RF Test Report

Applicant	:	Plasma Cloud Limited
Product Type	:	WiFi Access Point
Trade Name	:	Plasma Cloud
Model Number	:	PA300, PA300-E
Applicable Standard	:	FCC 47 CFR PART 15 SUBPART C ANSI C63.10:2013
Receive Date	:	Apr. 12, 2019
Test Period	:	May 07 ~ Jun. 04, 2019
Issue Date	:	Jun. 11, 2019

Issue by

A Test Lab Techno Corp.
No. 140-1, Changan Street, Bade District,
Taoyuan City 33465, Taiwan (R.O.C.)
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Taiwan Accreditation Foundation accreditation number: 1330
Test Firm MRA designation number: TW0010

Revision History

Rev.	Issue Date	Revisions	Revised By
00	Jun. 11, 2019	Initial Issue	Tobey Cheng

Verification of Compliance

Issued Date: Jun. 11, 2019

Applicant	:	Plasma Cloud Limited
Product Type	:	WiFi Access Point
Trade Name	:	Plasma Cloud
Model Number	:	PA300, PA300-E
FCC ID	:	2ASXXPA300
EUT Rated Voltage	:	DC 12-24 V, 1 A (DC Power Adapter) DC 24 V, 1 A (passive PoE injector) DC 48-54 V, 0.5 A (PoE injector (802.3af/at))
Test Voltage	:	120 Vac / 60 Hz
Applicable Standard	:	FCC 47 CFR PART 15 SUBPART C ANSI C63.10:2013
Test Result	:	Complied
Performing Lab.	:	A Test Lab Techno Corp. No. 140-1, Changan Street, Bade District, Taoyuan City 33465, Taiwan (R.O.C.) Tel：+886-3-2710188 / Fax：+886-3-2710190 Taiwan Accreditation Foundation accreditation number: 1330 http://www.atl-lab.com.tw/e-index.htm

A Test Lab Techno Corp. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by A Test Lab Techno Corp. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Approved By	: Fly Lu	Reviewed By	: Eric Ou Yang	
(Manager)	(Fly Lu)	(Testing Engineer)	(Eric Ou Yang)	

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1 General Information

1.1. Summary of Test Result

Standard	Item	Result	Remark
FCC			
15.207	AC Power Conducted Emission	PASS	-----
15.247(d)	Transmitter Radiated Emissions	PASS	-----
15.247(b)(3)	Max. Output Power	PASS	-----
15.247(a)(2)	6 dB RF Bandwidth	PASS	-----
15.247(e)	Maximum Power Spectral Density	PASS	-----
15.247(d)	Out of Band Conducted Spurious Emission	PASS	-----
15.203	Antenna Requirement	PASS	-----

The test results of this report relate only to the tested sample(s) identified in this report.

Standard	Description
CFR47, Part 15, Subpart C	Intentional Radiators
ANSI C63. 10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
KDB 558074 D01 15.247 Meas Guidance v05r02	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES

1.2. Measurement Uncertainty

Test Item	Frequency Range	Uncertainty (dB)
Conducted Emission	9 kHz ~ 150 kHz	2.7
	150 kHz ~ 30 MHz	2.7
Radiated Emission	9 kHz ~ 30 MHz	1.7
	30 MHz ~ 1000 MHz	5.7
	1000 MHz ~ 18000 MHz	5.5
	18000 MHz ~ 26500 MHz	4.8
	26500 MHz ~ 40000 MHz	4.8
Conducted Output Power	+0.27 dB / -0.28 dB	
RF Bandwidth	4.96 %	
Power Spectral Density	+0.71 dB / -0.77 dB	

2 EUT Description

<table>
<tr><td>Applicant</td><td colspan="5">Plasma Cloud Limited
5/F, Yat Chau Building 262 Des Voeux Road Central Hong Kong</td></tr>
<tr><td>Manufacturer</td><td colspan="5">Emplus Technologies, Inc.
Bldg. B, 10F., No.209, Sec. 1, Nangang Rd., Nangang Dist., Taipei City 11568, Taiwan</td></tr>
<tr><td>Product Type</td><td colspan="5">WiFi Access Point</td></tr>
<tr><td>Trade Name</td><td colspan="5">Plasma Cloud</td></tr>
<tr><td>Model Number</td><td colspan="5">PA300, PA300-E</td></tr>
<tr><td>Model Different Description</td><td colspan="5">PA300: built-in antenna
PA300-E: External antenna</td></tr>
<tr><td>FCC ID</td><td colspan="5">2ASXXPA300</td></tr>
<tr><td>Operate Freq. Band</td><td>Frequency Range (MHz)</td><td colspan="2">Modulation</td><td>Channel Bandwidth</td><td>Data Rate 400 / 800 GI (ns)</td></tr>
<tr><td>IEEE 802.11b</td><td>2412 ~ 2462</td><td colspan="2">DSSS</td><td>20 MHz</td><td>Up to 11 Mbps</td></tr>
<tr><td>IEEE 802.11g</td><td>2412 ~ 2462</td><td colspan="2">OFDM</td><td>20 MHz</td><td>Up to 54 Mbps</td></tr>
<tr><td>IEEE 802.11n 2.4 GHz 20 MHz</td><td>2412 ~ 2462</td><td colspan="2">OFDM</td><td>20 MHz</td><td>Up to 173.4 Mbps</td></tr>
<tr><td>IEEE 802.11n 2.4 GHz 40 MHz</td><td>2422 ~ 2452</td><td colspan="2">OFDM</td><td>40 MHz</td><td>Up to 400 Mbps</td></tr>
<tr><td rowspan="6">Antenna information</td><td colspan="5">Model: PA300: built-in antenna</td></tr>
<tr><td>ANT</td><td>Manufacturer</td><td>Model Number</td><td>Type</td><td>Max. Gain (dBi)</td></tr>
<tr><td>ANT-0</td><td>SENAO</td><td>5718A0436300</td><td>PIFA Antenna</td><td>3.1</td></tr>
<tr><td>ANT-1</td><td>SENAO</td><td>5718A0437300</td><td>PIFA Antenna</td><td>3.5</td></tr>
<tr><td colspan="5">Model: PA300-E: External antenna</td></tr>
<tr><td>ANT</td><td>Manufacturer</td><td>Model Number</td><td>Type</td><td>Max. Gain (dBi)</td></tr>
<tr><td>ANT-0</td><td>Master Wave</td><td>98143MRSX000</td><td>Dipole Antenna (Reverse SMA)</td><td>5.17</td></tr>
<tr><td>ANT-1</td><td>Master Wave</td><td>98143MRSX000</td><td>Dipole Antenna (Reverse SMA)</td><td>5.17</td></tr>
<tr><td>Antenna Delivery</td><td colspan="5">See section 3.1</td></tr>
<tr><td>Operate Temp. Range</td><td colspan="5">0 ~ +40 ℃</td></tr>
</table>

Model: PA300: built-in antenna	
Frequency Band	Max. RF Output Power (W)
IEEE 802.11b	0.364
IEEE 802.11g	0.378
IEEE 802.11n 2.4 GHz 20 MHz	0.365
IEEE 802.11n 2.4 GHz 40 MHz	0.345

Model: PA300-E: External antenna	
Frequency Band	Max. RF Output Power (W)
IEEE 802.11b	0.398
IEEE 802.11g	0.055
IEEE 802.11n 2.4 GHz 20 MHz	0.055
IEEE 802.11n 2.4 GHz 40 MHz	0.399

3 Test Methodology

3.1. Mode of Operation

Decision of Test ATL has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Test Mode
Mode 1: Transmit mode
Mode 2: IEEE 802.11b Continuous TX mode
Mode 3: IEEE 802.11g Continuous TX mode
Mode 4: IEEE 802.11n 2.4 GHz 20 MHz Continuous TX mode
Mode 5: IEEE 802.11n 2.4 GHz 40 MHz Continuous TX mode

Software used to control the EUT for staying in continuous transmitting mode was programmed.

After verification, all tests were carried out with the worst case test modes.

Model: PA300: built-in antenna			
Test Mode	ANT-0	ANT-1	ANT-0+1
Mode 2	V	V	V
Mode 3	V	V	V
Mode 4	V	V	V
Mode 5	V	V	V

Test Mode	Antenna Delivery	Data Rate (Mbps)	Test Channel
Mode 2	2TX(CDD)	1	1, 6, 11
Mode 3	2TX(CDD)	6	1, 6, 11
Mode 4	2TX(CDD)	13	1, 6, 11
Mode 5	2TX(CDD)	27	3, 6, 9

Model: PA300-E: External antenna			
Test Mode	ANT-0	ANT-1	ANT-0+1
Mode 2	V	V	V
Mode 3	V	V	V
Mode 4	V	V	V
Mode 5	V	V	V

Test Mode	Antenna Delivery	Data Rate (Mbps)	Test Channel
Mode 2	2TX(CDD)	1	1, 6, 11
Mode 3	2TX(CDD)	6	1, 6, 11
Mode 4	2TX(CDD)	13	1, 6, 11
Mode 5	2TX(CDD)	27	3, 6, 9

Duty cycle

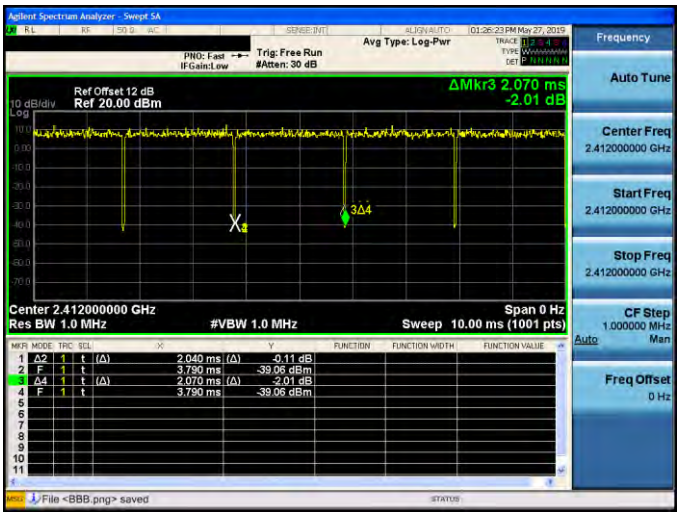
Model: PA300: built-in antenna						
Test Mode	Frequency (MHz)	on time (ms)	on+off time (ms)	Duty cycle	Duty Factor (dB)	1/T Minimum VBW (kHz)
Mode 2	2412.0	10.000	10.000	1.000	0.000	0.010
Mode 3	2412.0	2.040	2.070	0.986	0.063	0.010
Mode 4	2412.0	0.980	1.020	0.961	0.174	1.020
Mode 5	2422.0	0.494	0.526	0.939	0.273	2.024

