



Engineering Solutions & Electromagnetic Compatibility Services

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

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FCC ID IC	YL6143NK100T 9111A-143NK100T	Test Report Date	September 29, 2015
Platform	N/A	RTL Work Order #	2015014
Model	ADC-NK-100T	RTL Quote #	QRTL15-014B
American National Standard Institute	ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
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, 2014		
Industry Canada	RSS-210 Issue 8: License-Exempt Radio Apparatus (All Frequency Bands): Category I Equipment		
Digital Interface Information	Digital Interface was found to be compliant		
Frequency Range (MHz)	Output Power (W)	Frequency Tolerance	Emission Designator
908.4	N/A	N/A	187KF1D

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 C63.10.

Signature: 

Date: September 29, 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.

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1 General Information

1.1 Scope

This is an original certification application request.

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

1.2 Description of EUT

Equipment Under Test	Transceiver
Model	ADC-NK-100T
Power Supply	12 VDC
Modulation Type	FSK
Frequency Range	908.4 MHz
Antenna Connector Type	LTE - MMCX
Antenna Type	Wire, LTE – Trace, PCB

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-NK-100T, FCC ID: YL6143NK100T, IC: 9111A-143NK100T.

Requested grant notes: This device may be collocated with the following module:

- FCC ID: RI7CE910-DUAL (IC: 5131A-CE910DUAL)
- or
- FCC ID: RI7UE910NA (IC: 5131A-UE910NA)
- or
- FCC ID: RI7HE910NA (IC: 5131A-HE910NA)

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)
908.4

2.2 Exercising the EUT

The EUT was programmed for continuous transmission at 908.4 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	Pass
FCC 15.209	Radiated Emissions	Pass
FCC 15.249(a)	Field Strength of Fundamental and Harmonics	Pass
RSS-Gen	20 dB Bandwidth	Pass

2.4 Test System Details

The test samples were received on February 26, 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
5 V DC/AC Adapter	N/A	YS12-050020U	N/A	N/A	1.8m unshielded power	21616
5 V DC/AC Adapter	N/A	YS12-050020U	N/A	N/A	1.8m unshielded power	21190
Transceiver (Zwave 500 Series)	Alarm.com	ADC-NK-100T	N/A	YL6143NK100T	N/A	21740

