



# SHURE

## ELECTROMAGNETIC COMPATIBILITY LABORATORY

### TEST REPORT

**TEST REPORT TITLE:** Electromagnetic Compatibility tests for a Shure ULXD2 Handheld Microphone Transmitter

**TEST ITEM DESCRIPTION:**

ULXD2 is a digital wireless handheld microphone transmitter intended for use in mid-tier presentation, installed, and performance markets. The system operates in the UHF TV band (470 to 932 MHz). Regionally dependent 1mW, 10mW and 20mW output power modes are available. The ULXD2 transmitter is capable of operating with AA alkaline batteries or Shure rechargeable battery packs.

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

Project ID Number: SEL-014

Date Tested: June 17, 2013 – September 3, 2013

Test Personnel: Lovell Cueto, Craig Kozokar, Alex Stelmaszczyk, Shaun Syas, Juan Castrejon

Test Specification: FCC "Code of Federal Regulations" Title 47 Part 74  
Industry Canada RSS-123  
Industry Canada RSS-Gen

TEST REPORT BY:

SIGNATURE

GC ENGINEER II

POSITION

9/6/13

DATE

APPROVED BY:

SIGNATURE

Deputy Quality Manager

POSITION

9/6/13

DATE



## TABLE OF CONTENTS

<u>PARAGRAPH</u>	<u>DESCRIPTION OF CONTENTS</u>	<u>PAGE NO.</u>
0.	Report Revision History .....	4
1.	Introduction.....	5
1.1.	Scope of Tests .....	5
1.2.	Purpose .....	5
1.3.	Deviation, Additions and Exclusions.....	5
1.4.	EMC Laboratory Identification.....	5
1.5.	Summary of Tests Performed.....	5
2.	Applicable Documents.....	6
3.	EUT Setup and Operation.....	6
3.1.	General Description.....	6
3.1.1.	Power Input .....	6
3.1.2.	Signal Input/Output Leads.....	6
3.1.3.	Grounding Considerations.....	6
3.2.	Operational Mode .....	6
3.3.	Test Setup .....	7
3.3.1.	Power Input.....	7
3.3.2.	Signal Input/Output Leads.....	7
3.3.3.	Test Frequency Range.....	7
3.3.4.	Grounding Considerations.....	7
3.4.	Operational Mode .....	7
3.4.1.	Frequency and power output.....	7
4.	Test Instrumentation.....	7
5.	Test Procedures.....	7
6.	Other Test Conditions.....	7
6.1.	Test Personnel and Witnesses.....	7
6.2.	Disposition of the EUT .....	7
7.	Results of Tests.....	7
8.	Conclusions.....	8
9.	Certification .....	8
10.	Equipment List.....	9
11.	Appendix A - Conducted RF Power Output.....	10
12.	Appendix B - Modulation Characteristics .....	12
13.	Appendix C - Frequency Stability.....	12
14.	Appendix D - Occupied Bandwidth .....	15
15.	Appendix E - Spurious Emissions .....	30

**Note: This report shall not be reproduced, except in full, without the written approval of the Shure Incorporated Electromagnetic Laboratory (SEL). Total Page Count, including appendices is 52.**



**LIST OF APPENDICES**

APPENDIX	TEST DESCRIPTION
A	RF POWER OUTPUT MEASUREMENTS
B	MODULATION CHARACTERISTICS
C	FREQUENCY STABILITY
D	OCCUPIED BANDWIDTH MEASUREMENTS
E	FIELD STRENGTH OF SPURIOUS EMISSIONS

**REPORT REVISION HISTORY**

Revision	Date	Description
0	<u>8/8/13</u>	Initial Release
<u>1.0</u>	<u>9/4/13</u>	<u>Updated Occupied Bandwidth Procedure and Data</u>



Report Title:

## 1. INTRODUCTION

### 1.1. Scope of Tests

This document presents the results of a series of electromagnetic compatibility (EMC) tests performed on the Shure ULXD2 handheld microphone transmitter. The test items were manufactured and submitted for testing by Shure Incorporated located in Niles, IL. The data was taken following the measurement methods as described in the test specifications listed in the individual appendices of this document. Provided is the data for the test samples which also includes a summary of the measurements made and a description of the measurement setup. The EUT contained a transmitter that was designed to transmit in the following UHF frequency bands using an internal, non-removable helical antenna:

Group	Band	Frequency (MHz)	Output Power (mW)
B	H50	534-598	1, 10, 20

In order to facilitate conducted testing, a second test sample was employed where the helical antenna was disconnected and replaced by an SMA type coaxial connector. This test sample/configuration was used for the purpose of measuring RF Power Output, Frequency Stability and Occupied Bandwidth.

### 1.2. Purpose

This series of tests was performed to determine if the test item would meet the conducted and radiated RF emission specifications of the FCC "Code of Federal Regulations" Title 47 Part 74, Subpart H, Section 74.861. The test series was also performed to determine if the test items meet the radiated and conducted RF emission specifications of Industry Canada RSS-123, Sections (4.2), (7), (5.3), (5.5.1) and (6.3.1). Testing was performed in accordance with ANSI C63.4-2003 and RSS-GEN.

### 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 shown in Table 1 on page 6 were performed on the EUT in accordance with FCC "Code of Federal Regulations" Title 47 Part 74 and Industry Canada RSS-123 specifications:

**Table 1: Summary of tests performed**

Test Spec (STD)	Description	Tested Range	Described in Appendix	Test Results
FCC Part 74 (74.861) RSS-123 (4.2)	Conducted RF Power Output	534 – 598MHz	A	PASS
FCC Part 74 (74.861) RSS-123 (5.2)	Modulation Characteristics	534 – 598MHz	B	N/A
FCC Part 74 (74.861) RSS-123 (7)	Frequency Stability	534 – 598MHz -30 deg C to 50C	C	PASS
FCC Part 74 (74.861) RSS-123 (5.3 & 5.5.1)	Occupied Bandwidth	534 – 598MHz	D	PASS
FCC Part 74 (74.861) RSS-123 (6.3.1)	Spurious Emissions	30MHz – 6GHz	E	PASS

## 2. APPLICABLE DOCUMENTS

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

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 74, dated 1 October 2010
- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 2, dated 1 October 2010
- RSS-123, "Spectrum Management and Telecommunications Radio Standards Specification Licensed Low Power Radio Apparatus" Issue 2, February 2011
- RSS-Gen, "Spectrum Management and Telecommunications Radio Standards Specification General Requirements and Information for the Certification of Radiocommunication Equipment", Issue 3, December 2010
- ANSI C63.4-2003, "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"
- TIA-603-C-2004, "Land Mobile FM or PM Communications Equipment Measurement and Performance Standard"

## 3. EUT SET-UP AND OPERATION

### 3.1. General Description

The EUT is a wireless handheld microphone transmitter, model no. ULXD2. The EUT arrangement in which the testing was conducted can be found in the individual appendices.

### 3.2. Test Samples

The following product samples were tested:

Model	Band	Frequency (MHz)	Serial #	Test Mode
ULXD2	H50	534-598	4121173698	Conducted
ULXD2	H50	534-598	4111860672	Radiated



### 3.3. Test Setup

#### 3.3.1. Power Input

The EUT was powered with 3VDC from 2 internal "AA" batteries.

#### 3.3.2. Signal Input /Output Leads

The microphone port of the EUT was terminated with a Shure Beta 87 microphone capsule for all radiated emissions tests.

#### 3.3.3. Test Frequency Range

Per CFR Title 47, Section 2, part 1057 and RSS-GEN, Section 4.9 (a) for spurious radiated emissions measurements, the frequency spectrum shall be investigated up to at least the tenth harmonic of the highest fundamental frequency. The highest fundamental frequency internally generated by the EUT is 598MHz. Therefore, radiated emissions measurements were performed up to 6GHz.

#### 3.3.4. Grounding Considerations

The EUT was not grounded during testing.

### 3.4. Operational Mode

#### Frequency and Power Output:

All emissions tests were performed separately in the following transmit frequency and output power modes:

Tx @ 534.125MHz, 1mW; Tx @ 534.125MHz, 20mW (Low)

Tx @ 566.000MHz, 1mW; Tx @ 566.000MHz, 20mW (Mid)

Tx @ 597.875MHz, 1mW; Tx @ 597.875MHz, 20mW (High)

## 4. TEST INSTRUMENTATION

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

## 5. TEST PROCEDURES

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 the individual test appendices. In general, it was found that the Shure Incorporated ULXD2 met the radiated and conducted RF emission specifications of the FCC "Code of Federal Regulations" Title 47, Part 74, Subpart H, Section 74.861. It was also found that the ULXD2 met the radiated and conducted RF emissions specifications of Industry Canada RSS-123, Sections (4.2), (7), (5.3), (5.5.1) and (6.3.1).



## 8. CONCLUSIONS

It was determined that the Shure Incorporated ULXD2 did fully comply with the radiated and conducted RF emissions requirements of both the FCC "Code of Federal Regulations" Title 47 Part 74, Subpart H, Section 74.861 and Industry Canada RSS-123, Sections (4.2), (7), (5.3), (5.5.1) and (6.3.1).

## 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 to claim product endorsement by NVLAP or any agency of the US Government.

**10. EQUIPMENT LIST****Table 10-1: Test Equipment**

L# or ID	Description	Manufacturer	Model #	Serial #	Range	Cal Date	Due Date
L23-011-01	3 meter RF Chamber	ETS Lindgren	FACT-3	AJ640	25MHz - 18GHz	10/15/2012	10/15/2013
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	3/6/2013	3/6/2014
L23-011-16	Waveguide Horn Ant	ETS Lindgren	3115	29851	1-18 GHz	5/21/2013	5/21/2014
L23-011-19	PreAmp	Rohde & Schwarz	TS-PR18	100015	1-18 GHz	6/20/2013	6/20/2014
L23-011-25	EMI Test Receiver	Rohde & Schwarz	ESIB 40	100220	20Hz-40GHz	3/5/2013	3/5/2014
L23-011-31	EMI/EMS Test Software	Rohde & Schwarz	EMC32	V.4.04 100061	20Hz - 40GHz	N/A	N/A
L23-022-01	Spectrum Analyzer	R&S	FSU 1166.1660. K26	201043	20Hz – 26.5GHz	1/25/2013	1/24/2014
L23-040-03	20dB Attenuator	Mini Circuits	BW-N20W5+	0952	DC-18GHz	1/12/2013	1/12/2014
L23-031-01	Power Meter	AR	PM2003	0335363	10kHz – 40GHz	12/06/2012	12/06/2013
L23-032-01	Power Head	AR	PH2008	336213	100 kHz - 18GHz -40 to +33 dBm	12/12/2012	12/12/2013
L19-06-01	Temp. Chamber	ESPEC	SU-24	91004211	-40C - +130C	2/28/2013	2/28/2014
L04-107-01	Data Logger	Fluke	Hydra II	7607019	N/A	12/10/2012	12/31/2013
L23-011-41	Waveguide Horn Antenna	EMCO	3117	123511	1GHz -18GHz	10/26/2012	10/26/2013
L23-011-36C	Tuned Dipole Antenna	ETS Lindgren	312D-DB-3	123668	140-400MHz	3/21/2013	3/21/2014
L23-011-36D	Tuned Dipole Antenna	ETS Lindgren	312D-DB-4	123695	400-1000MHz	3/21/2013	3/21/2014



## A. RF POWER OUTPUT MEASUREMENTS

### A.1. PURPOSE:

This test was performed to determine if the EUT meets the RF power output requirements of the FCC Part 74.861(e)(1)(ii) and the RSS-123 Section 4.2 specifications over the EUT operating frequency range of 534MHz to 598MHz.

### A.2. REQUIREMENTS:

As stated in paragraph 74.861(e)(1)(ii), for low power auxiliary stations operating in the bands allocated for TV broadcasting, the power of the measured unmodulated carrier power at the output of the transmitter power amplifier (antenna input power) may not exceed 250 milliwatts in the 470-608 and 614-806MHz bands. Per the requirements set out in section 4.2 and Table 1 of Industry Canada RSS-123, the RF power output shall not exceed 250mW average power.

### A.3. 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	$U_{lab}$
RF Power Output	<b>0.354 dB</b>

$U_{lab}$  = 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.

### A.4. TEST SETUP AND INSTRUMENTATION:

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

### A.5. EUT OPERATION:

The EUT was powered up and the transmit frequency and power output level of the transmitter was selected using the front panel controls. The EUT was powered at 3VDC by 2 "AA" alkaline batteries. The EUT was checked for proper operation after it was setup for the test. Testing was conducted with the EUT set to transmit at 534.125MHz, 566MHz and 597.875MHz at output power levels of 1mW, 10mW and 20mW.

### A.6. TEST PROCEDURES:

- The EUT was connected to an RF power meter through a calibrated power head.
- The frequency of the power meter was set to the operating frequency of the EUT.
- The RF power meter was allowed to stabilize and then the output power measurement was recorded.

**Appendix A****A.7. RESULTS:**

The output power measurement data is presented below on page 11. As shown by the test data, the power output of the EUT is within the requirements of Part 74.861 and RSS-123.



Figure A-1 - Test Setup for RF Power Output

**Test Information**

EUT Name: ULXD2 Band H50  
Serial Number: 4121173698  
Test Description: FCC pt.74 and RSS-123 RF Power Output – Antenna Conducted  
Operating Conditions: Low, Mid and High Frequencies at 1mW, 10mW and 20mW  
Operator Name: Alex Stelmaszczyk  
Comment: PM2003 Power Meter and PH2008 Power Head  
Test Date: June 28, 2013

Checked By: Juan Castrejon Date: 08/05/2013

Frequency (MHz)	Nominal Power (mW)	Measured Power (dBm)	Measured Power (mW)	Limit (mW)
534.125	1	-0.10	0.98	250
534.125	10	10.31	10.74	250
534.125	20	13.55	22.65	250
566	1	0.43	1.10	250
566	10	10.95	12.45	250
566	20	13.86	24.32	250
597.875	1	0.40	1.10	250
597.875	10	11.03	12.68	250
597.875	20	13.60	22.91	250

**Appendix B and C****B. MODULATION CHARACTERISTICS****B.1. REQUIREMENTS:**

As stated in paragraph 74.861(e)(3) and paragraph 5.2 of RSS-123, for low power auxiliary stations operating in the bands allocated for TV broadcasting, any form of modulation may be used. A maximum deviation of  $\pm 75\text{kHz}$  is permitted when frequency modulation is employed.

**B.2 TEST PROCEDURES:**

Since the EUT employs digital modulation, no modulation characteristics tests were performed.

**C. FREQUENCY STABILITY****C.1. PURPOSE:**

This test was performed to determine if the EUT meets the frequency stability requirements of the FCC Part 74.861(e)(4) and the RSS-123 paragraph 7, table 1 specifications over the EUT operating frequency range of 534MHz to 598MHz.

**C.2. REQUIREMENTS:**

As stated in paragraph 74.861(e)(4) and paragraph 7 of RSS-123, Table 1, for low power auxiliary stations operating in the bands allocated for TV broadcasting, the frequency tolerance of the transmitter shall be 0.005 percent.

**C.3 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	$U_{\text{lab}}$
Frequency Error (Stability)	23.70 Hz

$U_{\text{lab}}$  = 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.

**C.4. TEST SETUP AND INSTRUMENTATION:**

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 T-Type thermocouple connected to a Fluke Hydra Data Logger. The EUTs frequency was measured with a spectrum analyzer set to measure signal count at 0.1Hz resolution. The center frequency of the spectrum analyzer was set to the selected transmit frequency of the EUT (Low, Mid or High). Photographs of the test setup are shown as Figure C-1. The test instrumentation can be determined from Table 10-1.

**Appendix C****C.5. EUT OPERATION:**

The antenna port of the EUT was connected to the 50 Ohm input of a spectrum analyzer. The EUT was set at its lowest power output setting (1mW) as representative of the worst case operational condition for this test. The EUT was set to transmit at a low, mid or high frequency within its operating band of 534 – 598MHz.

**C.6. TEST PROCEDURES:**

- a. The temperature chamber was set to -30C with the EUT inside and powered off.
- b. The EUT was allowed to soak for ~15 minutes after the temperature chamber reached the set temperature.
- c. The EUT was then powered on and allowed to stabilize for ~ 1 minute.
- d. The measured frequency of the transmitter was plotted with the screen capture function of the spectrum analyzer.
- e. Steps a. through d. were repeated at -20C through +50C in ten degree increments for representative low, mid and high frequencies within the EUTs operational band.

**C.7 RESULTS:**

The frequency stability measurements are presented in table C-1 on page 14. As shown by the test data, the test frequency deviation was within the 0.005 percent limit set out in the FCC Part 74.861 and the RSS-123 specifications.

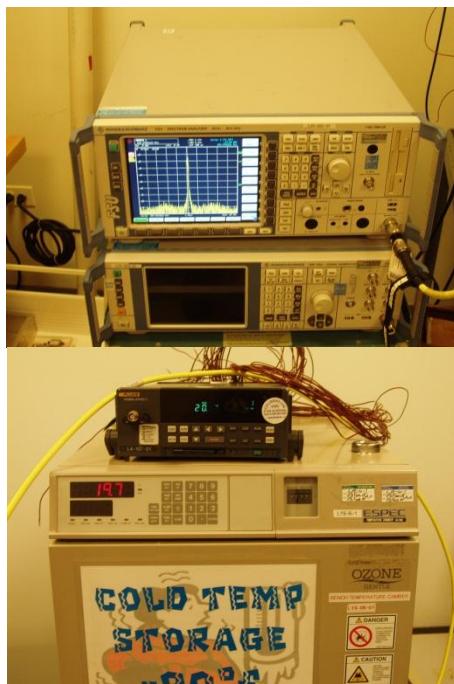


Figure C-1 - Test Setup for Frequency Stability



## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4121173698  
Test Description: FCC Part 74.861 and RSS-123 Frequency Stability  
Operating Conditions: Low, Mid and High Frequencies at 1mW, -30C to +50C  
Operator Name: Alex Stelmaszczyk  
Comment: R & S FSU Spectrum Analyzer and ESPEC Temp Chamber  
Test Date: June 24 - 26, 2013

Checked By: Juan Castrejon Date: 08/05/2013

**Table C-1: Frequency Stability Measurements**

Temp °C	Nominal Frequency (MHz)	Measured Frequency (MHz)	Deviation (%)	Frequency Stability (%)	Deviation (Hz)	Frequency Stability (Hz)	Pass Or Fail
-30	534.125	534.1102293	-0.0027654	0.005	-14771	26706.25	PASS
-20	534.125	534.1241257	-0.0001637	0.005	-874	26706.25	PASS
-10	534.125	534.1122210	-0.0023925	0.005	-12779	26706.25	PASS
0	534.125	534.1476374	0.0042382	0.005	22637	26706.25	PASS
10	534.125	534.1127994	-0.0022842	0.005	-12201	26706.25	PASS
20	534.125	534.1464884	0.0040231	0.005	21488	26706.25	PASS
30	534.125	534.1205378	-0.0008354	0.005	-4462	26706.25	PASS
40	534.125	534.1200000	-0.0009361	0.005	-5000	26706.25	PASS
50	534.125	534.1457707	0.0038887	0.005	20771	26706.25	PASS
-30	566	566.0069663	0.0012308	0.005	6966	28300	PASS
-20	566	565.9860382	-0.0024667	0.005	-13962	28300	PASS
-10	566	565.9852396	-0.0026078	0.005	-14760	28300	PASS
0	566	565.9883546	-0.0020575	0.005	-11645	28300	PASS
10	566	565.9856112	-0.0025422	0.005	-14389	28300	PASS
20	566	565.9853329	-0.0025914	0.005	-14667	28300	PASS
30	566	565.9882139	-0.0020823	0.005	-11786	28300	PASS
40	566	565.9876329	-0.0021850	0.005	-12367	28300	PASS
50	566	565.9865769	-0.0023716	0.005	-13423	28300	PASS
-30	597.875	597.8710185	-0.0006659	0.005	-3982	29893.75	PASS
-20	597.875	597.8734302	-0.0002626	0.005	-1570	29893.75	PASS
-10	597.875	597.8722827	-0.0004545	0.005	-2717	29893.75	PASS
0	597.875	597.8733882	-0.0002696	0.005	-1612	29893.75	PASS
10	597.875	597.8701361	-0.0008135	0.005	-4864	29893.75	PASS
20	597.875	597.8710596	-0.0006591	0.005	-3940	29893.75	PASS
30	597.875	597.8706145	-0.0007335	0.005	-4386	29893.75	PASS
40	597.875	597.8712561	-0.0006262	0.005	-3744	29893.75	PASS
50	597.875	597.8711739	-0.0006399	0.005	-3826	29893.75	PASS



## D. OCCUPIED BANDWIDTH MEASUREMENTS

### D.1. PURPOSE:

This test was performed to determine if the EUT meets the occupied bandwidth requirements of the FCC Part 74.861(e)(4) and the RSS-123 paragraph 7, table 1 specifications over the EUT operating frequency range of 534MHz to 598MHz.

