

FINAL REPORT
HEADSET ASSEMBLIES
CONTRACT NAS 9-5155

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas

By
Engineering Department
Electro-Voice, Incorporated
Buchanan, Michigan

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Robert C. Ramsey
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TABLE OF CONTENTS

	Page No.
1.0 INTRODUCTION	1
2.0 HEADSET DESIGN	4
2.1 Microphone	4
2.2 Earphone Assemblies	15
2.3 Headband and Earcup Support Hardware	22
2.4 Connector and Wiring Harness	22
3.0 CONCLUSIONS AND RECOMMENDATIONS	26

LIST OF ILLUSTRATIONS

	Page
Figure 1. Photograph of Prototype Headset	2
Figure 2. Headset Assembly Drawing	5
Figures 3 through 6. Acceptance Test Results	7-12
Figure 7. Close and Distance Microphone Frequency Response Curves	13
Figure 8. Microphone Magnetic Assembly	14
Figure 9. Microphone Boom	16
Figures 10 and 11. Microphone Amplifiers	17-18
Figure 12. Earphone Transducer Assembly	20
Figure 13. Earcup Attenuation	21
Figure 14. Cable Harness	24
Figure 15. Headset Wiring	25

1.0 INTRODUCTION

This report describes the results of work performed by the contractor in fulfilling the requirements of Contract NAS 9-5155. A complete headset assembly capable of being used inside an Apollo-type space helmet was designed and two prototype headsets were delivered to NASA on 23 March 1966.

The completed headset, as shown in Figure 1, consists of two boom mounted, dynamic, noise cancelling microphones with solid state amplifiers mounted within the boom, two dynamic earphone assemblies and mounting hardware including provisions for changing the ear-cushion clamping pressure. The system is designed for optimum operation at an ambient pressure of 5 psia. A more complete description of the headset design is included in section 2.0 of this report.

The design, testing and fabrication of the two prototype headsets was performed during the six and one-half month period starting on September 3, 1965 with the Design Coordination Meeting at NASA, Houston and ending on March 23, 1966 with the delivery of the headsets.

The important milestones in the performance of the required work are as follows:

Contract award	August 24, 1965
Design Coordination Meeting	September 3, 1965
Preliminary Design Completion	November 10, 1965
Final Design Review Meeting	December 2, 1965



Development Tests Completed

January 3, 1966

Delivery of Units

March 23, 1966

2.0 HEADSET DESIGN

Designing for the requirements of operation at 5 psia pressure, operation during short periods of high acoustic noise followed by relatively long periods of lower acoustic noise, minimum weight, small size and high sensitivity has resulted in a design with the following unique features:

- a. A dynamic, noise cancelling microphone transducer 0.7 inches in diameter by 0.5 inches thick capable of providing a 22 db signal to noise ratio in a simulated use test, with a frequency response at 5 psia within ± 3 db from 300 cps to 3000 cps.
- b. An adjustable damping pressure on the earcushions for use during periods of high acoustic noise.
- c. A dynamic earphone transducer 2 inches in diameter by $5/8$ inches thick with a sensitivity of 111 db SPL for one milliwatt input and a frequency response within ± 3 db from 300 cps to 3000 cps (both measurements at 5 psia ambient pressure).
- d. A weight of 329 grams (less cable and connector).

The headset as designed consists of the following components:

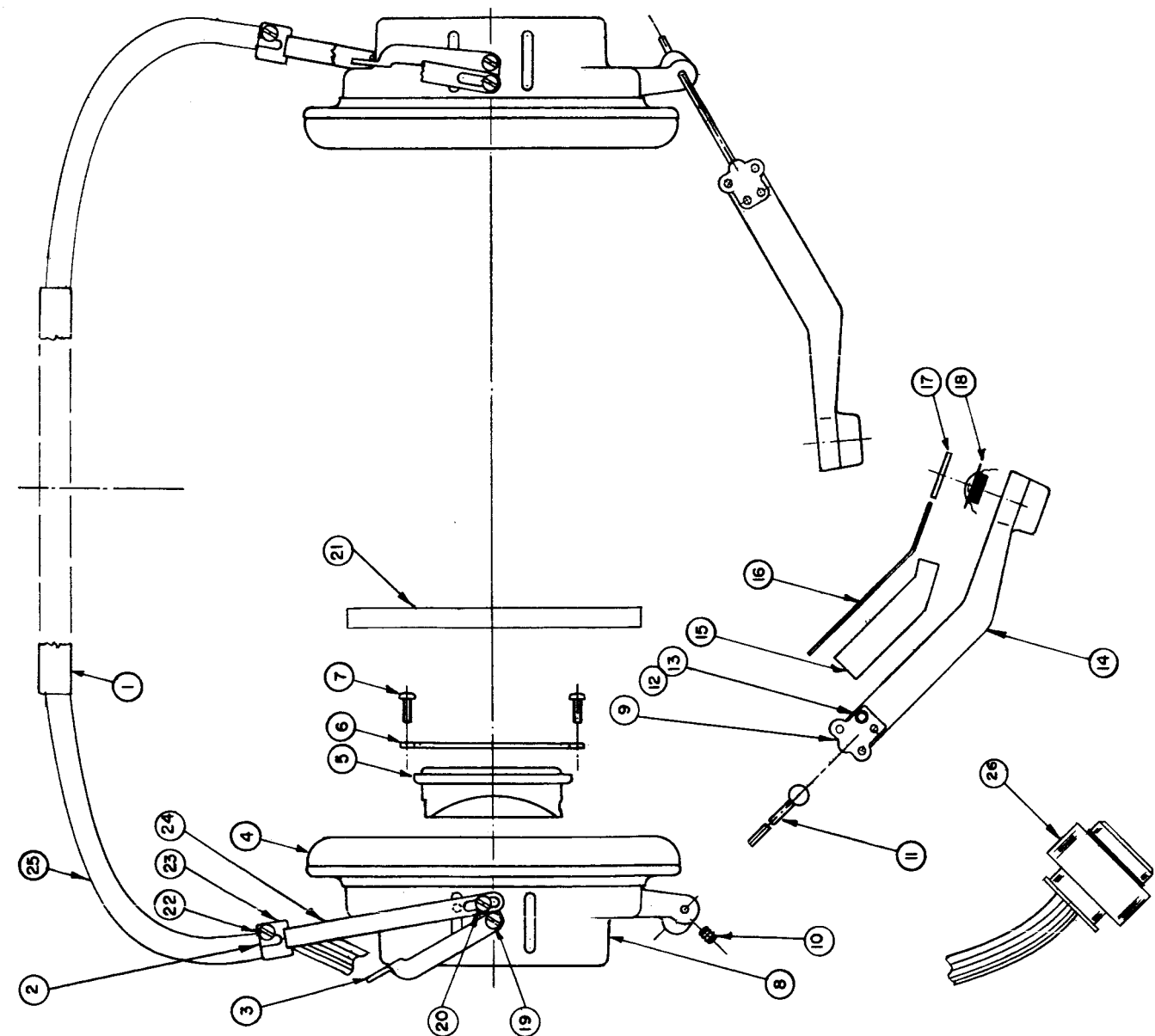
- a. Two microphones with self contained amplifiers.
- b. Two earphone assemblies.
- c. Headband and earcup support hardware.
- d. Connector and wiring harness.

An assembly drawing of the complete headset is shown in Figure 2.

2.1 Microphone

The microphone assembly consists of a microphone transducer, amplifier and microphone boom. When assembled, these elements

SYM	REVISIONS	DATE	APPROVAL



ITEM	PART NO.	REQD.	DESCRIPTION	FROM	COND.	QTY.
26			CONNECTOR SHELL			
25			TUBING PVC SHRINK			
24			HINGE EARPHONE			
23			BEARING EARPHONE			
22			SCREW 6-32 X 1/2 PAN HD.			
21			SCOT FOAM, 60 PPI			
20			SCREW 6-32 X 1/2 PAN HD			
19			SCREW 6-32 X 1/2 PAN HD			
18			DIAPHRAGM & VOICE COIL S/A.			
17			MICROPHONE COVER			
16			BOOM COVER			
15			AMPLIFIER			
14			BOOM			
13			SCREW 3-56 X 1/2 SOC HEAD			
12			NUT 3-56 HEX NUT			
11			BOOM SHAFT			
10			SET SCREW 6-32 X 1/2 SOC HD			
9			CLAMP SWIVEL			
8			EARCUP			
7			SCREW, 4-40 X 1/2			
6			CLAMPING RING			
5			EARPHONE			
4			EAR CUSHION			
3			PRESSURE INCREASING MECHANISM			
2			HEAD BAND			
1			ISOLATION NETWORK			

Electro-Voice, Inc. ELECTRO-VOICE INC. BUCARANN, MICHIGAN	
N.A.S.A. HEADSET ASSEMBLY	
MODEL _____	
CONTRACT OR CUSTOMER NO. _____	
SCALE 1:1	
DATE 11-19-65	
DRAWN G.B. / C.B.	
CHECKED _____	
ENGINEER _____	
PRINT THIS DATE _____	
A.Q.L. _____	

Figure 2

form an integral structure connected to the bottom of the earcup and extending forward to the side of the mouth. Adjustment of the microphone assembly is accomplished by means of a slide adjustment at the mechanical connection to the earcup and in a ball swivel at the rear of the microphone boom molding. Adjustment is sufficient to permit the microphone to be moved free of the mouth area during eating.

