



Company: Shure Incorporated  
Model Tested: MX690 G4  
Report Number: 13995

1250 Peterson Dr., Wheeling, IL 60090

FCC Rules and Regulations / Intentional Radiators

Low Power Auxiliary Stations

Part 74, Subpart H, Sections 74.801 - 74.882

Part 74.861 (e) TV Broadcasting

THE FOLLOWING **MEETS** THE ABOVE TEST SPECIFICATION

Formal Name: Wireless Boundary Microphone  
Kind of Equipment: Wireless Microphone Transmitter  
Frequency Range: 470 MHz – 494 MHz  
Test Configuration: Stand Alone (Tested at 3 vdc)  
Model Number(s): MX690  
Model(s) Tested: MX690 G4  
Serial Number(s): N/A  
Emission Designator: DD4MX690G4  
Date of Tests: March 12, 13, 18, & 20, 2008  
Test Conducted For: Shure Incorporated  
5800 W. Touhy Avenue  
Niles, Illinois 60714-4608

**NOTICE:** “This report must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government”. Please see the "Additional Description of Equipment Under Test" page listed inside of this report.

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Company: Shure Incorporated  
Model Tested: MX690 G4  
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SIGNATURE PAGE

Report By:

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Test Engineer  
EMC-001375-NE

Reviewed By:

William Stumpf  
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Approved By:

Brian Mattson  
General Manager



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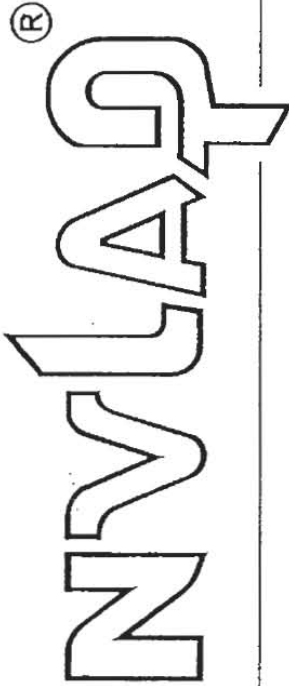


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United States Department of Commerce  
National Institute of Standards and Technology



# Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 100276-0

**D.L.S. Electronic Systems, Inc.**  
Wheeling, IL

is accredited by the National Voluntary Laboratory Accreditation Program for specific services,  
listed on the Scope of Accreditation, for:

## ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005.  
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality  
management system (refer to joint ISO-ILAC-IAF Communique dated 18 June 2005).



2007-10-01 through 2008-09-30

Effective dates

*Dolly S. Bruce*

For the National Institute of Standards and Technology

NVL AP-01C (REV. 2006-09-13)



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Model Tested: MX690 G4  
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## 1.0 SUMMARY OF TEST REPORT

It was found that the Wireless Boundary Microphone, Model Number(s) MX690 G4, **meets** the radio interference radiated emission requirements of the FCC "Rules and Regulations", Part 74, Subpart H, Section 74.861 (e), for low power auxiliary stations. The AC Power Line conducted emissions test was not required because the Wireless Boundary Microphone is powered from a D.C. power source. It does not have a line cord to plug into the A.C. power line.

## 2.0 INTRODUCTION

On March 12, 13, 18, & 20, 2008, a series of radio frequency interference measurements was performed on Wireless Boundary Microphone, Model Number(s) MX690 G4, Serial Number: N/A. The tests were performed according to the procedures of the FCC as stated in Part 2 - Frequency Allocations and Radio Treaty Matters: General Rules and Regulations, Subpart J, Equipment Authorization Procedures of the Code of Federal Regulations 47. Tests were performed by personnel of D.L.S. Electronic Systems, Inc. who are responsible to Donald L. Sweeney, Senior EMC Engineer.

D.L.S. Electronic Systems, Inc. is a full service EMC/Safety Testing Laboratory accredited to ISO Guide 17025. NVLAP Certificate and Scope can be viewed at <http://www.dlsemc.com/certificate>. Our facilities are registered with the FCC, Industry Canada, and VCCI. All immunity tests were performed by personnel of D.L.S. Electronic Systems, Inc. at the following location(s):

### **Main Test Facility:**

D.L.S. Electronic Systems, Inc.  
1250 Peterson Drive  
Wheeling, Illinois 60090

### **O.A.T.S. Test Facility:**

D.L.S. Electronic Systems, Inc.  
166 S. Carter Street  
Genoa City, Wisconsin 53128

## 3.0 OBJECT

The purpose of this series of tests was to determine if the test sample could meet the radio frequency interference requirements of the FCC "Rules and Regulations", Part 74, Subpart H, Section 74.861 (e), for low power auxiliary stations.



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#### 4.0 TEST SET-UP

All tests were performed at D.L.S. Electronic Systems, Inc. and set up according to the FCC and TIA-603C regulations. The conducted tests if required were performed with the test item placed on a non-conductive table (table top equipment), located in the test room. Equipment normally operated on the floor was tested by placing it on the metal ground plane. The ground plane has an electrical isolation layer over its surface approximately 7mm thick. The power line supplied was connected to a dual line impedance stabilization network electrically bonded to the ground plane, located on the floor. The networks were constructed per the requirements of the American National Standards Institute, ANSI C63.4-2003.

All radiated emissions tests were performed with the test item placed on a 80 cm high rotating non-conductive table, located in the test room. Equipment normally operated on the floor was placed on a metal covered turntable, which is flush with the surrounding conducting ground plane. The ground plane has an electrical isolation layer over its surface approximately 7 mm thick. The EUT is separated from the turntable ground plane by a non-conductive layer. The equipment under test was set up according to TIA Standard, TIA-603-C:2004, Section 2.2.12.



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## 5.0 TEST EQUIPMENT (Bandwidths and Detector Function)

All preliminary data below 1000 MHz was automatically plotted using the ESI 26/ESI 40 Fixed Tuned Receiver. The data was taken using Peak, Quasi-Peak or the Average Detector Functions as required. This information was then used to determine the frequencies of maximum emissions. Above 1000 MHz, final data was taken using the Average Detector.

Below 1000 MHz, final data was taken using the ESI 26/ESI 40 fixed tuned receiver. These plots were made using the Peak or Quasi-Peak Detector functions, with manual measurements performed on the questionable frequencies using the Quasi-Peak or the Average Detector Function of the Analyzer or ESI 26/ESI 40 Receiver as required. Above 1000 MHz, final data was taken using the Average Detector on the ESI 26/ESI 40 Fixed Tuned Receiver.

The bandwidths shown below are specified by ANSI C63.4-2003.

Frequency Range	Bandwidth (-6 dB)
10 to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz
30 MHz to 1 GHz	120 kHz
Above 1 GHz	1 MHz

A list of the equipment used can be found in Table 1. All primary equipment was calibrated against known reference standards with a verified traceable path to NIST.



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## 6.0 AMBIENT MEASUREMENTS

For emissions measurements, broadband antennas and an EMI Test Receiver with a panoramic spectrum display are used. First the frequency range is scanned and displayed on the test receiver display. Next the scanned frequency range is divided into smaller ranges, and then it is manually tuned through to determine the emissions from the EUT. A headset or loudspeaker is connected to the test receiver's AM/FM demodulated output as an aid in detecting ambient signals and finding frequencies of significant emission from the EUT. If there is any doubt as to the source of the emission, it is further investigated by rotating the EUT, or by disconnecting the power from the EUT.

The EUT is set up in its typical configuration and operated in its various modes. For tabletop systems, cables are manipulated within the range of likely configurations. For floor-standing equipment, the cables or are located in the same manner as the user would install them and no further manipulation is made. If the manner of cable installation is not known, or if it changes with each installation, cables or wires for floor-standing equipment shall be manipulated to the extent possible to produce the maximum level of emissions. For each mode of operation, the frequency spectrum is monitored. Variations in antenna height, antenna polarization, EUT azimuth, and cable or wire placement (each variable within bounds specified elsewhere) are explored to produce the emission that has the highest amplitude relative to the limit.

## 7.0 AC POWER LINE CONDUCTED EMISSION MEASUREMENTS – Part 15.207

**The Wireless Boundary Microphone is powered from a D.C. power source and will not at any time be directly plugged into the public utility lines, therefore the conducted emissions test was not performed.**





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## 8.0 DESCRIPTION OF TEST SAMPLE:

### 8.1 Description:

The Shure Model MX690 is a uP (microprocessor) controlled frequency agile UHF transmitter operating over the frequency range of 470 to 865 MHz and 944 to 952 MHz (in different frequency bands). The products are identical, with the exception of the frequency components needed for each range. The User Interface includes "mode", "set" and "mute" buttons, and an LCD that displays battery status, group/channel, and transmitter/receiver frequency synchronization. This product is intended for corporate boardroom, educational facilities and fixed installations.

### 8.2 PHYSICAL DIMENSIONS OF EQUIPMENT UNDER TEST

Length: 148 mm x Width: 87 mm x Height: 43 mm

### 8.3 LINE FILTER USED:

N/A

### 8.4 INTERNAL CLOCK FREQUENCIES:

Switching Power Supply Frequencies:

NA

Clock Frequencies:

0.32768 MHz & 16 MHz

### 8.5 DESCRIPTION OF ALL CIRCUIT BOARDS:

1. Printed Circuit Board 1 PN: 190-11080 rev.01
2. Printed Circuit Board 2 PN: 190A11076 rev.01



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9.0 ADDITIONAL DESCRIPTION OF TEST SAMPLE:  
(See also Paragraph 8.0)

1: There were no additional descriptions noted at the time of test.

NOTE:

Low, Mid and High channels were tested.

10.0 PHOTO INFORMATION AND TEST SET-UP

Item 0 Wireless Boundary Microphone  
Model Number: MX690 G4, Serial Number: N/A



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## 11.0 RADIATED PHOTOS TAKEN DURING TESTING



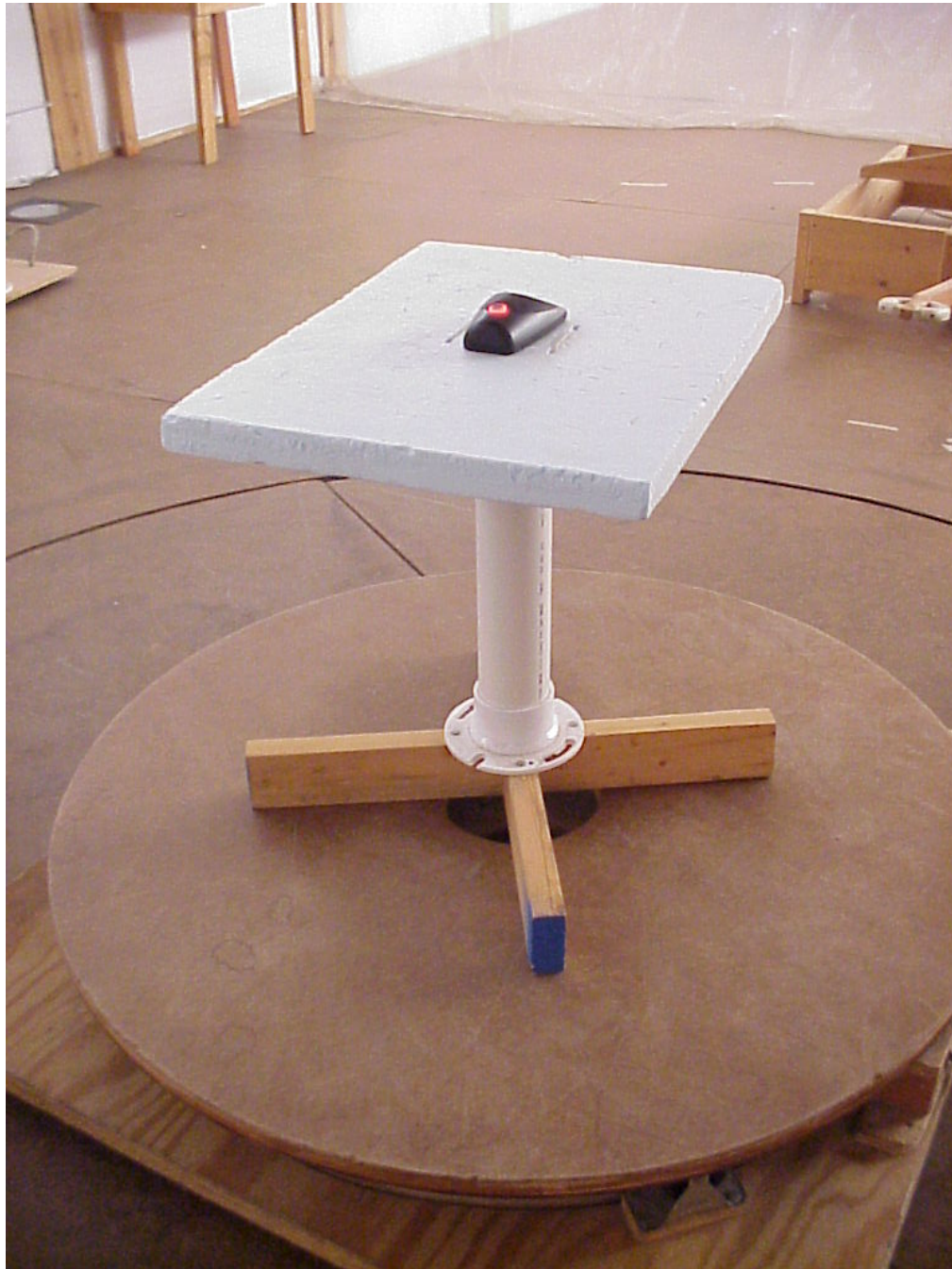
FRONT



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## 11.0 RADIATED PHOTOS TAKEN DURING TESTING



BACK



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## 12.0 RESULTS OF TESTS

The radio interference emission charts can be seen on the pages at the end of this report. Data sheets indicating the test measurements taken during testing can also be found at the end of this report.

