UNIFIED COMPLIANCE LABORATORY

427 West 12800 South
Draper, UT 84020

Test Report

Certification

FCC ID	SWX-LTULRR
ISED ID	6545A-LTULRR
Equipment Under Test	LTU-LR
Test Report Serial Number	TR3687_01
Dates of Test(s)	7/21/19 - 7/27/19
Report Issue Date	11/14/2019

Test Specification	Applicant
47 CFR FCC Part 15, Subpart C RSS-247	Ubiquiti Inc. 685 Third Avenue New York, NY 10019 U.S.A.

NVLAP TESTING ilac-MRA

NVLAP LAB CODE 600241-0

Certification of Engineering Report

This report has been prepared by Unified Compliance Laboratory (UCL) to document compliance of the device described below with the requirement of Federal Communication Commissions (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.

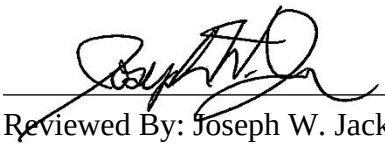
Applicant	Ubiquiti Inc.
Manufacturer	Ubiquiti Inc.
Brand Name	LTU
Model Number	LTU-LR
FCC ID	SWX-LTULRR
ISED ID	6545A-LTULRR

On this 14th day of November 2019, I individually and for Unified Compliance Laboratory 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 Unified Compliance Laboratory 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.

Unified Compliance Laboratory

Written By: Alex Macon



Reviewed By: Joseph W. Jackson

Revision History		
Revision	**Description**	**Date**
01	Original Report Release	11/14/2019

Table of Contents

1 Client Information

1.1 Applicant

Company	Ubiquiti Inc. 685 Third Avenue New York, NY 10017 U.S.A.
Contact Name	Mark Feil
Title	Compliance Manager

1.2 Manufacturer

Company	Ubiquiti Inc. 685 Third Avenue New York, NY 10017 U.S.A.
Contact Name	Mark Feil
Title	Compliance Manager

2 Equipment Under Test (EUT)

2.1 Identification of EUT

Brand Name	LTU
Model Number	LTU-LR
Serial Number	N/A
Dimensions (cm)	51.2 x 38.6 x 25.8

2.2 Description of EUT

The LTU-LR is a fixed point-to-point or point to multiple point transceiver, intended for outdoor use, operating in the UNII-1, UNII-2A/2C and UNII-3 frequency bands. A Bluetooth LE transceiver is included for device management. An Ethernet port is used for data transfer and to provide power using a POE-24V-5X-HD POE supply.

This report covers the circuitry of the device subject to FCC Part 15, Subpart C. The circuitry of the device subject to FCC Part 15 Subpart B and FCC Part 15 Subpart E was found to be compliant.

2.3 EUT and Support Equipment

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

Brand Name **Model Number** **Serial Number**	**Description**	**Name of Interface Ports / Interface Cables**
BN: LTU MN: LTU-Lite (Note 1) SN: None	Point to Point Transceiver	See section 2.4
BN: Ubiquiti MN: POE-24V-5X-HD (Note 1) SN: None	POE Supply	See Section 2.4
BN: Dell MN: XPS 13 SN: None	Computer	Ethernet/Shielded Cat 5e cable (Note 2)

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.

2.4 Interface Ports on EUT

Name of Ports	No. of Ports Fitted to EUT	Cable Description/Length
POE/Data	1	Shielded Cat 5e cable/8 meters
AC	1	3 conductor power cord/80 cm
Data	1	Shielded Cat 5e cable/1 meters
POE/Data	1	Shielded Cat 5e cable/8 meters

2.5 Operating Environment

Power Supply	120 VAC
AC Mains Frequency	60 Hz
Temperature	26.8 C
Humidity	43.1 %
Barometric Pressure	1018 mbar

2.6 Operating Modes

The 2.4 GHz radio operates in BLE mode. Continuous transmission

2.7 EUT Exercise Software

Ubiquiti test software and firmware were used to control the transceivers of the EUT. (ART)

2.8 Block Diagram of Test Configuration

N/A

2.9 Modification Incorporated/Special Accessories on EUT

There were no modifications made to the EUT during testing to comply with the specification.

2.10 Deviation, Opinions Additional Information or Interpretations from Test Standard

This model uses the same Bluetooth radio circuit found in a similar device. Model LTU-Lite (SWX-LTUL, 6545A-LTUL) The measurements contained within the body of this report are those taken during the original certification. The data contained within the Annex of this report is that taken during spot checks as per KDB 484596.

3 Test Specification, Method and Procedures

3.1 Test Specification

Title	47 CFR FCC Part 15, Subpart C, 15.203, 15.207 and 15.247 Limits and methods of measurement of radio interference characteristics of radio frequency devices. RSS-247
Purpose of Test	The tests were performed to demonstrate initial compliance

3.2 Methods & Procedures

3.2.1 47 CFR FCC Part 15 Section 15.203

See test standard for details.

3.2.2 47 CFR FCC Part 15 Section 15.207

See test standard for details.

3.2.3 47 CFR FCC Part 15 Section 15.247

See test standard for details.

3.3 FCC Part 15, Subpart C

3.3.1 Summary of Tests

FCC Section	ISED Section	Environmental Phenomena	Frequency Range (MHZ)	Result
15.203	N/A	Antenna requirements	Structural Requirement	Compliant
15.207	RSS-Gen	Conducted Disturbance at Mains Port	0.15 to 30	Compliant
15.247(a)	RSS-247 §5.2	Bandwidth Requirement	2400 to 2483.5	Compliant
15.247(b)	RSS-247 §5.4	Peak Output Power	2400 to 2483.5	Compliant
15.247(d)	RSS-247 §5.5	Antenna Conducted Spurious Emissions	0.009 to 25000	Compliant
15.247(d)	RSS-247 §5.5	Radiated Spurious Emissions	0.009 to 25000	Compliant
15.247(e)	RSS-247 §5.2	Peak Power Spectral Density	2400 to 2483.5	Compliant
The testing was performed according to the procedures in ANSI C63.10-2013, KDB 558074 and 47 CFR Part 15.				

3.4 Results

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

3.5 Test Location

The test results were tested at a 3rd party facility. This testing was performed at VPI Laboratories OATS located at 313 West 12800 South, Draper, UT 84020. VPI Laboratories is accredited by National Voluntary Laboratory Accreditation Program (NVLAP); NVLAP Code 100272-0

4 Test Equipment

4.1 Conducted Emissions at Mains Ports

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
EMI Receiver	AFJ	FFT3010	UCL-2500	12/14/2018	4/17/2020
Transient Limiter	Com-Power	LIT-930A	UCL-2496	2/11/2019	2/11/2020
LISN	AFJ	LS16C/10	UCL-2512	12/14/2018	4/17/2020
Cat6 ISN	Teseq	ISN T8-Cat6	UCL-2971	2/11/2019	5/21/2020
ISN	Teseq	ISN T800	UCL-2974	2/19/2019	5/21/2020
LISN	Com-Power	LIN-120C	UCL-2612	2/11/2019	2/11/2020
AC Power Source	Laplace Instruments	AC1000A	UCL-2857	N/A	N/A
Monitoring Probe	Teseq	MD 4070A	UCL-2980	3/16/2019	5/21/2020
Test Software	UCL	Revision 1	UCL-3107	N/A	N/A

Table 1:List of equipment used for Conducted Emissions Testing at Mains Port

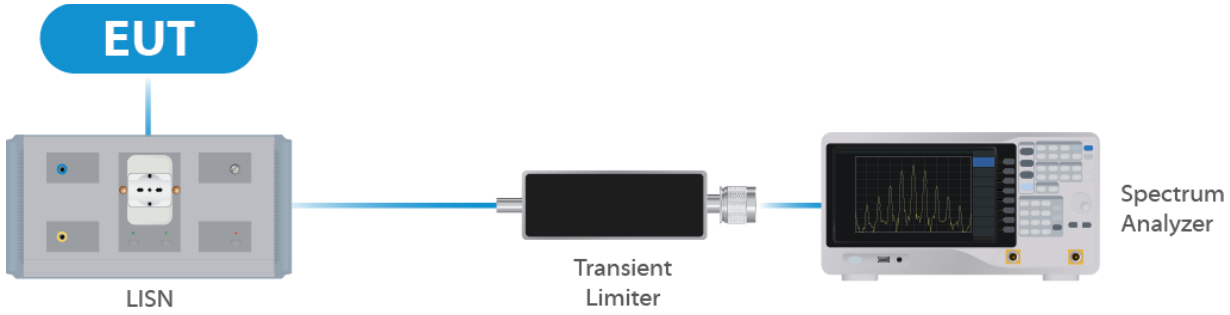


Figure 1: Conducted Emissions Test

4.2 Radiated Emissions

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
Spectrum Analyzer/Receiver	Rohde & Schwarz	ESU40	V033119	07/16/2018	07/16/2019
Spectrum Analyzer	Hewlett Packard	8566B	V048078	05/26/2019	05/26/2020
Quasi-Peak Detector	Hewlett Packard	85650A	V039474	05/02/2018	05/02/2020
Loop Antenna	EMCO	6502	V034216	02/11/2019	02/11/2021
Biconilog Antenna	EMCO	3142E-PA	V035736	07/05/2018	07/05/2020
Double Ridged Guide Antenna	EMCO	3115	V033469	04/13/2018	04/13/2020
Standard Gain Horn	ETS-Lindgren	3160-09	V034223	ICO	ICO
Standard Gain Horn	ETS-Lindgren	3160-10	V034224	ICO	ICO
High Frequency Amplifier	Miteq	AFS4-001018000-35-10P-4	V033997	01/08/2019	01/08/2020
High Frequency Amplifier	L3-Narda-Miteq	AMF-6F-18004000-37-8P	V042464	01/08/2019	01/08/2020
5.8 GHz High Pass Filter	Micro-Tronics	HPM50105	V034198	01/08/2019	01/08/2020
2.4 GHz Notch Filter	Micro-Tronics	BRM50702-03	V034213	01/08/2019	01/08/2020
6’ High Frequency Cable	Microcoax	UFB197C-0-0720-000000	V033638	01/08/2019	01/08/2020
20’ High Frequency Cable	Microcoax	UFB197C-1-3120-000000	V033979	01/08/2019	01/08/2020
3 Meter Radiated Emissions Cable Wanship Upper Site	Microcoax	UFB205A-0-4700-000000	V033639	01/08/2019	01/08/2020
Test Software (FCC)	VPI Labs	Revision 01	V035673	N/A	N/A

