NO. UMTA-MA-06-0031-73,XI

ELECTROMAGNETIC ENVIRONMENT MEASUREMENTS OF PRT SYSTEMS AT "TRANSPO®72" VOLUME XI TTI SYSTEM

Earl E. Jamison

JANUARY 1974

FINAL REPORT

DOCUMENT IS AVAILABLE TO THE PUBLIC THROUGH THE NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VIRGINIA 22151.

Prepared for

DEPARTMENT OF TRANSPORTATION
URBAN MASS TRANSPORTATION ADMINISTRATION
OFFICE OF RESEARCH, DEVELOPMENT AND DEMONSTRATIONS
Washington DC 20590

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Cotolog No.
UMTA-MA-06-0031-73,XI		

4. Title and Subtitle	5. Report Date
ELECTROMAGNETIC ENVIRONMENT MEASUREMENTS OF PRT SYSTEMS AT "TRANSPO®72", V. II. VOLUME XI - TTI SYSTEM.	January 1974
	6. Performing Orgonizotion Code
7. Author(s) Earl E. Jamison	8. Performing Orgonizotion Report No. DOT-TSC-UMTA-73-15,XI
9. Performing Orgonizotion Nome ond Address National Scientific Laboratories, Inc. Westgate Research Park McLean VA 22101*	10. Work Unit No. (TRAIS) UM409/R4716 11. Contract or Gront No. DOT-TSC-375, 11
12. Sponsoring Agency Nome ond Address Department of Transportation Urban Mass Transportation Administration Office of Research, Development and Demon. Washington DC 20590	13. Type of Report ond Period Covered Final Report Jan - Sep 1972 14. Sponsoring Agency Code

15. Supplementory Notes

*under contract to Department of Transportation, Transportation Systems Center, Kendall Square, Cambridge MA 02142

16. Abstroct

This report covers the measurements of the broadband conducted noise present on the A.C. power lines feeding the Personalized Rapid Transit (PRT) systems at Dulles Airport with each system operating individually.

The purpose of the measurement effort was to evaluate the electrical environment existing on each of the PRT "hot" and neutral A.C. power lines and to assess the effect of each system on the power line with all other PRT systems turned off.

The measurements obtained during this test will be used for a comparison with data obtained with no PRT systems operating and with all four PRT systems operating simultaneously.

17. Key Words	18. Distribution Stotement
Broadband, Conducted, A.C. Power Line, Individual Operation, Personalized Rapid Transit	DOCUMENT IS AVAILABLE TO THE PUBLIC THROUGH THE NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VIRGINIA 22151.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	28	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

PREFACE

The work described in this report was performed as part of a test program conducted to evaluate the Safety and Performance characteristics of the four Personalized Rapid Transit Systems (PRT) on display at Transpo® 72. Sponsored by the U.S. Department of Transportation, Transpo® 72 was the first United States International Transportation Exposition and was intended to demonstrate to the general public new technologies in transportation.

The PRT demonstration program was the responsibility of the Urban Mass Transportation Administration (UMTA) and was conducted to provide detailed engineering test data in addition to providing mature candidates for an Urban demonstration.

POWER LINE CONDUCTED NOISE MEASUREMENTS

TTI SYSTEM - TRANSPO®'72

1. INTRODUCTION

This technical report presents the data obtained in the performance of tests for power line conducted noise at the Personal Rapid Transit (PRT) System of Transportation Technology Incorporated (TTI) at TRANSPO®'72 - Dulles Airport, Washington, D. C. This report covers one of the four tests defined under Item 5 of Contract DOT-TSC-375, and as performed by National Scientific Laboratories.

Item 5 calls for the performance of conducted noise measurements on PRT a.c. power lines in the frequency range from d.c. to at least 10 kHz, with one PRT system on. The objective of the test was to gather operational data for each of the PRT systems. Such data will enable characterization of the noise increase attributable to system operations, when considered in comparison with the ambient data collected and documented* previously by NSL.

*Technical Report, Item 4, Ambient Power Line Conducted Noise Survey, PRT Systems, March 1972, Contract No. DOT-TSC-375, Department of Transportation, Transportation Systems Center, 55 Broadway, Cambridge, Massachusetts 02142.

The measurements reported in this document were made during the forenoon of July 25, 1972.

2. METHOD OF MEASUREMENT

2.1 Instruments

All measurements were made using test set-ups and instruments as nearly identical as possible to those used during ambient testing. The power-line conducted measurements were performed using a Fairchild Model EMC-10 Interference Analyzer. This device is a battery-operated calibrated RFI/EMI meter, which, when operated as a narrowband tunable device, covers the frequency range of d.c. to 50 kHz. The receiver has an internal calibration source and incorporates a meter circuit of such design that signal levels are expressed in decibels on a linear scale. In addition, the receiver incorporates circuitry providing buffered voltage outputs in proportion to meter indication and tuned frequency: A Hewlett Packard Model 3005B X-Y Plotter was driven from the receiver.

Signals were obtained from the power lines by means of a Fairchild Model PCL-10 Current Probe. This device is a clamp-on current transformer which provides an output voltage in proportion to the current on the conductor which passes through its aperture. This probe has a specified tranfer-admittance characteristic which is a function of frequency.

2.2 Power Line Arrangement

The power provided to the PRT site via an underground feeder is 480 v.a.c., 3 phase (Ø). These feeder lines enter commercial switchgear in the TTI building and are coded as follows:

PHASE	COLOR CODE
A	Orange
B	Brown
C	Yellow
Neutral	Noncoded

The current probe was attached at the point where the feeders enter the switchgear which is the same point as used when making the ambient tests described in report Item 4.

2.3 Measurement Technique

Each of the four power conductors were tested by scanning two frequency ranges, d.c. to 1 kHz using a 5 Hz bandwidth, and 1 kHz to 50 kHz using a 50 Hz bandwidth. Two recordings have been made for each frequency range, on each of the four power lines. The scanning time per recording averaged 4 to 6 minutes.

These recordings are reproduced in the Appendix as the upper half of Pages A-2 through A-17. The recordings are presented in order of phase rather then the order in which they were produced. The dB scale refers to the level at the instrument input connector.

Note that in some of the charts there are two scales indicated -- the upside down letter "Y" located somewhere along the bottom line of the chart indicates the point of switchover from the scale on the left side to the scale on the right side.

3. INTERPRETATION OF DATA

The amplitude/frequency charts produced during the test are reproduced in the upper half of each page in Appendix A. The lower chart on each page is a plot of levels within each major frequency increment generally showing peaks when available. A correction factor for the current probe (current probe amplitude response is non-linear with frequency) has been added to arrive at the levels plotted in the lower chart.

In the upper charts, noise peak recorded in the top major division are out of the calibrated range of the instrumentation system. Thus, the levels plotted for peaks that enter the upper division are plotted as having an amplitude of the highest level indicated numerically on the chart for that particular frequency.

Notations are written on the charts which denote vehicle movements occurring simultaneously with a noise peak. For the most part, the notations refer to docking and undocking operations at the station which were observed throughout the frequency range up to 50 kHz. Noises recorded during vehicle running on guideway were mostly in the frequency region below 20 kHz.

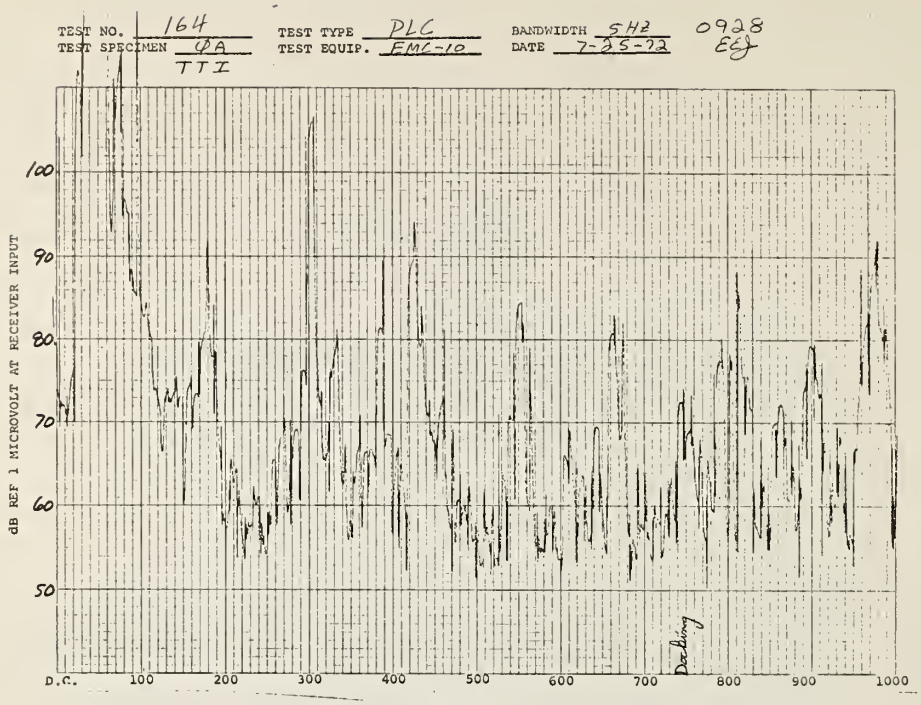
4. TIME LOG

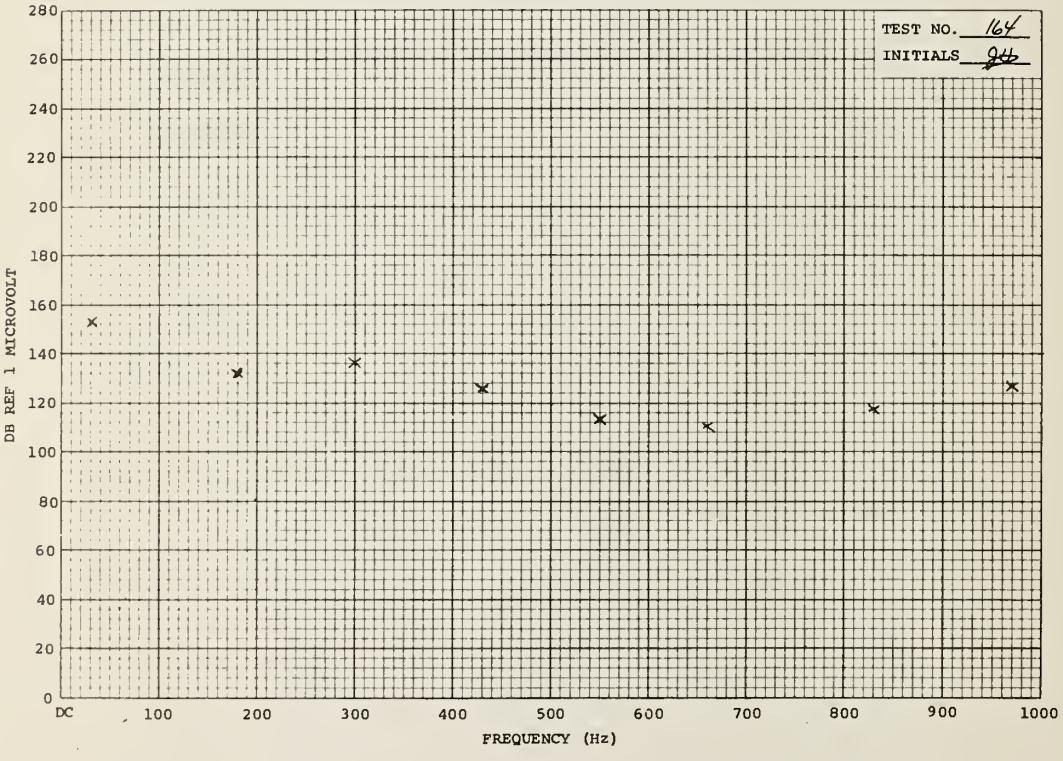
TTI had two vehicles operating continuously during the test period -- 0800 to 1200 o'clock -- and therefore did not consider it necessary to provide a statement to this fact since the test team was cognizant of their operation.

