SHURE

ELECTROMAGNETIC COMPATIBILITY LABORATORY
TEST REPORT

TEST REPORT TITLE: Electromagnetic Compatibility Tests of the Shure QLXD2-V50 Handheld Transmitter

TEST ITEM DESCRIPTION:

QLXD2-V50 is a digital wireless handheld transmitter intended for use in mid-tier presentation, installed, and performance markets. The system operates in the UHF TV band of 174.125 to 215.875 MHz. Power levels are switchable among 1mW and 10mW. The transmitter is capable of operating with AA alkaline batteries or with the Shure SB900A rechargeable battery pack.

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

Project ID Number: SEL-018

Date Tested: February 20, 2016 – April 6, 2016

Test Personnel: Tom Braxton, Russell Smith

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

TEST REPORT BY:	Thomas E Braxton (SIGNATURE)	EC Project Engineer (POSITION)	4/20/16 (DATE)
APPROVED BY:	Craig Kozelka (SIGNATURE)	GLOBAL COMPLIANCE PROJECT ENGINEER (POSITION)	APRIL 20, 2016 (DATE)

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B	FREQUENCY STABILITY
C	NECESSARY BANDWIDTH MEASUREMENTS
D	FIELD STRENGTH OF SPURIOUS EMISSIONS

REPORT REVISION HISTORY

Revision	Date	Description
0	4/20/2016	Initial Release

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 QLXD2-V50 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. This document provides the data for the test samples, including a summary of the measurements made and descriptions of the measurement setup. The equipment under test (EUT) contained a transmitter that was designed to transmit in the UHF frequency bands shown in Table 1-1.

Model	Band	Frequency (MHz)	Output Power (mW)
QLXD2	V50	174.125 – 215.875	1, 10

Table 1-1. EUT Frequency Band and Power Levels

1.2. Purpose

This series of tests was performed to determine if the test items would meet the radiated RF emission specifications of FCC Part 74H and Industry Canada 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. 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 1-2) were performed on the EUT in accordance with FCC Part 74H and Industry Canada RSS-GEN and RSS-210.

Test Spec	Description	Tested Range	Described in Appendix	Test Results
FCC 74H, RSS-210	**Radiated RF Power Output**	**174.125 -215.875 MHz**	**A**	PASS
FCC 74H, RSS-210	**Frequency Stability**	**174.125 -215.875 MHz**	**B**	PASS
FCC 74H, RSS-210	**Necessary Bandwidth**	**174.125 -215.875 MHz**	**C**	PASS
FCC 74H, RSS-210	**Spurious Emissions**	**25 MHz – 5 GHz**	**D**	PASS

Table 1-2: Summary of Tests Performed

2. APPLICABLE DOCUMENTS

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

- FCC Part 74H
- RSS-GEN
- RSS-210
- 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"
- 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

Model QLXD2-V50 is a handheld wireless microphone transmitter. 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 as shown in Table 3-1.

Model	Band	Frequency (MHz)	Serial #
QLXD2-V50	V50	174.125 – 215.875	EMC02

Table 3-1. Product Test Samples

3.3. Test Setup

3.3.1. Power Input

The EUT was powered with 3VDC from a Shure SB900 rechargeable battery.

3.3.2. Signal Input /Output Ports

For all emission tests the EUT was configured as follows:

- The microphone port of the QLXD2-V50 was terminated with a removable whip antenna that is supplied with the transmitter.

3.3.3. Test Frequency Range

Per FCC and IC requirements, for spurious radiated emissions measurements, the frequency spectrum shall be investigated from 30 MHz to 10x the highest oscillating frequency. Radiated emissions measurements were performed up to 10 GHz to increase the number of recorded harmonic emissions.

3.3.4. Grounding Considerations

The EUT was not grounded during testing.

3.4. Operational Mode

3.4.1. Frequency and Power Output:

All emissions tests were performed separately in the transmit frequency and output power modes shown in Table 3-2.

Band	Freq. (MHz)	L/M/H	Power Level (mW)
V50	174.125	Low	1.0
			10.0
	195.000	Medium	1.0
			10.0
	215.875	High	1.0
			10.0

Table 3-2. EUT Frequencies and Power Levels

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 QLXD2-V50 met the radiated and RF emission specifications of FCC 74H and RSS-210.

8. CONCLUSIONS

It was determined that the Shure Incorporated QLXD2-V50 did fully comply with the radiated RF emissions requirements of both FCC 74H and RSS-210.

9. CERTIFICATION

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

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

This report must not be used to claim product endorsement by NVLAP or any agency of the US Government.

10. EQUIPMENT LIST

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	6/5/2015	6/5/2016
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
L23-011-54	EMI Receiver	Rohde & Schwarz	ESR	101347	9kHz – 26.5MHz	6/30/2015	6/30/2016
L23-011-15	BiConiLog Antenna	ETS Lindgren	3142C	34790	25MHz-1GHz	4/6/2015	4/6/2016
L23-011-16	Waveguide Horn Ant	ETS Lindgren	3115	29851	1-18 GHz	9/24/2015	9/24/2016
L23-011-19	PreAmp	Rohde & Schwarz	TS-PR18	100015	1-18 GHz	9/30/2015	9/30/2016
L23-011-52	Double-Log Periodic Antenna	Schwarzbeck	STLP9148	STLP9148-149	1 - 18 GHz	4/17/2015	4/17/2016
L23-011-053	Waveguide Horn Antenna & Preamp	ETS Lindgren	3117PA	00200363	1 - 18 GHz	5/14/2015	5/14/2016
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	Rohde & Schwarz	FSU 1166.1660. K26	201043	20Hz – 26.5GHz	10/8/2014	10/8/2016
L05-068-02	Modulation Analyzer	Boonton	8200	24602BH	N/A	10/15/2014	10/15/2016
L23-031-01	Power Meter	AR	PM2003	0335363	10kHz – 40GHz	5/6/2015	5/6/2016
L23-032-01	Power Head	AR	PH2008	336213	100 kHz - 18GHz -40 to +33 dBm	5/6/2015	5/6/2016
L19-06-01	Temp. Chamber	ESPEC	SU-24	91004211	-40C - +130C	4/29/2015	4/29/2016
L23-011-41	Waveguide Horn Antenna	EMCO	3117	123511	1GHz -18GHz	12/15/2015	12/15/2016
L23-011-36D	Tuned Dipole Antenna	ETS Lindgren	312D-DB-4	123695	400-1000MHz	4/8/2015	4/8/2016
L23-023-01	Signal Generator	Rohde & Schwarz	SMF100A	101553	100kHz-22GHz	3/29/2015	3/29/2016
L23-034-08	Digital Thermometer	Extech	TM100/ TP870	13018733/ TE701576	N/A	9/23/2015	9/23/2016

Table 10-1: Test Equipment

A. RF POWER OUTPUT MEASUREMENTS

A.1. PURPOSE:

This test was performed to determine if the EUT meets the RF power output requirements of FCC Part 74H and RSS-210.

A.2. REQUIREMENTS:

As stated in FCC 74.861(e) and RSS-210, Amendment 1, for radio microphones operating between 174.125 MHz and 215.875 MHz, the power of the measured unmodulated carrier power may not exceed 50 milliwatts.

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}
Carrier power – power meter combined (RSS) standard uncertainty	0.177 dB
Carrier power – power meter expanded uncertainty	0.354 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.

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 a Shure SB900 battery. The EUT was checked for proper operation after it was setup for the test. Testing was conducted with the EUT set to transmit at the frequencies and power levels shown in Table A-1.

Band	Freq. (MHz)	L/M/H	Power Level (mW)
V50	174.125	Low	1.0
			10.0
	195.000	Medium	1.0
			10.0
	215.875	High	1.0
			10.0

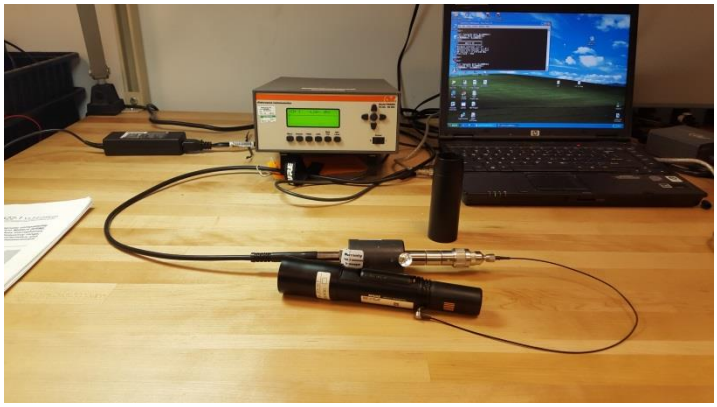
Table A-1. EUT Frequencies and Power Levels

A.6. TEST PROCEDURES

a) The EUT's antenna port was connected to an artificial antenna at ambient temperature.
b) The EUT's frequency was set at the lowest frequency (174.125 MHz) and the lowest switchable power level (1mW), and the power level was measured and recorded.
c) Step b) was repeated at all power levels (1mW and 10mW) and at medium (195.000 MHz) and high (215.875 MHz) frequencies.

A.7. RESULTS:

The output power measurement data is presented in Table A-1. As shown by the test data, the power output of the EUT is within the requirements of FCC Part 74 and RSS-210.



QLXD2 Output Power Measurement

EUT Frequency (MHz)	Declared Power mW (dBm)	Measured Power at Antenna Terminals (dBm)	Pass or Fail
174.125	1 (0.0)	-0.74	Pass
	10 (10.0)	9.33	Pass
195.000	1 (0.0)	-0.56	Pass
	10 (10.0)	9.52	Pass
215.875	1 (0.0)	-0.59	Pass
	10 (10.0)	9.50	Pass

Table A-1. QLXD2-V50 Power Output Data

CHECKED BY: Craig Kozlow

B. FREQUENCY STABILITY

B.1. PURPOSE:

This test was performed to determine if the EUT meets the frequency stability requirements of FCC Part 74.861(e)(4) and RSS-210.

B.2. REQUIREMENTS:

As stated in FCC Part 74.861(e)(4) and RSS-210, the tolerance of the transmitter shall be 0.005%, or 50 ppm.

B.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}
Frequency Error (Stability) at 195 MHz	7.95 Hz or 0.040775 ppm

- 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.

B.4. TEST SETUP AND INSTRUMENTATION:

The EUT was heated and cooled in an Espec temperature chamber over a temperature range of -10°C to +45°C. The temperature around the EUT was measured and monitored by an Extech digital thermometer. The EUT's 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 B-1 and Figure B-2 . The test instrumentation can be determined from Table 10-1

B.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. Each EUT was set to transmit at a low, mid or high frequency within its operating bands of 174.125 - 215.875 MHz.

