313 West 12800 South, Suite 311

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Test Report

Certification

FCC ID	2AJAC-TSSA1200
Equipment Under Test	TS-SA1-200
Test Report Serial No	V070353_02
Dates of Test	August 2-23, 2023
Report Issue Date	November 21, 2023

Test Specifications:	**Applicant:**
FCC Part 15, Subpart C 15.247	Snap One LLC 1800 Continental Blvd., Suite 200-300 Charlotte NC 28273 U.S.A.

NVLAP TESTING
NVLAP LAB CODE 100272-0

ilac-MRA

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	Snap One LLC
Manufacturer	Snap One LLC
Brand Name	Snap One
Model Number	TS-SA1-200
FCC ID	2AJAC-TSSA1200

On this 21st day of November 2023, 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	November 21, 2023
02	Adding Test Duty Cycle Information to Section 4.2	December 29, 2023

Table of Contents

1 Client Information

1.1 Applicant

Company Name	Snap One LLC 1800 Continental Blvd., Suite 200-300 Charlotte NC 28273 U.S.A.
Contact Name	Roger Midgley
Title	Sr. Regulatory Compliance Engineer

1.2 Manufacturer

Company Name	Snap One LLC 1800 Continental Blvd., Suite 200-300 Charlotte NC 28273 U.S.A.
Contact Name	Roger Midgley
Title	Sr. Regulatory Compliance Engineer

2 Equipment Under Test (EUT)

2.1 Identification of EUT

Brand Name	Snap One
Model Number	TS-SA1-200
Serial Number	ST232200250316F230
MAC Address	000FFF0C41BB
Dimensions (cm)	22 x 22 x 7
Antenna Gain (dBi)	Variable (See manufacturer-provided data) Peak In-Band: 2.7

2.2 Customer Supplied Data (if applicable)

2.2.1 Disclaimer

This test report contains customer supplied data that may affect the validity of the results presented. The customer maintains responsibility for the accuracy of these results.

2.3 Description of EUT

The TS-SA1-200 ("SA-1" or "EUT") is a streaming amplifier for use in Snap One home automation systems. It is powered by AC Mains. The SA-1 contains wireless circuitry that use the 2.4 GHz ISM band and the UNII bands. The 2.4 GHz ISM band transceiver operates on 11 channels with maximum power setting as shown in the following table:

Channel	Frequency	802.11b	802.11g	802.11n
1	2412	19	14	14
2	2417	20	16	16
3	2422	20	16	18
4	2427	20	18	18
5	2432	20	20	20
6	2437	20	20	20
7	2442	20	20	20
8	2447	20	18	19
9	2452	20	17	18
10	2457	20	16	17
11	2462	18	14	14

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 not evaluated by VPI Laboratories, Inc. The circuitry of the device subject to FCC Subpart E can be found in VPI Laboratories, Inc. report V070354, V070355, V070356, and V070357.

2.4 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: Snap One MN: TS-SA1-200 (Note 1) SN: ST232200250316F230 MAC: 000FFF0C41BB	Streaming Amplifier with Wireless Capabilities	See Section 2.4
BN: Trendnet MN: TEG-S50TXE SN: CA06225006898	Network Router	Network / Ethernet Cat 5e
BN: Panasonic MN: CF-31 SN: 3DTYB38805	Controller Laptop	Network / Ethernet Cat 5e

Notes: (1) EUT

(2) Interface port connected to EUT (See Section 2.4)

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

2.5 Interface Ports on EUT

Name of Ports	No. of Ports Fitted to EUT	Cable Description/Length
Network	1 of 1	Ethernet Cat 5e / 7 meters

2.6 Modifications Incorporated/Special Accessories on EUT

There were no modifications or special accessories required to comply with the specification.

2.7 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, 2024. 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	120 VAC
AC Mains Frequency	60 Hz

4.2 Operating Modes

The transmitter was tested on a single table-top axis. The AC mains voltage to the AC adapter was varied as required by §15.31(e) with no change seen in the voltage supplied to the transmitter or in transmitter characteristics.

The EUT has a single antenna that adjusts to vertical and horizontal positions. Each radiated measurement was taken with the EUT antenna adjusted for maximum coupling to the measurement antenna (horizontal for horizontally polarized measurements, and vertical for vertically polarized measurements).

For radiated emissions, in 802.11b mode a data rate of 1 Mbps was found worst-case, 802.11g a data rate of 6 Mbps was found to be worst-case, and 802.11n worst-case was found to be using data rate MCS4.

EUT was operated in Constant Transmit Mode (100% Duty Cycle) during testing.

4.3 EUT Exercise Software

Snap One firmware was used to exercise and control the transmitter for testing, which was managed by a laptop PC out of the test area and connected via network router, also out of the test area.

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	Complied
15.247(a)	Bandwidth Requirement	2400 to 2483.5	Complied
15.247(b)	Peak Output Power	2400 to 2483.5	Complied
15.247(d)	Antenna Conducted Spurious Emissions	0.009 - 26500	Complied
15.247(d)	Radiated Spurious Emissions	0.009 - 26500	Complied
15.247(e)	Peak Power Spectral Density	2400 to 2483.5	Complied

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.

Measurement results for each frequency indicate the power setting during that test. See section 2.1 for a summary of the maximum power setting per frequency and mode at which all requirements are met. Where power levels are reduced from the default maximum of 20 for band-edge compliance, adjacent channels were successively tested for compliance until out-of-band emissions were found compliant at the maximum power level of 20.

When calculations in this report require EUT antenna gains, those values have been provided by a manufacturer datasheet.

6.2 General Results (B-, G-, and N-Mode)

6.2.1 §15.203 Antenna Requirements

The EUT uses a reverse-polarization, screw-mount NIC Component Corp NAN-E108x9B2ARF antenna. The antenna can be manually adjusted to horizontal and vertical polarizations, and manufacturer states maximum in-band gain of 2.7dBi.

Result

The EUT complied with the specification.

6.2.2 Conducted Emissions at Mains Ports Data

All modes were evaluated at the maximum possible power level (20) and no changes to emissions on the AC Mains port were observed.

Hot Lead 120VAC:

Frequency (MHz)	Detector	Receiver Reading (dBµV)	Correction Factor (dB)	Measured Level (dBµV)	Class B Limit (dBµV)	Margin (dB)
0.25	Peak (Note 1)	28.5	9.9	38.3	51.7	-13.4
0.37	Peak (Note 1)	28.5	9.9	38.5	48.4	-10.0
0.43	Peak (Note 1)	26.1	9.9	36.1	47.2	-11.2
0.88	Peak (Note 1)	24.5	10.0	34.5	46.0	-11.5
1.7	Peak (Note 1)	20.1	10.0	30.1	46.0	-15.9
5.0	Peak (Note 1)	17.7	10.3	28.0	46.0	-18.0
17.4	Peak (Note 1)	17.4	11.1	28.4	50.0	-21.6
Note 1: The reference detector used for the measurements was Quasi-Peak or Peak and the data was compared to the average limit; therefore, the EUT was deemed to meet both the average and quasi-peak limits.						

Neutral Lead 120VAC:

Frequency (MHz)	Detector	Receiver Reading (dBµV)	Correction Factor (dB)	Measured Level (dBµV)	Class B Limit (dBµV)	Margin (dB)
0.15	Peak (Note 1)	30.5	9.9	40.4	56.0	-15.6
0.17	Peak (Note 1)	25.9	9.9	35.8	54.8	-19.0
0.42	Peak (Note 1)	21.0	10.0	31.0	47.5	-16.5
0.65	Peak (Note 1)	17.8	10.0	27.8	46.0	-18.2
5.0	Peak (Note 1)	17.9	10.3	28.2	46.0	-17.8
15.4	Peak (Note 1)	20.1	10.9	31.0	50.0	-19.0
18.1	Peak (Note 1)	18.1	11.1	29.2	50.0	-20.8
29.2	Peak (Note 1)	14.9	12.1	27.0	50.0	-23.0
Note 1: The reference detector used for the measurements was Quasi-Peak or Peak and the data was compared to the average limit; therefore, the EUT was deemed to meet both the average and quasi-peak limits.						

Result

The EUT complied with the specification limit by a margin of 10.0 dB.

6.3 Test Results (B-Mode)

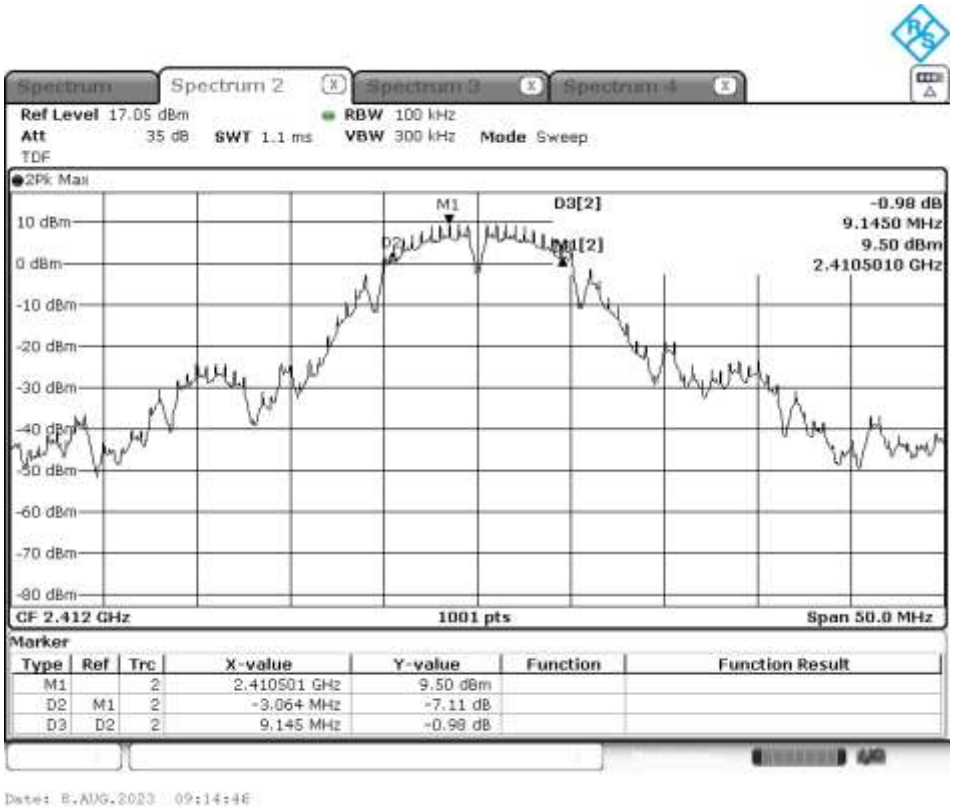
6.3.1 §15.247(a)(2) Emissions Bandwidth

Emission bandwidths were measured at power level 20 (the maximum possible output level) and found to be compliant at the low, middle, and high channels.

Frequency (MHz)	Emissions 6 dB bandwidth (MHz)
2412	9.1
2437	9.2
2462	9.2

Result

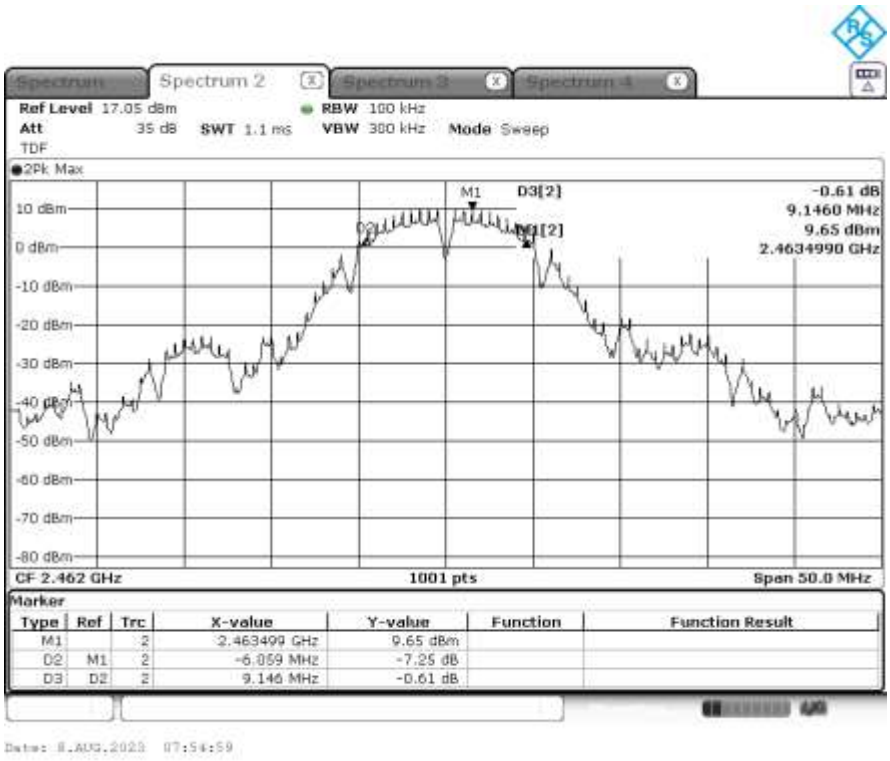
In the configuration tested, the 6 dB bandwidth was greater than 500 kHz; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).



Graph 1: Lowest Channel Bandwidth

PROPRIETARY

Graph 2: Middle Channel Bandwidth



Graph 3: Highest Channel Bandwidth

PROPRIETARY

6.3.2 §15.247(b)(3) Peak Output Power

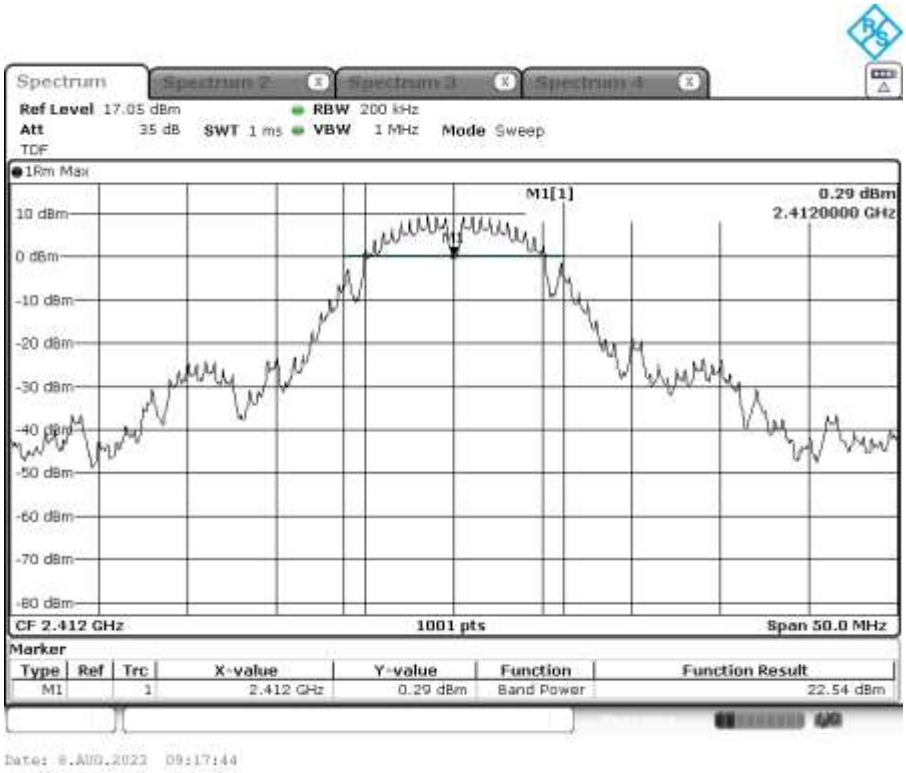
Peak output powers were measured at power level 20 (the maximum possible output level) and found to be compliant at the low, middle, and high channels.

The maximum peak RF Conducted output power measured for this device was 22.9 dBm or 195.0 mW. The limit is 30 dBm or 1 Watt when using antennas with 6 dBi or less gain. The antenna has a peak in-band gain of 2.7 dBi.

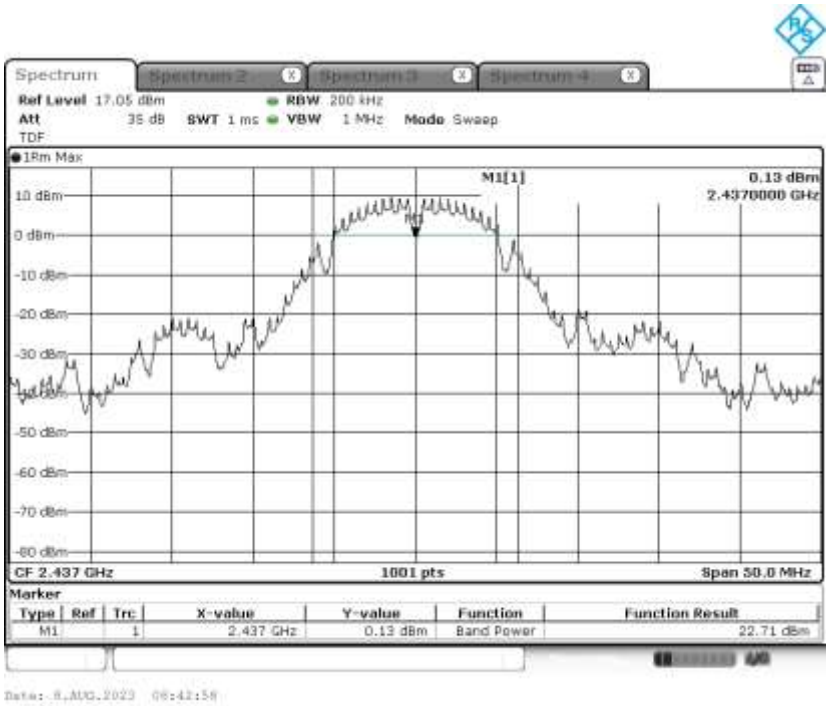
Frequency (MHz)	Measured Output Power (dBm)	Output Power (mW)
2412	22.5	177.8
2437	22.7	186.2
2462	22.9	195.0

Result

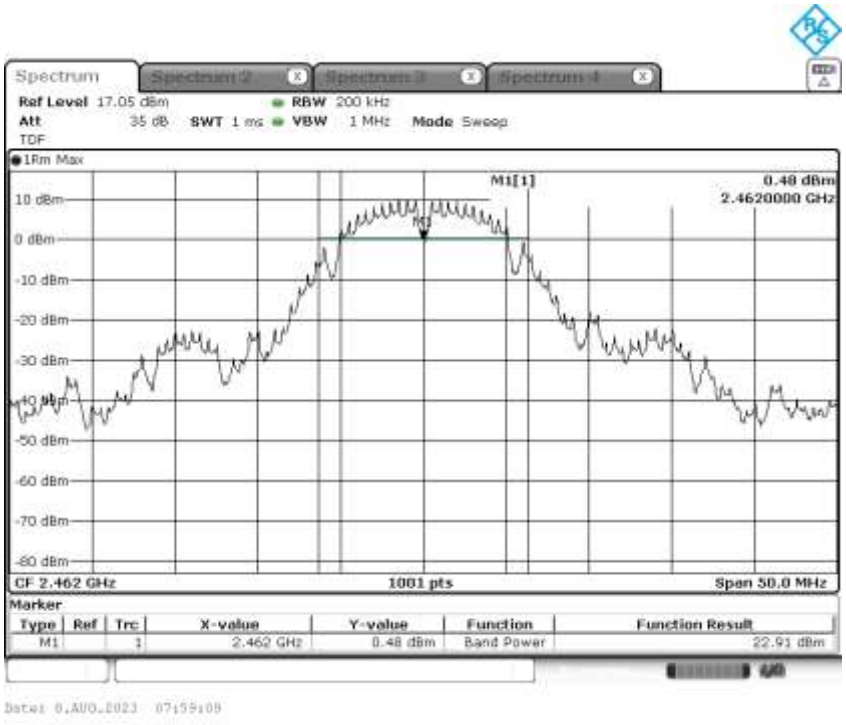
In the configuration tested, the RF peak output power was less than 1 Watt; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).



Graph 4: Lowest Channel Output Power Plot (Method AVGSA-3)



Graph 5: Middle Channel Output Power (Method AVGSA-3)



Graph 6: Highest Channel Output Power Plot (Method AVGSA-3)

6.3.3 §15.247(d) Spurious Emissions

Radiated Spurious Emissions in the Restricted Bands of §15.205

Frequencies from the lowest generated or used to the tenth harmonic of the highest fundamental emission was investigated to measure any radiated emissions in the restricted bands.

The following tables show measurements of any emission that fell into the restricted bands of §15.205. The tables show the measurement data when transmitting at the lowest frequency (maximum power level), middle frequency (maximum power level), and upper frequency (maximum power level). Each possible harmonic to the tenth harmonic was investigated. Emissions detected via conducted antenna-port testing at 1000MHz were closely examined and found compliant across all modulations at the maximum possible power setting, 20.

The emissions in the restricted bands must meet the limits specified in §15.209. Tabular data for each of the spurious emissions is shown below for each of the units.

Result

All emissions in the restricted bands of §15.205 met the limits specified in §15.209; therefore, the EUT complies with the specification.

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBµV)	Correction Factor (dB)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1000	Peak	Vertical	46.8	0.2	47.0	74.0	-27.0
1000	Average	Vertical	46.7	0.2	46.9	54.0	-7.2
1000	Peak	Horizontal	48.1	0.2	48.3	74.0	-25.8
1000	Average	Horizontal	47.7	0.2	47.9	54.0	-6.1
1500	Peak	Vertical	36.4	1.7	38.1	74.0	-36.0
1500	Average	Vertical	35.4	1.7	37.0	54.0	-17.0
1500	Peak	Horizontal	39.8	1.7	41.5	74.0	-32.5
1500	Average	Horizontal	39.0	1.7	40.6	54.0	-13.4
4824	Peak	Vertical	29.7	10.2	39.9	74.0	-34.1
4824	Average	Vertical	28.4	10.2	38.6	54.0	-15.4
4824	Peak	Horizontal	29.5	10.2	39.7	74.0	-34.3
4824	Average	Horizontal	27.8	10.2	38.0	54.0	-16.0
7236	Peak	Vertical	26.6	15.1	41.7	74.0	-32.3
7236	Average	Vertical	21.9	15.1	37.1	54.0	-16.9
7236	Peak	Horizontal	27.2	15.1	42.3	74.0	-31.7
7236	Average	Horizontal	22.4	15.1	37.5	54.0	-16.5
9648	Peak	Vertical	23.1	20.1	43.2	74.0	-30.8
9648	Average	Vertical	19.4	20.1	39.4	54.0	-14.6
9648	Peak	Horizontal	23.4	20.1	43.5	74.0	-30.5
9648	Average	Horizontal	18.6	20.1	38.7	54.0	-15.3
12060	Peak	Vertical	22.9	21.2	44.1	74.0	-29.9
12060	Average	Vertical	19.2	21.2	40.4	54.0	-13.7

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
12060	Peak	Horizontal	24.1	21.2	45.2	74.0	-28.8
12060	Average	Horizontal	19.9	21.2	41.0	54.0	-13.0
14472	Peak	Vertical	25.0	22.9	47.9	74.0	-26.1
14472	Average	Vertical	20.4	22.9	43.3	54.0	-10.7
14472	Peak	Horizontal	25.4	23.0	48.3	74.0	-25.7
14472	Average	Horizontal	20.2	23.0	43.2	54.0	-10.8
16884	Peak	Vertical	53.9	-10.7	43.3	74.0	-30.8
16884	Average	Vertical	50.2	-10.7	39.5	54.0	-14.5
16884	Peak	Horizontal	52.9	-10.6	42.3	74.0	-31.8
16884	Average	Horizontal	49.9	-10.6	39.3	54.0	-14.7
19296	Peak	Vertical	38.9	13.2	52.1	74.0	-22.0
19296	Average	Vertical	34.7	13.2	47.8	54.0	-6.2
19296	Peak	Horizontal	37.9	13.2	51.1	74.0	-22.9
19296	Average	Horizontal	34.9	13.2	48.1	54.0	-6.0
21708	Peak	Vertical	35.4	14.5	50.0	74.0	-24.0
21708	Average	Vertical	32.6	14.5	47.1	54.0	-6.9
21708	Peak	Horizontal	37.0	14.5	51.5	74.0	-22.5
21708	Average	Horizontal	33.2	14.5	47.7	54.0	-6.3
24120	Peak	Vertical	36.3	17.1	53.4	74.0	-20.6
24120	Average	Vertical	32.8	17.1	49.9	54.0	-4.1
24120	Peak	Horizontal	36.7	17.1	53.9	74.0	-20.1
24120	Average	Horizontal	32.7	17.1	49.9	54.0	-4.1

Table 2: Transmitting at the Lowest Frequency (2412MHz, Power Level 20)

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1000	Peak	Vertical	47.2	0.2	47.4	74.0	-26.7
1000	Average	Vertical	46.6	0.2	46.8	54.0	-7.3
1000	Peak	Horizontal	48.7	0.2	48.9	74.0	-25.1
1000	Average	Horizontal	48.5	0.2	48.6	54.0	-5.4
1500	Peak	Horizontal	40.2	1.7	41.9	74.0	-32.1
1500	Average	Horizontal	39.3	1.7	41.0	54.0	-13.0
4874	Peak	Vertical	30.1	10.3	40.3	74.0	-33.7
4874	Average	Vertical	28.4	10.3	38.6	54.0	-15.4
4874	Peak	Horizontal	29.8	10.3	40.1	74.0	-33.9
4874	Average	Horizontal	27.7	10.3	38.0	54.0	-16.0

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
7311	Peak	Vertical	26.4	15.5	41.8	74.0	-32.2
7311	Average	Vertical	22.8	15.5	38.3	54.0	-15.7
7311	Peak	Horizontal	27.5	15.5	43.0	74.0	-31.0
7311	Average	Horizontal	21.6	15.5	37.1	54.0	-16.9
9748	Peak	Vertical	24.4	20.3	44.7	74.0	-29.3
9748	Average	Vertical	19.3	20.3	39.6	54.0	-14.4
9748	Peak	Horizontal	24.7	20.3	45.0	74.0	-29.0
9748	Average	Horizontal	18.6	20.3	39.0	54.0	-15.0
12185	Peak	Vertical	23.6	20.8	44.4	74.0	-29.6
12185	Average	Vertical	18.9	20.8	39.7	54.0	-14.3
12185	Peak	Horizontal	25.7	20.8	46.5	74.0	-27.5
12185	Average	Horizontal	20.0	20.8	40.8	54.0	-13.2
14622	Peak	Vertical	23.8	23.2	47.0	74.0	-27.1
14622	Average	Vertical	19.4	23.2	42.6	54.0	-11.5
14622	Peak	Horizontal	23.6	23.2	46.8	74.0	-27.2
14622	Average	Horizontal	19.7	23.2	42.9	54.0	-11.1
17059	Peak	Vertical	53.6	-9.0	44.6	74.0	-29.5
17059	Average	Vertical	48.9	-9.0	39.9	54.0	-14.1
17059	Peak	Horizontal	53.7	-9.0	44.7	74.0	-29.3
17059	Average	Horizontal	49.5	-9.0	40.5	54.0	-13.5
19496	Peak	Vertical	38.5	13.2	51.7	74.0	-22.3
19496	Average	Vertical	33.5	13.2	46.7	54.0	-7.3
19496	Peak	Horizontal	37.4	13.2	50.5	74.0	-23.5
19496	Average	Horizontal	33.6	13.2	46.8	54.0	-7.2
21933	Peak	Vertical	36.2	15.0	51.2	74.0	-22.8
21933	Average	Vertical	32.3	15.0	47.3	54.0	-6.7
21933	Peak	Horizontal	36.6	14.8	51.4	74.0	-22.6
21933	Average	Horizontal	32.6	14.8	47.4	54.0	-6.6
24370	Peak	Vertical	35.1	17.7	52.9	74.0	-21.1
24370	Average	Vertical	31.5	17.7	49.2	54.0	-4.8
24370	Peak	Horizontal	36.3	17.7	54.0	74.0	-20.0
24370	Average	Horizontal	32.0	17.7	49.7	54.0	-4.3

