

FCC EVALUATION REPORT FOR CERTIFICATION

Manufacturer: Ohsung Electronics Co., Ltd.	Date of Issue: May 12, 2016
#181 Gongdan-dong, Gumi-si, Gyeongsangbuk-Do	Order Number: GETEC-C1-16-182
South Korea	Test Report Number: GETEC-E3-16-021
Attn: Mr. MOO-KUN YOON / TEAM LEADER OF R&D	Test Site: GUMI UNIVERSITY EMC CENTER
	(Test firm Registration Number: 269701)

FCC ID. : OZ5URCMRX4SEN2
Applicant : Ohsung Electronics Co., Ltd.

Rule Part(s)	: FCC Part 15 Subpart C-Intentional Radiator § 15.247
Test Method	: ANSI C63.10 (2013)
Equipment Class	: Digital Transmission System(DTS)
EUT Type	: Sensor Extender
Type of Authority	: Certification
Model Name	: MRX-4SEN2
Trade Mark	: UNIVERSAL Remote Control

This equipment has been shown to be in compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10 (2013)

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the vest of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Tested by,

Soon Hoon

Soon-Hoon Jeong, Senior Engineer
GUMI UNIVERSITY EMC CENTER

Reviewed by,

Jae-Hoon Jeong

Jae-Hoon Jeong, Technical Manager
GUMI UNIVERSITY EMC CENTER



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Scope: Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and / or unintentional radiators for compliance with technical rules and regulations of the Federal Communications Commission.

1. General Information

Applicant: Ohsung Electronics Co., Ltd.
Applicant Address: #141 Gongdan-dong, Gumi-si, Gyeongbuk, Republic of Korea
Manufacturer: Ohsung Electronics Co., Ltd.
Manufacturer Address: #141 Gongdan-dong, Gumi-si, Gyeongbuk, Republic of Korea
Contact Person: MOO-KUN YOON / TEAM LEADER OF R&D
Telephone Number: +82-54-468-7265 Fax Number: +82-54-461-8368

- **FCC ID.** OZ5URCMRX4SEN2
- **Equipment Class** Digital Transmission System (DTS)
- **EUT Type** Sensor Extender
- **Model Name** MRX-4SEN2
- **Rule Part(s)** FCC Part 15 Subpart C-Intentional Radiator § 15.247
- **Test Method** ANSI C63.10 (2013)
- **Type of Authority** Certification
- **Test Procedure(s)** ANSI C63.10 (2013), KDB558074 D01 DTS Meas Guidance v03r05(April 8,2016)
- **Dates of Test** April 26 ~ May 04, 2016
- **Place of Test** GUMI UNIVERSITY EMC CENTER (FCC Test firm Registration No.: 269701)
37 Yaeun-ro, Gumi-si, Gyeongsangbuk-do, 730-711, Republic of Korea
- **Test Report Number** GETEC-E3-16-021
- **Dates of Issue** May 12, 2016





2. Introduction

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Nose Emissions From Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2009) was used in determining radiated and conducted emissions emanating from **Ohsung Electronics Co., Ltd. Sensor Extender (Model name: MRX-4SEN2)**

These measurement tests were conducted at **GUMI UNIVERSITY EMC CENTER**.

The site address is 37 Yaeun-ro, Gumi-si, Gyeongsangbuk-do, 730-711, Gyeongnam 641-713, Korea

This test site is one of the highest point of Gumi 1 college at about 200 kilometers away from Seoul city and 40 kilometers away from Daeje city. It is located in the valley surrounded by mountains in all directions where ambient radio signal conditions are quiet and a favorable area to measure the radio frequency interference on open field test site for the computing and ISM devices manufactures. The detailed description of the measurement facility was found to be in compliance with the requirements of §2.948 according to ANSI C63.10 (2013)

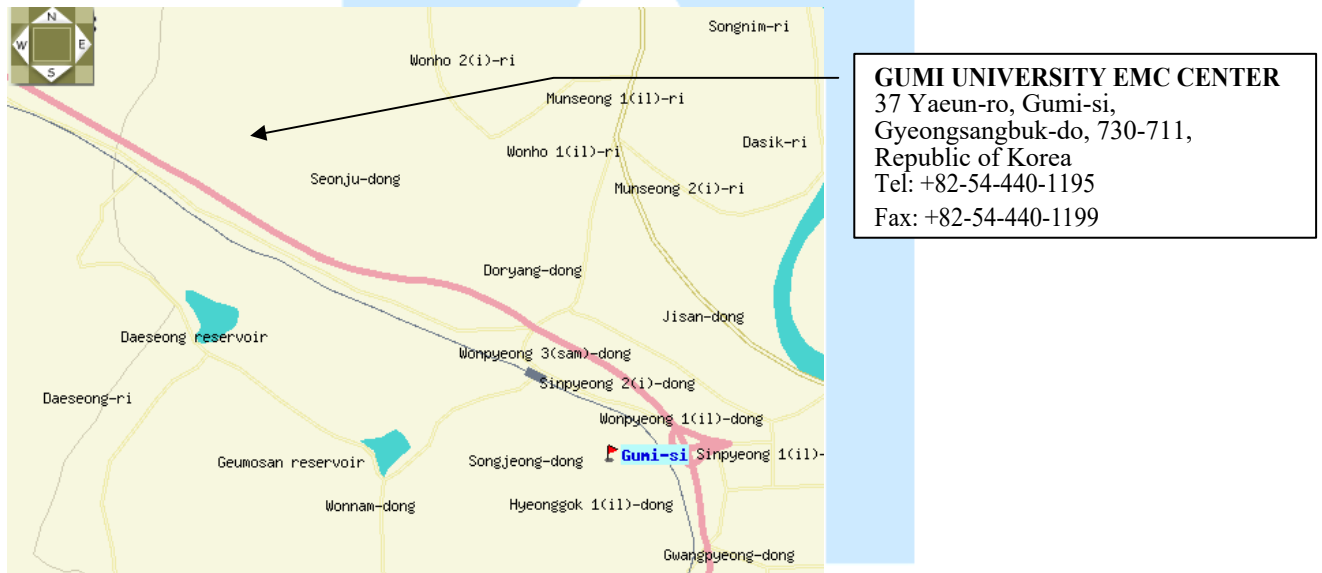


Fig 1. The map above shows the Gumi University in vicinity area.





3. Product Information

3.1 Description of EUT

The Equipment under Test (EUT) is the **Ohsung Electronics Co., Ltd. Sensor Extender (Model Name: MRX-4SEN2) FCC ID.: OZ5URCMRX4SEN2**

- Equipment	: Sensor Extender
- Model name	: MRX-4SEN2
- Brand name	: UNIVERSAL Remote Control
- Serial number	: Proto type
- Electrical Rating	: DC 5.0 V(AC/DC Adaptor)
- AC/DC Adaptor Spec.	: Model Name (MLF-A00060501000U0021) Input rating(AC 100 - 240 V, 50/60 Hz, 0.18 A) Output rating(DC 5 V, 1 A)
- Manufacturer	: Ohsung electronics Co., Ltd.
- Channel Separations	: 5 MHz
- Type of Modulation	: DSSS, OFDM
- Frequency range	: 2 412 MHz ~ 2462 MHz
- Number of channel	: 11
- Type of chain	: One
- Antenna specification	: Manufacturer: Ohsung Electronics Co., Ltd. Antenna type : PCB printed antenna Gain : 1.99 dBi
- Hardware version	: v0.0.0
- Software version	: v1.0.11.4

3.2 Definition of models

-None.





3.3 Support Equipment / Cables used

3.3.1 Used Support Equipment

Description	Manufacturer	Model Name	S/N & FCC ID.
RF Control board ¹⁾	Proto type	Proto type	S/N: None. FCC ID.: None
Notebook computer ¹⁾	Samsung Electronics Inc.	NT-R540	S/N : AZKW93AZC01238K FCC ID.: None.

Note)

1) The Support Equipment use only setting the test mode.

3.3.2 System configuration

Description	Manufacturer	Model Name	S/N & FCC ID.
AC/DC Adaptor	MEILE GROUP LTD.	MLF-A0006050100U0021	S/N : Proto type FCC ID.: None.
Sensor Extender	Ohsung Electronics Co., Ltd.	MRX-4SEN2	S/N : Proto type FCC ID.: OZ5URCMRX4SEN2

3.3.3 Used Cable(s)

Cable Name	Condition	Description
None.	-	-

3.4 Modification Item(s)

- None





4. Antenna Requirement - §15.203

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the applicant can be used with the device. The use of permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with this requirement.

4.1 Description of Antenna

The **Ohsung Electronics Co., Ltd. Sensor Extender**, comply with the requirement of §15.203 with a PCB printed antenna permanently attached to the transmitter.

5. Description of tests

5.1 Test Condition

The EUT was installed, arranged and operated in a manner that is most representative of equipment as typically used. The measurements were carried out while varying operating modes and cable positions within typically arrangement to determine maximum emission level.

The representative and worst test mode(s) were noted in the test report.

- Test Voltage / Frequency: AC 120 V / 60 Hz (DC 5 V AC/DC adaptor)
- Operating condition during the test(s) :
 - Continuous RF transmitting mode with nominal maximum RF output power.
 - The RF transmitting signal is DSSS and OFDM modulation signal.
 Operating channel frequency and moderation technology

Mode	Available channel	Frequency rang	Modulation Technology
IEEE 802.11 b	1 to 11	2412 ~ 2462 MHz	DSSS
IEEE 802.11 g	1 to 11	2412 ~ 2462 MHz	OFDM
IEEE 802.11 n	1 to 11	2412 ~ 2462 MHz	OFDM

- EUT set condition (RF power setting value)

Test Software version	RF power setting value		
	2 412 MHz	2 437 MHz	2 462 MHz
IEEE 802.11 b	9	9	9
IEEE 802.11 g	9	9	9
IEEE 802.11 n	9	9	9

6. References Standards

- FCC Part 15 (2009) Subpart C-Intentional Radiator §15.247
- ANSI C 63.10 (2013): American National Standard for Testing Unlicensed Wireless Devices
- KDB 558074 D01 DTS meas Guidance v03r05 (April 08, 2016): Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247





7. SUMMARY OF TEST RESULTS

FCC Part Section(s)	Test Description	Test Result
§15.247(a)(2)	6 dB Bandwidth	Pass
§15.247(b)(3)	Conducted Maximum Peak Output Power	Pass
§15.247(e)	Power Spectral Density	Pass
§15.247(d)	Conducted Out of Band Emission Emissions	Pass
§15.207(a)	AC Power line Conducted Emissions	Pass
§15.205, 15.209	Radiated Spurious Emissions	Pass
§15.247(d), 15.205, 15.209	Radiated Restricted Band Edge	Pass



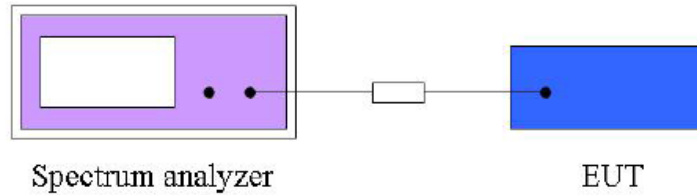


8. 6 dB Bandwidth Measurement

8.1 Operating environment

Temperature : 21.6 °C
 Relative Humidity : 40.3 % R.H.

8.2 Test Set-up (Layout)



8.3 Limit

For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz

8.4 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - FSP	Rohde & Schwarz	Spectrum Analyzer	101431	Jan. 04, 2017
■ - 8493C	Agilent	6 dB Attenuator	59862	Apr. 20, 2017

8.5 Test Test Procedure

- 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.





8.6 Test result

- Test Date : April 27, 2016
- Reference Standard : Part 15 Subpart C, Sec. 15.247(a)(2)
- Test Procedure(s) : ANSI C63.10 (2013), KDB558074 D01 DTS Meas Guidance v03r05(April 8,2016)
- Operating Condition : RF transmitting mode (1ch: 2 412 MHz, 6ch: 2 437 MHz, 11ch: 2 462 MHz)
- Power Source : DC 5 V
- Comment : Worst case data were report.

IEEE 802.11 b

Frequency (MHz)	6 dB Bandwidth (MHz)	Min. Limit (kHz)	Result
2 412	8.84	500	Complies
2 437	8.99	500	Complies
2 462	8.81	500	Complies

IEEE 802.11g

Frequency (MHz)	6 dB Bandwidth (MHz)	Min. Limit (kHz)	Result
2 412	15.71	500	Complies
2 437	16.01	500	Complies
2 462	15.70	500	Complies

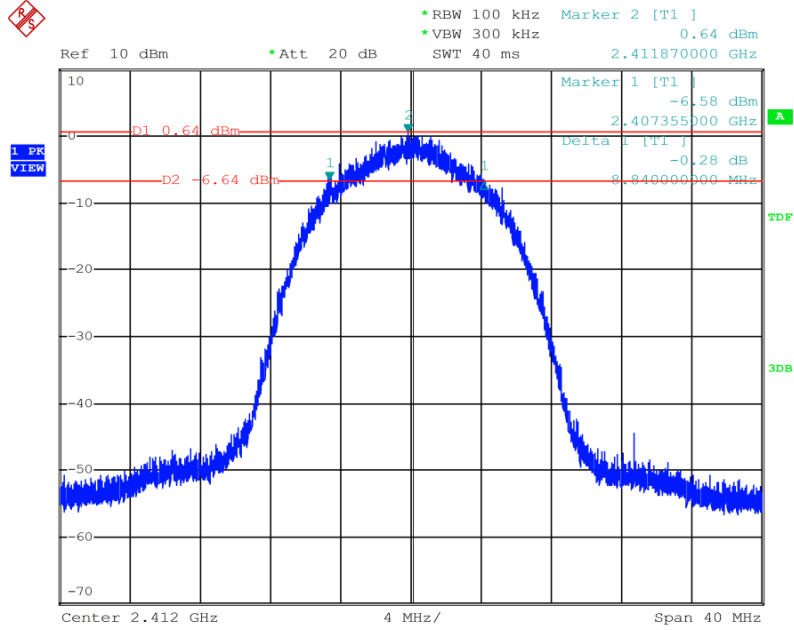
IEEE 802.11g

Frequency (MHz)	6 dB Bandwidth (MHz)	Min. Limit (kHz)	Result
2 412	15.12	500	Complies
2 437	15.43	500	Complies
2 462	15.93	500	Complies



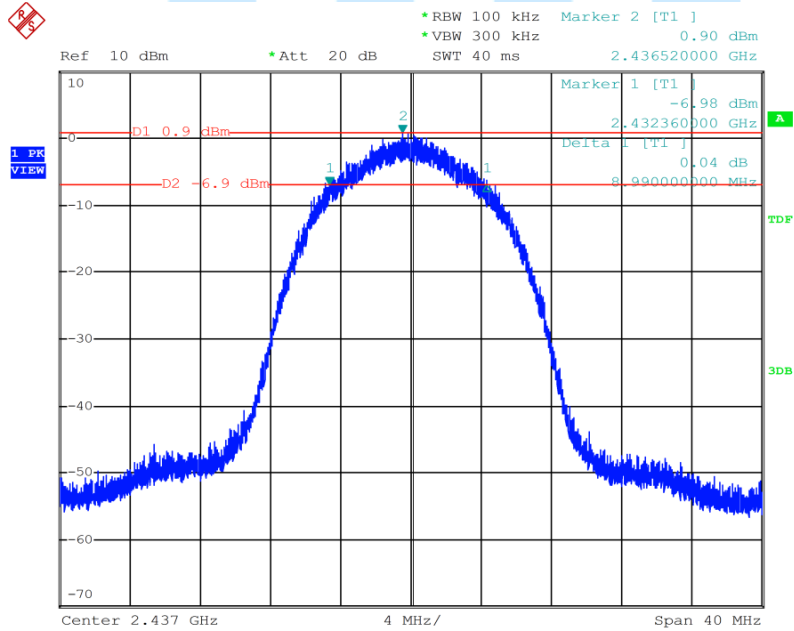


6 dB Bandwidth Plot on Configuration : IEEE 802.11b 1ch



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6 dB Bandwidth Plot on Configuration : IEEE 802.11b 6ch

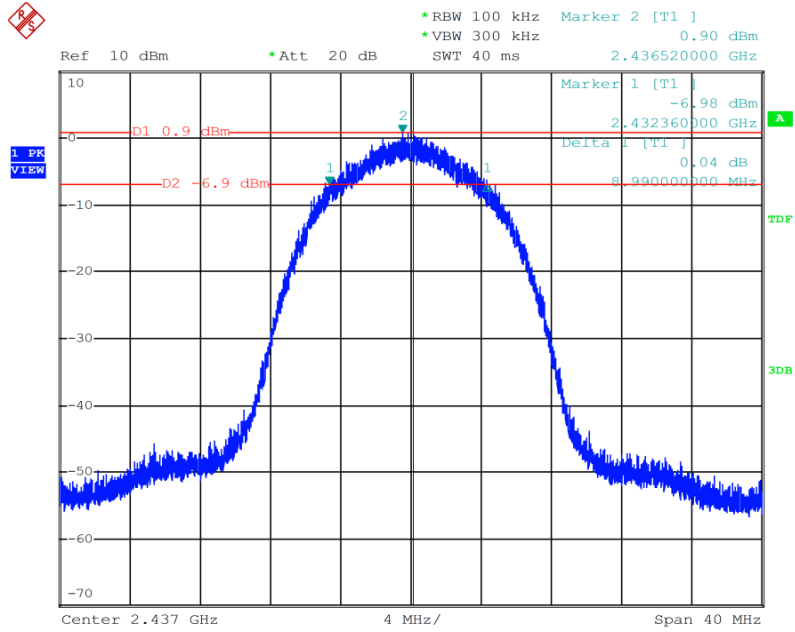


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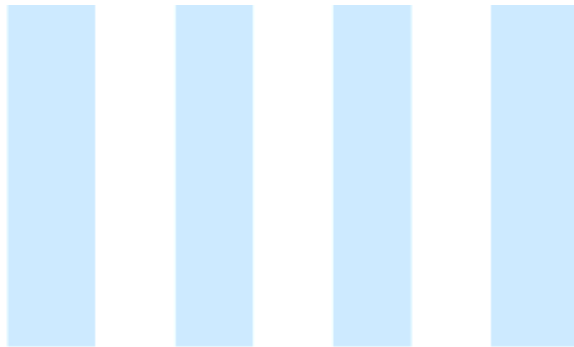




