



SHURE

ELECTROMAGNETIC COMPATIBILITY LABORATORY

TEST REPORT

TEST REPORT TITLE: Electromagnetic Compatibility Tests of the Shure ULXD2 Digital Wireless Transmitter in the J50A Band (572MHz to 608MHz and 614MHz to 616MHz)

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 J50A FCC15C

Date Tested: February 26 thru March 8, 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 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>3-15-2019</u>
APPROVED BY:	<u>[Signature]</u>	<u>Engineer Project Managing, G.C.</u>	<u>3-15-2019</u>
	Signature	Position	Date



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LIST OF APPENDICIES

APPENDIX	TEST DESCRIPTION
A	Necessary Bandwidth, Frequency Offset, Maximum Bandwidth
B	Spurious Emissions
C	Maximum Rated Power
D	Frequency Tolerance



REPORT REVISION HISTORY

Revision	Date	Description
0	March 15, 2019	Initial release

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, 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	J50A	572 to 608	1, 10, 20
ULXD2	J50A	614 to 616	1, 10

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, 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	2.3.30.0	572.000, 589.925, 607.875, 614.125, 615.875	A	Pass
15.236(f)(1)	Frequency Offset	2.3.30.0	607.875, 614.125, 615.875	A	Pass
15.236(f)(2)	Maximum Bandwidth	2.3.30.0	572.000, 589.925, 607.875, 614.125, 615.875	A	Pass
15.236(g)	Spurious Emissions	2.3.30.0	572.000, 589.925, 607.875, 614.125, 615.875	B	Pass
15.236(d)(1)	Maximum Rated Power	2.3.30.0	572.000, 589.925, 607.875, 614.125, 615.875	C	Pass
15.236(f)(3)	Frequency Tolerance	2.3.30.0	572.000, 589.925, 607.875, 614.125, 615.875	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 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)

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 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
J50A	J5x PPR GC SAMPLE finalClips

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 appendixes.

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, 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 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.



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 572.000MHz, 589.875MHz, 607.875, 614.125, and 615.875MHz.

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	$\pm 0.130 \%$

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.

Appendix A**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 572.000MHz, 589.925MHz, 607.875, at an output power level of 1mW and 20mW, except 614.125 and 615.875 which will have the power level of 1mW and 10mW. The transmitter was modulated per EN300422-1 V1.4.2 (2011-08), clause 7.1.2.

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 26. 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%.

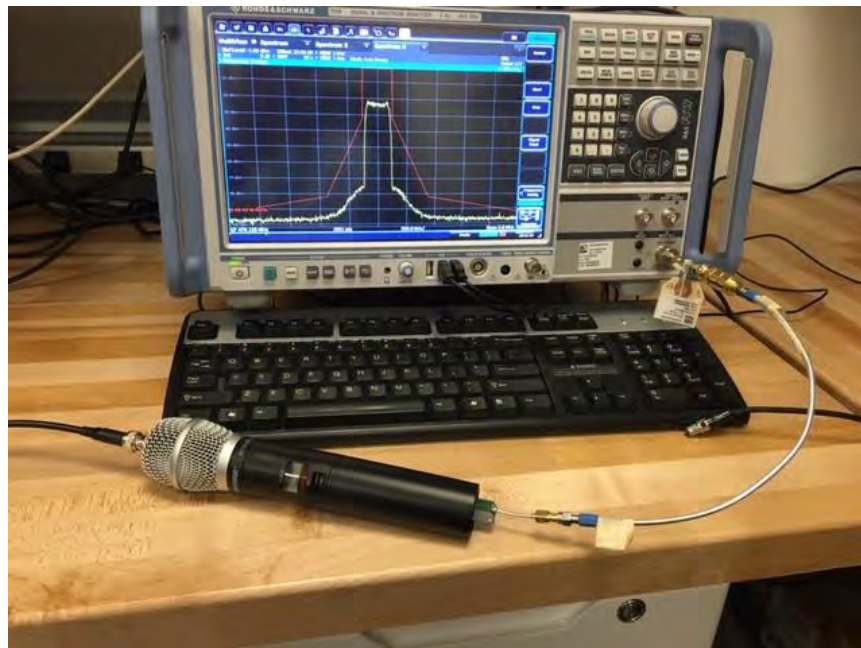
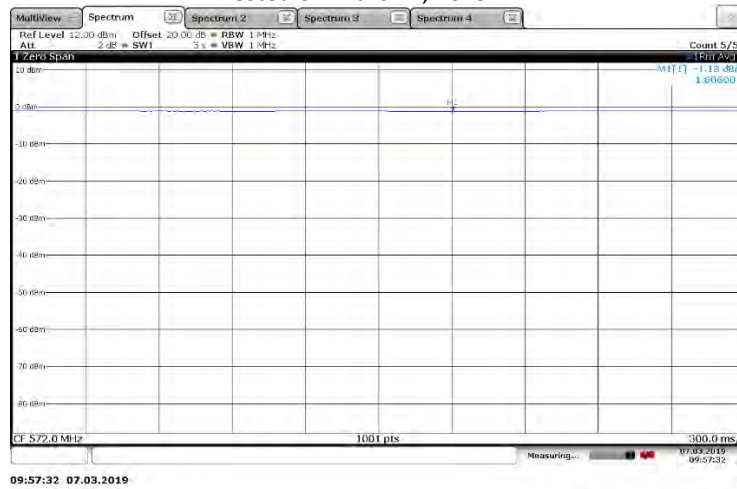


Figure A-1 - Test Setup for Necessary Bandwidth

Appendix A

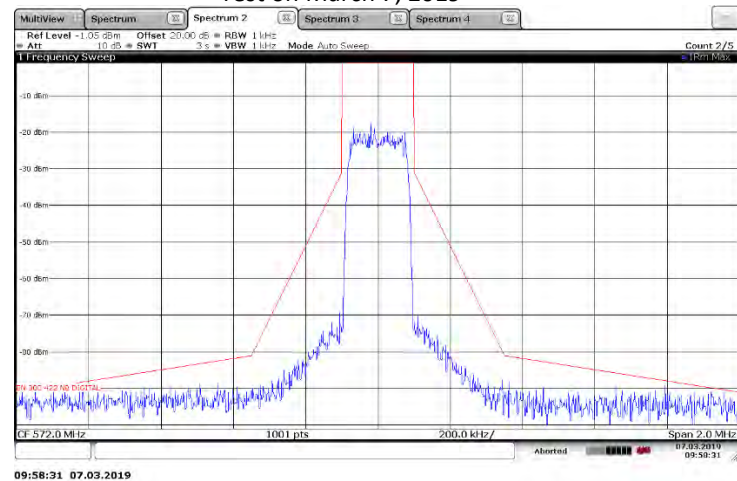
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 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: EN 300 422 Digital Necessary Bandwidth
 Operating Conditions: Low Band, Low Frequency, 572.000MHz, 1mW
 Operator Name: Craig Kozokar
 Comment: 8.3.2.1: Step 1; Carrier Power
 Date Tested: Tested on March 7, 2019



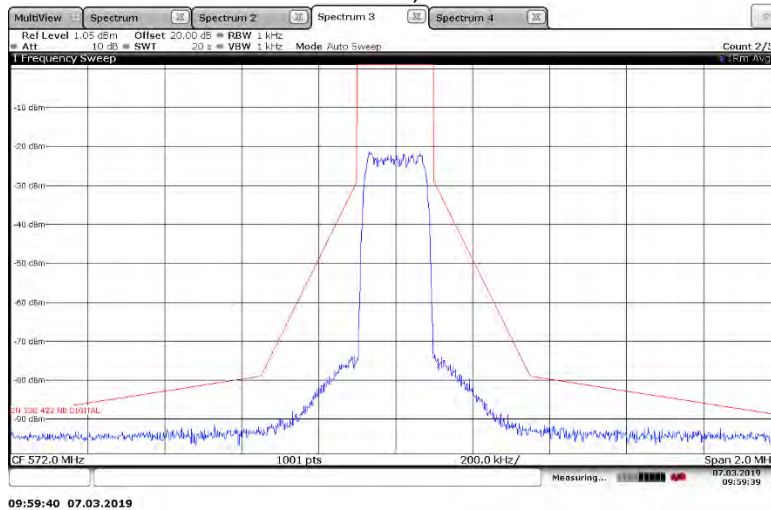
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 Operator Name: Craig Kozokar
 Comment: 8.3.2.1: Step 2;Maximum Relative Level
 Date Tested: Test on March 7, 2019



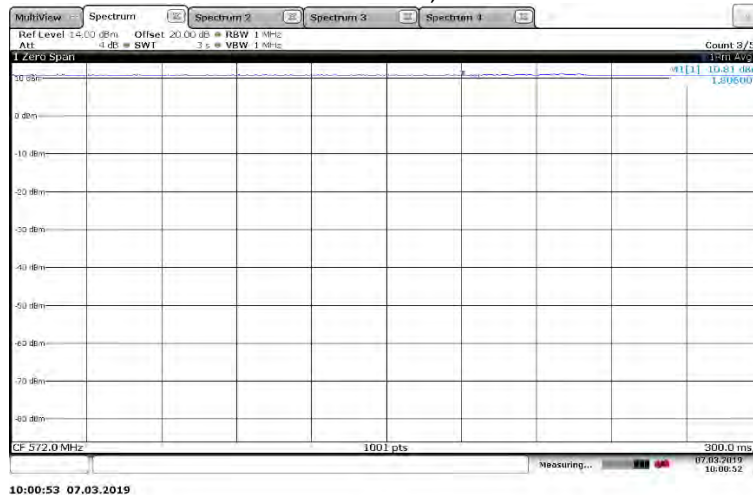
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 Serial Number: J5x PPR GC SAMPLE finalClips
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 Operating Conditions: Low Band, Low Frequency, 572.000MHz, 1mW
 Operator Name: Craig Kozokar
 Comment: 8.3.2.1: Step 3; Lower and upper frequency transmitter band
 Wide band noise floor
 Date Tested: Test on March 7, 2019



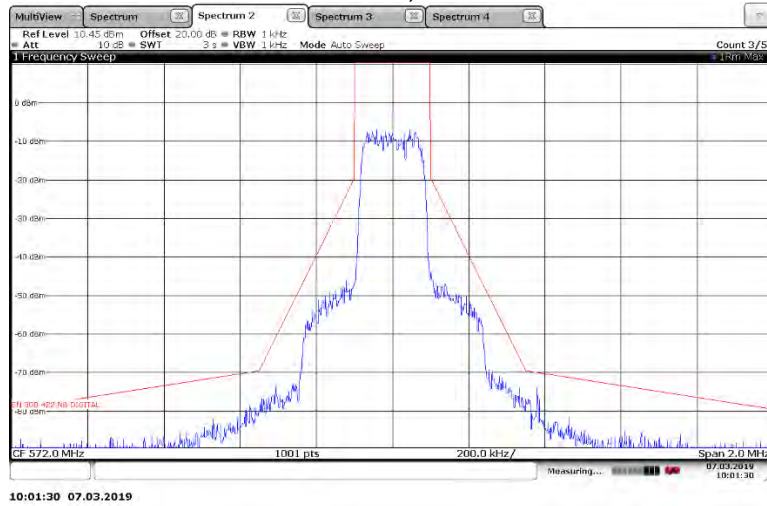
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 Test Description: EN 300 422 Digital Necessary Bandwidth
 Operating Conditions: Low Band, Low Frequency, 572.000MHz, 20mW
 Operator Name: Craig Kozokar
 Comment: 8.3.2.1: Step 1; Carrier Power
 Date Tested: Tested on March 7, 2019



