



Test report No.: 23C0510R-RFUSV03S-A

TEST REPORT

Product Name	Car Infotainment Unit
Trademark	APTIV
Model and /or type reference	IHP
FCC ID	LTQIHP
Applicant's name / address	Aptiv Services Deutschland GmbH Am Technologiepark 1 D-42119 Wuppertal Germany
Manufacturer's name	Aptiv Services Deutschland GmbH
Test method requested, standard	FCC CFR Title 47 Part 15 Subpart E ANSI C63.4: 2014, ANSI C63.10: 2013 KDB Publication 789033
Verdict Summary	IN COMPLIANCE
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Tested By (Senior Engineer / Ivan Chuang)	<i>Ivan Chuang</i>
Approved By (Senior Engineer / Steven Tsai)	<i>Steven Tsai</i>
Date of Receipt	2023/12/14
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Appendix 1: EUT Test Photographs

Appendix 2: Product Photos-Please refer to the file: 23C0510R-Product Photos

Competences and Guarantees

DEKRA is a testing laboratory competent to carry out the tests described in this report.

In order to assure the traceability to other national and international laboratories, DEKRA has a calibration and maintenance program for its measurement equipment.

DEKRA guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated in the report and it is based on the knowledge and technical facilities available at DEKRA at the time of performance of the test.

DEKRA is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

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General conditions


1. The test results relate only to the samples tested.
2. 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.
3. This report must not be used to claim product endorsement by TAF or any agency of the government.
4. The test report shall not be reproduced without the written approval of DEKRA Testing and Certification Co., Ltd.
5. 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.

Revision History

Report No.	Version	Description	Issued Date
23C0510R-RFUSV03S-A	V1.0	Initial issue of report.	2024/01/26

1. General Information

1.1. EUT Description

Product Name	Car Infotainment Unit
Trade Name	APTIV
Model No.	IHP
EUT Rated Voltage	DC 12V by Battery
EUT Test Voltage	DC 12V by Battery
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: 9 CH 802.11n/ac/ax-40 MHz: 4 CH 802.11ac/ax-80 MHz: 2 CH
Data Rate	802.11a: 6-54 Mbps 802.11n: up to 300 Mbps 802.11ac: up to 866.7 Mbps 802.11ax: up to 1201 Mbps
Type of Modulation	802.11a/n/ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
Channel Control	Auto
Blockchain verified QR code	

Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	AMOTECH	AMO-PHA-AP001	PIFA	1.85 dBi for 5150~5250 MHz 1.71 dBi for 5725~5850 MHz

Note:

1. The antenna of EUT is conforming to FCC 15.203.
2. The antenna gain as by the manufacturer provided.

For power CDD Directional gain:

1.85 dBi for 5150 MHz -5250 MHz

1.71 dBi for 5725 MHz -5850 MHz

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

For PSD Directional gain:

4.86 dBi for 5150 MHz -5250 MHz

4.72 dBi for 5725 MHz -5850 MHz

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)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
036	5180	040	5200	044	5220	048	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)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
038	5190	046	5230	151	5755	159	5795

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

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
042	5210	155	5775	--	--	--	--

Note:

1. This device is a Car Infotainment Unit with built-in WLAN and Bluetooth 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. (802.11a is 6Mbps, 802.11ac/ax-20 MHz/40 MHz/80 MHz is VHT0/MCS0)
4. The modulation and bandwidth are similar for 802.11n mode and 802.11ac/ax mode, therefore investigated worst case (802.11ac/ax) to representative mode.
5. The radiation measurements are performed in X, Y, Z axis positioning. Only the worst case is shown in the report
6. The spectrum plot against conducted item only shows the worst case.
7. This device does not support partial RU function.
8. DEKRA has evaluated each test mode. Only the worst case is shown in the report.
9. 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.

Test Mode	Mode 1	Transmit (802.11a) Transmit (802.11ac-20 MHz) Transmit (802.11ac-40 MHz) Transmit (802.11ac-80 MHz) Transmit (802.11ax-20 MHz) Transmit (802.11ax-40 MHz) Transmit (802.11ax-80 MHz)
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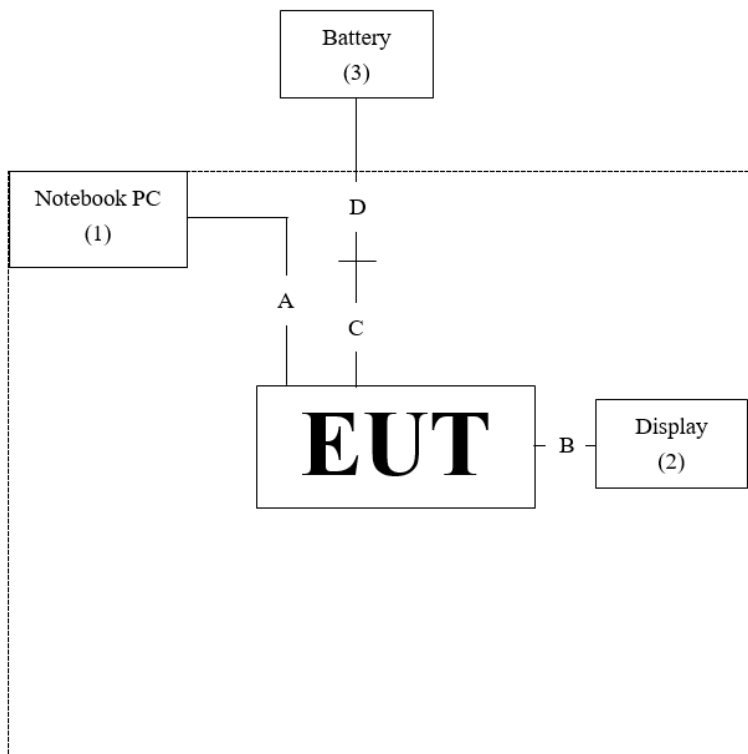
1.2. Tested System Details

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 Notebook PC	Lenovo	TP00067C	PF-0EW0C3	N/A
2 Display	N/A	IHP DISPLAY	N/A	N/A
3 Battery	BOSCH	60044	N/A	N/A

Cable Type	Cable Description
A USB Cable	Shielded, 1m
B 4 Pin cable	Non-shielded, 1m
C Power Cable	Non-shielded, 2m
D Power Cable	Non-shielded, 2m

1.3. Configuration of tested System



1.4. EUT Exercise Software

1	Setup the EUT as shown in Section 1.3.
2	Execute software “cmd Ver. 10.0.19045.3803” 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
Radiated Emission	Temperature (°C)	10~40 °C	23.7 °C
	Humidity (%RH)	10~90 %	34.0 %
Conductive	Temperature (°C)	10~40 °C	25.6 °C
	Humidity (%RH)	10~90 %	57.0 %

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.
	Linkou Laboratory
Address	No.5-22, Ruishukeng Linkou District, New Taipei City, 24451, Taiwan, R.O.C
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

1.6. List of Test Equipment

For Conducted Measurements / HY-SR02

	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
V	Spectrum Analyzer	R&S	FSV30	103465	2023/06/14	2024/06/13
V	Peak Power Analyzer	KEYSIGHT	8990B	MY51000539	2023/05/15	2024/05/14
V	Wideband Power Sensor	KEYSIGHT	N1923A	MY59240002	2023/05/18	2024/05/17
V	Wideband Power Sensor	KEYSIGHT	N1923A	MY59240003	2023/05/18	2024/05/17

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 V3.0.0.14.

For Radiated Measurements /HY-CB03

	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
V	Loop Antenna	AMETEK	HLA6121	49611	2023/02/21	2024/02/20
V	Bi-Log Antenna	SCHWARZBECK	VULB9168	9168-0675	2023/08/09	2025/08/08
V	Horn Antenna	Com-Power	AH-840	101100	2023/10/02	2025/10/01
V	Horn Antenna	RF SPIN	DRH18-E	210507A18ES	2023/05/11	2024/05/10
V	Pre-Amplifier	SGH	SGH0301-9	20211007-11	2023/01/10	2024/01/09
V	Pre-Amplifier	SGH	PRAMP118	20200701	2023/01/10	2024/01/09
V	Pre-Amplifier	EMCI	EMC05820SE	980310	2023/01/10	2024/01/09
V	Pre-Amplifier	EMCI	EMC184045SE	980369	2023/01/10	2024/01/09
	Coaxial Cable	EMCI	EMC102-KM-KM-600	1160314		
	Coaxial Cable	EMCI	EMC102-KM-KM-7000	170242		
	Filter	MICRO TRONICS	BRM50702	G269	2023/01/05	2024/01/04
V	Filter	MICRO TRONICS	BRM50716	G196	2023/01/05	2024/01/04
V	EMI Test Receiver	R&S	ESR3	102793	2023/12/11	2024/12/10
V	Spectrum Analyzer	R&S	FSV3044	101113	2023/02/04	2024/02/03
V	Coaxial Cable	SGH	SGH18	2021005-1	2023/01/10	2024/01/09
	Coaxial Cable	SGH	SGH18	202108-4		
V	Coaxial Cable	SGH	HA800	GD20110223-1	2023/01/10	2024/01/09
V	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 230303 dekra V9.

1.7. Uncertainty

Uncertainties have been calculated according to the DEKRA internal document.

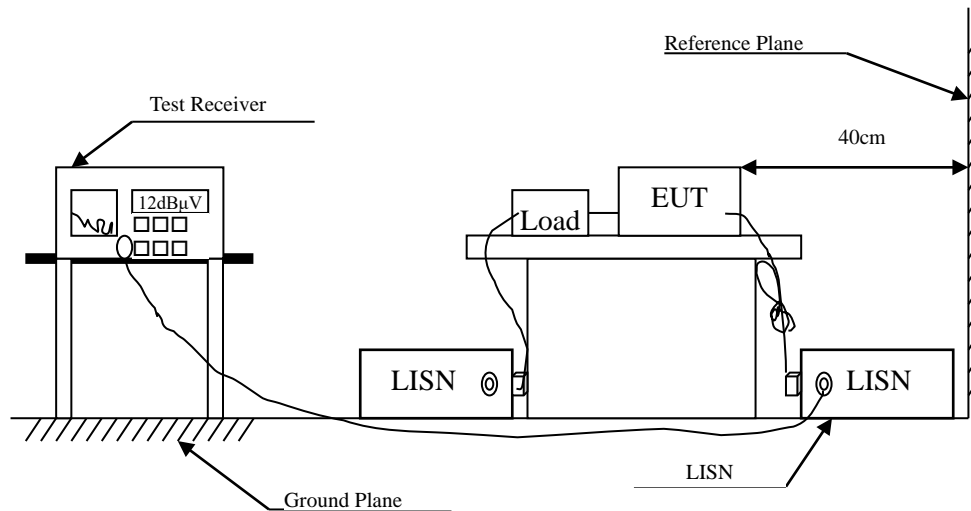
The reported expanded uncertainties are based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95%.

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	± 3.50 dB
Maximum conducted output power	Spectrum Analyzer: ± 2.14 dB Power Meter: ± 1.05 dB
Peak Power Spectral Density	± 2.14 dB
Radiated Emission	9 kHz~30 MHz: ± 3.88 dB 30 MHz~1 GHz: ± 4.42 dB 1 GHz~18 GHz: ± 4.28 dB 18 GHz~40 GHz: ± 3.90 dB
Band Edge	9 kHz~30 MHz: ± 3.88 dB 30 MHz~1 GHz: ± 4.42 dB 1 GHz~18 GHz: ± 4.28 dB 18 GHz~40 GHz: ± 3.90 dB
Occupied Bandwidth	± 1580.61 Hz
Duty Cycle	± 0.53 %

2. Conducted Emission

2.1. Test Setup



2.2. Limits

FCC Part 15 Subpart C Paragraph 15.207 (dBµV) 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 /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm /50uH 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 investigated over the frequency range from 0.15 MHz to 30 MHz using a receiver bandwidth of 9 kHz.

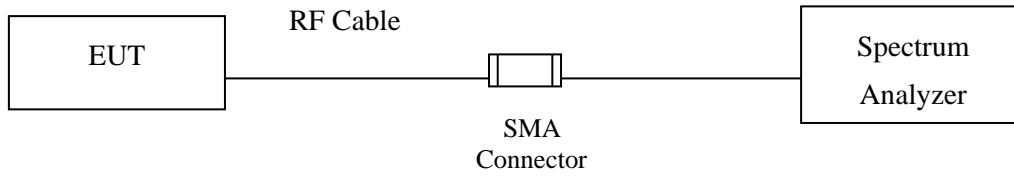
2.4. Test Result of Conducted Emission

Owing to the DC operation of EUT, this test item is not performed.

3. Maximun conducted output power

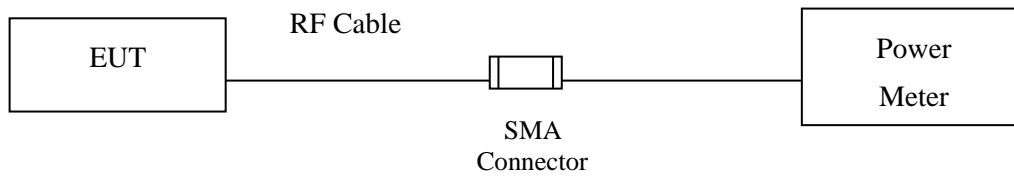
3.1. Test Setup

26dB Occupied Bandwidth

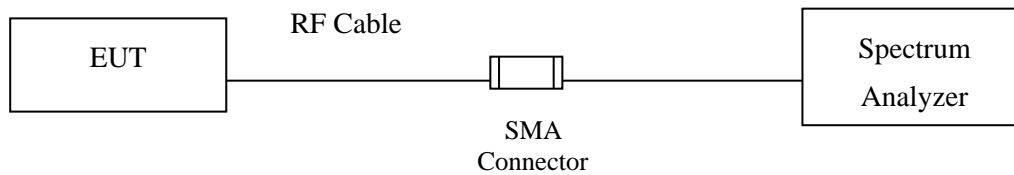


Conduction Power Measurement

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-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. 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 26dB 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 :

5150MHz-5250MHz: Directional gain = 1.85 dBi, Limit= 30dBm

5725MHz-5850MHz: Directional gain = 1.71 dBi, Limit= 30dBm

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

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 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.

802.11a/n/ac/ax (BW \leq 160MHz) 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, (KEYSIGHT / 8990B video bandwidth: 160MHz)

802.11n/ac/ax (BW \geq 160MHz) 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 : Car Infotainment Unit
Test Item : Maximum conducted output power
Test Mode : Transmit (802.11a)
Test Date : 2023/12/20

Channel No.	Frequency (MHz)	Chain A Power (dBm)	Chain B Power (dBm)	Output Power (dBm)	Output Power Limit (dBm)
36	5180	13.05	14.19	16.67	30
44	5220	13.18	14.56	16.93	30
48	5240	12.92	14.31	16.68	30
149	5745	11.97	14.93	16.71	30
157	5785	11.79	14.95	16.66	30
165	5825	12.83	14.80	16.94	30

Note: Output Power (dBm) = 10*LOG (Chain A(mW) + Chain B(mW))

Product : Car Infotainment Unit
Test Item : Maximum conducted output power
Test Mode : Transmit (802.11ac-20 MHz)
Test Date : 2023/12/20

Channel No.	Frequency (MHz)	Chain A Power (dBm)	Chain B Power (dBm)	Output Power (dBm)	Output Power Limit (dBm)
36	5180	12.69	14.23	16.54	30
44	5220	12.73	14.15	16.51	30
48	5240	12.90	14.38	16.71	30
149	5745	12.05	15.03	16.80	30
157	5785	11.62	14.93	16.59	30
165	5825	12.76	14.66	16.82	30

Note: Output Power (dBm) = 10*LOG (Chain A(mW) + Chain B(mW))

Product : Car Infotainment Unit
Test Item : Maximum conducted output power
Test Mode : Transmit (802.11ac-40 MHz)
Test Date : 2023/12/20

Channel No.	Frequency (MHz)	Chain A Power (dBm)	Chain B Power (dBm)	Output Power (dBm)	Output Power Limit (dBm)
38	5190	11.61	13.49	15.66	30
46	5230	13.11	14.65	16.96	30
151	5755	11.71	14.92	16.62	30
159	5795	11.53	14.96	16.59	30

Note: Output Power (dBm) = 10*LOG (Chain A(mW) + Chain B(mW))

Product : Car Infotainment Unit
Test Item : Maximum conducted output power
Test Mode : Transmit (802.11ac-80 MHz)
Test Date : 2023/12/20

Channel No.	Frequency (MHz)	Chain A Power (dBm)	Chain B Power (dBm)	Output Power (dBm)	Output Power Limit (dBm)
42	5210	9.54	11.29	13.51	30
155	5775	11.69	14.94	16.62	30

Note: Output Power (dBm) = 10*LOG (Chain A(mW) + Chain B(mW))

Product : Car Infotainment Unit
Test Item : Maximum conducted output power
Test Mode : Transmit (802.11ax-20 MHz)
Test Date : 2023/12/20

Channel No.	Frequency (MHz)	Chain A Power (dBm)	Chain B Power (dBm)	Output Power (dBm)	Output Power Limit (dBm)
36	5180	11.63	13.57	15.72	30
44	5220	12.80	14.38	16.67	30
48	5240	12.79	14.19	16.56	30
149	5745	11.66	14.89	16.58	30
157	5785	11.73	14.95	16.64	30
165	5825	12.48	14.42	16.57	30

Note: Output Power (dBm) = 10*LOG (Chain A(mW) + Chain B(mW))

Product : Car Infotainment Unit
Test Item : Maximum conducted output power
Test Mode : Transmit (802.11ax-40 MHz)
Test Date : 2023/12/20

Channel No.	Frequency (MHz)	Chain A Power (dBm)	Chain B Power (dBm)	Output Power (dBm)	Output Power Limit (dBm)
38	5190	12.65	14.36	16.60	30
46	5230	12.84	14.36	16.68	30
151	5755	11.63	14.84	16.54	30
159	5795	11.73	14.93	16.63	30

Note: Output Power (dBm) = 10*LOG (Chain A(mW) + Chain B(mW))

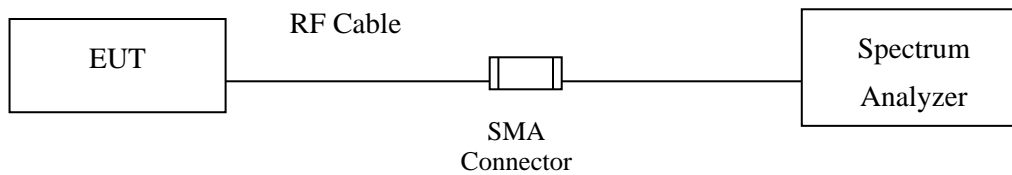
Product : Car Infotainment Unit
Test Item : Maximum conducted output power
Test Mode : Transmit (802.11ax-80 MHz)
Test Date : 2023/12/20

Channel No.	Frequency (MHz)	Chain A Power (dBm)	Chain B Power (dBm)	Output Power (dBm)	Output Power Limit (dBm)
42	5210	9.40	11.13	13.36	30
155	5775	10.96	14.24	15.91	30

Note: Output Power (dBm) = 10*LOG (Chain A(mW) + Chain B(mW))

4. 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.

For CDD mode :

5150MHz-5250MHz: Directional gain = 4.86 dBi, Limit= 17 dBm

5725MHz-5850MHz: Directional gain = 4.72 dBi, Limit= 30 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 Power Spectral Density

Product : Car Infotainment Unit
 Test Item : Power Spectral Density
 Test Mode : Transmit (802.11a)
 Test Date : 2023/12/20

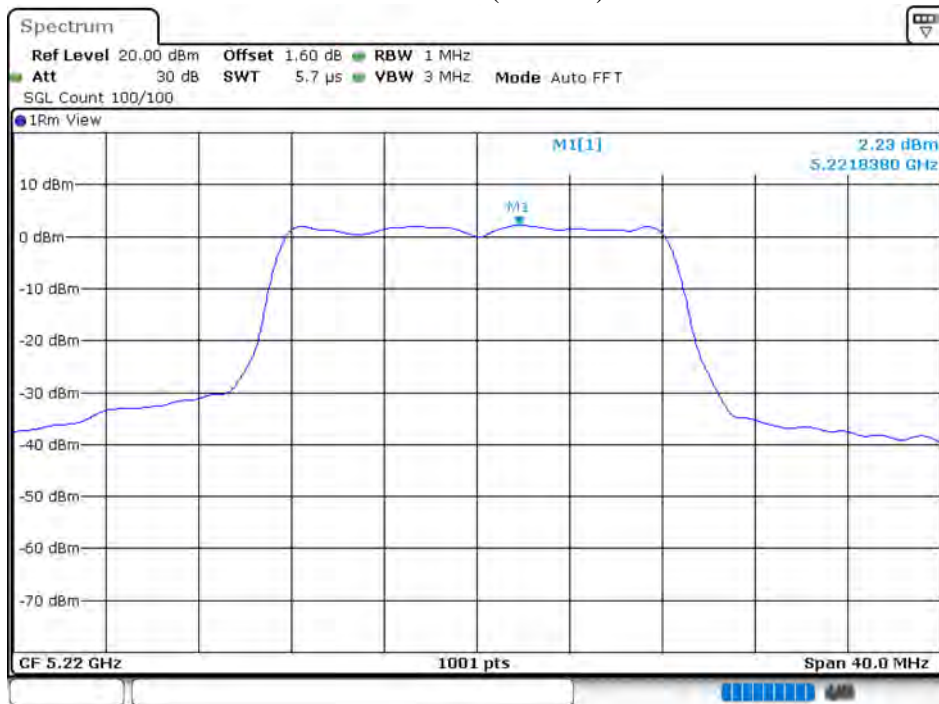
Channel No.	Frequency (MHz)	Data Rate (Mbps)	Chain	PSD/MHz (dBm)	Duty factor (dB)	Total PSD/MHz (dBm)	Required Limit (dBm)	Result
36	5180	6	A	0.64	0.00	4.24	<17	Pass
			B	1.74				Pass
44	5220	6	A	0.45	0.00	4.44	<17	Pass
			B	2.23				Pass
48	5240	6	A	-0.06	0.00	3.28	<17	Pass
			B	0.57				Pass

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

Channel No.	Frequency (MHz)	Data Rate (Mbps)	Chain	PSD (dBm)	Duty factor (dB)	Total PSD (dBm)	Required Limit (dBm)	Result
149	5745	6	A	-0.45	0.00	3.88	<30	Pass
			B	1.88				Pass
157	5785	6	A	-1.72	0.00	3.39	<30	Pass
			B	1.79				Pass
165	5825	6	A	-0.43	0.00	3.85	<30	Pass
			B	1.82				Pass

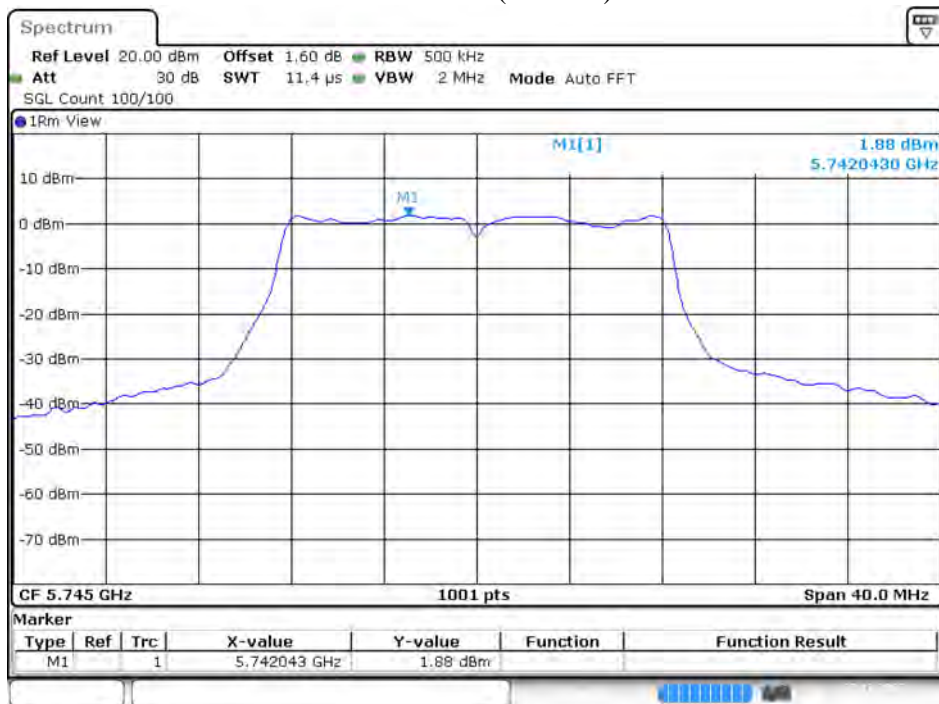
Note: Total PSD = $10 \cdot \log(\text{Chain A (mW)} + \text{Chain B (mW)}) + \text{Duty factor}$.

Channel 44 (Chain B)



Date: 27.DEC.2023 09:10:13

Channel 149 (Chain B)



Date: 27.DEC.2023 00:30:55

Product : Car Infotainment Unit
 Test Item : Power Spectral Density
 Test Mode : Transmit (802.11ac-20 MHz)
 Test Date : 2023/12/20

Channel No.	Frequency (MHz)	Data Rate (Mbps)	Chain	PSD/MHz (dBm)	Duty factor (dB)	Total PSD/MHz (dBm)	Required Limit (dBm)	Result
36	5180	VHT0	A	-0.50	0.00	4.11	<17	Pass
			B	2.27				Pass
44	5220	VHT0	A	-0.25	0.00	4.01	<17	Pass
			B	1.97				Pass
48	5240	VHT0	A	0.32	0.00	4.49	<17	Pass
			B	2.40				Pass

Note: Total PSD = 10*log(Chain A (mW) + Chain B (mW)) + Duty factor.

Channel No.	Frequency (MHz)	Data Rate (Mbps)	Chain	PSD (dBm)	Duty factor (dB)	Total PSD (dBm)	Required Limit (dBm)	Result
149	5745	VHT0	A	-1.30	0.00	3.17	<30	Pass
			B	1.25				Pass
157	5785	VHT0	A	-1.81	0.00	3.02	<30	Pass
			B	1.29				Pass
165	5825	VHT0	A	-0.69	0.00	3.26	<30	Pass
			B	1.02				Pass

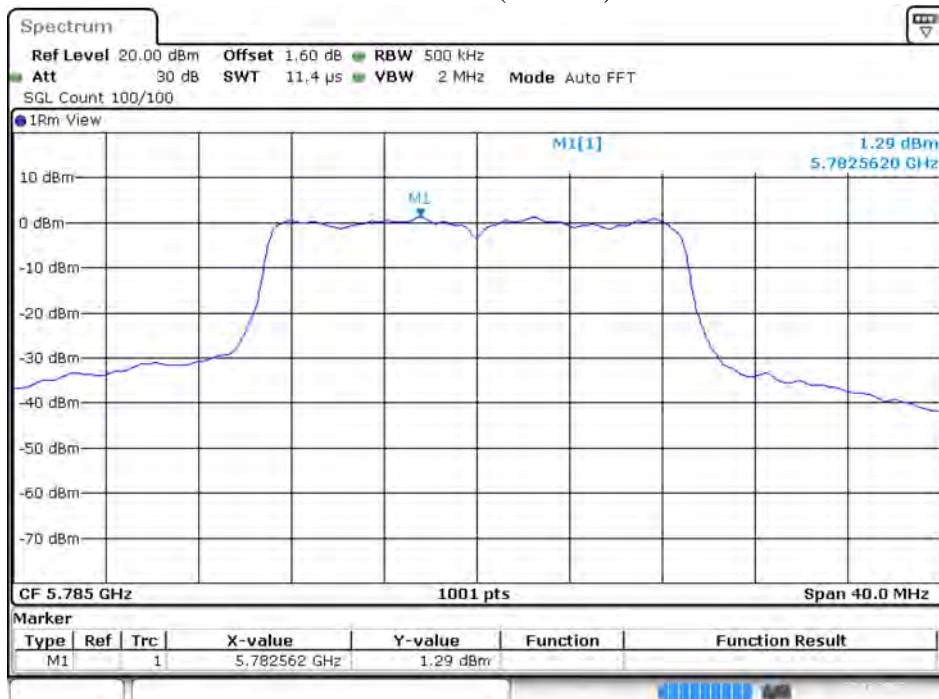
Note: Total PSD = 10*log(Chain A (mW) + Chain B (mW)) + Duty factor.

Channel 48 (Chain B)



Date: 27.DEC.2023 09:23:59

Channel 157 (Chain B)



Date: 27.DEC.2023 00:38:24

Product : Car Infotainment Unit
 Test Item : Power Spectral Density
 Test Mode : Transmit (802.11ac-40 MHz)
 Test Date : 2023/12/20

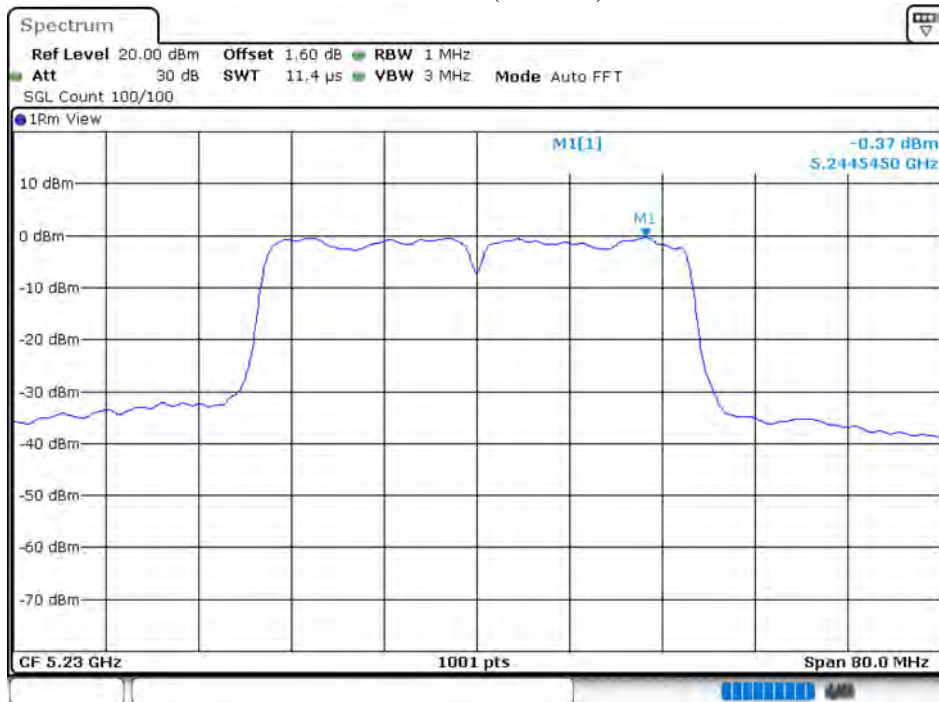
Channel No.	Frequency (MHz)	Data Rate	Chain	PSD/MHz (dBm)	Duty factor (dB)	Total PSD/MHz (dBm)	Required Limit (dBm)	Result
38	5190	VHT0	A	-3.68	0.13	0.73	<17	Pass
			B	-1.42				Pass
46	5230	VHT0	A	-2.20	0.13	1.95	<17	Pass
			B	-0.37				Pass

Note: Total PSD = 10*log(Chain A (mW) + Chain B (mW)) + Duty factor.

Channel No.	Frequency (MHz)	Data Rate	Chain	PSD (dBm)	Duty factor (dB)	Total PSD (dBm)	Required Limit (dBm)	Result
151	5755	VHT0	A	-4.76	0.13	0.37	<30	Pass
			B	-1.41				Pass
159	5795	VHT0	A	-5.43	0.13	-0.16	<30	Pass
			B	-1.88				Pass

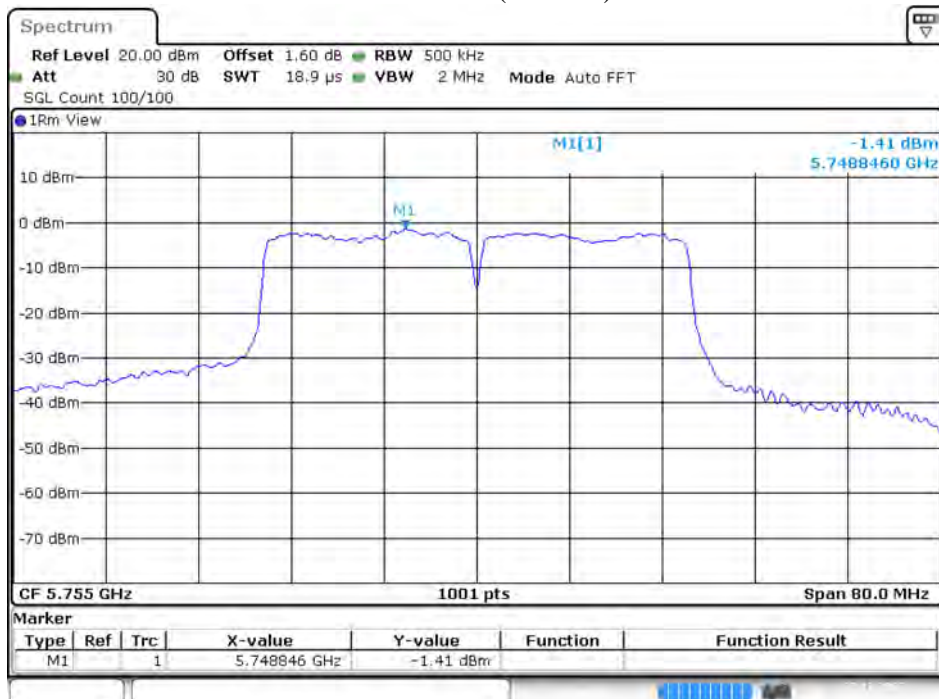
Note: Total PSD = 10*log(Chain A (mW) + Chain B (mW)) + Duty factor.

Channel 46 (Chain B)



Date: 27.DEC.2023 09:27:50

Channel 151 (Chain B)



Date: 27.DEC.2023 00:42:06

Product : Car Infotainment Unit
 Test Item : Power Spectral Density
 Test Mode : Transmit (802.11ac-80 MHz)
 Test Date : 2023/12/20

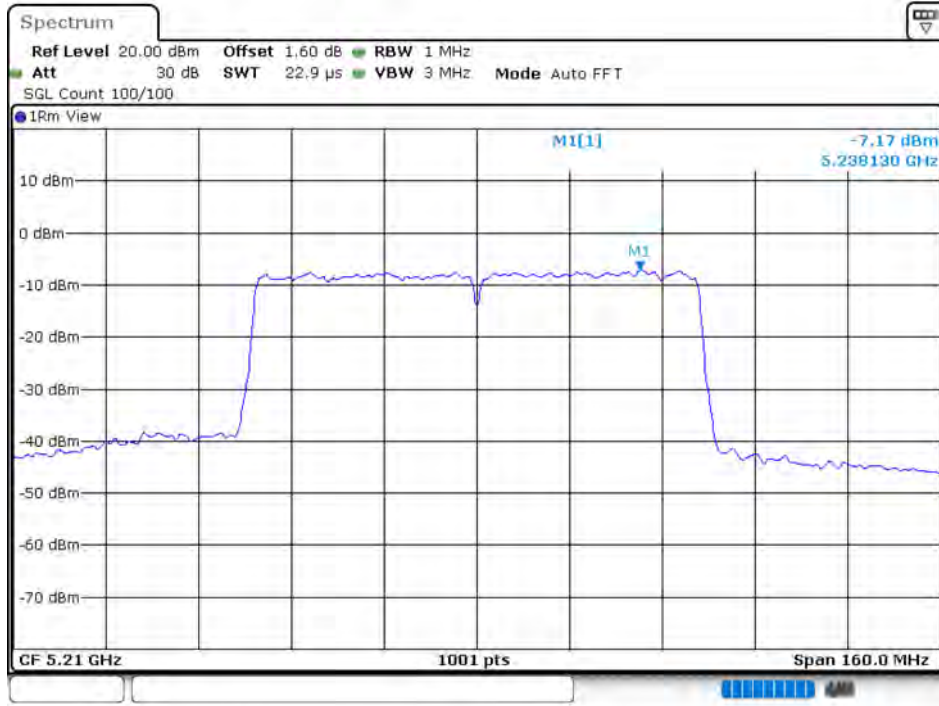
Channel No.	Frequency (MHz)	Data Rate	Chain	PSD/MHz (dBm)	Duty factor (dB)	Total PSD/MHz (dBm)	Required Limit (dBm)	Result
42	5210	VHT0	A	-8.98	0.32	-4.65	<17	Pass
			B	-7.17				Pass

Note: Total PSD = 10*log(Chain A (mW) + Chain B (mW)) + Duty factor.

Channel No.	Frequency (MHz)	Data Rate	Chain	PSD (dBm)	Duty factor (dB)	Total PSD (dBm)	Required Limit (dBm)	Result
155	5775	VHT0	A	-8.47	0.32	-3.14	<30	Pass
			B	-5.11				Pass

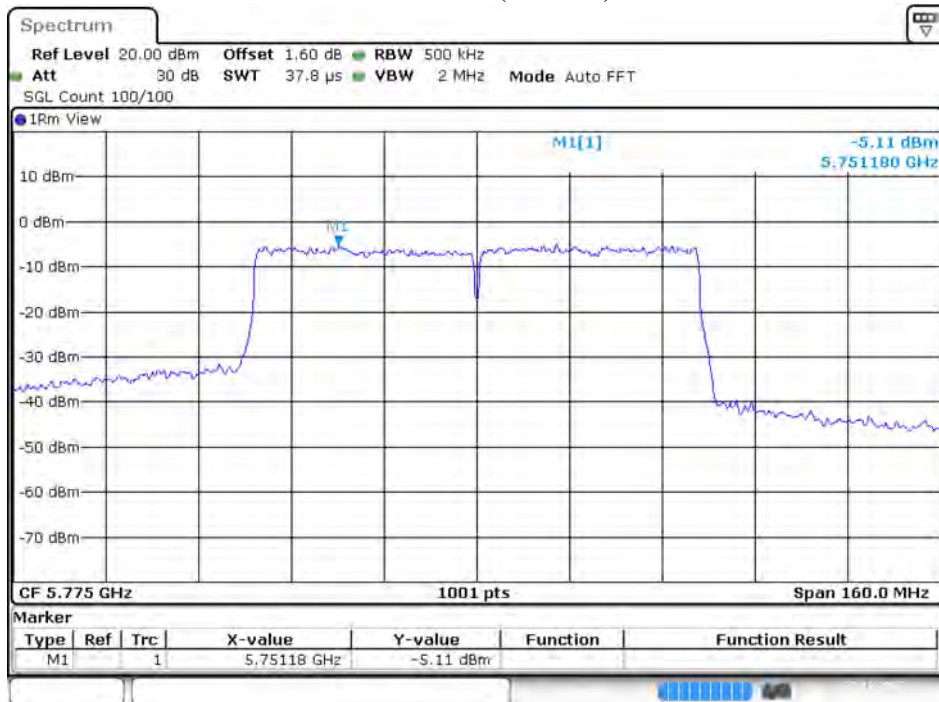
Note: Total PSD = 10*log(Chain A (mW) + Chain B (mW)) + Duty factor.

