



Engineering Solutions & Electromagnetic Compatibility Services

**Certification Application Report for
FCC Part 15.247 & Industry Canada RSS-210**

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FCC ID/ IC	YL6-143220ISGC 9111A-143220ISGC	Test Report Date:	July 15, 2015
Platform	N/A	RTL Work Order #	2015124
Model	ADC-IS-220-GC	RTL Quote #	QRTL15-124A
American National Standard Institute	ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
FCC Classification	DSS – Part 15 Spread Spectrum Transmitter		
FCC Rule Part(s)/Guidance	FCC Rules Part 15.247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz Direct Sequence System 2014		
Industry Canada	RSS-210 Issue 8: Low Power License-Exempt Communications Devices Industry Canada RSS-Gen Issue 4: General Requirements for Compliance of Radio Apparatus		
Digital Interface Information	Digital Interface was found to be compliant		
Frequency Range (MHz)	Output Power (W)*	Frequency Tolerance	Emission Designator
910-920	0.057	N/A	404KF1D

* power is 3m peak radiated

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this test report. No modifications were made to the equipment during testing in order to achieve compliance with these standards. Furthermore, there was no deviation from, additions to, or exclusions from, the applicable parts of FCC Part 2, FCC Part 15, Industry Canada RSS-210, RSS-Gen, and ANSI C63.10.

Signature: 

Date: July 15, 2015

Typed/Printed Name: Desmond A. Fraser

Position: President

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This/these test(s) is/are accredited under Rhein Tech Laboratories, Inc. ISO/IEC 17025 accreditation issued by the ANSI-ASQ National Accreditation Board. Refer to certificate and scope of accreditation AT-1445.

Table of Contents

1	General Information	5
1.1	Scope	5
1.2	Description of EUT	5
1.3	Test Facility	5
1.4	Related Submittal(s)/Grant(s)	5
1.5	Modifications	5
2	Test Information	6
2.1	Description of Test Modes	6
2.2	Exercising the EUT	6
2.3	Test Result Summary.....	6
2.4	Test System Details	7
2.5	Configuration of Tested System.....	7
3	Peak Output Power - 15.247(b)(2); IC RSS-210 A8.4(1), RSS-Gen 6.12	8
3.1	Power Output Test Procedure.....	8
3.2	Power Output Test Data.....	8
4	Antenna Conducted Spurious Emissions – FCC 15.247(d), RSS-210 A8.5	8
5	Compliance with the Band Edge – FCC 15.247(d); RSS-210 A8.5	9
5.1	Band Edge Test Procedure.....	9
5.2	Band Edge Test Procedure.....	9
5.3	Band Edge Test Results	10
5.3.1	Lower Band Edge – Plot	10
5.3.2	Upper Band Edge –Delta Plot	12
5.3.3	Calculation of Upper Band Edge.....	13
6	20 dB Bandwidth - 15.247(a)(1)(i); RSS-210 A8.1(a).....	14
6.1	20 dB Bandwidth Test Procedure – Minimum 20 dB Bandwidth	14
6.2	20 dB Bandwidth Test Results	14
7	Carrier Frequency Separation - 15.247(a)(1)(i), RSS-210 A8.1(b)	18
7.1	Carrier Frequency Separation Test Procedure	18
7.2	Carrier Frequency Separation Test Data	18
8	Hopping Characteristics – FCC 15.247(a)(1)(i), RSS-210 A8.1(c).....	19
8.1	Hopping Characteristics Test Procedure	19
8.2	Number of Hopping Frequencies	19
8.3	Average Time of Occupancy.....	20
9	Radiated Emissions - 15.209; RSS-210 6.2.1; RSS-Gen 6.13/7.1	22
9.1	Limits of Radiated Emissions Measurement.....	22
9.2	Radiated Emissions Measurement Test Procedure.....	22
9.3	Radiated Emissions Test Results	23
9.3.1	Unintentional Radiated Emissions Test Data.....	23
9.3.2	Spurious/Harmonics Radiated Emissions Test Data	24
10	Conclusion	26

Figure Index

Figure 2-1: Configuration of System under Test..... 7

Table Index

Table 2-1: Channels Tested 6
 Table 2-2: Test Result Summary – FCC Part 15 Subpart C (Section 15.247) & IC..... 6
 Table 2-3: Equipment Under Test 7
 Table 3-1: Power Output Test Equipment 8
 Table 3-2: Radiated Power Output Test Data 8
 Table 5-1: Radiated Band Edge Test Equipment..... 9
 Table 6-1: 6 dB Bandwidth Test Equipment..... 14
 Table 6-2: 20 dB Bandwidth Test Data 14
 Table 8-1: Hopping Characteristics Test Equipment..... 21
 Table 9-1: Radiated Emissions Test Equipment 23
 Table 9-2: Digital Radiated Emissions Test Data..... 23
 Table 9-3: Peak Radiated Emissions Spurious/Harmonics – 910.2 MHz 24
 Table 9-4: Average Radiated Emissions Spurious/Harmonics – 910.2 MHz..... 24
 Table 9-5: Peak Radiated Emissions Spurious/Harmonics - 915.04 MHz 24
 Table 9-6: Average Radiated Emissions Spurious/Harmonics – 915.04 MHz..... 25
 Table 9-7: Peak Radiated Emissions Spurious/Harmonics - 919.872 MHz..... 25
 Table 9-8: Average Radiated Emissions Spurious/Harmonics – 919.872 MHz..... 25

Plot Index

Plot 5-1: Lower Band Edge..... 10
 Plot 5-2: Lower Band Edge (Hopping)..... 11
 Plot 5-3: Upper Band Edge..... 12
 Plot 5-4: Upper Band Edge (Hopping)..... 13
 Plot 6-1: 20 dB Bandwidth – 910.2 MHz..... 15
 Plot 6-2: 20 dB Bandwidth – 915.04 MHz..... 16
 Plot 6-3: 20 dB Bandwidth – 919.872 MHz..... 17
 Plot 7-1: Carrier Frequency Separation..... 18
 Plot 8-1: Number of Hopping Frequencies 19
 Plot 8-2: Time of Occupancy (Dwell Time)..... 20
 Plot 8-3: Number of Pulses in 10Second Sweep..... 21

Appendix Index

Appendix A:	FCC Part 1.1307, 1.1310, 2.1091, 2.1093; IC RSS-Gen: RF Exposure.....	27
Appendix B:	ACB Agency Authorization Letter.....	28
Appendix C:	FCC Confidentiality Request Letter.....	29
Appendix D:	IC Letters.....	30
Appendix E:	IC Confidentiality Request.....	31
Appendix F:	Canadian-Based Representative Attestation.....	32
Appendix G:	Label and Label Location.....	33
Appendix H:	Technical Operational Description.....	34
Appendix I:	Schematics.....	35
Appendix J:	Block Diagram.....	36
Appendix K:	Manual.....	37
Appendix L:	Test Photographs.....	38
Appendix M:	External Photographs.....	40
Appendix N:	Internal Photographs.....	44

Photograph Index

Photograph 1:	ID Label & Location.....	33
Photograph 2:	Radiated Emissions Testing – Front View (with cones).....	38
Photograph 3:	Radiated Emissions Testing – Back View.....	39
Photograph 4:	Front.....	40
Photograph 5:	Right Side.....	41
Photograph 6:	Left Side.....	42
Photograph 7:	Back.....	43
Photograph 8:	PCB Front in Casing.....	44
Photograph 9:	PCB Back in Casing.....	45
Photograph 10:	PCB Front.....	46
Photograph 11:	PCB Back.....	47
Photograph 12:	PCB Right Side.....	48
Photograph 13:	PCB Left Side.....	49

1 General Information

1.1 Scope

This is an original FCC and Industry Canada certification application request.

Applicable Standards:

- FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.
- Industry Canada RSS-210: Low Power License-Exempt Communications Devices
Industry Canada RSS-Gen: General Requirements and Information for the Certification of Radio Apparatus

1.2 Description of EUT

Equipment Under Test	Transceiver
Model	ADC-IS-220-GC
Power Supply	2 AA batteries (1.5V each)
Modulation Type	FHSS
Frequency Range	910-920 MHz
Antenna Type & Gain	Chip

1.3 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located at 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4-2003).

