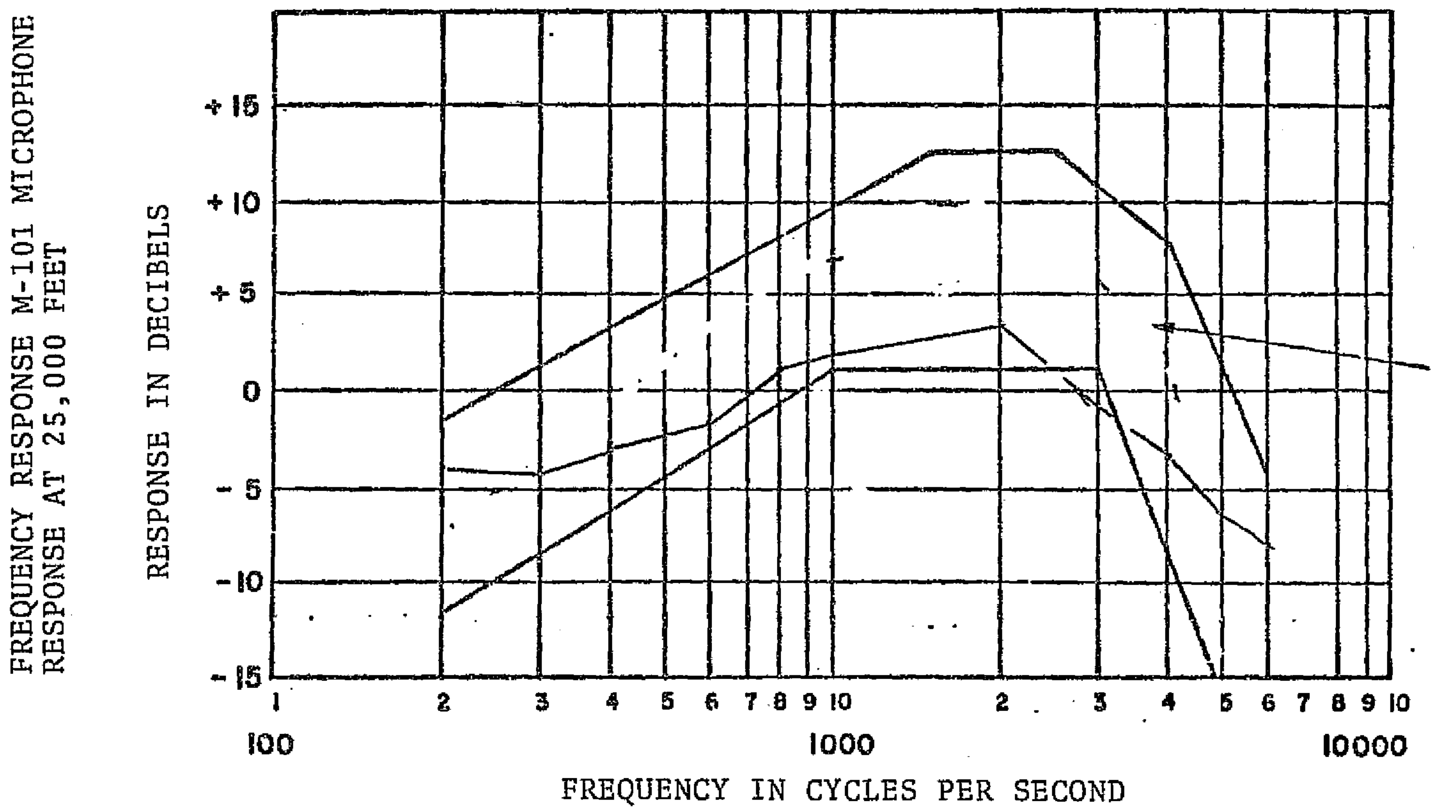


Figure B-57.— Electrovoice M-101 frequency response at 25,000 ft SN-27.

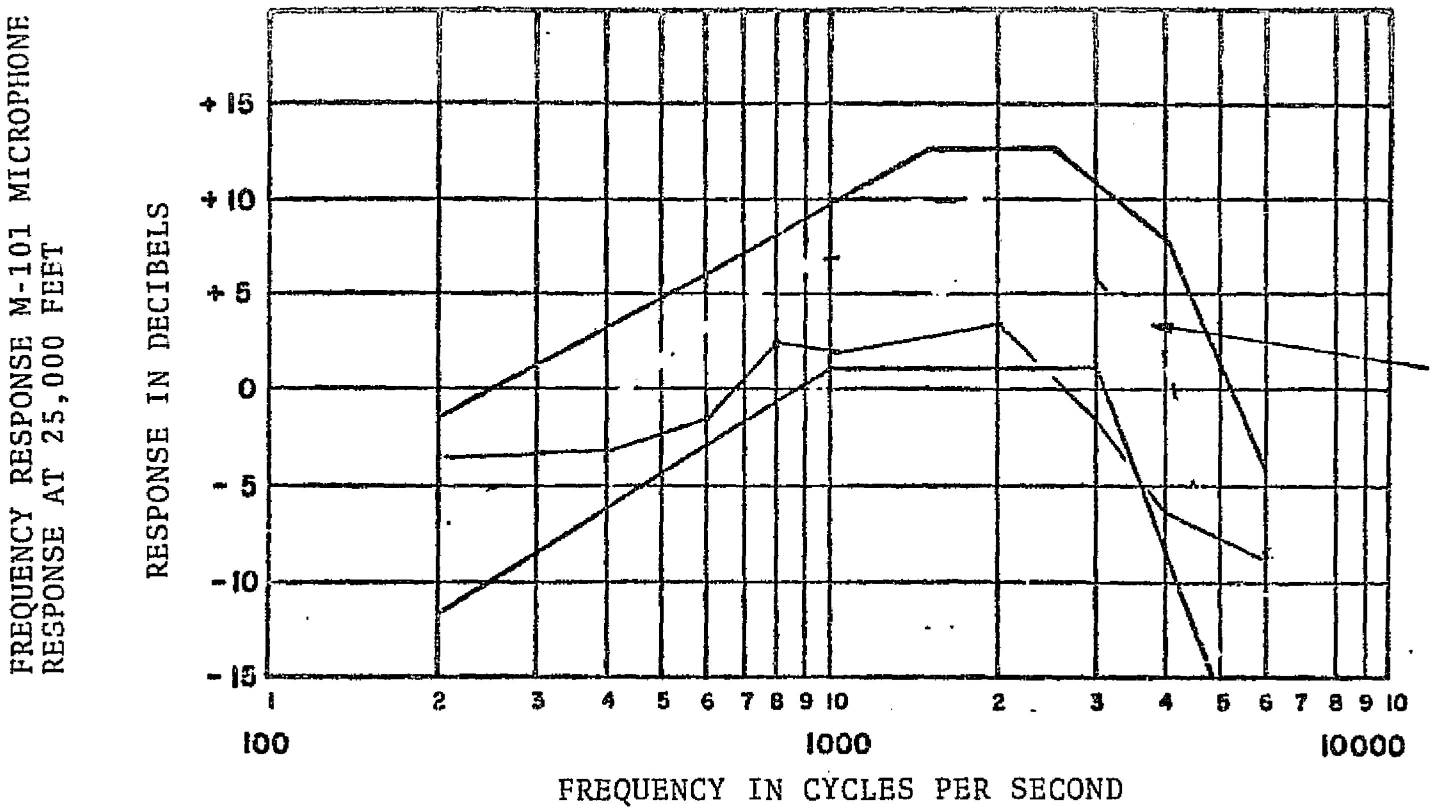


Figure B-58.— Electrovoice M-101 frequency response at 25,000 ft SN-28.

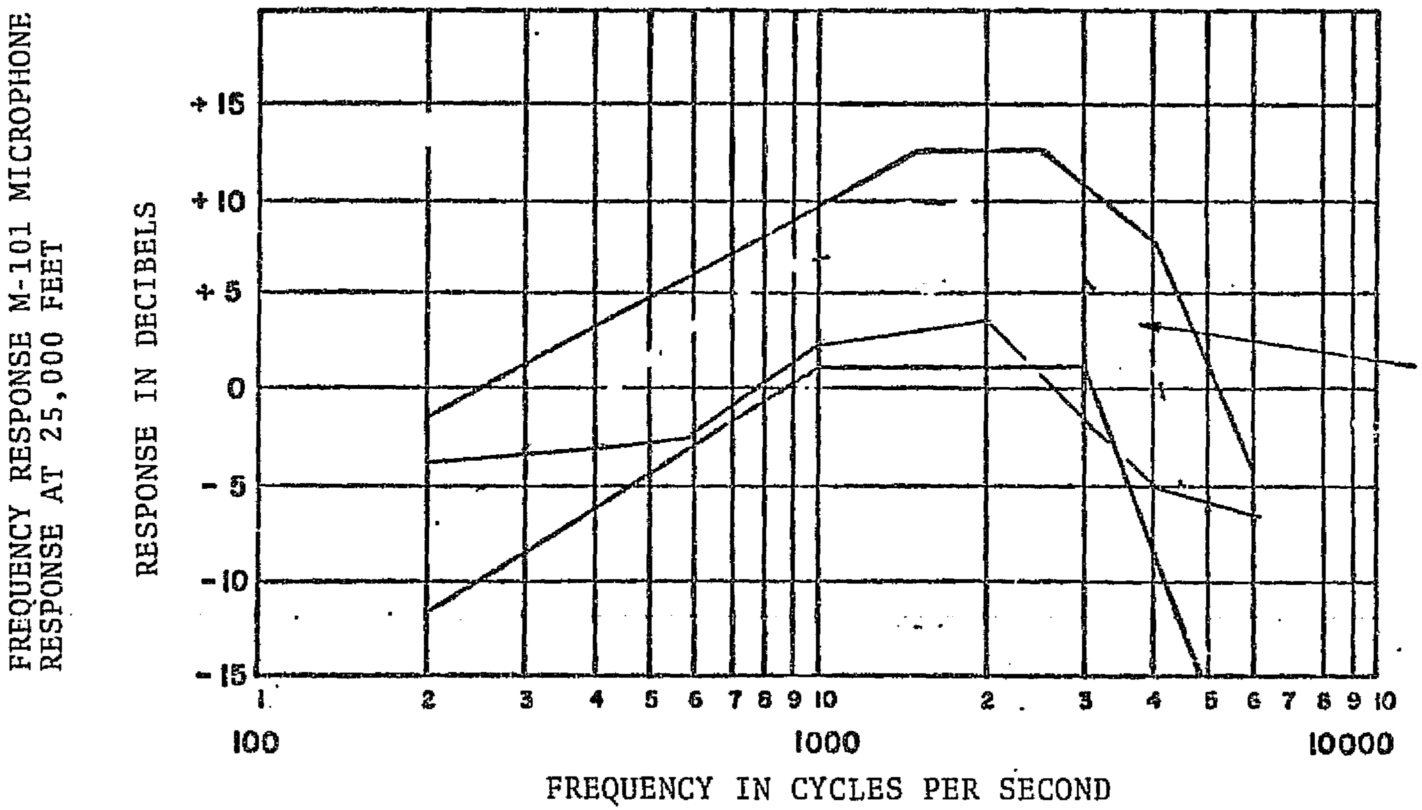


Figure B-59.– Electrovoice M-101 frequency response at 25,000 ft SN-29.

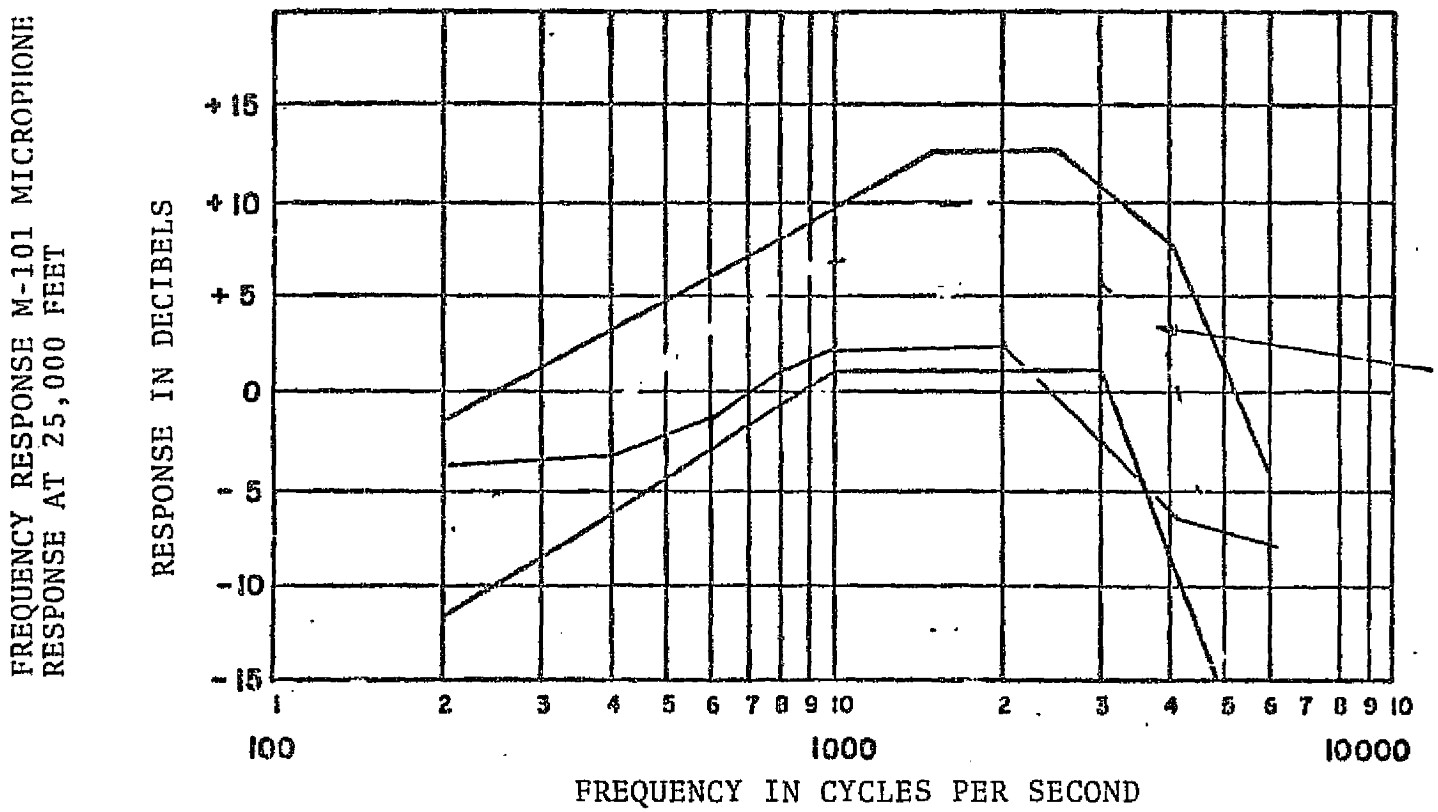


Figure B-60.– Electrovoice M-101 frequency response at 25,000 ft SN-30.

APPENDIX C

H-143/AIC EARPHONE FREQUENCY RESPONSE

AND LINEARITY GRAPHS

FIGURES

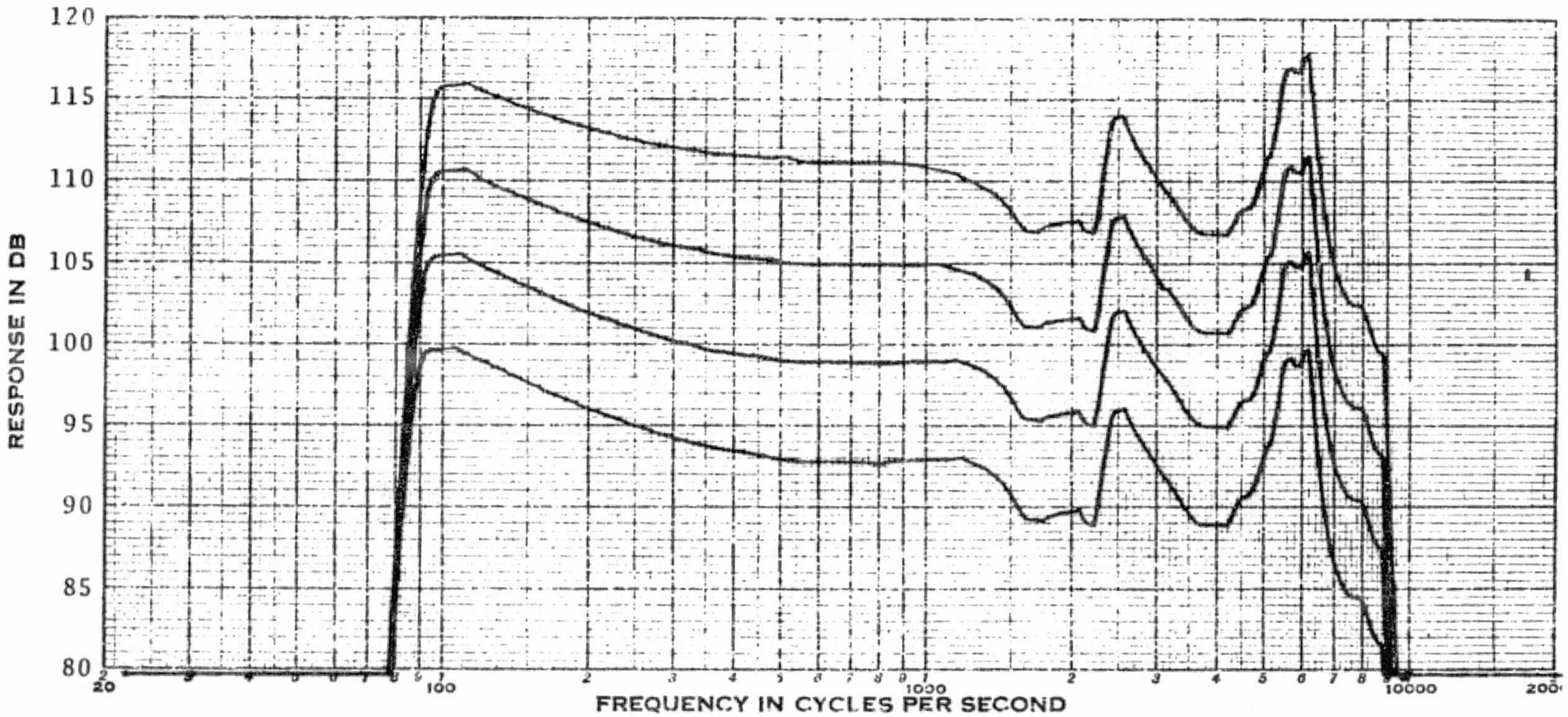


Figure C-1.– Carter H-143 frequency response SN-100.