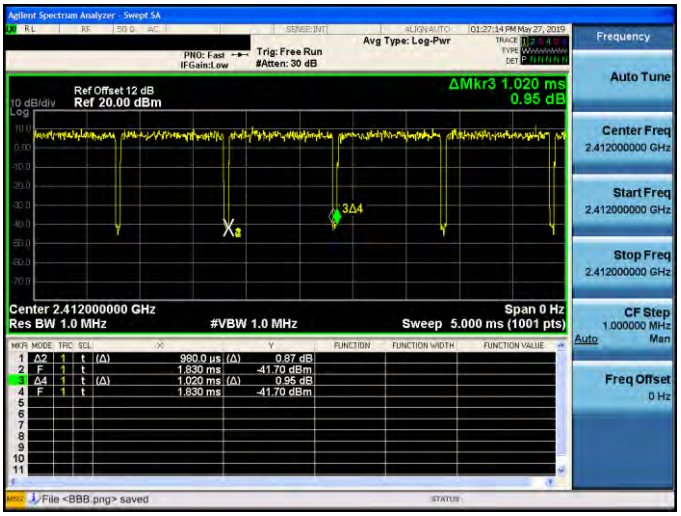
Model: PA300-E: External antenna						
Test Mode	Frequency (MHz)	on time (ms)	on+off time (ms)	Duty cycle	Duty Factor (dB)	1/T Minimum VBW (kHz)
Mode 2	2412.0	10.000	10.000	1.000	0.000	0.010
Mode 3	2412.0	2.040	2.070	0.986	0.063	0.010
Mode 4	2412.0	0.980	1.020	0.961	0.174	1.020
Mode 5	2422.0	0.494	0.526	0.939	0.273	2.024

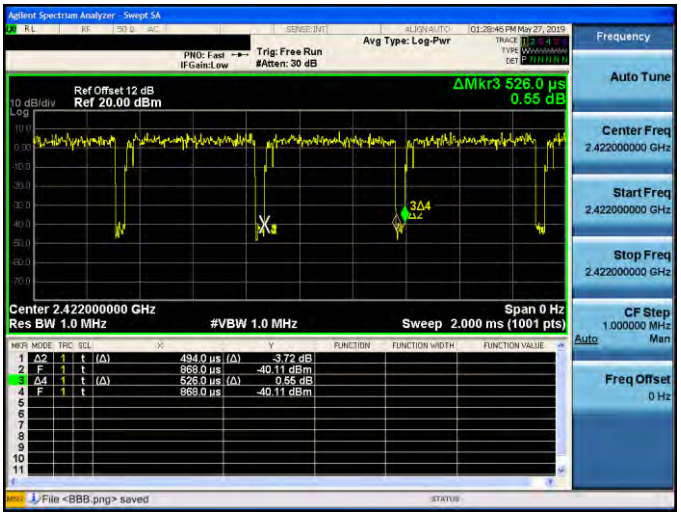
Duty Cycle Graphs

Model: PA300: built-in antenna

Mode 2: IEEE 802.11b Continuous TX mode

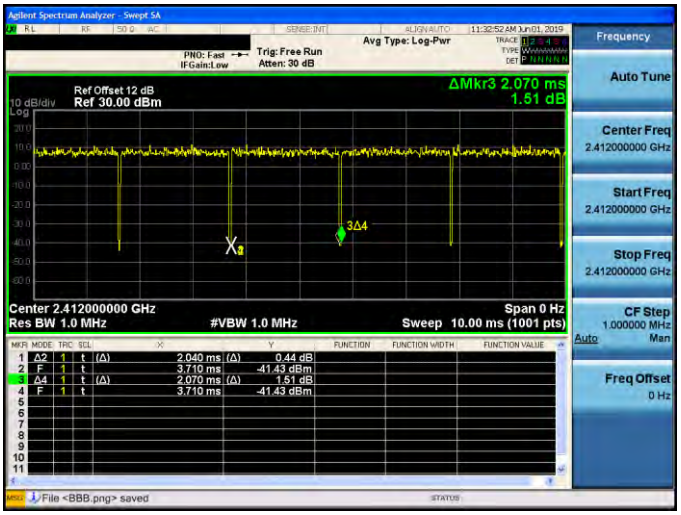

Mode 3: IEEE 802.11g Continuous TX mode


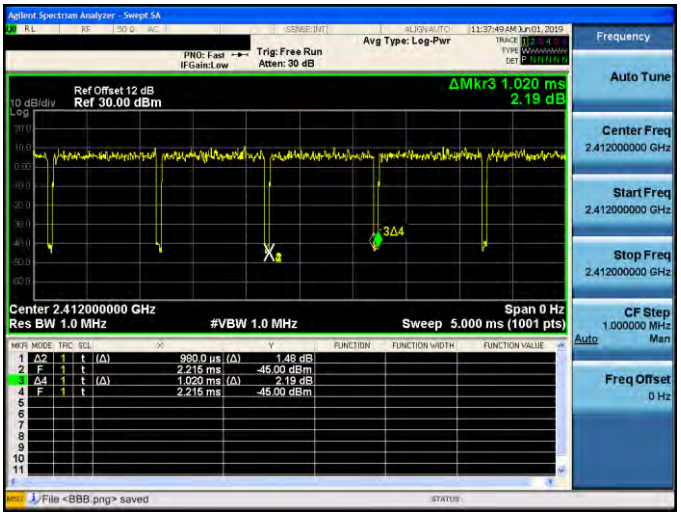
Mode 4: IEEE 802.11n 2.4 GHz 20 MHz Continuous TX mode


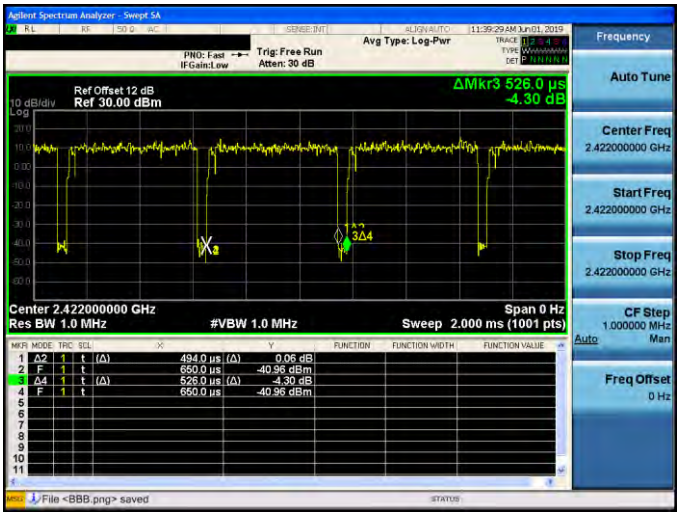
Mode 5: IEEE 802.11n 2.4 GHz 40 MHz Continuous TX mode


Model: PA300-E: External antenna

Mode 2: IEEE 802.11b Continuous TX mode


Mode 3: IEEE 802.11g Continuous TX mode


Mode 4: IEEE 802.11n 2.4 GHz 20 MHz Continuous TX mode


Mode 5: IEEE 802.11n 2.4 GHz 40 MHz Continuous TX mode


3.2. EUT Test Step

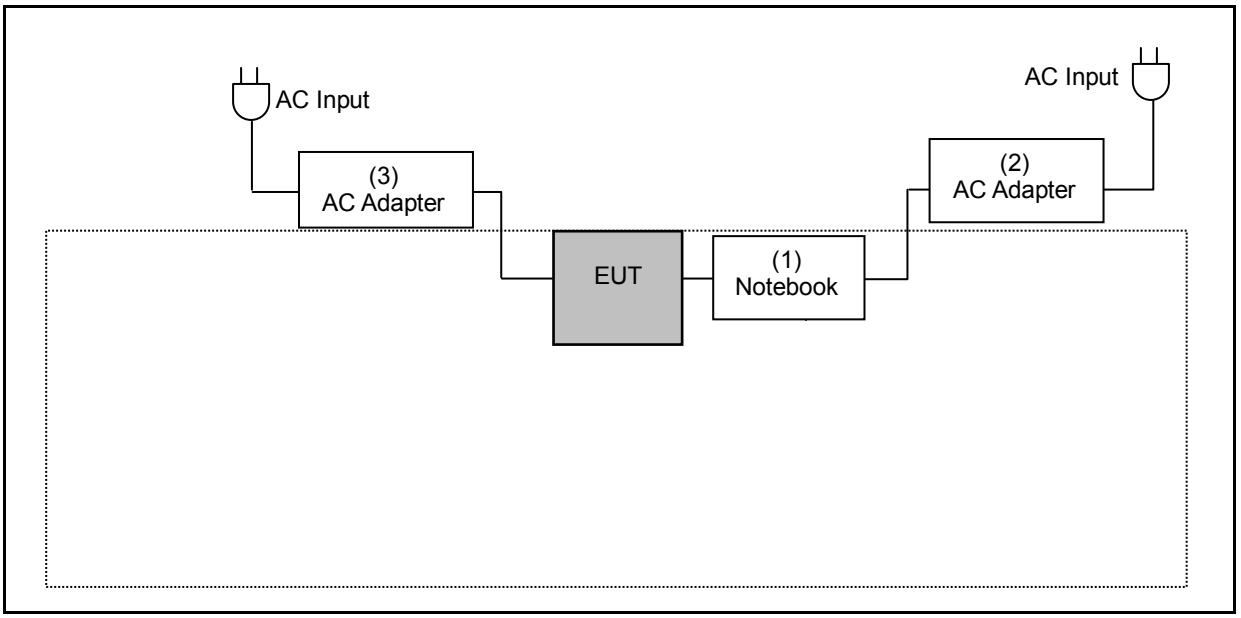
1.	Setup the EUT shown on “Configuration of Test System Details”.
2.	Turn on the power of all equipment.
3.	Turn Wi-Fi function link to Notebook.
4.	EUT run test program.

Measurement Software			
No.	Description	Software	Version
1	Conducted Emission	EZ EMC	1.1.4.3
2	Radiated Emission	EZ EMC	1.1.4.4

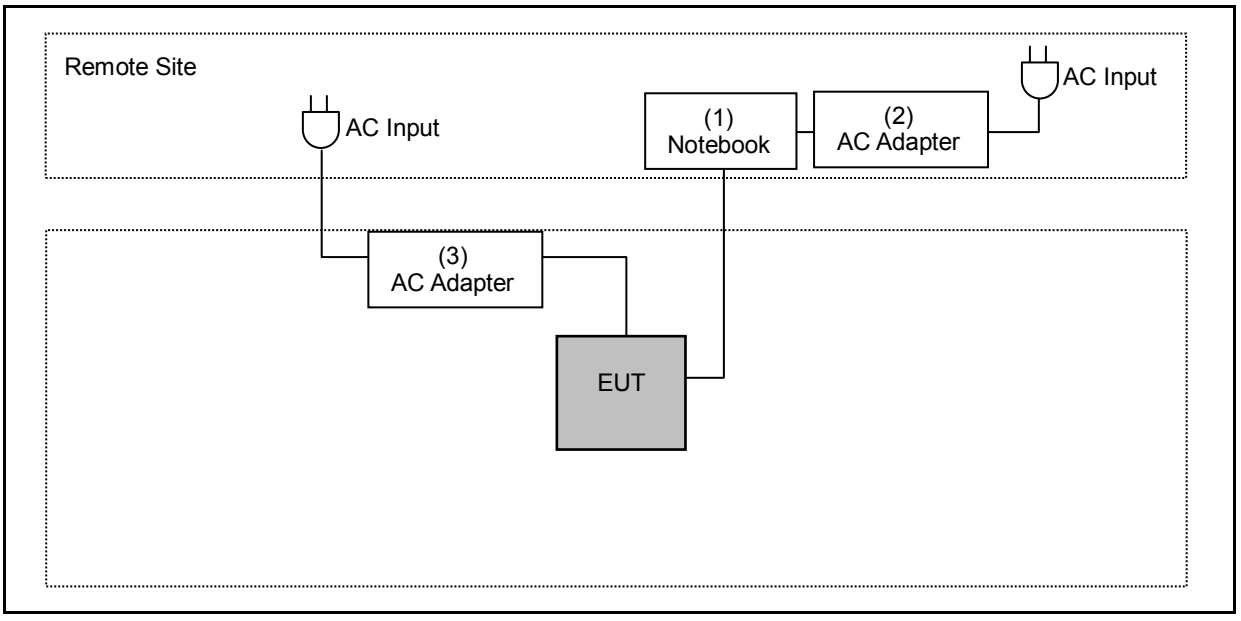
3.3. Configuration of Test System Details

