FCC RF Test Report

APPLICANT	:	Espressif Systems (Shanghai) Co.,Ltd.
EQUIPMENT	:	2.4GHz Wi-Fi & BT IoT Module
BRAND NAME	:	ESPRESSIF
MODEL NAME	:	ESP32-S3-WROOM-1
FCC ID	:	2AC7Z-ESPS3WROOM1
STANDARD	:	FCC Part 15 Subpart C §15.247
CLASSIFICATION	:	(DTS) Digital Transmission System
TEST DATE(S)	:	Dec. 27, 2021 ~ Dec. 31, 2021

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

Jason Jia

Reviewed by: Jason Jia / Supervisor

Alex Wang

Approved by: Alex Wang / Manager

ACCREDITED
Cert #5145.02

Sporton International Inc. (Kunshan)
No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR1N0920B	Rev. 01	Initial issue of report	Jan. 14, 2022

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(2)	6dB Bandwidth	≥ 0.5MHz	Pass	-
3.1	-	99% Bandwidth	-	Report Only	-
3.2	15.247(b)	Power Output Measurement	≤ 30dBm	Pass	-
3.3	15.247(e)	Power Spectral Density	≤ 8dBm/3kHz	Pass	-
3.4	15.247(d)	Conducted Band Edges	≤ 20dBc	Pass	-
		Conducted Spurious Emission		Pass	-
3.5	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 2.40 dB at 2389.950 MHz
3.6	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 7.36 dB at 0.151 MHz
3.7	15.203 & 15.247(b)	Antenna Requirement	15.203 & 15.247(b)	Pass	-
Remark: Not required means after assessing, test items are not necessary to carry out.					

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

1 General Description

1.1 Applicant

Espressif Systems (Shanghai) Co.,Ltd.
Suite 204, Block 2, 690 Bibo Road, Zhang Jiang Hi-Tech Park, Shanghai, China

1.2 Manufacturer

Espressif Systems (Shanghai) Co.,Ltd.
Suite 204, Block 2, 690 Bibo Road, Zhang Jiang Hi-Tech Park, Shanghai, China

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	2.4GHz Wi-Fi & BT IoT Module
Brand Name	ESPRESSIF
Model Name	ESP32-S3-WROOM-1
FCC ID	2AC7Z-ESPS3WROOM1
HW Version	V1.3
SW Version	v1.1.3.4
EUT Stage	Identical Prototype

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Channel Frequency Range	2412 MHz ~ 2462 MHz
Maximum (Peak) Output Power to antenna	802.11b : 22.77 dBm (0.1892 W) 802.11g : 25.56 dBm (0.3597 W) 802.11n HT20 : 25.32 dBm (0.3404 W) 802.11n HT40 : 25.22 dBm (0.3327 W)
99% Occupied Bandwidth	802.11b : 13.19MHz 802.11g : 18.78MHz 802.11n HT20 : 19.13MHz 802.11n HT40 : 34.67MHz
Antenna Type / Gain	PCB Antenna type with gain 3.26 dBi
Type of Modulation	802.11b : DSSS (DBPSK / DQPSK / CCK) 802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)

1.5 Modification of EUT

No modifications are made to the EUT during all test items.

1.6 Testing Location

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958		
Test Site No.	**Sporton Site No.**	**FCC Designation No.**	**FCC Test Firm Registration No.**
	CO01-KS 03CH02-KS TH01-KS	CN1257	314309

1.7 Test Software

Item	Site	Manufacturer	Name	Version
1.	03CH02-KS	AUDIX	E3	6.2009-8-24a
2.	CO01-KS	AUDIX	E3	6.2009-8-24

1.8 Applicable Standards

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

- 47 CFR Part 15 Subpart C §15.247
- FCC KDB 558074 D01 15.247 Meas Guidance v05r02
- ANSI C63.10-2013

Remark:

All test items were verified and recorded according to the standards and without any deviation during the test.

2 Test Configuration of Equipment Under Test

a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz),radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (X plane) were recorded in this report.

b. AC power line Conducted Emission was tested under maximum output power.

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	1	2412	7	2442
	2	2417	8	2447
	3	2422	9	2452
	4	2427	10	2457
	5	2432	11	2462
	6	2437		

2.2 Test Mode

Final test modes are considering the modulation and worse data rates as below table.

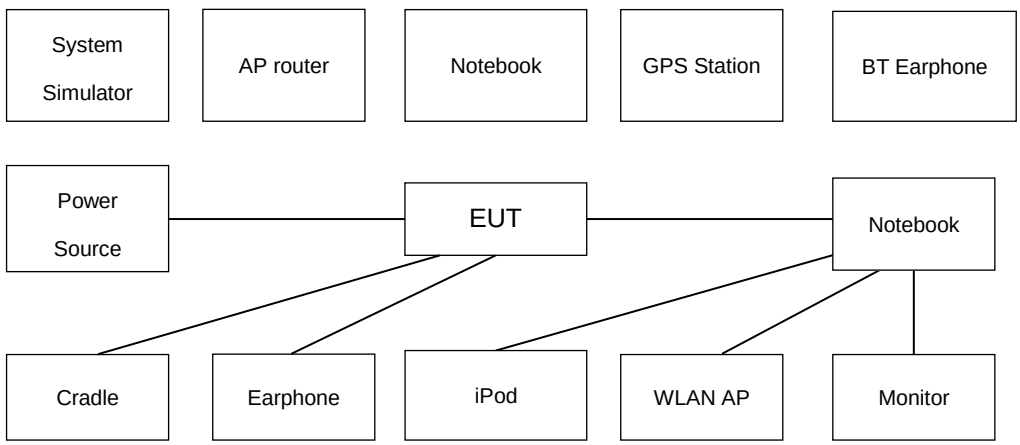
Modulation	Data Rate
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20	MCS0
802.11n HT40	MCS0

Test Cases	
AC Conducted Emission	Mode 1 : BT TX + NB Charging Mode 2 : WLAN TX + NB Charging

Remark:

1. The worst case of conducted emission is mode 1; only the test data of it was reported.
2. For Radiated Test Cases, The tests were performance with Adapter 1, Battery 1, Earphone 1, USB Cable 1

2.3 Connection Diagram of Test System



This example is connection diagram of EUT test configurations.

. For detail, please refer to test mode configuration and setup photographs for each test item.

2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Notebook	Lenovo	V130-15IKB005	N/A	N/A	AC I/P: Unshielded, 1.8 m DC O/P: Shielded, 1.8 m
2.	WLAN AP	D-link	DIR-655	KA21R655B1	N/A	Unshielded,1.8m

2.5 EUT Operation Test Setup

For WLAN RF test items, an engineering test program was provided and enabled to make EUT continuous transmit.

For AC power line conducted emissions, the EUT was set to connect with the WLAN AP under large package sizes transmission.

2.6 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example :

The spectrum analyzer offset is derived from RF cable loss.

Offset = RF cable loss.

Following shows an offset computation example with cable loss 5.50dB

Offset(dB) = RF cable loss(dB).

= 5.50 (dB)

3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

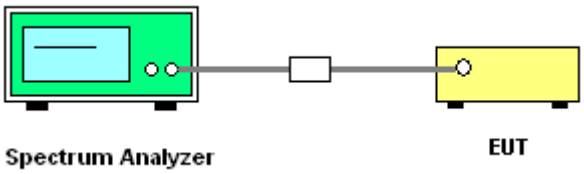
3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.1.3 Test Procedures

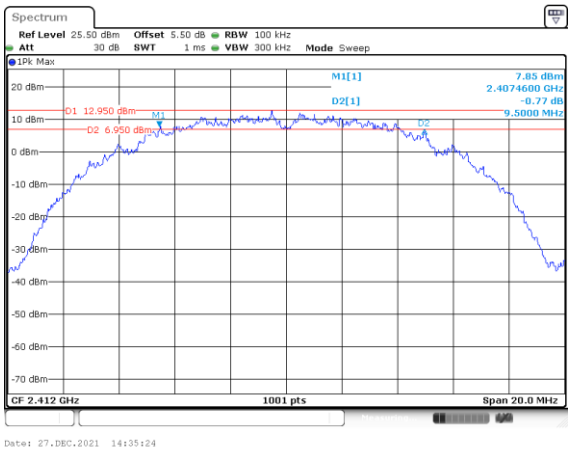
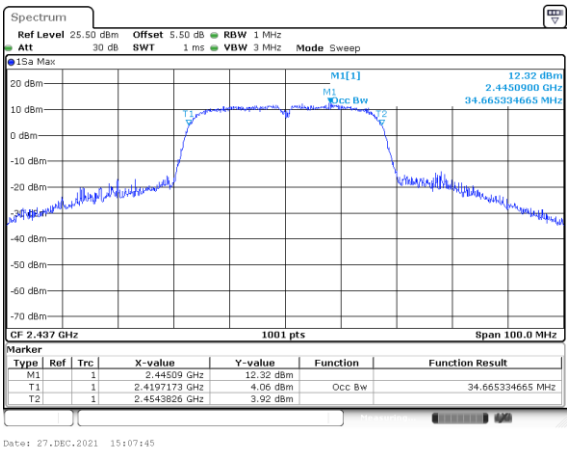
1. The testing follows ANSI C63.10-2013 clause 11.8
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) = 1MHz and set the Video bandwidth (VBW) = 3MHz.
6. Measure and record the results in the test report.

3.1.4 Test Setup



3.1.5 Test Result of 6dB and 99% Occupied Bandwidth

Please refer to Appendix A.

Minimum 6dB Bandwidth	Maximum 99% Occupied Bandwidth
	

Note : The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

3.2 Output Power Measurement

3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm. If transmitting antenna with directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

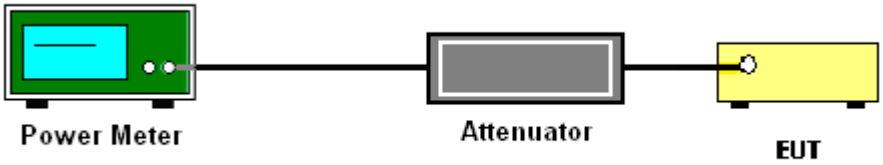
3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.2.3 Test Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 clause 11.9.1.3 PKPM1 Peak power meter or ANSI C63.10-2013 clause 11.9.2.3.2 Method AVGPM-G method.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power and record the results in the test report.

3.2.4 Test Setup



3.2.5 Test Result of Peak Output Power

Please refer to Appendix A.

3.2.6 Test Result of Average Output Power (Reporting Only)

Please refer to Appendix A.

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

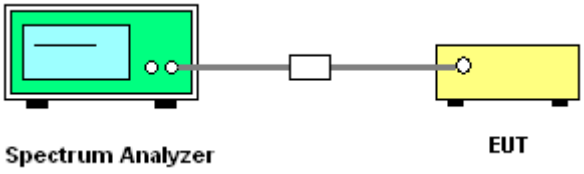
3.3.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.3.3 Test Procedures

1. The testing follows Measurement Procedure of ANSI C63.10-2013 clause 11.10.2 Method PKPSD.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.

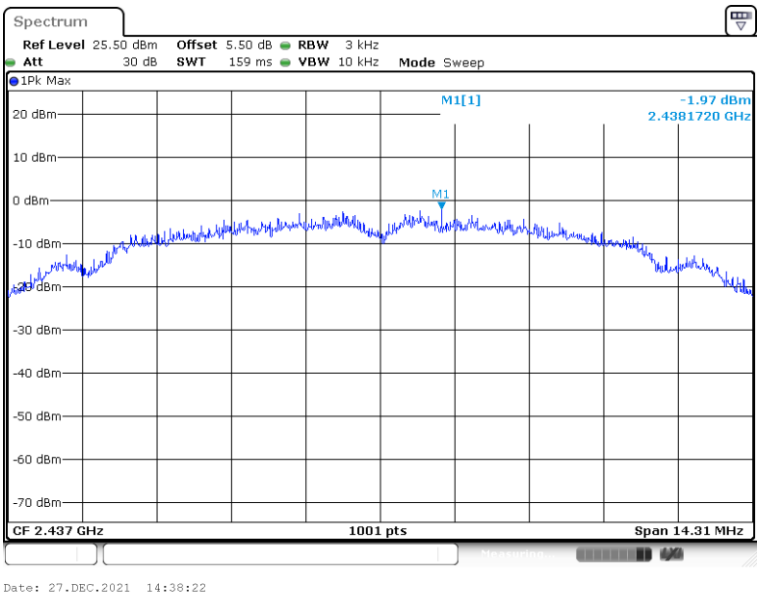
3.3.4 Test Setup



3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

Worst Case Power Density (dBm/3kHz)



3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission Measurement

In any 100 kHz bandwidth outside of the authorized frequency band, the emissions which fall in the non-restricted bands shall be attenuated at least 20 dB / 30dB relative to the maximum PSD level in 100 kHz by RF conducted measurement.

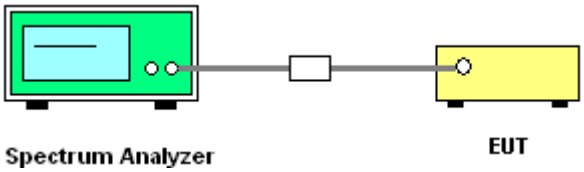
3.4.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.4.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 11.13
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB per 15.247(d).
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.4.4 Test Setup

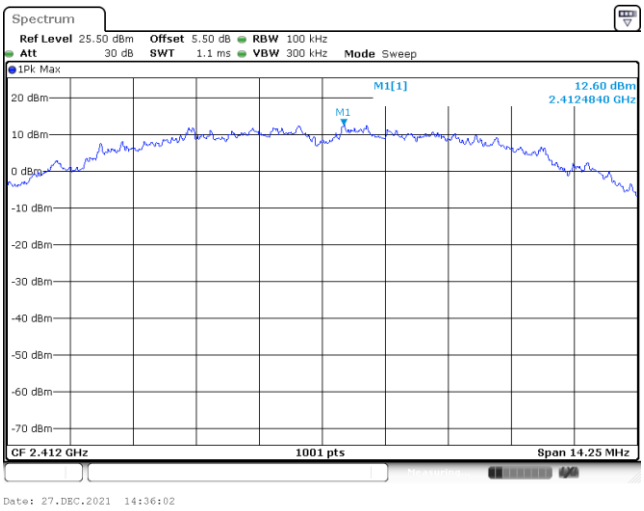


3.4.5 Test Result of Conducted Band Edges and Spurious Emission

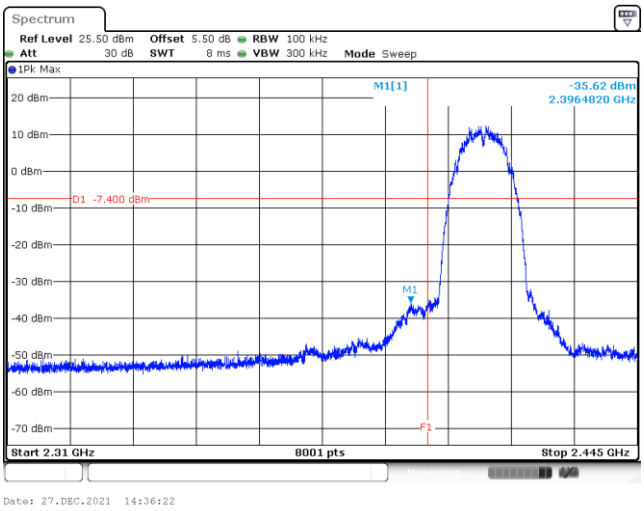
Test Engineer :	Jiang Jun	**Temperature :**	21~25℃
		Relative Humidity :	51~54%

Test Mode :	802.11b	**Test Channel :**	01

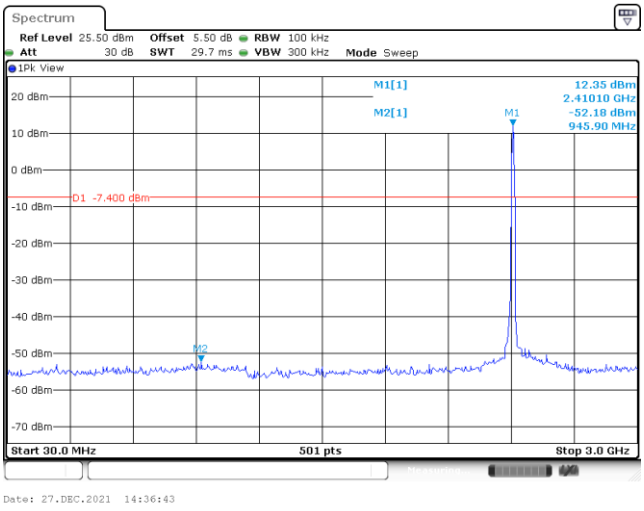
100kHz PSD reference Level



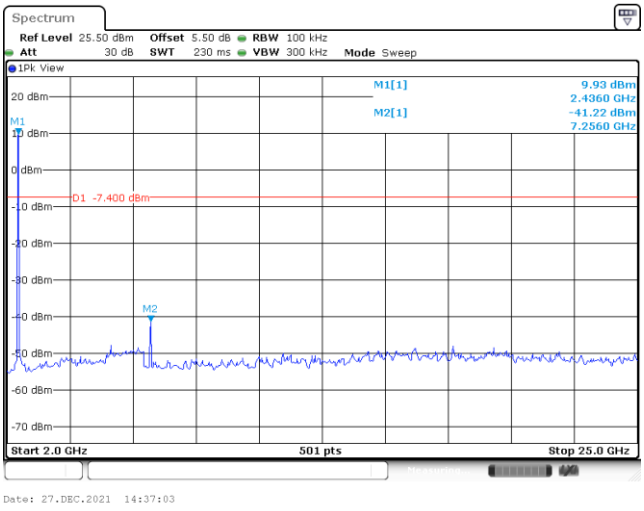
Channel Plot



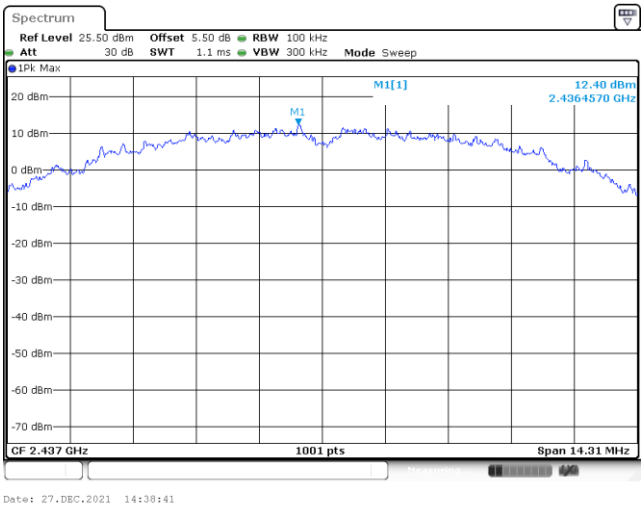
Spurious Emission 30MHz~3GHz

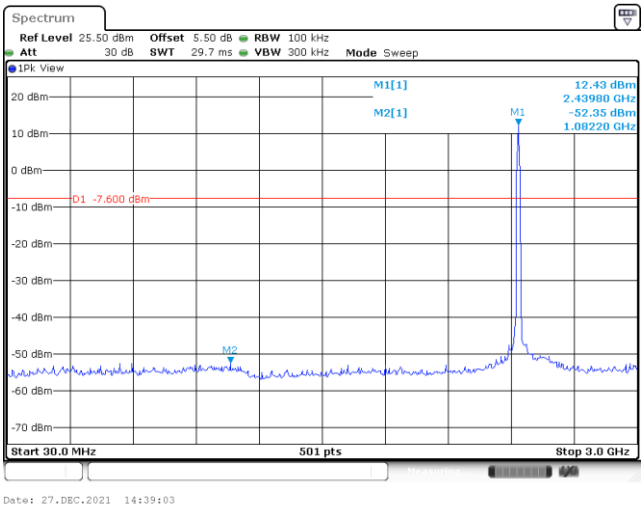
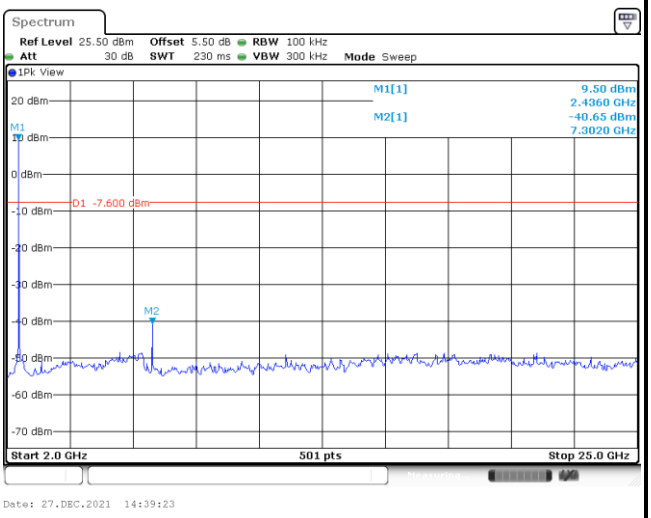


