



Company: Shure Incorporated
Model Tested: MX690L4
Report Number: 13480

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 (d) Other than TV Broadcasting

THE FOLLOWING "**MEETS**" THE ABOVE TEST SPECIFICATION

Formal Name: Wireless Boundary Microphone
Kind of Equipment: Wireless Microphone Transmitter
Test Configuration: Stand Alone (Tested at 3 vdc)
Model Number(s): MX690L4
Model(s) Tested: MX690L4
Serial Number(s): NA
Emission Designator: 120KF3E
Date of Tests: July 5, 12, & 13, 2007
Test Conducted For: Shure Incorporated
5800 West Touhy Ave.
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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Model Tested: MX690L4
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SIGNATURE PAGE

Report By:

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Test Engineer
EMC-001375-NE

Reviewed By:

William Stumpf
OATS Manager

Approved By:

Brian Mattson
General Manager

Company Official:

Shure Incorporated



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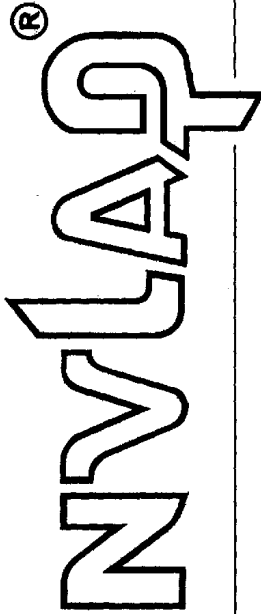
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United States Department of Commerce
 National Institute of Standards and Technology



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 Communiqué dated 18 June 2005).*



2006-10-01 through 2007-09-30
 Effective dates

Dolly A. Bruce
 For the National Institute of Standards and Technology

NVLAP-01C (REV. 2006-09-13)



Company: Shure Incorporated
Model Tested: MX690L4
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1.0 SUMMARY OF TEST REPORT

It was found that the Wireless Boundary Microphone, Model Number(s) MX690L4, "**meets**" the radio interference radiated emission requirements of the FCC "Rules and Regulations", Part 74, Subpart H, Section 74.861 (d), 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 July 5, 12, & 13, 2007, a series of radio frequency interference measurements was performed on Wireless Boundary Microphone, Model Number(s) MX690H5, Serial Number: NA. 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

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 (d), 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 American National Standards Institute, ANSI C63.4-2003. 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 HP Spectrum Analyzer or 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 HP Spectrum Analyzer and or 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, Section 4.2.

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 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. These methods are performed to the specifications in ANSI C63.4: 2003.

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 AC Power Line 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 518 to 865 MHz (in nine 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.

The unit will operate on two "AA" alkaline batteries which are placed in the battery compartment. The unit is turned on by holding the power button (on bottom of EUT) for 3 seconds, the LED around the Push button (on top of EUT) should turn Green.

8.2 PHYSICAL DIMENSIONS OF EQUIPMENT UNDER TEST

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

8.3 LINE FILTER USED:

NA

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 PHOTO INFORMATION AND TEST SET-UP

Item 0 Wireless Boundary Microphone
Model Number: MX690L4, Serial Number: NA



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10.0 RADIATED PHOTOS TAKEN DURING TESTING

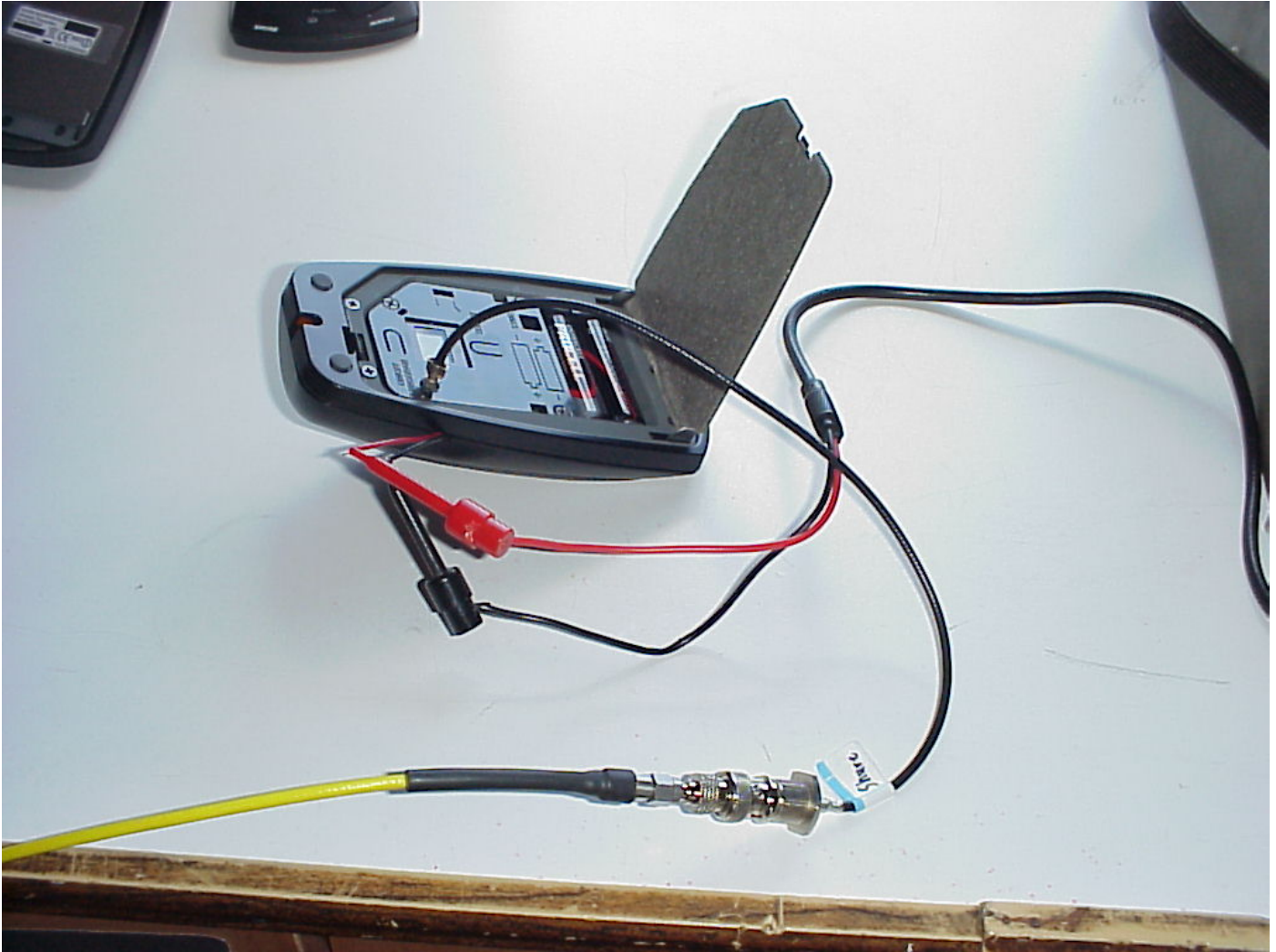




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10.0 RF CONDUCTED PHOTOS TAKEN DURING TESTING





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11.0 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.

12.0 CONCLUSION

It was found that the Wireless Boundary Microphone, Model Number(s) MX690L4 "**meets**" the radio interference radiated emission requirements of the FCC "Rules and Regulations", Part 74, Subpart H, Section 74.861 (d), 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

Test Equipment	Manufacturer	Model Number	Serial Number	Frequency Range	Cal Due Dates
Receiver	Rohde & Schwarz	ESI 26	837491/010	20 Hz – 26 GHz	11/07
Receiver	Rohde & Schwarz	ESI 40	837808/006	20 Hz – 40 GHz	12/07
Receiver	Rohde & Schwarz	ESI 40	837808/005	20 Hz – 40 GHz	12/07
Antenna	EMCO	3104C	00054891	20 MHz – 200 MHz	2/08
Antenna	Electrometrics	LPA-25	1114	200 MHz – 1 GHz	3/08
Antenna	EMCO	3104C	00054892	20 MHz – 200 MHz	3/08
Antenna	Electrometrics	3146	1205	200 MHz – 1 GHz	3/08
Antenna	EMCO	3104C	97014785	20 MHz – 200 MHz	2/08
Antenna	EMCO	3146	97024895	200 MHz – 1 GHz	3/08
Antenna	EMCO	3115	2479	1 GHz – 18 GHz	5/08
Antenna	EMCO	3115	99035731	1 GHz – 18 GHz	6/08
Antenna	Rohde & Schwarz	HUF-Z1	829381001	20 MHz – 1 GHz	2/08
Antenna	Rohde & Schwarz	HUF-Z1	829381005	20 MHz – 1 GHz	8/07

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



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TABLE 1 – EQUIPMENT LIST

Test Equipment	Manufacturer	Model Number	Serial Number	Frequency Range	Cal Due Dates
LISN	Solar	8012-50-R-24-BNC	8305116	10 MHz – 30 MHz	8/07
LISN	Solar	8012-50-R-24-BNC	814548	10 MHz – 30 MHz	8/07
LISN	Solar	9252-50-R-24-BNC	961019	10 MHz – 30 MHz	12/07
LISN	Solar	9252-50-R-24-BNC	971612	10 MHz – 30 MHz	10/07
LISN	Solar	9252-50-R-24-BNC	92710620	10 MHz – 30 MHz	7/08

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



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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 (d)(1), the RF output power should not exceed 1 watt(s). The RF output of the Wireless Boundary Microphone was connected to a Spectrum Analyzer 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:

7.59 dBm Measured output of the transmitter

7.59 dBm equals 0.00574 watt(s)

LIMIT:

Manufacturer's rated output power = 7.9 dBm \pm 2 dB

MARGIN:

$1 - 0.00574 = 0.9943$ watt(s)



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DATA TAKEN OF THE RF POWER

OUTPUT MEASUREMENT

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

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



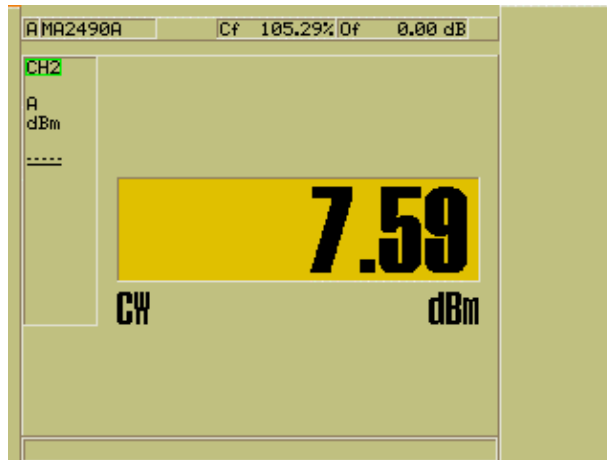
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APPENDIX A

Test Date: 07-12-2007
Company: Shure, Inc.
EUT: MX690-L4
Test: Peak Power Output - Conducted
Rule part: FCC Part 74; FCC Part 2.1046
Operator: Craig B
Comment: Channel: 638.2 MHz

Peak Output Power = 7.59 dBm = 5.74 mW





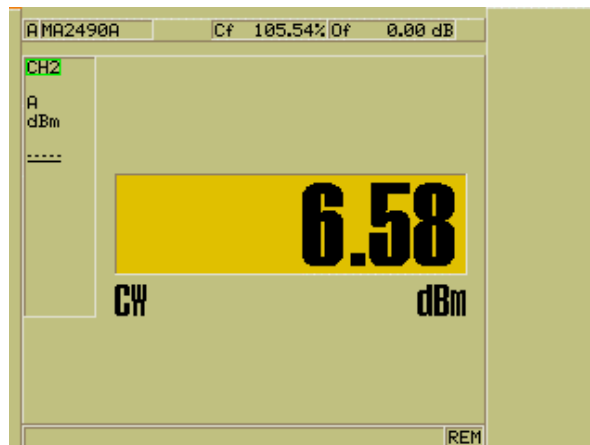
Company: Shure Incorporated
Model Tested: MX690L4
Report Number: 13480