APPENDIX A

POWER LINE CONDUCTION MEASUREMENTS DATA

Contains data charts for Test No. 160 through 175. The charts are presented in order of phase -- A, B, C, Neutral -- for ease of analysis, rather than in numerical order as the tests were performed.


TEST NO. 164
TEST SPECIMEN QA TTI
TEST TYPE PLC
TEST EQUIP. EMC-10
BANDWIDTH 5Hz
DATE 7-25-72
0928
EEJ
dB REF 1 MICROVOLT AT RECEIVER INPUT
100
90
80
70
60
50
D.C.
100
200
300
400
500
600
700
800
900
1000
Dowling

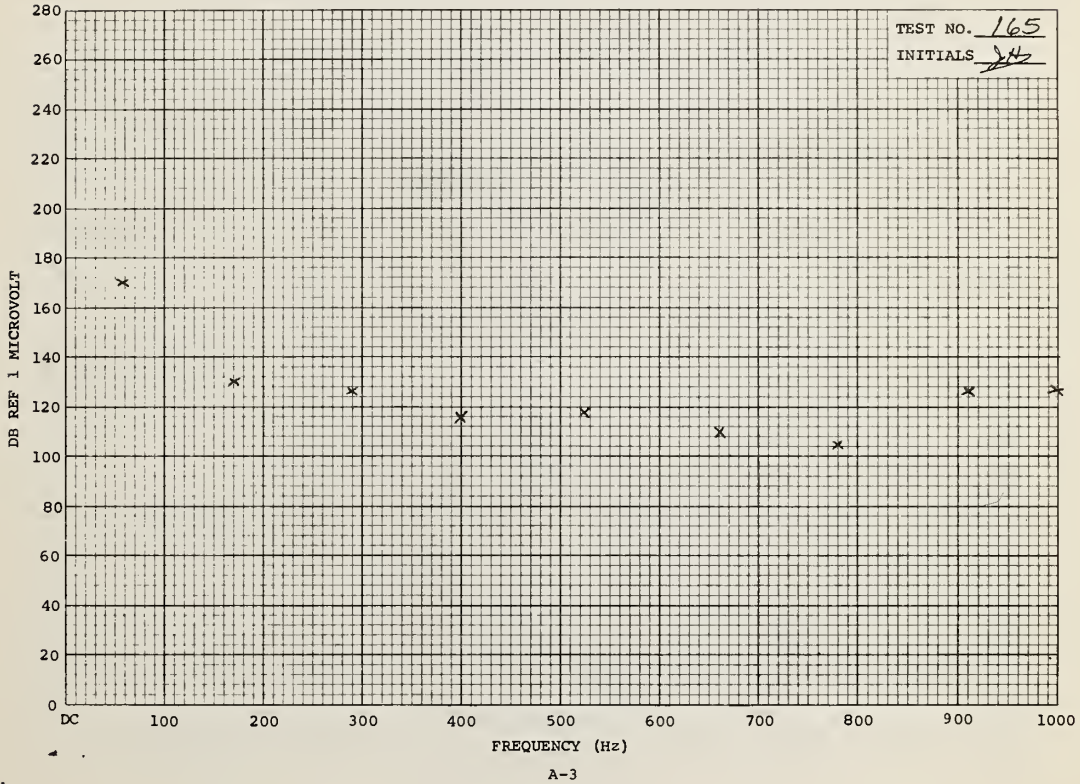

TEST NO. 164
INITIALS
DB REF 1 MICROVOLT
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
DC
100
200
300
400
500
600
700
800
900
1000
FREQUENCY (Hz)

