FCC RADIO TEST REPORT

FCC ID	:	W59XAP1610
Equipment	:	Apex Wave 2 AC3100 Dual-Band Wireless AP
Brand Name	:	Luxul
Model Name	:	XAP-1610, XWS-2610
Applicant	:	Luxul Wireless 12884 S Frontrunner Blvd Suite 201 Draper Utah United States 84020
Standard	:	47 CFR FCC Part 15.247

The product was received on Apr. 09, 2018, and testing was started from Sep. 18, 2018 and completed on Nov. 01, 2018. We, SPORTON INTERTIONAL INC. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2013 and shown compliance with the applicable technical standards.

The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

The test results in this variant report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERTIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Approved by: Sam Chen

SPORTON INTERTIONAL INC. EMC & Wireless Communications Laboratory
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

Table of Contents

History of this test report

Report No.	Version	Description	Issued Date
FR841602-01AA	01	Initial issue of report	Nov. 27, 2018

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
1.1.2	15.203	Antenna Requirement	PASS	-
3.1	15.247(d)	Emissions in Non-restricted Frequency Bands	PASS	-

Declaration of Conformity:
The judgment of conformity in the report is based on the measurement results excluding the measurement uncertainty.
Comments and Explanations:
All the specification of test configurations and test modes were based on customer's request.

Reviewed by: Sam Chen
Report Producer: Sandy Chuang

1 General Description

1.1 Information

1.1.1 RF General Information

Frequency Range (MHz)	IEEE Std. 802.11	Ch. Frequency (MHz)	Channel Number
2400-2483.5	b, g, n (HT20), ac (VHT20)	2412-2462	1-11 [11]
2400-2483.5	n (HT40), ac (VHT40)	2422-2452	3-9 [7]

Band	Mode	BWch (MHz)	Nant
2.4-2.4835GHz	802.11b	20	4TX
2.4-2.4835GHz	802.11g	20	4TX
2.4-2.4835GHz	802.11n HT20	20	4TX
2.4-2.4835GHz	802.11n HT20-BF	20	4TX
2.4-2.4835GHz	802.11ac VHT20	20	4TX
2.4-2.4835GHz	802.11ac VHT20-BF	20	4TX
2.4-2.4835GHz	802.11n HT40	40	4TX
2.4-2.4835GHz	802.11n HT40-BF	40	4TX
2.4-2.4835GHz	802.11ac VHT40	40	4TX
2.4-2.4835GHz	802.11ac VHT40-BF	40	4TX

Note:
- 11b mode uses a combination of DSSS-DBPSK, DQPSK, CCK modulation.
- 11g, HT20 and HT40 use a combination of OFDM-BPSK, QPSK, 16QAM, 64QAM modulation.
- VHT20, VHT40 use a combination of OFDM-BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM modulation.
- BWch is the nominal channel bandwidth.
- Nss-Min is the minimum number of spatial streams.
- Nant is the number of outputs. e.g., 2(2,3) means have 2 outputs for port 2 and port 3. 2 means have 2 outputs for port 1 and port 2.

1.1.2 Antenna Information

Ant.	Port	Brand	P/N	Antenna Type	Connector	Gain (dBi)	
						2.4GHz	5GHz
1	1	Hong Lin	290-20336	PIFA Antenna	I-PEX	2.76	3.23
2	2	Hong Lin	290-20337	PIFA Antenna	I-PEX	2.75	3.28
3	3	Hong Lin	290-20338	PIFA Antenna	I-PEX	2.33	3.58
4	4	Hong Lin	290-20339	PIFA Antenna	I-PEX	3.50	4.00

Note: The EUT has four antennas.
Port 1, Port 2, Port 3 and Port 4 could transmit/receive simultaneously.

1.1.3 EUT Operational Condition

EUT Power Type	From PoE			
Beamforming Function	☒	With beamforming	☐	Without beamforming
	The product has beamforming function for 802.11n/ac.			
Function	☒	Point-to-multipoint	☐	Point-to-point
Test Software Version	accessMTool_3_0_0_6			

1.1.4 Table for Multiple Listing

The EUT has two model names which are identical to each other in all aspects except for the following table:

Model Name	Description
XAP-1610	There is nothing different of two models, just for different marketing use.
XWS-2610	

From the above models, model: XAP-1610 was selected as representative model for the test and its data was recorded in this report.

1.1.5 Table for Class II Change

This product is an extension of original one reported under Sporton project number: FR841602AA

Below is the table for the change of the product with respect to the original one.

Modifications	Performance Checking
1. Changing the manufacture of IC Chip to TSMC (Part number: BCM4366EKMMLW1G) from UMC (Part number: BCM4366EKMMLWG). 2. Changing the antenna cable location.	Emissions in Restricted Frequency Bands 1. Below 1GHz Based on original output power to measure below test item: 2. Above 1GHz: 11b / 2437MHz - Non-Beamforming
3. Removing the PoE 2 (Brand Name: GOSPELL, Model Name: G0545-560-054-POE1000) and a power cable.	It does not need to re-test.

Note: The IC Chip design of the BCM4366EKMMLWG is the same as the BCM4366EKMMLW1G for 802.11a/b/g/n/ac functions. There is no change in terms of the HT20/40 and VHT/20/40/80 modulations. The two chips are pin to pin compatible in the 12x12mm package. Different part numbers are used to identify parts produced out of different manufacturing locations.

