

# Test Report

Product Name	WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module
Model No.	PCE2310M
FCC ID	U2M-PCE2310M

Applicant	Senao Networks, Inc.
Address	3F, No. 529, Chung Cheng Rd., Hsintien, Taipei, Taiwan

Date of Receipt	Oct. 12, 2022
Issued Date	Nov. 16, 2022
Report No.	22A0237R-RFUSV03S-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.

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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



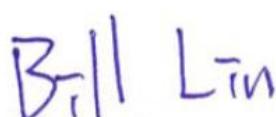
Product Name	WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module
Applicant	Senao Networks, Inc.
Address	3F, No. 529, Chung Cheng Rd., Hsintien, Taipei, Taiwan
Manufacturer	Senao Networks, Inc.
Model No.	PCE2310M
FCC ID	U2M-PCE2310M
EUT Rated Voltage	DC 3.7 V
EUT Test Voltage	AC 120 V / 60 Hz (by Adapter) DC 3.7 V (by Test Fixture)
Trade Name	Senao
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 :



( Senior Project Specialist / Joanne Lin )

Tested By :



( Senior Engineer / Bill Lin )

Approved By :



( Senior Engineer / Alan Chen )

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Appendix 1: EUT Test Photographs

Appendix 2: Product Photos-Please refer to the file: 22A0237R-Product Photos

## Revision History

Report No.	Version	Description	Issued Date
22A0237R-RFUSV03S-A	V1.0	Initial issue of report.	Nov. 16, 2022

## 1. General Information

### 1.1. EUT Description

Product Name	WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module
Trade Name	Senao
Model No.	PCE2310M
FCC ID	U2M-PCE2310M
Frequency Range	802.11a/n/ac/ax-20 MHz: 5180-5240 MHz, 5745-5825 MHz 802.11n/ac/ax-40 MHz: 5190-5230 MHz, 5755-5795 MHz 802.11ac/ax-80 MHz: 5210 MHz, 5775 MHz
Number of Channels	802.11a/n/ac/ax-20 MHz: 9CH, 802.11n/ac/ax-40 MHz: 4CH 802.11ac/ax-80 MHz: 2CH
Data Rate	802.11a: 6-54 Mbps, 802.11n: up to 300 MHz 802.11ac: up to 866.7 MHz, 802.11ax: up to 1201 MHz
Type of Modulation	OFDM, BPSK, QPSK, 16QAM, 64QAM, 256QAM OFDMA, BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM
Antenna type	Dipole
Channel Control	Auto
Antenna Gain	Refer to the Antenna List

#### Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	AWAN	A8EEE-000001	Dipole	5.11 dBi for 5150-5250 MHz 5.22 dBi for 5725-5850 MHz

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

For power CDD Directional gain:

5.11 dBi for 5150-5250 MHz

5.22 dBi for 5725-5850 MHz

For CDD mode:

5150-5250 MHz: Directional gain = 5.11 dBi

5725-5850 MHz: Directional gain = 5.22 dBi

(Directional gain =  $G_{ANT\ MAX} + \text{Array Gain}$ , Array Gain = 0 dB for  $N_{ANT} \leq 4$ )

For power Beamforming Directional gain:

8.12 dBi for 5150-5250 MHz

8.23 dBi for 5725-5850 MHz

For Beamforming mode:

5150-5250 MHz: Directional gain = 8.12 dBi

5725-5850 MHz: Directional gain = 8.23 dBi

Directional gain =  $G_{ANT\ MAX} + \text{Array Gain}$ , Array Gain =  $10 * \log(2) = 3.01$  dB)

For PSD Directional gain:

8.12 dBi for 5150-5250 MHz

8.23 dBi for 5725-5850 MHz

For PSD mode:

5150-5250 MHz: Directional gain = 8.12 dBi

5725-5850 MHz: Directional gain = 8.23 dBi

Directional gain =  $10 \log[(10^{G1/20} + 10^{G2/20})^2 / N_{ANT}]$  dBi

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

Channel	Frequency (MHz)						
36	5180	40	5200	44	5220	48	5240
149	5745	153	5765	157	5785	161	5805
165	5825						

## 802.11n/ac/ax-40 MHz Center Working Frequency of Each Channel:

Channel	Frequency (MHz)						
38	5190	46	5230	151	5755	159	5795

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

Channel	Frequency (MHz)	Channel	Frequency (MHz)				
42	5210	155	5775				

## Note:

1. This device is a WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module with built-in WLAN, 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 data rates are tested in each mode. Only worst case is shown in the report.  
(802.11a is 6 Mbps, 802.11ax-20 MHz/40 MHz/80 MHz is MCS0)
4. The CDD mode and Beamforming mode are presented in the power output test item. For other test items, CDD mode is the worst case for the final test and shown in this report.
5. The spectrum plot against conducted item only shows the worst case.
6. This device does not support partial RU function.
7. These tests were conducted on a sample for the purpose of demonstrating compliance of 802.11a/n/ac/ax transmitter with Part 15 Subpart E for Unlicensed National Information Infrastructure devices.

Test Mode	Mode 1	Transmit (802.11a-CDD)
		Transmit (802.11ax-20 MHz-CDD)
		Transmit (802.11ax-40 MHz-CDD)
		Transmit (802.11ax-80 MHz-CDD)
		Transmit (802.11ax-20 MHz-Beamforming)
		Transmit (802.11ax-40 MHz-Beamforming)
		Transmit (802.11ax-80 MHz-Beamforming)

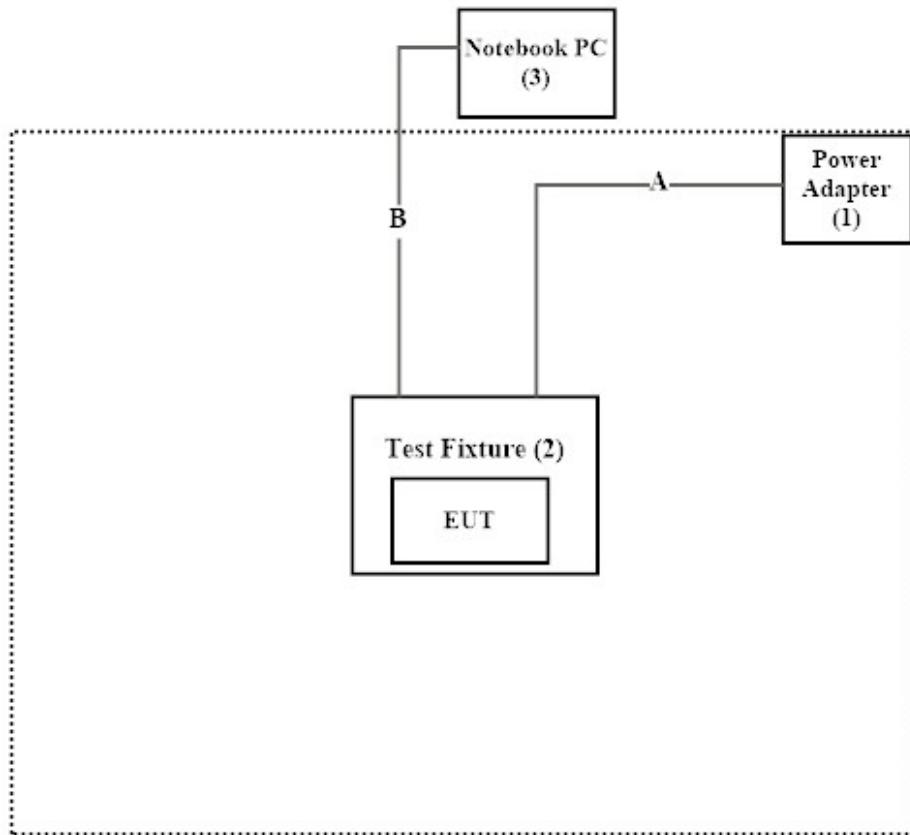
## 1.2. Tested System Details

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

Product	Manufacturer	Model No.	Serial No.	Power Cord
1 Power Adapter	Senao	WEEQU-1210	N/A	N/A
2 Test Fixture	Senao	N/A	N/A	N/A
3 Notebook PC	DELL	P62G	229FJC2	N/A

Cable Type	Cable Description
A Power Cable	Non-shielded, 1.1m
B LAN Cable	Non-shielded, 3m

## 1.3. Configuration of tested System



## 1.4. EUT Exercise Software

1. Setup the EUT as shown in Section 1.3.
2. Execute software “QATool Version 0.0.2.33” on the Notebook PC.
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
Conducted Emission	Temperature (°C)	10~40 °C	23.4 °C
	Humidity (%RH)	10~90 %	55.2 %
Radiated Emission	Temperature (°C)	10~40 °C	22.3 °C
	Humidity (%RH)	10~90 %	73.0 %
Conductive	Temperature (°C)	10~40 °C	24.7 °C
	Humidity (%RH)	10~90 %	60.0 %

USA : FCC Registration Number: TW0033

Canada : CAB Identifier Number: TW3023 / Company 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 : +886-3-327-8031  
Email Address : [info.tw@dekra.com](mailto:info.tw@dekra.com)  
Website : <http://www.dekra.com.tw>

## 1.6. List of Test Equipment

### For Conduction Measurements / HY-SR01

	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
V	EMI Test Receiver	R&S	ESR7	101601	2022/06/23	2023/06/22
V	Two-Line V-Network	R&S	ENV216	101306	2022/05/23	2023/05/22
V	Two-Line V-Network	R&S	ENV216	101307	2022/07/04	2023/07/03
V	Coaxial Cable	SUHNER	RG400 BNC	RF001	2022/05/24	2023/05/23

Note:

1. All equipments are calibrated every one year.
2. The test instruments marked with "V" are used to measure the final test results.
3. Test Software version: E3 210616 dekra V9.

### For Conducted Measurements / HY-SR02

	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
V	Spectrum Analyzer	R&S	FSV30	103466	2021/12/27	2022/12/26
V	Peak Power Analyzer	KEYSIGHT	8990B	MY51000539	2022/05/27	2023/05/26
V	Power Sensor	KEYSIGHT	N1923A	MY59240002	2022/05/19	2023/05/18
V	Power Sensor	KEYSIGHT	N1923A	MY59240003	2022/05/19	2023/05/18

Note:

1. All equipments are calibrated every one year.
2. The test instruments marked with "V" are used to measure the final test results.
3. Test Software version: RF Conducted Test Tools R3 V3.0.1.14.

### For Radiated Measurements / HY-CB03

	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
V	Loop Antenna	AMETEK	HLA6121	49611	2022/03/18	2023/03/17
V	Bi-Log Antenna	SCHWARZBECK	VULB9168	9168-675	2021/08/11	2023/08/10
V	Horn Antenna	RF SPIN	DRH18-E	210508A18ES	2022/06/08	2023/06/07
V	Horn Antenna	Com-Power	AH-840	101100	2021/10/04	2023/10/03
V	Pre-Amplifier	SGH	SGH0301-9	20211007-10	2022/02/22	2023/02/21
V	Pre-Amplifier	SGH	PRAMP118	20200701	2022/07/28	2023/07/27
V	Pre-Amplifier	EMCI	EMC05820SE	980310	2022/07/28	2023/07/27
V	Pre-Amplifier	EMCI	EMC184045SE	980369	2022/05/12	2023/05/11
	Coaxial Cable	EMCI	EMC102-KM-KM-600	1160314		
	Coaxial Cable	EMCI	EMC102-KM-KM-7000	170242		
V	Filter	MICRO TRONICS	BRM50702	G269	2022/07/31	2023/07/30
V	Filter	MICRO TRONICS	BRM50716	G196	2022/07/27	2023/07/26
V	EMI Test Receiver	R&S	ESR	102793	2021/12/15	2022/12/14
V	Spectrum Analyzer	R&S	FSV3044	101114	2022/02/11	2023/02/10
V	Coaxial Cable	SGH	SGH18	2021005-1	2022/03/18	2023/03/17
	Coaxial Cable	SGH	SGH18	202108-4		
	Coaxial Cable	SGH	SGH18	GD20110223-1		
	Coaxial Cable	SGH	HA800	GD20110222-3		

Note:

1. Bi-Log Antenna and Horn Antenna (AH-840) is calibrated every two years, the other equipments are calibrated every one year.
2. The test instruments marked with "V" are used to measure the final test results.
3. Test Software version: E3 210616 dekra V9.

## 1.7. Uncertainty

Uncertainties have been calculated according to the DEKRA internal document.

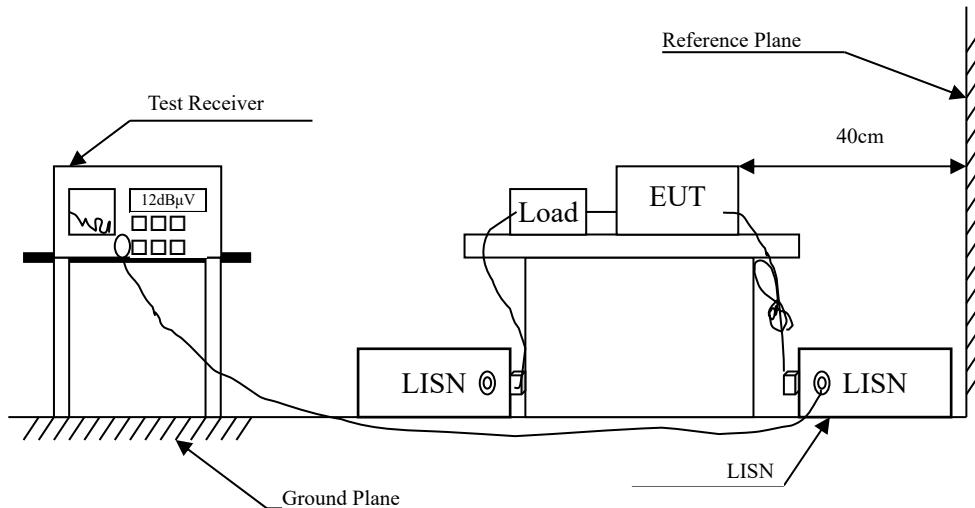
The reported expanded uncertainties are based on a standard uncertainty multiplied by a coverage factor of  $k=2$ , providing a level of confidence of approximately 95%.

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	
Conducted Emission	$\pm 3.42$ dB	
Maximum conducted output power	Power Meter $\pm 0.89$ dB	Spectrum Analyzer $\pm 2.06$ dB
Peak Power Spectral Density	$\pm 2.06$ dB	
Radiated Emission	Under 1 GHz $\pm 4.05$ dB	Above 1 GHz $\pm 3.73$ dB
Band Edge	Under 1 GHz $\pm 4.05$ dB	Above 1 GHz $\pm 3.73$ dB
Occupied Bandwidth	$\pm 1544.74$ Hz	
Duty Cycle	$\pm 2.31$ msec	

## 2. Conducted Emission

### 2.1. Test Setup



### 2.2. Limits

FCC Part 15 Subpart C Paragraph 15.207 (dB $\mu$ V) Limit		
Frequency MHz	Limits	
	QP	AV
0.15 - 0.50	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30	60	50

Remarks: In the above table, the tighter limit applies at the band edges.

### 2.3. Test Procedure

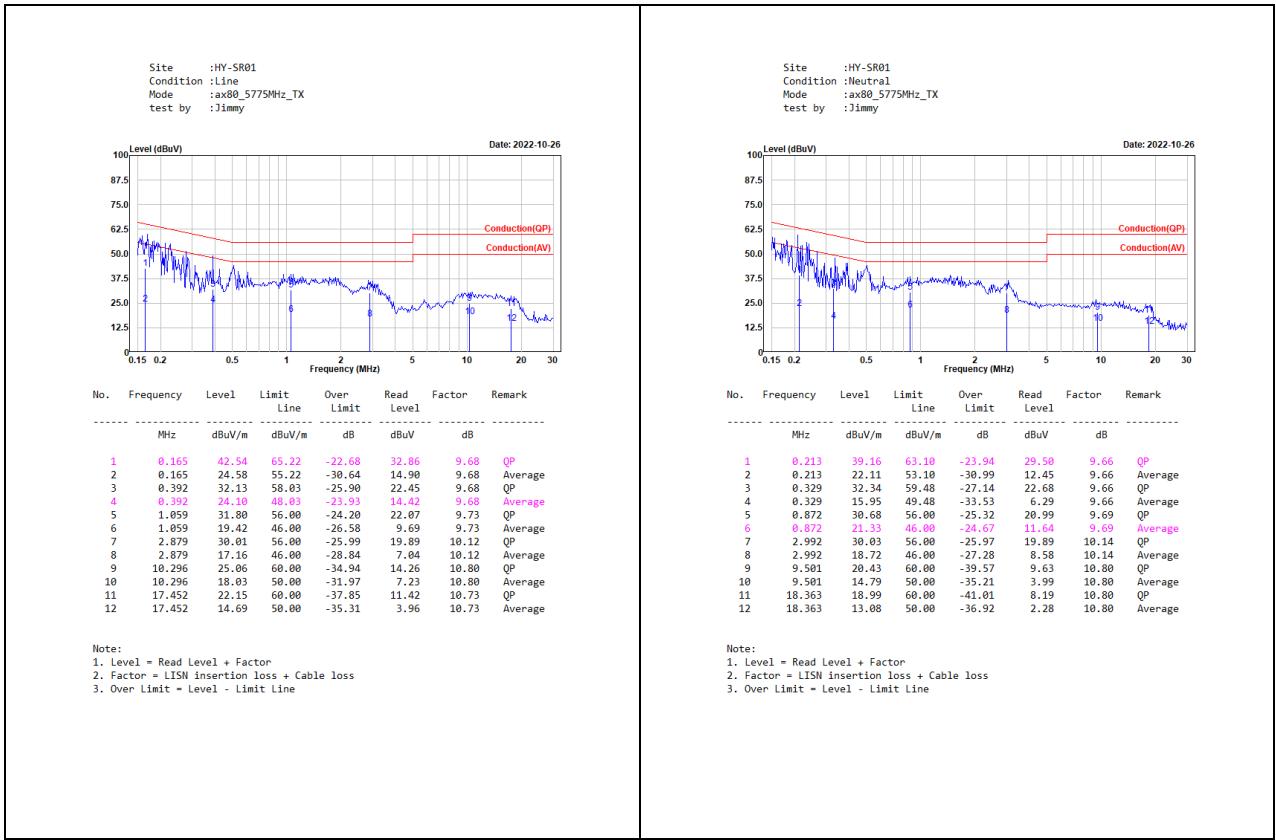
The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50  $\mu$ H coupling impedance for the measuring equipment.

The peripheral devices are also connected to the main power through a LISN that provides a 50ohm /50 $\mu$ H coupling impedance with 50ohm termination. (Please refers to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4:2014 on conducted measurement.

Conducted emissions were invested over the frequency range from 0.15 MHz to 30 MHz using a receiver bandwidth of 9 kHz.

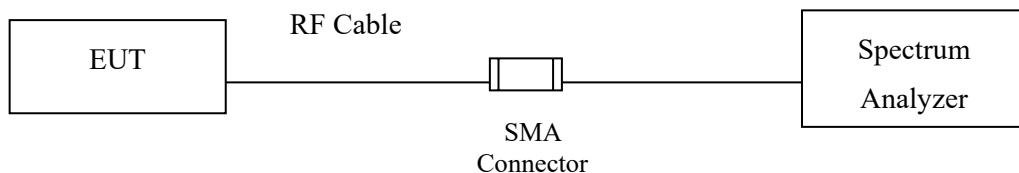
## 2.4. Test Result of Conducted Emission



### 3. Maximum conducted output power

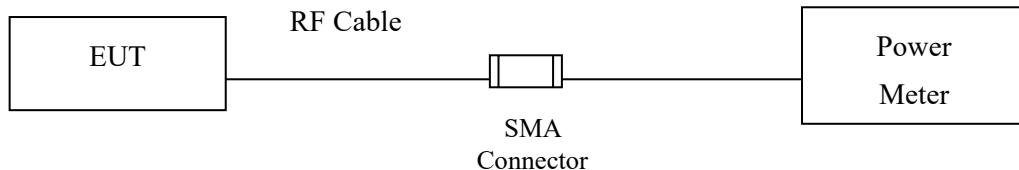
#### 3.1. Test Setup

##### 26dB Occupied Bandwidth

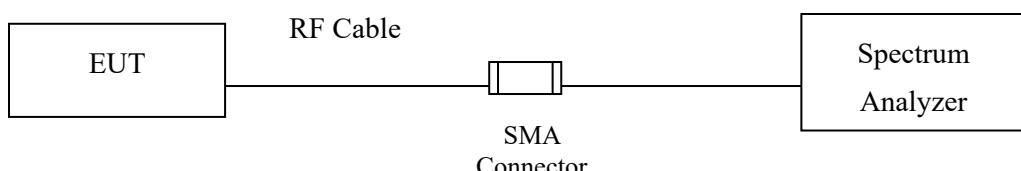


##### Conduction Power Measurement

Conduction Power Measurement (for 802.11an)



Conduction Power Measurement (for 802.11ac/ax)



### 3.2. Limits

For the band 5.15-5.25 GHz,

- (i)** For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. provided the maximum antenna gain does not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).
- (ii)** For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
- (iii)** For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-topoint U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.
- (iv)** For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or  $11 \text{ dBm} + 10 \log B$ , where B is the 99% emission bandwidth in megahertz. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, if transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point UNII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

The maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

**For CDD mode:**

5150-5250 MHz: Directional gain = 5.11 dBi, Limit= 30 dBm

5725-5850 MHz: Directional gain = 5.22 dBi, Limit= 30 dBm

(Directional gain =  $G_{ANT\ MAX} + \text{Array Gain}$ , Array Gain = 0 dB for  $N_{ANT} \leq 4$ )

**For Beamforming mode:**

5150-5250 MHz: Directional gain = 8.12 dBi, Limit= 27.88 dBm

5725-5850 MHz: Directional gain = 8.23 dBi, Limit= 27.77 dBm

(Directional gain =  $G_{ANT\ MAX} + \text{Array Gain}$ , Array Gain =  $10 \cdot \log(2) = 3.01$  dB)

### 3.3. Test Procedure

As an alternative to FCC KDB-789033, the EUT maximum conducted output power was measured with an average power meter employing a video bandwidth greater than the 6dB BW of the emission under test. Maximum conducted output power was read directly from the meter across all data rates, and across three channels within each sub-band. Special care was used to make sure that the EUT was transmitting in continuous mode. This method exceeds the limitations of FCC KDB-789033, and provides more accurate measurements.

802.11an (BW  $\leq$  40MHz) Maximum conducted output power using KDB 789033 section E)3)b) Method PM-G (Measurement using a gated RF average power meter)

Note: the power meter have a video bandwidth that is greater than or equal to the measurement bandwidth, (Anritsu/ MA2411B video bandwidth: 65 MHz)

802.11ac (BW=80 MHz) Maximum conducted output power using KDB 789033 section E)2)b) Method SA-1 (trace averaging with the EUT transmitting at full power throughout each sweep).

When transmitted signals consist of two or more non-contiguous spectrum segments (e.g., 80+80 MHz mode) or when a single spectrum segment of a transmission crosses the boundary between two adjacent U-NII bands, KDB 644545 D03 section D) procedure is used for measurements.

