Electromagnetic Compatibility Test Report

Tests Performed on an RF IDeas, Inc.

RFID Nano Dongle Reader,

Model RDR-6311AKU

Radiometrics Document RP-8019A

ACCREDITED
TESTING CERT #1495.01

Product Detail:
FCC ID: M9MLC6X11U IC ID: 6571A-LC6X11U Equipment type: RFID Nano Dongle Reader
Test Standards:
US CFR Title 47, Chapter I, FCC Part 15 Subpart C FCC Part 15 CFR Title 47: 2015 Industry Canada RSS-210, Issue 8: 2010 as required for Category I Equipment This report concerns: Class II Permissive Change FCC Part 15.209

Tests Performed For:	*Test Facility:*
RF IDeas, Inc. 4020 Winnetka Av. Rolling Meadows, IL 60008	**Radiometrics Midwest Corporation** 12 East Devonwood Romeoville, IL 60446

Test Date(s): (Month-Day-Year)
July 13 & 14, 2015

Document RP-8019A Revisions:

Rev.	Issue Date	Affected Sections	Revised By
0	July 21, 2015		

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1 ADMINISTRATIVE DATA

Equipment Under Test:	
A RF IDeas, Inc., RFID Nano Dongle Reader Model: RDR-6311AKU Serial Number: TN3100010 This will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics: July 13, 2015	*Test Date(s):* July 13 & 14, 2015
Test Report Written By: Joseph Strzelecki Senior EMC Engineer	*Test Witnessed By:* Shiung Lo RF IDeas, Inc.
Radiometrics' Personnel Responsible for Test: Joseph Strzelecki 07/21/2015 Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE	*Test Report Approved By* Chris W. Carlson Chris W. Carlson Director of Engineering NARTE EMC-000921-NE

2 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is an RFID Nano Dongle Reader, Model RDR-6311AKU, manufactured by RF IDeas, Inc. The detailed test results are presented in a separate section. The following is a summary of the test results.

Emissions Tests Results

Environmental Phenomena	Frequency Range	Basic Standard	Test Result
RF Radiated Emissions	30-1000 MHz	RSS-210 & FCC Part 15	Pass
Conducted Emissions, AC Mains	0.15 - 30 MHz	RSS-210 & FCC Part 15	Pass
RF Radiated Emissions H-Field	0.009 – 30 MHz	RSS-210 & FCC Part 15	Pass

Note: The RSS-210 specification is not currently covered in Radiometrics' Scope of Accreditation. This is technically very similar to FCC, CFR 47 Part 15 which is on Radiometrics scope.

2.1 RF Exposure Compliance Requirements

Since the effective power output is less than 1 mW, the EUT meets the FCC requirement for RF exposure and is exempt from RSS-102. There are no power level adjustments and the antenna is permanently attached. The detailed calculations for RF Exposure are presented in a separate document.

3 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is an RFID Nano Dongle reader, Model RDR-6311AKU, manufactured by RF IDeas, Inc. The EUT was in good working condition during the tests, with no known defects.

This product is a Class II permissive change. The PCB boards did not change, only component values.

3.1.1 FCC Section 15.203 & RSS-GEN Antenna Requirements

The antenna is permanently attached to the PCB. The antenna is internal to the EUT and it is not readily available to be modified by the end user.

3.2 Product Family

The following is the product family list of the readers that use the same electronics, components and PCB as the one tested in this report:

Model Number	Model Number
RDR-6321AKU	RDR-6221AKU
RDR-6211AKU	RDR-6911AKU

3.3 Description of Permissive Change

This is a Permissive Change for the purpose of adding addition card type formats to this reader. In order to accommodate, changes were made to the configuration resistors and the bias diode.

The changes from the original BOM are as follows;
1. Rotate D1 180 degrees
2. Install R12 = 47K Ohm, R16 = 0 Ohm, R17 = 47K Ohm, R19 = 470K Ohm, R5 = 0 Ohm,
3. Install C21 = 1nF, C22 = 2.2nF
4. Remove R15 (0 Ohm), R14 (47K Ohm), R18 = 0 Ohm, C4 = 2.2nF

The PCB traces did not change.

4 TESTED SYSTEM DETAILS

4.1 Tested System Configuration

The system was configured for testing in a typical fashion. The EUT was placed on an 80-cm high, nonconductive test stand. The testing was performed in conditions as close as possible to installed conditions. Wiring was consistent with manufacturer's recommendations. Power was supplied at 115 VAC, 60 Hz single-phase to the host computer. The EUT was powered from either the USB or PS/2 port.

