

## ***FCC EVALUATION REPORT FOR CERTIFICATION***

**Manufacturer: OHSUNG ELECTRONICS CO., LTD.**

**Date of Issue: December 12, 2014**

**#181 Gongdan-dong, Gumi-si, Gyeongbuk,**

**Order Number: GETEC-C1-14-456**

**Republic of Korea**

**Test Report Number: GETEC-E3-14-089**

**Attn: Mr. Hak-Ki Kim / General Manager**

**Test Site: GUMI UNIVERSITY EMC CENTER**

**FCC Registration Number: (100749, 443957)**

**FCC ID. : OZ5URCHCMC1**

**Applicant : OHSUNG ELECTRONICS CO., LTD.**

**Rule Part(s) : FCC Part 15 Subpart C-Intentional Radiator § 15.247**  
**Test Method : ANSI C63.10 (2009)**  
**Equipment Class : Digital Transmission System(DTS)**  
**EUT Type : Base Station**  
**Type of Authority : Certification**  
**Model Name : HCM-C1**  
**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 C63.4 (2009)**

**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,**

**Reviewed by,**



**Soon-Hoon Jeong, Senior Engineer**  
**GUMI UNIVERSITY EMC CENTER**



**Jae-Hoon Jeong, Technical Manager**  
**GUMI UNIVERSITY EMC CENTER**





## CONTENTS

<b>1. GENERAL INFORMATION .....</b>	<b>4</b>
<b>2. INTRODUCTION .....</b>	<b>5</b>
<b>3. PRODUCT INFORMATION .....</b>	<b>6</b>
<b>3.1 DESCRIPTION OF EUT.....</b>	<b>6</b>
<b>3.2 DEFINITION OF MODELS.....</b>	<b>6</b>
<b>3.3 SUPPORT EQUIPMENT / CABLES USED .....</b>	<b>7</b>
<b>3.4 MODIFICATION ITEM(S).....</b>	<b>7</b>
<b>4. DESCRIPTION OF TESTS.....</b>	<b>8</b>
<b>4.1 TEST CONDITION.....</b>	<b>8</b>
<b>4.3 TEST METHODOLOGY.....</b>	<b>9</b>
<b>4.4 REFERENCES STANDARDS .....</b>	<b>9</b>
<b>5. ANTENNA REQUIREMENT - §15.203 .....</b>	<b>10</b>
<b>5.1 DESCRIPTION OF ANTENNA.....</b>	<b>10</b>
<b>6. CONDUCTED EMISSION.....</b>	<b>11</b>
<b>6.1 OPERATING ENVIRONMENT .....</b>	<b>12</b>
<b>6.2 TEST SET-UP .....</b>	<b>12</b>
<b>6.3 MEASUREMENT UNCERTAINTY.....</b>	<b>12</b>
<b>6.4 LIMIT .....</b>	<b>13</b>
<b>6.5 TEST EQUIPMENT USED.....</b>	<b>13</b>
<b>6.6 TEST DATA FOR CONDUCTED EMISSION .....</b>	<b>13</b>
<b>7. MAXIMUM PEAK OUTPUT POWER MEASUREMENT .....</b>	<b>15</b>
<b>7.1 OPERATING ENVIRONMENT .....</b>	<b>15</b>
<b>7.2 TEST SET-UP (LAYOUT) .....</b>	<b>15</b>
<b>7.3 LIMIT .....</b>	<b>15</b>
<b>7.4 TEST EQUIPMENT USED.....</b>	<b>15</b>
<b>7.5 TEST RESULT .....</b>	<b>15</b>
<b>8. POWER SPECTRAL DENSITY MEASUREMENT .....</b>	<b>17</b>
<b>8.1 OPERATING ENVIRONMENT .....</b>	<b>17</b>
<b>8.2 TEST SET-UP (LAYOUT) .....</b>	<b>17</b>
<b>8.3 LIMIT .....</b>	<b>17</b>
<b>8.4 TEST EQUIPMENT USED.....</b>	<b>17</b>
<b>8.5 TEST RESULT .....</b>	<b>17</b>
<b>9. 6 DB SPECTRUM BANDWIDTH MEASUREMENT .....</b>	<b>24</b>
<b>9.1 OPERATING ENVIRONMENT .....</b>	<b>24</b>
<b>9.2 TEST SET-UP (LAYOUT) .....</b>	<b>24</b>
<b>9.3 LIMIT .....</b>	<b>24</b>
<b>9.4 TEST EQUIPMENT USED.....</b>	<b>24</b>
<b>9.5 TEST RESULT .....</b>	<b>24</b>





<b>10. BAND EDGE MEASUREMENT</b> .....	<b>31</b>
<b>10.1 OPERATING ENVIRONMENT</b> .....	<b>31</b>
<b>10.2 TEST SET-UP (LAY-OUT)</b> .....	<b>31</b>
<b>10.3 LIMIT</b> .....	<b>31</b>
<b>10.4 TEST EQUIPMENT USED</b> .....	<b>31</b>
<b>10.5 TEST RESULT</b> .....	<b>31</b>
<b>11. RADIATED EMISSION</b> .....	<b>38</b>
<b>11.1 OPERATING ENVIRONMENT</b> .....	<b>39</b>
<b>11.2 TEST SET-UP</b> .....	<b>39</b>
<b>11.3 MEASUREMENT UNCERTAINTY</b> .....	<b>39</b>
<b>11.4 LIMIT</b> .....	<b>39</b>
<b>11.5 TEST EQUIPMENT USED</b> .....	<b>40</b>
<b>11.6 RADIATED EMISSION TEST DATA</b> .....	<b>40</b>
<b>APPENDIX A – ATTESTATION STATEMENT</b>	
<b>APPENDIX B – LABELLING</b>	
<b>APPENDIX C – BLOCK DIAGRAM</b>	
<b>APPENDIX D – SCHEMATIC DIAGRAM</b>	
<b>APPENDIX E – TEST SETUP PHOTOGRAPH</b>	
<b>APPENDIX F – EXTERNAL PHOTOGRAPH</b>	
<b>APPENDIX G – INTERNAL PHOTOGRAPH</b>	
<b>APPENDIX H – USER’S MANUAL</b>	
<b>APPENDIX I – OPERATIONAL DESCRIPTION</b>	
<b>APPENDIX J – ANTENNA SPECIFICATION</b>	
<b>APPENDIX K – PART LIST</b>	
<b>APPENDIX L – MAXIMUM PERMISSIBLE EXPOSURE</b>	
<b>APPENDIX M – MODULAR APPROVAL LETTER</b>	





*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: #181 Gongdan-dong, Gumi-si, Gyeongbuk, Republic of Korea**

**Manufacturer: OHSUNG ELECTRONICS CO., LTD.**

**Manufacturer Address: #181 Gongdan-dong, Gumi-si, Gyeongbuk, Republic of Korea**

**Contact Person: Mr. Hak-Ki Kim / General Manager**

**Tel. Number: +82-54-468- 7281**

**Fax Number: +82-54- 461- 8368**

- **FCC ID.** OZ5URCHCMC1
- **Equipment Class** Digital Transmission System (DTS)
- **EUT Type** Base Station
- **Model Name** HCM-C1
- **Rule Part(s)** FCC Part 15 Subpart C-Intentional Radiator § 15.247
- **Test Method** ANSI C63.10 (2009)
- **Type of Authority** Certification
- **Test Procedure(s)** ANSI C63.4 (2009), KDB558074 D01 DTS Meas Guidance v03r02(June 5,2014)
- **Dates of Test** November 25 ~ December 10, 2014
- **Place of Test** **GUMI UNIVERSITY EMC CENTER** (FCC Registration No.: 100749, 443957)  
37 Yaeun-ro, Gumi-si, Gyeongsangbuk-do, 730-711, Korea
- **Test Report Number** GETEC-E3-14-089
- **Dates of Issue** December 12, 2014





## 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. Base Station (Model name: HCM-C1)**

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 UNIVERSITY at about 200 kilometers away from Seoul city and 40 kilometers away from Daegu 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 C63.4 (2009)

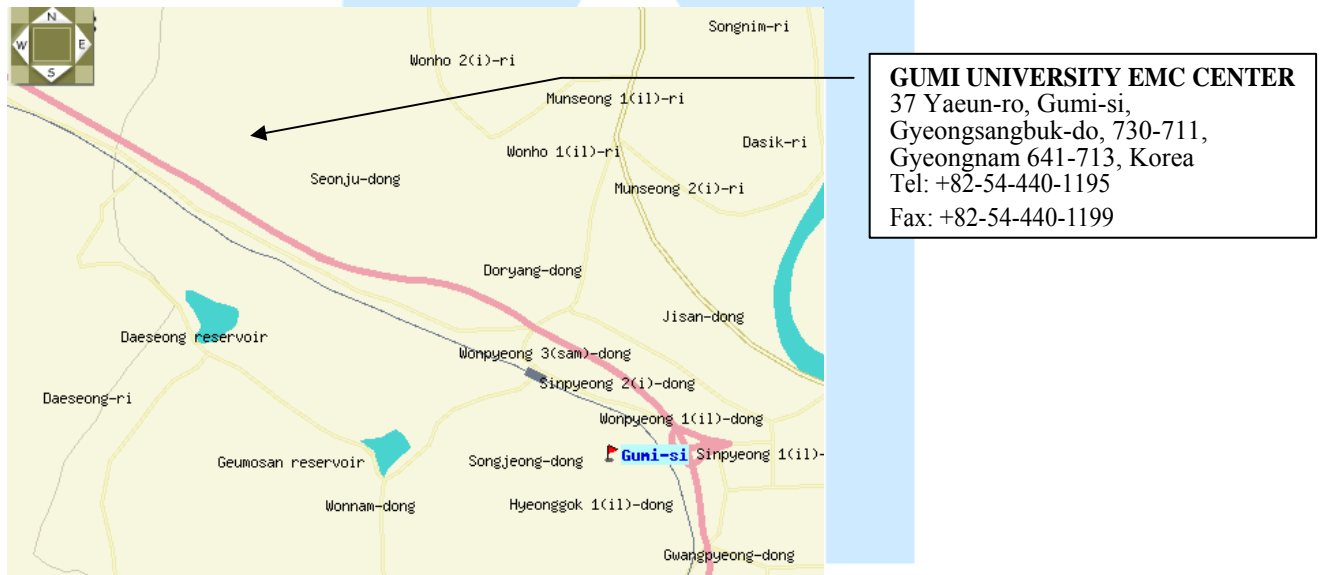


Fig 1. The map above shows the GUMI UNIVERSITY in vicinity area.





### 3. Product Information

#### 3.1 Description of EUT

The Equipment under Test (EUT) is the **OHSUNG ELECTRONICS CO., LTD. Base Station (Model Name: HCM-C1) FCC ID.: OZ5URCHCMC1**

EUT Type	Base Station
Model Name	HCM-C1
Serial Number	Prototype
Highest clock frequency	133 MHz
Crystal & Clock frequency	CRYSTAL : 26 MHz, 12 MHz, 32.768 kHz OSC : 50 MHz RESONATOR : 12 MHz
RF Frequency	2 412 MHz ~ 2 462 MHz
External connector	DC jack 12 V 1 EA, Ethernet port 1 EA, IR Emitter port 4 EA
Microprocessor	ARM9 400 MHz
RAM	128 Mbyte DDR2
NAND	128 Mbyte
IR Range (Line of Sight via infrared)	30 to 50 feet, depending on the environment
Macro Capability	Up to 255 setps each, however nesting is allowed
Wi-Fi	IEEE 802.11 b/g/n
Size	1.18”(H) by 4.63”(W) by 4.63”(D)
Weight	5.19 oz
Power	12 V, DC 1 A

#### 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.
Notebook computer	SAMSUNG	NT-Q45	S/N: ONBA4300168AI00683B7460 FCC ID.: N/A.

1) The Notebook computer be used to RF conducted and radiated test as E.U.T RF control equipment

See **“Appendix E – Test Setup Photographs”** for actual system test set-up

#### 3.3.2 System configuration

Description	Manufacturer	Model Name	S/N & FCC ID.
AC adaptor	MEILE GROUP LTD	MLF-A00121201000U0075	S/N: None. FCC ID.: N/A.

1) Input rating: AC (100 ~ 240) V, 50/60 Hz, 0.4 A

Output rating: DC 12 V, 1 A

#### 3.3.3 Used Cable(s)

Cable Name	Condition	Description
Adaptor DC power	Connected to the EUT and AC/DC adaptor.	1.75 m Unshielded.

