



Test report No.: 2370318R-RFUSV01S-A

TEST REPORT

Product Name	Celer, Celer-5G, Celer-LTE1, Celer-LTE2
Trademark	Windbit
Model and /or type reference	TLDPH00P1, TLDPH01P1, TLDPH02P1, TLDPH03P1
FCC ID	YUATLDPH00P1
Applicant's name / address	Teldat S.A. Parque Tecnológico de Madrid c/ Isaac Newton, Tres Cantos, 28760 Spain
Manufacturer's name	Teldat S.A.
Test method requested, standard	FCC CFR Title 47 Part 15 Subpart C ANSI C63.4: 2014, ANSI C63.10: 2013
Verdict Summary	IN COMPLIANCE
Documented By (Senior Project Specialist / Genie Chang)	<i>Genie Chang</i>
Tested By (Senior Engineer / Ivan Chuang)	<i>Ivan Chuang</i>
Approved By (Senior Engineer / Jack Hsu)	<i>Jack Hsu</i>
Date of Receipt	2023/07/11
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Report Version	V1.0

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Appendix 1: EUT Test Photographs

Appendix 2: Product Photos-Please refer to the file: 2370318R-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
2370318R-RFUSV01S-A	V1.0	Initial issue of report.	2023/12/14

1. General Information

1.1. EUT Description

Product Name	Celer, Celer-5G, Celer-LTE1, Celer-LTE2
Trademark	Windbit
Model and /or type reference	TLDPH00P1, TLDPH01P1, TLDPH02P1, TLDPH03P1
EUT Rated Voltage	DC 12V-24V
EUT Test Voltage	DC 12V
Frequency Range	802.11b/g/n/ac/ax-20 MHz: 2412-2462 MHz 802.11n/ac/ax-40 MHz: 2422-2452 MHz
Number of Channels	802.11b/g/n/ac/ax-20 MHz: 11CH 802.11n/ac/ax-40MHz: 7CH
Data Speed	802.11b: 1-11Mbps 802.11g: 6-54Mbps 802.11n: up to 300Mbps 802.11ac: up to 400Mbps 802.11ax: up to 573.6Mbps
Channel separation	802.11b/g/n/ac/ax: 5 MHz
Type of Modulation	802.11b: DSSS (DBPSK, DQPSK, CCK) 802.11g/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
Channel Control	Auto
Molex Cable	MFR: Dong Wei, M/N: DWE-EJ-382, Non-shielded, 1m
Tested Sample	Product: Celer-5G, Model: TLDPH01P1

Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	MASTER WAVE TECHNOLOGY CO., LTD.	98614PRSX000 (Main)	Dipole	2.44 dBi for 2400 MHz
		98614PRSX000 (Aux)		2.44 dBi for 2400 MHz

Note:

1. The antenna of EUT is conforming to FCC 15.203.
2. The antenna gain as by the manufacturer provided.
3. Each antenna has been evaluated and only the worst case (higher gain antenna) is presented in the report.

For CDD mode:

2400MHz: Power Directional gain = 2.44 dBi

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

2400MHz: PSD Directional gain = 5.45 dBi

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

802.11b/g/n/ac/ax-20 MHz Center Frequency of Each Channel:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
01	2412	02	2417	03	2422	04	2427
05	2432	06	2437	07	2442	08	2447
09	2452	10	2457	11	2462	--	--

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

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
03	2422	04	2427	05	2432	06	2437
07	2442	08	2447	09	2452	--	--

Note:

1. The EUT is a Celer, Celer-5G, Celer-LTE1, Celer-LTE2 with a built-in WLAN and Bluetooth transceiver, this report for 2.4GHz WLAN.
2. The difference between the 4 models except marketing purpose and also contains with different WWAN module as below.
For FCC, model TLDPH00P1 and TLDPH01P1 and TLDPH03P1 were used, and for CE, model TLDPH00P1 and TLDPH01P1 and TLDPH02P1 were used.

For testing purpose:

Product name	Model name	Contains WWAN module
Celer	TLDPH00P1	w/o WWAN module
Celer-5G	TLDPH01P1	5G module (Model: RM520N-GL, FCC ID: XMR2022RM520NGL)
Celer-LTE1	TLDPH02P1	4G module (Model: EM06-E)
Celer-LTE2	TLDPH03P1	4G module (Model: EM06-A, FCC ID:XMR201906EM06A)

Note: From the above models, model: TLDPH01P1 was selected as representative model for the test and its data was recorded in this report.

3. Regarding to the operation frequency, the lowest, middle and highest frequency are selected to perform the test. The other channels are for reference only.
4. Lowest data rates are tested in each mode. Only worst case is shown in the report.
(802.11b is 1Mbps 、 802.11g is 6Mbps 、 802.11ax-20BW/40BW is MCS0)
5. The CDD mode is the worst case for the final test and shown in this report.
6. The spectrum plot against conducted item only shows the worst case.
7. This device does not support partial RU function.
8. These tests are conducted on a sample for the purpose of demonstrating compliance of 802.11b/g/n/ac/ax transmitter with Part 15 Subpart C Paragraph 15.247 of spread spectrum devices.

Test Mode	Mode 1	
		Transmit (802.11b)
		Transmit (802.11g)
		Transmit (802.11ax-20BW)
		Transmit (802.11ax-40BW)

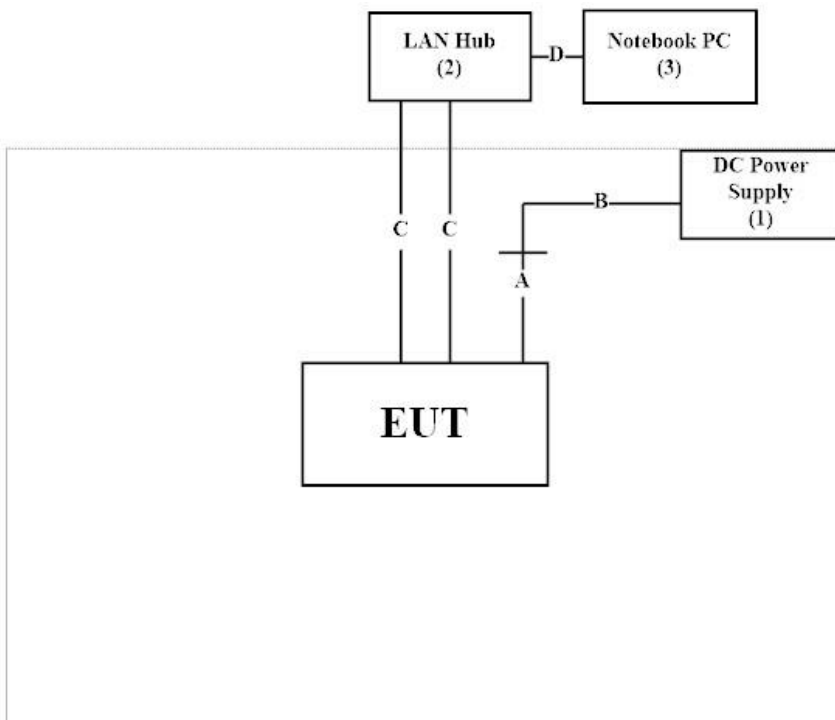
1.2. Tested System Details

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 DC POWER SUPPLY	KEYSIGHT	E36234A	MY59001234	Non-shielded, 1.8m
2 LAN Hub	TP-LINK	TL-SG108	2161597000480	Non-shielded, 1.5m
3 Notebook PC	Lenovo	TP00067C	PF-0EW0C3	N/A

Cable Type	Cable Description
A Power Cable	Non-shielded, 1m
B Power Cable	Non-shielded, 2m
C LAN Cable	Non-shielded, 3m
D LAN 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 “QSPR Version 5.0-00197” 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	25.5 °C
	Humidity (%RH)	10~90 %	59.0 %
Radiated Emission	Temperature (°C)	10~40 °C	22.4 °C
	Humidity (%RH)	10~90 %	44.0 %
Conductive	Temperature (°C)	10~40 °C	25.5 °C
	Humidity (%RH)	10~90 %	55.0 %

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 Item and Equipment

For Conduction measurements / HY-SR01

	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due. Date
V	EMI Test Receiver	R&S	ESR7	101601	2023/06/20	2024/06/19
V	Two-Line V-Network	R&S	ENV216	101306	2023/03/16	2024/03/15
V	Two-Line V-Network	R&S	ENV216	101307	2023/08/17	2024/08/16
V	Coaxial Cable	SUHNER	RG400_BNC	RF001	2023/01/10	2024/01/09

Note:

1. All equipments are calibrated every one year.
2. The test instruments marked with “X” are used to measure the final test results.
3. Test Software Version: e3 230303 dekra V9.

For Conducted measurements / HY-SR02

	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due. Date
V	Spectrum Analyzer	R&S	FSV30	103466	2022/12/22	2023/12/21
V	Peak Power Analyzer	KEYSIGHT	8990B	MY51000539	2023/05/15	2024/05/14
V	Power Sensor	KEYSIGHT	N1923A	MY59240002	2023/05/18	2024/05/17
V	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 “X” 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	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	101101	2021/11/30	2023/11/29
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		
V	Filter	MICRO TRONICS	BRM50702	G269	2023/01/05	2024/01/04
	Filter	MICRO TRONICS	BRM50716	G196	2023/01/05	2024/01/04
V	EMI Test Receiver	R&S	ESR3	102793	2022/12/05	2023/12/04
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		
	Coaxial Cable	SGH	HA800	GD20110223-1		
	Coaxial Cable	SGH	HA800	GD20110222-3		

Note:

1. All equipments are calibrated every one year.
2. The test instruments marked with “X” are used to measure the final test results.
3. Test Software version : e3 230303 dekra V9.

1.7. Uncertainty

Uncertainties have been calculated according to the DEKRA internal document.

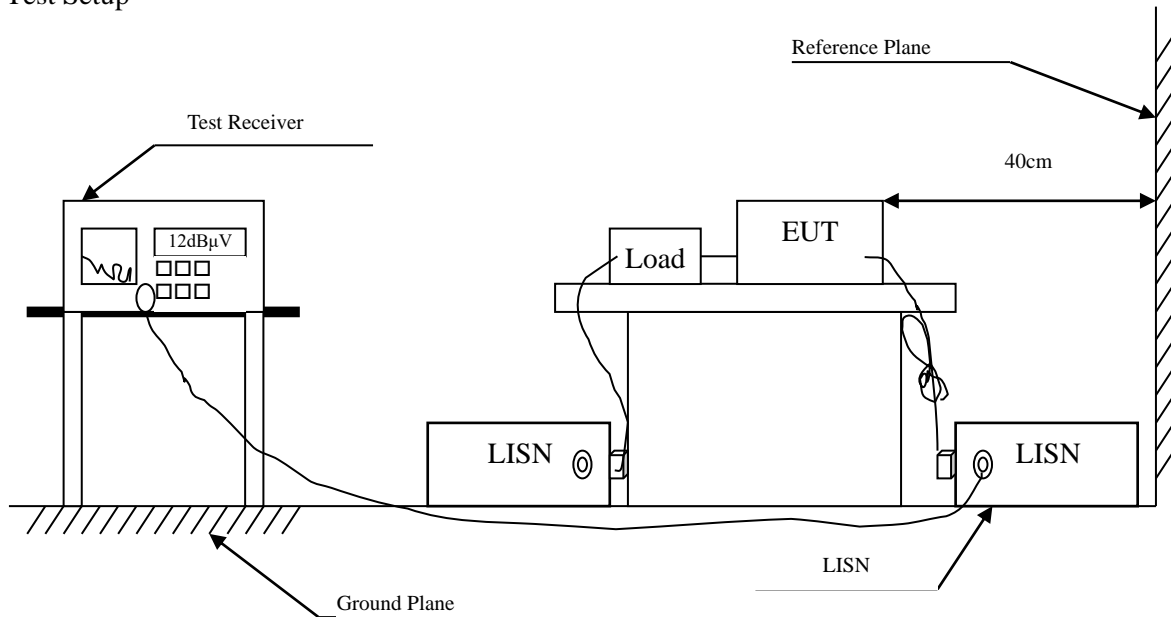
The reported expanded uncertainties are based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95%.

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 Power Output	Spectrum Analyzer: ± 2.14 dB Power Meter: ± 1.05 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
RF Antenna Conducted Test	± 2.14 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
6dB Bandwidth	± 1580.61 Hz
Power Density	± 2.14 dB
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	AVG
0.15 - 0.50	66-56	56-46
0.50 - 5.0	56	46
5.0 - 30	60	50

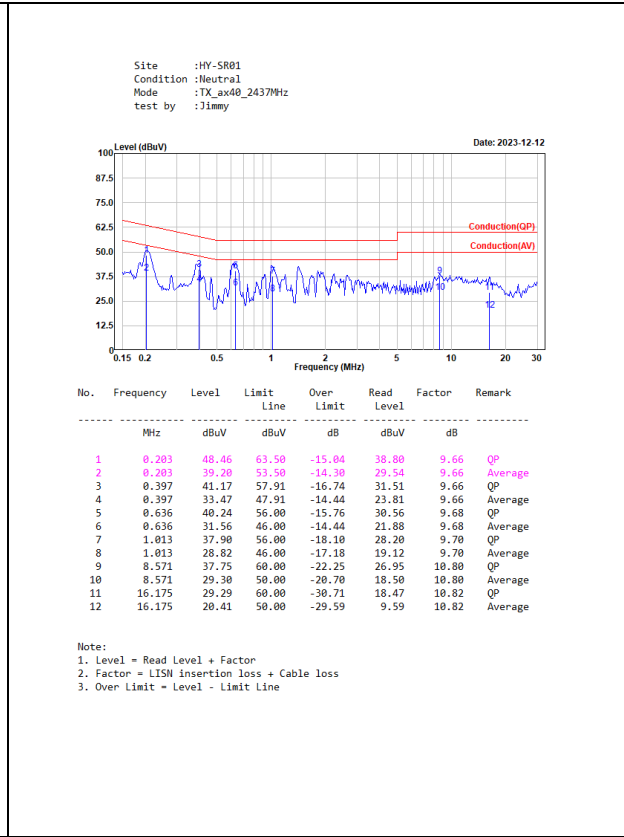
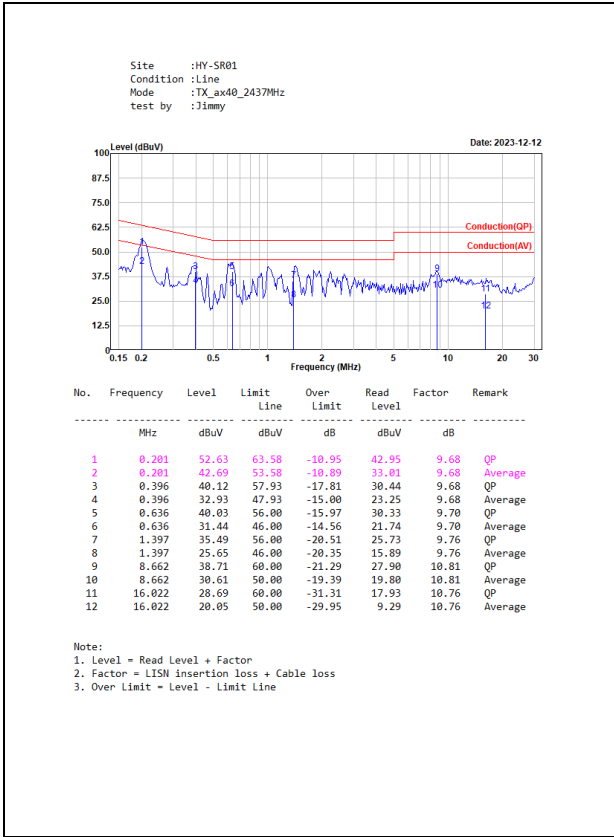
2.3. Test Procedure

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 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.

2.4. Test Result of Conducted Emission



3. Maximum Power Output

3.1. Test Setup



3.2. Limits

The maximum peak power shall be less 1 Watt.

3.3. Test Procedure

The EUT was tested according to C63.10:2013 for compliance to FCC 47CFR 15.247 requirements.

The maximum peak conducted output power using C63.10:2013 Section 11.9.1.3 PKPM1 Peak power meter method.

The maximum average conducted output power using C63.10:2013 Section 11.9.2.3

Measurement using a power meter (PM). (Measurement using a gated RF average-reading power meter).

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:

2400MHz: Directional gain = 2.44 dBi, Limit= 30dBm

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

3.4. Test Result of Maximum Power Output

Product : Celer, Celer-5G, Celer-LTE1, Celer-LTE2
Test Item : Maximum Power Output Data
Test Mode : Transmit (802.11b)
Test Date : 2023/08/04

Channel No.	Frequency (MHz)	Data Rate (Mbps)	Chain A Power (dBm)	Chain B Power (dBm)	Average Output Power Chain A+B (dBm)	Limit (dBm)	Result
01	2412	1	18.83	18.79	21.82	<30dBm	Pass
02	2417	1	18.49	18.61	21.56	<30dBm	Pass
06	2437	1	16.46	16.40	19.44	<30dBm	Pass

Note: Average Power Output Value (dBm) = $10 \cdot \text{LOG} (\text{Chain A (mW)} + \text{Chain B (mW)})$

Product : Celer, Celer-5G, Celer-LTE1, Celer-LTE2
Test Item : Maximum Power Output Data
Test Mode : Transmit (802.11g)
Test Date : 2023/08/04

Channel No.	Frequency (MHz)	Data Rate (Mbps)	Chain A Power (dBm)	Chain B Power (dBm)	Average Output Power Chain A+B (dBm)	Limit (dBm)	Result
01	2412	6	16.70	16.62	19.67	<30dBm	Pass
06	2437	6	18.59	18.65	21.63	<30dBm	Pass
11	2462	6	14.24	14.06	17.16	<30dBm	Pass

Note: Average Power Output Value (dBm) = $10 \cdot \text{LOG} (\text{Chain A (mW)} + \text{Chain B (mW)})$

Product : Celer, Celer-5G, Celer-LTE1, Celer-LTE2
Test Item : Maximum Power Output Data
Test Mode : Transmit (802.11ax-20BW)
Test Date : 2023/08/04

Channel No.	Frequency (MHz)	Data Rate	Chain A Power (dBm)	Chain B Power (dBm)	Average Output Power Chain A+B (dBm)	Limit (dBm)	Result
01	2412	MCS0	18.69	18.65	21.68	<30dBm	Pass
06	2437	MCS0	18.67	18.76	21.73	<30dBm	Pass
11	2462	MCS0	13.25	13.27	16.27	<30dBm	Pass

Note: Average Power Output Value (dBm) = $10 \cdot \text{LOG} (\text{Chain A (mW)} + \text{Chain B (mW)})$

Product : Celer, Celer-5G, Celer-LTE1, Celer-LTE2
Test Item : Maximum Power Output Data
Test Mode : Transmit (802.11ax-40BW)
Test Date : 2023/08/04

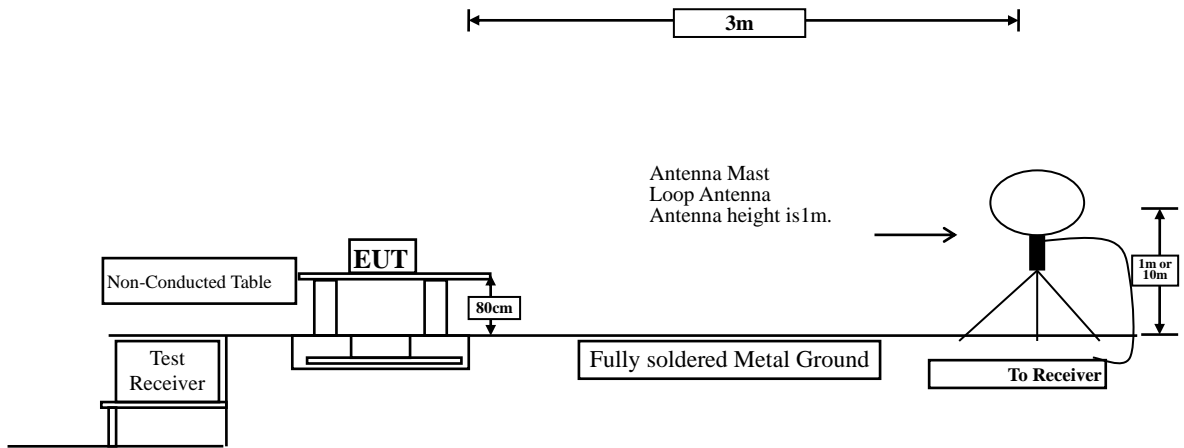
Channel No.	Frequency (MHz)	Data Rate	Chain A Power (dBm)	Chain B Power (dBm)	Average Output Power Chain A+B (dBm)	Limit (dBm)	Result
03	2422	MCS0	14.57	14.40	17.50	<30dBm	Pass
06	2437	MCS0	17.65	17.59	20.63	<30dBm	Pass
09	2452	MCS0	11.57	11.18	14.39	<30dBm	Pass

Note: Average Power Output Value (dBm) = $10 \cdot \text{LOG} (\text{Chain A (mW)} + \text{Chain B (mW)})$

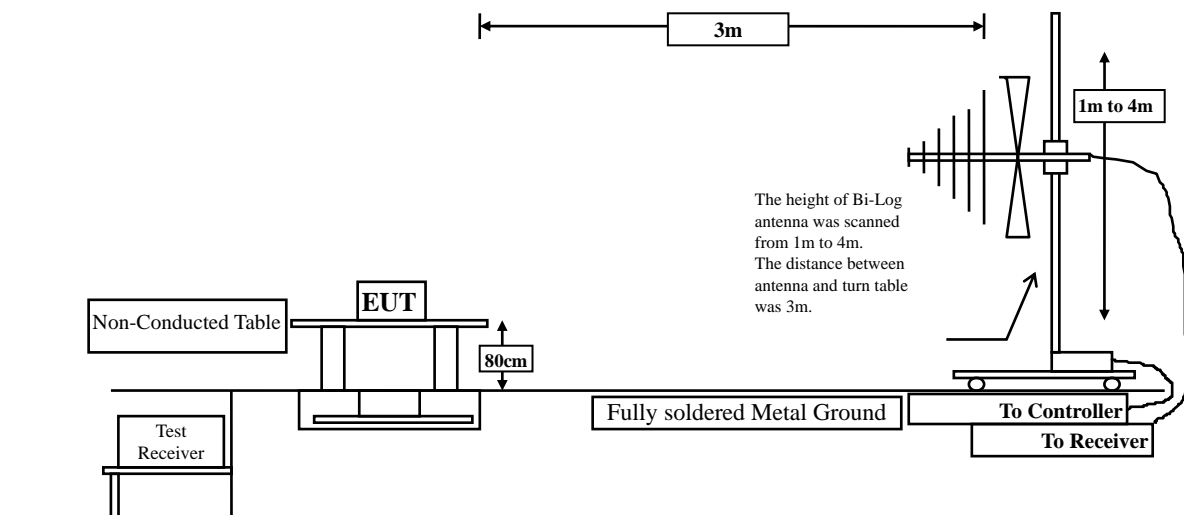
4. Radiated Emission

4.1. Test Setup

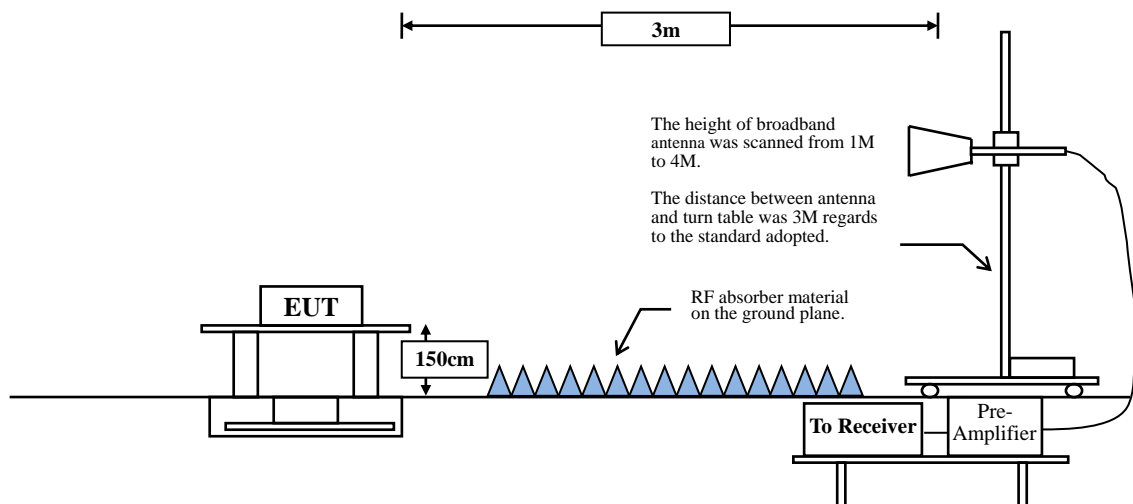
Radiated Emission Under 30MHz



Radiated Emission Below 1GHz



Radiated Emission Above 1GHz



4.2. Limits

► General Radiated Emission 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 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:
1. RF Voltage (dB μ V) = 20 log RF Voltage (μ 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.

4.3. Test Procedure

The EUT was setup according to ANSI C63.10: 2013 and tested according to C63.10:2013 Section 11.12.1 for compliance to FCC 47CFR 15.247 requirements.

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

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

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

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

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

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

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

The suspected frequencies are searched for in Preliminary Measurement with the measurement antenna kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. The antenna is pointed at an angle towards the source of the emission, and the EUT is rotated in both height and polarization to maximize the measured emission. The emission is kept within the illumination area of the 3 dB bandwidth of the antenna.

The measurement frequency range from 9kHz - 10th Harmonic of fundamental was investigated.

RBW and VBW Parameter setting:

According to C63.10 Section 11.12.2.4 Peak measurement procedure.

RBW = as specified in Table 1.

VBW $\geq 3 \times$ RBW.

Table 1 - RBW as a function of frequency

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

According to C63.10 Section 11.12.2.5 Average measurement procedure.

RBW = 1MHz.

