



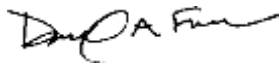
Engineering Solutions & Electromagnetic Compatibility Services

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

Test Lab: Rhein Tech Laboratories, Inc. 360 Herndon Parkway Suite 1400 Herndon, VA 20170 E-Mail: atcbinfo@rheintech.com		Applicant: Alarm.com 8150 Leesburg Pike Suite 1400 Vienna, VA 22182	
FCC ID/ IC YL6-143IS221 9111A-143IS221		Test Report Date: July 13, 2015	
Platform N/A		RTL Work Order # 2015133	
Model ADC-IS-221-LP		RTL Quote # QRTL14-202A	
American National Standard Institute		ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices	
FCC Classification		DTS – Digital Transmission System	
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 (10/01/2014)	
Industry Canada		RSS-210 Issue 8: Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment 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)*	
912 - 924		0.012	
Frequency Tolerance		Emission Designator	
N/A		721KF1D	

* power is peak conducted

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 13, 2015

Typed/Printed Name: Desmond A. Fraser

Position: President

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These test(s) 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.

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1 General Information

1.1 Scope

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

1.2 Description of EUT

Equipment Under Test	Transceiver
Model	ADC-IS-221-LP
Power Supply	2 AA batteries (1.5V each)
Modulation Type	FSK
Frequency Range	912-924 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.

1.4 Related Submittal(s)/Grant(s)

This is an original application for Alarm.com Model ADC-IS-221-LP, FCC ID: YL6-143IS221, IC: 9111A-143IS221.

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	912
Middle	918
High	924

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 2.2; RSS-Gen 6.13/7.1	Radiated Emissions	Pass
FCC 15.247(b)(3); RSS-210 A8.4(1), RSS-Gen 6.12	Maximum Peak Power Output	Pass
FCC 15.247(e); IC RSS-210 A8.1(b)	Peak Power Spectral Density	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)(2); RSS-210 A8.1(a)(b)(d)	Bandwidth	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 (conducted port) IS V2.2 Atmel	Alarm.com	ADC-IS-221-LP	N/A	YL6-143IS221	N/A	21632
Transceiver IS V2.2 Atmel	Alarm.com	ADC-IS-221-LP	N/A	YL6-143IS221	N/A	21631

2.5 Configuration of Tested System

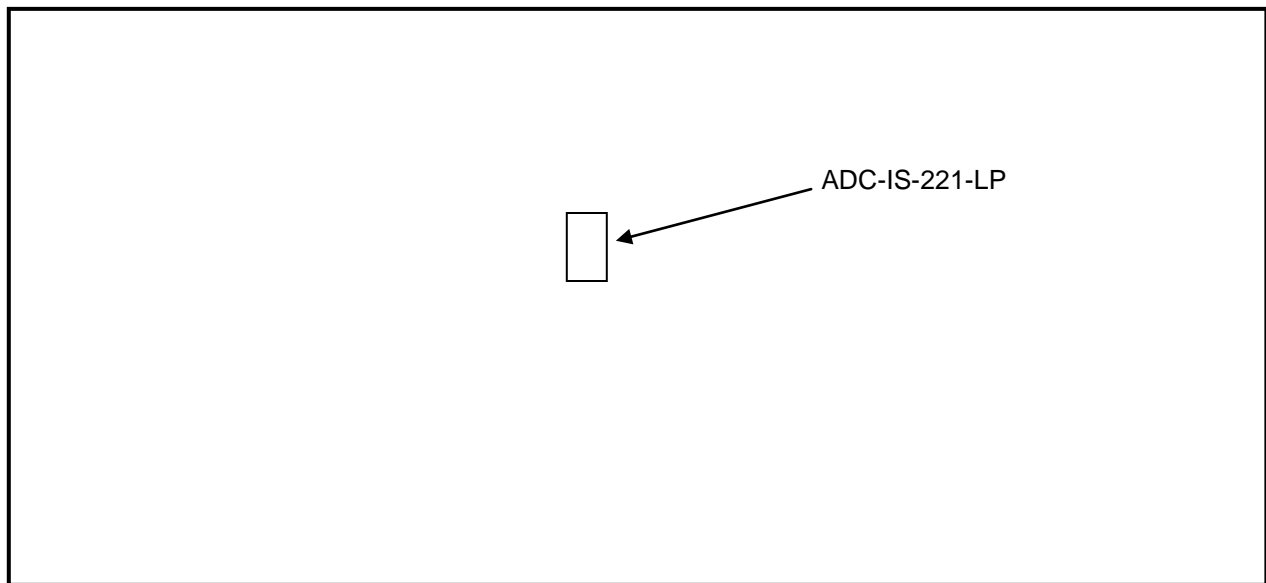


Figure 2-1: Configuration of System Under Test

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

3.1 Power Output Test Procedure

A PCB mounted U.FL connector provided a port for measurement using the automated channel power measurement on the spectrum analyzer, for the low, mid, and high channels.

Table 3-1: Power Output Test Equipment

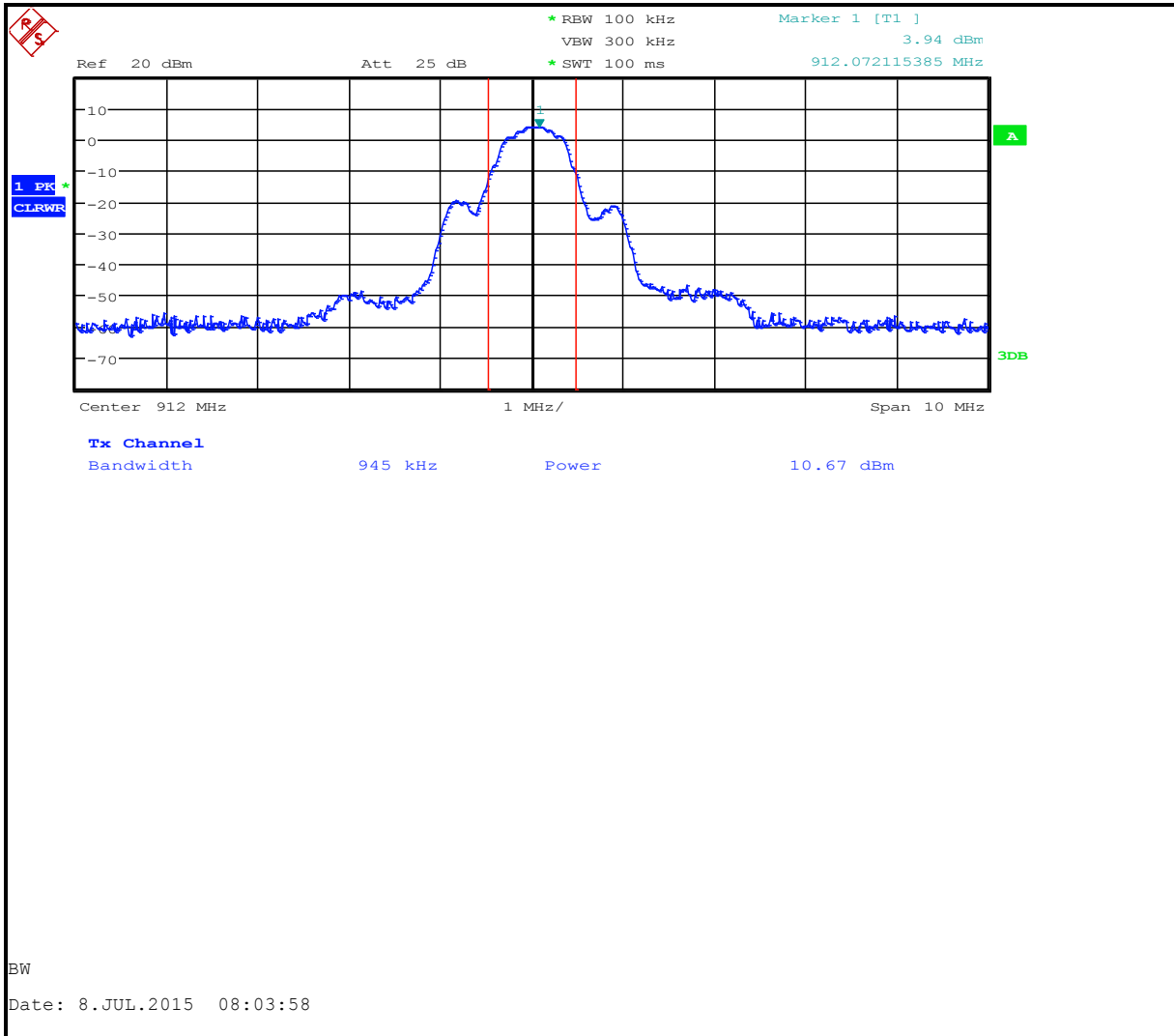
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	11/13/15