2.5 Configuration of Tested System

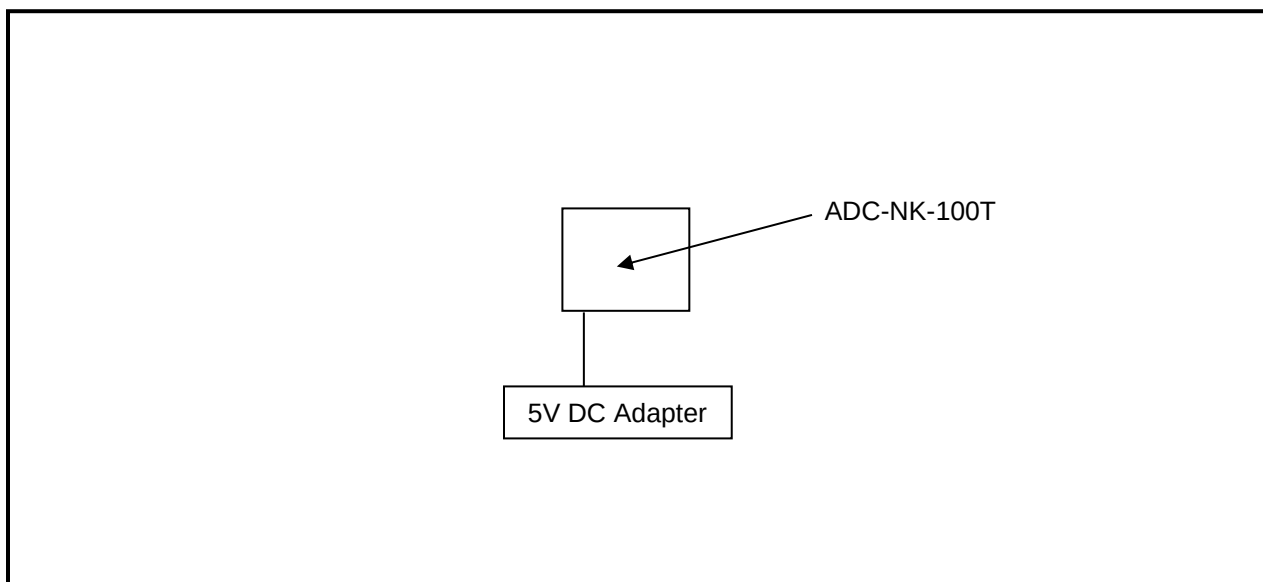


Figure 2-1: Configuration of System Under Test

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 20 dB under any circumstances of modulation.

3.1.1 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
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1-26.5 GHz)	3008A00505	9/5/15
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
901593	Insulated Wire Inc.	KPS-1503-360-KPR	SMK RF Cables 36"	NA	9/3/15
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	4/9/18
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
900356	EMCO	3160-08	Horn Antenna (12.4-18 GHz)	9607-1044	4/9/18
900325	EMCO	3160-9	Horn Antenna (18-26.5 GHz)	9605-1051	4/9/18
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	11/13/15
900724	Antenna Research Associates, Inc.	LPB-2520	BiLog Antenna (25-1000 MHz)	1037	4/30/17

3.2 Radiated Emissions Test Results

Table 3-2: Radiated Emissions Test Data

Emission Frequency (MHz)	Peak Detector Level (dBuV/m) (1 MHz RBW/10 Hz VBW)	Site Correction Factor (dB/m)	Peak Corrected (dBuV/m)	QP Limit (dBuV/m)	Margin (dB)
908.4	54.9	36.6	91.5	94.0	-2.5

* testing performed at 3m

3.3 Radiated Emissions Harmonics/Spurious Test Data

Table 3-3: Radiated Emissions Harmonics/Spurious – 908.4 MHz - Peak

Emission Frequency (MHz)	Peak Detector (dBuV/m) (1 MHz RBW/VBW)	Site Correction Factor (dB/m)	Peak Corrected (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
1816.791	-5.3	30.1	24.8	74.0	-49.2
2725.186	-19.7	33.3	13.6	74.0	-60.4
3633.581	-20.5	37.1	16.6	74.0	-57.4
4541.977	-22.9	38.3	15.4	74.0	-58.6
5450.372	-21.2	41.0	19.8	74.0	-54.2
6358.767	-20.7	42.0	21.3	74.0	-52.7
7267.163	-21.6	44.1	22.5	74.0	-51.5
8175.558	-20.4	45.3	24.9	74.0	-49.1

Table 3-4: Radiated Emissions Harmonics/Spurious – 908.4 MHz - Average

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)
1816.791	-6.2	30.1	23.9	54.0	-30.1
2725.186	-26.6	33.3	6.7	54.0	-47.3
3633.581	-29.5	37.1	7.6	54.0	-46.4
4541.977	-30.7	38.3	7.6	54.0	-46.4
5450.372	-24.7	41.0	16.3	54.0	-37.7
6358.767	-25.6	42.0	16.4	54.0	-37.6
7267.163	-28.2	44.1	15.9	54.0	-38.1
8175.558	-26.9	45.3	18.4	54.0	-35.6

Measurement uncertainty: Measurement uncertainties shown for these tests are expanded uncertainties expressed at 95% confidence level using a coverage factor $k = 2$. +4.0 dB / -2.65 dB

Rhein Tech Laboratories, Inc.
360 Herndon Parkway
Suite 1400
Herndon, VA 20170
<http://www.rheintech.com>

Client: Alarm.com
Model: ADC-NK-100T
Standards: FCC 15.249/IC RSS-210
IDs: YL6143NK100T/9111A-143NK100T
Report #: 2015014DXT

Note: radiated emissions were investigated with the module collocated and transmitting simultaneously with the Image Sensor transceiver presented in the DTS report in this application, and the following modularly approved devices. No non-compliant emissions were found; per FCC guidance, no data is being reported.

