

FCC RADIO TEST REPORT

FCC ID: 2AAA9-RA621EX

Product: Smart Access Point

Trade Mark: Relay2

Model No.: RA621EX

Family Model: N/A

Report No.: S23072505007002

Issue Date: Aug 29, 2023

Prepared for

Relay2, Inc.

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Prepared by

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TEST RESULT CERTIFICATION

Applicant's name : Relay2, Inc.

Address : 1525 McCarthy Blvd., Suite 209 Milpitas, CA 95035, USA

Manufacturer's Name : Emplus Technologies, Inc.

Address : 10F., Building B, No. 209, Sec. 1, Nangang Rd., Nangang Dist.,
Taipei City 11568, Taiwan

Product description

Product name : Smart Access Point

Trade Mark : Relay2

Model and/or type reference : RA621EX

Family Model : N/A

Standards : FCC Part15.407

Test procedure ANSI C63.10-2013 and KDB 789033 D02 General UNII Test
Procedures New Rules v02r01
FCC KDB 662911 D01 Multiple Transmitter Output v02r01

This device described above has been tested by NTEK, and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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Test Sample Number S230725050008

Date of Test

Date (s) of performance of tests Jul 25, 2023~ Aug 29, 2023

Date of Issue..... Aug 29, 2023

Test Result..... **Pass**

Testing Engineer :

Mukzi Lee

(Mukzi Lee)

Authorized Signatory :

Alex

(Alex Li)

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Revision History

[illegible]

1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:

FCC Part15 (15.407) , Subpart E			
Standard Section	Test Item	Judgment	Remark
15.207	AC Power Line Conducted Emissions	PASS	
15.209(a), 15.407 (b)(1) 15.407 (b)(4) 15.407(b)(8)(9)	Spurious Radiated Emissions	PASS	
15.407 (a)	26 dB and 99% Emission Bandwidth	PASS	
15.407(e)	Minimum 6 dB bandwidth	PASS	
15.407 (a)	Maximum Conducted Output Power	PASS	
15.407 (b)(1) 15.407 (b)(4)	Band Edge	PASS	
15.407 (a)	Power Spectral Density	PASS	
15.407(b)	Spurious Emissions at Antenna Terminals	PASS	
15.407(g)	Frequency Stability Measurement	PASS	
15.407(h)	Dynamic Frequency Selection(DFS)	N/A	
15.203	Antenna Requirement	PASS	
15.407(c)	Automatically discontinue transmission	PASS	

NOTE:

(1) "N/A" denotes test is not applicable in this Test Report

1.1 FACILITIES AND ACCREDITATIONS

FACILITIES

All measurement facilities used to collect the measurement data are located at
1/F, Building E, Fenda Science Park Sanwei, Xixiang, Bao'an District
Shenzhen, Guangdong, China

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.10 and CISPR Publication 22.

LABORATORY ACCREDITATIONS AND LISTINGS

Site Description

CNAS-Lab. : The Certificate Registration Number is L5516.

IC-Registration : The Certificate Registration Number is 9270A.
CAB identifier:CN0074

FCC- Accredited : Test Firm Registration Number: 463705.
Designation Number: CN1184

A2LA-Lab. : The Certificate Registration Number is 4298.01

Name of Firm : Shenzhen NTEK Testing Technology Co., Ltd.

Site Location : 1/F, Building E, Fenda Science Park Sanwei, Xixiang, Bao'an District
Shenzhen, Guangdong, China

1.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement $y \pm U$, where expanded uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %.

No.	Item	Uncertainty
1	Conducted Emission Test	$\pm 2.80\text{dB}$
2	RF power, conducted	$\pm 0.16\text{dB}$
3	Spurious emissions, conducted	$\pm 0.21\text{dB}$
4	Occupied bandwidth	$\pm 3.7\text{dB}$
5	All emissions, radiated(9KHz~30MHz)	$\pm 6\text{dB}$
6	All emissions, radiated(30MHz~1GHz)	$\pm 2.64\text{dB}$
7	All emissions, radiated(1GHz~6GHz)	$\pm 2.40\text{dB}$
8	All emissions, radiated(> 6GHz)	$\pm 2.52\text{dB}$
9	Temperature	$\pm 0.5^\circ\text{C}$
10	Humidity	$\pm 2\%$

1. GENERAL INFORMATION

1.1 GENERAL DESCRIPTION OF EUT

Equipment	Smart Access Point
Trade Mark	Relay2
Model Name	RA621EX
Family Model	N/A
Model Difference	N/A
FCC ID	2AAA9-RA621EX
Product Description	Mode Supported ☒802.11a ☒802.11n(HT20) ☒802.11n(HT40) ☒802.11ac(HT20) ☒802.11ac(HT40) ☒802.11ac(HT80) ☒802.11ax(HT20) ☒802.11ax(HT40) ☒802.11ax(HT80)
	Modulation OFDM with BPSK/QPSK/16QAM/64QAM/256QAM for 802.11a/n/ac OFDMA with BPSK/QPSK/16QAM/64QAM/256QAM/1024QAM for 802.11ax
	Operating Frequency Range ☒ U-NII-1: 5150 MHz ~5250MHz ☒ U-NII-3: 5725 MHz ~5850 MHz
	Function: ☒Outdoor AP ☐Indoor AP ☐Fixed P2P ☐Client
	Antenna Type Antenna 1: External Antenna Antenna 2: External Antenna
	Antenna Gain Antenna 1: 5.17dBi; Antenna 2: 5.17dBi
	Smart system ☒SISO for 802.11a/n/ac/ax ☒MIMO for 802.11n/ac/ax
	Based on the application, features, or specification exhibited in User's Manual, More details of EUT technical specification, please refer to the User's Manual.
Adapter	N/A
Power supply	PoE Input: DC 48V-54V
Connecting I/O Port(s)	Please refer to the User's Manual
HW Version	1.0
SW Version	3.2.3

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.
2. Frequency and Channel list:

Band	20MHz		40MHz		80MHz	
	Channel	Frequency	Channel	Frequency	Channel	Frequency
U-NII-1	36	5180 MHz	38	5190 MHz	42	5210 MHz
	40	5200 MHz	46	5230 MHz	-	-
	44	5220 MHz				
	48	5240 MHz				
U-NII-3	149	5745 MHz	151	5755 MHz	155	5775 MHz
	153	5765 MHz	159	5795 MHz		
	157	5785 MHz				
	161	5805 MHz				
	165	5825 MHz				

3. The module for 5G WIFI has two antenna, and different modes support different transmit mode what describe as Following form:

Antenna	Antenna Type	Gain (dBi)	NOTE
1(main)	External Antenna	5.17	Wifi Antenna
2(aux)	External Antenna	5.17	Wifi Antenna

Mode	Tx/Rx
802.11a	1TX, 1RX
802.11n/ac/ax	1Tx, 1Rx ,2Tx, 2Rx

Note: 802.11ax mode only support full resource unit size.

1.2 DESCRIPTION OF TEST MODES

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

For Radiated Emission	
Final Test Mode	Description
Mode 1	Normal Link Mode
Mode 2	802.11a / n 20 / ac 20/ax20 CH36/ CH40/ CH 48 802.11a / n 20 / ac 20/ax20 CH149/ CH157/ CH 165
Mode 3	802.11n40 / ac40/ax40 CH38/ CH 46 802.11n 40 / ac 40/ax40 CH 151 / CH 159
Mode 4	802.11ac80/ax80 CH 42 802.11ac 80/ax80 CH 155

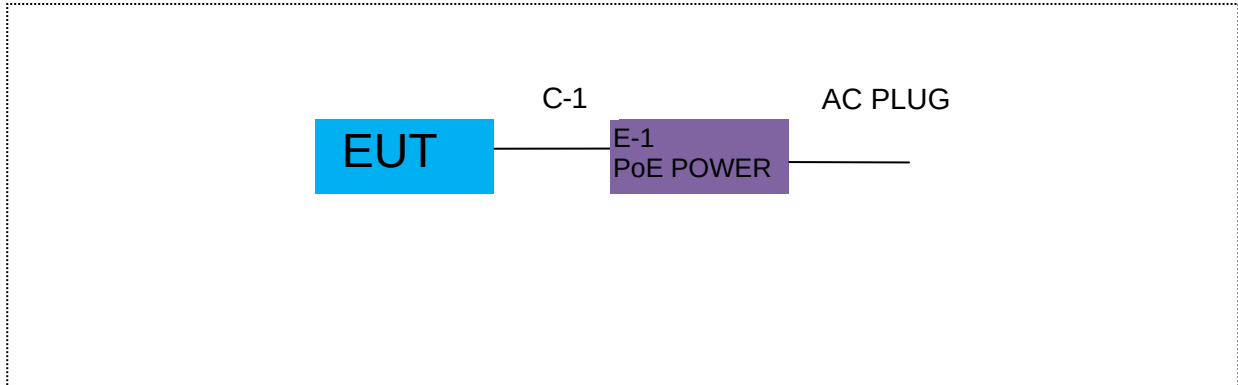
For Conducted Emission	
Final Test Mode	Description
Mode 1	Normal Link Mode
Mode 2	802.11a / n 20 / ac 20/ax20 CH36/ CH40/ CH 48 802.11a / n 20 / ac 20/ax20 CH149/ CH157/ CH 165
Mode 3	802.11n40 / ac40/ax40 CH38/ CH 46 802.11n 40 / ac 40/ax40 CH 151 / CH 159
Mode 4	802.11ac80/ax80 CH 42 802.11ac 80/ax80 CH 155

Note:

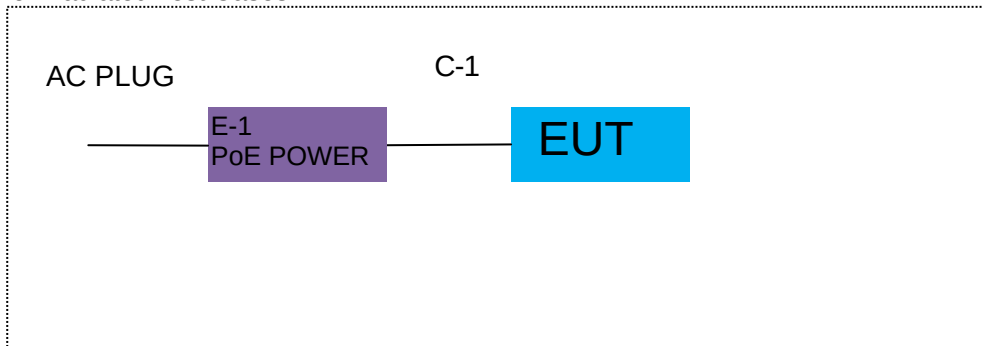
- (1) The measurements are performed at the highest, middle, lowest available channels.
- (2) The measurements are performed at all Bit Rate of Transmitter, the worst data was reported

1.3 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

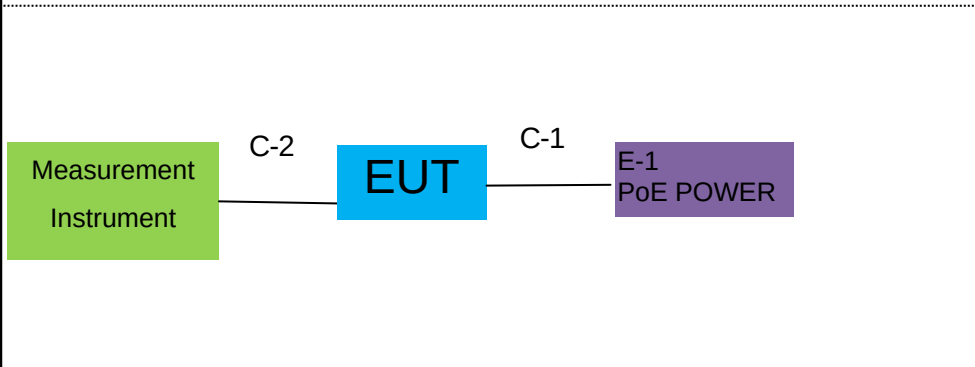
For AC Conducted Emission Mode



For Radiated Test Cases



For Conducted Test Cases



Note: 1. The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

1.4 DESCRIPTION OF SUPPORT UNITS(CONDUCTED MODE)

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Model/Type No.	Series No.	Note
E-1	PoE POWER	GP-B480-050	N/A	Peripherals

Item	Cable Type	Shielded Type	Ferrite Core	Length
C-1	Power Cable	NO	NO	1.0m
C-2	RF Cable	YES	NO	0.1m

Note:

- (1) The support equipment was authorized by Declaration of Confirmation.
- (2) For detachable type I/O cable should be specified the length in cm in 『Length』 column.
- (3) During the battery power test, the battery is fully charged.