3.2 Peak Output Power Test Data

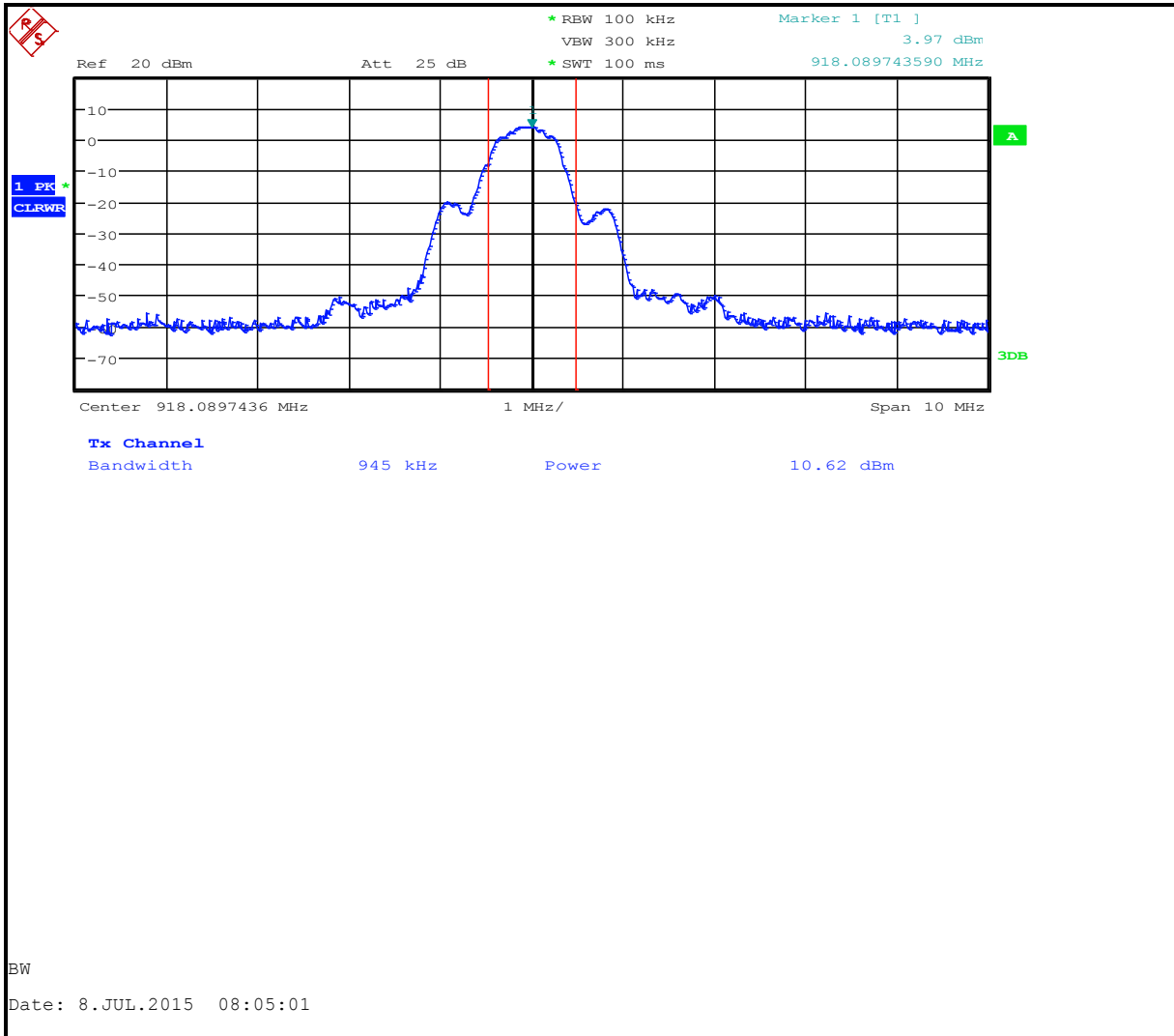
Table 3-2: Peak Output Power Test Data

Emission Frequency (MHz)	Peak Detector (dBm)	Peak Detector (W)
912	10.7	0.012
918	10.6	0.012
924	10.6	0.012

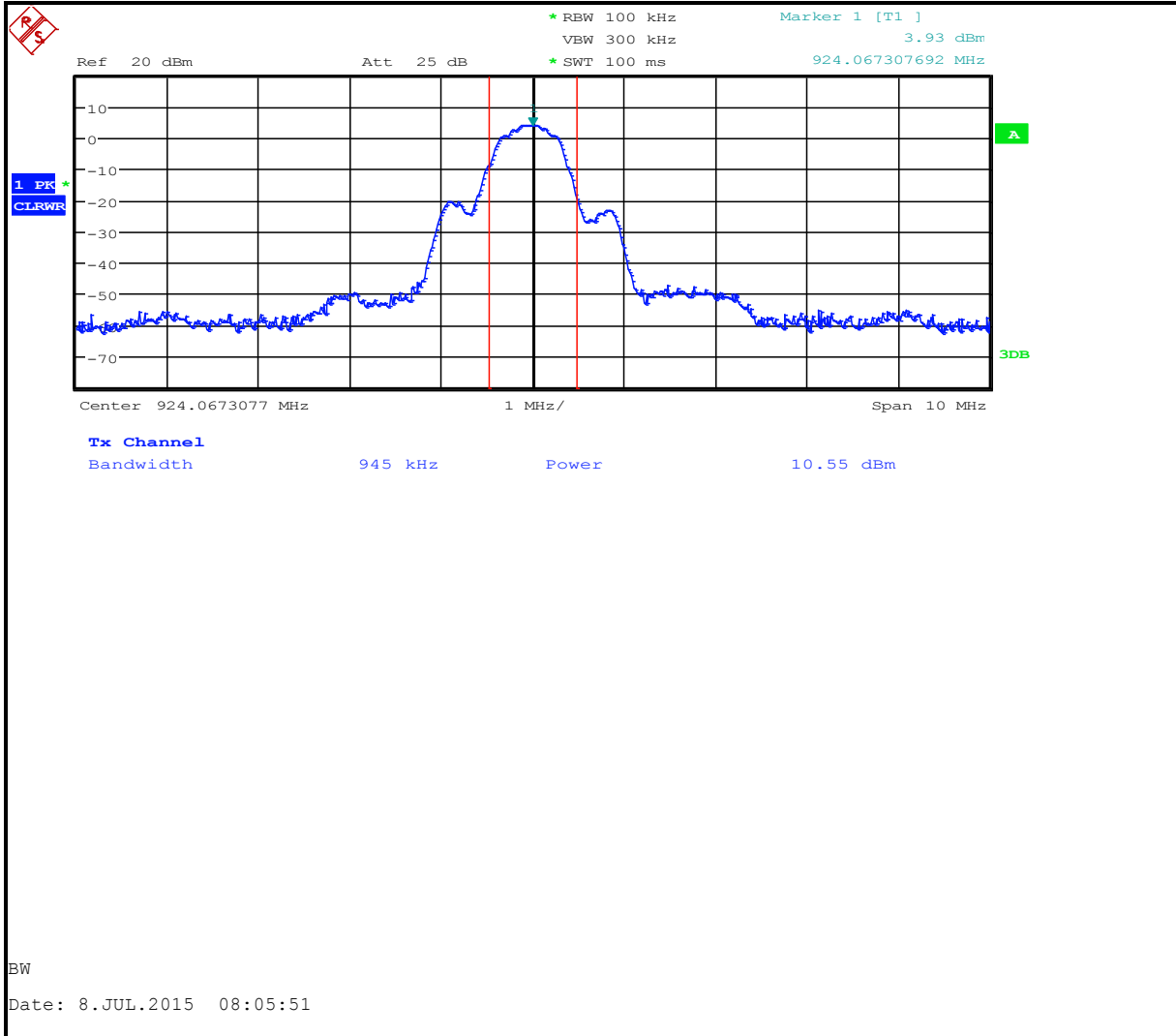
Plot 3-1: Peak Output Power – 912 MHz



Plot 3-2: Peak Output Power – 918 MHz



Plot 3-3: Peak Output Power – 924 MHz



Test Personnel:

Dan Baltzell
Test Engineer

Signature

July 8, 2015
Date of Test

4 Peak Power Spectral Density – FCC 15.247(e); IC RSS-210 A8.1(b)

4.1 Peak Spectral Density Test Procedure

Digitally modulated systems shall have conducted peak power spectral density of 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Table 4-1: Power Output Test Equipment