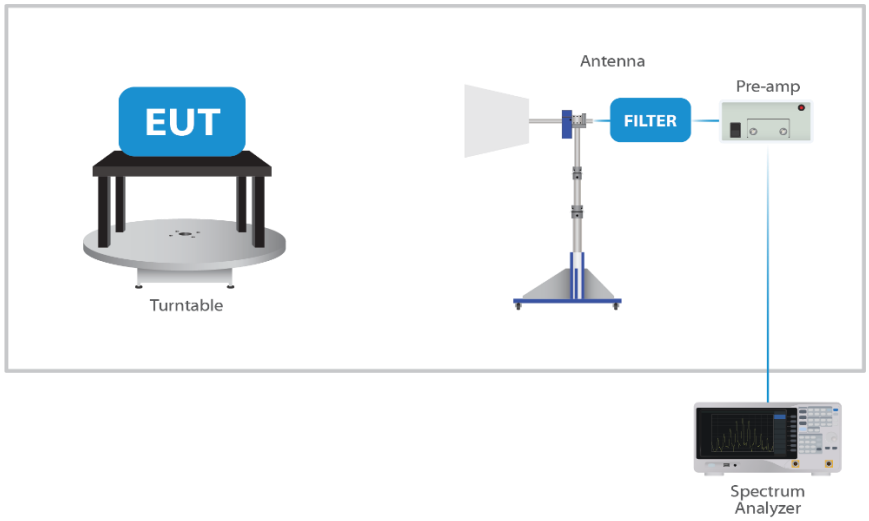


Figure 2: Radiated Emissions Test

4.3 Equipment Calibration

All applicable equipment is calibrated using either an independent calibration laboratory or Unified Compliance Laboratory 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 traceability is on file and is available for examination upon request.

4.4 Measurement Uncertainty

Test	Uncertainty (± dB)	Confidence (%)
Conducted Emissions	1.44	95
Radiated Emissions (9 kHz to 30 MHz)	2.50	95
Radiated Emissions (30 MHz to 1 GHz)	3.95	95
Radiated Emissions (1 GHz to 18 GHz)	5.56	95
Radiated Emissions (18 GHz to 40 GHz)	5.16	95

5 Test Results

5.1 §15.203 Antenna Requirements

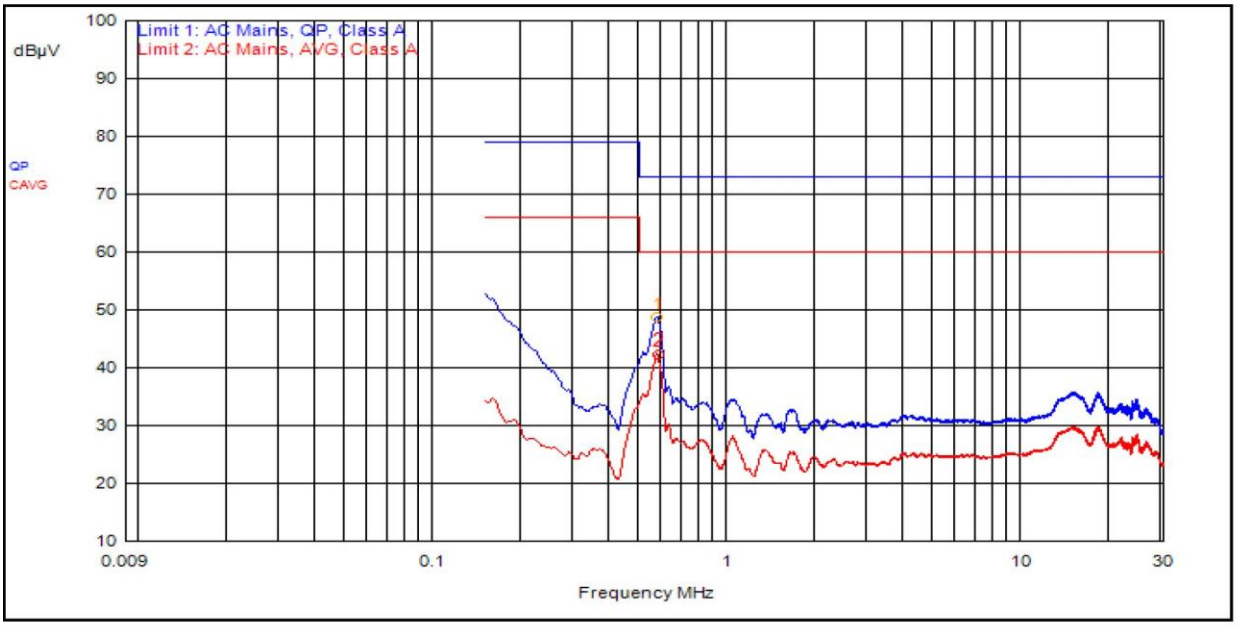
The EUT uses a integral PCB antenna The Maximum gain of the antenna is 2 dBi. The antenna is not user replaceable.

Results

The EUT complied with the specification

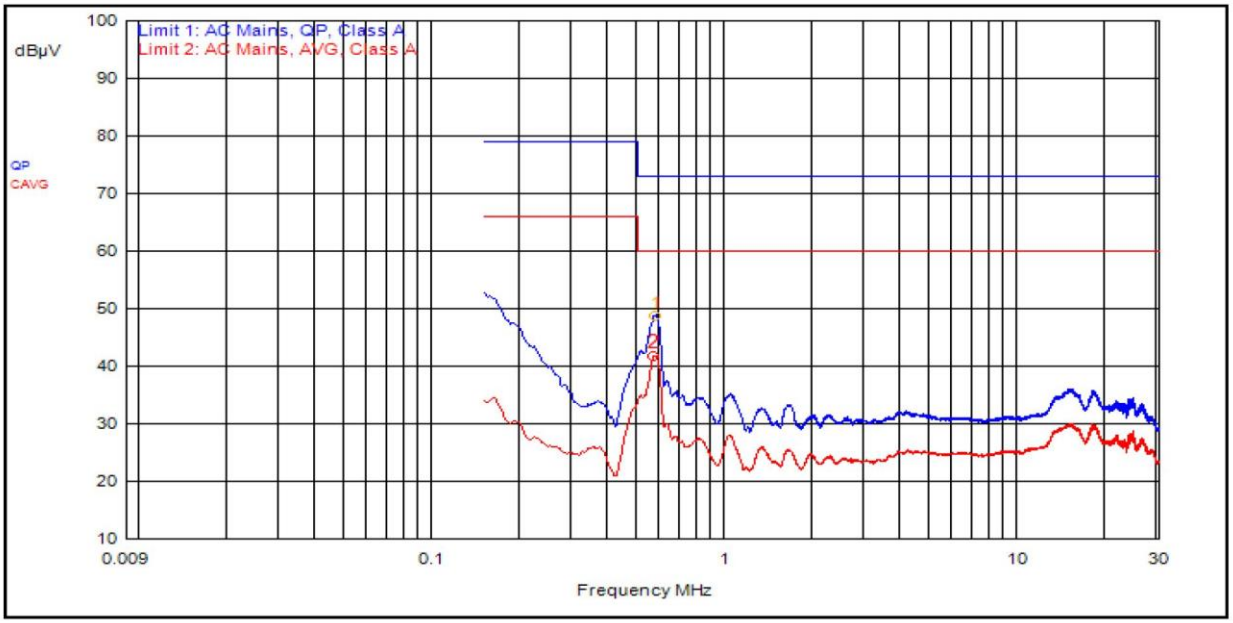
5.2 Conducted Emissions at Mains Ports Data

Line



ID	Frequency	Probe	Cable	Atten.	Detector	Meter Read	Meas Level	Limit	Limit Dist.
2	576.000kHz	12.3	0.0		C_AVG	30.0	42.2	60.0	-17.8
1	570.000kHz	12.3	0.0		QPeak	36.4	48.7	73.0	-24.3

Neutral



ID	Frequency	Probe	Cable	Atten.	Detector	Meter Read	Meas Level	Limit	Limit Dist.
2	567.000kHz	12.3	0.0		C_AVG	29.4	41.7	60.0	-18.3
1	570.000kHz	12.3	0.0		QPeak	36.6	48.8	73.0	-24.2

Result

The EUT complied with the specification limit.