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

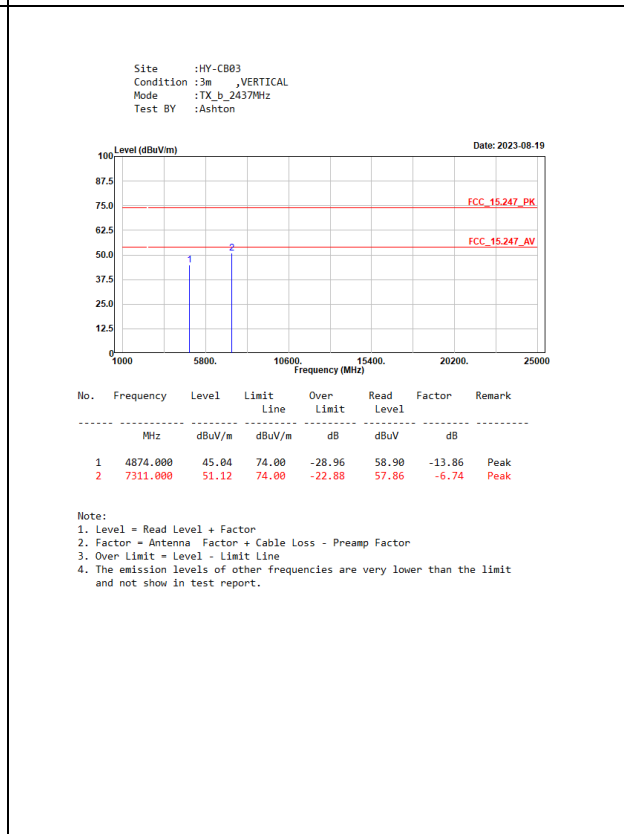
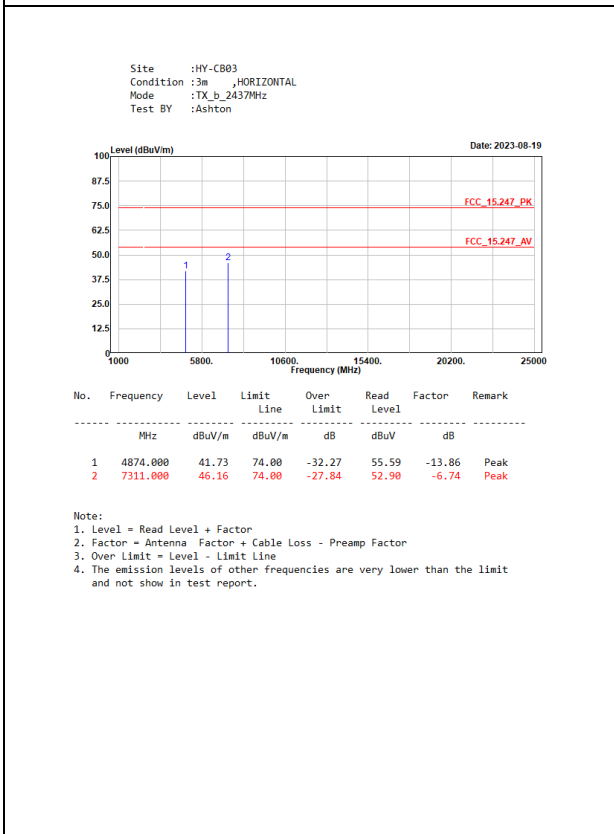
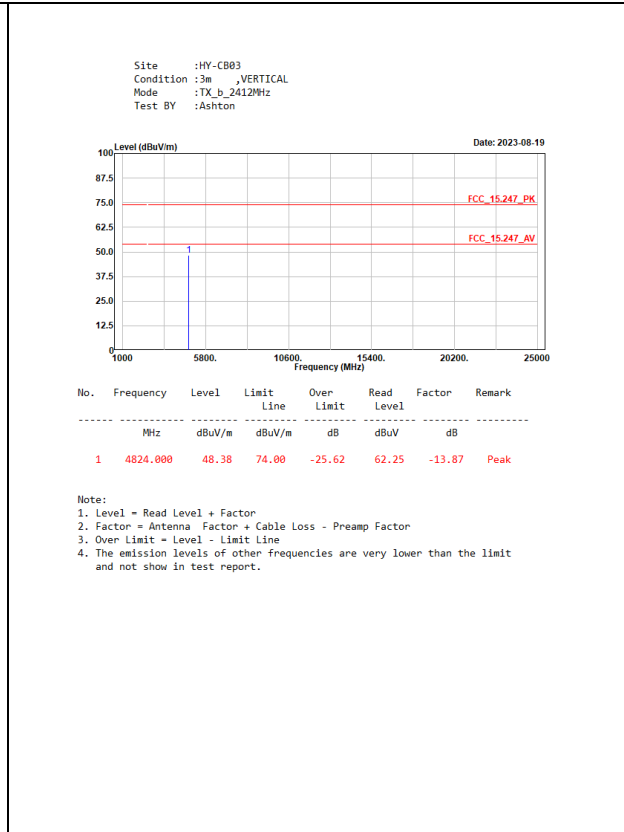
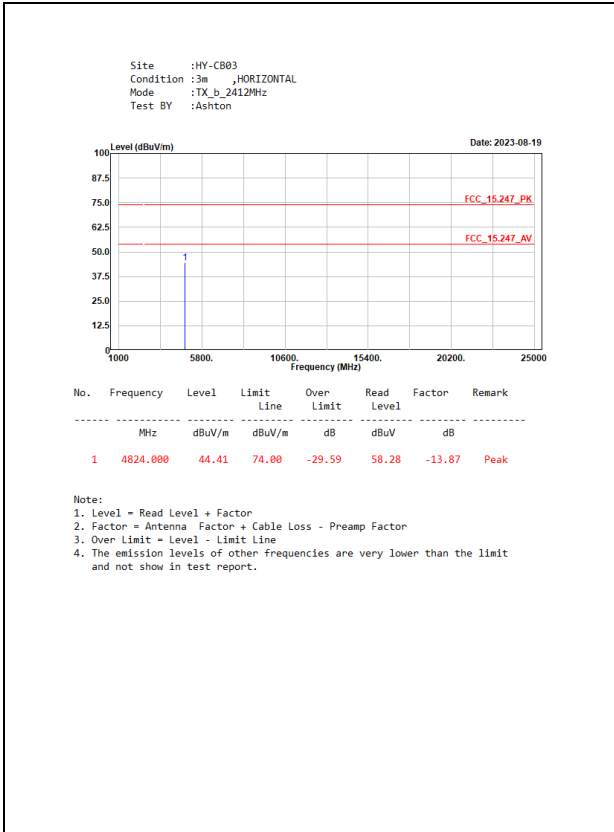
VBW $\geq 1/T$, when duty cycle $< 98 \%$

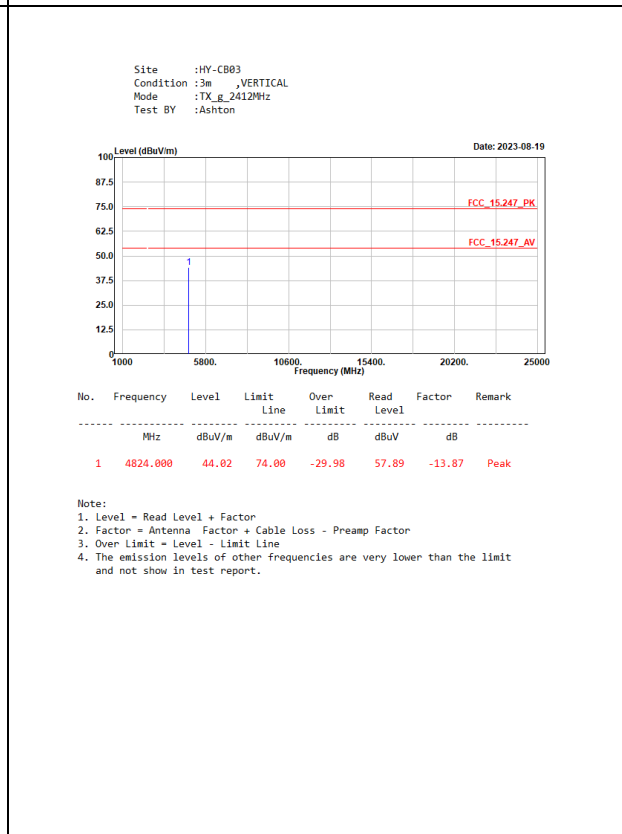
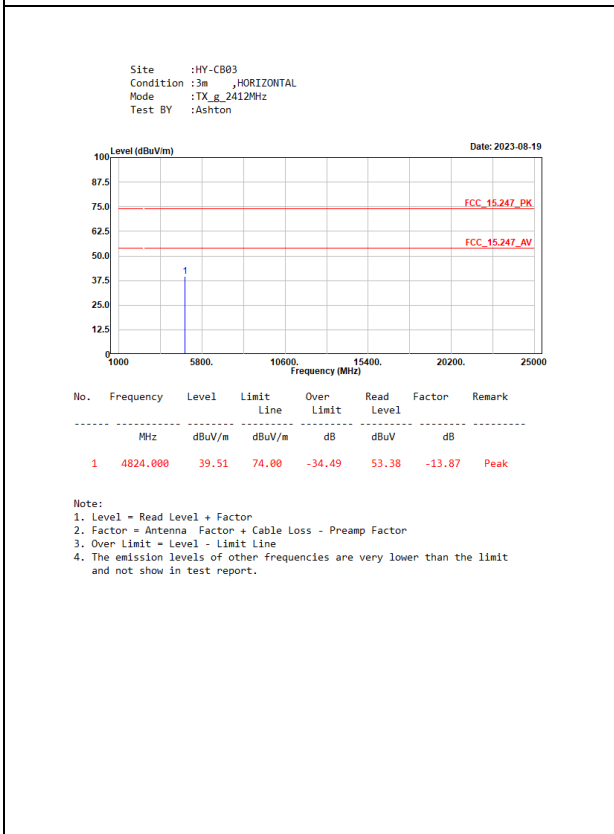
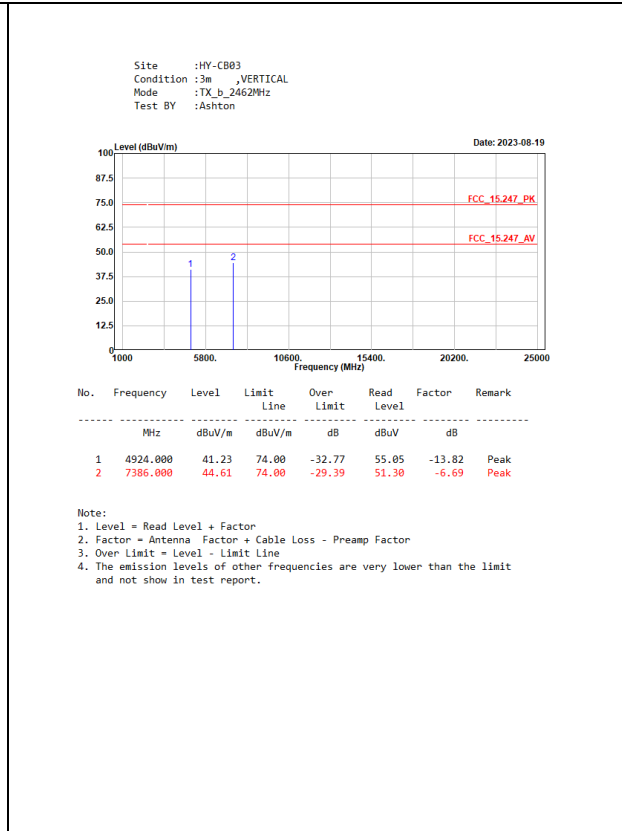
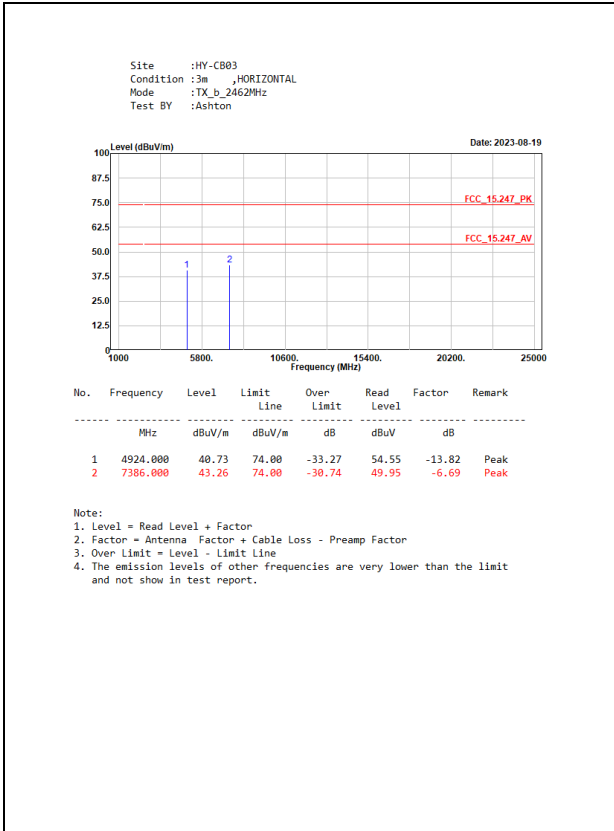
(T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

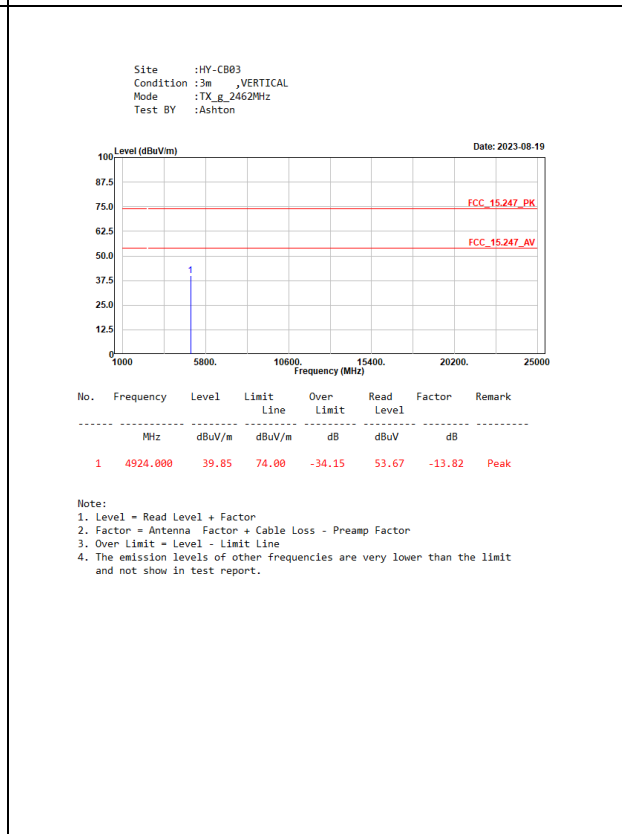
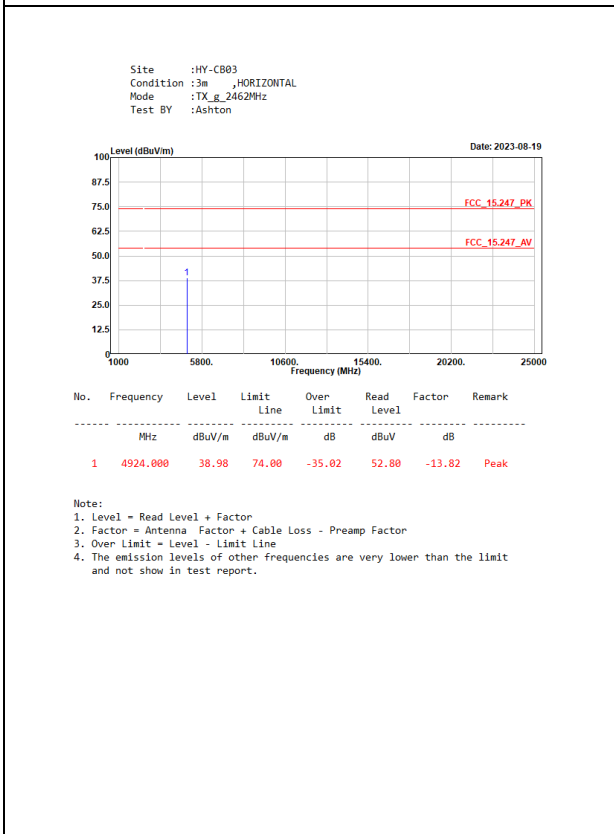
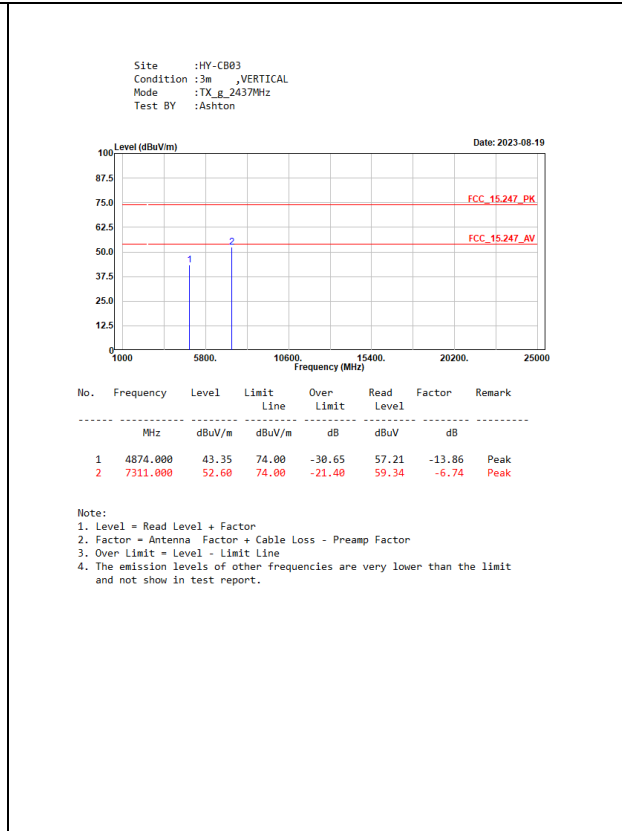
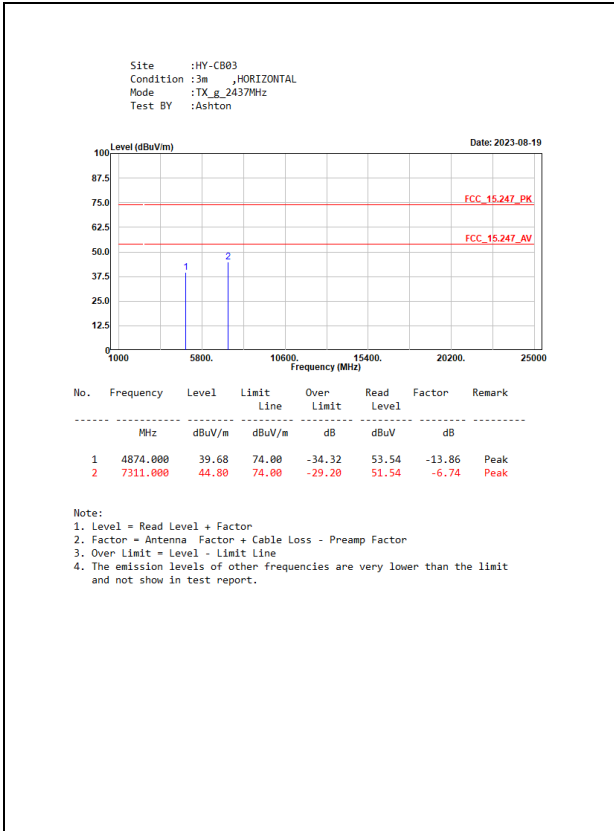
2.4GHz band	Duty Cycle (%)	T (ms)	1/T (Hz)	VBW (Hz)
802.11b	92.78	17.9821	56	100
802.11g	89.47	1.4280	700	1000
802.11ax-20 MHz	79.65	5.4000	185	200
802.11ax-40 MHz	80.09	5.4300	184	200

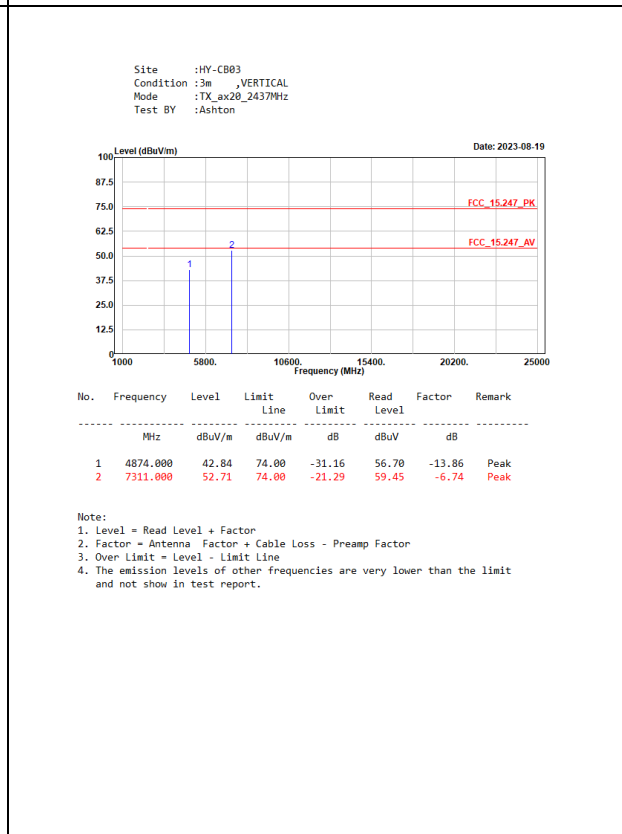
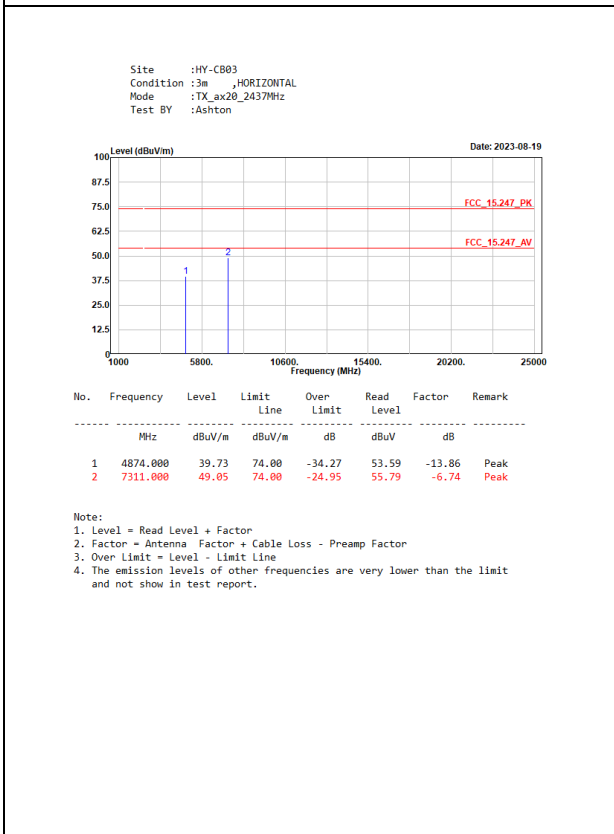
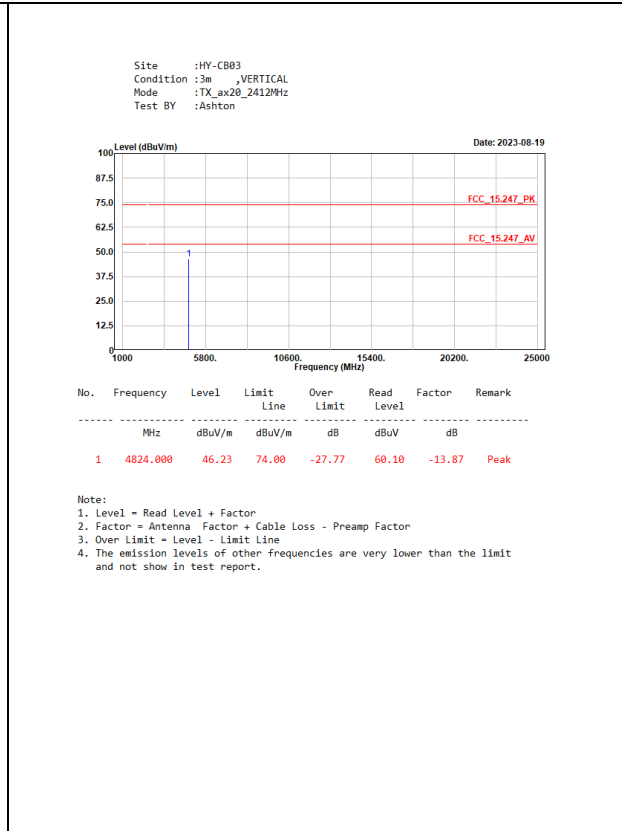
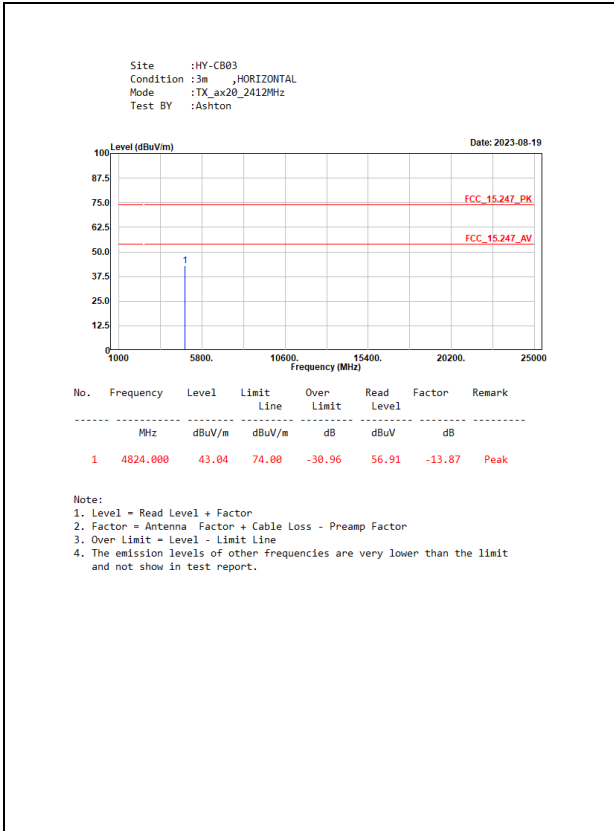
Note: Duty Cycle Refer to Section 9.