1.4 Related Submittal(s)/Grant(s)

This is an original application for Alarm.com Model ADC-IS-220-GC, FCC ID: YL6-143220ISGC, IC: 9111A-143220ISGC.

1.5 Modifications

No modifications were made to the equipment during testing in order to achieve compliance with these standards.

2 Test Information

2.1 Description of Test Modes

In accordance with FCC 15.31(m), and because the EUT utilizes an operating band greater than 10 MHz, the following frequencies were tested:

Table 2-1: Channels Tested

Channel	Frequency
Low	910
Middle	915.04
High	919.872

2.2 Exercising the EUT

The EUT was supplied with test firmware programmed with a high, mid, and low channel for testing. The EUT was tested in all three orthogonal planes in order to determine worst-case emissions. The EUT was provided with software to continuously transmit during testing. The carrier was also checked to verify that information was being transmitted. There were no deviations from the test standard(s) and/or methods. The test results reported relate only to the item tested.

2.3 Test Result Summary

Table 2-2: Test Result Summary – FCC Part 15 Subpart C (Section 15.247) & IC

Standard	Test	Pass/Fail or N/A
FCC 15.207; RSS-Gen 8.8	AC Power Conducted Emissions	N/A
FCC 15.209; RSS-210 6.2.1; RSS-Gen 6.13/7.1	Radiated Emissions	Pass
FCC 15.247(b)(2); RSS-210 A8.4(1), RSS-Gen 6.12	Maximum Peak Power Output	Pass
FCC 15.247(d); RSS-210 A8.5, RSS-Gen 6.13	Antenna Conducted Spurious Emissions	Pass
FCC 15.247(d); RSS-210 A8.5	Band Edge Measurement	Pass
FCC 15.247(a)(1)(i); RSS-210 A8.1(b)	Carrier Frequency Separation	Pass
FCC 15.247(a)(1)(i); RSS-210 A8.1(a)	20 dB Bandwidth	Pass
FCC 15.247(a)(1)(i); RSS-210 A8.1(c)	Hopping Characteristics	Pass
FCC 15.247(a)(1)(i); RSS-210 A8.1(c)	Average Time of Occupancy	Pass

2.4 Test System Details

The test samples were received on July 1, 2015. The FCC identifiers for all applicable equipment, plus descriptions of all cables used in the tested system, are identified in the following table.

Table 2-3: Equipment Under Test

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	RTL Bar Code
Transceiver (dwell time)	Alarm.com	ADC-IS-220-GC	2GIG IS2.2 Dwell Time P4	YL6- 143220ISGC	N/A	21679
Transceiver (modulated)	Alarm.com	ADC-IS-220-GC	2GIG IS2.2 FCC Modulated P4	YL6- 143220ISGC	N/A	21678
Transceiver (carrier wave)	Alarm.com	ADC-IS-220-GC	2GIG IS2.2 FCC CW P4	YL6- 143220ISGC	N/A	21677

2.5 Configuration of Tested System

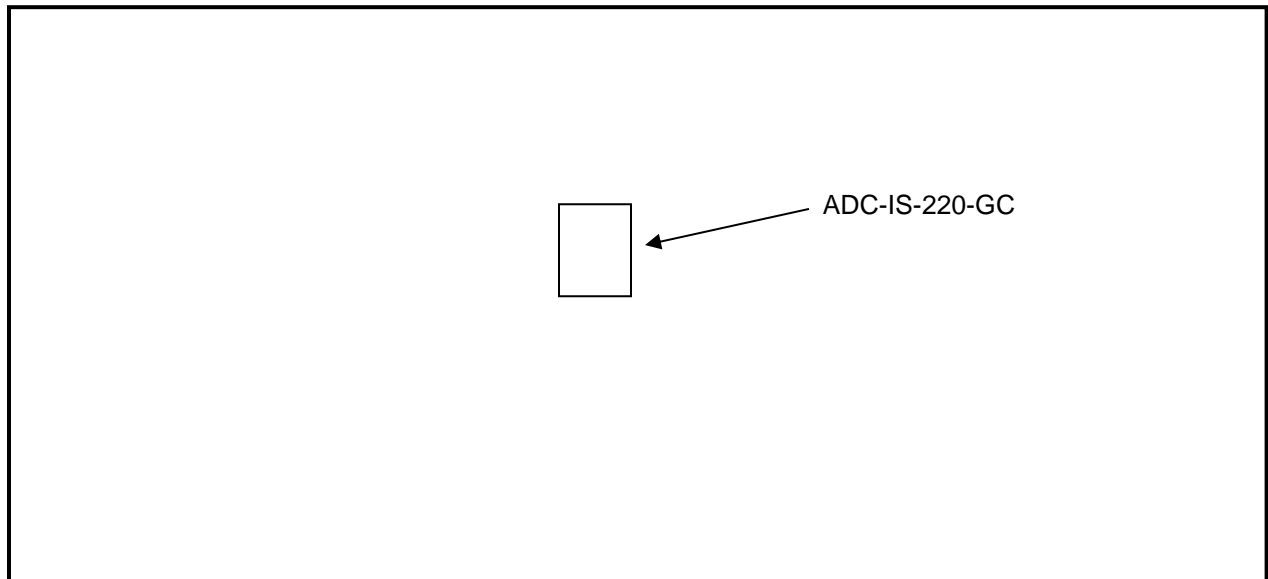


Figure 2-1: Configuration of System under Test

3 Peak Output Power - 15.247(b)(2); IC RSS-210 A8.4(1), RSS-Gen 6.12

3.1 Power Output Test Procedure

A conducted power measurement of the EUT was taken.
 Converted to watt using: $((10^{(J3/20)}/1E6)*3^2)/30$
 Converted to dBm using: $10*LOG(K3*1000)$

Table 3-1: Power Output Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	11/13/15

3.2 Power Output Test Data

Table 3-2: Radiated Power Output Test Data

Emission Frequency (MHz)	Peak Detector Level (dBuV/m) (2 MHz RBW/ 10 MHz VBW)	Site Correction Factor (dB/m)	Peak Corrected (dBuV/m)	Peak Corrected (W)	Peak Corrected (dBm)
910.222	89.3	23.5	112.8	0.057	17.6
915.055	88.5	23.4	111.9	0.046	16.7
919.897	86.9	23.1	110.0	0.030	14.8

* testing performed at 3m

Test Personnel:

Dan Baltzell Test Engineer	 Signature	July 1, 2015 Date of Test
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4 Antenna Conducted Spurious Emissions – FCC 15.247(d), RSS-210 A8.5

Procedure: C63.10-2013 6.7

No conducted antenna port is available so no conducted data is reported.

Test Personnel:

Daniel W. Baltzell EMC Test Engineer	 Signature	July 1, 2015 Date of Test
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5 Compliance with the Band Edge – FCC 15.247(d); RSS-210 A8.5

5.1 Band Edge Test Procedure

Procedure: C63.10-2013 6.10

The EUT was connected to the spectrum analyzer through suitable attenuation. The span was set wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation. The spectrum analyzer was set to the following:

RBW > = 1 % of span
 VBW > = RBW
 Sweep = auto
 Detector function = peak
 Trace = max hold

The trace was allowed to stabilize. The marker was set on the emission at the band edge. The marker-delta was used to show the delta between the maximum in-band emission and the emission at the band edge, and was compared to the 20 dBc requirement of 15.247(d) (when using peak emissions) or restricted band. This measurement was taken in both fixed frequency and hopping modes.

5.2 Band Edge Test Procedure

The transmitter output was connected to its appropriate antenna. A delta measurement was performed from the highest peak in the restricted band to the peak of the fundamental, and subtracted from the radiated field strength; the result was compared to the limit.