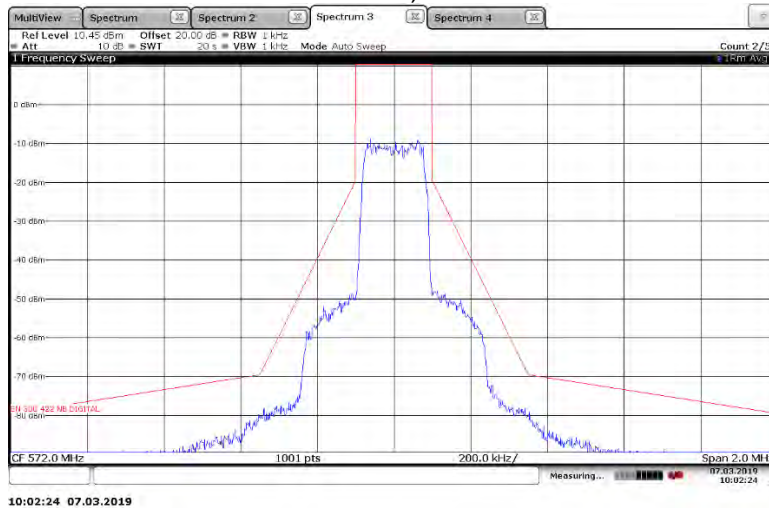
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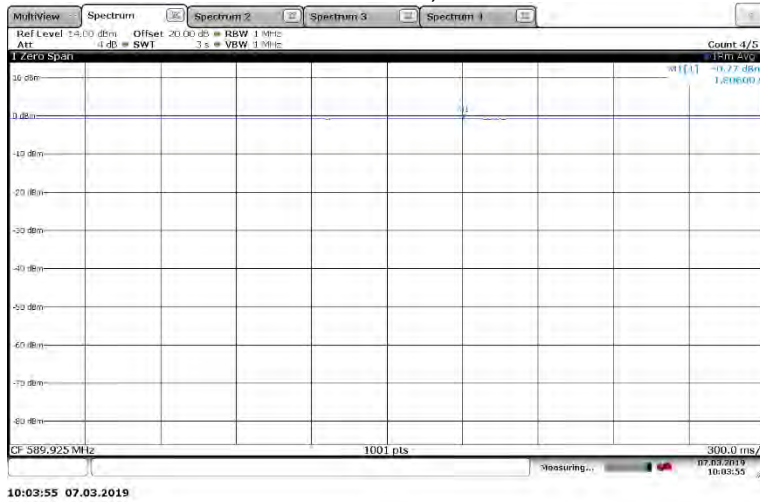
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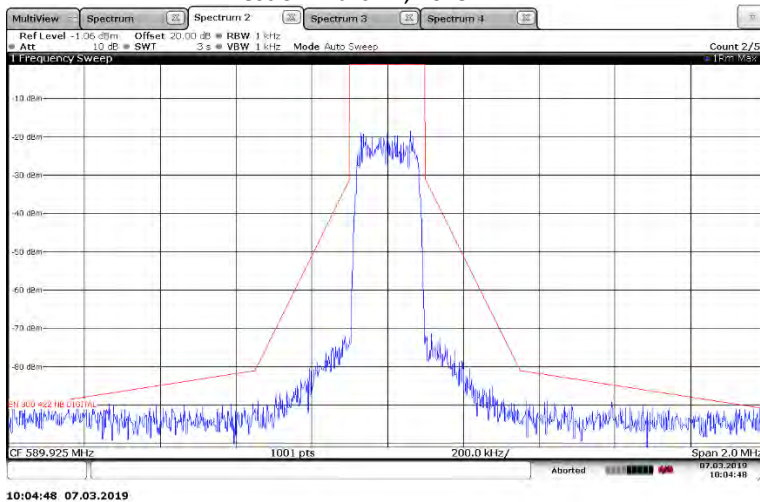
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 Operating Conditions: Low Band, Middle Frequency, 589.925MHz, 1mW
 Operator Name: Craig Kozokar
 Comment: 8.3.2.1: Step 1; Carrier Power
 Date Tested: Tested on March 7, 2019



Test Information

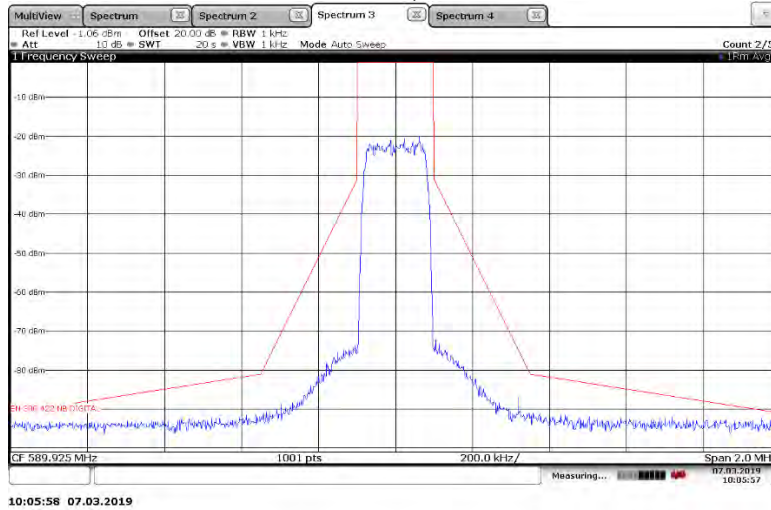
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 Operating Conditions: Low Band, Middle Frequency, 589.925MHz, 1mW
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Appendix A

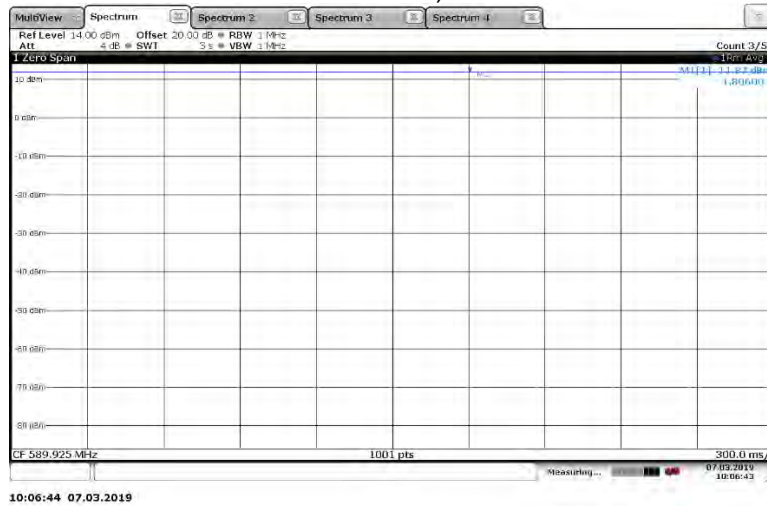
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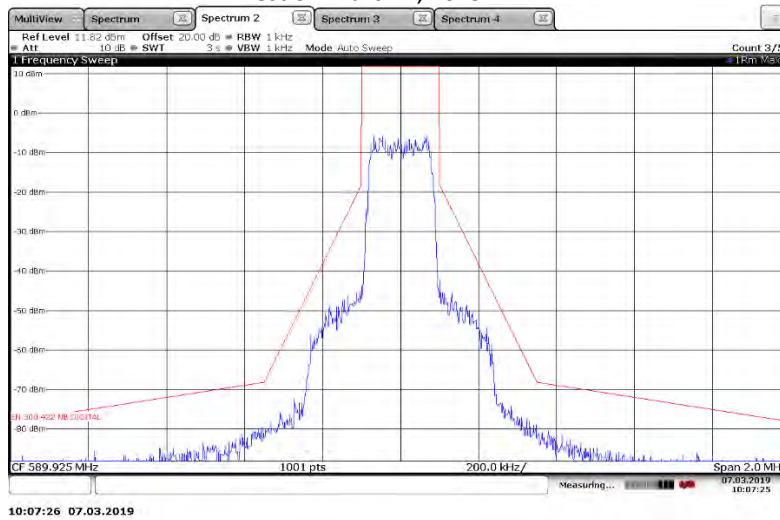
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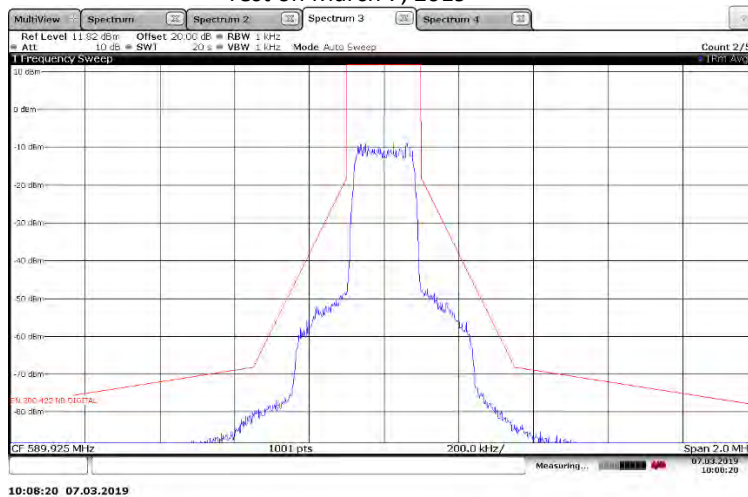
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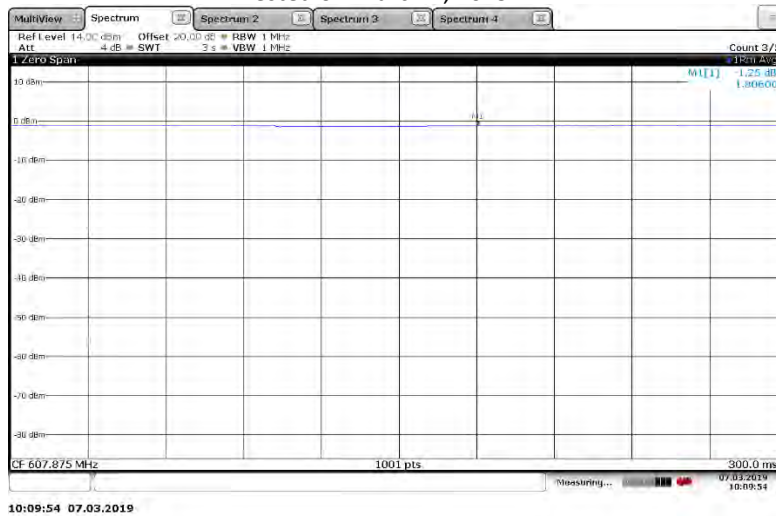
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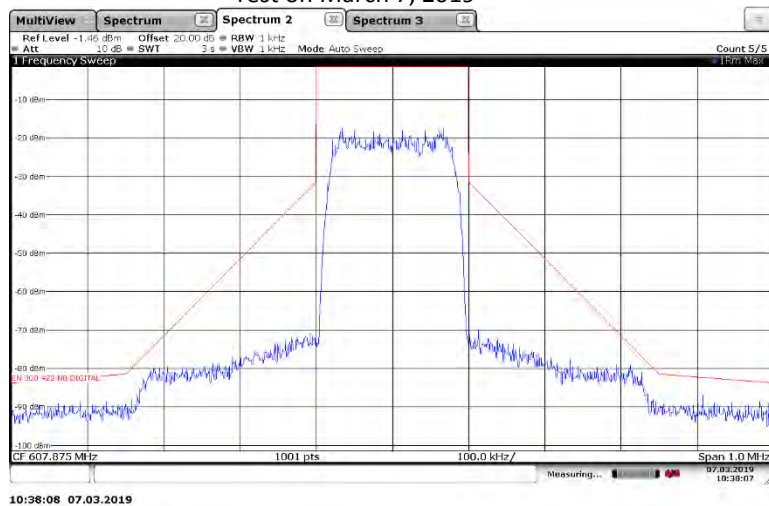
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 Serial Number: J5x PPR GC SAMPLE finalClips
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 Operator Name: Craig Kozokar
 Comment: 8.3.2.1: Step 1; Carrier Power
 Date Tested: Tested on March 7, 2019



