



Electromagnetic Compatibility Test Report

Tests Performed on an RF IDEas, Inc.

13.56 MHz Card Reader

Model RDR-7LH1AKU

Radiometrics Document RP-8823A



Product Detail:

FCC ID: M9MHP7LH1S

IC: 6571A-HP7LH1S

Equipment type: 13.56 MHz Card Reader

Test Standards:

US CFR Title 47, Chapter I, FCC Part 15 Subpart C

FCC Part 15 CFR Title 47: 2017

Canada ISED; RSS-210, Issue 9: 2016 as required for Category I Equipment

FCC Part 15.209 and 15.225

Tests Performed For:

RF IDEas, Inc.

4020 Winnetka Av.

Rolling Meadows, IL 60008

Test Facility:

Radiometrics Midwest Corporation

12 East Devonwood Avenue

Romeoville, IL 60446

Test Date(s): (Month-Day-Year)

March 1 to 28, 2018

Document RP-8823A Revisions:

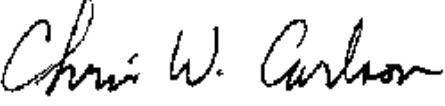
Rev.	Issue Date	Affected Sections	Revised By
0	March 29, 2018		
1	April 6, 2018	2.0 & 11.2	Joseph Strzelecki

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1.0 ADMINISTRATIVE DATA

<i>Equipment Under Test:</i>	
A RF IDEas, Inc., 13.56 MHz Card Reader Model: RDR-7LH1AKU Serial Numbers: H7LD000015, H7LD000013 This will be referred to as the EUT in this Report	
<i>Date EUT Received at Radiometrics: (Month-Day-Year)</i>	
March 1, 2018	
<i>Test Report Written and authorized by:</i>	<i>Test Witnessed By:</i>
Joseph Strzelecki Senior EMC Engineer	The tests were not witnessed by RF IDEas, Inc.
<i>Radiometrics' Personnel Responsible for Test:</i>	<i>Test Report Approved By</i>
	
Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE	Chris W. Carlson Director of Engineering NARTE EMC-000921-NE

2.0 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a 13.56 MHz Card Reader, Model RDR-7LH1AKU, 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
Occupied Bandwidth	13.56 MHz	RSS-210 & FCC Part 15	Pass
Frequency Stability	13.56 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.

3.0 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a 13.56 MHz card reader, Model RDR-7LH1AKU, manufactured by RF IDEas, Inc. The EUT was in good working condition during the tests, with no known defects.

3.1.1 Product Family

The following is the product family list of the readers that use the RF sections.

Model Number	Description
RDR-7LH1AKU	Keystroke firmware (Product Tested)
RDR-7LH2AKU	SDK firmware
RDR-7LH3AKU	MFP24 firmware (RF IDEas Branding)

The only differences between all three readers is the installed firmware. The printed circuit boards and electrical components are the same on all three units.

3.1.2 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 Related Submittals

RF IDEas, Inc. is not submitting any other products simultaneously for equipment authorization related to the EUT.

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

RF IDeas, Model: RDR-7LH1AKU 13.56 MHz RFID Reader

Tested System Configuration List

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	13.56 MHz Reader	E	RF IDeas	RDR-7LH1AKU	H7LD000013
2	13.56 MHz Reader	E	RF IDeas	RDR-7LH1AKU	H7LD000015
3	Desktop PC	H	Dell	DCNE	53FMFC1
4	Monitor	P	Dell	E156FPf	CN-0Y9998-72872-5BN-1KET
5	Keyboard	P	Dell	L100	CN-0RH659-73571-14C-0926
6	Modem (MDM-01)	P	US Robotics	0701	22SBBAC9FPMN

* Type: E = EUT, P = Peripheral, S = Support Equipment; H = Host Computer

List of EUT Cables

QTY	Length (m)	Cable Description	Shielded?
1	1.8	USB Cable to Card Reader	Yes
1	1.8	AC Cord to Computer	No
1	1.5	VGA cable to Monitor	Yes
1	1.9	Power cord to Monitor	No
1	1.5	Integral Mouse cable	Yes
1	1.2	Integral Keyboard cable	Yes
1	1.8	Serial cable from Modem to Computer	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.

5.0 TEST SPECIFICATIONS

Document	Date	Title
FCC CFR Title 47	2017	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices
IC RSS-210 Issue 9	2016	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)

6.0 TEST PROCEDURE DOCUMENTS

The tests were performed using the procedures from the following specifications:

Document	Date	Title
ANSI C63.4-2014	2014	Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10-2013	2013	American National Standard for Testing Unlicensed Wireless Devices

7.0 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 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).

8.0 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

9.0 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.

10.0 TEST EQUIPMENT TABLE

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
ANT-03	Tensor	Biconical Antenna	4104	2231	20-250MHz	24 Mo.	12/06/17
ANT-06	EMCO	Log-Periodic Ant.	3146	1248	200-1000MHz	24 Mo.	12/05/17
ANT-07	RMC	Log-Periodic Ant.	LP1000	1001	200-1000MHz	24 Mo.	08/10/16
ANT-08	RMC	Log-Periodic Ant.	LP1000	1002	200-1000MHz	24 Mo.	10/06/16
ANT-53	EMCO	Loop Antenna	6507	1453	1 kHz-30 MHz	24 Mo	12/28/17
CAB-106A	Teledyne	Coaxial Cable	N/A	1090	DC-2 GHz	24 Mo.	04/21/16
CAB-1090	Teledyne	Coaxial Cable	N/A	1090	DC-18 GHz	24 Mo.	04/19/16
CAB-160B	Teledyne	Coaxial Cable	N/A	1090	DC-18 GHz	24 Mo.	04/21/16
LSN-01	Electrometrics	50 uH LISN	FCC/VDE 50/2	1001	0.01-30MHz	24 Mo.	06/30/17
LSN-17	EMCO	LISN	3810/2NM	9602-1356	0.15 - 30MHz	24 Mo.	02/22/17
REC-21	Agilent	Spectrum Analyzer	E7405A	MY45118341	9kHz-26.5 GHz	24 Mo.	01/06/18
REC-43	Adventest	Spectrum Analyzer	U3772	150800305	9kHz-43GHz	24 Mo.	04/19/17

Note: All calibrated equipment is subject to periodic checks.