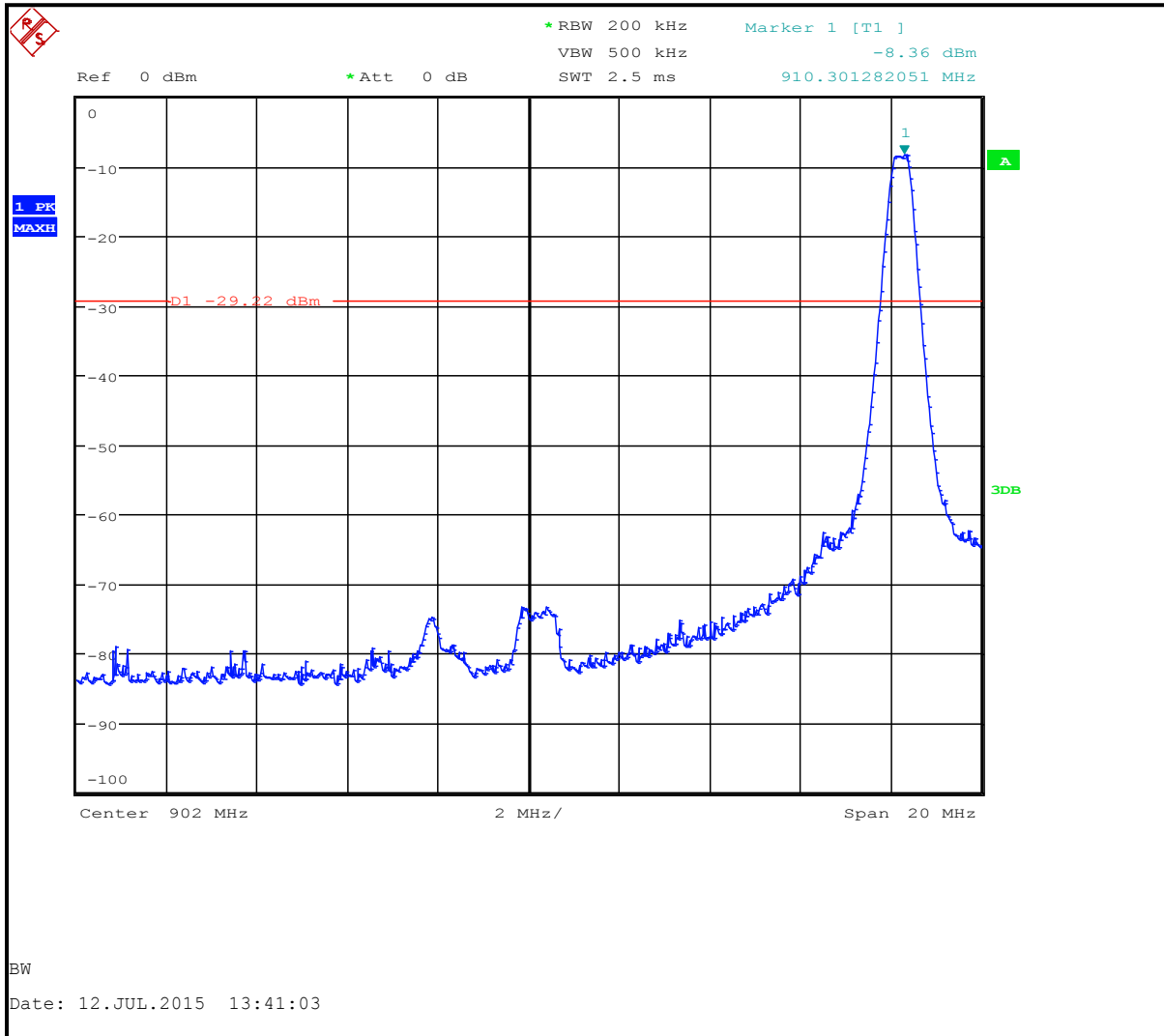
Table 5-1: Radiated Band Edge Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901592	Insulated Wire Inc.	KPS-1503-3600-KPR	SMK RF Cables 20'	NA	9/3/15
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	11/13/15
900791	Chase	CBL6111B	Bilog Antenna (30 MHz – 2000 MHz)	N/A	6/11/17
900886	EMI Shop	WRT000-0003	Turntable OATS	N/A	Not Required