6 dB Bandwidth Plot on Configuration : IEEE 802.11b 11ch

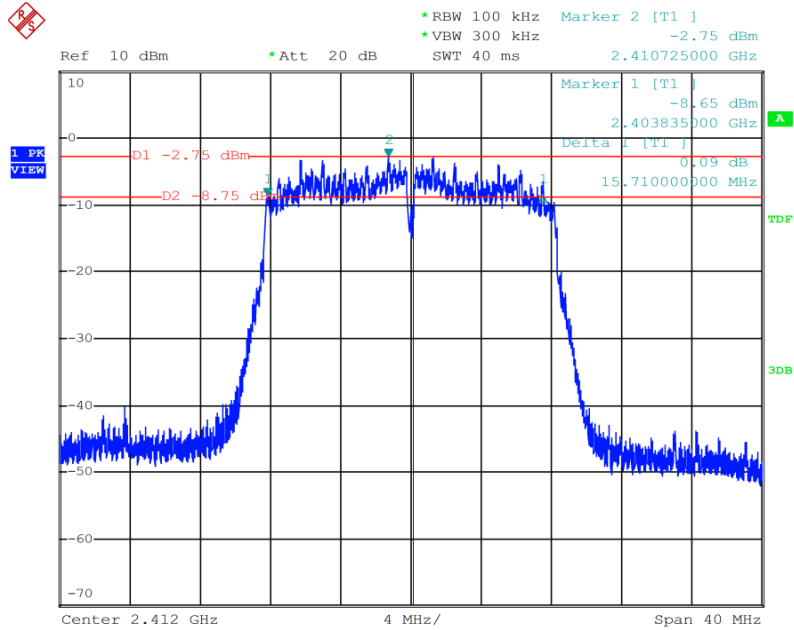


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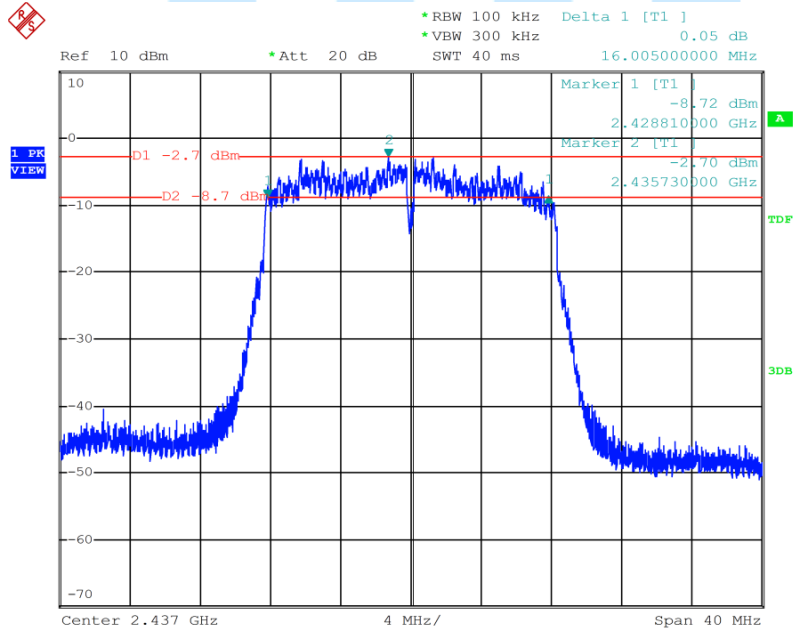


6 dB Bandwidth Plot on Configuration : IEEE 802.11g 1ch



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6 dB Bandwidth Plot on Configuration : IEEE 802.11g 6ch

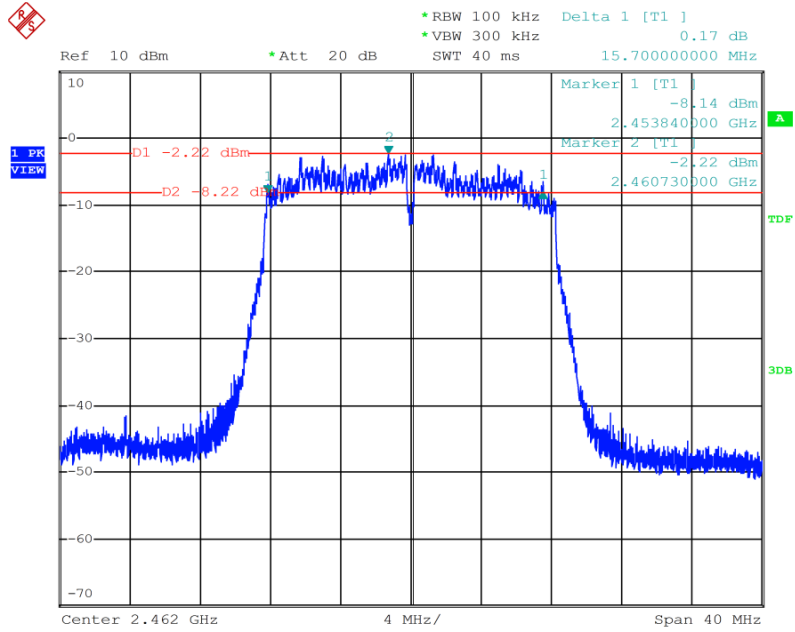


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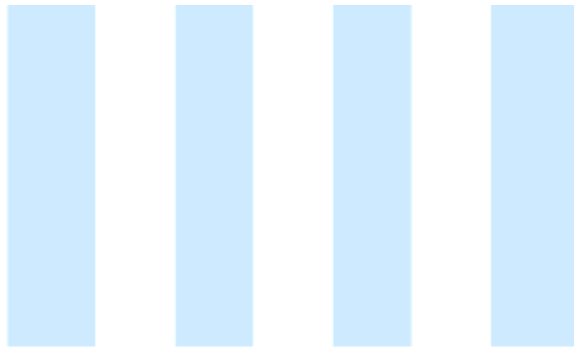




6 dB Bandwidth Plot on Configuration : IEEE 802.11g 11ch

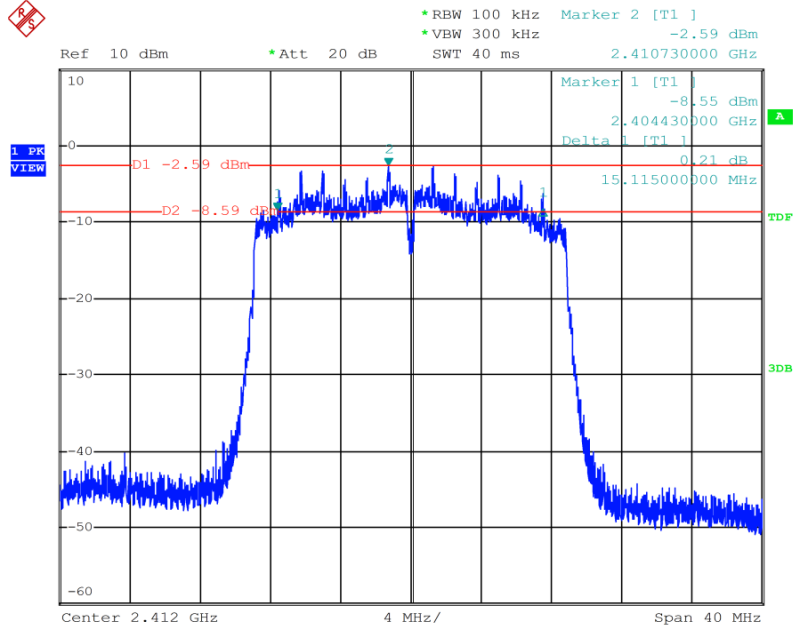


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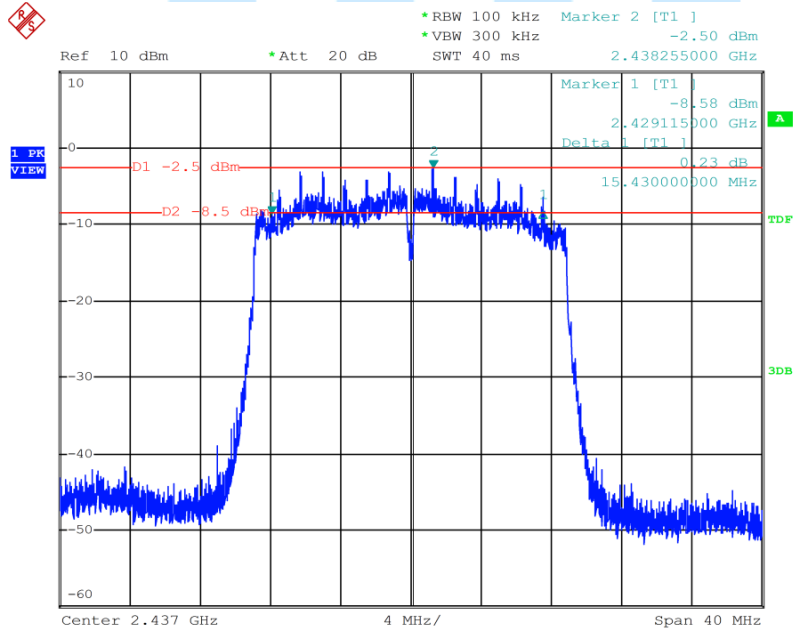


6 dB Bandwidth Plot on Configuration : IEEE 802.11n 1ch



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6 dB Bandwidth Plot on Configuration : IEEE 802.11n 6ch

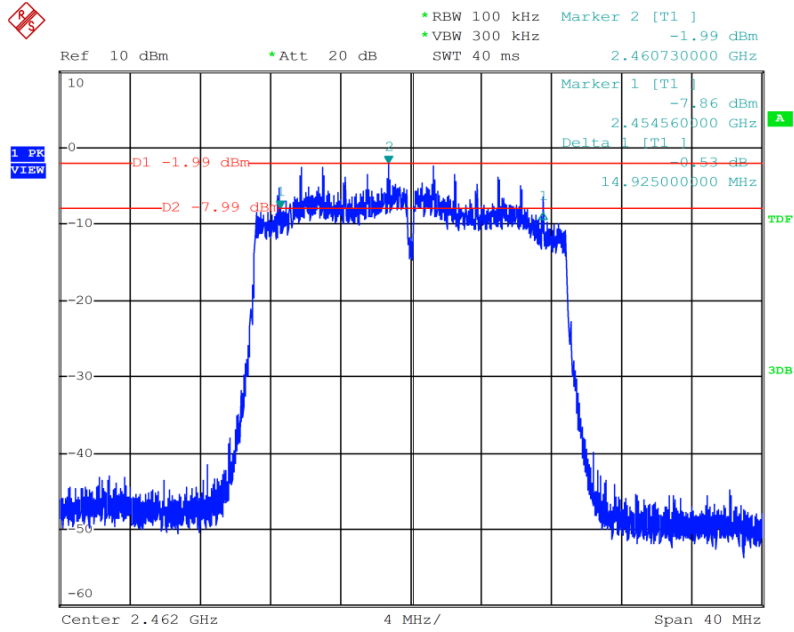


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6 dB Bandwidth Plot on Configuration : IEEE 802.11n 11ch



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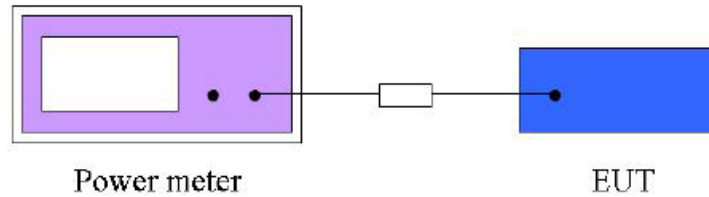


9. Conducted Maximum Peak Output Power Measurement

9.1 Operating environment

Temperature : 23.3 °C
 Relative Humidity : 42.5 % R.H.

9.2 Test Set-up (Layout)



9.3 Limit

For systems using digital modulation in the (2 400~2 483.5) MHz, the limit for peak output power is 30 dBm. The limit has to be reduced by the amount in dB that the gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

9.4 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - NRV-Z32	Rohde & Schwarz	Peak Power sensor	100049	Jan. 05, 2017
■ - NRVD	Rohde & Schwarz	Dual Channel Power Meter	837794/048	Apr. 19, 2017
■ - NRP-Z51	Rohde & Schwarz	Power sensor	1138.0005.02	Jan. 05, 2017
■ - 8493C	Agilent	6 dB Attenuator	59862	Apr. 20, 2017

9.5 Test Procedure

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.





9.6 Test Result

- Test Date : April 26, 2016
- Reference Standard : Part 15 Subpart C, Sec. 15.247(a)(2)
- Test Procedure(s) : ANSI C63.10 (2013), KDB558074 D01 DTS Meas Guidance v03r05(April 8,2016)
- Operating Condition : RF transmitting mode (1ch: 2 412 MHz, 6ch: 2 437 MHz, 11ch: 2 462 MHz)
- Power Source : DC 5 V

IEEE 802.11b

Frequency (MHz)	Average Conducted Power ¹⁾ (dBm)	Peak Conducted Power (dBm)	Max. Limit (dBm)	Result
2 412	9.70	11.30	30.00	Complies
2 437	9.90	11.73	30.00	Complies
2 462	9.80	12.01	30.00	Complies

Note: 1) The Average output power is reference data for RF Exposure.

IEEE 802.11g

Frequency (MHz)	Average Conducted Power ¹⁾ (dBm)	Peak Conducted Power (dBm)	Max. Limit (dBm)	Result
2 412	9.10	14.90	30.00	Complies
2 437	9.30	15.09	30.00	Complies
2 462	9.50	15.21	30.00	Complies

Note: 1) The Average output power is reference data for RF Exposure.

IEEE 802.11n

Frequency (MHz)	Average Conducted Power ¹⁾ (dBm)	Peak Conducted Power (dBm)	Max. Limit (dBm)	Result
2 412	9.10	14.44	30.00	Complies
2 437	9.20	14.65	30.00	Complies
2 462	9.50	14.91	30.00	Complies

Note: 1) The Average output power is reference data for RF Exposure.



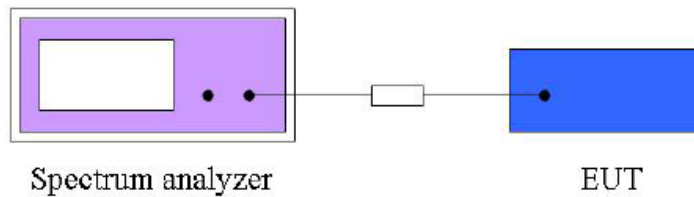


10. Power Spectral Density Measurement

10.1 Operating Environment

Temperature : 22.3 °C
 Relative Humidity : 41.5 % R.H.

10.2 Test Set-up (Layout)



10.3 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

10.4 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - FSP	Rohde & Schwarz	Spectrum Analyzer	101431	Jan. 04, 2017
■ - 8493C	Agilent	6 dB Attenuator	59862	Apr. 20, 2017

10.5 Test Procedure

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to 3 kHz
- Set the VBW to 10 kHz
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.





10.6 Test Result

- Test Date : April 27, 2016
- Reference Standard : Part 15 Subpart C, Sec. 15.247(e)
- Test Procedure(s) : ANSI C63.10 (2013), KDB558074 D01 DTS Meas Guidance v03r05(April 8,2016)
- Operating Condition : RF transmitting mode (1ch: 2 412 MHz, 6ch: 2 437 MHz, 11ch: 2 462 MHz)
- Power Source : DC 5 V
- Comment : Worst case data were report.