Table 3: Transmitting at the Middle Frequency (2437MHz, Power Level 20)

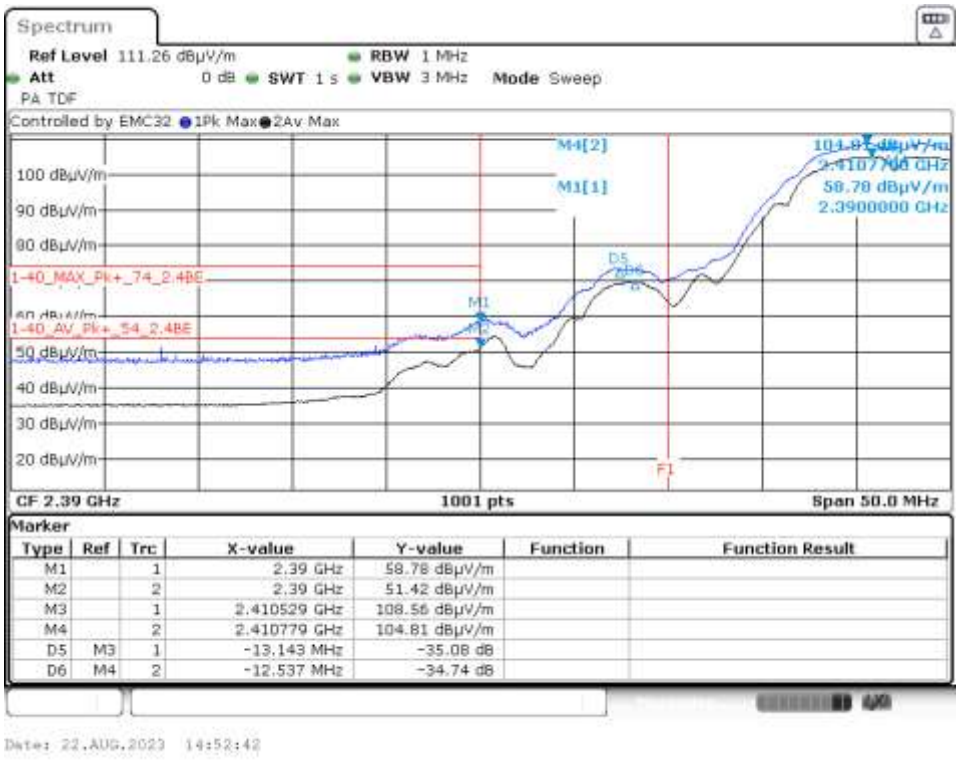
Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1000	Peak	Vertical	47.1	0.2	47.2	74.0	-26.8
1000	Average	Vertical	46.7	0.2	46.9	54.0	-7.1
1000	Peak	Horizontal	49.1	0.2	49.2	74.0	-24.8
1000	Average	Horizontal	48.7	0.2	48.9	54.0	-5.1
1500	Peak	Horizontal	39.5	1.7	41.1	74.0	-32.9
1500	Average	Horizontal	38.3	1.7	39.9	54.0	-14.1
4924	Peak	Vertical	30.2	10.3	40.5	74.0	-33.5
4924	Average	Vertical	28.1	10.3	38.4	54.0	-15.6
4924	Peak	Horizontal	28.7	10.3	39.0	74.0	-35.0
4924	Average	Vertical	27.6	10.3	37.9	54.0	-16.1
7386	Peak	Vertical	26.0	15.7	41.7	74.0	-32.3
7386	Average	Vertical	21.4	15.7	37.1	54.0	-16.9
7386	Peak	Horizontal	25.0	15.7	40.7	74.0	-33.3
7386	Average	Horizontal	21.0	15.7	36.7	54.0	-17.3
9848	Peak	Vertical	22.9	20.6	43.5	74.0	-30.5
9848	Average	Vertical	18.1	20.6	38.7	54.0	-15.3
9848	Peak	Horizontal	24.2	20.6	44.8	74.0	-29.2
9848	Average	Horizontal	19.1	20.6	39.7	54.0	-14.3
12310	Peak	Vertical	26.7	20.6	47.3	74.0	-26.7
12310	Average	Vertical	20.0	20.6	40.6	54.0	-13.5
12310	Peak	Horizontal	24.8	20.6	45.3	74.0	-28.7
12310	Average	Horizontal	19.8	20.6	40.3	54.0	-13.7
14772	Peak	Vertical	25.3	23.1	48.4	74.0	-25.6
14772	Average	Vertical	19.6	23.1	42.8	54.0	-11.2
14772	Peak	Horizontal	24.5	23.1	47.6	74.0	-26.4
14772	Average	Horizontal	19.8	23.1	42.9	54.0	-11.1
17234	Peak	Vertical	58.6	-8.4	50.2	74.0	-23.8
17234	Average	Vertical	53.6	-8.4	45.2	54.0	-8.8
17234	Peak	Horizontal	54.9	-8.6	46.3	74.0	-27.7
17234	Average	Horizontal	50.1	-8.6	41.6	54.0	-12.5
19696	Peak	Vertical	38.7	13.0	51.7	74.0	-22.3
19696	Average	Vertical	34.8	13.0	47.8	54.0	-6.2

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBµV)	Correction Factor (dB)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
19696	Peak	Horizontal	38.0	13.0	51.0	74.0	-23.0
19696	Average	Horizontal	34.7	13.0	47.7	54.0	-6.3
22158	Peak	Vertical	36.4	15.2	51.5	74.0	-22.5
22158	Average	Vertical	32.4	15.2	47.5	54.0	-6.5
22158	Peak	Horizontal	35.3	15.2	50.5	74.0	-23.5
22158	Average	Horizontal	32.6	15.2	47.8	54.0	-6.2
24620	Peak	Vertical	36.7	18.0	54.7	74.0	-19.3
24620	Average	Vertical	33.0	18.0	51.0	54.0	-3.0
24620	Peak	Horizontal	35.8	18.0	53.8	74.0	-20.2
24620	Average	Horizontal	32.7	18.0	50.7	54.0	-3.3

Table 4: Transmitting at the Highest Frequency (2462MHz, Power Level 20)

No other emissions were seen in the restricted bands.

Restricted Band-Edges (Band Edges of §15.205, 2390MHz and 2483.5MHz)



Graph 7: Radiated Lower Band Edge Plot (Transmitting 2412MHz, Power Level 19)

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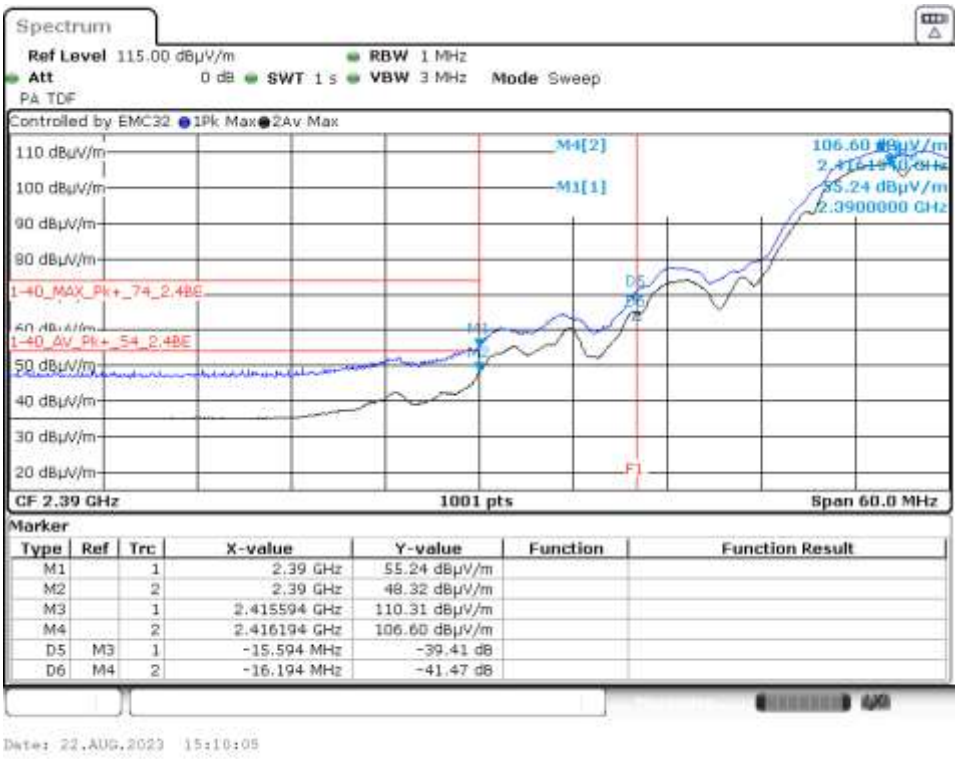
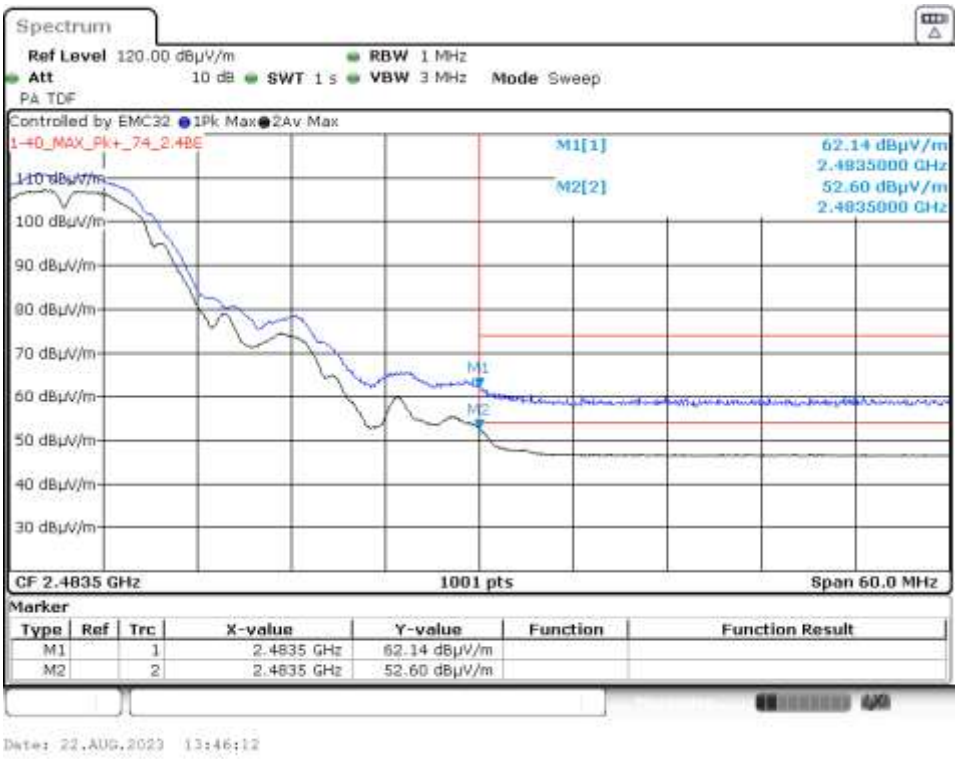


Graph 8: Radiated Lower Band Edge Plot (Transmitting 2417MHz, Power Level 20)



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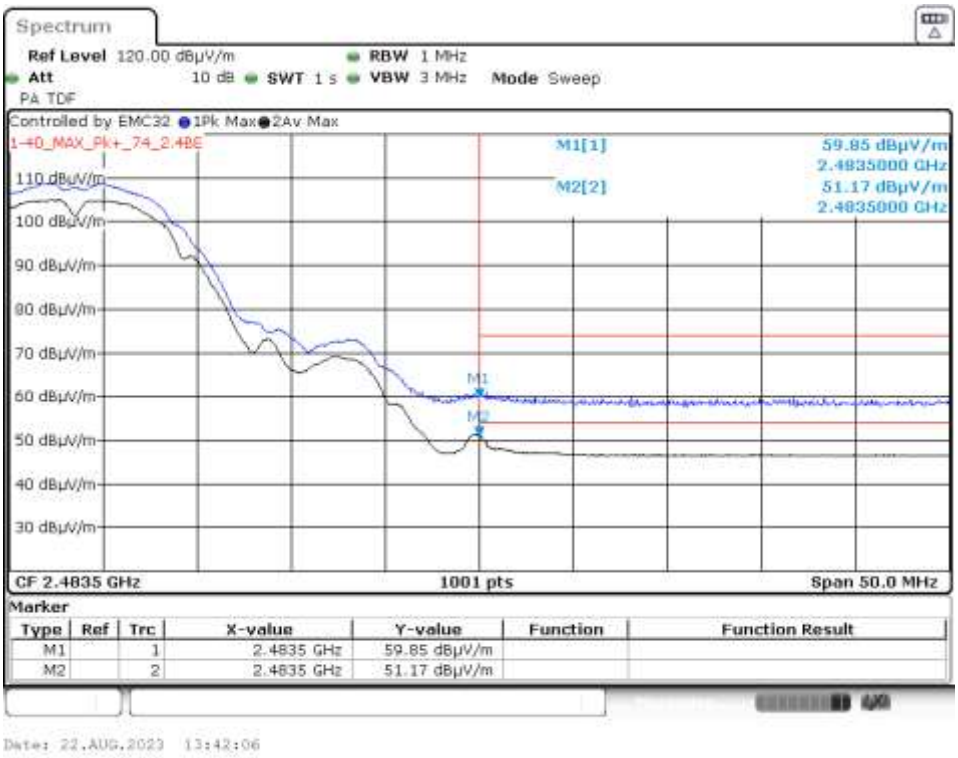
Graph 9: Radiated Upper Band Edge Plot (Transmitting 2457MHz, Power Level 20)



Graph 10: Radiated Upper Band Edge Plot (Transmitting 2462MHz, Power Level 18)

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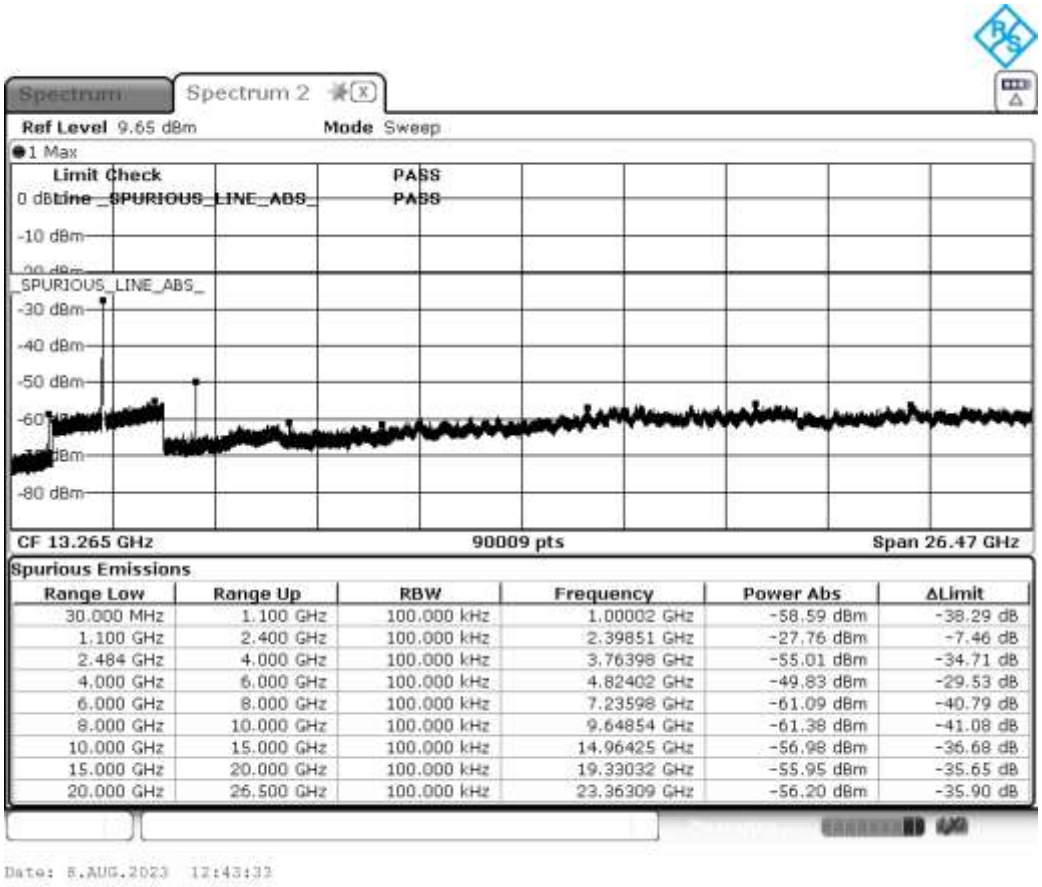
Conducted Spurious Emissions

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 graphs show the measurement data from spurious emissions noted across the frequency range when transmitting at the lowest frequencies (stepped power levels), middle frequency (maximum power level), and upper frequencies (stepped power levels).

The emissions must be attenuated 30 dB below the highest power level measured within the authorized band as measured with a 100 kHz RBW. The highest power measured in was 9.7 dBm; therefore, the criteria is 9.7 – 30 = 20.3 dBm.

Result

Conducted spurious emissions were attenuated 30 dB or more below the fundamental; therefore, the EUT complies with the specification.



Graph 11: Transmitting on 2412MHz (Power Level 19)

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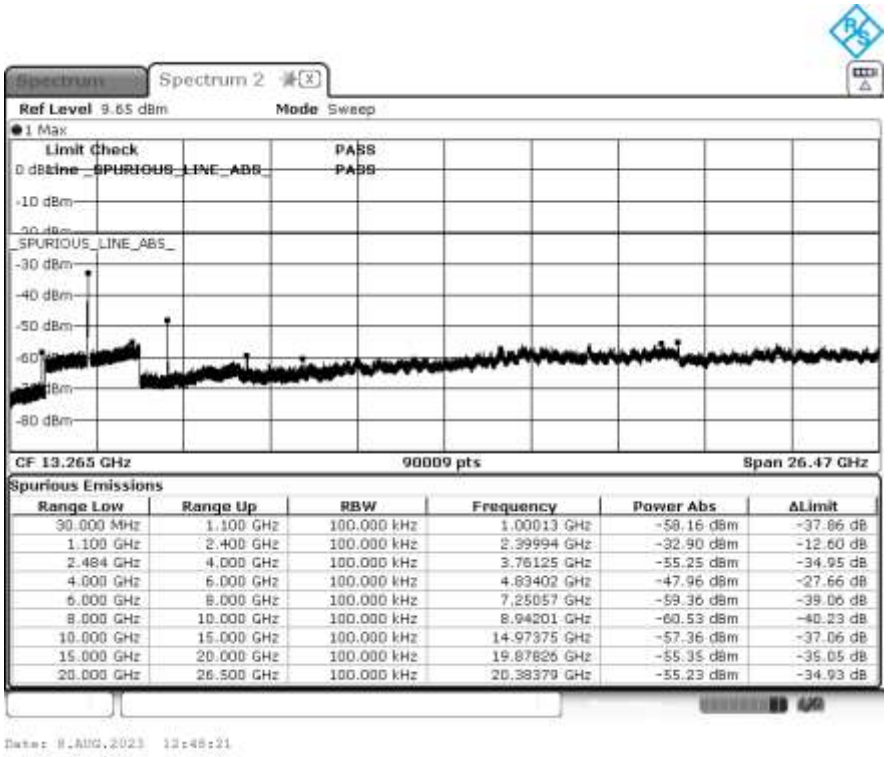
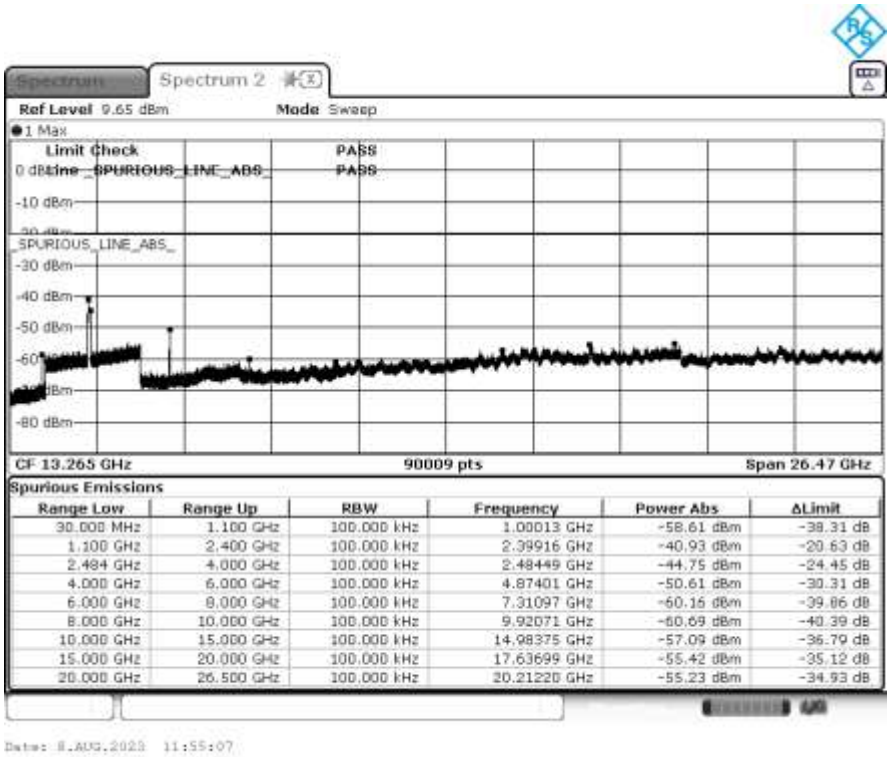
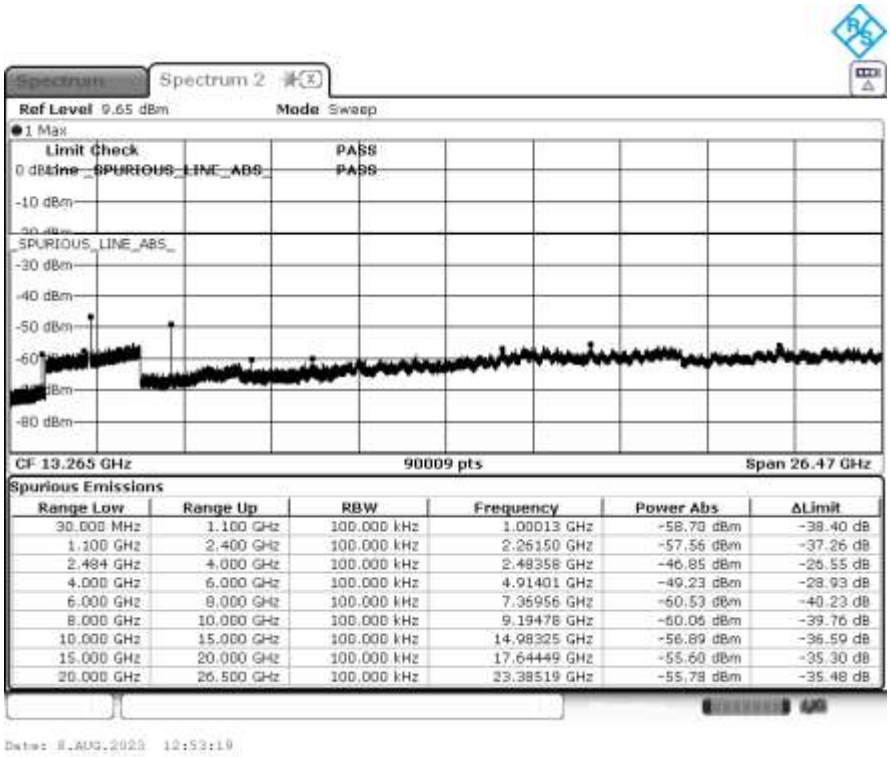


Graph 12: Transmitting on 2417MHz (Power Level 20)

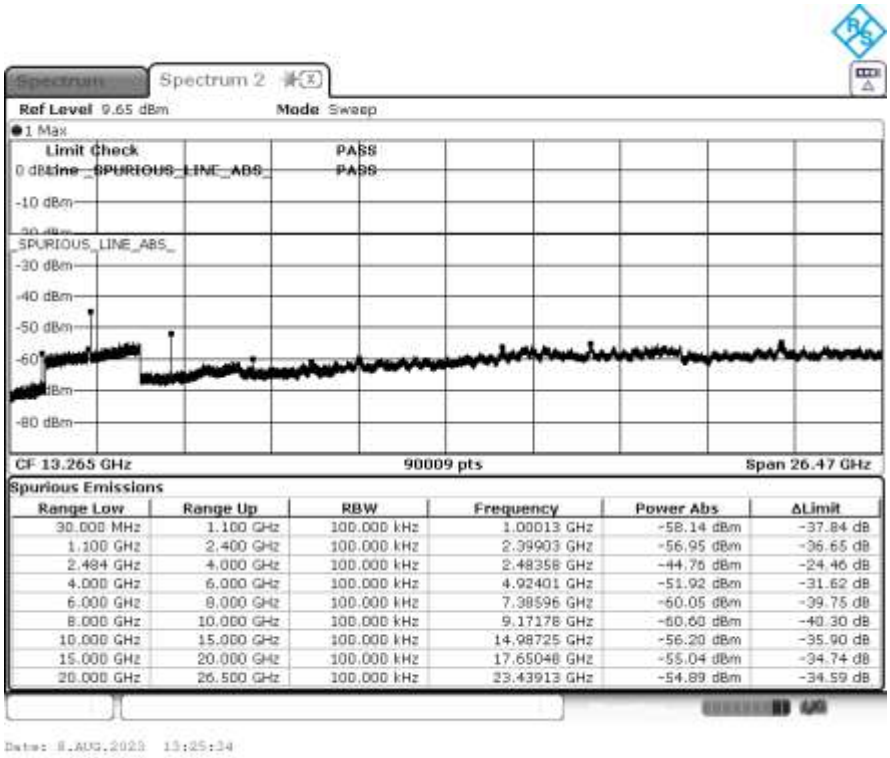


Graph 13: Transmitting on 2437MHz (Power Level 20)

PROPRIETARY



Graph 14: Transmitting on 2457MHz (Power Level 20)

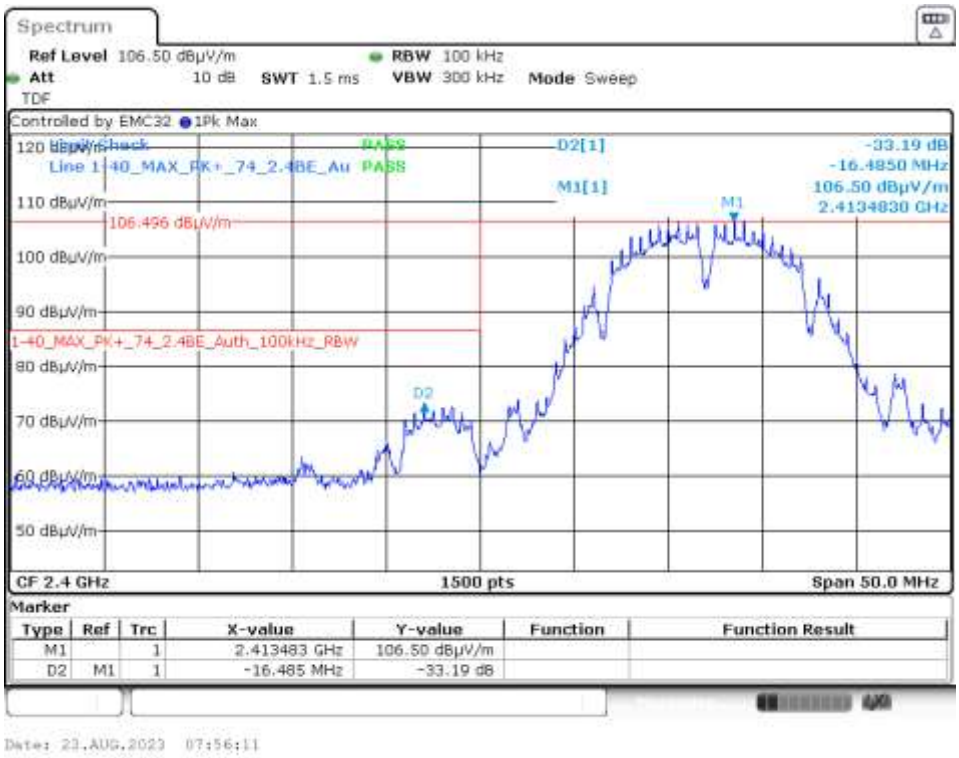


Graph 15: Transmitting on 2462MHz (Power Level 18)

PROPRIETARY

Authorized Band-Edges (Radiated Measurement, 2400MHz and 2483.5MHz)

Shown below are plots with the EUT tuned to the upper and lower channels at power level 20 (the maximum possible output level). These demonstrate compliance with the provisions of this section at the band edges.



