FCC Test Report

Report No.: AGC15705230930FR02

FCC ID	:	2BCO8-TF15EX-RID
APPLICATION PURPOSE	:	Original Equipment
PRODUCT DESIGNATION	:	GPS OBSTACLE AVOIDANCE DRONE
BRAND NAME	:	TRIPLEFINE
MODEL NAME	:	TF15-EX, TF770
APPLICANT	:	Guangzhou Xingde Industrial Development Co., LTD
DATE OF ISSUE	:	Oct. 19, 2023
STANDARD(S)	:	FCC Part 15 Subpart E §15.407
REPORT VERSION	:	V1.0

Attestation of Global Compliance (Shenzhen) Co., Ltd

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Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Oct. 19, 2023	Valid	Initial Release

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Table of Contents

1. General Information 5
2. Product Information 6
2.1 Product Technical Description 6
2.2 Table of Carrier Frequency 7
2.3 IEEE 802.11n Modulation Scheme 7
2.4 Related Submittal(S) / Grant (S) 8
2.5 Test Methodology 8
2.6 Special Accessories 8
2.7 Equipment Modifications 8
2.8 Antenna Requirement 8
2.9 Description of Available Antennas 9
2.10 Description of Test Software 10
3. Test Environment 11
3.1 Address of The Test Laboratory 11
3.2 Test Facility 11
3.3 Environmental Conditions 12
3.4 Measurement Uncertainty 12
3.5 List of Equipment Used 13
4.System Test Configuration 15
4.1 EUT Configuration 15
4.2 EUT Exercise 15
4.3 Configuration of Tested System 15
4.4 Equipment Used in Tested System 15
4.5 Summary of Test Results 16
5. Description of Test Modes 17
6. Duty Cycle Measurement 19
7. RF Output Power Measurement 21
7.1 Provisions Applicable 21
7.2 Measurement Procedure 21
7.3 Measurement Setup (Block Diagram of Configuration) 22
7.4 Measurement Result 22
8. 6dB&26dB Bandwidth Measurement 24
8.1 Provisions Applicable 24
8.2 Measurement Procedure 24
8.3 Measurement Setup (Block Diagram of Configuration) 24

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8.4 Measurement Results 25
9. Power Spectral Density Measurement 35
9.1 Provisions Applicable 35
9.2 Measurement Procedure 35
9.3 Measurement Setup (Block Diagram of Configuration) 35
9.4 Measurement Result 36
10. Conducted Band Edge and Out-of-Band Emissions 46
10.1 Provisions Applicable 46
10.2 Measurement Procedure 46
10.3 Measurement Setup (Block Diagram of Configuration) 46
10.4 Measurement Results 47
11. Radiated Spurious Emission 57
11.1 Measurement Limit 57
11.2 Measurement Procedure 58
11.3 Measurement Setup (Block Diagram of Configuration) 60
11.4 Measurement Result 61
12. AC Power Line Conducted Emission Test 69
12.1 Measurement limit 69
12.2 Block Diagram of Line Conducted Emission Test 69
12.3 Preliminary Procedure of Line Conducted Emission Test 70
12.4 Final Procedure of Line Conducted Emission Test 70
12.5 Test Result of Line Conducted Emission Test 70
Appendix I: Photographs of Test Setup 71
Appendix II: Photographs of EUT 71

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1. General Information

Applicant	Guangzhou Xingde Industrial Development Co., LTD
Address	Room 301, No. 2, Yingcai Street, Tianhe District, Guangzhou City, Guangdong province, China
Manufacturer	HK TECH SCIENCE&TECHNOLOGY CO., LTD
Address	Chenghai District Laimeilu South Union Industrial Park B District 4 South Building, Shantou City, Guangdong Province, China
Factory	Guangzhou Xingde Industrial Development Co., LTD
Address	Room 301, No. 2, Yingcai Street, Tianhe District, Guangzhou City, Guangdong province, China
Product Designation	GPS OBSTACLE AVOIDANCE DRONE
Brand Name	TRIPLEFINE
Test Model	TF15-EX
Series Model(s)	TF770
Difference Description	All the series models are the same as the test model except for the model names, the color of appearance and the packing.
Date of receipt of test item	Sep. 12, 2023
Date of Test	Sep. 12, 2023 - Oct.19, 2023
Deviation from Standard	No any deviation from the test method
Condition of Test Sample	Normal
Test Result	Pass
Test Report Form No	AGCER-FCC-5G WLAN-V1

Note: The test results of this report relate only to the tested sample identified in this report.

Prepared By	Bibo Zhang (Project Engineer)	Oct. 19, 2023
Reviewed By	Calvin Liu (Reviewer)	Oct. 19, 2023
Approved By	Max Zhang Authorized Officer	Oct. 19, 2023

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2. Product Information

2.1 Product Technical Description

Equipment Type	☐ Outdoor access points ☐ Indoor access points ☐ Fixed P2P access points ☒ Client devices
Operation Frequency	☒ U-NII 1:5150MHz~5250MHz ☐ U-NII 2A: 5250MHz~5350MHz ☐ U-NII 2C:5470MHz~5725MHz ☐ U-NII 3: 5725MHz~5850MHz
DFS Design Type	☐ Master ☐ Slave with radar detection ☒ Slave without radar detection
TPC Function	☐ Yes ☒ No
Hardware Version	V1.0
Software Version	V1.0
Test Frequency Range	For 802.11a/n-HT20/ac-VHT20: 5180~5240MHz
RF Output Power	IEEE 802.11a(HT20):12.74dBm; IEEE 802.11n(HT20):12.45dBm; IEEE 802.11ac(VHT20):10.76dBm
RF Output Power_MIMO	IEEE 802.11nHT(20):14.39dBm; IEEE 802.11ac(VHT20):12.93dBm
Modulation	802.11a/n:(64-QAM, 16-QAM, QPSK, BPSK) OFDM 802.11ac :(256-QAM, 64-QAM, 16-QAM, QPSK, BPSK) OFDM
Data Rate	802.11a:6/9/12/18/24/36/48/54Mbps; 802.11n:up to 300Mbps; 802.11ac:up to 866.6Mbps;
Number of channels	4 channels of U-NII-1 Band
Antenna Designation	Copper tube Antenna
Antenna Gain	Refer to Chapter 2.9 of the report.
Power Supply	DC 11.4V

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2.2 Table of Carrier Frequency

For 5180~5240MHz:

4 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20):

Channel	Frequency	Channel	Frequency
36	5180 MHz	44	5220 MHz
40	5200 MHz	48	5240 MHz

2.3 IEEE 802.11n Modulation Scheme

MCS Index	Nss	Modulation	R	N_{BPSC}	N_{CBPS}		N_{DBPS}		Data rate (Mbps) 800nsGI	
					20MHz	40MHz	20MHz	40MHz	20MHz	40MHz
0	1	BPSK	1/2	1	52	108	26	54	6.5	13.5
1	1	QPSK	1/2	2	104	216	52	108	13.0	27.0
2	1	QPSK	3/4	2	104	216	78	162	19.5	40.5
3	1	16-QAM	1/2	4	208	432	104	216	26.0	54.0
4	1	16-QAM	3/4	4	208	432	156	324	39.0	81.0
5	1	64-QAM	2/3	6	312	648	208	432	52.0	108.0
6	1	64-QAM	3/4	6	312	648	234	489	58.5	121.5
7	1	64-QAM	5/6	6	312	648	260	540	65.0	135.0

Symbol	Explanation
NSS	Number of spatial streams
R	Code rate
NBPSC	Number of coded bits per single carrier
NCBPS	Number of coded bits per symbol
NDBPS	Number of data bits per symbol
GI	Guard interval

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2.4 Related Submittal(S) / Grant (S)

This submittal(s) (test report) is intended for **FCC ID: 2BCO8-TF15EX-RID** filing to comply with the FCC Part 15 requirements.

2.5 Test Methodology

No.	Identity	Document Title
1	FCC 47 CFR Part 2	Frequency allocations and radio treaty matters; general rules and regulations
2	FCC 47 CFR Part 15	Radio Frequency Devices
3	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
4	KDB 662911	662911 D01 Multiple Transmitter Output v02r01
5	KDB 789033	789033 D02 General U-NII Test Procedures New Rules v02r01

2.6 Special Accessories

Refer to section 4.4.

2.7 Equipment Modifications

Not available for this EUT intended for grant.

2.8 Antenna Requirement

Standard Requirement
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.
EUT Antenna:
The non-detachable antenna inside the device cannot be replaced by the user at will. The gain of the antenna refer to Section 2.9 of the report

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2.9 Description of Available Antennas

Antenna Type	Frequency Band (MHz)	TX Paths	Bandwidth (MHz)	Max Peak Gain (dBi)		Max Directional Gain (dBi)
				Ant 1	Ant 2	
5G WIFI Copper tube Antenna List (5GHz 2*2 MIMO)						
Copper tube Antenna	5150 ~ 5250	2	20	2.4	2.4	5.41

Note 1: The EUT supports Cyclic Delay Diversity (CDD) technology for 802.11n/ac mode.

Note 2: The EUT supports Cyclic Delay Diversity (CDD) mode, and CDD signals are correlated.

If all antennas have the same gain, G_{ANT}, Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows.

- For power spectral density (PSD) measurements on devices:

  Array Gain = 10 log (N_{ANT}/ N_{SS}) dB = 3.01;

- For power measurements on IEEE 802.1devices:

  Array Gain = 0 dB for $N_{ANT} \leq 4$;

  Array Gain = 0 dB (i.e., no array gain) for channel widths ≥40 MHz for any N_{ANT};

  Array Gain = 5 log(N_{ANT}/N_{SS}) dB or 3 dB, whichever is less, for 20 MHz channel widths with $N_{ANT} \geq 5$.

If antenna gains are not equal, Directional gain may be calculated by using the formulas applicable to equal gain antennas with G_{ANT} set equal to the gain of the antenna having the highest gain.

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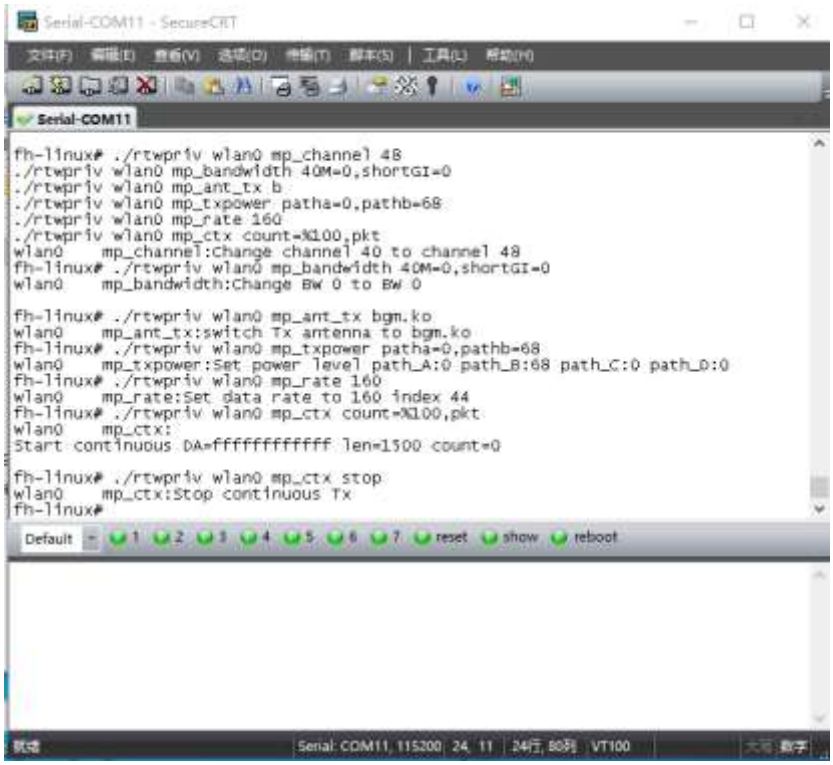
2.11 Description of Test Software

<u>For IEEE 802.11 mode:</u>

The test utility software used during testing was “SecureCRT”, and the version was “x86 7.1.1.264”.

Software Setting Diagram



Test Mode	Channel	Power Index	
		Chain 1	Chain 2
802.11a	L/M/H	60	60
802.11n(HT20)	L/M/H	60	60
802.11ac(VHT20)	L/M/H	60	60

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3. Test Environment

3.1 Address of The Test Laboratory

Laboratory: Attestation of Global Compliance (Shenzhen) Co., Ltd.

Address: 1-2/F, Building 19, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

3.2 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: L5488

Attestation of Global Compliance (Shenzhen) Co., Ltd. has been assessed and proved to follow CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories.)

A2LA-Lab Cert. No.: 5054.02

Attestation of Global Compliance (Shenzhen) Co., Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to follow ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

FCC-Registration No.: 975832

Attestation of Global Compliance (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files with Registration 975832.

IC-Registration No.: 24842 (CAB identifier: CN0063)

Attestation of Global Compliance (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the Certification and Engineering Bureau of Industry Canada. The acceptance letter from the IC is maintained in our files with Registration 24842.

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3.3 Environmental Conditions

	Normal Conditions
Temperature range (℃)	15 - 35
Relative humidity range	20% - 75%
Pressure range (kPa)	86 - 106
Power supply	11.4V

3.4 Measurement Uncertainty

The reported uncertainty of measurement y ±U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Item	Measurement Uncertainty
Uncertainty of Conducted Emission for AC Port	U_c = ±2.9 dB
Uncertainty of Radiated Emission below 1GHz	U_c = ±3.9 dB
Uncertainty of Radiated Emission above 1GHz	U_c = ±4.9 dB
Uncertainty of total RF power, conducted	U_c = ±0.8 dB
Uncertainty of RF power density, conducted	U_c = ±2.6 dB
Uncertainty of spurious emissions, conducted	U_c = ±2 %
Uncertainty of Occupied Channel Bandwidth	U_c = ±2.7 %

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3.5 List of Equipment Used

● RF Conducted Test System							
Used	Equipment No.	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
☒	AGC-ER-E036	Spectrum Analyzer	Agilent	N9020A	MY49100060	2023-06-01	2024-05-31
☒	AGC-ER-E062	Power Sensor	Agilent	U2021XA	MY54110007	2023-03-03	2024-03-02
☒	AGC-ER-E063	Power Sensor	Agilent	U2021XA	MY54110009	2023-03-03	2024-03-02
☒	AGC-EM-A152	6dB Attenuator	Eeatsheep	LM-XX-6-5W	N/A	2023-06-09	2024-06-08
☒	AGC-ER-E083	Signal Generator	Agilent	E4421B	US39340815	2023-06-01	2024-05-31
☒	N/A	RF Connection Cable	N/A	1#	N/A	Each time	N/A
☒	N/A	RF Connection Cable	N/A	2#	N/A	Each time	N/A

● Radiated Spurious Emission							
Used	Equipment No.	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
☒	AGC-EM-E046	EMI Test Receiver	R&S	ESCI	10096	2023-02-18	2024-02-17
☐	AGC-EM-E116	EMI Test Receiver	R&S	ESCI	100034	2023-06-03	2024-06-02
☒	AGC-EM-E061	Spectrum Analyzer	Agilent	N9010A	MY53470504	2023-06-01	2024-05-31
☒	AGC-EM-E086	Loop Antenna	ZHINAN	ZN30900C	18051	2022-03-12	2024-03-11
☒	AGC-EM-E001	Wideband Antenna	SCHWARZBECK	VULB9168	D69250	2023-05-11	2025-05-10
☒	AGC-EM-E029	Broadband Ridged Horn Antenna	ETS	3117	00034609	2023-03-23	2024-03-22
☒	AGC-EM-E082	Horn Antenna	SCHWARZBECK	BBHA 9170	#768	2021-10-31	2023-10-30
☒	AGC-EM-E146	Pre-amplifier	ETS	3117-PA	00246148	2022-08-04	2024-08-03
☒	AGC-EM-A118	5G Filter	SongYi	N/A	N/A	2023-06-01	2024-05-31
☒	AGC-EM-A138	6dB Attenuator	Eeatsheep	LM-XX-6-5W	N/A	2023-06-09	2024-06-08
☐	AGC-EM-A139	6dB Attenuator	Eeatsheep	LM-XX-6-5W	N/A	2023-06-09	2024-06-08

● AC Power Line Conducted Emission							
Used	Equipment No.	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
☐	AGC-EM-E045	EMI Test Receiver	R&S	ESPI	101206	2023-06-03	2024-06-02
☐	AGC-EM-E023	AMN	R&S	100086	ESH2-Z5	2023-06-03	2024/06/02

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● Test Software					
Used	Equipment No.	Test Equipment	Manufacturer	Model No.	Version Information
☒	AGC-EM-S003	RE-Test System	FARA	EZ-EMC	VRA-03A
☒	AGC-ER-S012	BT/WIFI-Test System	Tonscend	JS1120-2	2.6
☒	AGC-EM-S011	RSE Test System	Tonscend	TS+-Ver2.1(JS36-RSE)	4.0.0.0