TEST NO. 165
TEST SPECIMEN ØA
TTI

TEST TYPE PLC
TEST EQUIP. EMC-10

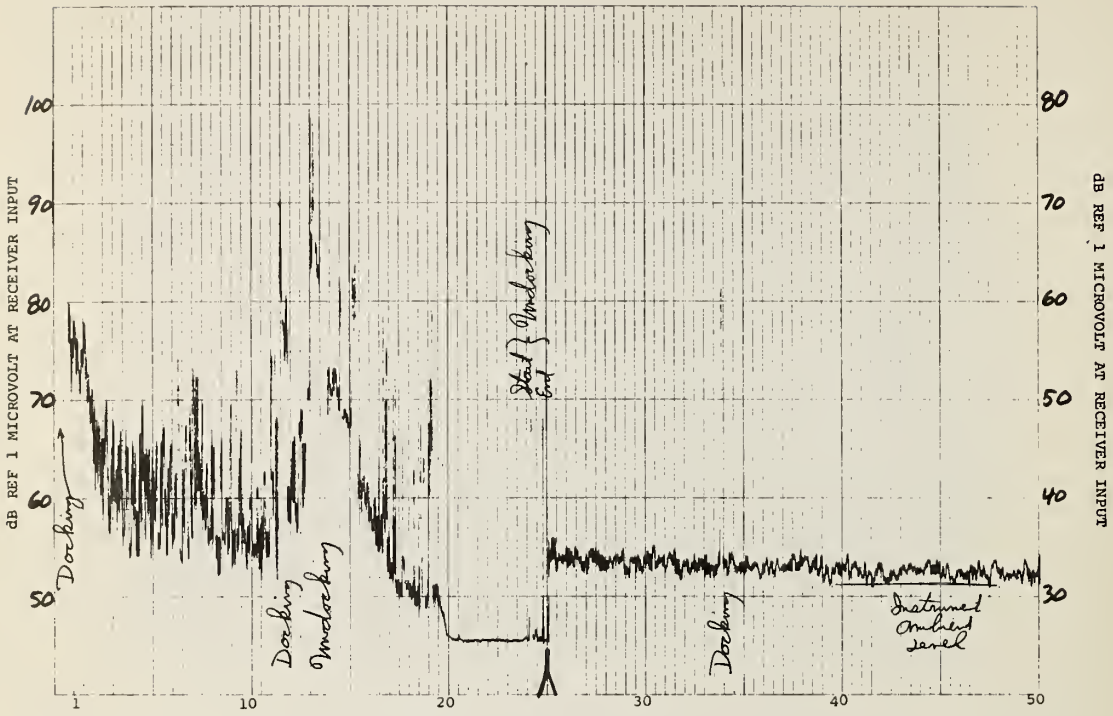
BANDWIDTH 5Hz
DATE 7-25-72

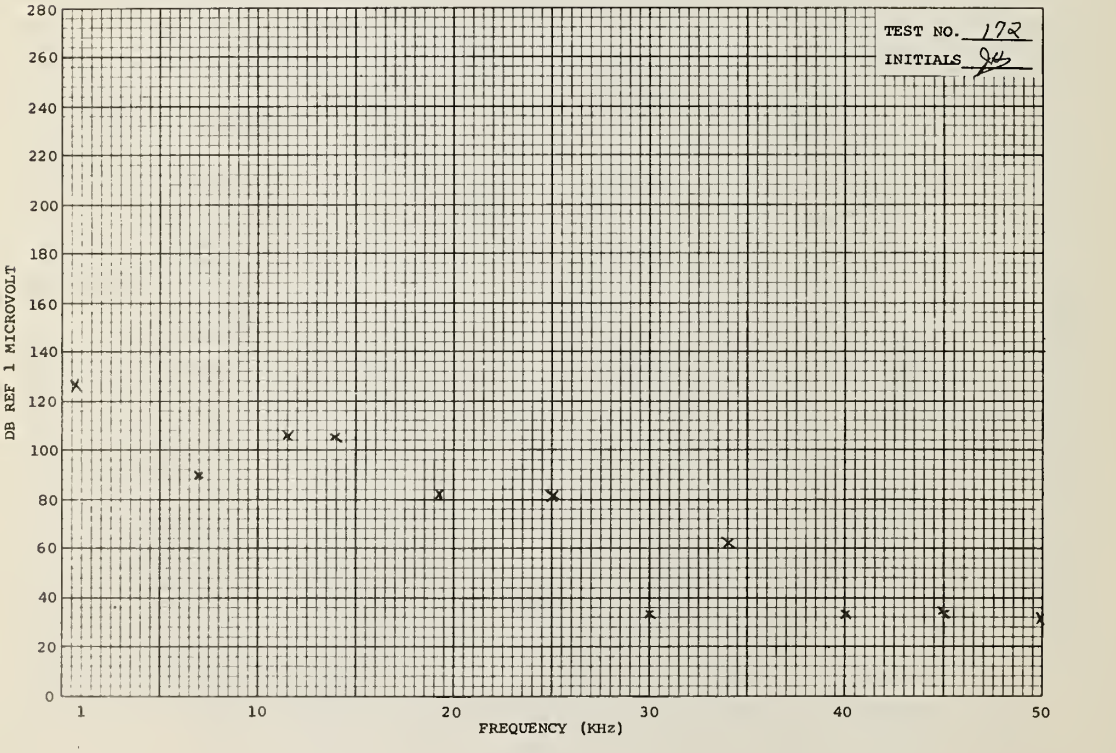
0934
EJ



TEST NO. 172 TEST TYPE PLC BANDWIDTH 50Hz
TEST SPECIMEN ØA TEST EQUIP. EMIC-10 DATE 7-25-72
TTI

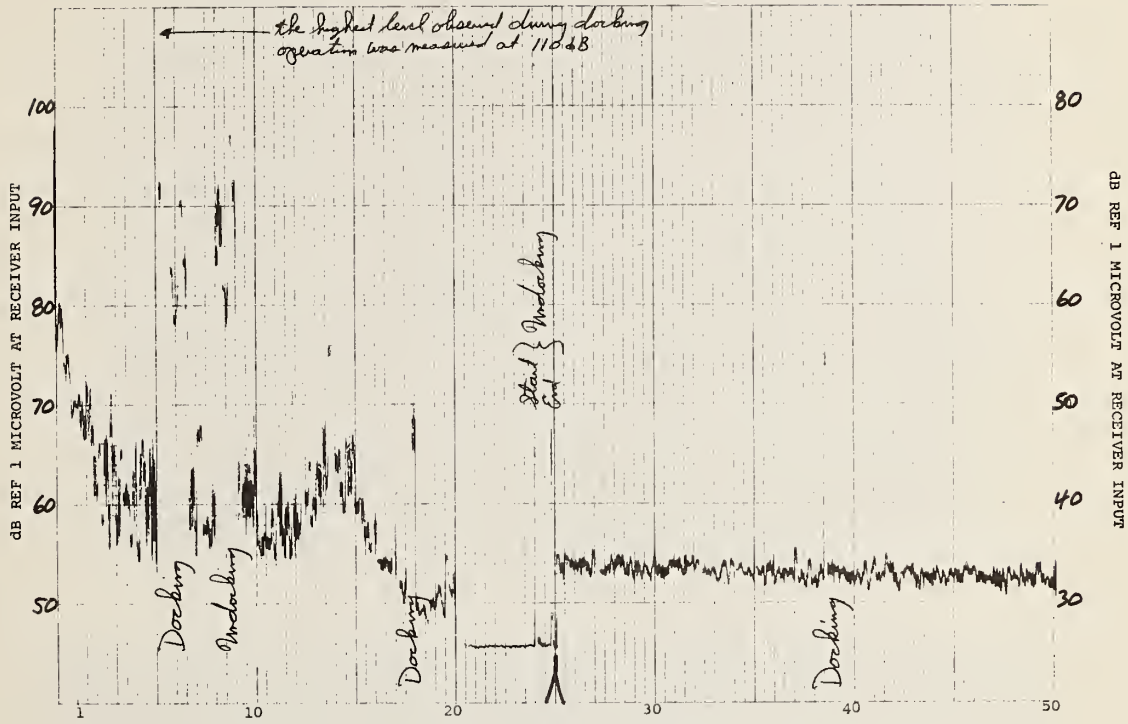
1044
JRC

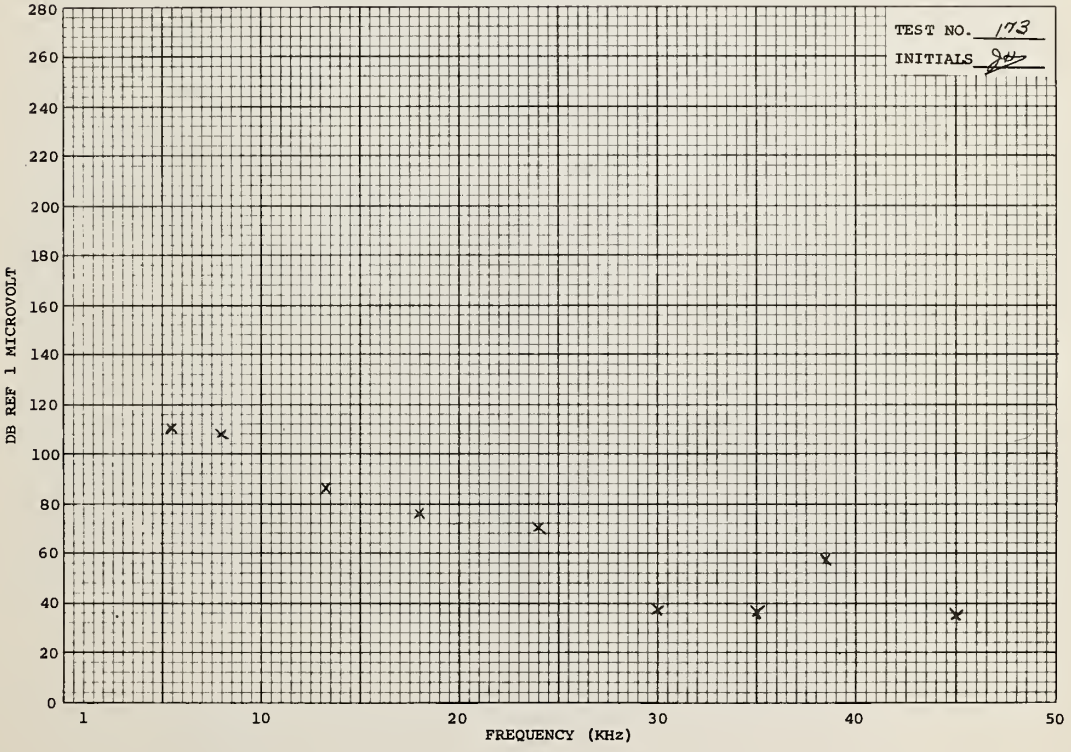




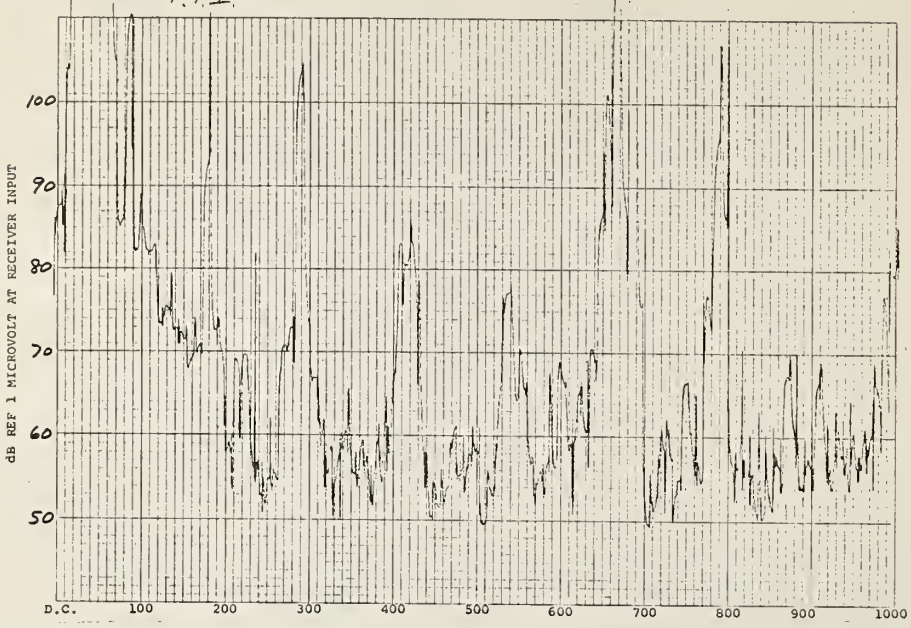
TEST NO. 173 TEST TYPE PLC BANDWIDTH 50Hz
TEST SPECIMEN QA TEST EQUIP. EMC-10 DATE 7-15-72
TTI