Graph 16: Transmitting on 2412MHz (Power Level 20)

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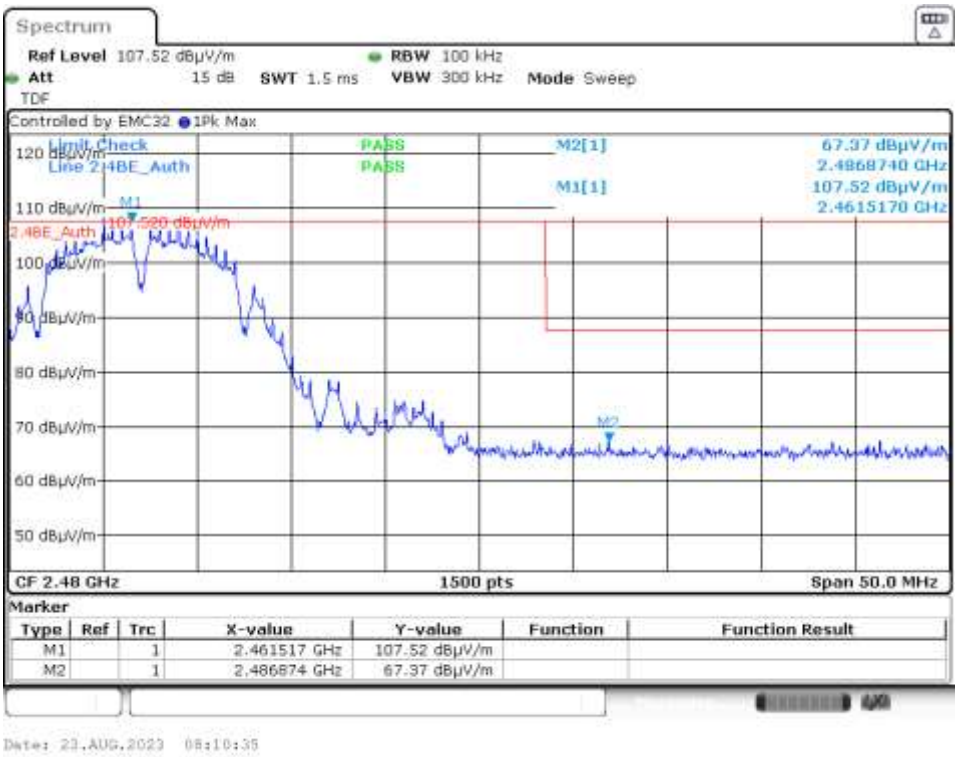


Graph 17: Transmitting on 2462MHz (Power Level 20)

6.3.4 §15.247(e) Peak Power Spectral Density

Power densities were measured at power level 20 (the maximum possible output level) and found to be compliant at the low, middle, and high channels.

The peak 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. Results of this testing are summarized.

Frequency (MHz)	Measurement (dBm)	Criteria (dBm)
2412	-2.9	8.0
2437	-3.1	8.0
2462	-3.0	8.0

Result

The maximum peak power spectral density was less than the limit of 8 dBm; therefore, the EUT complies with the specification.

Graph 18: Lowest Channel 3 kHz PSD Plot (Method AVGPSD-3)

Graph 19: Middle Channel 3 kHz PSD Plot (Method AVGPSD-3)

Graph 20: Highest Channel Output 3 kHz PSD Plot (Method AVGPSD-3)

PROPRIETARY

6.4 Test Results (G-Mode)

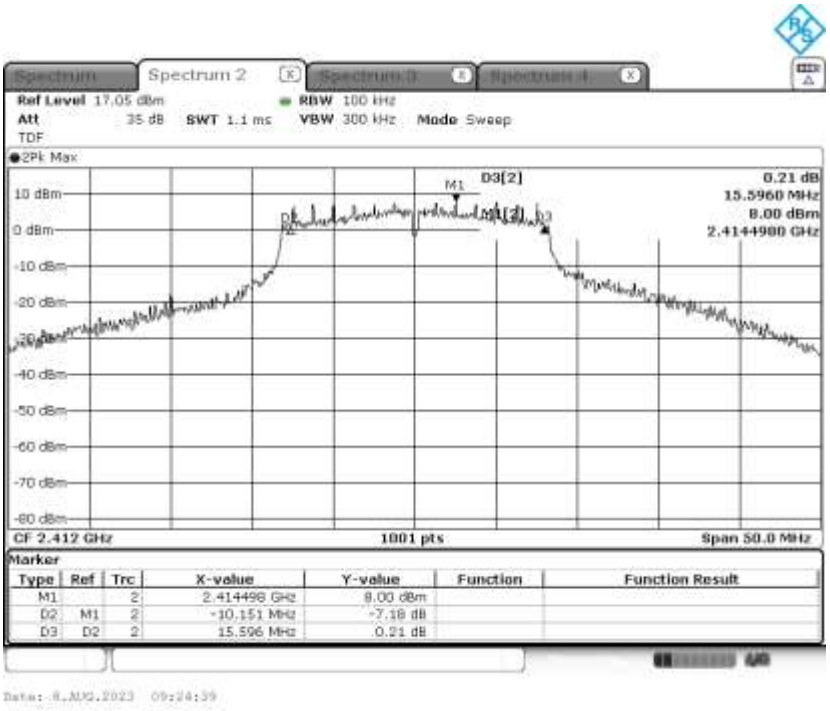
6.4.1 §15.247(a)(2) Emissions Bandwidth

Emission bandwidths were measured at power level 20 (the maximum possible output level) and found to be compliant at the low, middle, and high channels.

Frequency (MHz)	Emissions 6 dB bandwidth (MHz)
2412	15.6
2437	16.3
2462	15.3

Result

In the configuration tested, the 6 dB bandwidth was greater than 500 kHz; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).



Graph 21: Lowest Channel Bandwidth

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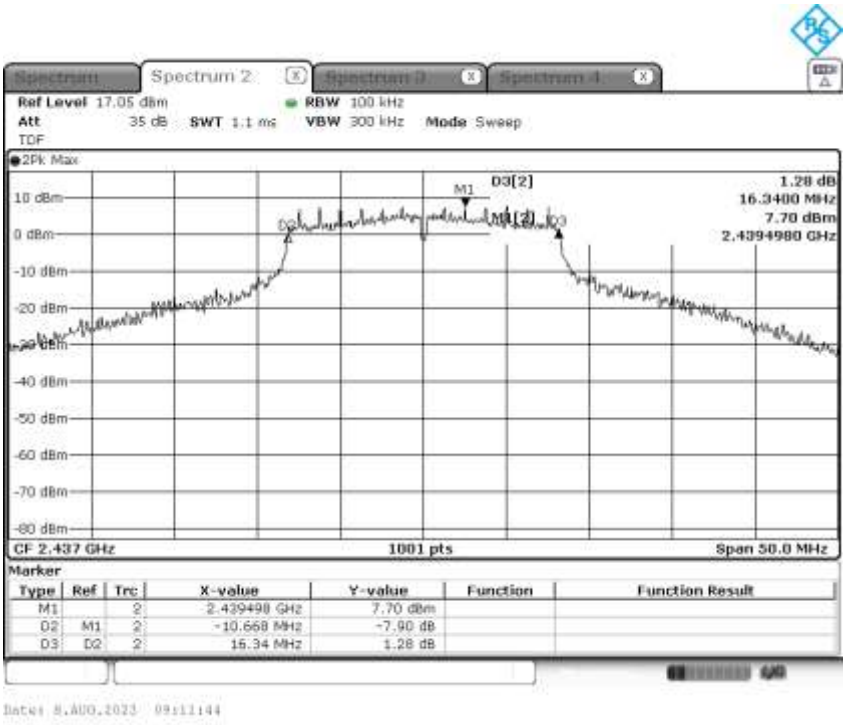
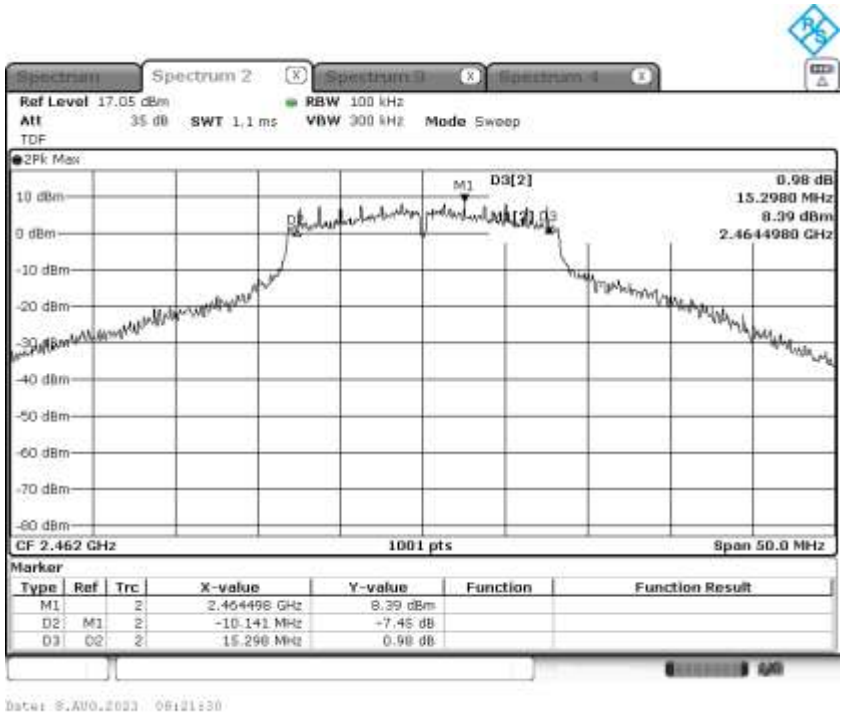


Graph 22: Middle Channel Bandwidth



Graph 23: Highest Channel Bandwidth

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6.4.2 §15.247(b)(3) Peak Output Power

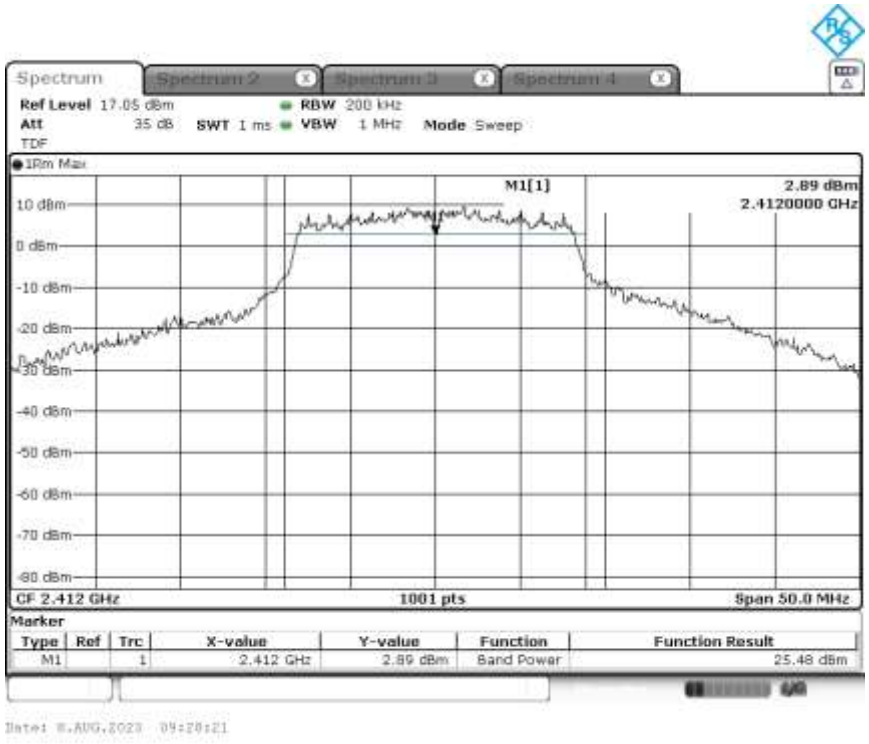
Peak output powers were measured at power level 20 (the maximum possible output level) and found to be compliant at the low, middle, and high channels.

The maximum peak RF Conducted output power measured for this device was 25.8 dBm or 380.2 mW. The limit is 30 dBm or 1 Watt when using antennas with 6 dBi or less gain. The antenna has a peak in-band gain of 2.7 dBi.

Frequency (MHz)	Measured Output Power (dBm)	Output Power (mW)
2412	25.5	354.8
2437	25.4	346.7
2462	25.8	380.2

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 (see spectrum analyzer plots below).



Graph 24: Lowest Channel Output Power Plot (Method AVGSA-3)

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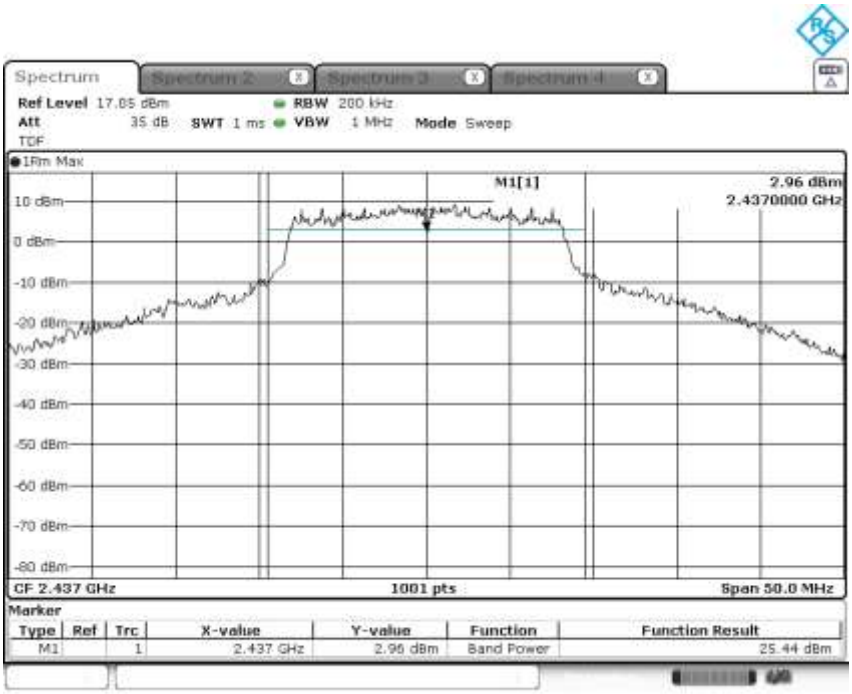
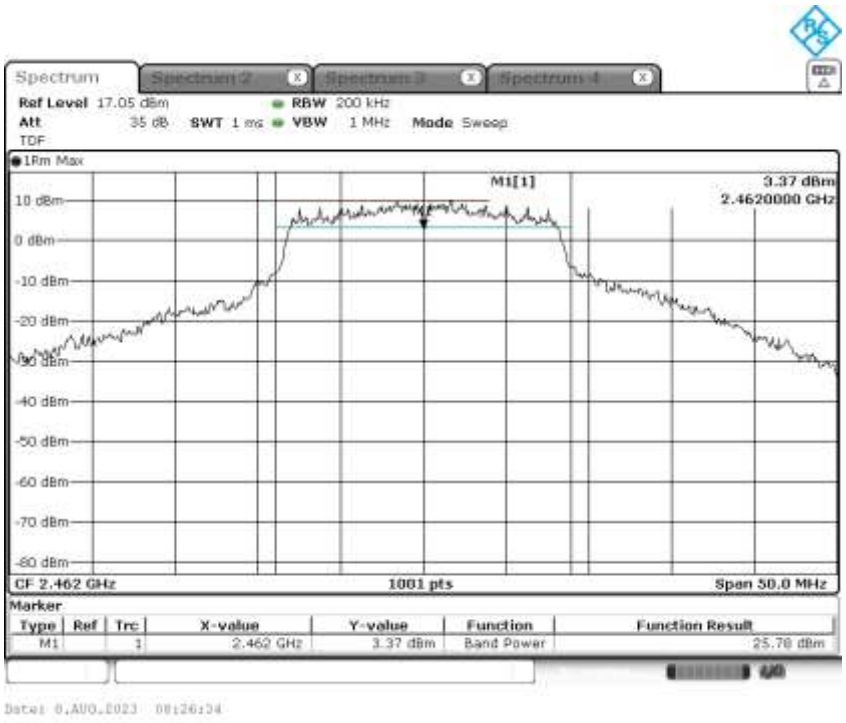


Graph 25: Middle Channel Output Power (Method AVGSA-3)



Graph 26: Highest Channel Output Power Plot (Method AVGSA-3)

PROPRIETARY

6.4.3 §15.247(d) Spurious Emissions

Radiated Spurious Emissions in the Restricted Bands of §15.205

Frequencies from the lowest generated or used to the tenth harmonic of the highest fundamental emission was investigated to measure any radiated emissions in the restricted bands.

The following tables show measurements of any emission that fell into the restricted bands of §15.205. The tables show the measurement data when transmitting at the lowest frequency (maximum power level), middle frequency (maximum power level), and upper frequency (maximum power level). Each possible harmonic to the tenth harmonic was investigated. Emissions detected via conducted antenna-port testing at 1000MHz were closely examined and found compliant across all modulations at the maximum possible power setting, 20.

The emissions in the restricted bands must meet the limits specified in §15.209. Tabular data for each of the spurious emissions is shown below for each of the units. Plots of the band edges are also shown at stepped power settings.

Result

All emissions in the restricted bands of §15.205 met the limits specified in §15.209; therefore, the EUT complies with the specification.

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBµV)	Correction Factor (dB)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1000	Peak	Vertical	47.0	0.2	47.2	74.0	-26.8
1000	Average	Vertical	46.9	0.2	47.1	54.0	-6.9
1000	Peak	Horizontal	49.1	0.2	49.3	74.0	-24.7
1000	Average	Horizontal	49.0	0.2	49.1	54.0	-4.9
1500	Peak	Vertical	36.3	1.7	38.0	74.0	-36.0
1500	Average	Vertical	34.9	1.7	36.6	54.0	-17.4
1500	Peak	Horizontal	39.4	1.7	41.0	74.0	-33.0
1500	Average	Horizontal	38.5	1.7	40.1	54.0	-13.9
4824	Peak	Vertical	30.4	10.2	40.6	74.0	-33.4
4824	Average	Vertical	28.6	10.2	38.7	54.0	-15.3
4824	Peak	Horizontal	29.4	10.2	39.6	74.0	-34.4
4824	Average	Horizontal	27.6	10.2	37.8	54.0	-16.2
7236	Peak	Vertical	26.5	15.1	41.6	74.0	-32.5
7236	Average	Vertical	22.5	15.1	37.6	54.0	-16.4
7236	Peak	Horizontal	27.2	15.1	42.3	74.0	-31.7
7236	Average	Horizontal	22.1	15.1	37.2	54.0	-16.8
9648	Peak	Vertical	23.6	20.1	43.6	74.0	-30.4
9648	Average	Vertical	18.9	20.1	39.0	54.0	-15.0
9648	Peak	Horizontal	24.7	20.1	44.8	74.0	-29.2
9648	Average	Horizontal	20.1	20.1	40.1	54.0	-13.9
12060	Peak	Vertical	24.7	21.2	45.8	74.0	-28.2

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
12060	Average	Vertical	19.8	21.2	40.9	54.0	-13.1
12060	Peak	Horizontal	23.6	21.2	44.7	74.0	-29.3
12060	Average	Horizontal	19.6	21.2	40.8	54.0	-13.2
14472	Peak	Vertical	25.6	23.0	48.6	74.0	-25.4
14472	Average	Vertical	21.3	23.0	44.3	54.0	-9.7
14472	Peak	Horizontal	24.8	22.9	47.7	74.0	-26.3
14472	Average	Horizontal	21.1	22.9	44.0	54.0	-10.0
16884	Peak	Vertical	54.2	-10.9	43.4	74.0	-30.6
16884	Average	Vertical	50.2	-10.9	39.3	54.0	-14.7
16884	Peak	Horizontal	53.6	-10.7	42.9	74.0	-31.1
16884	Average	Horizontal	50.3	-10.7	39.6	54.0	-14.4
19296	Peak	Vertical	38.8	13.2	51.9	74.0	-22.1
19296	Average	Vertical	34.4	13.2	47.6	54.0	-6.4
19296	Peak	Horizontal	38.2	13.2	51.4	74.0	-22.6
19296	Average	Horizontal	34.7	13.2	47.9	54.0	-6.1
21708	Peak	Vertical	36.7	14.6	51.3	74.0	-22.7
21708	Average	Vertical	32.4	14.6	47.0	54.0	-7.0
21708	Peak	Horizontal	38.0	14.4	52.4	74.0	-21.6
21708	Average	Horizontal	32.7	14.4	47.1	54.0	-6.9
24120	Peak	Vertical	35.5	17.3	52.8	74.0	-21.2
24120	Average	Vertical	32.7	17.3	50.0	54.0	-4.0
24120	Peak	Horizontal	36.0	17.2	53.2	74.0	-20.8
24120	Average	Horizontal	32.6	17.2	49.8	54.0	-4.2

Table 5: Transmitting at the Lowest Frequency (2412MHz, Power Level 20)

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1000	Peak	Vertical	47.2	0.2	47.4	74.0	-26.6
1000	Average	Vertical	47.1	0.2	47.3	54.0	-6.7
1000	Peak	Horizontal	48.8	0.2	48.9	74.0	-25.1
1000	Average	Horizontal	48.4	0.2	48.6	54.0	-5.5
3000	Peak	Vertical	36.2	7.0	43.2	74.0	-30.8
3000	Average	Vertical	34.4	7.0	41.4	54.0	-12.6
3000	Peak	Horizontal	33.2	7.0	40.3	74.0	-33.7
3000	Average	Horizontal	32.1	7.0	39.2	54.0	-14.9
4874	Peak	Vertical	29.3	10.3	39.5	74.0	-34.5

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Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4874	Average	Vertical	27.8	10.3	38.0	54.0	-16.0
4874	Peak	Horizontal	27.8	10.3	38.1	74.0	-35.9
4874	Average	Horizontal	27.3	10.3	37.5	54.0	-16.5
7311	Peak	Vertical	25.9	15.4	41.3	74.0	-32.7
7311	Average	Vertical	21.8	15.4	37.2	54.0	-16.8
7311	Peak	Horizontal	26.5	15.4	41.9	74.0	-32.1
7311	Average	Horizontal	21.9	15.4	37.3	54.0	-16.7
9748	Peak	Vertical	23.7	20.3	44.0	74.0	-30.0
9748	Average	Vertical	18.8	20.3	39.1	54.0	-14.9
9748	Peak	Horizontal	23.0	20.3	43.3	74.0	-30.7
9748	Average	Horizontal	18.8	20.3	39.1	54.0	-14.9
12185	Peak	Vertical	23.3	20.8	44.1	74.0	-29.9
12185	Average	Vertical	19.8	20.8	40.5	54.0	-13.5
12185	Peak	Horizontal	25.8	20.8	46.6	74.0	-27.4
12185	Average	Horizontal	19.5	20.8	40.2	54.0	-13.8
14622	Peak	Vertical	25.5	23.2	48.7	74.0	-25.3
14622	Average	Vertical	20.4	23.2	43.6	54.0	-10.4
14622	Peak	Horizontal	25.0	23.2	48.2	74.0	-25.8
14622	Average	Horizontal	20.5	23.2	43.7	54.0	-10.3
17059	Peak	Vertical	55.4	-9.0	46.4	74.0	-27.7
17059	Average	Vertical	50.2	-9.0	41.1	54.0	-12.9
17059	Peak	Horizontal	53.1	-9.1	44.0	74.0	-30.0
17059	Average	Horizontal	49.3	-9.1	40.2	54.0	-13.8
19496	Peak	Vertical	37.2	13.2	50.4	74.0	-23.6
19496	Average	Vertical	33.9	13.2	47.1	54.0	-6.9
19496	Peak	Horizontal	37.1	13.2	50.3	74.0	-23.7
19496	Average	Horizontal	33.9	13.2	47.0	54.0	-7.0
21933	Peak	Vertical	35.3	15.0	50.2	74.0	-23.8
21933	Average	Vertical	32.7	15.0	47.6	54.0	-6.4
21933	Peak	Horizontal	36.3	15.0	51.3	74.0	-22.7
21933	Average	Horizontal	32.7	15.0	47.7	54.0	-6.3
24370	Peak	Vertical	35.6	17.7	53.3	74.0	-20.7
24370	Average	Vertical	32.2	17.7	49.9	54.0	-4.1
24370	Peak	Horizontal	35.5	17.8	53.3	74.0	-20.7
24370	Average	Horizontal	32.4	17.8	50.1	54.0	-3.9