### 3.4. Test Result of Maximum conducted output power

Product : WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module  
 Test Item : Maximum conducted output power  
 Test Mode : Transmit (802.11a-CDD)  
 Test Date : 2022/10/19

#### Maximum conducted output power Measurement:

Channel No.	Frequency (MHz)	26 dB Bandwidth (MHz)	Chain A Power (dBm)	Chain B Power (dBm)	Output Power (dBm)	Output Power Limit	
						(dBm)	(dBm+10log(BW))
36	5180	--	16.65	17.49	20.10	30	--
44	5220	--	21.46	21.29	24.39	30	--
48	5240	--	21.61	21.51	24.57	30	--
149	5745	--	20.76	21.37	24.09	30	
157	5785	--	20.79	21.32	24.07	30	--
165	5825	--	21.25	21.59	24.43	30	--

Note:

1. Output Power Value (dBm) =  $10 * \text{LOG} (\text{Chain A(mW)} + \text{Chain B(mW)})$
2. 26 dB Bandwidth is the bandwidth of chain A or B whichever is less bandwidth, output power limitation is more stringent.

Product : WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module  
 Test Item : Maximum conducted output power  
 Test Mode : Transmit (802.11ax-20 MHz-CDD)  
 Test Date : 2022/10/19

**Maximum conducted output power Measurement:**

Channel No.	Frequency (MHz)	26 dB Bandwidth (MHz)	Chain A Power (dBm)	Chain B Power (dBm)	Output Power (dBm)	Output Power Limit	
						(dBm)	(dBm+10log(BW))
36	5180	--	16.94	17.74	20.37	30	--
44	5220	--	21.14	20.97	24.07	30	--
48	5240	--	21.74	21.51	24.64	30	--
149	5745	--	20.95	21.53	24.26	30	--
157	5785	--	20.94	21.46	24.22	30	--
165	5825	--	21.00	21.39	24.21	30	--

Note:

1. Output Power Value (dBm) =  $10 * \text{LOG} (\text{Chain A}(mW) + \text{Chain B}(mW))$
2. 26 dB Bandwidth is the bandwidth of chain A or B whichever is less bandwidth, output power limitation is more stringent.

Product : WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module  
 Test Item : Maximum conducted output power  
 Test Mode : Transmit (802.11ax-40 MHz-CDD)  
 Test Date : 2022/10/19

**Maximum conducted output power Measurement:**

Channel No.	Frequency (MHz)	26 dB Bandwidth (MHz)	Chain A Power (dBm)	Chain B Power (dBm)	Output Power (dBm)	Duty factor (dB)	Output Power Limit	
							(dBm)	(dBm+10log(BW))
38	5190	--	15.04	15.93	18.52	--	30	--
46	5230	--	20.14	20.11	23.14	--	30	--
151	5755	--	20.52	20.89	23.72	--	30	--
159	5795	--	20.98	21.33	24.17	--	30	--

Note:

1. Output Power Value (dBm) =  $10 * \text{LOG} (\text{Chain A}(mW) + \text{Chain B}(mW))$
2. 26 dB Bandwidth is the bandwidth of chain A or B whichever is less bandwidth, output power limitation is more stringent.

Product : WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module  
 Test Item : Maximum conducted output power  
 Test Mode : Transmit (802.11ax-80 MHz-CDD)  
 Test Date : 2022/10/19

**Maximum conducted output power Measurement**

Channel No.	Frequency (MHz)	26 dB Bandwidth (MHz)	Chain A	Chain B	Output Power (dBm)	Duty factor (dB)	Output Power Limit	
			Power (dBm)	Power (dBm)	(dBm)	(dBm)	dBm+10log(BW)	
42	5210	--	14.06	15.04	17.59	--	30	--
155	5775	--	17.25	17.82	20.55	--	30	--

Note:

1. Output Power Value (dBm) =  $10 * \text{LOG} (\text{Chain A}(mW) + \text{Chain B}(mW))$
2. 26 dB Bandwidth is the bandwidth of chain A or B whichever is less bandwidth, output power limitation is more stringent.

Product : WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module  
 Test Item : Maximum conducted output power  
 Test Mode : Transmit (802.11ax-20 MHz-Beamforming)  
 Test Date : 2022/10/19

**Maximum conducted output power Measurement:**

Channel No.	Frequency (MHz)	26 dB Bandwidth (MHz)	Chain A Power (dBm)	Chain B Power (dBm)	Output Power (dBm)	Duty factor (dB)	Output Power Limit	
							(dBm)	(dBm+10log(BW))
36	5180	--	13.93	14.73	17.36	--	27.88	--
44	5220	--	18.13	17.96	21.06	--	27.88	--
48	5240	--	18.73	18.50	21.63	--	27.88	--
149	5745	--	17.94	18.52	21.25	--	27.77	--
157	5785	--	17.93	18.45	21.21	--	27.77	--
165	5825	--	17.99	18.38	21.20	--	27.77	--

Note:

1. Output Power Value (dBm) =  $10 * \text{LOG} (\text{Chain A(mW)} + \text{Chain B(mW)})$
2. 26 dB Bandwidth is the bandwidth of chain A or B whichever is less bandwidth, output power limitation is more stringent.

Product : WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module  
 Test Item : Maximum conducted output power  
 Test Mode : Transmit (802.11ax-40 MHz-Beamforming)  
 Test Date : 2022/10/19

**Maximum conducted output power Measurement:**

Channel No.	Frequency (MHz)	26 dB Bandwidth (MHz)	Chain A Power (dBm)	Chain B Power (dBm)	Output Power (dBm)	Duty factor (dB)	Output Power Limit	
							(dBm)	(dBm+10log(BW))
38	5190	--	12.03	12.92	15.51	--	27.88	--
46	5230	--	17.13	17.10	20.13	--	27.88	--
151	5755	--	17.51	17.88	20.71	--	27.77	--
159	5795	--	17.97	18.32	21.16	--	27.77	--

Note:

1. Output Power Value (dBm) =  $10 * \text{LOG} (\text{Chain A}(mW) + \text{Chain B}(mW))$
2. 26 dB Bandwidth is the bandwidth of chain A or B whichever is less bandwidth, output power limitation is more stringent.

Product : WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module  
 Test Item : Maximum conducted output power  
 Test Mode : Transmit (802.11ax-80 MHz-Beamforming)  
 Test Date : 2022/10/19

**Maximum conducted output power Measurement**

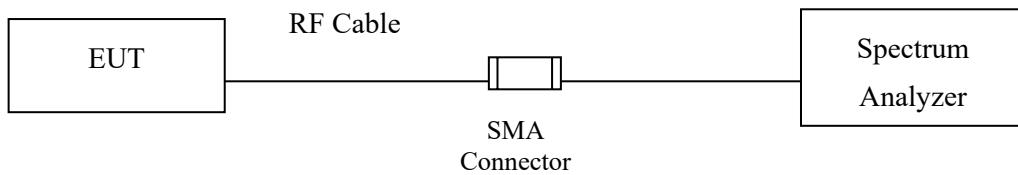
Channel No.	Frequency (MHz)	26 dB Bandwidth (MHz)	Chain A Power (dBm)	Chain B Power (dBm)	Output Power (dBm)	Duty factor (dB)	Output Power Limit	
							(dBm)	(dBm+10log(BW))
42	5210	--	11.05	12.03	14.58	--	27.88	--
155	5775	--	14.24	14.81	17.54	--	27.77	--

Note:

1. Output Power Value (dBm) =  $10 * \text{LOG} (\text{Chain A}(mW) + \text{Chain B}(mW))$
2. 26 dB Bandwidth is the bandwidth of chain A or B whichever is less bandwidth, output power limitation is more stringent.

## 4. Maximum Power Spectral Density

### 4.1. Test Setup



### 4.2. Limits

For the band 5.15-5.25 GHz,

- (i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
- (ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
- (iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.
- (iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point UNII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

The maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5150-5250 MHz: Directional gain = 8.12 dBi, Limit= 14.88 dBm

5725-5850 MHz: Directional gain = 8.23 dBi, Limit= 27.77 dBm

Directional gain =  $10 \log[(10^{G1/20} + 10^{G2/20})^2 / N_{ANT}]$  dBi

#### 4.3. Test Procedure

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.

The Peak Power Spectral Density using KDB 789033 section F) procedure, Create an average power spectrum for the EUT operating mode being tested by following the instructions in section E)2) for measuring maximum conducted output power using a spectrum analyzer.

SA-1 method is selected to run the test.

#### 4.4. Test Result of Maximum Power Spectral Density

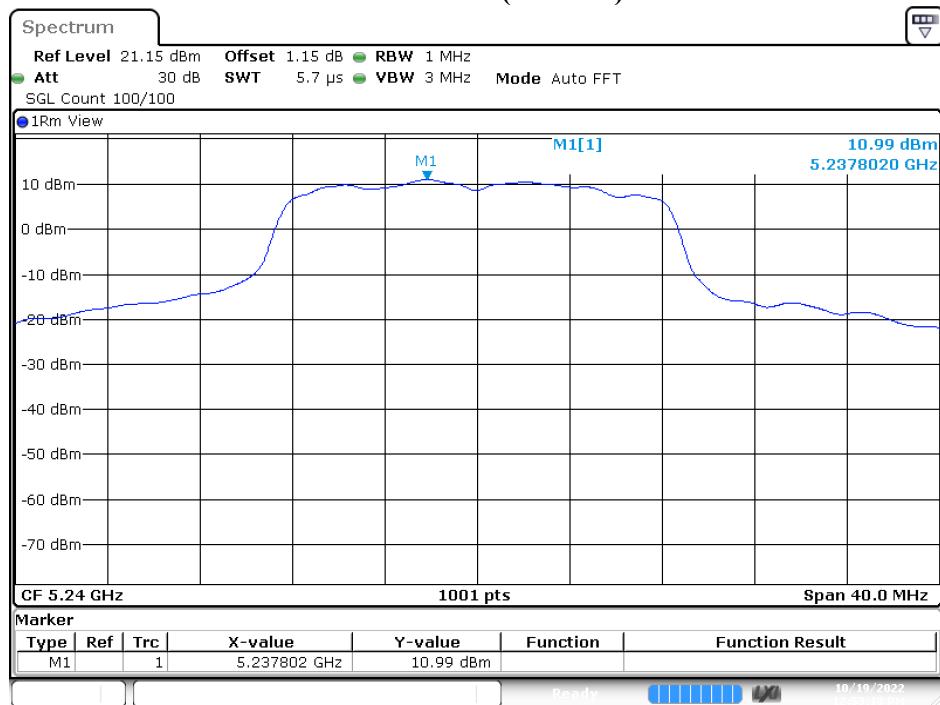
Product : WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module  
 Test Item : Maximum Power Spectral Density  
 Test Mode : Transmit (802.11a-CDD)

Channel No.	Frequency (MHz)	Data Rate (Mbps)	Chain	PPSD/MHz (dBm)	Duty factor (dB)	Total PPSD/MHz (dBm)	Limit (dBm)	Result
36	5180	6	A	5.48	0.20	9.19	14.88	Pass
			B	6.43				
44	5220	6	A	9.95	0.20	13.17	14.88	Pass
			B	9.97				
48	5240	6	A	10.39	0.20	13.91	14.88	Pass
			B	10.99				

Channel No.	Frequency (MHz)	Data Rate (Mbps)	Chain	PPSD/MHz (dBm)	Duty factor (dB)	Total PPSD/MHz (dBm)	Limit (dBm)	Result
149	5745	6	A	6.69	0.20	10.31	27.77	Pass
			B	7.48				
157	5785	6	A	6.62	0.20	10.51	27.77	Pass
			B	7.89				
165	5825	6	A	6.80	0.20	10.20	27.77	Pass
			B	7.17				

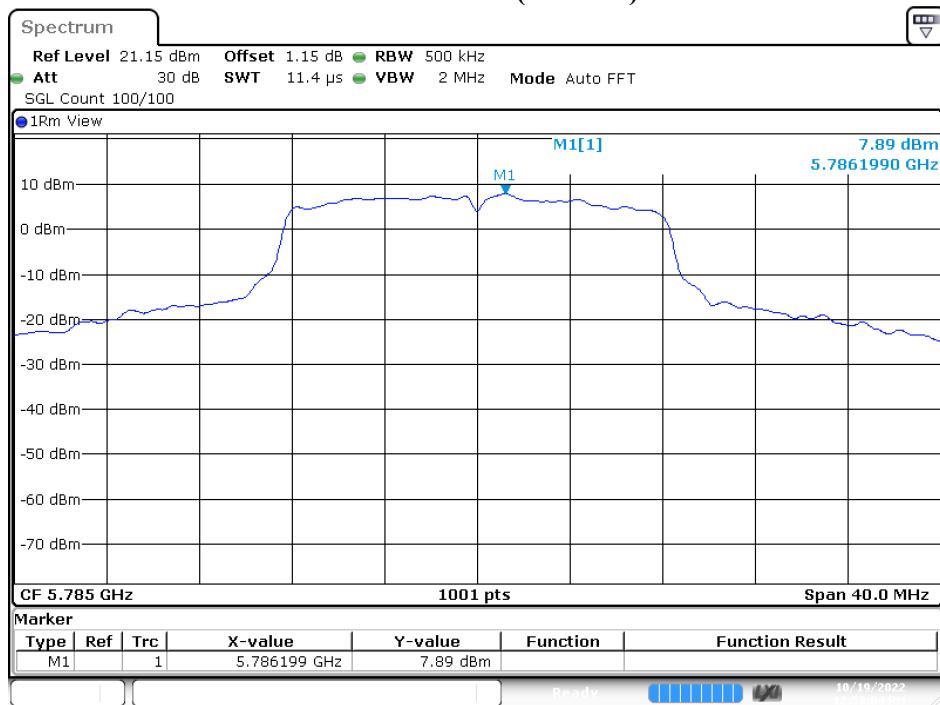
Note: Total PPSD =  $10 * \log(\text{Chain A (mW)} + \text{Chain B (mW)} + \text{Duty factor})$ .

### Channel 48 (Chain B):



Date: 19.OCT.2022 12:53:13

### Channel 157 (Chain B):



Date: 19.OCT.2022 12:58:04

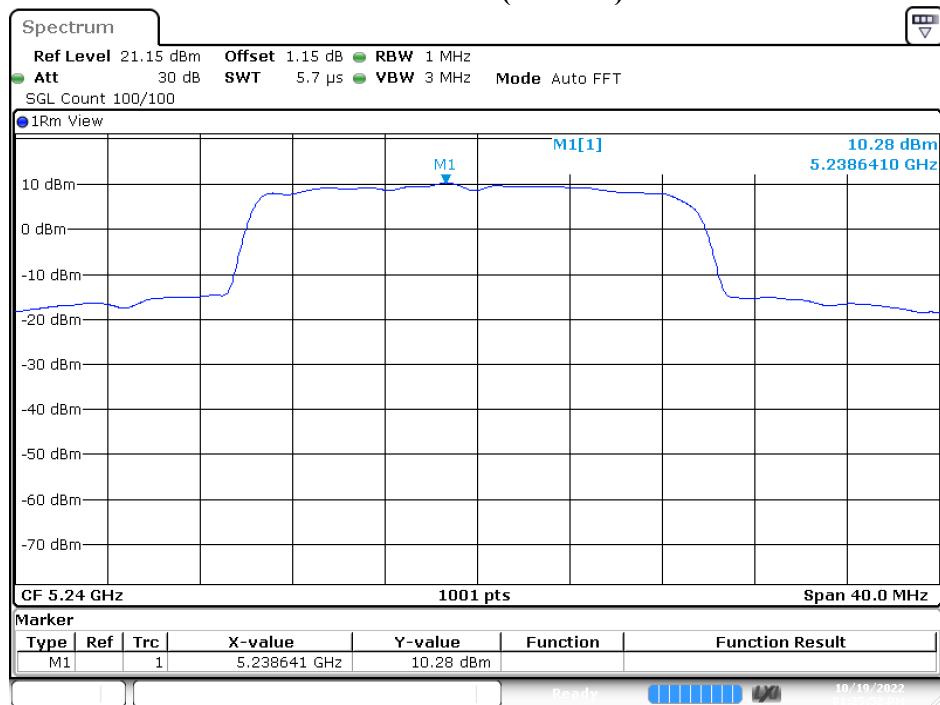
Product : WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module  
 Test Item : Maximun Power Spectral Density  
 Test Mode : Transmit (802.11ax-20 MHz-CDD)

Channel No.	Frequency (MHz)	Data Rate	Chain	PPSD/MHz (dBm)	Duty factor (dB)	Total PPSD/MHz (dBm)	Limit (dBm)	Result
36	5180	MCS0	A	4.90	0.29	8.46	14.88	Pass
			B	5.40				
44	5220	MCS0	A	9.60	0.29	12.60	14.88	Pass
			B	8.98				
48	5240	MCS0	A	9.73	0.29	13.31	14.88	Pass
			B	10.28				

Channel No.	Frequency (MHz)	Data Rate	Chain	PPSD/MHz (dBm)	Duty factor (dB)	Total PPSD/MHz (dBm)	Limit (dBm)	Result
149	5745	MCS0	A	6.53	0.29	10.11	27.77	Pass
			B	7.08				
157	5785	MCS0	A	6.20	0.29	9.71	27.77	Pass
			B	6.62				
165	5825	MCS0	A	6.01	0.29	9.94	27.77	Pass
			B	7.20				

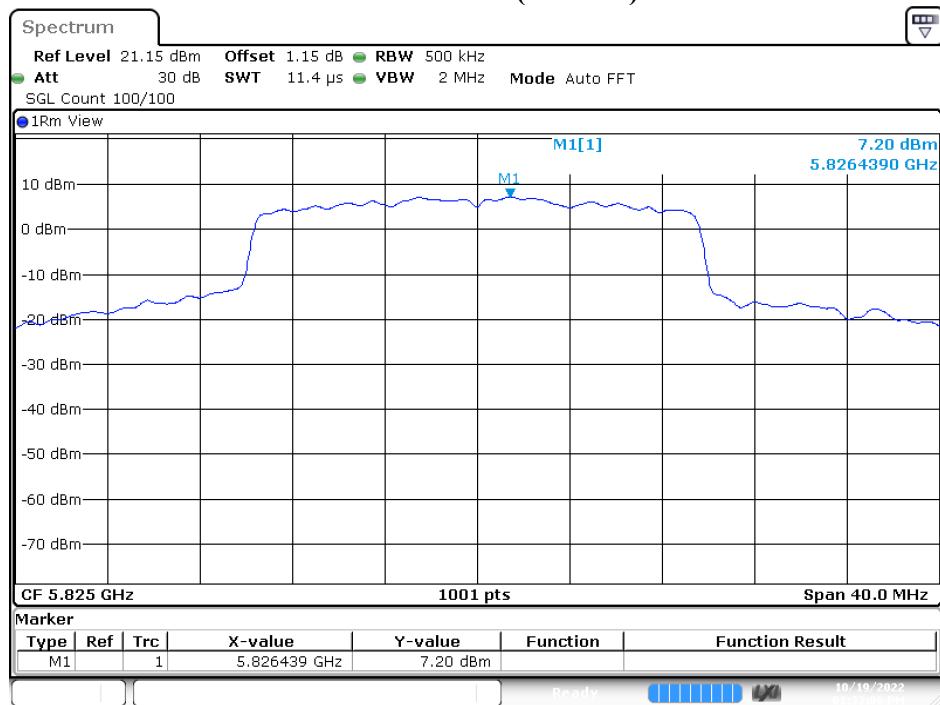
Note: Total PPSD =  $10 * \log(\text{Chain A (mW)} + \text{Chain B (mW)} + \text{Duty factor})$ .

### Channel 48 (Chain B):



Date: 19.OCT.2022 13:25:52

### Channel 165 (Chain B):



Date: 19.OCT.2022 13:33:06

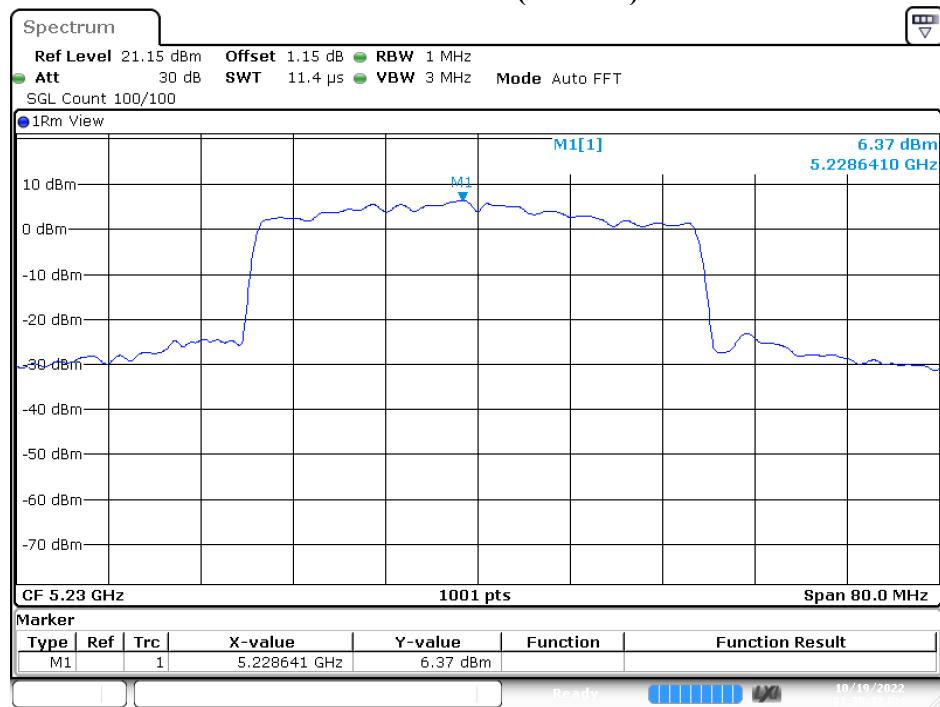
Product : WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module  
 Test Item : Maximun Power Spectral Density  
 Test Mode : Transmit (802.11ax-40 MHz-CDD)

Channel No.	Frequency (MHz)	Data Rate	Chain	PPSD/MHz (dBm)	Duty factor (dB)	Total PPSD/MHz (dBm)	Limit (dBm)	Result
38	5190	MCS0	A	1.30	0.45	5.09	14.88	Pass
			B	1.93				
46	5230	MCS0	A	6.30	0.45	9.80	14.88	Pass
			B	6.37				

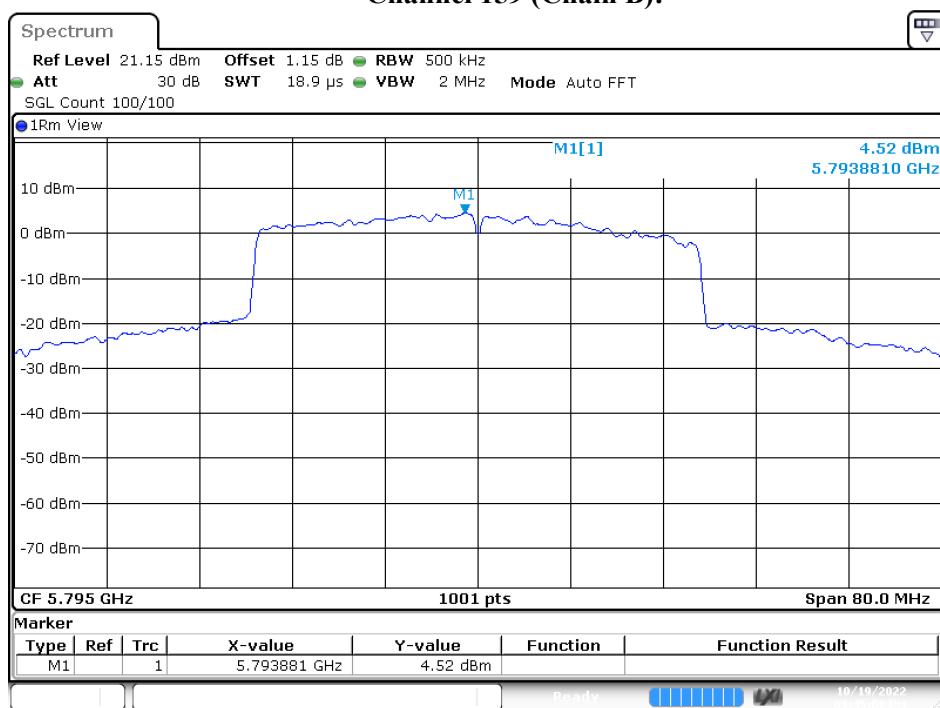
Channel No.	Frequency (MHz)	Data Rate	Chain	PPSD/MHz (dBm)	Duty factor (dB)	Total PPSD/MHz (dBm)	Limit (dBm)	Result
151	5755	MCS0	A	4.04	0.45	7.73	27.77	Pass
			B	4.49				
159	5795	MCS0	A	3.81	0.45	7.64	27.77	Pass
			B	4.52				

Note: Total PPSD =  $10 * \log(\text{Chain A (mW)} + \text{Chain B (mW)} + \text{Duty factor})$ .

