



SHURE

ELECTROMAGNETIC COMPATIBILITY LABORATORY

TEST REPORT

TEST REPORT TITLE: Electromagnetic Compatibility Tests of the Shure ULXD1 Digital Wireless Transmitter in the G50 Band (470MHz to 534MHz)

TEST ITEM DESCRIPTION:

The Shure ULXD1 is a digital wireless microphone transmitter.

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

Project ID Number: SEL-043/ULXD1 G50 FCC15C

Date Tested: February 13 thru February 27, 2019

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

Test Specification:

- 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
- FCC Title 47, Part 2.1051
- FCC Part 15C, Section 15.236(g)
- FCC Part 15C, Section 15.236(d)(1)
- FCC Part 15C, Section 15.236(f)(1)
- FCC Part 15C, Section 15.236(f)(2)
- FCC Part 15C, Section 15.236(f)(3)

TEST REPORT BY:	<u>Craig Kozokar</u>	<u>Global Compliance Engineer</u>	<u>3-14-2019</u>
APPROVED BY:	<u>[Signature]</u>	<u>Engineer Project Managing, G.C.</u>	<u>3-14-2019</u>
	Signature	Position	Date



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LIST OF APPENDICIES

APPENDIX	TEST DESCRIPTION
A	Necessary Bandwidth, Frequency Offset, Maximum Bandwidth
B	Radiated Spurious Emissions
C	Maximum Rated Power
D	Frequency Tolerance
E	Conducted Spurious Emissions at the Antenna Port



REPORT REVISION HISTORY

Revision	Date	Description
0	March 5, 2019	Initial release
1	March 5, 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 15C, Section 15.236(g), Section 15.236(d)(1), Section 15.236(f)(1), Section 15.236(f)(2), Section 15.236(f)(3), FCC OET Basic Certification Requirements for Wireless Microphones, FCC Part 2.1051, 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)
ULXD1	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 15C, Section 236(g), Section 15.236(d)(1), Section 15.236(f)(1), Section 15.236(f)(2), Section 15.236(f)(3), the FCC OET Basic Certification Requirements for Wireless Microphones, FCC Part 2.1051 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 15C Test Spec	Description	EUT Firmware	Tested Frequency in MHz	Appendix	Test Results
15.236(g)	Necessary Bandwidth	2.2.24	470.125, 502.050, 534.000	A	Pass
15.236(f)(1)	Frequency Offset	2.2.24	470.125	A	Pass
15.236(f)(2)	Maximum Bandwidth	2.2.24	470.125, 502.050, 534.000	A	Pass
15.236(g)	Radiated Spurious Emissions	2.2.24	470.125, 502.050, 534.000	B	Pass
15.236(d)(1)	Maximum Rated Power	2.2.24	470.125, 502.050, 534.000	C	Pass
15.236(f)(3)	Frequency Tolerance	2.2.24	470.125, 502.050, 534.000	D	Pass
2.1015	Conducted Spurious Emissions	2.2.24	470.125, 502.050, 534.000	E	Pass

2 APPLICABLE DOCUMENTS

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

FCC Part 15C, Section 15.236(g)

FCC Part 15C, Section 15.236(d)(1)

FCC Part 15C, Section 15.236(f)(1)

FCC Part 15C, Section 15.236(f)(2)

FCC Part 15C, Section 15.236(f)(3)

FCC Title 47, Chapter I, Subchapter A, Part 2 – Frequency Allocations and Radio Treaty Matters, General Rules and Regulations, Subpart J – Equipment Authorization Procedures

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 MICROPHONES”
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 ULXD1 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 ULXD1 Digital Wireless Transmitter Sample

Band	Serial Numbers
G50	WM # 1

3.3 Operational Mode

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

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 15C, Section 236(g), Section 15.236(d)(1), Section 15.236(f)(1), Section 15.236(f)(2), Section 15.236(f)(3), the FCC OET Basic Certification Requirements for Wireless Microphones, FCC 2.1051, RSS-Gen, and RSS-210



8. Conclusions:

It was determined that the Shure ULXD1 Digital Wireless Microphone Transmitter did fully comply with the requirements of FCC Part 15C, Section 236(g), Section 15.236(d)(1), Section 15.236(f)(1), Section 15.236(f)(2), Section 15.236(f)(3) and the FCC OET Basic Certification Requirements for Wireless Microphones, FCC 2.1051, RSS-Gen, 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

**NECESSARY BANDWIDTH
FREQUENCY OFFSET
OPERATING BANDWIDTH**

PURPOSE

This test was performed to determine if the EUT meets the necessary bandwidth requirements of EN 300 422-1, section 8.3.2., and RSS-210 Annex G, with the EUT operating at 470.125MHz, 502.050MHz, and 534.000MHz.

This testing results show the EUT meets FCC 15C 15.236(f)(1), a frequency offset of the lower band limits by 25kHz or an integral multiple thereof. The frequency offset is 125 kHz.

The testing results show the EUT meets FCC 15C 15.236(f)(2) and RSS-210, operating bandwidth does not exceed 200kHz.

REQUIREMENTS

As stated in 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}
Necessary 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 12 and 20. 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 8.3.2. 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%.

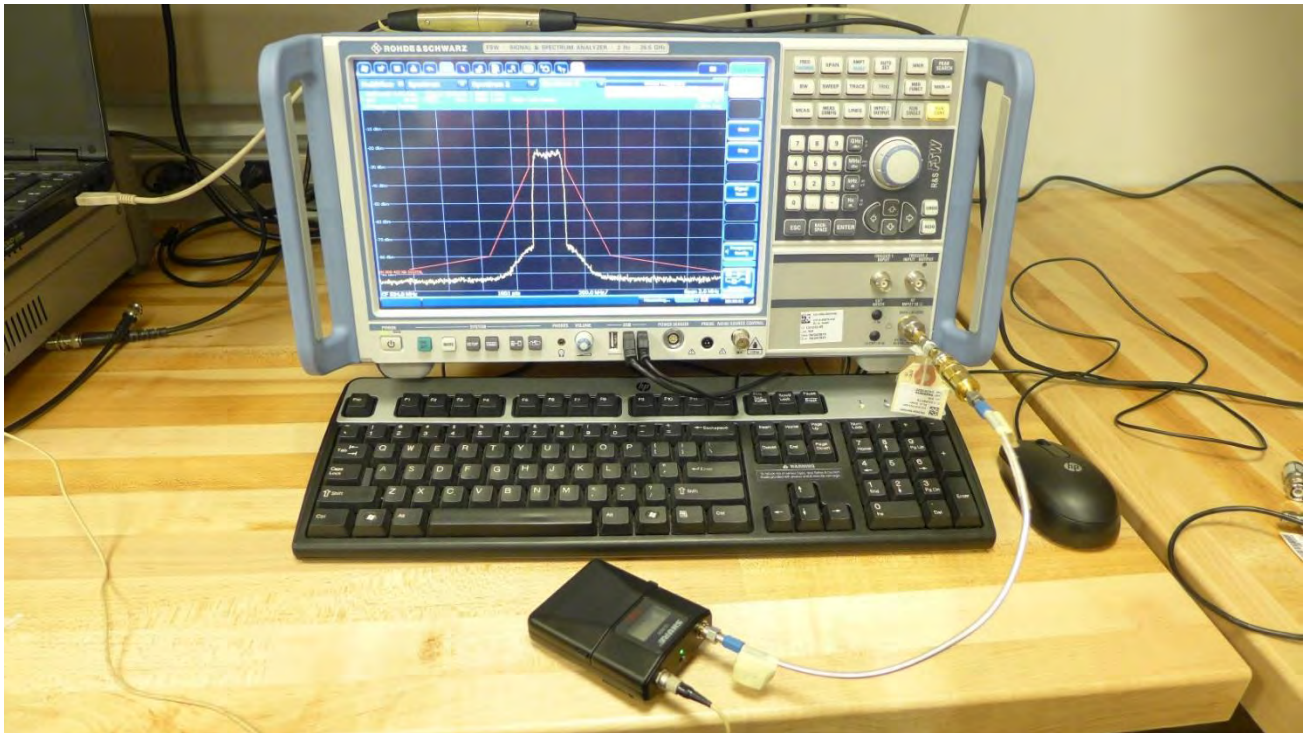
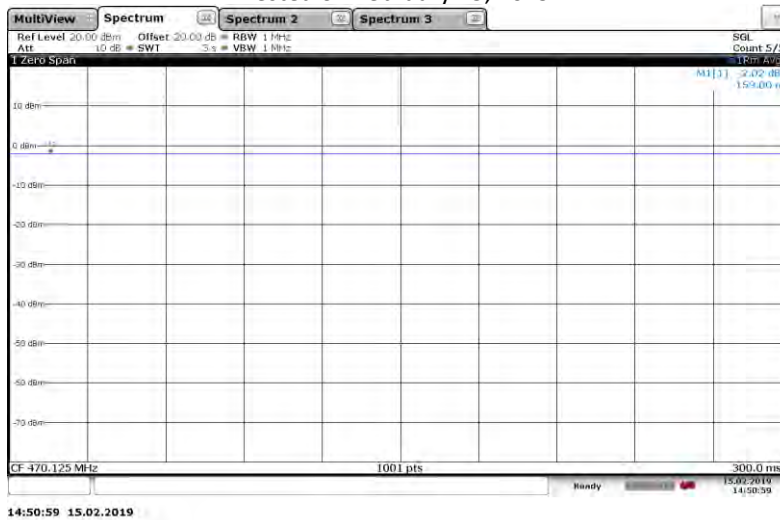


Figure A-1 - Test Setup for Necessary Bandwidth

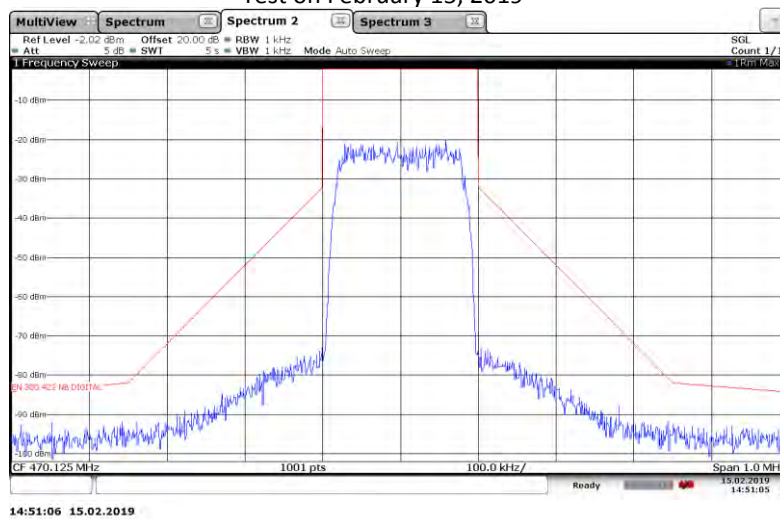
Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 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 15, 2019