Model: PA300: built-in antenna

Conducted Emissions

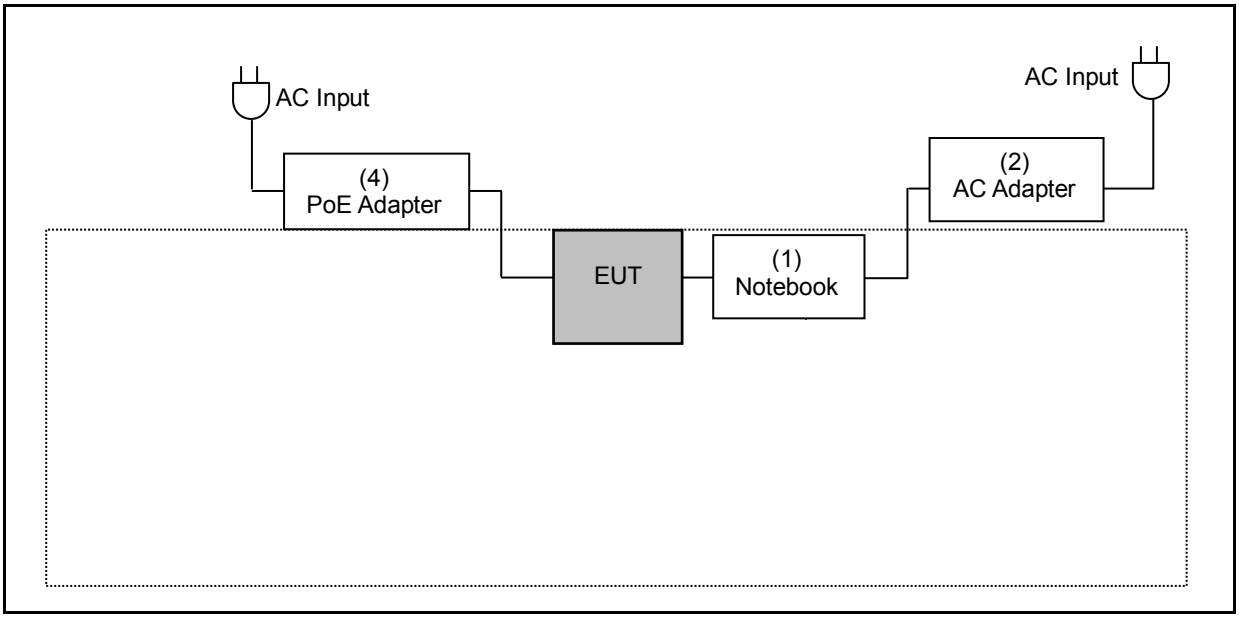


Radiated Emissions

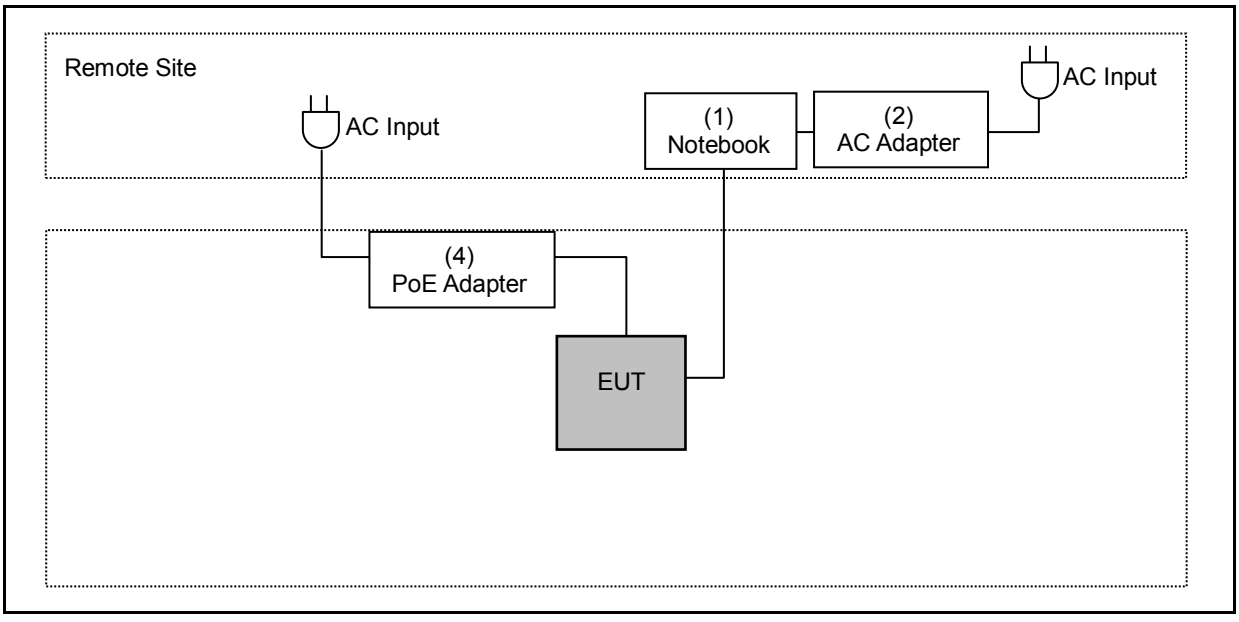


Model: PA300-E: External antenna

Conducted Emissions



Radiated Emissions



Devices Description					
Product		Manufacturer	Model Number	Serial Number	Power Cord
(1)	Notebook	ASUS	P2430U	GANXCV04H86940A	---
(2)	AC Adapter	ASUS	ADP-65GD B	---	Non-Shielded, 0.8 m
(3)	AC Adapter	Powertron Electronics Corp.	PA1024 -120HUB200	---	---
(4)	PoE Adapter	EnGenius	EPA2406GR	177214704	Non-Shielded, 1.0 m

3.4. Test Instruments

For Conducted Emission

Test Period: Jun. 04, 2019

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
Test Receiver	R&S	ESCI	100367	05/23/2019	1 year
LISN	R&S	ENV216	101040	04/03/2019	1 year
LISN	R&S	ENV216	101041	03/28/2019	1 year
RF Cable	Woken	00100D1380194M	TE-02-03	05/23/2019	1 year

For Radiated Emissions

Test Period: May 07 ~ May 28, 2019

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
EXA Signal Analyzer	Keysight	N9010A	MY52221312	01/14/2019	1 year
Amplifier	Agilent	8449B	3008A02237	10/16/2018	1 year
Amplifier	Agilent	8447D	2944A11119	01/14/2019	1 year
Trilog Broadband Antenna	Schwarzbeck Mess-Elektronik	VULB9168	416	10/23/2018	1 year
Horn Antenna (1~18 GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA9120D	9120D-550	08/23/2018	1 year
Horn Antenna (18~40 GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA9170	9170-320	08/07/2018	1 year

For Conducted

Test Period: May 27 ~ Jun. 01, 2019

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
Spectrum Analyzer (20 Hz~26.5 GHz)	Agilent	N9020A	US47520902	09/25/2018	1 year
Power Sensor	Anritsu	MA2411B	1126022	08/29/2018	1 year
Power Meter	Anritsu	ML2495A	1135009	08/29/2018	1 year

Note: N.C.R. = No Calibration Request.

3.5. Test Site Environment

Items	Required (IEC 60068-1)	Actual
Temperature (°C)	15-35	26
Humidity (%RH)	25-75	60
Barometric pressure (mbar)	860-1060	990

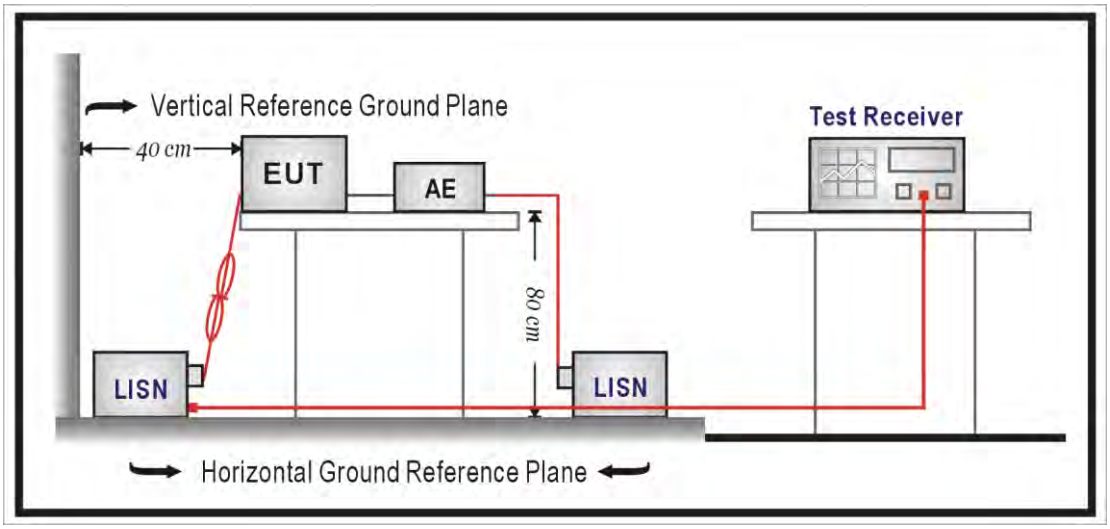
4 Measurement Procedure

4.1. AC Power Line Conducted Emission Measurement

■ **Limit**

Frequency (MHz)	Quasi-peak	Average
0.15 - 0.5	66 to 56	56 to 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

■ **Test Setup**



■ **Test Procedure**

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 Ω// 50 uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50 Ω// 50 uH coupling impedance with 50 ohm termination.

Tabletop device shall be placed on a non-conducting platform, of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The wall of screened room shall be located 40 cm to the rear of the EUT. Other surfaces of tabletop or floor standing EUT shall be at least 80 cm from any other ground conducting surface including one or more LISNs. For floor-standing device shall be placed under the EUT with a 12 mm insulating material.

Conducted emissions were investigated over the frequency range from 0.15 MHz to 30 MHz using a resolution bandwidth of 9 kHz. The equipment under test (EUT) shall be meet the limits in section 4.1, as applicable, including the average limit and the quasi-peak limit when using respectively, an average detector and quasi-peak detector measured in accordance with the methods described of related standard. When all of peak value were complied with quasi-peak and average limit from 150 kHz to 30 MHz then quasi-peak and average measurement was unnecessary.

The AMN shall be placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for AMNs mounted on top of the ground reference plane. This distance is between the closest points of the AMN and the EUT. All other units of the EUT and associated equipment shall be at least 0.8 m from the AMN. If the mains power cable is longer than 1 m then the cable shall be folded back and forth at the centre of the lead to form a bundle no longer than 0.4 m. All of interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long. All of EUT and AE shall be separate place more than 0.1 m. All 50 Ω ports of the LISN shall be resistively terminated into 50 Ω loads when not connected to the measuring instrument.

If the reading of the measuring receiver shows fluctuations close to the limit, the reading shall be observed for at least 15 s at each measurement frequency; the higher reading shall be recorded with the exception of any brief isolated high reading which shall be ignored.