## Channel 46 (Chain B):



## Channel 159 (Chain B):



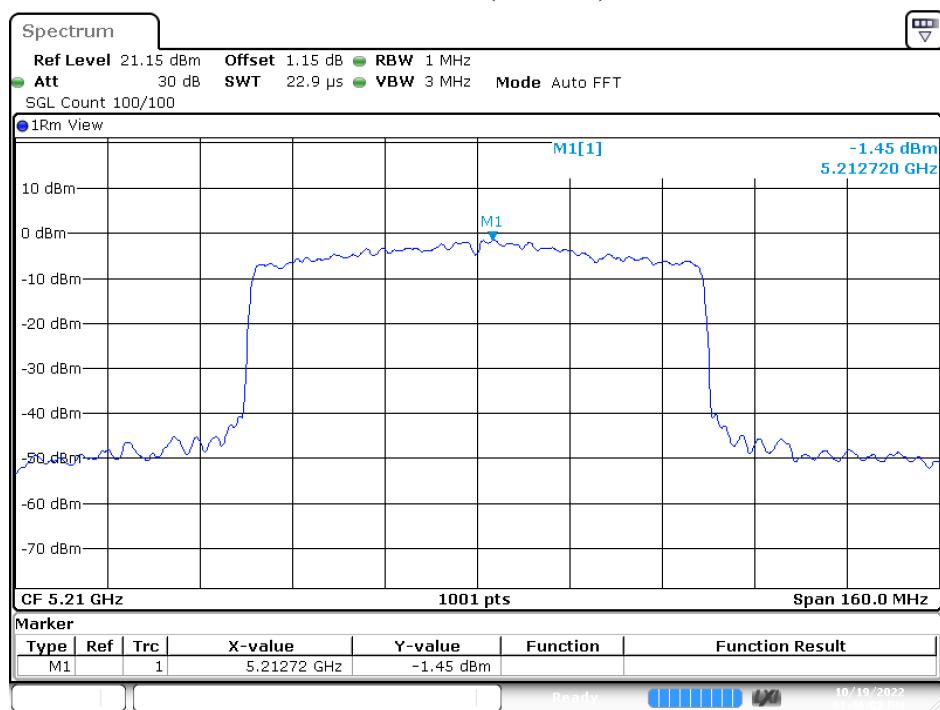
Product : WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module  
 Test Item : Maximun Power Spectral Density  
 Test Mode : Transmit (802.11ax-80 MHz-CDD)

Channel No.	Frequency (MHz)	Data Rate	Chain	PPSD/MHz (dBm)	Duty factor (dB)	Total PPSD/MHz (dBm)	Limit (dBm)	Result
42	5210	MCS0	A	-2.17	0.80	2.02	14.88	Pass
			B	-1.45				

Channel No.	Frequency (MHz)	Data Rate	Chain	PPSD/MHz (dBm)	Duty factor (dB)	Total PPSD/MHz (dBm)	Limit (dBm)	Result
155	5775	MCS0	A	-2.81	0.80	1.46	27.77	Pass
			B	-1.94				

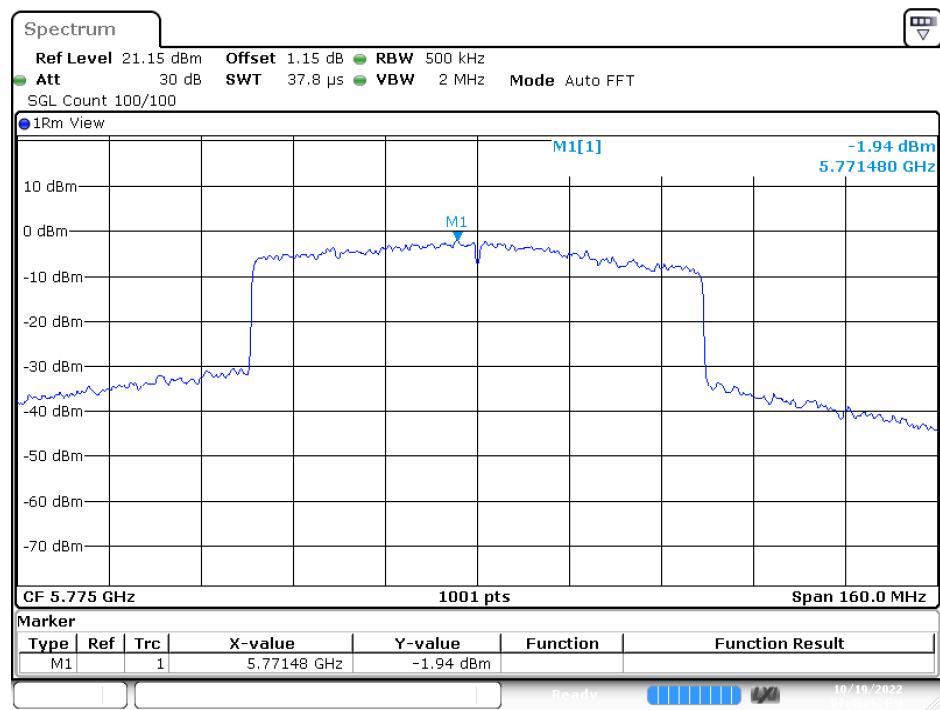
Note: Total PPSD =  $10 * \log(\text{Chain A (mW)} + \text{Chain B (mW)} + \text{Duty factor})$ .

## Channel 42 (Chain B):



Date: 19.OCT.2022 13:46:08

## Channel 155 (Chain B):

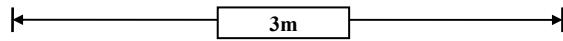


Date: 19.OCT.2022 13:48:42

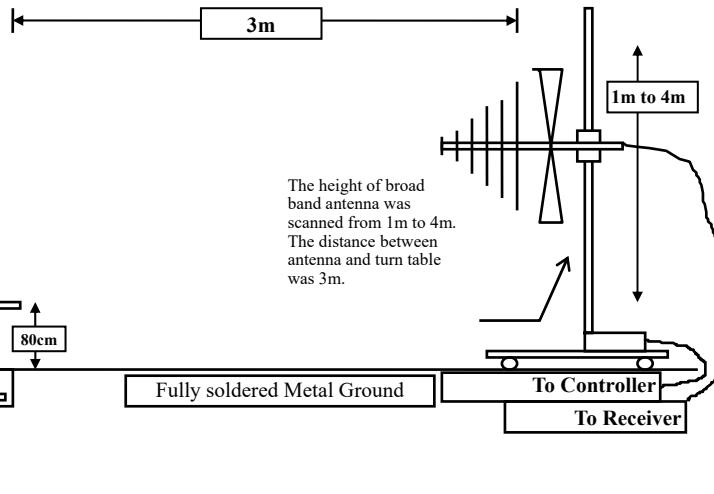
## 5. Radiated Emission

### 5.1. Test Setup

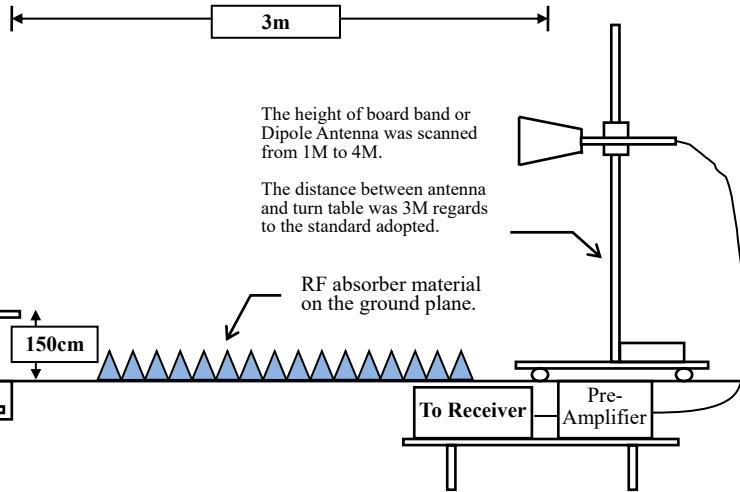
Radiated Emission Under 30 MHz



Radiated Emission Below 1 GHz



Radiated Emission Above 1GHz



## 5.2. 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.

<b>FCC Part 15 Subpart C Paragraph 15.209(a) Limits</b>		
Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (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 ( $\mu$ V/m).

### 5.3. 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 1 GHz, 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 9 kHz and

30 MHz~1 GHz is 120 kHz and above 1 GHz is 1 MHz.

Radiated emission measurements below 30 MHz are made using Loop Antenna and 30 MHz~1 GHz are made using broadband Bilog antenna and above 1 GHz 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 from 9 kHz - 10 th Harmonic of fundamental was investigated.

**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  $\geq$  3MHz.

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

RBW = 1 MHz.

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

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

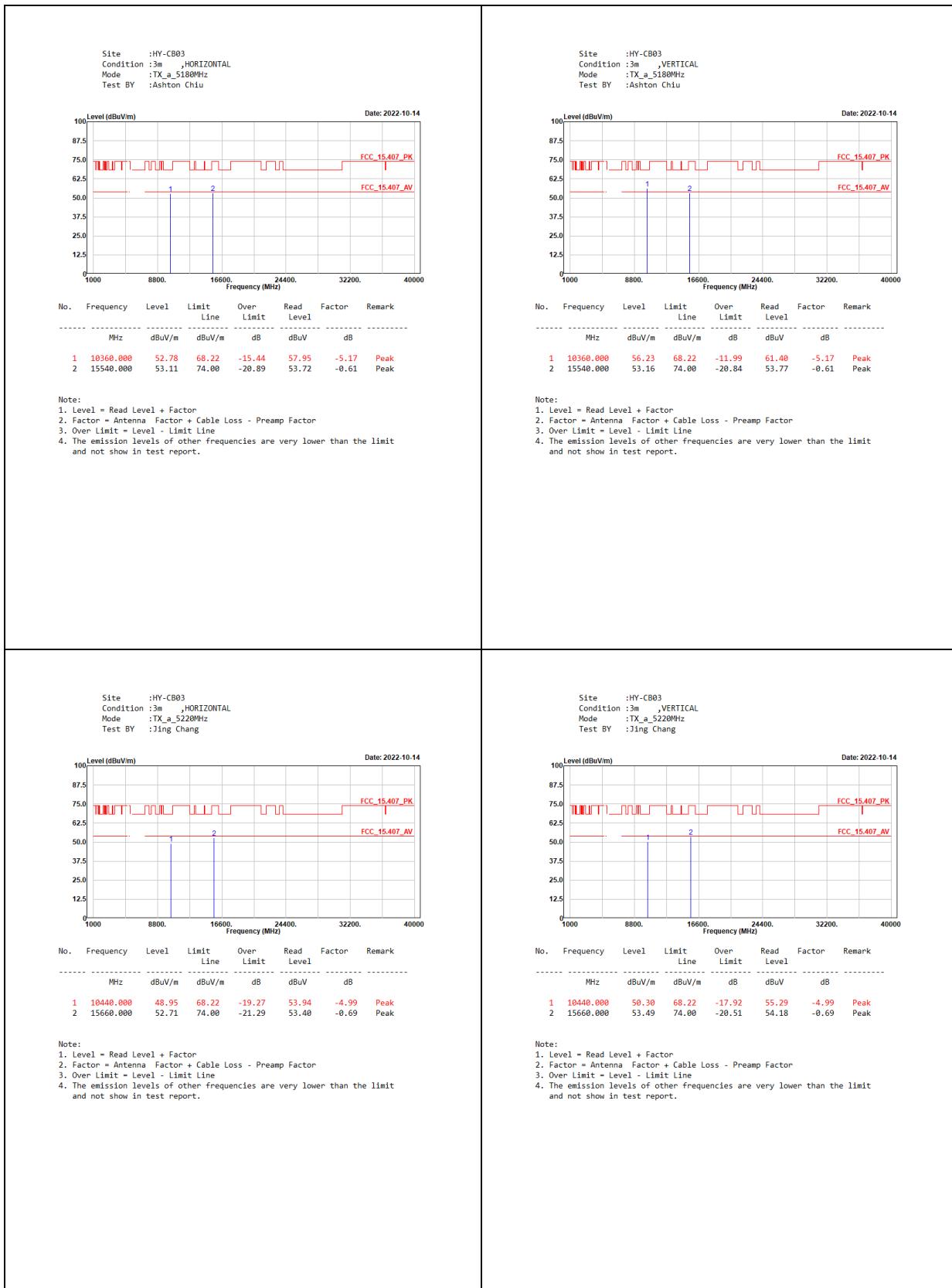
(T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

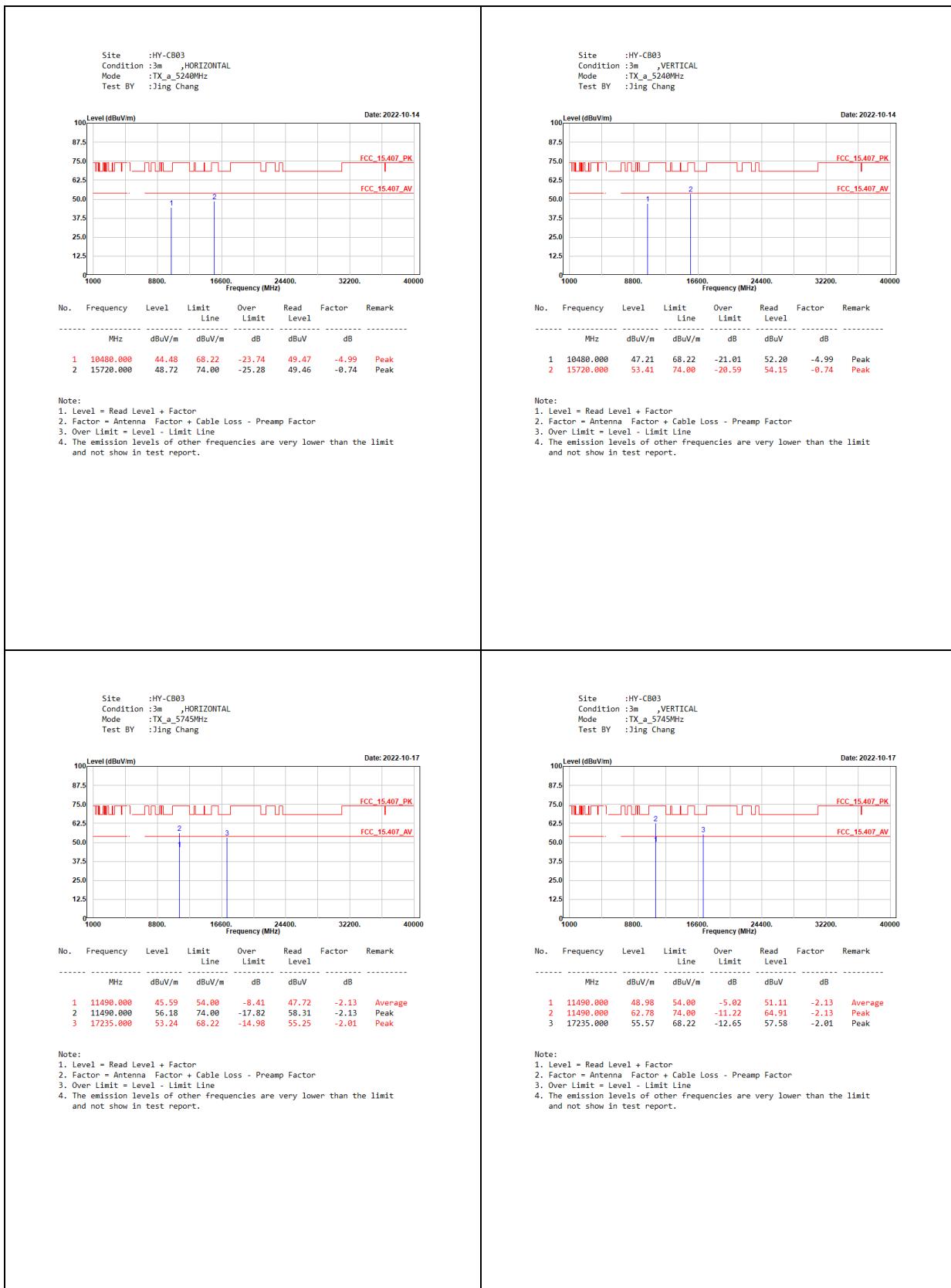
**CDD Mode:**

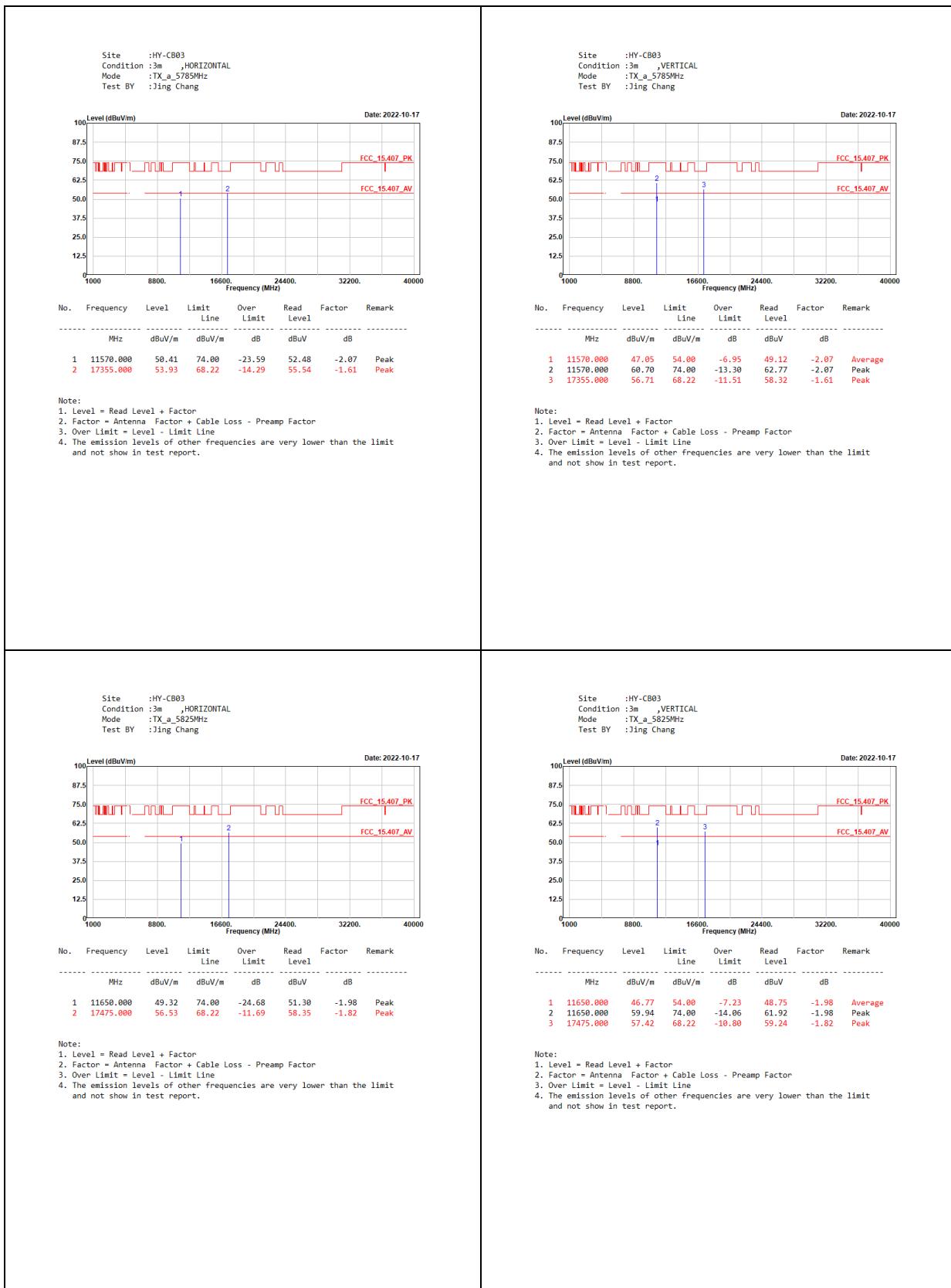
5 GHz band	Duty Cycle (%)	T (ms)	1/T (Hz)	VBW (Hz)
802.11a	95.56	1.4000	714	1000
802.11ax-20 MHz	93.58	1.0200	980	1000
802.11ax-40 MHz	90.10	0.5460	1832	2000
802.11ax-80 MHz	83.15	0.2960	3378	5000

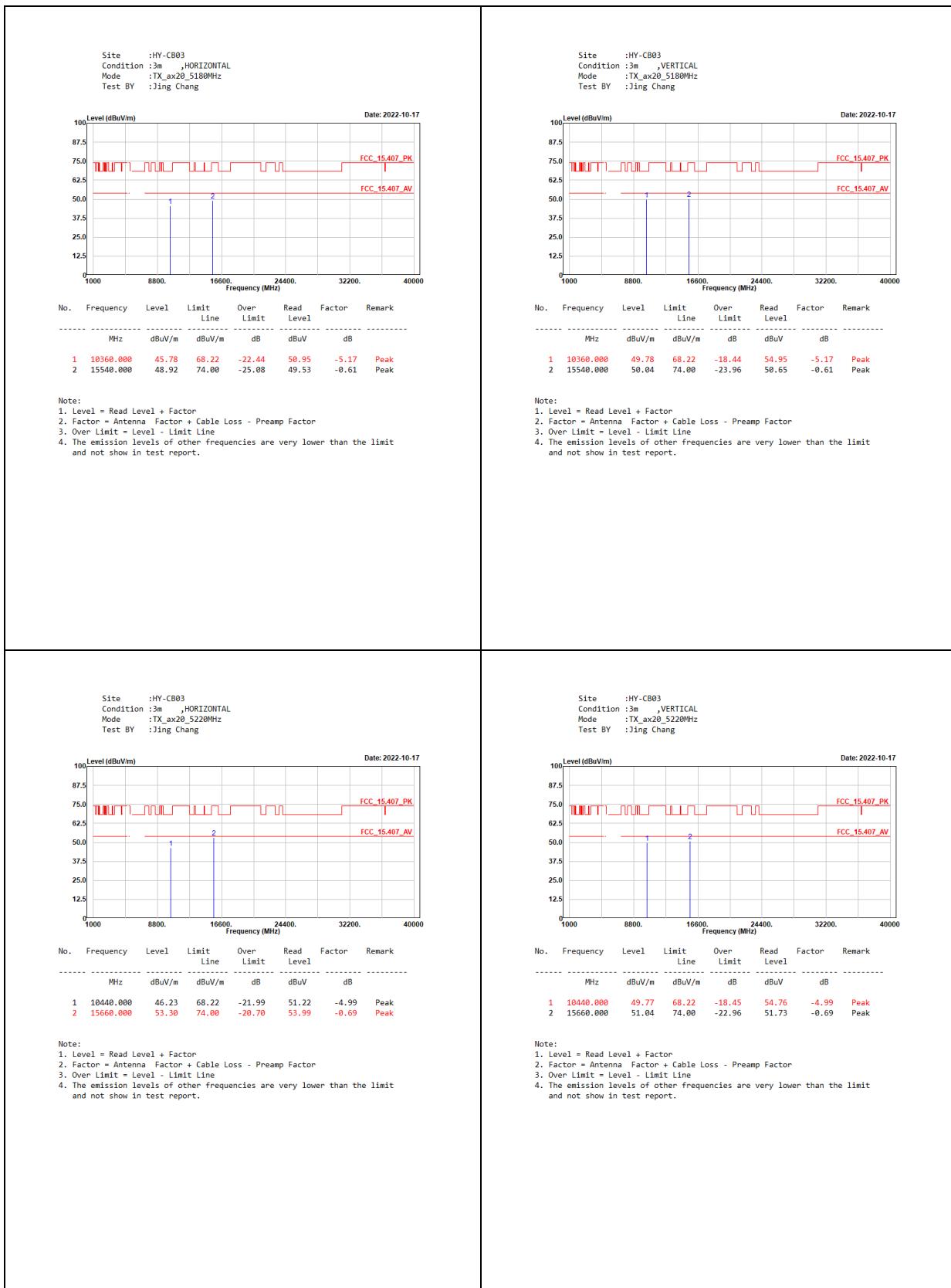
Note: Duty Cycle Refer to Section 8.