Software Company	Test Software Name	Version	Applicable Tests
Radiometrics	EN550XX0	02.28.17	RF Conducted Emissions (FCC Part 15 & EN 55011/22)
Radiometrics	REREC11D	04.19.17	RF Radiated Emissions (FCC Part 15 & EN 55011/22)
Agilent	PSA/ESA-E/L/EMC	2.4.0.42	Bandwidth and screen shots

11.0 TEST SECTIONS

11.1 AC Conducted Emissions

The tests and limits are in accordance with FCC section 15.207 and RSS Gen section 8.8.

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.

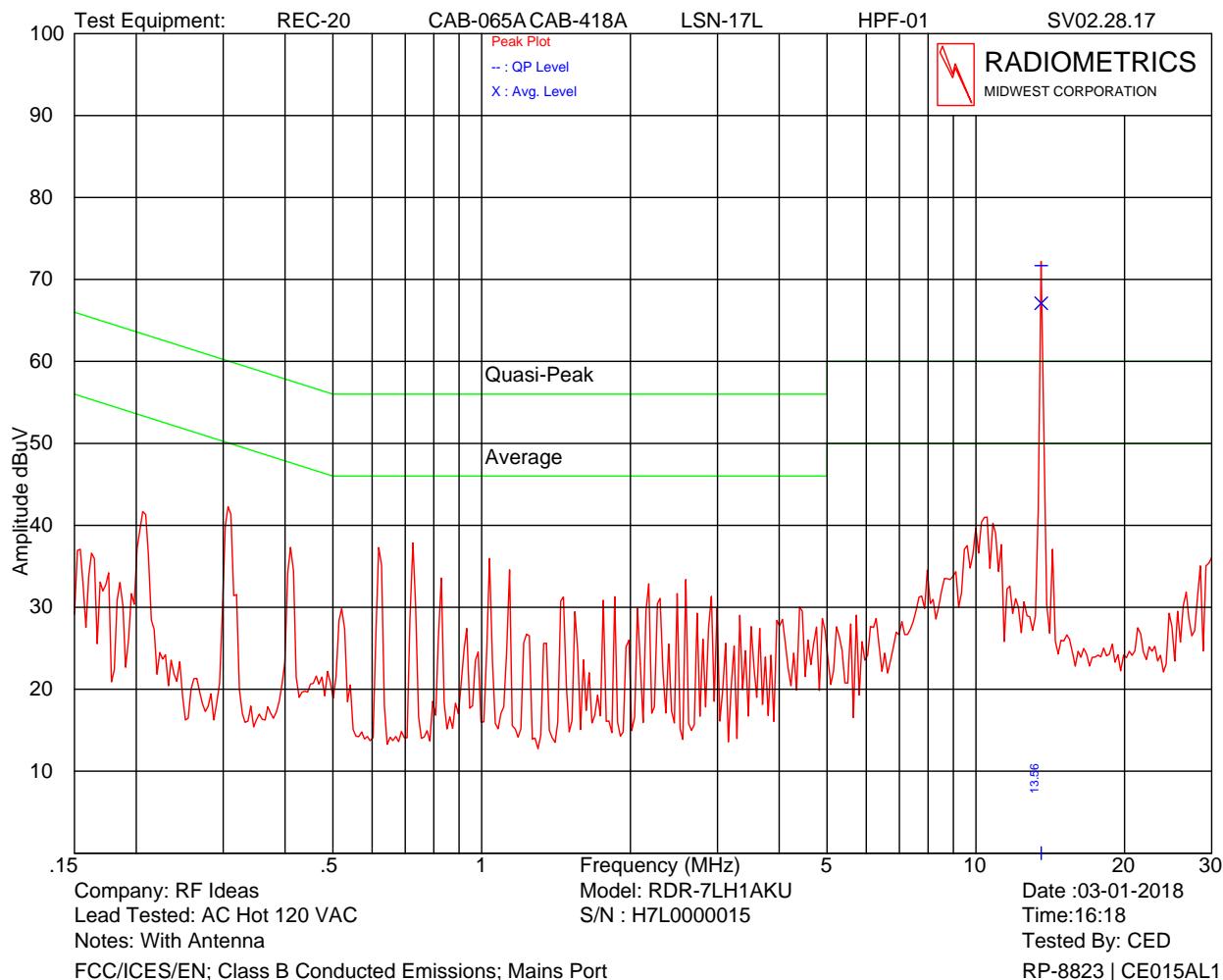
RF IDEas, Model: RDR-7LH1AKU 13.56 MHz RFID Reader

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. QP readings are quasi-peak with a 9 kHz bandwidth and no video filter.

Test Date : 03/01/2018

The 13.56 MHz transmitter was on during the following tests.