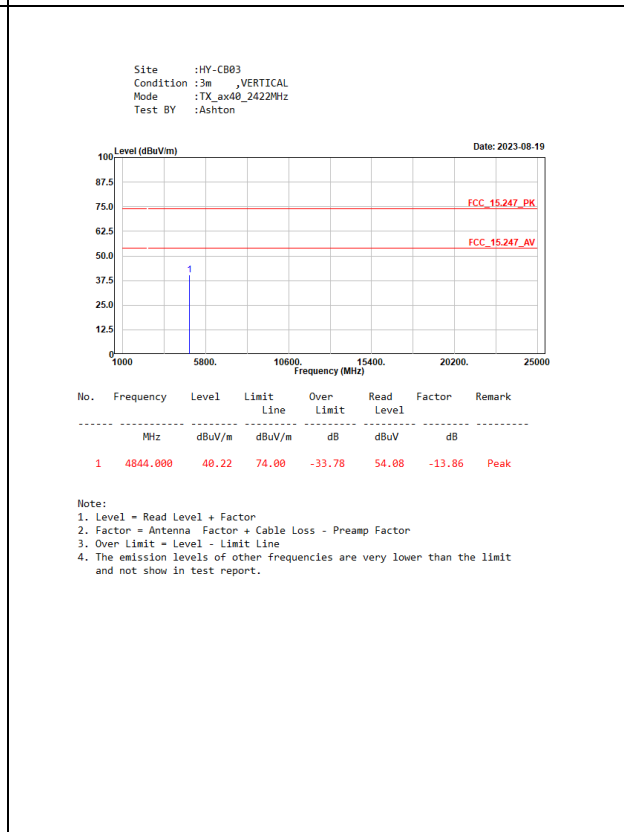
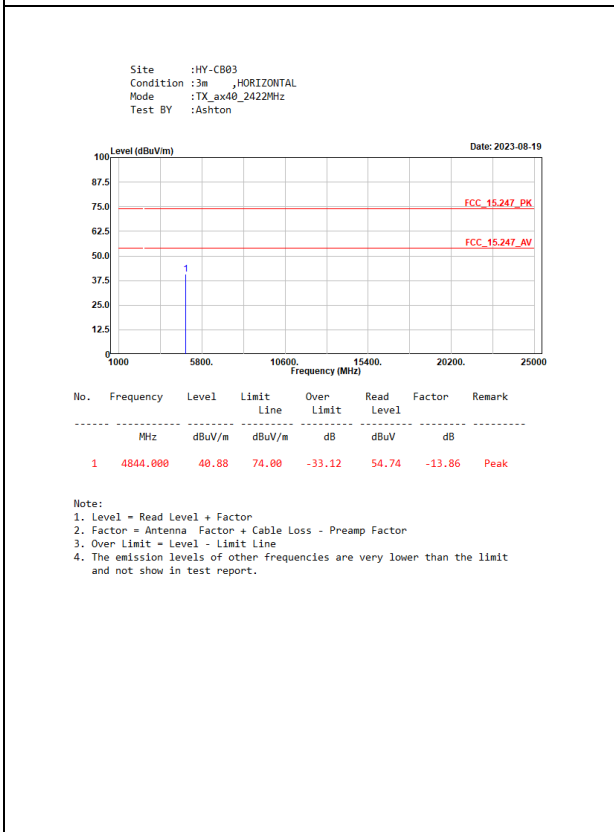
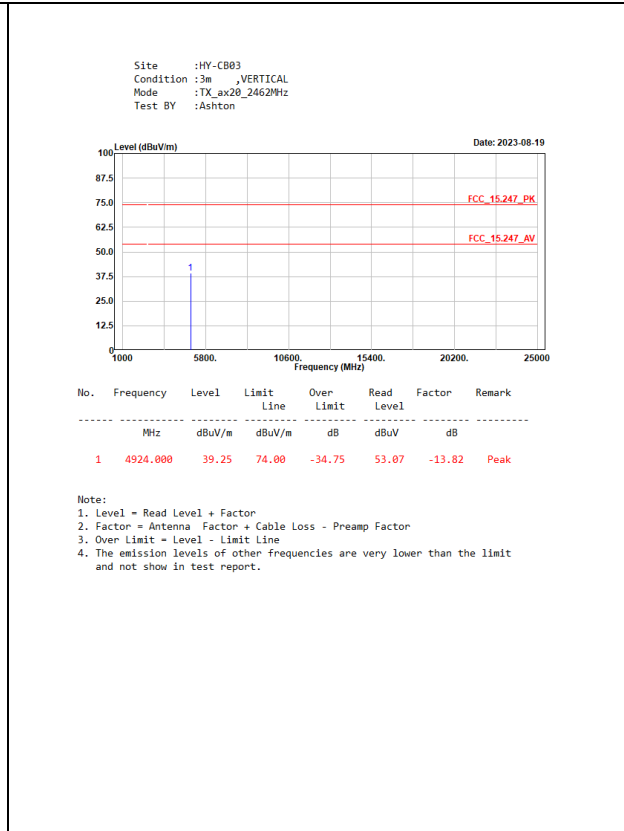
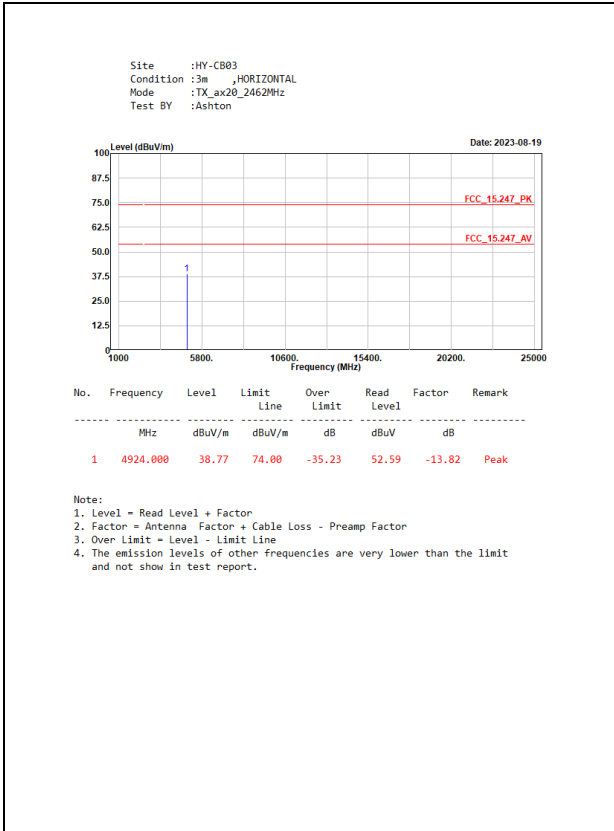
4.4. Test Result of Radiated Emission

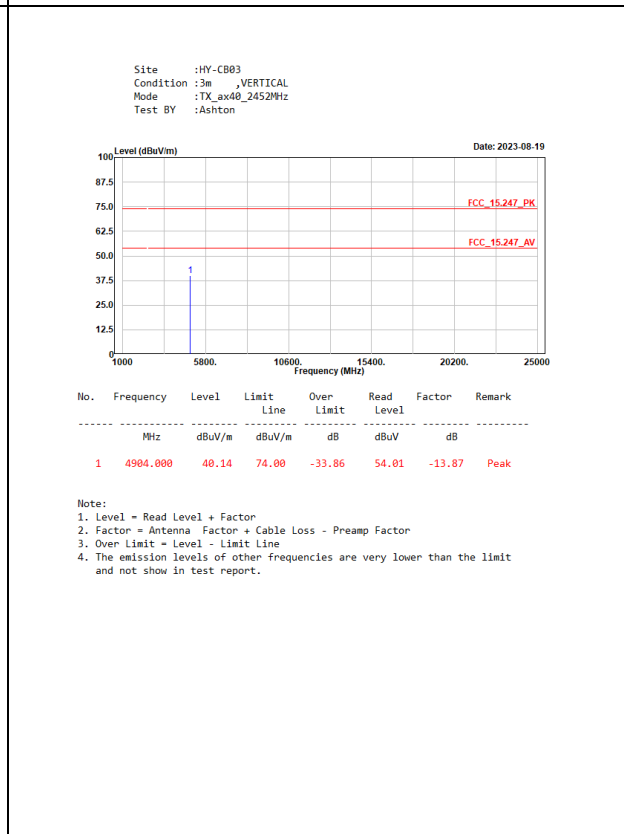
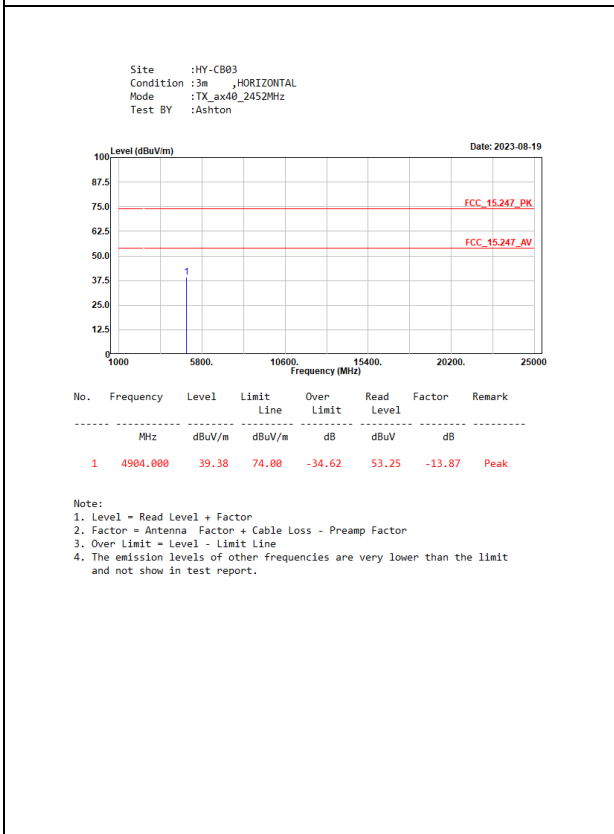
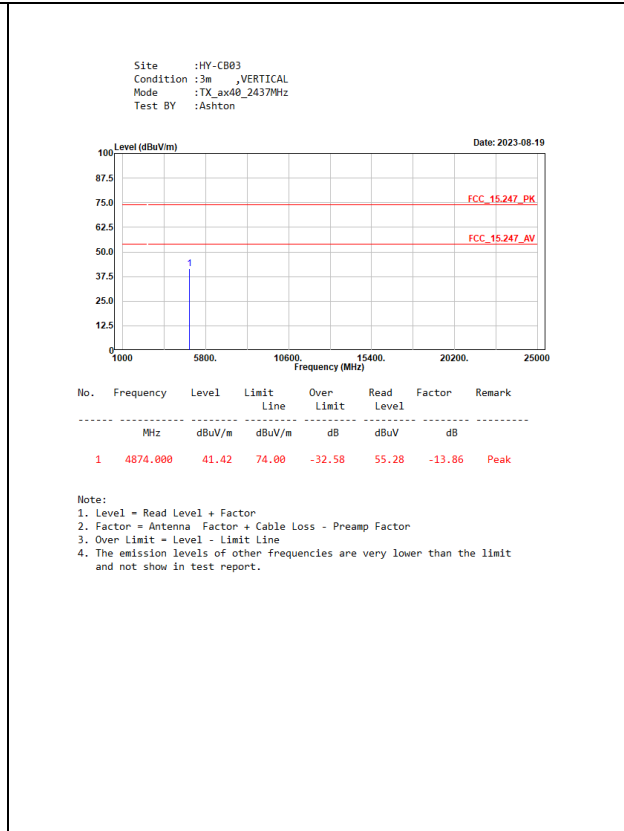
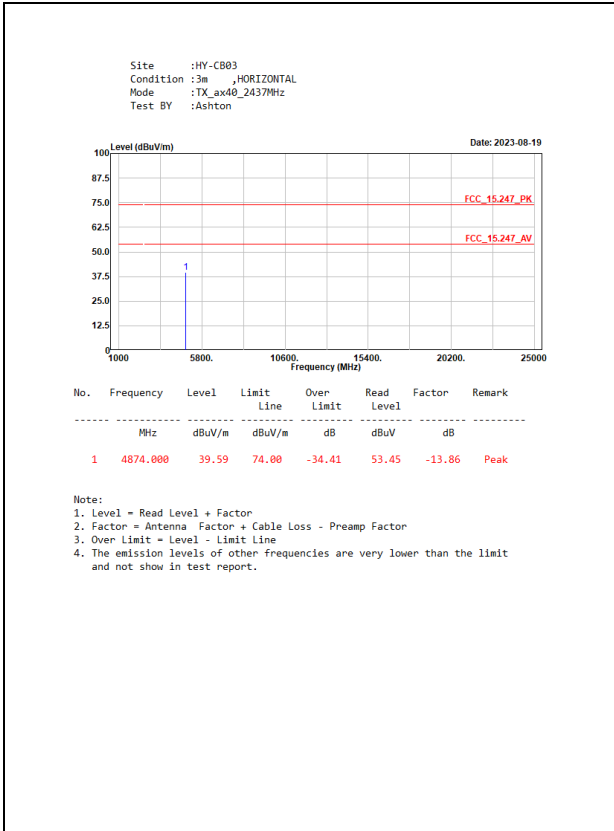


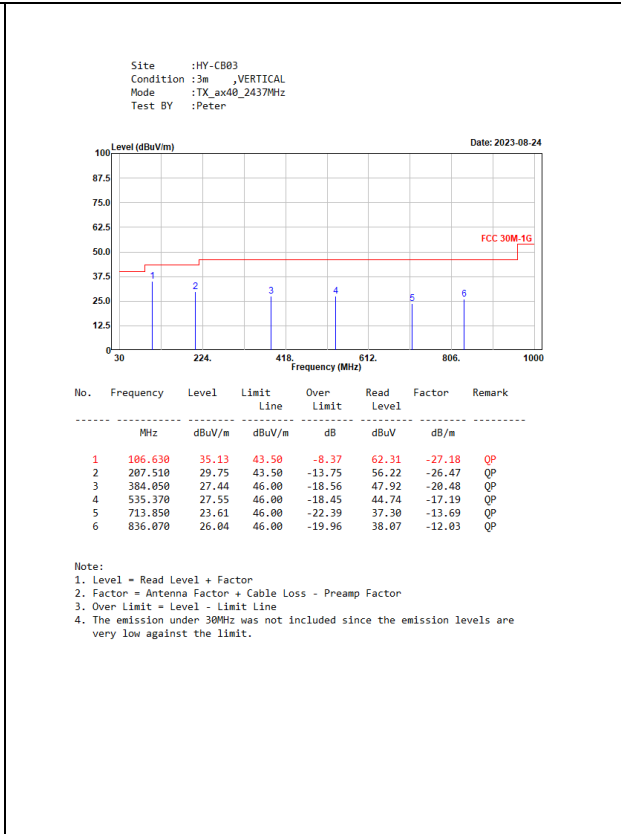
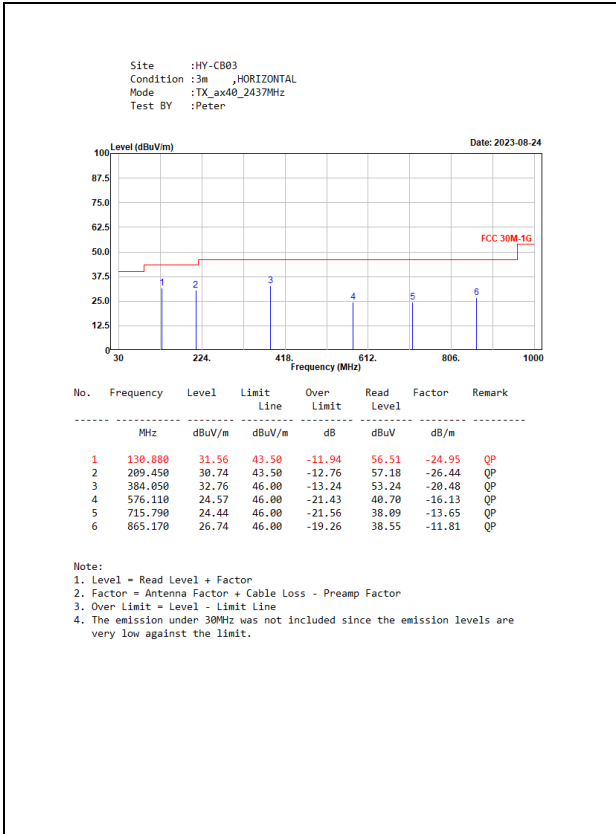




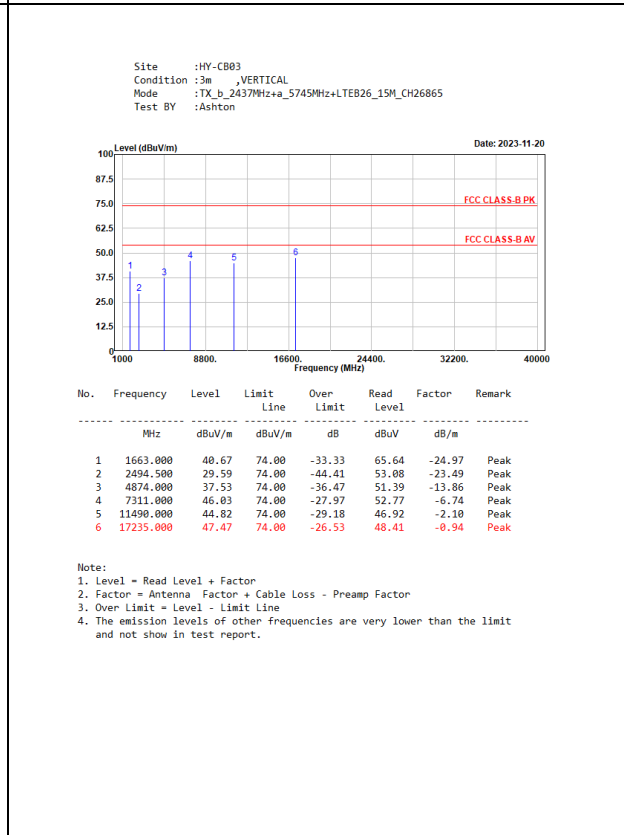
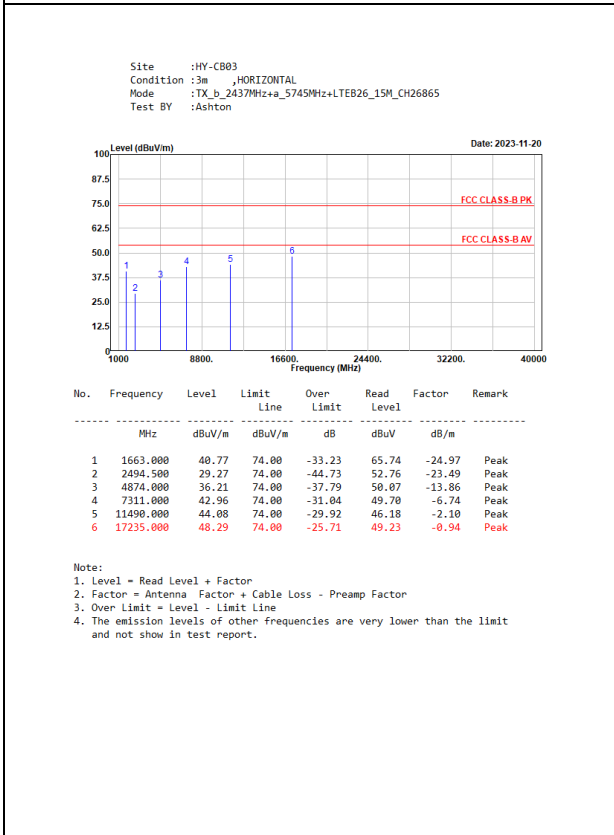
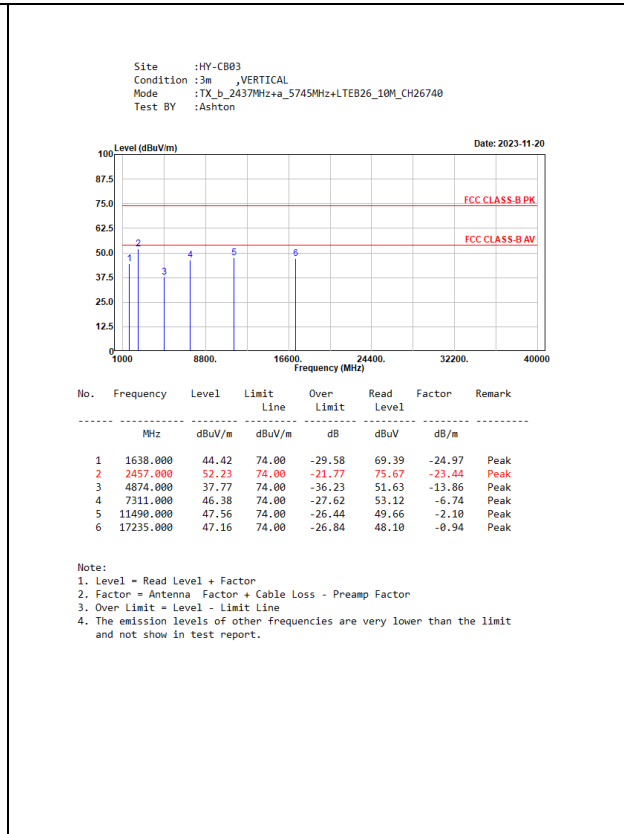
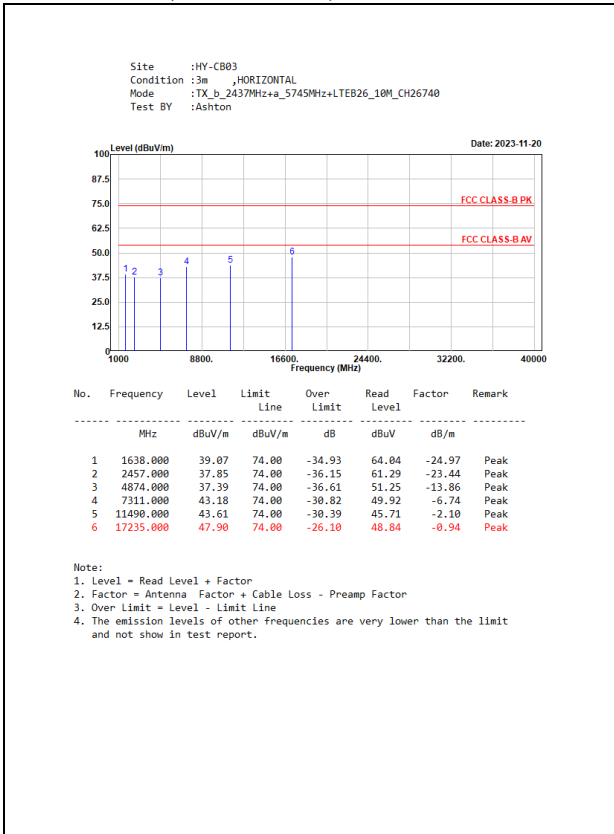


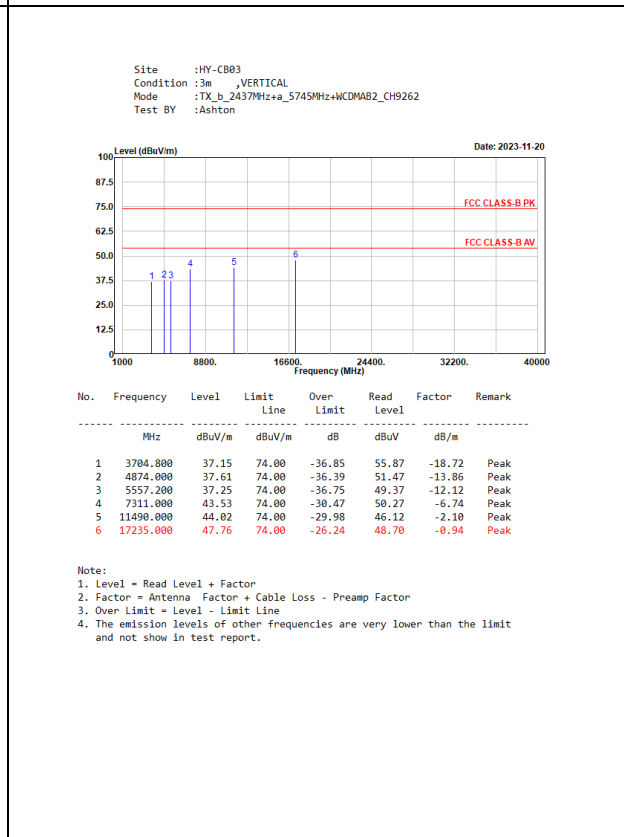
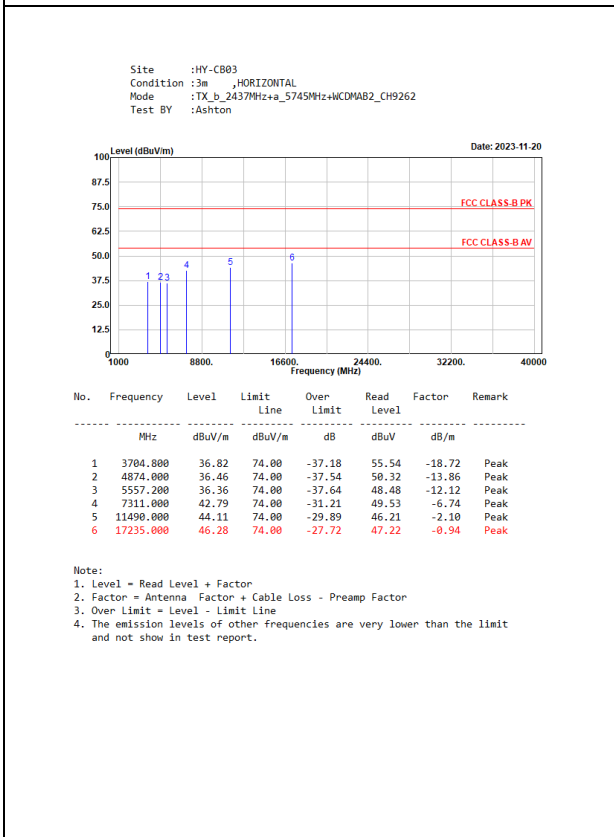
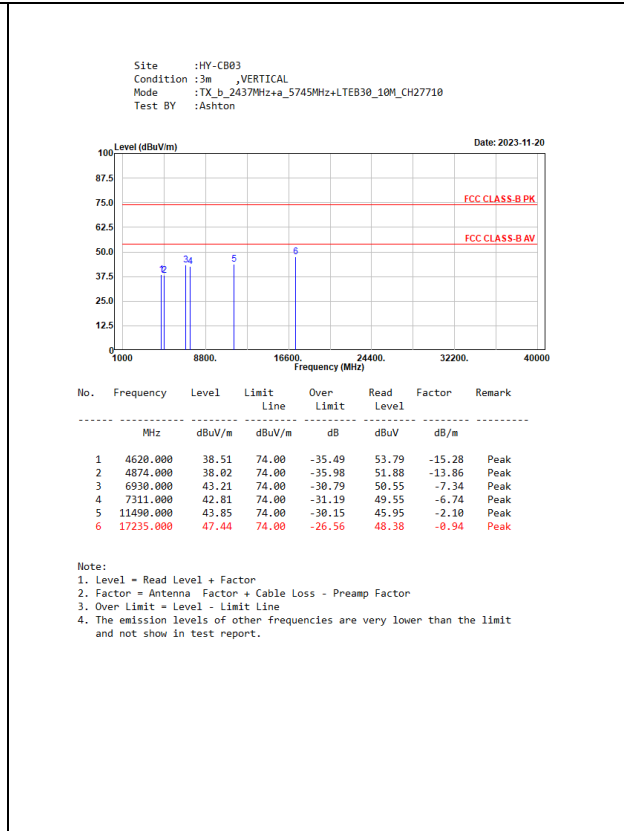
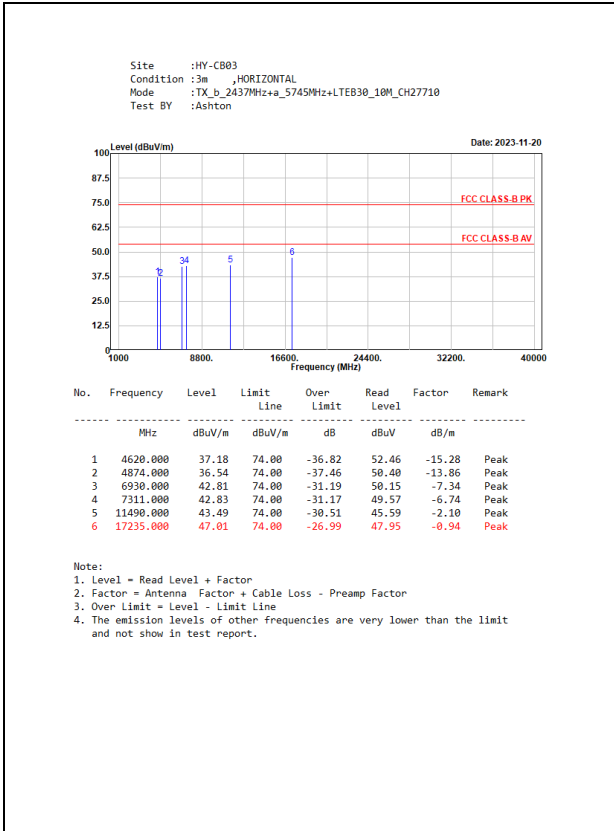