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APPENDIX A

Test Date: 07-12-2007
Company: Shure, Inc.
EUT: MX690-L4
Test: Peak Power Output - Conducted
Rule part: FCC Part 74; FCC Part 2.1046
Operator: Craig B
Comment: Channel: 650.5 MHz

Peak Output Power = 6.58 dBm = 4.55 mW





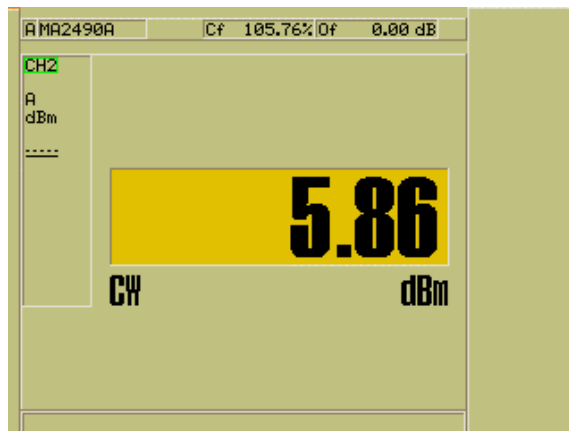
Company: Shure Incorporated
Model Tested: MX690L4
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APPENDIX A

Test Date: 07-12-2007
Company: Shure, Inc.
EUT: MX690-L4
Test: Peak Power Output - Conducted
Rule part: FCC Part 74; FCC Part 2.1046
Operator: Craig B
Comment: Channel: 661.8 MHz

Peak Output Power = 5.86 dBm = 3.85 mW



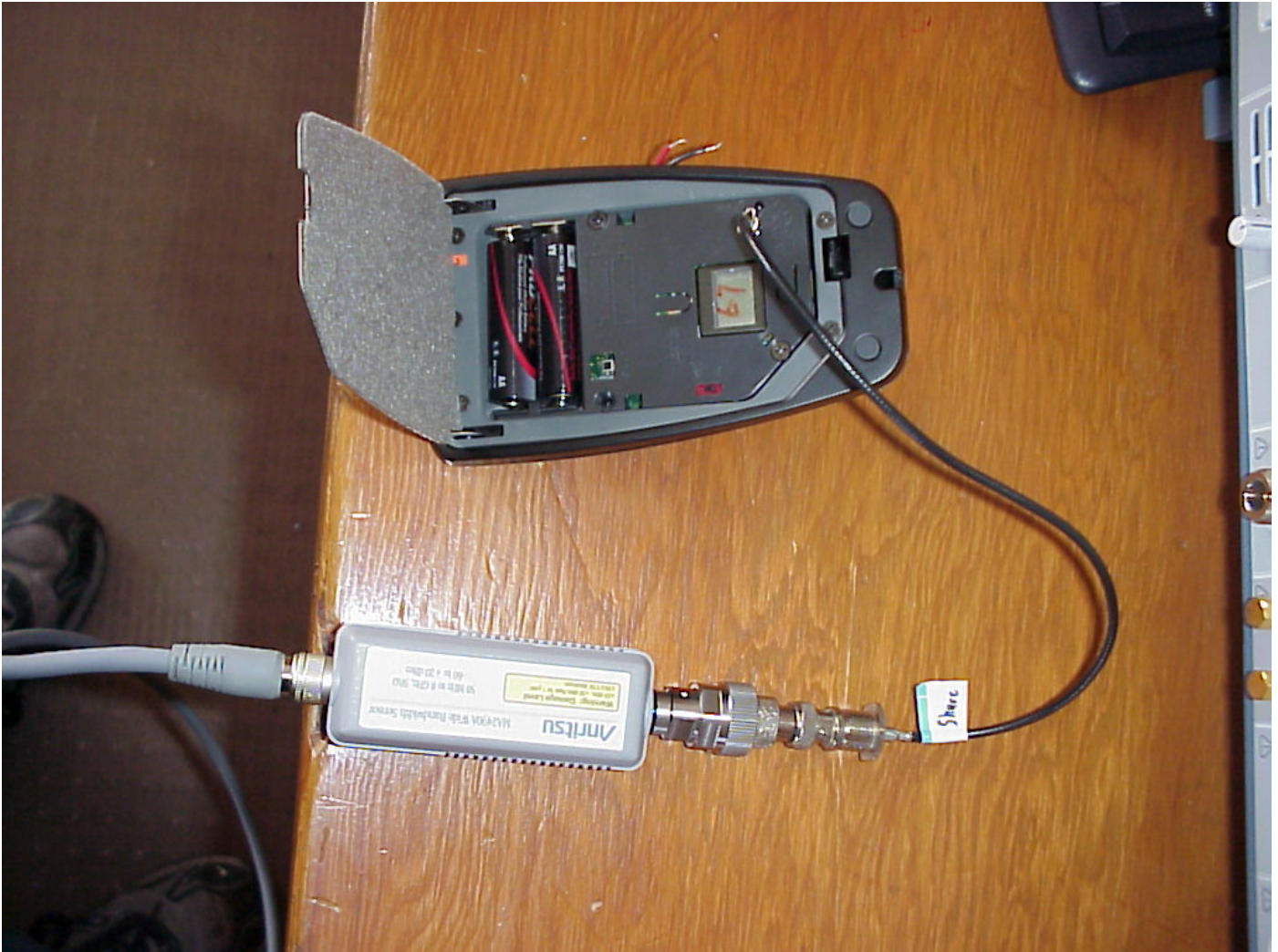


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APPENDIX A

3.0 RF POWER OUTPUT PHOTOS TAKEN DURING TESTING



CONDUCTED RF 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 - 20 kHz ± 3 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

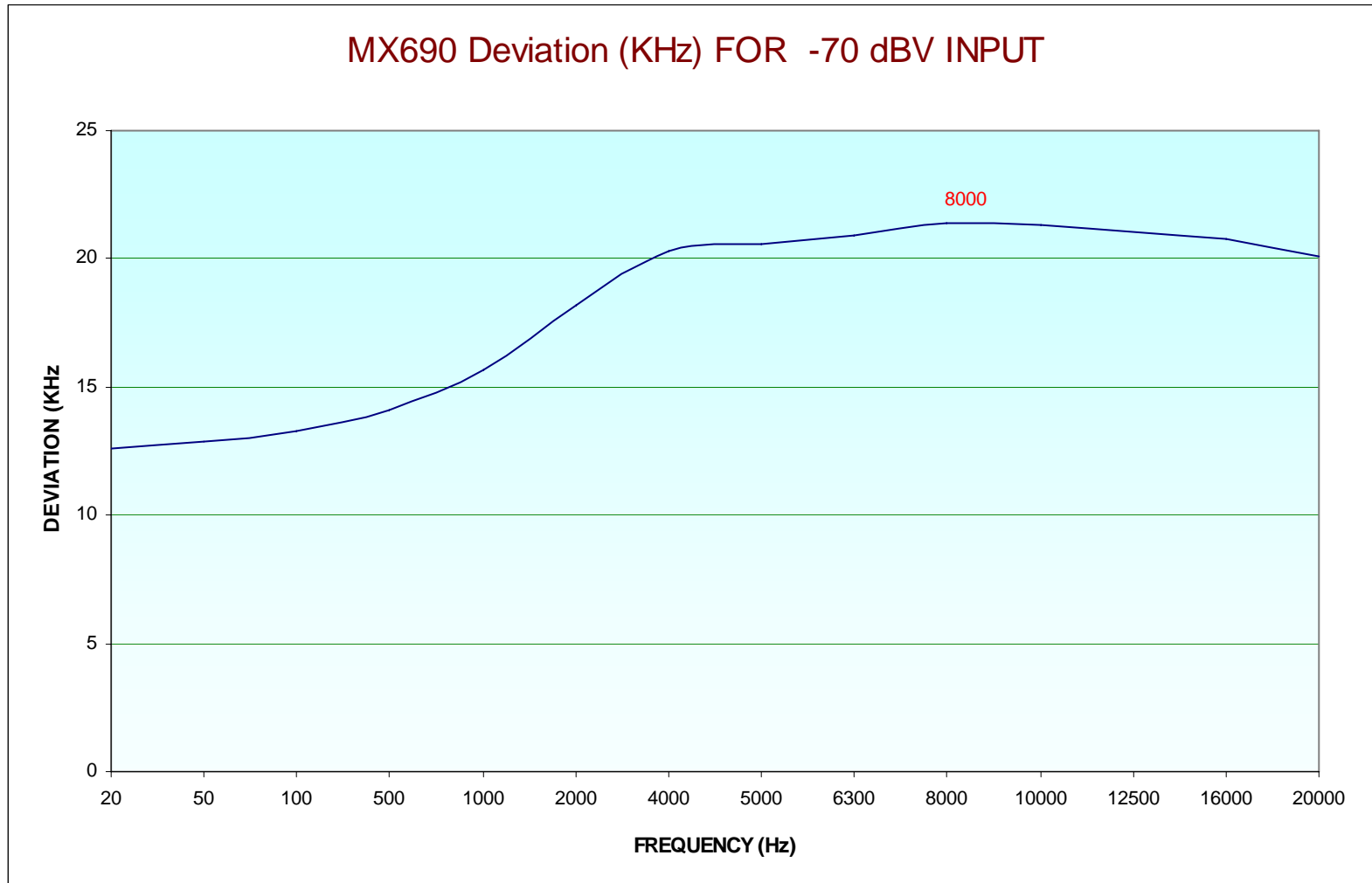
PART 2.1047



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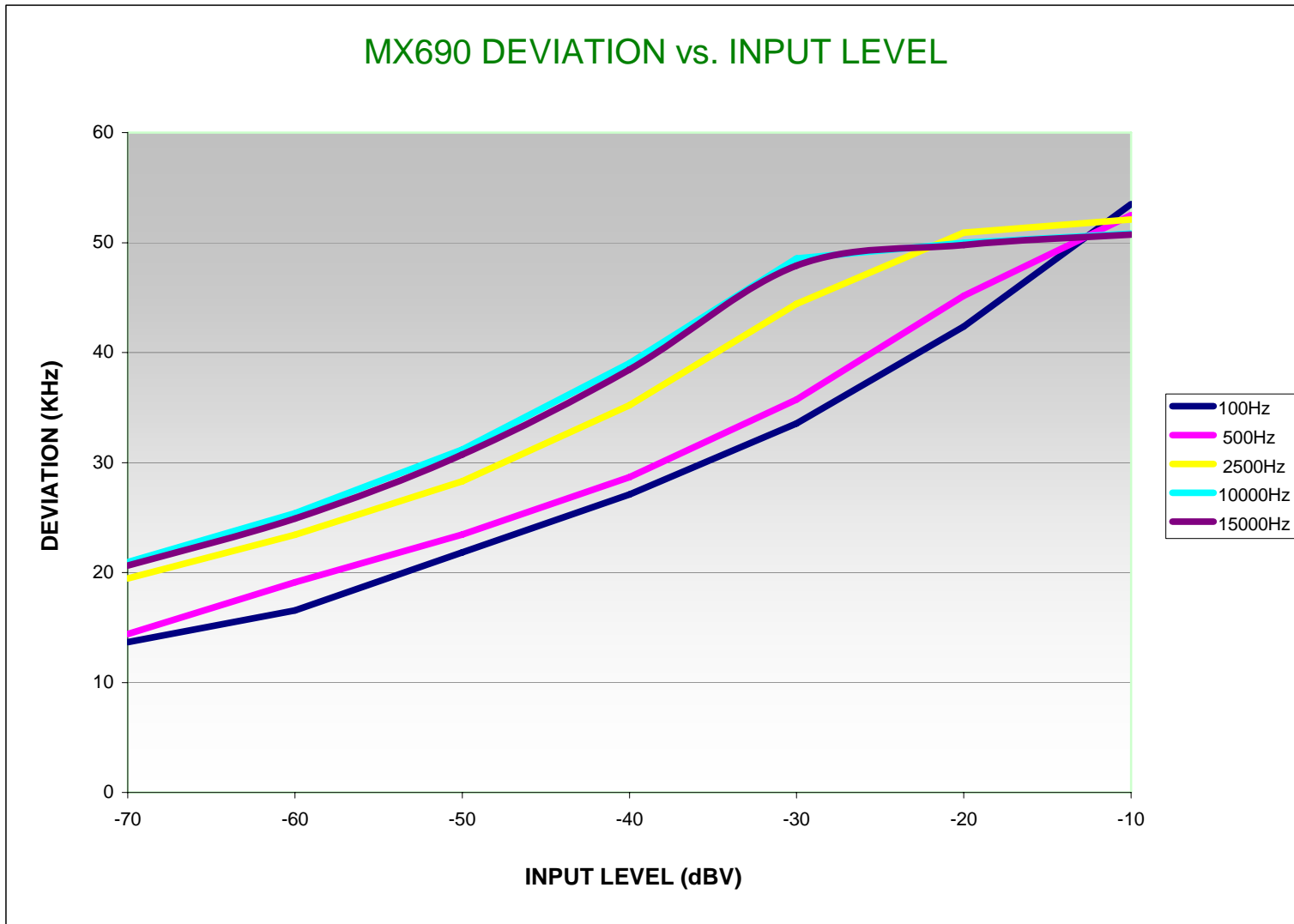




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APPENDIX A

**MX690-
L4 #8**

Note: Frequency response switch is set to full range setting for these measurements.