B.6. TEST PROCEDURES:

a. The measured frequency of the transmitter was captured at ambient temperature with the frequency counter function of the spectrum analyzer. The value was recorded.
b. The temperature chamber was set to -30C with the EUT inside and powered off.
c. The EUT was allowed to soak for ~30 minutes after the temperature chamber reached the set temperature.
d. The EUT was then powered on and allowed to stabilize for ~ 1 minute.
e. The measured frequency of the transmitter was captured with the frequency counter function of the spectrum analyzer. The value was recorded.
f. The temperature chamber was set to +45°C with the EUT inside and powered off.
g. The EUT was allowed to soak for ~30 minutes after the temperature chamber reached the set temperature.
h. The EUT was then powered on and allowed to stabilize for ~ 1 minute.
i. The measured frequency of the transmitter was captured with the frequency counter function of the spectrum analyzer. The value was recorded.
j. Steps a. through i. were repeated for representative low, mid and high frequencies within the EUT's operational bands.

B.7 RESULTS:

The frequency stability measurements are presented in Tables B-1 through B-4. As shown by the test data, the test frequency deviation was within the 0.005% limit set out in FCC Part 74 and RSS-210.

Figure B-1. Representative setup for frequency stability testing

Figure B-2. Sample unit in temperature chamber

Temp °C	Nominal Frequency (MHz)	Measured Frequency (MHz)	Deviation (%)	Deviation (Hz)	PPM	Frequency Stability Limit (%)	Pass Or Fail
-30	174.125000	174.125017	0.0000098	17	0.097631012	0.005	PASS
-20	174.125000	174.125024	0.0000138	24	0.137832017	0.005	PASS
-10	174.125000	174.125024	0.0000138	24	0.137832017	0.005	PASS
0	174.125000	174.1250150	0.0000086	15	0.086145011	0.005	PASS
10	174.125000	174.1250030	0.0000017	3	0.017229002	0.005	PASS
20	174.125000	174.1249990	-0.0000006	-1	-0.005743	0.005	PASS
23 (ambient)	174.125000	174.1249900	-0.0000057	-10	-0.05743001	0.005	PASS
30	174.125000	174.1250710	0.0000408	71	0.407753051	0.005	PASS
40	174.125000	174.1250510	0.0000293	51	0.292893037	0.005	PASS
50	174.125000	174.1250610	0.0000350	61	0.350323044	0.005	PASS
-30	195.000000	195.0000600	0.0000308	60	0.307692308	0.005	PASS
-20	195.000000	195.0000270	0.0000138	27	0.138461538	0.005	PASS
-10	195.000000	195.0000090	0.0000046	9	0.046153846	0.005	PASS
0	195.000000	195.0000200	0.0000103	20	0.102564103	0.005	PASS
10	195.000000	195.0000140	0.0000072	14	0.071794872	0.005	PASS
20	195.000000	194.9999970	-0.0000015	-3	-0.01538462	0.005	PASS
23 (ambient)	195.000000	195.0000090	0.0000046	9	0.046153846	0.005	PASS
30	195.000000	195.0000820	0.0000421	82	0.42051282	0.005	PASS
40	195.000000	195.0000640	0.0000328	64	0.328205128	0.005	PASS
50	195.000000	195.0000380	0.0000195	38	0.194871795	0.005	PASS
-30	215.875000	215.8750170	0.0000079	17	0.078749276	0.005	PASS
-20	215.875000	215.8750240	0.0000111	24	0.111175449	0.005	PASS
-10	215.875000	215.8750270	0.0000125	27	0.12507238	0.005	PASS
0	215.875000	215.8750200	0.0000093	20	0.092646207	0.005	PASS
10	215.875000	215.8750070	0.0000032	7	0.032426173	0.005	PASS
20	215.875000	215.8749990	-0.0000005	-1	-0.00463231	0.005	PASS
23 (ambient)	215.875000	215.8749890	-0.0000051	-11	-0.05095541	0.005	PASS
30	215.875000	215.8750084	0.0000039	8	0.038911407	0.005	PASS
40	215.875000	215.8750620	0.0000287	62	0.287203243	0.005	PASS
50	215.875000	215.8750700	0.0000324	70	0.324261726	0.005	PASS

Table B-1. QLXD2 V50 Frequency Stability

CHECKED BY: Craig Kozyra

C. OCCUPIED BANDWIDTH MEASUREMENTS

C.1. PURPOSE:

This test was performed to determine if the EUT meets the necessary bandwidth requirements of FCC Part 74.861(e) (5) and RSS-210.

C.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+10log10 (mean output power in watts) dB.

Per the specifications set out in RSS-210, the following technical requirements apply:

a) The authorized bandwidth shall not exceed 200 kHz.

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.

C.3. TEST SETUP AND INSTRUMENTATION:

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

C.4. 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 with a Shure SB900 rechargeable battery. The EUT was

checked for proper operation before it was set up for the test. Testing was conducted with the EUT set to transmit at the low, medium, and high frequencies of its operating band. Testing was performed at an output power level of 1mW and 10 mW. 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 necessary bandwidth testing.

C.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 typical digital modulation.

c) The spectrum analyzer center frequency was set to the EUT operating frequency; span was set to Zero; detector set to RMS; trace mode set to Average; resolution bandwidth and video bandwidth set to 1 MHz; sweep time set to 3 s.

d) The peak output power was recorded and used to set the reference level on the spectrum analyzer.

f) The spectrum analyzer span was then set to 1.5 MHz; trace mode set to Max Hold; resolution bandwidth and video bandwidth set to 1 kHz. The signal trace was allowed to stabilize and the image was held in View mode.

g) The emission mask from Clause 8.3.2.2 was overlaid on the spectrum analyzer display and the trace was recorded.

h) The spectrum analyzer trace mode was set to Average to measure the transmitter wide band noise floor, and step g) was repeated

i) Steps a) through i) were repeated at 1mW and 10mW at the high, medium, and low frequencies of the EUT's frequency band.

C.6. RESULTS:

The necessary bandwidth data are presented on Pages 29 - 112. Data are shown as pairs of figures at each frequency, the first figure showing the reference carrier power, the second figure showing the maximum relative level within the emission mask. As shown by the test data, the necessary bandwidth of the EUT meets the requirements of FCC Part 74 and RSS-210.

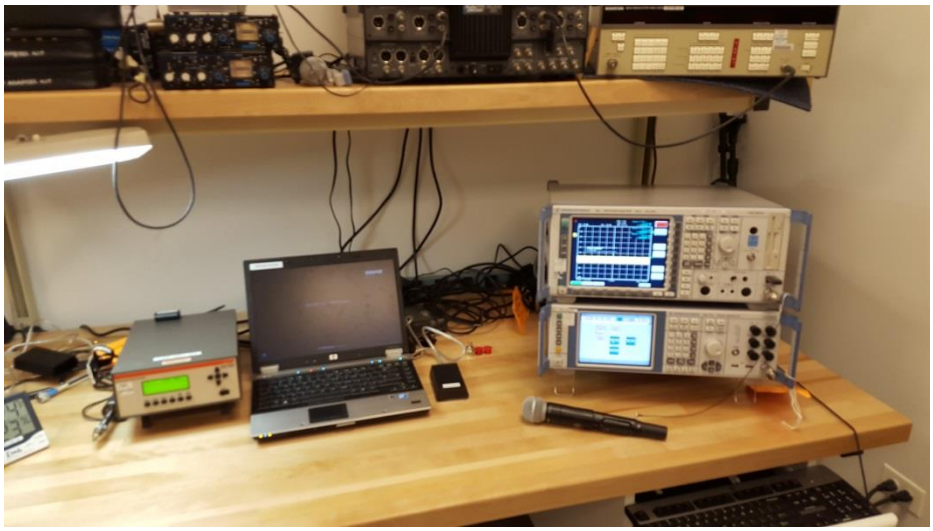
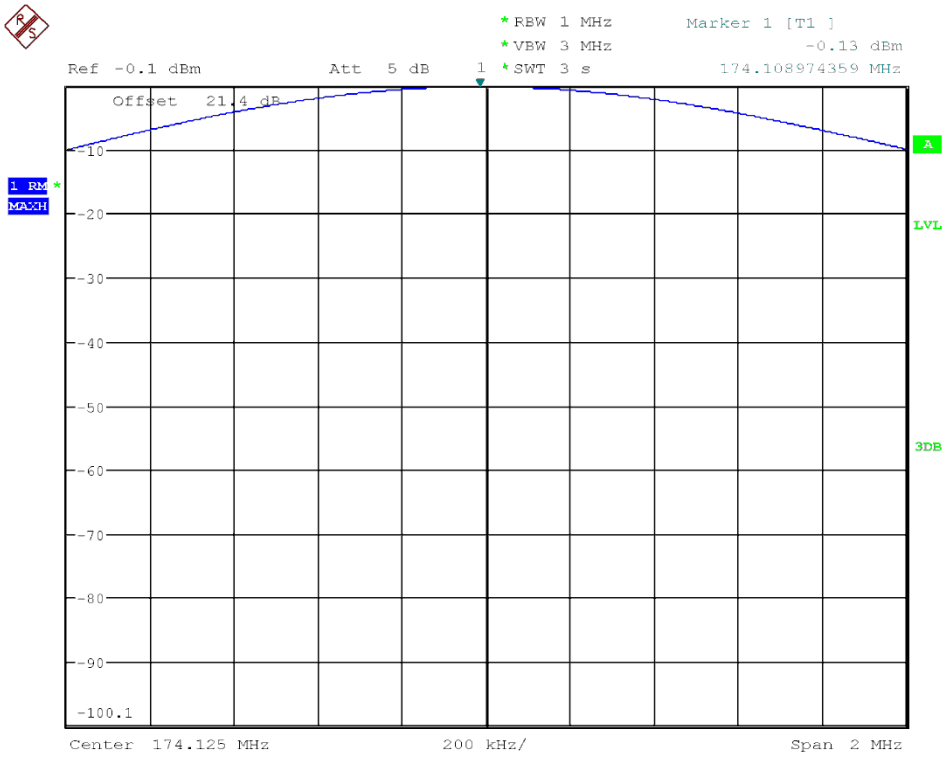