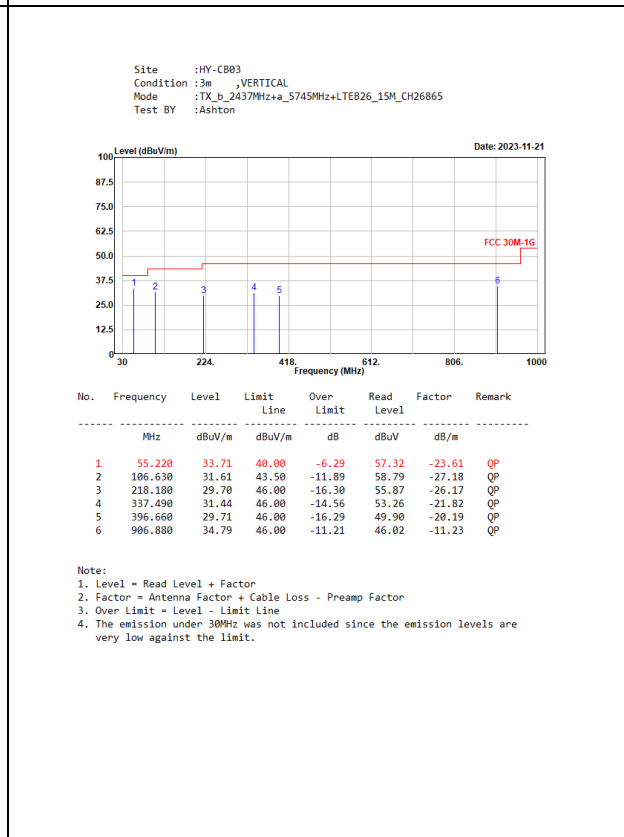
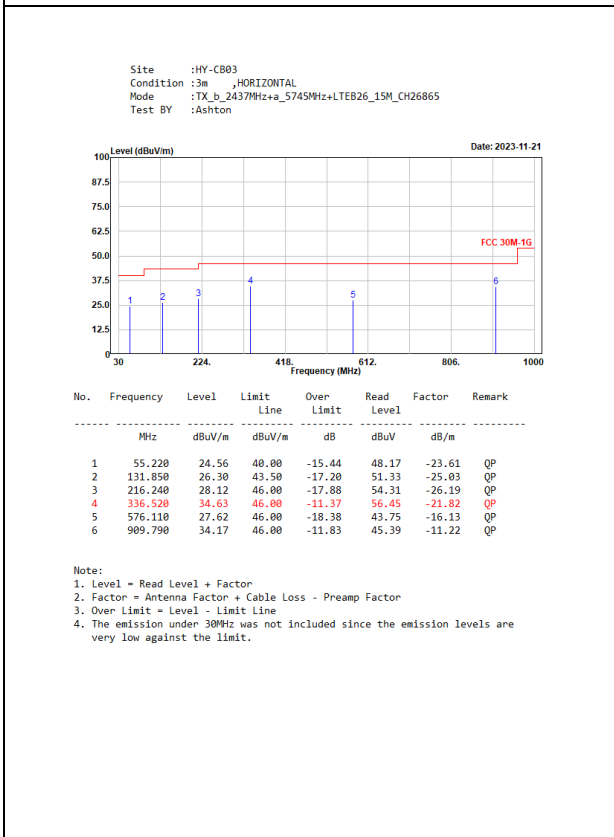
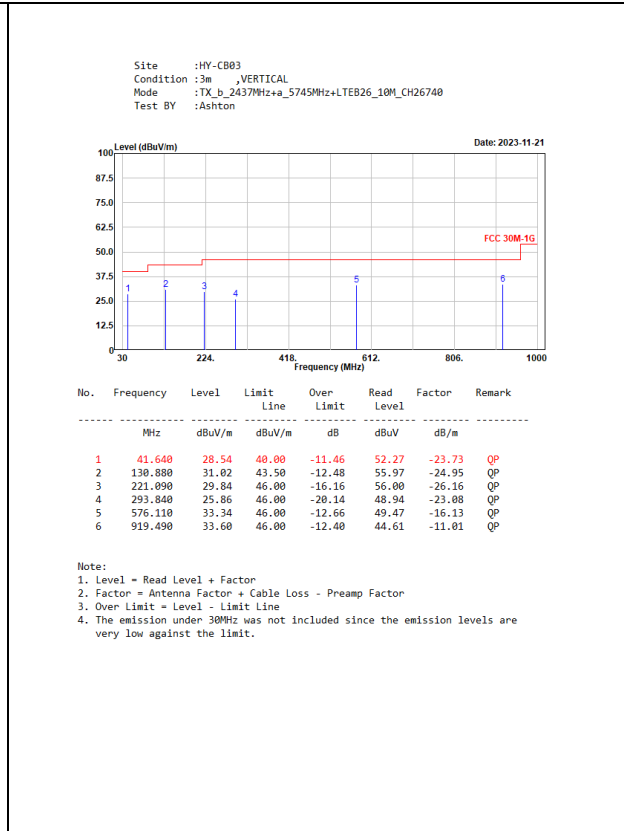
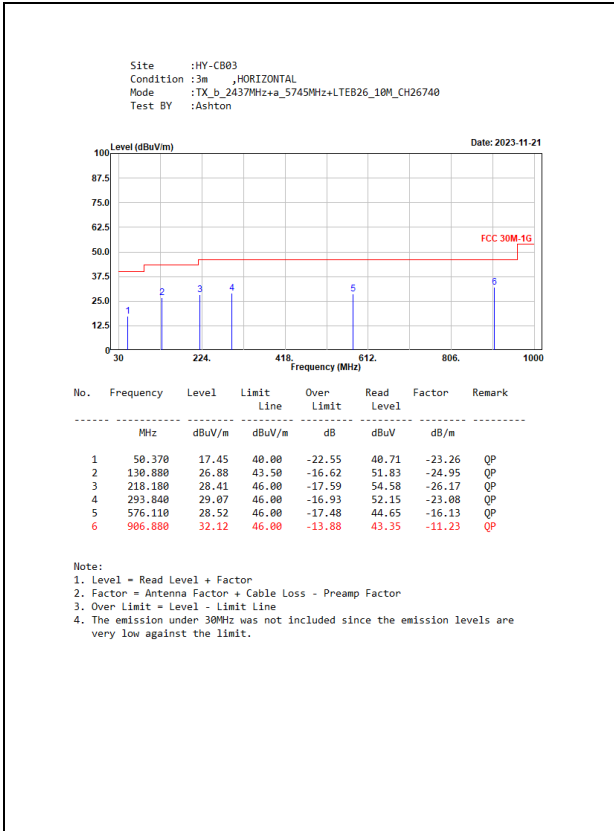


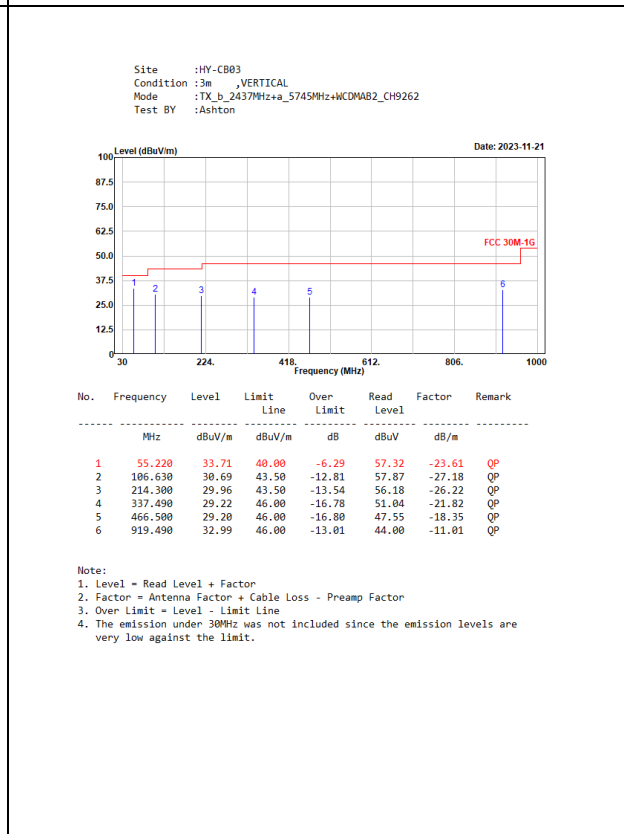
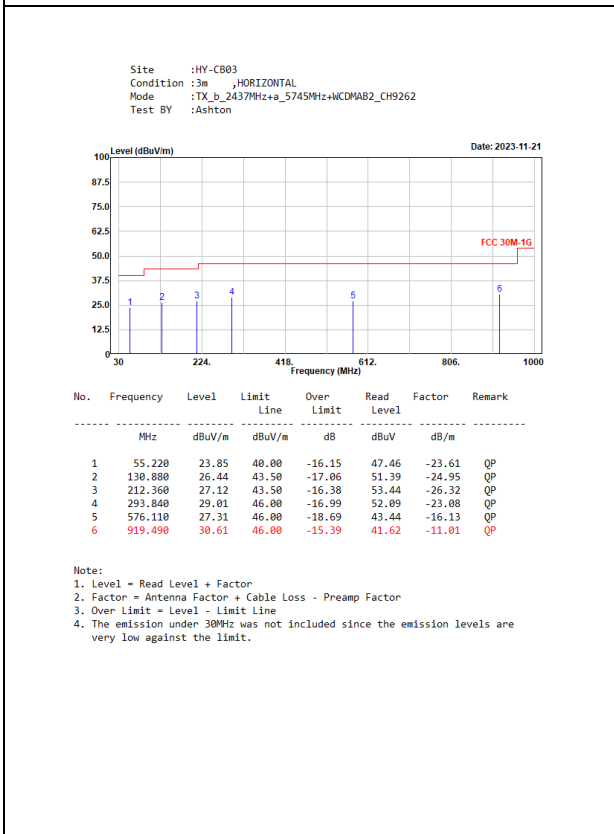
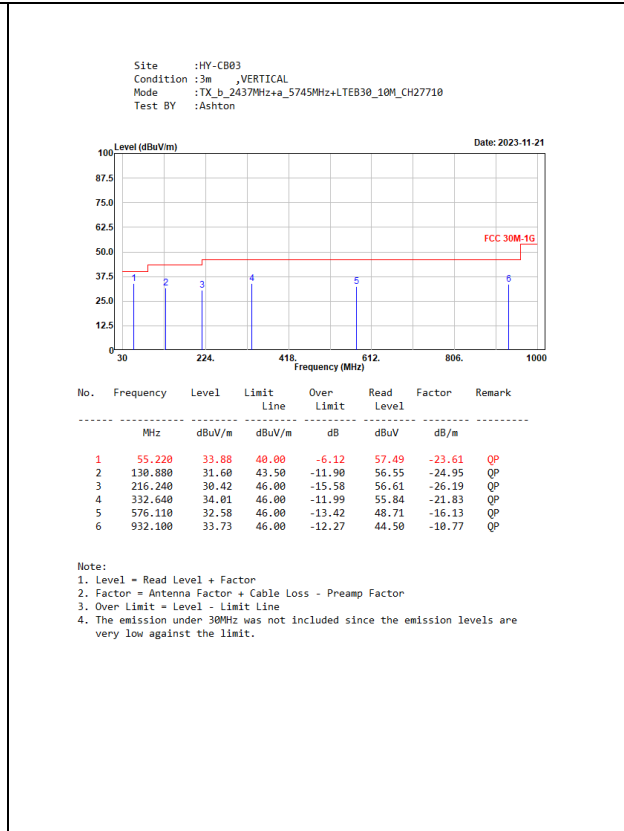
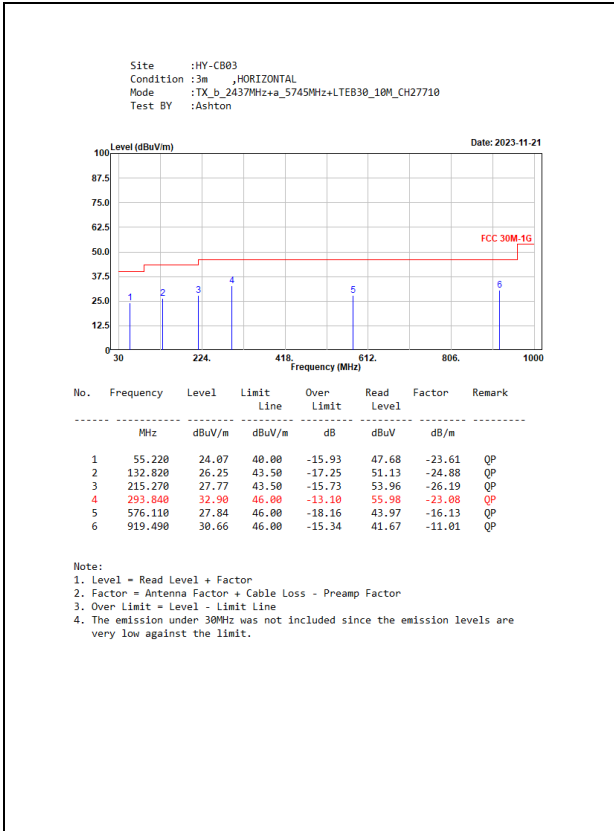


Co-location (EM06-A_4G)

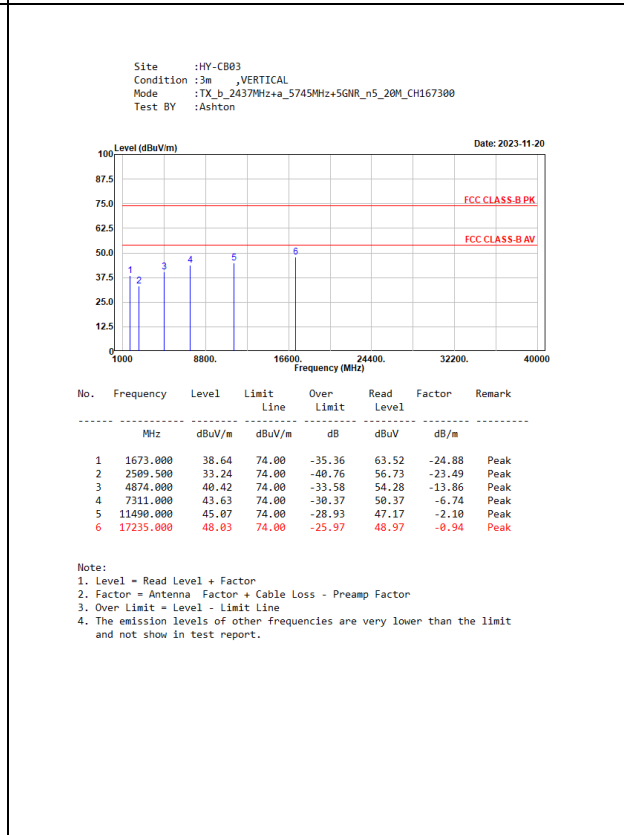
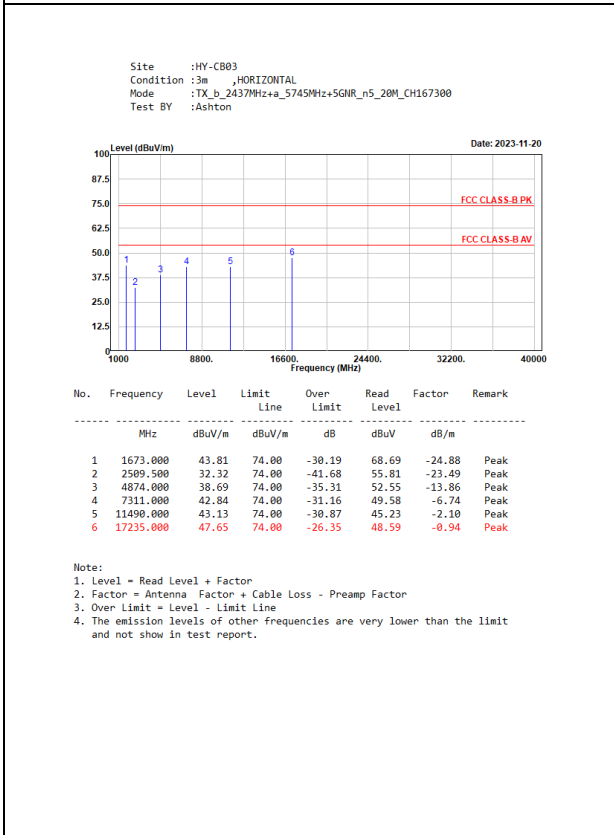
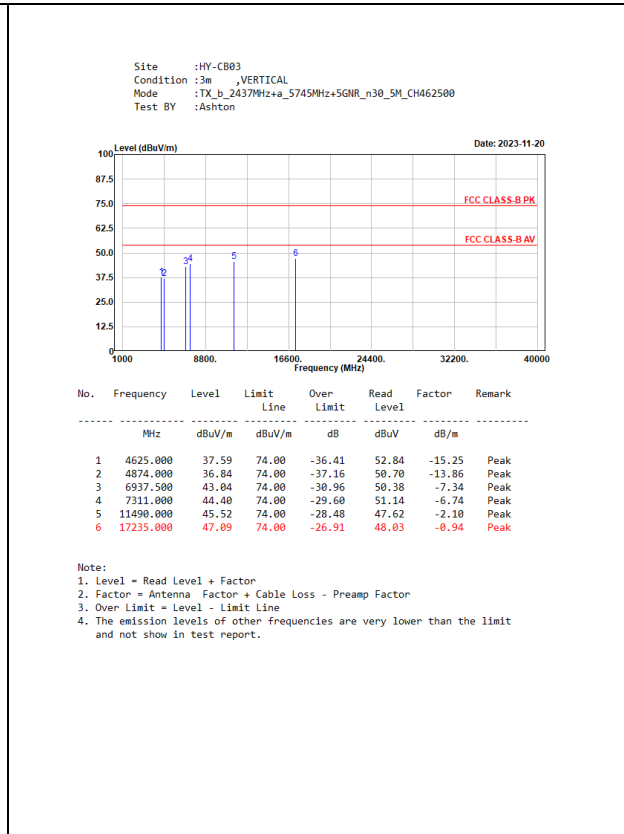
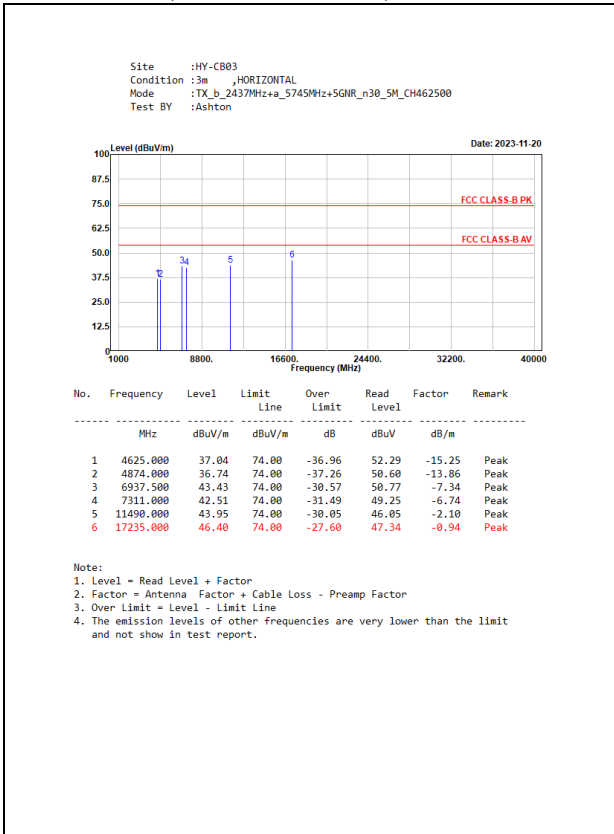


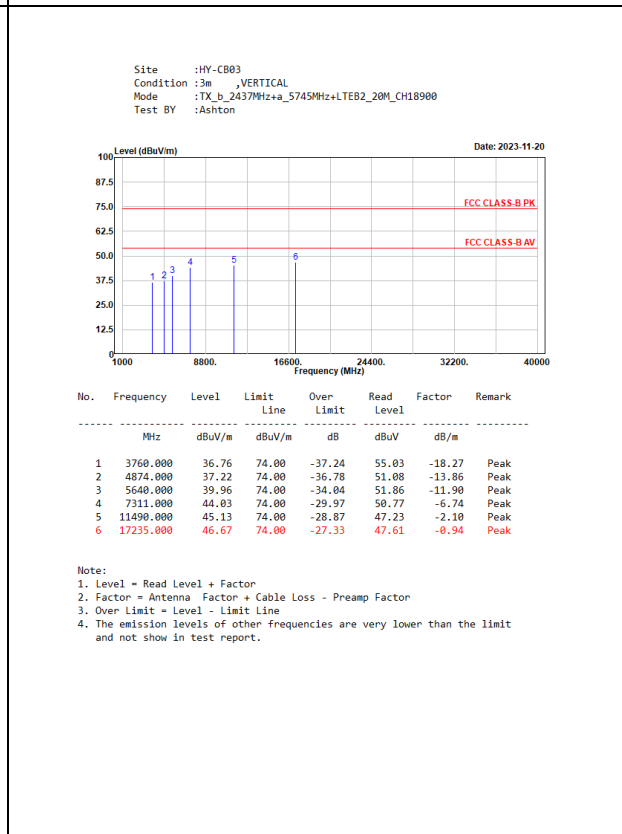
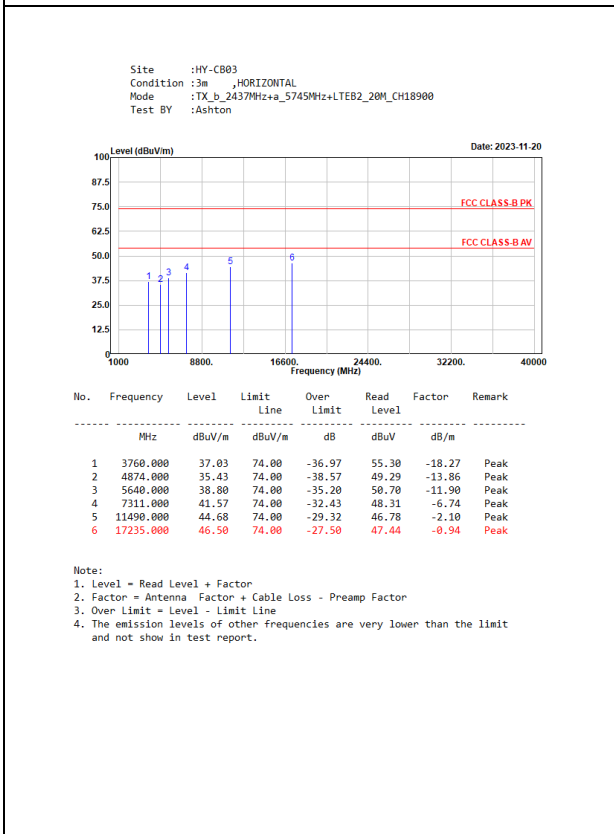
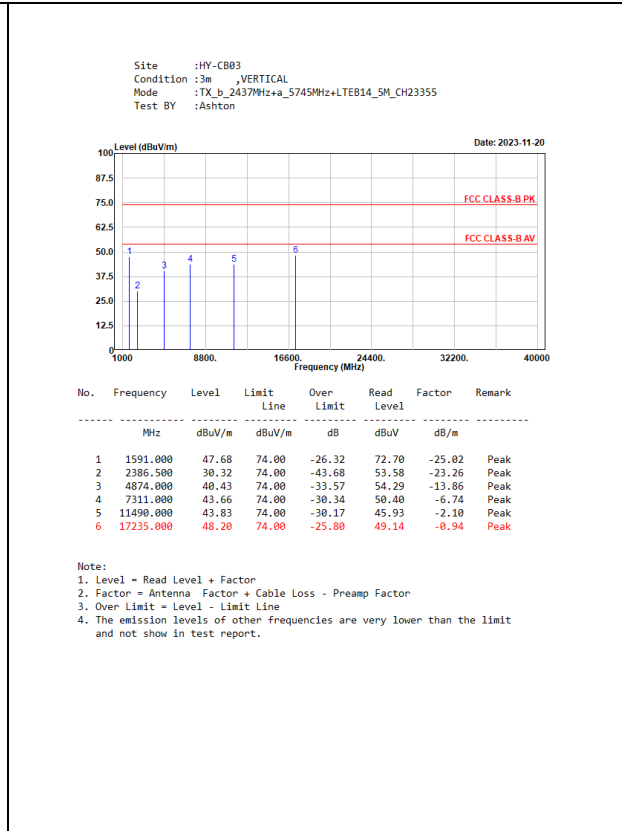
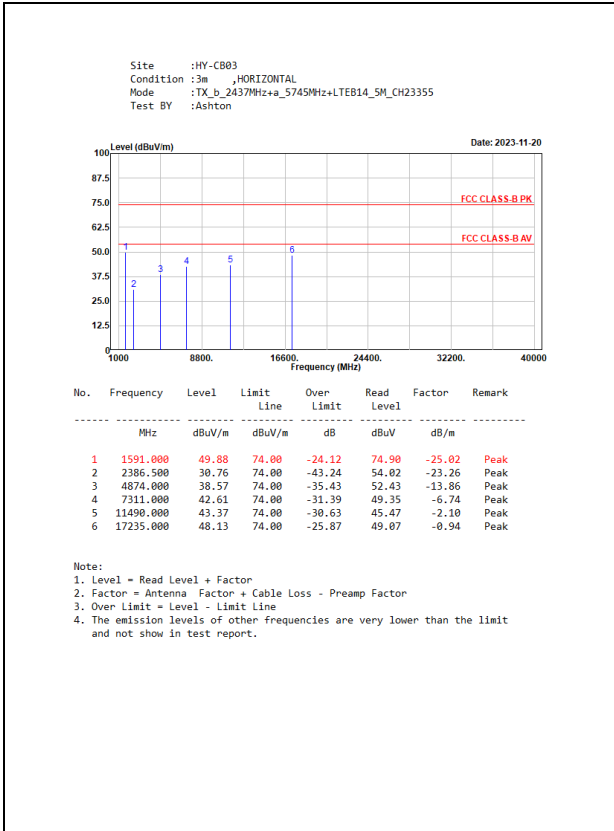


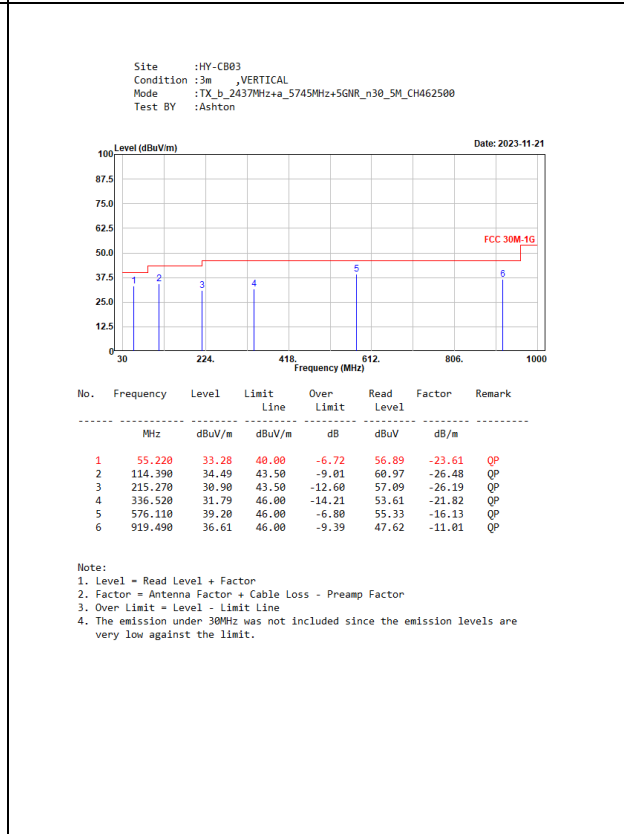
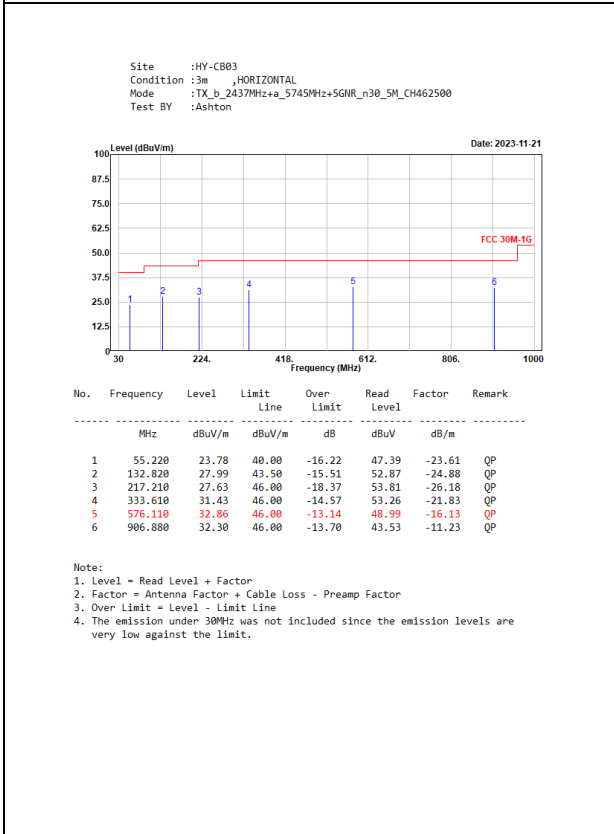
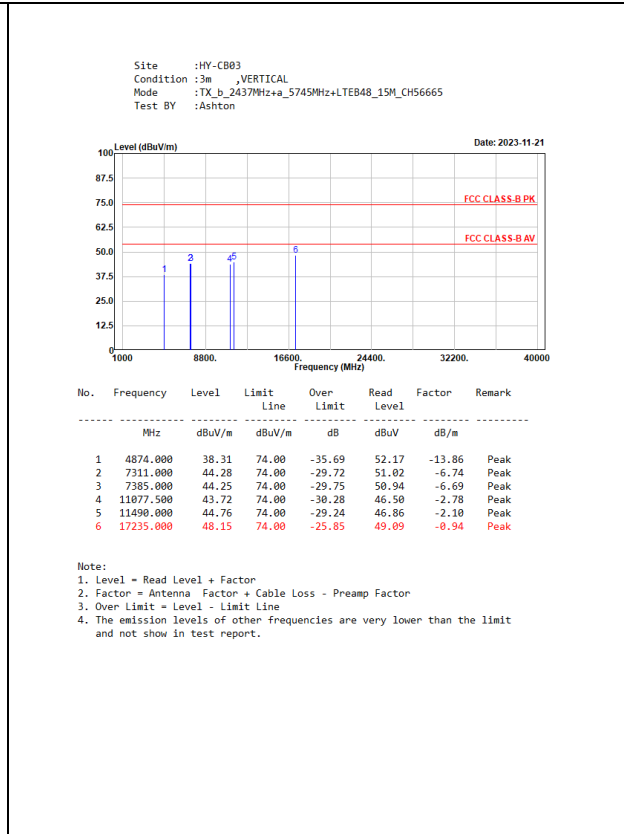
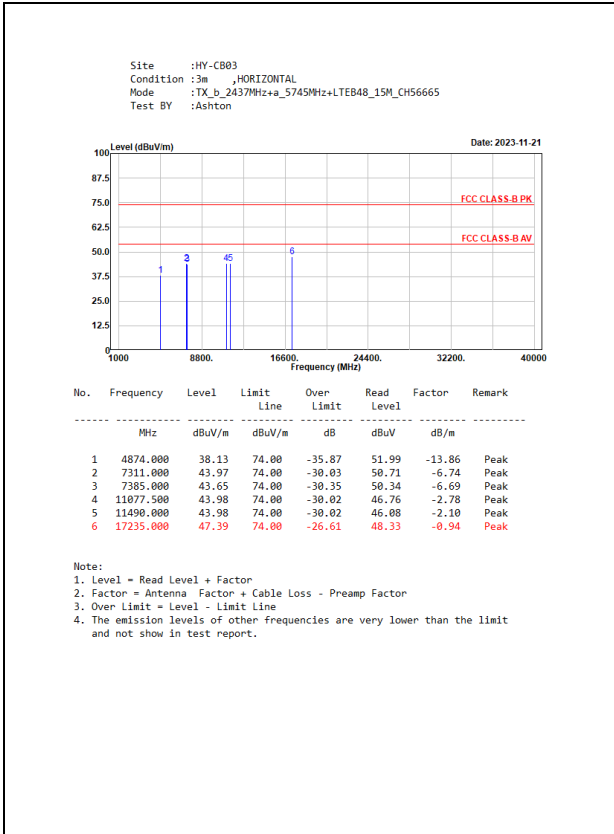


