



Engineering Solutions & Electromagnetic Compatibility Services

**Certification Application Report
FCC Part 15.249 & Industry Canada RSS-210**

Test Lab: Rhein Tech Laboratories, Inc. Tel: 703-689-0368 360 Herndon Parkway Fax: 703-689-2056 Suite 1400 www.rheintech.com Herndon, VA 20170 E-Mail: atcbinfo@rheintech.com		Applicant: Alarm.com Tel: 703-584-7319 8150 Leesburg Pike Suite 1400 Vienna, VA 22182	
FCC ID:	YL6-143IS22	Test Report Date:	January 22, 2015
IC:	9111A-143IS22		
Platform:	N/A	RTL Work Order #:	2014202
Model:	ADC-IS-220-LP	RTL Quote #:	QRTL14-202A
American National Standard Institute:	ANSI C63.4-2009: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
FCC Classification:	DXT – Part 15 Low Power Transceiver		
FCC Rule Part(s)/ Guidance:	15.249: Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz, October 1, 2013		
Industry Canada:	RSS-210 Issue 8: License-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)	Frequency Tolerance	Emission Designator
912-924	N/A	N/A	1M09F1D

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, RSS-210, and ANSI C63.4.

Signature: 

Date: January 22, 2015

Typed/Printed Name: Desmond A. Fraser

Position: President

This report may not be reproduced, except in full, without the written approval of Rhein Tech Laboratories, Inc. and Alarm.com. The test results relate only to the item(s) tested.

*These tests are accredited and meet the requirements of ISO/IEC 17025 as verified by ANAB.
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	Radiated Emissions – FCC 15.209, 15.249(a); RSS-210 A2.9; RSS-Gen	8
3.1	Limits of Radiated Emissions Measurement	8
3.2	Radiated Emissions Measurement Test Procedure	8
3.3	Radiated Emissions Test Results	10
3.4	Radiated Emissions Harmonics/Spurious Test Data	10
3.5	Radiated Emissions Digital/Receive Test Data	12
4	AC Conducted Emissions - FCC 15.207; RSS-Gen 8.8	13
5	99% Bandwidth – IC RSS-Gen 6.6	13
5.1	99% Bandwidth Test Procedure	13
5.2	99% Modulated Bandwidth Test Data	13
5.3	99% Bandwidth Plots	14
6	Conclusion	16

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 15.249).....	6
Table 2-3: Equipment Under Test	7
Table 3-1: Radiated Emissions Test Equipment	9
Table 3-2: Radiated Emissions Test Data	10
Table 3-3: Peak Radiated Emissions Harmonics/Spurious – 912 MHz	10
Table 3-4: Average Radiated Emissions Harmonics/Spurious – 912 MHz	10
Table 3-5: Peak Radiated Emissions Harmonics/Spurious – 918 MHz	11
Table 3-6: Average Radiated Emissions Harmonics/Spurious – 918 MHz	11
Table 3-7: Peak Radiated Emissions Harmonics/Spurious – 924 MHz	11
Table 3-8: Average Radiated Emissions Harmonics/Spurious – 924 MHz	12
Table 3-9: Digital/Receive Radiated Emissions Test Data	12
Table 5-1: 99% Bandwidth Test Equipment	13
Table 5-2: 99% Modulated Bandwidth Test Data	13

Plot Index

Plot 5-1: 99% Bandwidth; 912 MHz	14
Plot 5-2: 99% Bandwidth; 918 MHz	15
Plot 5-3: 99% Bandwidth; 924 MHz	16

Appendix Index

Appendix A: FCC Part 1.1307, 1.1310, 2.1091, 2.1093; IC RSS-Gen: RF Exposure	17
Appendix B: Agency Authorization Letter	18
Appendix C: FCC Confidentiality Request Letter	19
Appendix D: IC Letters	20
Appendix E: Canadian Based Representative Attestation Letter	21
Appendix F: IC Confidentiality Request Letter	22
Appendix G: ID Label and Label Location	23
Appendix H: Technical Operational Description	24
Appendix I: Schematics	25
Appendix J: Block Diagram	26
Appendix K: Manual	27
Appendix L: Test Photographs	28
Appendix M: External Photographs	30
Appendix N: Internal Photographs	32