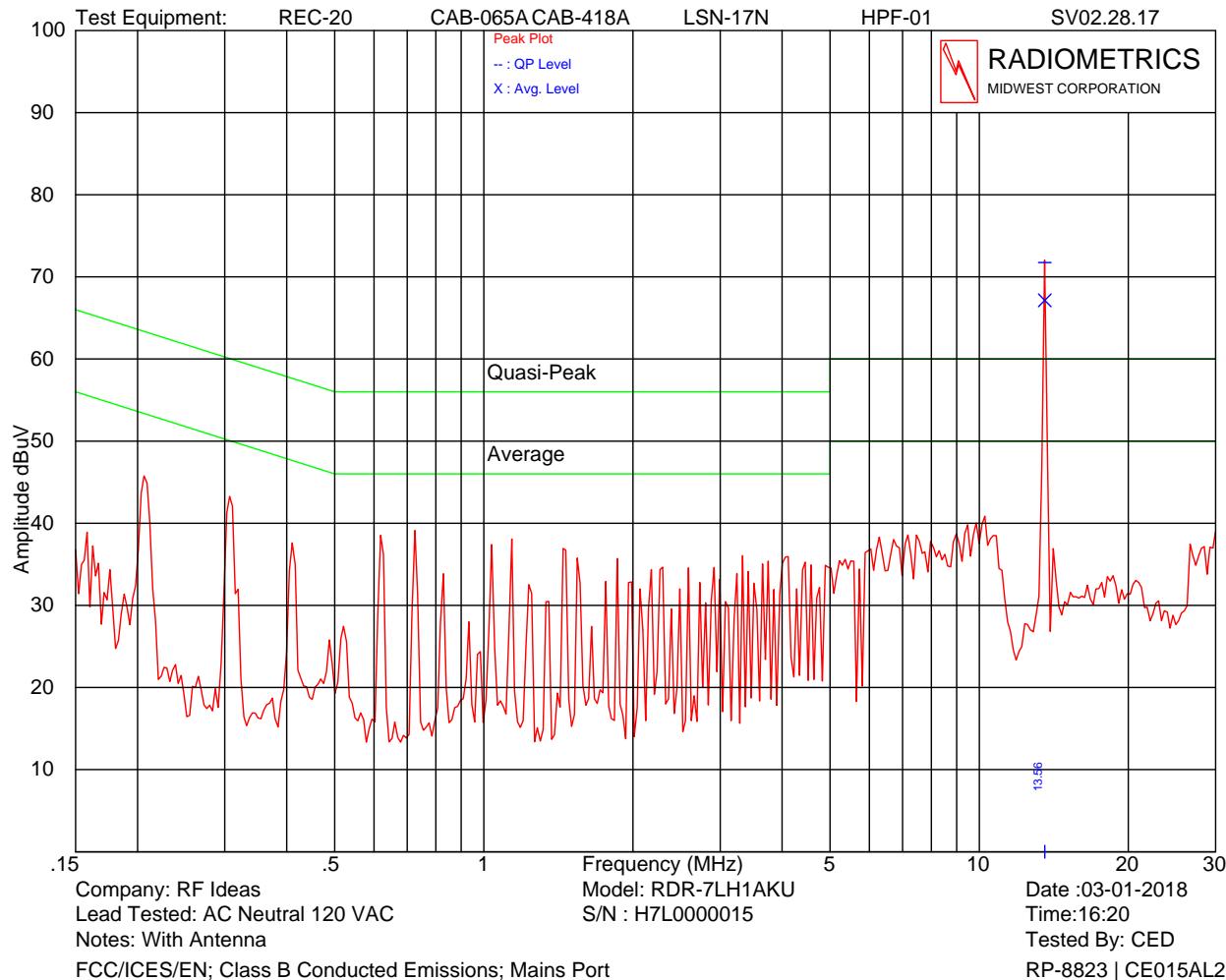
The Limit shown in the graphs are the FCC 15.107 and RSS-GEN Table 3.



Model: RDR-7LH1AKU; With Antenna

Frequency (MHz)	QP Amplitude (dBuV)	QP Limit (dBuV)	Average Amplitude (dBuV)	Average Limit (dBuV)	Margin (dB)
13.561	71.7	60.0	67.1	50	-17.1

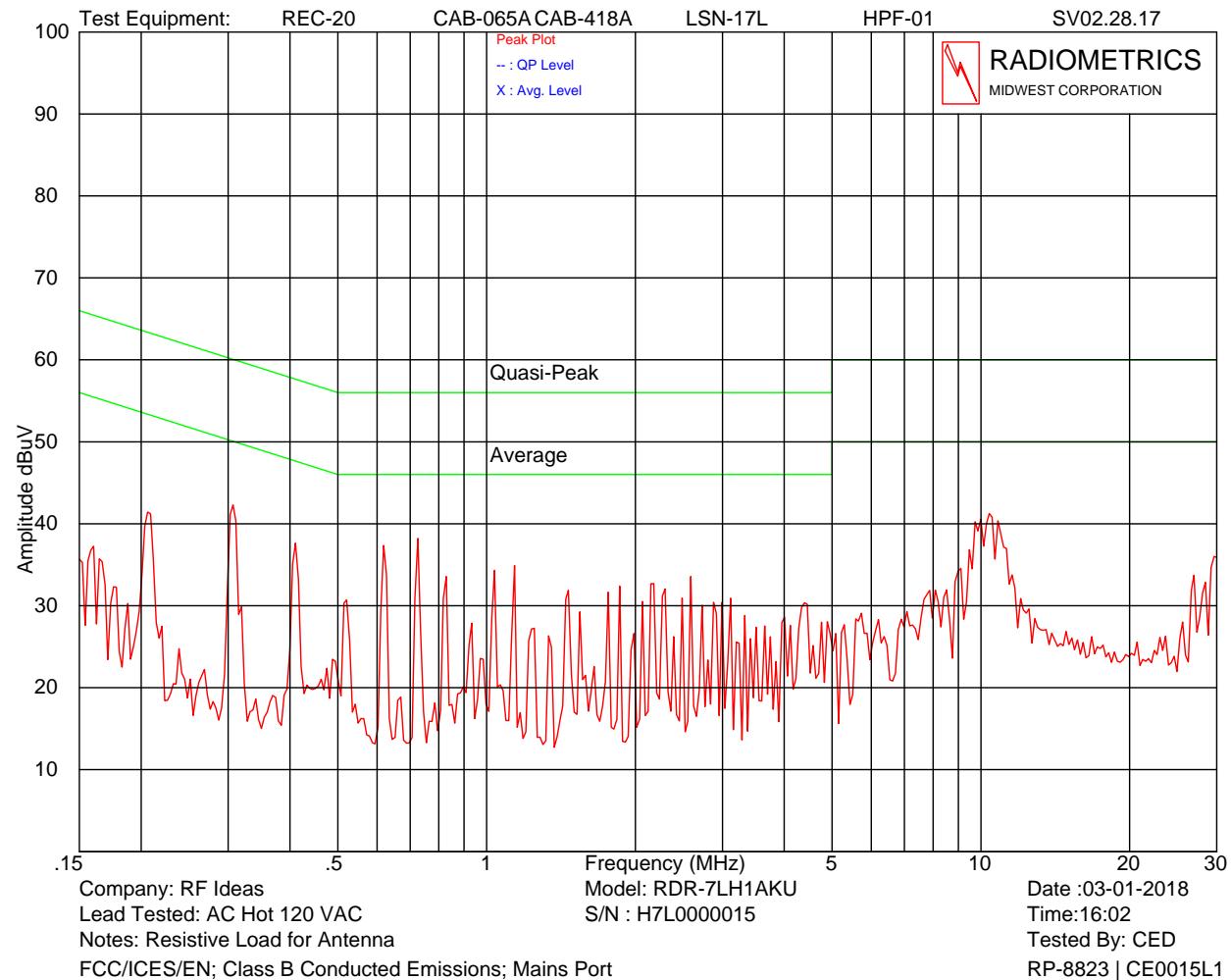
The emission at 13.56 MHz was re-measured with a resistive load in place of the antenna and was fully compliant.