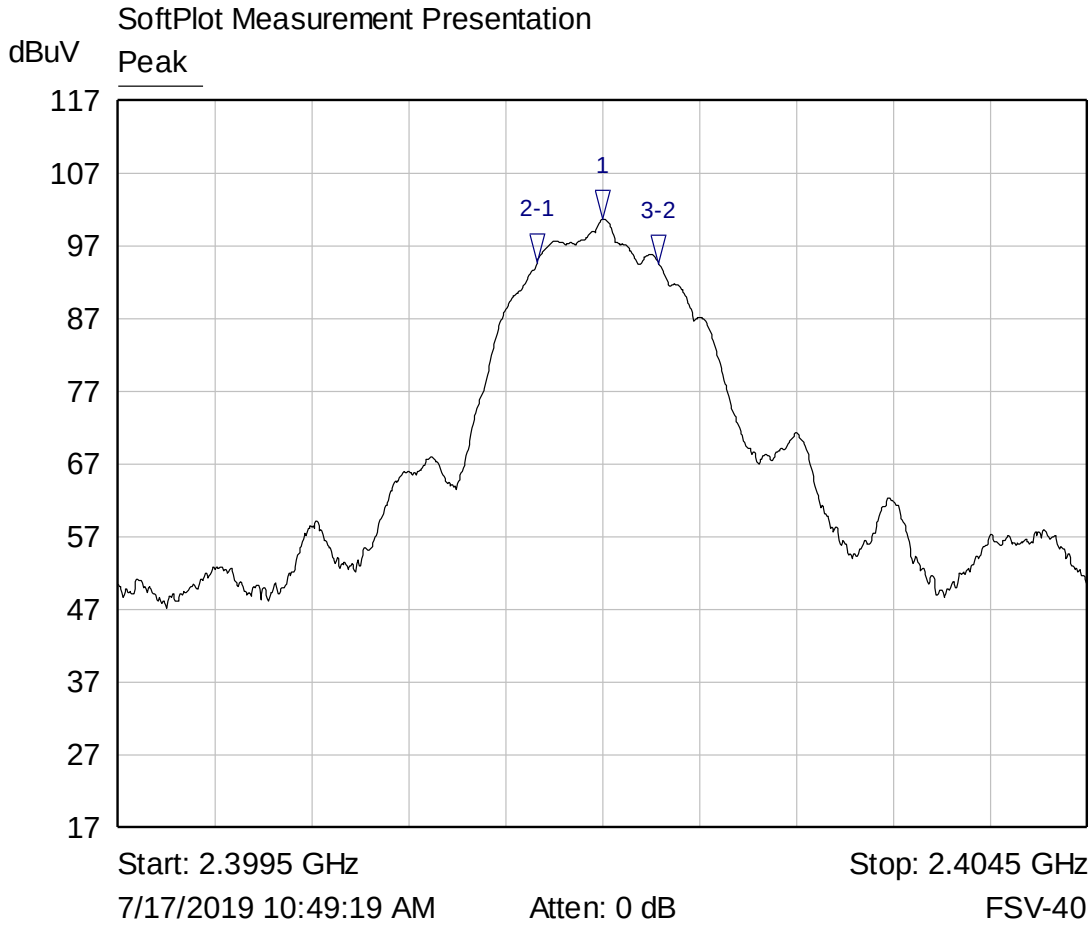
5.3 §15.247(a)(2) Bandwidth

Frequency (MHz)	99% Bandwidth (MHz)	Emissions 6 dB Bandwidth (MHz)
2402	1.01	0.97
2442	1.01	0.97
2480	1.00	0.98

Result

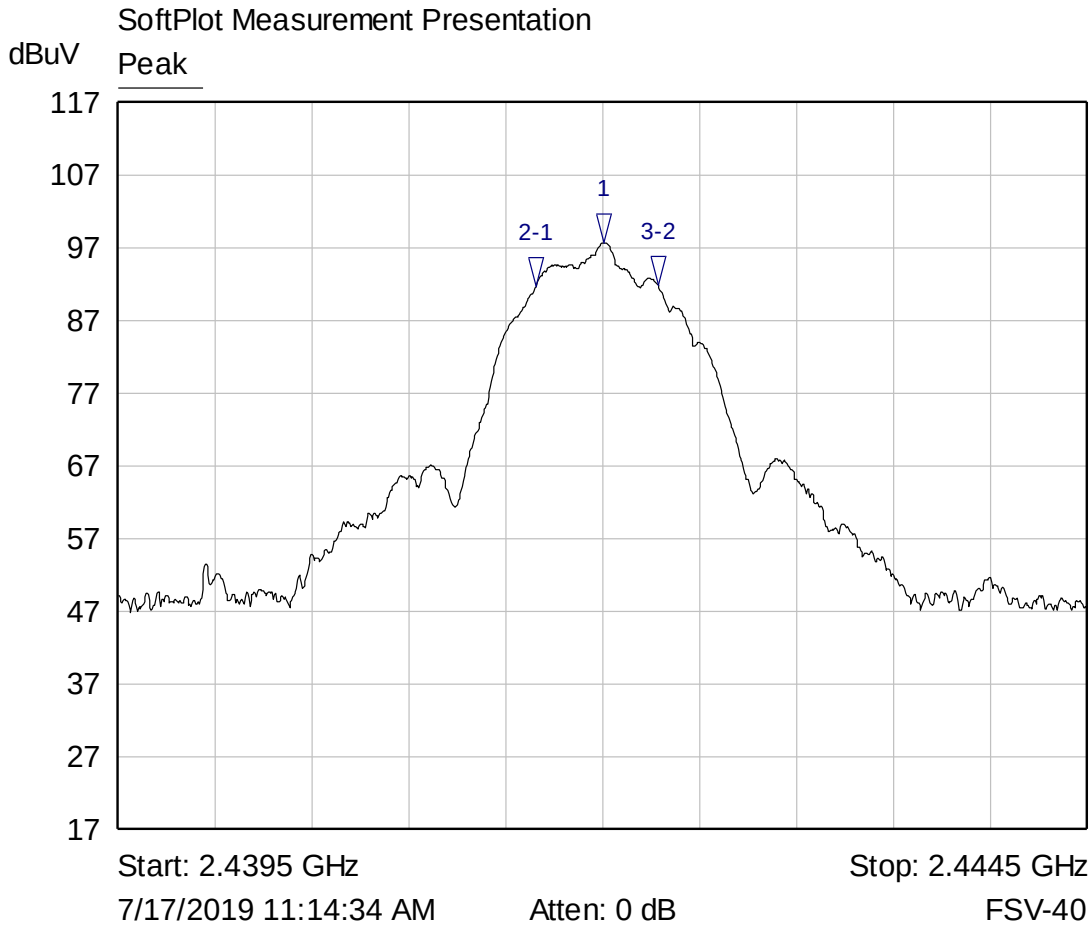
In the configuration tested, the 6 dB bandwidth was greater than 500 kHz; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plots below).

Emissions 6 dB Bandwidth



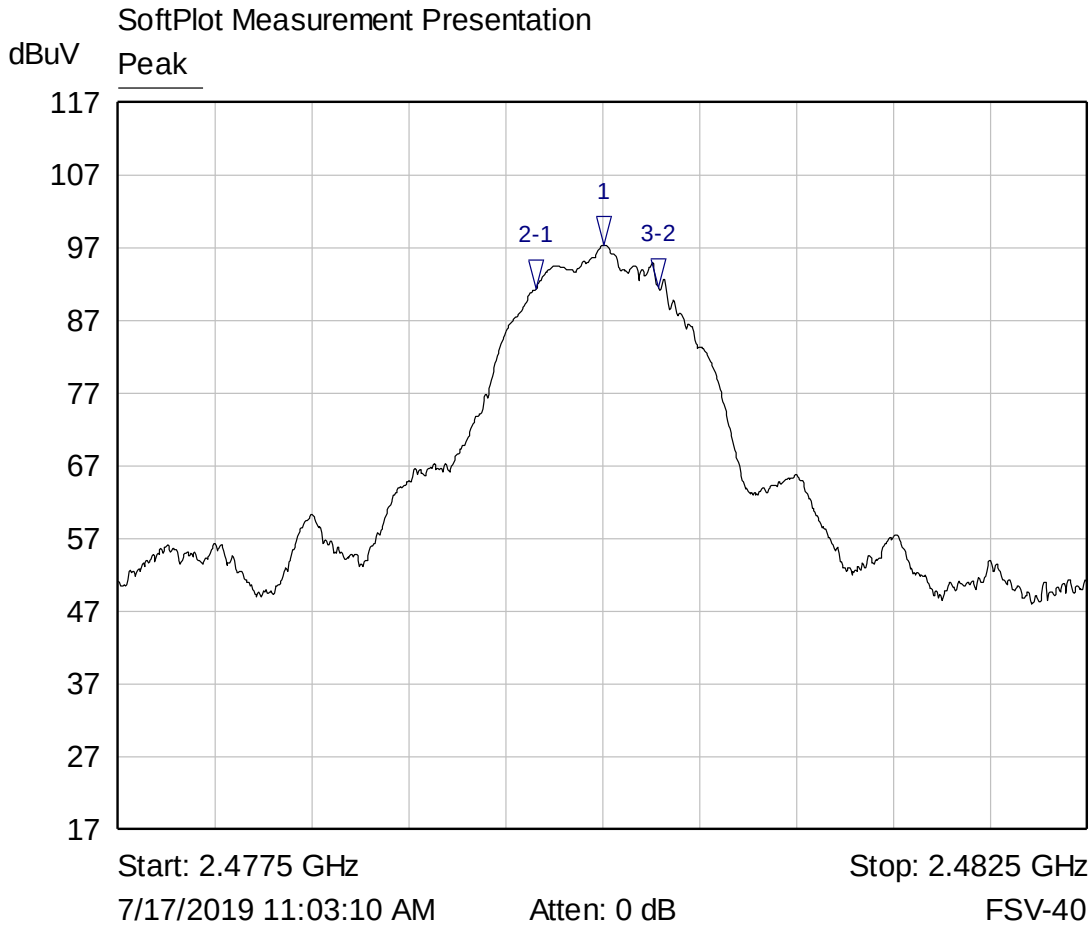
Mkr	Trace	X-Axis	Value	Notes
1	Peak	2.4020 GHz	100.66 dBuV	
2-1	Peak	-340.0000 kHz	-6.06 dB	
3-2	Peak	630.0000 kHz	-0.06 dB	

Graph 1: 2402 MHz 6dB Emissions Bandwidth



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.4420 GHz	97.72 dBuV	
2-1▽	Peak	-350.0000 kHz	-6.07 dB	
3-2▽	Peak	630.0000 kHz	0.10 dB	

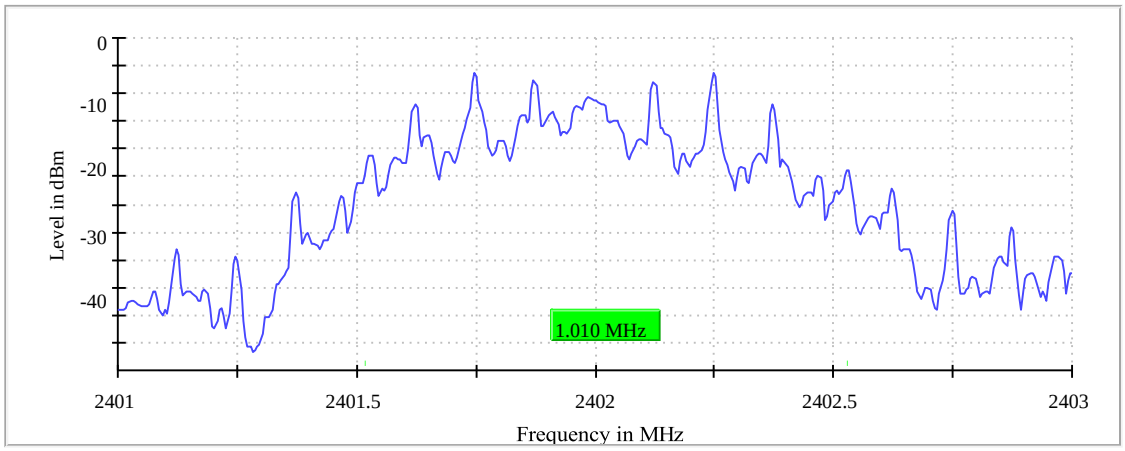
Graph 2:2442 MHz 6dB Emissions Bandwidth