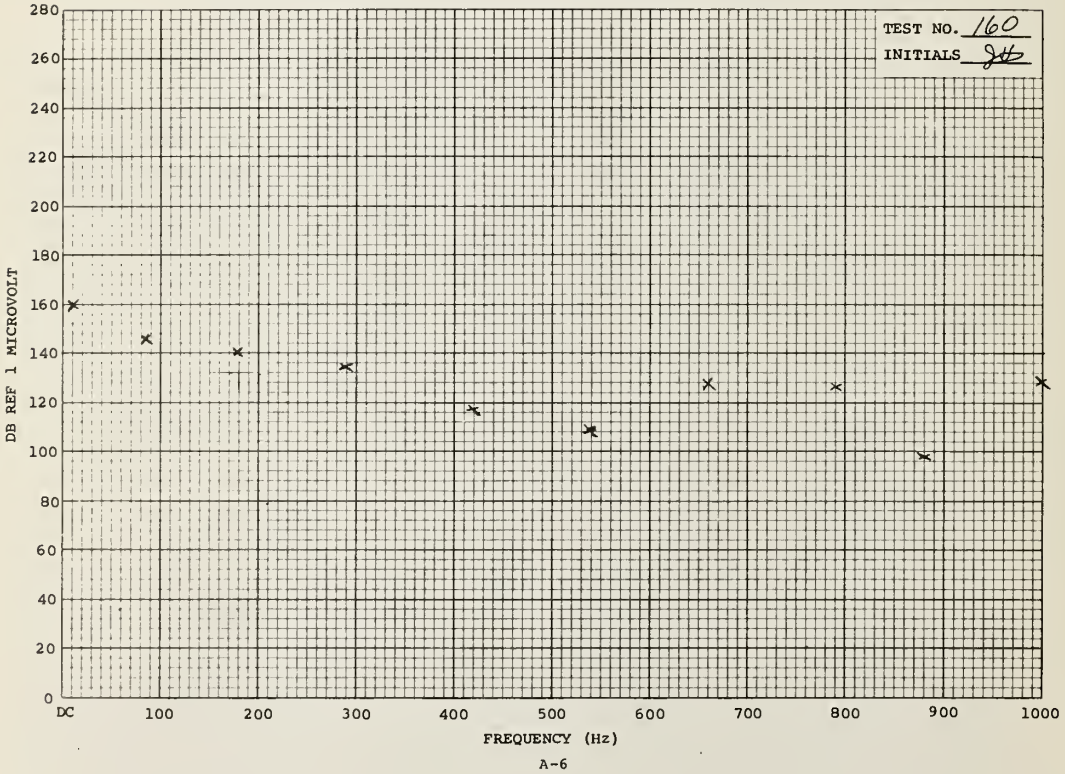
1054
USS



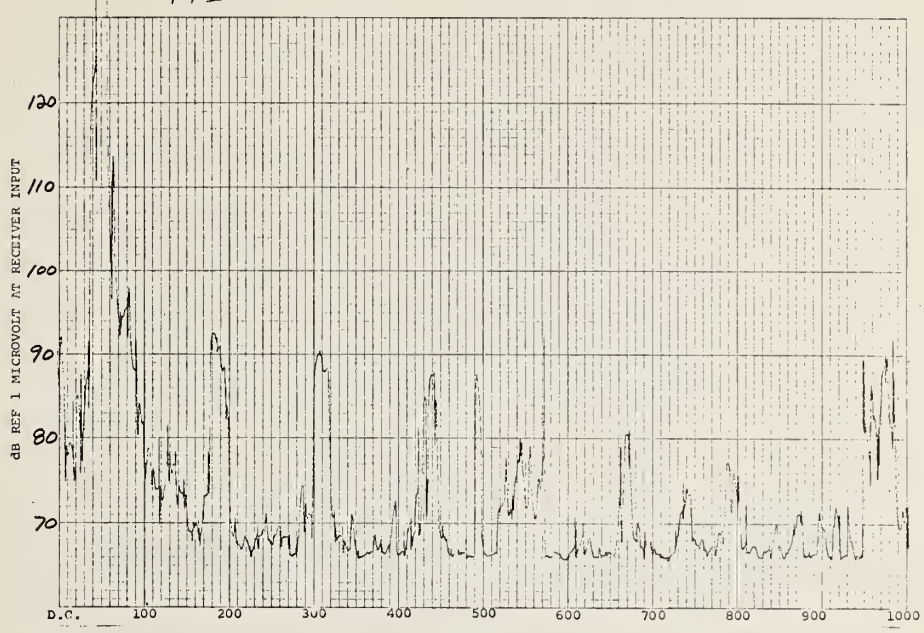


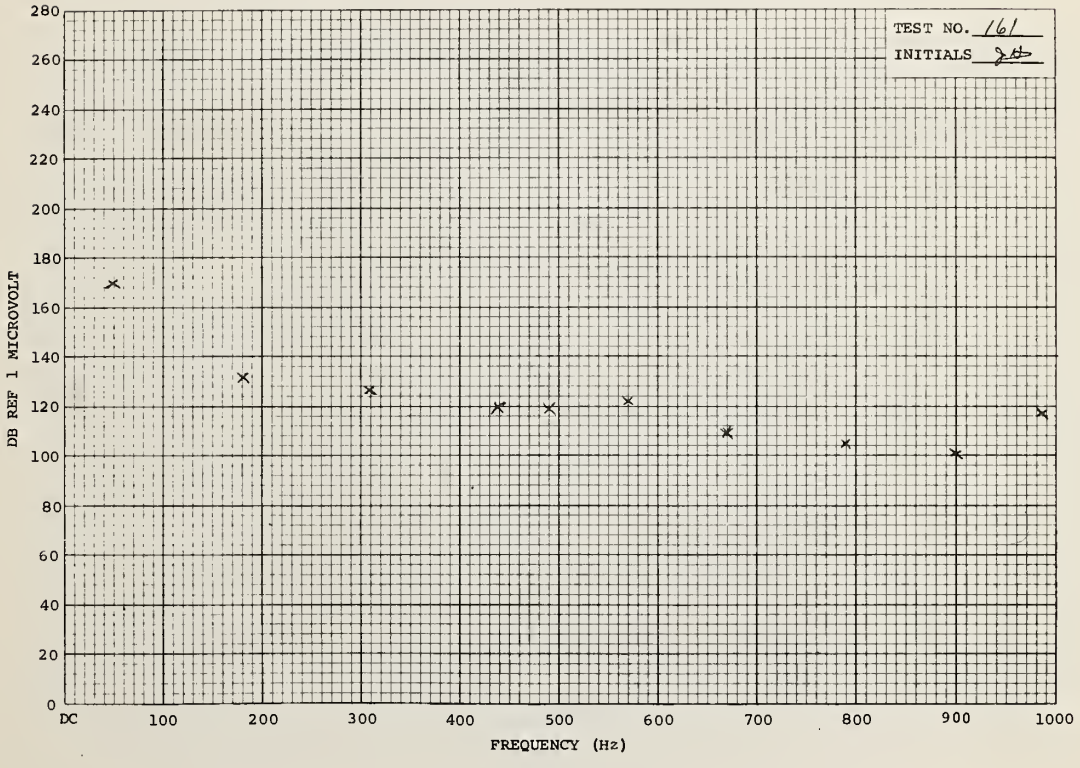
TEST NO. 160 TEST TYPE PLC BANDWIDTH 5HZ 9:00 a.m.
TEST SPECIMEN ØB T.T.I. TEST EQUIP. EMC-10 DATE 7-25-72 EJ



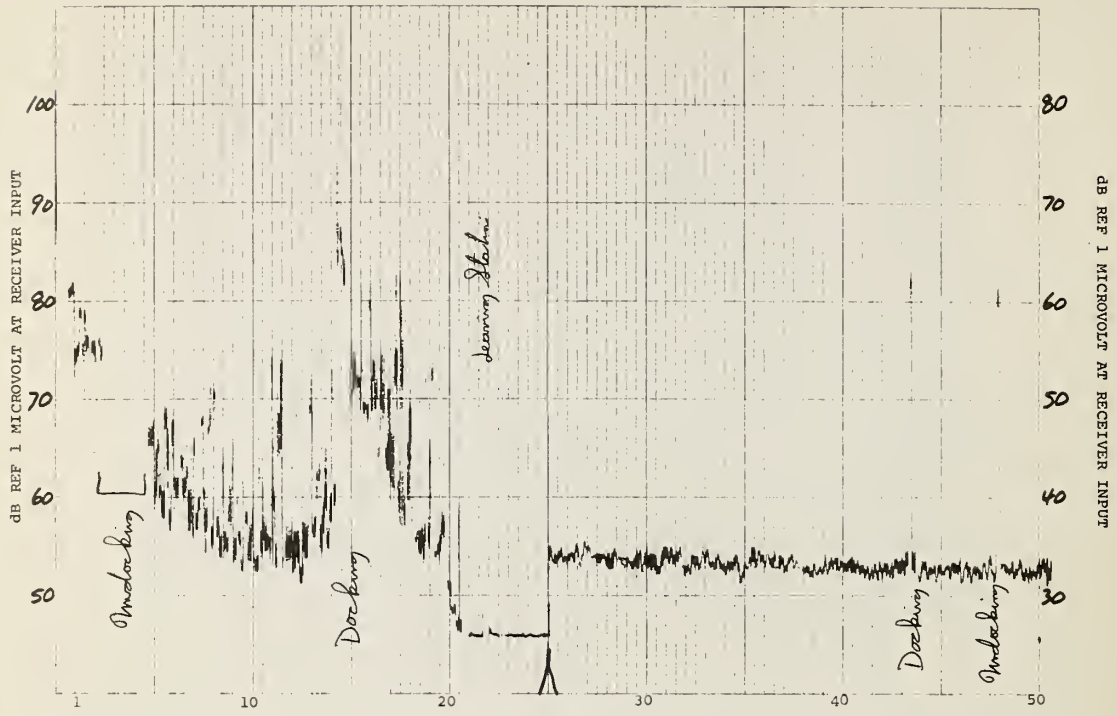


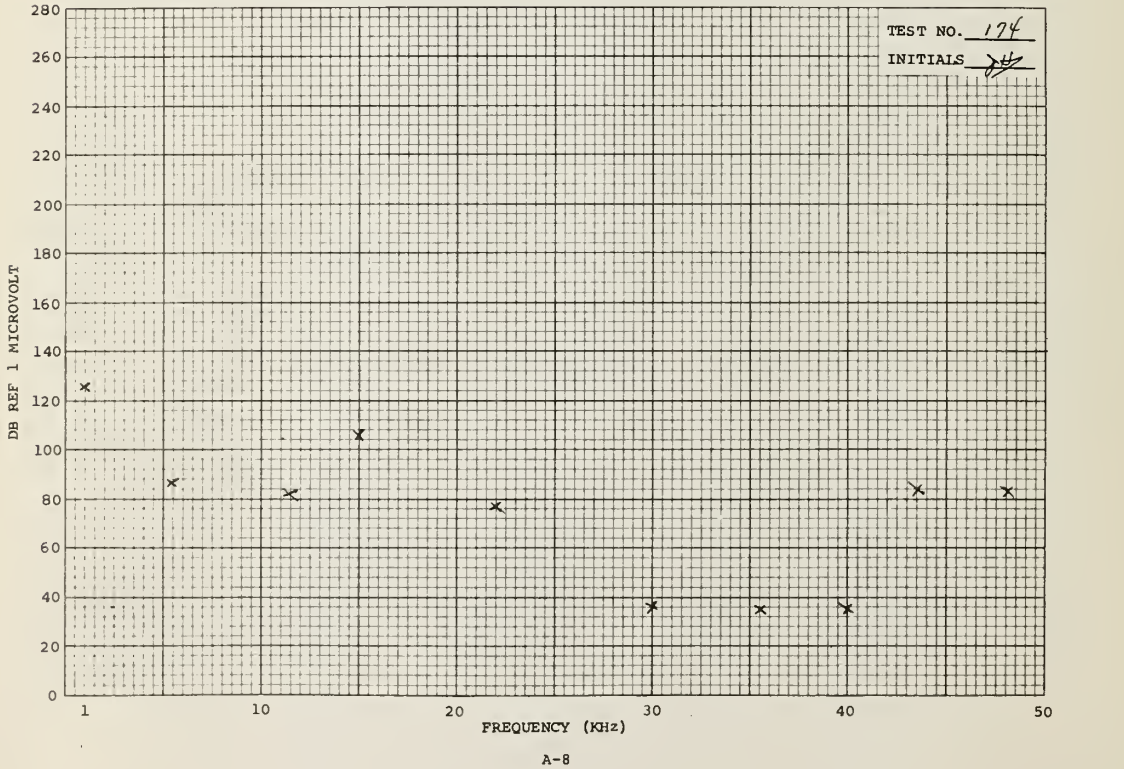
TEST NO. 161 TEST TYPE PLC BANDWIDTH 5 HZ 9:090 A.M.
TEST SPECIMEN ϕB TTI TEST EQUIP. EMC-10 DATE 2-25-72 EJ





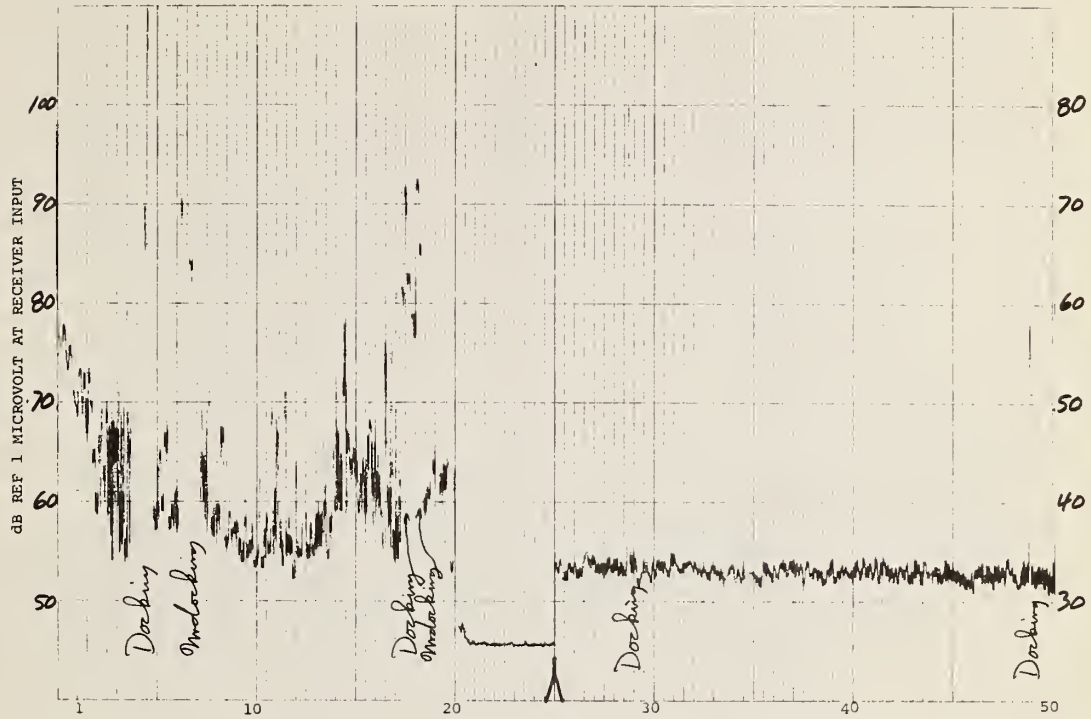
TEST NO. 174 TEST TYPE PLC BANDWIDTH 50Hz 1106
TEST SPECIMEN ØB TEST EQUIP. EMC-10 DATE 7-25-72 JAC
TTI