The electrical and acoustical design goals for the microphone that were set forth in the contract 'Statement' were achieved as evidenced by the results of the acceptance tests performed on the prototype headsets as shown in Figures 3 through 6.

The electrical output at 1 KC for a SPL input of 106 db was -1 dbm, well within the limits of 0 dbm ± 2 db. The frequency response curves (see Figure 5) were within the limits of ± 3 db over the range of 300 cps to 3000. The noise cancellation characteristics exceeded 20 db difference between simulated voice and noise signals. An additional noise cancellation measurement in the form of close and distance frequency response curves was performed during the development tests and the result of this measurement is shown in Figure 7.

The validity of noise cancellation measurements performed at ambient pressures as an indication of noise cancellation characteristics at 5 psia was also established during the development tests.

To reduce the size and weight of the microphone transducer, an Alnico IX magnet and 2V permendur steel structure are used in the magnetic assembly as shown in Figure 8.

HEADSET #1 **DATA SHEET**

1. Microphone Phasing:
 - A. Left microphone output -5 db (-6 to 0 db).
 - B. Right microphone output -6 db (-6 to 0 db).
2. Sensitivity at 1000 cps, 5 psia:
 - A. Microphone system -1 db (0 db minimum).
 - B. Earphones:
 - (1) Right 111 db (110 db minimum).
 - (2) Left 111.5 db (110 db minimum).
3. Frequency response: see attached curves.
4. Impedance at 1000 cps:
 - A. Microphone system: 570 ohms (500 to 600 ohms).
 - B. Right earphone: 611 ohms (500 to 600 ohms).
 - C. Left earphone: 611 ohms (500 to 600 ohms).

5. Distortion:

cps	Microphone System		Right Earphone		Left Earphone	
	106 db spl	116 db spl	110 db spl	125 db spl	117 db spl	125 db spl
300			<u>0.6</u> %	<u>0.9</u> %	<u>0.7</u> %	<u>0.8</u> %
1000	<u>.8</u> %	<u>1.0</u> %	<u>0.6</u> %	<u>1.0</u> %	<u>0.8</u> %	<u>1.3</u> %
3000	<u>1.0</u> %	<u>2.5</u> %	<u>0.7</u> %	<u>0.9</u> %	<u>0.7</u> %	<u>1.0</u> %
maximum permissible	2%	5%	2%	2%	2%	2%

6. Microphone system internal noise:
 - A. Output -54.5 dbm (-45 dbm maximum).
7. Microphone system linearity at 1000 cps:
 - A. Output for 96 db spl -9 dbm.
 - B. Output for 106 db spl -1 dbm.
 - C. Output for 116 db spl +8 dbm.
8. Microphone System Clipping:

cps	spl at which clipping was observed
300	<u>120.7</u> (115 db minimum)
1000	<u>123.5</u> (116 db minimum)
3000	<u>123.2</u> (116 db minimum)
9. Microphone System current drain: 30 ma (10 ma maximum)
10. Microphone system clipped output: -54.5 dbm (-45 dbm maximum).
11. Microphone system noise cancellation:
 - A. Output for voice 11.5 dbm.
 - B. Output for noise -11 dbm.
 - C. Difference of A and B 22.5 db (15 db minimum).

Figure 3

Headset #1

12. Variations of temperature and supply voltage:

Temperature	Supply Voltage	Microphone Output for 106db spl	spl at which clipping occurred (115 db minimum)
40°F	24 v	+ <u>.5</u> dbm	<u>126.6</u> db
40°F	28 v	+ <u>.6</u> dbm	<u>124.4</u> db
40°F	32 v	+ <u>.6</u> dbm	<u>124.4</u> db
ambient	24 v	- <u>1.2</u> dbm	<u>123.5</u> db
ambient	28 v	- <u>1.0</u> dbm	<u>123.5</u> db
ambient	32 v	- <u>1.0</u> dbm	<u>123.5</u> db
90°F	24 v	+ <u>.4</u> dbm	<u>122</u> db
90°F	28 v	+ <u>.4</u> dbm	<u>122</u> db
90°F	32 v	+ <u>.4</u> dbm	<u>122</u> db

13. Earphone linearity:

Power Input Milliwatts	spl (db)		
	Right	Left	
.126	<u>95.5</u> db	<u>98</u> db	95 db minimum
4.0	<u>111</u> db	<u>111.5</u> db	110 db minimum
126.4	<u>125.5</u> db	<u>128</u> db	125 db minimum

Figure 3

HEADSET #2 **DATA SHEET**

1. Microphone Phasing:
 - A. Left microphone output -6 db (-6 ± 1 db).
 - B. Right microphone output -6 db (-6 ± 1 db).
2. Sensitivity at 1000 cps, 5 psia:
 - A. Microphone system: -1 db (-1 ± 12 db).
 - B. Earphones:
 - (1) Right 111.5 db (110 db minimum).
 - (2) Left 111.5 db (110 db minimum).
3. Frequency response: see attached curves.
4. Impedance at 1000 cps:
 - A. Microphone system: 570 ohms (600 ± 30 ohms).
 - B. Right earphone: 625 ohms (600 ± 30 ohms).
 - C. Left earphone: 625 ohms (600 ± 30 ohms).

5. Distortion:

cps	Microphone System		Earphones			
	106 db spl	116 db spl	Right 110 db spl	Right 125 db spl	Left 110 db spl	Left 125 db spl
300	<u>0.8</u> %	<u>2.6</u> %	<u>0.6</u> %	<u>0.8</u> %	<u>0.7</u> %	<u>0.8</u> %
1000	<u>0.8</u> %	<u>2.6</u> %	<u>0.8</u> %	<u>1.1</u> %	<u>0.8</u> %	<u>1.1</u> %
3000	<u>1.0</u> %	<u>2.0</u> %	<u>0.8</u> %	<u>1.0</u> %	<u>0.8</u> %	<u>0.9</u> %
maximum permissible	2%	5%	2%	5%	2%	5%

6. Microphone system internal noise:
 - A. Output -53 dbm (-45 dbm maximum).
7. Microphone system linearity at 1000 cps:
 - A. Output for 96 db spl -10 dbm.
 - B. Output for 106 db spl -1 dbm.
 - C. Output for 116 db spl +8 dbm.

8. Microphone System Clipping:

cps	spl at which clipping was observed
300	<u>120.1</u> (110 db minimum)
1000	<u>123.5</u> (110 db minimum)
3000	<u>123.2</u> (110 db minimum)

9. Microphone System current drain: 29 ma (30 ma maximum).
10. Microphone system clipped output: -53 dbm (-45 dbm maximum).
11. Microphone system noise cancellation:
 - A. Output for voice 13 dbm.
 - B. Output for noise -10 dbm.
 - C. Difference of A and B 23 db (15 db minimum).

