Electromagnetic Compatibility Test Report

Tests Performed on rf IDeas, Inc.
WAVE ID Plus, RFID Reader

Models RDR-80031BKU-V2 and RDR-80032BKU-IMP

Radiometrics Document RP-9687

A2LA ACCREDITED
TESTING CERT #1495.01

Product Detail:	
FCC ID: M9MRNA0200 IC: 6571A-RNA0200 Equipment type: Dual Frequency Card Reader	
Test Standards:	
US CFR Title 47, Chapter I, FCC Part 15 Subpart C FCC Part 15 CFR Title 47: 2021 Canada ISED; RSS-210, Issue 10: 2019 as required for Category I Equipment FCC Part 15.209 & 15.225 This report concerns a Class II Permissive Change	
Tests Performed For:	**Test Facility:**
rf IDeas, Inc. 425 Martingale Rd., Ste. 1680 Schaumburg, IL 60173	Radiometrics Midwest Corporation 12 Devonwood Avenue Romeoville, IL 60446
Test Completion Date:	
August 18, 2022	

Document RP-9687 Revisions:		
Rev.	Issue Date	Revised By
0	September 9, 2022	
1	September 13, 2022	Joseph Strzelecki

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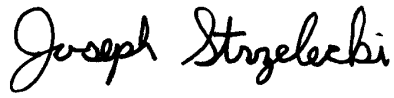
1.0 ADMINISTRATIVE DATA

Equipment Under Test:	
An rf IDeas, Inc., Wave ID Mobile SP, RFID Reader Models: RDR-80031BKU-V2; & RDR-80032BKU-V2-IMP These will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics: August 9, 2022	*Test Date(s):* August 9-18, 2022
Test Report Written and Authorized by:  05/24/2021 Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE	*Radiometrics' Personnel Responsible for Test:* Joseph Strzelecki Senior EMC Engineer Richard L. Tichgelaar EMC Technician Chris E. D'Alessio EMC Technician
Test Witnessed By: The tests were partially witnessed by Shiung Lo of rf IDeas, Inc.	

2.0 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a Wave ID Plus RFID Reader, 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 per RSS-210 & FCC Part 15

Environmental Phenomena	Frequency Range	Test Result
RF Radiated Emissions	30-1000 MHz	Pass
Conducted Emissions, AC Mains	0.15 - 30 MHz	Pass
RF Radiated Emissions H-Field	0.009 – 30 MHz	Pass
Occupied Bandwidth	125 kHz & 13.56 MHz	Pass
Frequency Stability vs Temp & Voltage	None	Note 1

The Frequency Stability test was not repeated, since the frequency determining circuitry was not changed. It fully complied in the original submittal.

Since the 13.56 MHz fundamental signal met the general limits of 15.209 and RSS-GEN section 8.9, the following tests are not required:

1. Mask compliance of FCC 15.225 b), c), d) and RSS-210 Annex B6. It met the requirements of the most stringent general limits.

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 WAVE ID Plus, Mobile SP, Dual Frequency, RFID Reader, Models RDR-80031BKU-V2; & RDR-80032BKU-V2-IMP, manufactured by rf IDeas, Inc. The EUT were in good working condition during the tests, with no known defects.

3.1.1 Product Family

The following table is the product family list of the readers that use the same electronics and PCB as the ones tested in this report. The untested model numbers listed below are electrically identical with the same electromagnetic emissions and electromagnetic compatibility characteristics as those tested, therefore the tests on the model numbers below are representative for the tested models.

Model Number	Description
RDR-80031BKU-V2	WAVE ID Plus V2 iClass ID/SE/SEOS Black USB Keystroke Reader **Tested Sample**
RDR-80031BKU-V2-C06	WAVE ID Plus Mini Keystroke V2 iClass ID/SE/SEOS Black 6in USB Reader
RDR-80031BKU-V2-C16	WAVE ID Plus Mini Keystroke V2 iClass ID/SE/SEOS Black 16in USB Reader
RDR-80031BKU-V2-KYC-C16	WAVE ID Plus Mini Keystroke V2 iClass ID/SE/SEOS Kyocera Black 16in USB Reader
RDR-80032BKU-V2	WAVE ID Plus Mini SDK V2 iClass ID/SE/SEOS Black USB Reader
RDR-80032BKU-V2-IMP	WAVE ID Plus Mini SDK V2 iClass ID/SE/SEOS Black Imprivata USB Reader **Tested Sample**
RDR-80036BKU-V2	WAVE ID Plus Mini CCID V2 iClass ID/SE & SEOS Black USB Reader

3.1.2 FCC Section 15.203 & RSS-GEN Antenna Requirements

The products will not be sold to the general public. rf IDeas or the OEM will be responsible to ensure the proper installation in accordance with RF IDeas requirements.

These two antennas have a unique interface connector to ensure no other OEM antennas can be used. 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 the USB. 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 Reader	E	rf IDeas	RDR-80031BKU-V2	W200000001
2	RFID Reader	E	rf IDeas	RDR-80032BKU-IMP	W200000012
3	Latitude Laptop PC	H	HP	Elite x2	5CG545482P
4	Laptop AC-DC power supply	P	HP	854055-002	None

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

List of Cables

QTY	Length (m)	Cable Description	Shielded?
1	1.8	USB Cable from Reader to Host computer	Yes
1	1.2	AC Cord to AC-DC power supply to host computer	No
1	1.5	DC Cord to Computer	No

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.

4.4 Description of Permissive Change

The changes are as follows:
The current HID SE processor used in the current models like RDR-80031BKU has reached the end-of-life cycle for IC designated at U50. The current IC part number and marking will change from SE3100A00 to SEL55100000, now designated at U511.

1 The new SE processor IC is not pin-for-pin compatible, therefore requiring a new PCB
2 The SE processor has digital signals only, not RF.
3 The PCB has changed from PCB-1109-03 to PCB-1125-04
4 The new SE processor has the same exact function as the old chip
5 No change in radio parameters has occurred.
6 The Integrated Circuits and components generating the 13.56 MHz and 125 kHz RF signals have not changed.

The Main PCB is the same for all versions of the product. The form, fit, and function of the IC remains identical. The clocks, tuning circuits, antennas, RF power, and modulation remained unchanged.

5.0 TEST SPECIFICATIONS

Document	Date	Title
FCC CFR Title 47	2021	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices
IC RSS-210 Issue 10	2019	Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands) Category I Equipment
IC RSS-Gen Issue 5	2019	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: 2017 "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 3124A with a CAB ID US0224.

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 with 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-53	EMCO	Loop Antenna	6507	1453	1 kHz-30 MHz	24 Mo	03/10/22
ANT-68	EMCO	Log-Periodic Ant.	93146	9604-4456	200-1000MHz	24 Mo.	02/07/22
ANT-80	AH Systems	Bicon Antenna	SAS-540	294	20-330MHz	24 Mo.	01/05/21
HPF-01	Solar	High Pass Filter	7930-100	HPF-1	0.15-30MHz	24 Mo.	03/07/22
LSN-01	Electrometrics	50 uH LISN	FCC/VDE 50/2	1001	0.01-30MHz	24 Mo.	08/23/21
REC-20	HP / Agilent	Spectrum Analyzer	85460A/84562A	33330A00135 3410A00178	30Hz-6GHz	24 Mo.	08/18/21
REC-21	Agilent	Spectrum Analyzer	E7405A	MY45118341	9kHz-26.5GHz	24 Mo.	02/24/22
REC-43	Adventest	Spectrum Analyzer	U3772	150800305	9Hz-43GHz	24 Mo.	07/13/21
TMP-01	Fluke	Temperature meter	80T-150UA	38280311	N/A	24 Mo.	06/07/21

Note: All calibrated equipment is subject to periodic checks.