The identification for all equipment, plus descriptions of all cables used in the tested system, are:

Tested System Configuration List

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	RFID Nano Dongle Reader	E	RF IDeas	RDR-6311AKU	TN3100010
2	Toughbook	H	Panasonic	CF-31	DFQX3A14XB
3	Laptop Power Supply	H	Panasonic	AA90PM111	5713AM113Y15073B
4	Modem (MDM-01)	P	US Robotics	0701	22SBBAC9FPMN

* Type: E = EUT, P = Peripheral, H = Host Computer

List of Cables Connected to the EUT

QTY	Length (m)	Cable Description	Shielded?
1	1.85	USB Cable to Card Reader from Laptop computer NB7	Yes

4.2 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

4.3 Equipment Modifications

No modifications were made at Radiometrics in order to meet the requirements listed in this report.

5 TEST SPECIFICATIONS AND RELATED DOCUMENTS

Document	Date	Title
FCC CFR Title 47	2014	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices
ANSI C63.4-2009	2009	Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
IC RSS-210 Issue 8	2010	Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands) Category I Equipment
IC RSS-Gen Issue 4	2014	General Requirements and Information for the Certification of Radiocommunication Equipment (RSS-Gen)

The test procedures used are in accordance with the Industry Canada RSS-Gen and ANSI document 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". The specific procedures are described herein. Radiated testing was performed at an antenna to EUT distance of 3 meters. The antenna was raised and lowered from 1 to 4 meters.

6 RADIOMETRICS' TEST FACILITIES

The results of these tests were obtained at Radiometrics Midwest Corp. in Romeoville, Illinois, USA. Radiometrics is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025: 2005 "General Requirements for the Competence of Calibration and Testing Laboratories". Radiometrics' Lab Code is 121191 and Certification Number is 1495.01. Radiometrics' scope of accreditation includes all of the test methods listed herein. A copy of the accreditation can be accessed on our web site (www.radiomet.com). Radiometrics accreditation status can be verified at A2LA's web site (www.a2la2.org).

The following is a list of shielded enclosures located in Romeoville, Illinois used during the tests:

Chamber A: Is an anechoic chamber that measures 24' L X 12' W X 12' H. The walls and ceiling are fully lined with ferrite absorber tiles. The floor has a 10' x 10' section of ferrite absorber tiles located in the center. Panashield of Rowayton, Connecticut manufactured the chamber. The enclosure is NAMAS certified.

Chamber E: Is a custom made anechoic chamber that measures 52' L X 30' W X 18' H. The walls and ceiling are fully lined with RF absorber. Pro-shield of Collinsville, Oklahoma manufactured the chamber.

Test Station F: Is an area that measures 10' D X 12' W X 10' H. The floor and back wall are metal shielded. This area is used for conducted emissions measurements.

A separate ten-foot long, brass plated, steel ground rod attached via a 6 inch copper braid grounds each of the above chambers. Each enclosure is also equipped with low-pass power line filters.

The FCC has accepted these sites as test site number US1065. The FCC test site Registration Number is 732175. Details of the site characteristics are on file with the Industry Canada as site number IC8727A-1.

A complete list of the test equipment is provided herein. The calibration due dates are indicated on the equipment list. The equipment is calibrated in accordance to ANSI/NCSL Z540-1 with traceability to the National Institute of Standards and Technology (NIST).

7 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

8 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification. The results relate only to the EUT listed herein. Any modifications made to the EUT subsequent to the indicated test date will invalidate the data and void this certification.

9 TEST EQUIPMENT TABLE

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
AMP-22	Anritsu	Pre-amplifier	MH648A	M23969	0.1-1200MHz	12 Mo.	01/07/15
ANT-04	Tensor	Biconical Antenna	4104	2246	20-250MHz	24 Mo.	05/15/14
ANT-06	EMCO	Log-Periodic Ant.	3146	1248	200-1000MHz	24 Mo.	11/26/13
ANT-53	EMCO	Loop Antenna	6507	1453	1 kHz-30 MHz	24 Mo	12/02/13
HPF-01	Solar	High Pass Filter	7930-100	HPF-1	0.15-30MHz	24 Mo.	02/24/14
LSN-01	Electrometrics	50 uH LISN	FCC/VDE 50/2	1001	0.01-30MHz	24 Mo.	06/23/15
LSN-03	Farnell	50 uH LISN	1EXLSN30B	000314	0.01-30MHz	24 Mo.	06/23/15
THM-02	Fluke	Temp/Humid Meter	971	93490471	N/A	24 Mo.	06/27/13
REC-20	HP / Agilent	EMI Receiver	8546A	33330A00135 3410A00178	30Hz-6GHz	24 Mo.	06/26/14
REC-11	HP / Agilent	Spectrum Analyzer	E7405A	US39110103	9Hz-26.5GHz	12 Mo	06/23/15

Note: All calibrated equipment is subject to periodic checks.