1.5 EQUIPMENTS LIST FOR ALL TEST ITEMS

Radiation& Conducted Test equipment

	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	Spectrum Analyzer	Agilent	E4407B	MY45108040	2023.03.27	2024.03.26	1 year
2	Spectrum Analyzer	Agilent	N9020A	MY49100060	2023.05.29	2024.05.28	1 year
3	Spectrum Analyzer	R&S	FSV40	101417	2023.05.29	2024.05.28	1 year
4	Test Receiver	R&S	ESPI7	101318	2023.03.27	2024.04.26	1 year
5	Bilog Antenna	TESEQ	CBL6111D	31216	2023.03.16	2024.03.16	1 year
6	50Ω Coaxial Switch	Anritsu	MP59B	6200983705	2023.05.06	2026.05.05	3 year
7	Horn Antenna	SCHWARZBECK	BBHA 9120D	2816	2023.01.12	2024.01.11	1 year
8	Broadband Horn Antenna	SCHWARZBECK	BBHA 9170	803	2022.11.07	2023.11.06	1 year
9	Amplifier	EMC	EMC051835SE	980246	2023.05.29	2024.05.28	1 year
10	Active Loop Antenna	SCHWARZBECK	FMZB 1519B	055	2022.11.04	2023.11.03	1 year
11	Power Meter	DARE	RPR3006W	15I00041SN084	2023.05.29	2024.05.28	1 year
12	Test Cable (9KHz-30MHz)	N/A	R-01	N/A	2022.06.17	2025.06.16	3 year
13	Test Cable (30MHz-1GHz)	N/A	R-02	N/A	2022.06.17	2025.06.16	3 year
14	High Test Cable(1G-40GHz)	N/A	R-03	N/A	2022.06.17	2025.06.16	3 year
15	Filter	TRILTHIC	2400MHz	29	2023.03.26	2026.03.25	3 year
16	temporary antenna connector (Note)	NTS	R001	N/A	N/A	N/A	N/A

Note:

We will use the temporary antenna connector (soldered on the PCB board) When conducted test
And this temporary antenna connector is listed within the instrument list

AC Conduction Test equipment

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	Test Receiver	R&S	ESCI	101160	2023.03.27	2024.03.26	1 year
2	LISN	R&S	ENV216	101313	2023.03.27	2024.03.26	1 year
3	LISN	SCHWARZBECK	NNLK 8129	8129245	2023.03.27	2024.03.26	1 year
4	50Ω Coaxial Switch	ANRITSU CORP	MP59B	6200983704	2023.05.06	2026.05.05	3 year
5	Test Cable (9KHz-30MHz)	N/A	C01	N/A	2023.05.06	2026.05.05	3 year
6	Test Cable (9KHz-30MHz)	N/A	C02	N/A	2023.05.06	2026.05.05	3 year
7	Test Cable (9KHz-30MHz)	N/A	C03	N/A	2023.05.06	2026.05.05	3 year

Note: Each piece of equipment is scheduled for calibration once a year except the Test Cable& Aux Equipment which is scheduled for calibration every 3 years.

2. EMC EMISSION TEST

2.1 CONDUCTED EMISSION MEASUREMENT

2.1.1 APPLICABLE STANDARD

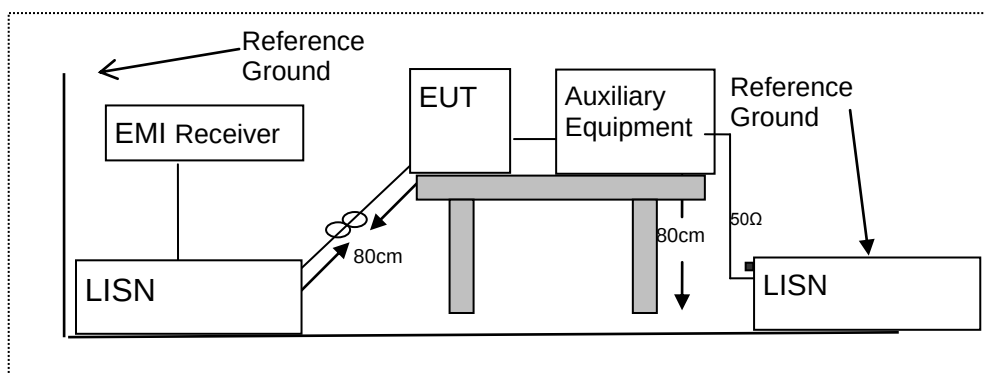
According to FCC Part 15.207(a)

2.1.2 CONFORMANCE LIMIT

Frequency(MHz)	Conducted Emission Limit	
	Quasi-peak	Average
0.15-0.5	66-56*	56-46*
0.5-5.0	56	46
5.0-30.0	60	50

Note: 1. *Decreases with the logarithm of the frequency
2. The lower limit shall apply at the transition frequencies
3. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

2.1.3 TEST CONFIGURATION



2.1.4 TEST PROCEDURE

According to the requirements in Section 13.1.4.1 of ANSI C63.10-2013 Conducted emissions the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-Peak and average detector mode.

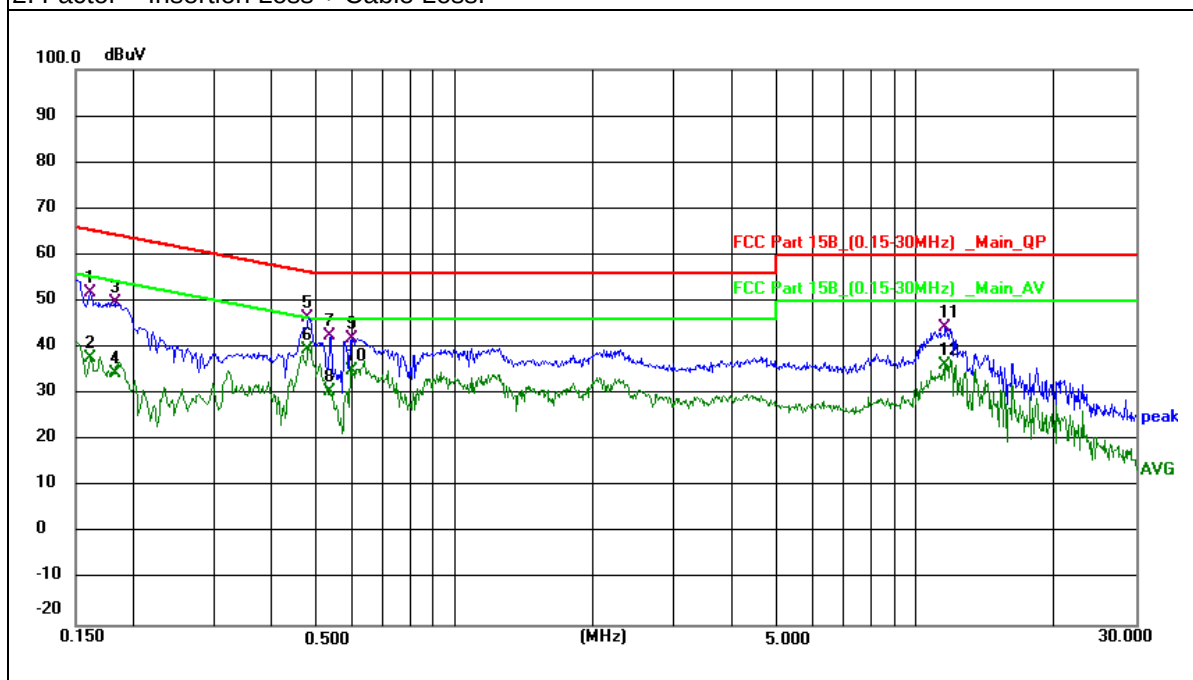
1. The EUT was placed 0.4 meter from the conducting wall of the shielding room.
2. The EUT was placed on a table which is 0.8m above ground plane.
3. Connect EUT to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
4. 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 to 40cm long.
5. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
6. LISN at least 80 cm from nearest part of EUT chassis.
7. The frequency range from 150KHz to 30MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth(IF bandwidth=9KHz) with Maximum Hold Mode
9. For the actual test configuration, please refer to the related Item –EUT Test Photos.

EUT :	Smart Access Point	Model Name. :	RA621EX
Temperature :	26 °C	Relative Humidity :	56%
Pressure :	1010hPa	Phase :	L
Test Voltage :	DC 48V from PoE Power AC 120V/60Hz	Test Mode :	Mode 1(5.2G)

Frequency (MHz)	Reading Level (dBμV)	Correct Factor (dB)	Measure-ment (dBμV)	Limits (dBμV)	Margin (dB)	Remark
0.1620	41.82	9.95	51.77	65.36	-13.59	QP
0.1620	27.85	9.95	37.80	55.36	-17.56	AVG
0.1824	39.80	9.99	49.79	64.38	-14.59	QP
0.1824	24.36	9.99	34.35	54.38	-20.03	AVG
0.4786	35.93	10.61	46.54	56.36	-9.82	QP
0.4786	28.80	10.61	39.41	46.36	-6.95	AVG
0.5350	31.85	10.73	42.58	56.00	-13.42	QP
0.5350	19.84	10.73	30.57	46.00	-15.43	AVG
0.5947	31.12	10.83	41.95	56.00	-14.05	QP
0.5947	24.36	10.83	35.19	46.00	-10.81	AVG
11.5860	34.74	9.69	44.43	60.00	-15.57	QP
11.5860	26.44	9.69	36.13	50.00	-13.87	AVG

Remark:

1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.

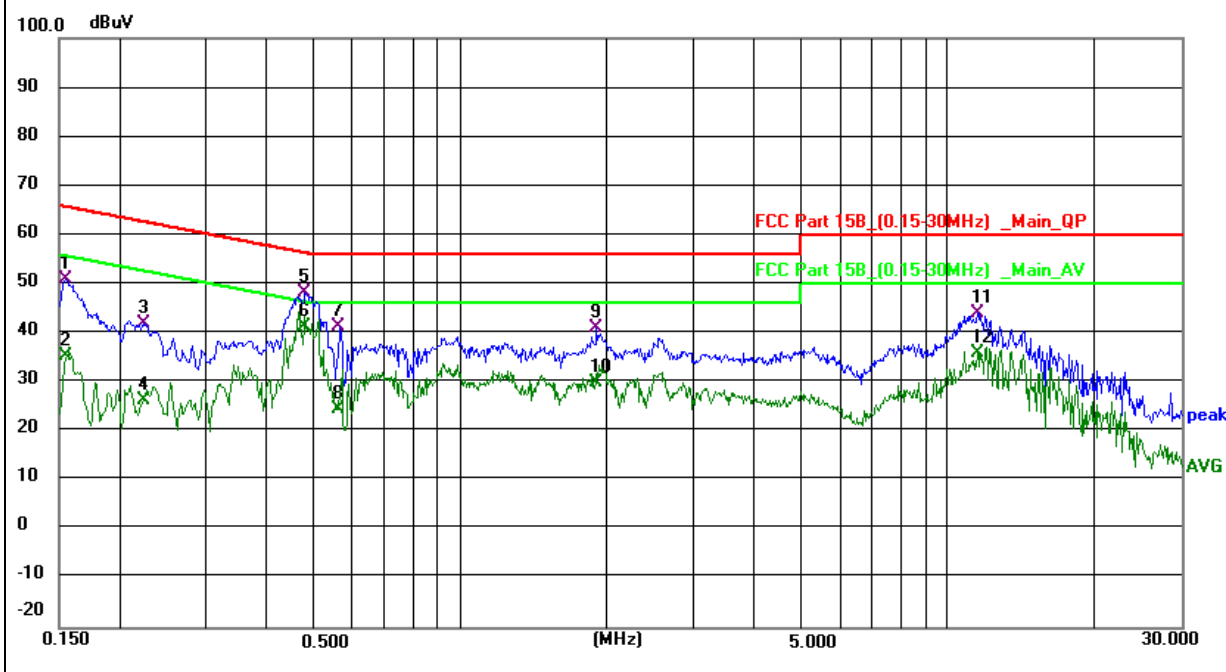


EUT :	Smart Access Point	Model Name. :	RA621EX
Temperature :	26 °C	Relative Humidity :	56%
Pressure :	1010hPa	Phase :	N
Test Voltage :	DC 48V from PoE Power AC 120V/60Hz	Test Mode :	Mode 1(5.2G)

Frequency (MHz)	Reading Level (dBμV)	Correct Factor (dB)	Measure-ment (dBμV)	Limits (dBμV)	Margin (dB)	Remark
0.1547	41.06	9.93	50.99	65.74	-14.75	QP
0.1547	25.32	9.93	35.25	55.74	-20.49	AVG
0.2230	31.90	10.08	41.98	62.71	-20.73	QP
0.2230	16.39	10.08	26.47	52.71	-26.24	AVG
0.4780	37.59	10.61	48.20	56.37	-8.17	QP
0.4780	30.77	10.61	41.38	46.37	-4.99	AVG
0.5620	30.60	10.77	41.37	56.00	-14.63	QP
0.5620	13.88	10.77	24.65	46.00	-21.35	AVG
1.8900	27.52	13.44	40.96	56.00	-15.04	QP
1.8900	16.59	13.44	30.03	46.00	-15.97	AVG
11.4657	34.34	9.69	44.03	60.00	-15.97	QP
11.4657	26.34	9.69	36.03	50.00	-13.97	AVG

Remark:

1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.