Test Information

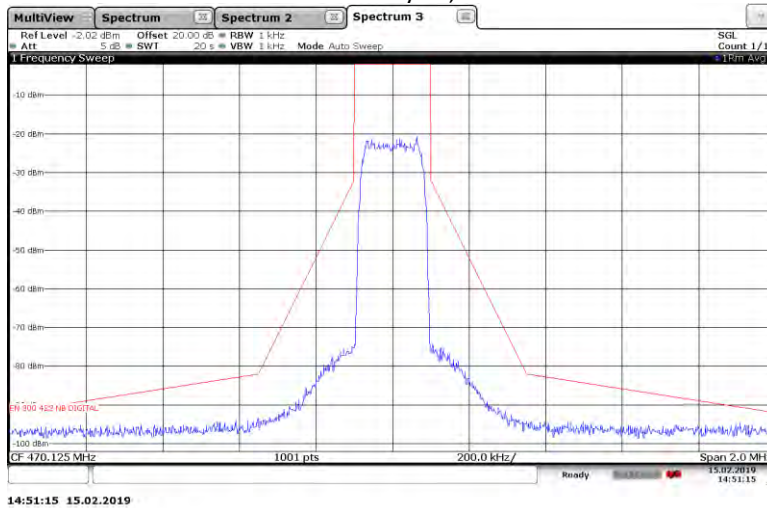
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 Serial Number: WM # 1
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 Operating Conditions: Low Frequency, 470.125MHz, 1mW
 Operator Name: Juan Castrejon
 Comment: 8.3.3.1: Step 2;Maximum Relative Level
 Date Tested: Test on February 15, 2019



Appendix A

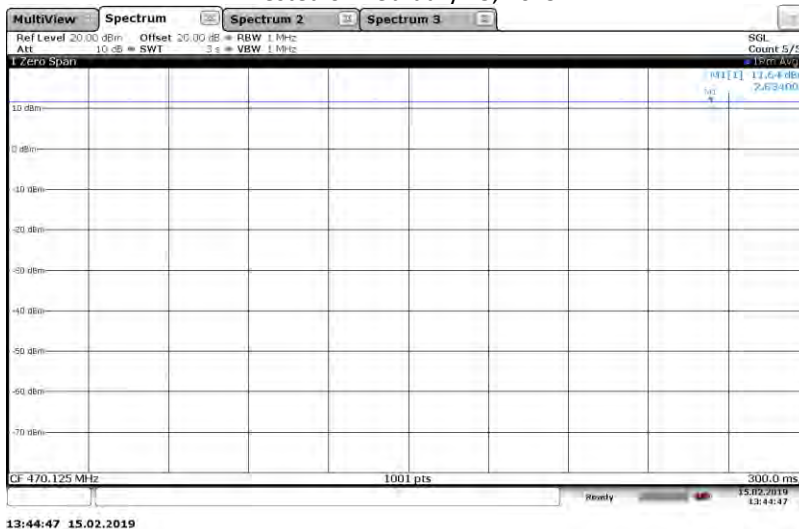
Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 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 15, 2019



Test Information

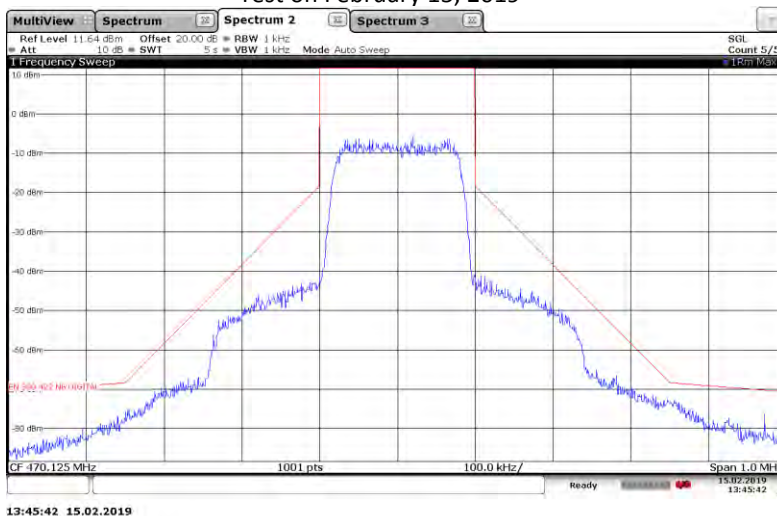
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 Serial Number: WM # 1
 Test Description: EN 300 422 Digital Necessary Bandwidth
 Operating Conditions: Low Frequency, 470.125MHz, 20mW
 Operator Name: Juan Castrejon
 Comment: 8.3.3.1: Step 1; Carrier Power
 Date Tested: Tested on February 15, 2019



Appendix A

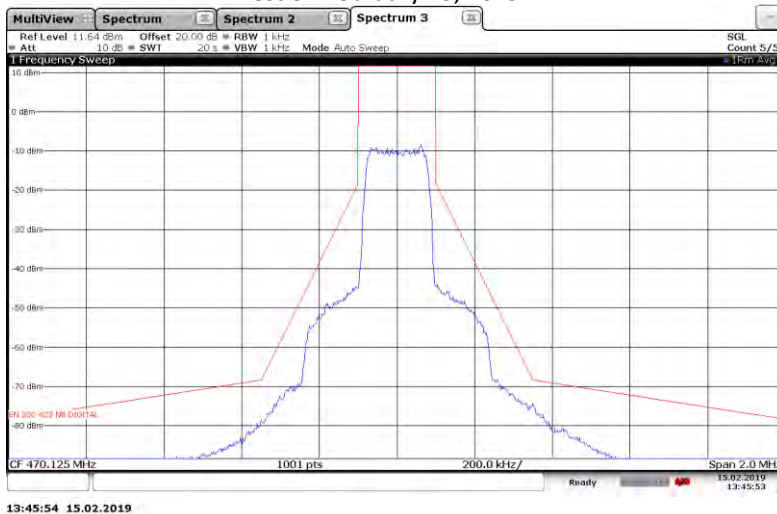
Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 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 15, 2019



Test Information

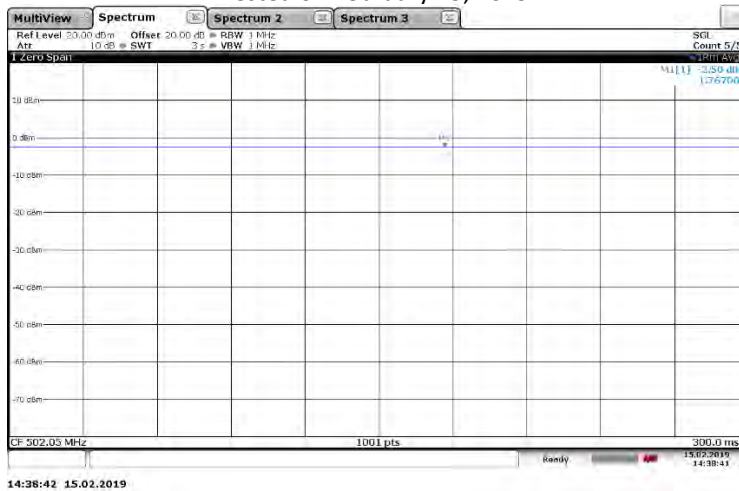
EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: EN 300 422 Digital Necessary Bandwidth
 Operating Conditions: Low Frequency, 470.125MHz, 20mW
 Operator Name: Juan Castrejon
 Comment: 8.3.3.1: Step 3;Lower and upper frequency transmitter band
 Wide band noise floor
 Date Tested: Test on February 15, 2019



Appendix A

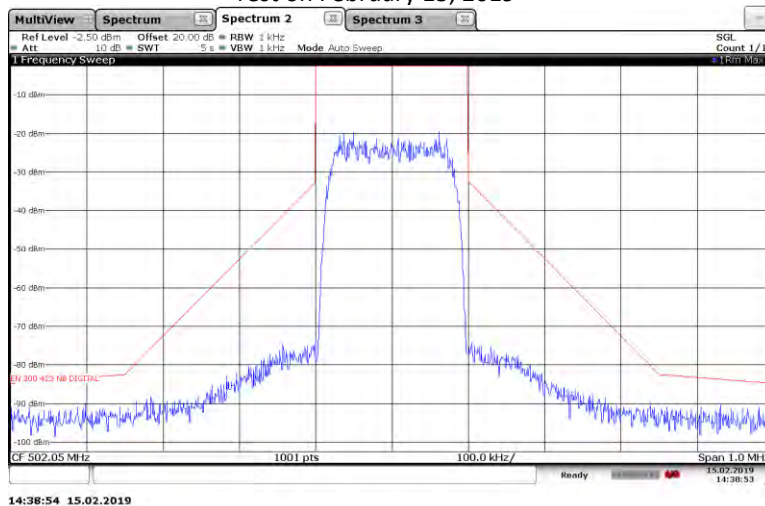
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EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: EN 300 422 Digital Necessary Bandwidth
 Operating Conditions: Middle Frequency, 502.050MHz, 1mW
 Operator Name: Juan Castrejon
 Comment: 8.3.3.1: Step 1; Carrier Power
 Date Tested: Tested on February 15, 2019