## 13.0 CONCLUSION

It was found that the Wireless Boundary Microphone, Model Number(s) MX690 G4 **meets** the radio interference radiated emission requirements of the FCC "Rules and Regulations", Part 74, Subpart H, Section 74.861 (e), for low power auxiliary stations. The AC Power Line conducted emissions test was not required because the Wireless Boundary Microphone is powered from a D.C. power source. It does not have a line cord to plug into the A.C. power line.



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TABLE 1 – EQUIPMENT LIST

<b>Test Equipment</b>	<b>Manufacturer</b>	<b>Model Number</b>	<b>Serial Number</b>	<b>Frequency Range</b>	<b>Cal Due Dates</b>
Receiver	Rohde & Schwarz	ESI 26	837491/010	20 Hz – 26 GHz	11/08
Preamp	Miteq	AMF-6D-100200-50	313936	1 GHz-10 GHz	5/08
Antenna	EMCO	3104C	97014785	20 MHz – 200 MHz	2/08
Antenna	EMCO	3146	97024895	200 MHz – 1 GHz	3/08
Horn Antenna	EMCO	3115	5731	1-18 GHz	6/08
Function Generator	Hewlett-Packard	HP3312A	2501A18150		8/08
Attenuator-20dB Fixed	Aeroflex Weinschel	75A-20-12	1071	DC – 40GHz	7/08
Power Meter	Anritsu	ML2487A	6K00002069		10/08
Power Sensor	Anritsu	MA2490A		50MHz-8GHz	10/08
Filter- High-Pass	Q-Microwave	100460		1.1GHz	5/08
Filter- High-Pass	Mini Circuits	NHP-600	438727	600MHz-7GHz	9/08

All primary equipment is calibrated against known reference standards with a verified traceable path to NIST.



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# APPENDIX A

## TEST PROCEDURE

### SUBPART H

#### LOW POWER AUXILIARY STATIONS OPERATING IN THE BANDS ALLOCATED FOR TV BROADCASTING



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## APPENDIX A

### 1.0 TEST SET-UP

All radiated emission tests were performed at D.L.S. Electronic Systems, Inc. The radiated tests were made with the test item placed on a non-conductive turntable located in the Test Room with the receive antenna placed three or one meter(s) from the device under test

### 2.0 RF-POWER OUTPUT – PART 2.1046 and EIA /TIA-603-C:2004, SECTION 2.2.17

As stated in PART 74.861 (e)(1)(ii), the RF output power should not exceed .25 watt(s). The RF output of the Wireless Boundary Microphone was connected to a Spectrum Analyzer or a Power Meter through suitable attenuation. All cables, connectors, and attenuators were calibrated prior to testing. The RF output power was measured using the following test method:

#### **Actual Measurements Taken:**

3.61 dBm Measured output of the transmitter

3.61 dBm equals 0.0023 watt(s)

#### **LIMIT:**

Manufacturer's rated output power = 2.5 dBm  $\pm$ 2.0 dBm

#### **MARGIN:**

.25 - 0.0023 = 0.2477 watt(s)





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## APPENDIX A

# DATA TAKEN OF THE RF POWER OUTPUT MEASUREMENT

EIA /TIA-603-C:2004, SECTION 2.2.17

FCC Part 74.861 (e)(1) & PART 2.1046



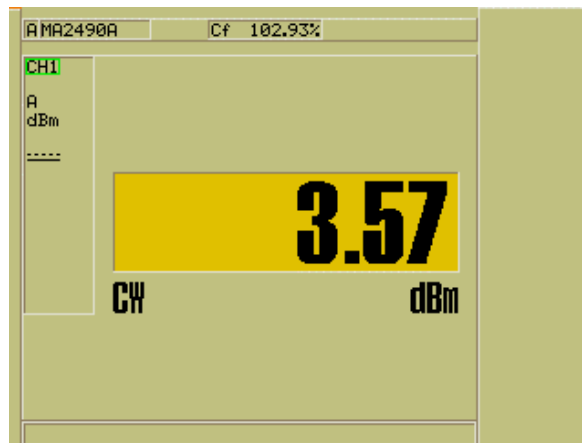
Company: Shure Incorporated  
Model Tested: MX690 G4  
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### APPENDIX A

Test Date: 03-13-2008  
Company: Shure, Inc.  
EUT: MX690-G4  
Test: Peak Power Output - Conducted  
Rule part: FCC Part 74; FCC Part 2.1046  
Operator: Craig B  
Comment: Channel: 470.125 MHz

Peak Output Power = 3.57 dBm = 2.28 mW





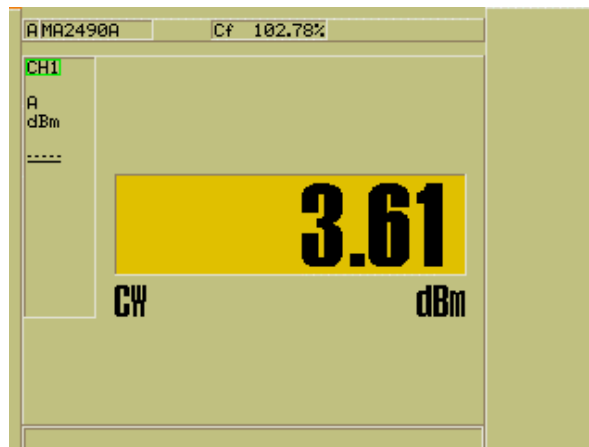
Company: Shure Incorporated  
Model Tested: MX690 G4  
Report Number: 13995

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### APPENDIX A

Test Date: 03-13-2008  
Company: Shure, Inc.  
EUT: MX690-G4  
Test: Peak Power Output - Conducted  
Rule part: FCC Part 74; FCC Part 2.1046  
Operator: Craig B  
Comment: Channel: 481.750 MHz

Peak Output Power = 3.61 dBm = 2.30 mW





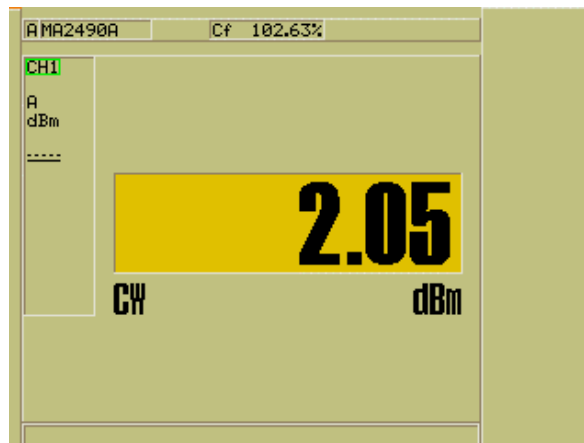
Company: Shure Incorporated  
Model Tested: MX690 G4  
Report Number: 13995

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## APPENDIX A

Test Date: 03-13-2008  
Company: Shure, Inc.  
EUT: MX690-G4  
Test: Peak Power Output - Conducted  
Rule part: FCC Part 74; FCC Part 2.1046  
Operator: Craig B  
Comment: Channel: 493.825 MHz

Peak Output Power = 2.05 dBm = 1.60 mW





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## APPENDIX A

### 3.0 RF POWER OUTPUT PHOTOS TAKEN DURING TESTING



RF COND PEAK OUTPUT POWER



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## APPENDIX A

### 4.0 MODULATION CHARACTERISTICS – PART 2.1047 and EIA /TIA-603-C:2004, SECTION 2.2.3

#### a. Voice modulated communication equipment.

A curve showing the frequency response of the audio modulating circuit over a range of 50 Hz to 20 kHz  $\pm 3.0$  dB Hz is submitted with this report.

#### b. Equipment which employs modulation limiting

A family of curves showing the percentage of modulation versus the modulation input voltage with sufficient information showing the modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.



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APPENDIX A

GRAPH(S) TAKEN SHOWING THE FREQUENCY  
RESPONSE OF THE  
AUDIO MODULATING CIRCUIT

EIA /TIA-603-C:2004, SECTION 2.2.3

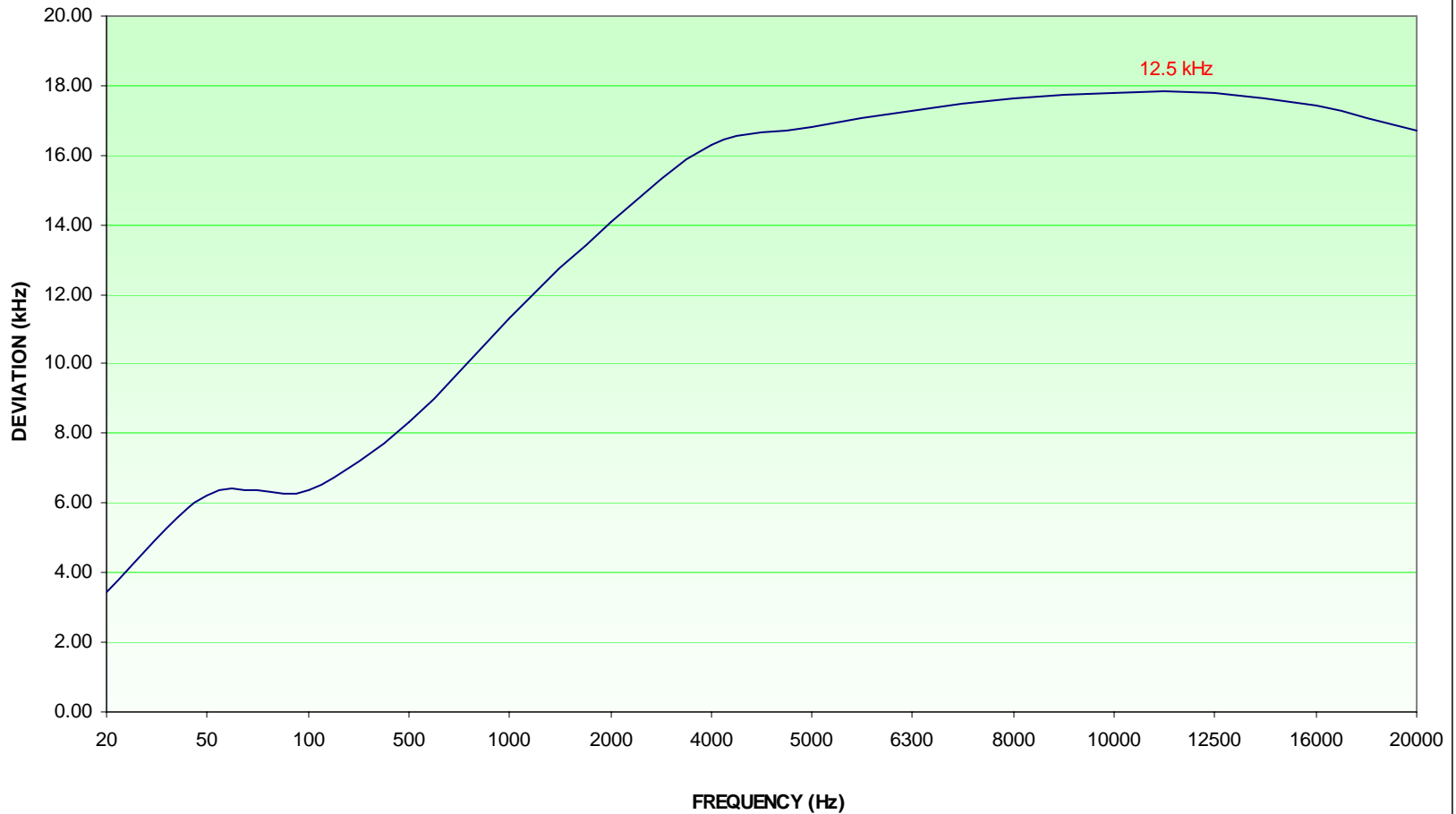
PART 2.1047



Company: Shure Incorporated  
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### MX690 #4 DEVIATION (kHz) FOR -60 dBu INPUT