Software Company	Test Software Name	Version	Applicable Tests
Radiometrics	EN550XX0	07.22.22	RF Conducted Emissions (FCC Part 15 & EN 55032)
Radiometrics	REREC11D	07.16.19	RF Radiated Emissions (FCC Part 15 & EN 55032)
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 computer recorded the data and then plotted it on a semi-log graph. 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

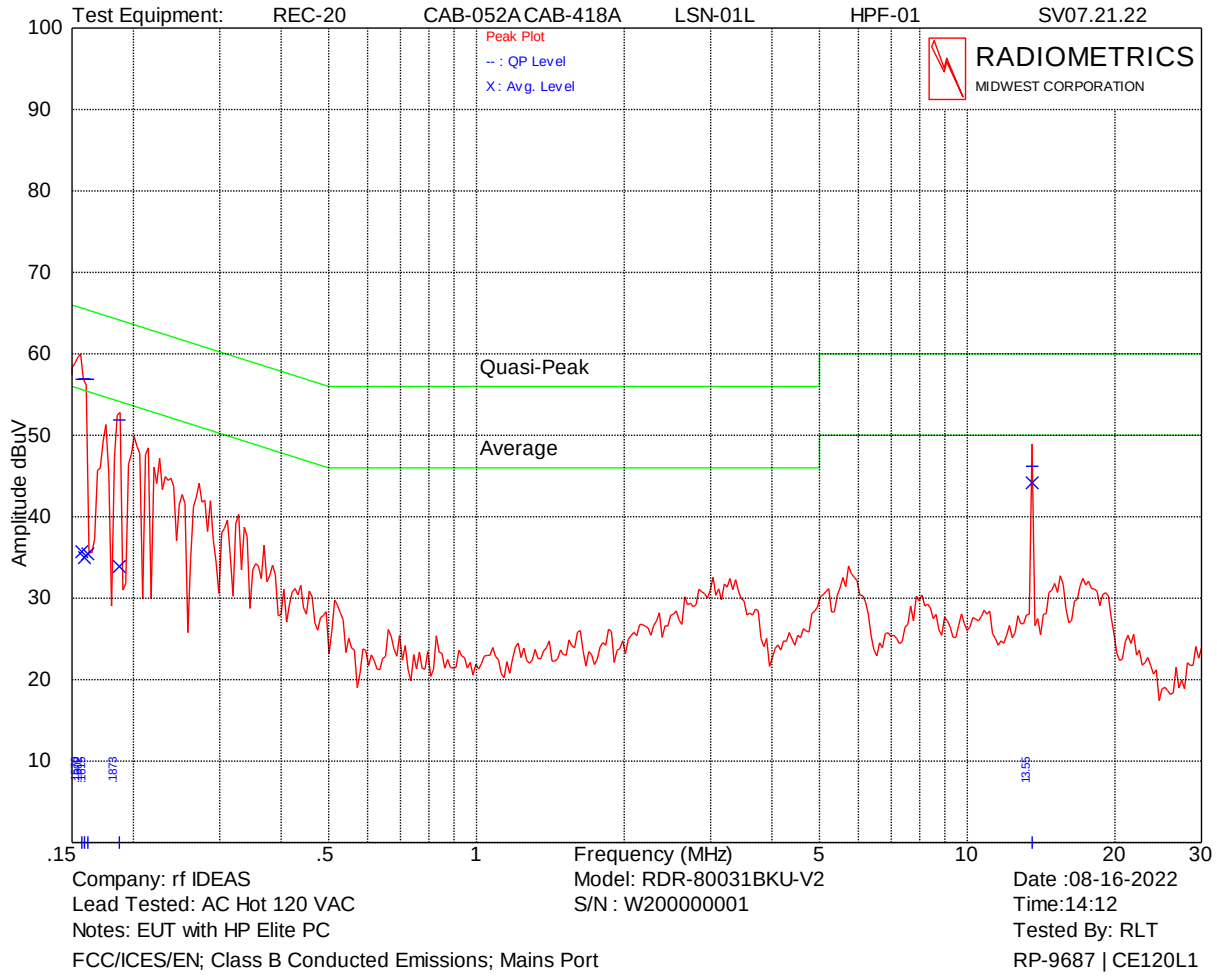
Frequency Range (MHz)	Class B Limits (dBuV)	
	Quasi-Peak	Average
0.150 - 0.50*	66 - 56	56 - 46
0.5 – 5.0	56	46
5.0 - 30	60	50
* The limit decreases linearly with the logarithm of the frequency in this range.		

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

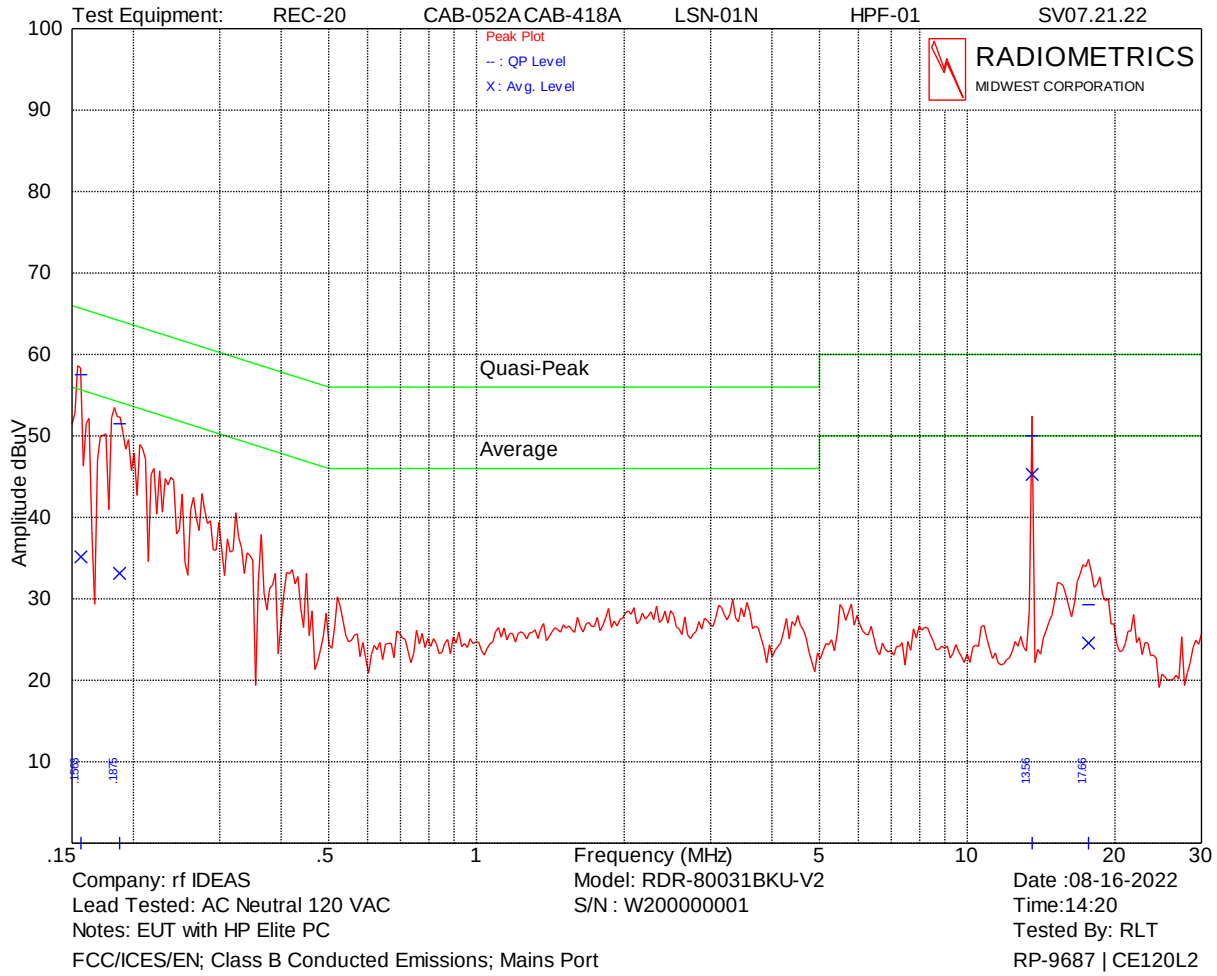
Tested by	Richard Tichgelaar
Test Dates	08/16/2022

The following shows the worst case from the 125 & 13.56 MHz transmitters.
The Limit shown in the graphs are the FCC 15.107 and RSS-GEN Table 3.

