



Electromagnetic Compatibility Test Report

Tests Performed on an rf IDEas, Inc.

Wave ID Mobile Keystroke USB Reader with Removeable Hinge Cover

Model WF30100

Radiometrics Document RP-9846A



Product Detail:

FCC ID: M9MW30300

IC: 6571A-W30300

Equipment type: Dual Frequency RFID Reader

Test Standards:

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

FCC Part 15 CFR Title 47: 2022

Canada ISSED; RSS-GEN, Issue 5: 2021

Canada ISSED; RSS-210, Issue 10: 2020

This report concerns: Original Grant

FCC Parts 15.209 and 15.225

Tests Performed For:

rf IDEAS, Inc.

425 Martingale Road, Suite 1680

Schaumburg, IL 60148

Test Facility:

Radiometrics Midwest Corporation

12 East Devonwood Avenue

Romeoville, IL 60446

Test Completion Date

June 29, 2023

Document RP-9846A Revisions:

Rev.	Issue Date	Revised By
0	February 6, 2024	



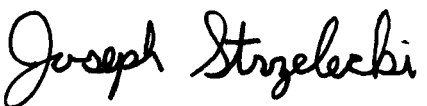
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1.0 ADMINISTRATIVE DATA

<i>Equipment Under Test:</i> An rf IDEas, Inc., WAVE ID Mobile Keystroke USB Reader with Removeable Hinge Cover Model: WF30100 Serial Number: WFM8000027 Firmware Number: WNC010500UBP700.H/ WNB020200 This will be referred to as the EUT in this Report	
<i>Date EUT Received at Radiometrics:</i> June 23, 2023	<i>Test Date(s):</i> June 23 to 29, 2023
<i>Test Report Written and Authorized By:</i> Joseph Strzelecki Senior EMC Engineer	<i>Test Witnessed By:</i> The tests were partially witnessed by Shiung Lo rf IDEas, Inc.
<i>Radiometrics' Personnel Responsible for Test:</i>  02/06/2024 Date Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE Chris Dalessio EMC Technician	<i>EUT Checked By:</i> Joseph Strzelecki Radiometrics The above personnel certifies: (1) The EUT had no loss of performance beyond the manufacture's performance level during the immunity tests. (2) A functional test was performed on the EUT after the immunity tests and no damage was sustained.

2.0 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a Dual Frequency RFID Reader, Model WF30100, 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	125 kHz and 13.56 MHz	RSS-210 & FCC Part 15	Pass
Frequency Stability vs Temp & Voltage	13.56 MHz	RSS-210 & FCC Part 15	Pass

The non-radio portion of the product is approved under the FCC's Supplier's Declaration of Conformity Procedures.



2.1 RF Exposure Compliance Requirements

Since the effective radiated power output is less than 10 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 Mobile Keystroke USB Reader with Removable Hinge Cover, Model WF30100, manufactured by rf IDEas, Inc. The EUT was in good working condition during the tests, with no known defects.

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 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. The wiring was consistent with the manufacturer's recommendations. Power was supplied at 115 VAC, 60 Hz single-phase to the host computer. The EUT was powered from the USB 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	Dual Frequency RFID Reader	E	rf IDEas	WF30100	WFM8000027
2	Latitude Laptop PC	H	HP	Elite x2	5CG545482P
3	Laptop AC-DC power supply	P	HP	854055-002	A000133

* 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.

5.0 TEST SPECIFICATIONS

Document	Date	Title
FCC CFR Title 47	2023	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices
IC RSS-210 Issue 10	2020	Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands) Category I Equipment
IC RSS-Gen Issue 5	2021	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 absorbers. 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 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	794	20-330MHz	24 Mo.	01/26/23
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-44	Agilent	Spectrum Analyzer	E4440A	US40420673	3Hz-26.5GHz	24 Mo.	03/31/22
TC-01	GS Blue M Electric	Temperature Chamber	ETC-04S-E	0003-ETC-201	-40 to 100 Deg C	24 Mo.	10/14/22
TMP-01	Fluke	Temperature meter	80T-150UA	38280311	N/A	24 Mo.	07/11/22

Note: All calibrated equipment is subject to periodic checks.

Software Company	Test Software Name	Version	Applicable Tests
Radiometrics	EN550XX0	07.21.22	RF Conducted Emissions (FCC/CE)
Radiometrics	REREC11D	07.25.22	RF Radiated Emissions (FCC/CE)
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.		

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.

In accordance with the FCC rules regarding transmitters below 30 MHz.

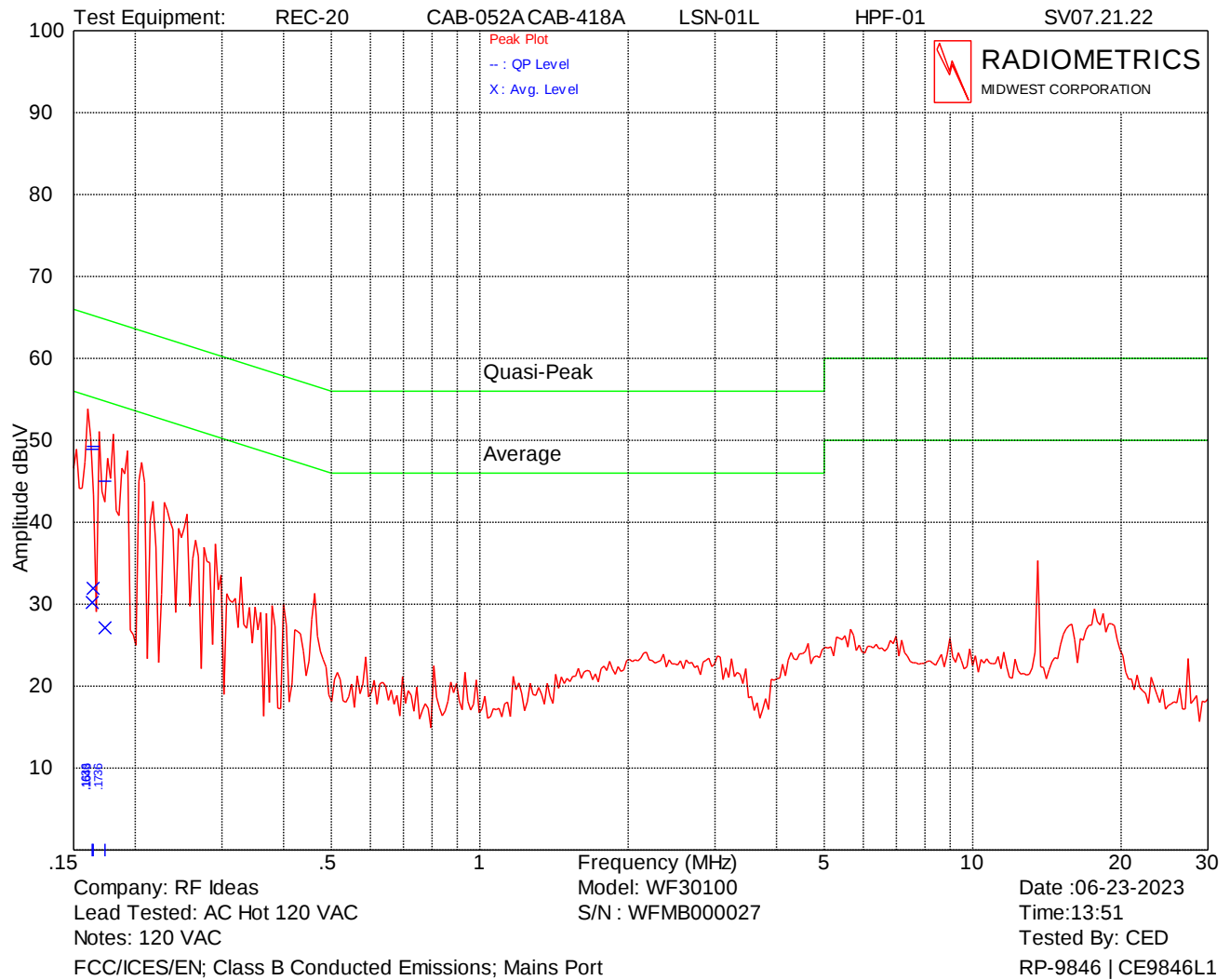
The transmitter was tested with a dummy load under the following conditions:

- 1) First, the AC line conducted tests with the antenna attached were performed to determine if the EUT complies with the 15.207 limits outside of the transmitter's fundamental emission band.
- 2) The AC line conducted emissions were retested with a dummy load to make sure the device complies with the 15.207 limits inside the transmitter's fundamental emission band. Only the fundamental TX emission band needs to be retested. The load was 50 Ohm. This is the characteristic impedance of the antenna.

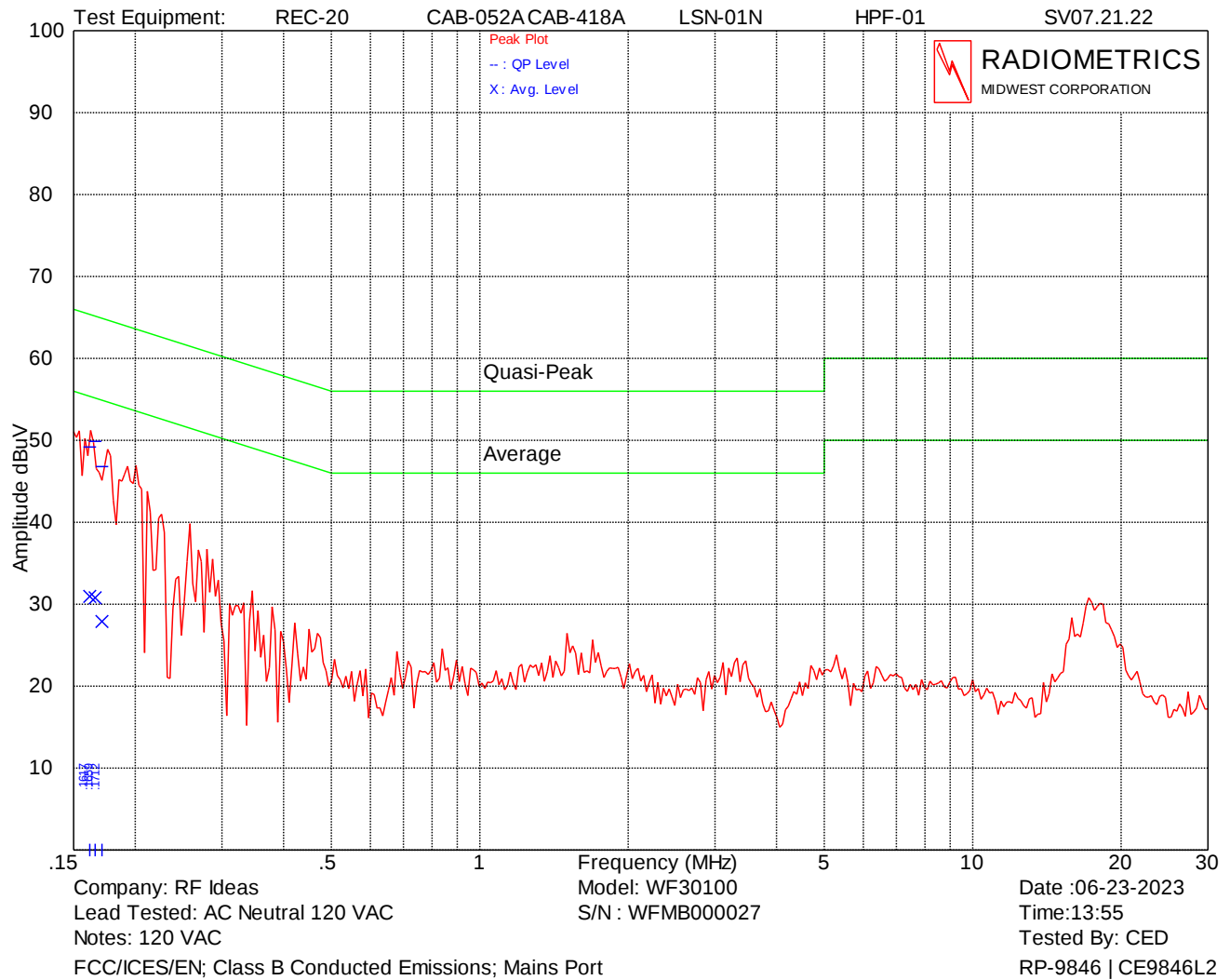
Test Date : June 6 , 2023

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

The Limit shown above is RSS-GEN Table 3.



