

FCC Test Report (Class II Permissive Change)

Product Name	Multimedia device with Bluetooth and WLAN
Model No	AIVI2SBXM
FCC ID	2AUXS-AIVI2SBXM

Applicant	Robert Bosch GmbH
Address	Robert-Bosch-Strasse 200 Hildesheim, 31139 Germany

Date of Receipt	Sep. 21, 2020
Issued Date	Nov. 16, 2021
Report No.	21A0126R-RFUSWL5V01-A
Report Version	V1.0





The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standard through the calibration report of the equipment and evaluated measurement uncertainty herein.

This report must not be used to claim product endorsement by TAF or any agency of the government.

The test report shall not be reproduced without the written approval of DEKRA Testing and Certification Co., Ltd. Measurement uncertainties evaluated for each testing system and associated connections are given here to provide the system information for reference. Compliance determinations do not take into account measurement uncertainties for each testing system, but are based on the results of the compliance measurement.



Test Report

Issued Date: Nov. 16, 2021

Report No.: 21A0126R-RFUSWL5V01-A



Product Name	Multimedia device with Bluetooth and WLAN
Applicant	Robert Bosch GmbH
Address	Robert-Bosch-Strasse 200 Hildesheim, 31139 Germany
Manufacturer	Robert Bosch GmbH
Model No.	AIVI2SBXM
FCC ID.	2AUXS-AIVI2SBXM
EUT Rated Voltage	DC 12V (Power by battery)
EUT Test Voltage	DC 12V (Power by battery)
Trade Name	Bosch
Applicable Standard	FCC CFR Title 47 Part 15 Subpart E
	ANSI C63.4: 2014, ANSI C63.10: 2013
	KDB Publication 789033
Test Result	Complied

Documented By	:	April Chen
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Tested By	:	Ivan Chuang
		(Senior Engineer / Ivan Chuang)
Approved By	:	Jack Hsu
		(Senior Engineer / Jack Hsu)



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Appendix 2: Product Photos-Please refer to the file: 21A0126R-Product Photos



Revision History

Report No.	Version	Description	Issued Date
21A0126R-RFUSWL5V01-A	V1.0	Initial issue of report.	Nov. 16, 2021



1. GENERAL INFORMATION

1.1. EUT Description

Product Name	Multimedia device with Bluetooth and WLAN				
Trade Name	Bosch				
FCC ID.	2AUXS-AIVI2SBXM				
Model No.	AIVI2SBXM				
Frequency Range	802.11a/n-20MHz: 5180-5320MHz, 5500-5700MHz, 5745-5825MHz				
	802.11n-40MHz: 5190-5310, 5510-5670MHz, 5755-5795MHz				
	802.11ac-80MHz: 5210-5290MHz, 5530-5690MHz, 5775MHz				
Number of Channels	802.11a/n-20MHz: 24; 802.11n-40MHz: 11, 802.11ac-80MHz: 6				
Data Rate	802.11a: 6 - 54Mbps				
	802.11n: up to 150Mbps				
	802.11ac-80MHz: up to 433.3Mbps				
Channel Control	Auto				
Type of Modulation	802.11a/n/ac: OFDM, BPSK, QPSK, 16QAM, 64QAM, 256QAM				
Antenna type	Metal Plate Antenna				
Antenna Gain	Refer to the table "Antenna List"				

Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	N/A	VPMASF-10849-AF	Metal Plate Antenna	0.83dBi For 5.15~5.25GHz
				1.45dBi For 5.25~5.35GHz
				2.44dBi For 5.47~5.725GHz
				0.29dBi For 5.725~5.825GHz
2	MITSUBISHI ELECTRIC	DU-7NW233AL-SAMPLE1	Metal Plate Antenna	-4.39dBi For 5.15~5.25GHz
	CORPORATION			-4.75dBi For 5.25~5.35GHz
				1.90dBi For 5.47~5.725GHz
				2.32dBi For 5.725~5.825GHz
3	Faurecia Clarion	ZM-8100	Metal Plate Antenna	-4.11dBi For 5.15~5.25GHz
	Electronics CO., LTD.			-4.17dBi For 5.25~5.35GHz
				-2.35dBi For 5.47~5.725GHz
				-2.16dBi For 5.725~5.825GHz

Note: The antenna of EUT is conforming to FCC 15.203.



802.11a/n-20MHz Center Working Frequency of Each Channel:

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 36:	5180 MHz	Channel 40:	5200 MHz	Channel 44:	5220 MHz	Channel 48:	5240 MHz
Channel 52:	5260 MHz	Channel 56:	5280 MHz	Channel 60:	5300 MHz	Channel 64:	5320 MHz
Channel 100:	5500 MHz	Channel 104:	5520 MHz	Channel 108:	5540 MHz	Channel 112:	5560 MHz
Channel 116:	5580 MHz	Channel 120:	5600 MHz	Channel 124:	5620 MHz	Channel 128:	5640 MHz
Channel 132:	5660 MHz	Channel 136:	5680 MHz	Channel 140:	5700 MHz	Channel 149:	5745 MHz
Channel 153:	5765 MHz	Channel 157:	5785 MHz	Channel 161:	5805 MHz	Channel 165:	5825 MHz

802.11n-40MHz Center Working Frequency of Each Channel:

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 38:	5190 MHz	Channel 46:	5230 MHz	Channel 54:	5270 MHz	Channel 62:	5310 MHz
Channel 102:	5510 MHz	Channel 110:	5550 MHz	Channel 118:	5590 MHz	Channel 126:	5630 MHz
Channel 134:	5670 MHz	Channel 151:	5755 MHz	Channel 159:	5795 MHz		

802.11ac-80MHz Center Working Frequency of Each Channel:

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 42:	5210 MHz	Channel 58:	5290 MHz	Channel 106:	5530 MHz	Channel 122:	5610 MHz
Channel 138:	5690 MHz	Channel 155:	5775 MHz				

Note:

- 1. This device is a Multimedia device with Bluetooth and WLAN with a built-in WLAN (802.11a/b/g/n/ac) with Bluetooth V4.2, V2.1+EDR transceiver, this report for 5GHz WLAN.
- 2. Regarding to the operation frequency, the lowest, middle and highest frequency are selected to perform the test.
- 3. Lowest and highest data rates are tested in each mode. Only worst case is shown in the report.
- 4. These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance of transmitter with Part 15 Subpart E for Unlicensed National Information Infrastructure devices.
- 5. This is to request a Class II permissive change for FCC ID: 2AUXS-AIVI2SBXM, originally granted on 11/19/2020.

According to the major change, DEKRA tests Radiated Emission and Radiated Band Edge items, and other testing data refer to original reports.

The major change filed under this application is: Additional antenna for WLAN which type is same as original grant and the antenna gain is higher than original grant.

Test Mode: Mode 1: Transmit

Note: The antenna for the final tests is antenna 1 for UNII-1/UNII-2A/UNII-2C, and antenna 2 for UNII-3.



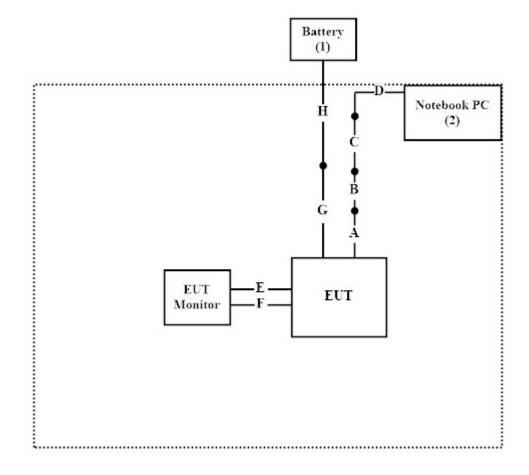
1.2. Tested System Datails

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

Prod	uct	Manufacturer	Model No.	Serial No.	Power Cord
1	Battery	YUASA	55D23L-SMF	N/A	N/A
2	Notebook PC	DELL	Latitude E5440	FS9TK32	N/A

Signal Cable Type		Signal cable Description	
A	USB to mini USB Cable	Non-shielded, 0.2m	
В	USB to LAN Cable	Non-shielded, 0.2m	
C	LAN Cable	Non-shielded, 1m	
D	USB to LAN Cable	Non-shielded, 0.2m	
Е	Orange connector Cable	Non-shielded, 1.8m	
F	Green connector Cable	Non-shielded, 2m	
G	Power Cable	Non-shielded, 1m	
Н	Power Cable Non-shielded, 1m		

1.3. Configuration of tested System





1.4. EUT Exercise Software

- 1. Setup the EUT as shown in Section 1.4.
- 2. Execute software "Dut labtool 2.0.0.89" on the EUT.
- 3. Configure the test mode, the test channel, and the data rate.
- 4. Press "OK" to start the continuous Transmit.
- 5. Verify that the EUT works properly.



