



427 West 12800 South
Draper, UT 84020

Test Report Certification

FCC ID	SWX-LTUL
Equipment Under Test	LTU-Lite
Test Report Serial Number	LTU-Lite_15.407_UNII-1_V 1.1
Dates of Tests	7/21/19 - 7/27/19
Report Issue Date	07/29/2019

Test Specification	Applicant
47 CFR FCC Part 15, Subpart E	Ubiquiti Networks, Inc. 685 Third Avenue, 27 th Floor New York, NY 10019 U.S.A.



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 E. 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 Networks, Inc.
Manufacturer	Ubiquiti Networks, Inc.
Brand Name	LTU
Model Number	LTU-Lite
FCC ID	SWX-LTUL

On this 27th day of July 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.



Written By: Alex Macon



Reviewed By: Mark Feil

Revision History		
Revision	Description	Date
01	Original Report Release	07/29/2019
02	Removed photos and updated footer	07/30/2019

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1 Client Information

1.1 Applicant

Company	Ubiquiti Networks, Inc. 685 Third Avenue, 27 th Floor New York, NY 10017 U.S.A.
Contact Name	Mark Feil
Title	Compliance Manager

1.2 Manufacturer

Company	Ubiquiti Networks, Inc. 685 Third Avenue, 27 th Floor 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-Lite
Serial Number	N/A
Dimensions (cm)	15.4 x 8.4 x 3.95

2.2 Description of EUT

The LTU-L is a fixed point-to-point transceiver, meant for outdoor use, operating in the UNII-1 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.

The UNII-1 transceiver and UNII-3 transceiver use 5 modulation bandwidths with channels spaced 5 MHz apart. Modulation bandwidths of 10 MHz, 20 MHz, 30 MHz, 40 MHz, and 50 MHz are used. There are 2 antennas on the PCB, one vertically polarized and on horizontally polarized, with reflectors. The maximum gain is 12 dBi. The table below show the channels used in each band with the different modulation bandwidths and maximum power settings. This report covers the circuitry of the device subject to FCC Part 15, Subpart E. The circuitry of the device subject to FCC Part 15 Subpart B was found to be compliant.

Band	Modulation Bandwidth	Frequency (MHz)	Maximum Power Setting
UNII-1	10 MHz	5160	TP13
		5165, 5170, 5175, 5180, 5185, 5185, 5190, 5195, 5200, 5205, 5210, 5215, 5220, 5225, 5230, 5235, 5240, 5245	TP16
	20 MHz	5165, 5170	TP2
		5175, 5180	TP6
		5185, 5190, 5195, 5200	TP5
		5205, 5210, 5215, 5220, 5225, 5230, 5235, 5240	TP12
	30 MHz	5170	TP3
		5175	TP8
		5180	TP9
		5185	TP11
		5190, 5195, 5200, 5205, 5210, 5215, 5220, 5225, 5230, 5235	TP12

	40 MHz	5175, 5180	TP1
		5185, 5195, 5200	TP3
		5190, 5205, 5210	TP4
		5215, 5220, 5225, 5230	TP12
	50 MHz	5180	TP1
		5185, 5190, 5195	TP0
		5200, 5205, 5210, 5215, 5220, 5225	TP3
UNII-3	10 MHz	5730, 5735, 5740, 5745, 5750, 5755, 5760, 5765, 5770, 5775, 5780, 5785, 5790, 5795, 5800, 5805, 5810, 5815, 5820, 5825, 5830, 5835, 5840, 5845	TP23
	20 MHz	5735, 5740, 5745, 5750, 5755, 5760, 5765, 5770, 5775, 5780, 5785, 5790, 5795, 5800, 5805, 5810, 5815, 5820, 5825, 5830, 5835, 5840	TP25
	30 MHz	5740, 5745, 5750, 5755, 5760, 5765, 5770, 5775, 5780, 5785, 5790, 5795, 5800, 5805, 5810, 5815, 5820, 5825, 5830, 5835	TP27
	40 MHz	5745, 5750, 5755, 5760, 5765, 5770, 5775, 5780, 5785, 5790, 5795, 5800, 5805, 5810, 5815, 5820, 5825, 5830	TP27
	50 MHz	5750, 5755, 5760, 5765, 5770, 5775, 5780, 5785, 5790, 5795, 5800, 5805, 5810, 5815, 5820, 5825	TP24

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 transmitter was tested while the UNII transceiver was in a constant transmit mode at the upper, middle, and lower channels for each modulation bandwidth and frequency band. The Bluetooth LE transceiver was active while testing the UNII-1 transceiver to assess any transmitter interactions.