Audio Limiting

		DEVIATION (KHz) AT				
LEVEL INPUT		100Hz	500Hz	2500Hz	10000Hz	15000Hz
dBV						
-70		13.68	14.42	19.47	20.94	20.64
-60		16.55	19.12	23.41	25.38	24.91
-50		21.83	23.45	28.29	31.19	30.73
-40		27.09	28.67	35.22	39.04	38.47
-30		33.56	35.71	44.42	48.55	47.90
-20		42.36	45.16	50.89	50.00	49.80
-10		53.50	52.50	52.10	50.80	50.72

Audio Frequency Response

UR1	INPUT : -70dBV
FREQUENCY (Hz)	DEVIATION (KHz)
20	12.61
50	12.9
100	13.28
500	14.1
1000	15.64
2000	18.22
4000	20.28
5000	20.54
6300	20.88
8000	21.37
10000	21.3
12500	21.05
16000	20.76
20000	20.08



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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 ± 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

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

NOTE:

The emissions mask measurements results were verified by using 2 kHz resolution bandwidth and 2 kHz video bandwidth. The 1.2 kHz was determined by taking 1% of the worst case measurement of 121.4 kHz, which yields 1.2 kHz.



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APPENDIX A

DATA AND GRAPH(S) TAKEN OF THE

99% OCCUPIED BANDWIDTH

Part 74.861(d)(3) & PART 2.1049



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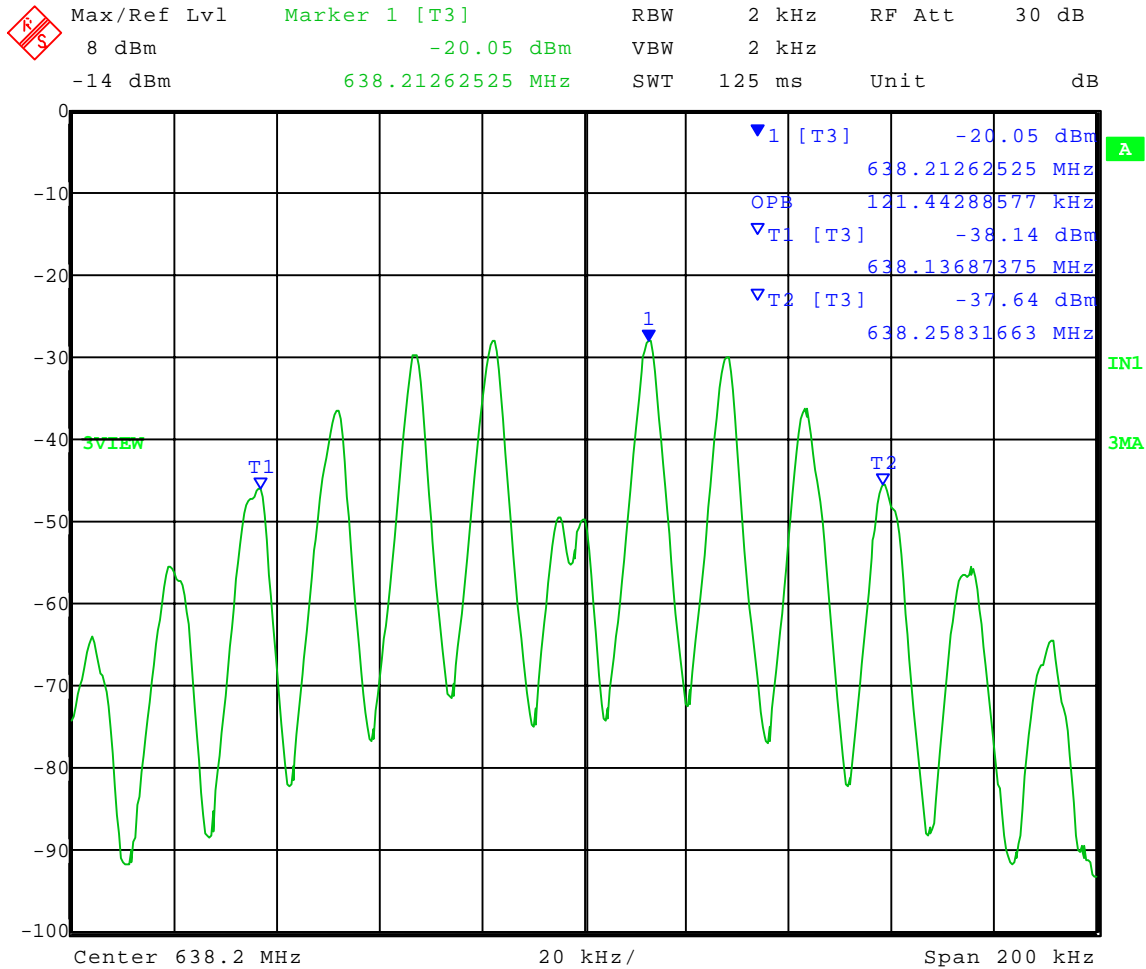
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APPENDIX A

Test Date: 07-12-2007
 Company: Shure, Inc.
 EUT: MX690-L4
 Test: Occupied Bandwidth; 99% bandwidth
 Rule part: FCC Part 74; FCC Part 2.1049
 Operator: Craig B

Frequency: 638.2 MHz

99% power bandwidth = 121.4 kHz



Date: 12.JUL.2007 13:33:59



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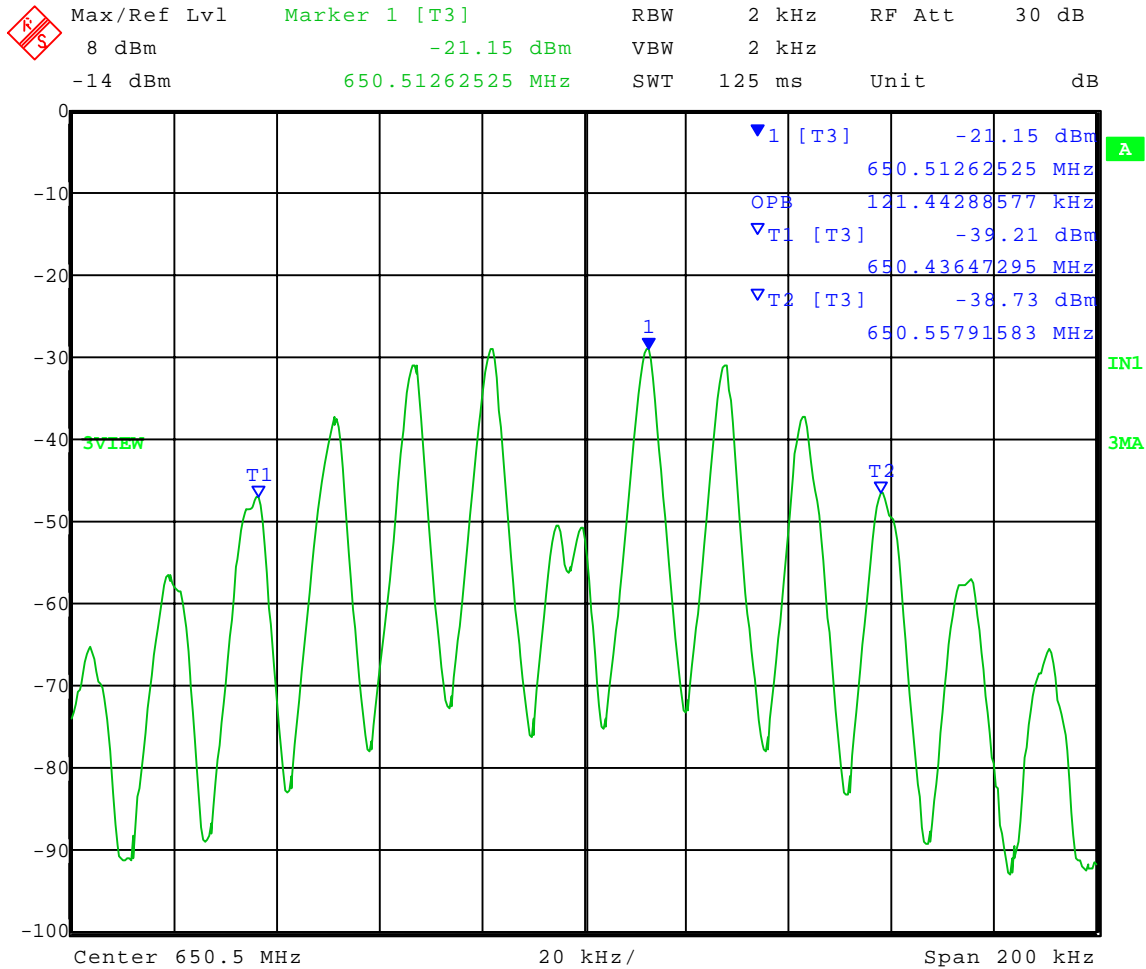
1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

Test Date: 07-12-2007
 Company: Shure, Inc.
 EUT: MX690-L4
 Test: Occupied Bandwidth; 99% bandwidth
 Rule part: FCC Part 74; FCC Part 2.1049
 Operator: Craig B