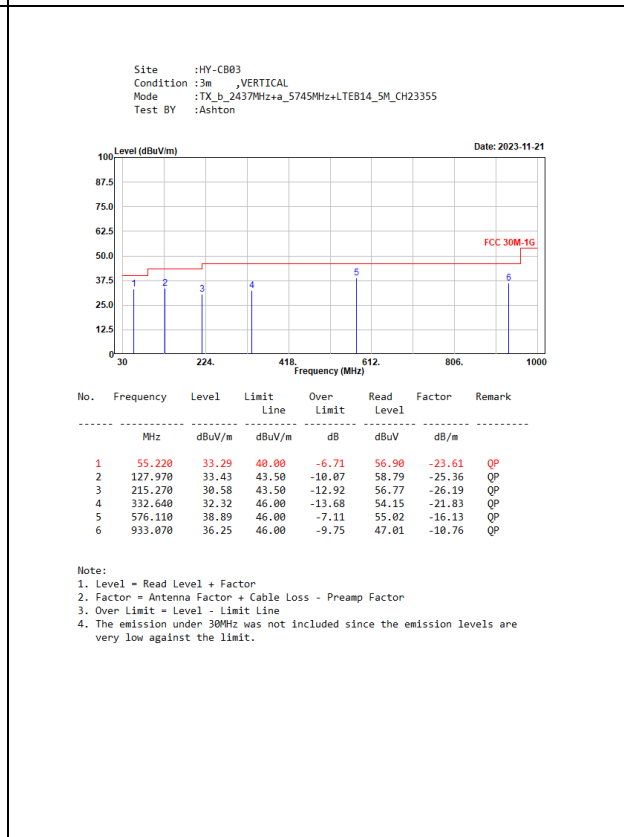
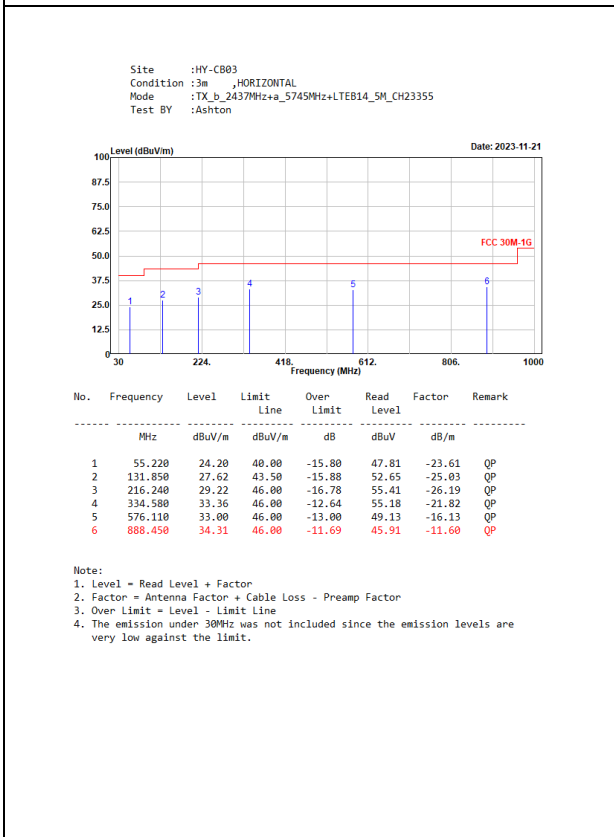
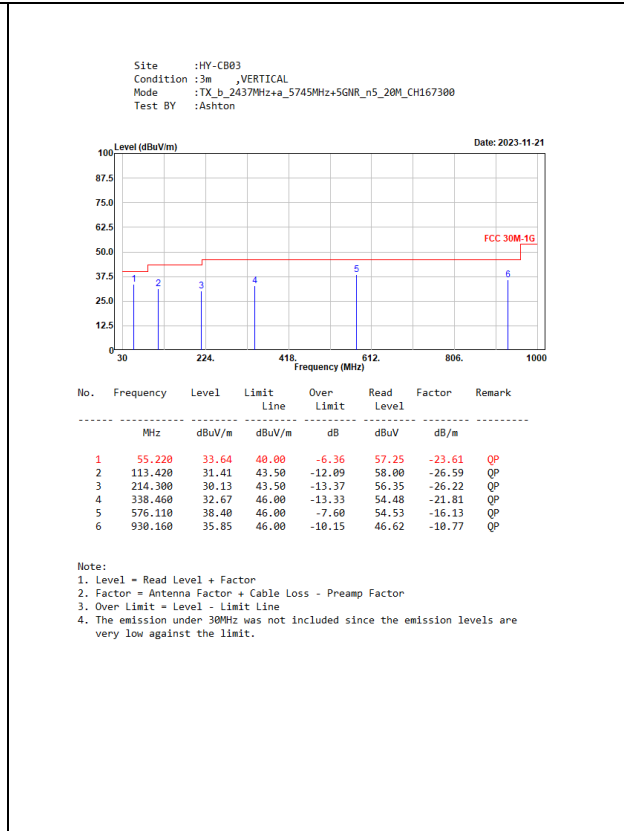
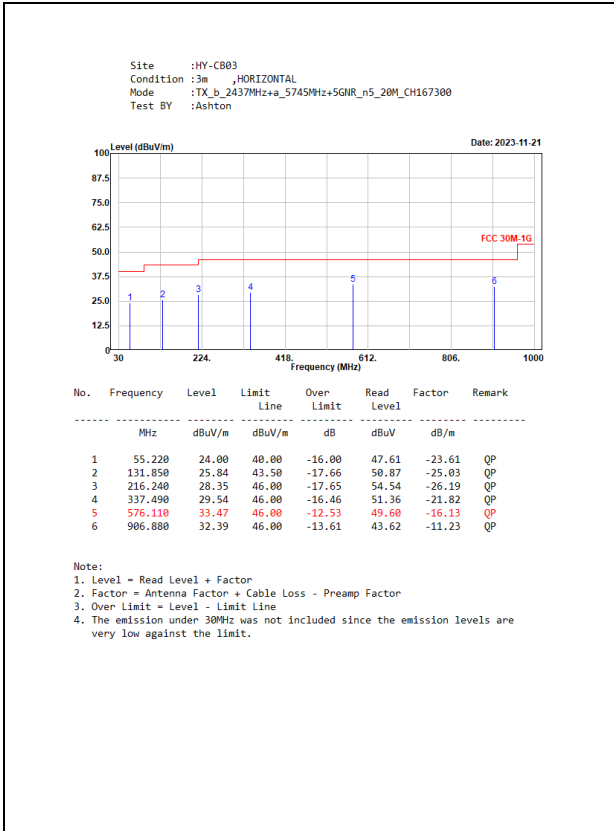


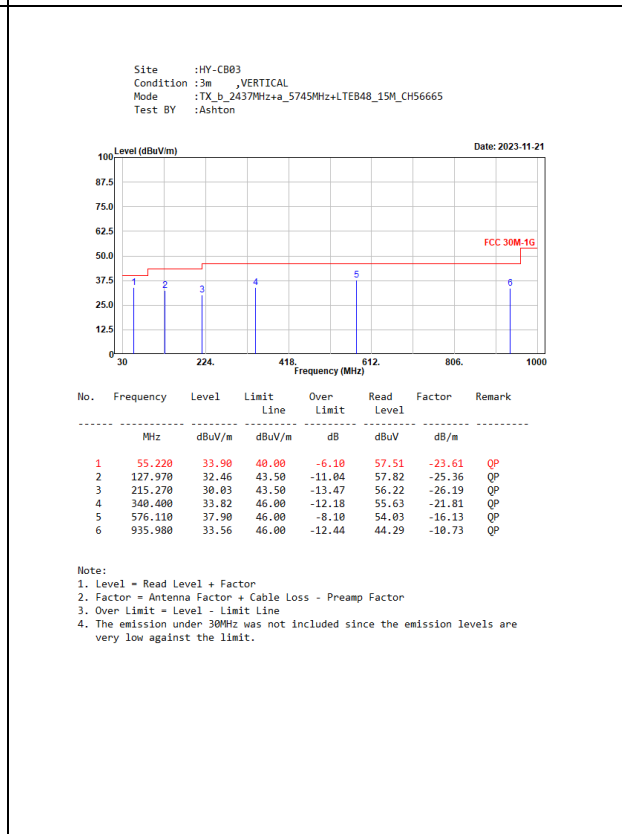
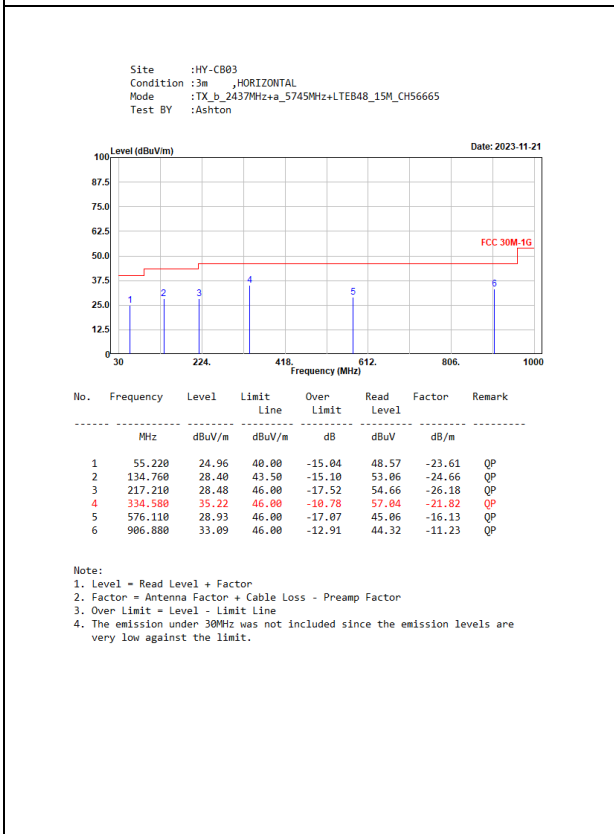
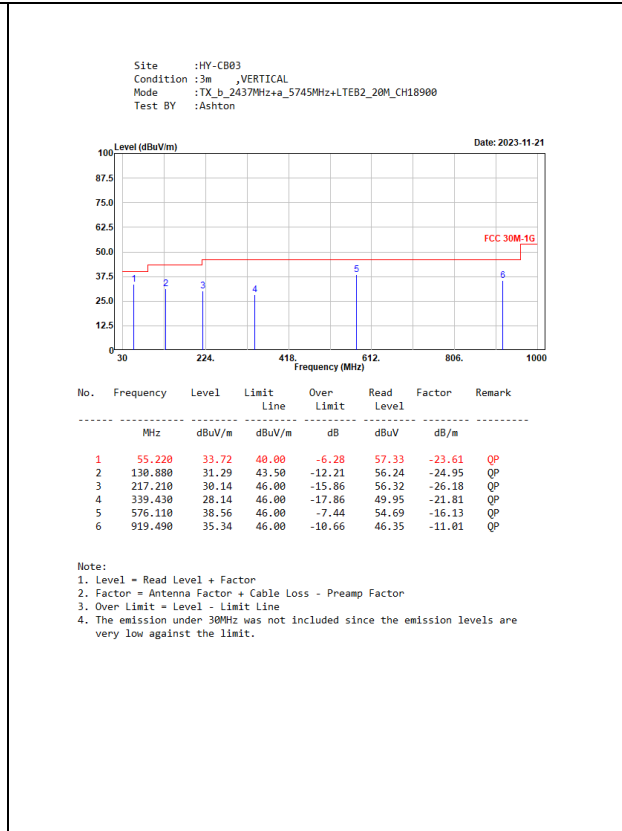
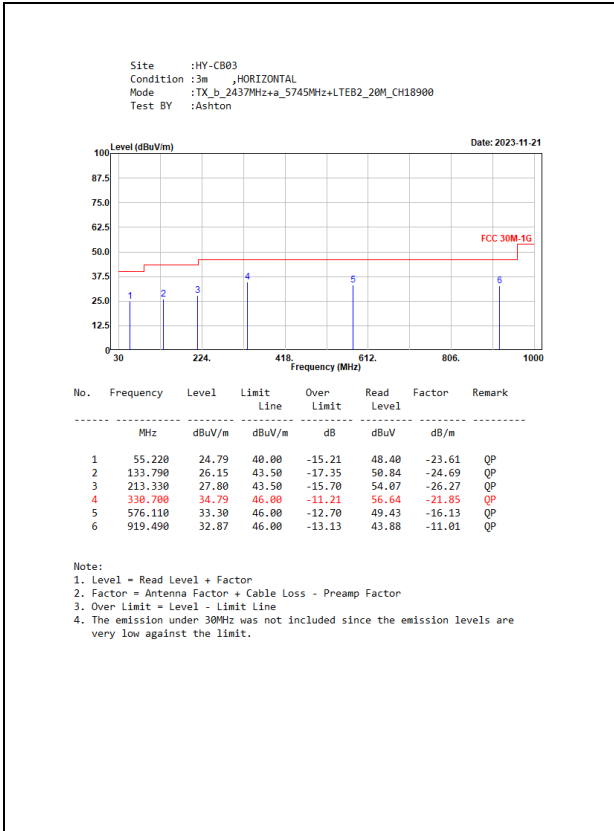
Co-location (RM520N-GL_5G)







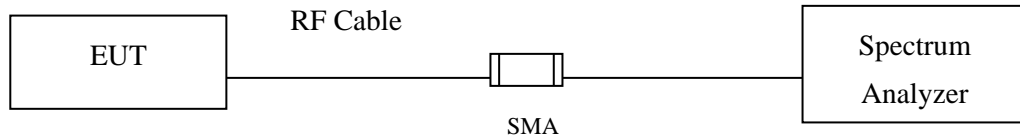




5. RF Antenna Conducted Test

5.1. Test Setup

RF antenna Conducted Measurement:



5.2. Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

5.3. Test Procedure

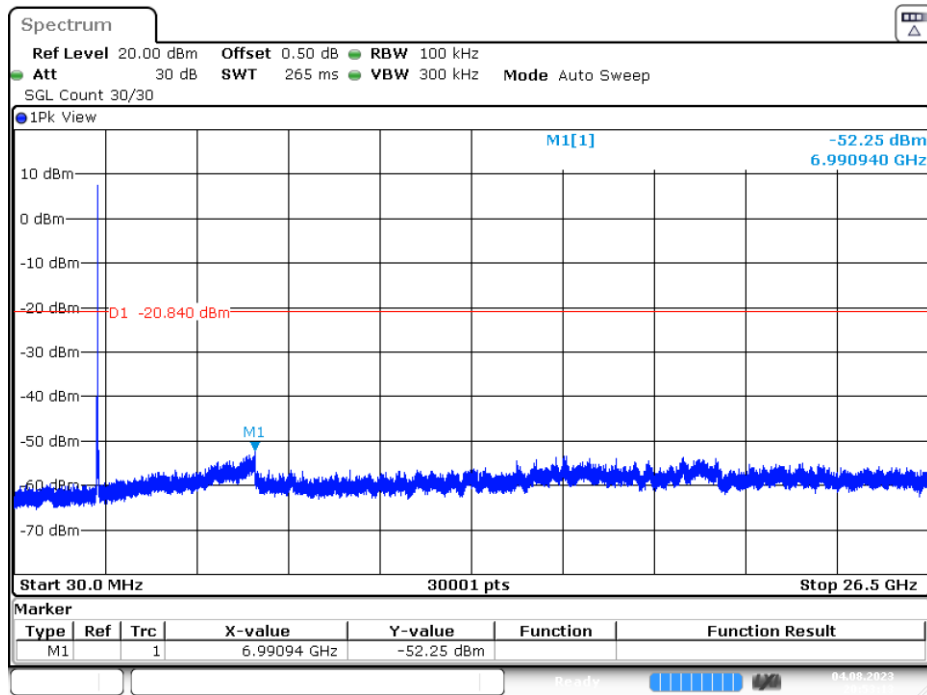
The EUT was tested according to C63.10:2013 Section 11.11 for compliance to FCC 47CFR 15.247 requirements.

Set RBW = 100 kHz, Set VBW > RBW, scan up through 10th harmonic.

5.4. Test Result of RF antenna conducted test

Product : Celer, Celer-5G, Celer-LTE1, Celer-LTE2
 Test Item : RF antenna conducted test
 Test Mode : Transmit (802.11b)
 Test Date : 2023/08/04

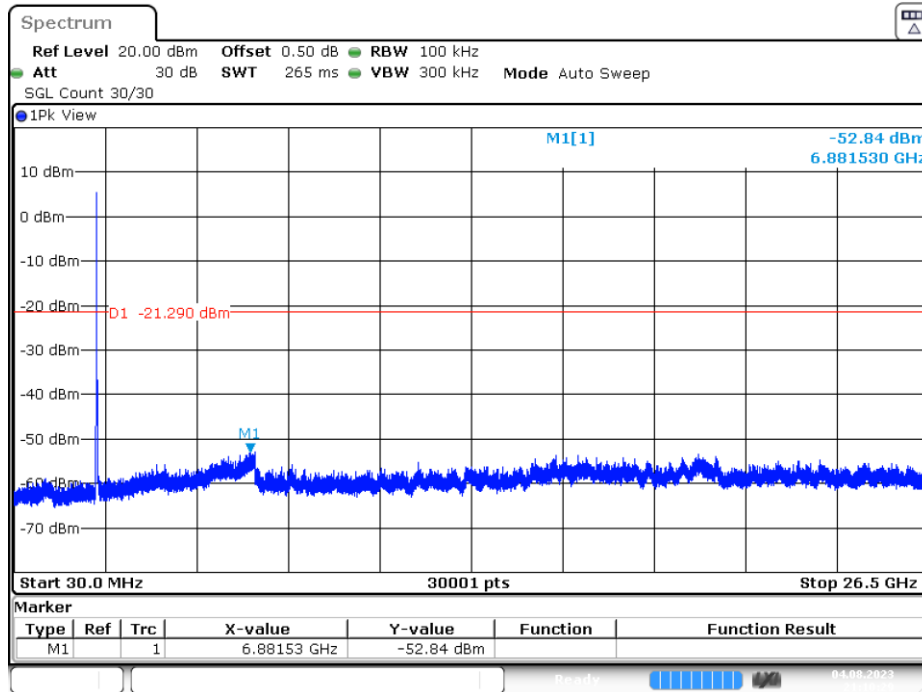
Channel 06 (2437MHz) (Chain A)



Date: 4.AUG.2023 20:53:13

Product : Celer, Celer-5G, Celer-LTE1, Celer-LTE2
 Test Item : RF Antenna Conducted Spurious
 Test Mode : Transmit (802.11g)
 Test Date : 2023/08/04

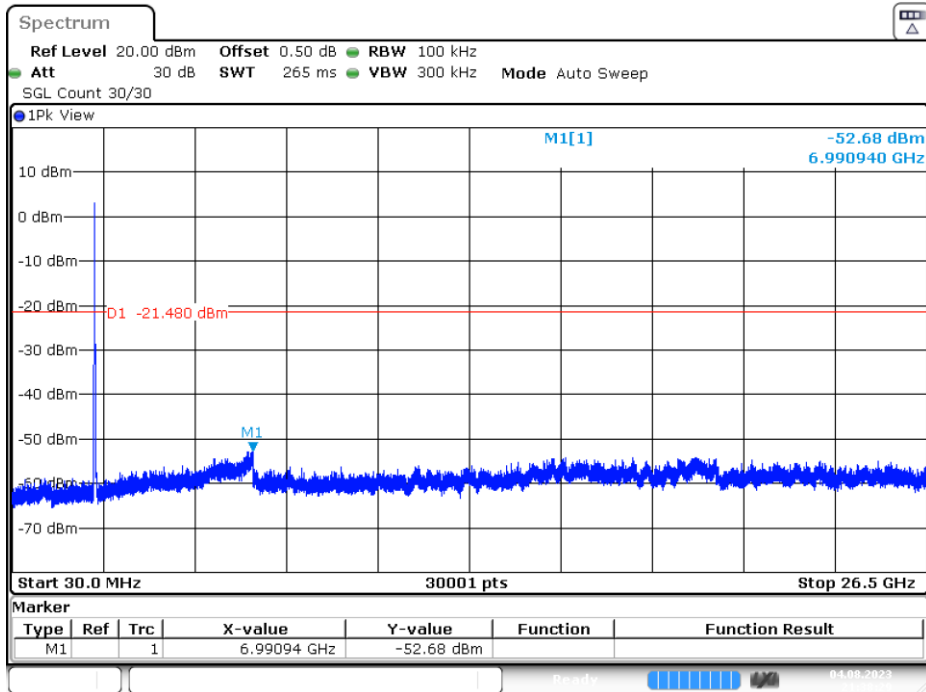
Channel 01 (2412MHz) (Chain B)



Date: 4.AUG.2023 21:10:29

Product : Celer, Celer-5G, Celer-LTE1, Celer-LTE2
 Test Item : RF Antenna Conducted Spurious
 Test Mode : Transmit (802.11ax-20BW)
 Test Date : 2023/08/04

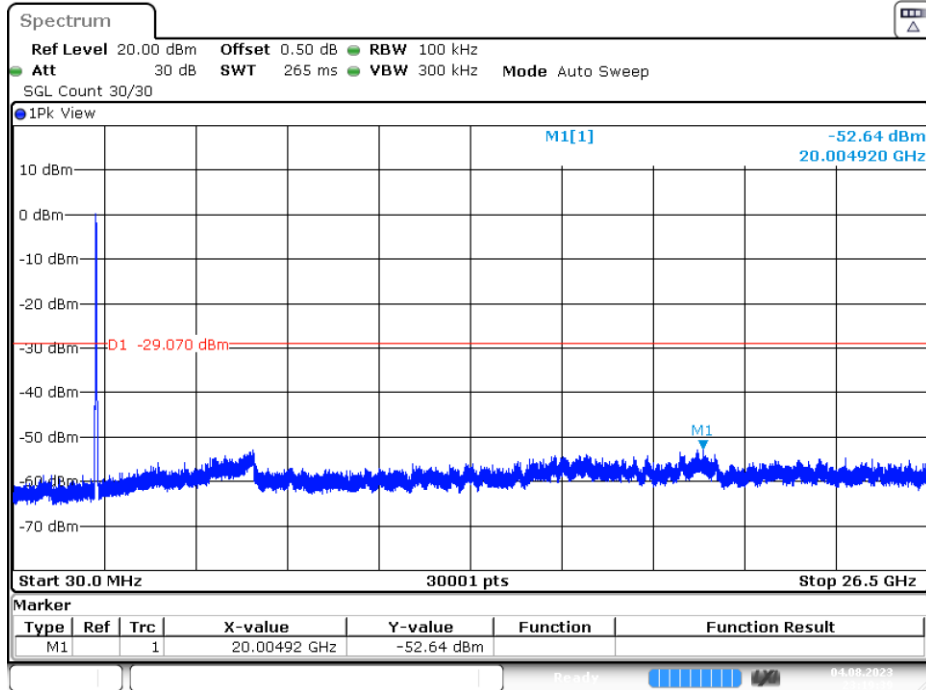
Channel 01 (2412MHz) (Chain A)



Date: 4.AUG.2023 21:38:30

Product : Celer, Celer-5G, Celer-LTE1, Celer-LTE2
 Test Item : RF Antenna Conducted Spurious
 Test Mode : Transmit (802.11ax-40BW)
 Test Date : 2023/08/04

Channel 03 (2422MHz) (Chain A)

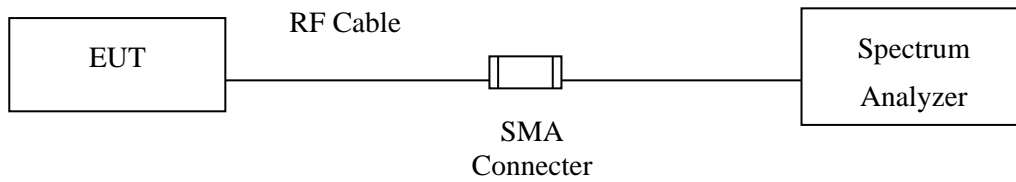


Date: 4.AUG.2023 23:19:39

6. Band Edge

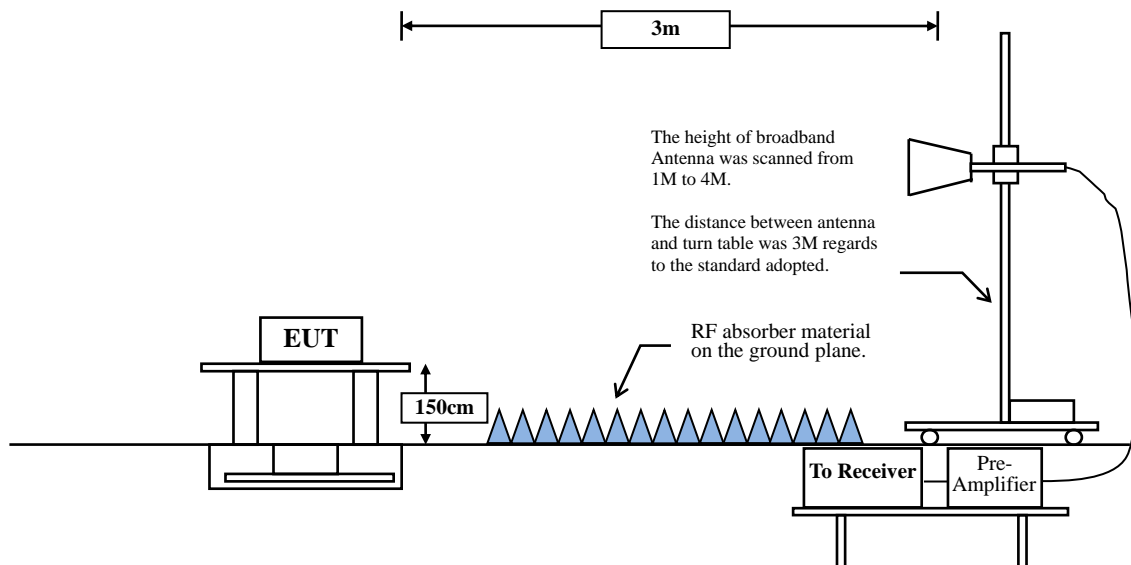
6.1. Test Setup

RF Conducted Measurement



RF Radiated Measurement

Above 1GHz



6.2. Limits

According to FCC Section 15.247(d). In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

6.3. Test Procedure

The EUT was setup according to ANSI C63.10, 2013 and tested according to C63.10:2013 Section 11.12.1 for compliance to FCC 47CFR 15.247 requirements.

