SHURE

ELECTROMAGNETIC COMPATIBILITY LABORATORY
TEST REPORT

TEST REPORT TITLE: Electromagnetic Compatibility Tests of the Shure ULXD2 Digital Wireless Transmitter in the G50 Band (470MHz to 534MHz)

TEST ITEM DESCRIPTION:

The Shure ULXD2 is a digital wireless microphone transmitter.

For: Shure Incorporated
5800 West Touhy Avenue
Niles, IL 60714

Project ID Number: SEL-043/ULXD2 G50 FCC74H

Date Tested: February 12 thru February 19, 2019

Test Personnel: Jamal Qureshi, Juan Castrejon, and Craig Kozokar

Test Specification:

FCC Part 74, Subpart H – Low Power Auxiliary Stations
IC RSS-GEN – General Requirements and Information for the Certification of Radio Apparatus
IC RSS-210 - License-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

TEST REPORT BY: Craig Kozokar		Global Compliance Engineer	3-14-2019
APPROVED BY:	Signature	Engineer Project Managing, G.C. Position	3-14-2019 Date

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LIST OF APPENDICIES

APPENDIX	TEST DESCRIPTION
A	Operating Bandwidth
B	Spurious Emissions
C	Maximum Rated Power
D	Frequency Tolerance

REPORT REVISION HISTORY

Revision	Date	Description
0	March 5, 2019	Initial release
1	March 1, 2019	Revised ISED Canada 99% Bandwidth measurement statement.
2	March 14, 2019	Revised EN300422 standard used.

1. INTRODUCTION

1.1. Scope of Tests

This report presents the results of testing per FCC Part 74H, Section 74.861(e)(1)(ii), Section 74.861(e)(4), Section 74.861(e)(5), Section 74.861(e)(7), FCC OET Basic Certification Requirements for Wireless Microphones, RSS-Gen, and RSS-210. The following data was taken following the measurement method as described in the document section(s) listed on page 1 of this document. Provided is the data for the test sample. Also included is a summary of the measurements made and a description of the measurement setup. The test samples meet the requirements of the above standards. The equipment under test (EUT) contained a transmitter that was designed to transmit in the UHF TV frequency bands shown in Table 1.

Model	Band	Frequency (MHz)	Output Power (mW)
ULXD2	G50	470 to 534	1, 10, 20

Table 1. EUT Frequencies and Power Levels

1.2. Purpose

This series of testing was performed to determine if the test item would meet the requirements of FCC Part 74H, Section 74.861(e)(1)(ii), Section 74.861(e)(4), Section 74.861(e)(5), Section 74.861(e)(7), the FCC OET Basic Certification Requirements for Wireless Microphones, RSS-Gen, and RSS-210.

1.3 Deviations, Additions and Exclusions

None

1.4 EMC Laboratory Identification

The electromagnetic compatibility tests were performed at the Shure Electromagnetic Laboratory, Shure Incorporated, 5800 West Touhy Ave, Niles, Illinois 60714-4608. This laboratory is registered with Industry Canada as Site # 616A-1. The Shure Electromagnetic Laboratory is accredited by the National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP).
The NVLAP Lab Code is: 200946-0.

1.5 Summary of Tests Performed

The following electromagnetic compatibility tests (Table 2) were performed on the test item in accordance with ETSI specifications.

Table 2. Summary of tests performed

FCC Part 74H Test Spec	Description	EUT Firmware	Tested Frequency in MHz	Appendix	Test Results
74.861(e)(5)	Operation Bandwidth	2.3.30.0	470.125, 502.050, 534.000	A	Pass
74.861(e)(7)	Spurious Emissions	2.3.30.0	470.125, 502.050, 534.000	B	Pass
74.861(e)(1)(ii)	Maximum Rated Power	2.3.30.0	470.125, 502.050, 534.000	C	Pass
74.861(e)(4)	Frequency Tolerance	2.3.30.0	470.125, 502.050, 534.000	D	Pass

2 APPLICABLE DOCUMENTS

The following documents of the exact issue designated form part of this document to the extent specified herein:

FCC Part 74H, Section 74.861(e)(1)(ii)

FCC Part 74H, Section 74.861(e)(4)

FCC Part 74H, Section 74.861(e)(5)

FCC Part 74H, Section 15.236(e)(7)

EN 300 422-1 V1.4.2 (2011-08), “Electromagnetic compatibility and Radio spectrum Matters (ERMM); Wireless Microphones in the 25 MHz to 3 GHz frequency range; Part 1: technical characteristics and methods of measurement”

ANSI C63.4 (2014), "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"

“Federal Communications Commission
Office of Engineering and Technology, Laboratory Division
BASIC CERTIFICATION REQUIREMENTS FOR WIRELESS MICROPOHONES”
Dated December 13, 2017

RSS-Gen Issue 5, “General Requirements for Compliance of Radio Apparatus”

RSS-210 Issue 9, “Licence-Exempt Radio Apparatus: Category I Equipment”

3 EUT SET-UP AND OPERATION

3.1. General Description

The test sample used was Shure ULXD2 digital wireless microphone transmitter. The EUT was arranged and tested per individual Appendices.

3.2 Test Sample

The following product sample was tested:

Table 3: Shure ULXD2 Digital Wireless Transmitter Sample

Band	Serial Numbers
G50	G5x PPR
G50	G5x PPR Rad Sample

3.3 Operational Mode

The transmit frequency and output power modes shown in the individual appendixes.

4. Test Instrumentation

A list of the test equipment used can be found in Table 10-1. All equipment used was within calibration during and throughout the duration of the tests. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

5. Procedure

The specific test procedures are presented in the individual appendices.

6. Other Test Conditions:

6.1. Test Personnel

All EMC tests were performed by qualified personnel from the Shure EMC Laboratory.

6.2. Disposition of the EUT

The EUTs and all associated equipment were returned to Shure Incorporated upon completion of the tests.

7. Results of Tests:

The results are presented in Appendices. It was found that the EUT meets the requirements of FCC Part 74H, Section 74.861(e)(1)(ii), Section 74.861(e)(4), Section 74.861(e)(5), Section 74.861(e)(7), the FCC OET Basic Certification Requirements for Wireless Microphones, RSS-Gen, and RSS-210.

8. Conclusions:

It was determined that the Shure ULXD2 Digital Wireless Microphone Transmitter did fully comply with the requirements of FCC Part 74H, Section 74.861(e)(1)(ii), Section 74.861(e)(4), Section 74.861(e)(5), Section 74.861(e)(7), the FCC OET Basic Certification Requirements for Wireless Microphones, RSS-Gen, and RSS-210.

9. **Certification**:

Shure EMC Laboratory certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specifications.

The data presented in this test report pertains to the EUTs at the test date. Any electrical or mechanical modification made to the EUTs subsequent to the specified test date will serve to invalidate the data and void this certification.

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

10. Equipment List

Table 10-1 Test Equipment

L# or ID	Description	Manufacturer	Model #	Serial #	Frequency Range	Cal Date	Due Date
L23-011-01	3 meter RF Chamber	ETS Lindgren	FACT-3	AJ640	25MHz - 18GHz	8/8/2016	8/8/2019
L23-011-02	Electric Powered Turntable	ETS Lindgren	2088	N/A	N/A	N/A	N/A
L23-011-08	Controller	EMCO	2090	29799	N/A	N/A	N/A
L23-011-09	Antenna Positioner	ETS Lindgren	2071-2	35500	N/A	N/A	N/A
L23-011-15	BiConiLog Antenna	ETS Lindgren	3142C	34790	25MHz-1GHz	6/22/2017	6/22/2019
L23-011-54	EMI Test Receiver	Rohde & Schwarz	ESR26	100220	9kHz-26GHz	11/28/2017	11/28/2019
L23-011-31	EMI/EMS Test Software	Rohde & Schwarz	EMC32	V 9.21.00	N/A	N/A	N/A
L23-011-53	Horn antenna with pre-amplifier	ETS Lindgren	3117-PA	200363	1GHz to 18 GHz	10/16/2017	4/27/2019
L23-011-41	Horn Antenna	ETS Lindgren	3117	123511	1GHz to 18 GHz	5/7/2017	5/7/2019
L23-011-56	High Pass Filter	K&L	11SH10-940/X10000-0/0	2	940MHz – 10GHz	10/18/2017	3/31/2019
L23-022-02	Spectrum Analyzer	Rohde & Schwarz	FSW26	103788	9kHz-26GHz	4-24-2018	4-24-2020
L23-022-01	Spectrum Analyzer	Rohde & Schwarz	FSU26	201043	9kHz-26GHz	8/23/2017	8/23/2019
L23-034-02	Temperature Hygrometer	Extech	445703	48254-65	N/A	5/2/2018	5/2/2019
L23-034-04	Temperature Hygrometer	Extech	445703	48254-13	N/A	5/2/2018	5/2/2019
L23-040-03	20dB Attenuator	MCL	BW-N20W5+	N/A	20MHz to 18GHz	5/31/2018	5/31/2020
L23-045-36	RF Power Sensor	ETS-Lindgren	7002-006	151071	10MHz to 6GHz	1-31-2018	1-31-2020
L23-024-01	Frequency Counter	Agilent	53220A	MY50006485	DC to 6GHz	11-27-2018	11-27-2020
L23-034-08	Thermometer	Extech	TM100	13018733	N/A	4-25-2018	04-25-2020
L19-006-01	Temperature Chamber	ESPEC	SU-240	910004211	N/A	4-5-2018	4-5-2019
L23-023-01	RF Signal Generator	Rohde & Schwarz	SMF100A	101553	20Hz to 26.5GHz	8/23/2017	8/23/2019

Appendix A

OPERATING BANDWIDTH

PURPOSE

This test was performed to determine if the EUT meets the operating bandwidth requirements of FCC Part 74 Section 74.861(e)(5) and EN 300 422-1, section 8.3.2., with the EUT operating at 470,125MHz, 502.050MHz, and 534.000MHz.

The testing results show the EUT meets FCC 74H Section 74.861(e)(5) and RSS-210, operating bandwidth does not exceed 200kHz.

REQUIREMENTS

As stated in FCC 74H Section 74.861(e)(5), operating bandwidth shall not exceed 200kHz, and EN 300 422-1, section 8.3.2, the emission mask given in section 8.3.2.2 shall not be exceeded.

TEST SETUP AND INSTRUMENTATION

A photograph of the test setup is shown in Figure A-1. The test instrumentation can be determined from Table 10-1.

MEASUREMENT UNCERTAINTY

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system. Values of Expanded Measurement Uncertainty (95% Confidence):

Measurement Type	U_{LAB}
Operating Bandwidth	**±0.130 %**

U_{lab} = Determined for Shure EMC Laboratory

Since U_{LAB} is less than or equal to U_{ETSI}:

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- Non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

EUT OPERATION

The EUT was powered up and the transmit frequency and power output of the EUT were selected. The EUT was checked for proper operation after it was setup for the test. Testing was conducted with the EUT set to transmit at 470.125MHz, 502.050MHz, and 534.000MHz, at an output power level of 1mW and 20mW. The transmitter was modulated per EN300422-1 V1.4.2 (2011-08), clause 7.1.2.

Appendix A

TEST PROCEDURE

The test procedure followed is shown in EN300422-1 V1.4.2 (2011-08), section 8.3.2.

RESULTS

The necessary bandwidth data is presented on pages 11 and 19. Data is shown on the figures for each transmitter. The figure shows the maximum relative level within the emission mask with modulation. As shown by the test data, the necessary bandwidth of the EUT meets the requirements of EN 300 422-1, section 8.3.3. The RSS-Gen maximum ISED Canada 99% bandwidth measurement was 163 kHz.

