313 West 12800 South, Suite 311
Draper, UT 84020
(801) 260-4040

Test Report

Certification

FCC ID	FCC# 2A8EC-NM4I
Equipment Under Test	NM4I
Test Report Serial No	V065342_02
Date of Test	September 9, 2022
Report Issue Date	October 24, 2022

Test Specifications:	Applicant:
FCC Part 15, Subpart C	Next Meters Global, LLC 517 W 100 N, Ste 105 Providence, UT 84332 U.S.A.

TESTING
NVLAP LAB CODE 100272-0

313 West 12800 South, Suite 311, Draper, UT 84020 • (801) 260-4040

Certification of Engineering Report

This report has been prepared by VPI Laboratories, Inc. to document compliance of the device described below with the requirements of Federal Communications Commission (FCC) Part 15, Subpart C. This report may be reproduced in full. Partial reproduction of this report may only be made with the written consent of the laboratory. The results in this report apply only to the sample tested.

Applicant	Next Meters Global, LLC
Manufacturer	Next Meters Global, LLC
Brand Name	Next Meter
Model Number	NM4I
FCC ID	FCC# 2A8EC-NM4I

On this 24th day of October 2022, I, individually and for VPI Laboratories, Inc., certify that the statements made in this engineering report are true, complete, and correct to the best of my knowledge, and are made in good faith.

Although NVLAP has accredited the VPI Laboratories, Inc. EMC testing facilities, this report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

VPI Laboratories, Inc.

Tested by: Benjamin N. Antczak

Reviewed by: Jason Stewart

Revision History		
Revision	**Description**	**Date**
01	Original Report Release	24 October 2022
02	Removing Photos for Confidentiality	07 December 2022

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1 Client Information

1.1 Applicant

Company Name	Next Meters Global, LLC 517 W 100 N, Ste 105 Providence, UT 84332 U.S.A.
Contact Name	Brett Jepsen
Title	Executive

1.2 Manufacturer

Company Name	Next Meters Global, LLC 517 W 100 N, Ste 105 Providence, UT 84332 U.S.A.
Contact Name	Brett Jepsen
Title	Executive

1.3 Party Responsible for Declaration of Conformity

Company Name	Next Meters Global, LLC 517 W 100 N, Ste 105 Providence, UT 84332 U.S.A.
Contact Name	Brett Jepsen
Title	Executive

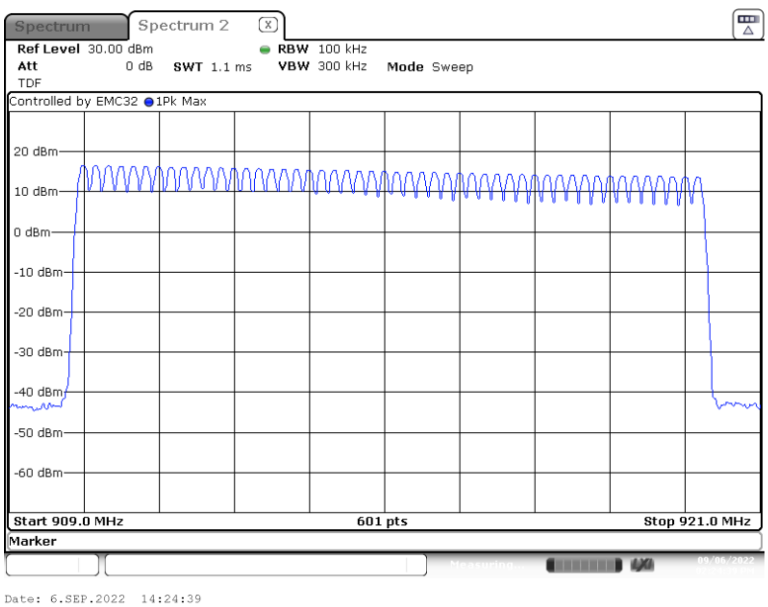
2 Equipment Under Test (EUT)

2.1 Identification of EUT

Brand Name	Next Meter
Model Number	NM4I
Serial Number	N/A
Dimensions (cm)	13 x 8 x 5
Antenna Gain (dBi)	0.7

2.2 Description of EUT

The Next Meter NM4I is a wireless water-flow meter for use in commercial and home settings. It is internally powered by a 3VDC CR18505 battery. EUT contains provisions for FHSS wireless communications in the 902 – 928 MHz ISM band on 50 channels beginning at 910MHz and spaced 200kHz apart (see plots below). EUT contains a trace antenna; gain data was provided via test report “NextMeter Test Report – 101622” transmitted to VPI Labs via e-mail on October 18, 2022.



Graph 1: EUT Channel Plot

This report covers the circuitry of the devices subject to FCC Part 15, Subpart C. The circuitry of the device subject to FCC Subpart B was found to be compliant and is covered in VPI Laboratories, Inc. report V065341_01.

2.3 EUT and Support Equipment

The EUT and support equipment used during the test are listed below.

Brand Name **Model Number** **Serial Number**	**Description**	**Name of Interface Ports / Interface Cables**
BN: Next Meter MN: NM4I (Note 1) SN: N/A	Wireless Water Meter	See Section 2.4

Notes: (1) EUT

The support equipment listed above was not modified in order to achieve compliance with this standard.

2.4 Interface Ports on EUT

There are no interface ports or the EUT.

2.5 Modification Incorporated/Special Accessories on EUT

The following modifications were made to the EUT by the Client during testing to comply with the specification. This report is not complete without an accompanying signed attestation, that the product will have all of the documented modifications incorporated into the product when manufactured and placed on the market.

- Transmit Output Power was set to a maximum of 10.

2.6 Deviation from Test Standard

There were no deviations from the test specification.

3 Test Specification, Methods and Procedures

3.1 Test Specification

Title	FCC PART 15, Subpart C (47 CFR 15) 15.203, 15.207, and 15.247 Limits and methods of measurement of radio interference characteristics of radio frequency devices.
Purpose of Test	The tests were performed to demonstrate initial compliance

3.2 Methods & Procedures

3.2.1 §15.203 Antenna Requirement

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

3.2.2 §15.207 Conducted Limits

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency range (MHz)	**Limit (dBμV)**	
	Quasi-peak	**Average**
0.15 to 0.50*	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

*Decreases with the logarithm of the frequency.