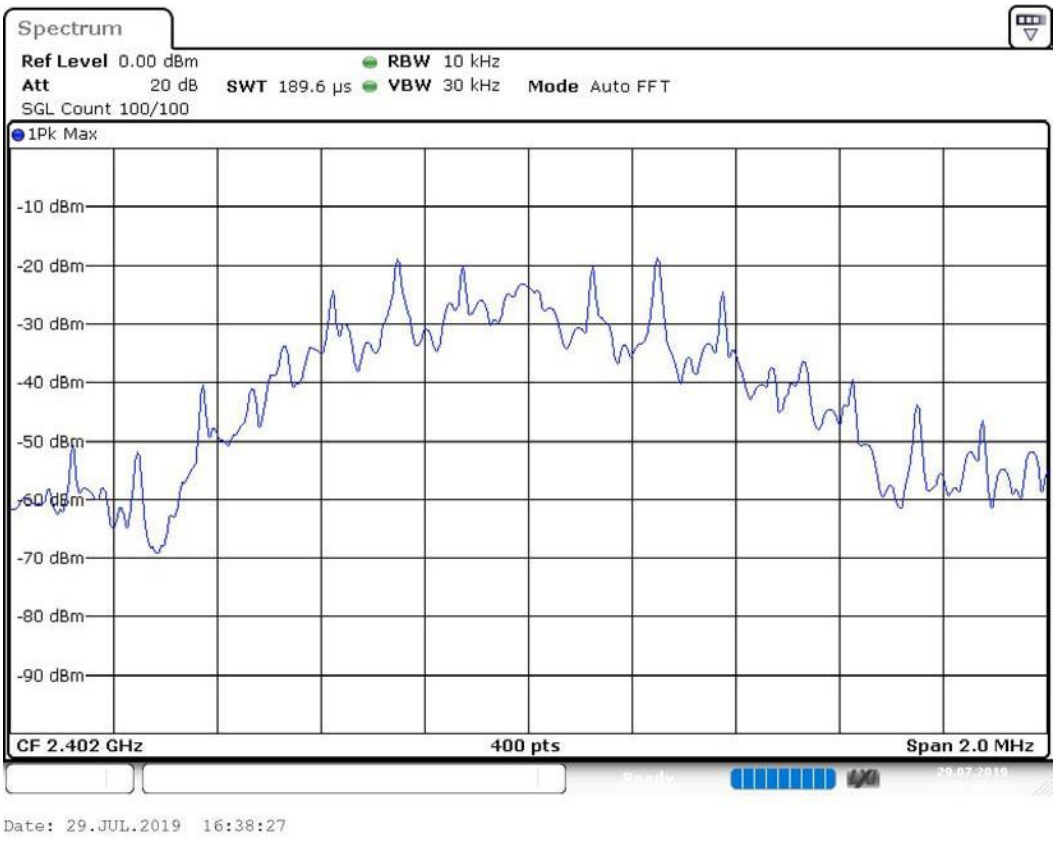


Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.4800 GHz	97.39 dBuV	
2-1▽	Peak	-350.0000 kHz	-6.09 dB	
3-2▽	Peak	635.0000 kHz	0.13 dB	

Graph 3: 2480 MHz 6dB Emissions Bandwidth

99 % Bandwidth





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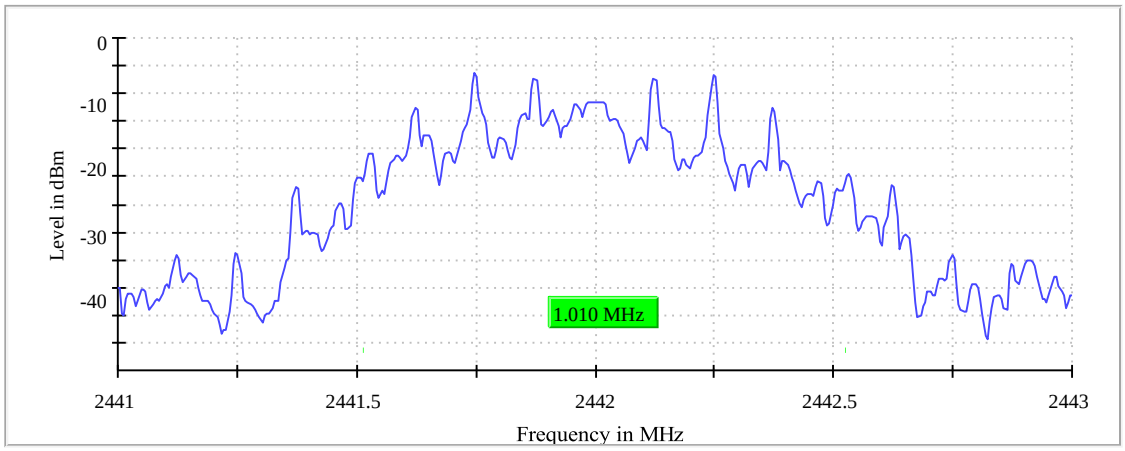
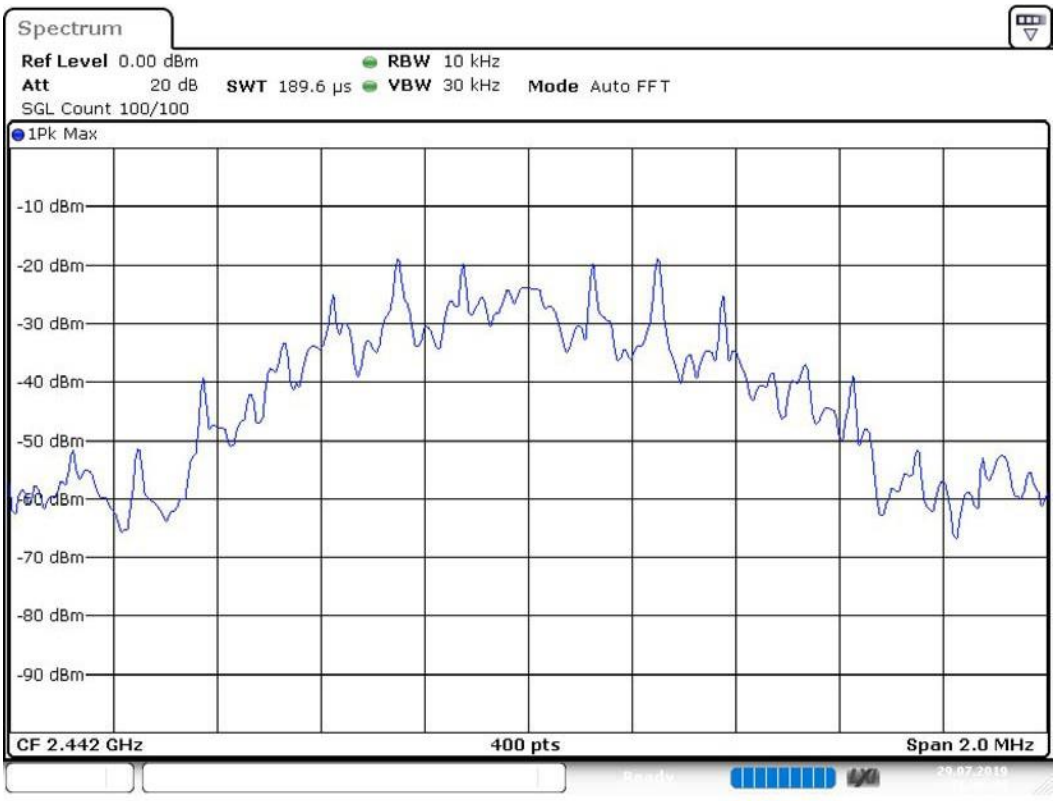
99 % Bandwidth