Model RDR-80031BKU-V2

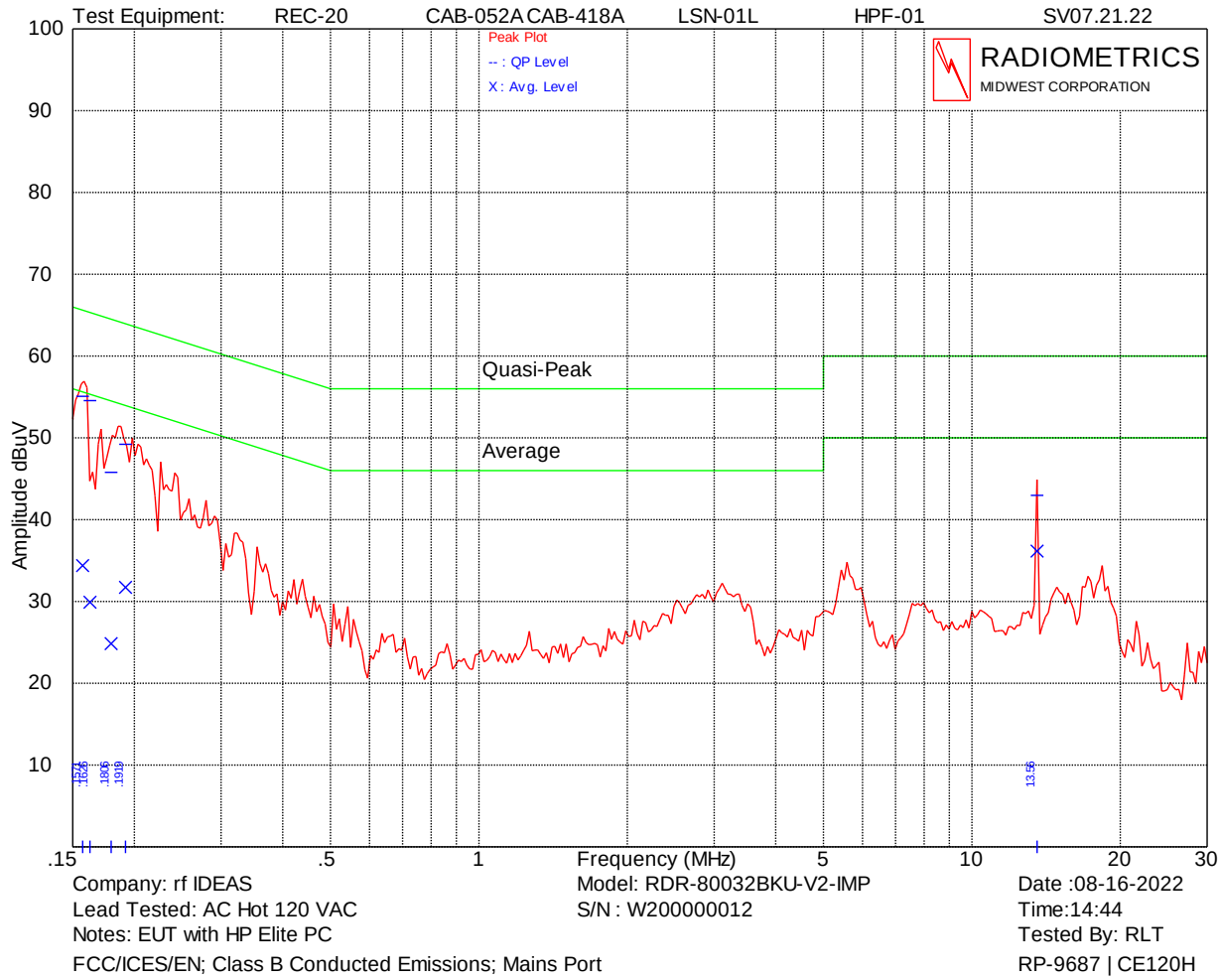


Frequency (MHz)	QP Amp. (dBuV)	QP Limit (dBuV)	Average Amp. (dBuV)	Average Limit (dBuV)	Margin Under Limit (dB)
0.157	56.9	65.6	35.7	55.6	8.7
0.160	56.9	65.5	35.0	55.5	8.6
0.162	56.9	65.4	35.4	55.4	8.5
0.187	52.0	64.2	33.9	54.2	12.2
13.560	46.2	60.0	43.4	50.0	6.6

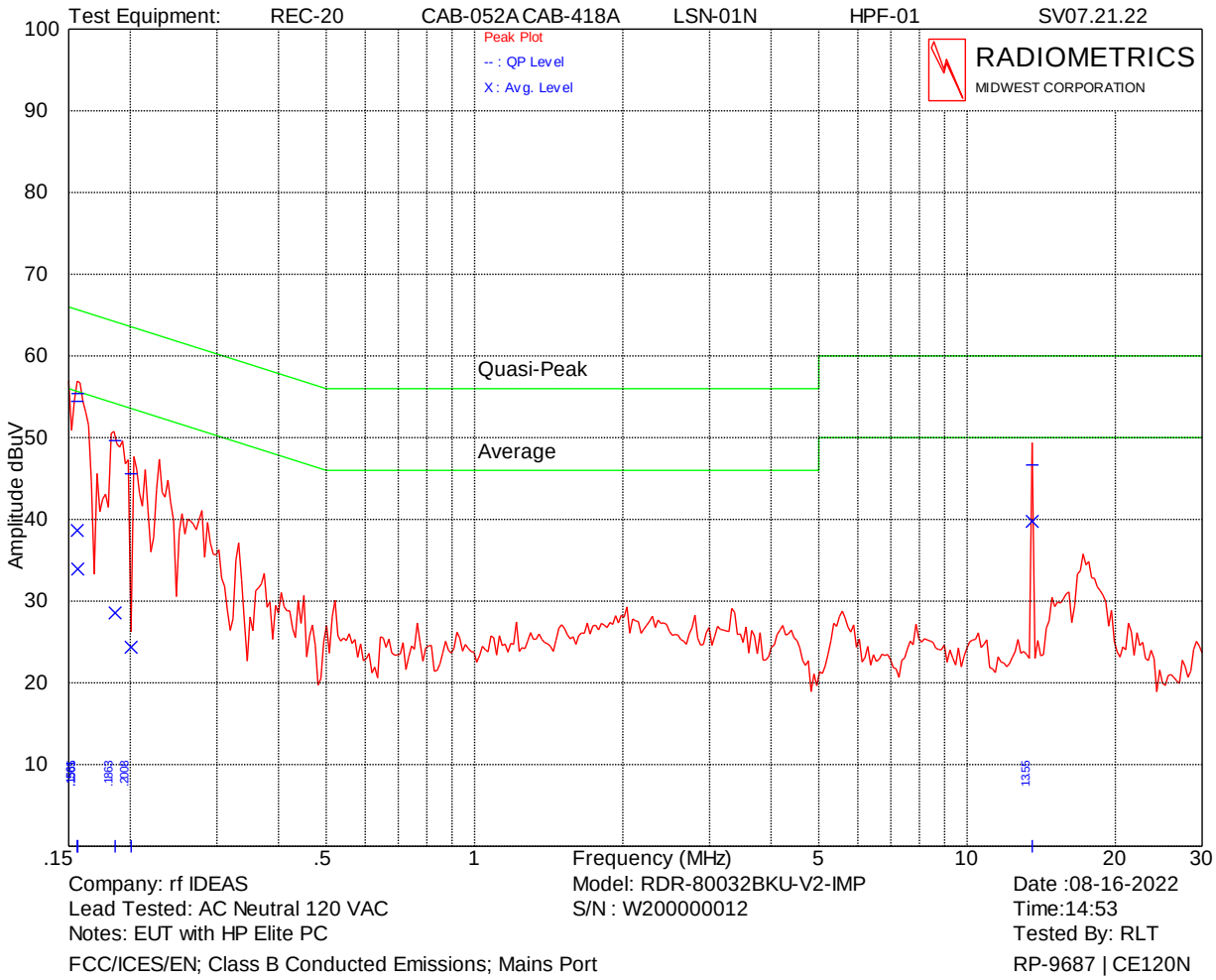


Frequency (MHz)	QP Amp. (dBuV)	QP Limit (dBuV)	Average Amp. (dBuV)	Average Limit (dBuV)	Margin Under Limit (dB)
0.156	57.6	65.7	35.2	55.7	8.1
0.188	51.5	64.1	33.1	54.1	12.6
13.560	50.0	60.0	44.5	50.0	5.5
17.664	29.3	60.0	23.8	50.0	26.2