Figure C-1. Test Setup for Necessary Bandwidth Tests

QLXD2 V50 Occupied Bandwidth

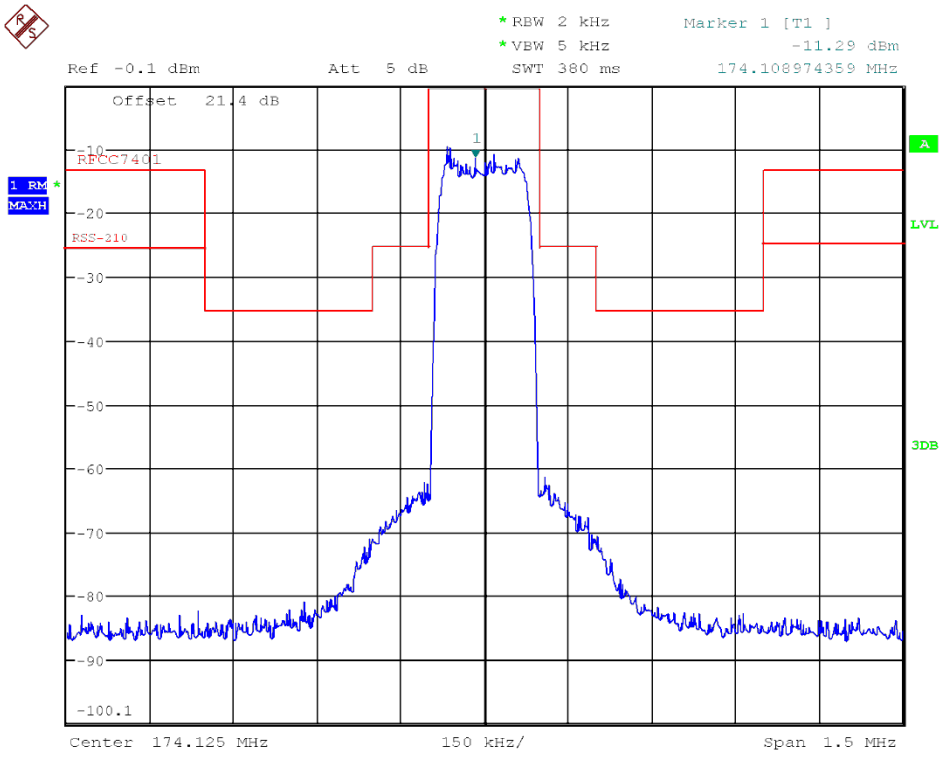
EUT	QLXD2 V50
Serial Number:	EMC02
Test Description:	OBW RF Power Output
Date of Test:	March 1, 2016
Operating Conditions:	Low Frequency (174.125 MHz) at 1mW
Operator Name:	Tom Braxton
Comment:	R & S FSU Spectrum Analyzer



mw 0 MOD

Date: 1.MAR.2016 11:56:44

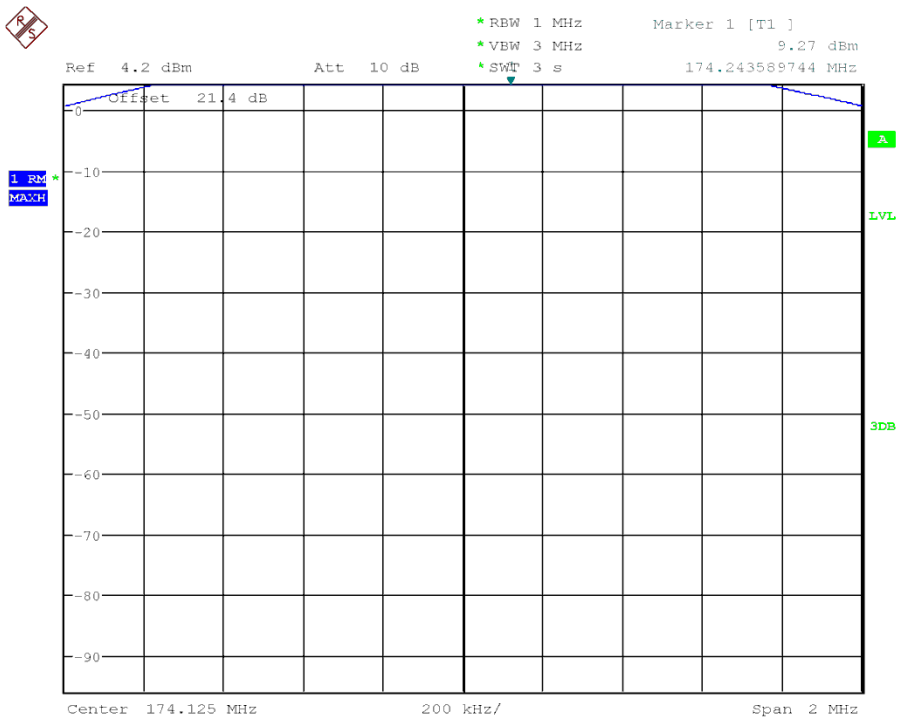
EUT	QLXD2 V50
Serial Number:	EMC02
Test Description:	ETSI Occupied Bandwidth Measurement
Date of Test:	March 1, 2016
Operating Conditions:	Low Frequency (174.125 MHz) at 1mW
Operator Name:	Tom Braxton
Comment:	R & S FSU Spectrum Analyzer



mw 0 MOD

Date: 1.MAR.2016 11:59:15

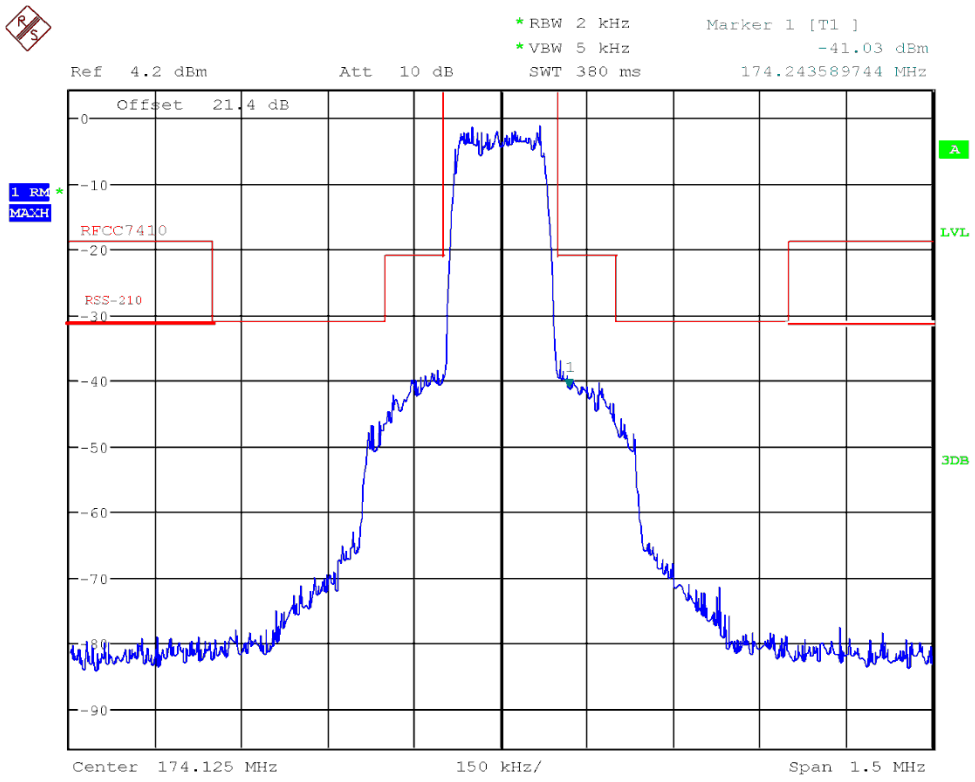
EUT	QLXD2 V50
Serial Number:	EMC02
Test Description:	OBW RF Power Output
Date of Test:	March 1, 2016
Operating Conditions:	Low Frequency (174.125 MHz) at 10 mW
Operator Name:	Tom Braxton
Comment:	R & S FSU Spectrum Analyzer



mw 0 MOD

Date: 1.MAR.2016 12:02:01

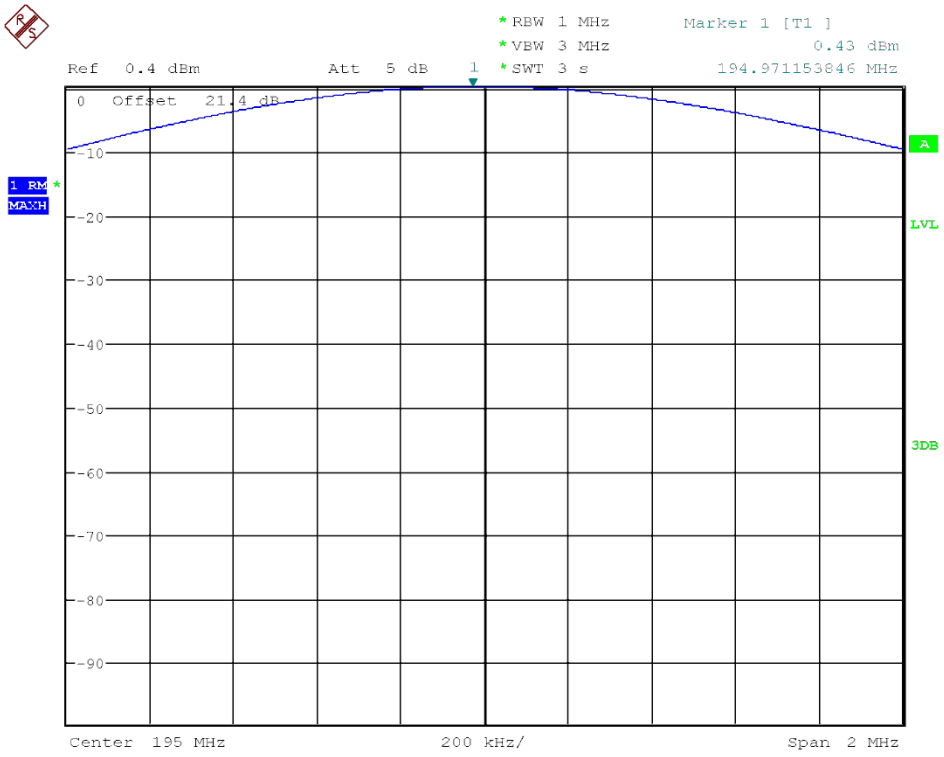
EUT	QLXD2 V50
Serial Number:	EMC02
Test Description:	ETSI Occupied Bandwidth Measurement
Date of Test:	March 1, 2016
Operating Conditions:	Low Frequency (174.125 MHz) at 10 mW
Operator Name:	Tom Braxton
Comment:	R & S FSU Spectrum Analyzer