Frequency: 650.5 MHz

99% power bandwidth = 121.4 kHz



Date: 12.JUL.2007 13:35:43



Company: Shure Incorporated
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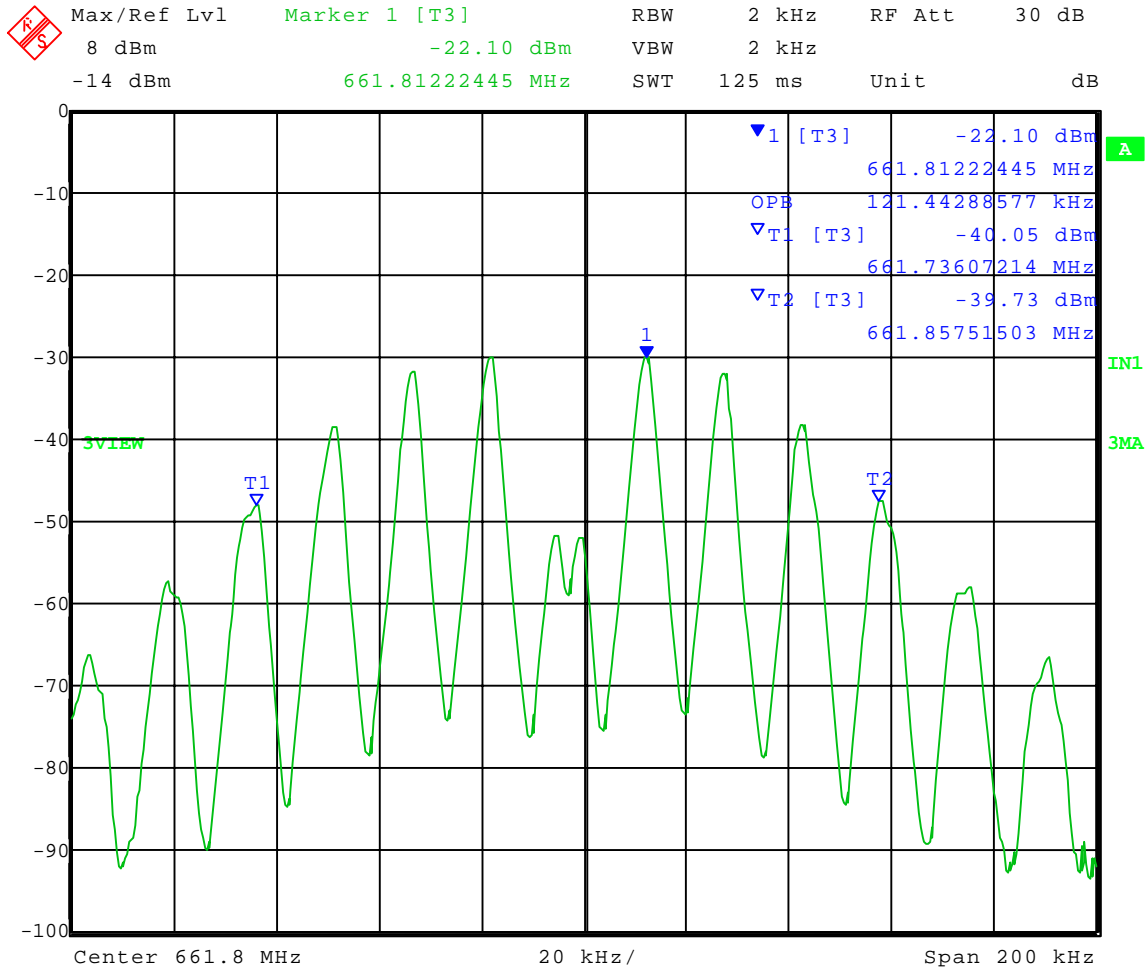
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APPENDIX A

Test Date: 07-12-2007
 Company: Shure, Inc.
 EUT: MX690-L4
 Test: Occupied Bandwidth; 99% bandwidth
 Rule part: FCC Part 74; FCC Part 2.1049
 Operator: Craig B

Frequency: **661.8 MHz**

99% power bandwidth = 121.4 kHz



Date: 12.JUL.2007 13:37:45



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APPENDIX A

DATA AND GRAPH(S) TAKEN OF THE EMISSION MASK

Part 74.861(d)(3) & PART 2.1049



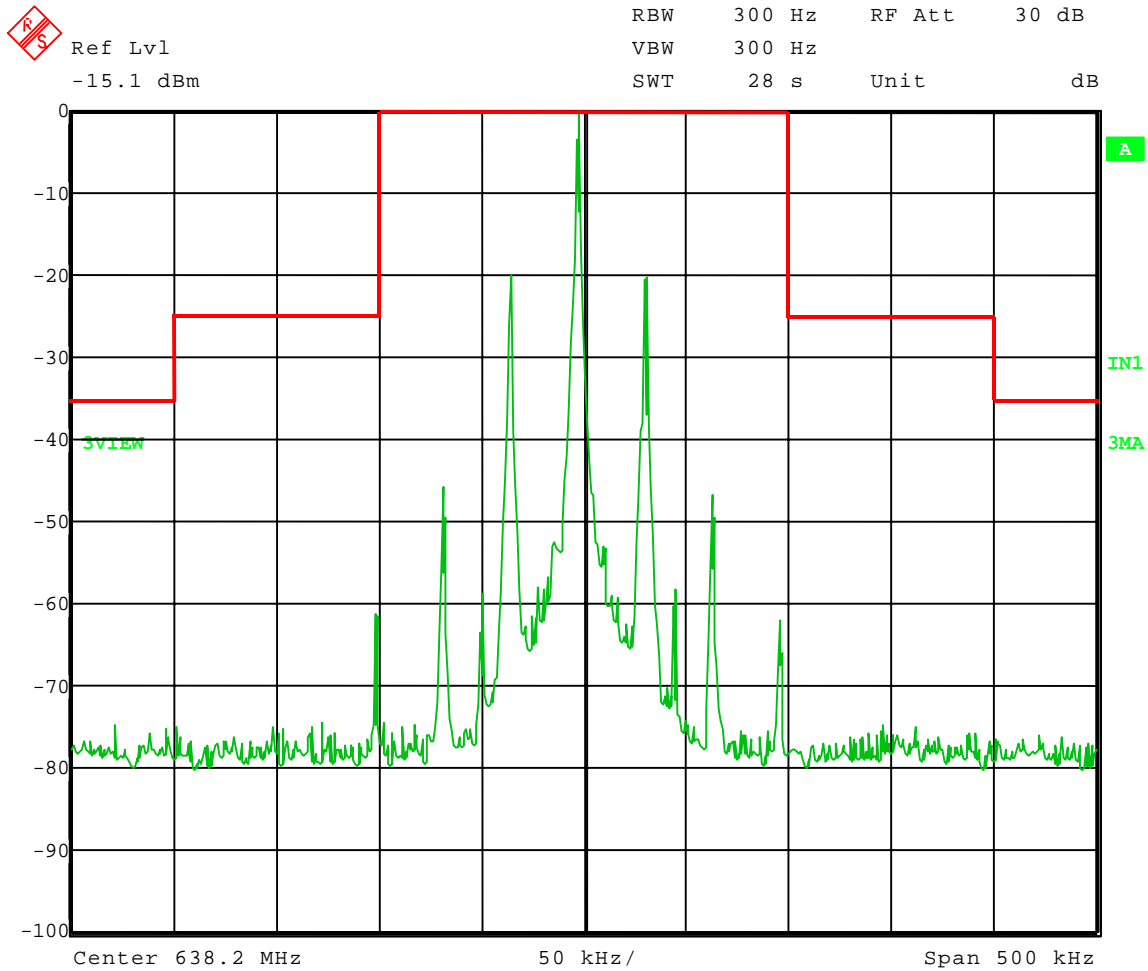
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Model Tested: MX690L4
Report Number: 13480

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

Test Date: 07-12-2007
Company: Shure, Inc.
EUT: MX690-L4
Test: Emission Mask
Rule part: FCC Part 74
Operator: Craig B

Nominal Frequency: 638.2 MHz
Unmodulated



Date: 12.JUL.2007 11:37:11



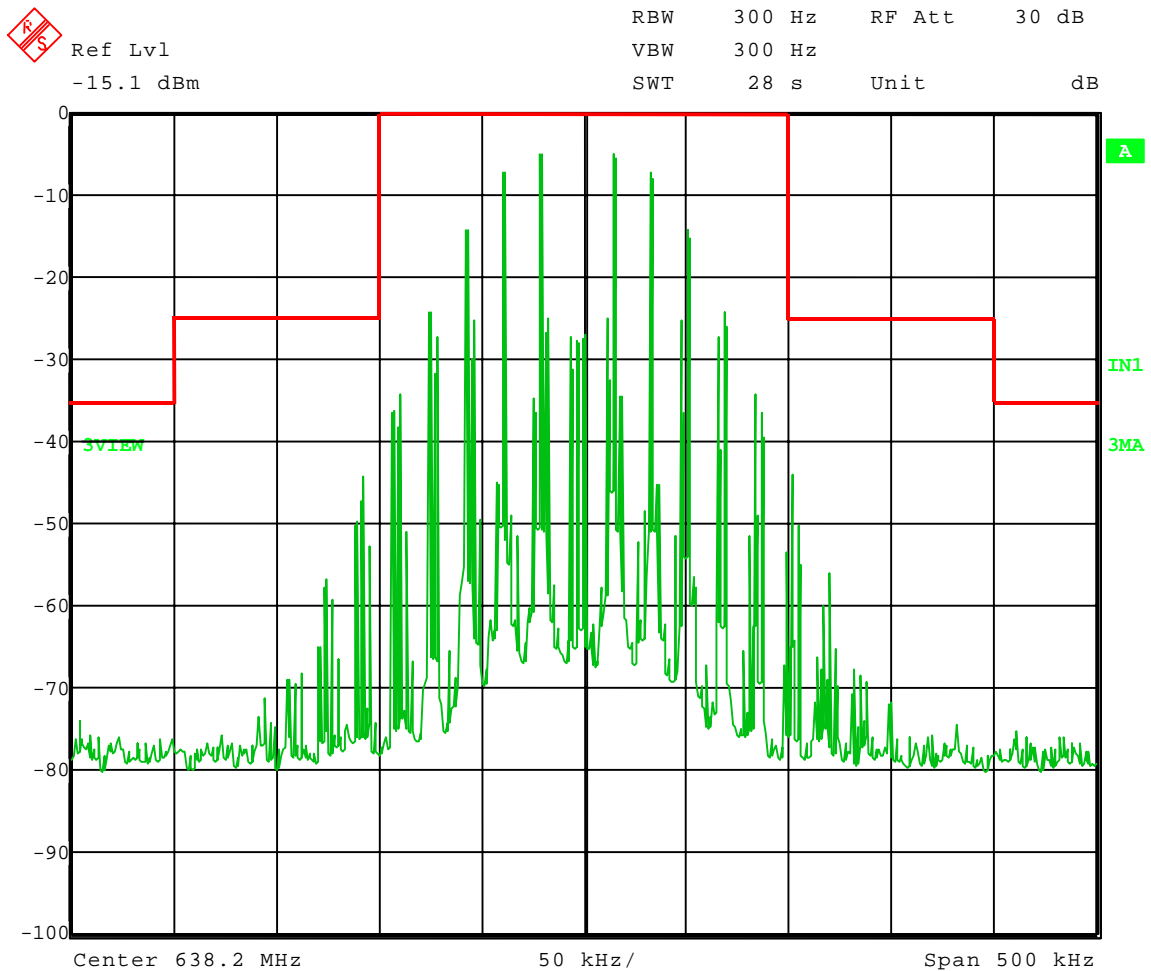
Company: Shure Incorporated
Model Tested: MX690L4
Report Number: 13480

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

Test Date: 07-12-2007
Company: Shure, Inc.
EUT: MX690-L4
Test: Emission Mask
Rule part: FCC Part 74
Operator: Craig B