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

There were no deviations, opinions, additional information or interpretations from the test specification.

3 Test Specification, Method and Procedures

3.1 Test Specification

Title	47 CFR FCC Part 15, Subpart E, Section 15.407 Limits and methods of measurement of radio interference characteristics of Unlicensed National Information Infrastructure Devices
Purpose of Test	The tests were performed to demonstrate initial compliance

3.2 Methods & Procedures

3.2.1 47 CFR FCC Part 15 Section 15.407

See test standard for details.

3.3 FCC Part 15, Subpart E

3.3.1 Summary of Tests

FCC Section	Environmental Phenomena	Frequency Range (MHZ)	Result
15.407(a)	Antenna requirements	Structural Requirement	Compliant
15.407(b)	Conducted Disturbance at Mains Port	0.15 to 30	Compliant
15.407(c)	Bandwidth Requirement	5150 to 5875	Compliant
15.407(e)	Peak Output Power	5150 to 5875	Compliant
15.407(f)	Antenna Conducted Spurious Emissions	0.009 to 40000	Compliant
15.407(g)	Radiated Spurious Emissions	0.009 to 40000	Compliant
15.407(h)	Peak Power Spectral Density	5150 to 5875	Compliant
The testing was performed according to the procedures in ANSI C63.10-2013, KDB 789033 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

Testing was performed at the Unified Compliance Laboratory located at 427 West 12800 South, Draper, UT 84020. Unified Compliance Laboratory is accredited by National Voluntary Laboratory Accreditation Program (NVLAP); NVLAP Code 600241-0 which is effective until 2020-06-30

The radiated 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

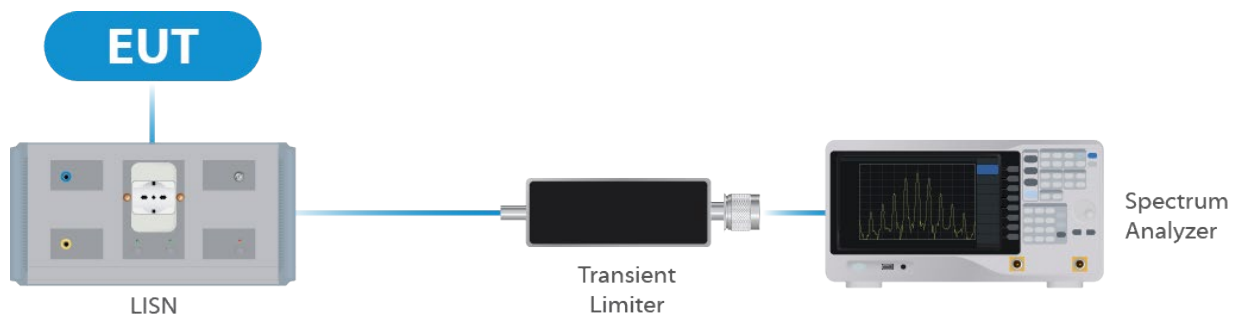


Figure 1: Conducted Emissions Test

4.2 Direct Connect at the Antenna Port Tests

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
Spectrum Analyzer	R&S	FSV40	UCL-2861	06/12/2019	06/12/2020
Signal Generator	R&S	SMB100A	UCL-2864	N/A	N/A
Vector Signal Generator	R&S	SMBV100A	UCL-2873	N/A	N/A
Switch Extension	R&S	OSP-B157WX	UCL-2867	06/13/2019	06/13/2020
Switch Extension	R&S	OSP-150W	UCL-2870	06/14/2019	06/14/2020