IEEE 802.11b

Frequency	PSD (dBm/3kHz)	Max. Limit (dBm/3kHz)	Result
2 412 MHz	-14.23	8.00	Complies
2 437 MHz	-14.42	8.00	Complies
2 462 MHz	-13.56	8.00	Complies

IEEE 802.11g

Frequency	PSD (dBm/3kHz)	Max. Limit (dBm/3kHz)	Result
2 412 MHz	-16.53	8.00	Complies
2 437 MHz	-16.82	8.00	Complies
2 462 MHz	-16.32	8.00	Complies

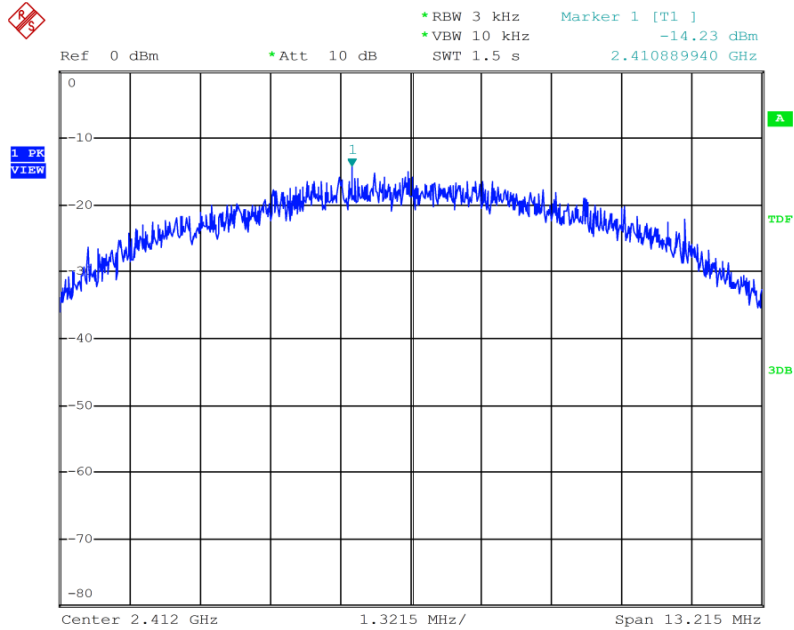
IEEE 802.11n

Frequency	PSD (dBm/3kHz)	Max. Limit (dBm/3kHz)	Result
2 412 MHz	-17.20	8.00	Complies
2 437 MHz	-17.58	8.00	Complies
2 462 MHz	-17.01	8.00	Complies



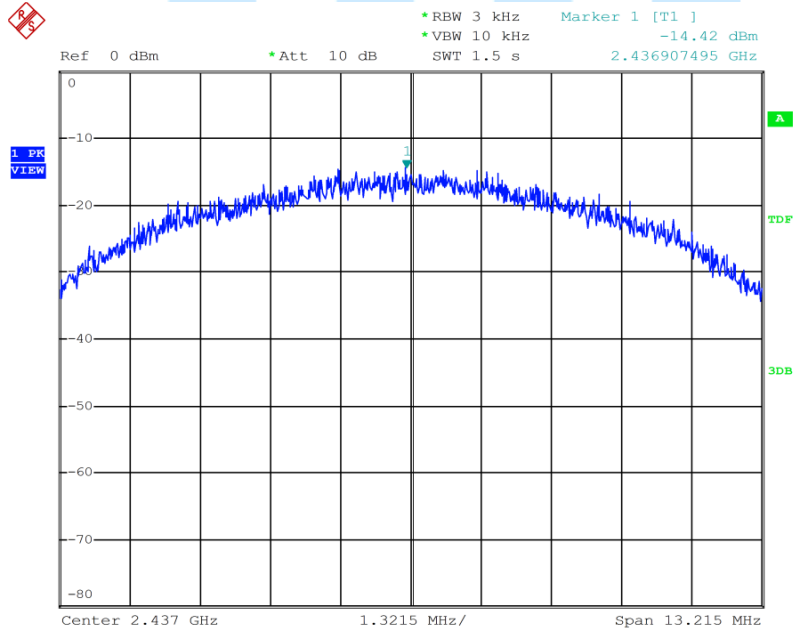


Power Density Plot on configuration : IEEE 802.11b 1ch



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Power Density Plot on configuration : IEEE 802.11b 6ch

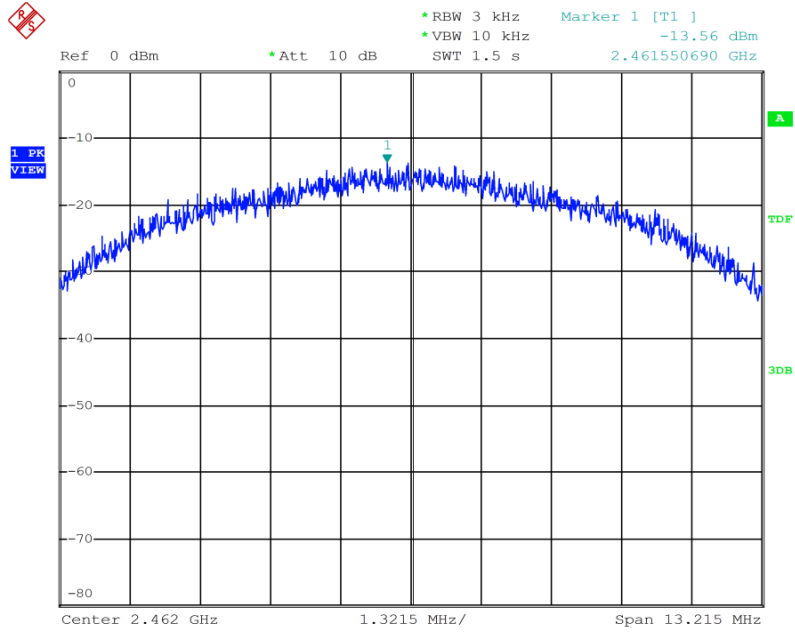


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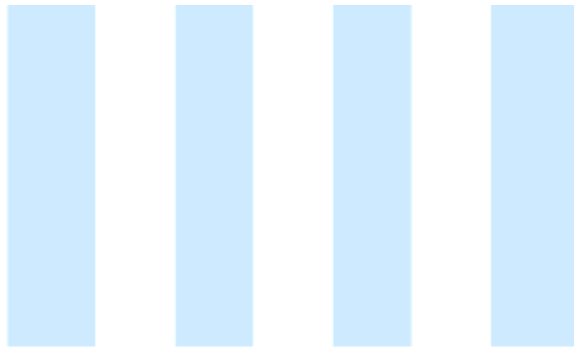




Power Density Plot on configuration : IEEE 802.11b 11ch

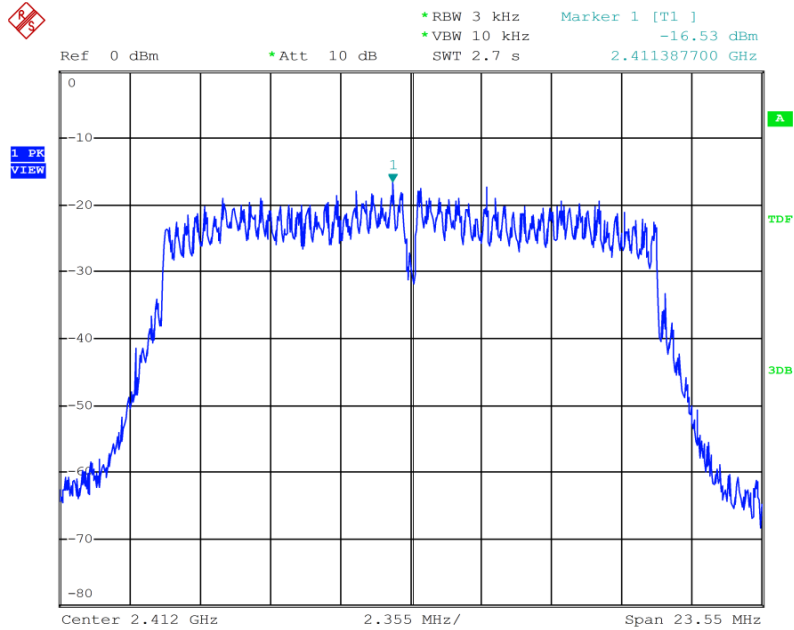


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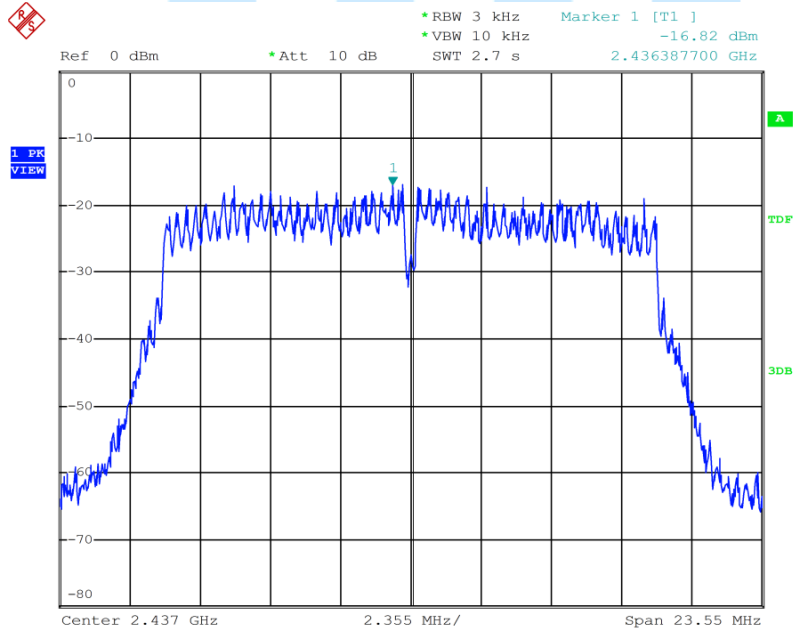


Power Density Plot on configuration : IEEE 802.11g 1ch



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Power Density Plot on configuration : IEEE 802.11g 6ch

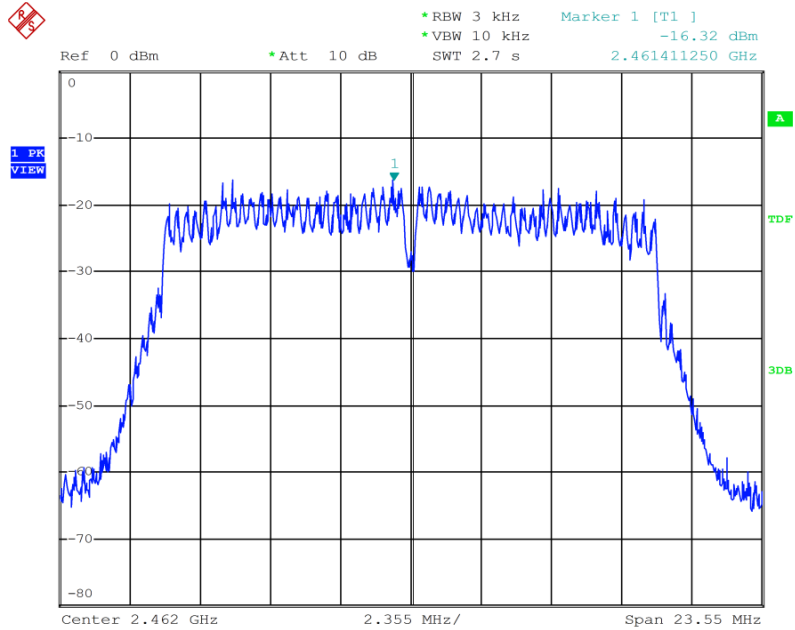


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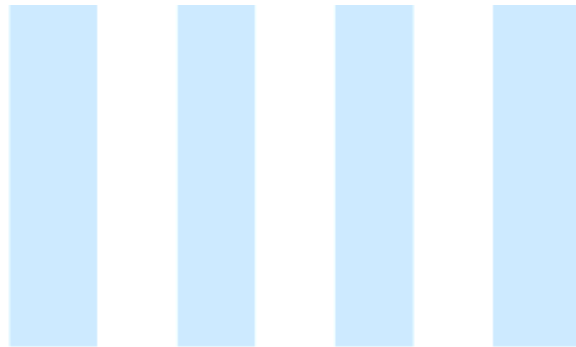




Power Density Plot on configuration : IEEE 802.11b 11ch

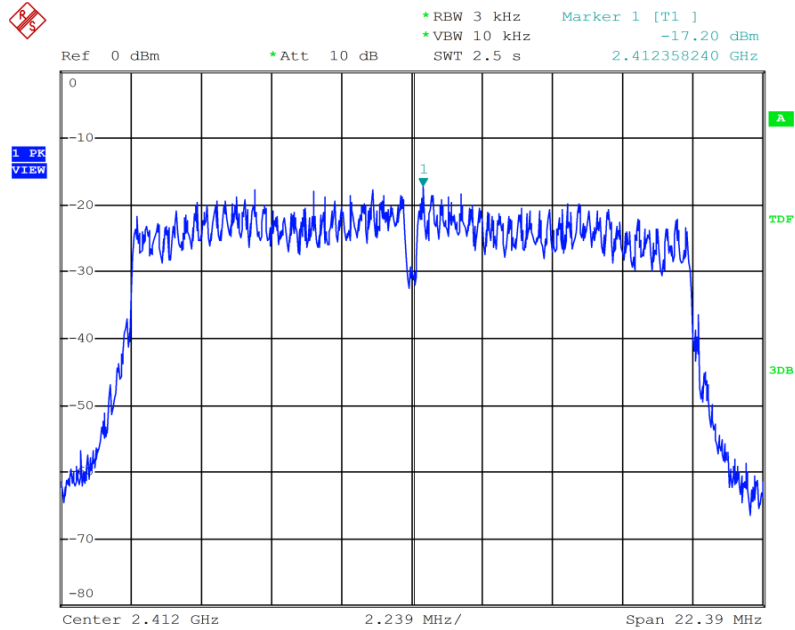


Date: 27.APR.2016 14:37:10



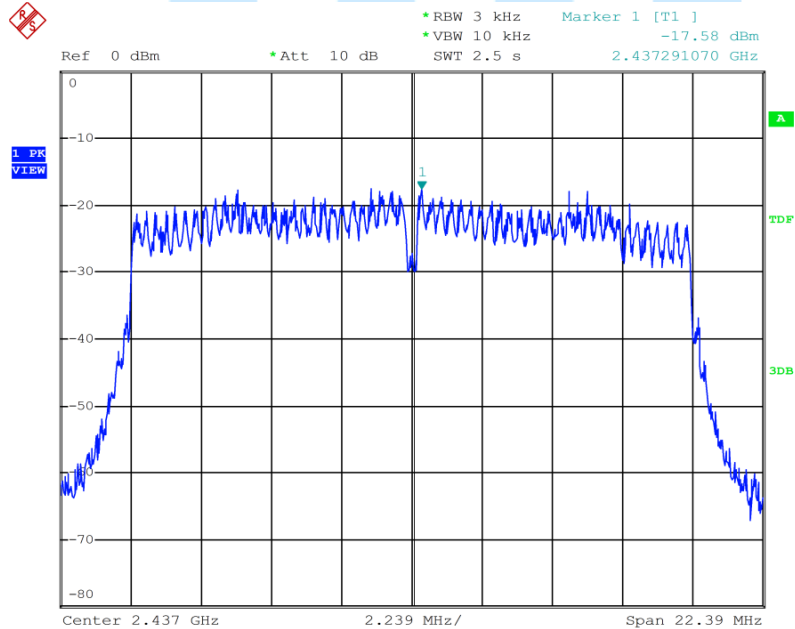


Power Density Plot on configuration : IEEE 802.11n 1ch



Date: 27.APR.2016 14:37:48

Power Density Plot on configuration : IEEE 802.11n 6ch

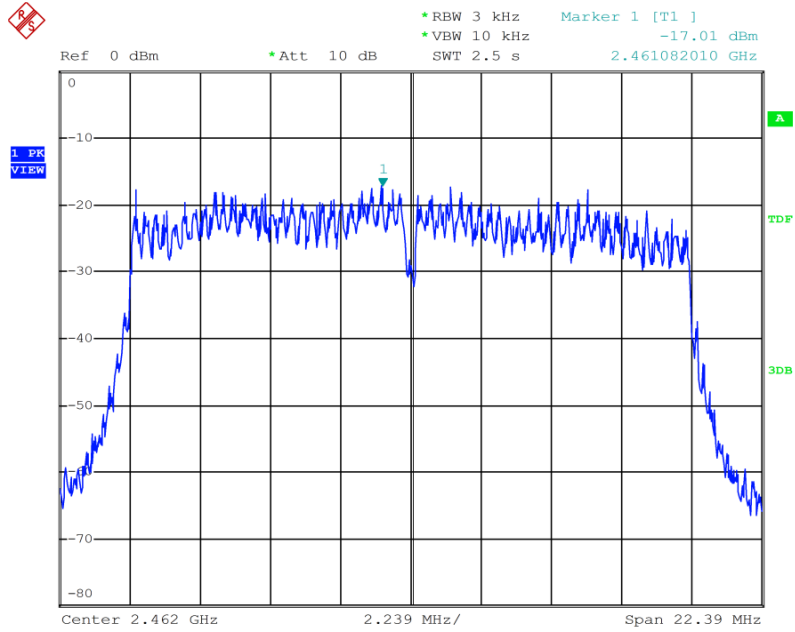


Date: 27.APR.2016 14:38:35

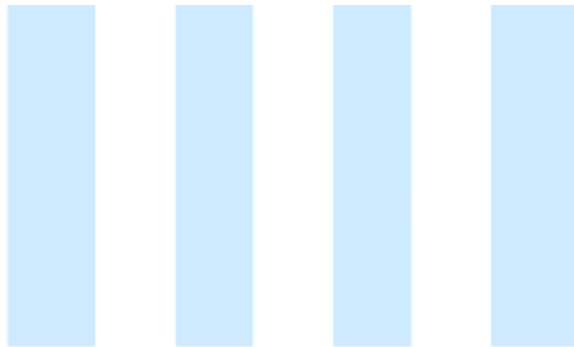




Power Density Plot on configuration : IEEE 802.11n 11ch



Date: 27.APR.2016 14:39:17



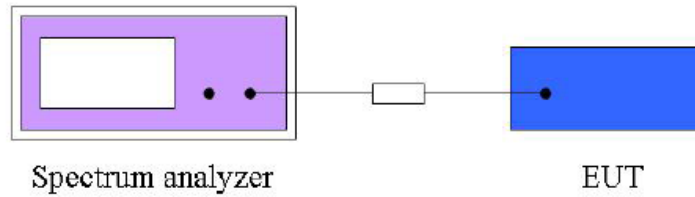


11. Conducted Spurious Emission & Out of Band Emission

11.1 Operating environment

Temperature : 22.8 °C
 Relative Humidity : 40.1 % R.H.

11.2 Test set-up (Lay-out)



11.3 Limit

Below -20 dB of the highest emission level of operating band (in 100 kHz resolution band width)

11.4 Test equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - FSP	Rohde & Schwarz	Spectrum Analyzer	101431	Jan. 30, 2017
■ - 8493C	Agilent	6 dB Attenuator	59862	Apr. 20, 2017

11.5 Test Procedure

- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the DTS bandwidth.
- c) Set the RBW to 3 kHz
- d) Set the VBW to 10 kHz
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.





11.6 Test Result

- Test Date : April 27, 2016
- Reference standard : Part 15 Subpart C, Sec. 15.247(e)
- Test Procedure(s) : ANSI C63.10 (2013), KDB558074 D01 DTS Meas Guidance v03r05(April 8,2016)
- Operating condition : RF transmitting mode (1ch: 2 412 MHz, 6ch: 2 437 MHz, 11ch: 2 462 MHz)
- Power Source : DC 5 V

11.6.1 Conducted Spurious Emission

IEEE 802.11b

Operating Frequency	Spurious (dBc)	Limits (dBc)	Result
2412	> -30.00	-20.00	Complies
2437	> -30.00		Complies
2462	> -30.00		Complies

Please refer to measurement plots on the following pages.

IEEE 802.11g

Operating Frequency	Spurious (dBc)	Limits (dBc)	Result
2412	> -30.00	-20.00	Complies
2437	> -30.00		Complies
2462	> -30.00		Complies

Please refer to measurement plots on the following pages.

IEEE 802.11n

Operating Frequency	Spurious (dBc)	Limits (dBc)	Result
2412	> -30.00	-20.00	Complies
2437	> -30.00		Complies
2462	> -30.00		Complies

Please refer to measurement plots on the following pages.





11.6.2 Conducted Out of Band(Band Edge) Emission

IEEE 802.11b

Operating Frequency	Band Edge (dBc)	Limits (dBc)	Result
2412	> -30.00	-20.00	Complies
2462	> -30.00		Complies

Please refer to measurement plots on the following pages.