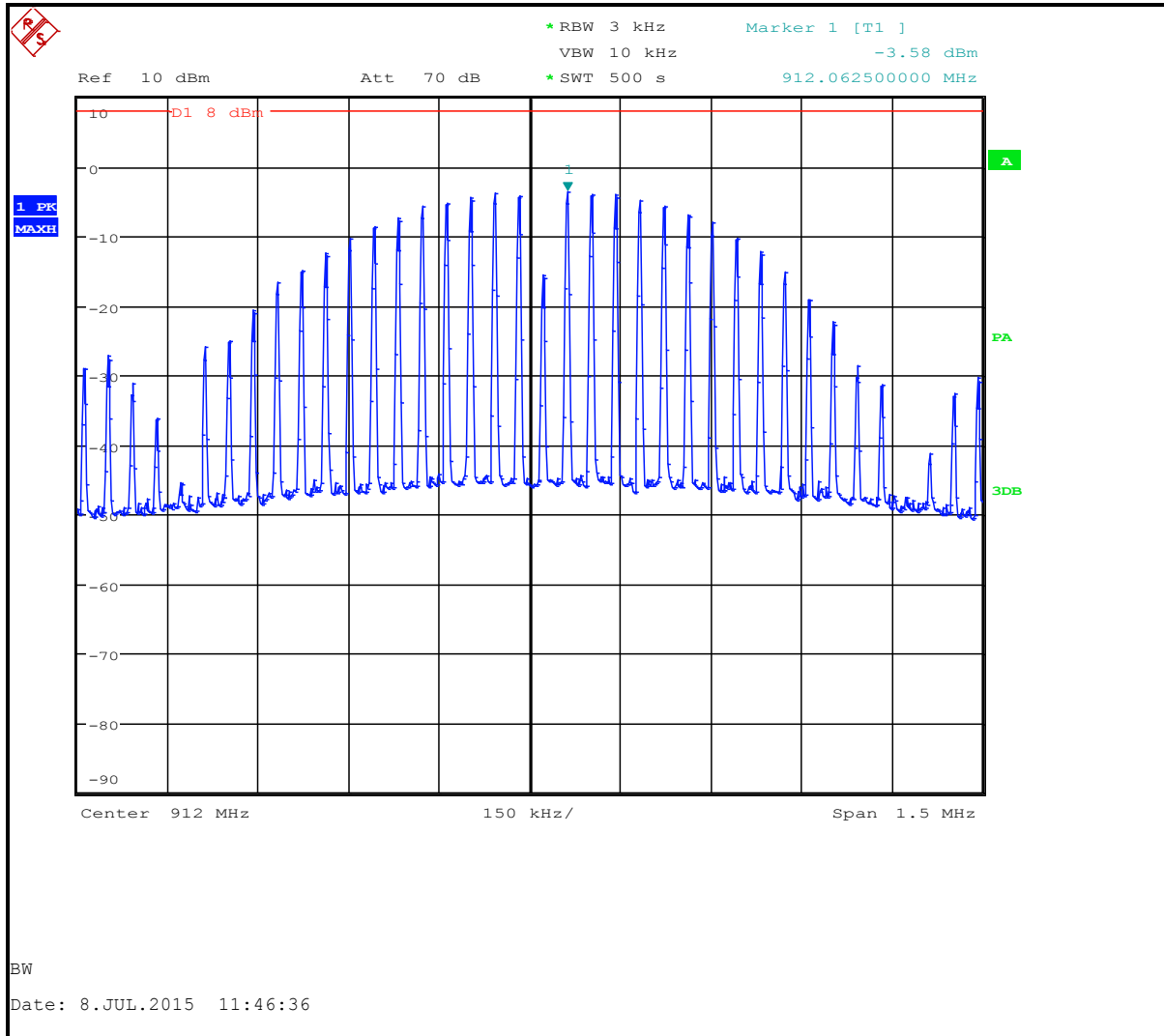
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	11/13/15

4.2 Peak Spectral Density Test Data

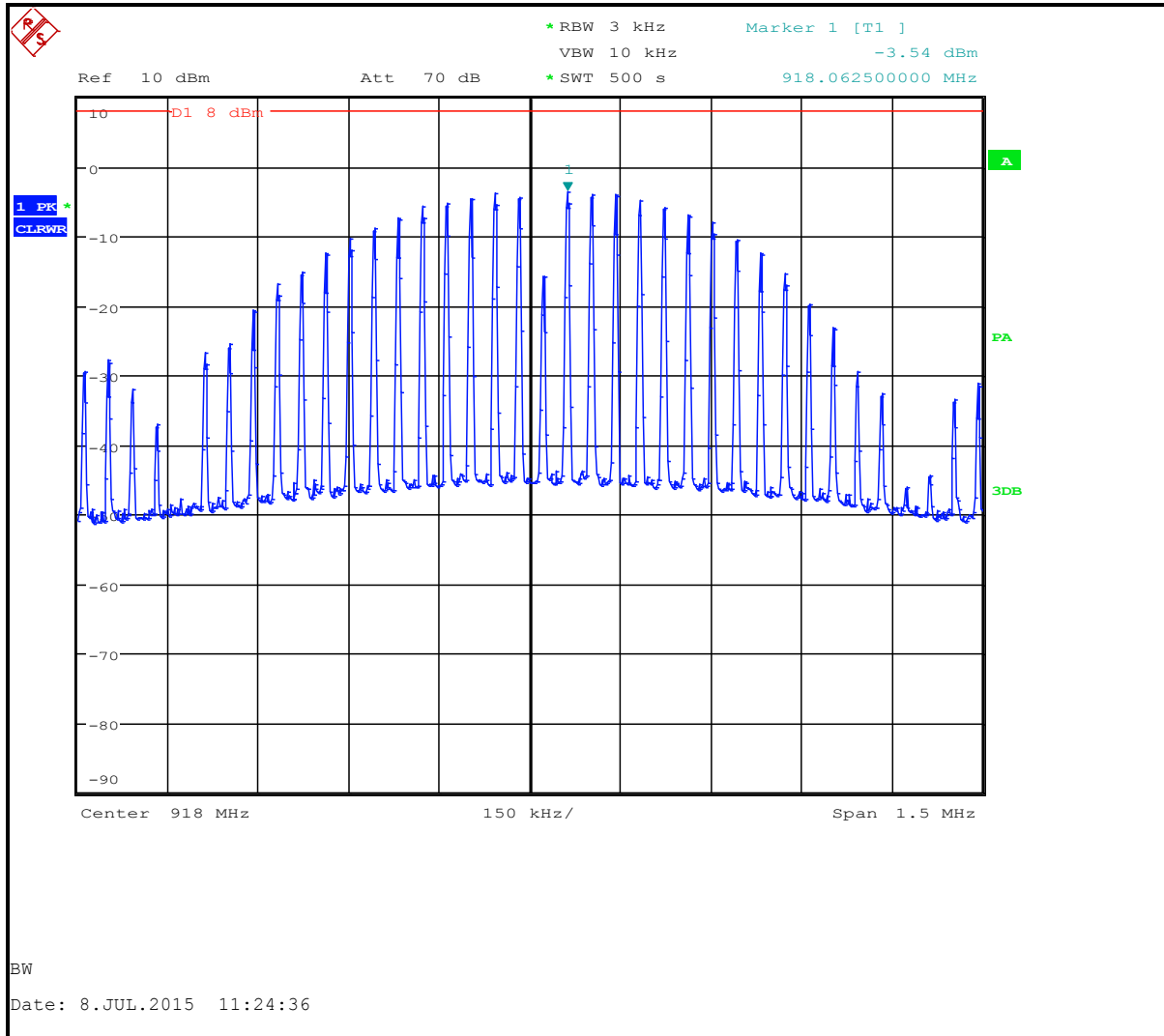
Table 4-2: Peak Spectral Density Test Data

Channels	Frequency (MHz)	Peak Output Power (dBm)
Low	912	-3.6
Mid	918	-3.5
High	924	-3.7