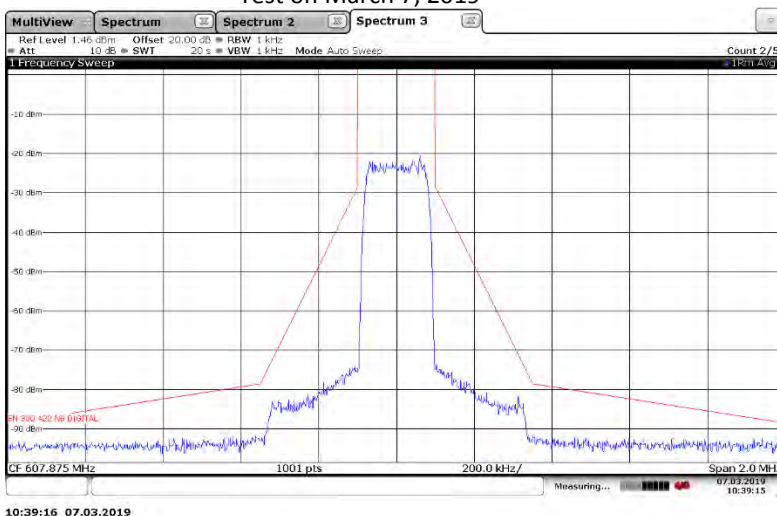
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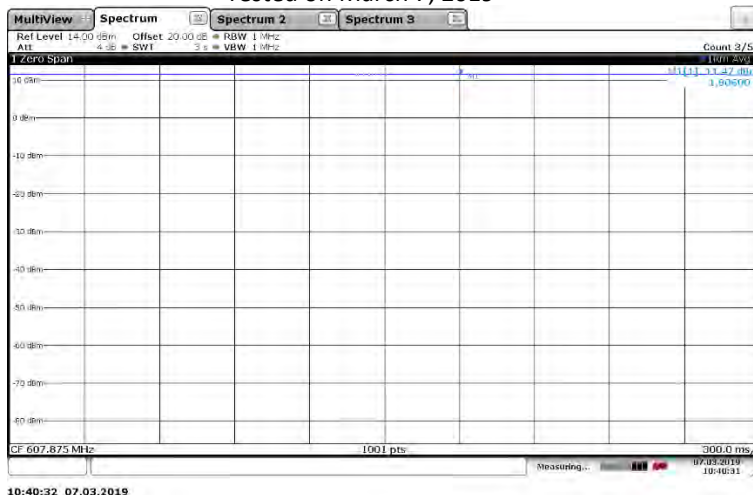
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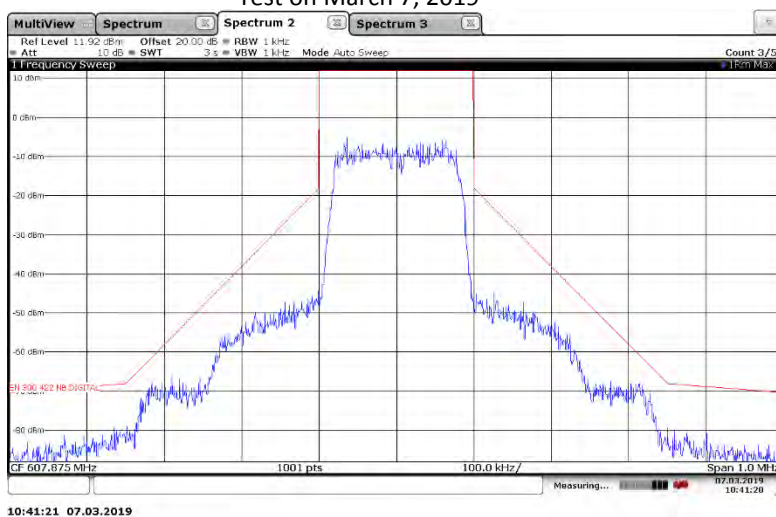
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 Test Description: EN 300 422 Digital Necessary Bandwidth
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 Date Tested: Tested on March 7, 2019



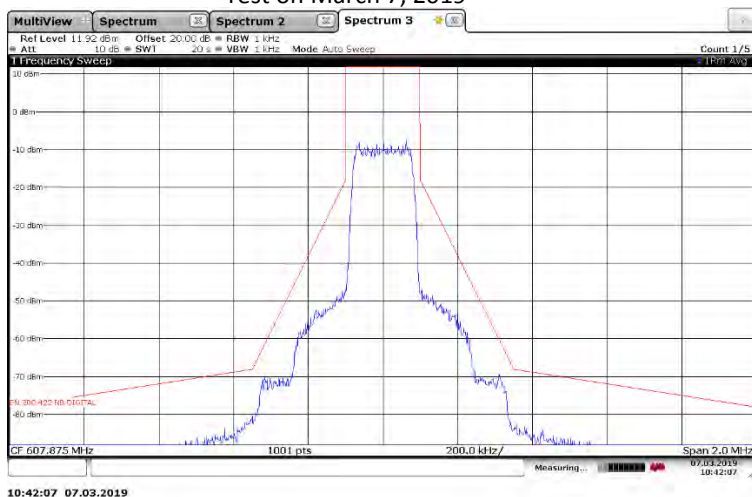
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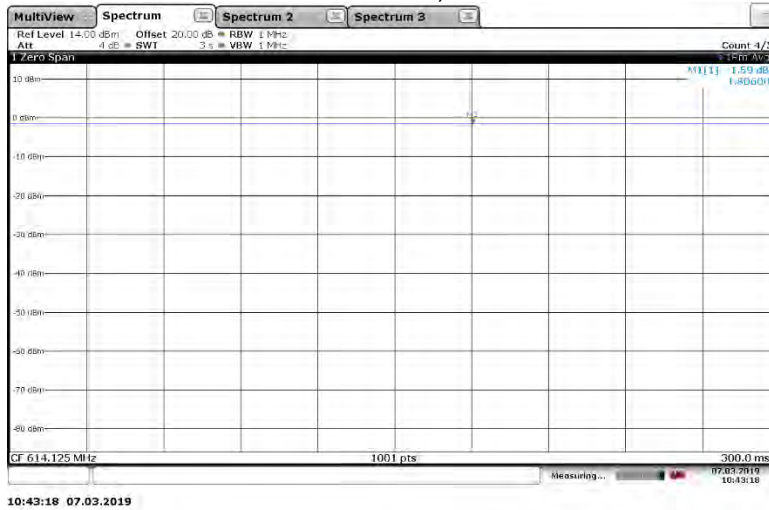
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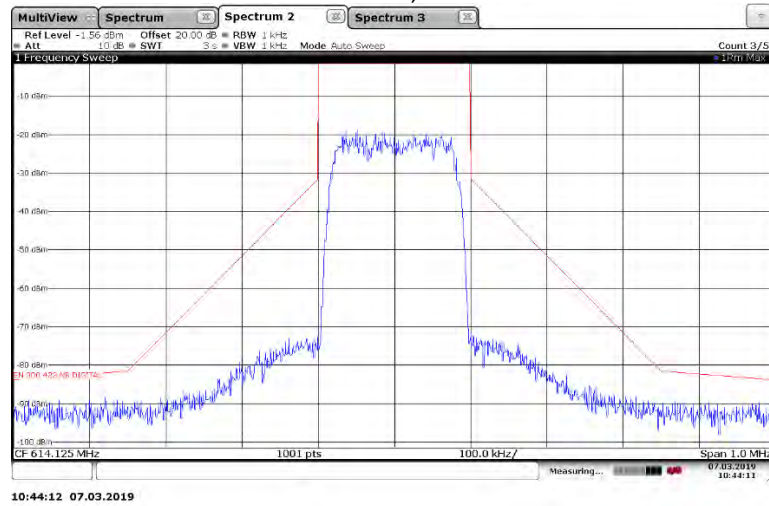
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 Test Description: EN 300 422 Digital Necessary Bandwidth
 Operating Conditions: High Band, Low Frequency, 614.125MHz, 1mW
 Operator Name: Craig Kozokar
 Comment: 8.3.2.1: Step 1; Carrier Power
 Date Tested: Tested on March 7, 2019



Test Information

EUT Name: ULXD2 J50A
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 Test Description: EN 300 422 Digital Necessary Bandwidth
 Operating Conditions: High Band, Low Frequency, 614.125MHz, 1mW
 Operator Name: Craig Kozokar
 Comment: 8.3.2.1: Step 2; Maximum Relative Level
 Date Tested: Test on March 7, 2019

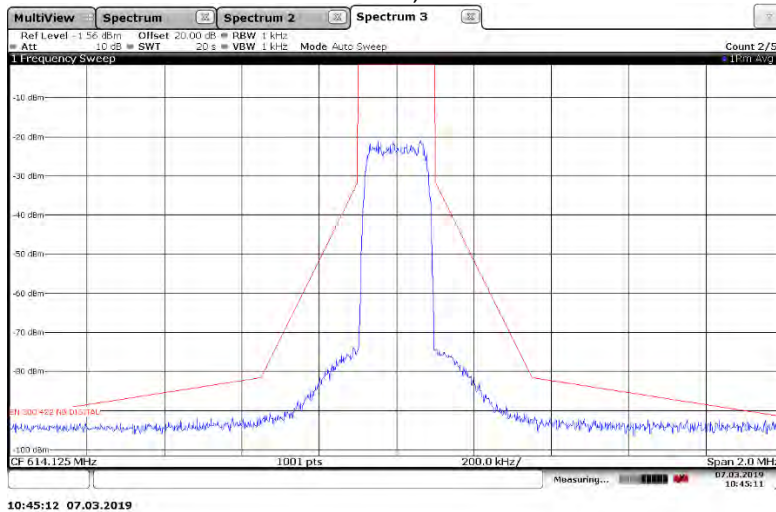




Appendix A

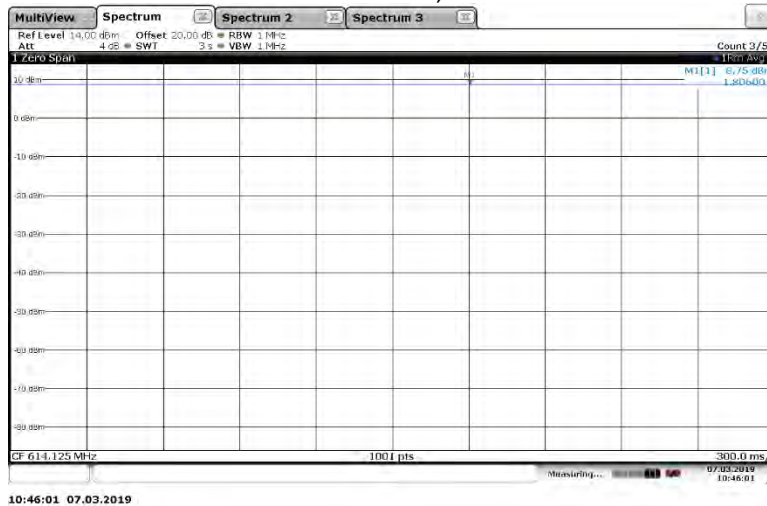
Test Information

EUT Name: ULXD2 J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: EN 300 422 Digital Necessary Bandwidth
 Operating Conditions: High Band, Low Frequency, 614.875MHz, 1mW
 Operator Name: Craig Kozokar
 Comment: 8.3.2.1: Step 3; Lower and upper frequency transmitter band
 Wide band noise floor
 Date Tested: Test on March 7, 2019