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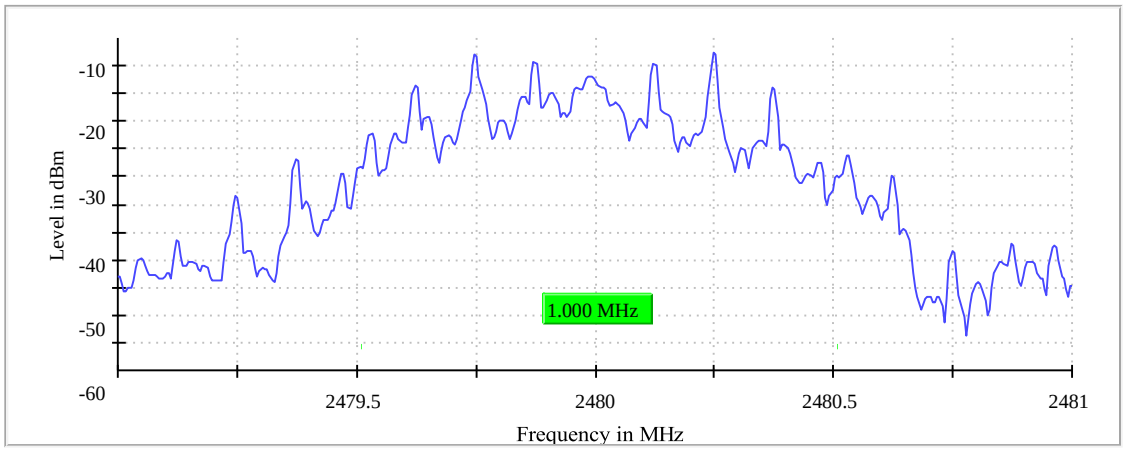
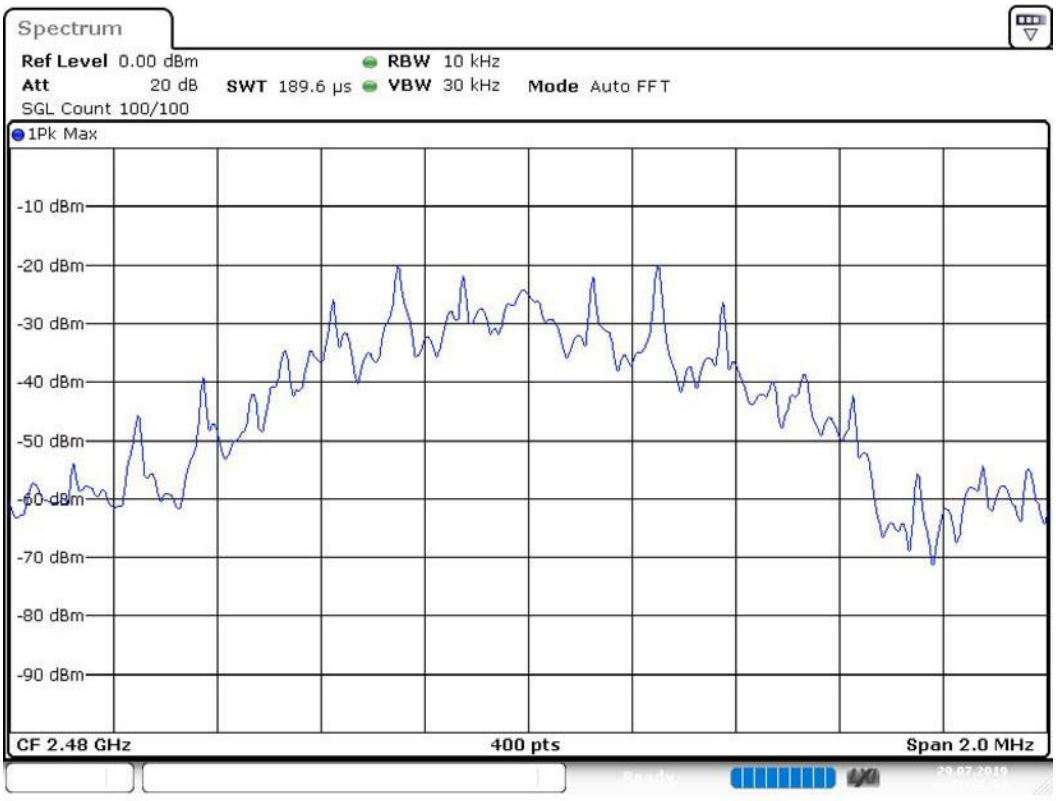
99 % Bandwidth





Date: 29.JUL.2019 16:56:35

5.4 §15.247(b)(3) Maximum Average Output Power

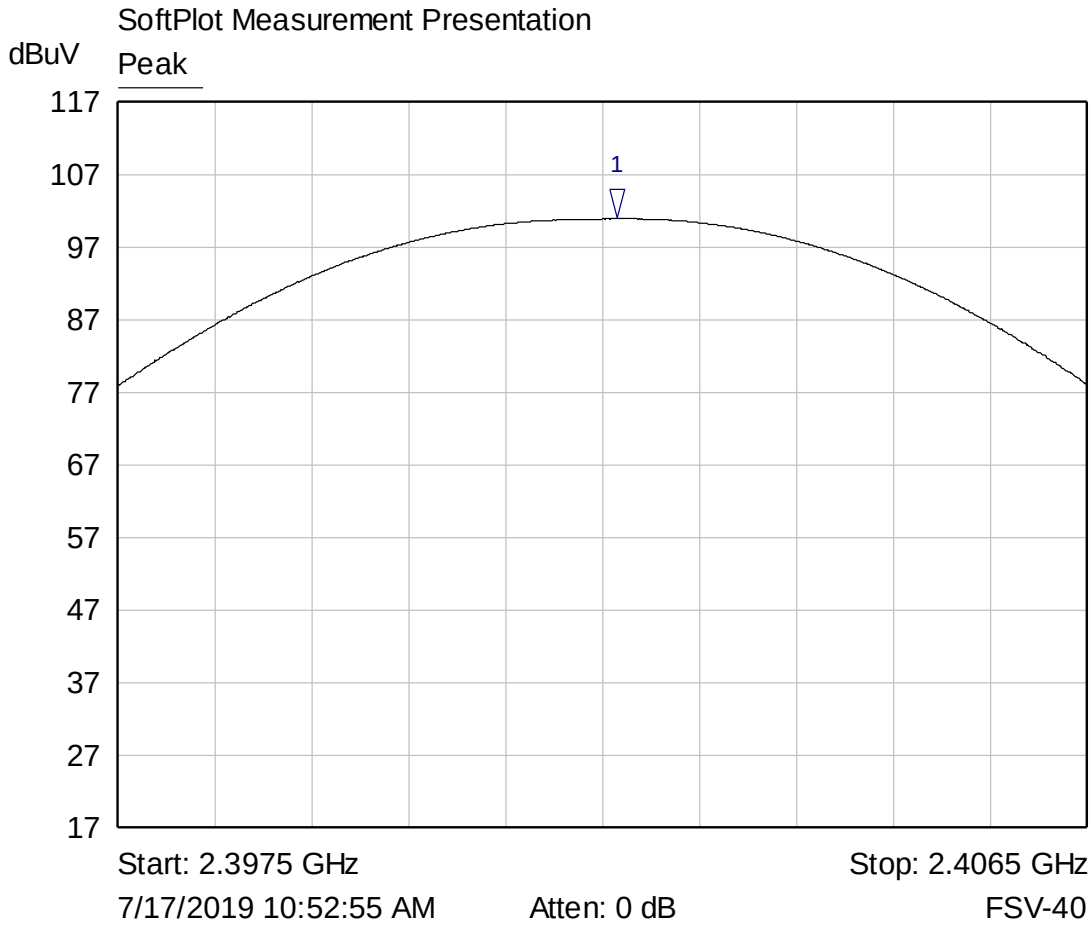
The maximum average RF conducted output power measured for this device was 3.75 dBm or 2.37 mW. The limit is 30 dBm or 1 Watt when using antennas with 6 dBi or less gain. The antenna has a gain of 2.0 dBi.

E[dBµV/m] = EIRP[dBm] - 20 log (d[m]) + 104.77
E[dBµV/m] = EIRP[dBm] + 95.2,
E[dBµV/m] – 95.2 = EIRP[dBm]

Frequency (MHz)	Measured Field Strength (dBuV)	EIRP Output Power (dBm)	Conducted Output Power (dBm)
2402	100.95	5.75	3.75
2442	98.04	2.84	0.84
2480	97.7	2.5	0.5