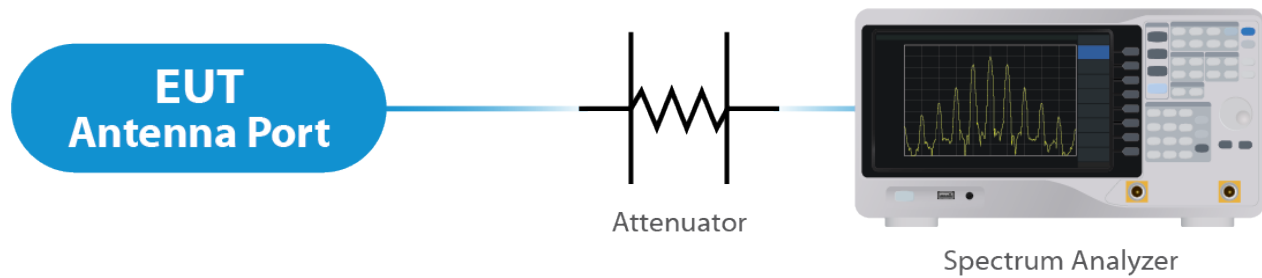


Figure 2: Direct Connect at the Antenna Port Test

4.3 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

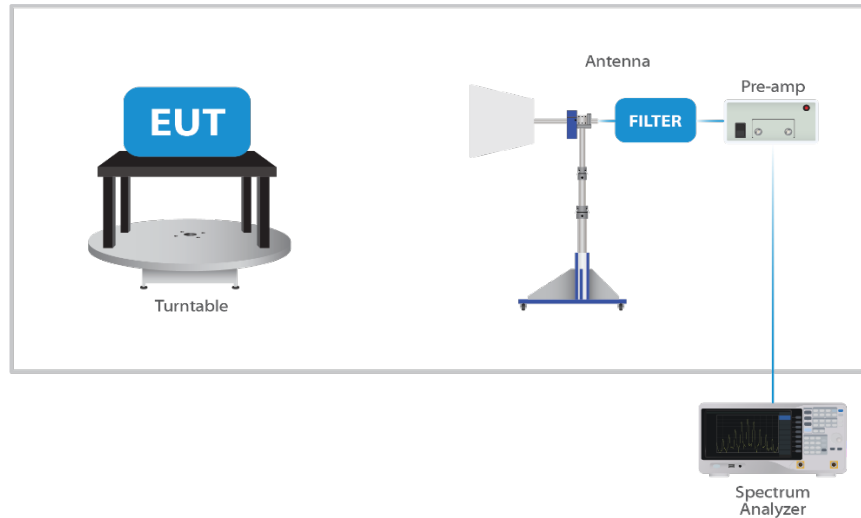


Figure 3: Radiated Emissions Test

4.4 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.

4.5 Measurement Uncertainty

Test	Uncertainty ($\pm$ 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
Direct Connect Tests	K Factor	Value
Emissions Bandwidth	2	2.0%
Output Power	2	1.0 dB
Peak Power Spectral Density	2	1.3 dB
Band Edge	2	0.8 dB
Transmitter Spurious Emissions	2	1.8 dB