Figure 4

12. Variations of temperature and supply voltage:

Temperature	Supply Voltage	Microphone Output for 106db spl	spl at which clipping occurred (116 db minimum)
40°F	24 v	<u>-1.6</u> dbm	<u>122</u> db
40°F	28 v	<u>-1.5</u> dbm	<u>121.6</u> db
40°F	32 v	<u>-1.5</u> dbm	<u>121.6</u> db
ambient	24 v	<u>-1.1</u> dbm	<u>123.5</u> db
ambient	28 v	<u>-1</u> dbm	<u>123.5</u> db
ambient	32 v	<u>-1</u> dbm	<u>123.5</u> db
90°F	24 v	<u>-1.3</u> dbm	<u>122</u> db
90°F	28 v	<u>-1.1</u> dbm	<u>121.1</u> db
90°F	32 v	<u>-1.1</u> dbm	<u>121.1</u> db

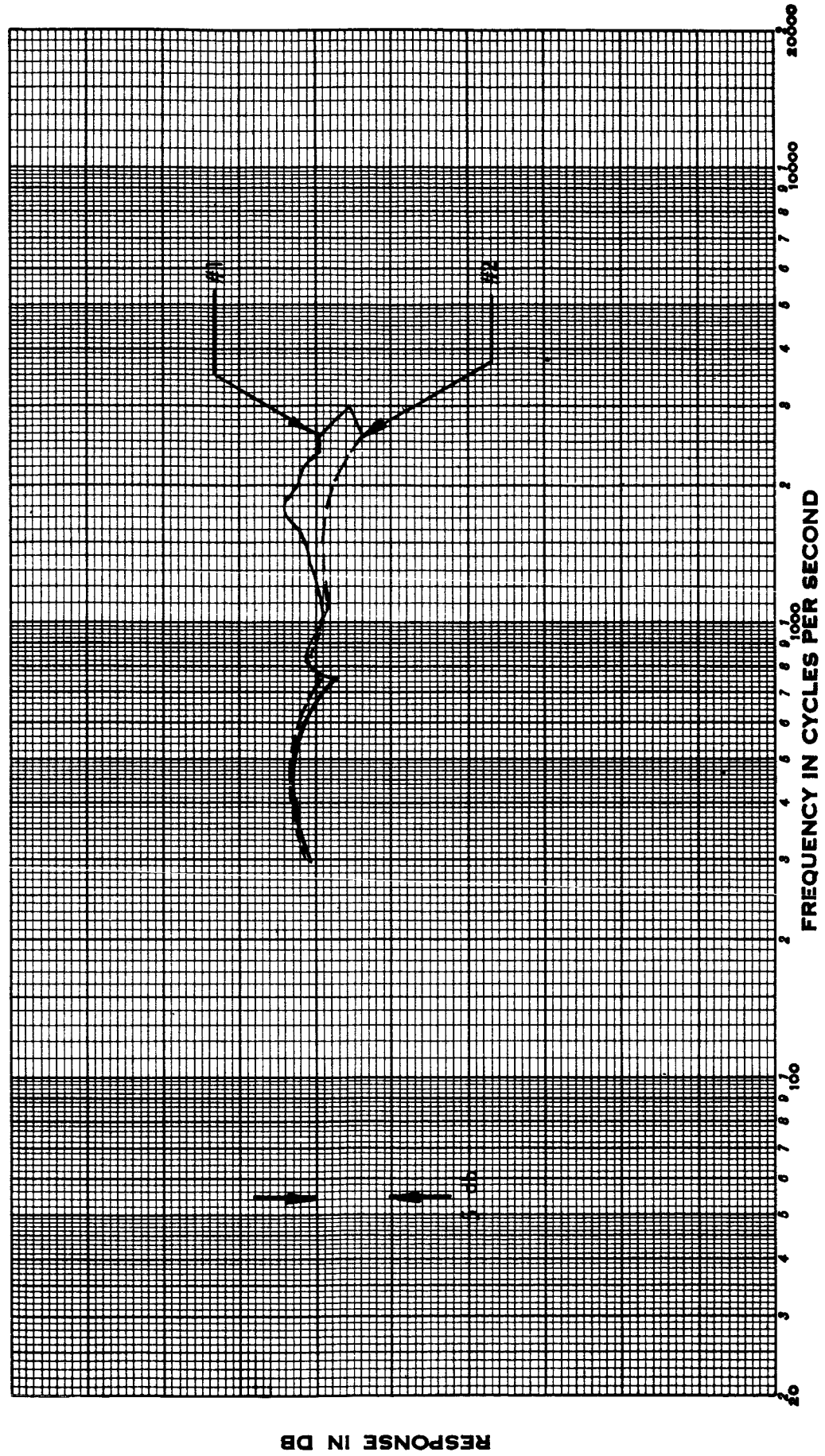
13. Earphone linearity:

Power Input Milliwatts	spl (db)		
	Right	Left	
.126	<u>97.5</u> db	<u>96</u> db	95 db minimum
4.0	<u>111.5</u> db	<u>111.5</u> db	110 db minimum
126.4	<u>127.5</u> db	<u>126</u> db	125 db minimum

Figure 4

SOUND PRESSURE 106 DB re .0002 dynes/cm²
 REFERENCE: 0 DB = 1 milliwatt
 MICROPHONE PLACEMENT _____ inches
 SENSITIVITY _____ db re 1 volt/dyne
 AT 1000 CPS -1 db re 1 milliwatt/10 dynes

MODEL _____ Microphone
 SPECIAL NOTES _____
NAS 9-5155
 Z _____ OHMS DATE _____



RESPONSE IN DB

FREQUENCY IN CYCLES PER SECOND

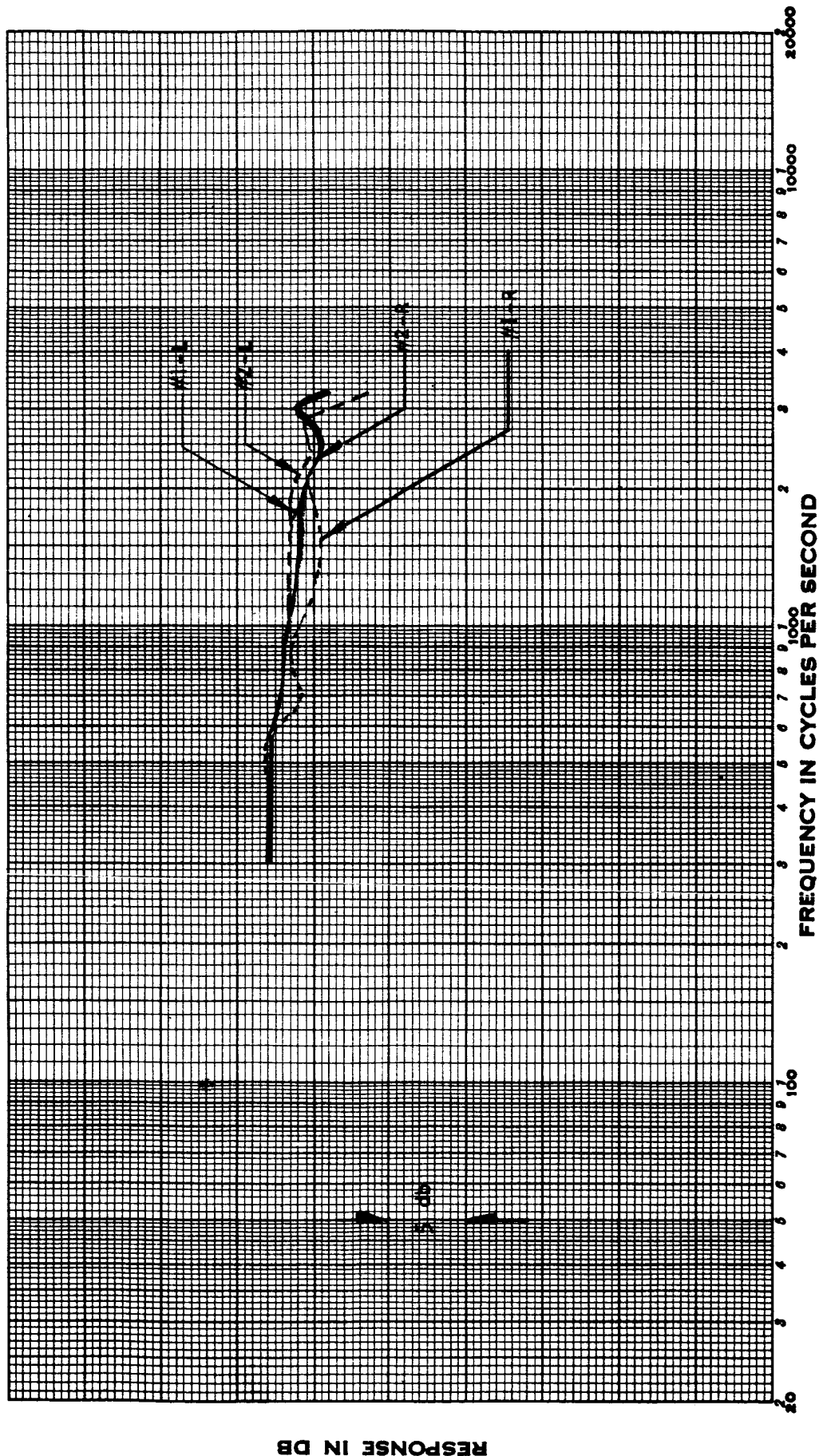
Electro-Voice

APPROVED _____

SOUND PRESSURE _____ DB re .0002 dynes/cm²
 REFERENCE: 0 DB = 110 db re .0002 dynes/cm²
 MICROPHONE PLACEMENT _____ inches
 SENSITIVITY _____ db re 1 volt/dyne
 AT _____ CPS _____ db re 1 milliwatt/10 dynes