Model RDR80032BKU-V2-IMP



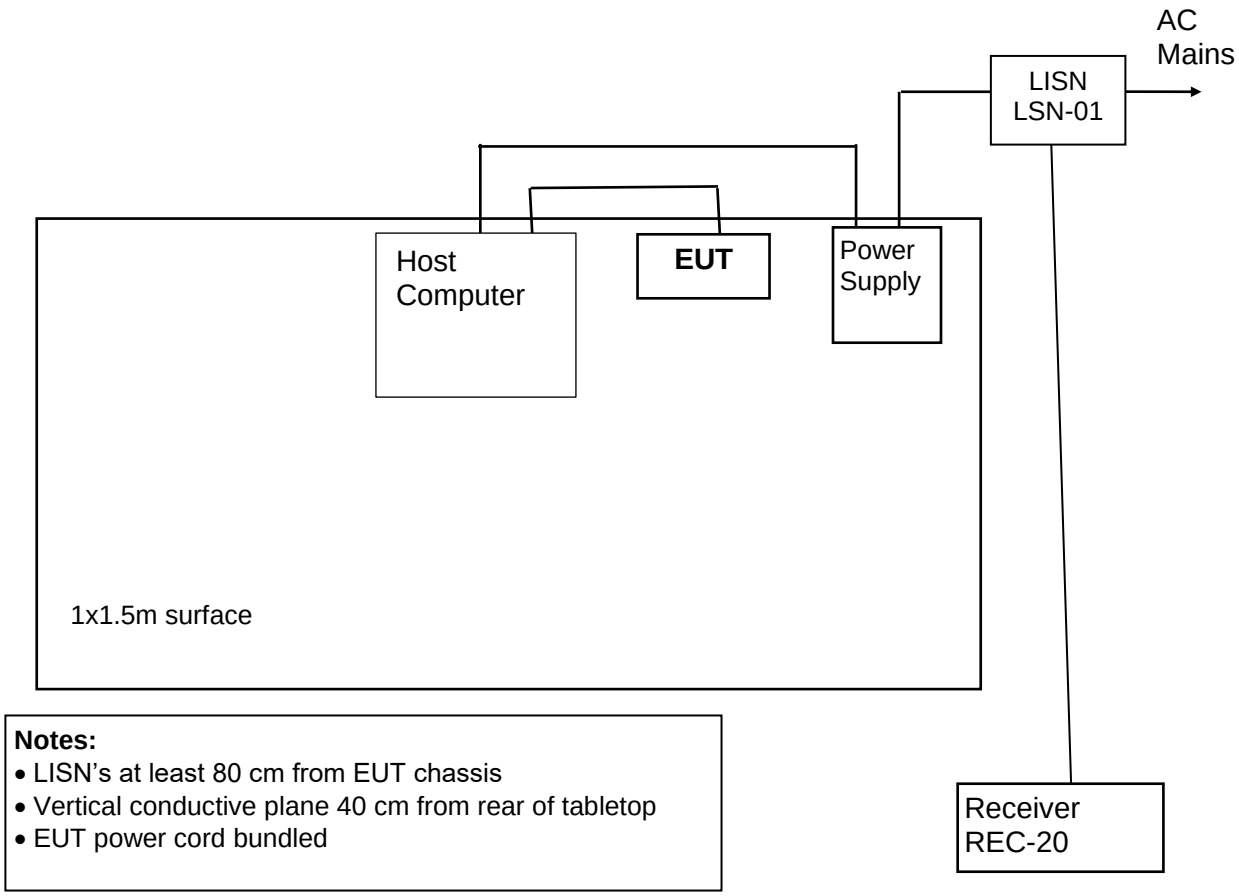
Frequency (MHz)	QP Amp. (dBuV)	QP Limit (dBuV)	Average Amp. (dBuV)	Average Limit (dBuV)	Margin Under Limit (dB)
0.157	55.1	65.6	34.4	55.6	10.5
0.163	54.5	65.3	29.9	55.3	10.8
0.181	45.8	64.5	24.8	54.5	18.7
0.192	49.2	64.0	31.7	54.0	14.7
13.561	43.0	60.0	36.2	50.0	13.8



Frequency (MHz)	QP Amp. (dBuV)	QP Limit (dBuV)	Average Amp. (dBuV)	Average Limit (dBuV)	Margin Under Limit (dB)
0.156	54.4	65.7	38.6	55.7	11.2
0.157	55.4	65.6	33.9	55.6	10.2
0.186	49.6	64.2	28.5	54.2	14.5
0.201	45.6	63.6	24.4	53.6	18.0
13.560	46.7	60.0	39.8	50.0	10.2

Judgement Pass by at least 5 dB.

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 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. The EUT was rotated through three orthogonal axes as per 5.10.1 of ANSI C63.10 during the radiated tests.

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 in dBuv
AF = Antenna Factor in dB/m
CF = Cable Attenuation Factor in dB
AG = Amplifier Gain in dB

11.2.2 Radiated Emissions Test Results

Test Dates	08/09/2022
Test Distance	3 Meters
Specification	FCC Part 15 Subpart C & RSS-210
Abbreviations	P = peak; Q = QP Pol = Antenna Polarization; V = Vertical; H = Horizontal
Tested by	Chris D'Alessio
Note	The following shows the worst case emissions from all transmitters and digital devices. The 125 kHz and the 13.56 MHz transmitter were both on during the following tests.

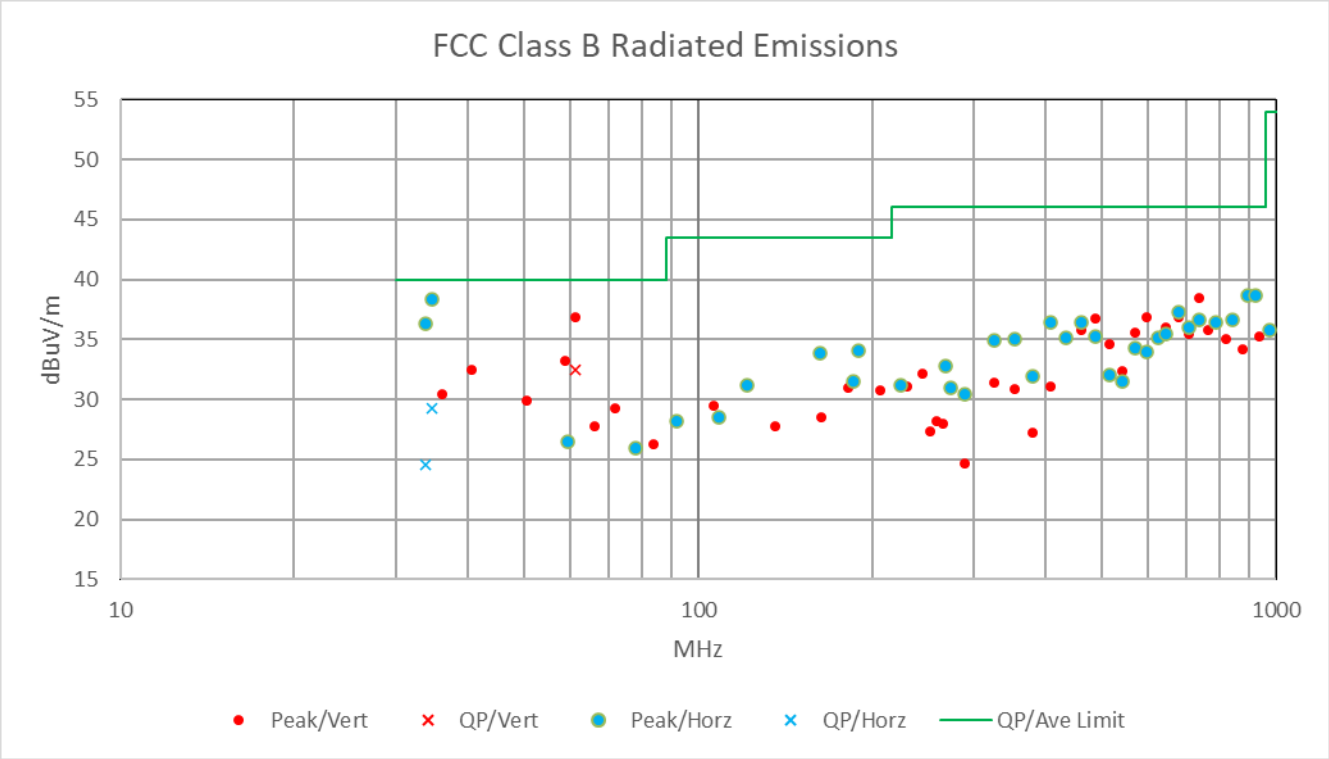
EUT	RDR-80031BKU-V2; Serial Number W200000001

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Antenna Factor (dB/m)	Cable Loss (dB)	Distance Factor (dB)	EUT (dBuV/m)	Limit (dBuV/m)	Margin Under Limit (dB)
33.8	23.2	P	H	12.5	0.6	0.0	36.3	40.0	3.7
33.8	11.5	Q	H	12.5	0.6	0.0	24.6	40.0	15.4
34.6	25.2	P	H	12.5	0.6	0.0	38.3	40.0	1.7
34.6	16.2	Q	H	12.5	0.6	0.0	29.3	40.0	10.7
59.4	16.5	P	H	9.2	0.8	0.0	26.5	40.0	13.5
77.8	15.7	P	H	9.3	1.0	0.0	26.0	40.0	14.0
91.7	17.4	P	H	9.8	1.0	0.0	28.2	43.5	15.3
108.5	16.5	P	H	10.9	1.1	0.0	28.5	43.5	15.0