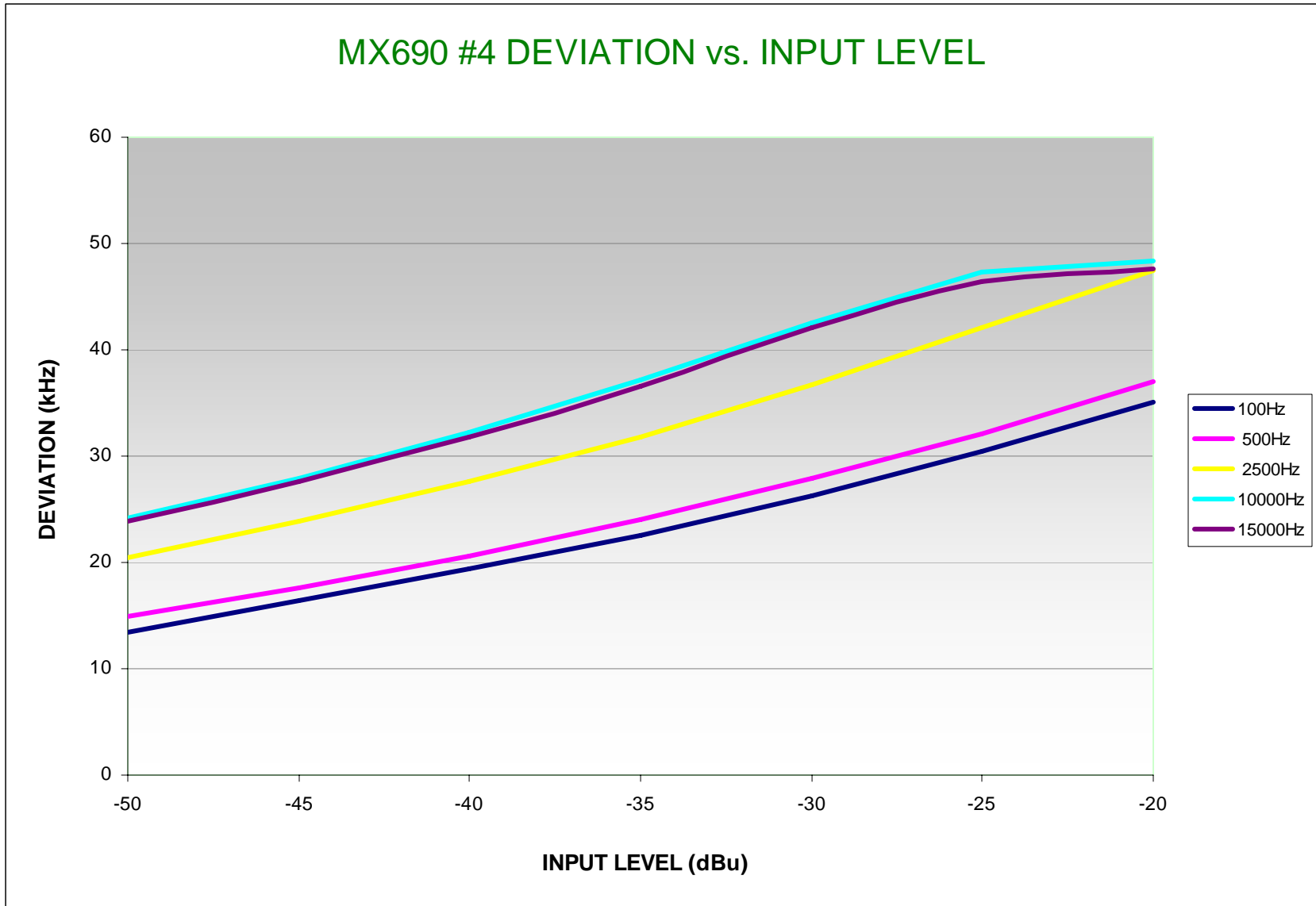




Company: Shure Incorporated  
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### MX690 #4 DEVIATION vs. INPUT LEVEL

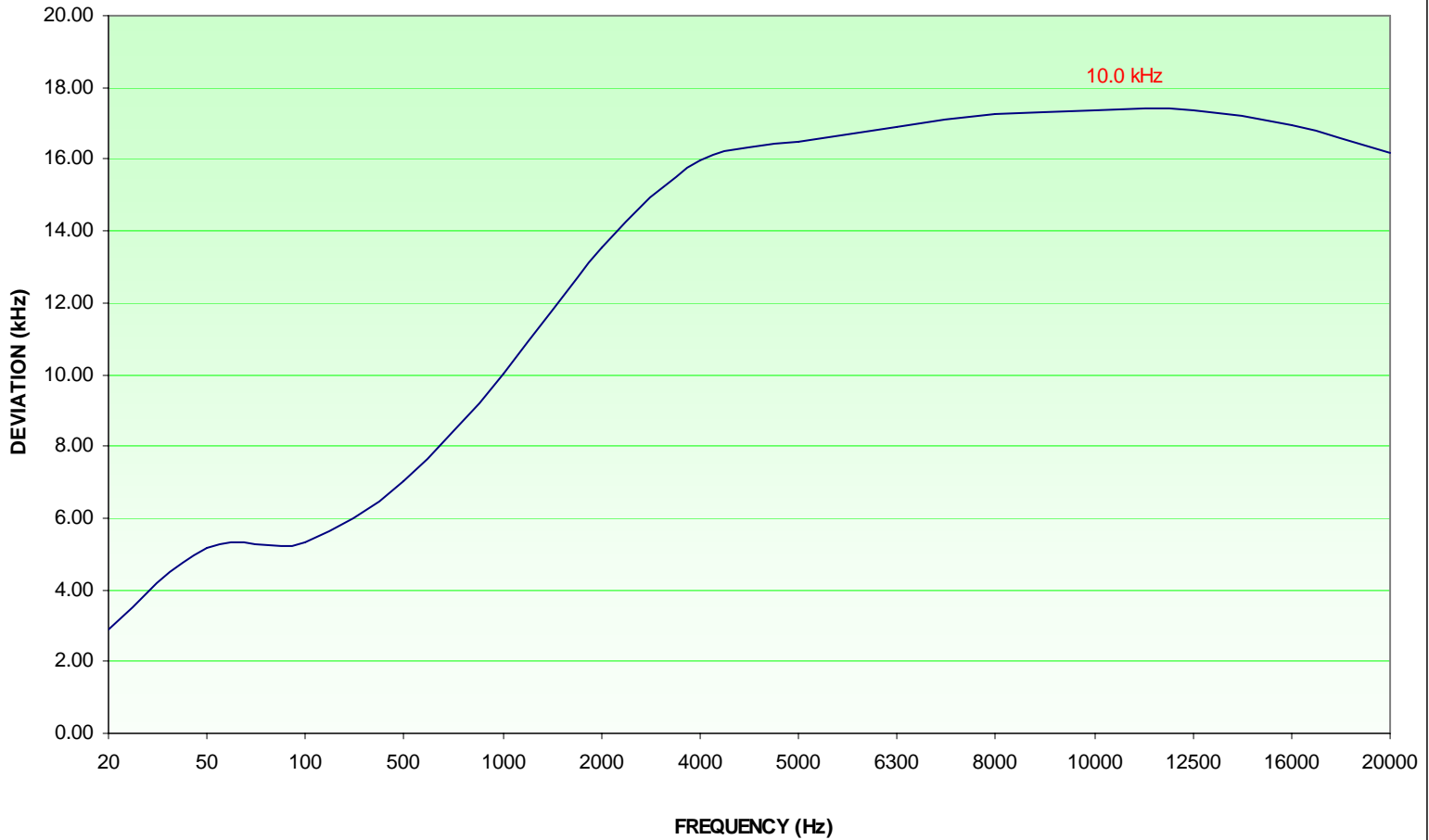




Company: Shure Incorporated  
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### MX690 #15 DEVIATION (kHz) FOR -60 dBu INPUT

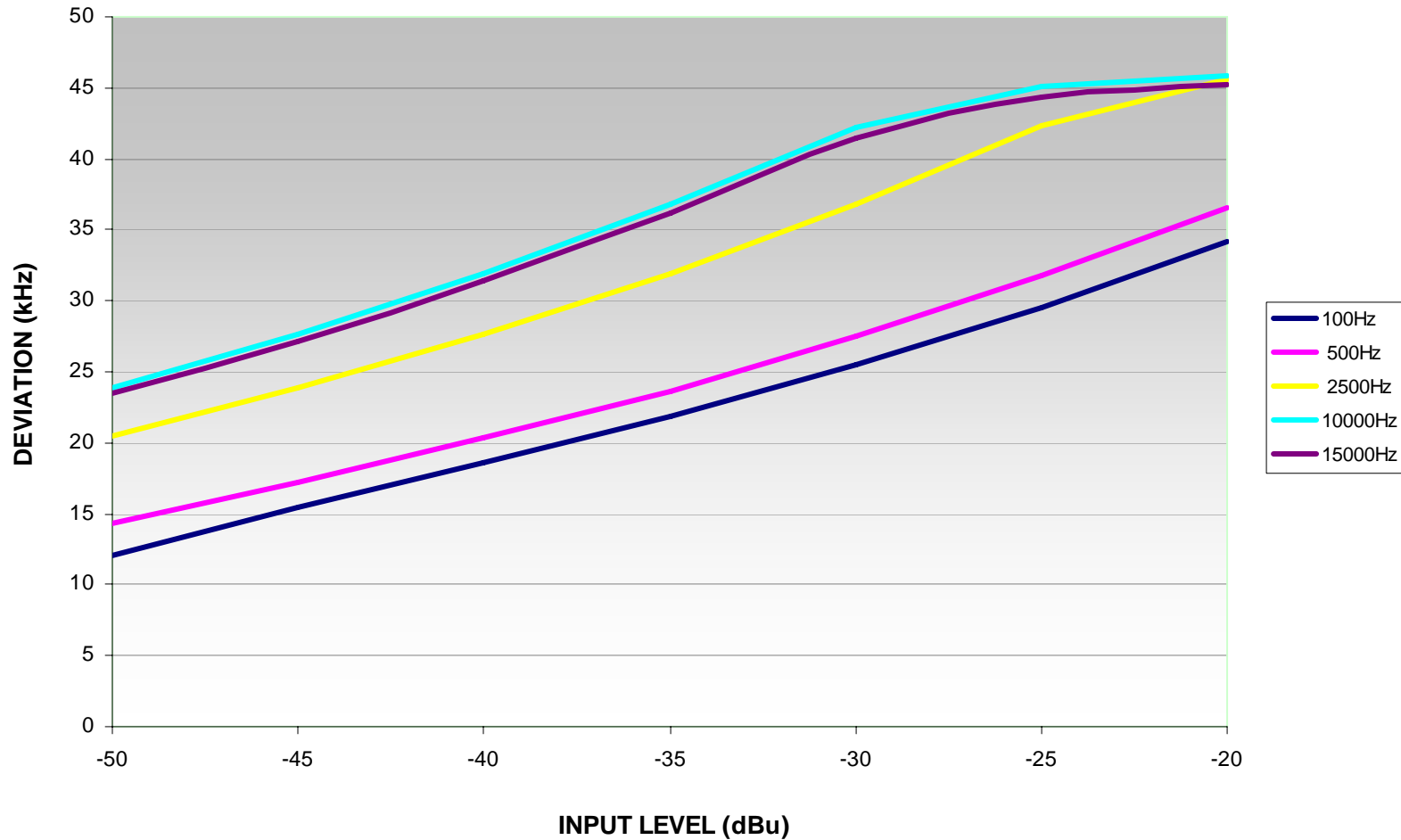




Company: Shure Incorporated  
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### MX690 #15 DEVIATION vs. INPUT LEVEL

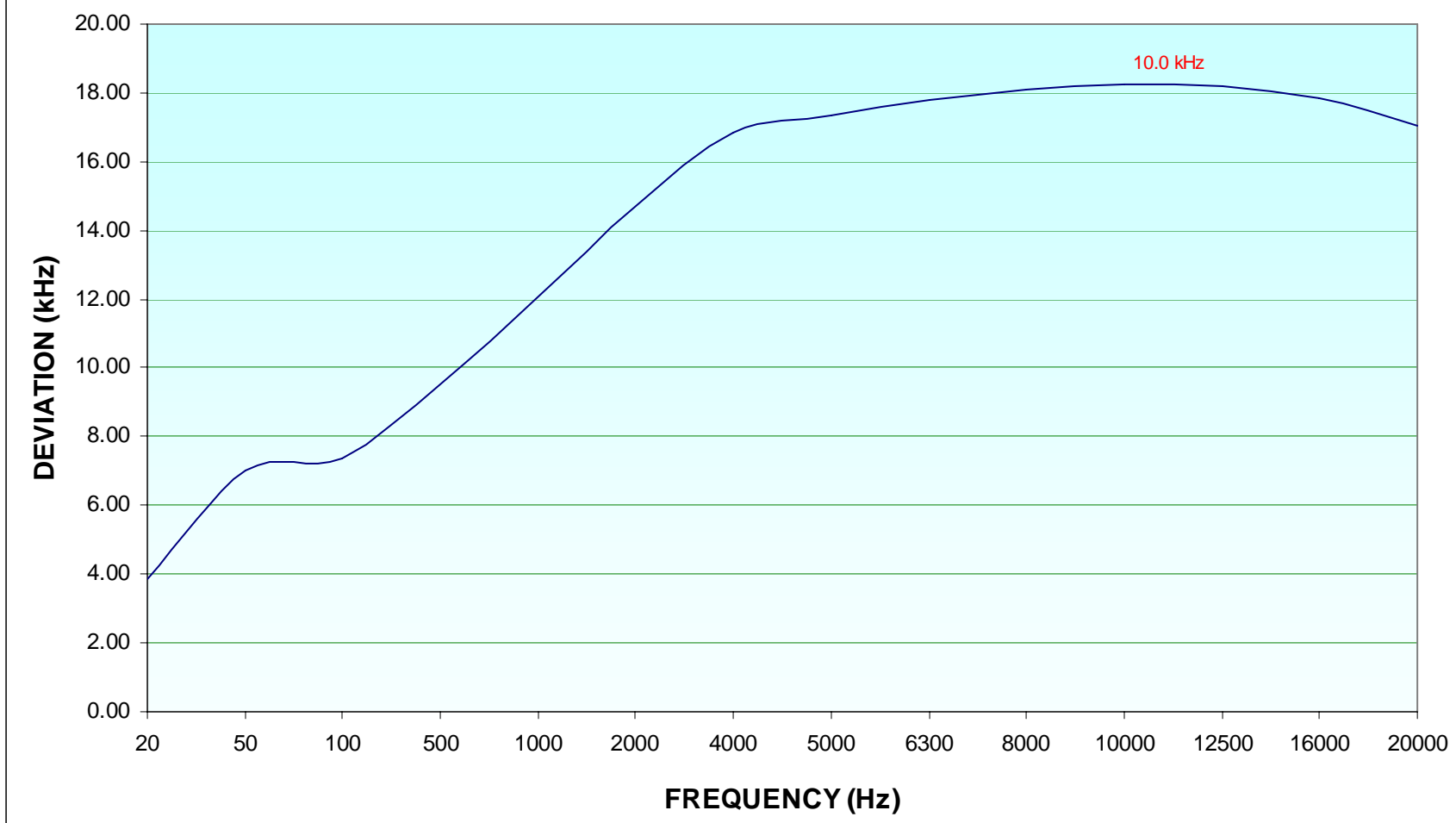




Company: Shure Incorporated  
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### MX690 #18 Deviation (kHz) FOR -60 dBu INPUT