The temperature during the testing was 74 degrees F, with relative humidity of 17%.

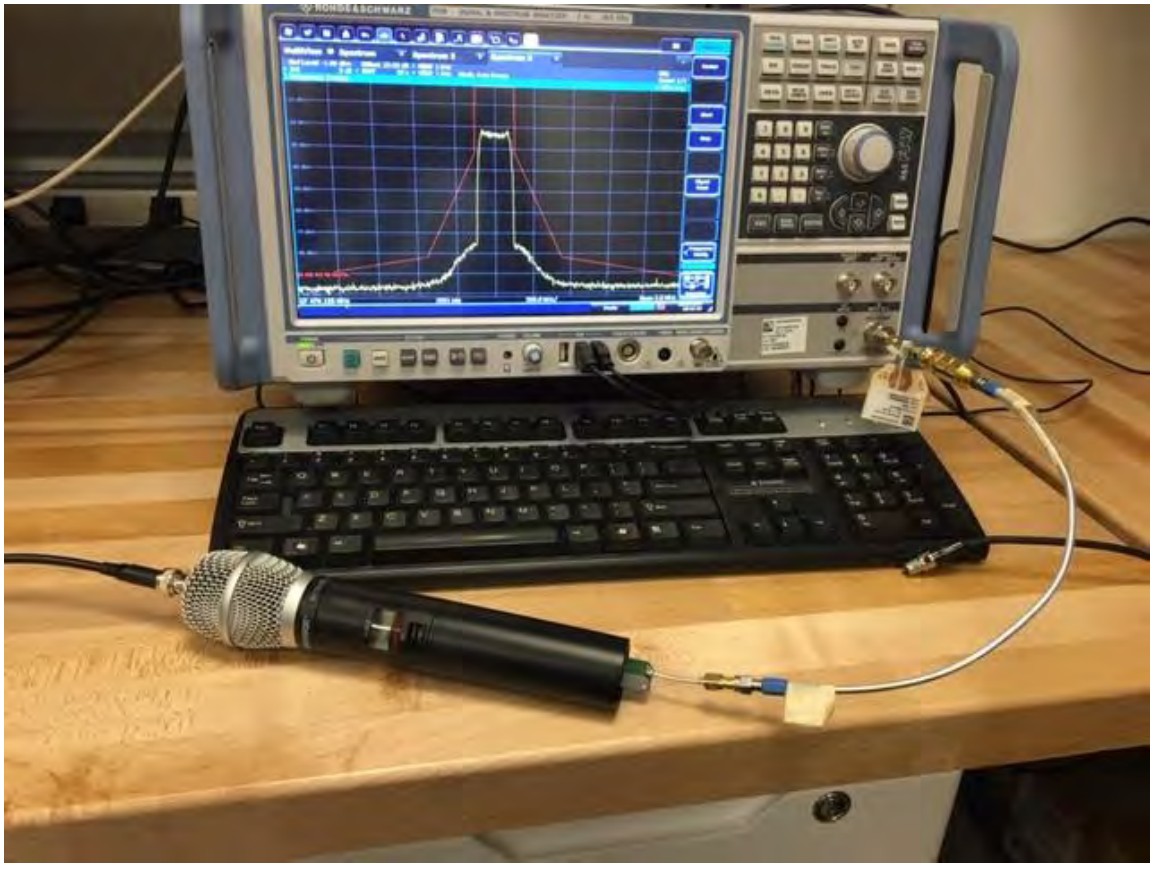
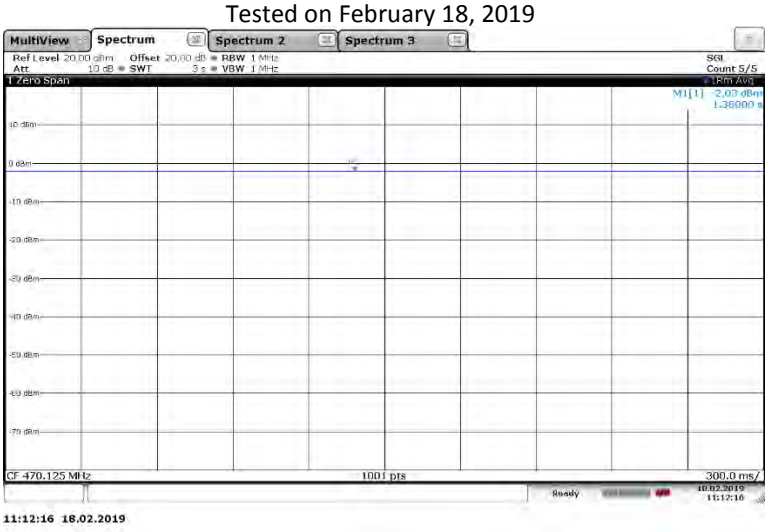


Figure A-1 - Test Setup for Necessary Bandwidth

Appendix A

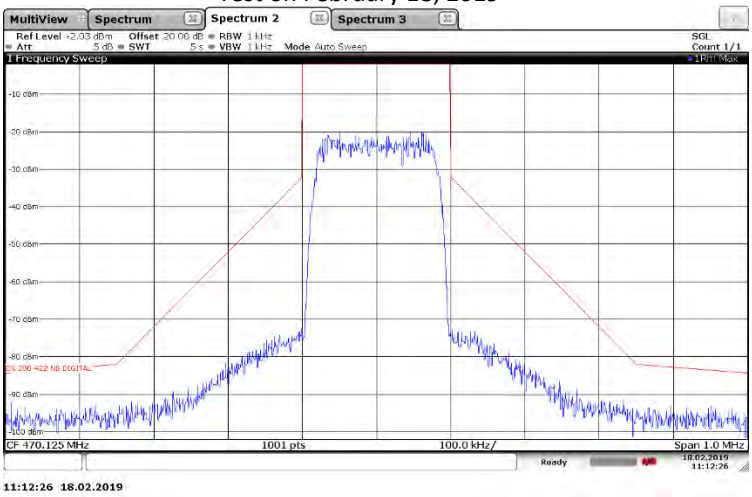
Test Information

EUT Name:	ULXD2 G50
Serial Number:	G5x PPR
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Frequency, 470.125MHz, 1mW
Operator Name:	Juan Castrejon
Comment:	8.3.3.1: Step 1; Carrier Power
Date Tested:	Tested on February 18, 2019



Test Information

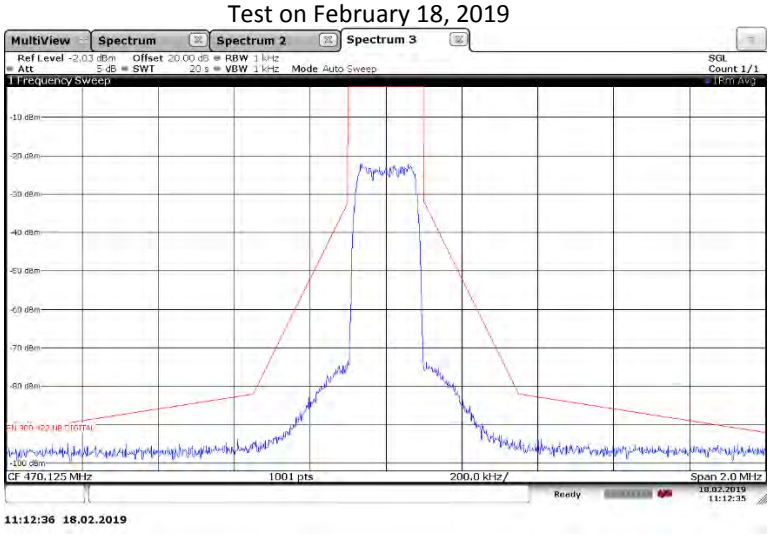
EUT Name:	ULXD2 G50
Serial Number:	G5x PPR
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Frequency, 470.125MHz, 1mW
Operator Name:	Juan Castrejon
Comment:	8.3.3.1: Step 2;Maximum Relative Level
Date Tested:	Test on February 18, 2019



Appendix A

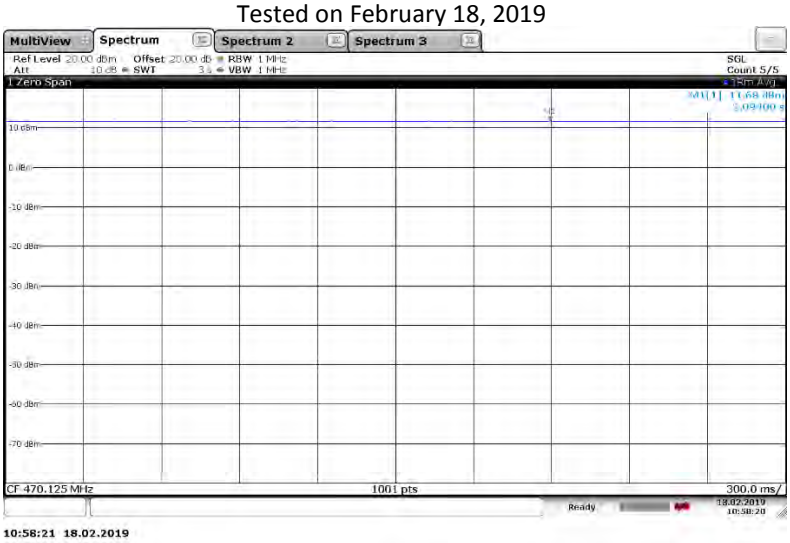
Test Information

EUT Name: ULXD2 G50
Serial Number: G5x PPR
Test Description: EN 300 422 Digital Necessary Bandwidth
Operating Conditions: Low Frequency, 470.125MHz, 1mW
Operator Name: Juan Castrejon
Comment: 8.3.3.1: Step 3;Lower and upper frequency transmitter band
Wide band noise floor
Date Tested: Test on February 18, 2019



Test Information

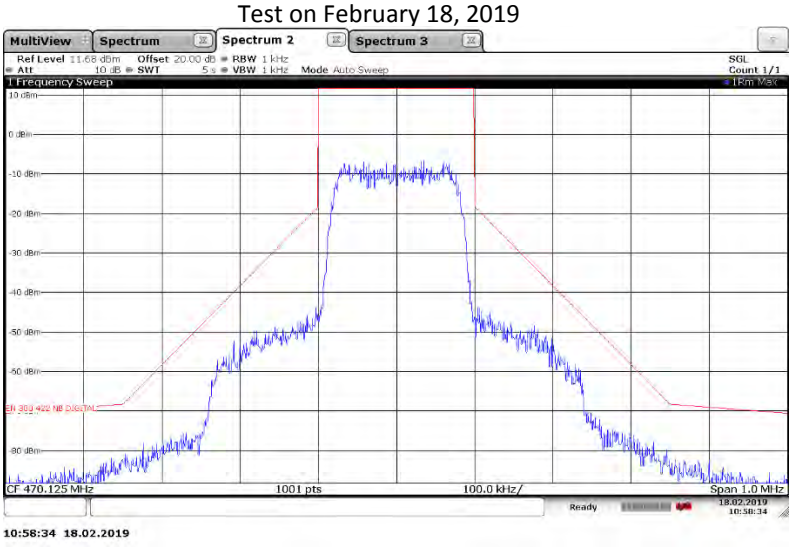
EUT Name: ULXD2 G50
Serial Number: G5x PPR
Test Description: EN 300 422 Digital Necessary Bandwidth
Operating Conditions: Low Frequency, 470.125MHz, 20mW
Operator Name: Juan Castrejon
Comment: 8.3.3.1: Step 1; Carrier Power
Date Tested: Tested on February 18, 2019