Table 6: Transmitting at the Middle Frequency (2437MHz, Power Level 20)

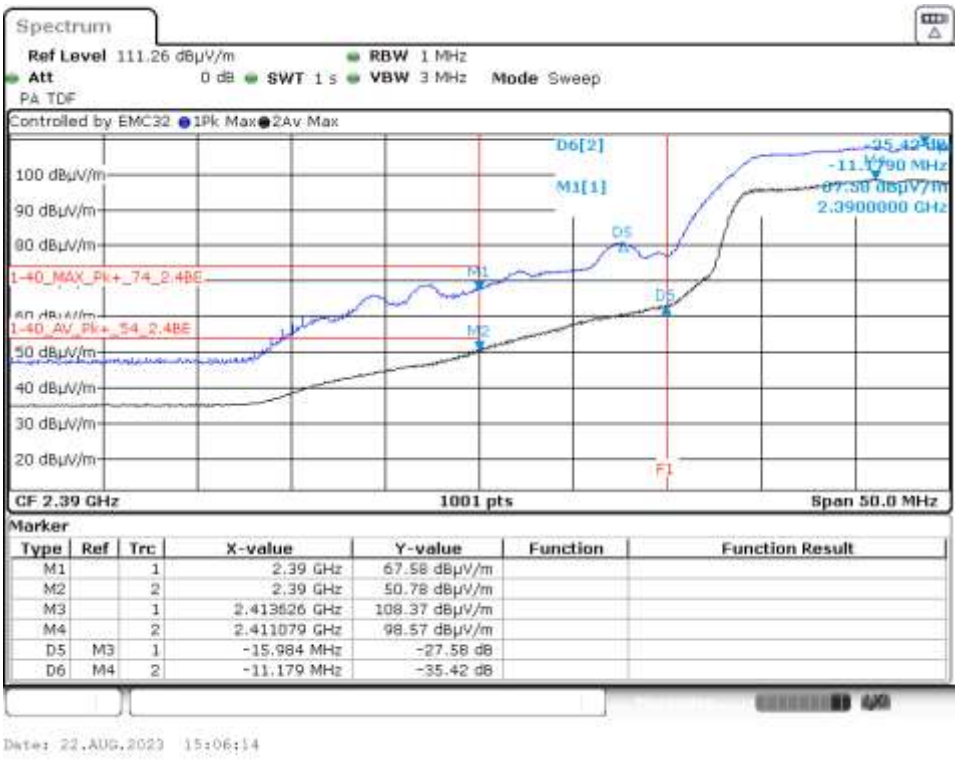
Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1000	Peak	Vertical	48.2	0.2	48.4	74.0	-25.7
1000	Average	Vertical	48.1	0.2	48.2	54.0	-5.8
1000	Peak	Horizontal	48.8	0.2	48.9	74.0	-25.1
1000	Average	Horizontal	48.6	0.2	48.8	54.0	-5.2
3000	Peak	Vertical	36.8	7.0	43.8	74.0	-30.2
3000	Average	Vertical	36.0	7.0	43.0	54.0	-11.0
3000	Peak	Horizontal	34.5	7.0	41.5	74.0	-32.5
3000	Average	Horizontal	33.2	7.0	40.3	54.0	-13.7
4924	Peak	Vertical	30.2	10.3	40.5	74.0	-33.5
4924	Average	Vertical	28.7	10.3	39.0	54.0	-15.0
4924	Peak	Horizontal	29.3	10.3	39.6	74.0	-34.4
4924	Average	Vertical	27.7	10.3	38.0	54.0	-16.0
7386	Peak	Vertical	25.3	15.7	41.0	74.0	-33.0
7386	Average	Vertical	21.0	15.7	36.7	54.0	-17.3
7386	Peak	Horizontal	25.8	15.7	41.5	74.0	-32.5
7386	Average	Horizontal	21.1	15.7	36.7	54.0	-17.3
9848	Peak	Vertical	23.2	20.6	43.8	74.0	-30.2
9848	Average	Vertical	18.7	20.6	39.3	54.0	-14.7
9848	Peak	Horizontal	23.3	20.6	43.9	74.0	-30.2
9848	Average	Horizontal	18.6	20.6	39.2	54.0	-14.8
12310	Peak	Vertical	24.0	20.6	44.5	74.0	-29.5
12310	Average	Vertical	19.8	20.6	40.4	54.0	-13.6
12310	Peak	Horizontal	25.3	20.6	45.9	74.0	-28.1
12310	Average	Horizontal	19.7	20.6	40.3	54.0	-13.7
14772	Peak	Vertical	24.0	23.1	47.1	74.0	-26.9
14772	Average	Vertical	19.5	23.1	42.6	54.0	-11.4
14772	Peak	Horizontal	24.6	23.1	47.7	74.0	-26.3
14772	Average	Horizontal	19.8	23.1	42.9	54.0	-11.1
17234	Peak	Vertical	55.4	-8.2	47.2	74.0	-26.8
17234	Average	Vertical	49.9	-8.2	41.7	54.0	-12.3
17234	Peak	Horizontal	54.6	-8.6	46.0	74.0	-28.0
17234	Average	Horizontal	50.7	-8.6	42.1	54.0	-11.9

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
19696	Peak	Vertical	37.9	13.1	50.9	74.0	-23.1
19696	Average	Vertical	35.3	13.1	48.4	54.0	-5.6
19696	Peak	Horizontal	38.5	13.0	51.6	74.0	-22.4
19696	Average	Horizontal	34.5	13.0	47.5	54.0	-6.5
22158	Peak	Vertical	35.6	15.2	50.8	74.0	-23.2
22158	Average	Vertical	32.2	15.2	47.4	54.0	-6.6
22158	Peak	Horizontal	35.9	15.2	51.1	74.0	-22.9
22158	Average	Horizontal	32.1	15.2	47.3	54.0	-6.7
24620	Peak	Vertical	35.6	18.0	53.5	74.0	-20.5
24620	Average	Vertical	32.6	18.0	50.5	54.0	-3.5
24620	Peak	Horizontal	36.6	18.0	54.6	74.0	-19.4
24620	Average	Horizontal	33.0	18.0	51.0	54.0	-3.0

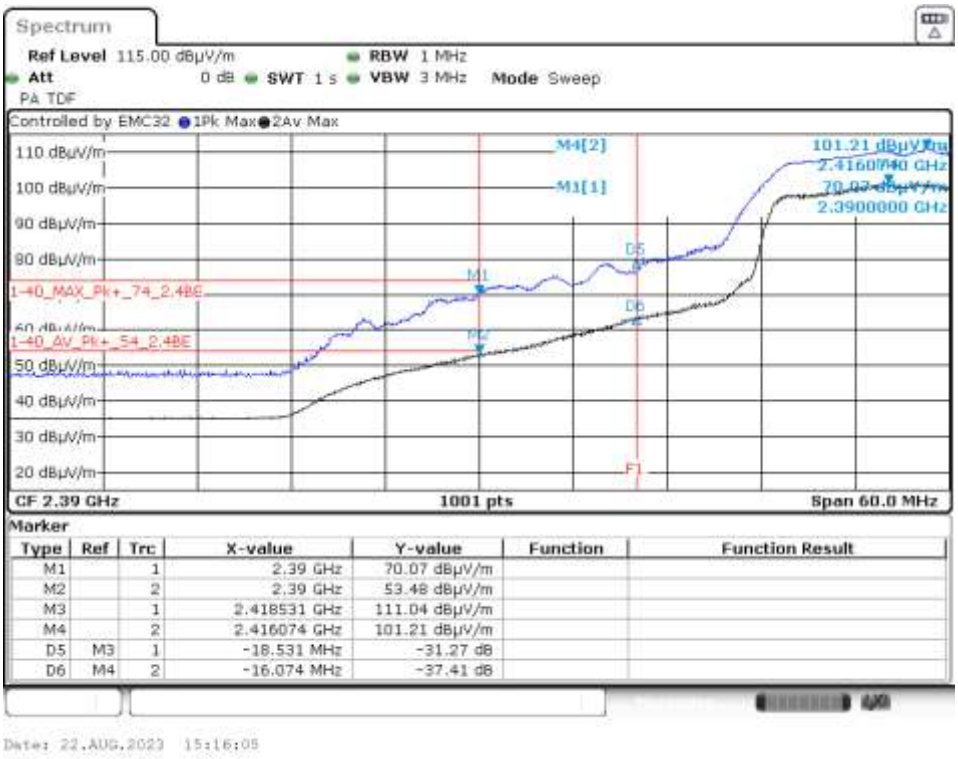
Table 7: Transmitting at the Highest Frequency (2462MHz, Power Level 20)

No other emissions were seen in the restricted bands.

Restricted Band-Edges (Band Edges of §15.205, 2390MHz and 2483.5MHz)



Graph 27: Radiated Lower Band Edge Plot (Transmitting 2412MHz, Power Level 14)



Graph 28: Radiated Lower Band Edge Plot (Transmitting 2417MHz, Power Level 16)

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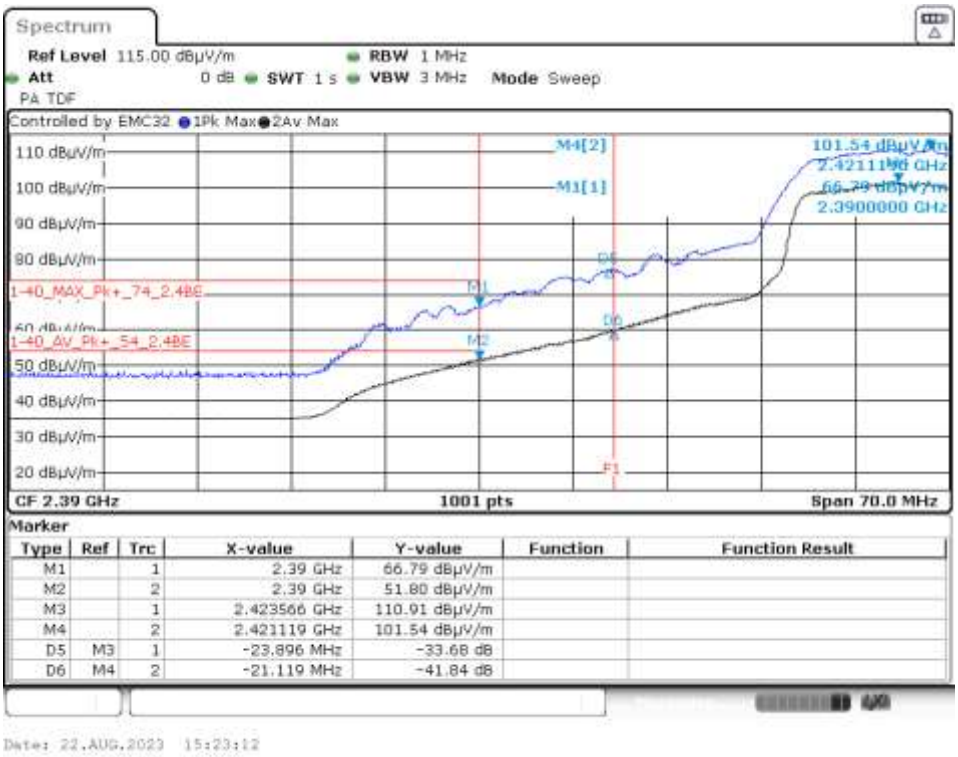
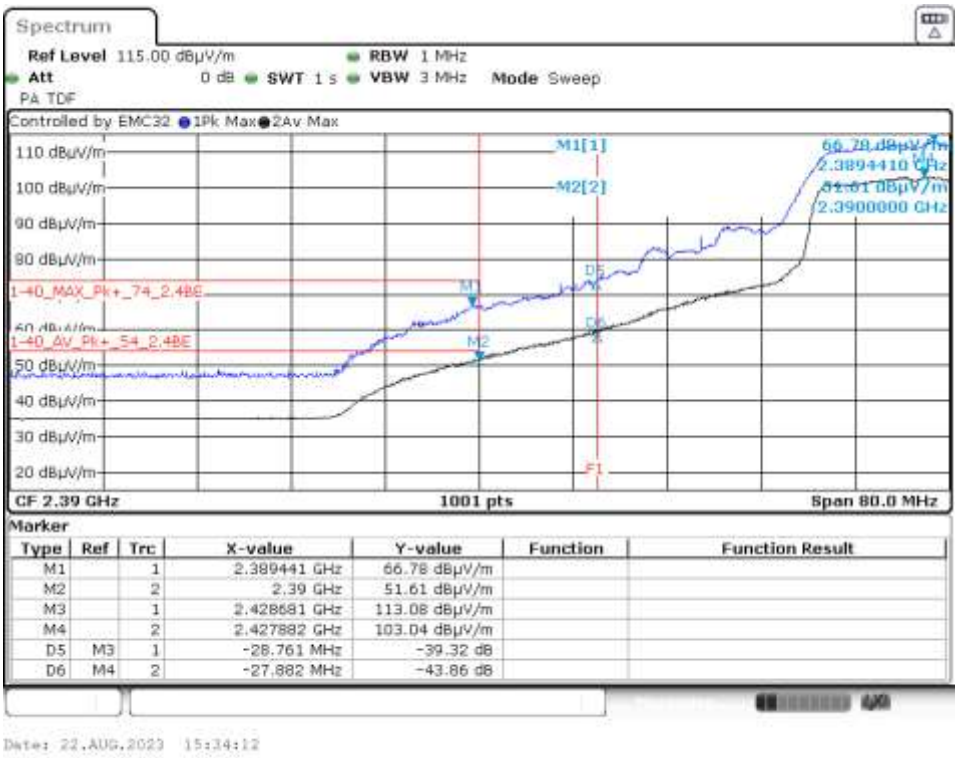


Graph 29: Radiated Lower Band Edge Plot (Transmitting 2422MHz, Power Level 16)



Graph 30: Radiated Lower Band Edge Plot (Transmitting 2427MHz, Power Level 18)

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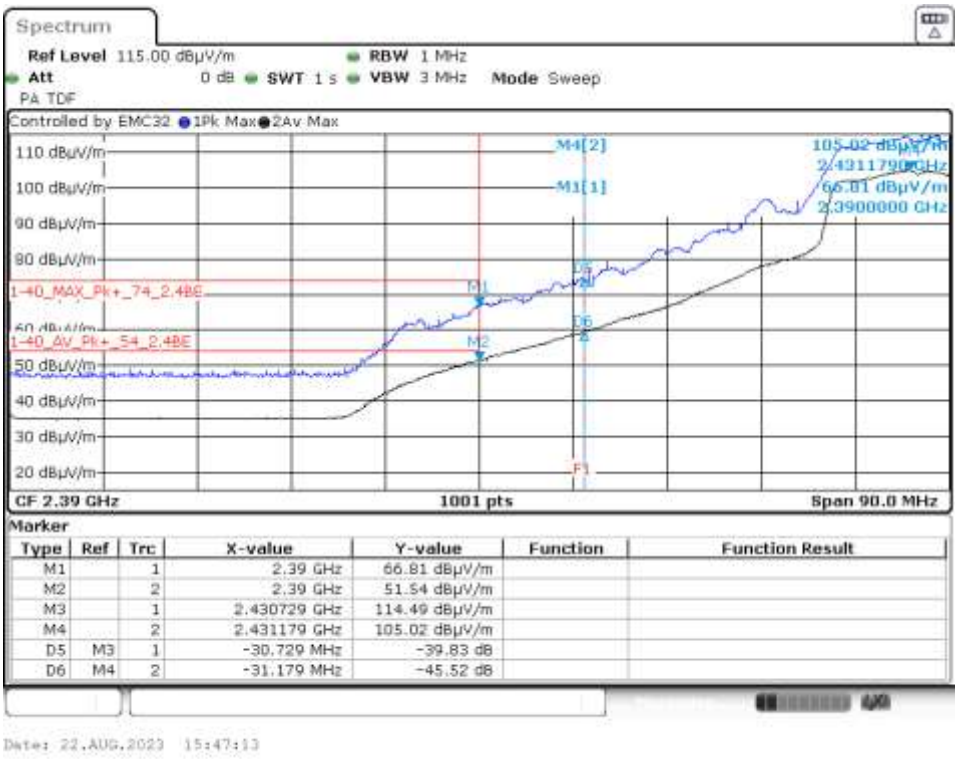
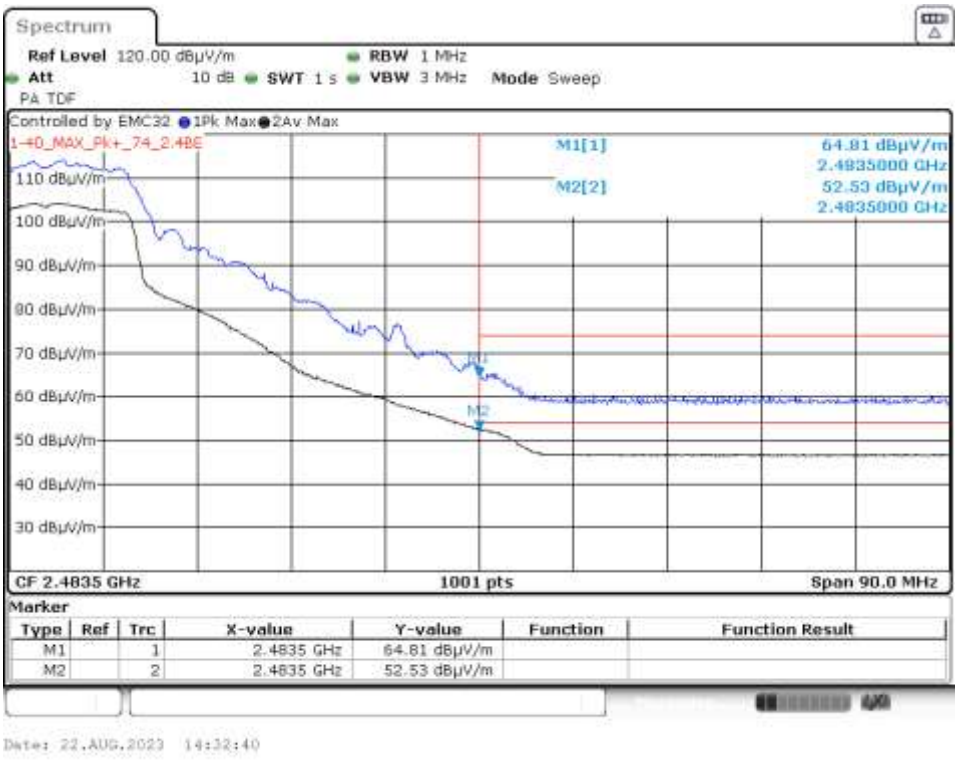


Graph 31: Radiated Lower Band Edge Plot (Transmitting 2432MHz, Power Level 20)



Graph 32: Radiated Upper Band Edge Plot (Transmitting 2442MHz, Power Level 20)

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Graph 33: Radiated Upper Band Edge Plot (Transmitting 2447MHz, Power Level 18)

Graph 34: Radiated Upper Band Edge Plot (Transmitting 2452MHz, Power Level 17)

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Graph 35: Radiated Upper Band Edge Plot (Transmitting 2457MHz, Power Level 16)

Graph 36: Radiated Upper Band Edge Plot (Transmitting 2462MHz, Power Level 14)

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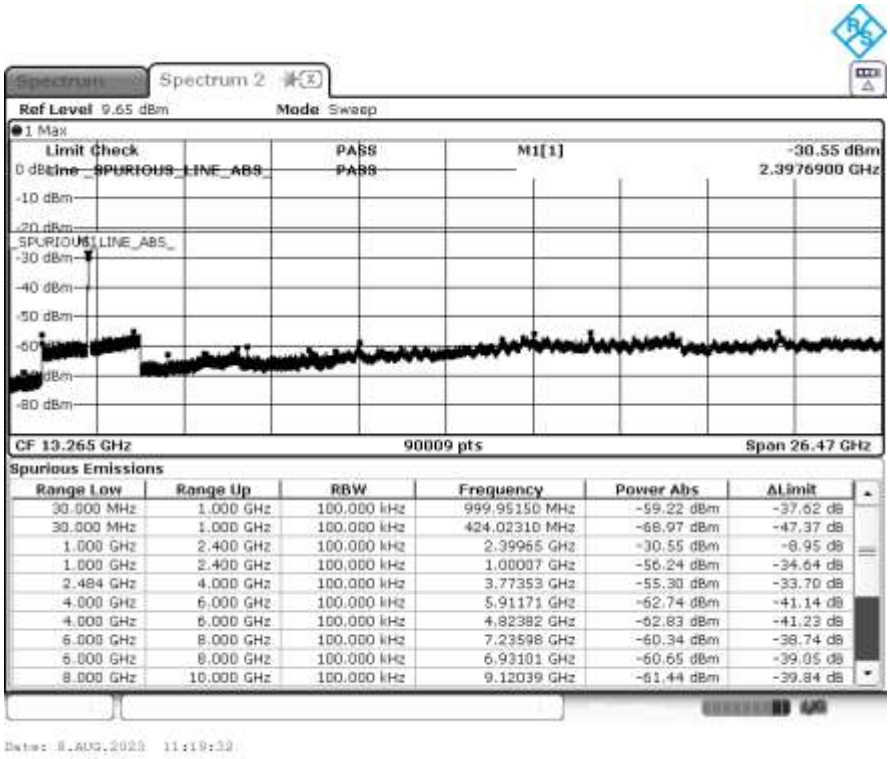
Conducted Spurious Emissions

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 frequencies (stepped power levels), middle frequency (maximum power level), and upper frequencies (stepped power levels).

The emissions must be attenuated 30 dB below the highest power level measured within the authorized band as measured with a 100 kHz RBW. The highest power measured in was 8.4 dBm; therefore, the criteria is 8.4– 30 = 21.6 dBm.

Result

Conducted spurious emissions were attenuated 30 dB or more below the fundamental; therefore, the EUT complies with the specification.



Graph 37: Transmitting on 2412MHz (Power Level 14)

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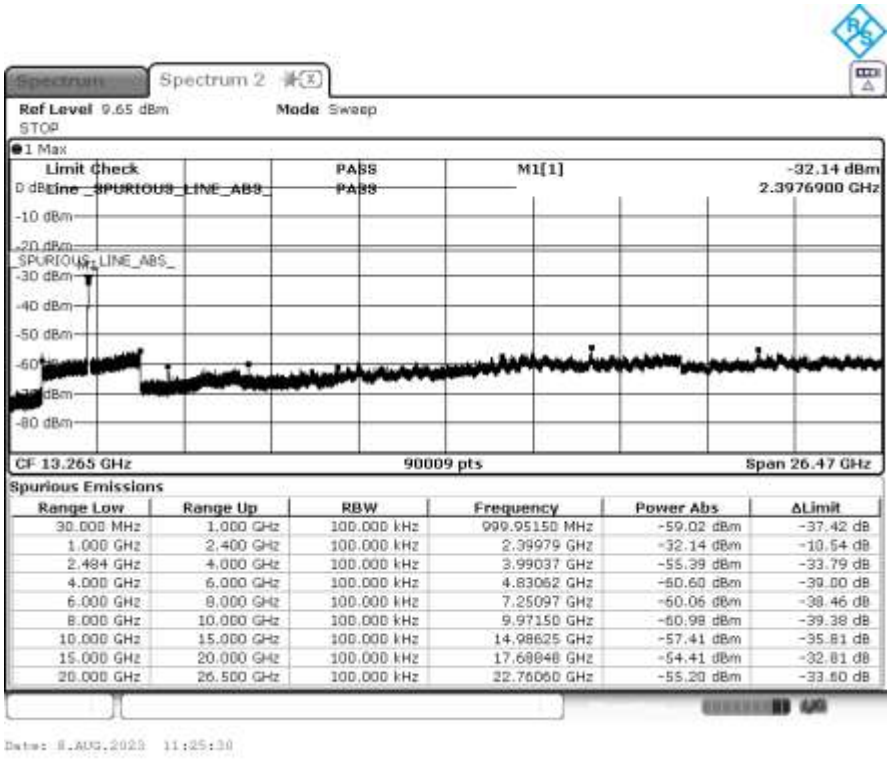
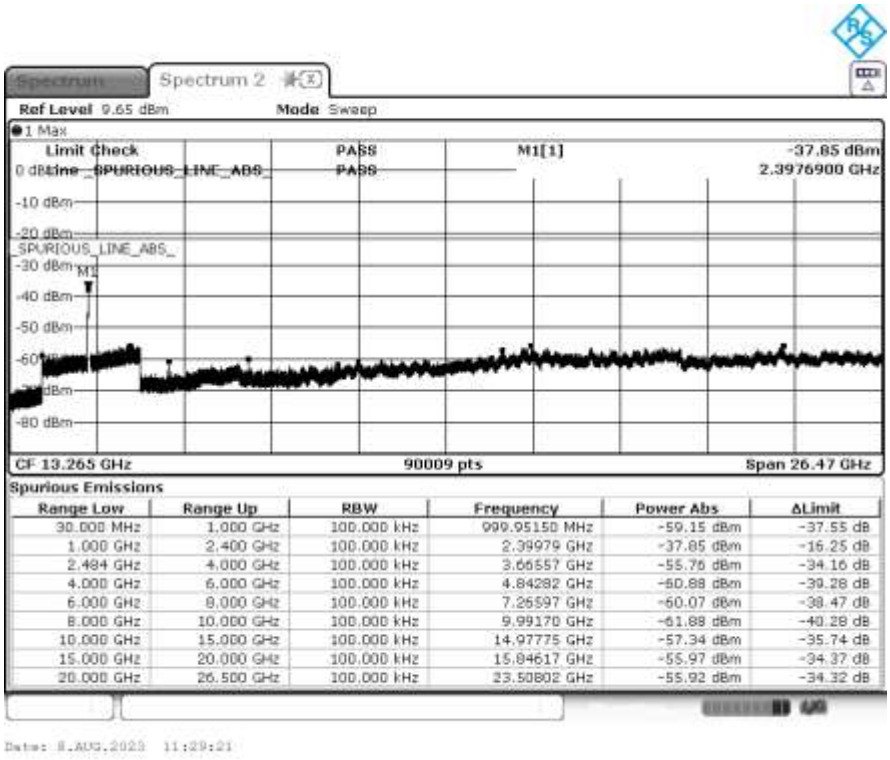


Graph 38: Transmitting on 2417MHz (Power Level 16)



Graph 39: Transmitting on 2422MHz (Power Level 16)