mw 0 MOD

Date: 1.MAR.2016 12:05:28

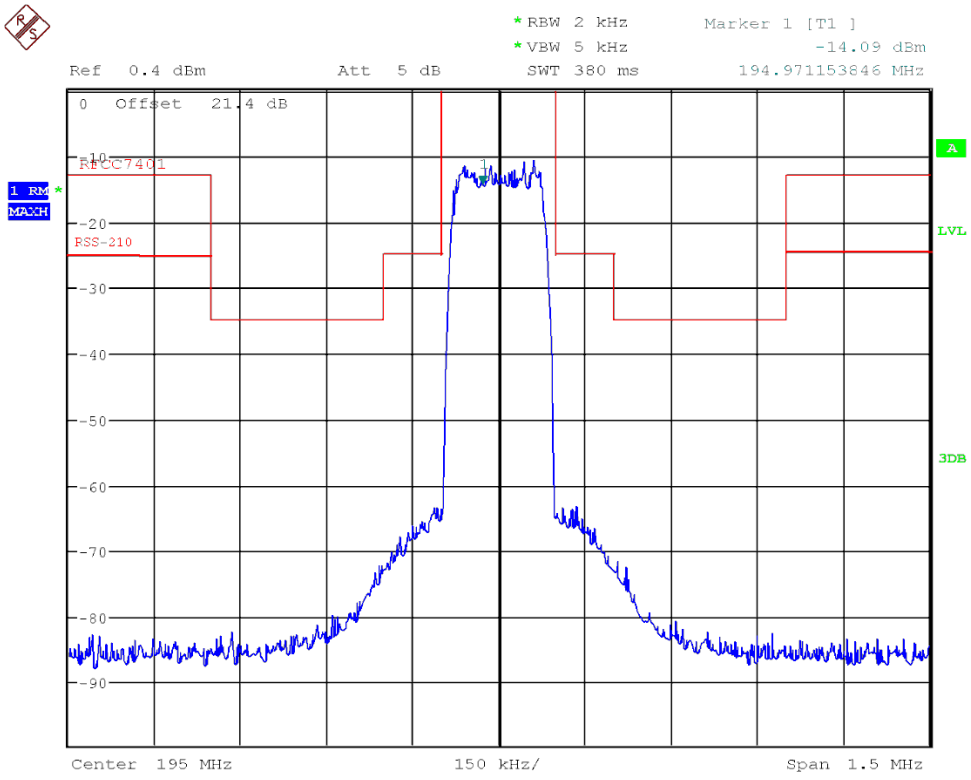
EUT	QLXD2 V50
Serial Number:	EMC02
Test Description:	OBW RF Power Output
Date of Test:	March 1, 2016
Operating Conditions:	Mid Frequency (195.000 MHz) at 1mW
Operator Name:	Tom Braxton
Comment:	R & S FSU Spectrum Analyzer



mw 0 MOD

Date: 1.MAR.2016 11:45:01

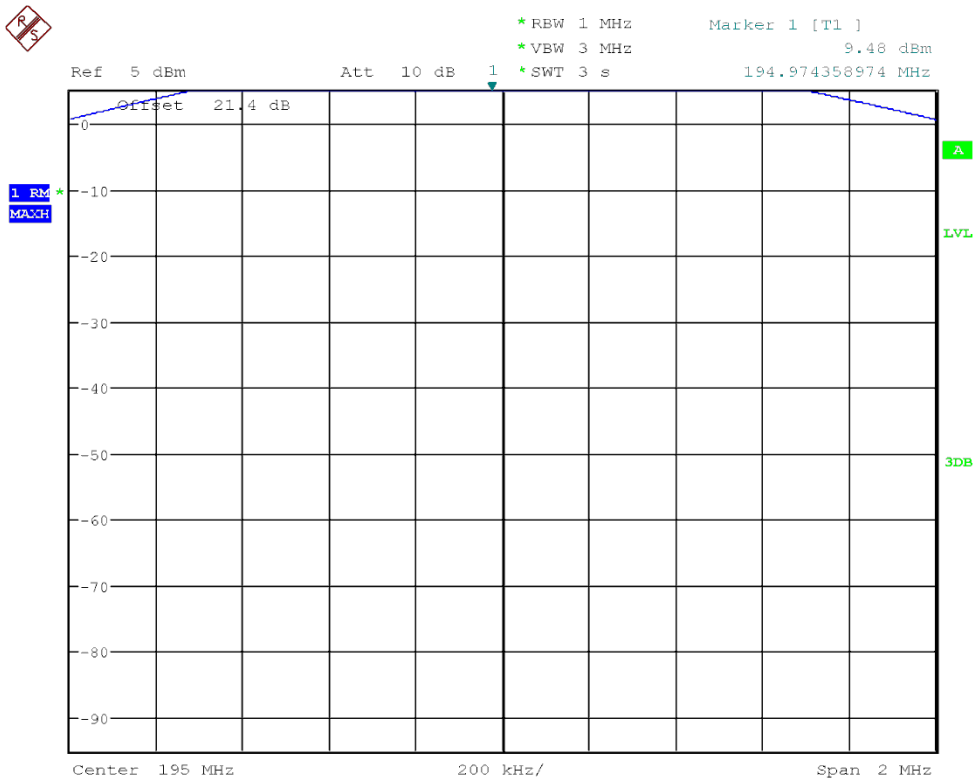
EUT	QLXD2 V50
Serial Number:	EMC02
Test Description:	ETSI Occupied Bandwidth Measurement
Date of Test:	March 1, 2016
Operating Conditions:	Mid Frequency (195.000 MHz) at 1mW
Operator Name:	Tom Braxton
Comment:	R & S FSU Spectrum Analyzer



mw 0 MOD

Date: 1.MAR.2016 11:47:05

EUT	QLXD2 V50
Serial Number:	EMC02
Test Description:	OBW RF Power Output
Date of Test:	March 1, 2016
Operating Conditions:	Mid Frequency (195.000 MHz) at 10mW
Operator Name:	Tom Braxton
Comment:	R & S FSU Spectrum Analyzer



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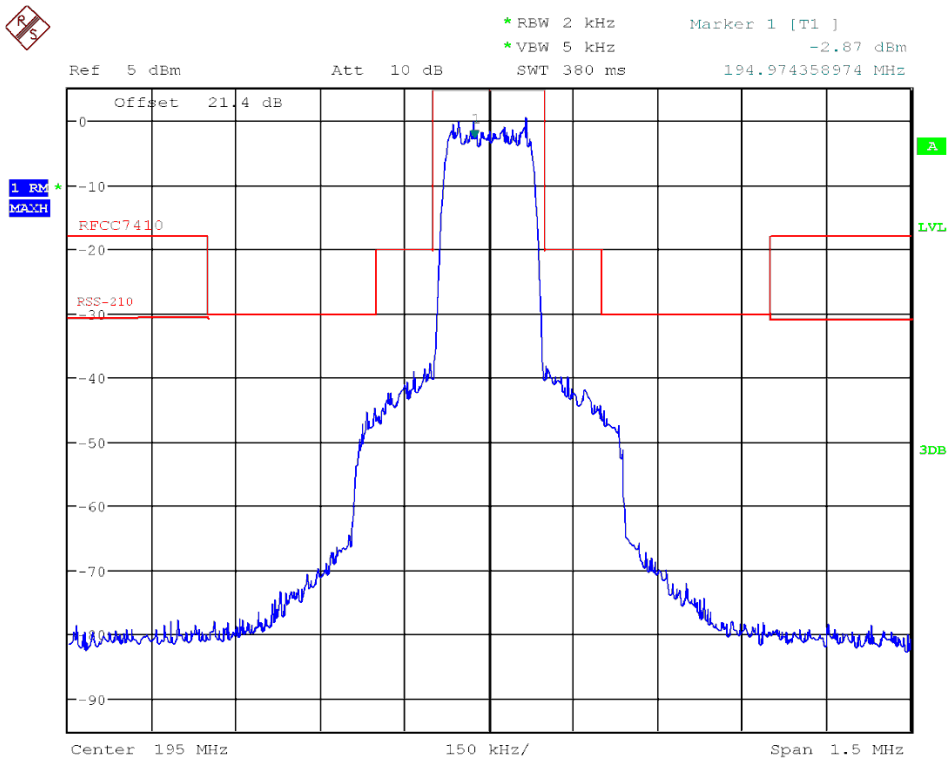
Date: 1.MAR.2016 11:49:48

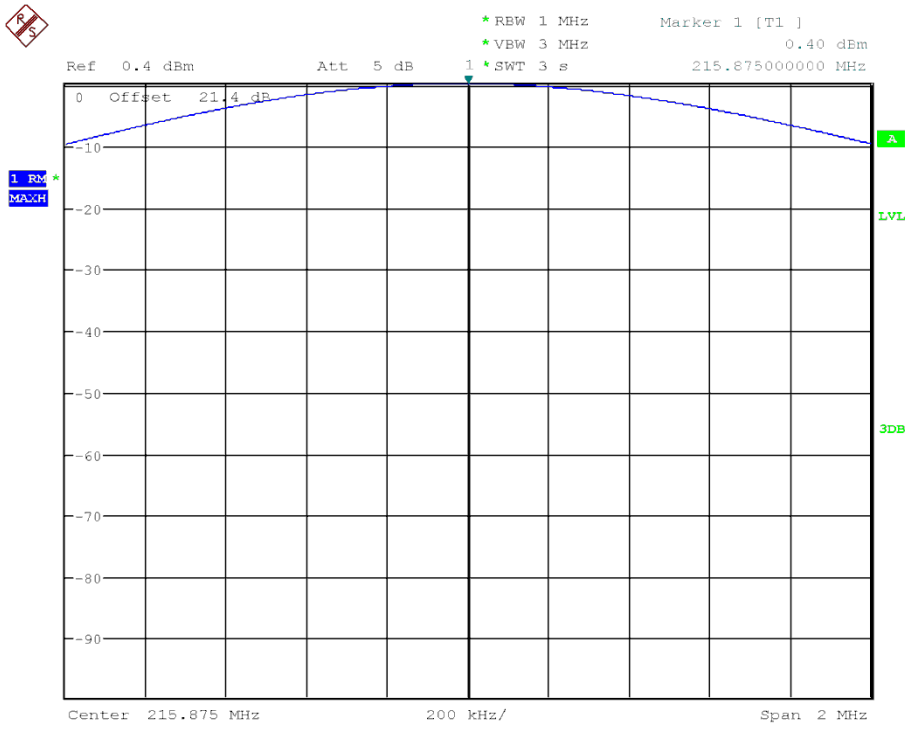
EUT	QLXD2 V50
Serial Number:	EMC02
Test Description:	ETSI Occupied Bandwidth Measurement
Date of Test:	March 1, 2016
Operating Conditions:	Mid Frequency (195.000 MHz) at 10mW
Operator Name:	Tom Braxton
Comment:	R & S FSU Spectrum Analyzer