1.5. Test Facility

Ambient conditions in the laboratory:

Performed Item	Items	Required	Actual
D 1' (1E ' '	Temperature (°C)	10~40 °C	22.6°C
Radiated Emission	Humidity (%RH)	10~90 %	52.5%
D 151	Temperature (°C)	10~40 °C	22.6°C
Band Edge	Humidity (%RH)	10~90 %	52.5%

USA : FCC Registration Number: TW0033 Canada : IC Registration Number: 26930

Site Description : Accredited by TAF

Accredited Number: 3023

Test Laboratory : DEKRA Testing and Certification Co., Ltd

Address : No. 5-22, Ruishukeng Linkou District, New Taipei City,

24451, Taiwan

Performed Location : No. 26, Huaya 1st Rd., Guishan Dist., Taoyuan City

333411, Taiwan, R.O.C.

Phone number : +886-3-275-7255

Fax number : +866-3-327-8031

Email address : info.tw@dekra.com

Website : http://www.dekra.com.tw



1.6. List of Test Equipment

For Radiated measurements / 966-3

	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due. Date
X	Loop Antenna	AMETEK	HLA6121	56736	2021.04.14	2022.04.13
X	Bi-Log Antenna	SCHWARZBECK	VULB9168	9168-675	2021.08.11	2022.08.10
X	Horn Antenna	ETS-Lindgren	3117	00227700	2021.10.12	2022.10.11
X	Horn Antenna	Com-Power	AH-840	101101	2020.11.19	2021.11.18
X	Pre-Amplifier	EMCI	EMC001330	980254	2021.01.20	2022.01.19
X	Pre-Amplifier	EMCI	EMC051835SE	980313	2020.11.25	2021.11.24
X	Pre-Amplifier	EMCI	EMC05820SE	980310	2021.07.07	2022.07.06
X	Pre-Amplifier	EMCI	EMC184045SE	980314	2021.06.24	2022.06.23
X	Filter	MICRO TRONICS	BRM50702	G251	2021.09.16	2022.09.15
X	Filter	MICRO TRONICS	BRM50716	G188	2021.09.16	2022.09.15
X	EMI Test Receiver	R&S	ESR	102793	2020.12.17	2021.12.16
X	Spectrum Analyzer	R&S	FSV3044	101115	2021.02.03	2022.02.02
X	Coaxial Cable	SGH, EMCI	HA800, SGH18	HY2103-001C	2021.03.03	2022.03.02
X	Mircoflex Cable	HUBER SUHNER	SUCOFLEX 102	MY3381/2	2021.06.25	2022.06.24

Note:

- 1. All equipments are calibrated every one year.
- 2. The test instruments marked with "X" are used to measure the final test results.
- 3. Test Software version : AUDIX e3 V9



1.7. Uncertainty

Uncertainties have been calculated according to the DEKRA internal document, and is described in each test chapter of this report.

The reported expanded uncertainties are based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Measurement uncertainties evaluated for each testing system and associated connections are given here to provide the system information for reference. Compliance determinations do not take into account measurement uncertainties for each testing system, but are based on the results of the compliance measurement.

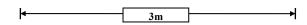
Test item	Uncertainty		
Dodistad Emission	Under 1GHz	Above 1GHz	
Radiated Emission	±4.06 dB	±3.73 dB	
Band Edge	Under 1GHz	Above 1GHz	
	±4.06 dB	±3.73 dB	
Duty Cycle	±2.31 ms		

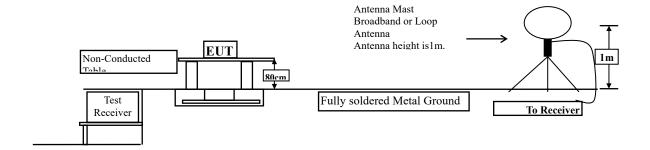


2. Radiated Emission

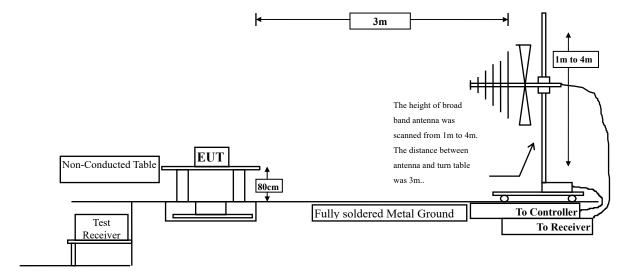
2.1. Test Setup

Radiated Emission Under 30MHz

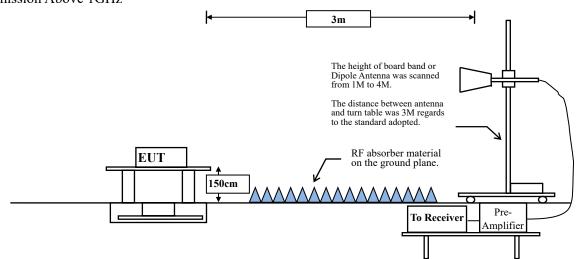




Radiated Emission Below 1GHz



Radiated Emission Above 1GHz



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2.2. Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

FCC Part 15 Subpart C Paragraph 15.209(a) Limits						
Frequency MHz	Field strength	Measurement distance				
WIIIZ	(microvolts/meter)	(meter)				
0.009-0.490	2400/F(kHz)	300				
0.490-1.705	24000/F(kHz)	30				
1.705-30	30	30				
30-88	100	3				
88-216	150	3				
216-960	200	3				
Above 960	500	3				

Remarks: E field strength $(dB\mu V/m) = 20 \log E$ field strength (uV/m)



2.3. Test Procedure

The EUT was setup according to ANSI C63.10, 2013 and tested according to FCC KDB-789033 test procedure for compliance to FCC 47CFR 15. 407 requirements.

Measuring the frequency range below 1GHz, the EUT is placed on a turn table which is 0.8 meter above ground, when measuring the frequency range above 1GHz, the EUT is placed on a turn table which is 1.5 meter above ground.

The turn table is rotated 360 degrees to determine the position of the maximum emission level.

The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned between 1 meter and 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10: 2013 on radiated measurement.

The resolution bandwidth below 30MHz setting on the field strength meter is 9kHz and 30MHz~1GHz is 120kHz and above 1GHz is 1MHz.

Radiated emission measurements below 30MHz are made using Loop Antenna and 30MHz~1GHz are made using broadband Bilog antenna and above 1GHz are made using Horn Antennas.

The measurement is divided into the Preliminary Measurement and the Final Measurement.

The suspected frequencies are searched for in Preliminary Measurement with the measurement antenna kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. The antenna is pointed at an angle towards the source of the emission, and the EUT is rotated in both height and polarization to maximize the measured emission. The emission is kept within the illumination area of the 3 dB bandwidth of the antenna. The measurement frequency range form 9kHz - 10th Harmonic of fundamental was investigated.

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RBW and VBW Parameter setting:

According to KDB 789033 section II.G.5 Procedure for Unwanted Maximum Emissions Measurements above 1000 MHz.

RBW = 1MHz.

 $VBW \ge 3MHz$.

According to KDB 789033 section II.G.6 Procedures for Average Unwanted Emissions Measurements above 1000 MHz.

RBW = 1MHz.

VBW = 10Hz, when duty cycle ≥ 98 %

VBW \geq 1/T, when duty cycle \leq 98 %

(T refers to 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.)

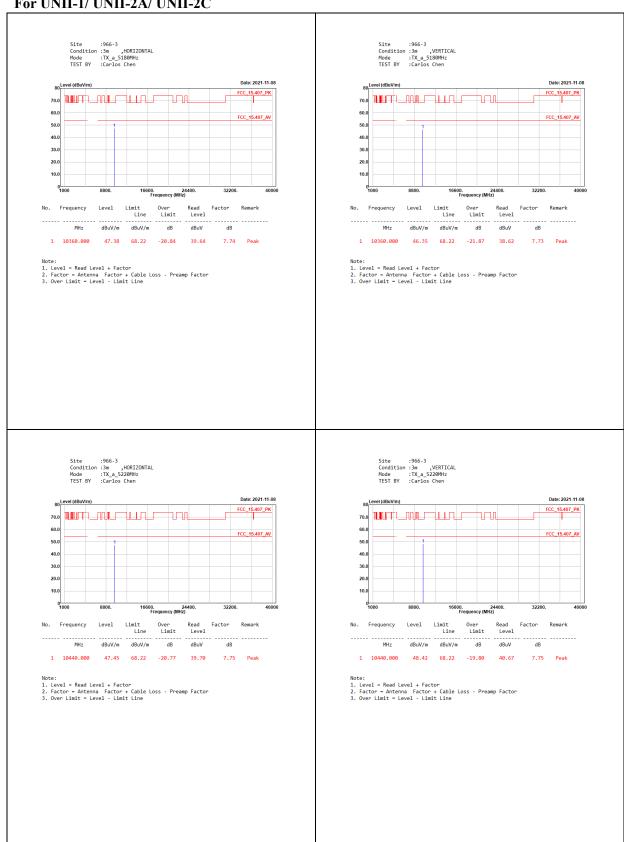
5GHz band	Duty Cycle	T	1/T	VBW	
	(%)	(ms)	(Hz)	(Hz)	
802.11a	100.00			10	
802.11n20	100.00	1		10	
802.11n40	100.00	1		10	
802.11ac80	100.00	-		10	

Note: Duty Cycle Refer to Section 4.