With Antenna

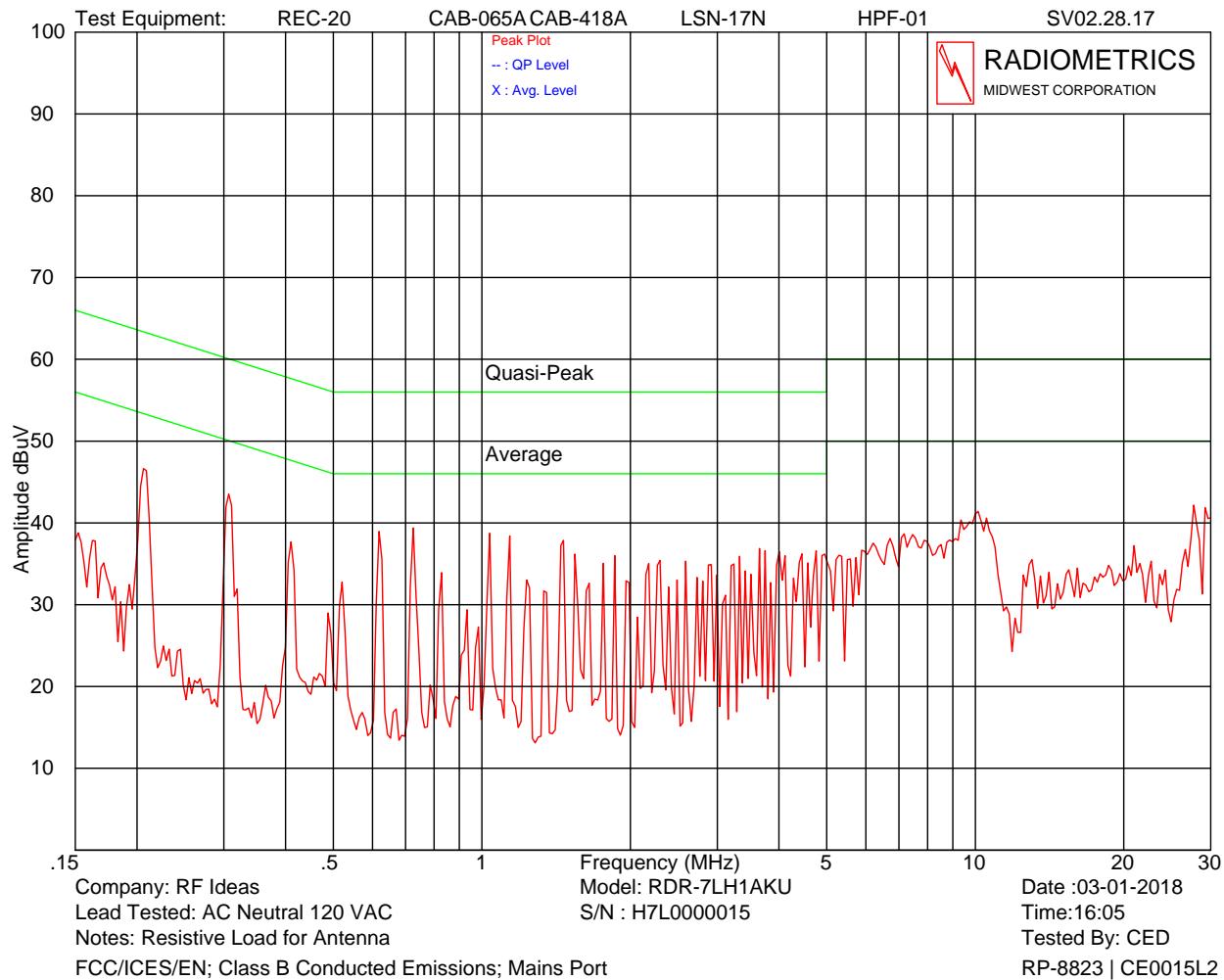
Frequency (MHz)	QP Amplitude (dBuV)	QP Limit (dBuV)	Average Amplitude (dBuV)	Average Limit (dBuV)	Margin (dB)
13.560	71.8	60.0	67.1	50.0	-17.1

The emission at 13.56 MHz was re-measured with a resistive load in place of the antenna and was fully compliant.