Frequency (MHz)	QP Amplitude (dBuV)	QP Limit (dBuV)	Average Amplitude (dBuV)	Average Limit (dBuV)	Margin (dB)
0.164	49.3	65.2	31.9	55.2	16.0
0.174	45.0	64.8	27.1	54.8	19.8

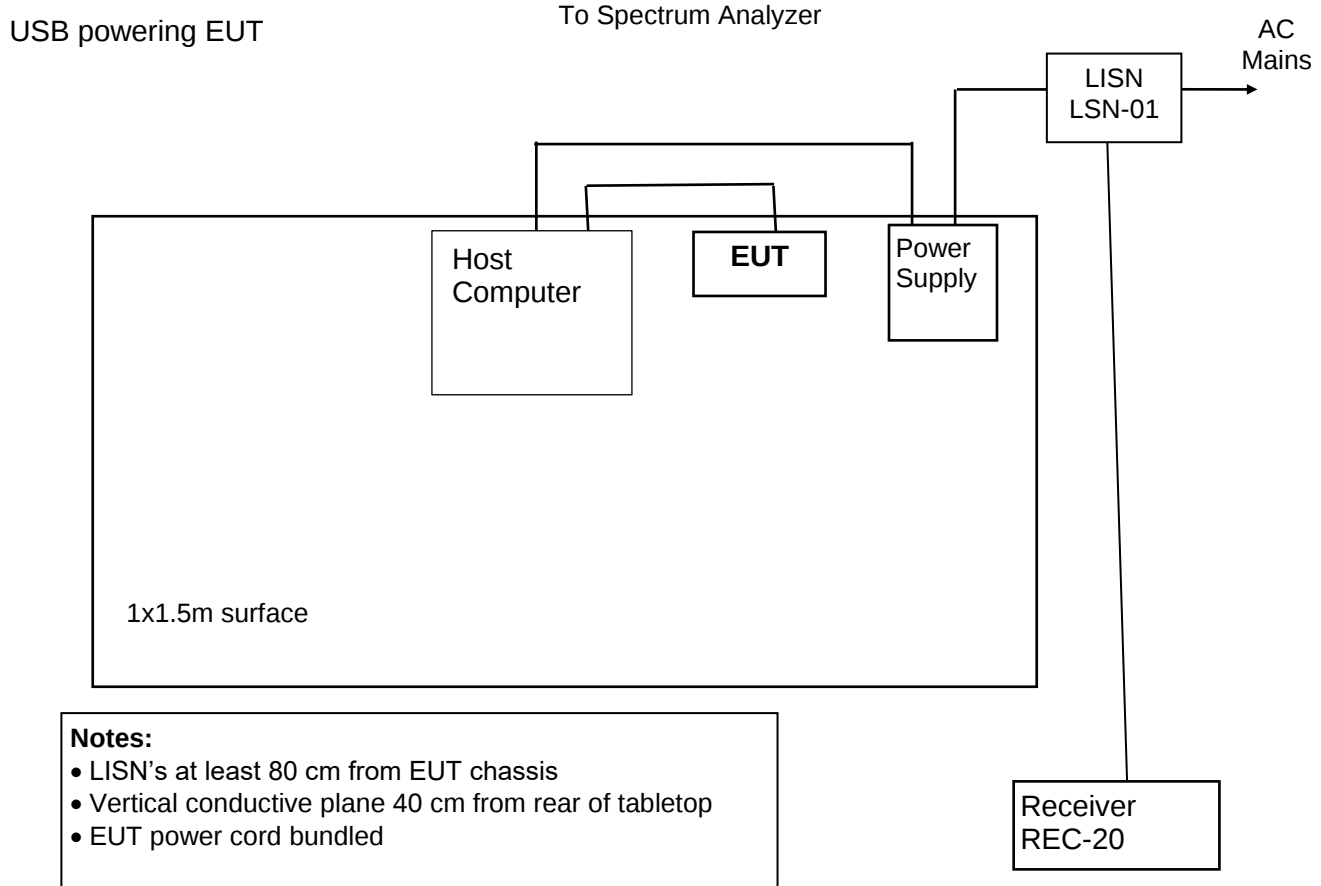


Frequency (MHz)	QP Amplitude (dBuV)	QP Limit (dBuV)	Average Amplitude (dBuV)	Average Limit (dBuV)	Margin (dB)
0.162	49.2	65.4	31.0	55.4	16.2
0.166	49.9	65.2	30.8	55.2	15.3
0.171	46.8	64.9	27.9	54.9	18.1

Judgement: Pass by at least 15 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 kHz and the bandwidth from 30 MHz to 1000 MHz is 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.

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 Attenuation Factor, and by subtracting the Amplifier Gain from the measured reading. Each antenna, cable and amplifier has individual factors across its usable frequency range. The antenna factor converts the voltage reading in dBuV to field strength in dBuV/meter. The equation is as follows:

$$FS = RA + AF + CF - AG$$

Where: FS = Field Strength in dBuV/m

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 (30-1000 MHz)

Test Date	06/23/2023
Test Distance	3 Meters
Specification	FCC Part 15 Subpart C & RSS-210
Notes	The actual FCC limits are in uV/m. The data in the table below converted the limit to dBuV/m The QP data is the final measure of Compliance
Abbreviations	P = peak; Q = QP Pol = Antenna Polarization; V = Vertical; H = Horizontal

EUT		Model WF30100; S/N: WFM8000027							
Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor dB/m	Cable Factors dB	Dist. Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB
37.3	13.9	P	H	11.3	0.6	0.0	25.8	40.0	14.2
56.5	12.1	P	H	8.8	0.8	0.0	21.7	40.0	18.3
66.7	12.7	P	H	9.1	0.8	0.0	22.6	40.0	17.4
69.4	9.7	P	H	8.9	0.9	0.0	19.5	40.0	20.5
85.1	10.2	P	H	9.1	1.0	0.0	20.3	40.0	19.7
89.1	10.3	P	H	9.3	1.0	0.0	20.6	43.5	22.9
102.1	12.6	P	H	10.3	1.1	0.0	24.0	43.5	19.5