10 TEST SECTIONS

10.1 AC Conducted Emissions

The tests and limits are in accordance with FCC section 15.207 and RSS Gen section 7.2.2.

A computer-controlled analyzer was used to perform the conducted emissions measurements. The frequency range was divided into 500 subranges equally spaced on a logarithmic scale. The computer recorded the peak of each subrange. This data was then plotted on a semi-log graph generated by the computer. Adjusting the positions of the cables and orientation of the test system then maximizes the highest emissions.

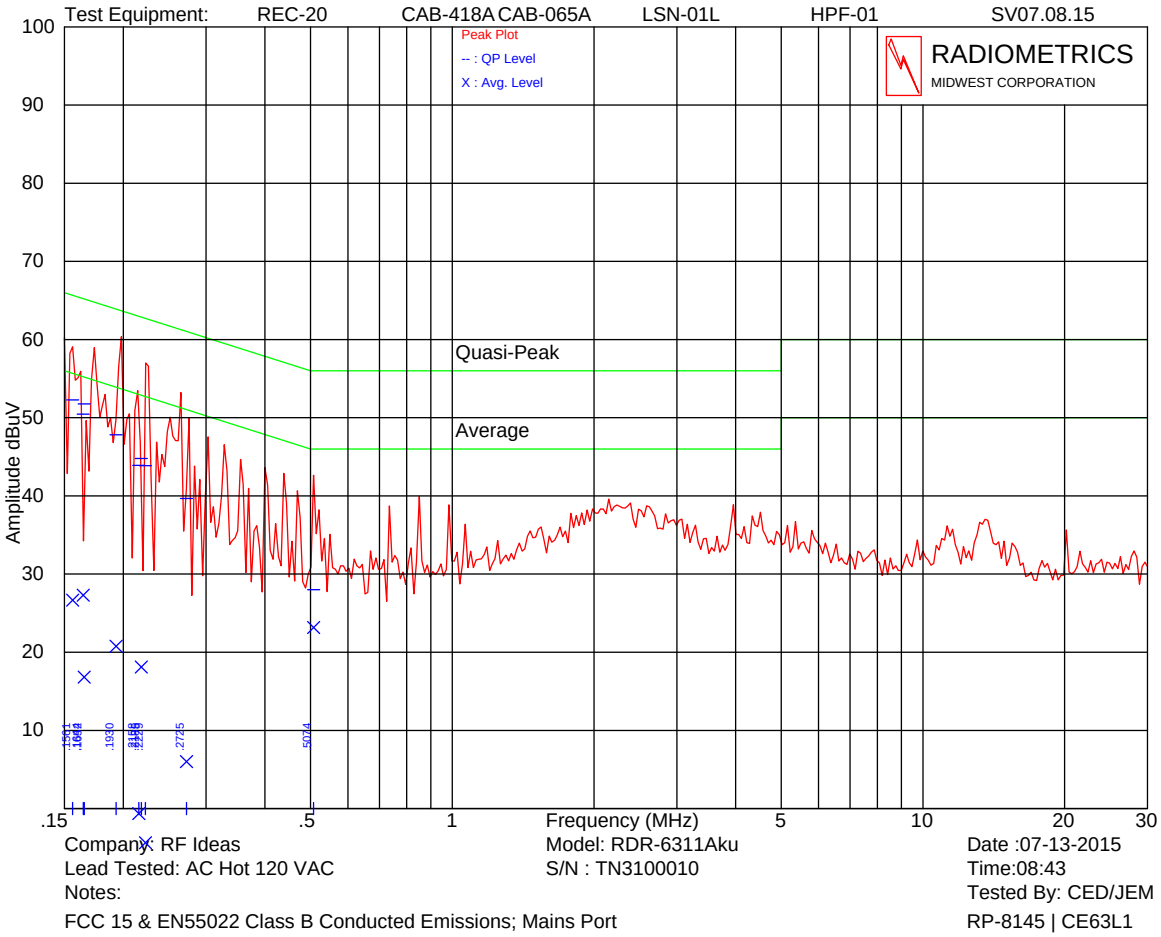
Mains Conducted emission measurements were performed using a 50 Ohm/50 uH Line Impedance Stabilization Network (LISN) as the pick-up device. Measurements were repeated on both leads within the power cord. If the EUT power cord exceeded 80 cm in length, the excess length of the power cord was made into a 30 to 40 cm bundle near the center of the cord. The LISN was placed on the floor at the base of the test platform and electrically bonded to the ground plane.