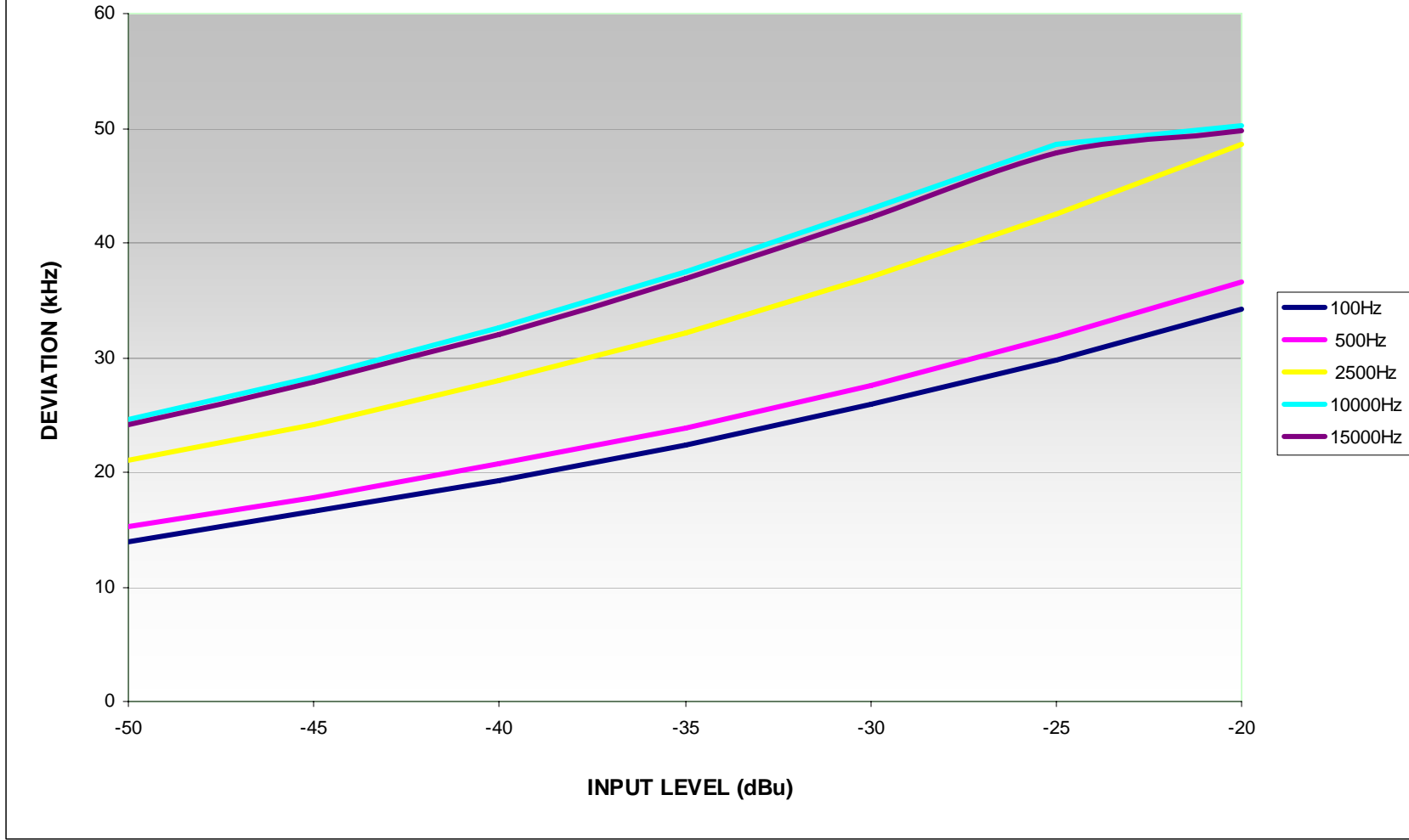




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### MX690 #18 DEVIATION vs. INPUT LEVEL





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## APPENDIX A

### 5.0 OCCUPIED BANDWIDTH - PART 2.1049

The occupied bandwidth is that between the lower and upper limits of the signal where the mean power is 99.0% of the total mean power and measured under the following conditions:

For low power auxiliary stations operating in the bands other than those allocated for TV broadcasting, the occupied bandwidth shall not be greater than that necessary for satisfactory transmission and emissions appearing on any discrete frequency outside the authorize band shall be attenuated  $43+10 \log^{10}$  (mean output power, in watts) dB below the mean output power of the transmitting unit (device under test).

For low power auxiliary stations operating in the bands allocated for TV broadcasting, any form of modulation may be used. A maximum of  $\pm 75$  kHz is permitted when frequency modulation is used. The operating bandwidth shall not exceed 200 kHz.

Carson's Rule:

Section 2.202 (g)

$$B_n = 2M + 2DK, \quad K=1$$

$B_n$  = Bandwidth

$$M = 15 \text{ kHz,}$$

$M$  = Maximum Modulating Frequency

$$D = 45 \text{ kHz,}$$

$D$  = Peak Deviation

$$B_n = 2(15) + 2(45)(1) = 120 \text{ kHz}$$



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## APPENDIX A

DATA AND GRAPH(S) TAKEN OF THE

99% OCCUPIED BANDWIDTH

Part 74.861 (e)(5) & PART 2.1049



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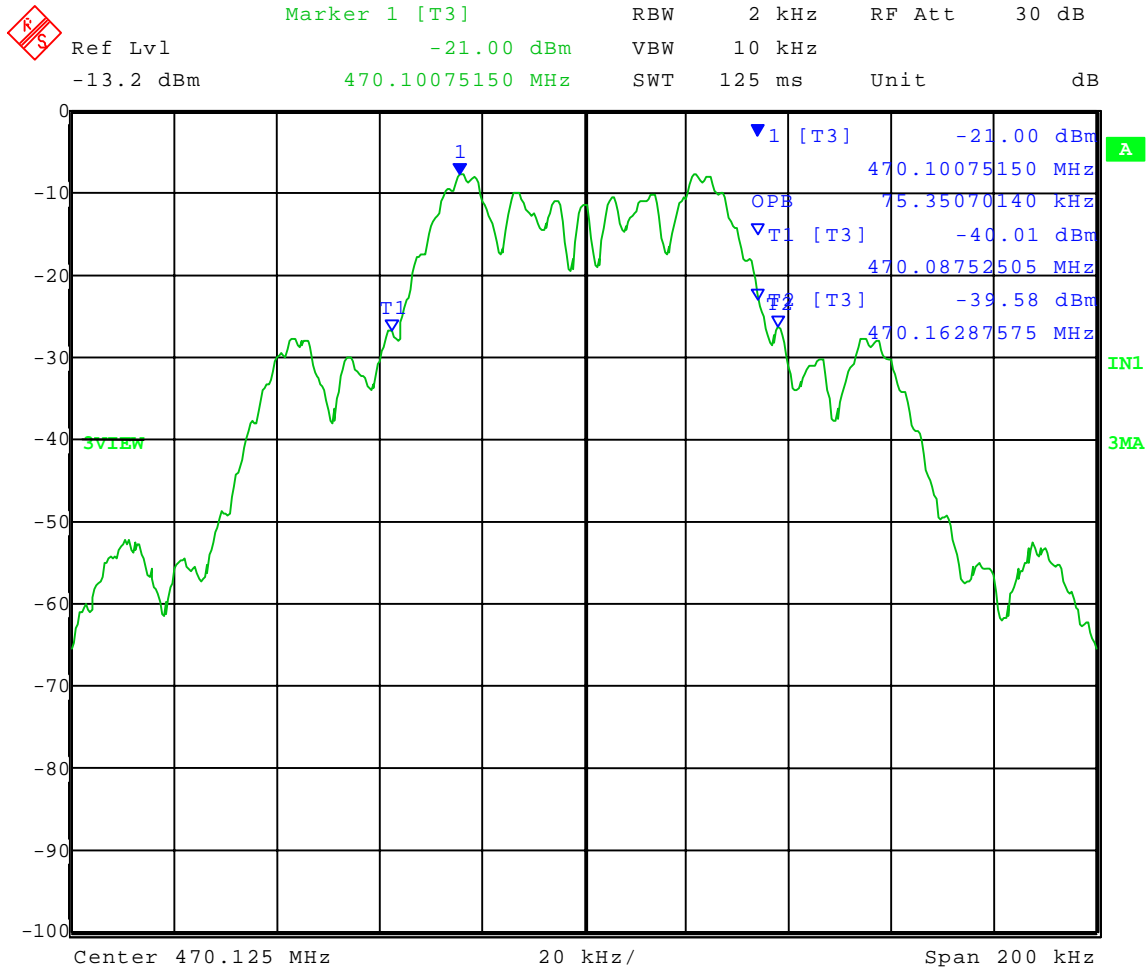
1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

Test Date: 03-18-2008  
 Company: Shure, Inc.  
 EUT: MX690-G4  
 Test: Occupied Bandwidth; 99% bandwidth  
 Rule part: FCC Part 74; FCC Part 2.1049  
 Operator: Craig B

Frequency: 470.125 MHz

99% power bandwidth = 75.4 kHz



Date: 18.MAR.2008 10:27:38





Company: Shure Incorporated  
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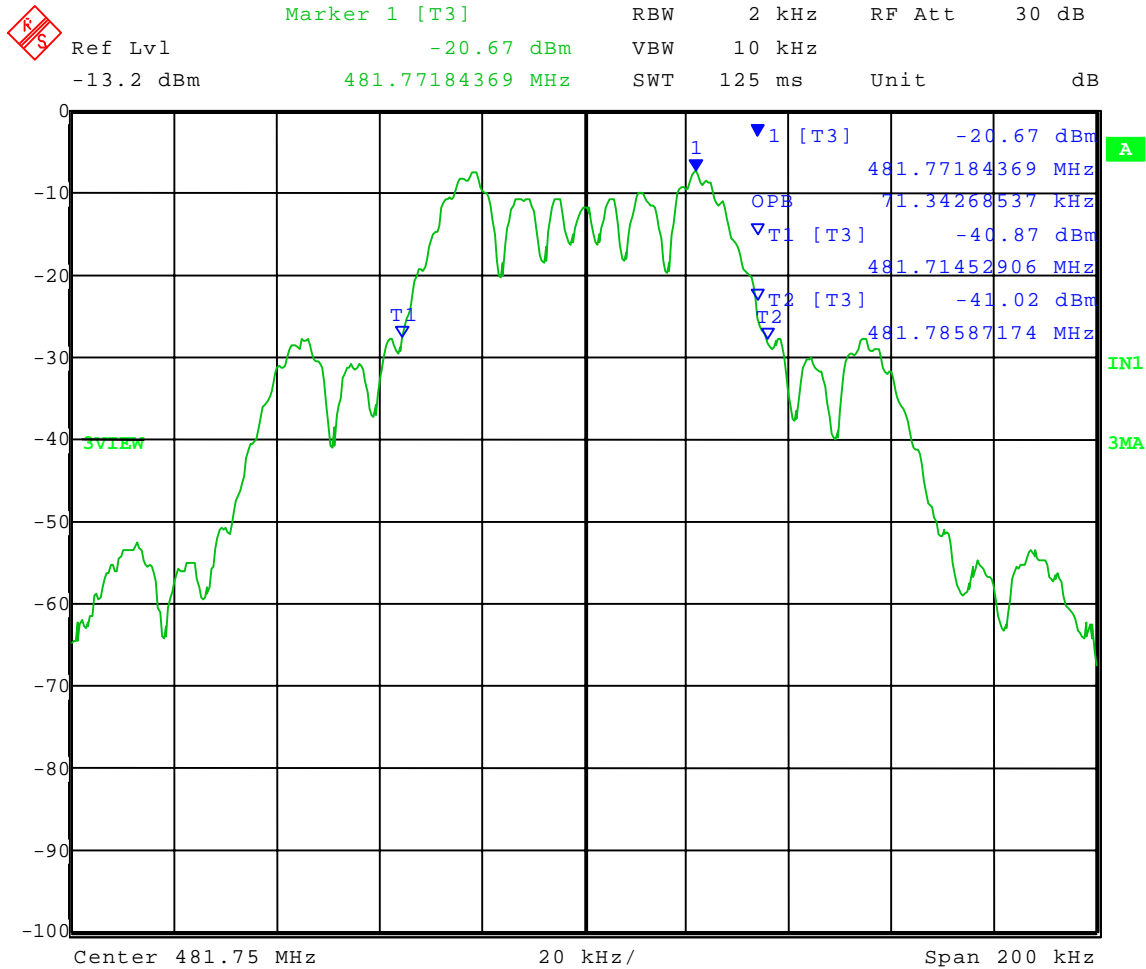
1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

Test Date: 03-18-2008  
 Company: Shure, Inc.  
 EUT: MX690-G4  
 Test: Occupied Bandwidth; 99% bandwidth  
 Rule part: FCC Part 74; FCC Part 2.1049  
 Operator: Craig B