Channel 42 (Chain B)



Date: 27.DEC.2023 09:30:39

Channel 155 (Chain B)



Date: 27.DEC.2023 00:45:51

Product : Car Infotainment Unit
 Test Item : Power Spectral Density
 Test Mode : Transmit (802.11ax-20 MHz)
 Test Date : 2023/12/20

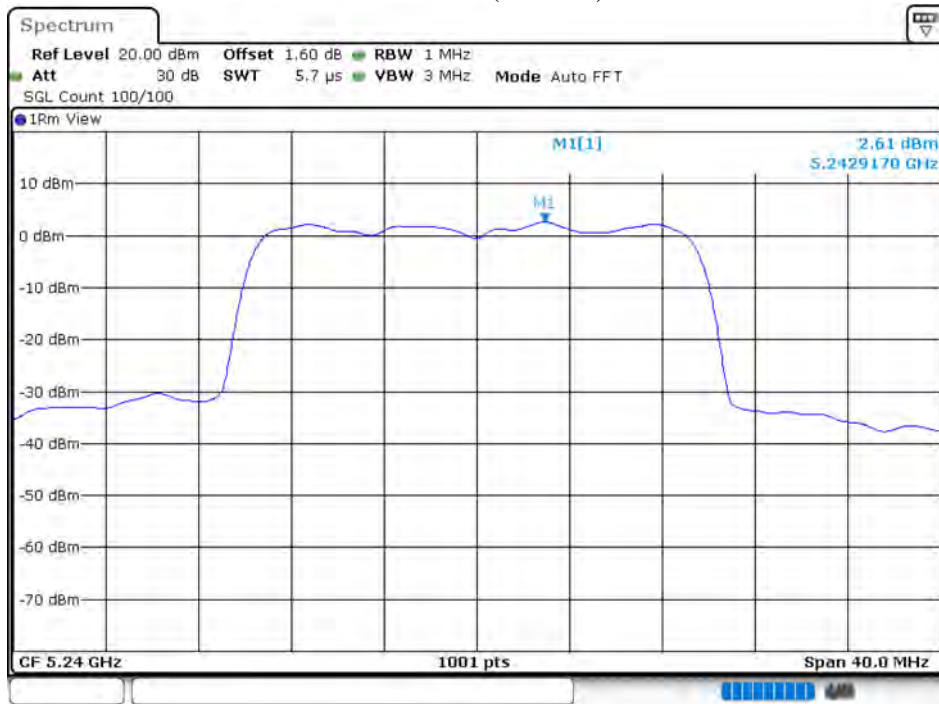
Channel No.	Frequency (MHz)	Data Rate	Chain	PSD/MHz (dBm)	Duty factor (dB)	Total PSD/MHz (dBm)	Required Limit (dBm)	Result
36	5180	MCS0	A	-0.69	0.00	3.86	<17	Pass
			B	1.98				Pass
44	5220	MCS0	A	0.45	0.00	4.59	<17	Pass
			B	2.47				Pass
48	5240	MCS0	A	0.12	0.00	4.55	<17	Pass
			B	2.61				Pass

Note: Total PSD = 10*log(Chain A (mW) + Chain B (mW)) + Duty factor.

Channel No.	Frequency (MHz)	Data Rate	Chain	PSD (dBm)	Duty factor (dB)	Total PSD (dBm)	Required Limit (dBm)	Result
149	5745	MCS0	A	-1.75	0.00	2.55	<30	Pass
			B	0.53				Pass
157	5785	MCS0	A	-2.79	0.00	2.42	<30	Pass
			B	0.86				Pass
165	5825	MCS0	A	-1.89	0.00	2.60	<30	Pass
			B	0.69				Pass

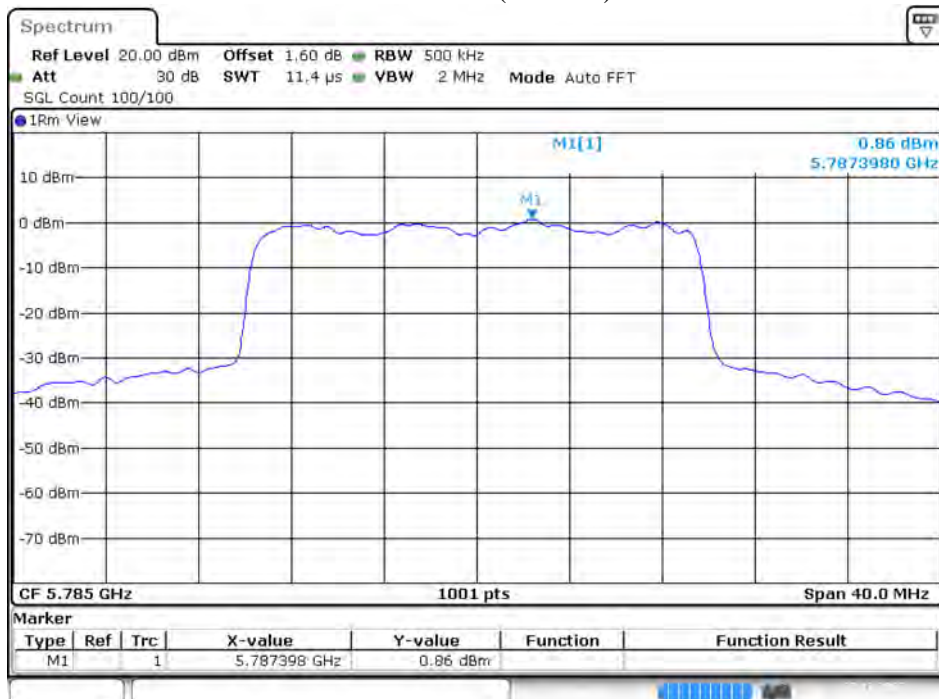
Note: Total PSD = 10*log(Chain A (mW) + Chain B (mW)) + Duty factor.

Channel 48 (Chain B)



Date: 27.DEC.2023 10:28:37

Channel 157 (Chain B)



Date: 27.DEC.2023 00:49:35

Product : Car Infotainment Unit
 Test Item : Power Spectral Density
 Test Mode : Transmit (802.11ax-40 MHz)
 Test Date : 2023/12/20

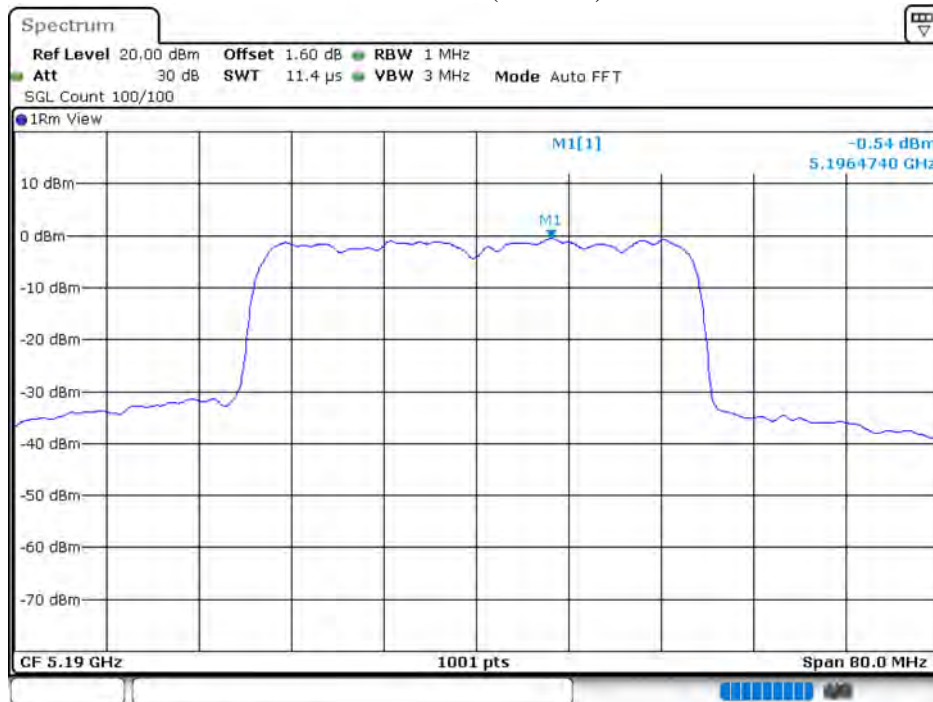
Channel No.	Frequency (MHz)	Data Rate	Chain	PSD/MHz (dBm)	Duty factor (dB)	Total PSD/MHz (dBm)	Required Limit (dBm)	Result
38	5190	MCS0	A	-2.75	0.16	1.66	<17	Pass
			B	-0.54				Pass
46	5230	MCS0	A	-2.42	0.16	1.78	<17	Pass
			B	-0.55				Pass

Note: Total PSD = 10*log(Chain A (mW) + Chain B (mW)) + Duty factor.

Channel No.	Frequency (MHz)	Data Rate	Chain	PSD (dBm)	Duty factor (dB)	Total PSD (dBm)	Required Limit (dBm)	Result
151	5755	MCS0	A	-5.24	0.16	-0.24	<30	Pass
			B	-2.12				Pass
159	5795	MCS0	A	-5.94	0.16	-0.87	<30	Pass
			B	-2.72				Pass

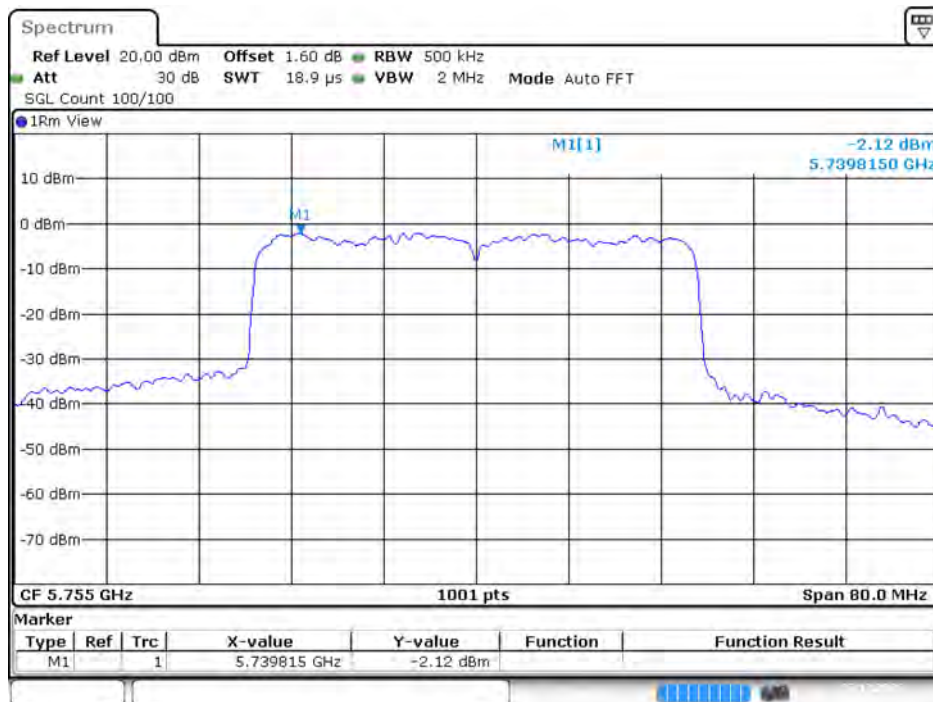
Note: Total PSD = 10*log(Chain A (mW) + Chain B (mW)) + Duty factor.

Channel 38 (Chain B)



Date: 27.DEC.2023 10:31:04

Channel 151 (Chain B)



Date: 27.DEC.2023 00:55:56

Product : Car Infotainment Unit
 Test Item : Power Spectral Density
 Test Mode : Transmit (802.11 ax-80 MHz)
 Test Date : 2023/12/20

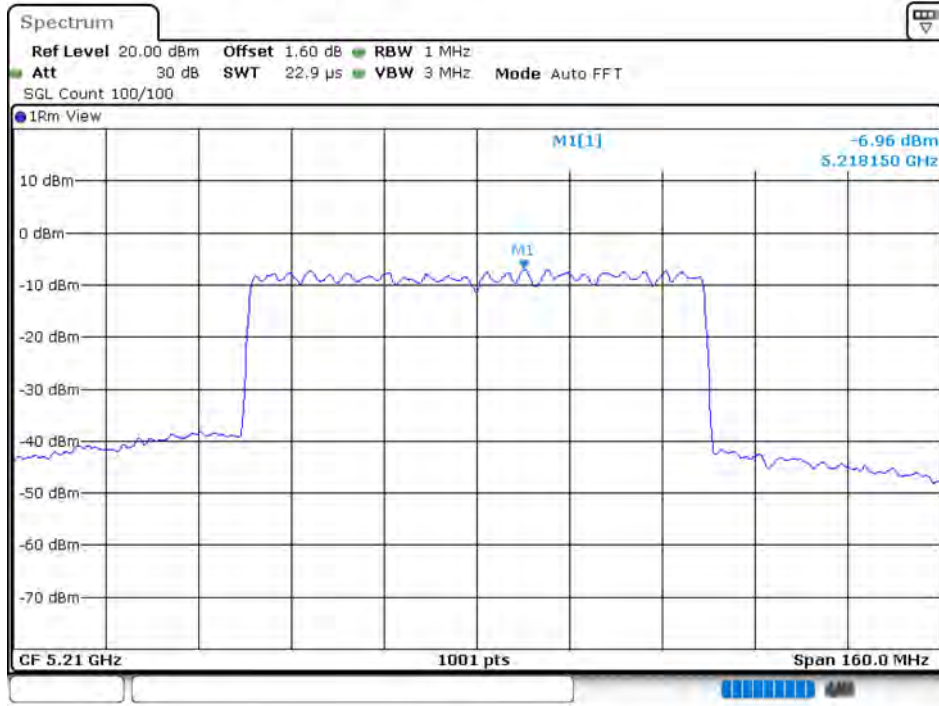
Channel No.	Frequency (MHz)	Data Rate	Chain	PSD/MHz (dBm)	Duty factor (dB)	Total PSD/MHz (dBm)	Required Limit (dBm)	Result
42	5210	MCS0	A	-9.36	0.29	-4.69	<17	Pass
			B	-6.96				Pass

Note: Total PSD = 10*log(Chain A (mW) + Chain B (mW)) + Duty factor.

Channel No.	Frequency (MHz)	Data Rate	Chain	PSD (dBm)	Duty factor (dB)	Total PSD (dBm)	Required Limit (dBm)	Result
155	5775	MCS0	A	-8.88	0.29	-3.64	<30	Pass
			B	-5.61				Pass

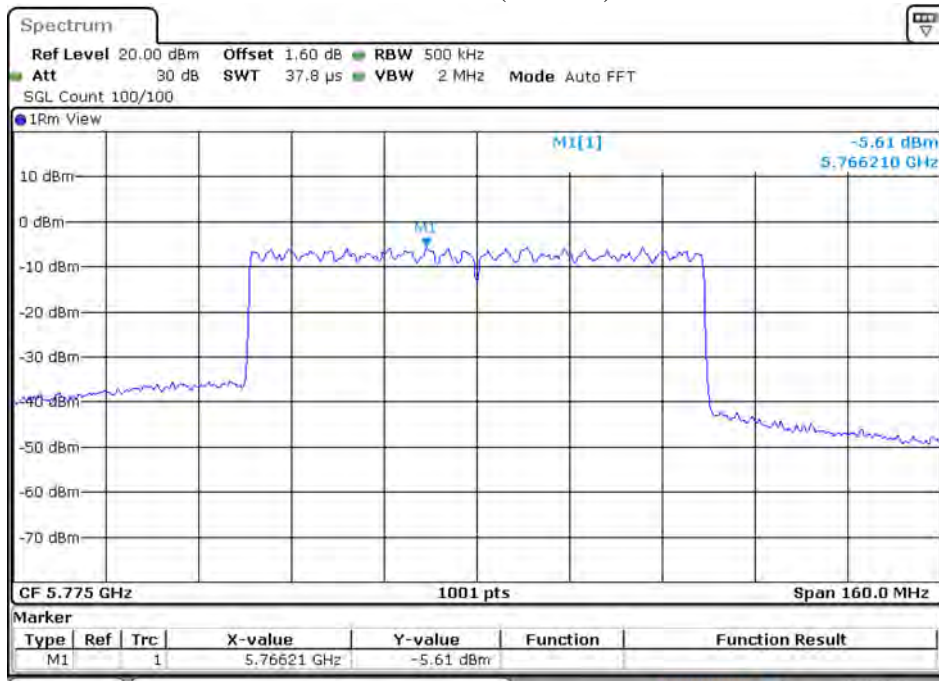
Note: Total PSD = 10*log(Chain A (mW) + Chain B (mW)) + Duty factor.

Channel 42 (Chain B)



Date: 27.DEC.2023 10:35:07

Channel 155 (Chain B)

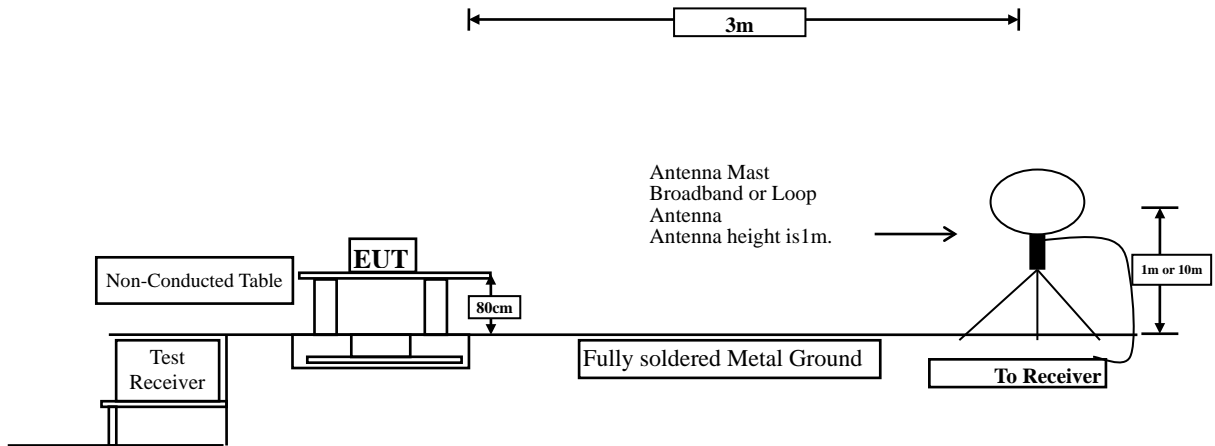


Date: 27.DEC.2023 01:06:08

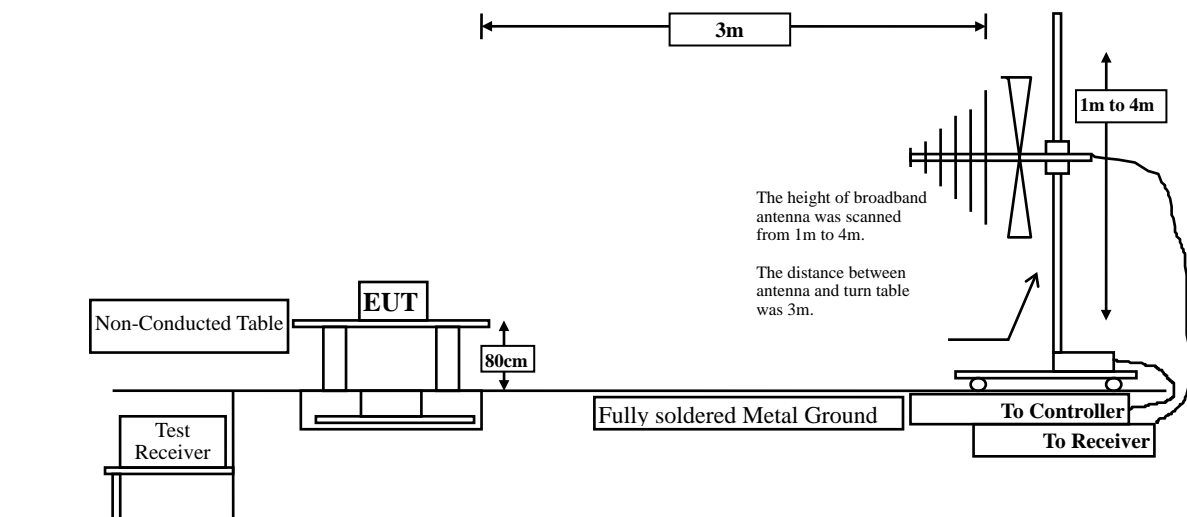
5. Radiated Emission

5.1. Test Setup

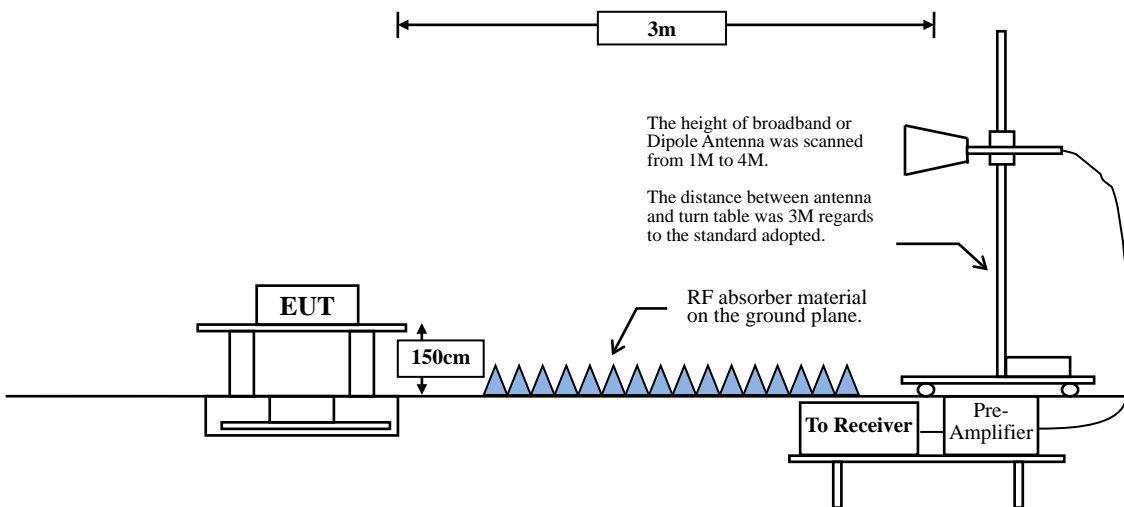
Radiated Emission Under 30 MHz



Radiated Emission Below 1 GHz



Radiated Emission Above 1 GHz



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.

FCC Part 15 Subpart C Paragraph 15.209(a) Limits		
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 μ V/m) = 20 log E field strength (μ V/m)

- 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.
- 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.
- 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.
- For transmitters operating in the 5.725-5.85 GHz band:
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.
- For transmitters operating within the 5.925-7.125 GHz band: Any emissions outside of the 5.925-7.125 GHz band must not exceed an e.i.r.p. of -27 dBm/MHz.

Based on ANSI C63.10-2013 Section 12.7.3 d) provides the conversion formula between field strength and EIRP, if distance is 3m, -27dBm is equivalent to 68.22dBuV/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 1 GHz, 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 30 MHz setting on the field strength meter is 9kHz 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 - 10th 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 = 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 %

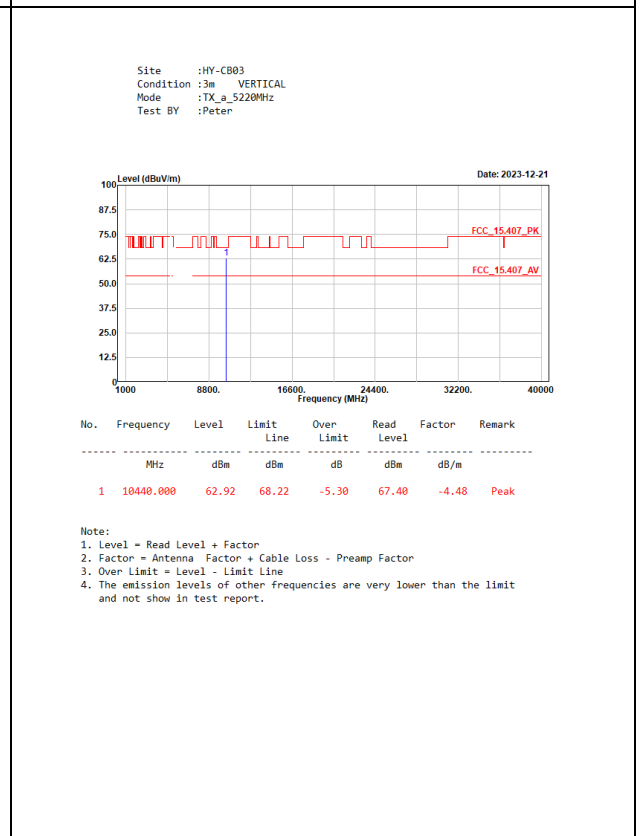
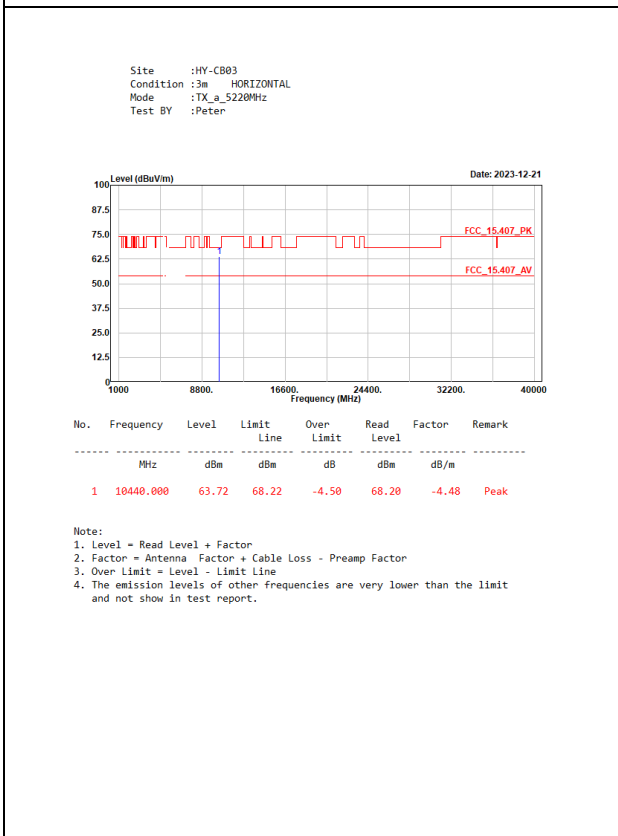
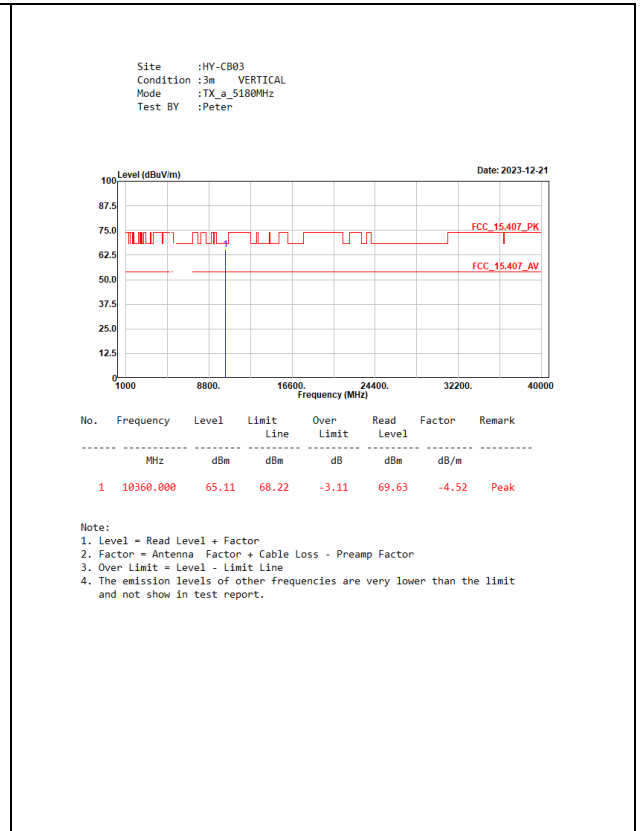
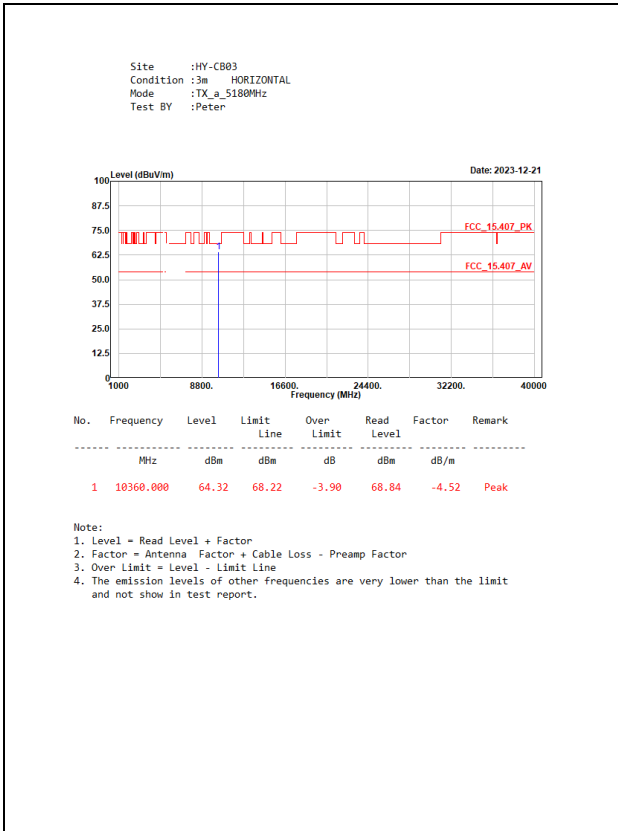
VBW \geq 1/T, when duty cycle < 98 %

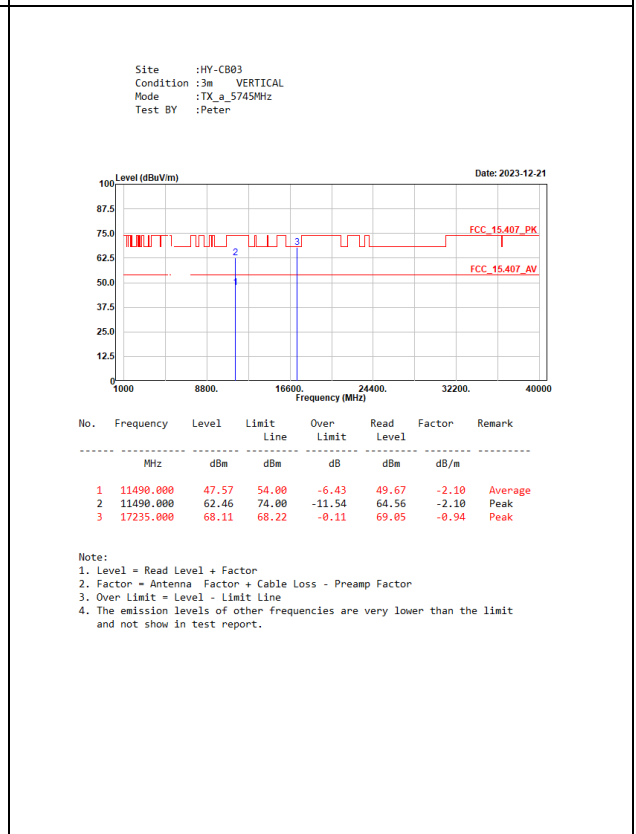
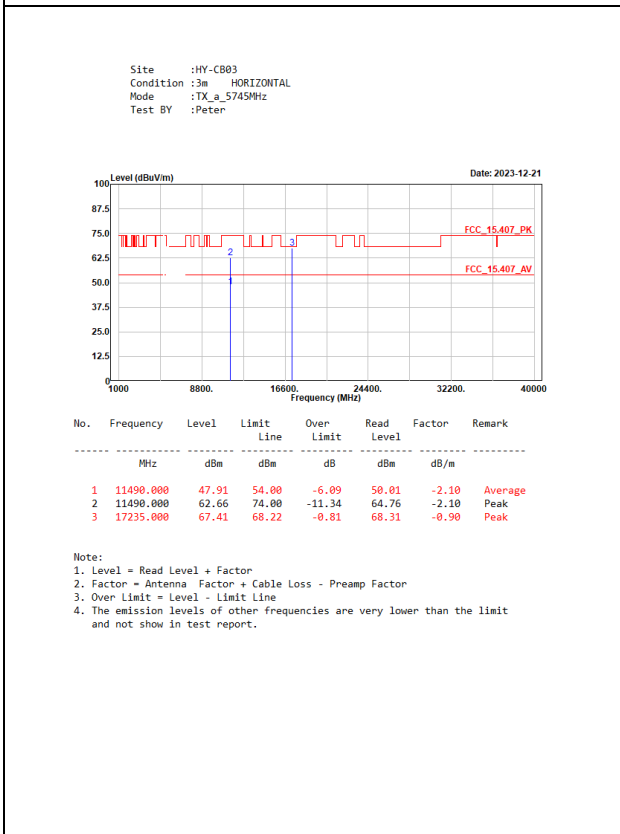
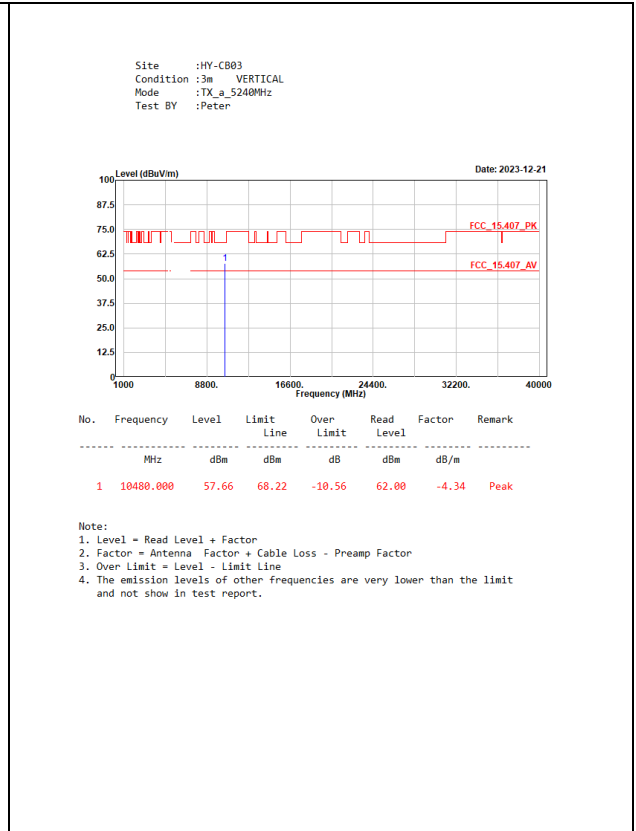
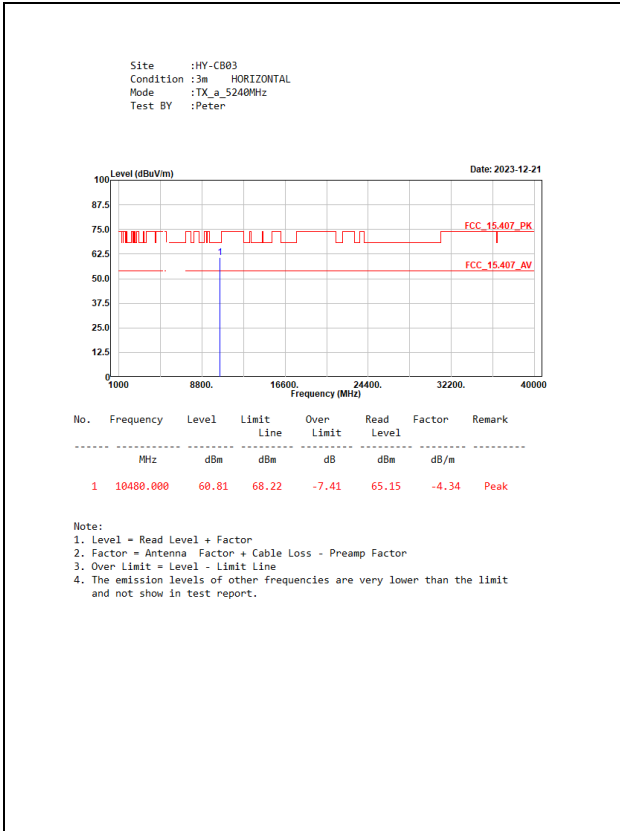
(T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

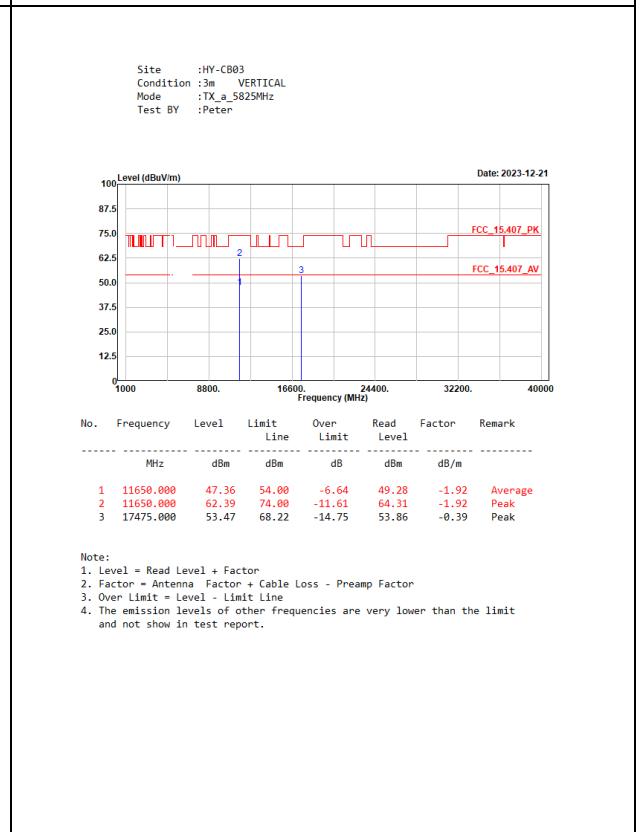
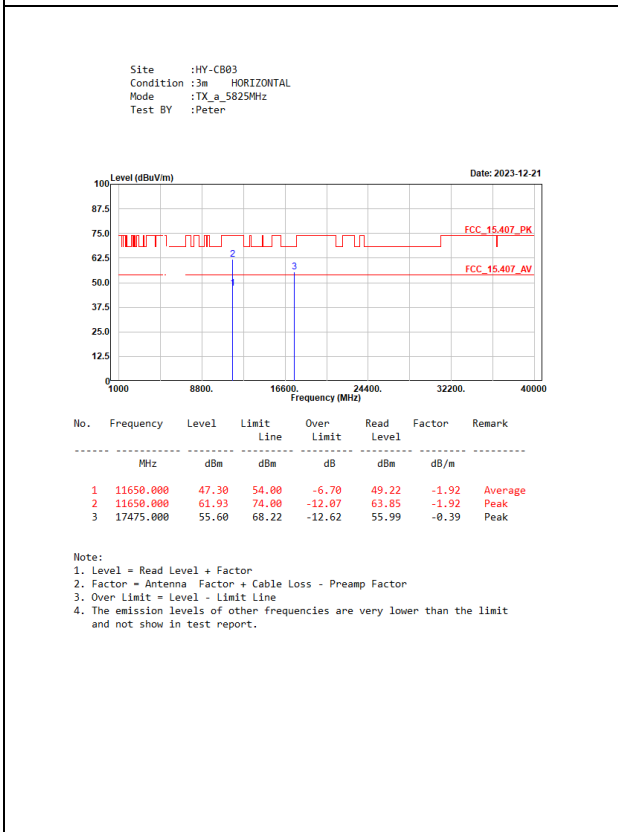
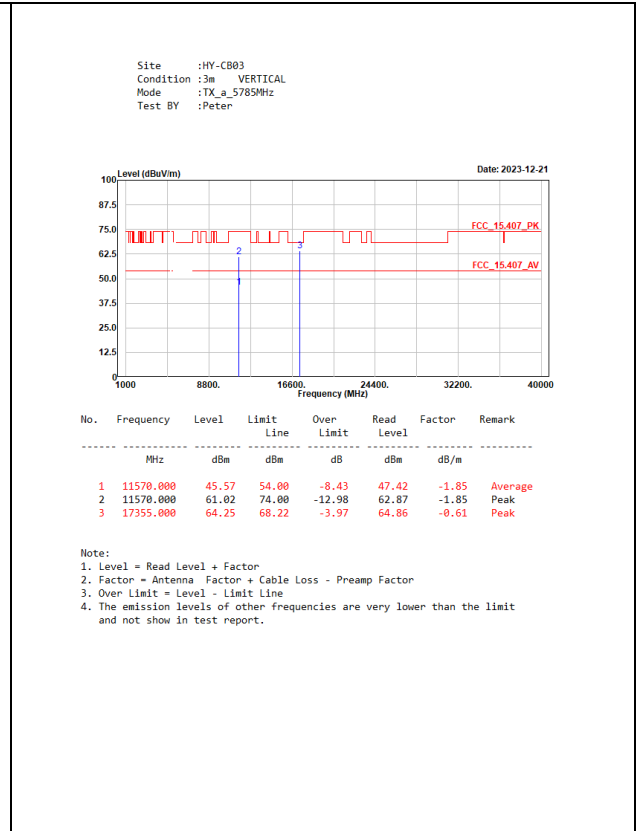
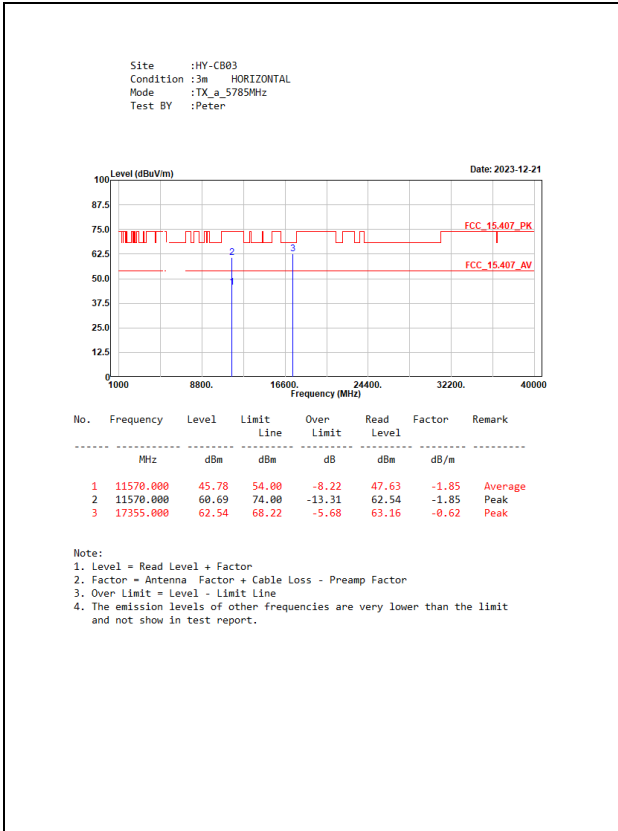
5 GHz band	Duty Cycle (%)	T (ms)	1/T (Hz)	VBW (Hz)
802.11a	98.62	1.4250	702	10
802.11ac-20 MHz	98.53	1.3450	743	10
802.11ac-40 MHz	97.08	0.6650	1504	2000
802.11ac-80 MHz	92.86	0.3250	3077	5000
802.11ax-20 MHz	98.11	1.0400	962	10
802.11ax-40 MHz	96.49	0.5500	1818	2000
802.11ax-80 MHz	93.44	0.2850	3509	5000