4.2. Radiated Emission Measurement

■ **Limit**

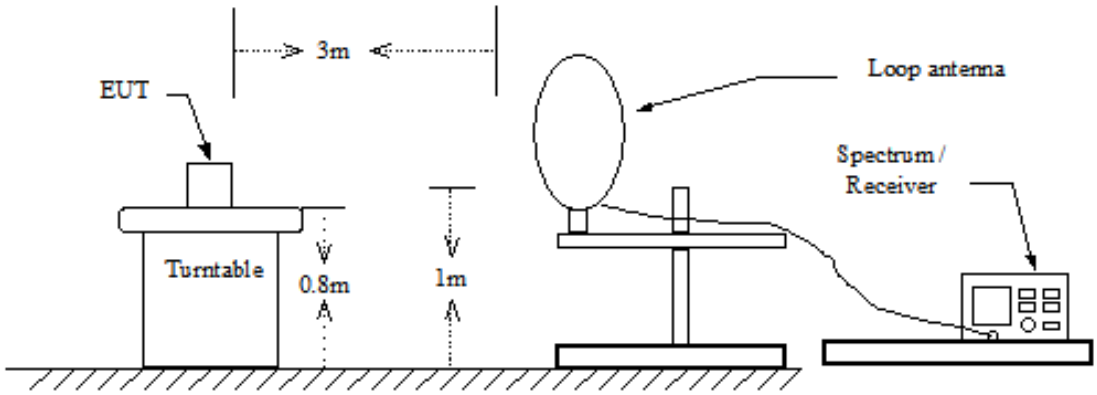
According to §15.209(a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μV/m at meter)	Measurement Distance (meters)
0.009 – 0.490	2400 / F (kHz)	300
0.490 – 1.705	24000 / F (kHz)	30
1.705 – 30.0	30	30
30 - 88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

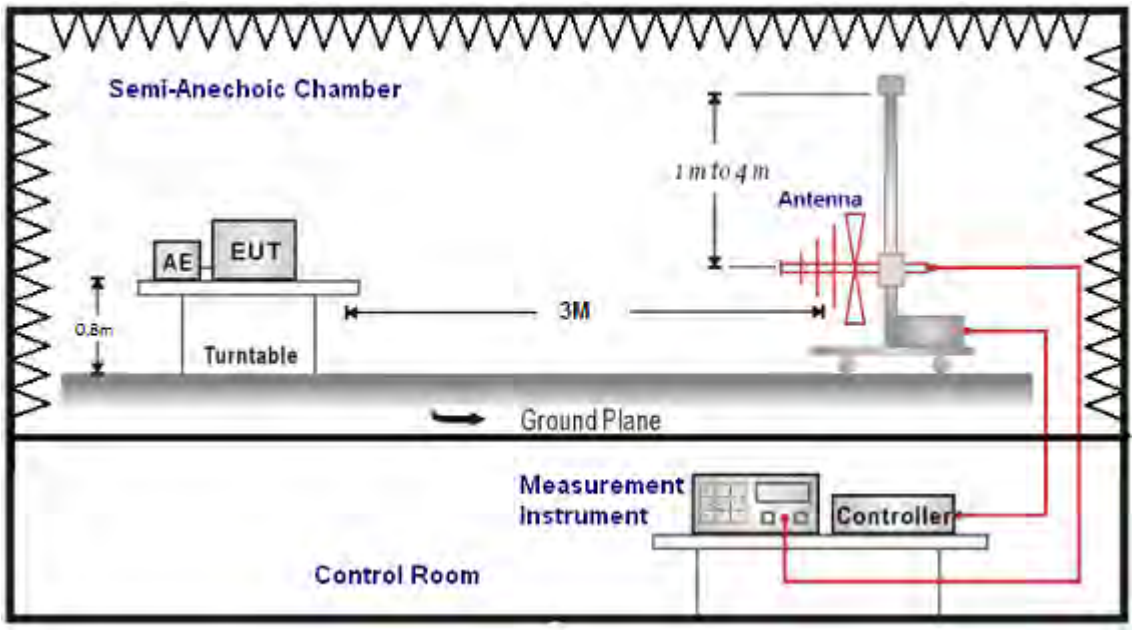
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

■ **Setup**

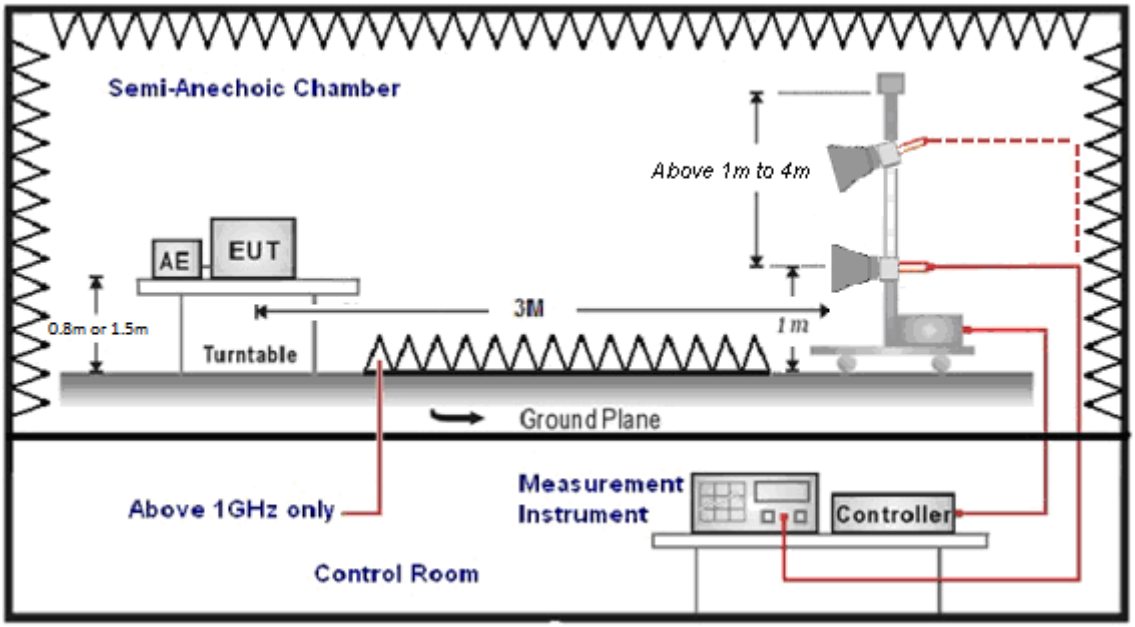
9 kHz ~ 30 MHz



Below 1 GHz



Above 1 GHz



■ **Test Procedure**

Final radiation measurements were made on a three-meter, Semi Anechoic Chamber. The EUT system was placed on a nonconductive turntable which is 0.8 or 1.5 meters height, top surface 1.0 x 1.5 meter. The spectrum was examined from 250 MHz to 2.5 GHz in order to cover the whole spectrum below 10th harmonic which could generate from the EUT. During the test, EUT was set to transmit continuously & Measurements spectrum range from 9 kHz to 26.5 GHz is investigated.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 3 MHz for peak measurements and 10 Hz for average measurements when Duty cycle >0.98 / 1/T for average measurements when Duty cycle <0.98. A nonconductive material surrounded the EUT to supporting the EUT for standing on tree orthogonal planes. At each condition, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters to find the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarization.

SCHWARZBECK MESS-ELEKTRONIK Biconilog Antenna at 3 Meter and the SCHWARZBECK Double Ridged Guide Antenna was used in frequencies 1 –26.5 GHz at a distance of 3 meter. The antenna at an angle toward the source of the emission. All test results were extrapolated to equivalent signal at 3 meters utilizing an inverse linear distance extrapolation Factor (20 dB/decade).

For testing above 1 GHz, the emission level of the EUT in peak mode was 20 dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

Appropriate preamplifiers were used for improving sensitivity and precautions were taken to avoid overloading or desensitizing the spectrum analyzer. No post – detector video filters were used in the test.

The spectrum analyzer's 6 dB bandwidth was set to 1 MHz, and the analyzer was operated in the peak detection mode, for frequencies both below and up 1 GHz. The average levels were obtained by subtracting the duty cycle correction factor from the peak readings.

The following procedures were used to convert the emission levels measured in decibels referenced to 1 microvolt (dBuV) into field intensity in micro volts pre meter (uV/m).

The actual field intensity in decibels referenced to 1 microvolt in to field intensity in micro colts per meter (dBuV/m).

The actual field is intensity in referenced to 1 microvolt per meter (dBuV/m) is determined by algebraically adding the measured reading in dBuV, the antenna factor (dB), and cable loss (dB) and Subtracting the gain of preamplifier (dB) is auto calculate in spectrum analyzer.

(1) Amplitude (dBuV/m) = FI (dBuV) +AF (dBuV) +CL (dBuV)-Gain (dB)
FI= Reading of the field intensity.
AF= Antenna factor.
CL= Cable loss.
P.S Amplitude is auto calculate in spectrum analyzer.

(2) Actual Amplitude (dBuV/m) = Amplitude (dBuV)-Dis(dB)
The FCC specified emission limits were calculated according the EUT operating frequency and by following linear interpolation equations:
(a) For fundamental frequency : Transmitter Output < +30 dBm
(b) For spurious frequency : Spurious emission limits = fundamental emission limit /10

Data of measurement within this frequency range without mark in the table above means the reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.

4.3. Maximum Conducted Output Power Measurement

■ **Limit**

For systems using digital modulation in the 2400-2483.5 MHz, the limit for maximum output power is 30 dBm.

And According to 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Model: PA300: built-in antenna

IEEE 802.11b / IEEE 802.11g / IEEE 802.11n 2.4 GHz 20 MHz / IEEE 802.11n 2.4 GHz 40 MHz

∗ Directional Gain = 10*log{[10^(G1/10)+10^(G2/10)+⋯+10^(Gn/10)]/NANT} = 3.30 dBi < 6dBi

∗ Directional= G_{ANT} : 3.30 dBi

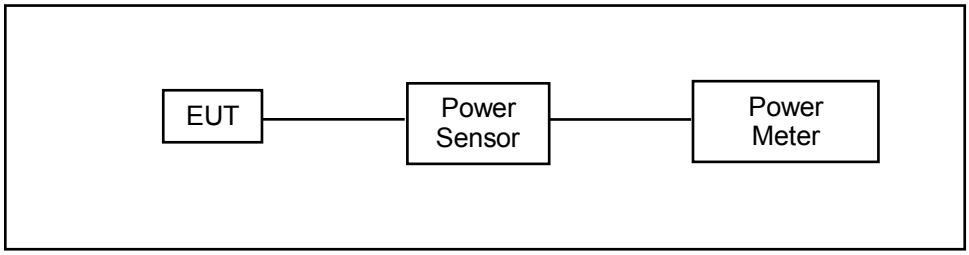
Model: PA300-E: External antenna

IEEE 802.11b / IEEE 802.11g / IEEE 802.11n 2.4 GHz 20 MHz / IEEE 802.11n 2.4 GHz 40 MHz

∗ Directional Gain = 10*log{[10^(G1/10)+10^(G2/10)+…+10^(Gn/10)]/NANT} = 5.17 dBi < 6dBi

∗ Directional= G_{ANT} : 5.17 dBi

■ **Test Setup**



■ **Test Procedure**

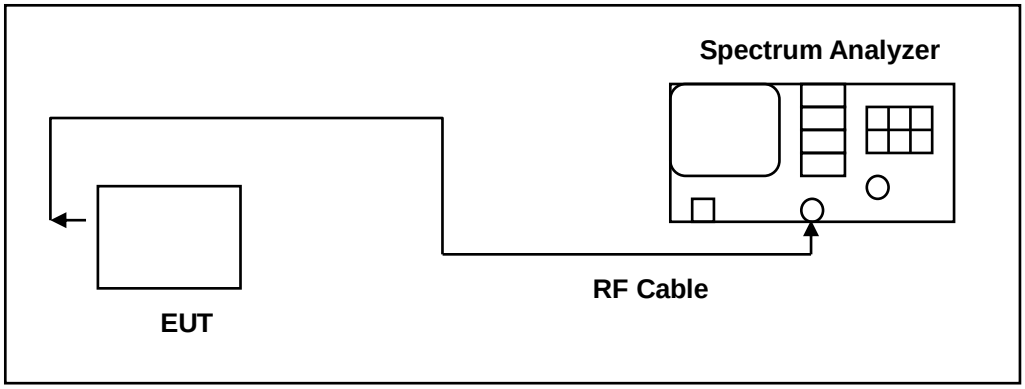
The tests below are run with the EUT's transmitter set at high power in TX mode. The EUT is needed to force selection of output power level and channel number. While testing, EUT was set to transmit continuously. Remove the Subjective device's antenna and connect the RF output port to power sensor.