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4.System Test Configuration

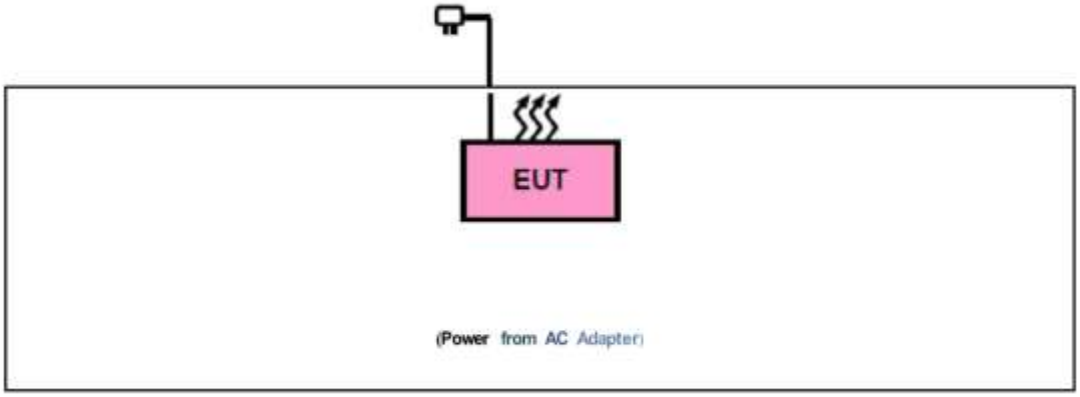
4.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commission's requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

4.2 EUT Exercise

The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

4.3 Configuration of Tested System



4.4 Equipment Used in Tested System

The following peripheral devices and interface cables were connected during the measurement:

☐ Test Accessories Come From The Laboratory

No.	Equipment	Model No.	Manufacturer	Specification Information	Cable
1	-	-	-	-	-

☐ Test Accessories Come From The Manufacturer

No.	Equipment	Model No.	Manufacturer	Specification Information	Cable
1	-	-	-	-	-

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4.5 Summary of Test Results

Item	FCC Rules	Description Of Test	Result
1	§15.203	Antenna Equipment	Pass
2	§15.407(a)(1)	RF Output Power	Pass
3	§15.407(e)	6dB Bandwidth Measurement	Not applicable
4	§2.1049	26dB bandwidth Measurement	Pass
5	§15.407(a)(1)	Power Spectral Density	Pass
6	§15.407(b)(1)	Conducted Spurious Emission	Pass
7	§15.209,§15.407(b)(4)	Radiated Emission& Band Edge	Pass
8	§15.207	AC Power Line Conducted Emission	Not applicable

Note: Typical RF working state, unable to operate normally during charging.

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5. Description of Test Modes

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE > 1G	RE < 1G	PLC	APCM	
A	--	--	☒	--	Powered by Adapter with WIFI(5G) Link
B	☒	☒	--	☒	Powered by Battery with WIFI(5G) Link
C	--	--	--	--	Powered by USB with WIFI(5G) Link

Where, **RE > 1G: Radiated Emission above 1GHz** **PLC: Power Line Conducted Emission**

RE < 1G: Radiated Emission below 1GHz **APCM: Antenna Port Conducted Measurement**

NOTE 1: The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on X-plane.

NOTE 2: "--"means no effect.

NOTE 3: The radiation part tests the dual-antenna MIMO as the worst combination.

Radiated Emission Test (Above 1GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations be Meen available modulations, data rates and antenna ports (IF EUT with antenna diversity architecture).

☒ The equipment under test has multiple antennas, and only the MIMO mode is recorded as the worst.

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Freq. Band (MHz)	Available Channel	Tested Channel	Modulation	Data Rate (Mbps)
B	802.11n (20MHz)	5180-5240	36 to 48	36, 40, 48	OFDM	MCS0

Radiated Emission Test (Below 1GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations be Meen available modulations, data rates and antenna ports (If EUT with antenna diversity architecture).

☒ The equipment under test has multiple antennas, and only the MIMO mode is recorded as the worst.

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Freq. Band (MHz)	Available Channel	Tested Channel	Modulation	Data Rate (Mbps)
B	802.11n(20MHz)	5180-5240	36 to 48	36	OFDM	MCS0

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Power Line Conducted Emission Test:

☐ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations be Meen available modulations, data rates and antenna ports (If EUT with antenna diversity architecture).
☐ The equipment under test has multiple antennas, and only the MIMO mode is recorded as the worst.
☐ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Freq. Band (MHz)	Available Channel	Tested Channel	Modulation	Data Rate (Mbps)
A	802.11n(20MHz)	5180-5240	36 to 48	36	OFDM	MCS0

Bandedge Measurement:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations be Meen available modulations, data rates and antenna ports (If EUT with antenna diversity architecture).
☒ The equipment under test has multiple antennas, and only the MIMO mode is recorded as the worst.
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Freq. Band (MHz)	Available Channel	Tested Channel	Modulation	Data Rate (Mbps)
B	802.11n (20MHz)	5180-5240	36 to 48	36, 40, 48	OFDM	MCS0

Antenna Port Conducted Measurement:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations be Meen available modulations, data rates and antenna ports (If EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Freq. Band (MHz)	Available Channel	Tested Channel	Modulation	Data Rate (Mbps)
B	802.11a	5180-5240	36 to 48	36, 40, 48	OFDM	6.0
B	802.11n (20MHz)		36 to 48	36, 40, 48	OFDM	MCS0
B	802.11ac (20MHz)		36 to 48	36, 40, 48	OFDM	MCS9

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6. Duty Cycle Measurement

5GHz WLAN (NII) operation is possible in 20MHz channel bandwidths. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = Peak. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Operating mode	Data rates (Mbps)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)	Average Factor (dB)
IEEE 802.11a	6	93.27	0.30	0.48	-0.61
IEEE 802.11n-HT20	MCS0	92.34	0.35	0.52	-0.69
IEEE 802.11ac-VHT20	MCS9	87.44	0.58	1.06	-1.17

Remark:

1. Duty Cycle factor = 10 * log (1/ Duty cycle)
2. Average factor = 20 log10 Duty Cycle
3. The duty cycle of each frequency band mode reflects the determination requirements of the low channel measurement value.
4. Involving the test items of duty cycle compensation coefficient, the final results of Power and PSD have been added and calculated by the software and presented.

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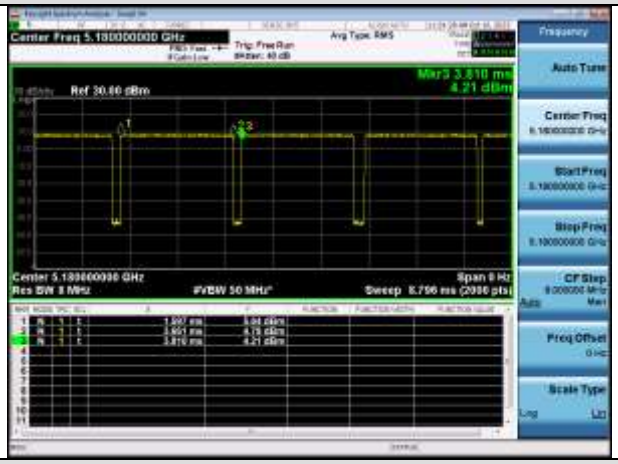
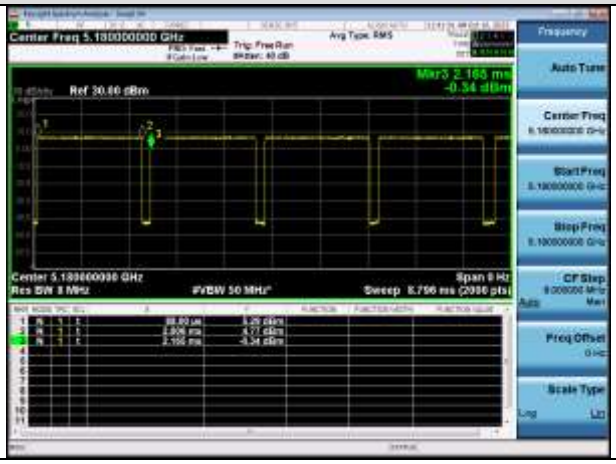
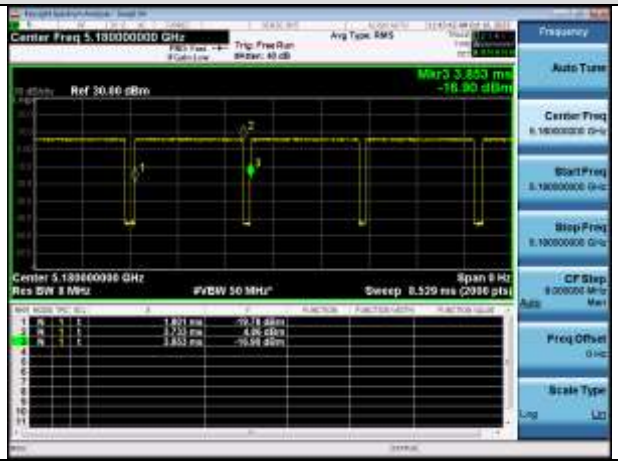
The test plots as follows:

IEEE 802.11a	IEEE 802.11n-HT20
	

IEEE 802.11ac-VHT20


Any report having not been signed by authorized approver, or having been altered without authorization, or having not been stamped by the "Dedicated Testing/Inspection Stamp" is deemed to be invalid. Copying or excerpting portion of, or altering the content of the report is not permitted without the written authorization of AGC. The test results presented in the report apply only to the tested sample. Any objections to report issued by AGC should be submitted to AGC within 15days after the issuance of the test report. Further enquiry of validity or verification of the test report should be addressed to AGC by agc01@agccert.com.

7. RF Output Power Measurement

7.1 Provisions Applicable

Operation Band	EUT Category		LIMIT
U-NII-1	☐	Outdoor Access Point	1 Watt (30 dBm) (Max. e.i.r.p < 125mW(21 dBm) at any elevation angle above 30 degrees as measured from the horizon)
	☐	Fixed point-to-point Access Point	1 Watt (30 dBm)
	☐	Indoor Access Point	1 Watt (30 dBm)
	☒	Client devices	250mW (23.98 dBm)

Note: Where B is the 26dB emission bandwidth in MHz.

7.2 Measurement Procedure

☒Method PM is Measurement using an RF average power meter. The procedure for this method is as follows:

1. The testing follows the ANSI C63.10 Section 12.3.3.1
2. Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the following conditions are satisfied:
3. The EUT is configured to transmit continuously, or to transmit with a constant duty cycle.
4. At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.
5. The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
6. Determine according to the duty cycle of the equipment: when it is less than 98%, follow the steps below.
7. Measure the average power of the transmitter. This measurement is an average over both the ON and OFF periods of the transmitter.
8. Adjust the measurement in dBm by adding [10 log (1 / D)], where D is the duty cycle {e.g., [10 log (1 / 0.25)], if the duty cycle is 25%}.
9. Record the test results in the report.

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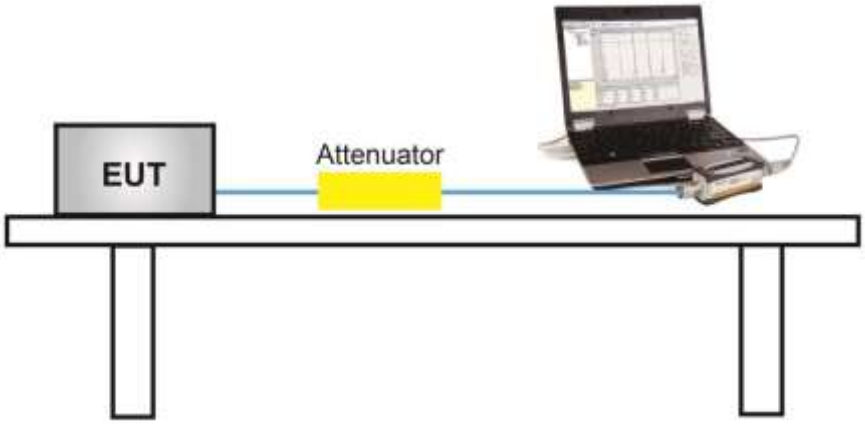
7.3 Measurement Setup (Block Diagram of Configuration)



7.4 Measurement Result

Test Data of Conducted Output Power for band 5.15-5.25 GHz-ANT 1				
Test Mode	Test Channel (MHz)	Average Power (dBm)	Limits (dBm)	Pass or Fail
802.11a	5180	10.97	23.98	Pass
	5200	9.19	23.98	Pass
	5240	8.99	23.98	Pass
802.11n20	5180	9.96	23.98	Pass
	5200	9.22	23.98	Pass
	5240	9.27	23.98	Pass
802.11ac20	5180	8.87	23.98	Pass
	5200	8.76	23.98	Pass
	5240	8.87	23.98	Pass

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Test Data of Conducted Output Power for band 5.15-5.25 GHz-ANT 2				
Test Mode	Test Channel (MHz)	Average Power (dBm)	Limits (dBm)	Pass or Fail
802.11a	5180	12.74	23.98	Pass
	5200	10.26	23.98	Pass
	5240	9.83	23.98	Pass
802.11n20	5180	12.45	23.98	Pass
	5200	11.46	23.98	Pass
	5240	10.92	23.98	Pass
802.11ac20	5180	10.76	23.98	Pass
	5200	10.59	23.98	Pass
	5240	9.60	23.98	Pass

Test Data of Conducted Output Power for band 5.15-5.25 GHz-MIMO				
Test Mode	Test Channel (MHz)	Average Power (dBm)	Limits (dBm)	Pass or Fail
802.11n20	5180	14.39	23.98	Pass
	5200	13.49	23.98	Pass
	5240	13.18	23.98	Pass
802.11ac20	5180	12.93	23.98	Pass
	5200	12.78	23.98	Pass
	5240	12.26	23.98	Pass

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8. 6dB&26dB Bandwidth Measurement

8.1 Provisions Applicable

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

8.2 Measurement Procedure

◆ **-6dB bandwidth (DTS bandwidth) Test setting:**

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on operation frequency individually.
3. Set RBW = 100kHz.
4. Set the VBW ⩾3*RBW. Detector = Peak. Trace mode = max hold.
5. Measure the maximum width of the emission that is 6 dB down from the peak of the emission.

◆ **99% occupied bandwidth test setting:**

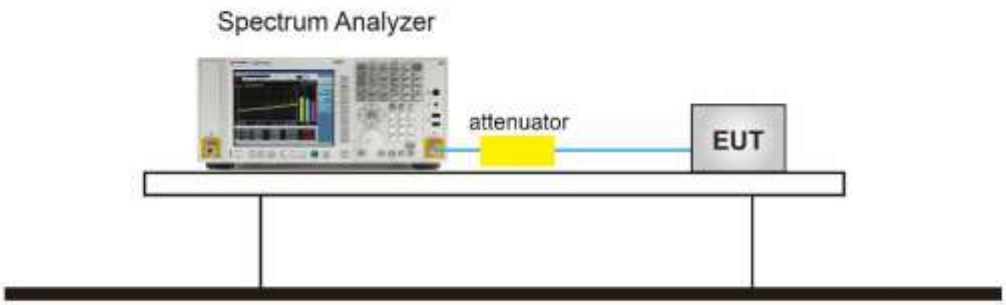
1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, the middle and the bottom operation frequency individually.
3. Set Span = approximately 1.5 to 5 times the OBW, centered on a nominal channel
   The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW; Sweep = auto; Detector function = peak
4. Set SPA Trace 1 Max hold, then View.

◆ **-26dB Bandwidth test setting:**

1. Set RBW = approximately 1% of the emission bandwidth.
2. Set the VBW > RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

Note: The EUT was tested according to KDB 789033 for compliance to FCC 47CFR 15.407 requirements.