IEEE 802.11g

Operating Frequency	Band Edge (dBc)	Limits (dBc)	Result
2412	> -30.00	-20.00	Complies
2462	> -30.00		Complies

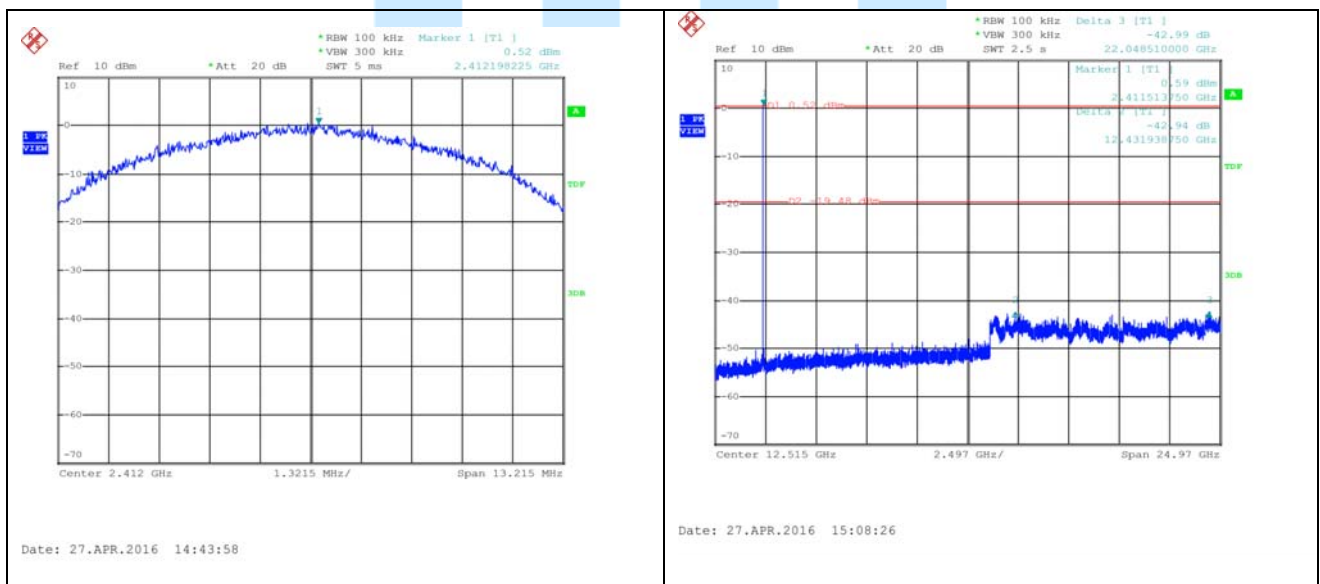
Please refer to measurement plots on the following pages.

IEEE 802.11n

Operating Frequency	Band Edge (dBc)	Limits (dBc)	Result
2412	> -30.00	-20.00	Complies
2462	> -30.00		Complies

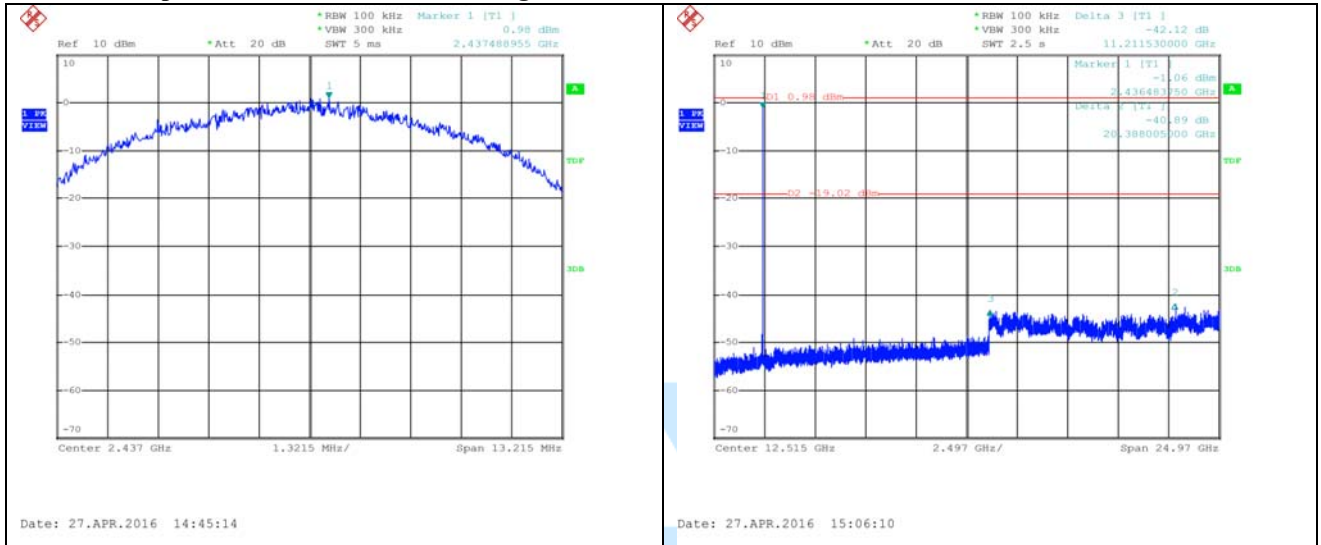
Please refer to measurement plots on the following pages.