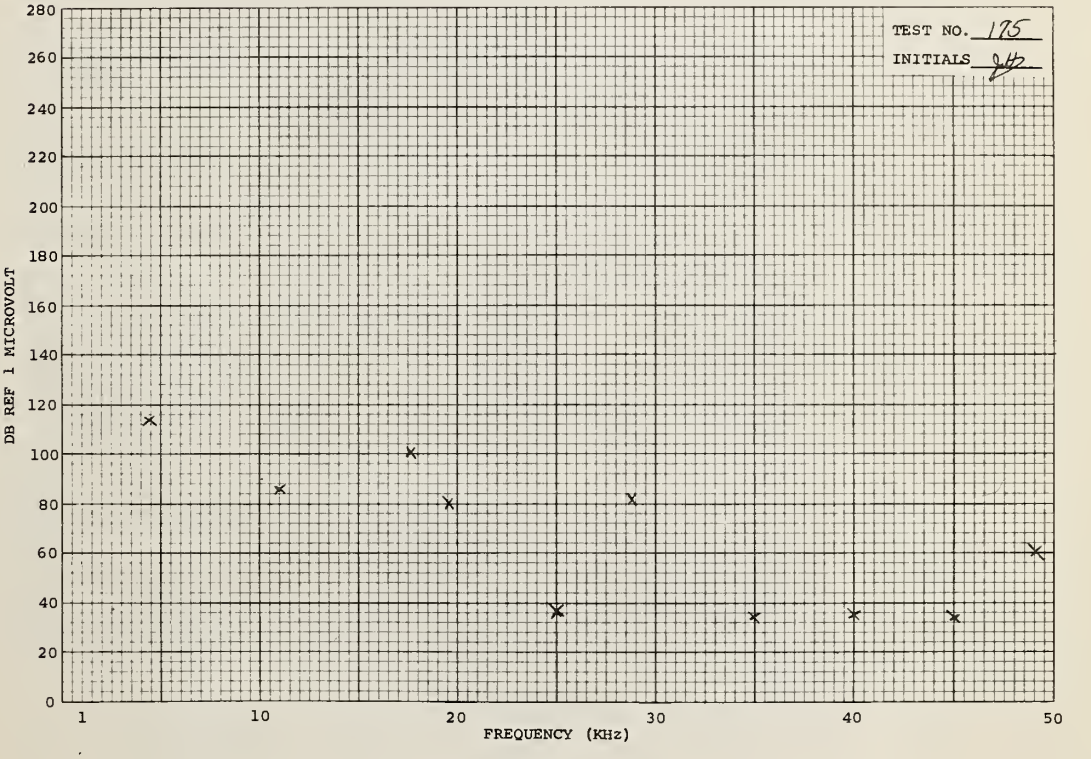




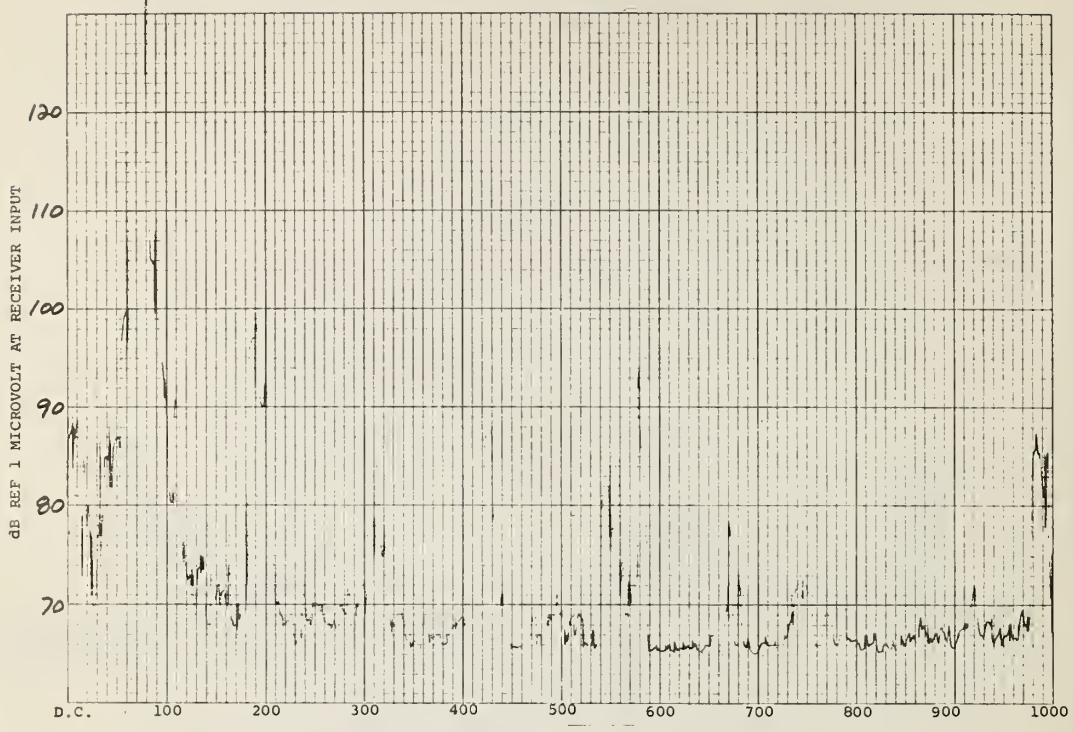
TEST NO. 175 TEST TYPE RLC BANDWIDTH 50Hz
TEST SPECIMEN QB DATE 7-25-72
TTI

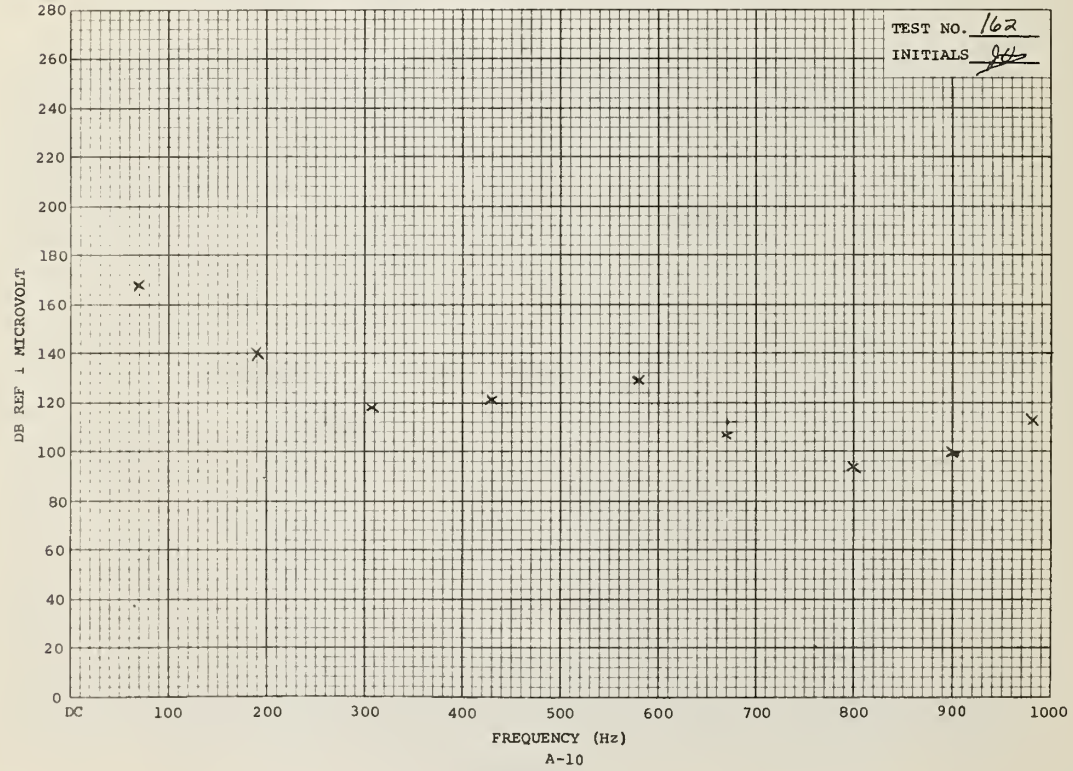
1112
JRC



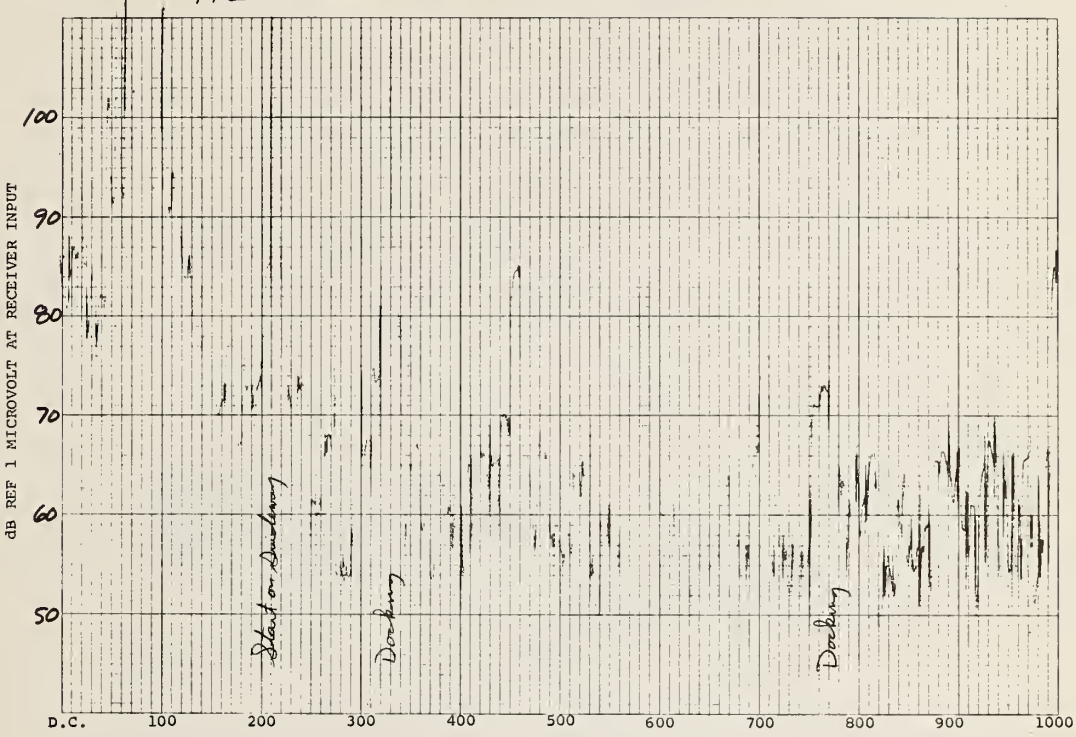


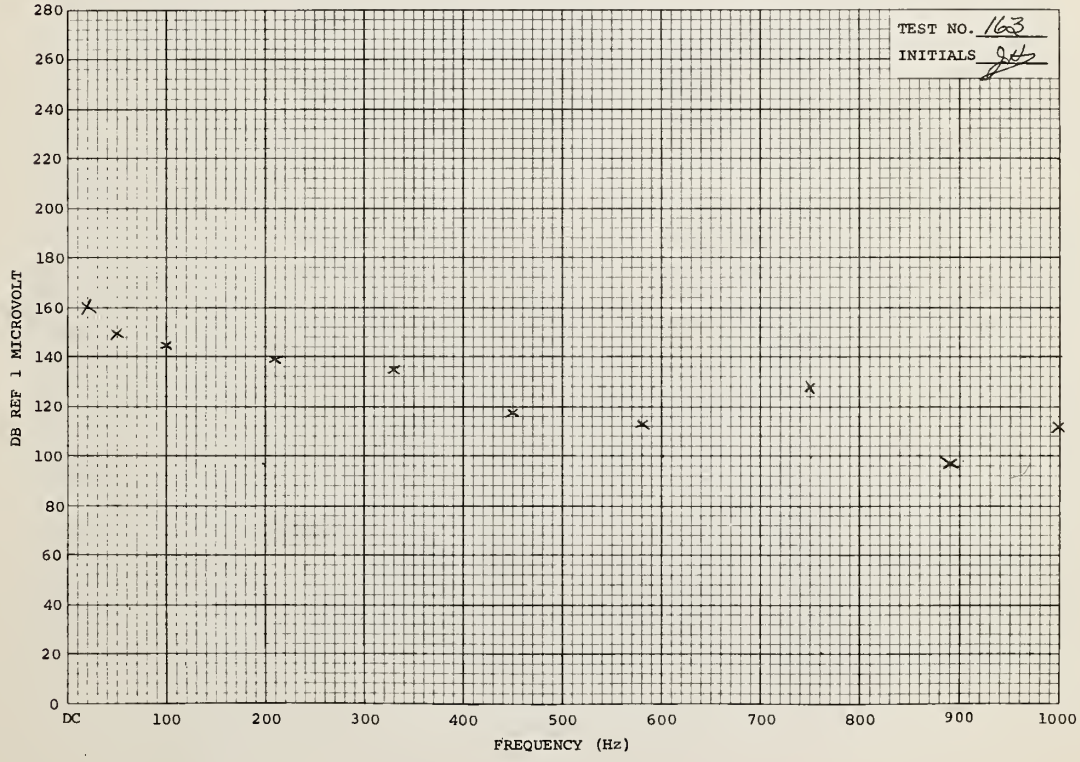
TEST NO. 162 TEST TYPE PLC BANDWIDTH 5 HZ 0914