8.3 Measurement Setup (Block Diagram of Configuration)



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8.4 Measurement Results

Test Data of Occupied Bandwidth and -26dB Bandwidth for band 5.15-5.25 GHz-ANT 1					
Test Mode	Test Channel (MHz)	99% Occupied Bandwidth (MHz)	-26dB Bandwidth (MHz)	Limits (MHz)	Pass or Fail
802.11a	5180	16.335	18.395	N/A	Pass
	5200	16.347	18.311	N/A	Pass
	5240	16.321	18.182	N/A	Pass
802.11n20	5180	17.501	19.176	N/A	Pass
	5200	17.515	19.280	N/A	Pass
	5240	17.517	19.333	N/A	Pass
802.11ac20	5180	17.522	19.212	N/A	Pass
	5200	17.519	19.254	N/A	Pass
	5240	17.516	19.201	N/A	Pass

Test Data of Occupied Bandwidth and -26dB Bandwidth for band 5.15-5.25 GHz-ANT 2					
Test Mode	Test Channel (MHz)	99% Occupied Bandwidth (MHz)	-26dB Bandwidth (MHz)	Limits (MHz)	Pass or Fail
802.11a	5180	16.332	18.353	N/A	Pass
	5200	16.318	18.237	N/A	Pass
	5240	16.341	18.265	N/A	Pass
802.11n20	5180	17.522	19.313	N/A	Pass
	5200	17.515	19.231	N/A	Pass
	5240	17.518	19.247	N/A	Pass
802.11ac20	5180	17.515	19.257	N/A	Pass
	5200	17.521	19.213	N/A	Pass
	5240	17.509	19.249	N/A	Pass

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Test Graphs of Occupied Bandwidth and -26dB Bandwidth for band 5.15-5.25 GHz

Test_Graph_802.11a_ANT1_5180_6Mbps_OBW

Test_Graph_802.11a_ANT1_5200_6Mbps_OBW

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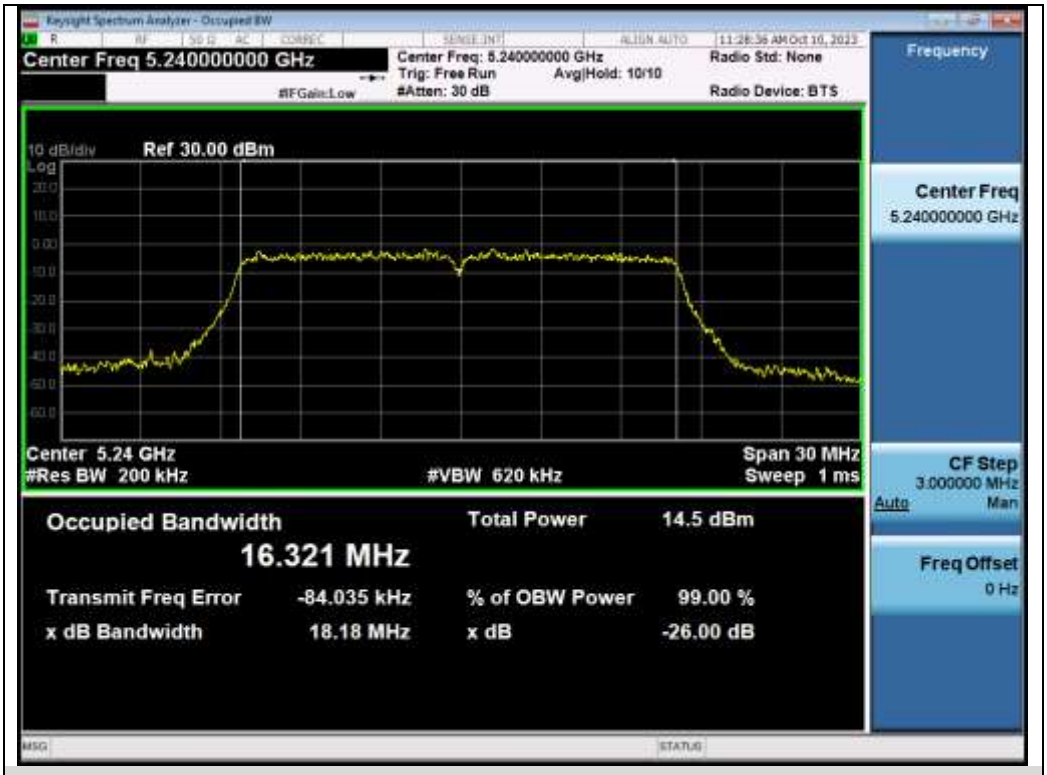
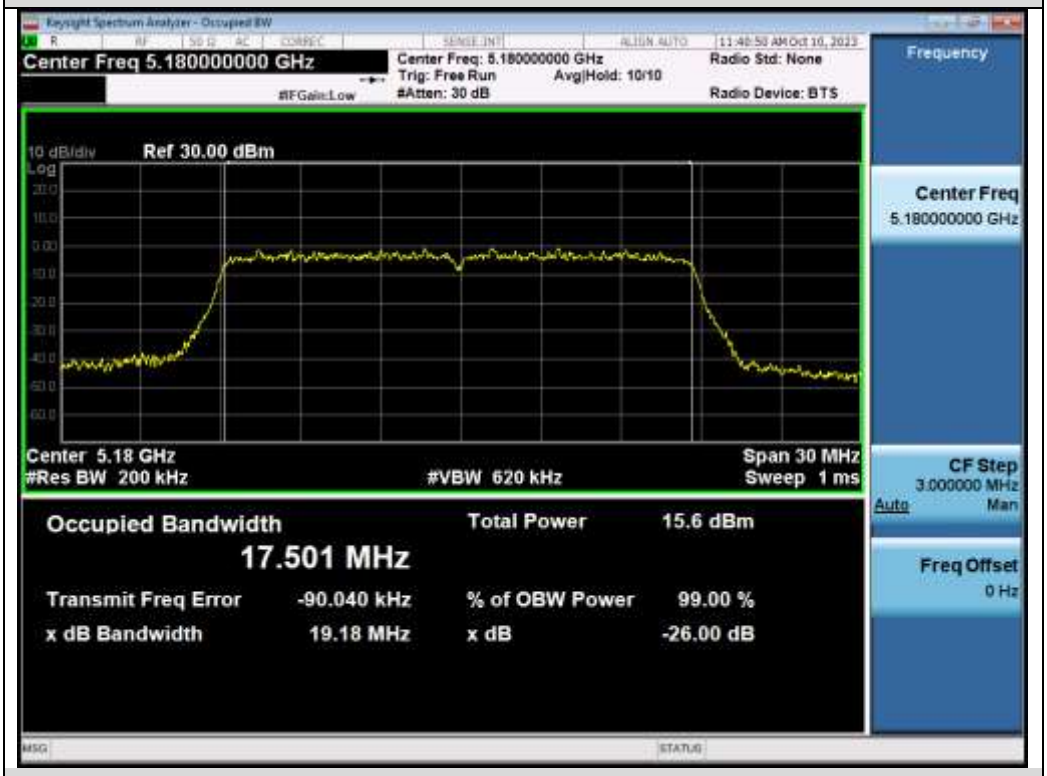


Test_Graph_802.11a_ANT1_5240_6Mbps_OBW



Test_Graph_802.11n20_ANT1_5180_MCS0_OBW

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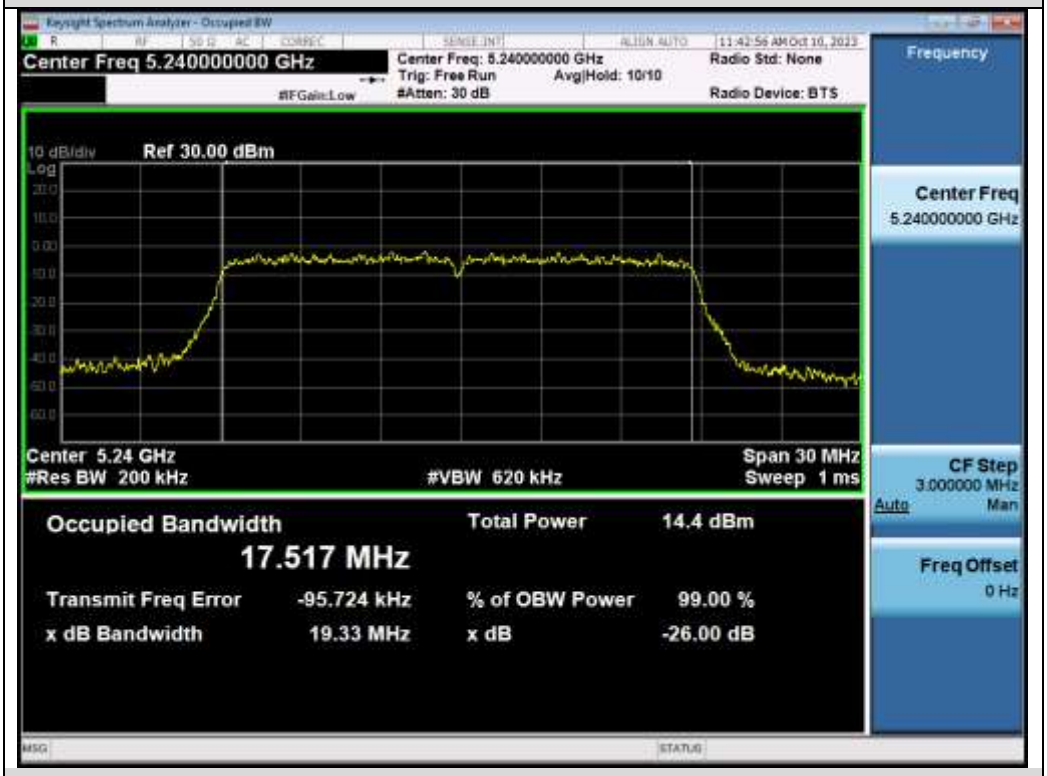
Test_Graph_802.11n20_ANT1_5200_MCS0_OBW



Test_Graph_802.11n20_ANT1_5240_MCS0_OBW

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Test_Graph_802.11ac20_ANT1_5180_MCS0_OBW

Test_Graph_802.11ac20_ANT1_5200_MCS0_OBW

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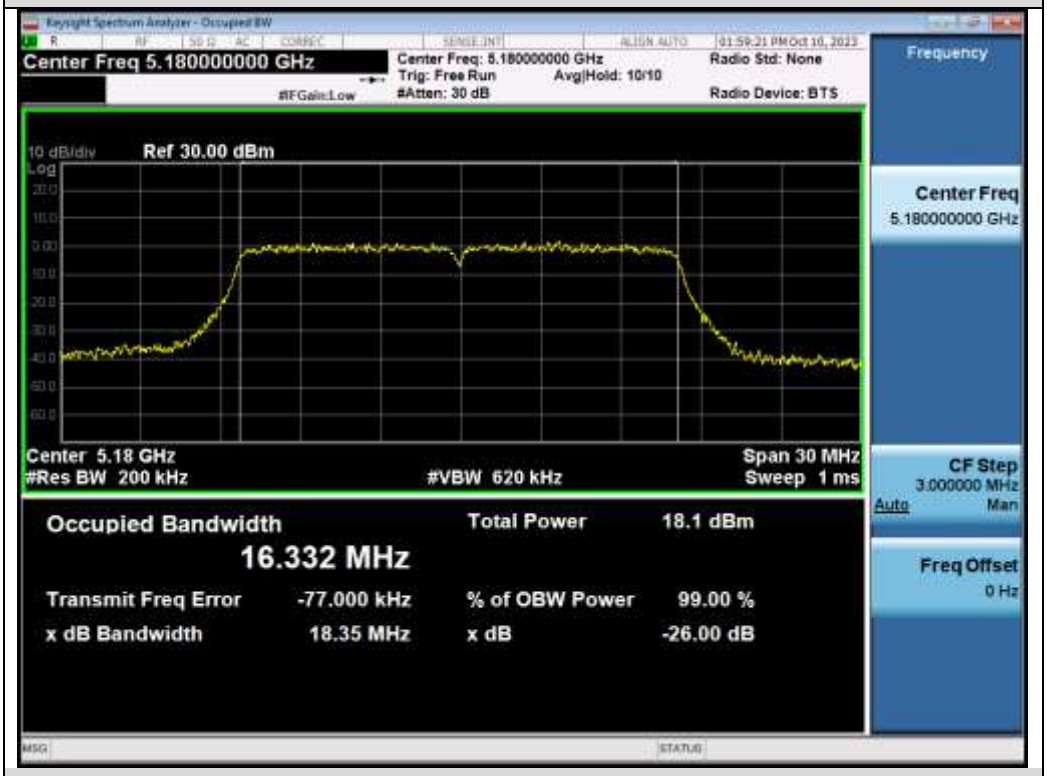
Test_Graph_802.11ac20_ANT1_5240_MCS9_OBW



Test_Graph_802.11a_ANT2_5180_6Mbps_OBW

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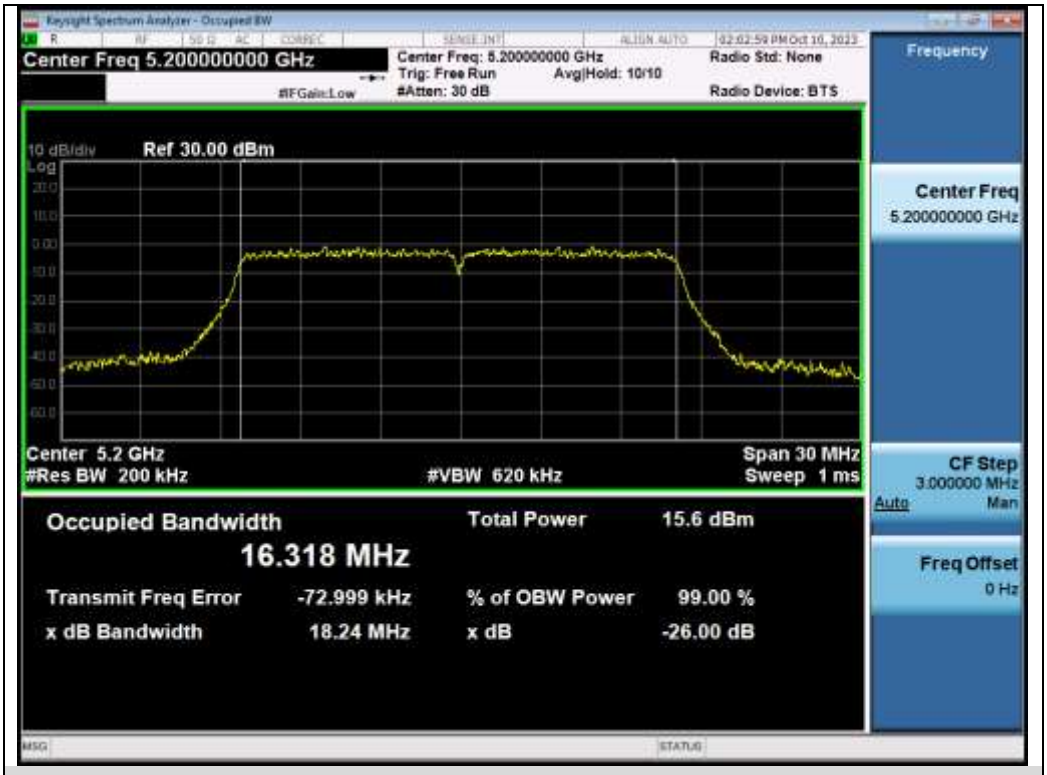
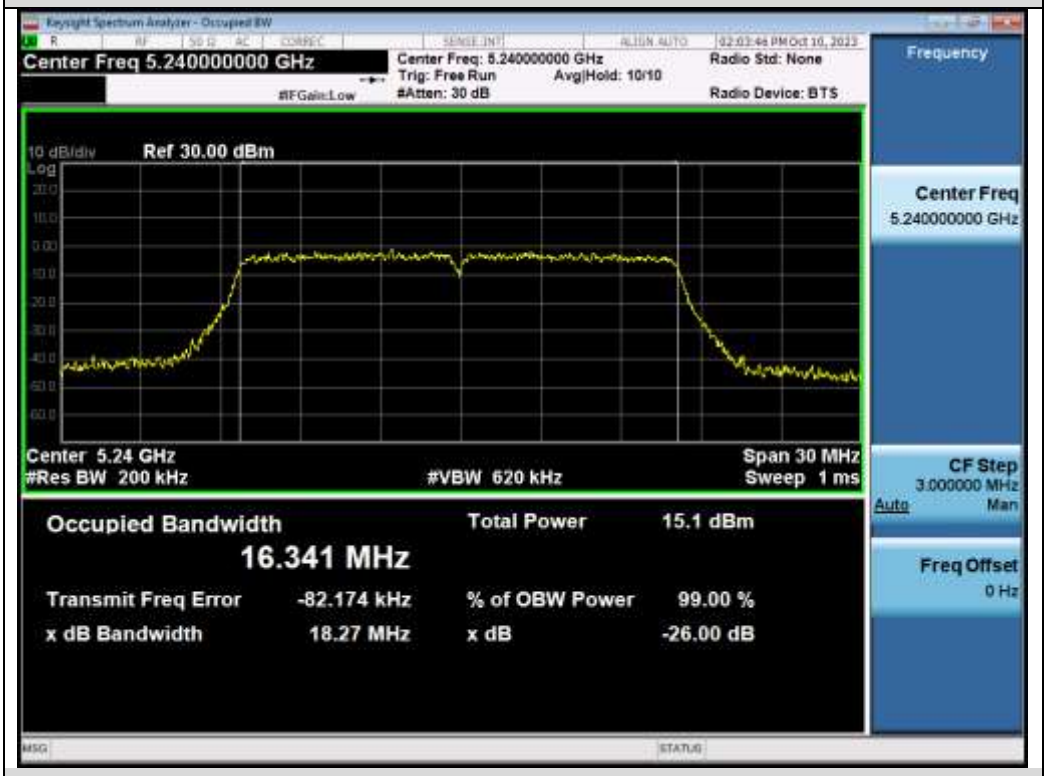