Conducted spurious Emission Plot on Configuration : IEEE 802.11b 1ch

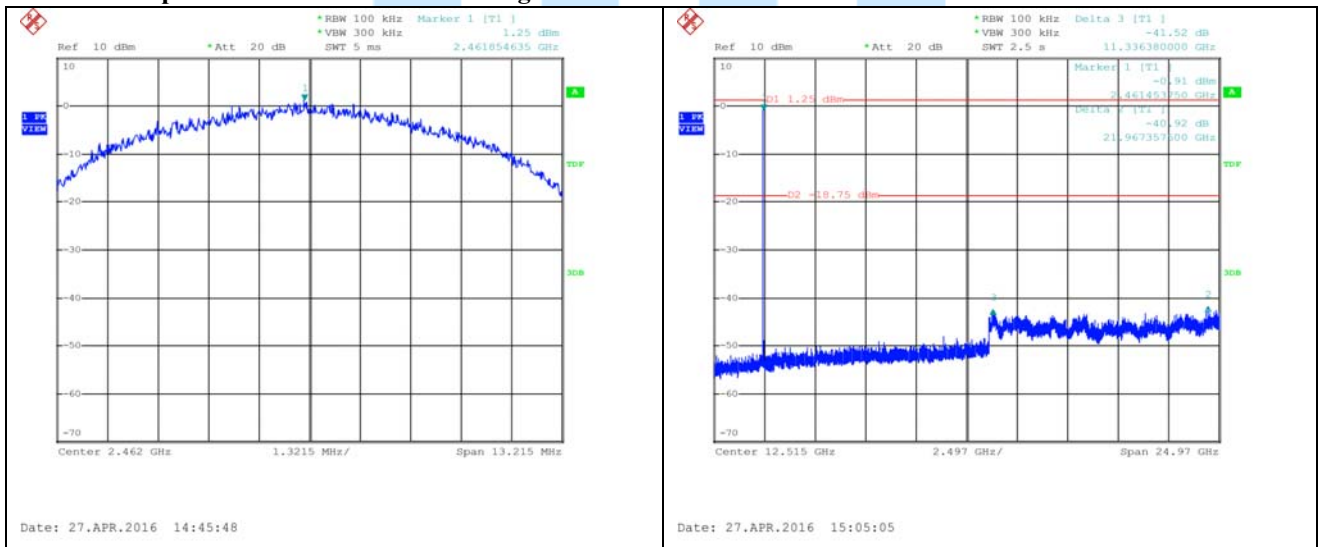




Conducted spurious Emission Plot on Configuration : IEEE 802.11b 6ch

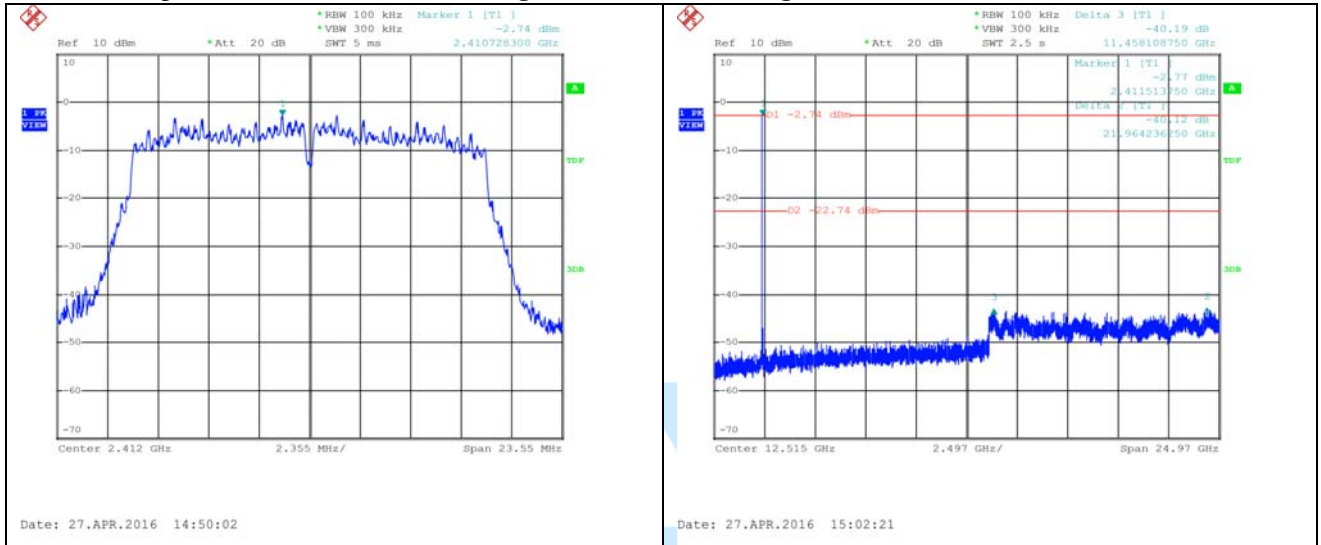


Conducted spurious Emission Plot on Configuration : IEEE 802.11b 11ch

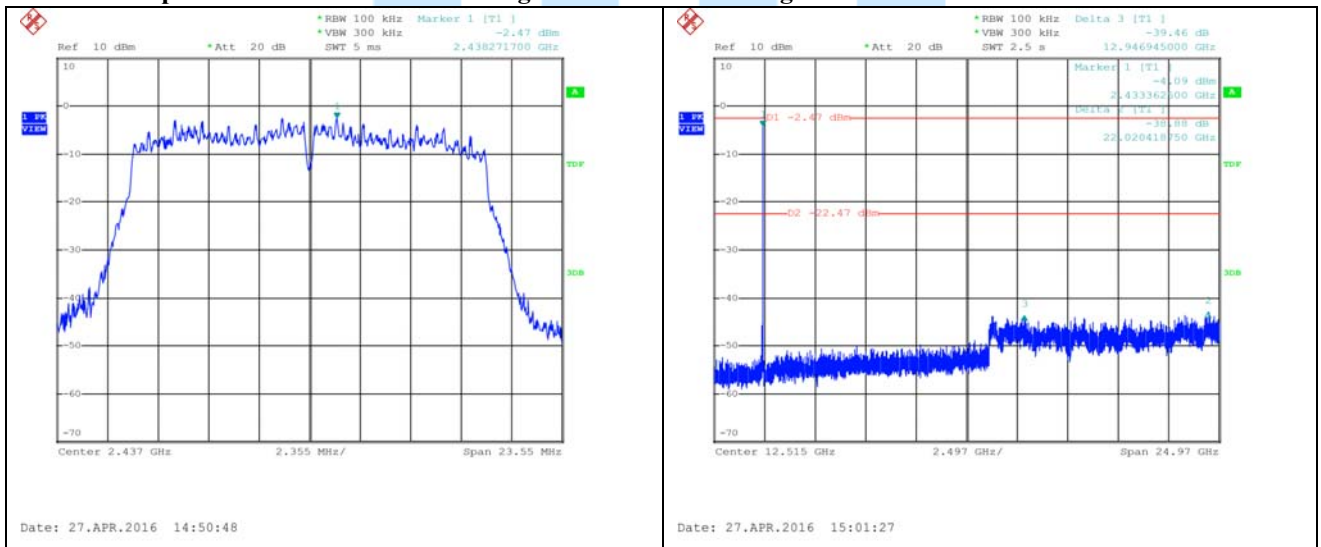




Conducted spurious Emission Plot on Configuration : IEEE 802.11g 1ch

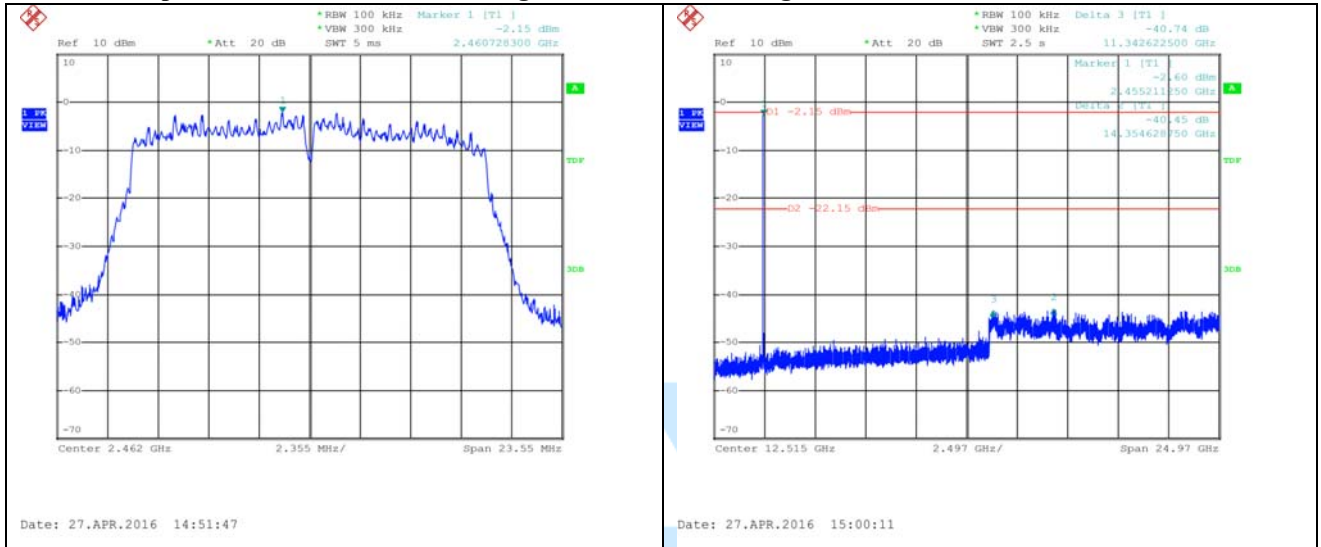


Conducted spurious Emission Plot on Configuration : IEEE 802.11g 6ch

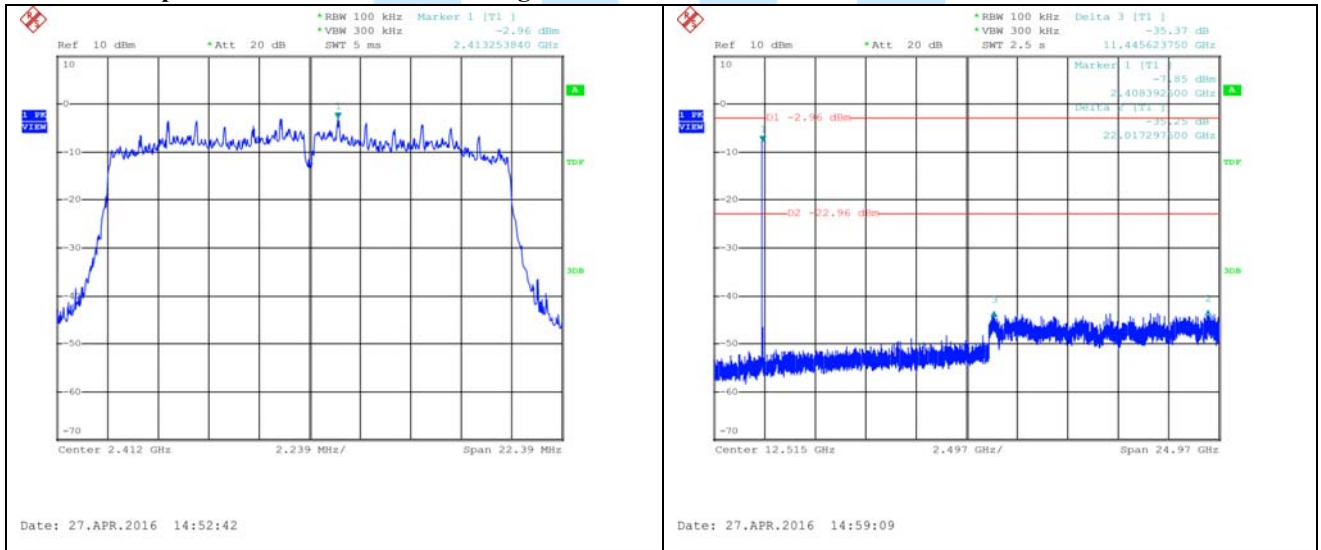




Conducted spurious Emission Plot on Configuration : IEEE 802.11g 11ch

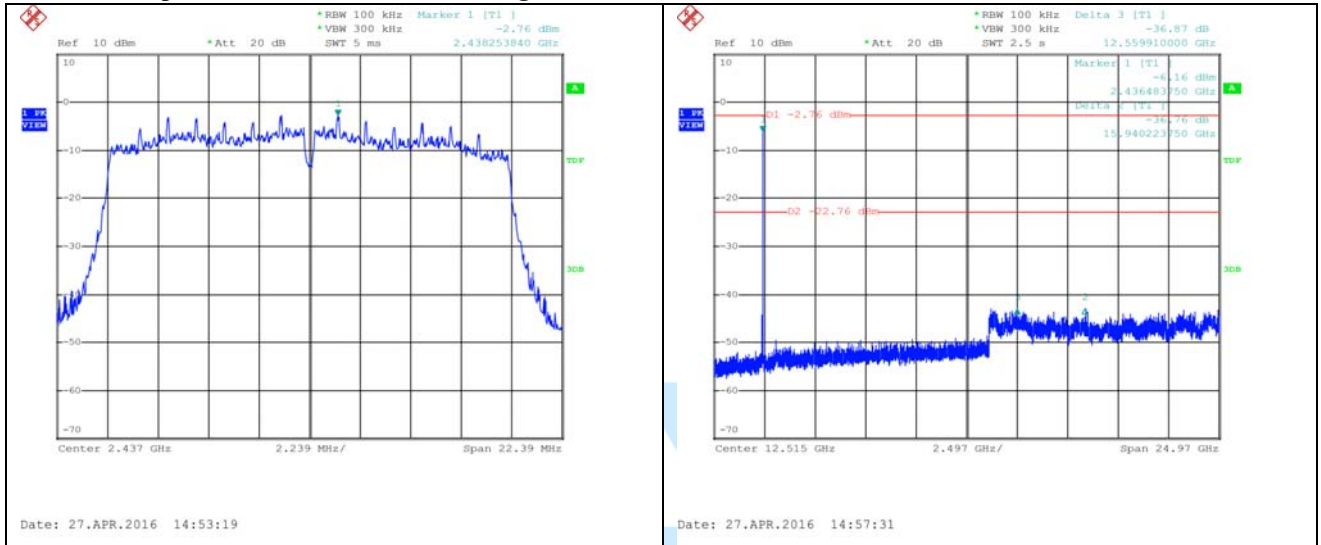


Conducted spurious Emission Plot on Configuration : IEEE 802.11n 1ch

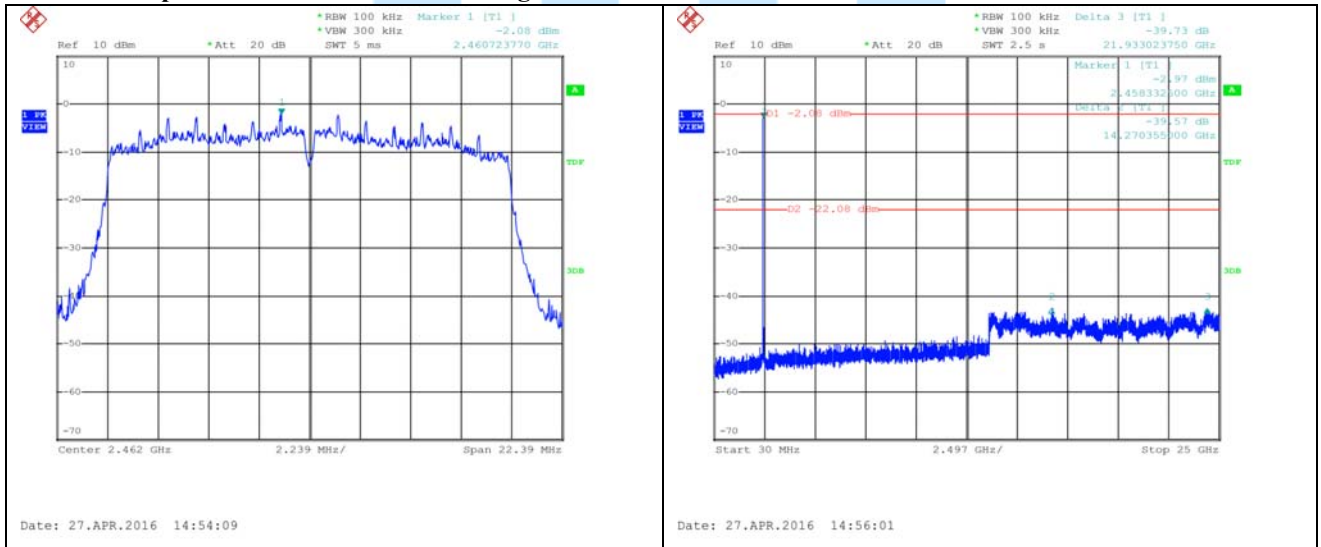




Conducted spurious Emission Plot on Configuration : IEEE 802.11n 6ch

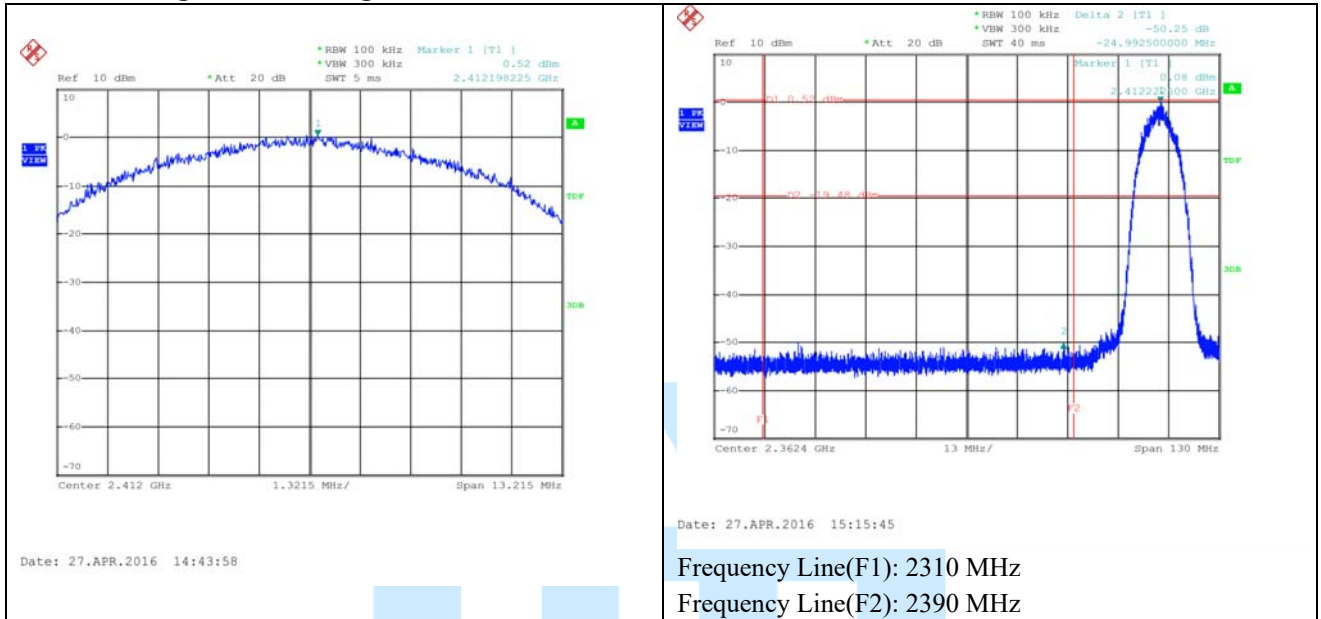


Conducted spurious Emission Plot on Configuration : IEEE 802.11n 11ch

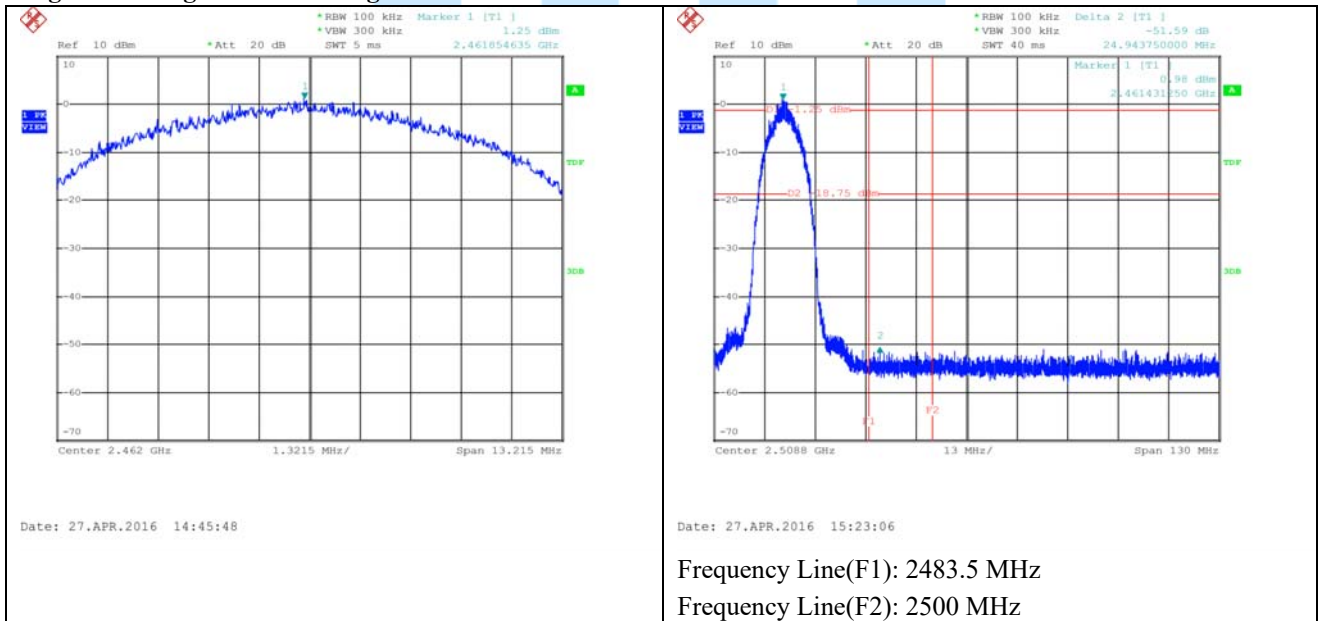




Low Band Edge Plot on Configuration : IEEE 802.11b 1ch

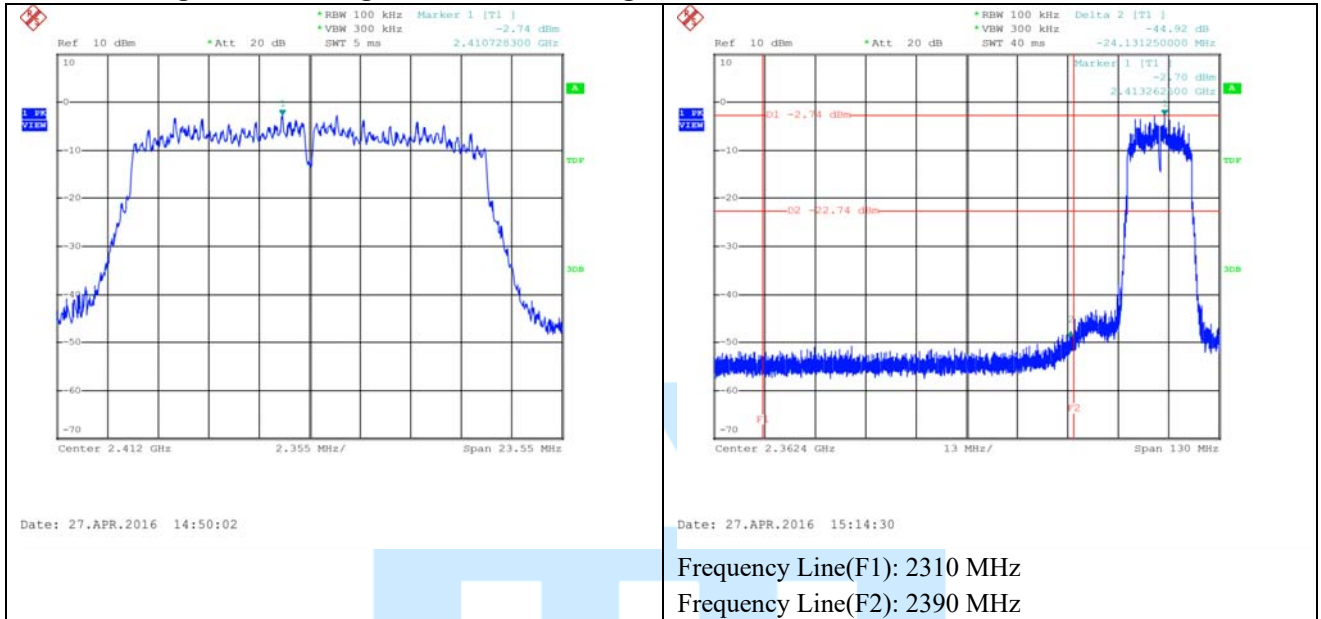


High Band Edge Plot on Configuration : IEEE 802.11b 11ch

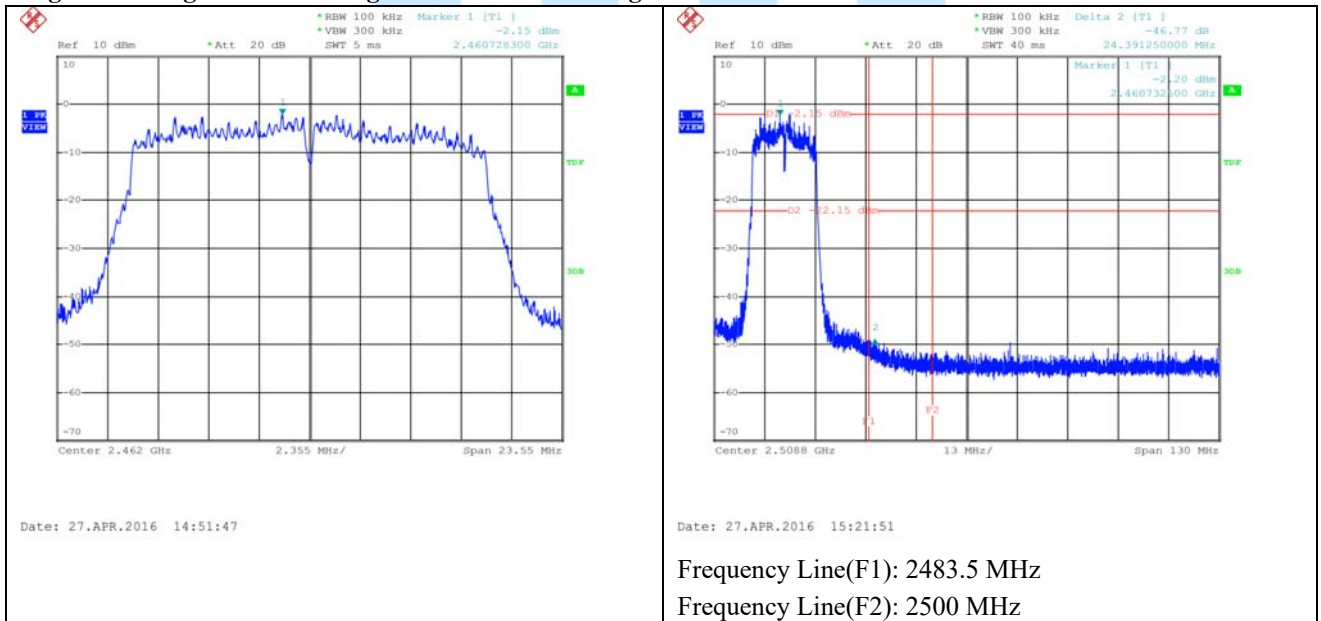




Low Band Edge Plot on Configuration : IEEE 802.11g 1ch

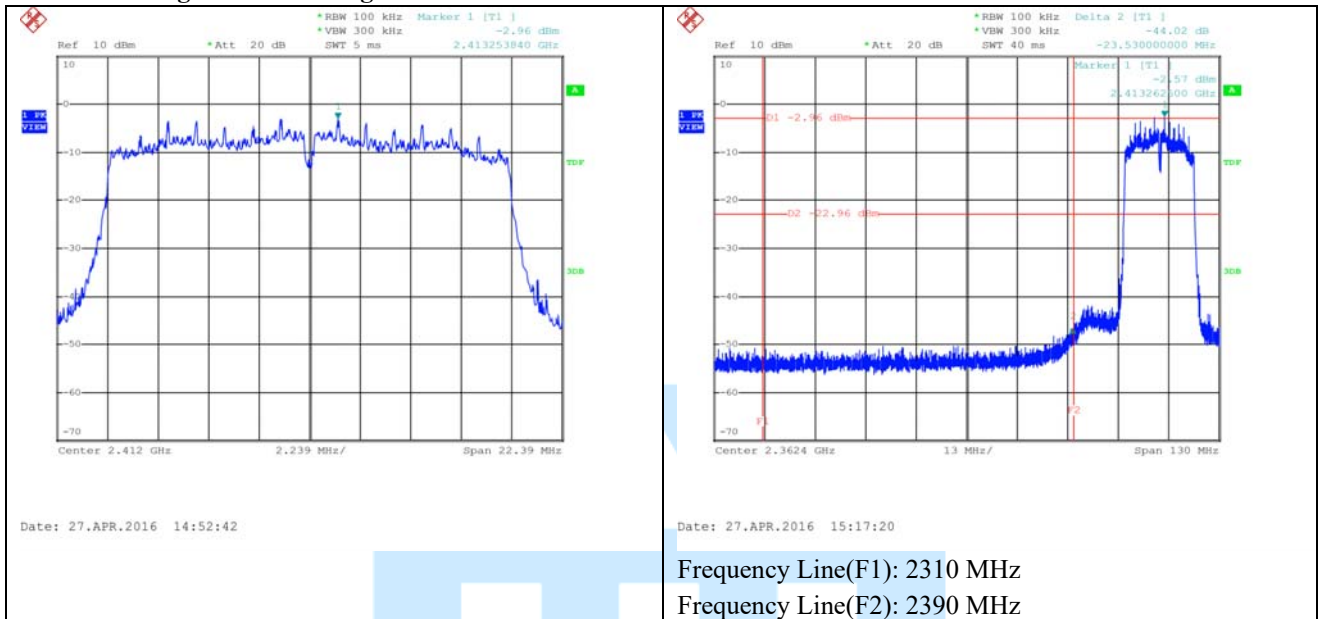


High Band Edge Plot on Configuration : IEEE 802.11g 11ch

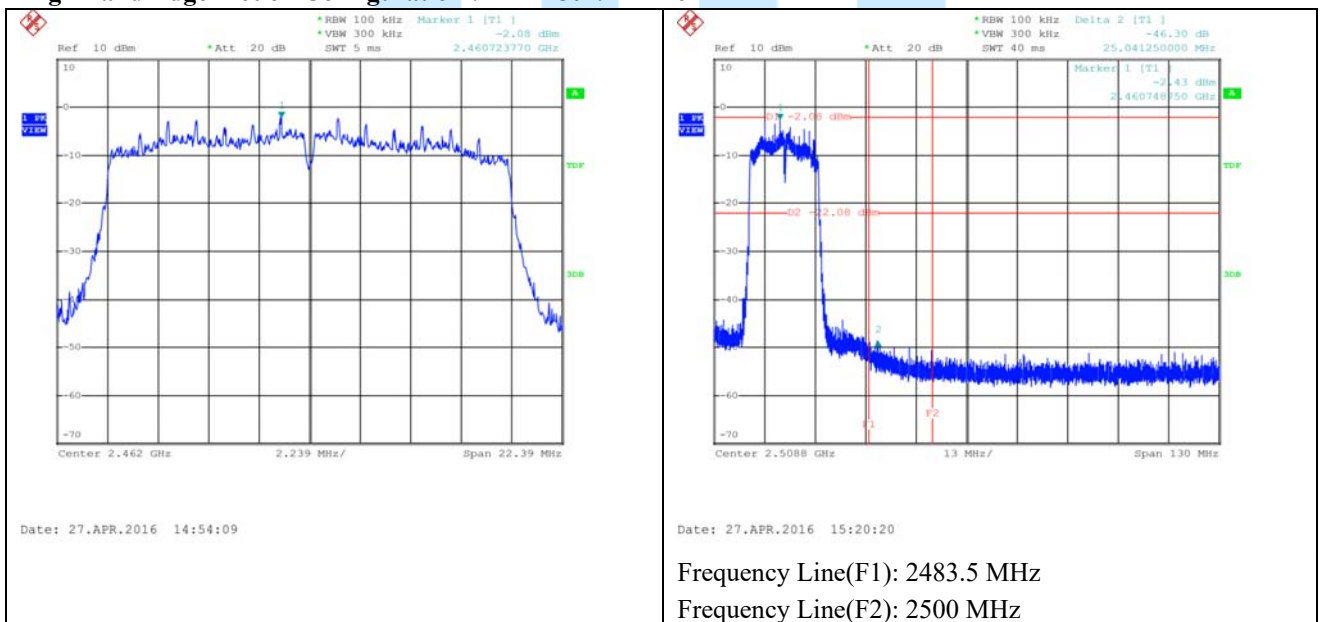




Low Band Edge Plot on Configuration : IEEE 802.11n 1ch



High Band Edge Plot on Configuration : IEEE 802.11n 11ch





12. AC Power line Conducted emission

-Test Description

The Line conducted emission test facility is inside a 4 m × 8 m × 2.5 m shielded enclosure. (Test firm Registration Number: 269701)

The EUT was placed on a non-conducting 1.0 m by 1.5 m table, which is 0.8 m in height and 0.4 m away from the vertical wall of the shielded enclosure.

The EUT is powered from the Rohde & Schwarz LISN (ENV216) and the support equipment is powered from the Rohde & Schwarz LISN (ENV216). Powers to the LISN are filtered by high-current high insertion loss power line filter.

Sufficient time for EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition.

The RF output of the LISN was connected to the EMI test receiver (Rohde & Schwarz, ESCI).

Exploratory measurements were conducted to identify the highest emission by operating the EUT in a range of typical modes of operation, cable positions, system configuration and arrangement.

Based on exploratory measurements, the final measurements were conducted at the worst test conditions.

Exploratory measurements were scanned using Peak mode of EMI Test receiver from 150 kHz to 30 MHz with 20 ms sweep time. The final measurements were measured with Quasi-Peak and Average mode.

The bandwidth of EMI Test Receiver was set to 9 kHz. Interface cables were connected to the available interface ports of the test unit. Excess cable lengths were bundled at center with 30 cm ~ 40 cm.

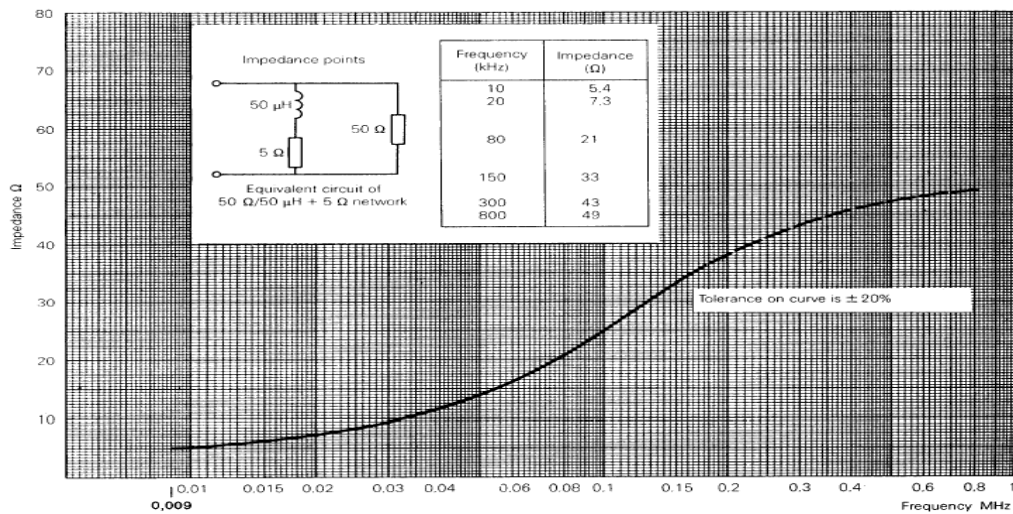


Fig 2. Impedance of LISN





12.1 Operating Environment

Temperature : 25.6 °C
 Relative Humidity : 47.2 % R.H.

12.2 Test Set-up

The conducted emission measurements were performed in the shielded room.

The EUT was placed on wooden table, 0.8 m heights above the floor, 0.4 m from the reference ground plane (GRP) wall and 0.8 m from AMN & ISN.

AMN is bonded on horizontal reference ground plane.

The ground plane, which was electrically bonded to the shield room, ground system and all power lines entering the shield room, were filtered.

12.3 Measurement Uncertainty

The measurement uncertainty was calculated in accordance with ISO “Guide to the expression of uncertainty in measurement.”

The measurement uncertainty was given with a confidence of 95 %.

Test Items	Uncertainty	Remark
Conducted emission (9 kHz ~ 150 kHz)	3.94 dB	Confidence level of approximately 95 % ($k = 2$)
Conducted emission (150 kHz ~ 30 MHz)	3.43 dB	Confidence level of approximately 95 % ($k = 2$)





