CERAMIC SHEAR TUBE CONTACT TRANSDUCER MICROPHONE TECHNICAL MANUAL

Copy 8 of 60

August 1970

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

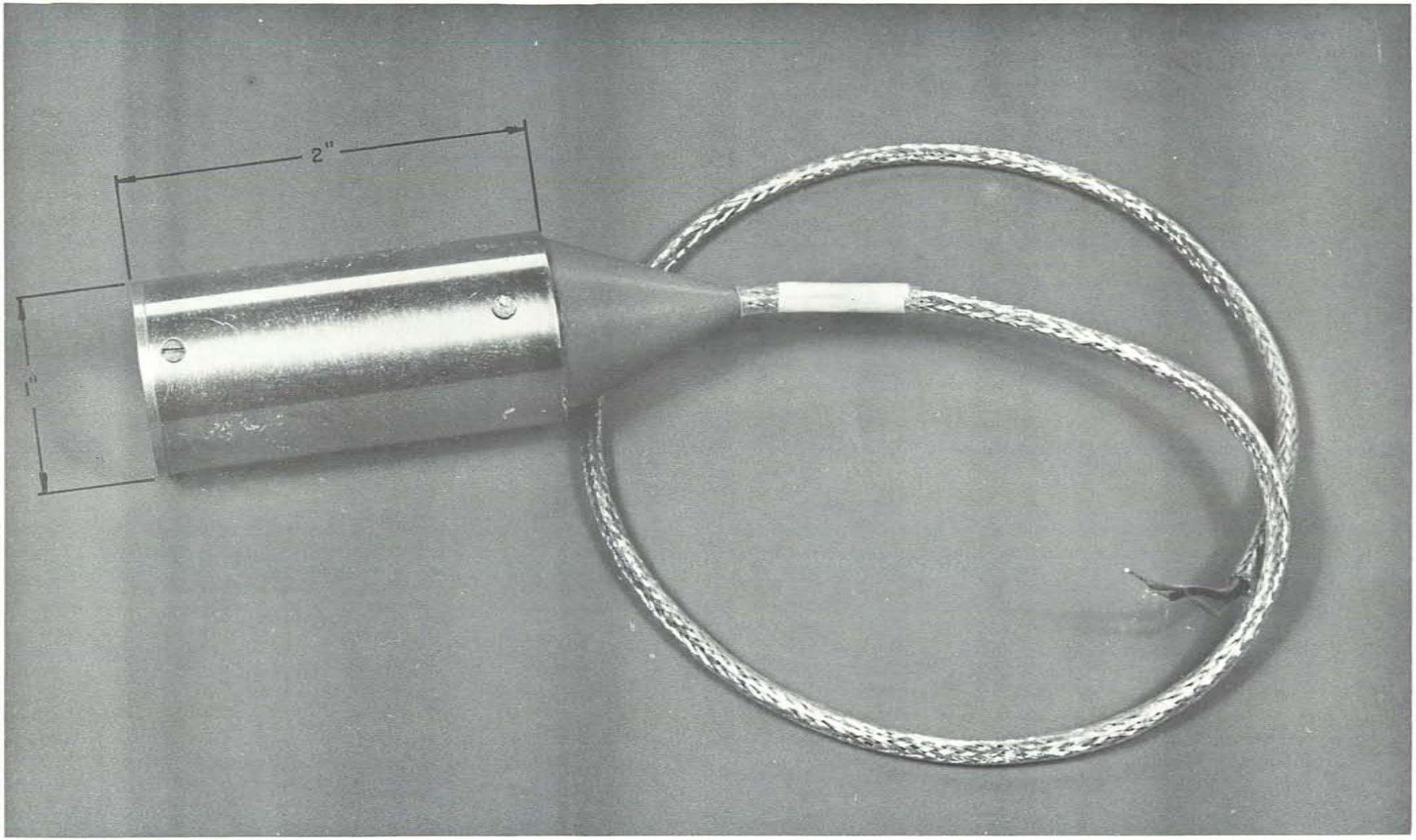


FIGURE 1. PHOTOGRAPH OF CERAMIC SHEAR TUBE CONTACT TRANSDUCER MICROPHONE

1.0 INTRODUCTION

This instruction manual contains information for the field use of the Ceramic Shear Tube Contact Transducer Microphone. A photograph of the transducer is shown in Figure 1.