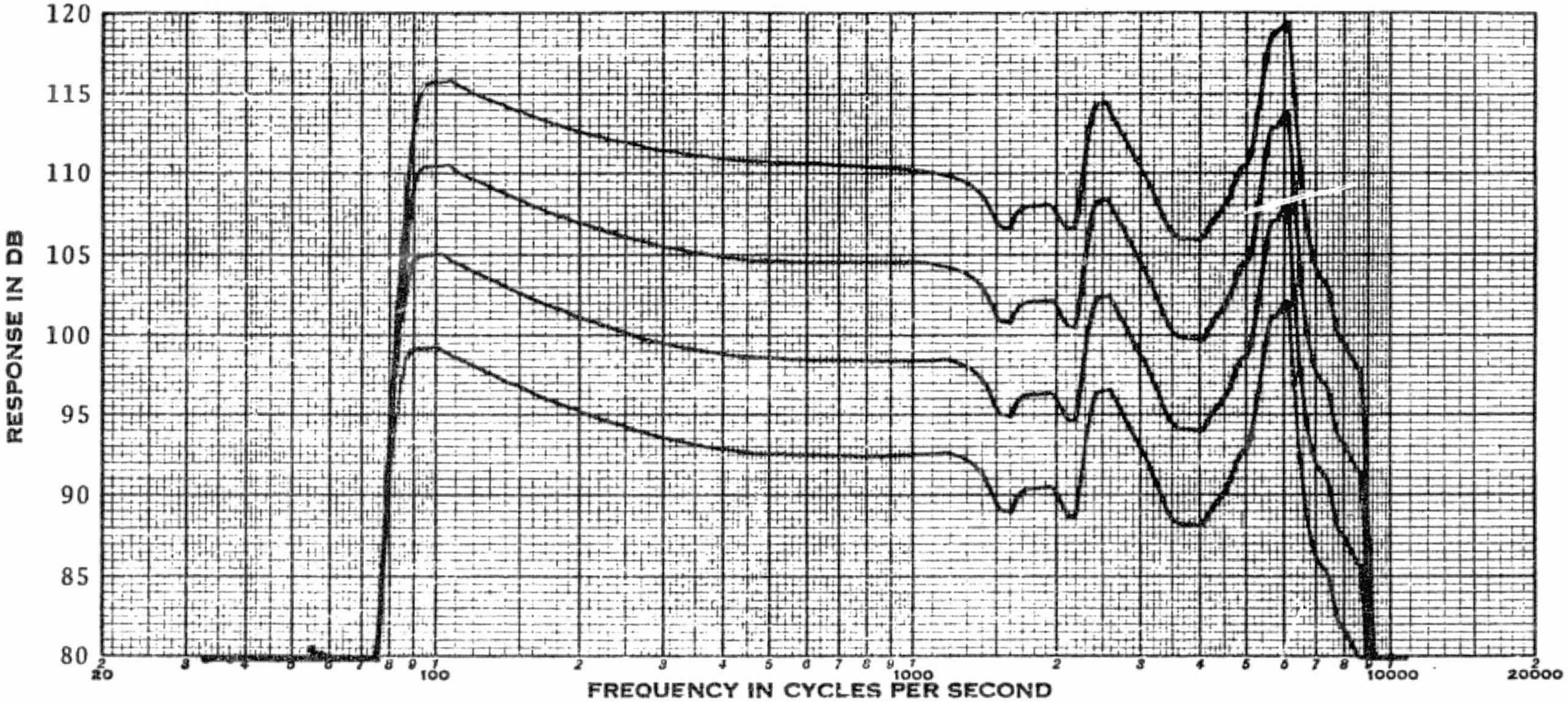


Figure C-2.– Carter H-143 frequency response SN-99.

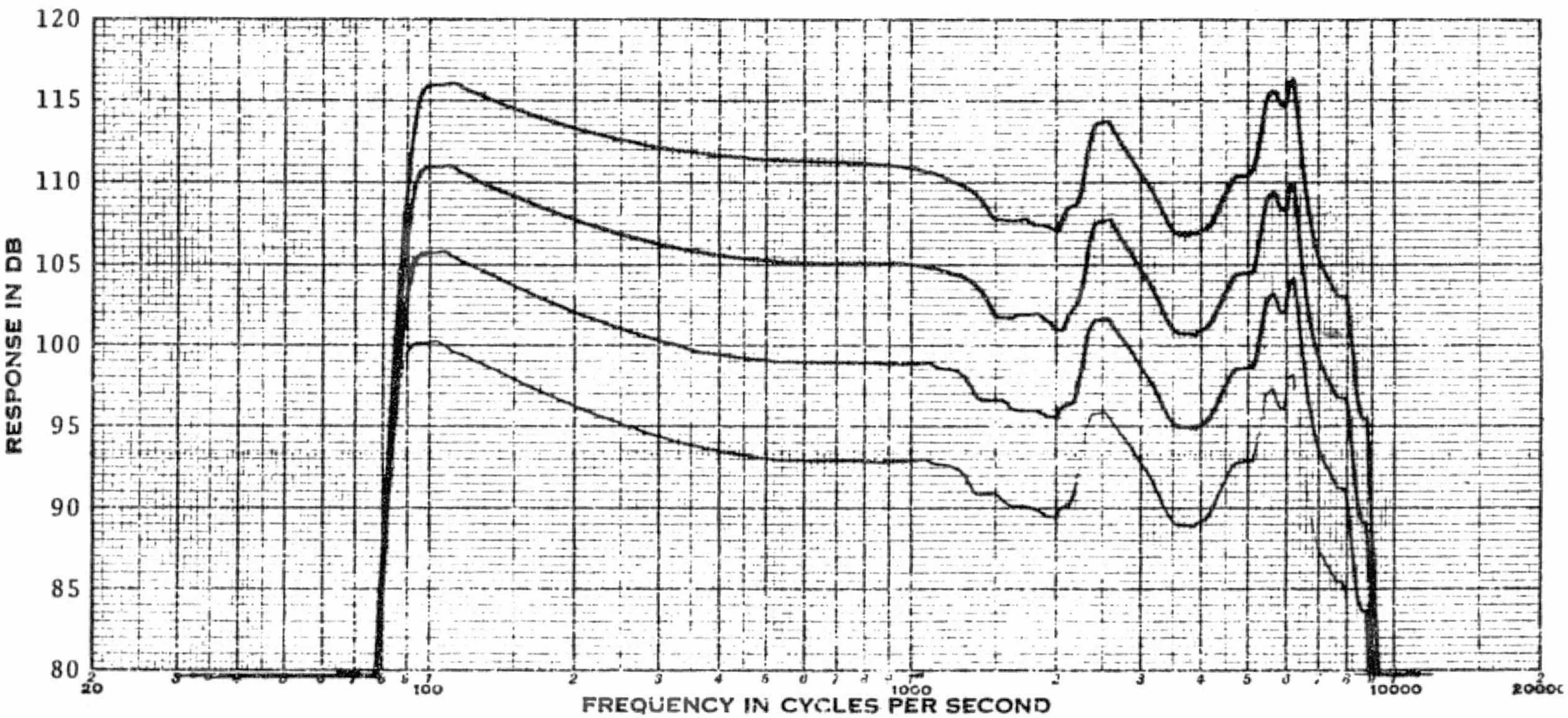


Figure C-3.— Carter H-143 frequency response SN-98.

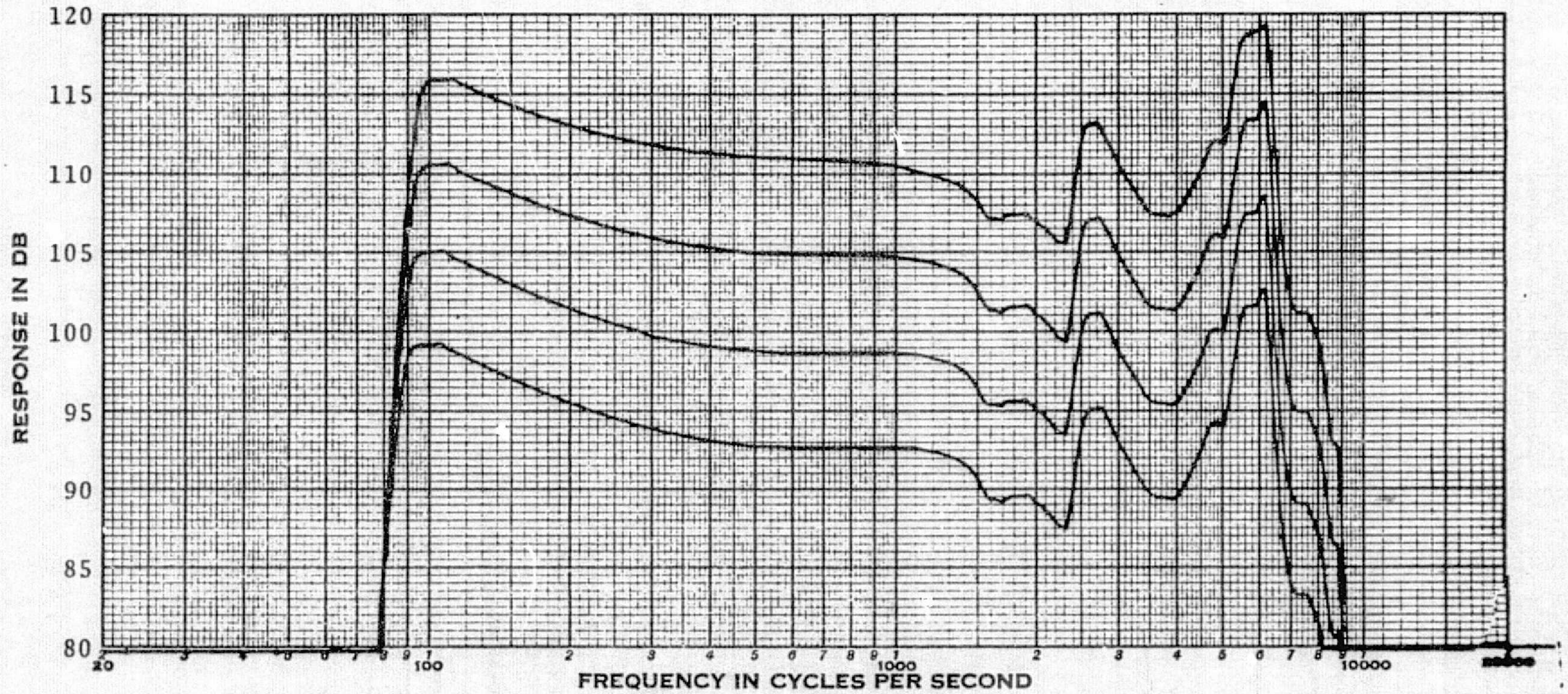


Figure C-4.— Carter H-143 frequency response SN-97.

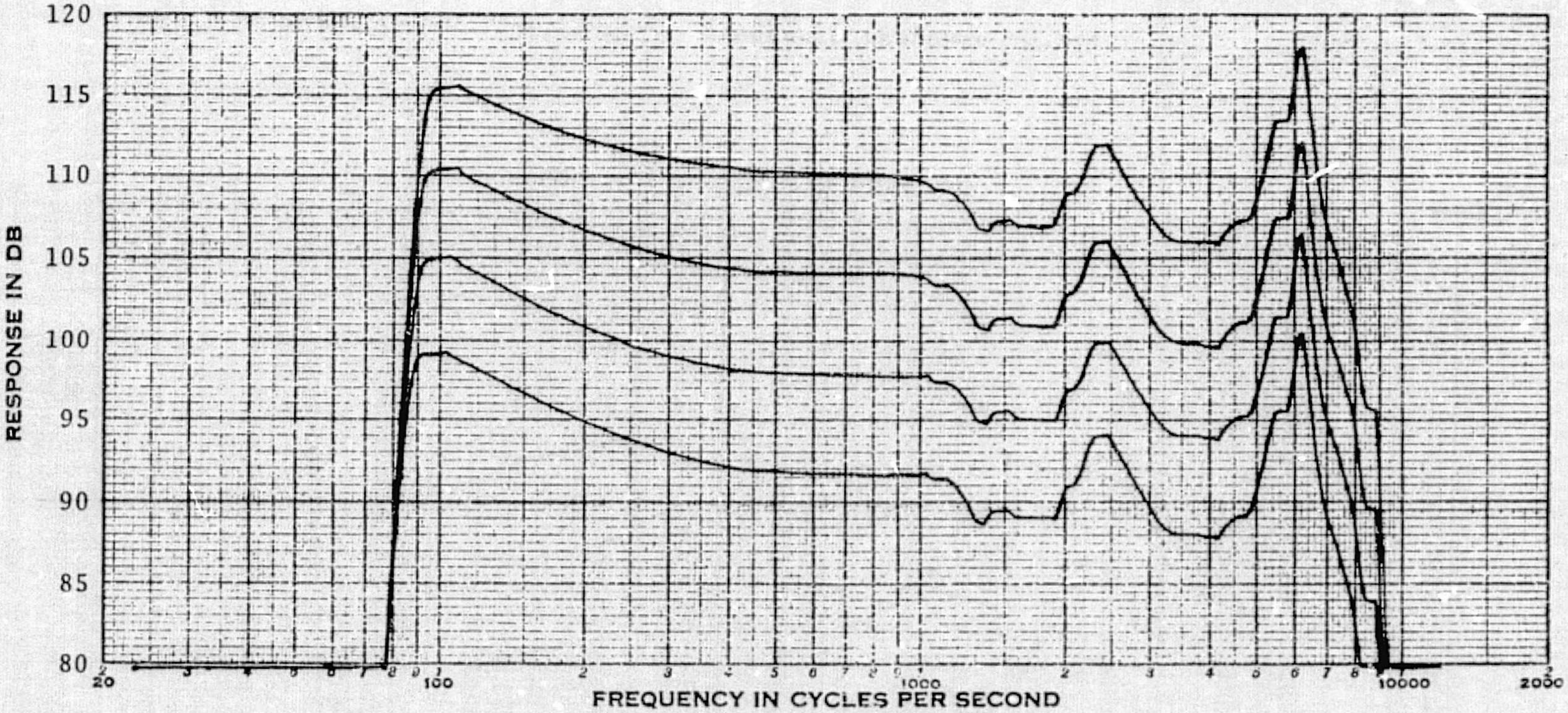


Figure C-5.— Carter H-143 frequency response SN-96.

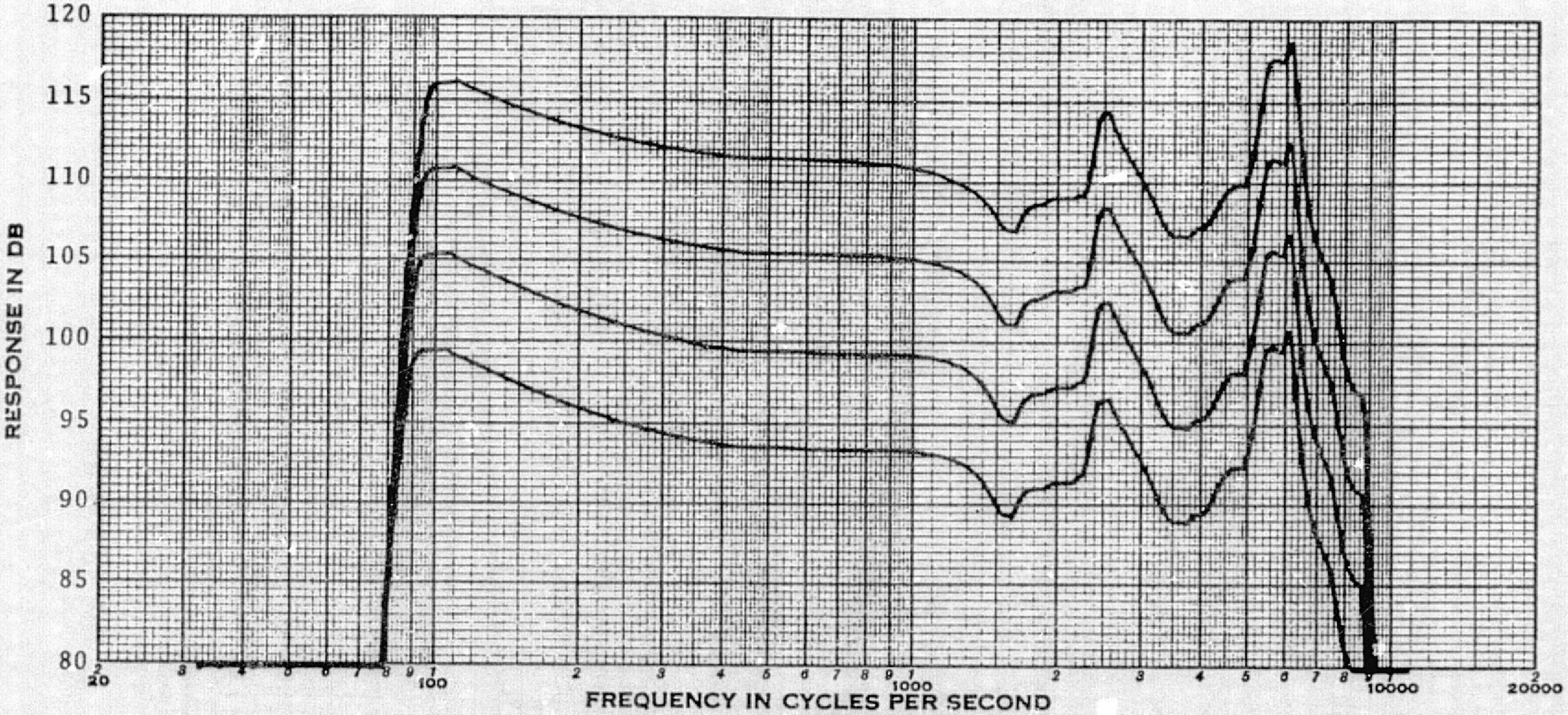


Figure C-6.— Carter H-143 frequency response SN-95.

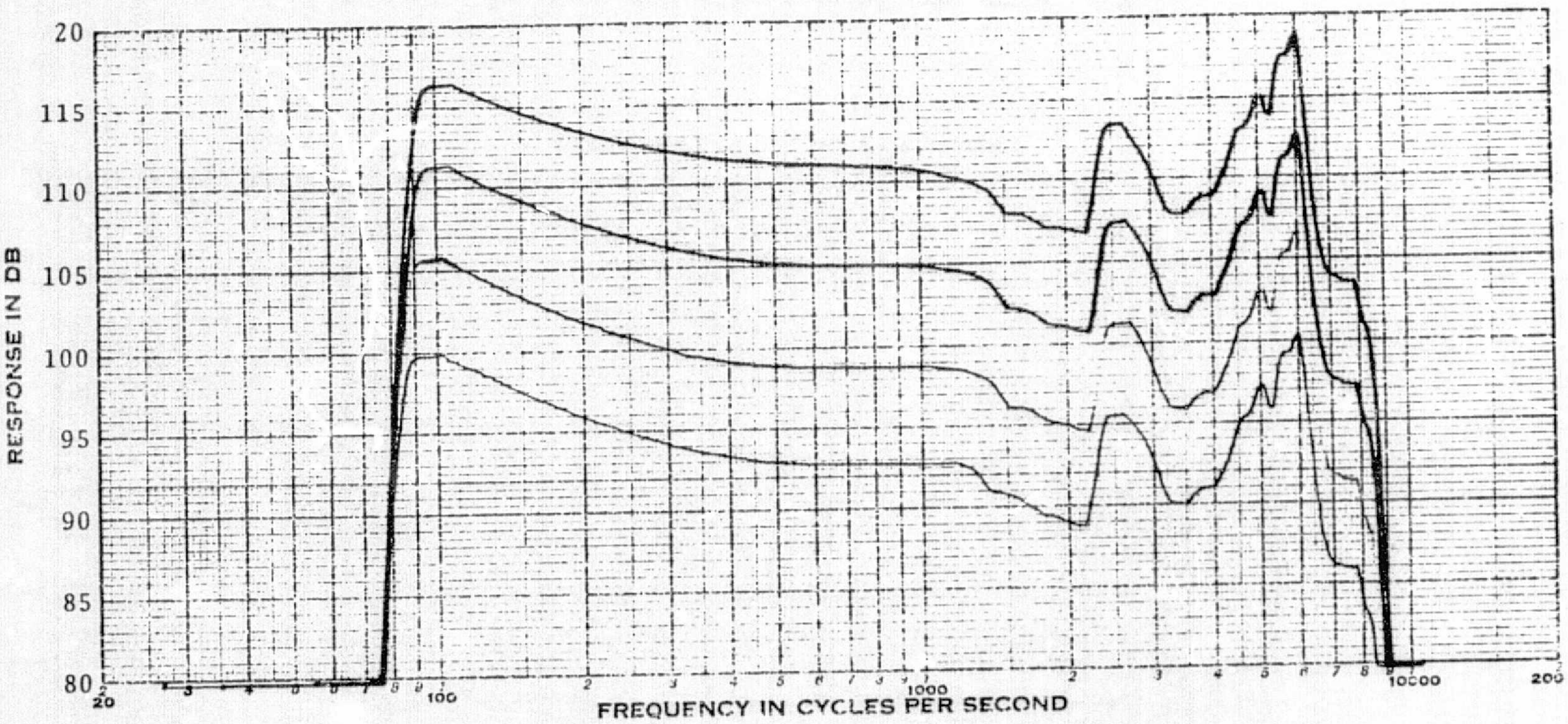


Figure C-7.— Carter H-143 frequency response SN-93.

