

Prüfbericht-Nr.: <i>Test report No.:</i>	50247793 001	Auftrags-Nr.: <i>Order No.:</i>	170109196	Seite 1 von 28 <i>Page 1 of 28</i>
Kunden-Referenz-Nr.: <i>Client reference No.:</i>	N/A	Auftragsdatum: <i>Order date.:</i>	29.04.2019	
Auftraggeber: <i>Client:</i>	Guangdong MD Consumer Electric Manufacturing Co., Ltd 19 Sanle Road, Beijiao, Shunde Foshan, Guangdong 528311 P. R. China			
Prüfgegenstand: <i>Test item:</i>	Wi-Fi Module			
Bezeichnung / Typ-Nr.: <i>Identification / Type No.:</i>	QCA4004SIP			
Auftrags-Inhalt: <i>Order content:</i>	FCC approval			
Prüfgrundlage: <i>Test specification:</i>	CFR47 FCC Part 15: Subpart C Section 15.247 CFR47 FCC Part 15: Subpart C Section 15.207 CFR47 FCC Part 15: Subpart C Section 15.209 CFR47 FCC Part 2: Section 2.1091			
Wareneingangsdatum: <i>Date of receipt:</i>	10.05.2019	Please refer to photo documents		
Prüfmuster-Nr.: <i>Test sample No.:</i>	A000920201-001			
Prüfzeitraum: <i>Testing period:</i>	09.05.2019 - 30.08.2019			
Ort der Prüfung: <i>Place of testing:</i>	TÜV Rheinland (Guangdong) Ltd.			
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland (Guangdong) Ltd.			
Prüfergebnis*: <i>Test result*:</i>	Pass			
geprüft von / tested by:		kontrolliert von / reviewed by:		
				
14.08.2019	Strom Shu / Assistant Project Manager	16.08.2019	Amy Wang / Technical Certifier	
Datum <i>Date</i>	Name/Stellung <i>Name/Position</i>	Unterschrift <i>Signature</i>	Datum <i>Date</i>	Name/Stellung <i>Name/Position</i>
Sonstiges / Other:				
FCC ID: TAPMC-4004SIP				
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>		Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged:</i>		
* Legende: 1 = sehr gut 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet Legend: 1 = very good 2 = good 3 = satisfactory 4 = sufficient 5 = poor P(ass) = passed a.m. test specifications(s) F(ail) = failed a.m. test specifications(s) N/A = not applicable N/T = not tested				
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i>				

Test Summary

5.1.1 ANTENNA REQUIREMENT

RESULT: Pass

5.1.2 MAXIMUM OUTPUT POWER

RESULT: Pass

5.1.3 CONDUCTED POWER SPECTRAL DENSITY

RESULT: Pass

5.1.4 6dB BANDWIDTH

RESULT: Pass

5.1.5 CONDUCTED SPURIOUS EMISSIONS MEASURED IN 100 KHz BANDWIDTH

RESULT: Pass

5.1.6 RADIATED SPURIOUS EMISSION

RESULT: Pass

5.1.7 CONDUCTED EMISSION ON AC MAINS

RESULT: Pass

6.1.1 ELECTROMAGNETIC FIELDS

RESULT: Pass

Contents

1	GENERAL REMARKS	4
1.1	COMPLEMENTARY MATERIALS	4
2	TEST SITES	4
2.1	TEST FACILITIES	4
2.2	LIST OF TEST AND MEASUREMENT INSTRUMENTS.....	5
2.3	TRACEABILITY	6
2.4	CALIBRATION	6
2.5	MEASUREMENT UNCERTAINTY.....	6
2.6	LOCATION OF ORIGINAL DATA.....	6
2.7	STATUS OF FACILITY USED FOR TESTING.....	6
3	GENERAL PRODUCT INFORMATION	7
3.1	PRODUCT FUNCTION AND INTENDED USE.....	7
3.2	RATINGS AND SYSTEM DETAILS	7
3.3	INDEPENDENT OPERATION MODES	8
3.4	NOISE GENERATING AND NOISE SUPPRESSING PARTS	8
3.5	SUBMITTED DOCUMENTS.....	8
4	TEST SET-UP AND OPERATION MODES	9
4.1	PRINCIPLE OF CONFIGURATION SELECTION	9
4.2	TEST OPERATION AND TEST SOFTWARE	9
4.3	SPECIAL ACCESSORIES AND AUXILIARY EQUIPMENT	9
4.4	COUNTERMEASURES TO ACHIEVE EMC COMPLIANCE	9
4.5	TEST SETUP DIAGRAM	10
5	TEST RESULTS	12
5.1	TRANSMITTER REQUIREMENT & TEST SUITES	12
5.1.1	Antenna Requirement	12
5.1.2	Maximum Peak Conducted Output Power	13
5.1.3	Conducted Power Spectral Density	14
5.1.4	6dB Bandwidth	19
5.1.5	Conducted Spurious Emissions Measured in 100 kHz Bandwidth	24
5.1.6	Radiated Spurious Emission	25
5.1.7	Conducted Emission on AC Mains.....	26
6	SAFETY HUMAN EXPOSURE	27
6.1	RADIO FREQUENCY EXPOSURE COMPLIANCE	27
6.1.1	Electromagnetic Fields	27
7	PHOTOGRAPHS OF THE TEST SET-UP	28
8	LIST OF TABLES.....	28

1 General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix A: Photographs of the Test Set-up

Appendix B: Test Results of Wi-Fi 802.11 b/g/n

2 Test Sites

2.1 Test Facilities

TÜV Rheinland (Guangdong) Ltd.

No.102, 1F of Southwest and No.205, 2F No.767 Tianyuan Road, Tianhe District, Guangzhou 510663,
Guangdong Province P.R. China

FCC Accreditation Designation No.: CN1207

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

TÜV Rheinland (Guangdong) Ltd.