Test_Graph_802.11a_ANT2_5200_6Mbps_OBW



Test_Graph_802.11a_ANT2_5240_6Mbps_OBW

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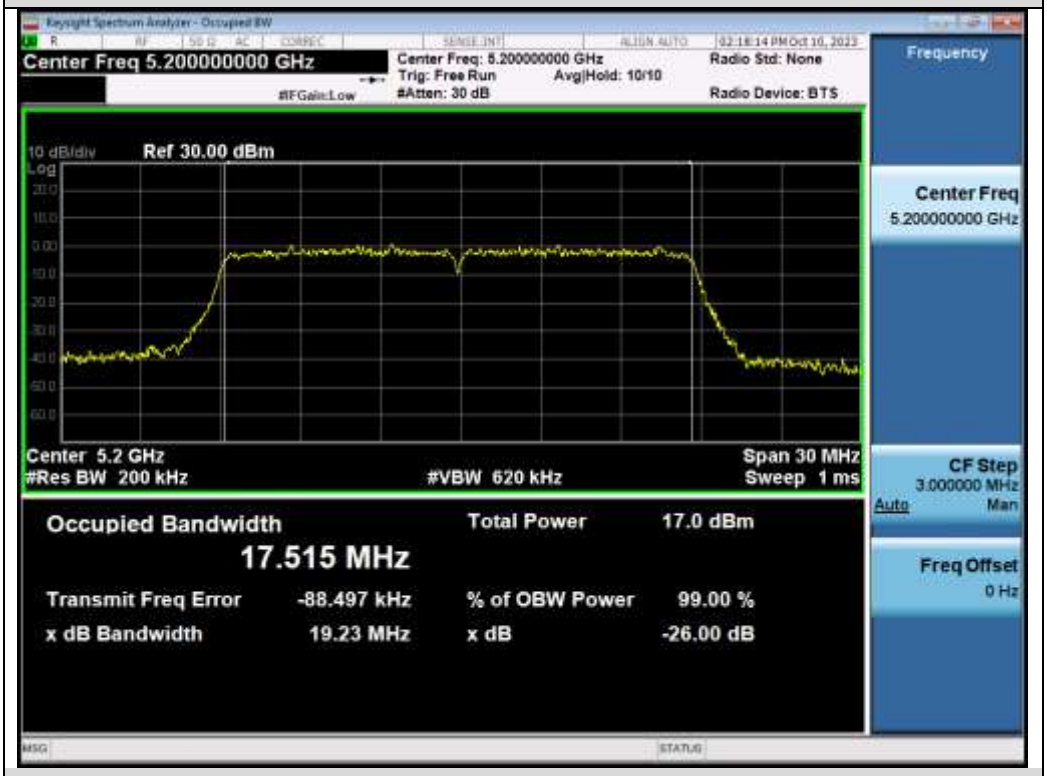
Test_Graph_802.11n20_ANT2_5180_MCS0_OBW



Test_Graph_802.11n20_ANT2_5200_MCS0_OBW

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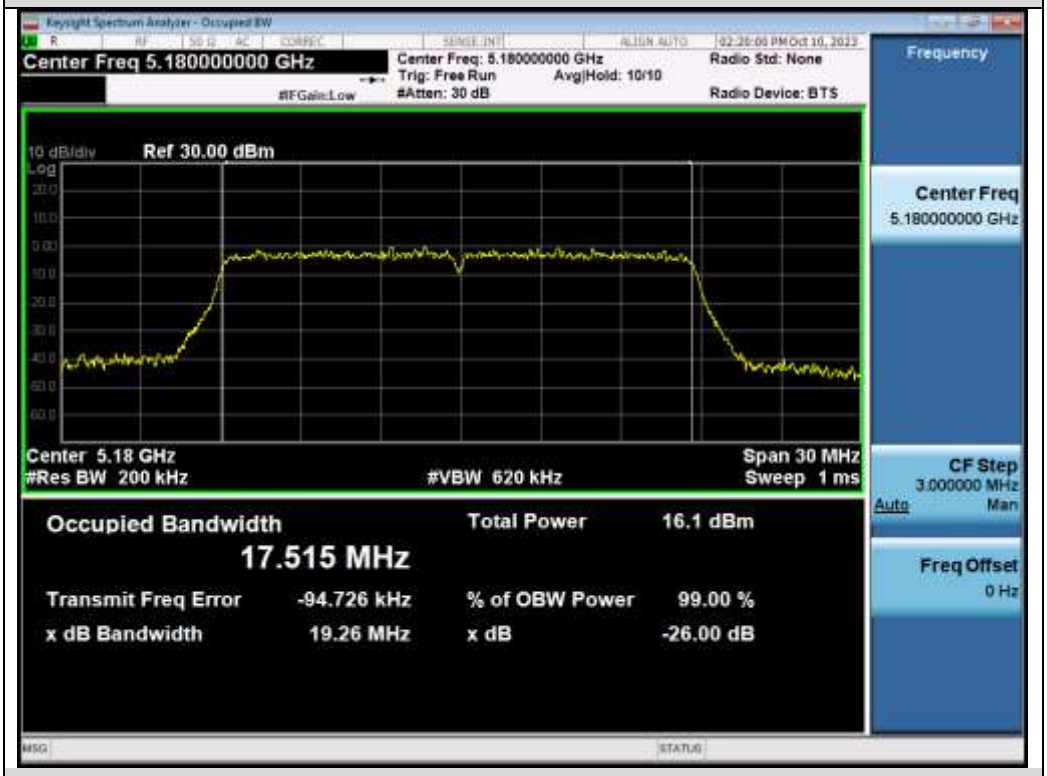
Test_Graph_802.11n20_ANT2_5240_MCS0_OBW



Test_Graph_802.11ac20_ANT2_5180_MCS0_OBW

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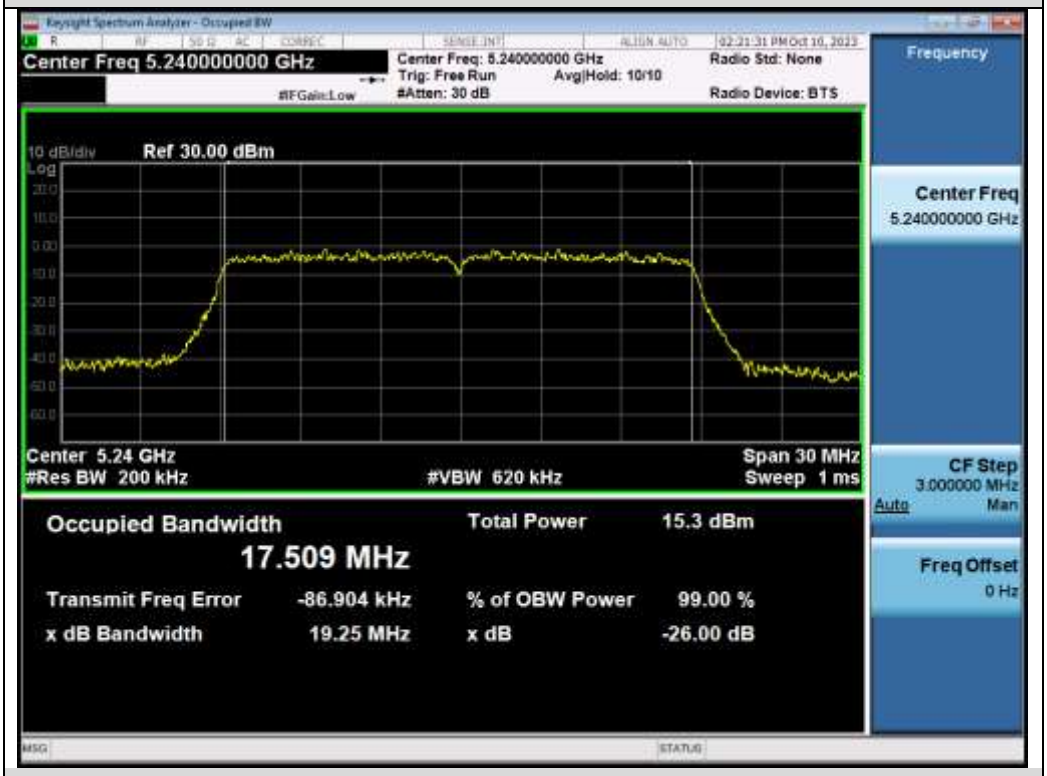
Test_Graph_802.11ac20_ANT2_5200_MCS0_OBW



Test_Graph_802.11ac20_ANT2_5240_MCS9_OBW

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9. Power Spectral Density Measurement

9.1 Provisions Applicable

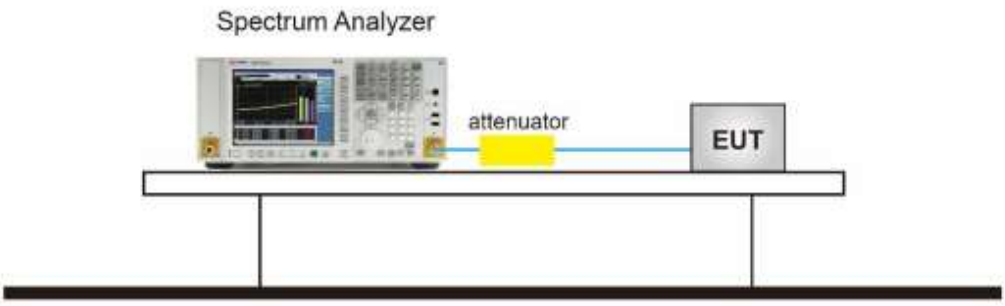
Operation Band	EUT Category		LIMIT
U-NII-1	☐	Outdoor Access Point	17dBm/ MHz
	☐	Fixed point-to-point Access Point	17dBm/ MHz
	☐	Indoor Access Point	17dBm/ MHz
	☒	Client devices	11dBm/ MHz

9.2 Measurement Procedure

☒For Average power spectral density test:

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator.
2. Span was set to encompass the entire 26dB EBW of the signal.
3. RBW = 1MHz.
4. If measurement bandwidth of Maximum PSD is specified in 500 kHz, RBW = 100KHz
5. Set VBW≥[3×RBW].
6. Sweep Time=Auto couple.
7. Detector function=RMS (i.e., power averaging).
8. Trace average at least 100 traces in power averaging (rms) mode.
9. When the measurement bandwidth of Maximum PSD is specified in 100 kHz, add a constant factor 10*log(500kHz/100kHz) = 6.99 dB to the measured result.
10. Determine according to the duty cycle of the equipment: when it is less than 98%, follow the steps below.
11. Add [10 log (1/D)], where D is the duty cycle, to the measured power to compute the average power during the actual transmission times (because the measurement represents an average over both the ON and OFF times of the transmission). For example, add [10 log (1/0.25)] = 6 dB if the duty cycle is 25%.
12. Record the test results in the report.

9.3 Measurement Setup (Block Diagram of Configuration)



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9.4 Measurement Result

Test Data of Conducted Output Power Density for band 5.15-5.25 GHz-ANT 1				
Test Mode	Test Channel (MHz)	Average Power Density (dBm/MHz)	Limits (dBm/MHz)	Pass or Fail
802.11a	5180	-0.177	11	Pass
	5200	-1.816	11	Pass
	5240	-2.084	11	Pass
802.11n20	5180	-1.469	11	Pass
	5200	-2.348	11	Pass
	5240	-2.117	11	Pass
802.11ac20	5180	-2.463	11	Pass
	5200	-2.597	11	Pass
	5240	-2.701	11	Pass

Test Data of Conducted Output Power Density for band 5.15-5.25 GHz-ANT 2				
Test Mode	Test Channel (MHz)	Average Power Density (dBm/MHz)	Limits (dBm/MHz)	Pass or Fail
802.11a	5180	1.285	11	Pass
	5200	-0.792	11	Pass
	5240	-1.305	11	Pass
802.11n20	5180	0.873	11	Pass
	5200	-0.173	11	Pass
	5240	-0.630	11	Pass
802.11ac20	5180	-0.584	11	Pass
	5200	-0.767	11	Pass
	5240	-1.814	11	Pass

Test Data of Conducted Output Power Density for band 5.15-5.25 GHz-MIMO				
Test Mode	Test Channel (MHz)	Average Power Density (dBm/MHz)	Limits (dBm/MHz)	Pass or Fail
802.11n20	5180	2.868	11	Pass
	5200	1.885	11	Pass
	5240	1.700	11	Pass
802.11ac20	5180	1.588	11	Pass
	5200	1.424	11	Pass
	5240	0.775	11	Pass

Note:The Total PSD(dBm/ MHz) = 10*log {$10^{(\text{Ant 1 PSD}/10)}$ + $10^{(\text{Ant 2 PSD}/10)}$}(dBm/ MHz).

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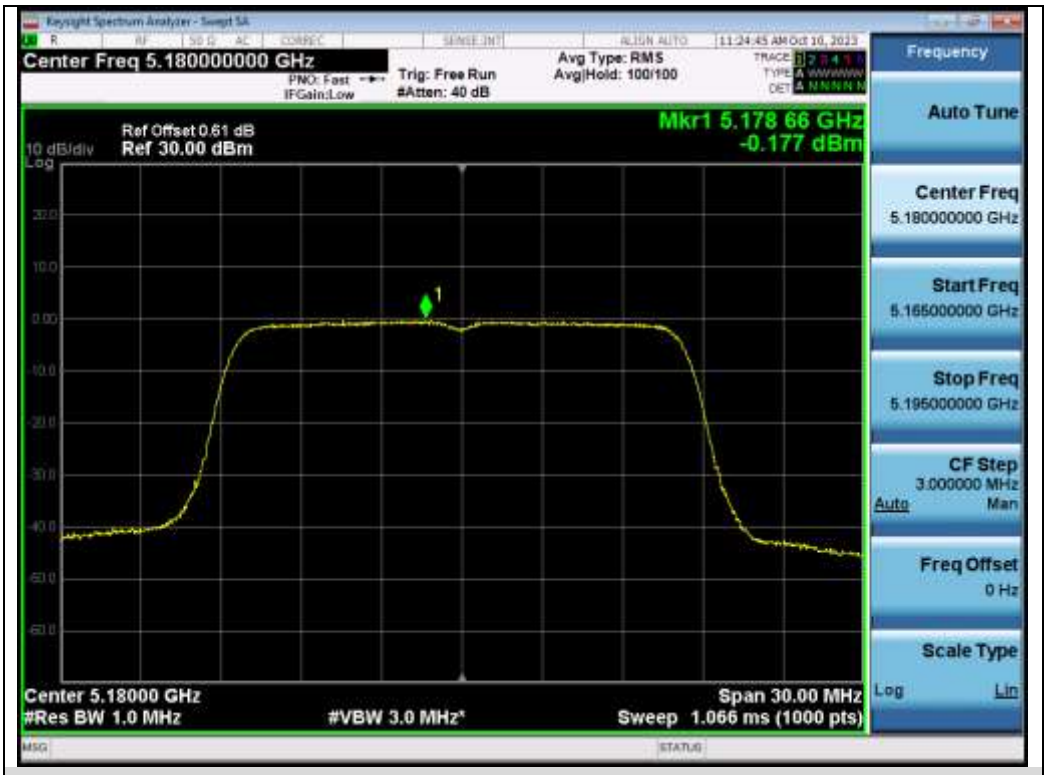
Test Graphs of Conducted Output Power Spectral Density for band 5.15-5.25 GHz