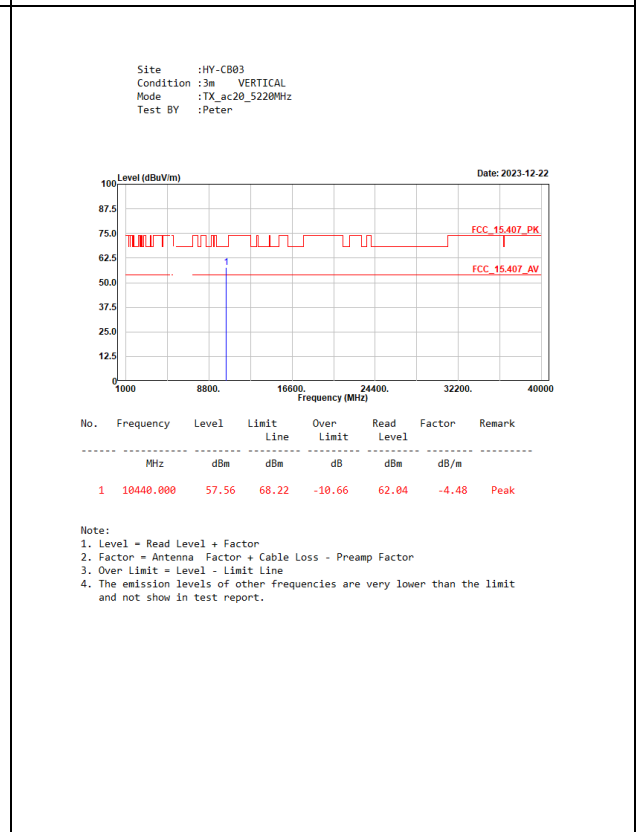
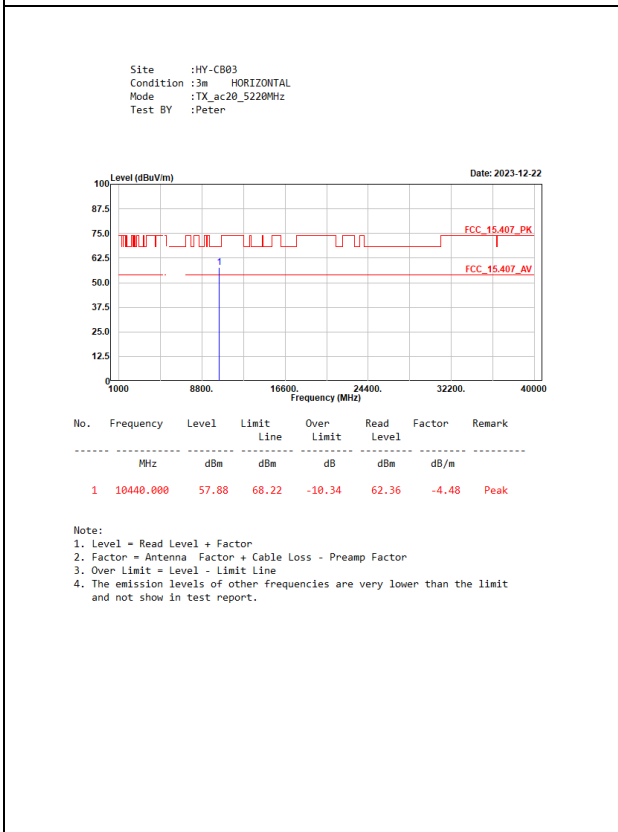
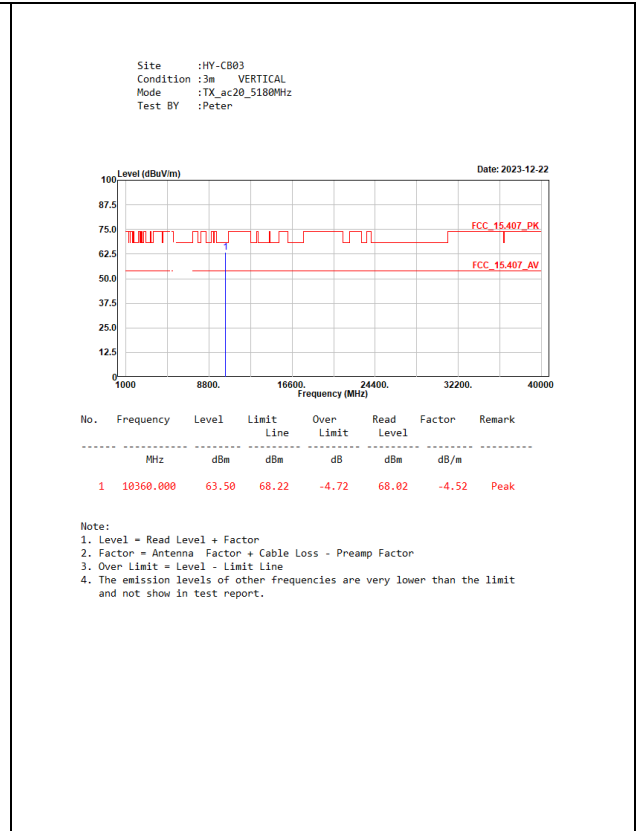
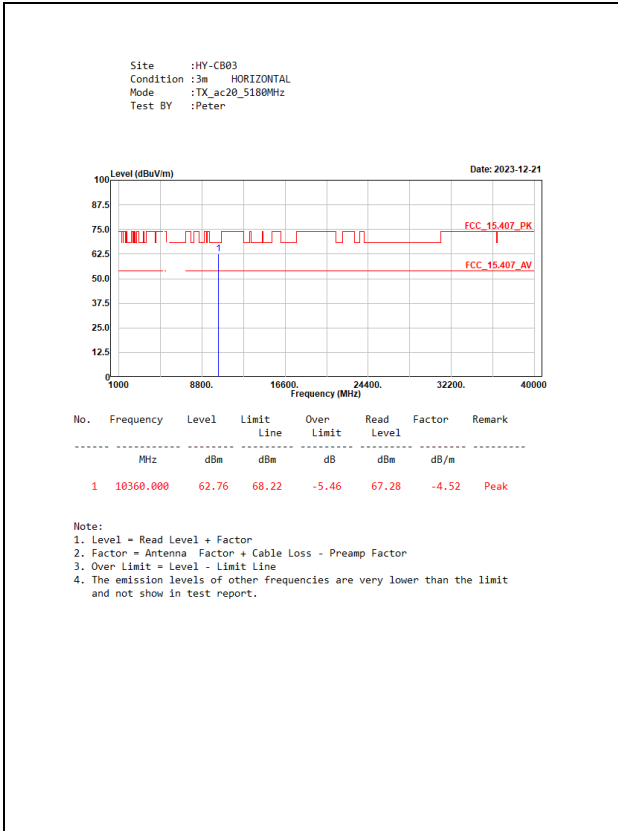
Note: Duty Cycle Refer to Section 8.

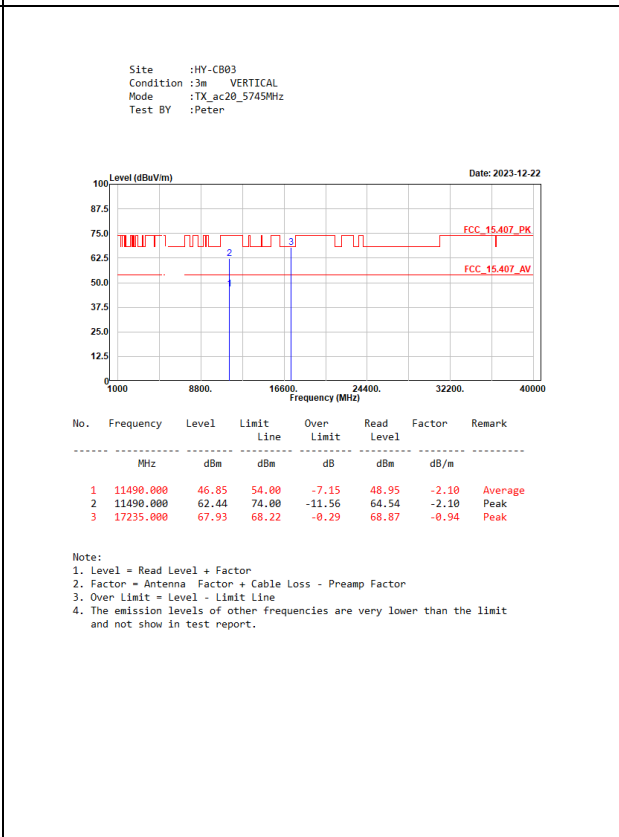
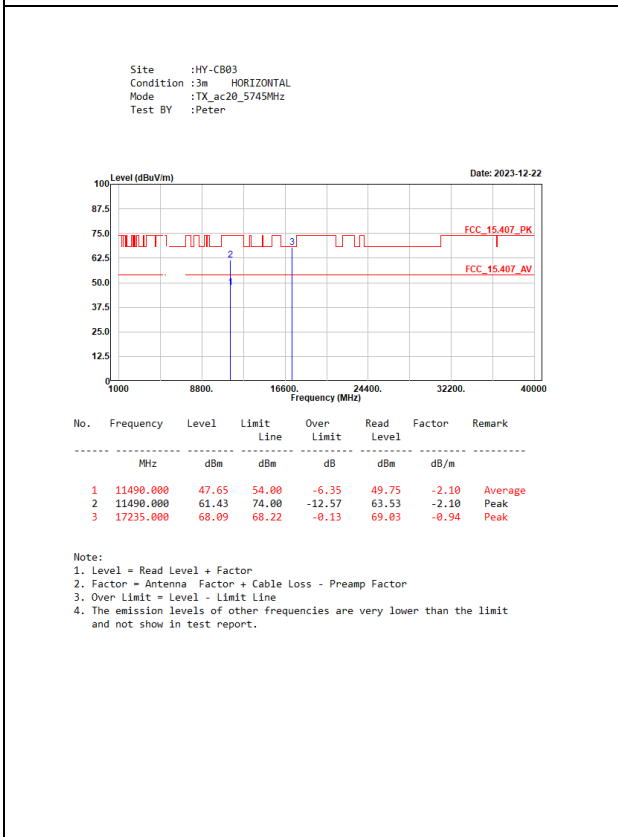
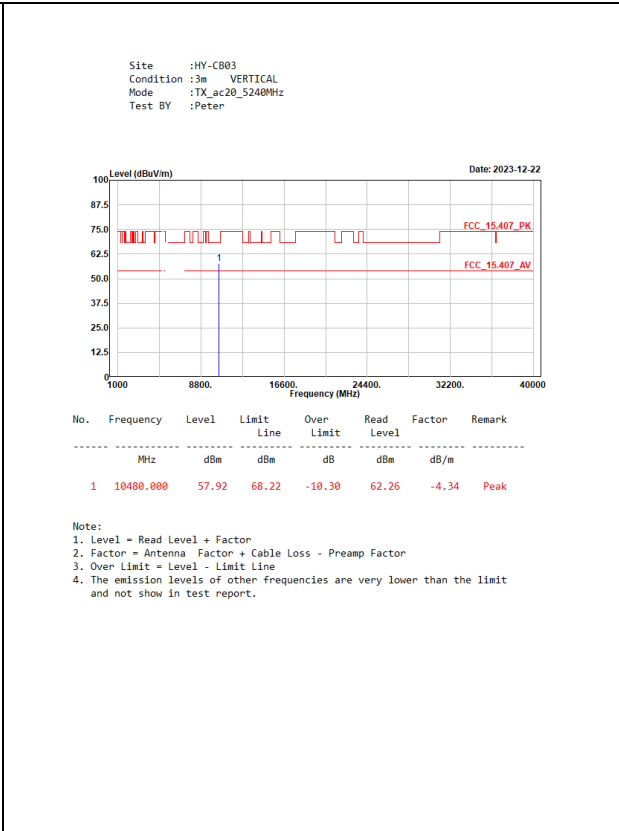
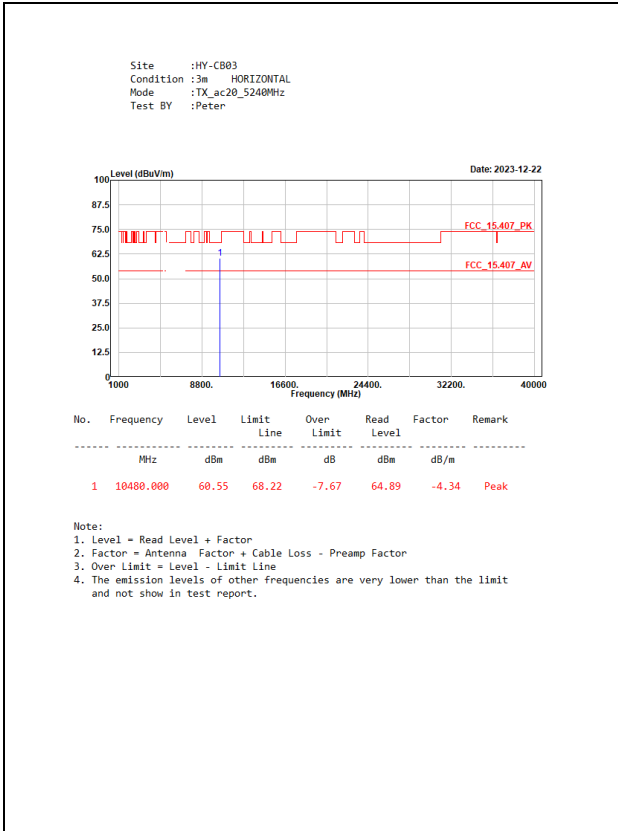
5.4. Test Result of Radiated Emission

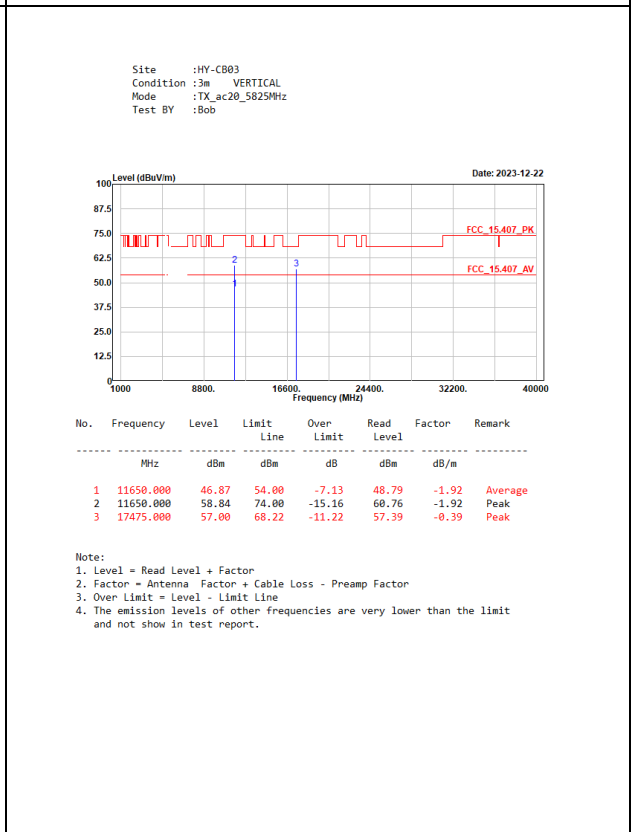
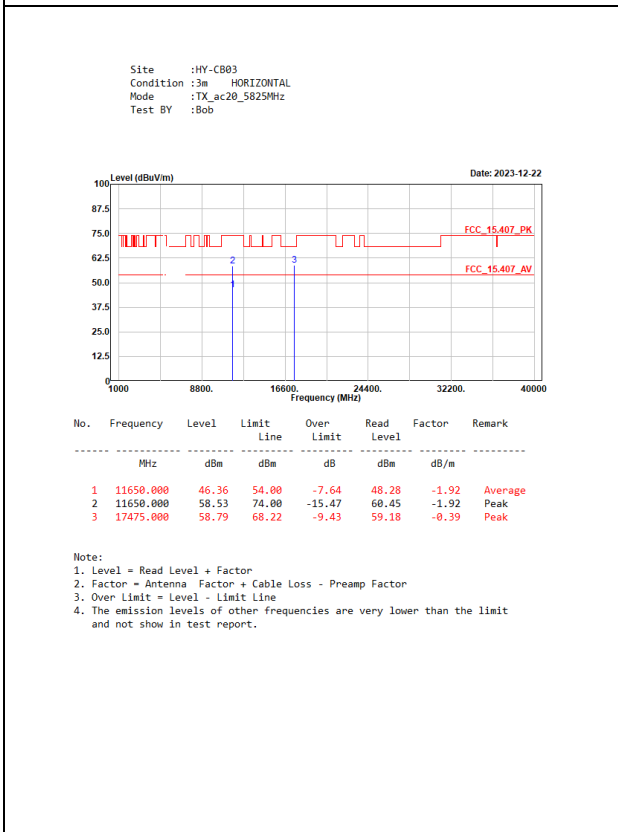
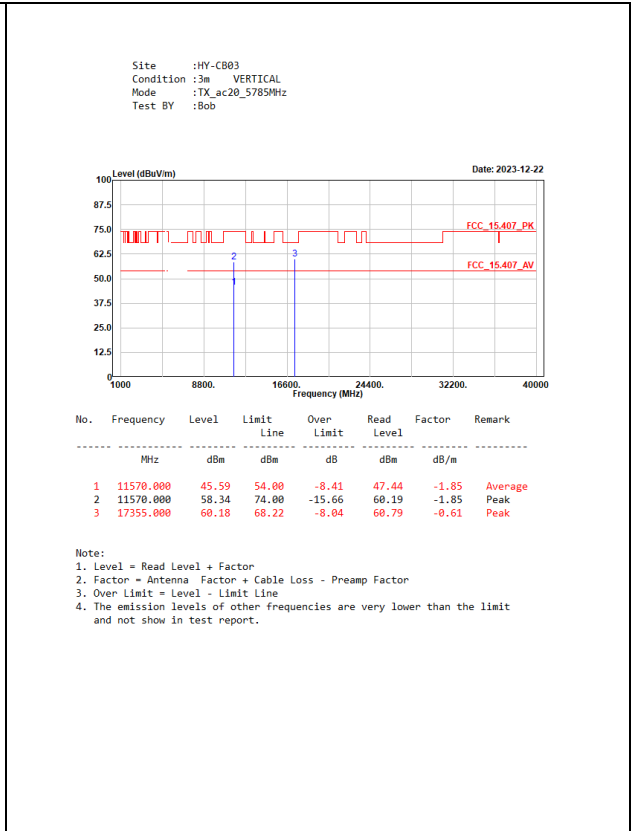
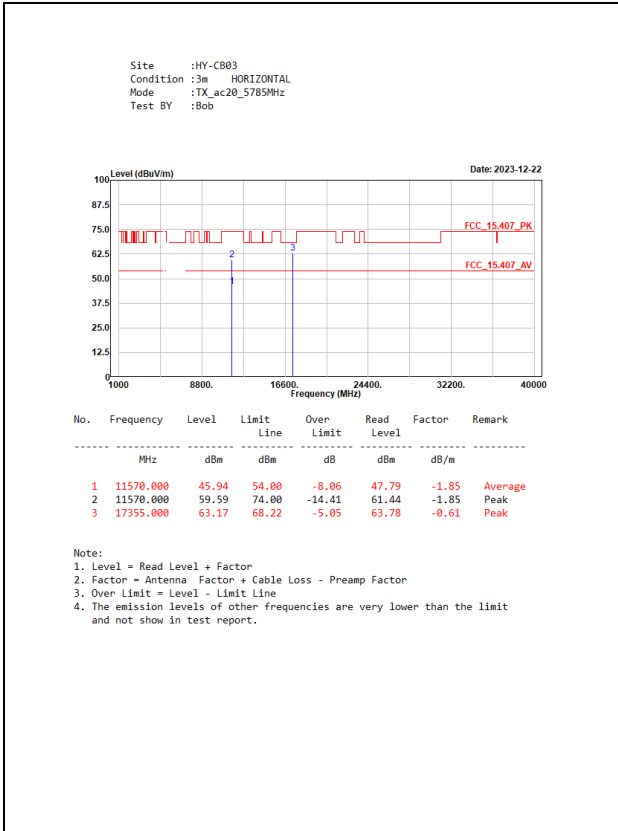


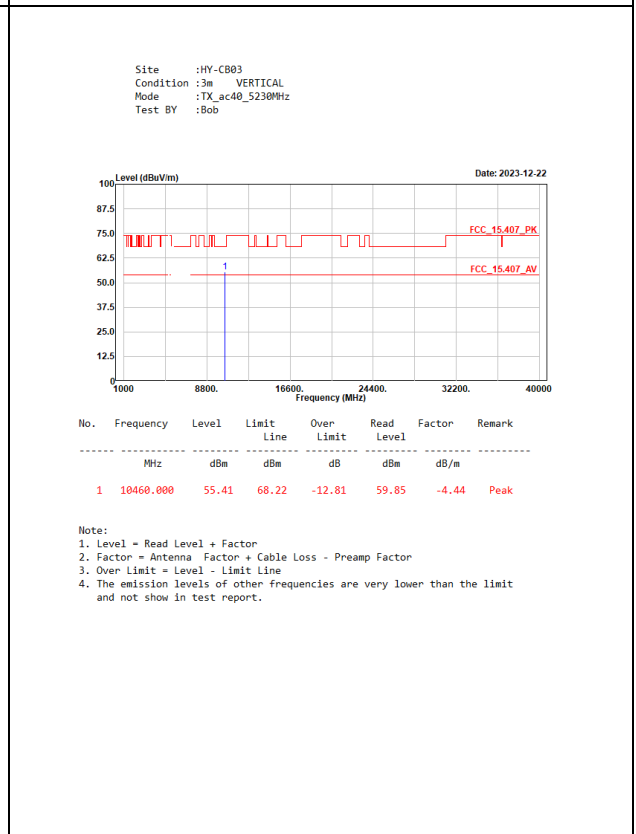
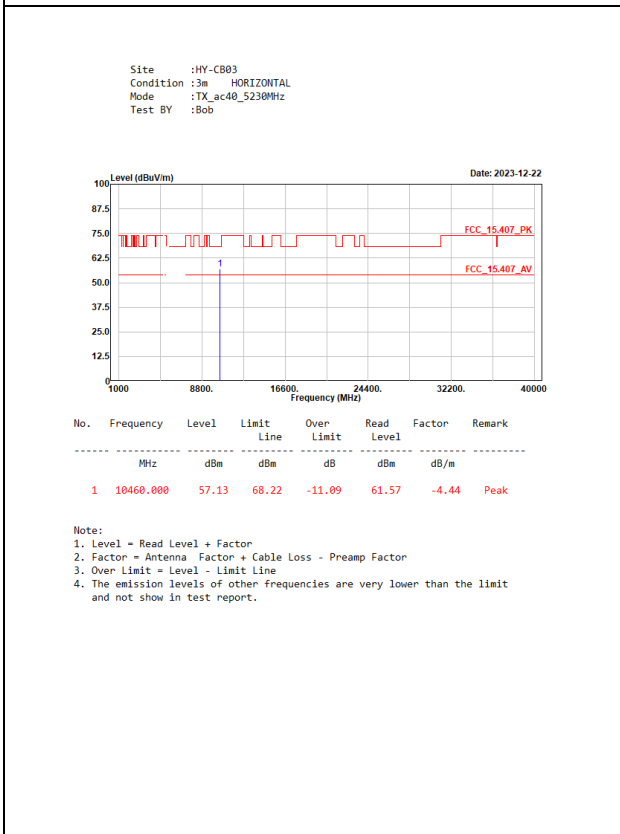
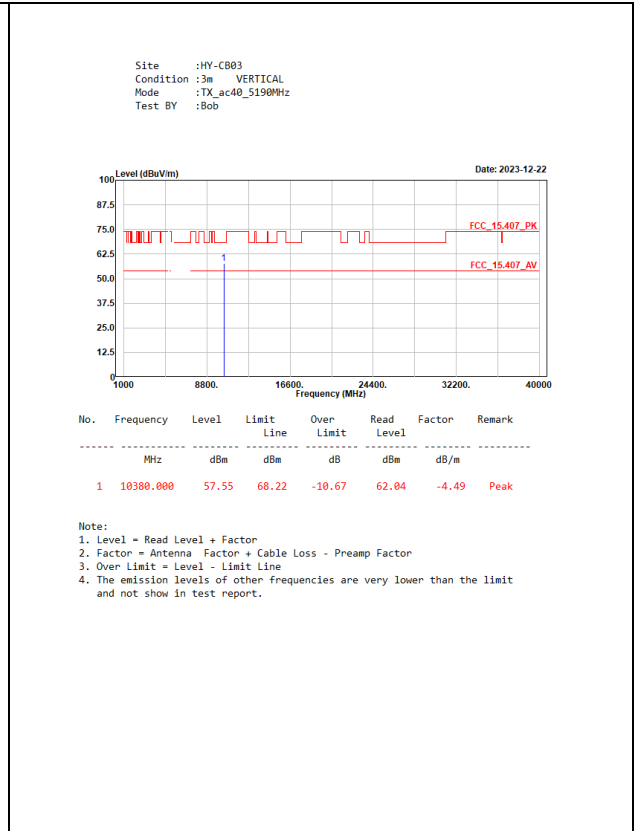
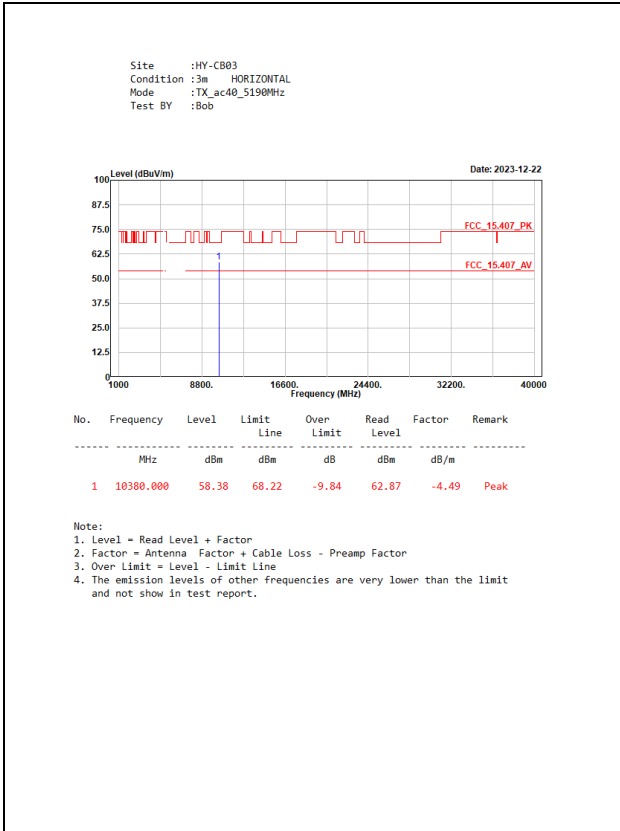


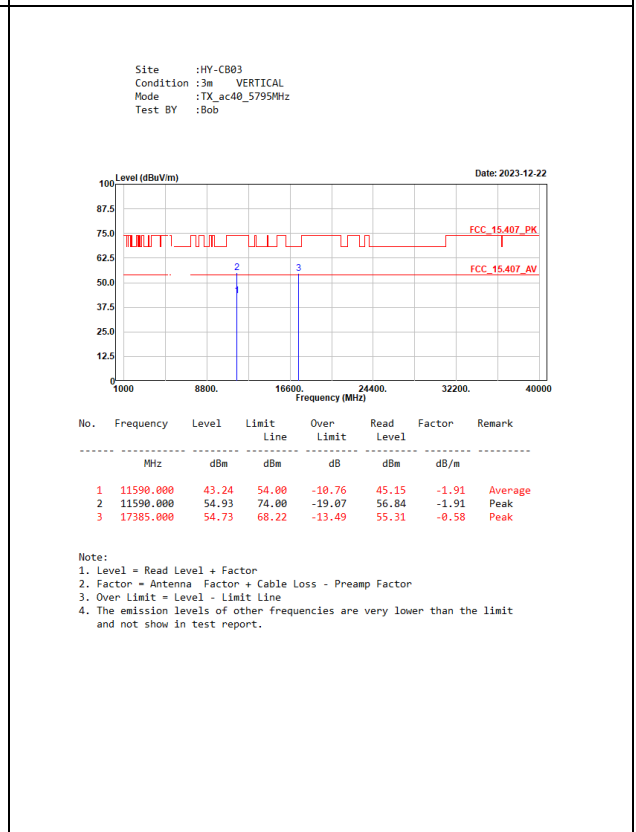
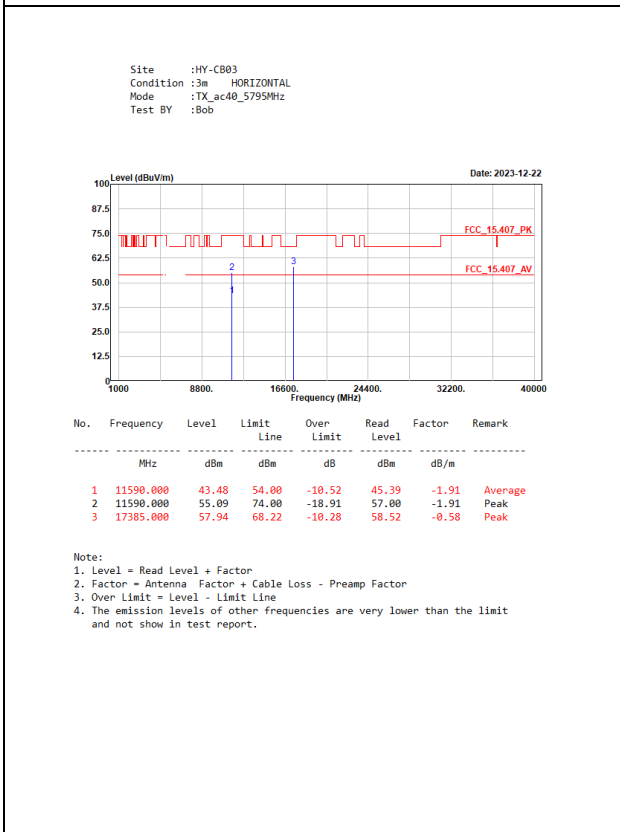
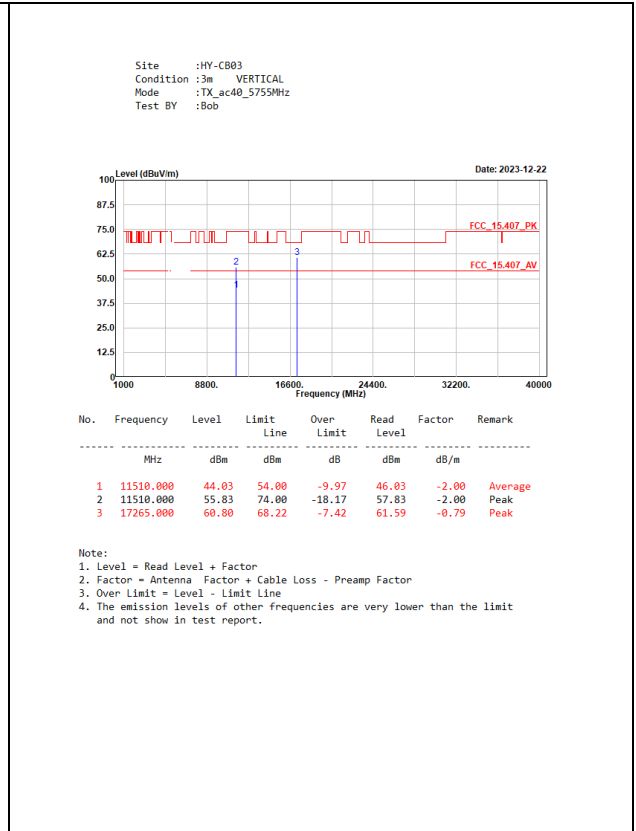
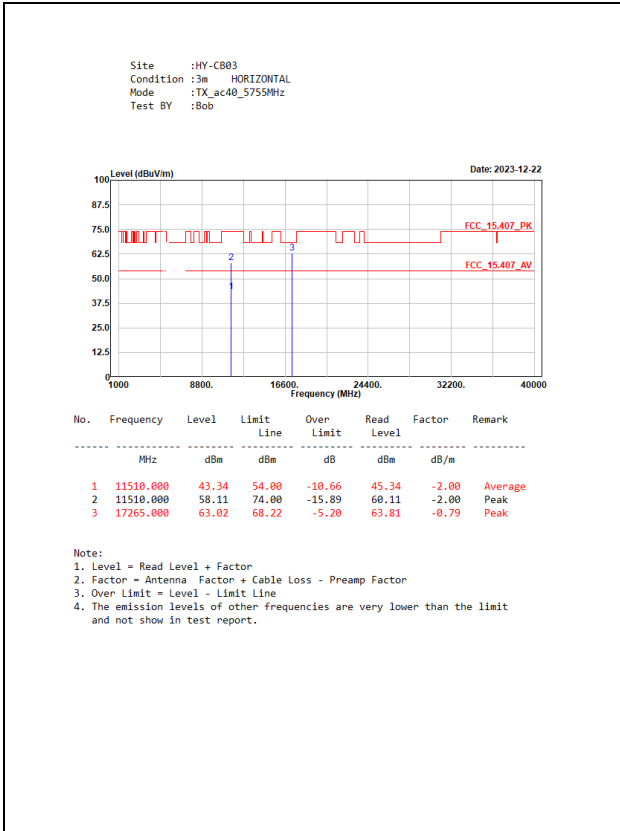


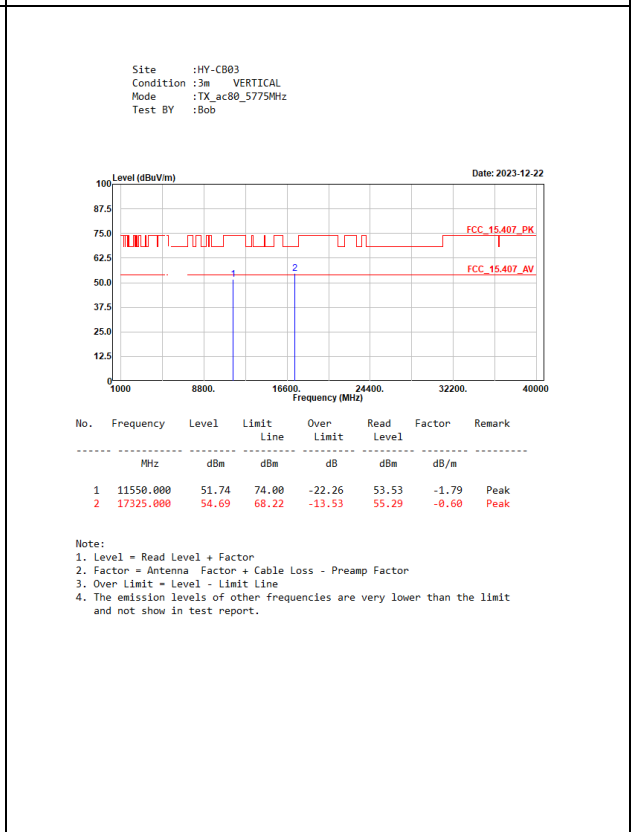
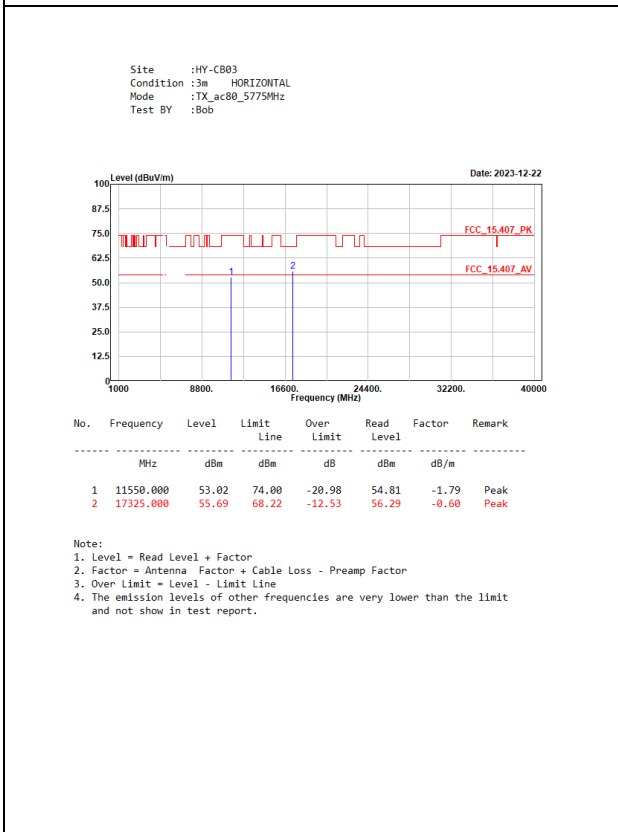
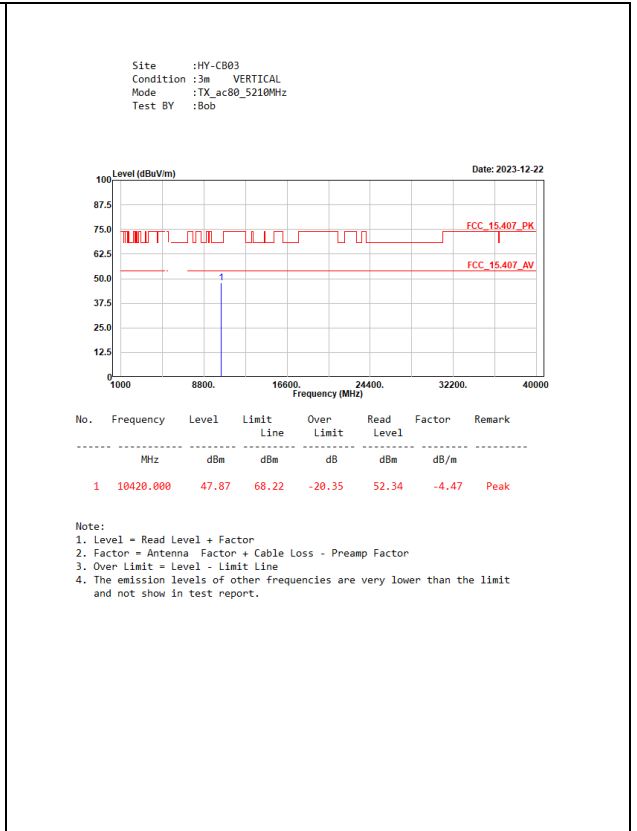
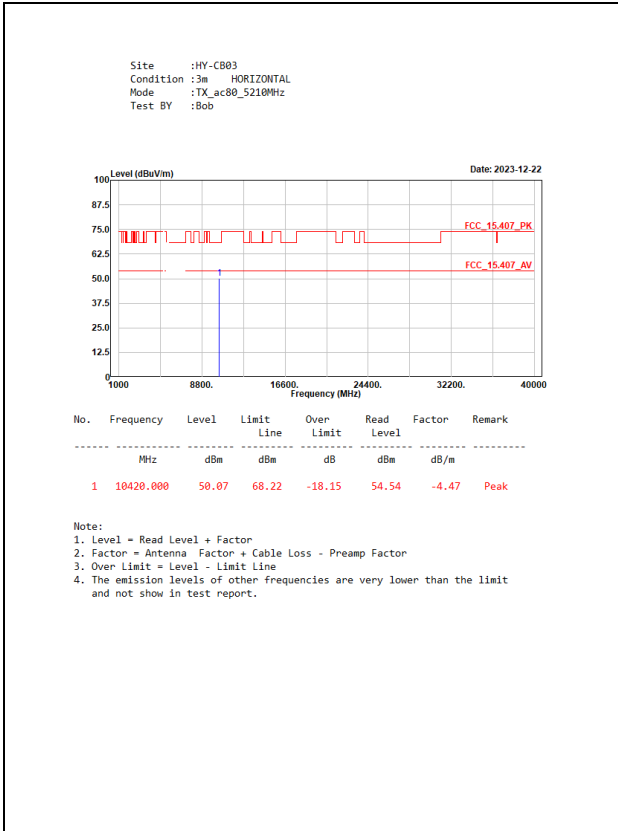