4.4. 6 dB RF Bandwidth Measurement

■ **Limit**

6 dB RF Bandwidth: Systems using digital modulation techniques may operate in the 2400–2483.5 MHz bands. The minimum 6 dB band-width shall be at least 500 kHz.

■ **Test Setup**



■ **Test Procedure**

The EUT tested to DTS test procedure of ANSI C63.10:2013 section 11.8.2 option2 for compliance to FCC 47CFR 15.247 requirements.

6 dB RF Bandwidth: The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RBW was set to 100 kHz. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A peak output reading was taken, a DISPLAY line was drawn 6 dB lower than peak level. The 6 dB bandwidth was determined from where the channel output spectrum intersected the display line.

The test was performed at 3 channels (Channel low, middle, high)

4.5. Maximum Power Density Measurement

■ **Limit**

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.

Model: PA300: built-in antenna

IEEE 802.11b / IEEE 802.11g / IEEE 802.11n 2.4 GHz 20 MHz / IEEE 802.11n 2.4 GHz 40 MHz

∗ Directional Gain = 10*log{[10^(G1/20)+10^(G2/20)+…+10^(Gn/20)]^2/NANT} = 6.31 dBi > 6dBi

∗ Conducted Power Spectral Density Limit = 8 - 0.31 = 7.69 dBm/3 KHz

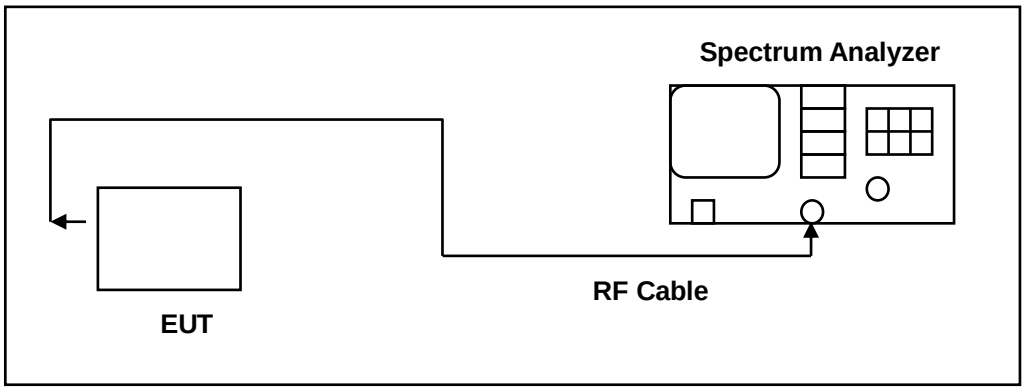
Model: PA300-E: External antenna

IEEE 802.11b / IEEE 802.11g / IEEE 802.11n 2.4 GHz 20 MHz / IEEE 802.11n 2.4 GHz 40 MHz

∗ Directional Gain = 10*log{[10^(G1/20)+10^(G2/20)+…+10^(Gn/20)]^2/NANT} = 8.18 dBi > 6dBi

∗ Conducted Power Spectral Density Limit = 8 - 2.18 = 5.82 dBm/3 KHz

■ **Test Setup**



■ **Test Procedure**

The EUT tested to DTS test procedure of ANSI C63.10:2013 section 11.10.2 for compliance to FCC 47CFR 15.247 requirements.

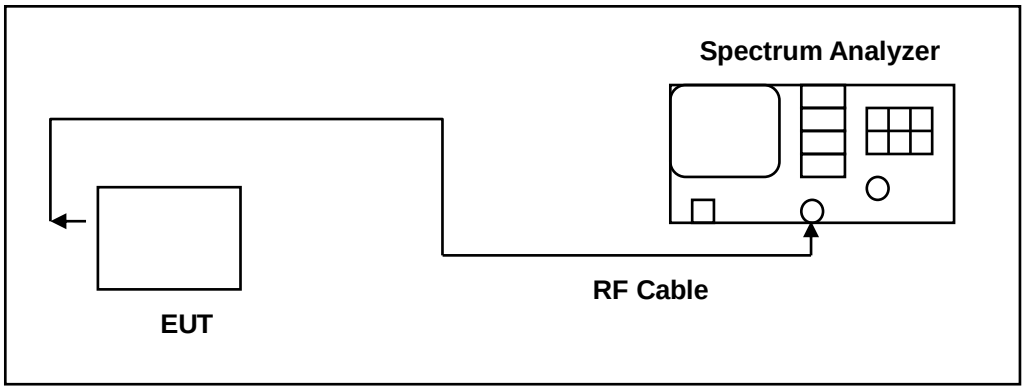
1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
4. Set the VBW ≥ 3 × RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

4.6. Out of Band Conducted Emissions Measurement

■ **Limit**

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

■ **Test Setup**



■ **Test Procedure**

In any 100 kHz bandwidth outside the EUT pass band, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20 dB below that of the maximum in-band 100 kHz emission, antenna output of the EUT was coupled directly to spectrum analyzer; if an external attenuator and/or cable was used, these losses are compensated for with the analyzer OFFSET function.
All other types of emissions from the EUT shall meet the general limits for radiated frequencies outside the pass band.
The test was performed at 3 channels.

4.7. Antenna Measurement

- **Limit**

For intentional device, according to 15.203, 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.

And According to 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

- **Antenna Description**

See section 2 – antenna information.

■ **Directional Gain Calculated**

Model: PA300: built-in antenna

For Maximum Conducted Output Power

Directional Gain = 10*log{[10^(G1/10)+10^(G2/10)+⋯+10^(Gn/10)]/NANT}

Operate Freq. Band	Directional Gain (dBi)
IEEE 802.11b	3.30
IEEE 802.11g	3.30
IEEE 802.11n 2.4 GHz 20 MHz	3.30
IEEE 802.11n 2.4 GHz 40 MHz	3.30

For Maximum Power Density

Directional Gain = 10*log{[10^(G1/20)+10^(G2/20)+⋯+10^(Gn/20)]^2/NANT}

Operate Freq. Band	Directional Gain (dBi)
IEEE 802.11b	6.31
IEEE 802.11g	6.31
IEEE 802.11n 2.4 GHz 20 MHz	6.31
IEEE 802.11n 2.4 GHz 40 MHz	6.31

Model: PA300-E: External antenna

For Maximum Conducted Output Power

Directional Gain = 10*log{[10^(G1/10)+10^(G2/10)+⋯+10^(Gn/10)]/NANT}

Operate Freq. Band	Directional Gain (dBi)
IEEE 802.11b	5.17
IEEE 802.11g	5.17
IEEE 802.11n 2.4 GHz 20 MHz	5.17
IEEE 802.11n 2.4 GHz 40 MHz	5.17

For Maximum Power Density

Directional Gain = 10*log{[10^(G1/20)+10^(G2/20)+⋯+10^(Gn/20)]^2/NANT}

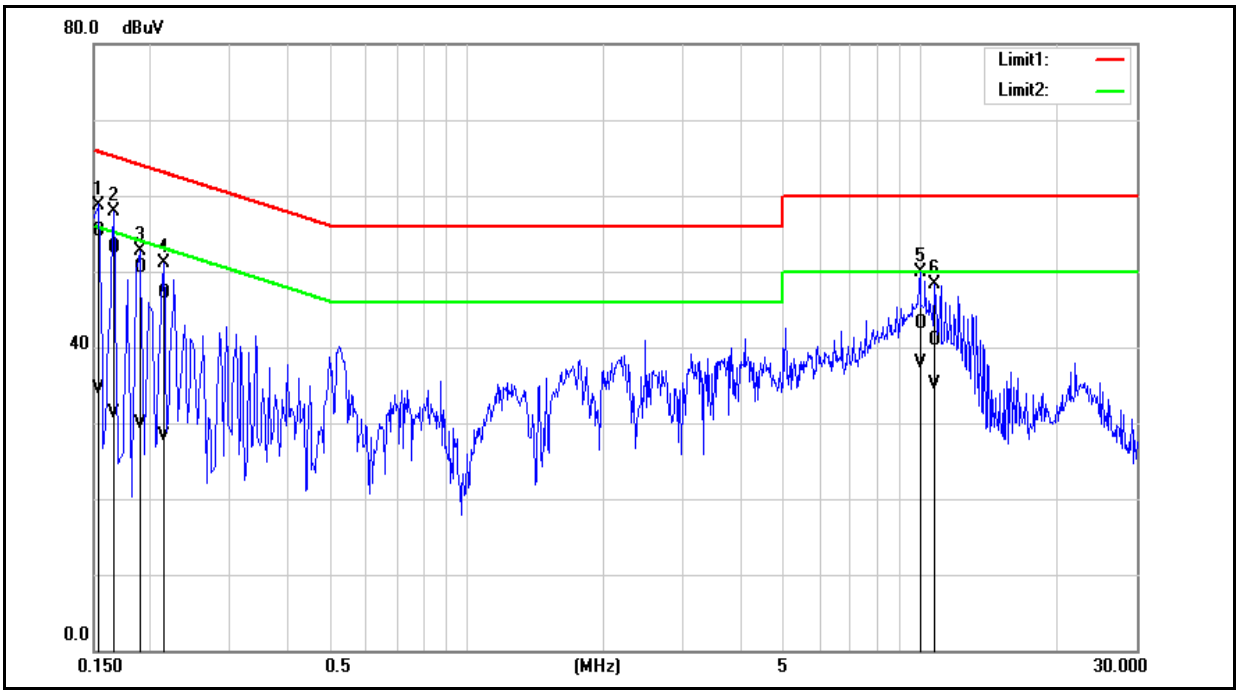
Operate Freq. Band	Directional Gain (dBi)
IEEE 802.11b	8.18
IEEE 802.11g	8.18
IEEE 802.11n 2.4 GHz 20 MHz	8.18
IEEE 802.11n 2.4 GHz 40 MHz	8.18