Test_Graph_802.11a_ANT1_5180_6Mbps_PSD

Test_Graph_802.11a_ANT1_5200_6Mbps_PSD

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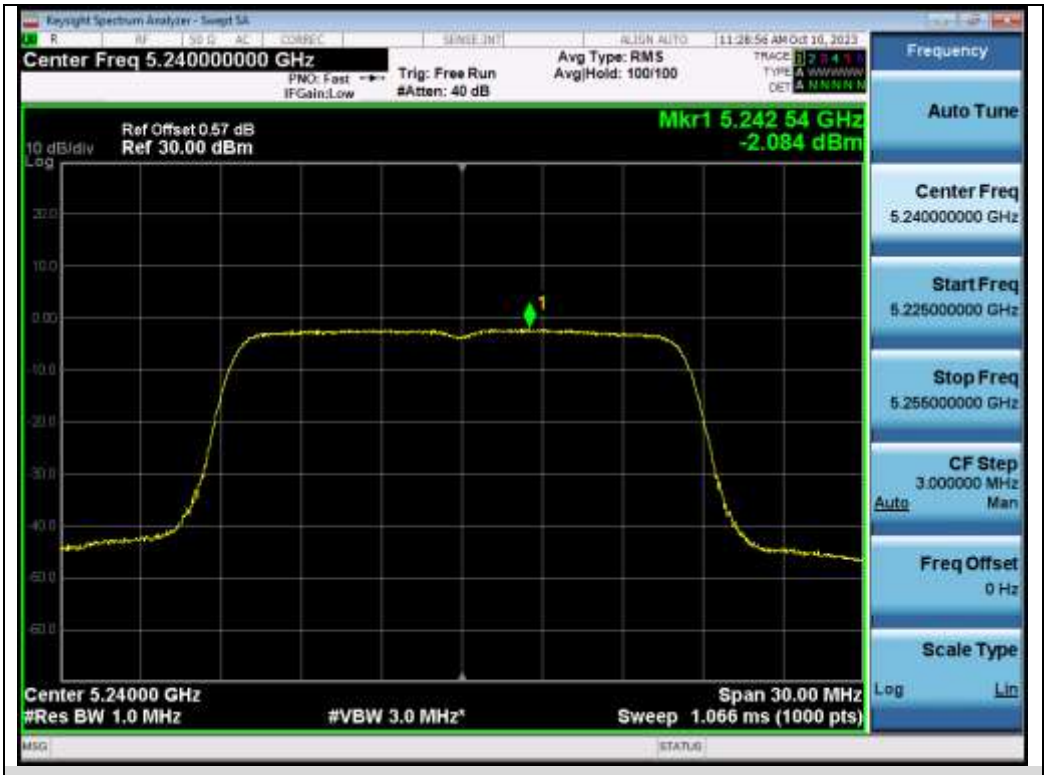

Test_Graph_802.11a_ANT1_5240_6Mbps_PSD

Test_Graph_802.11n20_ANT1_5180_MCS0_PSD

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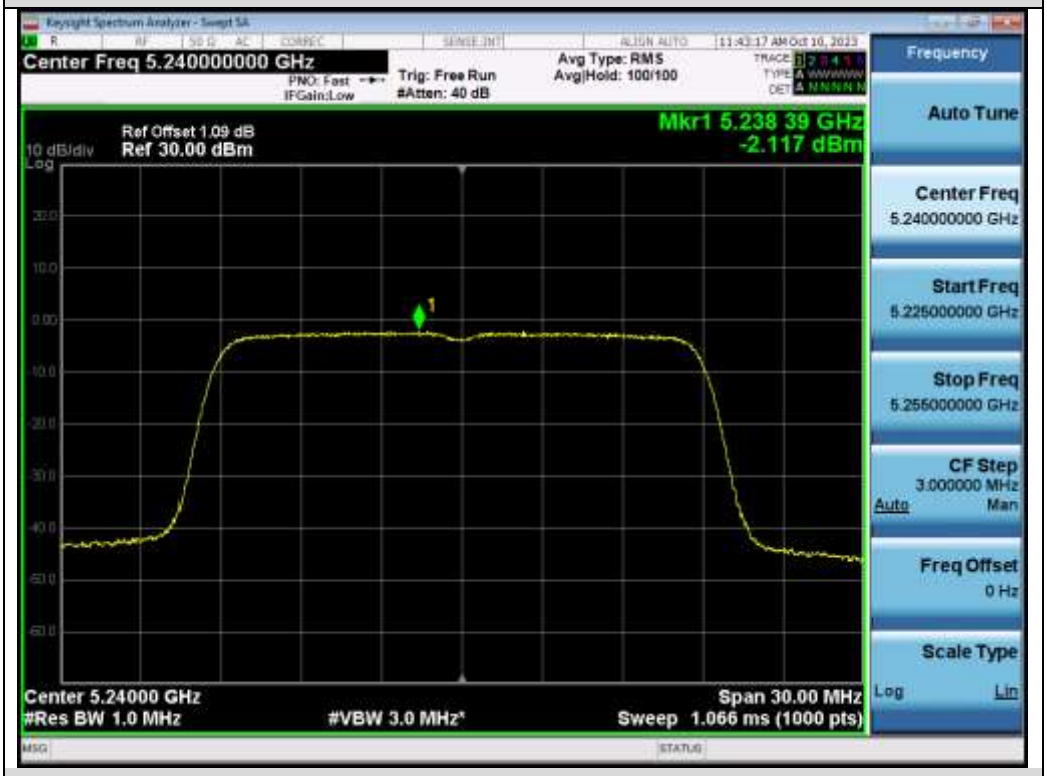
Test_Graph_802.11n20_ANT1_5200_MCS0_PSD



Test_Graph_802.11n20_ANT1_5240_MCS0_PSD

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Test_Graph_802.11ac20_ANT1_5180_MCS0_PSD

Test_Graph_802.11ac20_ANT1_5200_MCS0_PSD

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Test_Graph_802.11ac20_ANT1_5240_MCS9_PSD

Test_Graph_802.11a_ANT2_5180_6Mbps_PSD

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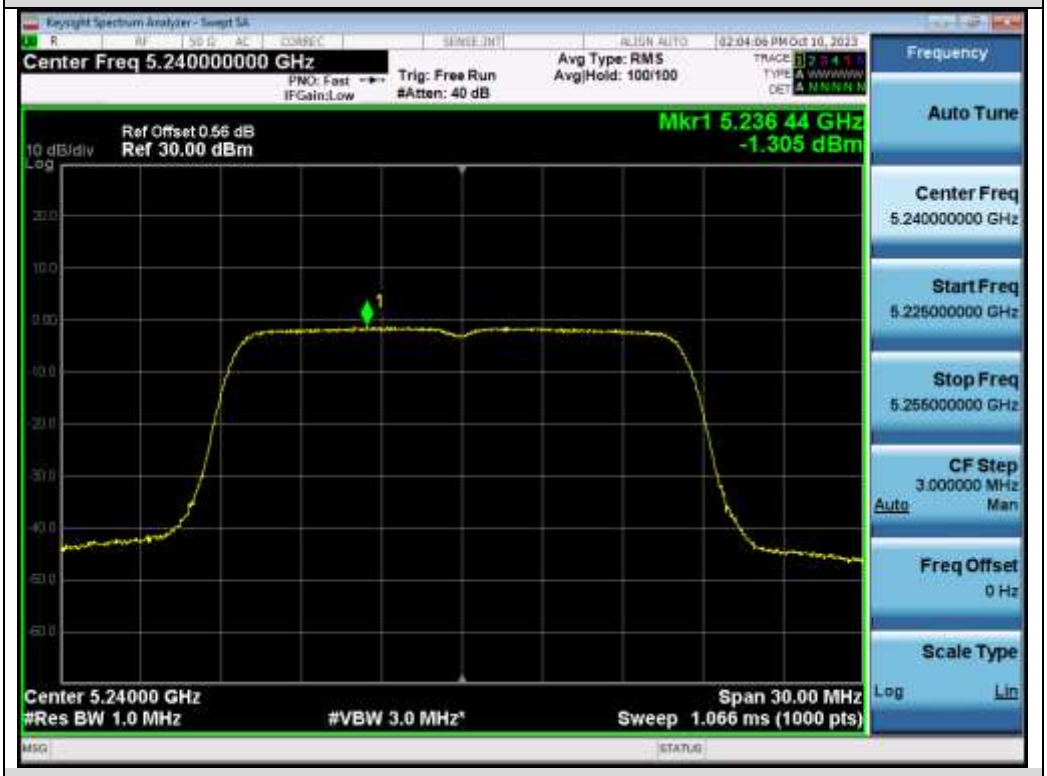
Test_Graph_802.11a_ANT2_5200_6Mbps_PSD



Test_Graph_802.11a_ANT2_5240_6Mbps_PSD

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Test_Graph_802.11n20_ANT2_5180_MCS0_PSD

Test_Graph_802.11n20_ANT2_5200_MCS0_PSD

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Test_Graph_802.11n20_ANT2_5240_MCS0_PSD

Test_Graph_802.11ac20_ANT2_5180_MCS0_PSD

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Test_Graph_802.11ac20_ANT2_5200_MCS0_PSD

Test_Graph_802.11ac20_ANT2_5240_MCS9_PSD

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10. Conducted Band Edge and Out-of-Band Emissions

10.1 Provisions Applicable

	Applicable to	Limit	
Restricted bands	789033 D02 General UNII Test Procedures New Rules v02r01	Field strength at 3m (dBuV/m)	
		PK: 74	AV: 54
Out of the restricted bands	Applicable to	EIRP Limit (dBm/MHz)	Equivalent field Strength at 3m (dBuV/m)
	FCC 15.407(b)(1)	PK: -27	PK: 68.2
	15.407(b)(2)		
	15.407(b)(3)		
	15.407(b)(4)	See Note 2	

Note 1: The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength:

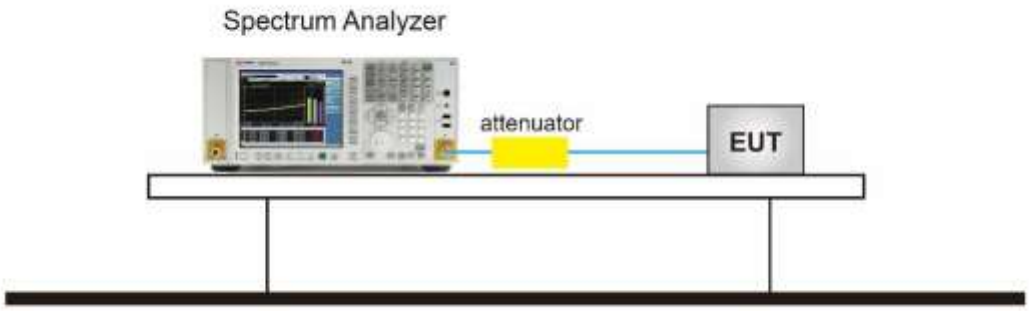
$$E = \frac{1000000 \sqrt{30 P}}{3} \quad \mu V/m, \text{ where P is the eirp (Watts).}$$

Note 2: All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

10.2 Measurement Procedure

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, the Middle and the bottom operation frequency individually.
3. Set the Span = wide enough to capture the peak level of the in-band emission and all spurious emissions from the lowest frequency generated in the EUT up through the 10th harmonic.
4. RBW = 100 kHz; VBW= 300 kHz; Sweep = auto; Detector function = peak.(Test frequency below 1GHz)
5. RBW = 1 MHz; VBW= 3 MHz; Sweep = auto; Detector function = peak.(Test frequency Above 1GHz)
6. Set SPA Trace 1 Max hold, then View.
7. Mark the maximum useless stray point and compare it with the limit value to record the result.

10.3 Measurement Setup (Block Diagram of Configuration)



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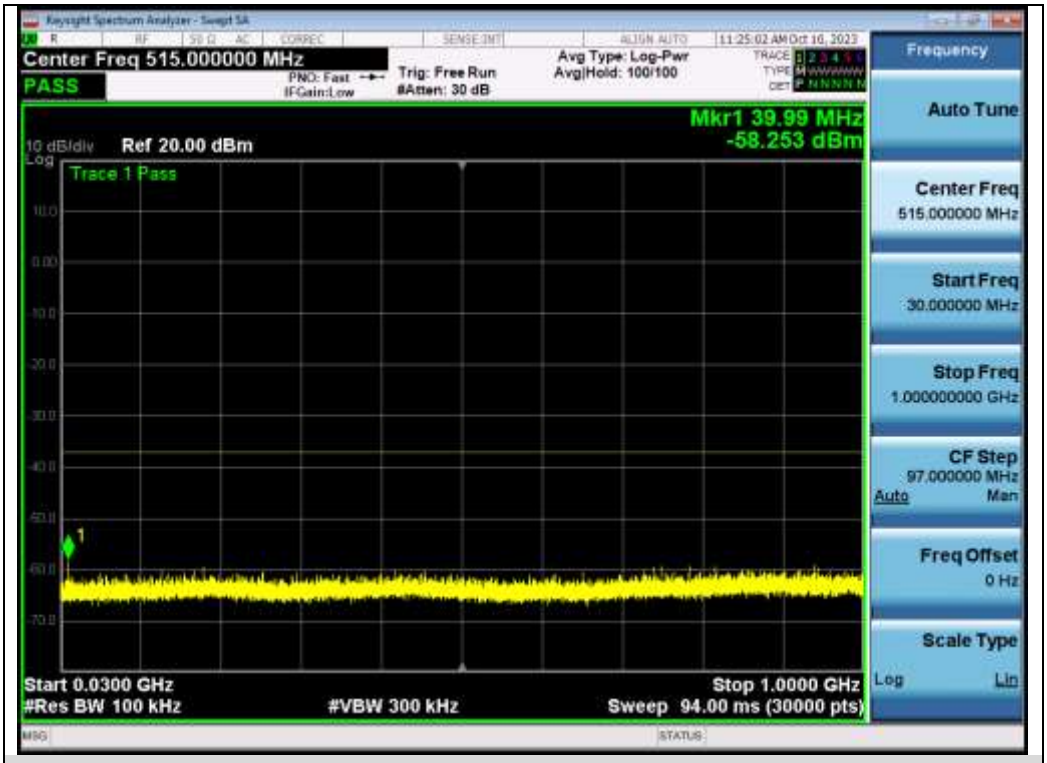
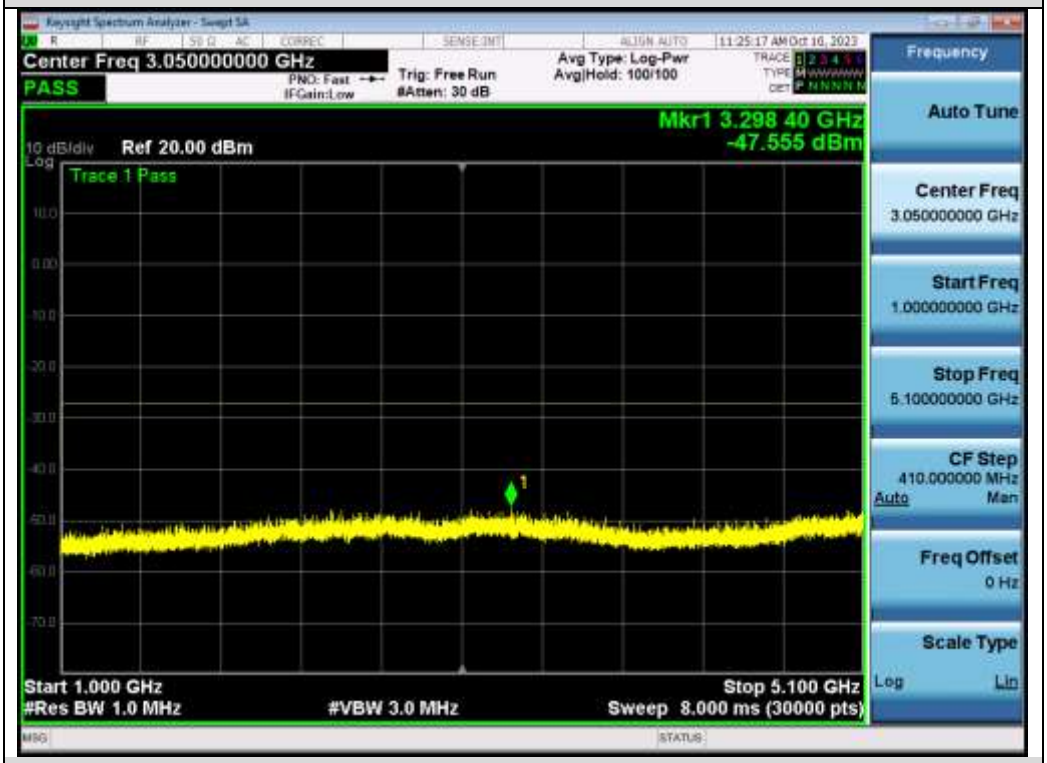
10.4 Measurement Results

Test Graphs of Spurious Emissions outside of the 5.15-5.25 GHz band for transmitters operating in the 5.15-5.25 GHz band