MODEL _____ Earphone
 SPECIAL NOTES _____
 NAS 9-5155

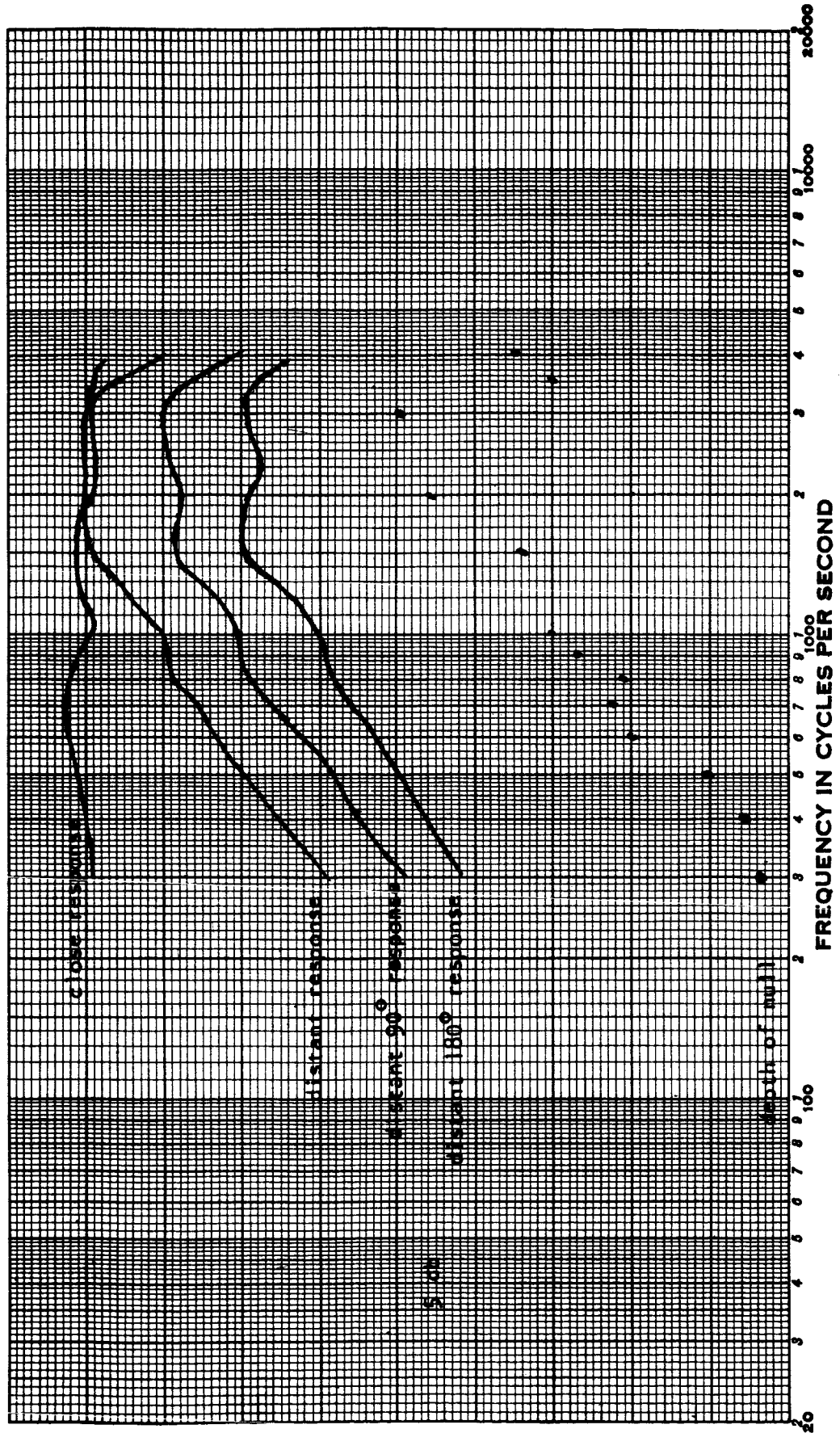
Z _____ OHMS DATE _____



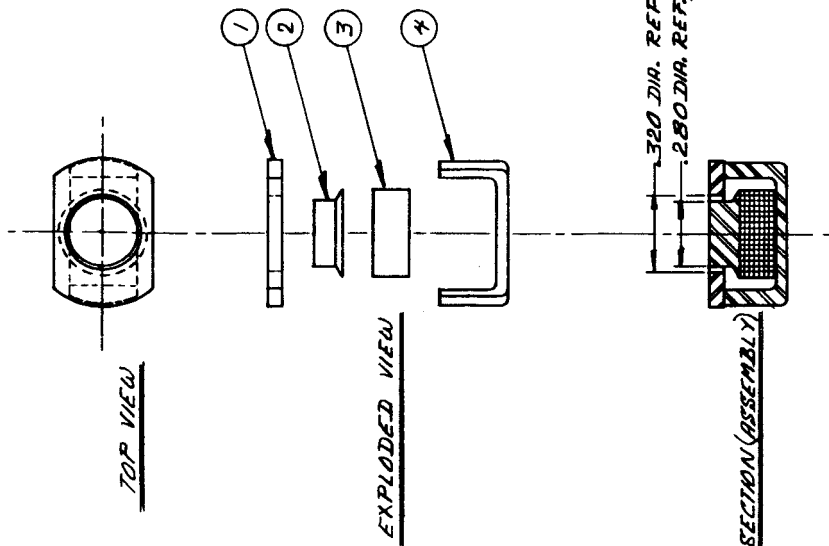
Electro-Voice

APPROVED _____

Corrected Curves
Ground Level



MICROPHONE SYSTEM



NOTE:

1. CEMENT PARTS TOGETHER WITH REBUILT.
- 1 PART OF 97012 TO 2 PARTS OF 97008.

FULL SECTION (ASSEMBLY)

320 DIA. REF.
280 DIA. REF.
THESE DIAMETERS TO
BE CONCENTRIC WITHIN
.002 T.I.R..

ITEM	PART NO.	REQD	DESCRIPTION	FROM	COND.	DRAWN
4		1	YOKER			A
3		1	MAGNET			A
2		1	PALE PIECE			A
1		1	FACE PLATE			A

BILL OF MATERIAL FOR ONE COMPLETE UNIT

DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED		* NOTES *	
FRACTIONS	DECIMALS	ANGLES	CONCENTRICITY
± .010	± .003	± 1/4°	± .010 T.I.R.
UNMARKED ANGLES & INTERSECTIONS 90°.			
REMOVE BURRS & EXPOSED SHARP EDGES.			
THREADS TO BE UNIFIED SERIES CLASS 2.			
AFTER PLATING UNLESS OTHERWISE SPECIFIED.			
DO NOT SCALE DRAWING			
A.Q.L.		PRINT ISSUE DATE	

TITLE
POT STRUCTURE S/A

Electro-Voice
ELECTRO-VOICE, INC.
BUCHANAN, MICHIGAN

MATERIAL	MODEL
END FINISH	CONTRACT OR CUSTOMER NO.
HEAT TREAT	SCALE
DRAWN	PART NO.
CHECKED	2/1
ENGINEER	DATE

21K-913-13

Figure 8

This assembly is insert molded as a part of the microphone boom as shown in Figure 9.

The microphone amplifiers are fabricated using welded, cord-wood construction and are potted in the microphone boom. A cover is cemented over the open section of the boom to protect the cable connections and amplifier.