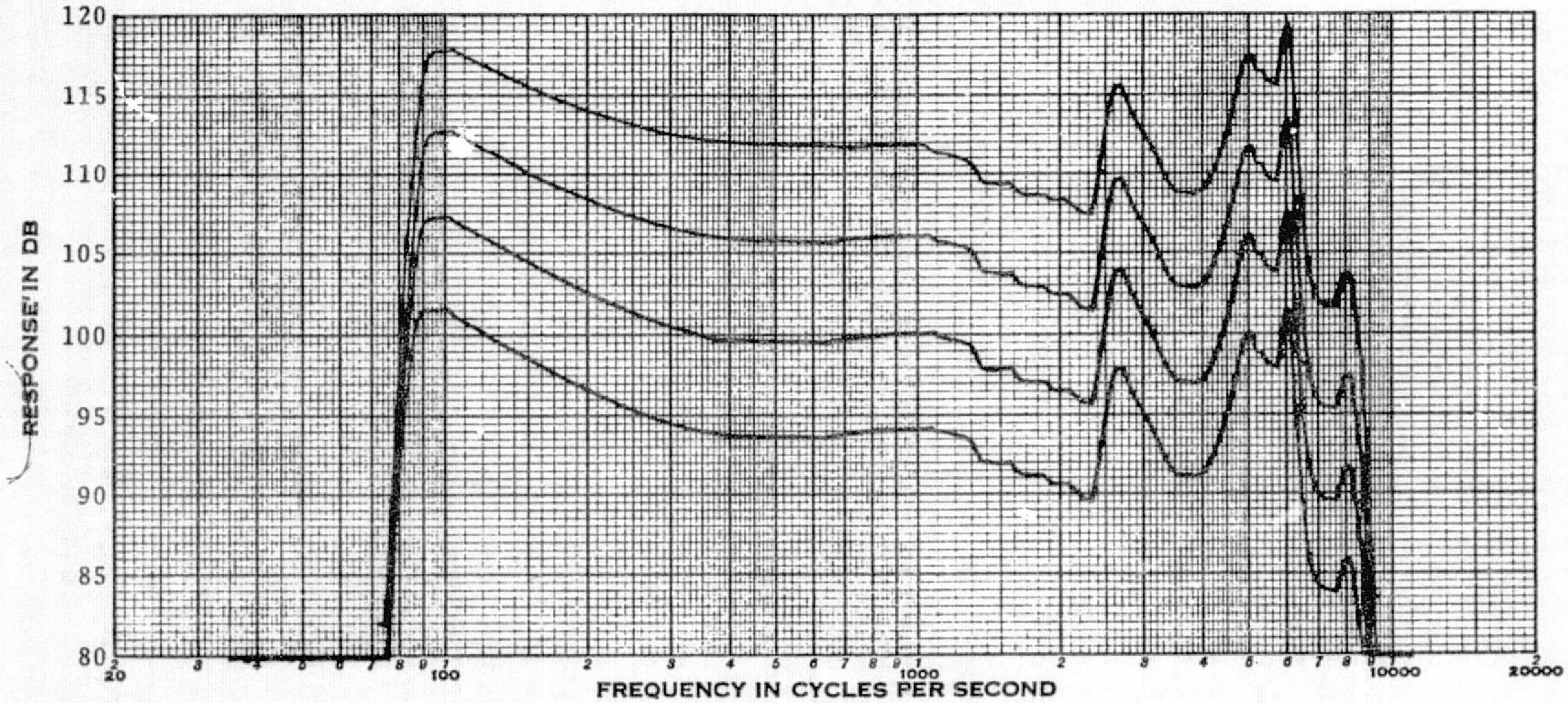


Figure C-8.– Carter H-143 frequency response SN-92.

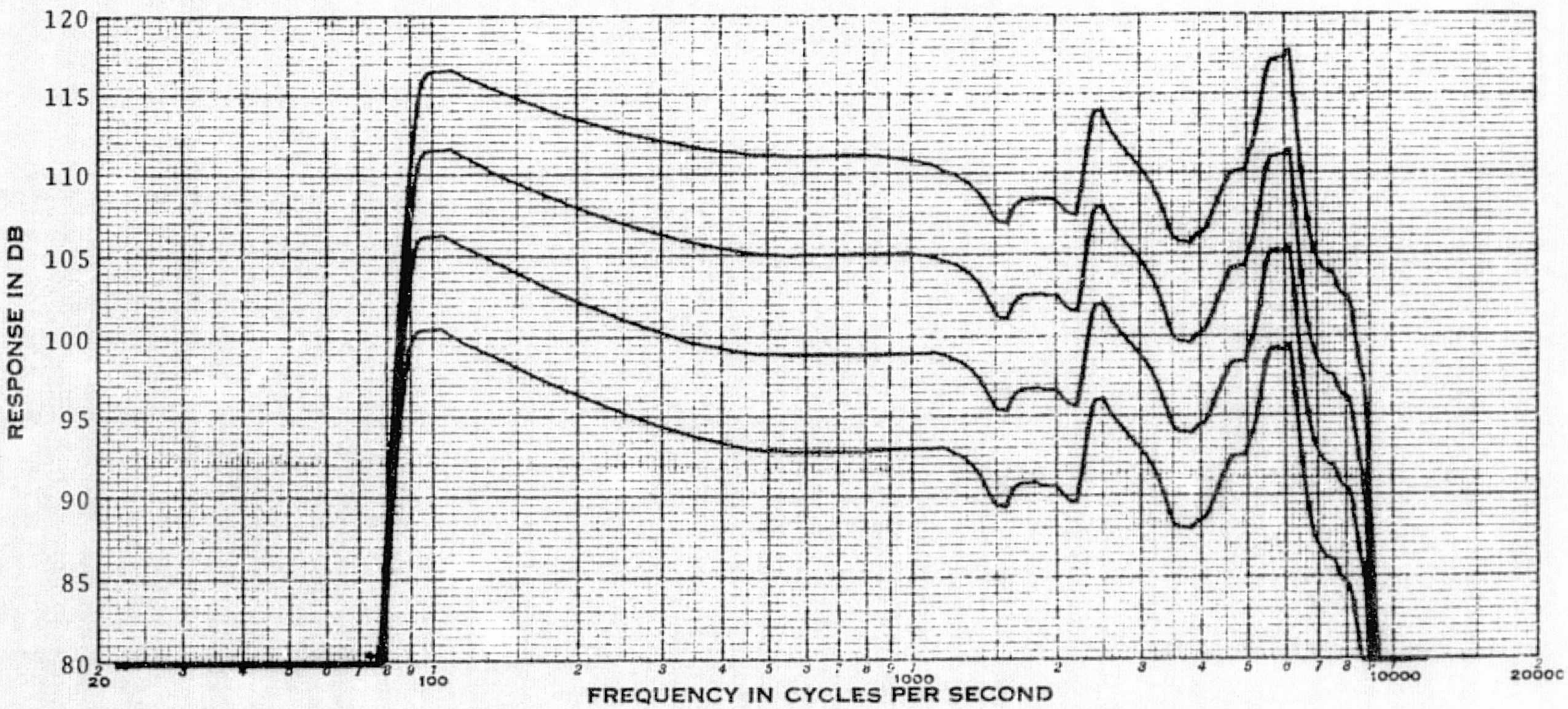


Figure C-9.— Carter H-143 frequency response SN-91.

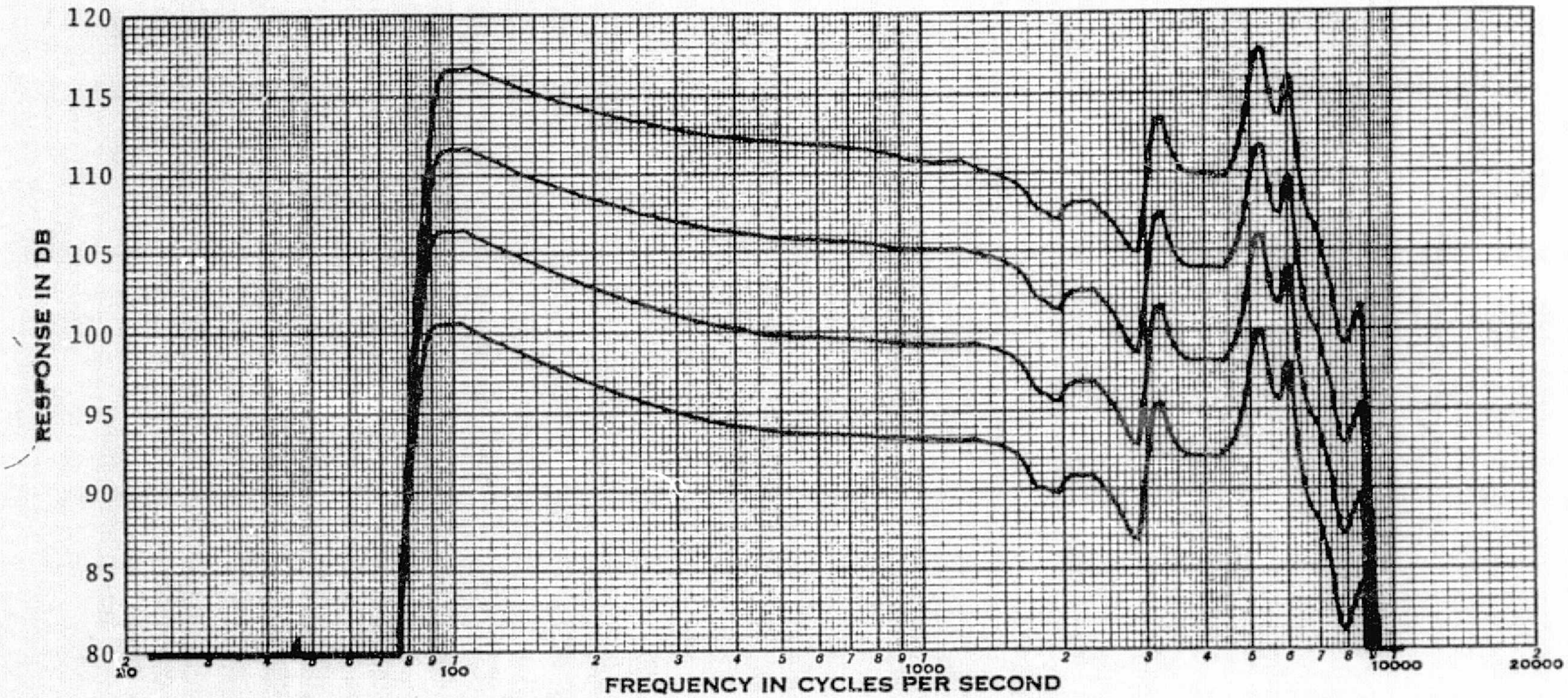


Figure C-10.– Carter H-143 frequency response SN-90.

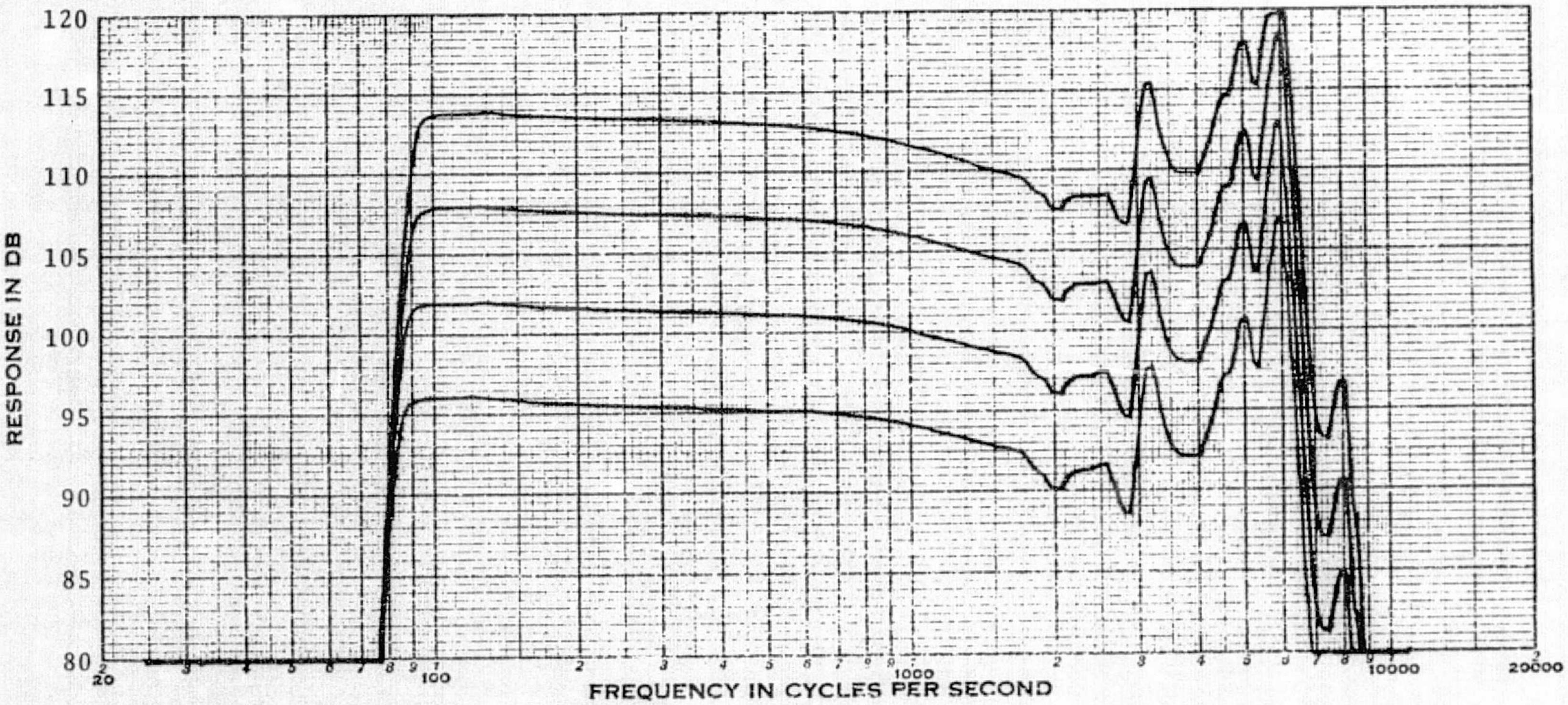


Figure C-11.– Carter H-143 frequency response SN-89.

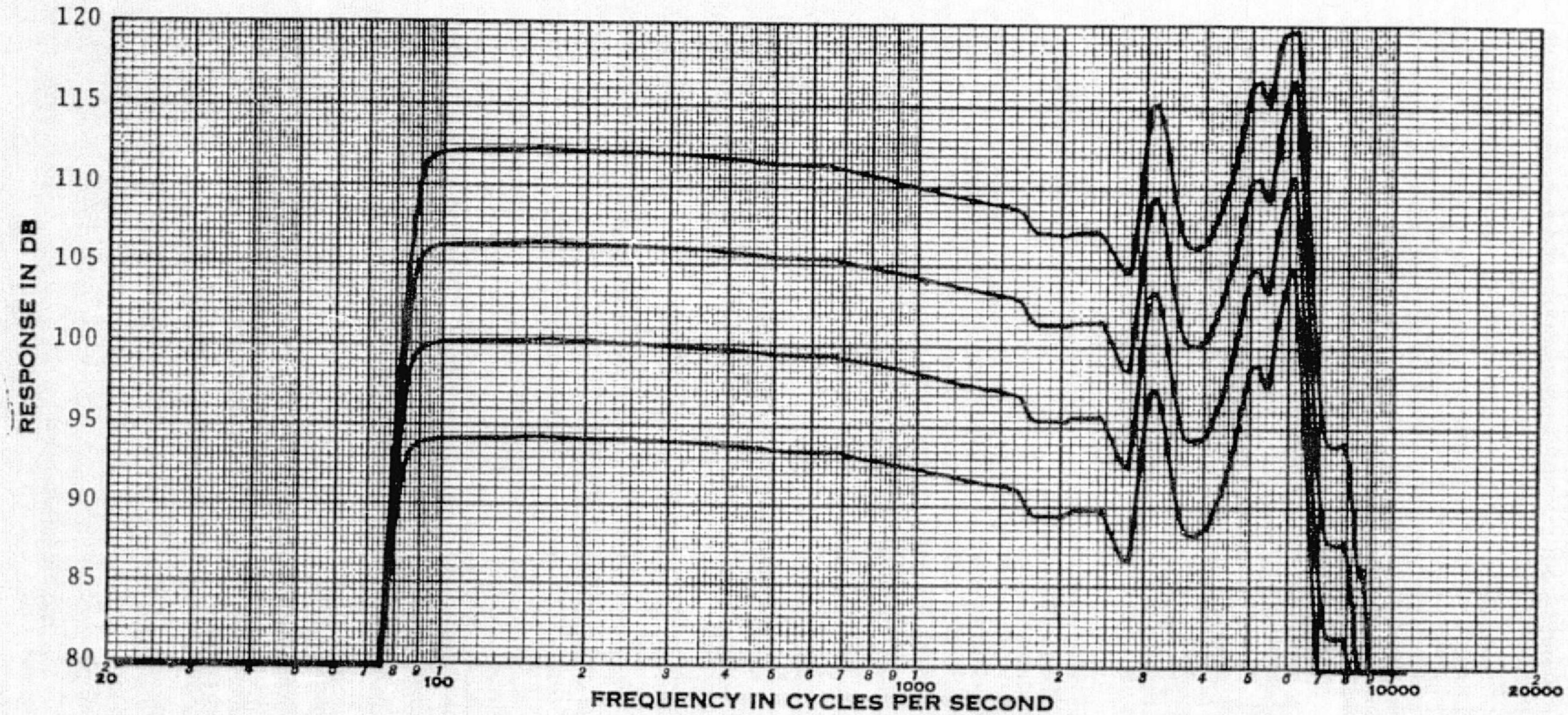


Figure C-12.– Carter H-143 frequency response SN-87.

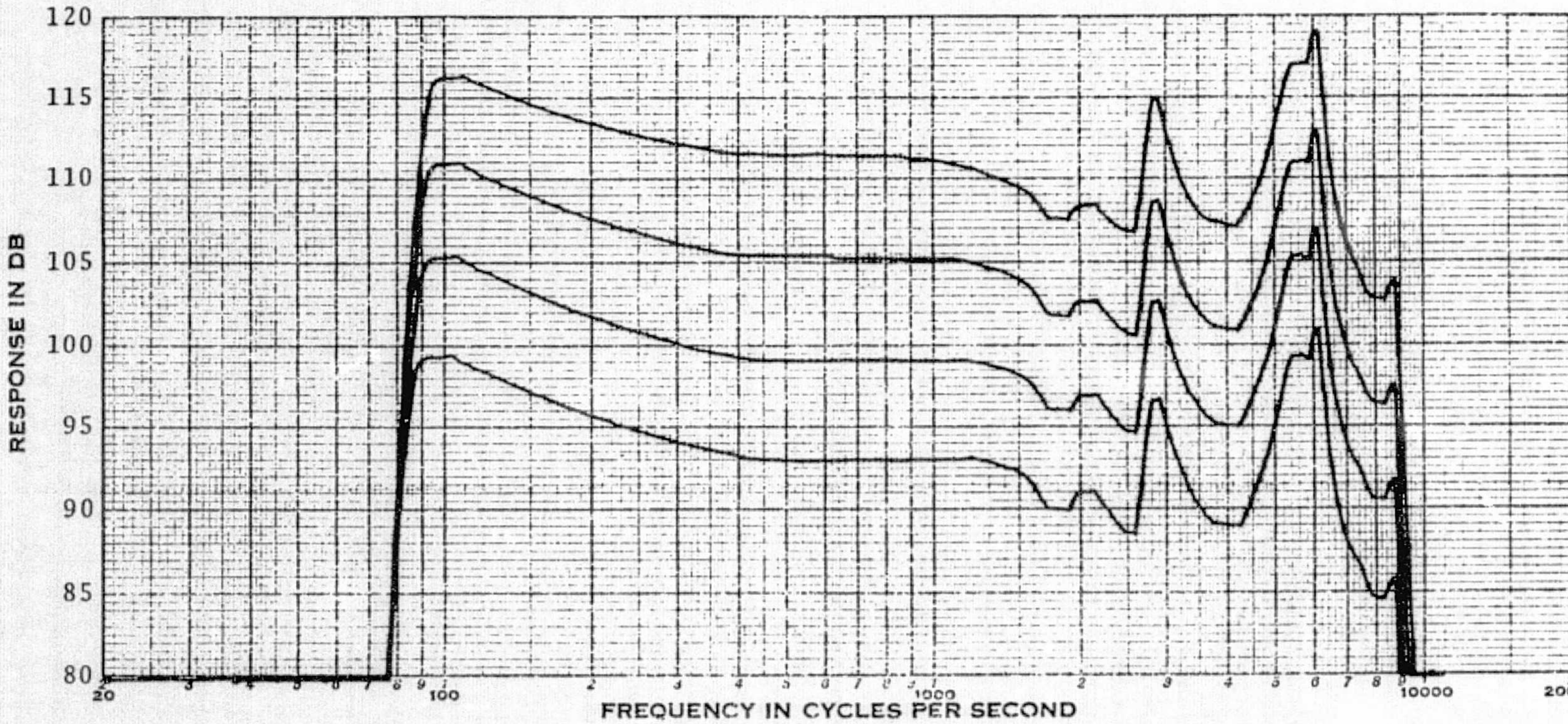


Figure C-13.– Carter H-143 frequency response SN-86.