5 Test Results

5.1 §15.203 Antenna Requirements

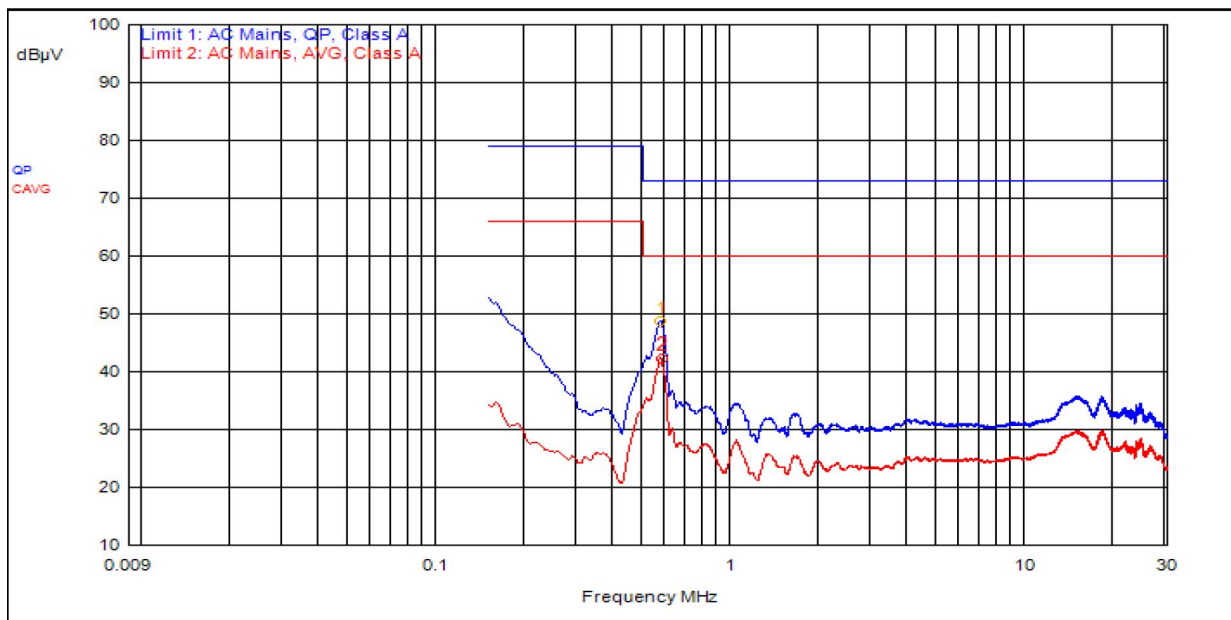
The EUT uses an integral antenna The Maximum gain of the antenna is 12 dBi. The antenna is not user replaceable.

Results

The EUT complied with the specification

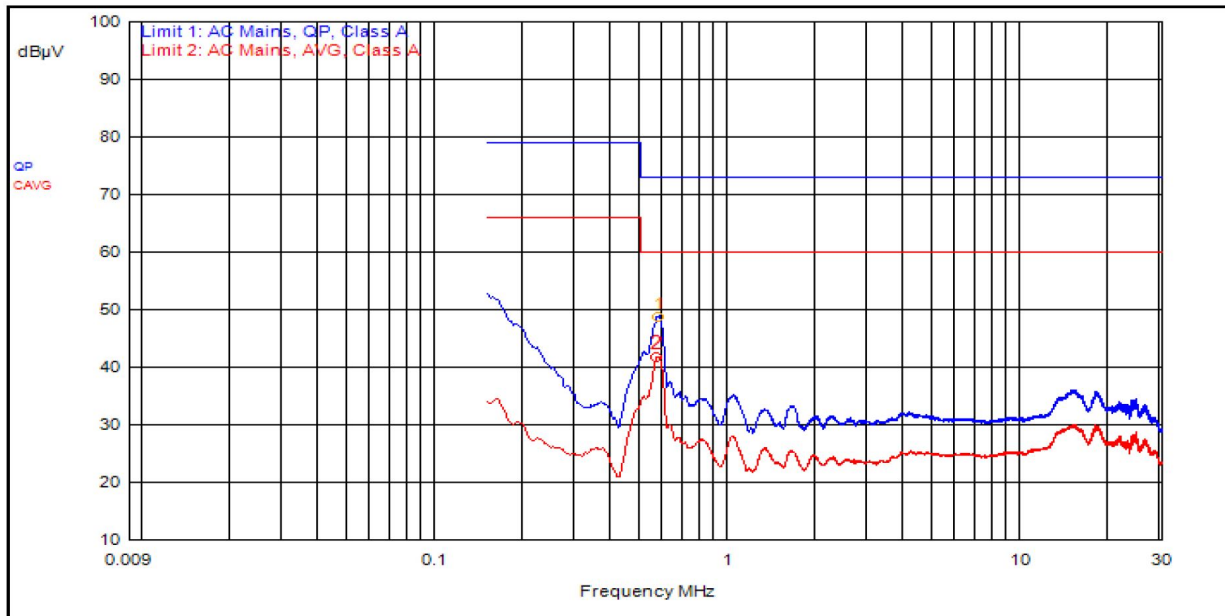
5.2 Conducted Emissions at Mains Ports Data

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 §15.403(i) 26dB Emission Bandwidth

Frequency (MHz)	99% Bandwidth (MHz)	Emissions 26 dB Bandwidth (MHz)
5160	9.45	10.35
5200	9.45	10.5
5245	9.45	10.4

Result

The 26 dB bandwidths are reported for informational purposes. Please see Annex for all bandwidth measurements

5.4 §15.407(a)(1) Maximum Average Output Power

The maximum average RF conducted output power measured for this device was 16.7 dBm or 46.8 mW. The limit is 30 dBm or 1 Watt when using antennas with 23 dBi or less gain. The antenna has a gain of 12 dBi.