### D.2. REQUIREMENTS:

As stated in paragraph 74.861(e)(5) and (6), for low power auxiliary stations operating in the bands allocated for TV broadcasting, the following technical requirements apply:

- a) The operating bandwidth shall not exceed 200 kHz.
- b) The mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:
  - i. On any frequency removed from the operating frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: at least 25 dB;
  - ii. On any frequency removed from the operating frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: at least 35 dB;
  - iii. On any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth: at least  $43+10\log_{10}$  (mean output power in watts) dB.

Per the specifications set out in RSS-123 paragraph 5.3 and 5.5.1, the following technical requirements apply:

- a) The authorized bandwidth shall not exceed 200kHz.
- b) the power of unwanted emissions shall be attenuated below the mean transmitter power in accordance with the following schedule:
  - i. On any frequency removed from the carrier frequency by more than 50% up to and including 100% of the authorized bandwidth: at least 25 dB.
  - ii. On any frequency removed from the carrier frequency by more than 100% up to and including 250% of the authorized bandwidth: at least 35 dB.
  - iii. On any frequency removed from the carrier frequency by more than 250% of the authorized bandwidth: at least  $55 + 10 \log (P)$  dB.

### D.3. TEST SETUP AND INSTRUMENTATION:

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

### D.4. EUT OPERATION:

The EUT was powered up and the transmit frequency and power output level of the transmitter were selected using the front panel controls. The EUT was powered at 3VDC by 2 "AA" alkaline batteries. The EUT was



---

**Appendix D**

checked for proper operation after it was setup for the test. Testing was conducted with the EUT set to transmit at 534.125MHz, 566MHz and 597.875MHz at an output power level of 20mW. Testing was also performed at an output power level of 1mW in normal channel bandwidth mode and high density channel bandwidth mode to demonstrate compliance to the occupied bandwidth requirements stated in section D.2. For the purpose of measuring and setting the peak output power reference level on the spectrum analyzer, the EUT was programmed to transmit a continuous string of "0"s in order to simulate an unmodulated carrier condition. The EUT was then returned to normal operation for the occupied bandwidth testing.

**D.5. TEST PROCEDURES:**

- a) The EUT was connected to the 50 ohm input of a spectrum analyzer through 20dB of attenuation.
- b) The EUT was modulated with a string of "0"s via software code.
- c) The bandwidth of the spectrum analyzer was set to 1MHz.
- d) The peak output power was measured and used to set the reference level on the spectrum analyzer.
- e) The EUT was then modulated with a typical digital modulation.
- f) The bandwidth of the spectrum analyzer was set to 2kHz (1% of Authorized BW).

**D.6. RESULTS:**

The occupied bandwidth measurement data is presented on page 18 – page 29. As shown by the test data, the occupied bandwidth of the EUT meets the requirements set out in FCC Part 74.861 and RSS-123.

The maximum Industry Canada 99% bandwidth measurement was 164kHz.

## Appendix D

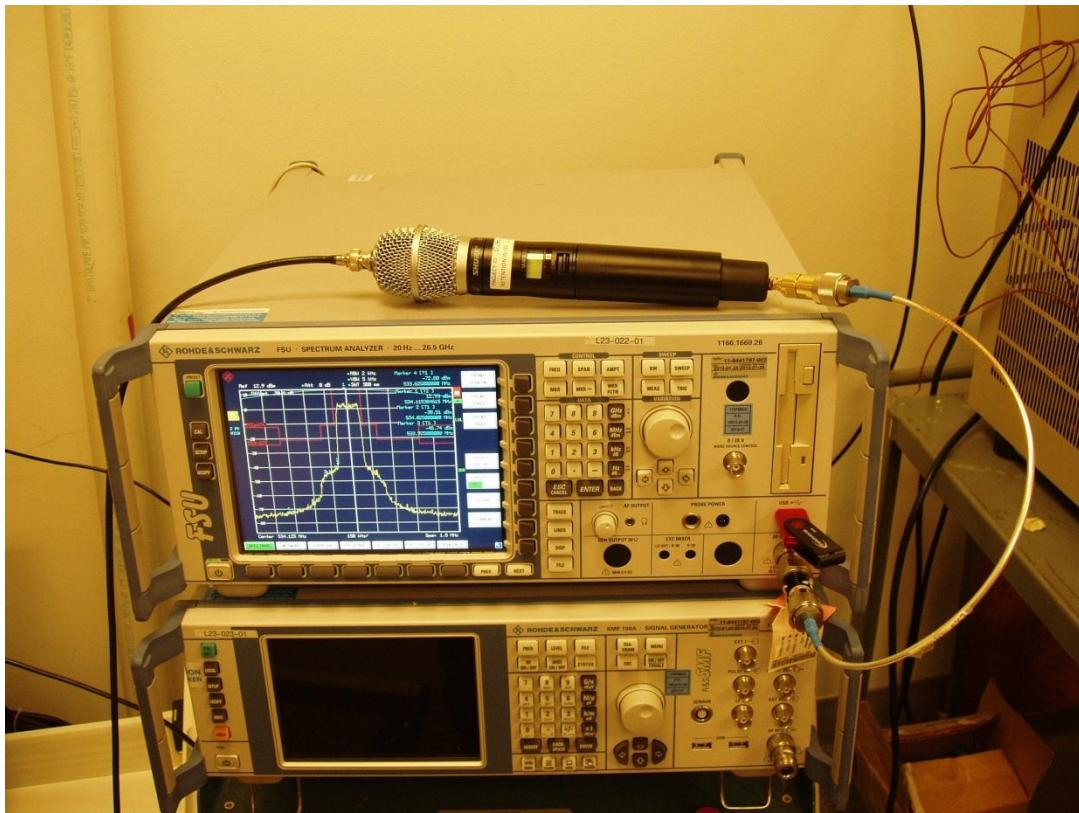
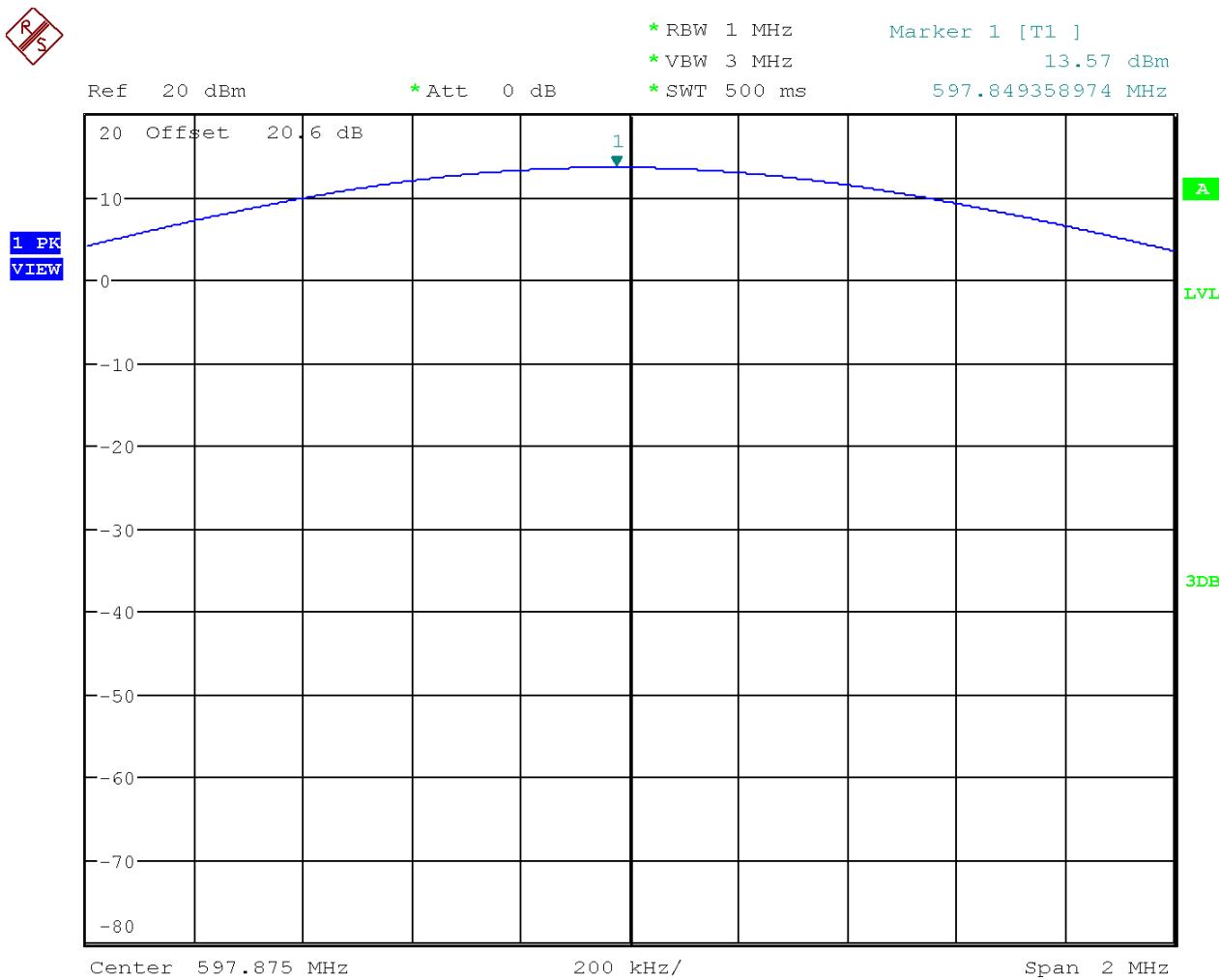


Figure D-1 - Test Setup for Occupied Bandwidth



## Test Information

Serial Number: ULXD2 Band H50  
4121173698  
Test Description: FCC Part 74.861 and RSS-123 Occupied Bandwidth  
Operating Conditions: Output Power Reference  
High Frequency (597.875MHz) at 20mW  
Operator Name: Alex Stelmaszczyk  
Comment: R & S FSU Spectrum Analyzer  
Test Date: September 3, 2013

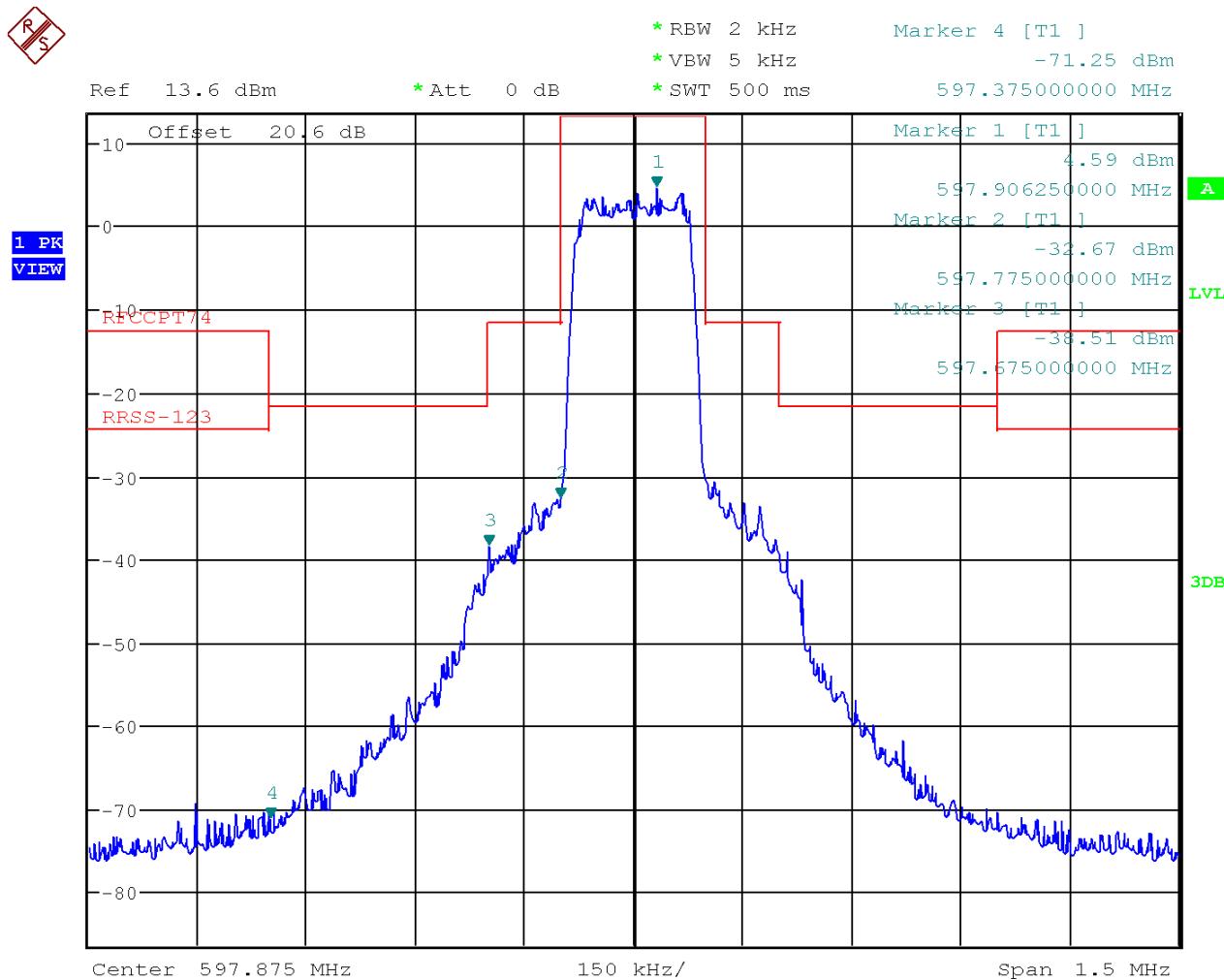


Date: 3.SEP.2013 13:40:01



## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4121173698  
Test Description: FCC Part 74.861 and RSS-123 Occupied Bandwidth  
Operating Conditions: High Frequency (597.875MHz) at 20mW  
Operator Name: Alex Stelmaszczyk  
Comment: R & S FSU Spectrum Analyzer  
Test Date: September 3, 2013

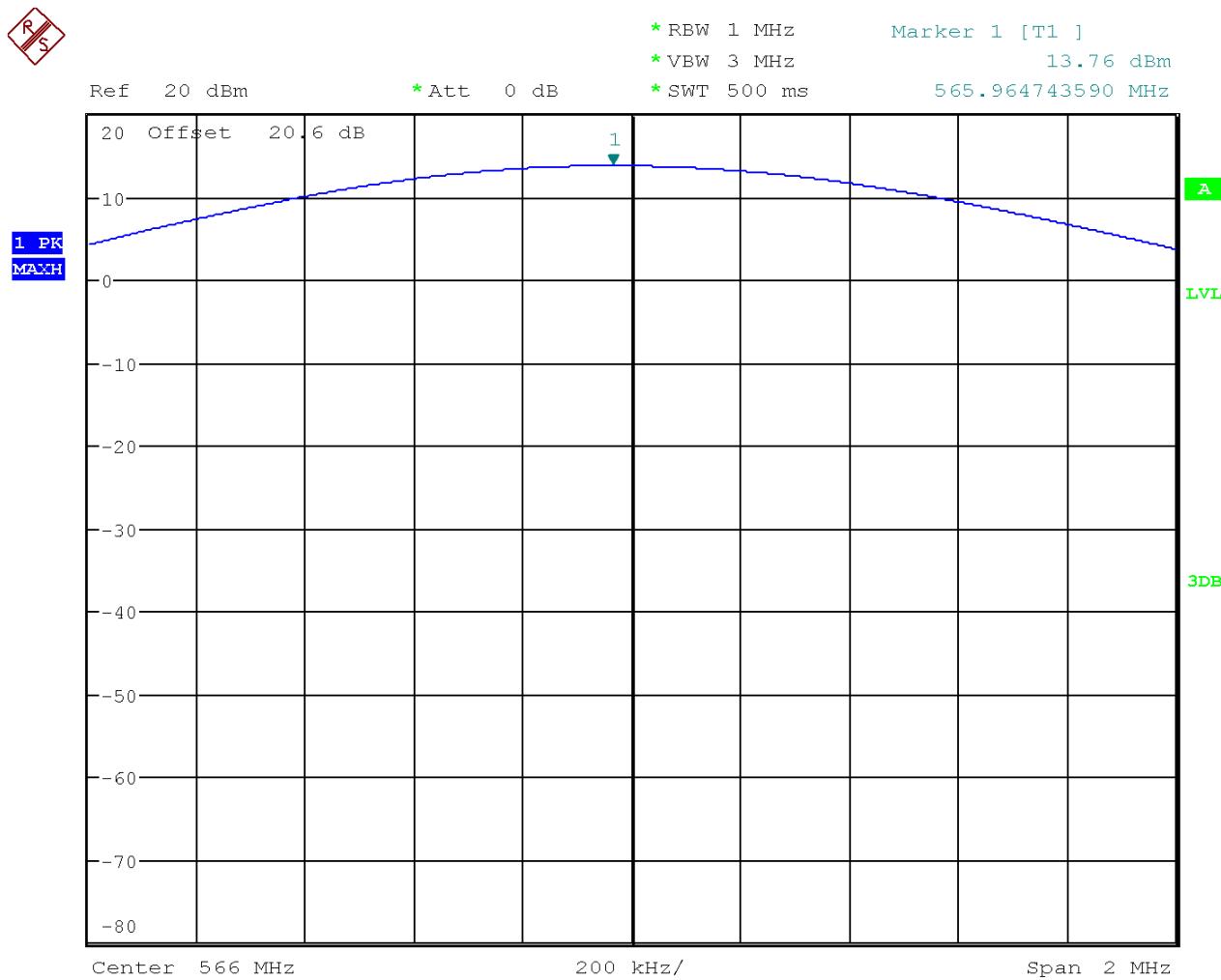


Date: 3.SEP.2013 13:44:03



## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4121173698  
Test Description: FCC Part 74.861 and RSS-123 Occupied Bandwidth  
Operating Conditions: Output Power Reference  
Operator Name: Mid Frequency (566.000MHz) at 20mW  
Comment: Alex Stelmaszczyk  
Test Date: R & S FSU Spectrum Analyzer  
September 3, 2013