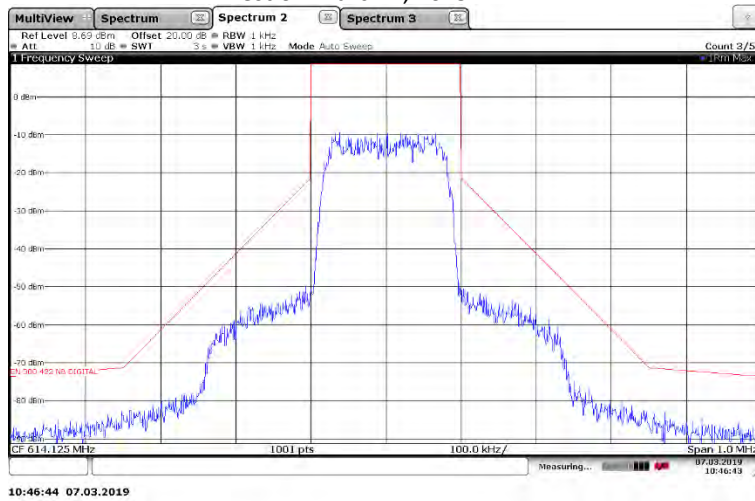
Test Information

EUT Name: ULXD2 J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: EN 300 422 Digital Necessary Bandwidth
 Operating Conditions: High Band, Low Frequency, 614.125MHz, 10mW
 Operator Name: Craig Kozokar
 Comment: 8.3.2.1: Step 1; Carrier Power
 Date Tested: Tested on March 7, 2019



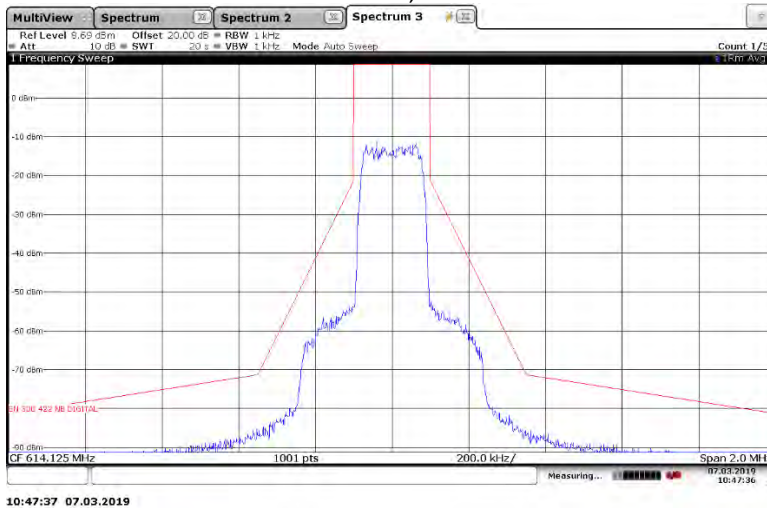
Test Information

EUT Name: ULXD2 J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: EN 300 422 Digital Necessary Bandwidth
 Operating Conditions: High Band, Low Frequency, 614.125MHz, 10mW
 Operator Name: Craig Kozokar
 Comment: 8.3.2.1: Step 2;Maximum Relative Level
 Date Tested: Test on March 7, 2019



Test Information

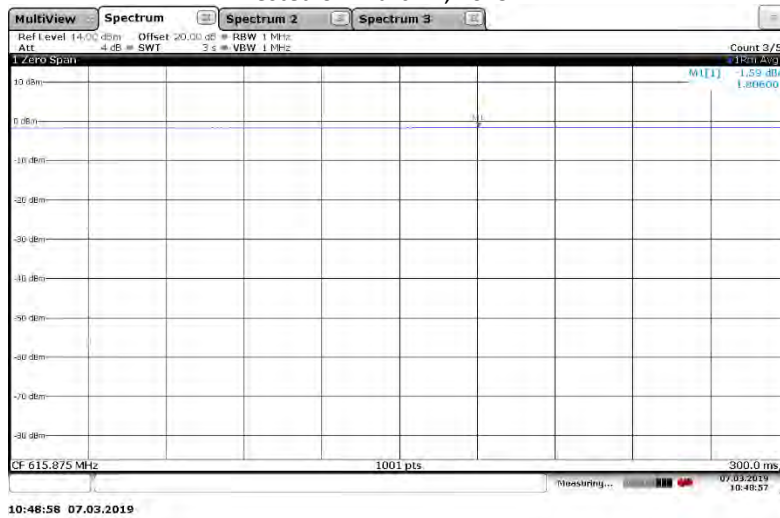
EUT Name: ULXD2 J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: EN 300 422 Digital Necessary Bandwidth
 Operating Conditions: High Band, Low Frequency, 614.125MHz, 10mW
 Operator Name: Craig Kozokar
 Comment: 8.3.2.1: Step 3;Lower and upper frequency transmitter band
 Wide band noise floor
 Date Tested: Test on March 7, 2019



Appendix A

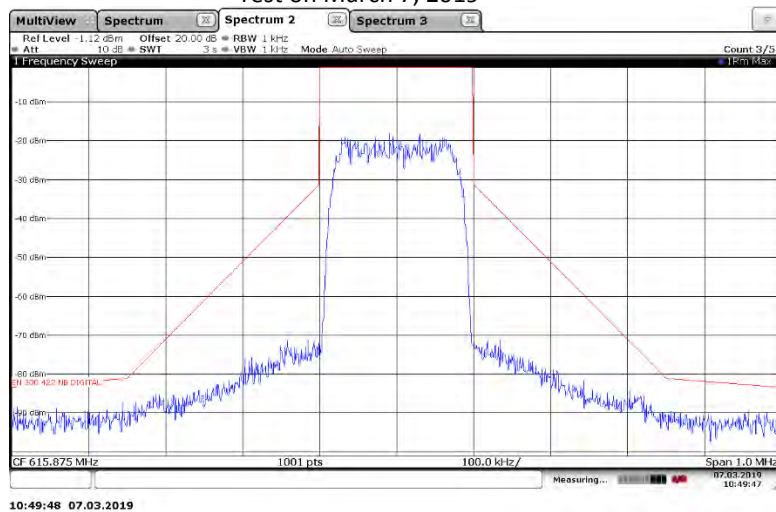
Test Information

EUT Name: ULXD2 J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: EN 300 422 Digital Necessary Bandwidth
 Operating Conditions: High Band, High Frequency, 615.875MHz, 1mW
 Operator Name: Craig Kozokar
 Comment: 8.3.2.1: Step 1; Carrier Power
 Date Tested: Tested on March 7, 2019



Test Information

EUT Name: ULXD2 J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: EN 300 422 Digital Necessary Bandwidth
 Operating Conditions: High Band, High Frequency, 615.875MHz, 1mW
 Operator Name: Craig Kozokar
 Comment: 8.3.2.1: Step 2; Maximum Relative Level
 Date Tested: Test on March 7, 2019

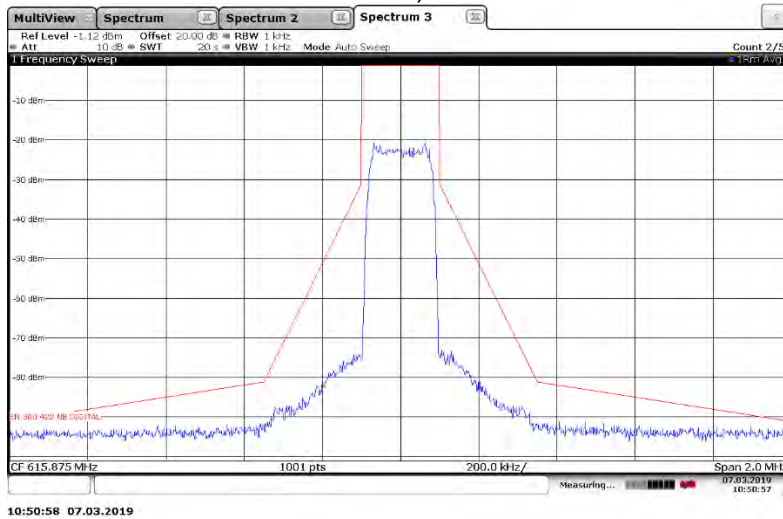




Appendix A

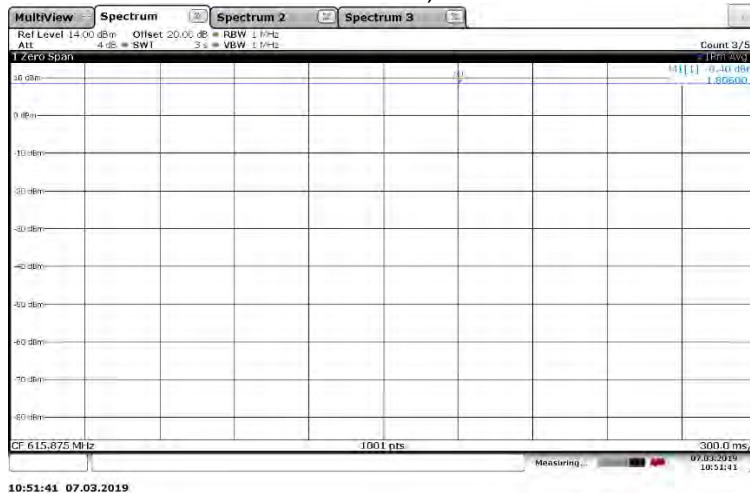
Test Information

EUT Name: ULXD2 J50A
Serial Number: J5x PPR GC SAMPLE finalClips
Test Description: EN 300 422 Digital Necessary Bandwidth
Operating Conditions: High Band, High Frequency, 615.875MHz, 1mW
Operator Name: Craig Kozokar
Comment: 8.3.2.1: Step 3; Lower and upper frequency transmitter band
Wide band noise floor
Date Tested: Test on March 7, 2019



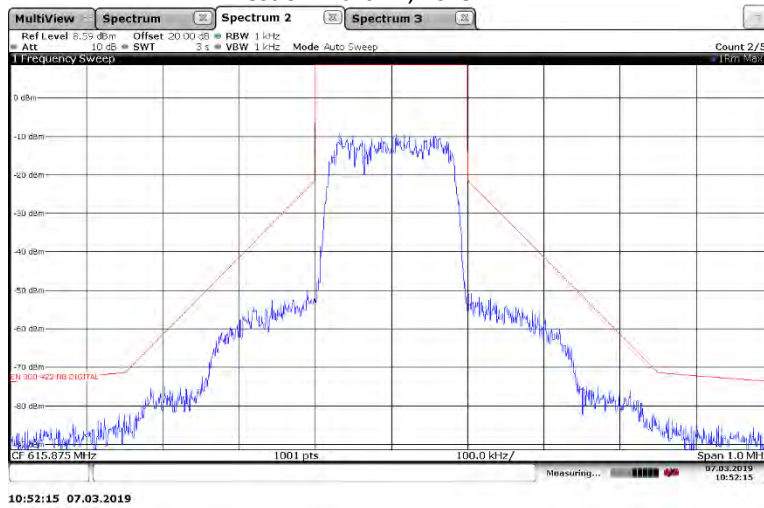
Test Information

EUT Name: ULXD2 J50A
Serial Number: J5x PPR GC SAMPLE finalClips
Test Description: EN 300 422 Digital Necessary Bandwidth
Operating Conditions: High Band, High Frequency, 615.875MHz, 10mW
Operator Name: Craig Kozokar
Comment: 8.3.2.1: Step 1; Carrier Power
Date Tested: Tested on March 7, 2019