Test_Graph_802.11a_ANT1_5180_6Mbps_Frequency Band 1



Test_Graph_802.11a_ANT1_5180_6Mbps_Frequency Band 2

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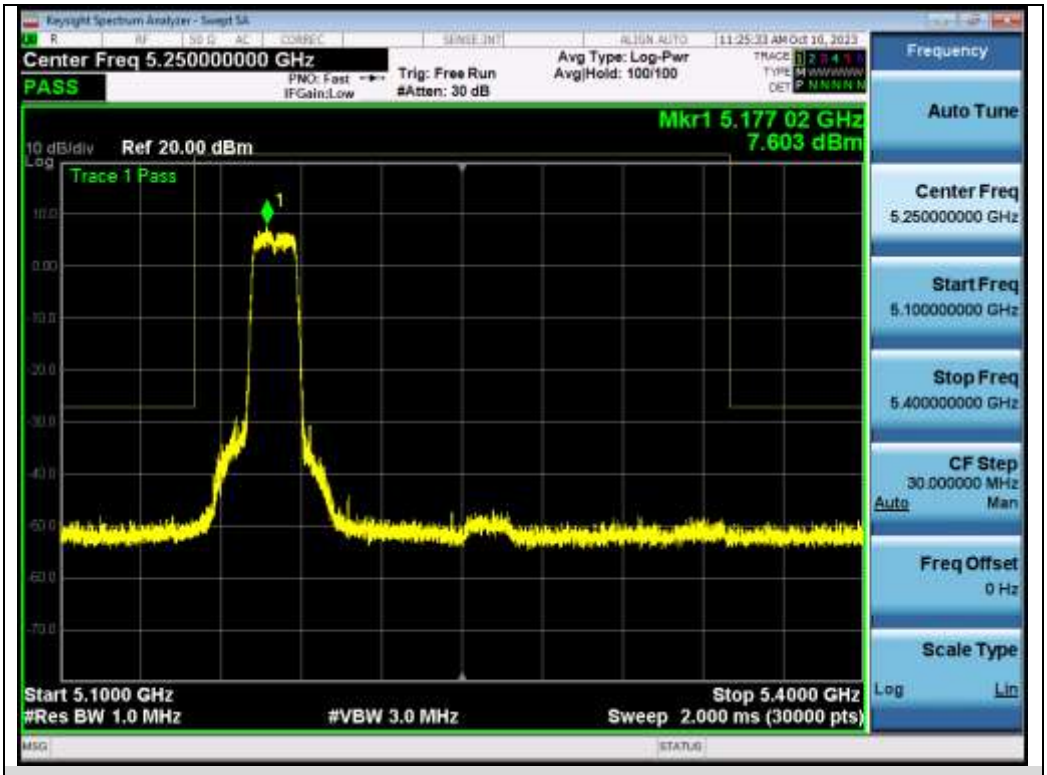

Test_Graph_802.11a_ANT1_5180_6Mbps_Frequency Band 3

Test_Graph_802.11a_ANT1_5180_6Mbps_Frequency Band 4

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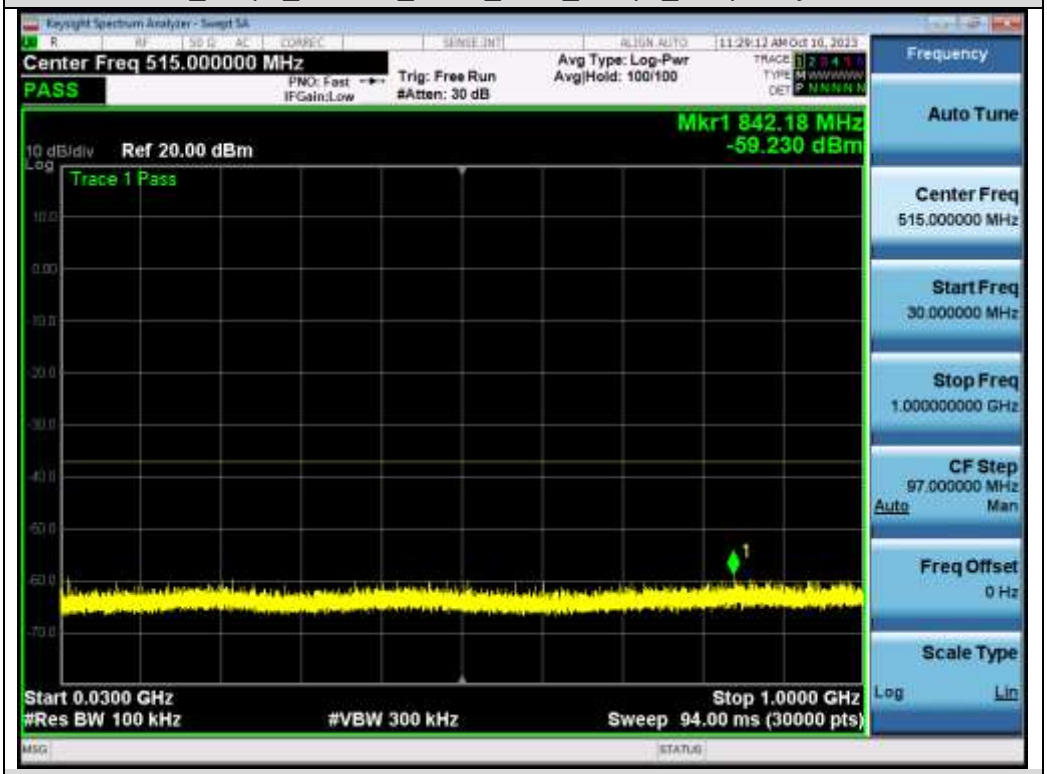
Test_Graph_802.11a_ANT1_5180_6Mbps_Frequency Band 5



Test_Graph_802.11a_ANT1_5240_6Mbps_Frequency Band 1

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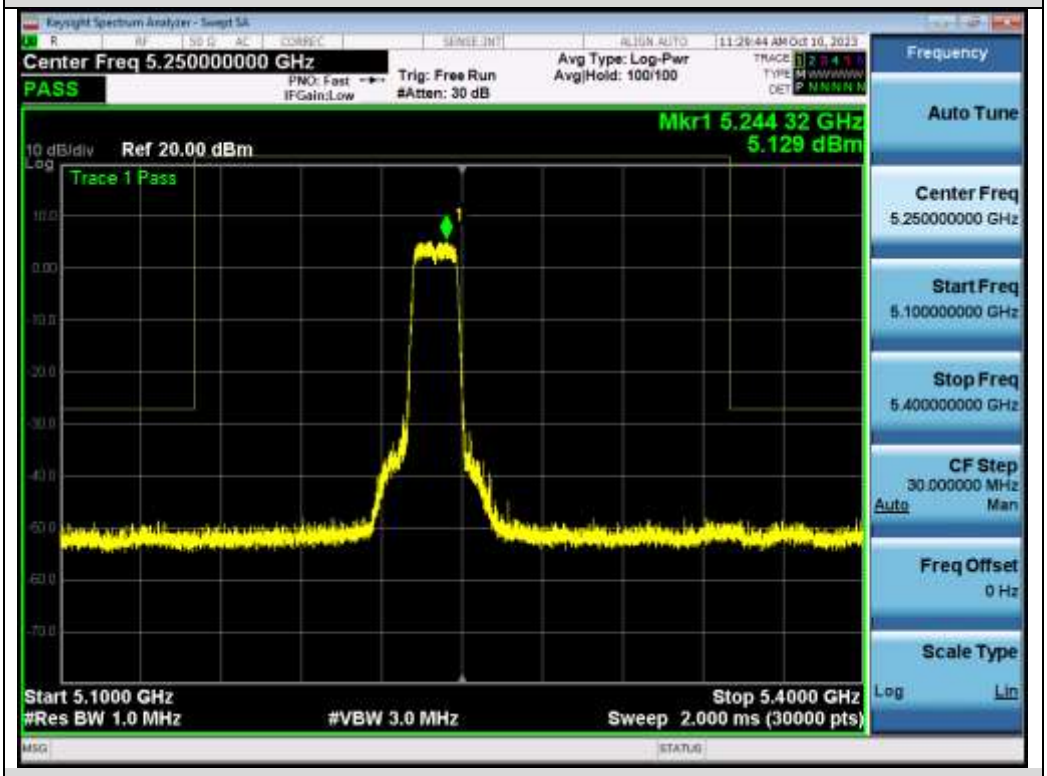
Test_Graph_802.11a_ANT1_5240_6Mbps_Frequency Band 2



Test_Graph_802.11a_ANT1_5240_6Mbps_Frequency Band 3

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Test_Graph_802.11a_ANT1_5240_6Mbps_Frequency Band 4

Test_Graph_802.11a_ANT1_5240_6Mbps_Frequency Band 5

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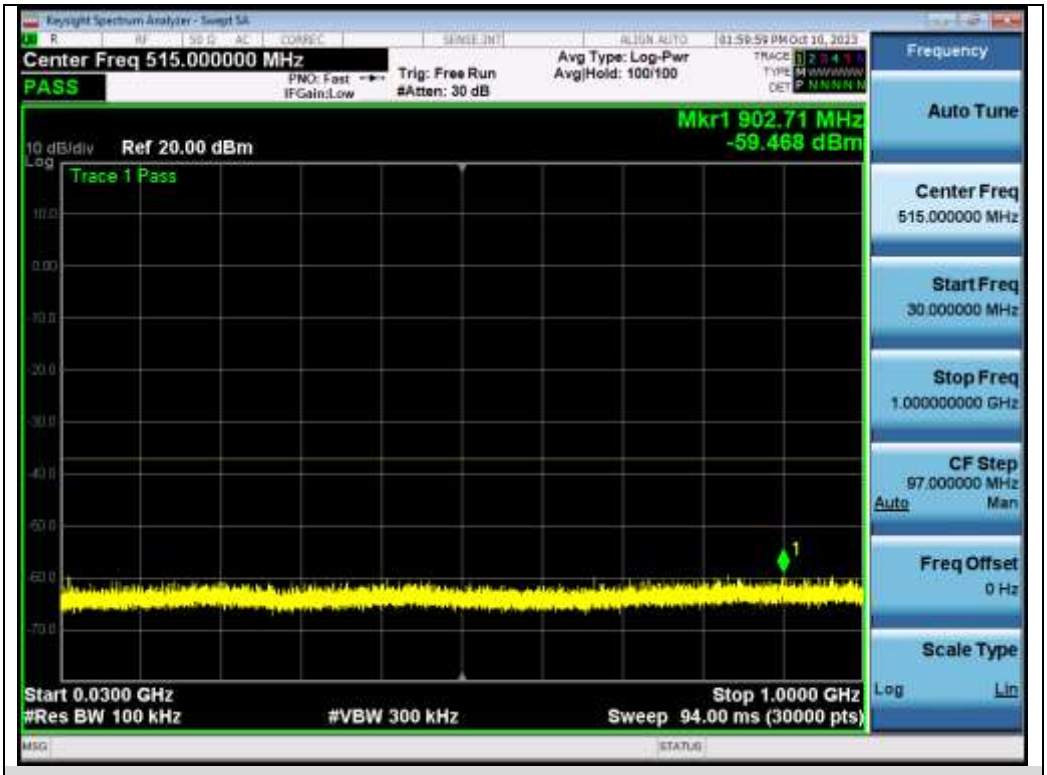

Test_Graph_802.11a_ANT2_5180_6Mbps_Frequency Band 1

Test_Graph_802.11a_ANT2_5180_6Mbps_Frequency Band 2

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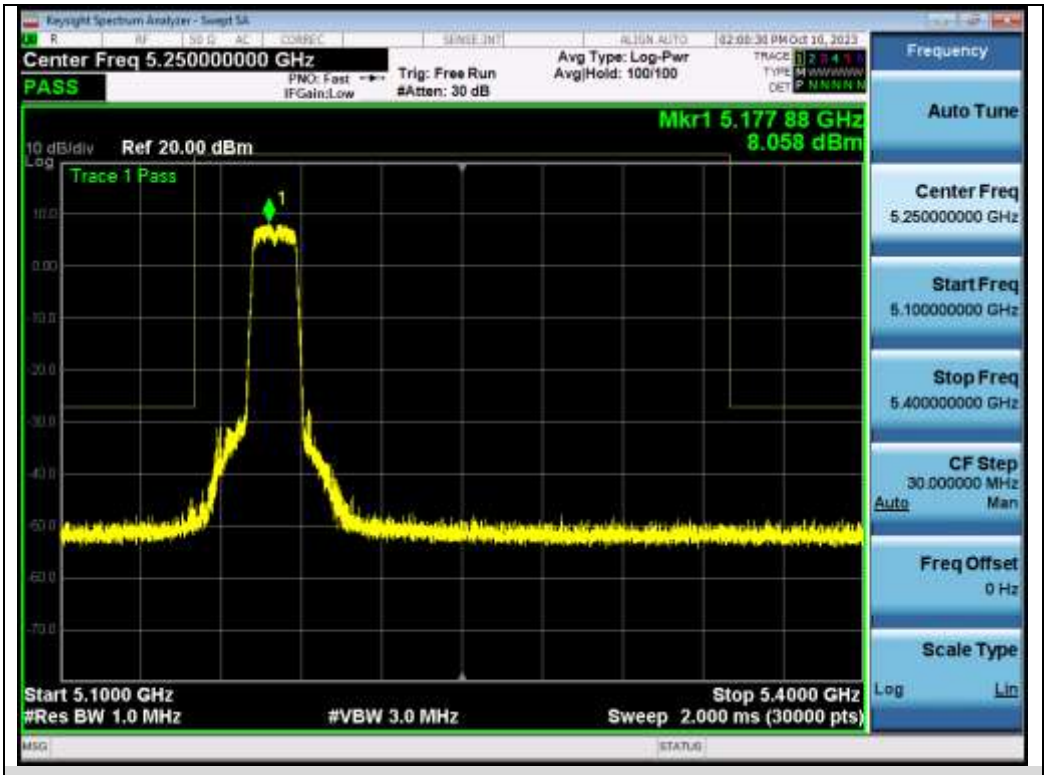

Test_Graph_802.11a_ANT2_5180_6Mbps_Frequency Band 3

Test_Graph_802.11a_ANT2_5180_6Mbps_Frequency Band 4

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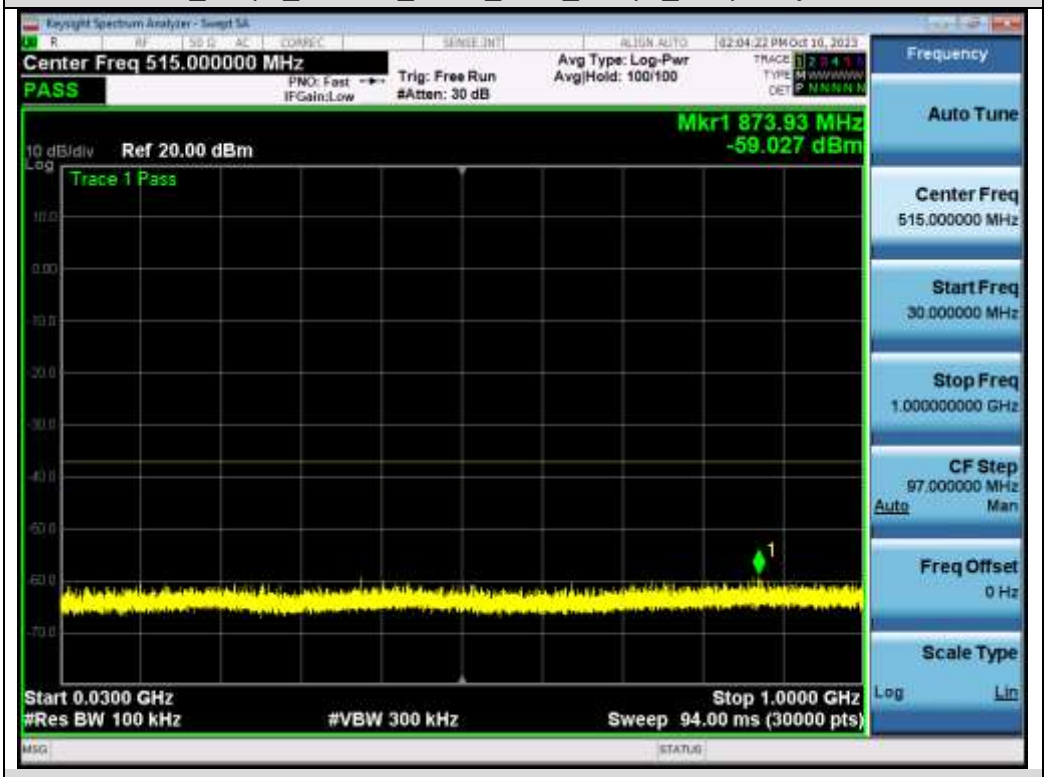
Test_Graph_802.11a_ANT2_5180_6Mbps_Frequency Band 5