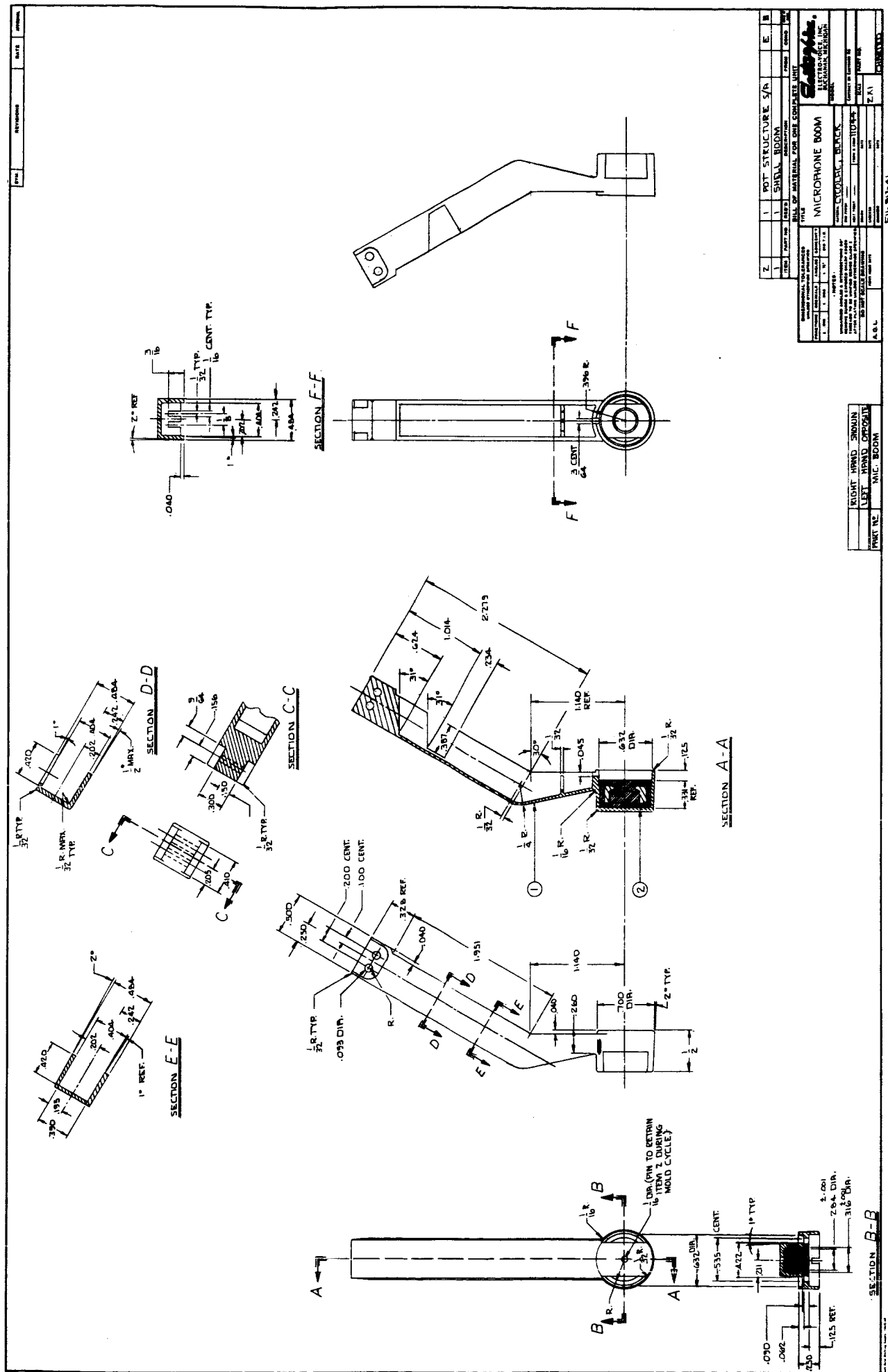
The amplifiers designs are shown in Figures 10 and 11. A combination regulator and capacitor multipliers is used in the power feed to permit operation over the power supply voltage variation specified (28 ± 4 v. d.c.) and to reduce the affect of ripple in the supply. The amplifier is a d.c. coupled two stage amplifier utilizing d.c. bias feedback and a thermistor to provide temperature stability. The 1N276 diode prevents amplifier damage due to d.c. supply voltage reversal. The amplifier is designed to operate from a 28 v. source with a 560Ω isolation resistor.

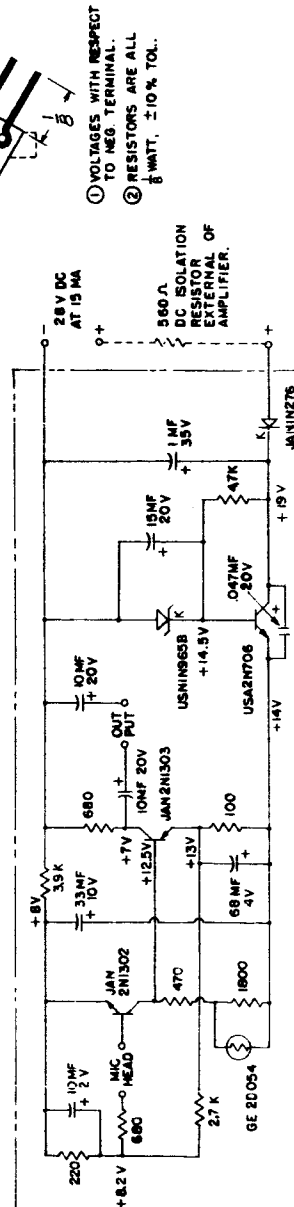
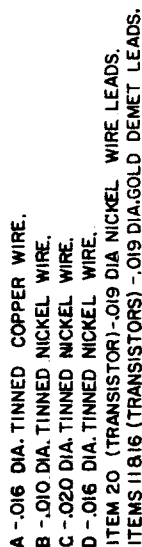
2.2 Earphone Assemblies

The earphone assembly consists of an earphone transducer, an earcup and an earmuff (see Figure 2).

The earphone transducer is a dynamic type, constructed as an integral sub assembly to reduce acoustic and mechanical coupling to the microphone and to permit measurement of its acoustic parameters on a 6 cc coupler.

The principal problem encountered during the design of the earphone transducer was the achievement of the required sensitivity





ITEM	PART NO.	REQ'D	DESCRIPTION	PRECIN	COND.	GRS. & DIS.
25	1	1	PIN ON DIA. ¹ / ₁₆ INCH WIRE ¹⁸ / ₃₂ LG.			
24	1	1	NICKEL RIBBON .032 X .010 INK.			
23	10	1	PIN ON DIA. ¹ / ₁₆ INCH WIRE, ¹⁸ / ₃₂ LG.			
22	1	1	CAPACITOR, 1MF 35V.			
21	1	1	RESISTOR, 2.7 K			
20	1	1	TRANSISTOR, JAN 2N1302			
19	1	1	DIODE, ZENER, USN 1N965B			
18	1	1	RESISTOR, 4.7 K			
17	1	1	RESISTOR, 220			
16	1	1	TRANSISTOR, USA 2N706			
15	2	1	CAPACITOR, 10MF 20V.			
14	1	1	CAPACITOR, 68MF 4K			
13	1	1	DIODE, JAN 1N276			
12	1	1	RESISTOR, 1000			
11	1	1	TRANSISTOR, JAN 2N1303			
10	1	1	RESISTOR, 100			
9	1	1	RESISTOR, 470			
8	1	1	THERMISTOR, GE 2D054			
7	2	1	RESISTOR, 680			
6	1	1	RESISTOR, 39K			
5	1	1	CAPACITOR, 0.07MF 20V.			
4	1	1	CAPACITOR, 33 MF 10V.			
3	1	1	CAPACITOR, 10MF 2V.			
2	1	1	CAPACITOR, 15MF 20V.			
1	1	1	BOARD, MFG.			

E11-913-34

Q.L.		PRINT ISSUE DATE		DO NOT SCALE DRAWING		UNARMED ANGLES & INTERSECTIONS DO REMOVE HUNG & EXPOSED SHARP EDGES AFTER PLATING UNLESS OTHERWISE SPECIFIED		DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS DECIMALS ANGLES CONCENTRY 1/8" .003 1" .010 T.M.		TITLE		BILL OF MATERIAL FOR ONE COMPLETE UNIT	
UNARMED ANGLES & INTERSECTIONS DO REMOVE HUNG & EXPOSED SHARP EDGES AFTER PLATING UNLESS OTHERWISE SPECIFIED		1/8" .003 1" .010 T.M.		DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS DECIMALS ANGLES CONCENTRY		TITLE		AMPLIFIER S/A		Electro-Voice, Inc. ELECTRO-VOICE, INC. BUCHEMAN, MICHIGAN		MODEL	
END FINISH _____ TREAT _____ FROM & TO _____		SCALE _____ PART NO _____ DATE 12-22-65 DRAWN C.D. CHECKED _____ APPROVED _____		CONTRACT OR CUSTOMER NO _____		SCALE _____ PART NO _____ DATE 12-22-65 DRAWN C.D. CHECKED _____ APPROVED _____		CONTRACT OR CUSTOMER NO _____		SCALE _____ PART NO _____ DATE 12-22-65 DRAWN C.D. CHECKED _____ APPROVED _____		CONTRACT OR CUSTOMER NO _____	

Electro-Voice.