1.1 Description

The Contact Transducer Microphone consists of a mass loaded piezo-ceramic shear tube and transistorized preamplifier in a brass housing. As shown in Figure 2, the shear tube is a cylindrical ceramic element which is rigidly mounted on a center post and mass loaded on the outer cylindrical face. The preamplifier consists of two transistor gain-stages on a printed circuit board. A schematic diagram of the preamplifier circuit is shown in Section 5, Schematic Diagram. Both the shear tube and preamplifier are contained in a brass housing which is completely filled with a high viscosity silicone oil to provide damping for the element. Electrical connections to the unit are made through the cable which is potted to one end of the housing.

1.2 Specifications

1.	Output Voltage:	500 volts $\pm$ 6 db at 2 KHz with 100 g acceleration drive, B^+ = 1.5 volts, temperature = 75°F
2.	Frequency Response:	Flat $\pm$ 3 db from 600 Hz to 3 KHz
3.	Resonant Frequency:	5 KHz minimum
4.	Input Drive:	5 mg acceleration maximum for an undistorted output
5.	Temperature Range:	0°F to 150°F, voltage output $\pm$ 6 db from that measured under Output Voltage. No oil leakage from the unit
6.	Current Drain:	40 amps maximum at B^+ = 1.5 volts
7.	Weight:	185 grams
8.	Dimensions:	1.0 inch diameter by 2.1 inches long
9.	Cable Length:	18.0 inches with 1.0 inch enclosed in a strain relief boot