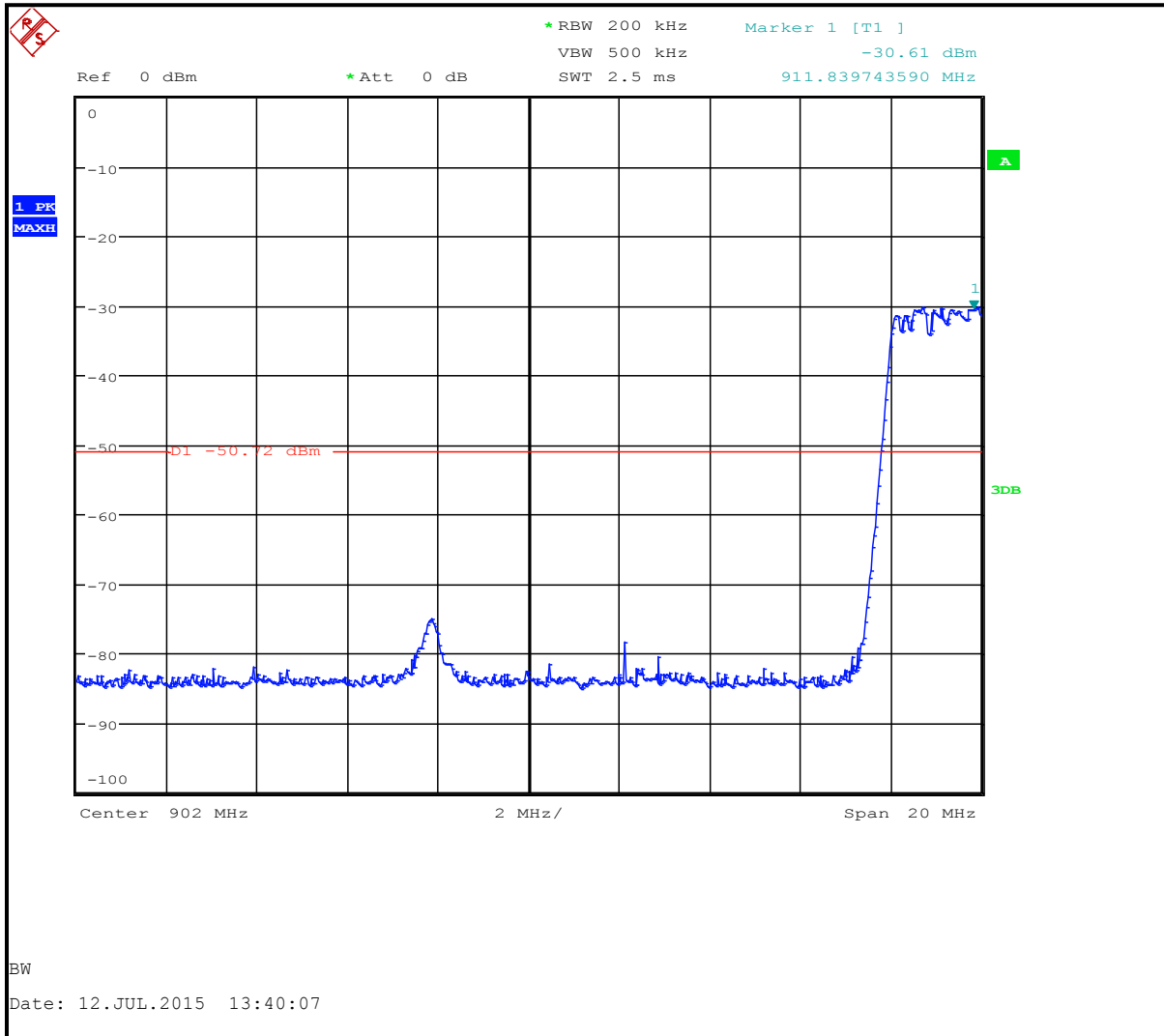
5.3 Band Edge Test Results

5.3.1 Lower Band Edge – Plot

Plot 5-1: Lower Band Edge

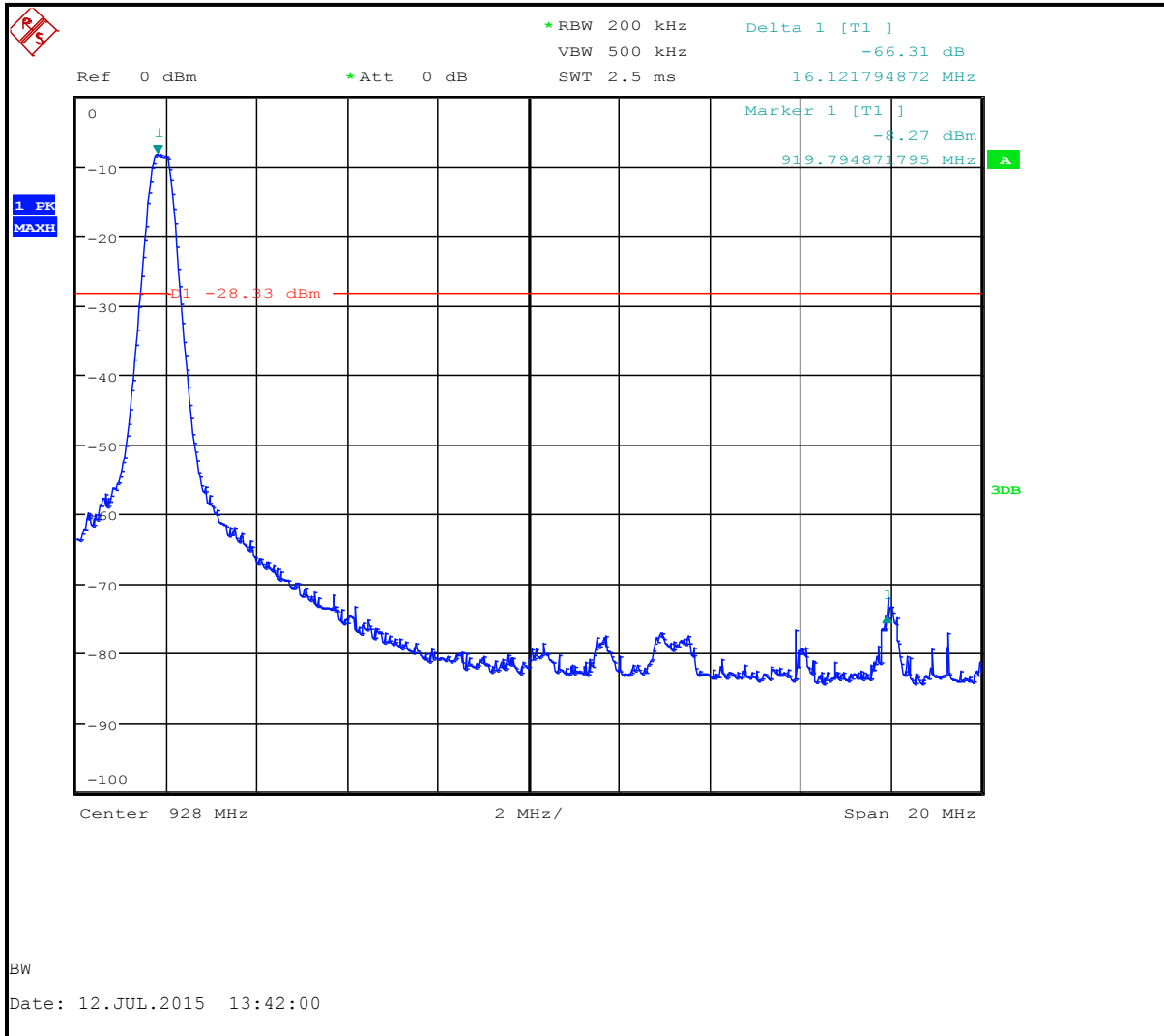


Plot 5-2: Lower Band Edge (Hopping)

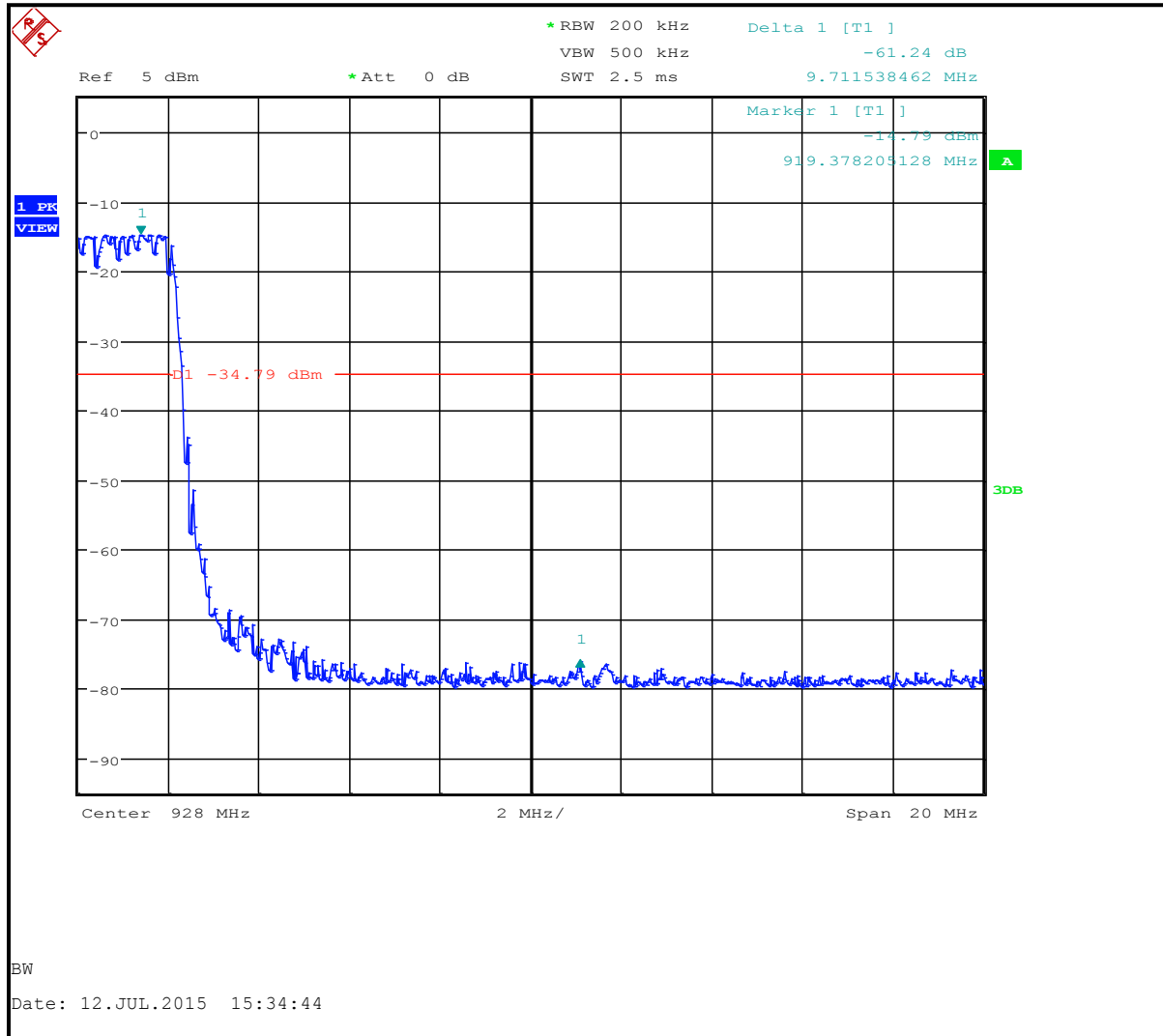


5.3.2 Upper Band Edge -Delta Plot

Plot 5-3: Upper Band Edge



Plot 5-4: Upper Band Edge (Hopping)



5.3.3 Calculation of Upper Band Edge

109.7 dBuV/m is the field strength measurement, from which the delta measurement of 61.2 dB is subtracted, resulting in a level of 48.5 dB. This level has a margin of 5.5 dB below the limit of 54 dBuV/m.

Calculation: $109.7 \text{ dBuV/m} - 61.2 \text{ dB} - 54 \text{ dBuV/m} = -5.5 \text{ dB}$

Peak Field Strength of Upper Band Edge (1 MHz RBW/10 MHz VBW) = 110.0 dBuV/m

QP Field Strength of Upper Band Edge (1 MHz RBW/10 MHz VBW) = 109.7 dBuV/m

Delta measurement = 61.2 dB

Test Personnel:

Dan Baltzell
 Test Engineer

Signature

July 12, 2015
 Date of Test

6 20 dB Bandwidth - 15.247(a)(1)(i); RSS-210 A8.1(a)

6.1 20 dB Bandwidth Test Procedure – Minimum 20 dB Bandwidth

The minimum 20 dB bandwidths per FCC 15.247(a)(1)(i) were measured using a 50 ohm spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at 1 MHz. The device was modulated. The minimum 20 dB bandwidths are presented below.