1.2 Testing Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR FCC Part 15
- ANSI C63.10-2013
- FCC KDB 558074 D01 v05
- FCC KDB 662911 D01 v02r01

1.3 Testing Location Information

Testing Location			
☐	HWA YA	ADD :	No. 52, Hwa Ya 1st Rd., Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.
		TEL :	886-3-327-3456 FAX : 886-3-318-0055
☒	JHUBEI	ADD :	No.8, Lane 724, Bo-ai St., Jhubei City, HsinChu County 302, Taiwan, R.O.C.
		TEL :	886-3-656-9065 FAX : 886-3-656-9085

Test Condition	Test Site No.	Test Engineer	Test Environment	Test Date
Radiated	03CH01-CB	KJ Huang	24.7°C / 65%	Sep. 18, 2018~ Nov. 01, 2018

Test site Designation No. TW0006 with FCC.
Test site registered number IC 4086D with Industry Canada.

1.4 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Test Items	Uncertainty	Remark
Radiated Emission (30MHz ~ 1,000MHz)	3.6 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	3.7 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	3.5 dB	Confidence levels of 95%

2 Test Configuration of EUT

2.1 The Worst Case Measurement Configuration

The Worst Case Mode for Following Conformance Tests	
Tests Item	Emissions in Restricted Frequency Bands
Test Condition	Radiated measurement If EUT consist of multiple antenna assembly (multiple antenna are used in EUT regardless of spatial multiplexing MIMO configuration), the radiated test should be performed with highest antenna gain of each antenna type.
Operating Mode < 1GHz	Normal Link
The test condition as below: 1.EUT in Z axis 2.EUT in Y axis 3.local EUT / remote PoE 4.local PoE / remote EUT “EUT Z axis + PoE (local EUT / remote PoE)” generated the worst test result test from original report, So the measurement will follow this same test configuration.	
1	EUT Z axis + PoE (local EUT / remote PoE)
Operating Mode > 1GHz	CTX
The EUT can be placed in Y-axis and Z-axis. After evaluating, “Y axis” generated the worst test result from original report, So the measurement will follow this same test configuration.	
1	EUT Y axis

2.2 EUT Operation during Test

For CTX Mode:

The EUT was programmed to be in continuously transmitting mode.

For Normal Link:

During the test, the EUT operation to normal function.

2.3 Accessories

Accessories				
No.	**Equipment Name**	**Brand Name**	**Model Name**	**Rating**
1	PoE	PHIHONG	POE29U-560	INPUT: 100-240Vac~0.8A, 50-60Hz OUTPUT: 56Vdc, 0.536A
No.	**Other**			
2	Wall-mounted rack*1			
3	Power cable*1: Non-shielded, 1.8m			
4	RJ-45 cable*1: Non-shielded, 1m			

2.4 Support Equipment

For Test Site No: 03CH01-CB (below 1GHz)

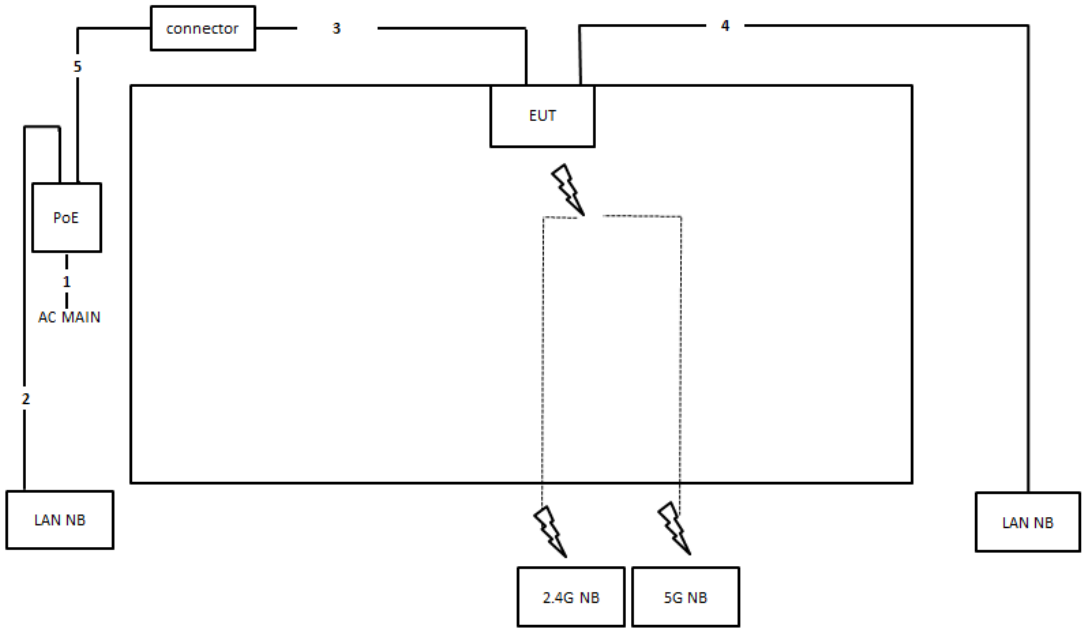
Support Equipment				
No.	**Equipment**	**Brand Name**	**Model Name**	**FCC ID**
1	NB*4	DELL	E4300	N/A