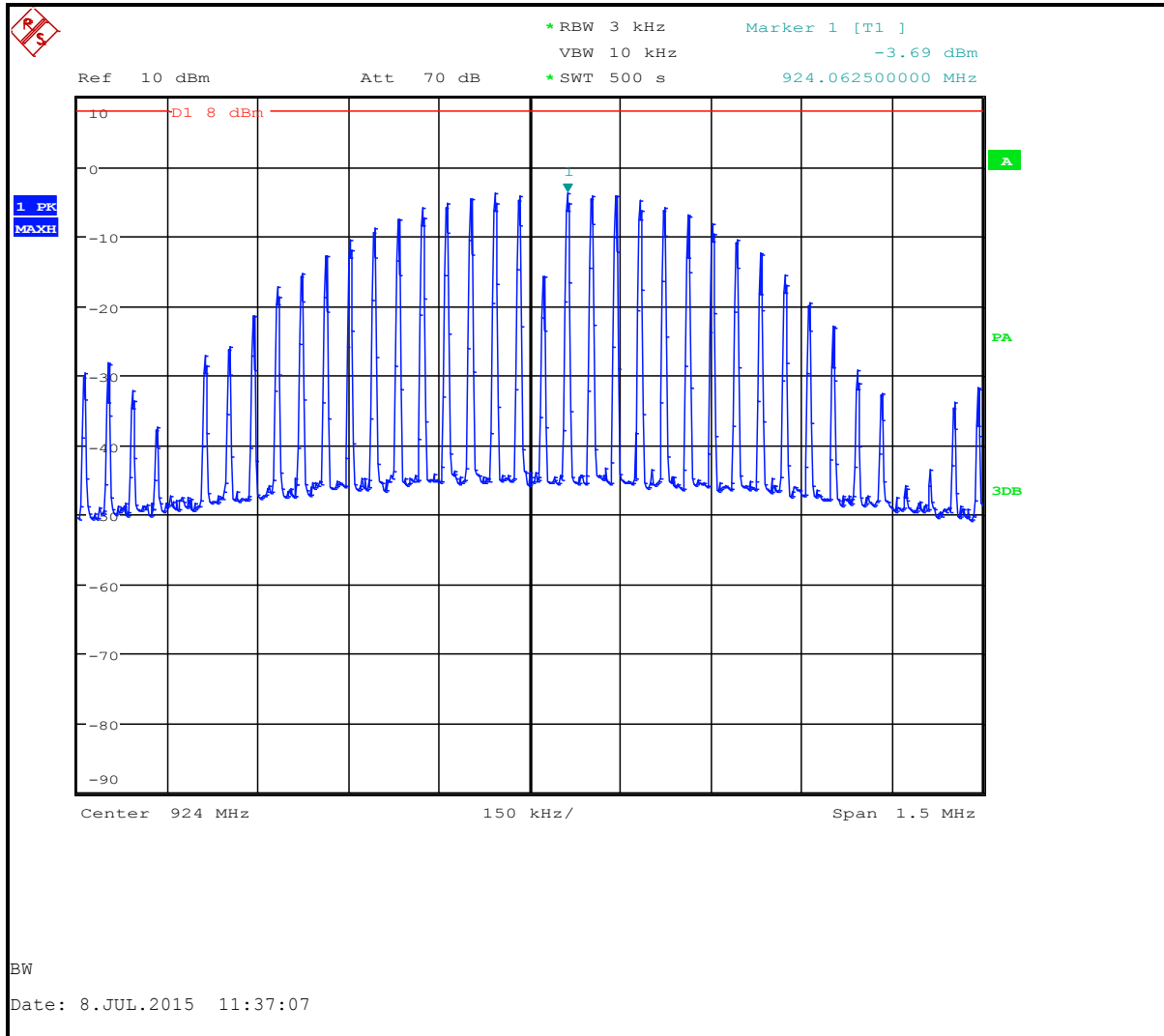
Plot 4-1: Peak Spectral Density – 912 MHz



Plot 4-2: Peak Spectral Density – 918 MHz



Plot 4-3: Peak Spectral Density – 924 MHz



Test Personnel:

Dan Baltzell
Test Engineer

Signature

July 8, 2015
Date of Test

5 Antenna Conducted Spurious Emissions – FCC 15.247(d), RSS-210 A8.5

5.1 Antenna Conducted Spurious Emissions Test Procedure

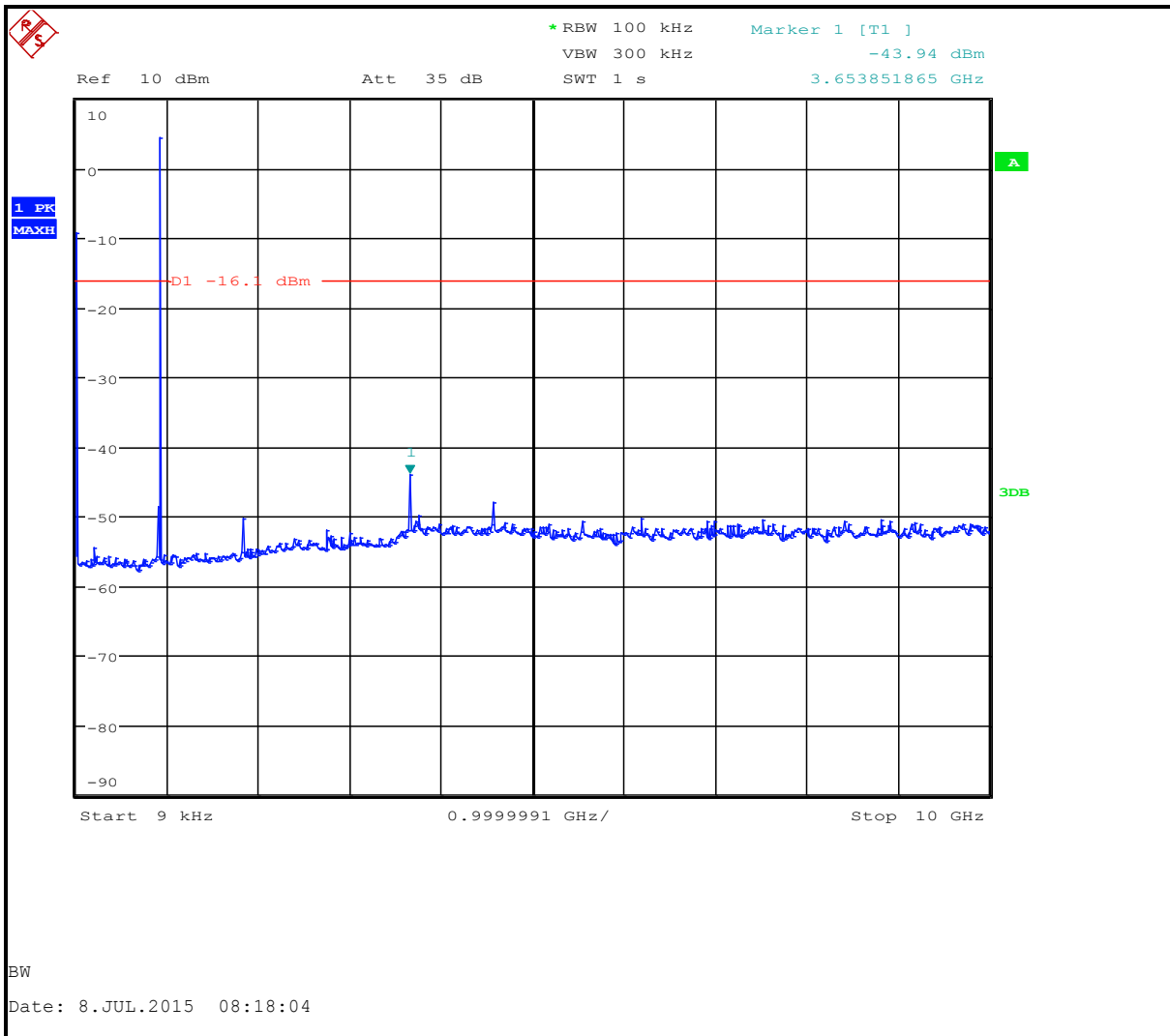
A PCB mounted U.FL connector provided a port for measurement from 9 kHz to the 10th harmonic with the spectrum analyzer, for the low, mid, and high channels.