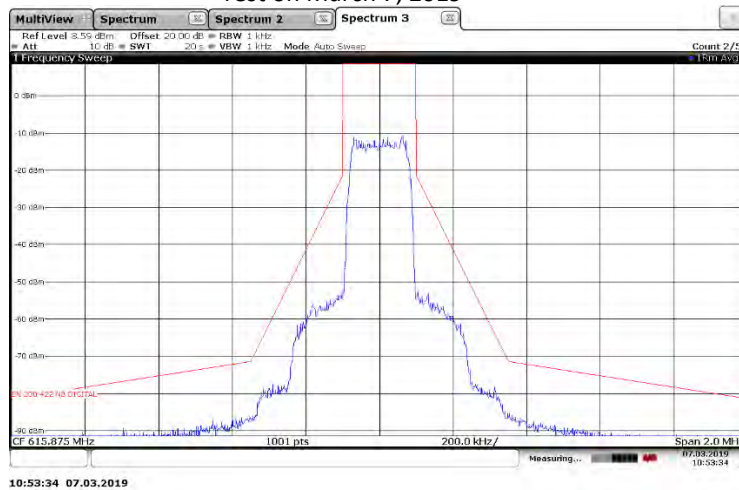
Test Information

EUT Name: ULXD2 J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: EN 300 422 Digital Necessary Bandwidth
 Operating Conditions: High Band, High Frequency, 615.875MHz, 10mW
 Operator Name: Craig Kozokar
 Comment: 8.3.2.1: Step 2;Maximum Relative Level
 Date Tested: Test on March 7, 2019



Test Information

EUT Name: ULXD2 J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: EN 300 422 Digital Necessary Bandwidth
 Operating Conditions: High Band, High Frequency, 615.875MHz, 10mW
 Operator Name: Craig Kozokar
 Comment: 8.3.2.1: Step 3;Lower and upper frequency transmitter band
 Wide band noise floor
 Date Tested: Test on March 7, 2019



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 7GHz. 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 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:

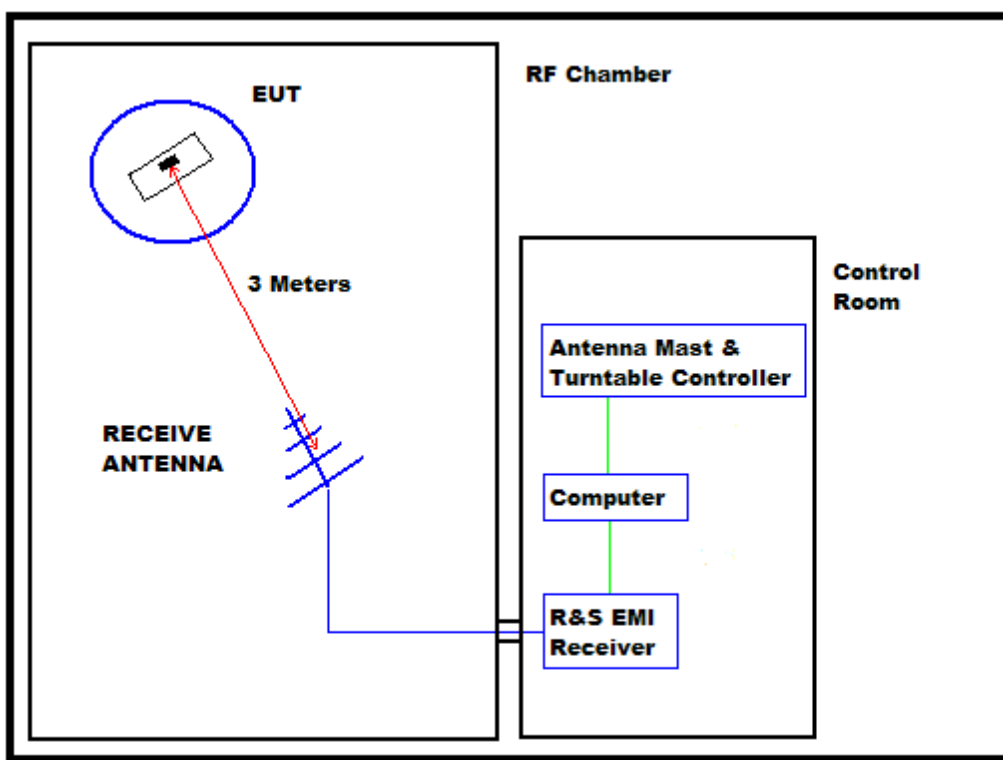
The EUT was powered up and the frequency of the transmitter was selected using the front panel controls. The EUT was checked for proper operation after it was setup on the test table. For radiated spurious emissions the testing was performed with the EUT set to the Low Band, 572.000, 589.925, 607.875, with RF power output of 1mW and 20mW, and the High Band, 614.125 and 615.875, with RF power output of 1mW and 10mW.

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 30 thru page 39. The ERP measurements are shown on pages 40 thru page 44. 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%.

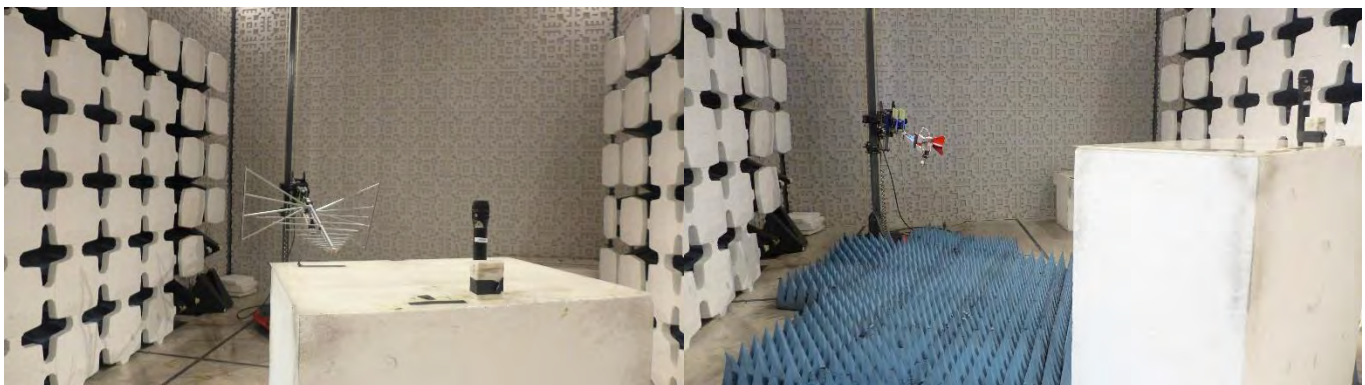


Figure B 1: ULXD2 Transmitter Test Setup

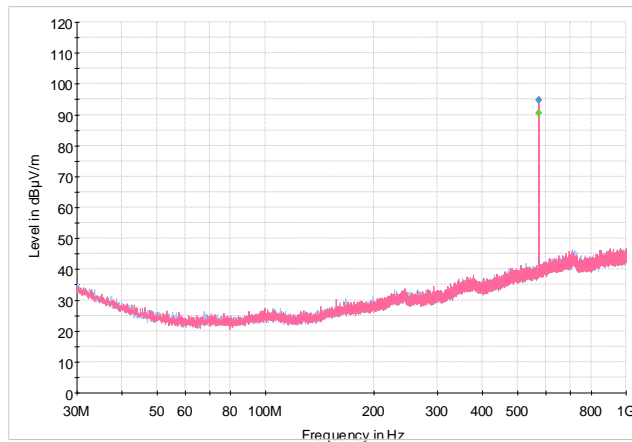
Figure B 2: ULXD2 Transmitter Test Setup

SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT:	ULXD2 J50A
Serial Number:	J5x PPR GC SAMPLE finalClips
Operating Frequency:	Low Band, Low Frequency 572.000MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 27, 2019

Full Spectrum

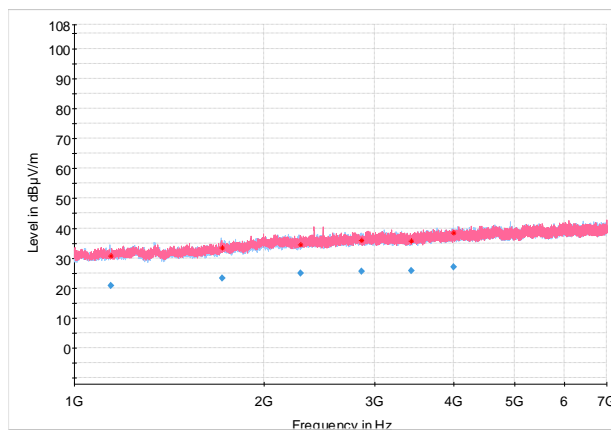


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD2 J50A
Serial Number:	J5x PPR GC SAMPLE finalClips
Operating Frequency:	Low Band, Low frequency 572.000MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 26, 2019

Full Spectrum

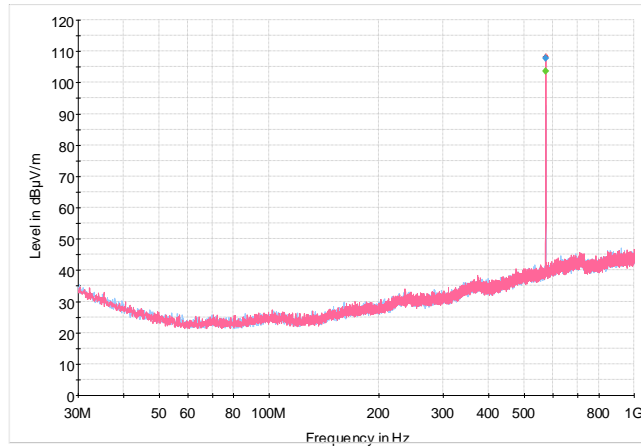


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT:	ULXD2 J50A
Serial Number:	J5x PPR GC SAMPLE finalClips
Operating Frequency:	Low Band, Low Frequency 572.000MHz
RF Power Level	20mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 27, 2019

Full Spectrum

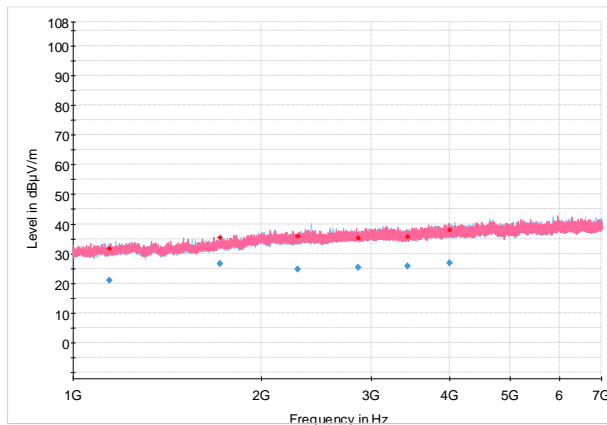


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD2 J50A
Serial Number:	J5x PPR GC SAMPLE finalClips
Operating Frequency:	Low Band, Low Frequency 572.000MHz
RF Power Level	20mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 26, 2019

Full Spectrum

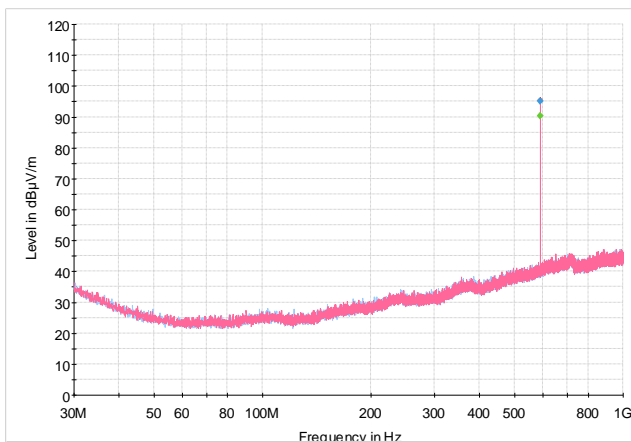


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT:	ULXD2 J50A
Serial Number:	J5x PPR GC SAMPLE finalClips
Operating Frequency:	Low Band, Middle Frequency 589.925MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 28, 2019