With 100 Ohm Resistor in place of antenna

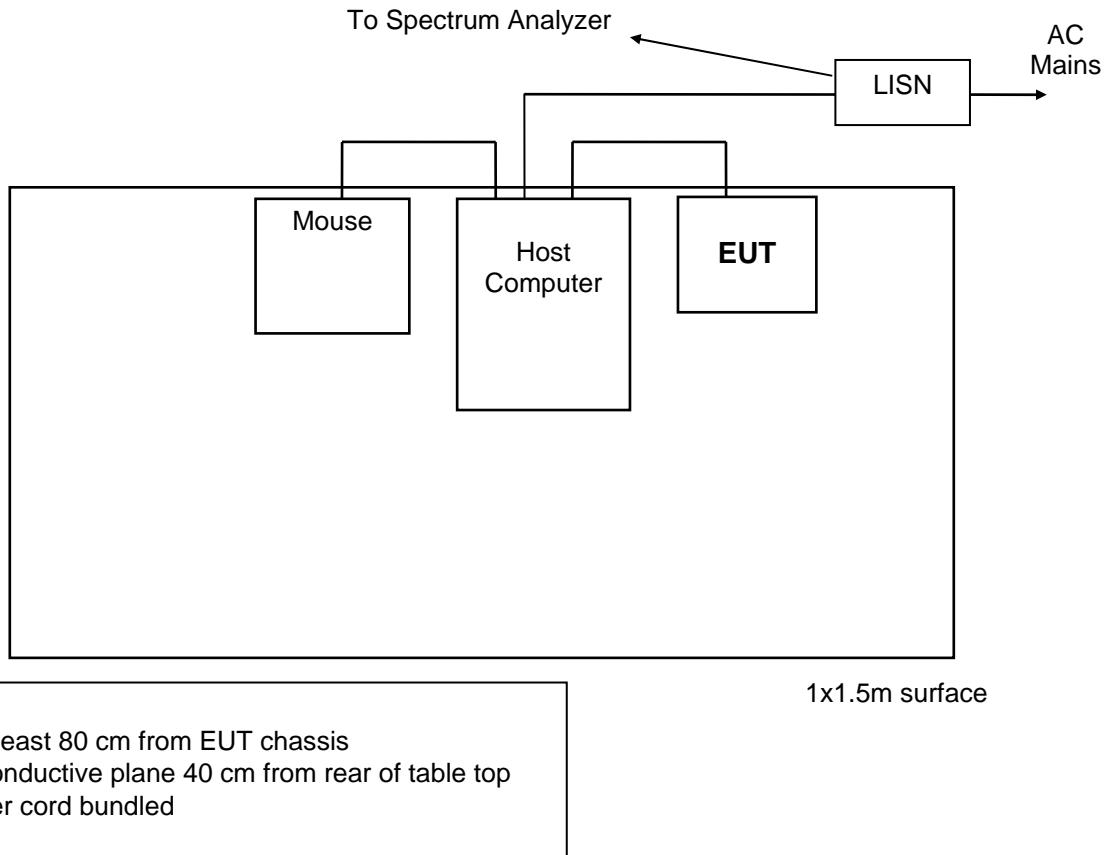
RF IDeas, Model: RDR-7LH1AKU 13.56 MHz RFID Reader



With 100 Ohm Resistor in place of antenna

Judgment: Passed by at least 8 dB at 13.56 MHz with Resistive Load in place of standard Loop antenna.

Passed by at least 5 dB at all frequencies, except 13.56 MHz, with standard Loop antenna installed.

Figure 1. Conducted Emissions Test Setup

11.2 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. 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	
		uV/m	dB(uV/m)
0.009-0.490	300	2400/F(kHz)	20*LOG(2400/kHz)
0.490-1.705	30	24000/F(kHz)	20*LOG(24000/kHz)
1.705-30.0	30	30	29.5
30 - 88	3	100	40.0
88 - 216	3	150	43.5
216 - 960	3	200	46.0
Above 960	3	500	54.0

The emission limits shown in the above table are based on measurements using a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

11.2.1 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

11.2.2 Radiated Emissions Test Results

Test Dates	03/01/2018
Test Distance	3 Meters
Specification	FCC Part 15 Subpart C & RSS-210
Notes	Corr. Factors = cable loss distance factor.
Abbreviations	P = peak; Q = QP Pol = Antenna Polarization; V = Vertical; H = Horizontal
EUT	RDR-7LH1AKU; SN: H7LD000013

The 13.56 MHz transmitter was on during the following tests.

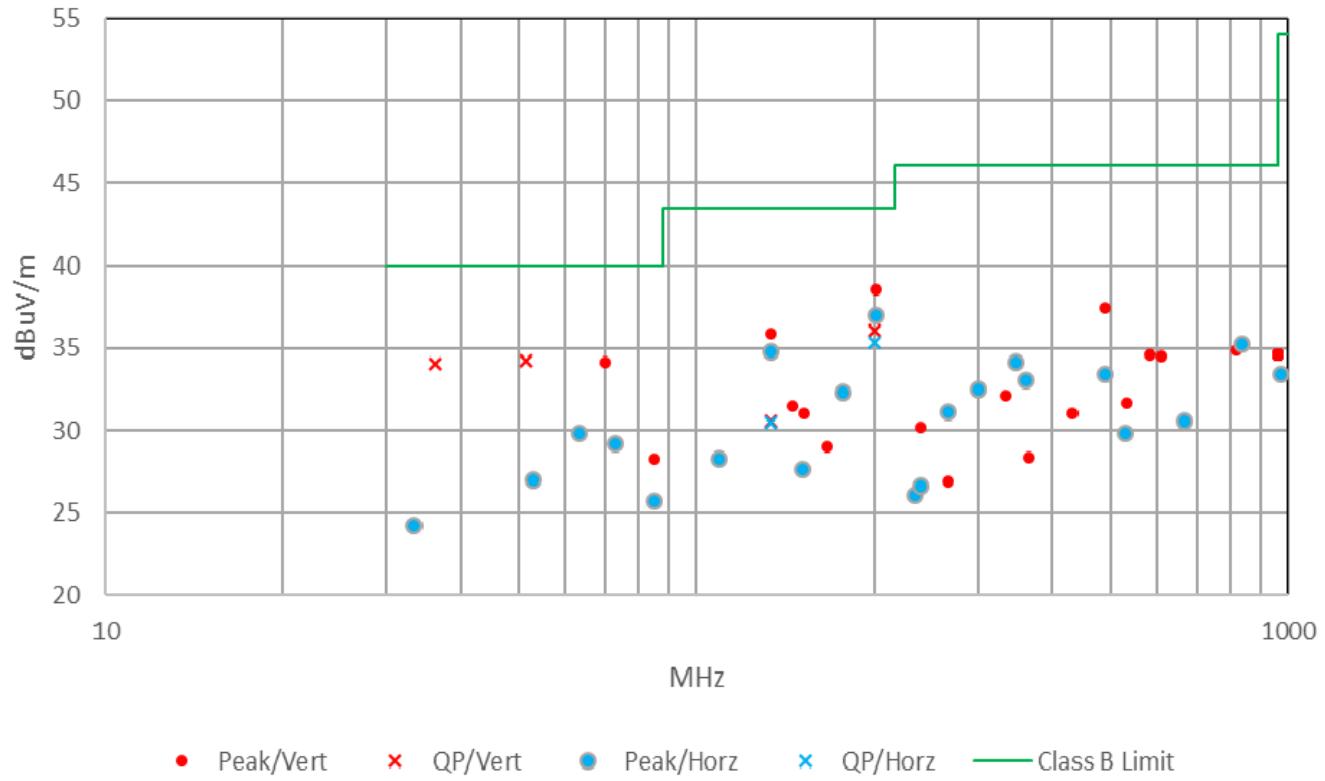
Freq. MHz	Meter Reading dBuV	Dect. Type	Antenna		Corr. Factors dB	Field Strength dBuV/m		Margin Under Limit dB
			Polarity	Factor dB		EUT	Limit	
33.4	12.7	P	H	11.0	0.5	24.2	40.0	15.8
52.8	13.8	P	H	12.6	0.6	27.0	40.0	13.0
63.5	18.5	P	H	10.7	0.6	29.8	40.0	10.2
73.0	20.6	P	H	7.9	0.7	29.2	40.0	10.8
85.0	15.2	P	H	9.7	0.8	25.7	40.0	14.3
109.6	14.0	P	H	13.4	0.9	28.3	43.5	15.2
133.6	15.7	Q	H	13.8	1.0	30.5	43.5	13.0