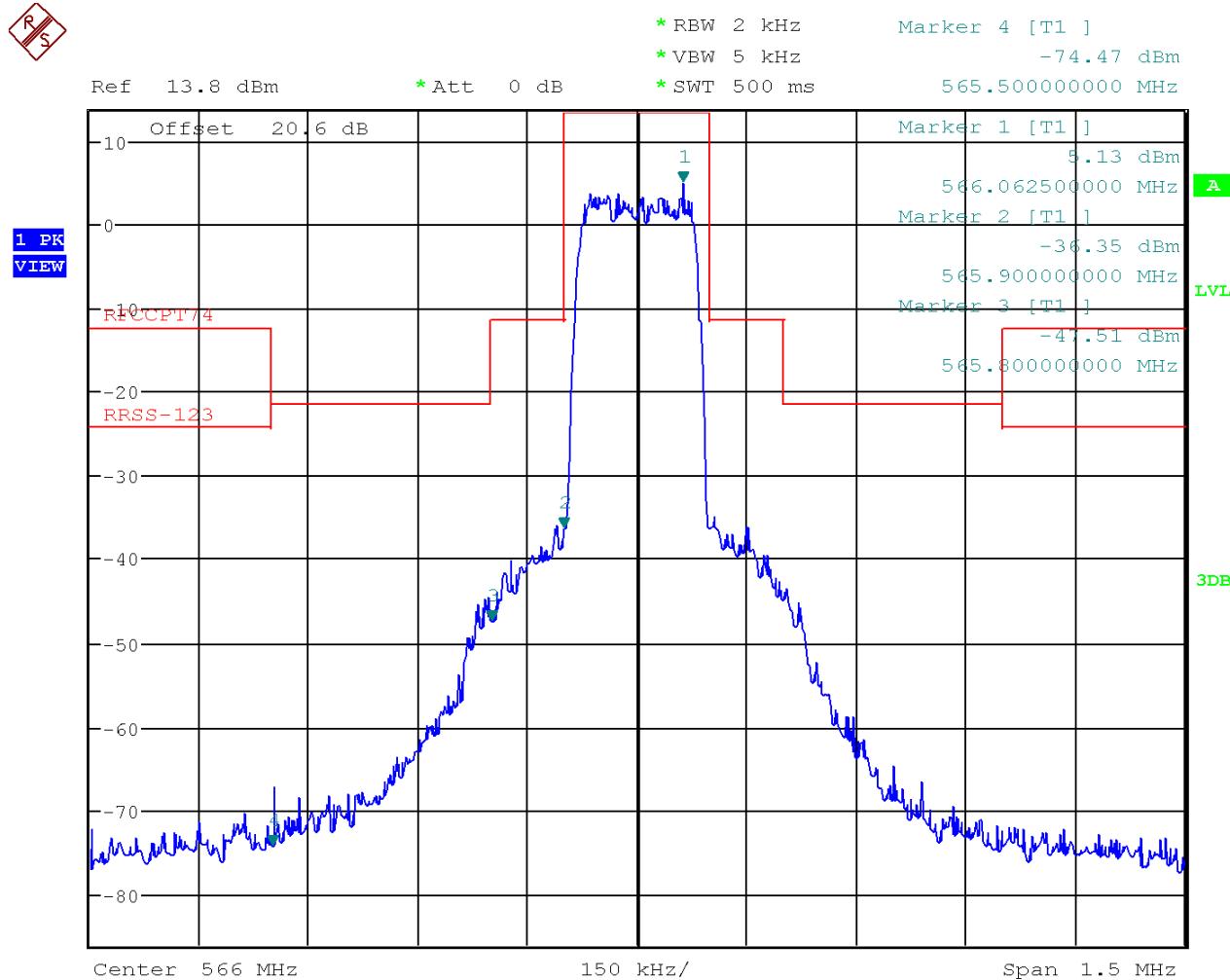


Date: 3.SEP.2013 13:57:02



## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4121173698  
Test Description: FCC Part 74.861 and RSS-123 Occupied Bandwidth  
Operating Conditions: Mid Frequency (566.000MHz) at 20mW  
Operator Name: Alex Stelmaszczyk  
Comment: R & S FSU Spectrum Analyzer  
Test Date: September 3, 2013

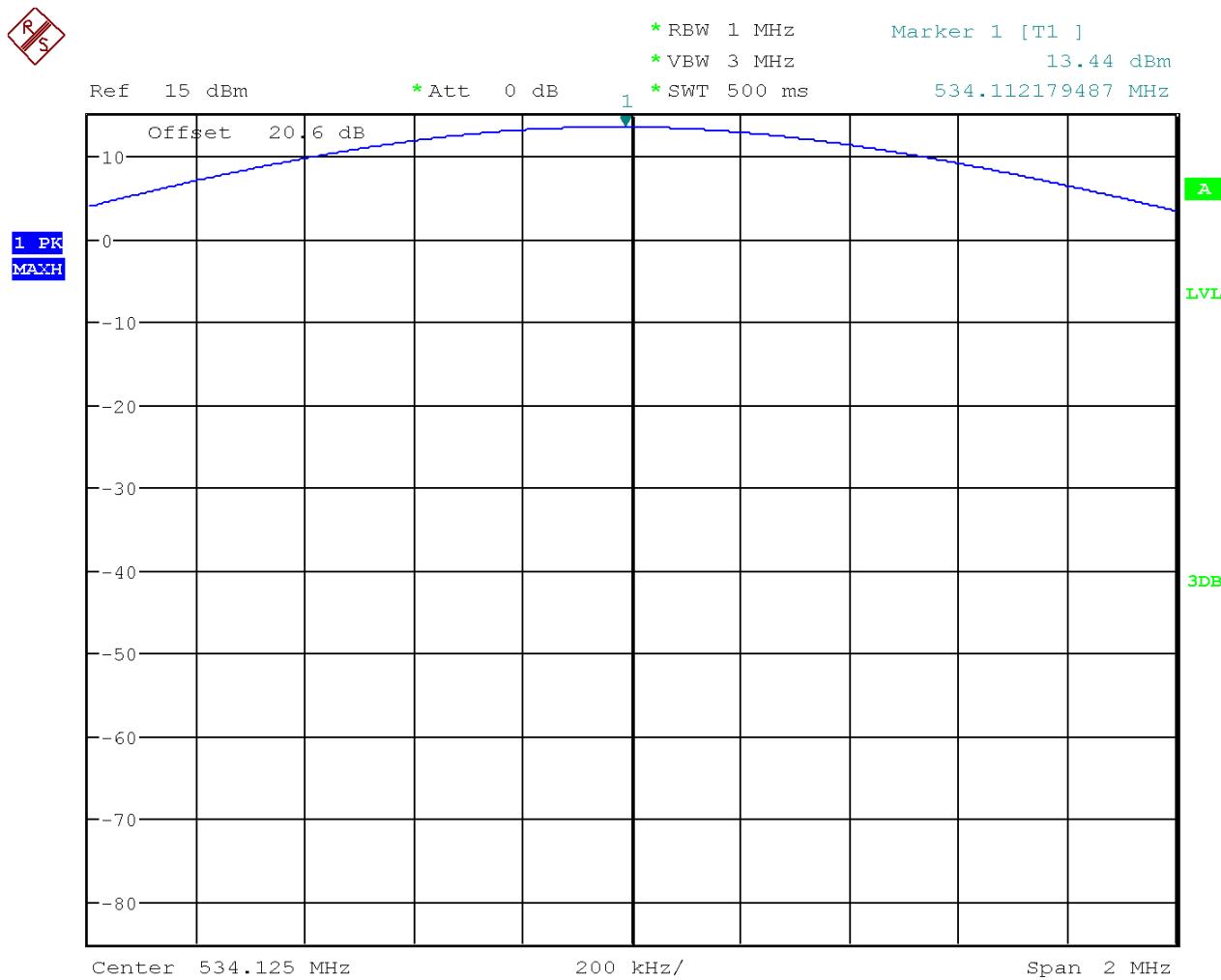


Date: 3.SEP.2013 14:00:05



## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4121173698  
Test Description: FCC Part 74.861 and RSS-123 Occupied Bandwidth  
Operating Conditions: Output Power Reference  
Operator Name: Low Frequency (534.125MHz) at 20mW  
Comment: Alex Stelmaszczyk  
Test Date: R & S FSU Spectrum Analyzer  
September 3, 2013

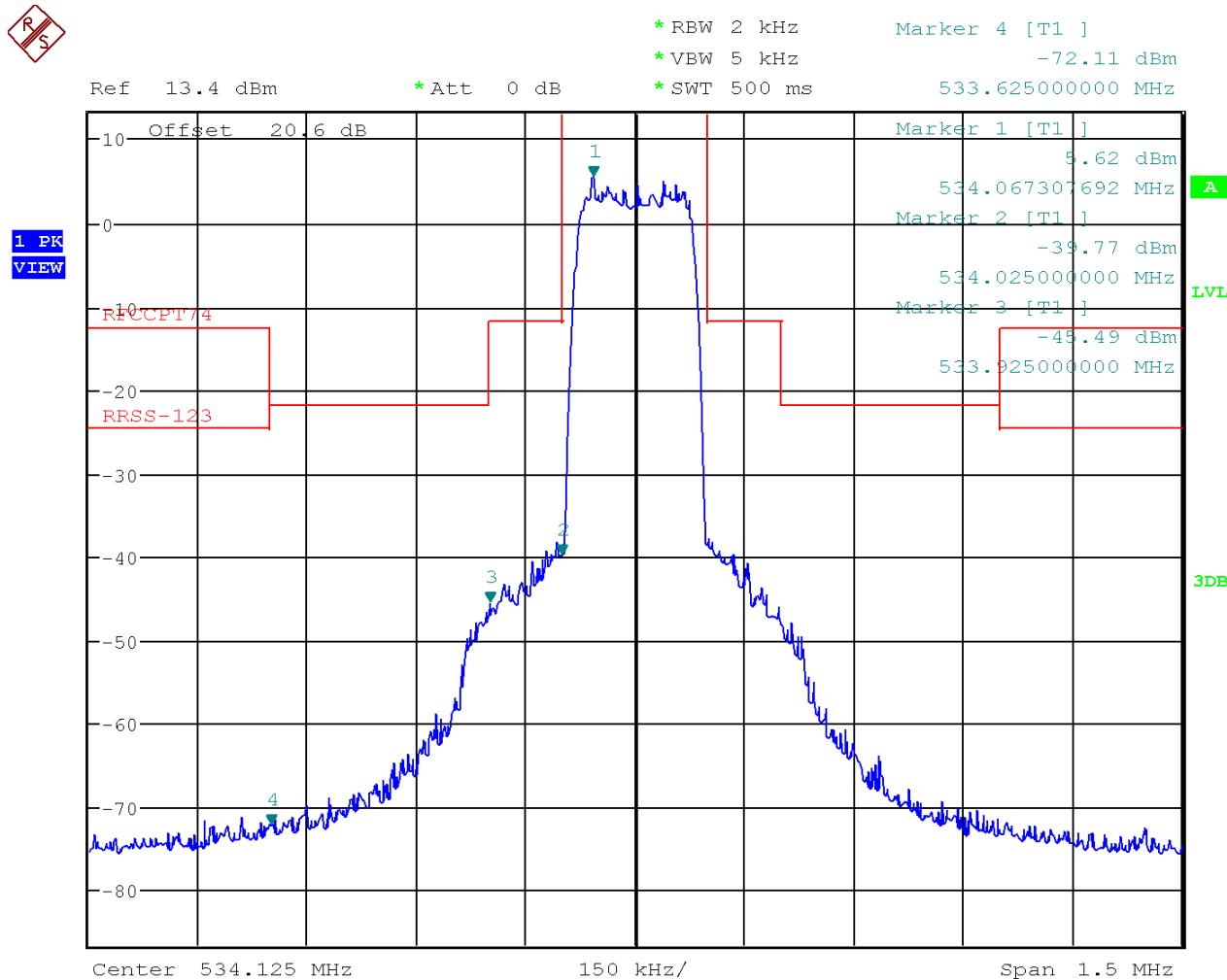


Date: 3.SEP.2013 14:41:30



## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4121173698  
Test Description: FCC Part 74.861 and RSS-123 Occupied Bandwidth  
Operating Conditions: Low Frequency (534.125MHz) at 20mW  
Operator Name: Alex Stelmaszczyk  
Comment: R & S FSU Spectrum Analyzer  
Test Date: September 3, 2013

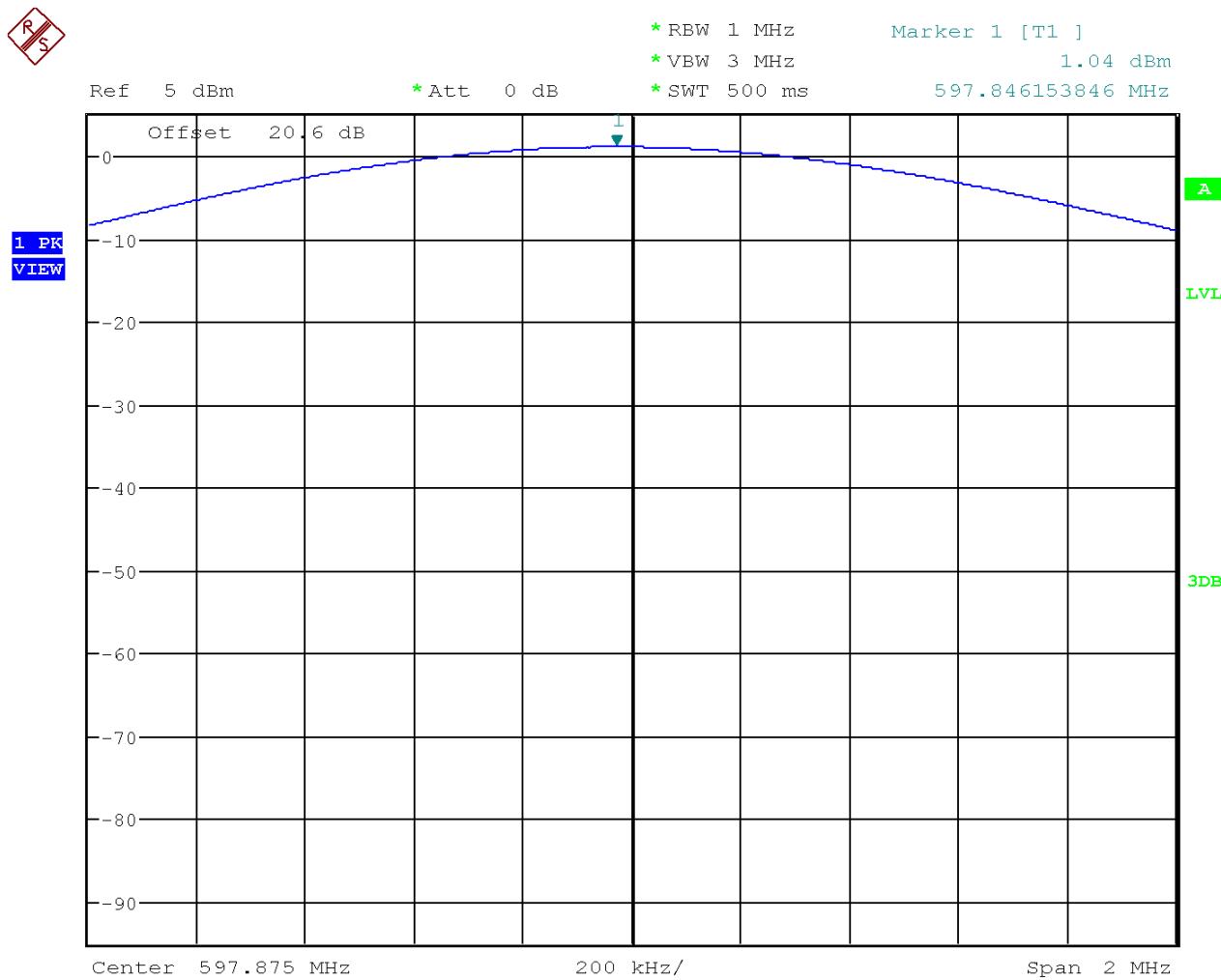


Date: 3.SEP.2013 14:45:23



## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4121173698  
Test Description: FCC Part 74.861 and RSS-123 Occupied Bandwidth  
Operating Conditions: Output Power Reference  
Operator Name: High Frequency (597.875MHz) at 1mW  
Comment: Alex Stelmaszczyk  
Test Date: R & S FSU Spectrum Analyzer  
September 3, 2013

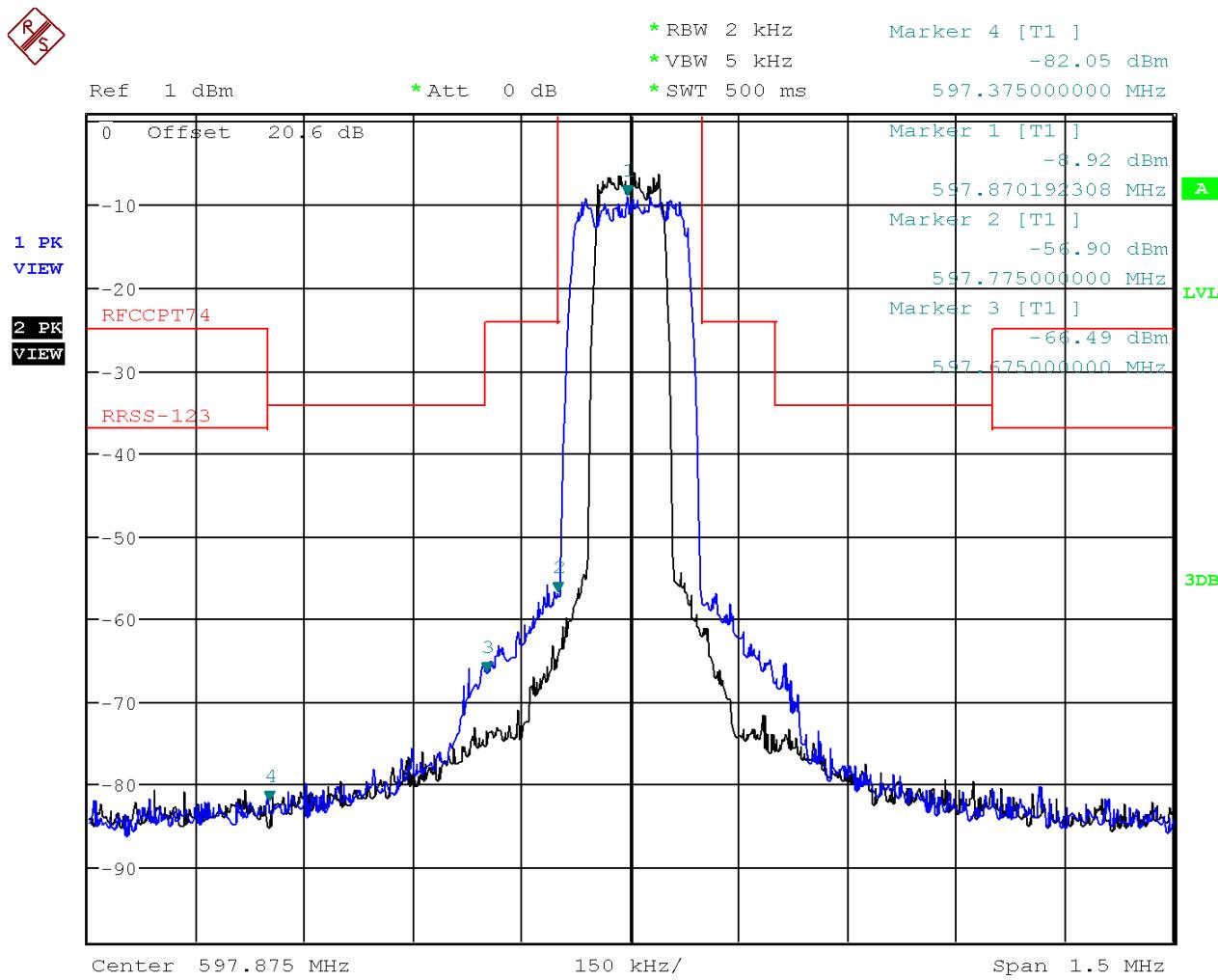


Date: 3.SEP.2013 13:47:05



## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4121173698  
Test Description: FCC Part 74.861 and RSS-123 Occupied Bandwidth  
Operating Conditions: High Frequency (597.875MHz) at 1mW in Normal Mode  
(Blue Trace) and High Density Mode (Black Trace)  
(Channel Bandwidth Options)  
Operator Name: Alex Stelmaszczyk  
Comment: R & S FSU Spectrum Analyzer  
Test Date: September 3, 2013