Photograph Index

Photograph 1:	Radiated Emissions Testing – Front View	28
Photograph 2:	Radiated Emissions Testing – Back View	29
Photograph 3:	Front	30
Photograph 4:	Back	31
Photograph 5:	Battery Compartment	32
Photograph 6:	PCB Side 1	33
Photograph 7:	PCB Side 2	34

1 General Information

1.1 Scope

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

Applicable Standards:

- FCC Part 15.249: Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz
- Industry Canada RSS-210: Low Power License-Exempt Communications Devices & RSS-Gen Issue 4: General Requirements for Compliance of Radio Apparatus

1.2 Description of EUT

Equipment Under Test	Transceiver
Model	ADC-IS-220-LP
Power Supply	2 AA size 1.5V Cells
Modulation Type	FSK
Frequency Range	912-924 MHz
Antenna Connector Type	N/A
Antenna Type	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 certification application for Alarm.com, Model: ADC-IS-220-LP, FCC ID: YL6-143IS22, IC: 9111A-143IS22.

1.5 Modifications

N/A

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

Frequency (MHz)
912
918
924

2.2 Exercising the EUT

The EUT was selectively programmed for continuous transmission at all three channels, 912, 918, and 924 MHz. The EUT was tested in all three orthogonal planes in order to determine worst-case emissions. The carrier was also checked to verify that information was being transmitted.

2.3 Test Result Summary

Table 2-2: Test Result Summary – FCC Part 15, Subpart C (Section 15.249)

Standard	Test	Pass/Fail or N/A
FCC 15.207	AC Power Conducted Emissions	N/A
FCC 15.209	Radiated Emissions	Pass
FCC 15.249(a)	Field Strength of Fundamental and Harmonics	Pass
RSS-Gen	99% Bandwidth	Pass

2.4 Test System Details

The test samples were received on January 6, 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	Alarm.com	ADC-IS-220-LP	N/A	YL6-143IS22	N/A	21537
Transceiver	Alarm.com	ADC-IS-220-LP	N/A	YL6-143IS22	N/A	21538

2.5 Configuration of Tested System

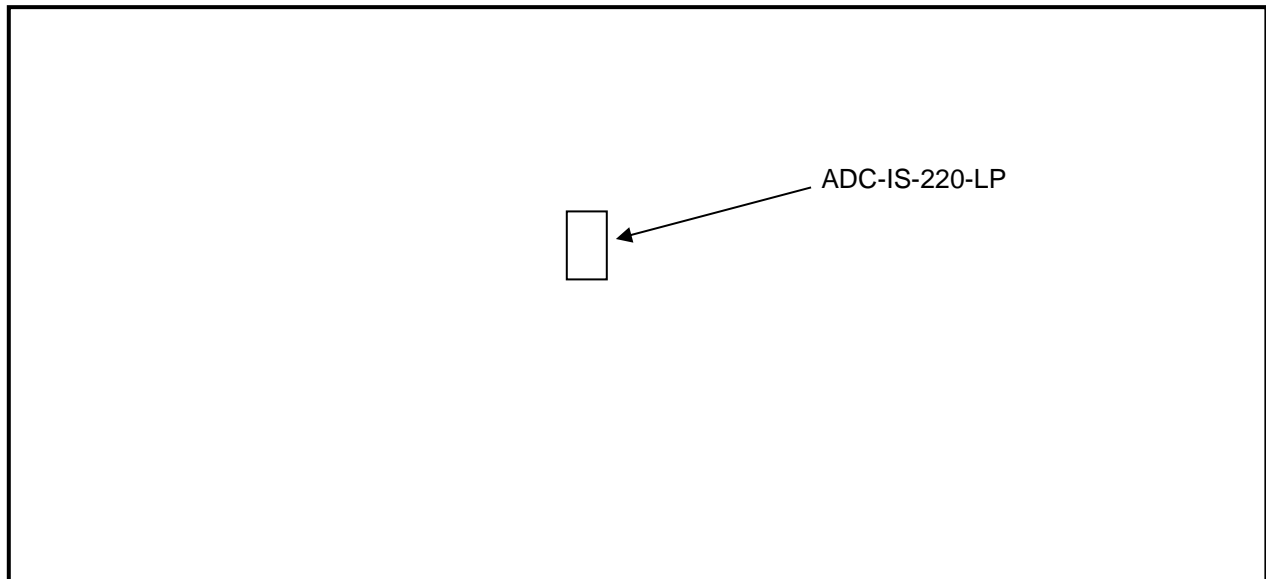


Figure 2-1: Configuration of System Under Test

3 Radiated Emissions – FCC 15.209, 15.249(a); RSS-210 A2.9; RSS-Gen

3.1 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 99% under any circumstances of modulation.