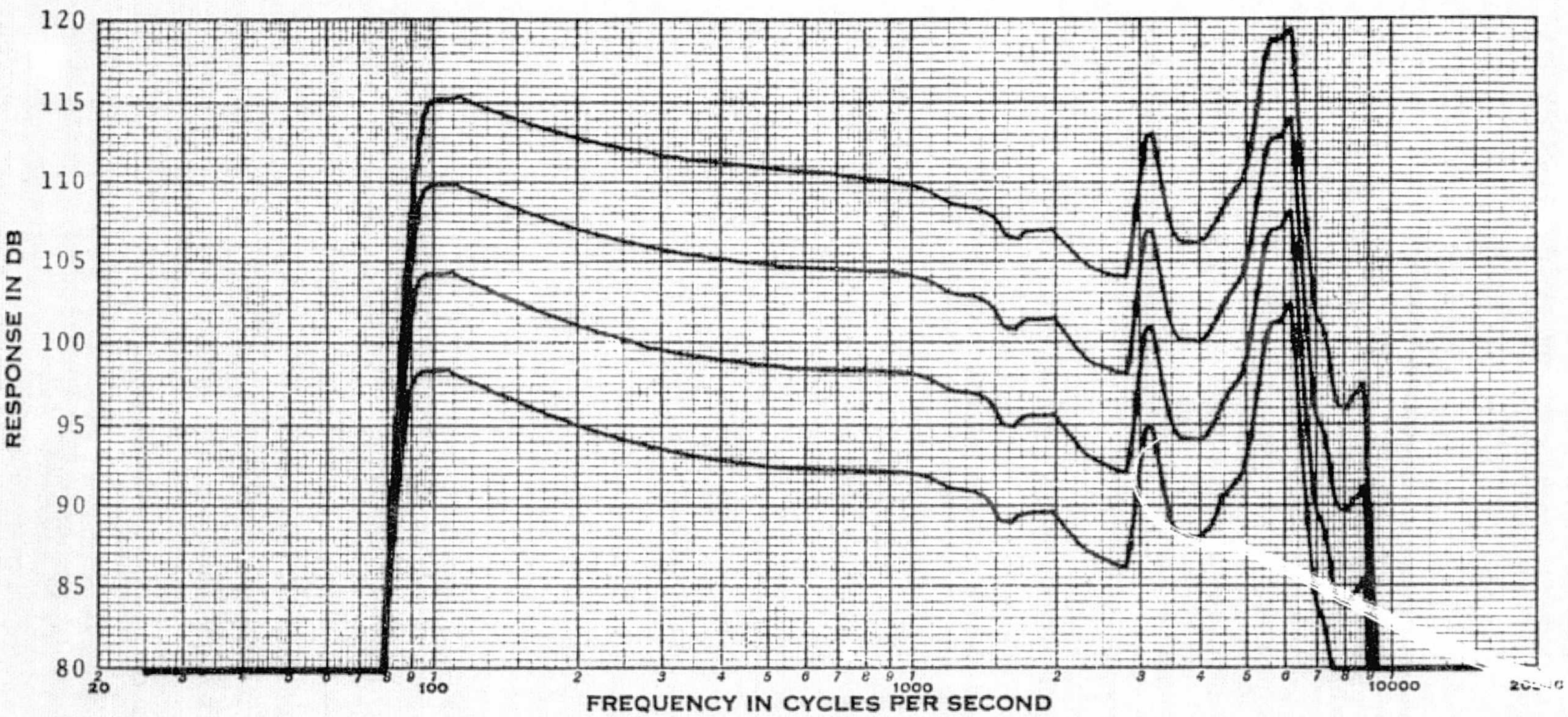


Figure C-14.– Carter H-143 frequency response SN-83.

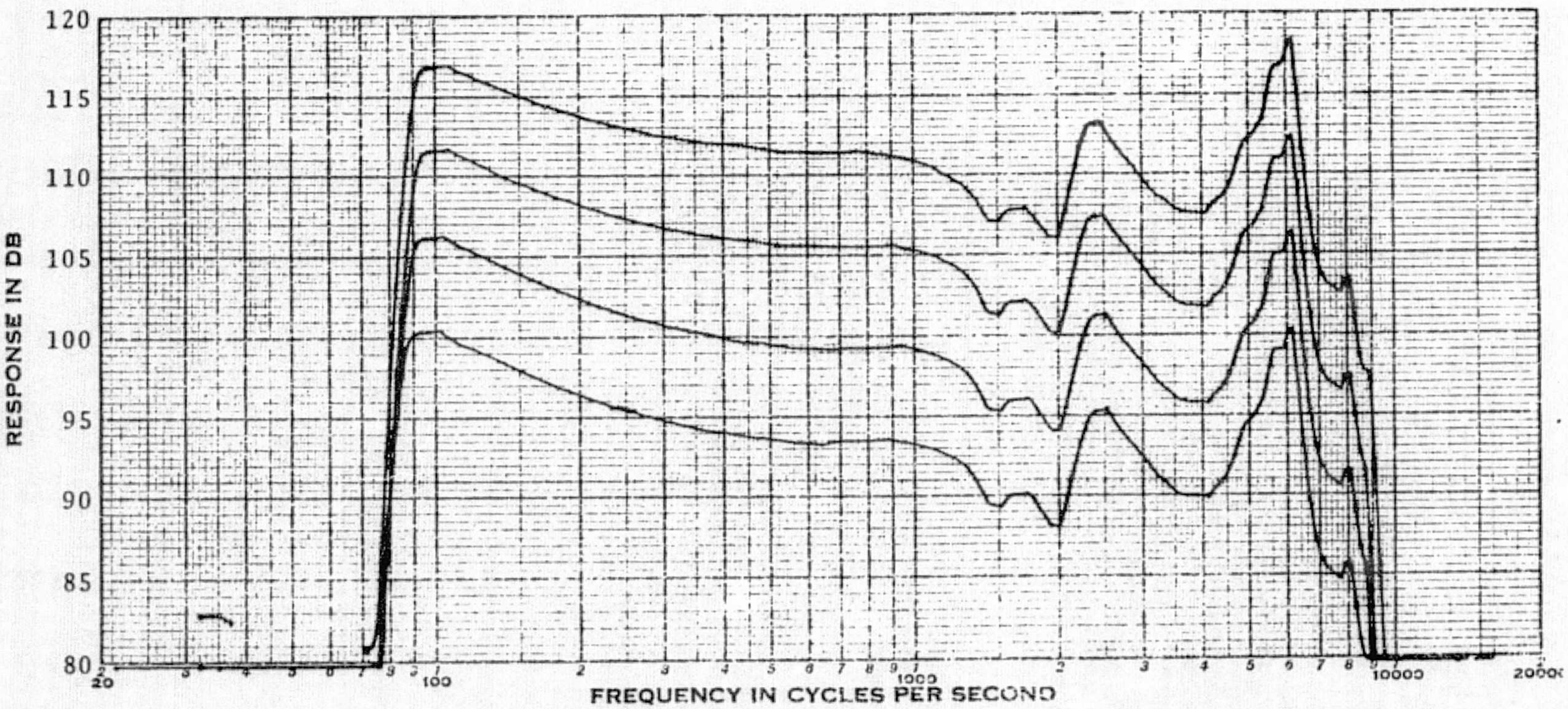


Figure C-15.– Carter H-143 frequency response SN-82.

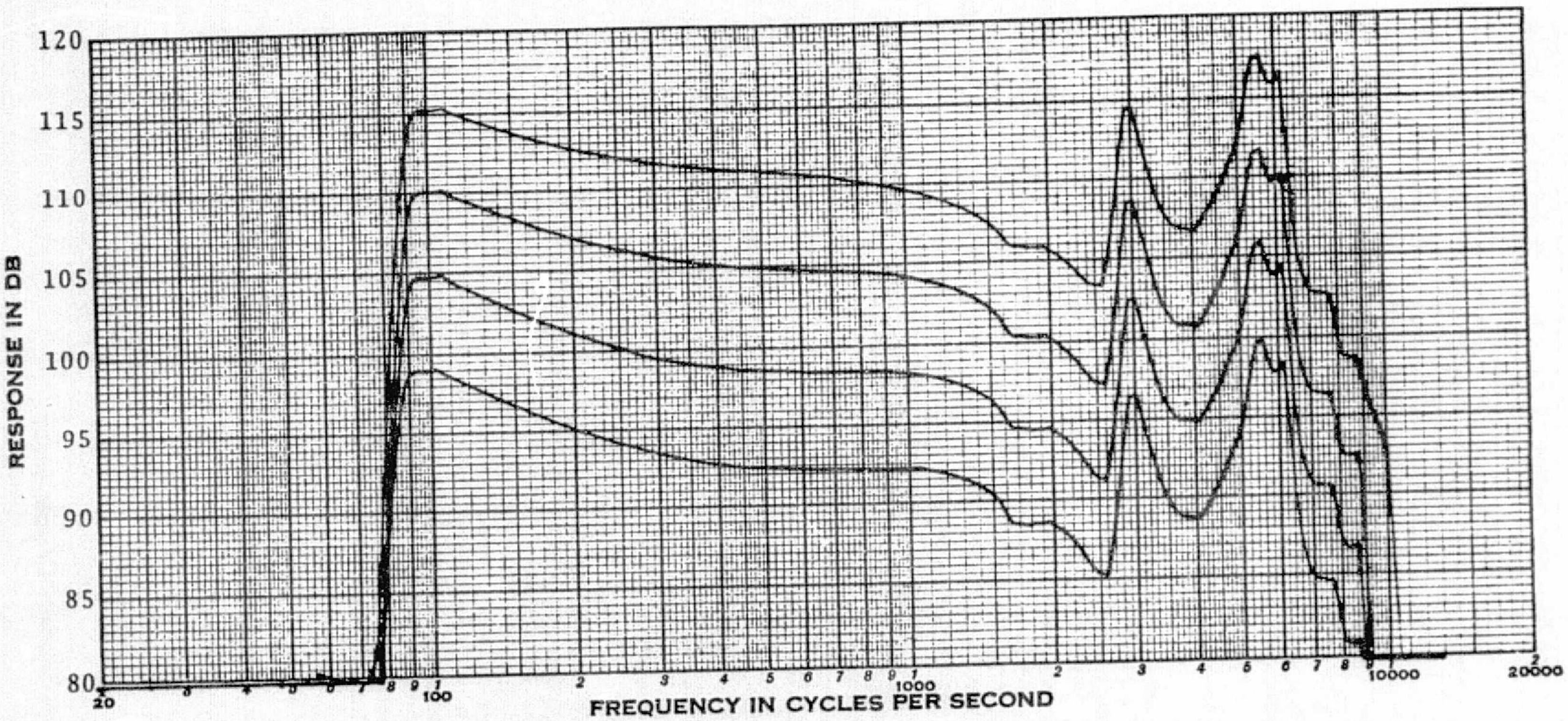


Figure C-16.— Astrocom H-143 frequency response SN-61.

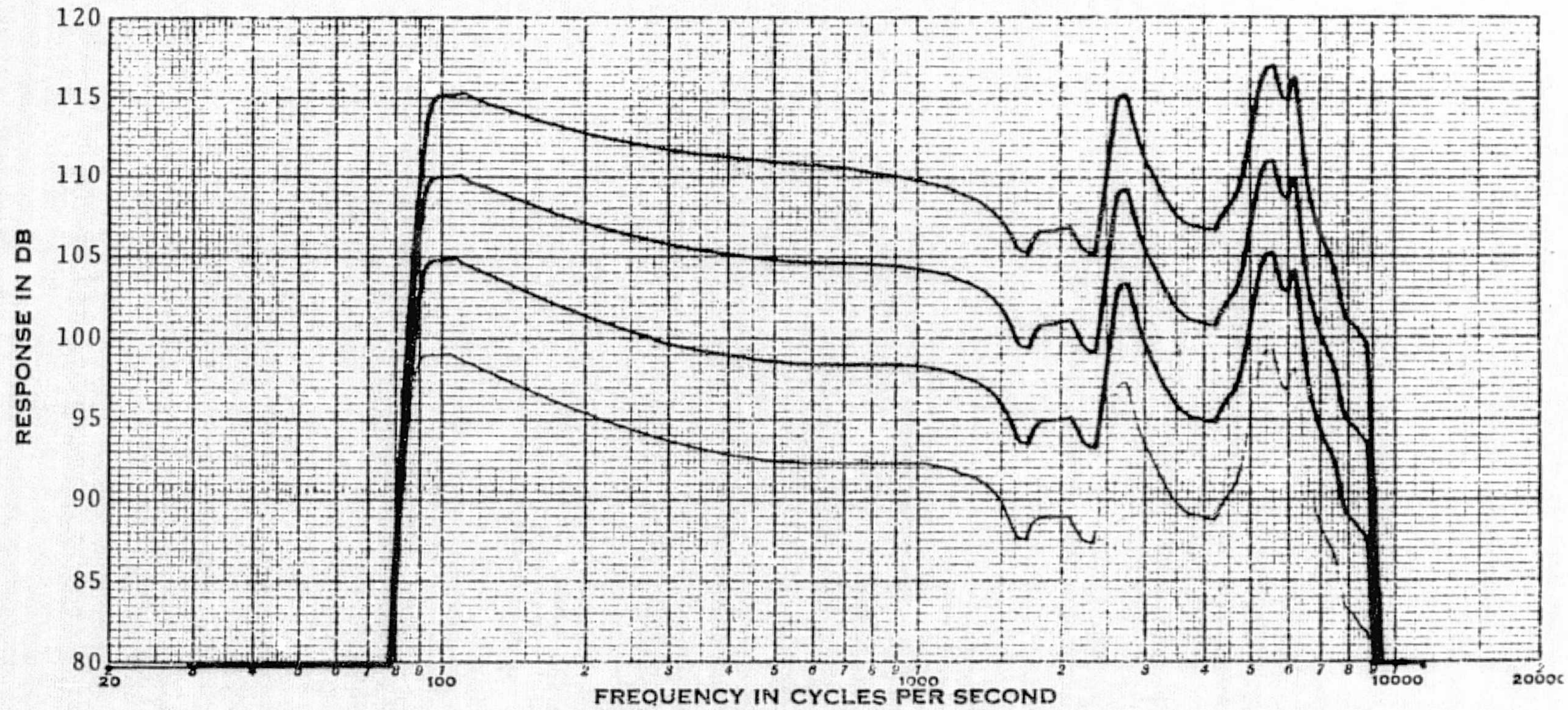


Figure C-17.– Astrocom H-143 frequency response SN-62.

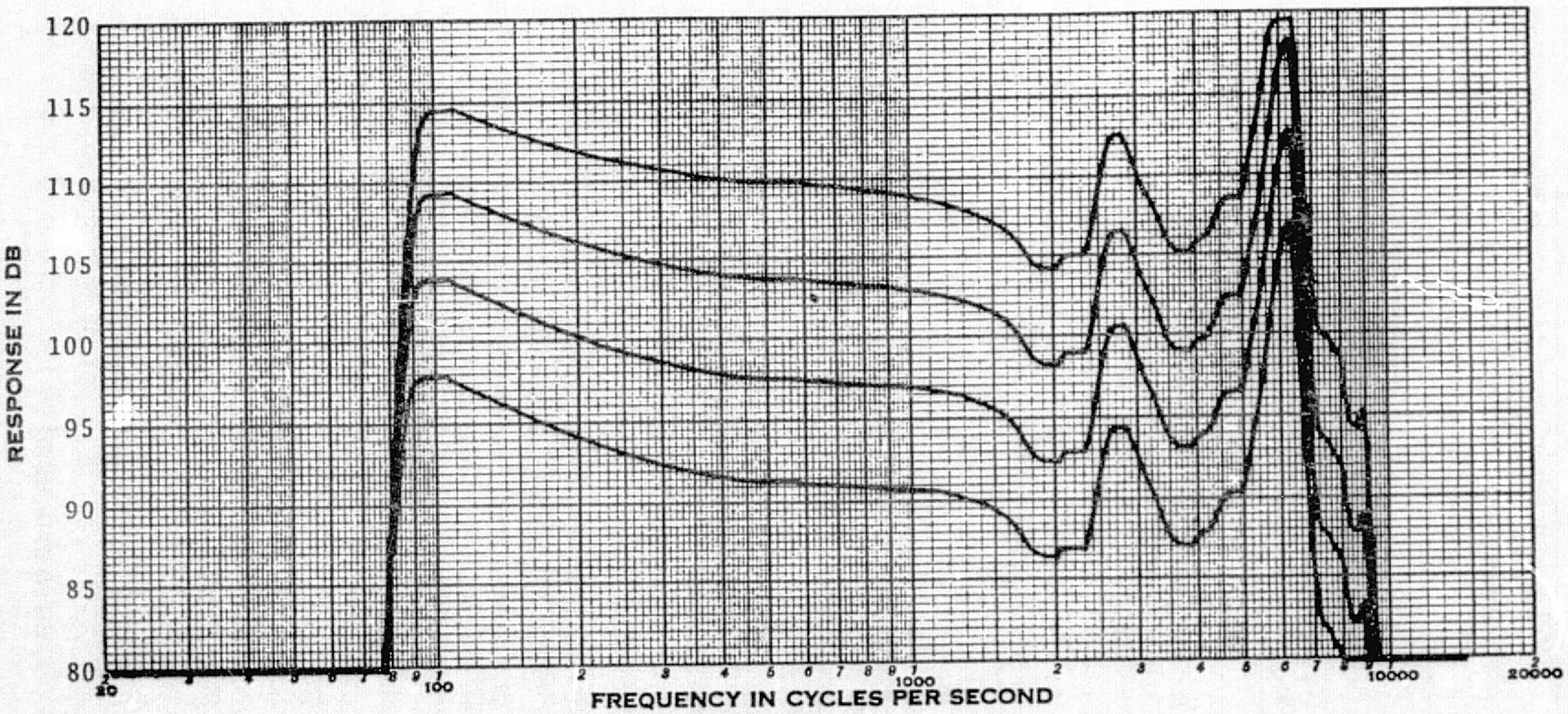


Figure C-18.– Astrocom H-143 frequency response SN-63.