Table 1: Limits for conducted emissions at mains ports of Class B ITE.

3.2.3 §15.247 Operation within the bands 902 – 928 MHz, 2400 – 2483.5 MHz, and 5725 – 5850 MHz

a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions.

1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400 – 2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudorandomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

   i. For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

   ii. Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

   iii. Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 non-overlapping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 non-overlapping channels are used.

2) Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

b) The maximum peak output power of the intentional radiator shall not exceed the following:

1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725 – 5850 MHz bands: 1 watt. As an alternative to a peak power measurement,

compliance with the Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

c) Operation with directional antenna gains greater than 6 dBi.

1) Fixed point-to-point operation:

i. Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

ii. Systems operating in the 5725-5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

iii. Fixed, point-to-point operation, as used in paragraphs (b)(4)(i) and (b)(4)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum or digitally modulated intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

2) In addition to the provisions in paragraphs (b)(1), (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400-2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

i. Different information must be transmitted to each receiver.

ii. If the transmitter employs an antenna system that emits multiple directional beams but does not emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna /antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:

A. The directional gain shall be calculated as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or stave having the highest gain.

B. A lower value for the directional gain than that calculated in paragraph (c)(2)(ii)(A) of this section will be accepted if sufficient evidence is presented, e.g., due to shading of the array or coherence loss in the beamforming.

iii. If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the power limit specified in paragraph (c)(2)(ii) of this section. If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the limit specified in paragraph (c)(2)(ii) of this section. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in paragraph (c)(2)(ii) of this section by more than 8 dB.

iv. Transmitters that emit a single directional beam shall operate under the provisions of paragraph (c)(1) of this section.

d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

f) For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4. The digital modulation operation of the hybrid system, with the frequency hopping turned off, shall comply with the power density requirements of paragraph (d) of this section.

g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

i) Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this Chapter.

Note: Spread spectrum systems are sharing these bands on a noninterference basis with systems supporting critical Government requirements that have been allocated the usage of these bands, secondary only to ISM equipment operated under the provisions of Part 18 of this Chapter. Many of these Government systems are airborne radiolocation systems that emit a high EIRP which can cause interference to other users. Also, investigations of the effect of spread spectrum interference to U. S. Government operations in the 902-928 MHz band may require a future decrease in the power limits allowed for spread spectrum operation.

3.3 Test Procedure

VPI Laboratories, Inc. is accredited by National Voluntary Laboratory Accreditation Program (NVLAP); NVLAP Lab Code: 100272-0, which is effective until September 30, 2023. VPI Laboratories, Inc. carries FCC Accreditation Designation Number US5263. VPI Laboratories main office is located at 313 W 12800 S, Suite 311, Draper, UT 84020. The testing was performed according to the procedures in ANSI C63.10-2013, KDB 558074, and 47 CFR Part 15.

4 Operation of EUT During Testing

4.1 Operating Environment

Power Supply	3VDC Battery (CR18505)
AC Mains Frequency	N/A

4.2 Operating Modes

The transmitter was tested on 3 orthogonal axes while in a constant transmit mode at the upper, middle, and lower channels. The worst case was found to be with the EUT on its back for frequencies below 1000MHz, whereas the highest spurious emissions were found to be with the EUT standing on its long edge. See Section 8 herein for reference.

A new battery was installed for testing.

4.3 EUT Exercise Software

NextCentury software was used to put the EUT into continuous transmit mode or normal hopping mode, and internal software continued to exercise the EUT during testing.

5 Summary of Test Results

5.1 FCC Part 15, Subpart C

5.1.1 Summary of Tests

Section	Environmental Phenomena	Frequency Range (MHz)	Result
15.203	Antenna Requirements	Structural requirement	Complied
15.207	Conducted Disturbance at Mains Ports	0.15 to 30	Not Applicable
15.247(a)	Channel Separation	902 – 928	Complied
15.247(a)	20 dB Bandwidth	902 – 928	Complied
15.247(a)	Time of Occupancy	902 – 928	Complied
15.247(b)	Peak Output Power	902 – 928	Complied
15.247(d)	Antenna Conducted Spurious Emissions	0.009 - 25000	Complied
15.247(d)	Radiated Spurious Emissions	902 – 928	Complied
15.247(g)	Channel Usage	902 – 928	Complied (Note 1)
15.247(h)	Channel Intelligence/Avoidance	902 – 928	Complied (Note 1)
15.247(i)	RF Exposure	902 – 928	Complied (Note 1)
Note 1: Compliance with these requirements is shown in documents filed with the FCC at the time of Certification.			

5.2 Result

In the configuration tested, the EUT complied with the requirements of the specification.

6 Measurements, Examinations and Derived Results

6.1 General Comments

This section contains the test results only. Details of the test methods used and a list of the test equipment used during the measurements can be found in Section 7 of this report.

When calculations in this report require EUT antenna gains, those values have been provided by the manufacturer unless otherwise noted.

6.2 Test Results

6.2.1 §15.203 Antenna Requirements

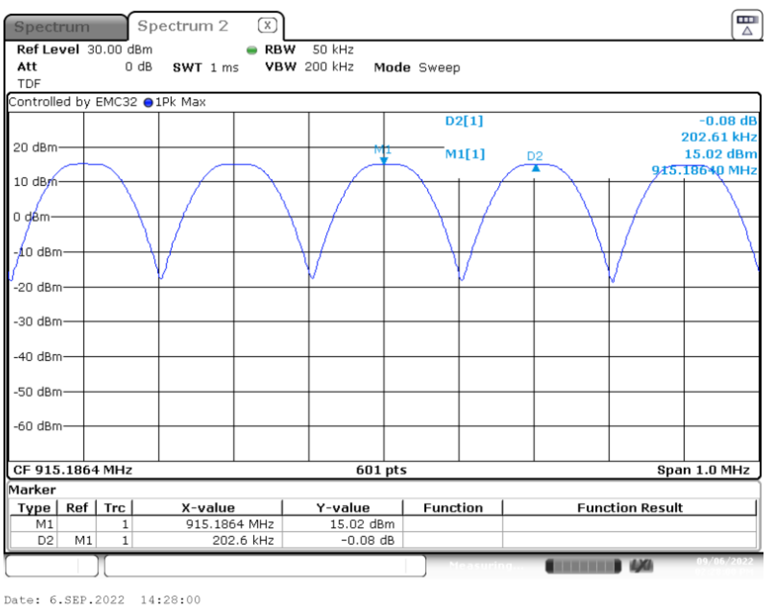
The EUT uses a PCB Trace Antenna. Manufacturer provided gain data was by reference to external testing. See section 2.2 for details.