Equip.	Description	Model	Manufacturer	Inte. (mon)	Due Date DD.MM.YYYY
1813944	EMI Test Receiver	ESCI	Rohde & Schwarz	12	15.03.2020
1813943	Two-Line V-Network	ENV216	Rohde & Schwarz	12	24.05.2020
1813832	EMI Test Receiver	ESCI	Rohde & Schwarz	12	14.03.2020
1813829	FSP30 Spectrum Analyzer	FSP30	Rohde & Schwarz	12	22.08.2019
1814142	Trilog Broadband Antenna	VULB9168(6dB)	SCHWARZBECK	24	20.09.2019
1813850	Loop Antenna	HFH2-Z2	Rohde & Schwarz	24	15.03.2021
1814199	Double-Ridged Horn Antenna	HF907(3米)	Rohde & Schwarz	24	23.10.2020
1813833	Horn Antenna	3160-09	EMCO	60	19.01.2024
1814068	Pre-Amplifier	A44-00101800-25-10P-	MITEQ	12	08.05.2020
1813846	Band Reject Filter	BRM50702	Micro-Tronics	24	04.07.2020
1813834	Pre-Amplifier	A33-18002650-30-8P-4	MITEQ	24	29.07.2021
1813697	SAC	N/A	Albatross Project	36	27.11.2021
1814012	Shielding Room	9x4x3.4	Changzhou Yuanping	60	06.12.2020
1814017	Regulated power supply	APS-33045TT	APS	12	15.07.2020
1814004	Frequency Invertor	APW-1100N	APE	12	15.07.2020
1814018	Regulated power supply	APS-11020	APS	12	15.07.2020
1822646	Stable Power Supply	APS-11010GG	APS	12	15.07.2020
1813877	Automatic Voltage Regulator	AFR-345	Allpower	12	26.04.2020
1822647	Frequency Invertor	CIF-5000A	IDRC	12	15.07.2020
1822648	Artificial Mains Network	LT32C/10	AFJ	12	30.07.2020
1825388	EMI Test Receiver	ESR7	Rohde & Schwarz	12	08.04.2020

2.3 Traceability

All measurement equipment calibrations are traceable to NIM (National Institute of Metrology) or where calibration is performed in other countries, to equivalent nationally recognized standards organizations.

2.4 Calibration

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer's specifications. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

2.5 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements as below table.

Item		Extended Uncertainty
Conducted Emission		± 3.17 dB
Radiated Emission (30-1000MHz)	Field strength (dB μ V/m)	± 5.16 dB
Radiated Emission (above 1000MHz)	Field strength (dB μ V/m)	± 2.22 dB
Radio Spectrum		± 4.51 dB

2.6 Location of Original Data

The original copies of all test data taken during actual testing were attached at Appendix A & B of this report and delivered to the applicant. A copy has been retained in the TÜV Rheinland (Guangdong) Ltd. file for certification follow-up purposes.

2.7 Status of Facility Used for Testing

The TÜV Rheinland (Guangdong) Ltd. Test facility located at No.102, 1F of Southwest and No.205, 2F No.767 Tianyuan Road, Tianhe District, Guangzhou 510663, Guangdong Province P.R. China is listed on the US Federal Communications Commission list of facilities approved to perform measurements.

3 General Product Information

3.1 Product Function and Intended Use

The EUT QC4004SIP is a wireless module that supports Wi-Fi 802.11 b/g/n wireless technologies.

According to the declaration of the applicant, full tests were performed on QC4004SIP.

For details refer to the User Manual, Technical Description and Circuit Diagram.

3.2 Ratings and System Details

Table 2: Technical Specification of EUT

General Information of EUT	Value
Kind of Equipment	Wi-Fi Module
Type Designation	QCA4004SIP
FCC ID	TAPMC-4004SIP
Operating Voltage	DC 5.0V (external power supply)
Testing Voltage	DC 5.0V (external power supply)
Technical Specification of Wi-Fi 802.11 b/g/n	
Operating Frequency	2412 - 2462 MHz for 802.11b/g/n(HT20) 2422 - 2452 MHz for 802.11n(HT40)
Type of Modulation	DSSS(DBPSK/DQPSK/CCK) OFDM(BPSK/QPSK/16QAM/64QAM)
Data Rate	1/2/5.5/11 Mbps for 802.11b 6/9/12/18/24/36/48/54 Mbps for 802.11g MCS0 ~ MCS7 for 802.11n
Channel Number	11 channels for 802.11b/g/n(HT20) 7 channels for 802.11n(HT40)
Channel Separation	5 MHz
Antenna Type	Integral Antenna
Gain	0 dBi
Note: the information of the EUT is declared by the manufacturer.	

Table 3: RF Channel and Frequency of Wi-Fi 802.11 b/g/n

RF Channel	802.11 b/g/n(HT20)	802.11 n(HT40)
	Frequency (MHz)	Frequency (MHz)
01	2412	/
02	2417	/
03	2422	2422
04	2427	2427
05	2432	2432
06	2437	2437
07	2442	2442
08	2447	2447
09	2452	2452
10	2457	/
11	2462	/

Test frequencies are lowest channel: 2412 MHz, middle channel: 2437 MHz and highest channel: 2462 MHz for 802.11b/g/n(HT20)

Test frequencies are lowest channel: 2422 MHz, middle channel: 2437 MHz and highest channel: 2452 MHz for 802.11n(HT40)

3.3 Independent Operation Modes

The basic operation modes are:

- A. On, Wi-Fi 802.11 b/g/n wireless transmitting mode
 - 1. Low channel
 - 2. Middle channel
 - 3. High channel
- B. On, Normal operation with Wi-Fi mode
- C. Off

3.4 Noise Generating and Noise Suppressing Parts

Refer to Circuit Diagram for further details.

3.5 Submitted Documents

- Application Form
- Block Diagram
- FCC/IC Label and Location Info
- Operation Description
- Photo Document
- Schematics
- User Manual

4 Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

Radio Spectrum: The equipment under test (EUT) was configured at its highest power output in order to measure its highest possible radiation and conducted level. The test modes were adapted accordingly in reference to the instructions for use.

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Test operation refers to test setup in chapter 5. All tests were performed according to the procedures in ANSI C63.10: 2013.

According to clause 3.1, all tests were performed on model QCA4004SIP in this report.

4.3 Special Accessories and Auxiliary Equipment

Table 4: List of Accessories and Auxiliary Equipment

Description	Manufacturer	Model	S/N	Rating
Notebook	Lenovo	ThinkPad X260	PC0DZSKR	N/A

4.4 Countermeasures to Achieve EMC Compliance

The test sample which has been tested contained the noise suppression parts as described in the Technical Construction File (TCF).

No additional measures were employed to achieve compliance.