Appendix A

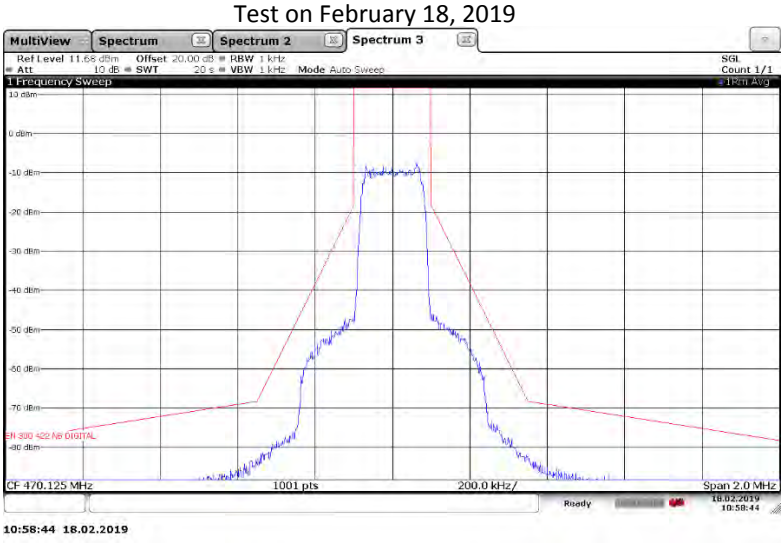
Test Information

EUT Name: ULXD2 G50
Serial Number: G5x PPR
Test Description: EN 300 422 Digital Necessary Bandwidth
Operating Conditions: Low Frequency, 470.125MHz, 20mW
Operator Name: Juan Castrejon
Comment: 8.3.3.1: Step 2;Maximum Relative Level
Date Tested: Test on February 18, 2019



Test Information

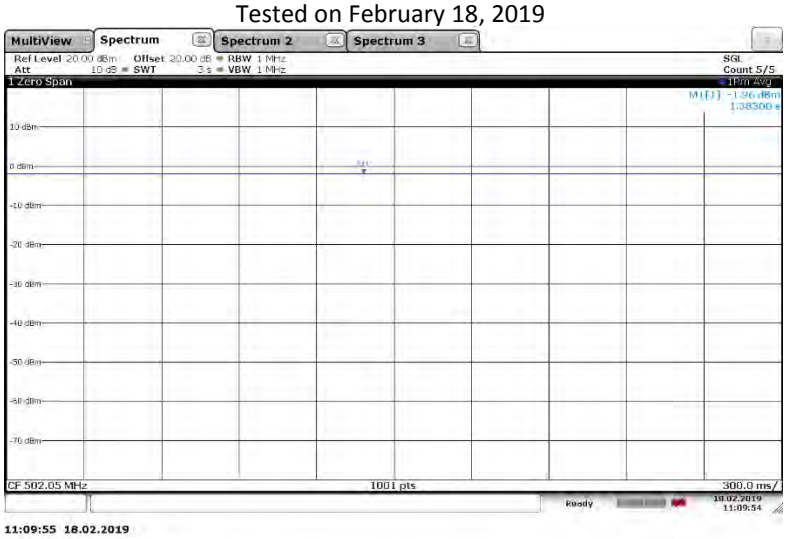
EUT Name: ULXD2 G50
Serial Number: G5x PPR
Test Description: EN 300 422 Digital Necessary Bandwidth
Operating Conditions: Low Frequency, 470.125MHz, 20mW
Operator Name: Juan Castrejon
Comment: 8.3.3.1: Step 3;Lower and upper frequency transmitter band Wide band noise floor
Date Tested: Test on February 18, 2019



Appendix A

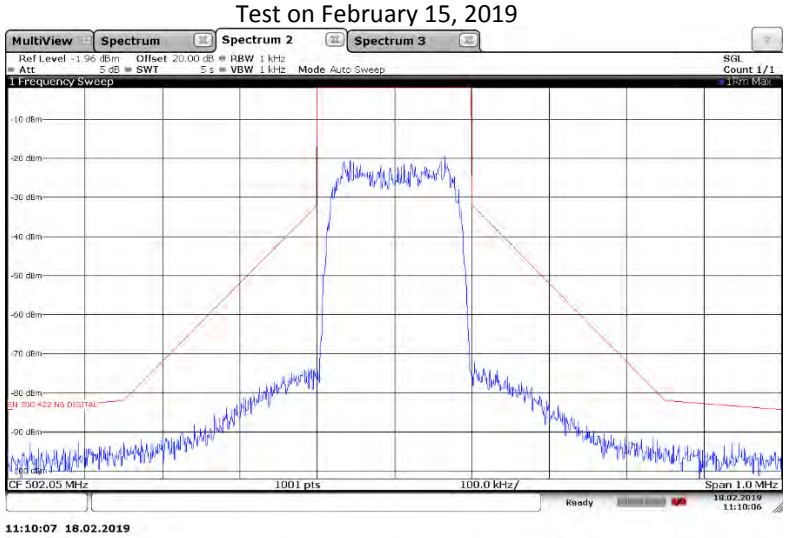
Test Information

EUT Name: ULXD2 G50
Serial Number: G5x PPR
Test Description: EN 300 422 Digital Necessary Bandwidth
Operating Conditions: Middle Frequency, 502.050MHz, 1mW
Operator Name: Juan Castrejon
Comment: 8.3.3.1: Step 1; Carrier Power
Date Tested: Tested on February 18, 2019



Test Information

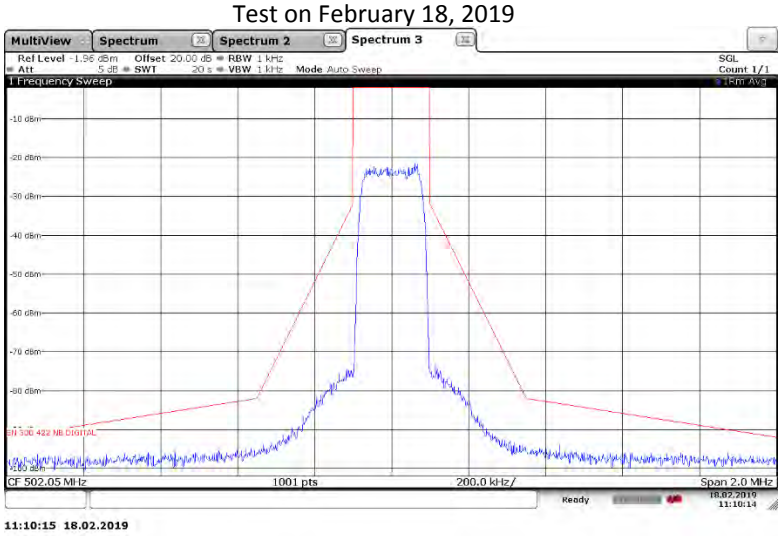
EUT Name: ULXD2 G50
Serial Number: G5x PPR
Test Description: EN 300 422 Digital Necessary Bandwidth
Operating Conditions: Middle Frequency, 502.050MHz, 1mW
Operator Name: Juan Castrejon
Comment: 8.3.3.1: Step 2;Maximum Relative Level
Date Tested: Test on February 15, 2019



Appendix A

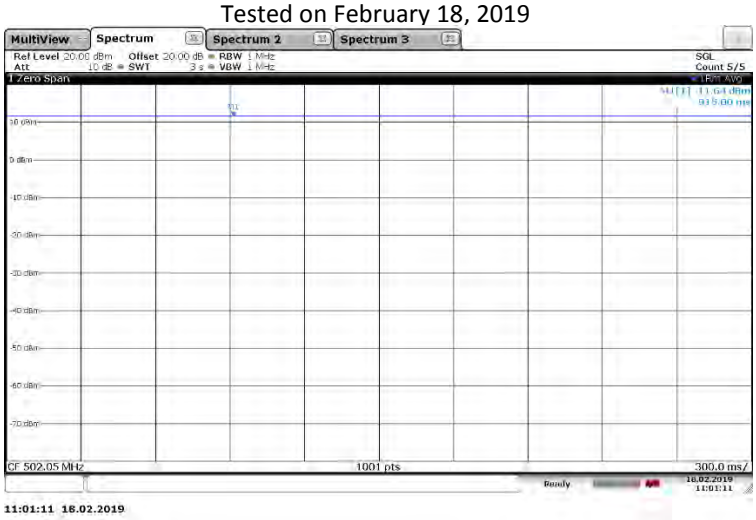
Test Information

EUT Name: ULXD2 G50
Serial Number: G5x PPR
Test Description: EN 300 422 Digital Necessary Bandwidth
Operating Conditions: Middle Frequency, 502.050MHz, 1mW
Operator Name: Juan Castrejon
Comment: 8.3.3.1: Step 3;Lower and upper frequency transmitter band
Wide band noise floor
Date Tested: Test on February 18, 2019



Test Information

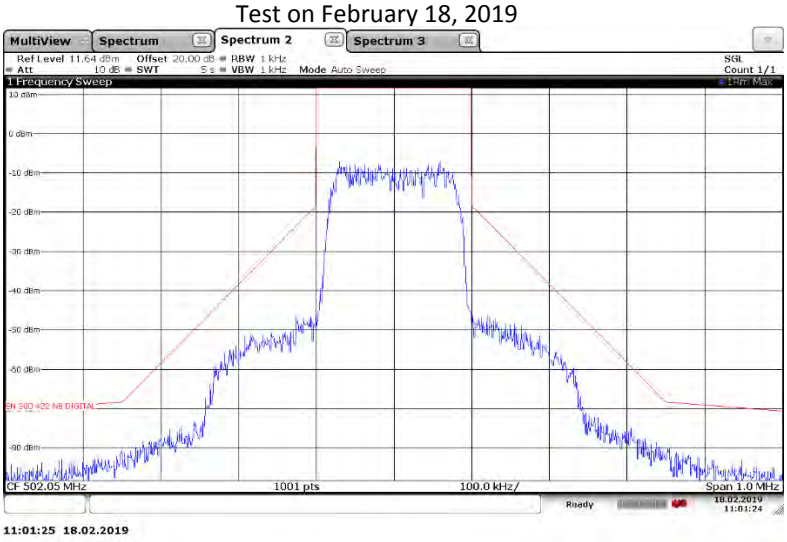
EUT Name: ULXD2 G50
Serial Number: G5x PPR
Test Description: EN 300 422 Digital Necessary Bandwidth
Operating Conditions: Middle Frequency, 502.050MHz, 20mW
Operator Name: Juan Castrejon
Comment: 8.3.3.1: Step 1; Carrier Power
Date Tested: Tested on February 18, 2019