Table 5-1: Antenna Conducted Spurious Emissions Test Equipment

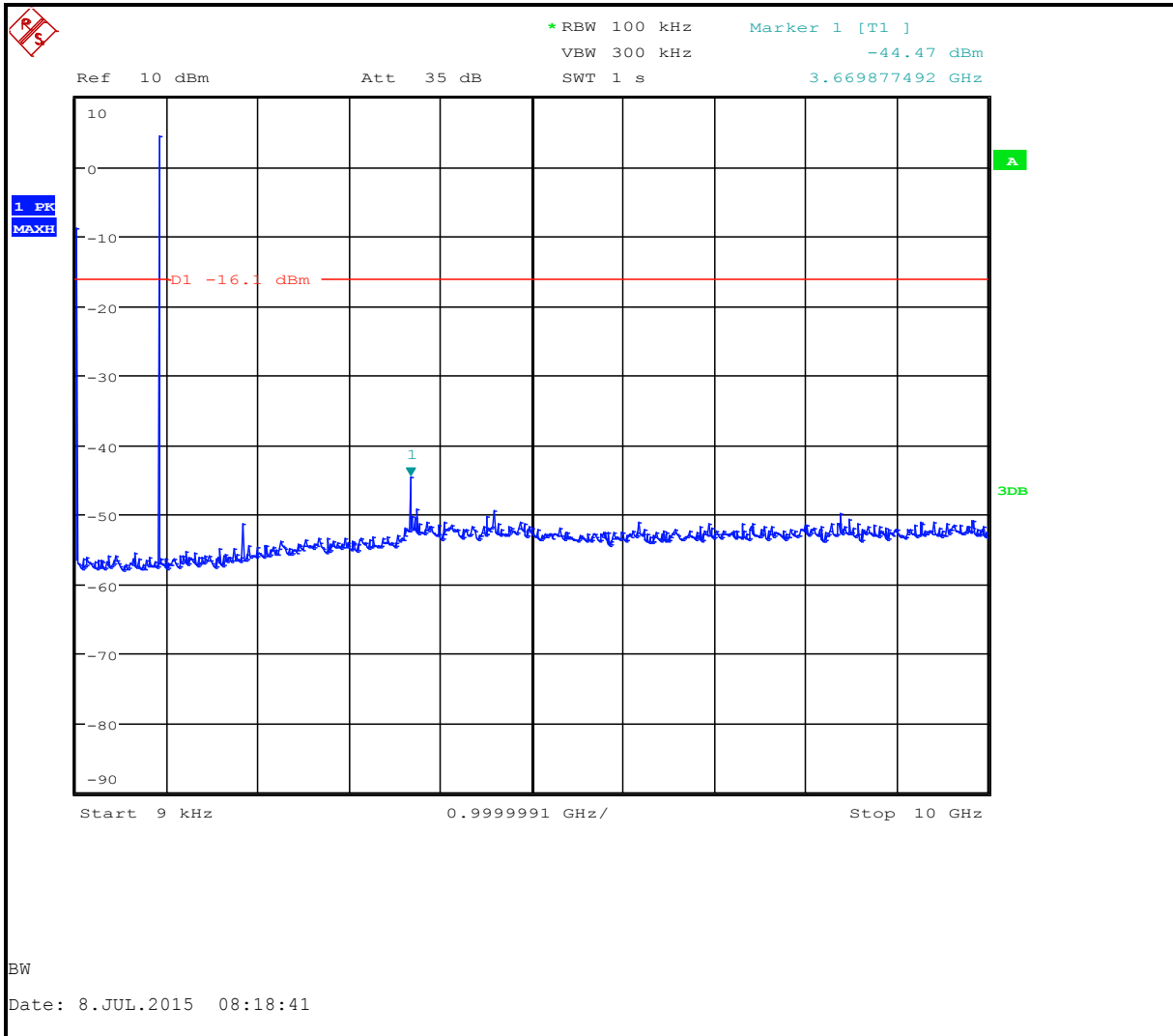
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	11/13/15

5.2 Peak Output Power Test Data

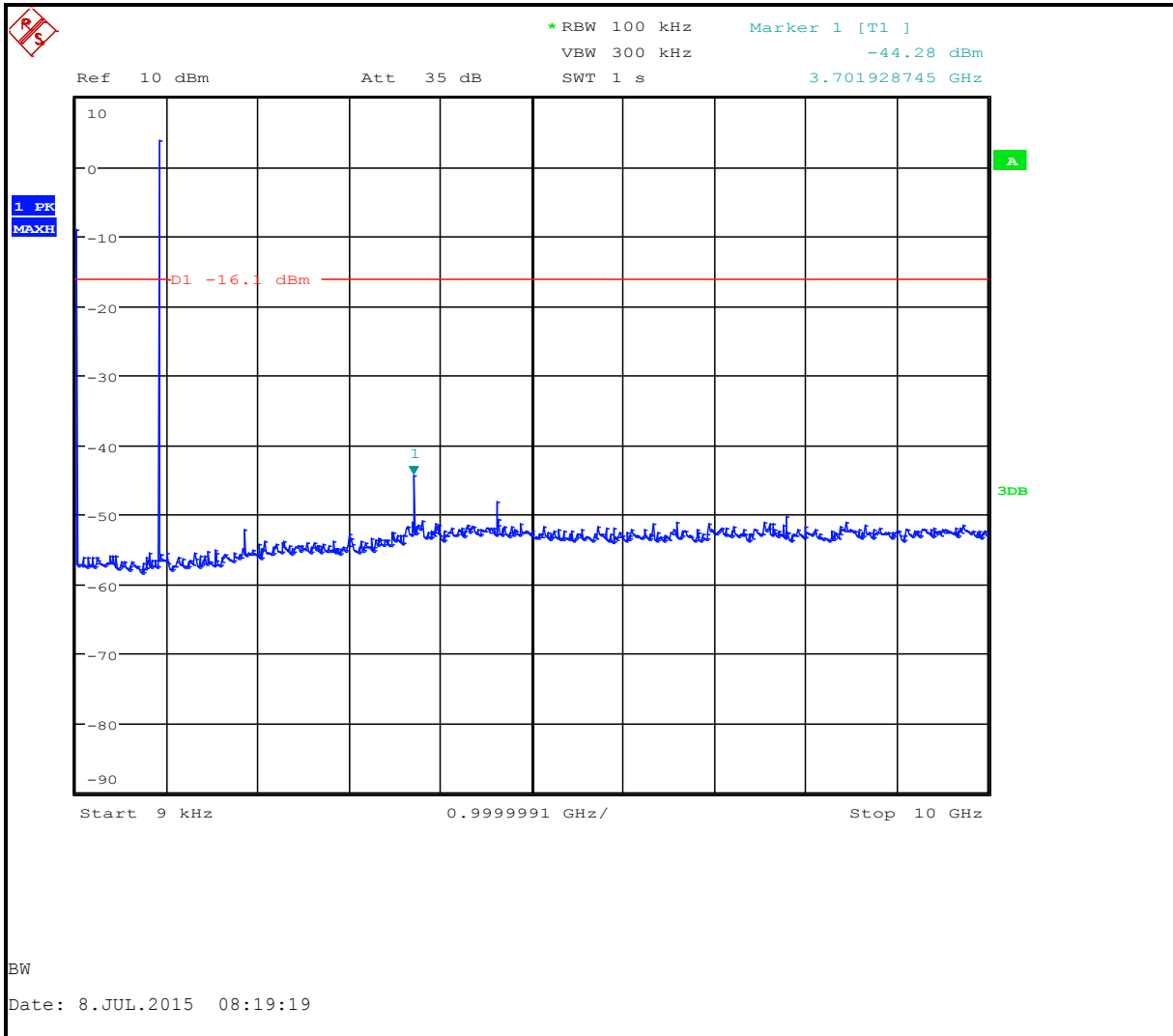
Plot 5-1: Antenna Conducted Spurious Emissions – 912 MHz



Plot 5-2: Antenna Conducted Spurious Emissions – 918 MHz



Plot 5-3: Antenna Conducted Spurious Emissions – 924 MHz



Test Personnel:

Daniel W. Baltzell
EMC Test Engineer

Signature

July 8, 2015
Date of Test

6 Compliance with the Band Edge – FCC 15.247(d); RSS-210 A8.5

6.1 Band Edge Test Procedure

Conducted measurements were taken. 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.