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 from 1 meter to 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.

RBW and VBW Parameter setting:

According to C63.10 Section 11.12.2.4 Peak measurement procedure.

RBW = as specified in Table 1.

VBW $\geq 3 \times$ RBW.

Table 1 - RBW as a function of frequency

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

According to C63.10 Section 11.12.2.5 Average measurement procedure.

RBW = 1MHz.

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

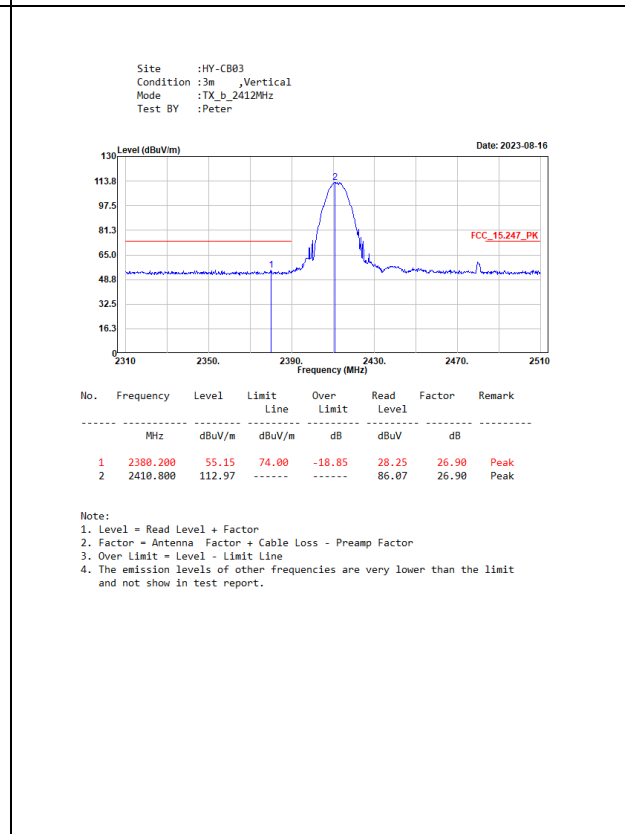
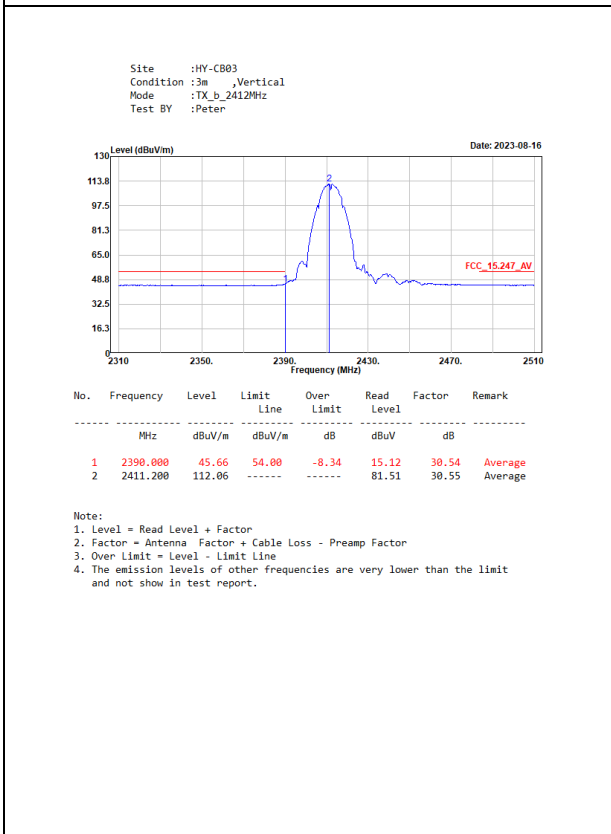
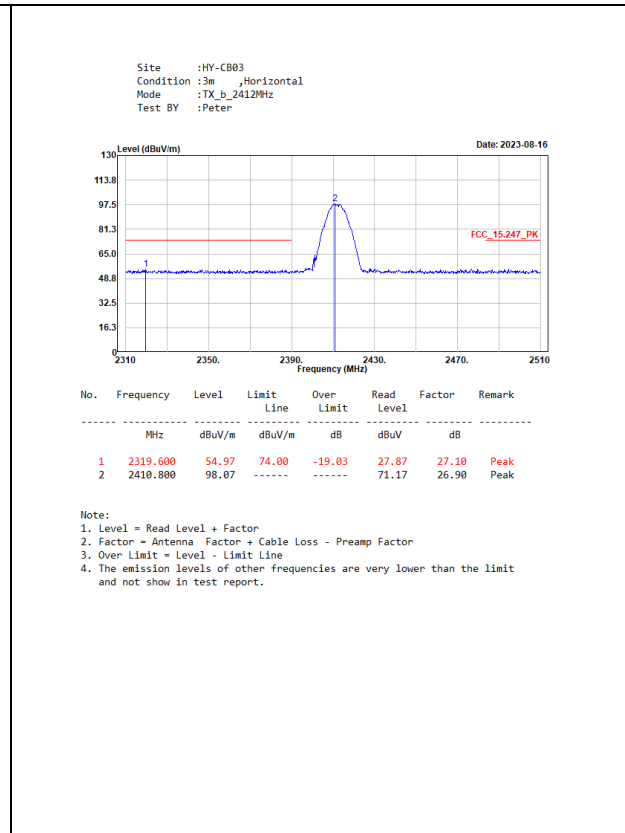
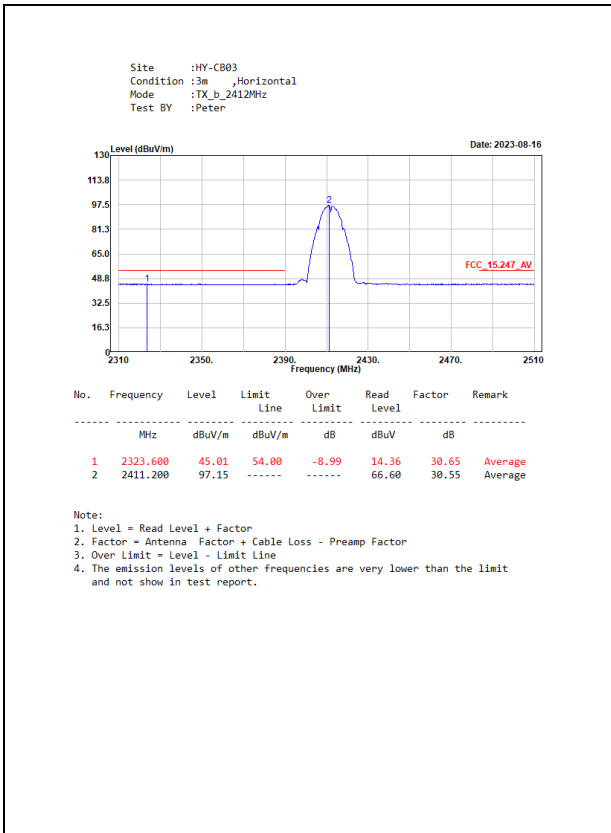
VBW $\geq 1/T$, when duty cycle $< 98 \%$

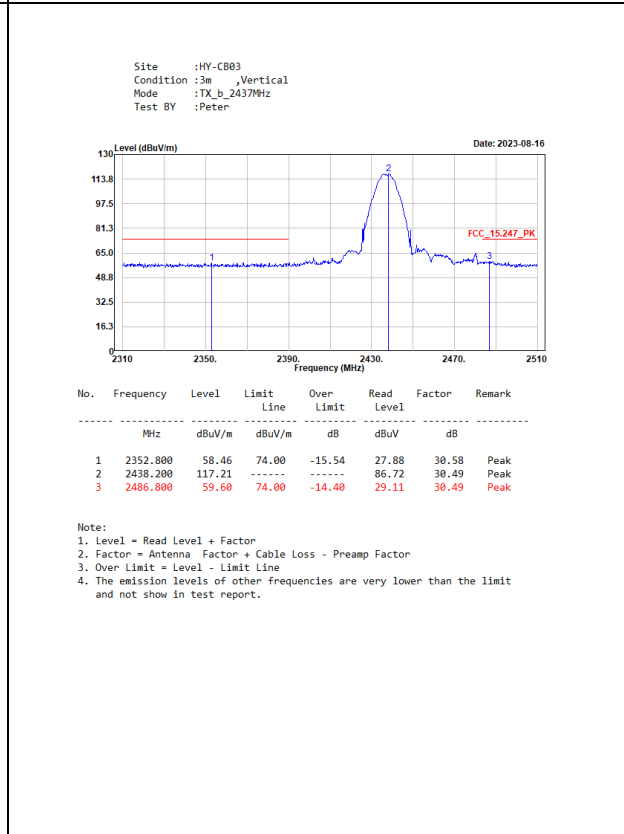
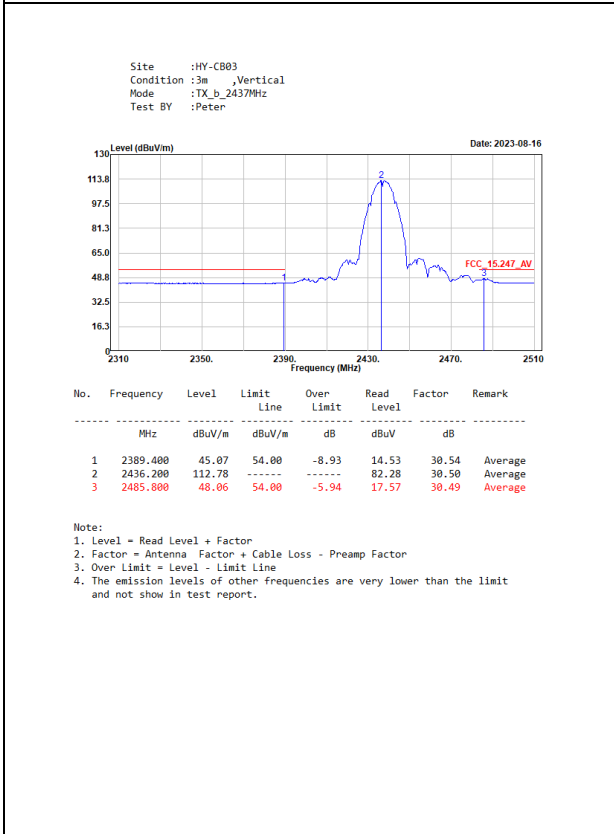
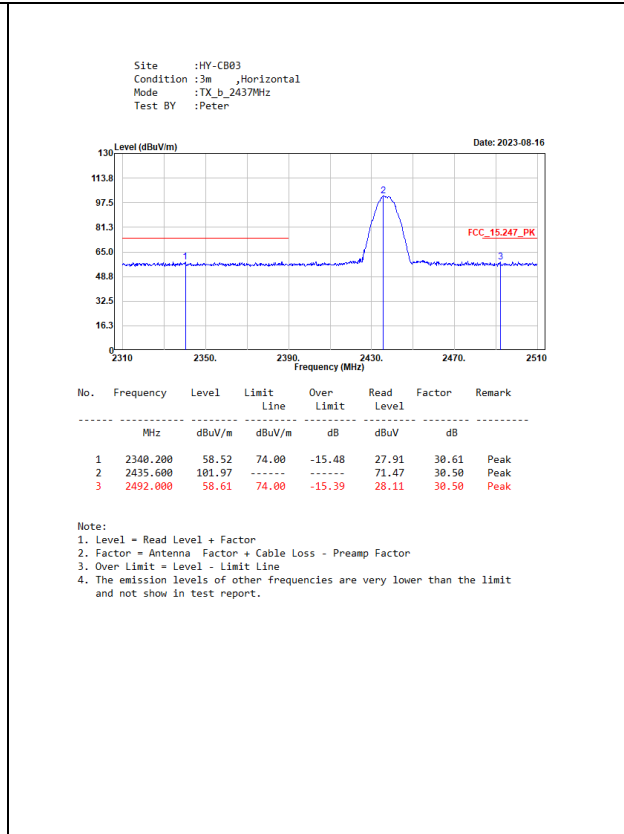
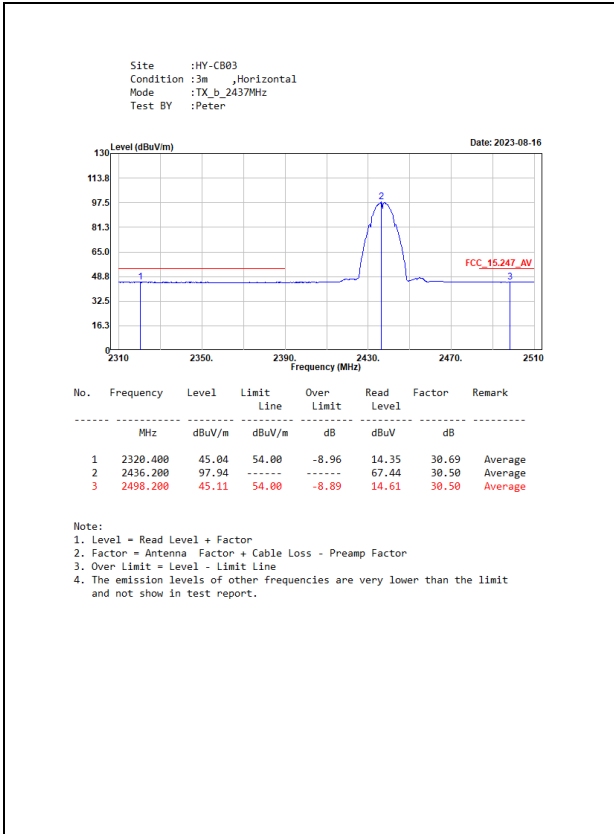
(T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

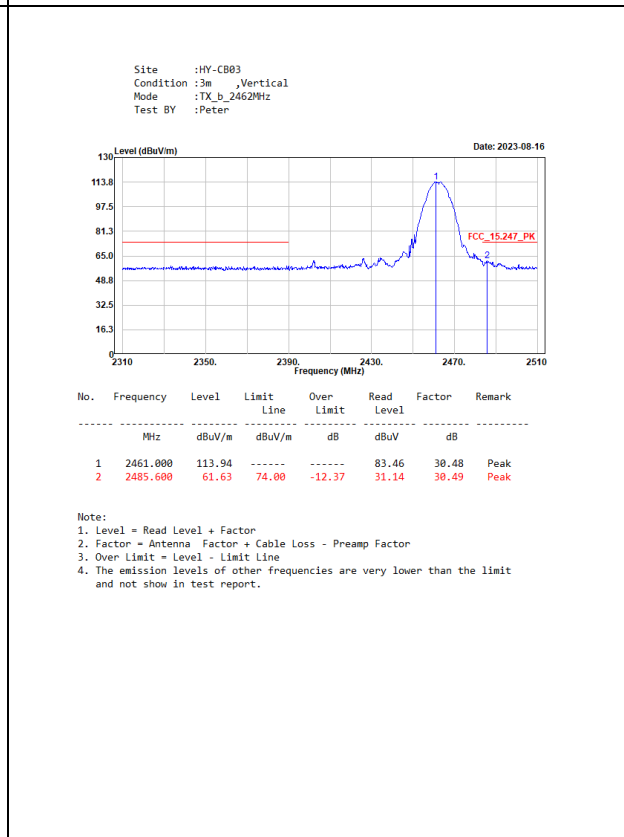
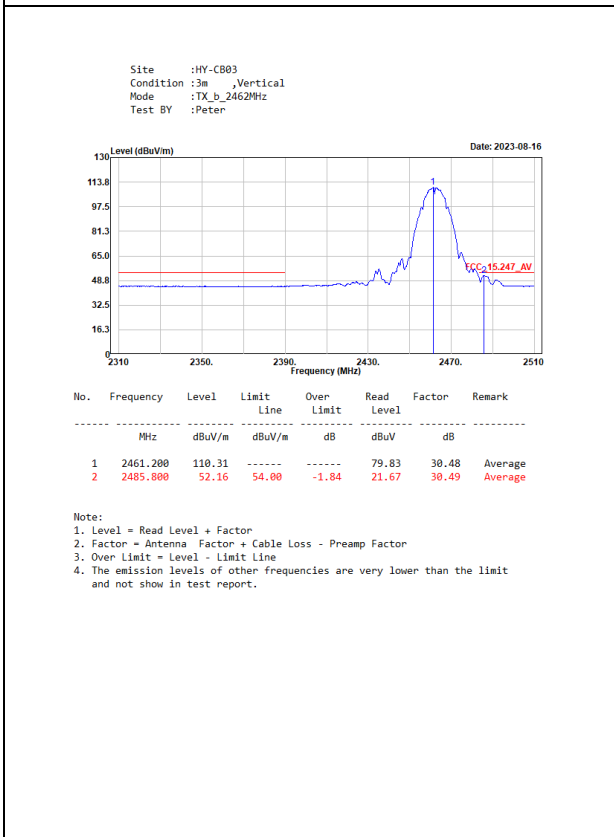
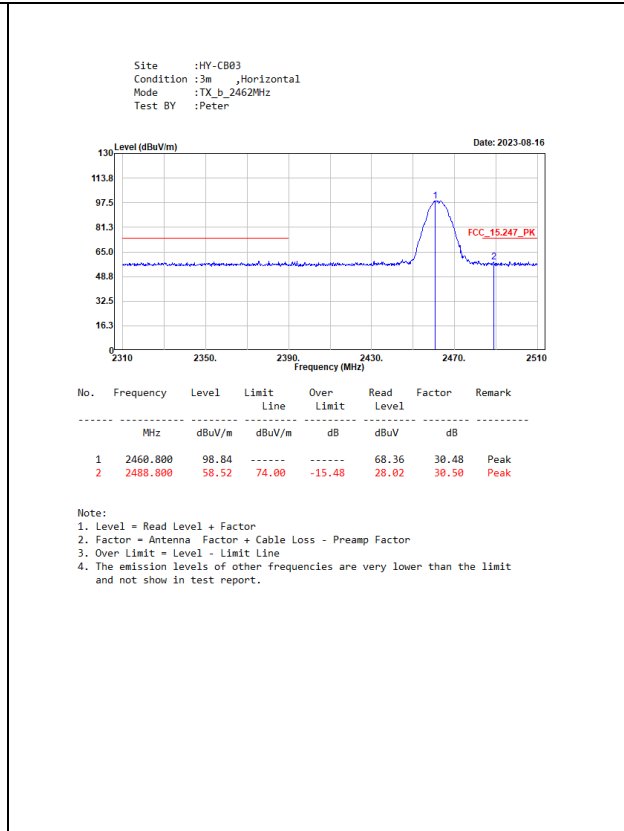
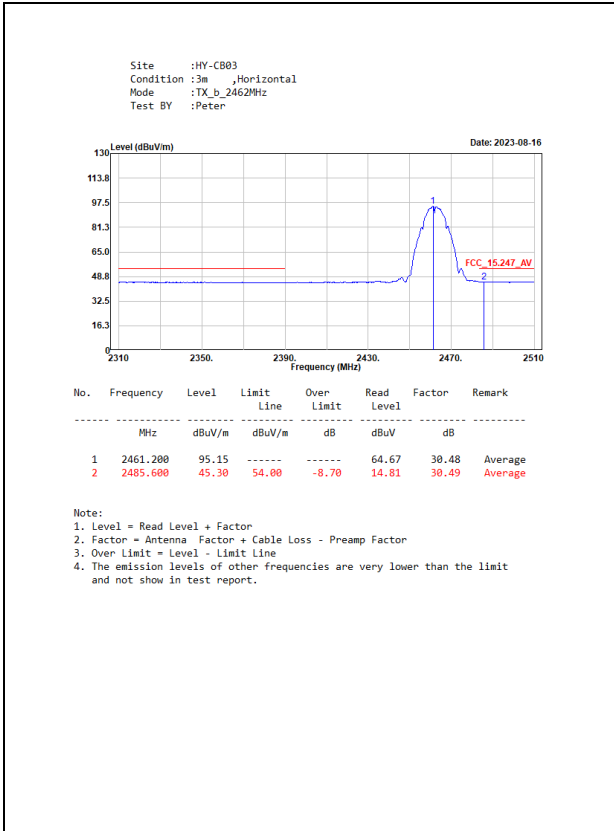
2.4GHz band	Duty Cycle (%)	T (ms)	1/T (Hz)	VBW (Hz)
802.11b	92.78	17.9821	56	100
802.11g	89.47	1.4280	700	1000
802.11ax-20 MHz	79.65	5.4000	185	200
802.11ax-40 MHz	80.09	5.4300	184	200

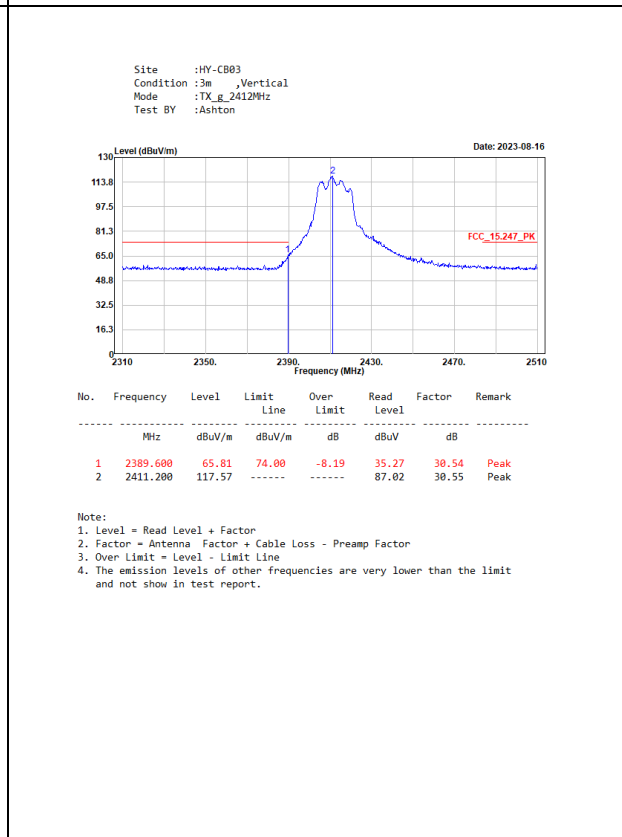
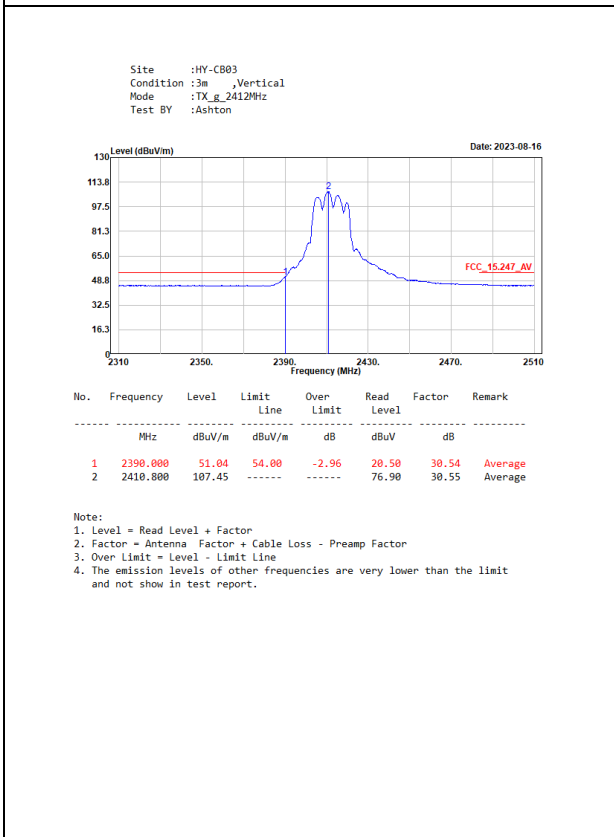
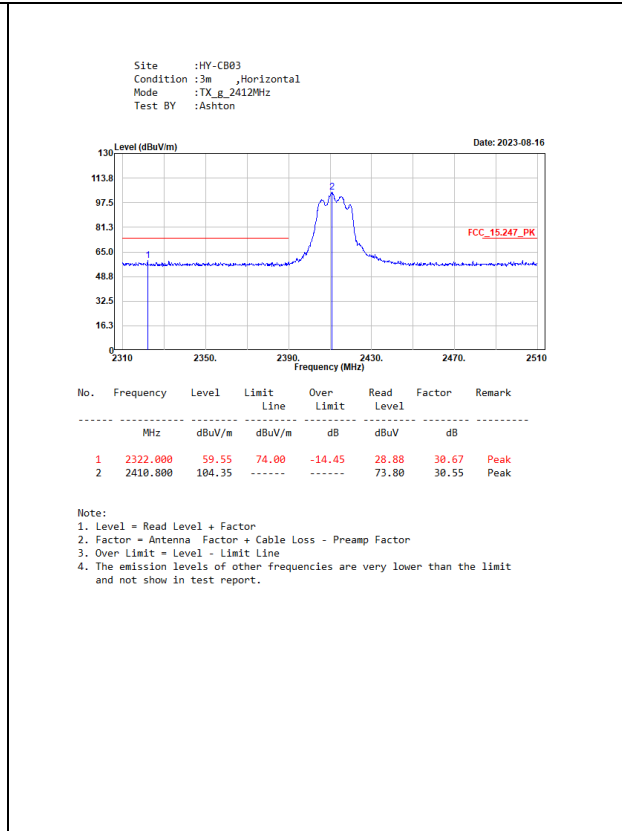
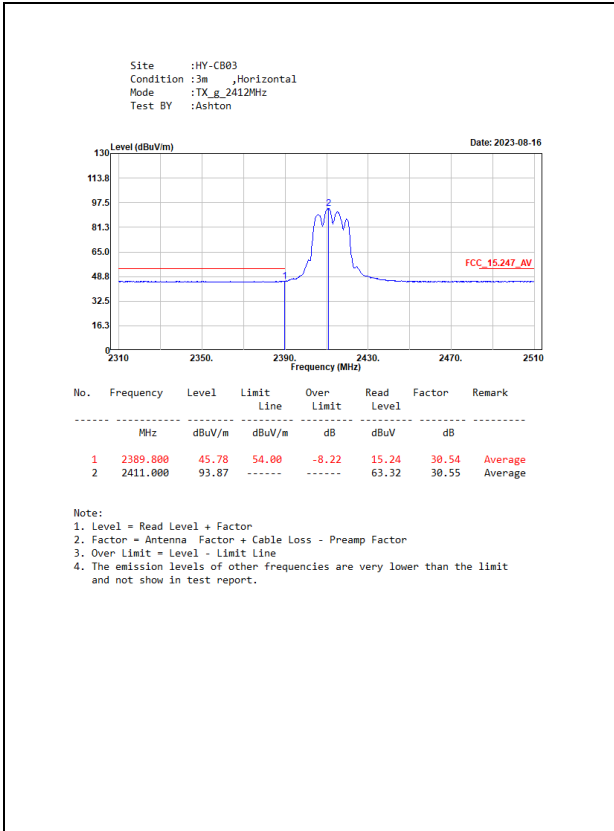
Note: Duty Cycle Refer to Section 9.