Appendix A

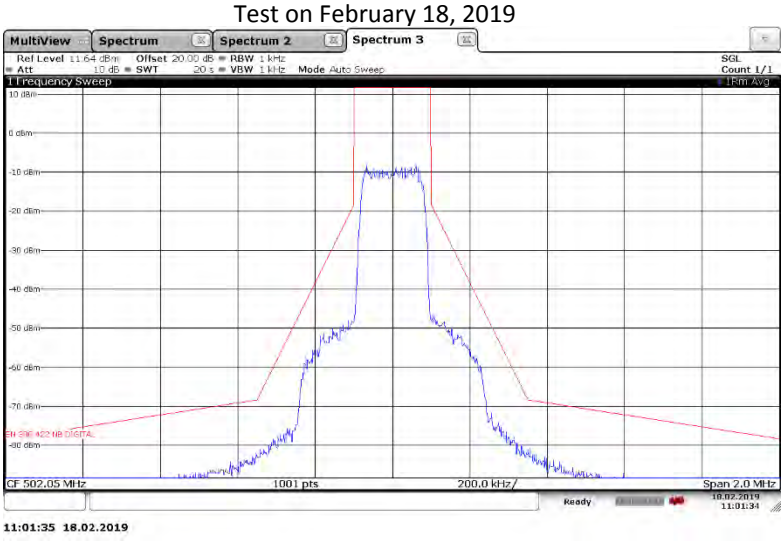
Test Information

EUT Name: ULXD2 G50
Serial Number: G5x PPR
Test Description: EN 300 422 Digital Necessary Bandwidth
Operating Conditions: Middle Frequency, 502.050MHz, 20mW
Operator Name: Juan Castrejon
Comment: 8.3.3.1: Step 2;Maximum Relative Level
Date Tested: Test on February 18, 2019



Test Information

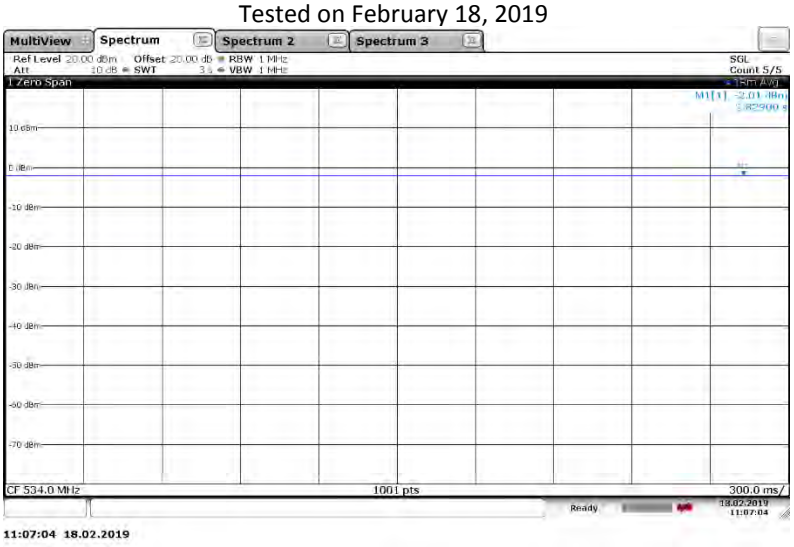
EUT Name: ULXD2 G50
Serial Number: G5x PPR
Test Description: EN 300 422 Digital Necessary Bandwidth
Operating Conditions: Middle Frequency, 502.050MHz, 20mW
Operator Name: Juan Castrejon
Comment: 8.3.3.1: Step 3;Lower and upper frequency transmitter band Wide band noise floor
Date Tested: Test on February 18, 2019



Appendix A

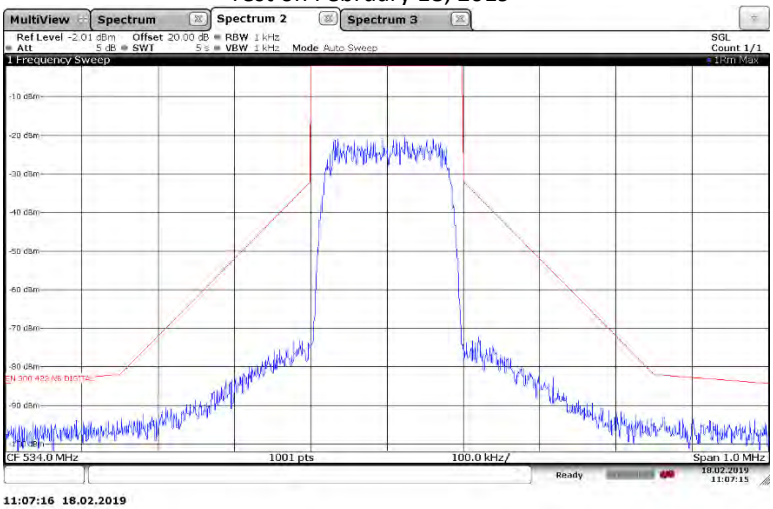
Test Information

EUT Name: ULXD2 G50
Serial Number: G5x PPR
Test Description: EN 300 422 Digital Necessary Bandwidth
Operating Conditions: High Frequency, 534.000MHz, 1mW
Operator Name: Juan Castrejon
Comment: 8.3.3.1: Step 1; Carrier Power
Date Tested: Tested on February 18, 2019



Test Information

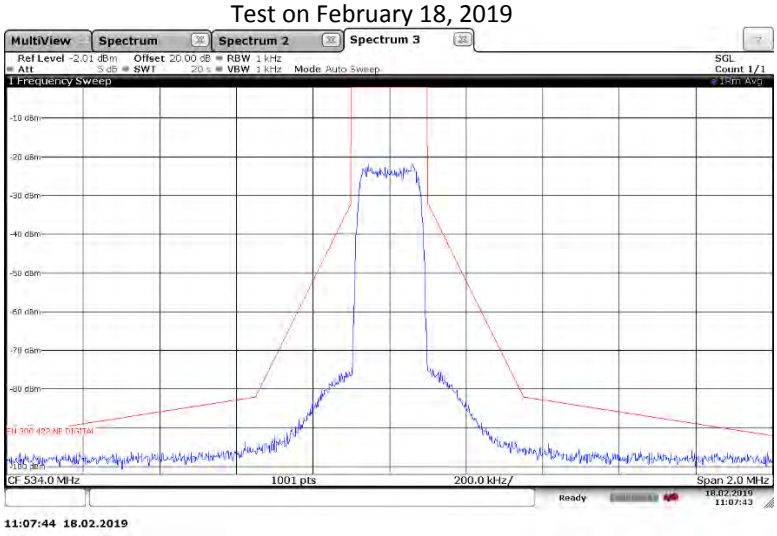
EUT Name: ULXD2 G50
Serial Number: G5x PPR
Test Description: EN 300 422 Digital Necessary Bandwidth
Operating Conditions: High Frequency, 534.000MHz, 1mW
Operator Name: Juan Castrejon
Comment: 8.3.3.1: Step 2;Maximum Relative Level
Date Tested: Test on February 18, 2019



Appendix A

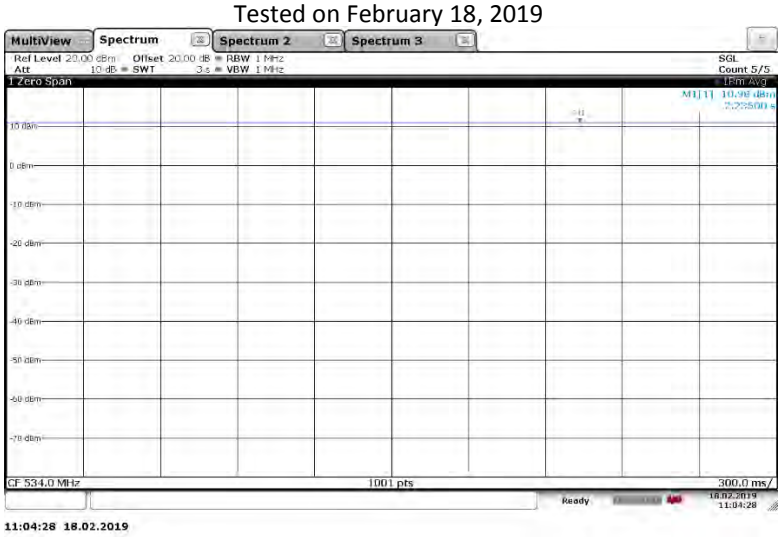
Test Information

EUT Name: ULXD2 G50
Serial Number: G5x PPR
Test Description: EN 300 422 Digital Necessary Bandwidth
Operating Conditions: High Frequency, 534.000MHz, 1mW
Operator Name: Juan Castrejon
Comment: 8.3.3.1: Step 3;Lower and upper frequency transmitter band
Wide band noise floor
Date Tested: Test on February 18, 2019



Test Information

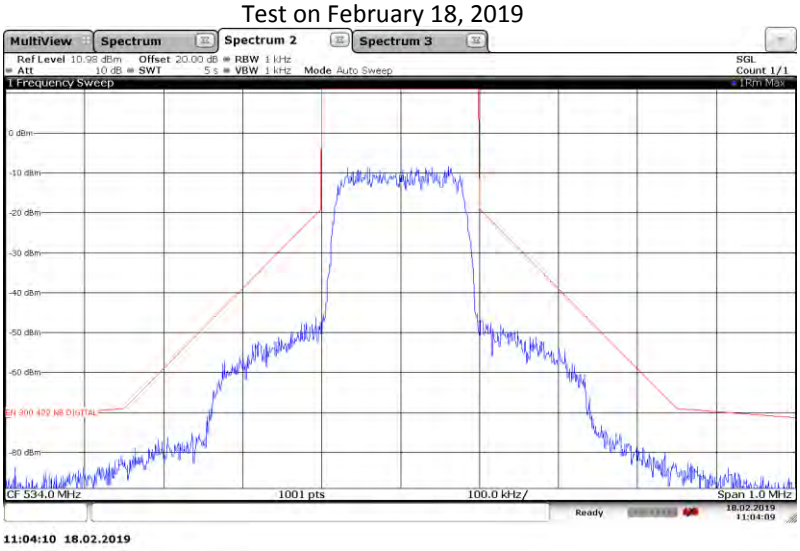
EUT Name: ULXD2 G50
Serial Number: G5x PPR
Test Description: EN 300 422 Digital Necessary Bandwidth
Operating Conditions: High Frequency, 534.000MHz, 20mW
Operator Name: Juan Castrejon
Comment: 8.3.3.1: Step 1; Carrier Power
Date Tested: Tested on February 18, 2019



Appendix A

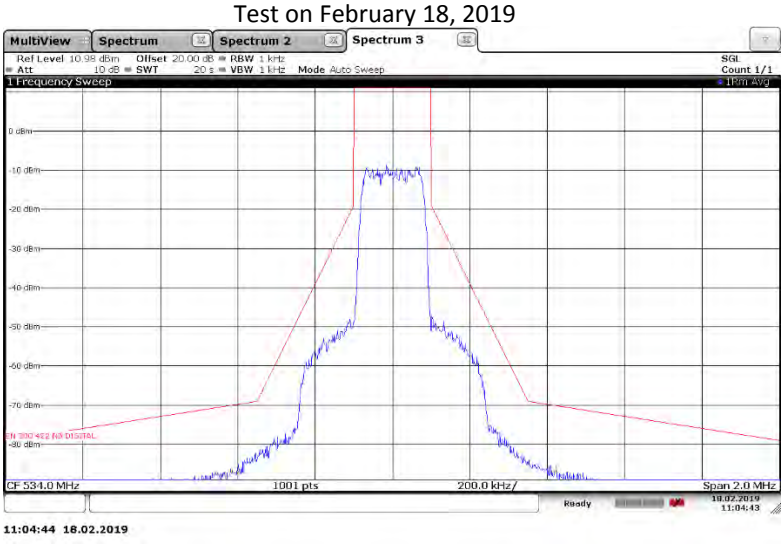
Test Information

EUT Name: ULXD2 G50
Serial Number: G5x PPR
Test Description: EN 300 422 Digital Necessary Bandwidth
Operating Conditions: High Frequency, 534.000MHz, 20mW
Operator Name: Juan Castrejon
Comment: 8.3.3.1: Step 2;Maximum Relative Level
Date Tested: Test on February 18, 2019



Test Information

EUT Name: ULXD2 G50
Serial Number: G5x PPR
Test Description: EN 300 422 Digital Necessary Bandwidth
Operating Conditions: High Frequency, 534.000MHz, 20mW
Operator Name: Juan Castrejon
Comment: 8.3.3.1: Step 3;Lower and upper frequency transmitter band
Wide band noise floor
Date Tested: Test on February 18, 2019



Appendix B

Spurious Emissions

Purpose:

This test performed to determine if the EUT meets the radiated RF emission requirements of the FCC Part 74H Section 74.861(e)(7) and FCC OET Basic Certification Requirements for Wireless Microphones over the frequency range from 30MHz to 6GHz. An Average detector was used for the measurements.