Figure 10

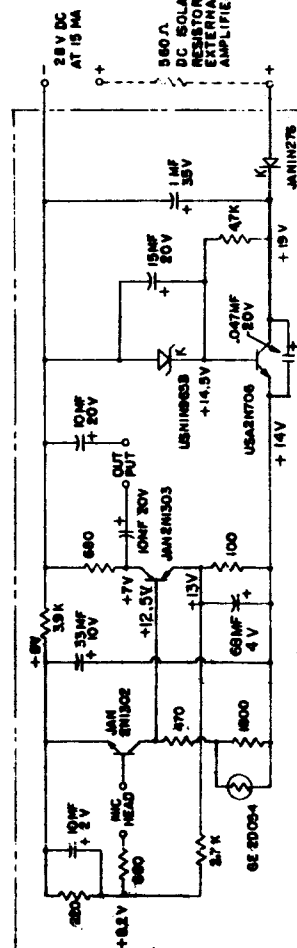
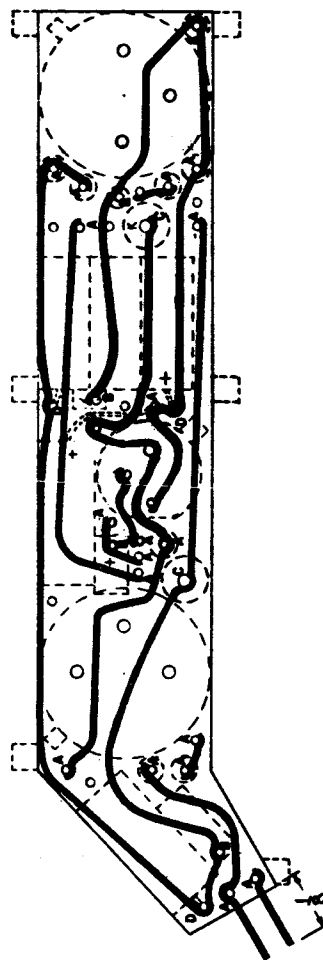


Figure 11

ITEM	PART NO.	QTY	DESCRIPTION	FROM	CONG.	UNIT
25	1		PH 06 DIA. UNFIN. WIRE LG			
24	1		NICKEL RIBBON .032 X .010 THK.			
23	10		PH 06 DIA. TINED WIRE LG			
22	1		CAPACITOR, 10M 35V			
21	1		RESISTOR, 2.7K			
20	1		TRANSISTOR, JAN 2N1302			
19	1		DIODE, ZENER, USN 1N965B			
18	1		RESISTOR, 4.7K			
17	1		RESISTOR, 220			
16	1		TRANSISTOR, USA 2N706			
15	2		CAPACITOR, 10M 20V			
14	1		CAPACITOR, 68M 4V			
13	1		DIODE, JAN 1N276			
12	1		RESISTOR, 1800			
11	1		TRANSISTOR, JAN 2N503			
10	1		RESISTOR, 100			
9	1		RESISTOR, 470			
8	1		TRANSISTOR, GE 2D054			
7	2		RESISTOR, 680			
6	1		RESISTOR, 39K			
5	1		CAPACITOR, 047M 20V			
4	1		CAPACITOR, 53M 10V			
3	1		CAPACITOR, 10M 2V			
2	1		CAPACITOR, 15M 20V			
1	1		BOARD, MFG.			

11-913-34

TITLE

AMPLIFIER S/A

DATE 11-22-65

BY C.D.

CHKD

ENG'NR

UNLESS OTHERWISE SPECIFIED

FRACTIONS: 1/16 1/8 1/4 1/2 3/4 1 1 1/2 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

NOTES:

UNARMED ANGLES & INTERSECTIONS 90°

REMOVE BURRS & EXPOSED THREADS

REMOVE BURRS & EXPOSED THREADS

AFTER PLATING UNLESS OTHERWISE SPECIFIED

DO NOT SCALE DRAWING

PRINT NAME DATE

CONTRACT NO.

SCALE

PART NO.

MODEL

CONTRACT NO.

SCALE

PART NO.

UNLESS OTHERWISE SPECIFIED

FRACTIONS: 1/16 1/8 1/4 1/2 3/4 1 1 1/2 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

NOTES:

UNARMED ANGLES & INTERSECTIONS 90°

REMOVE BURRS & EXPOSED THREADS

REMOVE BURRS & EXPOSED THREADS

AFTER PLATING UNLESS OTHERWISE SPECIFIED

DO NOT SCALE DRAWING

PRINT NAME DATE

CONTRACT NO.

SCALE

PART NO.

MODEL

CONTRACT NO.

SCALE

PART NO.

at 5 psia (110 db SPL at 1 KC for 1 millivolt input) without exceeding the weight goal of 49 grams. These objectives were successfully achieved as evidenced by the measurements performed on the prototype headsets (see Figures 3 and 4). The weight of each prototype earphone transducer was 43 grams.

To obtain maximum sensitivity a magnetic structure using an Alnico IX magnet and 2V permendur steel has been utilized. The assembly of these parts is shown in Figure 12. The weight of the assembly was kept to a minimum through the use of an ABS plastic cover and an aluminum rear case.

The frequency response curves of the prototype earphone transducers (measured at 5 psia) are shown in Figure 6. The results of the remaining acceptance tests on the earphone transducer are shown in Figures 3 and 4.

The transducer impedance was achieved without the use of transformers through the utilization of fine wire (#49) copper voice coils. The compatibility of this small diameter wire with the requirement of the 'Statement of Work' for a power handling capability of 50 mw was successfully demonstrated during the development tests.

The basic function of the earcup and earcushion is to provide an area surrounding the ear in which external noise is attenuated. Measurement of the earcup attenuation by objective methods was performed during the development tests and results of this test, which conform to the requirements in the 'Statement of Work' are shown in Figure 13.