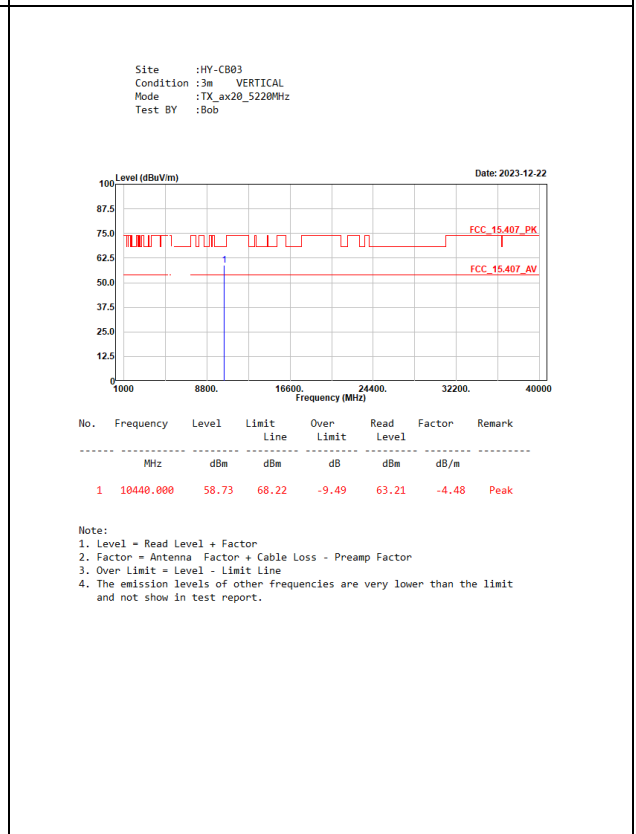
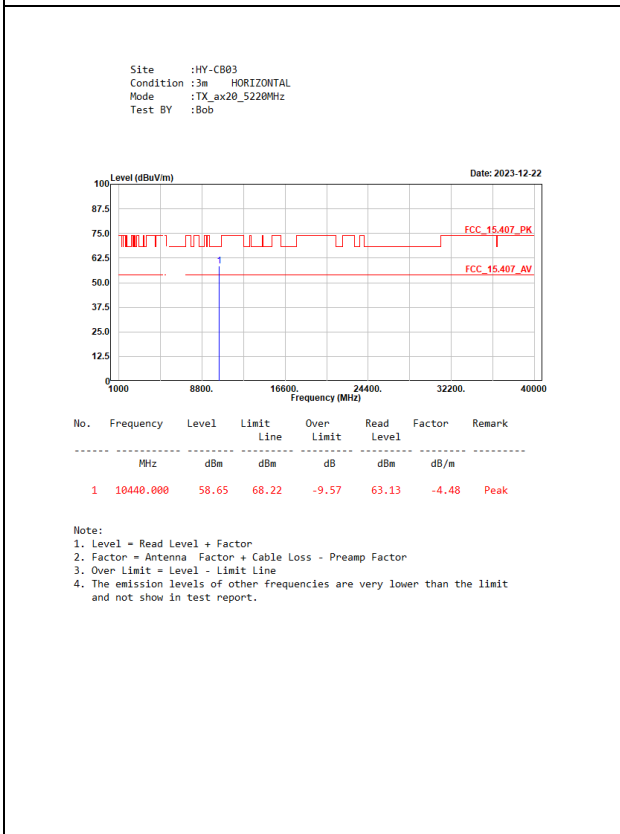
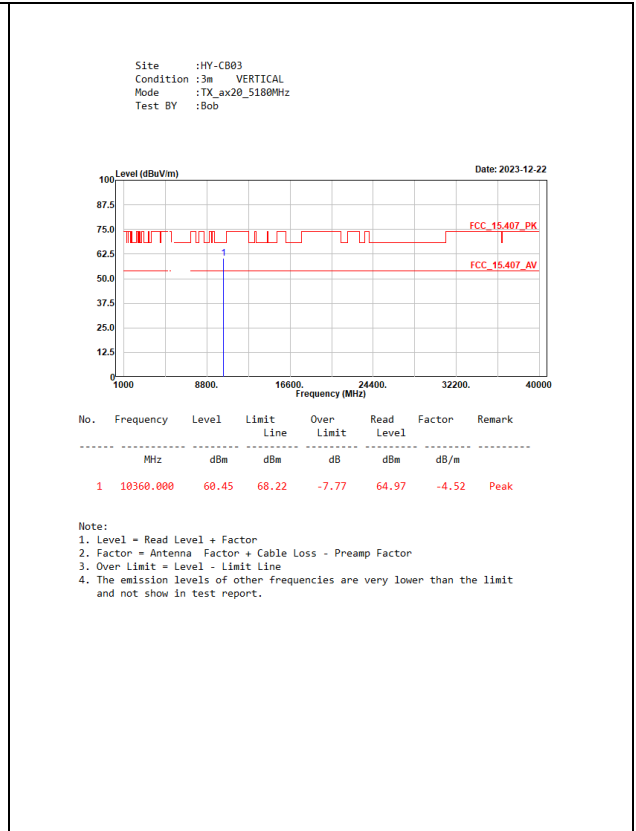
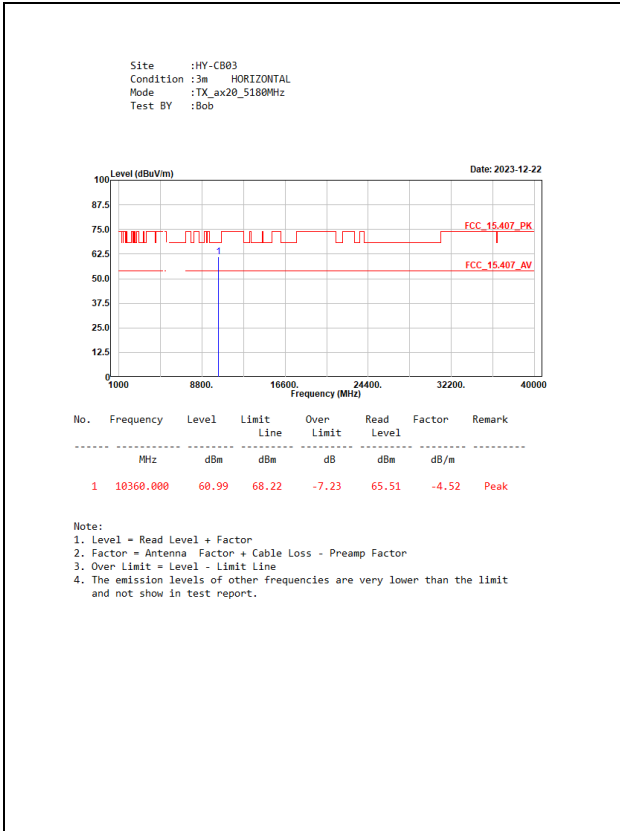


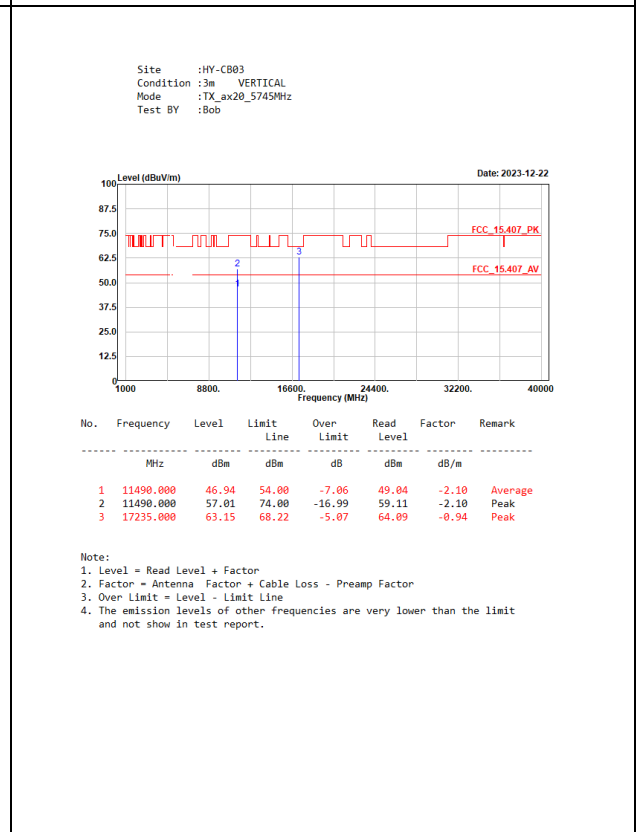
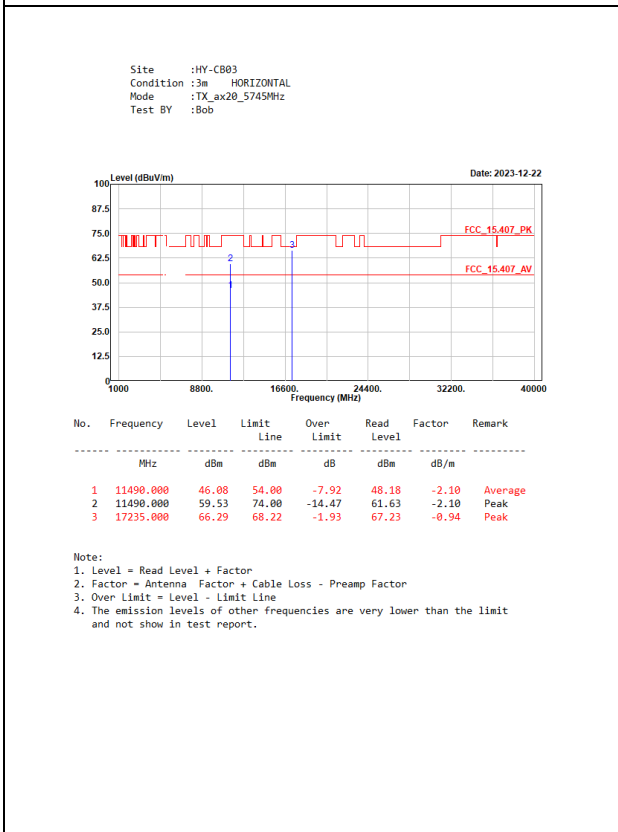
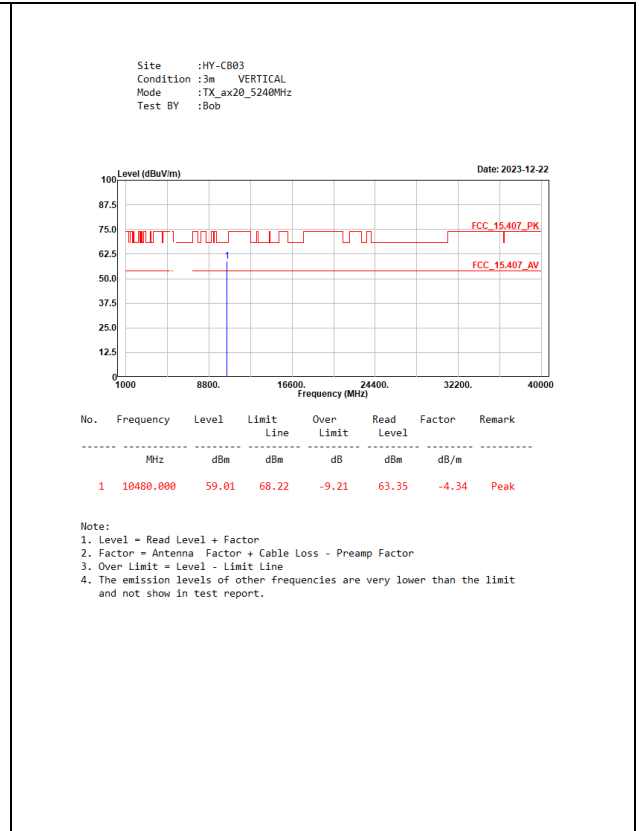
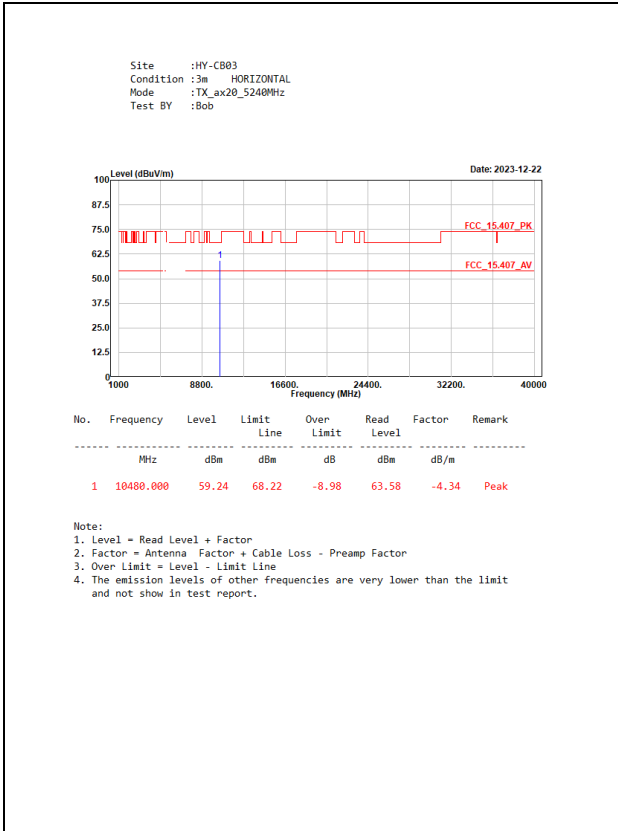


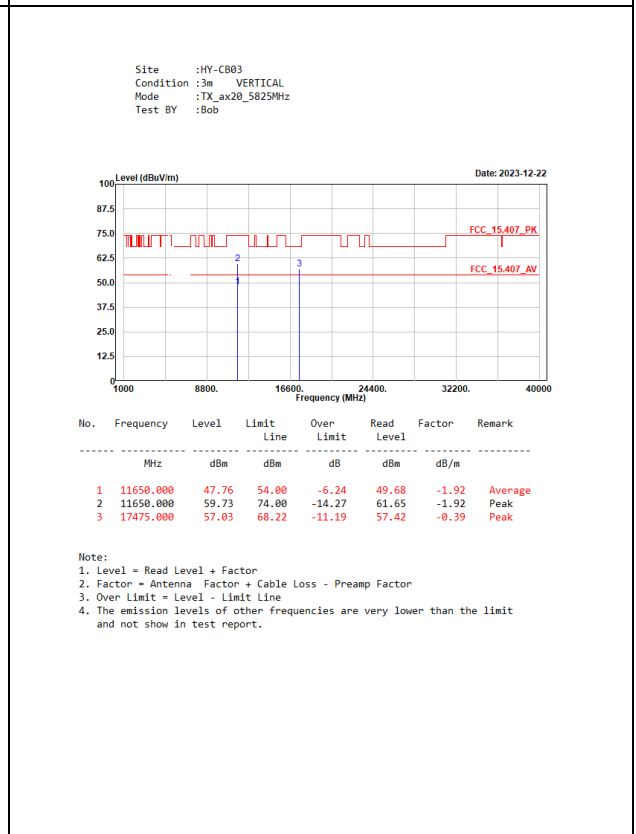
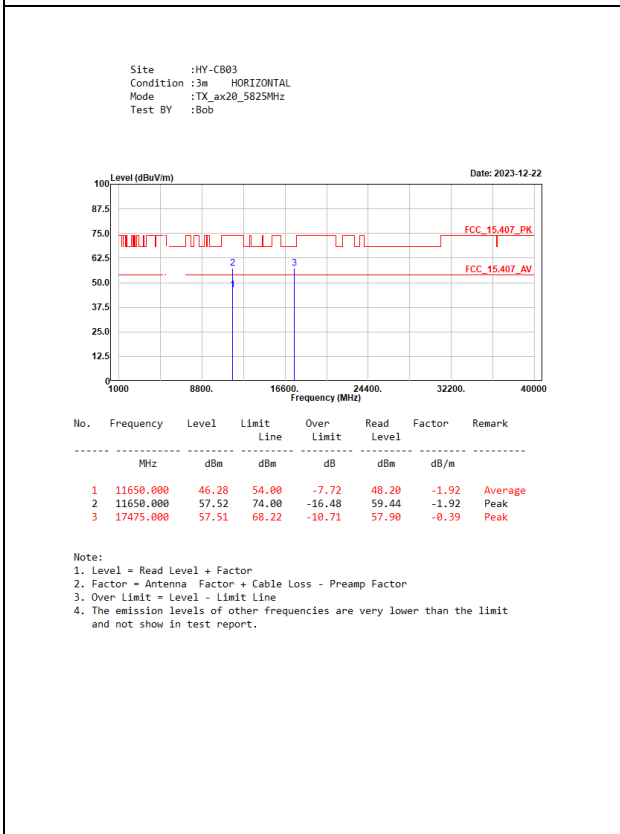
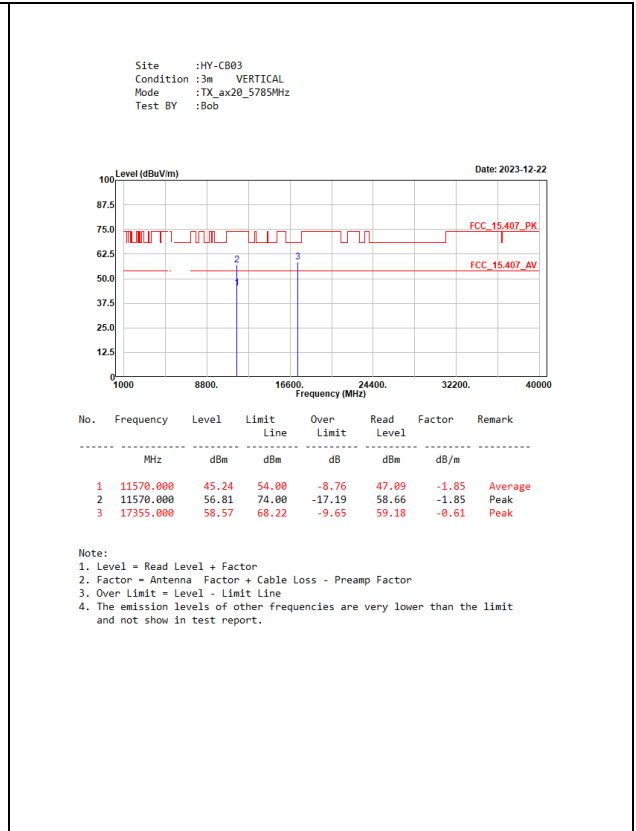
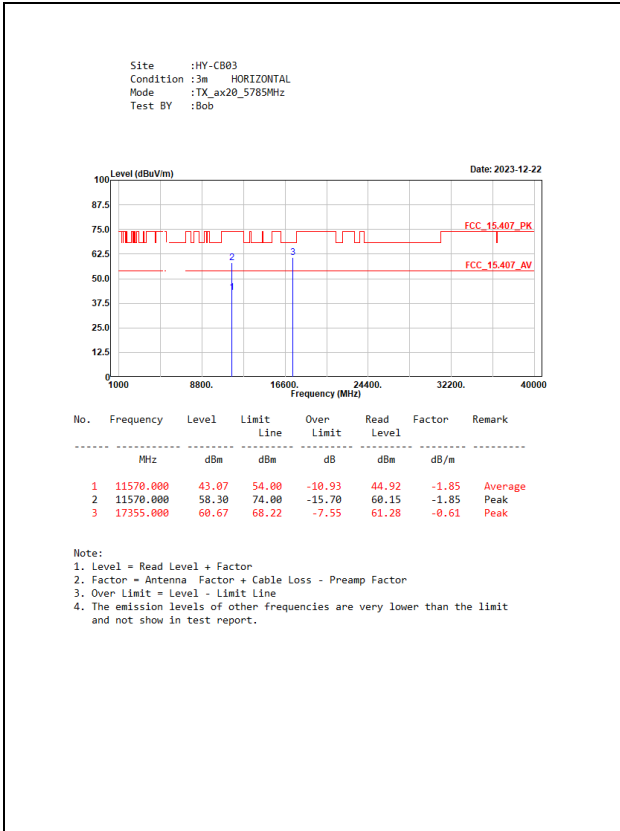


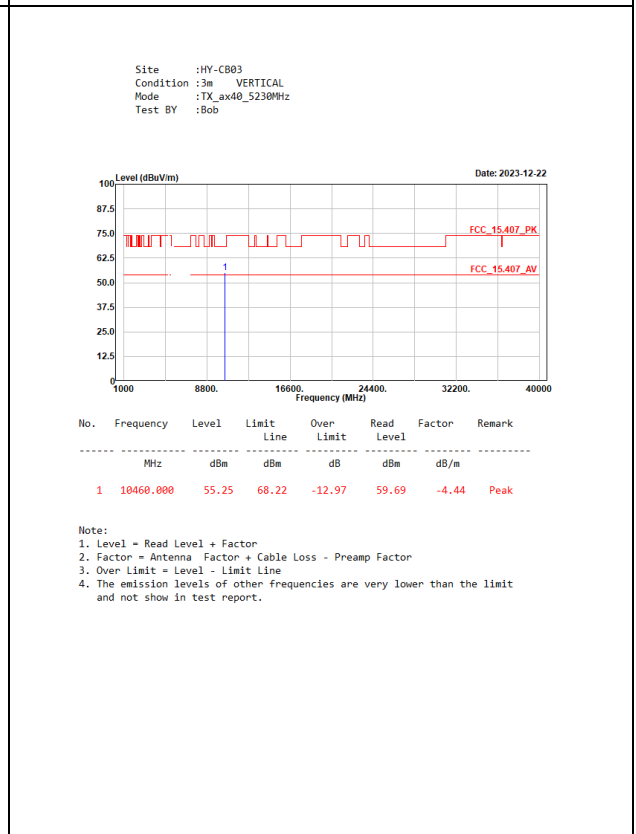
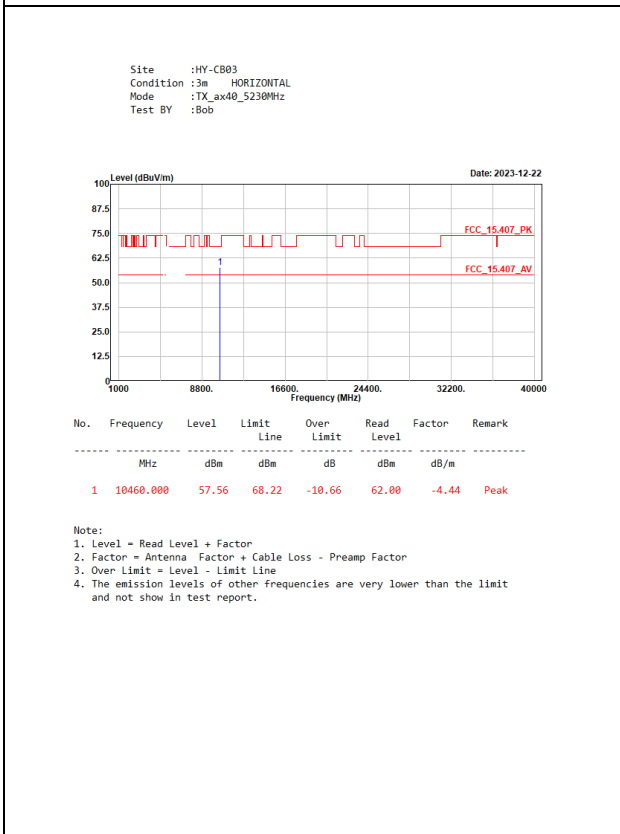
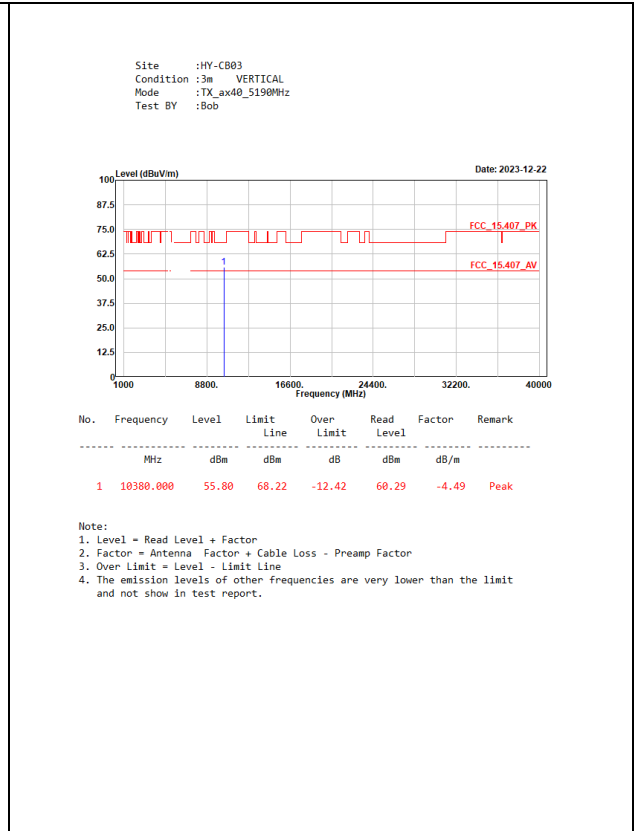
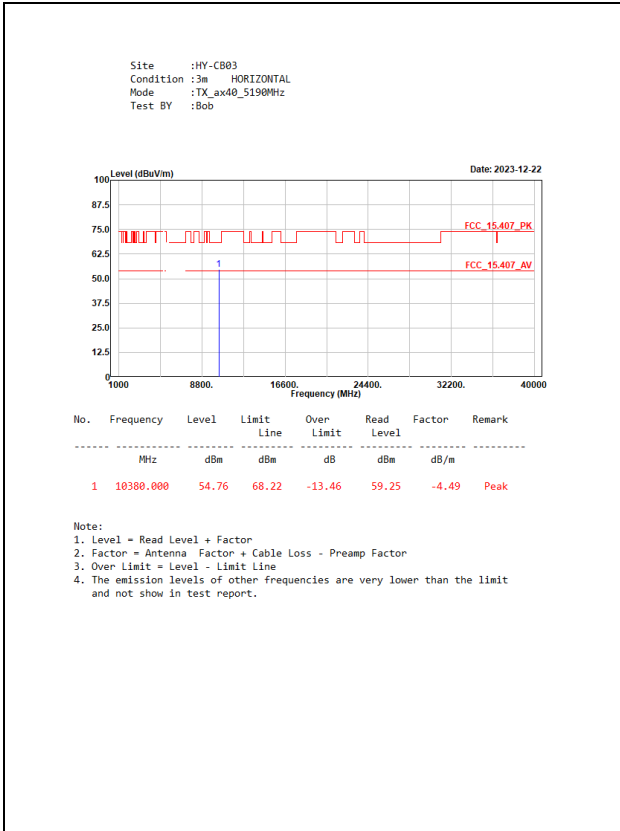


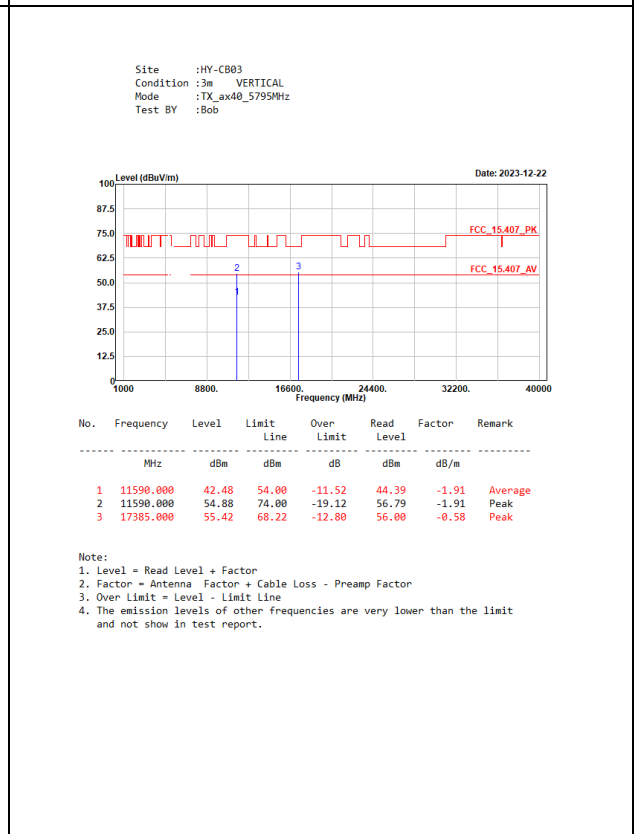
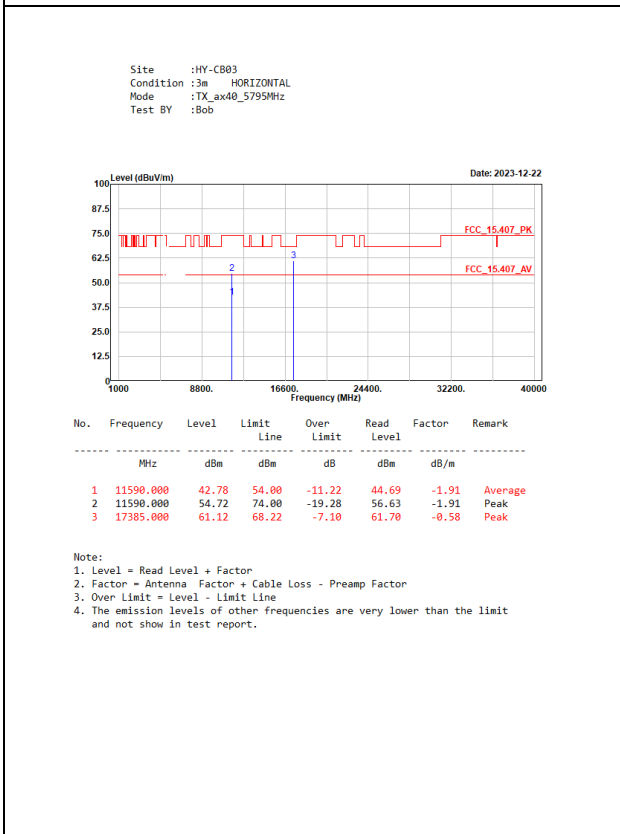
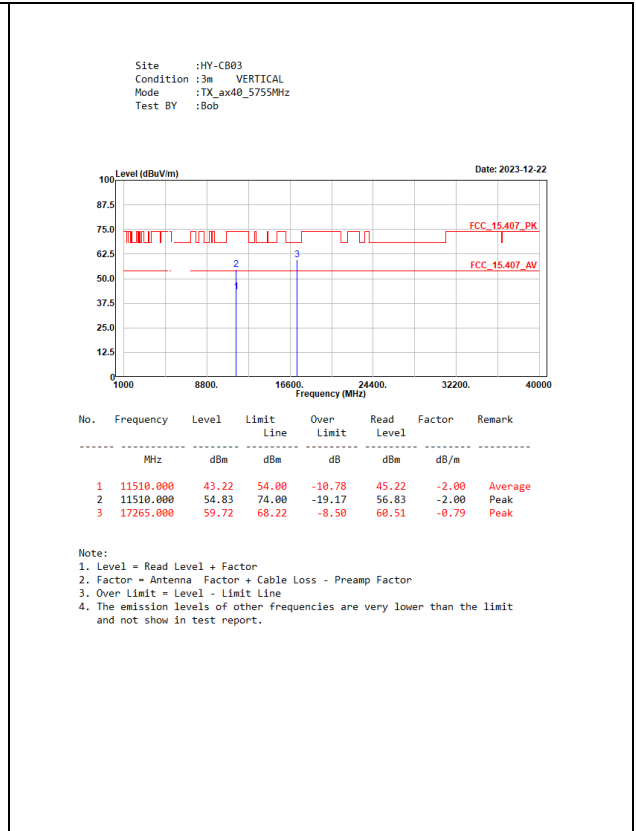
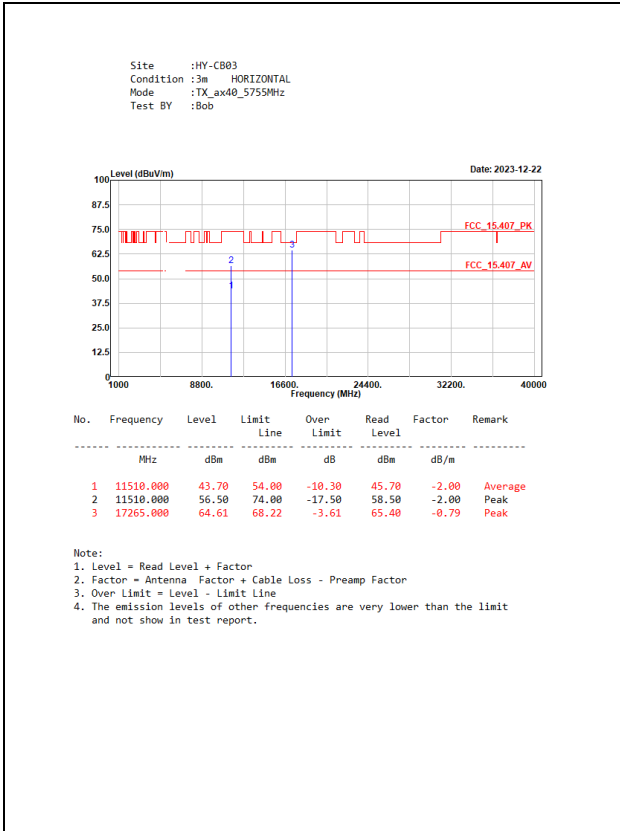


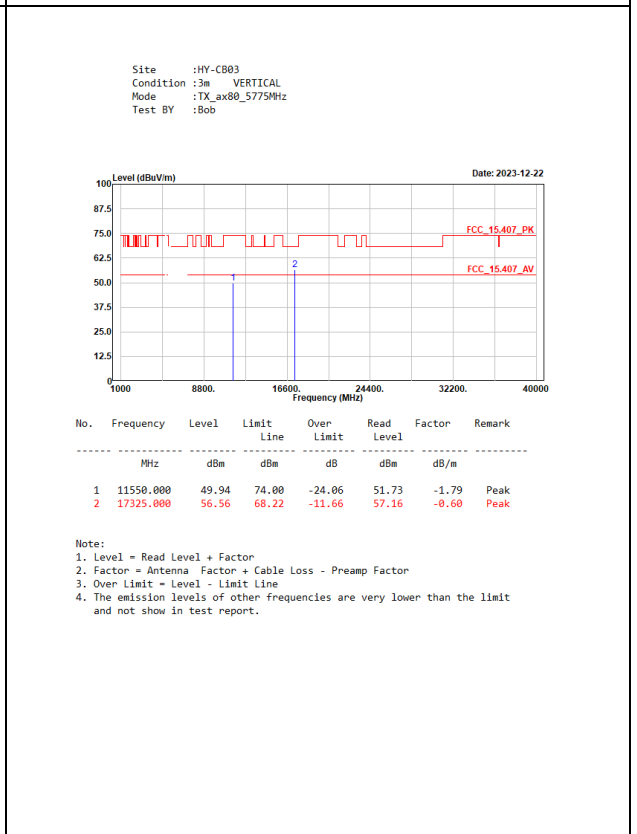
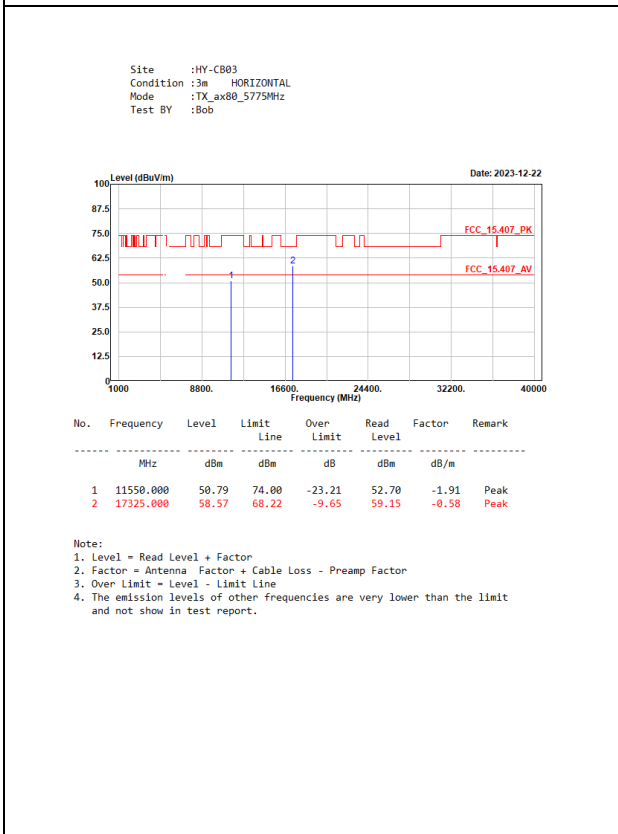
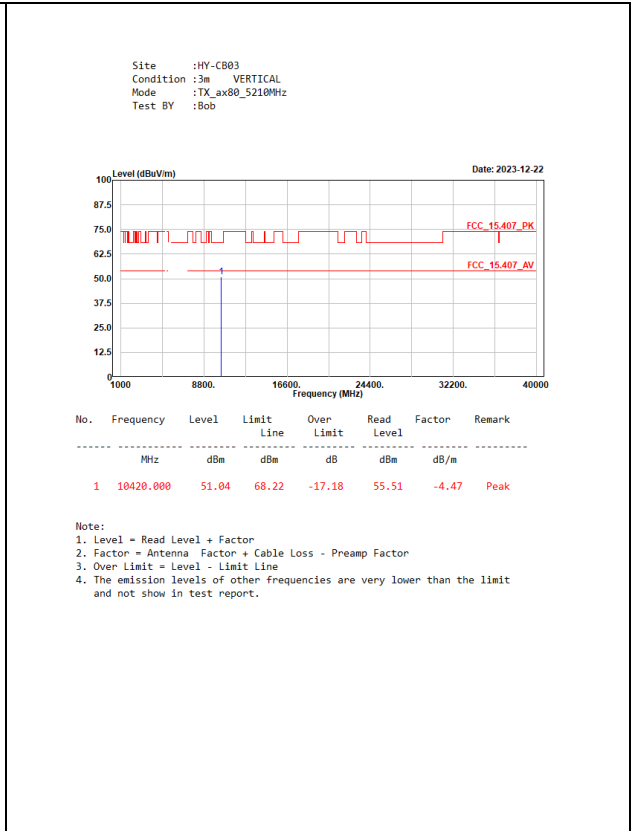
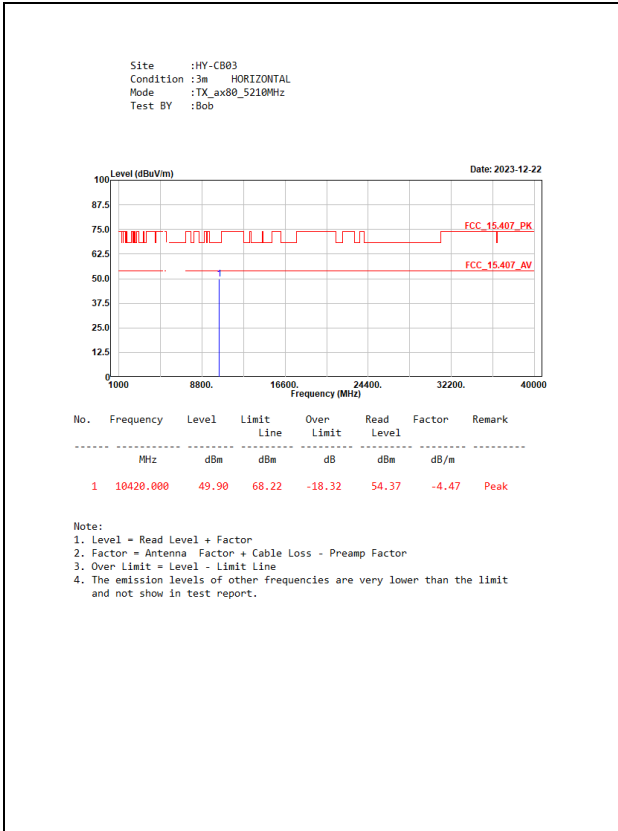