Frequency: 481.750 MHz

99% power bandwidth = 71.3 kHz



Date: 18.MAR.2008 10:25:20



Company: Shure Incorporated  
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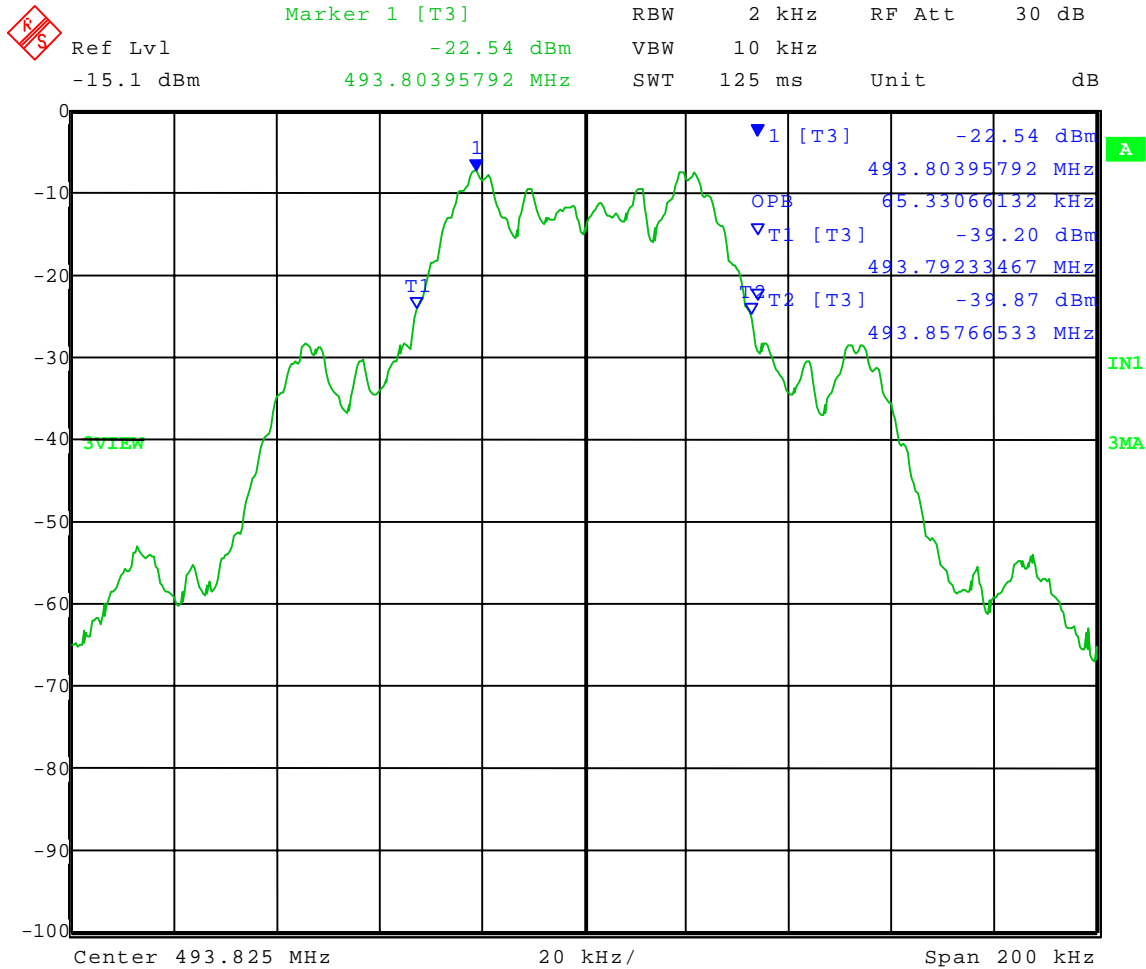
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APPENDIX A

Test Date: 03-18-2008  
 Company: Shure, Inc.  
 EUT: MX690-G4  
 Test: Occupied Bandwidth; 99% bandwidth  
 Rule part: FCC Part 74; FCC Part 2.1049  
 Operator: Craig B

Frequency: 493.825 MHz

99% power bandwidth = 65.3 kHz



Date: 18.MAR.2008 10:22:02



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## APPENDIX A

DATA AND GRAPH(S) TAKEN OF THE

BAND EDGE COMPLIANCE

Part 74.861 (e)(5) & PART 2.1051



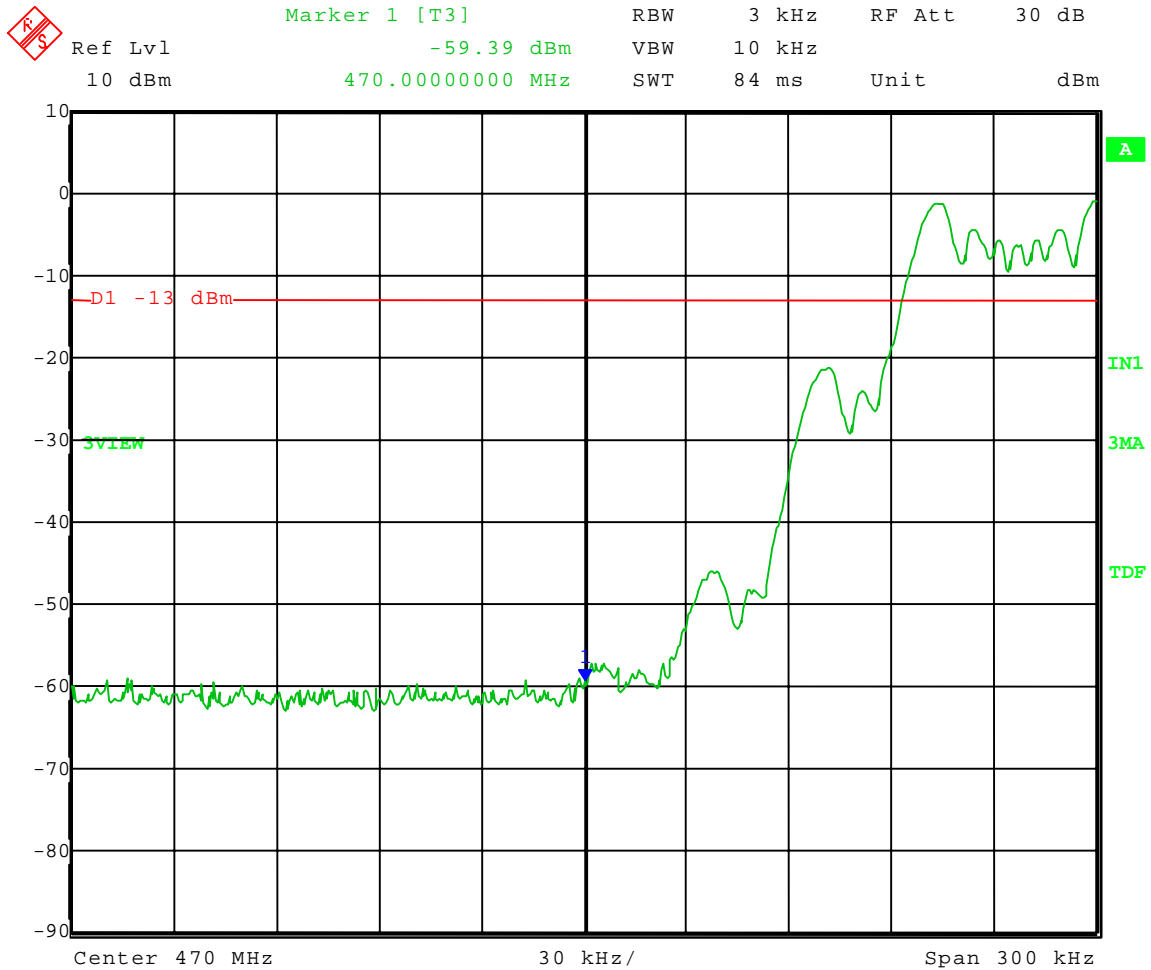
Company: Shure Incorporated  
 Model Tested: MX690 G4  
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APPENDIX A

Test Date: 03-18-2008  
 Company: Shure, Inc.  
 EUT: MX690-G4  
 Test: Band-Edge Compliance - Conducted  
 Rule part: FCC Part 74; FCC Part 2.1051  
 Operator: Craig B  
 Comment: Channel; 470.125 MHz

Band-Edge Frequency = 470 MHz  
 Band-Edge limit = -13 dBm



Date: 18.MAR.2008 11:46:44



1250 Peterson Dr., Wheeling, IL 60090

Company: Shure Incorporated  
Model Tested: MX690 G4  
Report Number: 13995

## APPENDIX A

DATA AND GRAPH(S) TAKEN OF THE

EMISSION MASK

Part 74.861(d)(3) (e)(6) & PART 2.1049



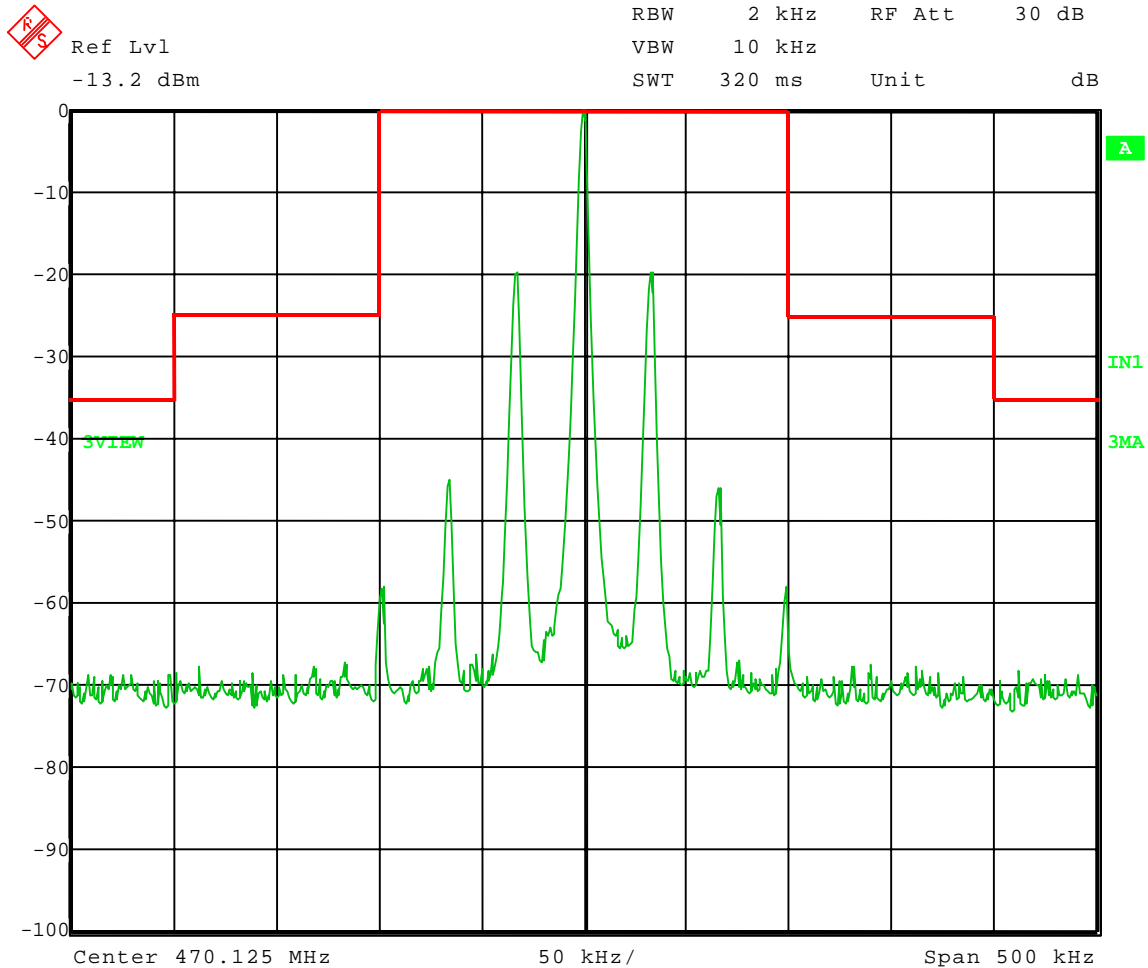
Company: Shure Incorporated  
Model Tested: MX690 G4  
Report Number: 13995

1250 Peterson Dr., Wheeling, IL 60090

### APPENDIX A

Test Date: 03-18-2008  
Company: Shure, Inc.  
EUT: MX690-G4  
Test: Occupied Bandwidth  
Operator: Craig B

Nominal Frequency: 470.125 MHz  
Unmodulated



Date: 18.MAR.2008 10:09:11



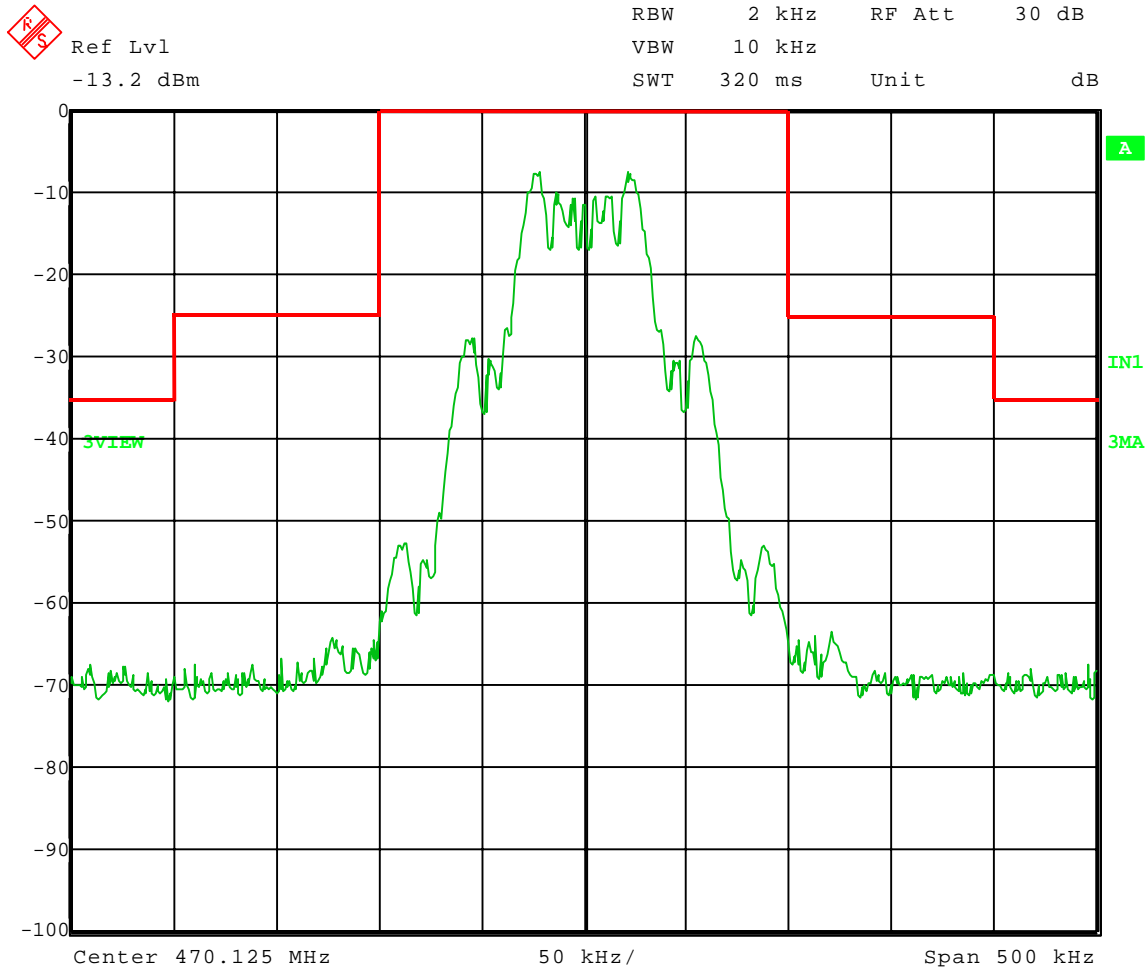
Company: Shure Incorporated  
Model Tested: MX690 G4  
Report Number: 13995