For Test Site No: 03CH01-CB (above 1GHz)

Support Equipment				
No.	**Equipment**	**Brand Name**	**Model Name**	**FCC ID**
1	NB	DELL	E4300	N/A

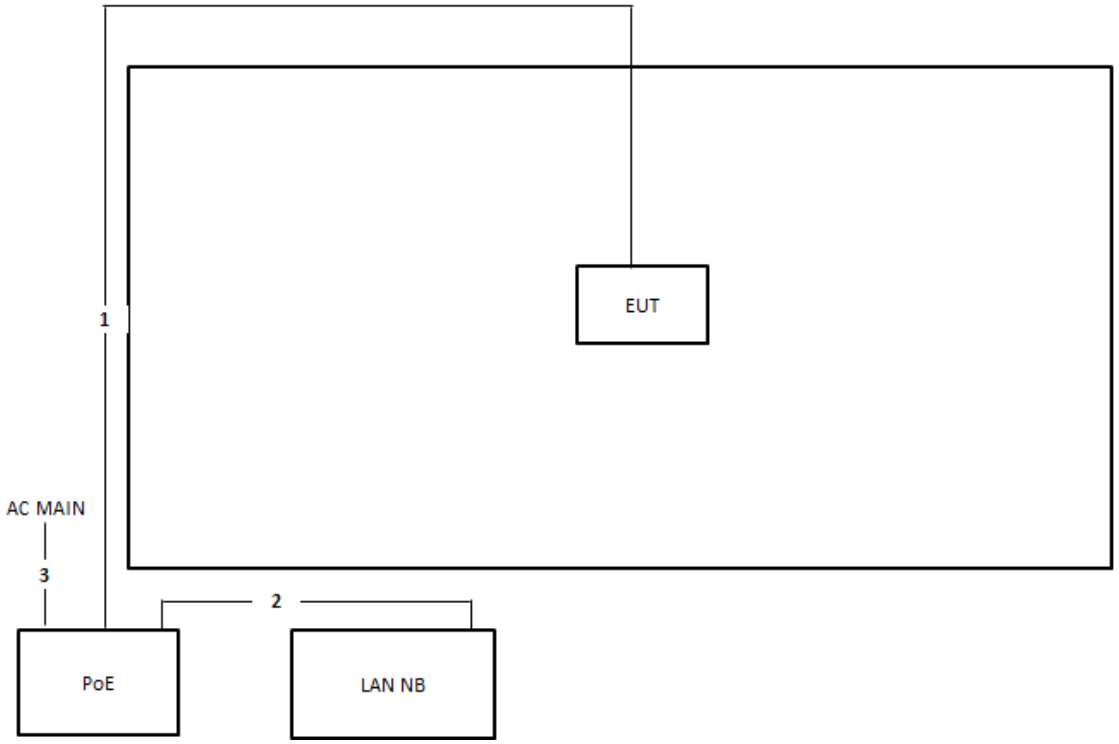
2.5 Test Setup Diagram

Test Setup Diagram - Radiated Test < 1GHz



Item	Connection	Shielded	Length
1	Power cable	No	1.8m
2	RJ-45 cable	No	1.5m
3	RJ-45 cable	No	1m
4	RJ-45 cable	No	10m
5	RJ-45 cable	No	10m

Test Setup Diagram - Radiated Test > 1GHz



Item	Connection	Shielded	Length
1	RJ-45 cable	No	10m
2	RJ-45 cable	No	1.5m
3	Power cable	No	1.8m

3 Transmitter Test Result

3.1 Emissions in Restricted Frequency Bands

3.1.1 Emissions in Restricted Frequency Bands Limit

Restricted Band Emissions Limit			
Frequency Range (MHz)	**Field Strength (uV/m)**	**Field Strength (dBuV/m)**	**Measure Distance (m)**
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1: Test distance for frequencies at or above 30 MHz, measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).

Note 2: Test distance for frequencies at below 30 MHz, measurements may be performed at a distance closer than the EUT limit distance; however, an attempt should be made to avoid making measurements in the near field. When performing measurements below 30 MHz at a closer distance than the limit distance, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two or more distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). The test report shall specify the extrapolation method used to determine compliance of the EUT.

Note 3: Using the distance of 1m during the test for above 18 GHz, and the test value to correct for the distance factor at 3m.