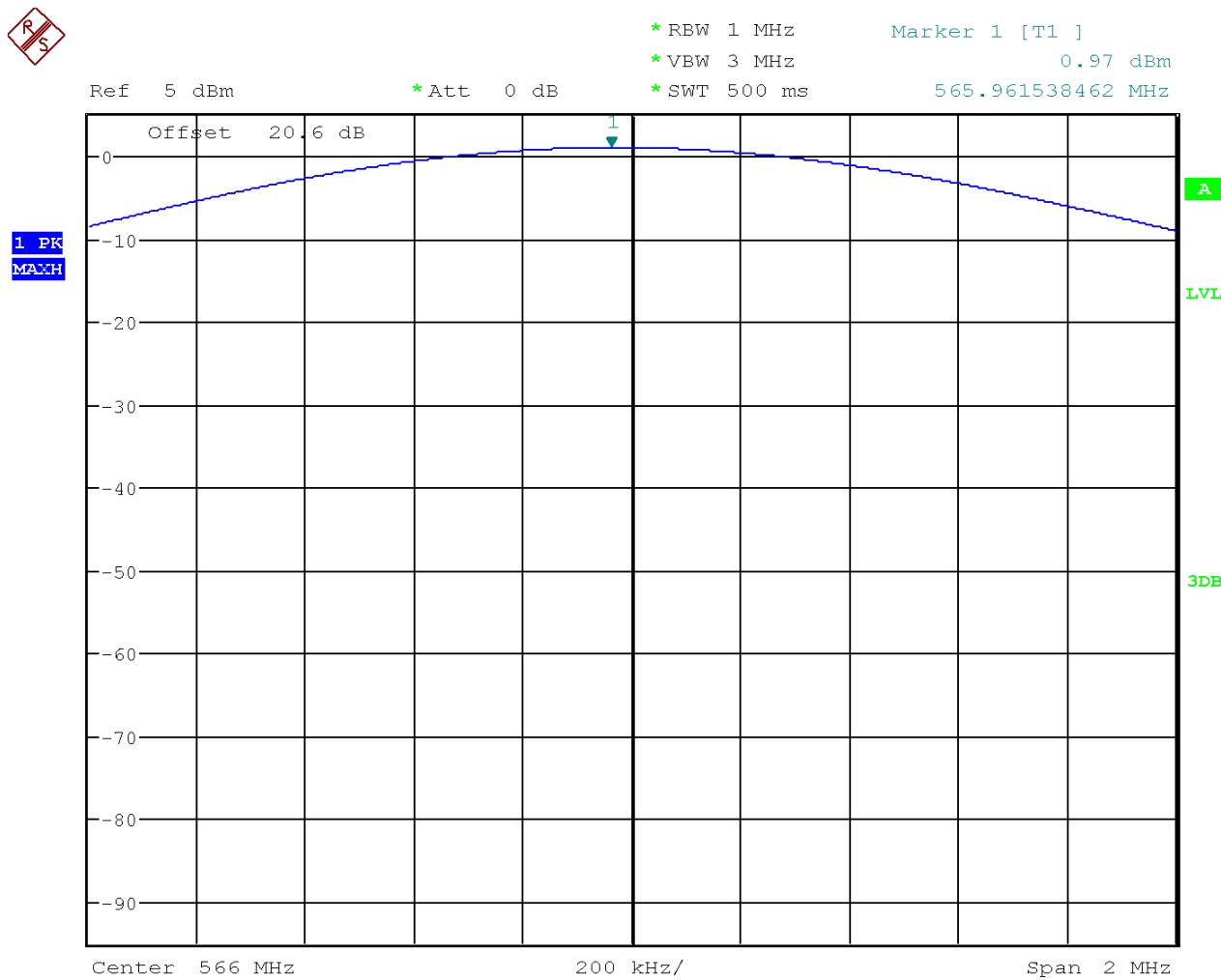


Date: 3.SEP.2013 13:53:15



## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4121173698  
Test Description: FCC Part 74.861 and RSS-123 Occupied Bandwidth  
Operating Conditions: Output Power Reference  
Operator Name: Mid Frequency (566.000MHz) at 1mW  
Comment: Alex Stelmaszczyk  
Test Date: R & S FSU Spectrum Analyzer  
September 3, 2013

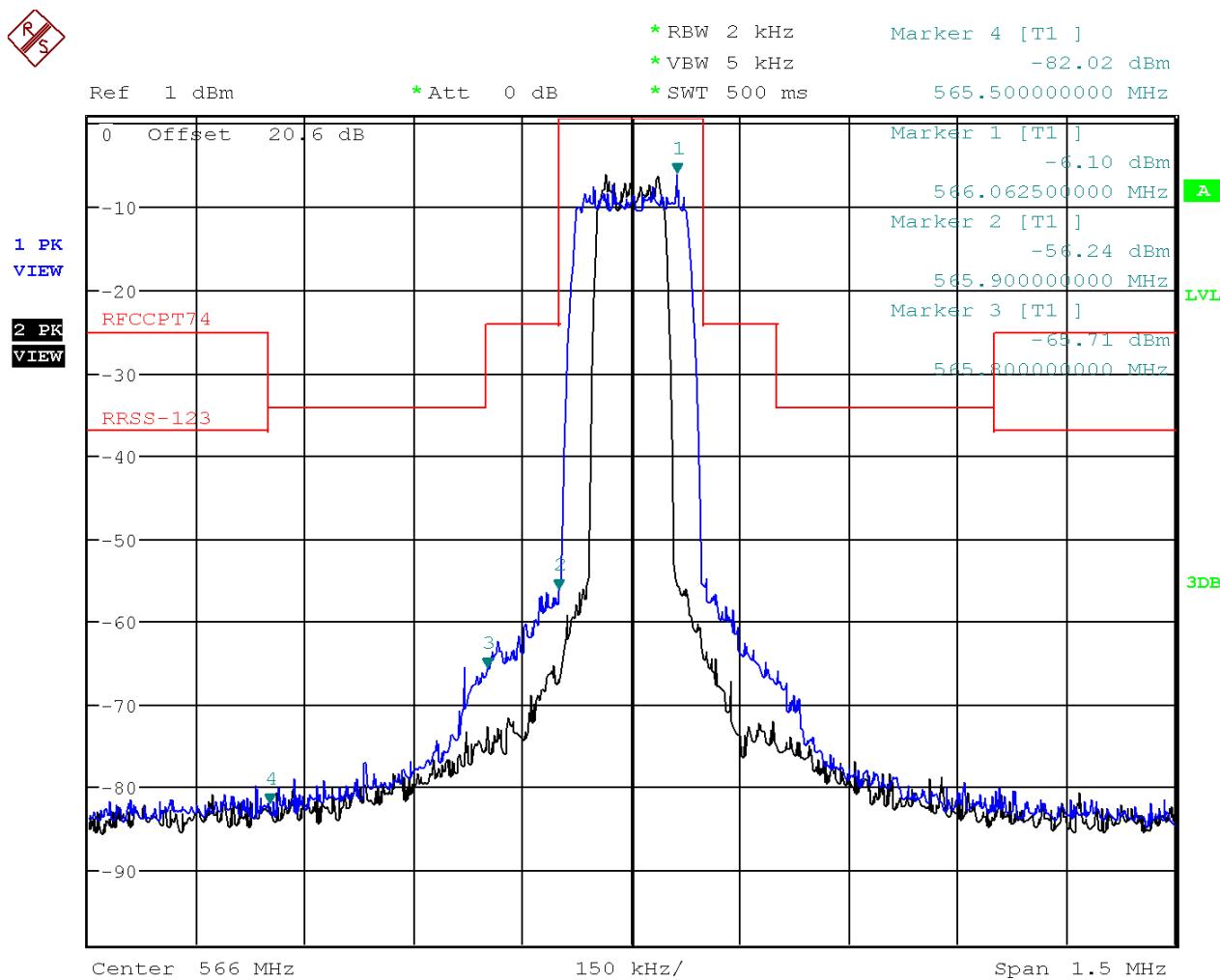


Date: 3.SEP.2013 14:31:31



## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4121173698  
Test Description: FCC Part 74.861 and RSS-123 Occupied Bandwidth  
Operating Conditions: Mid Frequency (566.000MHz) at 1mW in Normal Mode  
(Blue Trace) and High Density Mode (Black Trace)  
(Channel Bandwidth Options)  
Operator Name: Alex Stelmaszczyk  
Comment: R & S FSU Spectrum Analyzer  
Test Date: September 3, 2013

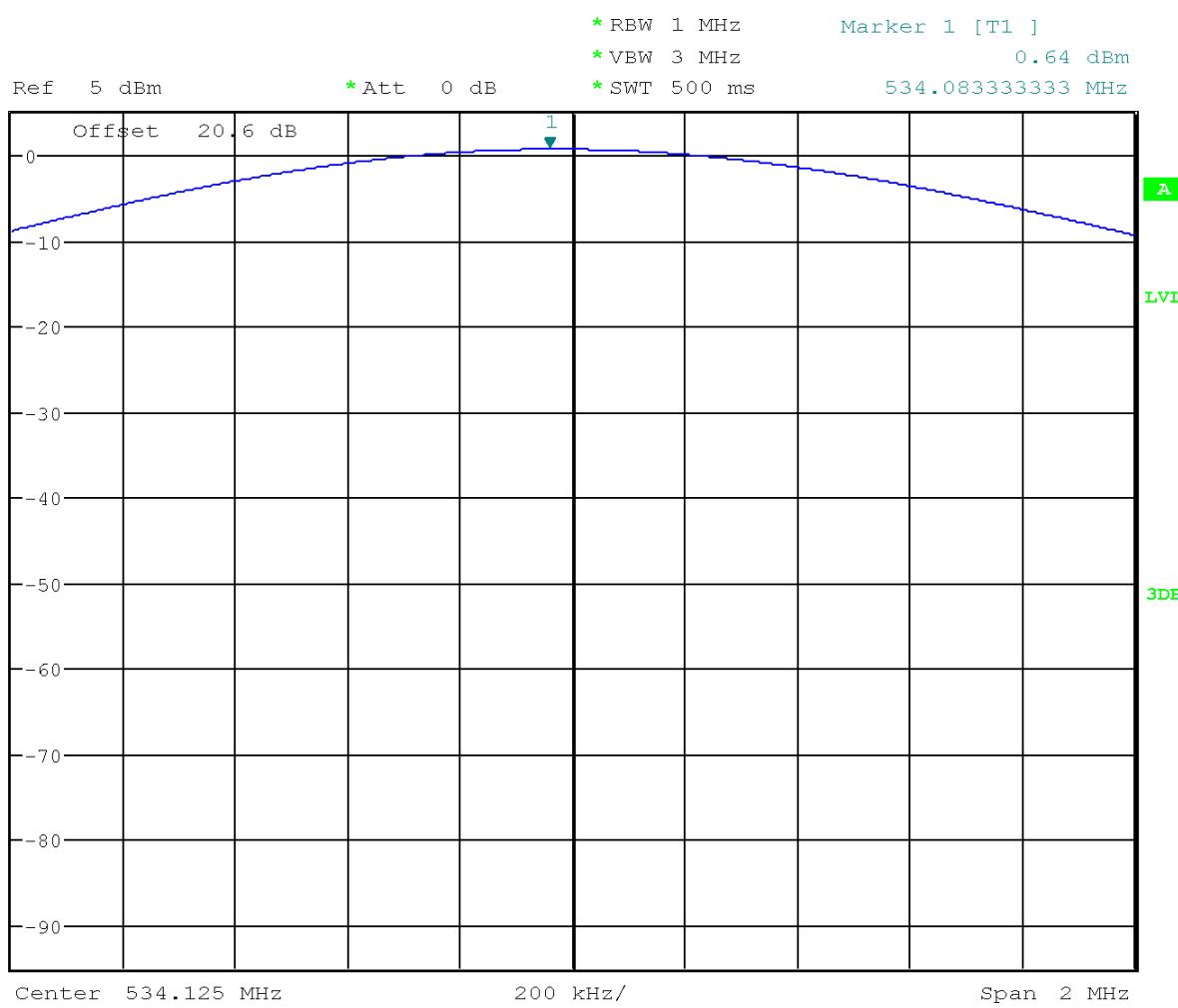


Date: 3.SEP.2013 14:36:37



## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4121173698  
Test Description: FCC Part 74.861 and RSS-123 Occupied Bandwidth  
Operating Conditions: Output Power Reference  
Operator Name: Low Frequency (534.125MHz) at 1mW  
Comment: Alex Stelmaszczyk  
Test Date: R & S FSU Spectrum Analyzer  
September 3, 2013

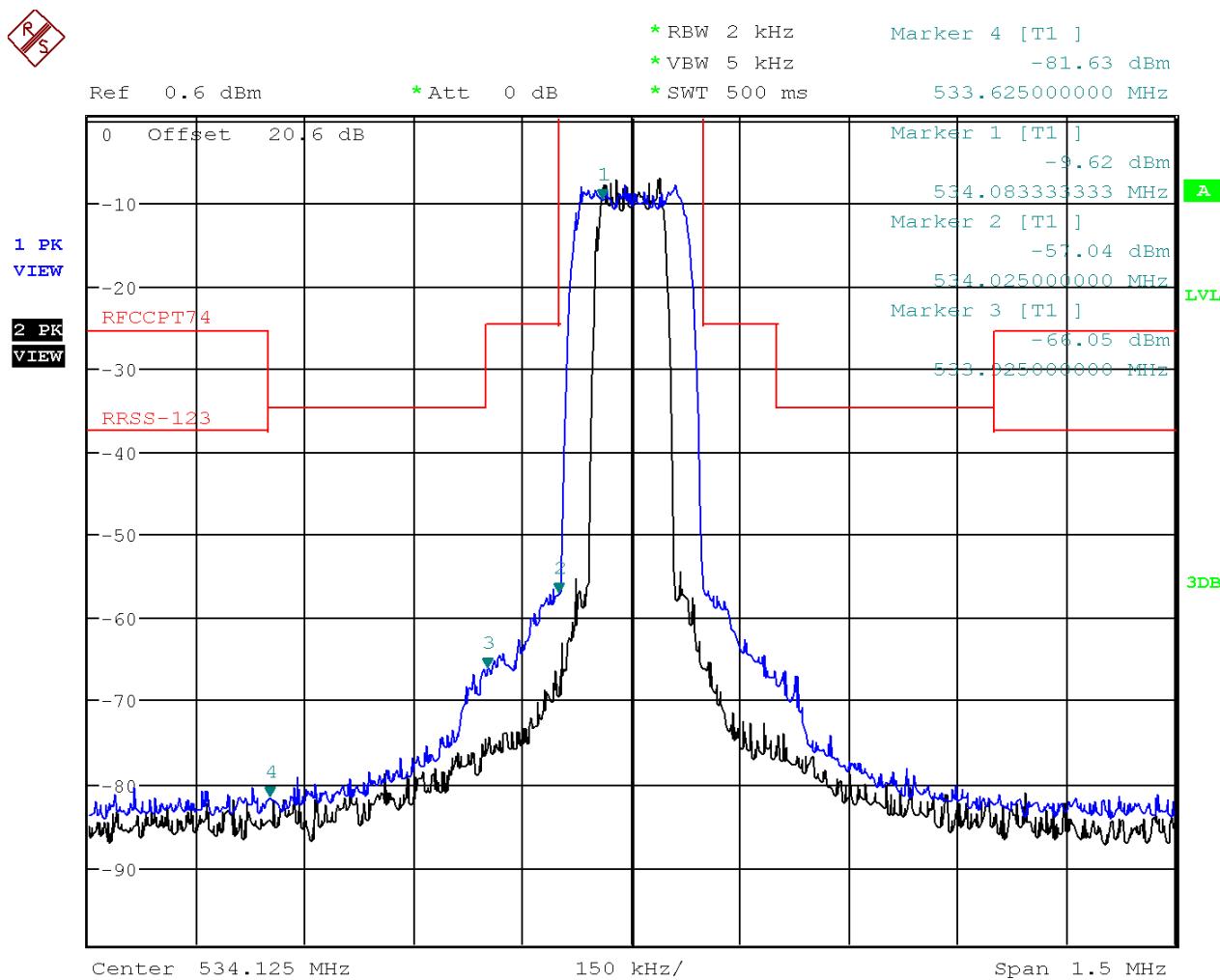


Date: 3.SEP.2013 15:35:50



## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4121173698  
Test Description: FCC Part 74.861 and RSS-123 Occupied Bandwidth  
Operating Conditions: Low Frequency (534.125MHz) at 1mW in Normal Mode  
(Blue Trace) and High Density Mode (Black Trace)  
(Channel Bandwidth Options)  
Operator Name: Alex Stelmaszczyk  
Comment: R & S FSU Spectrum Analyzer  
Test Date: September 3, 2013



Date: 3.SEP.2013 15:42:16



---

Appendix E

## E. FIELD STRENGTH OF SPURIOUS EMISSIONS – 30 MHz TO 6000 MHz

### E.1. PURPOSE:

This test was performed to determine if the ULXD2 (EUT) meets the radiated RF emission requirements of the FCC Part 74.861(e)(6)(iii), and the RSS-123 Section 6 specifications, over the frequency range from 30MHz to 6GHz.

### E.2. REQUIREMENTS:

As stated in paragraph 74.861 for low power auxiliary stations operating in the bands allocated for TV broadcasting, the mean power of emissions shall be attenuated by at least  $43 + 10 \log (P)$  dB below the mean output power on any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth.

As stated in section 5.5.1 of RSS-123 for low power auxiliary equipment, the power of unwanted emissions shall be attenuated by at least  $55 + 10 \log (P)$  dB below the mean output power on any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth.

### E.3. 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 disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.17 dB
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 12.75 GHz)	4.60 dB

$U_{lab}$  = 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.

### E.4. TEST SETUP AND INSTRUMENTATION:

Photographs of the test setup are shown in Figures E-1, E-2 and E-3 on pages 33 - 34. The test instrumentation can be determined from Table 10-1.

### E.5. EUT OPERATION:

The EUT was powered up and the frequency of the transmitter was selected using the front panel controls.