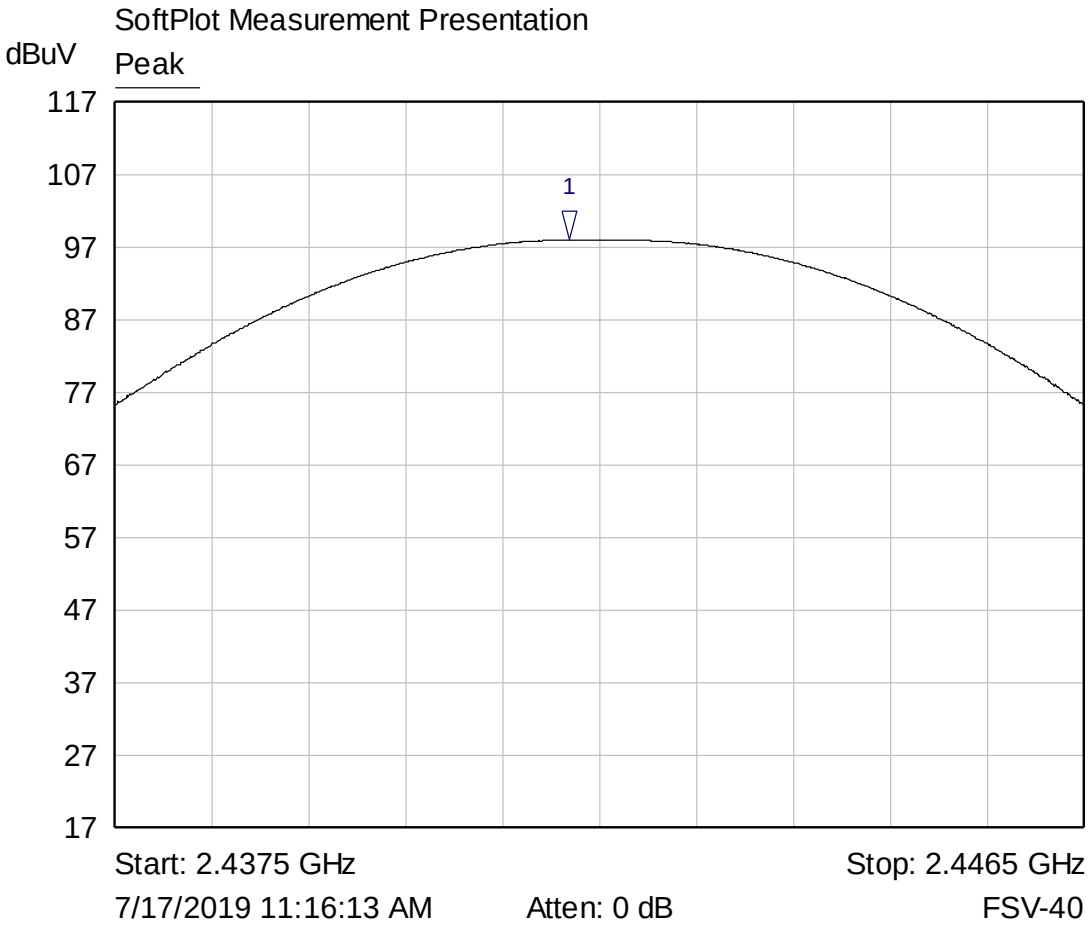
Result

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



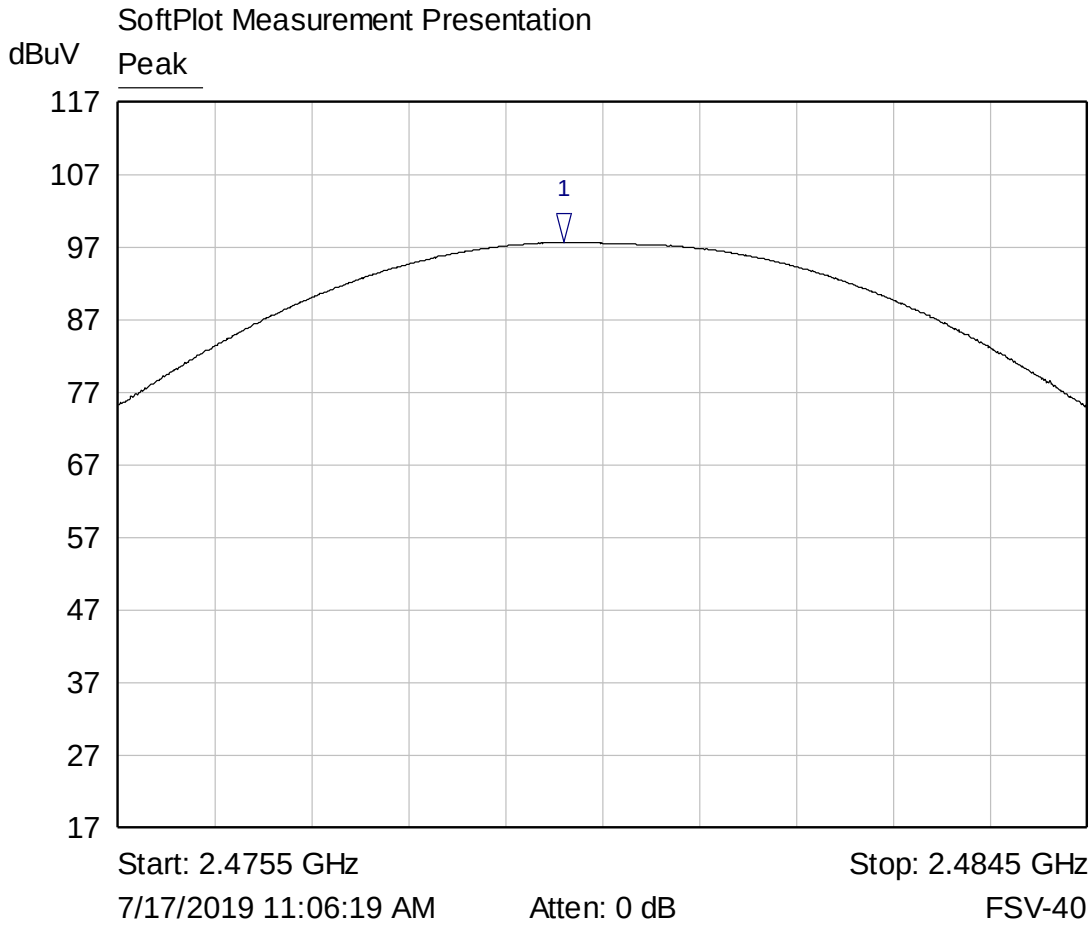
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.4021 GHz	100.95 dBuV	

Graph 4: 2402 Maximum Field Strength



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.4417 GHz	98.04 dBuV	

Graph 5: 2442 Maximum Field Strength



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.4796 GHz	97.70 dBuV	

Graph 6: 2480 Maximum Field Strength

5.5 §15.247(d) Spurious Emissions

5.5.1 Conducted Spurious Emissions

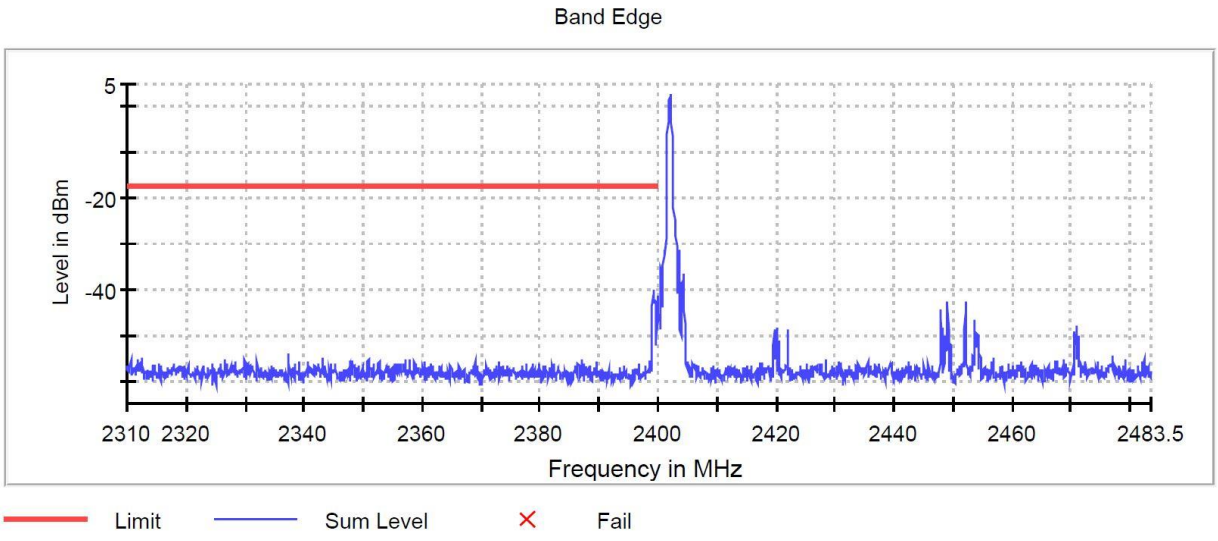
The frequency range from the lowest frequency generated or used in the device to the tenth harmonic of the highest fundamental frequency was investigated to measure any antenna-conducted emissions. The table show the measurement data from spurious emissions noted across the frequency range when transmitting at the lowest frequency, middle frequency and upper frequency. Shown below are plots with

the EUT tuned to the upper and lower channels. These demonstrate compliance with the provisions of this section at the band edges.

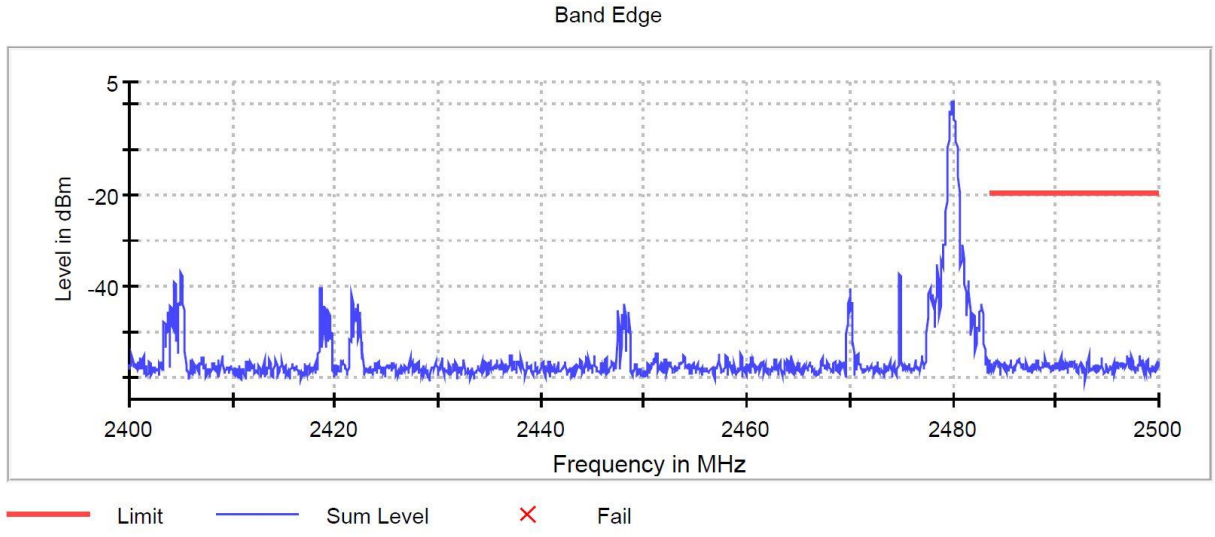
The emissions must be attenuated 30 dB below the highest power spectral density level measured within the authorized band as measured with a 100 kHz RBW.

Result

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



Graph 7: Lower Band Edge Plot



Graph 8: Upper Band Edge Plot

5.5.2 Radiated Spurious Emissions in the Restricted Bands of §15.205

The frequency range from the lowest frequency generated or used in the device to the tenth harmonic of the highest fundamental emissions was investigated to measure any radiated emissions in the restricted bands. The following tables show measurements of any emissions that fell into the restricted bands of §15.205. The tables show the worst-case emissions measured from the EUT. For frequencies above 18.0 GHz, a measurement distance of 1 meter was used. The noise floor was a minimum of 6 dB below the limits. The emissions in the restricted bans 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.