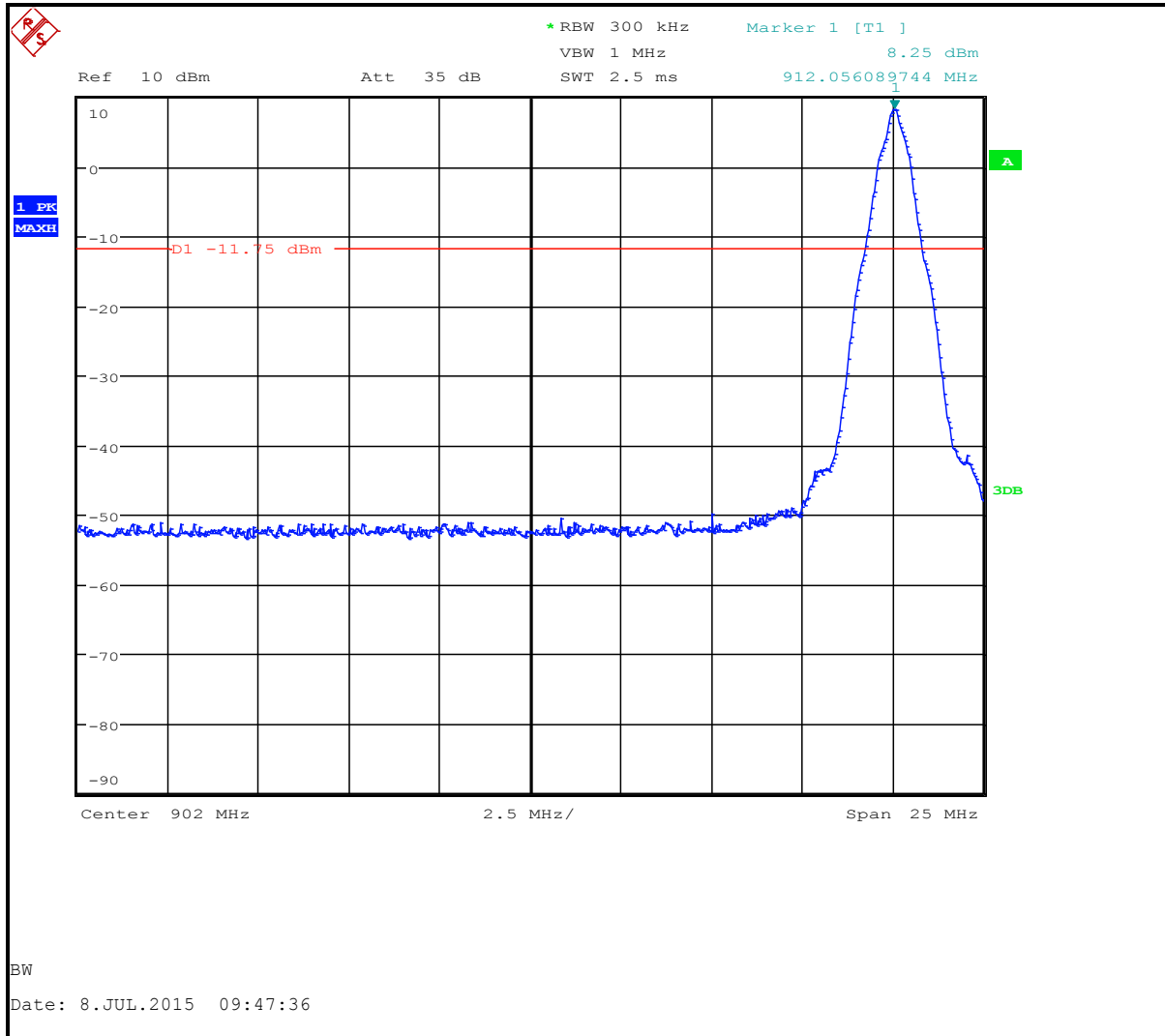
Table 6-1: Band Edge Test Equipment

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 Band Edge Test Results

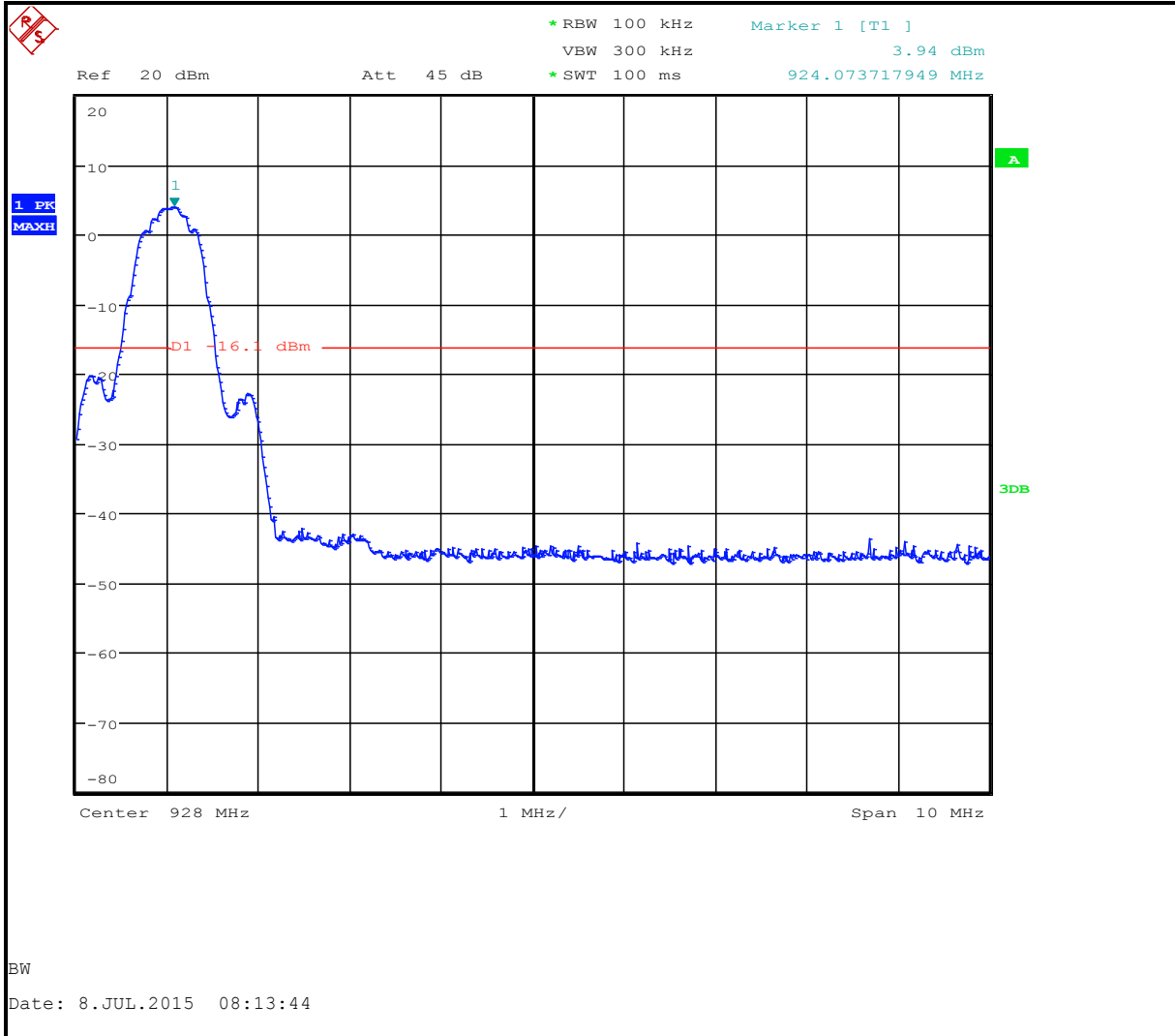
6.2.1 Lower Band Edge – Plot

Plot 6-1: Lower Band Edge



6.2.2 Upper Band Edge

Plot 6-2: Upper Band Edge



Test Personnel:

Dan Baltzell
Test Engineer

Signature

July 8, 2015
Date of Test

7 Bandwidth – FCC 15.247(a)(2); RSS-210 A8.1(a)(b)(d)

7.1 6 dB Bandwidth Test Procedure

The minimum 6 bandwidth per FCC 15.247 (a)(1) and RSS-210 were measured using a 50-ohm spectrum analyzer. The carrier was adjusted on the analyzer so that it was displayed entirely on the spectrum analyzer. The sweep time was set to auto and allowed through several sweeps with the max hold function used in peak detector mode. The resolution bandwidth was set to 100 kHz, and the video bandwidth set at 300 kHz.