5 Test Results

Annex A. Conducted Emission

Model: PA300: built-in antenna

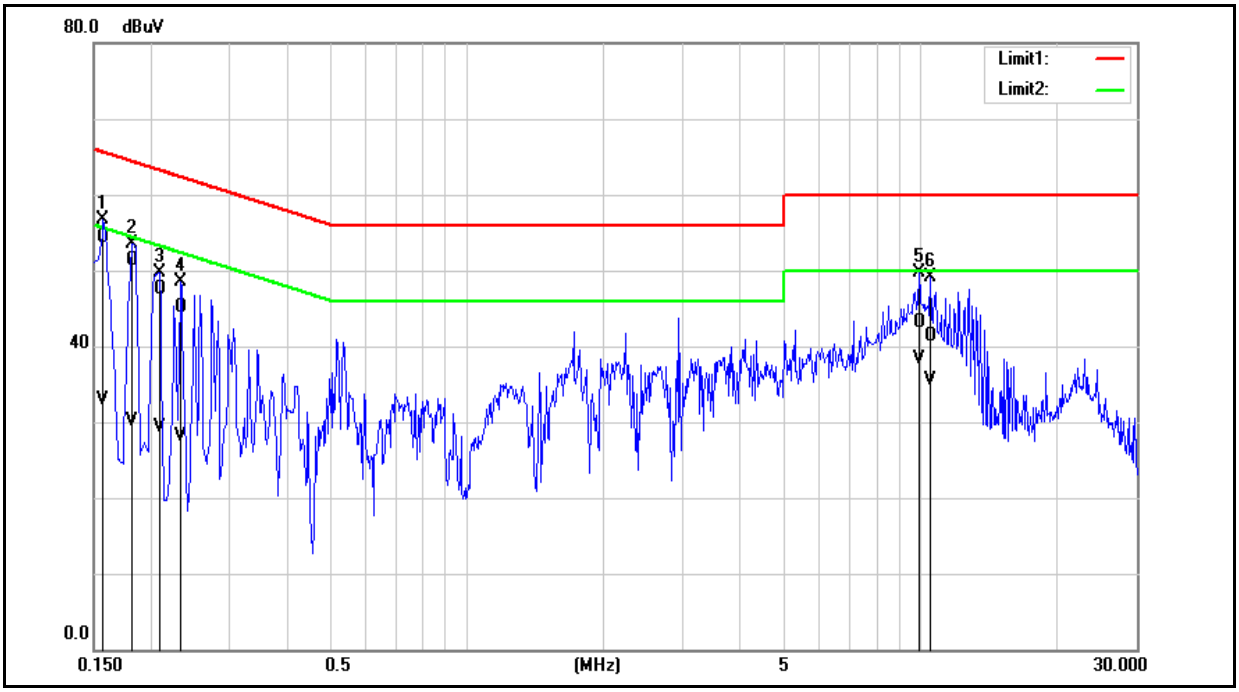
Standard:	FCC Part 15.247	Line:	L1
Test item:	Conducted Emission	Power:	AC 120 V/60 Hz
Test Mode:	Mode 1	Temp.(℃)/Hum.(%RH):	26(℃)/60 %RH
Description:			



No.	Frequency (MHz)	QP reading (dBuV)	AVG reading (dBuV)	Correction factor (dB)	QP result (dBuV)	AVG result (dBuV)	QP limit (dBuV)	AVG limit (dBuV)	QP margin (dB)	AVG margin (dB)	Remark
1	0.1540	45.71	24.83	9.65	55.36	34.48	65.78	55.78	-10.42	-21.30	Pass
2	0.1660	43.43	21.64	9.65	53.08	31.29	65.16	55.16	-12.08	-23.87	Pass
3	0.1900	40.95	20.24	9.64	50.59	29.88	64.04	54.04	-13.45	-24.16	Pass
4	0.2140	37.46	18.65	9.64	47.10	28.29	63.05	53.05	-15.95	-24.76	Pass
5	9.9900	33.22	28.06	9.90	43.12	37.96	60.00	50.00	-16.88	-12.04	Pass
6	10.7740	31.00	25.16	9.91	40.91	35.07	60.00	50.00	-19.09	-14.93	Pass

Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).
2. Correction factor (dB) = Cable loss (dB) + L.I.S.N. factor (dB).

Standard:	FCC Part 15.247	Line:	N
Test item:	Conducted Emission	Power:	AC 120 V/60 Hz
Test Mode:	Mode 1	Temp.(℃)/Hum.(%RH):	26(℃)/60 %RH
Description:			

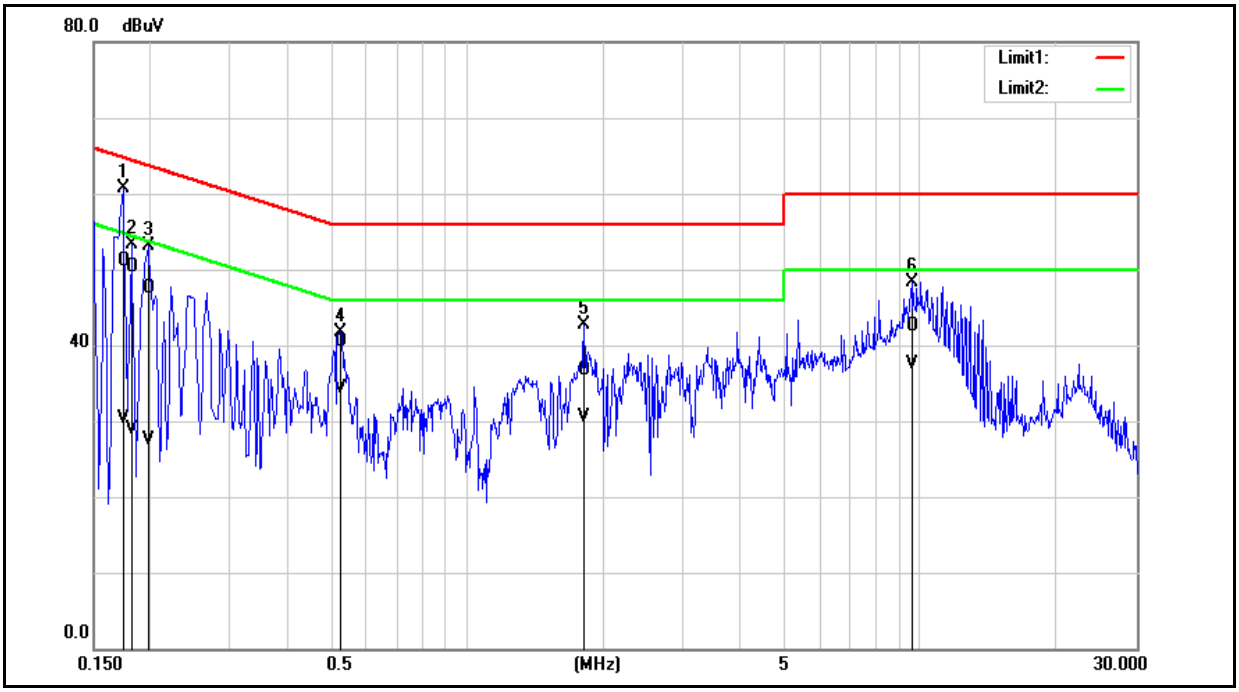


No.	Frequency (MHz)	QP reading (dBuV)	AVG reading (dBuV)	Correction factor (dB)	QP result (dBuV)	AVG result (dBuV)	QP limit (dBuV)	AVG limit (dBuV)	QP margin (dB)	AVG margin (dB)	Remark
1	0.1580	44.70	23.14	9.68	54.38	32.82	65.57	55.57	-11.19	-22.75	Pass
2	0.1820	41.55	20.52	9.67	51.22	30.19	64.39	54.39	-13.17	-24.20	Pass
3	0.2100	37.91	19.56	9.67	47.58	29.23	63.21	53.21	-15.63	-23.98	Pass
4	0.2340	35.41	18.39	9.67	45.08	28.06	62.31	52.31	-17.23	-24.25	Pass
5	9.9380	33.24	28.26	9.96	43.20	38.22	60.00	50.00	-16.80	-11.78	Pass
6	10.5580	31.36	25.52	9.98	41.34	35.50	60.00	50.00	-18.66	-14.50	Pass

Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).
2. Correction factor (dB) = Cable loss (dB) + L.I.S.N. factor (dB).

Model: PA300-E: External antenna

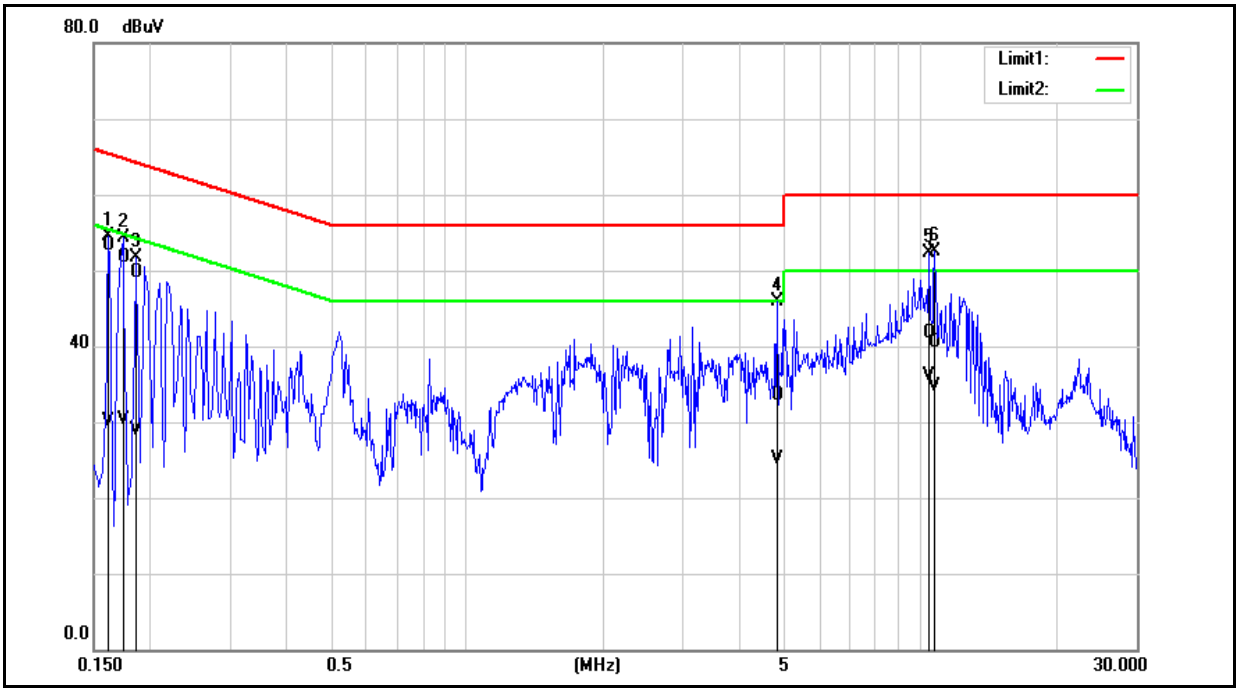
Standard:	FCC Part 15.247	Line:	L1
Test item:	Conducted Emission	Power:	AC 120 V/60 Hz
Test Mode:	Mode 1	Temp.(℃)/Hum.(%RH):	26(℃)/60 %RH
Description:			



No.	Frequency (MHz)	QP reading (dBuV)	AVG reading (dBuV)	Correction factor (dB)	QP result (dBuV)	AVG result (dBuV)	QP limit (dBuV)	AVG limit (dBuV)	QP margin (dB)	AVG margin (dB)	Remark
1	0.1740	41.40	20.59	9.65	51.05	30.24	64.77	54.77	-13.72	-24.53	Pass
2	0.1820	40.74	19.22	9.64	50.38	28.86	64.39	54.39	-14.01	-25.53	Pass
3	0.1980	37.86	17.95	9.64	47.50	27.59	63.69	53.69	-16.19	-26.10	Pass
4	0.5260	30.78	24.57	9.66	40.44	34.23	56.00	46.00	-15.56	-11.77	Pass
5	1.8140	26.95	20.74	9.71	36.66	30.45	56.00	46.00	-19.34	-15.55	Pass
6	9.6460	32.63	27.62	9.90	42.53	37.52	60.00	50.00	-17.47	-12.48	Pass

Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).
2. Correction factor (dB) = Cable loss (dB) + L.I.S.N. factor (dB).