Test_Graph_802.11a_ANT2_5240_6Mbps_Frequency Band 1

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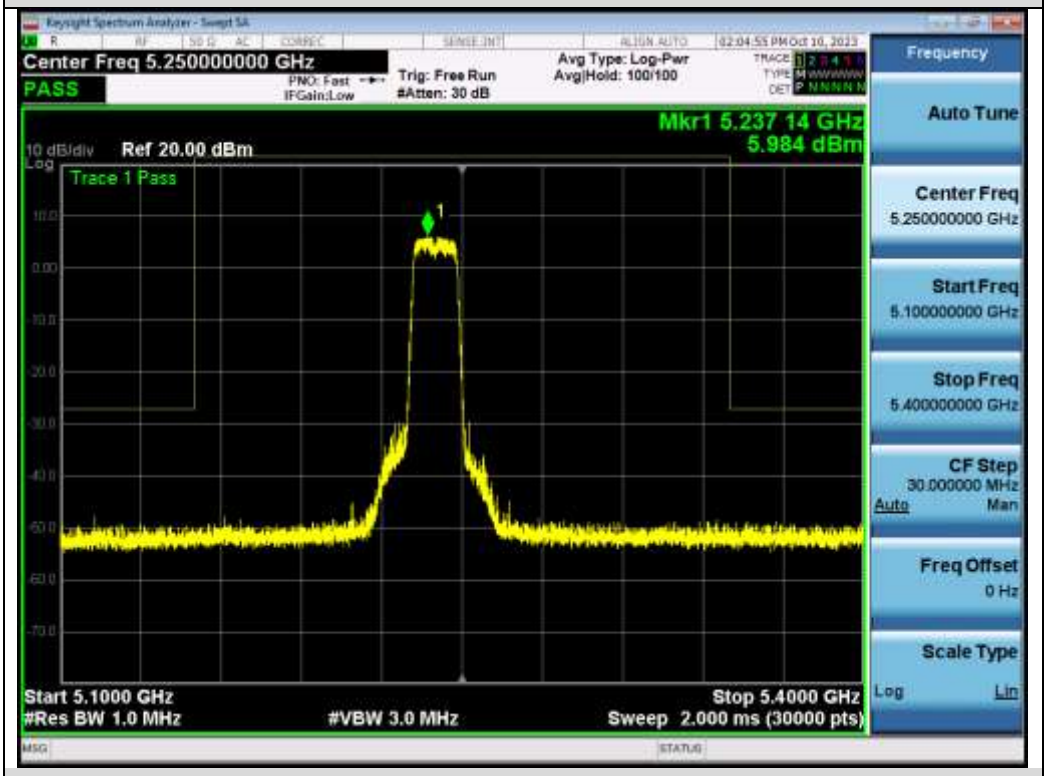
Test_Graph_802.11a_ANT2_5240_6Mbps_Frequency Band 2



Test_Graph_802.11a_ANT2_5240_6Mbps_Frequency Band 3

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Test_Graph_802.11a_ANT2_5240_6Mbps_Frequency Band 4

Test_Graph_802.11a_ANT2_5240_6Mbps_Frequency Band 5

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11. Radiated Spurious Emission

11.1 Measurement Limit

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table:

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

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

Restricted bands	Applicable to	Limit	
	789033 D02 General UNII Test Procedures New Rules v02r01	Field strength at 3m (dBuV/m)	
		PK: 74	AV: 54
Out of the restricted bands	Applicable to	EIRP Limit (dBm/MHz)	Equivalent field Strength at 3m (dBuV/m)
	FCC 15.407(b)(1)	PK: -27	PK: 68.2
	15.407(b)(2)		
	15.407(b)(3)		
	15.407(b)(4)	See Note 2	

Note 1: The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength:

$$E = \frac{1000000 \sqrt{30 P}}{3} \quad \mu V/m, \text{ where P is the eirp (Watts).}$$

Note 2: All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

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11.2 Measurement Procedure

1. The EUT was placed on the top of the turntable 0.8 or 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emission, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz RBW and 3MHz VBW for peak reading. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum values.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case.

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The following table is the setting of spectrum analyzer and receiver.

Receiver Parameter	Setting
Start ~Stop Frequency	9KHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150KHz~30MHz/RB 9KHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120KHz for QP

The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r04.Section G) Unwanted emissions measurement.

◆ **Procedure for Unwanted Emissions Measurements Below 1000MHz:**

- RBW = 120 kHz
- VBW = 300 kHz
- Detector = Peak
- Trace mode = max hold

◆ **Procedure for Peak Unwanted Emissions Measurements Above 1000 MHz:**

- RBW = 1 MHz
- VBW ≥ 3 MHz
- Detector = Peak
- Sweep time = auto
- Trace mode = max hold

◆ **Procedures for Average Unwanted Emissions Measurements Above 1000MHz:**

- RBW = 1 MHz
- 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.

◆ **Procedures for Average Unwanted Emissions Measurements Above 1000MHz:**

- RBW = 1 MHz
- VBW = 3 MHz • Detector = power averaging (rms), set span/(# of points in sweep) ≥ RBW/2.
- Averaging type = power averaging (RMS)
- The correction factor shall be offset is 10 log (1/x), where x is the duty cycle.

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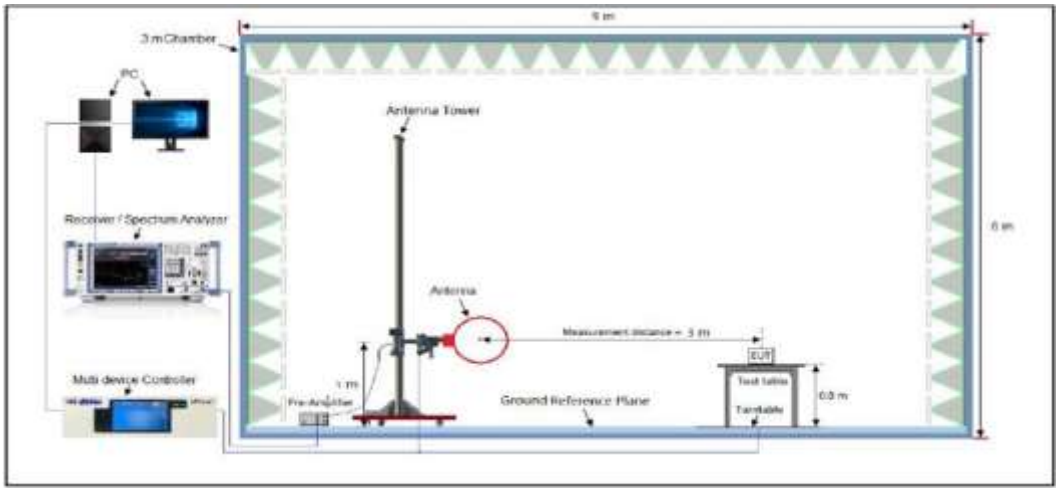
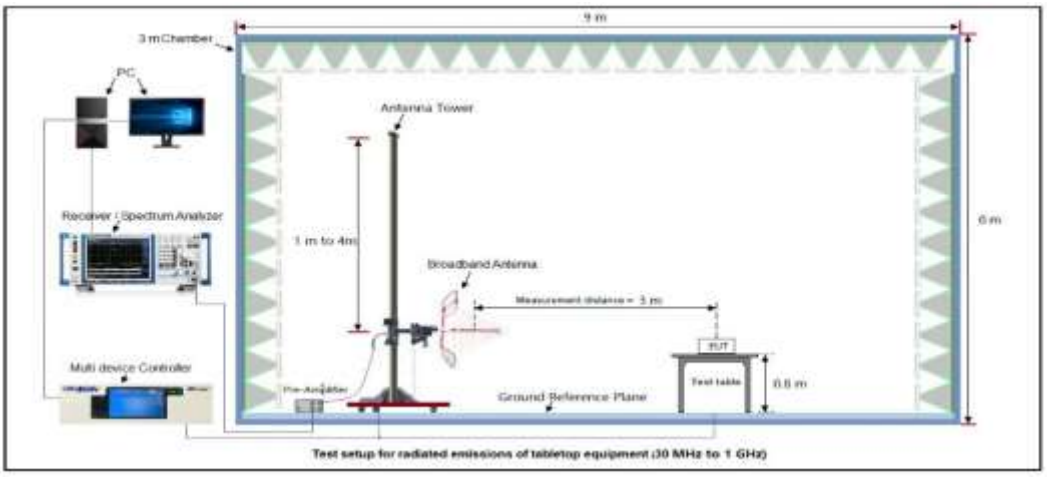
11.3 Measurement Setup (Block Diagram of Configuration)

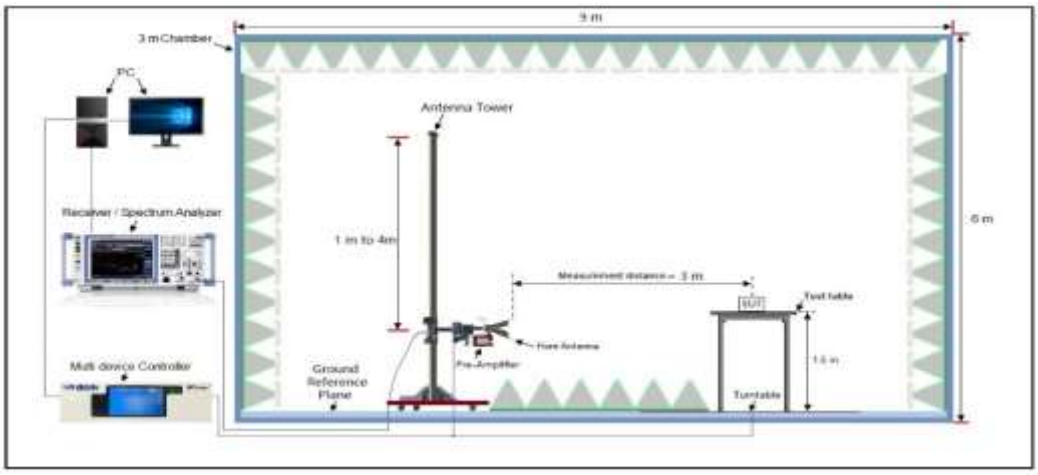
Radiated Emission Test Setup 9kHz-30MHz



Radiated Emission Test Setup 30MHz-1000MHz



Radiated Emission Test Setup Above 1000MHz



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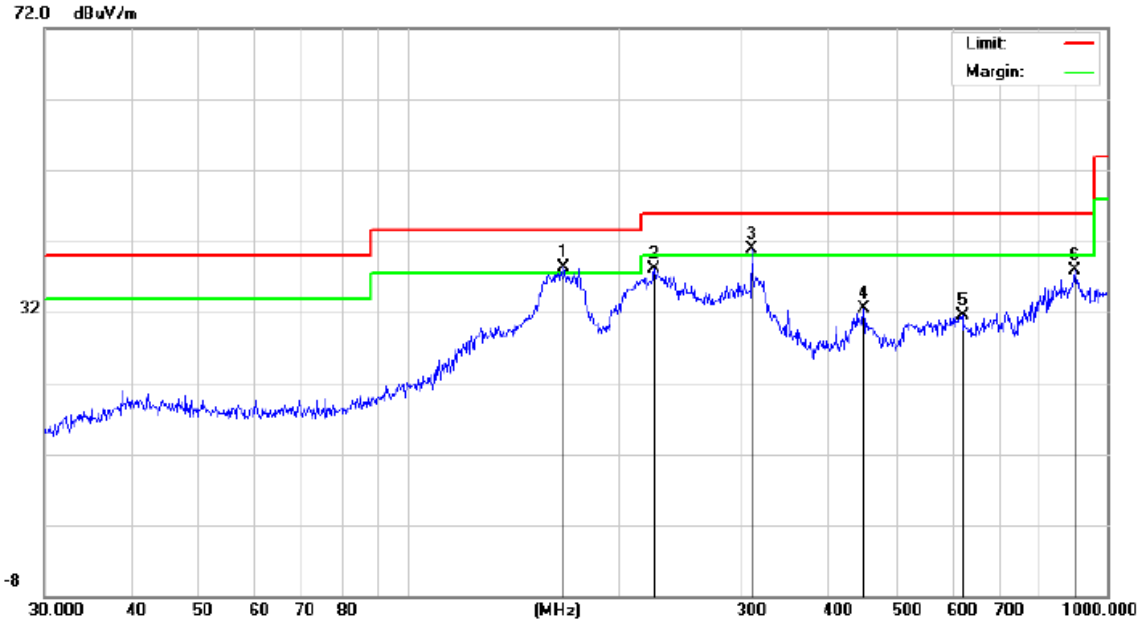
11.4 Measurement Result

Radiated Emission Below 30MHz

The amplitude of spurious emissions from 9kHz to 30MHz which are attenuated more than 20 dB below the permissible value need not be reported.

Radiated Emission Test Results at 30MHz-1GHz

EUT Name	GPS OBSTACLE AVOIDANCE DRONE	**Model Name**	TF15-EX
Temperature	24.2°C	**Relative Humidity**	58.5%
Pressure	960hPa	**Test Voltage**	Normal Voltage
Test Mode	802.11n(20MHz)_5180MHz	**Antenna**	Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1	*	166.6513	26.19	12.20	38.39	43.50	-5.11	peak
2		224.5192	23.40	14.63	38.03	46.00	-7.97	peak
3	!	309.9977	24.33	16.50	40.83	46.00	-5.17	peak
4		447.9821	7.75	24.82	32.57	46.00	-13.43	peak
5		620.7096	6.30	25.13	31.43	46.00	-14.57	peak
6		900.1473	6.15	31.78	37.93	46.00	-8.07	peak

Result: Pass

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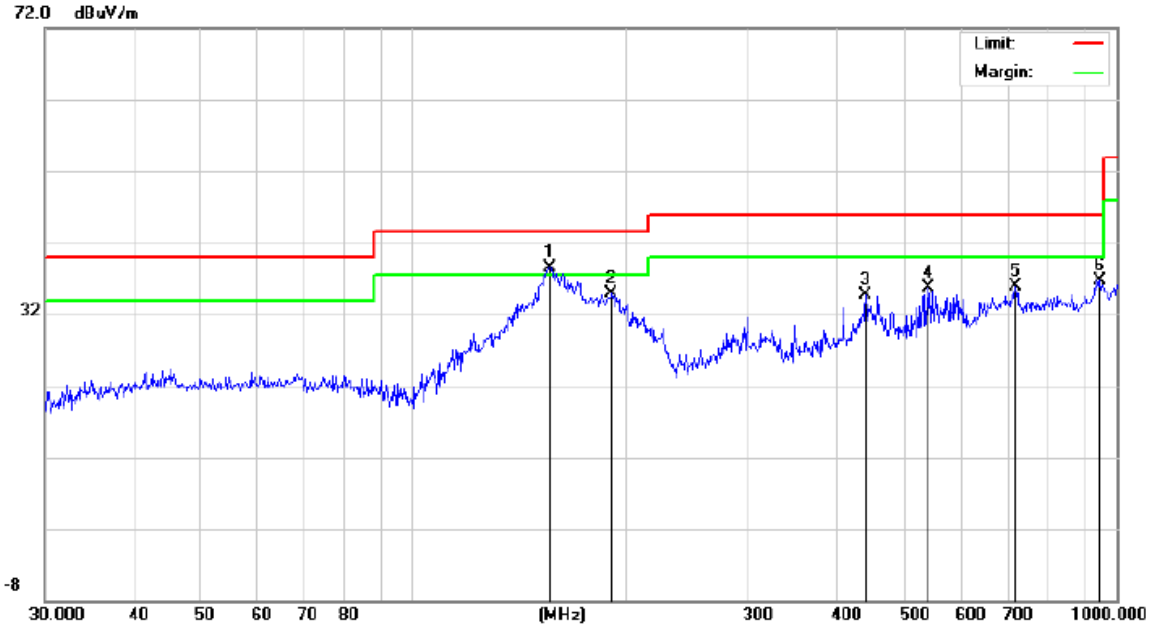
EUT Name	GPS OBSTACLE AVOIDANCE DRONE	Model Name	TF15-EX
Temperature	24.2°C	Relative Humidity	58.5%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	802.11n(20MHz)_5180MHz	Antenna	Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1	*	156.4576	20.32	18.20	38.52	43.50	-4.98	peak
2		191.7450	16.75	18.15	34.90	43.50	-8.60	peak
3		440.1963	8.59	26.09	34.68	46.00	-11.32	peak
4		539.4773	11.08	24.66	35.74	46.00	-10.26	peak
5		719.1992	7.13	28.77	35.90	46.00	-10.10	peak
6		948.7608	5.99	30.65	36.64	46.00	-9.36	peak

Result: Pass

Note:

1. Factor=Antenna Factor + Cable loss, Margin=Measurement-Limit.
2. All test modes had been pre-tested, Refer to Chapter 5 of the report for details.