12.4 Limit

RFI Conducted	FCC Limit(dBμV/m) Class B	
Freq. Range	Quasi-Peak	Average
150 kHz ~ 0.5 MHz	66 ~ 56*	56 ~ 46*
0.5 MHz ~ 5 MHz	56	46
5 MHz ~ 30 MHz	60	50

*Limits decreases linearly with the logarithm of frequency.

12.5 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■- ESCI	Rohde & Schwarz	EMI test receiver	100237	Apr 18. 2017
■-- ENV216	Rohde & Schwarz	LISN	100172	Apr 19. 2017
□- ENV216	Rohde & Schwarz	LISN	100173	Apr 19. 2017
□ - ISN T8	TESEQ. GmbH	ISN	24568	Apr 22. 2017

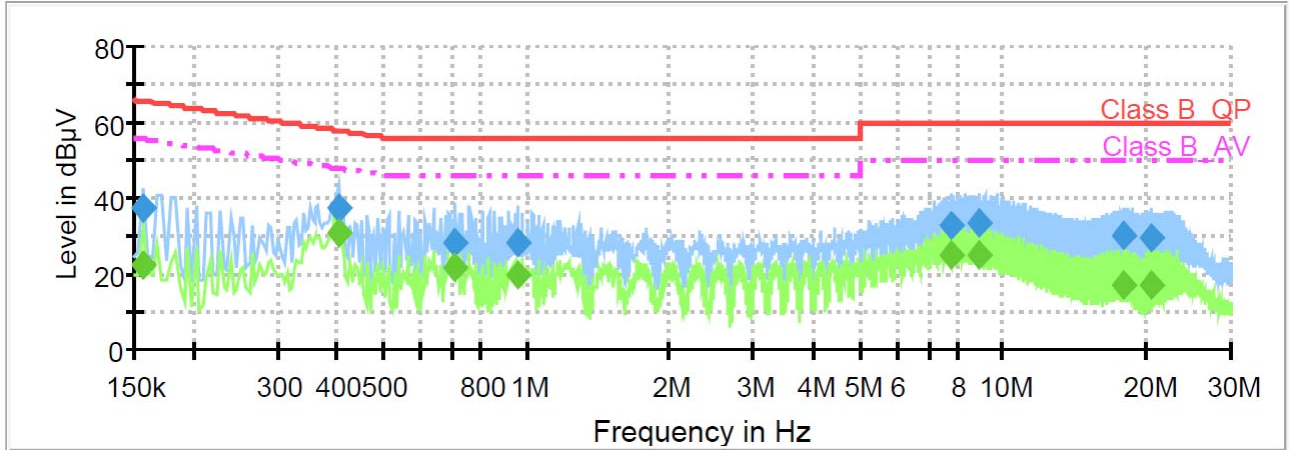
12.6 Test data for Conducted Emission

- Test Date : May 02, 2016
- Reference Standard : Part 15 Subpart C, Sec. 15.207
- Test Procedure(s) : ANSI C63.10 (2013)
- Operating Condition : RF transmitting mode
- Power Source : AC 120 V / 60 Hz
- Frequency rage : 0.15 MHz ~ 30 MHz
- Line : AC Power line(Live with Neutral)
- Comment : Worst case test result was reported.





IEEE 802.11b 11ch



Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.157463	37.1	100.0	9.000	FLO	L1	10.1	28.5	65.6	
0.403725	37.2	100.0	9.000	FLO	L1	10.1	20.5	57.8	
0.709688	28.5	100.0	9.000	FLO	L1	10.2	27.5	56.0	
0.959681	28.0	100.0	9.000	FLO	L1	10.2	28.0	56.0	
7.813988	32.8	100.0	9.000	FLO	L1	10.5	27.2	60.0	
8.881125	33.4	100.0	9.000	FLO	L1	10.6	26.6	60.0	
17.843588	30.3	100.0	9.000	FLO	L1	10.6	29.7	60.0	
20.533819	29.4	100.0	9.000	FLO	L1	10.7	30.6	60.0	

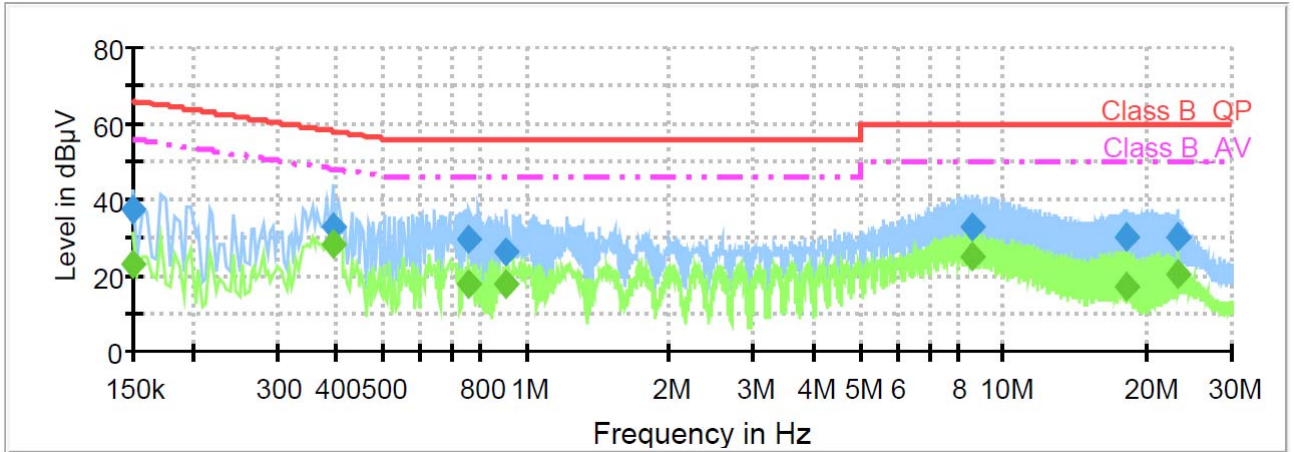
Final Result 2

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.157463	22.5	100.0	9.000	FLO	L1	10.1	33.1	55.6	
0.403725	30.9	100.0	9.000	FLO	L1	10.1	16.9	47.8	
0.709688	21.6	100.0	9.000	FLO	L1	10.2	24.4	46.0	
0.959681	19.6	100.0	9.000	FLO	L1	10.2	26.4	46.0	
7.813988	24.9	100.0	9.000	FLO	L1	10.5	25.1	50.0	
8.881125	24.8	100.0	9.000	FLO	L1	10.6	25.2	50.0	
17.843588	17.3	100.0	9.000	FLO	L1	10.6	32.7	50.0	
20.533819	16.8	100.0	9.000	FLO	L1	10.7	33.2	50.0	





IEEE 802.11g 11ch



Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.150000	37.6	100.0	9.000	FLO	L1	10.1	28.4	66.0	
0.392531	32.8	100.0	9.000	FLO	L1	10.1	25.2	58.0	
0.761925	29.8	100.0	9.000	FLO	N	10.2	26.2	56.0	
0.911175	26.0	100.0	9.000	FLO	L1	10.2	30.0	56.0	
8.575163	33.0	100.0	9.000	FLO	L1	10.5	27.0	60.0	
18.130894	30.3	100.0	9.000	FLO	L1	10.6	29.7	60.0	
23.078531	30.4	100.0	9.000	FLO	L1	10.7	29.6	60.0	

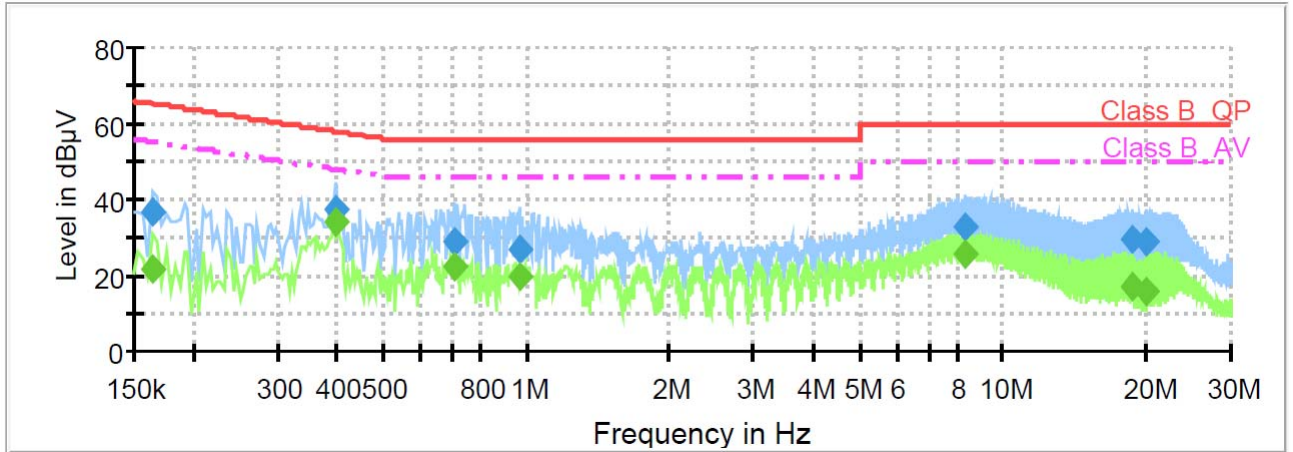
Final Result 2

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.150000	22.8	100.0	9.000	FLO	L1	10.1	33.2	56.0	
0.392531	28.4	100.0	9.000	FLO	L1	10.1	19.6	48.0	
0.761925	17.6	100.0	9.000	FLO	N	10.2	28.4	46.0	
0.911175	17.7	100.0	9.000	FLO	L1	10.2	28.3	46.0	
8.575163	24.8	100.0	9.000	FLO	L1	10.5	25.2	50.0	
18.130894	17.3	100.0	9.000	FLO	L1	10.6	32.7	50.0	
23.078531	20.2	100.0	9.000	FLO	L1	10.7	29.8	50.0	





IEEE 802.11n 11ch



Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.164925	36.5	100.0	9.000	FLO	L1	10.1	28.7	65.2	
0.399994	37.5	100.0	9.000	FLO	L1	10.1	20.4	57.9	
0.705956	28.6	100.0	9.000	FLO	L1	10.2	27.4	56.0	
0.967144	27.0	100.0	9.000	FLO	L1	10.2	29.0	56.0	
8.299050	33.0	100.0	9.000	FLO	L1	10.5	27.0	60.0	
18.671925	29.6	100.0	9.000	FLO	L1	10.6	30.4	60.0	
20.045025	28.9	100.0	9.000	FLO	L1	10.6	31.1	60.0	

Final Result 2

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.164925	21.8	100.0	9.000	FLO	L1	10.1	33.4	55.2	
0.399994	34.2	100.0	9.000	FLO	L1	10.1	13.6	47.9	
0.705956	22.5	100.0	9.000	FLO	L1	10.2	23.5	46.0	
0.967144	19.6	100.0	9.000	FLO	L1	10.2	26.4	46.0	
8.299050	25.3	100.0	9.000	FLO	L1	10.5	24.7	50.0	
18.671925	16.8	100.0	9.000	FLO	L1	10.6	33.2	50.0	
20.045025	15.7	100.0	9.000	FLO	L1	10.6	34.3	50.0	





13. Radiated Spurious & Restricted Band Edge Emission

Exploratory Radiated measurements were conducted at the 3m semi anechoic chamber in order to identify the highest emission by operating the EUT in a range of typical modes of operation, cable positions, system configuration and arrangement.

Based on exploratory measurements, the final measurements were conducted at the worst test conditions.