FCC ID: RI7CE910-DUAL (IC: 5131A-CE910DUAL)

FCC ID: RI7UE910NA (IC: 5131A-UE910NA)

FCC ID: RI7HE910NA (IC: 5131A-HE910NA)

Test Personnel:

Daniel W. Baltzell		March 22-August 14, 2015
Test Engineer	Signature	Dates of Test

4 AC Conducted Emissions - FCC 15.207; RSS-Gen 7.2.4: Conducted Limits

4.1 Site and Test Description

The power line conducted emissions measurements were performed in a Series 81 type shielded enclosure manufactured by Rayproof. The EUT was assembled on a wooden table 80 centimeters high. Power was fed to the EUT through a 50-ohm/50 microhenry Line Impedance Stabilization Network (LISN). The EUT LISN was fed power through an A.C. filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. A second LISN, the peripheral LISN, provides isolation for the EUT test peripherals. This peripheral LISN was also fed A.C. power. A metal power outlet box, which is bonded to the ground plane and electrically connected to the peripheral LISN, powers the EUT host peripherals.

The spectrum analyzer was connected to the AC line through an isolation transformer. The 50-ohm output of the EUT LISN was connected to the spectrum analyzer input through a Solar 100 kHz high-pass filter. The filter is used to prevent overload of the spectrum analyzer from noise below 100 kHz. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or peak mode if applicable).

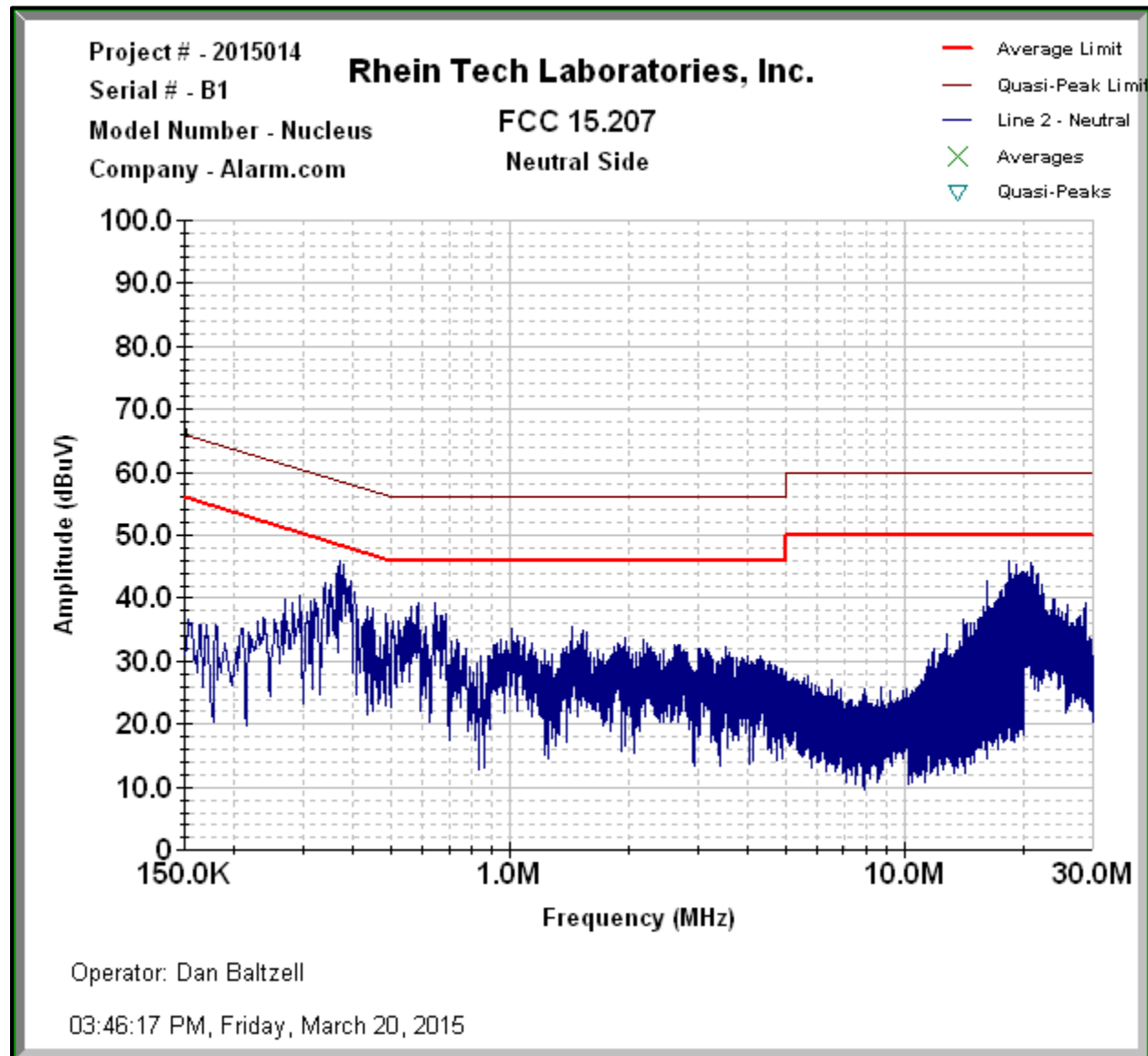
The analyzer's 6 dB bandwidth was set to 9 kHz. Video filter less than 10 times the resolution bandwidth is not used. Average measurements are performed in linear mode using a 10 kHz resolution bandwidth, a 1 Hz video bandwidth, and by increasing the sweep time in order to obtain a calibrated measurement. The emission spectrum was scanned from 150 kHz to 30 MHz. The highest emission amplitudes relative to the appropriate limits were measured and have been recorded.