Test Information

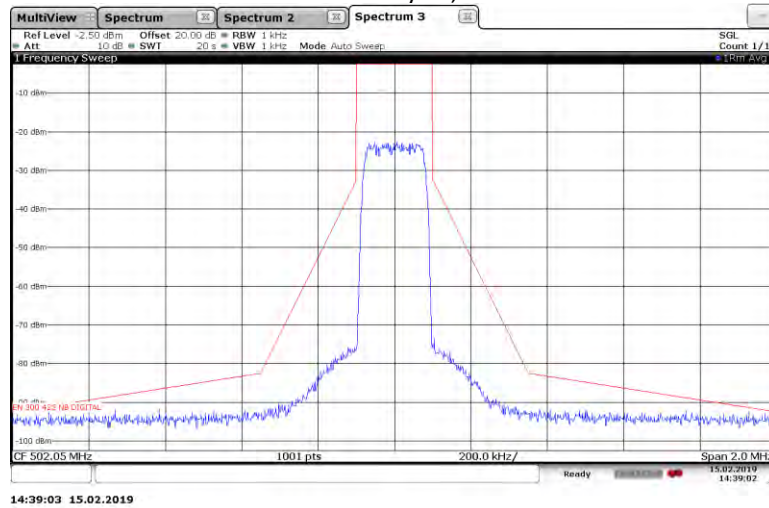
EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: EN 300 422 Digital Necessary Bandwidth
 Operating Conditions: Middle Frequency, 502.050MHz, 1mW
 Operator Name: Juan Castrejon
 Comment: 8.3.3.1: Step 2;Maximum Relative Level
 Date Tested: Test on February 15, 2019



Appendix A

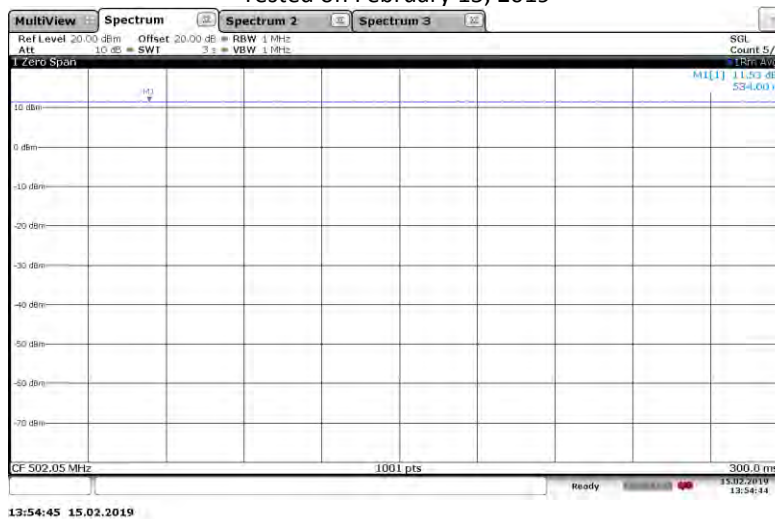
Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 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 15, 2019



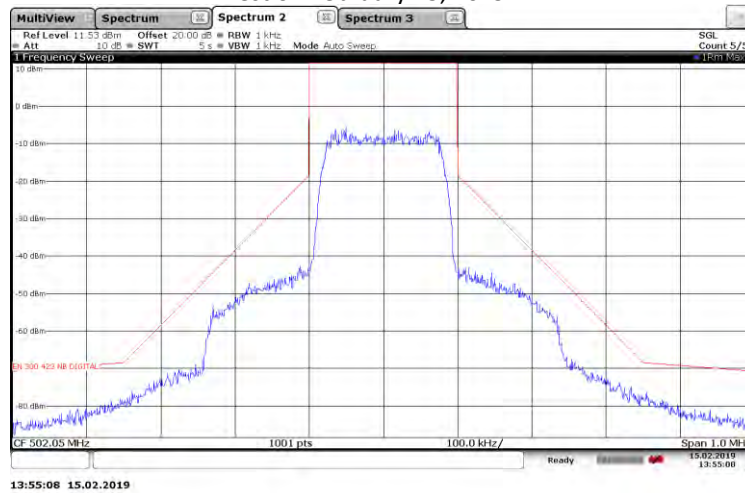
Test Information

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 Serial Number: WM # 1
 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 15, 2019



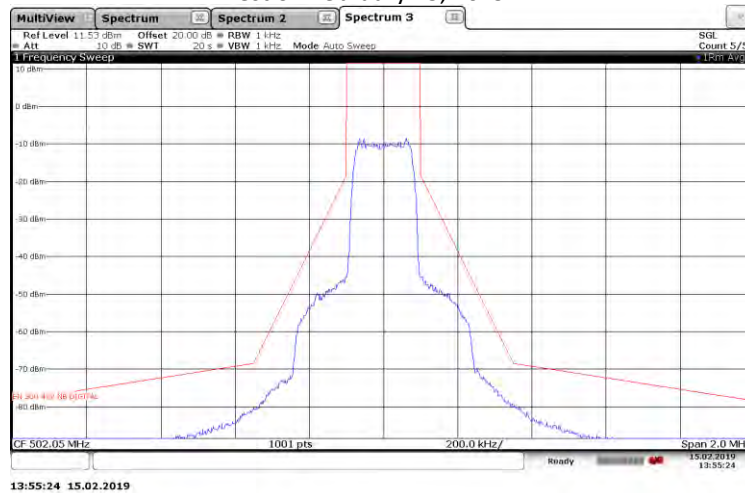
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EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: EN 300 422 Digital Necessary Bandwidth
 Operating Conditions: Middle Frequency, 502.050MHz, 20mW
 Operator Name: Juan Castrejon
 Comment: 8.3.3.1: Step 2;Maximum Relative Level
 Date Tested: Test on February 15, 2019



Test Information

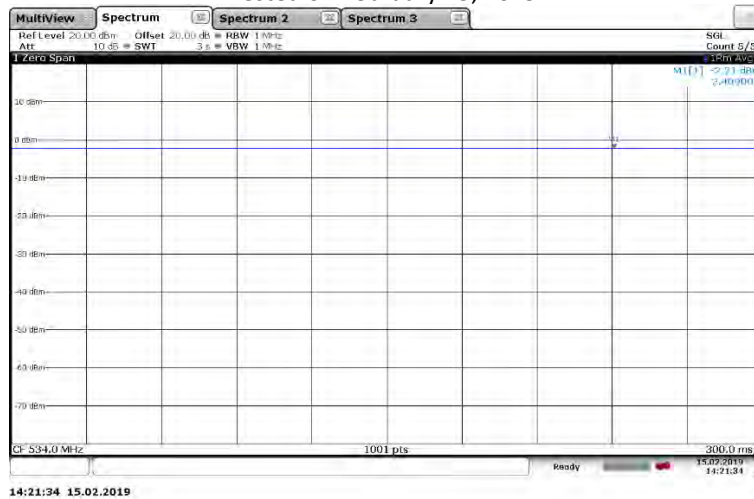
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 Serial Number: WM # 1
 Test Description: EN 300 422 Digital Necessary Bandwidth
 Operating Conditions: Middle Frequency, 502.050MHz, 20mW
 Operator Name: Juan Castrejon
 Comment: 8.3.3.1: Step 3;Lower and upper frequency transmitter band
 Wide band noise floor
 Date Tested: Test on February 15, 2019



Appendix A

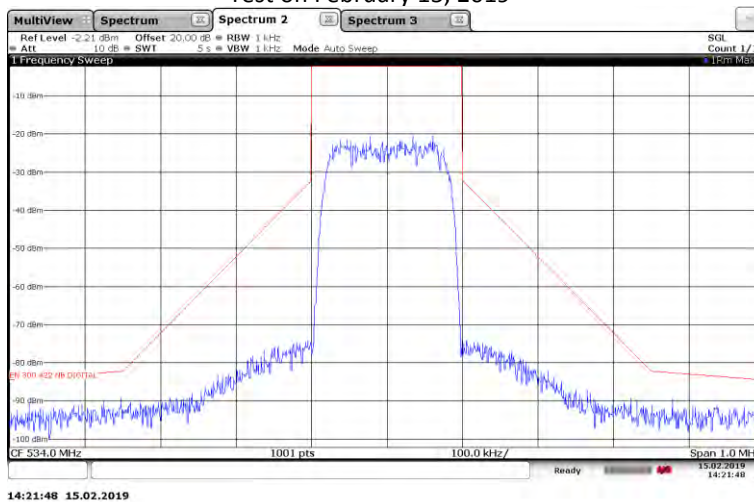
Test Information

EUT Name: ULXD1 G50
 Serial Number: WM# 1
 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 15, 2019



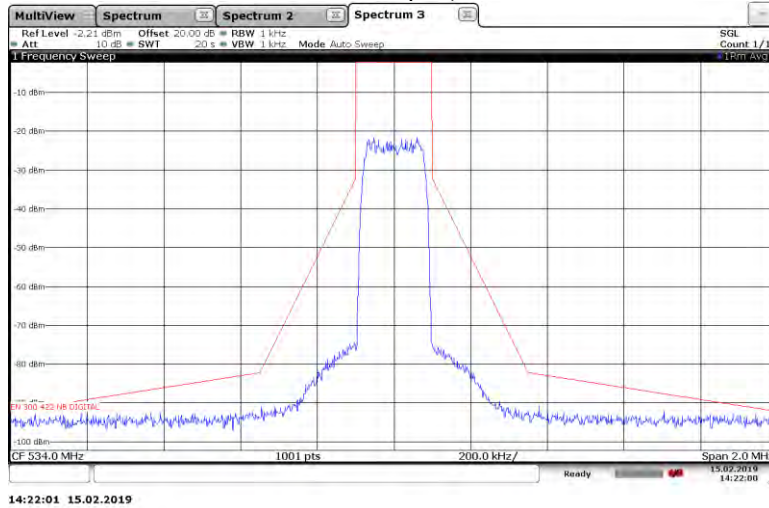
Test Information

EUT Name: ULXD1 G50
 Serial Number: WM# 1
 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 15, 2019