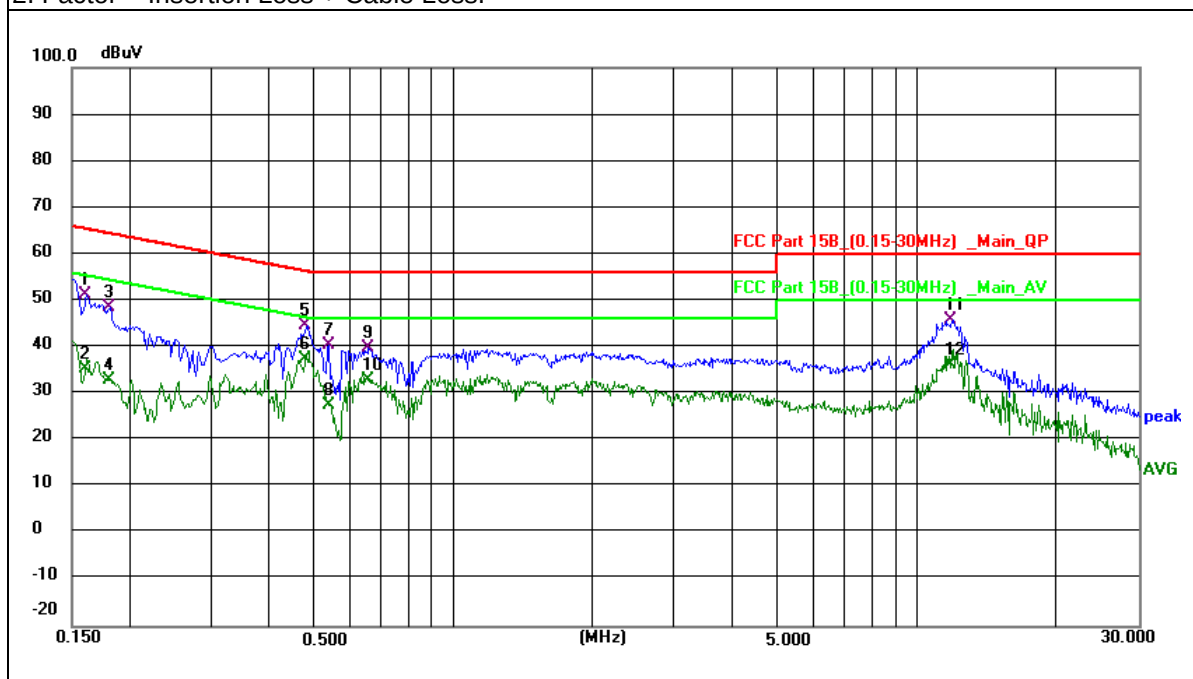


EUT :	Smart Access Point	Model Name. :	RA621EX
Temperature :	26 °C	Relative Humidity :	56%
Pressure :	1010hPa	Phase :	L
Test Voltage :	DC 48V from PoE Power AC 120V/60Hz	Test Mode :	Mode 1(5.8G)

Frequency (MHz)	Reading Level (dBμV)	Correct Factor (dB)	Measure-ment (dBμV)	Limits (dBμV)	Margin (dB)	Remark
0.1607	41.32	9.95	51.27	65.43	-14.16	QP
0.1607	25.36	9.95	35.31	55.43	-20.12	AVG
0.1804	38.53	9.99	48.52	64.47	-15.95	QP
0.1804	23.03	9.99	33.02	54.47	-21.45	AVG
0.4786	33.92	10.61	44.53	56.36	-11.83	QP
0.4786	26.80	10.61	37.41	46.36	-8.95	AVG
0.5380	29.85	10.73	40.58	56.00	-15.42	QP
0.5380	16.96	10.73	27.69	46.00	-18.31	AVG
0.6540	28.84	10.95	39.79	56.00	-16.21	QP
0.6540	21.94	10.95	32.89	46.00	-13.11	AVG
11.8620	36.08	9.70	45.78	60.00	-14.22	QP
11.8620	26.57	9.70	36.27	50.00	-13.73	AVG

Remark:

1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.

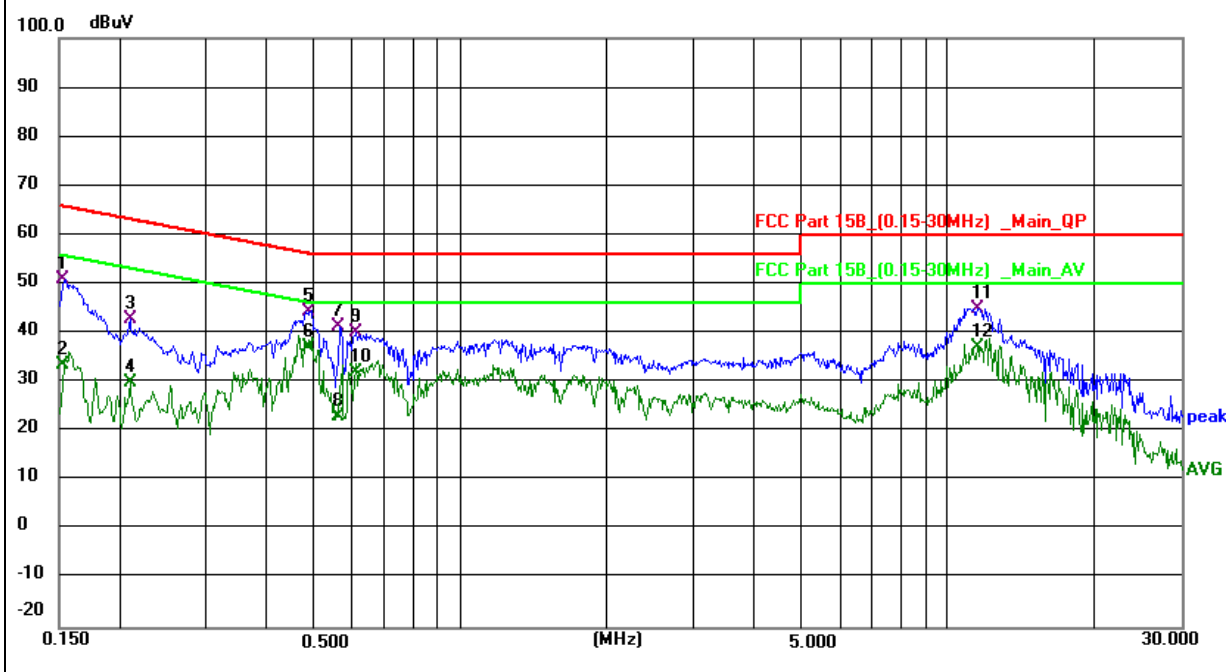


EUT :	Smart Access Point	Model Name. :	RA621EX
Temperature :	26 °C	Relative Humidity :	56%
Pressure :	1010hPa	Phase :	N
Test Voltage :	DC 48V from PoE Power AC 120V/60Hz	Test Mode :	Mode 1(5.8G)

Frequency (MHz)	Reading Level (dBμV)	Correct Factor (dB)	Measure-ment (dBμV)	Limits (dBμV)	Margin (dB)	Remark
0.1539	41.06	9.93	50.99	65.79	-14.80	QP
0.1539	23.62	9.93	33.55	55.79	-22.24	AVG
0.2100	32.77	10.06	42.83	63.21	-20.38	QP
0.2100	19.93	10.06	29.99	53.21	-23.22	AVG
0.4863	33.87	10.63	44.50	56.23	-11.73	QP
0.4863	26.53	10.63	37.16	46.23	-9.07	AVG
0.5620	30.60	10.77	41.37	56.00	-14.63	QP
0.5620	12.38	10.77	23.15	46.00	-22.85	AVG
0.6100	29.15	10.87	40.02	56.00	-15.98	QP
0.6100	21.07	10.87	31.94	46.00	-14.06	AVG
11.4657	35.34	9.69	45.03	60.00	-14.97	QP
11.4657	27.34	9.69	37.03	50.00	-12.97	AVG

Remark:

1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.



2.2 RADIATED EMISSION MEASUREMENT

2.2.1 APPLICABLE STANDARD

According to FCC Part 15.407(d) and 15.209

2.2.2 CONFORMANCE LIMIT

According to FCC Part 15.407(b)(10): radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
According to FCC Part 15.205, Restricted bands

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(2)
13.36-13.41			

In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed. All other emissions which fall in non-restricted band shall employing the limit refer to part 15.407(b)(1)(2)(3)(4)

Restricted Frequency(MHz)	Field Strength (μV/m)	Field Strength (dBμV/m)	Measurement Distance
0.009-0.490	2400/F(KHz)	20 log (uV/m)	300
0.490-1.705	24000/F(KHz)	20 log (uV/m)	30
1.705-30.0	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

Limits of Radiated Emission Measurement(Above 1000MHz)

Frequency(MHz)	Class B (dBuV/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

Remark :1. Emission level in dBuV/m=20 log (uV/m)

2. Measurement was performed at an antenna to the closed point of EUT distance of meters.

3. For Frequency 9kHz~30MHz:

Distance extrapolation factor =40log(Specific distance/ test distance)(dB);

Limit line=Specific limits(dBuV) + distance extrapolation factor.

For Frequency above 30MHz:

Distance extrapolation factor =20log(Specific distance/ test distance)(dB);

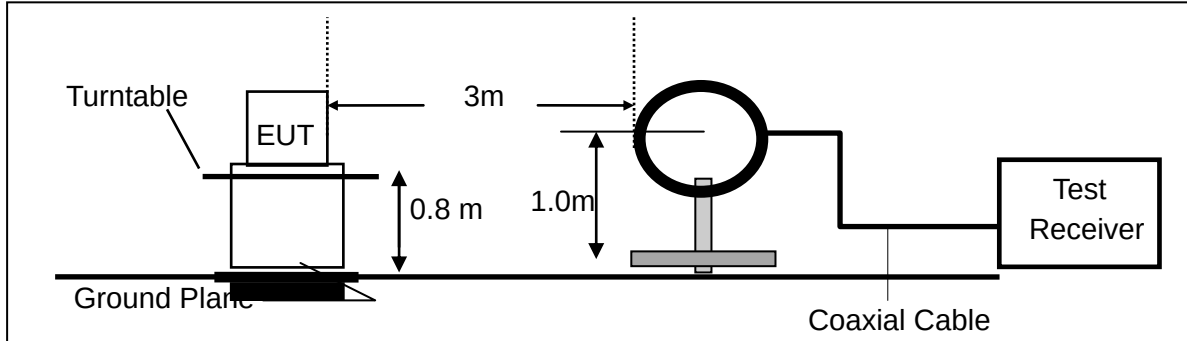
Limit line=Specific limits(dBuV) + distance extrapolation factor.

2.2.3 MEASURING INSTRUMENTS

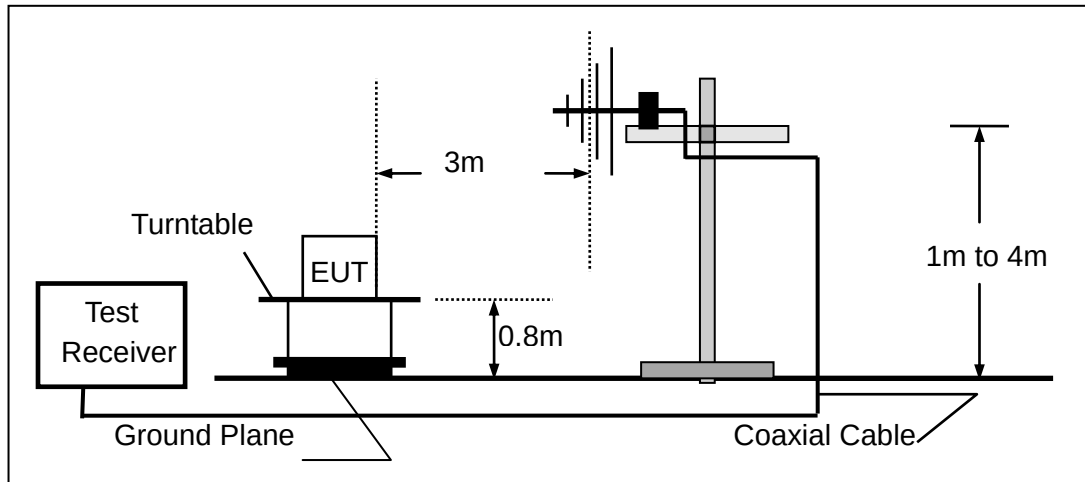
The Measuring equipment is listed in the section 6.3 of this test report.