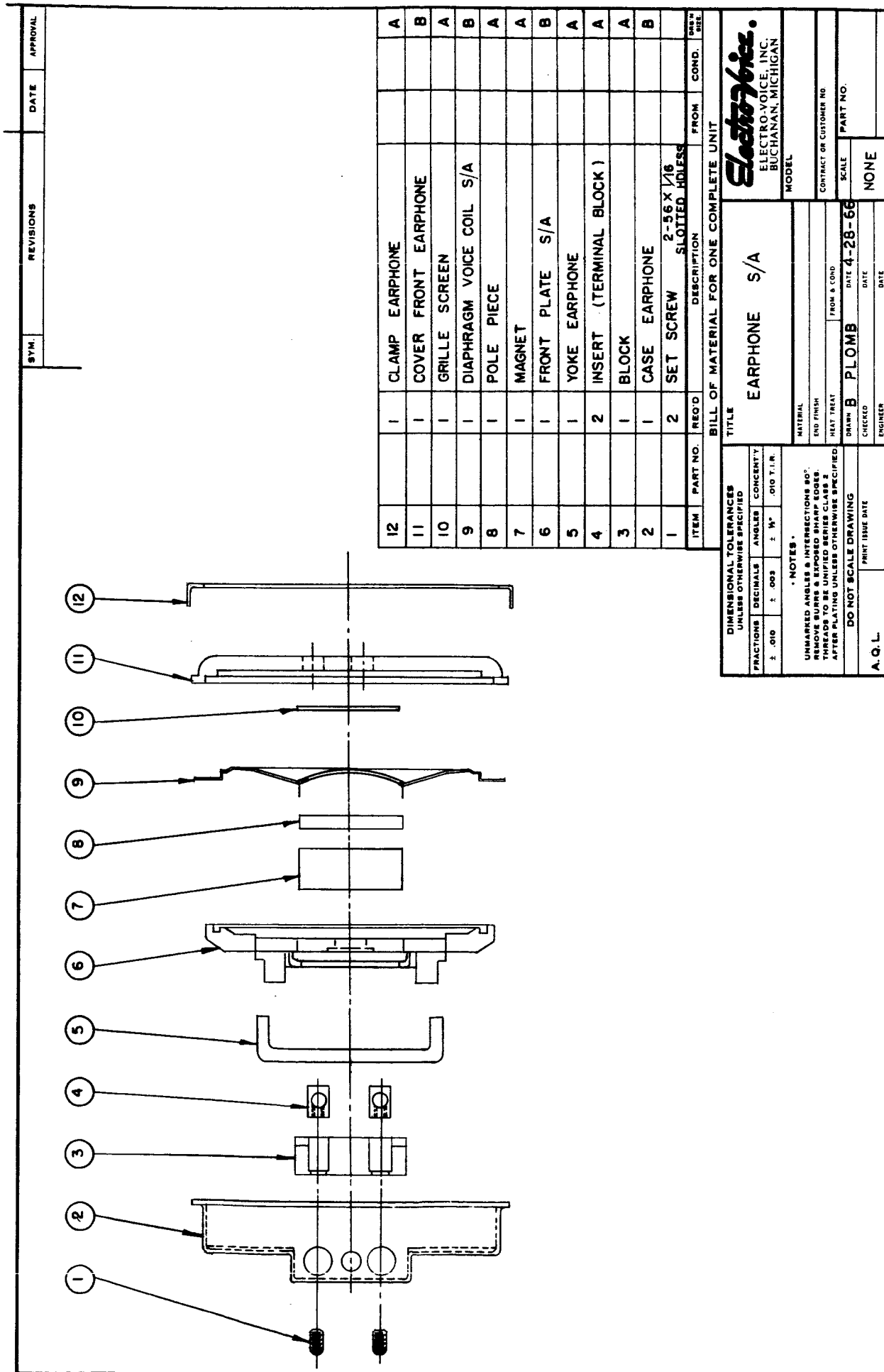
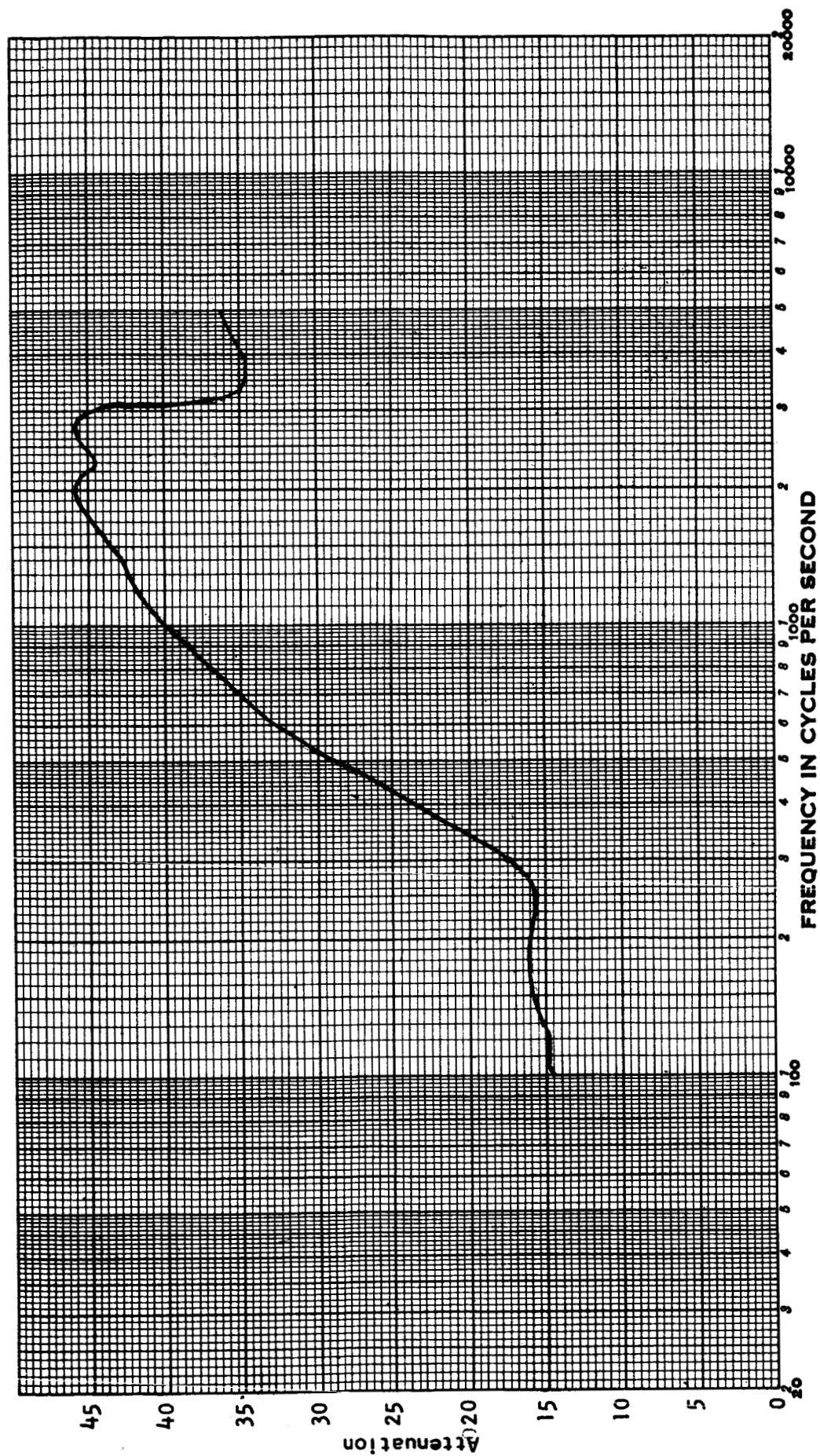


Figure 12

EARCUP ATTENUATION



The earcups were fabricated from ABS plastic and contain metal inserts for fastening purposes. The earphone transducer is secured to the earcup by means of a metal plate as shown in Figure 2. The earcushion is a plastic foam cushion heat sealed inside a vinyl cover. The cushion is stretched over a backing plate that is shaped to conform to normal head dimensions.

2.3 Headband and Earcup Support Hardware

The headset is supported on the head by the headband which also provides the clamping force which seals the earcushions against the head. The headband consists of two 0.113 diameter steel wires joined at each end by nylon blocks which are attached by a sliding fit to aluminum yokes. The yoke is attached to the earcup by a swivel which permits an increase in clamping by means of a U shaped bar which is rotated from the top of the earcup to the bottom of the earcup. This feature allows the user to increase the clamping pressure on the earcushions and thereby increase noise attenuation during periods of high noise environment. The headband also supports the electrical terminal box at its center. The exposed portions of the headband are covered with PVC shrink tubing.

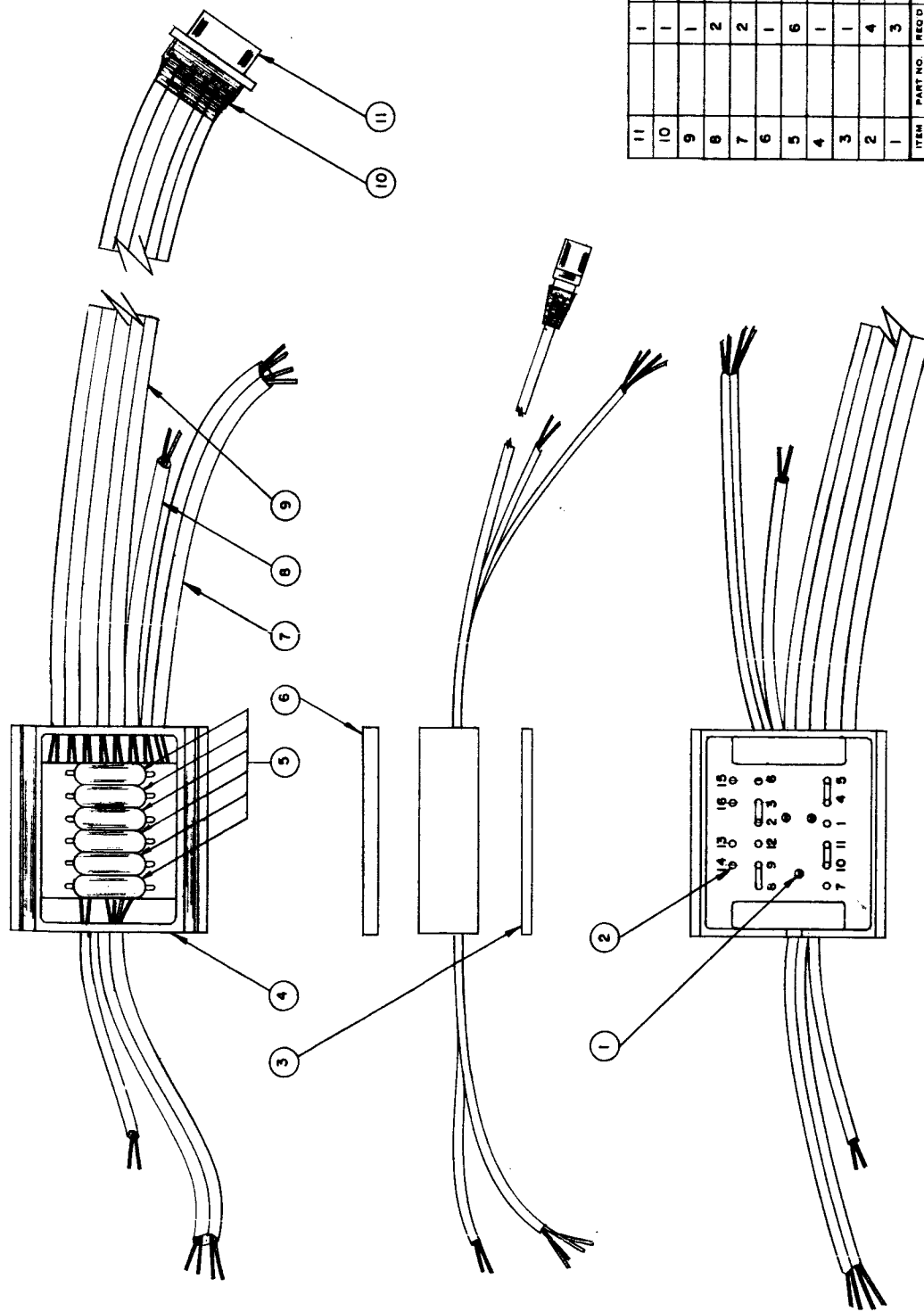
2.4 Connector and Wiring Harness

The headset is designed to connect to the Apollo communications system by means of a MD1-21SL1 Cannon insert mounted in an 832-1 Air Lock housing. The connector is wired to a five, shielded pair cable. Each pair is insulated from all other pairs in a woven, flat construction. This cable attaches to the headset

at a terminal block mounted on the headband at the top of the headset. The terminal block contains terminations for the five pair cable, the isolation networks, and terminations for the cables connecting the microphones and earphones. The wiring harness and termination block are shown in the drawing on page 24 (Figure 14).