3.2 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 (9.08 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 average detector function 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 3-1: Radiated Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900151	Rohde and Schwarz	HFH2-Z2	Loop Antenna (9 kHz-30 MHz)	827525/019	3/4/17
900905	Rhein Tech Laboratories	PR-1040	OATS 1 Preamplifier 40dB (30 MHz–2 GHz)	1006	9/5/15
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
900913	Hewlett Packard	85462A	EMI Receiver RF Section (9 kHz–6.5 GHz)	3325A00159	12/11/15
900914	Hewlett Packard	85460A	RF Filter Section (100 kHz-6.5 GHz)	3330A00107	12/11/15
900772	EMCO	3161-02	Horn Antenna (2-4 GHz)	9804-1044	4/20/15
900321	EMCO	3161-03	Horn Antenna (4.0-8.2 GHz)	9508-1020	4/20/15
900323	EMCO	3160-07	Horn Antenna (8.2-12.4 GHz)	9605-1054	4/20/15
900356	EMCO	3160-08	Horn Antenna (12.4-18 GHz)	9607-1044	4/20/15
900325	EMCO	3160-9	Horn Antenna (18-26.5 GHz)	9605-1051	4/19/15
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

3.3 Radiated Emissions Test Results

Table 3-2: Radiated Emissions Test Data

Emission Frequency (MHz)	Quasi-Peak Analyzer Level (dBuV/m) (100 kHz RBW/ 300 kHz VBW)	Site Correction Factor (dB/m)	Peak Corrected (dBuV/m)	Limit (dBuV/m)	Margin (dB)
912	66.7	23.2	89.9	94.0	-4.1
918	70.3	23.0	93.3	94.0	-0.7
924	69.8	22.8	92.6	94.0	-1.4

* testing performed at 3m

3.4 Radiated Emissions Harmonics/Spurious Test Data

Table 3-3: Peak Radiated Emissions Harmonics/Spurious – 912 MHz

Emission Frequency (MHz)	Peak Measurement (dBuV/m) (1 MHz RBW/VBW)	Site Correction Factor (dB/m)	Peak Corrected (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
1824.058	25.4	3.1	28.5	74.0	-45.5
2736.087	15.9	25.8	41.7	74.0	-32.3
3648.123	21.2	27.6	48.8	74.0	-25.2
4560.152	12.8	33.1	45.9	74.0	-28.1
5472.181	11.1	33.9	45.0	74.0	-29.0
6384.210	9.0	34.9	43.9	74.0	-30.1
7296.239	6.4	35.7	42.1	74.0	-31.9
8208.268	8.0	41.5	49.5	74.0	-24.5

Table 3-4: Average Radiated Emissions Harmonics/Spurious – 912 MHz

Emission Frequency (MHz)	Average Detector (dBuV/m) (1 MHz RBW/10 Hz VBW)	Site Correction Factor (dB/m)	Average Corrected (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
1824.058	24.1	3.1	27.2	54.0	-26.8
2736.087	10.9	25.8	36.7	54.0	-17.3
3648.123	20.3	27.6	47.9	54.0	-6.1
4560.152	3.0	33.1	36.1	54.0	-17.9
5472.181	3.6	33.9	37.5	54.0	-16.5
6384.21	-8.0	34.9	26.9	54.0	-27.1
7296.239	-7.7	35.7	28.0	54.0	-26.0
8208.268	-6.0	41.5	35.5	54.0	-18.5

Table 3-5: Peak Radiated Emissions Harmonics/Spurious – 918 MHz

Emission Frequency (MHz)	Peak Measurement (dBuV/m) (1 MHz RBW/VBW)	Site Correction Factor (dB/m)	Peak Corrected (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
1836.030	28.8	3.2	32.0	74.0	-42.0
2754.030	22.2	25.8	48.0	74.0	-26.0
3672.030	24.6	27.6	52.2	74.0	-21.8
4590.030	15.9	33.1	49.0	74.0	-25.0
5508.030	10.0	33.9	43.9	74.0	-30.1
6426.030	8.3	34.9	43.2	74.0	-30.8
7344.030	7.0	35.7	42.7	74.0	-31.3
8262.030	7.1	41.5	48.6	74.0	-25.4