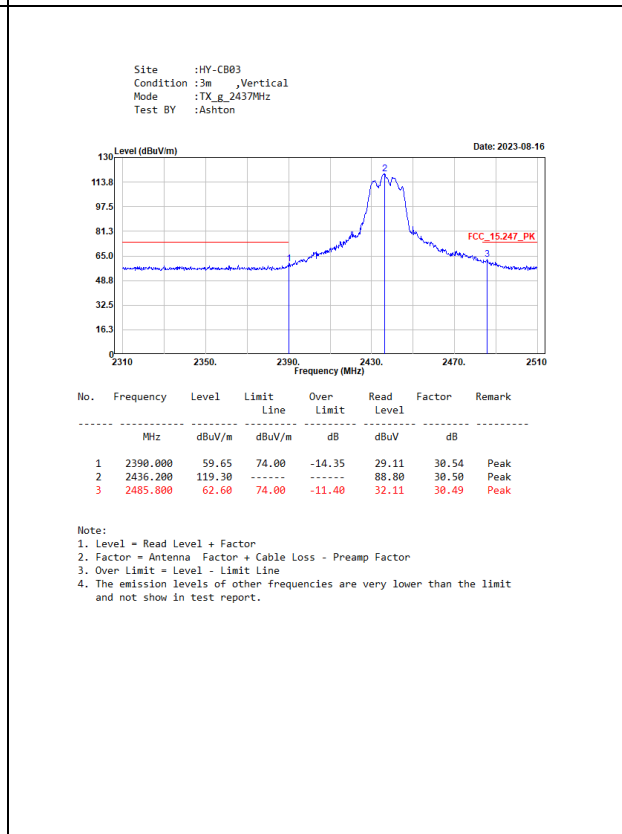
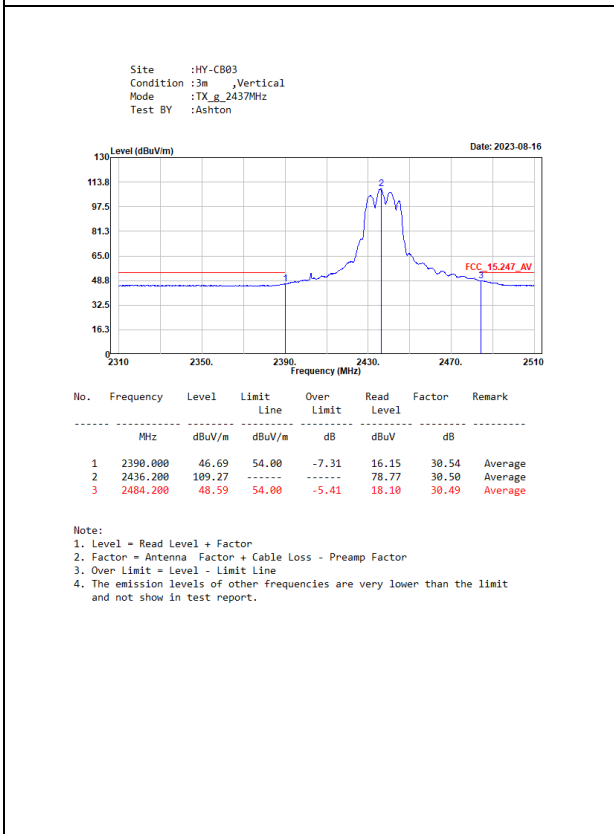
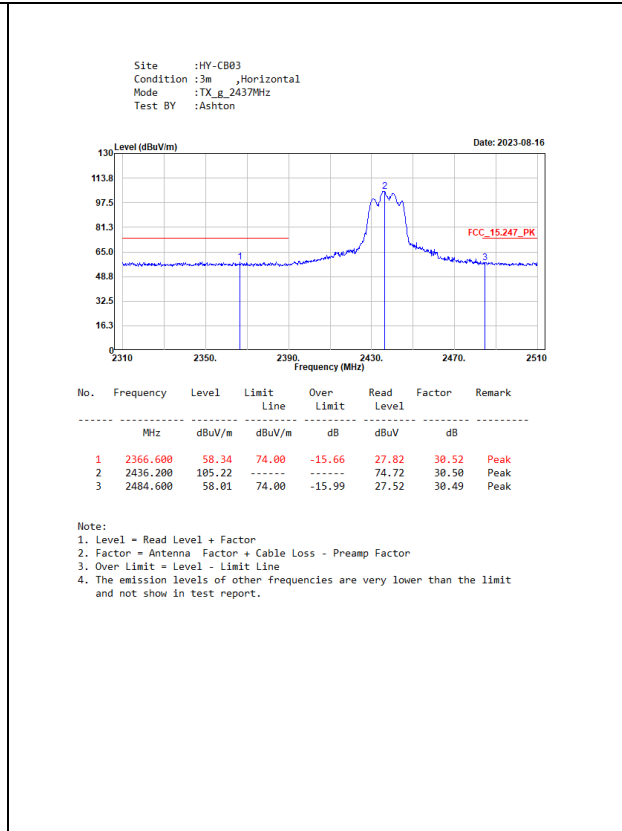
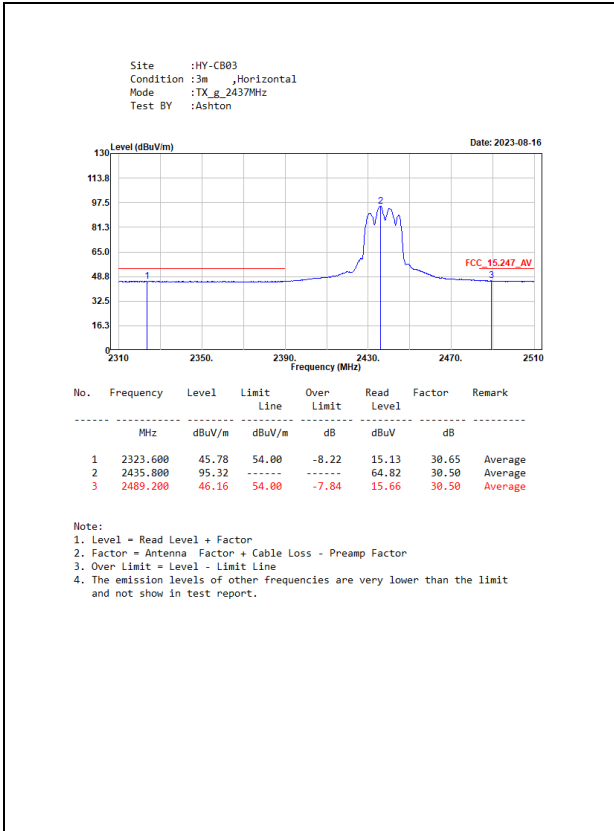
6.4. Test Result of Band Edge

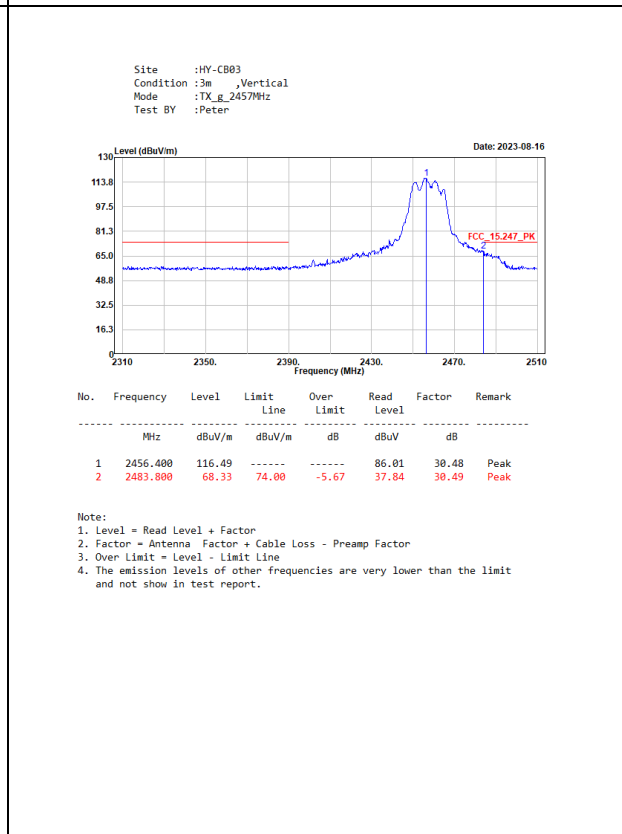
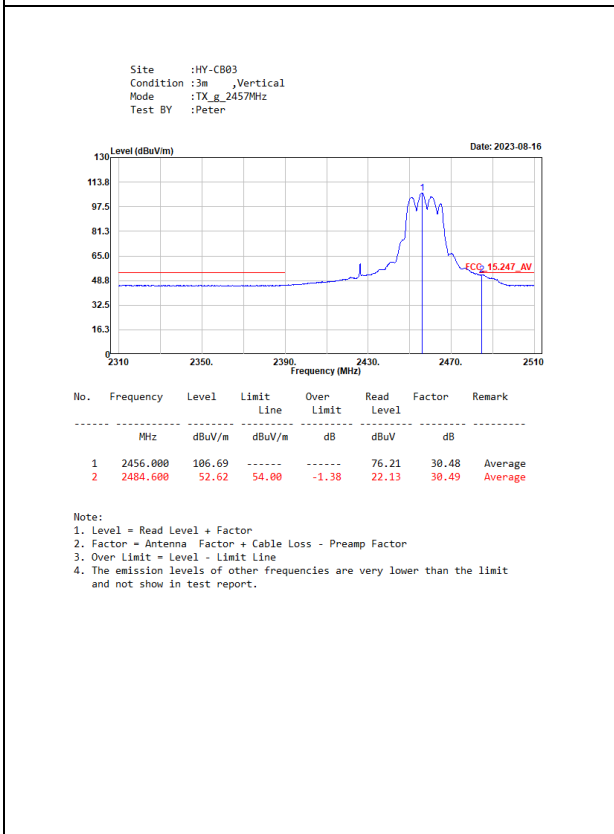
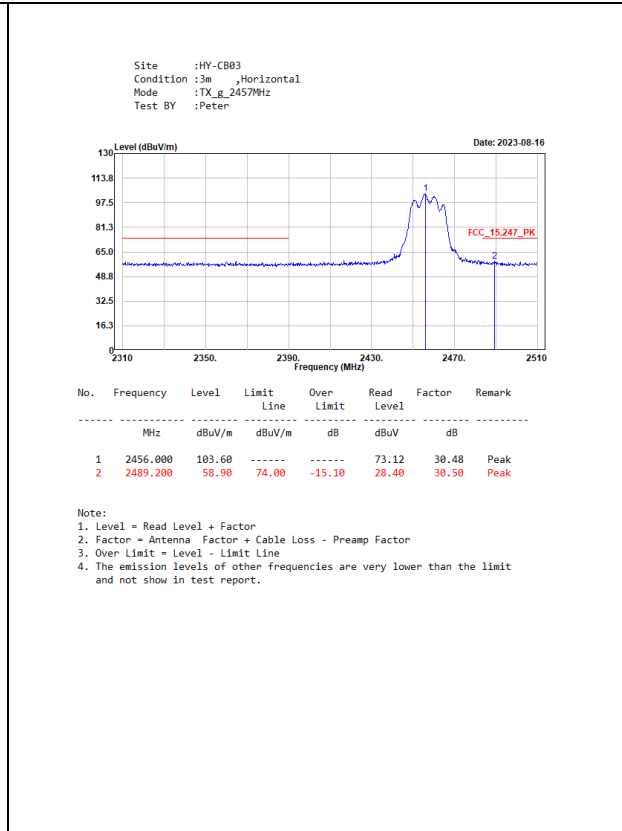
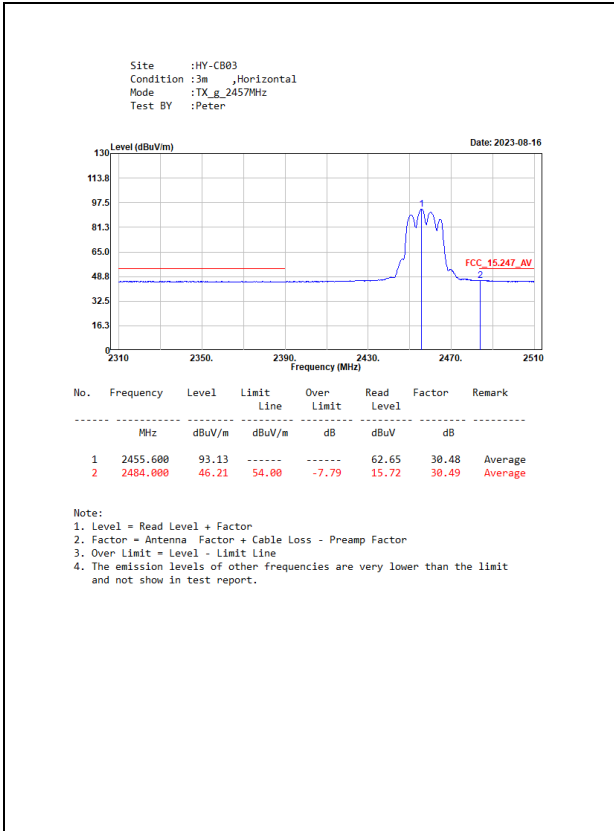


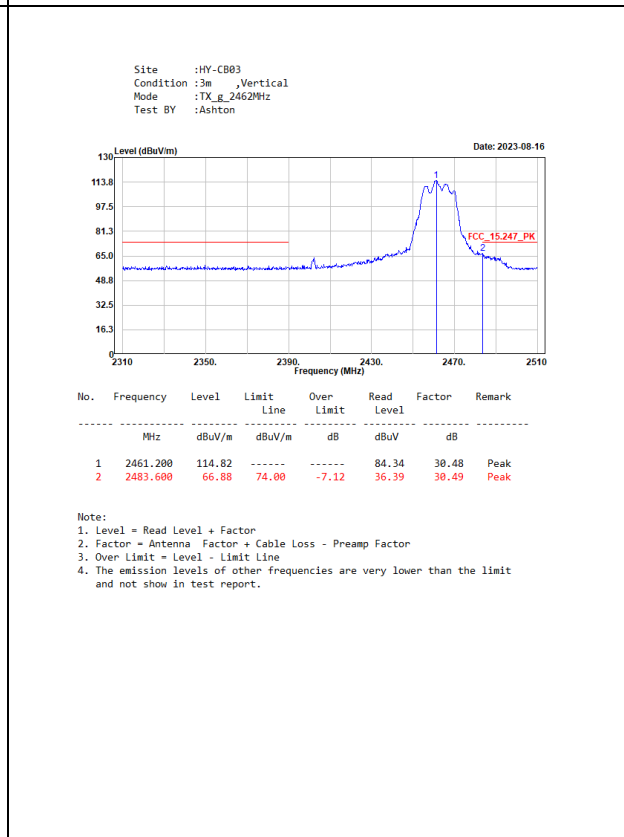
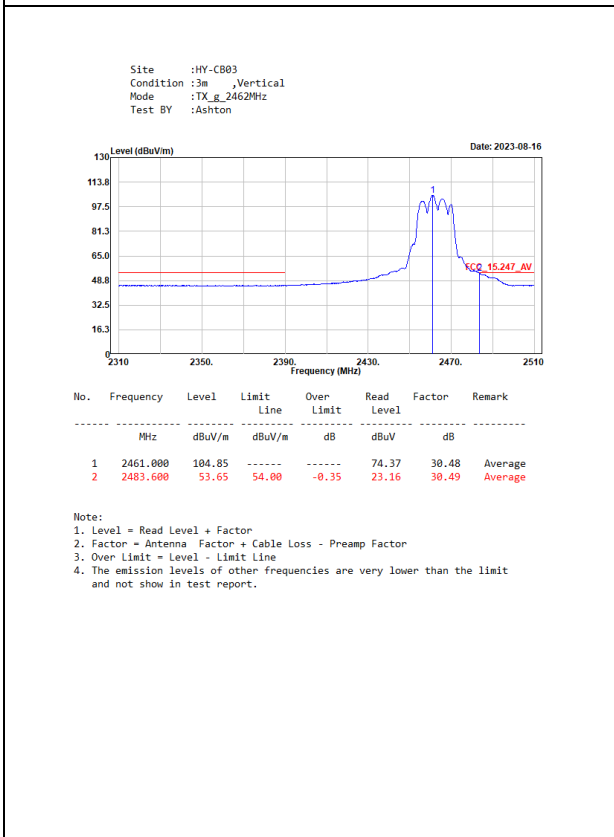
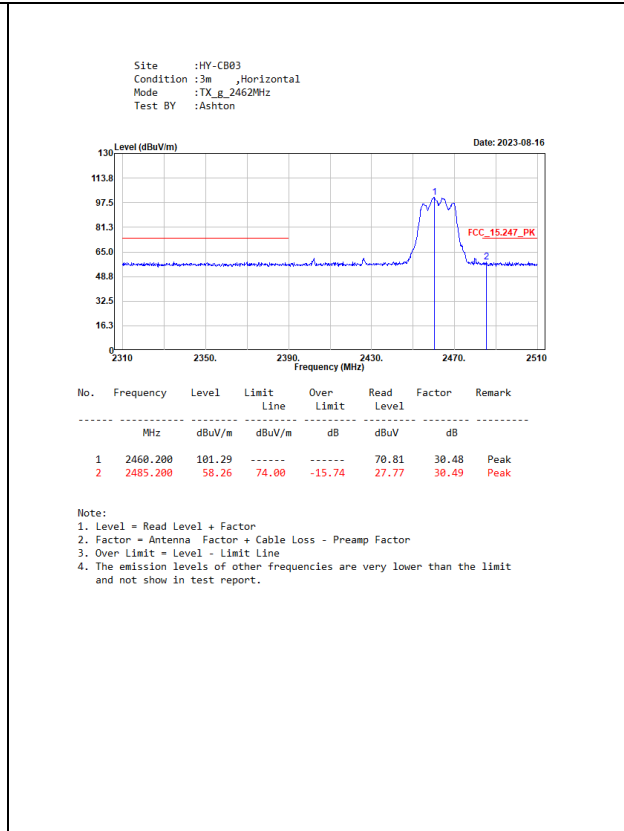
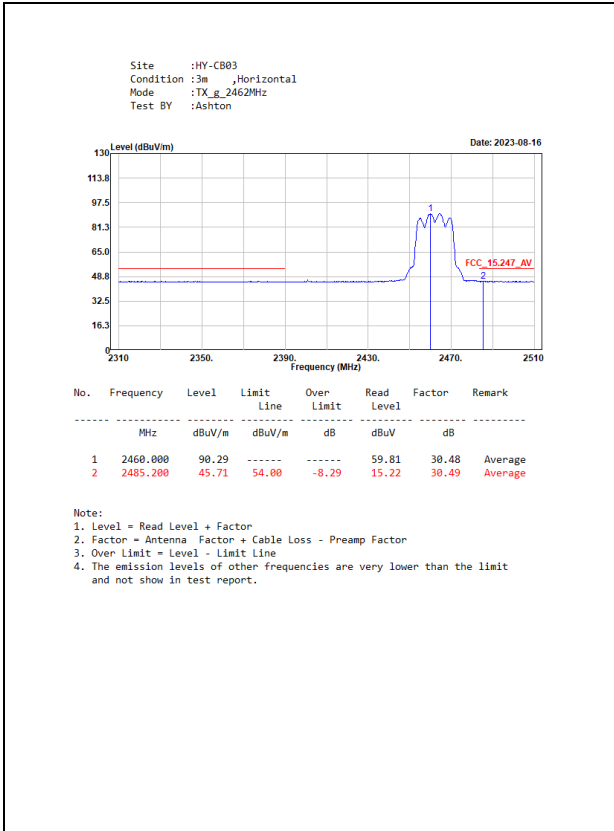


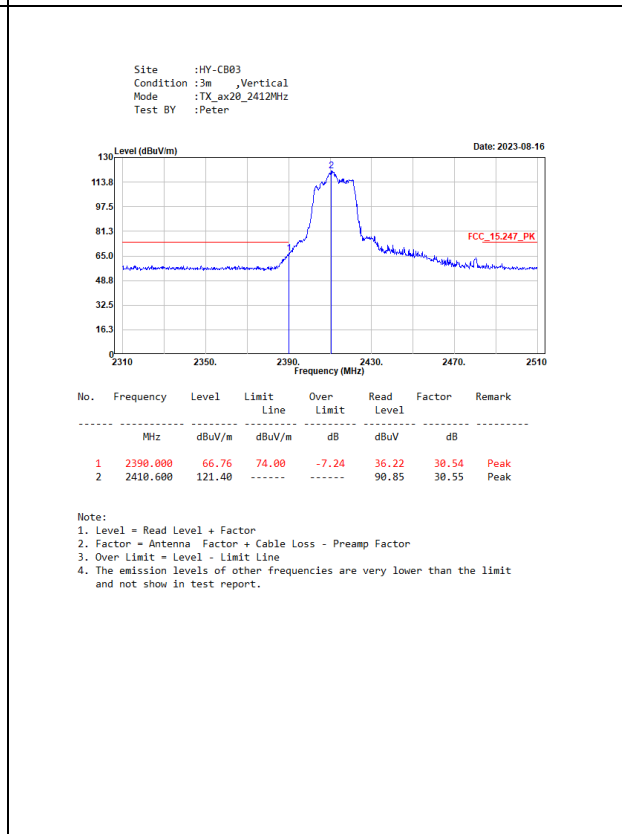
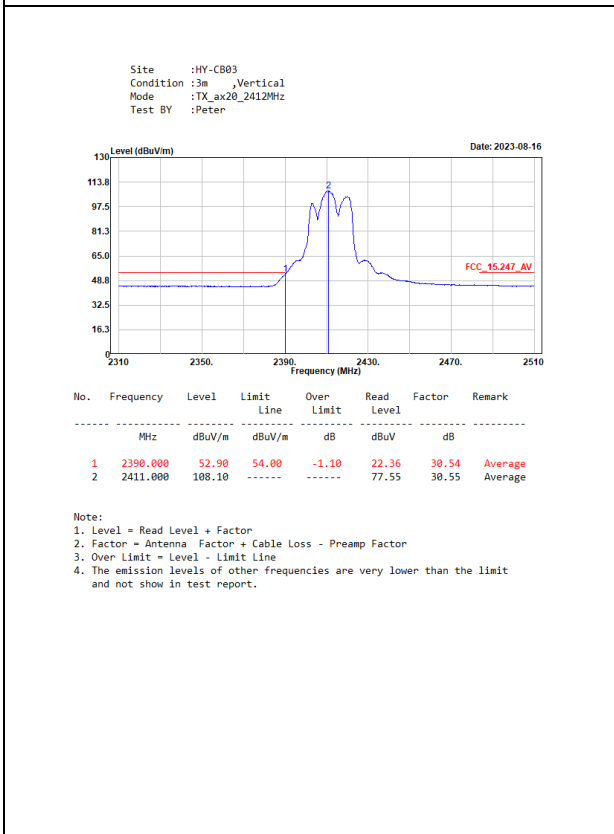
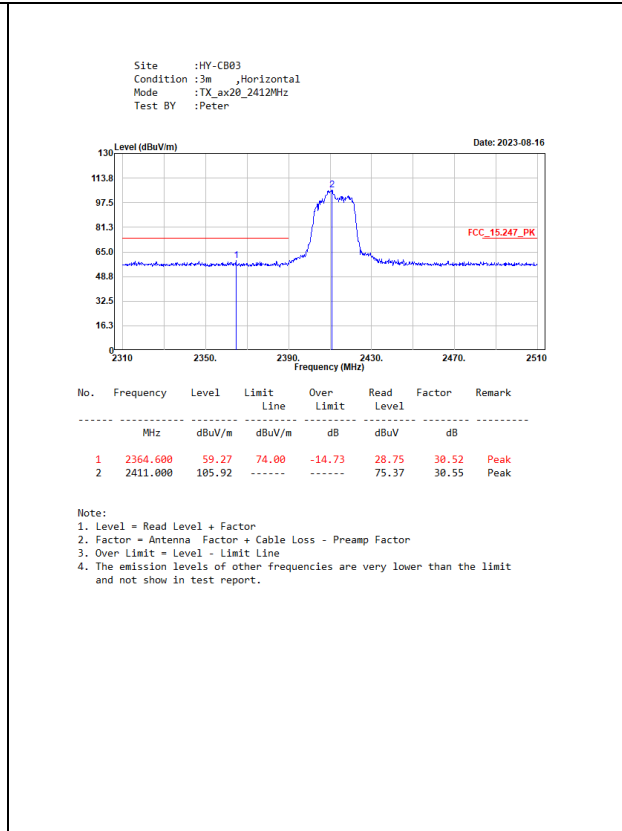
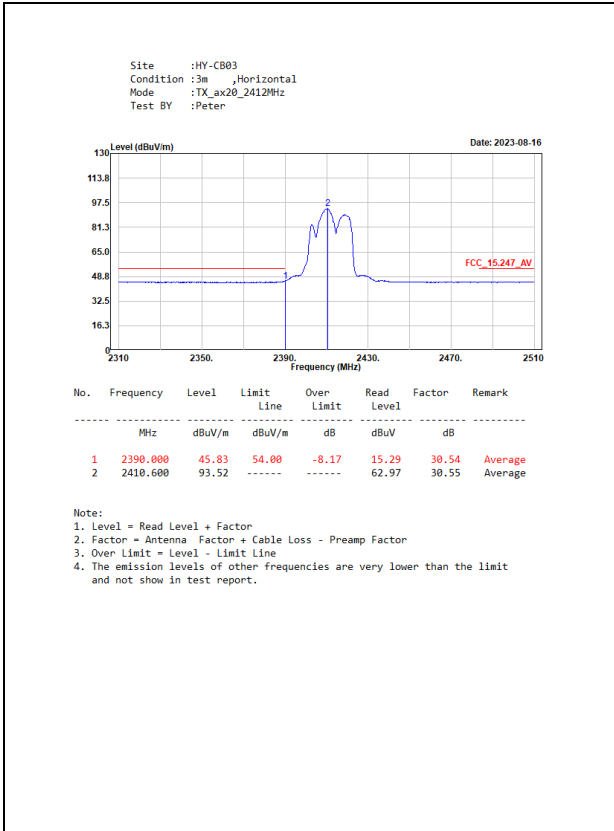