Table 7-1: 6 dB Bandwidth Test Equipment

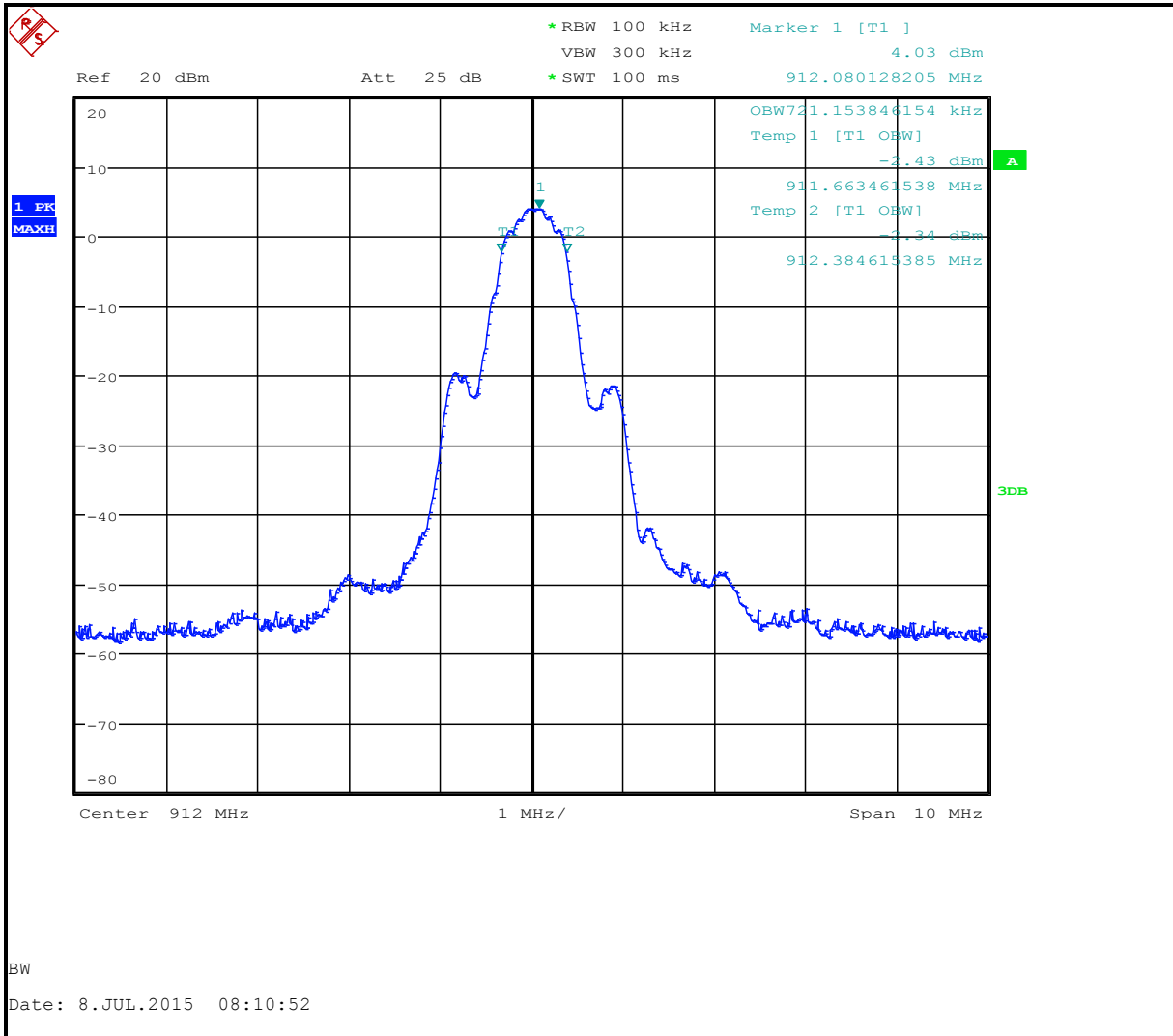
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	11/13/15

7.2 Bandwidth Test Results

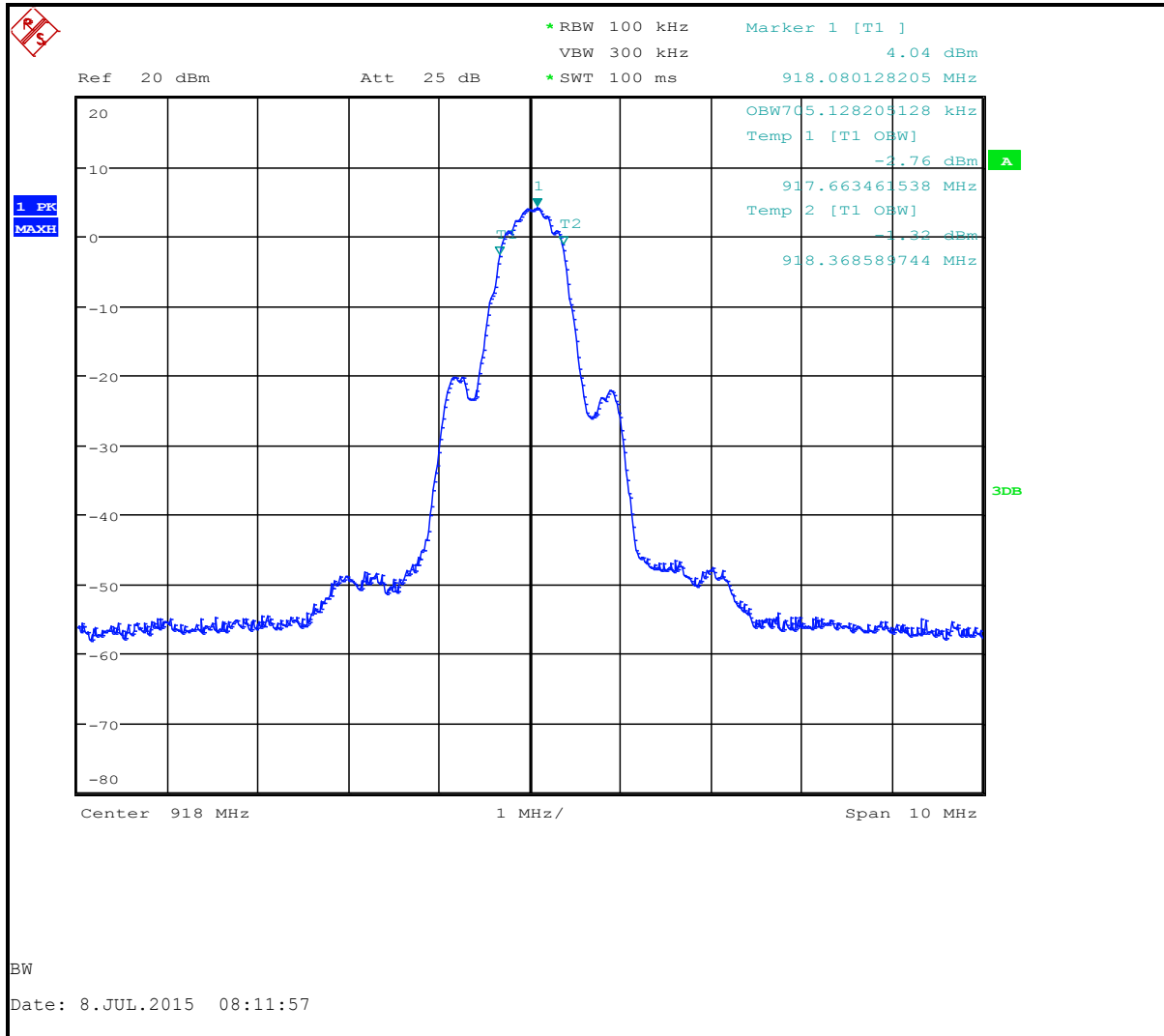
Table 7-2: 6 dB Bandwidth Test Data

Frequency (MHz)	6 dB Bandwidth (kHz)	Maximum Limit (MHz)	Pass/Fail
912	721	0.5	Pass
918	705	0.5	Pass
924	705	0.5	Pass