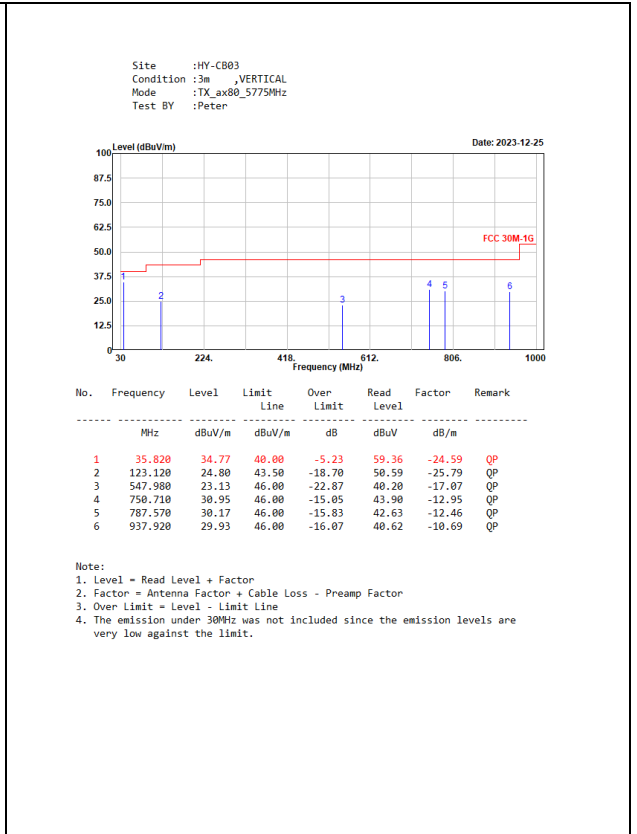
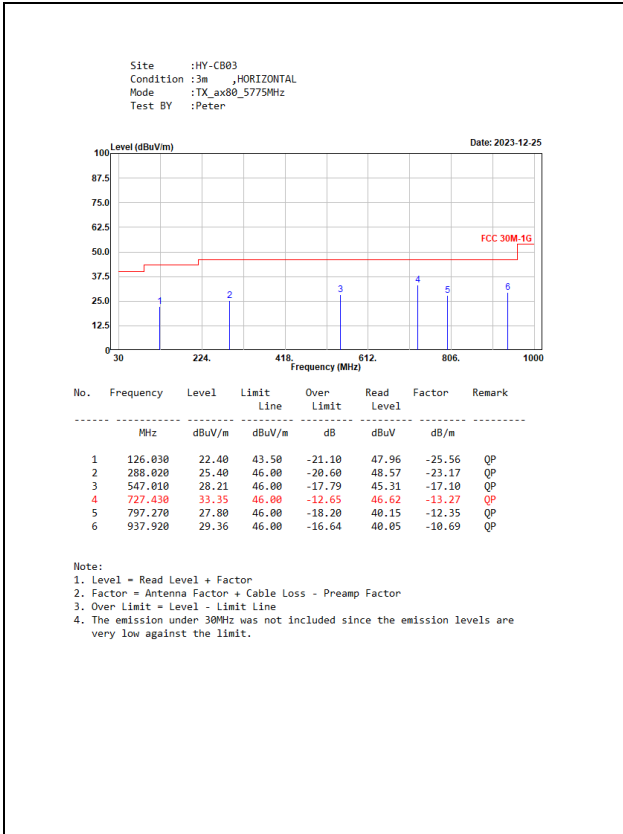








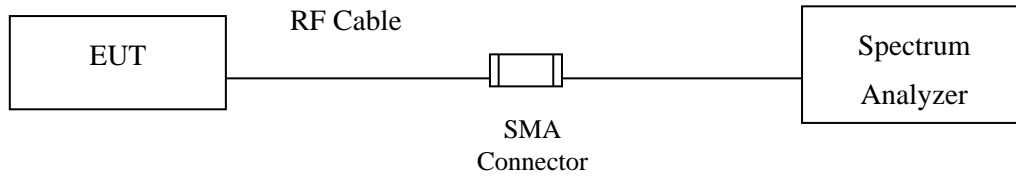




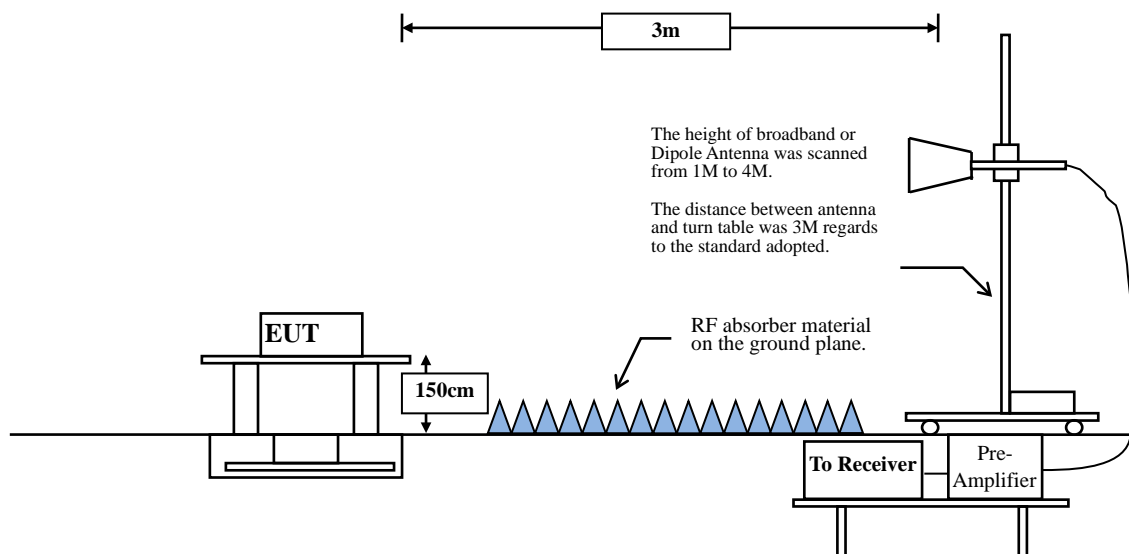
6. Band Edge

6.1. Test Setup

RF Conducted Measurement:



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	$\mu\text{V/m}$ @3m	$\text{dB}\mu\text{V/m}$ @3m
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

- Remarks :
1. RF Voltage ($\text{dB}\mu\text{V}$) = $20 \log$ RF Voltage (μV)
 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.
- 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.
 - 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.
 - 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.
 - For transmitters operating in the 5.725-5.85 GHz band:
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.
 - For transmitters operating within the 5.925-7.125 GHz band: Any emissions outside of the 5.925-7.125 GHz band must not exceed an e.i.r.p. of -27 dBm/MHz.

Based on ANSI C63.10-2013 Section 12.7.3 d) provides the conversion formula between field strength and EIRP, if distance is 3m, -27 dBm is equivalent to 68.22dBuV/m.

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 1 GHz setting on the field strength meter is 120 kHz, above 1 GHz 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 %

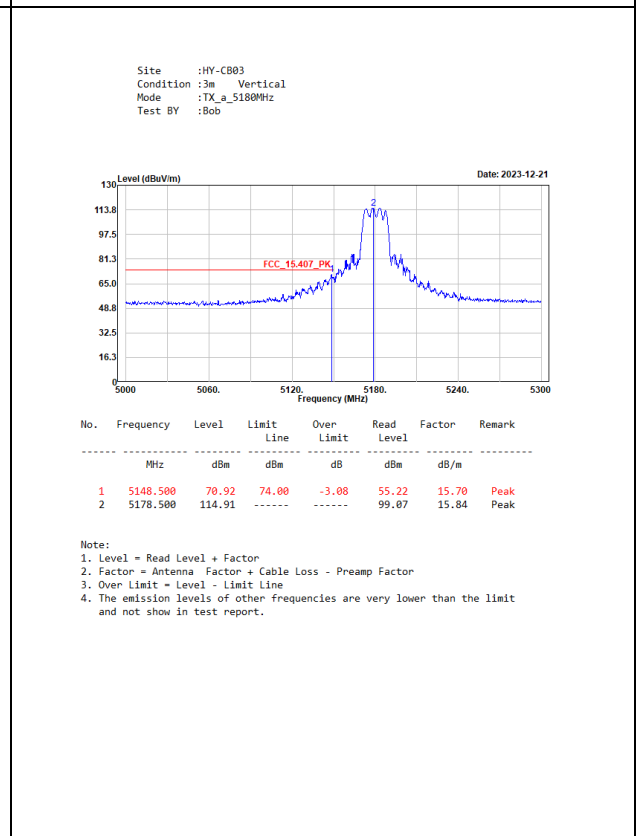
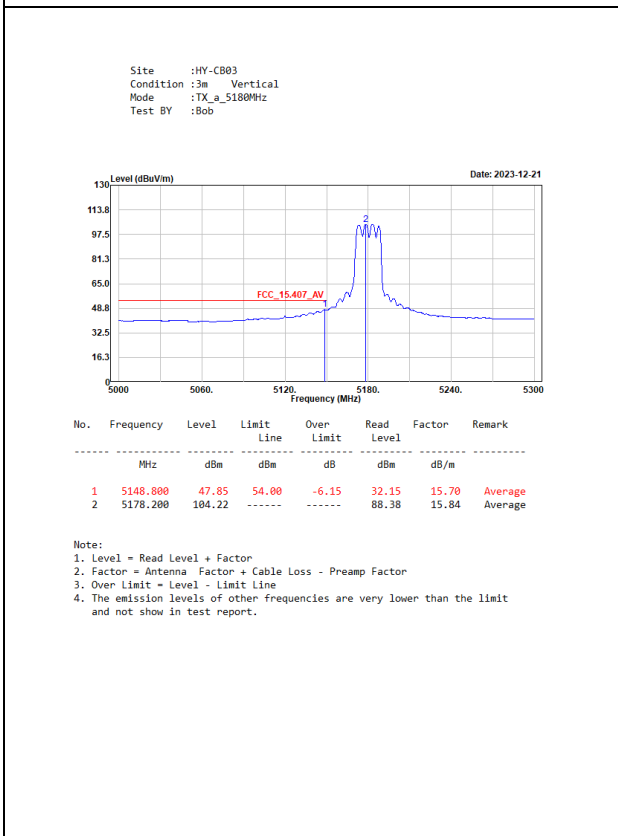
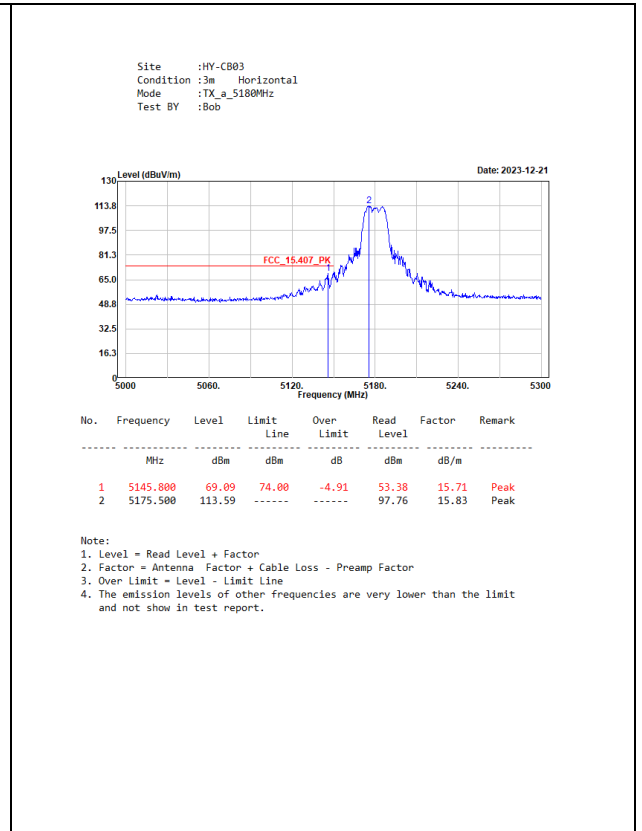
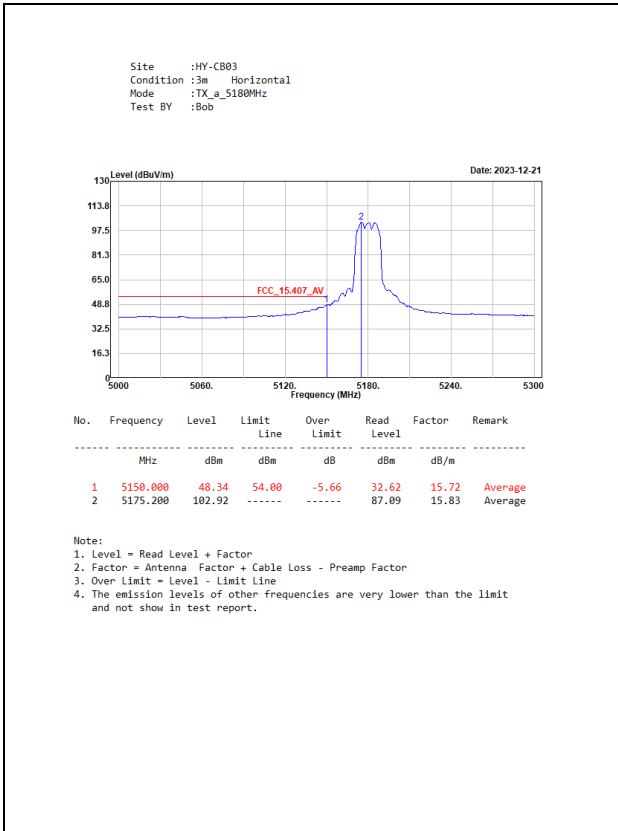
VBW \geq 1/T, when duty cycle < 98 %

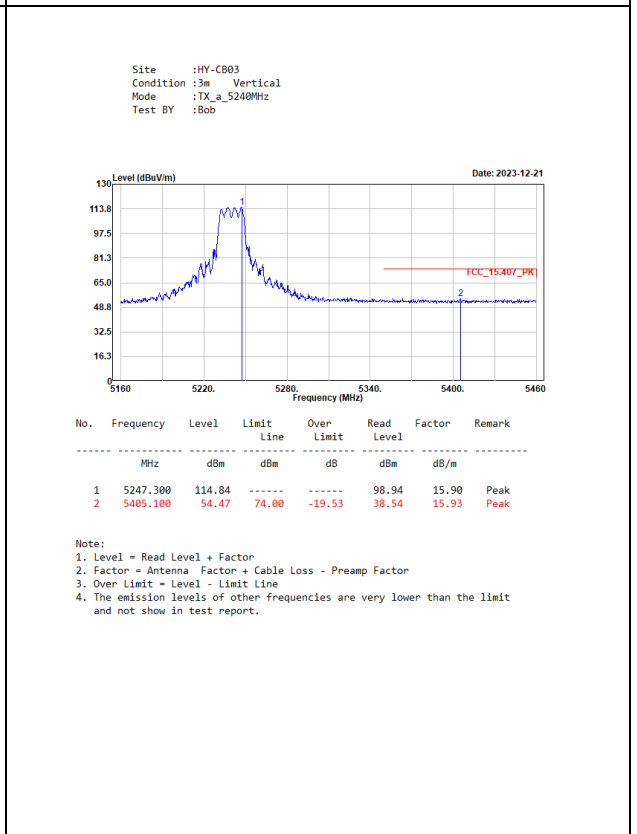
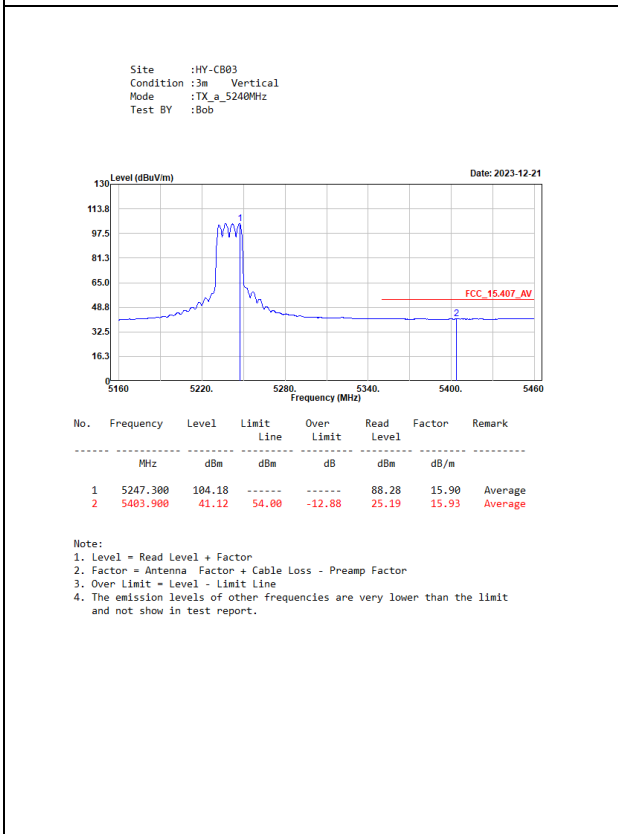
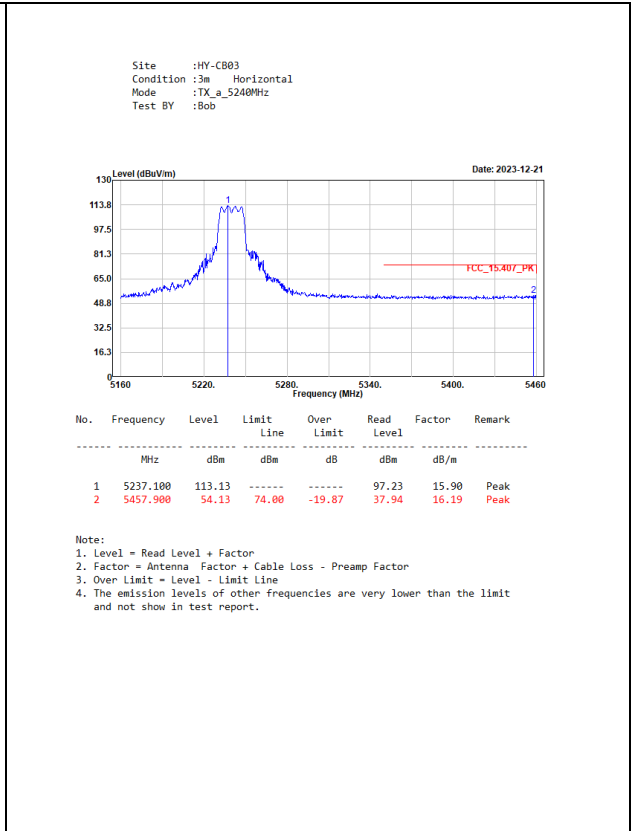
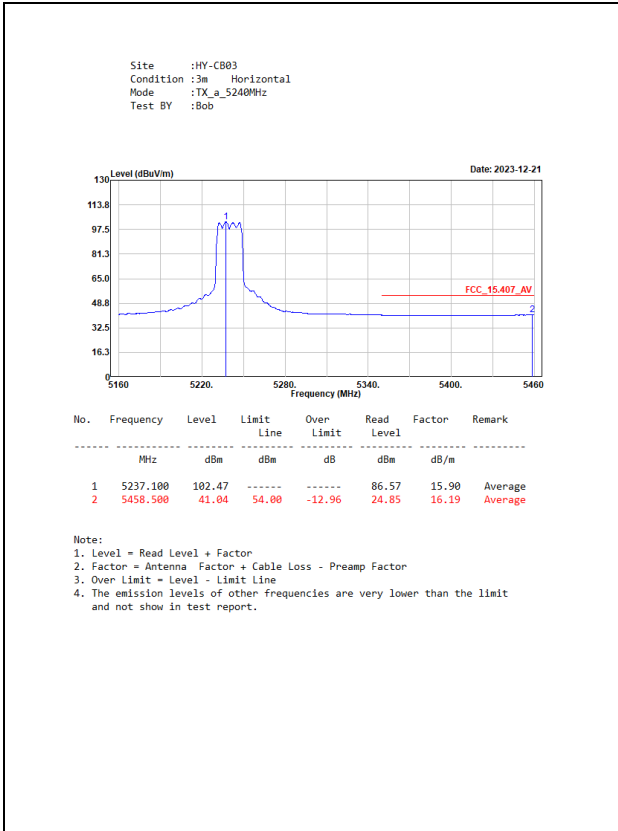
(T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

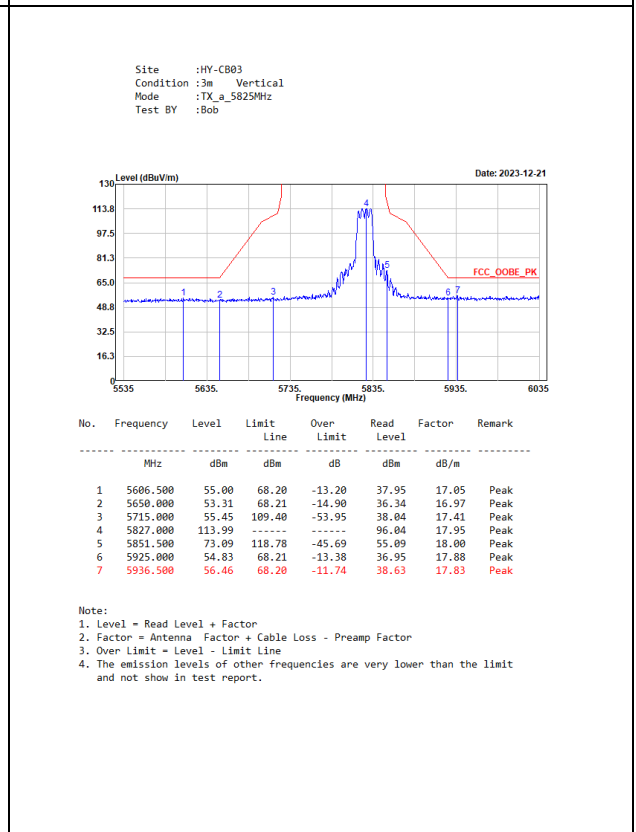
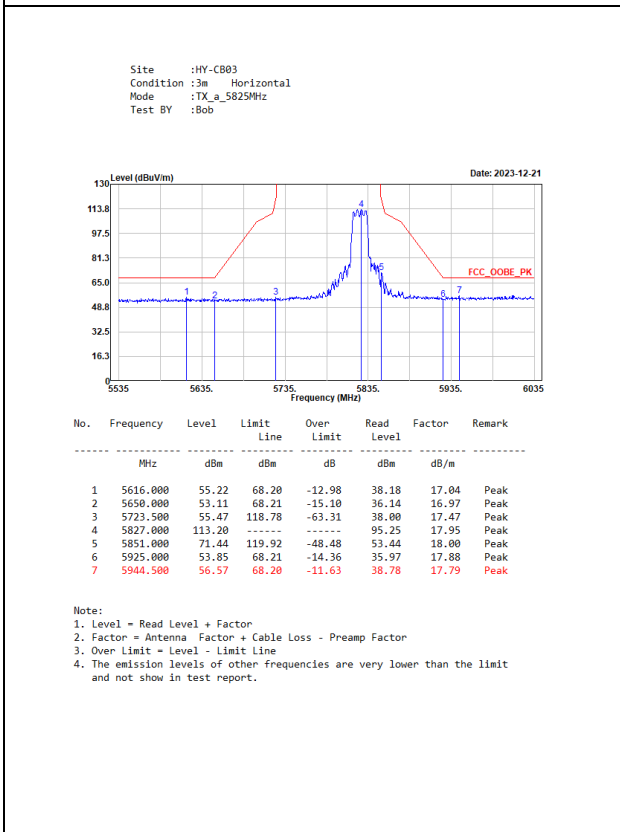
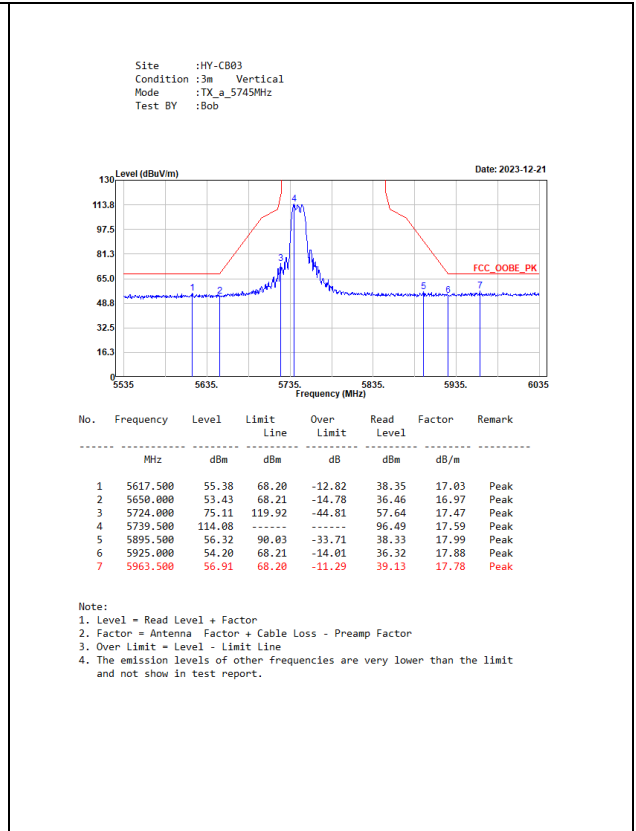
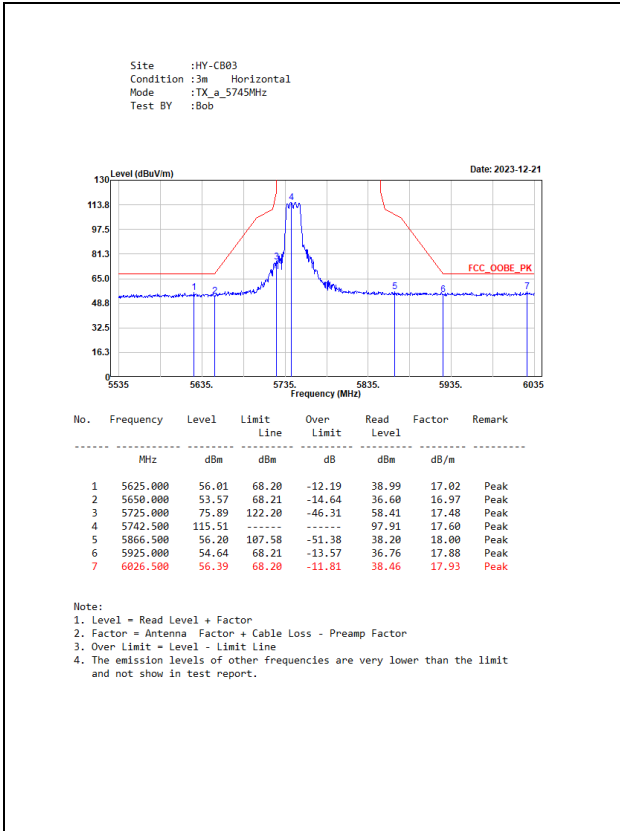
5 GHz band	Duty Cycle (%)	T (ms)	1/T (Hz)	VBW (Hz)
802.11a	98.62	1.4250	702	10
802.11ac-20 MHz	98.53	1.3450	743	10
802.11ac-40 MHz	97.08	0.6650	1504	2000
802.11ac-80 MHz	92.86	0.3250	3077	5000
802.11ax-20 MHz	98.11	1.0400	962	10
802.11ax-40 MHz	96.49	0.5500	1818	2000
802.11ax-80 MHz	93.44	0.2850	3509	5000

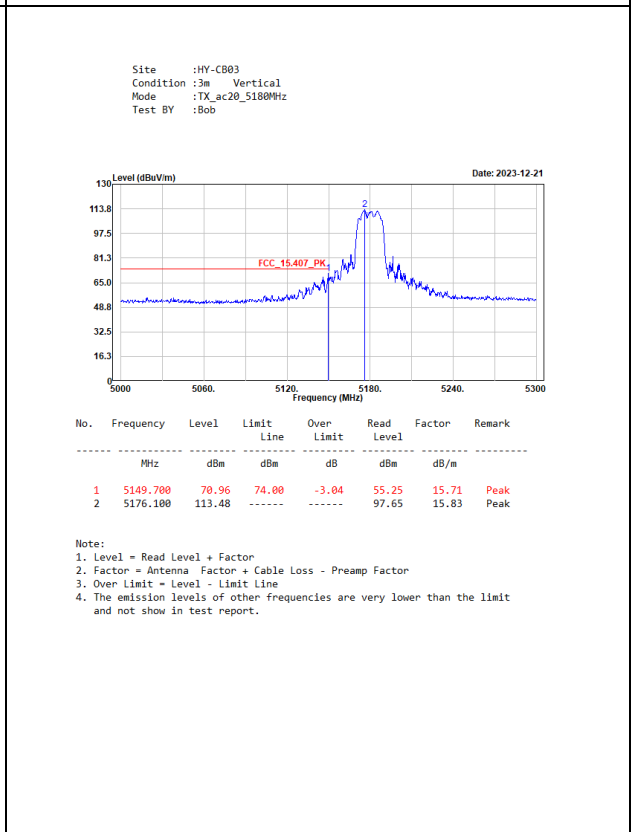
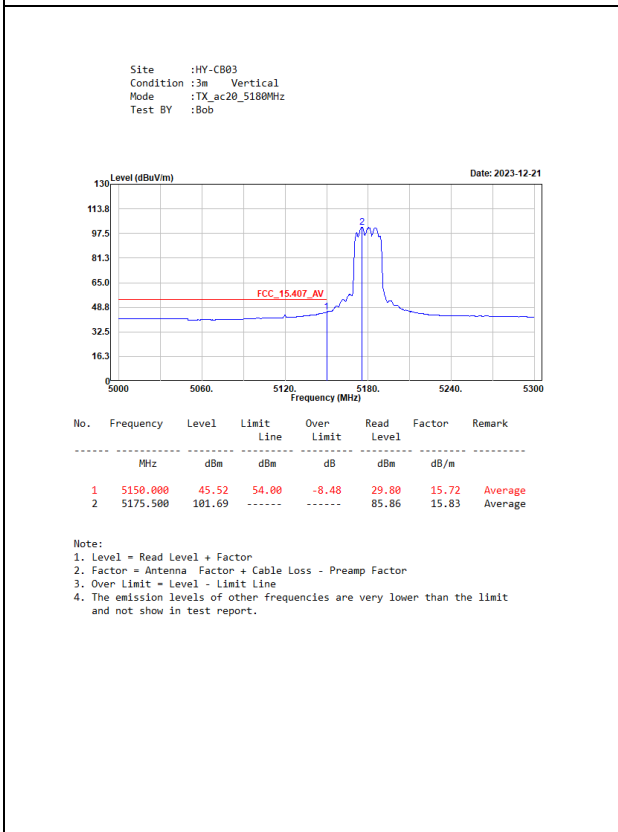
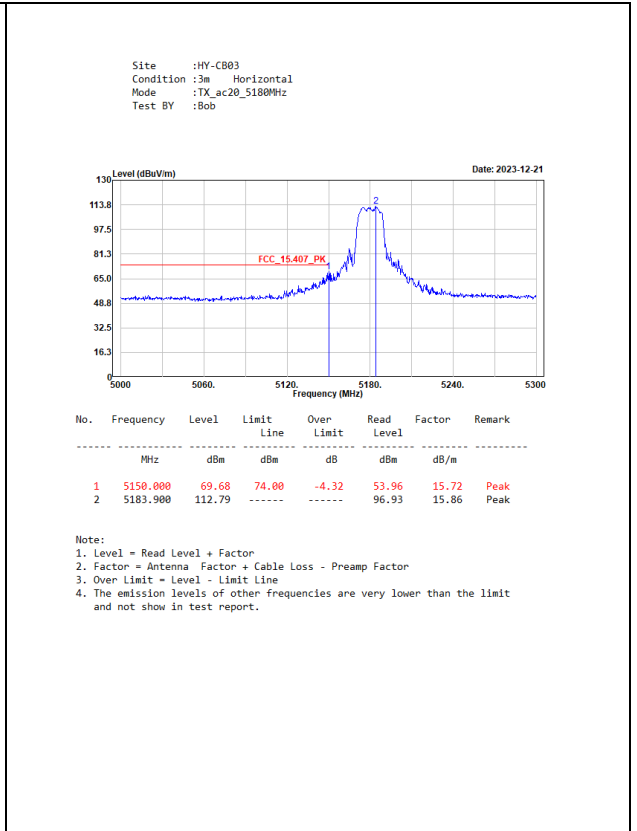
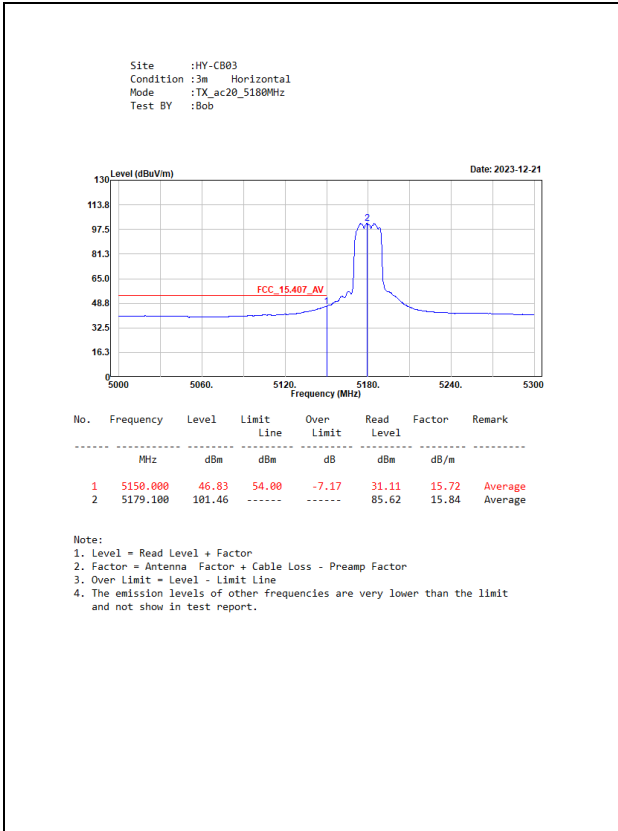
Note: Duty Cycle Refer to Section 8.

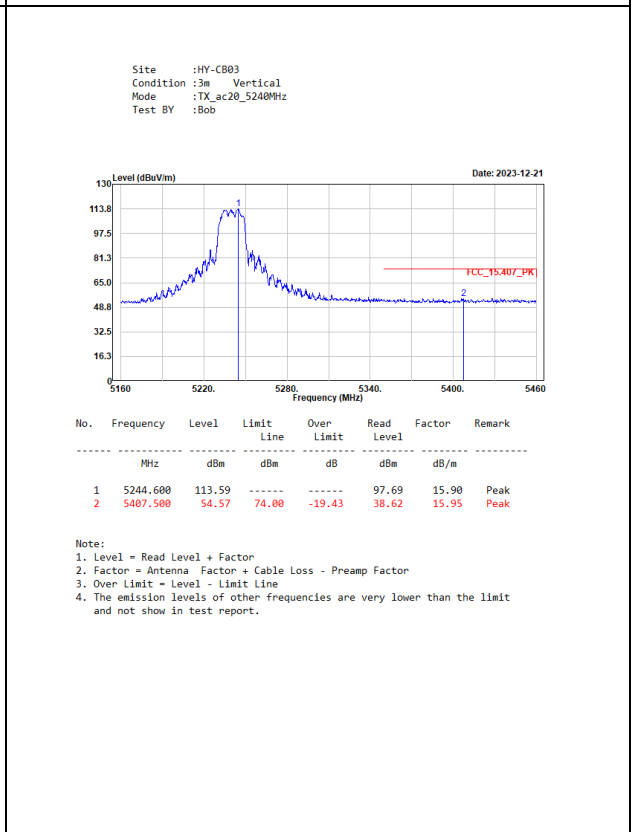
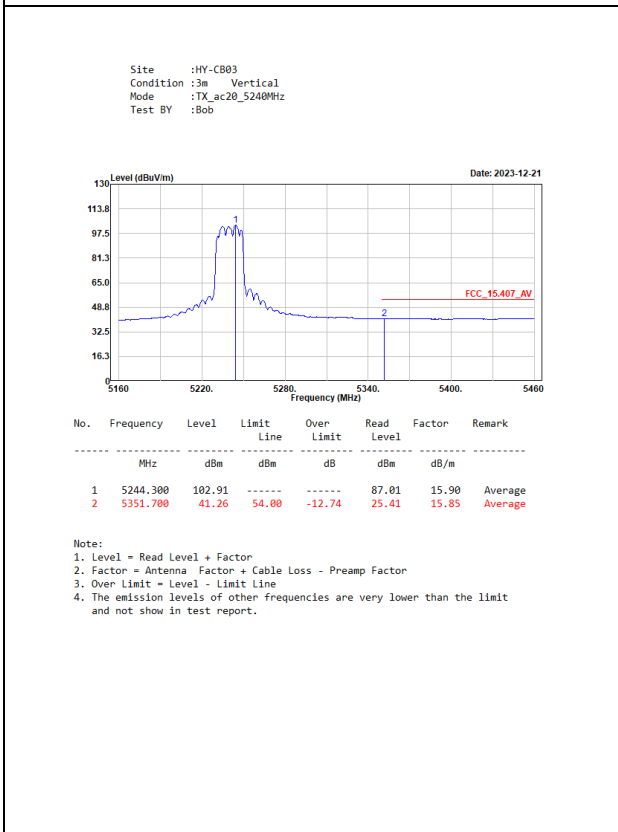
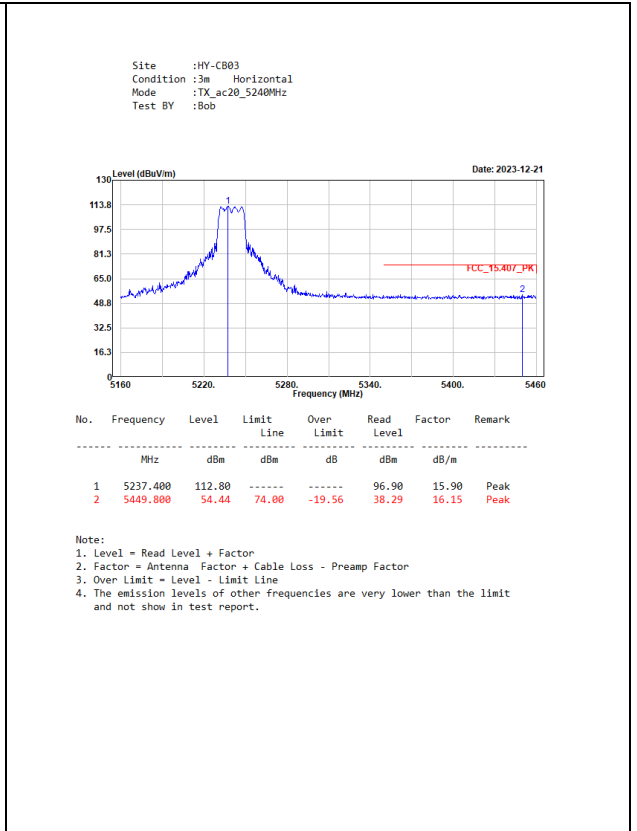
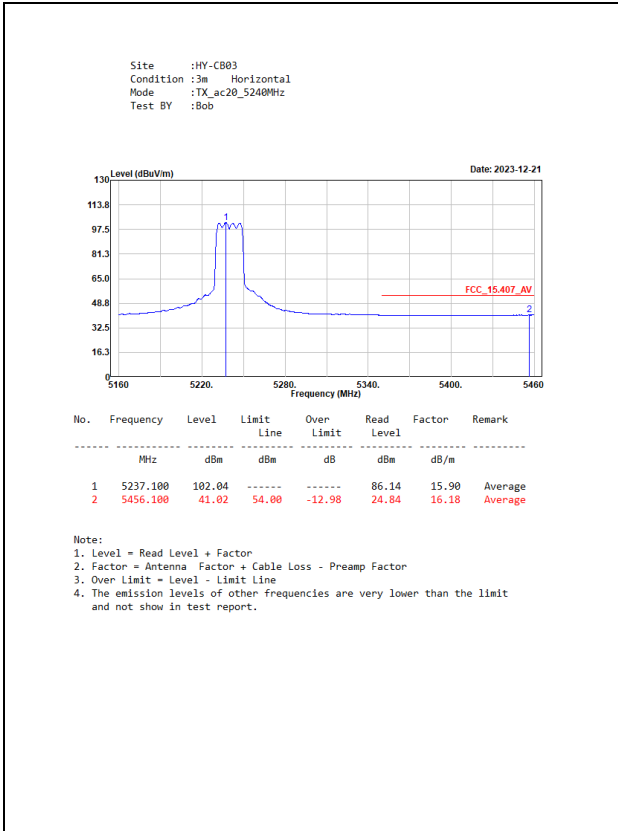
6.4. Test Result of Band Edge