Full Spectrum

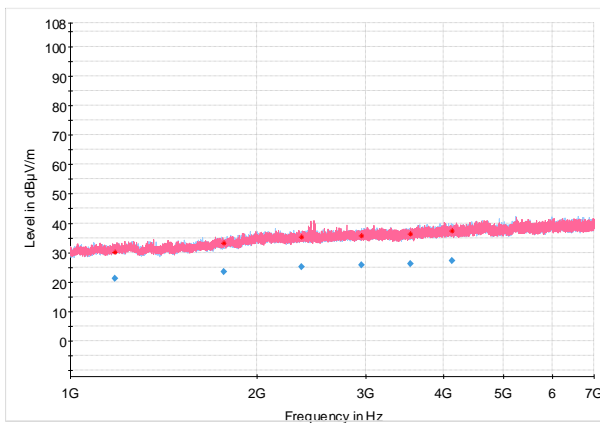


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD2 J50A
Serial Number:	J5x PPR GC SAMPLE finalClips
Operating Frequency:	Low Band, Middle Frequency 589.925MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 26, 2019

Full Spectrum



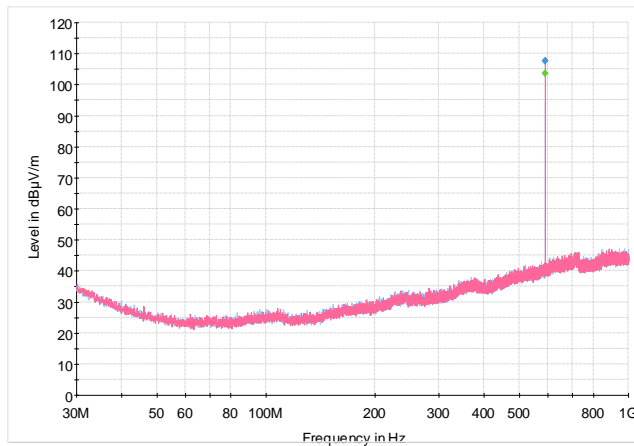


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT	ULXD2 J50A
Serial Number	J5x PPR GC SAMPLE finalClips
Operating Frequency:	Low Band, Middle Frequency 589.925MHz
RF Power Level	20mW
Tester Name	Jamal Qureshi
Date Tested	Tested on February 28, 2019

Full Spectrum

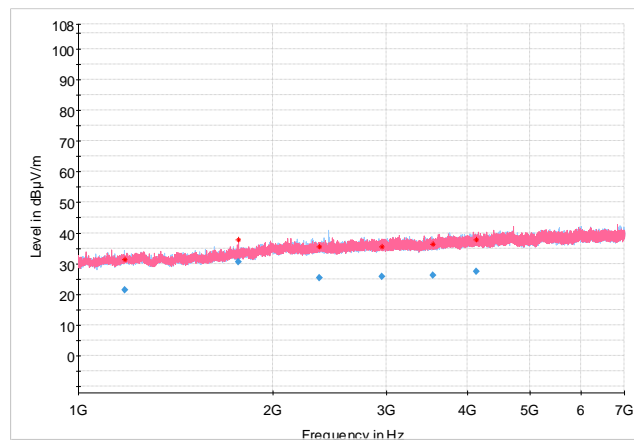


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD2 J50A
Serial Number:	J5x PPR GC SAMPLE finalClips
Operating Frequency:	Low Band, Middle Frequency 589.925MHz
RF Power Level	20mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 26, 2019

Full Spectrum

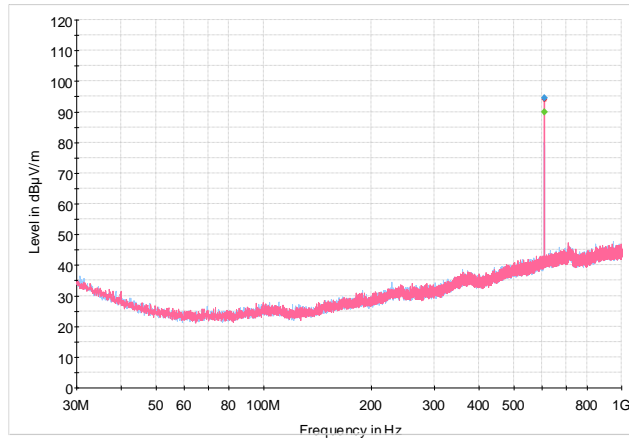


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT	ULXD2 J50A
Serial Number	J5x PPR GC SAMPLE finalClips
Operating Frequency:	Low Band, High Frequency 607.875MHz
RF Power Level	1mW
Tester Name	Jamal Qureshi
Date Tested	Tested on February 28, 2019

Full Spectrum

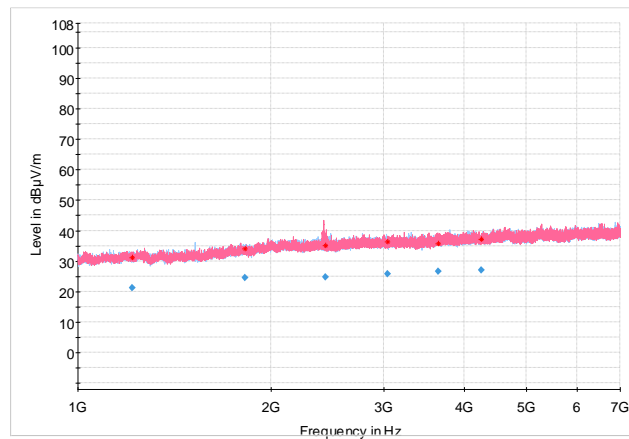


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD2 J50A
Serial Number:	J5x PPR GC SAMPLE finalClips
Operating Frequency:	Low Band, High Frequency 607.875MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 26, 2019

Full Spectrum



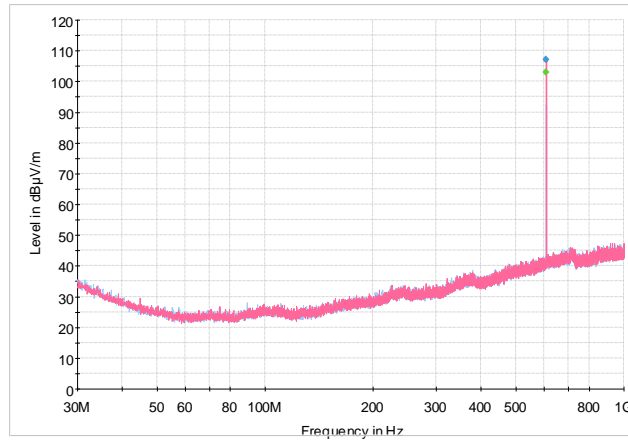


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT	ULXD2 J50A
Serial Number	J5x PPR GC SAMPLE finalClips
Operating Frequency:	Low Band, High Frequency 607.875MHz
RF Power Level	20mW
Tester Name	Jamal Qureshi
Date Tested	Tested on February 28, 2019

Full Spectrum

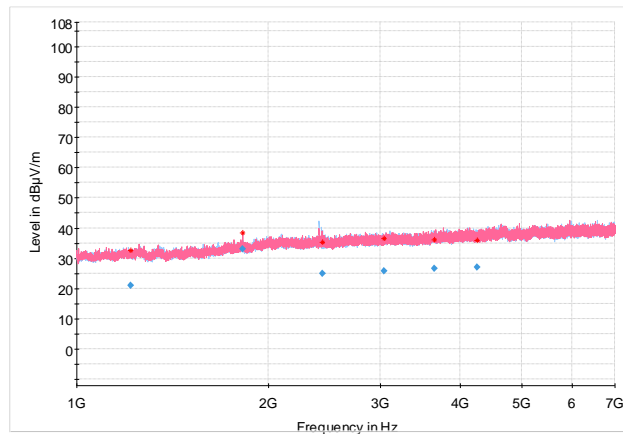


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD2 J50A
Serial Number:	J5x PPR GC SAMPLE finalClips
Operating Frequency:	Low Band, High Frequency 607.875MHz
RF Power Level	20mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 26, 2019

Full Spectrum



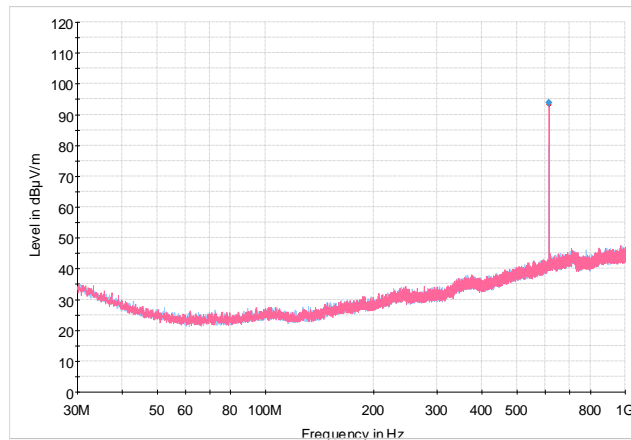


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT	ULXD2 J50A
Serial Number	J5x PPR GC SAMPLE finalClips
Operating Frequency:	High Band, Low Frequency 614.125MHz
RF Power Level	1mW
Tester Name	Jamal Qureshi
Date Tested	Tested on February 28, 2019

Full Spectrum

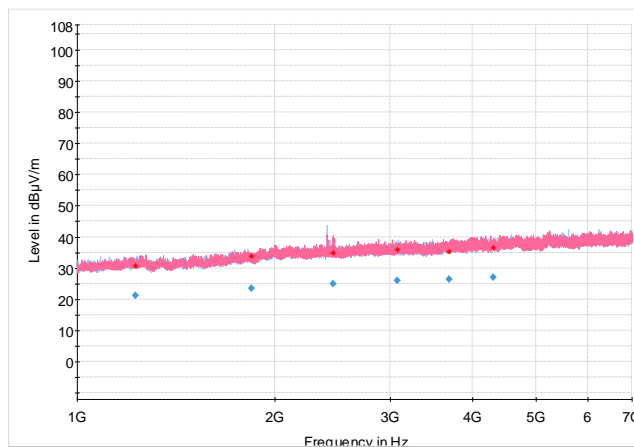


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD2 J50A
Serial Number:	J5x PPR GC SAMPLE finalClips
Operating Frequency:	High Band, Low Frequency 614.125MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 26, 2019

Full Spectrum

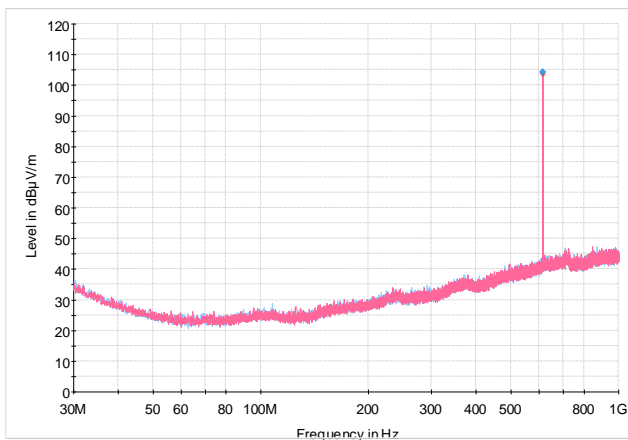


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT	ULXD2 J50A
Serial Number	J5x PPR GC SAMPLE finalClips
Operating Frequency:	High Band, Low Frequency 614.125MHz
RF Power Level	10mW
Tester Name	Jamal Qureshi
Date Tested	Tested on March 7, 2019