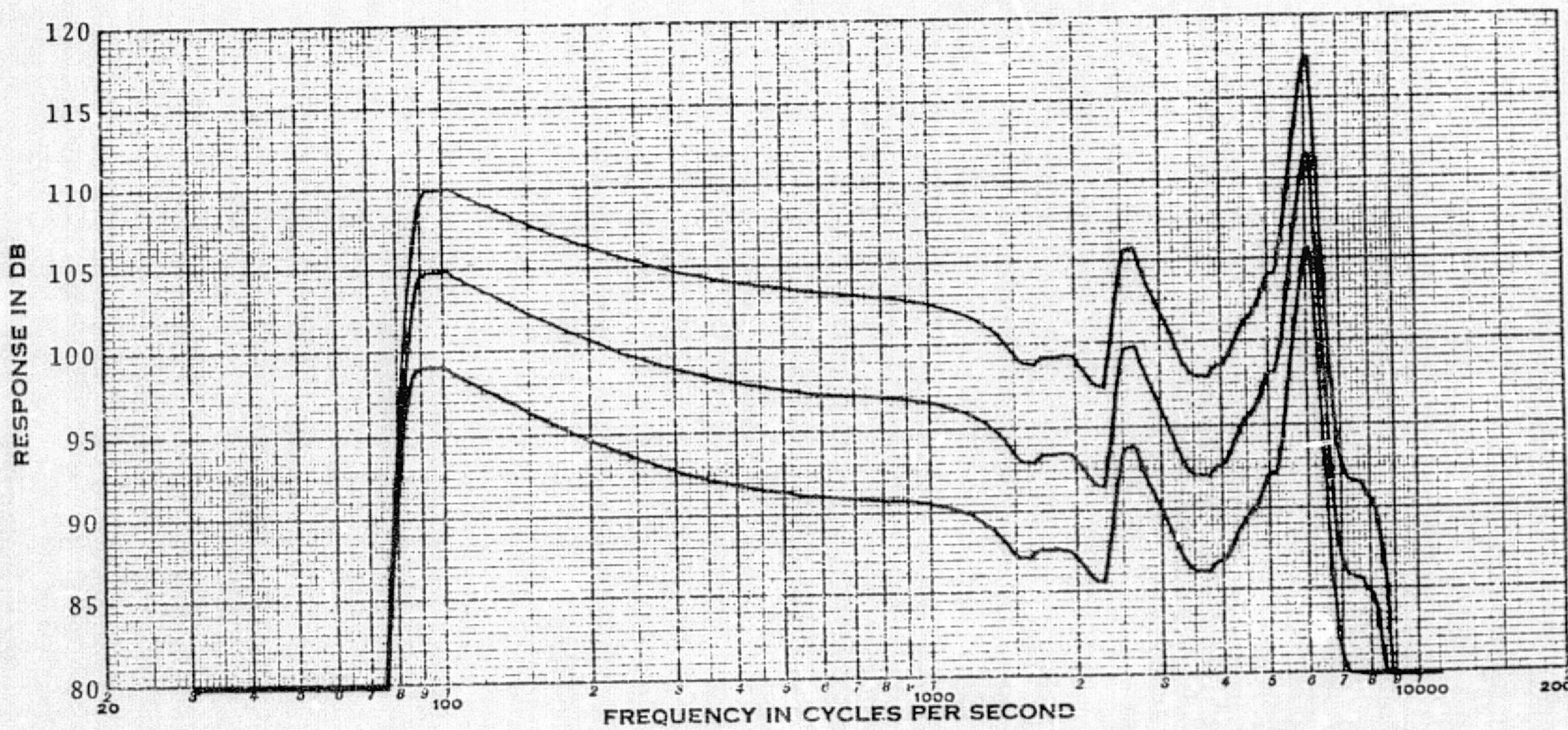


Figure C-19.– Astrocom H-143 frequency response SN-64.

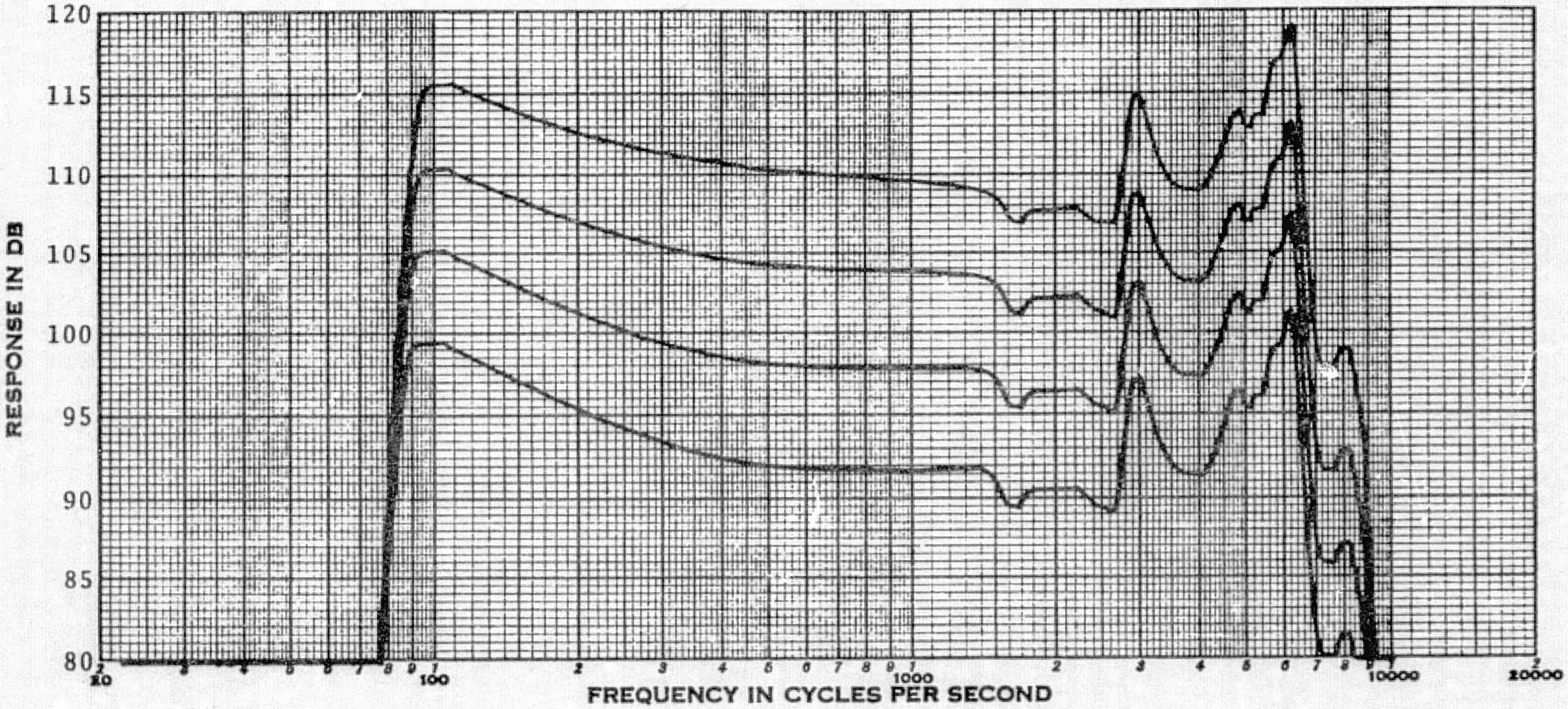


Figure C-20.— Astrocom H-143 frequency response SN-65.

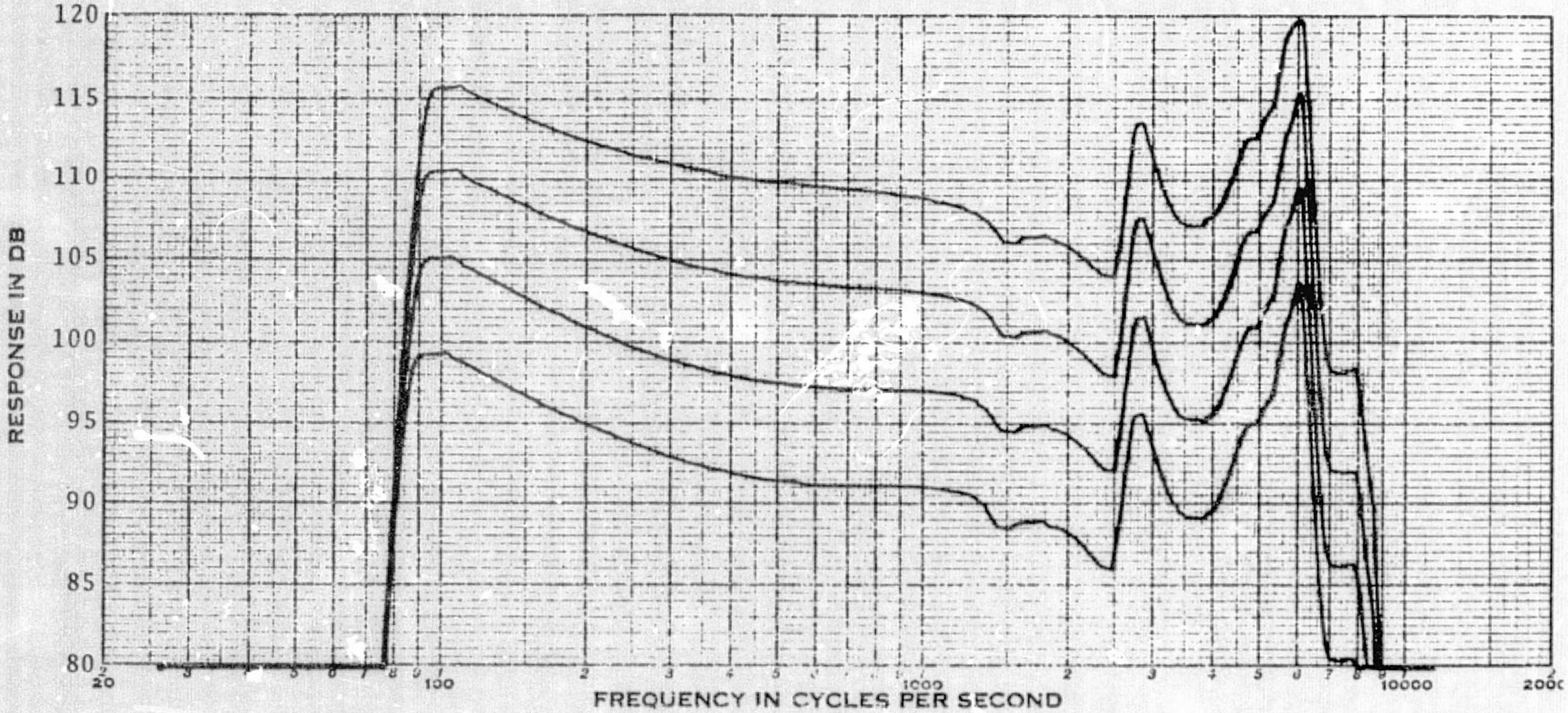


Figure C-21.— Astrocom H-143 frequency response SN-66.

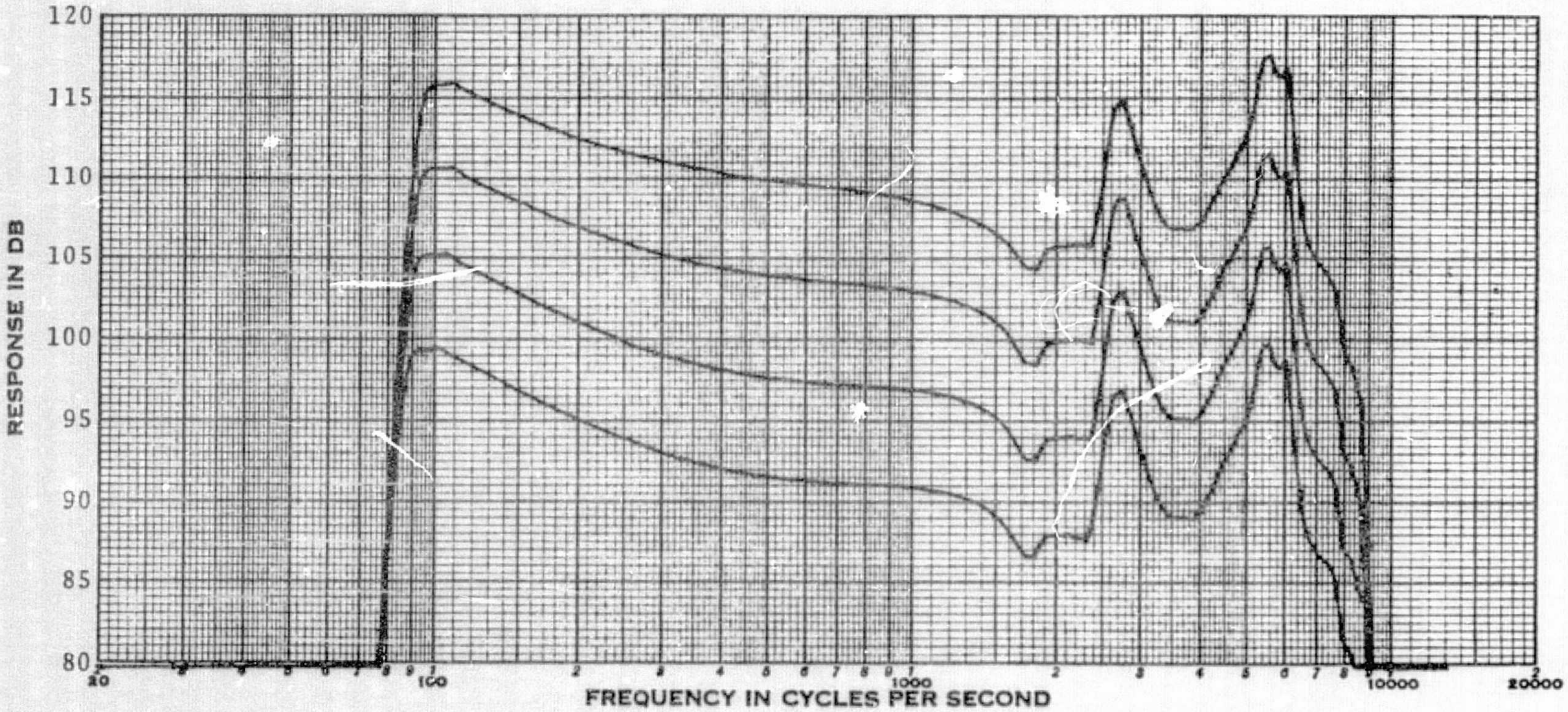


Figure C-22.– Astrocom H-143 frequency response SN-67.

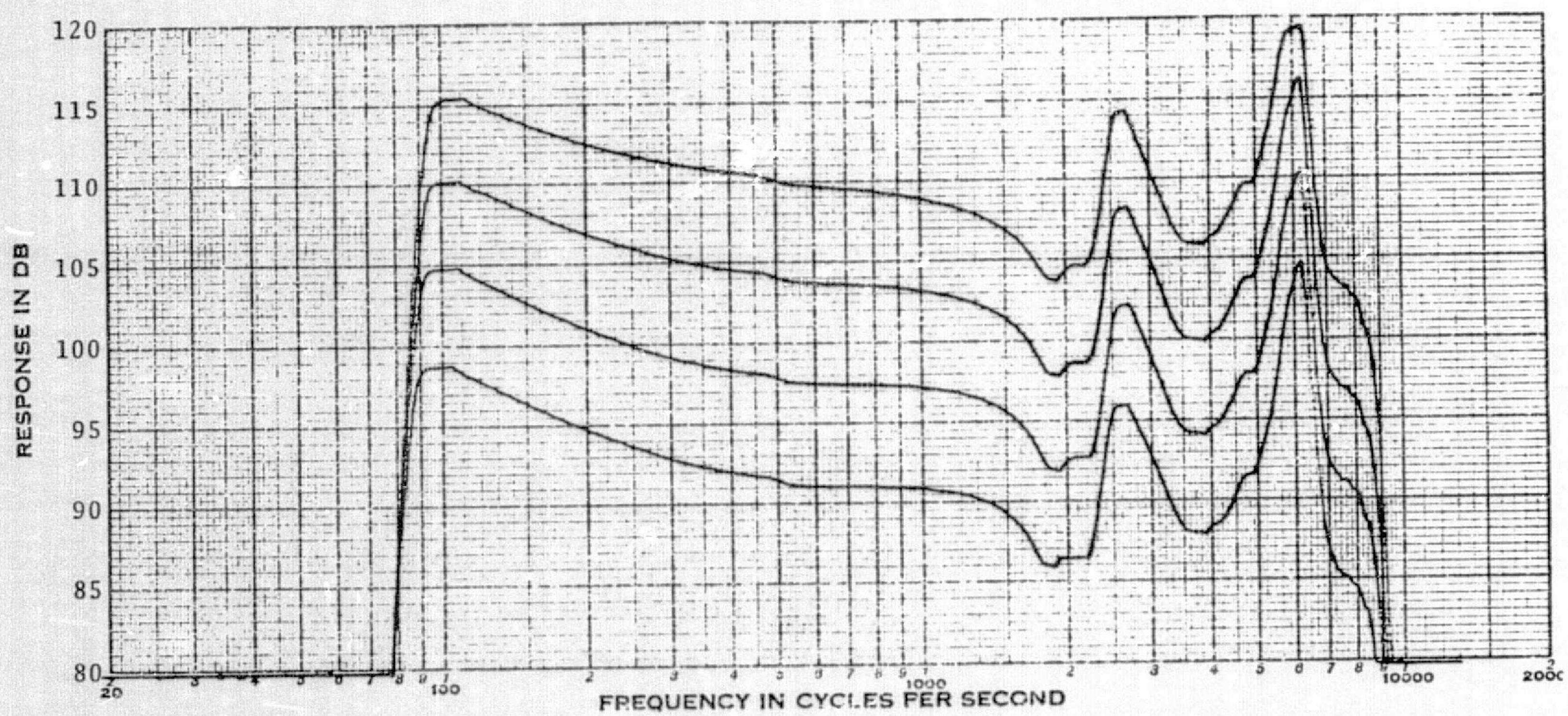


Figure C-23.– Astrocom H-143 frequency response SN-68.

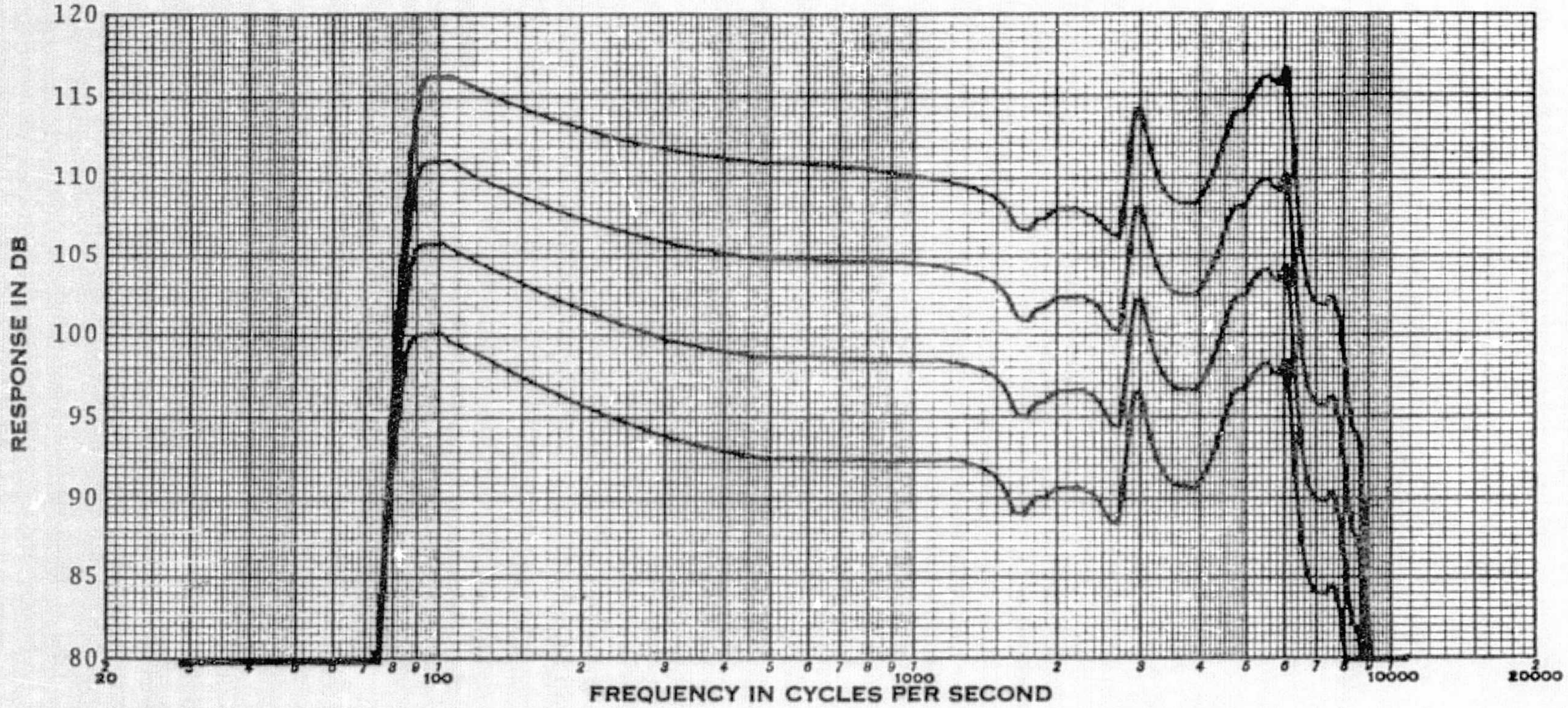


Figure C-24.– Astrocom H-143 frequency response SN-69.