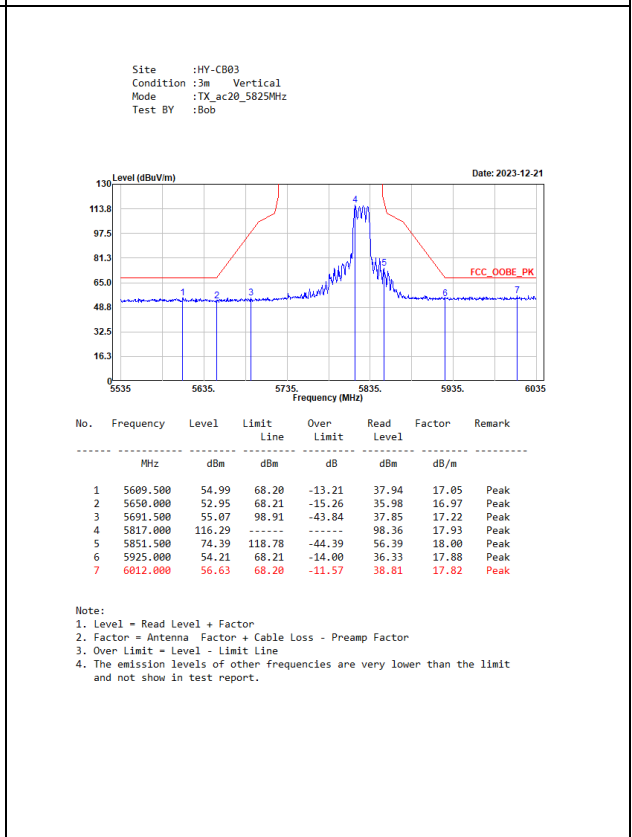
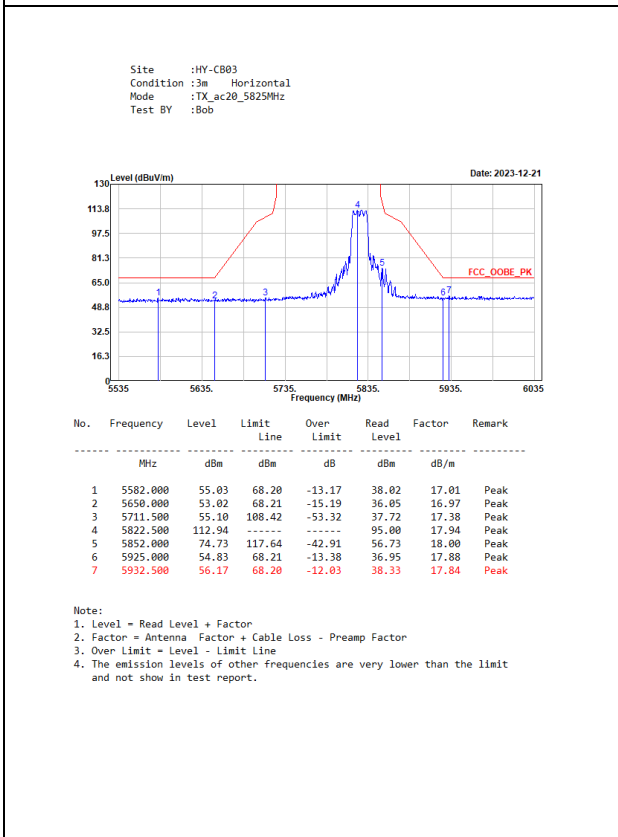
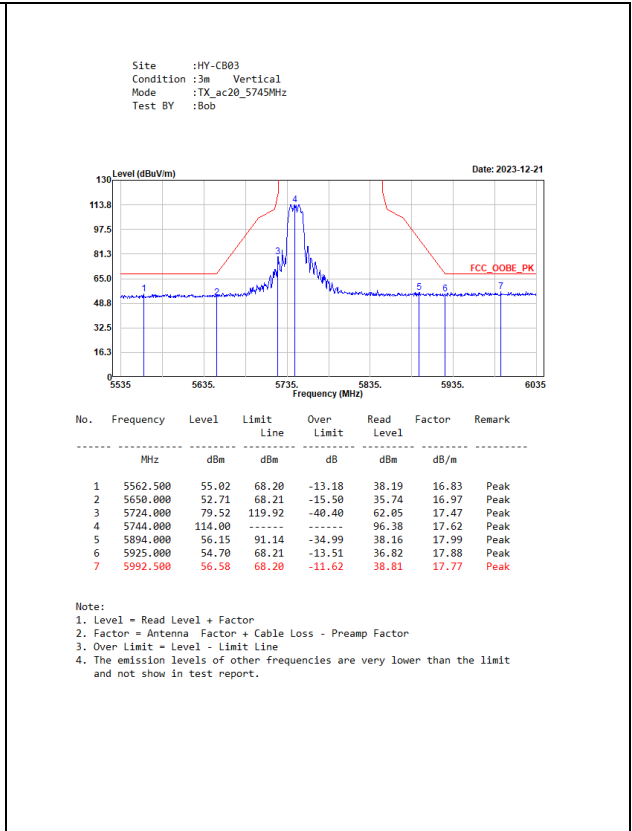
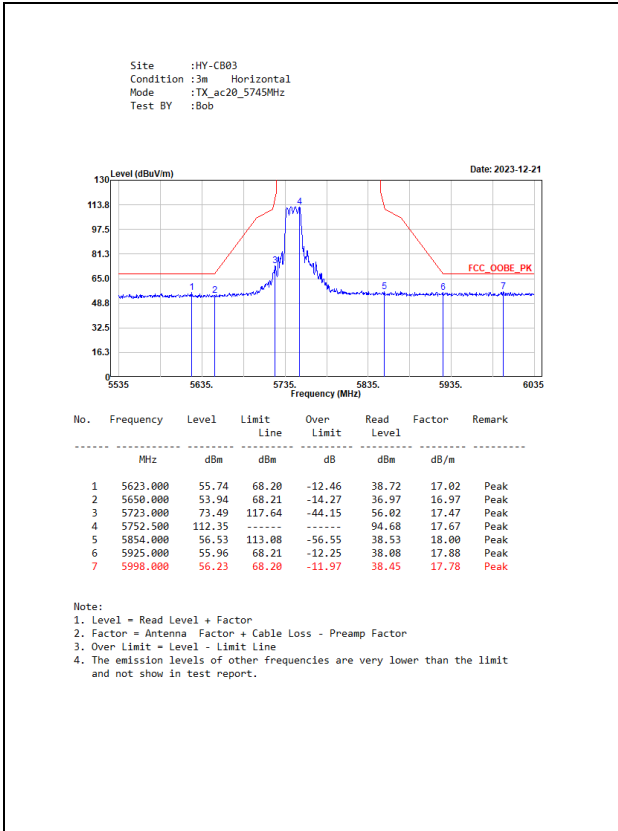


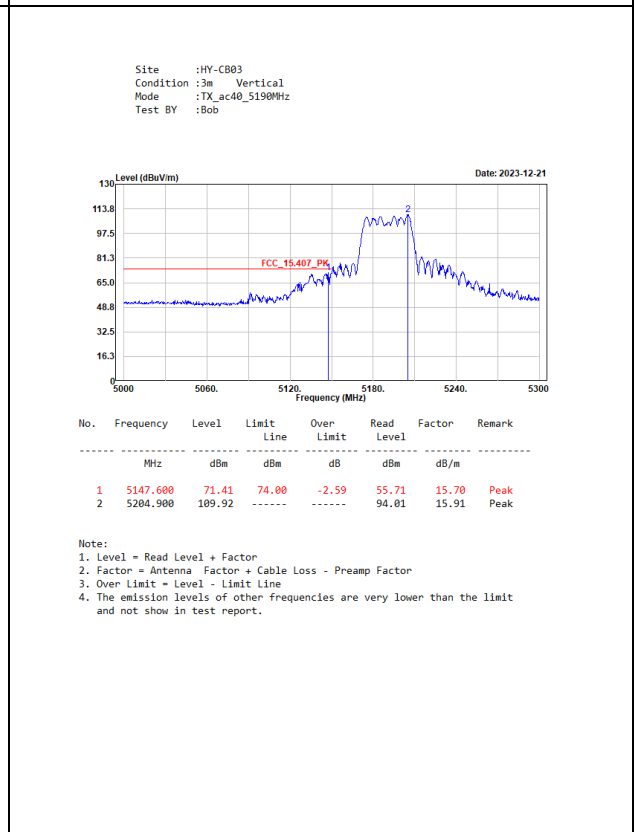
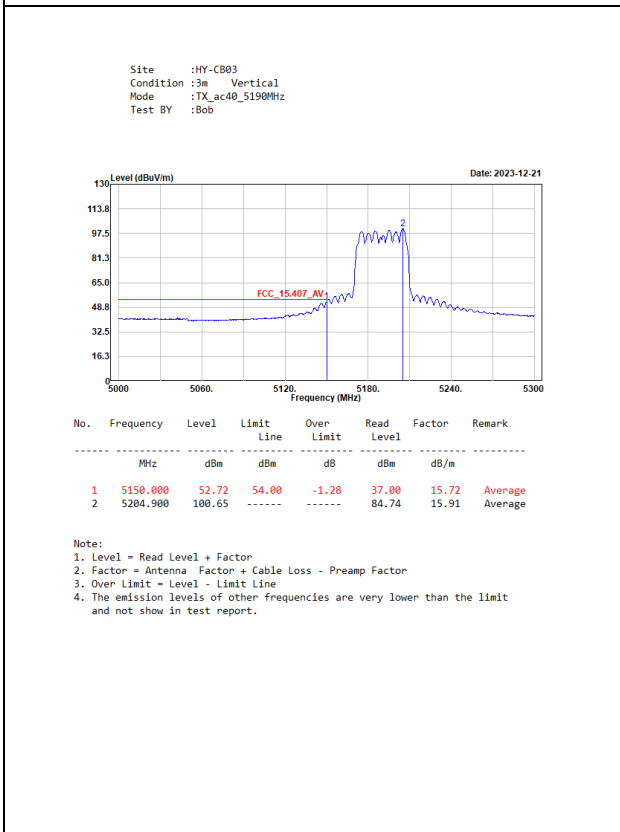
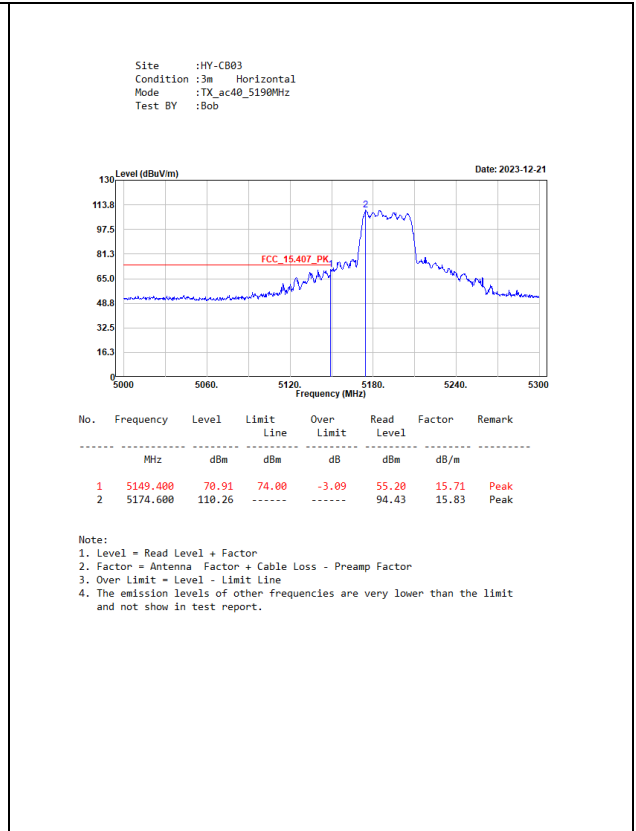
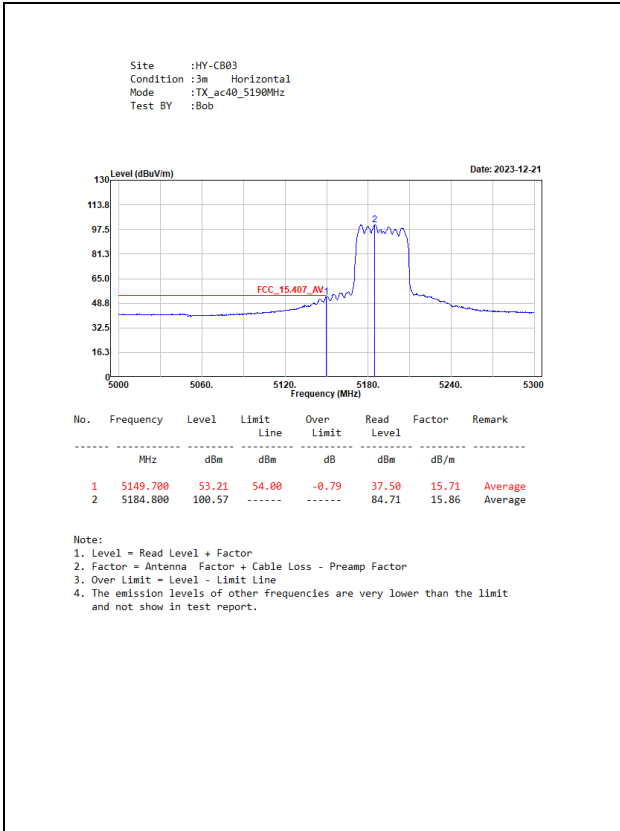


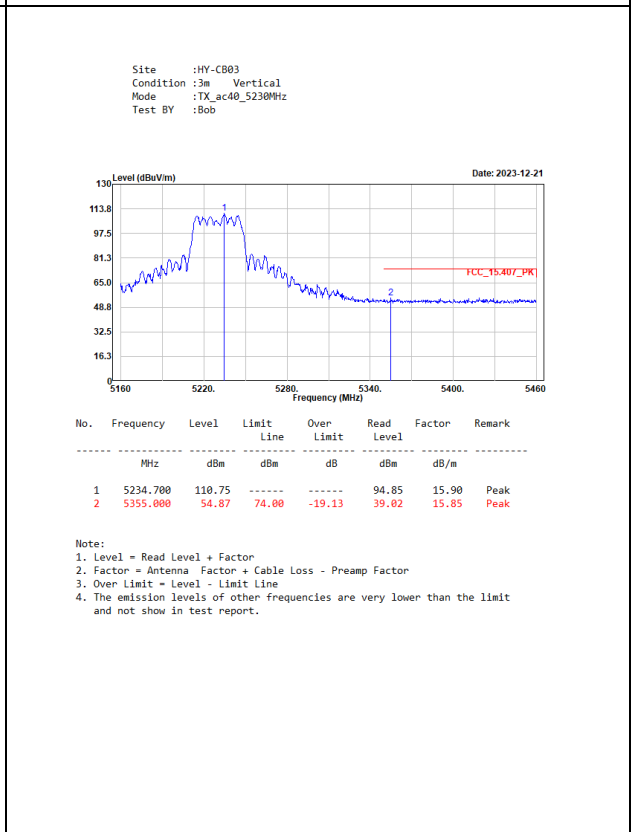
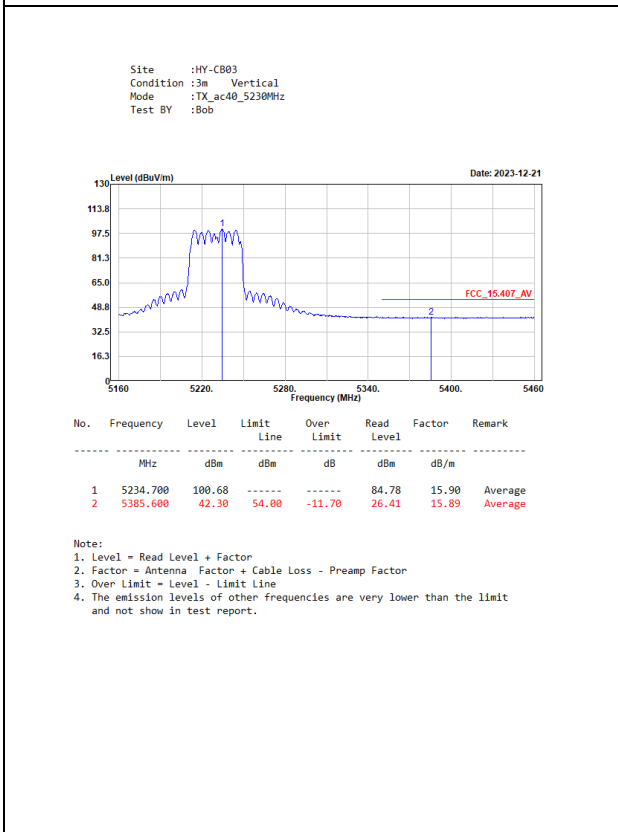
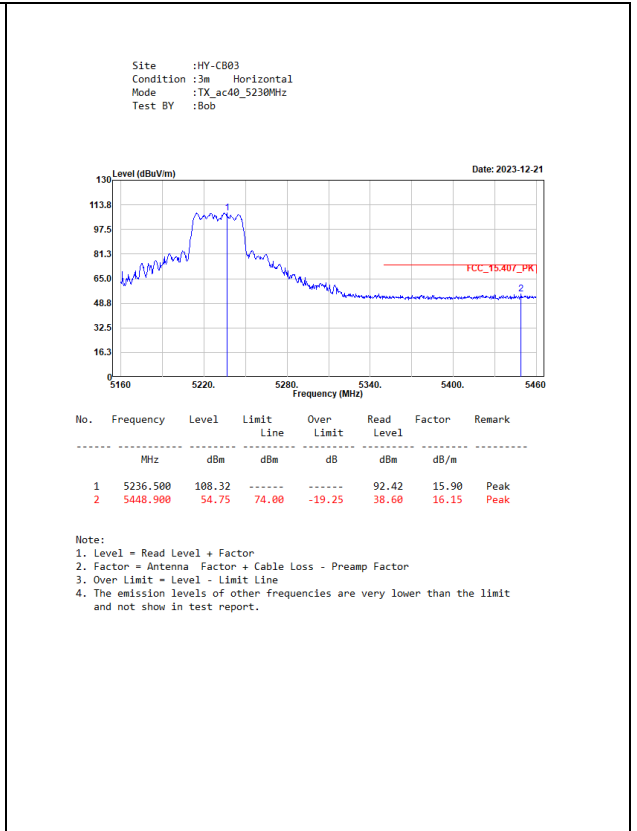
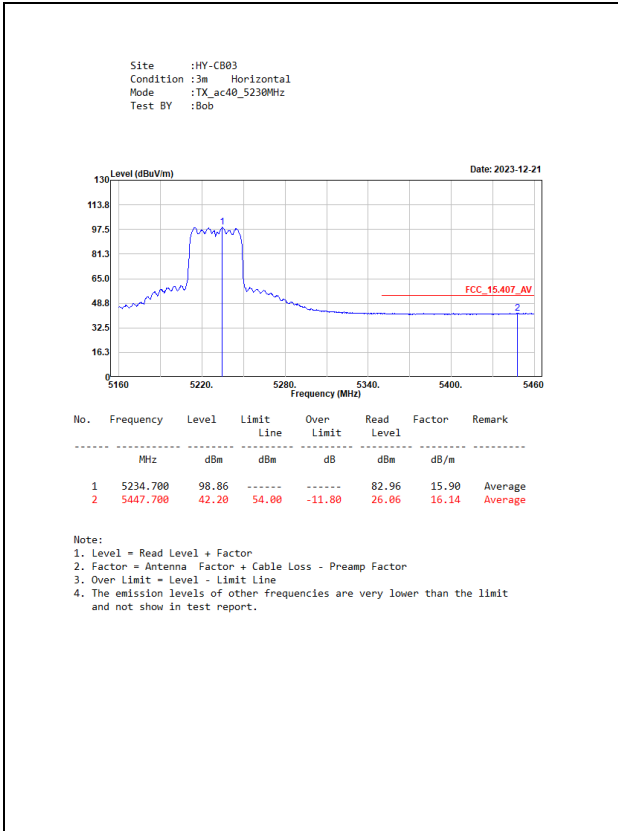


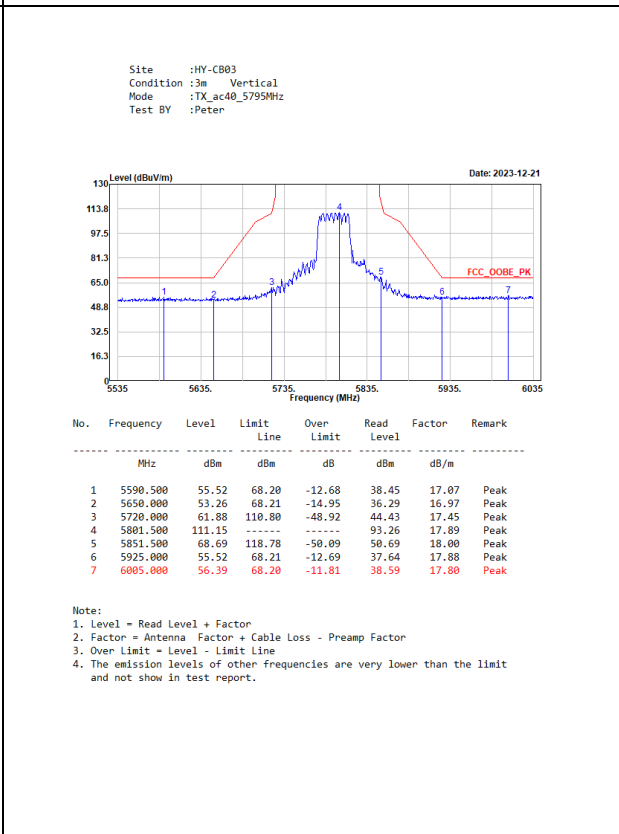
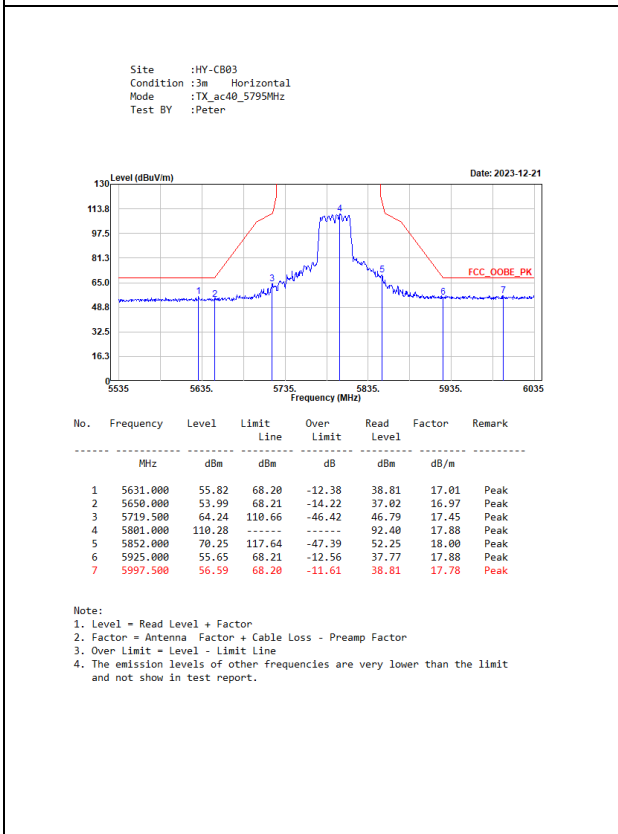
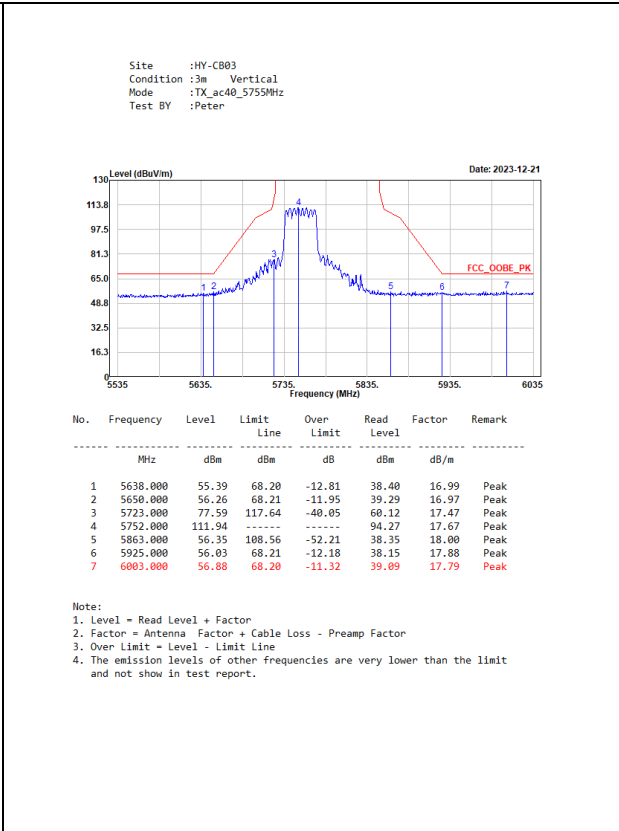
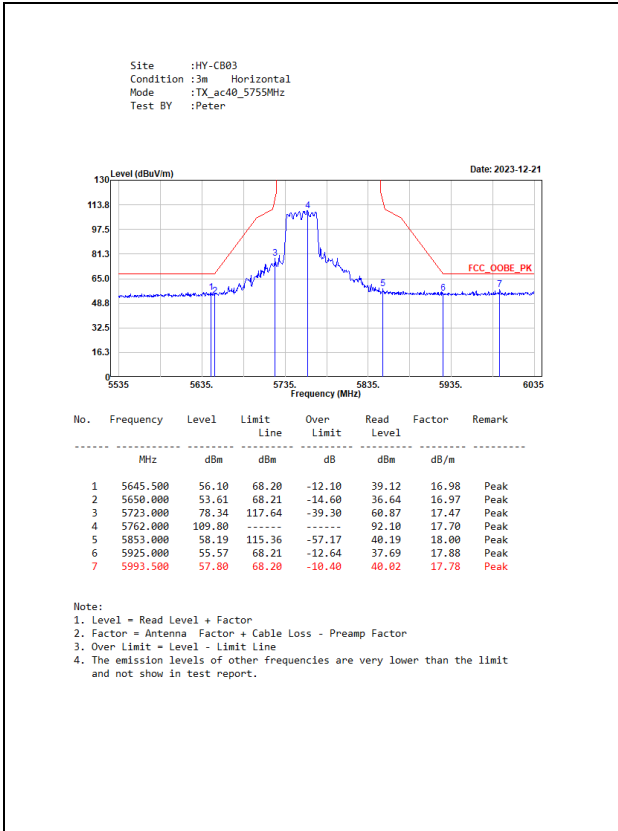


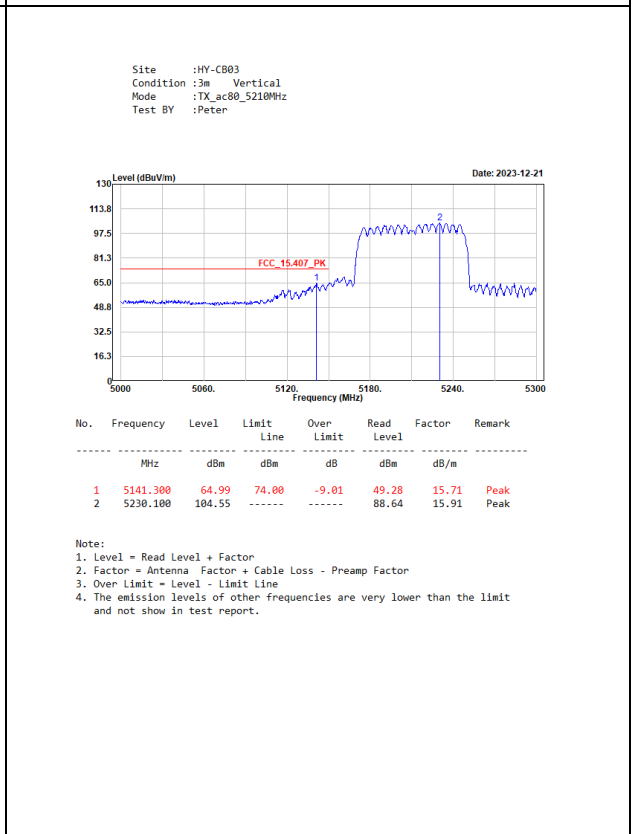
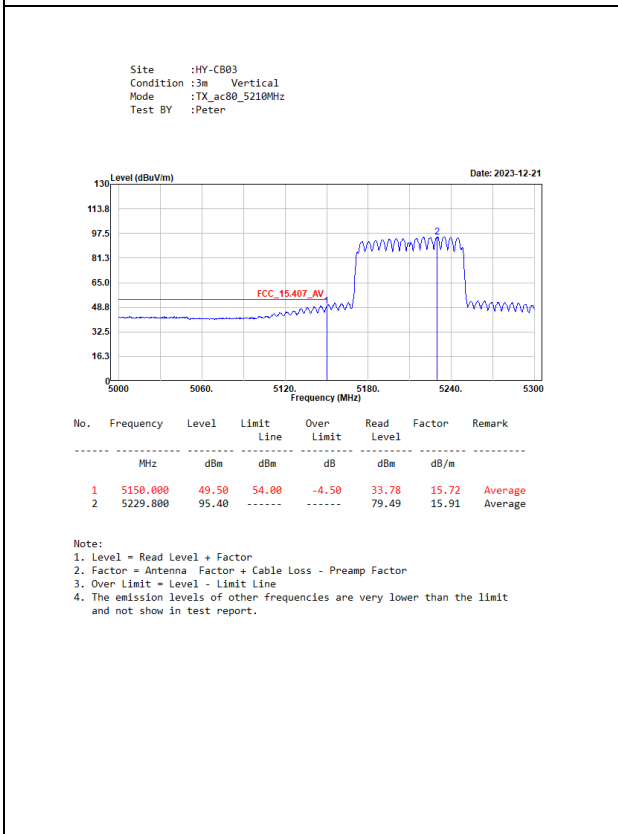
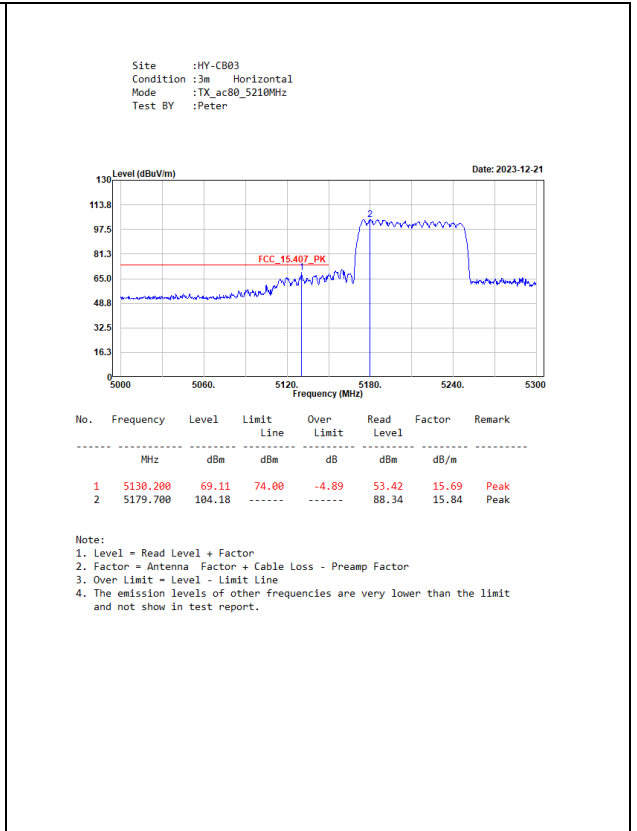
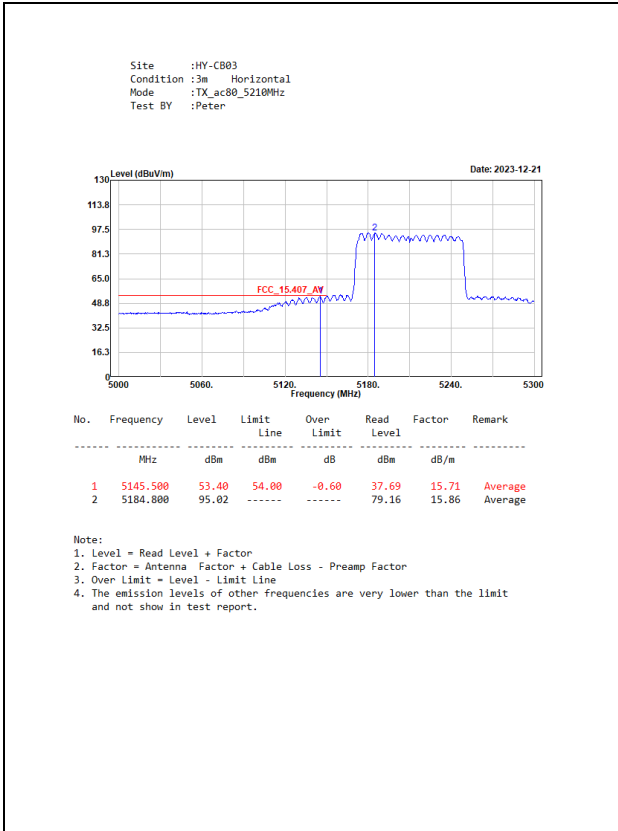


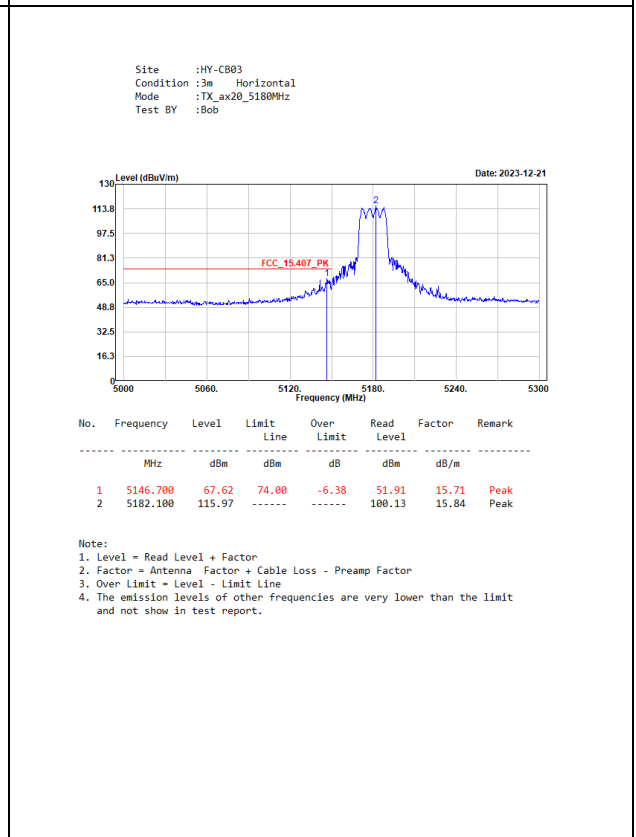
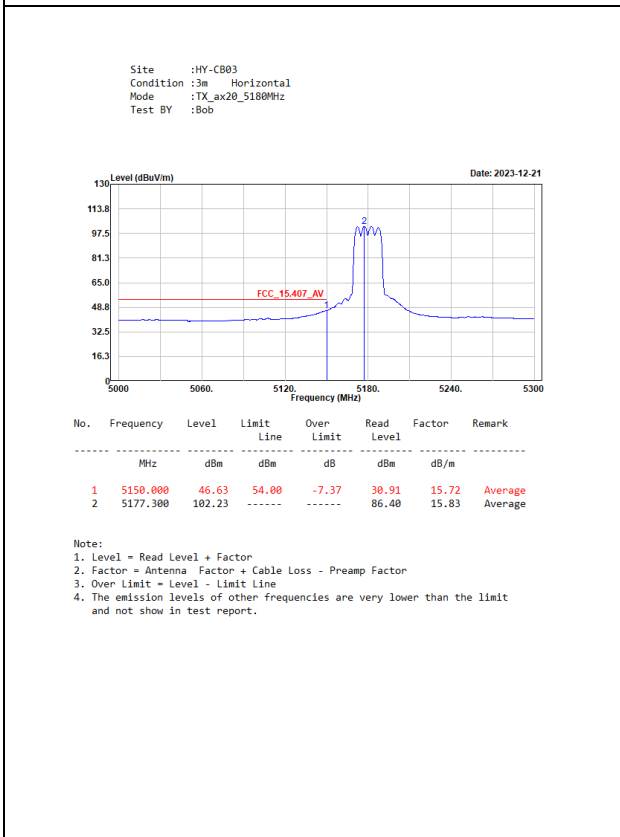
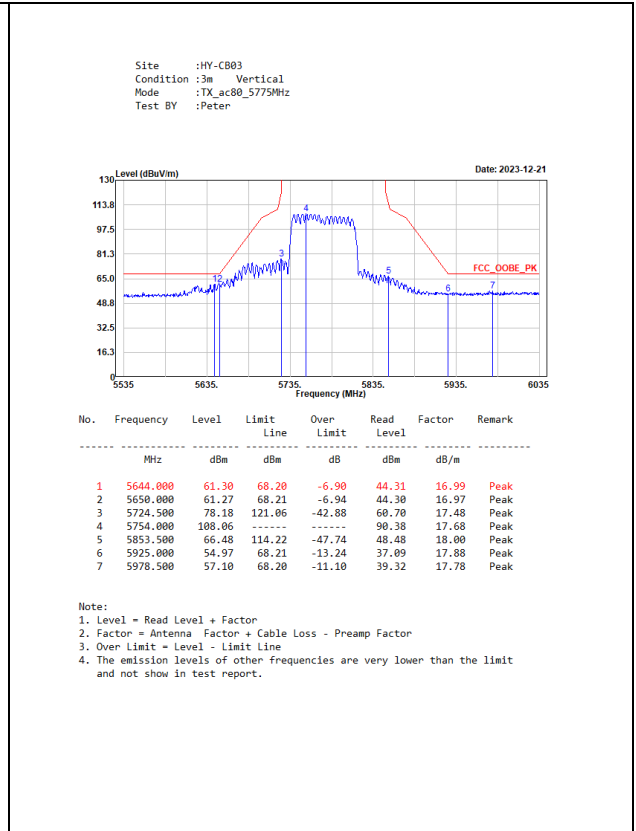
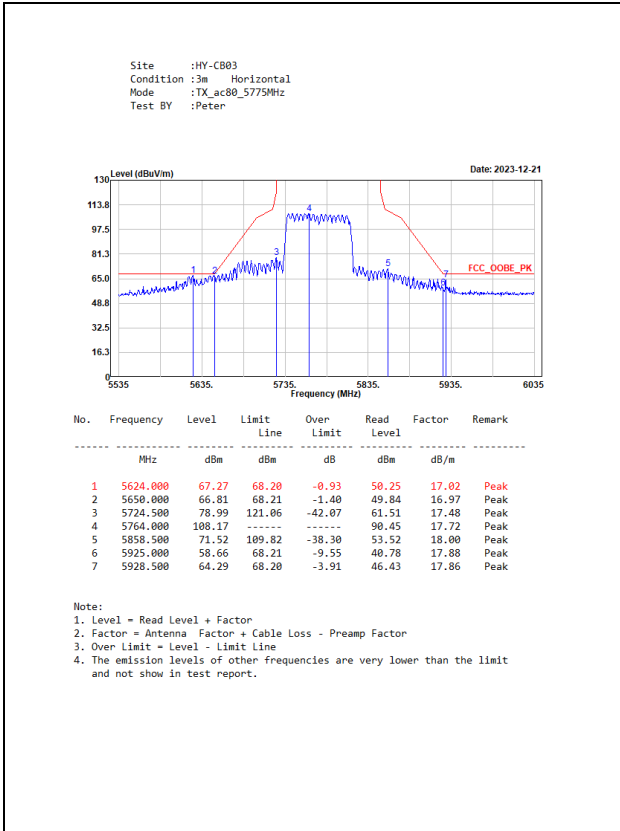