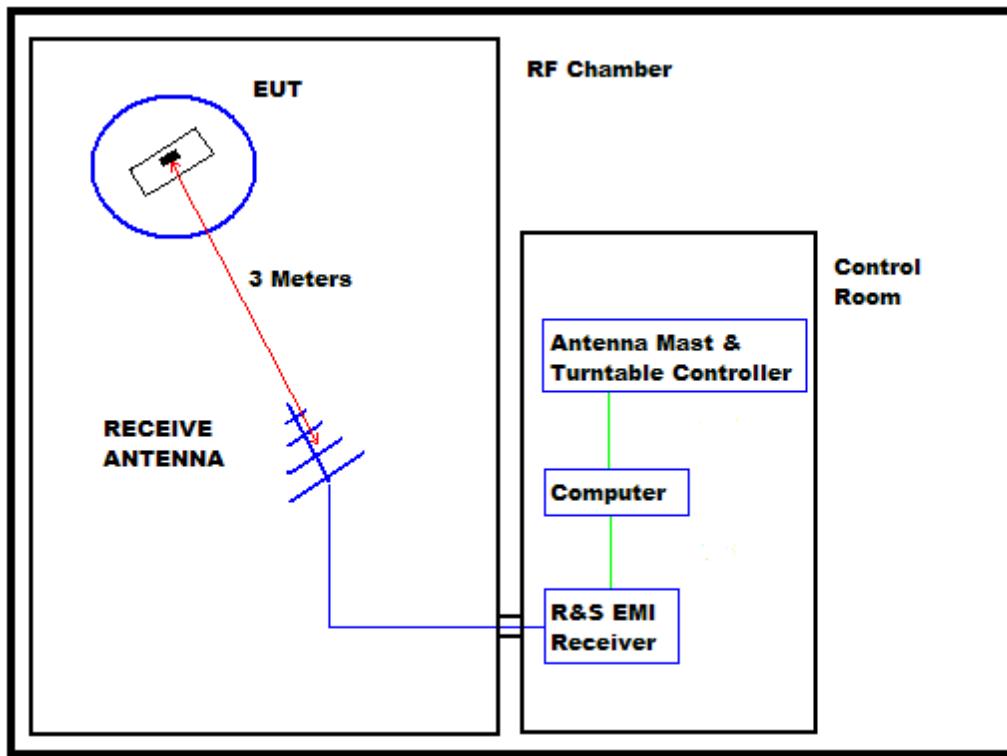
The EUT was checked for proper operation after it was setup on the table. Testing was conducted with the EUT set to the Low, Mid and High frequency within the operating frequency range, and powered with 2 "AA" batteries.

## Appendix E

## E.6. 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. The broadband measuring antenna was positioned at a 3 meter distance from the EUT. The frequency range from 30MHz to 1GHz was investigated using a peak detector function with the BiConiLog antenna at horizontal and vertical polarization, and with several different orientations of the EUT with respect to the antenna. The maximum levels measured for each antenna polarization were then automatically plotted. The resultant field strength (FS) is a summation in decibels (dB) of the EMI receiver measurement (ERM), the antenna correction factor (AF), and the cable loss factor (CF). If an external pre-amplifier is used, the total is reduced by its gain (-PA).

Formula 1:  $FS (dB\mu V/m) = MTR (dB\mu V) + AF (dB/m) + CF (dB) + (- PA (dB))$

To convert the Field Strength  $dB\mu V/m$  term to  $\mu V/m$ , the  $dB\mu V/m$  is first divided by 20. The Base 10 AntiLog is taken of this quotient. The result is the Field Strength value in  $\mu V/m$  terms.

**Appendix E**

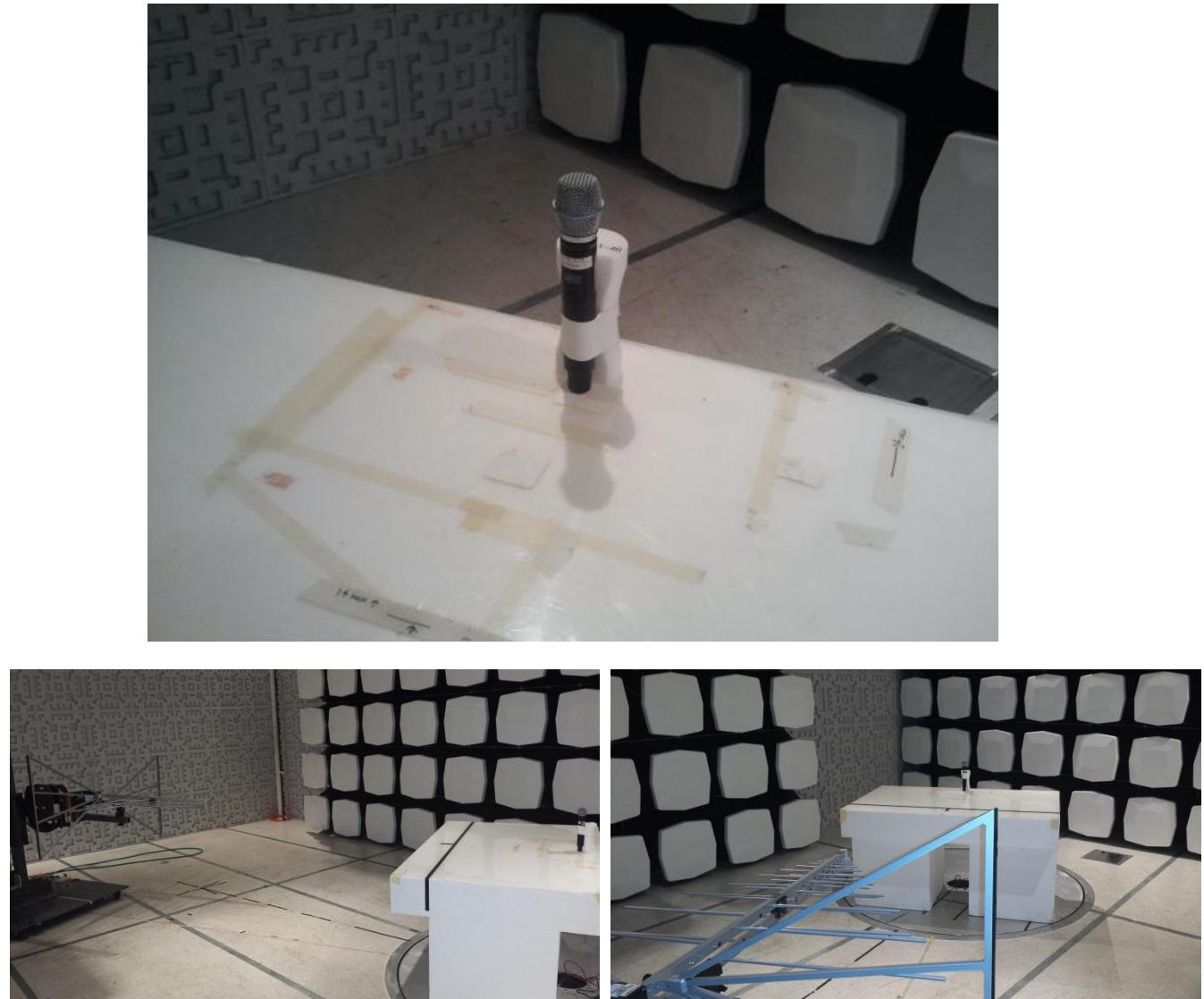
Formula 2:  $FS (\mu V/m) = AntiLog [(FS (dB\mu V/m))/20]$

Final radiated RF emissions were performed on all significant broadband and narrowband emissions found in the preliminary sweeps using the following methods:

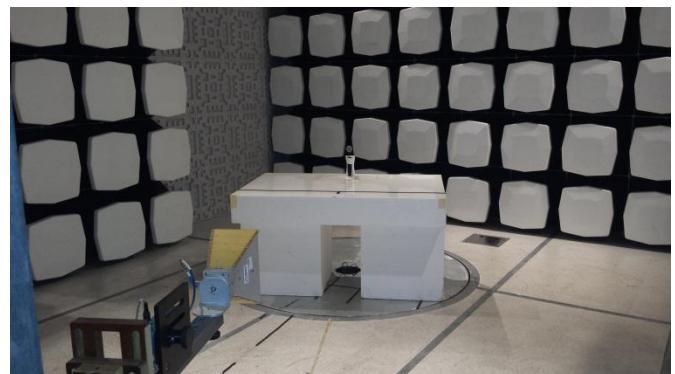
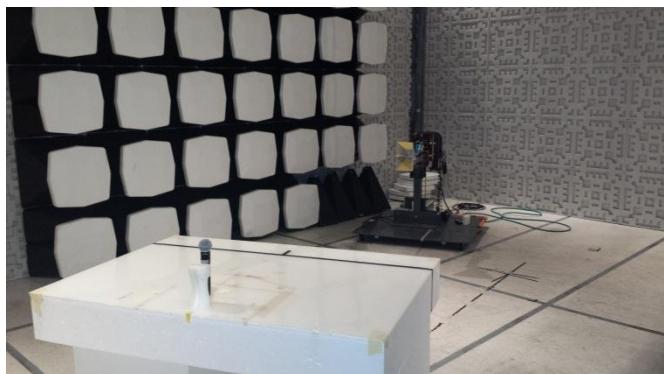
- 1) Measurements of all significant broadband and narrowband signals from 30MHz to 1GHz were made using a quasi-peak detector and a BiConiLog antenna. Measurements above 1GHz were made using an average detector and a broadband double ridged waveguide antenna.
- 2) To ensure that maximum or worst case, 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 antenna is 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.
- 3) Once the significant narrowband emissions were defined and their measurements maximized, the measurements were confirmed by matching the field strength of the maximized signal from the EUT by substituting the EUT with a dipole antenna below 1GHz and a waveguide horn antenna above 1GHz and reproducing the field strength measurement.
  - i. The substitution antenna was positioned in the same orientation as the EUT.
  - ii. The output of a signal generator set at the same frequency as the significant narrow band emission was fed into the substitution antenna.
  - iii. The test antenna was raised or lowered as necessary to ensure that the maximum signal was still received.
  - iv. The output power level (in dBm) of the signal generator was increased until the corresponding reading on the test receiver matched the maximized field strength measurement.
  - v. The output power level of the signal generator was recorded as the absolute level of the spurious radiated emission in dBm taking into account any cable loss and antenna gain inherent in the substitution test setup.

#### E.7. RESULTS:

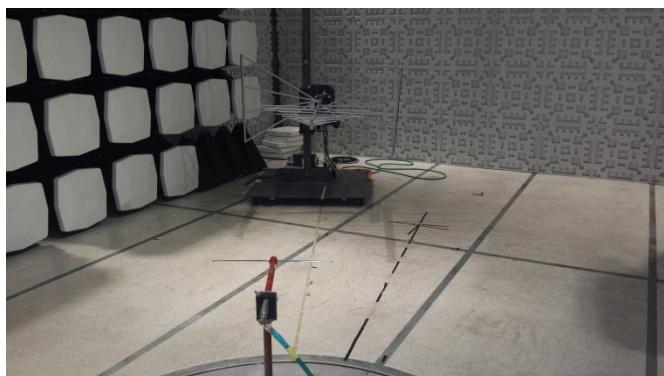
The plots of the peak preliminary radiated voltage levels are presented on pages 35 through 51. The maximized peak radiated voltage level results are presented on pages 37, 40, 43, 46, 49 and 52. All emissions measured from the ULXD2 were within both the FCC "Code of Federal Regulations" Title 47 Part 74, Subpart H and Industry Canada RSS-123 Sections 6 specification limits.



**Figure E-1 - Test Setup for Spurious Emissions 30MHz to 1GHz**



**Figure E-2 - Test Setup for Spurious Emissions 1GHz to 6GHz**



**Figure E-3 - Test Setup for Matching 30MHz to 1GHz**



**Figure E-4 - Test Setup for Matching 1GHz to 6GHz**



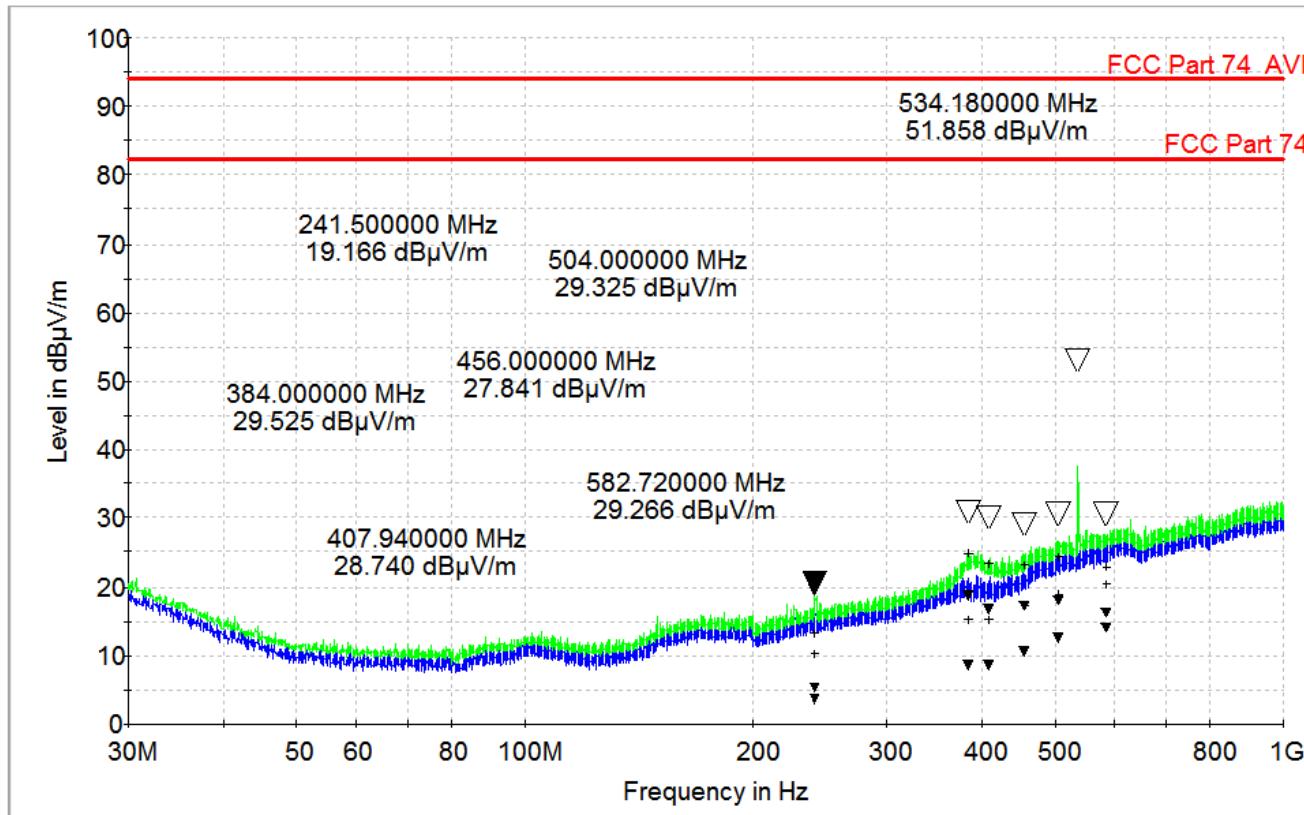
## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4111860672  
Test Description: Radiated RF Emissions 1GHz  
Operating Conditions: Freq = 534.125MHz, 20mW  
Operator Name: Craig Kozokar  
Comment: Horizontal and Vertical Antenna  
Description: ULXD2 H50\_Low Freq\_20mW\_22s prescans  
Test Date & Time: June 24, 2013 1:40:14

## Scan Setup: COMPLIANCE TEST FCC EN55022 30 to 1000 MHz [EMI radiated]

Hardware Setup: Electric Field Strength 2013 04 10  
Level Unit: dB $\mu$ V/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
30MHz - 1GHz	MaxPeak	120kHz	0.02s	Receiver





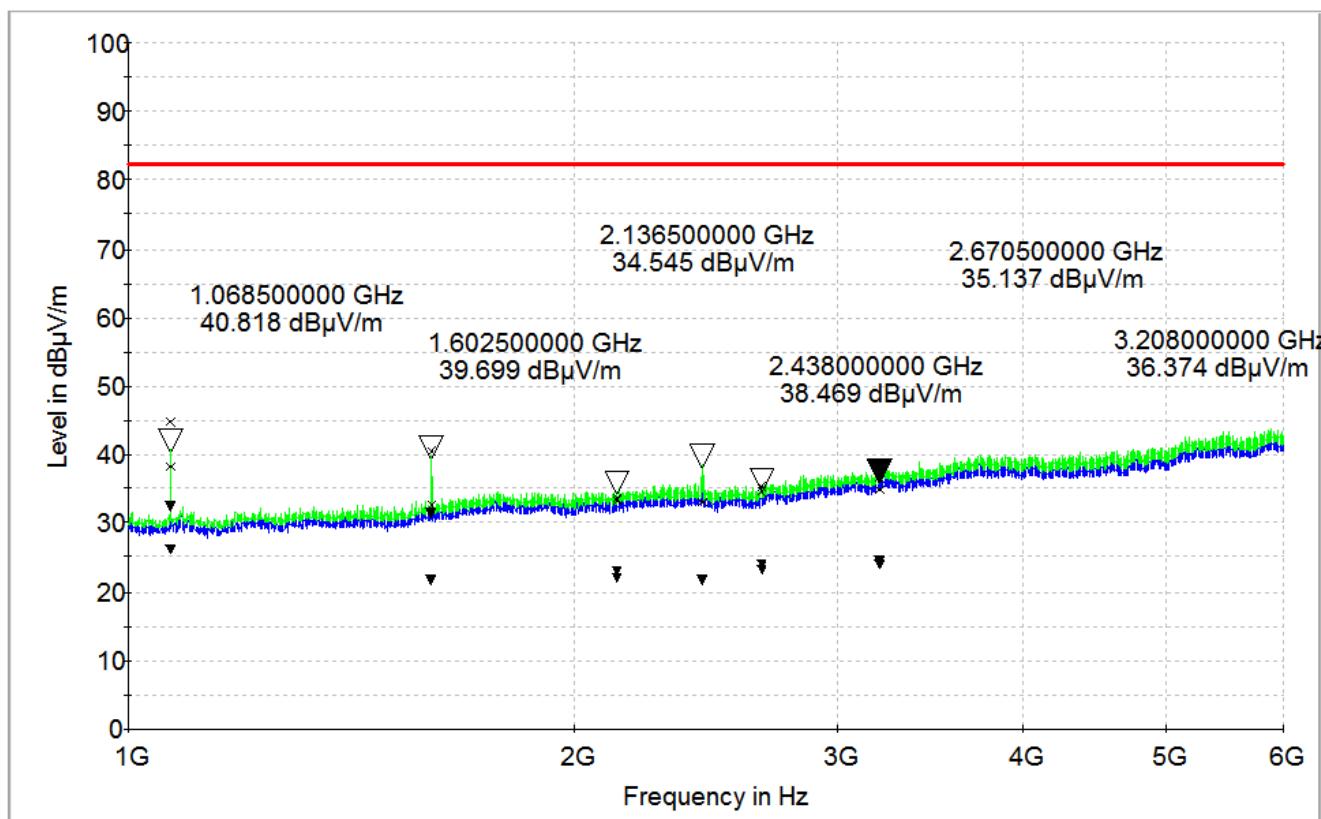
## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4111860672  
Test Description: Radiated RF Emissions 1-6GHz  
Operating Conditions: Freq = 534.125MHz, 20mW  
Operator Name: Shaun Syas  
Comment: Horizontal and Vertical Antenna  
Description: ULXD2 H50\_Low Freq\_20mW\_Max\_Above 1GHz\_prescans  
Test Date & Time: June 28, 2013 1:40:54

## Scan Setup: COMPLIANCE TEST FCC Part 74 1 to 6 GHz [EMI radiated]

Hardware Setup: Electric Field Strength  
Level Unit: dB $\mu$ V/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
1GHz - 6GHz	MaxPeak	1MHz	0.02s	Receiver





## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4111860672  
Test Description: FCC pt.74 & RSS-123 Spurious Radiated Emissions  
Operating Conditions: RX @ 534.125 MHz @ 20mW  
Operator Name: Shaun Syas  
Comment: Horizontal and Vertical Antennae  
Test Date: July 12, 2013

Checked By: Alex Stelmaszczyk August 8, 2013

		Frequency MHz	Antenna Polarity	Measured QuasiPeak (or AVG >1GHz) Level dBuV	Matched Sig. Gen. Reading dBm	Antenna Gain dB	Cable Loss dB	ERP Total dBm	Limit dBm
DB-3		241.500	H	13.10	-94.20	0.00	2.15	<b>-96.35</b>	-25.00
DB-3		241.500	V	10.20	-104.80	0.00	2.15	<b>-106.95</b>	-25.00
DB-3		384.000	H	15.20	-101.00	0.00	2.82	<b>-103.82</b>	-25.00
DB-3		384.000	V	24.90	-74.10	0.00	2.82	<b>-76.92</b>	-25.00
DB-4		407.940	H	15.10	-106.00	0.00	3.06	<b>-109.06</b>	-25.00
DB-4		407.940	V	23.50	-78.50	0.00	3.06	<b>-81.56</b>	-25.00
DB-4		456.000	H	17.10	-94.57	0.00	3.11	<b>-97.68</b>	-25.00
DB-4		456.000	V	23.10	-78.33	0.00	3.11	<b>-81.44</b>	-25.00
DB-4		504.000	H	18.90	-101.00	0.00	3.10	<b>-104.10</b>	-25.00
DB-4		504.000	V	24.30	-79.32	0.00	3.10	<b>-82.42</b>	-25.00
DB-4		582.720	H	20.50	-100.00	0.00	3.49	<b>-103.49</b>	-25.00
DB-4		582.720	V	22.80	-83.55	0.00	3.49	<b>-87.04</b>	-25.00
EMCO 3117		1068.500	H	44.70	-54.00	2.40	4.56	<b>-56.16</b>	-25.00
EMCO 3117		1068.500	V	38.30	-62.50	2.40	4.56	<b>-64.66</b>	-25.00
EMCO 3117		1602.500	H	32.50	-79.00	5.70	5.54	<b>-78.84</b>	-25.00
EMCO 3117		1602.500	V	40.60	-60.60	5.70	5.54	<b>-60.44</b>	-25.00
EMCO 3117		2136.500	H	33.40	-77.80	5.00	6.32	<b>-79.12</b>	-25.00
EMCO 3117		2136.500	V	33.60	-60.38	5.00	6.32	<b>-61.70</b>	-25.00
EMCO 3117		2438.500	H	33.20	-82.00	6.10	6.73	<b>-82.63</b>	-25.00
EMCO 3117		2438.500	V	33.20	-80.00	6.10	6.73	<b>-80.63</b>	-25.00
EMCO 3117		3204.500	H	34.50	-77.00	7.60	7.65	<b>-77.05</b>	-25.00
EMCO 3117		3204.500	V	35.20	-73.20	7.60	7.65	<b>-73.25</b>	-25.00
EMCO 3117		3580.000	H	34.90	-80.00	8.20	8.05	<b>-79.85</b>	-25.00
EMCO 3117		3580.000	V	36.60	-80.00	8.20	8.05	<b>-79.85</b>	-25.00

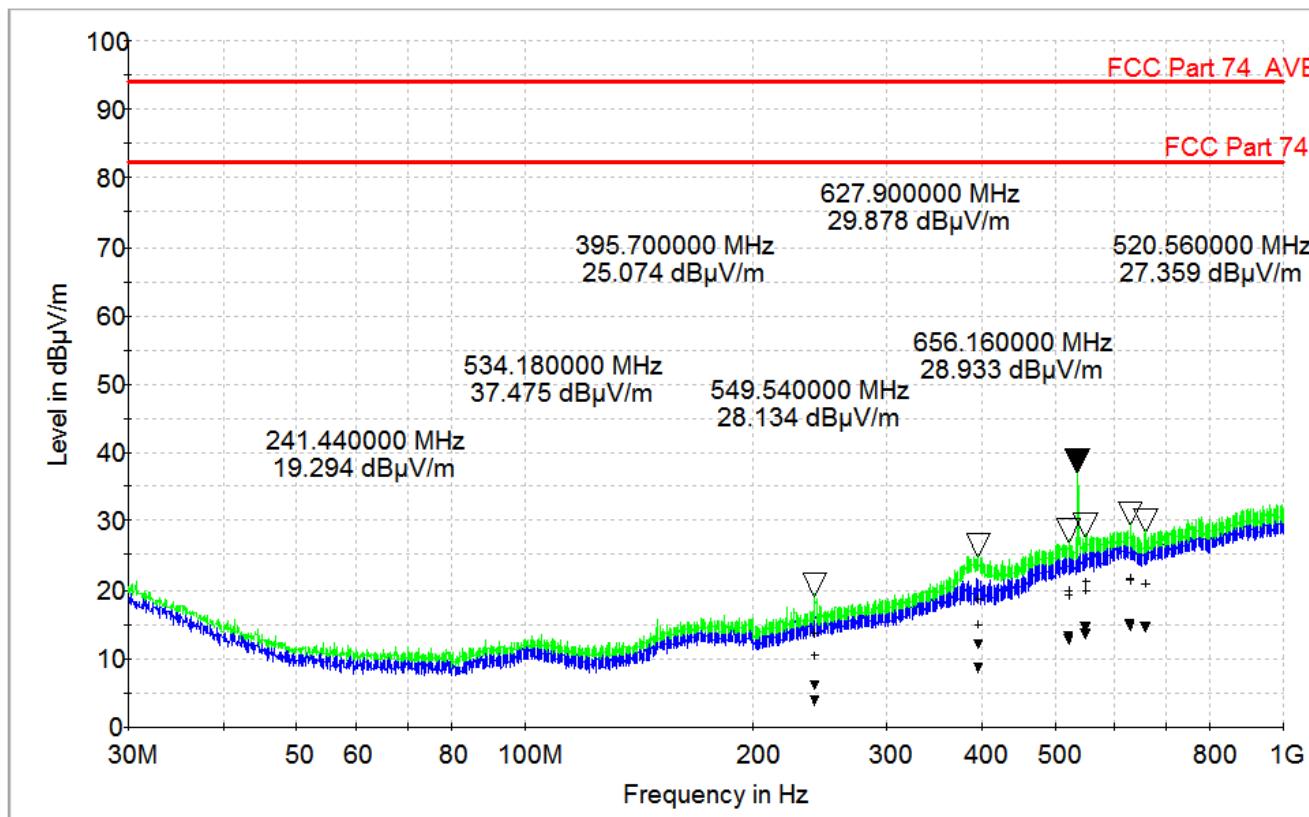
## Test Information

EUT Name: ULXD2 Band H50  
 Serial Number: 4111860672  
 Test Description: Radiated RF Emissions 1GHz  
 Operating Conditions: Freq = 534.125MHz, 1mW  
 Operator Name: Lovell Cueto  
 Comment: Horizontal and Vertical Antennae  
 Description: ULXD2 H50\_Low Freq\_1mW\_Max\_HV  
 Test Date & Time: June 21, 2013 2:46:10

## Scan Setup: COMPLIANCE TEST FCC EN55022 30 to 1000 MHz [EMI radiated]

Hardware Setup: Electric Field Strength 2013 04 10  
 Level Unit: dB $\mu$ V/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
30MHz - 1GHz	MaxPeak	120kHz	0.02s	Receiver





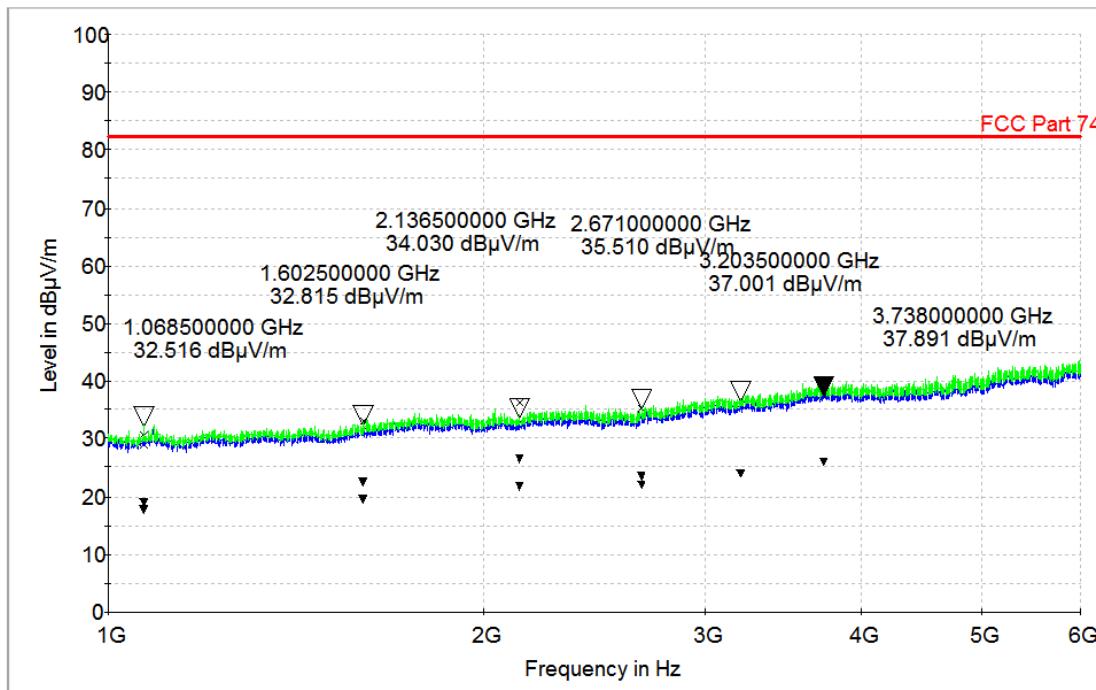
## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4111860672  
Test Description: Radiated RF Emissions 1-6GHz  
Operating Conditions: Freq = 534.125MHz, 1mW  
Operator Name: Shaun Syas  
Comment: Horizontal and Vertical Antenna  
Description: ULXD2 H50\_Low Freq\_1mW\_Max\_Above 1GHz\_prescans  
Test Date & Time: June 28, 2013 11:07:47 AM

## Scan Setup: COMPLIANCE TEST FCC Part 74 1 to 6 GHz [EMI radiated]

Hardware Setup: Electric Field Strength  
Level Unit: dB $\mu$ V/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
1GHz - 6GHz	MaxPeak	1MHz	0.02s	Receiver





## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4111860672  
Test Description: FCC pt.74 & RSS-123 Spurious Radiated Emissions  
Operating Conditions: RX @ 534.125 MHz @ 1mW  
Operator Name: Shaun Syas  
Comment: Horizontal and Vertical Antennae  
Test Date: July 12, 2013

Checked By: Alex Stelmaszczyk August 8, 2013

		Frequency MHz	Antenna Polarity	Measured QuasiPeak (or AVG >1GHz) Level dBuV	Matched Sig. Gen. Reading dBm	Antenna Gain dB	Cable Loss dB	ERP Total dBm	Limit dBm
DB-3		241.440	H	13.70	-92.80	0.00	2.15	<b>-94.95</b>	-25.00
DB-3		241.440	V	10.40	-104.80	0.00	2.15	<b>-106.95</b>	-25.00
DB-3		395.700	H	14.90	-109.00	0.00	3.00	<b>-112.00</b>	-25.00
DB-3		395.700	V	18.60	-85.00	0.00	3.00	<b>-88.00</b>	-25.00
DB-4		520.560	H	19.20	-101.00	0.00	3.42	<b>-104.42</b>	-25.00
DB-4		520.560	V	19.90	-92.35	0.00	3.42	<b>-95.77</b>	-25.00
DB-4		549.540	H	20.00	-101.00	0.00	3.40	<b>-104.40</b>	-25.00
DB-4		549.540	V	21.10	-89.20	0.00	3.40	<b>-92.60</b>	-25.00
DB-4		627.900	H	21.50	-96.00	0.00	3.09	<b>-99.09</b>	-25.00
DB-4		627.900	V	21.60	-96.00	0.00	3.09	<b>-99.09</b>	-25.00
DB-4		656.160	H	21.00	-91.00	0.00	3.16	<b>-94.16</b>	-25.00
DB-4		656.160	V	20.90	-92.00	0.00	3.16	<b>-95.16</b>	-25.00
EMCO 3117		1068.500	H	28.80	-90.00	2.40	4.56	<b>-92.16</b>	-25.00
EMCO 3117		1068.500	V	30.50	-81.20	2.40	4.56	<b>-83.36</b>	-25.00
EMCO 3117		1602.500	H	31.30	-91.00	5.70	5.54	<b>-90.84</b>	-25.00
EMCO 3117		1602.500	V	33.00	-75.20	5.70	5.54	<b>-75.04</b>	-25.00
EMCO 3117		2136.500	H	32.90	-83.00	5.00	6.32	<b>-84.32</b>	-25.00
EMCO 3117		2136.500	V	36.30	-57.70	5.00	6.32	<b>-59.02</b>	-25.00
EMCO 3117		2671.000	H	34.00	-79.30	6.10	6.73	<b>-79.93</b>	-25.00
EMCO 3117		2671.000	V	35.40	-71.70	6.10	6.73	<b>-72.33</b>	-25.00
EMCO 3117		3203.500	H	35.90	-80.00	7.60	7.65	<b>-80.05</b>	-25.00
EMCO 3117		3203.500	V	35.90	-80.00	7.60	7.65	<b>-80.05</b>	-25.00
EMCO 3117		3738.000	H	37.30	-80.00	8.20	8.05	<b>-79.85</b>	-25.00
EMCO 3117		3738.000	V	37.50	-79.60	8.20	8.05	<b>-79.45</b>	-25.00



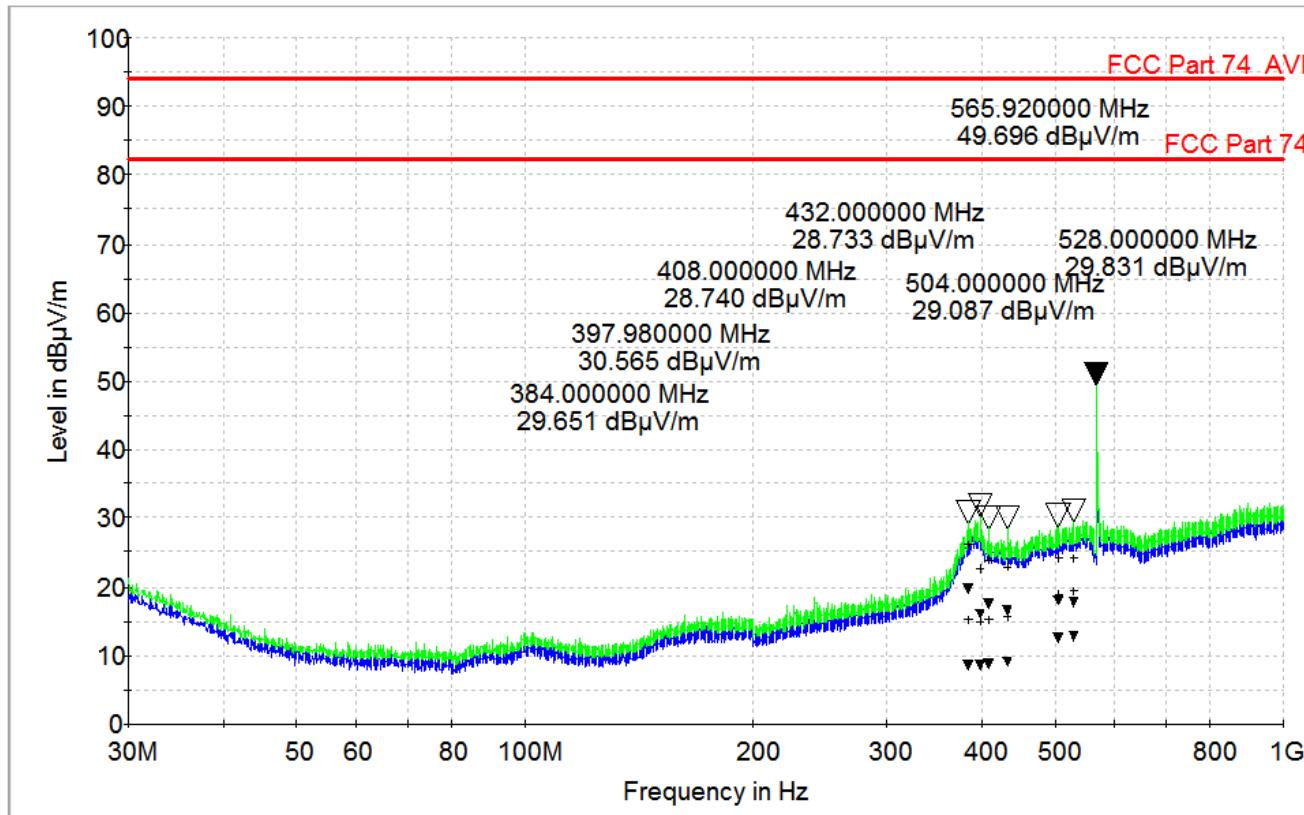
## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4111860672  
Test Description: Radiated RF Emissions 1GHz  
Operating Conditions: Freq = 566MHz, 20mW  
Operator Name: Lovell Cueto  
Comment: Horizontal and Vertical Antennae  
Description: ULXD2 H50\_Mid Freq\_20mW\_HV\_MAX  
Test Date & Time: June 25, 2013 12:48:34 PM

## Scan Setup: COMPLIANCE TEST FCC EN55022 30 to 1000 MHz [EMI radiated]

Hardware Setup: Electric Field Strength 2013 04 10  
Level Unit: dB $\mu$ V/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
30MHz - 1GHz	MaxPeak	120kHz	0.02s	Receiver