### 3.4 Modification Item(s)

- None





#### 4. Description of tests

##### 4.1 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 12 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	Modulation Technology	Data rate (Mbps)
IEEE 802.11 b	1 to 11	DSSS	11
IEEE 802.11 g	1 to 11	OFDM	54
IEEE 802.11 n	1 to 11	OFDM	72.2

- Test condition (description of RF setting)

Following photograph with the specific test software “Tera term(V4.64)” are used to set the product

Test Software version	Tera Term_RF power setting value		
Frequency	2 412 MHz	2 437 MHz	2 462 MHz
IEEE 802.11 b	4	4	4
IEEE 802.11 g	4	4	4
IEEE 802.11 n	4	4	4

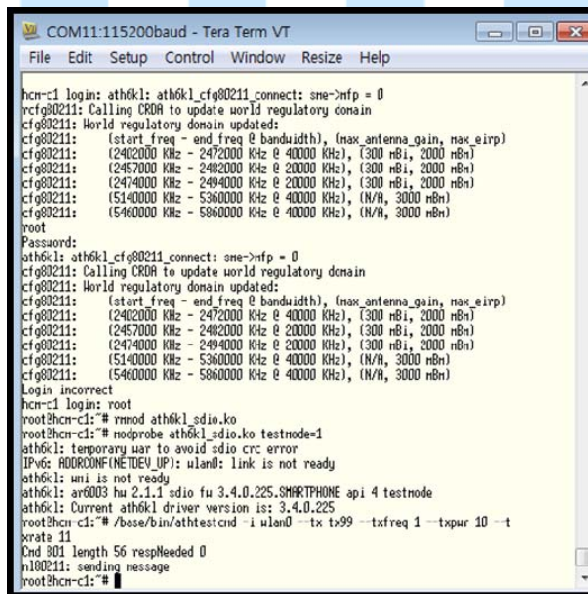


Fig 1. Photograph of RF test software (Tera term)







## 4.2 General Test Procedures

### Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4 (2009) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

### Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.4 (2009)

### Conducted Antenna Terminal

See Section from 9.1 to 9.2.(KDB 558074)

## 4.3 Test methodology

FCC KDB 558074 D01 DTS meas Guidance v03r02 dated June, 05, 2014 entitled “Guidance for Performing Compliance Measurements on Digital Transmission Systems(DTS) and the measurement procedure described in the American National Standard for Testing Unlicensed Wireless Devices(ANSI C63.4-2009) Operating Under §15.247” were used in the measurement.

## 4.4 References Standards

- FCC Part 15 (2009) Subpart C-Intentional Radiator §15.247
- ANSI C 63.10 (2009): American National Standard for Testing Unlicensed Wireless Devices
- ANSI C 63.4 (2009): American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
- KDB 558074 D01 DTS meas Guidance v03r02 (Jun 5, 2014): Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247





## 5. 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 the provisions of this section.

### 5.1 Description of Antenna

The **OHSUNG ELECTRONICS CO., LTD. Base Station (Model Name: HCM-C1)** comply with the requirement of §15.203 with a PCB pattern antenna permanently attached to the transmitter.





## 6. Conducted Emission

### -Test Description

The Line conducted emission test facility is inside a 4 m × 8 m × 2.5 m shielded enclosure. (FCC Registration No.: 100749)

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.

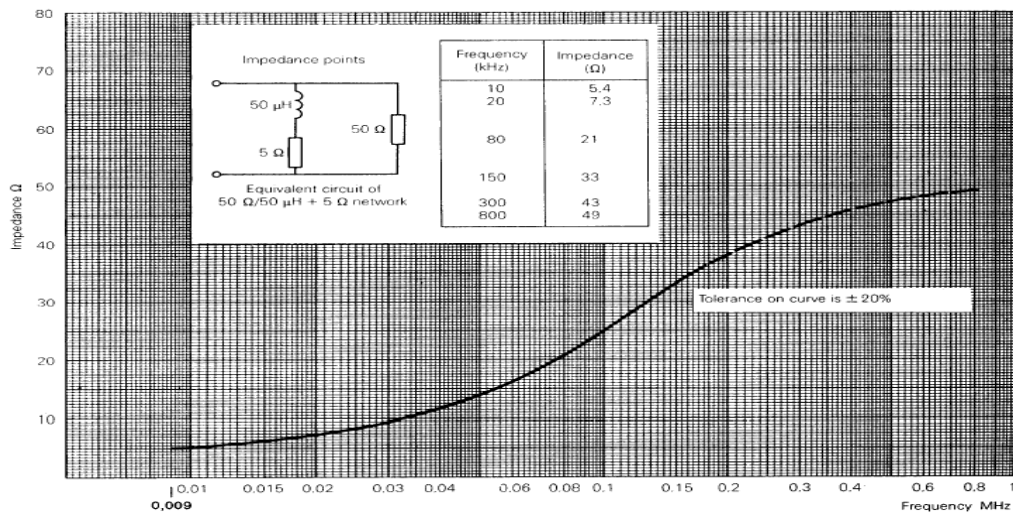


Fig 2. Impedance of LISN





### 6.1 Operating Environment

Temperature : 19.2 °C  
 Relative Humidity : 25.1 % R.H.

### 6.2 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.

### 6.3 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)	± 3.89 dB	Confidence level of approximately 95 % ( $k = 2$ )
Conducted emission (150 kHz ~ 30 MHz)	± 3.37 dB	Confidence level of approximately 95 % ( $k = 2$ )





**6.4 Limit**

RFI Conducted	FCC Limit(dBμV/m) Class B	
	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.

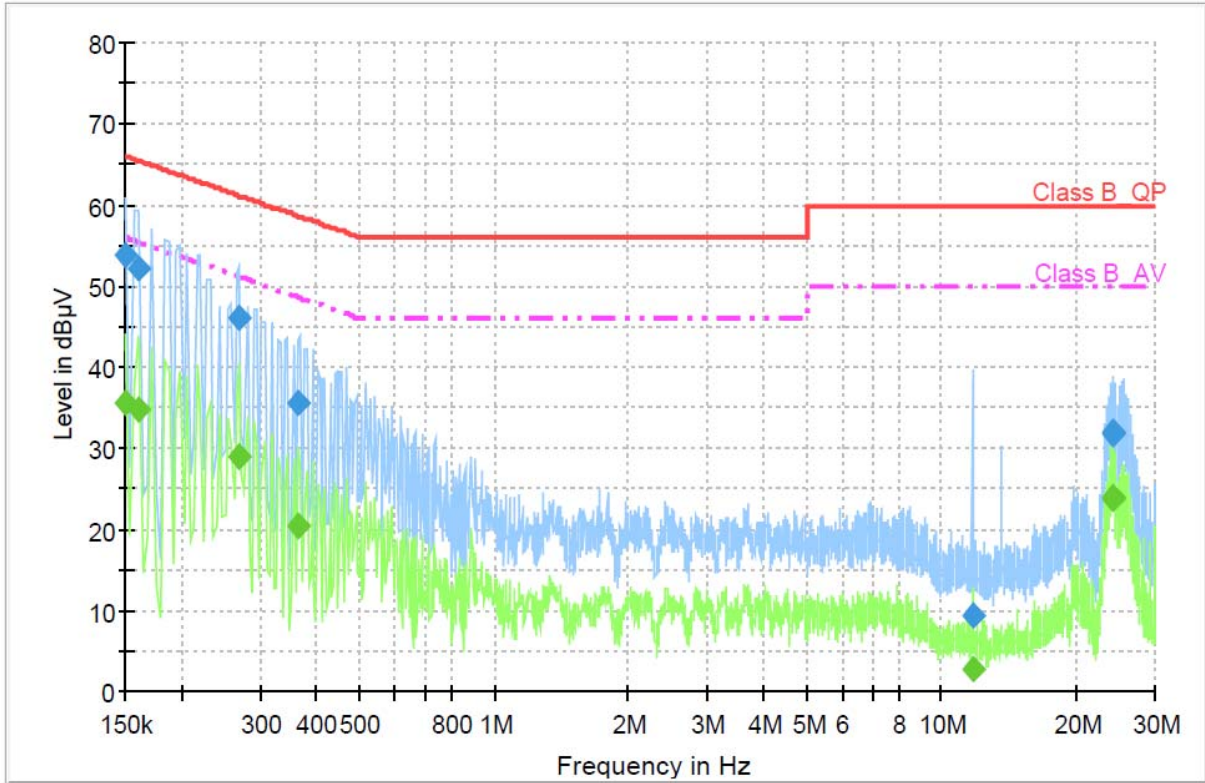
**6.5 Test Equipment used**

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESCI	Rohde & Schwarz	EMI test receiver	100237	Apr 30. 2015
■ - ENV216	Rohde & Schwarz	LISN	100173	Apr 30. 2015
□ - ENV216	Rohde & Schwarz	LISN	100172	Apr 30. 2015
□ - ISN T8	TESEQ. GmbH	ISN	24568	May 23. 2015

**6.6 Test data for Conducted Emission**

- Test Date : December 10, 2014
- Reference Standard : Part 15 Subpart C, Sec. 15.207
- Test Procedure(s) : ANSI C63.4 (2009), KDB558074 D01 DTS Meas Guidance v03r02(June 5,2014)
- Operating Condition : RF transmitting mode (IEEE 802.11 n: 2 437 MHz)
- Frequency rage : 0.15MHz ~ 30 MHz
- Comment :





**Final Result 1**

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.150000	53.7	100.0	9.000	Off	N	9.7	12.3	66.0	
0.161194	52.0	100.0	9.000	Off	L1	9.7	13.4	65.4	
0.269400	46.2	100.0	9.000	Off	N	9.7	15.0	61.1	
0.366413	35.6	100.0	9.000	Off	L1	9.7	23.0	58.6	
11.728069	9.5	100.0	9.000	Off	L1	10.0	50.5	60.0	
24.197906	32.0	100.0	9.000	Off	N	10.2	28.0	60.0	
24.235219	31.7	100.0	9.000	Off	N	10.2	28.3	60.0	

**Final Result 2**

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.150000	35.5	100.0	9.000	Off	N	9.7	20.5	56.0	
0.161194	34.8	100.0	9.000	Off	L1	9.7	20.6	55.4	
0.269400	29.0	100.0	9.000	Off	N	9.7	22.1	51.1	
0.366413	20.5	100.0	9.000	Off	L1	9.7	28.1	48.6	
11.728069	2.8	100.0	9.000	Off	L1	10.0	47.2	50.0	
24.197906	24.0	100.0	9.000	Off	N	10.2	26.0	50.0	
24.235219	23.6	100.0	9.000	Off	N	10.2	26.4	50.0	

< Fig 3. Conducted emission result >



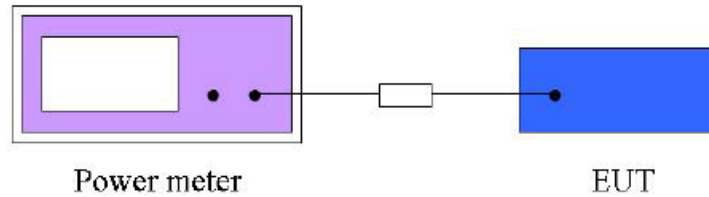


## 7. Maximum Peak Output Power Measurement

### 7.1 Operating environment

Temperature : 22.0 °C  
 Relative Humidity : 37.8 % R.H.

### 7.2 Test Set-up (Layout)



### 7.3 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.

### 7.4 Test Equipment used

Model Number	Manufacturer	Description	Serial Number	Due to Calibration
■ - NRVD	Rohde & Schwarz	Power meter	837794/048	Apr 29. 2015
■ - NRP-Z32	Rohde & Schwarz	Power sensor	100062	Apr 30. 2015

### 7.5 Test Result

- Test Date : November 27, 2014  
 - Reference Standard : Part 15 Subpart C, Sec. 15.247(b)(3) / ANSI C63.10 Clause 6.10.2.1 (a)  
 - Test Procedure(s) : ANSI C63.4 (2009), KDB558074 D01 DTS Meas Guidance v03r02(June 5,2014)  
 - Operating Condition : RF transmitting mode (Low: 2 412 MHz, Middle: 2 437 MHz, High: 2 462 MHz)  
 - Power Source : DC 12 V  
 - Comment :





**Configuration IEEE 802.11 b**

Frequency (MHz)	Peak Conducted Power (mW)	Peak Conducted Power (dBm)	Max. Limit (dBm)	Result
2 412	2.04	3.09	30.00	Complies
2 437	2.25	3.52	30.00	Complies
2 462	2.37	3.75	30.00	Complies

**Configuration IEEE 802.11 g**

Frequency (MHz)	Peak Conducted Power (mW)	Peak Conducted Power (dBm)	Max. Limit (dBm)	Result
2 412	4.39	6.42	30.00	Complies
2 437	4.96	6.95	30.00	Complies
2 462	5.31	7.25	30.00	Complies

**Configuration IEEE 802.11 n**

Frequency (MHz)	Peak Conducted Power (mW)	Peak Conducted Power (dBm)	Max. Limit (dBm)	Result
2 412	3.89	5.90	30.00	Complies
2 437	5.28	7.23	30.00	Complies
2 462	4.75	6.77	30.00	Complies





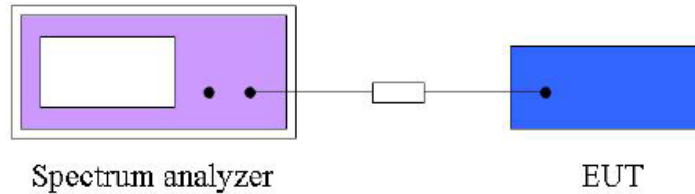


## 8. Power Spectral Density Measurement

### 8.1 Operating Environment

Temperature : 24.10 °C  
 Relative Humidity : 40.0 % R.H.