Table 6-1: 6 dB Bandwidth Test Equipment

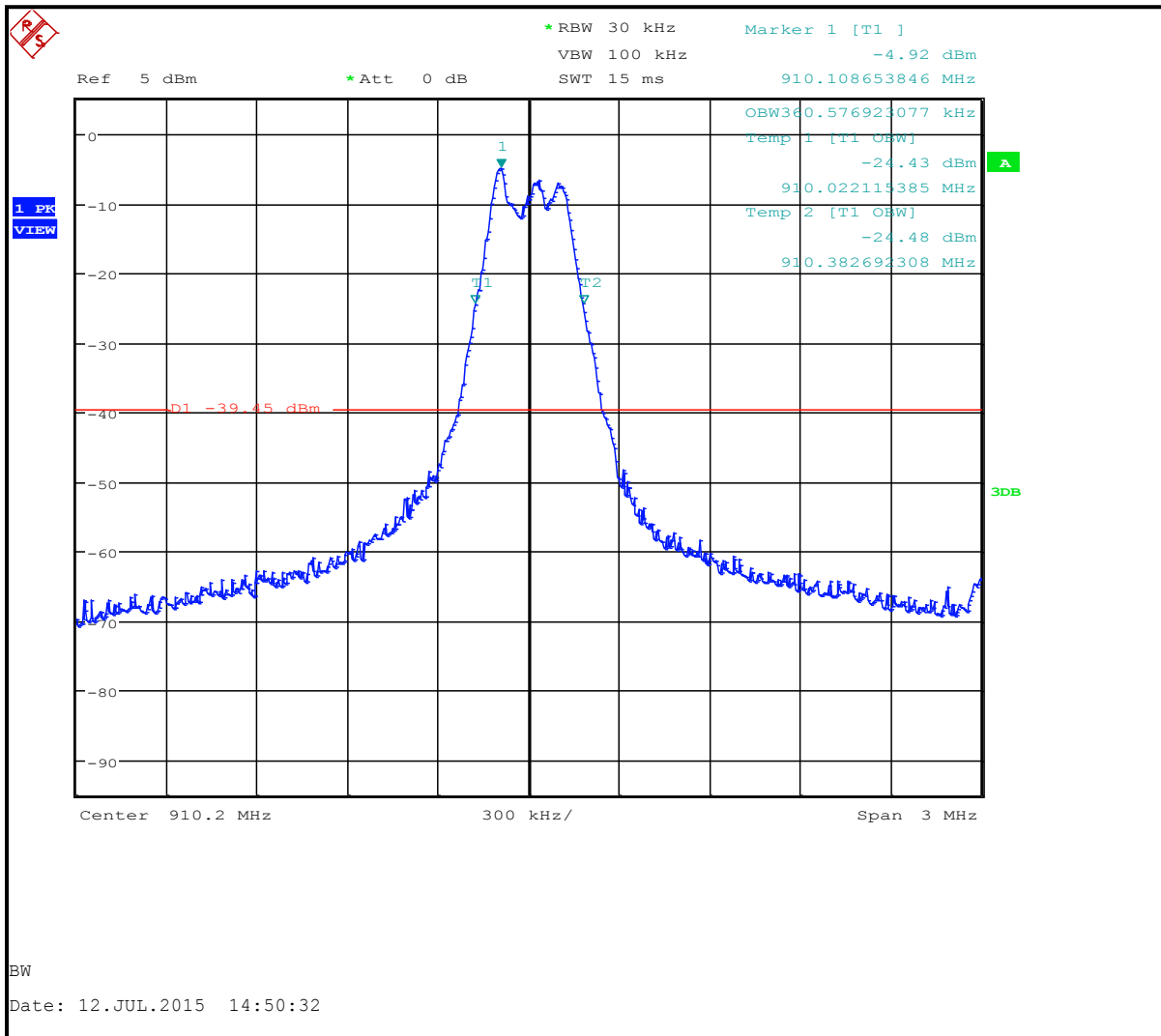
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	11/13/15

6.2 20 dB Bandwidth Test Results

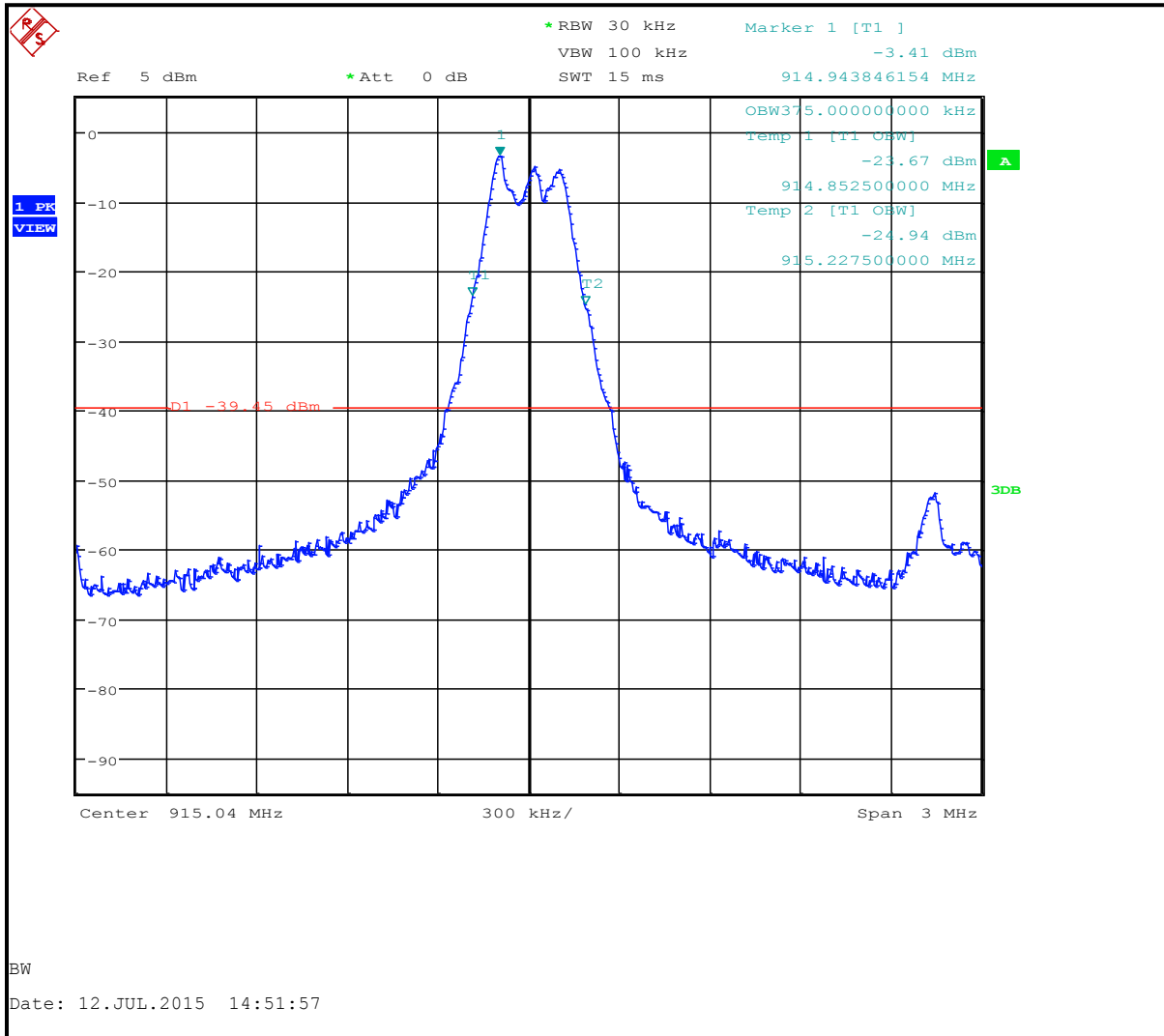
Table 6-2: 20 dB Bandwidth Test Data

Frequency (MHz)	20 dB Bandwidth (kHz)	Maximum Limit (MHz)	Pass/Fail
910.2	361.0	0.5	Pass
915.04	375.0	0.5	Pass
919.872	403.8	0.5	Pass