1250 Peterson Dr., Wheeling, IL 60090

### APPENDIX A

Test Date: 03-18-2008  
Company: Shure, Inc.  
EUT: MX690-G4  
Test: Occupied Bandwidth  
Operator: Craig B

Nominal Frequency: 470.125 MHz  
2500 Hz 16 dB > 50% modulated



Date: 18.MAR.2008 10:10:33



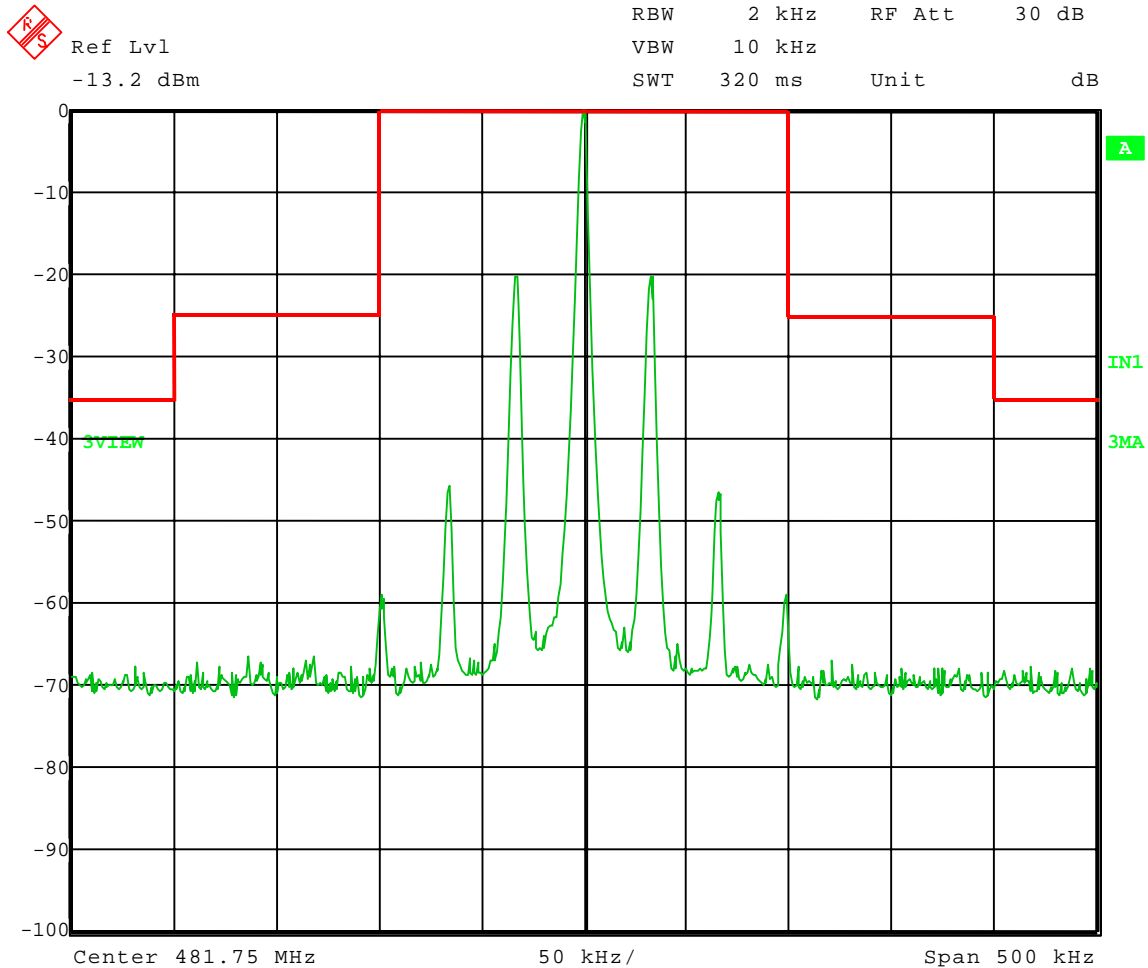
Company: Shure Incorporated  
Model Tested: MX690 G4  
Report Number: 13995

1250 Peterson Dr., Wheeling, IL 60090

### APPENDIX A

Test Date: 03-18-2008  
Company: Shure, Inc.  
EUT: MX690-G4  
Test: Occupied Bandwidth  
Operator: Craig B

Nominal Frequency: 481.750 MHz  
Unmodulated



Date: 18.MAR.2008 10:13:50





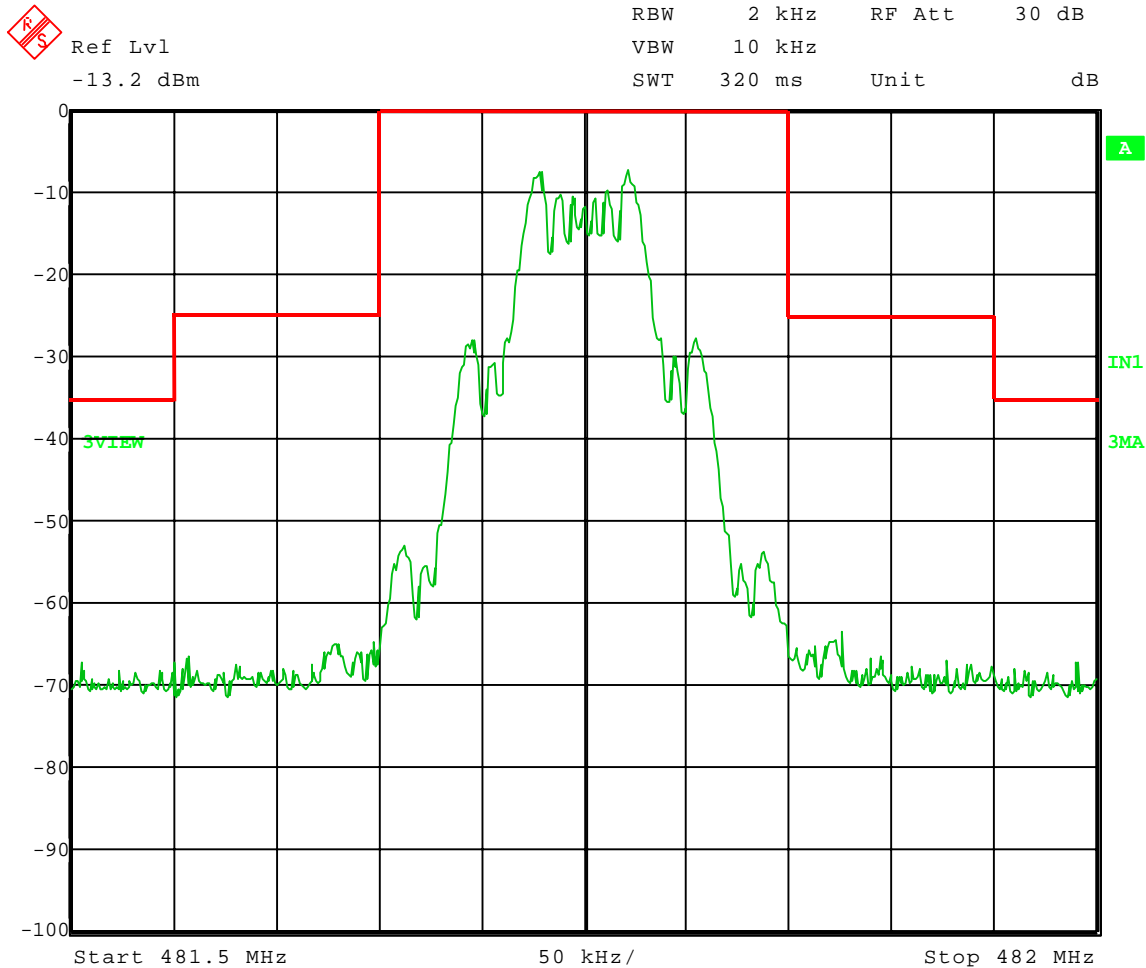
Company: Shure Incorporated  
Model Tested: MX690 G4  
Report Number: 13995

1250 Peterson Dr., Wheeling, IL 60090

### APPENDIX A

Test Date: 03-18-2008  
Company: Shure, Inc.  
EUT: MX690-G4  
Test: Occupied Bandwidth  
Operator: Craig B

Nominal Frequency: 481.750 MHz  
2500 Hz 16 dB > 50% modulated



Date: 18.MAR.2008 10:15:24



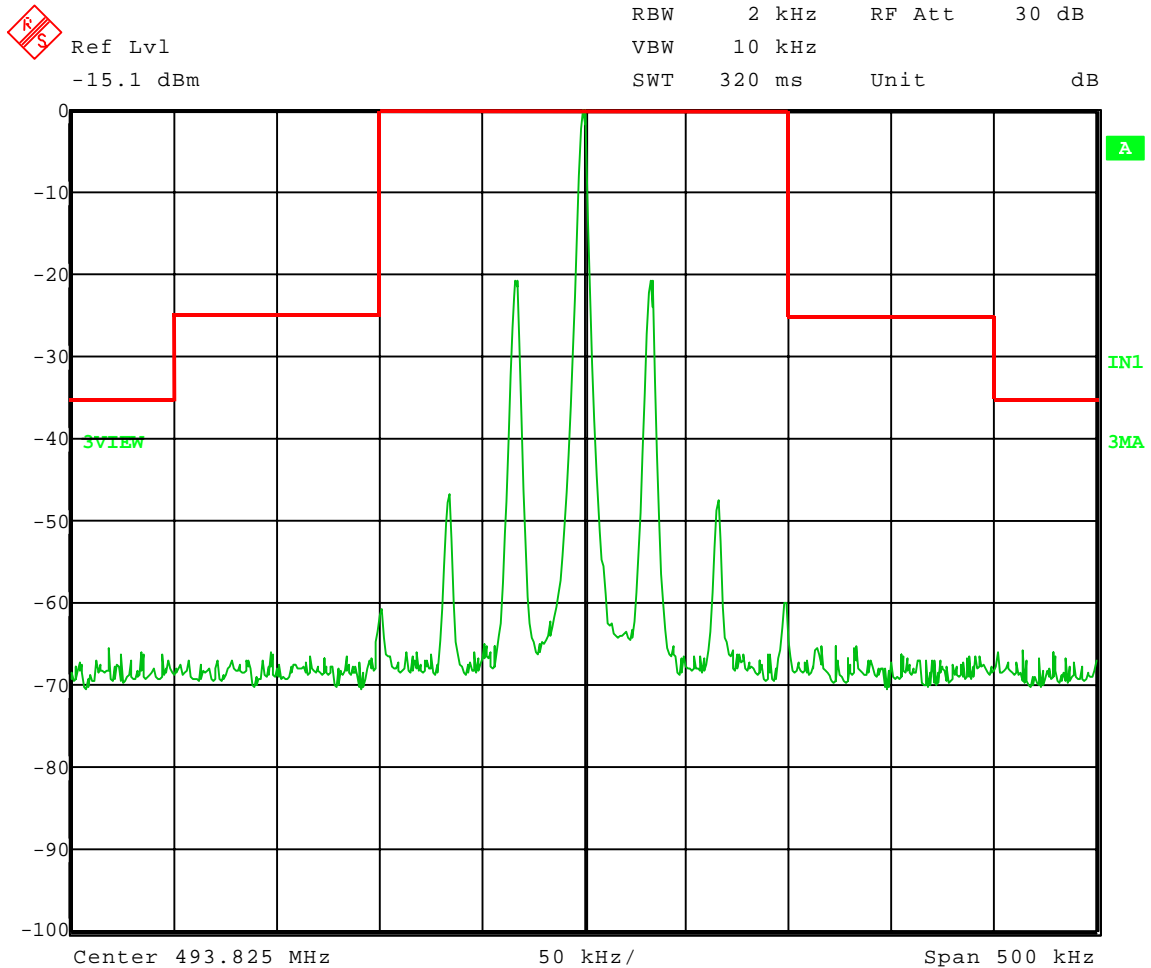
Company: Shure Incorporated  
Model Tested: MX690 G4  
Report Number: 13995

1250 Peterson Dr., Wheeling, IL 60090

### APPENDIX A

Test Date: 03-18-2008  
Company: Shure, Inc.  
EUT: MX690-G4  
Test: Occupied Bandwidth  
Operator: Craig B