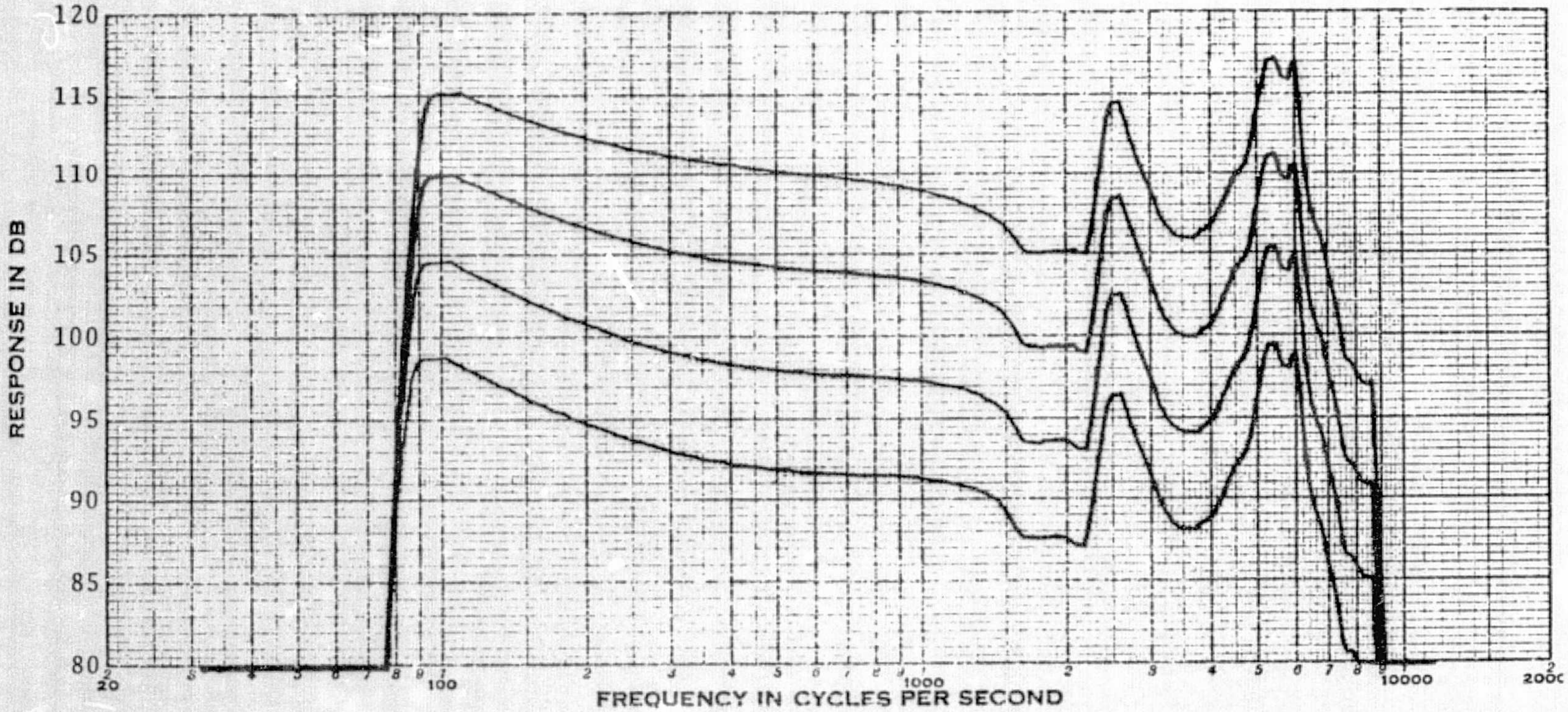


Figure C-25.– Astrocom H-143 frequency response SN-71.

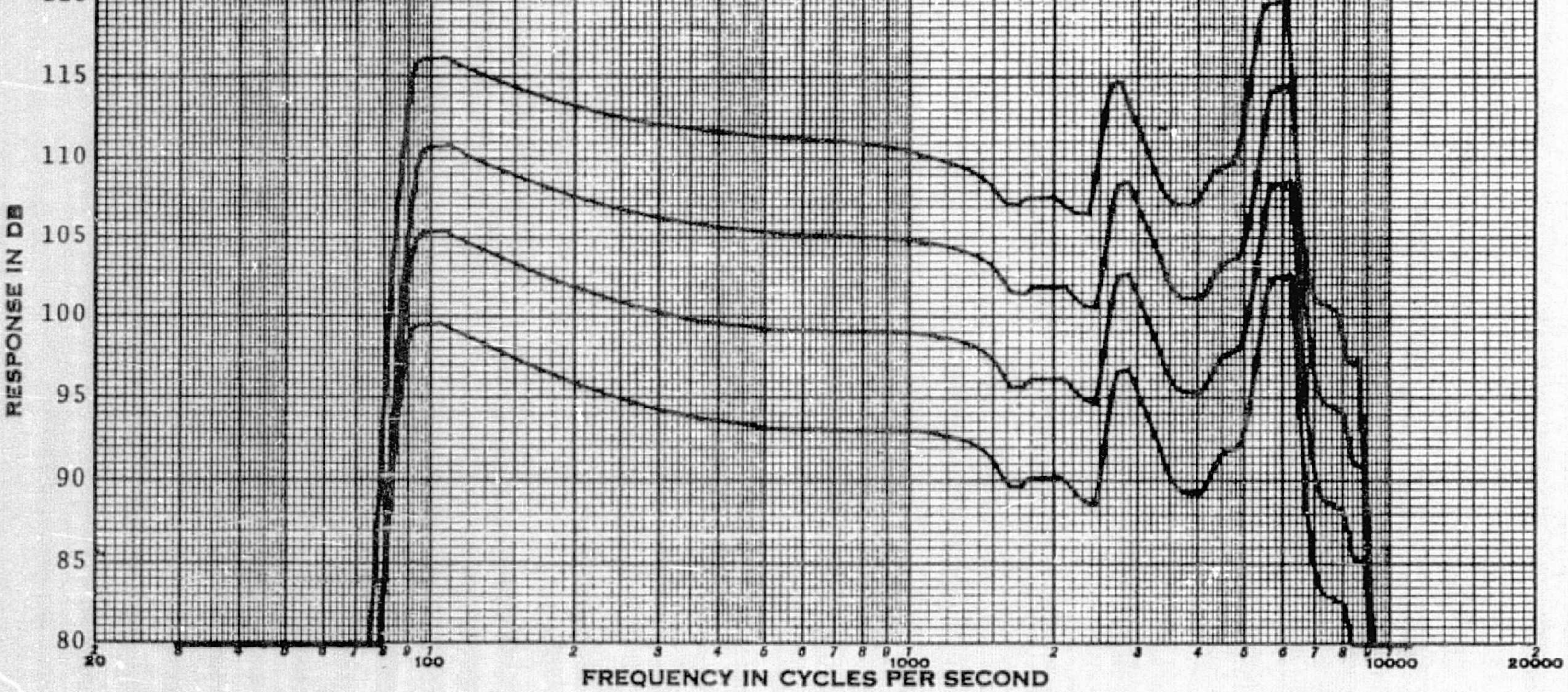


Figure C-26.– Astrocom H-143 frequency response SN-72.

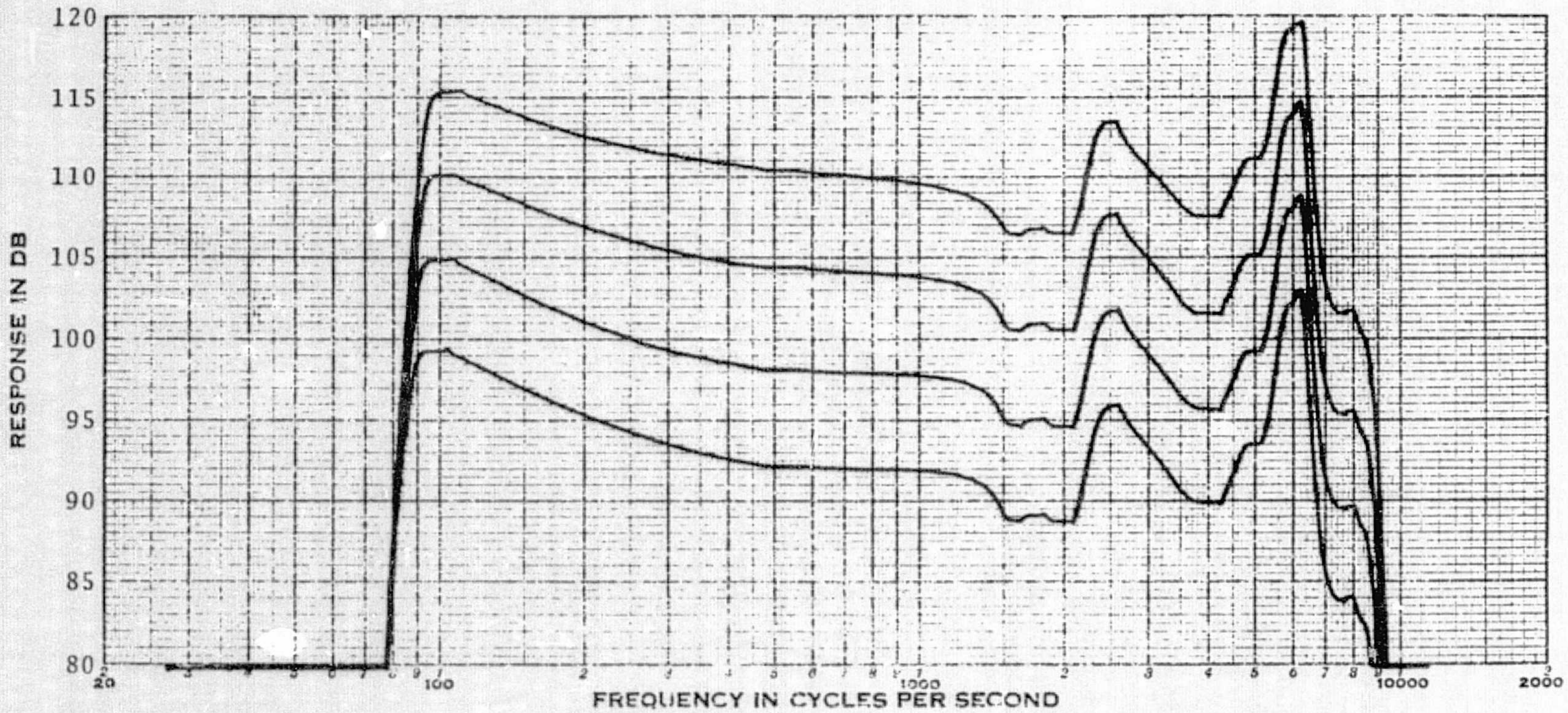


Figure C-27.— Astrocom H-143 frequency response SN-73.

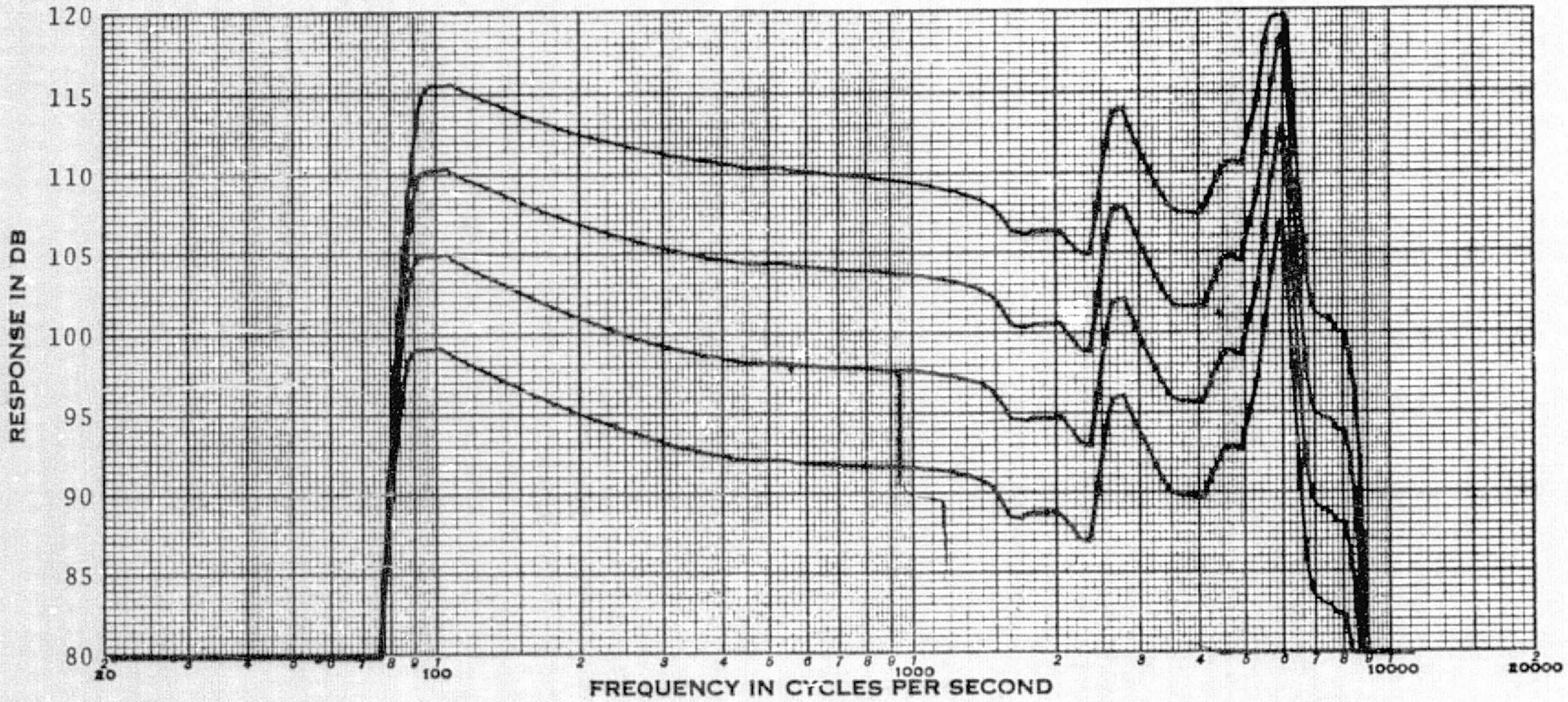


Figure C-28.– Astrocom H-143 frequency response SN-77.

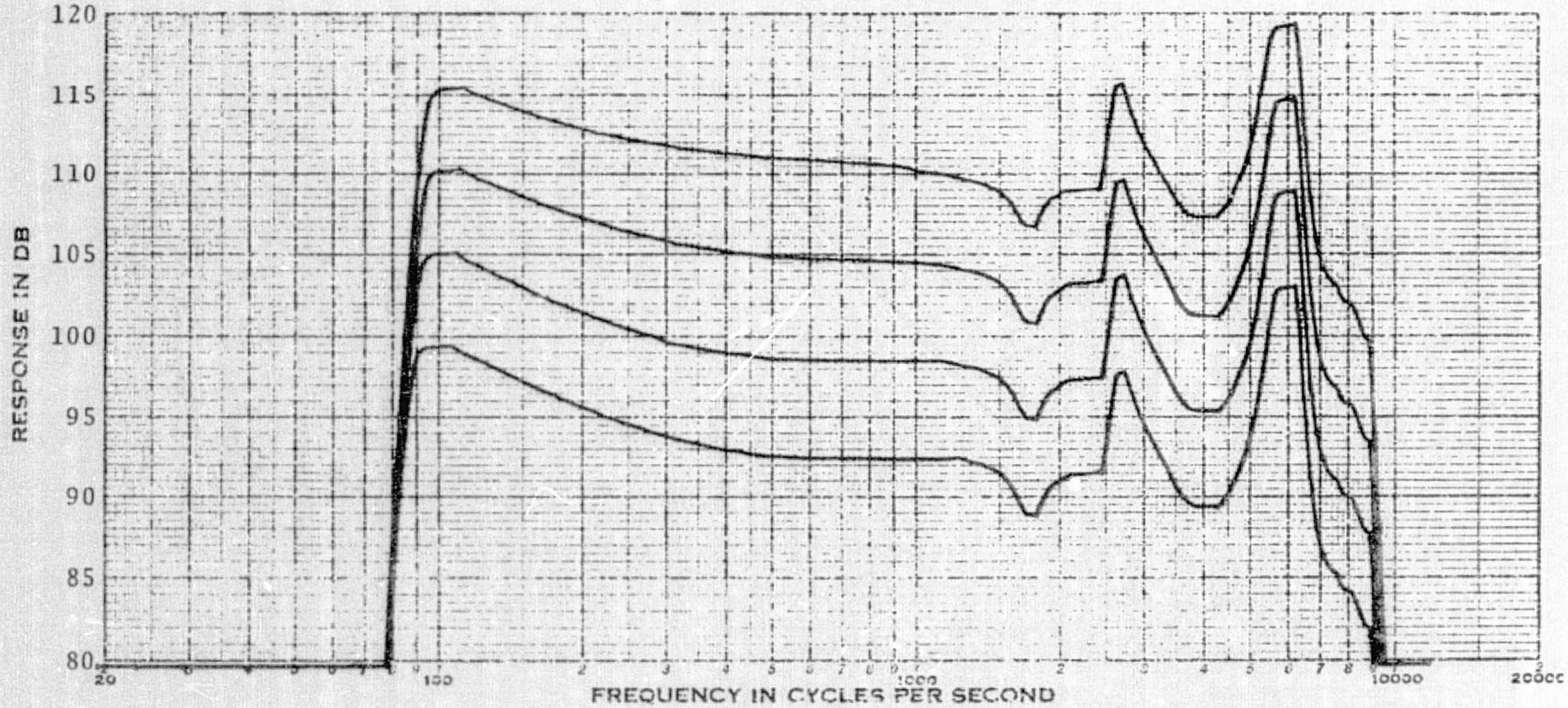


Figure C-29.– Astrocom H-143 frequency response SN-78.

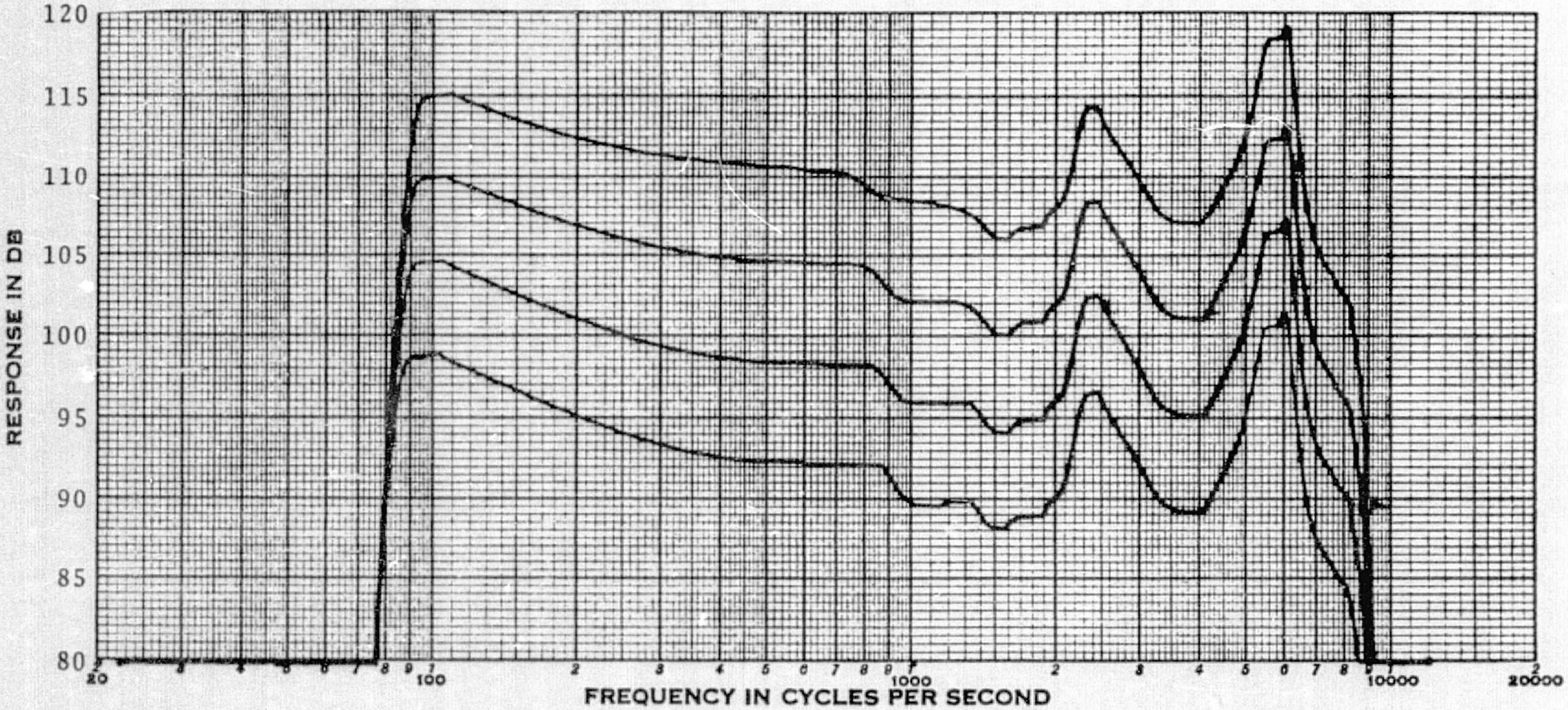


Figure C-30.– Astrocom H-143 frequency response SN-80.