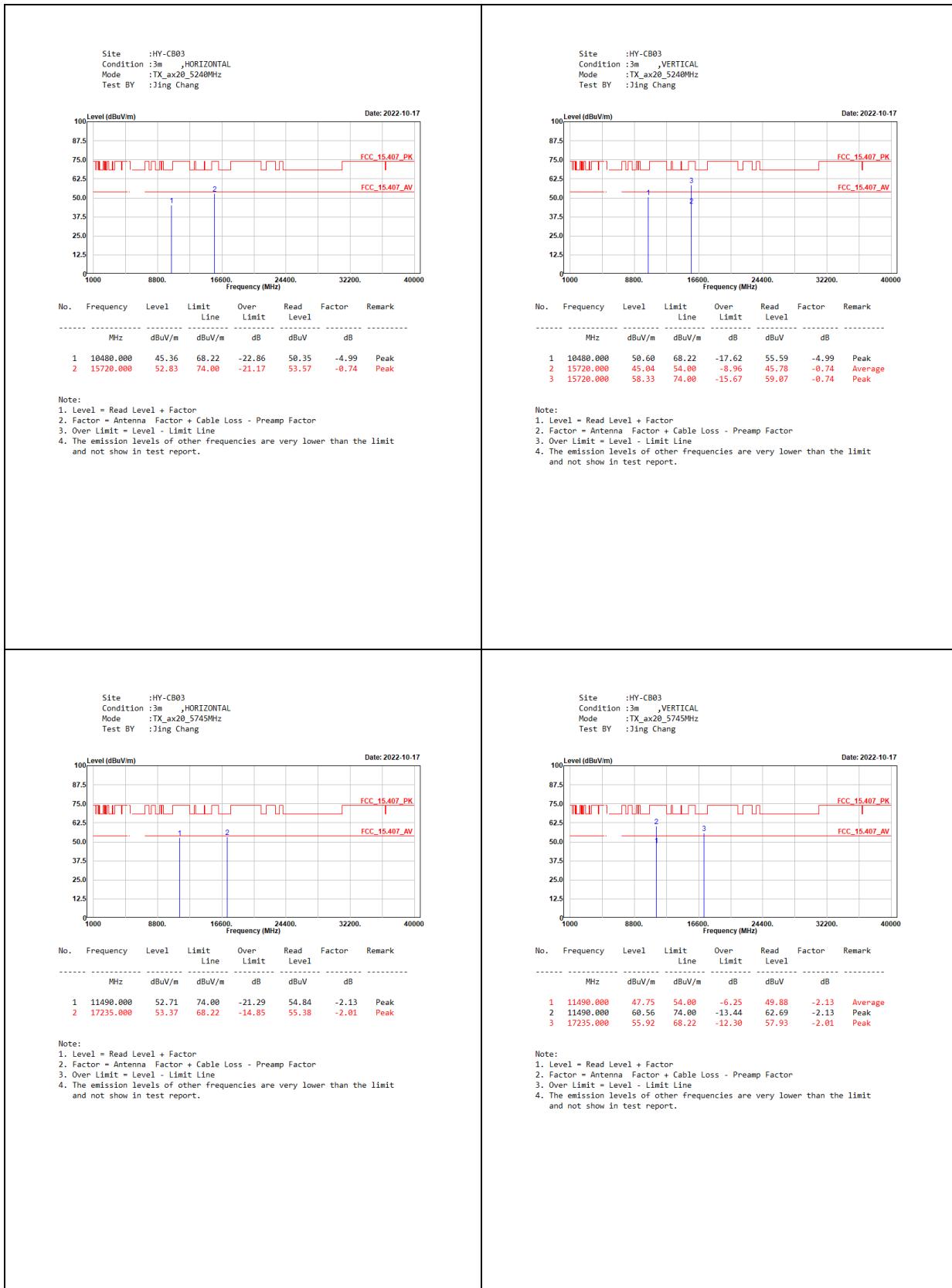
## 5.4. Test Result of Radiated Emission