RF IDEAS, Model: RDR-7LH1AKU 13.56 MHz RFID Reader

Freq. MHz	Meter Reading dBuV	Dect. Type	Antenna		Corr. Factors dB	Field Strength dBuV/m		Margin Under Limit dB
			Polarity	Factor dB		EUT	Limit	
133.6	20.0	P	H	13.8	1.0	34.8	43.5	8.7
150.8	13.2	P	H	13.4	1.0	27.6	43.5	15.9
176.2	12.4	P	H	18.8	1.1	32.3	43.5	11.2
200.3	16.8	Q	H	17.3	1.2	35.3	43.5	8.2
200.7	18.5	P	H	17.3	1.2	37.0	43.5	6.5
234.7	13.9	P	H	10.9	1.3	26.1	46.0	19.9
239.3	14.2	P	H	11.1	1.3	26.6	46.0	19.4
267.2	16.9	P	H	12.8	1.4	31.1	46.0	14.9
300.4	15.9	P	H	15.1	1.5	32.5	46.0	13.5
348.0	18.3	P	H	14.2	1.6	34.1	46.0	11.9
360.8	16.9	P	H	14.5	1.6	33.0	46.0	13.0
489.9	13.8	P	H	17.7	1.9	33.4	46.0	12.6
528.8	10.9	P	H	16.9	2.0	29.8	46.0	16.2
667.5	8.7	P	H	19.6	2.3	30.6	46.0	15.4
833.8	11.5	P	H	21.2	2.5	35.2	46.0	10.8
975.0	8.3	P	H	22.4	2.7	33.4	54.0	20.6
36.0	21.9	Q	V	11.6	0.5	34.0	40.0	6.0
51.5	20.9	Q	V	12.7	0.6	34.2	40.0	5.8
70.0	24.8	P	V	8.6	0.7	34.1	40.0	5.9
85.0	17.8	P	V	9.7	0.8	28.3	40.0	11.7
133.6	15.7	Q	V	13.9	1.0	30.6	43.5	12.9
133.6	21.1	P	V	13.8	1.0	35.9	43.5	7.6
145.2	17.3	P	V	13.2	1.0	31.5	43.5	12.0
151.7	16.5	P	V	13.5	1.0	31.0	43.5	12.5
166.3	11.6	P	V	16.3	1.1	29.0	43.5	14.5
200.3	17.6	Q	V	17.3	1.2	36.1	43.5	7.4
200.7	20.0	P	V	17.3	1.2	38.5	43.5	5.0
239.3	17.8	P	V	11.1	1.3	30.2	46.0	15.8
266.4	12.8	P	V	12.7	1.4	26.9	46.0	19.1
332.9	16.3	P	V	14.3	1.5	32.1	46.0	13.9
366.1	12.2	P	V	14.6	1.6	28.4	46.0	17.6
433.3	12.8	P	V	16.4	1.8	31.0	46.0	15.0
489.9	17.8	P	V	17.7	1.9	37.4	46.0	8.6
532.5	12.7	P	V	17.0	2.0	31.7	46.0	14.3
581.3	14.0	P	V	18.5	2.1	34.6	46.0	11.4
608.8	13.5	P	V	18.9	2.1	34.5	46.0	11.5
817.5	11.2	P	V	21.1	2.6	34.9	46.0	11.1
962.5	9.4	P	V	22.5	2.7	34.6	54.0	19.4