Table 3-6: Average Radiated Emissions Harmonics/Spurious – 918 MHz

Emission Frequency (MHz)	Average Detector (dBuV/m) (1 MHz RBW/10 Hz VBW)	Site Correction Factor (dB/m)	Average Corrected (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
1836.03	27.9	3.2	31.1	54.0	-22.9
2754.03	11.3	25.8	37.1	54.0	-16.9
3672.03	19.8	27.6	47.4	54.0	-6.6
4590.03	6.0	33.1	39.1	54.0	-14.9
5508.03	0.3	33.9	34.2	54.0	-19.8
6426.03	1.0	34.9	35.9	54.0	-18.1
7344.03	-5.6	35.7	30.1	54.0	-23.9
8262.03	-5.9	41.5	35.6	54.0	-18.4

Table 3-7: Peak Radiated Emissions Harmonics/Spurious – 924 MHz

Emission Frequency (MHz)	Peak Measurement (dBuV/m) (1 MHz RBW/VBW)	Site Correction Factor (dB/m)	Peak Corrected (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
1848.059	29.4	3.2	32.6	74.0	-41.4
2772.201	22.8	25.9	48.7	74.0	-25.3
3696.128	25.7	27.7	53.4	74.0	-20.6
4620.192	13.2	33.1	46.3	74.0	-27.7
5544.191	8.2	33.9	42.1	74.0	-31.9
6468.118	6.2	35.0	41.2	74.0	-32.8
7392.045	6.2	35.7	41.9	74.0	-32.1
8315.972	2.3	41.6	43.9	74.0	-30.1

Table 3-8: Average Radiated Emissions Harmonics/Spurious – 924 MHz

Emission Frequency (MHz)	Average Detector (dBuV/m) (1 MHz RBW/10 Hz VBW)	Site Correction Factor (dB/m)	Average Corrected (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
1848.059	28.5	3.2	31.7	54.0	-22.3
2772.201	11.6	25.9	37.5	54.0	-16.5
3696.128	20.7	27.7	48.4	54.0	-5.6
4620.192	3.8	33.1	36.9	54.0	-17.1
5544.191	-4.4	33.9	29.5	54.0	-24.5
6468.118	-7.9	35.0	27.1	54.0	-26.9
7392.045	-8.9	35.7	26.8	54.0	-27.2
8315.972	-10.3	41.6	31.3	54.0	-22.7

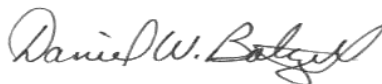
3.5 Radiated Emissions Digital/Receive Test Data

Table 3-9: Digital/Receive Radiated Emissions Test Data

Temperature: 36°F Humidity: 47%										
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
160.273	Qp	V	0	1.0	39.0	-21.1	17.9	43.5	-25.6	Pass
421.871	Qp	V	0	1.0	31.1	-13.3	17.8	46.0	-28.2	Pass
426.711	Qp	V	0	1.0	31.1	-13.2	17.9	46.0	-28.1	Pass
1327.564	Av	H	0	1.0	28.0	-0.4	27.6	54.0	-26.4	Pass
1333.894	Av	H	0	1.0	28.0	-0.3	27.7	54.0	-26.3	Pass
1402.854	Av	V	90	1.0	45.6	1.1	46.7	54.0	-7.3	Pass
1408.560	Av	H	90	1.0	41.3	1.2	42.5	54.0	-11.5	Pass
1663.622	Av	H	90	1.0	39.0	3.1	42.1	54.0	-11.9	Pass

Test Personnel:

Daniel W. Baltzell
Test Engineer



Signature

January 16, 2015
Date of Test

4 AC Conducted Emissions - FCC 15.207; RSS-Gen 8.8

Device has 2 AA 1.5VDC cells and does not connect to AC line, therefore no conducted emissions testing required.