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Antenna Factor (dB/m)	Cable Loss (dB)	Distance Factor (dB)	EUT (dBuV/m)	Limit (dBuV/m)	Margin Under Limit (dB)
121.8	18.3	P	H	11.7	1.2	0.0	31.2	43.5	12.3
162.7	19.5	P	H	13.0	1.4	0.0	33.9	43.5	9.6
186.0	16.2	P	H	13.8	1.5	0.0	31.5	43.5	12.0
189.9	18.7	P	H	13.9	1.5	0.0	34.1	43.5	9.4
224.5	14.7	P	H	14.9	1.6	0.0	31.2	46.0	14.8
267.9	18.5	P	H	12.5	1.8	0.0	32.8	46.0	13.2
274.0	16.4	P	H	12.8	1.8	0.0	31.0	46.0	15.0
289.6	15.1	P	H	13.5	1.8	0.0	30.4	46.0	15.6
325.4	18.7	P	H	14.2	2.0	0.0	34.9	46.0	11.1
352.7	18.5	P	H	14.4	2.1	0.0	35.0	46.0	11.0
379.7	15.0	P	H	14.8	2.1	0.0	31.9	46.0	14.1
406.9	18.7	P	H	15.5	2.2	0.0	36.4	46.0	9.6
433.9	16.8	P	H	16.0	2.3	0.0	35.1	46.0	10.9
461.1	17.2	P	H	16.8	2.4	0.0	36.4	46.0	9.6
488.1	15.8	P	H	17.0	2.5	0.0	35.3	46.0	10.7
515.5	10.7	P	H	18.7	2.6	0.0	32.0	46.0	14.0
542.5	10.9	P	H	18.0	2.6	0.0	31.5	46.0	14.5
569.6	13.2	P	H	18.4	2.7	0.0	34.3	46.0	11.7
596.6	12.6	P	H	18.7	2.7	0.0	34.0	46.0	12.0
626.6	13.2	P	H	19.1	2.8	0.0	35.1	46.0	10.9
645.6	13.2	P	H	19.5	2.8	0.0	35.5	46.0	10.5
678.2	13.5	P	H	20.9	2.9	0.0	37.3	46.0	8.7
705.2	11.7	P	H	21.3	3.0	0.0	36.0	46.0	10.0
735.7	12.5	P	H	21.0	3.1	0.0	36.6	46.0	9.4
786.3	12.2	P	H	21.0	3.2	0.0	36.4	46.0	9.6
840.8	11.2	P	H	22.1	3.3	0.0	36.6	46.0	9.4
894.9	12.5	P	H	22.8	3.4	0.0	38.7	46.0	7.3
921.9	12.3	P	H	23.0	3.4	0.0	38.7	46.0	7.3
975.0	8.6	P	H	23.6	3.6	0.0	35.8	54.0	18.2
36.0	17.7	P	V	12.1	0.6	0.0	30.4	40.0	9.6
40.6	20.7	P	V	11.1	0.7	0.0	32.5	40.0	7.5
50.6	19.4	P	V	9.7	0.8	0.0	29.9	40.0	10.1
58.8	23.1	P	V	9.3	0.8	0.0	33.2	40.0	6.8
61.2	26.9	P	V	9.2	0.8	0.0	36.9	40.0	3.1
61.2	22.5	Q	V	9.2	0.8	0.0	32.5	40.0	7.5
66.3	17.7	P	V	9.3	0.8	0.0	27.8	40.0	12.2
72.0	19.1	P	V	9.3	0.9	0.0	29.3	40.0	10.7
83.8	15.8	P	V	9.5	1.0	0.0	26.3	40.0	13.7
106.3	17.7	P	V	10.7	1.1	0.0	29.5	43.5	14.0
135.7	14.1	P	V	12.4	1.3	0.0	27.8	43.5	15.7
163.0	14.1	P	V	13.0	1.4	0.0	28.5	43.5	15.0
182.0	15.9	P	V	13.6	1.5	0.0	31.0	43.5	12.5
206.5	14.6	P	V	14.6	1.6	0.0	30.8	43.5	12.7
229.5	14.4	P	V	15.0	1.7	0.0	31.1	46.0	14.9
243.9	15.1	P	V	15.3	1.7	0.0	32.1	46.0	13.9
252.3	13.6	P	V	12.0	1.7	0.0	27.3	46.0	18.7
258.1	14.2	P	V	12.2	1.8	0.0	28.2	46.0	17.8
265.1	13.8	P	V	12.4	1.8	0.0	28.0	46.0	18.0
289.6	9.4	P	V	13.5	1.8	0.0	24.7	46.0	21.3
325.4	15.2	P	V	14.2	2.0	0.0	31.4	46.0	14.6
352.7	14.4	P	V	14.4	2.1	0.0	30.9	46.0	15.1
378.7	10.4	P	V	14.7	2.1	0.0	27.2	46.0	18.8
406.9	13.4	P	V	15.5	2.2	0.0	31.1	46.0	14.9
461.1	16.6	P	V	16.8	2.4	0.0	35.8	46.0	10.2

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Antenna Factor (dB/m)	Cable Loss (dB)	Distance Factor (dB)	EUT (dBuV/m)	Limit (dBuV/m)	Margin Under Limit (dB)
488.1	17.2	P	V	17.0	2.5	0.0	36.7	46.0	9.3
515.5	13.3	P	V	18.7	2.6	0.0	34.6	46.0	11.4
542.5	11.8	P	V	18.0	2.6	0.0	32.4	46.0	13.6
569.6	14.5	P	V	18.4	2.7	0.0	35.6	46.0	10.4
596.6	15.4	P	V	18.7	2.7	0.0	36.8	46.0	9.2
623.6	13.2	P	V	19.1	2.8	0.0	35.1	46.0	10.9
645.6	13.7	P	V	19.5	2.8	0.0	36.0	46.0	10.0
678.2	13.0	P	V	20.9	2.9	0.0	36.8	46.0	9.2
705.2	11.2	P	V	21.3	3.0	0.0	35.5	46.0	10.5
736.2	14.4	P	V	21.0	3.1	0.0	38.5	46.0	7.5
763.3	11.7	P	V	21.0	3.1	0.0	35.8	46.0	10.2
820.3	10.1	P	V	21.6	3.3	0.0	35.0	46.0	11.0
874.9	8.3	P	V	22.6	3.3	0.0	34.2	46.0	11.8
936.4	8.6	P	V	23.1	3.5	0.0	35.2	46.0	10.8

Radiated emissions in a graphical format. The following chart has the same data as the previous table.