4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test (Below 1GHz)

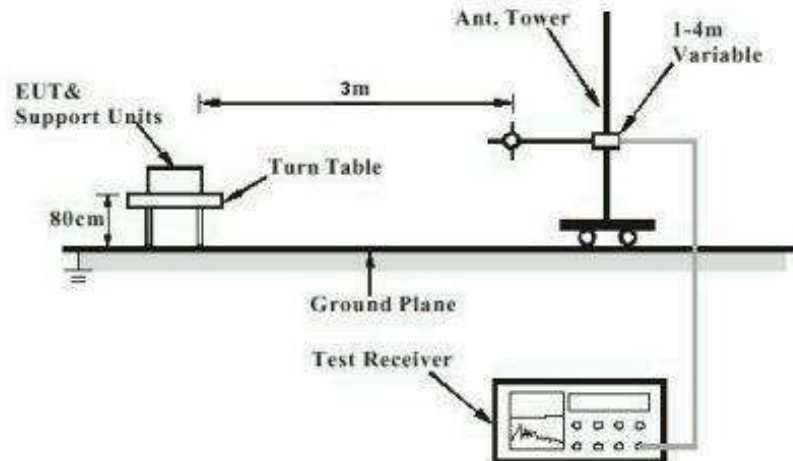


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

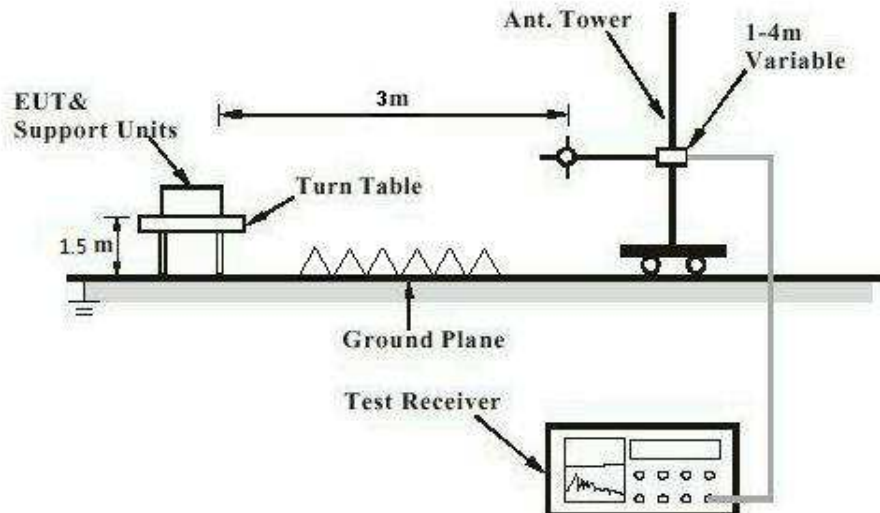


Diagram of Measurement Configuration for Mains Conduction Measurement

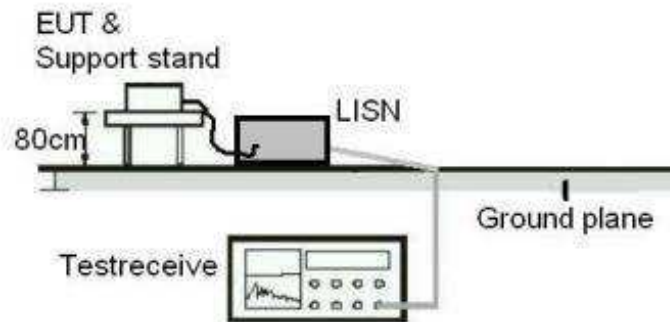
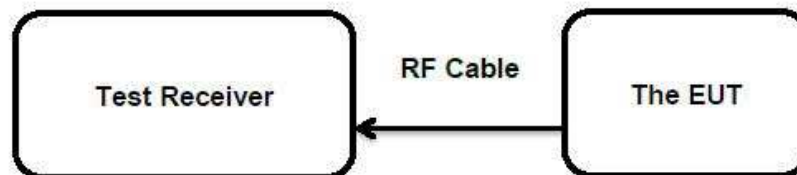


Diagram of Measurement Configuration for Conducted Transmitter Measurement



5 Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT:**Pass****Test Specification**

Test standard : FCC Part 15.247(b)(4) and Part 15.203

According to the manufacturer declared, the EUT has one internal antennas, the directional gain of antenna is 0 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Therefore the EUT is considered sufficient to comply with the provision.

Therefore the EUT is considered sufficient to comply with the provision.

Refer to EUT Photo for further details.

5.1.2 Maximum Output Power

RESULT:
Pass
Test Specification

Test standard : FCC Part 15.247(b)(3)
 Basic standard : ANSI C63.10: 2013
 Limits : DSSS < 1.0 Watts
 Kind of test site : Shielded Room

Test Setup

Date of testing : 12.07.2019
 Input voltage : DC 5.0V (external power supply)
 Operation mode : A, B
 Test channel : Low / Middle / High
 Ambient temperature : 25 °C
 Relative humidity : 56 %
 Atmospheric pressure : 101 kPa

For details refer to following test result.

Table 5: Test Result of Output Power, Wi-Fi 802.11 b/g/n

Test Mode	Data Rate	Test Channel (MHz)	Measured Peak Output Power		Limit (W)
			(dBm)	(W)	
802.11b	1 Mbps	2412	18.88	0.077	< 1.0
		2437	19.61	0.091	
		2462	19.78	0.095	
802.11g	6 Mbps	2412	17.24	0.053	
		2437	17.67	0.058	
		2462	17.48	0.056	
802.11n (HT20)	MCS0	2412	17.07	0.051	
		2437	17.52	0.057	
		2462	17.10	0.051	
802.11n (HT40)	MCS0	2422	16.81	0.048	
		2437	16.58	0.045	
		2452	16.73	0.047	
Maximum Measured Value			19.78	0.095	

Note:

1) The cable loss is taken into account in results.

5.1.3 Conducted Power Spectral Density

RESULT:
Pass
Test Specification

Test standard : FCC Part 15.247(e)
 Basic standard : ANSI C63.10: 2013
 Limits : < 8 dBm / 3kHz
 Kind of test site : Shielded Room

Test Setup

Date of testing : 11.06.2019
 Input voltage : DC 5.0V (external power supply)
 Operation mode : A
 Test channel : Low / Middle / High
 Ambient temperature : 25 °C
 Relative humidity : 56 %
 Atmospheric pressure : 101 kPa

For details refer to following test result.