Result

The EUT complied with the specification.

6.2.2 §15.247(a) Channel Separation

The EUT must have the hopping channel carrier frequencies separated by 25 kHz or the 20 dB bandwidth, whichever is greater. A plot showing a 203 kHz channel separation is shown below. The 20 dB bandwidth is 40 kHz and is shown in section 6.2.4.



Graph 2: Channel Separation Plot

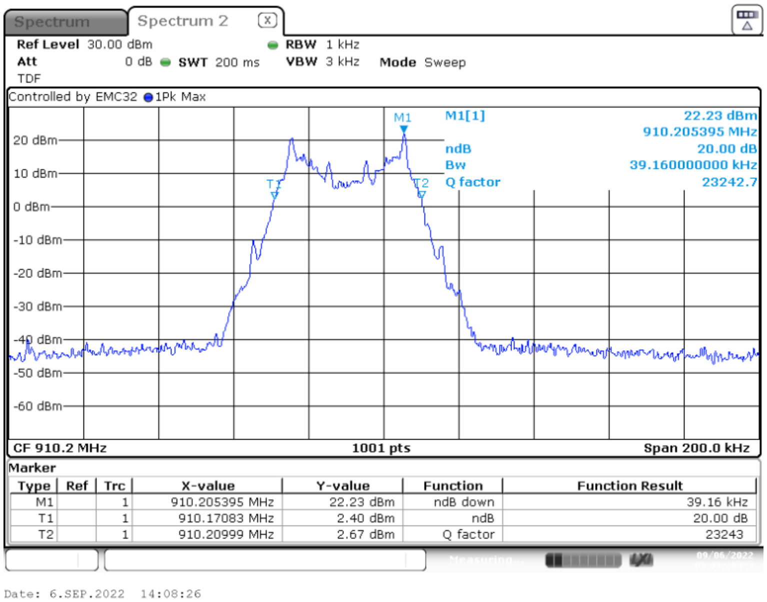
Result

The channel carrier frequency separation is 203 kHz, which is greater than the 20 dB bandwidth; therefore, the EUT complies with the specification.

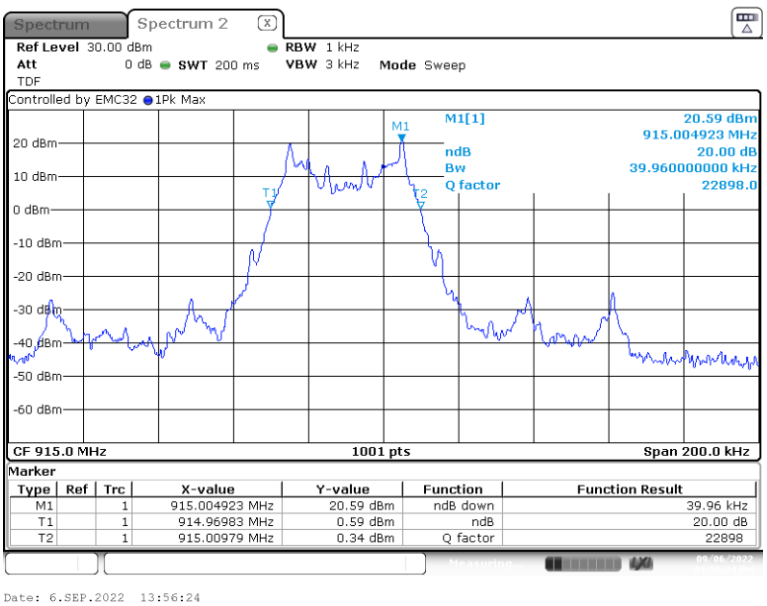
6.2.3 §15.247(a)(2) Emissions Bandwidth

The 20 dB bandwidth of the hopping channels is shown in the table and plots below.

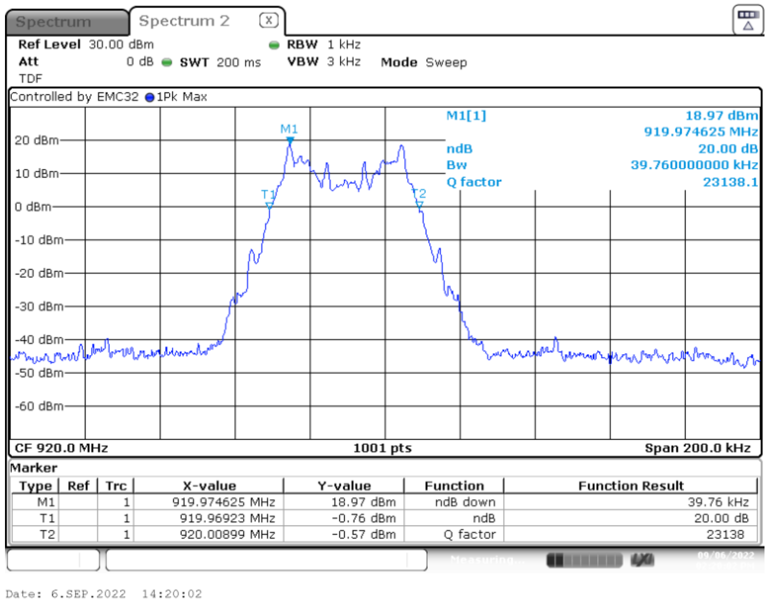
Frequency (MHz)	Emissions 20 dB bandwidth (kHz)
910	39.2
915	40.0
920	39.8