FCC/IC Limits of Conducted Emissions at the AC Mains Ports

Frequency Range (MHz)	Class B Limits (dBuV)	
	Quasi-Peak	Average
0.150 - 0.50*	66 - 56	56 - 46
0.5 – 5.0	56	46
5.0 - 30	60	50
* The limit decreases linearly with the logarithm of the frequency in this range.		

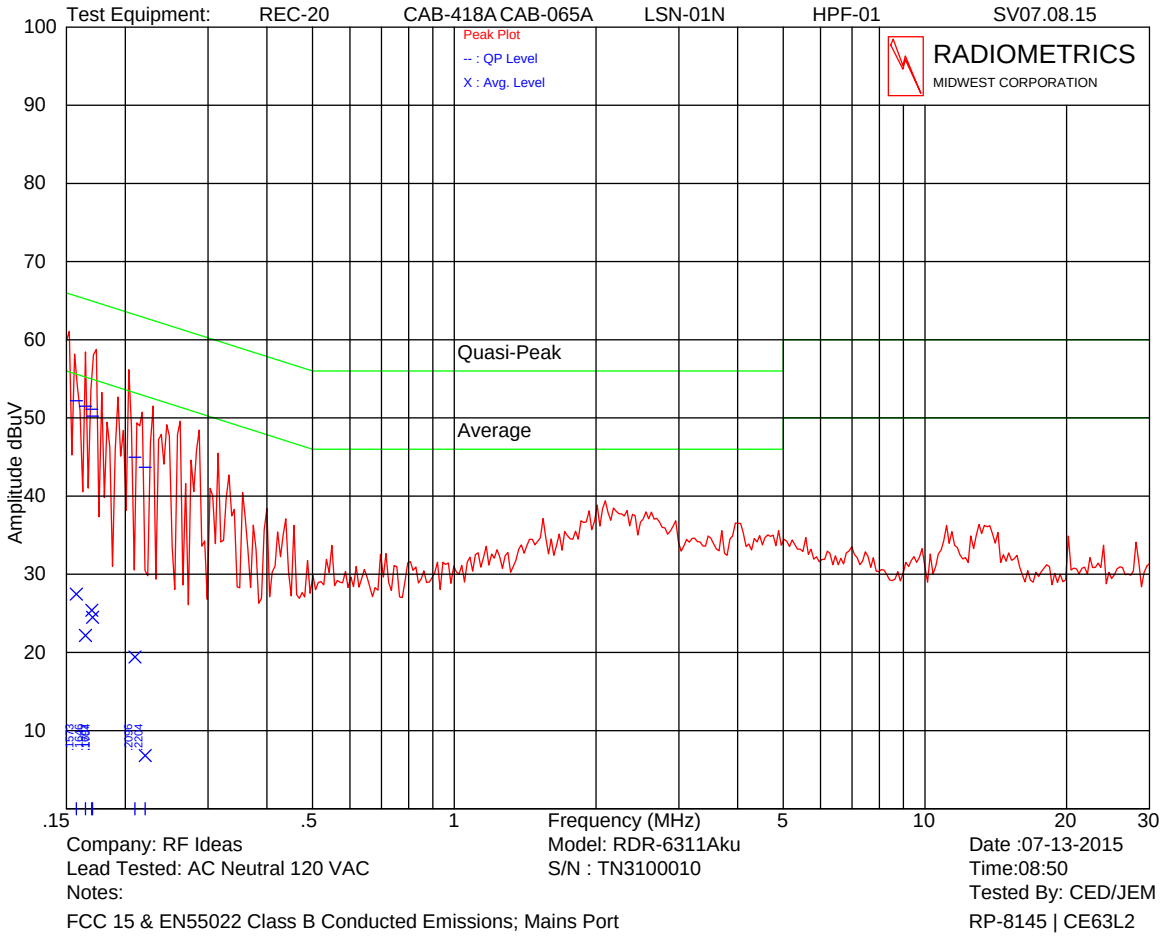
The initial step in collecting conducted data is a peak detector scan and the plotting of the measurement range. Significant peaks are then marked as shown on the following table, and these signals are then measured with the quasi-peak detector. The following represents the worst case emissions from the host computer (with the EUT connected) power cord, after testing all modes of operation.