EUT Model WF30100; S/N: WFM8000027									
Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor dB/m	Cable Factors dB	Dist. Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB
114.1	12.5	P	H	11.1	1.1	0.0	24.7	43.5	18.8
119.6	11.7	P	H	11.5	1.2	0.0	24.4	43.5	19.1
139.5	13.6	P	H	12.4	1.3	0.0	27.3	43.5	16.2
150.1	13.8	P	H	12.6	1.3	0.0	27.7	43.5	15.8
162.7	15.9	P	H	12.8	1.4	0.0	30.1	43.5	13.4
174.0	14.8	P	H	13.2	1.4	0.0	29.4	43.5	14.1
189.9	19.6	P	H	13.8	1.5	0.0	34.9	43.5	8.6
189.9	16.7	Q	H	13.8	1.5	0.0	32.0	43.5	11.5
203.4	13.8	P	H	14.4	1.6	0.0	29.8	43.5	13.7
216.9	21.5	P	H	14.7	1.6	0.0	37.8	46.0	8.2
216.9	18.9	Q	H	14.7	1.6	0.0	35.2	46.0	10.8
234.0	14.2	P	H	14.9	1.7	0.0	30.8	46.0	15.2
244.1	19.2	P	H	15.2	1.7	0.0	36.1	46.0	9.9
261.9	17.6	P	H	12.3	1.8	0.0	31.7	46.0	14.3
268.7	17.5	P	H	12.6	1.8	0.0	31.9	46.0	14.1
271.2	18.2	P	H	12.7	1.8	0.0	32.7	46.0	13.3
283.6	12.8	P	H	13.3	1.8	0.0	27.9	46.0	18.1
298.4	19.4	P	H	13.9	1.9	0.0	35.2	46.0	10.8
325.4	17.6	P	H	14.2	2.0	0.0	33.8	46.0	12.2
352.7	14.7	P	H	14.4	2.1	0.0	31.2	46.0	14.8
379.7	12.5	P	H	14.8	2.1	0.0	29.4	46.0	16.6
418.8	11.5	P	H	15.6	2.3	0.0	29.4	46.0	16.6
479.0	10.1	P	H	17.1	2.4	0.0	29.6	46.0	16.4
559.6	8.5	P	H	18.2	2.6	0.0	29.3	46.0	16.7
581.1	17.3	P	H	18.6	2.7	0.0	38.6	46.0	7.4
617.6	9.7	P	H	18.9	2.8	0.0	31.4	46.0	14.6
655.7	10.1	P	H	20.0	2.8	0.0	32.9	46.0	13.1
754.8	8.2	P	H	20.9	3.1	0.0	32.2	46.0	13.8
767.8	9.3	P	H	21.0	3.1	0.0	33.4	46.0	12.6
823.3	7.7	P	H	21.6	3.3	0.0	32.6	46.0	13.4
843.8	8.4	P	H	22.1	3.3	0.0	33.8	46.0	12.2
924.4	7.7	P	H	23.0	3.4	0.0	34.1	46.0	11.9
930.9	8.7	P	H	23.1	3.5	0.0	35.3	46.0	10.7
32.9	18.4	P	V	12.4	0.6	0.0	31.4	40.0	8.6
33.5	15.7	P	V	12.3	0.6	0.0	28.6	40.0	11.4
40.8	14.5	P	V	10.5	0.7	0.0	25.7	40.0	14.3
43.7	14.7	P	V	10.0	0.7	0.0	25.4	40.0	14.6
46.1	15.2	P	V	9.9	0.7	0.0	25.8	40.0	14.2
54.3	17.8	P	V	9.2	0.8	0.0	27.8	40.0	12.2
61.9	18.5	P	V	9.0	0.8	0.0	28.3	40.0	11.7
66.9	14.6	P	V	9.1	0.8	0.0	24.5	40.0	15.5
68.1	13.2	P	V	8.8	0.9	0.0	22.9	40.0	17.1
73.6	14.7	P	V	9.0	0.9	0.0	24.6	40.0	15.4
89.5	11.4	P	V	9.4	1.0	0.0	21.8	43.5	21.7
95.0	12.9	P	V	9.9	1.0	0.0	23.8	43.5	19.7
105.7	13.1	P	V	10.5	1.1	0.0	24.7	43.5	18.8
114.1	9.8	P	V	11.1	1.1	0.0	22.0	43.5	21.5
129.3	10.0	P	V	11.9	1.2	0.0	23.1	43.5	20.4
130.9	11.1	P	V	12.0	1.2	0.0	24.3	43.5	19.2
149.5	10.9	P	V	12.6	1.3	0.0	24.8	43.5	18.7
151.0	9.9	P	V	12.6	1.3	0.0	23.8	43.5	19.7
171.8	10.5	P	V	13.1	1.4	0.0	25.0	43.5	18.5



EUT		Model WF30100; S/N: WFM8000027							
Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor dB/m	Cable Factors dB	Dist. Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB
173.6	10.1	P	V	13.2	1.4	0.0	24.7	43.5	18.8
196.1	10.3	P	V	14.1	1.5	0.0	25.9	43.5	17.6
214.7	11.0	P	V	14.7	1.6	0.0	27.3	43.5	16.2
237.9	11.3	P	V	15.0	1.7	0.0	28.0	46.0	18.0
238.4	10.6	P	V	15.0	1.7	0.0	27.3	46.0	18.7
254.3	16.1	P	V	12.1	1.7	0.0	29.9	46.0	16.1
325.4	13.1	P	V	14.2	2.0	0.0	29.3	46.0	16.7
352.7	12.1	P	V	14.4	2.1	0.0	28.6	46.0	17.4
371.3	9.1	P	V	14.5	2.1	0.0	25.7	46.0	20.3
419.0	11.7	P	V	15.6	2.3	0.0	29.6	46.0	16.4
433.9	11.7	P	V	16.0	2.3	0.0	30.0	46.0	16.0
468.7	8.3	P	V	17.1	2.4	0.0	27.8	46.0	18.2
478.0	9.4	P	V	17.1	2.4	0.0	28.9	46.0	17.1
581.1	14.2	P	V	18.6	2.7	0.0	35.5	46.0	10.5
639.6	9.5	P	V	19.4	2.8	0.0	31.7	46.0	14.3
668.2	9.0	P	V	20.6	2.9	0.0	32.5	46.0	13.5
738.2	7.0	P	V	21.0	3.1	0.0	31.1	46.0	14.9
782.8	10.2	P	V	21.0	3.2	0.0	34.4	46.0	11.6
822.8	11.1	P	V	21.6	3.3	0.0	36.0	46.0	10.0
914.4	7.6	P	V	22.9	3.4	0.0	33.9	46.0	12.1
917.9	8.7	P	V	22.9	3.4	0.0	35.0	46.0	11.0

Where there is both peak and quasi peak data, the quasi-peak is the final determination of compliance.
Judgment: Passed by 7.4 dB