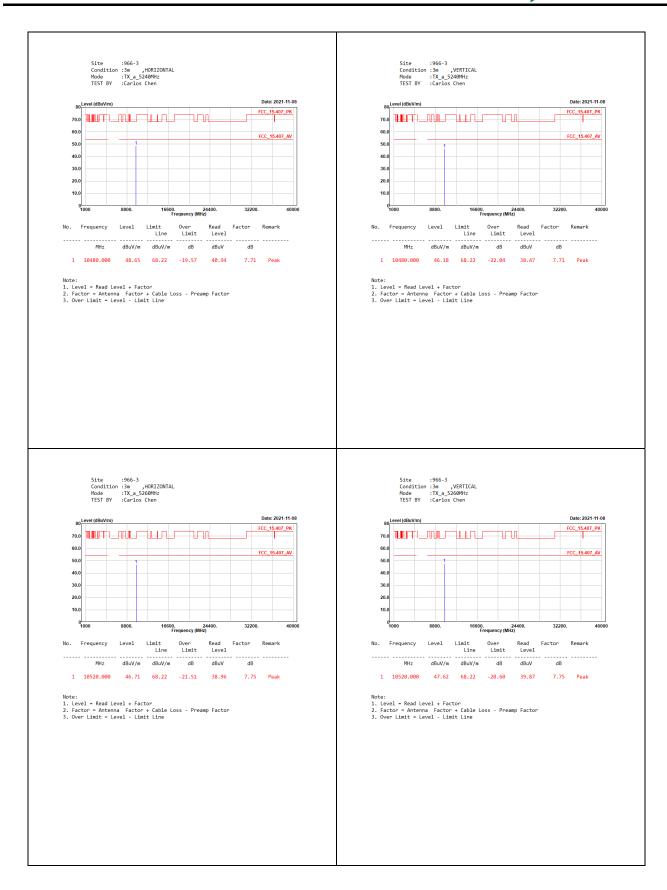


2.4. **Test Result of Radiated Emission**

For UNII-1/ UNII-2A/ UNII-2C







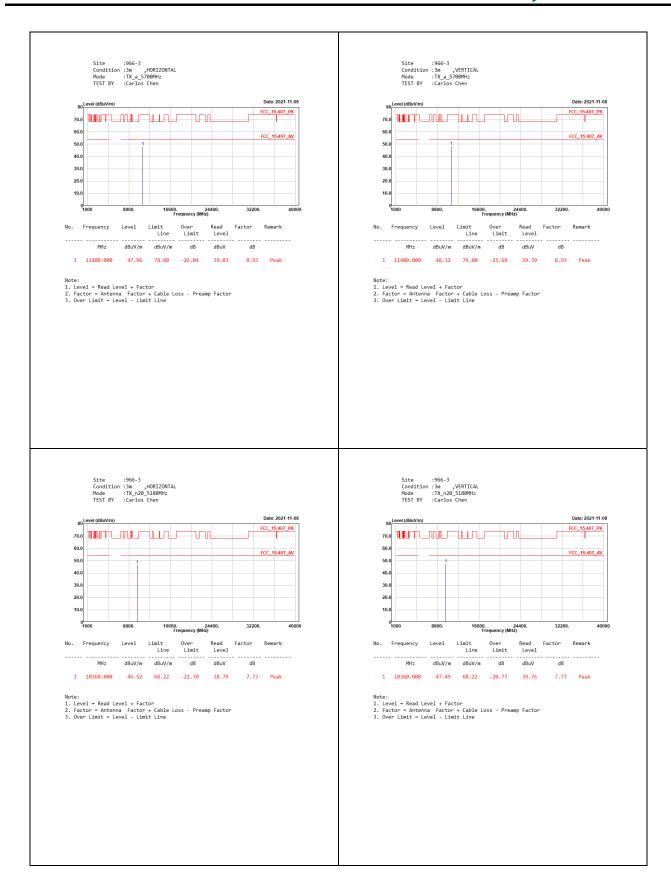












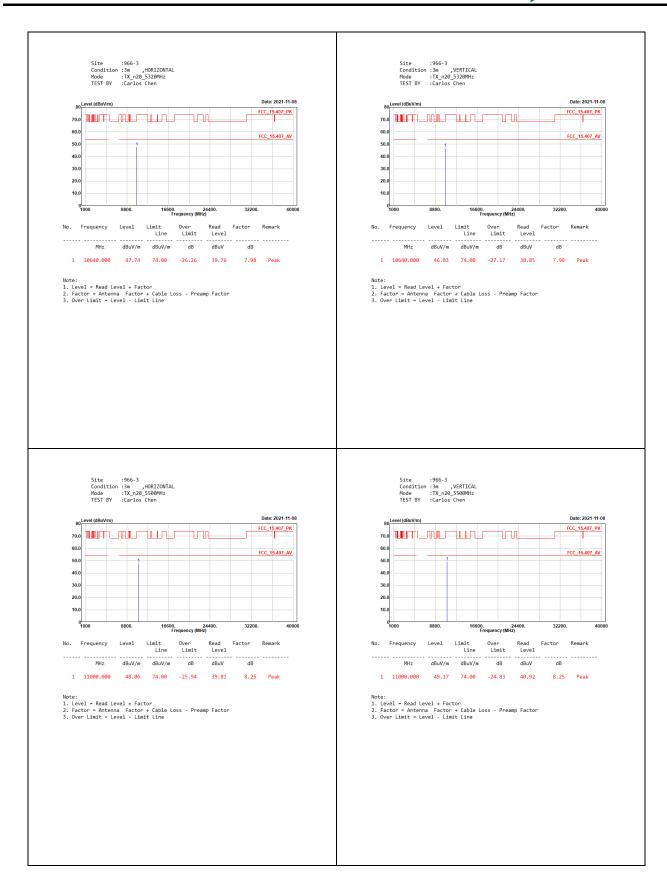












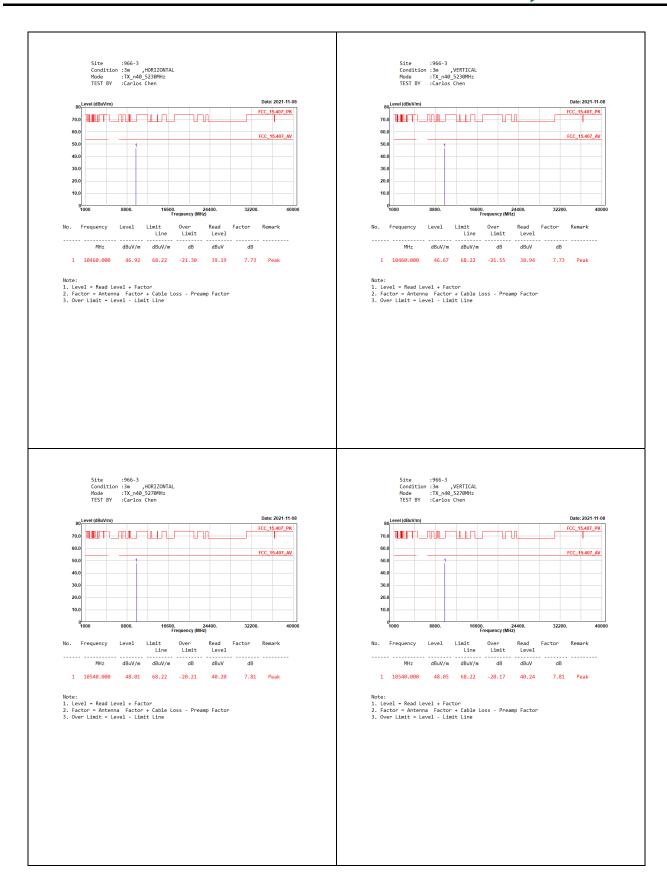




















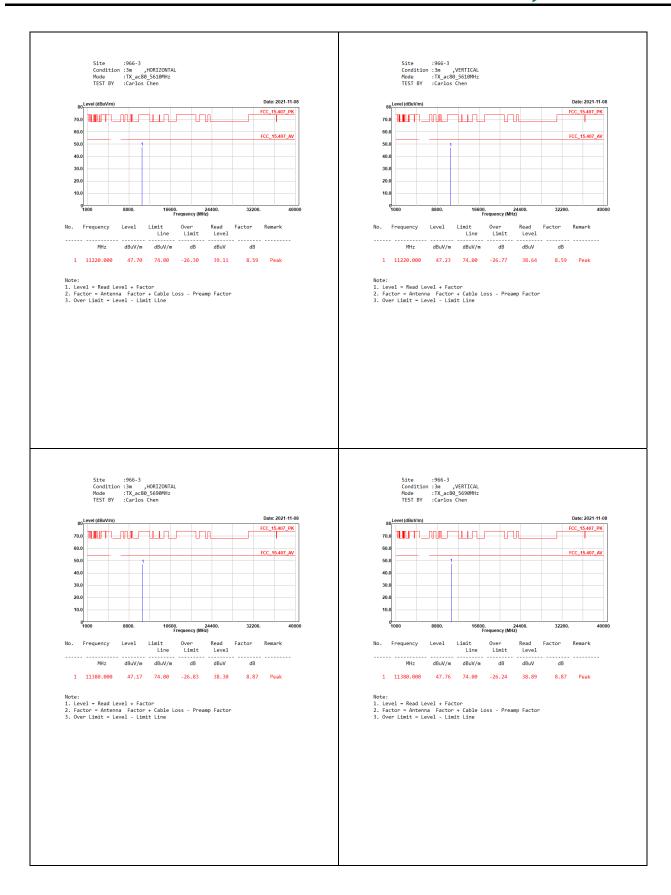










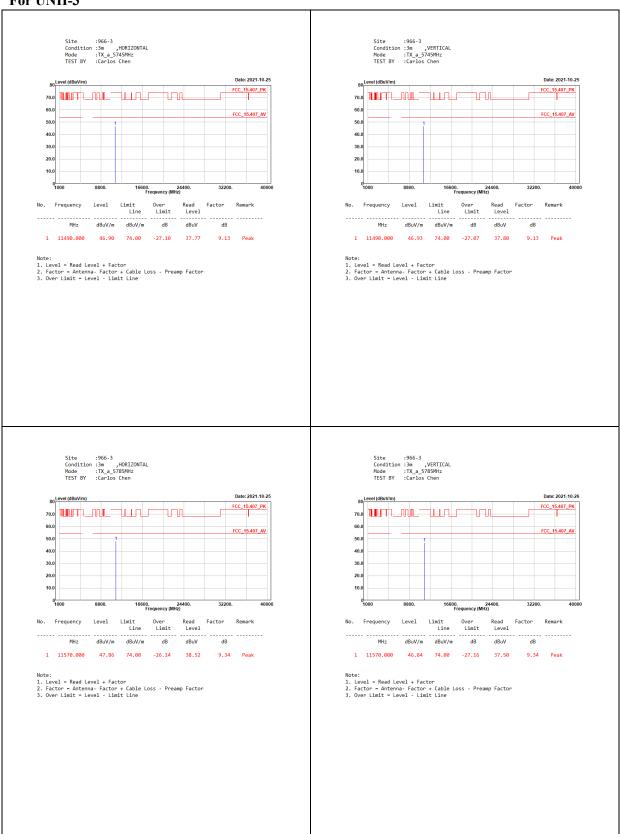








For UNII-3







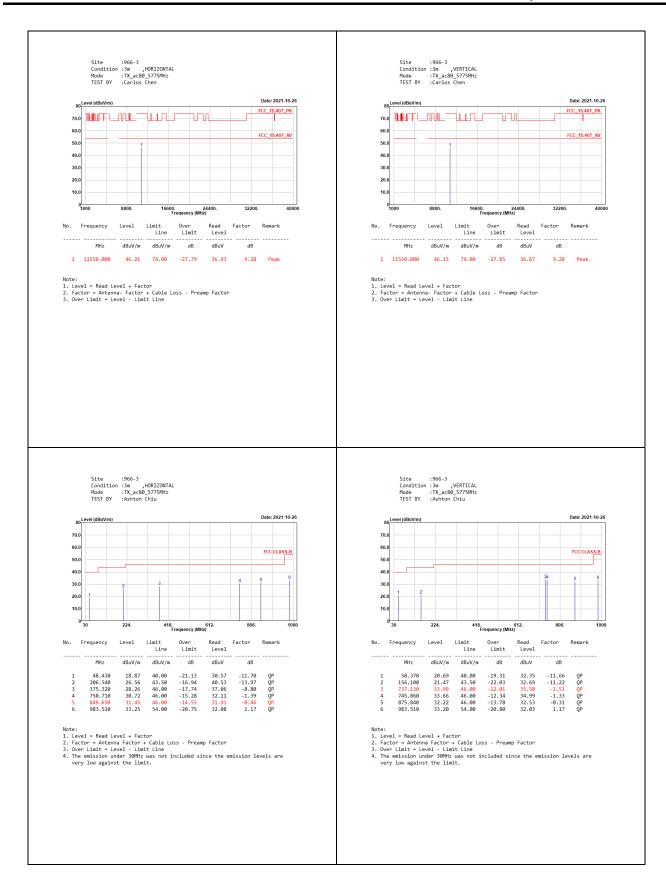










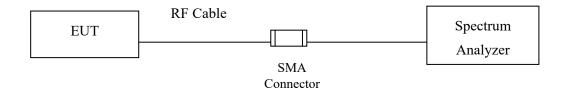




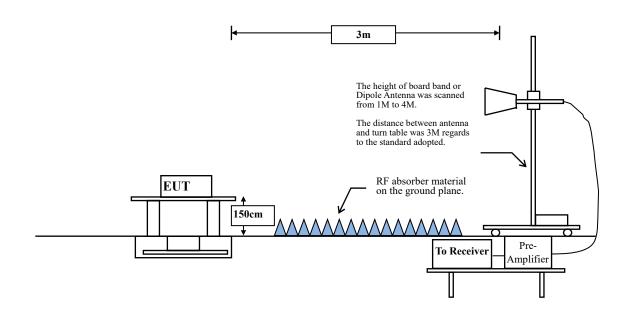
3. Band Edge

3.1. Test Setup

RF Conducted Measurement:



RF Radiated Measurement:





3.2. Limits

The provisions of Section 15.205 of this part apply to intentional radiators operating under this section.

Radiated emissions which fall in the restricted bands, as defined in Section 15.205, must also comply with the radiated emission limits specified in Section 15.209:

FCC Part 15 Subpart C Paragraph 15.209 Limits				
Frequency MHz	uV/m @3m	dBµV/m@3m		
30-88	100	40		
88-216	150	43.5		
216-960	200	46		
Above 960	500	54		

- Remarks: 1. RF Voltage $(dB\mu V) = 20 \log RF \text{ Voltage } (uV)$
 - 2. In the Above Table, the tighter limit applies at the band edges.
 - 3. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

15.407 (b) Undesirable emission limits. The maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

- (1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (4) For transmitters operating in the 5.725-5.85 GHz band:
- (i) 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.

According to ANSI C63.10:2013 section 12.7.3 on radiated measurement.

 $EIRP[dBm] = E[dB\mu V/3m] - 95.2$

-27dBm = 68.22dBuv	15.6 dBm = 110.8 dBuV
10dBm = 105.2dBuv	27 dBm = 122.2 dBuV

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3.3. Test Procedure

The EUT is placed on a turn table which is 1.5 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level.

Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.10:2013 on radiated measurement.

The bandwidth below 1GHz setting on the field strength meter is 120 kHz, above 1GHz are 1 MHz. The EUT was setup to ANSI C63.10, 2013; tested to UNII test procedure of FCC KDB-789033 for compliance to FCC 47CFR Subpart E requirements.

RBW and **VBW** Parameter setting:

According to KDB 789033 section II.G.5 Procedure for Unwanted Maximum Emissions Measurements above 1000 MHz.

RBW = 1MHz.

 $VBW \ge 3MHz$.

According to KDB 789033 section II.G.6 Procedures for Average Unwanted Emissions Measurements above 1000 MHz.

RBW = 1MHz.