Spurious Emission 2GHz~25GHz

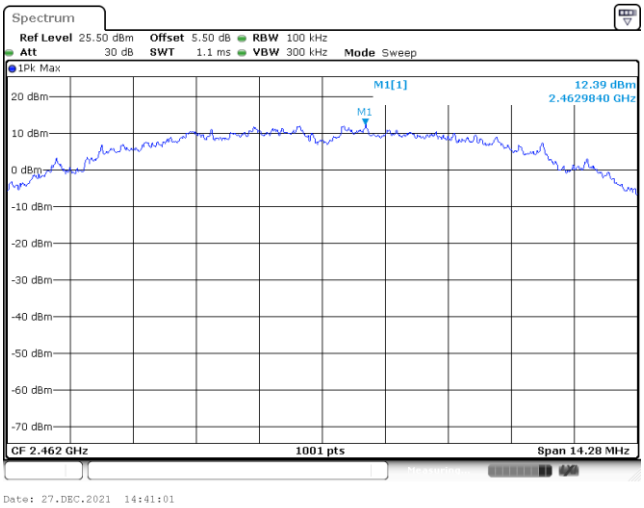
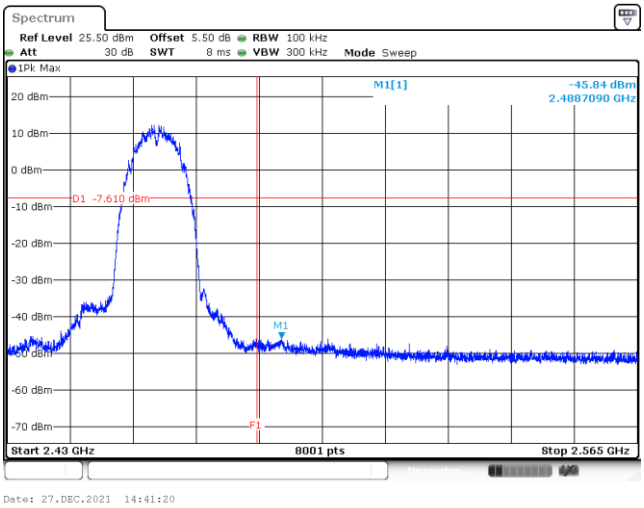
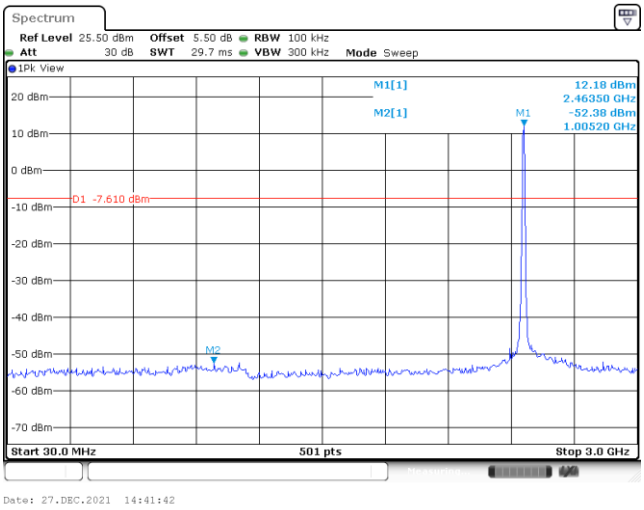
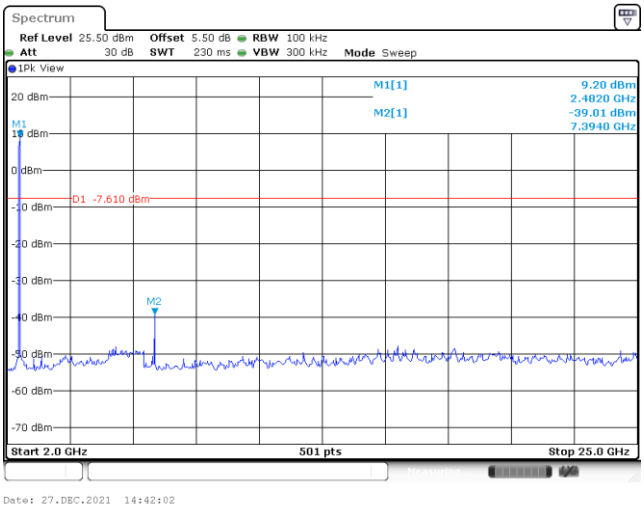


Test Mode :	802.11b	Test Channel :	06

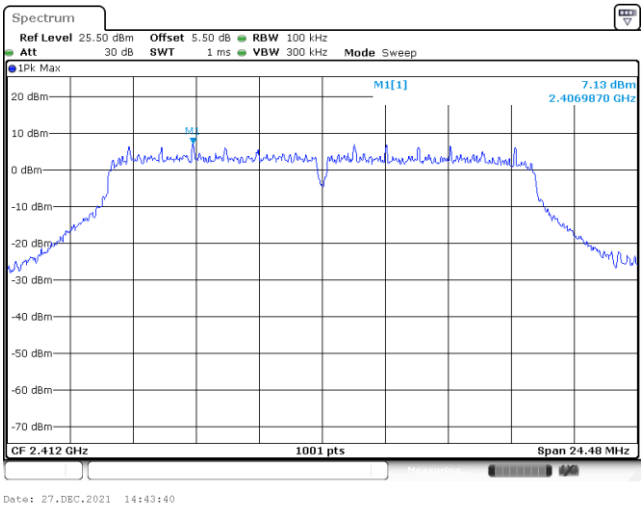
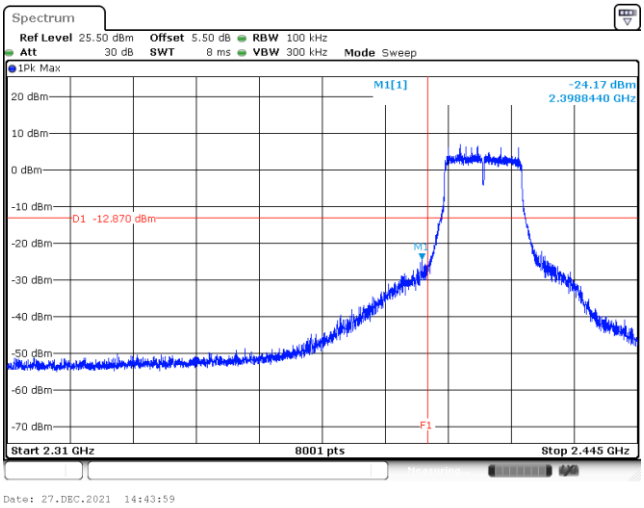
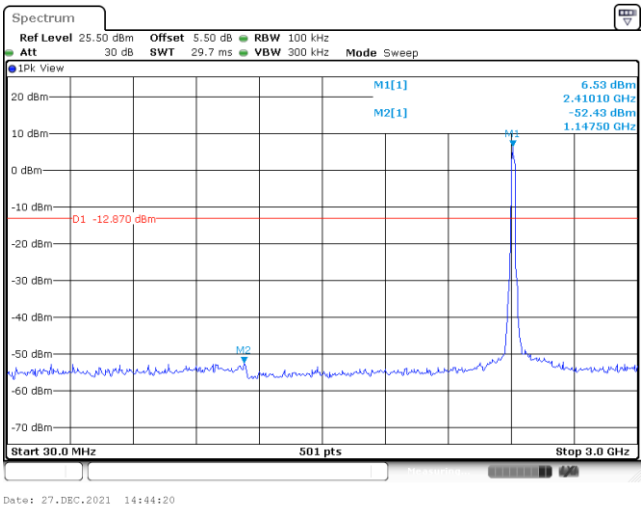
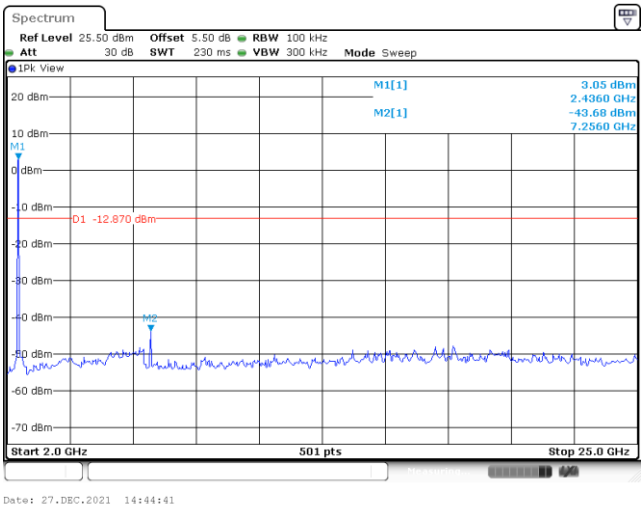
100kHz PSD reference Level	Channel Plot
	

Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

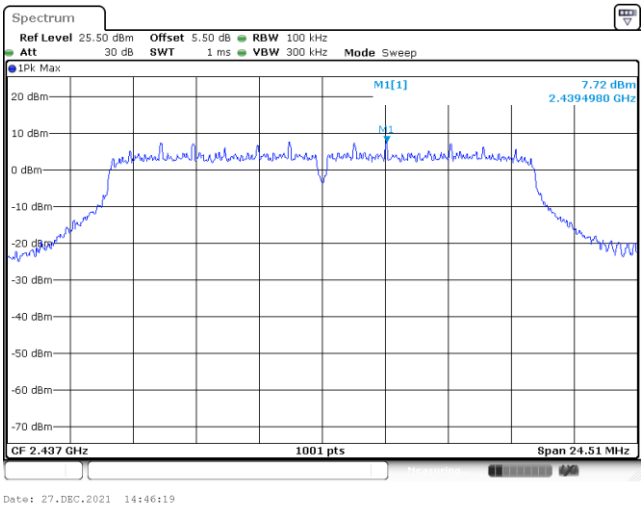
Test Mode :	802.11b	Test Channel :	11

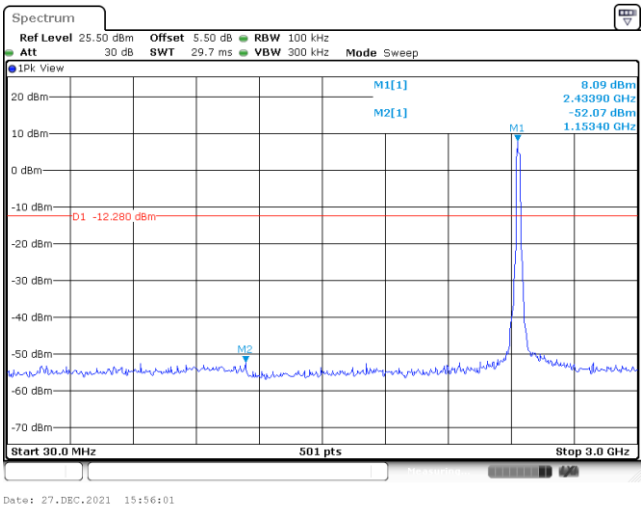
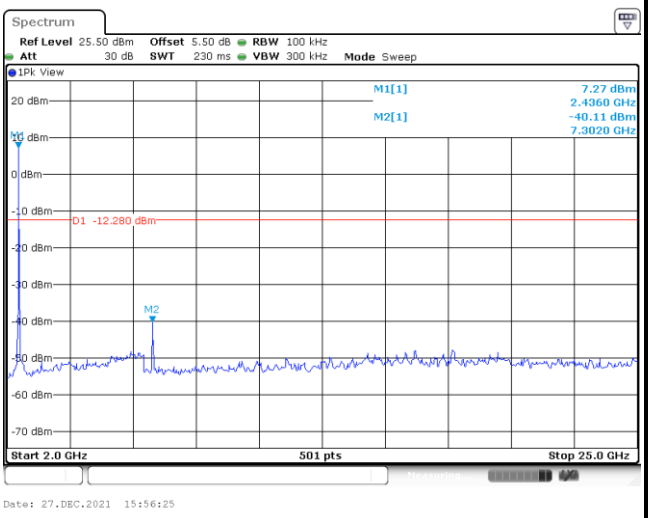
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11g	Test Channel :	01

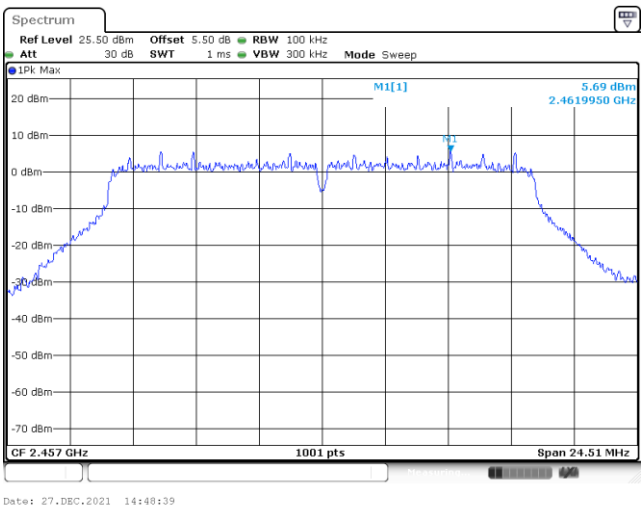
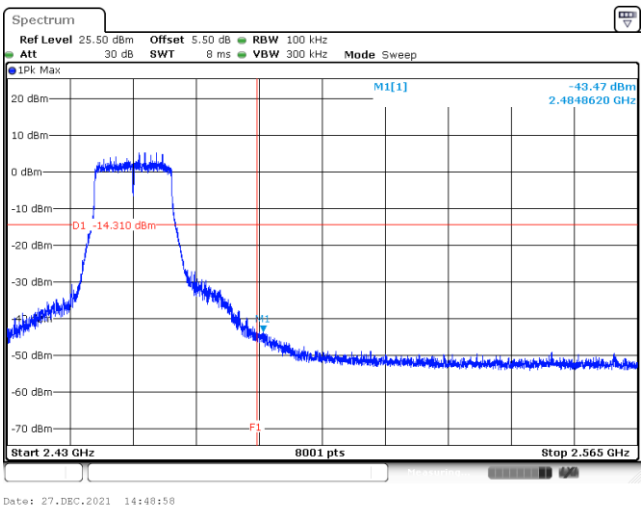
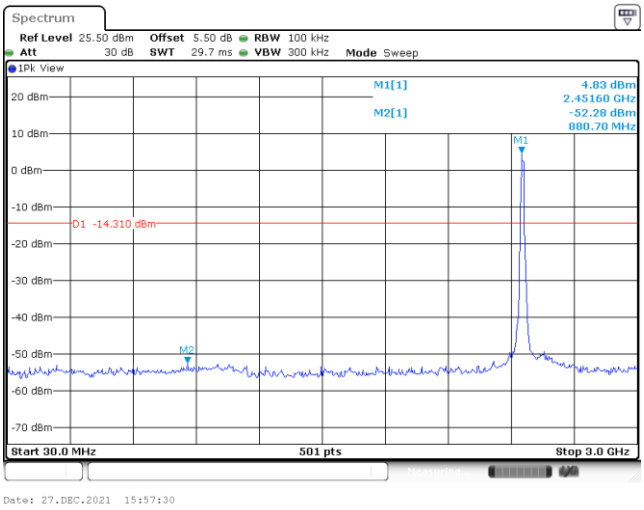
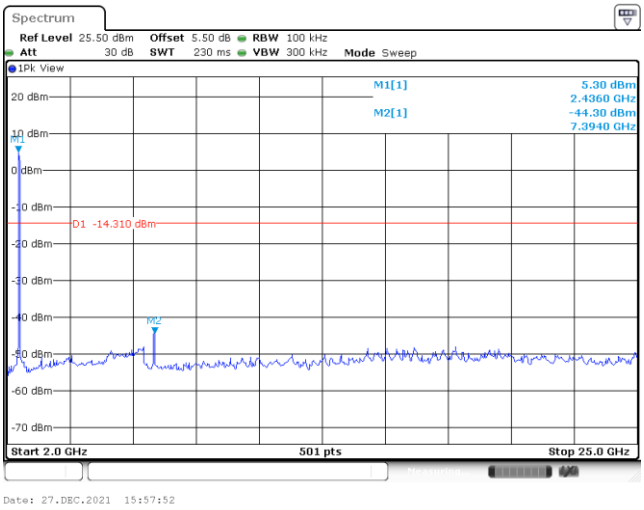
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11g	Test Channel :	06

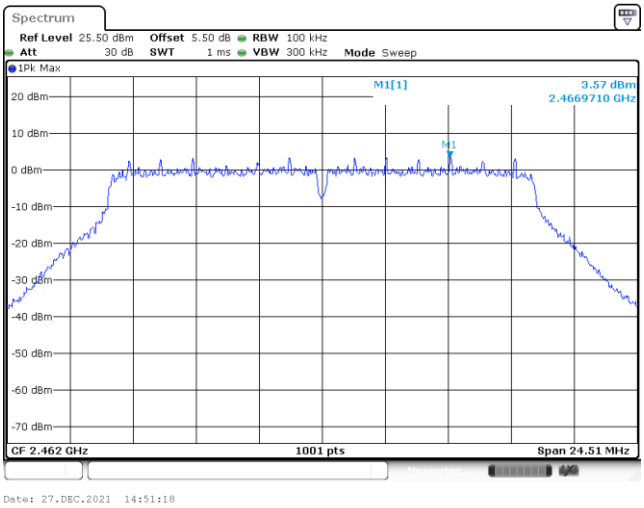
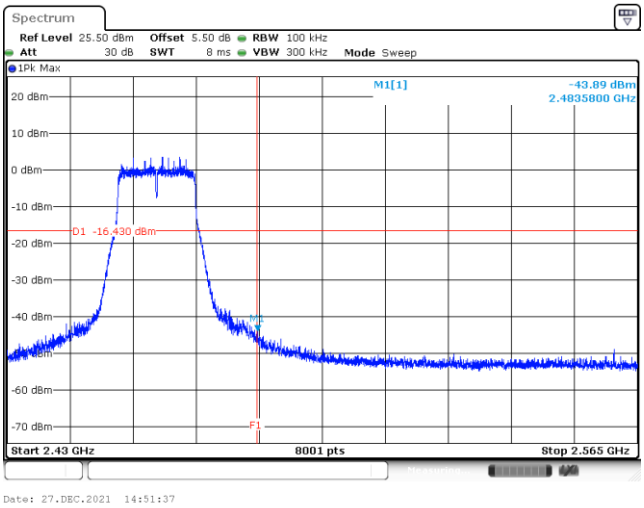
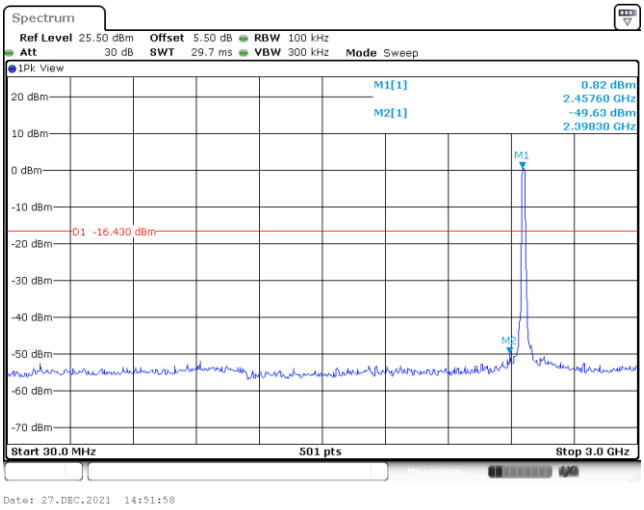
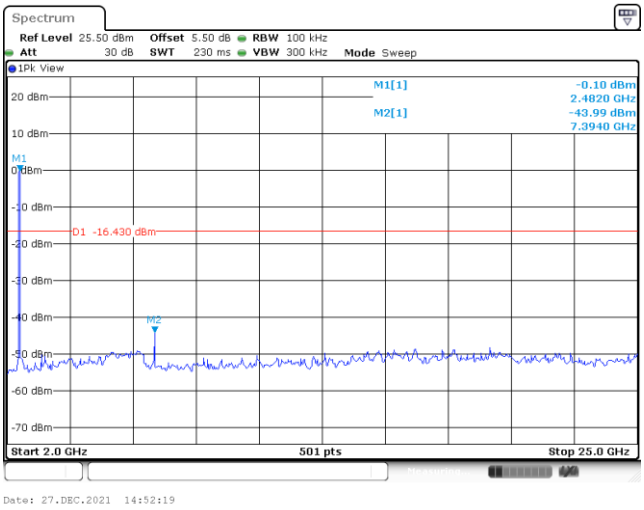
100kHz PSD reference Level	Channel Plot
	

Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

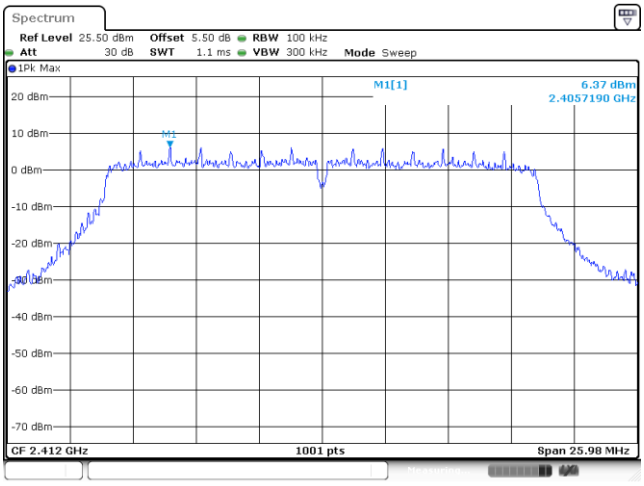
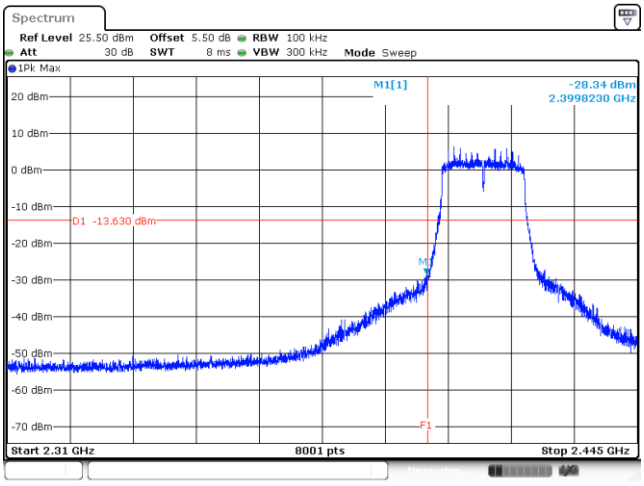
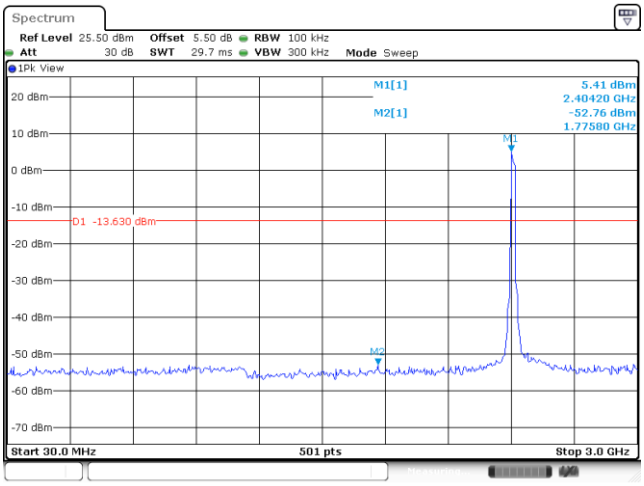
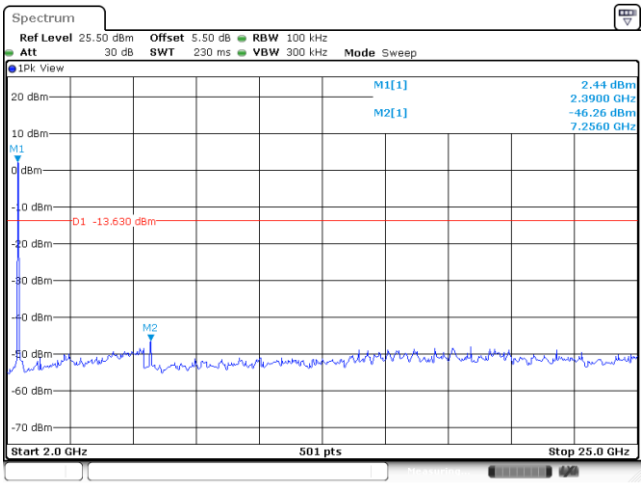
Test Mode :	802.11g	Test Channel :	10

100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

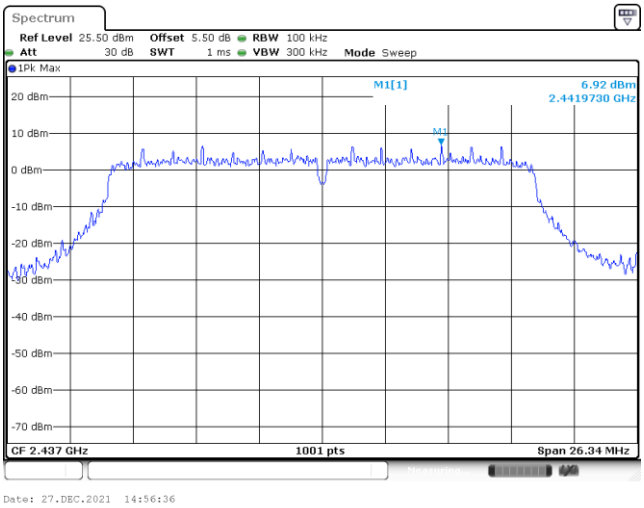
Test Mode :	802.11g	Test Channel :	11

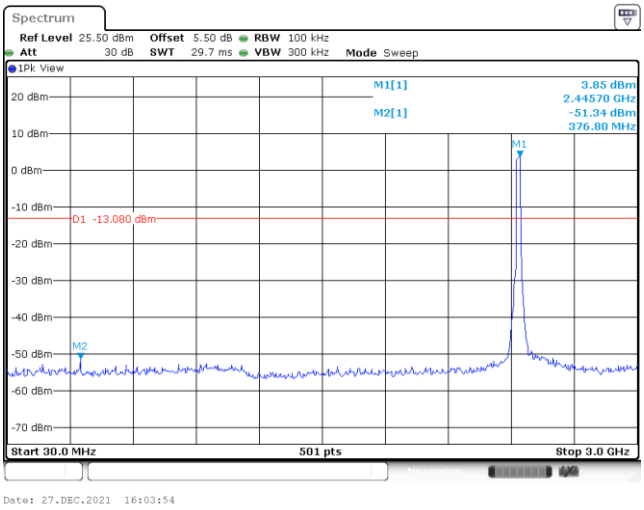
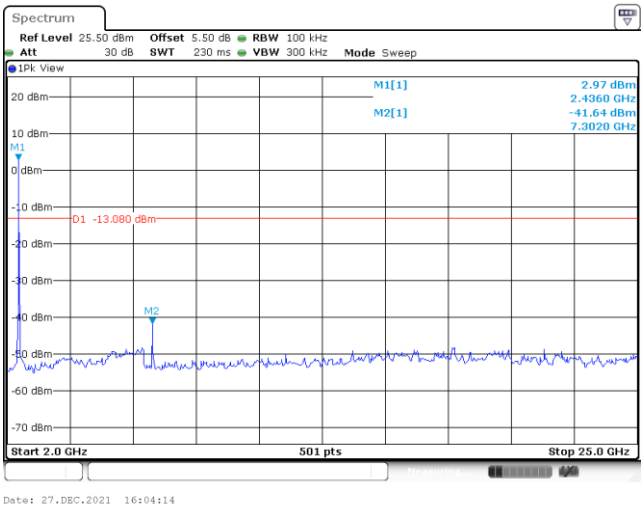
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11n HT20	Test Channel :	01

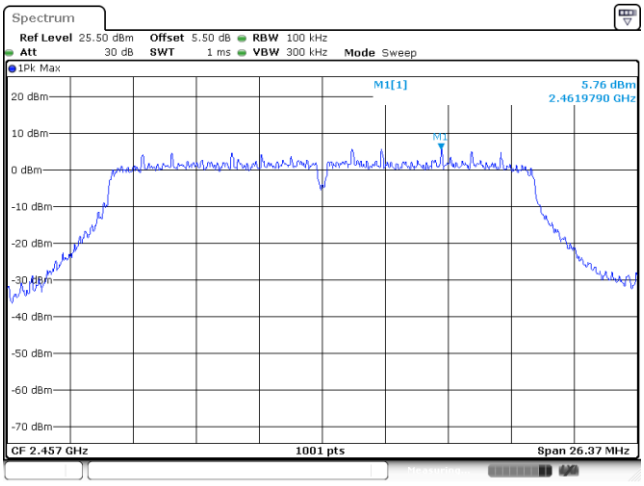
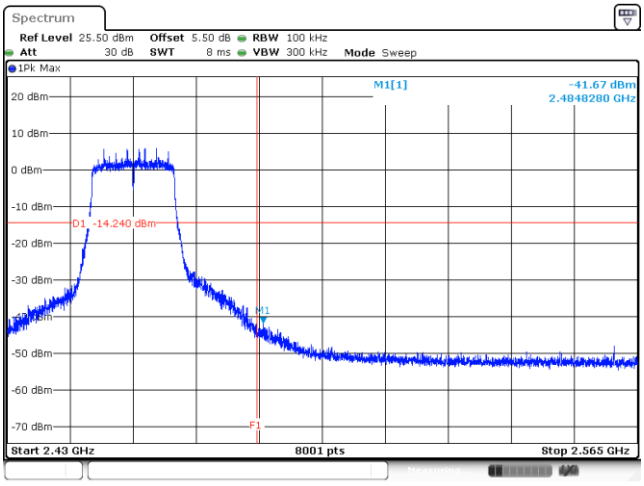
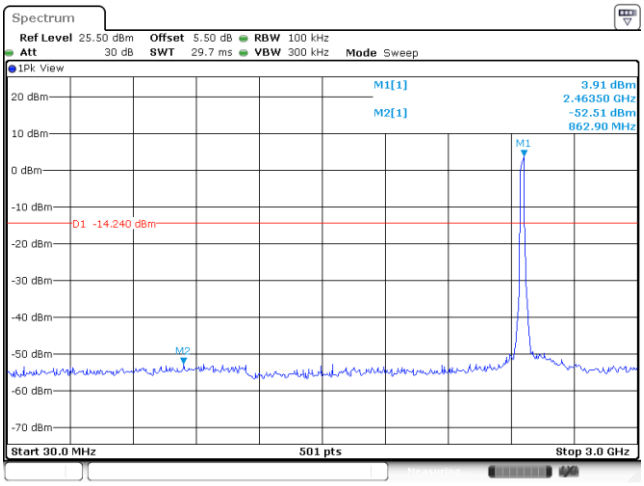
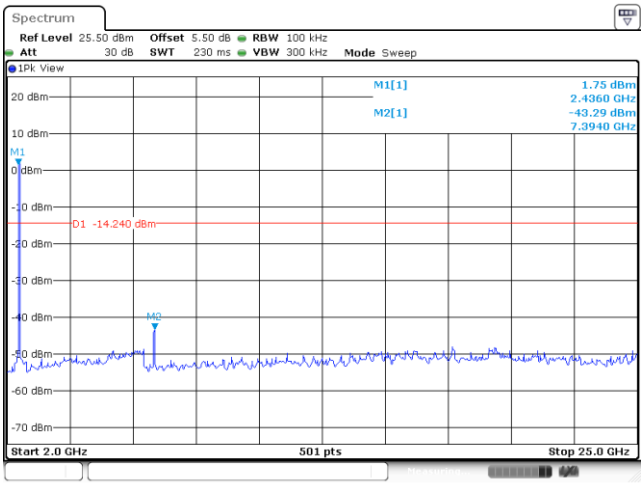
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11n HT20	Test Channel :	06

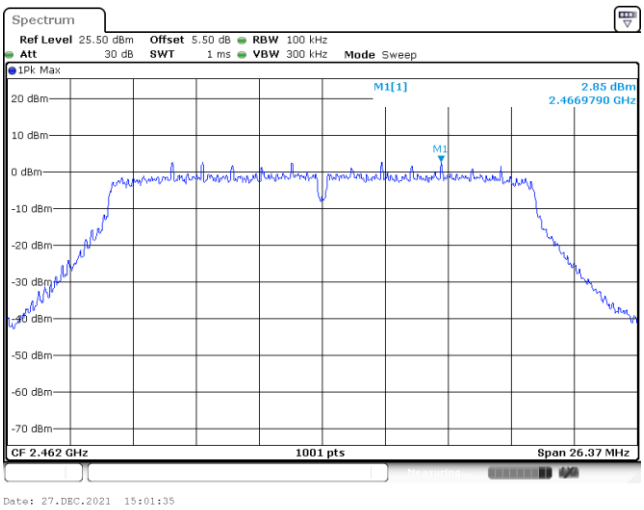
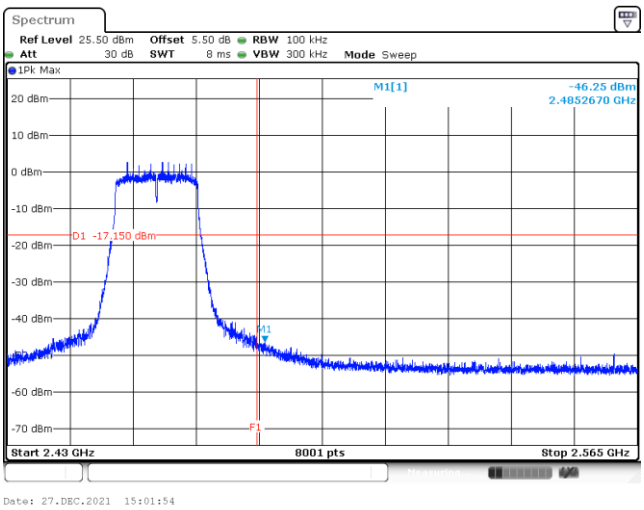
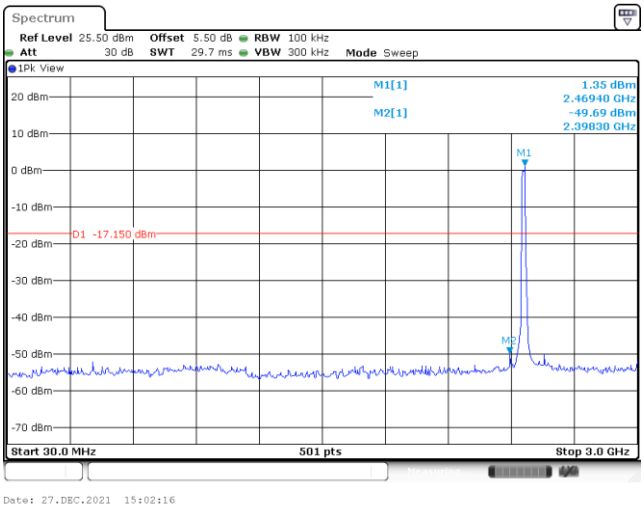
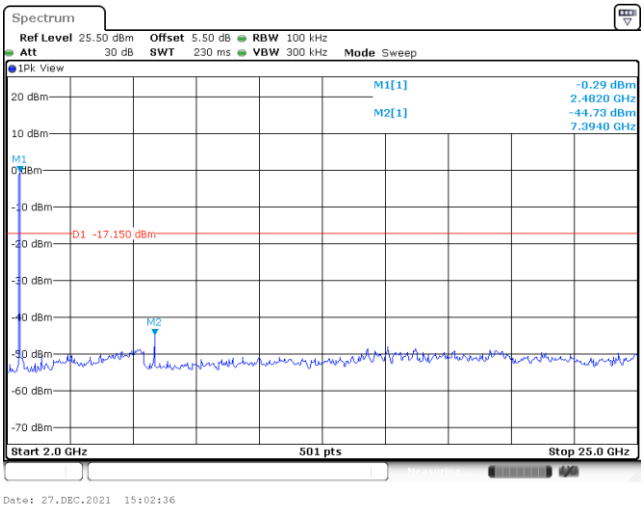
100kHz PSD reference Level	Channel Plot
	

Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

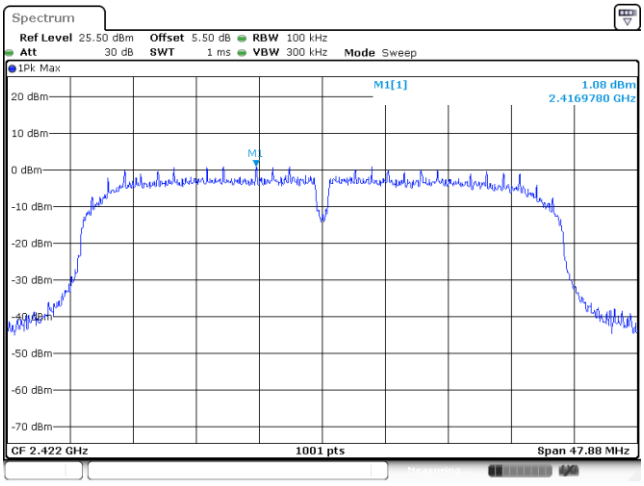
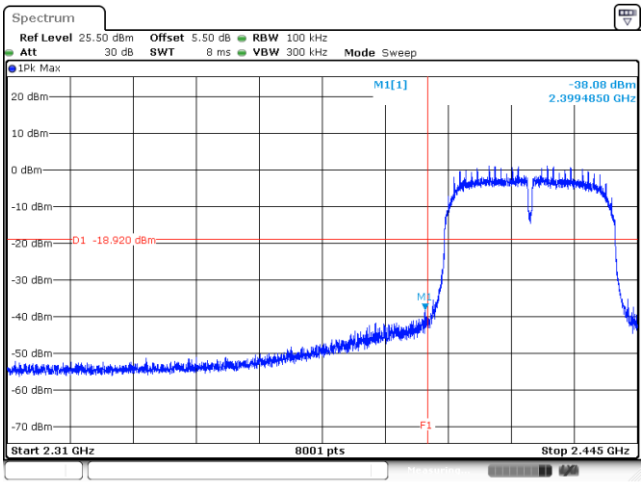
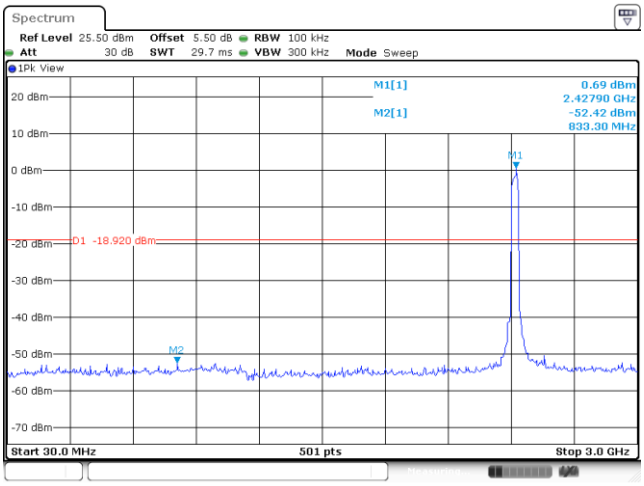
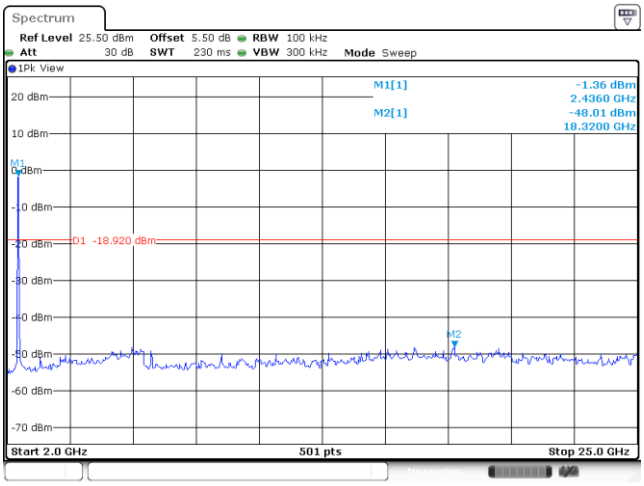
Test Mode :	802.11n HT20	Test Channel :	10

100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

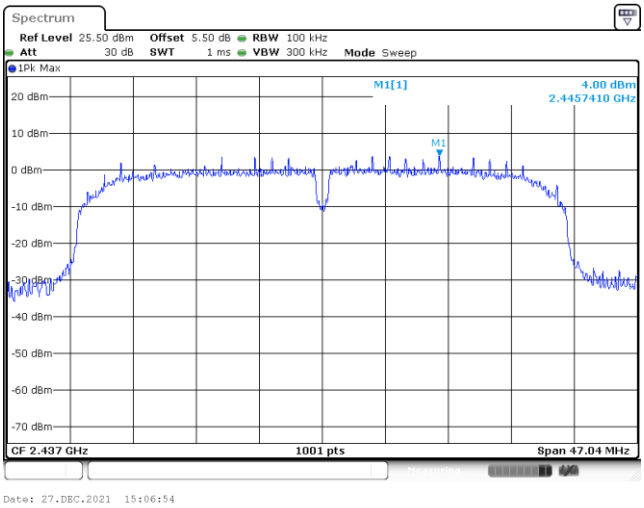
Test Mode :	802.11n HT20	Test Channel :	11