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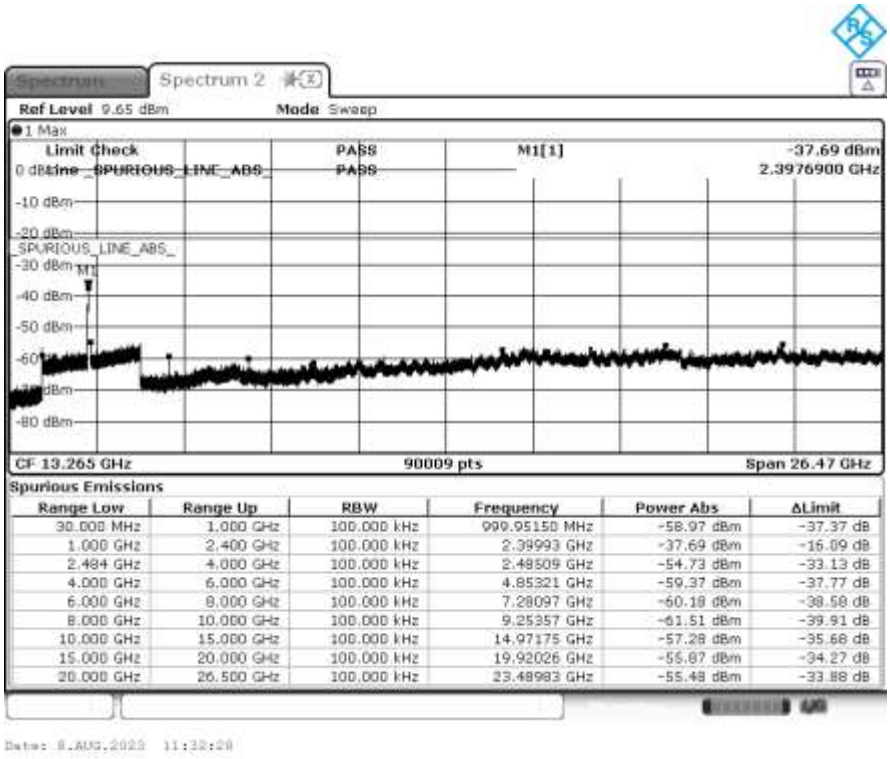
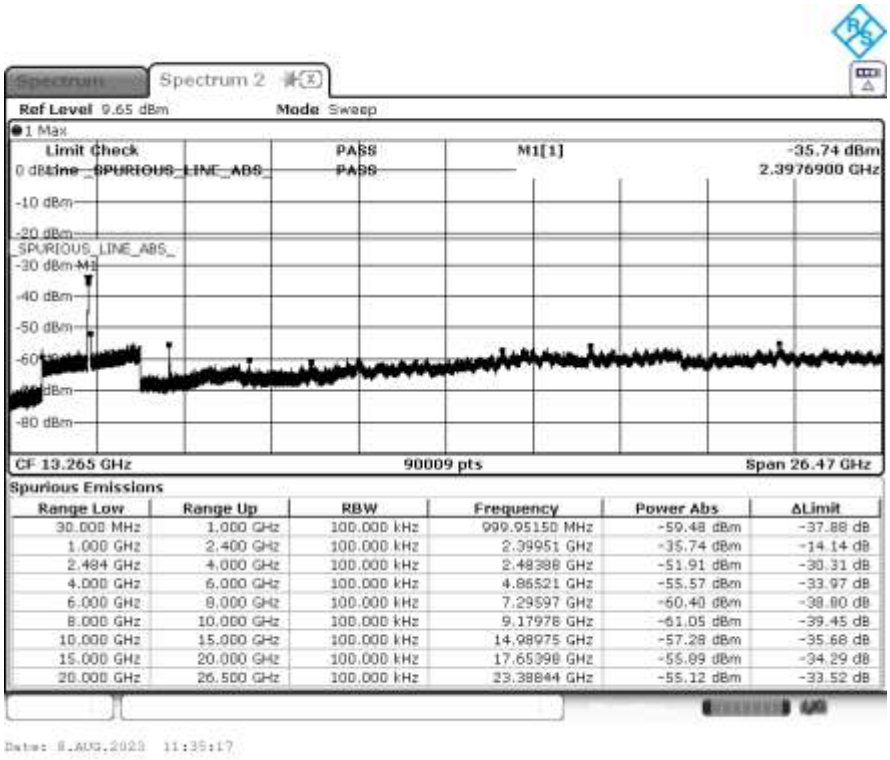


Graph 40: Transmitting on 2427MHz (Power Level 18)



Graph 41: Transmitting on 2432MHz (Power Level 20)

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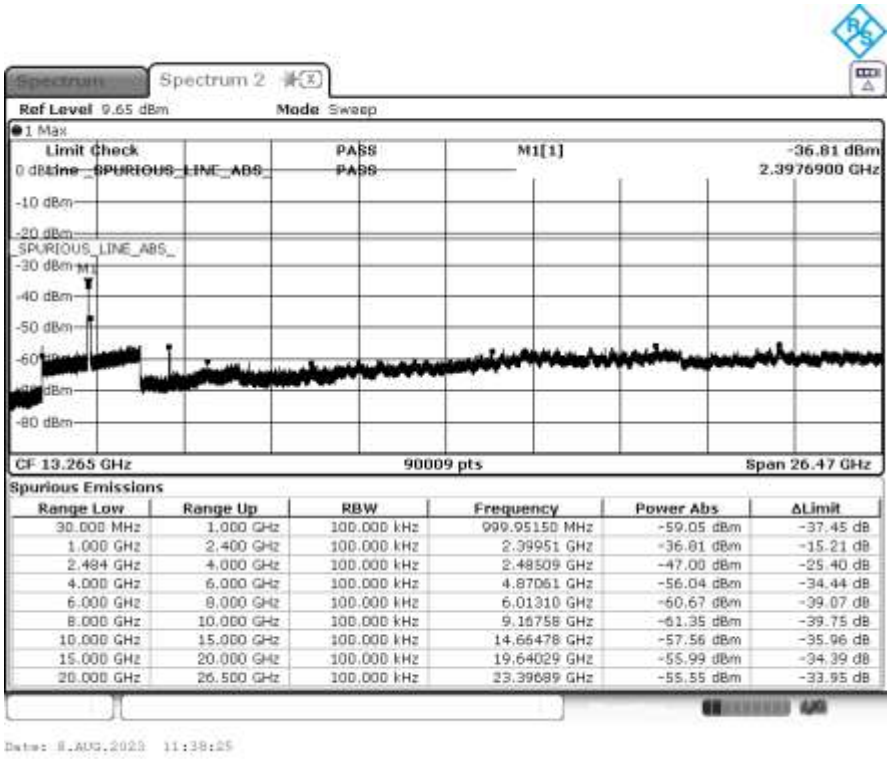
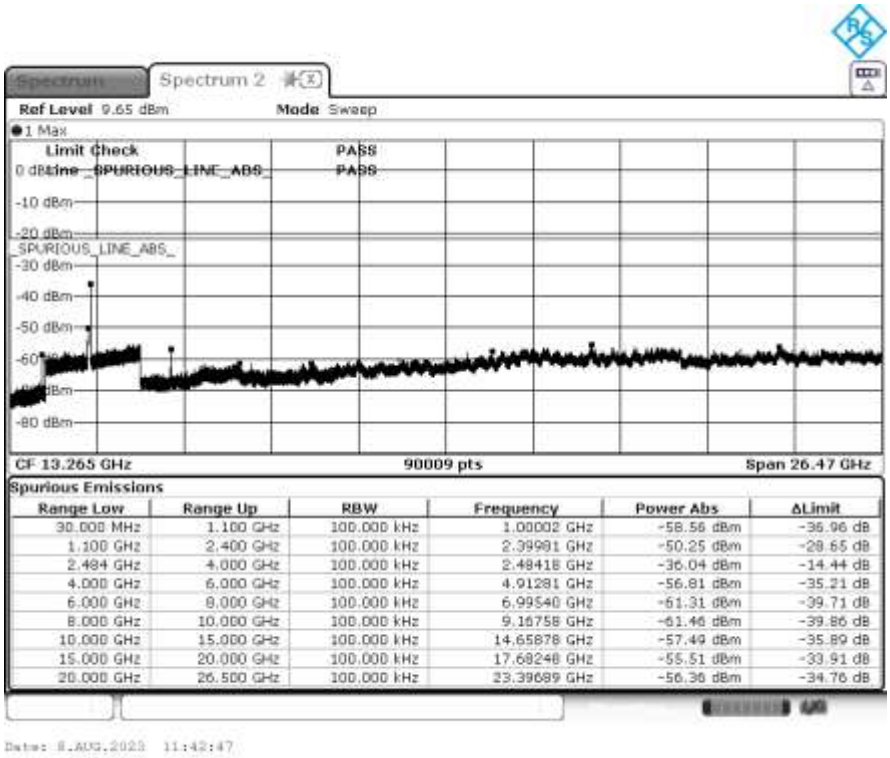


Graph 42: Transmitting on 2437MHz (Power Level 20)



Graph 43: Transmitting on 2457MHz (Power Level 20)

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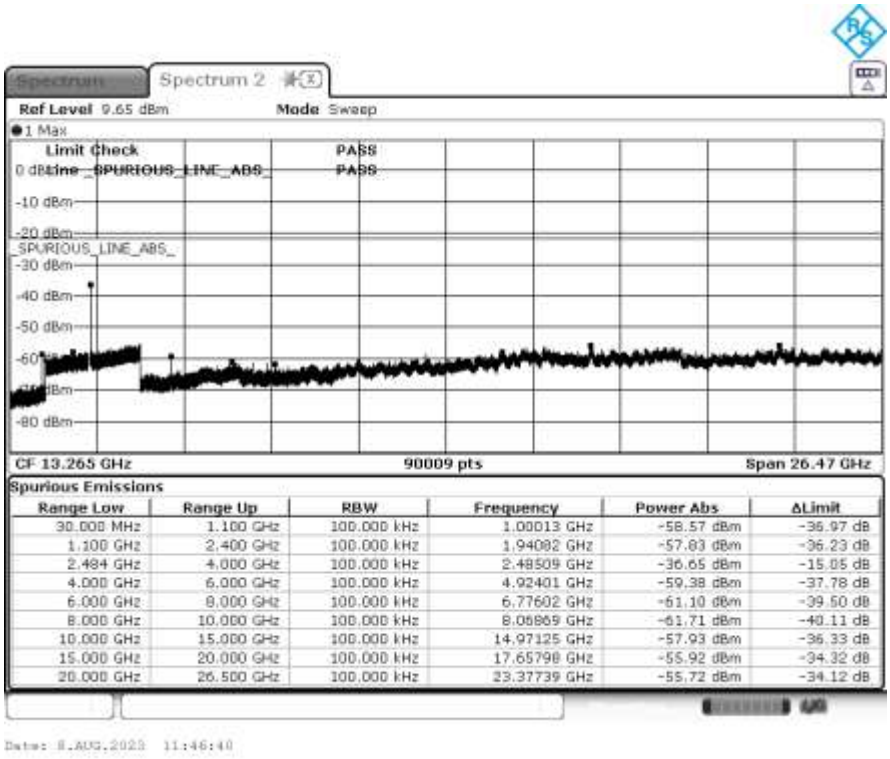
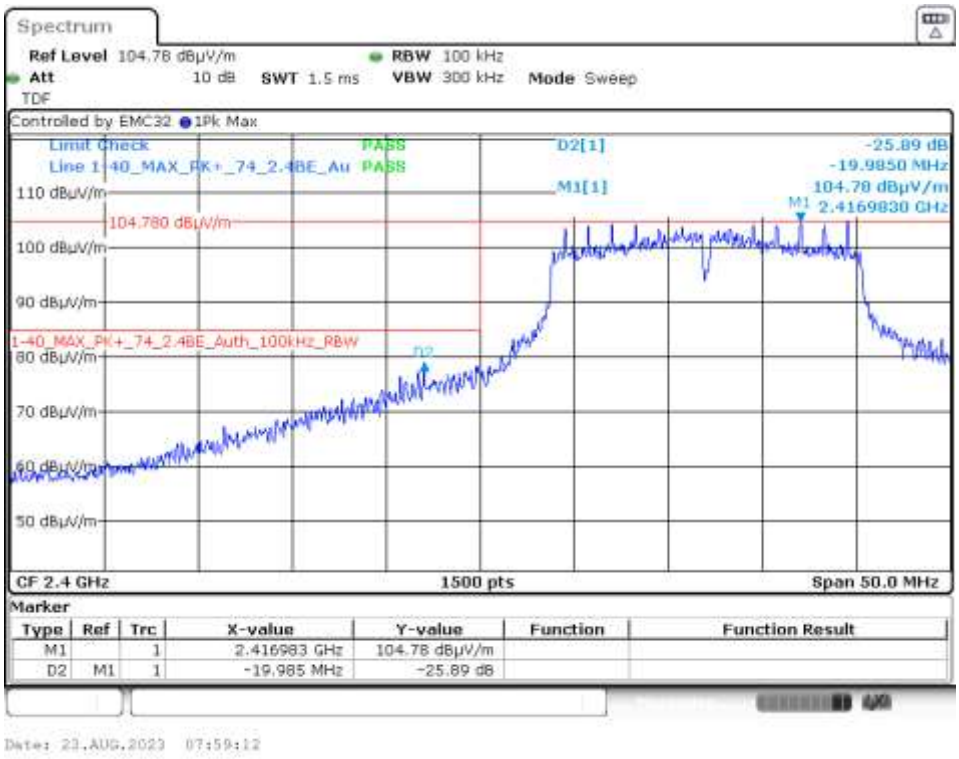


Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
30.000 MHz	1.100 GHz	100.000 kHz	1.00013 GHz	-58.57 dBm	-36.97 dB
1.100 GHz	2.400 GHz	100.000 kHz	1.94082 GHz	-57.83 dBm	-36.23 dB
2.484 GHz	4.000 GHz	100.000 kHz	2.48509 GHz	-36.65 dBm	-15.05 dB
4.000 GHz	6.000 GHz	100.000 kHz	4.92401 GHz	-59.38 dBm	-37.78 dB
6.000 GHz	8.000 GHz	100.000 kHz	6.77602 GHz	-61.10 dBm	-39.50 dB
8.000 GHz	10.000 GHz	100.000 kHz	8.06869 GHz	-61.71 dBm	-40.11 dB
10.000 GHz	15.000 GHz	100.000 kHz	14.97125 GHz	-57.93 dBm	-36.33 dB
15.000 GHz	20.000 GHz	100.000 kHz	17.65798 GHz	-55.92 dBm	-34.32 dB
20.000 GHz	26.500 GHz	100.000 kHz	23.37739 GHz	-55.72 dBm	-34.12 dB

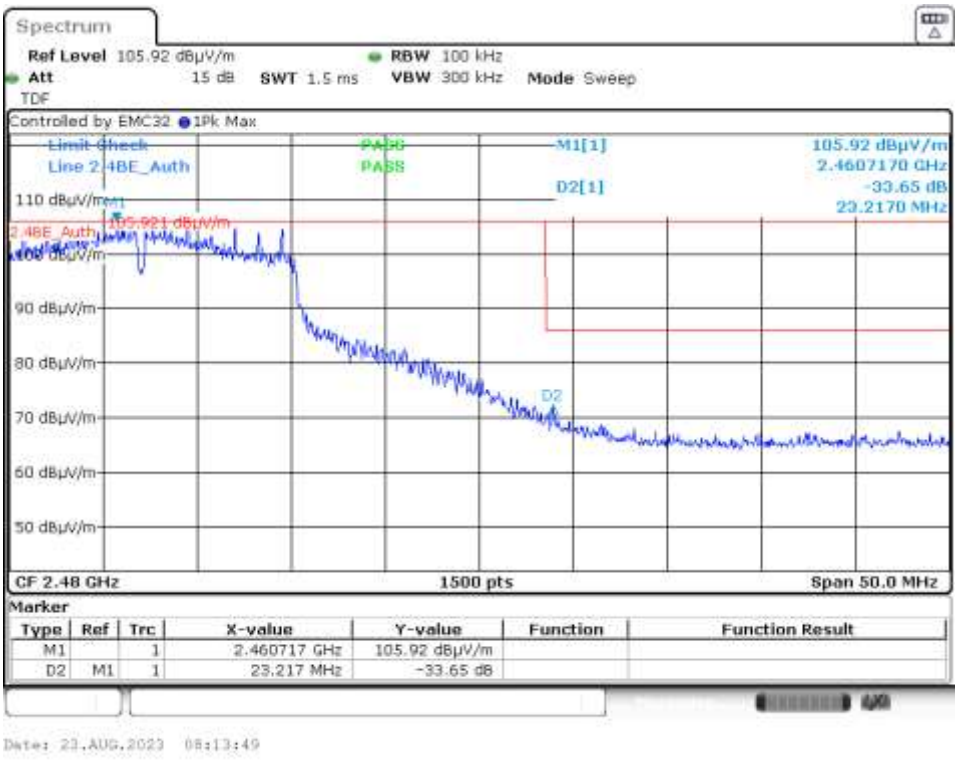
Graph 44: Transmitting on 2462MHz (Power Level 18)

Authorized Band-Edges (Radiated Measurement, 2400MHz and 2483.5MHz)

Shown below are plots with the EUT tuned to the upper and lower channels at power level 20 (the maximum possible output level). These demonstrate compliance with the provisions of this section at the band edges.



Graph 45: Transmitting on 2412MHz (Power Level 20)



Graph 46: Transmitting on 2462MHz (Power Level 20)

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6.4.4 §15.247(e) Peak Power Spectral Density

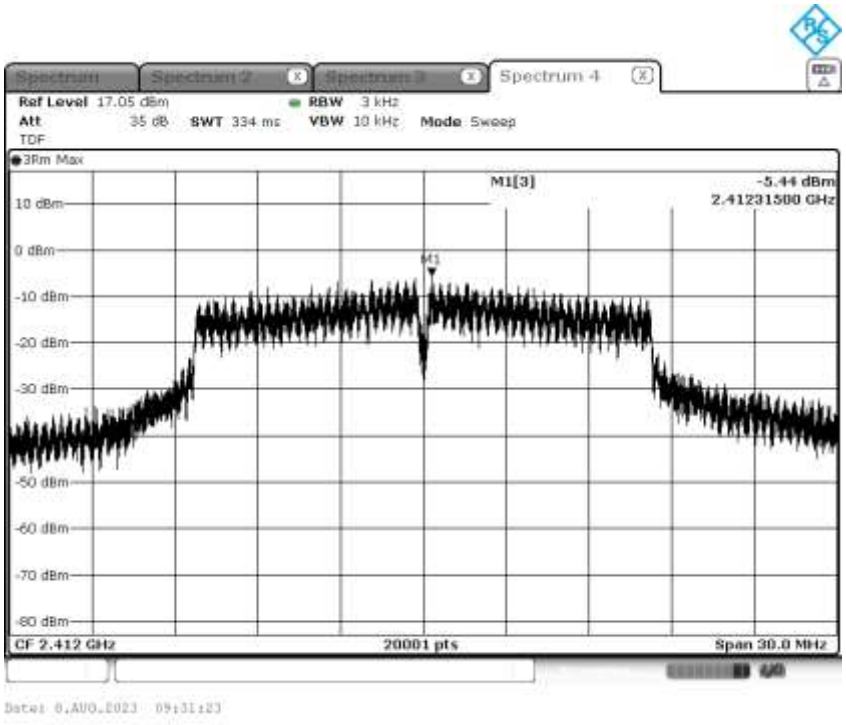
Power densities were measured at power level 20 (the maximum possible output level) and found to be compliant at the low, middle, and high channels.

The peak 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. Results of this testing are summarized.

Frequency (MHz)	Measurement (dBm)	Criteria (dBm)
2412	-5.4	8.0
2437	-5.6	8.0
2462	-5.6	8.0

Result

The maximum peak power spectral density was less than the limit of 8 dBm; therefore, the EUT complies with the specification.



Graph 47: Lowest Channel 3 kHz PSD Plot (Method AVGPSD-3)

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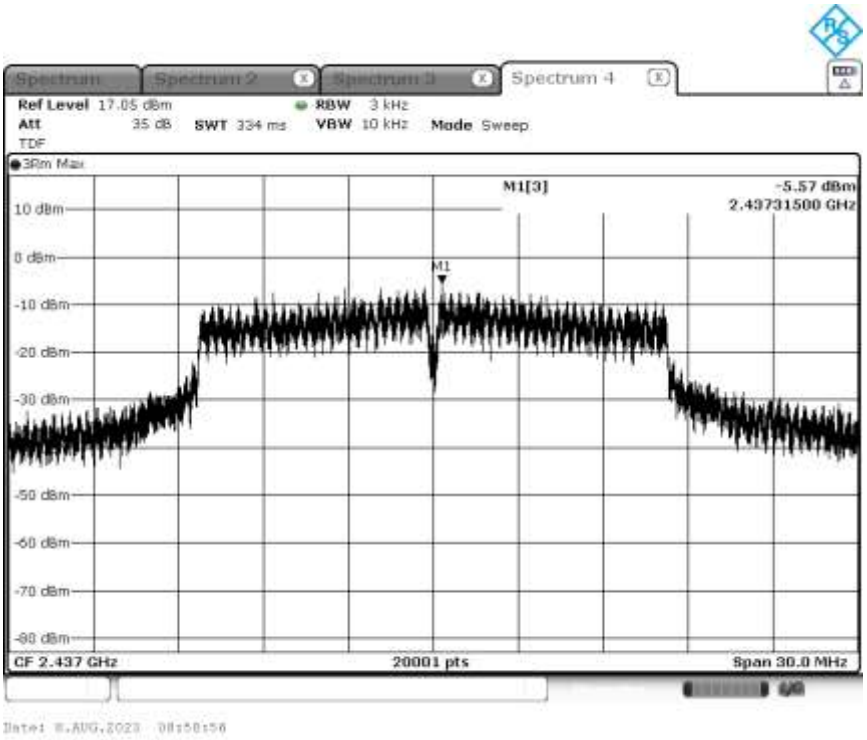
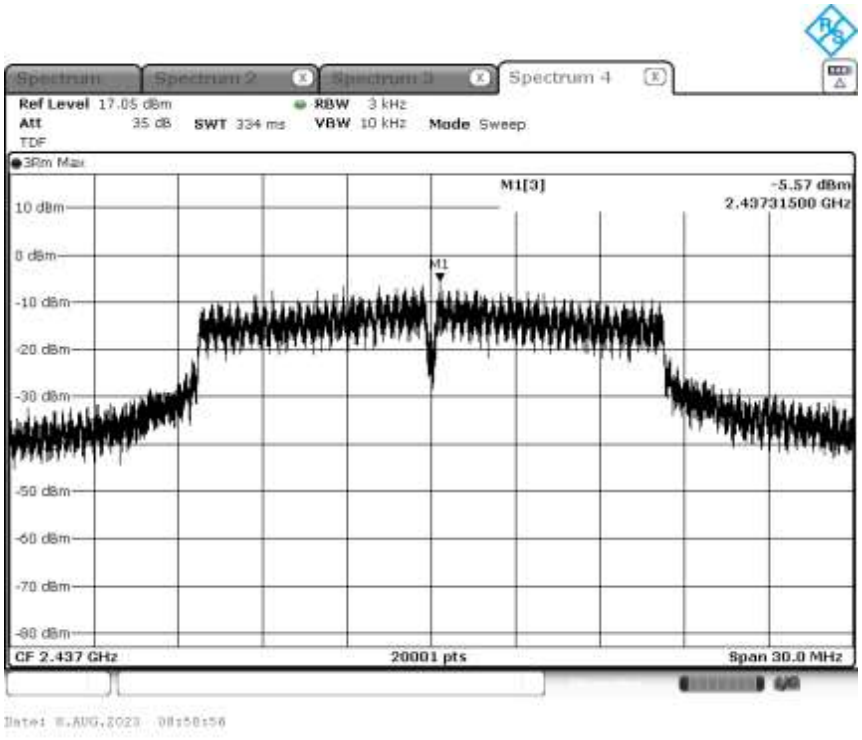


Graph 48: Middle Channel 3 kHz PSD Plot (Method AVGPSD-3)



Graph 49: Highest Channel Output 3 kHz PSD Plot (Method AVGPSD-3)

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6.5 Test Results (N-Mode)

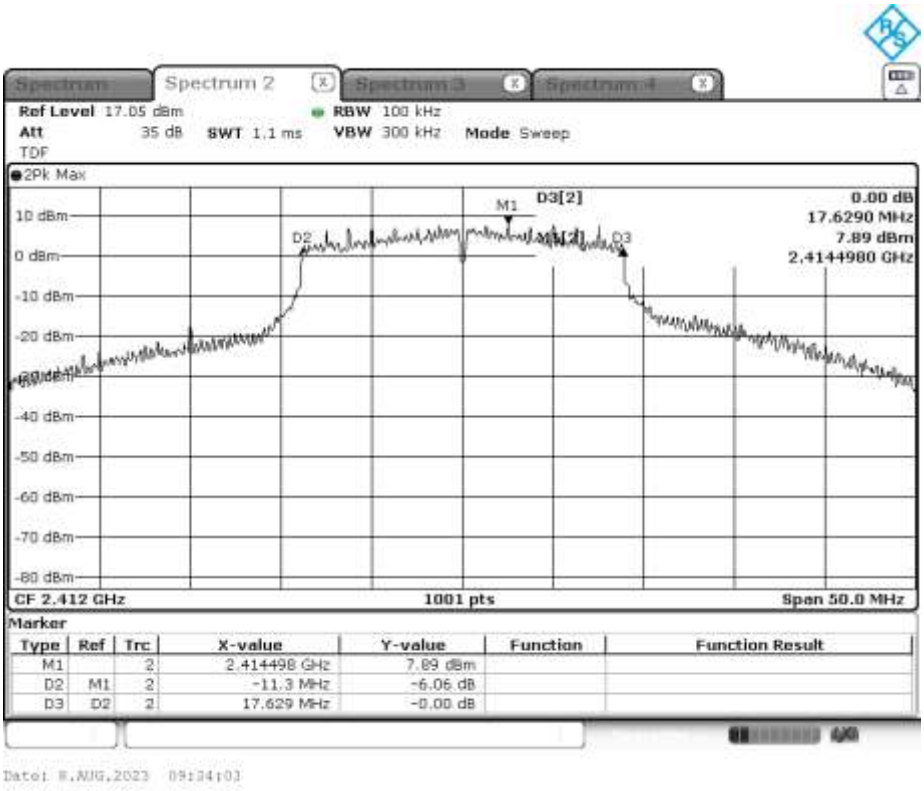
6.5.1 §15.247(a)(2) Emissions Bandwidth

Emission bandwidths were measured at power level 20 (the maximum possible output level) and found to be compliant at the low, middle, and high channels.

Frequency (MHz)	Emissions 6 dB bandwidth (MHz)
2412	17.6
2437	17.7
2462	17.3

Result

In the configuration tested, the 6 dB bandwidth was greater than 500 kHz; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).