VBW = 10Hz, when duty cycle \geq 98 %

VBW $\geq 1/T$, when duty cycle $\leq 98 \%$

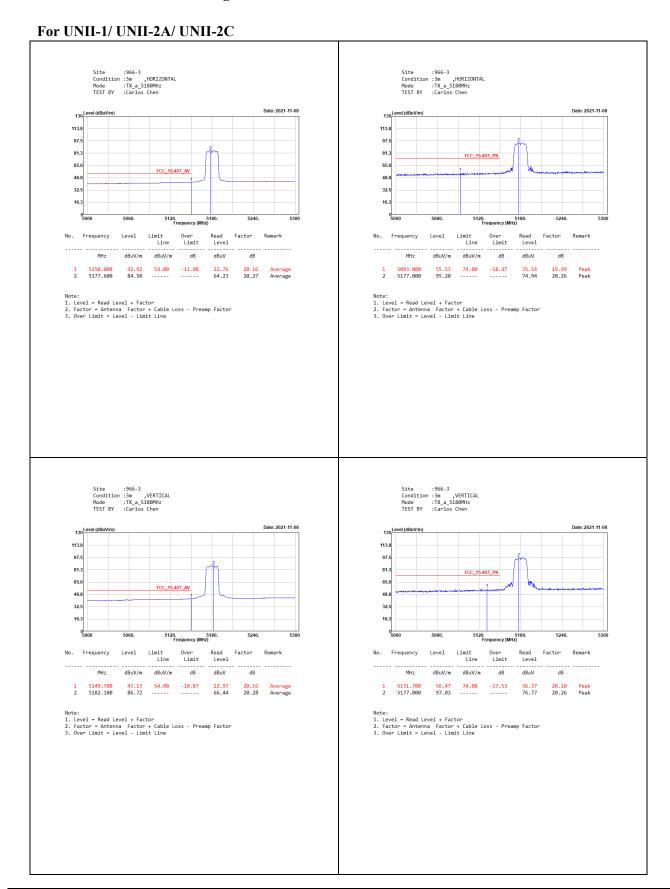
(T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

5GHz band	Duty Cycle	T 1/T		VBW
	(%)	(ms)	(Hz)	(Hz)
802.11a	100.00			10
802.11n20	100.00			10
802.11n40	100.00			10
802.11ac80	100.00			10

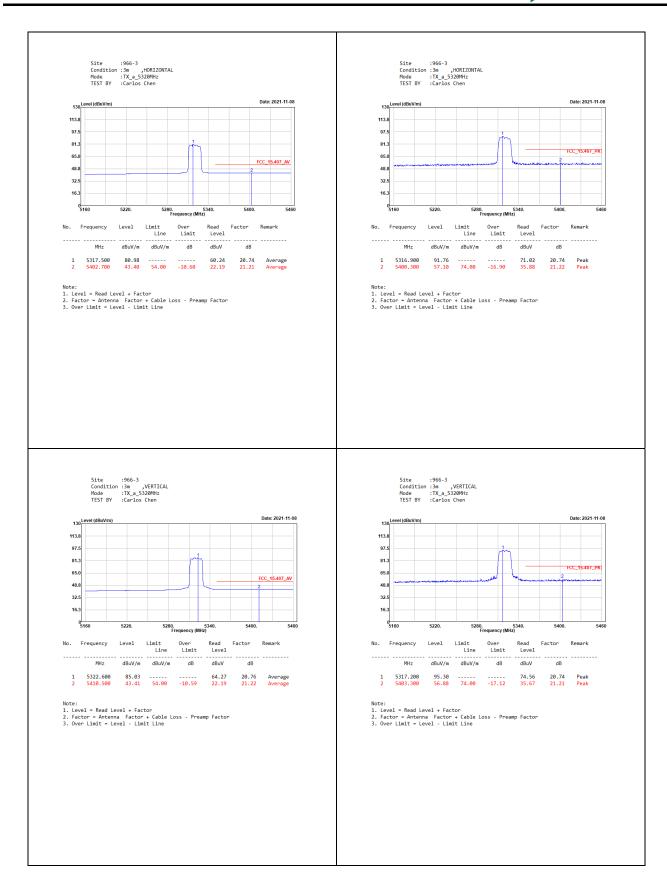
Note: Duty Cycle Refer to Section 4.