Bandwidth	Test Frequency	Data Rate	TP setting	Measured EIRP	Measured PSD
MHz	MHz			dBm	dBm
10	5160	vt0	13	24.2	3.23
	5165		16	27.1	5.87
	5170		16	27.1	5.11
	5200		16	28.3	6.14
	5245		16	28.7	6.1
20	5165	vt0	2	14.2	-9.86
	5200		5	17.4	-6.96
	5240		12	24.2	-0.36
30	5170	vt0	3	14.8	-9.71
	5200		12	23.7	-0.88
	5235		12	24	-1.13
40	5175	vf0	1	13	-12.81
	5200		3	15.3	-10.76
	5230		12	23.8	-2.22
50	5180	vf0	1	13	-13.93
	5200		3	15.1	-11.76
	5225		3	15.4	-11.65

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 in attached Annex).

5.5 §15.407(b)Spurious Emissions

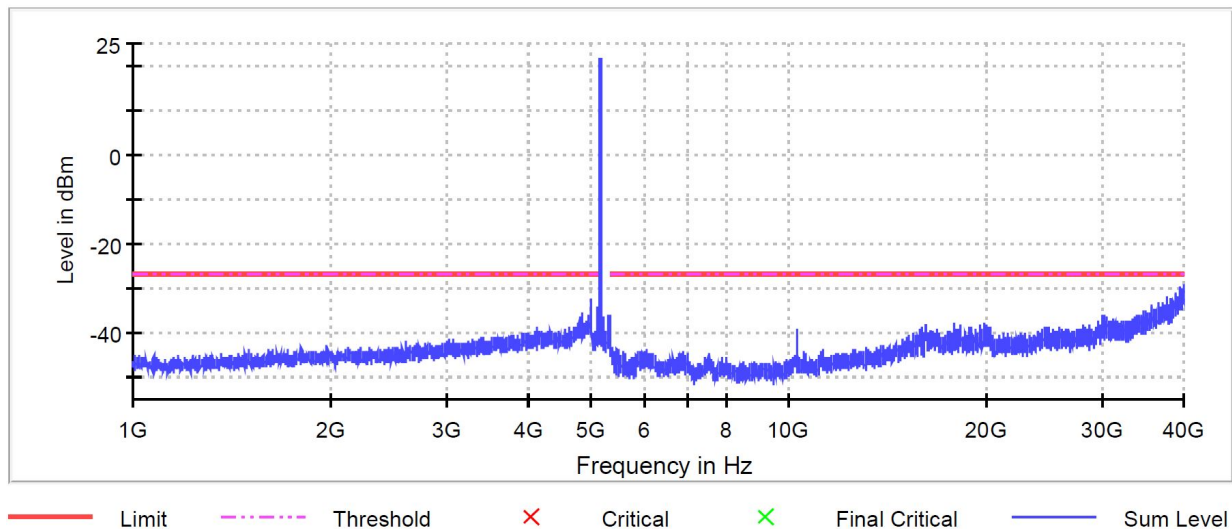
5.5.1 Conducted Spurious Emissions

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 graphs 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 with the antenna gain of 12 dBi accounted for. These demonstrate compliance with the provisions of this section at the band edges.