mw 0 MOD

Date: 1.MAR.2016 11:52:14

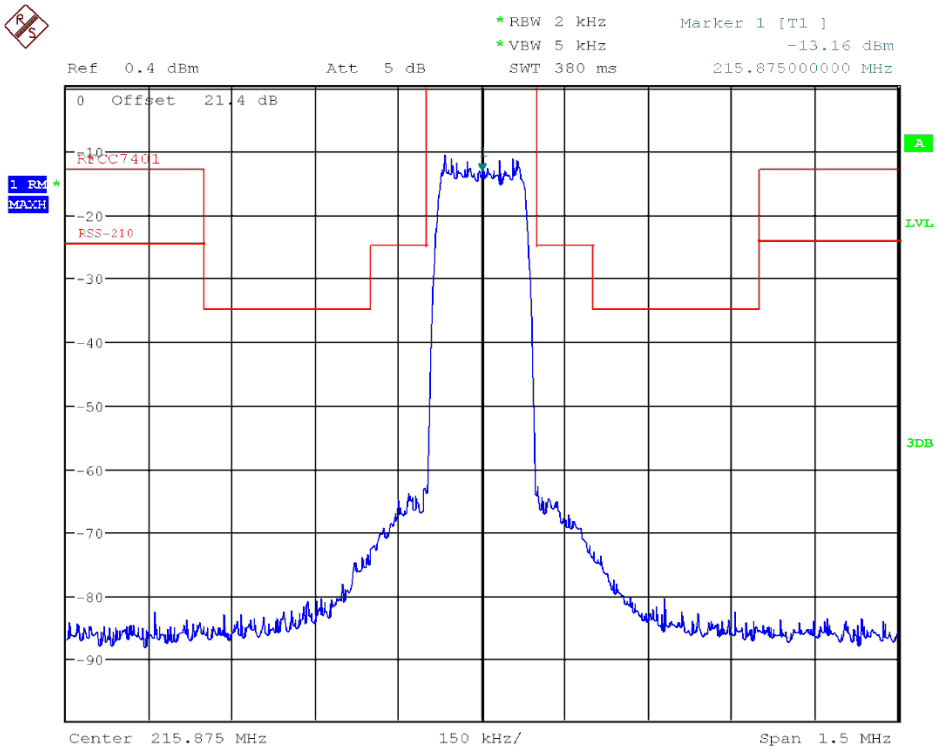
EUT	QLXD2 V50
Serial Number:	EMC02
Test Description:	OBW RF Power Output
Date of Test:	March 1, 2016
Operating Conditions:	High Frequency (215.875 MHz) at 1mW
Operator Name:	Tom Braxton
Comment:	R & S FSU Spectrum Analyzer



mw 0 MOD

Date: 1.MAR.2016 12:09:09

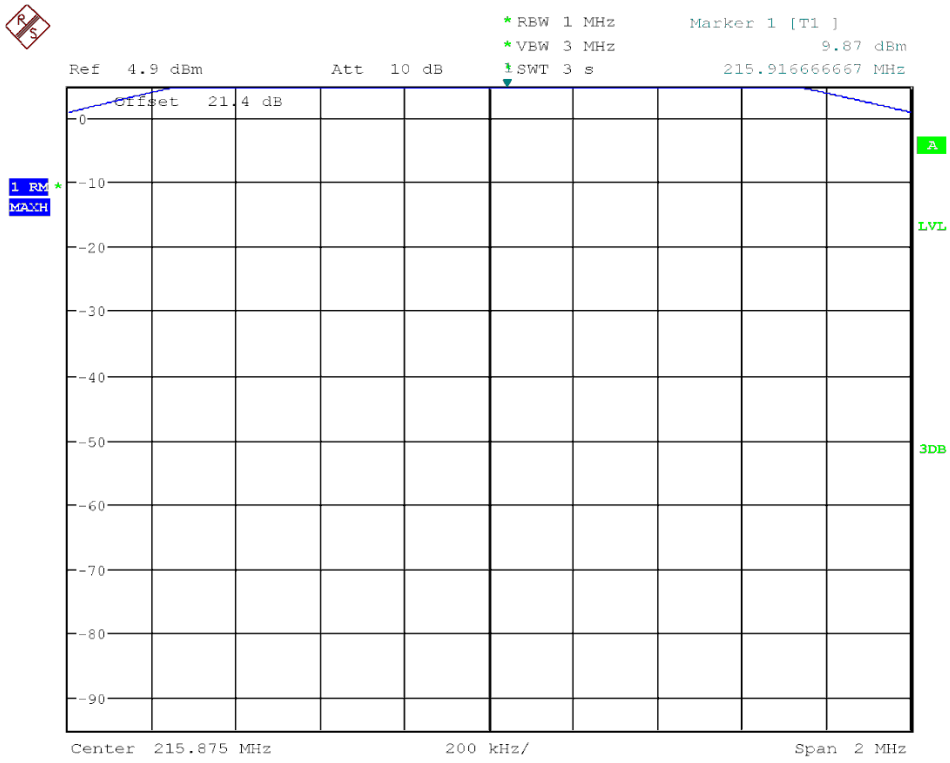
EUT	QLXD2 V50
Serial Number:	EMC02
Test Description:	ETSI Occupied Bandwidth Measurement
Date of Test:	March 1, 2016
Operating Conditions:	High Frequency (215.875 MHz) at 1mW
Operator Name:	Tom Braxton
Comment:	R & S FSU Spectrum Analyzer



mw 0 MOD

Date: 1.MAR.2016 12:11:09

EUT	QLXD2 V50
Serial Number:	EMC02
Test Description:	OBW RF Power Output
Date of Test:	March 1, 2016
Operating Conditions:	High Frequency (215.875 MHz) at 10mW
Operator Name:	Tom Braxton
Comment:	R & S FSU Spectrum Analyzer



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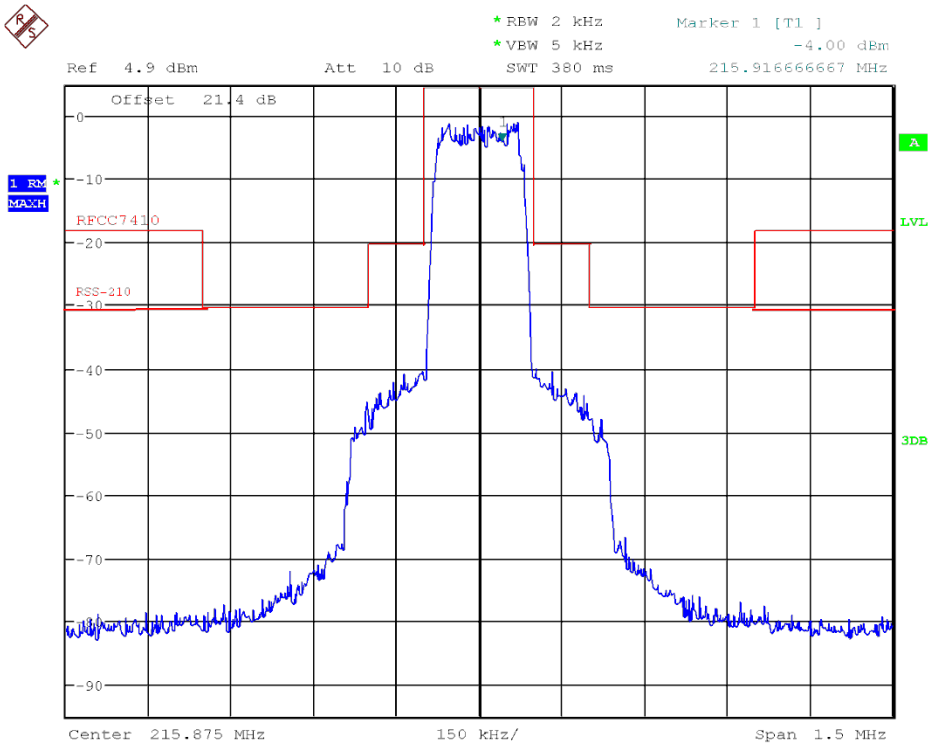
Date: 1.MAR.2016 12:13:49

EUT	QLXD2 V50
Serial Number:	EMC02
Test Description:	ETSI Occupied Bandwidth Measurement
Date of Test:	March 1, 2016
Operating Conditions:	High Frequency (215.875 MHz) at 10mW
Operator Name:	Tom Braxton
Comment:	R & S FSU Spectrum Analyzer



mw 0 MOD

Date: 1.MAR.2016 12:15:31

D. FIELD STRENGTH OF SPURIOUS EMISSIONS

D.1. PURPOSE:

This test was performed to determine if the QLXD2-V50 (EUT) meets the radiated RF emission requirements of the FCC Part 74 and RSS-210 over the frequency range from 30MHz to 10GHz.

D.2. REQUIREMENTS:

As stated in FCC Part 74, spurious emissions must fall below the limits given below.

(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+10log10 (mean output power in watts) dB.

And as stated in RSS-210:

The power of unwanted emissions (measured with a resolution bandwidth of 1% of the authorized bandwidth) shall be attenuated below the mean output power, P_{MEAN} in dBW, of the transmitter as follows:

i. at least 25 dB on any frequency removed from the operating frequency by more than 50% up to and including 100% of the authorized bandwidth; and

ii. at least 35 dB on any frequency removed from the operating frequency by more than 100% up to and including 250% of the authorized bandwidth.

The power of unwanted emissions (measured with a resolution bandwidth of 30 kHz) shall be attenuated below the mean output power, PMEAN in dBW, of the transmitter as follows:

i. at least 55 + $10\log_{10}$ (P_{MEAN} in watts) dB: on any frequency removed from the operating frequency by more than 250% of the authorized bandwidth.

D.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}	U_{ETSI}
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.12 dB	6.00 dB
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 12.75 GHz)	4.56 dB	6.00 dB

U_{lab} = Determined for Shure EMC Laboratory

U_{ETSI} = From ETSI EN 300 422-1 Table 6

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.