Graph 3: Lowest Channel 20 dB Bandwidth



Graph 4: Middle Channel 20 dB Bandwidth



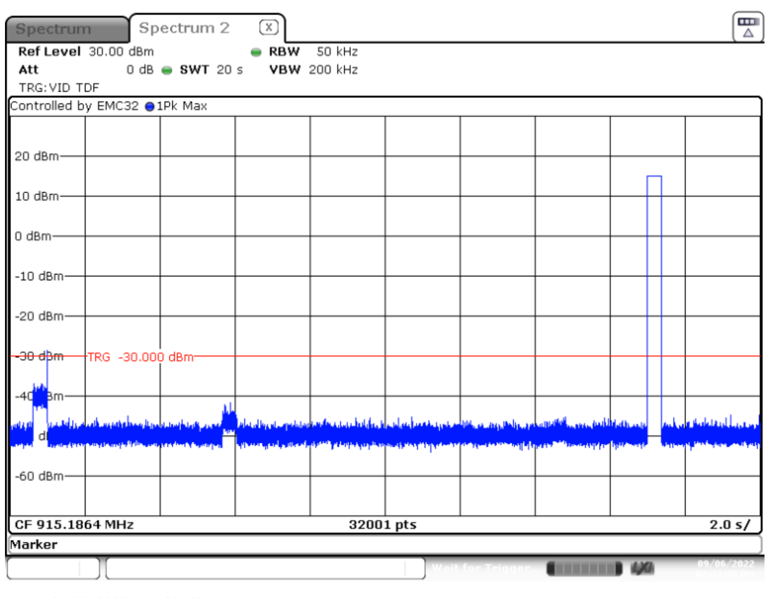
Graph 5: Highest Channel 20 dB Bandwidth

Result

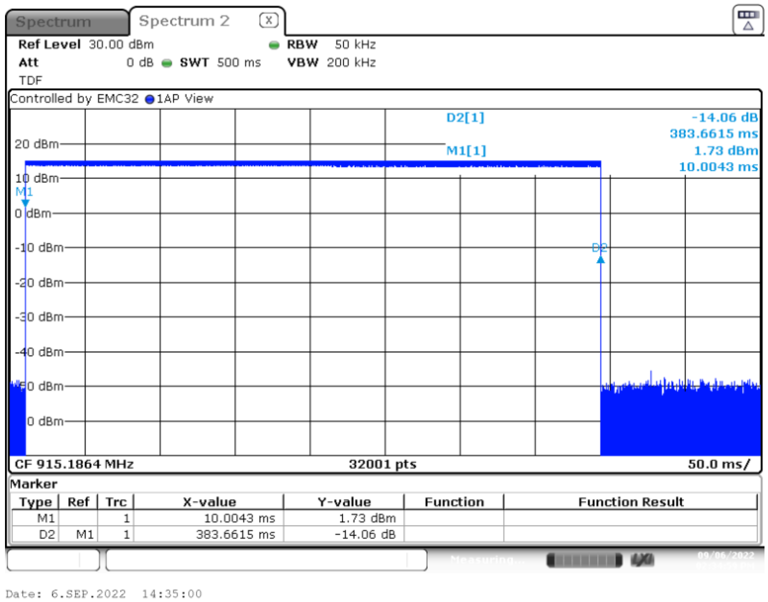
In the configuration tested, the channel bandwidth allows the channel separation of 200 kHz to be compliant; therefore, the EUT complied with the requirements of the specification.

6.2.4 §15.247(a) Channel Occupancy

The EUT uses 50 channels that have a bandwidth less than 250 kHz; therefore, the EUT must have an average time of occupancy on any frequency that is no greater than 0.4 seconds in a period of 20 seconds. See the plots and calculations below.



Graph 6: Timing Plot Showing Channel Hits



Graph 7: Timing Plot Showing Duration of Channel Hits

From the plot, the EUT transmits up to 1 time per 20 seconds for 384 ms at each transmission.

Dwell Time = 384 ms x 1 hit/20 second period
= 385 ms in 20 seconds

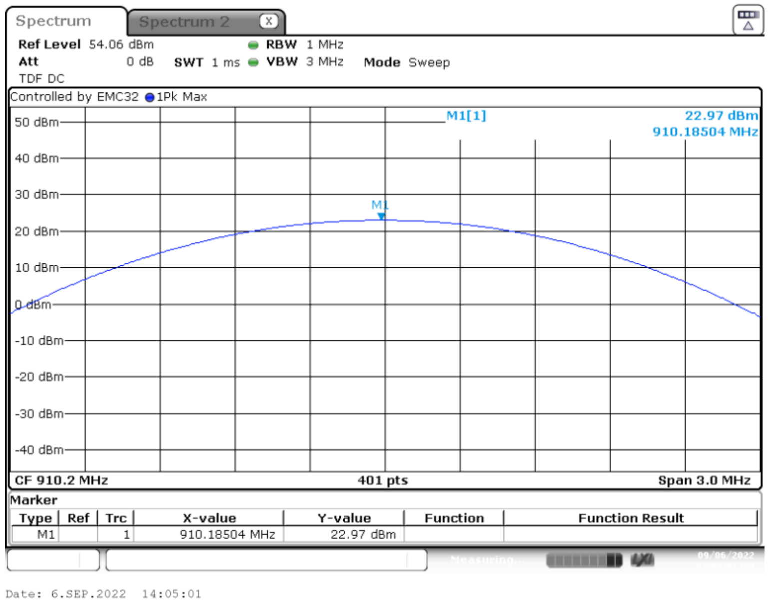
Result

The EUT complies with the specification as the EUT transmits on an individual channel for a maximum of 384 milliseconds in 20 seconds, less than the 0.4 seconds allowed by the specification.