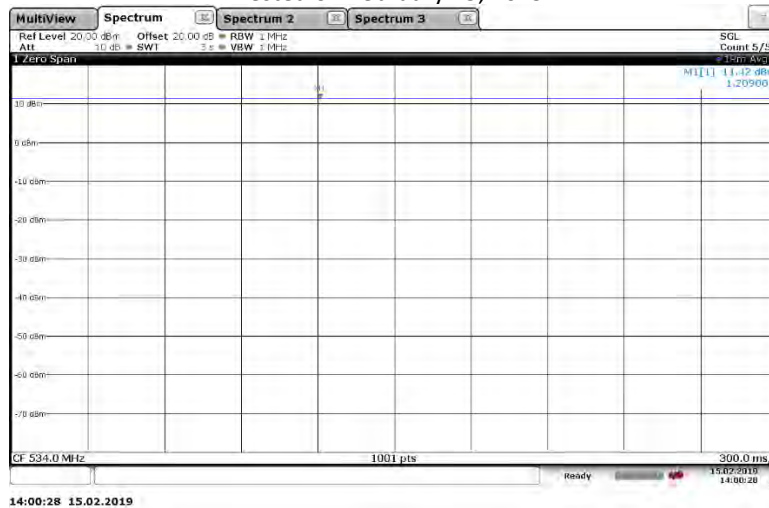
Test Information

EUT Name: ULXD1 G50
 Serial Number: WM# 1
 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 15, 2019



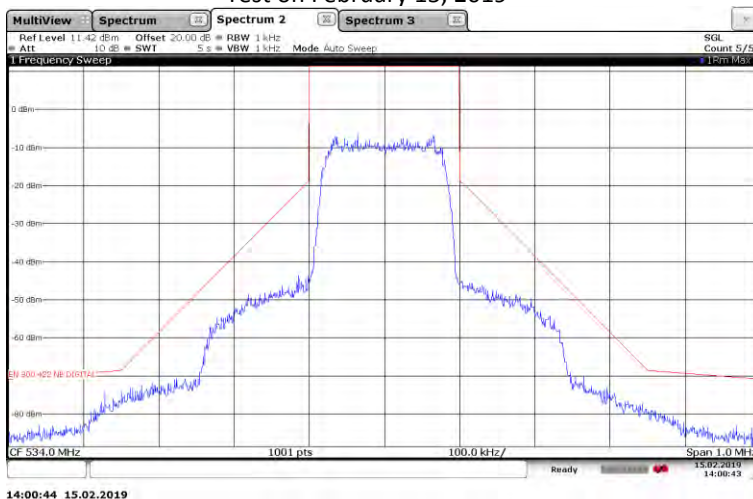
Test Information

EUT Name: ULXD1 G50
 Serial Number: WM# 1
 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 15, 2019



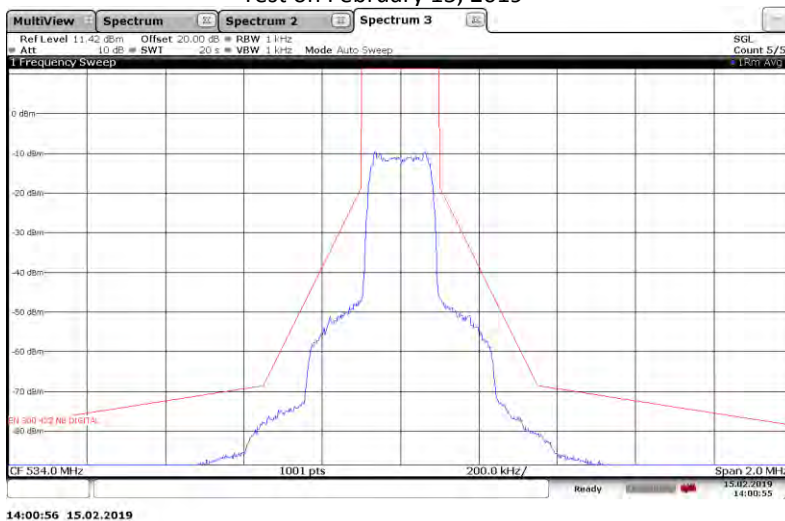
Test Information

EUT Name: ULXD1 G50
 Serial Number: WM# 1
 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 15, 2019



Test Information

EUT Name: ULXD1 G50
 Serial Number: WM# 1
 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 15, 2019



Radiated Spurious Emissions

Purpose:

This test performed to determine if the EUT meets the radiated RF emission requirements of the FCC Part 15C section 236(g) and FCC OET Basic Certification Requirements for Wireless Microphones over the frequency range from 30MHz to 6GHz. A Quasi-Peak and Average detectors were used for the measurements. Both FCC Part 15C and IC RSS-Gen require measurements to the 10th harmonic of the carrier.

Requirements:

As stated in FCC 15C section 236(g), 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 QP detector below 1GHz and a RMS Average detector above 1GHz. Emissions shall be investigated up to the 10th 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 LEMO TL47T/O, serial number 2RD2581598, was plugged into the EUT microphone socket. 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:

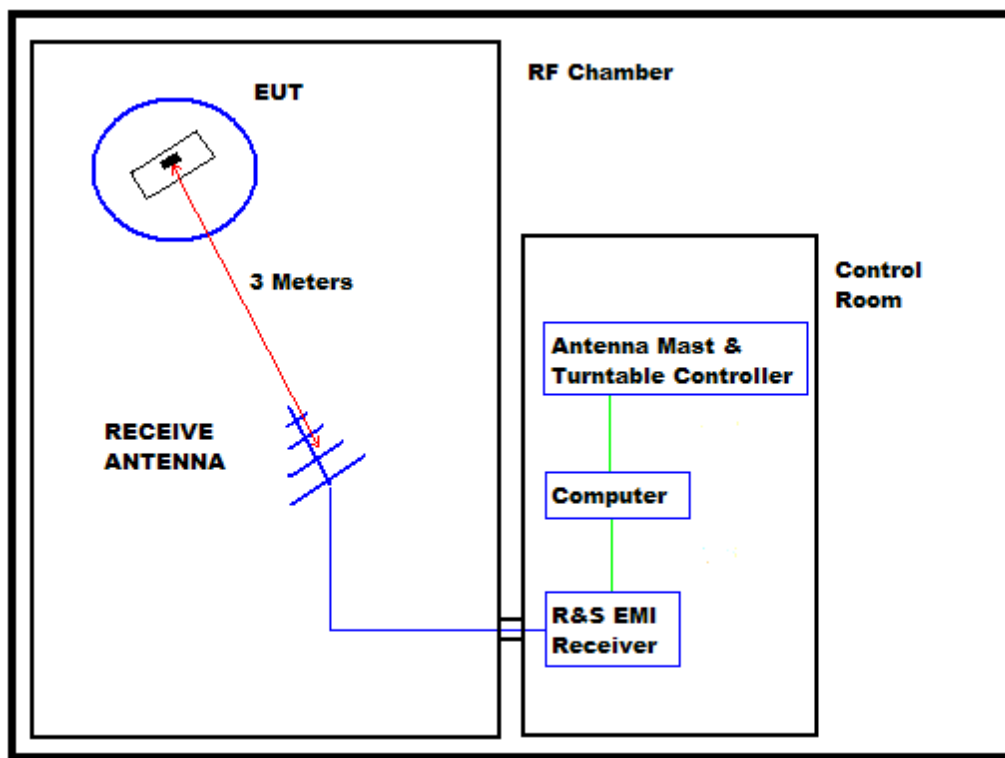
The EUT was powered up and the frequency of the transmitter was selected using the front panel controls. The EUT was checked for proper operation after it was setup on the test table. For radiated spurious emissions the testing was performed with the EUT set to the low, middle, and high frequencies with 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 24 thru page 29. The ERP measurements are shown on pages 30 thru page 32. 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%.

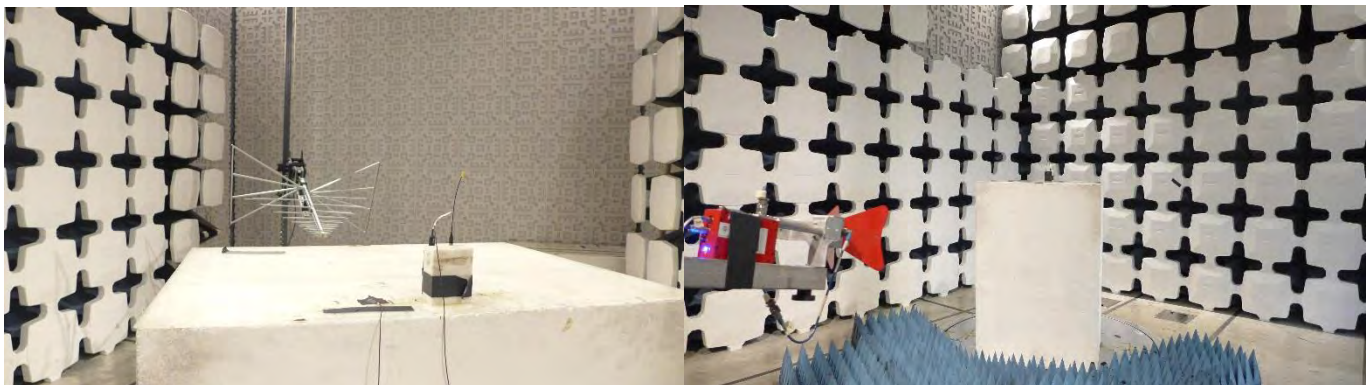


Figure B 1: ULXD1 Transmitter Test Setup

Figure B 2: ULXD1 Transmitter Test Setup



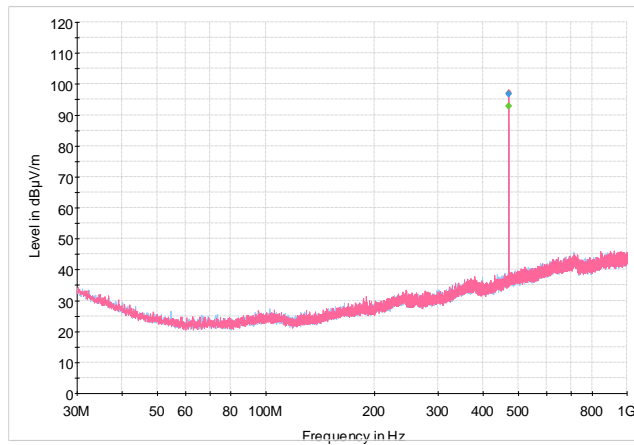
Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT:	ULXD1 G50
Serial Number:	WM # 1
Operating Frequency:	Low Frequency 470.125MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 19, 2019