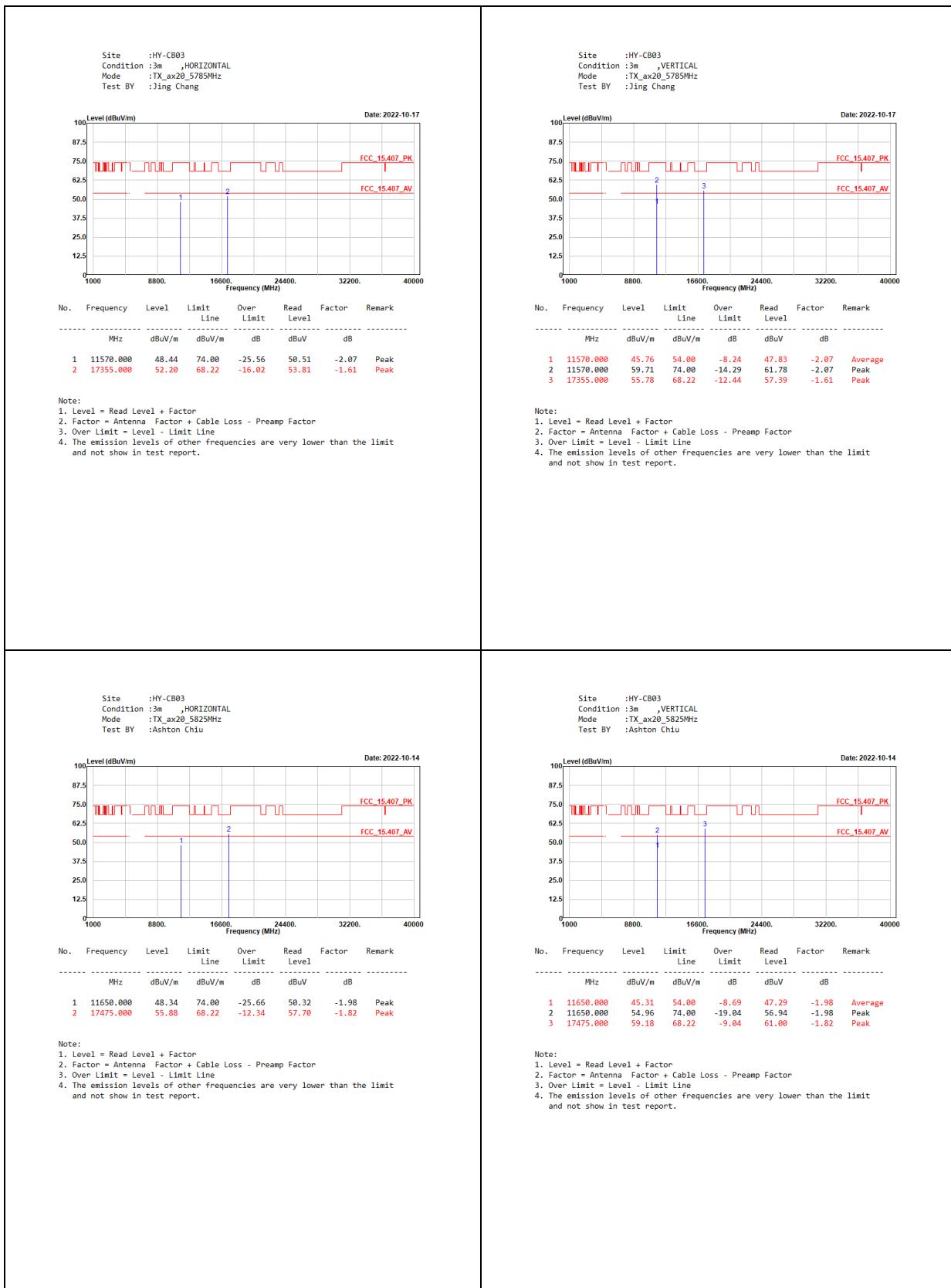


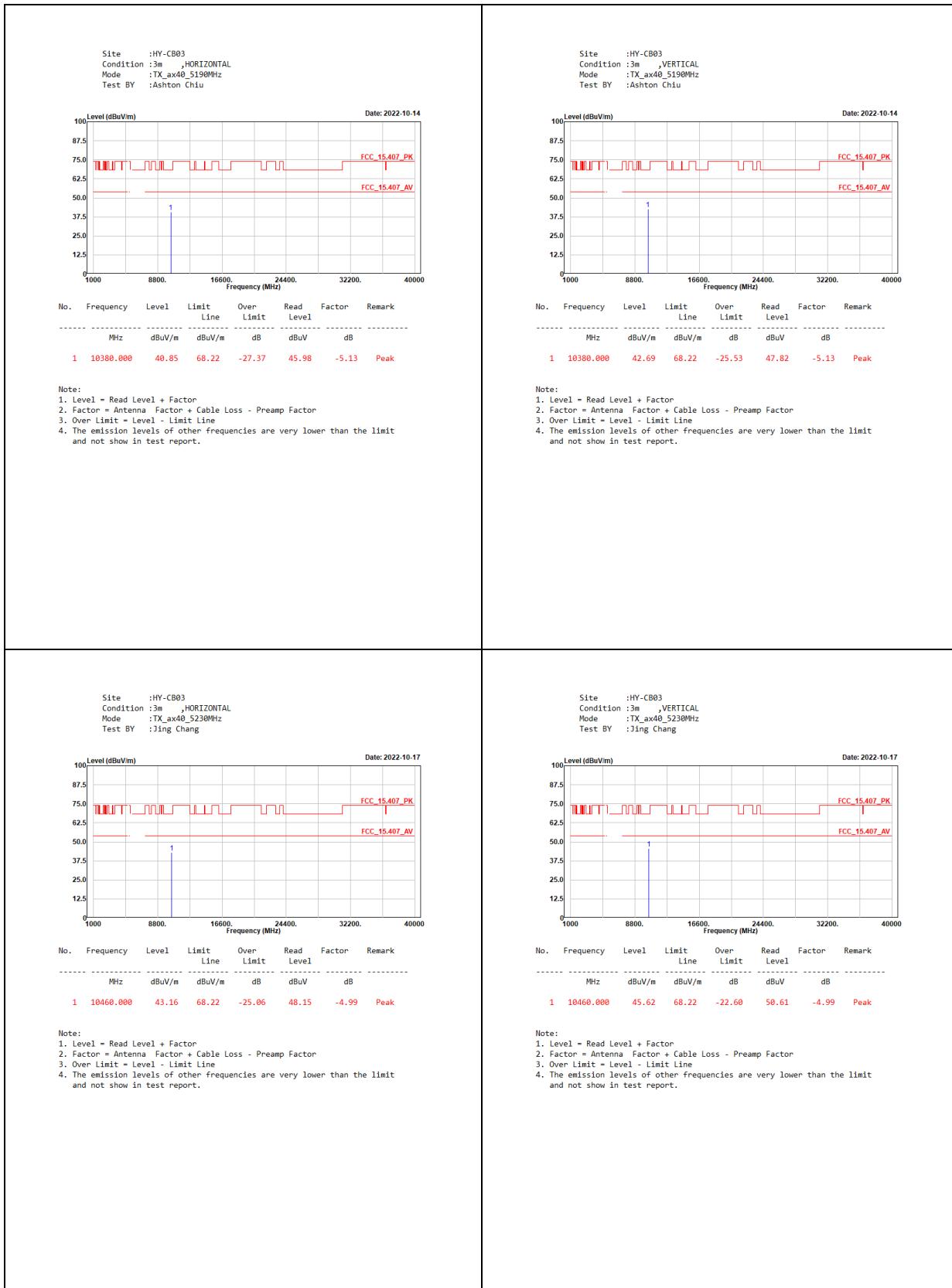


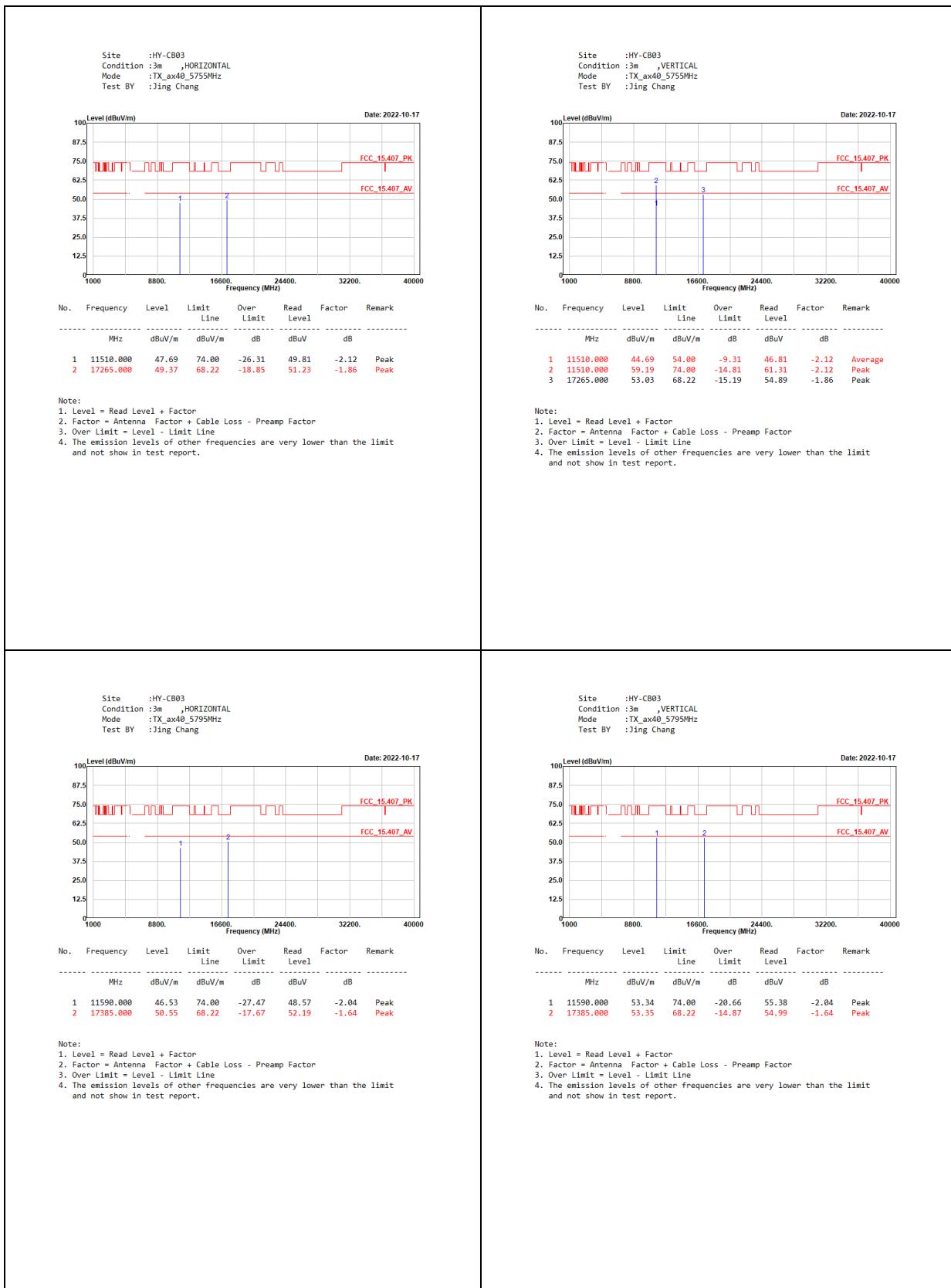


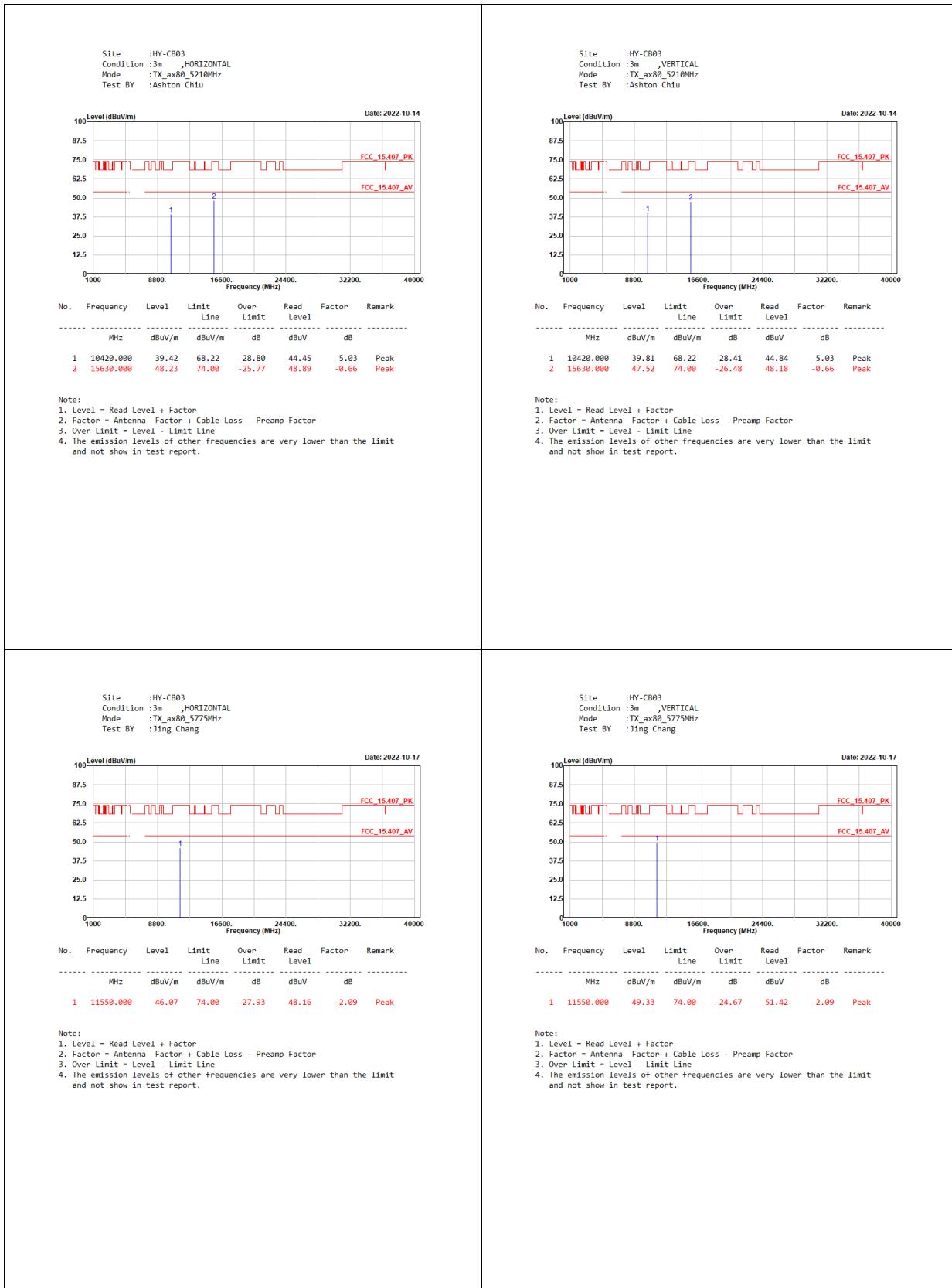


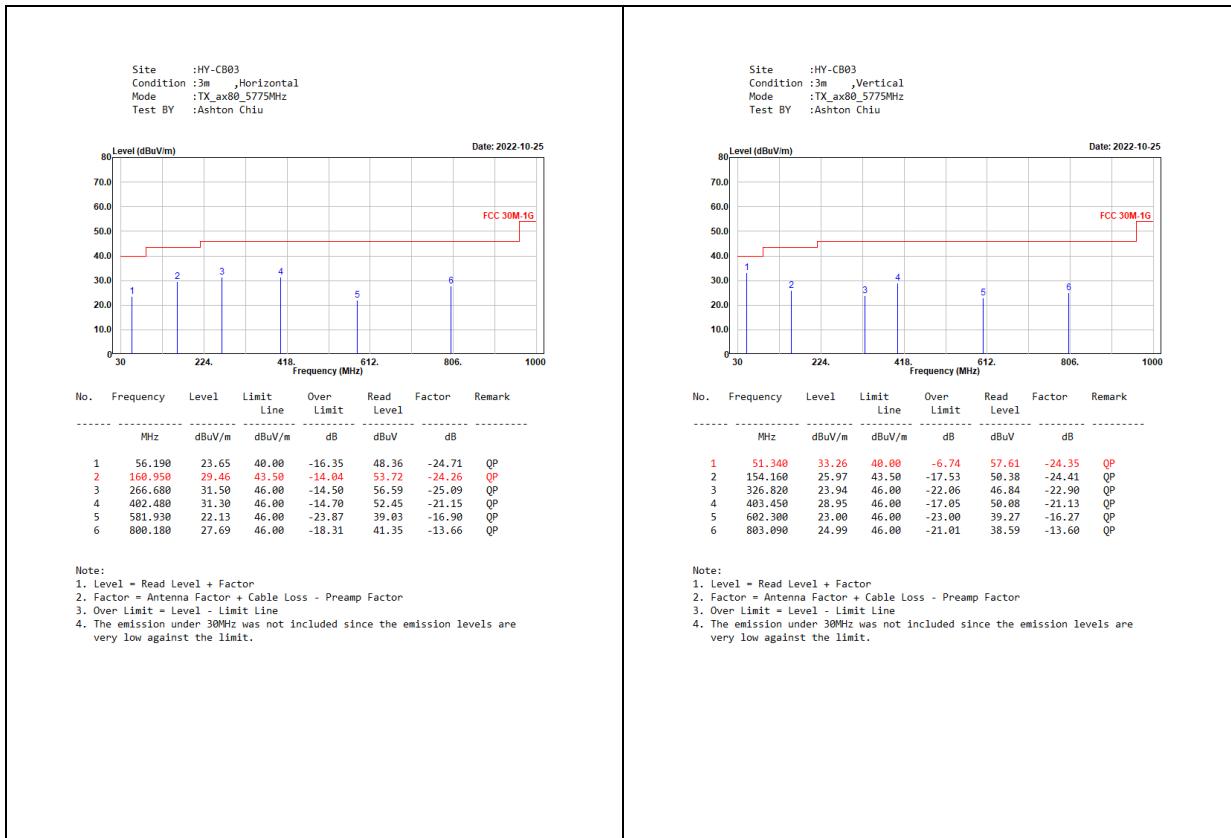








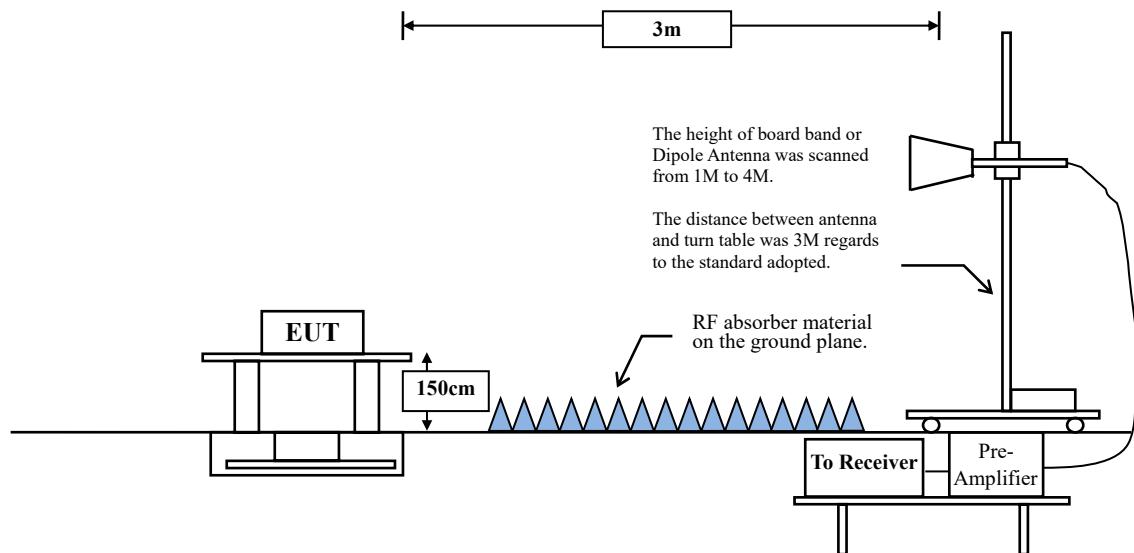




## 6. Band Edge

### 6.1. Test Setup

RF Radiated Measurement:



### 6.2. 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	$\mu$ V/m @3m	dB $\mu$ V/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 Voltage ( $\mu$ V).
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.

### 6.3. 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 = 1 MHz.

VBW  $\geq$  3 MHz.

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

RBW = 1 MHz.

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

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

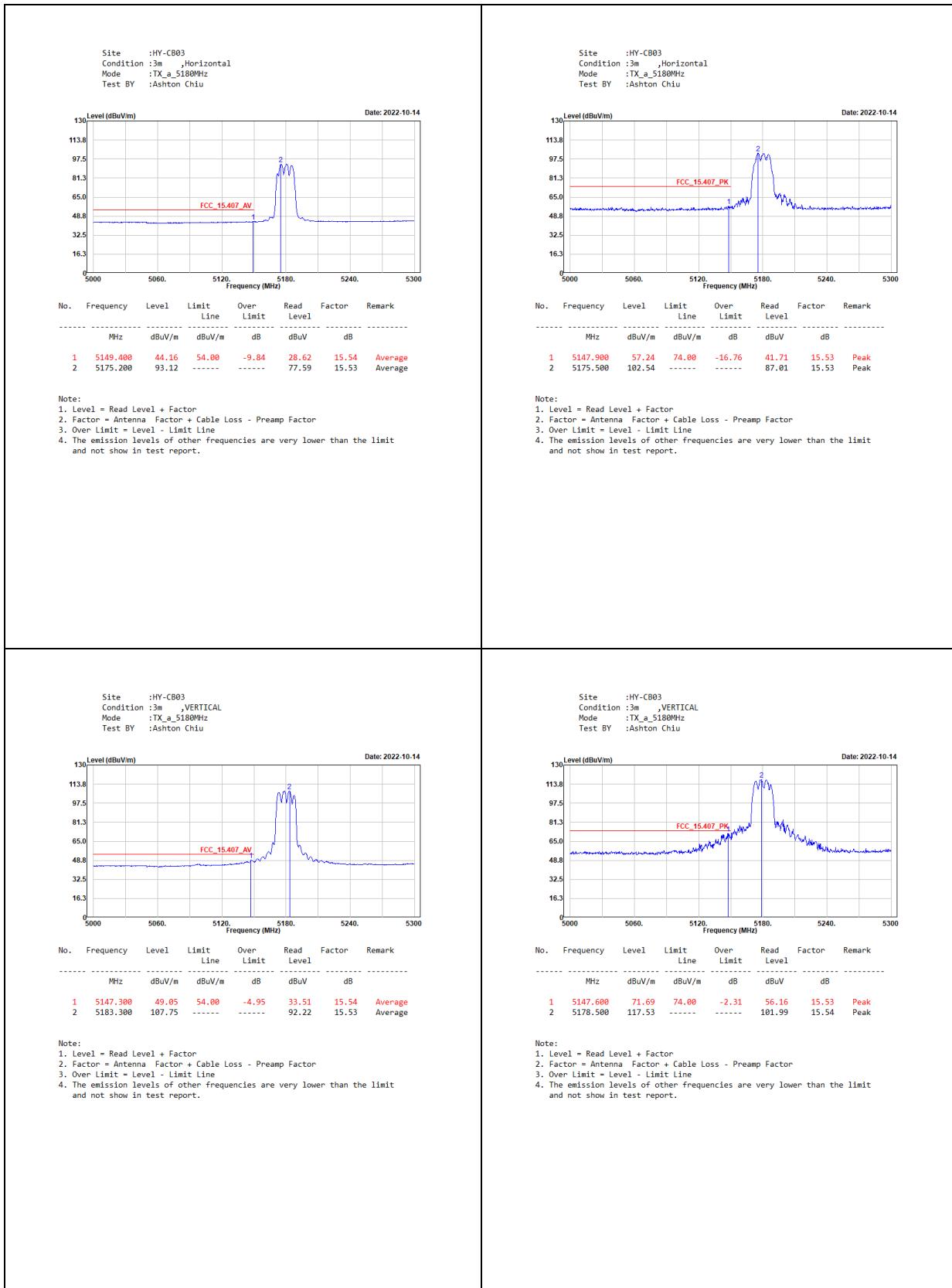
(T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

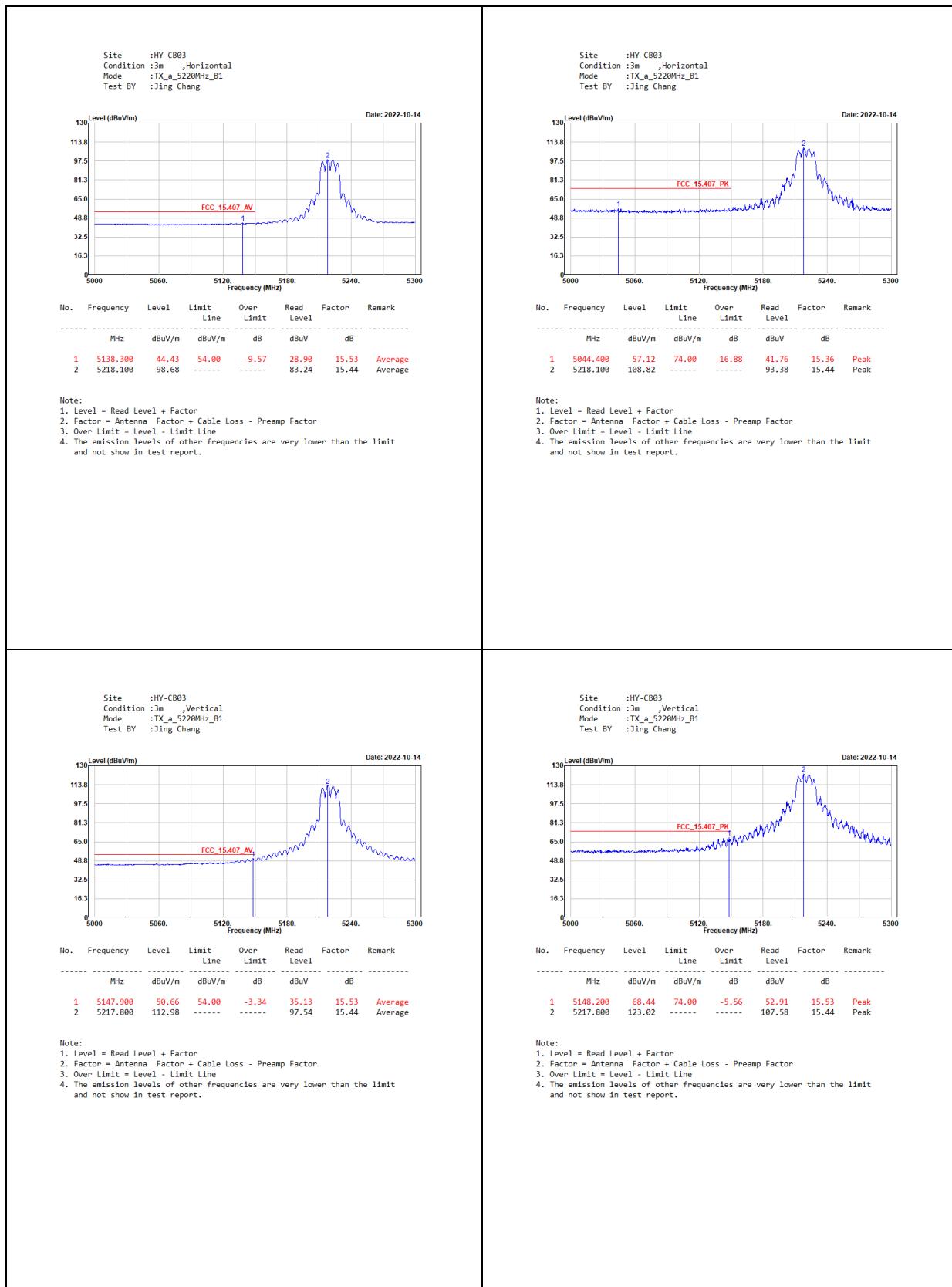
#### **CDD Mode:**

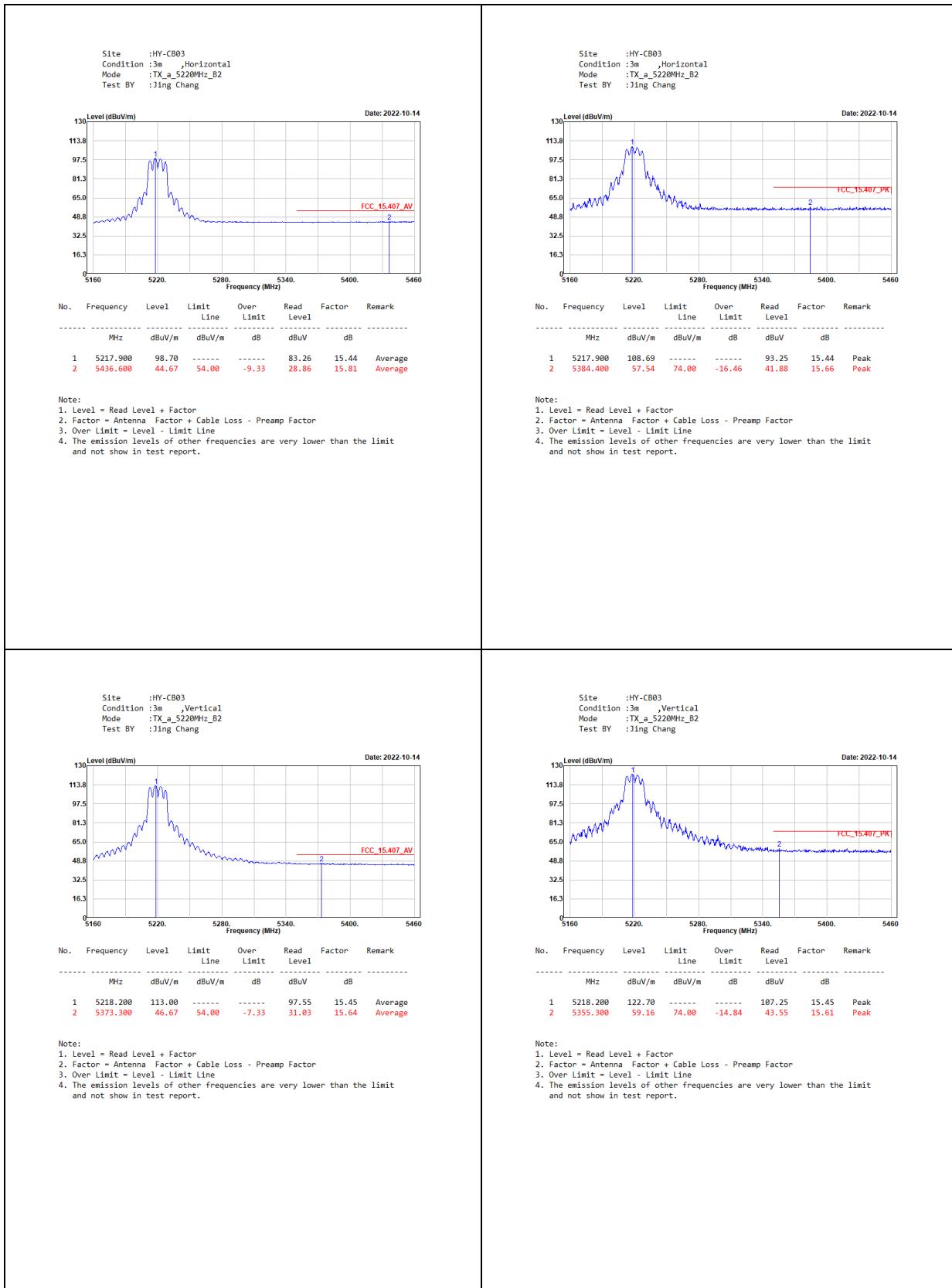
5 GHz band	Duty Cycle (%)	T (ms)	1/T (Hz)	VBW (Hz)
802.11a	95.56	1.4000	714	1000
802.11ax-20 MHz	93.58	1.0200	980	1000
802.11ax-40 MHz	90.10	0.5460	1832	2000
802.11ax-80 MHz	83.15	0.2960	3378	5000

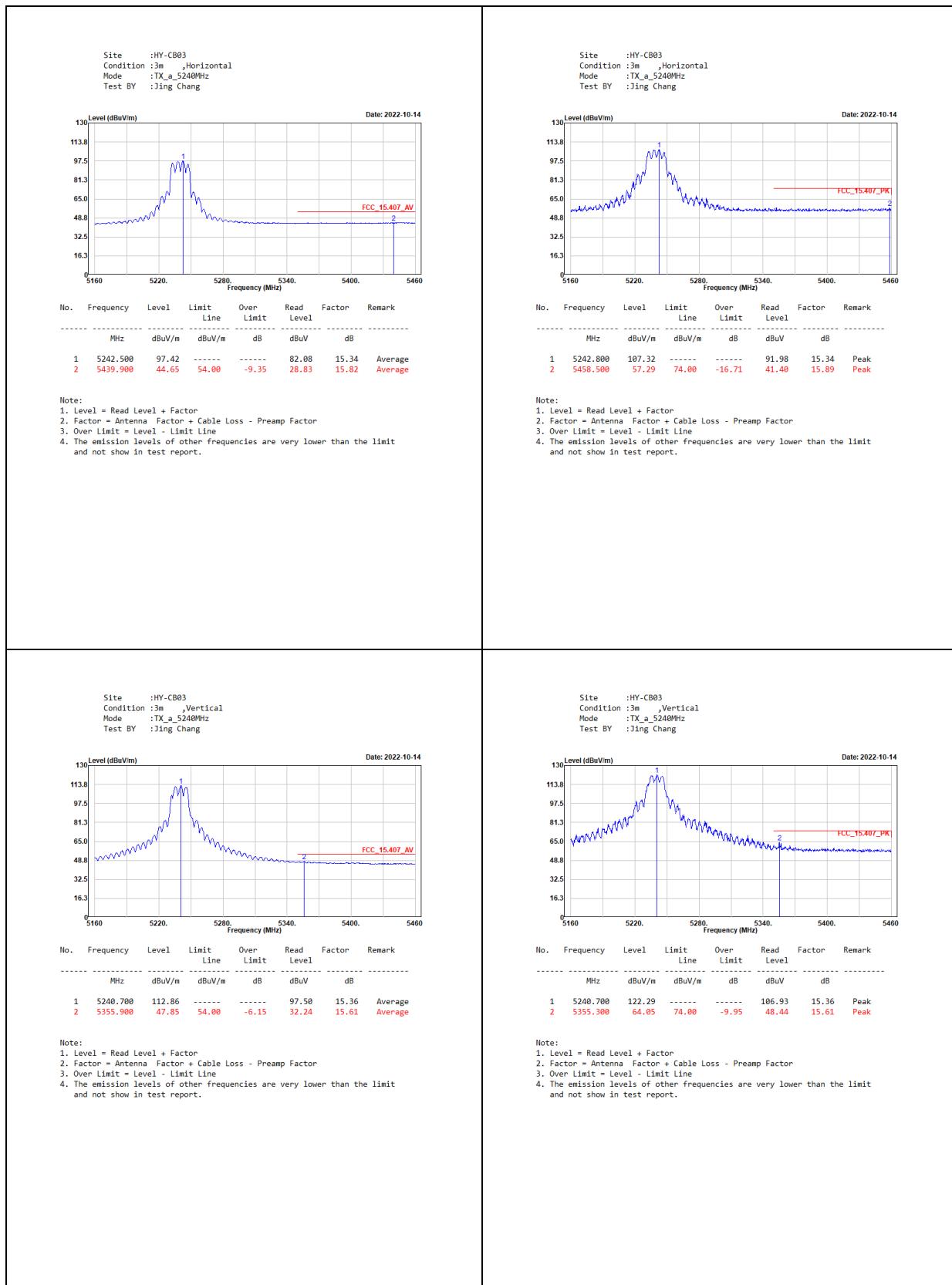
Note: Duty Cycle Refer to Section 8.