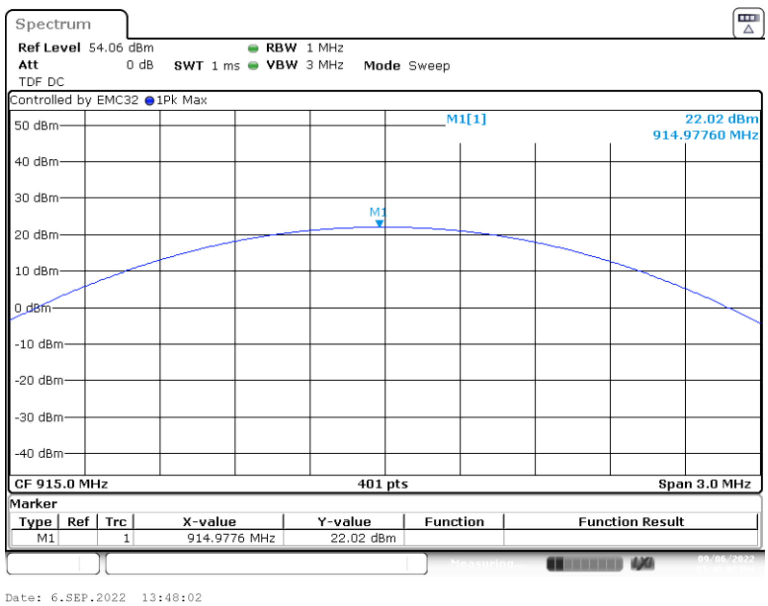
6.2.5 §15.247(b)(3) Peak Output Power

The antenna used with the EUT has a maximum gain of 0.7 dBi. The EUT used 50 hopping channels. Radiated measurements were taken as the EUT has and integral antenna. The radiated field strengths were converted to E.I.R.P. using the guidance of ANSI C63.10. The E.I.R.P. limit for this device is 30dBm or 1W. Plots are shown below and the results of this testing are summarized in the table.

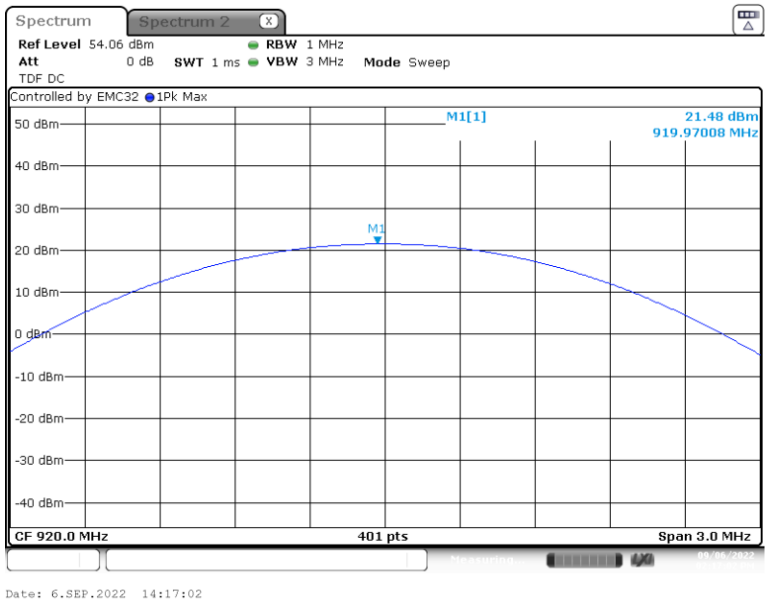
Frequency (MHz)	E.I.R.P. (dBm)	E.I.R.P. (mW)
910	23.0	199.5
915	22.0	158.5
920	21.5	141.3



Graph 8: Low Channel Peak Power Plot



Graph 9: Middle Channel Peak Power Plot



Graph 10: High Channel Peak Power Plot

Result

In the configuration tested, the RF peak output power was less than 1 Watt; therefore, the EUT complied with the requirements of the specification.

6.2.6 §15.247(d) Spurious Emissions

Conducted Spurious Emissions

The frequency range from the lowest frequency generated or used in the device to the tenth harmonic of the highest fundamental frequency was investigated to measure any antenna-conducted emissions. The tables show the measurement data from spurious emissions noted across the frequency range when transmitting at the lowest frequency, middle frequency, and upper frequency. Shown below are plots with the EUT tuned to the upper and lower channels. These demonstrate compliance with the provisions of this section at the band edges.

The emissions must be attenuated 20 dB below the highest power level measured within the authorized band. The highest power measured in was 29 dBm; therefore, the criteria is 29 – 20 = 9 dBm (104dBuV/m at 3 meters)

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1820.6*	Peak	Horizontal	47.1	-0.5	46.6	74.0	-27.4
1820.6*	Average	Horizontal	45.9	-0.5	45.4	54.0	-8.6
1820.6*	Peak	Vertical	48.4	-0.3	48.1	74.0	-25.9
1820.6*	Average	Vertical	48.0	-0.3	47.7	54.0	-6.3
2730.6	Peak	Horizontal	34.4	2.9	37.3	74.0	-36.7
2730.6	Average	Horizontal	31.8	2.9	34.7	54.0	-19.3
2730.6	Peak	Vertical	35.2	2.9	38.1	74.0	-35.9
2730.6	Average	Vertical	33.1	2.9	36.0	54.0	-18.0
3640.9	Peak	Horizontal	29.9	7.0	36.9	74.0	-37.1
3640.9	Average	Horizontal	27.7	7.0	34.7	54.0	-19.3
3640.9	Peak	Vertical	30.5	7.0	37.6	74.0	-36.5
3640.9	Average	Vertical	27.2	7.0	34.2	54.0	-19.8
4557.8	Peak	Horizontal	30.4	7.8	38.2	74.0	-35.8
4557.8	Average	Horizontal	25.4	7.8	33.2	54.0	-20.8
4550.8	Peak	Vertical	29.0	7.9	36.9	74.0	-37.1
4550.8	Average	Vertical	25.5	7.9	33.4	54.0	-20.7
5461.1	Peak	Horizontal	31.8	9.8	41.6	74.0	-32.4
5461.1	Average	Horizontal	29.8	9.8	39.6	54.0	-14.4
5461.6	Peak	Vertical	32.7	9.8	42.6	74.0	-31.5
5461.1	Average	Vertical	30.9	9.8	40.7	54.0	-13.3
6371.9	Peak	Horizontal	28.5	10.8	39.3	74.0	-34.7
6371.9	Average	Horizontal	24.4	10.8	35.2	54.0	-18.8