### 8.2 Test Set-up (Layout)



### 8.3 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

### 8.4 Test Equipment used

Model Number	Manufacturer	Description	Serial Number	Due to Calibration
■ - FSP	Rohde & Schwarz	Spectrum Analyzer	101431	Apr 30. 2015

### 8.5 Test Result

- Test Date : November 28, 2014  
 - Reference Standard : Part 15 Subpart C, Sec. 15.247(e) / ANSI C63.10 Clause 6.11.2  
 - Test Procedure(s) : KDB558074 D01 DTS Meas Guidance v03r02(June 5,2014)  
 - Operating Condition : RF transmitting mode (Low: 2 412 MHz, Middle: 2 437 MHz, High: 2 462 MHz)  
 - Power Source : DC 12 V  
 - Comment :

#### Spectrum Analyzer Setting:

- Resolution bandwidth : 3 kHz  
 - Video bandwidth : 10 kHz  
 - Span frequency : 1.5 times the DTS bandwidth  
 - Detector : Peak  
 - Sweep time : Auto couple  
 - Trace mode : Max. Hold





**Configuration IEEE 802.11 b**

Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
2 412 MHz	-20.47	8.00	Complies
2 437 MHz	-20.08	8.00	Complies
2 462 MHz	-19.87	8.00	Complies

**Configuration IEEE 802.11 g**

Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
2 412 MHz	-23.65	8.00	Complies
2 437 MHz	-23.53	8.00	Complies
2 462 MHz	-23.04	8.00	Complies

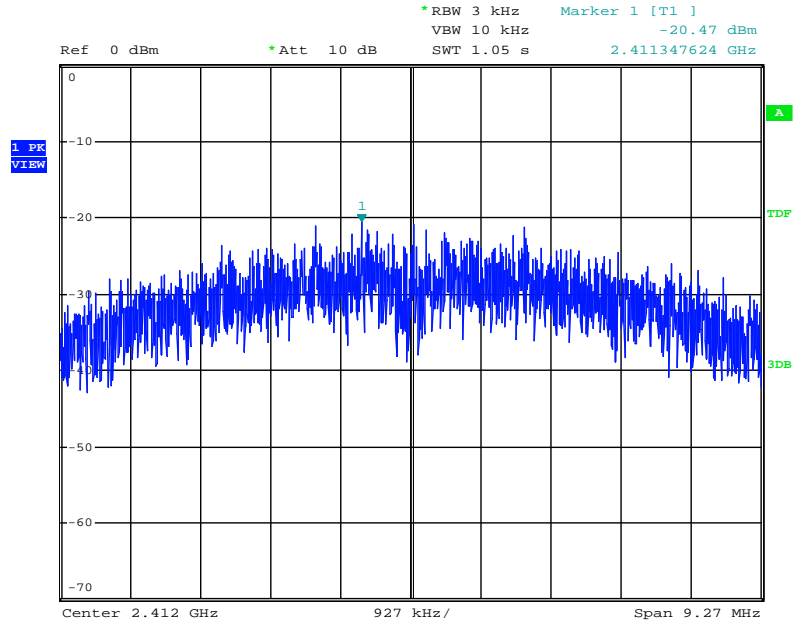
**Configuration IEEE 802.11 n**

Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
2 412 MHz	-22.69	8.00	Complies
2 437 MHz	-21.89	8.00	Complies
2 462 MHz	-22.25	8.00	Complies