2.2.4 TEST CONFIGURATION

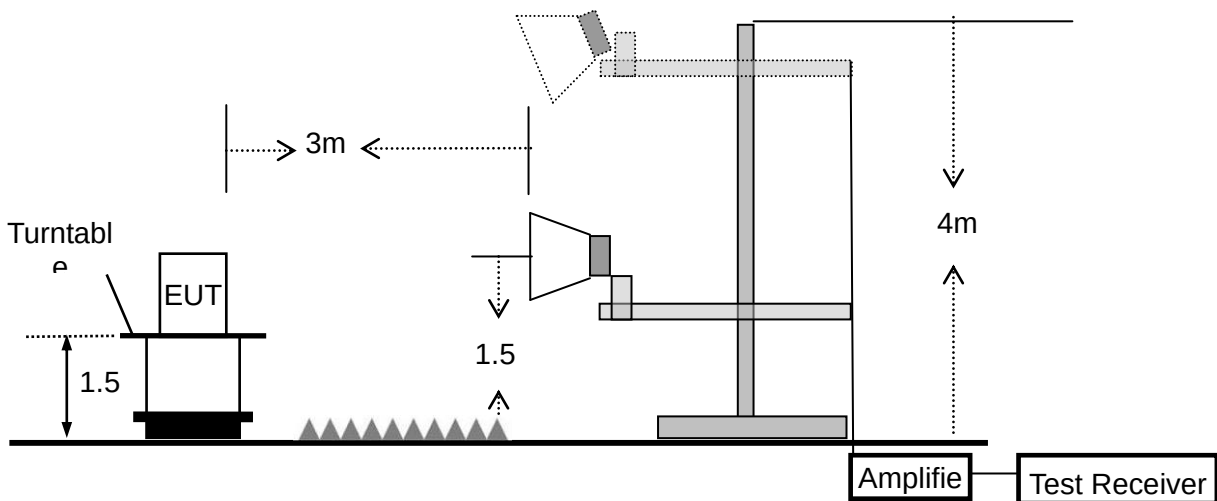
(a) For radiated emissions below 30MHz



(b) For radiated emissions from 30MHz to 1000MHz



(c) For radiated emissions above 1000MHz



2.2.5 TEST PROCEDURE

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4 dB according to the standards: ANSI C63.10-2013. The test distance is 3m. The setup is according to the requirements in Section 13.1.4.1 of ANSI C63.10-2013 and CAN/CSA-CEI/IEC CISPR 22.

This test is required for any spurious emission that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT.

Use the following spectrum analyzer settings:

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / 10Hz for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

- The measuring distance of at 3 m shall be used for measurements at frequency up to 1GHz. For frequencies above 1GHz, any suitable measuring distance may be used.
- The EUT was placed on the top of a rotating table 0.8 m for below 1GHz and 1.5m for above 1GHz the ground at a 3 meter. The table was rotated 360 degrees to determine the position of the highest radiation.
- The height of the equipment or of the substitution antenna shall be 0.8 m for below 1GHz and 1.5m for above 1GHz; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

Note:

Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported

During the radiated emission test, the Spectrum Analyzer was set with the following configurations:

Frequency Band (MHz)	Function	Resolution bandwidth	Video Bandwidth
30 to 1000	QP	120 kHz	300 kHz
Above 1000	Peak	1 MHz	1 MHz
	Average	1 MHz	10 Hz

Note: for the frequency ranges below 30 MHz, a narrower RBW is used for these ranges but the measured value should add a RBW correction factor (RBWCF) where $RBWCF [dB] = 10 \cdot \lg(100 [kHz] / \text{narrower RBW [kHz]})$. , the narrower RBW is 1 kHz and RBWCF is 20 dB for the frequency 9 kHz to 150 kHz, and the narrower RBW is 10 kHz and RBWCF is 10 dB for the frequency 150 kHz to 30 MHz.

2.2.6 TEST RESULTS (9KHZ – 30 MHZ)

EUT :	Smart Access Point	Model Name :	RA621EX
Temperature :	26 °C	Relative Humidity :	54%
Pressure:	1010 hPa	Test Voltage :	DC 48V
Test Mode :	TX	Polarization :	--

Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F
--	--	--	--	N/A
--	--	--	--	N/A

NOTE:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

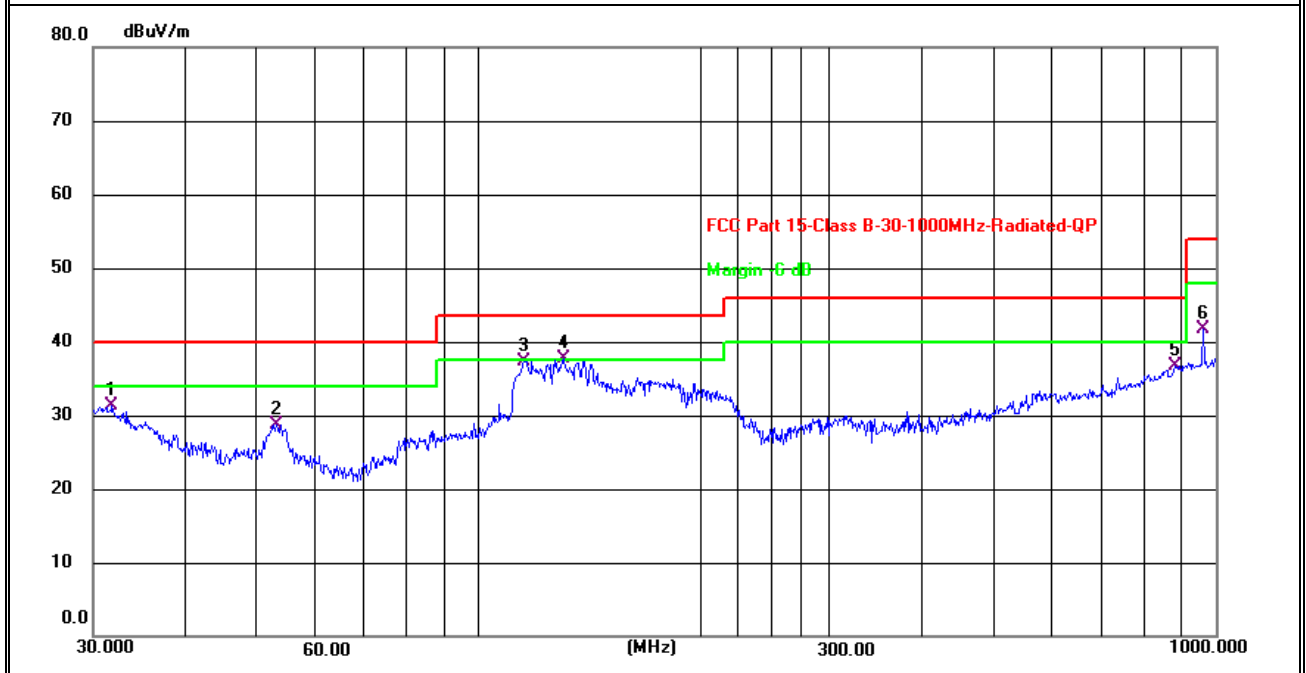
2.2.7 TEST RESULTS (30MHZ – 1GHZ)

EUT :	Smart Access Point	Model Name :	RA621EX
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010 hPa	Test Voltage :	DC 48V
Test Mode :	TX(5.2G)- 802.11ax20 MIMO Mode(Low CH)		

Polar (H/V)	Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Remark
	(MHz)	(dBuV)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	
V	31.8427	5.82	25.45	31.27	40.00	-8.73	QP
V	53.1313	15.00	13.78	28.78	40.00	-11.22	QP
V	115.3204	18.73	18.64	37.37	43.50	-6.13	QP
V	130.3790	18.79	18.86	37.65	43.50	-5.85	QP
V	881.4067	6.14	30.57	36.71	46.00	-9.29	QP
V	962.1621	10.25	31.41	41.66	54.00	-12.34	QP

Remark:

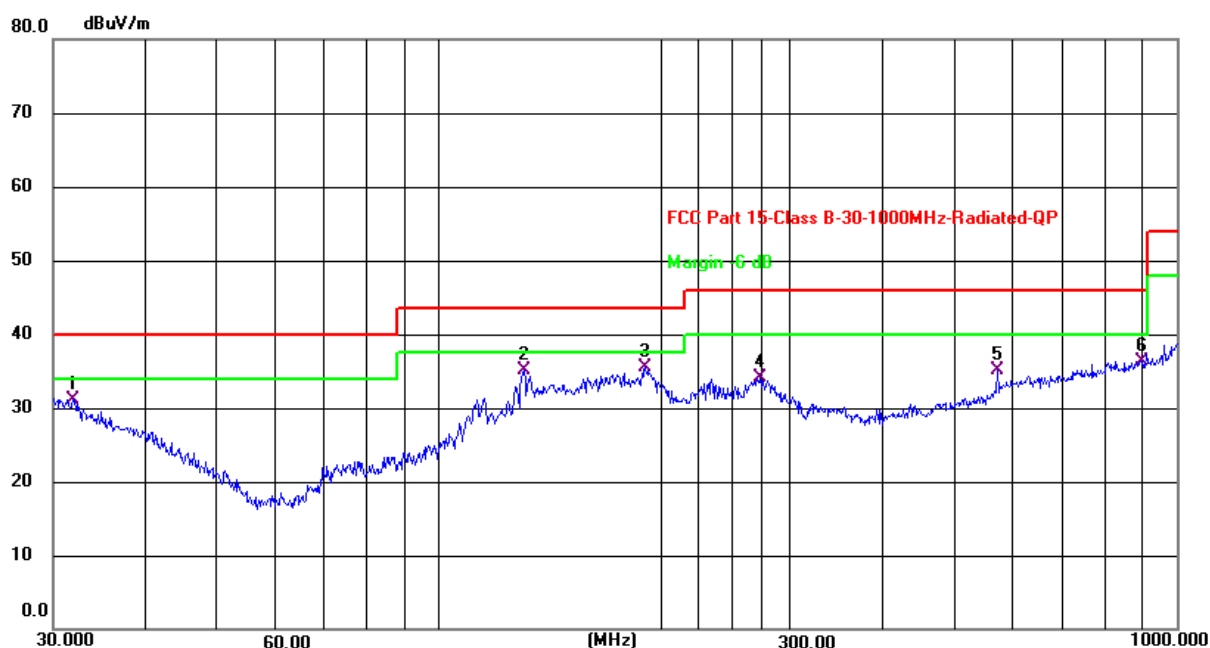
Emission Level= ReadingLevel+ Factor, Margin= Emission Level - Limit



Polar (H/V)	Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Remark
	(MHz)	(dBuV)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	
H	32.0667	5.82	25.32	31.14	40.00	-8.86	QP
H	130.3790	16.31	18.86	35.17	43.50	-8.33	QP
H	190.4050	19.08	16.46	35.54	43.50	-7.96	QP
H	272.2776	14.30	19.82	34.12	46.00	-11.88	QP
H	570.6100	9.14	25.99	35.13	46.00	-10.87	QP
H	896.9963	5.54	30.76	36.30	46.00	-9.70	QP

Remark:

Emission Level= ReadingLevel+ Factor, Margin= Emission Level - Limit

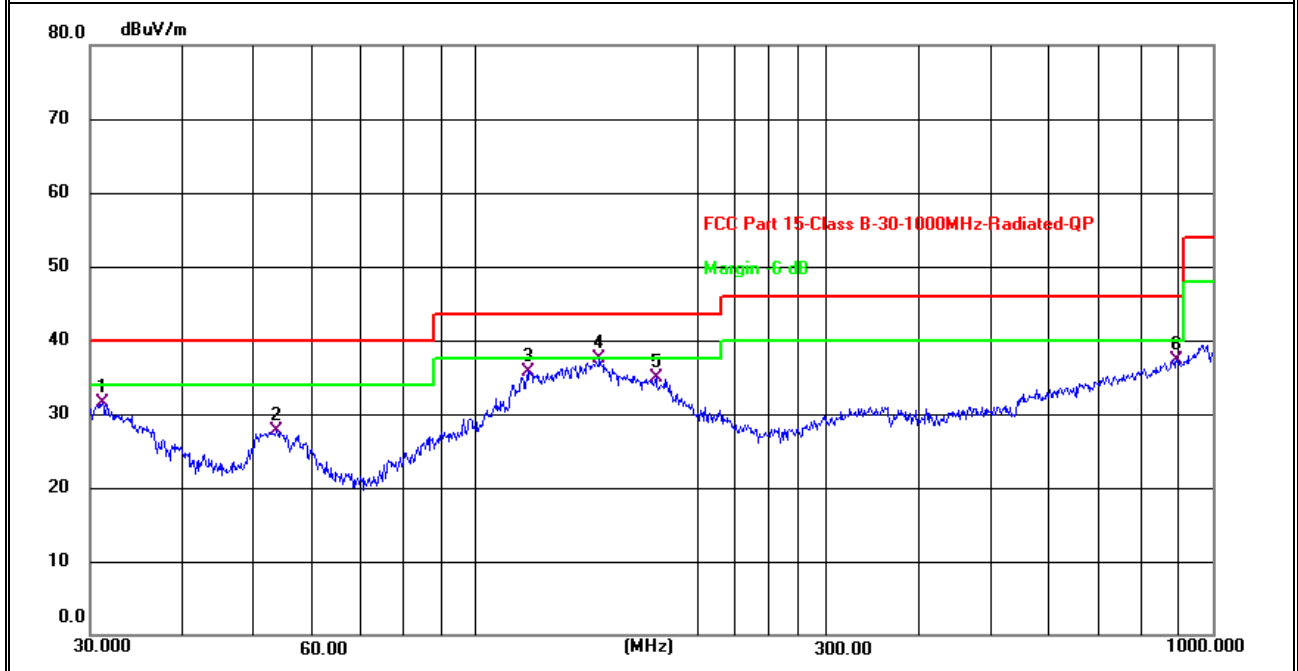


EUT :	Smart Access Point	Model Name :	RA621EX
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010 hPa	Test Voltage :	DC 48V
Test Mode :	TX(5.8G)- 802.11n20 MIMO Mode(Mid CH)		

Polar (H/V)	Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Remark
	(MHz)	(dBuV)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	
V	31.1797	5.63	25.82	31.45	40.00	-8.55	QP
V	53.6931	14.19	13.51	27.70	40.00	-12.30	QP
V	118.1860	17.07	18.69	35.76	43.50	-7.74	QP
V	147.4036	18.89	18.57	37.46	43.50	-6.04	QP
V	175.6516	17.67	17.18	34.85	43.50	-8.65	QP
V	893.8564	6.54	30.72	37.26	46.00	-8.74	QP

Remark:

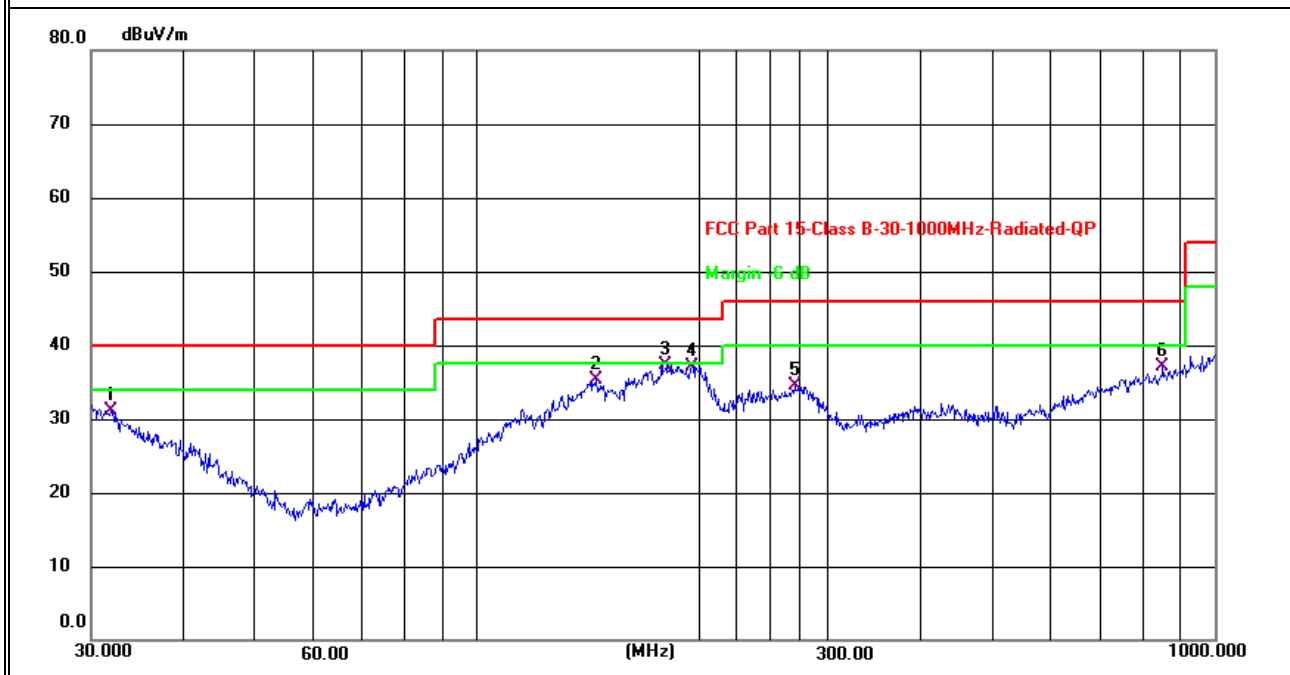
Emission Level= ReadingLevel+ Factor, Margin= Emission Level - Limit



Polar (H/V)	Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Remark
	(MHz)	(dBuV)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	
H	32.0667	5.82	25.32	31.14	40.00	-8.86	QP
H	145.3505	16.63	18.61	35.24	43.50	-8.26	QP
H	180.6484	20.47	16.90	37.37	43.50	-6.13	QP
H	195.8220	20.78	16.39	37.17	43.50	-6.33	QP
H	269.4282	14.67	19.75	34.42	46.00	-11.58	QP
H	851.0353	6.91	30.23	37.14	46.00	-8.86	QP

Remark:

Emission Level= ReadingLevel+ Factor, Margin= Emission Level - Limit



Note: All modes have been tested, just the the worst mode has been recorded in the report.

2.2.8 TEST RESULTS (1GHz-18GHz)

EUT :	Smart Access Point	Model Name. :	RA621EX
Temperature :	20 °C	Relative Humidity :	48%
Pressure :	1010 hPa	Test Voltage :	DC 48V
Test Mode :	TX(5.2G) - 802.11ax20 MIMO Mode		

Polar	Frequency	Meter Reading	Cable loss	Antenna Factor	Preamp Factor	Emission Level	Limits	Margin	Detector Type
(H/V)	(MHz)	(dBuV)	(dB)	dB/m	(dB)	(dBuV/m)	(dBuV/m)	(dB)	
Low Channel (5180 MHz)-Above 1G									
Vertical	3694.58	61.83	5.94	35.40	44.00	59.17	74.00	-14.83	Pk
Vertical	3694.50	42.67	5.94	35.40	44.00	40.01	54.00	-13.99	AV
Vertical	10360.65	58.63	8.46	39.75	44.50	62.34	68.20	-5.86	Pk
Vertical	15540.76	61.32	10.12	38.80	44.10	66.14	74.00	-7.86	Pk
Vertical	15540.79	39.94	10.12	38.80	42.70	46.16	54.00	-7.84	AV
Horizontal	3713.35	63.70	5.94	35.18	44.00	60.82	74.00	-13.18	Pk
Horizontal	3713.52	44.03	5.94	35.18	44.00	41.15	54.00	-12.85	AV
Horizontal	10360.98	59.27	8.46	38.71	44.50	61.94	68.20	-6.26	Pk
Horizontal	15540.91	57.74	10.12	38.38	44.10	62.14	74.00	-11.86	Pk
Horizontal	15540.65	41.26	10.12	38.38	44.10	45.66	54.00	-8.34	AV
middle Channel (5200 MHz)-Above 1G									
Vertical	3624.48	58.77	6.48	36.35	44.05	57.55	74.00	-16.45	Pk
Vertical	3624.42	43.30	6.48	36.35	44.05	42.08	54.00	-11.92	AV
Vertical	10400.34	60.26	8.47	37.88	44.51	62.10	68.20	-6.10	Pk
Vertical	15600.60	60.42	10.12	38.80	44.10	65.24	74.00	-8.76	Pk
Vertical	15600.62	39.81	10.12	38.80	42.70	46.03	54.00	-7.97	AV
Horizontal	4202.48	58.48	6.48	36.37	44.05	57.28	74.00	-16.72	Pk
Horizontal	4202.52	45.13	6.48	36.37	44.05	43.93	54.00	-10.07	AV
Horizontal	10400.48	61.83	8.47	38.64	44.50	64.44	68.20	-3.76	Pk
Horizontal	15600.82	60.44	10.12	38.38	44.10	64.84	74.00	-9.16	Pk
Horizontal	15600.82	41.61	10.12	38.38	44.10	46.01	54.00	-7.99	AV
High Channel (5240 MHz)-Above 1G									
Vertical	4598.08	64.10	7.10	37.24	43.50	64.94	74.00	-9.06	Pk
Vertical	4598.07	43.72	7.10	37.24	43.50	44.56	54.00	-9.44	AV
Vertical	10480.54	60.48	8.46	37.68	44.50	62.12	68.20	-6.08	Pk
Vertical	15720.68	61.88	10.12	38.80	44.10	66.70	74.00	-7.30	Pk
Vertical	15720.48	40.48	10.12	38.80	42.70	46.70	54.00	-7.30	AV
Horizontal	4589.76	61.60	7.10	37.24	43.50	62.44	74.00	-11.56	Pk
Horizontal	4589.78	41.70	7.10	37.24	43.50	42.54	54.00	-11.46	AV
Horizontal	10481.14	62.56	8.46	38.57	44.50	65.09	68.20	-3.11	Pk
Horizontal	15720.45	60.01	10.12	38.38	44.10	64.41	74.00	-9.59	Pk
Horizontal	15720.66	43.45	10.12	38.38	44.10	47.85	54.00	-6.15	AV

Note: "802.11ac20 MIMO (5G)" mode is the worst mode. PK value is lower than the Average value limit, So average didn't record.
The amplitude of spurious emissions that are attenuated by more than 20dB below the permissible value has no need to be reported. Emission level (dBuV/m) = 20 log Emission level (uV/m).
Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

EUT :	Smart Access Point	Model Name. :	RA621EX
Temperature :	20 °C	Relative Humidity :	48%
Pressure :	1010 hPa	Test Voltage :	DC 48V
Test Mode :	TX (5.8G) -- 802.11n20 MIMO Mode		