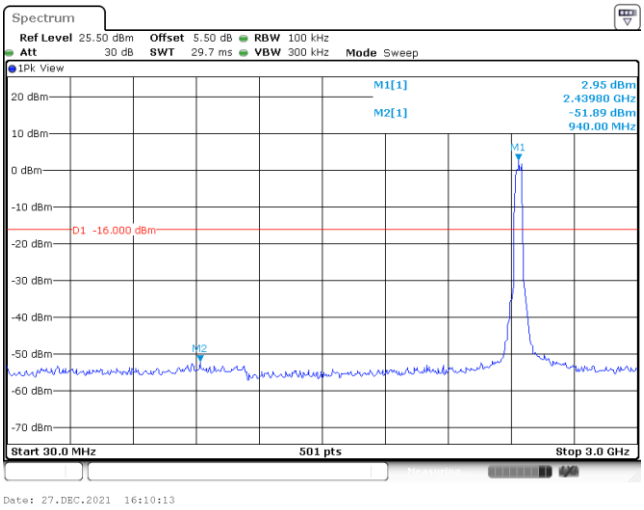
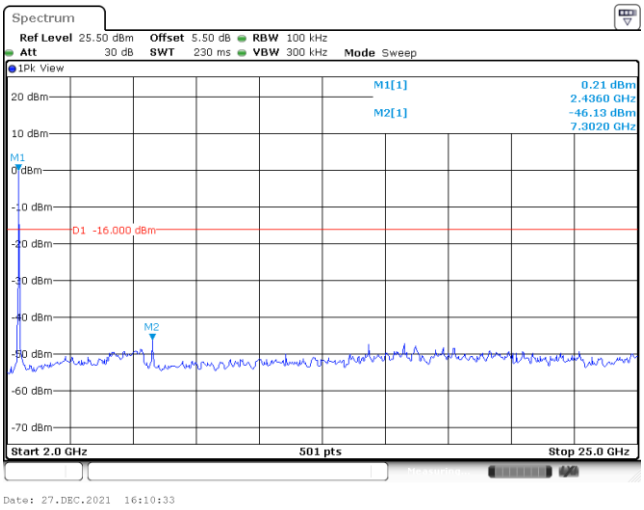
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11n HT40	Test Channel :	03

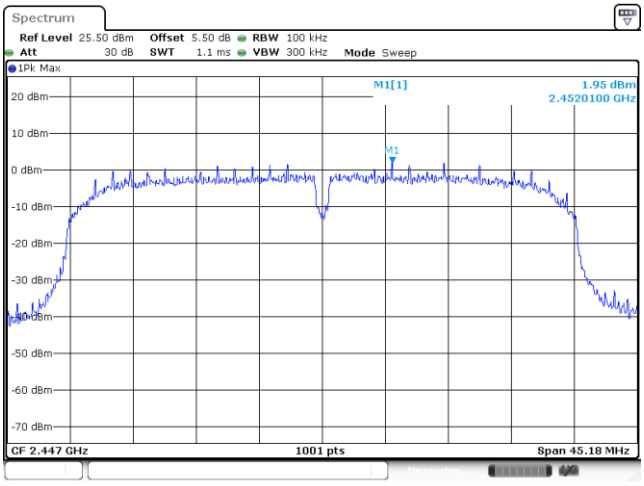
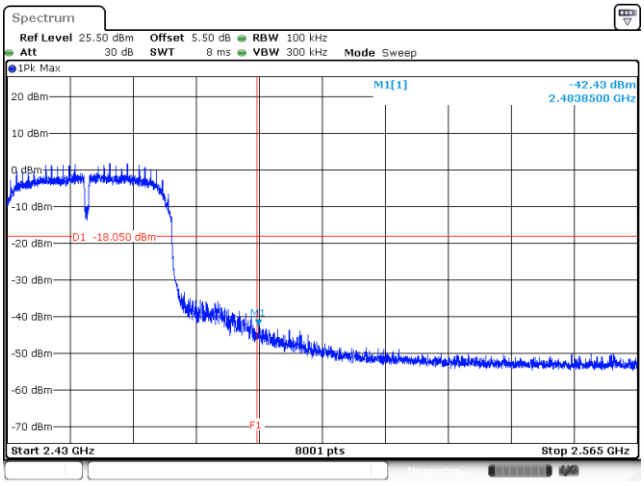
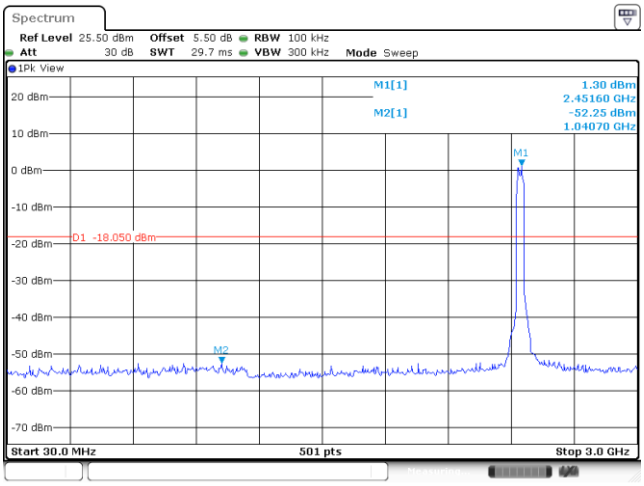
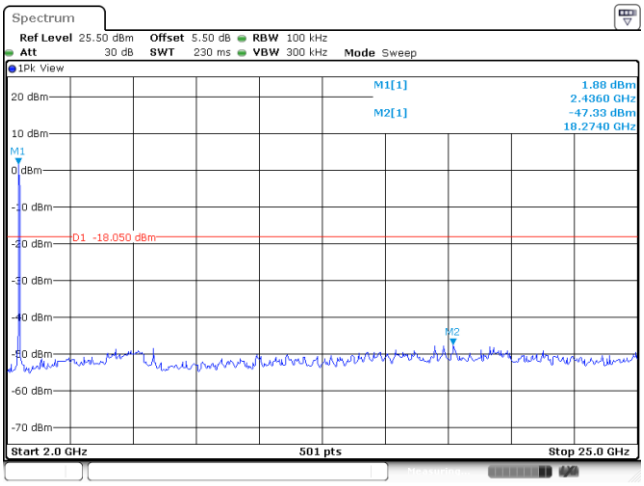
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11n HT40	Test Channel :	06

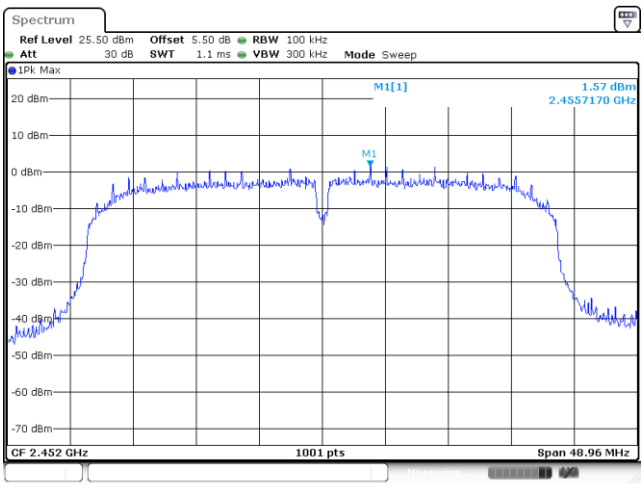
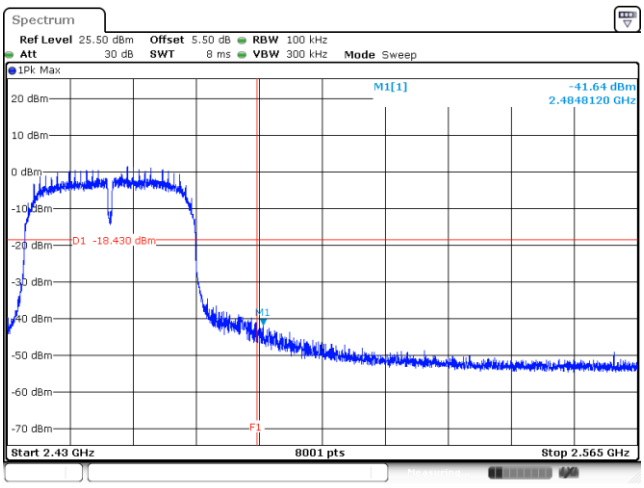
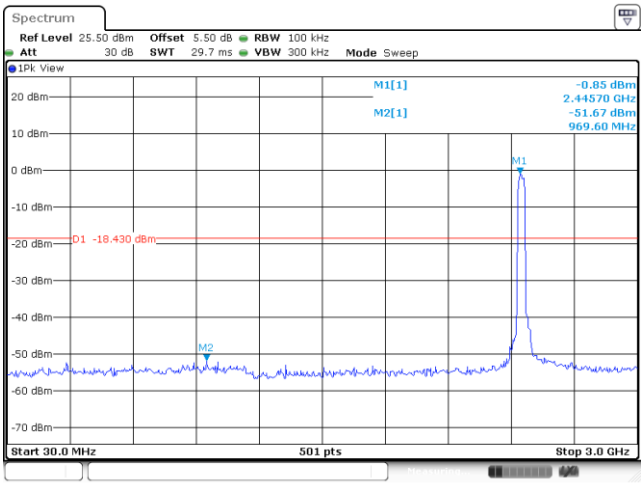
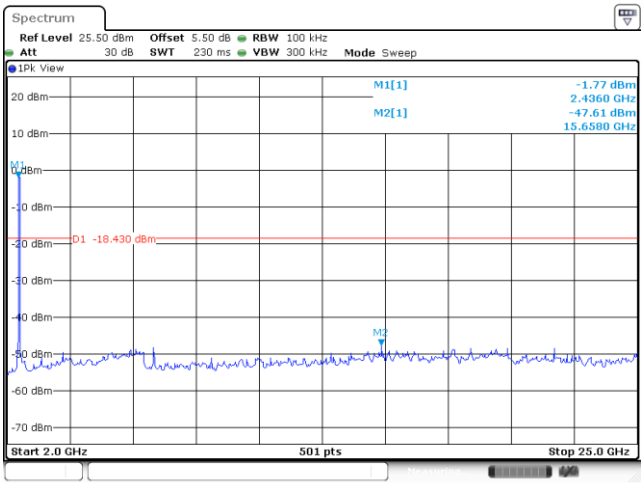
100kHz PSD reference Level	Channel Plot
	

Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

Test Mode :	802.11n HT40	Test Channel :	08

100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11n HT40	Test Channel :	09

100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 Limit of Radiated band edge and Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/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

3.5.2 Measuring Instruments

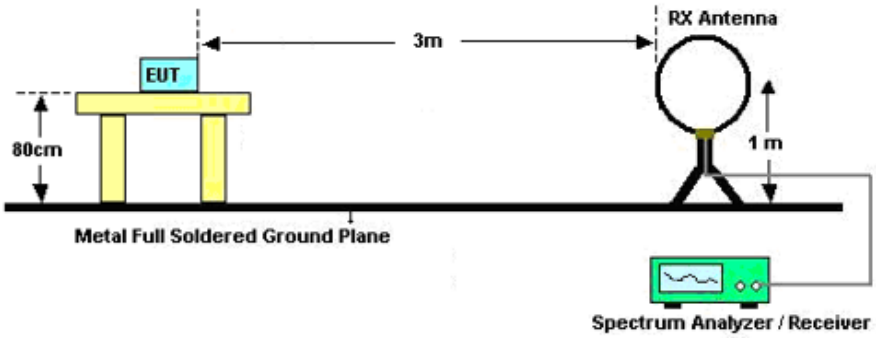
The measuring equipment is listed in the section 4 of this test report.

3.5.3 Test Procedures

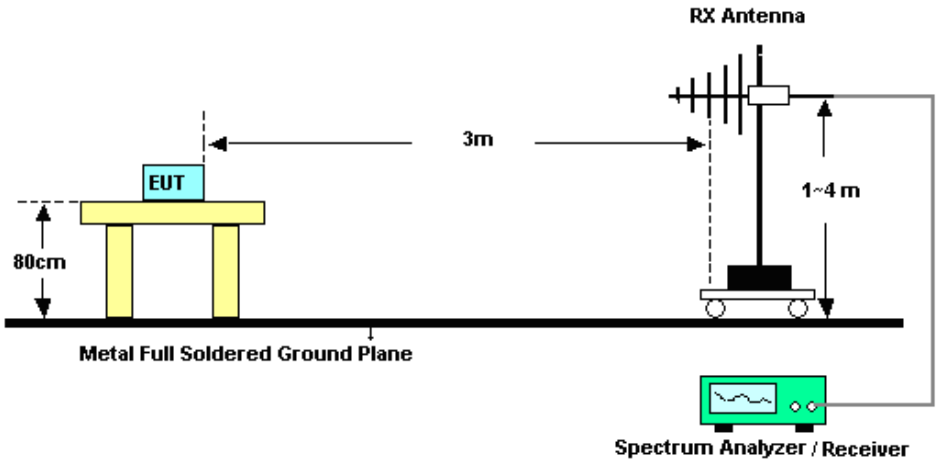
1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than peak limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
8. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW= 3MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.5.4 Test Setup

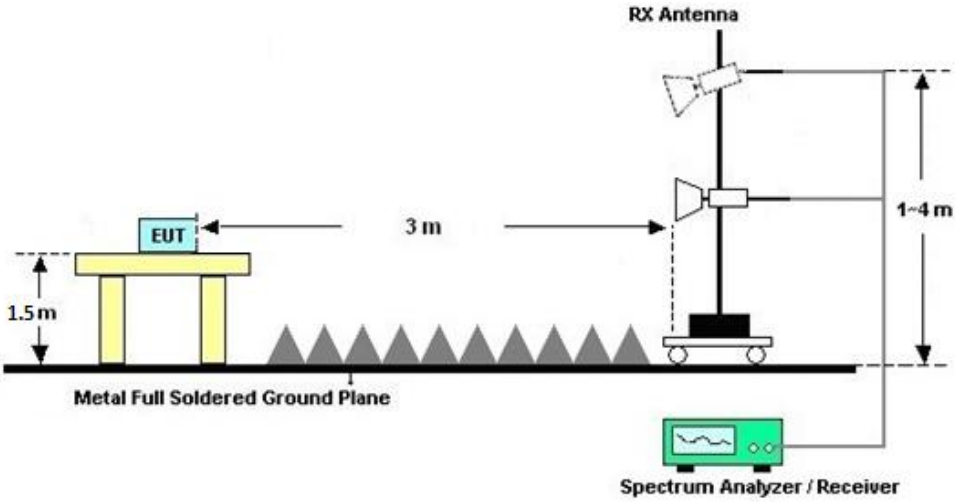
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.5.5 Test Results of Radiated Spurious Emissions (9kHz ~ 30MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C and Appendix D.

3.5.7 Duty Cycle

Please refer to Appendix E.

3.5.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic or 40GHz, whichever is lower)

Please refer to Appendix C and Appendix D.

3.6 AC Conducted Emission Measurement

3.6.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

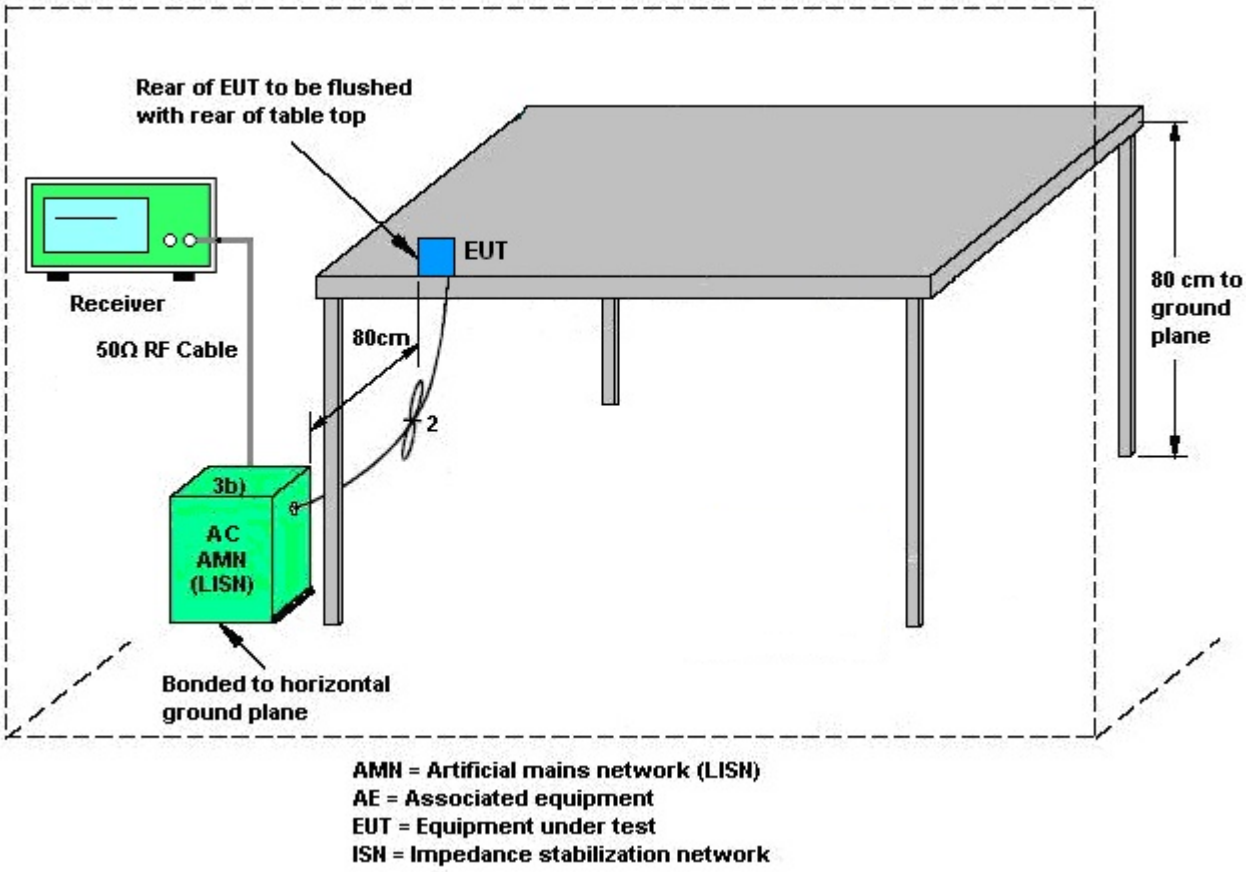
3.6.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.6.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room, and it was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF bandwidth = 9kHz) with Maximum Hold Mode.

3.6.4 Test Setup



3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix B.