APPENDIX D

M-87 FAR FIELD FREQUENCY RESPONSE

TEST DATA

Appendix D

The far field graphs in this section were prepared according to MIL-M-25642A; that is, with the far field frequency response graph offset from the near field graph by the number of decibels difference between the near field and far field sensitivity at 1000 Hz.

TABLES

FIGURES

C.4

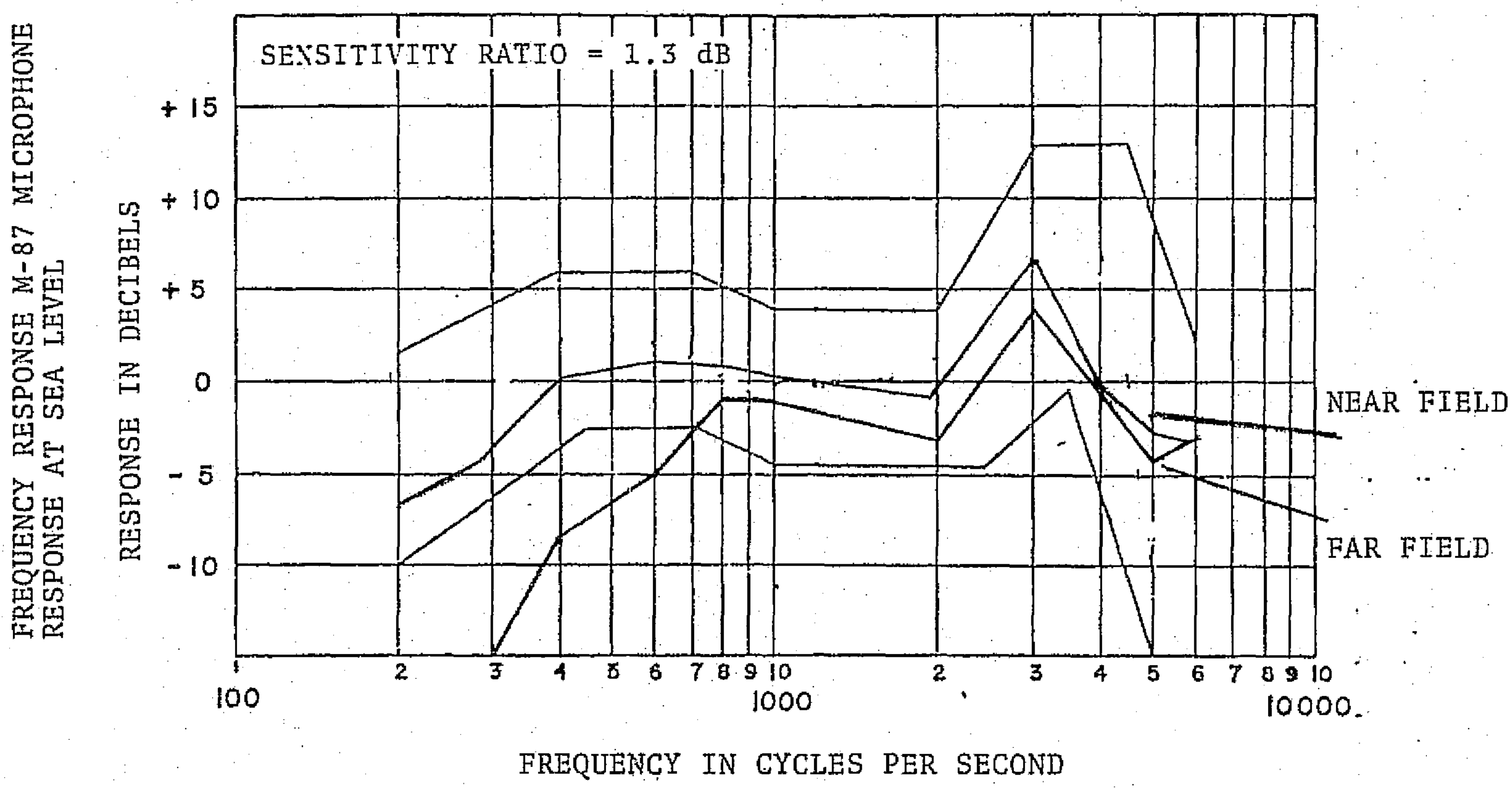
RESPONSE FREQUENCY CHARACTERISTIC TO A CLOSE SOUND SOURCE

TABLE D-1.— CARTER AND ASTROCOM FAR FIELD TEST DATA

INPUT: Far Field 110 dB SPL 6 ft

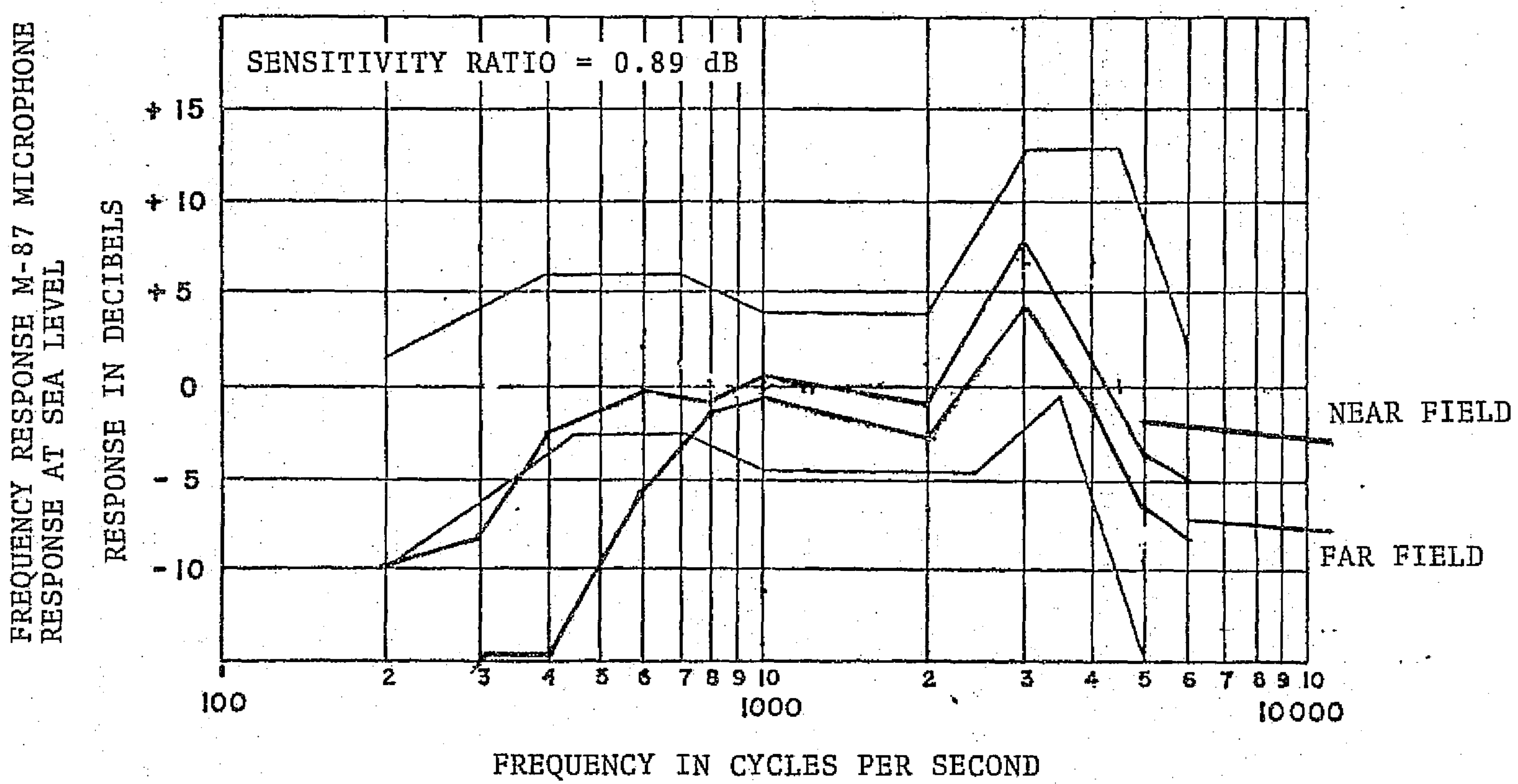
FREQUENCY	OUTPUT LEVEL											
200	TE	TE	TE	TE	TE	---	---	---	---	---		
300	N/R	N/R	N/R	N/R	N/R	---	---	---	---	---		
400	37	N/R	37	33	30	---	33	34	---	---		
600	54	50	51	43	43	37	40	41	41	40		
800	84	78	60	72	73	62	64	79	70	65		
1000	84	88	113	85	78	60	80	47	84	68		
2000	64	68	110	72	57	48	55	70	30	65		
3000	165	162	197	132	162	120	212	185	145	155		
4000	96	83	78	90	87	83	70	64	84	80		
5000	55	44	52	57	63	57	60	56	52	62		
6000	60	36	44	60	60	52	53	57	42	60		
MICROPHONE SERIAL NUMBER	41	44	50	47	48	57	53	54	51	52		

MANUFACTURER: Carter CE-87/AIC



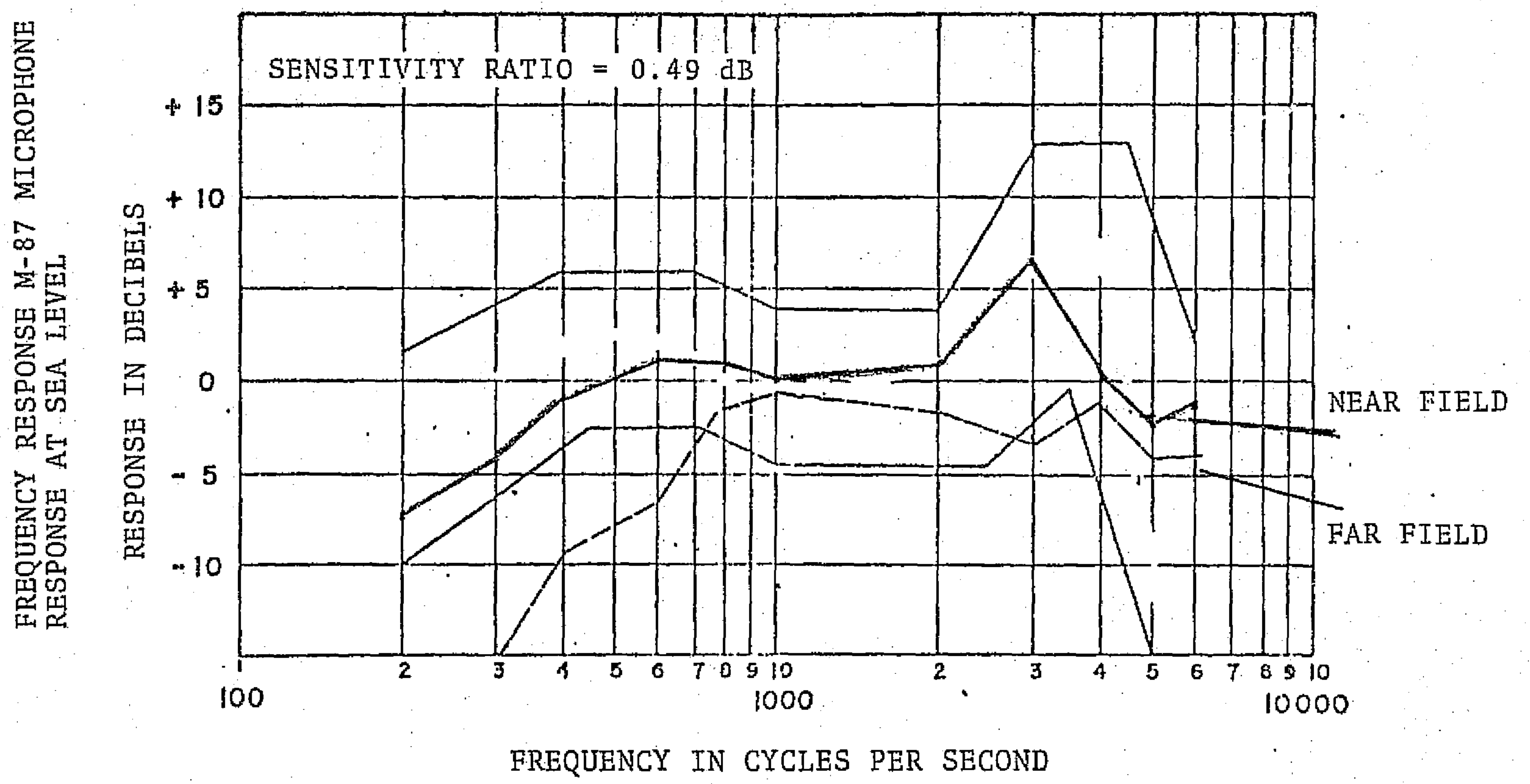
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure D-1.— Carter far field frequency response SN-41.



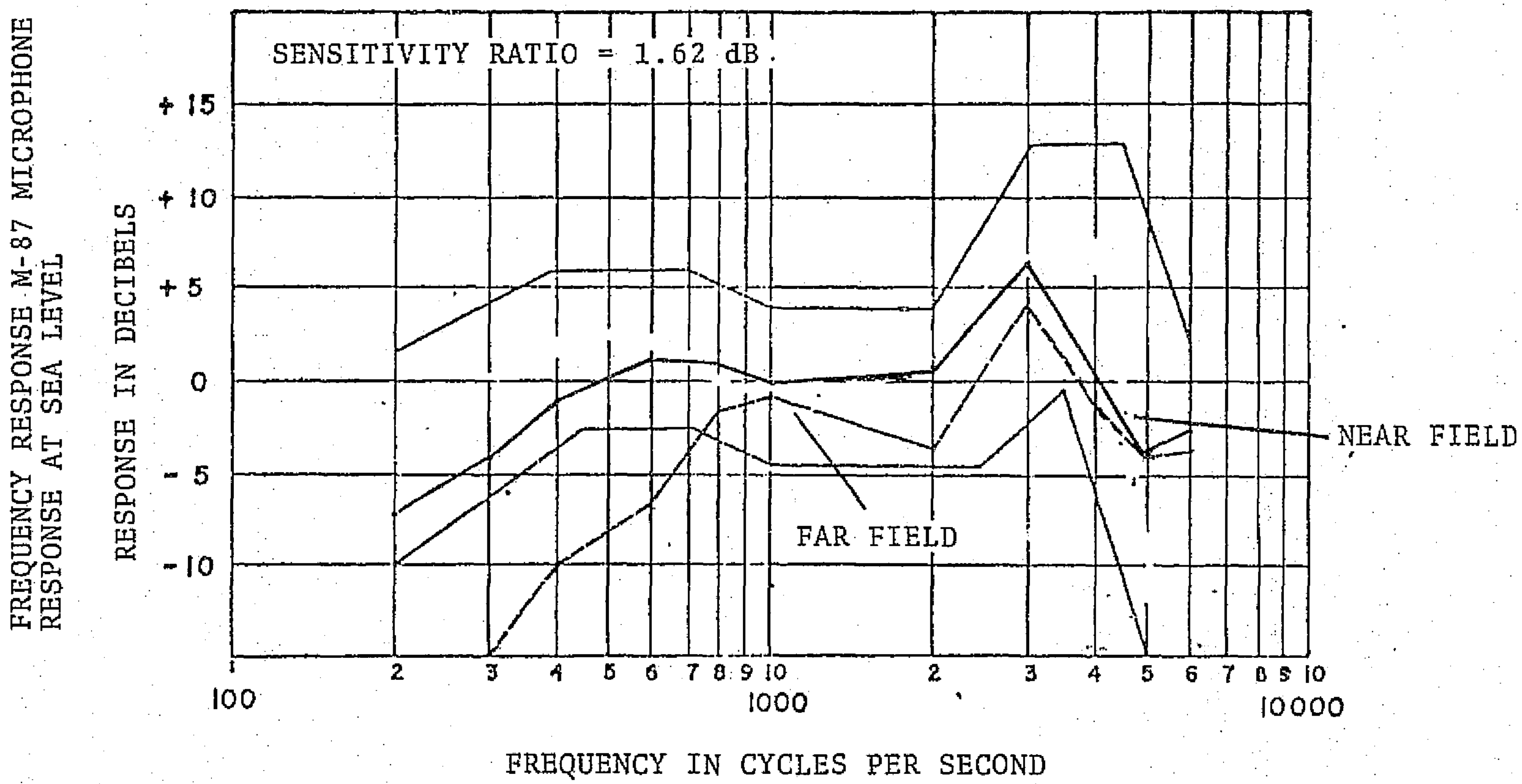
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure D-2.— Carter far field frequency response SN-44.



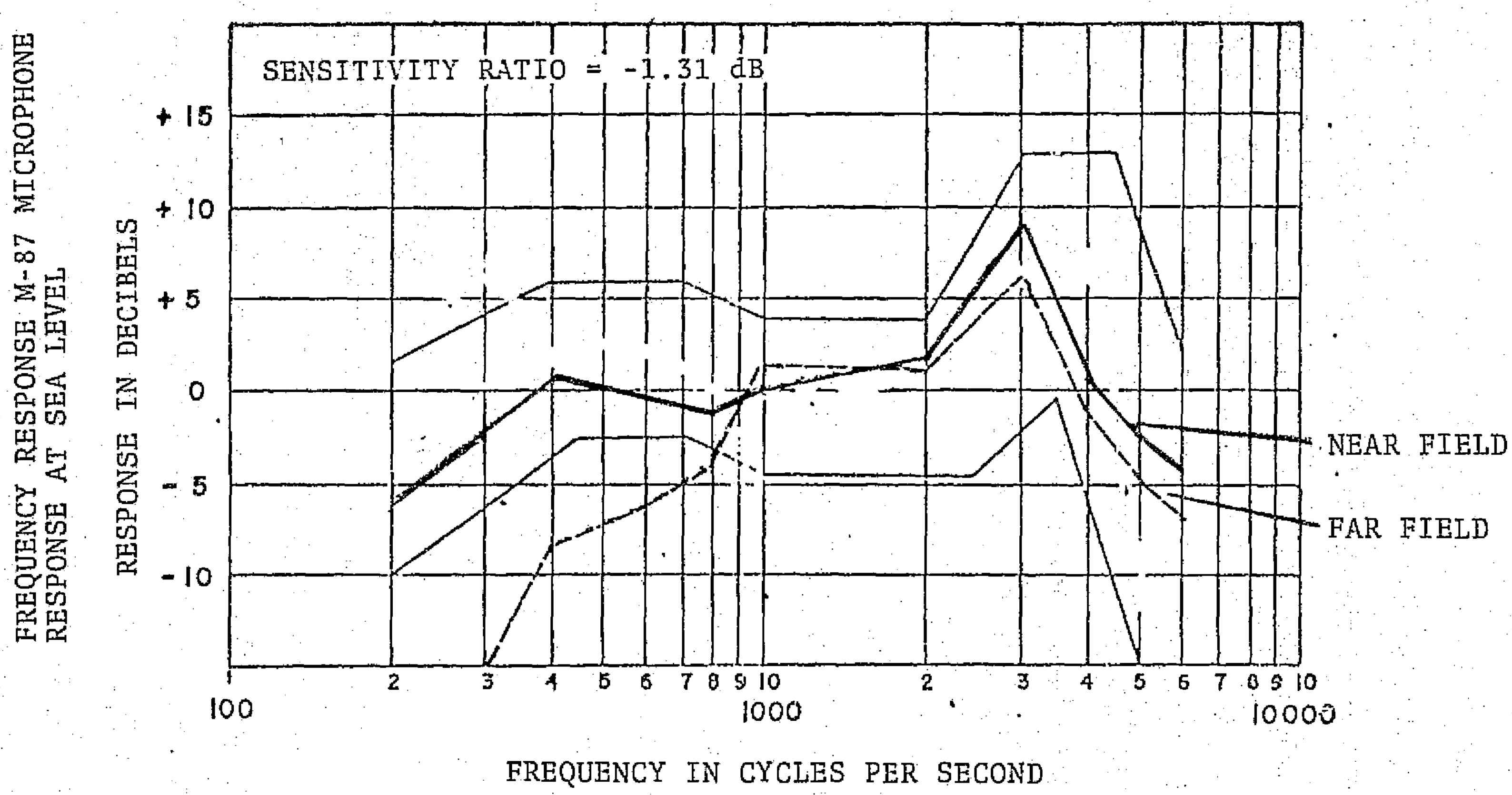
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure D-3.— Carter far field frequency response SN-47.