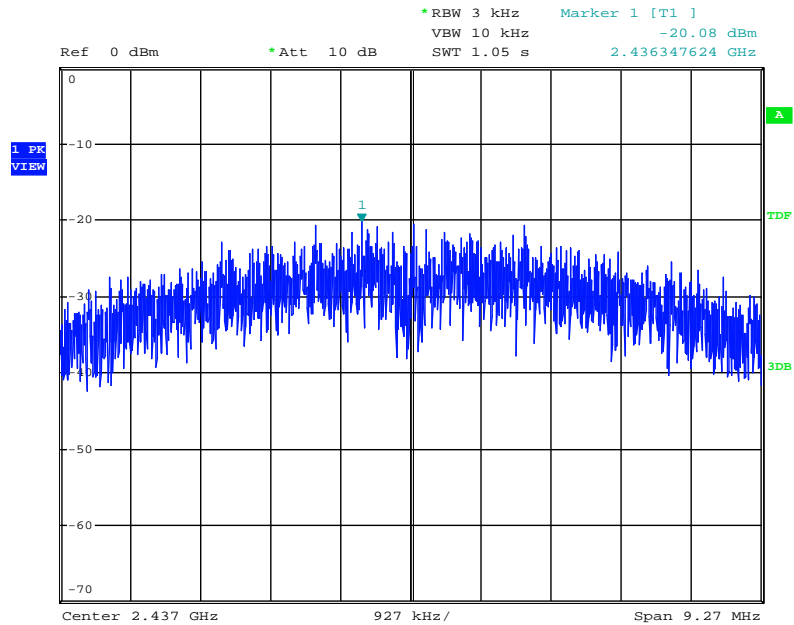


### Power Density Plot on configuration IEEE 802.11 b / 2 412 MHz



Date: 28.NOV.2014 15:21:05

### Power Density Plot on configuration IEEE 802.11 b / 2 437 MHz

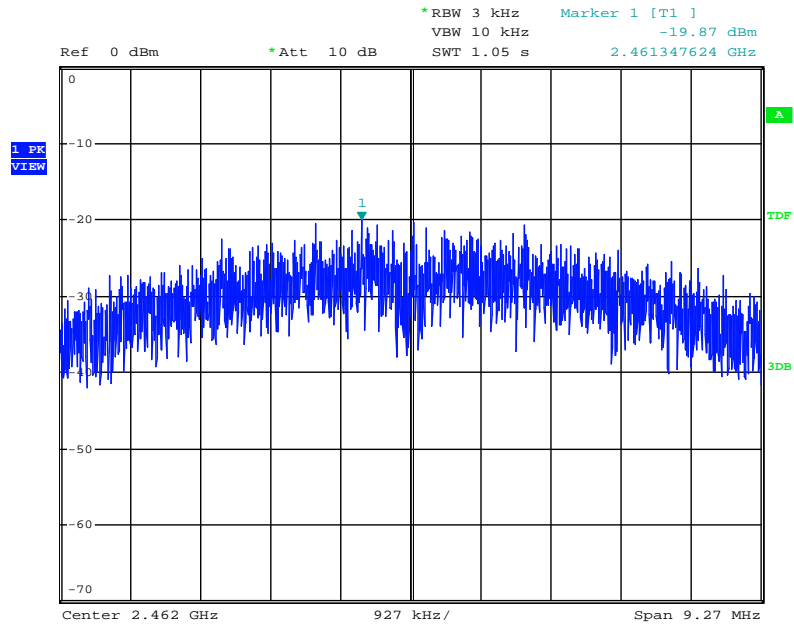


Date: 28.NOV.2014 15:27:47



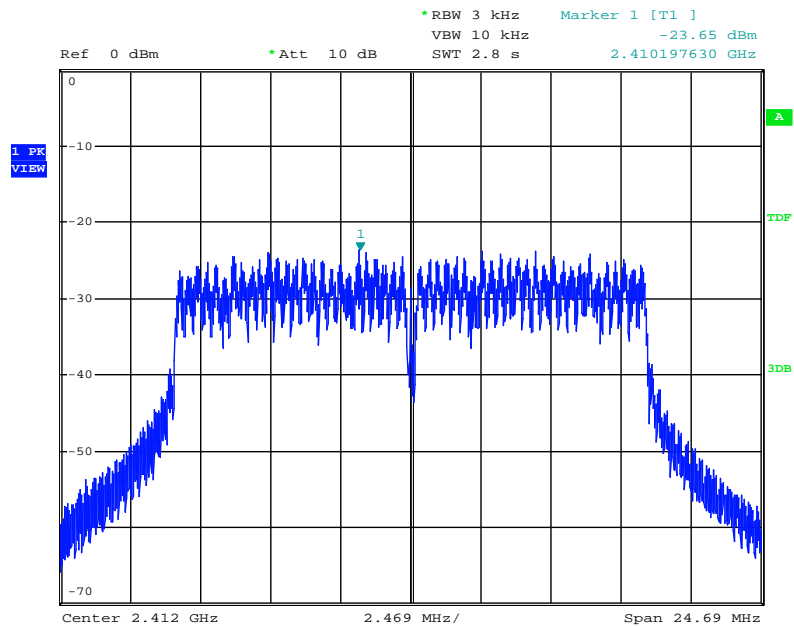


### Power Density Plot on configuration IEEE 802.11 b / 2 462 MHz



Date: 28.NOV.2014 15:31:26

### Power Density Plot on configuration IEEE 802.11 g / 2 412 MHz

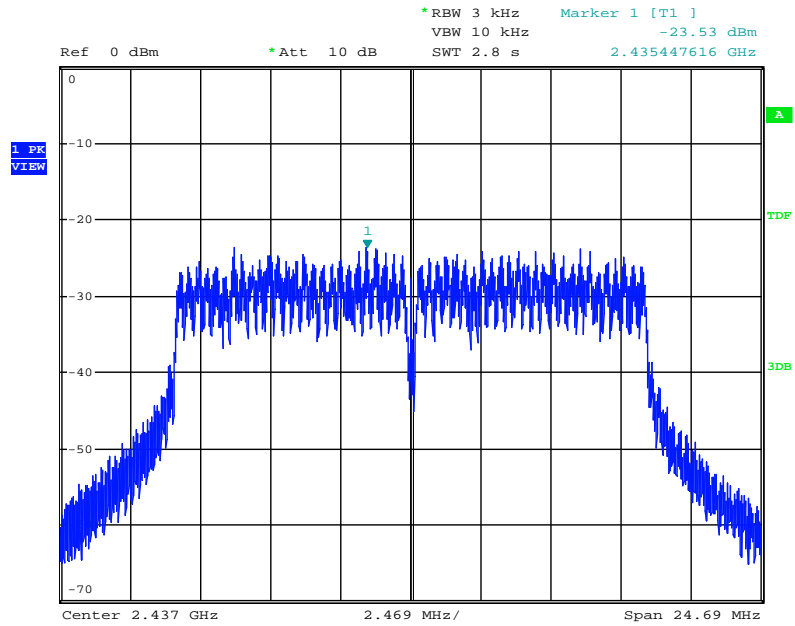


Date: 28.NOV.2014 15:40:13



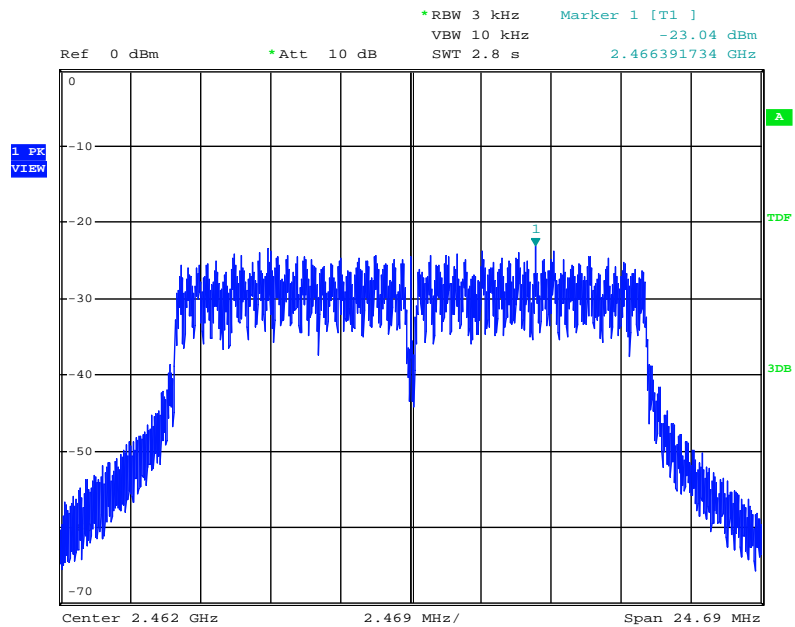


**Power Density Plot on configuration IEEE 802.11 g / 2 437 MHz**



Date: 28.NOV.2014 15:42:16

**Power Density Plot on configuration IEEE 802.11 g / 2 462 MHz**

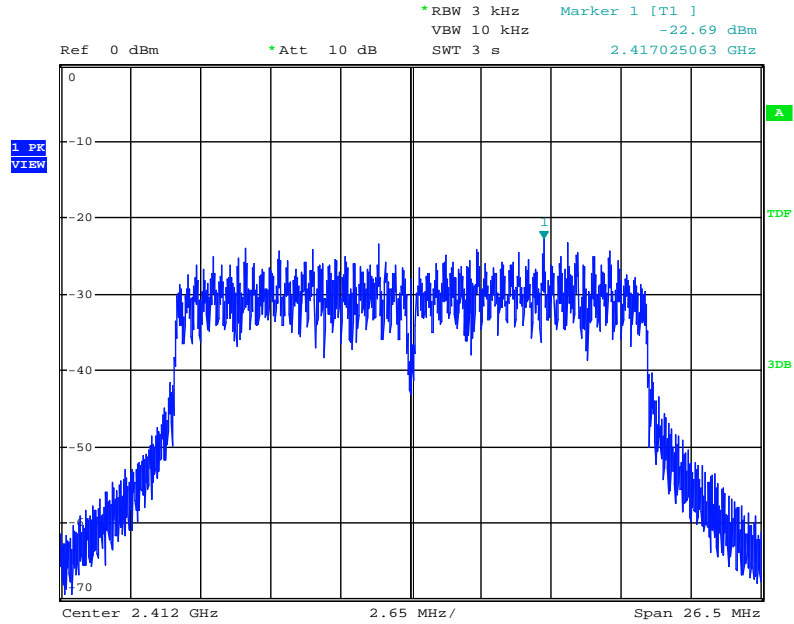


Date: 28.NOV.2014 15:44:08



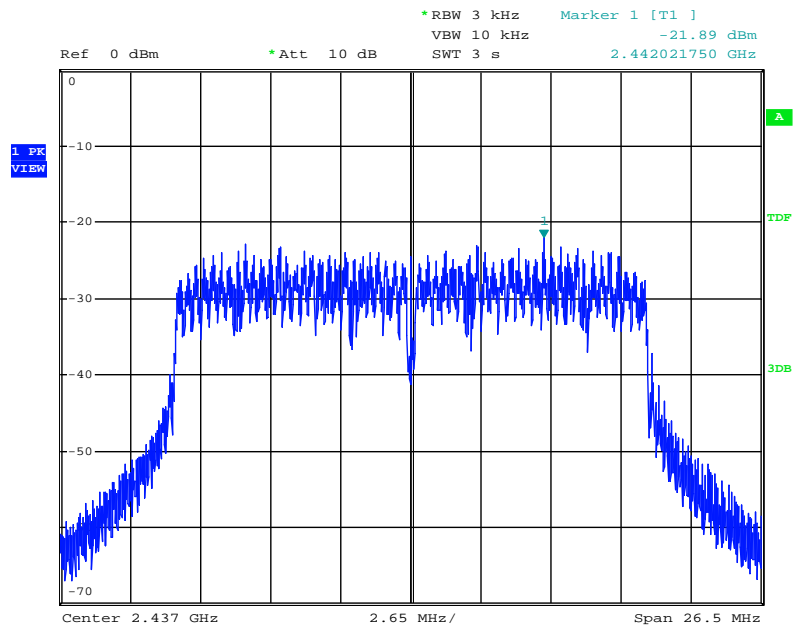


### Power Density Plot on configuration IEEE 802.11 n / 2 412 MHz



Date: 28.NOV.2014 15:46:19

### Power Density Plot on configuration IEEE 802.11 n / 2 437 MHz

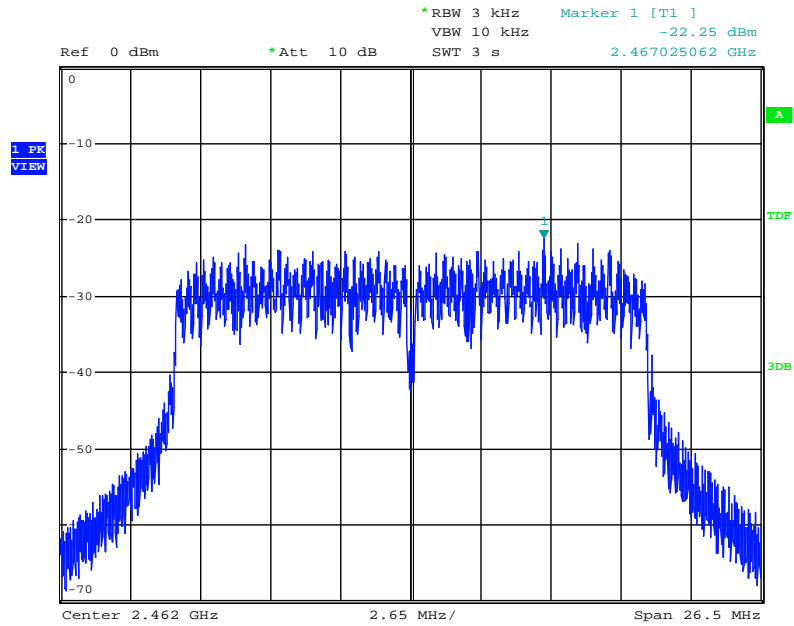


Date: 28.NOV.2014 15:50:21

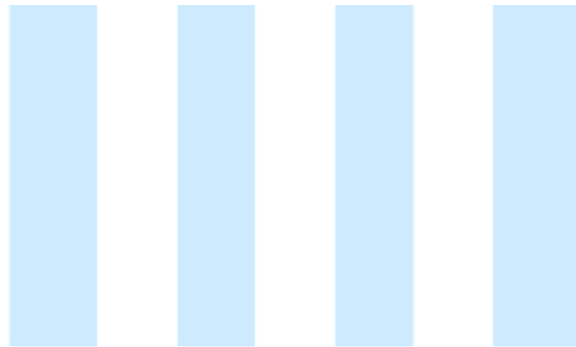




### Power Density Plot on configuration IEEE 802.11 n / 2 462 MHz



Date: 28.NOV.2014 15:52:38



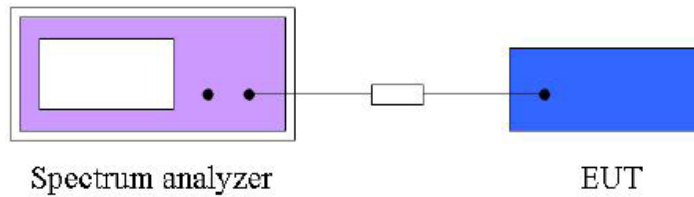


## 9. 6 dB Spectrum bandwidth Measurement

### 9.1 Operating environment

Temperature : 22.0 °C  
 Relative Humidity : 38.4 % R.H.

### 9.2 Test Set-up (Layout)



### 9.3 Limit

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

### 9.4 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - FSP	Rohde & Schwarz	Spectrum Analyzer	101431	Apr 30. 2015

### 9.5 Test result

- Test Date : November 27, 2014  
 - Reference Standard : Part 15 Subpart C, Sec. 15.247(a)(2)  
 - Test Procedure(s) : ANSI C63.4 (2009), KDB558074 D01 DTS Meas Guidance v03r02(June 5,2014)  
 - Operating Condition : RF transmitting mode (Low: 2 412 MHz, Middle: 2 437 MHz, High: 2 462 MHz)  
 - Power Source : DC 12 V  
 - Comment :

#### Spectrum Analyzer Setting:

- Resolution bandwidth : 100 kHz  
 - Video bandwidth : 300 kHz  
 - Span frequency : 30 MHz  
 - Detector : Peak  
 - Trace mode : Max. Hold  
 - Sweep time : Auto couple







**Configuration IEEE 802.11 b**

Frequency (MHz)	6 dB Bandwidth (MHz)	Min. Limit (kHz)	Result
2 412	6.18	500	Complies
2 437	6.17	500	Complies
2 462	6.18	500	Complies

**Configuration IEEE 802.11 g**

Frequency (MHz)	6 dB Bandwidth (MHz)	Min. Limit (kHz)	Result
2 412	16.45	500	Complies
2 437	16.46	500	Complies
2 462	16.46	500	Complies

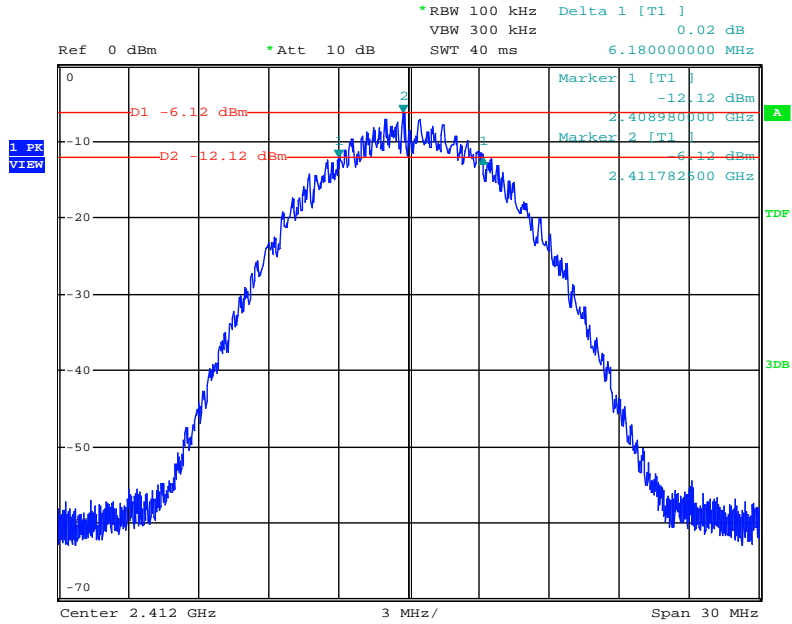
**Configuration IEEE 802.11 n**

Frequency (MHz)	6 dB Bandwidth (MHz)	Min. Limit (kHz)	Result
2 412	17.67	500	Complies
2 437	17.67	500	Complies
2 462	17.65	500	Complies