Polar	Frequency	Meter Reading	Cable loss	Antenna Factor	Preamplifier Factor	Emission Level	Limits	Margin	Detector Type
(H/V)	(MHz)	(dBuV)	(dB)	dB/m	(dB)	(dBuV/m)	(dBuV/m)	(dB)	
Low Channel (5745 MHz)-Above 1G									
Vertical	5122.79	64.02	5.94	35.40	44.00	61.36	74.00	-12.64	Pk
Vertical	5123.00	45.61	5.94	35.40	44.00	42.95	54.00	-11.05	AV
Vertical	11490.99	60.44	8.46	39.75	44.50	64.15	74.00	-9.85	Pk
Vertical	11490.85	43.70	8.46	39.75	44.50	47.41	54.00	-6.59	AV
Vertical	17235.98	52.52	10.12	38.80	44.10	57.34	68.20	-10.86	Pk
Horizontal	5167.01	59.75	5.94	35.18	44.00	56.87	68.20	-11.33	Pk
Horizontal	11490.84	59.46	8.46	38.71	44.50	62.13	74.00	-11.87	Pk
Horizontal	11490.93	42.58	8.46	38.71	44.50	45.25	54.00	-8.75	AV
Horizontal	17236.04	51.74	10.12	38.38	44.10	56.14	68.20	-12.06	Pk
middle Channel (5785 MHz)-Above 1G									
Vertical	5433.88	63.09	6.48	36.35	44.05	61.87	74.00	-12.13	Pk
Vertical	5433.80	43.35	6.48	36.35	44.05	42.13	54.00	-11.87	AV
Vertical	11570.96	60.69	8.47	37.88	44.51	62.53	74.00	-11.47	Pk
Vertical	11570.65	43.43	8.47	37.88	44.51	45.27	54.00	-8.73	AV
Vertical	17356.20	56.00	10.12	38.80	44.10	60.82	68.20	-7.38	Pk
Horizontal	4867.09	60.23	6.48	36.37	44.05	59.03	74.00	-14.97	Pk
Horizontal	4866.94	43.20	6.48	36.37	44.05	42.00	54.00	-12.00	AV
Horizontal	11570.60	62.87	8.47	38.64	44.50	65.48	74.00	-8.52	Pk
Horizontal	11570.55	44.26	8.47	38.64	44.50	46.87	54.00	-7.13	AV
Horizontal	17356.04	57.01	10.12	38.38	44.10	61.41	68.20	-6.79	Pk
High Channel (5825 MHz)-Above 1G									
Vertical	5243.76	62.10	7.10	37.24	43.50	62.94	68.20	-5.26	Pk
Vertical	11651.80	61.79	8.46	37.68	44.50	63.43	74.00	-10.57	Pk
Vertical	11651.67	43.28	8.46	37.68	44.50	44.92	54.00	-9.08	AV
Vertical	17472.85	60.59	10.12	38.80	44.10	65.41	68.20	-2.79	Pk
Vertical	17472.91	60.56	10.12	38.80	44.10	65.38	68.20	-2.82	Pk
Horizontal	5284.45	60.48	7.10	37.24	43.50	61.32	68.20	-6.88	Pk
Horizontal	11651.91	60.43	8.46	38.57	44.50	62.96	74.00	-11.04	Pk
Horizontal	11652.08	41.98	8.46	38.57	44.50	44.51	54.00	-9.49	AV
Horizontal	17473.91	58.41	10.12	38.38	44.10	62.81	68.20	-5.39	Pk
Horizontal	17473.94	58.22	10.12	38.38	44.10	62.62	68.20	-5.58	Pk

Note: "802.11n20 MIMO(5G)" mode is the worst mode. PK value is lower than the Average value limit, So average didn't record.
The amplitude of spurious emissions that are attenuated by more than 20dB below the permissible value has no need to be reported.
Emission level (dBuV/m) = 20 log Emission level (uV/m).
Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamplifier Factor = Level.

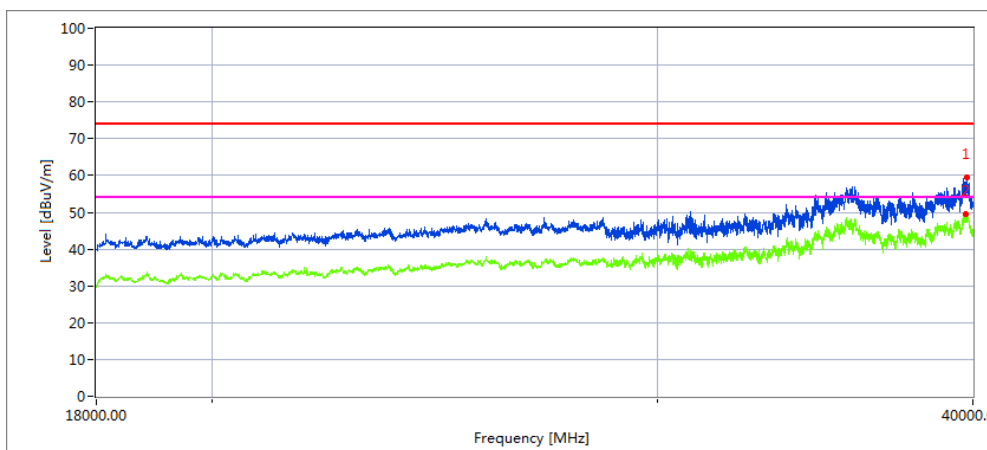
2.2.10 TEST RESULTS (18GHz-40GHz)

EUT :	Smart Access Point	Model Name. :	RA621EX
Temperature :	20 °C	Relative Humidity :	48%
Pressure :	1010 hPa	Test Voltage :	DC 48V
Test Mode :	TX (5.2G)-802.11ac20 5180MHz~5240MHz; TX (5.8G)-802.11n20 5745MHz~5825MHz		

All the modulation modes have been tested, and the worst result was report as below:

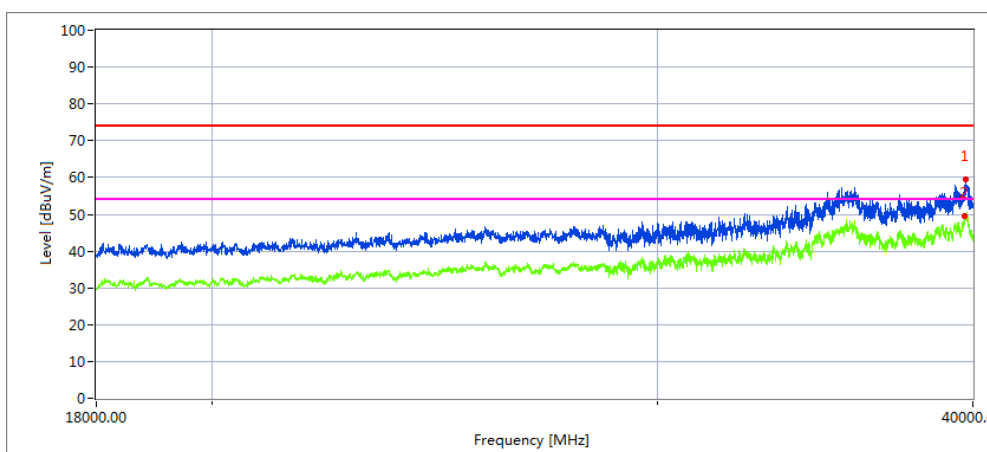
Low Channel (5180 MHz)-Above 1G

Horizontal



Frequency (MHz)	Meter Reading (dBuV)	Cable loss (dB)	Antenna Factor dB/m	Preamp Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
39768.8	39.3	20.09	44.07	43.48	59.98	68.2	8.22	Peak
39766.77	27.46	20.09	44.04	43.48	48.11	54	5.89	AVG

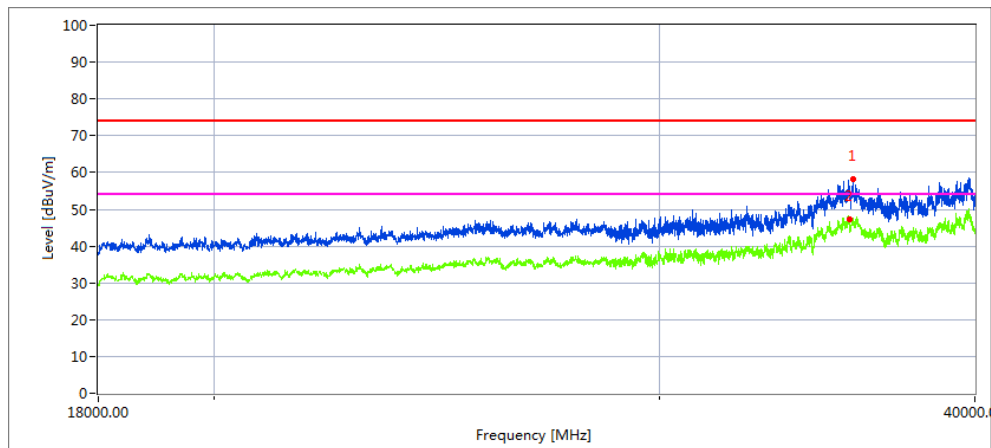
Vertical



Frequency (MHz)	Meter Reading (dBuV)	Cable loss (dB)	Antenna Factor dB/m	Preamp Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
39769.376	36	20.09	44.07	43.48	56.68	68.2	11.52	Peak
39769.155	27.41	20.09	44.04	43.48	48.06	54	5.94	AVG

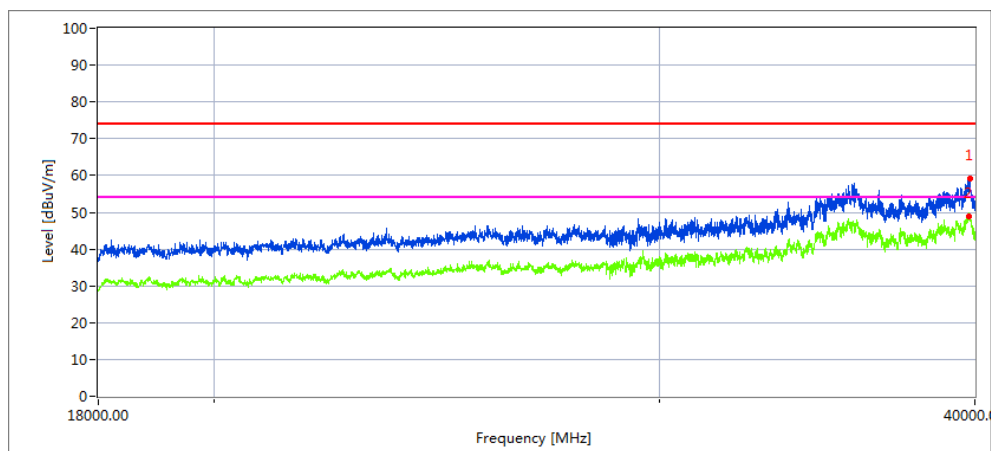
High Channel (5240 MHz)-Above 1G

Horizontal



Frequency (MHz)	Meter Reading (dBuV)	Cable loss (dB)	Antenna Factor dB/m	Preamp Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
35627.98	41	19.11	42.73	44.61	58.23	68.2	9.97	Peak
35596.476	31.62	19.11	42.73	44.61	48.85	54	5.15	AVG

Vertical

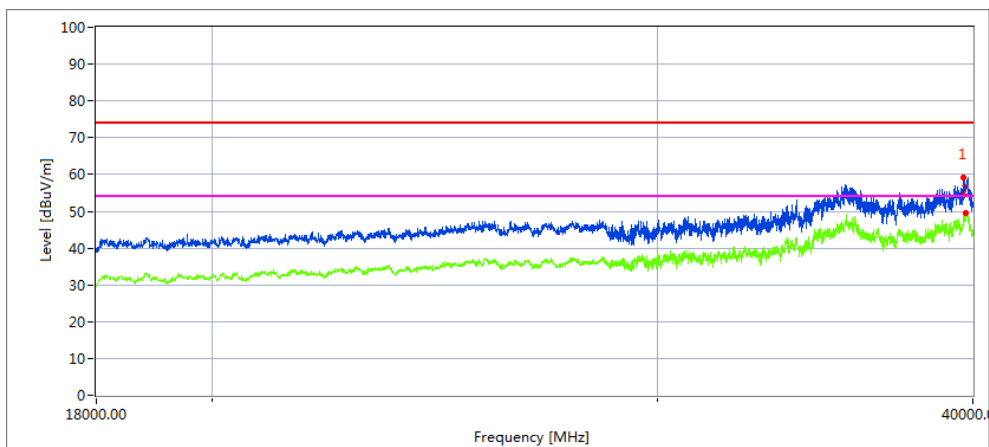


Frequency (MHz)	Meter Reading (dBuV)	Cable loss (dB)	Antenna Factor dB/m	Preamp Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
39769.326	37.28	20.09	44.07	43.48	57.96	68.2	10.24	Peak
39769.446	25.37	20.09	44.04	43.48	46.02	54	7.98	AVG

Note: 802.11ac20 MIMO mode is the worst mode.