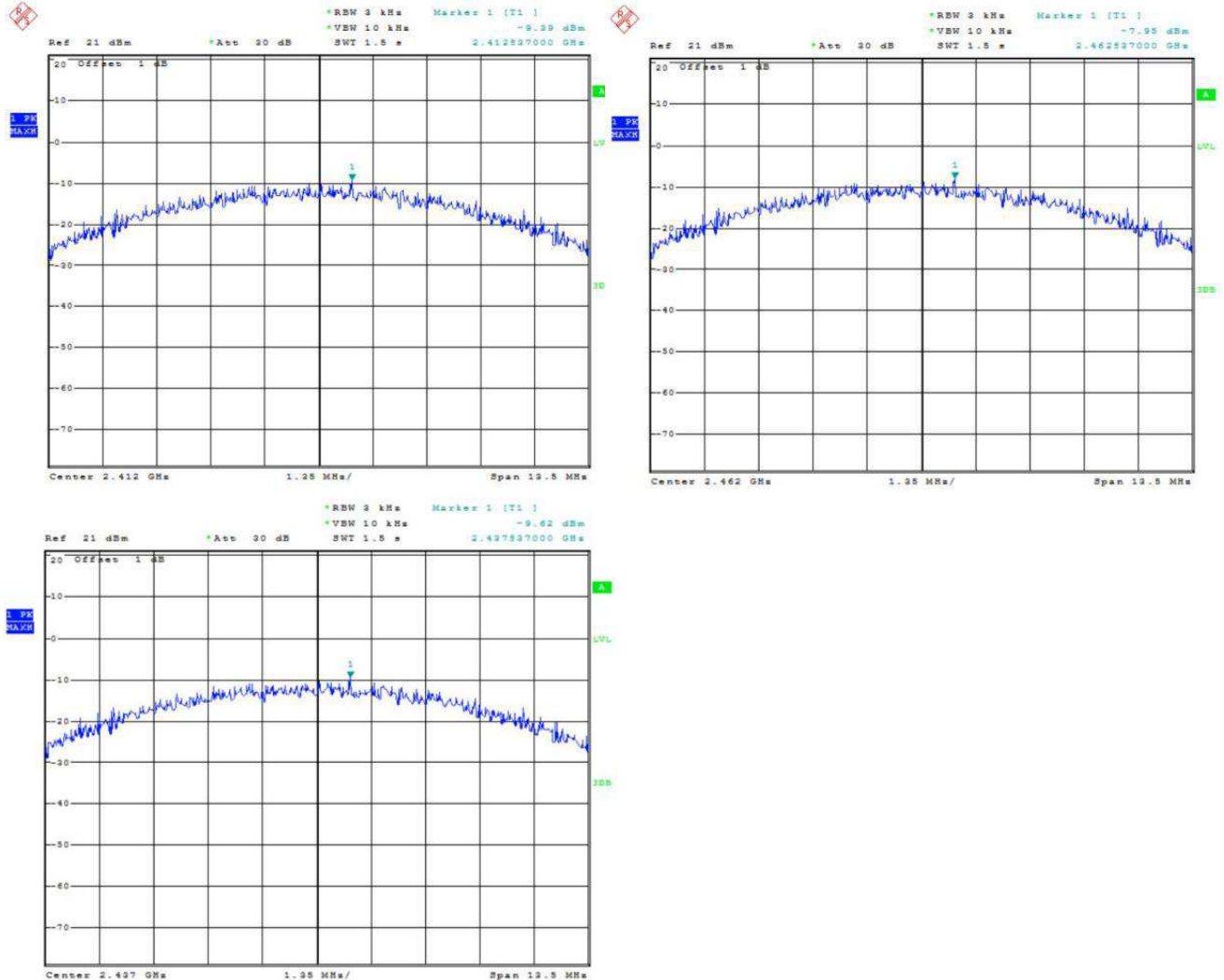
Table 6: Test Result of Power Spectral Density, Wi-Fi 802.11 b/g/n

Test Mode	Data Rate	Test Channel (MHz)	Measured Peak Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
802.11b	1 Mbps	2412	-9.39	8 dBm / 3kHz
		2437	-9.62	
		2462	-7.95	
802.11g	6 Mbps	2412	-14.28	
		2437	-13.90	
		2462	-13.10	
802.11n (HT20)	MCS0	2412	-12.75	
		2437	-14.08	
		2462	-12.14	
802.11n (HT40)	MCS0	2422	-16.25	
		2437	-17.01	
		2452	-15.40	
Maximum Measured Value			-7.95	

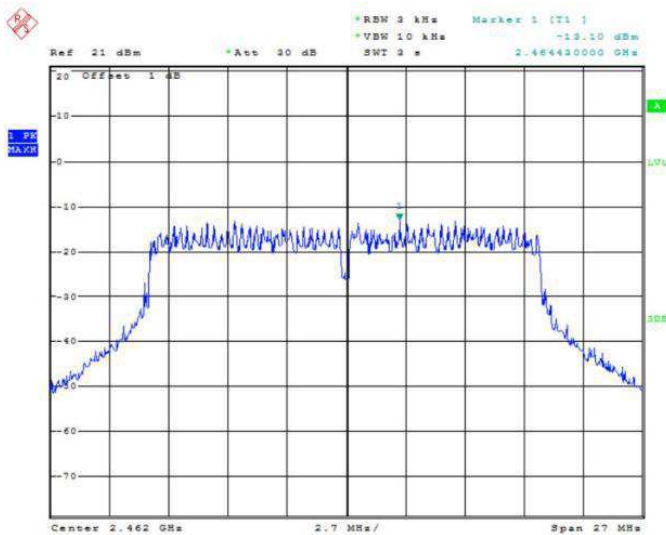
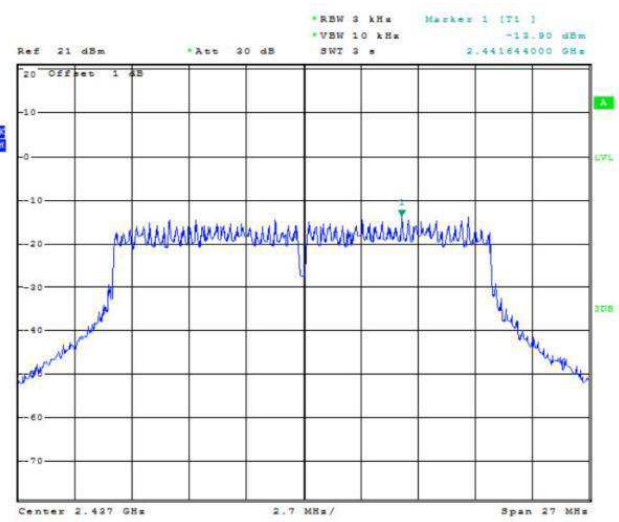
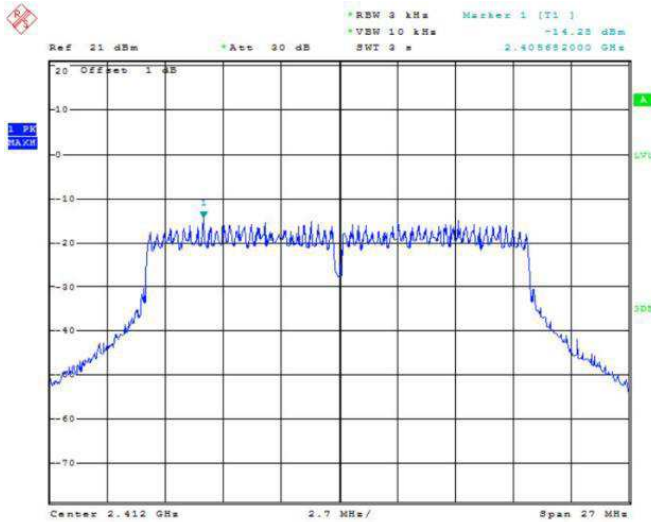
Note: The cable loss is taken into account in results.