Nominal Frequency: 638.2 MHz
15 kHz 85% modulated



Date: 12.JUL.2007 11:46:28



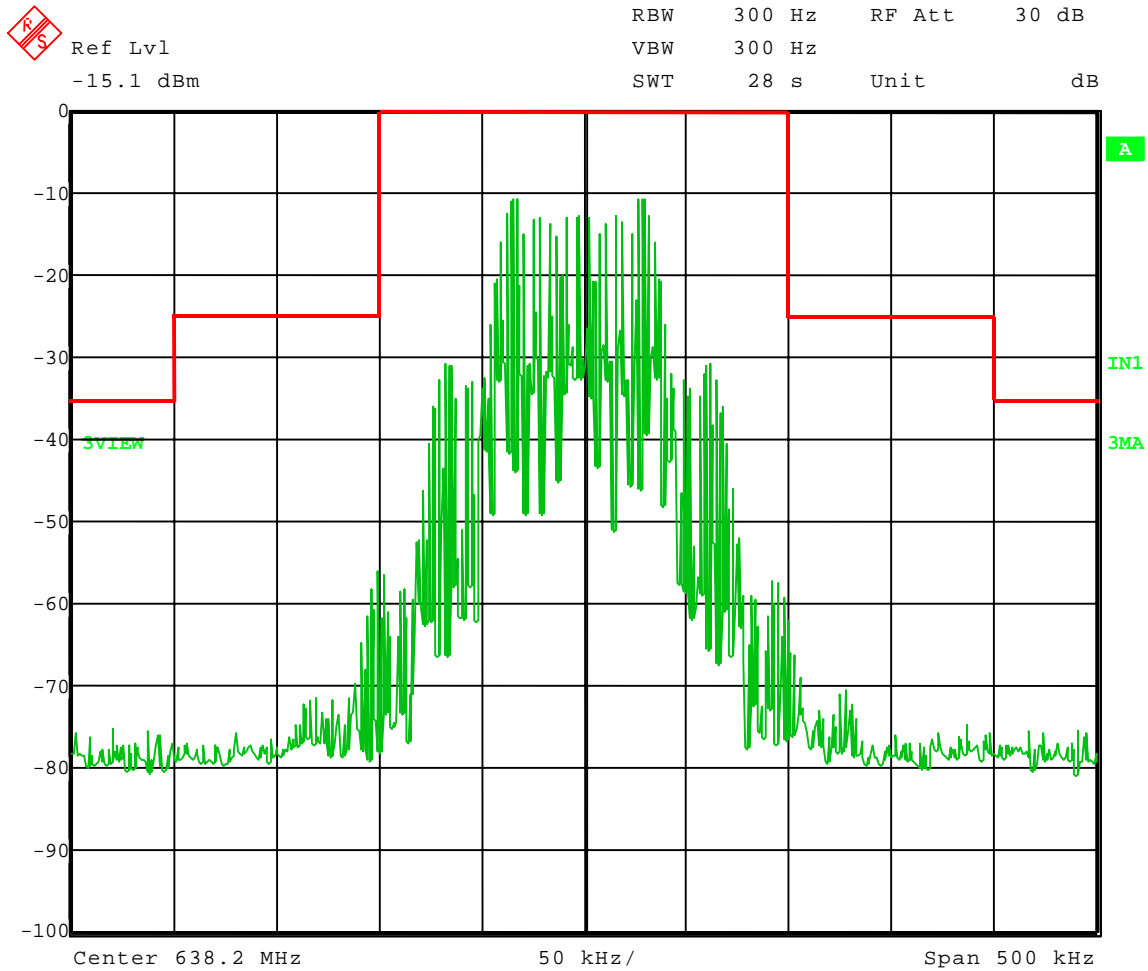
Company: Shure Incorporated
Model Tested: MX690L4
Report Number: 13480

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

Test Date: 07-12-2007
Company: Shure, Inc.
EUT: MX690-L4
Test: Emission Mask
Rule part: FCC Part 74
Operator: Craig B

Nominal Frequency: 638.2 MHz
2500 Hz 16 dB > 50% modulated



Date: 12.JUL.2007 11:43:02



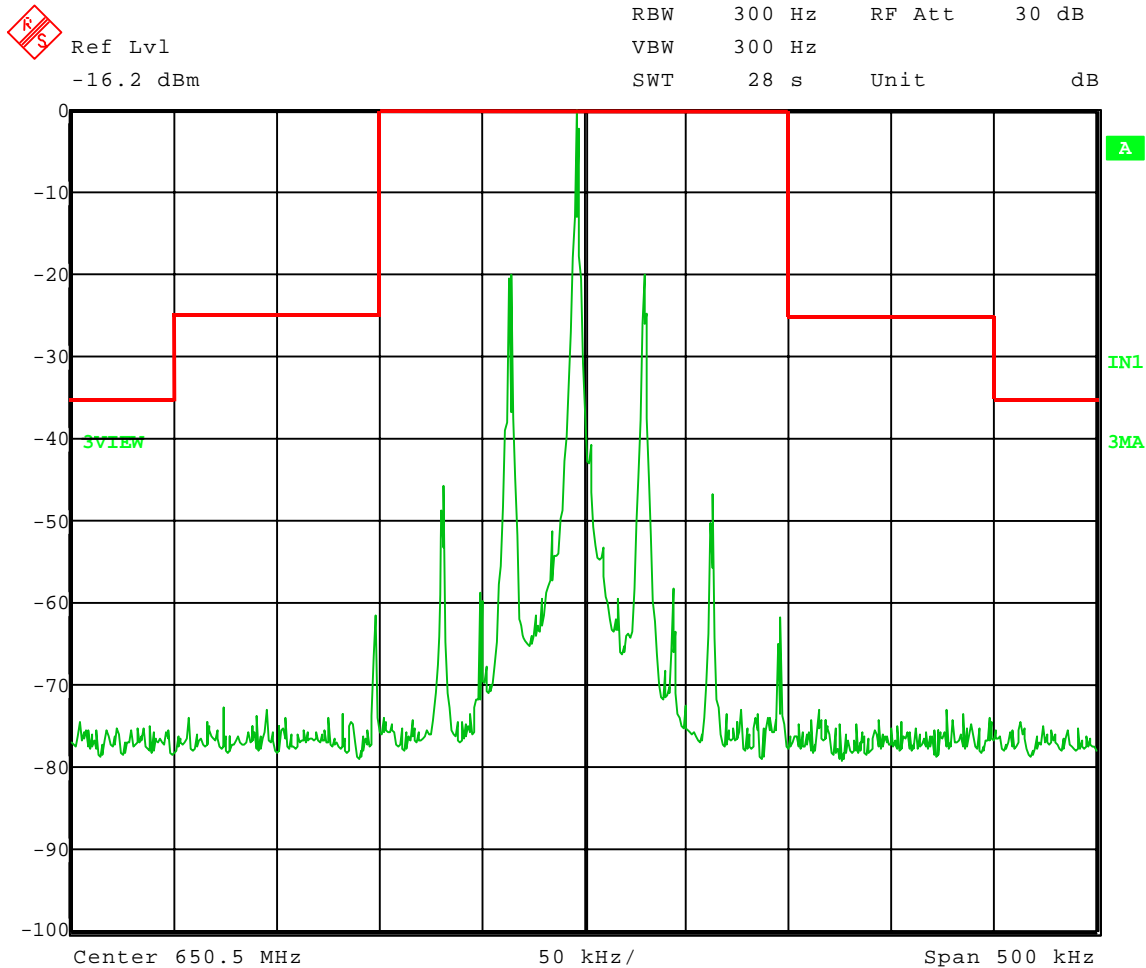
Company: Shure Incorporated
Model Tested: MX690L4
Report Number: 13480

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

Test Date: 07-12-2007
Company: Shure, Inc.
EUT: MX690-L4
Test: Emission Mask
Rule part: FCC Part 74
Operator: Craig B

Nominal Frequency: **650.5 MHz**
Unmodulated



Date: 12.JUL.2007 11:50:30



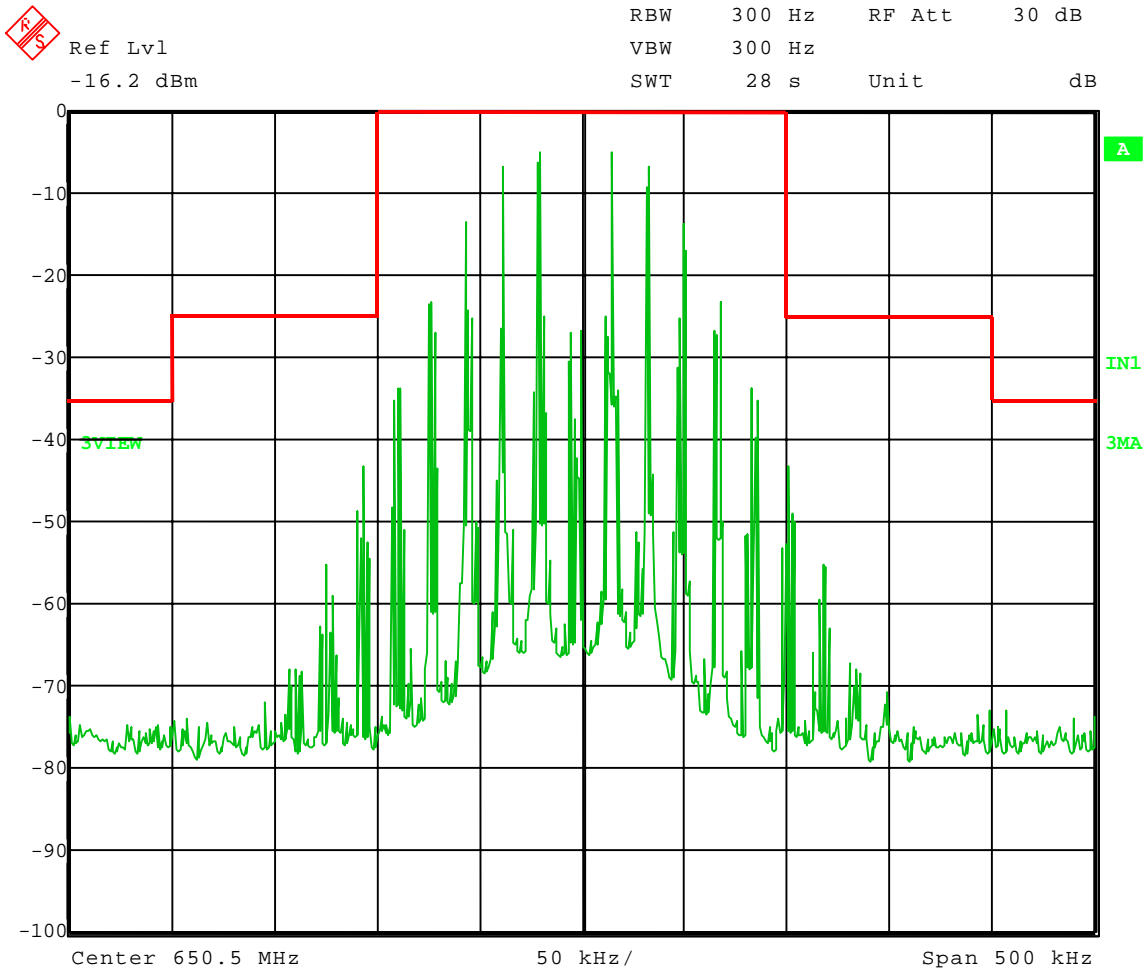
Company: Shure Incorporated
Model Tested: MX690L4
Report Number: 13480

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

Test Date: 07-12-2007
Company: Shure, Inc.
EUT: MX690-L4
Test: Emission Mask
Rule part: FCC Part 74
Operator: Craig B