Nominal Frequency: **493.825 MHz**  
Unmodulated



Date: 18.MAR.2008 10:18:16



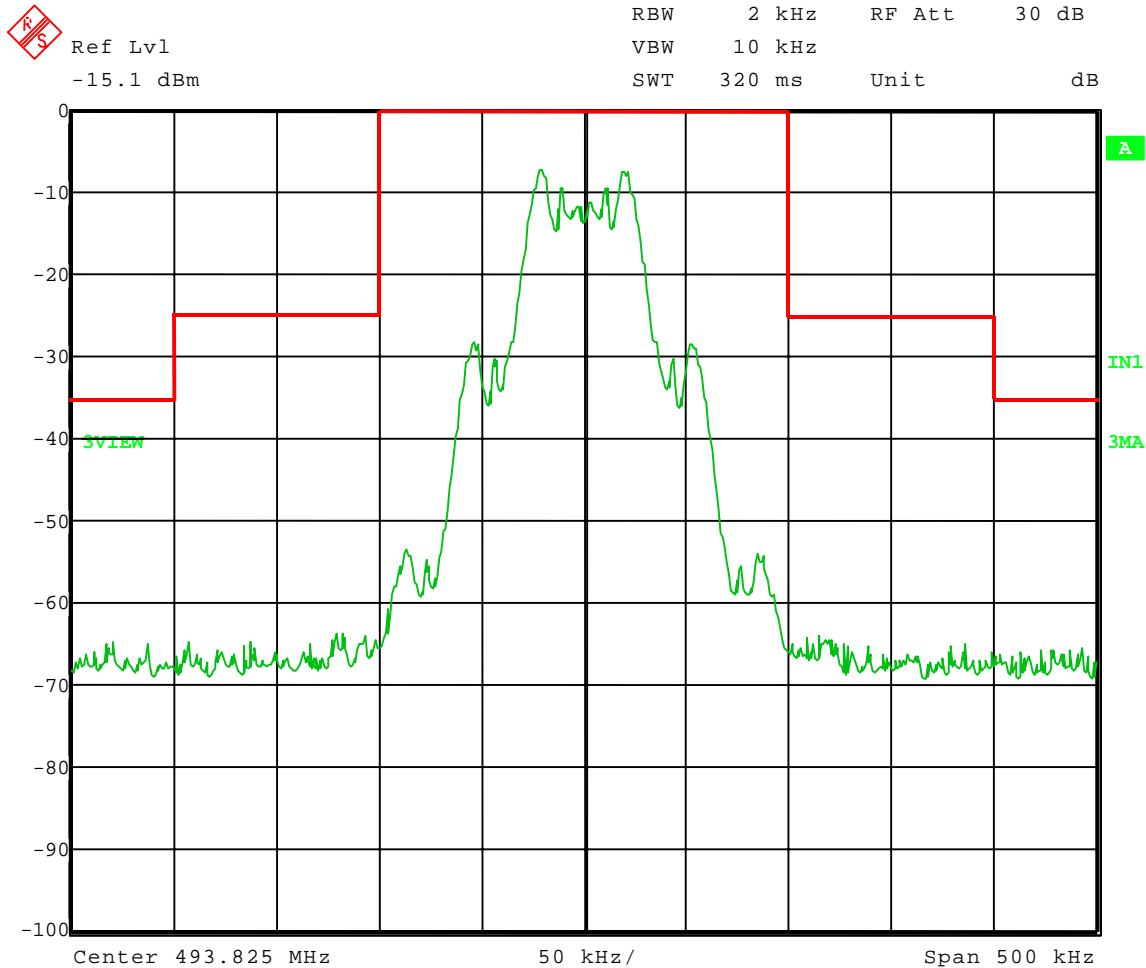
Company: Shure Incorporated  
 Model Tested: MX690 G4  
 Report Number: 13995

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

Test Date: 03-18-2008  
 Company: Shure, Inc.  
 EUT: MX690-G4  
 Test: Occupied Bandwidth  
 Operator: Craig B

Nominal Frequency: 493.825 MHz  
 2500 Hz 16 dB > 50% modulated



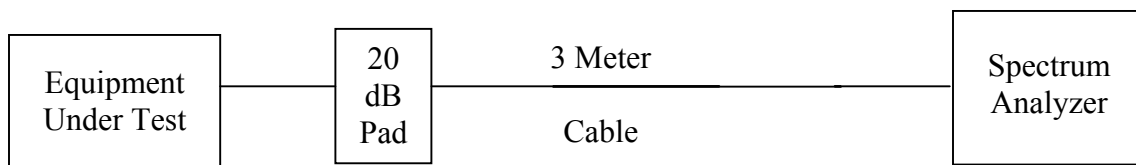
Date: 18.MAR.2008 10:19:46



## APPENDIX A

### 6.0 SPURIOUS EMISSIONS AT ANTENNA TERMINALS – PART 2.1051 and EIA /TIA-603-C:2004, SECTION 2.2.13

Spurious conducted emissions were measured at the antenna terminals using an artificial load. Plots were made showing the amplitude of each harmonic emission with the equipment operated as specified in 2.989. Measurements were made up to the 10<sup>th</sup> harmonic of the fundamental. The following setup was used showing placement of the attenuators:



The allowed emissions for transmitters operating in the 470 MHz - 494 MHz bands for Wireless Boundary Microphone equipment are found under Part 74, Section 74.861, Paragraph e-6 for Low Power Auxiliary Stations. This paragraph states the mean power of the emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

- (1) On any frequency removed from the operating frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: at least 25 dB.
- (2) On any frequency removed from the operating frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: at least 35 dB.
- (3) On any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth: at least  $43+10\text{Log}_{10}$  (mean output power in watts) dB.

#### NOTE:

**The Wireless Boundary Microphone uses the Bent Monopole on Flex PCB (non-removeable).**



Company: Shure Incorporated  
Model Tested: MX690 G4  
Report Number: 13995

1250 Peterson Dr., Wheeling, IL 60090

## APPENDIX A

### 7.0 FIELD STRENGTH OF SPURIOUS EMISSION MEASUREMENTS – PART 2.1053 and EIA /TIA-603-C:2004, SECTION 2.2.12

Radiated measurements were performed scanning the frequency range from 200 MHz to at least the 10<sup>th</sup> harmonic of the fundamental frequency.

For the Wireless Boundary Microphone, the highest fundamental frequency is 493.825 so the scans were made up to 10000 MHz, to cover the tenth harmonic.

All signals in the frequency range of 30 MHz to 200 MHz were measured with a Biconical Antenna and from 200 MHz to 1000 MHz a Log Periodic Antenna was used as the pickup devices. From 1000 MHz to 10000 MHz, a Double Ridge Horn Antenna was used. The cables and equipment were placed and moved within the range of positions likely to find their maximum emissions. Tests were made in both the horizontal and vertical planes of polarization.

The allowed emissions for transmitters operating in the 470 MHz - 494 MHz bands for Wireless Boundary Microphone are found under Part 74, Section 74.861, Paragraph e-6 for Low Power Auxiliary Stations. This paragraph states that the mean power of the emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

- (1) On any frequency removed from the operating frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: at least 25 dB.
- (2) On any frequency removed from the operating frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: at least 35 dB.
- (3) On any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth: at least  $43+10\text{Log}_{10}$  (mean output power in watts) dB.



1250 Peterson Dr., Wheeling, IL 60090

Company: Shure Incorporated  
Model Tested: MX690 G4  
Report Number: 13995

APPENDIX A

RADIATED EMISSION DATA & CHARTS TAKEN  
FOR FUNDAMENTAL EMISSIONS  
USING THE SUBSTITUTION METHOD  
EIA /TIA-603-C:2004, SECTION 2.2.12

PART 2.1053



1250 Peterson Dr., Wheeling, IL 60090

Company: Shure Incorporated  
 Model Tested: MX690 G4  
 Report Number: 13995

## APPENDIX A

DLS Electronic Systems, Inc.

Company: Shure, Inc.  
 Operator: Craig B  
 Date of test: 03-12-2008  
 Temperature: 70 deg. F  
 Humidity: 23% R.H.

Rated Power = 2.5 dBm (conducted)

### Output Power - ERP - Substitution Method

Model: <b>MX690-G4</b>								
Channel: <b>470.125 MHz</b>								
Frequency and Polarization (MHz)	Max. Field Strength of EUT @ 3 meters (dBuV/m)	Output of Signal Generator when field strength equals that of EUT (dBm)	Correction factor for cable between Signal Gen. and subst. antenna (dB)	Gain of subst. antenna (dBi)	Strength of emission [ERP] (dBm)	Limit (dBm)	Margin (dB)	Strength of emission [ERP] (mW)
470.125 vertical	84.04	-10.30	4.69	2.15	-14.99	24	38.99	0.03
470.125 horizontal	87.10	-6.40	4.69	2.15	-11.09	24	35.09	0.08

$EIRP = \text{Signal generator output} - \text{cable loss} + \text{antenna gain}$

$ERP_{(ref. to \frac{1}{2}\lambda \text{ dipole})} = \text{Signal generator output} - \text{cable loss} + \text{antenna gain} - 2.15$



1250 Peterson Dr., Wheeling, IL 60090

Company: Shure Incorporated  
 Model Tested: MX690 G4  
 Report Number: 13995

## APPENDIX A

DLS Electronic Systems, Inc.

Company: Shure, Inc.  
 Operator: Craig B  
 Date of test: 03-12-2008  
 Temperature: 70 deg. F  
 Humidity: 23% R.H.

Rated Power = 2.5 dBm (conducted)

### Output Power - ERP - Substitution Method

Model: <b>MX690-G4</b>								
Channel: <b>481.750 MHz</b>								
Frequency and Polarization (MHz)	Max. Field Strength of EUT @ 3 meters (dBuV/m)	Output of Signal Generator when field strength equals that of EUT (dBm)	Correction factor for cable between Signal Gen. and subst. antenna (dB)	Gain of subst. antenna (dBi)	Strength of emission [ERP] (dBm)	Limit (dBm)	Margin (dB)	Strength of emission [ERP] (mW)
481.750 vertical	84.16	-11.10	4.76	2.15	-15.86	24	39.86	0.03
481.750 horizontal	88.80	-6.40	4.76	2.15	-11.16	24	35.16	0.08

$EIRP = \text{Signal generator output} - \text{cable loss} + \text{antenna gain}$

$ERP_{(ref. to \frac{1}{2}\lambda \text{ dipole})} = \text{Signal generator output} - \text{cable loss} + \text{antenna gain} - 2.15$





1250 Peterson Dr., Wheeling, IL 60090

Company: Shure Incorporated  
 Model Tested: MX690 G4  
 Report Number: 13995

## APPENDIX A

DLS Electronic Systems, Inc.

Company: Shure, Inc.  
 Operator: Craig B  
 Date of test: 03-12-2008  
 Temperature: 70 deg. F  
 Humidity: 23% R.H.

Rated Power = 2.5 dBm (conducted)

### Output Power - ERP - Substitution Method

Model: <b>MX690-G4</b>								
Channel: <b>493.825 MHz</b>								
Frequency and Polarization (MHz)	Max. Field Strength of EUT @ 3 meters (dBuV/m)	Output of Signal Generator when field strength equals that of EUT (dBm)	Correction factor for cable between Signal Gen. and subst. antenna (dB)	Gain of subst. antenna (dBi)	Strength of emission [ERP] (dBm)	Limit (dBm)	Margin (dB)	Strength of emission [ERP] (mW)
493.825 vertical	81.64	-12.8	4.8	2.15	-17.6	24	41.6	0.02
493.825 horizontal	86.09	-7.8	4.8	2.15	-12.6	24	36.6	0.05

$EIRP = \text{Signal generator output} - \text{cable loss} + \text{antenna gain}$

$ERP_{(ref. to \frac{1}{2}\lambda \text{ dipole})} = \text{Signal generator output} - \text{cable loss} + \text{antenna gain} - 2.15$



1250 Peterson Dr., Wheeling, IL 60090

Company: Shure Incorporated  
Model Tested: MX690 G4  
Report Number: 13995

APPENDIX A

RADIATED EMISSION DATA & CHARTS TAKEN

FOR SPURIOUS EMISSIONS

USING THE SUBSTITUTION METHOD

EIA /TIA-603-C:2004, SECTION 2.2.12

PART 2.1053



Company: Shure Incorporated  
 Model Tested: MX690 G4  
 Report Number: 13995

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

DLS Electronic Systems, Inc.

Company: Shure, Inc.  
 Operator: Craig B  
 Date of test: 03-13-2008  
 Temperature: 72 deg. F.  
 Humidity: 25% R.H.

Radiated Spurious Emissions (e.r.p. substitution method) FCC Part 74; FCC Part 2.1053								
Model: <b>MX690-G4</b> Transmit Frequency: <b>470.125 MHz</b>								
Frequency GHz	Field Strength Level dBuV/m	Factor to Convert to dBm	Power ERP dBm	Limit dBm	Margin dB	Receive Antenna Polarization	EUT Orientation (degrees)	Receive Antenna Height (m)
0.94025	35.5	95.2	-59.7	-13	46.7	Horizontal	160	1.2
1.41038	25.7	100.0	-74.3	-13	61.3	Horizontal	20	1.1
1.88050	30.9	99.8	-68.9	-13	55.9	Horizontal	50	1.1
2.35063	43.0	101.0	-58.0	-13	45.0	Horizontal	170	1.1
2.82075	32.7	101.5	-68.8	-13	55.8	Horizontal	0	1.1
3.29088	36.1	100.9	-64.8	-13	51.8	Horizontal	40	1.0
3.76100	33.9	100.9	-67.0	-13	54.0	Horizontal	270	1.1
4.23113	33.2	100.4	-67.2	-13	54.2	Horizontal	315	2.0
4.70125	40.1	100.2	-60.1	-13	47.1	Horizontal	185	1.8
5.17138	37.5	100.2	-62.7	-13	49.7	Horizontal	0	1.1
0.94025	32.7	96.7	-64.0	-13	51.0	Vertical	180	1.0
1.41038	28.8	101.0	-72.2	-13	59.2	Vertical	90	1.2
1.88050	31.7	98.9	-67.2	-13	54.2	Vertical	270	1.2
2.35063	44.9	100.0	-55.1	-13	42.1	Vertical	15	1.2
2.82075	35.7	100.9	-65.2	-13	52.2	Vertical	45	1.0
3.29088	36.1	99.1	-63.0	-13	50.0	Vertical	45	1.2
3.76100	36.3	100.0	-63.7	-13	50.7	Vertical	225	1.1
4.23113	35.4	100.3	-64.9	-13	51.9	Vertical	290	1.2
4.70125	43.8	100.5	-56.7	-13	43.7	Vertical	30	1.2
5.17138	40.8	100.6	-59.9	-13	46.9	Vertical	30	1.1



Company: Shure Incorporated  
 Model Tested: MX690 G4  
 Report Number: 13995

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

DLS Electronic Systems, Inc.