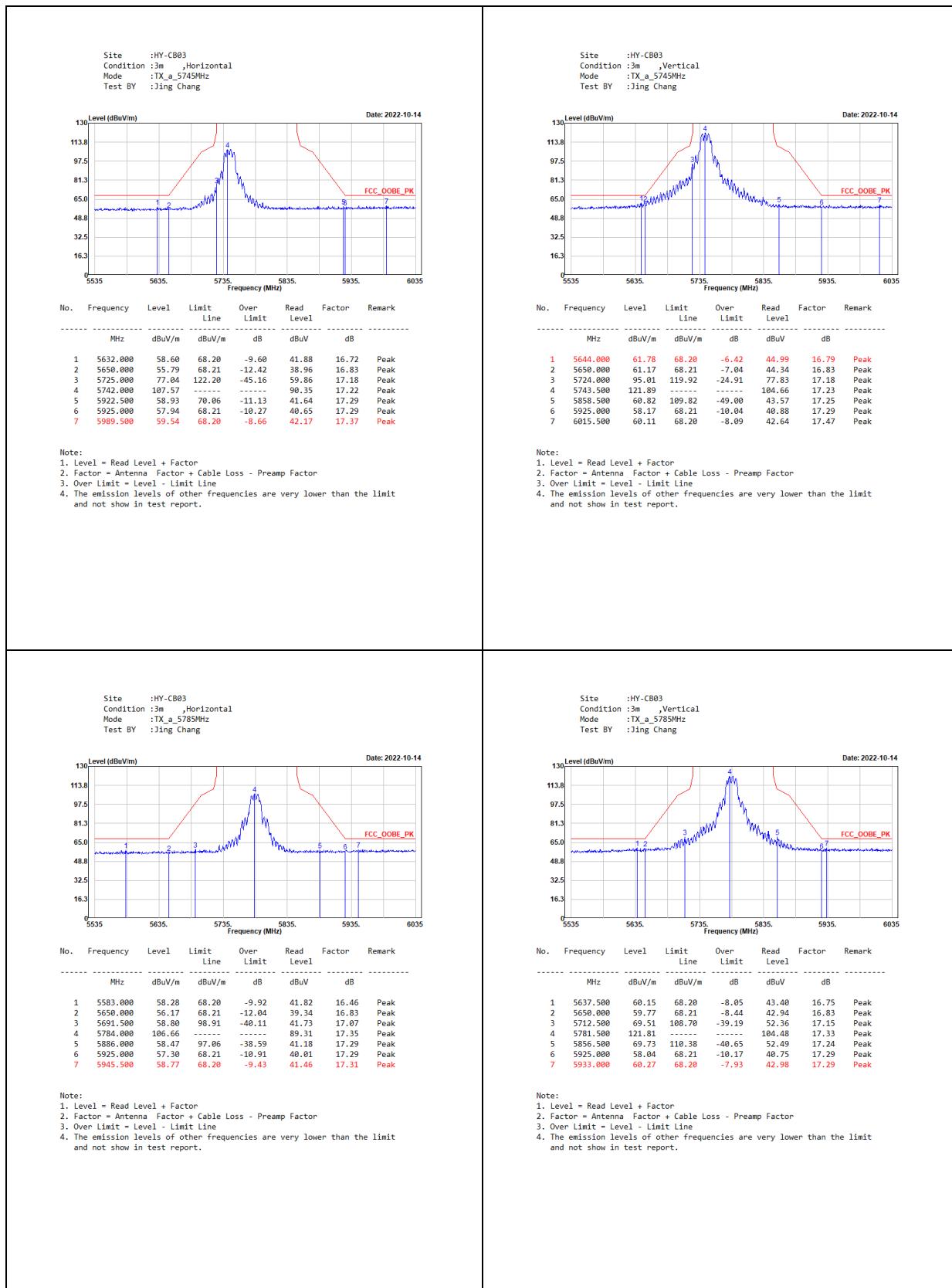
## 6.4. Test Result of Band Edge

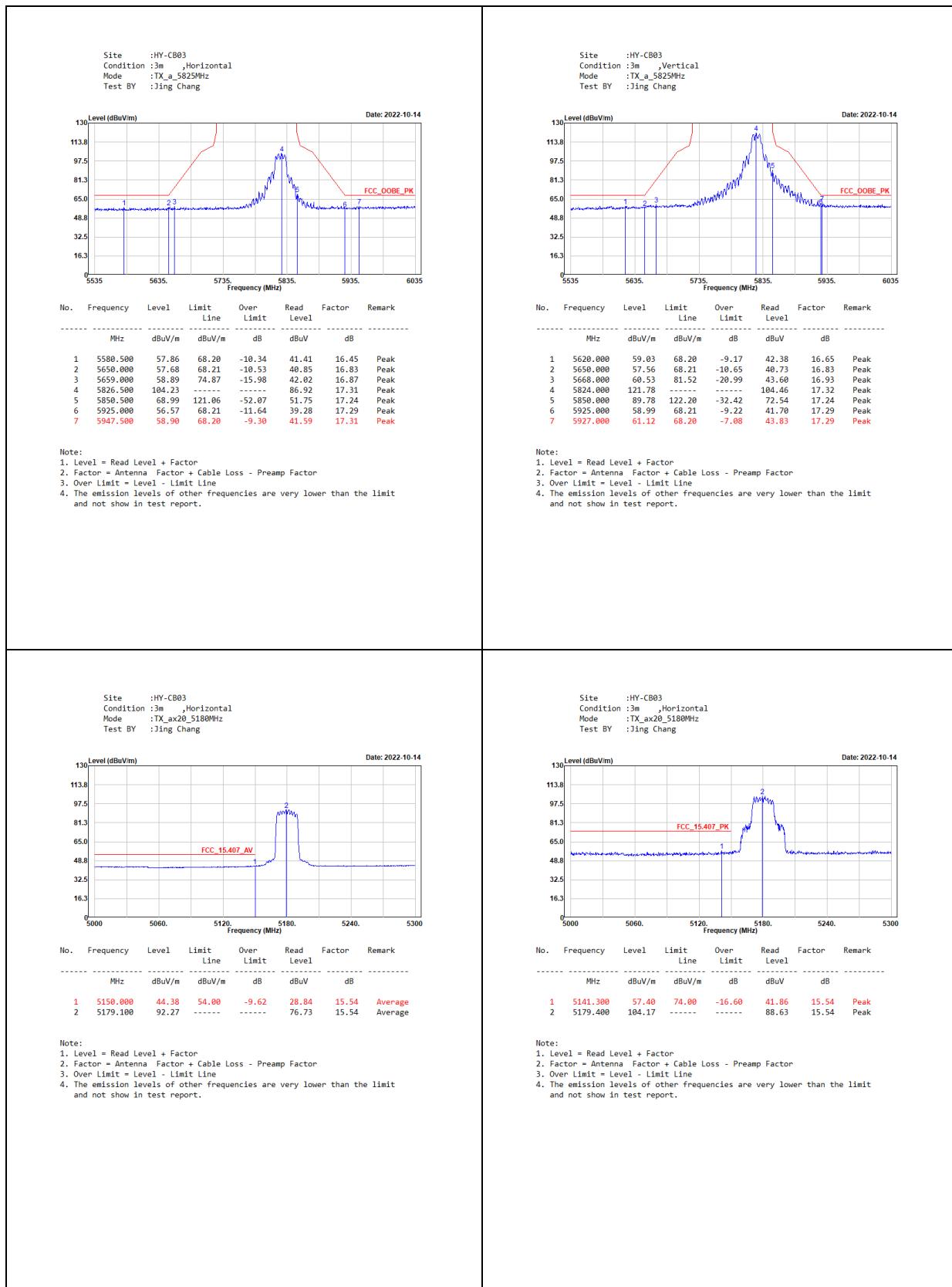


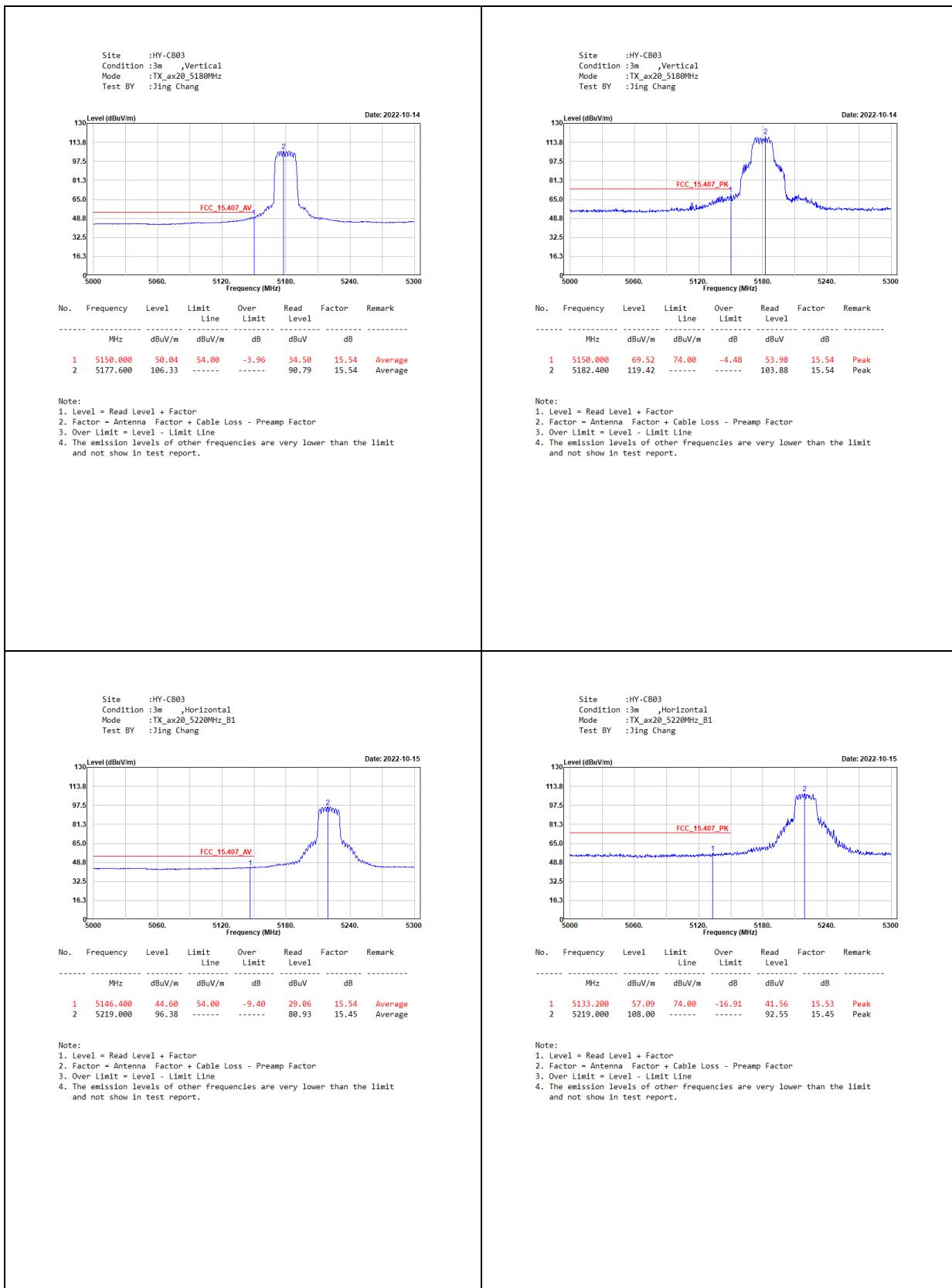


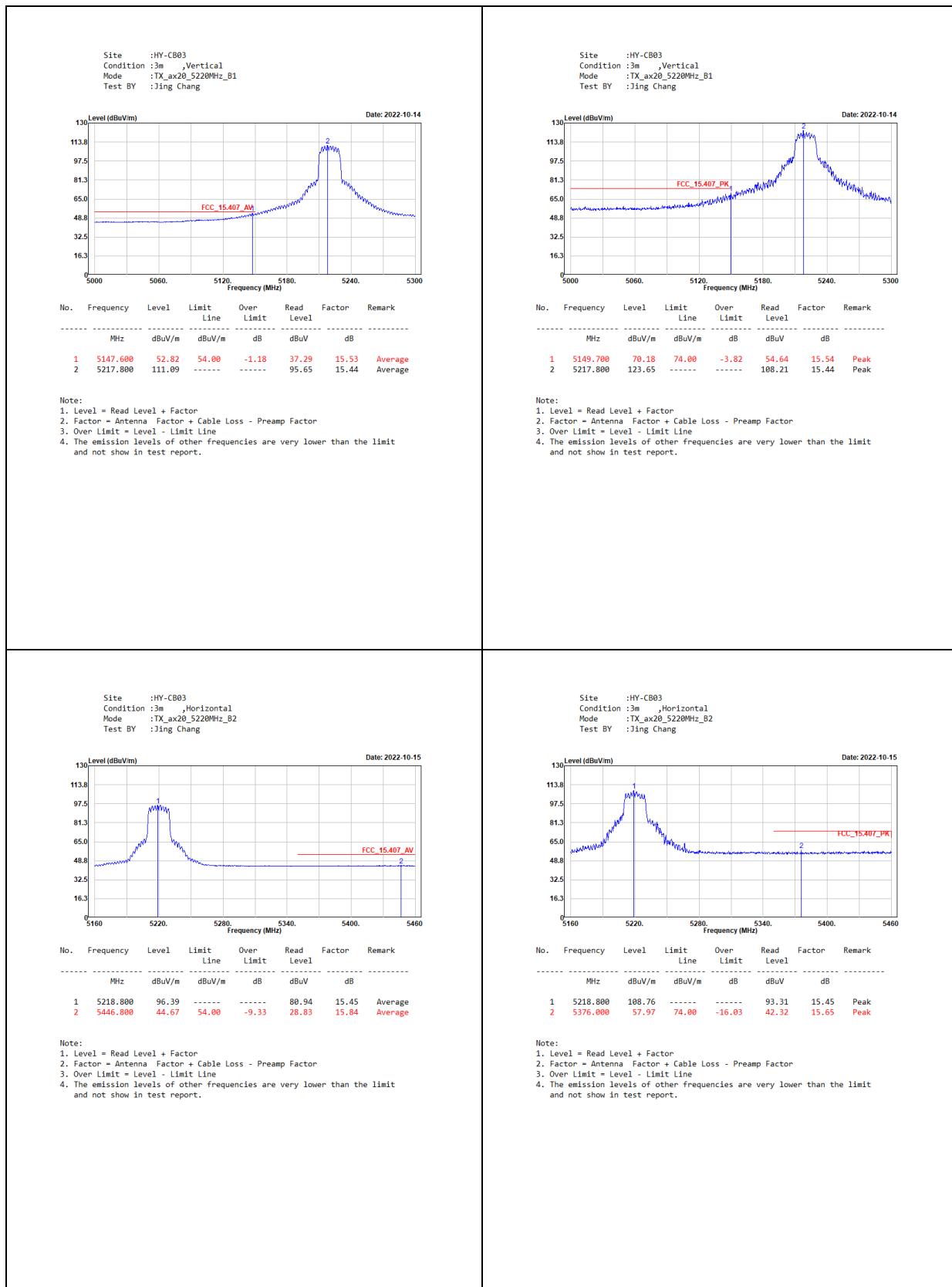


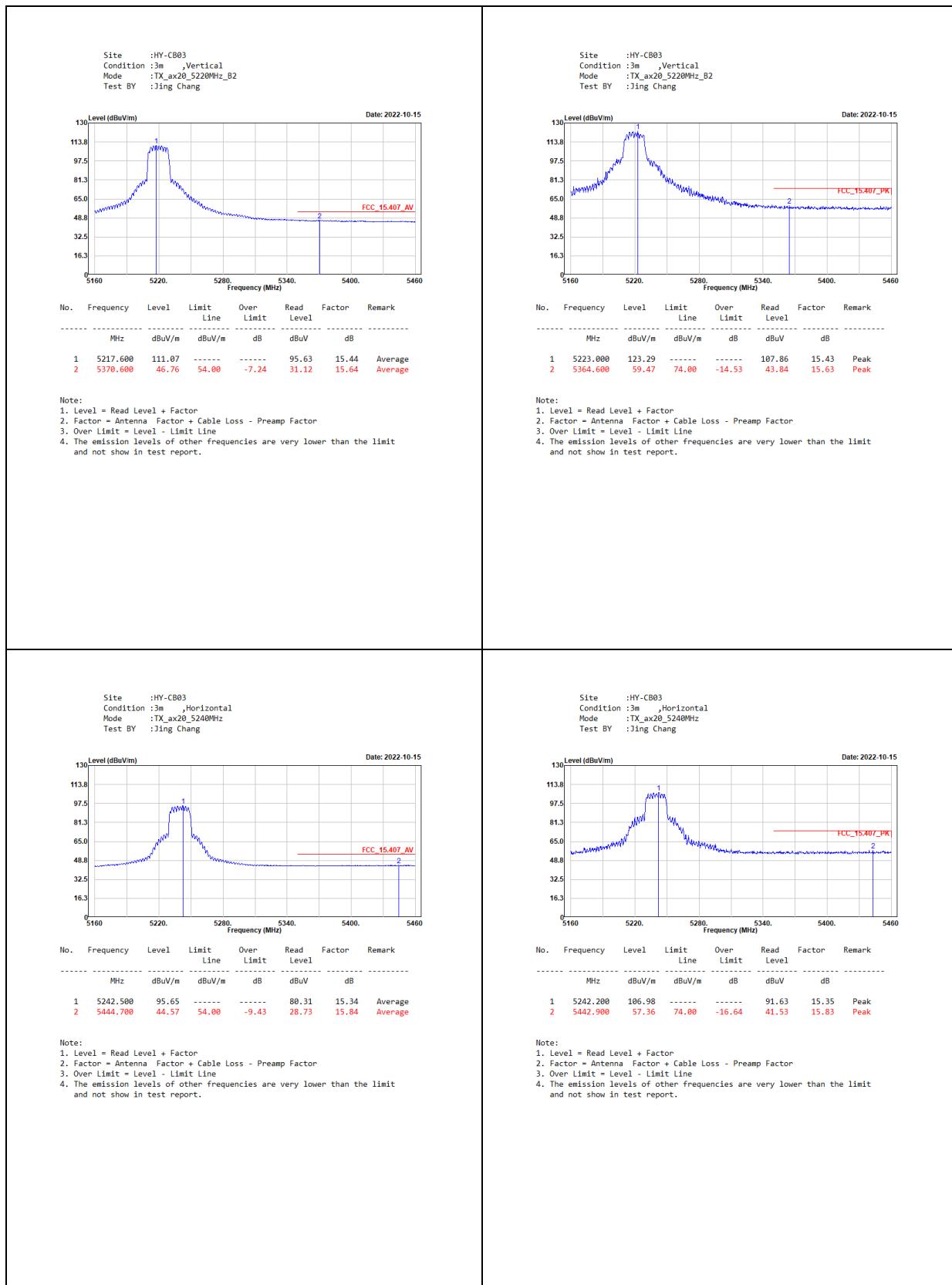


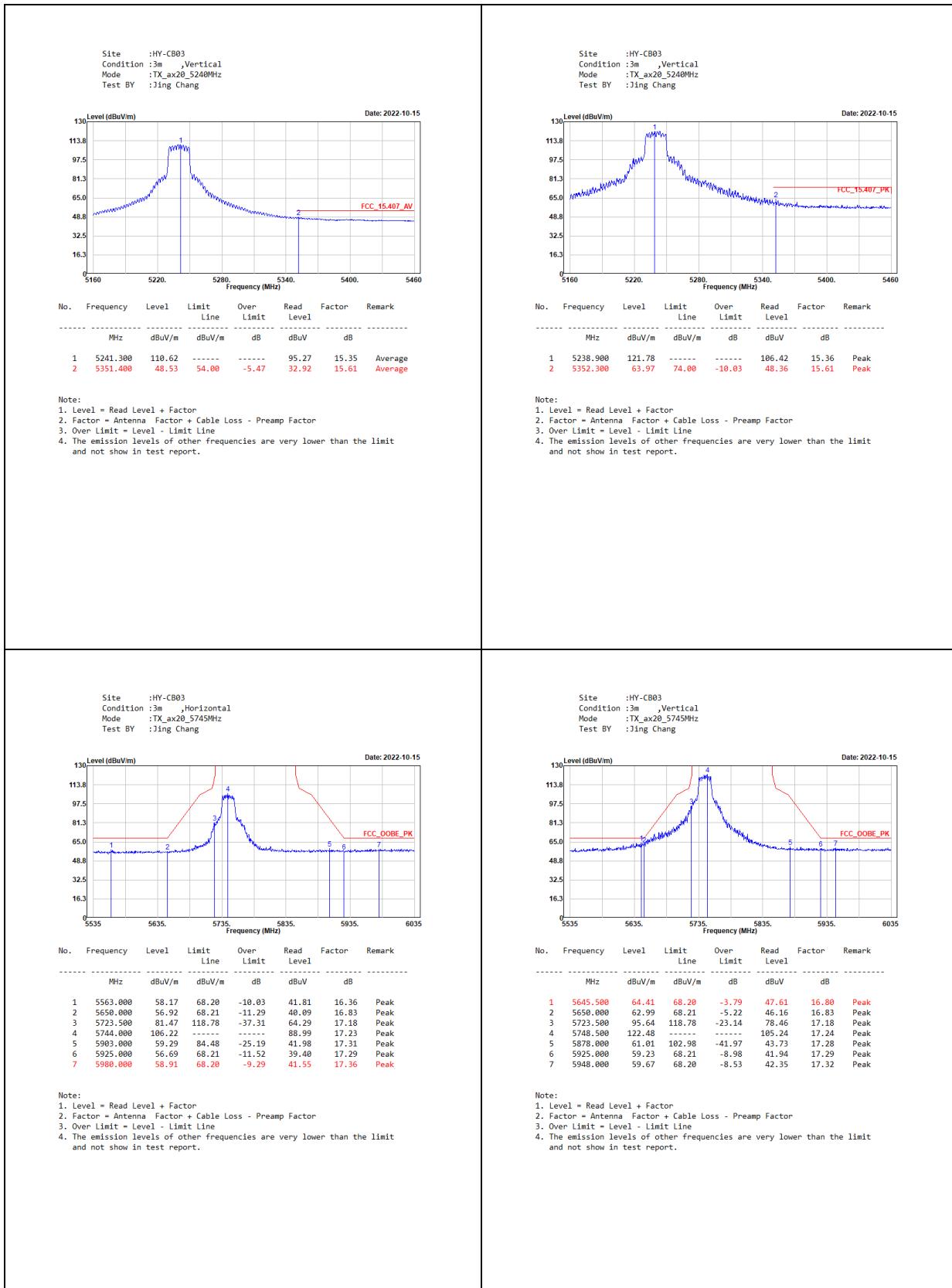


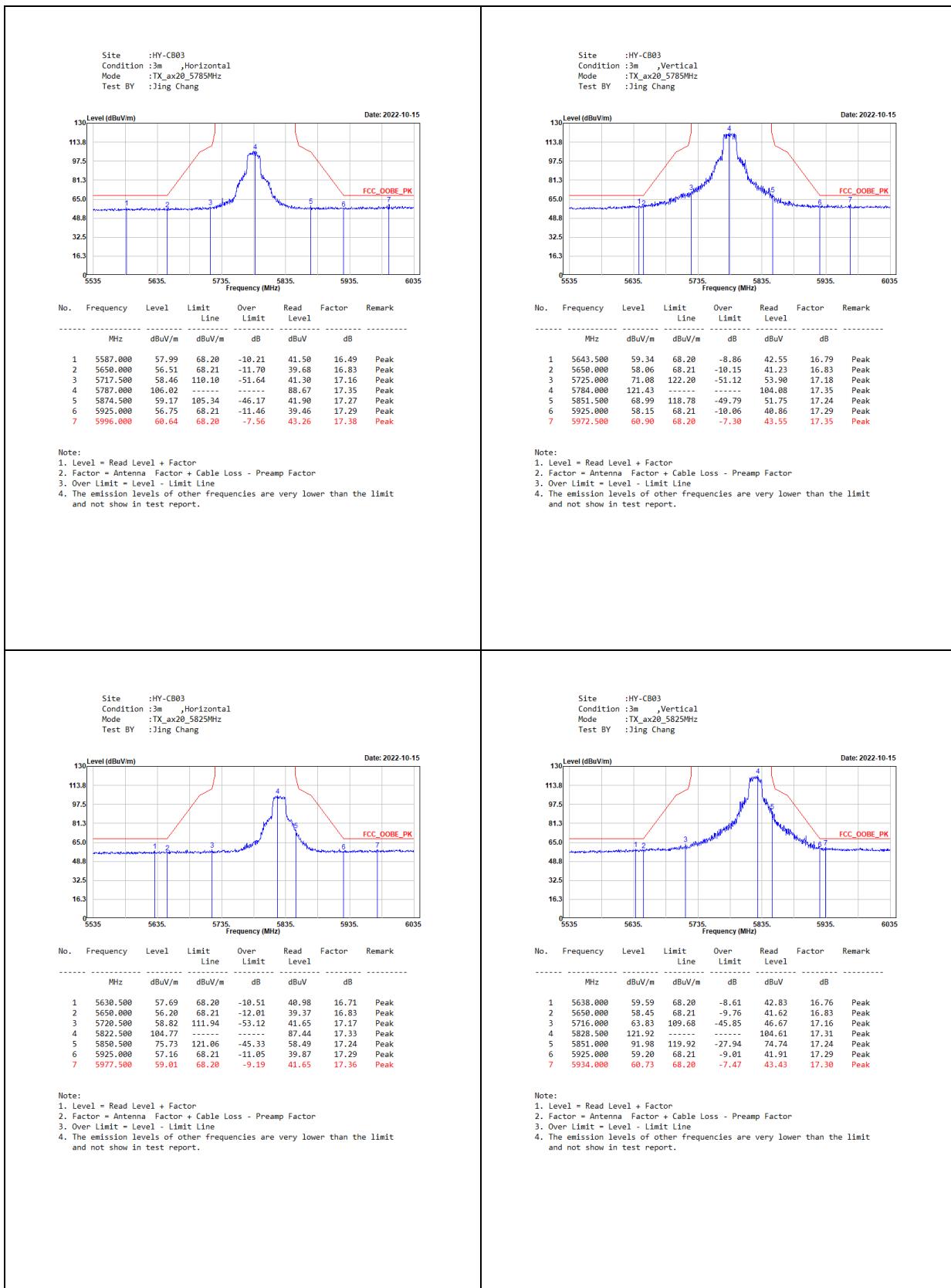


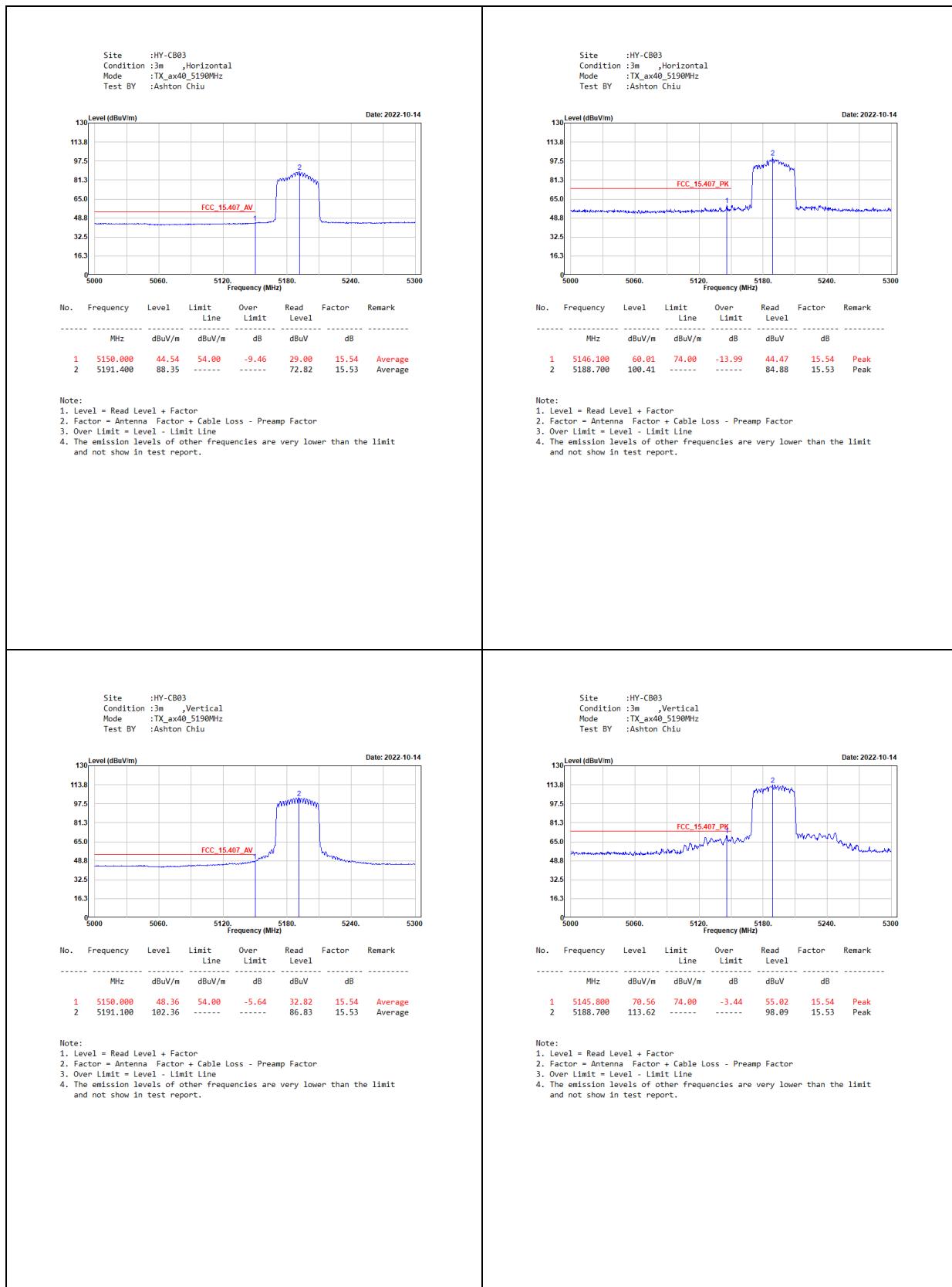


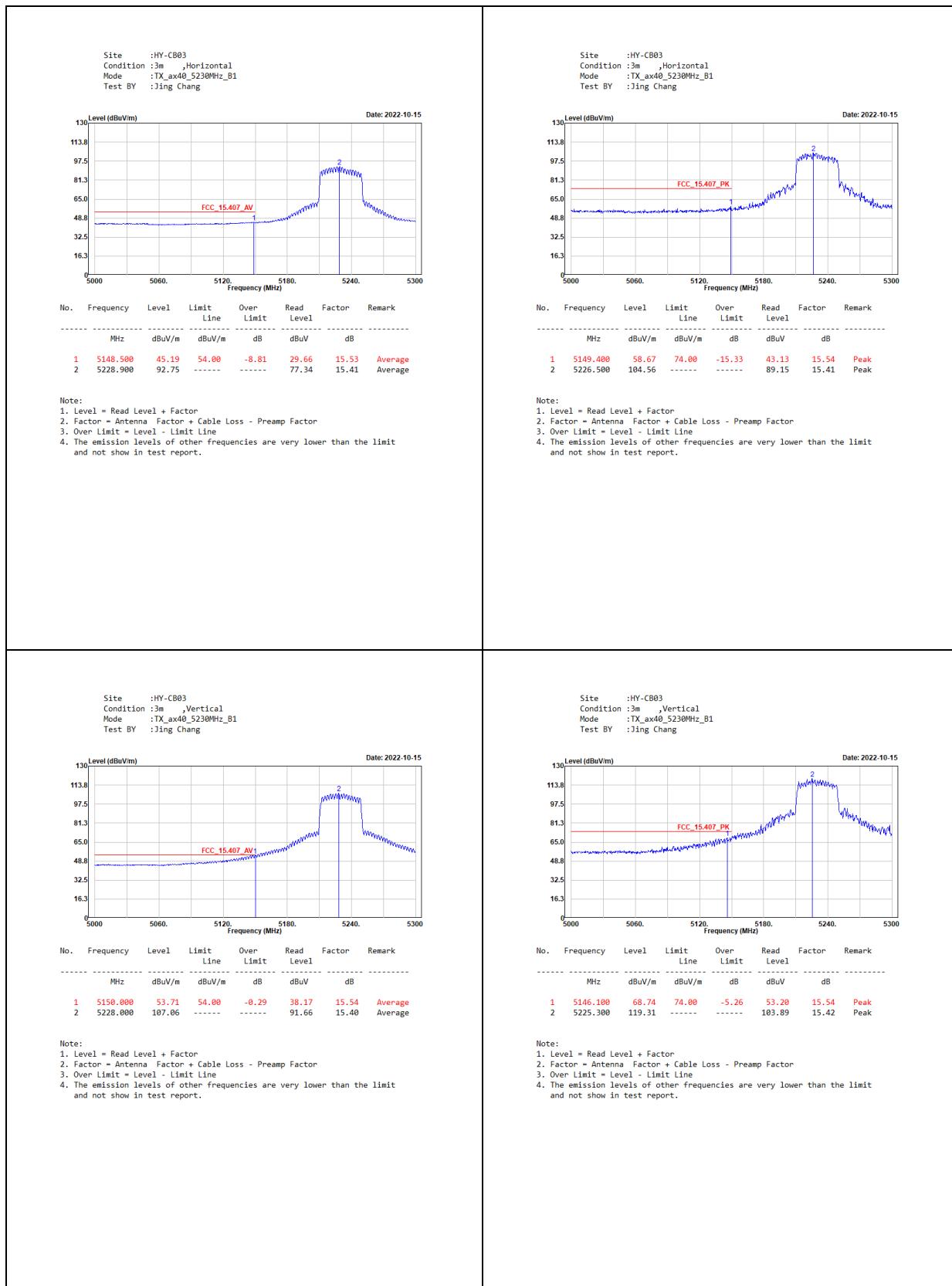


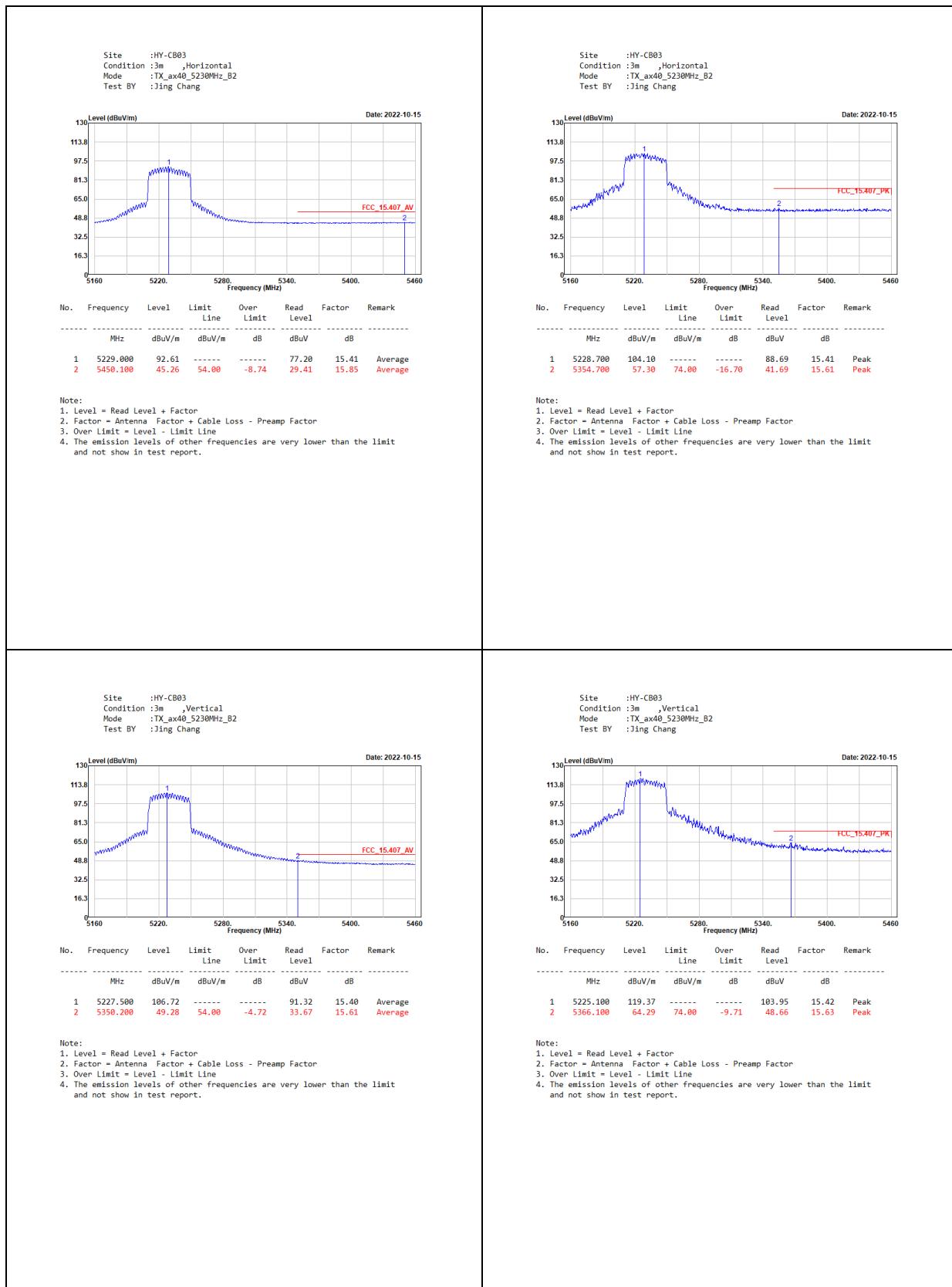