Judgment: Passed by 5.0 dB

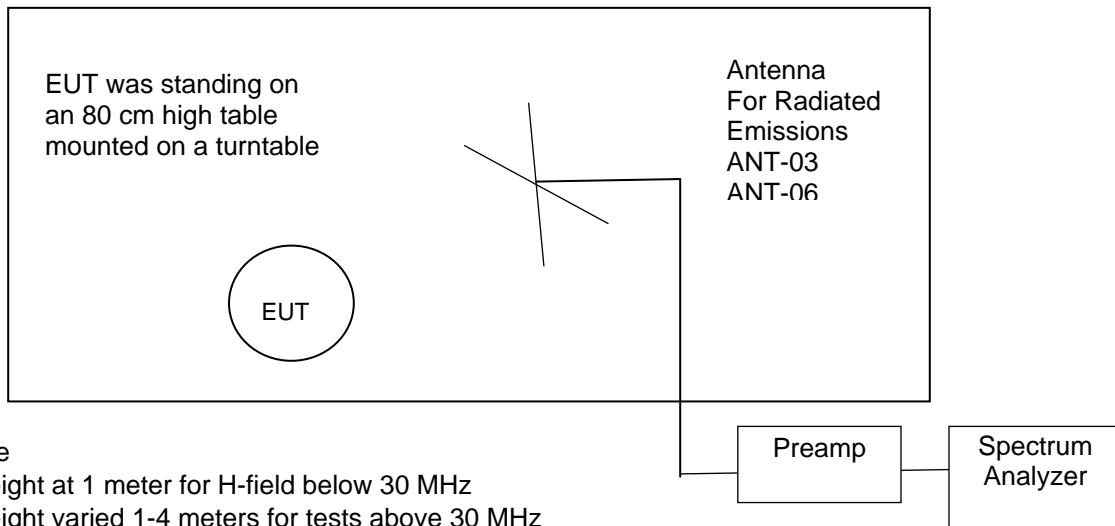
30-1000 MHz Radiated Emissions



Radiated emissions in a graphical format. The above chart is the same data as the previous table.

Figure 2. Drawing of Radiated Emissions Test Setup

Chamber E, anechoic



Frequency Range	Receive Antenna	Pre-Amplifier	Spectrum Analyzer
30 to 200 MHz	ANT-03	AMP-22	REC-21
200 to 1000 MHz	ANT-06	AMP-22	REC-21

11.3 Magnetic Field Measurements and Decay Factor Calculations

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

The distance correction factor is calculated as follows:

The distance factor in (dB) = $DE \cdot 20 \cdot \log(TD/SD)$

Where: DE = Decay Exponent (2.0 is used for this)

TD = Test distance in meters. This is 3 meters

SD = Specification Distance in meters

From 9 kHz to 490 kHz, the Specification Distance is 300m therefore the distance factor is $2 \cdot 20 \cdot \log(300/3) = 80$ dB.

From 490 kHz to 30 MHz, the Specification Distance is 30m therefore the distance factor is $2 \cdot 20 \cdot \log(30/3) = 40$ dB.

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

Test Date	March 1, 2018
Test Distance	3 Meters
Specification	FCC 15 & RSS-GEN
Notes	A shielded Loop Antenna was used for this test.

13.56 MHz Frequencies

Freq (MHz)	meter reading dBuV	Loop Ant Factor	Dist (m)	Decay exp	Cable Loss dB	FCC Distance factor dB	Field Strength dBuV/m	FCC & RSS-GEN Limit dBuV/m	Margin under limit
13560	59.4	16.8	3.0	2.0	0.4	-40.0	36.6	40.5	3.9
27120	24.6	16.0	3.0	2.0	0.5	-40.0	1.1	29.5	28.4

The limit shown at 13.56 MHz in the above table is the lowest limit from 15.225 sections (a), (b) and (c).

The limit from 13.553-13.567 MHz at 30 meters is 15,848 uV/m which = 84 dBuV/m in accordance with FCC 15.225 (c) and RSS-210 section B2.6 (a).

The limit drops to 334uV/m from 13.410-13.553 MHz and 13.567-13.710 MHz, and 106uV/m = 40.5 dBuV/m from the bands 13.110-13.410 MHz and 13.710-14.010 MHz.

The lower limit (40.5 dBuV/m) was used for all frequencies from 13.110-14.010 MHz.
All other limits are general limits of FCC 15.209 or the RSS-Gen.

The emissions were scanned from 10 kHz to 30 MHz, including 13.110 and 14.010 MHz.
No other emissions were detected from 10 kHz to 30 MHz within 10 dB of the 15.209 or the RSS-GEN limits.

Judgement: Passed by 3.9 dB.