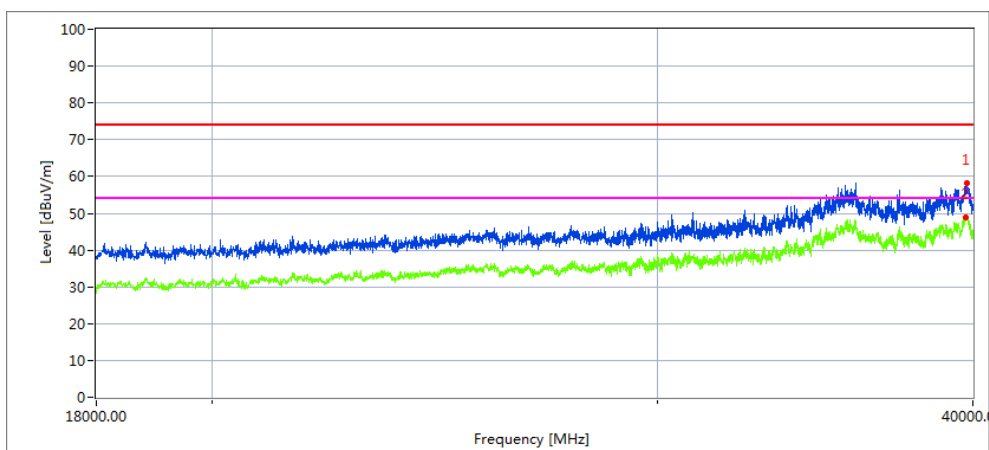
Low Channel (5745 MHz)-Above 1G

Horizontal



Frequency (MHz)	Meter Reading (dBuV)	Cable loss (dB)	Antenna Factor dB/m	Preamp Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
39669.684	38.55	20.09	44.16	43.48	59.32	68.2	8.88	Peak
39669.684	29.54	20.09	44.16	43.48	50.31	54	3.69	AVG

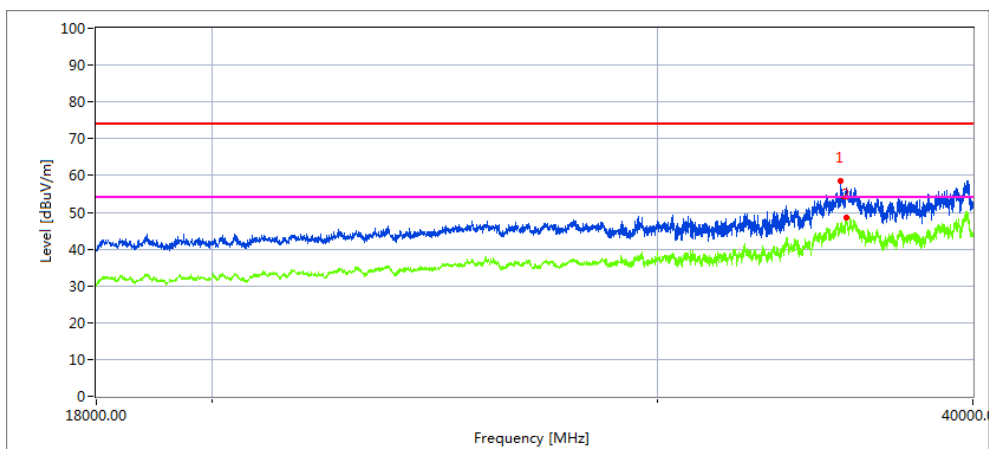
Vertical



Frequency (MHz)	Meter Reading (dBuV)	Cable loss (dB)	Antenna Factor dB/m	Preamp Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
39731.072	37.48	20.06	44.07	43.21	58.4	68.2	9.8	Peak
39731.062	28.64	20.06	44.07	43.21	49.56	54	4.44	AVG

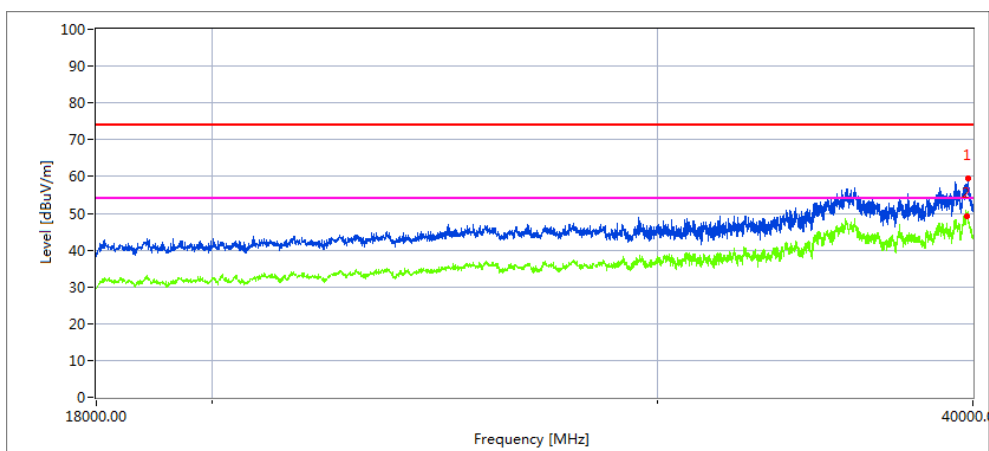
High Channel (5825 MHz)-Above 1G

Horizontal



Frequency (MHz)	Meter Reading (dBuV)	Cable loss (dB)	Antenna Factor dB/m	Preamp Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
35628.094	39.64	19.11	42.63	43.48	57.9	68.2	10.3	Peak
35635.728	29.99	19.12	42.63	43.48	48.26	54	5.74	AVG

Vertical



Frequency (MHz)	Meter Reading (dBuV)	Cable loss (dB)	Antenna Factor dB/m	Preamp Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
39821.663	38.57	20.1	44.1	43.22	59.55	68.2	8.65	Peak
39821.723	29.13	20.1	44.1	43.22	50.11	54	3.89	AVG

Note:802.11n20 MIMO mode is the worst mode.

2.2.10 Spurious Emission in Restricted Band 4.5GHz~5.150 GHz& 5.350GHz~5460GHz

EUT :	Smart Access Point	Model Name. :	RA621EX
Temperature :	20 °C	Relative Humidity :	48%
Pressure :	1010 hPa	Test Voltage :	DC 48V
Test Mode :	TX (5.2G)-802.11ac20 MIMO Mode 5180MHz~5240MHz,		

All the modulation modes have been tested, The report just record the worst data mode.

Frequency	Meter Reading	Cable Loss	Antenna Factor	Preamplifier Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBμV)	(dB)	dB/m	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type	
5.2G WIFI-802.11ac20 MIMO Mode									
4500	56.36	5.2	35.6	44.2	52.96	74	-21.04	Pk	Horizontal
4500	47.28	5.2	35.6	44.2	43.88	54	-10.12	AV	Horizontal
4500	59.44	5.2	35.6	44.2	56.04	74	-17.96	Pk	Vertical
4500	46.52	5.2	35.6	44.2	43.12	54	-10.88	AV	Vertical
5150	70.49	5.36	35.66	44.22	67.29	74	-6.71	Pk	Horizontal
5150	49.87	5.36	35.66	44.22	46.67	54	-7.33	AV	Horizontal
5150	57.10	5.36	35.66	44.22	53.9	74	-20.1	Pk	Vertical
5150	38.27	5.36	35.66	44.22	35.07	54	-18.93	AV	Vertical
5350	65.67	5.68	35.68	44.22	62.81	74	-11.19	Pk	Vertical
5350	47.40	5.68	35.68	44.22	44.54	54	-9.46	AV	Vertical
5350	60.90	5.68	35.68	44.22	58.04	74	-15.96	Pk	Horizontal
5350	45.83	5.68	35.68	44.22	42.97	54	-11.03	AV	Horizontal

Note: (1) Emission Level= Antenna Factor + Cable Loss + Read Level - Preamplifier Factor

(2) "802.11ac20 MIMO " mode is the worst mode. When PK value is lower than the Average value limit, average don't record.

3. POWER SPECTRAL DENSITY TEST

3.1 APPLIED PROCEDURES / LIMIT

According to FCC §15.407(a)

For the band 5.15-5.25 GHz,

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For client devices in the 5.15-5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the band 5.725-5.85 GHz

(3) For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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3.2 TEST PROCEDURE

For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in § 15.407(a)(5). For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, “provided that the measured power is integrated over the full reference bandwidth” to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500 KHz bandwidth, the following adjustments to the procedures apply:

- a) Set $RBW \geq 1/T$, where T is defined in section II.B.I.a).
- b) Set $VBW \geq 3$ RBW.
- c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add $10\log(500\text{kHz}/RBW)$ to the measured result, whereas $RBW (< 500 \text{ KHz})$ is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
- d) If measurement bandwidth of Maximum PSD is specified in 1 MHz, add $10\log(1\text{MHz}/RBW)$ to the measured result, whereas $RBW (< 1 \text{ MHz})$ is the reduced resolution bandwidth of spectrum analyzer set during measurement.
- e) Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

Note: As a practical matter, it is recommended to use reduced RBW of 100 KHz for the sections 5.c) and 5.d) above, since $RBW=100 \text{ KHz}$ is available on nearly all spectrum analyzers.

3.3 DEVIATION FROM STANDARD

No deviation.

3.4 TEST SETUP



3.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.1 Unless otherwise a special operating condition is specified in the follows during the testing.

3.6 TEST RESULTS

EUT :	Smart Access Point	Model Name :	RA621EX
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1015 hPa	Test Voltage :	DC 48V
Test Mode :	TX Frequency Band 1 (5180-5240MHz), Band 3 (5745-5825MHz)		

Note:

For 802.11n/ax has MIMO mode. Directional gain=GANT + Array Gain=5.17+3.01=8.18dBi

Band1 For 802.11n/ac/ax 5GHz has MIMO mode.

8.18dBi>6.0dBi so power spectral density limit = 14.82dBm

Band 3 For 802.11n/ac 5GHz has MIMO mode.

8.18dBi>6.0dBi so power spectral density limit = 27.82dBm

Test data reference attachment.

4. 26DB & 99% EMISSION BANDWIDTH

4.1 APPLIED PROCEDURES / LIMIT

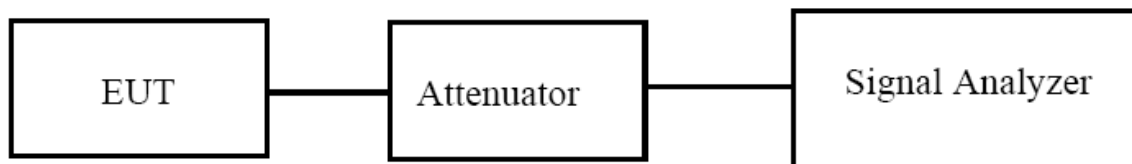
The maximum power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements in the 5.725-5.85 GHz band are made over a reference bandwidth of 500 kHz or the 26 dB emission bandwidth of the device, whichever is less. Measurements in the 5.15-5.25 GHz, 5.25-5.35 GHz, and the 5.47-5.725 GHz bands are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full reference bandwidth.

4.2 TEST PROCEDURE

- a) Set RBW = approximately 1% of the emission bandwidth.
- b) Set the VBW > RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

The following procedure shall be used for measuring (99 %) power bandwidth:

1. Set center frequency to the nominal EUT channel center frequency.
2. Set span = 1.5 times to 5.0 times the OBW.
3. Set RBW = 1 % to 5 % of the OBW
4. Set VBW $\geq 3 \cdot$ RBW
5. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
6. Use the 99 % power bandwidth function of the instrument (if available).
7. If the instrument does not have a 99 % power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5 % of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies.



4.3 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

4.4 TEST RESULTS

EUT :	Smart Access Point	Model Name :	RA621EX
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1012 hPa	Test Voltage :	DC 48V
Test Mode :	TX Frequency Band 1 (5180-5240MHz), Band 3 (5745-5825MHz)		

Test data reference attachment.

5. MINIMUM 6 DB BANDWIDTH

5.1 APPLIED PROCEDURES / LIMIT

According to FCC §15.407(e)

(e) Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

5.2 TEST PROCEDURE

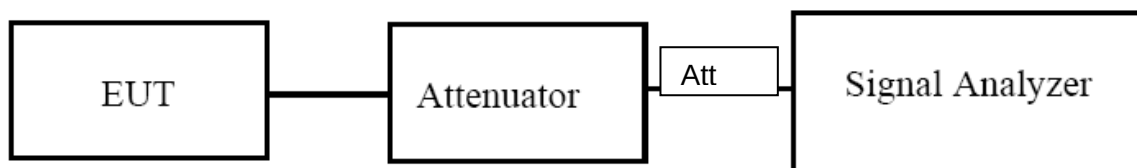
Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for the band 5.715-5.85 GHz. The following procedure shall be used for measuring this bandwidth:

- a) Set RBW = 100 kHz.
- b) Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

5.3 DEVIATION FROM STANDARD

No deviation.

5.4 TEST SETUP



5.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

5.6 TEST RESULTS

EUT :	Smart Access Point	Model Name :	RA621EX
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1012 hPa	Test Voltage :	DC 48V
Test Mode :	TX (5G) Mode Frequency Band 3 (5745-5825MHz)		

Test data reference attachment.