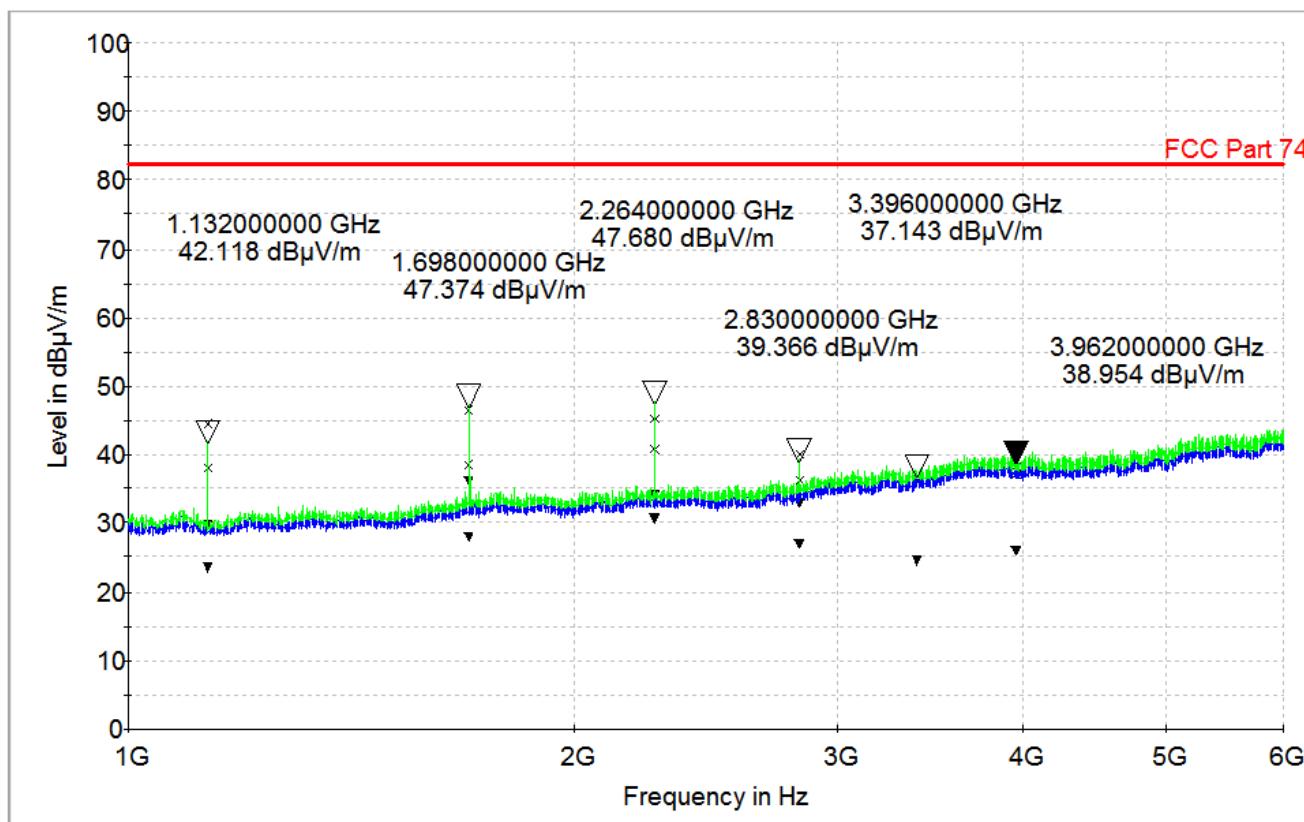
**Appendix E**
**Test Information**

EUT Name: ULXD2 Band H50  
 Serial Number: 4111860672  
 Test Description: Radiated RF Emissions 1-6GHz  
 Operating Conditions: Freq = 566MHz, 20mW  
 Operator Name: Lovell Cueto  
 Comment: Horizontal and Vertical Antenna  
 Description: ULXD2 H50\_Mid Freq\_20mW\_45s\_Above 1GHz\_Max  
 Test Date & Time: June 27, 2013 2:57:36

**Scan Setup: COMPLIANCE TEST FCC Part 74 1 to 6 GHz [EMI radiated]**

Hardware Setup: Electric Field Strength  
 Level Unit: dB $\mu$ V/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
1GHz - 6GHz	MaxPeak	1MHz	0.02s	Receiver





## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4111860672  
Test Description: FCC pt.74 & RSS-123 Spurious Radiated Emissions  
Operating Conditions: RX @ 566 MHz @ 20mW  
Operator Name: Shaun Syas  
Comment: Horizontal and Vertical Antennae  
Test Date: July 12, 2013

Checked By: Alex Stelmaszczyk August 8, 2013

		Frequency MHz	Antenna Polarity	Measured QuasiPeak (or AVG >1GHz) Level dBuV	Matched Sig. Gen. Reading dBm	Antenna Gain dB	Cable Loss dB	ERP Total dBm	Limit dBm
DB-3		384.000	H	15.20	-101.00	0.00	2.86	<b>-103.86</b>	-25.00
DB-3		384.000	V	26.20	-72.40	0.00	2.86	<b>-75.26</b>	-25.00
DB-3		397.980	H	14.90	-109.20	0.00	3.00	<b>-112.20</b>	-25.00
DB-3		397.980	V	22.50	-77.70	0.00	3.00	<b>-80.70</b>	-25.00
DB-4		408.000	H	15.10	-106.00	0.00	3.04	<b>-109.04</b>	-25.00
DB-4		408.000	V	23.90	-75.30	0.00	3.04	<b>-78.34</b>	-25.00
DB-4		432.000	H	15.60	-101.00	0.00	3.10	<b>-104.10</b>	-25.00
DB-4		432.000	V	22.90	-76.85	0.00	3.10	<b>-79.95</b>	-25.00
DB-4		504.000	H	19.00	-101.00	0.00	3.19	<b>-104.19</b>	-25.00
DB-4		504.000	V	24.20	-79.54	0.00	3.19	<b>-82.73</b>	-25.00
DB-4		528.000	H	19.30	-99.50	0.00	3.42	<b>-102.92</b>	-25.00
DB-4		528.000	V	24.20	-76.65	0.00	3.42	<b>-80.07</b>	-25.00
EMCO 3117		1132.000	H	38.00	-60.31	3.00	4.69	<b>-62.00</b>	-25.00
EMCO 3117		1132.000	V	44.50	-52.00	3.00	4.69	<b>-53.69</b>	-25.00
EMCO 3117		1698.000	H	38.50	-66.61	5.70	5.66	<b>-66.57</b>	-25.00
EMCO 3117		1698.000	V	46.50	-54.30	5.70	5.66	<b>-54.26</b>	-25.00
EMCO 3117		2264.000	H	40.90	-71.80	5.60	6.49	<b>-72.69</b>	-25.00
EMCO 3117		2264.000	V	45.30	-59.30	5.60	6.49	<b>-60.19</b>	-25.00
EMCO 3117		2830.000	H	36.20	-73.00	6.60	7.30	<b>-73.70</b>	-25.00
EMCO 3117		2830.000	V	40.00	-70.80	6.60	7.30	<b>-71.50</b>	-25.00
EMCO 3117		3396.000	H	36.10	-79.00	7.60	7.92	<b>-79.32</b>	-25.00
EMCO 3117		3396.000	V	36.50	-68.40	7.60	7.92	<b>-68.72</b>	-25.00
EMCO 3117		3962.000	H	38.40	-74.00	8.90	8.53	<b>-73.63</b>	-25.00
EMCO 3117		3962.000	V	37.10	-90.00	8.90	8.53	<b>-89.63</b>	-25.00



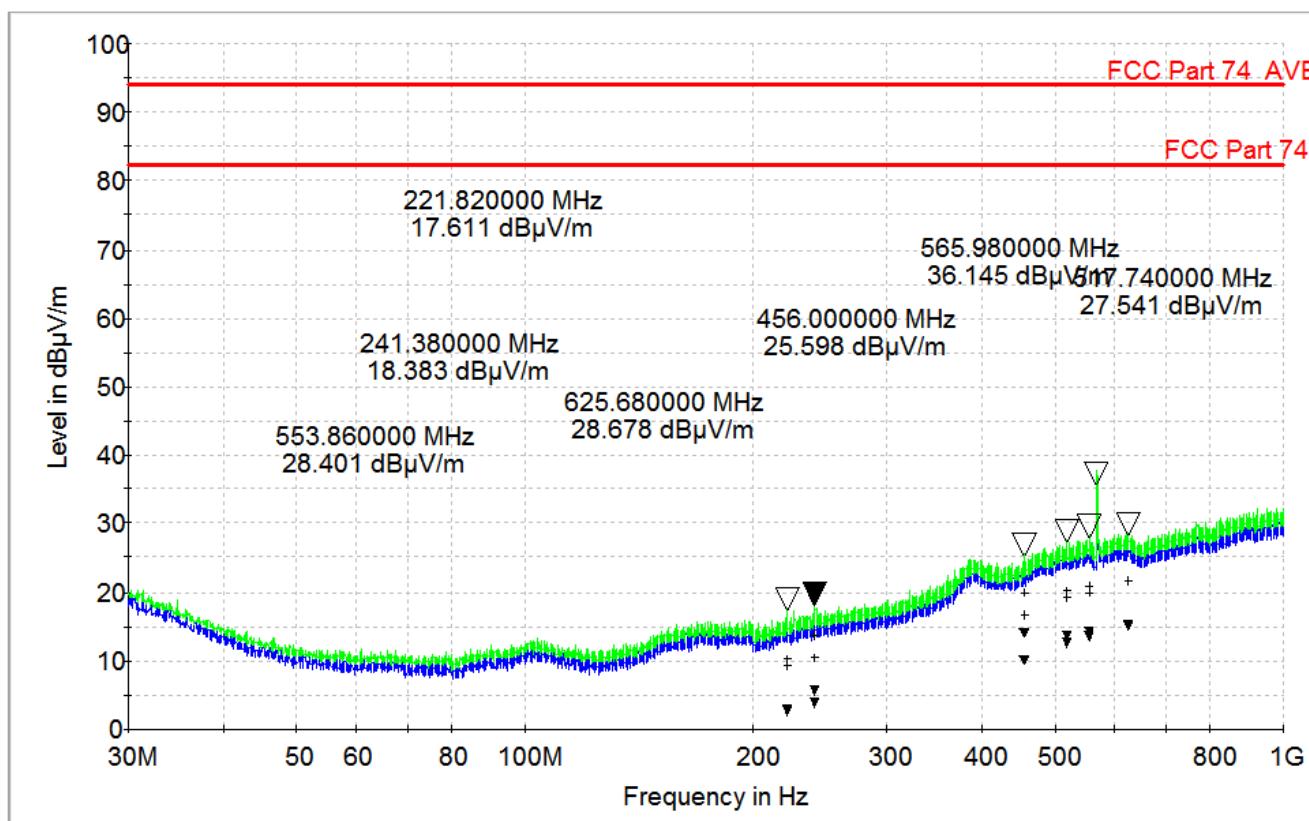
## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4111860672  
Test Description: Radiated RF Emissions 1GHz  
Operating Conditions: Freq = 566MHz, 1mW  
Operator Name: Lovell Cueto  
Comment: Horizontal and Vertical Antennae  
Description: ULXD2 H50\_Mid Freq\_1mW\_22s prescans\_HV  
Test Date & Time: June 25, 2013 10:15:51 PM

## Scan Setup: COMPLIANCE TEST FCC EN55022 30 to 1000 MHz [EMI radiated]

Hardware Setup: Electric Field Strength 2013 04 10  
Level Unit: dB $\mu$ V/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
30MHz - 1GHz	MaxPeak	120kHz	0.02s	Receiver





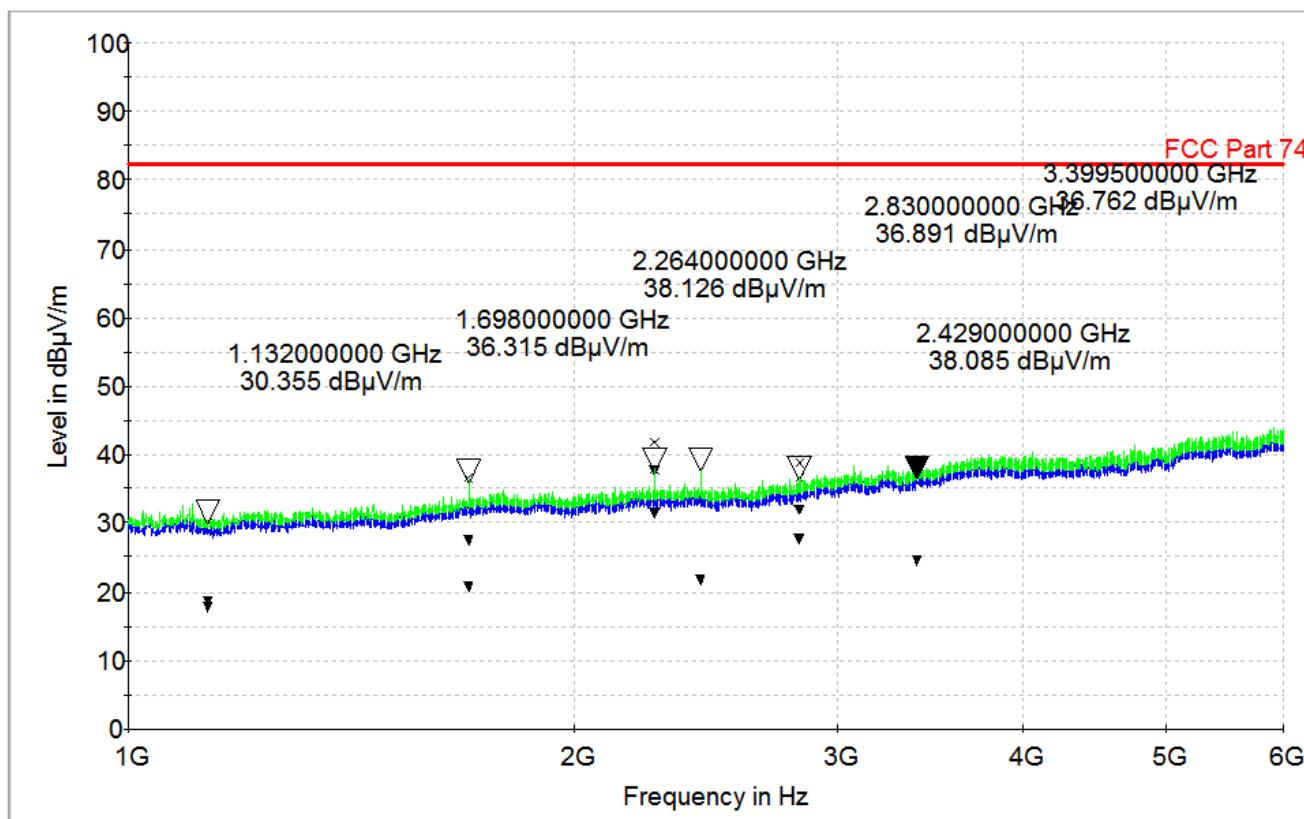
## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4111860672  
Test Description: Radiated RF Emissions 1-6GHz  
Operating Conditions: Freq = 566 MHz, 1mW  
Operator Name: Shaun Syas  
Comment: Horizontal and Vertical Antenna  
Description: ULXD2 H50\_Mid\_1mW\_45s\_Above 1GHz\_Prescans  
Test Date & Time: June 28, 2013 8:46:21 AM

## Scan Setup: COMPLIANCE TEST FCC Part 74 1 to 6 GHz [EMI radiated]

Hardware Setup: Electric Field Strength  
Level Unit: dB $\mu$ V/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
1GHz - 6GHz	MaxPeak	1MHz	0.02s	Receiver





## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4111860672  
Test Description: FCC pt.74 & RSS-123 Spurious Radiated Emissions  
Operating Conditions: RX @ 566 MHz @ 1mW  
Operator Name: Shaun Syas  
Comment: Horizontal and Vertical Antennae  
Test Date: July 12, 2013

Checked By: Alex Stelmaszczyk August 8, 2013

		Frequency MHz	Antenna Polarity	Measured QuasiPeak (or AVG >1GHz) Level dBuV	Matched Sig. Gen. Reading dBm	Antenna Gain dB	Cable Loss dB	ERP Total dBm	Limit dBm
DB-3		221.820	H	10.30	-107.00	0.00	2.13	<b>-109.13</b>	-25.00
DB-3		221.820	V	9.10	-105.00	0.00	2.13	<b>-107.13</b>	-25.00
DB-3		241.380	H	13.60	-93.10	0.00	2.15	<b>-95.25</b>	-25.00
DB-3		241.380	V	10.40	-104.80	0.00	2.15	<b>-106.95</b>	-25.00
DB-4		456.000	H	16.70	-101.00	0.00	3.10	<b>-104.10</b>	-25.00
DB-4		456.000	V	19.90	-84.65	0.00	3.10	<b>-87.75</b>	-25.00
DB-4		517.740	H	19.20	-103.00	0.00	3.31	<b>-106.31</b>	-25.00
DB-4		517.740	V	20.10	-91.41	0.00	3.31	<b>-94.72</b>	-25.00
DB-4		553.860	H	20.00	-101.00	0.00	3.41	<b>-104.41</b>	-25.00
DB-4		553.860	V	20.90	-90.00	0.00	3.41	<b>-93.41</b>	-25.00
DB-4		625.680	H	21.50	-100.00	0.00	3.95	<b>-103.95</b>	-25.00
DB-4		625.680	V	21.70	-99.00	0.00	3.95	<b>-102.95</b>	-25.00
EMCO 3117		1132.000	H	28.80	-90.00	3.00	4.69	<b>-91.69</b>	-25.00
EMCO 3117		1132.000	V	30.10	-79.00	3.00	4.69	<b>-80.69</b>	-25.00
EMCO 3117		1698.000	H	32.40	-86.00	5.70	5.66	<b>-85.96</b>	-25.00
EMCO 3117		1698.000	V	36.70	-69.00	5.70	5.66	<b>-68.96</b>	-25.00
EMCO 3117		2264.000	H	37.70	-68.50	5.60	6.49	<b>-69.39</b>	-25.00
EMCO 3117		2264.000	V	41.80	-58.00	5.60	6.49	<b>-58.89</b>	-25.00
EMCO 3117		2429.000	H	33.00	-93.00	6.60	7.30	<b>-93.70</b>	-25.00
EMCO 3117		2429.000	V	33.30	-90.00	6.60	7.30	<b>-90.70</b>	-25.00
EMCO 3117		2830.000	H	36.80	-85.00	7.60	7.92	<b>-85.32</b>	-25.00
EMCO 3117		2830.000	V	38.90	-67.10	7.60	7.92	<b>-67.42</b>	-25.00
EMCO 3117		3396.000	H	35.80	-90.00	8.90	8.53	<b>-89.63</b>	-25.00
EMCO 3117		3396.000	V	35.90	-90.00	8.90	8.53	<b>-89.63</b>	-25.00

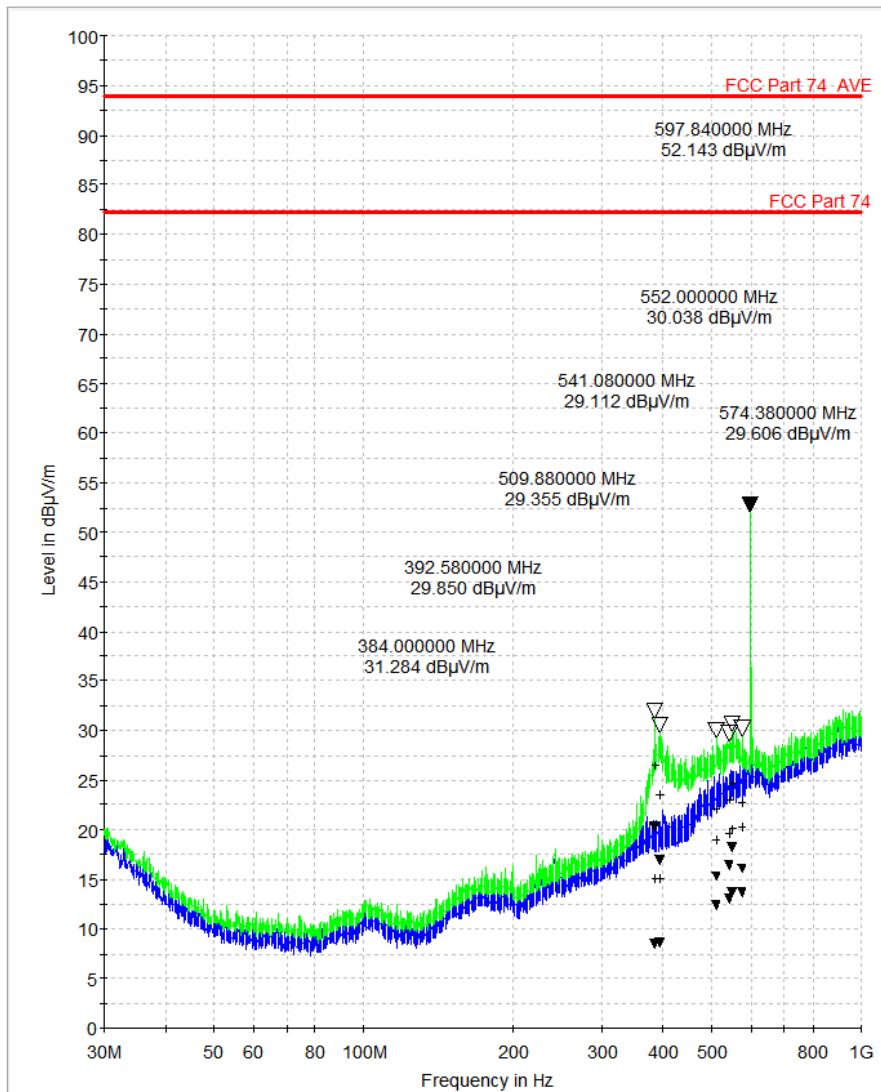
## Test Information

EUT Name: ULXD2 Band H50  
 Serial Number: 4111860672  
 Test Description: Radiated RF Emissions 1GHz  
 Operating Conditions: Freq = 597.875MHz, 20mW  
 Operator Name: Lovell Cueto  
 Comment: Horizontal and Vertical Antennae  
 Description: ULXD2 H50\_High Freq\_20mW\_HV\_MAX  
 Test Date & Time: June 25, 2013 3:19:03 PM