Test Date : 07/13/2015
"QP" readings are quasi-peak with a 9 kHz bandwidth and no video filter.
All tests are with Antenna Installed



AC Hot

Frequency MHz	QP Amplitude	QP Limit	Average Amplitude	Average Limit	Margin dB
0.156	52.3	65.7	26.7	55.7	13.4
0.165	51.8	65.2	16.8	55.2	13.4
0.193	47.8	63.9	20.8	53.9	16.1
0.223	43.9	62.7	-4.4	52.7	18.8
0.216	43.9	63.0	-0.6	53.0	19.1
0.219	44.8	62.9	18.1	52.9	18.1
0.273	39.7	61.0	6.0	51.0	21.4
0.507	28.0	56.0	23.2	46.0	22.8

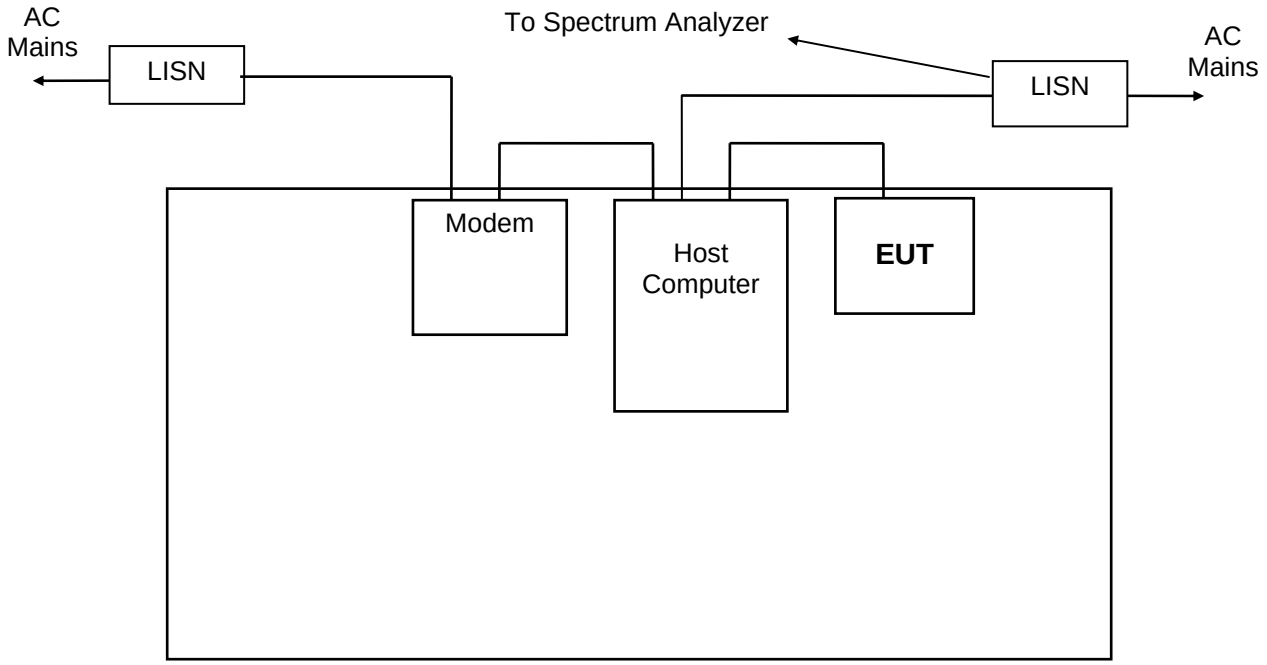


AC Neutral

Frequency MHz	QP Amplitude	QP Limit	Average Amplitude	Average Limit	Margin dB
0.170	51.1	65.0	25.4	55.0	13.9
0.164	50.5	65.2	27.3	55.2	14.8
0.157	52.2	65.6	27.5	55.6	13.4
0.165	51.5	65.2	22.2	55.2	13.7
0.210	45.0	63.2	19.4	53.2	18.2
0.220	43.7	62.8	6.8	52.8	19.1