11.4 Occupied Bandwidth Data

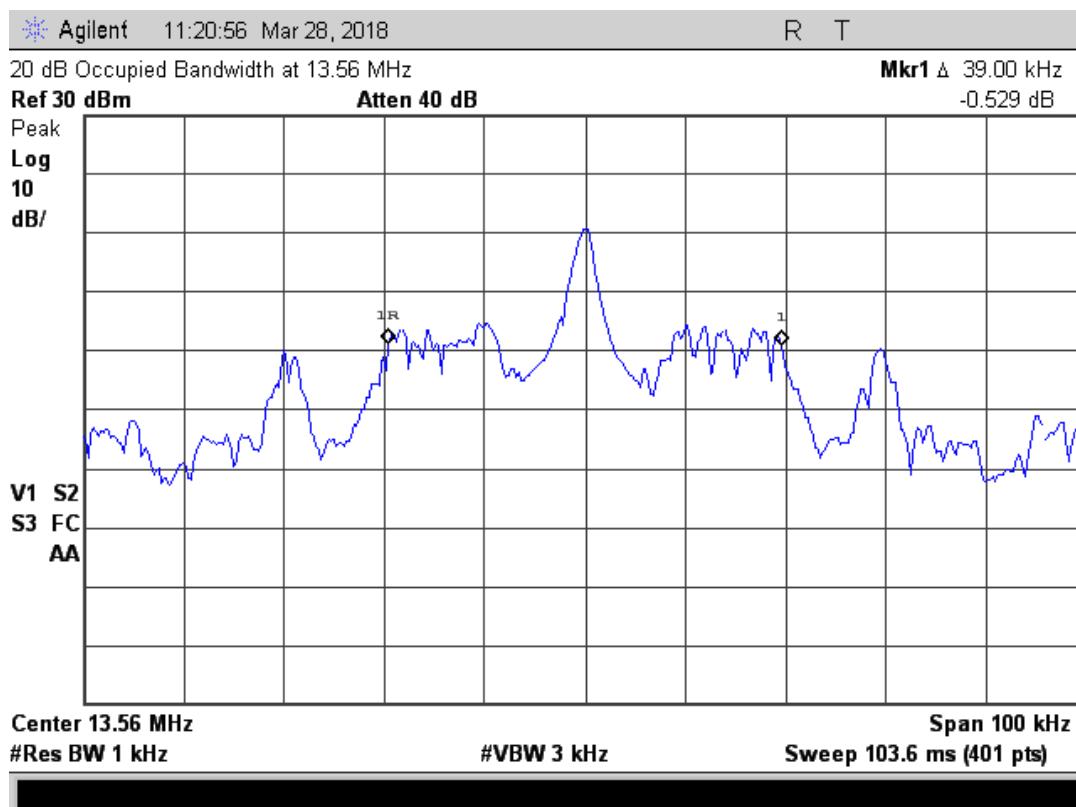
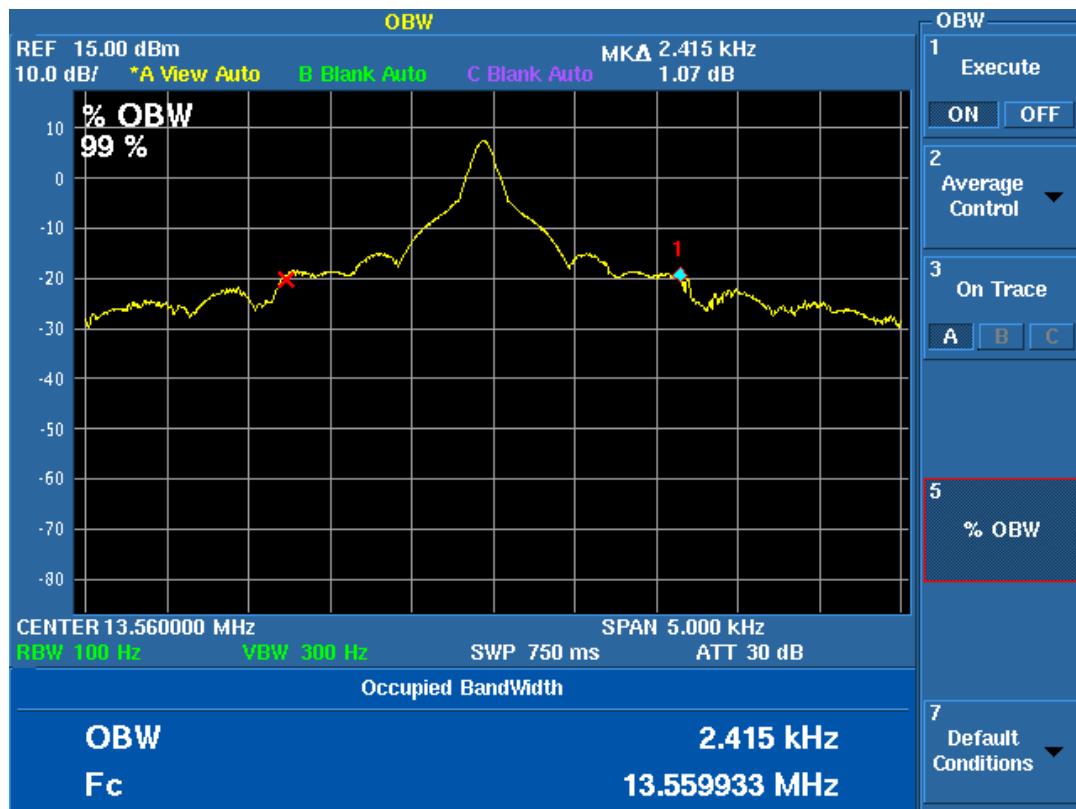
The occupied bandwidth of the RF output was measured using a spectrum analyzer. The bandwidth was measured using the peak detector function and a narrow resolution bandwidth.

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.

99% EBW	20 dB OBW
13.56 MHz Signal	13.56 MHz Signal
2.415 kHz	39.00 kHz

Judgement: Pass

Figure 3. Occupied Bandwidth Plots 13.56 MHz



11.5 Frequency Stability

The tests were in accordance to FCC 15.225 and RSS-210 Section B.6. Since the product is USB powered, a Desktop PC was used to power the device. The input power to the desktop PC was varied by 15%, using a variable AC supply.

11.5.1 Test Results for Frequency Stability

Specification	FCC Part 15.225 RSS-210 Section B.6	Test Personnel	Richard Tichgelaar
Test Date	March 22, 2018	Nominal Frequency	13.560 MHz
Test Equipment	Spectrum Analyzer (REC-21); Temperature Chamber TC-01 Power Supply (PSA-02)		
EUT	RDR-7LH1AKU; SN: H7LD000013		

Temp.	Freq. @0min.	Freq. @2min.	Freq. @5min	Freq. @10min	Percent Change from Nominal	
	Deg C	(MHz)	(MHz)	(MHz)	Max %	Min %
50	13.559975	13.559963	13.559975	13.559950	-0.00046	-0.00074
40	13.559950	13.559945	13.559965	13.559955	-0.00070	-0.00074
30	13.559990	13.559935	13.559970	13.559950	-0.00055	-0.00055
20	13.560010	13.560015	13.560020	13.560005	-0.00037	-0.00052
10	13.560045	13.560025	13.560035	13.560035	-0.00018	-0.00029
0	13.560050	13.560050	13.560045	13.560025	0.00000	-0.00015
-10	13.560055	13.560065	13.560060	13.560055	0.00000	-0.00026
-20	13.560050	13.560065	13.560070	13.560065	-0.00015	-0.00037

Volts	Freq.	Change from Nominal
	AC (MHz)	%
102.0	13.560012	0.00009
120.0	13.559967	-0.00024
138.0	13.559987	-0.00010

Test Requirements: Limit is 100 ppm or 0.01% deviation.

Judgement: Pass

12.0 MEASUREMENT INSTRUMENTATION UNCERTAINTY

The uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2 in accordance with CISPR 16-4-2.

Measurement	Uncertainty
Conducted Emissions, LISN method, 150 kHz to 30 MHz	2.7 dB
Radiated Emissions, H-field, 3 meters, 9 kHz to 30 MHz	2.7 dB
Radiated Emissions, E-field, 3 meters, 30 to 200 MHz	3.3 dB
Radiated Emissions, E-field, 3 meters, 200 to 1000 MHz	4.9 dB
Frequency counter at 13.56 MHz; REC-21	136 Hz
99% Occupied Bandwidth using REC-43	1% of frequency span
Temperature THM-03	0.6 Deg C