Requirements:

As stated in FCC 74H section 74.861(e)(7), the FCC OET Basic Certification Requirements For Wireless Microphones, and RSS-210 Annex G, Compliance for spurious emission requirements shall be demonstrated using the applicable measurement procedures of ETSI EN 300 422-1. Compliance with the emission limits shall be demonstrated using a RMS Average detector. Both the FCC Part 74H and RSS-210 require Emissions shall be investigated up to the 10^{th} harmonic of the fundamental.

Measurement Uncertainty:

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

Values of Expanded Measurement Uncertainty (95% Confidence)

Measurement Type	U_{lab}	U_{ETSI}
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.24 dB	6.00 dB
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 13 GHz)	4.56 dB	6.00 dB

U_{lab} = Determined for Shure EMC Laboratory

U_{ETSI} = From ETSI EN 300 422-1 Table 10

Since U_{lab} is less than or equal to U_{ETSI}:

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit; Non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

Test Setup and Instrumentation:

A Shure model KSM8 microphone head was connected to the EUT. Photographs of the test setup are shown in Figure B 1 and Figure B 2. The test instrumentation can be determined from Table 10-1.

EUT Operation:

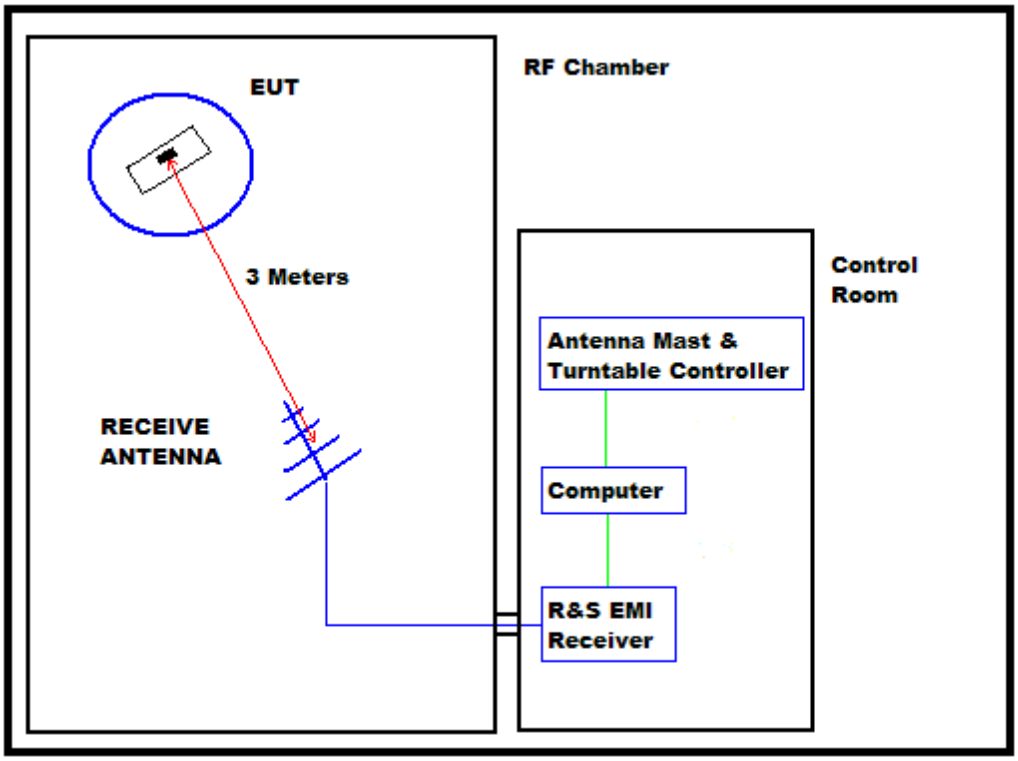
The EUT was powered up and the frequency of the transmitter was selected using the front panel controls. The EUT was checked for proper operation after it was setup on the test table. For radiated spurious emissions the testing was performed with the EUT set to the low, middle, and high frequencies with RF power output of 1mW and 20mW.

Appendix B

Specific Test Procedures:

All tests were performed in a 28ft. x 20ft. x 18.5ft. 3m semi-anechoic test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2003 for site attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All power lines and signal lines entering the enclosure pass through filters on the enclosure wall. The power line filters prevent extraneous signals from entering the enclosure on these leads.



BLOCK DIAGRAM OF SHIELDED ENCLOSURE

Preliminary radiated measurements were performed to determine the frequencies where the significant emissions might be found. With the EUT at one set position and the measurement antenna at a set height (i.e. without maximizing), the radiated emissions were measured using a peak detector and automatically plotted. The BiConiLog measuring antenna was positioned at a 3 meter distance from the EUT for below 1GHz testing, and a double ridged waveguide antenna above 1GHz testing.

Appendix B

All significant broadband and narrowband signals found in the preliminary sweeps were then measured using a peak detector at a test distance of 3 meters. The measurements were made with a BiConiLog antenna over the frequency range of 30 MHz to 1 GHz, and a double ridged waveguide antenna over the frequency range of 1 GHz to 10 GHz.

To ensure that maximum emission levels were measured, the following steps were taken:

i. The EUT was rotated so that all of its sides were exposed to the receiving antenna.
ii. Since the measuring antennas are linearly polarized, both horizontal and vertical field components were measured.
iii. The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.

The equivalent power was determined from the field intensity levels measured at 3 meters using the substitution method. To determine the emission power, another antenna was set in place of the EUT and connected to a calibrated signal generator. (A tuned dipole was used for all measurements below 1GHz and a double ridged waveguide antenna was used for all measurements above 1GHz.) The output of the signal generator was adjusted to match the received level at the EMI receiver. The signal level was recorded. The reading was corrected to compensate for cable loss and antenna gain.

Results:

The plots of the peak preliminary radiated voltage levels in the graphs on page 23 thru page 28. The ERP measurements are shown on pages 29 thru page 31. All emissions measured from the EUT were within the ETSI EN 300 422-1 specification limits.

The temperature during the testing in the RF Chamber was 73 degrees F, with relative humidity of 17%.

Figure B 1: ULXD2 Transmitter Test Setup

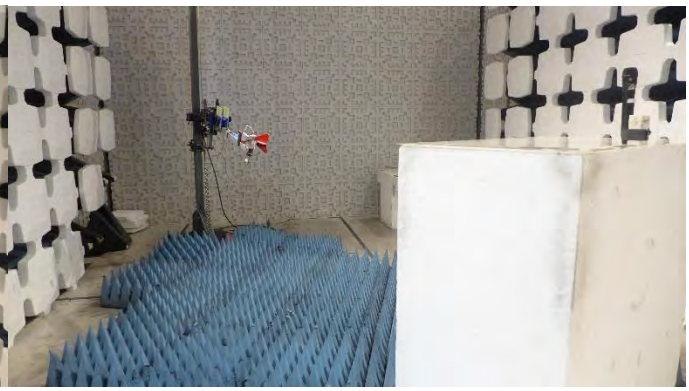


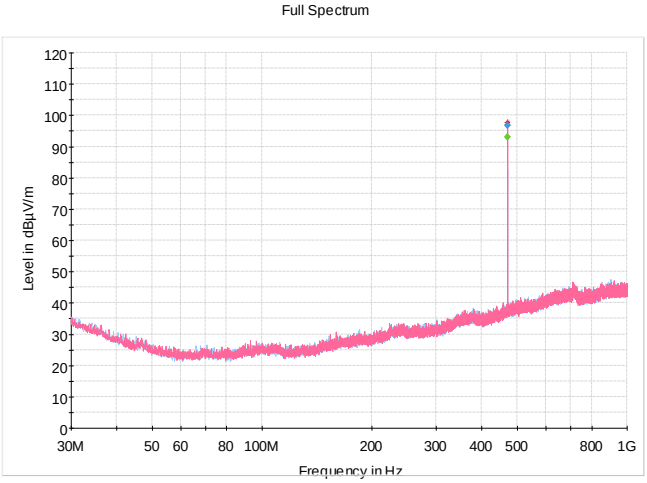
Figure B 2: ULXD2 Transmitter Test Setup

Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

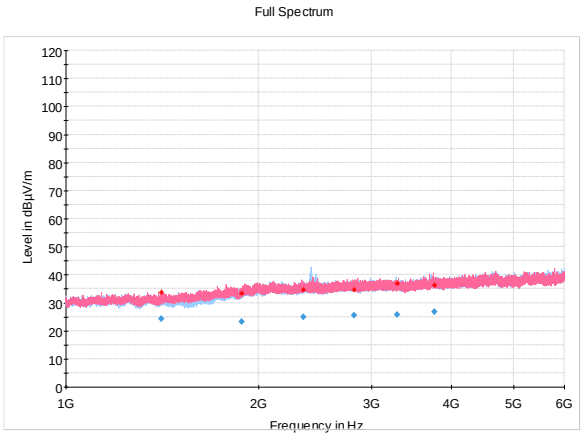
Test Description:	FCC 74H Radiated Emissions 30MHz - 1GHz
EUT:	ULXD2 G50
Serial Number:	G5x PPR Rad Sample
Operating Frequency:	Low Frequency 470.125MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 13, 2019



SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 74H Radiated Emissions 1GHz - 6GHz
EUT:	ULXD2 G50
Serial Number:	G5x PPR Rad Sample
Operating Frequency:	Low frequency 470.125MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 14, 2019

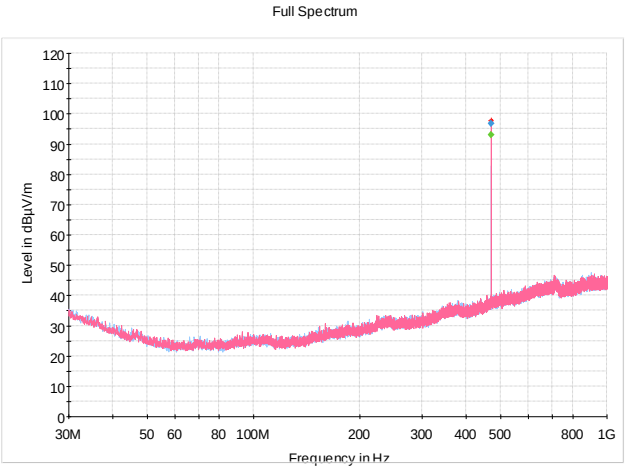


Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

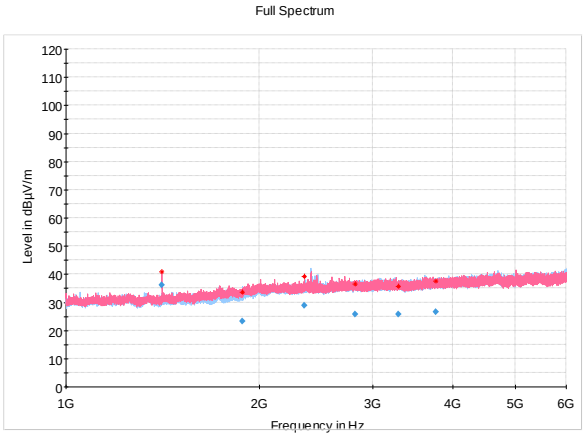
Test Description:	FCC 74H Radiated Emissions 30MHz - 1GHz
EUT:	ULXD2 G50
Serial Number:	G5x PPR Rad Sample
Operating Frequency:	Low Frequency 470.125MHz
RF Power Level	20mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 13, 2019



SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 74H Radiated Emissions 1GHz - 6GHz
EUT:	ULXD2 G50
Serial Number:	G5x PPR Rad Sample
Operating Frequency:	Low Frequency 470.125MHz
RF Power Level	20mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 14, 2019

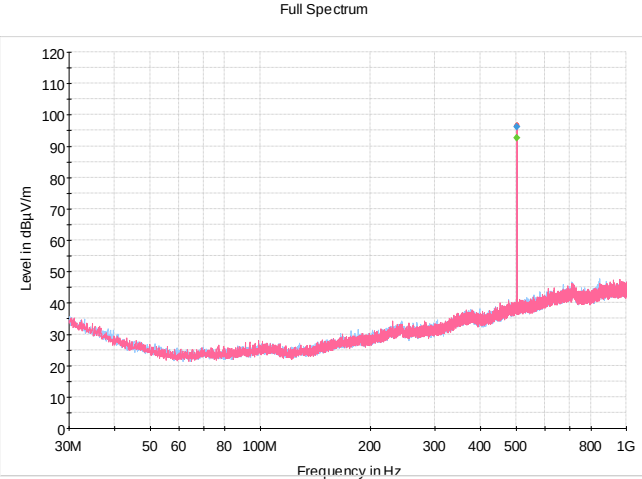


Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

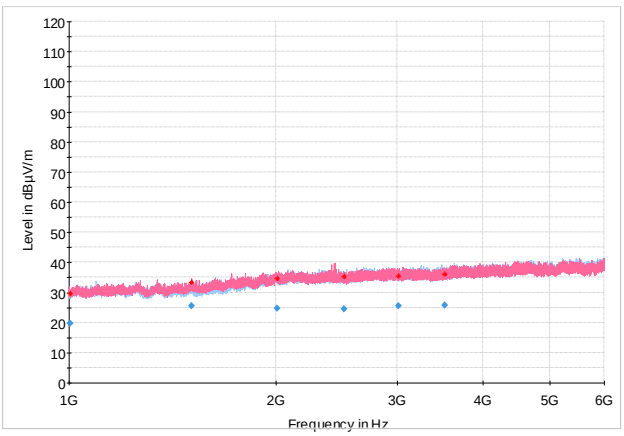
Test Description:	FCC 74H Radiated Emissions 30MHz - 1GHz
EUT:	ULXD2 G50
Serial Number:	G5x PPR Rad Sample
Operating Frequency:	Middle Frequency 502.050MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 13, 2019



SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 74H Radiated Emissions 1GHz - 6GHz
EUT:	ULXD2 G50
Serial Number:	G5x PPR Rad Sample
Operating Frequency:	Middle Frequency 502.050MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 14, 2019

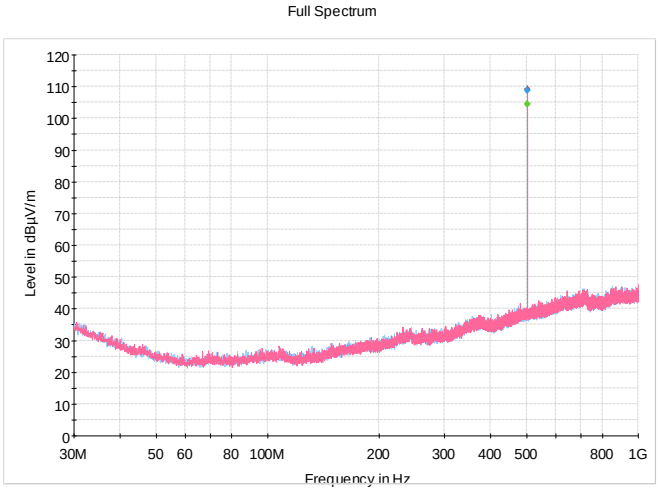


Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

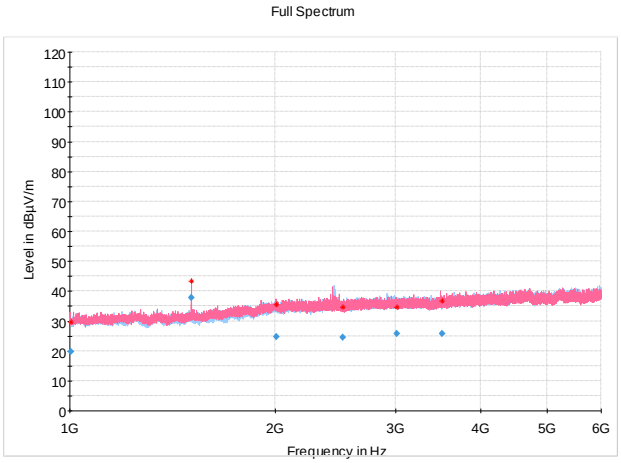
Test Description:	FCC 74H Radiated Emissions 30MHz - 1GHz
EUT	ULXD2 G50
Serial Number	G5x PPR Rad Sample
Operating Frequency:	Middle Frequency 502.050MHz
RF Power Level	20mW
Tester Name	Jamal Qureshi
Date Tested	Tested on February 13, 2019



SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 74H Radiated Emissions 1GHz - 6GHz
EUT:	ULXD2 G50
Serial Number:	G5x PPR Rad Sample
Operating Frequency:	Middle Frequency 502.050MHz
RF Power Level	20mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 14, 2019

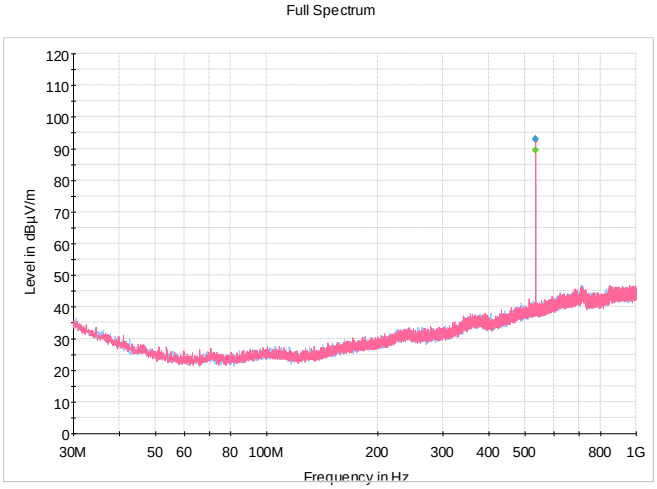


Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

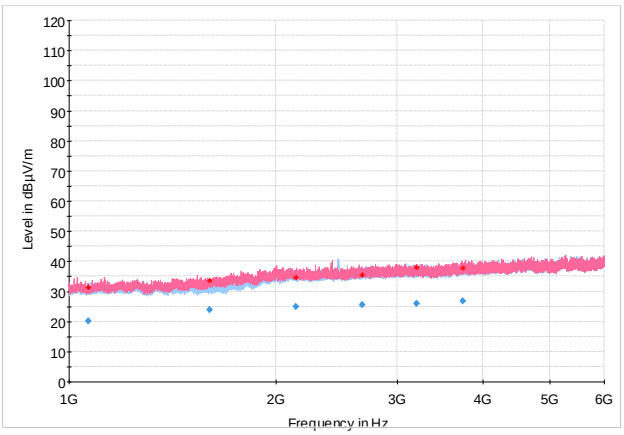
Test Description:	FCC 74H Radiated Emissions 30MHz - 1GHz
EUT	ULXD2 G50
Serial Number	G5x PPR Rad Sample
Operating Frequency:	High Frequency 534.000MHz
RF Power Level	1mW
Tester Name	Jamal Qureshi
Date Tested	Tested on February 13, 2019



SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 74H Radiated Emissions 1GHz - 6GHz
EUT:	ULXD2 G50
Serial Number:	G5x PPR Rad Sample
Operating Frequency:	High Frequency 534.000MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 15, 2019

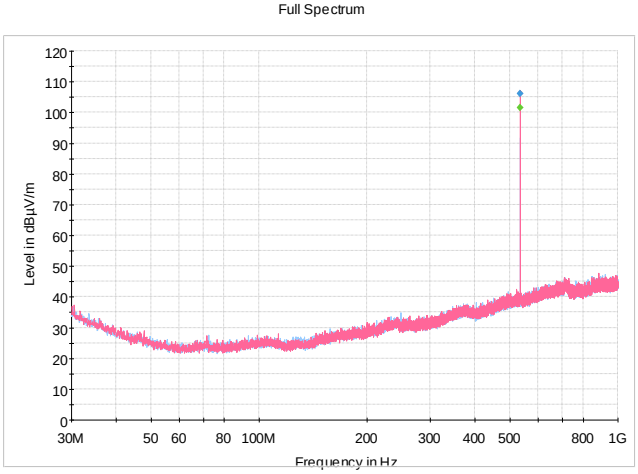


Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

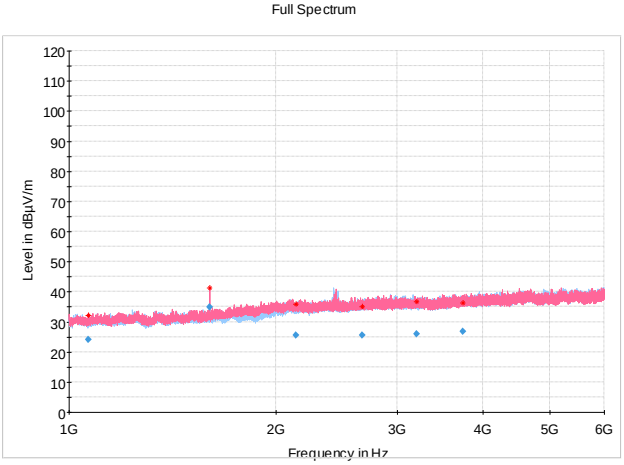
Test Description:	FCC 74H Radiated Emissions 30MHz - 1GHz
EUT	ULXD2 G50
Serial Number	G5x PPR Rad Sample
Operating Frequency:	High Frequency 534.000MHz
RF Power Level	20mW
Tester Name	Jamal Qureshi
Date Tested	Tested on February 13, 2019



SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 74H Radiated Emissions 1GHz - 6GHz
EUT:	ULXD2 G50
Serial Number:	G5x PPR Rad Sample
Operating Frequency:	High Frequency 534.000MHz
RF Power Level	20mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 15, 2019



Appendix B

Date: February 16, 2019
EUT: ULXD2
Band: G50
Serial Number: G5x PPR Rad Sample
Specification: EN 300 422-1, Spurious Radiated Emissions
Comments: Test Distance is 3 meters
Mode: EUT set to Low Frequency 470.125 MHz at 1mW
Tested By: Jamal Qureshi

Frequency in MHz	Detector Used	Antenna Polarity	Measured Level in dBuV	Matched Sig. Gen. Reading in dBm	Antenna Gain in dB	Cable Loss in dB	ERP Total in dBm	ETSI Limit in dBm
470.125	QP	V	96.81	0.41	0.00	2.46		
1410.375	Average	V	24.18	-73.0	5.26	3.91	-71.65	-30
1880.500	Average	V	23.52	-85.6	5.26	4.38	-84.72	-30
2350.625	Average	V	25.04	-85.9	5.69	4.80	-85.01	-30
2820.750	Average	V	25.71	-88.0	6.88	5.11	-86.23	-30
3290.875	Average	V	26.05	-89.6	7.81	5.45	-87.24	-30
3761.000	Average	V	26.91	-90.0	8.45	6.22	-87.77	-30