The two pair cable connecting the microphone to the terminal block is threaded through the earcup to avoid mechanical interference with the pressure adjusting mechanism.

The wiring of the headset, including pin connections to the Cannon insert, is shown in Figure 15.

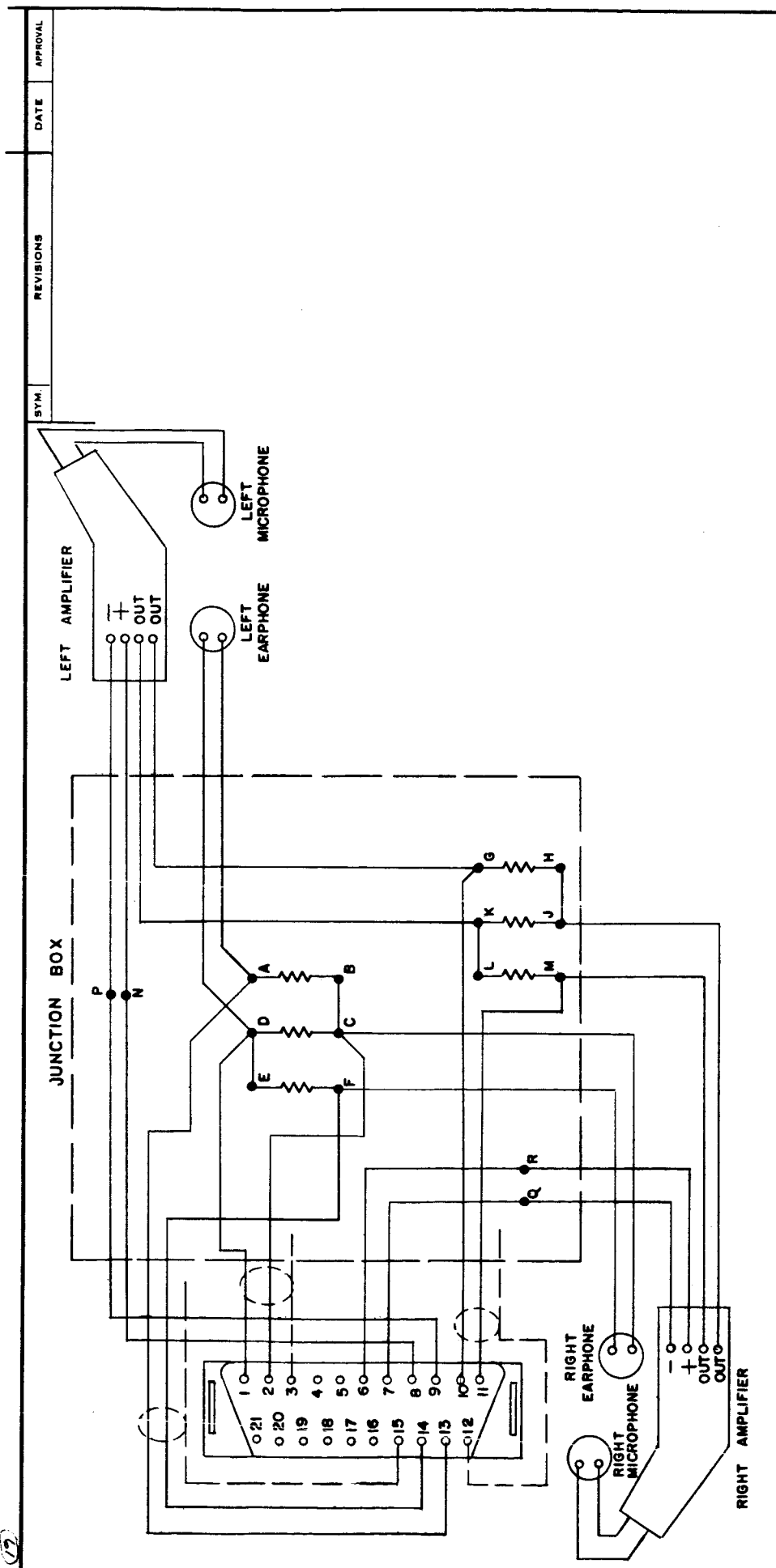


ITEM	PART NO.	REQ'D	DESCRIPTION	FROM	COND.	UNIT
11		1	INSERT MDI 21 SLI			
10		1	TUBING PVC SHRINK			
9		1	NYLON BRAIDED PVC INSULATION 11" LONG			
8		2	NYLON BRAIDED PVC INSULATION 11" LONG			
7		2	NYLON BRAIDED PVC INSULATION 17" LONG			
6		1	COVER BOTTOM (NETWORK)			
5		6	RESISTOR WIRE WOUND 1/2 1%			
4		1	CASE (NETWORK)			
3		1	COVER TOP (NETWORK)			
2		4	TERMINAL PIN (NETWORK)			
1		3	POST STAY CORD			

Electro-Voice ELECTRO-VOICE, INC. BELLEVILLE, ILLINOIS	
CABLE HARNESS S/A	
TITLE BILL OF MATERIAL FOR ONE COMPLETE UNIT	
DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONS DECIMALS ANGLES CONCENTRICITY ± .010 ± .005 ± .010 ± .010 ± .010	
NOTES: UNMATED ANGLES & INTERSECTIONS 90° UNLESS OTHERWISE SPECIFIED THREADS TO BE UNIFIED SERIES CLASS 2 AFTER PLATING UNLESS OTHERWISE SPECIFIED DO NOT SCALE DRAWING	
A.Q.L. PART TIME DATE CHECKED ENGINEER	MATERIAL END FINISH PART NO. DATE SCALE 2:1

Figure 14

12



ITEM	PART NO.	REQ'D	DESCRIPTION	FROM	COND.	QTY
BILL OF MATERIAL FOR ONE COMPLETE UNIT						
TITLE				ELECTRO-VOICE, INC. BUECHANAN, MICHIGAN		
CABLE HARNESS SCHEMATIC				MODEL		
MATERIAL				CONTRACT OR CUSTOMER NO.		
END FINISH				PART NO.		
NEXT TREAT				SCALE		
DRAWN B. PLOMB				NONE		
DATE 4-28-66				DATE		
CHECKED				ENGINEER		
PRINT ISSUE DATE				DATE		
A.Q.L.				DATE		

- 1-2 AUDIO WARNING
 3 SHIELD AUDIO WARNING
 6-7 RIGHT MICROPHONE POWER
 8-9 LEFT MICROPHONE POWER
 10-11 MICROPHONE SIGNAL OUTPUT
 12 SHIELD MICROPHONE SIGNAL
 13-14 EARPHONE SIGNAL INPUT
 15 SHIELD EARPHONE SIGNAL

Figure 15

3.0 CONCLUSIONS AND RECOMMENDATIONS

The headset design as represented by the two prototype units delivered to NASA meet the electrical and acoustic design goals as stated in the contract 'Statement of Work' (par 4.7.1) and the contractor's technical proposal. The weight of the completed headset is 329 grams (less cable and connector) well under the original estimate of 338 grams.

Some specific recommendations concerning the headset design are as follows:

- a. The microphone amplifier has been designed to operate from a 28 ± 4 volts d.c. supply with a 560 ohm isolation resistor. Specifying the supply in this manner, rather than as specified in paragraph 4.7.1.1.10 of the 'Statement', permits the utilization of the isolation resistor as a part of the microphone amplifier power supply filter, since transients peaks and ripple voltages are now considered as appearing in the 28 volt supply.
- b. The noise attenuation measurement shown in Figure 13 should be considered as being optimum since leakage around the ear-cushion during actual use will reduce the earcup attenuation, especially at low frequencies.
- c. The utilization of magnets with very high energy products ($B \times H$) results in the generation of magnetic leakage fields in the area immediately surrounding the earphone and microphone transducers. Though no requirements are stated for the magnitude of these leakage fields, their existence, we feel, should be noted.

- d. No provision for support of the headset during periods of high acceleration has been provided in the headset design. Some provision for this support should be provided, preferably in the helmet design.