5 99% Bandwidth – IC RSS-Gen 6.6

5.1 99% Bandwidth Test Procedure

The minimum 99% bandwidths per RSS-Gen were measured using a 50-ohm spectrum analyzer. The modulated carrier was adjusted on the analyzer so that it was displayed entirely on the spectrum analyzer. The sweep time was 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 to 1 MHz. The table below contains the bandwidth measurement results.

Table 5-1: 99% 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

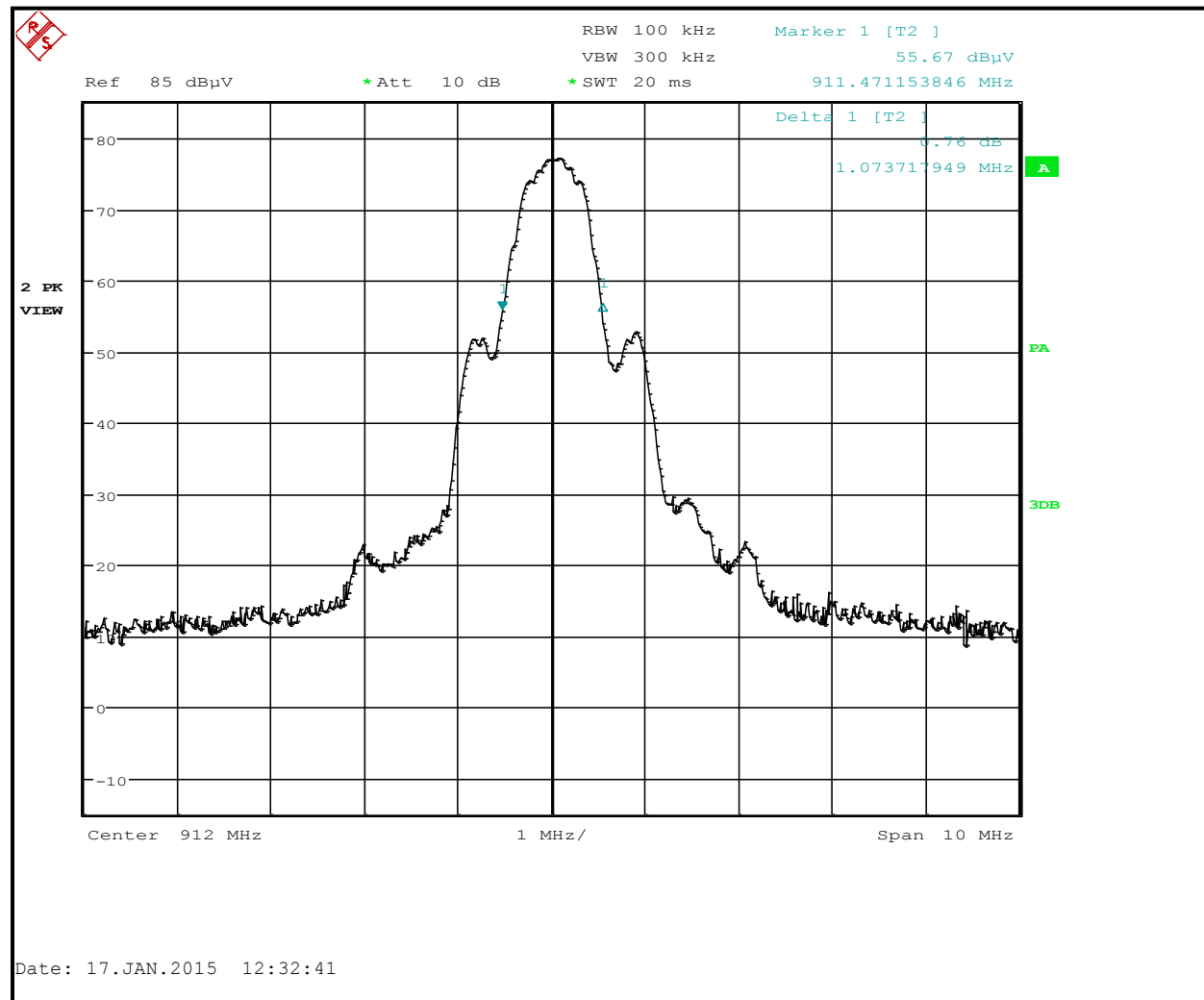
5.2 99% Modulated Bandwidth Test Data

Table 5-2: 99% Modulated Bandwidth Test Data

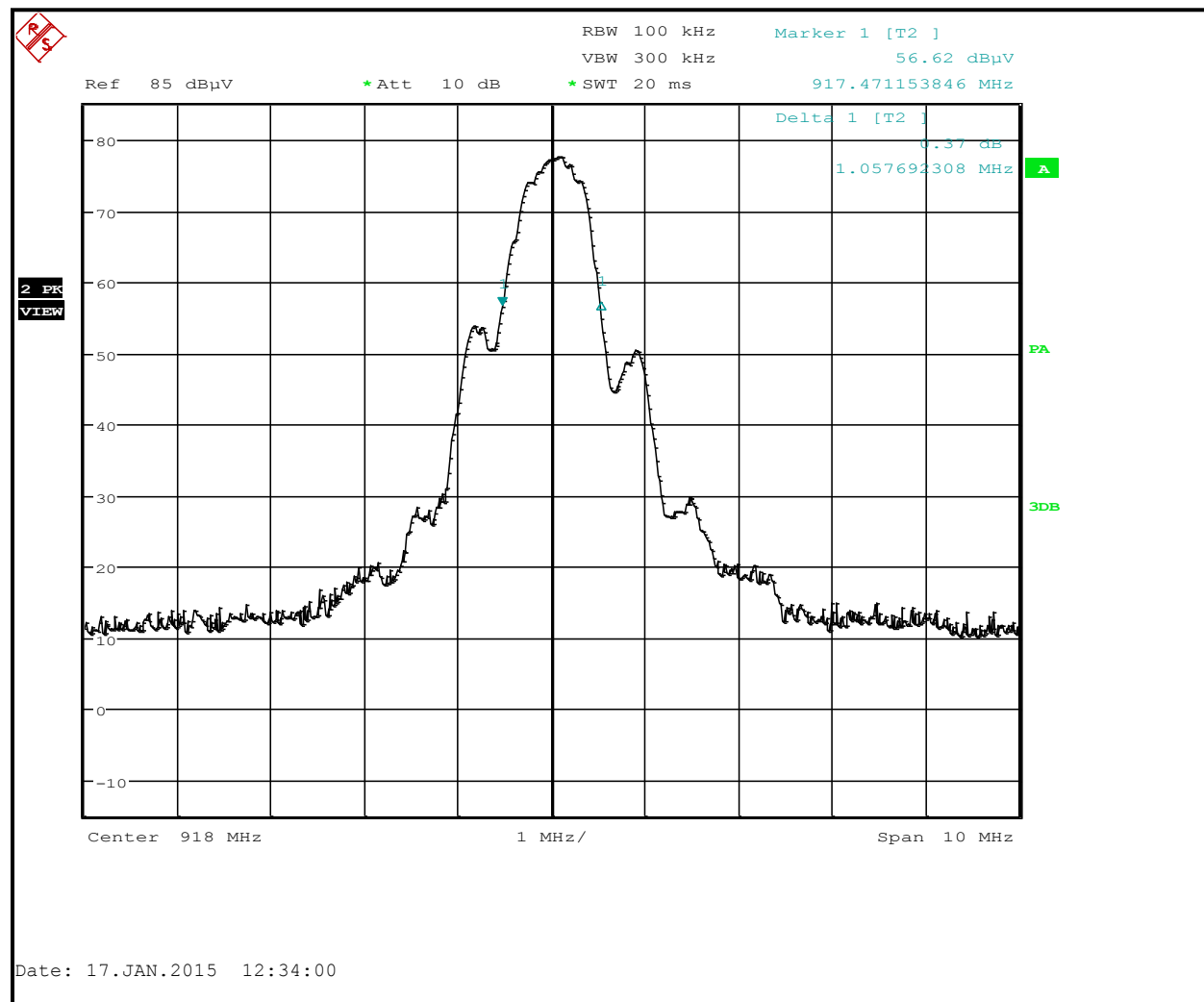
Minimum 99% bandwidths	
Frequency (MHz)	99% Bandwidth (MHz)
912	1.07
918	1.04
924	1.09