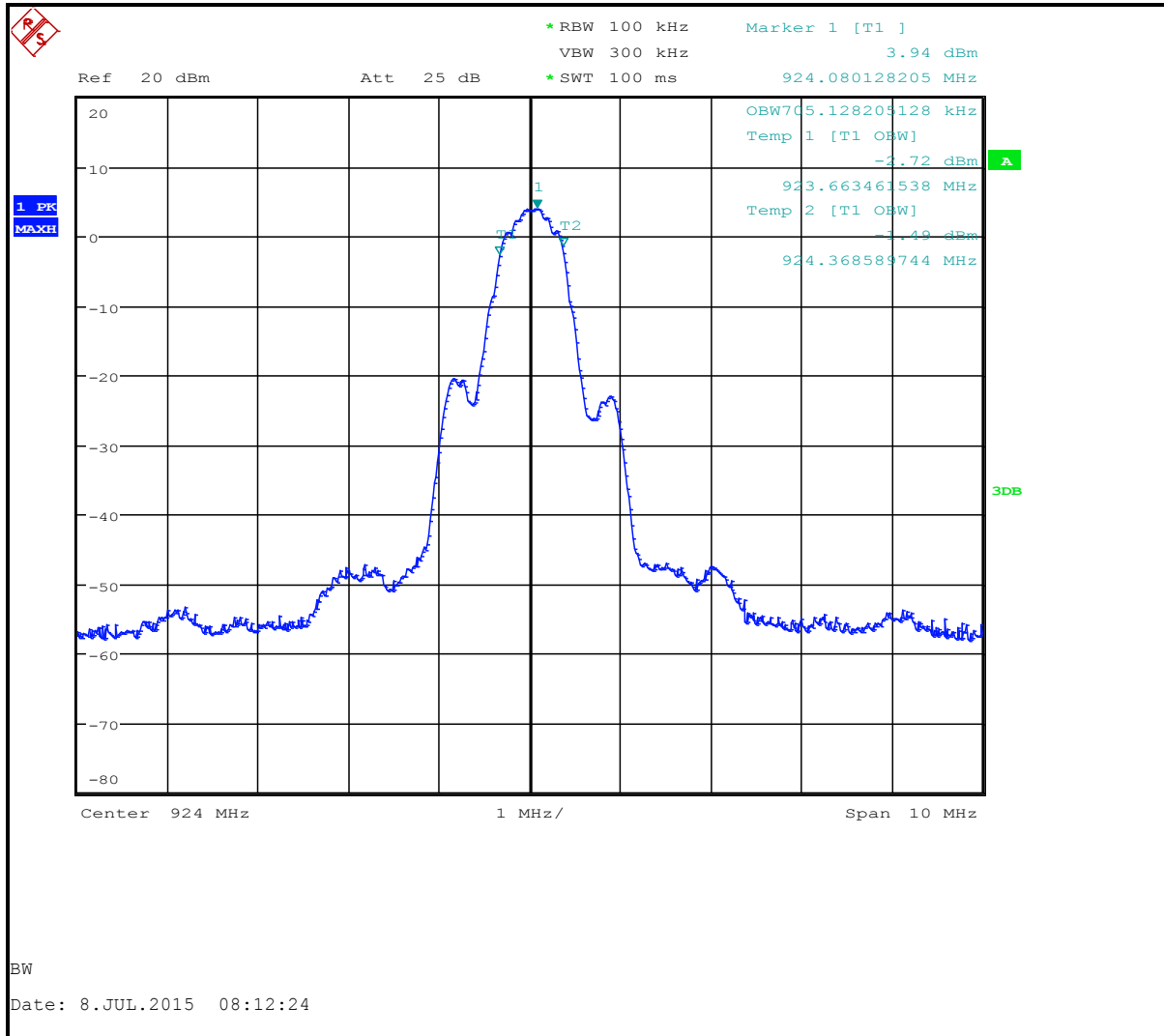
Plot 7-1: 6 dB Bandwidth – 912 MHz



Plot 7-2: 6 dB Bandwidth – 918 MHz



Plot 7-3: 6 dB Bandwidth – 924 MHz



Test Personnel:

Dan Baltzell
 Test Engineer

Signature

July 8, 2015
 Date of Test

8 Radiated Emissions - 15.209; RSS-210 2.2; RSS-Gen 6.13/7.1

8.1 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.

8.2 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 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 8-1: 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
901593	Insulated Wire Inc.	KPS-1503-360-KPR	SMK RF Cables 36"	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

8.3 Radiated Emissions Test Results

8.3.1 Unintentional Radiated Emissions Test Data

Table 8-2: Digital Radiated Emissions Test Data

Temperature: 78°F Humidity: 80%										
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
432.0	Qp	H	0	1.0	2.0	18.2	20.2	46.0	-25.8	Pass
464.0	Qp	V	0	1.0	9.6	18.6	28.2	46.0	-17.8	Pass
496.0	Qp	H	90	1.0	5.6	18.8	24.4	46.0	-21.6	Pass
528.0	Qp	V	0	1.0	5.0	19.9	24.9	46.0	-21.1	Pass
544.0	Qp	V	0	1.0	0.8	21.6	22.4	46.0	-23.6	Pass
560.0	Qp	H	270	1.0	-3.4	19.9	16.5	46.0	-29.5	Pass
576.9	Qp	V	0	1.0	-2.6	20.4	17.8	46.0	-28.2	Pass
608.0	Qp	H	0	1.0	-2.8	20.6	17.8	46.0	-28.2	Pass
624.0	Qp	V	0	1.0	-3.5	21.3	17.8	46.0	-28.2	Pass
640.0	Qp	V	0	1.0	7.6	20.9	28.5	46.0	-17.5	Pass
656.0	Qp	V	0	1.0	1.8	20.9	22.7	46.0	-23.3	Pass
672.0	Qp	H	270	1.0	-0.6	21.0	20.4	46.0	-25.6	Pass
704.0	Qp	H	85	1.0	-0.4	20.8	20.4	46.0	-25.6	Pass
720.0	Qp	H	0	1.0	-2.2	21.9	19.7	46.0	-26.3	Pass
1088.0	Pk	V	0	1.0	4.9	24.5	29.4	54.0	-24.6	Pass
1120.0	Pk	H	90	1.0	13.3	24.2	37.5	54.0	-16.5	Pass
1152.0	Pk	V	0	1.0	0.7	25.9	26.6	54.0	-27.4	Pass
1184.0	Pk	V	0	1.0	1.0	25.3	26.3	54.0	-27.7	Pass
1216.0	Pk	H	270	1.0	5.9	27.1	33.0	54.0	-21.0	Pass
1248.0	Pk	V	0	1.0	1.2	26.5	27.7	54.0	-26.3	Pass
1280.0	Pk	H	0	1.0	0.5	27.4	27.9	54.0	-26.1	Pass
1312.0	Pk	V	0	1.0	0.8	27.0	27.8	54.0	-26.2	Pass

8.3.2 Spurious/Harmonics Radiated Emissions Test Data

Table 8-3: Peak Radiated Emissions Spurious/Harmonics – 912 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)
2736.0	23.9	25.8	49.7	74.0	-22.9
3648.0	24.2	27.6	51.8	74.0	-20.5
4560.0	16.2	33.6	49.8	74.0	-28.4
7296.0	12.6	35.7	48.3	74.0	-18.0
8208.0	13.9	41.7	55.6	74.0	-20.2
9120.0	10.8	41.9	52.7	74.0	-19.7

Table 8-4: Average Radiated Emissions Spurious/Harmonics – 912 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)
2736.0	12.9	25.8	38.7	54.0	-15.3
3648.0	18.6	27.6	46.2	54.0	-7.8
4560.0	5.0	33.6	38.6	54.0	-15.4
7296.0	-1.0	35.7	34.7	54.0	-19.3
8208.0	-0.2	41.7	41.5	54.0	-12.5
9120.0	-0.7	41.9	41.2	54.0	-12.8

Table 8-5: Peak Radiated Emissions Spurious/Harmonics - 918 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)
2754.0	22.4	25.8	48.2	74.0	-25.8
3672.0	24.9	27.6	52.5	74.0	-21.5
4590.0	16.4	33.5	49.9	74.0	-24.1
7344.0	12.4	35.7	48.1	74.0	-25.9
8262.0	14.0	41.7	55.7	74.0	-18.3
9180.0	13.2	42.0	55.2	74.0	-18.8

Table 8-6: Average Radiated Emissions Spurious/Harmonics – 918 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)
2754.0	11.0	25.8	36.8	54.0	-17.2
3672.0	20.1	27.6	47.7	54.0	-6.3
4590.0	6.2	33.5	39.7	54.0	-14.3
7344.0	-1.5	35.7	34.2	54.0	-19.8
8262.0	-0.9	41.7	40.8	54.0	-13.2
9180.0	-1.5	42.0	40.5	54.0	-13.5

Table 8-7: Peak Radiated Emissions Spurious/Harmonics - 924 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)
2772.0	22.1	25.9	48.0	74.0	-26.0
3696.0	26.0	27.7	53.7	74.0	-20.3
4620.0	16.9	33.4	50.3	74.0	-23.7
7392.0	12.7	35.7	48.4	74.0	-25.6
8316.0	11.5	41.8	53.3	74.0	-20.7

Table 8-8: Average Radiated Emissions Spurious/Harmonics – 924 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)
2772.0	10.6	25.9	36.5	54.0	-17.5
3696.0	20.1	27.7	47.8	54.0	-6.2
4620.0	8.6	33.4	42.0	54.0	-12.0
7392.0	-1.7	35.7	34.0	54.0	-20.0
8316.0	-0.9	41.8	40.9	54.0	-13.1

Test Personnel:

Daniel W. Baltzell
 Test Engineer



Signature

July 8, 2015
 Date of Test

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Client: Alarm.com
Model: ADC-IS-221-LP
Standards: FCC 15.247/IC RSS-210
ID's: YL6-143IS221/9111A-143IS221
Report #: 2015133

9 Conclusion

The data in this measurement report shows that the EUT as tested, Alarm.com Model ADC-IS-221-LP, FCC ID: YL6-143IS221, IC: 9111A-143IS221, complies with the applicable requirements of Parts 2 and 15 of the FCC Rules and Regulations and Industry Canada RSS-210 and RSS-Gen.