D.4. TEST SETUP AND INSTRUMENTATION:

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

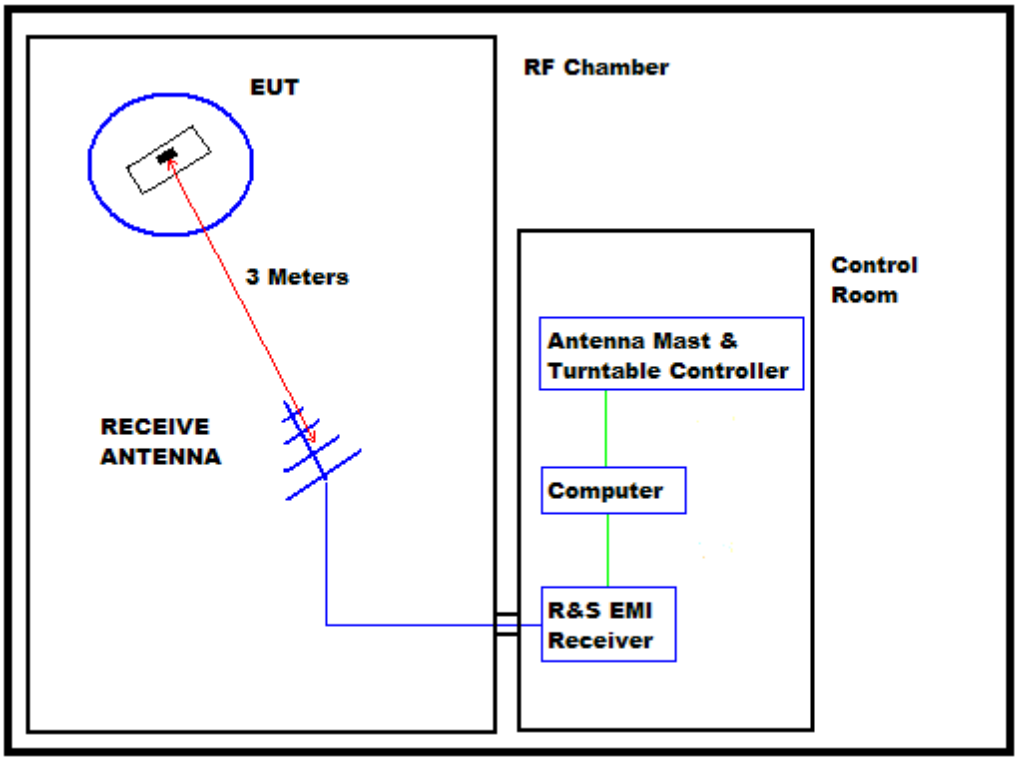
D.5. EUT OPERATION:

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 a Shure SB900 rechargeable battery.

D.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 25MHz 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 (dBµV/m) = MTR (dBµV) + AF (dB/m) + CF (dB) + (- PA (dB))

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

Formula 2: FS (µV/m) = AntiLog [(FS (dBµV/m))/20]

Initial relative measurements were performed to determine whether the use of AA alkaline batteries or Shure rechargeable batteries would result in different emission levels. A judgment was made that a slightly higher emission level was seen when the Shure SB900 battery was used to power the EUT.

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 25MHz 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 measurement s 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.

D.7. RESULTS:

The plots of the radiated spurious emission levels are presented on pages 118 through 173, as follows:

- Table D-1 summarizes the tabular data for maximized spurious emissions for QLXD2-V50, followed by representative graphical data taken before maximization for each of the low, medium, and high frequencies at 1mW and 10mW output power, measured in the ranges of 1-10 GHz and 30-1000 MHz,

All emissions measured from the QLXD2-V50 were within the limits set in FCC Part 74 and RSS-210.

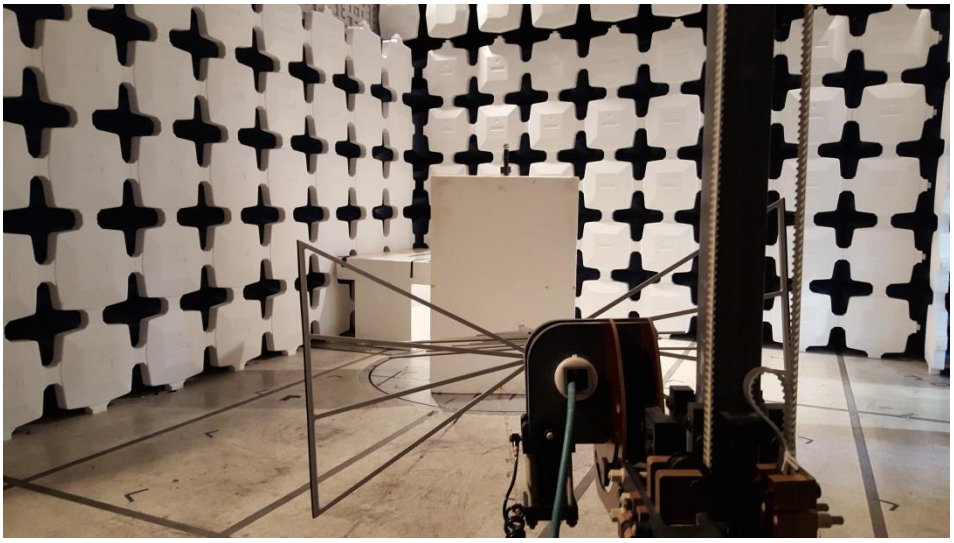
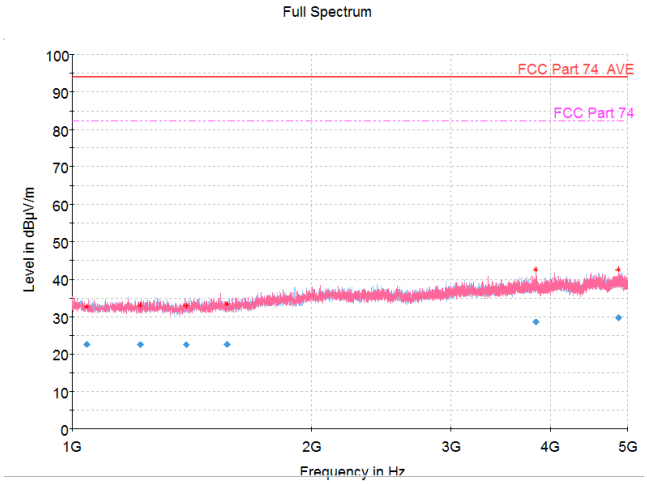


Figure D-1. QLXD2-V50 Emission Setup

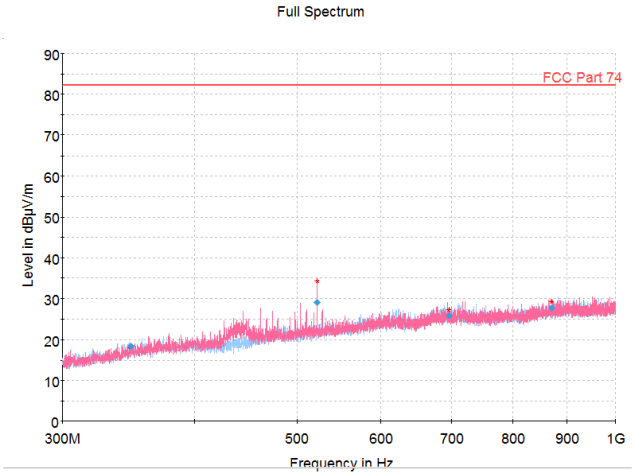
Actual Frequency (MHz)	Harmonics (MHz)	Polarity	Cable Loss (dB)	Antenna Gain (dB)	10mW Scan (dBµV)	10mW Equivalent Measured from Sig Gen (dBm)	10 mW ERP Total (dBm)	Limit (dBm)	Status	1mW Scan (dBµV)	1mW Equivalent Measured from Sig Gen (dBm)	1 mW ERP Total (dBm)	Limit (dBm)	Status
174.125	348.25	H	2.3	5.7	18.1	-77.0	-73.6	-36.0	Pass	18.3	-77.0	-73.6	-36.0	Pass
	348.25	V	2.3	5.7		-80.0	-76.6	-36.0	Pass		-80.0	-76.6	-36.0	Pass
	522.375	H	2.7	5.6	47.1	-43.0	-40.1	-36.0	Pass	29.2	-68.0	-65.1	-36.0	Pass
	522.375	V	2.7	5.6		-47.0	-44.1	-36.0	Pass		-73.0	-70.1	-36.0	Pass
	696.500	H	3.1	5.4	26.3	-79.0	-76.7	-36.0	Pass	25.9	-81.0	-78.7	-36.0	Pass
	696.500	V	3.1	5.4		-81.0	-78.7	-36.0	Pass		-83.0	-80.7	-36.0	Pass
	870.625	H	3.4	6.0	39.1	-62.0	-59.4	-36.0	Pass	27.7	-82.0	-79.4	-36.0	Pass
	870.625	V	3.4	6.0		-57.0	-54.4	-36.0	Pass		-80.0	-77.4	-36.0	Pass
	1044.75	H	3.8	6.1	33.2	-62.6	-60.3	-36.0	Pass	33.0	-83.0	-80.7	-36.0	Pass
	1044.75	V	3.8	6.1		-60.6	-58.3	-36.0	Pass		-81.0	-78.7	-36.0	Pass
	1218.875	H	4.4	5.5	33.2	-68.0	-66.9	-36.0	Pass	33.2	-78.0	-76.9	-36.0	Pass
	1218.875	V	4.4	5.5		-69.7	-68.6	-36.0	Pass		-79.7	-78.6	-36.0	Pass
	1393.000	H	4.7	6.0	32.5	-71.6	-70.3	-36.0	Pass	33.3	-80.1	-78.8	-36.0	Pass
	1393.000	V	4.7	6.0		-70.1	-68.8	-36.0	Pass		-79.2	-77.9	-36.0	Pass
	1567.125	H	5.2	7.5	32.7	-72.0	-69.7	-36.0	Pass	33.6	-78.4	-76.1	-36.0	Pass
	1567.125	V	5.2	7.5		-73.4	-71.1	-36.0	Pass		-76.5	-74.2	-36.0	Pass
195.000	390	H	2.5	6.1	21.4	-69.0	-65.4	-36.0	Pass	19.9	-72.0	-68.4	-36.0	Pass
	390	V	2.5	6.1		-71.0	-67.4	-36.0	Pass		-74.0	-70.4	-36.0	Pass
	585	H	2.8	6.0	43.9	-47.0	-43.8	-36.0	Pass	33.4	-69.0	-65.8	-36.0	Pass
	585	V	2.8	6.0		-45.0	-41.8	-36.0	Pass		-68.0	-64.8	-36.0	Pass
	780	H	3.2	5.4	27.7	-79.0	-76.8	-36.0	Pass	27.3	-82.0	-79.8	-36.0	Pass
	780	V	3.2	5.4		-77.0	-74.8	-36.0	Pass		-79.0	-76.8	-36.0	Pass
	975	H	3.5	6.1	28.2	-76.0	-73.4	-36.0	Pass	28.6	-75.0	-72.4	-36.0	Pass
	975	V	3.5	6.1		-74.0	-71.4	-36.0	Pass		-74.5	-71.9	-36.0	Pass
	1170	H	3.9	6.3	32.6	-78.5	-76.1	-36.0	Pass	32.9	-79.0	-76.6	-36.0	Pass
	1170	V	3.9	6.3		-78.7	-76.3	-36.0	Pass		-78.3	-75.9	-36.0	Pass
	1365	H	4.4	6.3	31.0	-81.0	-79.1	-36.0	Pass	32.1	-80.1	-78.2	-36.0	Pass
	1365	V	4.4	6.3		-82.0	-80.1	-36.0	Pass		-81.2	-79.3	-36.0	Pass
	1560	H	4.7	6.8	33.9	-78.5	-76.4	-36.0	Pass	31.8	-81.3	-79.2	-36.0	Pass
	1560	V	4.7	6.8		-81.1	-79.0	-36.0	Pass		-79.4	-77.3	-36.0	Pass
	1755	H	5.3	7.9	35.0	-75.0	-72.4	-36.0	Pass	33.8	-73.0	-70.4	-36.0	Pass
	1755	V	5.3	7.9		-79.0	-76.4	-36.0	Pass		-73.2	-70.6	-36.0	Pass
215.875	431.750	H	2.3	6.4	35.1	-64.0	-59.9	-36.0	Pass	19.1	-82.0	-77.9	-36.0	Pass
	431.750	V	2.3	6.4		-63.0	-58.9	-36.0	Pass		-80.0	-75.9	-36.0	Pass
	647.625	H	2.8	6.0	33.3	-61.0	-57.8	-36.0	Pass	24.3	-65.0	-61.8	-36.0	Pass
	647.625	V	2.8	6.0		-69.0	-65.8	-36.0	Pass		-68.0	-64.8	-36.0	Pass
	863.500	H	3.2	6.0	29.2	-71.0	-68.2	-36.0	Pass	28.5	-67.5	-64.7	-36.0	Pass
	863.500	V	3.2	6.0		-72.0	-69.2	-36.0	Pass		-69.0	-141.0	-36.0	Pass
	1079.375	H	3.5	6.2	32.5	-77.2	-74.5	-36.0	Pass	31.8	-80.8	-78.1	-36.0	Pass
	1079.375	V	3.5	6.2		-80.3	-77.6	-36.0	Pass		-81.2	-78.5	-36.0	Pass
	1295.25	H	3.9	6.7	33.4	-80.1	-77.3	-36.0	Pass	33.6	-79.9	-77.1	-36.0	Pass
	1295.25	V	3.9	6.7		-79.6	-76.8	-36.0	Pass		-80.2	-77.4	-36.0	Pass
	1511.125	H	4.4	7.4	34.1	-78.0	-75.0	-36.0	Pass	32.0	-81.8	-78.8	-36.0	Pass
	1511.125	V	4.4	7.4		-72.0	-69.0	-36.0	Pass		-80.9	-77.9	-36.0	Pass
	1727	H	4.5	7.6	34.2	-76.8	-73.7	-36.0	Pass	35.2	-79.1	-190.1	-36.0	Pass
	1727	V	4.5	7.6		-72.0	-68.9	-36.0	Pass		-76.1	-148.1	-36.0	Pass