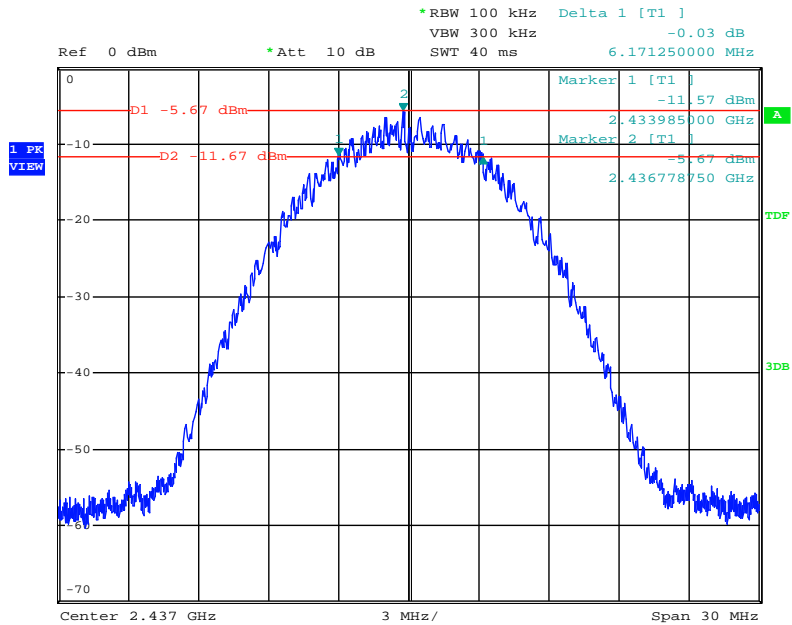


**6 dB Bandwidth Plot on Configuration IEEE 802.11 b / 2 412 MHz**



Date: 27.NOV.2014 22:32:43

**6 dB Bandwidth Plot on Configuration IEEE 802.11 b / 2 437 MHz**

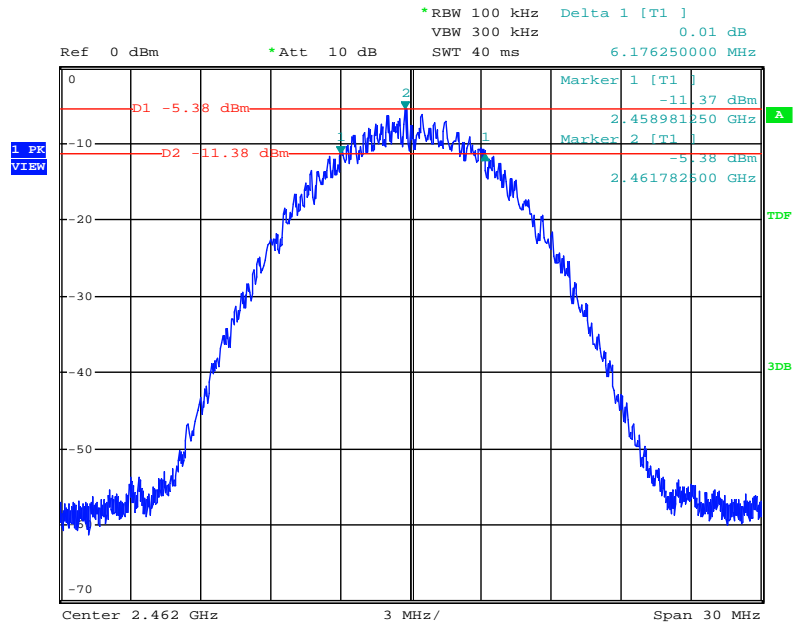


Date: 27.NOV.2014 22:04:15



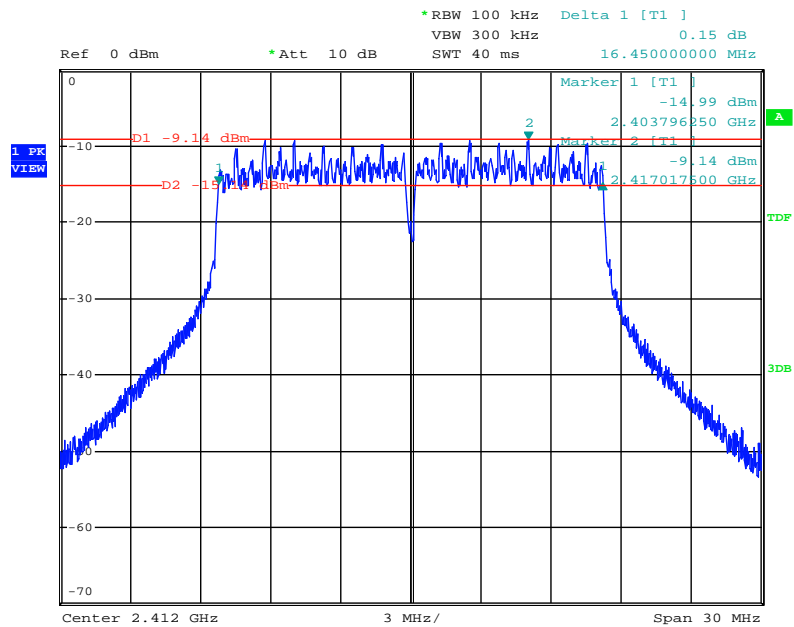


### 6 dB Bandwidth Plot on Configuration IEEE 802.11 b / 2 462 MHz



Date: 27.NOV.2014 21:33:43

### 6 dB Bandwidth Plot on Configuration IEEE 802.11 g / 2 412 MHz

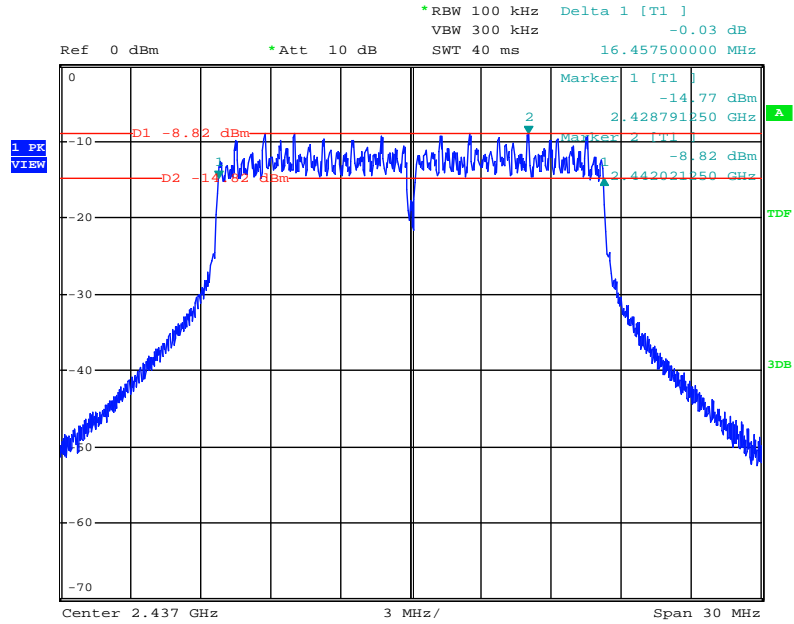


Date: 27.NOV.2014 22:21:11



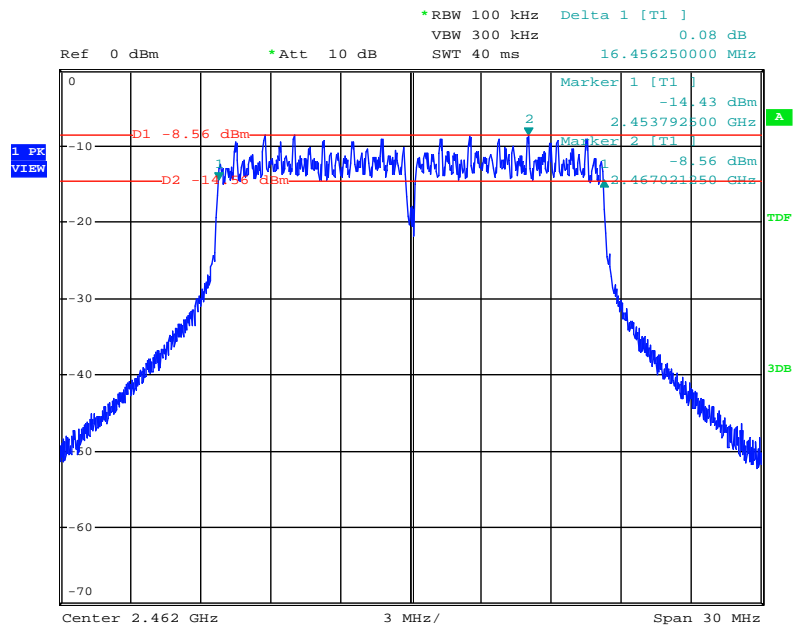


**6 dB Bandwidth Plot on Configuration IEEE 802.11 g / 2 437 MHz**



Date: 27.NOV.2014 22:10:14

**6 dB Bandwidth Plot on Configuration IEEE 802.11 g / 2 462 MHz**

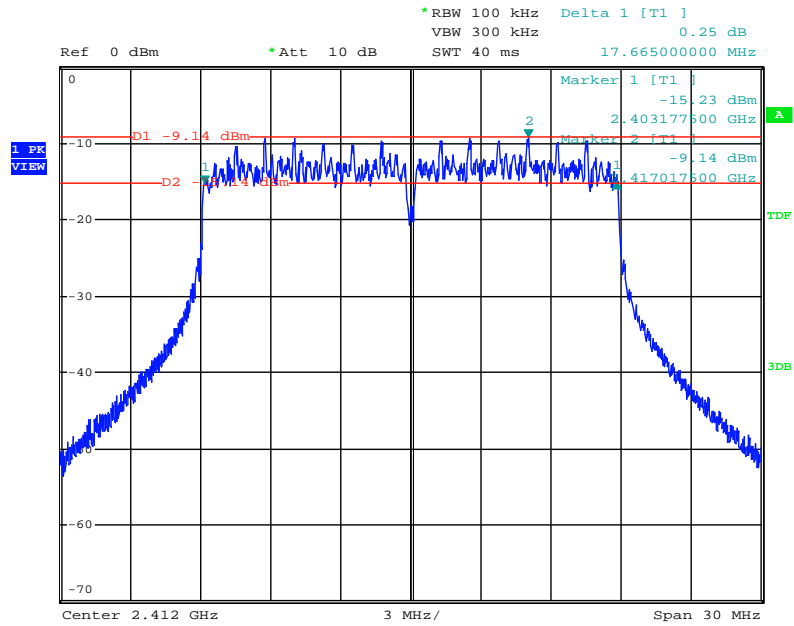


Date: 27.NOV.2014 21:21:26



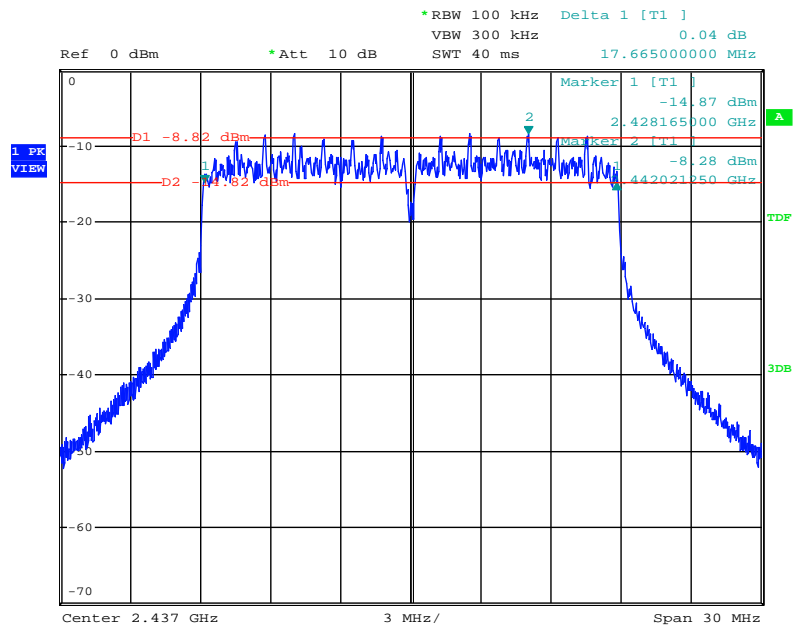


**6 dB Bandwidth Plot on Configuration IEEE 802.11 n / 2 412 MHz**



Date: 27.NOV.2014 22:18:29

**6 dB Bandwidth Plot on Configuration IEEE 802.11 n / 2 437 MHz**

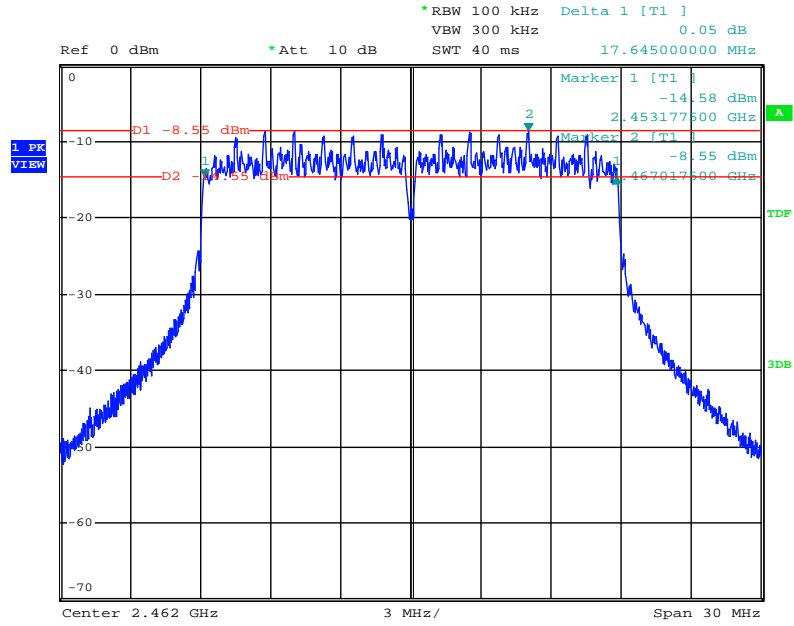


Date: 27.NOV.2014 22:13:58

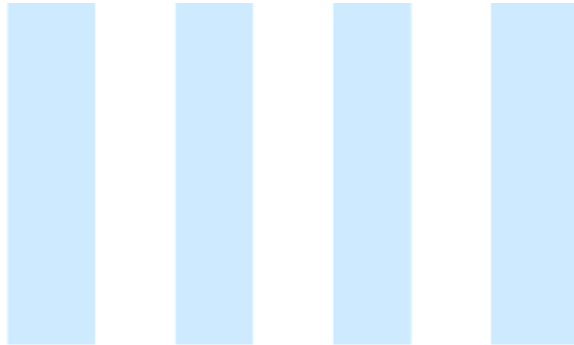




**6 dB Bandwidth Plot on Configuration IEEE 802.11 n / 2 462 MHz**



Date: 27.NOV.2014 21:15:38



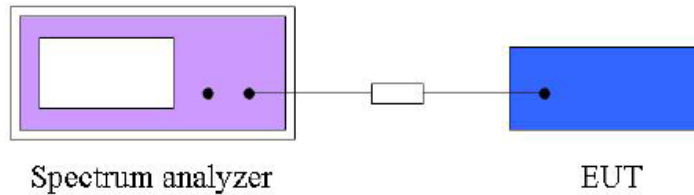


## 10. Band Edge Measurement

### 10.1 Operating environment

Temperature : 24.0 °C  
 Relative Humidity : 40.2 % R.H.