Standard:	FCC Part 15.247	Line:	N
Test item:	Conducted Emission	Power:	AC 120 V/60 Hz
Test Mode:	Mode 1	Temp.(℃)/Hum.(%RH):	26(℃)/60 %RH
Description:			



No.	Frequency (MHz)	QP reading (dBuV)	AVG reading (dBuV)	Correction factor (dB)	QP result (dBuV)	AVG result (dBuV)	QP limit (dBuV)	AVG limit (dBuV)	QP margin (dB)	AVG margin (dB)	Remark
1	0.1620	43.54	20.39	9.68	53.22	30.07	65.36	55.36	-12.14	-25.29	Pass
2	0.1740	41.96	20.53	9.68	51.64	30.21	64.77	54.77	-13.13	-24.56	Pass
3	0.1860	40.05	19.24	9.67	49.72	28.91	64.21	54.21	-14.49	-25.30	Pass
4	4.8300	23.69	15.19	9.83	33.52	25.02	56.00	46.00	-22.48	-20.98	Pass
5	10.4580	31.73	26.11	9.98	41.71	36.09	60.00	50.00	-18.29	-13.91	Pass
6	10.7340	30.47	24.82	9.98	40.45	34.80	60.00	50.00	-19.55	-15.20	Pass

Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).
2. Correction factor (dB) = Cable loss (dB) + L.I.S.N. factor (dB).

Annex B. Conducted Test Results

Maximum Conducted Output Power Measurement

Model: PA300: built-in antenna

Test Mode	Frequency (MHz)	Data Rate	Average Output Power				
			ANT-0		ANT-1		Limit
			(dBm)	(W)	(dBm)	(W)	dBm
Mode 2	2412	1 M	22.55	0.180	21.87	0.154	≤ 30.00
	2437		21.23	0.133	21.31	0.135	≤ 30.00
	2462		22.69	0.186	22.50	0.178	≤ 30.00
Mode 3	2412	6 M	22.23	0.167	22.10	0.162	≤ 30.00
	2437		22.42	0.175	21.82	0.152	≤ 30.00
	2462		22.90	0.195	22.63	0.183	≤ 30.00
Mode 4	2412	13 M	22.59	0.182	22.12	0.163	≤ 30.00
	2437		22.46	0.176	22.06	0.161	≤ 30.00
	2462		22.52	0.179	22.71	0.187	≤ 30.00
Mode 5	2422	27 M	20.82	0.121	20.40	0.110	≤ 30.00
	2437		22.54	0.179	22.20	0.166	≤ 30.00
	2452		20.60	0.115	20.46	0.111	≤ 30.00

Test Mode	Frequency (MHz)	Data Rate	Average Output Power		
			ANT-0+1		Limit
			(dBm)	(W)	dBm
Mode 2	2412	1 M	25.23	0.334	≤ 30.00
	2437		24.28	0.268	≤ 30.00
	2462		**25.61**	**0.364**	≤ 30.00
Mode 3	2412	6 M	25.18	0.329	≤ 30.00
	2437		25.14	0.327	≤ 30.00
	2462		**25.78**	**0.378**	≤ 30.00
Mode 4	2412	13 M	25.37	0.344	≤ 30.00
	2437		25.27	0.337	≤ 30.00
	2462		**25.63**	**0.365**	≤ 30.00
Mode 5	2422	27 M	23.63	0.230	≤ 30.00
	2437		**25.38**	**0.345**	≤ 30.00
	2452		23.54	0.226	≤ 30.00

Note: The relevant measured result has the offset with cable loss already.

Model: PA300-E: External antenna

Test Mode	Frequency (MHz)	Data Rate	Average Output Power				
			ANT-0		ANT-1		Limit
			(dBm)	(W)	dBm	(W)	dBm
Mode 2	2412	1 M	23.15	0.207	22.54	0.179	≤ 30.00
	2437		16.67	0.046	16.47	0.044	≤ 30.00
	2462		23.28	0.213	22.68	0.185	≤ 30.00
Mode 3	2412	6 M	14.48	0.028	14.25	0.027	≤ 30.00
	2437		11.22	0.013	11.17	0.013	≤ 30.00
	2462		11.61	0.014	11.40	0.014	≤ 30.00
Mode 4	2412	13 M	13.86	0.024	13.56	0.023	≤ 30.00
	2437		10.84	0.012	10.58	0.011	≤ 30.00
	2462		14.65	0.029	14.20	0.026	≤ 30.00
Mode 5	2422	27 M	21.32	0.136	20.51	0.112	≤ 30.00
	2437		23.19	0.208	22.79	0.190	≤ 30.00
	2452		22.35	0.172	21.97	0.157	≤ 30.00

Test Mode	Frequency (MHz)	Data Rate	Average Output Power		
			ANT-0+1		Limit
			(dBm)	(W)	dBm
Mode 2	2412	1 M	25.87	0.386	≤ 30.00
	2437		19.58	0.091	≤ 30.00
	2462		**26.00**	**0.398**	≤ 30.00
Mode 3	2412	6 M	**17.38**	**0.055**	≤ 30.00
	2437		14.21	0.026	≤ 30.00
	2462		14.52	0.028	≤ 30.00
Mode 4	2412	13 M	16.72	0.047	≤ 30.00
	2437		13.72	0.024	≤ 30.00
	2462		**17.44**	**0.055**	≤ 30.00
Mode 5	2422	27 M	23.94	0.248	≤ 30.00
	2437		**26.00**	**0.399**	≤ 30.00
	2452		25.17	0.329	≤ 30.00

Note: The relevant measured result has the offset with cable loss already.

6 dB RF Bandwidth Measurement

Model: PA300: built-in antenna				
Test Mode	Frequency (MHz)	Measurement (kHz)		Limit (kHz)
		ANT-0	ANT-1	
Mode 2	2412	9596	10020	≥ 500
	2437	9588	10060	≥ 500
	2462	10100	9601	≥ 500
Mode 3	2412	15130	15120	≥ 500
	2437	15120	15100	≥ 500
	2462	15130	15100	≥ 500
Mode 4	2412	15120	15130	≥ 500
	2437	15140	15140	≥ 500
	2462	15130	15140	≥ 500
Mode 5	2422	33880	33870	≥ 500
	2437	33840	33820	≥ 500
	2452	33890	33880	≥ 500

Model: PA300-E: External antenna				
Test Mode	Frequency (MHz)	Measurement (kHz)		Limit (kHz)
		ANT-0	ANT-1	
Mode 2	2412	9593	9587	≥ 500
	2437	9547	9615	≥ 500
	2462	9580	10080	≥ 500
Mode 3	2412	15130	15120	≥ 500
	2437	15130	15120	≥ 500
	2462	15130	15140	≥ 500
Mode 4	2412	15130	15120	≥ 500
	2437	15130	15140	≥ 500
	2462	15130	15100	≥ 500
Mode 5	2422	33860	33870	≥ 500
	2437	33890	33810	≥ 500
	2452	33890	32600	≥ 500

■ **Test Graphs**

Model: PA300: built-in antenna

6 dB RF Bandwidth

Mode 2: IEEE 802.11b Continuous TX mode_ANT-0	
2412	
2437	
2462	

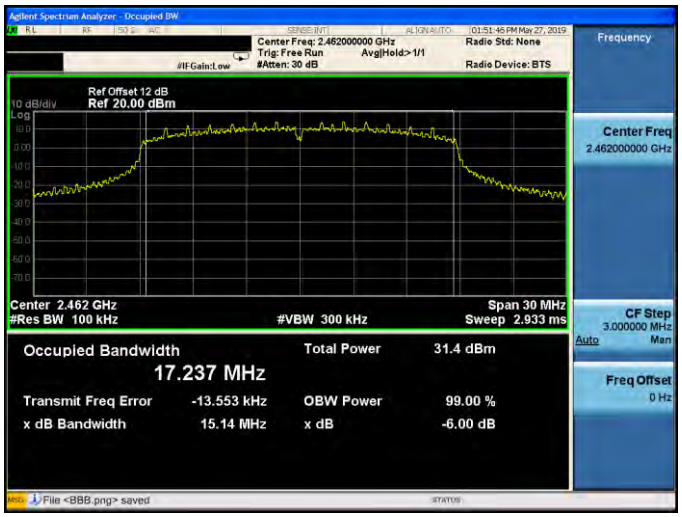
Mode 3: IEEE 802.11g Continuous TX mode_ANT-0	
2412	
2437	
2462	

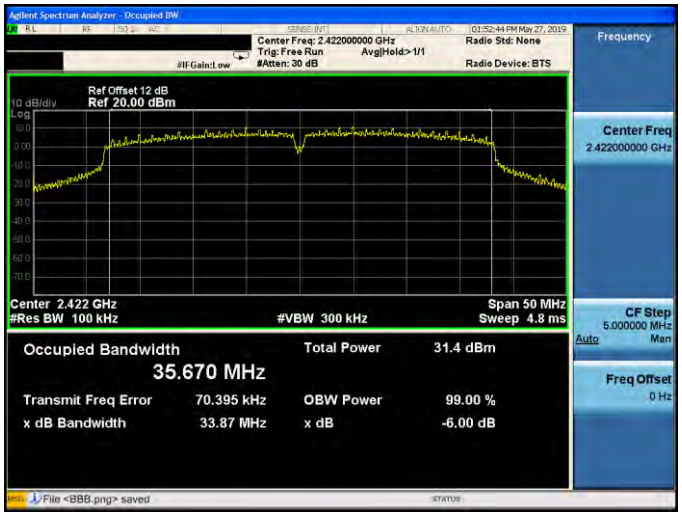
Mode 4: IEEE 802.11n 2.4 GHz 20 MHz link mode_ANT-0	
2412	
2437	
2462	

Mode 5: IEEE 802.11n 2.4 GHz 40 MHz link mode_ANT-0	
2422	
2437	
2452	

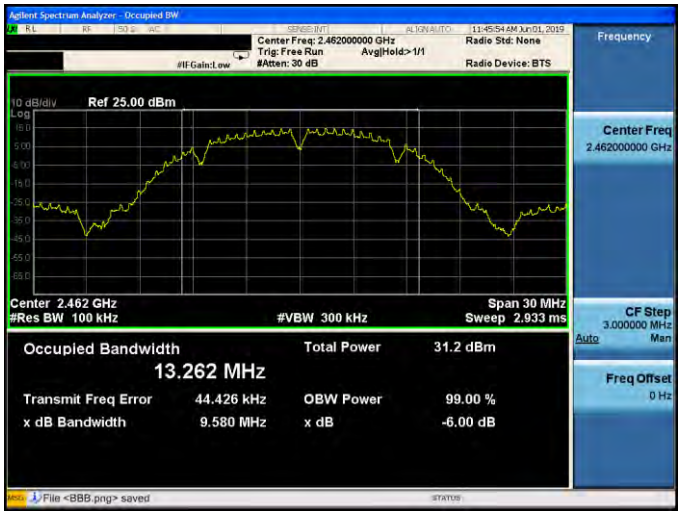
Mode 2: IEEE 802.11b Continuous TX mode_ANT-1	
2412	
2437	
2462	