TEST SPECIMEN ØC TEST EQUIP. EMC-10 DATE 7-25-72 EEJ
TTI





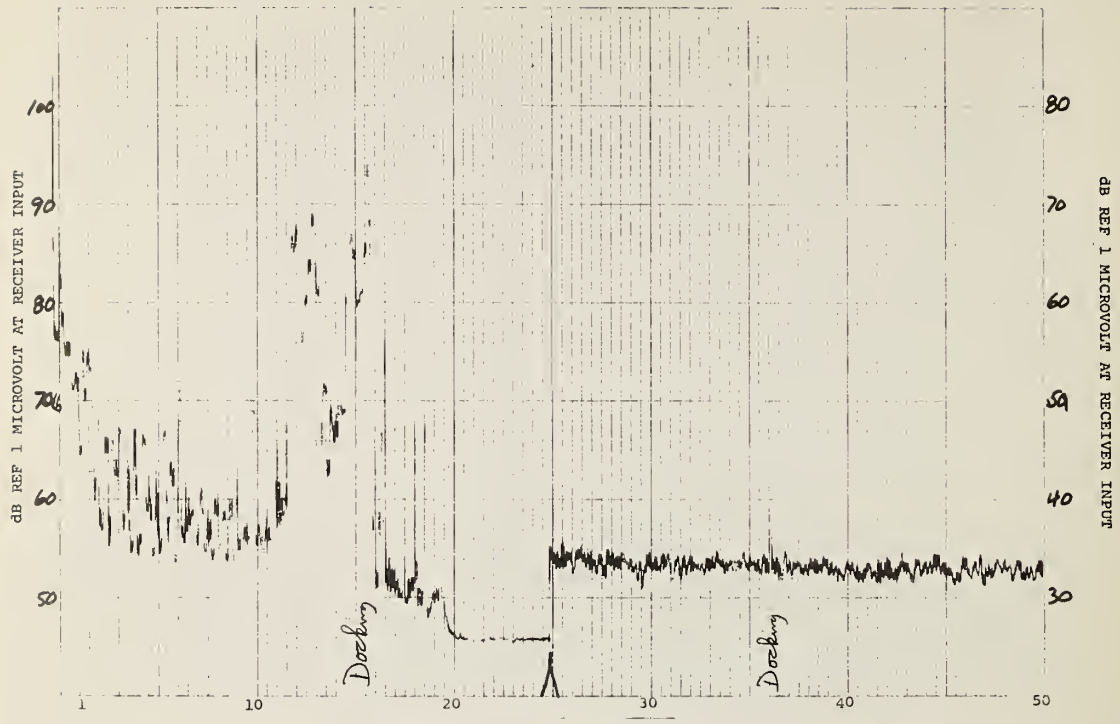
TEST NO. 163 TEST TYPE PLC BANDWIDTH 5 Hz 0921
TEST SPECIMEN ΦC TEST EQUIP. EMC-10 DATE 7-25-72 EEJ
TTI

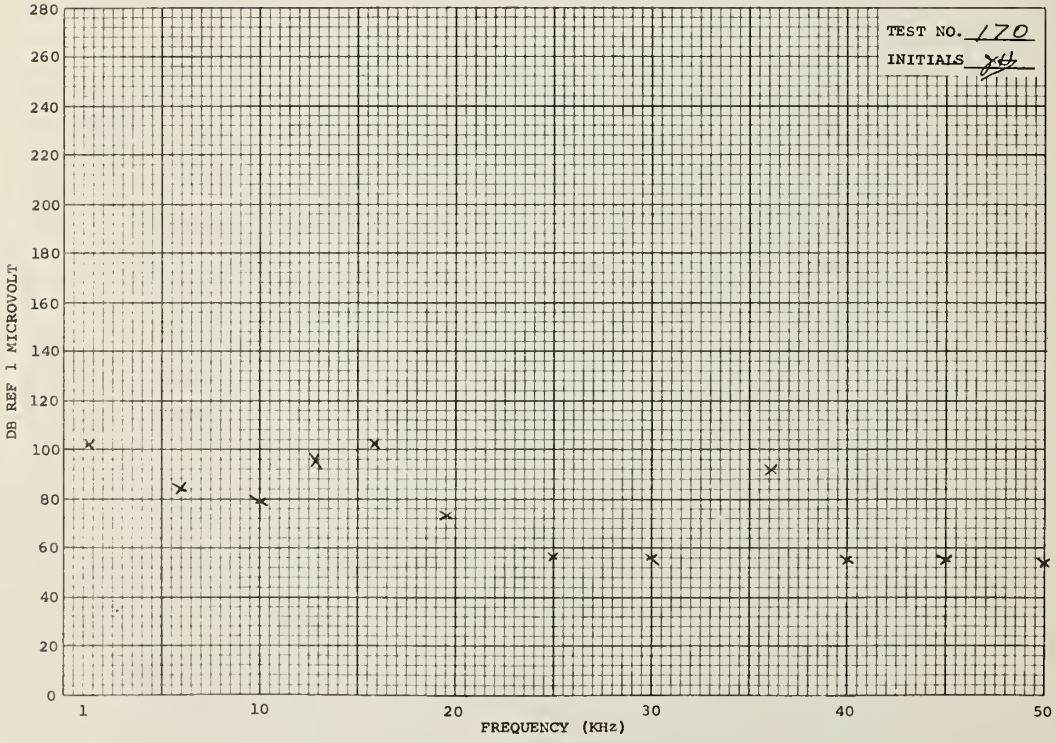




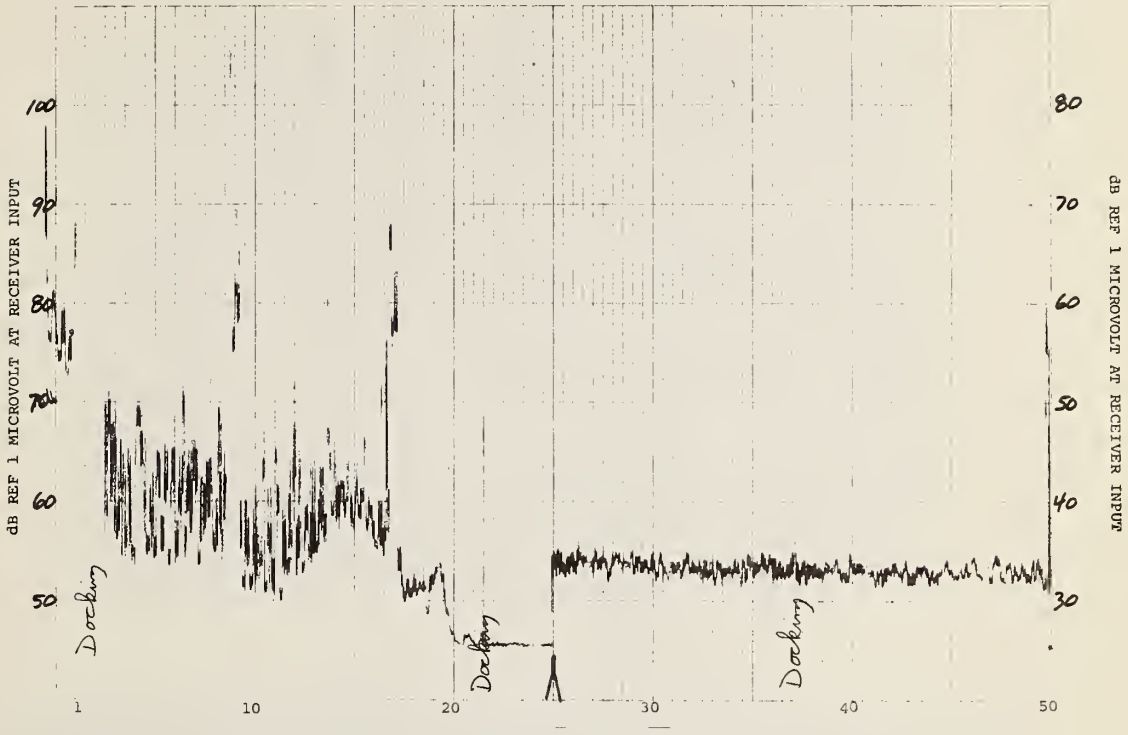
TEST NO. 170 TEST TYPE PLC BANDWIDTH 50 Hz
TEST SPECIMEN ØC TEST EQUIP. EMC-10 DATE 7-25-72
TTI