Total (dBm) = Matched Signal. Generator Reading (dBm) + Antenna Gain (dB) – Cable Loss (dB)

Date: February 16, 2019
EUT: ULXD2
Band: G50
Serial Number: G5x PPR Rad Sample
Specification: EN 300 422-1, Spurious Radiated Emissions
Comments: Test Distance is 3 meters
Mode: EUT set to Low Frequency 470.125MHz at 20mW
Tested By: Jamal Qureshi

Frequency in MHz	Detector Used	Antenna Polarity	Measured Level in dBuV	Matched Sig. Gen. Reading in dBm	Antenna Gain in dB	Cable Loss in dB	ERP Total in dBm	ETSI Limit in dBm
470.125	QP	V	108.98	12.6	0.00	2.46		
1410.375	Average	V	36.13	-58.6	5.26	3.91	-57.25	-30
1880.500	Average	V	23.41	-94.9	5.26	4.38	-94.02	-30
2350.625	Average	V	28.88	-67.1	5.69	4.80	-66.21	-30
2820.750	Average	V	25.80	-82.9	6.88	5.11	-81.13	-30
3290.875	Average	V	26.02	-95.2	7.81	5.45	-92.84	-30
3761.000	Average	V	26.90	-90.8	8.45	6.22	-88.57	-30

Total (dBm) = Matched Signal. Generator Reading (dBm) + Antenna Gain (dB) – Cable Loss (dB)

Appendix B

Date: February 16, 2019
EUT: ULXD2
Band: G50
Serial Number: G5x PPR Rad Sample
Specification: EN 300 422-1, Spurious Radiated Emissions
Comments: Test Distance is 3 meters
Mode: EUT set to Middle Frequency 502.050MHz at 1mW
Tested By: Jamal Qureshi

Frequency in MHz	Detector Used	Antenna Polarity	Measured Level in dBuV	Matched Sig. Gen. Reading in dBm	Antenna Gain in dB	Cable Loss in dB	ERP Total in dBm	ETSI Limit in dBm
502.050	QP	V	96.02	0.45	0.00	2.46		
1004.100	Average	V	19.96	-90.0	3.44	3.91	-90.47	-30
1506.150	Average	V	25.54	-71.1	4.01	4.38	-71.74	-30
2008.200	Average	V	24.88	-95.0	4.44	4.80	-95.36	-30
2510.250	Average	V	24.88	-92.7	4.95	5.11	-82.86	-30
3012.300	Average	V	25.62	-73.8	5.28	5.45	-73.97	-30
3514.350	Average	V	26.09	-93.0	5.60	6.22	-93.62	-30

Total (dBm) = Matched Signal. Generator Reading (dBm) + Antenna Gain (dB) – Cable Loss (dB)

Date: February 16, 2019
EUT: ULXD2
Band: G50
Serial Number: G5x PPR Rad Sample
Specification: EN 300 422-1, Spurious Radiated Emissions
Comments: Test Distance is 3 meters
Mode: EUT set to Middle Frequency 502.050MHz at 20mW
Tested By: Jamal Qureshi

Frequency in MHz	Detector Used	Antenna Polarity	Measured Level in dBuV	Matched Sig. Gen. Reading in dBm	Antenna Gain in dB	Cable Loss in dB	ERP Total in dBm	ETSI Limit in dBm
502.050	QP	V	108.84	13.27	0.00	2.46		
1004.100	Average	V	19.96	-90.0	3.44	3.44	-90.47	-30
1506.150	Average	V	37.78	-57.0	4.01	4.01	-57.37	-30
2008.200	Average	V	24.88	-95.0	4.44	4.44	-95.36	-30
2510.250	Average	V	24.88	-92.7	4.95	4.95	-92.86	-30
3012.300	Average	V	25.69	-73.4	5.28	5.28	-73.57	-30
3514.350	Average	V	26.09	-93.0	5.60	5.60	-93.62	-30

Total (dBm) = Matched Signal. Generator Reading (dBm) + Antenna Gain (dB) – Cable Loss (dB)

Appendix B

Date: February 16, 2019
EUT: ULXD2
Band: G50
Serial Number: G5x PPR Rad Sample
Specification: EN 300 422-1, Spurious Radiated Emissions
Comments: Test Distance is 3 meters
Mode: EUT set to High Frequency 534.000MHz at 1mW
Tested By: Jamal Qureshi

Frequency in MHz	Detector Used	Antenna Polarity	Measured Level in dBuV	Matched Sig. Gen. Reading in dBm	Antenna Gain in dB	Cable Loss in dB	ERP Total in dBm	ETSI Limit in dBm
534.000	QP	V	93.01	-2.7	0.00	2.46		
1068.000	Average	V	20.29	-93.8	3.37	3.91	-94.34	-30
1602.000	Average	V	22.09	-90.9	6.16	4.38	-89.12	-30
2136.000	Average	V	24.82	-80.3	5.41	4.80	-79.64	-30
2670.000	Average	V	25.62	-81.2	6.48	5.11	-79.83	-30
3204.000	Average	V	25.97	-82.9	7.47	5.45	-80.88	-30
3738.000	Average	V	26.88	-86.4	8.42	6.22	-84.20	-30

Total (dBm) = Matched Signal. Generator Reading (dBm) + Antenna Gain (dB) – Cable Loss (dB)

Date: February 16, 2019
EUT: ULXD2
Band: G50
Serial Number: G5x PPR Rad Sample
Specification: EN 300 422-1, Spurious Radiated Emissions
Comments: Test Distance is 3 meters
Mode: EUT set to High Frequency 534.000MHz at 20mW
Tested By: Jamal Qureshi

Frequency in MHz	Detector Used	Antenna Polarity	Measured Level in dBuV	Matched Sig. Gen. Reading in dBm	Antenna Gain in dB	Cable Loss in dB	ERP Total in dBm	ETSI Limit in dBm
534.000	QP	V	106.03	10.47	0.00	2.46		
1068.000	Average	V	24.00	-71.3	3.37	3.91	-71.84	-30
1602.000	Average	V	34.89	-59.4	6.16	4.38	-57.62	-30
2136.000	Average	V	24.61	-90.4	5.41	4.80	-89.74	-30
2670.000	Average	V	25.56	-82.4	6.48	5.11	-81.03	-30
3204.000	Average	V	25.95	-83.6	7.47	5.45	-81.58	-30
3738.000	Average	V	26.83	-91.6	8.42	6.22	-89.40	-30

Appendix C

Maximum Conducted Power

Purpose:

This test performed to determine if the EUT meets the Maximum Conducted Power requirements of the FCC Part 74H, Section 74.861(e)(1)(ii), the FCC OET Basic Certification Requirements For Wireless Microphones, and RSS-210.

Requirements:

As stated in FCC Part 74H, Section 74.861(e)(1)(ii). In the FCC OET Basic Certification Requirements For Wireless Microphones, it states in Part III(e)(1)(ii) that this measurement is conducted. RSS-210 requirement is for EIRP.

Measurement Uncertainty:

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

Values of Expanded Measurement Uncertainty (95% Confidence)

Measurement Type	U_{lab}
Conducted measurements (30 MHz – 1000 MHz)	1.24 dB

U_{lab} = Determined for Shure EMC Laboratory

Since U_{lab} is less than or equal to U_{ETSI}:

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit; Non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

Test Setup and Instrumentation:

Photographs of the test setup are shown in Figure C 1. The test instrumentation can be determined from Table 10-1.

EUT Operation:

The EUT was powered up and the frequency of the transmitter was selected using the front panel controls. For rated output power, the testing was performed with the EUT set to the low, middle, and high frequency within the operating frequency range, and at 1mW and 20mW RF output.

Appendix C

Specific Test Procedures:

The output of the EUT was connected to the input of a 20dB attenuator. The output of the attenuator was connected to the input of an ETS-Lindgren EMPower USB RF Power Sensor.

The EMPower software was set to:
Trigger Level = -40dBm
Measure Time = 500mS
Sample Rate (S/s) = 5MS/s
Gap Time = 2.5mS
Threshold Level = -30dBc
Assembly Gain = 0dBi
Beamforming Gain = 0dB

The EUT was set to transmit on the low, middle, and high frequencies, and power levels of 1mW and 20mW.

Results:

The conducted RF power output for all frequencies measured meets the FCC 74H Section 74.861(e)(1)(ii) and the FCC OET "Basic Certification Requirements For Wireless Microphones, Part III(e)(1)(ii).

The results are shown on page 34 thru page 39.
The temperature during the test was 75 degrees F, with relative humidity of 18%.

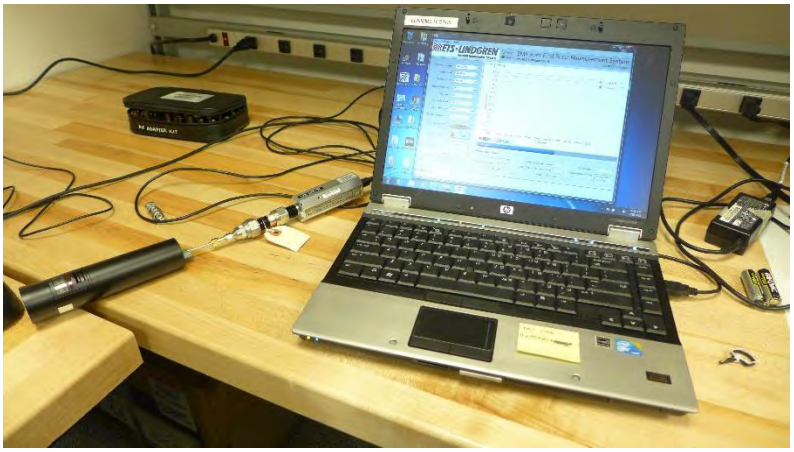


Figure C 1: Test setup for Maximum Power Output

Appendix C

Test Information

EUT Name:	ULXD2 G50
Serial Number:	G5x PPR
Test Description:	Maximum Power Output
Operating Conditions:	Low Frequency, 470,125MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	FCC Part 74H, Section 74.861(e)(1)(ii)
Date Tested:	Tested on February 12, 2019

Power Meter Measurement in dBm	Power Meter Measured in mW	Limit in dBm	Limit in mW	Margin In mW
-1.00	0.79	23.98	250.00	249.21

Test Information

EUT Name:	ULXD2 G50
Serial Number:	G5x PPR
Test Description:	Maximum Rated Output
Operating Conditions:	Low Frequency, 470.125MHz, 20mW
Operator Name:	Craig Kozokar
Comment:	FCC Part 74H, Section 74.861(e)(1)(ii)
Date Tested:	Tested on February 12, 2019

Power Meter Measurement in dBm	Power Meter Measured in mW	Limit in dBm	Limit in mW	Margin In mW
+11.80	15.14	23.98	250.00	234.86

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Test Information

EUT Name:	ULXD2 G50
Serial Number:	G5x PPR
Test Description:	Maximum Rated Output
Operating Conditions:	Middle Frequency, 502.050MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	FCC Part 74H, Section 74.861(e)(1)(ii)
Date Tested:	Tested on February 12, 2019

Power Meter Measurement in dBm	Power Meter Measured in mW	Limit in dBm	Limit in mW	Margin In mW
-1.16	0.77	23.98	250.00	249.23