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

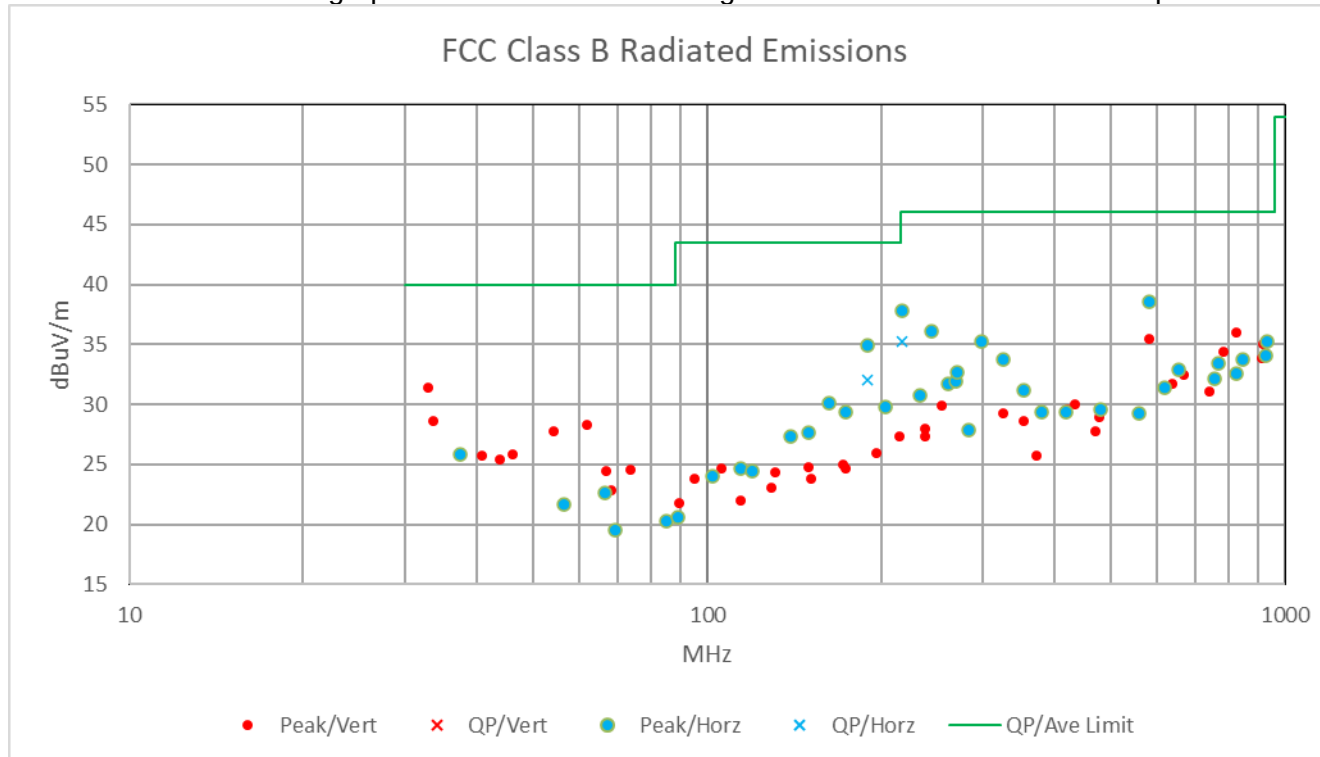
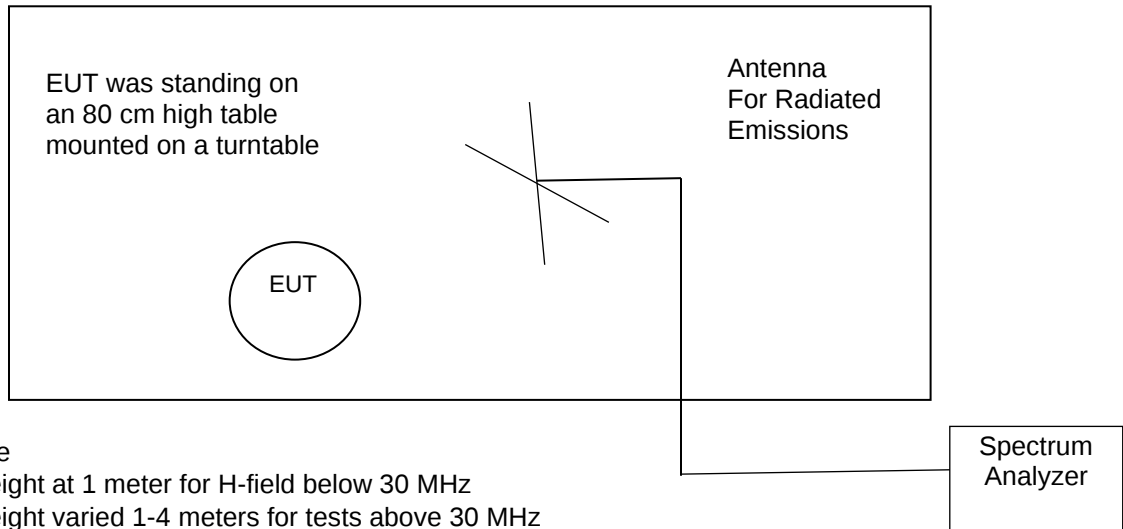




Figure 2. Drawing of Radiated Emissions Test Setup

Chamber E, anechoic



Notes:

- Not to Scale
- Antenna height at 1 meter for H-field below 30 MHz
- Antenna height varied 1-4 meters for tests above 30 MHz
- 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-53	None; Active Antenna	REC-21
30 to 200 MHz	ANT-80	Internal	REC-21
200 to 1000 MHz	ANT-68	Internal	REC-21