4.2 Test Limits

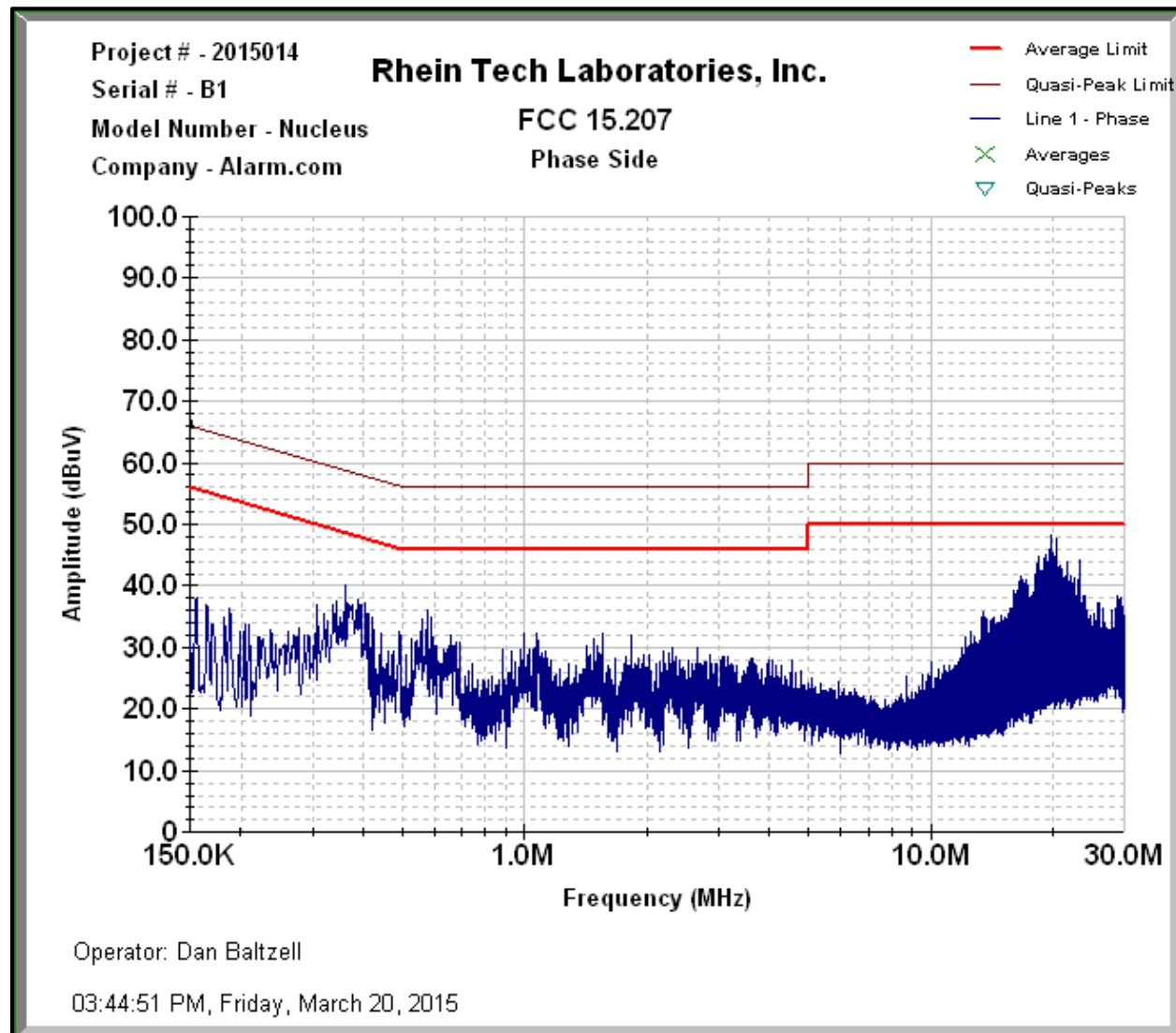
Line-Conducted Emissions		
Limit (dBµV)		
Frequency (MHz)	Quasi-Peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5.00	56	46
5.00 to 30.00	60	50