Test Plot of Power Spectral Density

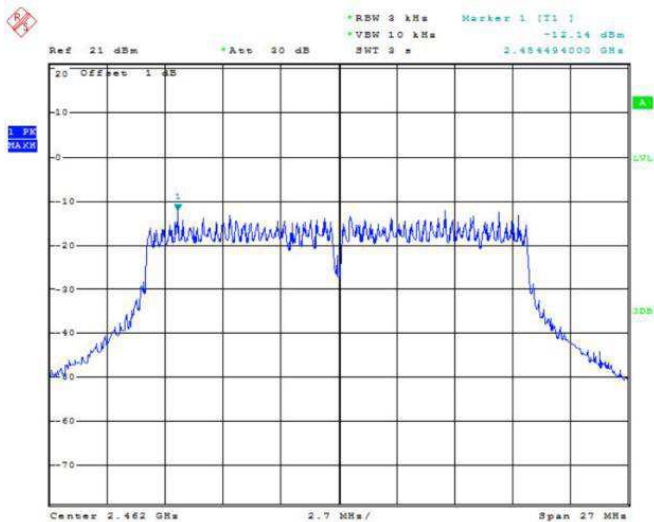
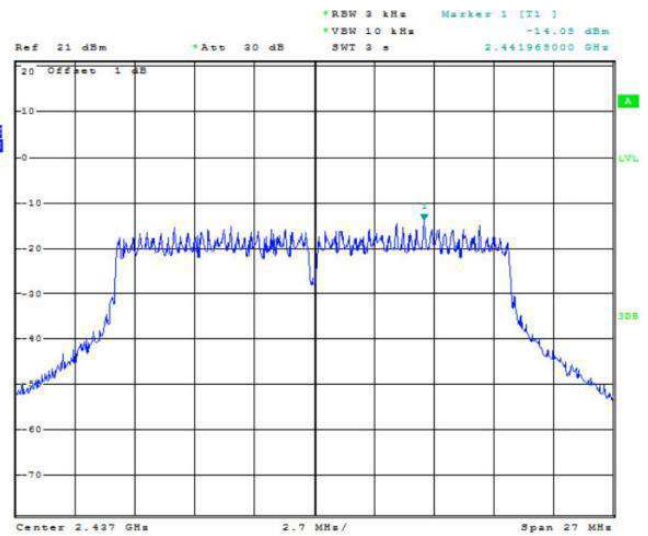
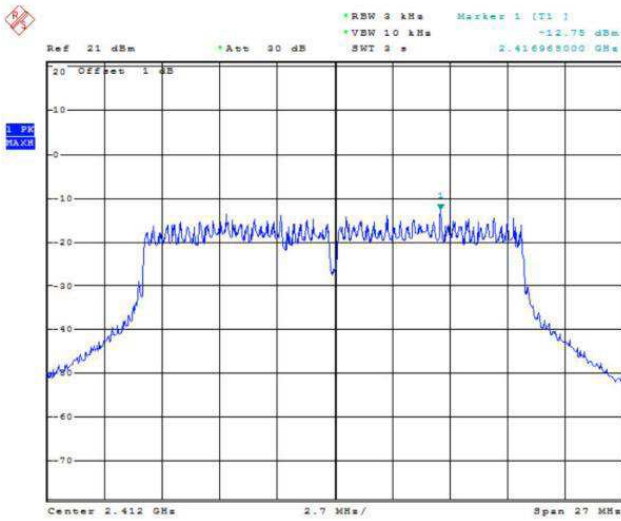
802.11b,1 Mbps



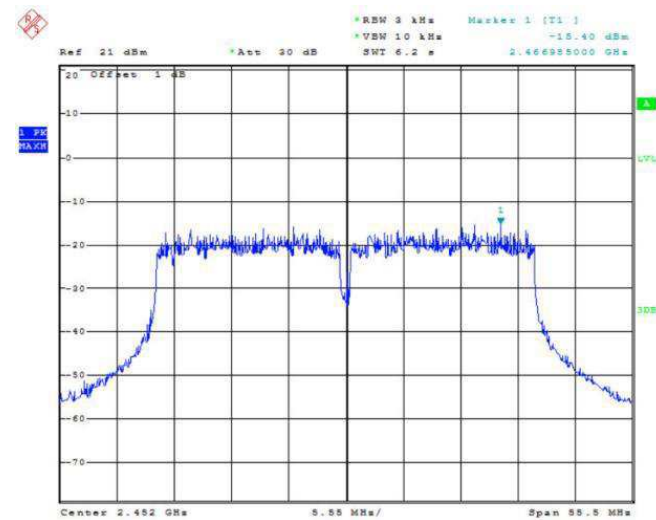
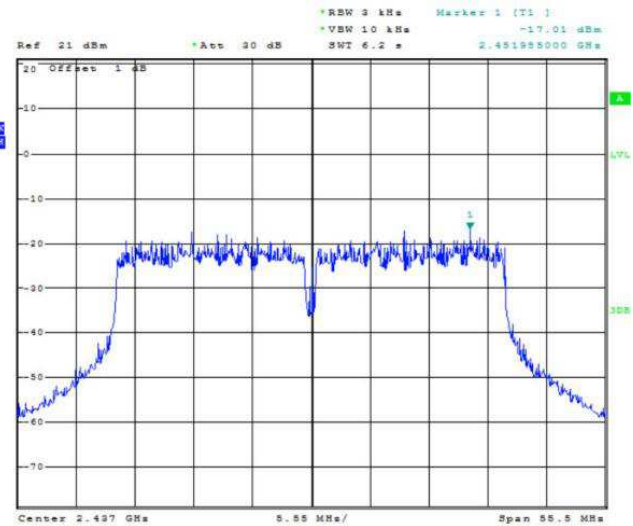
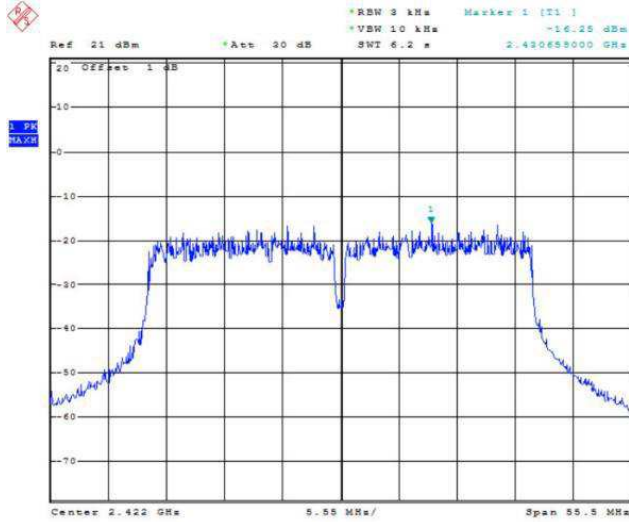
802.11g, 6 Mbps