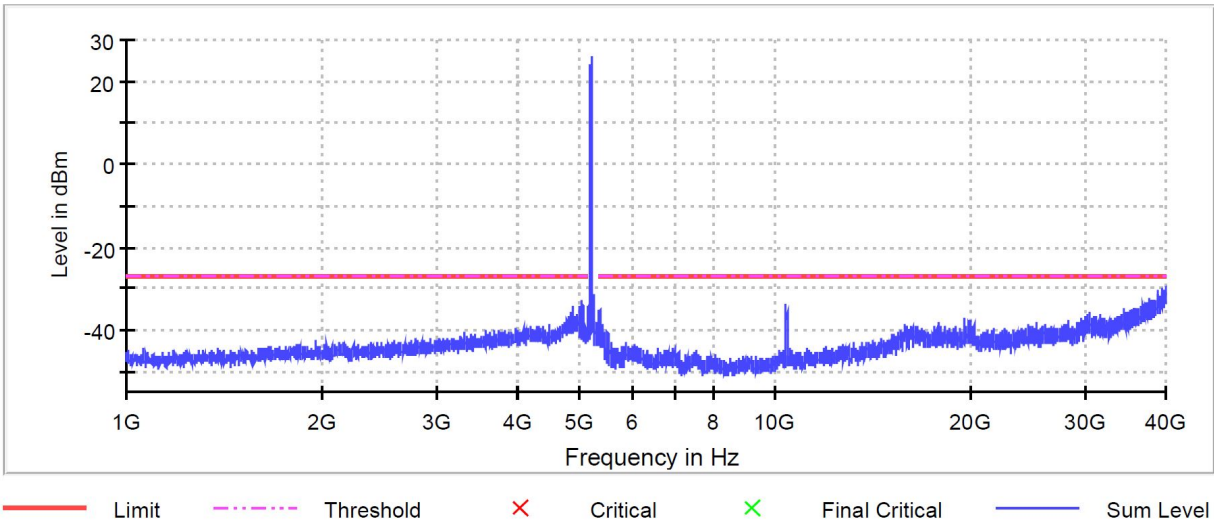
The emissions must be remain below -27 dBm EIRP

Result

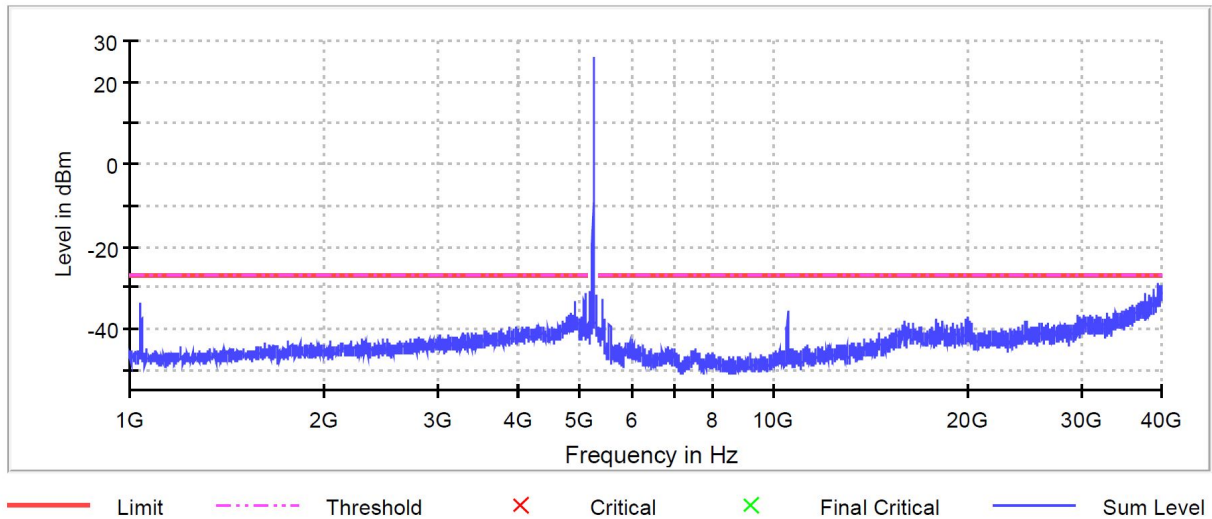
Conducted spurious emissions were below -27dBm; therefore, the EUT complies with the specification.