Full Spectrum

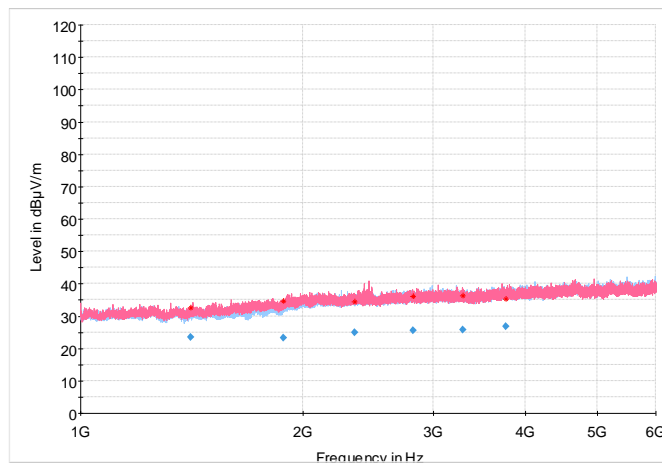


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 6GHz
EUT:	ULXD1 G50
Serial Number:	WM # 1
Operating Frequency:	Low frequency 470.125MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 15, 2019

Full Spectrum

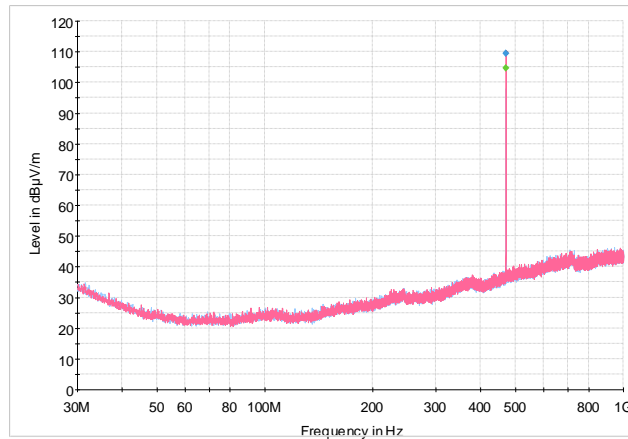


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT:	ULXD1 G50
Serial Number:	WM # 1
Operating Frequency:	Low Frequency 470.125MHz
RF Power Level	20mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 19, 2019

Full Spectrum

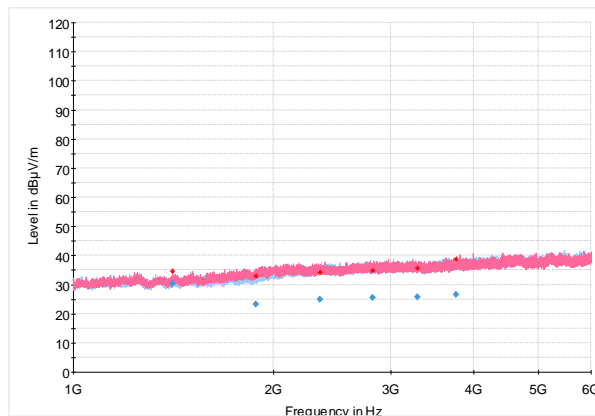


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 6GHz
EUT:	ULXD1 G50
Serial Number:	WM # 1
Operating Frequency:	Low Frequency 470.125MHz
RF Power Level	20mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 15, 2019

Full Spectrum



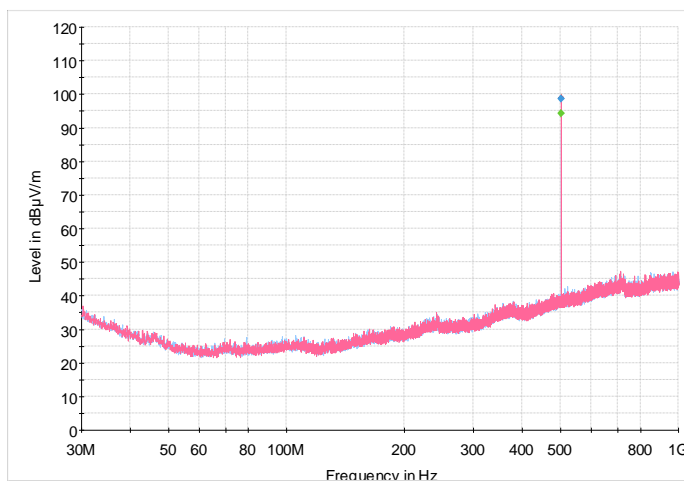


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT:	ULXD1 G50
Serial Number:	WM # 1
Operating Frequency:	Middle Frequency 502.050MHz
RF Power Level:	1mW
Tester Name:	Jamal Qureshi
Date Tested:	Tested on February 13, 2019

Full Spectrum

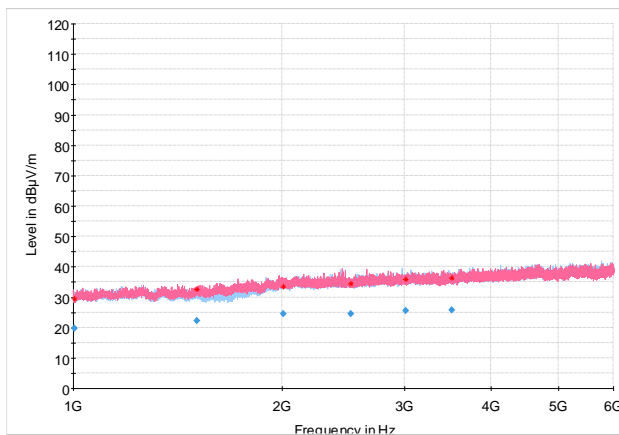


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 6GHz
EUT:	ULXD1 G50
Serial Number:	WM # 1
Operating Frequency:	Middle Frequency 502.050MHz
RF Power Level:	1mW
Tester Name:	Jamal Qureshi
Date Tested:	Tested on February 15, 2019

Full Spectrum





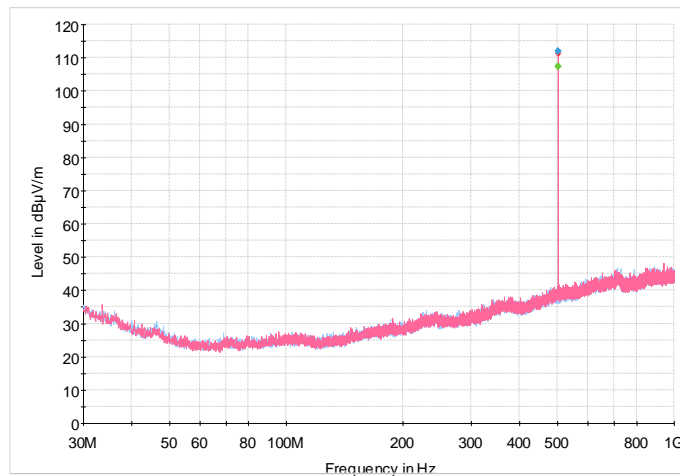
Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT	ULXD1 G50
Serial Number	WM # 1
Operating Frequency:	Middle Frequency 502.050MHz
RF Power Level	20mW
Tester Name	Jamal Qureshi
Date Tested	Tested on February 13, 2019

Full Spectrum

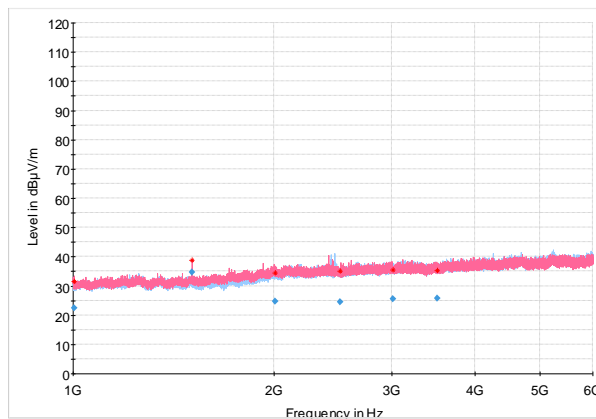


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 6GHz
EUT:	ULXD1 G50
Serial Number:	WM # 1
Operating Frequency:	Middle Frequency 502.050MHz
RF Power Level	20mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 15, 2019

Full Spectrum





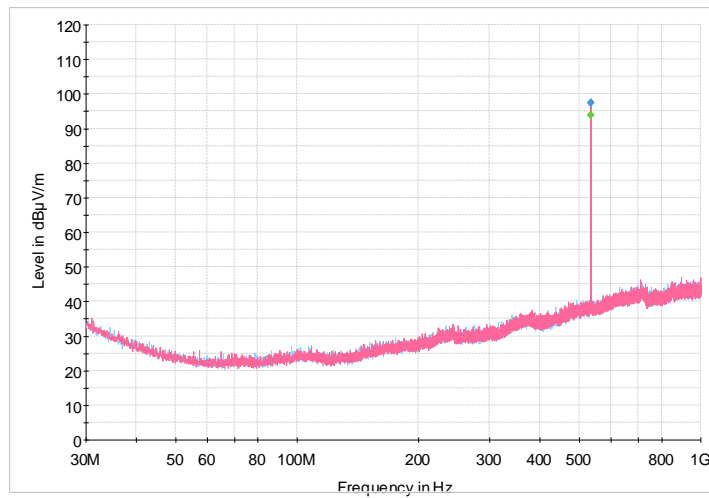
Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

Test Description: FCC 15C Radiated Emissions 30MHz - 1GHz
EUT: ULXD1 G50
Serial Number: WM # 1
Operating Frequency: High Frequency 534.000MHz
RF Power Level: 1mW
Tester Name: Jamal Qureshi
Date Tested: Tested on February 19, 2019