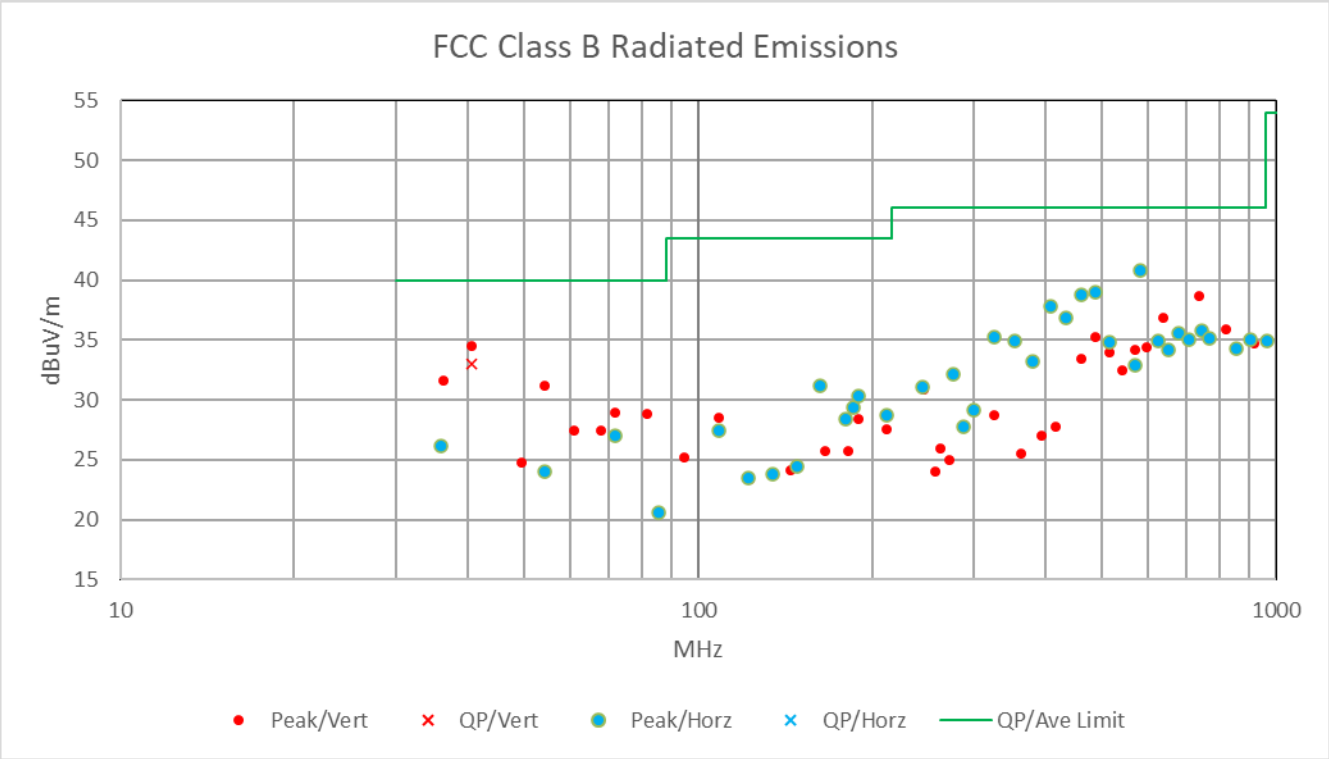


EUT	RDR-80032BKU-V2-IMP; Serial Number W200000012

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Antenna Factor (dB/m)	Cable Loss (dB)	Distance Factor (dB)	EUT (dBuV/m)	Limit (dBuV/m)	Margin Under Limit (dB)
35.8	13.4	P	H	12.2	0.6	0.0	26.2	40.0	13.8
54.3	13.8	P	H	9.4	0.8	0.0	24.0	40.0	16.0
72.0	16.8	P	H	9.3	0.9	0.0	27.0	40.0	13.0
85.3	10.1	P	H	9.5	1.0	0.0	20.6	40.0	19.4
108.5	15.4	P	H	10.9	1.1	0.0	27.4	43.5	16.1
122.2	10.5	P	H	11.8	1.2	0.0	23.5	43.5	20.0
134.4	10.2	P	H	12.3	1.3	0.0	23.8	43.5	19.7
147.9	10.5	P	H	12.7	1.3	0.0	24.5	43.5	19.0
162.7	16.8	P	H	13.0	1.4	0.0	31.2	43.5	12.3
180.0	13.3	P	H	13.6	1.5	0.0	28.4	43.5	15.1
186.0	14.1	P	H	13.8	1.5	0.0	29.4	43.5	14.1
189.9	14.9	P	H	13.9	1.5	0.0	30.3	43.5	13.2
211.6	12.4	P	H	14.7	1.6	0.0	28.7	43.5	14.8
244.4	14.1	P	H	15.3	1.7	0.0	31.1	46.0	14.9
276.0	17.5	P	H	12.9	1.8	0.0	32.2	46.0	13.8
287.8	12.5	P	H	13.5	1.8	0.0	27.8	46.0	18.2
299.4	13.3	P	H	14.0	1.9	0.0	29.2	46.0	16.8
325.4	19.1	P	H	14.2	2.0	0.0	35.3	46.0	10.7
352.7	18.4	P	H	14.4	2.1	0.0	34.9	46.0	11.1
379.7	16.3	P	H	14.8	2.1	0.0	33.2	46.0	12.8
406.9	20.1	P	H	15.5	2.2	0.0	37.8	46.0	8.2
433.9	18.5	P	H	16.0	2.3	0.0	36.8	46.0	9.2
461.1	19.6	P	H	16.8	2.4	0.0	38.8	46.0	7.2
488.1	19.5	P	H	17.0	2.5	0.0	39.0	46.0	7.0
515.5	13.5	P	H	18.7	2.6	0.0	34.8	46.0	11.2
569.6	11.8	P	H	18.4	2.7	0.0	32.9	46.0	13.1
581.1	19.5	P	H	18.6	2.7	0.0	40.8	46.0	5.2
626.6	13.0	P	H	19.1	2.8	0.0	34.9	46.0	11.1
651.2	11.6	P	H	19.8	2.8	0.0	34.2	46.0	11.8
678.2	11.8	P	H	20.9	2.9	0.0	35.6	46.0	10.4
705.2	10.7	P	H	21.3	3.0	0.0	35.0	46.0	11.0
743.2	11.8	P	H	20.9	3.1	0.0	35.8	46.0	10.2
765.8	11.0	P	H	21.0	3.1	0.0	35.1	46.0	10.9
852.4	8.6	P	H	22.4	3.3	0.0	34.3	46.0	11.7
904.4	8.8	P	H	22.8	3.4	0.0	35.0	46.0	11.0
965.5	7.9	P	H	23.5	3.5	0.0	34.9	54.0	19.1
36.2	18.9	P	V	12.1	0.6	0.0	31.6	40.0	8.4
40.6	22.7	P	V	11.1	0.7	0.0	34.5	40.0	5.5
40.6	21.2	Q	V	11.1	0.7	0.0	33.0	40.0	7.0
49.5	14.4	P	V	9.7	0.7	0.0	24.8	40.0	15.2
54.3	21.0	P	V	9.4	0.8	0.0	31.2	40.0	8.8
61.0	17.4	P	V	9.2	0.8	0.0	27.4	40.0	12.6
67.8	17.3	P	V	9.2	0.9	0.0	27.4	40.0	12.6
72.0	18.7	P	V	9.3	0.9	0.0	28.9	40.0	11.1
81.5	18.4	P	V	9.4	1.0	0.0	28.8	40.0	11.2
94.8	14.2	P	V	10.0	1.0	0.0	25.2	43.5	18.3
108.5	16.5	P	V	10.9	1.1	0.0	28.5	43.5	15.0
122.5	10.4	P	V	11.8	1.2	0.0	23.4	43.5	20.1
144.2	10.2	P	V	12.6	1.3	0.0	24.1	43.5	19.4
166.1	11.2	P	V	13.1	1.4	0.0	25.7	43.5	17.8

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Antenna Factor (dB/m)	Cable Loss (dB)	Distance Factor (dB)	EUT (dBuV/m)	Limit (dBuV/m)	Margin Under Limit (dB)
182.0	10.6	P	V	13.6	1.5	0.0	25.7	43.5	17.8
189.9	13.0	P	V	13.9	1.5	0.0	28.4	43.5	15.1
211.8	11.2	P	V	14.7	1.6	0.0	27.5	43.5	16.0
245.7	13.9	P	V	15.3	1.7	0.0	30.9	46.0	15.1
257.3	10.1	P	V	12.2	1.7	0.0	24.0	46.0	22.0
263.1	11.8	P	V	12.4	1.8	0.0	26.0	46.0	20.0
272.0	10.5	P	V	12.7	1.8	0.0	25.0	46.0	21.0
325.4	12.5	P	V	14.2	2.0	0.0	28.7	46.0	17.3
362.5	9.0	P	V	14.4	2.1	0.0	25.5	46.0	20.5
393.5	9.5	P	V	15.3	2.2	0.0	27.0	46.0	19.0
416.0	9.9	P	V	15.6	2.3	0.0	27.8	46.0	18.2
461.1	14.2	P	V	16.8	2.4	0.0	33.4	46.0	12.6
488.1	15.7	P	V	17.0	2.5	0.0	35.2	46.0	10.8
515.5	12.7	P	V	18.7	2.6	0.0	34.0	46.0	12.0
542.5	11.9	P	V	18.0	2.6	0.0	32.5	46.0	13.5
569.6	13.1	P	V	18.4	2.7	0.0	34.2	46.0	11.8
596.6	13.0	P	V	18.7	2.7	0.0	34.4	46.0	11.6
639.6	14.7	P	V	19.4	2.8	0.0	36.9	46.0	9.1
736.2	14.6	P	V	21.0	3.1	0.0	38.7	46.0	7.3
821.3	11.0	P	V	21.6	3.3	0.0	35.9	46.0	10.1
915.9	8.4	P	V	22.9	3.4	0.0	34.7	46.0	11.3

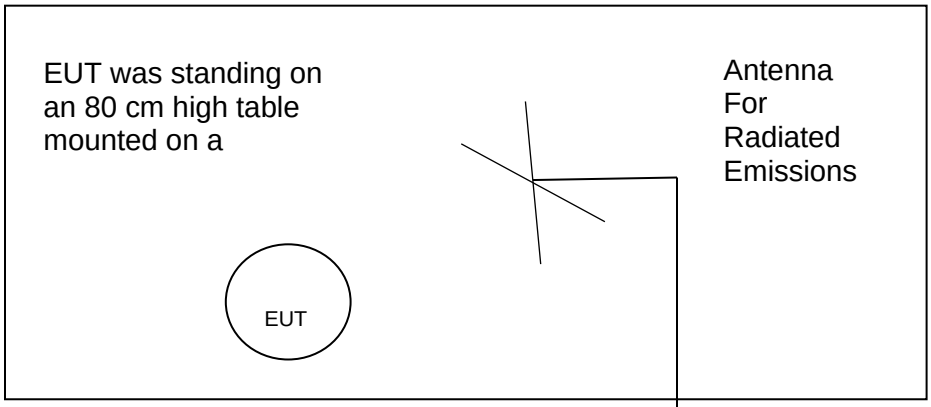
Radiated emissions in a graphical format. The following chart has the same data as the previous table.



Judgment: Passed by 5.2 dB; Where both peak data and quasi-peak data is performed, the quasi-peak is the final determination of compliance.