Graph 50: Lowest Channel Bandwidth

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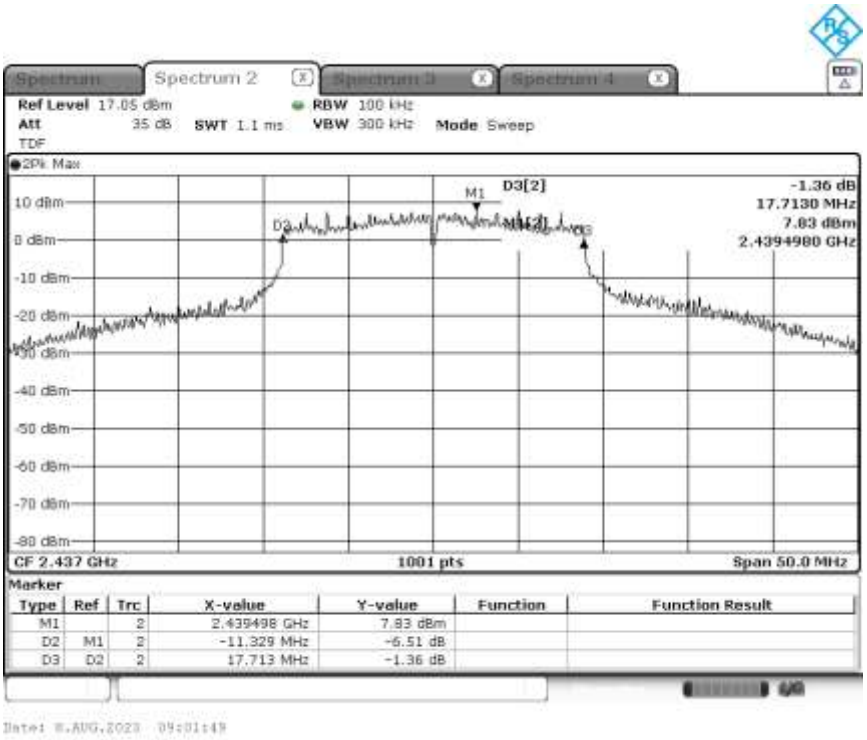
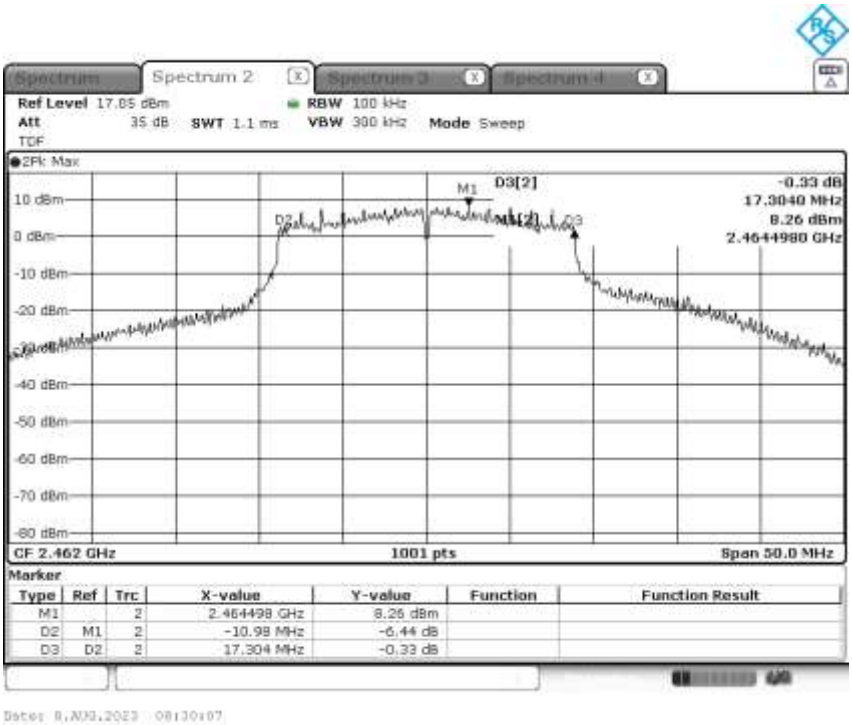


Graph 51: Middle Channel Bandwidth



Graph 52: Highest Channel Bandwidth

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6.5.2 §15.247(b)(3) Peak Output Power

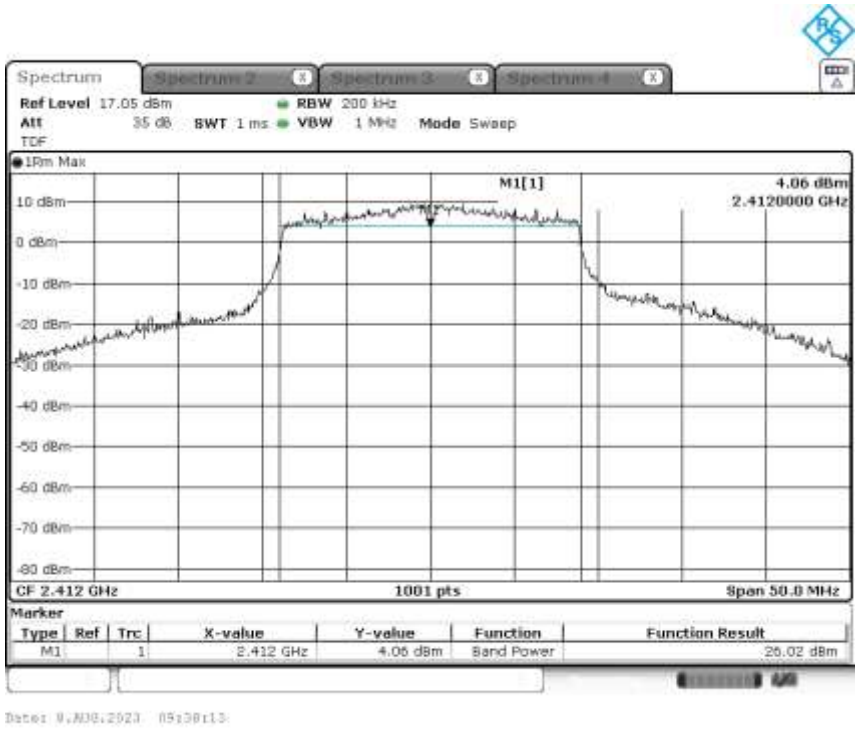
Peak output powers were measured at power level 20 (the maximum possible output level) and found to be compliant at the low, middle, and high channels.

The maximum peak RF Conducted output power measured for this device was 26.4 dBm or 436.5 mW. The limit is 30 dBm or 1 Watt when using antennas with 6 dBi or less gain. The antenna has a peak in-band gain of 2.7 dBi.

Frequency (MHz)	Measured Output Power (dBm)	Output Power (mW)
2412	26.0	398.1
2437	26.2	416.9
2462	26.4	436.5

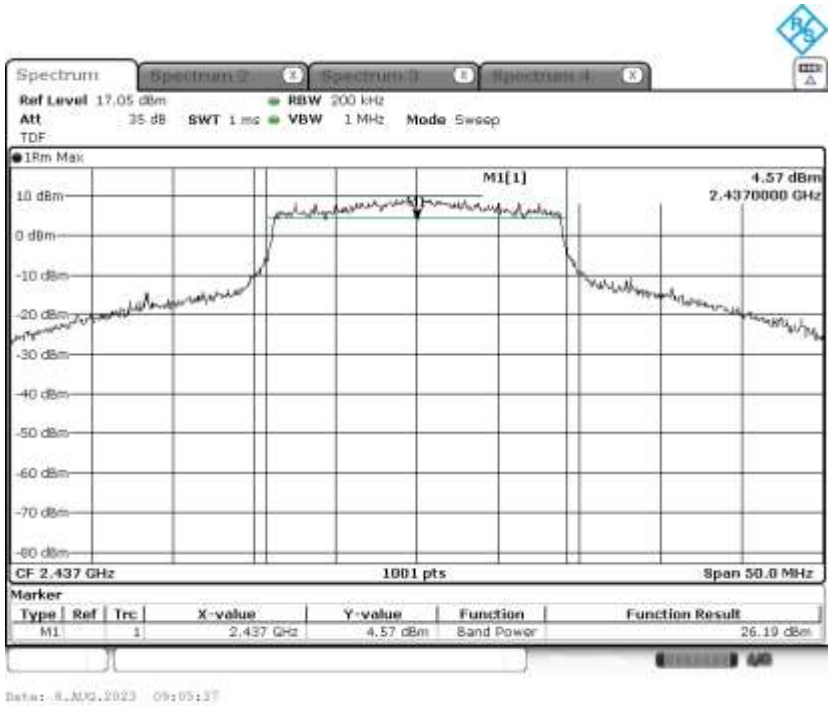
Result

In the configuration tested, the RF peak output power was less than 1 Watt; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).

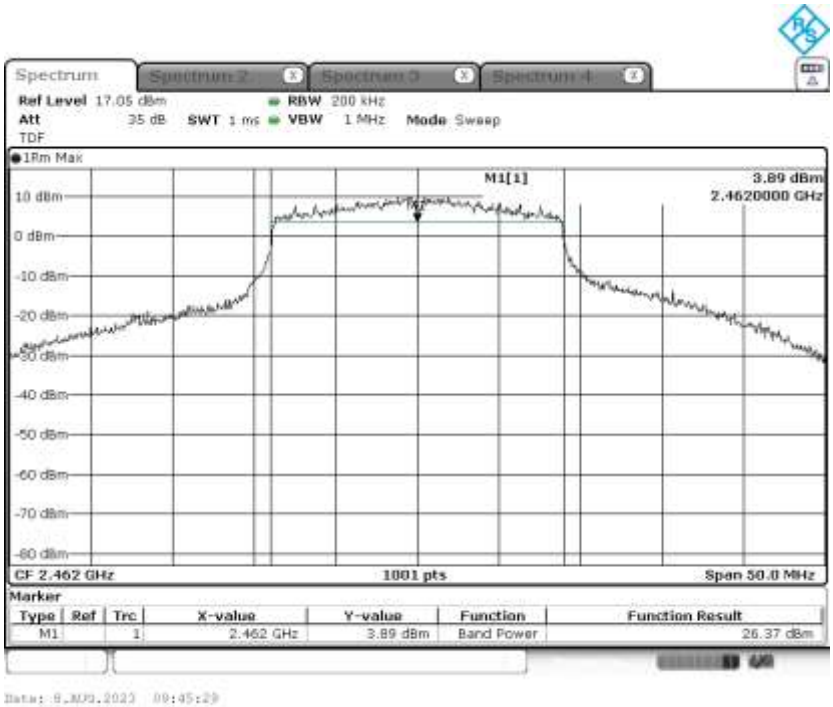


Graph 53: Lowest Channel Output Power Plot (Method AVGSA-3)

PROPRIETARY



Graph 54: Middle Channel Output Power (Method AVGSA-3)



Graph 55: Highest Channel Output Power Plot (Method AVGSA-3)

6.5.3 §15.247(d) Spurious Emissions

Radiated Spurious Emissions in the Restricted Bands of §15.205

Frequencies from the lowest generated or used to the tenth harmonic of the highest fundamental emission was investigated to measure any radiated emissions in the restricted bands.

The following tables show measurements of any emission that fell into the restricted bands of §15.205. The tables show the measurement data when transmitting at the lowest frequency (maximum power level), middle frequency (maximum power level), and upper frequency (maximum power level). Each possible harmonic to the tenth harmonic was investigated. Emissions detected via conducted antenna-port testing at 1000MHz were closely examined and found compliant across all modulations at the maximum possible power setting, 20.

The emissions in the restricted bands must meet the limits specified in §15.209. Tabular data for each of the spurious emissions is shown below for each of the units. Plots of the band edges are also shown at stepped power settings.

Result

All emissions in the restricted bands of §15.205 met the limits specified in §15.209; therefore, the EUT complies with the specification.

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBµV)	Correction Factor (dB)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1000	Peak	Vertical	48.3	0.2	48.4	74.0	-25.6
1000	Average	Vertical	48.0	0.2	48.1	54.0	-5.9
1000	Peak	Horizontal	50.0	0.2	50.2	74.0	-23.8
1000	Average	Horizontal	49.9	0.2	50.0	54.0	-4.0
1500	Peak	Horizontal	41.7	1.7	43.4	74.0	-30.6
1500	Average	Horizontal	41.0	1.7	42.7	54.0	-11.3
3000	Peak	Vertical	36.9	7.0	43.9	74.0	-30.1
3000	Average	Vertical	35.8	7.0	42.9	54.0	-11.2
4824	Peak	Vertical	30.6	10.1	40.8	74.0	-33.2
4824	Average	Vertical	28.7	10.1	38.8	54.0	-15.2
4824	Peak	Horizontal	29.3	10.2	39.4	74.0	-34.6
4824	Average	Horizontal	28.3	10.2	38.4	54.0	-15.6
7236	Peak	Vertical	26.2	15.1	41.3	74.0	-32.7
7236	Average	Vertical	22.5	15.1	37.6	54.0	-16.4
7236	Peak	Horizontal	26.7	15.1	41.7	74.0	-32.3
7236	Average	Horizontal	22.4	15.1	37.5	54.0	-16.6
9648	Peak	Vertical	24.9	20.1	44.9	74.0	-29.1
9648	Average	Vertical	19.4	20.1	39.5	54.0	-14.5
9648	Peak	Horizontal	23.9	20.1	44.0	74.0	-30.1
9648	Average	Horizontal	19.5	20.1	39.5	54.0	-14.5
12060	Peak	Vertical	25.5	21.2	46.6	74.0	-27.4

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
12060	Average	Vertical	19.7	21.2	40.9	54.0	-13.1
12060	Peak	Horizontal	24.4	21.2	45.6	74.0	-28.4
12060	Average	Horizontal	19.8	21.2	41.0	54.0	-13.0
14472	Peak	Vertical	25.7	23.0	48.7	74.0	-25.3
14472	Average	Vertical	20.3	23.0	43.3	54.0	-10.7
14472	Peak	Horizontal	25.3	23.0	48.3	74.0	-25.7
14472	Average	Horizontal	20.0	23.0	43.0	54.0	-11.0
16884	Peak	Vertical	54.8	-10.7	44.1	74.0	-29.9
16884	Average	Vertical	50.2	-10.7	39.5	54.0	-14.5
16884	Peak	Horizontal	54.8	-10.7	44.1	74.0	-29.9
16884	Average	Horizontal	50.5	-10.7	39.9	54.0	-14.1
19296	Peak	Vertical	37.6	13.2	50.7	74.0	-23.3
19296	Average	Vertical	34.6	13.2	47.7	54.0	-6.3
19296	Peak	Horizontal	38.6	13.2	51.7	74.0	-22.3
19296	Average	Horizontal	34.7	13.2	47.8	54.0	-6.2
21708	Peak	Vertical	35.9	14.4	50.3	74.0	-23.7
21708	Average	Vertical	32.2	14.4	46.7	54.0	-7.3
21708	Peak	Horizontal	36.3	14.6	50.9	74.0	-23.1
21708	Average	Horizontal	32.5	14.6	47.0	54.0	-7.0
24120	Peak	Vertical	36.8	17.2	54.1	74.0	-19.9
24120	Average	Vertical	33.5	17.2	50.7	54.0	-3.3
24120	Peak	Horizontal	36.6	17.1	53.7	74.0	-20.3
24120	Average	Horizontal	33.0	17.1	50.2	54.0	-3.8

Table 8: Transmitting at the Lowest Frequency (2412MHz, Power Level 20)

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1000	Peak	Vertical	48.6	0.2	48.8	74.0	-25.2
1000	Average	Vertical	48.5	0.2	48.7	54.0	-5.3
1000	Peak	Horizontal	50.2	0.2	50.3	74.0	-23.7
1000	Average	Horizontal	50.1	0.2	50.2	54.0	-3.8
3000	Peak	Vertical	36.7	7.0	43.8	74.0	-30.3
3000	Average	Vertical	35.5	7.0	42.5	54.0	-11.5
3000	Peak	Horizontal	36.8	7.0	43.8	74.0	-30.2
3000	Average	Horizontal	35.7	7.0	42.8	54.0	-11.3
4874	Peak	Vertical	29.6	10.3	39.9	74.0	-34.1

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4874	Average	Vertical	28.1	10.3	38.3	54.0	-15.7
4874	Peak	Horizontal	28.6	10.3	38.9	74.0	-35.1
4874	Average	Horizontal	27.6	10.3	37.8	54.0	-16.2
7311	Peak	Vertical	26.5	15.5	42.0	74.0	-32.0
7311	Average	Vertical	21.3	15.5	36.8	54.0	-17.2
7311	Peak	Horizontal	26.8	15.5	42.2	74.0	-31.8
7311	Average	Horizontal	21.7	15.5	37.1	54.0	-16.9
9748	Peak	Vertical	24.5	20.3	44.8	74.0	-29.2
9748	Average	Vertical	19.0	20.3	39.3	54.0	-14.7
9748	Peak	Horizontal	23.7	20.3	44.0	74.0	-30.0
9748	Average	Horizontal	18.8	20.3	39.1	54.0	-14.9
12185	Peak	Vertical	24.8	20.8	45.5	74.0	-28.5
12185	Average	Vertical	19.9	20.8	40.6	54.0	-13.4
12185	Peak	Horizontal	24.6	20.8	45.4	74.0	-28.6
12185	Average	Horizontal	19.4	20.8	40.2	54.0	-13.8
14622	Peak	Vertical	24.0	23.2	47.2	74.0	-26.8
14622	Average	Vertical	20.0	23.2	43.2	54.0	-10.9
14622	Peak	Horizontal	24.3	23.2	47.5	74.0	-26.6
14622	Average	Horizontal	20.9	23.2	44.1	54.0	-9.9
17059	Peak	Vertical	53.2	-9.2	43.9	74.0	-30.1
17059	Average	Vertical	49.7	-9.2	40.4	54.0	-13.6
17059	Peak	Horizontal	52.6	-9.0	43.6	74.0	-30.4
17059	Average	Horizontal	49.3	-9.0	40.3	54.0	-13.7
19496	Peak	Vertical	36.9	13.1	50.1	74.0	-23.9
19496	Average	Vertical	34.0	13.1	47.1	54.0	-6.9
19496	Peak	Horizontal	37.4	13.2	50.6	74.0	-23.4
19496	Average	Horizontal	33.4	13.2	46.6	54.0	-7.4
21933	Peak	Vertical	36.8	15.0	51.8	74.0	-22.2
21933	Average	Vertical	31.9	15.0	46.9	54.0	-7.1
21933	Peak	Horizontal	36.4	15.0	51.3	74.0	-22.7
21933	Average	Horizontal	32.2	15.0	47.2	54.0	-6.8
24370	Peak	Vertical	35.2	17.7	53.0	74.0	-21.1
24370	Average	Vertical	32.0	17.7	49.8	54.0	-4.2
24370	Peak	Horizontal	35.4	17.8	53.2	74.0	-20.9
24370	Average	Horizontal	31.9	17.8	49.7	54.0	-4.3

Table 9: Transmitting at the Middle Frequency (2437MHz, Power Level 20)

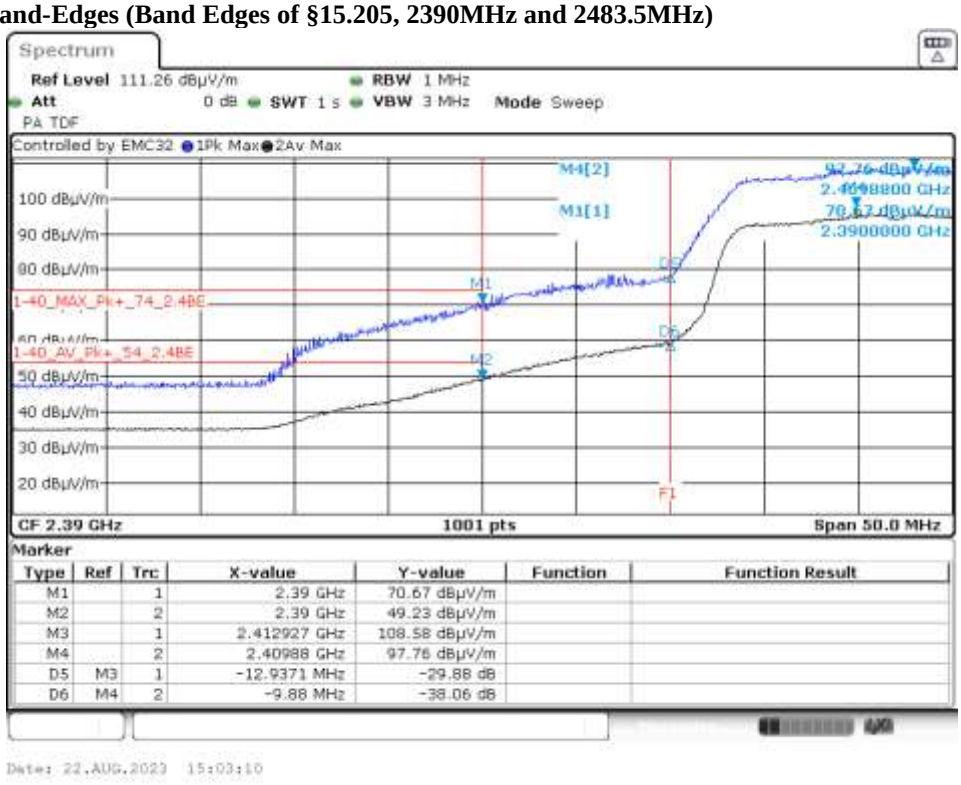
Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1000	Peak	Vertical	48.7	0.2	48.8	74.0	-25.2
1000	Average	Vertical	48.4	0.2	48.6	54.0	-5.4
1000	Peak	Horizontal	51.4	0.2	51.5	74.0	-22.5
1000	Average	Horizontal	51.3	0.2	51.4	54.0	-2.6
1500	Peak	Vertical	37.2	1.7	38.8	74.0	-35.2
1500	Average	Vertical	34.9	1.7	36.6	54.0	-17.4
1500	Peak	Horizontal	42.7	1.7	44.4	74.0	-29.6
1500	Average	Horizontal	42.5	1.7	44.1	54.0	-9.9
4924	Peak	Vertical	29.7	10.3	40.0	74.0	-34.0
4924	Average	Vertical	27.6	10.3	37.9	54.0	-16.1
4924	Peak	Horizontal	29.3	10.3	39.6	74.0	-34.4
4924	Average	Vertical	27.8	10.3	38.1	54.0	-16.0
7386	Peak	Vertical	25.5	15.7	41.2	74.0	-32.8
7386	Average	Vertical	21.6	15.7	37.3	54.0	-16.7
7386	Peak	Horizontal	25.9	15.6	41.6	74.0	-32.4
7386	Average	Horizontal	21.2	15.6	36.8	54.0	-17.2
9848	Peak	Vertical	23.3	20.7	44.0	74.0	-30.0
9848	Average	Vertical	19.1	20.7	39.7	54.0	-14.3
9848	Peak	Horizontal	23.9	20.7	44.5	74.0	-29.5
9848	Average	Horizontal	18.4	20.7	39.1	54.0	-14.9
12310	Peak	Vertical	24.8	20.5	45.3	74.0	-28.7
12310	Average	Vertical	19.8	20.5	40.3	54.0	-13.7
12310	Peak	Horizontal	24.5	20.6	45.0	74.0	-29.0
12310	Average	Horizontal	19.9	20.6	40.4	54.0	-13.6
14772	Peak	Vertical	24.4	23.1	47.5	74.0	-26.5
14772	Average	Vertical	19.2	23.1	42.3	54.0	-11.7
14772	Peak	Horizontal	24.3	23.1	47.4	74.0	-26.6
14772	Average	Horizontal	19.5	23.1	42.7	54.0	-11.3
17234	Peak	Vertical	54.2	-8.6	45.6	74.0	-28.4
17234	Average	Vertical	62.1	-8.5	53.6	54.0	-0.4
17234	Peak	Horizontal	50.0	-8.6	41.4	74.0	-32.6
17234	Average	Horizontal	53.1	-8.5	44.6	54.0	-9.4

Frequency (MHz)	Detector	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
19696	Peak	Vertical	38.0	13.0	51.0	74.0	-23.0
19696	Average	Vertical	37.2	13.0	50.2	54.0	-3.8
19696	Peak	Horizontal	34.9	13.0	48.0	74.0	-26.1
19696	Average	Horizontal	34.5	13.0	47.5	54.0	-6.5
22158	Peak	Vertical	35.4	15.2	50.7	74.0	-23.3
22158	Average	Vertical	35.5	15.1	50.7	54.0	-3.3
22158	Peak	Horizontal	32.5	15.2	47.8	74.0	-26.3
22158	Average	Horizontal	31.6	15.1	46.8	54.0	-7.2
24620	Peak	Vertical	35.8	18.0	53.8	74.0	-20.2
24620	Average	Vertical	35.8	18.0	53.8	54.0	-0.2
24620	Peak	Horizontal	33.2	18.0	51.1	74.0	-22.9
24620	Average	Horizontal	32.9	18.0	50.9	54.0	-3.1

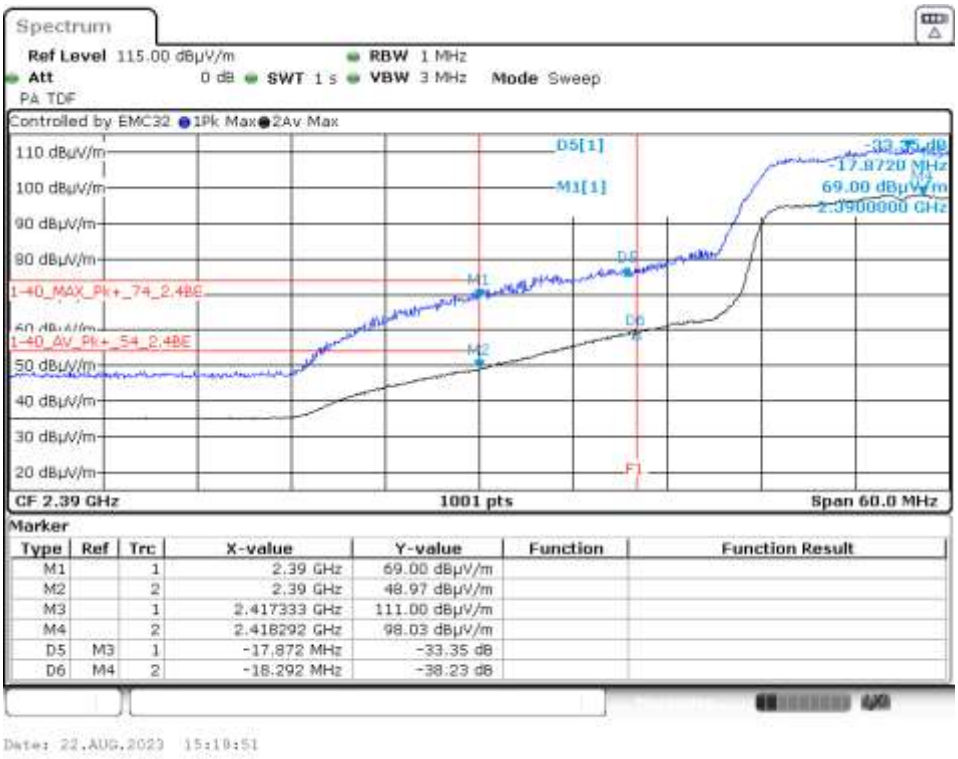
Table 10: Transmitting at the Highest Frequency (2462MHz, Power Level 20)

No other emissions were seen in the restricted bands.