Table D-1. QLXD2-V50 Spurious Emission Substitution Data

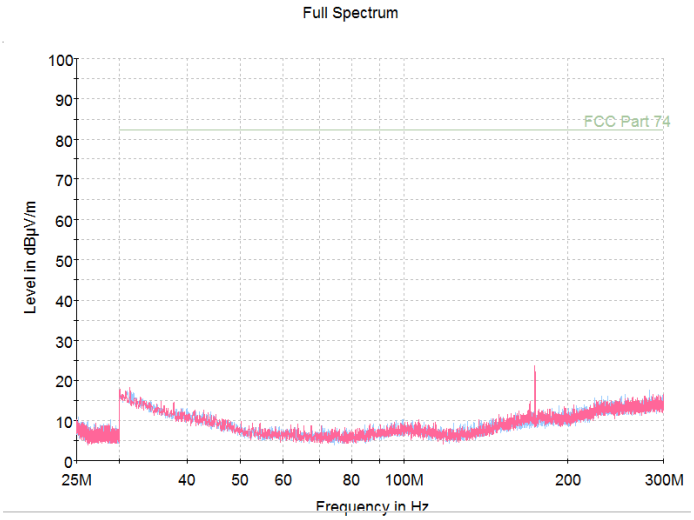
QLXD2-V50
174.125 MHz
1 mW
1-5 GHz



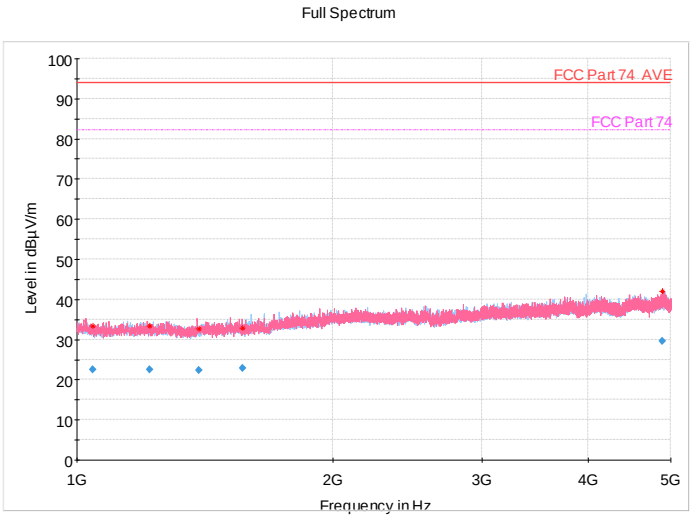
QLXD2-V50
174.125 MHz
1 mW
300-1000 MHz



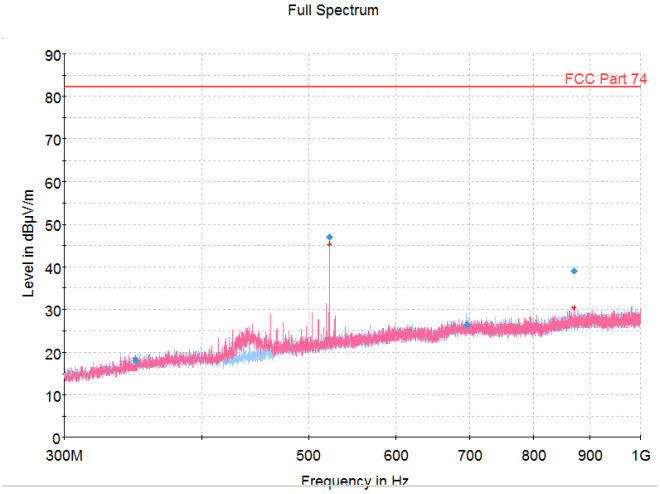
QLXD2-V50
174.125 MHz
1 mW
25-300 MHz



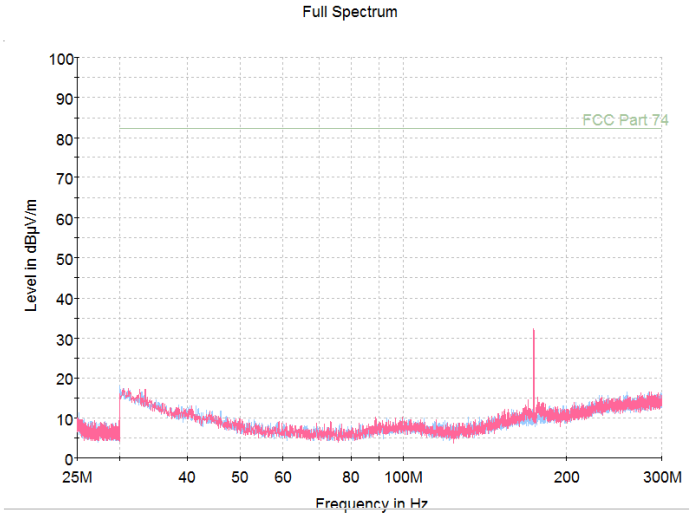
QLXD2-V50
174.125 MHz
10 mW
1-5 GHz



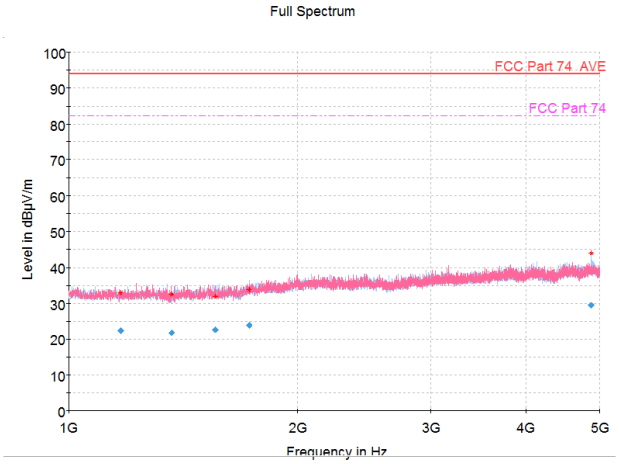
QLXD2-V50
174.125 MHz
10 mW
300-1000 MHz