3.7 Antenna Requirements

3.7.1 Standard Applicable

If directional gain of transmitting Antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached Antenna or of an Antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.7.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Oct. 14, 2021	Dec. 27, 2021	Oct. 13, 2022	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 07, 2021	Dec. 27, 2021	Jan. 06, 2022	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 07, 2021	Dec. 27, 2021	Jan. 06, 2022	Conducted (TH01-KS)
Temperature &humidity chamber	Hongzhan	LP-150U	H2014011440	-40~+150°C 20%~95%RH	Jul. 12, 2021	Dec. 27, 2021	Jul. 11, 2022	Conducted (TH01-KS)
EMI Test Receiver	R&S	ESR7	101403	9kHz~7GHz;Max 30dBm	Oct. 16, 2021	Dec. 27, 2021	Oct. 15, 2022	Radiation (03CH02-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55370528	10Hz-44G,MAX 30dB	Oct. 16, 2021	Dec. 27, 2021	Oct. 15, 2022	Radiation (03CH02-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 30, 2021	Dec. 27, 2021	Oct. 29, 2022	Radiation (03CH02-KS)
Bilog Antenna	TeseQ	CBL6111D	44483	30MHz-1GHz	Jan. 26, 2021	Dec. 27, 2021	Jan. 25, 2022	Radiation (03CH02-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	75957	1GHz~18GHz	Oct. 30, 2021	Dec. 27, 2021	Oct. 29, 2022	Radiation (03CH02-KS)
high gain Amplifier	MITEQ	AMF-7D-00101800-30-10P	2025788	100MHz-18GHz	Jan. 06, 2021	Dec. 27, 2021	Jan. 05, 2022	Radiation (03CH02-KS)
SHF-EHF Horn	Com-power	AH-840	101115	18GHz~40GHz	Nov. 05, 2021	Dec. 27, 2021	Nov. 04, 2022	Radiation (03CH02-KS)
Amplifier	SONOMA	310N	187289	9KHz-1GHz	Jan. 06, 2021	Dec. 27, 2021	Jan. 05, 2022	Radiation (03CH02-KS)
Amplifier	Keysight	83017A	MY53270316	500MHz~26.5GHz	Oct. 16, 2021	Dec. 27, 2021	Oct. 15,2022	Radiation (03CH02-KS)
Amplifier	MITEQ	EM18G40GGA	060728	18~40GHz	Jan. 06, 2021	Dec. 27, 2021	Jan. 05, 2022	Radiation (03CH02-KS)
AC Power Source	Chroma	61601	616010002473	N/A	NCR	Dec. 27, 2021	NCR	Radiation (03CH02-KS)
Turn Table	MF	MF7802	N/A	0~360 degree	NCR	Dec. 27, 2021	NCR	Radiation (03CH02-KS)
Antenna Mast	MF	MF7802	N/A	1 m~4 m	NCR	Dec. 27, 2021	NCR	Radiation (03CH02-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	Apr. 21, 2021	Dec. 31, 2021	Apr. 20, 2022	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 14, 2021	Dec. 31, 2021	Oct. 13, 2022	Conduction (CO01-KS)
AC LISN	R&S	ENV216	100334	9kHz~30MHz	Apr. 13, 2021	Dec. 31, 2021	Apr. 12, 2022	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP000000811	AC 0V~300V, 45Hz~1000Hz	Oct. 14, 2021	Dec. 31, 2021	Oct. 13, 2022	Conduction (CO01-KS)

NCR: No Calibration Required

5 Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**2.94dB**

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.9dB**

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.0dB**

Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.1dB**

---------- THE END ----------

Appendix A. Conducted Test Results

Report Number : FR1N0920B

Test Engineer:	Jiang Jun	Temperature:	21~25	°C
Test Date:	2021/12/27	Relative Humidity:	51~54	%

Report Number : FR1N0920B

TEST RESULTS DATA
Peak Power Spectral Density

2.4GHz Band Single Antenna								
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak PSD (dBm/3kHz)	DG (dBi)	Peak PSD Limit (dBm/3kHz)	Pass/Fail
					Ant1	Ant1	Ant1	
11b	1Mbps	1	1	2412	-2.37	3.26	8.00	Pass
11b	1Mbps	1	6	2437	-1.97	3.26	8.00	Pass
11b	1Mbps	1	11	2462	-2.20	3.26	8.00	Pass
11g	6Mbps	1	1	2412	-6.92	3.26	8.00	Pass
11g	6Mbps	1	6	2437	-6.42	3.26	8.00	Pass
11g	6Mbps	1	10	2457	-8.27	3.26	8.00	Pass
11g	6Mbps	1	11	2462	-10.30	3.26	8.00	Pass
HT20	MCS0	1	1	2412	-7.30	3.26	8.00	Pass
HT20	MCS0	1	6	2437	-6.18	3.26	8.00	Pass
HT20	MCS0	1	10	2457	-7.29	3.26	8.00	Pass
HT20	MCS0	1	11	2462	-10.16	3.26	8.00	Pass
HT40	MCS0	1	3	2422	-11.84	3.26	8.00	Pass
HT40	MCS0	1	6	2437	-9.70	3.26	8.00	Pass
HT40	MCS0	1	8	2447	-11.76	3.26	8.00	Pass
HT40	MCS0	1	9	2452	-11.94	3.26	8.00	Pass

Measured power density (dBm) has offset with cable loss.

Report Number : FR1N0920B

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

2.4GHz Band Single Antenna								
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
					Ant1	Ant1		
11b	1Mbps	1	1	2412	13.19	9.50	0.50	Pass
11b	1Mbps	1	6	2437	13.14	9.54	0.50	Pass
11b	1Mbps	1	11	2462	13.14	9.52	0.50	Pass
11g	6Mbps	1	1	2412	18.48	16.32	0.50	Pass
11g	6Mbps	1	6	2437	18.78	16.34	0.50	Pass
11g	6Mbps	1	10	2457	18.28	16.34	0.50	Pass
11g	6Mbps	1	11	2462	18.23	16.34	0.50	Pass
HT20	MCS0	1	1	2412	18.98	17.32	0.50	Pass
HT20	MCS0	1	6	2437	19.13	17.56	0.50	Pass
HT20	MCS0	1	10	2457	18.98	17.58	0.50	Pass
HT20	MCS0	1	11	2462	18.93	17.58	0.50	Pass
HT40	MCS0	1	3	2422	34.47	31.92	0.50	Pass
HT40	MCS0	1	6	2437	34.67	31.36	0.50	Pass
HT40	MCS0	1	8	2447	34.47	30.12	0.50	Pass
HT40	MCS0	1	9	2452	34.37	32.64	0.50	Pass

FR1N0920B

TEST RESULTS DATA
Peak Output Power

2.4GHz Band Single Antenna										
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
					Ant1	Ant1	Ant1	Ant1	Ant1	
11b	1Mbps	1	1	2412	21.86	30.00	3.26	25.12	36.00	Pass
11b	1Mbps	1	6	2437	22.30	30.00	3.26	25.56	36.00	Pass
11b	1Mbps	1	11	2462	22.77	30.00	3.26	26.03	36.00	Pass
11g	6Mbps	1	1	2412	25.15	30.00	3.26	28.41	36.00	Pass
11g	6Mbps	1	6	2437	25.56	30.00	3.26	28.82	36.00	Pass
11g	6Mbps	1	10	2457	24.82	30.00	3.26	28.08	36.00	Pass
11g	6Mbps	1	11	2462	23.65	30.00	3.26	26.91	36.00	Pass
HT20	MCS0	1	1	2412	24.84	30.00	3.26	28.10	36.00	Pass
HT20	MCS0	1	6	2437	25.32	30.00	3.26	28.58	36.00	Pass
HT20	MCS0	1	10	2457	24.98	30.00	3.26	28.24	36.00	Pass
HT20	MCS0	1	11	2462	23.46	30.00	3.26	26.72	36.00	Pass
HT40	MCS0	1	3	2422	23.89	30.00	3.26	27.15	36.00	Pass
HT40	MCS0	1	6	2437	25.22	30.00	3.26	28.48	36.00	Pass
HT40	MCS0	1	8	2447	23.98	30.00	3.26	27.24	36.00	Pass
HT40	MCS0	1	9	2452	23.78	30.00	3.26	27.04	36.00	Pass

Note: Measured power (dBm) has offset with cable loss.

FR1N0920B

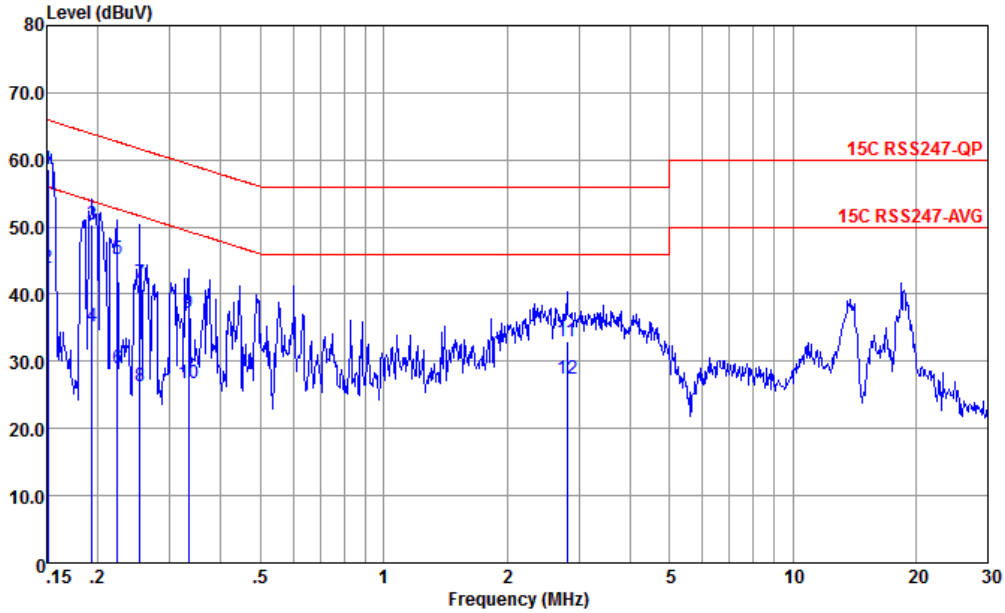
TEST RESULTS DATA
Average Output Power

2.4GHz Band Single Antenna											
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
					Ant 1	Ant1	Ant1	Ant1	Ant1	Ant1	
11b	1Mbps	1	1	2412	0.00	19.41	30.00	3.26	22.67	36.00	Pass
11b	1Mbps	1	6	2437	0.00	19.82	30.00	3.26	23.08	36.00	Pass
11b	1Mbps	1	11	2462	0.00	19.93	30.00	3.26	23.19	36.00	Pass
11g	6Mbps	1	1	2412	0.00	17.75	30.00	3.26	21.01	36.00	Pass
11g	6Mbps	1	6	2437	0.00	19.12	30.00	3.26	22.38	36.00	Pass
11g	6Mbps	1	10	2457	0.00	17.01	30.00	3.26	20.27	36.00	Pass
11g	6Mbps	1	11	2462	0.00	14.58	30.00	3.26	17.84	36.00	Pass
HT20	MCS0	1	1	2412	0.00	16.82	30.00	3.26	20.08	36.00	Pass
HT20	MCS0	1	6	2437	0.00	18.25	30.00	3.26	21.51	36.00	Pass
HT20	MCS0	1	10	2457	0.00	16.87	30.00	3.26	20.13	36.00	Pass
HT20	MCS0	1	11	2462	0.00	13.98	30.00	3.26	17.24	36.00	Pass
HT40	MCS0	1	3	2422	0.00	14.78	30.00	3.26	18.04	36.00	Pass
HT40	MCS0	1	6	2437	0.00	17.56	30.00	3.26	20.82	36.00	Pass
HT40	MCS0	1	8	2447	0.00	14.61	30.00	3.26	17.87	36.00	Pass
HT40	MCS0	1	9	2452	0.00	14.04	30.00	3.26	17.30	36.00	Pass

Note: Measured power (dBm) has offset with cable loss.

Appendix B. AC Conducted Emission Test Results_

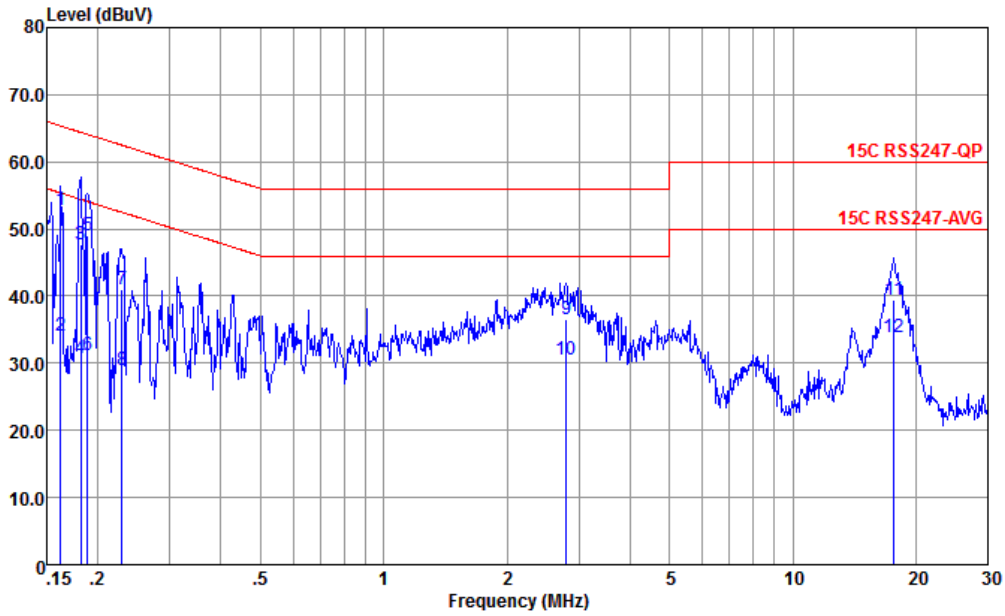
Test Engineer :	Amos Zhang	**Temperature :**	25.3~26.2℃
		Relative Humidity :	38~40%
Test Voltage :	120Vac / 60Hz	**Phase :**	Line



Site : CO01-KS
Condition : 15C RSS247-QP LISN-060105-L LINE

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1 *	0.151	58.60	-7.36	65.96	48.10	0.02	10.48	QP
2	0.151	43.80	-12.16	55.96	33.30	0.02	10.48	Average
3	0.193	50.32	-13.57	63.89	39.90	0.04	10.38	QP
4	0.193	35.22	-18.67	53.89	24.80	0.04	10.38	Average
5	0.223	45.20	-17.50	62.70	34.80	0.05	10.35	QP
6	0.223	28.90	-23.80	52.70	18.50	0.05	10.35	Average
7	0.253	41.59	-20.05	61.64	31.20	0.06	10.33	QP
8	0.253	26.29	-25.35	51.64	15.90	0.06	10.33	Average
9	0.334	37.27	-22.08	59.35	26.90	0.08	10.29	QP
10	0.334	26.67	-22.68	49.35	16.30	0.08	10.29	Average
11	2.809	32.99	-23.01	56.00	22.60	0.15	10.24	QP
12	2.809	27.49	-18.51	46.00	17.10	0.15	10.24	Average

Test Engineer :	Amos Zhang	**Temperature :**	25.3~26.2℃
		Relative Humidity :	38~40%
Test Voltage :	120Vac / 60Hz	**Phase :**	Neutral
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



Site : CO01-KS
Condition : 15C RSS247-QP LISN-060105-N NEUTRAL

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	*	0.162	52.75	-12.59	65.34	42.19	0.11	10.45	QP
2		0.162	34.05	-21.29	55.34	23.49	0.11	10.45	Average
3		0.182	47.71	-16.71	64.42	37.21	0.10	10.40	QP
4		0.182	30.81	-23.61	54.42	20.31	0.10	10.40	Average
5		0.188	49.09	-15.02	64.11	38.60	0.10	10.39	QP
6		0.188	31.29	-22.82	54.11	20.80	0.10	10.39	Average
7		0.229	40.95	-21.53	62.48	30.50	0.10	10.35	QP
8		0.229	29.05	-23.43	52.48	18.60	0.10	10.35	Average
9		2.794	36.59	-19.41	56.00	26.20	0.15	10.24	QP
10		2.794	30.59	-15.41	46.00	20.20	0.15	10.24	Average
11		17.661	39.48	-20.52	60.00	28.60	0.43	10.45	QP
12		17.661	33.78	-16.22	50.00	22.90	0.43	10.45	Average

Note:

1. Level(dBμV) = Read Level(dBμV) + LISN Factor(dB) + Cable Loss(dB)
2. Over Limit(dB) = Level(dBμV) – Limit Line(dBμV)

Appendix C. Radiated Spurious Emission

Test Engineer :	Carry Xu	Temperature :	22~23°C
		Relative Humidity :	41~42%

Band		Power setting
11b Tx	CH01	0
11b Tx	CH06	0
11b Tx	CH11	0
11g Tx	CH01	6
11g Tx	CH06	0
11g Tx	CH10	11
11g Tx	CH11	19
11n(20M) Tx	CH01	6
11n(20M) Tx	CH06	0
11n(20M) Tx	CH10	7
11n(20M) Tx	CH11	17
11n(40M) Tx	CH03	11
11n(40M) Tx	CH06	0
11n(40M) Tx	CH08	10
11n(40M) Tx	CH09	11

2.4GHz 2400~2483.5MHz

WIFI 802.11b (Band Edge @ 3m)