### 10.2 Test set-up (Lay-out)



### 10.3 Limit

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

### 10.4 Test equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - FSP	Rohde & Schwarz	Spectrum Analyzer	101431	Apr 30. 2015

### 10.5 Test Result

- Test Date : November 28, 2014  
 - Reference standard : Part 15 Subpart C, Sec. 15.247(d)  
 - Test Procedure(s) : ANSI C63.4 (2009), KDB558074 D01 DTS Meas Guidance v03r02(June 5,2014)  
 - Operating condition : RF transmitting mode (802.11 b/g/n Low: 2 412 MHz, High: 2 462 MHz)  
 - Power Source : DC 12 V  
 - Comment :

The spectrum plots are attached on the following 8 images, D1 line indicates the highest level, D2 line indicates the 20 dB offset below D1. It shows compliance with the requirement in part 15.247(d)

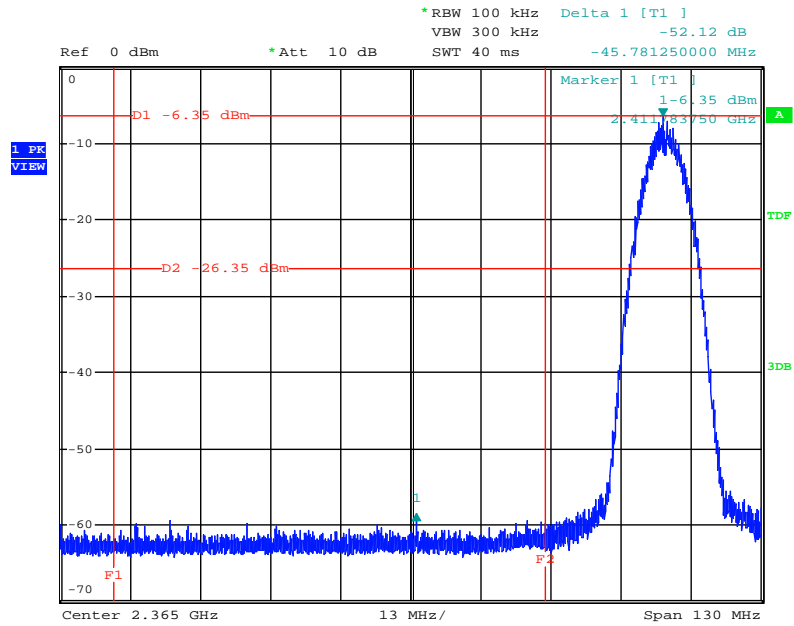
#### Spectrum Analyzer Setting:

- Resolution bandwidth : 100 kHz  
 - Video bandwidth : 300 kHz  
 - Detector : Peak  
 - Trace mode : Max. Hold  
 - Sweep time : Auto couple