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBµV)	Correction Factor (dB)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
6377.5	Peak	Vertical	30.5	10.9	41.4	74.0	-32.7
6378.4	Average	Vertical	24.7	10.9	35.6	54.0	-18.4
7282.2	Peak	Horizontal	28.0	14.8	42.8	74.0	-31.2
7281.7	Average	Horizontal	24.9	14.8	39.7	54.0	-14.3
7282.2	Peak	Vertical	28.4	14.8	43.3	74.0	-30.7
7281.7	Average	Vertical	25.4	14.8	40.3	54.0	-13.7
8195.8	Peak	Horizontal	25.3	17.3	42.6	74.0	-31.4
8195.8	Average	Horizontal	22.3	17.3	39.6	54.0	-14.4
8192.0	Peak	Vertical	26.9	17.2	44.2	74.0	-29.8
8191.1	Average	Vertical	21.8	17.2	39.0	54.0	-15.0
9102.3	Peak	Horizontal	23.6	19.5	43.1	74.0	-30.9
9102.3	Average	Horizontal	19.6	19.5	39.1	54.0	-14.9
9104.2	Peak	Vertical	24.9	19.4	44.3	74.0	-29.7
9104.2	Average	Vertical	21.3	19.4	40.8	54.0	-13.2
*Emission is not in the restricted bands but was compared to the lower limit of the restricted bands.							

Table 2: Transmitting on the Lowest Channel

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBµV)	Correction Factor (dB)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1830.4	Peak	Horizontal	46.4	-0.5	45.9	74.0	-28.1
1830.4	Average	Horizontal	45.5	-0.5	45.0	54.0	-9.0
1830.4	Peak	Vertical	45.1	-0.3	44.8	74.0	-29.2
1830.4	Average	Vertical	44.2	-0.3	43.9	54.0	-10.1
2745.2	Peak	Horizontal	32.5	2.9	35.3	74.0	-38.7
2745.2	Average	Horizontal	29.9	2.9	32.8	54.0	-21.2
2744.7	Peak	Vertical	31.1	2.9	33.9	74.0	-40.1
2744.7	Average	Vertical	29.5	2.9	32.4	54.0	-21.6
3659.7	Peak	Horizontal	28.4	7.0	35.4	74.0	-38.6
3659.7	Average	Horizontal	25.1	7.0	32.1	54.0	-21.9
3660.2	Peak	Vertical	30.2	7.0	37.2	74.0	-36.8
3660.2	Average	Vertical	26.1	7.0	33.1	54.0	-20.9
4575.6	Peak	Horizontal	29.8	7.8	37.6	74.0	-36.4

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4574.7	Average	Horizontal	26.2	7.8	34.0	54.0	-20.0
4575.2	Peak	Vertical	29.4	7.9	37.3	74.0	-36.8
4575.6	Average	Vertical	24.7	7.9	32.6	54.0	-21.4
5490.2	Peak	Horizontal	31.1	9.7	40.8	74.0	-33.2
5490.2	Average	Horizontal	28.6	9.7	38.3	54.0	-15.7
5490.2	Peak	Vertical	29.9	9.8	39.6	74.0	-34.4
5490.2	Average	Vertical	27.1	9.8	36.9	54.0	-17.1
6403.3	Peak	Horizontal	27.6	11.0	38.6	74.0	-35.4
6403.8	Average	Horizontal	24.4	11.0	35.4	54.0	-18.6
6403.8	Peak	Vertical	30.8	11.0	41.8	74.0	-32.2
6403.8	Average	Vertical	24.5	11.0	35.5	54.0	-18.5
7320.2	Peak	Horizontal	28.2	15.3	43.6	74.0	-30.5
7320.2	Average	Horizontal	25.4	15.3	40.7	54.0	-13.3
7320.6	Peak	Vertical	26.4	15.3	41.7	74.0	-32.3
7320.2	Average	Vertical	21.9	15.3	37.2	54.0	-16.8
8230.5	Peak	Horizontal	26.3	17.4	43.7	74.0	-30.3
8230.0	Average	Horizontal	22.2	17.4	39.7	54.0	-14.3
8235.2	Peak	Vertical	23.7	17.5	41.2	74.0	-32.8
8235.2	Average	Vertical	20.6	17.5	38.1	54.0	-15.9
9147.3	Peak	Horizontal	21.7	19.4	41.1	74.0	-32.9
9147.3	Average	Horizontal	20.0	19.4	39.4	54.0	-14.6
9150.2	Peak	Vertical	23.1	19.3	42.4	74.0	-31.6
9150.2	Average	Vertical	19.1	19.3	38.4	54.0	-15.6
*Emission is not in the restricted bands but was compared to the lower limit of the restricted bands.							

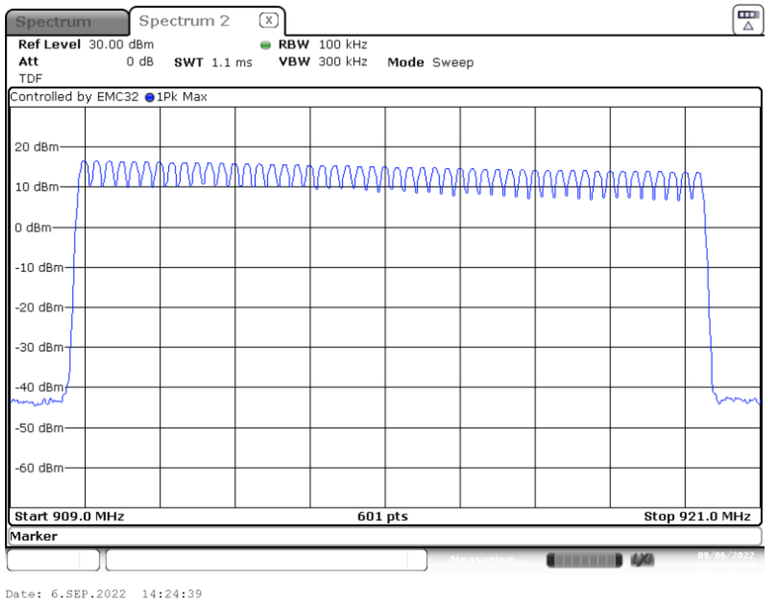
Table 3: Transmitting on the Middle Channel

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1840.5	Peak	Horizontal	41.2	-0.5	40.7	74.0	-33.3
1840.5	Average	Horizontal	38.8	-0.5	38.4	54.0	-15.6
1840.0	Peak	Vertical	42.0	-0.4	41.7	74.0	-32.3