Final measurements of below 1GHz were made at 3m or 10 m Chamber that complies with CISPR 16/ANSI C63.10. Above 1GHz final measurements were conducted at the 3m Chamber only.

For measurements above 1GHz, the bottom side of 3m chamber was installed with absorbers in order to meet SVSWR Limit.

Exploratory measurements were scanned using Peak mode of EMI Test receiver and final measurements were measured with Quasi-Peak mode (Below 1GHz) and Peak & Average mode (Above 1GHz).

The measurements were performed by rotating the EUT 360° and adjusting the receive antenna height from 1.0 m to 4.0 m. All frequencies were investigated in both horizontal and vertical antenna polarity.

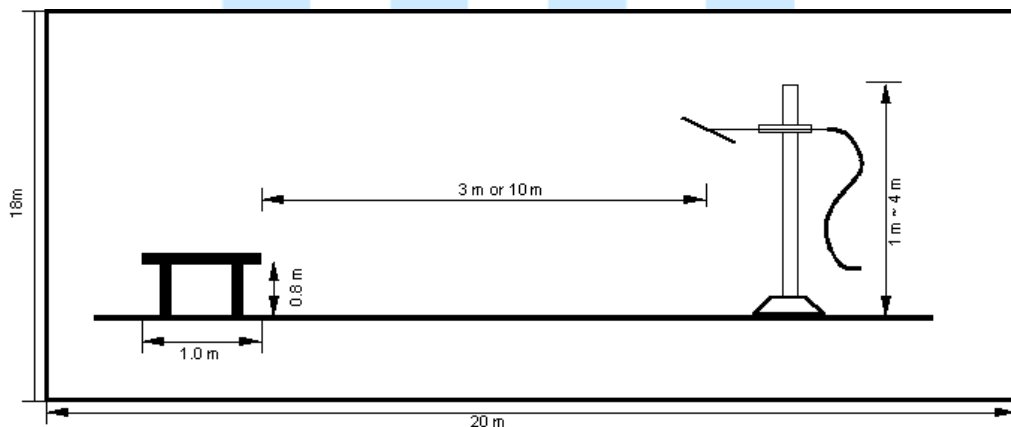


Fig 3. Dimensions of test site (Below 1GHz)

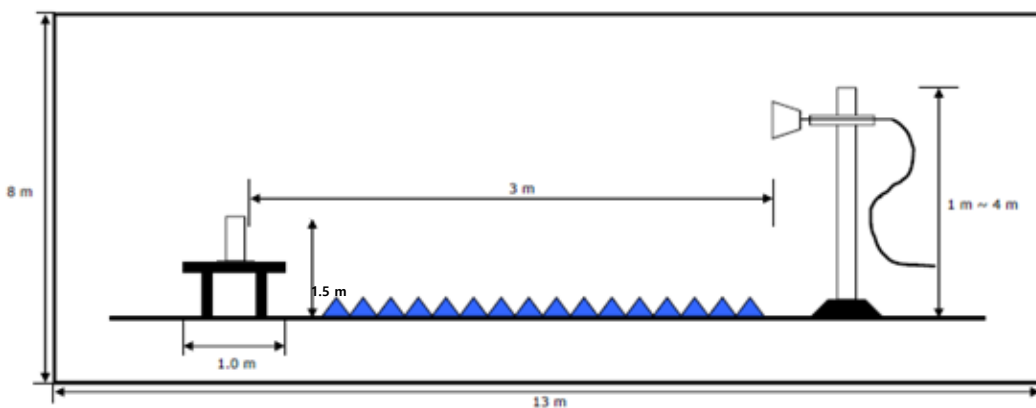


Fig 4. Dimensions of test site (Above 1GHz)





13.1 Operating environment

Temperature : 23.0 °C
 Relative humidity : 49.5 % R.H.

13.2 Test set-up

A preliminary and final measurement was at 3 m anechoic chamber.

The EUT was placed on a non-conducting table.

For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane.

For emission measurements above 1 GHz, the table height is 1.5 m above the reference ground plane.

The turntable with EUT was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels.

This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

13.3 Measurement uncertainty

The measurement uncertainty was calculated in accordance with ISO “Guide to the expression of uncertainty in measurement”.

The measurement uncertainty was given with a confidence of 95 %.

Test items(Anechoic Chamber)	Uncertainty	Remark
Radiated emission (30 MHz ~ 300 MHz, 3 m, Vertical)	4.66 dB	Confidence level of approximately 95 % ($k = 2$)
Radiated emission (30 MHz ~ 300 MHz, 3 m, Horizontal)	4.65 dB	Confidence level of approximately 95 % ($k = 2$)
Radiated emission (300 MHz ~ 1 000 MHz, 3 m, Vertical)	4.91 dB	Confidence level of approximately 95 % ($k = 2$)
Radiated emission (300 MHz ~ 1 000 MHz, 3 m, Horizontal)	4.88 dB	Confidence level of approximately 95 % ($k = 2$)
Radiated emission (1 000 MHz ~ 6 000 MHz, 3 m, V/H)	5.32 dB	Confidence level of approximately 95 % ($k = 2$)
Radiated emission (6 000 MHz ~ 18 000 MHz, 3 m, V/H)	5.45 dB	Confidence level of approximately 95 % ($k = 2$)





13.4 Limit

20 dB in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (microvolt/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2 400/F (kHz)	300
0.490 ~ 1.705	2 400/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

13.5 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESIB26	Rohde & Schwarz	EMI Test Receiver	830482/010	Apr. 18, 2017
■ - HFH2-Z2	Rohde & Schwarz	Loop Antenna	100041	Dec. 21, 2017
■ - VULB9160	Schwarzbeck	Broadband Test Antenna	3193	Mar. 28. 2018
■ - BBHA9120D	Schwarzbeck	Horn Antenna	207	Mar. 15. 2018
■ - 3160-09	Schwarzbeck	Horn Antenna	LM3981	Nov. 29. 2017
■ - MCU066	maturo GmbH	Position Controller	1390306	N/A
■ - TT2.5SI	maturo GmbH	Turntable	1390307	N/A
■ - AM 4.0	maturo GmbH	Antenna Mast	1390308	N/A
■ - AFS 44 00101800-25-10P-44	MITEQ	Preamplifier	1258943	Jan. 05. 2017
■ - SCU-F1826-G47-BZ42-CSS	BONN Elektronik	Preamplifier	10003	Jan. 12. 2017



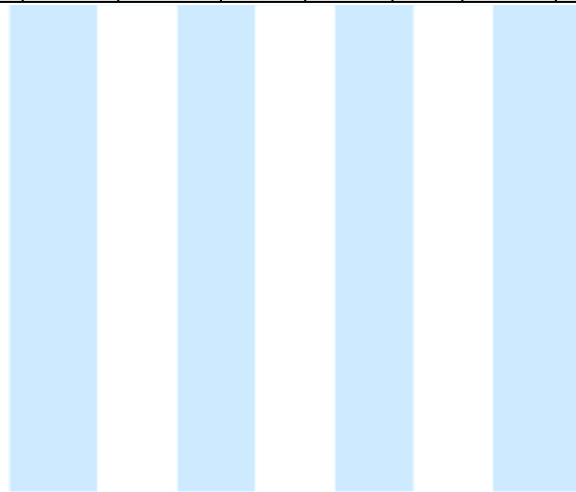


13.6 Test data for Radiated Spurious Emission

- Test Date : May 02~04, 2016
- Reference Standard : Part 15 Subpart C, Sec. 15.247(d)
- Measuring Distance : 3 m
- Resolution Bandwidth : 9 kHz(9 kHz ~ 30 MHz) / 120 kHz(30 MHz ~ 1GHz) / 1 MHz(Above 1GHz)
- Detector mode : Quasi Peak detector mode / Peak detector mode / Average detector mode
- Power Source : DC 5.0 V
- Note : Worst case data were report.

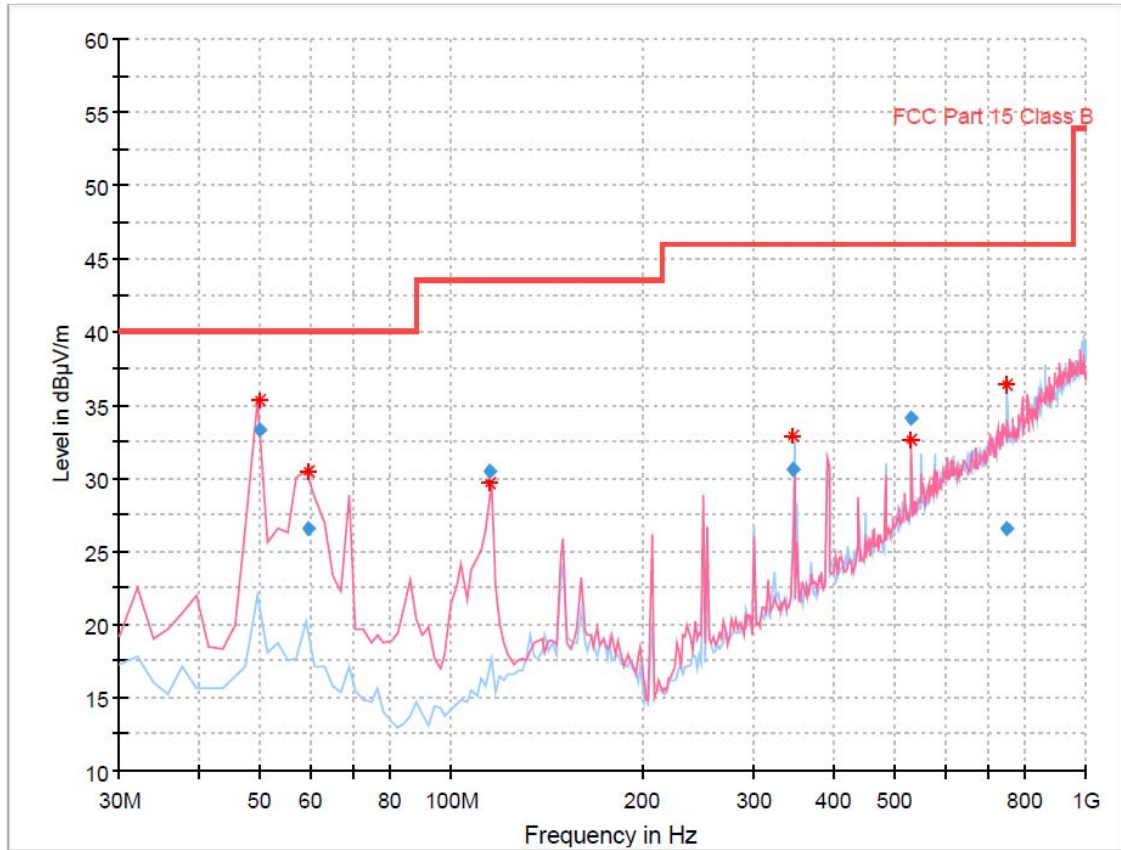
Radiated Spurious Emission (9 kHz to 30 MHz) IEEE 802.11b/g/n

Frequency (MHz)	Measurement Level					Limit (dBμV/m)		Margin (dB)		Positioning System				
	Reading Value (dBμV/m)		AF	AMP / CL	Duty Cycle collection					Test Result (dBμV/m)		Pol.	Height	Angle
	Peak	Average	(dB/m)	(dB)	(dB)	Peak	Average	Peak	Average	(H/V)	(cm)	(°)		
The emission level was not found														





Radiated Spurious Emission (30 MHz to 1 000 MHz): IEEE 802.11b 11ch



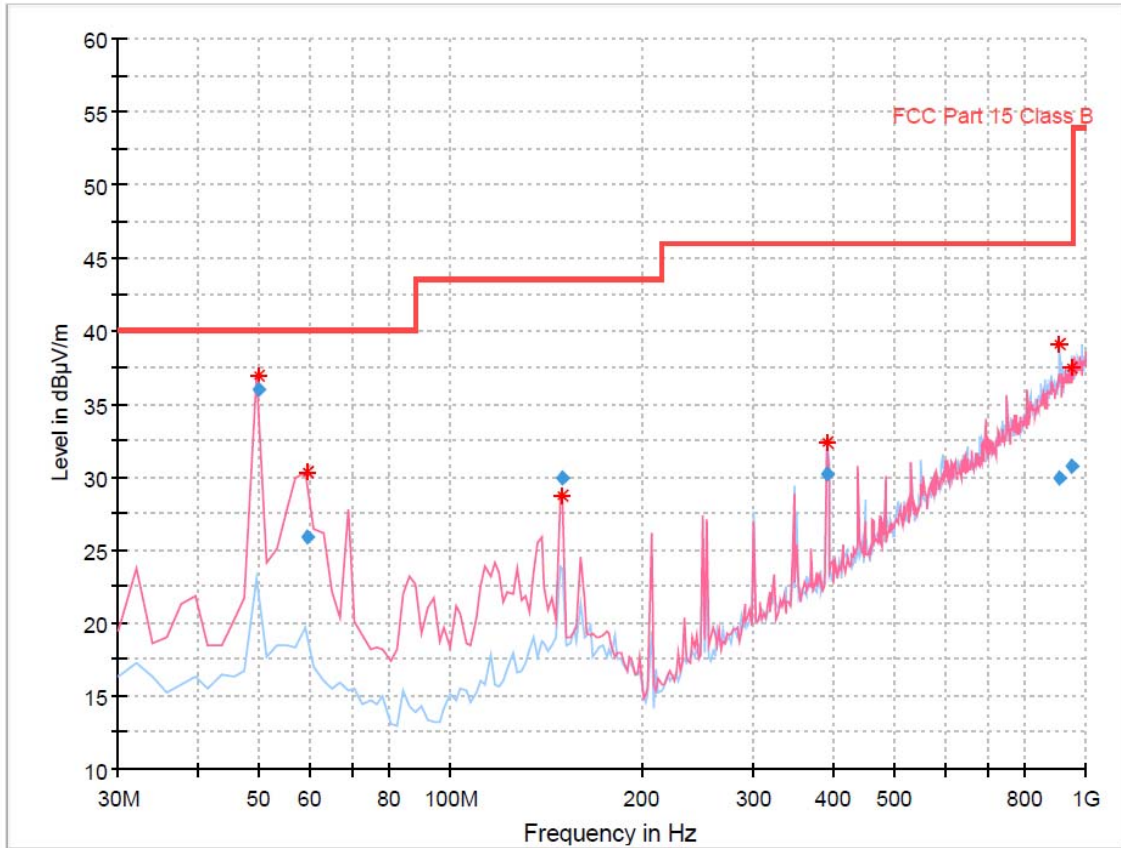
Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
49.958878	33.30	40.00	6.70	1000.0	120.000	106.0	V	178.0	13.3
59.478317	26.64	40.00	13.36	1000.0	120.000	113.0	V	109.0	12.7
115.371062	30.54	43.50	12.96	1000.0	120.000	107.0	V	69.0	12.6
346.213707	30.62	46.00	15.38	1000.0	120.000	125.0	H	352.0	18.6
530.683046	34.13	46.00	11.87	1000.0	120.000	106.0	V	188.0	23.9
750.382365	26.54	46.00	19.46	1000.0	120.000	190.0	H	192.0	28.7





Radiated Spurious Emission (30 MHz to 1 000 MHz): IEEE 802.11g 11ch



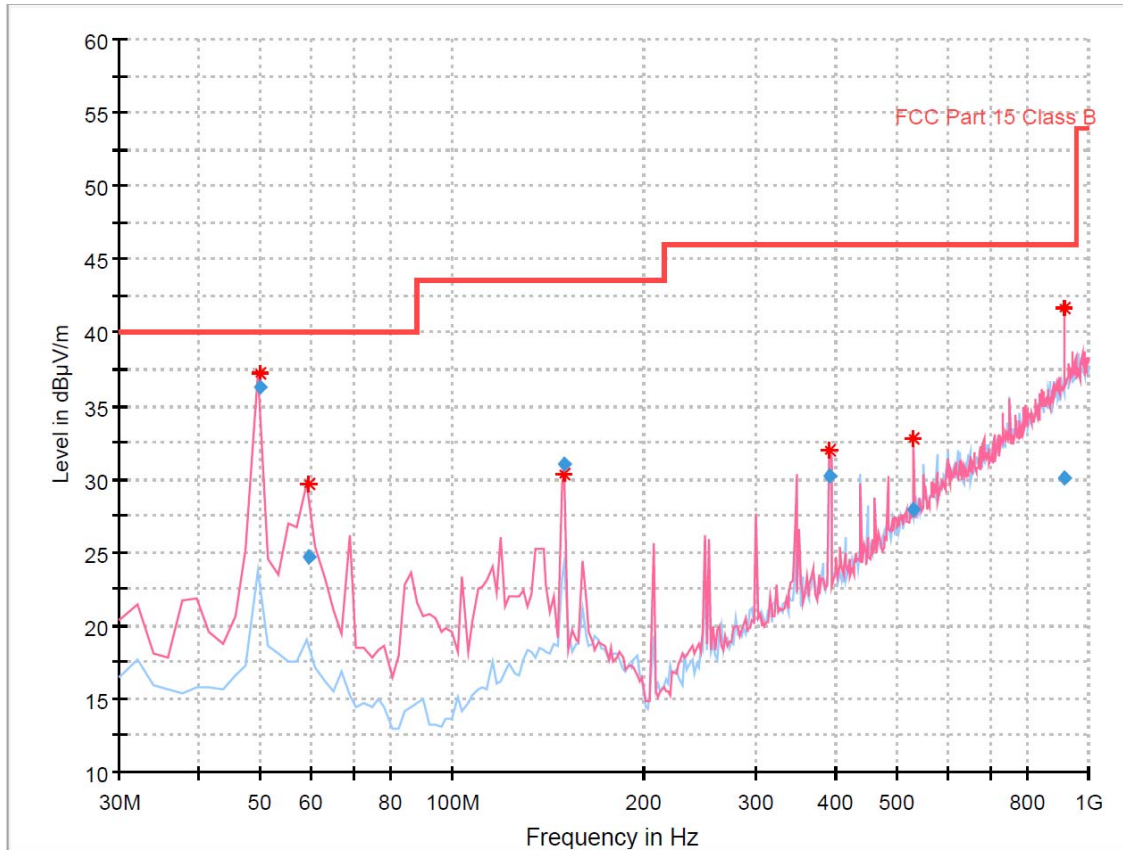
Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
49.958878	36.04	40.00	3.96	1000.0	120.000	106.0	V	178.0	13.3
59.478317	25.90	40.00	14.10	1000.0	120.000	107.0	V	80.0	12.7
149.961042	29.98	43.50	13.52	1000.0	120.000	106.0	V	316.0	15.2
392.323126	30.26	46.00	15.74	1000.0	120.000	100.0	H	317.0	19.9
909.621162	29.99	46.00	16.01	1000.0	120.000	125.0	H	10.0	31.9
946.795030	30.81	46.00	15.19	1000.0	120.000	216.0	H	18.0	32.4