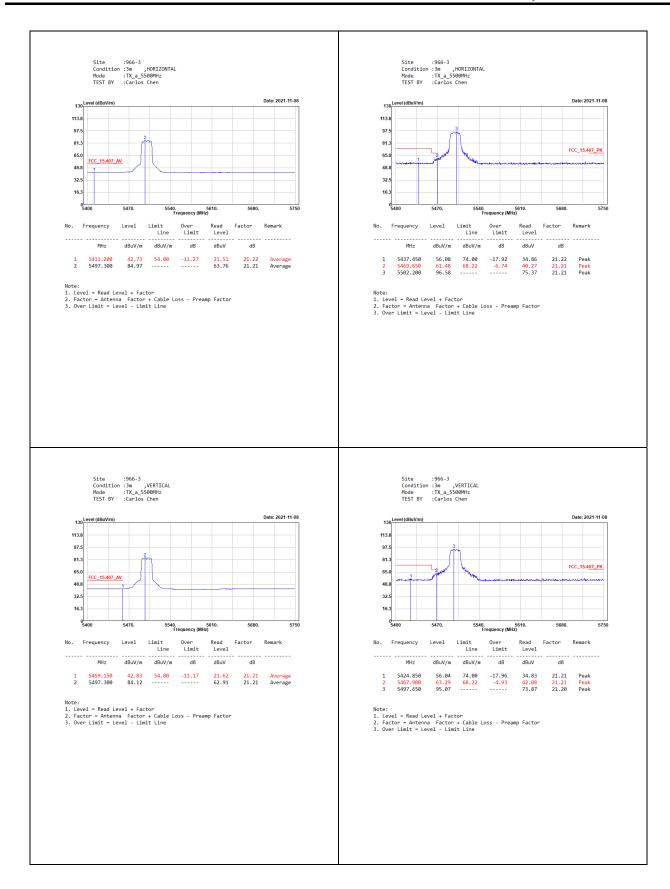
3.4. Test Result of Band Edge



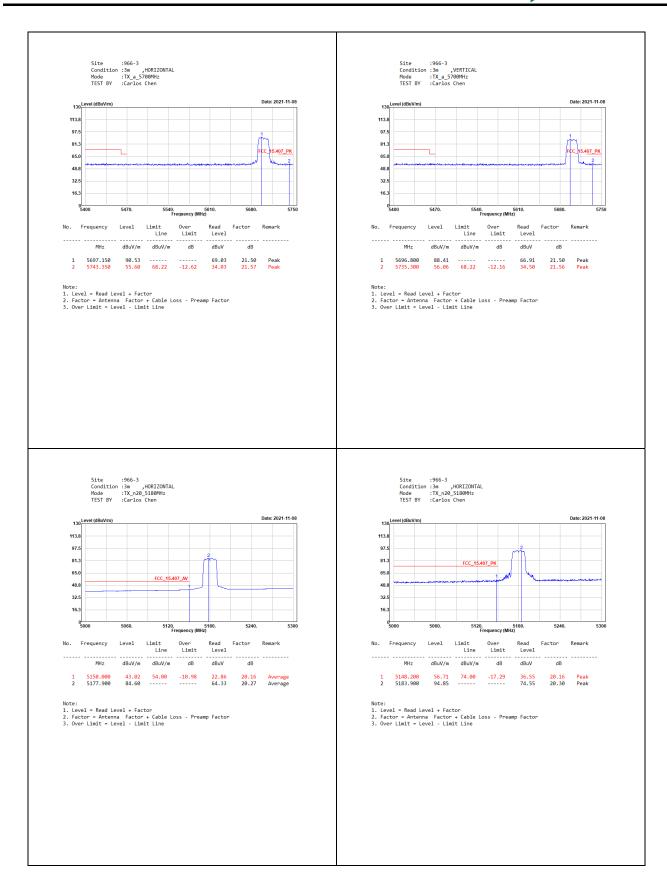




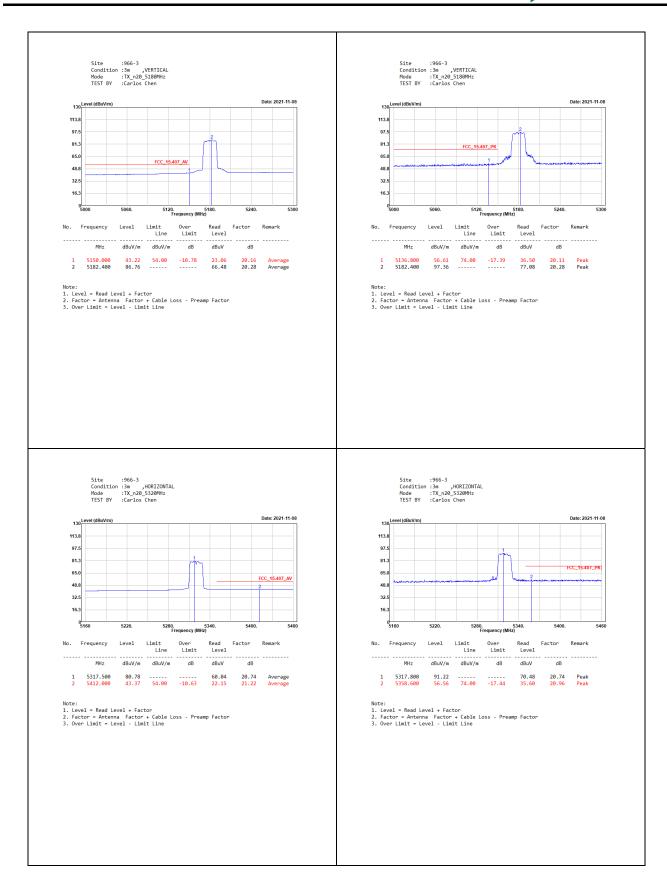




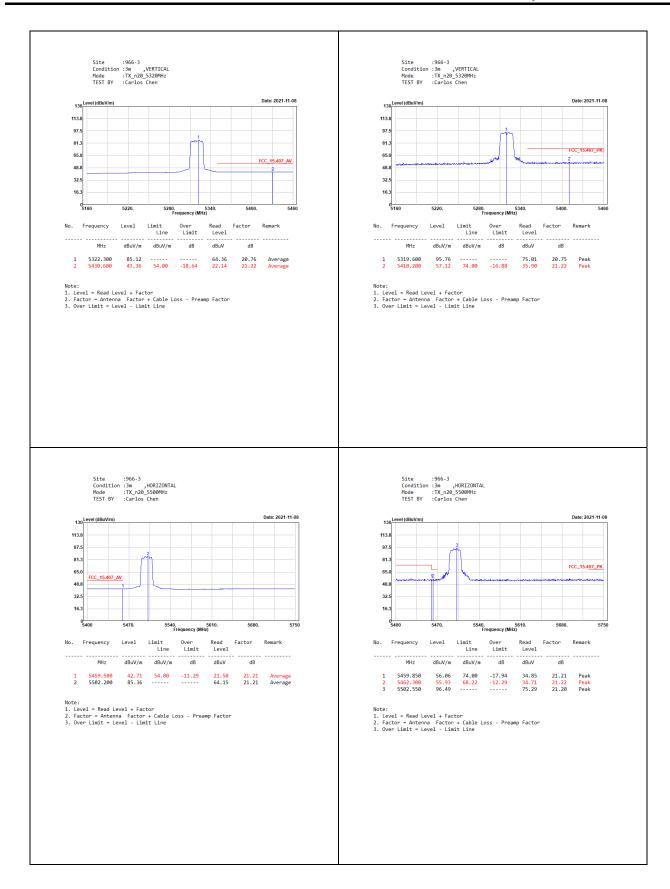








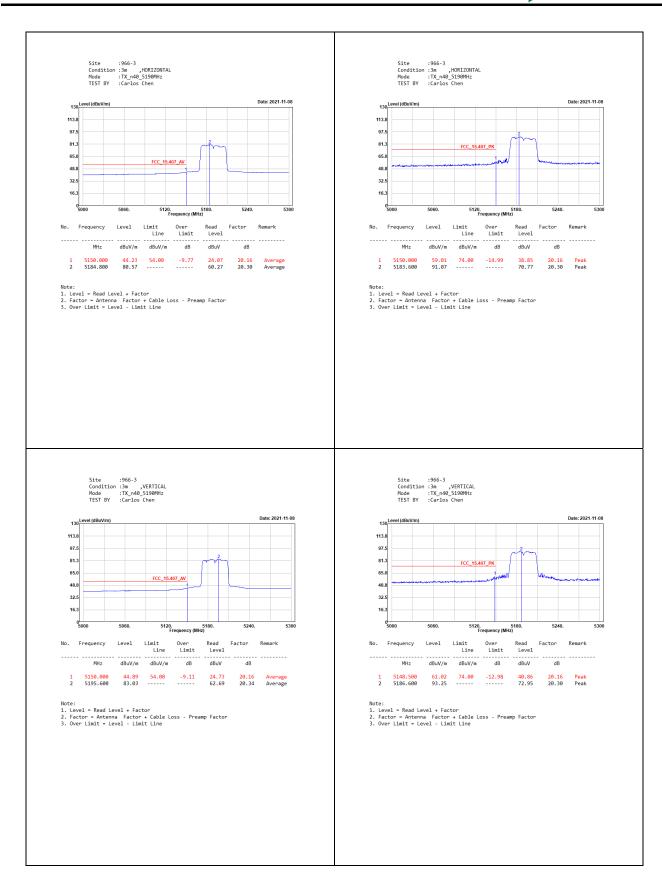




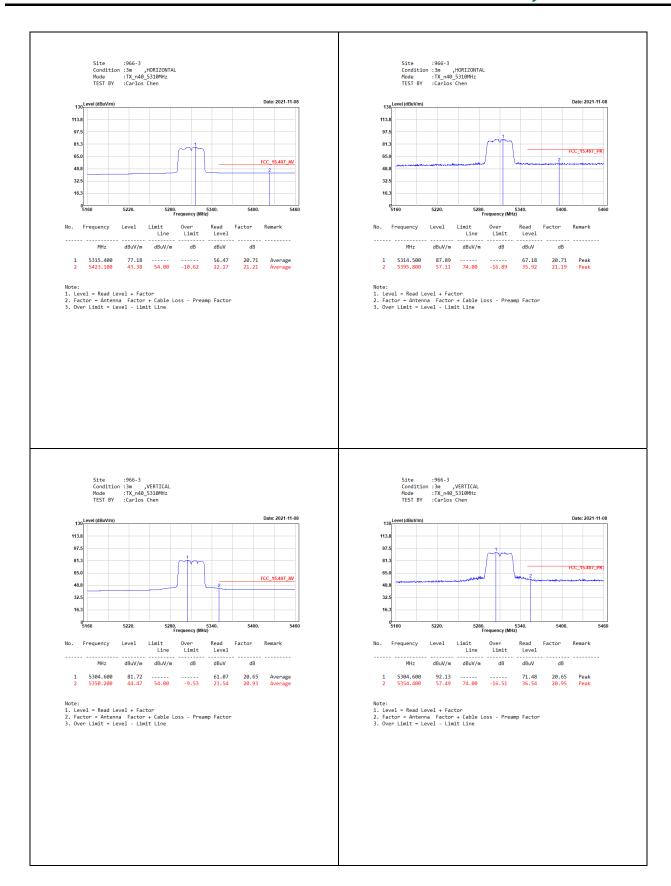




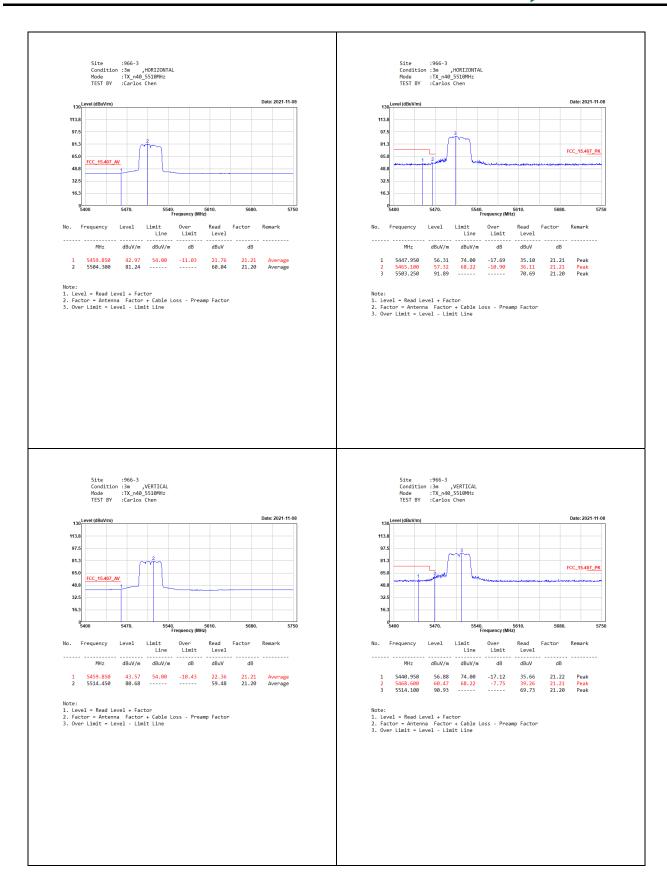




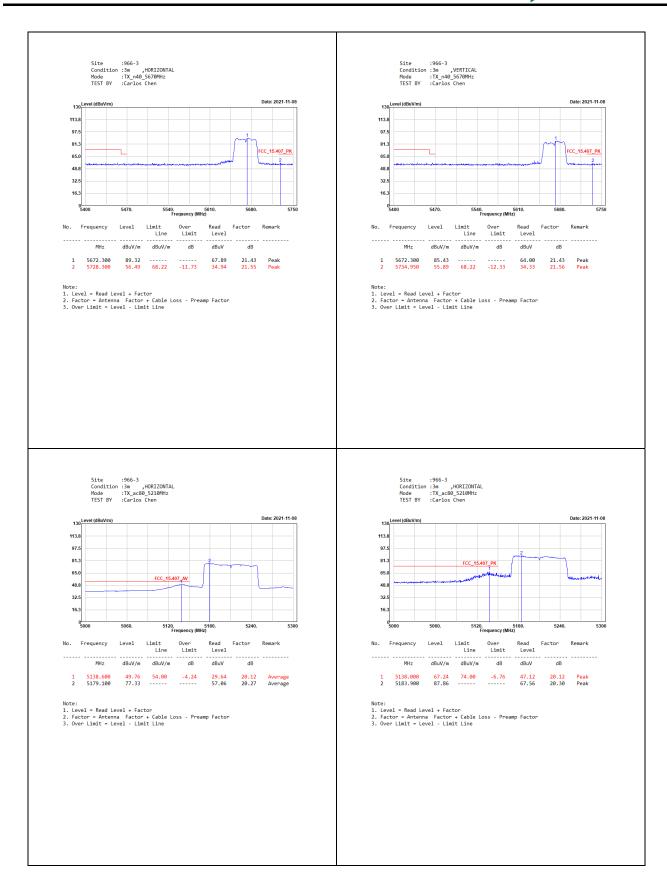




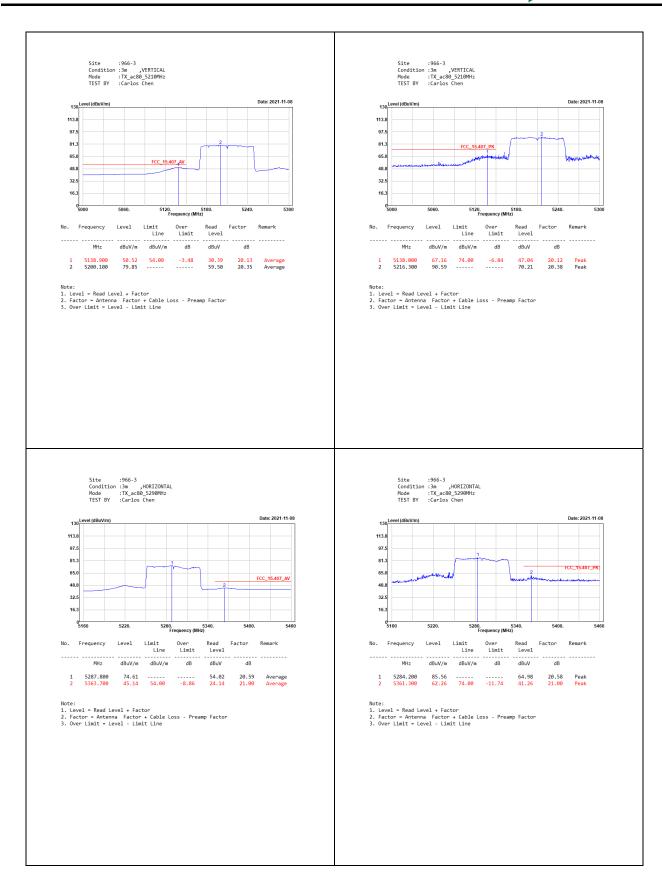




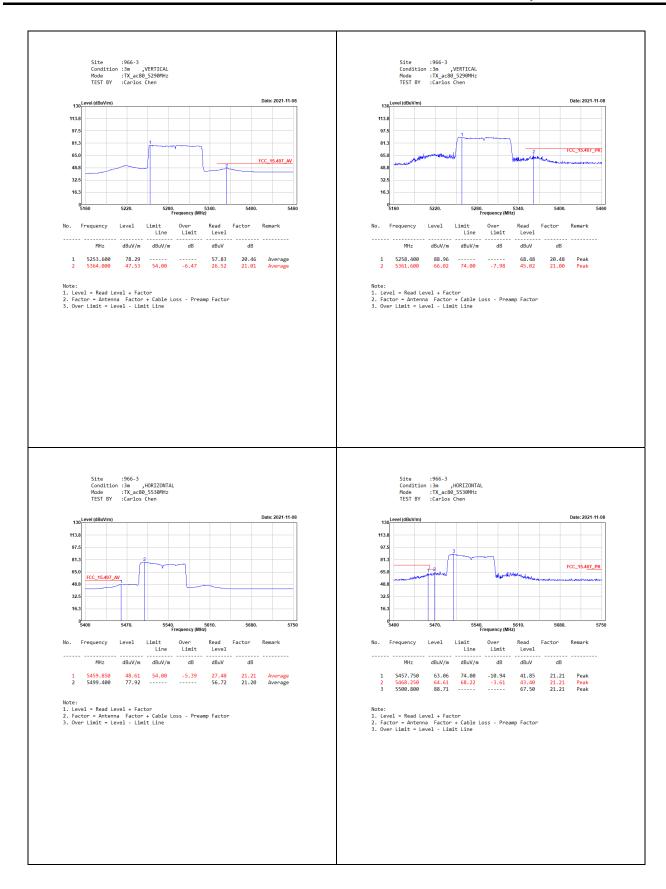




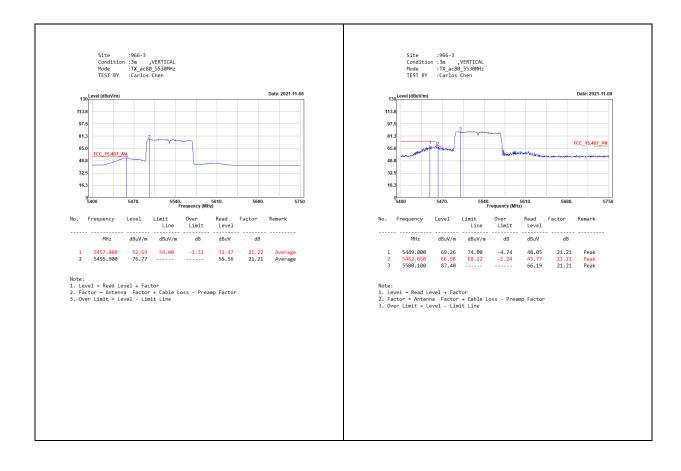






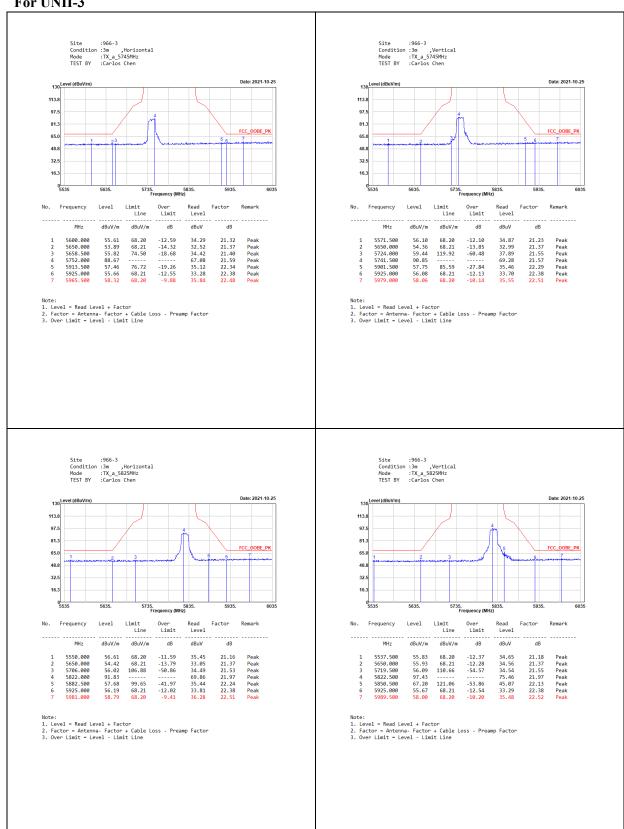




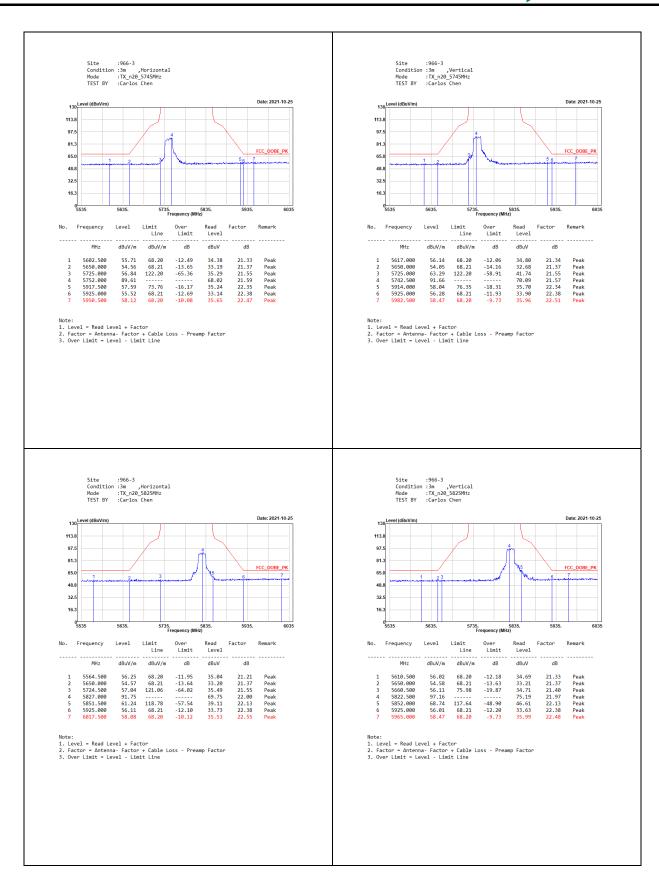