Test Information

EUT Name:	ULXD2 G50
Serial Number:	G5x PPR
Test Description:	Maximum Rated Output
Operating Conditions:	Middle Frequency, 502.050MHz, 20mW
Operator Name:	Craig Kozokar
Comment:	FCC Part 74H, Section 74.861(e)(1)(ii)
Date Tested:	Tested on February 12, 2019

Power Meter Measurement in dBm	Power Meter Measured in mW	Limit in dBm	Limit in mW	Margin In mW
+11.82	15.21	23.98	250.00	234.79

Appendix C

Test Information

EUT Name:	ULXD2 G50
Serial Number:	G5x PPR
Test Description:	Maximum Rated Output
Operating Conditions:	High Frequency, 534.000MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	FCC Part 74H, Section 74.861(e)(1)(ii)
Date Tested:	Tested on February 12, 2019

Power Meter Measurement in dBm	Power Meter Measurement in mW	Limit in dBm	Limit in mW	Margin In mW
-1.62	0.69	23.98	250.00	249.31

Test Information

EUT Name:	ULXD2 G50
Serial Number:	G5x PPR
Test Description:	Maximum Rated Output
Operating Conditions:	High Frequency, 534.000MHz, 20mW
Operator Name:	Craig Kozokar
Comment:	FCC Part 74H, Section 74.861(e)(1)(ii)
Date Tested:	Tested on February 12, 2019

Power Meter Measurement in dBm	Power Meter Measurement in mW	Limit in dBm	Limit in mW	Margin In mW
+11.49	14.09	23.98	250.00	235.91

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Test Information

EUT Name:	ULXD2 G50
Serial Number:	G5x PPR
Test Description:	Maximum Power Output
Operating Conditions:	Low Frequency, 470.125MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	RSS-210
Date Tested:	Tested on February 12, 2019

Power Meter Measurement in dBm	Power Meter Measured in mW	RSS-210: Measured Antenna Gain in dB	RSS-210: Equivalent Antenna Gain in dB	RSS-210: EIRP in dBm	RSS-210: EIRP in mW	RSS-210: EIRP LIMIT in mW
-1.00	0.79	0.30	2.15	3.24	2.11	250

EIRP = (dBm) = Measurement (dBm) + Antenna Gain + Equivalent Antenna Gain (dB)

G50 Measured antenna gain = 0.3dB

Test Information

EUT Name:	ULXD2 G50
Serial Number:	G5x PPR
Test Description:	Maximum Rated Output
Operating Conditions:	Low Frequency, 470.125MHz, 20mW
Operator Name:	Craig Kozokar
Comment:	RSS-210
Date Tested:	Tested on February 12, 2019

Power Meter Measurement in dBm	Power Meter Measured in mW	RSS-210: Measured Antenna Gain in dB	RSS-210: Equivalent Antenna Gain in dB	RSS-210: EIRP in dBm	RSS-210: EIRP in mW	RSS-210: EIRP LIMIT in mW
+11.80	15.14	0.30	2.15	17.59	57.41	250

EIRP = (dBm) = Measurement (dBm) + Antenna Gain + Equivalent Antenna Gain (dB)

G50 Measured antenna gain = 0.3dB

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Test Information

EUT Name:	ULXD2 G50
Serial Number:	G5x PPR
Test Description:	Maximum Rated Output
Operating Conditions:	Middle Frequency, 502.050MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	RSS-210
Date Tested:	Tested on February 12, 2019

Power Meter Measurement in dBm	Power Meter Measured in mW	RSS-210: Measured Antenna Gain in dB	RSS-210: Equivalent Antenna Gain in dB	RSS-210: EIRP in dBm	RSS-210: EIRP in mW	RSS-210: EIRP LIMIT in mW
-1.16	0.77	0.3	2.15	3.22	2.10	250

EIRP = (dBm) = Measurement (dBm) + Antenna Gain + Equivalent Antenna Gain (dB)

G50 Measured antenna gain = 0.3dB

Test Information

EUT Name:	ULXD2 G50
Serial Number:	G5x PPR
Test Description:	Maximum Rated Output
Operating Conditions:	Middle Frequency, 502.050MHz, 20mW
Operator Name:	Craig Kozokar
Comment:	RSS-210
Date Tested:	Tested on February 12, 2019

Power Meter Measurement in dBm	Power Meter Measured in mW	RSS-210: Measured Antenna Gain in dB	RSS-210: Equivalent Antenna Gain in dB	RSS-210: EIRP in dBm	RSS-210: EIRP in mW	RSS-210: EIRP LIMIT in mW
+11.82	15.21	0.3	2.15	17.66	58.35	250

EIRP = (dBm) = Measurement (dBm) + Antenna Gain + Equivalent Antenna Gain (dB)

G50 Measured antenna gain = 0.3dB

Appendix C

Test Information

EUT Name:	ULXD2 G50
Serial Number:	G5x PPR
Test Description:	Maximum Rated Output
Operating Conditions:	High Frequency, 534.000MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	RSS-210
Date Tested:	Tested on February 12, 2019

Power Meter Measurement in dBm	Power Meter Measurement in mW	RSS-210: Measured Antenna Gain in dB	RSS-210: Equivalent Antenna Gain in dB	RSS-210: EIRP in dBm	RSS-210: EIRP in mW	RSS-210: EIRP LIMIT in mW
-1.62	0.69	0.3	2.15	3.14	2.06	250

EIRP = (dBm) = Measurement (dBm) + Antenna Gain + Equivalent Antenna Gain (dB)

G50 Measured antenna gain = 0.3dB

Test Information

EUT Name:	ULXD2 G50
Serial Number:	G5x PPR
Test Description:	Maximum Rated Output
Operating Conditions:	High Frequency, 534.000MHz, 20mW
Operator Name:	Craig Kozokar
Comment:	RSS-210
Date Tested:	Tested on February 12, 2019

Power Meter Measurement in dBm	Power Meter Measurement in mW	RSS-210: Measured Antenna Gain in dB	RSS-210: Equivalent Antenna Gain in dB	RSS-210: EIRP in dBm	RSS-210: EIRP in mW	RSS-210: EIRP LIMIT in mW
+11.49	14.09	0.3	2.15	16.54	45.08	250

EIRP = (dBm) = Measurement (dBm) + Antenna Gain + Equivalent Antenna Gain (dB)

G50 Measured antenna gain = 0.3dB

Appendix D

FREQUENCY TOLERANCE

PURPOSE:
This test was performed to determine if the EUT meets the frequency stability requirements of the FCC Part 74H, Section 74.861(e)(4) and the RSS-210 paragraph 6, table 1 specifications over the EUT operating frequency range of 470MHz to 534MHz.

REQUIREMENTS:

As stated in paragraph 74.861(e)(4) and paragraph 6 of RSS-210 Table 1, for low power auxiliary stations operating in the bands allocated for TV broadcasting, the frequency tolerance of the transmitter shall be 0.005 percent.

MEASUREMENT UNCERTAINTY:

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

Values of Expanded Measurement Uncertainty (95% Confidence):

Measurement Type	U_{lab}
Frequency Error (Stability)	.0000000583 ppm

U_{lab} = Determined for Shure EMC Laboratory

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- Non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

TEST SETUP AND INSTRUMENTATION:

The EUT firmware was temporarily changed to transmit a CW signal just for this test. The EUT was heated and cooled in an ESPEC temperature chamber over a temperature range of -30C to +50C. The temperature around the EUT was measured and monitored by a J-Type thermocouple connected to an Extech thermometer. The EUTs frequency was measured with a frequency counter set to measure signal count at 0.1Hz resolution. The EUT was measured at low, middle, and high frequencies. Photographs of the test setup are shown as Figure B-1. The test instrumentation can be determined from Table 10-1.

EUT OPERATION:

The antenna port of the EUT was connected to the 50 Ohm input of a frequency counter. The EUT was operated at 1mW. The EUT was set to transmit at a low, mid or high frequency within its operating band of G50 Band (470MHz to 534.000MHz).

Appendix D

TEST PROCEDURES:

a. The temperature chamber was set to 20C, ambient temperature, with the EUT inside and powered on.

b. The EUT was allowed to soak for at least 15 minutes after the temperature chamber reached the set temperature.

c. The measured frequency of the transmitter was measured on the frequency counter.

d. Steps a. through c. were repeated at -30C through +50C in ten degree increments for representative low, mid and high frequencies within the EUTs operational band.

RESULTS:

The frequency stability measurements are presented on page 42. As shown by the test data, the test frequency deviation was within the 0.005 percent limit set out in the FCC Part 15C Section 15.236(f)(3) and the RSS-210 ±50ppm specifications.

The temperature in the test room during the test was 75 degrees F, with relative humidity of 18%.

Figure D-1 - Test Setup for Frequency Stability

Appendix D

Test Information

EUT Name: ULXD2 G50
Serial Number: G5x PPR
Test Description: FCC Part 74H Section 74.861(e)(4) Frequency Tolerance
Operating Conditions: Low, Middle, and High frequency at 1mW, -30C to +50C
Operator Name: Juan Castreion and Craig Kozokar
Comment: R & S FSU Spectrum Analyzer and ESPEC Temp Chamber
Test Date February 15, 2019

Temp in °C	Nominal Frequency (MHz)	Measured Frequency (MHz)	Deviation (Hz)	Deviation (%)	FCC Limit (%)	Deviation (ppm)	RSS Limit (ppm)
-30	470.125	470.125380	380	0.00010253	0.005	0.80829566	±50
-20	470.125	470.125174	174	0.00003701	0.005	0.37011433	±50
-10	470.125	470.125141	141	0.00002999	0.005	0.29992023	±50
0	470.125	470.125154	154	0.00003276	0.005	0.32757245	±50
10	470.125	470.125161	161	0.00003425	0.005	0.34246211	±50
20	470.125	470.125196	196	0.00004169	0.005	0.41691040	±50
30	470.125	470.125221	221	0.00004701	0.005	0.47008774	±50
40	470.125	470.125254	254	0.00005403	0.005	0.54028184	±50
50	470.125	470.125248	248	0.00005275	0.005	0.52751928	±50
-30	502.050	502.050420	420	0.00008366	0.005	0.83657006	±50
-20	502.050	502.050197	197	0.00003924	0.005	0.39239120	±50
-10	502.050	502.050159	159	0.00003167	0.005	0.31670152	±50
0	502.050	502.050161	161	0.00003207	0.005	0.32068519	±50
10	502.050	502.050176	176	0.00003506	0.005	0.35056269	±50
20	502.050	502050212	212	0.00004223	0.005	0.42226870	±50
30	502.050	502.050237	237	0.00004721	0.005	0.47206454	±50
40	502.050	502.050268	268	0.00005338	0.005	0.53381137	±50
50	502.050	502.050268	267	0.00005318	0.005	0.53181954	±50
-30	534.000	534.000360	360	0.00006742	0.005	0.67415730	±50
-20	534.000	534.000364	364	0.00006817	0.005	0.68164794	±50
-10	534.000	534.000182	182	0.00003408	0.005	0.34082397	±50
0	534.000	534.000159	159	0.00002978	0.005	0.29775281	±50
10	534.000	534.000189	189	0.00003539	0.005	0.35393258	±50
20	534.000	534.000224	224	0.00004195	0.005	0.41947566	±50
30	534.000	534.000256	256	0.00004794	0.005	0.47940075	±50
40	534.000	534.000285	285	0.00005337	0.005	0.53370787	±50
50	534.000	534.000291	291	0.00005449	0.005	0.54494382	±50