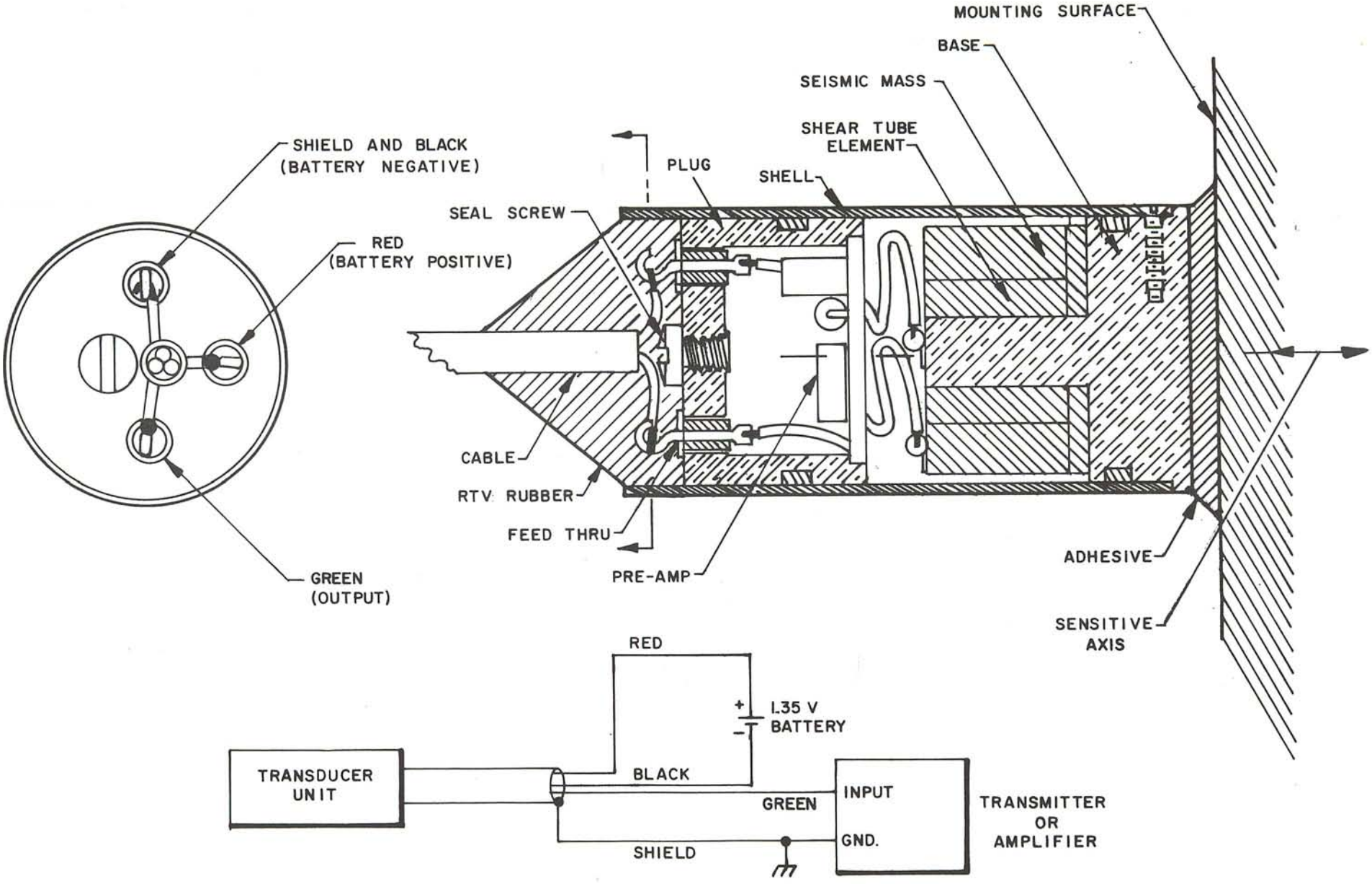


FIGURE 2. CERAMIC SHEAR TUBE CONTACT TRANSDUCER MICROPHONE

2.0 INSTALLATION

The shear tube transducer is end-on sensitive and therefore, must always be mounted with the flat end parallel to the surface being monitored. A typical mounting to a wall surface with an adhesive is shown in Figure 2. The transducer has been designed to accept normal field abuse; however, reasonable care should be used whenever the device is handled. Avoid dropping the transducer since this could cause failure of the unit.

Four different mounting applications will be discussed here: (1) temporary surface mounting, (2) permanent surface mounting, (3) drilled hole mounting, and (4) wet concrete wall embedment. Although other mounting conditions may be encountered in field applications which are not covered here, the installation details provided should enable the operator to improvise and help him make a satisfactory installation for all field conditions. Electrical connection of the transducer to other equipment such as a transmitter will also be covered in detail.

2.1 Electrical Connections

The cable extending from the end of the transducer provides all of the electrical connections. Connections should be made as shown in Figure 2, i.e., (1) Black to negative of a 1.35-volt battery, (2) Red to the battery positive, (3) Green, the signal lead, to the input of the follow-up equipment such as an amplifier or transmitter, and (4) Cable shield should be connected to the chassis of the follow-up equipment. The cable can be cut to any desired length without affecting the operation of the transducer. The transducer, which has no switches, is in operation whenever the battery leads are connected.

2.2 Temporary Surface Mounting

Temporary mounting on the surface of a wall may be done in any way that is convenient to the operator and produces results. The transducer may be hand-held to check various points of the wall for optimum location. During this search operation the transducer must always be held such that the flat end of the cylindrical housing is in contact with the wall. After determining the mounting location, the unit may be temporarily secured with sticky wax to free the operator's hands. To do this, melt a small pool of wax on the flat end of the transducer and immediately apply to the wall. Hold the transducer firmly in place until the wax hardens. The unit may also be mounted using some quick setting adhesive such as Eastman 910 or Devcon SF. When using this type of adhesive, the manufacturer's directions should be followed for proper application.

2.3 Permanent Surface Mounting

Permanent mounting on the surface of a wall is the same as temporary mounting except for the type of adhesive used. An adhesive should be selected that becomes hard when completely cured and does not deteriorate with age. An adhesive such as Eastman 910, Devcon SF or a silver alloy amalgam might be used. Low melting temperature alloys or solder are not recommended since the maximum temperature that the transducer should be exposed to is 150°F. Once again the transducer must be firmly held in place until the adhesive has cured to insure maximum adhesion. Mounting location should also be given more consideration to ensure that the optimum location is utilized.

2.4 Drilled Hole Mounting

For optimum results the drilled hole mounting technique should be used. The diameter of the hole should be slightly larger than the 1.00 inch diameter of the transducer. A hole drilled with a water-cooled 1.125 inch diameter diamond core drill will work very well. Hole depth should be such that the bottom of the hole is as close to the wall surface being monitored as is practical. A smooth bottom in the hole will help in making a good contact between the wall and the transducer. The adhesive used should meet the requirements as detailed in Section 2.3 Permanent Wall Mounting. Once again, it is very important to hold the transducer firmly in place until the adhesive cures. Wedges of wood or concrete can be placed around the transducer to aid in this operation.