Nominal Frequency: 650.5 MHz
15 kHz 85% modulated



Date: 12.JUL.2007 11:52:08



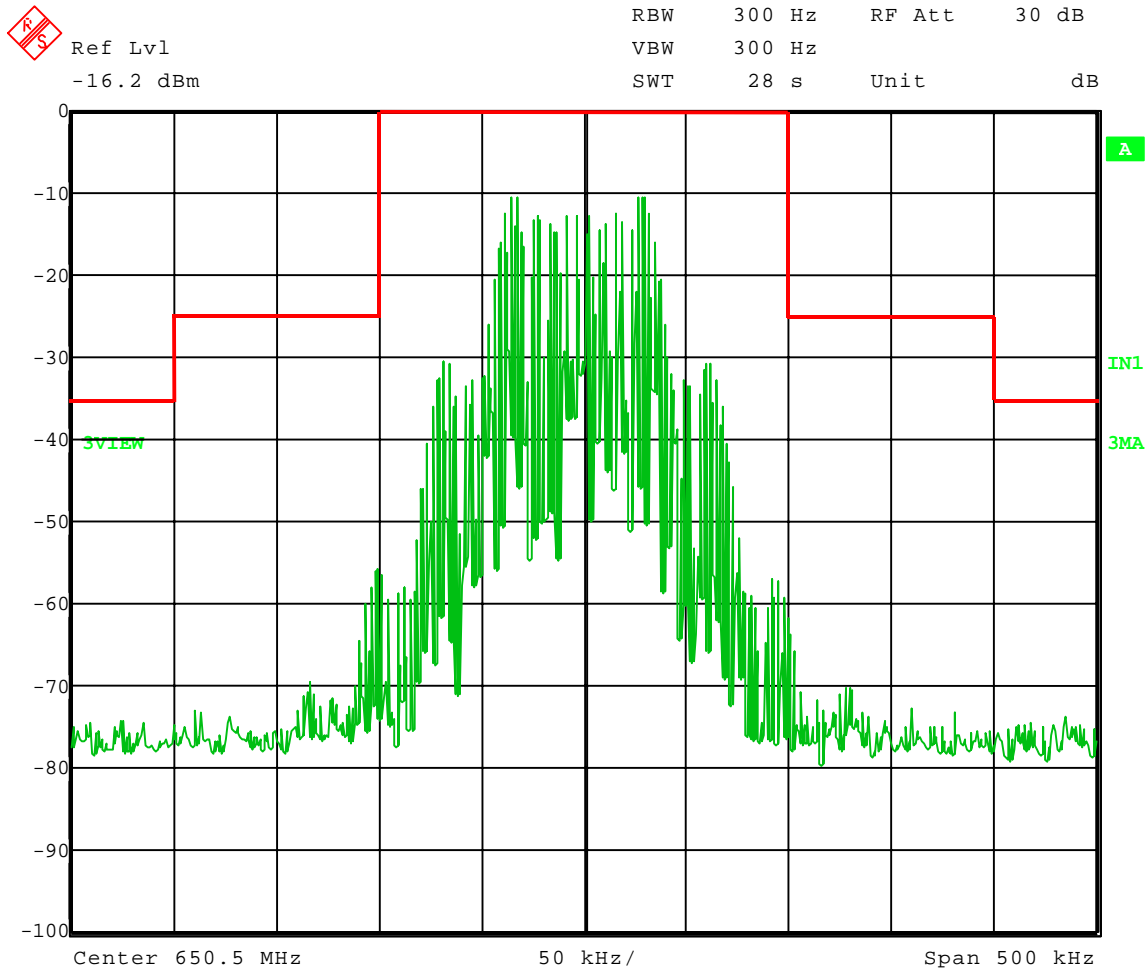
Company: Shure Incorporated
Model Tested: MX690L4
Report Number: 13480

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

Test Date: 07-12-2007
Company: Shure, Inc.
EUT: MX690-L4
Test: Emission Mask
Rule part: FCC Part 74
Operator: Craig B

Nominal Frequency: 650.5 MHz
2500 Hz 16 dB > 50% modulated



Date: 12.JUL.2007 11:53:59



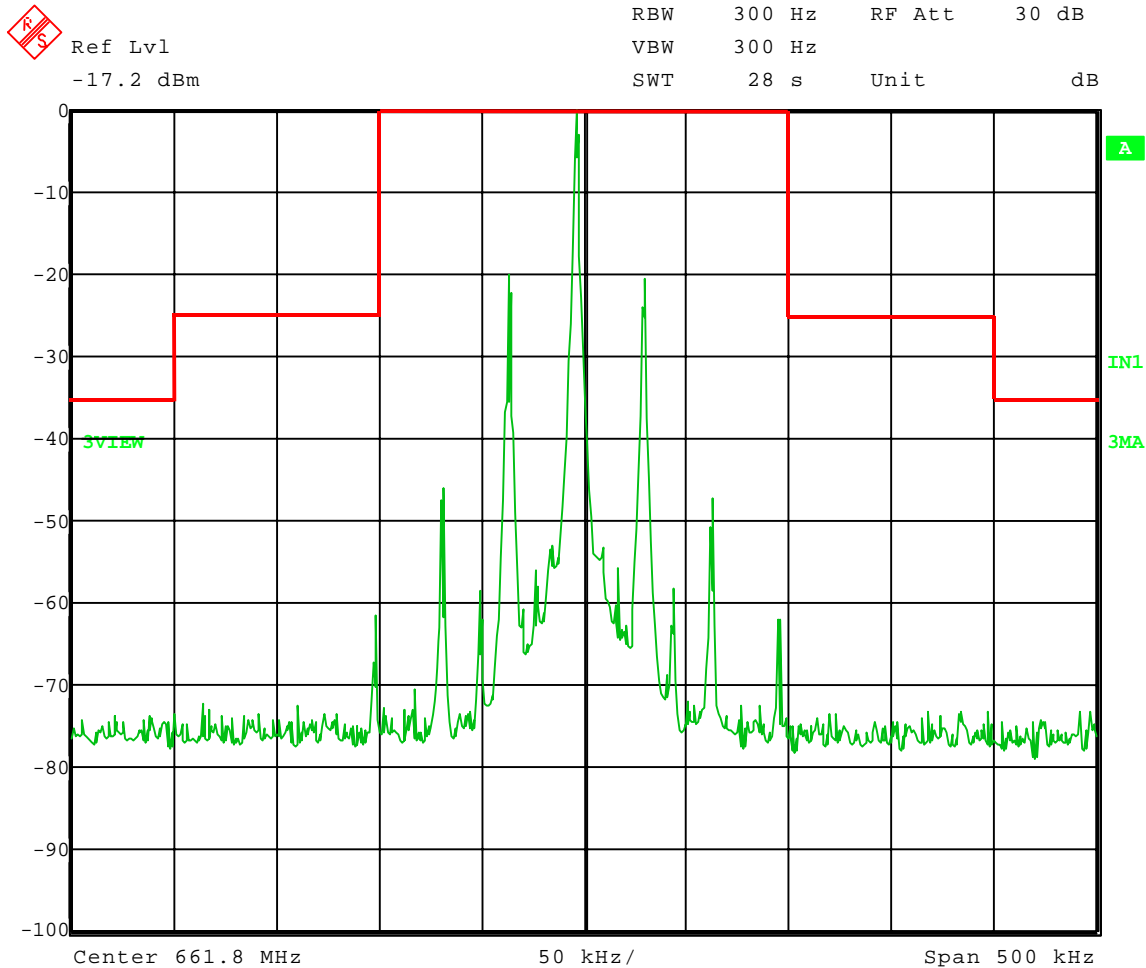
Company: Shure Incorporated
Model Tested: MX690L4
Report Number: 13480

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

Test Date: 07-12-2007
Company: Shure, Inc.
EUT: MX690-L4
Test: Emission Mask
Rule part: FCC Part 74
Operator: Craig B

Nominal Frequency: **661.8 MHz**
Unmodulated



Date: 12.JUL.2007 11:58:20



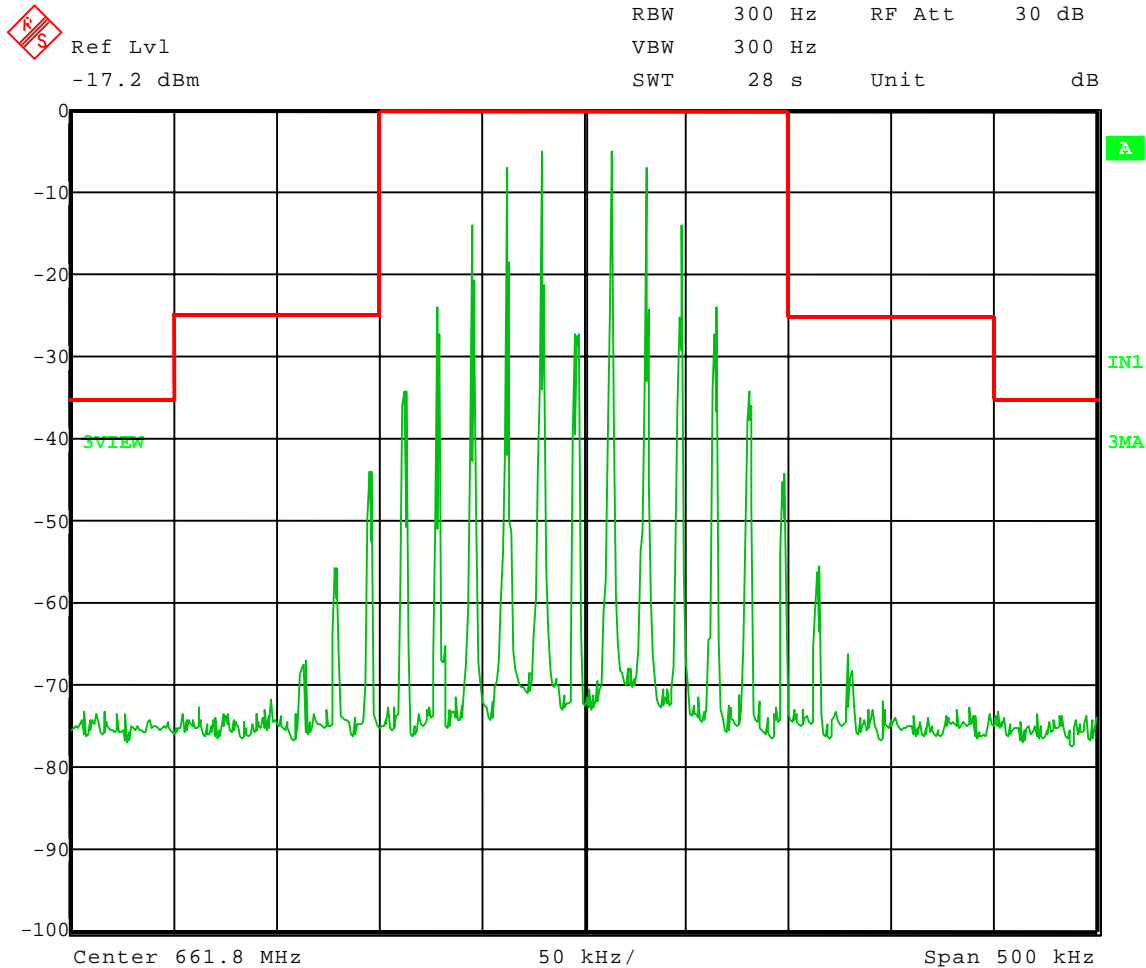
Company: Shure Incorporated
Model Tested: MX690L4
Report Number: 13480

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

Test Date: 07-12-2007
Company: Shure, Inc.
EUT: MX690-L4
Test: Emission Mask
Rule part: FCC Part 74
Operator: Craig B