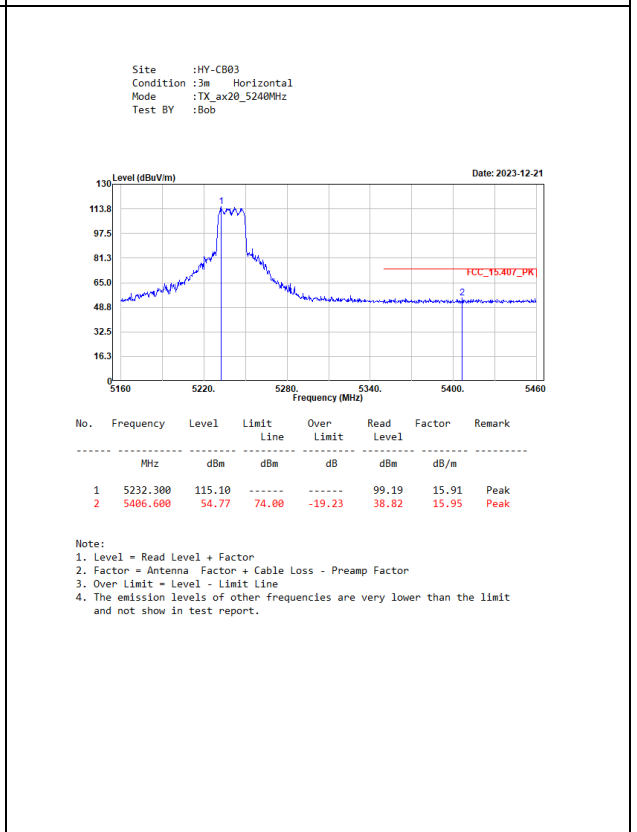
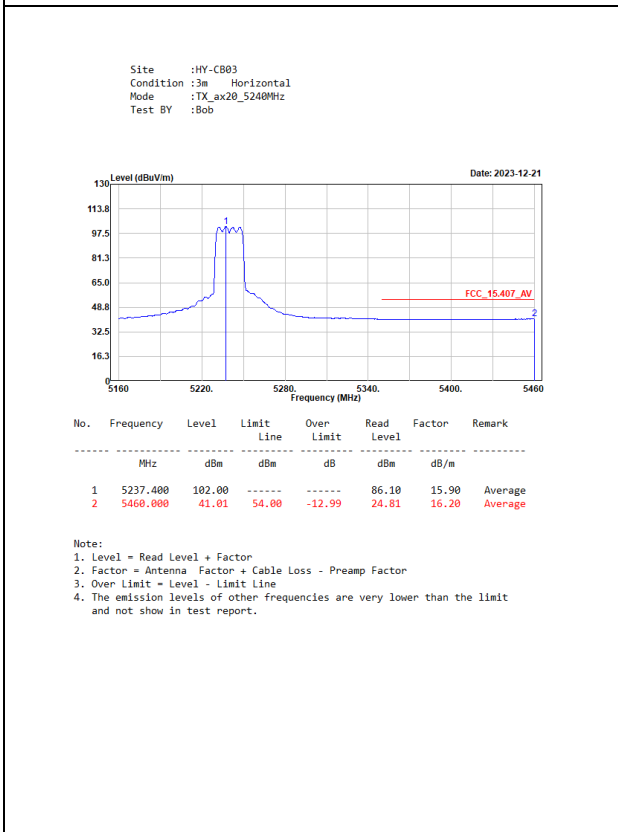
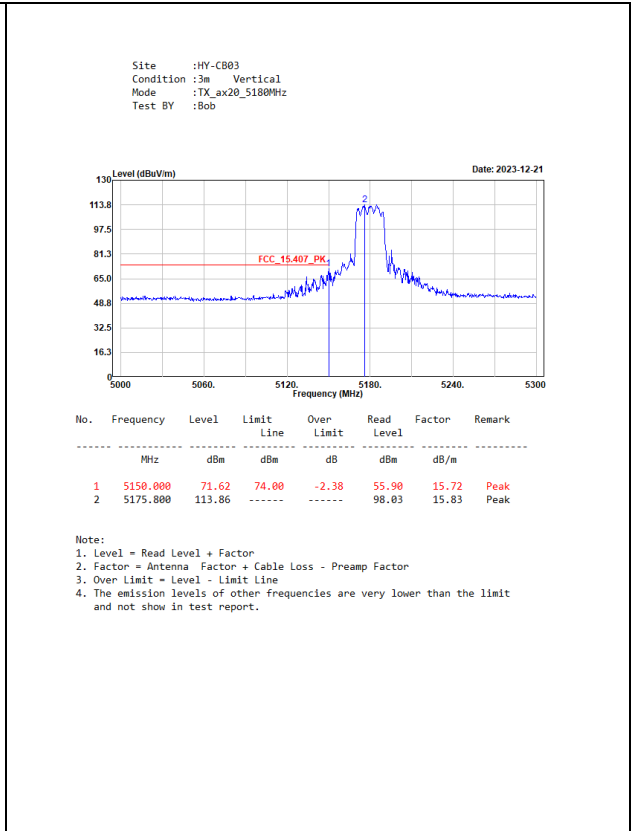
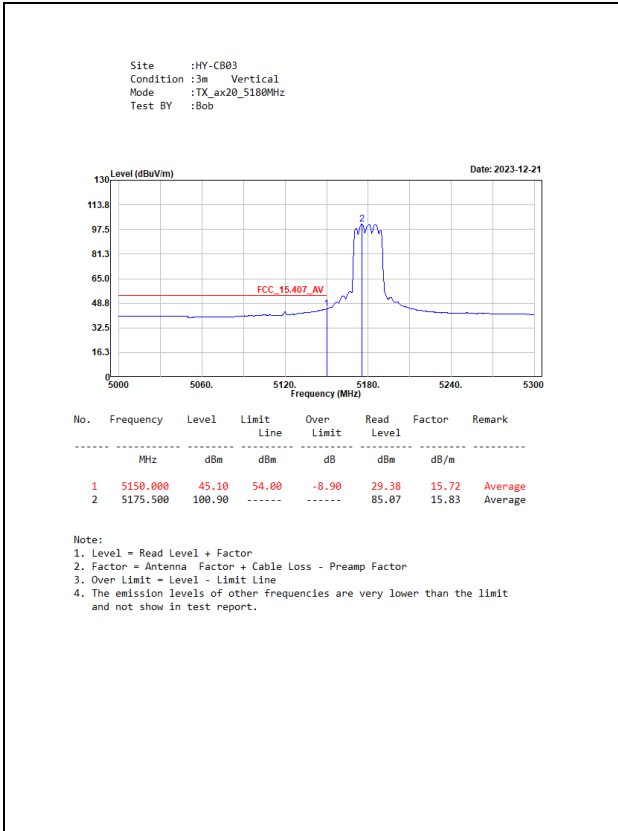


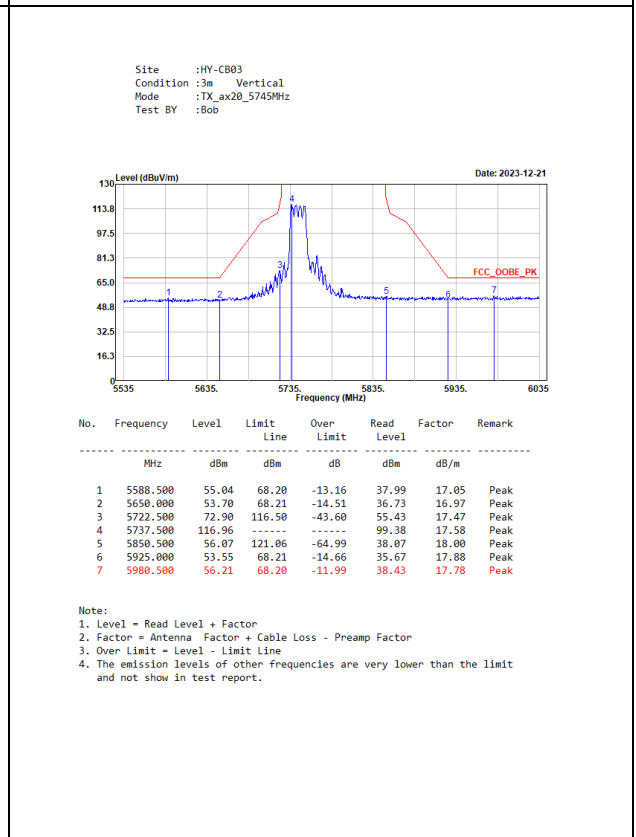
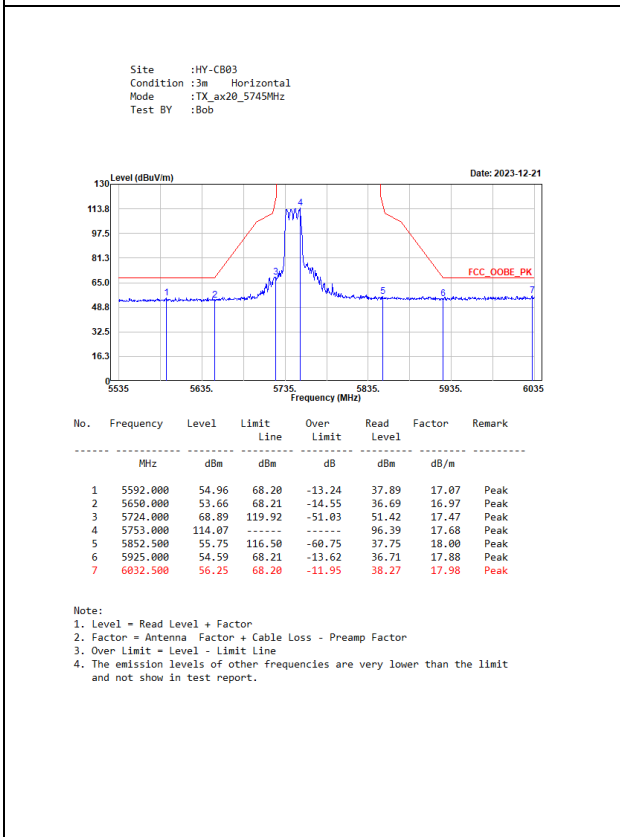
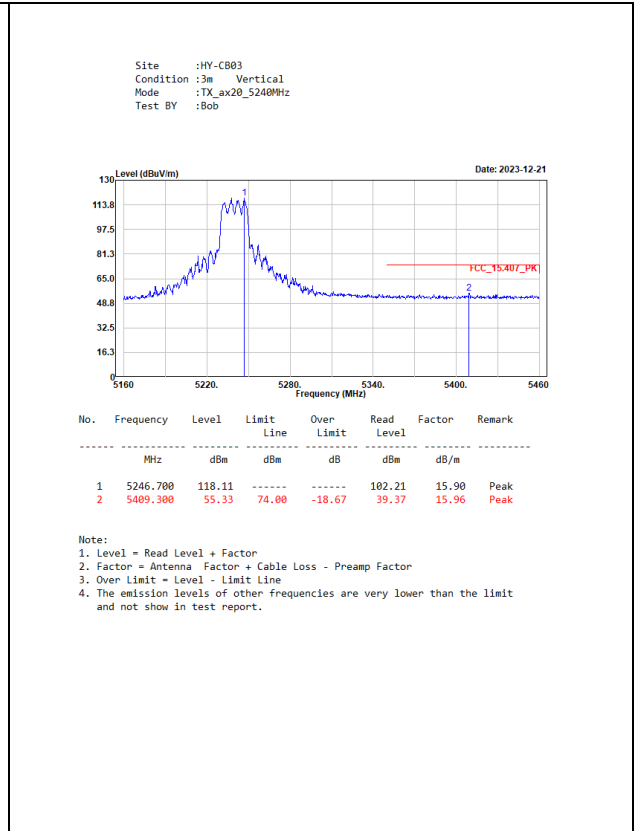
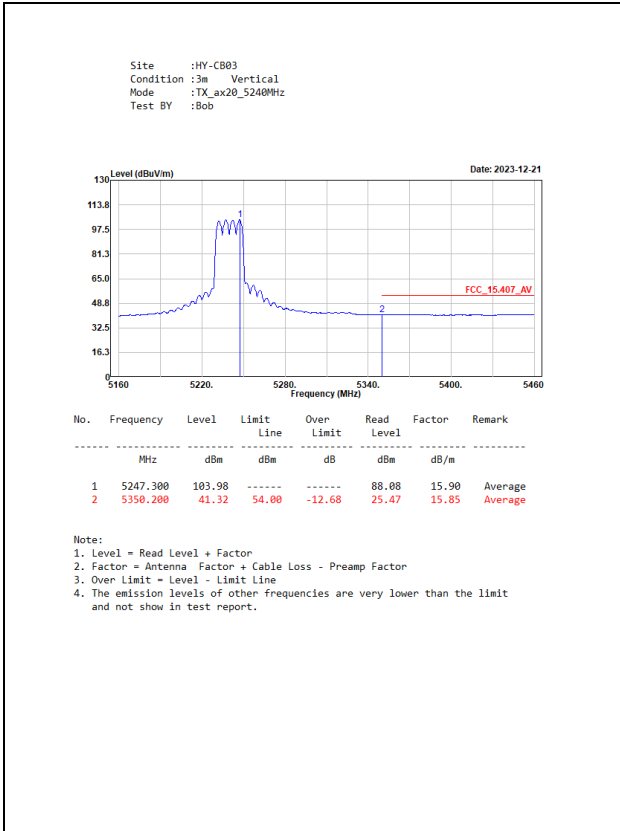


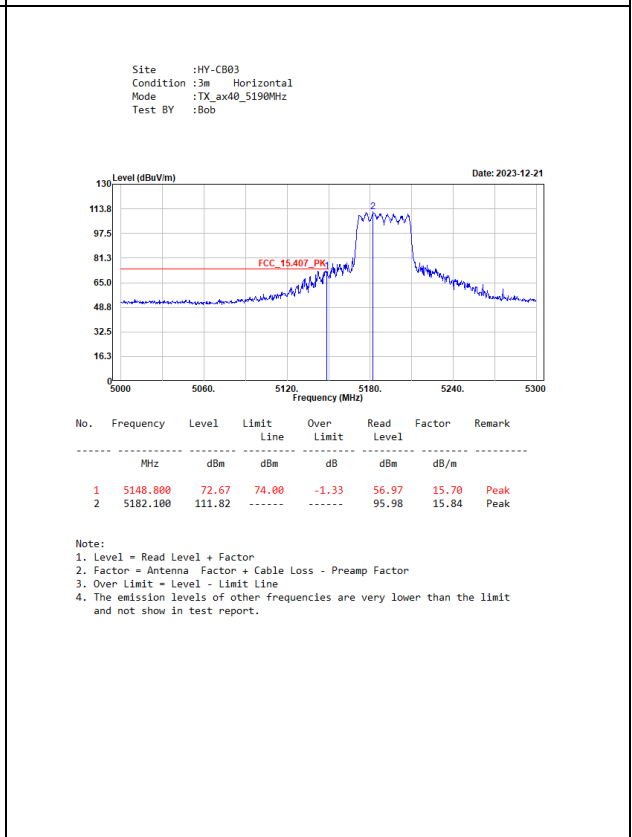
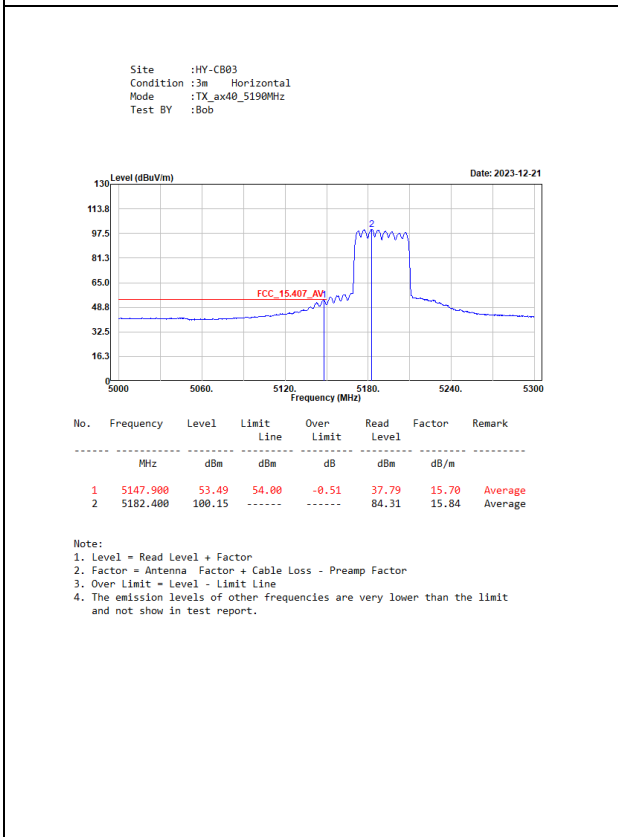
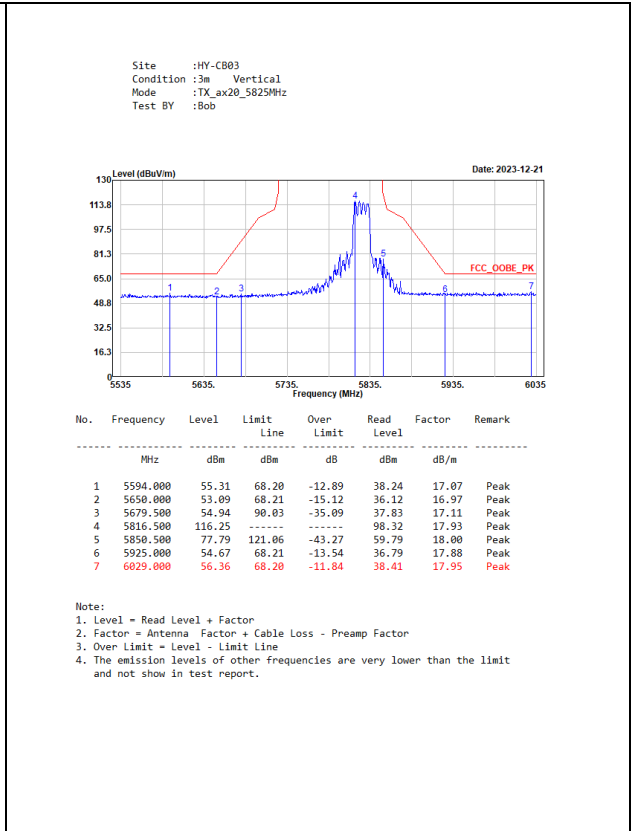
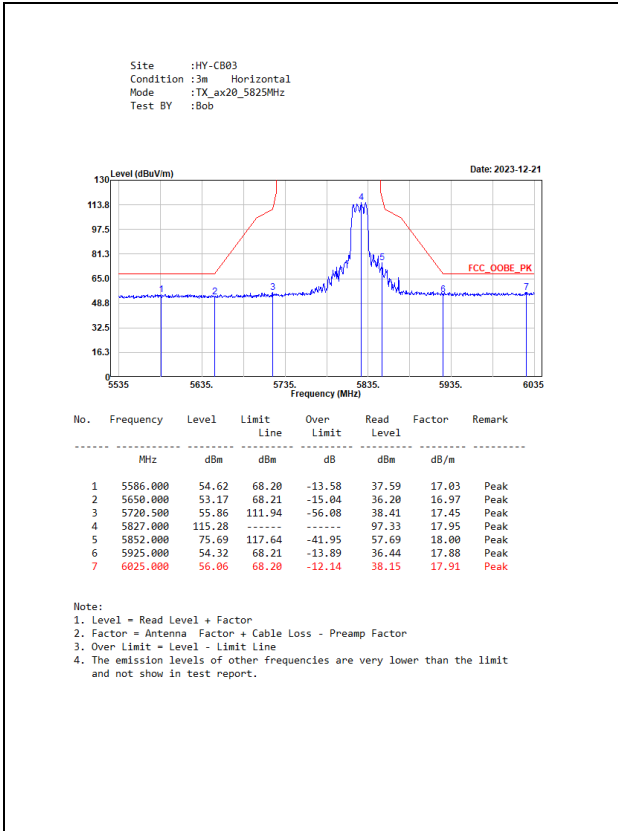


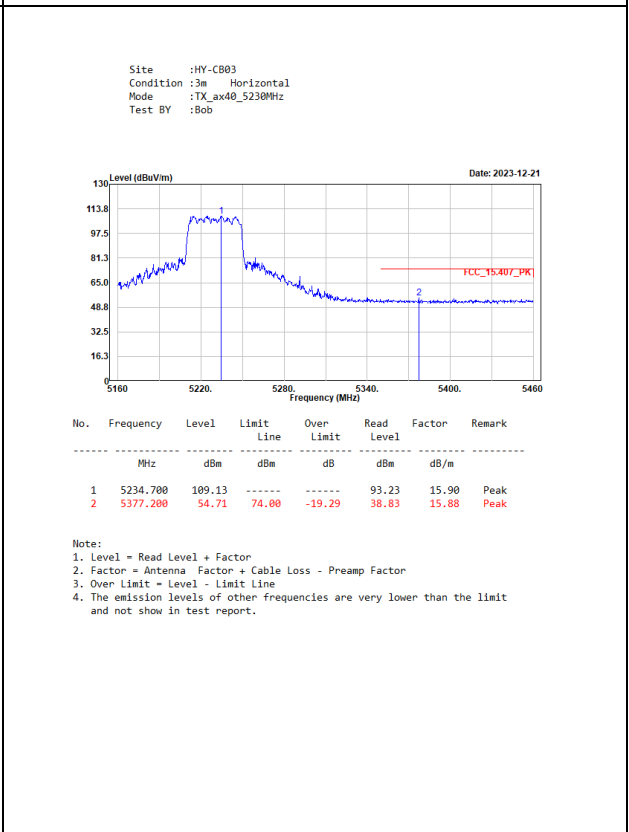
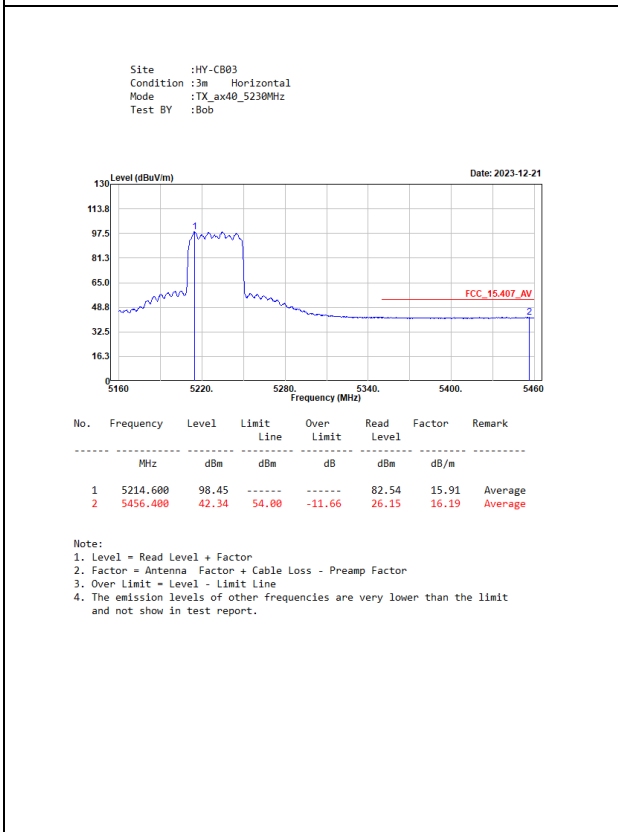
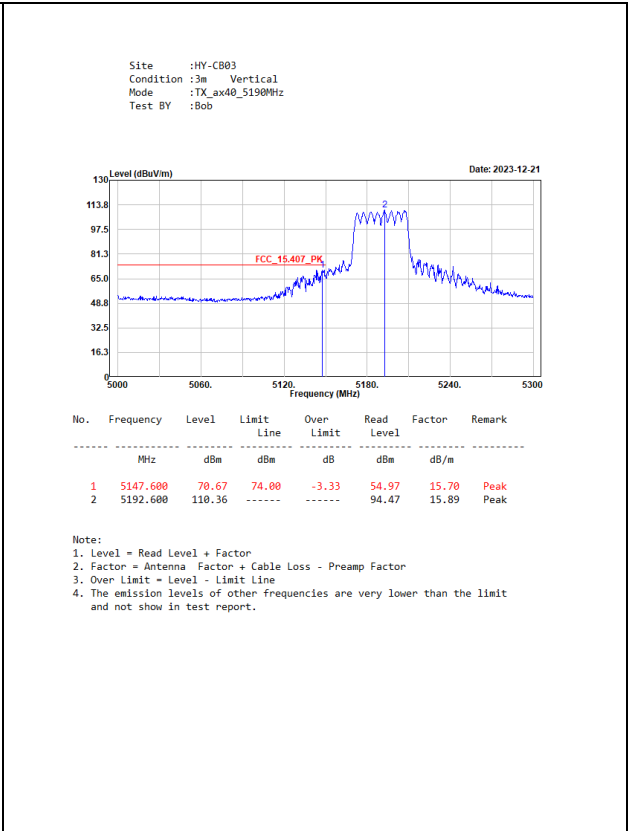
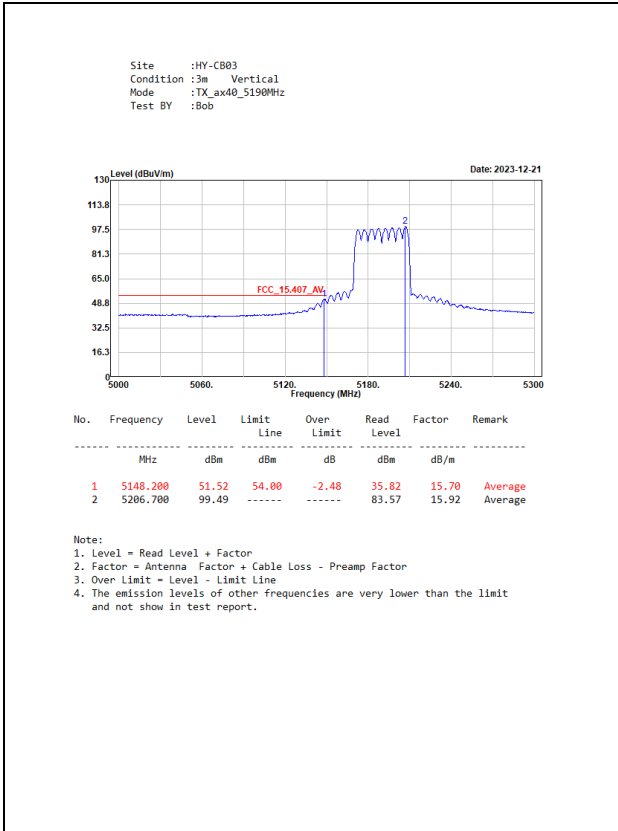


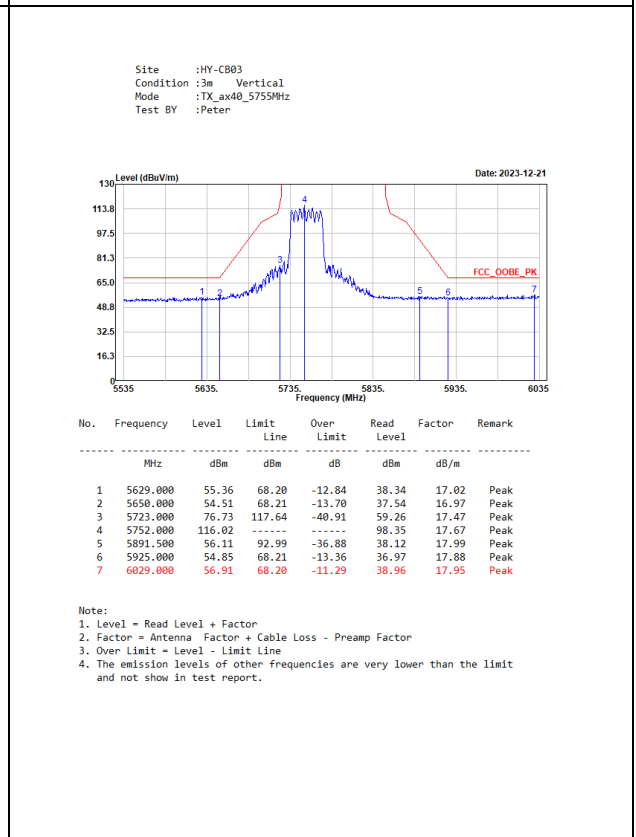
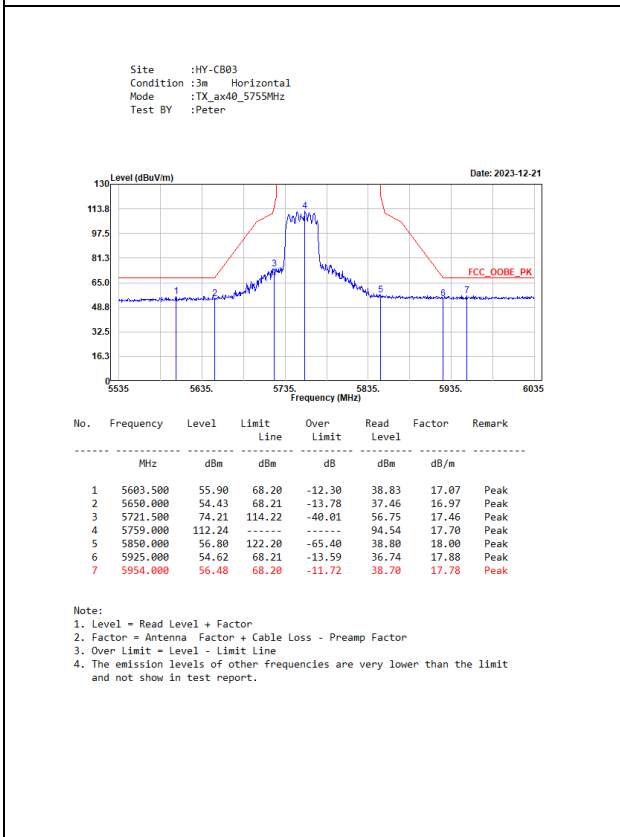
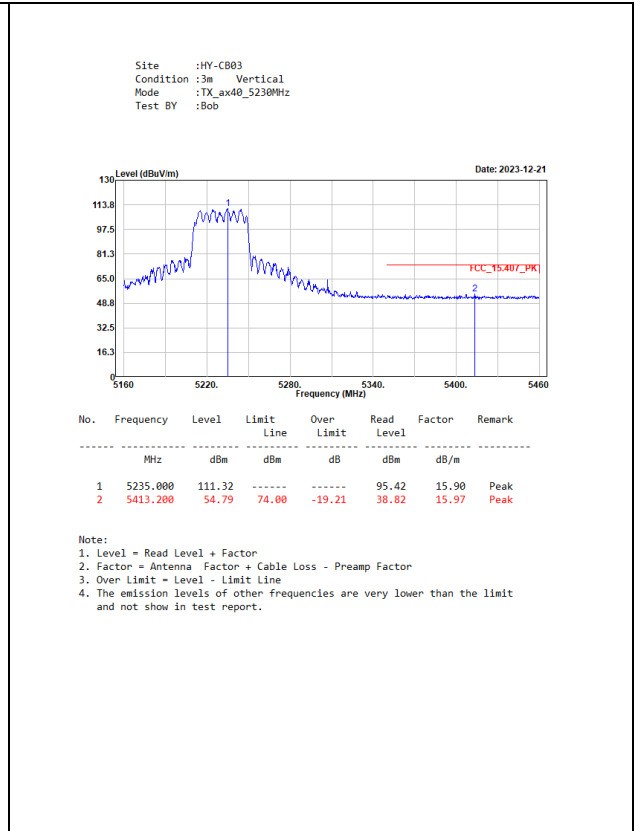
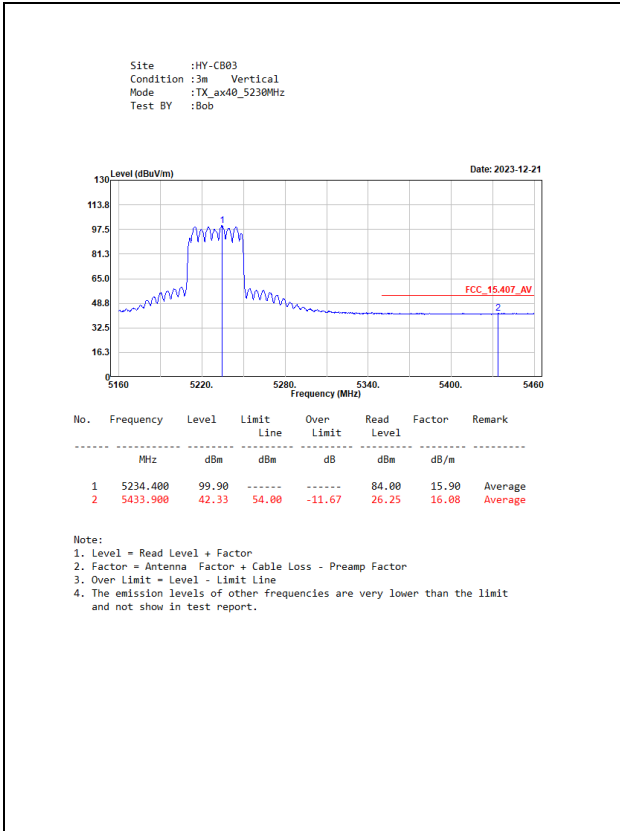


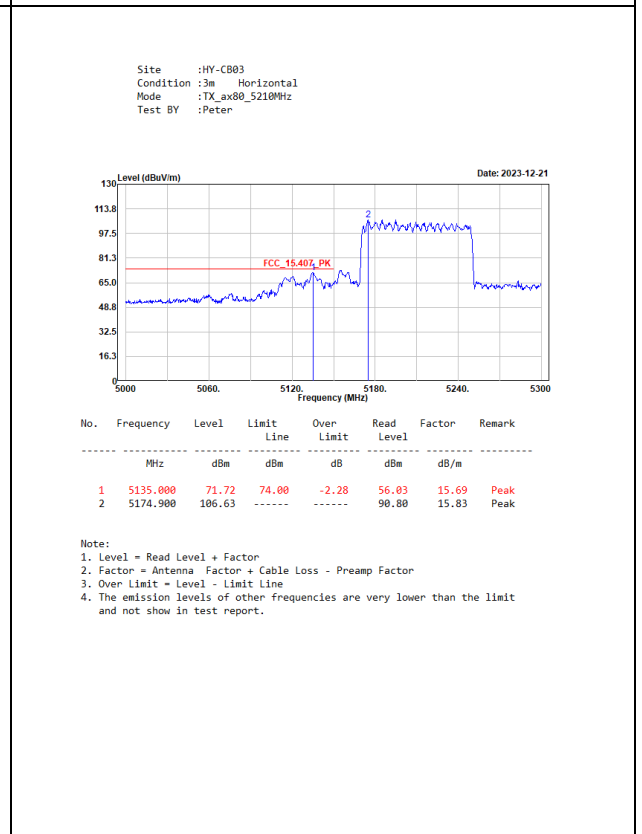
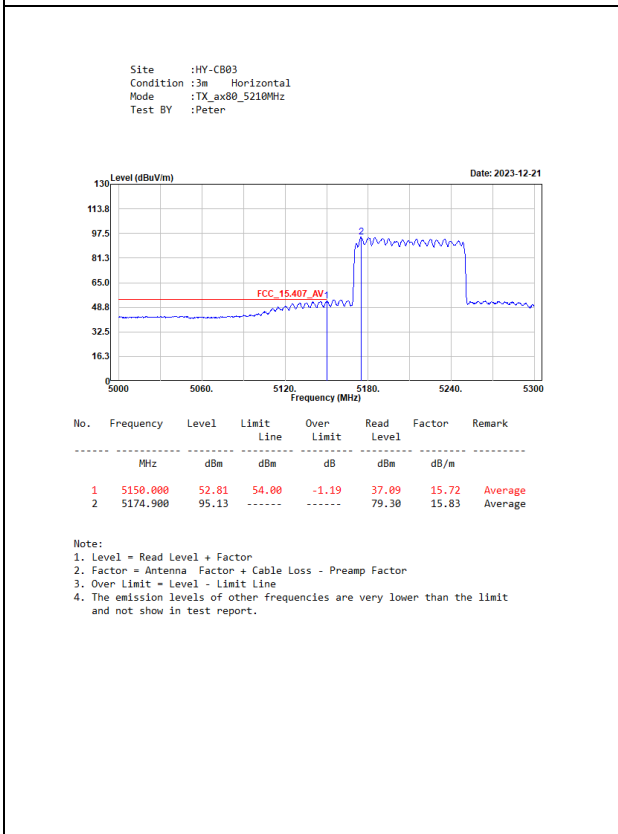
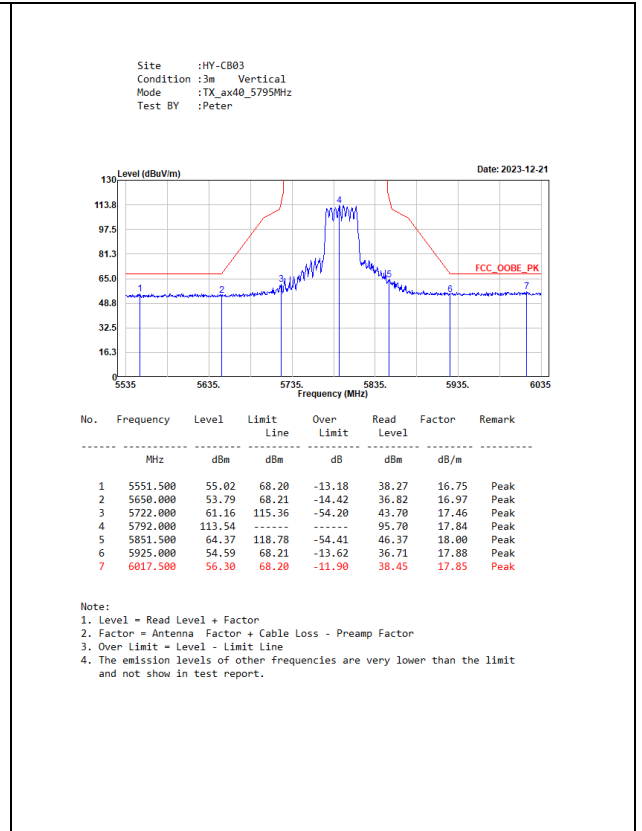
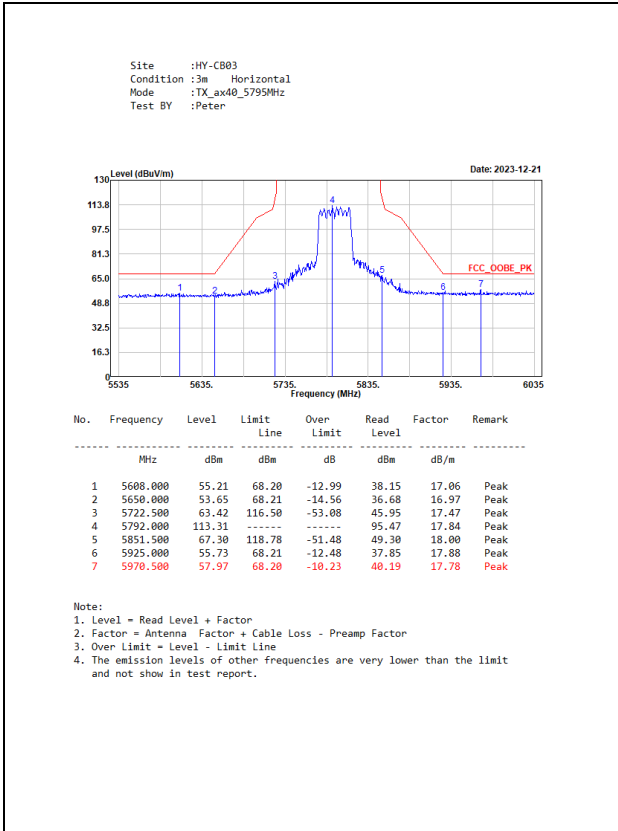