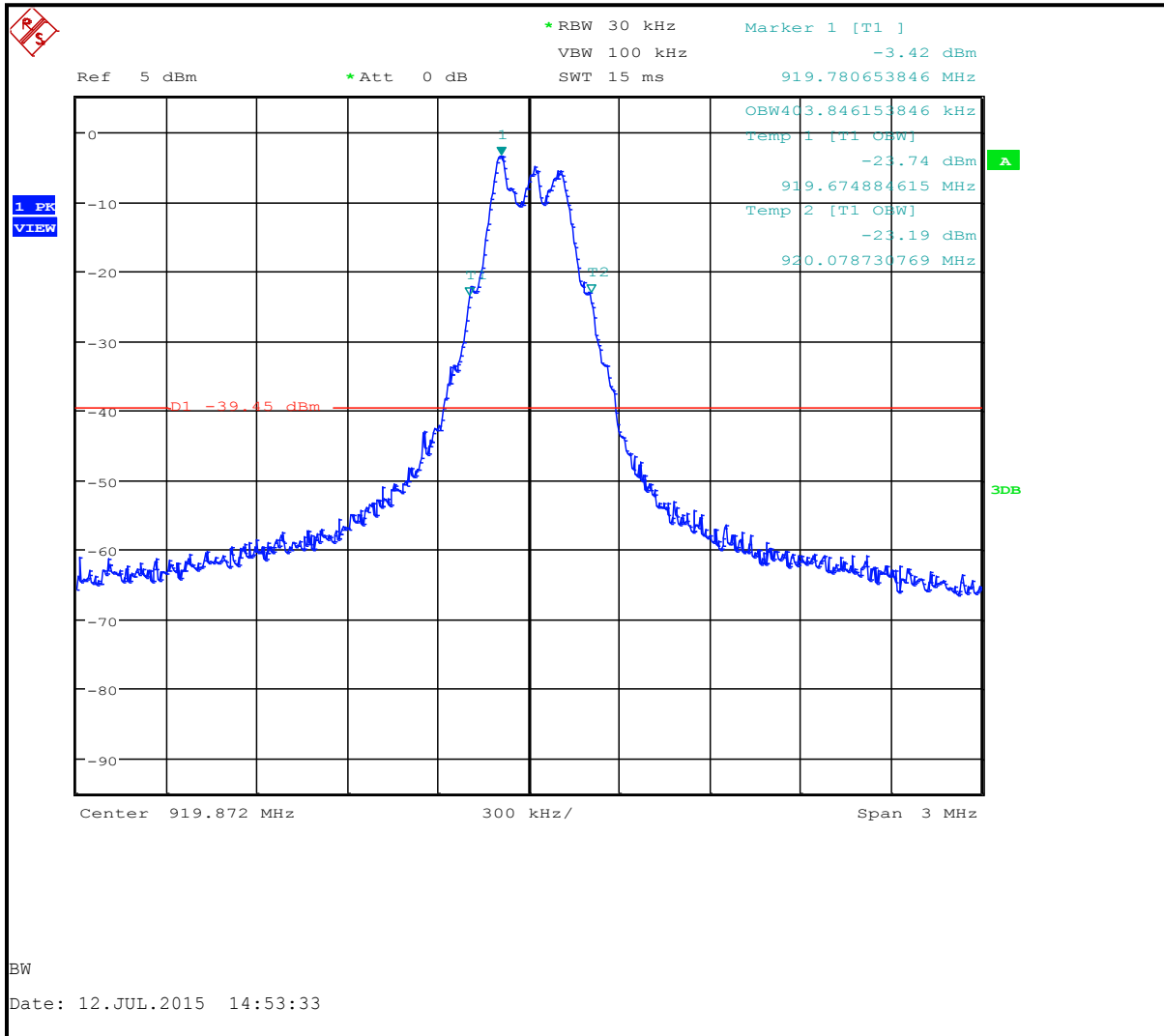
Plot 6-1: 20 dB Bandwidth – 910.2 MHz



Plot 6-2: 20 dB Bandwidth – 915.04 MHz



Plot 6-3: 20 dB Bandwidth – 919.872 MHz



Test Personnel:

Dan Baltzell
 Test Engineer

Signature

July 12, 2015
 Date of Test

7 Carrier Frequency Separation - 15.247(a)(1)(i), RSS-210 A8.1(b)

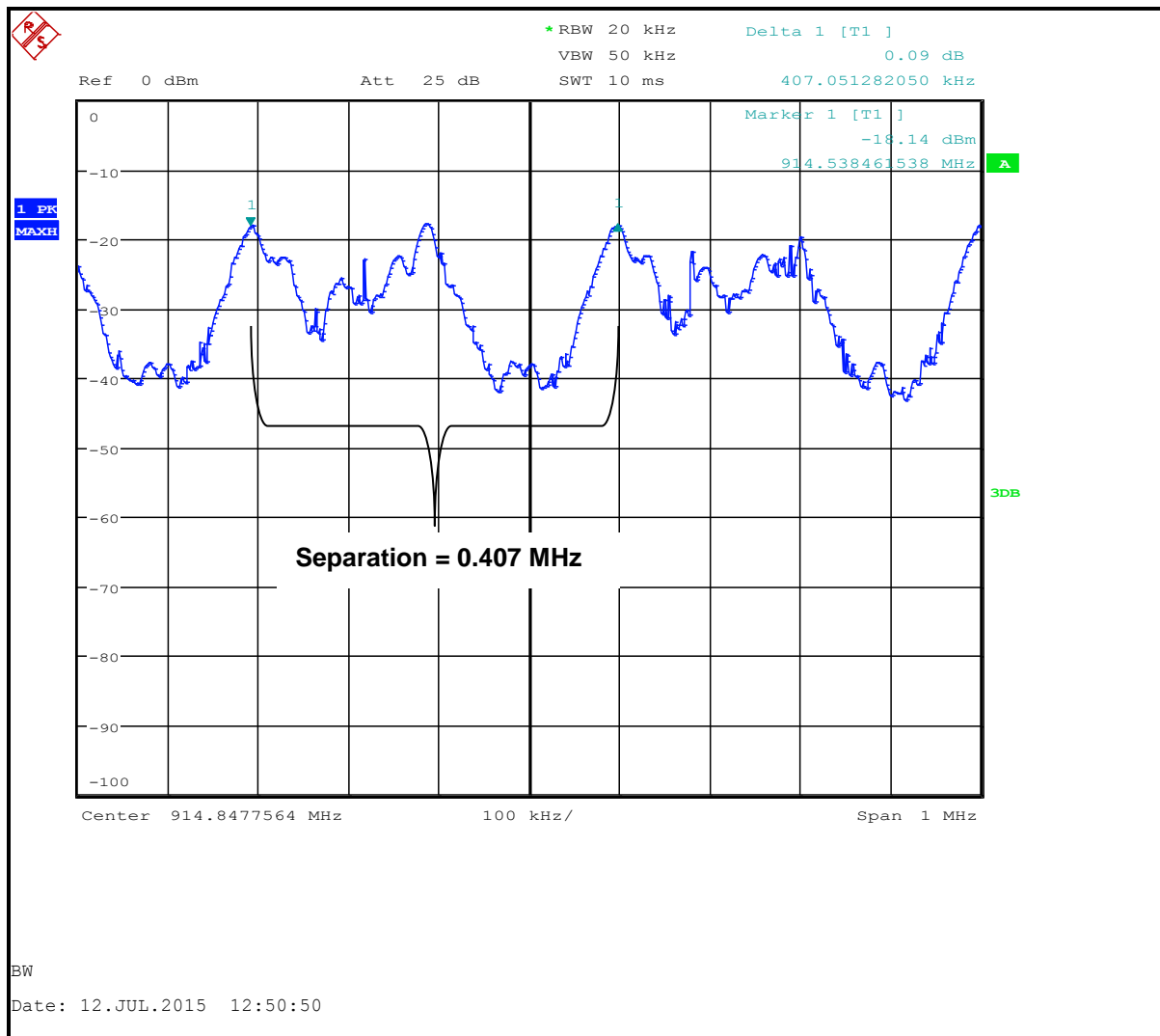
7.1 Carrier Frequency Separation Test Procedure

Procedure: C63.10-2013 7.8.2

Measured frequency separation = 407 kHz

7.2 Carrier Frequency Separation Test Data

Plot 7-1: Carrier Frequency Separation



8 Hopping Characteristics – FCC 15.247(a)(1)(i), RSS-210 A8.1(c)

8.1 Hopping Characteristics Test Procedure

Procedure: C63.10-2013 7.8.3

If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

8.2 Number of Hopping Frequencies

Measured number of hopping frequencies = 25

Plot 8-1: Number of Hopping Frequencies



8.3 Average Time of Occupancy

Procedure: C63.10-2013 7.8.4

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 10 seconds.