3.1.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

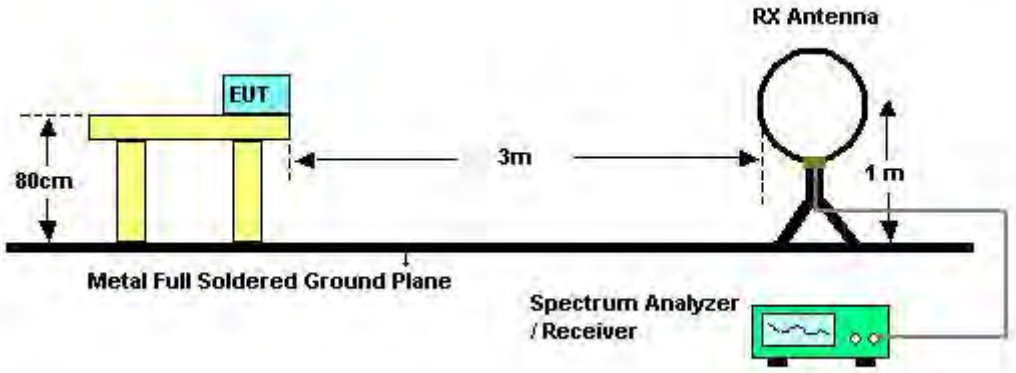
3.1.3 Test Procedures

Test Method		
▪ Measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. Measurements shall not be performed at a distance greater than 30 m for frequencies above 30 MHz, unless it can be further demonstrated that measurements at a distance of 30 m or less are impractical. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).		
▪ The average emission levels shall be measured in [duty cycle ≥ 98 or duty factor].		
▪ For the transmitter unwanted emissions shall be measured using following options below:		
	▪ Refer as FCC KDB 558074, clause H)2) for unwanted emissions into non-restricted bands.	
	▪ Refer as FCC KDB 558074, clause H)1) for unwanted emissions into restricted bands.	
		☐ Refer as FCC KDB 558074, H)6) Method AD (Trace Averaging).
		☒ Refer as FCC KDB 558074, H)6) Method VB (Reduced VBW).
		☐ Refer as ANSI C63.10, clause 4.2.3.2.3 (Reduced VBW). VBW ≥ 1/T, where T is pulse time.
		☐ Refer as ANSI C63.10, clause 4.2.3.2.4 average value of pulsed emissions.
		☒ Refer as FCC KDB 558074, clause H)5) measurement procedure peak limit.
		☐ Refer as ANSI C63.10, clause 4.2.3.2.2 measurement procedure peak limit.
▪ For radiated measurement.		
	▪ Refer as ANSI C63.10, clause 6.4 for radiated emissions below 30 MHz and test distance is 3m.	
	▪ Refer as ANSI C63.10, clause 6.5 for radiated emissions 30 MHz to 1 GHz and test distance is 3m.	
	▪ Refer as ANSI C63.10, clause 6.6 for radiated emissions above 1GHz.	
▪ The any unwanted emissions level shall not exceed the fundamental emission level.		
▪ All amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.		