802.11n (HT20), MCS0



802.11n(HT40), MCS0



5.1.4 6dB Bandwidth

RESULT:
Pass
Test Specification

Test standard : FCC Part 15.247(a)(2)
 Basic standard : ANSI C63.10: 2013
 Limits : > 500 KHz
 Kind of test site : Shielded Room

Test Setup

Date of testing : 06.11.2019
 Input voltage : DC 5.0V (external power supply)
 Operation mode : A
 Test channel : Low / Middle / High
 Ambient temperature : 25 °C
 Relative humidity : 56 %
 Atmospheric pressure : 101 kPa

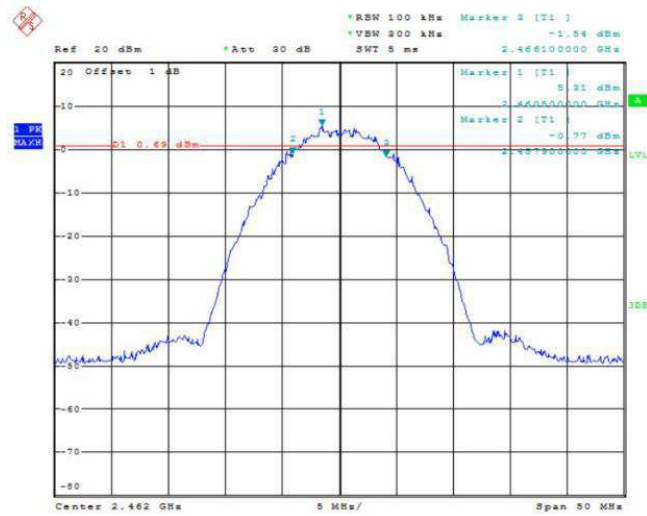
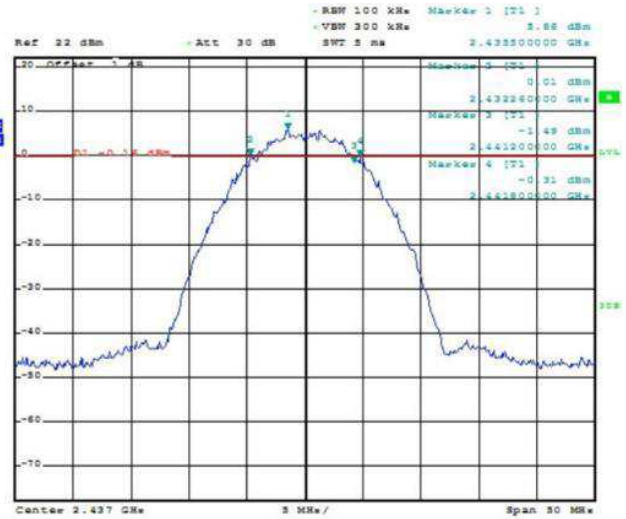
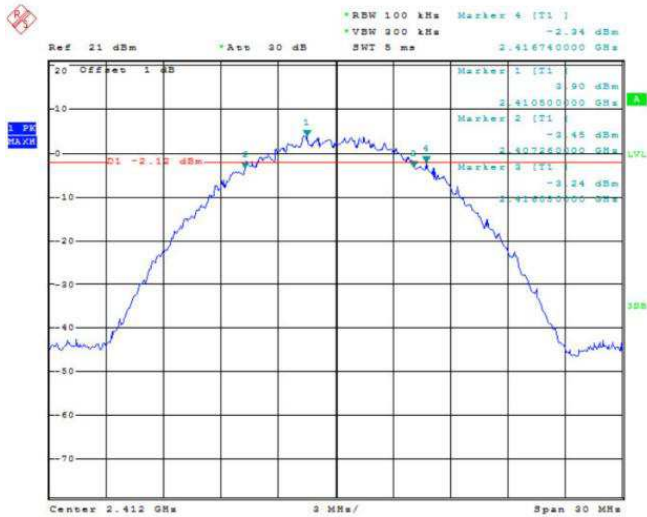
For details refer to following test result.