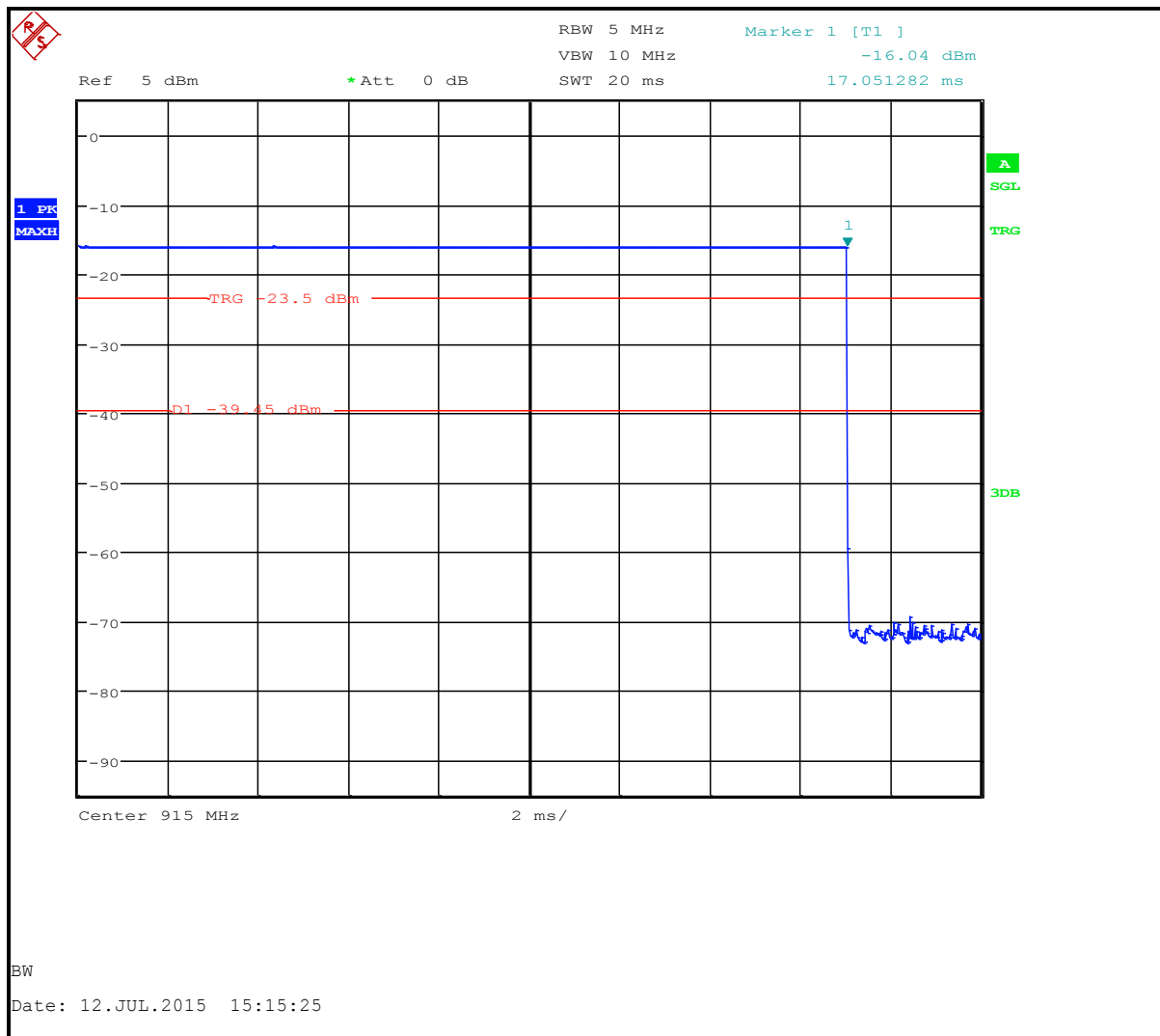
Allowed period = 10 s

Pulse width = 17.1 ms

Number of pulses within a 10 s sweep = 3

Average time of occupancy in 10 s = 17.1 ms X 3 pulses = **51.3 ms**, which meets the limit of 0.4 s

Plot 8-2: Time of Occupancy (Dwell Time)



Plot 8-3: Number of Pulses in 10Second Sweep

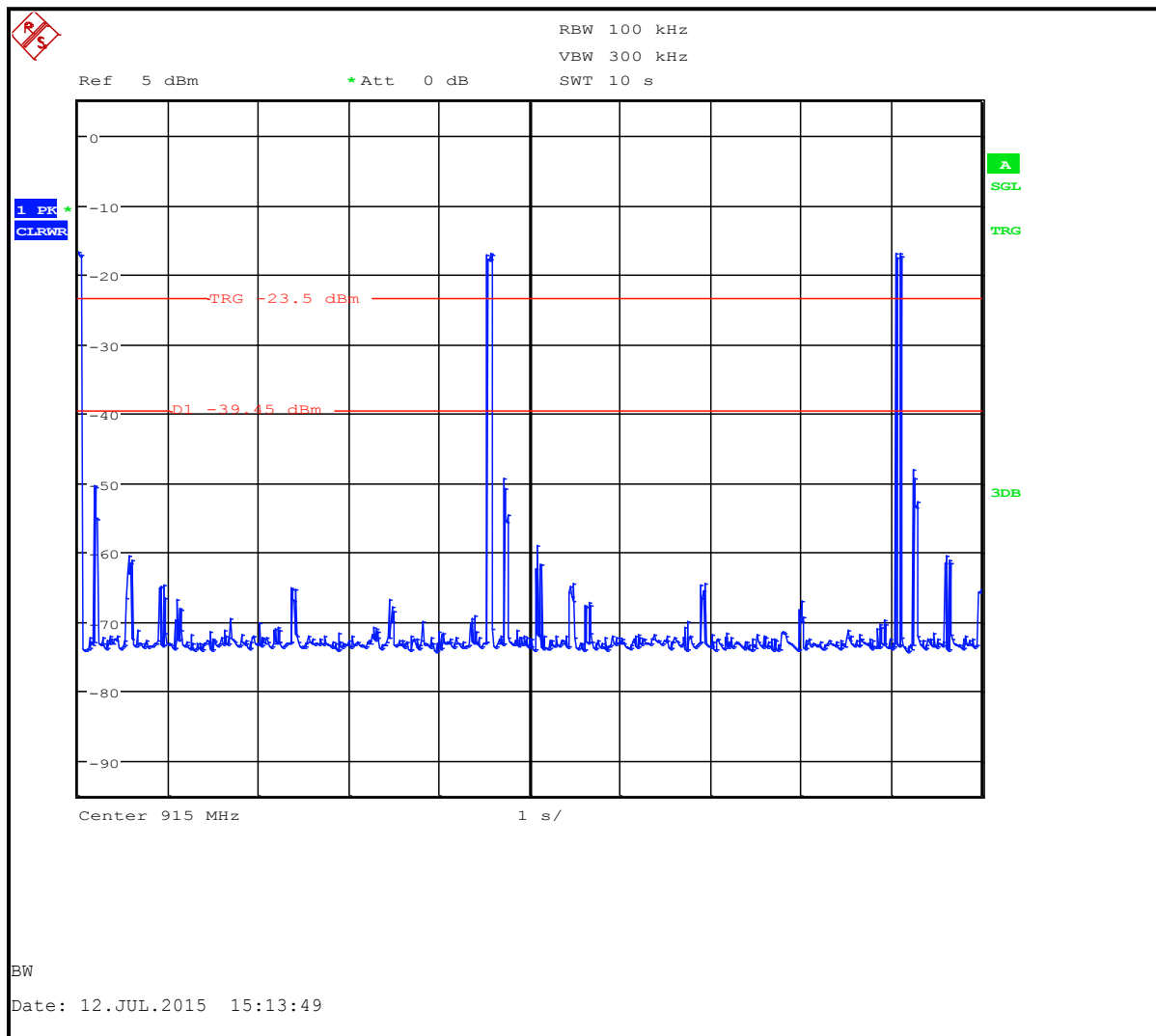


Table 8-1: Hopping Characteristics Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	11/13/15

Test Personnel:

Daniel W. Baltzell
 EMC Test Engineer

Signature

July 12, 2015
 Date of Test

9 Radiated Emissions - 15.209; RSS-210 6.2.1; RSS-Gen 6.13/7.1

9.1 Limits of Radiated Emissions Measurement

Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009-0.490	2400/f (kHz)	300
0.490-1.705	2400/f (kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

As shown in 15.35(b), for frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any circumstances of modulation.