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Radiated Emissions Test Results Above 1GHz

EUT Name	GPS OBSTACLE AVOIDANCE DRONE	**Model Name**	TF15-EX
Temperature	24.2°C	**Relative Humidity**	58.5%
Pressure	960hPa	**Test Voltage**	Normal Voltage
Test Mode	802.11n20_5180MHz	**Antenna**	Horizontal/Vertical

Radiated Emission Above 1GHz–Horizontal

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
10360.042	47.64	9.14	56.78	68.20	-11.42	peak
15540.063	40.23	10.22	50.45	74.00	-23.55	peak
15540.063	31.54	10.22	41.76	54.00	-12.24	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Radiated Emission Above 1GHz–Vertical

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
10360.042	46.28	9.14	55.42	68.20	-12.78	peak
15540.063	41.05	10.22	51.27	74.00	-22.73	peak
15540.063	32.05	10.22	42.27	54.00	-11.73	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Result: Pass

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Radiated Emissions Test Results Above 1GHz

EUT Name	GPS OBSTACLE AVOIDANCE DRONE	**Model Name**	TF15-EX
Temperature	24.2°C	**Relative Humidity**	58.5%
Pressure	960hPa	**Test Voltage**	Normal Voltage
Test Mode	802.11n20_5200MHz	**Antenna**	Horizontal/Vertical

Radiated Emission Above 1GHz–Horizontal

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
10400.042	47.64	9.14	56.78	68.20	-11.42	peak
15600.063	42.05	10.22	52.27	74.00	-21.73	peak
15600.063	31.53	10.22	41.75	54.00	-12.25	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Radiated Emission Above 1GHz–Vertical

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
10400.042	47.64	9.14	56.78	68.20	-11.42	peak
15600.063	42.05	10.22	52.27	74.00	-21.73	peak
15600.063	32.42	10.22	42.64	54.00	-11.36	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Result: Pass

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Radiated Emissions Test Results Above 1GHz

EUT Name	GPS OBSTACLE AVOIDANCE DRONE	**Model Name**	TF15-EX
Temperature	24.2°C	**Relative Humidity**	58.5%
Pressure	960hPa	**Test Voltage**	Normal Voltage
Test Mode	802.11n20_5240MHz	**Antenna**	Horizontal/Vertical

Radiated Emission Above 1GHz–Horizontal

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
10480.042	47.64	9.27	56.91	68.20	-11.29	peak
15720.063	42.16	10.38	52.54	74.00	-21.46	peak
15720.063	32.47	10.38	42.85	54.00	-11.15	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Radiated Emission Above 1GHz–Vertical

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
10480.042	47.64	9.27	56.91	68.20	-11.29	peak
15720.063	42.05	10.38	52.43	74.00	-21.57	peak
15720.063	31.54	10.38	41.92	54.00	-12.08	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Result: Pass

Note:

1. The amplitude of other spurious emissions from 1GHz to 25 GHz which are attenuated more than 20 dB below the permissible value need not be reported.
2. Factor = Antenna Factor + Cable loss - Amplifier gain, Margin=Measure Result-Limit.
3. The “Factor” value can be calculated automatically by software of measurement system.
4. All test modes had been pre-tested. Refer to Chapter 5 of the report for details.

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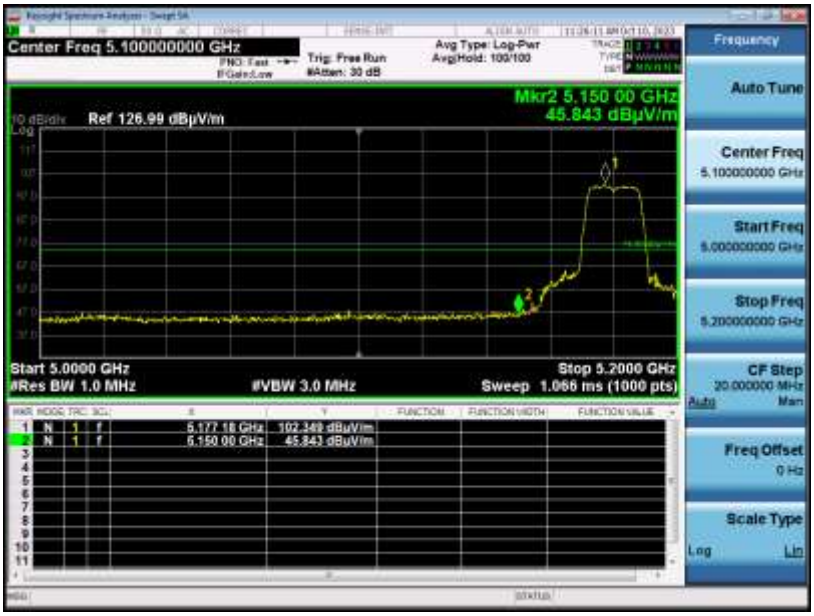
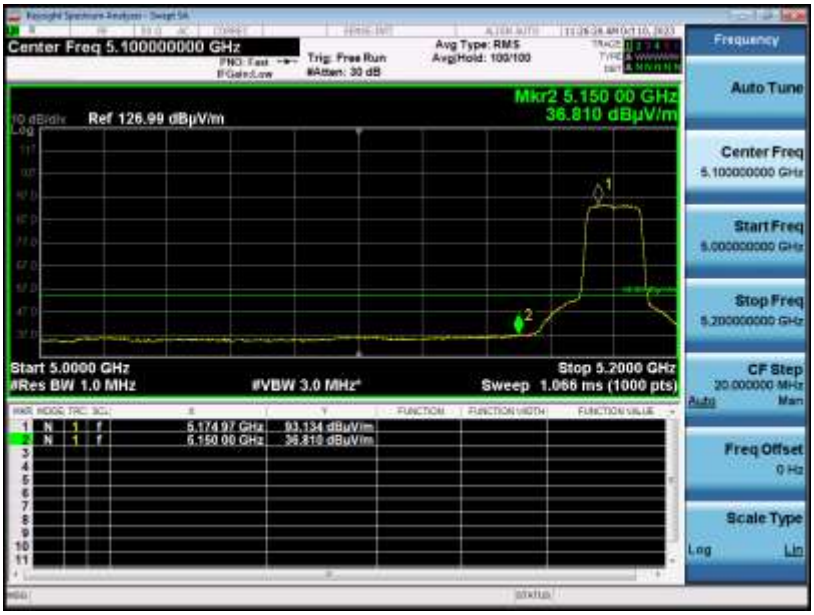
Test Result for Band edge Emission at Restricted bands

EUT Name	GPS OBSTACLE AVOIDANCE DRONE	**Model Name**	TF15-EX
Temperature	25°C	**Relative Humidity**	55.4%
Pressure	960hPa	**Test Voltage**	Normal Voltage
Test Mode	802.11n20_5180MHz	**Antenna**	Horizontal

Test Graph for Peak Measurement



Test Graph for Average Measurement



Result: Pass

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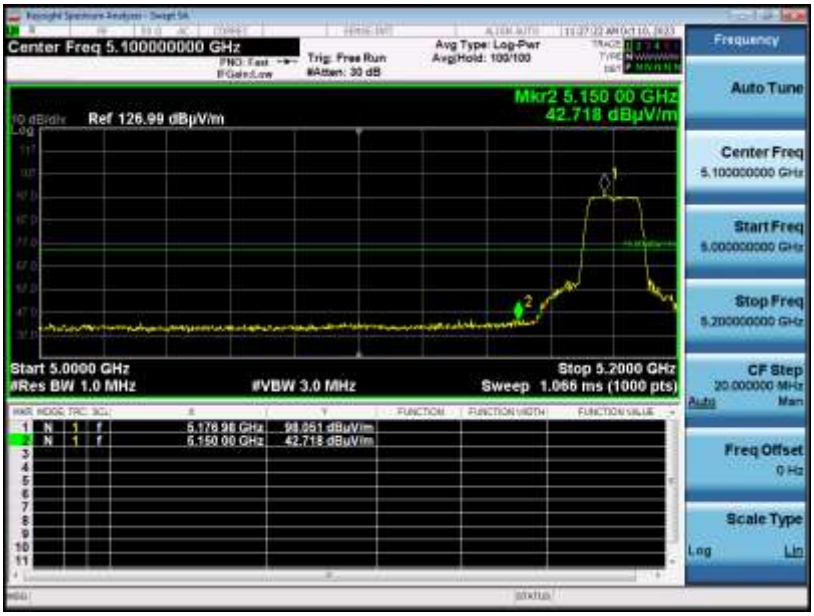
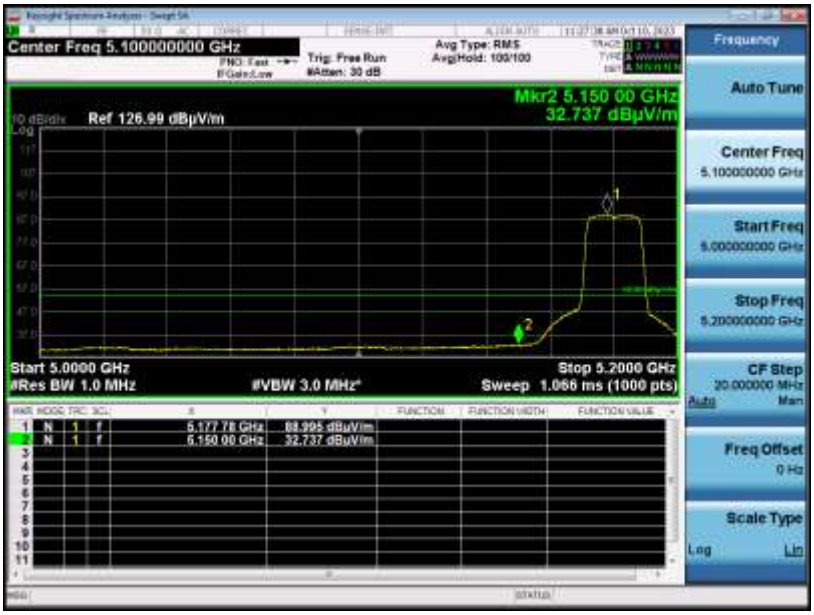
Test Result for Band edge Emission at Restricted bands

EUT Name	GPS OBSTACLE AVOIDANCE DRONE	**Model Name**	TF15-EX
Temperature	25°C	**Relative Humidity**	55.4%
Pressure	960hPa	**Test Voltage**	Normal Voltage
Test Mode	802.11n20_5180MHz	**Antenna**	Vertical

Test Graph for Peak Measurement



Test Graph for Average Measurement



Result: Pass

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Note:

1. The factor had been edited in the “Input Correction” of the Spectrum Analyzer.
2. All test modes had been pre-tested, Refer to Chapter 5 of the report for details.

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12. AC Power Line Conducted Emission Test

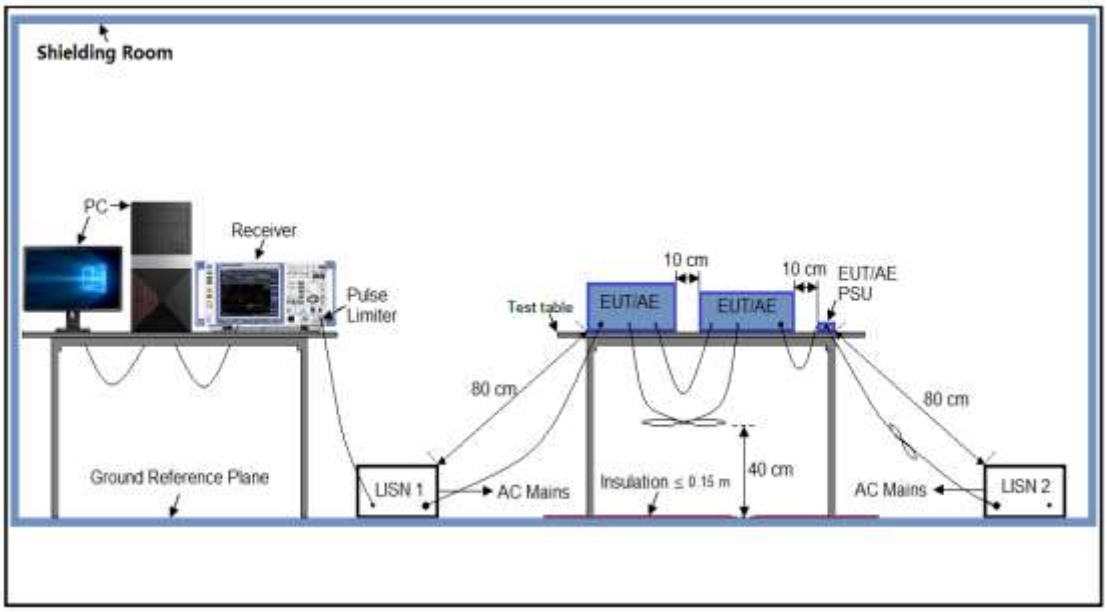
12.1 Measurement limit

Frequency	Maximum RF Line Voltage	
	Q.P (dBμV)	Average (dBμV)
150kHz~500kHz	66-56	56-46
500kHz~5MHz	56	46
5MHz~30MHz	60	50

Note:

1. The lower limit shall apply at the transition frequency.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50MHz.

12.2 Block Diagram of Line Conducted Emission Test



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12.3 Preliminary Procedure of Line Conducted Emission Test

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. When the EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10 (see Test Facility for the dimensions of the ground plane used). When the EUT is a floor-standing equipment, it is placed on the ground plane which has a 3-12 mm non-conductive covering to insulate the EUT from the ground plane.
2. Support equipment, if needed, was placed as per ANSI C63.10.
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.
4. All support equipment received AC120V/60Hz power from a LISN, if any.
5. The EUT received charging voltage by adapter which received 120V/60Hzpower by a LISN.
6. The test program was started. Emissions were measured on each current carrying line of the EUT using spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 Ohm load; the second scan had Line 1 connected to a 50 Ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 kHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.
9. The test mode(s) were scanned during the preliminary test.

Then, the EUT configuration and cable configuration of the above highest emission level were recorded for reference of final testing.

12.4 Final Procedure of Line Conducted Emission Test

1. EUT and support equipment was set up on the test bench as per step 2 of the preliminary test.
2. A scan was taken on both power lines, Line 1 and Line 2, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. If EUT emission level was less –2dB to the A.V. limit in Peak mode, then the emission signal was re-checked using Q.P and Average detector.
3. The test data of the worst case was reported on the Summary Data page.
4. The worst mode is 802.11n20 5180MHz, antenna 1 and antenna 2 work together.

12.5 Test Result of Line Conducted Emission Test

Note: Typical RF working state, unable to operate normally during charging.

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Appendix I: Photographs of Test Setup

Refer to the Report No.: AGC15705230930AP01

Appendix II: Photographs of EUT

Refer to the Report No.: AGC15705230930AP02

----End of Report----

Any report having not been signed by authorized approver, or having been altered without authorization, or having not been stamped by the "Dedicated Testing/Inspection Stamp" is deemed to be invalid. Copying or excerpting portion of, or altering the content of the report is not permitted without the written authorization of AGC. The test results presented in the report apply only to the tested sample. Any objections to report issued by AGC should be submitted to AGC within 15days after the issuance of the test report. Further enquiry of validity or verification of the test report should be addressed to AGC by agc01@agccert.com.

Conditions of Issuance of Test Reports

1. All samples and goods are accepted by the Attestation of Global Compliance (Shenzhen) Co., Ltd (the "Company") solely for testing and reporting in accordance with the following terms and conditions. The company provides its services on the basis that such terms and conditions constitute express agreement between the company and any person, firm or company requesting its services (the "Clients").

2. Any report issued by Company as a result of this application for testing services (the "Report") shall be issued in confidence to the Clients and the Report will be strictly treated as such by the Company. It may not be reproduced either in its entirety or in part and it may not be used for advertising or other unauthorized purposes without the written consent of the Company. The Clients to whom the Report is issued may, however, show or send it, or a certified copy thereof prepared by the Company to its customer, supplier or other persons directly concerned. The Company will not, without the consent of the Clients, enter into any discussion or correspondence with any third party concerning the contents of the Report, unless required by the relevant governmental authorities, laws or court orders.

3.The Company shall not be called or be liable to be called to give evidence or testimony on the Report in a court of law without its prior written consent, unless required by the relevant governmental authorities, laws or court orders.

4. In the event of the improper use of the report as determined by the Company, the Company reserves the right to withdraw it, and to adopt any other additional remedies which may be appropriate.

5. Samples submitted for testing are accepted on the understanding that the Report issued cannot form the basis of, or be the instrument for, any legal action against the Company.

6. The Company will not be liable for or accept responsibility for any loss or damage however arising from the use of information contained in any of its Reports or in any communication whatsoever about its said tests or investigations.

7.Clients wishing to use the Report in court proceedings or arbitration shall inform the Company to that effect prior to submitting the sample for testing.

8. The Company is not responsible for recalling the electronic version of the original report when any revision is made to them. The Client assumes the responsibility to providing the revised version to any interested party who uses them.

9. Subject to the variable length of retention time for test data and report stored hereinto as otherwise specifically required by individual accreditation authorities, the Company will only keep the supporting test data and information of the test report for a period of six years. The data and information will be disposed of after the aforementioned retention period has elapsed. Under no circumstances shall we provide any data and information which has been disposed of after retention period. Under no circumstances shall we be liable for damage of any kind, including (but not limited to) compensatory damages, lost profits, lost data, or any form of special, incidental, indirect, consequential or punitive damages of any kind, whether based on breach of contract of warranty, tort (including negligence), product liability or otherwise, even if we are informed in advance of the possibility of such damages.

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