Restricted Band-Edges (Band Edges of §15.205, 2390MHz and 2483.5MHz)

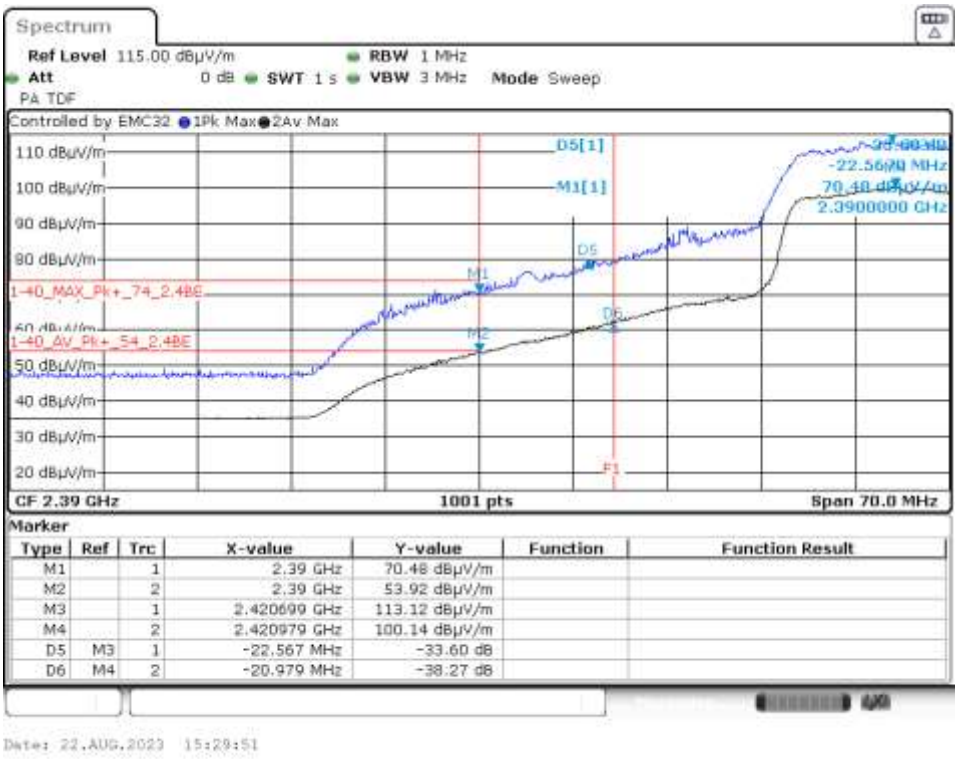


Graph 56: Radiated Lower Band Edge Plot (Transmitting 2412MHz, Power Level 14)

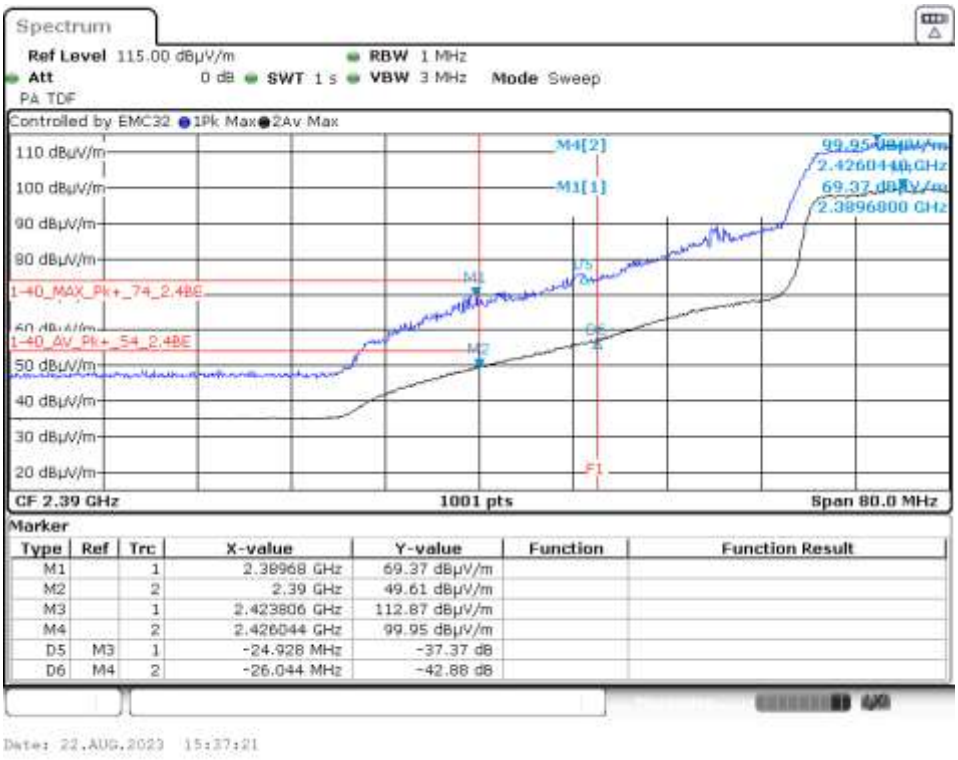


Graph 57: Radiated Lower Band Edge Plot (Transmitting 2417MHz, Power Level 16)

PROPRIETARY

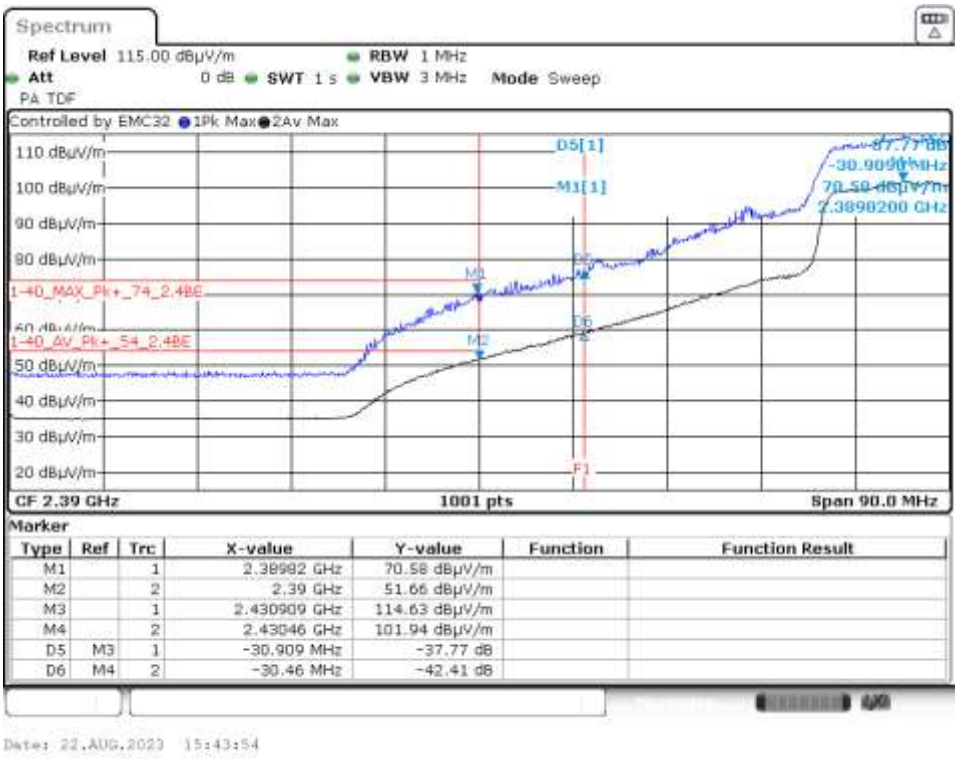


Graph 58: Radiated Lower Band Edge Plot (Transmitting 2422MHz, Power Level 18)



Graph 59: Radiated Lower Band Edge Plot (Transmitting 2427MHz, Power Level 18)

PROPRIETARY

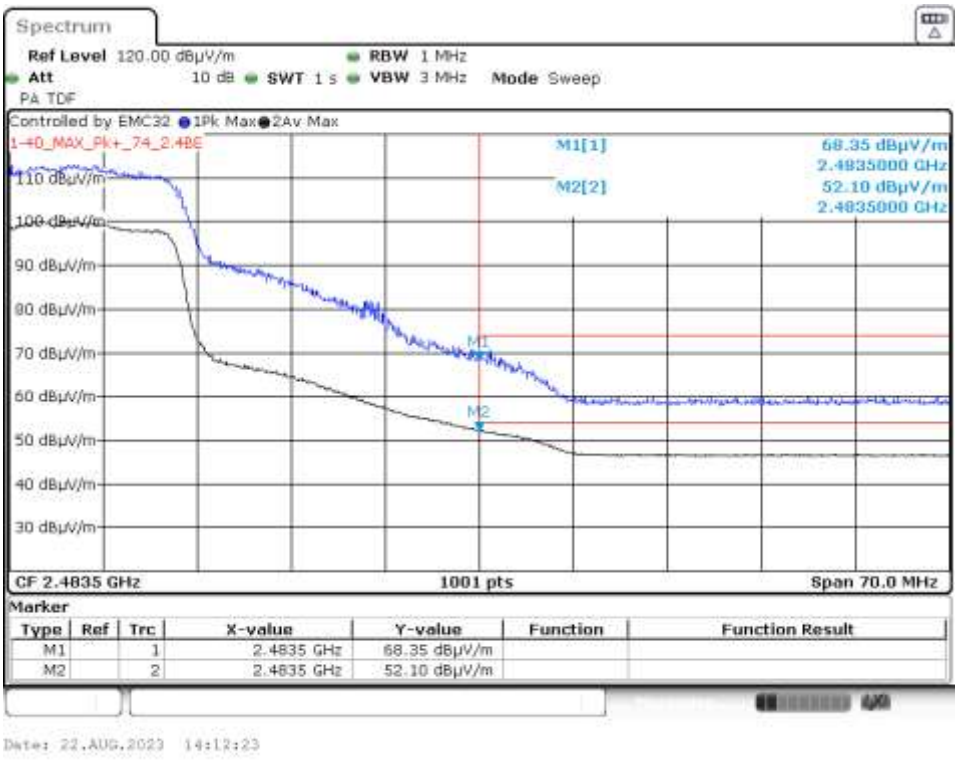


Graph 60: Radiated Lower Band Edge Plot (Transmitting 2432MHz, Power Level 20)

Graph 61: Radiated Lower Band Edge Plot (Transmitting 2442MHz, Power Level 20)

PROPRIETARY

Graph 62: Radiated Lower Band Edge Plot (Transmitting 2447MHz, Power Level 19)



Graph 63: Radiated Lower Band Edge Plot (Transmitting 2452MHz, Power Level 18)

PROPRIETARY

Graph 64: Radiated Upper Band Edge Plot (Transmitting 2457MHz, Power Level 17)

Graph 65: Radiated Upper Band Edge Plot (Transmitting 2462MHz, Power Level 14)

PROPRIETARY

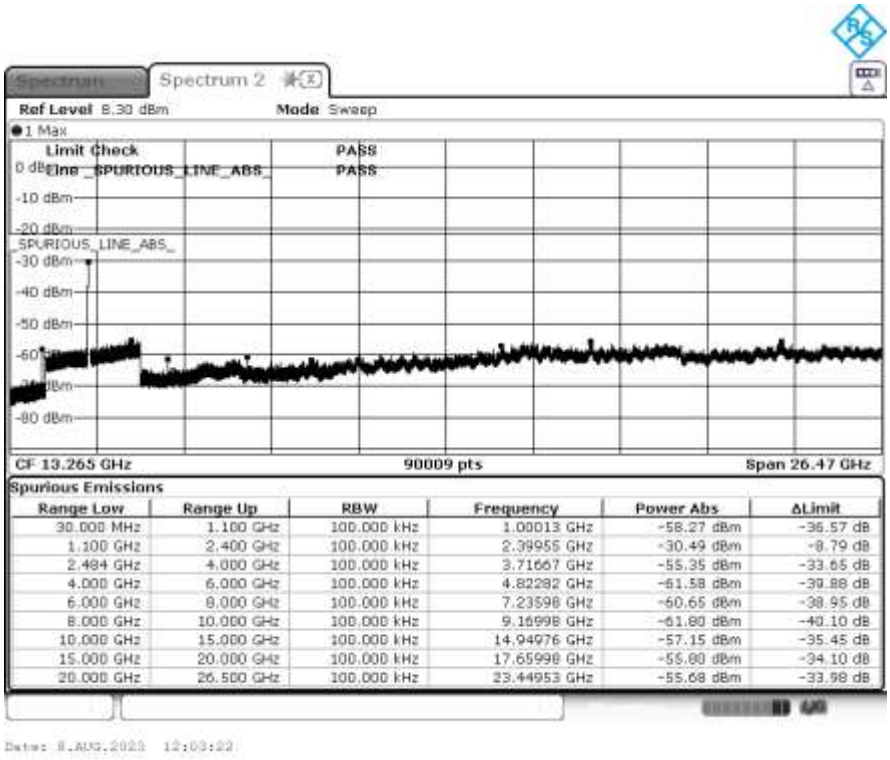
Conducted Spurious Emissions

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 frequencies (stepped power levels), middle frequency (maximum power level), and upper frequencies (stepped power levels). 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.

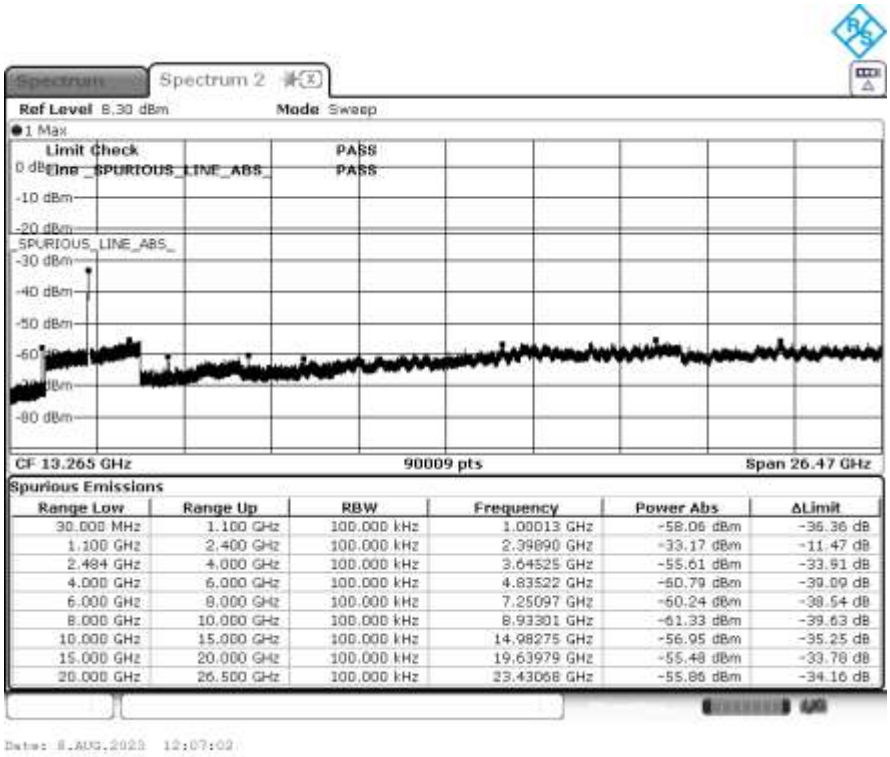
The emissions must be attenuated 30 dB below the highest power level measured within the authorized band as measured with a 100 kHz RBW. The highest power measured in was 8.3 dBm; therefore, the criteria is 8.3 – 30 = 20.7 dBm.

Result

Conducted spurious emissions were attenuated 30 dB or more below the fundamental; therefore, the EUT complies with the specification.



Graph 66: Transmitting on 2412MHz (Power Level 15)



Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
30.000 MHz	1.100 GHz	100.000 kHz	1.00013 GHz	-58.06 dBm	-36.36 dB
1.100 GHz	2.400 GHz	100.000 kHz	2.39890 GHz	-33.17 dBm	-11.47 dB
2.484 GHz	4.000 GHz	100.000 kHz	3.64525 GHz	-55.61 dBm	-33.91 dB
4.000 GHz	6.000 GHz	100.000 kHz	4.83522 GHz	-60.79 dBm	-39.09 dB
6.000 GHz	8.000 GHz	100.000 kHz	7.25097 GHz	-60.24 dBm	-38.54 dB
8.000 GHz	10.000 GHz	100.000 kHz	8.93301 GHz	-61.33 dBm	-39.63 dB
10.000 GHz	15.000 GHz	100.000 kHz	14.98275 GHz	-56.95 dBm	-35.25 dB
15.000 GHz	20.000 GHz	100.000 kHz	19.63979 GHz	-55.48 dBm	-33.78 dB
20.000 GHz	26.500 GHz	100.000 kHz	23.43068 GHz	-55.86 dBm	-34.16 dB

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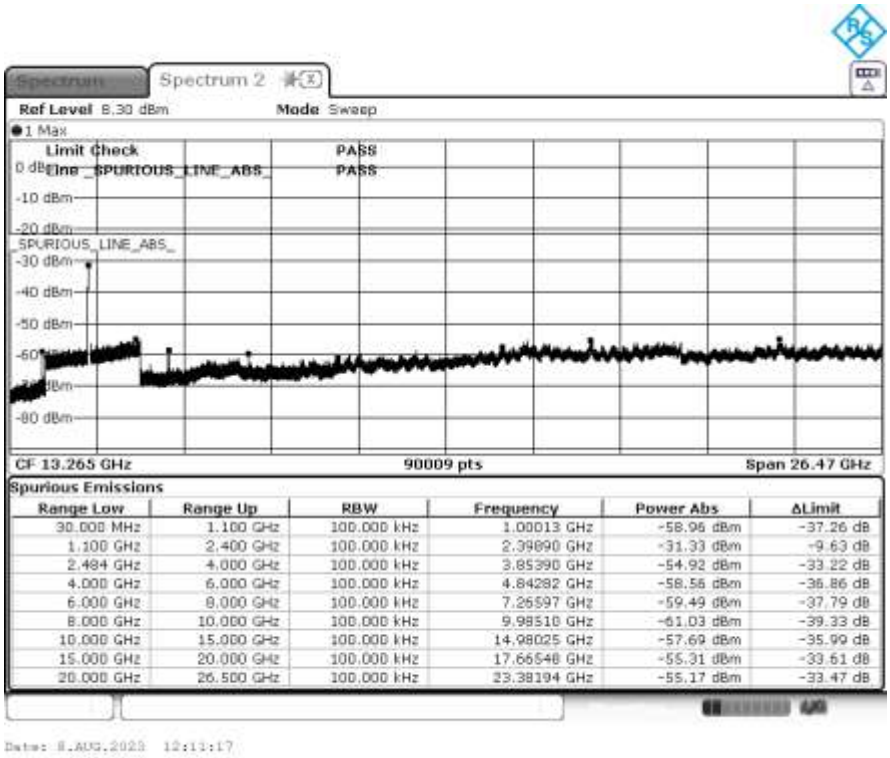
Graph 67: Transmitting on 2417MHz (Power Level 16)



Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
30.000 MHz	1.100 GHz	100.000 kHz	1.00013 GHz	-58.96 dBm	-37.26 dB
1.100 GHz	2.400 GHz	100.000 kHz	2.39890 GHz	-31.33 dBm	-9.63 dB
2.484 GHz	4.000 GHz	100.000 kHz	3.85390 GHz	-54.92 dBm	-33.22 dB
4.000 GHz	6.000 GHz	100.000 kHz	4.84282 GHz	-58.56 dBm	-36.86 dB
6.000 GHz	8.000 GHz	100.000 kHz	7.26597 GHz	-59.49 dBm	-37.79 dB
8.000 GHz	10.000 GHz	100.000 kHz	9.98510 GHz	-61.03 dBm	-39.33 dB
10.000 GHz	15.000 GHz	100.000 kHz	14.98025 GHz	-57.69 dBm	-35.99 dB
15.000 GHz	20.000 GHz	100.000 kHz	17.66548 GHz	-55.31 dBm	-33.61 dB
20.000 GHz	26.500 GHz	100.000 kHz	23.38194 GHz	-55.17 dBm	-33.47 dB

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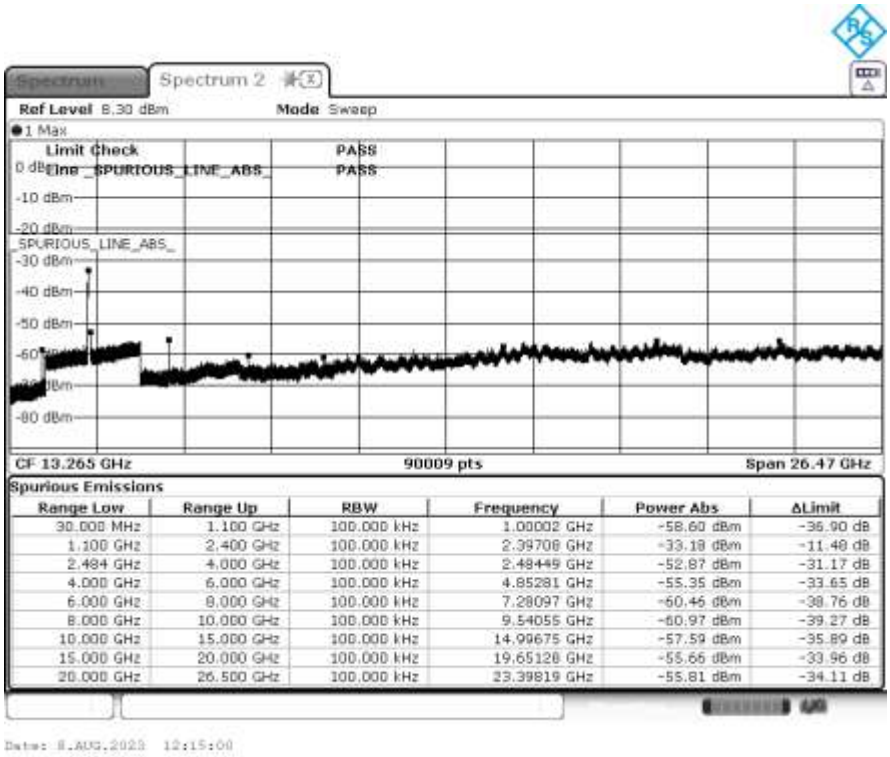
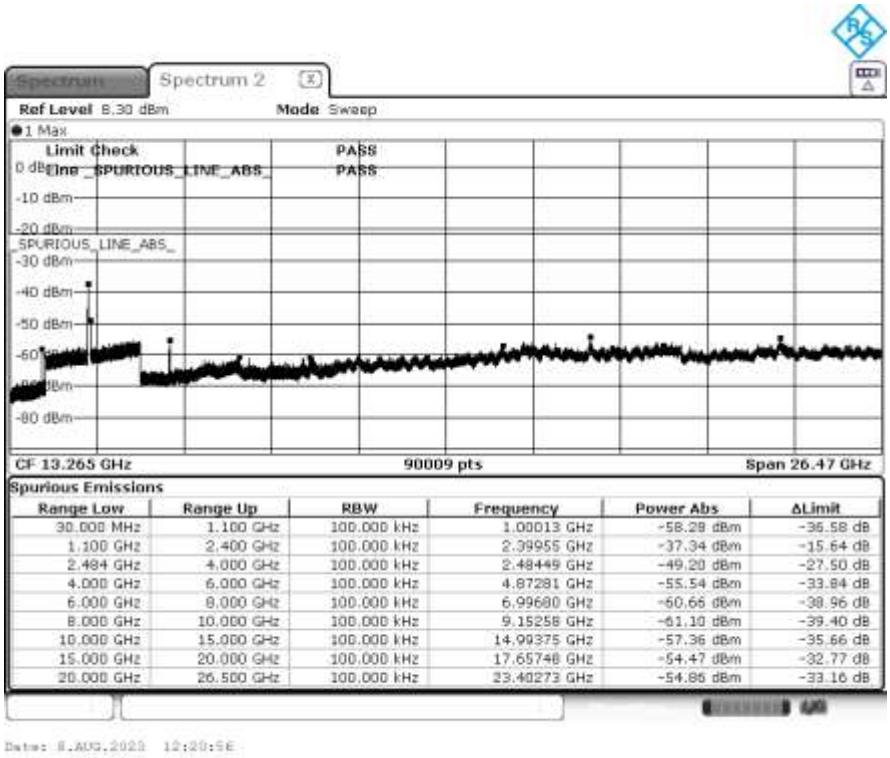
Graph 68: Transmitting on 2422MHz (Power Level 18)

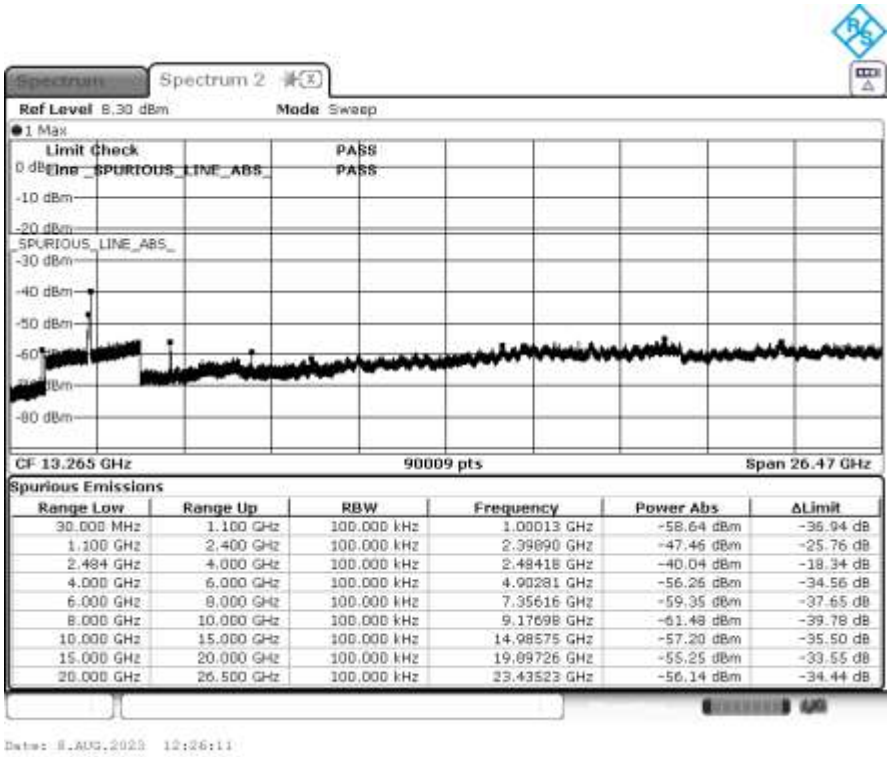


Graph 69: Transmitting on 2427MHz (Power Level 20)