Full Spectrum

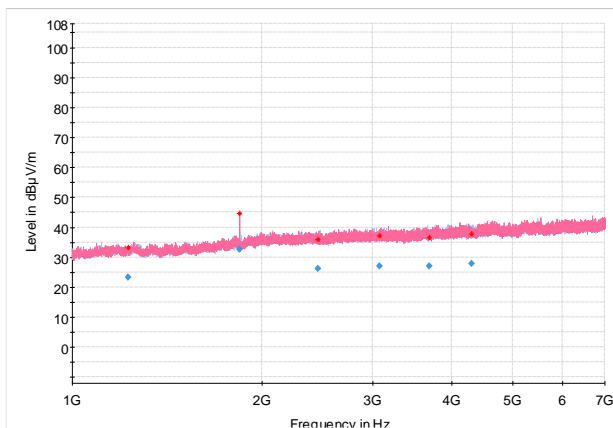


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD2 J50A
Serial Number:	J5x PPR GC SAMPLE finalClips
Operating Frequency:	High Band, Low Frequency 614.125MHz
RF Power Level	10mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on March 7, 2019

Full Spectrum



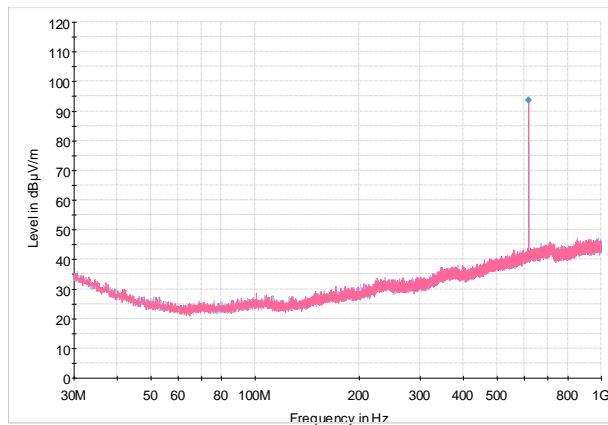


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT	ULXD2 J50A
Serial Number	J5x PPR GC SAMPLE finalClips
Operating Frequency:	High Band, High Frequency 615.875MHz
RF Power Level	1mW
Tester Name	Jamal Qureshi
Date Tested	Tested on February 28, 2019

Full Spectrum

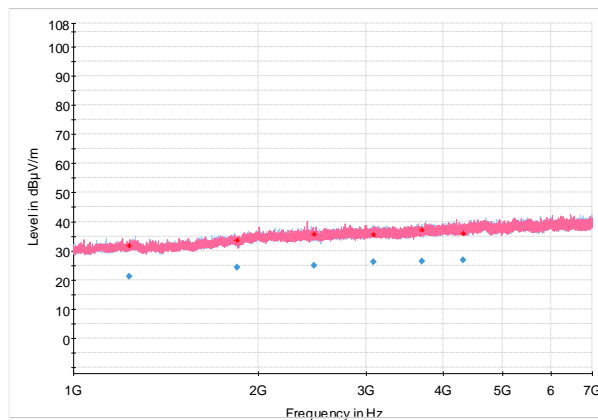


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD2 J50A
Serial Number:	J5x PPR GC SAMPLE finalClips
Operating Frequency:	High Band, High Frequency 615.875MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 26, 2019

Full Spectrum



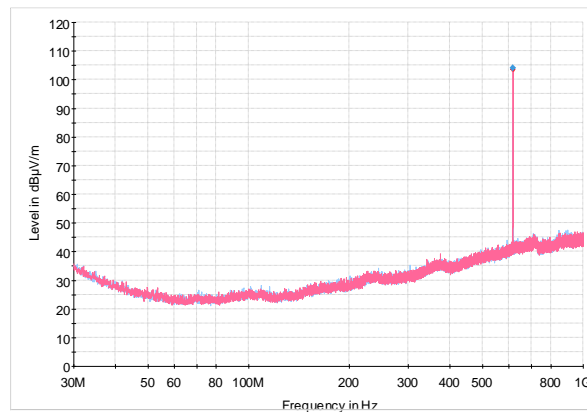


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT	ULXD2 J50A
Serial Number	J5x PPR GC SAMPLE finalClips
Operating Frequency:	High Band, High Frequency 615.875MHz
RF Power Level	10mW
Tester Name	Jamal Qureshi
Date Tested	Tested on March 7, 2019

Full Spectrum

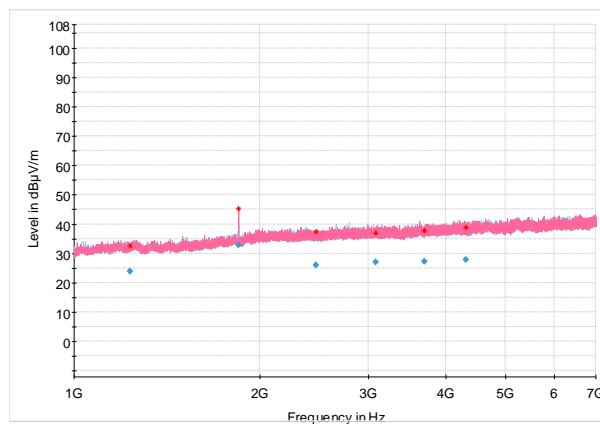


SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD2 J50A
Serial Number:	J5x PPR GC SAMPLE finalClips
Operating Frequency:	High Band, High Frequency 615.875MHz
RF Power Level	10mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on March 7, 2019

Full Spectrum





Appendix B

Date: March 4, 2019
 EUT: ULXD2
 Band: J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Specification: EN 300 422-1, Spurious Radiated Emissions
 Comments: Test Distance is 3 meters
 Mode: EUT set to Low Band, Low Frequency 572.000 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
572.000	QP	V	94.57	-1.33	0.00	2.75		
1144.000	Average	V	21.49	-90.0	3.43	3.57	-90.14	-30
1716.000	Average	V	24.02	-90.0	5.55	4.20	-88.65	-30
2288.000	Average	V	25.61	-90.0	5.61	4.72	-89.11	-30
2860.000	Average	V	26.43	-90.0	6.89	5.07	-88.18	-30
3432.000	Average	V	26.59	-90.0	8.15	5.47	-87.32	-30
4004.000	Average	V	27.81	-90.0	8.86	6.29	-87.43	-30

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

Date: March 4, 2019
 EUT: ULXD2
 Band: J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Specification: EN 300 422-1, Spurious Radiated Emissions
 Comments: Test Distance is 3 meters
 Mode: EUT set to Low Band, Low Frequency 572.000MHz 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
572.000	QP	V	107.66	11.7	0.00	2.75		
1144.000	Average	V	21.48	-90.0	3.43	3.57	-90.14	-30
1716.000	Average	V	26.55	-72.0	5.55	4.20	-70.61	-30
2288.000	Average	V	25.61	-90.0	5.61	4.72	-89.11	-30
2860.000	Average	V	26.43	-90.0	6.89	5.07	-88.18	-30
3432.000	Average	V	26.59	-90.0	8.15	5.47	-87.32	-30
4004.000	Average	V	27.81	-90.0	8.86	6.29	-87.43	-30

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



Appendix B

Date: March 4, 2019
 EUT: ULXD2
 Band: J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Specification: EN 300 422-1, Spurious Radiated Emissions
 Comments: Test Distance is 3 meters
 Mode: EUT set to Low Band, Middle Frequency 589.925MHz 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
589.925	QP	V	95.01	-1.30	0.00	2.76		
1179.850	Average	V	22.19	-90.0	3.56	3.66	-90.10	-30
1769.775	Average	V	23.64	-90.0	5.26	4.24	-88.98	-30
2359.700	Average	V	26.08	-88.8	5.70	4.75	-87.89	-30
2949.625	Average	V	26.66	-90.0	6.97	5.20	-88.23	-30
3539.550	Average	V	27.00	-90.0	8.23	5.56	-87.33	-30
4129.475	Average	V	28.21	-90.0	9.19	6.16	-86.97	-30

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

Date: March 4, 2019
 EUT: ULXD2
 Band: J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Specification: EN 300 422-1, Spurious Radiated Emissions
 Comments: Test Distance is 3 meters
 Mode: EUT set to Low Band, Middle Frequency 589.925MHz 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
589.925	QP	V	107.64	11.35	0.00	2.76		
1179.850	Average	V	22.18	-90.0	3.56	3.66	-90.10	-30
1769.775	Average	V	30.56	-65.4	5.26	4.24	-64.39	-30
2359.700	Average	V	26.07	-90.0	5.70	4.75	-89.05	-30
2949.625	Average	V	26.66	-90.0	6.97	5.20	-88.23	-30
3539.550	Average	V	27.00	-90.0	8.23	5.56	-87.33	-30
4129.475	Average	V	28.20	-90.0	9.19	6.16	-86.97	-30

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



Appendix B

Date: March 4, 2019
 EUT: ULXD2
 Band: J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Specification: EN 300 422-1, Spurious Radiated Emissions
 Comments: Test Distance is 3 meters
 Mode: EUT set to Low Band, High Frequency 607.875MHz 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
607.875	QP	V	94.48	-1.8	0.00	2.78		
1215.750	Average	V	21.61	-90.0	3.60	3.68	-90.08	-30
1823.625	Average	V	24.52	-84.4	5.03	4.25	-83.66	-30
2431.500	Average	V	25.85	-90.0	5.81	4.81	-89.00	-30
3039.375	Average	V	26.57	-90.0	7.07	5.25	-88.18	-30
3647.250	Average	V	27.56	-90.0	4.95	6.09	-91.14	-30
4255.125	Average	V	27.92	-90.0	9.45	6.44	-86.99	-30

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

Date: March 4
 EUT: ULXD2
 Band: J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Specification: EN 300 422-1, Spurious Radiated Emissions
 Comments: Test Distance is 3 meters
 Mode: EUT set to Low Band, High Frequency 607.875MHz 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
607.875	QP	V	107.22	10.7	0.00	2.78		
1215.750	Average	V	21.61	-90.0	3.60	3.68	-90.08	-30
1823.625	Average	V	33.13	-62.8	5.03	4.25	-62.00	-30
2431.500	Average	V	25.86	-90.0	5.81	4.81	-89.00	-30
3039.375	Average	V	26.57	-90.0	7.07	5.25	-88.18	-30
3647.250	Average	V	26.65	-90.0	4.95	6.09	-91.14	-30
4255.125	Average	V	27.92	-90.0	9.45	6.44	-86.99	-30



Appendix B

Date: March 4, 2019
 EUT: ULXD2
 Band: J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Specification: EN 300 422-1, Spurious Radiated Emissions
 Comments: Test Distance is 3 meters
 Mode: EUT set to High Band, Low Frequency 614.125MHz 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
614.125	QP	V	93.83	-3.06	0.00	2.80		
1228.250	Average	V	21.81	-90.0	3.56	3.66	-90.10	-30
1842.375	Average	V	24.00	-90.0	5.11	4.33	-89.22	-30
2456.500	Average	V	25.86	-90.0	5.89	4.84	-88.95	-30
3070.625	Average	V	26.99	-90.0	7.11	5.31	-88.20	-30
3684.750	Average	V	27.13	-90.0	8.33	6.06	-87.73	-30
4298.875	Average	V	27.81	-90.0	9.48	6.45	-86.97	-30

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

Date: March 7, 2019
 EUT: ULXD2
 Band: J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Specification: EN 300 422-1, Spurious Radiated Emissions
 Comments: Test Distance is 3 meters
 Mode: EUT set to High Band, Low Frequency 614.125MHz at 10mW
 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
614.125	QP	V	104.12	7.04	0.00	2.80		
1228.250	Average	V	23.29	-71.5	3.56	3.66	-71.64	-30
1842.375	Average	V	32.74	-56.2	5.11	4.33	-55.44	-30
2456.500	Average	V	26.20	-69.7	5.89	4.84	-68.67	-30
3070.625	Average	V	26.99	-69.1	7.11	5.31	-67.30	-30
3684.750	Average	V	27.13	-68.2	8.33	6.06	-65.93	-30
4298.875	Average	V	27.85	-69.7	9.48	6.45	-66.63	-30