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)	Antenna Polarity	Detector	Receiver Reading (dBµV)	Amplifier Gain (dB)	Correction Factor (dB)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4804.0	V	P	38.0	30.5	38.7	46.2	74.0	-27.8
4804.0	V	A	29.7	30.5	38.7	37.9	54.0	-16.1
4804.0	H	P	39.4	30.5	38.7	47.6	74.0	-26.4
4804.0	H	A	33.2	30.5	38.7	41.4	54.0	-12.6
7206.0	V	P	38.2	29.1	42.8	51.9	74.0	-22.1
7206.0	V	A	30.7	29.1	42.8	44.4	54.0	-9.6
7206.0	H	P	42.2	29.1	42.8	55.9	74.0	-18.1
7206.0	H	A	31.4	29.1	42.8	45.1	54.0	-8.9
14412.0	V	P	33.8	30.9	51.9	54.8	74.0	-19.2
14412.0	V	A	21.8	30.9	51.9	42.8	54.0	-11.2
14412.0	H	P	33.9	30.9	51.9	54.9	74.0	-19.1
14412.0	H	A	21.7	30.9	51.9	42.7	54.0	-11.3

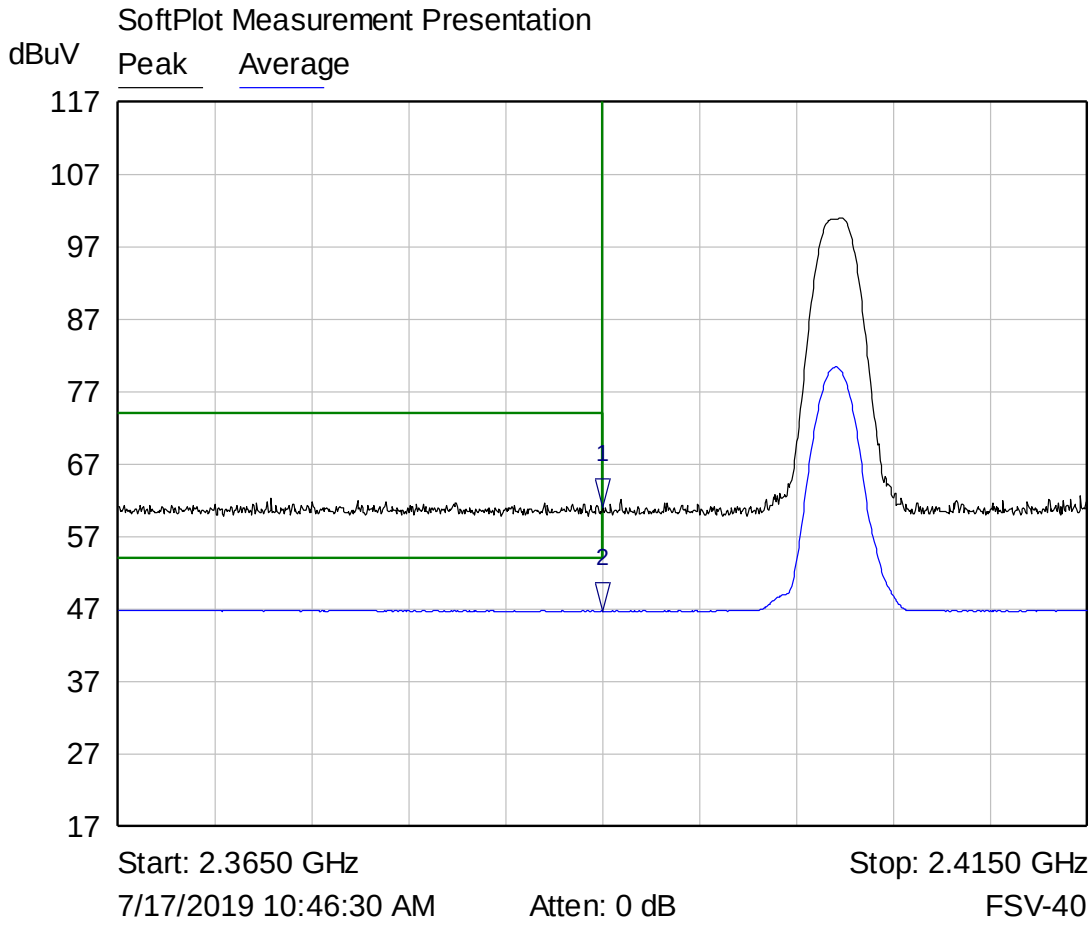
Table 2: Transmitting at the Lowest Frequency

Frequency (MHZ)	Antenna Polarity	Detector	Receiver Reading (dBµV)	Amplifier Gain (dB)	Correction Factor (dB)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4882.0	V	P	38.8	30.5	38.9	47.2	74.0	-26.8
4882.0	V	A	30.0	30.5	38.9	38.4	54.0	-15.6
4882.0	H	P	38.4	30.5	38.9	46.8	74.0	-27.2
4882.0	H	A	29.2	30.5	38.9	37.6	54.0	-16.4
7326.0	V	P	41.2	28.9	43.2	55.5	74.0	-18.5
7326.0	V	A	33.5	28.9	43.2	47.8	54.0	-6.2
7326.0	H	P	41.1	28.9	43.2	55.4	74.0	-18.6
7326.0	H	A	34.0	28.9	43.2	48.3	54.0	-5.7
14412.0	V	P	32.7	30.9	51.9	53.7	74.0	-20.3
14412.0	V	A	20.9	30.9	51.9	41.9	54.0	-12.1
14412.0	H	P	34.0	30.9	51.9	55.0	74.0	-19.0
14412.0	H	A	20.6	30.9	51.9	41.6	54.0	-12.4

Table 3:Transmitting at the Middle Frequency

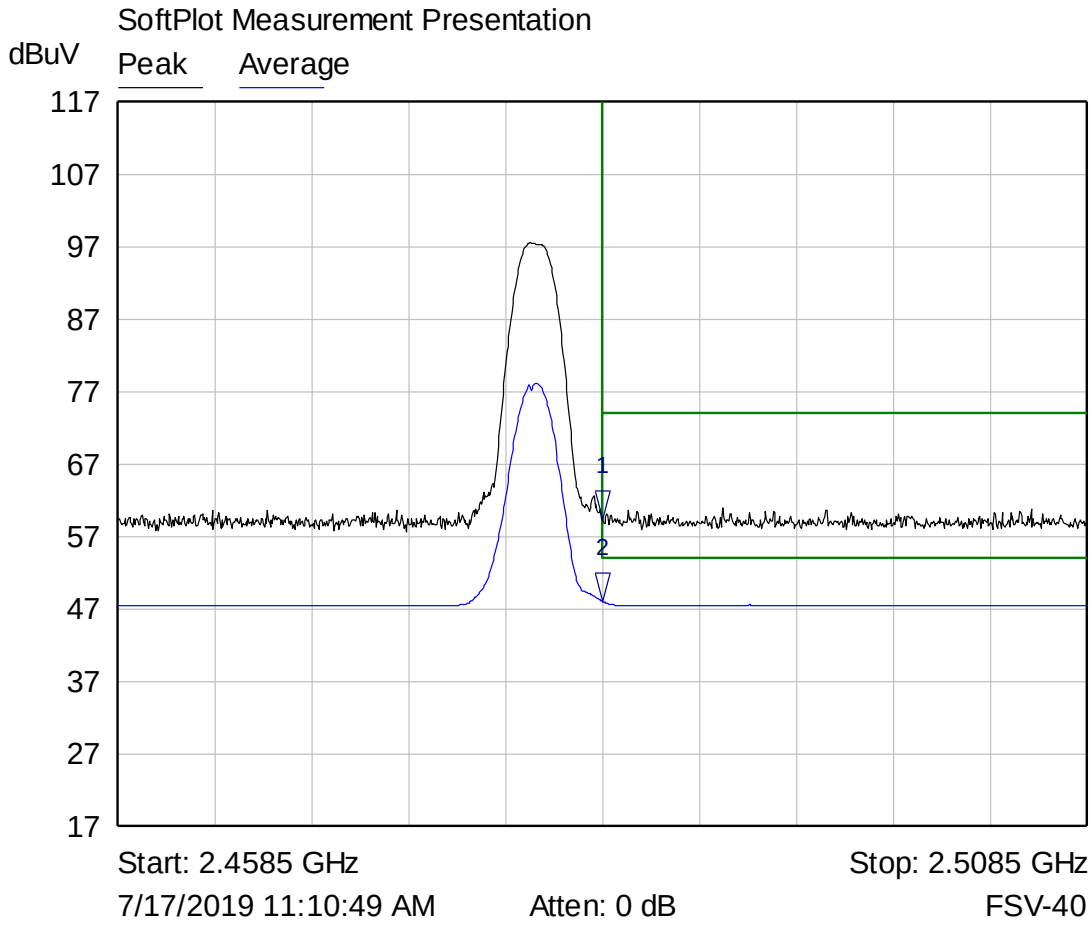
Frequency (MHZ)	Antenna Polarity	Detector	Receiver Reading (dBµV)	Amplifier Gain (dB)	Correction Factor (dB)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4960.0	V	P	38.1	30.6	39.1	46.6	74.0	-27.4
4960.0	V	A	28.5	30.6	39.1	37.0	54.0	-17.0
4960.0	H	P	38.2	30.6	39.1	46.7	74.0	-27.3
4960.0	H	A	29.5	30.6	39.1	38.0	54.0	-16.0
7440.0	V	P	38.4	28.7	43.6	53.3	74.0	-20.7
7440.0	V	A	29.2	28.7	43.6	44.1	54.0	-9.9
7440.0	H	P	38.6	28.7	43.6	53.5	74.0	-20.5
7440.0	H	A	28.8	28.7	43.6	43.7	54.0	-10.3
17360.0	V	P	31.1	27.1	53.6	57.6	74.0	-16.4
17360.0	V	A	19.7	27.1	53.6	46.2	54.0	-7.8
17360.0	H	P	33.0	27.1	53.6	59.5	74.0	-14.5
17360.0	H	A	19.7	27.1	53.6	46.2	54.0	-7.8

Table 4: Transmitting at the Highest Frequency



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.3900 GHz	60.92 dBuV	
2 ▽	Average	2.3900 GHz	46.75 dBuV	

Graph 9: Radiated Lower Band Edge Plot



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.4835 GHz	59.34 dBuV	
2 ▽	Average	2.4835 GHz	48.07 dBuV	