2.5 Wet Concrete Wall Embedment

Embedment of a transducer during the construction of a concrete wall is the simplest method of transducer mounting since it does not require the use of adhesives. The transducer may be attached to any support structure, such as reinforcement steel, by any means available such as string, wire, tape, etc. Care should be taken to minimize the possibility of damage during concrete placement. The electrical cable should be located such that it is readily accessible after the wall is completed.

3.0 MAINTENANCE

The internal mechanism of the transducer is a precise, accurate assembly, and therefore, under no conditions should the unit be disassembled in the field. It is also oil filled under vacuum which would be impossible to reproduce satisfactorily in the field.

The only maintenance possible is the repair of a broken electrical lead. The green rubbery material around the cable can be carefully carved out with a knife to gain access to the solder terminals on the transducer. Electrical connections of the cable conductors are made as shown in the end view of the transducer in Figure 2. The cavity should then be filled with some material, preferably a silicone rubber, to protect the connections and provide strain relief for the cable.

4.0 TESTING

To field test the transducer, connect it to a follow-up amplifier or transmitter as shown in the hook-up diagram in Figure 2. Since the transducer has no switches, it is in operation whenever the battery leads are connected. While monitoring the follow-up equipment, lightly scratch the transducer with a fingernail. This signal should be audible on the follow-up equipment. Receipt of such a signal indicates that the transducer is functioning properly. The transducer is essentially a go-no-go device and any degradation will cause it to become completely inoperative with no signal output.