Judgment: Passed by at least 6 dB

Figure 1. Conducted Emissions Test Setup



Notes:
- LISN's at least 80 cm from EUT chassis
- Vertical conductive plane 40 cm from rear of table top
- EUT power cord bundled

10.2 Radiated RF Emissions

Radiated emission measurements were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. The radiated emission measurements were performed with a spectrum analyzer. The bandwidth used from 150 kHz to 30 MHz is 9 or 10 kHz and the bandwidth from 30 MHz to 1000 MHz is 100 or 120 kHz. Above 1 GHz, a 1 MHz bandwidth is used. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists.

From 30 to 1000 MHz, an Anritsu spectrum analyzer was used. For tests from 1 to 25 GHz, an HP 8566 spectrum analyzer was used. Figure 4 herein lists the details of the test equipment used during radiated emissions tests.

Final radiated emissions measurements were performed inside of an anechoic chamber at a test distance of 3 meters. The anechoic chamber is designated as Chamber E. This Chamber meets the Site Attenuation requirements of ANSI C63.4 and CISPR 16-1. Chamber E is located at 12 East Devonwood Ave. Romeoville, Illinois EMI test lab.

The entire frequency range from 30 to 1000 MHz was slowly scanned with particular attention paid to those frequency ranges which appeared high. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst case emissions were recorded. All measurements may be performed using either the peak, average or quasi-peak detector functions. If the peak detector data exceeds or is marginally close to the limits, the measurements are repeated using a quasi-peak detector or average function as required by the specification for final determination of compliance.

The detected emission levels were maximized by rotating the EUT, adjusting the positions of all cables, and by scanning the measurement antenna from 1 to 4 meters above the ground.

Radiated Emissions Field Strength Limits

Frequency Range (MHz)	Test Distance (meters)	Class B Limits (dBuV/m)		
		QP	Average	Peak
0.009-0.490	2400/F(kHz)	300	N/A	N/A
0.490-1.705	24000/F(kHz)	30	N/A	N/A
1.705-30.0	30	30	N/A	N/A
30 - 230	10	30	N/A	N/A
230 - 1000	10	37	N/A	N/A
1000 - 3000	3	N/A	50	70
>3000	3	N/A	54	74

An Average detector can be used for 9-90 kHz and 110-490 kHz.

10.2.1 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

FS = RA + AF + CF – AG

Where: FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain

10.2.2 Radiated Emissions Test Results

Test Date	07/13/2015
EUT	RDR-6311AKU; Serial Number TN3100010
Test Distance	3 Meters
Specification	FCC Part 15 Subpart C & RSS-210
Notes	Cable and Amp Factors = cable loss – preamp gain
Abbreviations	P = peak; Q = QP Pol = Antenna Polarization; V = Vertical; H = Horizontal

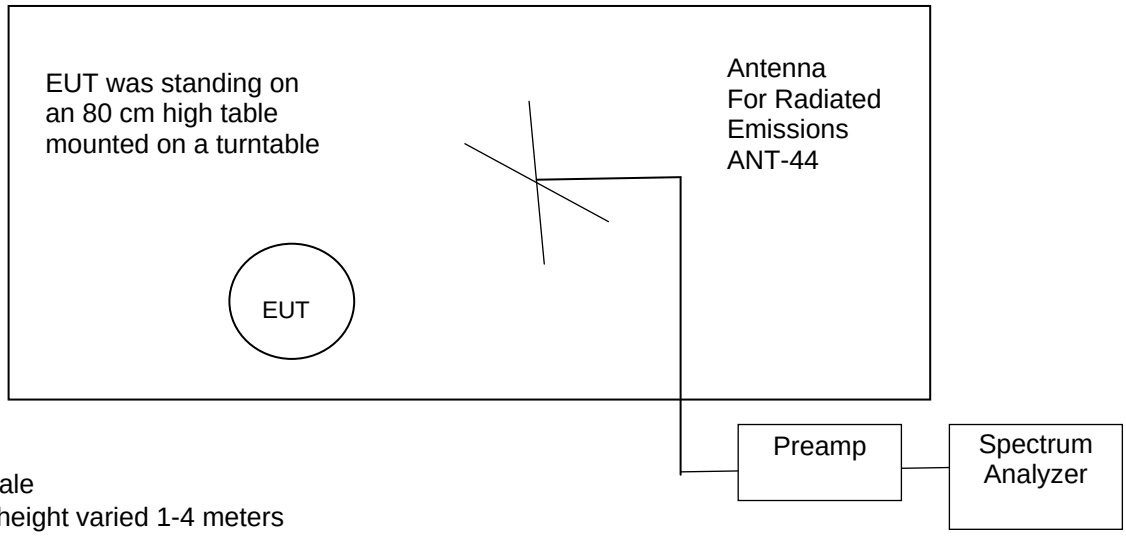
Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor	Cable & Amp Factors	Dist Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB
36.0	38.0	P	H	16.5	-28.2	-10.5	15.8	30.0	14.2
47.6	36.0	P	H	14.8	-28.1	-10.5	12.2	30.0	17.8
60.3	38.7	P	H	10.6	-28.0	-10.5	10.8	30.0	19.2
74.0	43.4	P	H	7.2	-27.9	-10.5	12.2	30.0	17.8
81.7	38.2	P	H	7.1	-27.9	-10.5	7.0	30.0	23.0