Graph 10: Radiated Upper Band Edge Plot

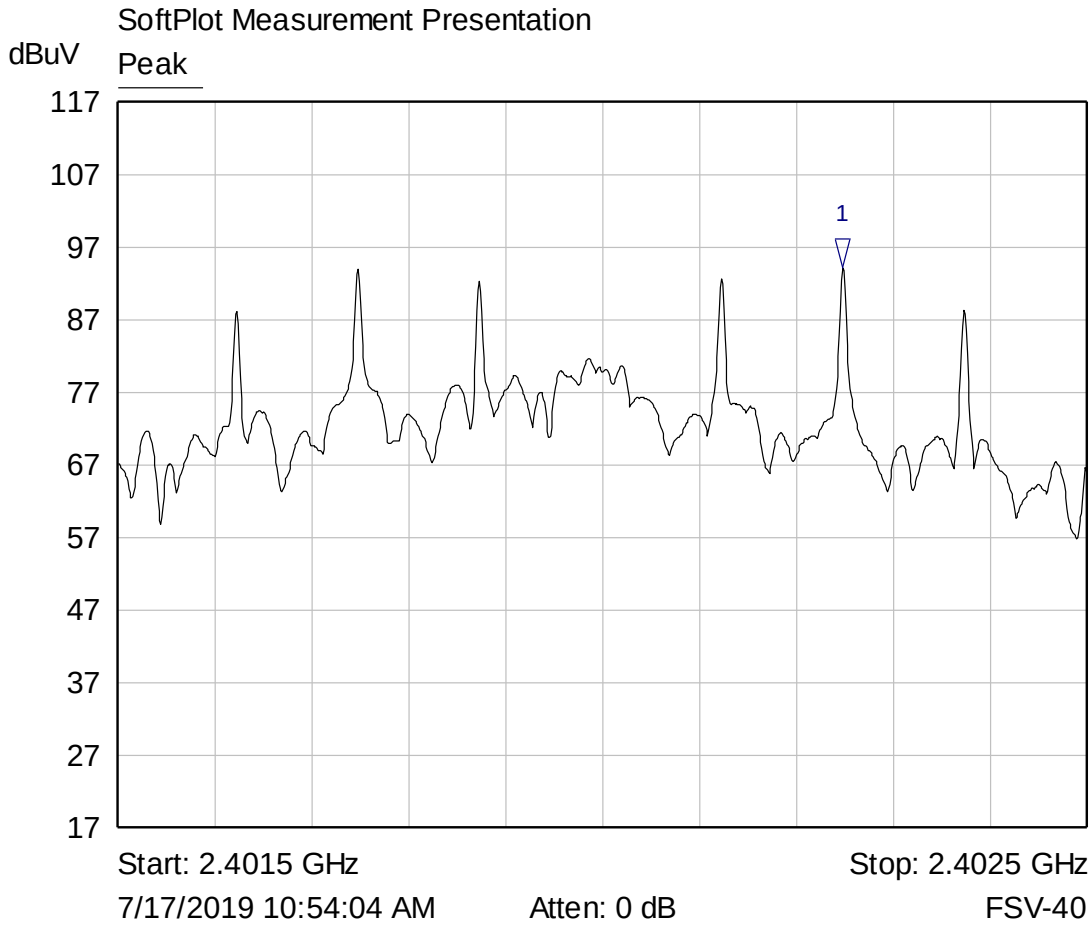
5.6 §15.247(e) Maximum Average Power Spectral Density

The maximum average power spectral density conducted from the intentional radiator of 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. The antenna gain is 2 dBi

E[dBµV/m] = EIRP[dBm] - 20 log (d[m]) + 104.77
E[dBµV/m] = EIRP[dBm] + 95.2,
E[dBµV/m] – 95.2 – Ant Gain = Corrected Data

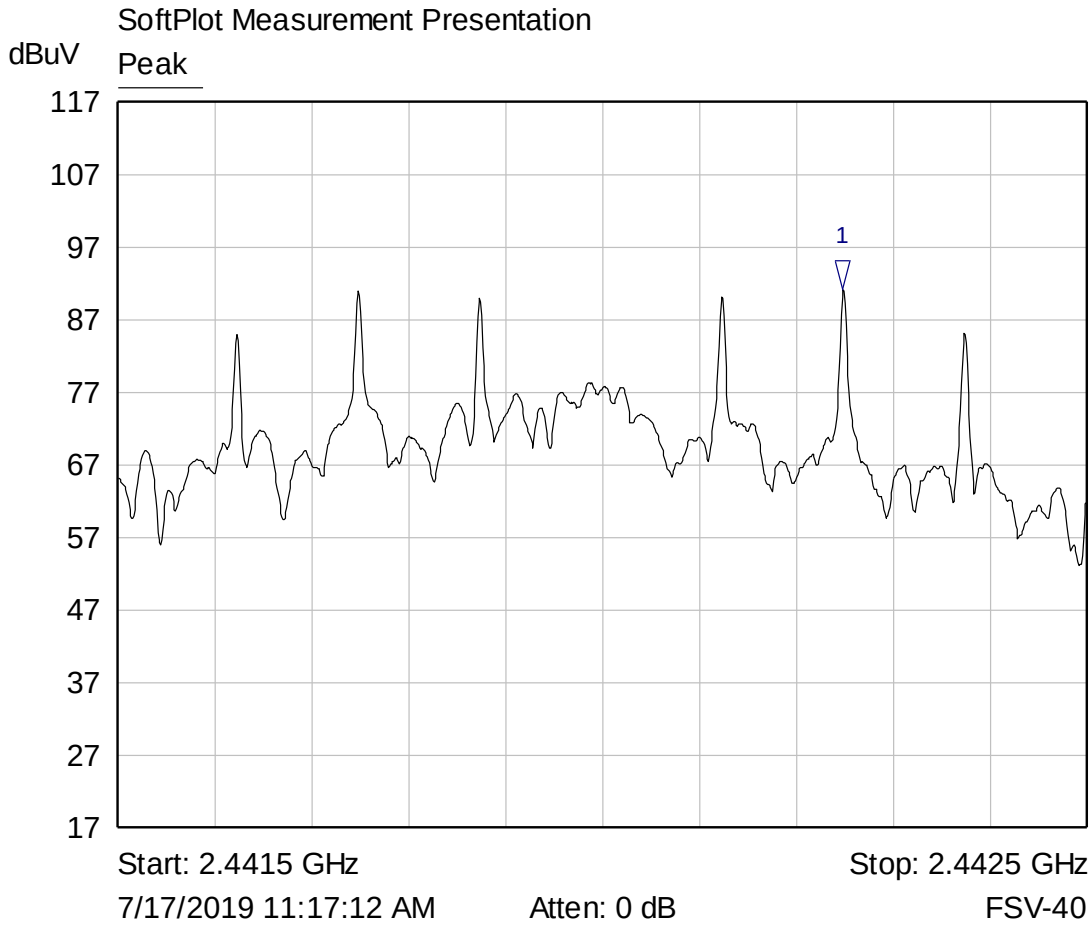
Frequency (MHz)	Measurement (dBuV)	Corrected Data (dBm)	Criteria (dBm)
2402	94.19	-3.01	8.0
2442	91.09	-6.11	8.0
2480	90.92	-6.28	8.0

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



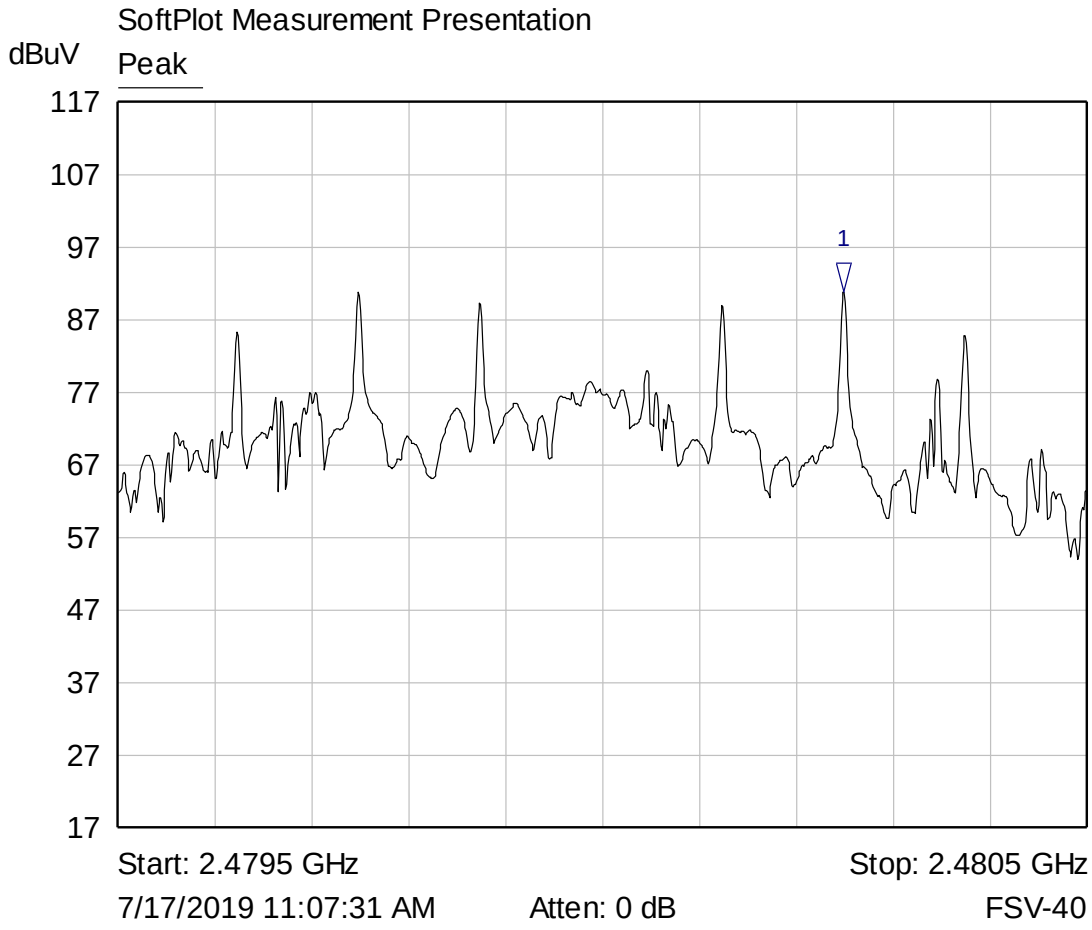
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.4022 GHz	94.19 dBuV	

Graph 11: 2402 MHz Lowest Channel 3 kHz PSD Plot



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.4422 GHz	91.09 dBuV	

Graph 12: 2442 MHz Middle Channel 3 kHz PSD Plot



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Peak	2.4802 GHz	90.92 dBuV	

Graph 13: 2480 MHz Highest Channel Output 3 kHz PSD Plot

-- End of Test Report --