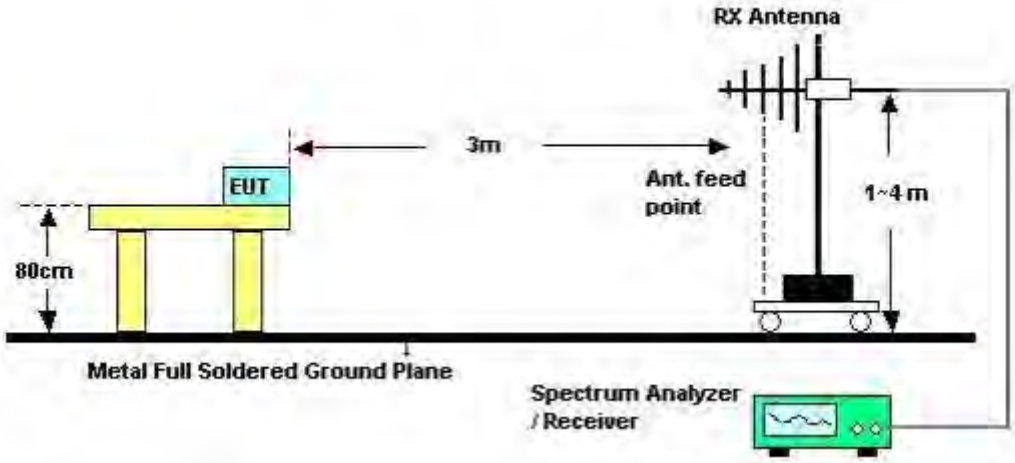
3.1.4 Test Setup

Transmitter Radiated Emissions

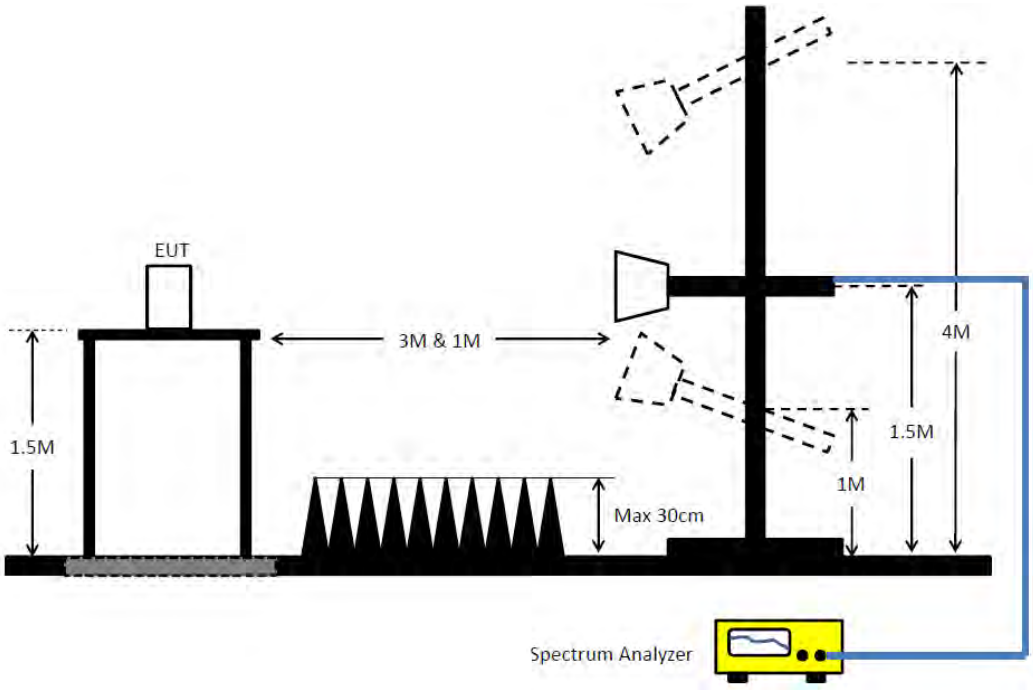
9kHz ~30MHz



30MHz~1GHz



Above 1GHz



3.1.5 Transmitter Radiated Unwanted Emissions (Below 30MHz)

All amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.
The radiated emissions were investigated from 9 kHz or the lowest frequency generated within the device, up to the 10 harmonic or 40 GHz, whichever is appropriate.

3.1.6 Test Result of Transmitter Radiated Unwanted Emissions

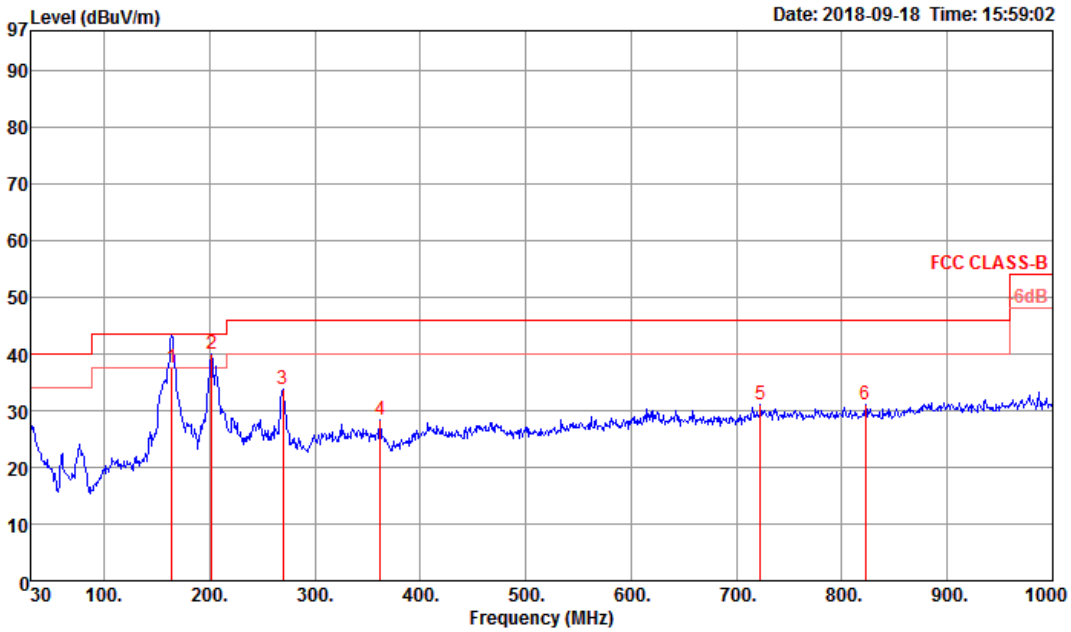
Refer as Appendix A

4 Test Equipment and Calibration Data

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
BILOG ANTENNA with 6dB Attenuator	TESEQ & EMCI	CBL6112D & N-6-06	37880 & AT-N0609	20MHz ~ 2GHz	Aug. 27, 2018	Aug. 26, 2019	Radiation (03CH01-CB)
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	Mar. 16, 2018	Mar. 15, 2019	Radiation (03CH01-CB)
Horn Antenna	EMCO	3115	00075790	750MHz ~ 18GHz	Nov. 20, 2017	Nov. 19, 2018	Radiation (03CH01-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Jun. 28, 2018	Jun. 27, 2019	Radiation (03CH01-CB)
Pre-Amplifier	EMCI	EMC330N	980332	20MHz ~ 3GHz	May 02, 2018	May 01, 2019	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8449B	3008A02310	1GHz ~ 26.5GHz	Jan. 09, 2018	Jan. 08, 2019	Radiation (03CH01-CB)
Pre-Amplifier	MITEQ	TTA1840-35-HG	1864479	18GHz ~ 40GHz	Jul. 04, 2018	Jul. 03, 2019	Radiation (03CH01-CB)
Spectrum Analyzer	R&S	FSP40	100056	9kHz ~ 40GHz	Nov. 23, 2017	Nov. 22, 2018	Radiation (03CH01-CB)
EMI Test	R&S	ESCS	100354	9kHz ~ 2.75GHz	Dec. 08, 2017	Dec. 07, 2018	Radiation (03CH01-CB)
RF Cable-low	Woken	Low Cable-16+17	N/A	30 MHz ~ 1 GHz	Oct. 11, 2017	Oct. 10, 2018	Radiation (03CH01-CB)
RF Cable-low	Woken	Low Cable-16+17	N/A	30 MHz ~ 1 GHz	Oct. 08, 2018	Oct. 07, 2019	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-16	N/A	1 GHz ~ 18 GHz	Oct. 11, 2017	Oct. 10, 2018	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-16	N/A	1 GHz ~ 18 GHz	Oct. 08, 2018	Oct. 07, 2019	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-16+17	N/A	1 GHz ~ 18 GHz	Oct. 11, 2017	Oct. 10, 2018	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-16+17	N/A	1 GHz ~ 18 GHz	Oct. 08, 2018	Oct. 07, 2019	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G#1	N/A	18GHz ~ 40 GHz	Jul. 27, 2018	Jul. 26, 2019	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G#2	N/A	18GHz ~ 40 GHz	Jul. 27, 2018	Jul. 26, 2019	Radiation (03CH01-CB)