5.3 99% Bandwidth Plots

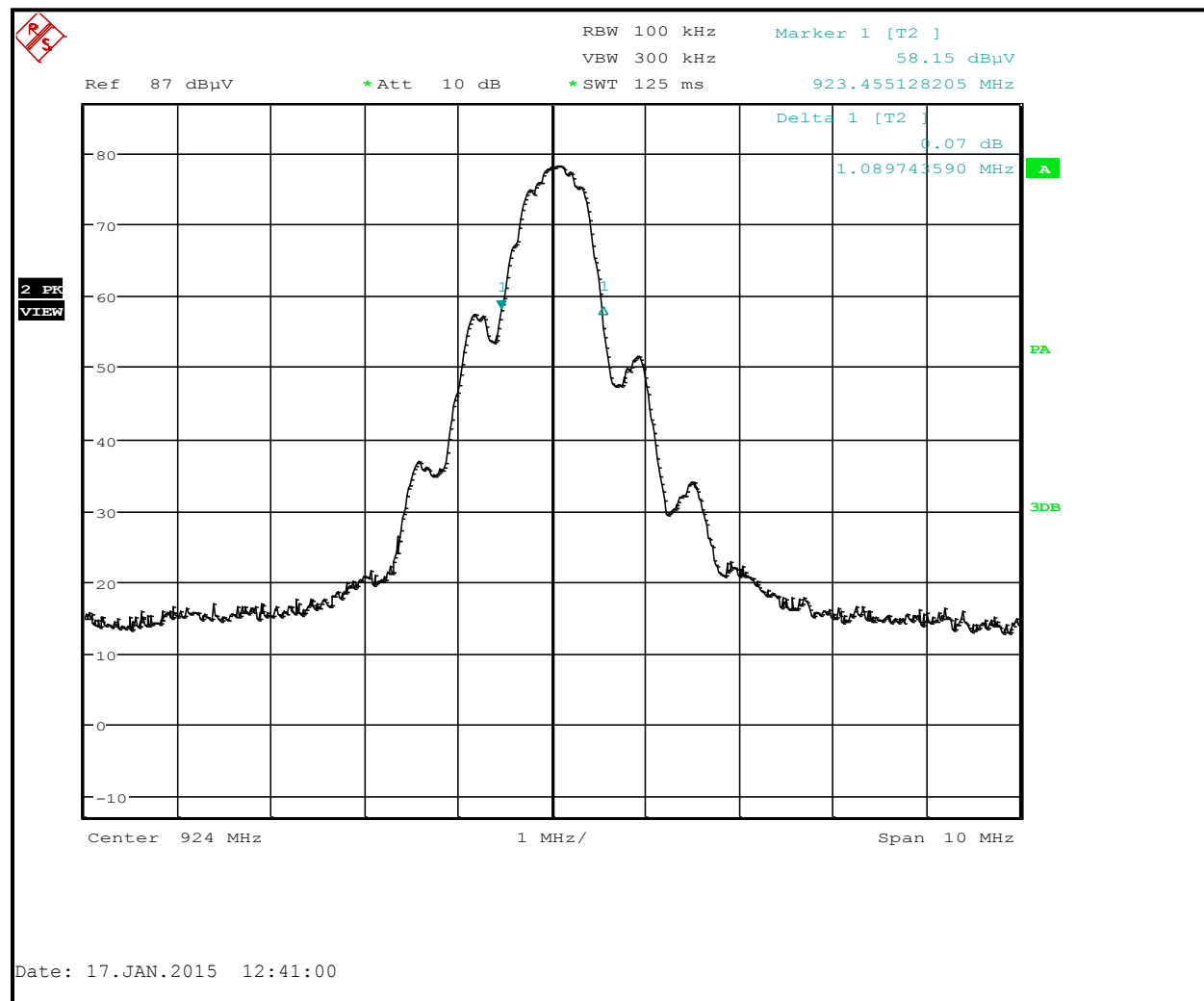
Plot 5-1: 99% Bandwidth; 912 MHz



Plot 5-2: 99% Bandwidth; 918 MHz



Plot 5-3: 99% Bandwidth; 924 MHz



Test Personnel:

Daniel W. Baltzell
Test Engineer

Signature

January 17, 2015
Date of Test

6 Conclusion

The data in this measurement report shows that the EUT as tested, Alarm.com Model: ADC-IS-220-LP, FCC ID: YL6-143IS22, IC: 9111A-143IS22, complies with the applicable requirements of Parts 2 and 15 of the FCC Rules and Regulations, and IC RSS-210 and RSS-Gen.