Figure 2. Drawing of Radiated Emissions Test Setup

Chamber E, anechoic

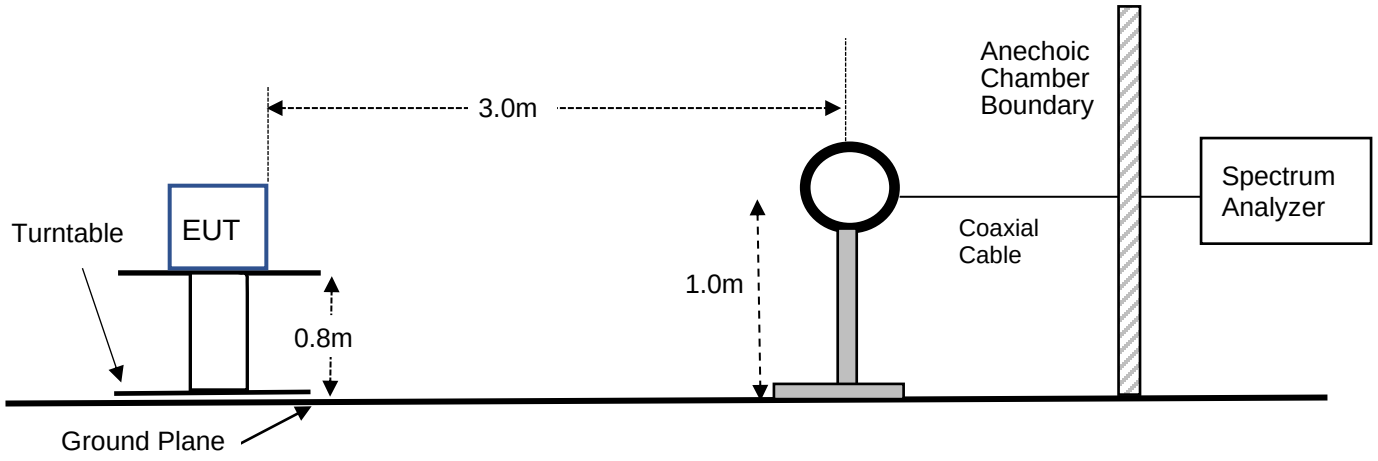


Spectrum Analyzer

Notes:
- Not to Scale
- AC cords not shown. They are connected to an AC outlet with low-pass filter on turntable

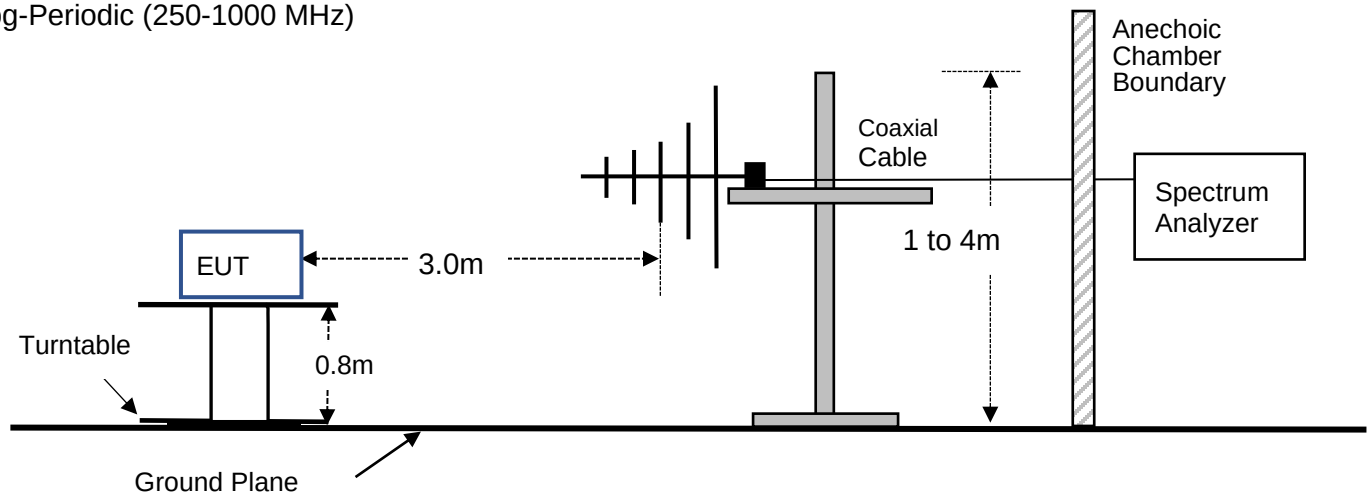
Frequency Range	Receive Antenna	Spectrum Analyzer
0.01 to 30 MHz	ANT-53	REC-21
30 to 200 MHz	ANT-80	REC-21
200 to 1000 MHz	ANT-68	REC-21

Radiated Emissions Test Setup for Frequencies Below 30MHz (Side View)



Radiated Emissions Test Setup for Frequencies from 30MHz to 1000MHz (Side View)

Biconical antenna (30-250 MHz)
Log-Periodic (250-1000 MHz)



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

From 9 kHz to 490 kHz, the Specifcation Distance is 300m therefore the distance factor is 2*20*LOG(300/3) = 80 dB.
From 490 kHz to 30 MHz, the Specifcation Distance is 30m therefore the distance factor is 2*20*LOG(30/3) = 40 dB.

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

Test Date	08/09/2022
EUT	Model: RDR-80031BKU-V2; Serial Number W200000001; EUT #1 Model: RDR-80032BKU-V2-IMP; Serial Number W200000012; EUT #2
Test Distance	3 Meters
Specification	FCC 15 & RSS-GEN
Notes	A shielded Loop Antenna was used for this test. Test were performed with a 0.8 meter table
Tested by	Chris D'Alessio

Freq (kHz)	Peak reading dBuV	Loop Ant Factor dB/m	Test Dist. (m)	Decay exp	Cable Loss dB	FCC Distance factor dB	Field Strength dBuV/m	RSS & FCC Limit dBuV/m	Margin under limit	Notes
125.0	61.2	18.9	3.0	2.0	0.1	-80.0	0.2	25.7	25.5	EUT #1
250.0	36.5	18.6	3.0	2.0	0.1	-80.0	-24.8	19.6	44.4	EUT #1
375.0	33.6	18.4	3.0	2.0	0.1	-80.0	-27.9	16.1	44.0	EUT #1
13560	51.6	16.0	3.0	2.0	0.4	-40.0	28.0	29.5	1.5	EUT #1
27120	20.3	15.3	3.0	2.0	0.5	-40.0	-3.9	29.5	33.4	EUT #1
125.0	62.5	18.9	3.0	2.0	0.1	-80.0	1.5	25.7	24.2	EUT #2
250.0	36.9	18.6	3.0	2.0	0.1	-80.0	-24.4	19.6	44.0	EUT #2
375.0	33.1	18.4	3.0	2.0	0.1	-80.0	-28.4	16.1	44.5	EUT #2
13560	51.5	16.0	3.0	2.0	0.4	-40.0	27.9	29.5	1.6	EUT #2
27120	19.8	15.3	3.0	2.0	0.5	-40.0	-4.4	29.5	33.9	EUT #2

All limits above are the general limits of FCC 15.209 or the RSS-Gen including the 13.56 MHz.

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 B.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.

Therefore, it met all limits since the general limits are lower than the FCC 15.225 and the RSS-210 section B.6 (a) limits.

The emissions were scanned from 10 kHz to 30 MHz, including 13.11 and 14.01 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 general limit by 1.5 dB at 13.56 MHz. Passed all other emissions by at least 10 dB.

11.4 Occupied Bandwidth Data

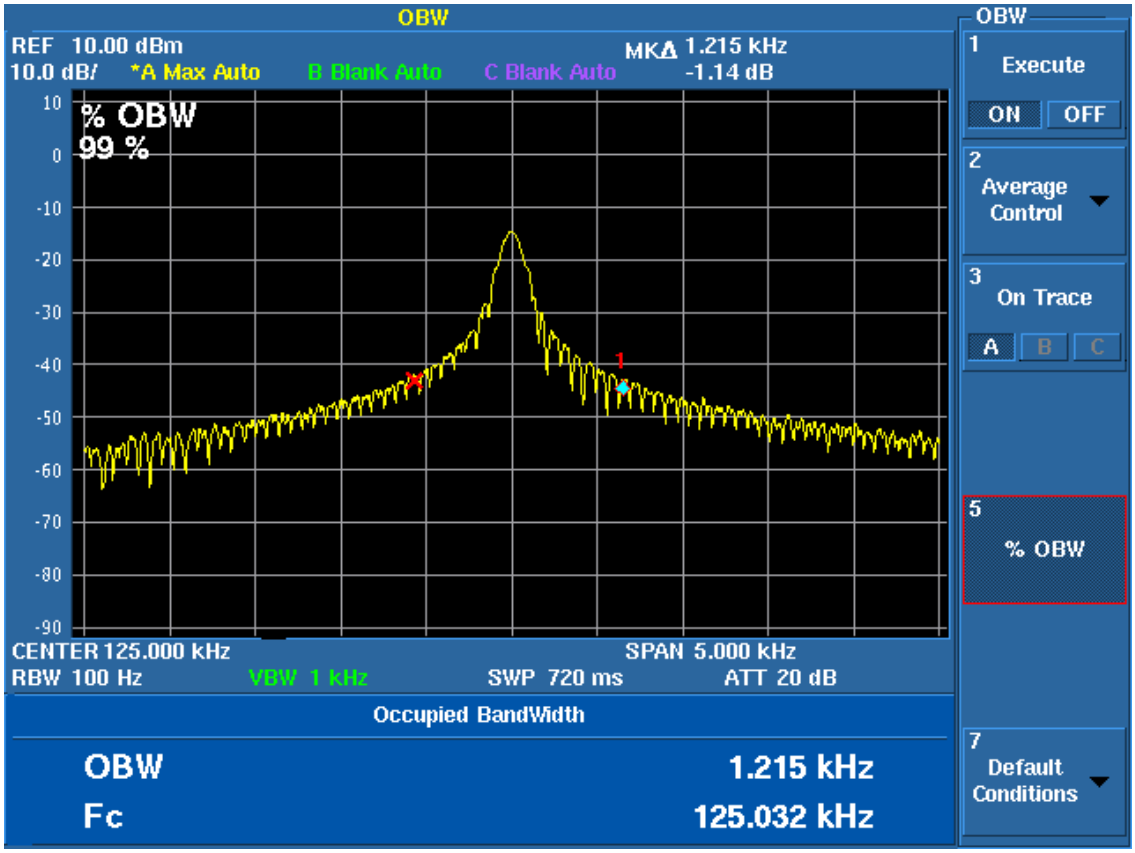
The occupied bandwidth of the RF output was measured using a spectrum analyzer using a peak detector function and a narrow resolution bandwidth. A broadband antenna was used to receive the modulated signal. The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The spectrum analyzer display was digitized and plotted. The plots of the occupied bandwidth for the EUT are supplied on the following page.