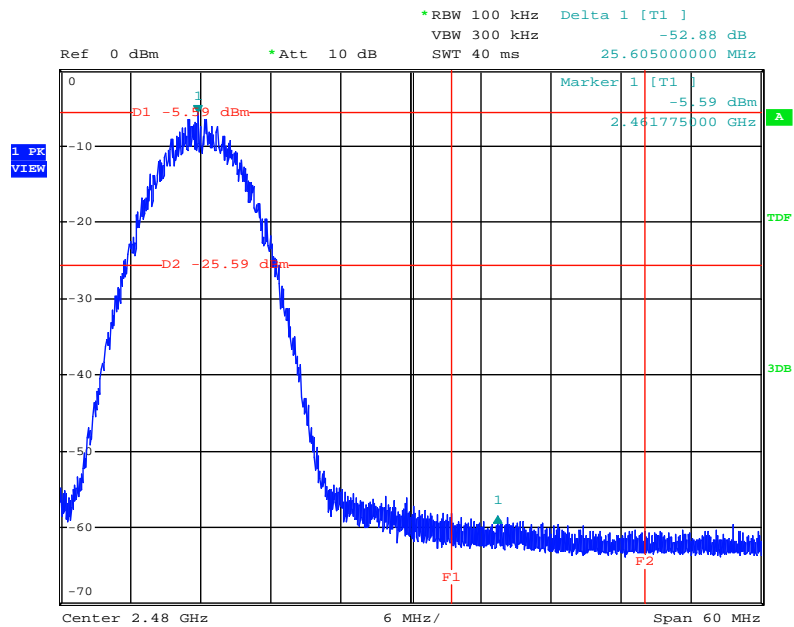


**Low Band Edge Plot on Configuration IEEE 802.11 b / 2 412 MHz**



Date: 28.NOV.2014 16:21:46

**High Band Edge Plot on Configuration IEEE 802.11 b / 2 462 MHz**



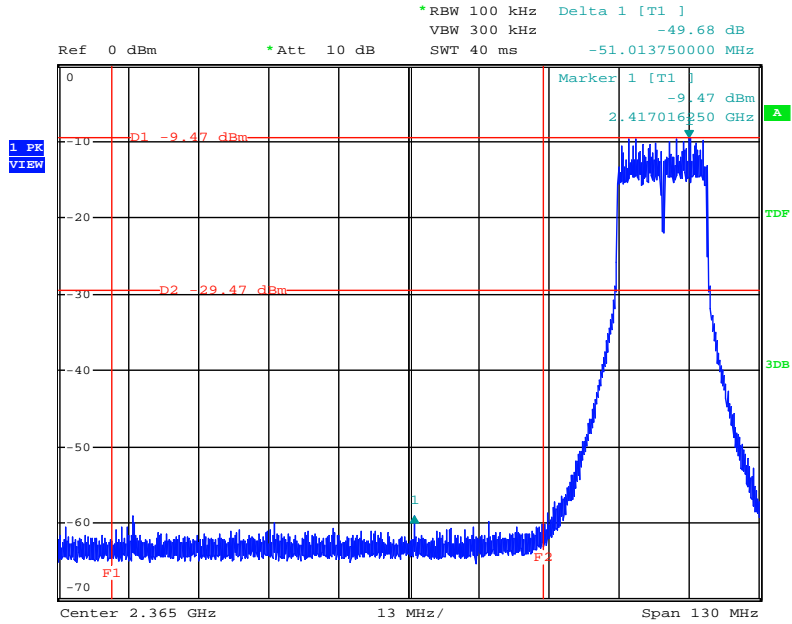
Date: 28.NOV.2014 16:12:54





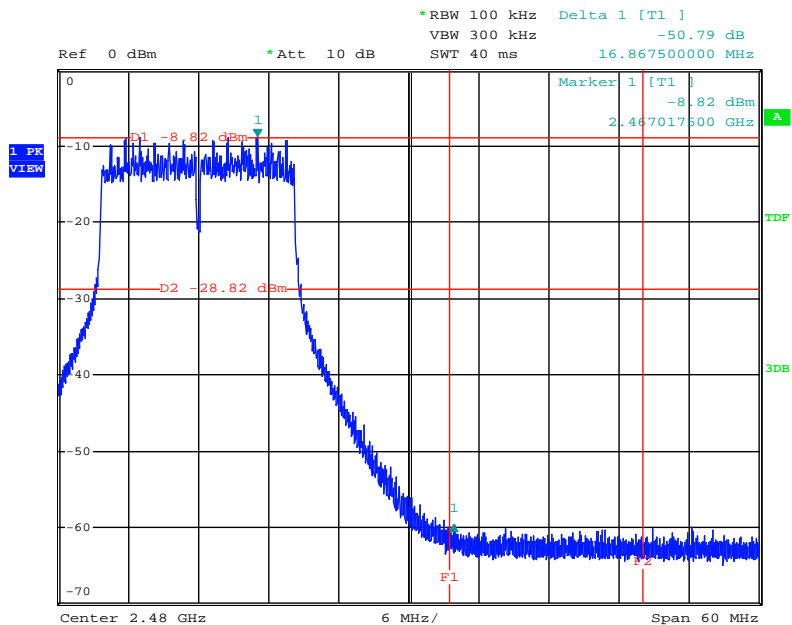


**Low Band Edge Plot on Configuration IEEE 802.11 g / 2 412 MHz**



Date: 28.NOV.2014 16:24:45

**High Band Edge Plot on Configuration IEEE 802.11 g / 2 462 MHz**

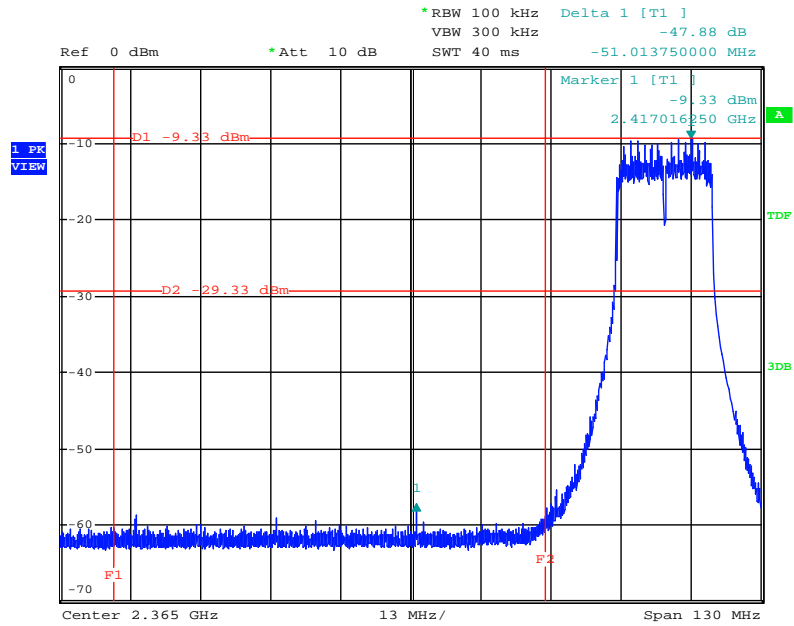


Date: 28.NOV.2014 16:04:17



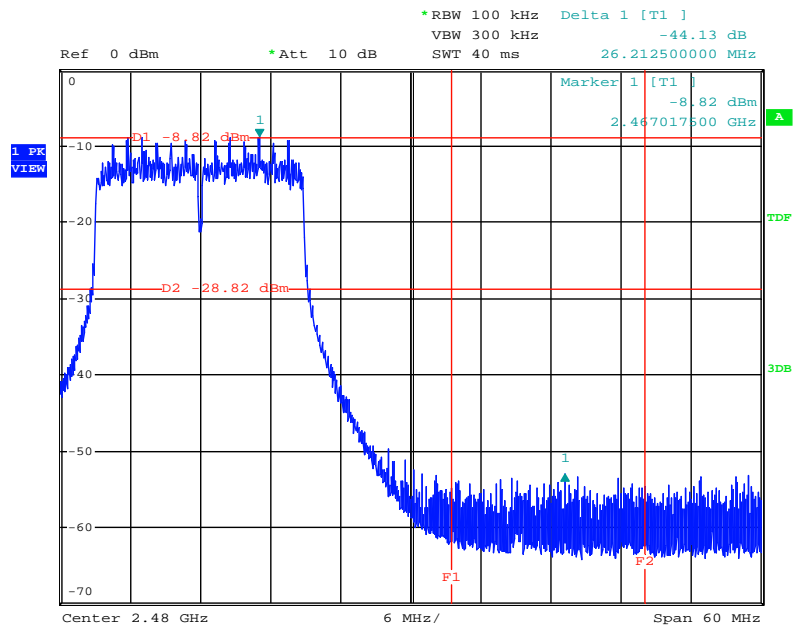


**Low Band Edge Plot on Configuration IEEE 802.11 n / 2 412 MHz**



Date: 28.NOV.2014 16:52:03

**High Band Edge Plot on Configuration IEEE 802.11 n / 2 462 MHz**

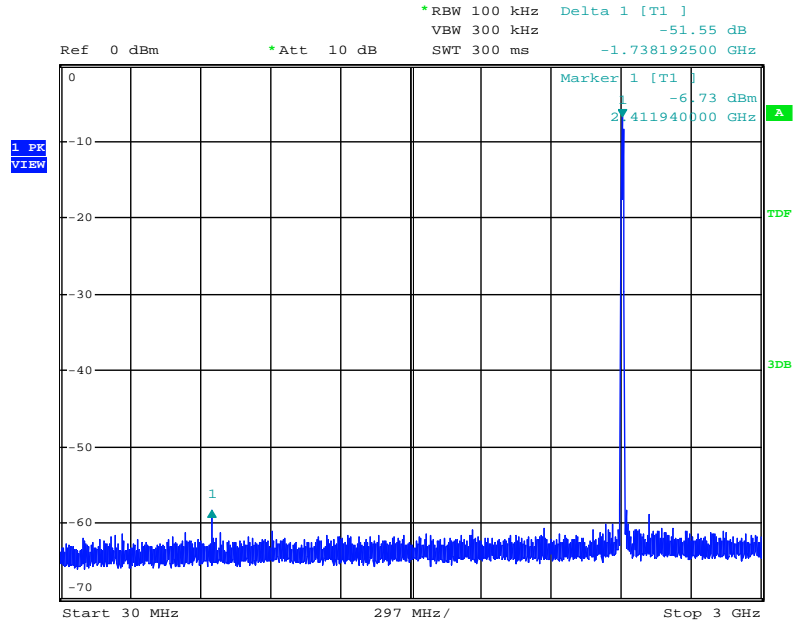


Date: 28.NOV.2014 15:59:43



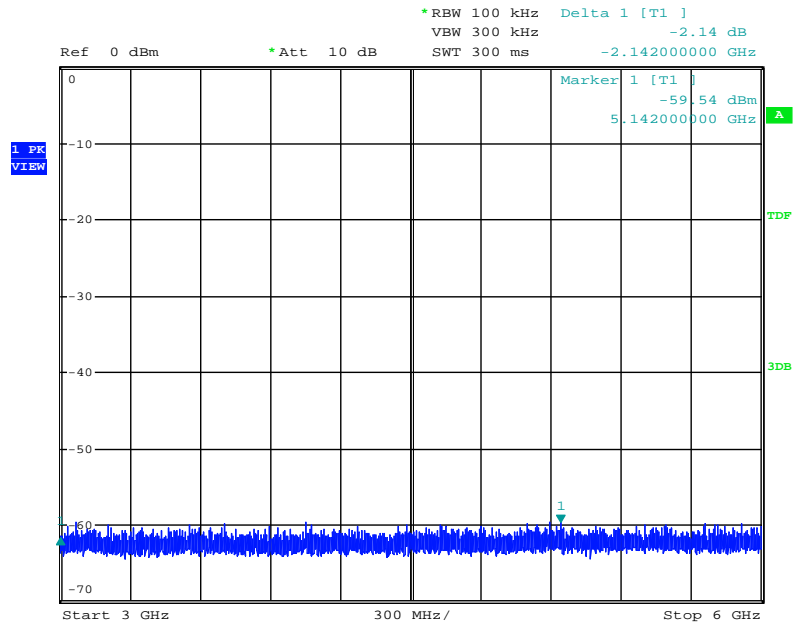


**Worst case result Emissions in non-Restricted frequency bands Plot**  
**IEEE 802.11 b / 2 412 MHz (30 MHz to 3 GHz)**



Date: 28.NOV.2014 20:32:12

**IEEE 802.11 b / 2 412 MHz (3 GHz to 6 GHz)**

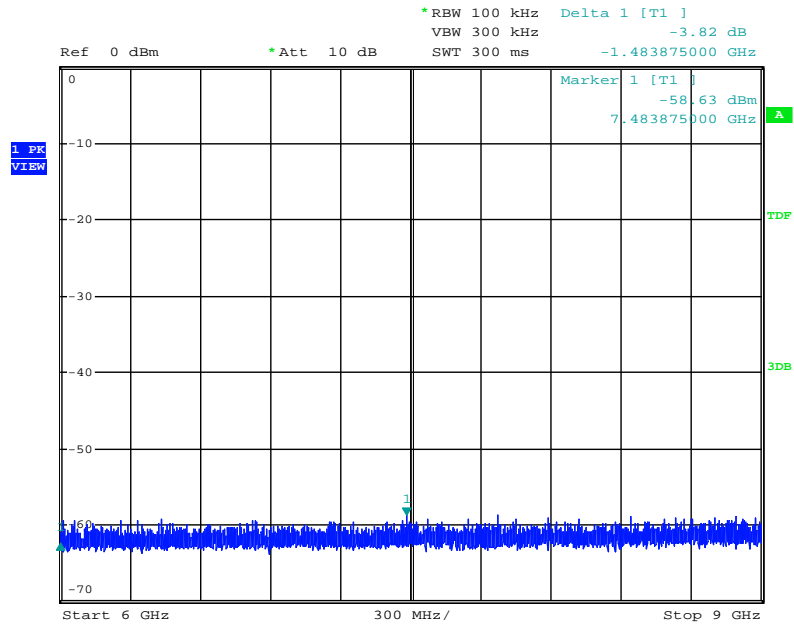


Date: 28.NOV.2014 20:35:09



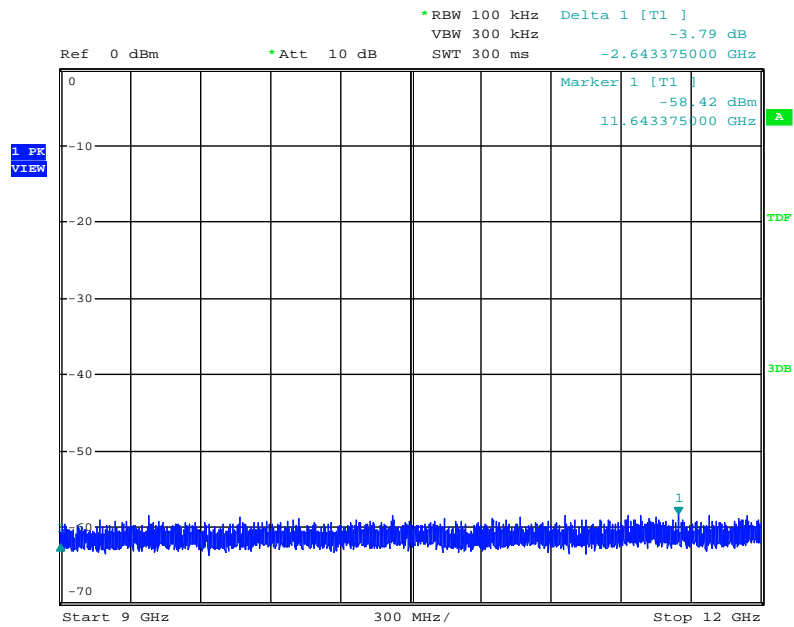


**IEEE 802.11 b / 2 412 MHz (6 GHz to 9 GHz)**



Date: 28.NOV.2014 20:37:42

**IEEE 802.11 b / 2 412 MHz (9 GHz to 12 GHz)**

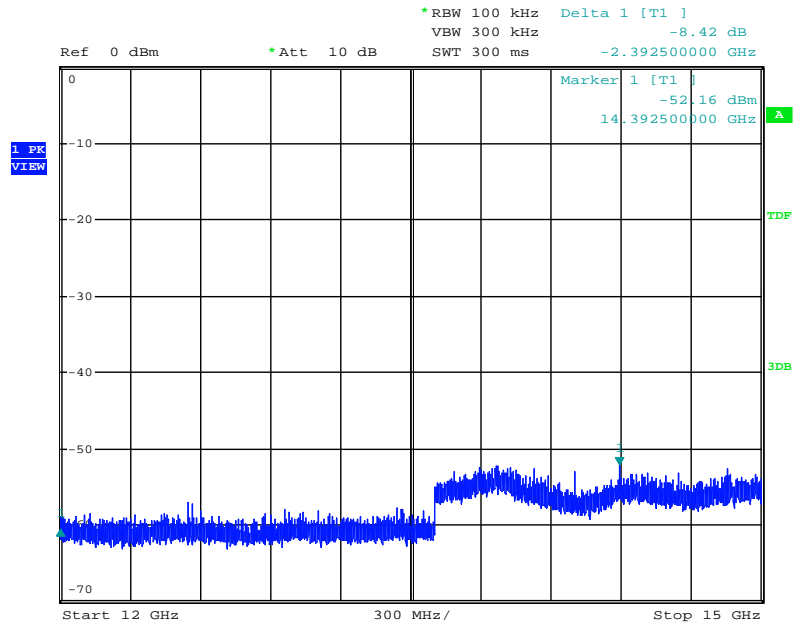


Date: 28.NOV.2014 20:39:05



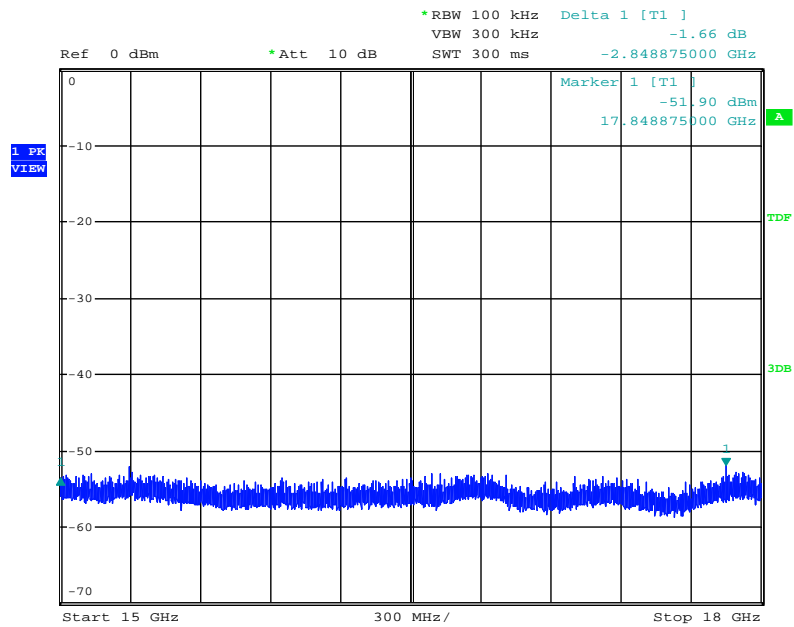


**IEEE 802.11 b / 2 412 MHz (12 GHz to 15 GHz)**



Date: 28.NOV.2014 20:40:16

**IEEE 802.11 b / 2 412 MHz (15 GHz to 18 GHz)**



Date: 28.NOV.2014 20:41:46





## 11. Radiated Emission

### - Test Description

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 Chamber (FCC Registration No.: 443957) or Open area test site (FCC Registration No.: 100749) that complies with CISPR 16/ANSI C63.4.

Above 1GHz final measurements were conducted at the 3m Chamber (FCC Registration No.: 443957) 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.

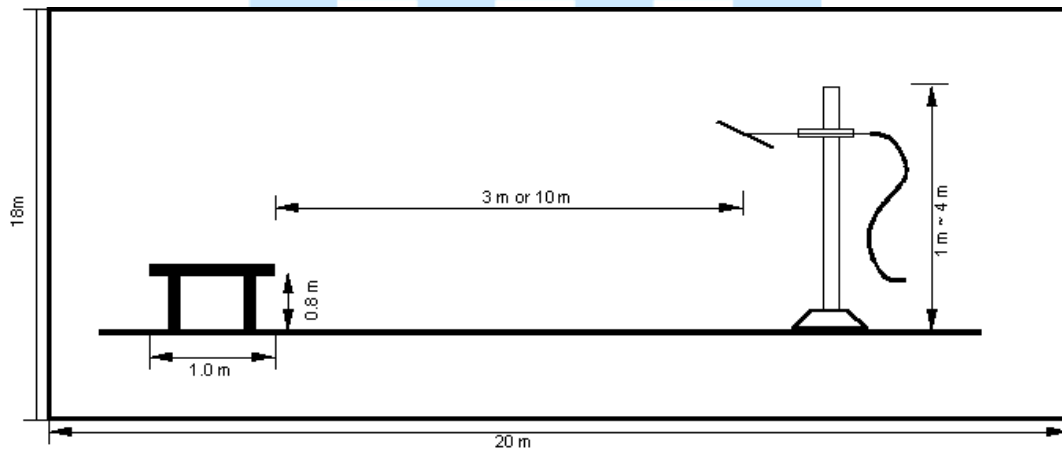


Fig 4. Dimensions of test site (Below 1GHz)

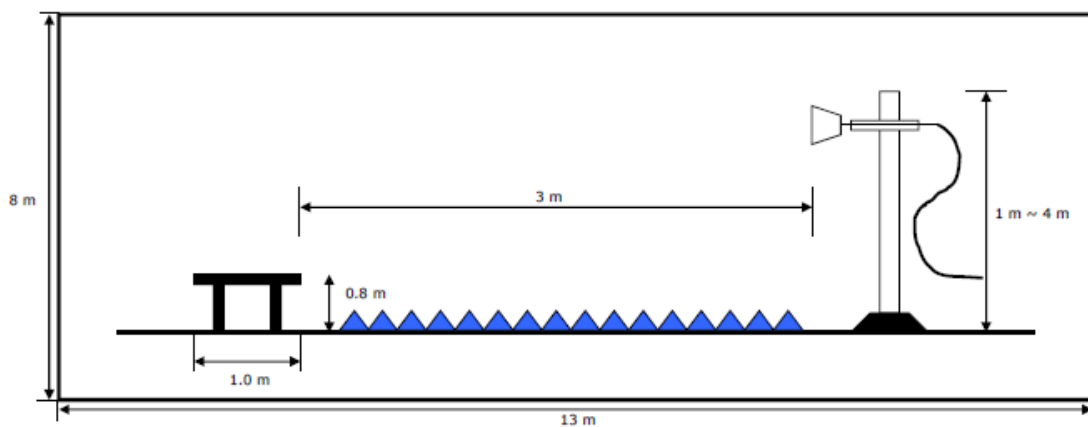


Fig 5. Dimensions of test site (Above 1GHz)





### 11.1 Operating Environment

Temperature : 20.0 °C  
 Relative Humidity : 40.1 % R.H.