WIFI Ant.	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11b CH 01 2412MHz		2386.44	57.68	-16.32	74	56.94	30.5	7.1	36.86	186	173	P	H
		2385.66	47.57	-6.43	54	46.83	30.5	7.1	36.86	186	173	A	H
	*	2410	113.99	-	-	113.14	30.57	7.13	36.85	186	173	P	H
	*	2412	107.14	-	-	106.29	30.57	7.13	36.85	186	173	A	H
		2385.79	56.73	-17.27	74	55.99	30.5	7.1	36.86	396	244	P	V
		2385.66	47.16	-6.84	54	46.42	30.5	7.1	36.86	396	244	A	V
	*	2414	112.5	-	-	111.65	30.57	7.13	36.85	396	244	P	V
	*	2412	105.43	-	-	104.58	30.57	7.13	36.85	396	244	A	V
802.11b CH 11 2462MHz		2487.58	59.49	-14.51	74	58.12	30.93	7.25	36.81	380	293	P	H
		2488.6	49.04	-4.96	54	47.67	30.93	7.25	36.81	380	293	A	H
	*	2462	117.22	-	-	116.04	30.79	7.22	36.83	380	293	P	H
	*	2464	110.42	-	-	109.24	30.79	7.22	36.83	380	293	P	H
		2487.7	55.43	-18.57	74	54.06	30.93	7.25	36.81	382	237	P	V
		2488.6	45.12	-8.88	54	43.75	30.93	7.25	36.81	382	237	A	V
	*	2460	113.99	-	-	112.81	30.79	7.22	36.83	382	237	P	V
	*	2460	107	-	-	105.82	30.79	7.22	36.83	382	237	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11b (Harmonic @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11b CH 01 2412MHz		4824	52.5	-21.5	74	72.06	34.61	11.21	65.38	106	79	P	H
		4824	46.82	-7.18	54	66.38	34.61	11.21	65.38	106	79	A	H
		4824	49.45	-24.55	74	69.01	34.61	11.21	65.38	300	360	P	V
802.11b CH 06 2437MHz		4872	48.5	-25.5	74	67.95	34.69	11.28	65.42	300	0	P	H
		7311	46.28	-27.72	74	62.79	36.68	12.72	65.91	300	0	P	H
		4872	49.44	-24.56	74	68.89	34.69	11.28	65.42	300	360	P	V
		7311	47.49	-26.51	74	64	36.68	12.72	65.91	300	360	P	V
802.11b CH 11 2462MHz		4926	53.01	-20.99	74	72.34	34.77	11.35	65.45	116	153	P	H
		4926	47.7	-6.3	54	67.03	34.77	11.35	65.45	116	153	A	H
		7386	49.23	-24.77	74	64.95	36.64	13.8	66.16	300	0	P	H
		4926	54.44	-19.56	74	73.77	34.77	11.35	65.45	360	243	P	V
		4926	48.99	-5.01	54	68.32	34.77	11.35	65.45	360	243	A	V
		7386	50.52	-23.48	74	66.24	36.64	13.8	66.16	300	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11g (Band Edge @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11g CH 01 2412MHz		2389.95	69.94	-4.06	74	69.2	30.5	7.1	36.86	184	174	P	H
		2389.95	50.81	-3.19	54	50.07	30.5	7.1	36.86	184	174	A	H
	*	2412	109.93	-	-	109.08	30.57	7.13	36.85	184	174	P	H
	*	2410	102.03	-	-	101.18	30.57	7.13	36.85	184	174	A	H
		2389.82	70.52	-3.48	74	69.78	30.5	7.1	36.86	396	223	P	V
		2389.95	51.6	-2.4	54	50.86	30.5	7.1	36.86	396	223	A	V
	*	2418	108.01	-	-	107.13	30.57	7.16	36.85	396	223	P	V
	*	2418	99.96	-	-	99.08	30.57	7.16	36.85	396	223	A	V
802.11g CH 10 2457MHz		2486.2	66.31	-7.69	74	65.02	30.86	7.25	36.82	128	172	P	H
		2483.5	50.73	-3.27	54	49.44	30.86	7.25	36.82	128	172	A	H
		2458	110.76	-	-	109.58	30.79	7.22	36.83	128	172	P	H
		2458	102.94	-	-	101.76	30.79	7.22	36.83	128	172	A	H
		2484.04	62.87	-11.13	74	61.58	30.86	7.25	36.82	343	252	P	V
		2483.5	47.48	-6.52	54	46.19	30.86	7.25	36.82	343	252	A	V
		2460	109.21	-	-	108.03	30.79	7.22	36.83	343	252	P	V
		2458	100.61	-	-	99.43	30.79	7.22	36.83	343	252	A	V
802.11g CH 11 2462MHz		2483.5	69.6	-4.4	74	68.31	30.86	7.25	36.82	384	295	P	H
		2483.5	50.42	-3.58	54	49.13	30.86	7.25	36.82	384	295	A	H
	*	2460	110.41	-	-	109.23	30.79	7.22	36.83	384	295	P	H
	*	2460	102.62	-	-	101.44	30.79	7.22	36.83	384	295	A	H
		2483.56	65.87	-8.13	74	64.58	30.86	7.25	36.82	382	238	P	V
		2483.5	47.32	-6.68	54	46.03	30.86	7.25	36.82	382	238	A	V
	*	2462	108	-	-	106.82	30.79	7.22	36.83	382	238	P	V
	*	2456	99.88	-	-	98.7	30.79	7.22	36.83	382	238	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11g (Harmonic @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11g CH 01 2412MHz		4830	47.22	-26.78	74	67.74	34.61	10.25	65.38	300	0	P	H
		4830	44.51	-29.49	74	65.03	34.61	10.25	65.38	100	0	P	V
802.11g CH 06 2437MHz		4875	49.19	-24.81	74	69.63	34.69	10.29	65.42	300	0	P	H
		7305	54.91	-19.09	74	71.42	36.68	12.72	65.91	107	305	P	H
		7305	42.39	-11.61	54	58.9	36.68	12.72	65.91	107	305	A	H
		4875	46.93	-27.07	74	67.37	34.69	10.29	65.42	100	0	P	V
		7305	50.62	-23.38	74	67.13	36.68	12.72	65.91	100	0	P	V
802.11g CH 10 2457MHz		4914	46.81	-27.19	74	67.17	34.74	10.34	65.44	300	0	P	H
		7371	47.85	-26.15	74	64.58	36.65	12.73	66.11	300	0	P	H
		4914	45.88	-28.12	74	66.24	34.74	10.34	65.44	100	0	P	V
		7371	46.71	-27.29	74	63.44	36.65	12.73	66.11	100	0	P	V
802.11g CH 11 2462MHz		4920	47.95	-26.05	74	68.29	34.77	10.34	65.45	300	0	P	H
		7380	44.41	-29.59	74	61.14	36.65	12.73	66.11	300	0	P	H
		4920	45.07	-28.93	74	65.41	34.77	10.34	65.45	100	0	P	V
		7380	43.81	-30.19	74	60.54	36.65	12.73	66.11	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11n HT20 (Band Edge @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT20 CH 01 2412MHz		2387.87	66.07	-7.93	74	65.33	30.5	7.1	36.86	184	174	P	H
		2389.95	50.78	-3.22	54	50.04	30.5	7.1	36.86	184	174	A	H
	*	2410	110.18	-	-	109.33	30.57	7.13	36.85	184	174	P	H
	*	2408	101.49	-	-	100.64	30.57	7.13	36.85	184	174	A	H
		2389.82	66.41	-7.59	74	65.67	30.5	7.1	36.86	395	233	P	V
		2389.95	50.36	-3.64	54	49.62	30.5	7.1	36.86	395	233	A	V
	*	2418	108.31	-	-	107.43	30.57	7.16	36.85	395	233	P	V
	*	2418	100.27	-	-	99.39	30.57	7.16	36.85	395	233	A	V
802.11n HT20 CH 10 2457MHz		2484.34	66.27	-7.73	74	64.98	30.86	7.25	36.82	390	292	P	H
		2483.5	50.63	-3.37	54	49.34	30.86	7.25	36.82	390	292	A	H
		2454	111.69	-	-	110.51	30.79	7.22	36.83	390	292	P	H
		2456	103.25	-	-	102.07	30.79	7.22	36.83	390	292	A	H
		2483.98	62.99	-11.01	74	61.7	30.86	7.25	36.82	342	253	P	V
		2483.5	48.04	-5.96	54	46.75	30.86	7.25	36.82	342	253	A	V
		2462	108.19	-	-	107.01	30.79	7.22	36.83	342	253	P	V
		2462	100.14	-	-	98.96	30.79	7.22	36.83	342	253	A	V
802.11n HT20 CH 11 2462MHz		2483.8	65.52	-8.48	74	64.23	30.86	7.25	36.82	383	293	P	H
		2483.5	49.91	-4.09	54	48.62	30.86	7.25	36.82	383	293	A	H
	*	2460	109.4	-	-	108.22	30.79	7.22	36.83	383	293	P	H
	*	2462	102.12	-	-	100.94	30.79	7.22	36.83	383	293	A	H
		2483.74	63.08	-10.92	74	61.79	30.86	7.25	36.82	383	238	P	V
		2483.5	47.67	-6.33	54	46.38	30.86	7.25	36.82	383	238	A	V
	*	2460	107.1	-	-	105.92	30.79	7.22	36.83	383	238	P	V
	*	2460	99.19	-	-	98.01	30.79	7.22	36.83	383	238	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11n HT20 (Harmonic @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT20 CH 01 2412MHz		4830	44.48	-29.52	74	65	34.61	10.25	65.38	300	0	P	H
		4830	42.58	-31.42	74	63.1	34.61	10.25	65.38	100	0	P	V
802.11n HT20 CH 06 2437MHz		4875	48.07	-25.93	74	68.51	34.69	10.29	65.42	300	0	P	H
		7305	48.99	-25.01	74	65.5	36.68	12.72	65.91	300	0	P	H
		4875	45.84	-28.16	74	66.28	34.69	10.29	65.42	100	0	P	V
		7305	54.93	-19.07	74	71.44	36.68	12.72	65.91	373	244	P	V
		7305	41.79	-12.21	54	58.3	36.68	12.72	65.91	373	244	A	V
802.11n HT20 CH 10 2457MHz		4914	48.01	-25.99	74	68.37	34.74	10.34	65.44	300	0	P	H
		7371	46.44	-27.56	74	63.17	36.65	12.73	66.11	300	0	P	H
		4914	45.07	-28.93	74	65.43	34.74	10.34	65.44	100	0	P	V
		7371	46.65	-27.35	74	63.38	36.65	12.73	66.11	100	0	P	V
802.11n HT20 CH 11 2462MHz		4920	43.05	-30.95	74	63.39	34.77	10.34	65.45	300	0	P	H
		7380	45.28	-28.72	74	62.01	36.65	12.73	66.11	300	0	P	H
		4920	42.61	-31.39	74	62.95	34.77	10.34	65.45	100	0	P	V
		7380	43.57	-30.43	74	60.3	36.65	12.73	66.11	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11n HT40 (Band Edge @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT40 CH 03 2422MHz		2389.43	65.26	-8.74	74	64.52	30.5	7.1	36.86	400	289	P	H
		2389.95	50.48	-3.52	54	49.74	30.5	7.1	36.86	400	289	A	H
		2489.44	52.26	-21.74	74	50.89	30.93	7.25	36.81	400	289	P	H
		2498.38	41.46	-12.54	54	40.06	30.93	7.28	36.81	400	289	A	H
	*	2412	106.52	-	-	105.67	30.57	7.13	36.85	400	289	P	H
	*	2412	98.77	-	-	97.92	30.57	7.13	36.85	400	289	A	H
		2389.56	61.51	-12.49	74	60.77	30.5	7.1	36.86	396	233	P	V
		2389.95	47.22	-6.78	54	46.48	30.5	7.1	36.86	396	233	A	V
		2486.98	51.09	-22.91	74	49.8	30.86	7.25	36.82	396	233	P	V
		2492.5	40.13	-13.87	54	38.73	30.93	7.28	36.81	396	233	A	V
	*	2420	104.33	-	-	103.38	30.64	7.16	36.85	396	233	P	V
	*	2420	96.41	-	-	95.46	30.64	7.16	36.85	396	233	A	V
802.11n HT40 CH 06 2437MHz		2389.95	65.36	-8.64	74	64.62	30.5	7.1	36.86	347	289	P	H
		2389.95	49.64	-4.36	54	48.9	30.5	7.1	36.86	347	289	A	H
		2483.56	63.6	-10.4	74	62.31	30.86	7.25	36.82	347	289	P	H
		2483.5	49.95	-4.05	54	48.66	30.86	7.25	36.82	347	289	A	H
	*	2446	109.42	-	-	108.36	30.71	7.19	36.84	347	289	P	H
	*	2440	100.87	-	-	99.81	30.71	7.19	36.84	347	289	A	H
		2389.95	63.03	-10.97	74	62.29	30.5	7.1	36.86	391	248	P	V
		2389.95	47.97	-6.03	54	47.23	30.5	7.1	36.86	391	248	A	V
		2483.68	60.37	-13.63	74	59.08	30.86	7.25	36.82	391	248	P	V
		2483.5	46.79	-7.21	54	45.5	30.86	7.25	36.82	391	248	A	V
	*	2440	106.91	-	-	105.85	30.71	7.19	36.84	391	248	P	V
	*	2440	98.93	-	-	97.87	30.71	7.19	36.84	391	248	A	V

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT40 CH 08 2447MHz		2385.66	53.35	-20.65	74	52.61	30.5	7.1	36.86	182	172	P	H
		2389.95	41.97	-12.03	54	41.23	30.5	7.1	36.86	182	172	A	H
		2484.88	66.08	-7.92	74	64.79	30.86	7.25	36.82	182	172	P	H
		2483.5	50.07	-3.93	54	48.78	30.86	7.25	36.82	182	172	A	H
	*	2456	106.55	-	-	105.37	30.79	7.22	36.83	182	172	P	H
	*	2450	98.23	-	-	97.17	30.71	7.19	36.84	182	172	A	H
		2386.18	53.28	-20.72	74	52.54	30.5	7.1	36.86	392	251	P	V
		2389.95	41.12	-12.88	54	40.38	30.5	7.1	36.86	392	251	A	V
		2484.82	61.22	-12.78	74	59.93	30.86	7.25	36.82	392	251	P	V
		2483.5	45.9	-8.1	54	44.61	30.86	7.25	36.82	392	251	A	V
	*	2444	104.68	-	-	103.62	30.71	7.19	36.84	392	251	P	V
	*	2446	96.89	-	-	95.83	30.71	7.19	36.84	392	251	A	V
802.11n HT40 CH 09 2452MHz		2389.69	55.61	-18.39	74	54.87	30.5	7.1	36.86	106	173	P	H
		2389.95	43.86	-10.14	54	43.12	30.5	7.1	36.86	106	173	A	H
		2483.68	67.52	-6.48	74	66.23	30.86	7.25	36.82	106	173	P	H
		2483.5	50.58	-3.42	54	49.29	30.86	7.25	36.82	106	173	A	H
	*	2456	107.35	-	-	106.17	30.79	7.22	36.83	106	173	P	H
	*	2454	99.19	-	-	98.01	30.79	7.22	36.83	106	173	A	H
		2385.92	51.82	-22.18	74	51.08	30.5	7.1	36.86	343	231	P	V
		2389.95	40.7	-13.3	54	39.96	30.5	7.1	36.86	343	231	A	V
		2483.5	63.78	-10.22	74	62.49	30.86	7.25	36.82	343	231	P	V
		2483.5	46.34	-7.66	54	45.05	30.86	7.25	36.82	343	231	A	V
	*	2448	104.72	-	-	103.66	30.71	7.19	36.84	343	231	P	V
	*	2450	96.8	-	-	95.74	30.71	7.19	36.84	343	231	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11n HT40 (Harmonic @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n		4845	43.69	-30.31	74	64.2	34.63	10.25	65.39	300	0	P	H
HT40		7260	46.05	-27.95	74	62.39	36.7	12.72	65.76	300	0	P	H
CH 03		4845	42.26	-31.74	74	62.77	34.63	10.25	65.39	100	0	P	V
2422MHz		7260	45.26	-28.74	74	61.6	36.7	12.72	65.76	100	0	P	V
802.11n		4875	45.6	-28.4	74	66.04	34.69	10.29	65.42	300	0	P	H
HT40		7311	46.36	-27.64	74	62.87	36.68	12.72	65.91	300	0	P	H
CH 06		4875	44.99	-29.01	74	65.43	34.69	10.29	65.42	100	0	P	V
2437MHz		7311	47.53	-26.47	74	64.04	36.68	12.72	65.91	100	0	P	V
802.11n		4894	43.96	-30.04	74	64.36	34.71	10.32	65.43	300	0	P	H
HT40		7341	44.39	-29.61	74	61.02	36.66	12.72	66.01	300	0	P	H
CH 08		4894	43.1	-30.9	74	63.5	34.71	10.32	65.43	100	0	P	V
2447MHz		7341	44.2	-29.8	74	60.83	36.66	12.72	66.01	100	0	P	V
802.11n		4905	44.33	-29.67	74	64.69	34.74	10.34	65.44	300	0	P	H
HT40		7350	44.23	-29.77	74	60.91	36.66	12.72	66.06	300	0	P	H
CH 09		4905	43.47	-30.53	74	63.83	34.74	10.34	65.44	100	0	P	V
2452MHz		7350	44.38	-29.62	74	61.06	36.66	12.72	66.06	100	0	P	V

Remark

1. No other spurious found.
2. All results are PASS against Peak and Average limit line.

2.4GHz 2400~2483.5MHz

Emission below 1GHz

2.4GHz WIFI 802.11g (LF)

WIFI Ant.	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
1		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz 802.11g LF		30.97	20.33	-19.67	40	27.07	24.7	0.76	32.2	-	-	-	H
		167.74	23.29	-20.21	43.5	38.01	15.5	1.88	32.1	-	-	-	H
		408.3	27.65	-18.35	46	34.85	22.06	3.02	32.28	-	-	-	H
		497.54	33.66	-12.34	46	39.16	23.75	3.14	32.39	-	-	-	H
		640.13	35.95	-10.05	46	38.16	26.3	3.71	32.22	-	-	-	H
		780.78	27.39	-18.61	46	27.42	28.1	4.17	32.3	-	-	-	H
		30	21.4	-18.6	40	28.04	24.8	0.76	32.2	-	-	-	V
		167.74	23.17	-20.33	43.5	37.89	15.5	1.88	32.1	-	-	-	V
		263.77	21.27	-24.73	46	31.22	20	2.22	32.17	-	-	-	V
		408.3	28.62	-17.38	46	35.82	22.06	3.02	32.28	-	-	-	V
		498.51	33.62	-12.38	46	39.1	23.77	3.14	32.39	-	-	-	V
		640.13	35.84	-10.16	46	38.05	26.3	3.71	32.22	-	-	-	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) =

Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

3. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)

= 43.54 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is “PASS”.

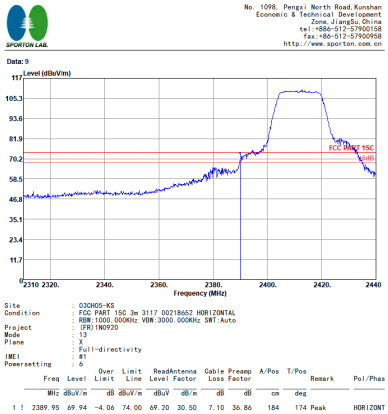
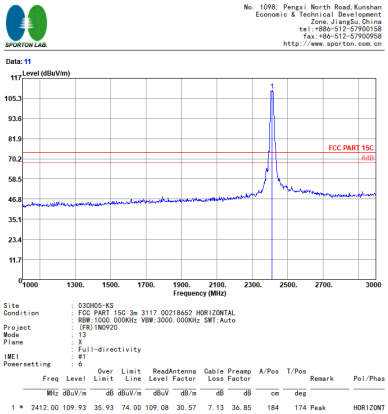
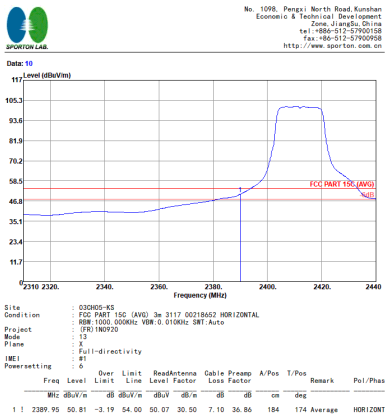
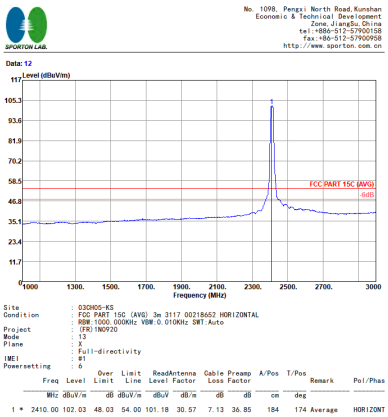
Appendix D. Radiated Spurious Emission Plots

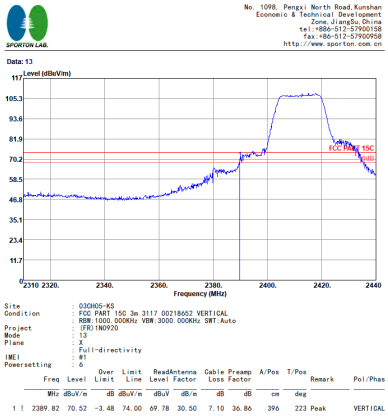
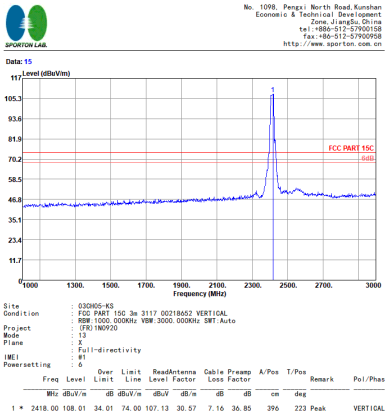
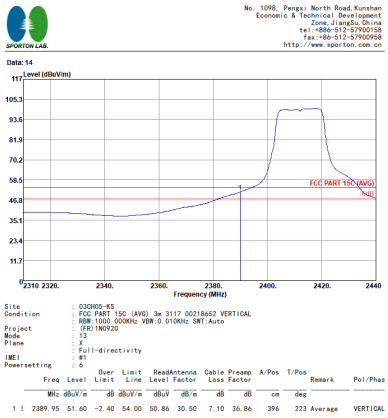
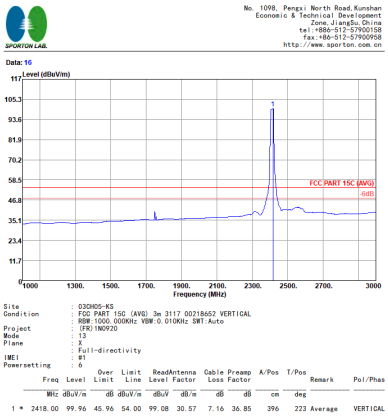
Note symbol

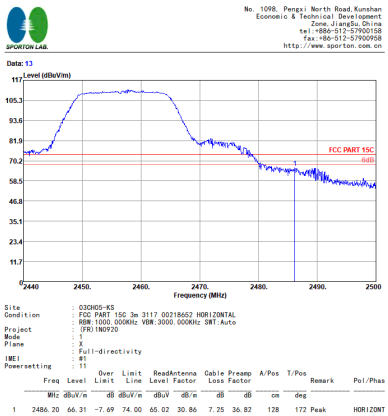
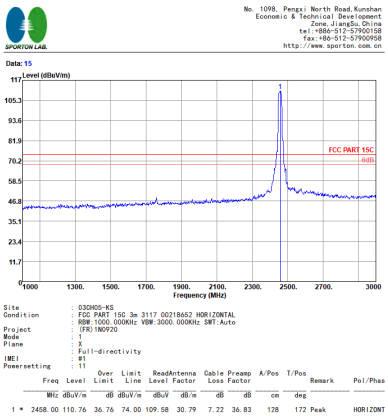
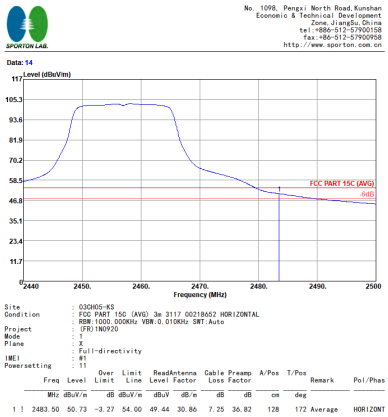
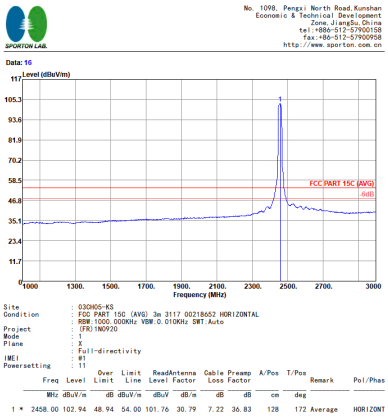
-L	**Low channel location**
-R	**High channel location**