1028
302C

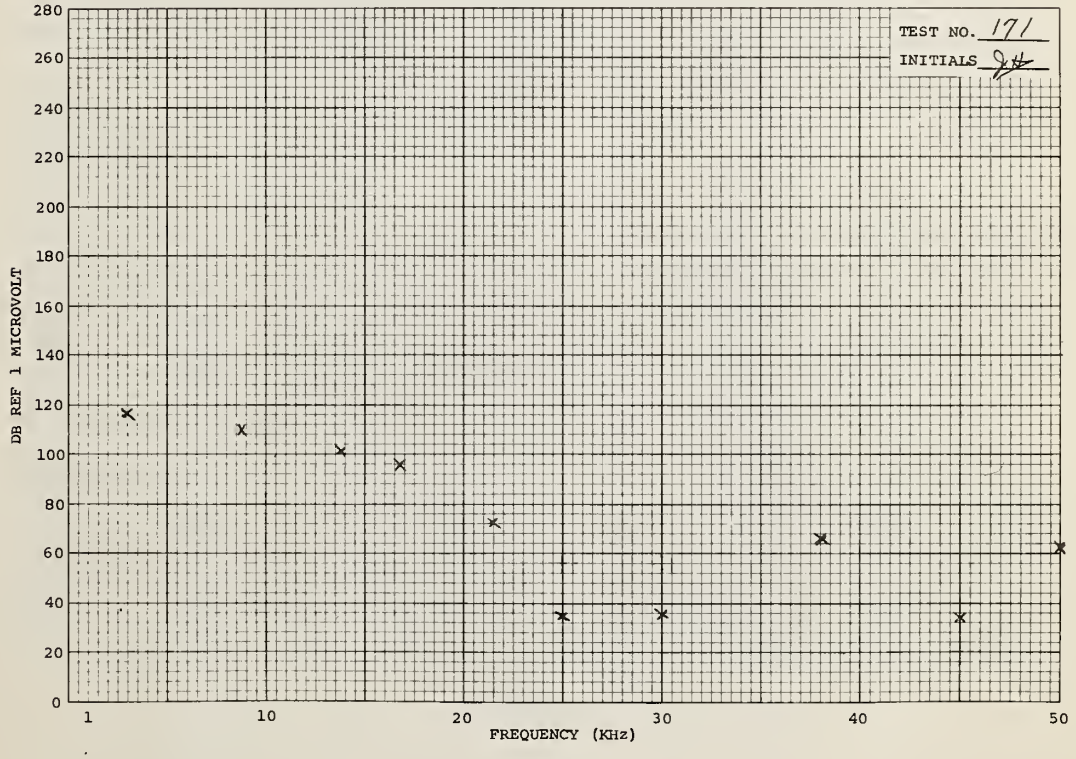




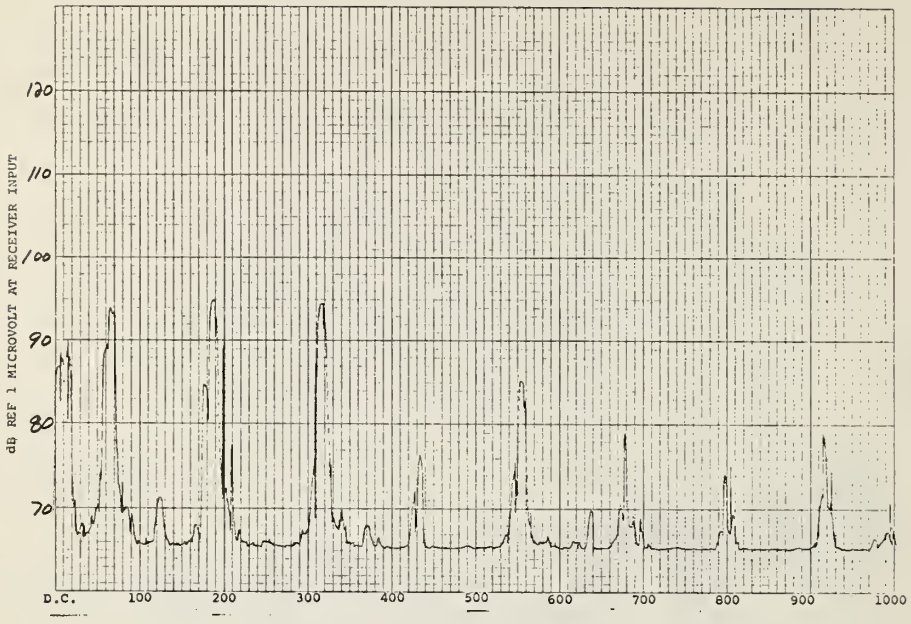
TEST NO. 171 TEST TYPE PLC BANDWIDTH 50 Hz 1036
TEST SPECIMEN QC TEST EQUIP. EMC-10 DATE 7-25-72 JRC
TTI

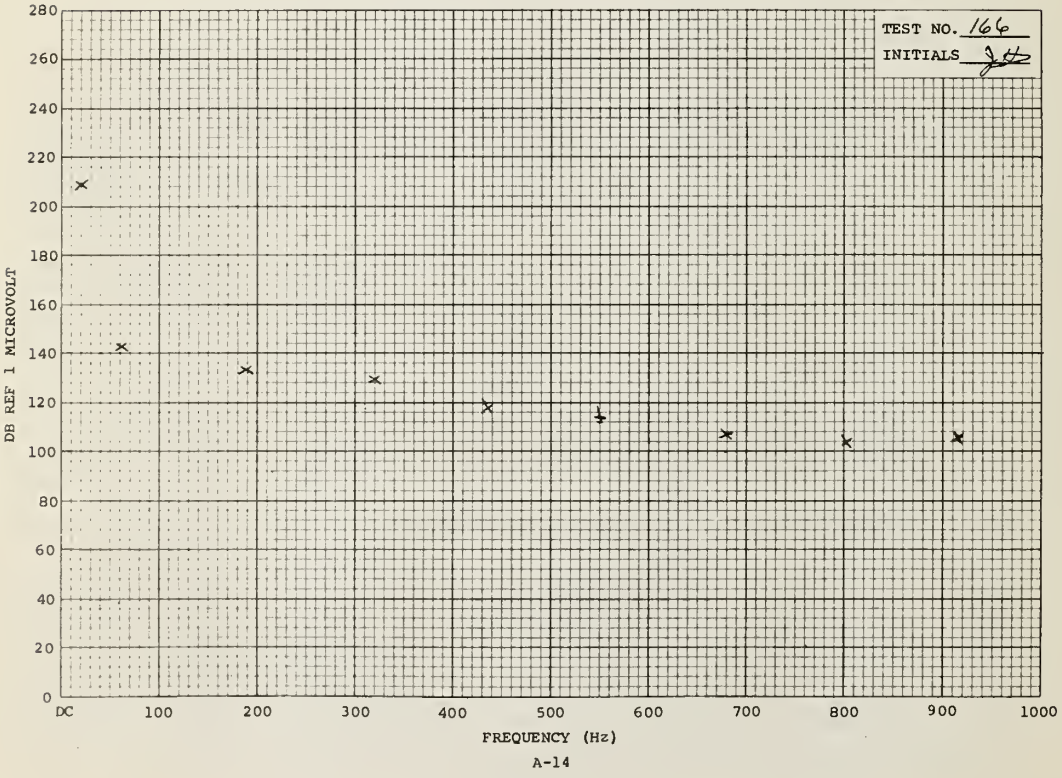


dB REF 1 MICROVOLT AT RECEIVER INPUT

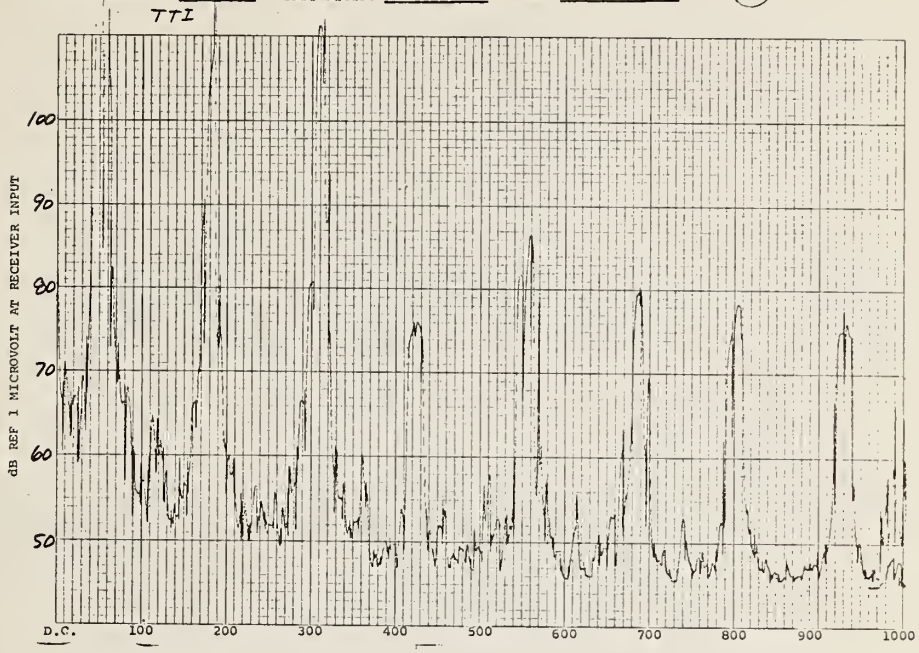


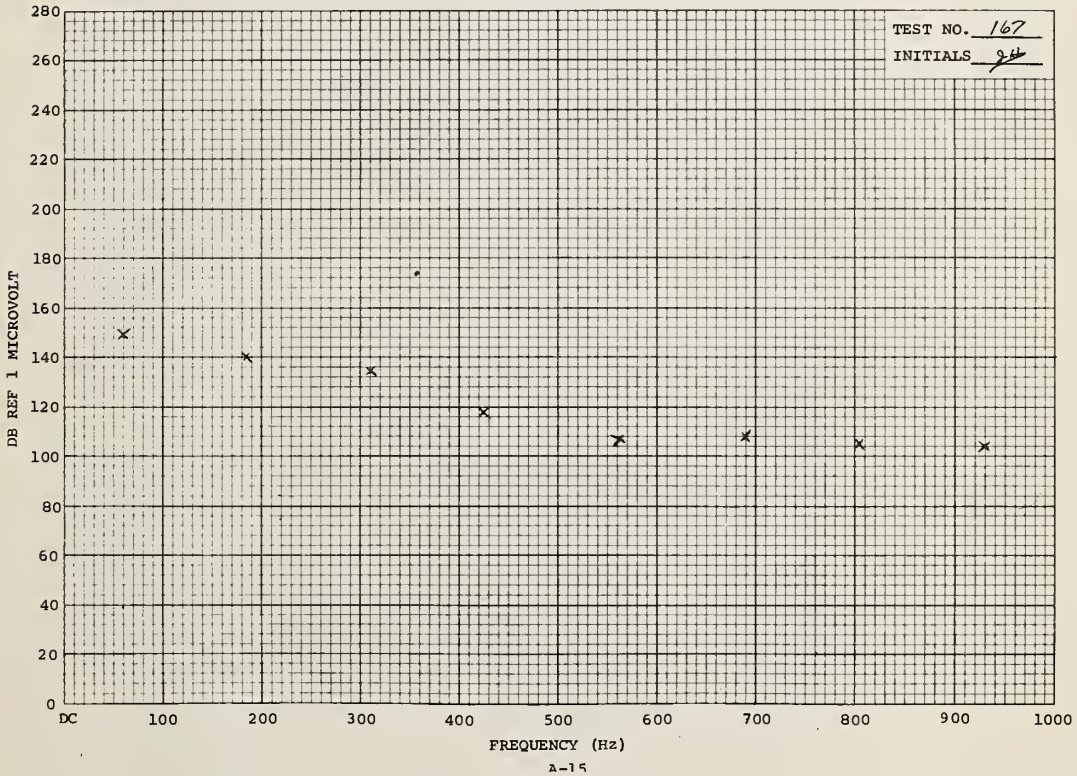
TEST NO. 166 TEST TYPE PLC BANDWIDTH 5Hz 0940
TEST SPECIMEN Neutral TTI TEST EQUIP. EMC-10 DATE 7-25-72 EEJ