Table 7: Test Result of 6dB Bandwidth, Wi-Fi 802.11 b/g/n

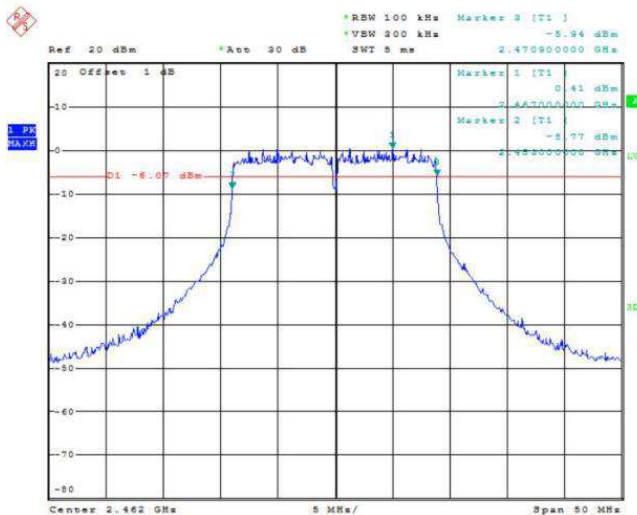
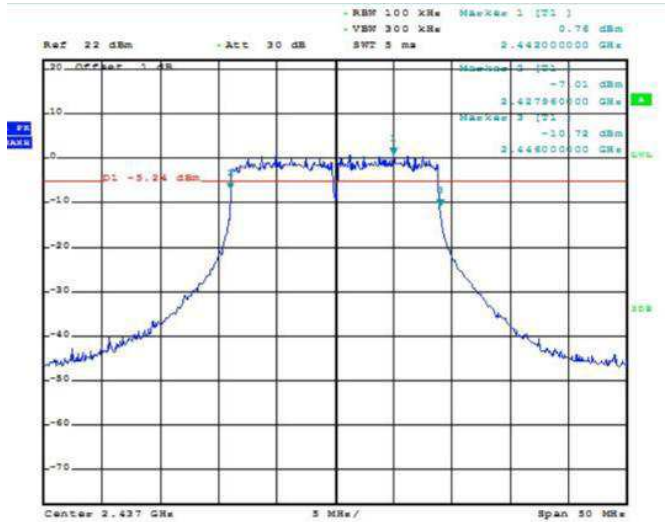
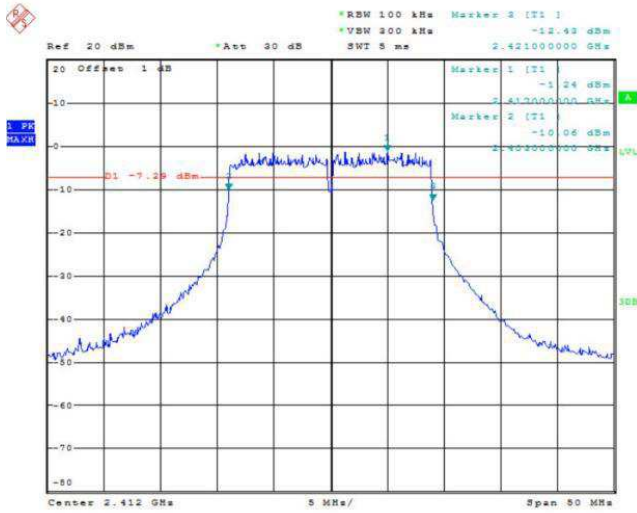
Test Mode	Data Rate	Test Channel (MHz)	-6dB Bandwidth (MHz)	Limit (kHz)
802.11b	1 Mbps	2412	9.44	> 500
		2437	9.60	
		2462	8.20	
802.11g	6 Mbps	2412	18.00	
		2437	18.04	
		2462	17.90	
802.11n (HT20)	MCS0	2412	18.00	
		2437	18.03	
		2462	18.00	
802.11n (HT40)	MCS0	2422	36.60	
		2437	37.10	
		2452	36.80	
Minimum Measured Value			8.20	

Test Plot of 6dB Bandwidth

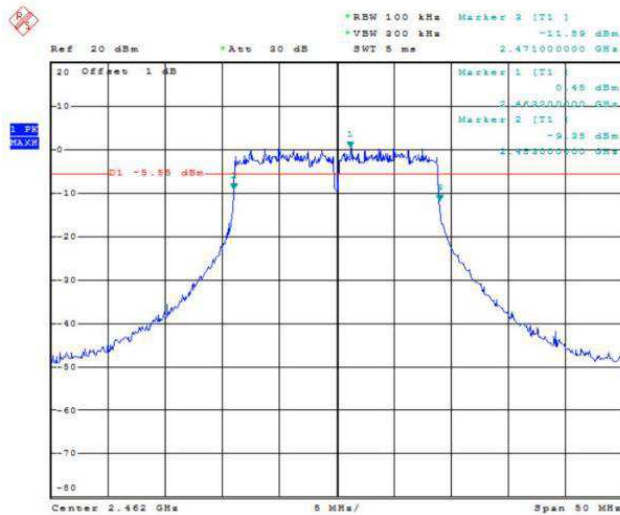
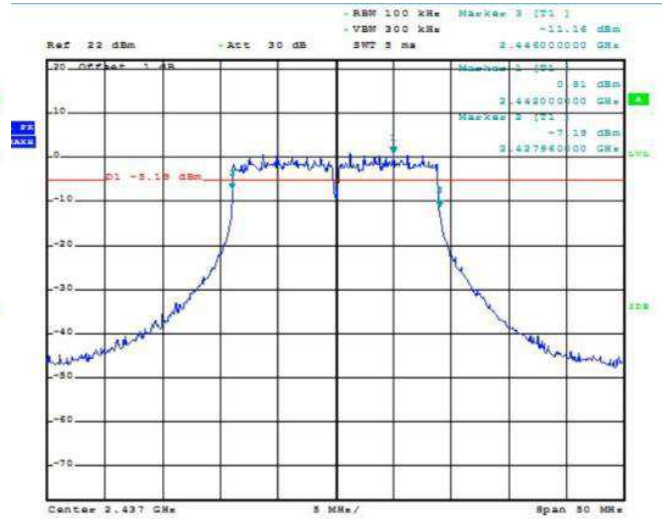
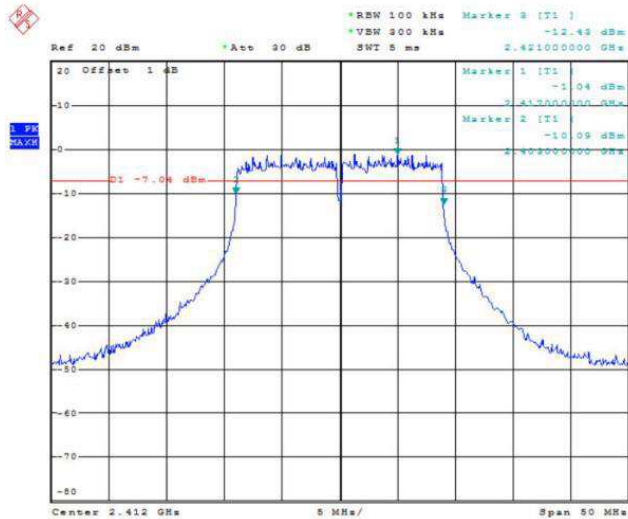
802.11b,1 Mbps