Radiated Spurious Emission (30 MHz to 1 000 MHz): IEEE 802.11n 6ch



Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
49.958878	36.32	40.00	3.68	1000.0	120.000	100.0	V	188.0	13.3
59.478317	24.75	40.00	15.25	1000.0	120.000	111.0	V	106.0	12.7
149.961042	31.09	43.50	12.41	1000.0	120.000	106.0	V	283.0	15.2
392.243126	30.20	46.00	15.80	1000.0	120.000	106.0	H	344.0	19.9
530.643046	27.95	46.00	18.05	1000.0	120.000	107.0	V	181.0	23.9
913.748938	30.04	46.00	15.96	1000.0	120.000	220.0	V	355.0	31.9





Radiated Spurious Emission (1 GHz to 25 GHz): IEEE 802.11b 1ch

Frequency [MHz]	Pol.	Reading [dBuV]	Transducer Factor [dB]	Test Result [dBuV/m]	Limits [dBuV/m]	Margin [dB]	Detector Type
1084.17	H	50.26	-13.60	36.66	74.00	37.34	PK
1084.17	H	41.07	-13.60	27.47	54.00	26.53	AV
1549.10	H	49.40	-12.40	37.00	74.00	37.00	PK
1549.10	H	35.99	-12.40	23.59	54.00	30.41	AV
1889.78	V	45.69	-11.80	33.89	74.00	40.12	PK
1889.78	V	34.72	-11.80	22.92	54.00	31.08	AV
1985.97	V	45.62	-11.60	34.02	74.00	39.98	PK
1985.97	V	34.74	-11.60	23.14	54.00	30.86	AV
2254.51	H	45.57	-10.60	34.97	74.00	39.03	PK
2254.51	H	36.02	-10.60	25.42	54.00	28.58	AV
2575.15	V	44.06	-9.50	34.56	74.00	39.44	PK
2575.15	V	33.33	-9.50	23.83	54.00	30.17	AV

Radiated Spurious Emission (1 GHz to 25 GHz): IEEE 802.11b 6ch

Frequency [MHz]	Pol.	Reading [dBuV]	Transducer Factor [dB]	Test Result [dBuV/m]	Limits [dBuV/m]	Margin [dB]	Detector Type
1084.17	V	51.11	-13.60	37.51	74.00	36.49	PK
1084.17	V	41.07	-13.60	27.47	54.00	26.53	AV
1549.10	V	50.55	-12.40	38.15	74.00	35.86	PK
1549.10	V	40.48	-12.40	28.08	54.00	25.92	AV
1917.84	V	48.93	-11.80	37.13	74.00	36.87	PK
1917.84	V	36.46	-11.80	24.66	54.00	29.34	AV
2262.53	H	51.23	-10.50	40.73	74.00	33.27	PK
2262.53	H	38.04	-10.50	27.54	54.00	26.46	AV
2643.29	V	48.67	-9.30	39.37	74.00	34.63	PK
2643.29	V	37.29	-9.30	27.99	54.00	26.01	AV
2779.56	V	48.50	-9.00	39.50	74.00	34.50	PK
2779.56	V	36.46	-9.00	27.46	54.00	26.54	AV





Radiated Spurious Emission (1 GHz to 25 GHz): IEEE 802.11b 11ch

Frequency [MHz]	Pol.	Reading [dBuV]	Transducer Factor [dB]	Test Result [dBuV/m]	Limits [dBuV/m]	Margin [dB]	Detector Type
1549.10	V	47.50	-12.40	35.10	74.00	38.90	PK
1549.10	V	38.20	-12.40	25.80	54.00	28.20	AV
1817.64	V	47.12	-11.90	35.22	74.00	38.78	PK
1817.64	V	33.66	-11.90	21.76	54.00	32.24	AV
1865.73	V	47.60	-11.80	35.80	74.00	38.20	PK
1865.73	V	37.00	-11.80	25.20	54.00	28.80	AV
2246.49	H	53.51	-10.60	42.91	74.00	31.09	PK
2246.49	H	36.72	-10.60	26.12	54.00	27.88	AV
2559.12	H	48.30	-9.50	38.80	74.00	35.20	PK
2559.12	H	36.30	-9.50	26.80	54.00	27.20	AV
2647.29	H	45.30	-9.30	36.00	74.00	38.00	PK
2647.29	H	35.10	-9.30	25.80	54.00	28.20	AV

Note:

Corrected reading: + Transducer Factor + Read value = Test result

※ Transducer Factor: Antenna factor + Cable loss + AMP gain + High Pass Filter(if use)

Pol.: H(Horizontal), V(Vertical)





Radiated Spurious Emission (1 GHz to 25 GHz): IEEE 802.11g 1ch

Frequency [MHz]	Pol.	Reading [dBuV]	Transducer Factor [dB]	Test Result [dBuV/m]	Limits [dBuV/m]	Margin [dB]	Detector Type
1549.10	V	46.90	-12.40	34.50	74.00	39.50	PK
1549.10	V	38.22	-12.40	25.82	54.00	28.19	AV
1737.47	V	45.54	-12.10	33.44	74.00	40.56	PK
1737.47	V	34.06	-12.10	21.96	54.00	32.04	AV
1909.82	V	46.00	-11.80	34.20	74.00	39.80	PK
1909.82	V	34.05	-11.80	22.25	54.00	31.75	AV
2214.43	V	45.18	-10.70	34.48	74.00	39.52	PK
2214.43	V	34.71	-10.70	24.01	54.00	30.00	AV
2603.21	H	44.12	-9.40	34.72	74.00	39.28	PK
2603.21	H	32.84	-9.40	23.44	54.00	30.56	AV
2771.54	V	45.13	-9.00	36.13	74.00	37.87	PK
2771.54	V	33.69	-9.00	24.69	54.00	29.31	AV

Radiated Spurious Emission (1 GHz to 25 GHz): IEEE 802.11g 6ch

Frequency [MHz]	Pol.	Reading [dBuV]	Transducer Factor [dB]	Test Result [dBuV/m]	Limits [dBuV/m]	Margin [dB]	Detector Type
1084.17	H	50.09	-13.60	36.49	74.00	37.52	PK
1084.17	H	41.07	-13.60	27.47	54.00	26.53	AV
1549.10	V	50.37	-12.40	37.97	74.00	36.03	PK
1549.10	V	40.48	-12.40	28.08	54.00	25.92	AV
1881.76	V	49.07	-11.80	37.27	74.00	36.73	PK
1881.76	V	36.41	-11.80	24.61	54.00	29.39	AV
2250.50	H	50.09	-10.60	39.49	74.00	34.51	PK
2250.50	H	38.10	-10.60	27.50	54.00	26.50	AV
2290.58	H	49.71	-10.40	39.31	74.00	34.69	PK
2290.58	H	37.29	-10.40	26.89	54.00	27.12	AV
2523.05	V	48.68	-9.60	39.08	74.00	34.92	PK
2523.05	V	37.26	-9.60	27.66	54.00	26.35	AV
2655.31	H	48.27	-9.30	38.97	74.00	35.03	PK
2655.31	H	37.28	-9.30	27.98	54.00	26.02	AV





Radiated Spurious Emission (1 GHz to 25 GHz): IEEE 802.11g 11ch

Frequency [MHz]	Pol.	Reading [dBuV]	Transducer Factor [dB]	Test Result [dBuV/m]	Limits [dBuV/m]	Margin [dB]	Detector Type
1549.10	V	47.98	-12.40	35.58	74.00	38.42	PK
1549.10	V	37.99	-12.40	25.59	54.00	28.41	AV
2210.42	H	46.73	-10.80	35.93	74.00	38.07	PK
2210.42	H	33.70	-10.80	22.90	54.00	31.10	AV
2242.48	H	51.28	-10.60	40.68	74.00	33.32	PK
2242.48	H	37.05	-10.60	26.45	54.00	27.55	AV
2258.52	H	53.86	-10.50	43.36	74.00	30.64	PK
2258.52	H	37.29	-10.50	26.79	54.00	27.21	AV
2270.54	H	53.91	-10.50	43.41	74.00	30.59	PK
2270.54	H	36.85	-10.50	26.35	54.00	27.65	AV
2503.01	H	65.20	-9.70	55.50	74.00	18.50	PK
2503.01	H	48.84	-9.70	39.14	54.00	14.87	AV
2555.11	H	45.62	-9.50	36.12	74.00	37.89	PK
2555.11	H	36.80	-9.50	27.30	54.00	26.70	AV
2619.28	H	45.52	-9.40	36.12	74.00	37.89	PK
2619.28	H	33.29	-9.40	23.89	54.00	30.11	AV

Note:

Corrected reading: + Transducer Factor + Read value = Test result

※ Transducer Factor: Antenna factor + Cable loss + AMP gain + High Pass Filter(if use)

Pol.: H(Horizontal), V(Vertical)





Radiated Spurious Emission (1 GHz to 25 GHz): IEEE 802.11n 1ch

Frequency [MHz]	Pol.	Reading [dBuV]	Transducer Factor [dB]	Test Result [dBuV/m]	Limits [dBuV/m]	Margin [dB]	Detector Type
1244.49	V	46.41	-13.00	33.41	74.00	40.59	PK
1244.49	V	34.42	-13.00	21.42	54.00	32.58	AV
1549.10	V	47.38	-12.40	34.98	74.00	39.02	PK
1549.10	V	37.99	-12.40	25.59	54.00	28.41	AV
1901.80	H	45.11	-11.80	33.31	74.00	40.69	PK
1901.80	H	35.07	-11.80	23.27	54.00	30.73	AV
2254.51	H	47.70	-10.60	37.10	74.00	36.91	PK
2254.51	H	35.75	-10.60	25.15	54.00	28.85	AV
2523.05	V	44.38	-9.60	34.78	74.00	39.22	PK
2523.05	V	34.39	-9.60	24.79	54.00	29.21	AV
2631.26	H	44.65	-9.40	35.25	74.00	38.75	PK
2631.26	H	33.36	-9.40	23.96	54.00	30.04	AV

Radiated Spurious Emission (1 GHz to 25 GHz): IEEE 802.11n 6ch

Frequency [MHz]	Pol.	Reading [dBuV]	Transducer Factor [dB]	Test Result [dBuV/m]	Limits [dBuV/m]	Margin [dB]	Detector Type
1036.07	H	49.13	-13.70	35.43	74.00	38.57	PK
1036.07	H	41.67	-13.70	27.97	54.00	26.04	AV
1084.16	V	49.52	-13.60	35.92	74.00	38.08	PK
1084.16	V	39.88	-13.60	26.28	54.00	27.72	AV
1549.10	V	51.20	-12.40	38.80	74.00	35.20	PK
1549.10	V	40.48	-12.40	28.08	54.00	25.92	AV
2158.32	V	48.88	-10.90	37.98	74.00	36.03	PK
2158.32	V	37.26	-10.90	26.36	54.00	27.64	AV
2254.50	H	48.95	-10.60	38.35	74.00	35.65	PK
2254.50	H	37.31	-10.60	26.71	54.00	27.29	AV
2539.08	V	48.88	-9.60	39.28	74.00	34.72	PK
2539.08	V	37.23	-9.60	27.63	54.00	26.38	AV
2655.31	H	48.71	-9.30	39.41	74.00	34.59	PK
2655.31	H	37.29	-9.30	27.99	54.00	26.01	AV





Radiated Spurious Emission (1 GHz to 25 GHz): IEEE 802.11n 11ch

Frequency [MHz]	Pol.	Reading [dBuV]	Transducer Factor [dB]	Test Result [dBuV/m]	Limits [dBuV/m]	Margin [dB]	Detector Type
1256.51	V	45.72	-13.00	32.72	74.00	41.28	PK
1256.51	V	34.07	-13.00	21.07	54.00	32.93	AV
1549.10	V	49.88	-12.40	37.48	74.00	36.52	PK
1549.10	V	36.04	-12.40	23.64	54.00	30.36	AV
2250.50	H	53.15	-10.60	42.55	74.00	31.45	PK
2250.50	H	38.72	-10.60	28.12	54.00	25.88	AV
2266.53	H	53.90	-10.50	43.40	74.00	30.60	PK
2266.53	H	37.34	-10.50	26.84	54.00	27.16	AV
2306.61	H	51.34	-10.30	41.04	74.00	32.96	PK
2306.61	H	37.32	-10.30	27.02	54.00	26.99	AV
2543.09	H	50.53	-9.60	40.93	74.00	33.07	PK
2543.09	H	37.76	-9.60	28.16	54.00	25.84	AV
2591.18	H	47.91	-9.50	38.41	74.00	35.59	PK
2591.18	H	34.08	-9.50	24.58	54.00	29.43	AV

Note:

Corrected reading: + Transducer Factor + Read value = Test result

※ Transducer Factor: Antenna factor + Cable loss + AMP gain + High Pass Filter(if use)

Pol.: H(Horizontal), V(Vertical)





13.7 Test data for Radiated Restricted Band Edge Emission

- Test Date : May 02~04, 2016
- Reference Standard : Part 15 Subpart C, Sec. 15.247(d)
- Measuring Distance : 3 m
- Resolution Bandwidth : 1 MHz
- Detector mode : Peak detector mode / Average detector mode
- Power Source : DC 5.0 V
- Note : Worst case data were report.

IEEE 802.11b (1ch, 11ch)

Frequency [MHz]	Pol.	Reading [dBuV]	Transducer Factor [dB]	Test Result [dBuV/m]	Limits [dBuV/m]	Margin [dB]	Detector Type
2390.00	H	57.26	-10.10	47.16	74.00	26.84	PK
2390.00	H	43.00	-10.10	32.90	54.00	21.10	AV
2483.50	H	60.85	-9.70	51.15	74.00	22.85	PK
2483.50	H	52.09	-9.70	42.39	54.00	11.61	AV

IEEE 802.11g (1ch, 11ch)

Frequency [MHz]	Pol.	Reading [dBuV]	Transducer Factor [dB]	Test Result [dBuV/m]	Limits [dBuV/m]	Margin [dB]	Detector Type
2390.00	H	77.90	-10.10	67.80	74.00	6.20	PK
2390.00	H	58.96	-10.10	48.86	54.00	5.14	AV
2483.50	H	79.99	-9.70	70.29	74.00	3.71	PK
2483.50	H	60.69	-9.70	50.99	54.00	3.01	AV

IEEE 802.11g (1ch, 11ch)

Frequency [MHz]	Pol.	Reading [dBuV]	Transducer Factor [dB]	Test Result [dBuV/m]	Limits [dBuV/m]	Margin [dB]	Detector Type
2390.00	H	79.45	-10.10	69.35	74.00	4.65	PK
2390.00	H	59.78	-10.10	49.68	54.00	4.32	AV
2483.50	H	83.06	-9.70	73.36	74.00	0.64	PK
2483.50	H	62.79	-9.70	53.09	54.00	0.91	AV

Note:

Corrected reading: + Transducer Factor + Read value = Test result

※ Transducer Factor: Antenna factor + Cable loss + AMP gain

Pol.: H(Horizontal), V(Vertical)





14. Sample Calculations

$$\begin{aligned} \text{dB}\mu\text{V} &= 20 \text{ Log}_{10}(\mu\text{V}/\text{m}) \\ \text{dB}\mu\text{V} &= \text{dBm} + 107 \\ \mu\text{V} &= 10^{(\text{dB}\mu\text{V}/20)} \end{aligned}$$

14.1 Example 1 :

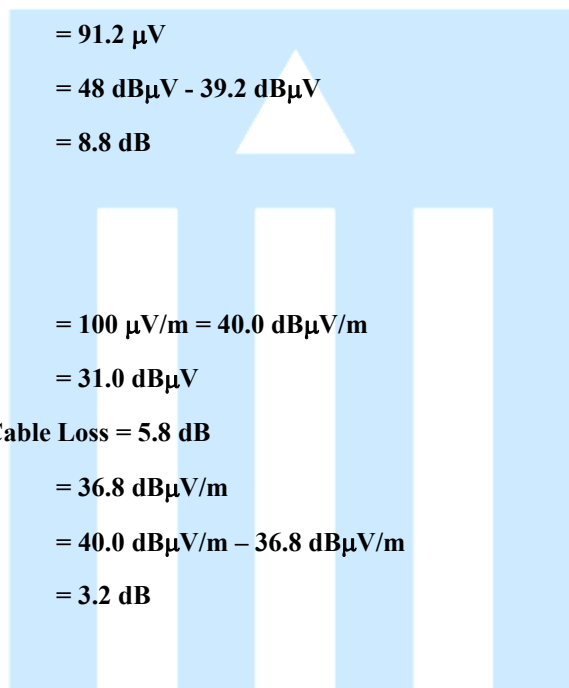
■ 20.3 MHz

Class B Limit = 250 μV = 48 dB μV

Reading = 39.2 dB μV

$10^{(39.2\text{dB}\mu\text{V}/20)}$ = 91.2 μV

Margin = 48 dB μV - 39.2 dB μV
 = 8.8 dB



14.2 Example 2 :

■ 66.7 MHz

Class B Limit = 100 $\mu\text{V}/\text{m}$ = 40.0 dB $\mu\text{V}/\text{m}$

Reading = 31.0 dB μV

Antenna Factor + Cable Loss = 5.8 dB

Total = 36.8 dB $\mu\text{V}/\text{m}$

Margin = 40.0 dB $\mu\text{V}/\text{m}$ - 36.8 dB $\mu\text{V}/\text{m}$
 = 3.2 dB





15. Recommendation & Conclusion

The data collected shows that the **Ohsung Electronics Co., Ltd. Sensor Extender (Model Name: MRX-4SEN2)** was complies with §15.247 of the FCC Rules.

- The end -