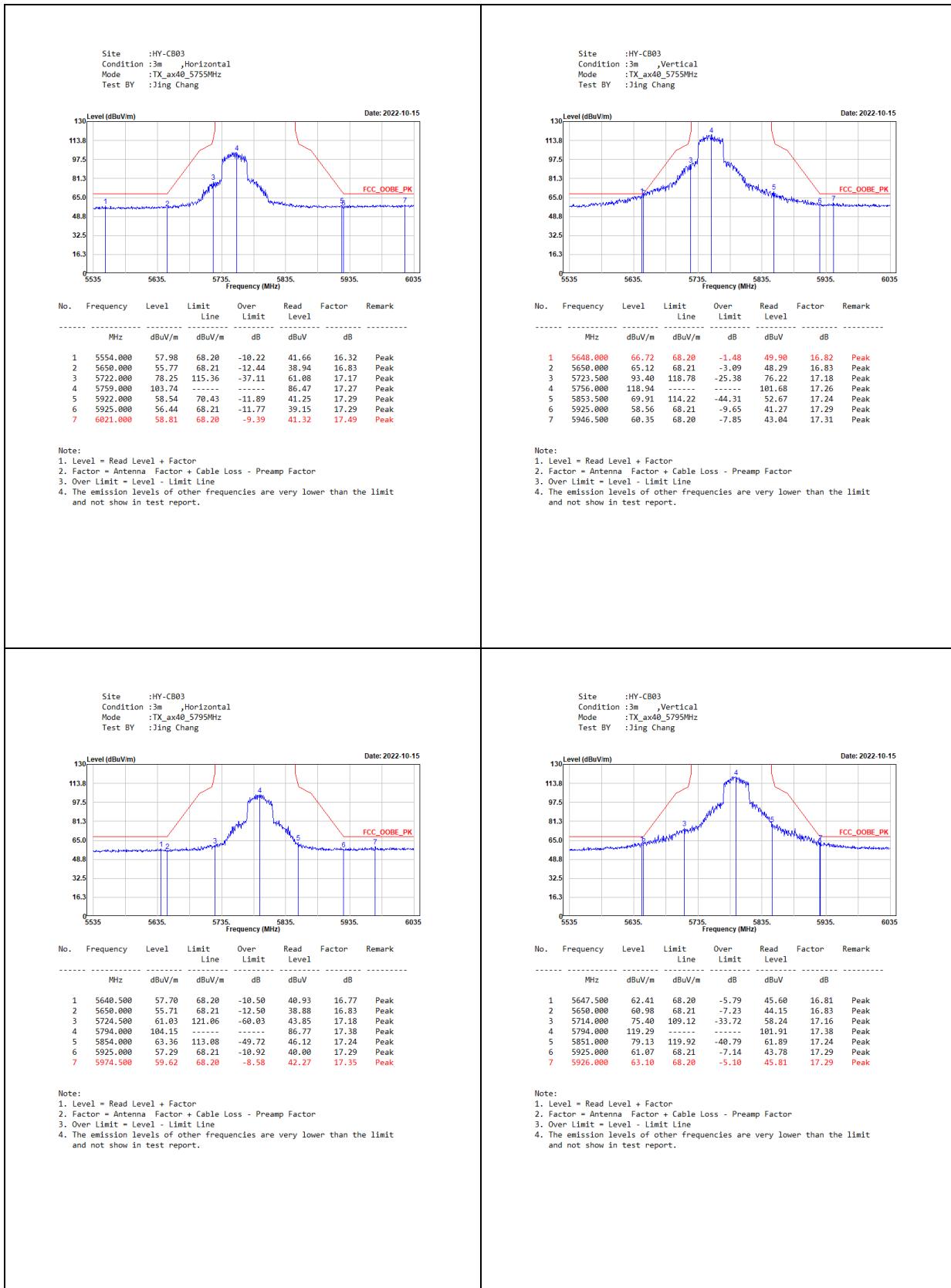


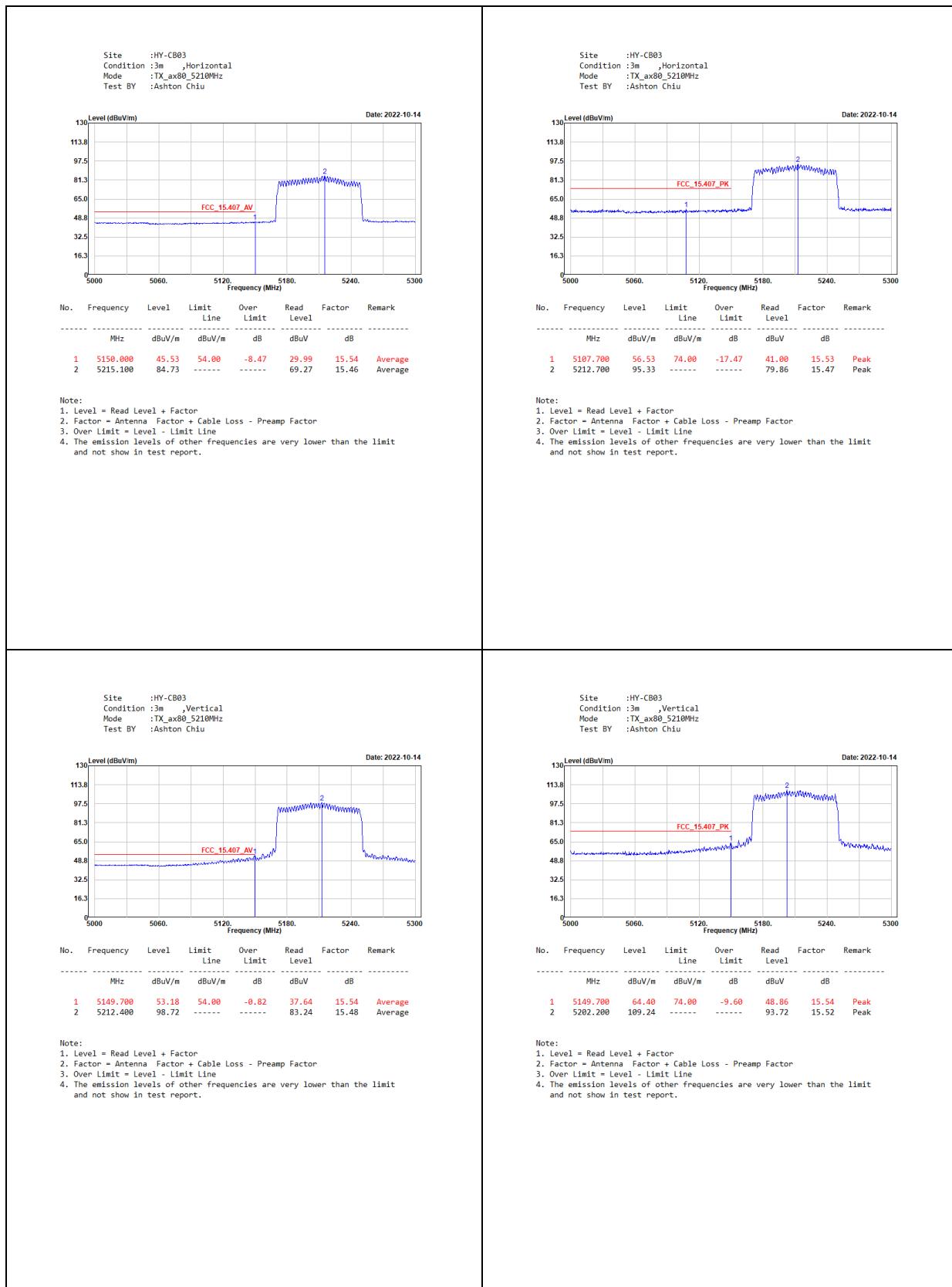








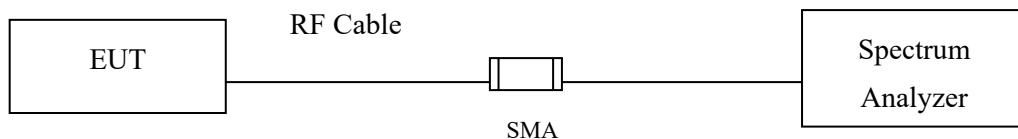






## 7. Occupied Bandwidth

### 7.1. Test Setup



### 7.2. Limits

For the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

### 7.3. Test Procedure

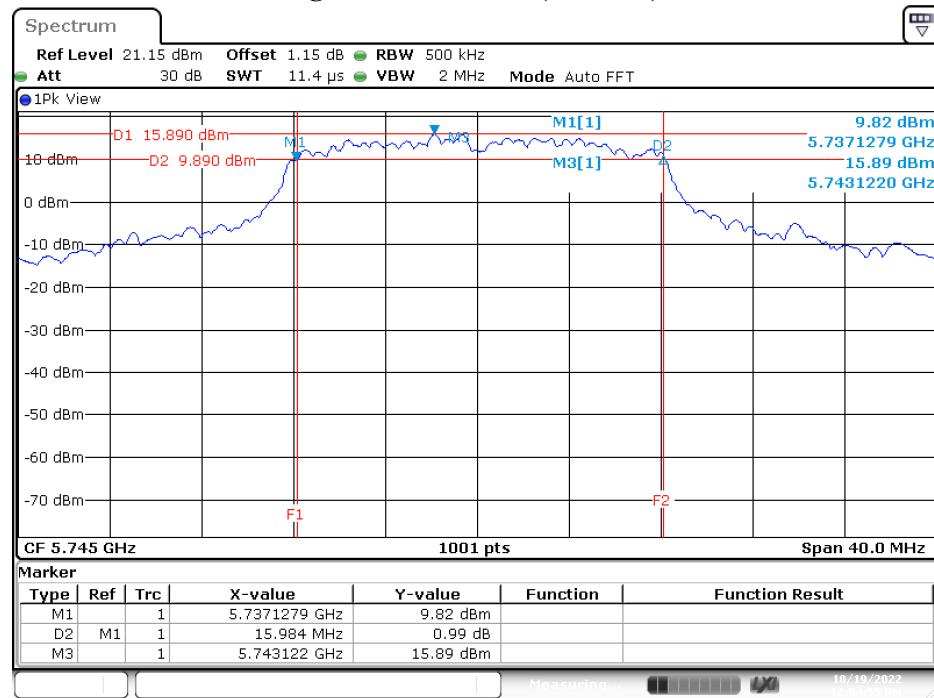
The EUT was setup to ANSI C63.10, 2013; tested to UNII test procedure of FCC KDB-789033 for compliance to FCC 47CFR Subpart E requirements.