Item 1: 5160 MHz Transmitting on the Lowest Channel



Item 2: 5200 Transmitting on the Middle Channel



Item 3: 5245MHz Transmitting on the Highest Channel

5.5.2 Radiated Spurious Emissions in the Restricted Bands of §15.205

The EUT uses various power settings based on the channel in use. In order to reduce test time, the radiated spurious emissions at the lowest, middle, and highest channel were measured at the maximum power of TP19, as this setting was found to be worst case for spurious emissions. Power was subsequently reduced during in-band and band edge testing. The band edge at the restricted band ending at 5150 MHz was measured using conducted measurement at the antenna port methods. The worst-case band edge at 5150 MHz is shown for each channel that steps up in power as shown in the table of 2.2. The radiated band edges show the peak emission compared to the average limit.

Result

All emissions in the restricted bands of §15.205 met the limits specified in §15.209; therefore, the EUT complies with the specification. See Annex for Conducted Band edge plots.

Frequency (MHZ)	Antenna Polarity	Detector	Receiver Reading (dBµV)	Amplifier Gain (dB)	Correction Factor (dB)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
15480.0	V	P	31.9	28.9	48.3	51.3	74.0	-22.7
15480.0	V	A	21.2	28.9	48.3	40.6	54.0	-13.4
15480.0	H	P	30.6	28.9	48.3	50.0	74.0	-24.0
15480.0	H	A	20.9	28.9	48.3	40.3	54.0	-13.7

Table 2: Transmitting at the Lowest Frequency 5160MHz

Frequency (MHZ)	Antenna Polarity	Detector	Receiver Reading (dBµV)	Amplifier Gain (dB)	Correction Factor (dB)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
15600.0	V	P	32.5	28.7	48.2	52.0	74.0	-22.0
15600.0	V	A	22.3	28.7	48.2	41.8	54.0	-12.2
15600.0	H	P	32.0	28.7	48.2	51.5	74.0	-22.5
15600.0	H	A	22.0	28.7	48.2	41.5	54.0	-12.5

Table 3: Transmitting at the Middle Frequency 5200 MHz

Frequency (MHZ)	Antenna Polarity	Detector	Receiver Reading (dBµV)	Amplifier Gain (dB)	Correction Factor (dB)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
15735.0	V	P	32.4	28.4	48.2	52.2	74.0	-21.8
15735.0	V	A	21.6	28.4	48.2	41.4	54.0	-12.6
15735.0	H	P	32.1	28.4	48.2	51.9	74.0	-22.1
15735.0	H	A	23.1	28.4	48.2	42.9	54.0	-11.1
9363.0	V	P	53.6	26.9	45.7	72.4	74.0	-1.6
9363.0	V	A	20.5	26.9	45.7	39.3	54.0	-14.7
9363.0	H	P	54.0	26.9	45.7	72.8	74.0	-1.2
9363.0	H	A	17.5	26.9	45.7	36.3	54.0	-17.7

Table 4: Transmitting at the Highest Frequency 5245 MHz

5.6 §15.407(a) Maximum Power Spectral Density

The maximum average power spectral density conducted from the intentional radiator of the antenna shall not be greater than 17 dBm in any 1 MHz band during any time interval of continuous transmission.

Results of this testing are summarized.

Bandwidth	Test Frequency	Data Rate	TP setting	Measured EIRP	Measured PSD
MHz	MHz			dBm	dBm
10	5160	vt0	13	24.2	3.23
10	5165	vt0	16	27.1	5.87
10	5170	vt0	16	27.1	5.11
10	5200	vt0	16	28.3	6.14
10	5245	vt0	16	28.7	6.1
20	5165	vt0	2	14.2	-9.86
20	5200	vt0	5	17.4	-6.96
20	5240	vt0	12	24.2	-0.36
30	5170	vt0	3	14.8	-9.71
30	5200	vt0	12	23.7	-0.88
30	5235	vt0	12	24	-1.13
40	5175	vf0	1	13	-12.81
40	5200	vf0	3	15.3	-10.76
40	5230	vf0	12	23.8	-2.22
50	5180	vf0	1	13	-13.93
50	5200	vf0	3	15.1	-11.76
50	5225	vf0	3	15.4	-11.65

Result

The maximum average power spectral density was less than the limit of 17 dBm; therefore, the EUT complies with the specification.

-- End of Test Report --