Nominal Frequency: **661.8 MHz**
15 kHz 85% modulated



Date: 12.JUL.2007 12:03:45



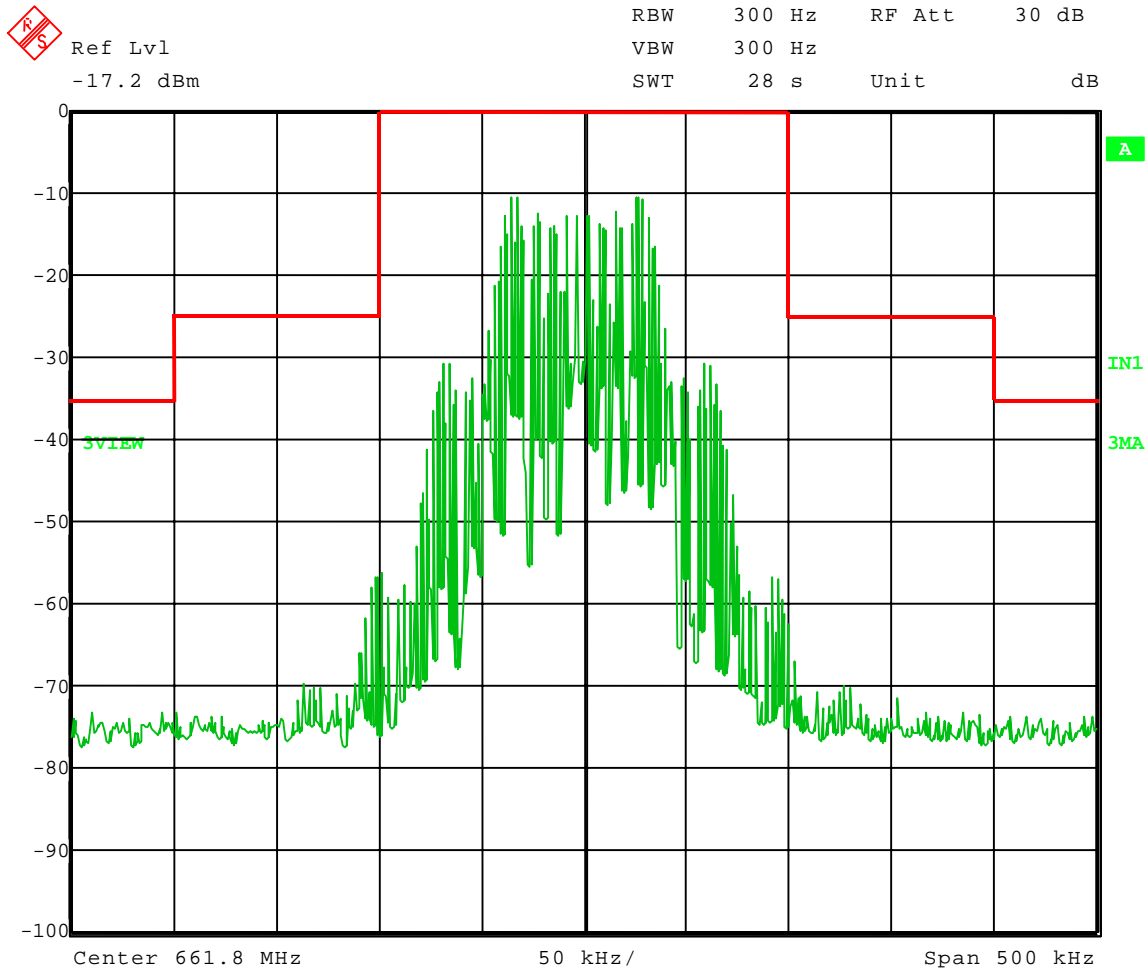
Company: Shure Incorporated
Model Tested: MX690L4
Report Number: 13480

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

Test Date: 07-12-2007
Company: Shure, Inc.
EUT: MX690-L4
Test: Emission Mask
Rule part: FCC Part 74
Operator: Craig B

Nominal Frequency: **661.8 MHz**
2500 Hz 16 dB > 50% modulated



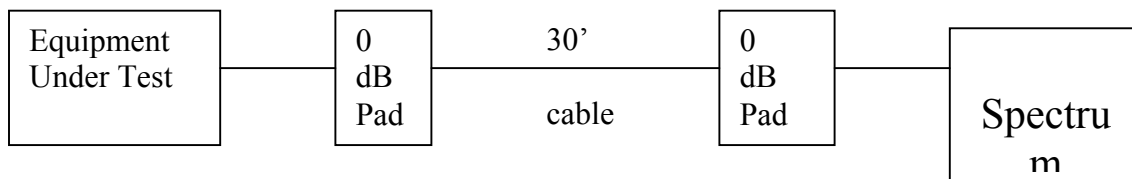
Date: 12.JUL.2007 12:00:34



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 10th harmonic of the fundamental. The following setup was used showing placement of the attenuators:



The allowed emissions for transmitters operating in the 638 MHz - 662 MHz bands for Wireless Boundary Microphone equipment are found under Part 74, Section 74.861, Paragraph d-3 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) any discrete frequency outside the authorized band shall be attenuated, at least, $43+10\text{Log}^{10}$ (mean output power, in watts) dB below the mean output power of the transmitting unit.

NOTE:

The Wireless Boundary Microphone uses a bent Monopole permanently attached to the Flex PCB preventing any connection to the Antenna Port, therefore this test was not run.



1250 Peterson Dr., Wheeling, IL 60090

Company: Shure Incorporated
Model Tested: MX690L4
Report Number: 13480

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 10th harmonic of the fundamental frequency.

For the Wireless Boundary Microphone, the highest fundamental frequency is 704 MHz 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 638 MHz - 662 MHz bands for Wireless Boundary Microphone are found under Part 74, Section 74.861, Paragraph d-3 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) any discrete frequency outside the authorized band shall be attenuated, at least, $43+10\text{Log}^{10}$ (mean output power, in watts) dB below the mean output power of the transmitting unit.



1250 Peterson Dr., Wheeling, IL 60090

Company: Shure Incorporated
Model Tested: MX690L4
Report Number: 13480

APPENDIX A

7.0 FIELD STRENGTH OF SPURIOUS EMISSION MEASUREMENTS (CON'T) – PART 2.1053 and EIA /TIA-603-C:2004, SECTION 2.2.12

As stated in Part 74, Section 74.861 (d-1) the limit is 1 Watt in the frequency range 638 MHz – 662 MHz.

To determine the **LIMIT** for Spurious Emissions the following method was used:

Mean output power in watts:

Manufacturer's rated wattage = **7.9 dBm ±2 dB Watt(s)**
(See Paragraph 2.0, page 2 of this Appendix)

Free Space Formula

Convert to 10 meter test distance using the Free Space Formula

$$\frac{\sqrt{49.2 * \text{rated wattage}}}{\text{Distance}} = 5.433231\text{E-}02 \text{ volts/meter} = 54332.31 \text{ uV/m}$$

$$20 * \text{Log}(54332.31) = 94.70116 \text{ dBuV}$$

Therefore, the Fundamental at three meters equals 94.70116 dBuV,

The emissions must be reduced by:

$$43 + 10 * \text{LOG}_{10}(0.006 \text{ watts}) = 20.78151 \text{ dB}$$

Therefore, the **LIMIT** at ten meters equals:

94.70116 dBuV extrapolated level for 0.006 watts
-20.78151 dB required reduction below the unmodulated fundamental
73.91965 dBuV maximum spurious emissions allowed



1250 Peterson Dr., Wheeling, IL 60090

Company: Shure Incorporated
Model Tested: MX690L4
Report Number: 13480

APPENDIX A

RADIATED EMISSION DATA & CHARTS TAKEN

FOR FUNDAMENTAL EMISSIONS

USING THE SUBSTITUTION METHOD

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



Company: Shure Incorporated
 Model Tested: MX690L4
 Report Number: 13480

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

DLS Electronic Systems, Inc.

Company: Shure, Inc.
 Operator: Craig B
 Date of test: 07-05-2007
 Temperature: 72 deg. F
 Humidity: 59% R.H.

Spurious Emissions - ERP - Substitution Method

Model: MX 690-L4								
Channels: 638.2 MHz, 650.5 MHz, and 661.8 MHz								
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)
638.2 vertical	85.1	-3.5	9.0	2.15	-12.5	24.0	36.5	0.06
638.2 horizontal	91.9	-0.2	9.0	2.15	-9.2	24.0	33.2	0.12
650.5 vertical	87.0	-3.7	9.2	2.15	-12.9	24.0	36.9	0.05
650.5 horizontal	91.2	-0.5	9.2	2.15	-9.7	24.0	33.7	0.11
661.8 vertical	87.5	-2.8	9.3	2.15	-12.1	24.0	36.1	0.06
661.8 horizontal	91.8	-0.5	9.3	2.15	-9.8	24.0	33.8	0.10

EIRP = Signal generator output - cable loss + antenna gain

ERP_(ref. to 1/2λ dipole) = Signal generator output - cable loss + antenna gain - 2.15



1250 Peterson Dr., Wheeling, IL 60090

Company: Shure Incorporated
Model Tested: MX690L4
Report Number: 13480

APPENDIX A

RADIATED EMISSION DATA AND GRAPH(S)

TAKEN FOR

SPURIOUS EMISSION MEASUREMENTS

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

PART 2.1053

FCC Part 15.109 Class B using CISPR 22

Electric Field Strength

EUT: MX 690
Manufacturer: Shure Inc
Operating Condition: 72 deg F; 63% R.H.
Test Site: D.L.S. O.F. Site 3
Operator: Tim O
Test Specification:
Comment:
Date: 07-13-2007

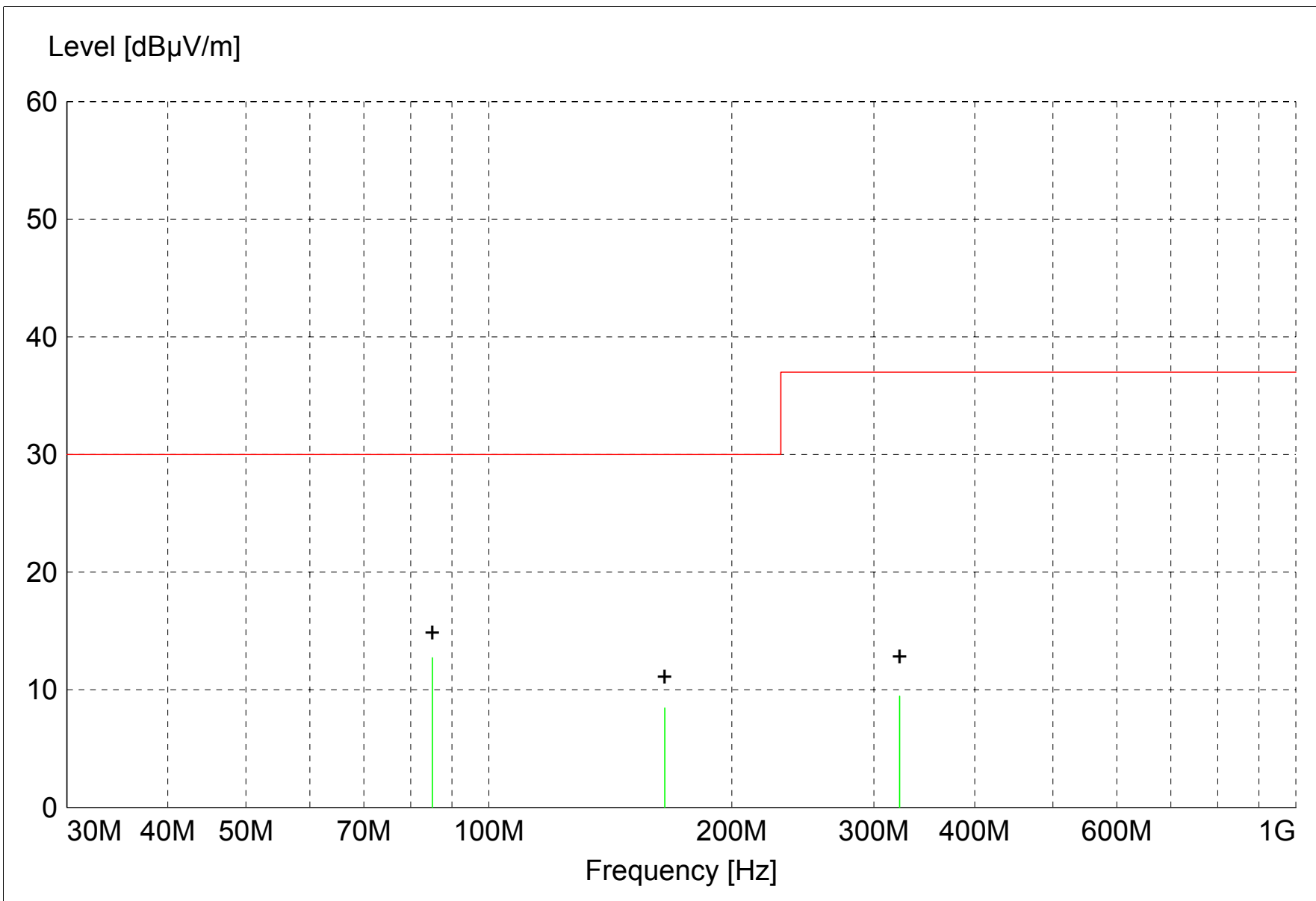
TEXT: "Site 3 MidV 10M"