6. MAXIMUM CONDUCTED OUTPUT POWER

6.1 PPLIED PROCEDURES / LIMIT

According to FCC §15.407

The maximum conducted output power should not exceed:

Frequency Band(MHz)	Limit
5150~5250	1W
5250~5350	250 mW or 11 dBm + 10 log B Note: The limit is the smaller of the two, "B" represents -26dB bandwidth.
5470~5725	250 mW or 11 dBm + 10 log B Note: The limit is the smaller of the two, "B" represents -26dB bandwidth.
5725~5850	1W

6.2 TEST PROCEDURE

The testing follows Measurement Procedure Subclause 12.3.3.2 of ANSI C63.10

12.3.3.2 Method PM-G

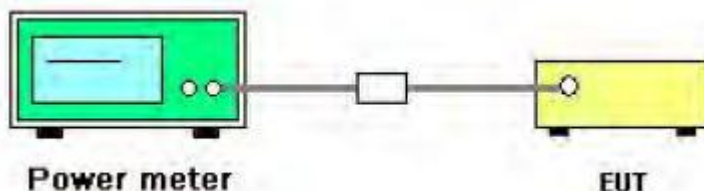
Method PM-G is measurement using a gated RF average power meter.

Measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Because the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

6.3 DEVIATION FROM STANDARD

No deviation.

6.4 TEST SETUP



6.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

6.2 TEST RESULTS

EUT :	Smart Access Point	Model Name :	RA621EX
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1012 hPa	Test Voltage :	DC 48V
Test Mode :	TX (5G) Mode Frequency Band 1 (5180-5240MHz), Band 3 (5745-5825MHz)		

Note:

For 802.11n/ax has MIMO mode. Directional gain=GANT + Array Gain=5.17+0=5.17dBi

Band1 For 802.11n/ac/ax 5GHz has MIMO mode.

6.0dBi>5.17dBi so output power limit = 30dBm

Band 3 For 802.11n/ac 5GHz has MIMO mode.

6.0dBi>5.17dBi so output power limit = 30dBm

Test data reference attachment. The duty cycle factor has increased in the test result.

7. OUT OF BAND EMISSIONS

7.1 APPLICABLE STANDARD

According to FCC §15.407(b)

Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

- (1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (4) For transmitters operating in the 5.725-5.85 GHz band:
 - (i) All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.
 - (ii) Devices certified before March 2, 2017 with antenna gain greater than 10 dBi may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease by March 2, 2018. Devices certified before March 2, 2018 with antenna gain of 10 dBi or less may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease before March 2, 2020.

7.2 TEST PROCEDURE

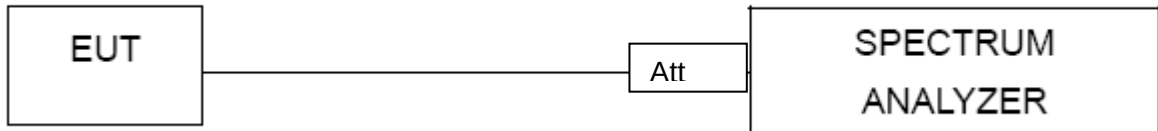
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 1 MHz with a convenient frequency span.

4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

7.3 DEVIATION FROM STANDARD

No deviation.

7.4 TEST SETUP



7.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

7.6 TEST RESULTS

EUT :	Smart Access Point	Model Name :	RA621EX
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1012 hPa	Test Voltage :	DC 48V

Test data reference attachment.

NOTE: The 27GHz-40GHz amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

8. Frequency Stability Measurement

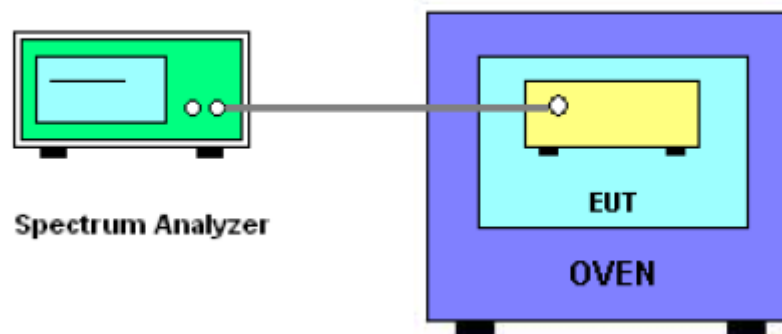
8.1 LIMIT

Manufactures of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

8.2 TEST PROCEDURES

1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. EUT have transmitted absence of modulation signal and fixed channelize.
3. Set the spectrum analyzer span to view the entire absence of modulation emissions bandwidth.
4. Set RBW = 10 kHz, VBW = 10 kHz with peak detector and maxhold settings.
5. f_c is declaring of channel frequency. Then the frequency error formula is $(f_c - f)/f_c \times 10^6$ ppm and the limit is less than ± 20 ppm (IEEE 802.11 specification).
6. The test extreme voltage is to change the primary supply voltage from 85 to 115 percent of the nominal value
7. Extreme temperature is $-20^{\circ}\text{C} \sim 70^{\circ}\text{C}$.

8.3 TEST SETUP LAYOUT



8.4 EUT OPERATION DURING TEST

1. The EUT was programmed to be in continuously un-modulation transmitting mode.
2. The module has two antennas, and the worst data is Antenna 1, only shown Antenna 1 Plot.

8.5 TEST RESULTS

EUT :	Smart Access Point	Model Name. :	RA621EX
Temperature :	25 °C	Relative Humidity :	56%
Pressure :	1012 hPa	Test Voltage :	DC 48V
Test Mode :	TX Frequency Band I (5180-5240MHz) -5.2G		

Voltage vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5180MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
T nom (°C)	20	V nom (V)	48.00	5180.0248	5180	0.0248	-4.7876
		V max (V)	55.20	5180.0142	5180	0.0142	-2.7413
		V min (V)	40.80	5180.0292	5180	0.0292	-5.6371
Limits				Within 5150-5250MHz			
Result				Complies			

Temperature vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5180MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
V nom (V)	48	T (°C)	-20	5180.0101	5180	0.0101	-1.9498
		T (°C)	-10	5180.0335	5180	0.0335	-6.4672
		T (°C)	0	5180.0044	5180	0.0044	-0.8494
		T (°C)	10	5180.0029	5180	0.0029	-0.5598
		T (°C)	20	5180.0223	5180	0.0223	-4.3050
		T (°C)	30	5180.0143	5180	0.0143	-2.7606
		T (°C)	40	5180.0340	5180	0.0340	-6.5637
		T (°C)	50	5180.0108	5180	0.0108	-2.0849
		T (°C)	60	5180.0097	5180	0.0097	-1.8726
		T (°C)	70	5180.0209	5180	0.0209	-4.0347
Limits				Within 5150-5250MHz			
Result				Complies			

Voltage vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5200MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
T nom (°C)	20	V nom (V)	48.00	5200.0053	5200	0.0053	-1.0192
		V max (V)	55.20	5200.0223	5200	0.0223	-4.2885
		V min (V)	40.80	5200.0253	5200	0.0253	-4.8654
Limits				Within 5150-5250MHz			
Result				Complies			

Temperature vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5200MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
V nom (V)	48	T (°C)	-20	5200.0212	5200	0.0212	-4.0769
		T (°C)	-10	5200.0102	5200	0.0102	-1.9615
		T (°C)	0	5200.0061	5200	0.0061	-1.1731
		T (°C)	10	5200.0017	5200	0.0017	-0.3269
		T (°C)	20	5200.0269	5200	0.0269	-5.1731
		T (°C)	30	5200.0190	5200	0.0190	-3.6538
		T (°C)	40	5200.0142	5200	0.0142	-2.7308
		T (°C)	50	5200.0202	5200	0.0202	-3.8846
		T (°C)	60	5200.0246	5200	0.0246	-4.7308
		T (°C)	70	5200.0080	5200	0.0080	-1.5385
Limits				Within 5150-5250MHz			
Result				Complies			

Voltage vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5240MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
T nom (°C)	20	V nom (V)	48.00	5240.0077	5240	0.0077	-1.4695
		V max (V)	55.20	5240.022	5240	0.0220	-4.1985
		V min (V)	40.80	5240.0099	5240	0.0099	-1.8893
Limits				Within 5150-5250MHz			
Result				Complies			

Temperature vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5240MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
V nom (V)	48	T (°C)	-20	5240.0054	5240	0.0054	-1.0305
		T (°C)	-10	5240.0314	5240	0.0314	-5.9924
		T (°C)	0	5240.0067	5240	0.0067	-1.2786
		T (°C)	10	5240.0145	5240	0.0145	-2.7672
		T (°C)	20	5240.0130	5240	0.0130	-2.4809
		T (°C)	30	5240.0006	5240	0.0006	-0.1145
		T (°C)	40	5240.0222	5240	0.0222	-4.2366
		T (°C)	50	5240.0071	5240	0.0071	-1.3550
		T (°C)	60	5240.0106	5240	0.0106	-2.0229
		T (°C)	70	5240.0102	5240	0.0102	-1.9466
Limits				Within 5150-5250MHz			
Result				Complies			

EUT :	Smart Access Point	Model Name. :	RA621EX
Temperature :	25 °C	Relative Humidity :	56%
Pressure :	1012 hPa	Test Voltage :	DC 48V
Test Mode :	TX Frequency(5745-5825MHz) -5.8G		

Voltage vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5745MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
T nom (°C)	20	V nom (V)	48.00	5745.0158	5745	0.01580	-2.7502
		V max (V)	55.20	5745.0319	5745	0.03190	-5.5527
		V min (V)	40.80	5745.022	5745	0.02200	-3.8294
Limits				Within 5745-5850MHz			
Result				Complies			

Temperature vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5745MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
V nom (V)	48	T (°C)	-20	5745.0002	5745	0.00020	-0.0348
		T (°C)	-10	5745.0134	5745	0.01340	-2.3325
		T (°C)	0	5745.0024	5745	0.00240	-0.4178
		T (°C)	10	5745.0043	5745	0.00430	-0.7485
		T (°C)	20	5745.0161	5745	0.01610	-2.8024
		T (°C)	30	5745.0132	5745	0.01320	-2.2977
		T (°C)	40	5745.0079	5745	0.00790	-1.3751
		T (°C)	50	5745.0071	5745	0.00710	-1.2359
		T (°C)	60	5745.0089	5745	0.00890	-1.5492
		T (°C)	70	5745.0118	5745	0.01180	-2.0540
Limits				Within 5745-5850MHz			
Result				Complies			

Voltage vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5785MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
T nom (°C)	20	V nom (V)	48.00	5785.0197	5785	0.01970	-3.4054
		V max (V)	55.20	5785.0227	5785	0.02270	-3.9239
		V min (V)	40.80	5785.0299	5785	0.02990	-5.1685
Limits				Within 5745-5850MHz			
Result				Complies			

Temperature vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5785MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
V nom (V)	48	T (°C)	-20	5785.0282	5785	0.02820	-4.8747
		T (°C)	-10	5785.0138	5785	0.01380	-2.3855
		T (°C)	0	5785.0156	5785	0.01560	-2.6966
		T (°C)	10	5785.0274	5785	0.02740	-4.7364
		T (°C)	20	5785.0004	5785	0.00040	-0.0691
		T (°C)	30	5785.0331	5785	0.03310	-5.7217
		T (°C)	40	5785.0211	5785	0.02110	-3.6474
		T (°C)	50	5785.0192	5785	0.01920	-3.3189
		T (°C)	60	5785.0216	5785	0.02160	-3.7338
		T (°C)	70	5785.0300	5785	0.03000	-5.1858
Limits				Within 5745-5850MHz			
Result				Complies			

Voltage vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5825MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
T nom (°C)	20	V nom (V)	48.00	5825.0155	5825	0.01550	-2.6609
		V max (V)	55.20	5825.0267	5825	0.02670	-4.5837
		V min (V)	40.80	5825.0067	5825	0.00670	-1.1502
Limits				Within 5745-5850MHz			
Result				Complies			

Temperature vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5825MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
V nom (V)	48	T (°C)	-20	5825.0269	5825	0.02690	-4.6180
		T (°C)	-10	5825.0118	5825	0.01180	-2.0258
		T (°C)	0	5825.0095	5825	0.00950	-1.6309
		T (°C)	10	5825.0244	5825	0.02440	-4.1888
		T (°C)	20	5825.0265	5825	0.02650	-4.5494
		T (°C)	30	5825.0282	5825	0.02820	-4.8412
		T (°C)	40	5825.0144	5825	0.01440	-2.4721
		T (°C)	50	5825.0197	5825	0.01970	-3.3820
		T (°C)	60	5825.0151	5825	0.01510	-2.5923
		T (°C)	70	5825.0021	5825	0.00210	-0.3605
Limits				Within 5745-5850MHz			
Result				Complies			

Note: antenna 1 is the worst case.

9. ANTENNA REQUIREMENT

9.1 STANDARD REQUIREMENT

15.203 requirement: 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.

9.2 EUT ANTENNA

The EUT antenna is External Antenna. It comply with the standard requirement.

10. TEST RESULT

Refer to attachment