Mode 3: IEEE 802.11g Continuous TX mode_ANT-1	
2412	
2437	
2462	

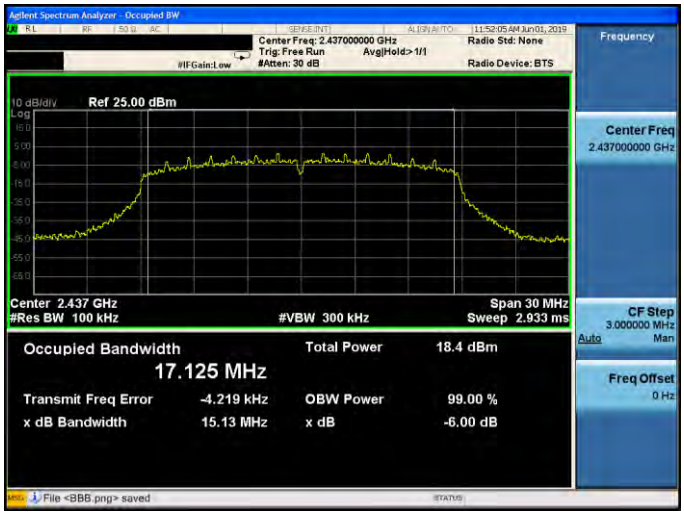
Mode 4: IEEE 802.11n 2.4 GHz 20 MHz link mode_ANT-1	
2412	
2437	
2462	

Mode 5: IEEE 802.11n 2.4 GHz 40 MHz link mode_ANT-1	
2422	
2437	
2452	

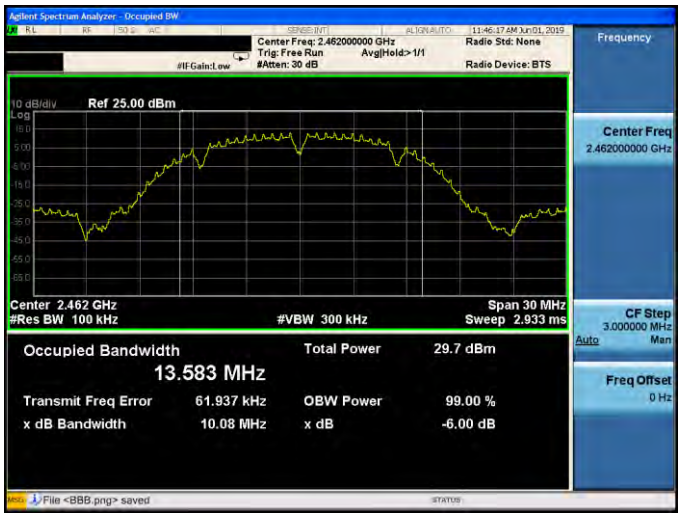
Model: PA300-E: External antenna

Mode 2: IEEE 802.11b Continuous TX mode_ANT-0	
2412	
2437	
2462	

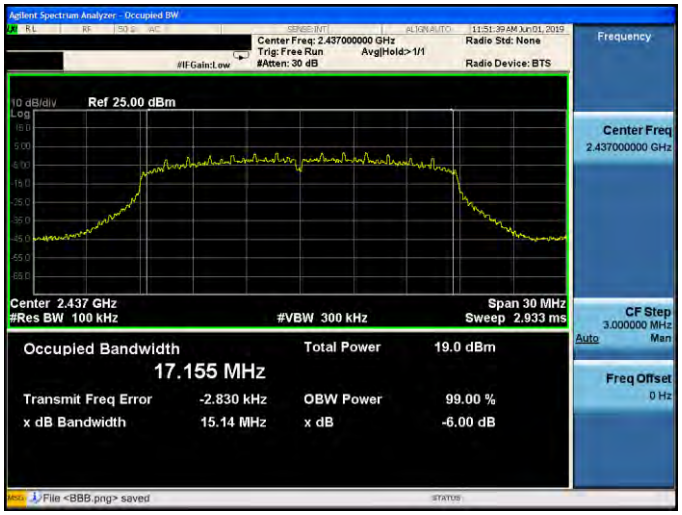
Mode 3: IEEE 802.11g Continuous TX mode_ANT-0	
2412	
2437	
2462	

Mode 4: IEEE 802.11n 2.4 GHz 20 MHz link mode_ANT-0	
2412	
2437	
2462	

Mode 5: IEEE 802.11n 2.4 GHz 40 MHz link mode_ANT-0	
2422	
2437	
2452	

Mode 2: IEEE 802.11b Continuous TX mode_ANT-1	
2412	
2437	
2462	

Mode 3: IEEE 802.11g Continuous TX mode_ANT-1	
2412	
2437	
2462	

Mode 4: IEEE 802.11n 2.4 GHz 20 MHz link mode_ANT-1	
2412	
2437	
2462	

Mode 5: IEEE 802.11n 2.4 GHz 40 MHz link mode_ANT-1	
2422	
2437	
2452	

Maximum Power Density Measurement

Model: PA300: built-in antenna					
est Mode	Frequency (MHz)	Measurement Results (dBm/3 kHz)			Limit (dBm/3 kHz)
		ANT-0	ANT-1	ANT-0+1	
Mode 2	2412	0.237	-0.603	2.848	≤ 7.69
	2437	-0.981	-1.983	1.557	≤ 7.69
	2462	0.539	0.333	3.448	≤ 7.69
Mode 3	2412	-1.036	-0.578	2.209	≤ 7.69
	2437	-0.781	-0.669	2.286	≤ 7.69
	2462	-0.473	-0.852	2.352	≤ 7.69
Mode 4	2412	-1.374	-1.463	1.592	≤ 7.69
	2437	-1.686	-1.577	1.379	≤ 7.69
	2462	-1.572	-0.923	1.775	≤ 7.69
Mode 5	2422	-5.956	-5.799	-2.866	≤ 7.69
	2437	-4.294	-4.235	-1.254	≤ 7.69
	2452	-6.070	-5.738	-2.891	≤ 7.69

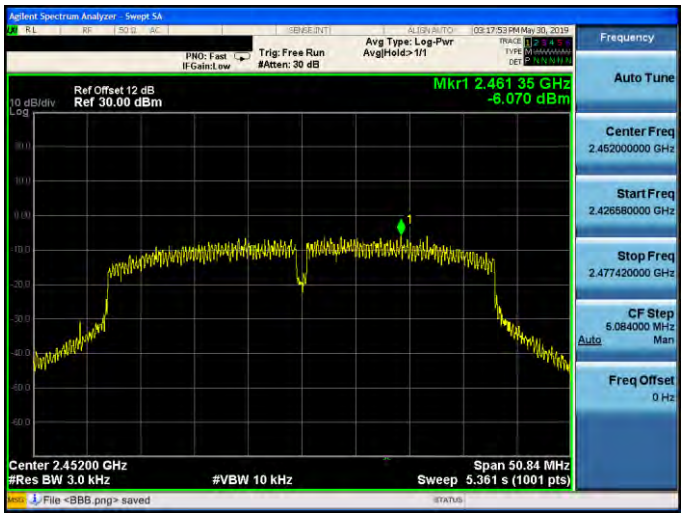
Model: PA300-E: External antenna					
Test Mode	Frequency (MHz)	Measurement Results (dBm/3 kHz)			Limit (dBm/3 kHz)
		ANT-0	ANT-1	ANT-0+1	
Mode 2	2412	0.649	0.116	3.401	≤ 5.82
	2437	-6.445	-6.267	-3.345	≤ 5.82
	2462	0.435	0.453	3.454	≤ 5.82
Mode 3	2412	-9.667	-9.602	-6.624	≤ 5.82
	2437	-12.519	-12.361	-9.429	≤ 5.82
	2462	-12.283	-12.173	-9.217	≤ 5.82
Mode 4	2412	-10.359	-10.522	-7.429	≤ 5.82
	2437	-12.983	-13.119	-10.040	≤ 5.82
	2462	-9.302	-9.788	-6.528	≤ 5.82
Mode 5	2422	-5.600	-5.578	-2.579	≤ 5.82
	2437	-3.956	-3.730	-0.831	≤ 5.82
	2452	-4.893	-4.600	-1.734	≤ 5.82

■ **Test Graphs**

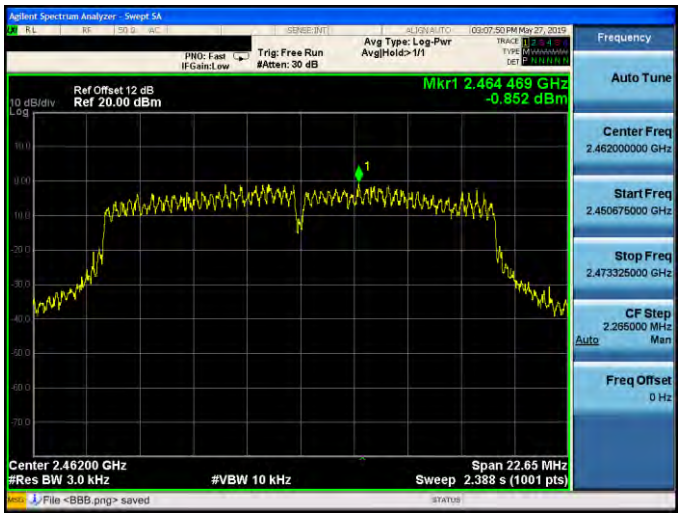
Model: PA300: built-in antenna	
Mode 2: IEEE 802.11b Continuous TX mode_ANT-0	
2412	
2437	
2462	

Mode 3: IEEE 802.11g Continuous TX mode_ANT-0	
2412	
2437	
2462	

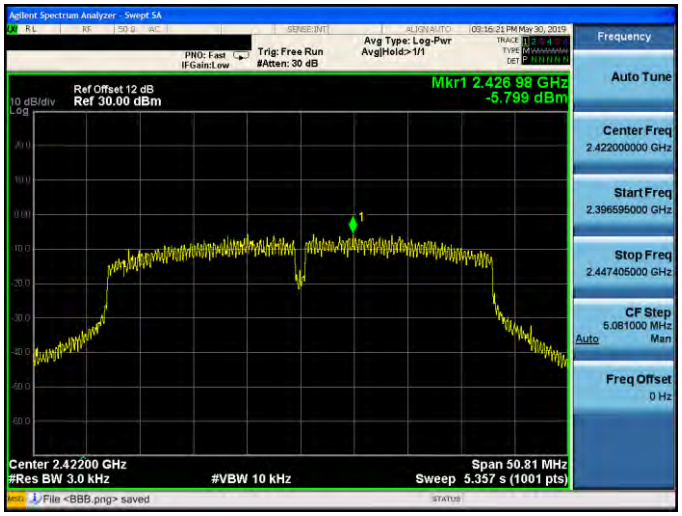
Mode 4: IEEE 802.11n 2.4 GHz 20 MHz Continuous TX mode_ANT-0	
2412	
2437	
2462	

Mode 5: IEEE 802.11n 2.4 GHz 40 MHz Continuous TX mode_ANT-0	
2422	
2437	
2452	

Mode 2: IEEE 802.11b Continuous TX mode_ANT-1	
2412	
2437	
2462	

Mode 3: IEEE 802.11g Continuous TX mode_ANT-1	
2412	
2437	
2462	

Mode 4: IEEE 802.11n 2.4 GHz 20 MHz Continuous TX mode_ANT-1	
2412	
2437	
2462	

Mode 5: IEEE 802.11n 2.4 GHz 40 MHz Continuous TX mode_ANT-1	
2422	
2437	
2452