### 11.2 Test set-up

The formal radiated emission was measured at 3 m distance anechoic chamber.  
 The EUT was placed on a non-conductive turntable approximately 0.8 m above the 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.

### 11.3 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 (Semi anechoic chamber)	Uncertainty	Remark
Radiated emission (30 MHz ~ 300 MHz, 3 m, Vertical)	± 4.47 dB	Confidence level of approximately 95 % ( <i>k</i> = 2)
Radiated emission (30 MHz ~ 300 MHz, 3 m, Horizontal)	± 4.46 dB	Confidence level of approximately 95 % ( <i>k</i> = 2)
Radiated emission (300 MHz ~ 1 000 MHz, 3 m, Vertical)	± 4.74 dB	Confidence level of approximately 95 % ( <i>k</i> = 2)
Radiated emission (300 MHz ~ 1 000 MHz, 3 m, Horizontal)	± 4.70 dB	Confidence level of approximately 95 % ( <i>k</i> = 2)
Radiated emission (1 GHz ~ 6 GHz, 3 m)	± 5.28 dB	Confidence level of approximately 95 % ( <i>k</i> = 2)
Radiated emission (6 GHz ~ 18 GHz, 3 m)	± 5.37 dB	Confidence level of approximately 95 % ( <i>k</i> = 2)

### 11.4 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	2400/F (kHz)	300
0.490 ~ 1.705	2400/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

$$[\text{Limit at 3 m}] = [\text{Limit at 300 m}] - 40 \times \log(3 \text{ [m]} / 300 \text{ [m]})$$

$$[\text{Limit at 3 m}] = [\text{Limit at 30 m}] - 40 \times \log(3 \text{ [m]} / 30 \text{ [m]})$$





**11.5 Test equipment used**

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESIB26	Rohde & Schwarz	EMI Test Receiver	830482/010	Apr 29. 2015
■ - FSP	Rohde & Schwarz	Spectrum Analyzer	101431	Apr 30. 2015
■ - VULB9160	Schwarzbeck	Broadband test antenna	3193	Mar 25. 2016
■ - MCU066	ature GmbH	Position Controller	1390306	N/A
■ - TT2.5SI	ature GmbH	Turntable	1390307	N/A
■ - AM4.0	ature GmbH	Antenna Mast	1390308	N/A
■ - BBHA9120D	Schwarzbeck	Horn antenna	207	Mar 07. 2016
■ - 3160-09	ETS LINDGREN	Horn antenna	LM3423	Nov 08. 2015
■ - AFS44-00101800-25-10P-44	MITEQ	Preamplifier	1258942	Jan 15. 2015
■ - AFS44-00101800-25-10P-44	MITEQ	Preamplifier	1258943	Jan 15. 2015

**11.6 Radiated emission test data**

- Test Date : November 27, 2014
- Reference standard : Part 15 Subpart C, Sec. 15.247(d) / ANSI C63.10
- Test Procedure(s) : ANSI C63.4 (2009), KDB558074 D01 DTS Meas Guidance v03r02(June 5,2014)
- Operating condition : RF transmitting mode (Low: 2 412 MHz, Middle: 2 437 MHz, High: 2 462 MHz)
- Measuring distance : 3 m
- Power Source : AC 120 V / 60 Hz (DC 12 V Supply from AC/DC adaptor)
- Note :

- Measurement

Frequency range	9 kHz ~ 90 kHz, 110 kHz ~ 150 kHz	90 kHz ~ 110 kHz	150 kHz ~ 490 kHz	490 kHz ~ 30 MHz	30 MHz ~ 1 GHz	Above 1 GHz
Detector type	Peak / Average	Quasi peak	Peak / Average	Quasi peak	Quasi peak	Peak / Average
IF bandwidth	200 Hz	200 Hz	9 kHz	9 kHz	120 kHz	1 MHz





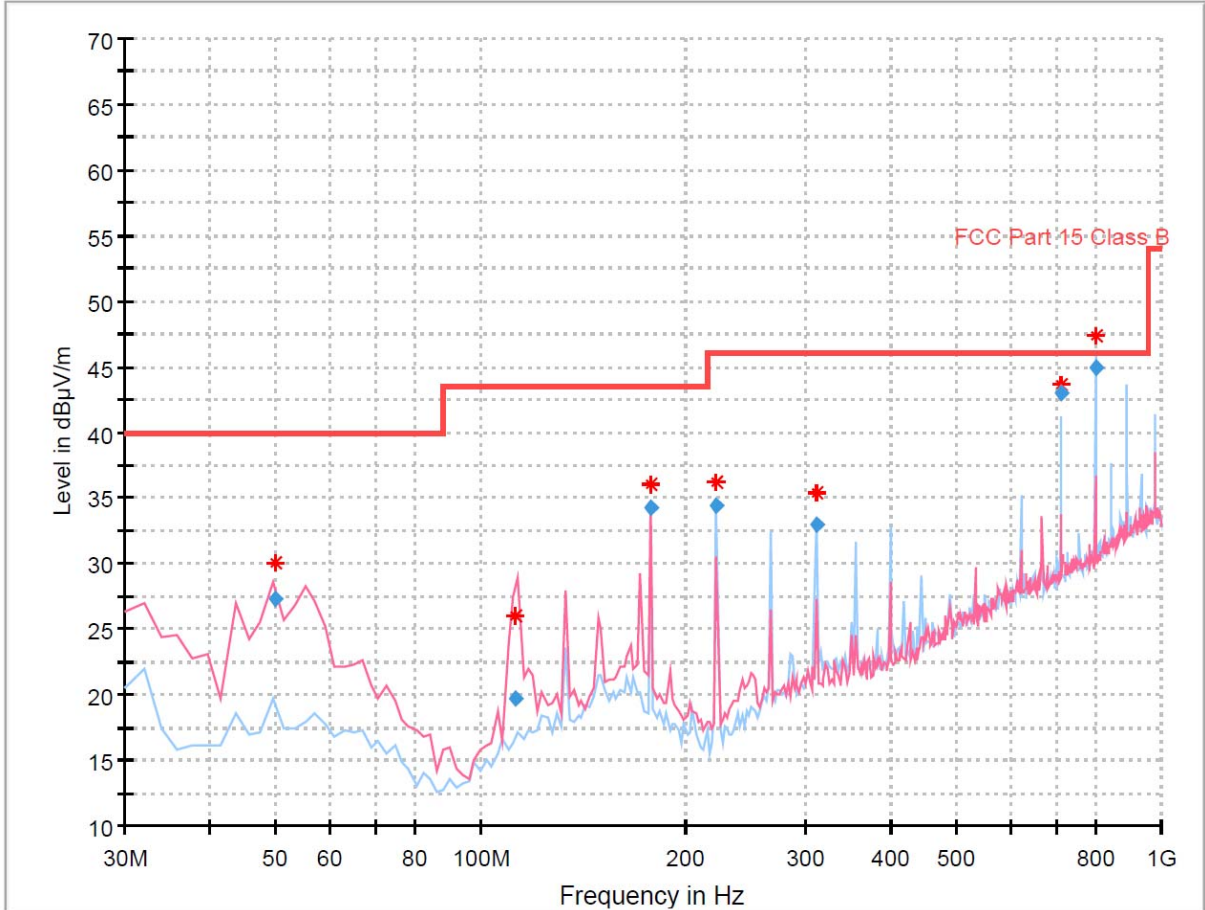


**Result of radiated emission (9 kHz to 30 MHz)**

No emission found between lowest internal used/generated frequencies to 30 MHz.

**Result of radiated emission (30 MHz to 1 000 MHz)**

(IEEE 802.11 b\_2 462 MHz)



**Final Result**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
49.962878	27.25	40.00	12.75	1000.0	120.000	106.0	V	320.0	14.5
112.827674	19.77	43.50	23.73	1000.0	120.000	165.0	V	255.0	13.4
177.771971	34.27	43.50	9.23	1000.0	120.000	100.0	V	160.0	14.9
222.203890	34.47	46.00	11.53	1000.0	120.000	159.0	H	34.0	13.5
311.067228	33.00	46.00	13.00	1000.0	120.000	125.0	H	15.0	17.7
711.097109	43.00	46.00	3.00	1000.0	120.000	119.0	H	0.0	25.2
799.960447	45.00	46.00	1.00	1000.0	120.000	118.0	H	-4.0	26.4

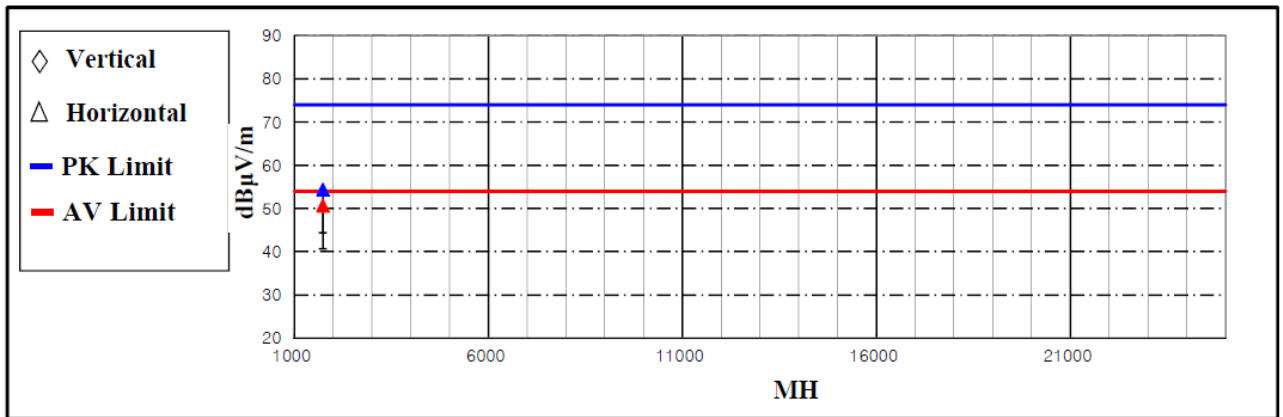




**Result of radiated emission (1 GHz to 25 GHz)**

**(IEEE 802.11 g 2 412 MHz)**

Frequency (MHz)	Measurement Level						Limit (dBµV/m)		Margin (dB)		Positioning System		
	Reading Value (dBµV/m)		AF	AMP / CL	Test Result (dBµV/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average	(dB/m)	(dB)	Peak	Average							
1733.37	66.46	62.75	25.68	-37.74	54.40	50.69	74.00	54.00	19.60	3.31	H	100	355



\*Comment : AMP/CL\_Cable loss value + AMP gain value  
 AF : Antenna factor value  
 Pol. : H(Horizontal), V(Vertical)

**Worst case Result of radiated emission (Band Edge)**

**(IEEE 802.11 n, 2 412 MHz)**

Frequency (MHz)	Measurement Level						Limit (dBµV/m)		Margin (dB)		Positioning System		
	Reading Value (dBµV/m)		AF	AMP / CL	Test Result (dBµV/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average	(dB/m)	(dB)	Peak	Average							
2390.00	79.07	62.87	26.96	-37.38	68.65	52.45	74.00	54.00	5.35	1.55	H	100	133

**(IEEE 802.11 n, 2 462 MHz)**

Frequency (MHz)	Measurement Level						Limit (dBµV/m)		Margin (dB)		Positioning System		
	Reading Value (dBµV/m)		AF	AMP / CL	Test Result (dBµV/m)		Peak	Average	Peak	Average	Pol. (H/V)	Height (cm)	Angle (°)
	Peak	Average	(dB/m)	(dB)	Peak	Average							
2483.50	79.54	63.37	27.21	-37.33	69.42	53.25	74.00	54.00	4.58	0.75	H	106	88

Note:

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

Emission level (dBµV/m) = 20 log Emission level (µV/m).

Corrected reading: Antenna factor + Cable loss + Preamplifier gain + Read value = Test result





**Worst case Result of radiated emission (1 GHz to 10<sup>th</sup> harmonics)**

**(IEEE 802.11 n, 2 412 MHz)**

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

**(IEEE 802.11 n, 2 437 MHz)**

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

**(IEEE 802.11 n, 2 462 MHz)**

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

Note:

Emission level (dBμV/m) = 20 log Emission level (μV/m).

Corrected Reading: Reading value + AF (Antenna Factor) + AMP/CL (Cable Loss + Preamp factor) = Test result

- The end -