Figure 3. Radiated Emissions Test Setup for Frequencies Below 30MHz

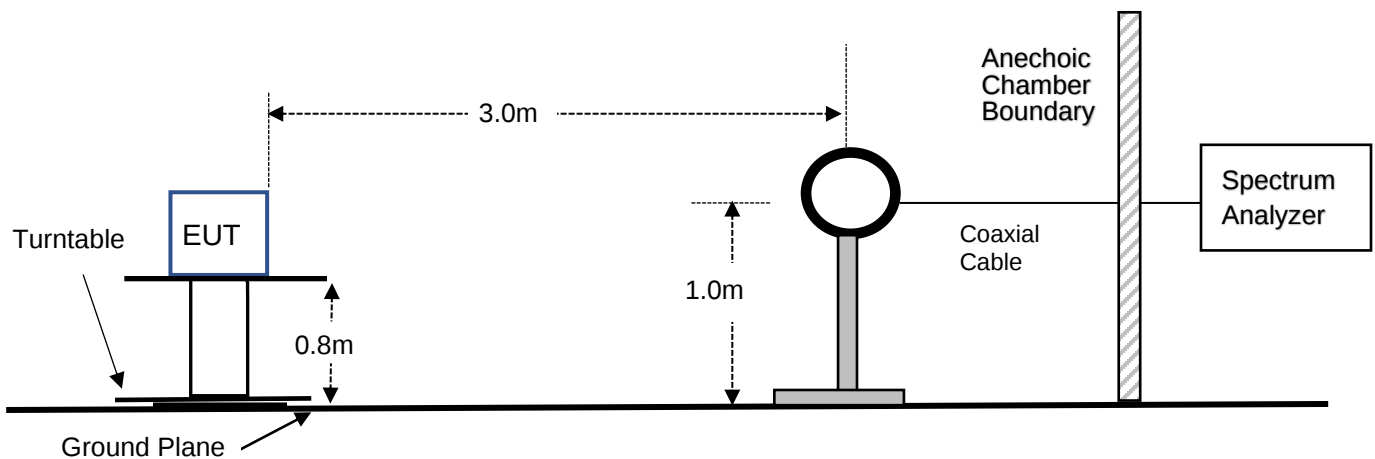
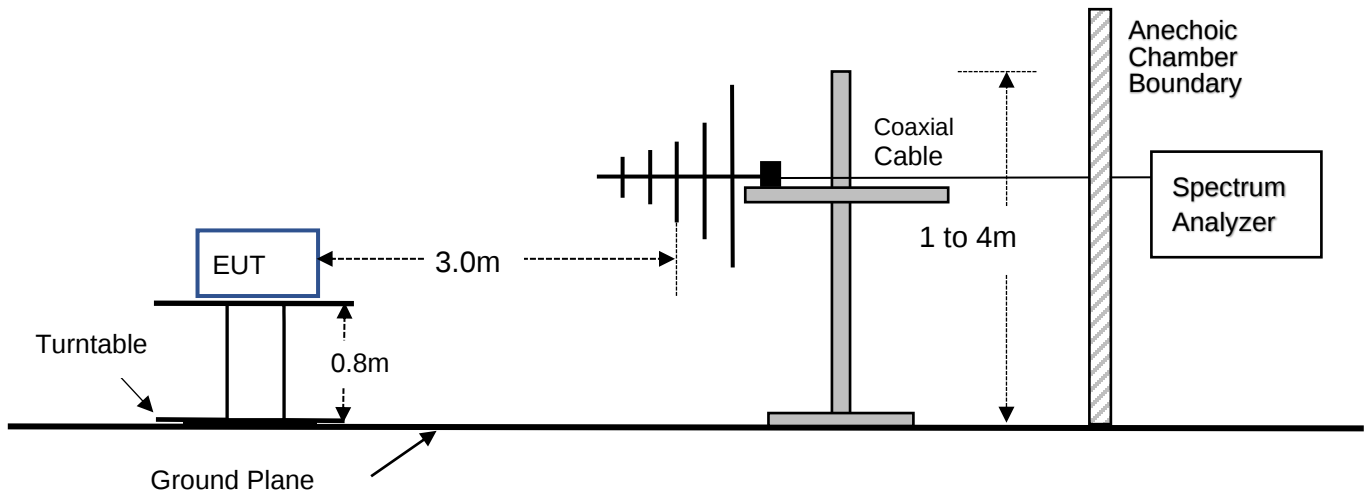




Figure 4. Radiated Emissions Test Setup for Frequencies from 30MHz to 1000MHz



11.3 Magnetic Field Measurements and Decay Factor Calculations

Radiated emission measurements are performed with an EMCO shielded loop antenna. The antenna and the EUT were 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 to 490 kHz, the SD = 300m, therefore the distance factor is $2 \cdot 20 \cdot \log(300/3) = 80$ dB.

From 0.49 to 30 MHz, the SD = 30m, therefore the distance factor is $2 \cdot 20 \cdot \log(30/3) = 40$ dB.

**11.3.1 Radiated Emissions Tests Results (0.009 to 30 MHz)**

Test Date	06/23/2023
Test Distance	3 Meters
Specification	FCC 15 & RSS-GEN
Product	Model: WF30100; Serial Number: WFM8000027

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	59.9	18.9	3.0	2.0	0.1	-80.0	-1.1	25.7	26.8	
250.0	35.7	18.6	3.0	2.0	0.1	-80.0	-25.6	19.6	45.2	
375.0	34.6	18.4	3.0	2.0	0.1	-80.0	-26.9	16.1	43.0	
500.0	33.2	18.3	3.0	2.0	0.1	-40.0	11.6	33.6	22.0	
625.0	32.1	18.2	3.0	2.0	0.1	-40.0	10.4	31.7	21.3	
13560	53.9	16.0	3.0	2.0	0.4	-40.0	30.3	40.5	10.2	
27120	19.4	15.3	3.0	2.0	0.5	-40.0	-4.8	29.5	34.3	
Column numbers										
1	2	3	4	5	6	7	8	9	10	

Notes on Columns:

- Column #1. Frequency of Tested Emission.
Column #2. Uncorrected readings from the spectrum analyzer (Peak)
Column #3. Antenna factor converts dBuV to dBuV/m
Column #4. Test Distance in meters
Column #5. Decay Exponent
Column #6. Cable Loss
Column #7. Distance factor (dB) = (Decay Exponent)*20*Log(Test Distance/Specification Distance)
Column #8. Total field strength. This = Columns 2 + 3 + 6 + 7
Column #9. FCC and Canada Limit in dBuV/m
Column #10. This is the margin under the limit for that row.

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 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.

The lower limit (40.5 dBuV/m) was used for all frequencies from 13.110-14.010 MHz. Therefore it also met 15.225 (a) (b) since the (a) & (b) limits are less stringent than (c).

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 13.11 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.