Note: Calibration Interval of instruments listed above is one year.

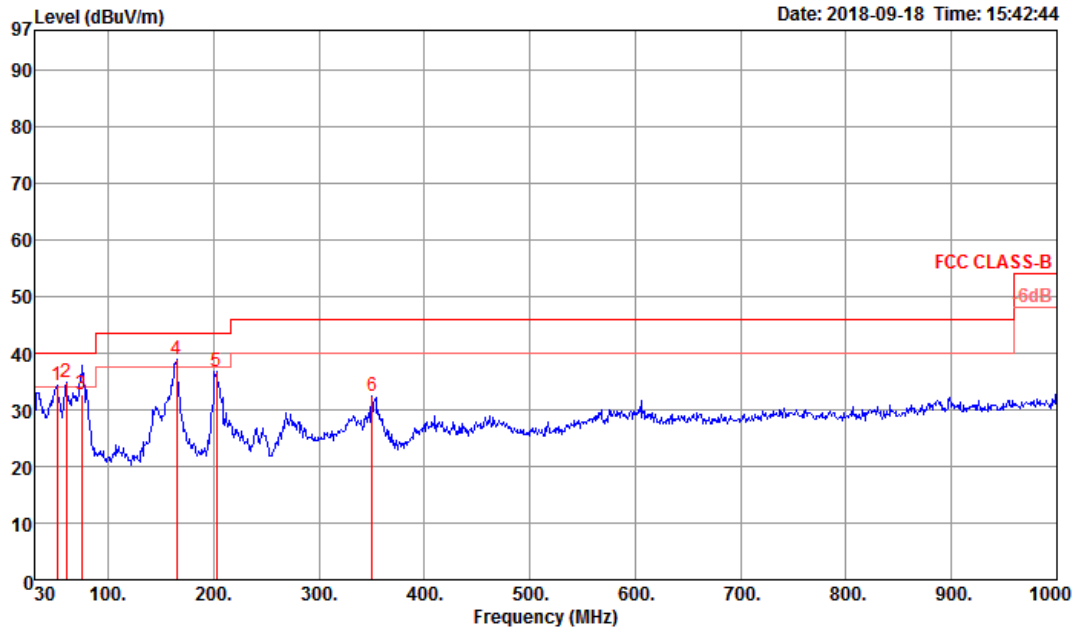
RSE below 1GHz Result			
Operating Mode	1	**Polarization**	Horizontal
Operating Function	Normal Link		



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	163.86	37.64	43.50	-5.86	51.90	1.10	16.40	31.76	253	79	QP	HORIZONTAL
2	201.69	39.93	43.50	-3.57	53.27	1.96	16.46	31.76	100	360	Peak	HORIZONTAL
3	269.59	33.67	46.00	-12.33	43.53	2.48	19.47	31.81	100	360	Peak	HORIZONTAL
4	361.74	28.30	46.00	-17.70	37.06	1.75	21.38	31.89	100	360	Peak	HORIZONTAL
5	722.58	31.03	46.00	-14.97	34.04	3.50	25.75	32.26	100	360	Peak	HORIZONTAL
6	822.49	31.14	46.00	-14.86	33.77	3.03	26.55	32.21	100	360	Peak	HORIZONTAL

Note 1: ">20dB" means emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: "N/F" means Nothing Found emissions (No emissions were detected.)

RSE below 1GHz Result			
Operating Mode	1	**Polarization**	Vertical
Operating Function	Normal Link		



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	51.34	34.39	40.00	-5.61	50.21	1.40	14.37	31.59	300	0	Peak	VERTICAL
2	60.07	34.78	40.00	-5.22	52.68	1.26	12.50	31.66	300	0	Peak	VERTICAL
3	74.62	32.72	40.00	-7.28	50.39	0.84	13.18	31.69	163	168	QP	VERTICAL
4	164.83	38.84	43.50	-4.66	53.17	1.13	16.30	31.76	300	0	Peak	VERTICAL
5	202.66	36.73	43.50	-6.77	50.01	1.98	16.51	31.77	300	0	Peak	VERTICAL
6	350.10	32.34	46.00	-13.66	41.85	1.36	21.00	31.87	300	0	Peak	VERTICAL

Note 1: “>20dB” means emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found emissions (No emissions were detected.)