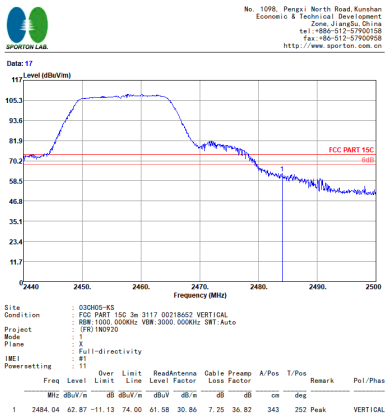
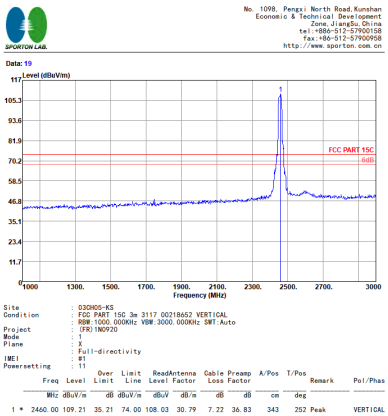
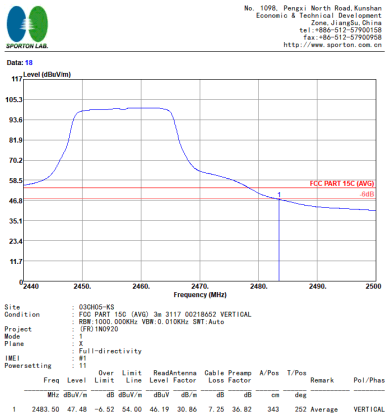
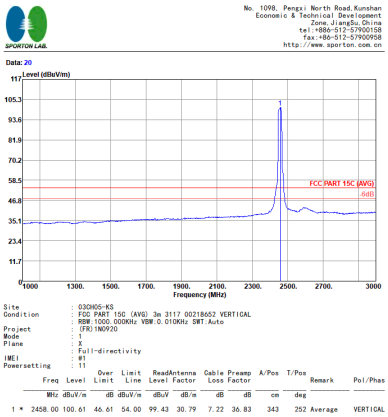
2.4GHz 2400~2483.5MHz

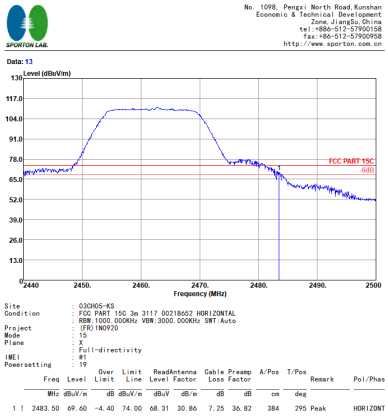
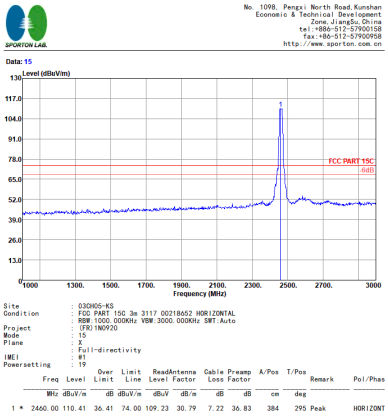
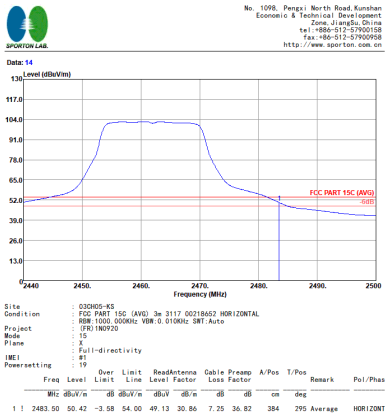
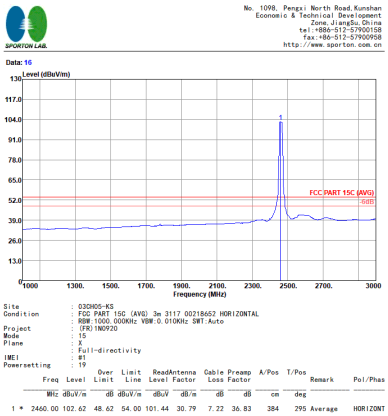
WIFI 802.11g (Band Edge @ 3m)

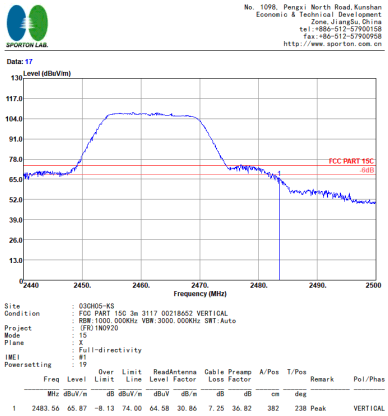
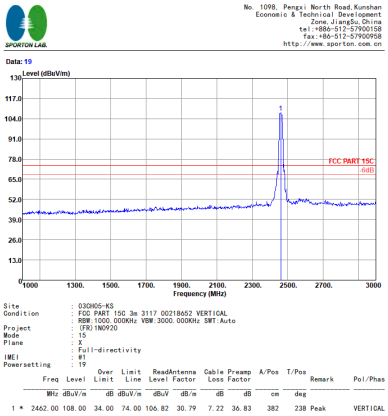
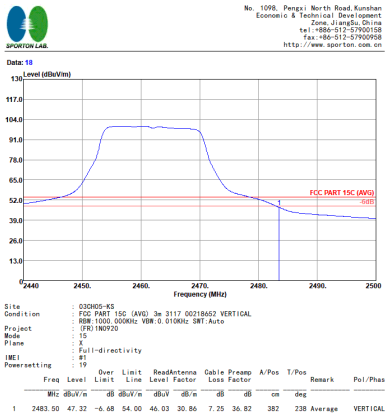
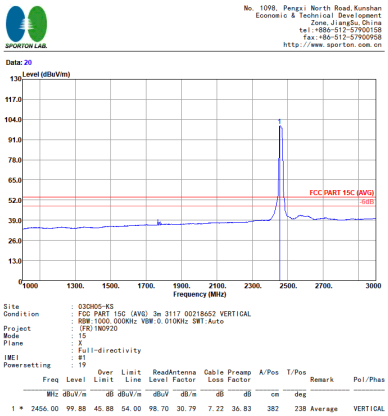
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11g CH01 2412MHz	
1	Horizontal	Fundamental
Peak		
Avg.		

WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11g CH01 2412MHz	
1	Vertical	Fundamental
Peak		
Avg.		

WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11g CH10 2457MHz	
1	Horizontal	Fundamental
Peak		
Avg.		

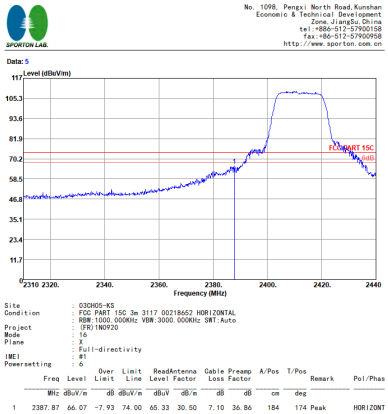
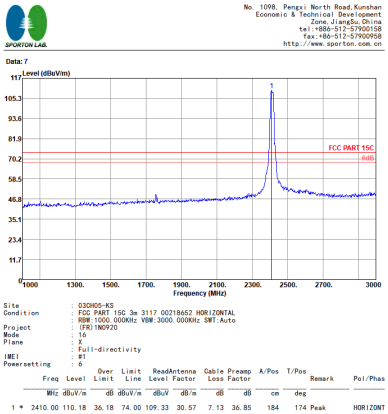
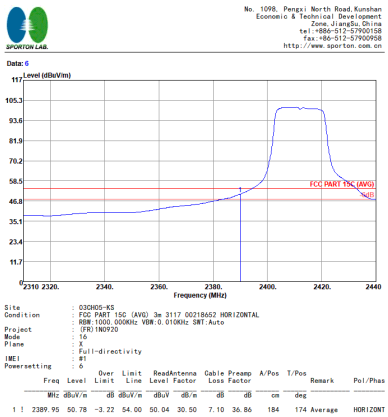
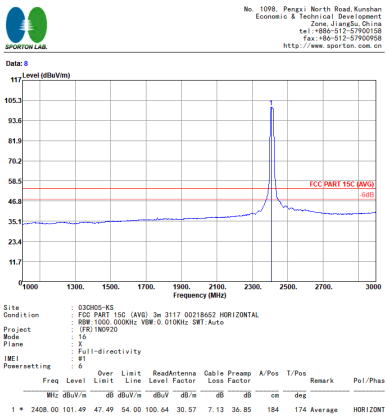
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11g CH10 2457MHz	
1	Vertical	Fundamental
Peak		
Avg.		

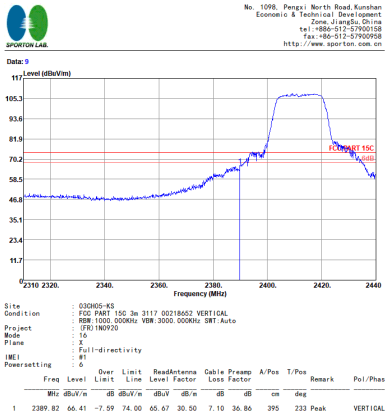
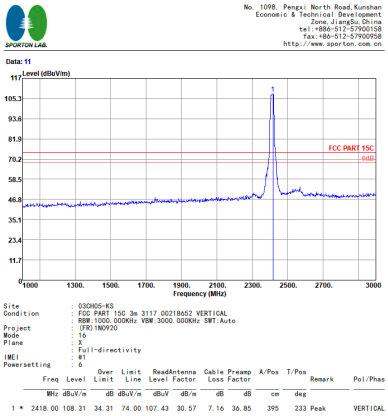
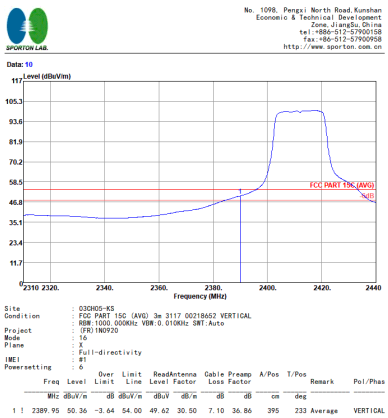
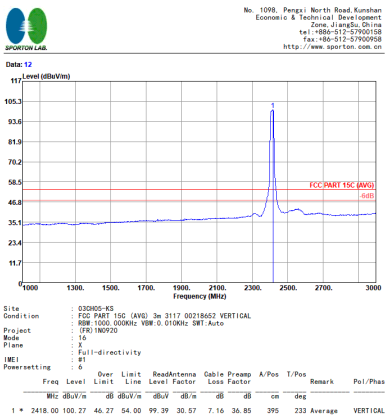
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11g CH11 2462MHz	
1	Horizontal	Fundamental
Peak		
Avg.		

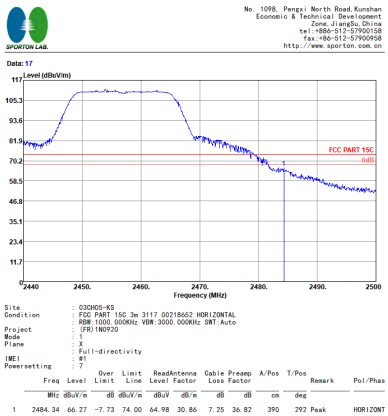
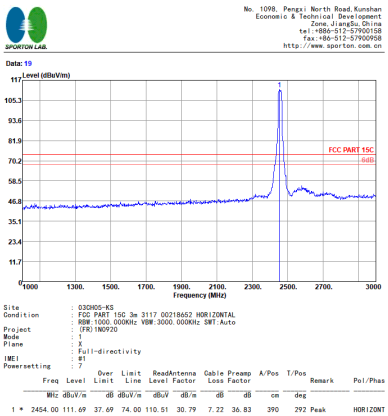
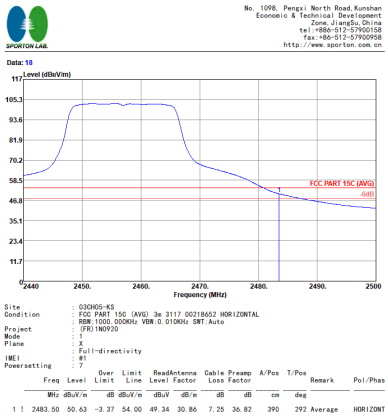
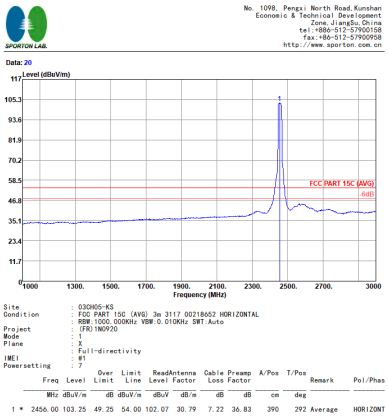
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11g CH11 2462MHz	
1	Vertical	Fundamental
Peak		
Avg.		

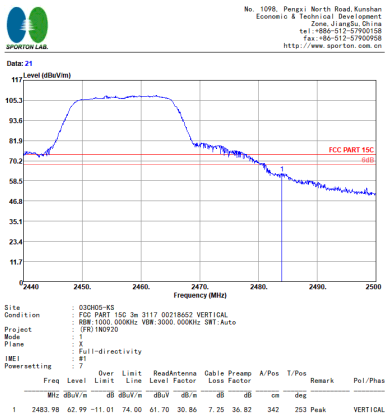
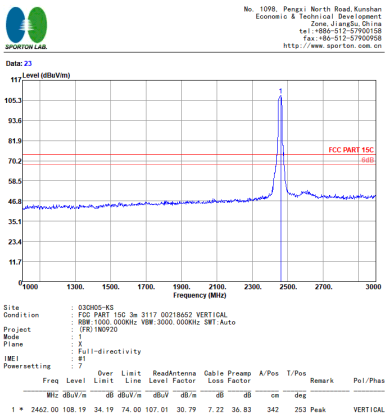
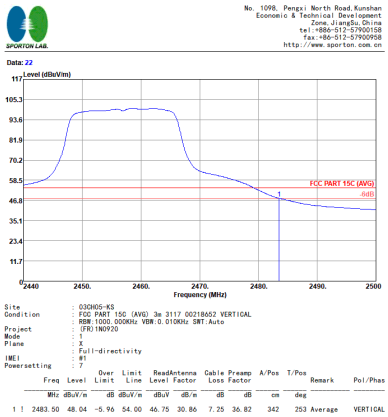
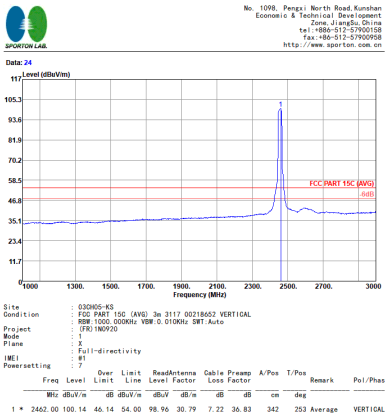
2.4GHz 2400~2483.5MHz

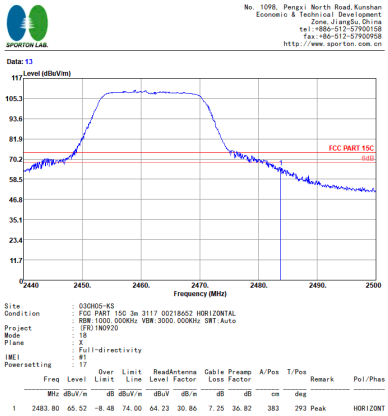
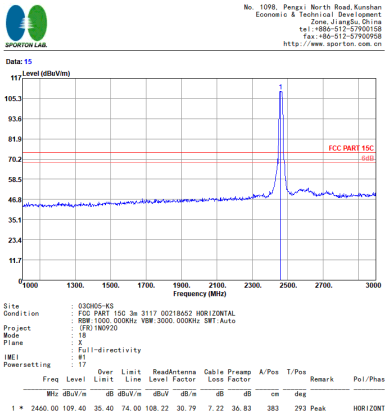
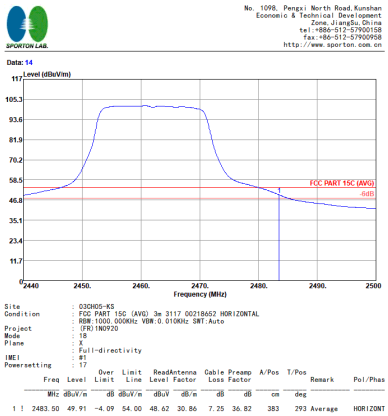
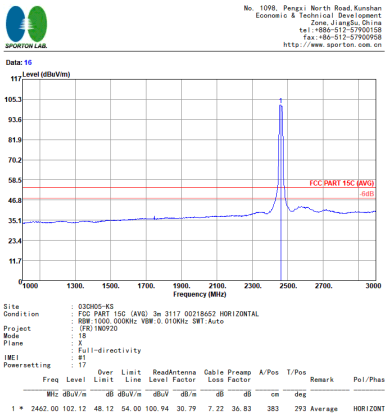
WIFI 802.11n HT20 (Band Edge @ 3m)

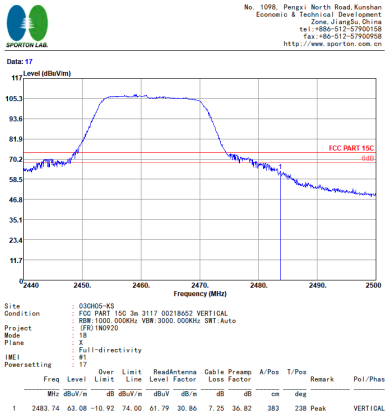
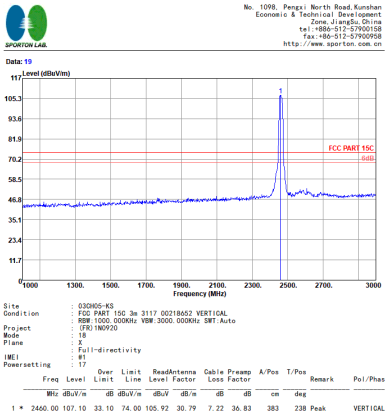
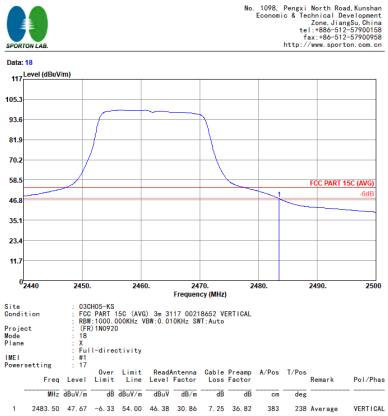
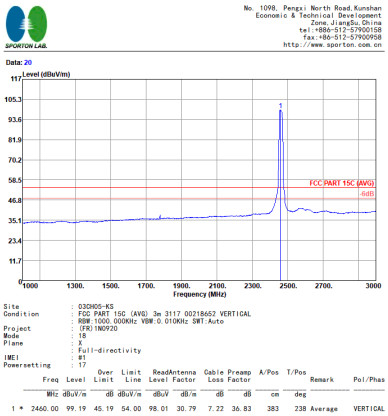
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT20 CH01 2412MHz	
1	Horizontal	Fundamental
Peak		
Avg.		

WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT20 CH01 2412MHz	
1	Vertical	Fundamental
Peak		
Avg.		

WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT20 CH10 2457MHz	
1	Horizontal	Fundamental
Peak		
Avg.		

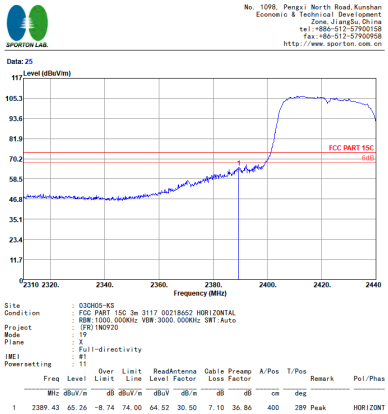
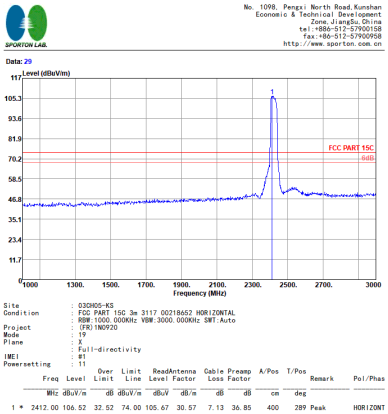
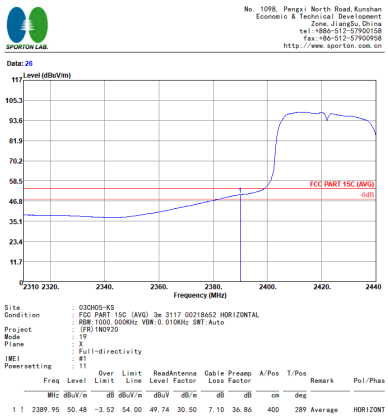
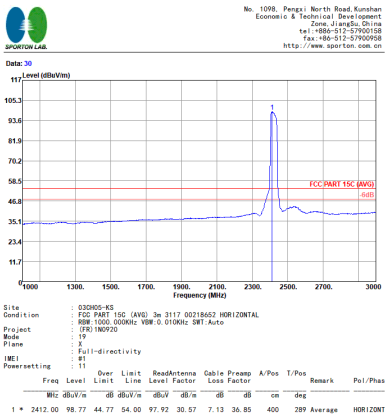
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT20 CH10 2457MHz	
1	Vertical	Fundamental
Peak		
Avg.		