Full Spectrum

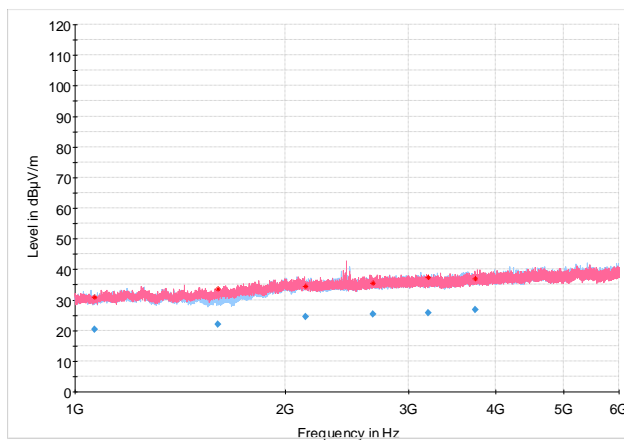


SHURE Radiated RF Emissions Test Report

Common Information

Test Description: FCC 15C Radiated Emissions 1GHz - 6GHz
EUT: ULXD1 G50
Serial Number: WM # 1
Operating Frequency: High Frequency 534.000MHz
RF Power Level: 1mW
Tester Name: Jamal Qureshi
Date Tested: Tested on February 15, 2019

Full Spectrum



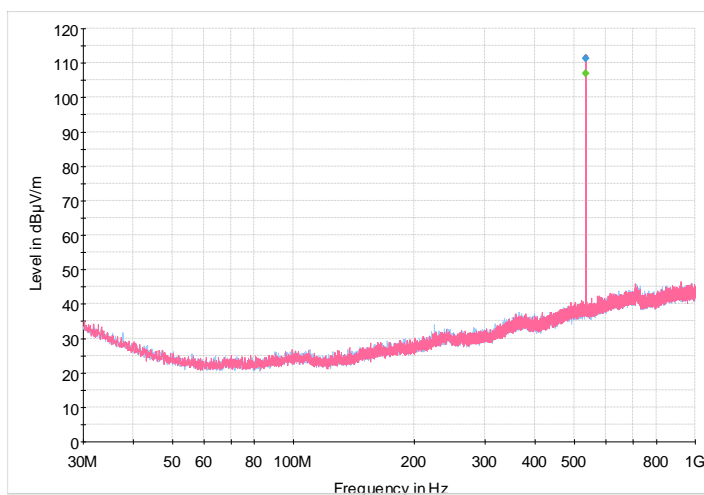


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT	ULXD1 G50
Serial Number	WM # 1
Operating Frequency:	High Frequency 534.000MHz
RF Power Level	20mW
Tester Name	Jamal Qureshi
Date Tested	Tested on February 19, 2019

Full Spectrum

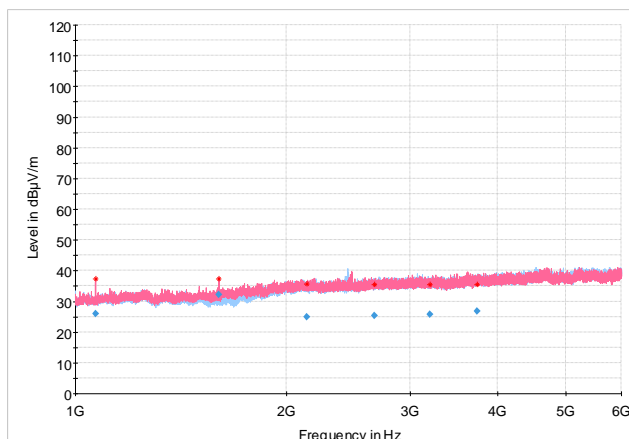


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 6GHz
EUT:	ULXD1 G50
Serial Number:	WM # 1
Operating Frequency:	High Frequency 534.000MHz
RF Power Level	20mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 15, 2019

Full Spectrum





Appendix B

Date: February 19, 2019
 EUT: ULXD1
 Band: G50
 Serial Number: WM # 1
 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	96.67	0.27	0.00	2.46		
1410.375	Average	V	23.42	-74.6	5.26	3.91	-73.25	-30
1880.500	Average	V	23.38	-95.1	5.26	4.38	-94.22	-30
2350.625	Average	V	24.96	-93.5	5.69	4.80	-92.61	-30
2820.750	Average	V	25.69	-89.6	6.88	5.11	-87.83	-30
3290.875	Average	V	26.04	-89.4	7.81	5.45	-87.04	-30
3761.000	Average	V	26.90	-91.0	8.45	6.22	-88.77	-30

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

Date: February 19, 2019
 EUT: ULXD1
 Band: G50
 Serial Number: WM # 1
 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	109.36	12.98	0.00	2.46		
1410.375	Average	V	30.35	-64.69	5.26	3.91	-63.34	-30
1880.500	Average	V	23.38	-95.1	5.26	4.38	-94.22	-30
2350.625	Average	V	24.98	-89.7	5.69	4.80	-88.81	-30
2820.750	Average	V	25.69	-89.6	6.88	5.11	-87.83	-30
3290.875	Average	V	26.04	-89.4	7.81	5.45	-87.04	-30
3761.000	Average	V	26.90	-91.0	8.45	6.22	-88.77	-30

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



Appendix B

Date: February 19, 2019
 EUT: ULXD1
 Band: G50
 Serial Number: WM # 1
 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	98.66	3.10	0.00	2.46		
1004.100	Average	V	19.81	-95.0	3.44	3.91	-95.47	-30
1506.150	Average	V	22.17	-85.3	4.01	4.38	-85.67	-30
2008.200	Average	V	24.97	-82.2	4.44	4.80	-82.56	-30
2510.250	Average	V	24.97	-82.5	4.95	5.11	-82.66	-30
3012.300	Average	V	25.84	-87.1	5.28	5.45	-87.27	-30
3514.350	Average	V	26.06	-91.8	5.60	6.22	-92.42	-30

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

Date: February 19, 2019
 EUT: ULXD1
 Band: G50
 Serial Number: WM # 1
 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	111.82	16.26	0.00	2.46		
1004.100	Average	V	22.46	-72.4	3.44	3.44	-72.87	-30
1506.150	Average	V	34.74	-60.2	4.01	4.01	-60.57	-30
2008.200	Average	V	24.97	-82.2	4.44	4.44	-82.56	-30
2510.250	Average	V	24.87	-82.5	4.95	4.95	-82.66	-30
3012.300	Average	V	25.84	-87.1	5.28	5.28	-87.27	-30
3514.350	Average	V	26.06	-91.8	5.60	5.60	-92.42	-30

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



Appendix B

Date: February 19, 2019
 EUT: ULXD1
 Band: G50
 Serial Number: WM # 1
 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	97.31	1.78	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	24.60	-95.0	5.41	4.80	-94.39	-30
2670.000	Average	V	25.39	-95.0	6.48	5.11	-93.63	-30
3204.000	Average	V	25.85	-90.0	7.47	5.45	-87.98	-30
3738.000	Average	V	26.84	-91.6	8.42	6.22	-89.40	-30

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

Date: February 19, 2019
 EUT: ULXD1
 Band: G50
 Serial Number: WM # 1
 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	111.18	15.64	0.00	2.46		
1068.000	Average	V	25.89	-68.5	3.37	3.91	-69.04	-30
1602.000	Average	V	32.18	-62.27	6.16	4.38	-60.49	-30
2136.000	Average	V	24.85	-79.45	5.41	4.80	-78.84	-30
2670.000	Average	V	25.39	-95.0	6.48	5.11	-93.63	-30
3204.000	Average	V	25.82	-92.0	7.47	5.45	-89.98	-30
3738.000	Average	V	26.84	-91.6	8.42	6.22	-89.40	-30



Appendix C

Maximum Radiated Power**Purpose:**

This test performed to determine if the EUT meets the Maximum Radiated Power requirements of the FCC Part15C, Section 15.236, the FCC OET Basic Certification Requirements for Wireless Microphones, and RSS-210 Annex G.

Requirements:

As stated in FCC 15C Section 15.236 (6)(2). the FCC OET Basic Certification Requirements for Wireless Microphones, and RSS-210 Annex G.

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}
Radiated measurements (30 MHz – 1000 MHz)	4.24 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 B 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 Maximum Rated Power test was performed during the Spurious Emission testing, Appendix B. The carrier frequency power level was documented in Appendix B.

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

Results:

The EIRP for all frequencies measured meets the FCC15C 15.236 requirements, the FCC OET Basic Certification Requirements for Wireless Microphones requirements, and RSS-210 Annex G.

The results are shown on page 35 thru page 40.



Appendix C

Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: Maximum Rated Output
 Operating Conditions: Low Frequency, 470.125MHz, 1mW
 Operator Name: Jamal Qureshi
 Comment: FCC Part15C, Section 15.236
 Date Tested: Tested on February 19, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In mW
96.67	0.27	2.15	2.46	-0.04	0.99	50.00	49.01

$EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)$

Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: Maximum Rated Output
 Operating Conditions: Low Frequency, 470.125MHz, 20mW
 Operator Name: Jamal Qureshi
 Comment: FCC Part15C, Section 15.236
 Date Tested: Tested on February 19, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In mW
109.36	+12.98	2.15	2.46	12.67	18.49	50.00	31.50

$EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)$



Appendix C

Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: Maximum Rated Output
 Operating Conditions: Middle Frequency, 502.050MHz, 1mW
 Operator Name: Jamal Qureshi
 Comment: FCC Part15C, Section 15.236
 Date Tested: Tested on February 19, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In mW
98.66	3.10	2.15	2.46	2.79	1.90	50.00	48.10

$EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)$

Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: Maximum Rated Output
 Operating Conditions: Middle Frequency, 502.050MHz, 20mW
 Operator Name: Jamal Qureshi
 Comment: FCC Part15C, Section 15.236
 Date Tested: Tested on February 19, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In mW
111.82	+16.26	2.15	2.46	15.95	39.36	50.00	10.64

$EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)$



Appendix C

Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: Maximum Rated Output
 Operating Conditions: High Frequency, 534.000MHz, 1mW
 Operator Name: Jamal Qureshi
 Comment: FCC Part15C, Section 15.236
 Date Tested: Tested on February 19, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In dB
97.31	1.78	2.15	2.46	1.47	1.40	50.00	48.60

$EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)$

Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: Maximum Rated Output
 Operating Conditions: High Frequency, 534.000MHz, 20mW
 Operator Name: Jamal Qureshi
 Comment: FCC Part15C, Section 15.236
 Date Tested: Tested on February 19, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In dB
111.18	+15.64	2.15	2.46	15.33	34.12	50.00	15.88

$EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)$



Appendix C

Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: Maximum Rated Output
 Operating Conditions: Low Frequency, 470,125MHz, 1mW
 Operator Name: Jamal Qureshi
 Comment: RSS-210
 Date Tested: Tested on February 19, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In mW
96.67	0.27	2.15	2.46	-0.04	0.99	250.00	249.01

$EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)$

Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: Maximum Rated Output
 Operating Conditions: Low Frequency, 470.125MHz, 20mW
 Operator Name: Jamal Qureshi
 Comment: RSS-210
 Date Tested: Tested on February 19, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In mW
109.36	+12.98	2.15	2.46	12.67	18.49	250.00	231.50

$EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)$



Appendix C

Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: Maximum Rated Output
 Operating Conditions: Middle Frequency, 502.050MHz, 1mW
 Operator Name: Jamal Qureshi
 Comment: RSS-210
 Date Tested: Tested on February 19, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In mW
98.66	3.10	2.15	2.46	2.79	1.90	250.00	248.10

$EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)$

Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: Maximum Rated Output
 Operating Conditions: Middle Frequency, 502.050MHz, 20mW
 Operator Name: Jamal Qureshi
 Comment: RSS-210
 Date Tested: Tested on February 19, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In mW
111.82	+16.26	2.15	2.46	15.95	39.36	250.00	210.64

$EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)$



Appendix C

Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: Maximum Rated Output
 Operating Conditions: High Frequency, 534.000MHz, 1mW
 Operator Name: Jamal Qureshi
 Comment: RSS-210
 Date Tested: Tested on February 19, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In dB
97.31	1.78	2.15	2.46	1.47	1.40	250.00	248.60

$EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)$

Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: Maximum Rated Output
 Operating Conditions: High Frequency, 534.000MHz, 20mW
 Operator Name: Jamal Qureshi
 Comment: RSS-210
 Date Tested: Tested on February 19, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In dB
111.18	+15.64	2.15	2.46	15.33	34.12	250.00	215.88

$EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)$



FREQUENCY TOLERANCE

PURPOSE:

This test was performed to determine if the EUT meets the frequency stability requirements of the FCC Part 15C, Section 15.236(f)(3) and the RSS-210 Annex G Table G1, specifications over the EUT operating frequency range of 470MHz to 534MHz.

REQUIREMENTS:

As stated in paragraph 15.236(f)(3) and, for low power auxiliary stations operating in the bands allocated for TV broadcasting, the frequency tolerance of the transmitter shall be 0.005 percent. RSS-210 Annex G Table G1 require ± 50 ppm.

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 D-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 23C, 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 43. 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 specifications.

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



Figures D-1 - Test Setup for Frequency Stability



Appendix D

Test Information

EUT Name: ULXD1 G50
 Serial Number: WM #1
 Test Description: FCC Part 15C Section 15.236(f)(3) 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 14, 2019

Temp °C	Nominal Frequency (MHz)	Measured Frequency (MHz)	Deviation (%)	Frequency Stability (%)	Deviation (Hz)	PPM	Pass Or Fail
-30	470.125	470.125482	0.00010253	0.005	482	1.02525924	PASS
-20	470.125	470.125493	0.00010253	0.005	493	1.04865727	PASS
-10	470.125	470.125320	0.00006807	0.005	320	0.68067004	PASS
0	470.125	470.125218	0.00004637	0.005	218	0.46370646	PASS
10	470.125	470.125155	0.00003297	0.005	155	0.32969955	PASS
20	470.125	470.125102	0.00002170	0.005	102	0.21696357	PASS
23	470.125	470.125155	0.00003297	0.005	155	0.32969955	PASS
30	470.125	470.125159	0.00003382	0.005	159	0.33820792	PASS
40	470.125	470.125144	0.00003063	0.005	144	0.30630152	PASS
50	470.125	470.125095	0.00002021	0.005	95	0.20207392	PASS
-30	502.050	502.050550	0.00010955	0.005	550	1.09550842	PASS
-20	502.050	502.050499	0.00009939	0.005	499	0.99392491	PASS
-10	502.050	502.050334	0.00006653	0.005	334	0.66527238	PASS
0	502.050	502.050248	0.00004940	0.005	248	0.49397471	PASS
10	502.050	502.050154	0.00003067	0.005	154	0.30674236	PASS
20	502.050	502.050109	0.00002171	0.005	109	0.21271099	PASS
23	502.050	502.050165	0.00003287	0.005	165	0.32865253	PASS
30	502.050	502.050170	0.00003386	0.005	170	0.33861169	PASS
40	502.050	502.050148	0.00002948	0.005	148	0.29479136	PASS
50	502.050	502.050105	0.00002091	0.005	105	0.209142516	PASS
-30	534.000	534.000637	0.00011929	0.005	637	1.192883895	PASS
-20	534.000	534.000467	0.00008745	0.005	467	0.874531835	PASS
-10	534.000	534.000353	0.00006611	0.005	353	0.661048689	PASS
0	534.000	534.000264	0.00004944	0.005	264	0.494382022	PASS
10	534.000	534.000166	0.00003109	0.005	166	0.310861423	PASS
20	534.000	534.000117	0.00002191	0.005	117	0.219101124	PASS
23	534.000	534.000177	0.00003315	0.005	177	0.331460674	PASS
30	534.000	534.000183	0.00003427	0.005	183	0.342696629	PASS
40	534.000	534.000157	0.00002940	0.005	157	0.294007491	PASS
50	534.000	534.000122	0.00002285	0.005	122	0.228464419	PASS

Appendix E

Spurious Emissions at Antenna Terminals

Purpose:

This test performed to determine if the EUT meets the conducted spurious emissions at the antenna port requirements of the FCC Part 2.1051.

Requirements:

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

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.

The expanded measurement uncertainty (95% confidence) has been determined to be ± 1.28 dB.

Test Setup and Instrumentation:

Photograph of the test setup is shown in Figure E 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 conducted 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 E**Specific Test Procedures:**

The testing was performed as states in FCC Part 2.1051.

Results:

The plots of the antenna port spurious emissions are shown on page 46 thru page 51. All emissions measured from the EUT were within the ETSI EN 300 422-1 specification limits. All spurious emissions were at least

The temperature during the testing was 76 degrees F, with relative humidity of 17%.

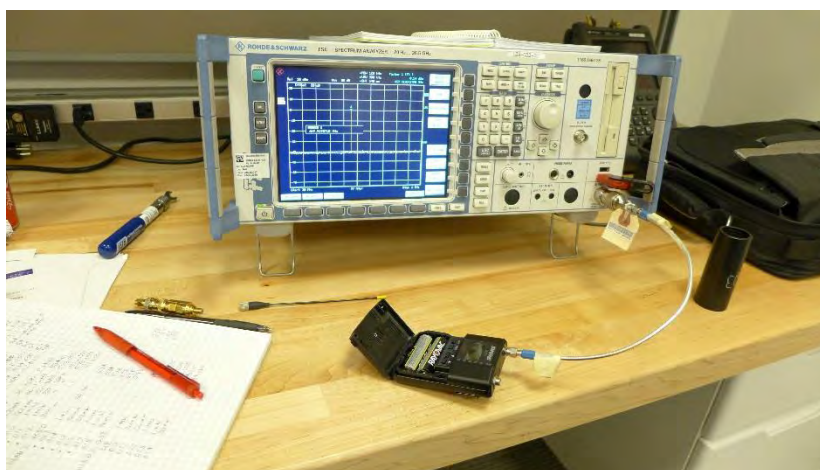
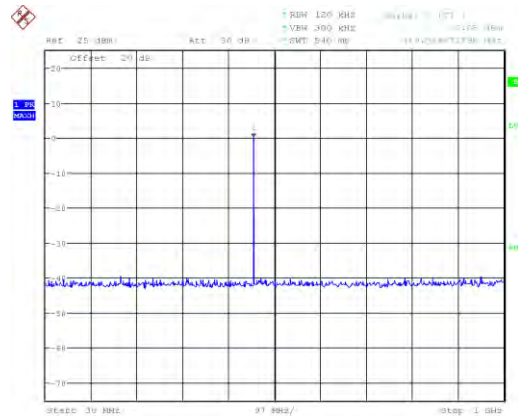


Figure E 1: ULXD1 Transmitter Test Setup

Appendix E

Test Information

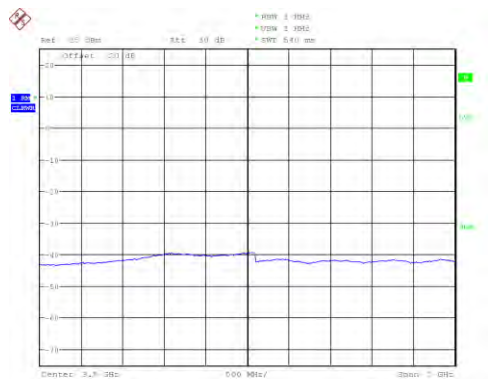
EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: 2.1051 Spurious Emissions at Antenna Port
 Operating Conditions: Low Frequency, 470.125MHz, 1mW
 Frequency Range: 30MHz to 1000MHz
 Operator Name: Craig Kozokar
 Date Tested: Tested on February 27, 2019



mw 0.000
 Date: 27.FEB.2019 12:46:09

Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: 2.1051 Spurious Emissions at Antenna Port
 Operating Conditions: Low Frequency, 470.125MHz, 1mW
 Frequency Range: 1GHz to 6GHz
 Operator Name: Craig Kozokar
 Date Tested: Tested on February 27, 2019



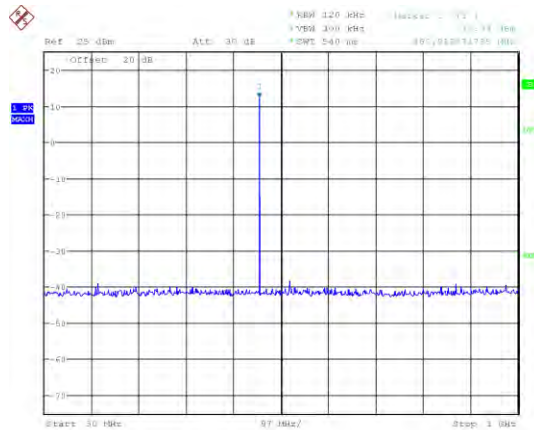
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 Date: 27.FEB.2019 11:40:20