Appendix B

Date: March 4, 2019
 EUT: ULXD2
 Band: J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Specification: EN 300 422-1, Spurious Radiated Emissions
 Comments: Test Distance is 3 meters
 Mode: EUT set to High Band, High Frequency 615.875MHz 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
615.875	QP	V	93.62	-3.42	0.00	2.84		
1231.750	Average	V	22.33	-90.0	3.54	3.66	-90.12	-30
1847.625	Average	V	24.33	-62.4	5.13	4.29	-61.59	-30
2463.500	Average	V	25.91	-90.0	5.90	4.85	-88.95	-30
3079.375	Average	V	27.12	-90.0	7.13	5.24	-88.11	-30
3695.250	Average	V	27.31	-90.0	8.33	5.90	-87.57	-30
4311.125	Average	V	27.92	-90.0	9.48	6.65	-87.17	-30

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

Date: March 7, 2019
 EUT: ULXD2
 Band: J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Specification: EN 300 422-1, Spurious Radiated Emissions
 Comments: Test Distance is 3 meters
 Mode: EUT set to High Band, High Frequency 615.875MHz at 10mW
 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
615.875	QP	V	103.98	6.50	0.00	2.84		
1231.750	Average	V	23.90	-70.7	3.54	3.66	-70.78	-30
1847.625	Average	V	32.92	-56.7	5.13	4.29	-55.85	-30
2463.500	Average	V	26.01	-70.6	5.90	4.85	-69.58	-30
3079.375	Average	V	26.94	-69.8	7.13	5.24	-67.86	-30
3695.250	Average	V	27.15	-68.2	8.33	5.90	-65.75	-30
4311.125	Average	V	27.80	-67.8	9.48	6.65	-65.00	-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 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 Band, 572.000, 589.925, 607.875, with RF power output of 1mW and 20mW, and the High Band, 614.125 and 615.875, with RF power output of 1mW and 10mW.



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.

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 47 thru page 51.



Appendix C

Test Information

EUT Name: ULXD2 J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: Maximum Rated Output
 Operating Conditions: Low Band, Low Frequency, 572.000MHz, 1mW
 Operator Name: Jamal Qureshi
 Comment: FCC Part15C, Section 15.236
 Date Tested: Tested on February 27, 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
94.57	-1.33	2.15	2.46	-1.64	0.69	50.00	49.31

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

Test Information

EUT Name: ULXD2 J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: Maximum Rated Output
 Operating Conditions: Low Band, Low Frequency, 572.000MHz, 20mW
 Operator Name: Jamal Qureshi
 Comment: FCC Part15C, Section 15.236
 Date Tested: Tested on February 27, 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
107.66	+11.72	2.15	2.46	11.41	13.84	50.00	36.16

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



Appendix C

Test Information

EUT Name: ULXD2 J50A
Serial Number: J5x PPR GC SAMPLE finalClips
Test Description: Maximum Rated Output
Operating Conditions: Low Band, Middle Frequency, 589.925MHz, 1mW
Operator Name: Jamal Qureshi
Comment: FCC Part15C, Section 15.236
Date Tested: Tested on February 28, 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
95.01	-1.30	2.15	2.46	-1.61	0.69	50.00	49.31

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

Test Information

EUT Name: ULXD2 J50A
Serial Number: J5x PPR GC SAMPLE finalClips
Test Description: Maximum Rated Output
Operating Conditions: Low Band, Middle Frequency, 598.925MHz, 20mW
Operator Name: Jamal Qureshi
Comment: FCC Part15C, Section 15.236
Date Tested: Tested on February 28, 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
107.64	+11.35	2.15	2.46	11.04	12.71	50.00	37.29

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



Appendix C

Test Information

EUT Name: ULXD2 J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: Maximum Rated Output
 Operating Conditions: Low Band, High Frequency, 607.875MHz, 1mW
 Operator Name: Jamal Qureshi
 Comment: FCC Part15C, Section 15.236
 Date Tested: Tested on February 28, 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
94.48	-1.78	2.15	2.46	-2.09	0.62	50.00	49.38

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

Test Information

EUT Name: ULXD2 J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: Maximum Rated Output
 Operating Conditions: Low Band, High Frequency, 607.875MHz, 20mW
 Operator Name: Jamal Qureshi
 Comment: FCC Part15C, Section 15.236
 Date Tested: Tested on February 28, 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
107.22	+10.68	2.15	2.46	10.37	10.89	50.00	39.11

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



Appendix C

Test Information

EUT Name: ULXD2 J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: Maximum Rated Output
 Operating Conditions: High Band, Low Frequency, 614.125MHz, 1mW
 Operator Name: Jamal Qureshi
 Comment: RSS-210
 Date Tested: Tested on February 28, 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
93.83	-3.06	2.15	2.46	-3.37	0.46	250.00	249.54

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

Test Information

EUT Name: ULXD2 J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: Maximum Rated Output
 Operating Conditions: High Band, Low Frequency, 614.125MHz, 10mW
 Operator Name: Jamal Qureshi
 Comment: RSS-210
 Date Tested: Tested on March 7, 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
104.12	+7.04	2.15	2.46	6.73	4.71	250.00	245.29

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



Appendix C

Test Information

EUT Name: ULXD2 J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: Maximum Rated Output
 Operating Conditions: High Band, High Frequency, 615.875MHz, 1mW
 Operator Name: Jamal Qureshi
 Comment: RSS-210
 Date Tested: Tested on February 28, 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
93.62	-3.42	2.15	2.46	-3.73	0.42	250.00	249.58

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

Test Information

EUT Name: ULXD2 J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: Maximum Rated Output
 Operating Conditions: High Band, High Frequency, 615.875MHz, 10mW
 Operator Name: Jamal Qureshi
 Comment: RSS-210
 Date Tested: Tested on March 7, 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
103.98	+6.5	2.15	2.46	6.19	4.16	250.00	245.84

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



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 the Low Band of 572MHz to 608MHz, and the High Band of 614MHz to 616MHz.

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 Band low, middle, high frequencies, and High Band Low 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 10mW.

TEST PROCEDURES:

- a. The temperature chamber was set to 20C 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 pages 54 and 55. 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 within the ± 50 ppm RSS-210 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 J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: FCC Part 15C Section 15.236(f)(3), RSS-210 Frequency Tolerance
 Operating Conditions: Low Band: Low, Middle, and High frequency at 10mW, -30C to +50C
 Operator Name: Juan Castrejon
 Comment: Agilent Frequency Counter and ESPEC Temp Chamber
 Test Date: March 8, 2019

Temp °C	Nominal Frequency (MHz)	Measured Frequency (MHz)	Deviation (%)	FCC Frequency Stability Limit in %	Deviation in Hz	Deviation in PPM	RSS Limit in ppm	FCC Pass/Fail	RSS Pass/Fail
-30	572.000	572.000038	0.000007	0.005	38.34	0.067028	±50	PASS	PASS
-20	572.000	572.000148	0.000026	0.005	147.67	0.258164	±50	PASS	PASS
-10	572.000	572.000244	0.000043	0.005	244.47	0.427395	±50	PASS	PASS
0	572.000	572.000315	0.000055	0.005	315.11	0.550892	±50	PASS	PASS
10	572.000	572.000332	0.000058	0.005	331.88	0.580210	±50	PASS	PASS
20	572.000	572.000377	0.000066	0.005	376.71	0.658584	±50	PASS	PASS
30	572.000	572.000361	0.000063	0.005	361.24	0.631538	±50	PASS	PASS
40	572.000	572.000389	0.000068	0.005	388.60	0.679371	±50	PASS	PASS
50	572.000	572.000407	0.000071	0.005	407.3	0.712063	±50	PASS	PASS
-30	589.925	589.925048	0.000008	0.005	47.60	0.080688	±50	PASS	PASS
-20	589.925	589.925152	0.000026	0.005	151.51	0.256829	±50	PASS	PASS
-10	589.925	589.925253	0.000043	0.005	252.51	0.428037	±50	PASS	PASS
0	589.925	589.925325	0.000055	0.005	324.70	0.550409	±50	PASS	PASS
10	589.925	589.925342	0.000058	0.005	341.81	0.579413	±50	PASS	PASS
20	589.925	589.925388	0.000066	0.005	388.07	0.657829	±50	PASS	PASS
30	589.925	589.925371	0.000063	0.005	371.33	0.629453	±50	PASS	PASS
40	589.925	589.925400	0.000068	0.005	400.31	0.678578	±50	PASS	PASS
50	589.925	589.925418	0.000071	0.005	417.54	0.707785	±50	PASS	PASS
-30	607.875	607.875057	0.000009	0.005	57.38	0.094394	±50	PASS	PASS
-20	607.875	607.875156	0.000026	0.005	156.11	0.256813	±50	PASS	PASS
-10	607.875	607.875863	0.000142	0.005	863.44	1.420424	±50	PASS	PASS
0	607.875	607.875336	0.000055	0.005	336.12	0.552943	±50	PASS	PASS
10	607.875	607.875354	0.000058	0.005	353.66	0.581797	±50	PASS	PASS
20	607.875	607.875401	0.000066	0.005	401.03	0.659724	±50	PASS	PASS
30	607.875	607.875383	0.000063	0.005	382.88	0.629724	±50	PASS	PASS
40	607.875	607.875414	0.000068	0.005	413.73	0.680617	±50	PASS	PASS
50	607.875	607.875429	0.000071	0.005	429.14	0.705968	±50	PASS	PASS



Appendix D

EUT Name: ULXD2 J50A
 Serial Number: J5x PPR GC SAMPLE finalClips
 Test Description: FCC Part 15C Section 15.236(f)(3), RSS-210 Frequency Tolerance
 Operating Conditions: High Band: Low and High frequency at 10mW, -30C to +50C
 Operator Name: Juan Castrejon
 Comment: Agilent Frequency Counter and ESPEC Temp Chamber
 Test Date: March 8, 2019

Temp °C	Nominal Frequency (MHz)	Measured Frequency (MHz)	Deviation (%)	FCC Frequency Stability Limit in %	Deviation in Hz	Deviation in PPM	RSS Limit in ppm	FCC Pass/Fail	RSS Pass/Fail
-30	614.125	614.125064	0.000010	0.005	63.95	0.104132	±50	PASS	PASS
-20	614.125	614.125157	0.000026	0.005	157.22	0.256007	±50	PASS	PASS
-10	614.125	614.125268	0.000044	0.005	268.46	0.437142	±50	PASS	PASS
0	614.125	614.125340	0.000055	0.005	339.77	0.553259	±50	PASS	PASS
10	614.125	614.125358	0.000058	0.005	357.55	0.582210	±50	PASS	PASS
20	614.125	614.125405	0.000066	0.005	405.23	0.659849	±50	PASS	PASS
30	614.125	614.125386	0.000063	0.005	386.40	0.629188	±50	PASS	PASS
40	614.125	614.125418	0.000068	0.005	418.37	0.681246	±50	PASS	PASS
50	614.125	614.125432	0.000070	0.005	431.55	0.702707	±50	PASS	PASS
-30	615.875	615.875069	0.000011	0.005	69.47	0.112799	±50	PASS	PASS
-20	615.875	615.875157	0.000025	0.005	156.70	0.254435	±50	PASS	PASS
-10	615.875	615.875271	0.000044	0.005	271.44	0.440739	±50	PASS	PASS
0	615.875	615.875340	0.000055	0.005	340.33	0.552596	±50	PASS	PASS
10	615.875	615.875359	0.000058	0.005	359.02	0.582943	±50	PASS	PASS
20	615.875	615.875406	0.000066	0.005	406.21	0.659566	±50	PASS	PASS
30	615.875	615.875387	0.000063	0.005	387.07	0.628488	±50	PASS	PASS
40	615.875	615.875420	0.000068	0.005	419.60	0.681307	±50	PASS	PASS
50	615.875	615.875431	0.000070	0.005	431.36	0.700402	±50	PASS	PASS