4.3 Conducted Emissions Test Data

Plot 4-1: Conducted Emissions Transmit - Neutral Side – Z-Wave Module



Plot 4-2: Conducted Emissions Transmit - Phase Side – Z-Wave Module



Measurement uncertainty: Measurement uncertainties shown for these tests are expanded uncertainties expressed at 95% confidence level using a coverage factor $k = 2$. ± 3.6 dB

Table 4-1: Conducted 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
901083	AFJ International	LS16	16A LISN (110 V)	16010020080	3/11/16
N/A	ETS-Lindgren	TILE	Emissions testing software Rev. 7	N/A	N/A

Test Personnel:

Daniel W. Baltzell		March 20, 2015
Test Engineer	Signature	Date of Test

5 20 dB Bandwidth – IC RSS-Gen

5.1 20 dB Bandwidth Test Procedure

The minimum 20 dB 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: 20 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

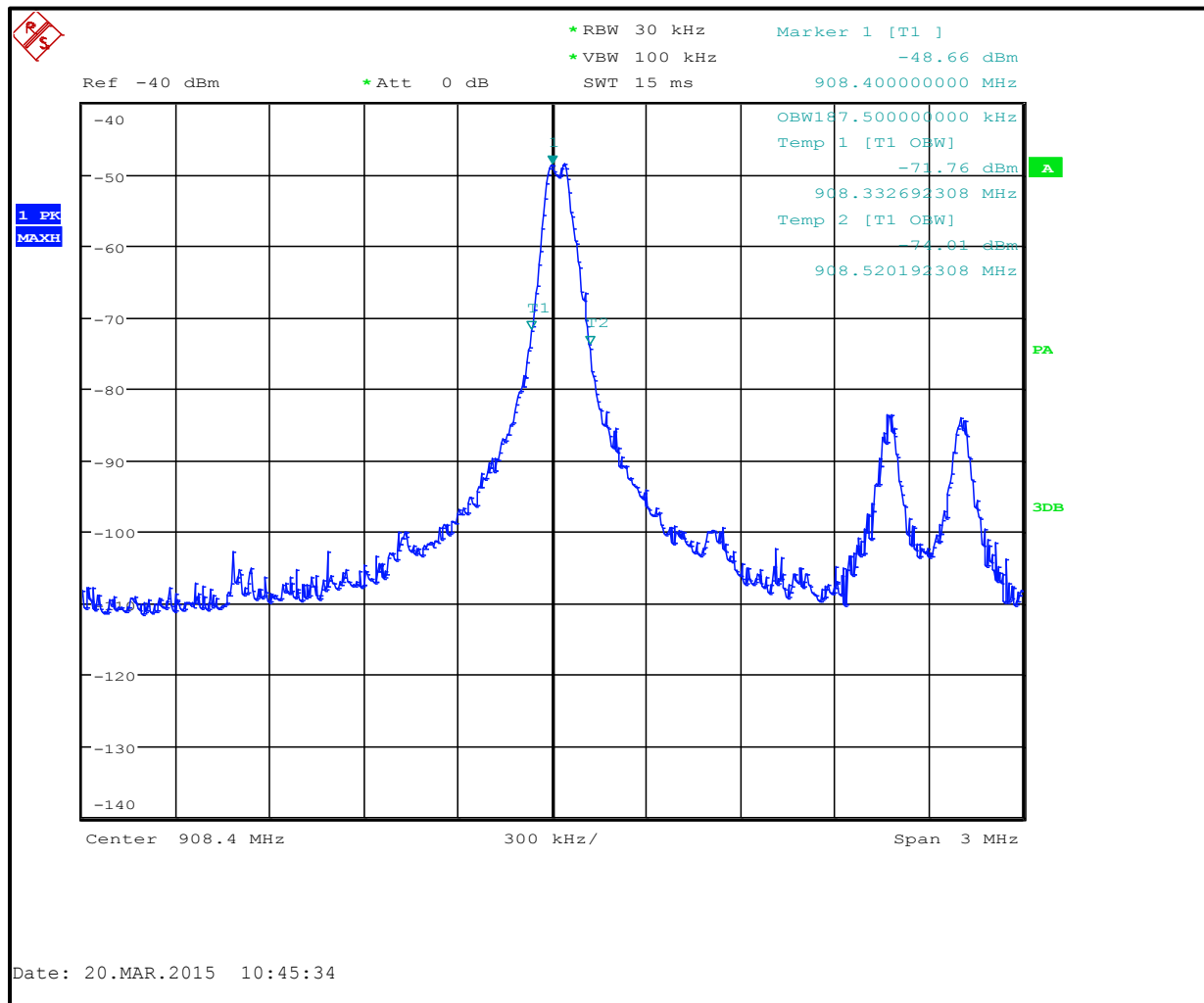
5.2 20 dB Modulated Bandwidth Test Data

Table 5-2: 20 dB Modulated Bandwidth Test Data

Minimum 20 dB bandwidths	
Frequency (MHz)	20 dB Bandwidth (kHz)
908.4	187.5

5.3 20 dB Bandwidth Plots

Plot 5-1: 20 dB Bandwidth; 908.4 MHz



Test Personnel:

Daniel W. Baltzell
 Test Engineer

Daniel W. Baltzell

Signature

March 20, 2015
 Date of Test

Rhein Tech Laboratories, Inc.
360 Herndon Parkway
Suite 1400
Herndon, VA 20170
<http://www.rheintech.com>

Client: Alarm.com
Model: ADC-NK-100T
Standards: FCC 15.249/IC RSS-210
IDs: YL6143NK100T/9111A-143NK100T
Report #: 2015014DXT

6 Conclusion

The data in this measurement report shows that the EUT as tested, Alarm.com Model: ADC-NK-100T, FCC ID: YL6143NK100T, IC: 9111A-143NK100T, complies with the applicable requirements of Parts 2 and 15 of the FCC Rules and Regulations, and IC RSS-210 and RSS-Gen.