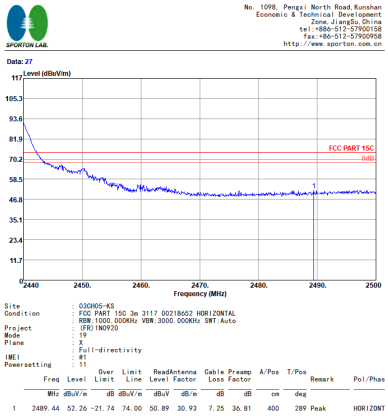
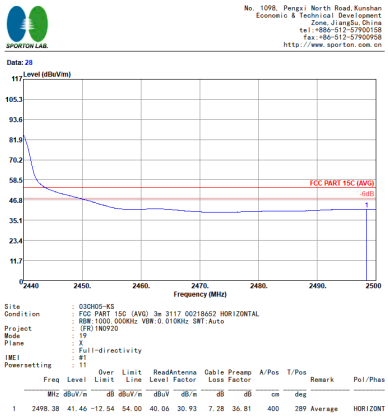
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT20 CH11 2462MHz	
1	Horizontal	Fundamental
Peak		
Avg.		

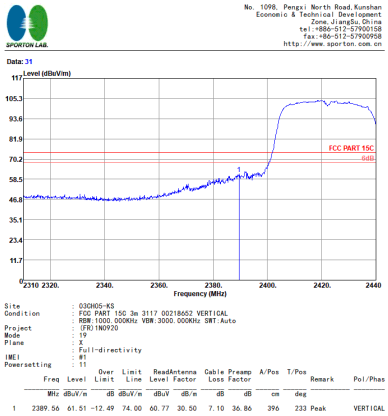
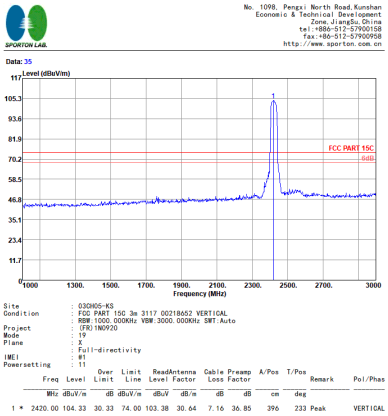
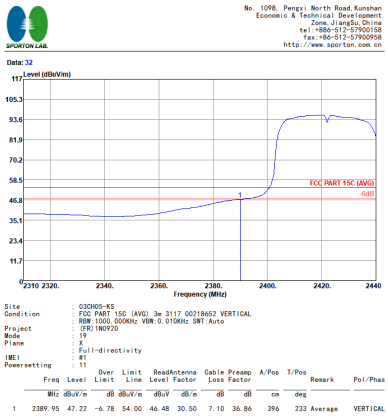
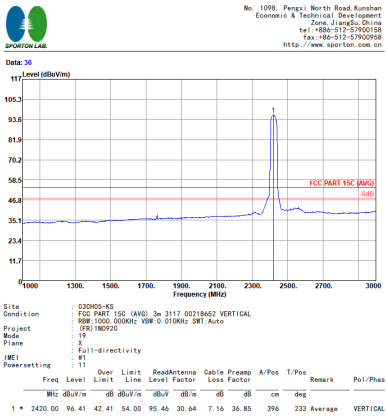
WIFI	2.4GHz 2400~2483.5MHz Fundamental @ 3m	
ANT	802.11n HT20 CH11 2462MHz	
1	Vertical	Fundamental
Peak		
Avg.		

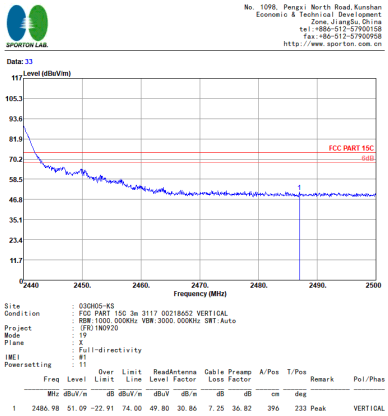
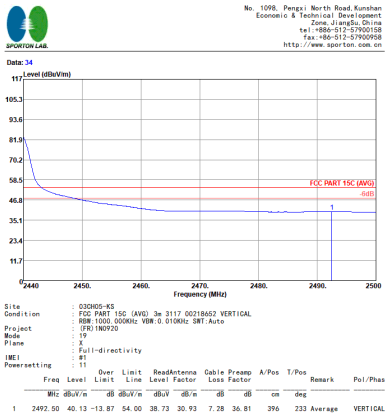
2.4GHz 2400~2483.5MHz

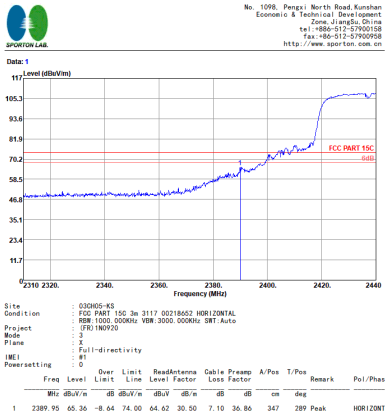
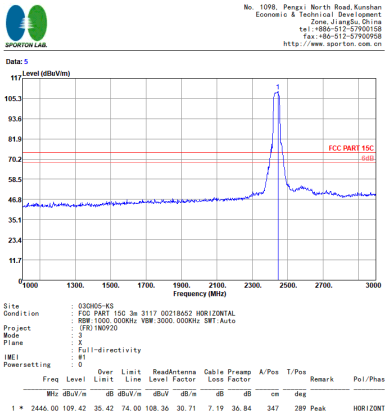
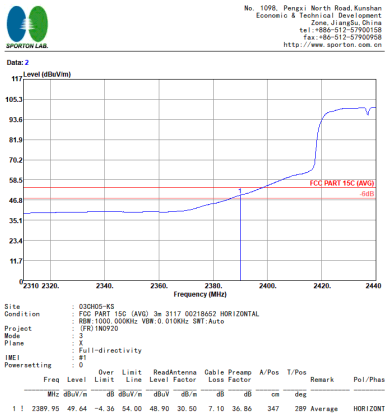
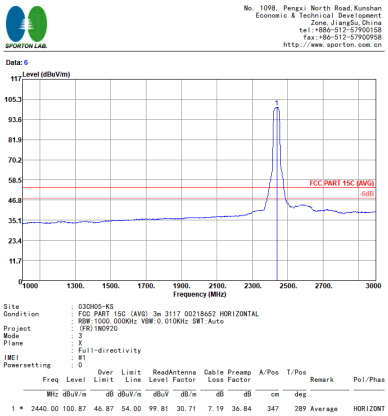
WIFI 802.11n HT40 (Band Edge @ 3m)

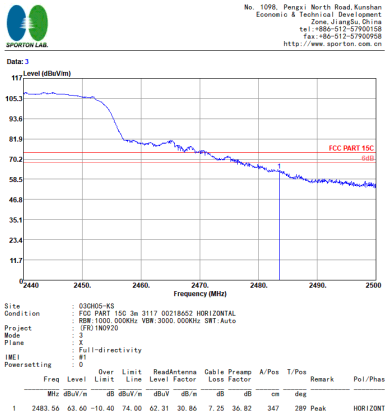
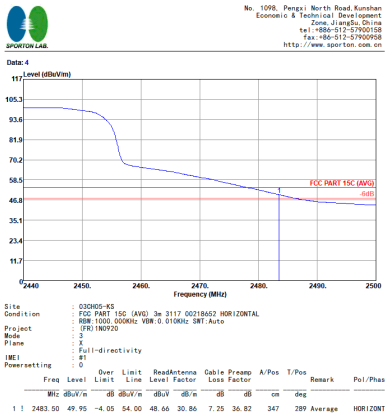
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT40 CH03 2422MHz - L	
1	Horizontal	Fundamental
Peak		
Avg.		

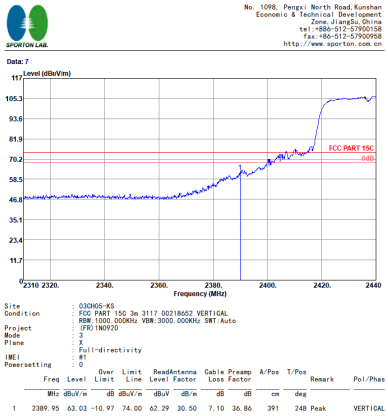
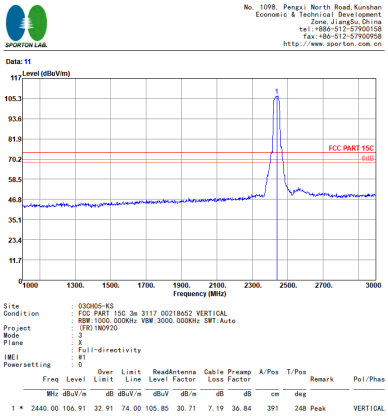
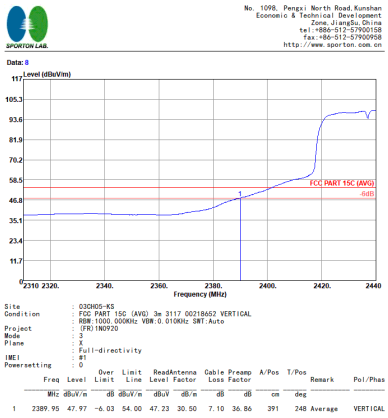
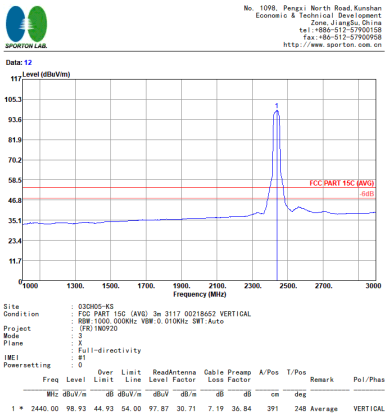
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT40 CH03 2422MHz - R	
1	Horizontal	Fundamental
Peak		Left Blank
Avg.		Left Blank

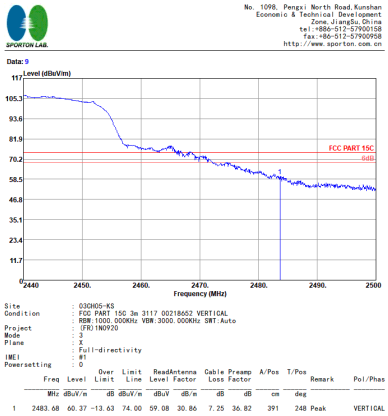
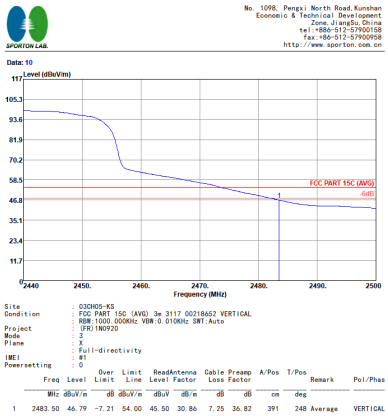
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT40 CH03 2422MHz - L	
1	Vertical	Fundamental
Peak		
Avg.		

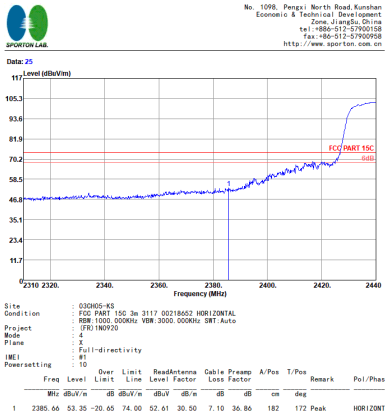
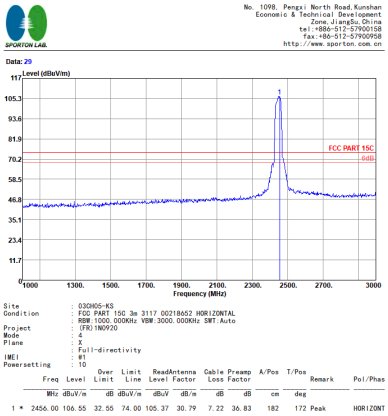
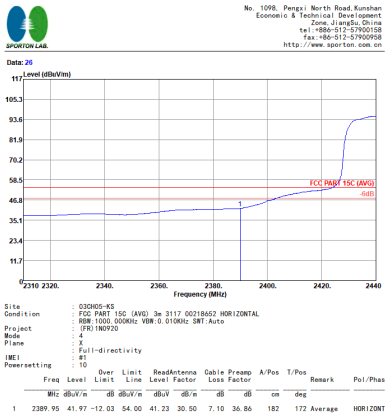
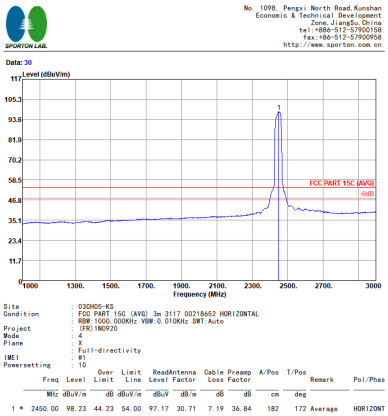
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT40 CH03 2422MHz - R	
1	Vertical	Fundamental
Peak		Left blank
Avg.		Left blank

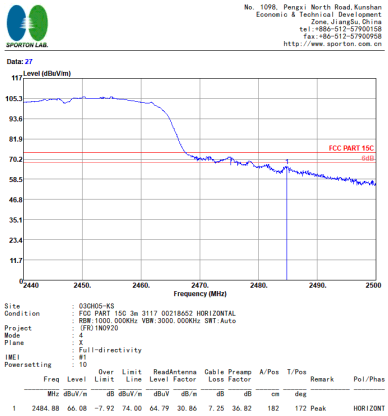
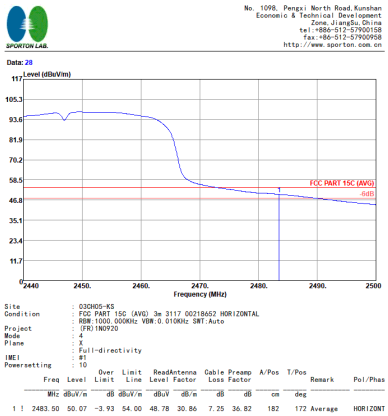
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT40 CH06 2437MHz - L	
1	Horizontal	Fundamental
Peak		
Avg.		

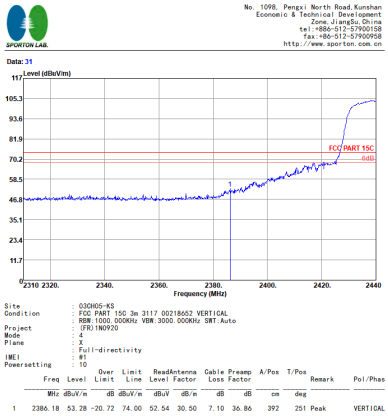
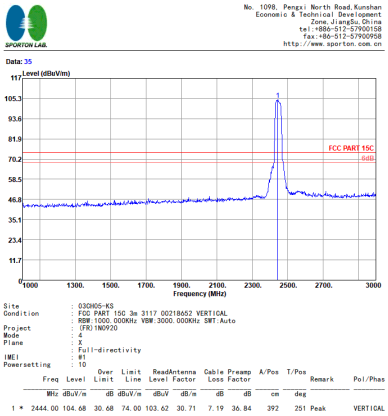
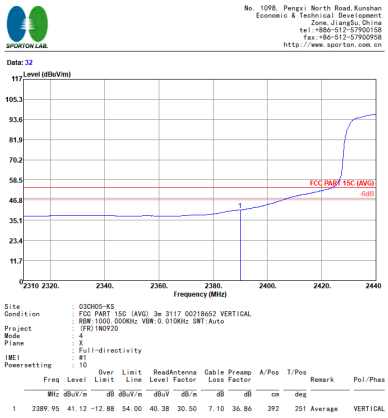
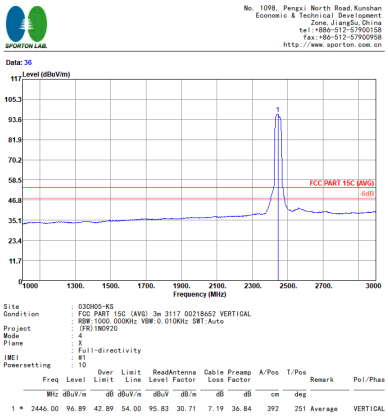
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT40 CH06 2437MHz - R	
1	Horizontal	Fundamental
Peak		Left blank
Avg.		Left blank

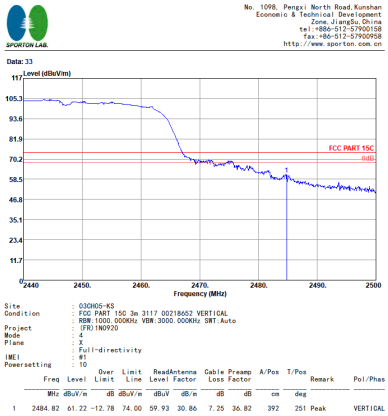
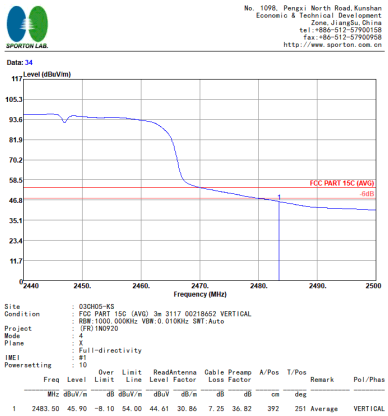
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT40 CH06 2437MHz - L	
1	Vertical	Fundamental
Peak		
Avg.		

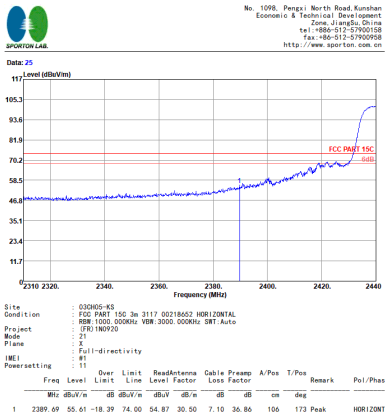
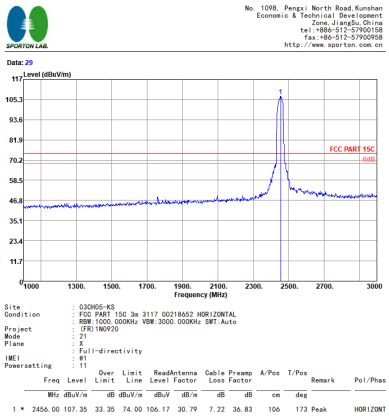
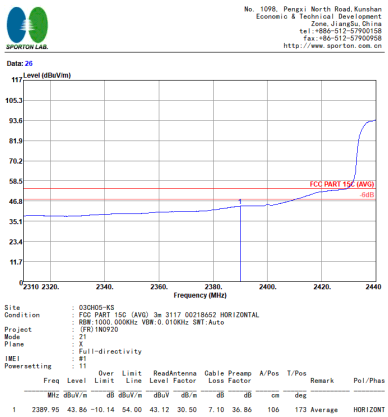
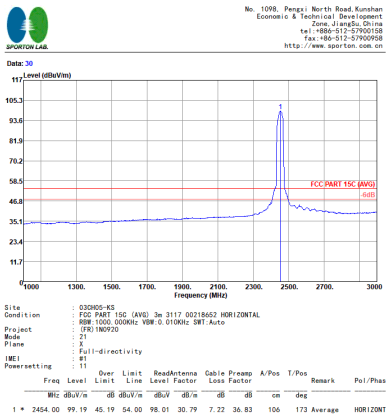
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT40 CH06 2437MHz - R	
1	Horizontal	Fundamental
Peak		Left blank
Avg.		Left blank

WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT40 CH08 2447MHz - L	
1	Horizontal	Fundamental
Peak		
Avg.		

WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT40 CH08 2447MHz - R	
1	Horizontal	Fundamental
Peak		Left blank
Avg.		Left blank

WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT40 CH08 2447MHz - L	
1	Vertical	Fundamental
Peak		
Avg.		

WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT40 CH08 2447MHz - R	
1	Horizontal	Fundamental
Peak		Left blank
Avg.		Left blank

WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT40 CH09 2452MHz - L	
1	Horizontal	Fundamental
Peak		
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