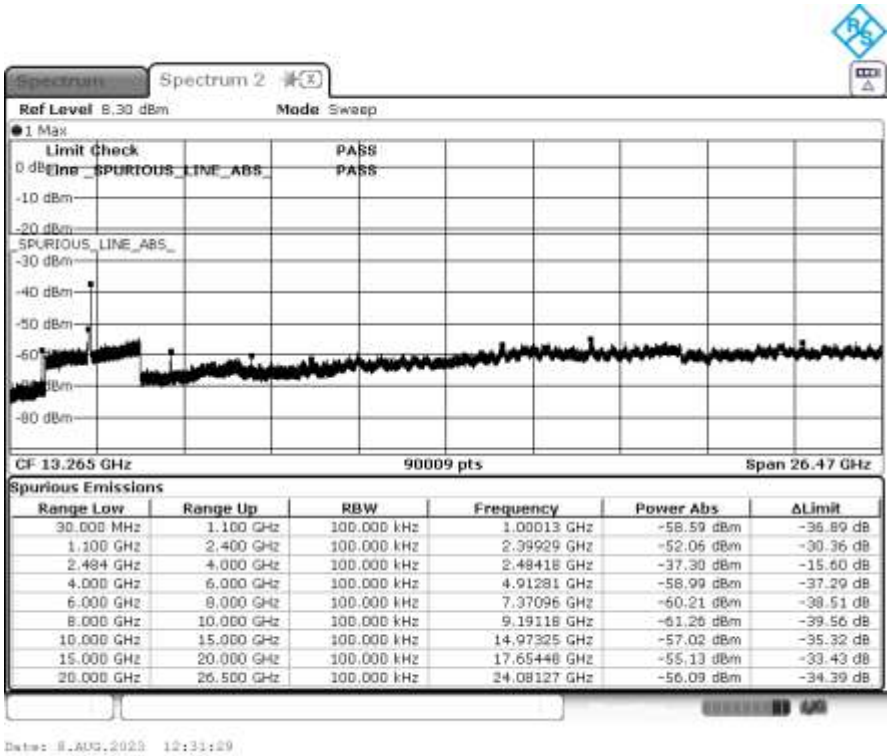


Graph 70: Transmitting on 2437MHz (Power Level 20)

PROPRIETARY

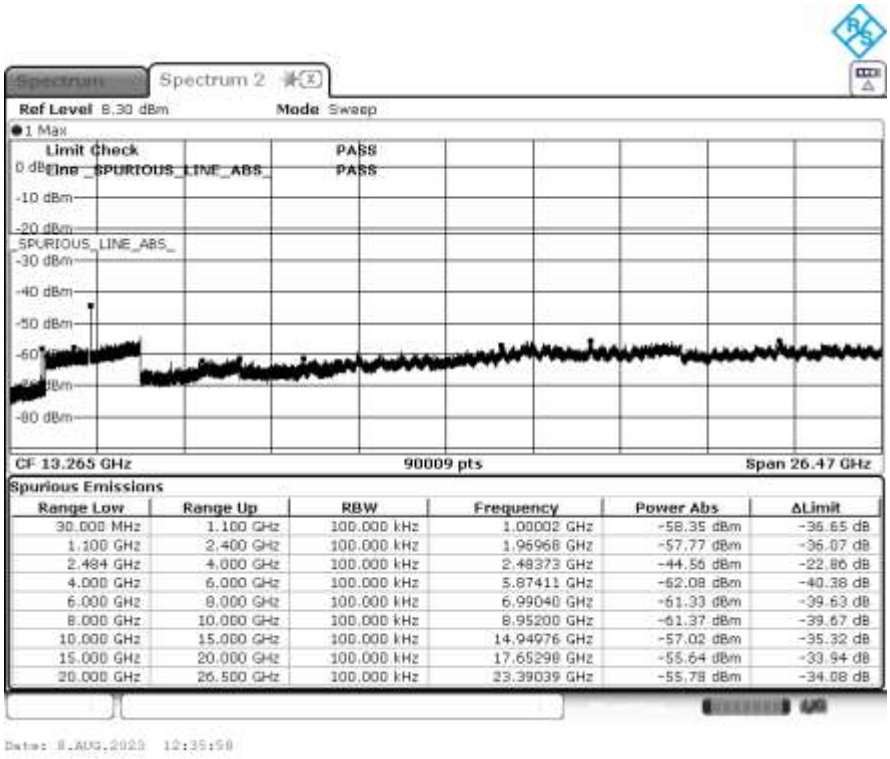


Graph 71: Transmitting on 2452MHz (Power Level 20)



Graph 72: Transmitting on 2457MHz (Power Level 18)

PROPRIETARY

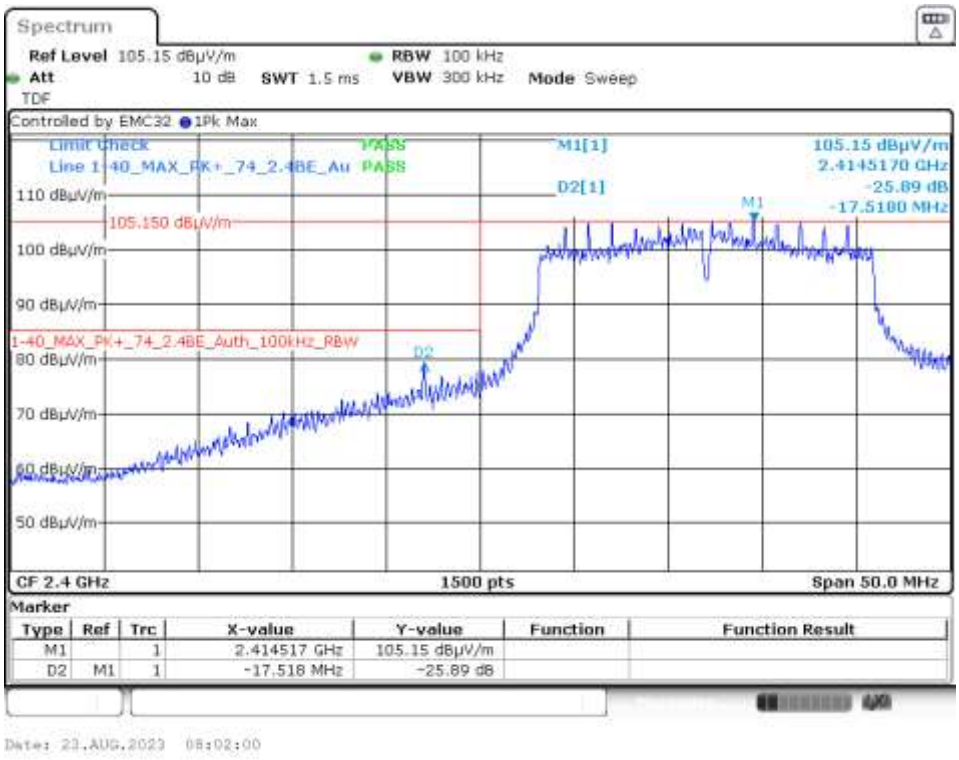


Graph 73: Transmitting on 2462MHz (Power Level 15)

PROPRIETARY

Authorized Band-Edges (Radiated Measurements, 2400MHz and 2483.5MHz)

Shown below are plots with the EUT tuned to the upper and lower channels at power level 20 (the maximum possible output level). These demonstrate compliance with the provisions of this section at the band edges.



Graph 74: Transmitting on 2412MHz (Power Level 20)

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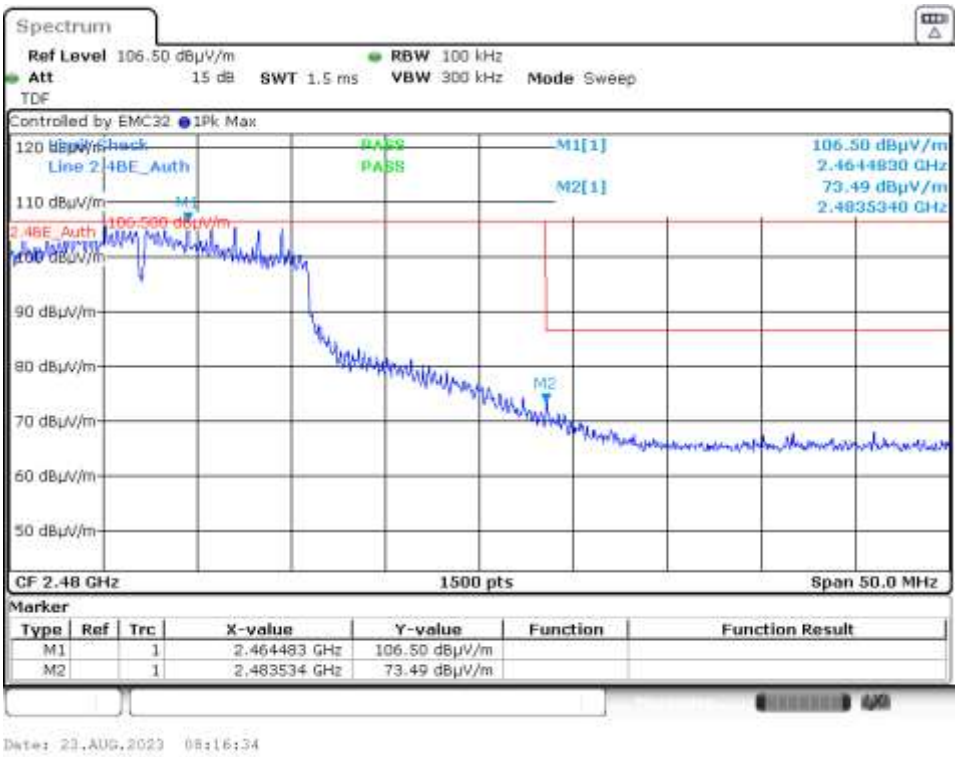


Graph 75: Transmitting on 2462MHz (Power Level 20)

6.5.4 §15.247(e) Peak Power Spectral Density

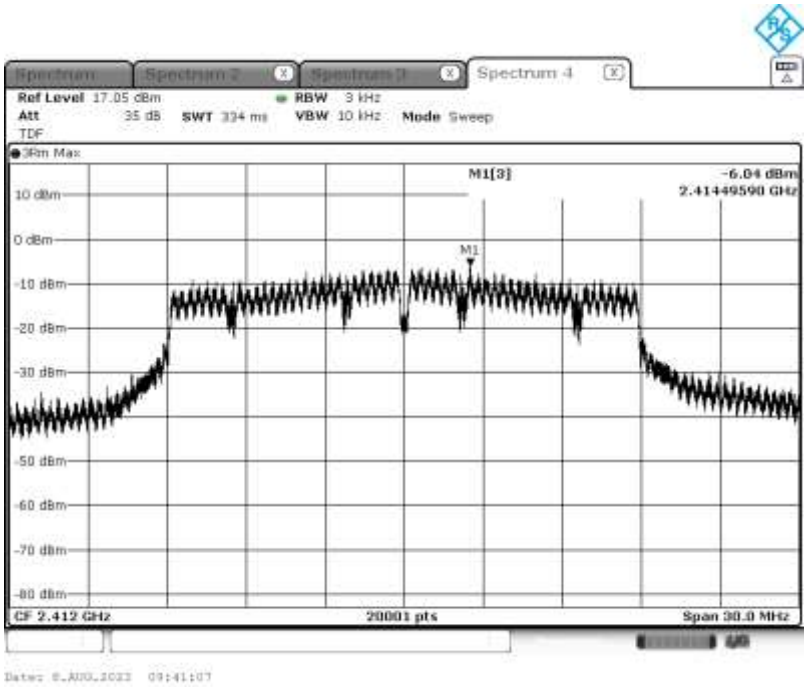
Power densities were measured at power level 20 (the maximum possible output level) and found to be compliant at the low, middle, and high channels.

The peak 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. Results of this testing are summarized.

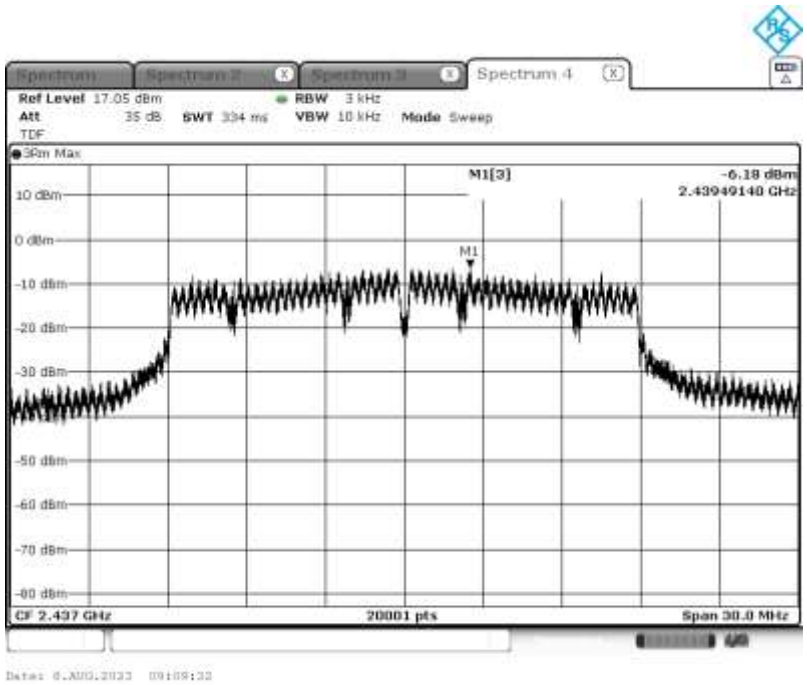
Frequency (MHz)	Measurement (dBm)	Criteria (dBm)
2412	-6.0	8.0
2437	-6.2	8.0
2462	-5.2	8.0

Result

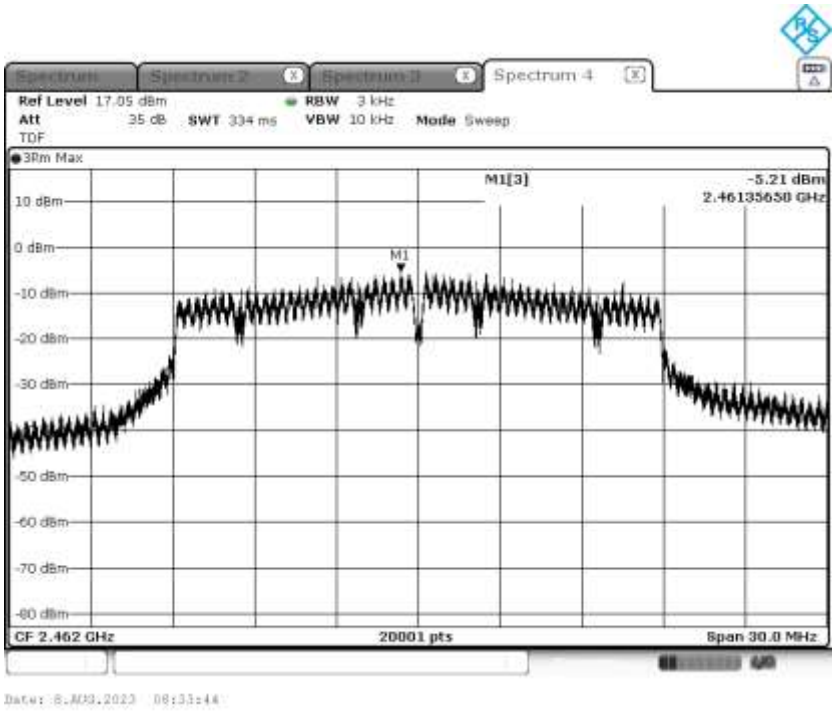
The maximum peak power spectral density was less than the limit of 8 dBm; therefore, the EUT complies with the specification.



Graph 76: Lowest Channel 3 kHz PSD Plot (Method AVGPSD-3)



Graph 77: Middle Channel 3 kHz PSD Plot (Method AVGPSD-3)



Graph 78: Highest Channel Output 3 kHz PSD Plot (Method AVGPSD-3)

6.6 Sample Measurement Calculations

6.6.1 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.

$$Receiver\ Amplitude\ Reading\ =\ 42.5 - 26.5\ =\ 16.0\ \text{dBµV/m}$$

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

$$Field\ Strength\ =\ 16.0 + 8.5\ =\ 24.5\ \text{dBµV/m}$$

6.6.2 Conducted Measurement Value Calculations

A conducted emission value is calculated by adding the *Correction Factor* (*LISN Transducer Factor + Cable Factor*) to the measured value from the receiver. The LISN contains an internal 10dB (nominal) attenuation accounted for in the LISN Transducer Factor. Amplifiers are not utilized for this measurement. The basic equation with a sample calculation is shown below:

Correction Factor = LISN Transducer Factor + Cable Factor

Conducted Emission Value = Receiver Amplitude Reading + Correction Factor

Example

Assuming a *Receiver Reading* of 20.8 dBµV is obtained from the receiver, *LISN Transducer Factor* is 10.1 dB, and the *Cable Factor* is 0.3 dB. The *Conducted Emissions Value* is calculated by adding the *Correction Factor*, giving a *Conducted Emissions Value* of 31.2 dBµV.

$$Receiver\ Amplitude\ Reading\ =\ 20.8\ \text{dBµV}$$

$$Correction\ Factor\ =\ 10.1 + 0.3\ =\ 10.4\ \text{dB}$$

$$Conducted\ Emissions\ Value\ =\ 20.8 + 10.4\ =\ 31.2\ \text{dBµV}$$

7 Test Procedures and Test Equipment

7.1 Conducted Emissions at Mains Ports

The conducted emissions at mains and telecommunications ports from the EUT were measured using a spectrum analyzer with a quasi-peak adapter for peak, quasi-peak and average readings. The quasi-peak adapter uses a bandwidth of 9 kHz, with the spectrum analyzer's resolution bandwidth set at 100 kHz, for readings in the 150 kHz to 30 MHz frequency ranges.

The conducted emissions at mains ports measurements are performed in a screen room using a (50 Ω/50 µH) Line Impedance Stabilization Network (LISN).

Where mains flexible power cords are longer than 1 m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4 m in length.

Where the EUT is a collection of devices with each device having its own power cord, the point of connection for the LISN is determined from the following rules:

- Each power cord, which is terminated in a mains supply plug, shall be tested separately.
- Power cords, which are not specified by the manufacturer to be connected via a host unit, shall be tested separately.
- Power cords which are specified by the manufacturer to be connected via a host unit or other power supplying equipment shall be connected to that host unit and the power cords of that host unit connected to the LISN and tested.
- Where a special connection is specified, the necessary hardware to effect the connection is supplied by the manufacturer for the testing purpose.
- When testing equipment with multiple mains cords, those cords not under test are connected to an artificial mains network (AMN) different than the AMN used for the mains cord under test.

For testing, desktop EUT are placed on a non-conducting table at least 0.8 meters from the metallic floor and placed 40 cm from the vertical coupling plane (copper plating in the wall behind EUT table). Floor standing equipment is placed directly on the earth grounded floor.

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	03/08/2024
LISN	Teseq	NNB 51	V045406	12/05/2022	12/05/2023
Conductance Cable Wanship Upper Site	VPI Labs	Cable J	V034832	12/23/2022	12/23/2023
EMC32 Test Software	Rohde & Schwarz	10.60.20	N/A	N/A	N/A

Table 11: List of equipment used for conducted emissions testing at mains ports.

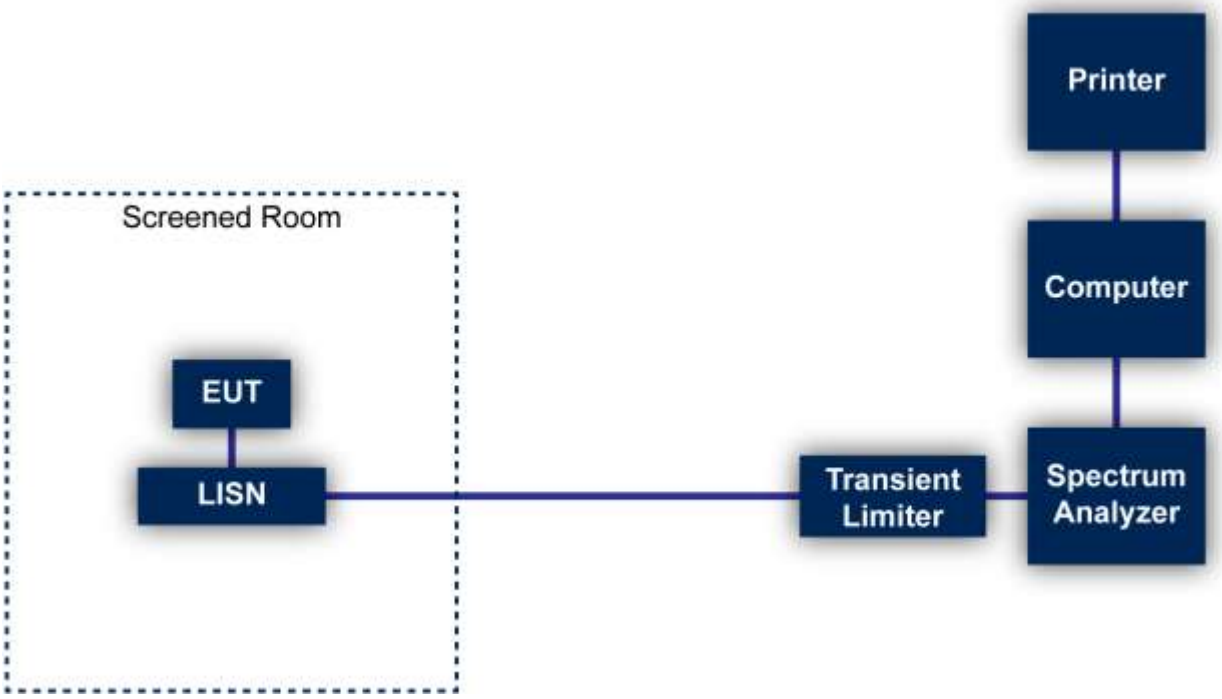


Figure 1: Conducted Emissions Test

7.2 Direct Connection at the Antenna Port Tests

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	03/08/2024
40GHz Switch Base Unit	Rohde & Schwarz	OSP-120	V044487	03/23/2022	04/30/2024
"DUT 5" Cable	N/A	N/A	N/A	12/23/2022	12/23/2023

7.2.1 Test Configuration Block Diagram

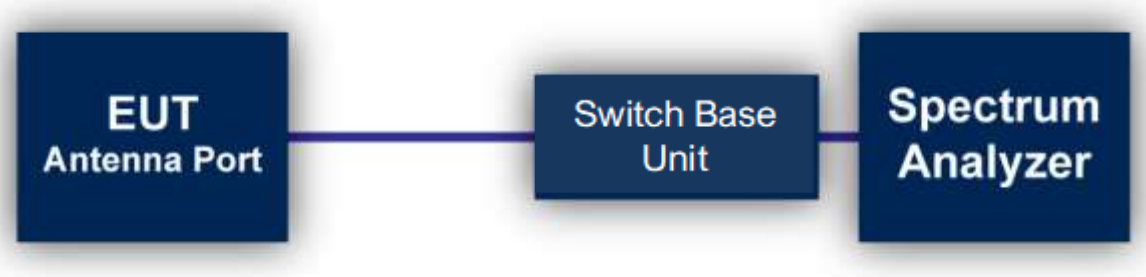


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Figure 2: Direct Connection at the Antenna Port Test

7.3 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 was used to increase the sensitivity of the measuring instrumentation below 1GHz. 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 distance of 3 and/or 1 meter 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	03/08/2024
Loop Antenna	EMCO	6502	V034216	04/27/2023	04/27/2024
Biconilog Antenna	EMCO	3142E	V057461	06/06/2023	06/06/2025
Power Amplifier	HP	5086-7005	V067767	03/14/2023	03/14/2024
Double Ridged Guide Antenna	EMCO	3115	V034413	01/25/2023	01/25/2025
Standard Gain Horn	ETS-Lindgren	3160-09	V034223	ICO	ICO
High Frequency Amplifier	Miteq	AFS4-001018000-35-10P-4	V033997	12/21/2022	12/21/2023
900 MHz High Pass Filter	Micro-Tronics	HPM50108-03	V034185	12/21/2022	12/21/2023

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
2.4 GHz High Pass Filter	Micro-Tronics	HPM50111-03	V034183	12/21/2022	12/21/2023
2.4 GHz Notch Filter	Micro-Tronics	BRM50702-03	V034213	12/21/2022	12/21/2023
6' High Frequency Cable	Microcoax	UFB197C-0-0720-000000	V033638	12/21/2022	12/21/2023
20' High Frequency Cable	Microcoax	UFB197C-1-3120-000000	V033979	12/21/2022	12/21/2023
3 Meter Radiated Emissions Cable Wanship Upper Site	Microcoax	UFB205A-0-4700-000000	V033639	12/21/2022	12/21/2023
EMC32 Test Software	Rohde & Schwarz	10.60.20	N/A	N/A	N/A

Table 12: List of equipment used for radiated emissions testing.

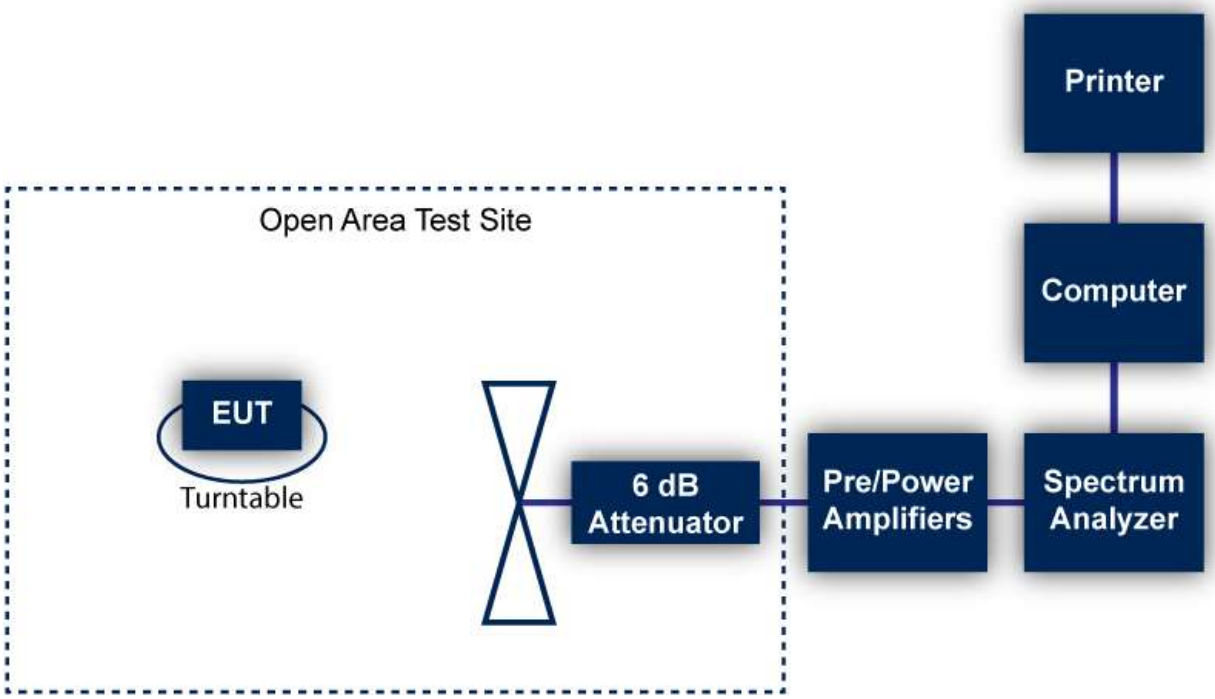

Figure 3: Radiated Emissions Test

7.4 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.

7.5 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 an external appendix.

--- End of Report ---