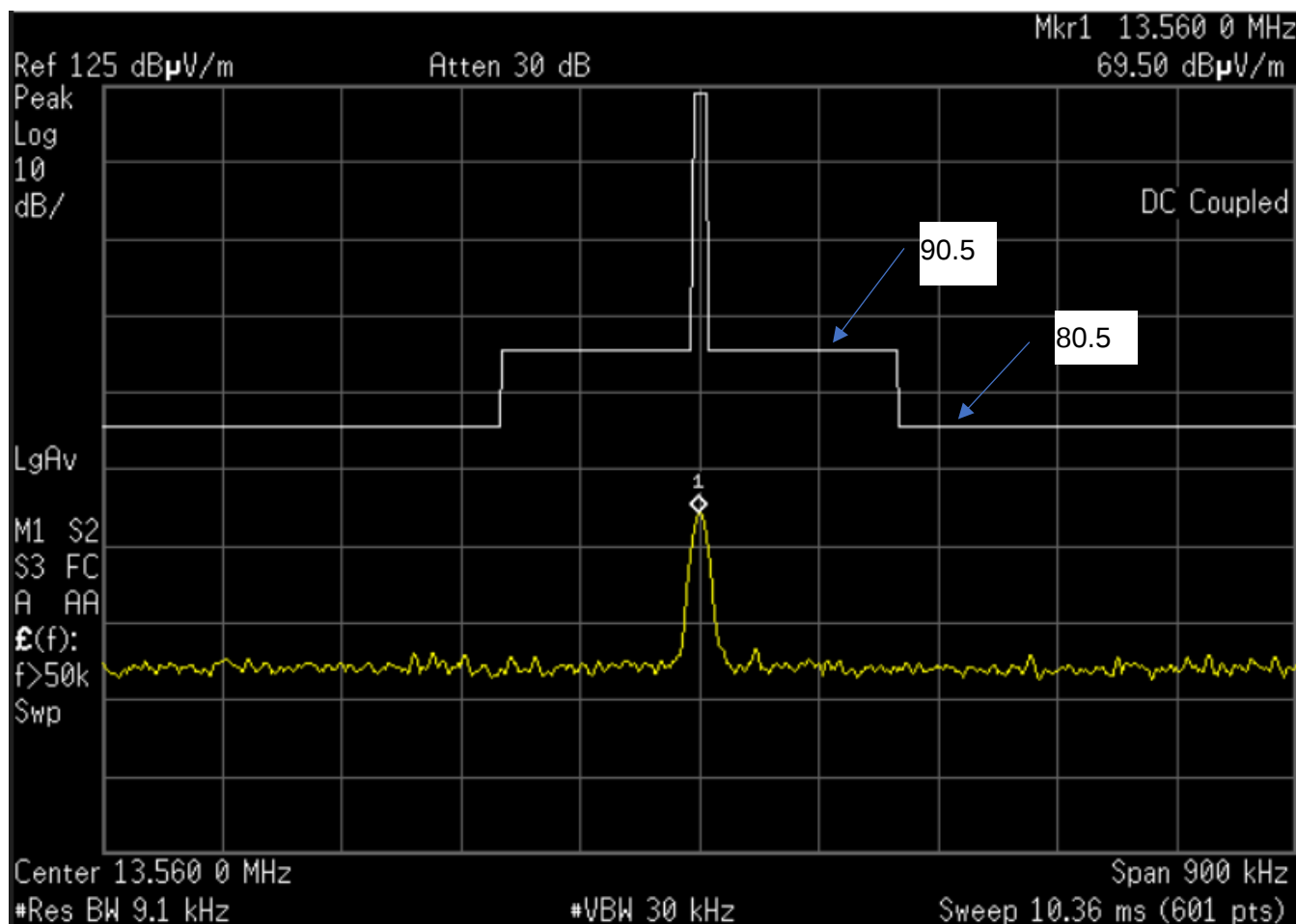
Judgement: Passed by at least 10 dB.



11.3.2 Emissions Mask at 13.56 MHz

RSS-210 Section B.6 and FCC section 15.225 limits, corrected for 3 meters.

40 dB is added to the limits to convert from 30 to 3 meters.



11.3.3 Field Strength at 3 meters

This is the field Strength results with no distance correction factor. This is used for ISED forms and RF exposure calculations.

Freq (kHz)	Peak reading dBuV	Loop Ant Factor dB/m	Test Dist. (m)	Cable Loss dB	Field Strength dBuV/m	Notes
125	59.9	18.9	3	0.1	78.9	Field Strength at 3 meters
13560	53.9	16.0	3	0.4	70.3	Field Strength at 3 meters



11.4 Occupied Bandwidth Data

The occupied bandwidth of the RF output was measured using a spectrum analyzer. 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.