Appendix E

Test Information

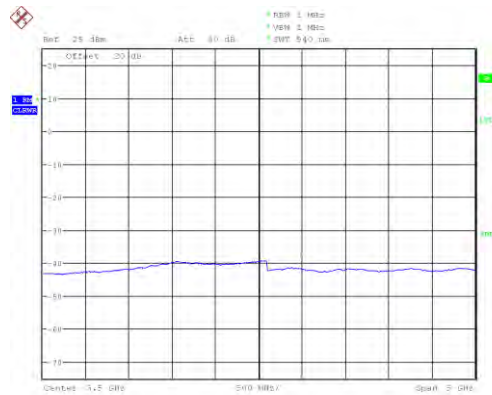
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Serial Number: WM # 1
Test Description: 2.1051 Spurious Emissions at Antenna Port
Operating Conditions: Low Frequency, 470.125MHz, 20mW
Frequency Range: 30MHz to 1000MHz
Operator Name: Craig Kozokar
Date Tested: Tested on February 27, 2019



SW: 0 MOD
Date: 27.FEB.2019 12:49:28

Test Information

EUT Name: ULXD1 G50
Serial Number: WM # 1
Test Description: 2.1051 Spurious Emissions at Antenna Port
Operating Conditions: Low Frequency, 470.125MHz, 20mW
Frequency Range: 1GHz to 6GHz
Operator Name: Craig Kozokar
Date Tested: Tested on February 27, 2019

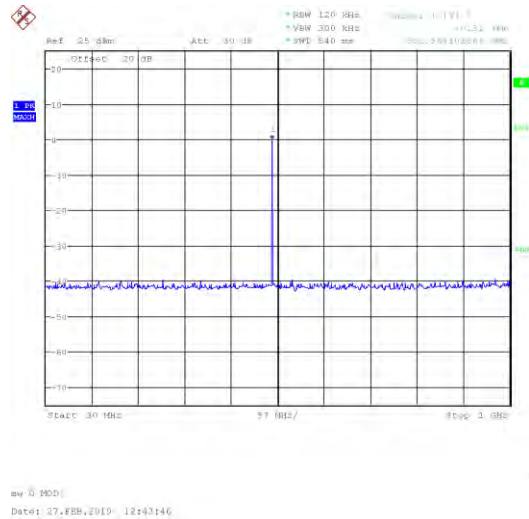


SW: 0 MOD
Date: 27.FEB.2019 12:41:05

Appendix E

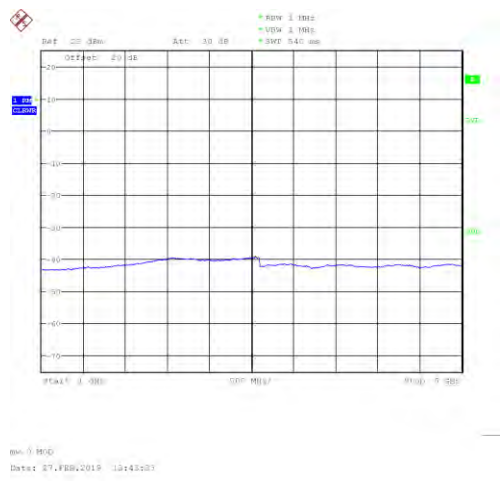
Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: 2.1051 Spurious Emissions at Antenna Port
 Operating Conditions: Low Frequency, 502.050MHz, 1mW
 Frequency Range: 30MHz to 1000MHz
 Operator Name: Craig Kozokar
 Date Tested: Tested on February 27, 2019



Test Information

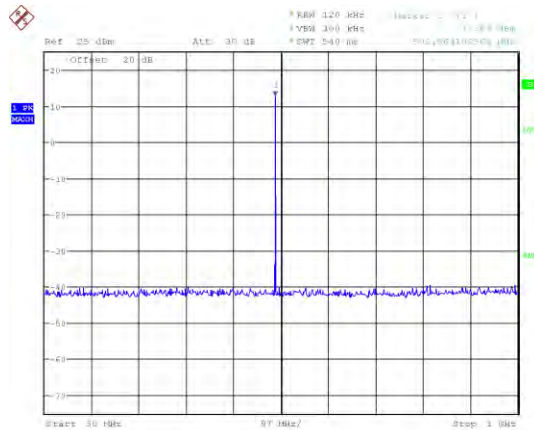
EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: 2.1051 Spurious Emissions at Antenna Port
 Operating Conditions: Low Frequency, 502.050MHz, 1mW
 Frequency Range: 1GHz to 6GHz
 Operator Name: Craig Kozokar
 Date Tested: Tested on February 27, 2019



Appendix E

Test Information

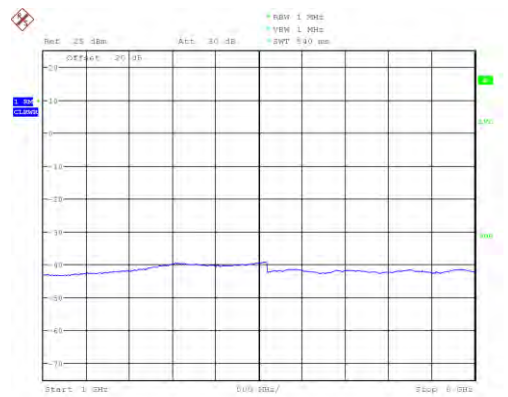
EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: 2.1051 Spurious Emissions at Antenna Port
 Operating Conditions: Low Frequency, 502.050MHz, 20mW
 Frequency Range: 30MHz to 1000MHz
 Operator Name: Craig Kozokar
 Date Tested: Tested on February 27, 2019



SW: 0 MOD
 Date: 27.FEB.2019 12:44:24

Test Information

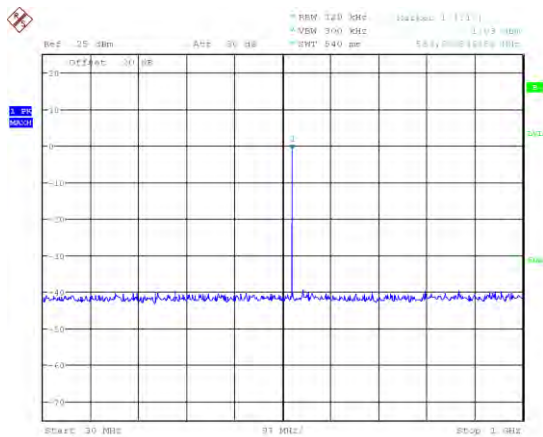
EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: 2.1051 Spurious Emissions at Antenna Port
 Operating Conditions: Low Frequency, 502.050MHz, 20mW
 Frequency Range: 1GHz to 6GHz
 Operator Name: Craig Kozokar
 Date Tested: Tested on February 27, 2019



SW: 0 MOD
 Date: 27.FEB.2019 13:43:00

Test Information

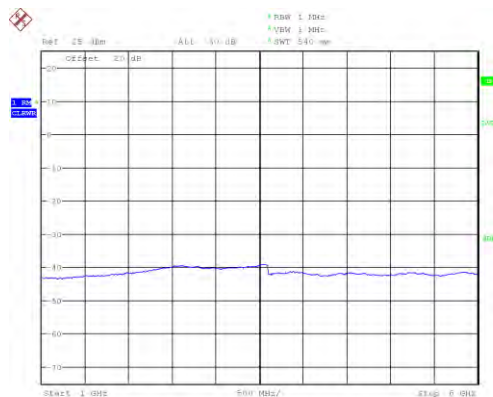
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 Serial Number: WM # 1
 Test Description: 2.1051 Spurious Emissions at Antenna Port
 Operating Conditions: Low Frequency, 534.000MHz, 1mW
 Frequency Range: 30MHz to 1000MHz
 Operator Name: Craig Kozokar
 Date Tested: Tested on February 27, 2019



mw 0:00:00
 Date: 27/FEB/2019 12:42:46

Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: 2.1051 Spurious Emissions at Antenna Port
 Operating Conditions: Low Frequency, 534.000MHz, 1mW
 Frequency Range: 1GHz to 6GHz
 Operator Name: Craig Kozokar
 Date Tested: Tested on February 27, 2019



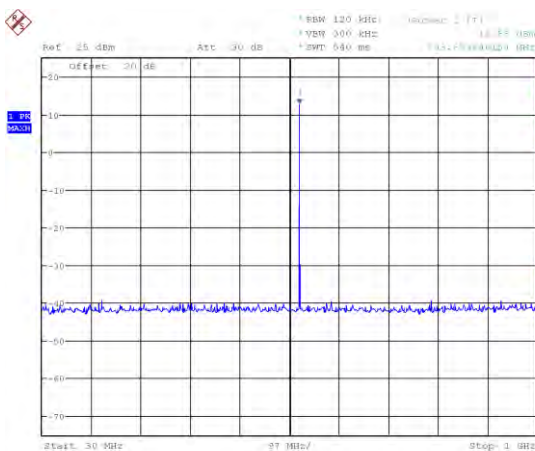
mw 0:00:00
 Date: 27/FEB/2019 12:44:14



Appendix E

Test Information

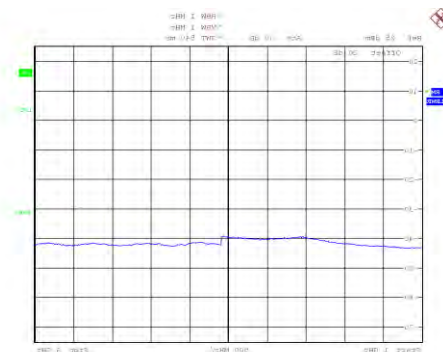
EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: 2.1051 Spurious Emissions at Antenna Port
 Operating Conditions: Low Frequency, 534.000MHz, 20mW
 Frequency Range: 30MHz to 1000MHz
 Operator Name: Craig Kozokar
 Date Tested: Tested on February 27, 2019



mm 0-0000
 Date: 27.FEB.2019 13:43:05

Test Information

EUT Name: ULXD1 G50
 Serial Number: WM # 1
 Test Description: 2.1051 Spurious Emissions at Antenna Port
 Operating Conditions: Low Frequency, 534.000MHz, 20mW
 Frequency Range: 1GHz to 6GHz
 Operator Name: Craig Kozokar
 Date Tested: Tested on February 27, 2019



mm 0-0000
 Date: 27.FEB.2019 13:43:05