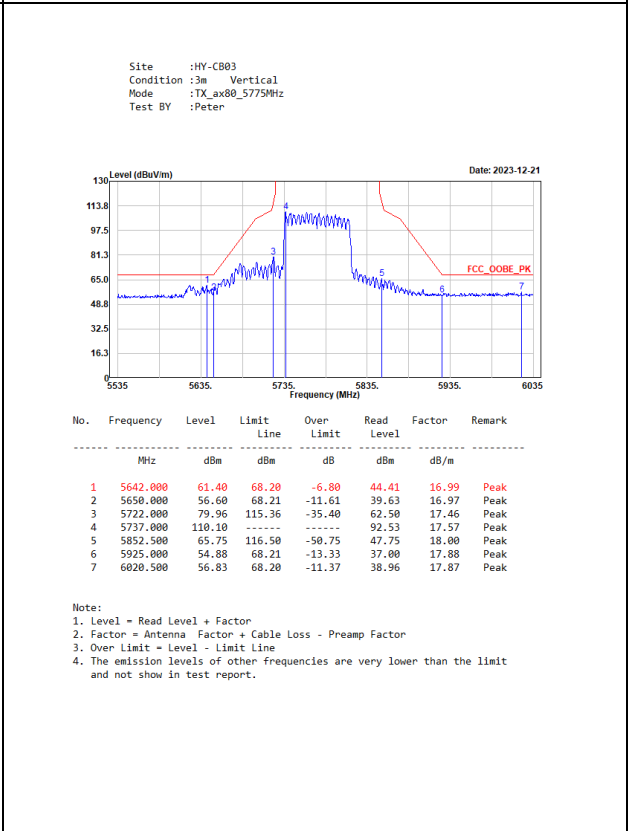
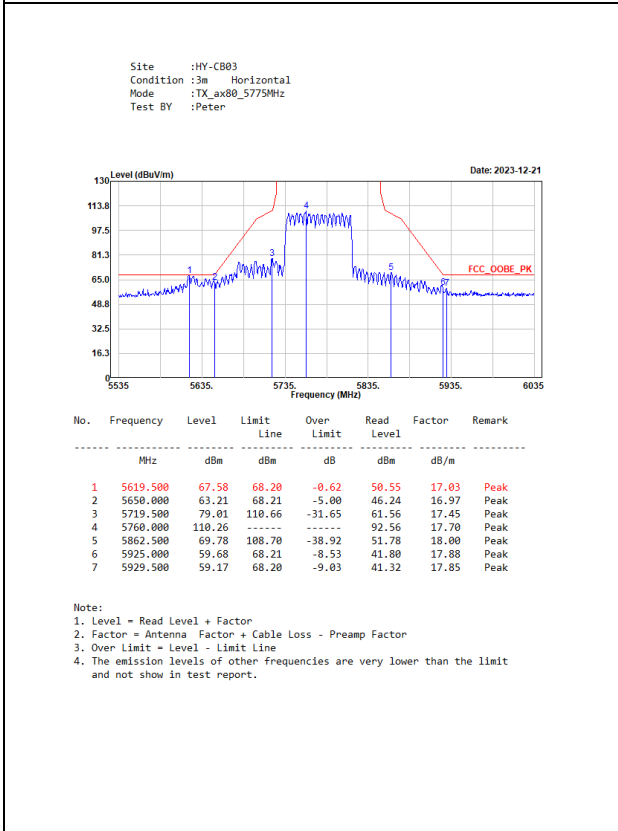
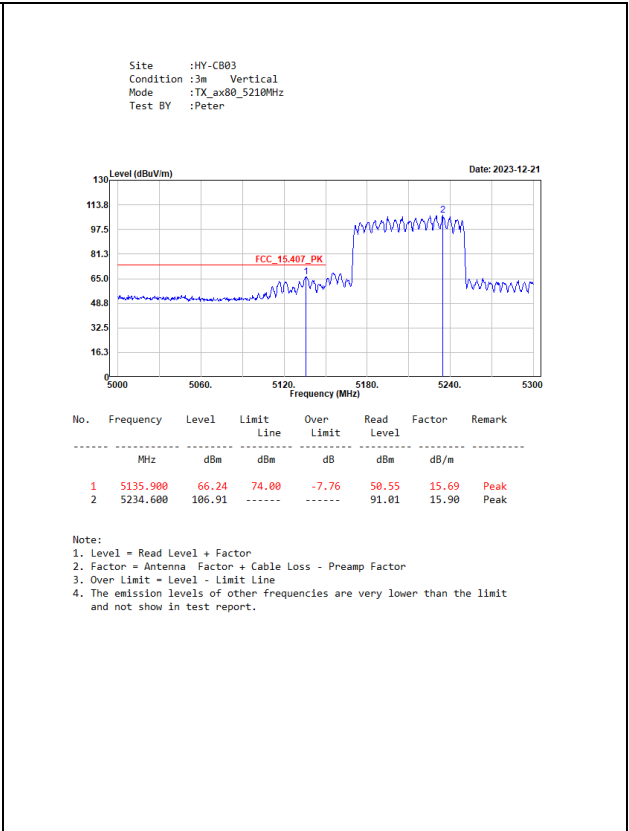
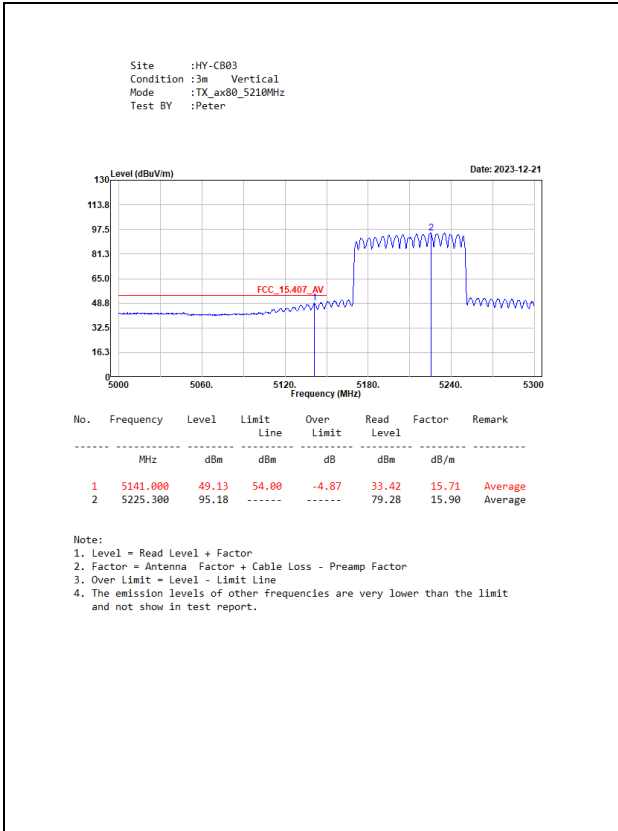












Product : Car Infotainment Unit
 Test Item : Band Edge Data
 Test Mode : Transmit (802.11a)

Chain A

Test Frequency (MHz)	Measurement Level (MHz)	Limit (MHz)	Result
5240	5248.35	<5250	PASS

Chain B

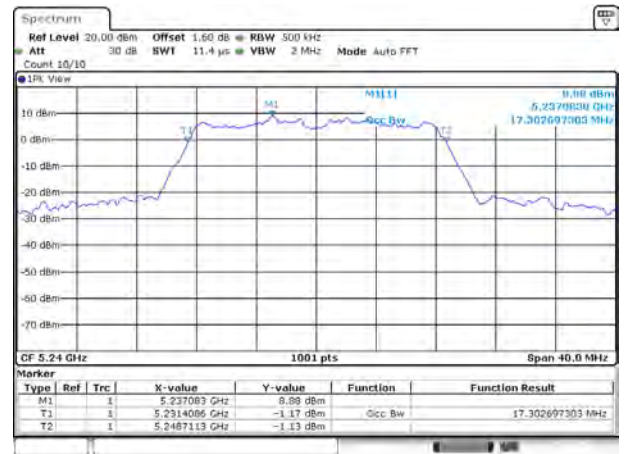
Test Frequency (MHz)	Measurement Level (MHz)	Limit (MHz)	Result
5240	5248.71	<5250	PASS

Channel 48 (Chain A)



Date: 19 DEC 2023 04:23:07

Channel 48 (Chain B)



Date: 19 DEC 2023 20:38:38

Product : Car Infotainment Unit
 Test Item : Band Edge Data
 Test Mode : Transmit (802.11ac-20 MHz)

Chain A

Test Frequency (MHz)	Measurement Level (MHz)	Limit (MHz)	Result
5240	5248.87	<5250	PASS

Chain B

Test Frequency (MHz)	Measurement Level (MHz)	Limit (MHz)	Result
5240	5249.03	<5250	PASS

Channel 48 (Chain A)



Channel 48 (Chain B)



Product : Car Infotainment Unit
 Test Item : Band Edge Data
 Test Mode : Transmit (802.11ac-40 MHz)

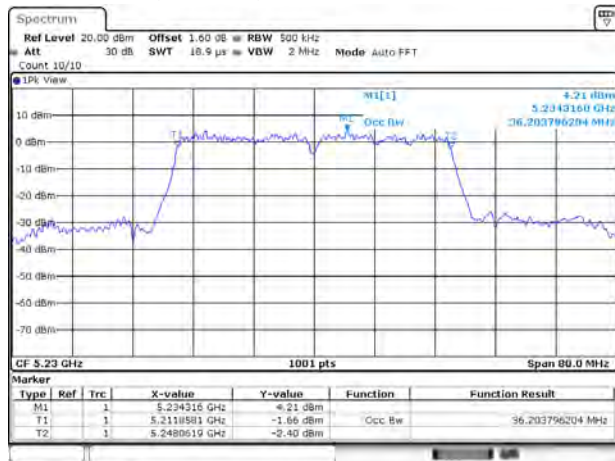
Chain A

Test Frequency (MHz)	Measurement Level (MHz)	Limit (MHz)	Result
5230	5248.06	<5250	PASS

Chain B

Test Frequency (MHz)	Measurement Level (MHz)	Limit (MHz)	Result
5230	5248.30	<5250	PASS

Channel 46 (Chain A)



Date: 19 DEC 2023 21:18:23

Channel 46 (Chain B)



Date: 19 DEC 2023 21:18:54

Product : Car Infotainment Unit
 Test Item : Band Edge Data
 Test Mode : Transmit (802.11ac-80 MHz)

Chain A

Test Frequency (MHz)	Measurement Level (MHz)	Limit (MHz)	Result
5210	5248.04	<5250	PASS

Chain B

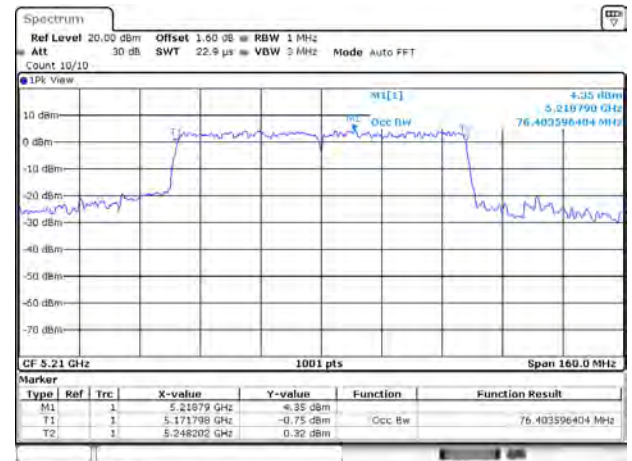
Test Frequency (MHz)	Measurement Level (MHz)	Limit (MHz)	Result
5210	5248.20	<5250	PASS

Channel 42 (Chain A)



Date: 19 DEC 2023 21:34:52

Channel 42 (Chain B)



Date: 19 DEC 2023 21:36:05

Product : Car Infotainment Unit
 Test Item : Band Edge Data
 Test Mode : Transmit (802.11ax-20 MHz)

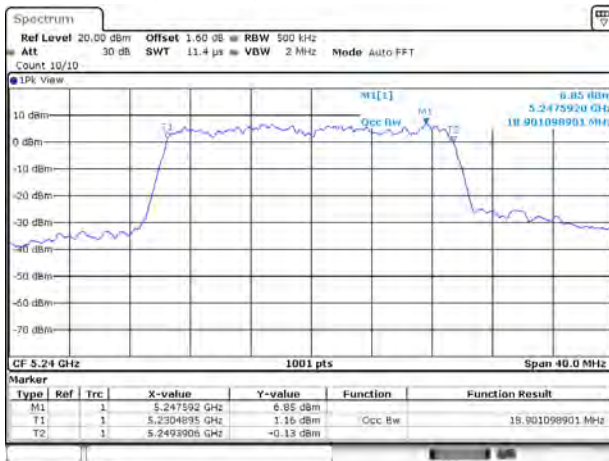
Chain A

Test Frequency (MHz)	Measurement Level (MHz)	Limit (MHz)	Result
5240	5249.39	<5250	PASS

Chain B

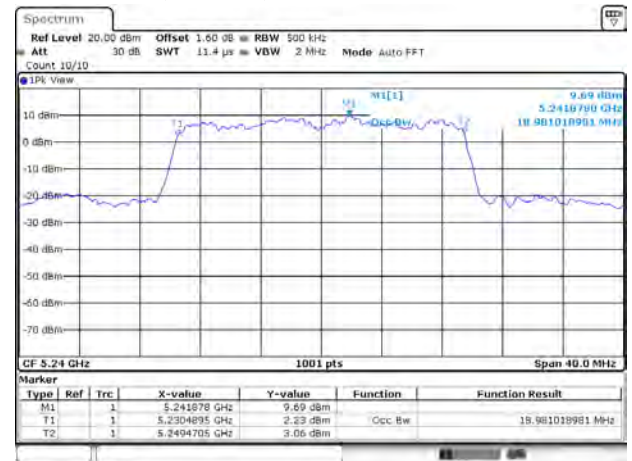
Test Frequency (MHz)	Measurement Level (MHz)	Limit (MHz)	Result
5240	5249.47	<5250	PASS

Channel 48 (Chain A)



Date: 19 DEC 2023 22:01:42

Channel 48 (Chain B)



Date: 19 DEC 2023 22:03:17

Product : Car Infotainment Unit
 Test Item : Band Edge Data
 Test Mode : Transmit (802.11ax-40 MHz)

Chain A

Test Frequency (MHz)	Measurement Level (MHz)	Limit (MHz)	Result
5230	5248.70	<5250	PASS

Chain B

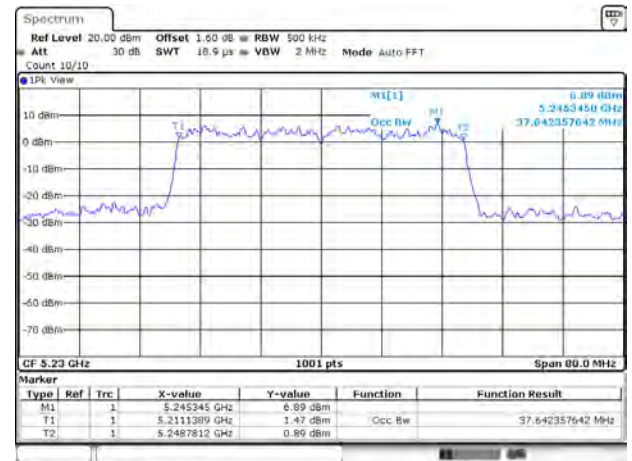
Test Frequency (MHz)	Measurement Level (MHz)	Limit (MHz)	Result
5230	5248.78	<5250	PASS

Channel 46 (Chain A)



Date 20 DEC 2023 00:27:03

Channel 46 (Chain B)



Date 20 DEC 2023 00:26:03

Product : Car Infotainment Unit
 Test Item : Band Edge Data
 Test Mode : Transmit (802.11ax-80 MHz)

Chain A

Test Frequency (MHz)	Measurement Level (MHz)	Limit (MHz)	Result
5210	5248.84	<5250	PASS

Chain B

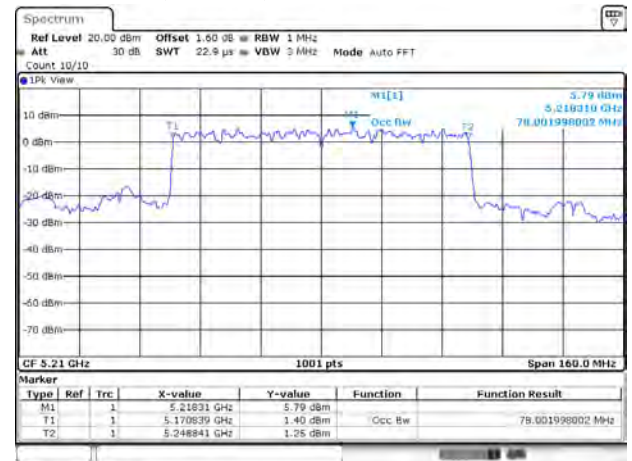
Test Frequency (MHz)	Measurement Level (MHz)	Limit (MHz)	Result
5210	5248.84	<5250	PASS

Channel 42 (Chain A)



Date 20 DEC 2023 00:41:42

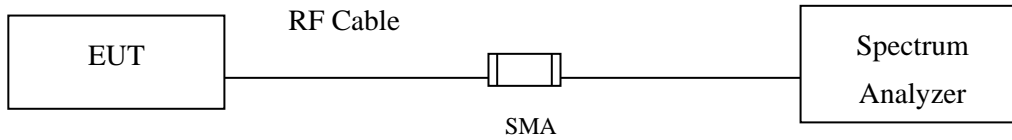
Channel 42 (Chain B)



Date 20 DEC 2023 00:45:32

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 : Car Infotainment Unit
 Test Item : Occupied Bandwidth Data
 Test Mode : Transmit (802.11a)
 Test Date : 2023/12/19

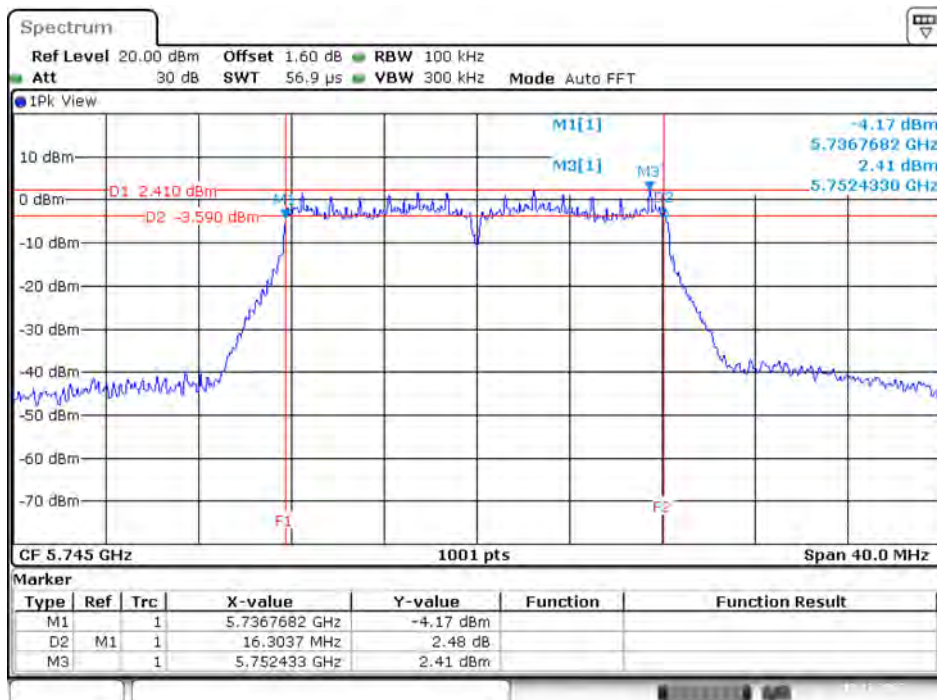
Chain A

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
149	5745	16304	>500	Pass
157	5785	16304	>500	Pass
165	5825	16304	>500	Pass

Chain B

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
149	5745	16304	>500	Pass
157	5785	16344	>500	Pass
165	5825	16344	>500	Pass

Channel 149 (Chain A)



Date: 19.DEC.2023 04:29:55

Product : Car Infotainment Unit
 Test Item : Occupied Bandwidth Data
 Test Mode : Transmit (802.11ac-20 MHz)
 Test Date : 2023/12/19

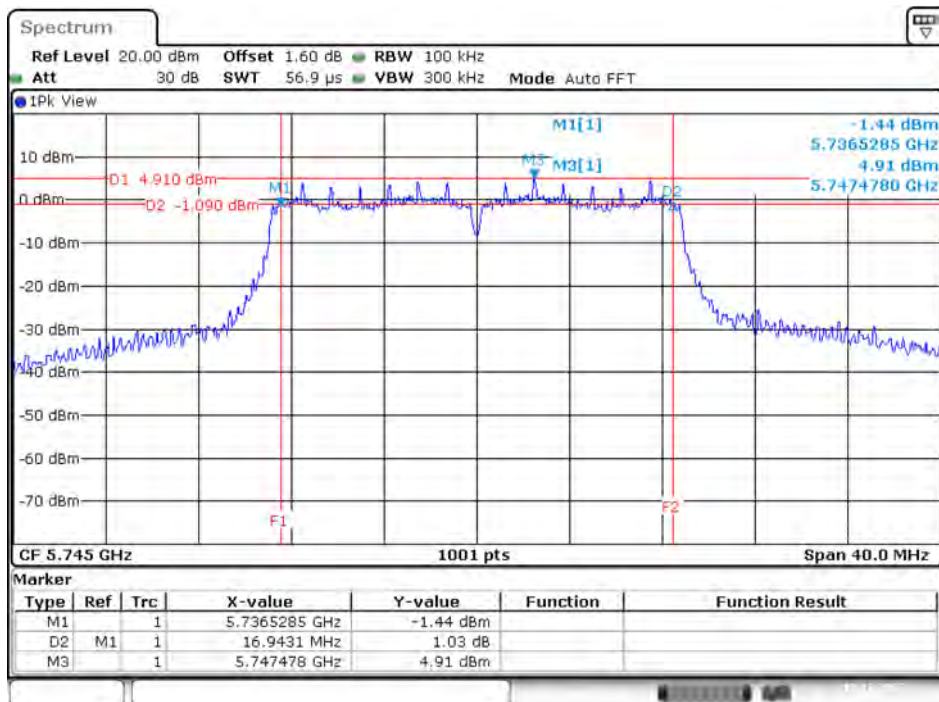
Chain A

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
149	5745	17543	>500	Pass
157	5785	17543	>500	Pass
165	5825	17503	>500	Pass

Chain B

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
149	5745	16943	>500	Pass
157	5785	17023	>500	Pass
165	5825	17063	>500	Pass

Channel 149 (Chain B)



Date: 19.DEC.2023 20:57:37

Product : Car Infotainment Unit
 Test Item : Occupied Bandwidth Data
 Test Mode : Transmit (802.11ac-40 MHz)
 Test Date : 2023/12/19

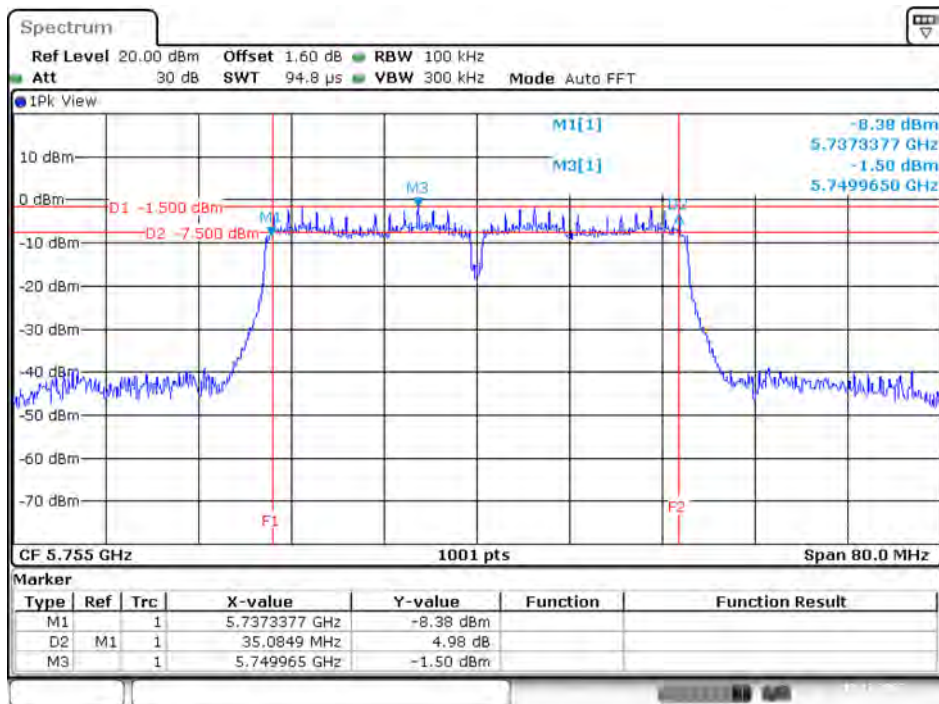
Chain A

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
151	5755	35085	>500	Pass
159	5795	35405	>500	Pass

Chain B

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
151	5755	35325	>500	Pass
159	5795	35325	>500	Pass

Channel 151 (Chain A)



Date: 19 DEC 2023 21:20:57

Product : Car Infotainment Unit
 Test Item : Occupied Bandwidth Data
 Test Mode : Transmit (802.11ac-80 MHz)
 Test Date : 2023/12/20

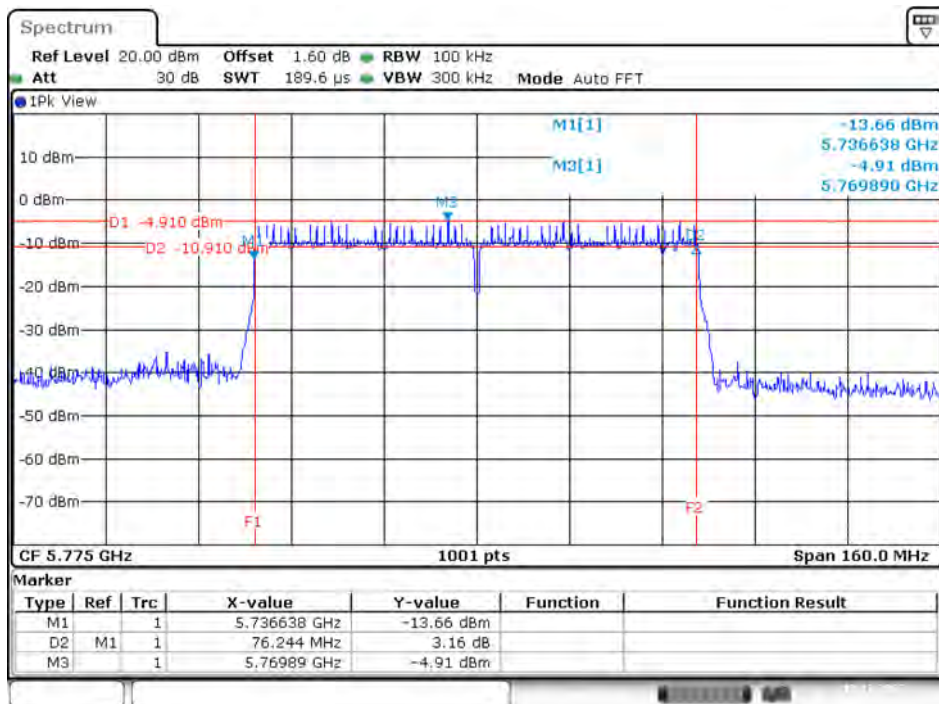
Chain A

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
155	5775	76244	>500	Pass

Chain B

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
155	5775	76244	>500	Pass

Channel 155 (Chain A)



Date: 19.DEC.2023 21:43:43

Product : Car Infotainment Unit
 Test Item : Occupied Bandwidth Data
 Test Mode : Transmit (802.11ax-20 MHz)
 Test Date : 2023/12/19

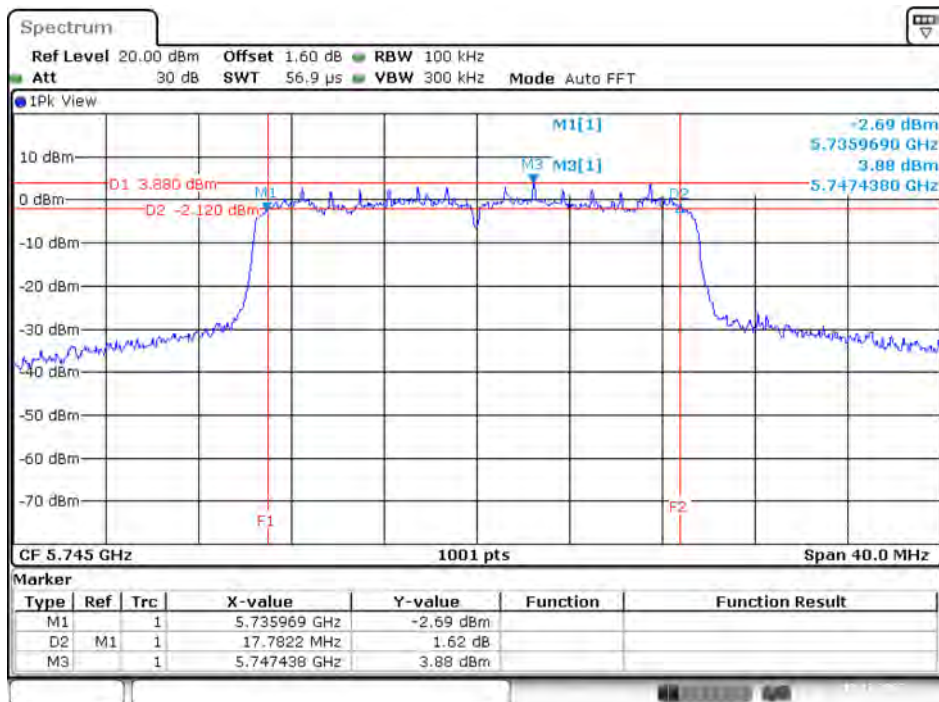
Chain A

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
149	5745	18022	>500	Pass
157	5785	18142	>500	Pass
165	5825	18422	>500	Pass

Chain B

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
149	5745	17782	>500	Pass
157	5785	18022	>500	Pass
165	5825	18182	>500	Pass

Channel 149 (Chain B)



Date: 19.DEC.2023 22:05:32

Product : Car Infotainment Unit
 Test Item : Occupied Bandwidth Data
 Test Mode : Transmit (802.11 ax-40 MHz)
 Test Date : 2023/12/20

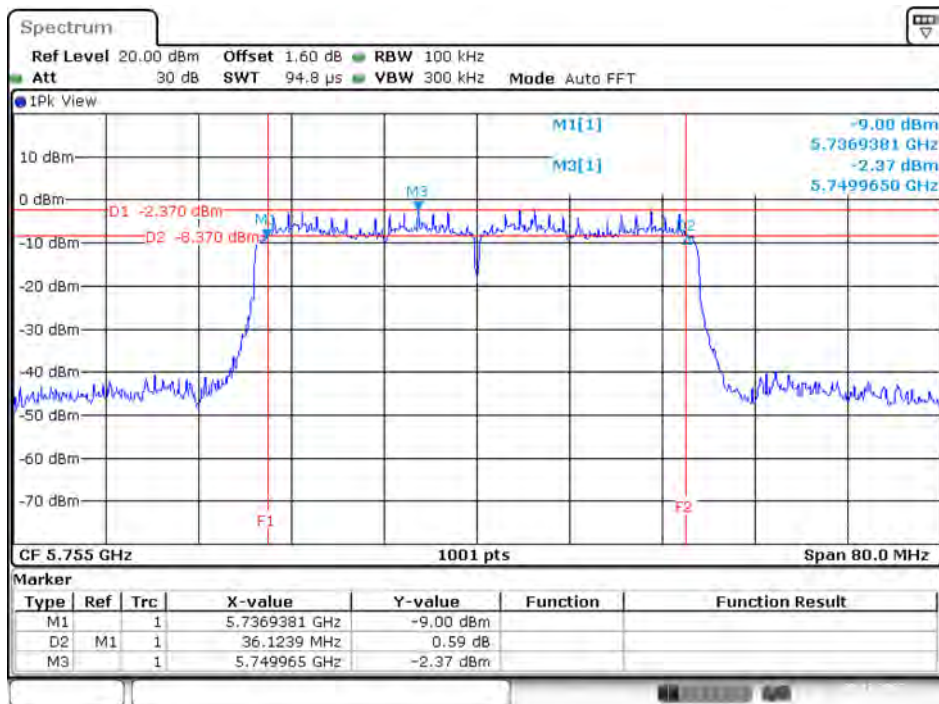
Chain A

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
151	5755	36124	>500	Pass
159	5795	36204	>500	Pass

Chain B

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
151	5755	36524	>500	Pass
159	5795	36364	>500	Pass

Channel 151 (Chain A)



Date: 20.DEC.2023 00:28:39

Product : Car Infotainment Unit
 Test Item : Occupied Bandwidth Data
 Test Mode : Transmit (802.11ax-80 MHz)
 Test Date : 2023/12/20

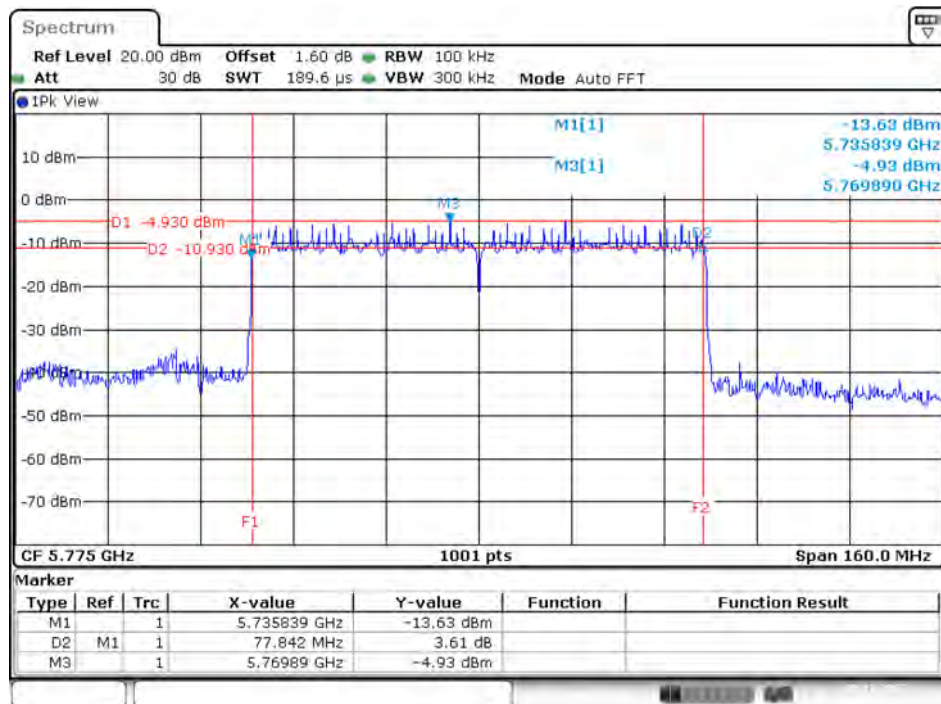
Chain A

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
155	5775	77842	>500	Pass

Chain B

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
155	5775	77842	>500	Pass

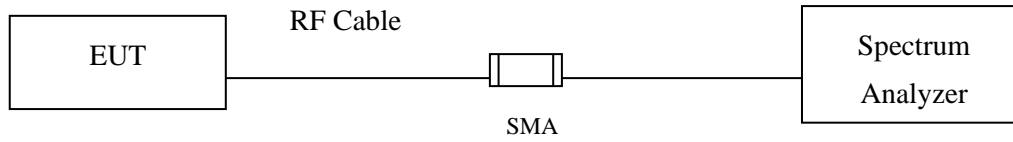
Channel 155 (Chain A)



Date: 20.DEC.2023 00:52:53

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 : Car Infotainment Unit
Test Item : Duty Cycle
Test Mode : Transmit

Duty Cycle Formula:

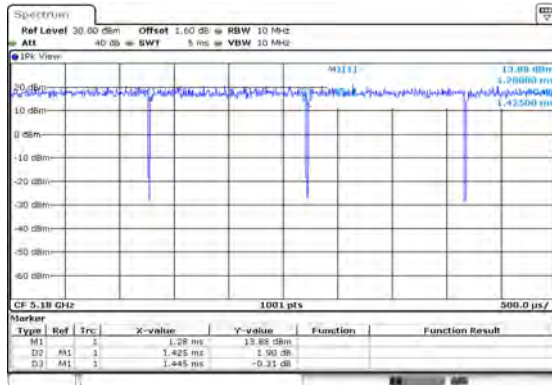
Duty Cycle = $T_{on} / (T_{on} + T_{off})$

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

Results:

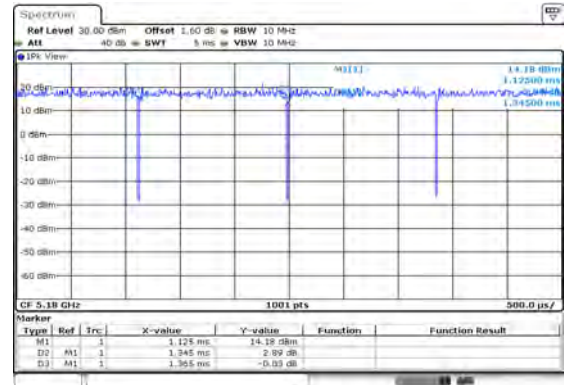
5 GHz band	Ton (ms)	Ton + Toff (ms)	Duty Cycle (%)	Duty Factor (dB)
802.11a	1.4250	1.4450	98.62	0.06
802.11ac-20 MHz	1.3450	1.3650	98.53	0.06
802.11ac-40 MHz	0.6650	0.6850	97.08	0.13
802.11ac-80 MHz	0.3250	0.3500	92.86	0.32
802.11ax-20 MHz	1.0400	1.0600	98.11	0.08
802.11ax-40 MHz	0.5500	0.5700	96.49	0.16
802.11ax-80 MHz	0.2850	0.3050	93.44	0.29

802.11a



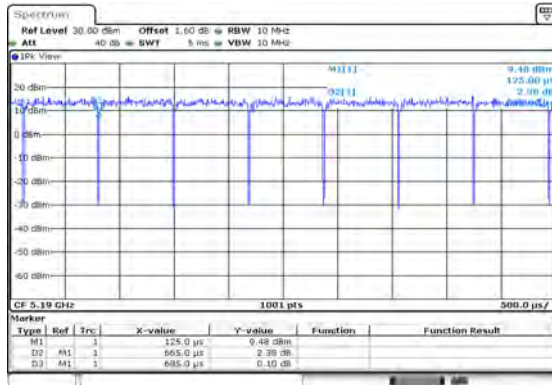
Date: 19 DEC 2023 04:20:27

802.11ac-20 MHz



Date: 19 DEC 2023 04:43:51

802.11ac-40 MHz



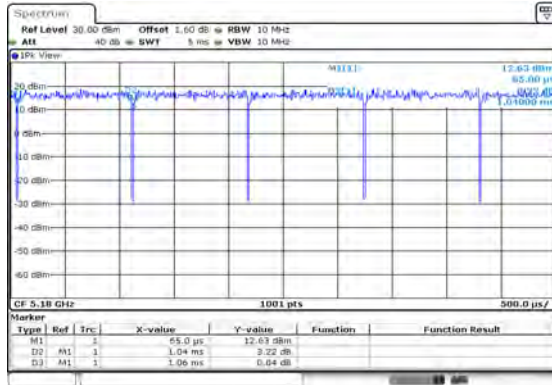
Date: 19 DEC 2023 21:11:34

802.11ac-80 MHz



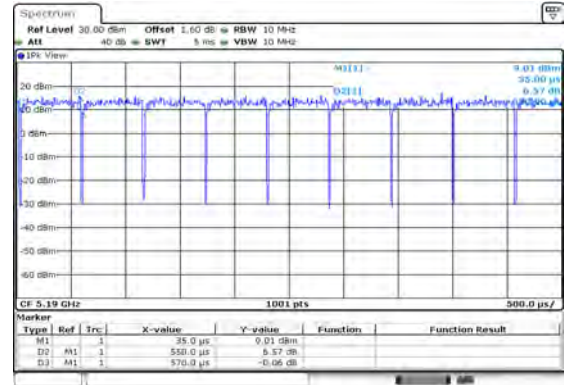
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802.11ax-20 MHz



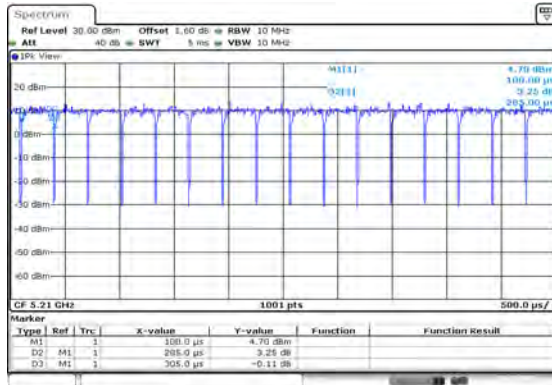
Date: 19 DEC 2023 21:50:36

802.11ax-40 MHz



Date: 20 DEC 2023 00:21:56

802.11ax-80 MHz



Date: 20 DEC 2023 00:41:33