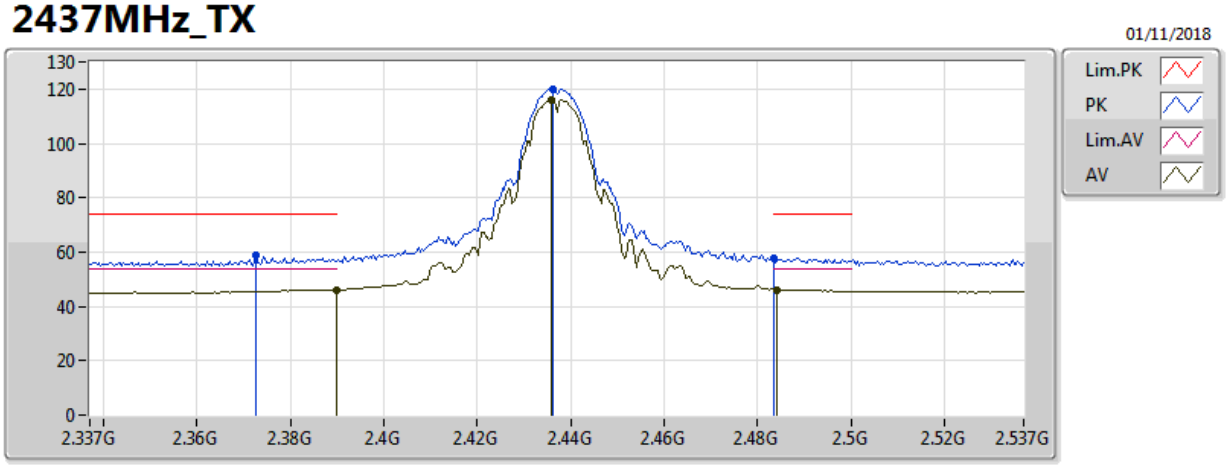
TEL : 886-3-656-9065
FAX : 886-3-656-9085

Summary

Mode	Result	Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comments
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-	-	-
802.11b_Nss1,(1Mbps)_4TX	Pass	AV	4.874G	51.31	54.00	-2.69	6.99	3	Vertical	204	1.46	-

802.11b_Nss1,(1Mbps)_4TX

2437MHz_TX

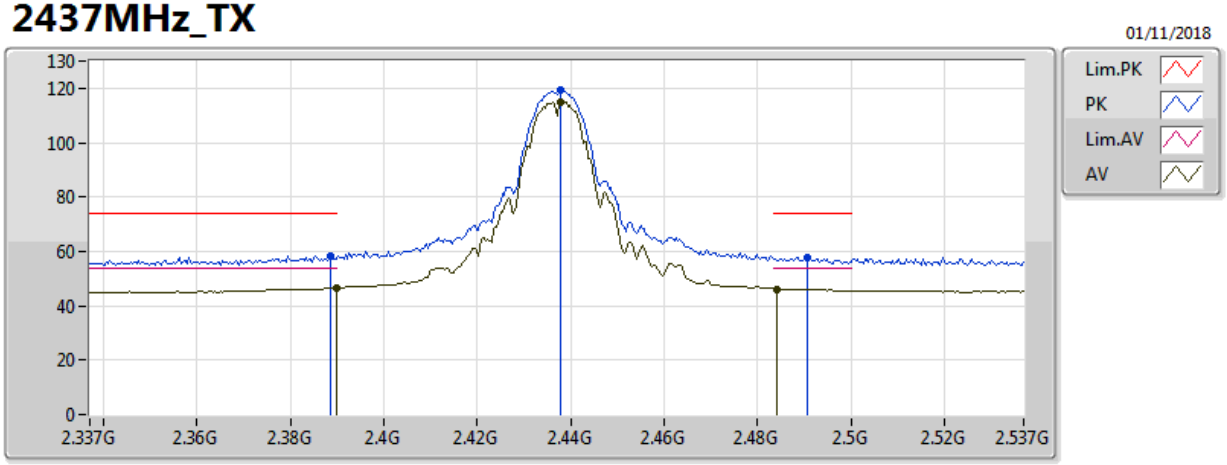


EUT Y_4TX
Setting 85
04-P-2
FSP(100142)

Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comments
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)	
PK	2.3726G	58.68	74.00	-15.32	33.15	3	Vertical	28	1.02	-
AV	2.3898G	46.07	54.00	-7.93	33.17	3	Vertical	28	1.02	-
PK	2.4362G	120.11	Inf	-Inf	33.18	3	Vertical	28	1.02	-
AV	2.4358G	116.03	Inf	-Inf	33.18	3	Vertical	28	1.02	-
PK	2.483502G	57.82	74.00	-16.18	33.18	3	Vertical	28	1.02	-
AV	2.4842G	46.17	54.00	-7.83	33.18	3	Vertical	28	1.02	-