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBµV)	Correction Factor (dB)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1840.0	Average	Vertical	41.1	-0.4	40.7	54.0	-13.3
2760.2	Peak	Horizontal	30.6	2.8	33.4	74.0	-40.6
2760.2	Average	Horizontal	28.3	2.8	31.1	54.0	-22.9
2759.7	Peak	Vertical	31.5	2.9	34.3	74.0	-39.7
2759.7	Average	Vertical	28.4	2.9	31.3	54.0	-22.7
3679.4	Peak	Horizontal	28.8	7.0	35.8	74.0	-38.2
3679.4	Average	Horizontal	25.5	7.0	32.5	54.0	-21.5
3679.8	Peak	Vertical	28.4	7.0	35.4	74.0	-38.6
3679.8	Average	Vertical	25.4	7.0	32.4	54.0	-21.6
4600.0	Peak	Horizontal	28.1	7.8	36.0	74.0	-38.0
4600.0	Average	Horizontal	24.5	7.8	32.3	54.0	-21.7
4599.1	Peak	Vertical	28.0	7.9	35.9	74.0	-38.1
4599.1	Average	Vertical	25.6	7.9	33.5	54.0	-20.5
5519.7	Peak	Horizontal	28.9	9.9	38.8	74.0	-35.2
5519.7	Average	Horizontal	26.6	9.9	36.6	54.0	-17.5
5519.7	Peak	Vertical	30.9	10.0	40.9	74.0	-33.1
5520.2	Average	Vertical	27.9	10.0	37.8	54.0	-16.2
6436.1	Peak	Horizontal	29.0	11.2	40.2	74.0	-33.9
6436.1	Average	Horizontal	24.7	11.2	35.9	54.0	-18.1
6443.6	Peak	Vertical	28.7	11.2	39.9	74.0	-34.1
6443.6	Average	Vertical	23.7	11.2	35.0	54.0	-19.0
7360.5	Peak	Horizontal	26.4	15.8	42.2	74.0	-31.8
7360.0	Average	Horizontal	22.5	15.8	38.3	54.0	-15.7
7360.5	Peak	Vertical	26.5	15.8	42.3	74.0	-31.7
7360.5	Average	Vertical	22.4	15.8	38.2	54.0	-15.8
8282.0	Peak	Horizontal	24.9	17.9	42.8	74.0	-31.2
8281.6	Average	Horizontal	20.2	17.9	38.1	54.0	-15.9
8279.7	Peak	Vertical	25.5	17.9	43.4	74.0	-30.6
8280.2	Average	Vertical	21.3	17.9	39.3	54.0	-14.7
9198.4	Peak	Horizontal	23.4	19.4	42.8	74.0	-31.2

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
9198.9	Average	Horizontal	18.7	19.4	38.1	54.0	-15.9
9199.8	Peak	Vertical	22.8	19.3	42.1	74.0	-31.9
9199.8	Average	Vertical	17.9	19.3	37.2	54.0	-16.8
*Emission is not in the restricted bands but was compared to the lower limit of the restricted bands.							

Table 4: Transmitting on the Highest Channel



Graph 11: Hopping Band Edge Plot

Result

Conducted spurious emissions were attenuated 20 dB or more from the fundamental; therefore, the EUT complies with the specification.

6.3 Sample Measurement Calculations

6.3.1 Filed Strength Calculations

The field strength is calculated by adding the *Correction Factor* (*Antenna Factor* + *Cable Factor*), to the measured level from the receiver. The receiver amplitude reading is compensated for any amplifier gain. When an average measurement requires an average measurement correction value, it is also accounted for. The basic equation with a sample calculation is shown below:

Receiver Amplitude Reading=Receiver Reading-Amplifier Gain

Correction Factor=Antenna Factor + Cable Factor

Field Strength=Receiver Amplitude Reading + Correction Factor [+ Average Correction Value]

Example

Assuming a *Receiver Reading* of 42.5 dBμV is obtained from the receiver, the *Amplifier Gain* is 26.5 dB the *Antenna Factor* is 4.5 dB, and the *Cable Factor* is 4.0 dB. The *Field Strength* is calculated by subtracting the *Amplifier Gain* and adding the *Correction Factor*, giving a *Field Strength* of 24.5 dBμV/m.

$$Receiver\ Amplitude\ Reading\ =\ 42.5 - 26.5\ =\ 16.0\ \mathrm{dB\mu V/m}$$

$$Correction\ Factor\ =\ 4.5 + 4.0\ =\ 8.5\ \mathrm{dB}$$

$$Field\ Strength\ =\ 16.0 + 8.5\ =\ 24.5\ \mathrm{dB\mu V/m}$$

7 Test Procedures and Test Equipment

7.1 Direct Connection at the Antenna Port Test

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
Spectrum Analyzer/Receiver	Rohde & Schwarz	ESU40	V033119	08/24/2022	08/24/2023
Spectrum Analyzer/ Signal Analyzer	Rohde & Schwarz	FSV40	V044352	03/08/2022	03/08/2023
6 dB Attenuator	Pasternack	PE7004-6	V033645	01/10/2022	01/10/2023
Low Loss Cable	N/A	N/A	V034173	01/10/2022	01/10/2023

7.1.1 Test Configuration Block Diagram

Figure 1: Direct Connection at the Antenna Port Test

7.2 Radiated Emissions

The radiated emissions from the EUT were measured using a spectrum analyzer with a quasi-peak adapter for peak and quasi-peak readings.

A preamplifier with a fixed gain of 51 dB was used to increase the sensitivity of the measuring instrumentation. The quasi-peak adapter uses a bandwidth of 120 kHz, with the spectrum analyzer's resolution bandwidth set at 1 MHz, for readings in the 30 to 1000 MHz frequency ranges. For frequencies below 30 MHz, a 9 kHz resolution Bandwidth was used.

A loop antenna was used to measure frequencies below 30 MHz. A biconilog antenna was used to measure the frequency range of 30 to 1000 MHz, at a distance of 3 meters from the EUT. The readings obtained by these antennas are correlated to the levels obtained with a tuned dipole antenna by adding antenna factors. A double-ridged guide antenna was used to measure the emissions at frequencies above 1000 MHz at a 3 meter or 1 meter distance from the EUT.