9.2 Radiated Emissions Measurement Test Procedure

Before final measurements of radiated emissions were made on the open-field three/ten meter range, the EUT was scanned indoors at one and three meter distances. This was done in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the open-field range, at each frequency, in order to ensure that maximum emission amplitudes were attained.

Final radiated emissions measurements were made on the three/ten-meter, open-field test site. The EUT was placed on a nonconductive turntable 0.8 meters above the ground plane. The spectrum was examined from 9 kHz to the 10th harmonic of the highest fundamental transmitter frequency (10 GHz).

At each frequency, the EUT was rotated 360°, and the antenna was raised and lowered from 1 to 4 meters in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations. For frequencies between 30 and 1000 MHz, the spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. For emissions above 1000 MHz, emissions are measured using the a VBW of 10 Hz, with a minimum resolution bandwidth of 1 MHz. No video filter less than 10 times the resolution bandwidth was used. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

Table 9-1: Radiated Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900878	Rhein Tech Laboratories	AM3-1197-0005	3 meter antenna mast, polarizing	Outdoor Range 1	Not Required
901592	Insulated Wire Inc.	KPS-1503-3600-KPR	SMK RF Cables 20'	NA	9/3/15
901242	Rhein Tech Laboratories	WRT-000-0003	Wood rotating table	N/A	Not Required
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	11/13/15
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	4/9/18
900321	EMCO	3161-03	Horn Antenna (4.0 - 8.2 GHz)	9508-1020	4/9/18
900323	EMCO	3160-07	Horn Antenna (8.2 - 12.4 GHz)	9605-1054	4/9/18
900791	Chase	CBL6111B	Bilog Antenna (30 MHz – 2000 MHz)	N/A	6/11/17
901663	Rohde & Schwarz	HFH2-Z2	Active Loop	881056/062	5/21/17

9.3 Radiated Emissions Test Results

9.3.1 Unintentional Radiated Emissions Test Data

Table 9-2: Digital Radiated Emissions Test Data

Temperature: 85.6°F Humidity: 43%										
Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/Fail
29.492	Qp	V	0	1	2.6	23.0	25.6	49.5	-23.9	Pass
58.983	Qp	V	225	1	14.3	7.0	21.3	40.0	-18.7	Pass
117.964	Qp	V	90	1	2.1	13.0	15.1	43.5	-28.4	Pass
147.356	Qp	V	30	1	4.1	11.8	15.9	43.5	-27.6	Pass
206.44	Qp	V	180	1	1.2	10.4	11.6	43.5	-31.9	Pass
294.912	Qp	H	350	1	-2.8	14.4	11.6	46.0	-34.4	Pass
442.268	Qp	V	270	1	-3.5	18.6	15.1	46.0	-30.9	Pass
560.331	Qp	V	180	1	-1.2	19.9	18.7	46.0	-27.3	Pass

9.3.2 Spurious/Harmonics Radiated Emissions Test Data

Table 9-3: Peak Radiated Emissions Spurious/Harmonics – 910.2 MHz

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/ 3 MHz VBW)	Site Correction Factor (dB/m)	Peak Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
2730.6	22.6	25.8	48.4	74.0	-25.6
3640.8	29.6	27.5	57.1	74.0	-16.9
4551.0	14.0	33.6	47.6	74.0	-26.4
7281.6	16.8	35.7	52.5	74.0	-21.5
8191.8	14.4	41.6	56.0	74.0	-18.0
9102.0	10.8	41.9	52.7	74.0	-21.3

Table 9-4: Average Radiated Emissions Spurious/Harmonics – 910.2 MHz

Emission Frequency (MHz)	Average Analyzer Reading (dBuV) (1 MHz RBW/ 10 Hz VBW)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
2730.6	17.1	25.8	42.9	54.0	-11.1
3640.8	19.3	27.5	46.8	54.0	-7.2
4551.0	5.2	33.6	38.8	54.0	-15.2
7281.6	-1.7	35.7	34.0	54.0	-20.0
8191.8	-1.1	41.6	40.5	54.0	-13.5
9102.0	-1.4	41.9	40.5	54.0	-13.5

Table 9-5: Peak Radiated Emissions Spurious/Harmonics - 915.04 MHz

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/ 3 MHz VBW)	Site Correction Factor (dB/m)	Peak Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
2745.1	24.7	25.8	50.5	74.0	-23.5
3660.2	28.7	27.6	56.3	74.0	-17.7
4575.2	17.8	33.5	51.3	74.0	-22.7
7320.3	13.2	35.7	48.9	74.0	-25.1
8235.4	13.6	41.7	55.3	74.0	-18.7
9150.4	13.3	41.9	55.2	74.0	-18.8

Table 9-6: Average Radiated Emissions Spurious/Harmonics – 915.04 MHz

Emission Frequency (MHz)	Average Analyzer Reading (dBuV) (1 MHz RBW/ 10 Hz VBW)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
2745.1	16.6	25.8	42.4	54.0	-11.6
3660.2	18.3	27.6	45.9	54.0	-8.1
4575.2	5.4	33.5	38.9	54.0	-15.1
7320.3	-1.9	35.7	33.8	54.0	-20.2
8235.4	-0.9	41.7	40.8	54.0	-13.2
9150.4	-1.4	41.9	40.5	54.0	-13.5

Table 9-7: Peak Radiated Emissions Spurious/Harmonics - 919.872 MHz

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/ 3 MHz VBW)	Site Correction Factor (dB/m)	Peak Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
2759.6	26.5	25.9	52.4	74.0	-21.6
3679.5	28.1	27.6	55.7	74.0	-18.3
4599.4	17.5	33.4	50.9	74.0	-23.1
7359.0	12.7	35.7	48.4	74.0	-25.6
8278.8	13.5	41.8	55.3	74.0	-18.7
9198.7	12.9	42.0	54.9	74.0	-19.1

Table 9-8: Average Radiated Emissions Spurious/Harmonics – 919.872 MHz

Emission Frequency (MHz)	Average Analyzer Reading (dBuV) (1 MHz RBW/ 10 Hz VBW)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
2759.6	18.9	25.9	44.8	54.0	-9.2
3679.5	17.7	27.6	45.3	54.0	-8.7
4599.4	7.2	33.4	40.6	54.0	-13.4
7359.0	-1.9	35.7	33.8	54.0	-20.2
8278.8	-0.6	41.8	41.2	54.0	-12.8
9198.7	-1.3	42.0	40.7	54.0	-13.3

Test Personnel:

Daniel W. Baltzell
 Test Engineer



Signature

July 1, 2015
 Date of Test

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Client: Alarm.com
Model: ADC-IS-220-GC
Standards: FCC 15.247/IC RSS-210
ID's: YL6-143220ISGC/9111A-143220ISGC
Report #: 2015124

10 Conclusion

The data in this measurement report shows that the EUT as tested, Alarm.com Model ADC-IS-220-GC, FCC ID: YL6-143220ISGC, IC: 9111A-143220ISGC, complies with the applicable requirements of Parts 2 and 15 of the FCC Rules and Regulations and Industry Canada RSS-210 and RSS-Gen.