Test Date: June 29, 2023

Tested by: Joseph Strzelecki

99% OBW	
125 kHz signal	13.56 MHz Signal
1.2472 kHz	1.3758 kHz

Judgement: Pass

Figure 5. Occupied Bandwidth Plot 125 kHz

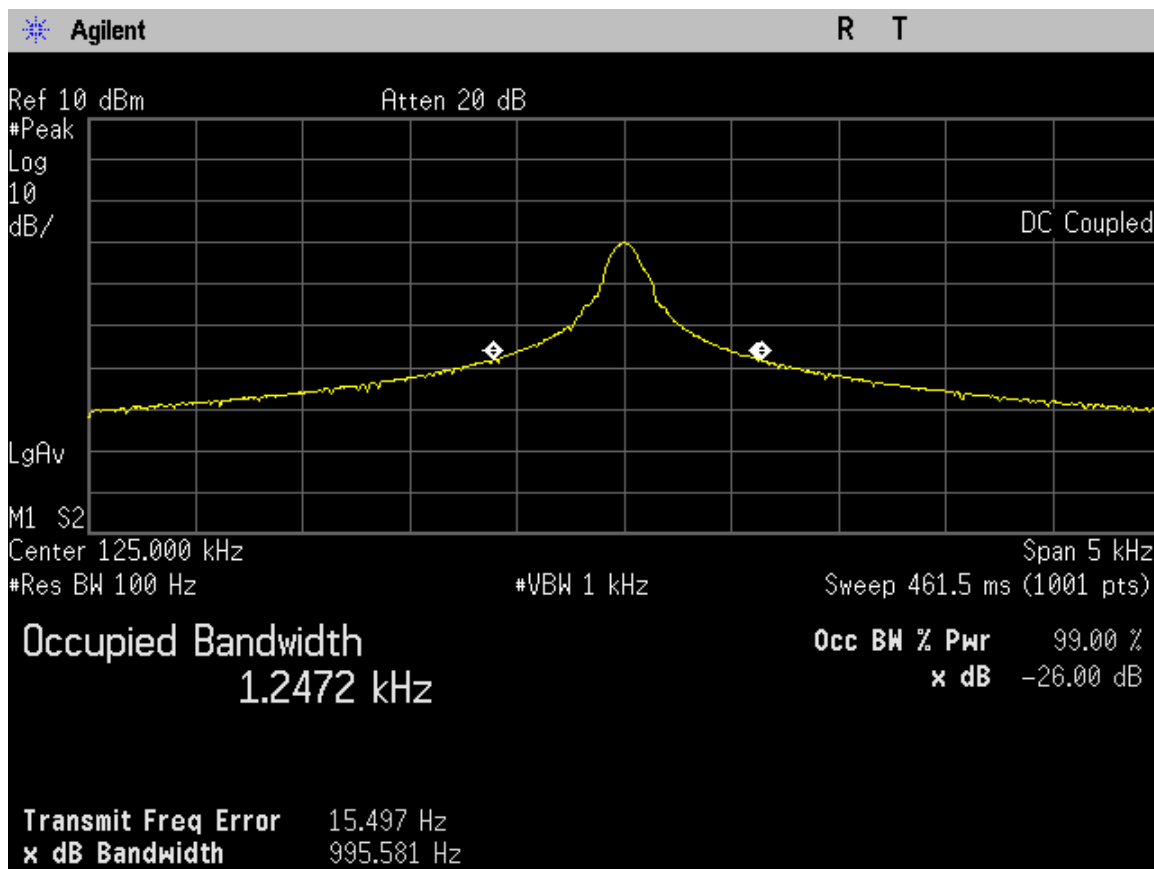
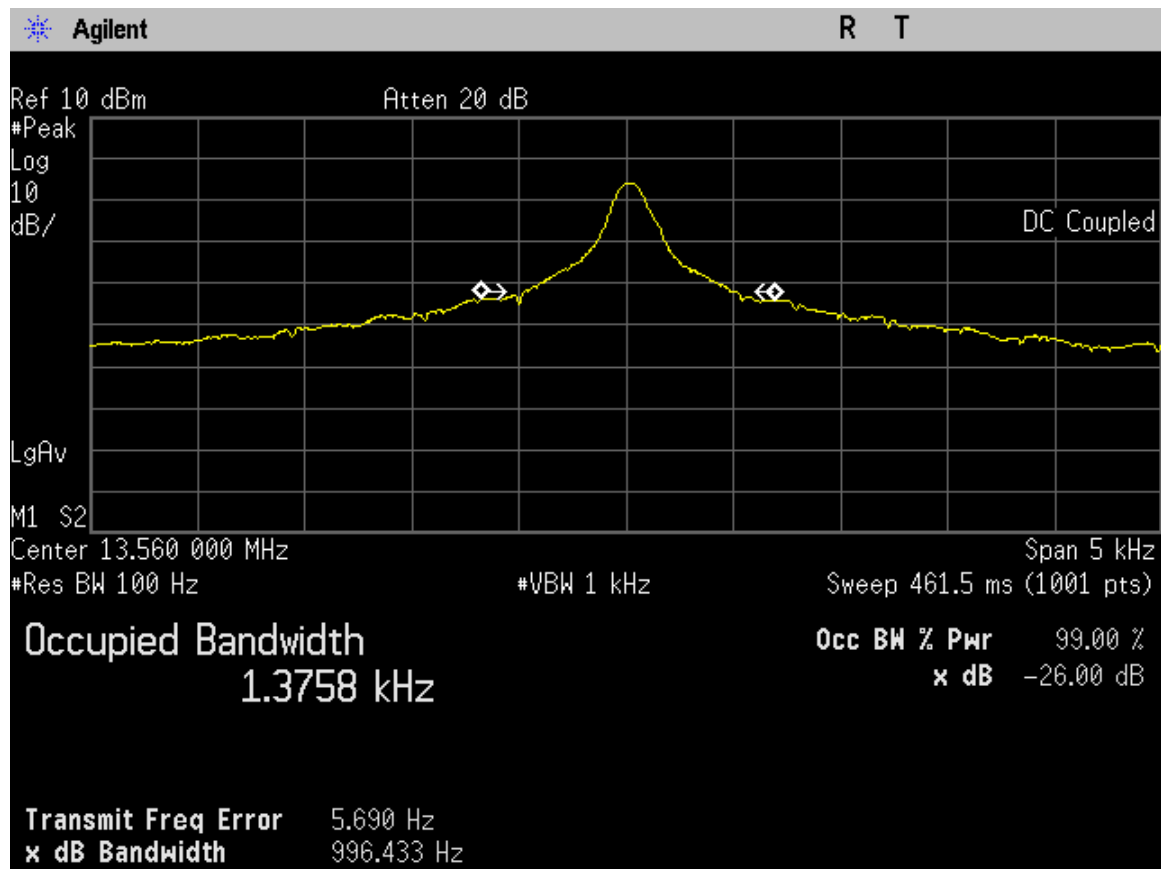




Figure 6. Occupied Bandwidth Plot 13.56 MHz



11.5 Frequency Stability

The tests were in accordance with FCC 15.225 and RSS-210 Section A2.6. 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

Model	WF30100	Specification	FCC Part 15.225 RSS-210 Section A2.6
Serial Number	WFM8000027	Test Date	June 29, 2023
Test Personnel	Chris D'Alessio	Test Location	Station F
Test Equipment	Spectrum Analyzer (REC-31); Temperature Chamber TC-01		
Notes	10 minutes at each Temperature; 1 min at each voltage		
Nominal Frequency	13.560003 MHz		

Volts VAC	Freq. (MHz)	Deviation %	PPM
102.0	13.560011	0.000059	0.59
120.0	13.560003	0.000000	0.00
138.0	13.560009	0.000044	0.44



Temp.	Freq.	Freq.	Freq.	Freq.	Change from Nominal			
Deg C	(@0min.)	(@2min.)	(@5min.)	(@10min.)	% 0 min.	% 2 min.	% 5 min	% 10 min.
50	13.560010	13.560005	13.560031	13.560126	0.00005	0.00001	0.00021	0.00091
40	13.559995	13.559990	13.560029	13.559993	-0.00006	-0.00010	0.00019	-0.00007
30	13.560007	13.560003	13.560005	13.560017	0.00003	0.00000	0.00001	0.00010
20	13.560003	13.560010	13.559957	13.560010	0.00000	0.00005	-0.00034	0.00005
10	13.560170	13.560021	13.560043	13.560195	0.00123	0.00013	0.00029	0.00142
0	13.560052	13.559973	13.560076	13.560045	0.00036	-0.00022	0.00054	0.00031
-10	13.560028	13.560026	13.559812	13.559971	0.00018	0.00017	-0.00141	-0.00024
-20	13.559993	13.559988	13.559978	13.559914	-0.00007	-0.00011	-0.00018	-0.00066

Max deviation is 14.16 ppm or 0.001416%

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	3.1 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
99% Occupied Bandwidth	1% of frequency span
Temperature THM-03	0.6 Deg C

13.0 REVISION HISTORY

RP-9846A Revisions:			
Rev.	Affected Sections	Description	Rationale