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor	Cable & Amp Factors	Dist Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB
97.1	39.6	P	H	8.7	-27.8	-10.5	10.1	30.0	19.9
135.6	40.8	P	H	12.8	-27.6	-10.5	15.5	30.0	14.5
162.6	40.8	P	H	10.5	-27.5	-10.5	13.3	30.0	16.7
166.9	41.1	P	H	9.8	-27.5	-10.5	12.9	30.0	17.1
184.0	45.6	P	H	9.3	-27.5	-10.5	17.0	30.0	13.0
221.4	45.5	P	H	12.1	-27.4	-10.5	19.8	30.0	10.2
232.9	46.2	P	H	12.0	-27.3	-10.5	20.4	37.0	16.6
264.4	46.3	P	H	12.9	-27.4	-10.5	21.4	37.0	15.6
300.0	49.4	P	H	13.3	-27.2	-10.5	25.1	37.0	11.9
336.3	45.1	P	H	14.6	-27.3	-10.5	22.0	37.0	15.0
366.3	48.5	P	H	15.7	-27.1	-10.5	26.7	37.0	10.3
386.9	40.2	P	H	15.4	-27.3	-10.5	17.8	37.0	19.2
400.0	40.9	P	H	16.0	-27.2	-10.5	19.3	37.0	17.7
433.8	46.0	P	H	17.0	-27.1	-10.5	25.4	37.0	11.6
479.4	38.6	P	H	17.5	-26.7	-10.5	18.9	37.0	18.1
528.8	38.3	P	H	18.9	-26.5	-10.5	20.2	37.0	16.8
567.5	44.9	P	H	19.5	-26.7	-10.5	27.3	37.0	9.7
632.5	40.5	P	H	19.3	-26.5	-10.5	22.8	37.0	14.2
698.8	38.0	P	H	20.5	-26.3	-10.5	21.8	37.0	15.2
721.3	38.3	P	H	19.7	-26.1	-10.5	21.5	37.0	15.5
767.5	39.3	P	H	20.8	-26.1	-10.5	23.6	37.0	13.4
800.0	38.6	P	H	19.9	-25.8	-10.5	22.3	37.0	14.7
832.5	38.6	P	H	21.6	-25.7	-10.5	24.1	37.0	12.9
898.8	37.4	P	H	21.3	-25.1	-10.5	23.2	37.0	13.8
32.8	38.1	Q	V	16.8	-28.3	-10.5	16.1	30.0	13.9
59.2	37.7	Q	V	10.9	-28.1	-10.5	10.1	30.0	19.9
73.4	43.7	P	V	7.3	-27.9	-10.5	12.6	30.0	17.4
96.6	45.3	P	V	8.7	-27.8	-10.5	15.7	30.0	14.3
120.2	48.5	P	V	14.6	-27.7	-10.5	25.0	30.0	5.0
124.6	34.8	Q	V	14.9	-27.7	-10.5	11.5	30.0	18.5
162.6	43.5	P	V	10.5	-27.5	-10.5	16.0	30.0	14.0
166.4	44.5	P	V	9.9	-27.5	-10.5	16.4	30.0	13.6
222.5	44.7	P	V	12.1	-27.4	-10.5	19.0	30.0	11.0
277.5	43.0	P	V	13.2	-27.3	-10.5	18.5	37.0	18.5
300.0	44.7	P	V	13.3	-27.2	-10.5	20.3	37.0	16.7
336.3	42.2	P	V	14.6	-27.3	-10.5	19.1	37.0	17.9
366.9	48.0	P	V	15.7	-27.1	-10.5	26.2	37.0	10.8
386.9	40.7	P	V	15.4	-27.3	-10.5	18.3	37.0	18.7
433.1	49.0	P	V	17.0	-27.1	-10.5	28.5	37.0	8.5
473.8	47.0	P	V	17.4	-26.8	-10.5	27.2	37.0	9.8
516.3	42.9	P	V	18.8	-26.8	-10.5	24.4	37.0	12.6
566.3	44.7	P	V	19.5	-26.7	-10.5	27.1	37.0	9.9
698.8	37.4	P	V	20.5	-26.3	-10.5	21.2	37.0	15.8
765.0	39.2	P	V	20.7	-26.1	-10.5	23.3	37.0	13.7
833.8	38.8	P	V	21.6	-25.7	-10.5	24.3	37.0	12.7
898.8	38.0	P	V	21.3	-25.1	-10.5	23.8	37.0	13.2