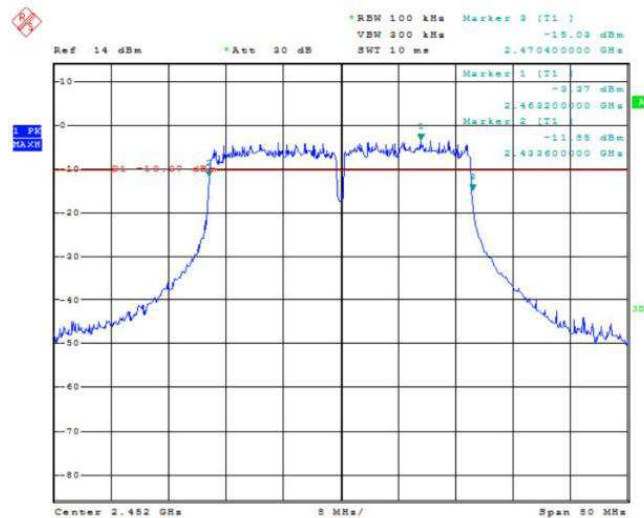
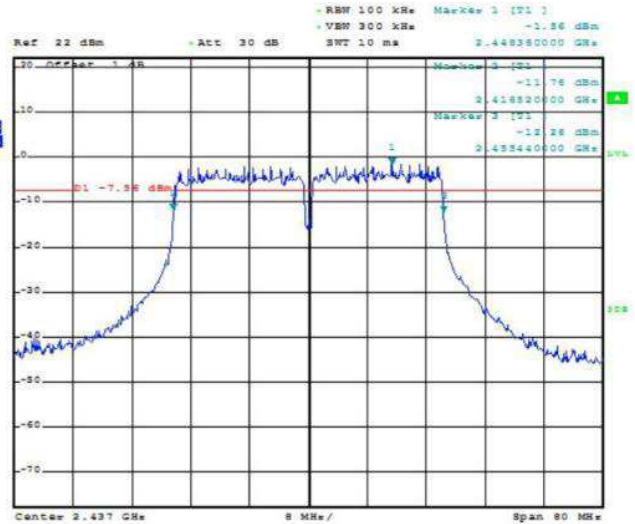
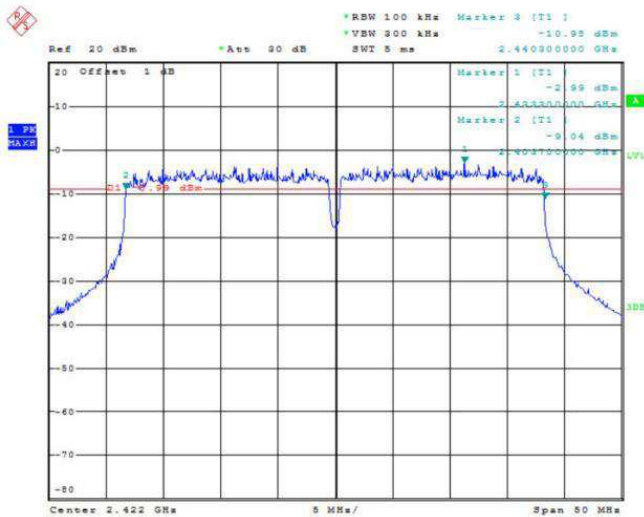
802.11g, 6 Mbps



802.11n (HT20), MCS0



802.11n(HT40), MCS0



5.1.5 Conducted Spurious Emissions Measured in 100 kHz Bandwidth

RESULT:**Pass****Test Specification**

Test standard	: FCC Part 15.247(d)
Basic standard	: ANSI C63.10: 2013
Limits	: 20dB (below that in the 100kHz bandwidth within the band that contains the highest level of the desired power); In addition, radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits specified in 15.209(a)
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 22.01.2018
Input voltage	: DC 5.0V (external power supply)
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: 25 °C
Relative humidity	: 56 %
Atmospheric pressure	: 101 kPa

Test results of 100kHz Bandwidth of Frequency Band Edge by Conducted method refer to test plots, and compliance is achieved as well.

For the measurement records, refer to the appendix B.

5.1.6 Radiated Spurious Emission

RESULT:**Pass****Test Specification**

Test standard	: FCC Part 15.247(d) & FCC Part 15.205
Basic standard	: ANSI C63.10: 2013
Limits	: Refer to 15.209(a) of FCC part 15.247(d)
Kind of test site	: 3m Semi-anechoic Chamber

Test Setup

Date of testing	: Refer to test result
Input voltage	: DC 5.0V (external power supply)
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: 22 °C
Relative humidity	: 53 %
Atmospheric pressure	: 101 kPa

Remark:

During the pretest the EUT was rotated through three orthogonal axes to determine the attitude that maximizes the emissions. After that the EUT was manually handled to find the orientation that has the maximum emission, which is the orientation shown in the test set-up photos.

Testing was carried out within frequency range 9kHz to the tenth harmonics.

For the measurement records, refer to the appendix B.

5.1.7 Conducted Emission on AC Mains

RESULT:**Pass****Test Specification**

Test standard	: FCC Part 15.207(a)
Basic standard	: ANSI C63.10: 2013
Frequency range	: 0.15 – 30MHz
Limits	: FCC Part 15.207(a)
Kind of test site	: Shielded Room

Test Setup

Date of testing	: Refer to test result
Input voltage	: DC 5.0V (external power supply) (external power supply)
Operation mode	: B
Earthing	: Not connected
Ambient temperature	: 24 °C
Relative humidity	: 53 %
Atmospheric pressure	: 101 kPa

For the measurement records, refer to the appendix B.

6 Safety Human Exposure

6.1 Radio Frequency Exposure Compliance

6.1.1 Electromagnetic Fields

RESULT:

Pass

Test Specification

Test standard : CFR47 FCC Part 2: Section 2.1091
CFR47 FCC Part 1: Section 1.1310
FCC KDB Publication 447498 v06
FCC KDB Publication 865664 D02 v01r02
OET Bulletin 65 (Edition 97-01)

➤ FCC requirements

FCC requirement: Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 20cm normally can be maintained between the user and the device.

MPE Calculation Method according to OET Bulletin 65

Power Density: $S_{(mW/cm^2)} = PG/4\pi R^2$ or $EIRP/4\pi R^2$

Where:

S = power density (mW/cm²)

P = power input to the antenna (mW)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna (cm)

The nominal maximum conducted output power specified:

Wi-Fi 802.11 b/g/n: 19.93 dBm

From the peak RF output power, the minimum mobile separation distance, d=20 cm, as well as the antenna gain (0.0 dBi for Wi-Fi 802.11 b/g/n), the RF power density can be calculated as below:

For Wi-Fi 802.11 b/g/n: $S_{(mW/cm^2)} = PG/4\pi R^2 = 0.020 \text{ mW/cm}^2$

Limits for Maximum Permissible Exposure (MPE) according to FCC Part 1.1310:

1.0 mW/cm²

“RF Radiation Exposure Statement Caution: This Transmitter must be installed to provide a separation distance of at least 20 cm from all persons.”

7 Photographs of the Test Set-Up

For photographs of the test set-up, refer to the appendix A.

8 List of Tables

Table 1: List of Test and Measurement Equipment.....	5
Table 2: Technical Specification of EUT	7
Table 3: RF Channel and Frequency of Wi-Fi 802.11 b/g/n	8
Table 4: List of Accessories and Auxiliary Equipment.....	9
Table 5: Test Result of Output Power, Wi-Fi 802.11 b/g/n	13
Table 6: Test Result of Power Spectral Density, Wi-Fi 802.11 b/g/n	14
Table 7: Test Result of 6dB Bandwidth, Wi-Fi 802.11 b/g/n	19