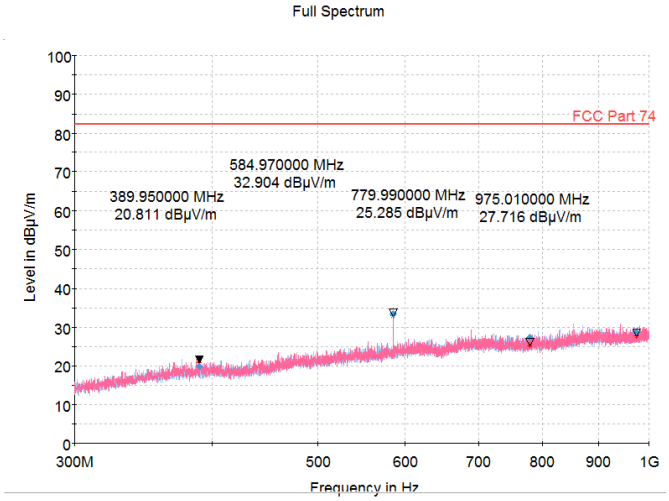
QLXD2-V50
174.125 MHz
10 mW
25-300 MHz



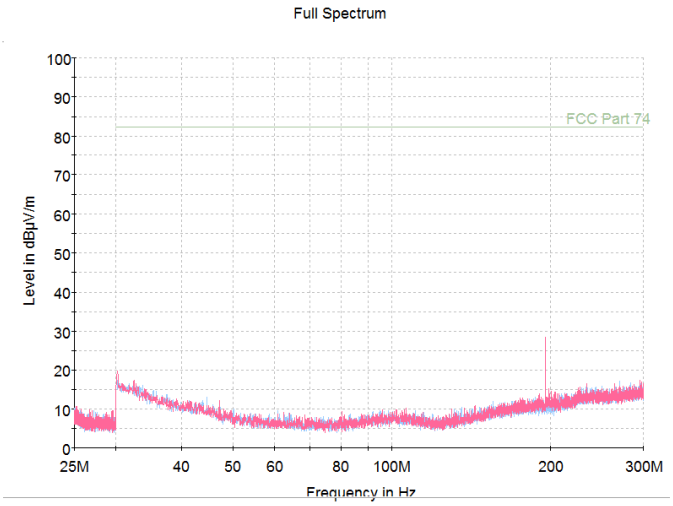
QLXD2-V50
195 MHz 1 mW
1-10 GHz



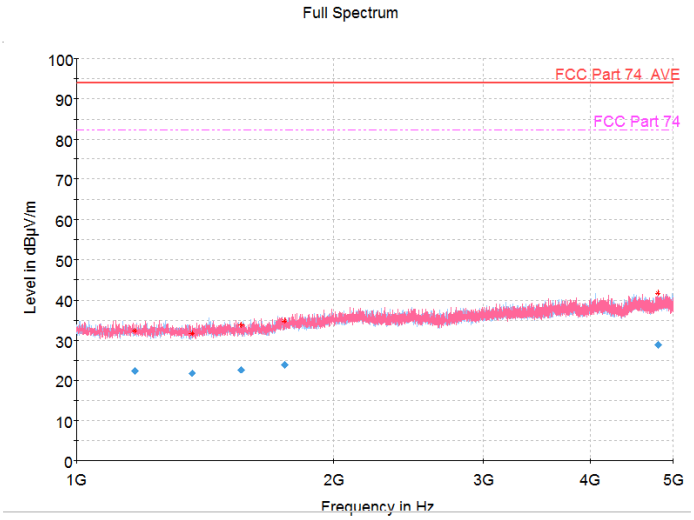
QLXD2-V50
195 MHz
1 mW
300-1000 MHz



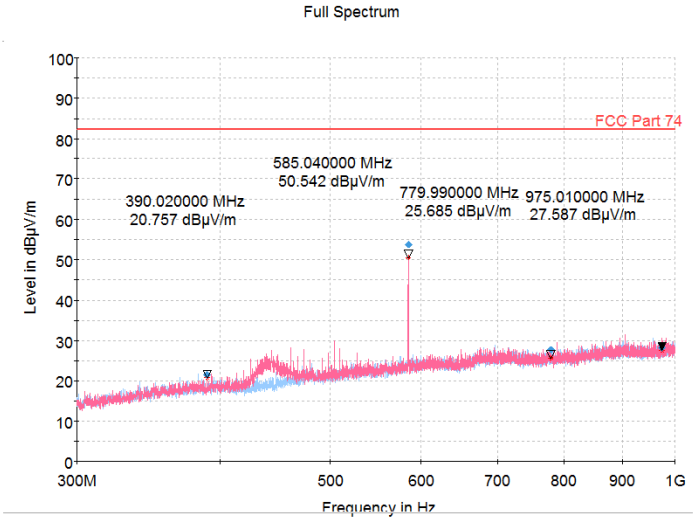
QLXD2-V50
195 MHz 1 mW
25-300 MHz



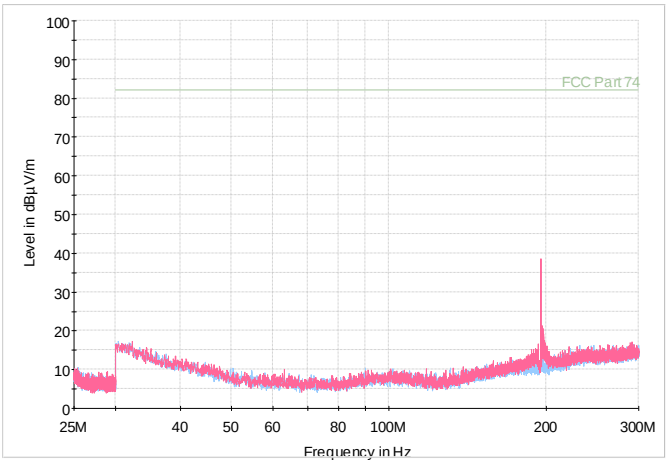
QLXD2-V50
195 MHz 10 mW
1-5 GHz



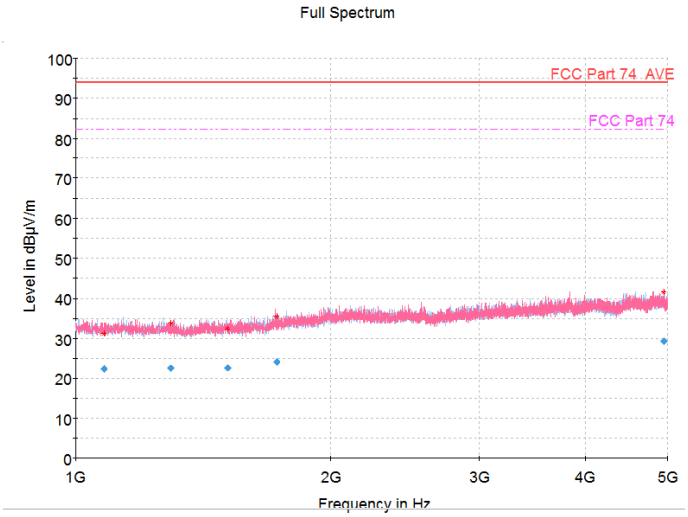
QLXD2-V50
195 MHz
10 mW
300-1000 MHz



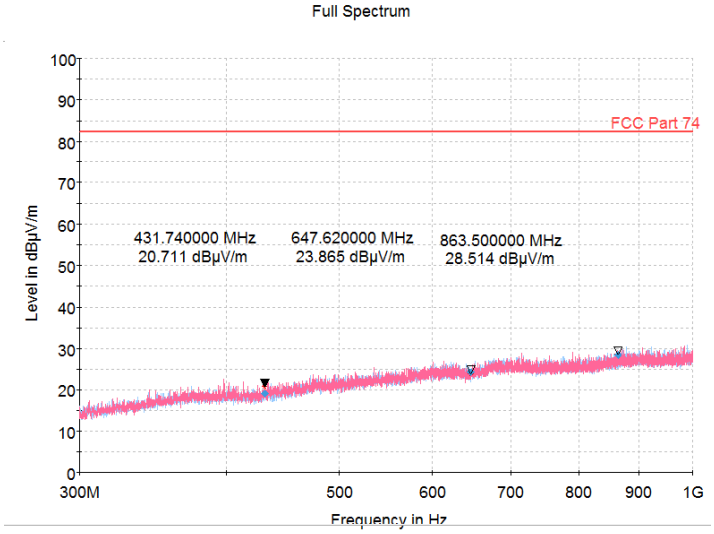
QLXD2-V50
195 MHz
10 mW
25-300 MHz



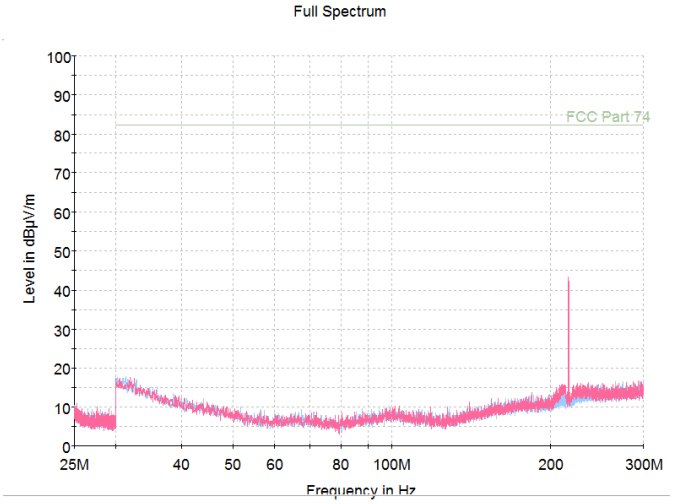
QLXD2-V50
215.875 MHz
1 mW
1-5 GHz



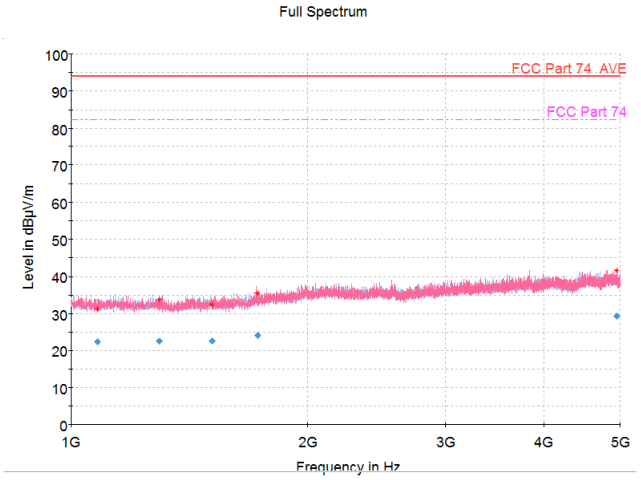
QLXD2-V50
215.875 MHz
1 mW
300-1000 MHz



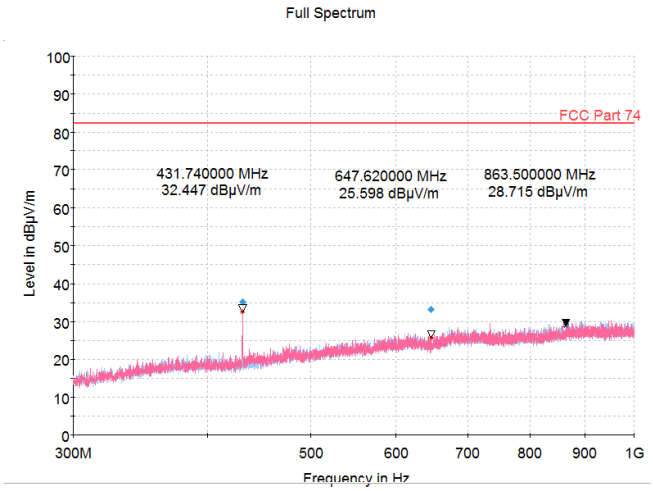
QLXD2-V50
215.875 MHz
1 mW
25-300 MHz



QLXD2-V50
215.875 MHz
10 mW
1-5 GHz



QLXD2-V50
215.875 MHz
10 mW
300-1000 MHz



QLXD2-V50
215.875 MHz
10 mW
25-300 MHz