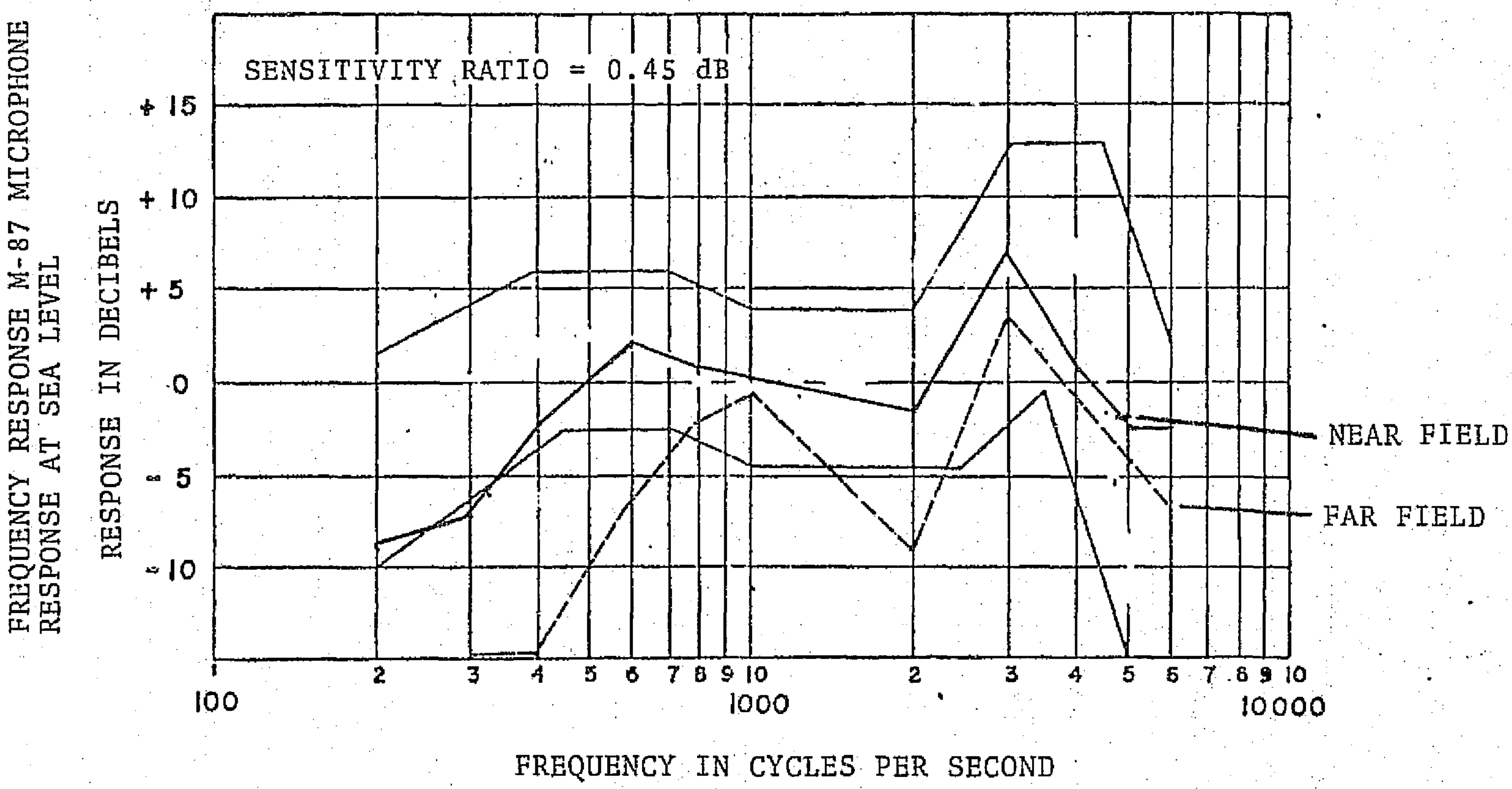
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure D-4.– Carter far field frequency response SN-48.



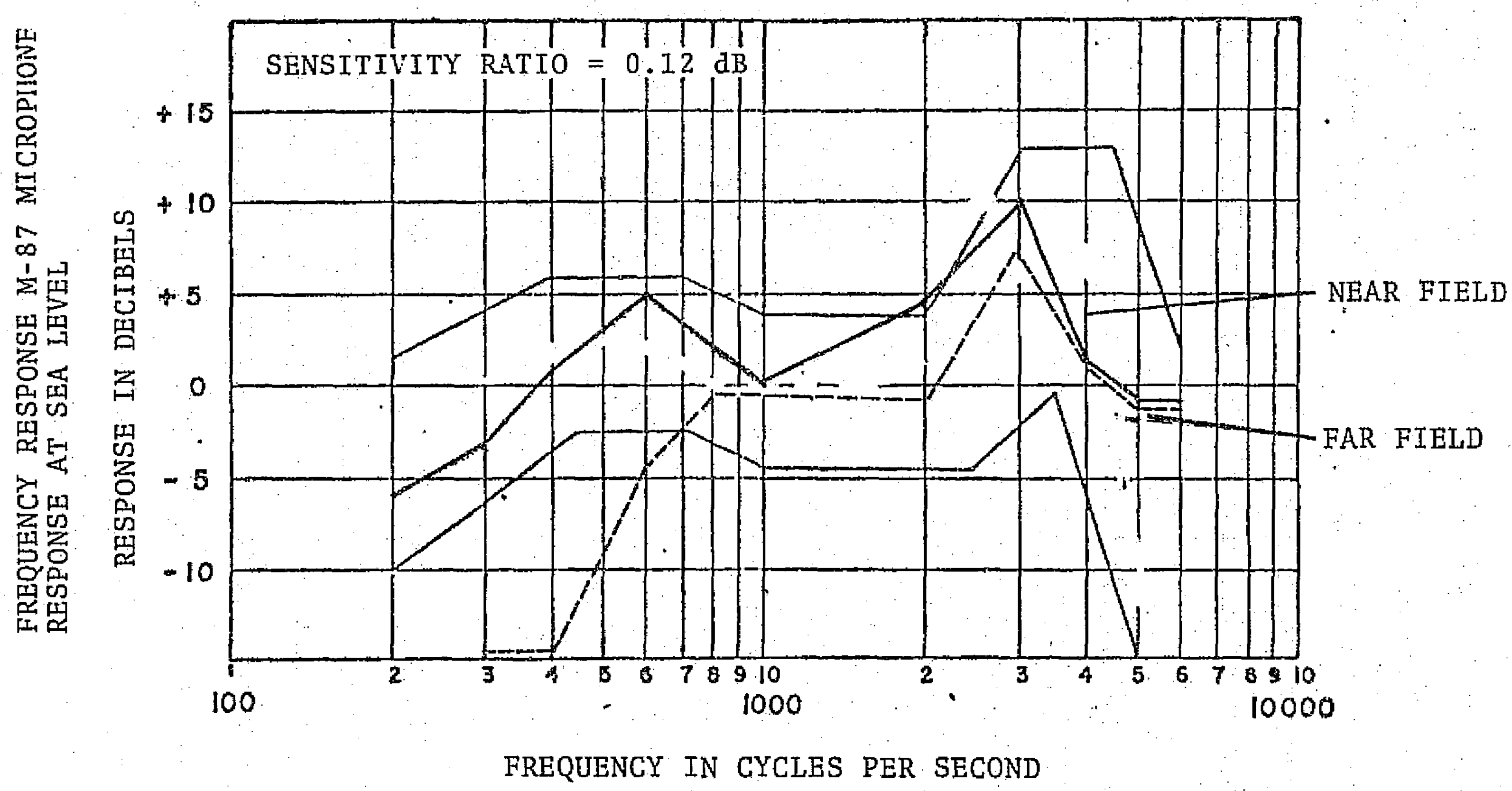
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure D-5.— Carter far field frequency response SN-50.



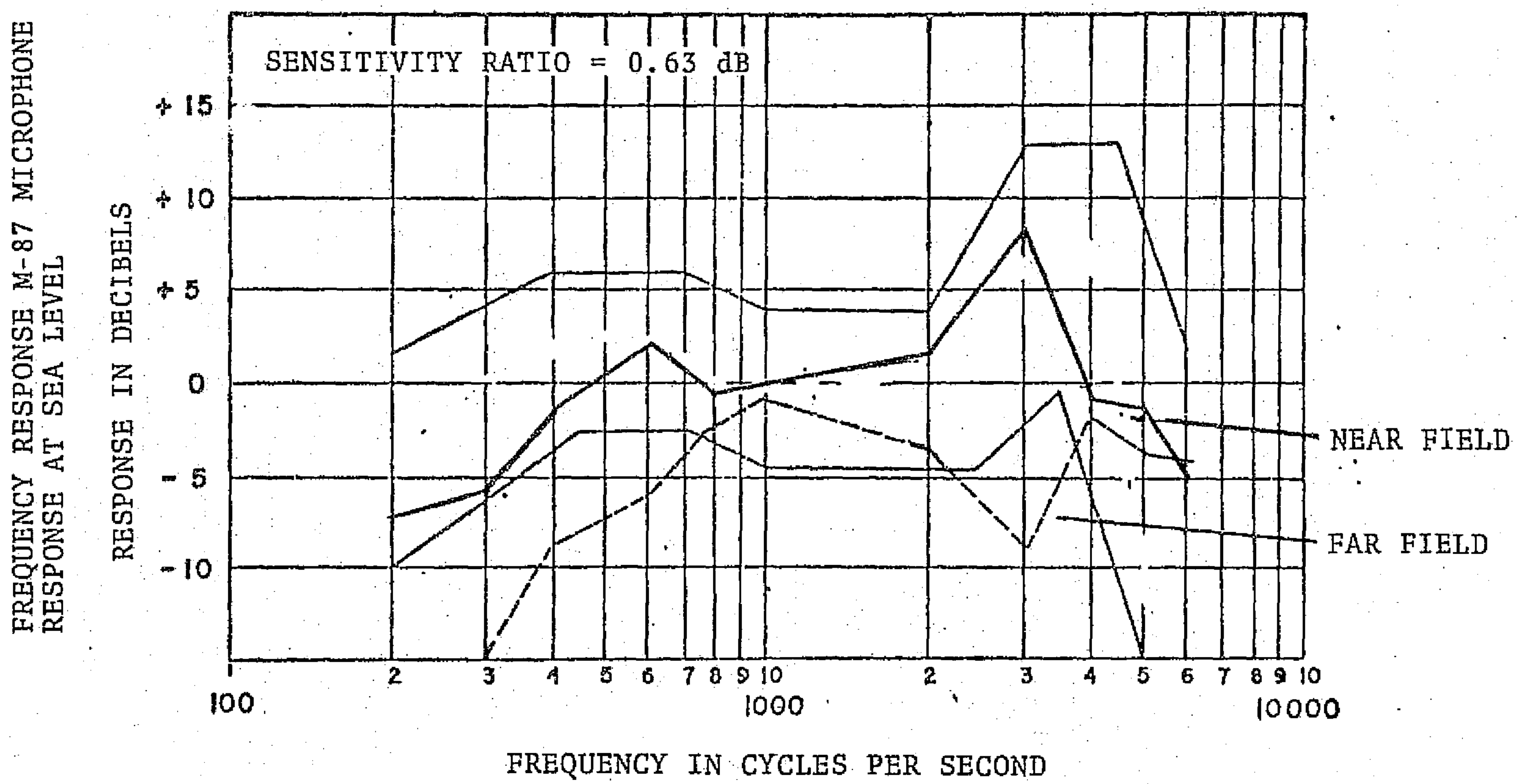
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure D-6.— Electrovoice far field frequency response SN-51.



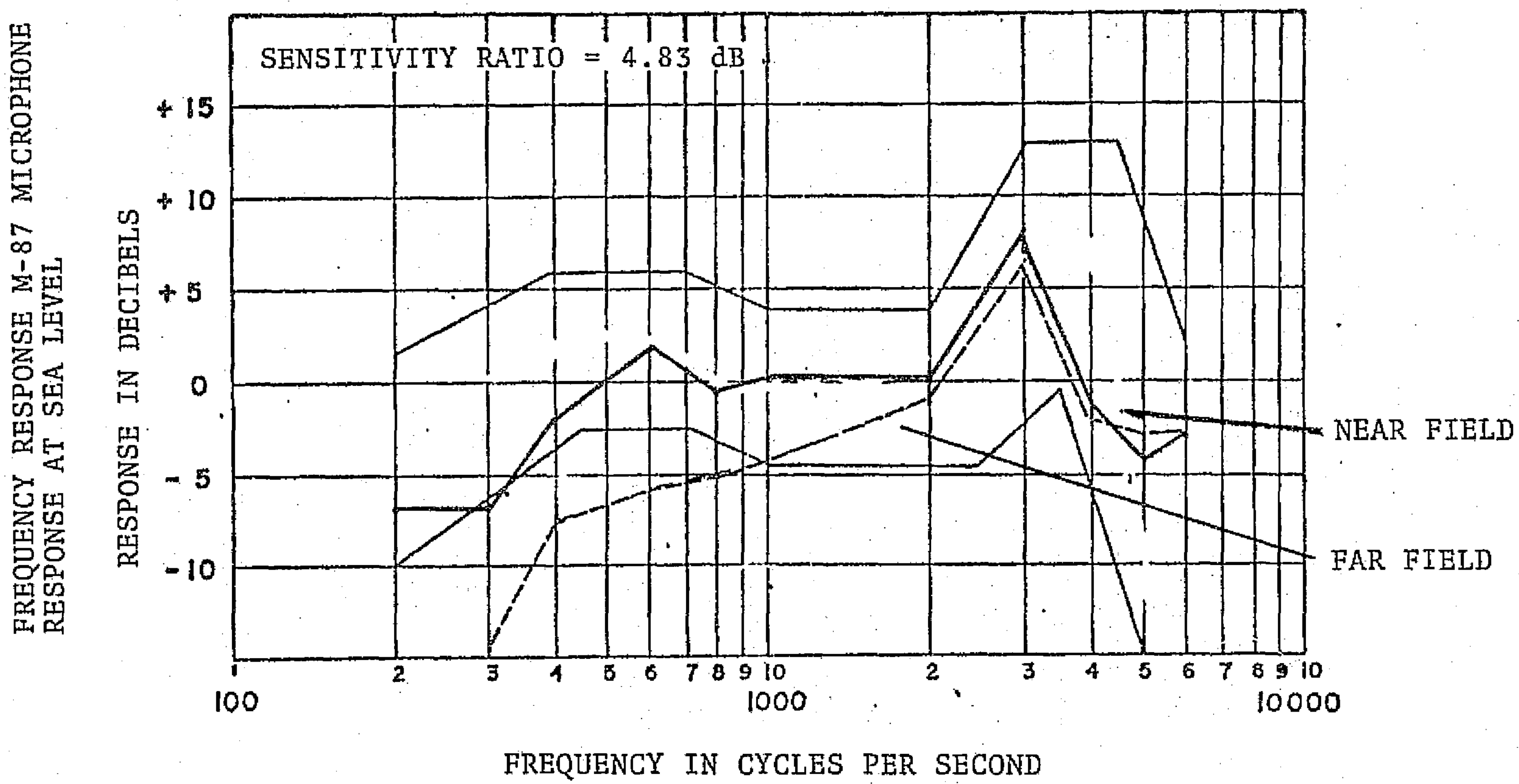
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure D-7.— Electrovoice far field frequency response SN-52.



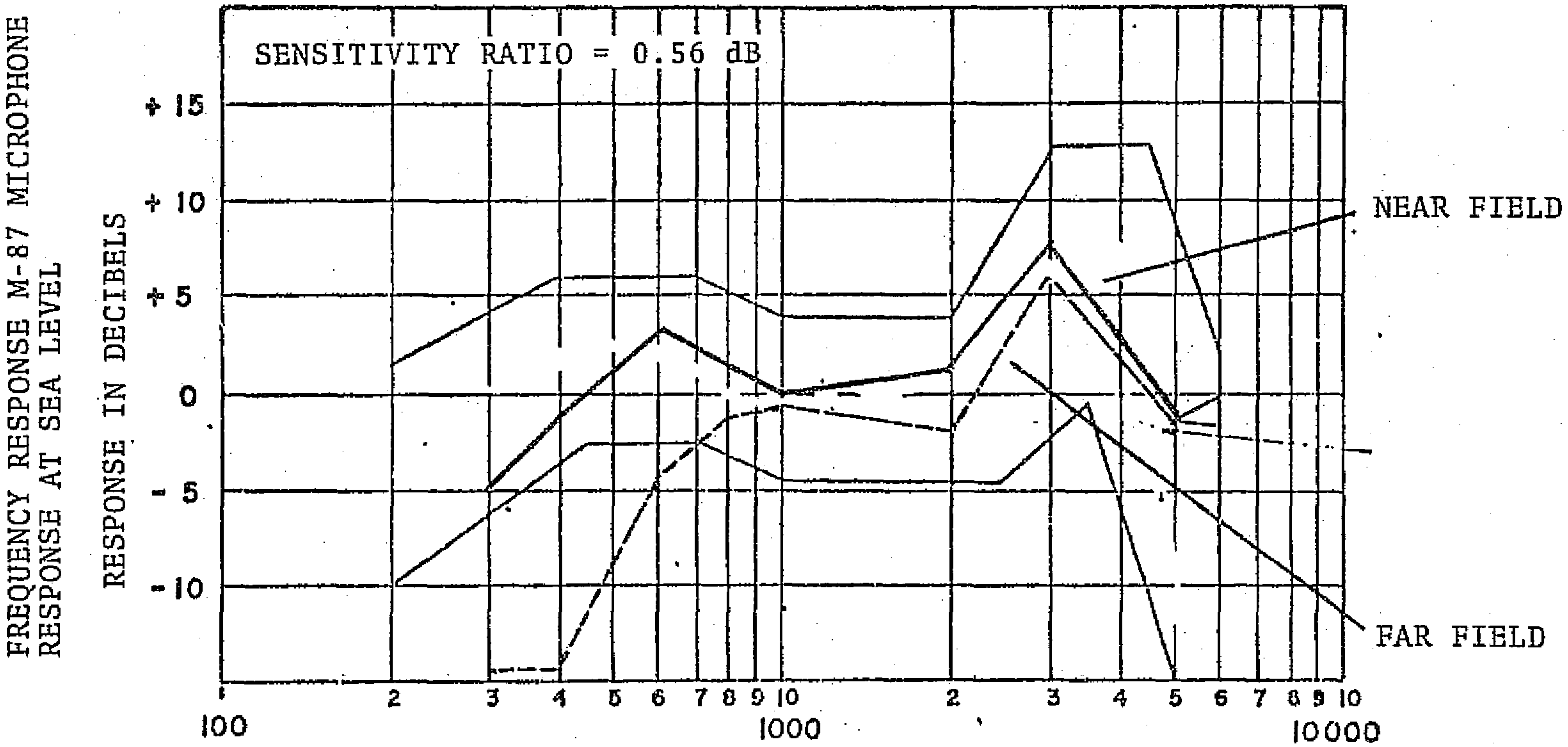
Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure D-8.— Electrovoice far field frequency response SN-53.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure D-9.— Electrovoice far field frequency response SN-54.



Dip is allowed, within the 1100 to 1700 CPS Range
To extend below the limits of the envelope.
The portion of the dip which occurs outside of
The envelope may be no greater than 150 CPS wide.

Figure D-10.— Electrovoice far field frequency response SN-57.