Short Description: Test Set-up Vert30-1000MHz
TEST EQUIPMENT: Receiver --- Rohde&Schwarz ESI 40 SN: 837808/005

Antennas ---
Biconical -- EMCO 3104C SN: 9701-4785
Log Periodic -- EMCO 3146 SN: 9702-4895

Pre-Amp --- Rohde&Schwarz TS-PR10 SN: 032001/005

TEST SET-UP: EUT Measured at 10 Meters with VERTICAL Antenna Polarization



```

||||| MES AMX69_F1V_Quasi-Peak
+ + +MES AMX69_F1V_Peak_List
— LIM CISPR 22B F QP Field Strength QP Limit

```

MEASUREMENT RESULT: "AMX69_F1V_Final"

7/13/2007 10:56AM

Frequency	Level	Antenna	System	Total	Limit	Margin	Height	EuT	Final	Comment
MHz	dB μ V	Factor	Loss	Level	dB μ V/m	dB	Ant.	Angle	Detector	
		dB μ V/m	dB	dB μ V/m			m	deg		
85.080000	28.93	7.18	-23.4	12.7	30.0	17.3	1.00	0	QUASI-PEAK	Noise Floor
165.180000	17.06	14.12	-22.7	8.5	30.0	21.5	1.00	0	QUASI-PEAK	Noise Floor
322.880000	16.56	14.03	-21.1	9.5	37.0	27.5	1.00	0	QUASI-PEAK	Noise Floor

FCC Part 15.109 Class B using CISPR 22

Electric Field Strength

EUT: MX 690
Manufacturer: Shure Inc
Operating Condition: 72 deg F; 63% R.H.
Test Site: D.L.S. O.F. Site 3
Operator: Tim O
Test Specification:
Comment:
Date: 07-13-2007

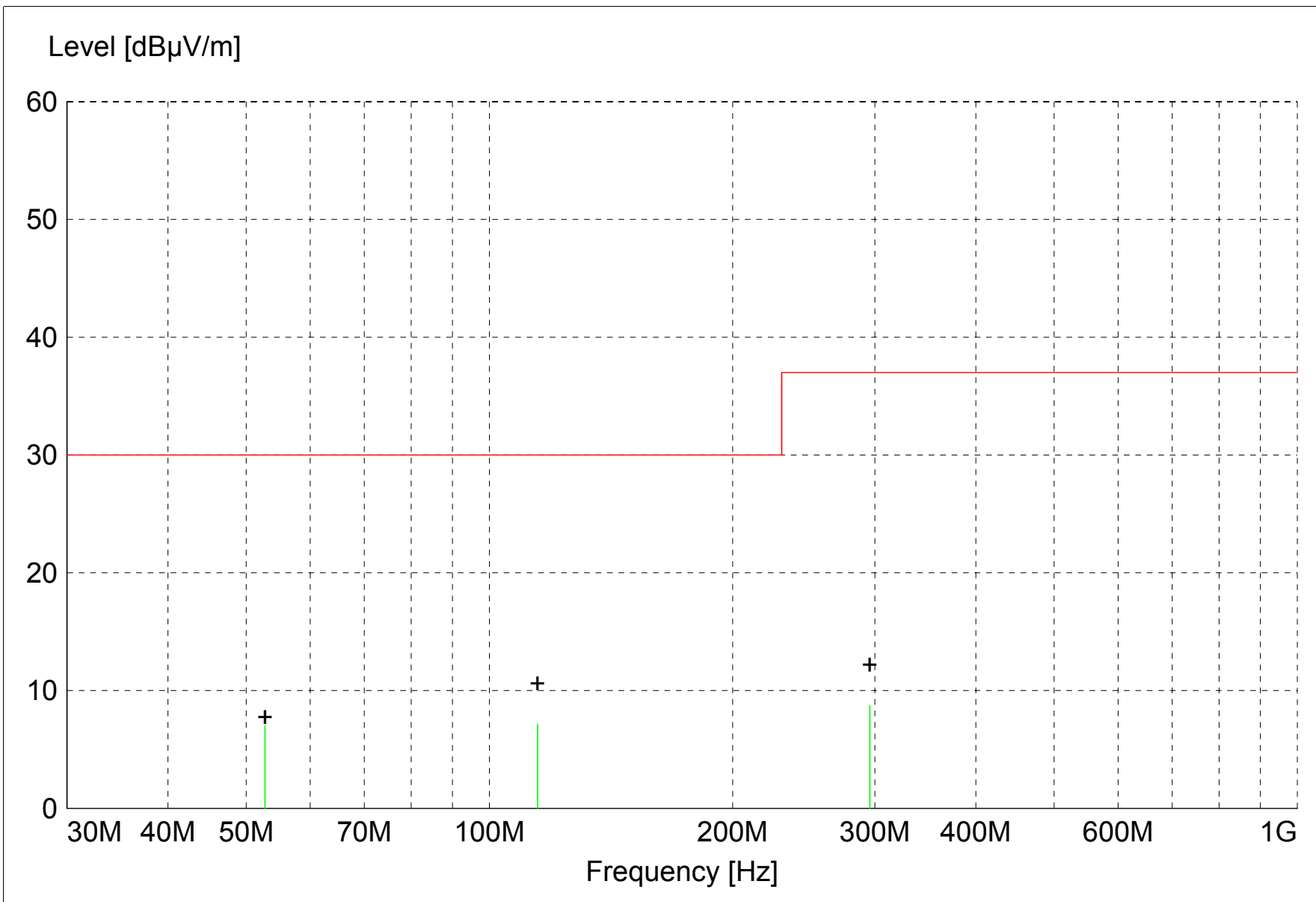
TEXT: "Site 3 MidH 10M"

Short Description: Test Set-up Horz30-1000MHz
TEST EQUIPMENT: Receiver --- Rohde&Schwarz ESI 40 SN: 837808/005

Antennas ---
Biconical -- EMCO 3104C SN: 9701-4785
Log Periodic -- EMCO 3146 SN: 9702-4895

Pre-Amp --- Rohde&Schwarz TS-PR10 SN: 032001/005

TEST SET-UP: EUT Measured at 10 Meters with HORIZONTAL Antenna Polarization



```

||||| MES   AMX69_F1H_Quasi-Peak
+ + +MES   AMX69_F1H_Peak_List
— LIM     CISPR 22B F QP           Field Strength QP Limit

```

MEASUREMENT RESULT: "AMX69_F1H_Final"

7/13/2007 10:56AM

Frequency	Level	Antenna	System	Total	Limit	Margin	Height	EuT	Final	Comment
MHz	dB μ V	Factor	Loss	Level	dB μ V/m	dB	Ant.	Angle	Detector	
		dB μ V/m	dB	dB μ V/m	dB μ V/m		m	deg		
114.720000	18.10	12.18	-23.1	7.2	30.0	22.8	3.00	0	QUASI-PEAK	Noise Floor
52.740000	20.31	10.78	-24.1	7.0	30.0	23.0	3.00	0	QUASI-PEAK	Noise Floor
295.700000	16.52	13.36	-21.2	8.7	37.0	28.3	3.00	0	QUASI-PEAK	Noise Floor



1250 Peterson Dr., Wheeling, IL 60090

Company: Shure Incorporated
Model Tested: MX690L4
Report Number: 13480

APPENDIX A

DLS Electronic Systems, Inc.

Company: Shure, Inc.
Operator: Craig Brandt
Date of test: 07-05-2007
Temperature: 72 deg. F.
Humidity: 59% R.H.

Radiated Spurious Emissions (e.r.p. substitution method) FCC Part 74; FCC Part 2.1053								
Model: MX690-L4 Transmit Frequency: 638.2 MHz								
Frequency GHz	Field Strength Level dBuV/m	Factor to Convert to dBm	Power ERP dBm	Limit dBm	Margin dB	Receive Antenna Polarization	EUT Antenna Orientation	Receive Antenna Height (m)
2.5528	30.62	98.8	-68.18	-13	55.18	Vertical	180	1.0
3.191	30.71	98.4	-67.69	-13	54.69	Vertical	135	1.0



1250 Peterson Dr., Wheeling, IL 60090

Company: Shure Incorporated
Model Tested: MX690L4
Report Number: 13480

APPENDIX A

DLS Electronic Systems, Inc.

Company: Shure, Inc.
Operator: Craig Brandt
Date of test: 07-05-2007
Temperature: 72 deg. F.
Humidity: 59% R.H.

Radiated Spurious Emissions (e.r.p. substitution method) FCC Part 74; FCC Part 2.1053								
Model: MX690-L4 Transmit Frequency: 650.5 MHz								
Frequency GHz	Field Strength Level dBuV/m	Factor to Convert to dBm	Power ERP dBm	Limit dBm	Margin dB	Receive Antenna Polarization	EUT Antenna Orientation	Receive Antenna Height (m)
3.2525	30.27	100.5	-70.23	-13	57.23	Horizontal	30	1.0
2.602	30.33	99.3	-68.97	-13	55.97	Vertical	270	1.0
3.2525	31.97	98.8	-66.83	-13	53.83	Vertical	90	1.2



1250 Peterson Dr., Wheeling, IL 60090

Company: Shure Incorporated
Model Tested: MX690L4
Report Number: 13480

APPENDIX A

DLS Electronic Systems, Inc.

Company: Shure, Inc.
Operator: Craig Brandt
Date of test: 07-05-2007
Temperature: 72 deg. F.
Humidity: 59% R.H.

Radiated Spurious Emissions (e.r.p. substitution method) FCC Part 74; FCC Part 2.1053								
Model: MX690-L4 Transmit Frequency: 661.8 MHz								
Frequency GHz	Field Strength Level dBuV/m	Factor to Convert to dBm	Power ERP dBm	Limit dBm	Margin dB	Receive Antenna Polarization	EUT Antenna Orientation	Receive Antenna Height (m)
3.309	31.96	100.2	-68.24	-13	55.24	Horizontal	30	2.0
2.6472	30.34	99.3	-68.96	-13	55.96	Vertical	270	1.0
3.309	33.21	98.8	-65.59	-13	52.59	Vertical	90	1.4



1250 Peterson Dr., Wheeling, IL 60090

Company: Shure Incorporated
Model Tested: MX690L4
Report Number: 13480

APPENDIX A

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

The frequency stability was measured from -30° to $+50^{\circ}$ centigrade at intervals of 10° 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: MX690L4
Report Number: 13480

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: MX690L4
 Report Number: 13480

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

DLS Electronic Systems, Inc.

Company: Shure, Inc.
 Operator: Craig B
 Date of test: 07-13-2007

Limit = 31.9 kHz (0.005% of 638.2 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-L4	638.200	638.193467	-6.533	638.194509	-5.491	638.196112	-3.888	638.197555	-2.445	638.199319	-0.681
MX690-L4	650.500	650.493547	-6.453	650.494429	-5.571	650.495952	-4.048	650.497395	-2.605	650.499238	-0.762
MX690-L4	661.800	661.793226	-6.774	661.794509	-5.491	661.795631	-4.369	661.797796	-2.204	661.798998	-1.002

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-L4	638.200	638.200601	0.601	638.200842	0.842	638.201162	1.162	638.201082	1.082	638.197074	-2.926
MX690-L4	650.500	650.500441	0.441	650.500922	0.922	650.501162	1.162	650.501002	1.002	650.497234	-2.766
MX690-L4	661.800	661.800762	0.762	661.800842	0.842	661.801002	1.002	661.801082	1.082	661.797074	-2.926



Company: Shure Incorporated
Model Tested: MX690H5
Report Number: 13480

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

10.0 FREQUENCY STABILITY PHOTOS TAKEN DURING TESTING