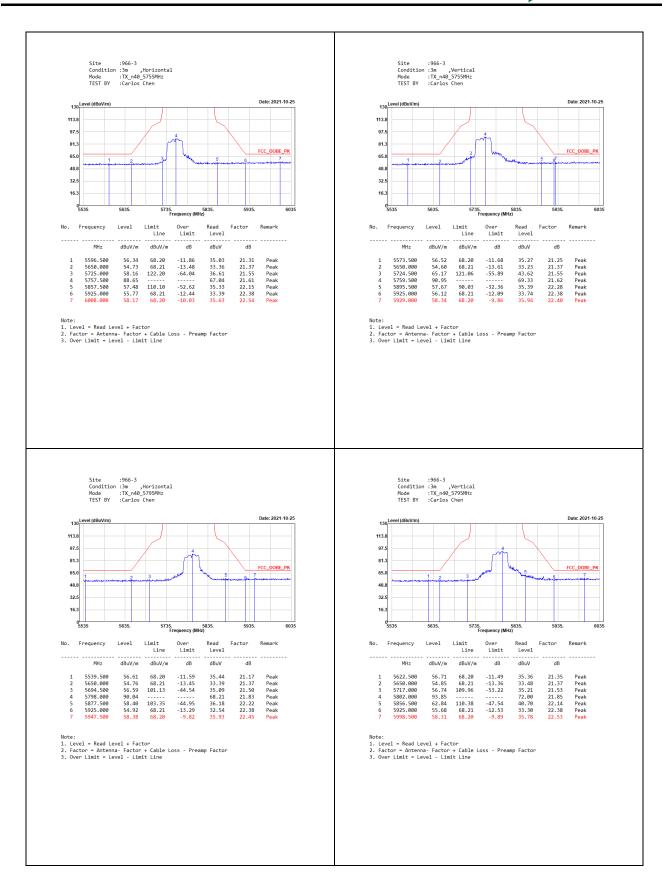
For UNII-3



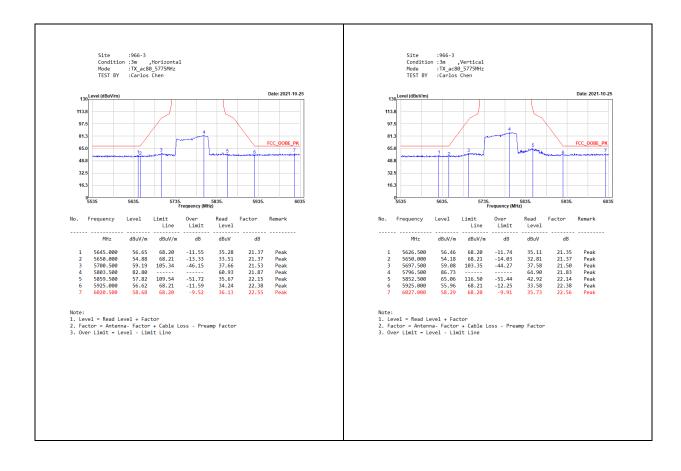








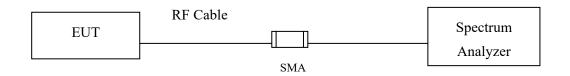






4. Duty Cycle

4.1. Test Setup



4.2. Test Procedure

The EUT was setup according to ANSI C63.10 2013; tested according to U-NII test procedure of KDB789033 for compliance to FCC 47CFR 15.407 requirements.



4.3. Test Result of Duty Cycle

Product : Multimedia device with Bluetooth and WLAN

Test Item : Duty Cycle Test Mode : Transmit

Duty Cycle Formula:

 $Duty \ Cycle = Ton \ / \ (Ton + Toff)$

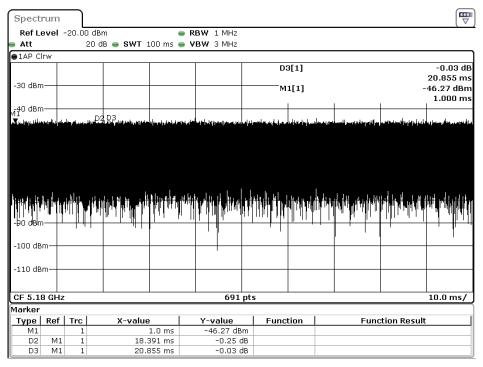
Duty Factor = 10 Log (1/Duty Cycle)

Results:

5GHz band	Ton	Ton + Toff Duty Cycle		Duty Factor	
	(ms)	(ms)	(%)	(dB)	
802.11a	1.0000	1.0000	100.00	0.00	
802.11n20	1.0000	1.0000	100.00	0.00	
802.11n40	1.0000	1.0000	100.00	0.00	
802.11ac80	1.0000	1.0000	100.00	0.00	

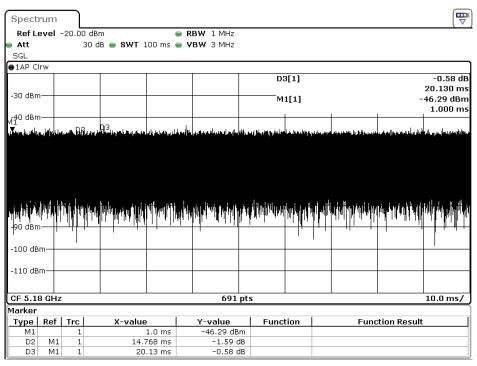






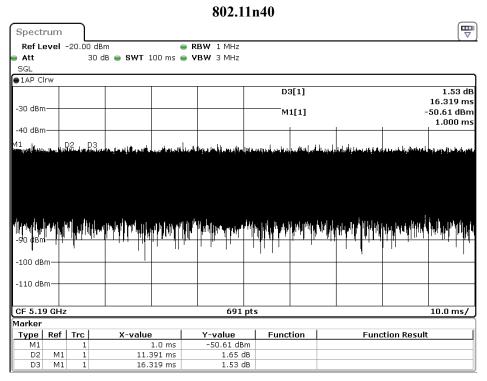
Date: 15.OCT.2020 17:47:24

802.11n20

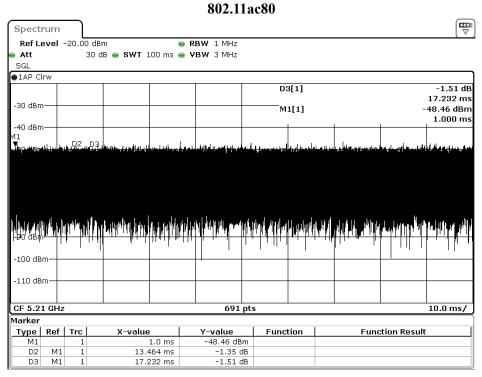


Date: 15.OCT.2020 17:51:39





Date: 15.OCT.2020 17:53:09



Date: 15.OCT.2020 17:54:35



5.	EMI Reduction	Method	During	Compliance	Testing
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No modification was made during testing.