Model	RDR-80031BKU-V2; EUT #1 RDR-80032BKU-V2-IMP; EUT #2	Specification	FCC Part 15.225 RSS-210
Serial Number	W20000001; EUT #1 W200000012; EUT #2	Test Date	08/18/2022
Test Personnel	Joseph Strzelecki	Equipment	REC-43

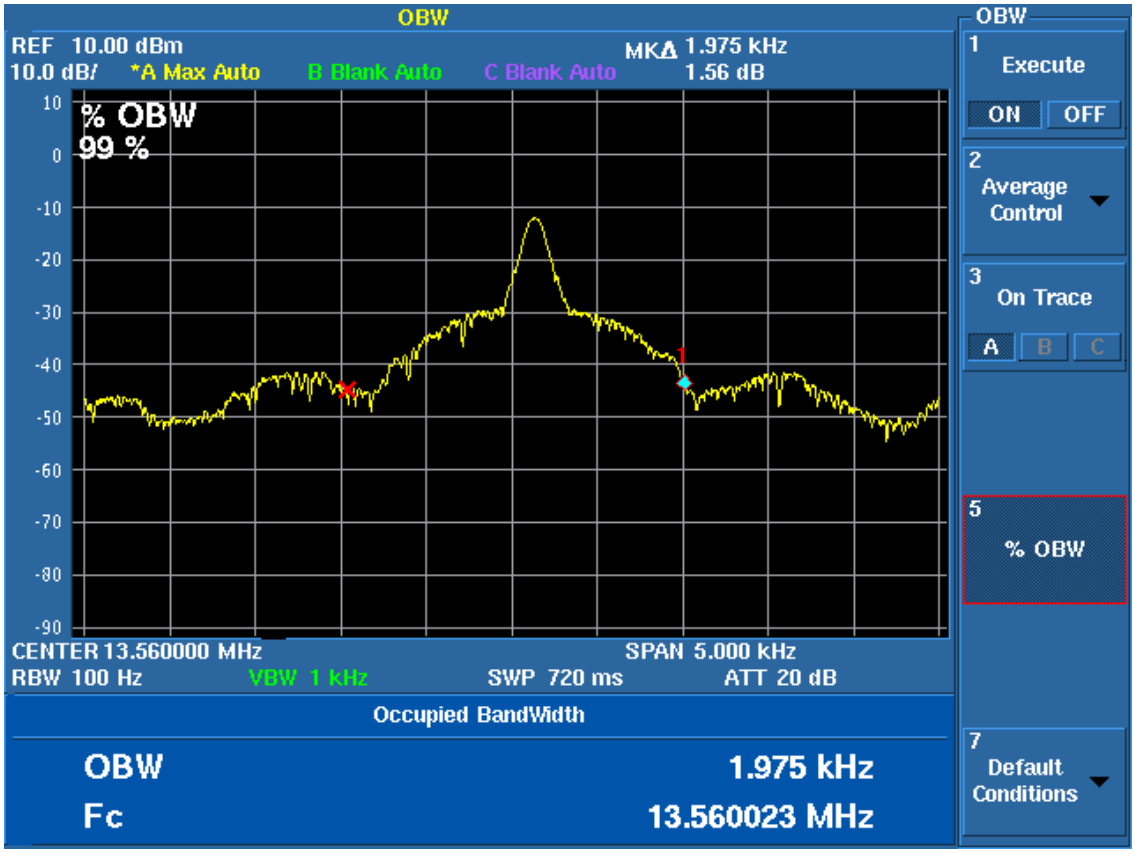
99% OBW = 1.215 kHz at 125 kHz #1
99% OBW = 1.975 kHz at 13.56 MHz #1
99% OBW = 1.195 kHz at 125 kHz #2
99% OBW = 2.005 kHz at 13.56 MHz #2

Judgement: Pass

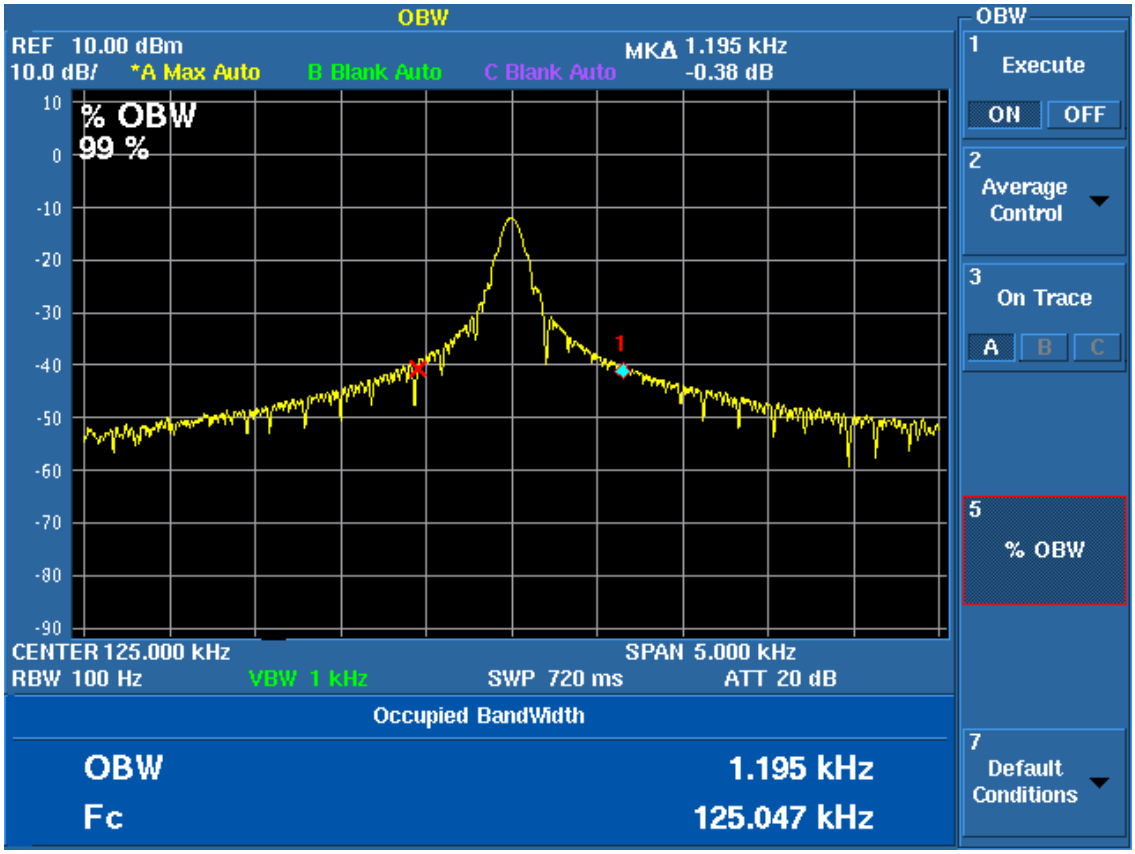
Figure 3. Occupied Bandwidth Plots



RDR-80031BKU-V2



RDR-80031BKU-V2



RDR-80031BKU-V2-IMP

RDR-80031BKU-V2-IMP

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 with REC-11	136 Hz
99% Occupied Bandwidth using REC-43	1% of frequency span
Temperature THM-03	0.6 Deg C

13.0 REVISION HISTORY

RP-9687 Revisions:			
Rev.	Affected Sections	Description	Rationale
1	2 & 11.3.1	Statement explaining why Emissions Masks were not included	Clarification
1	4.4	Revised permissive change description	Clarification