5.0 SCHEMATIC DIAGRAM

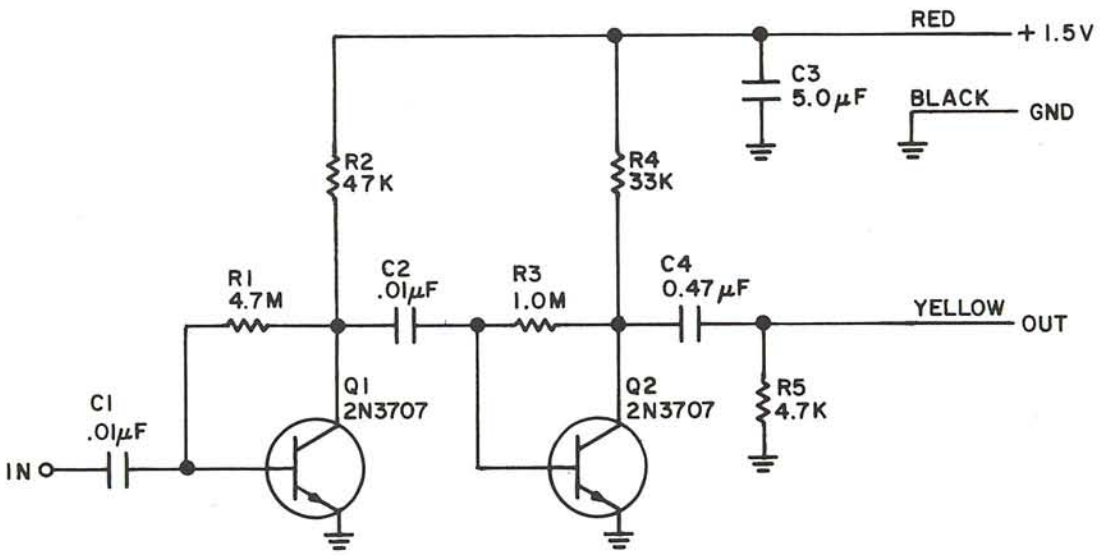


FIGURE 3. PREAMPLIFIER SCHEMATIC DIAGRAM

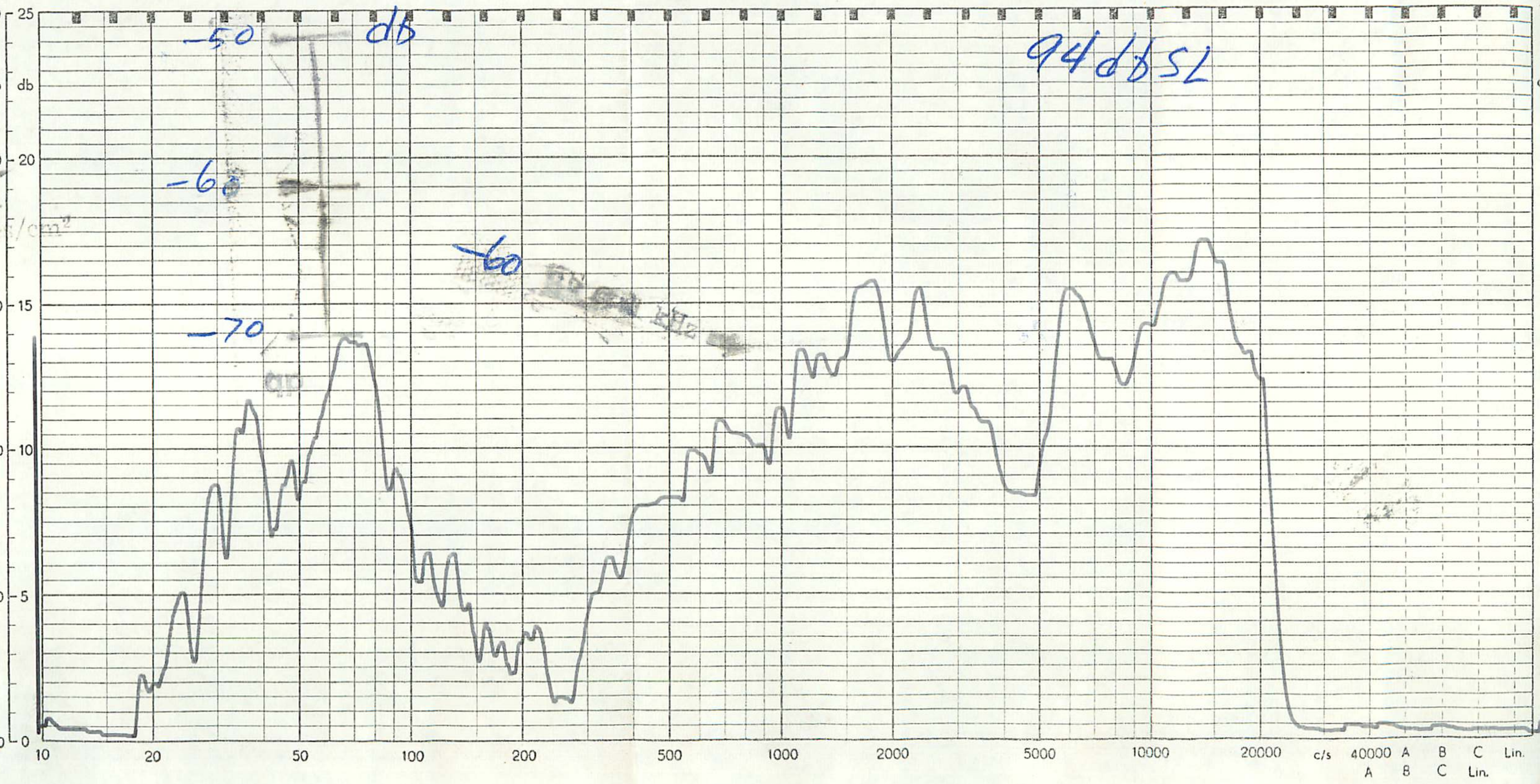
Brüel & Kjær
Copenhagen

Measuring Object:

SWM 25
SN 5-499
dB re: 1 volt/10 dynes/cm²
Open circuit voltage

44

Rec. No.:
Date: 1970
Sign.:
Rect.:
Zero Lev.:
L. Lim. Fr.:
Pot.:
Wr. Sp.:
Paper Sp.:
Multiply Freq. Scale by:



QP 1123

Brüel & Kjær
Copenhagen

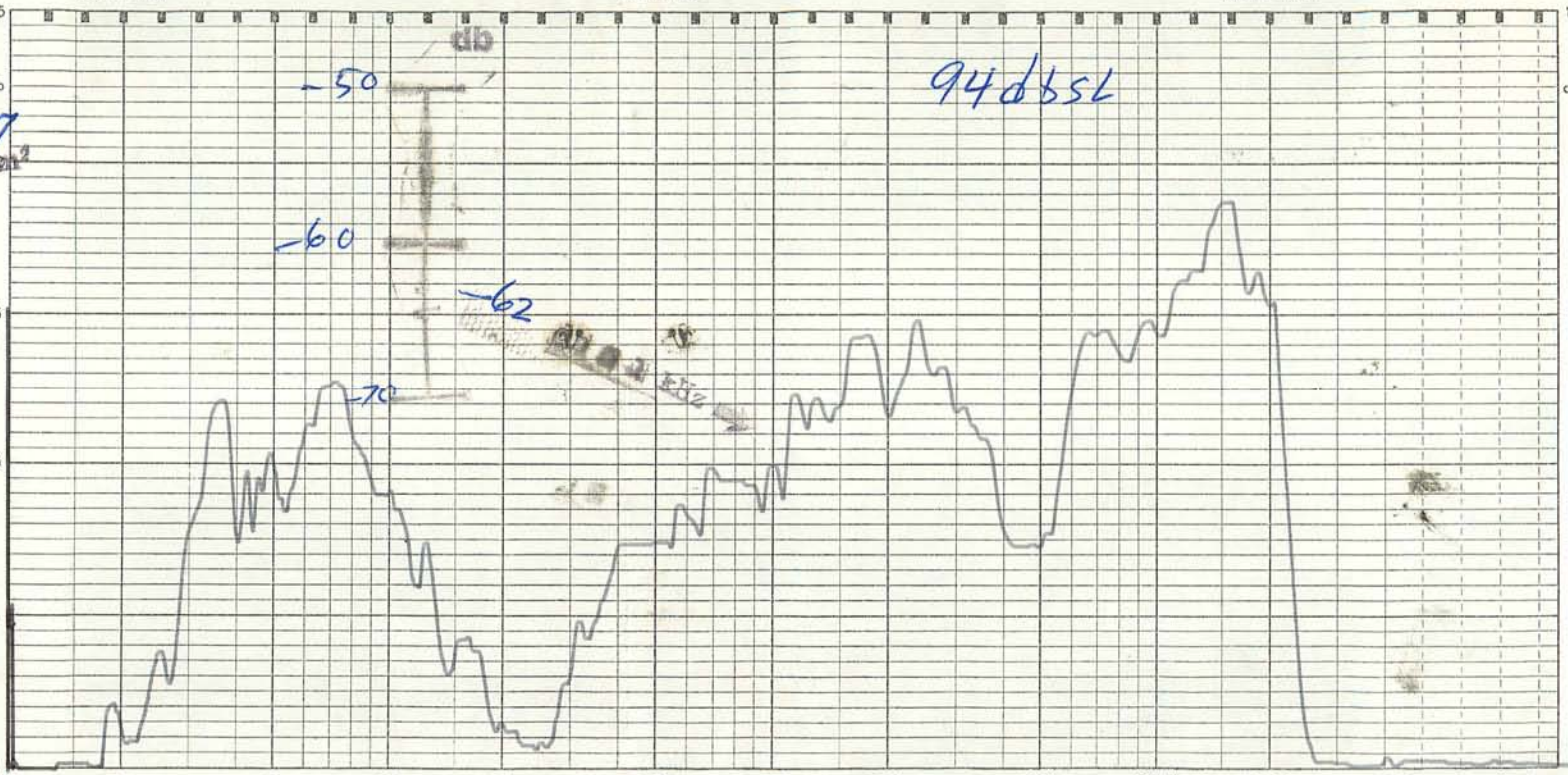
Measuring Object: 25 S-507

dB re: 1 volt/10 dynes/cm²

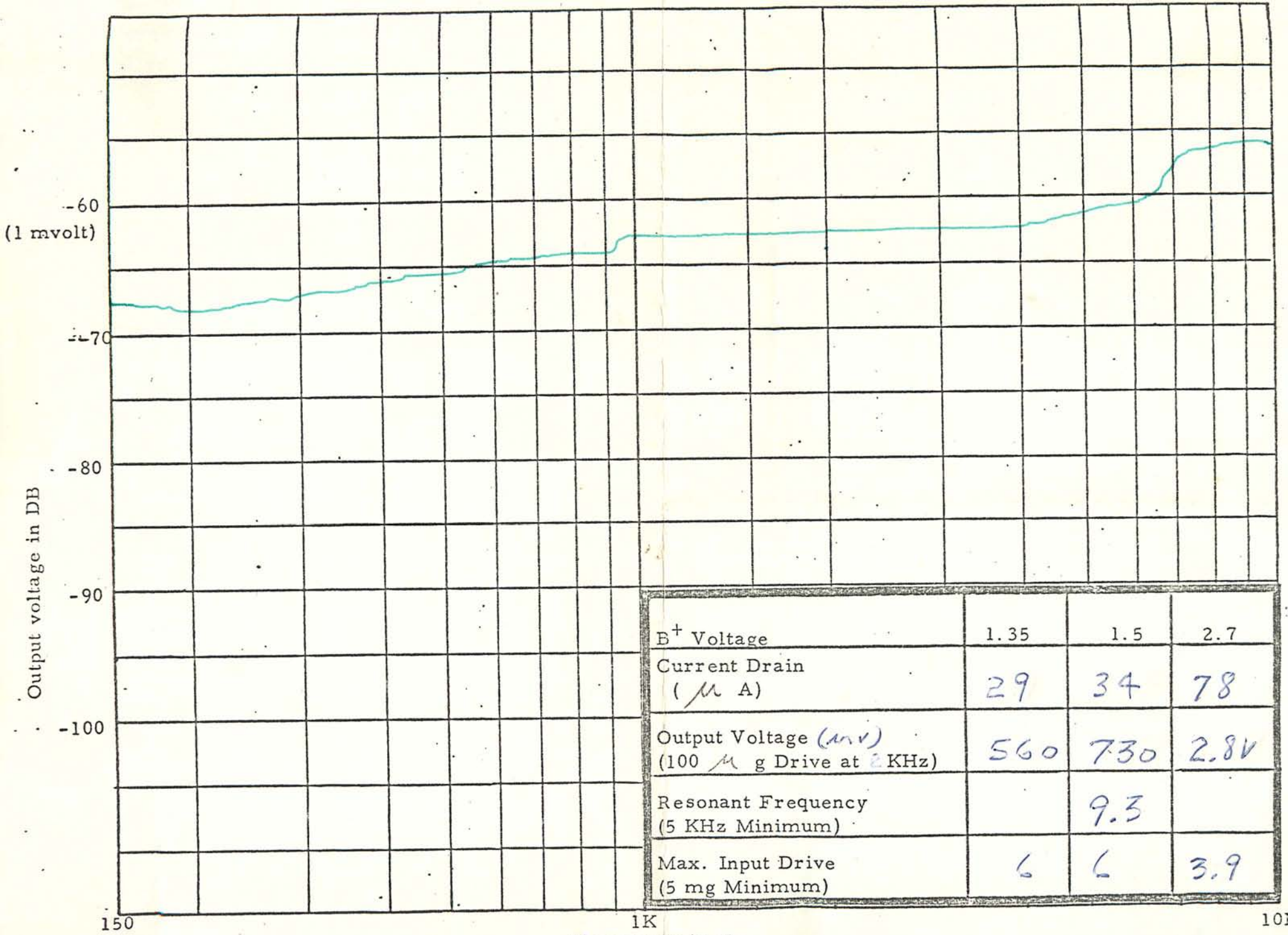
Open circuit voltage

44

Rec. No.:
Date: 1 DEC 1970
Sign.:
Rect.:
Zero Lev.:
L. Lim. Fr.:
Pot.:
Wr. Sp.:
Paper Sp.:
Multiply Freq. Scale by:



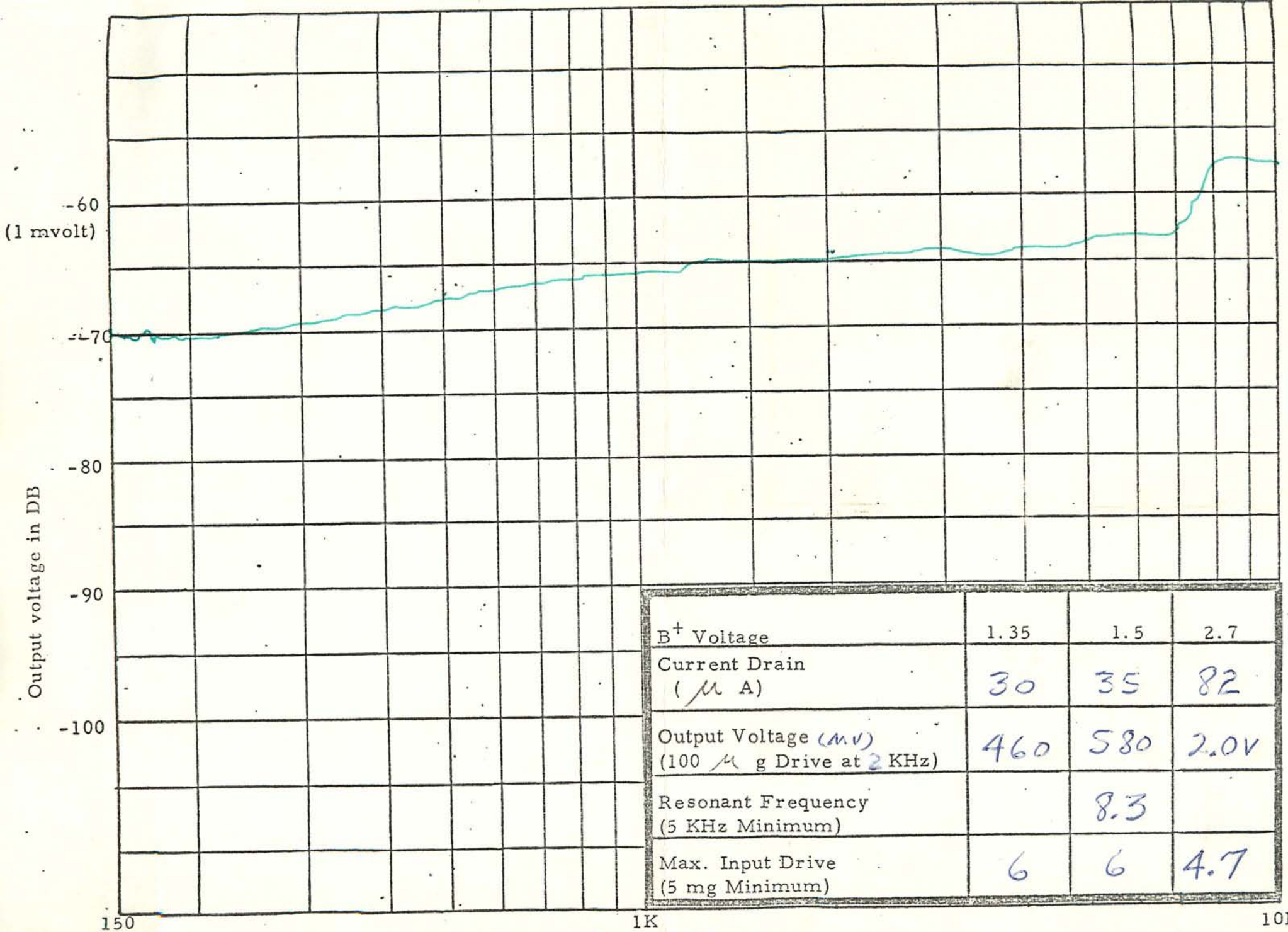
QP 1123



B^+ Voltage	1.35	1.5	2.7
Current Drain (μ A)	29	34	78
Output Voltage (mV) (100 μ g Drive at 2 KHz)	560	730	2.8V
Resonant Frequency (5 KHz Minimum)		9.3	
Max. Input Drive (5 mg Minimum)	6	6	3.9

SHEAR TUBE TRANSDUCER RESPONSE
WITH 100 μ g ACCELERATION DRIVE

Serial No. S-507



B^+ Voltage	1.35	1.5	2.7
Current Drain (μ A)	30	35	82
Output Voltage (MV) (100 μ g Drive at 2 KHz)	460	580	2.0V
Resonant Frequency (5 KHz Minimum)		8.3	
Max. Input Drive (5 mg Minimum)	6	6	4.7

SHEAR TUBE TRANSDUCER RESPONSE
WITH 100 μ g ACCELERATION DRIVE

Serial No. S-499