Company: Shure, Inc.  
 Operator: Craig B  
 Date of test: 03-13-2008  
 Temperature: 72 deg. F.  
 Humidity: 25% R.H.

Radiated Spurious Emissions (e.r.p. substitution method) FCC Part 74; FCC Part 2.1053								
Model: <b>MX690-G4</b> Transmit Frequency: <b>481.750 MHz</b>								
Frequency GHz	Field Strength Level dBuV/m	Factor to Convert to dBm	Power ERP dBm	Limit dBm	Margin dB	Receive Antenna Polarization	EUT Orientation (degrees)	Receive Antenna Height (m)
0.963500	42.0	96.0	-54.0	-13	41.0	Horizontal	150	1.1
1.445250	26.1	100.3	-74.2	-13	61.2	Horizontal	10	1.0
1.927000	35.7	99.9	-64.2	-13	51.2	Horizontal	45	1.0
2.408750	42.3	100.8	-58.5	-13	45.5	Horizontal	135	1.1
2.890500	35.5	101.2	-65.7	-13	52.7	Horizontal	225	1.1
3.372250	39.1	100.3	-61.2	-13	48.2	Horizontal	45	1.0
3.854000	38.3	100.6	-62.3	-13	49.3	Horizontal	280	1.0
4.335750	36.7	100.5	-63.8	-13	50.8	Horizontal	200	1.0
4.817500	41.8	99.8	-58.0	-13	45.0	Horizontal	300	1.0
5.299250	37.6	100.4	-62.8	-13	49.8	Horizontal	40	1.1
0.963500	41.1	97.1	-56.0	-13	43.0	Vertical	80	1.1
1.445250	29.3	100.7	-71.5	-13	58.5	Vertical	90	1.1
1.927000	39.2	99.9	-60.7	-13	47.7	Vertical	20	1.2
2.408750	46.3	99.5	-53.2	-13	40.2	Vertical	10	1.2
2.890500	41.5	100.7	-59.2	-13	46.2	Vertical	290	1.2
3.372250	40.4	100.4	-60.0	-13	47.0	Vertical	290	1.2
3.854000	41.8	100.2	-58.4	-13	45.4	Vertical	180	1.2
4.335750	40.3	100.4	-60.1	-13	47.1	Vertical	90	1.2
4.817500	43.2	100.9	-57.7	-13	44.7	Vertical	30	1.1
5.299250	40.2	100.9	-60.7	-13	47.7	Vertical	30	1.1



Company: Shure Incorporated  
 Model Tested: MX690 G4  
 Report Number: 13995

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

DLS Electronic Systems, Inc.

Company: Shure, Inc.  
 Operator: Craig B  
 Date of test: 03-13-2008  
 Temperature: 72 deg. F.  
 Humidity: 25% R.H.

Radiated Spurious Emissions (e.r.p. substitution method) FCC Part 74; FCC Part 2.1053								
Model: <b>MX690-G4</b> Transmit Frequency: <b>493.825 MHz</b>								
Frequency GHz	Field Strength Level dBuV/m	Factor to Convert to dBm	Power ERP dBm	Limit dBm	Margin dB	Receive Antenna Polarization	EUT Orientation (degrees)	Receive Antenna Height (m)
0.987650	43.2	95.9	-52.7	-13	39.7	Horizontal	170	1.2
1.481475	41.5	100.4	-59.0	-13	46.0	Horizontal	90	1.1
1.975300	48.0	100.3	-52.3	-13	39.3	Horizontal	20	1.1
2.469125	42.3	101.1	-58.8	-13	45.8	Horizontal	35	1.1
2.962950	37.2	101.5	-64.3	-13	51.3	Horizontal	315	1.1
3.456775	39.9	100.8	-61.0	-13	48.0	Horizontal	40	1.3
3.950600	45.5	101.1	-55.6	-13	42.6	Horizontal	180	1.0
4.444425	38.7	99.5	-60.8	-13	47.8	Horizontal	90	1.0
4.938250	39.4	100.2	-60.8	-13	47.8	Horizontal	350	1.0
5.432075	38.3	99.7	-61.4	-13	48.4	Horizontal	270	1.2
0.987650	41.9	96.6	-54.7	-13	41.7	Vertical	260	1.1
1.481475	41.6	101.1	-59.5	-13	46.5	Vertical	90	1.1
1.975300	49.0	99.9	-50.9	-13	37.9	Vertical	0	1.2
2.469125	41.7	99.8	-58.1	-13	45.1	Vertical	35	1.1
2.962950	35.6	100.3	-64.7	-13	51.7	Vertical	45	1.7
3.456775	39.6	100.4	-60.8	-13	47.8	Vertical	45	1.0
3.950600	46.3	101.0	-54.7	-13	41.7	Vertical	180	1.1
4.444425	39.4	100.0	-60.6	-13	47.6	Vertical	90	1.2
4.938250	39.8	100.6	-60.8	-13	47.8	Vertical	350	1.1
5.432075	28.3	100.3	-72.0	-13	59.0	Vertical	270	1.2



Company: Shure Incorporated  
Model Tested: MX690 G4  
Report Number: 13995

1250 Peterson Dr., Wheeling, IL 60090

## APPENDIX A

### 8.0 FREQUENCY STABILITY (TEMPERATURE)– PART 2.1055(a1)

The frequency stability was measured from  $-30^{\circ}$  to  $+50^{\circ}$  centigrade at intervals of  $10^{\circ}$  centigrade throughout the range. Prior to each frequency measurement, the equipment was left alone for a sufficient period of time (approximately 30 minutes or more) to allow the components of the Wireless Boundary Microphone oscillator circuitry to stabilize.

See the following page for the data taken during testing.

### 9.0 FREQUENCY STABILITY (VOLTAGE VARIATION)– PART 2.1055(d2)

The frequency stability of Wireless Boundary Microphone was measured by reducing the primary supply voltage to the battery end point specified by the manufacturer.

See the following page for the data taken during testing.



1250 Peterson Dr., Wheeling, IL 60090

Company: Shure Incorporated  
Model Tested: MX690 G4  
Report Number: 13995

APPENDIX A

DATA TAKEN FOR FREQUENCY

STABILITY WHEN VARYING THE TEMPERATURE

AND

PRIMARY SUPPLY VOLTAGE VARIATION

PART 2.1055a(1) & PART 2.1055d(d2)



Company: Shure Incorporated  
 Model Tested: MX690 G4  
 Report Number: 13995

1250 Peterson Dr., Wheeling, IL 60090

DLS Electronic Systems, Inc.

Company: Shure, Inc.  
 Operator: Craig B  
 Date of test: 03-20-2008

Limit = 23.5 kHz (0.005% of 470 MHz)

Frequency Stability FCC Part 74; FCC Part 2.1055

Model	Nominal Frequency (MHz)	Measured Frequency									
		+50 deg. C	Error (kHz)	+40 deg. C	Error (kHz)	+30 deg. C	Error (kHz)	+20 deg. C	Error (kHz)	+10 deg. C	Error (kHz)
MX690-G4	470.125	470.12085	<b>-4.150</b>	470.12195	<b>-3.050</b>	470.12355	<b>-1.450</b>	470.12430	<b>-0.700</b>	470.12675	<b>1.750</b>
MX690-G4	481.750	481.74565	<b>-4.350</b>	481.74670	<b>-3.300</b>	481.74840	<b>-1.600</b>	481.74935	<b>-0.650</b>	481.75160	<b>1.600</b>
MX690-G4	493.825	493.82050	<b>-4.500</b>	493.82155	<b>-3.450</b>	493.82330	<b>-1.700</b>	493.82440	<b>-0.600</b>	493.82650	<b>1.500</b>

Frequency Stability FCC Part 74; FCC Part 2.1055

Model	Nominal Frequency (MHz)	Measured Frequency									
		0 deg. C	Error (kHz)	-10 deg. C	Error (kHz)	-20 deg. C	Error (kHz)	-30 deg. C	Error (kHz)	2.1 Volts	Error (kHz)
MX690-G4	470.125	470.12770	<b>2.700</b>	470.12800	<b>3.000</b>	470.12725	<b>2.250</b>	470.12550	<b>0.500</b>	470.12490	<b>-0.100</b>
MX690-G4	481.750	481.75265	<b>2.650</b>	481.75310	<b>3.100</b>	481.75260	<b>2.600</b>	481.75115	<b>1.150</b>	481.74950	<b>-0.500</b>
MX690-G4	493.825	493.82760	<b>2.600</b>	493.82815	<b>3.150</b>	493.82795	<b>2.950</b>	493.82680	<b>1.800</b>	493.82435	<b>-0.650</b>

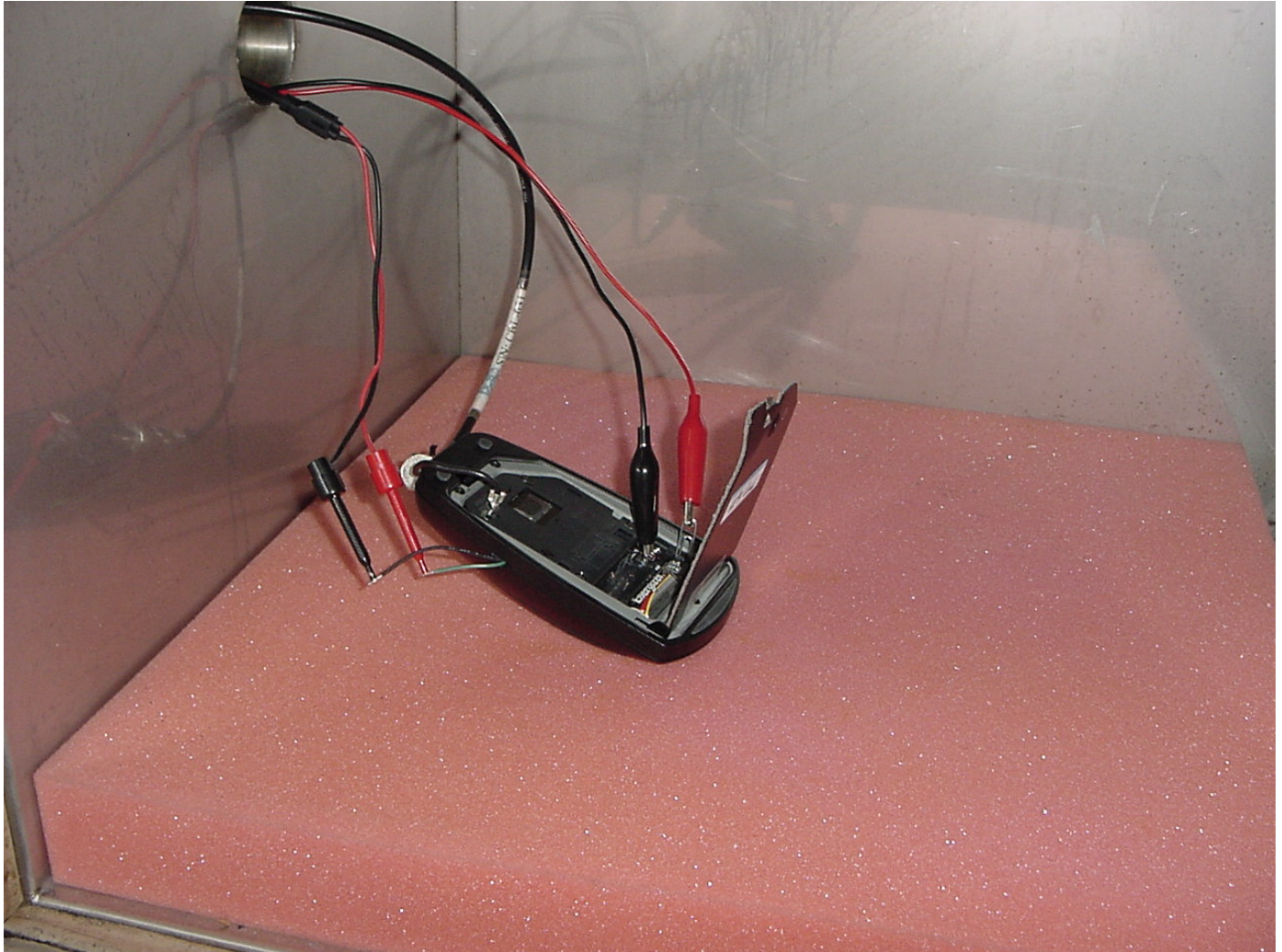




Company: Shure Incorporated  
Model Tested: MX690 G4  
Report Number: 13995

1250 Peterson Dr., Wheeling, IL 60090

## 10.0 FREQUENCY STABILITY PHOTOS TAKEN DURING TESTING



**RF CONDUCTED**