#### 7.4. Test Result of Occupied Bandwidth

Product : WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module  
 Test Item : Occupied Bandwidth Data  
 Test Mode : Transmit (802.11a-CDD)  
 Test Date : 2022/10/19

Channel No.	Frequency (MHz)	Chain	Measurement Level (kHz)	Required Limit (kHz)	Result
149	5745	A	16384	>500	Pass
157	5785	A	16264	>500	Pass
165	5825	A	16424	>500	Pass
149	5745	B	15984	>500	Pass
157	5785	B	16384	>500	Pass
165	5825	B	16304	>500	Pass

Figure Channel 149 (Chain B):

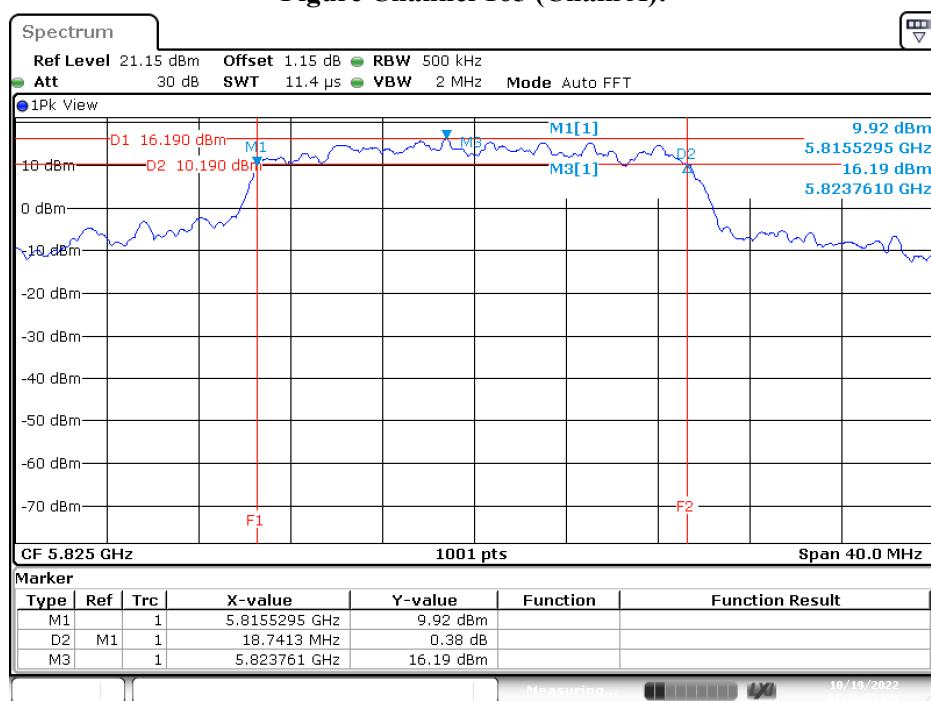


Date: 19.OCT.2022 12:54:55

Product : WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module  
 Test Item : Occupied Bandwidth Data  
 Test Mode : Transmit (802.11ax-20 MHz-CDD)  
 Test Date : 2022/10/19

Channel No.	Frequency (MHz)	Chain	Measurement Level (kHz)	Required Limit (kHz)	Result
149	5745	A	18941	>500	Pass
157	5785	A	18821	>500	Pass
165	5825	A	18741	>500	Pass
149	5745	B	19061	>500	Pass
157	5785	B	19181	>500	Pass
165	5825	B	18941	>500	Pass

**Figure Channel 165 (Chain A):**

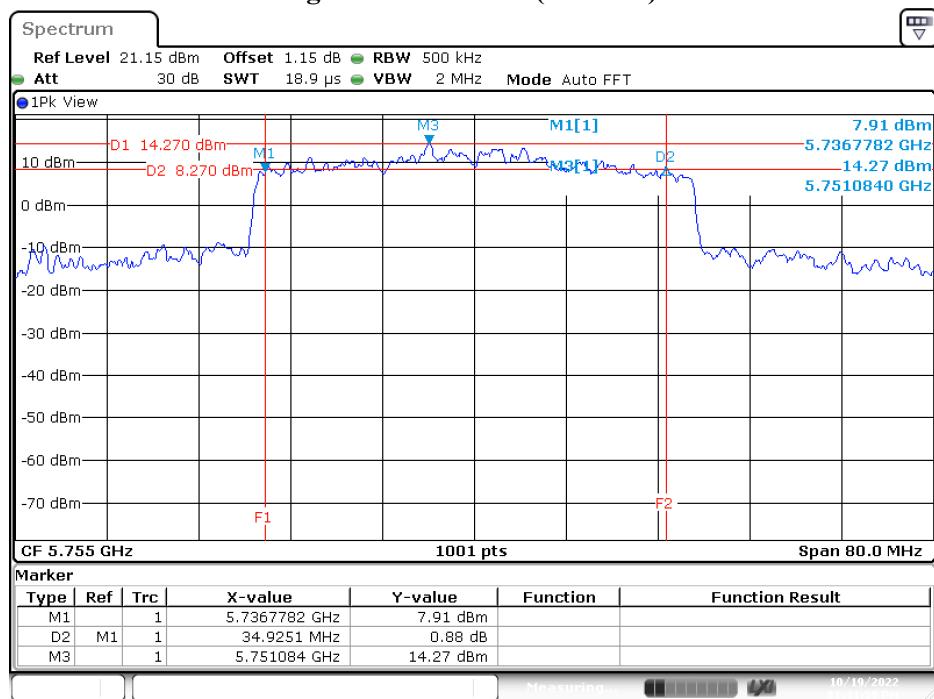


Date: 19.OCT.2022 13:33:55

Product : WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module  
 Test Item : Occupied Bandwidth Data  
 Test Mode : Transmit (802.11ax-40 MHz-CDD)  
 Test Date : 2022/10/19

Channel No.	Frequency (MHz)	Chain	Measurement Level (kHz)	Required Limit (kHz)	Result
151	5755	A	34925	>500	Pass
159	5795	A	37323	>500	Pass
151	5755	B	36843	>500	Pass
159	5795	B	36603	>500	Pass

**Figure Channel 151 (Chain A):**

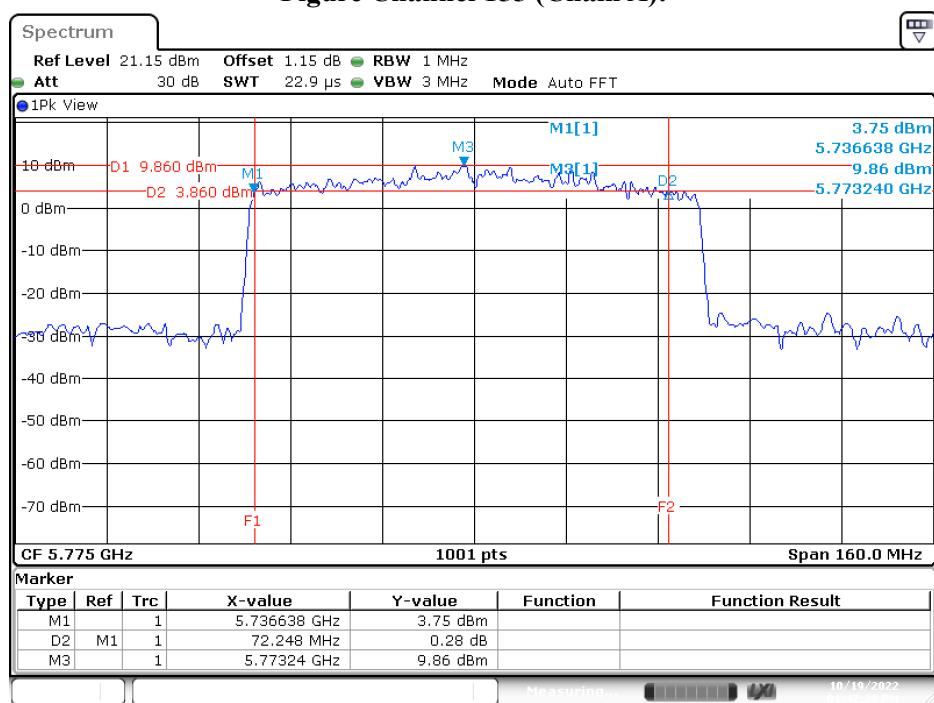


Date: 19.OCT.2022 13:42:00

Product : WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module  
 Test Item : Occupied Bandwidth Data  
 Test Mode : Transmit (802.11ax-80 MHz-CDD)  
 Test Date : 2022/10/19

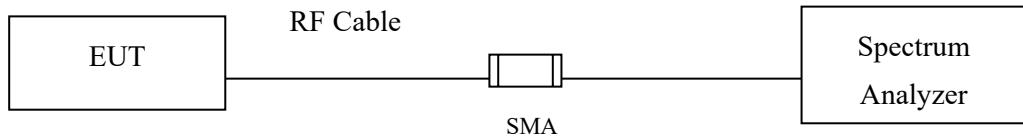
Channel No.	Frequency (MHz)	Chain	Measurement Level (kHz)	Required Limit (kHz)	Result
155	5775	A	72248	>500	Pass
155	5775	B	74486	>500	Pass

Figure Channel 155 (Chain A):



## 8. Duty Cycle

### 8.1. Test Setup



### 8.2. 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.

### 8.3. Test Result of Duty Cycle

Product : WiFi 6 ax1800 2x2 dual concurrent M.2 B key Module  
Test Item : Duty Cycle  
Test Mode : Transmit-CDD mode

Duty Cycle Formula:

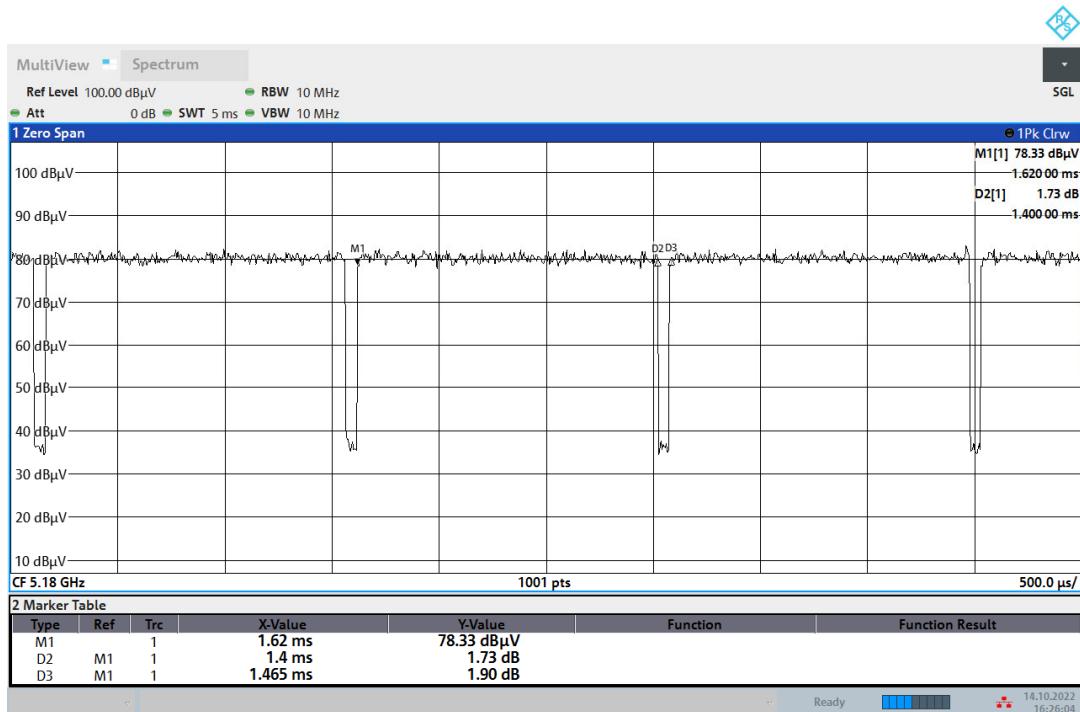
$$\text{Duty Cycle} = \text{Ton} / (\text{Ton} + \text{Toff})$$

$$\text{Duty Factor} = 10 \log (1/\text{Duty Cycle})$$

Results:

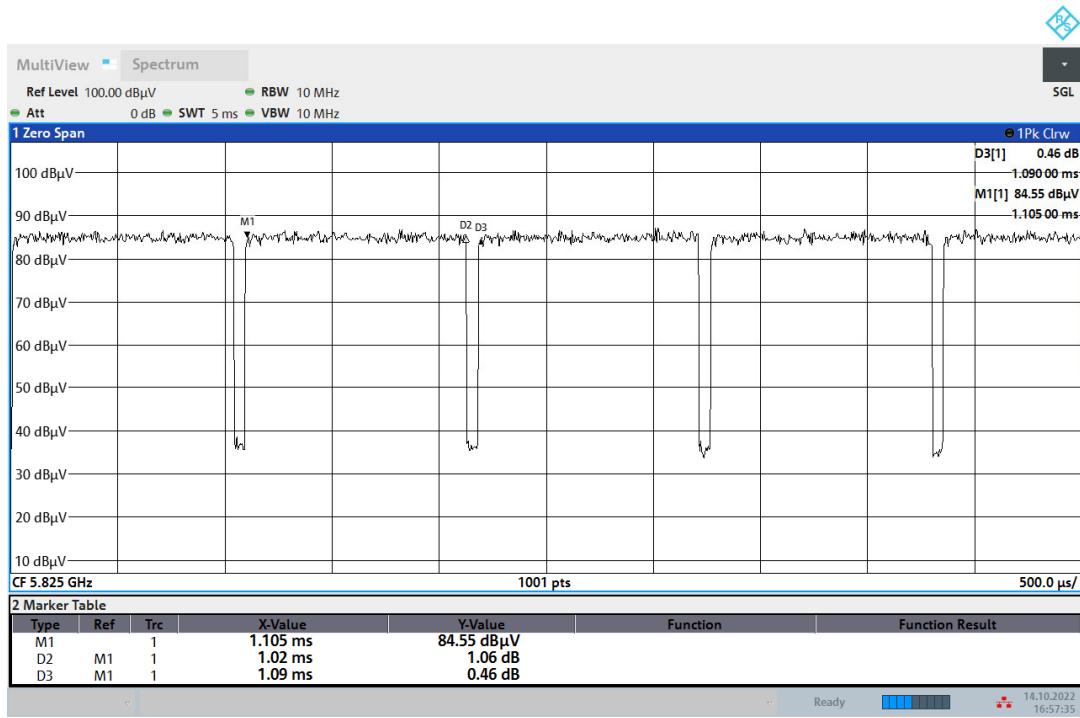
5 GHz band	Ton (ms)	Ton + Toff (ms)	Duty Cycle (%)	Duty Factor (dB)
802.11a	1.4000	1.4650	95.56	0.20
802.11ax-20 MHz	1.0200	1.0900	93.58	0.29
802.11ax-40 MHz	0.5460	0.6060	90.10	0.45
802.11ax-80 MHz	0.2960	0.3560	83.15	0.80

## 802.11a



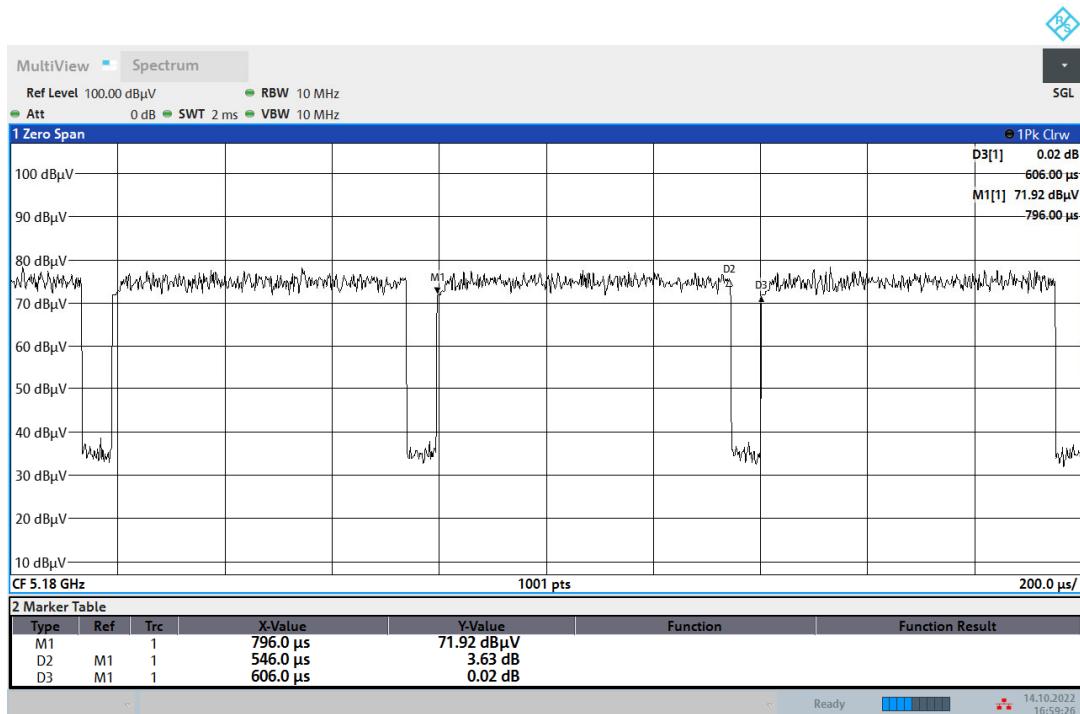
16:26:05 14.10.2022

## 802.11ax-20 MHz



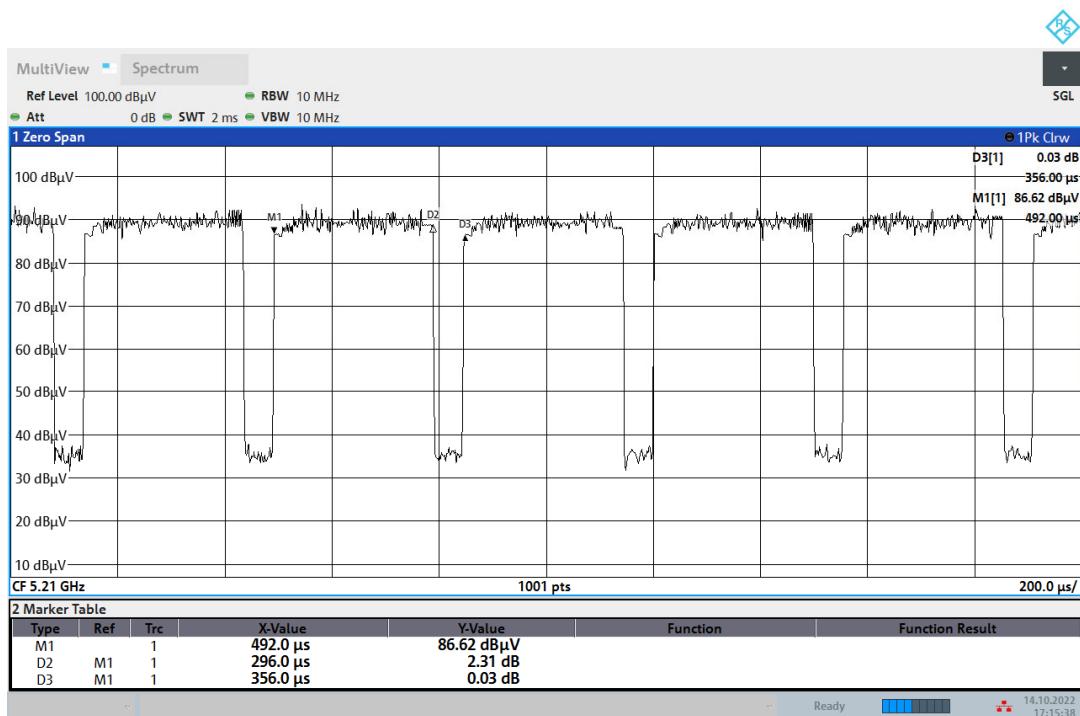
16:57:36 14.10.2022

## 802.11ax-40 MHz



16:59:27 14.10.2022

## 802.11ax-80 MHz



17:15:39 14.10.2022

## Appendix 1: EUT Test Setup Photographs

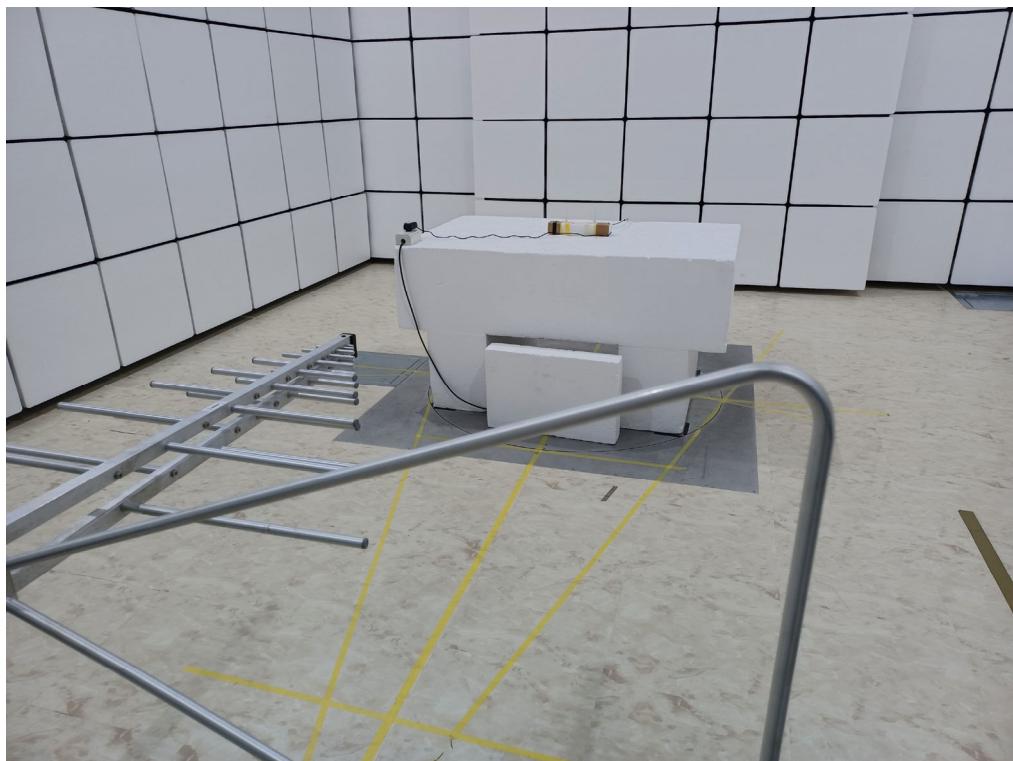
Front View of Conducted Test



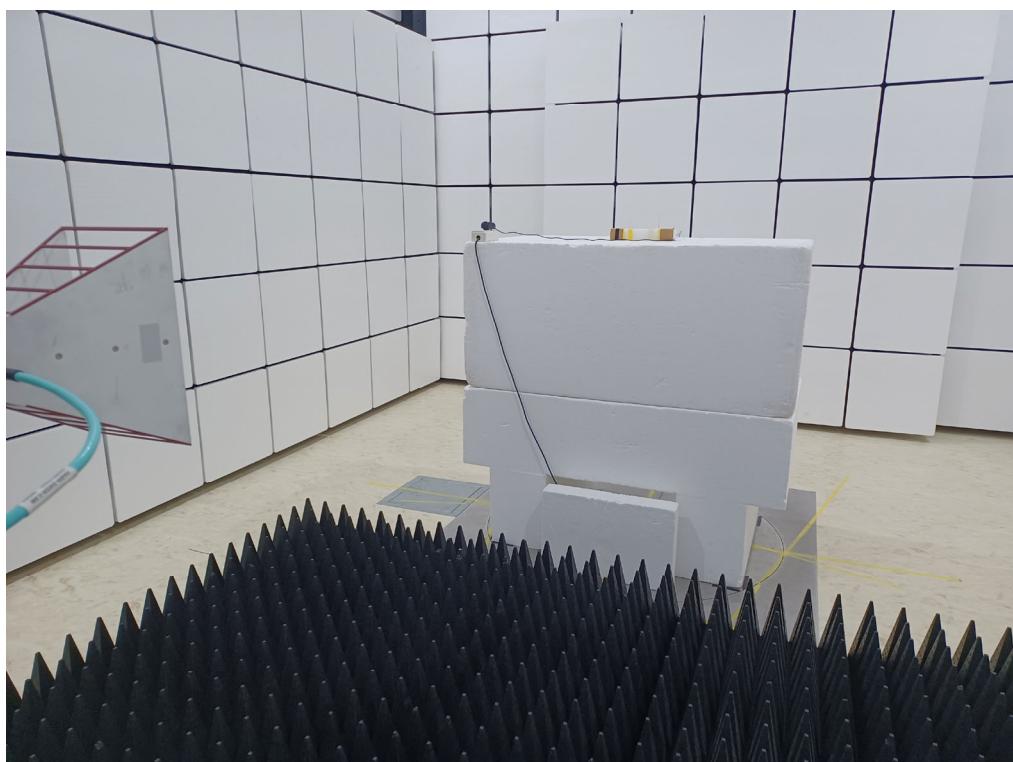
Back View of Conducted Test



Radiated Test



Radiated Test (Horn)



Radiated Test (Horn)