The configuration of the EUT was varied to find the maximum radiated emission. The EUT was connected to the peripherals listed in Section 2.3 via the interconnecting cables listed in Section 2.4. A technician manually manipulated these interconnecting cables to obtain worst-case radiated emissions. The EUT was rotated 360 degrees, and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission. Where there were multiple interface ports all of the same type, cables are either placed on all of the ports or cables added to these ports until the emissions do not increase by more than 2 dB.

Desktop EUT are measured on a non-conducting table 0.8 meters above the ground plane. For frequencies above 1000 MHz, the EUT is placed on a table 1.5 meters above the ground plane. The table is placed on a turntable, which is level with the ground plane. For equipment normally placed on floors, the equipment shall be placed directly on the turntable.

For radiated emissions testing that is performed at distances closer than the specified distance; an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
Spectrum Analyzer/Receiver	Rohde & Schwarz	ESU40	V033119	08/24/2022	08/24/2023
Spectrum Analyzer/ Signal Analyzer	Rohde & Schwarz	FSV40	V044352	03/08/2022	03/08/2023
Loop Antenna	EMCO	6502	V034216	02/03/2021	02/03/2023
Biconilog Antenna	EMCO	3142E	V057461	7/21/2021	07/21/2023
3142E Power Amplifier	EMCO	3142E-PA	V036056	05/19/2022	05/19/2023
Double Ridged Guide Antenna	EMCO	3115	V033469	01/25/2021	01/25/2023
Standard Gain Horn	ETS-Lindgren	3160-09	V034223	ICO	ICO
High Frequency Amplifier	Miteq	AFS4-001018000-35-10P-4	V033997	01/10/2022	01/10/2023
900 MHz High Pass Filter	Micro-Tronics	HPM50108-03	V034185	01/10/2022	01/10/2023
2.4 GHz High Pass Filter	Micro-Tronics	HPM50111-03	V034183	01/10/2022	01/10/2023
2.4 GHz Notch Filter	Micro-Tronics	BRM50702-03	V034213	01/10/2022	01/10/2023
6’ High Frequency Cable	Microcoax	UFB197C-0-0720-000000	V033638	01/10/2022	01/10/2023
20’ High Frequency Cable	Microcoax	UFB197C-1-3120-000000	V033979	01/10/2022	01/10/2023
3 Meter Radiated Emissions Cable Wanship Upper Site	Microcoax	UFB205A-0-4700-000000	V033639	01/10/2022	01/10/2023
EMC32 Test Software	Rohde & Schwarz	10.60.20	N/A	N/A	N/A

Table 5: List of equipment used for radiated emissions testing.

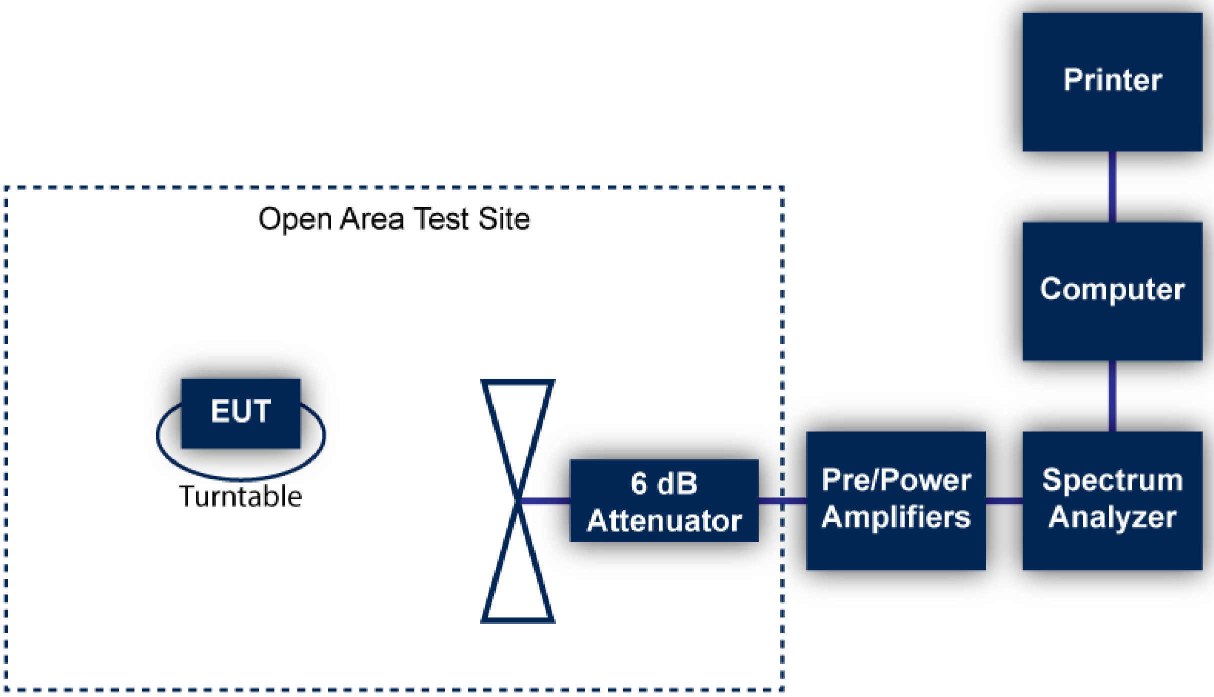


Figure 2: Radiated Emissions Test

7.3 Equipment Calibration

All applicable equipment is calibrated using either an independent calibration laboratory or VPI Laboratories, Inc. personnel at intervals defined in ANSI C63.4:2014 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

7.4 Measurement Uncertainty

Test	Uncertainty (±dB)	Confidence (%)
Conducted Emissions	2.8	95
Radiated Emission (9 kHz to 30 MHz)	3.3	95
Radiated Emissions (30 MHz to 1 GHz)	3.4	95
Radiated Emissions (1 GHz to 18 GHz)	5.0	95
Radiated Emissions (18 GHz to 40 GHz)	4.1	95

8 Photographs

Photographs are contained in a separate exhibit.

--- End of Report ---