Judgment: Passed by at least 5.0 dB

Figure 2. Drawing of Radiated Emissions Test Setup

Chamber E, anechoic



Notes:
- Not to Scale
- Antenna height varied 1-4 meters
- Distance from antenna to tested system is 3 meters
- AC cords not shown. They are connected to AC outlet with low-pass filter on turntable

Frequency Range	Receive Antenna	Pre-Amplifier	Spectrum Analyzer
0.01 to 30 MHz	ANT-44	None	REC-11
30 to 1000 MHz	ANT-44	AMP-22	REC-11

10.3 Magnetic Field Measurements and Decay Factor Calculations

Radiated emission measurements are performed with a shielded loop antenna. An EMCO Loop antenna was used. The antenna was rotated in order to find the maximize readings.

The distance factor in (dB) = DE*20*Log(TD/SD)
Where: DE = Decay Exponent (2.0 is used for this)
TD = Test distance in meters. This is usually 3 meters
SD = Specifciation Distance in meters

For frequencies below 490 kHz, the specification distance is 300 meters below 490 kHz. The Distance correction factor at 3 meters is -80 dB for frequencies below 490 kHz.

For frequencies above 490 kHz, the specification distance is 30. The Distance correction factor at 3 meters is -40 dB.

10.3.1 Magnetic Field Radiated Emissions Results (0.009 to 30 MHz)

Test Date	07/13/2015
Test Distance	3 Meters
Specification	FCC 15 & RSS-GEN
Notes	A shielded Loop Antenna was used for this test.
EUT Serial #	TN3100011

The distance correction factor is calculated as follows:
Distance factor (dB) = (Decay Exponent)*20*Log(TD/SD)
The decay exponent is 3 for 125 kHz, below 2 MHz.
TD is the actual test distance in meters. SD is the specification distance in meters.
For the FCC, SD = 300 meters below 490 kHz and 30 meters above.

Freq (kHz)	Peak Analyzer reading dBuV	Loop Ant Factor	Dist (m)	Decay exp	Cable Loss dB	FCC Distance factor dB	Field Strength dBuV/m	FCC/Can Limit dBuV/m	Margin under limit
125.0	54.5	19.1	3.0	3.0	0.1	-120.0	-46.3	25.7	72.0
250.0	44.0	18.9	3.0	3.0	0.1	-120.0	-57.0	19.6	76.6
375.0	42.0	18.9	3.0	3.0	0.1	-120.0	-59.0	16.1	75.1

No other emissions were detected from 10 kHz to 30 MHz within 20 dB of the limits.

Judgement: Passed by at least 72.0 dB.

10.4 Occupied Bandwidth Data

The occupied bandwidth of the RF output was measured using a spectrum analyzer. The bandwidth was measured using the peak detector function and a narrow resolution bandwidth.

A broadband antenna was used to receive the modulated signal. The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The spectrum analyzer display was digitized and plotted. A limit was drawn on the plots based on the level of the modulated carrier. The plots of the occupied bandwidth for the EUT are supplied on the following page.

Product	20 dB EBW 125 kHz Signal
USB	3.5 kHz

Judgement: Pass

Figure 3. Occupied Bandwidth Plot 125 kHz