802.11b_Nss1,(1Mbps)_4TX

2437MHz_TX

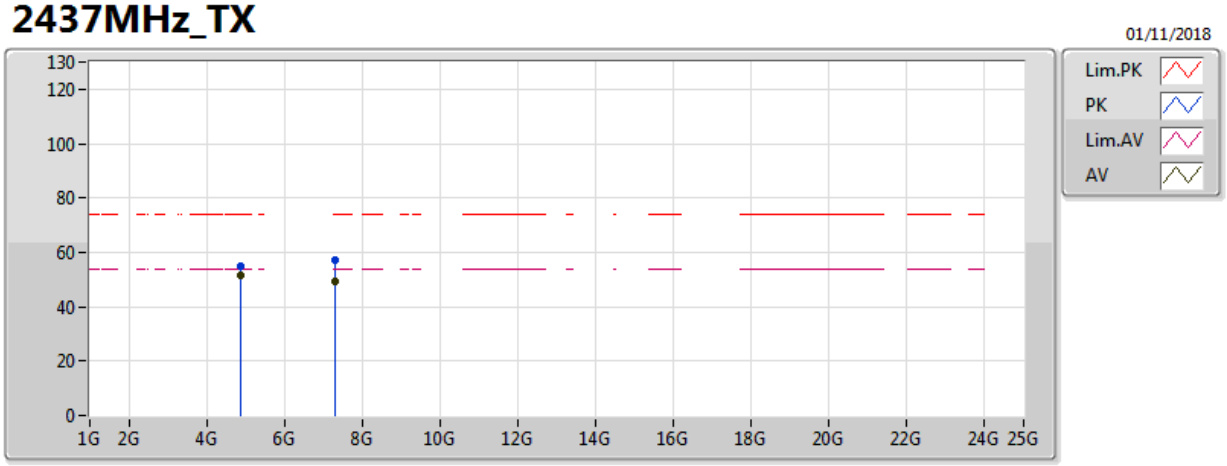


EUT Y_4TX
Setting 85
04-P-2
FSP(100142)

Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comments
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)	
PK	2.3886G	58.54	74.00	-15.46	33.17	3	Horizontal	65	1.65	-
AV	2.3898G	46.50	54.00	-7.50	33.17	3	Horizontal	65	1.65	-
PK	2.4378G	119.09	Inf	-Inf	33.18	3	Horizontal	65	1.65	-
AV	2.4378G	115.02	Inf	-Inf	33.18	3	Horizontal	65	1.65	-
PK	2.4906G	57.87	74.00	-16.13	33.18	3	Horizontal	65	1.65	-
AV	2.4842G	46.14	54.00	-7.86	33.18	3	Horizontal	65	1.65	-

802.11b_Nss1,(1Mbps)_4TX

2437MHz_TX

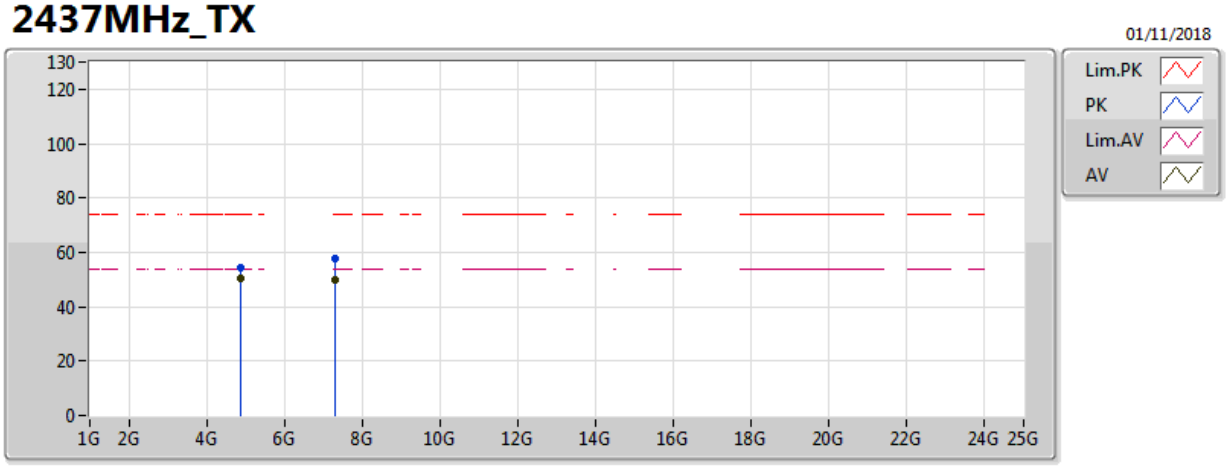


EUT Y_4TX
Setting 85
04-P-2
FSP(100142)

Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comments
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)	
PK	4.87396G	54.89	74.00	-19.11	6.99	3	Vertical	204	1.46	-
AV	4.874G	51.31	54.00	-2.69	6.99	3	Vertical	204	1.46	-
PK	7.31004G	57.29	74.00	-16.71	11.70	3	Vertical	153	1.96	-
AV	7.31016G	49.36	54.00	-4.64	11.70	3	Vertical	153	1.96	-

802.11b_Nss1,(1Mbps)_4TX

2437MHz_TX



EUT Y_4TX
Setting 85
04-P-2
FSP(100142)

Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comments
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)	
PK	4.87394G	54.13	74.00	-19.87	6.99	3	Horizontal	119	1.50	-
AV	4.874G	50.37	54.00	-3.63	6.99	3	Horizontal	119	1.50	-
PK	7.30896G	57.51	74.00	-16.49	11.70	3	Horizontal	101	2.08	-
AV	7.31016G	49.75	54.00	-4.25	11.70	3	Horizontal	101	2.08	-