## Scan Setup: COMPLIANCE TEST FCC EN55022 30 to 1000 MHz [EMI radiated]

Hardware Setup: Electric Field Strength 2013 04 10  
 Level Unit: dB $\mu$ V/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
30MHz - 1GHz	MaxPeak	120kHz	0.02s	Receiver





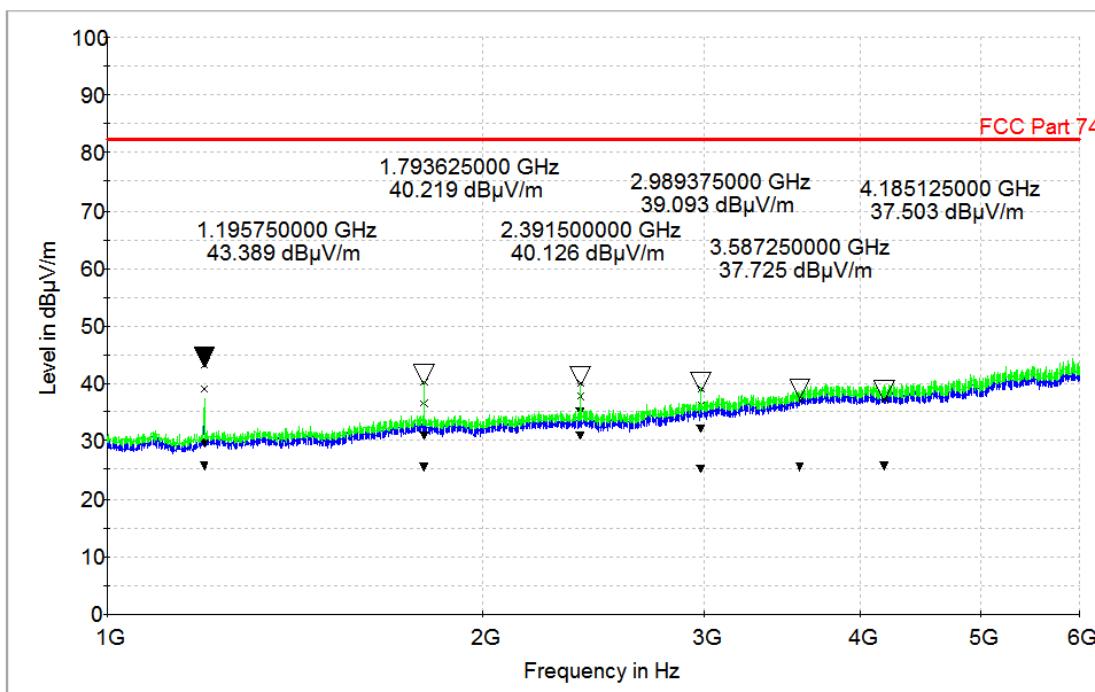
## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4111860672  
Test Description: Radiated RF Emissions 1-6GHz  
Operating Conditions: Freq = 597.875MHz, 20mW  
Operator Name: Lovell Cueto  
Comment: Horizontal and Vertical Antenna  
Description: ULXD2 H50\_High Freq\_20mW\_45s\_Above 1GHz\_Max  
Test Date & Time: June 27, 2013 11:15:52 AM

## Scan Setup: COMPLIANCE TEST FCC Part 74 1 to 6 GHz [EMI radiated]

Hardware Setup: Electric Field Strength  
Level Unit: dB $\mu$ V/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
1GHz - 6GHz	MaxPeak	1MHz	0.02s	Receiver





## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4111860672  
Test Description: FCC pt.74 & RSS-123 Spurious Radiated Emissions  
Operating Conditions: RX @ 597.875MHz @ 20mW  
Operator Name: Shaun Syas  
Comment: Horizontal and Vertical Antennae  
Test Date: July 12, 2013

Checked By: Alex Stelmaszczyk August 8, 2013

		Frequency MHz	Antenna Polarity	Measured QuasiPeak (or AVG >1GHz) Level dBuV	Matched Sig. Gen. Reading dBm	Antenna Gain dB	Cable Loss dB	ERP Total dBm	Limit dBm
DB-3		384.000	H	15.00	-103.00	0.00	2.77	<b>-105.77</b>	-25.00
DB-3		384.000	V	26.50	-72.00	0.00	2.77	<b>-74.77</b>	-25.00
DB-3		392.580	H	15.00	-104.00	0.00	2.86	<b>-106.86</b>	-25.00
DB-3		392.580	V	23.60	-76.10	0.00	2.86	<b>-78.96</b>	-25.00
DB-4		509.880	H	19.00	-102.00	0.00	3.30	<b>-105.30</b>	-25.00
DB-4		509.880	V	22.10	-84.09	0.00	3.30	<b>-87.39</b>	-25.00
DB-4		541.080	H	19.70	-100.50	0.00	3.42	<b>-103.92</b>	-25.00
DB-4		541.080	V	23.00	-81.85	0.00	3.42	<b>-85.27</b>	-25.00
DB-4		552.000	H	24.70	-77.57	0.00	3.50	<b>-81.07</b>	-25.00
DB-4		552.000	V	20.10	-100.00	0.00	3.50	<b>-103.50</b>	-25.00
DB-4		574.380	H	20.20	-100.20	0.00	3.54	<b>-103.74</b>	-25.00
DB-4		574.380	V	22.70	-82.40	0.00	3.54	<b>-85.94</b>	-25.00
EMCO 3117		1195.750	H	39.10	-54.90	3.60	4.74	<b>-56.04</b>	-25.00
EMCO 3117		1195.750	V	43.40	-56.70	3.60	4.74	<b>-57.84</b>	-25.00
EMCO 3117		1793.625	H	36.70	-68.20	5.70	5.75	<b>-68.25</b>	-25.00
EMCO 3117		1793.625	V	40.20	-61.10	5.70	5.75	<b>-61.15</b>	-25.00
EMCO 3117		2391.500	H	37.90	-65.90	5.60	6.64	<b>-66.94</b>	-25.00
EMCO 3117		2391.500	V	40.10	-61.00	5.60	6.64	<b>-62.04</b>	-25.00
EMCO 3117		2989.375	H	36.30	-65.00	6.90	7.34	<b>-65.44</b>	-25.00
EMCO 3117		2989.375	V	39.10	-63.60	6.90	7.34	<b>-64.04</b>	-25.00
EMCO 3117		3587.250	H	37.70	-85.00	8.20	8.21	<b>-85.01</b>	-25.00
EMCO 3117		3587.250	V	37.10	-90.00	8.20	8.21	<b>-90.01</b>	-25.00
EMCO 3117		4185.125	H	37.50	-90.00	9.00	8.81	<b>-89.81</b>	-25.00
EMCO 3117		4185.125	V	37.40	-90.00	9.00	8.80	<b>-89.80</b>	-25.00



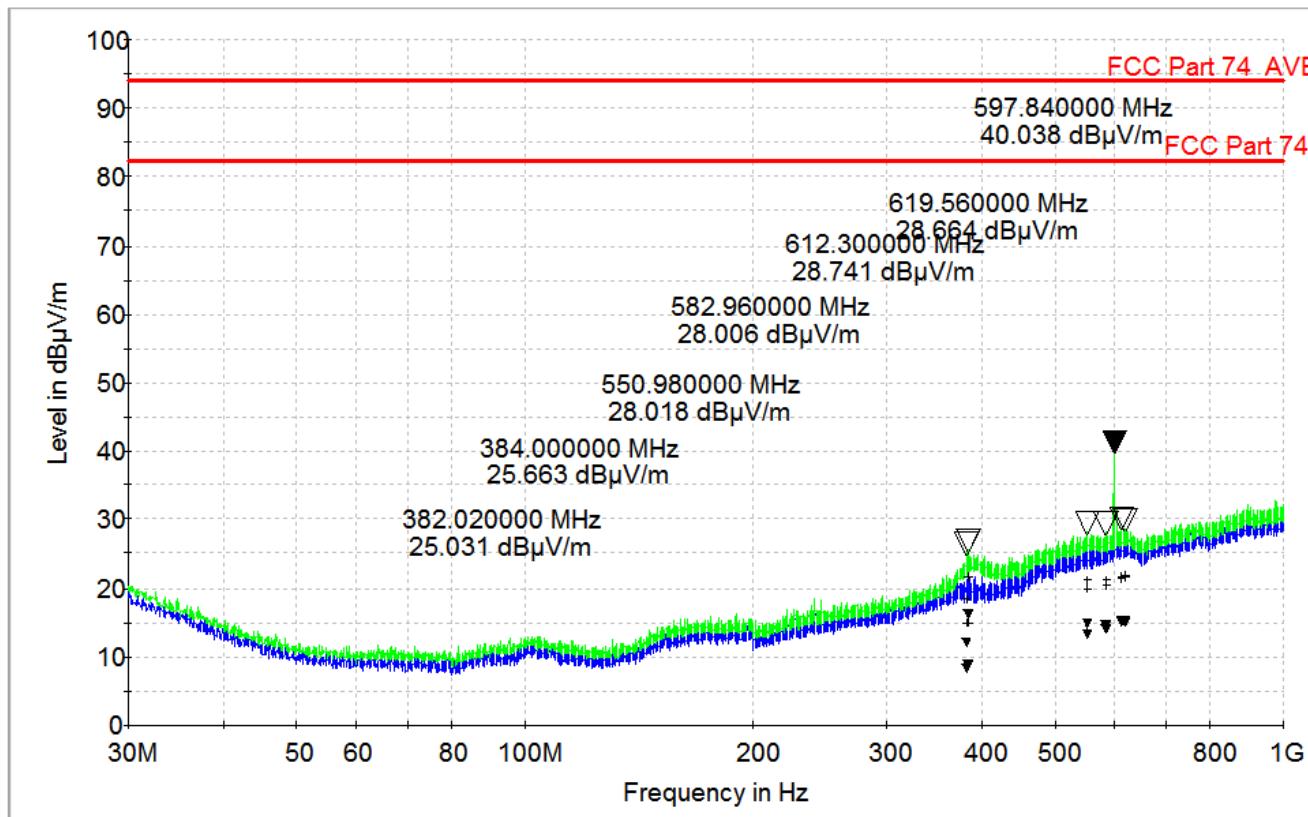
## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4111860672  
Test Description: Radiated RF Emissions 1GHz  
Operating Conditions: Freq = 597.875MHz, 1mW  
Operator Name: Lovell Cueto  
Comment: Horizontal and Vertical Antennae  
Description: ULXD2 H50\_High Freq\_1mW\_MAX  
Test Date & Time: June 26, 2013 10:01:41 AM

## Scan Setup: COMPLIANCE TEST FCC EN55022 30 to 1000 MHz [EMI radiated]

Hardware Setup: Electric Field Strength 2013 04 10  
Level Unit: dB $\mu$ V/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
30MHz - 1GHz	MaxPeak	120kHz	0.02s	Receiver





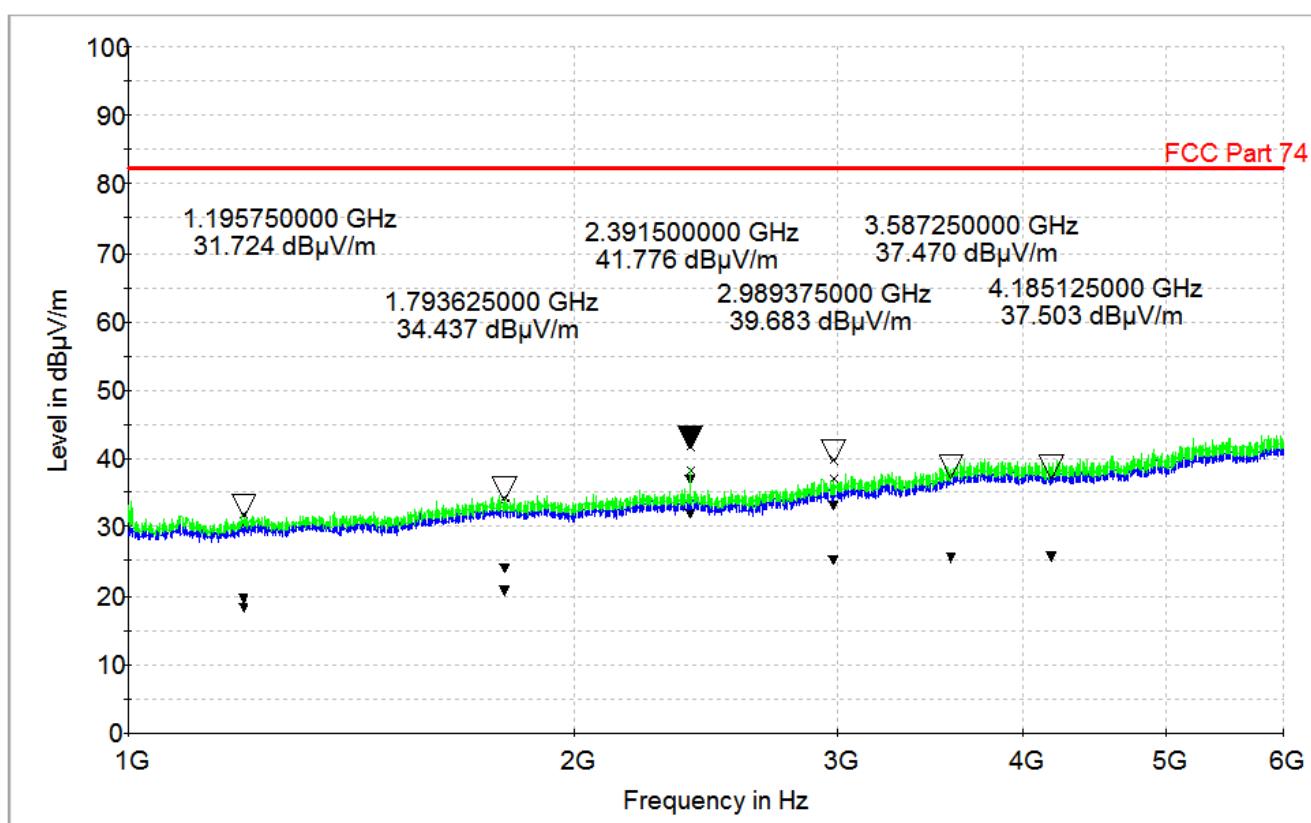
## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4111860672  
Test Description: Radiated RF Emissions 1-6GHz  
Operating Conditions: Freq = 597.875MHz, 1mW  
Operator Name: Lovell Cueto  
Comment: Horizontal and Vertical Antenna  
Description: ULXD2 H50\_High Freq\_1mW\_45s\_Above 1GHz\_Max  
Test Date & Time: June 27, 2013 1:03:43

## Scan Setup: COMPLIANCE TEST FCC Part 74 1 to 6 GHz [EMI radiated]

Hardware Setup: Electric Field Strength  
Level Unit: dB $\mu$ V/m

Subrange	Detectors	IF Bandwidth	Meas. Time	Receiver
1GHz - 6GHz	MaxPeak	1MHz	0.02s	Receiver





## Test Information

EUT Name: ULXD2 Band H50  
Serial Number: 4111860672  
Test Description: FCC pt.74 & RSS-123 Spurious Radiated Emissions  
Operating Conditions: RX @ 597.875MHz @ 1mW  
Operator Name: Shaun Syas  
Comment: Horizontal and Vertical Antennae  
Test Date: July 12, 2013

Checked By: Alex Stelmaszczyk August 8, 2013

		Frequency MHz	Antenna Polarity	Measured QuasiPeak (or AVG >1GHz) Level dBuV	Matched Sig. Gen. Reading dBm	Antenna Gain dB	Cable Loss dB	ERP Total dBm	Limit dBm
DB-3		382.020	H	15.00	-105.00	0.00	2.74	<b>-107.74</b>	-25.00
DB-3		382.020	V	18.40	-82.90	0.00	2.74	<b>-85.64</b>	-25.00
DB-3		384.000	H	15.00	-103.00	0.00	2.74	<b>-105.74</b>	-25.00
DB-3		384.000	V	21.70	-78.60	0.00	2.74	<b>-81.34</b>	-25.00
DB-4		550.980	H	20.00	-102.50	0.00	3.41	<b>-105.91</b>	-25.00
DB-4		550.980	V	21.30	-88.35	0.00	3.41	<b>-91.76</b>	-25.00
DB-4		582.960	H	20.50	-101.00	0.00	3.44	<b>-104.44</b>	-25.00
DB-4		582.960	V	21.10	-91.90	0.00	3.44	<b>-95.34</b>	-25.00
DB-4		612.300	H	21.50	-101.00	0.00	3.43	<b>-104.43</b>	-25.00
DB-4		612.300	V	21.80	-93.90	0.00	3.43	<b>-97.33</b>	-25.00
DB-4		619.560	H	21.60	-100.30	0.00	3.42	<b>-103.72</b>	-25.00
DB-4		619.560	V	21.80	-94.45	0.00	3.42	<b>-97.87</b>	-25.00
EMCO 3117		1195.750	H	30.40	-76.80	3.60	4.74	<b>-77.94</b>	-25.00
EMCO 3117		1195.750	V	31.70	-80.00	3.60	4.74	<b>-81.14</b>	-25.00
EMCO 3117		1793.625	H	33.40	-79.20	5.70	5.75	<b>-79.25</b>	-25.00
EMCO 3117		1793.625	V	34.40	-74.00	5.70	5.75	<b>-74.05</b>	-25.00
EMCO 3117		2391.500	H	38.20	-66.00	5.60	6.64	<b>-67.04</b>	-25.00
EMCO 3117		2391.500	V	41.80	-58.90	5.60	6.64	<b>-59.94</b>	-25.00
EMCO 3117		2989.375	H	37.00	-65.00	6.90	7.34	<b>-65.44</b>	-25.00
EMCO 3117		2989.375	V	39.70	-62.70	6.90	7.34	<b>-63.14</b>	-25.00
EMCO 3117		3587.250	H	37.50	-85.00	8.20	8.21	<b>-85.01</b>	-25.00
EMCO 3117		3587.250	V	37.60	-90.00	8.20	8.21	<b>-90.01</b>	-25.00
EMCO 3117		4185.125	H	37.50	-90.00	9.00	8.81	<b>-89.81</b>	-25.00
EMCO 3117		4185.125	V	37.30	-90.00	9.00	8.81	<b>-89.81</b>	-25.00