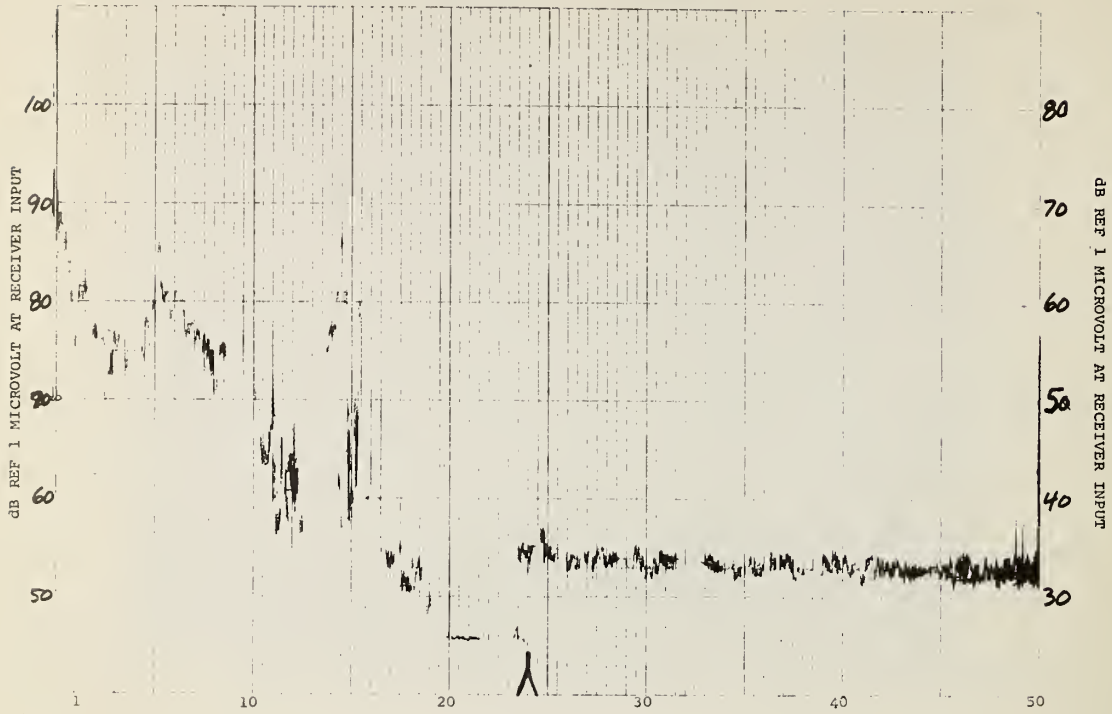


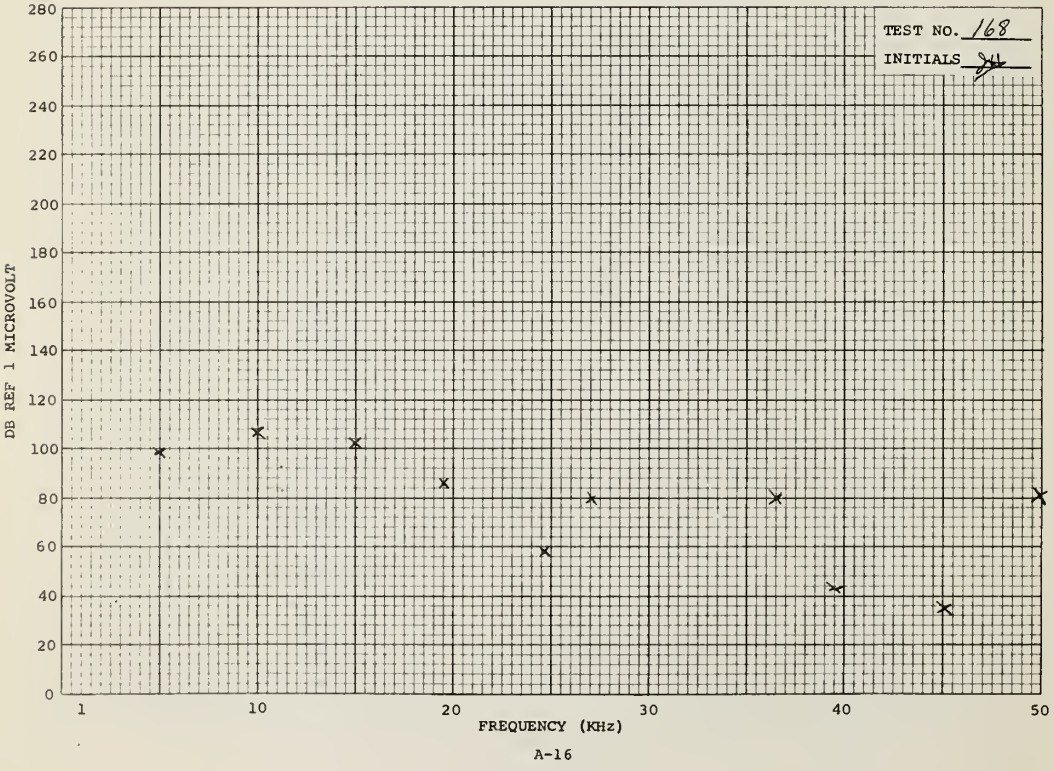
TEST NO. 167
TEST SPECIMEN Neutral TTI
TEST TYPE PLC
TEST EQUIP. EMC-10
BANDWIDTH 5HZ
DATE 7-25-72
0945

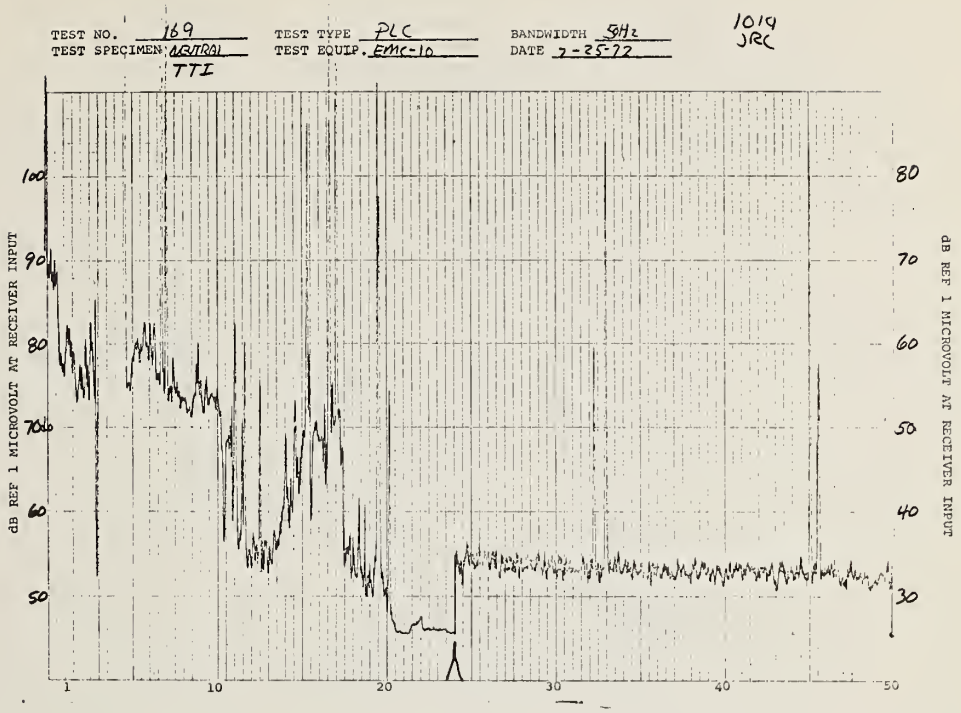


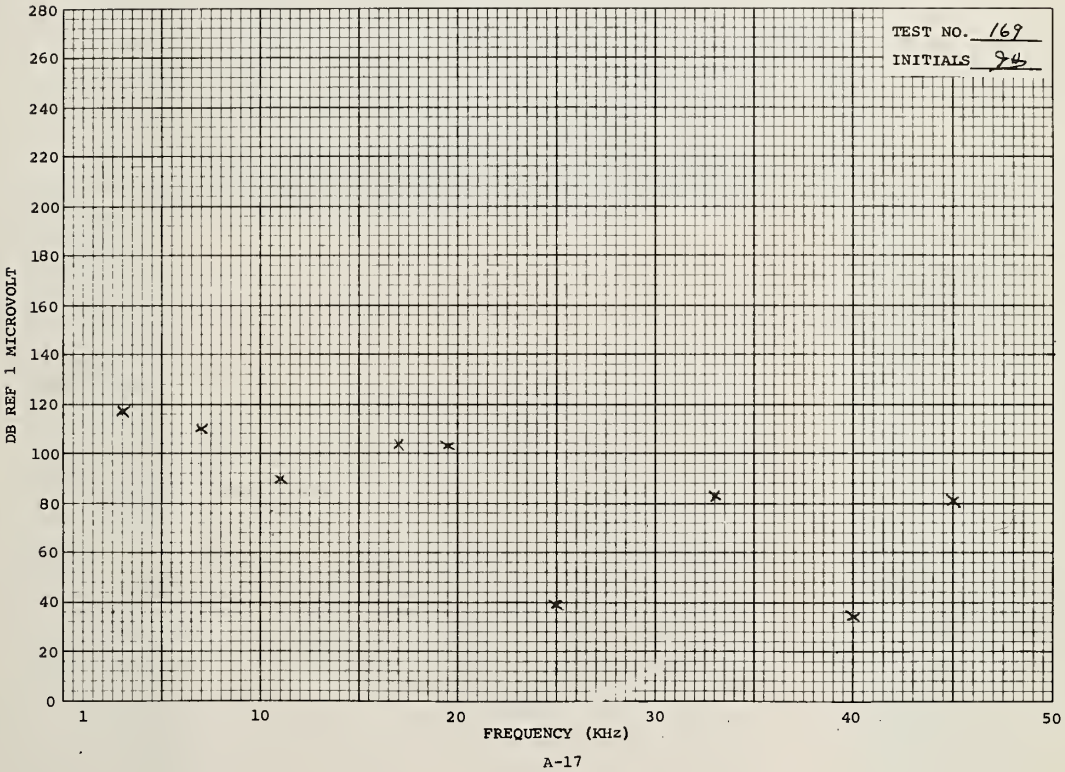


TEST NO. 168 TEST TYPE PLC BANDWIDTH 50 Hz 1006
TEST SPECIMEN NEUTRAL TEST EQUIP. EMC-10 DATE 7-25-72 JRC
TTI






TEST NO. 169
TEST TYPE PLC
BANDWIDTH 5Hz
TEST SPECIMEN NEUTRAL
TTI
TEST EQUIP. EMC-10
DATE 7-25-72
1014
JRC
dB REF 1 MICROVOLT AT RECEIVER INPUT
100
90
80
70
60
50
80
70
60
50
40
30
1
10
20
30
40
50


TEST NO. 169
INITIALS JG
DB REF 1 MICROVOLT
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
1
10
20
30
40
50
FREQUENCY (KHz)