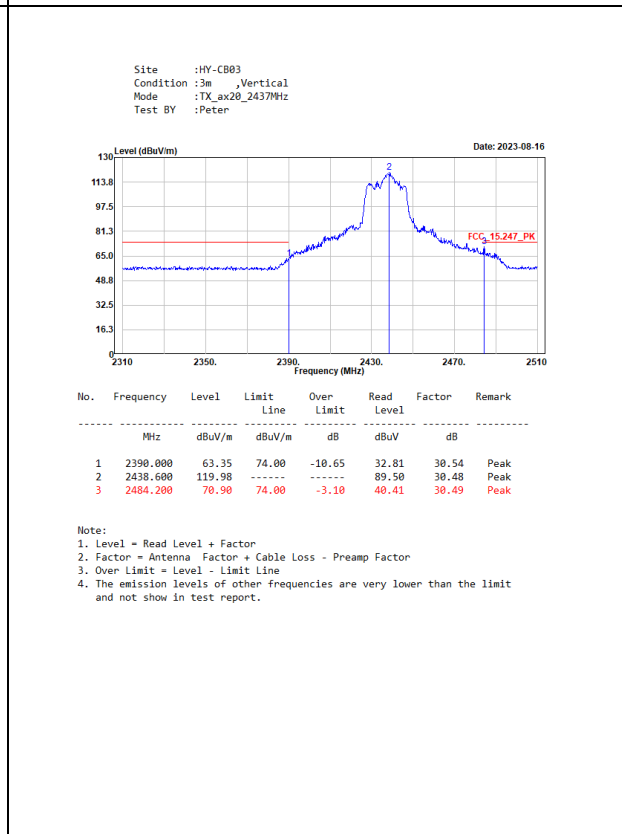
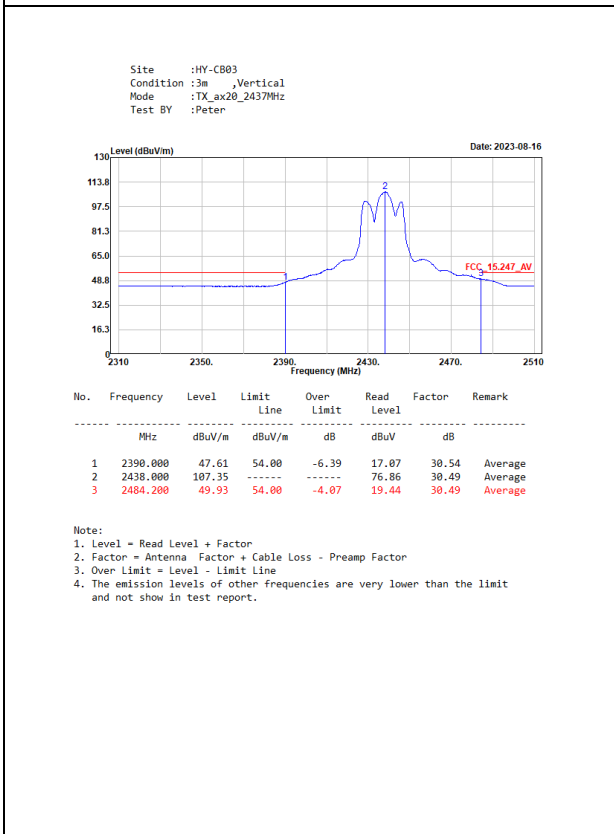
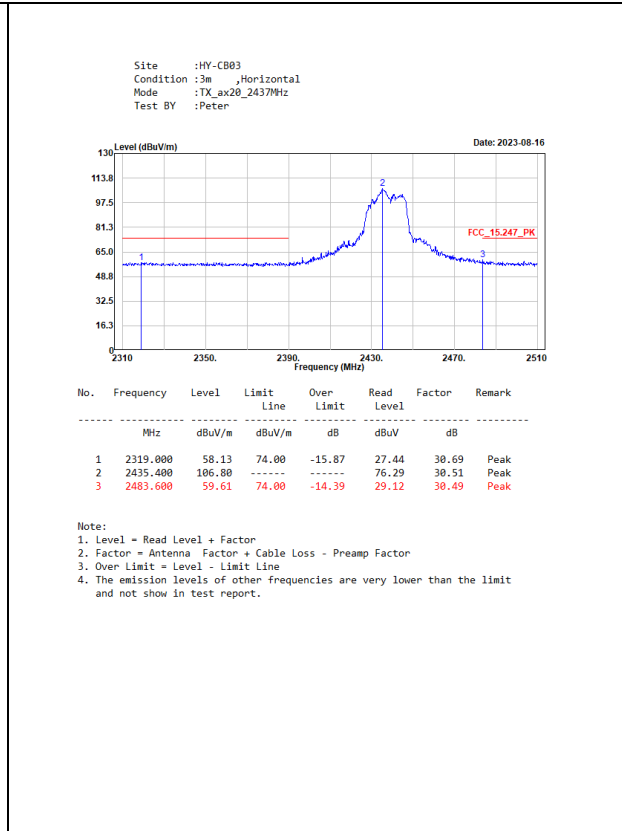
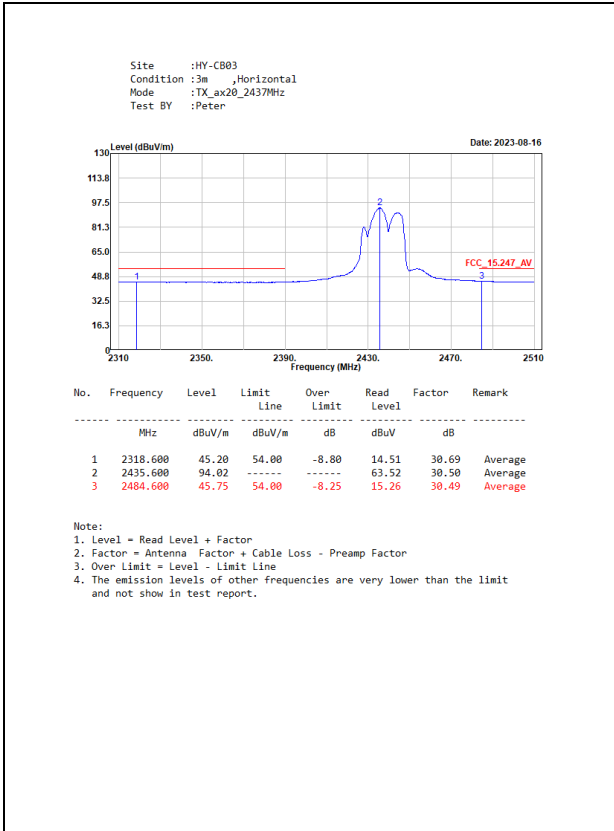


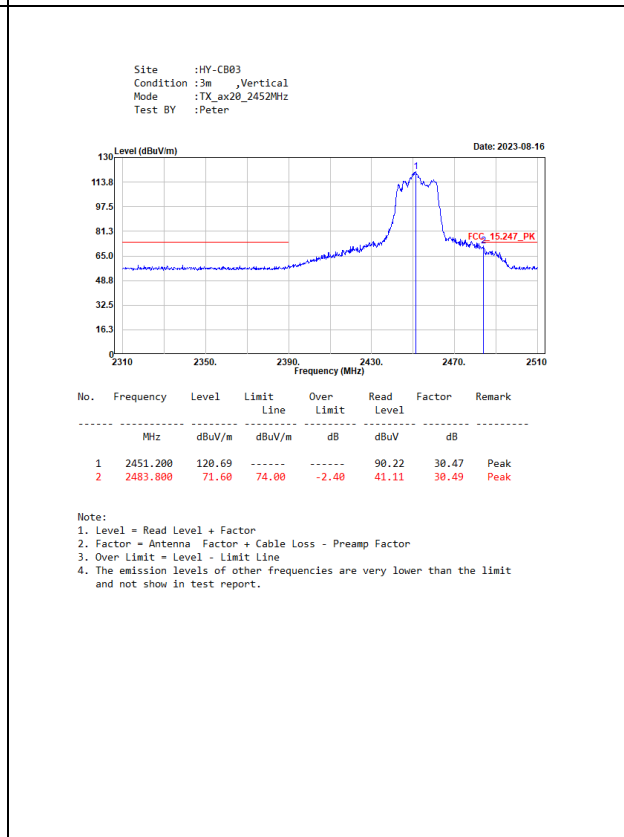
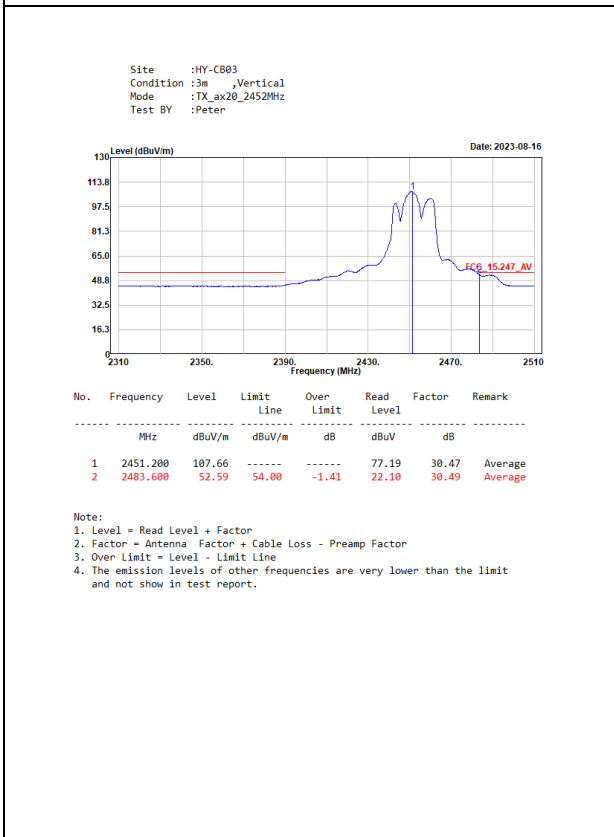
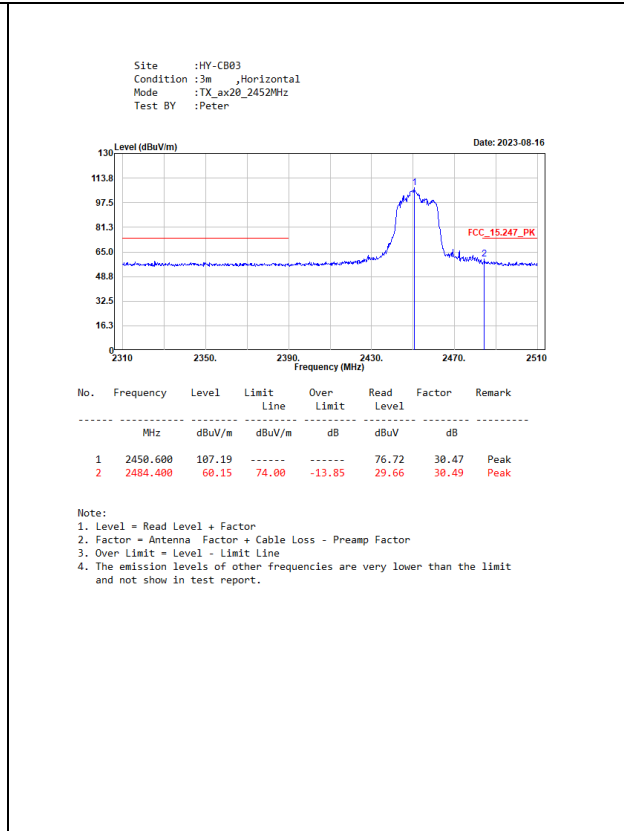
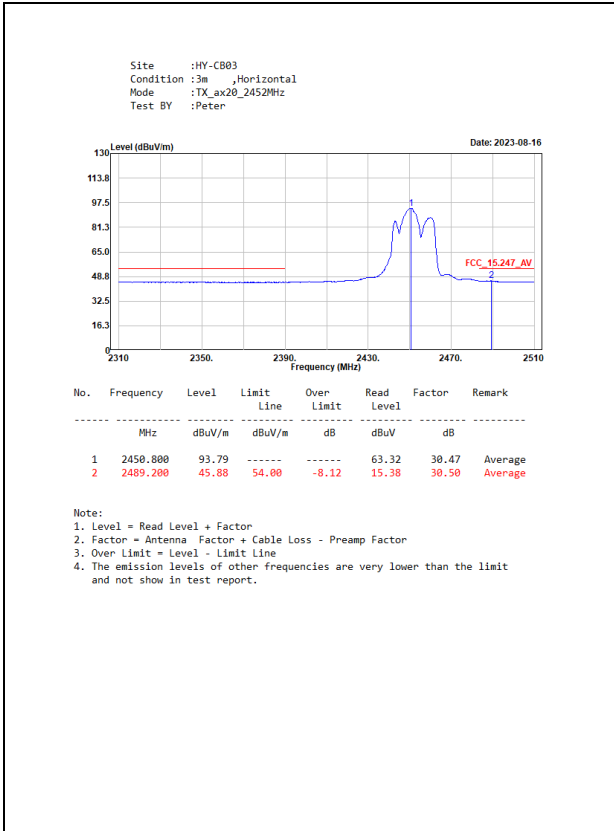


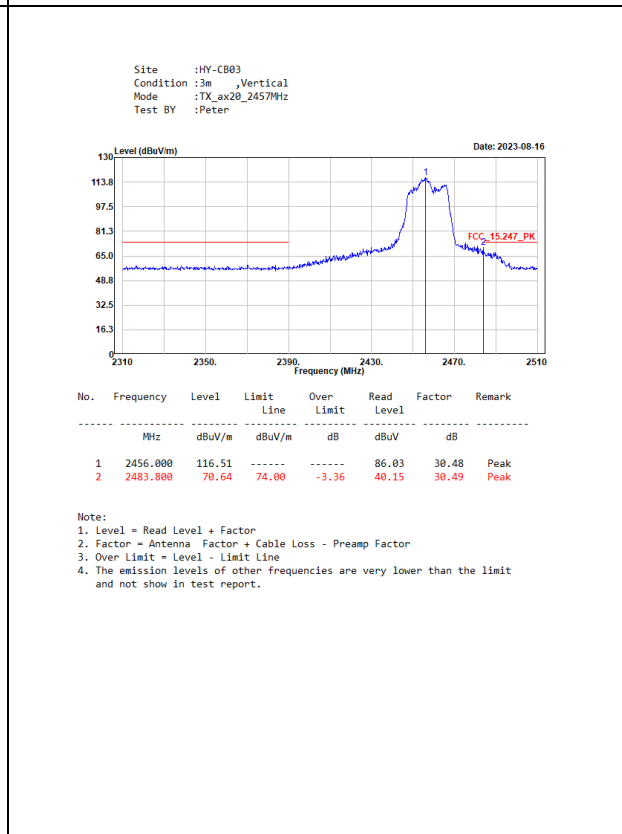
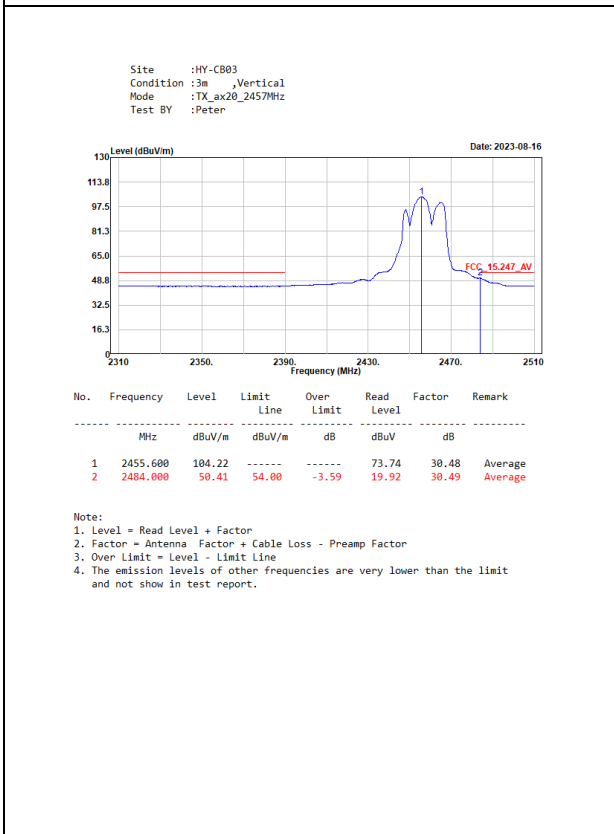
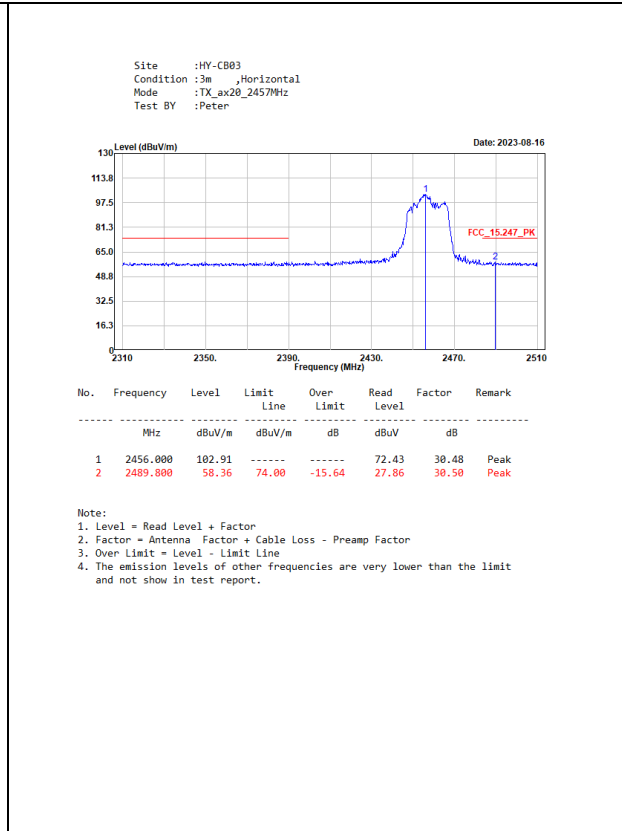
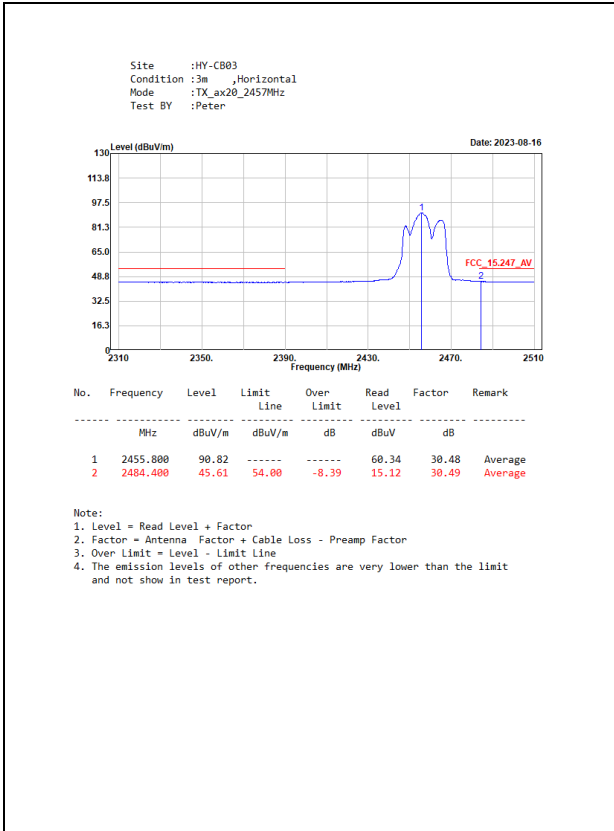


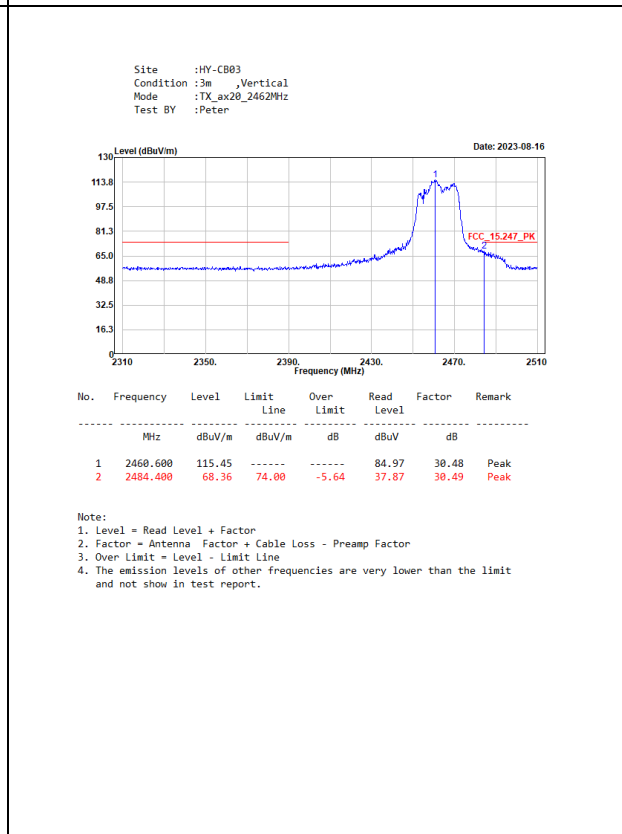
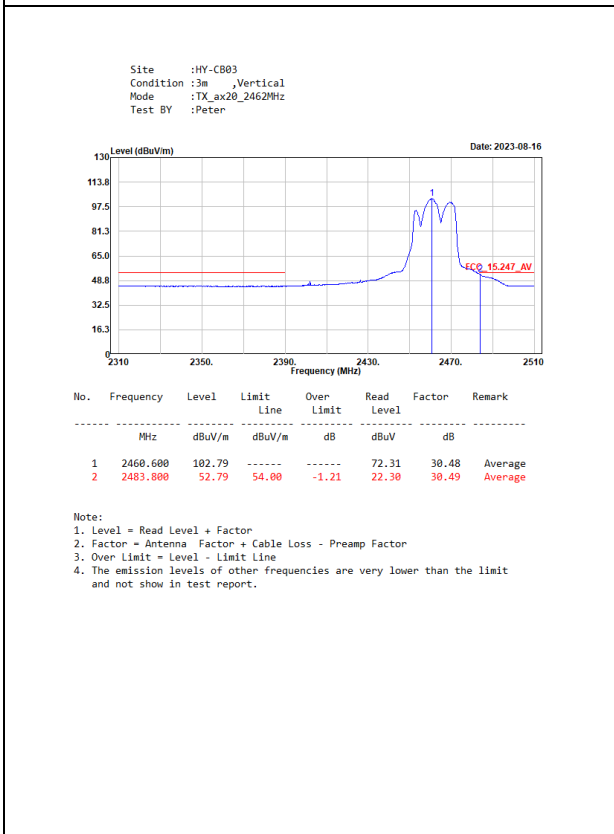
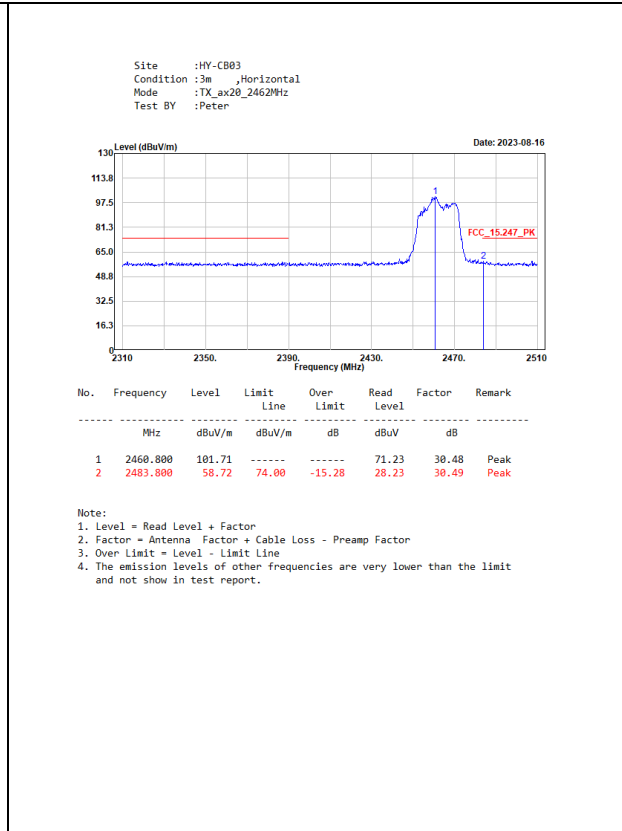
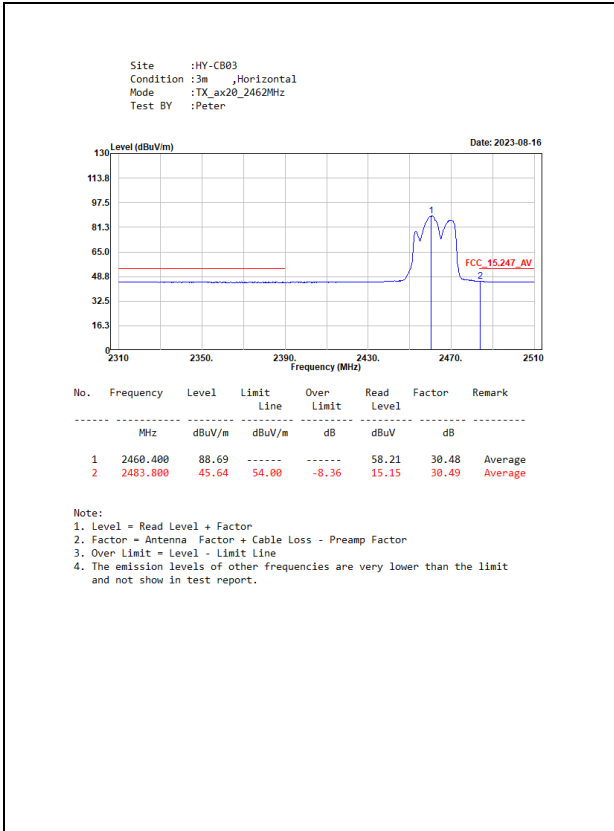


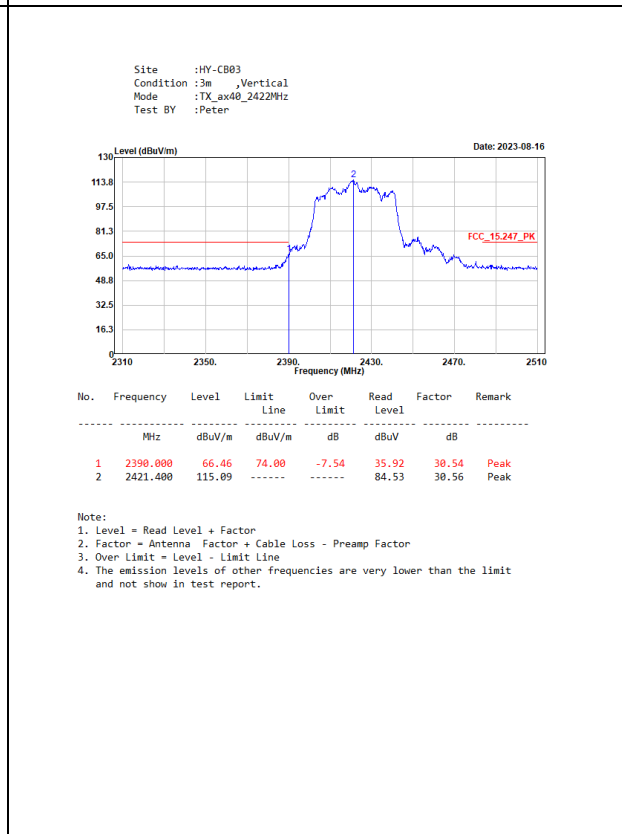
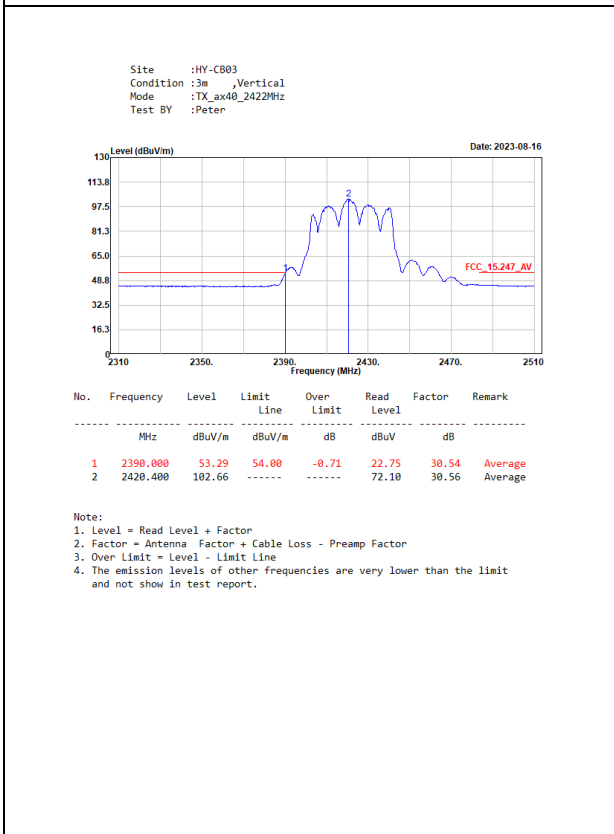
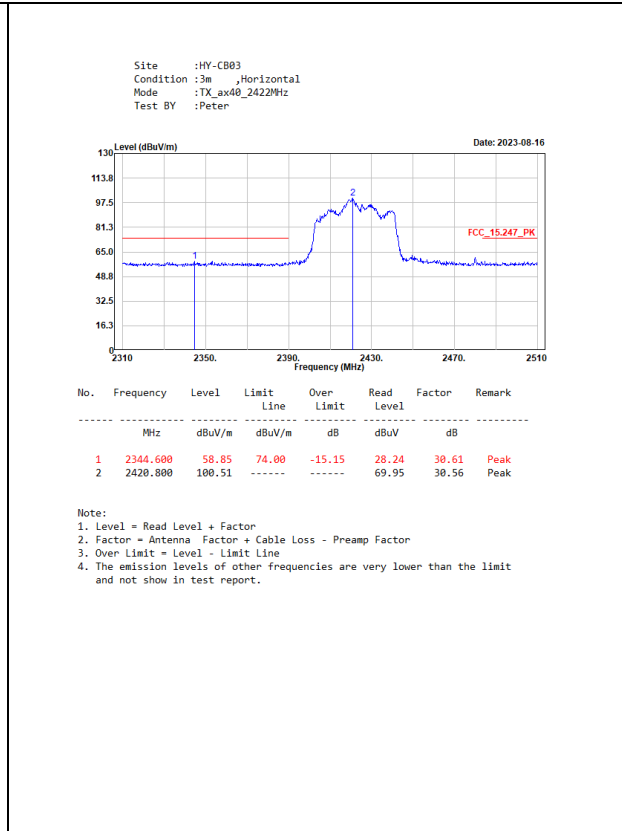
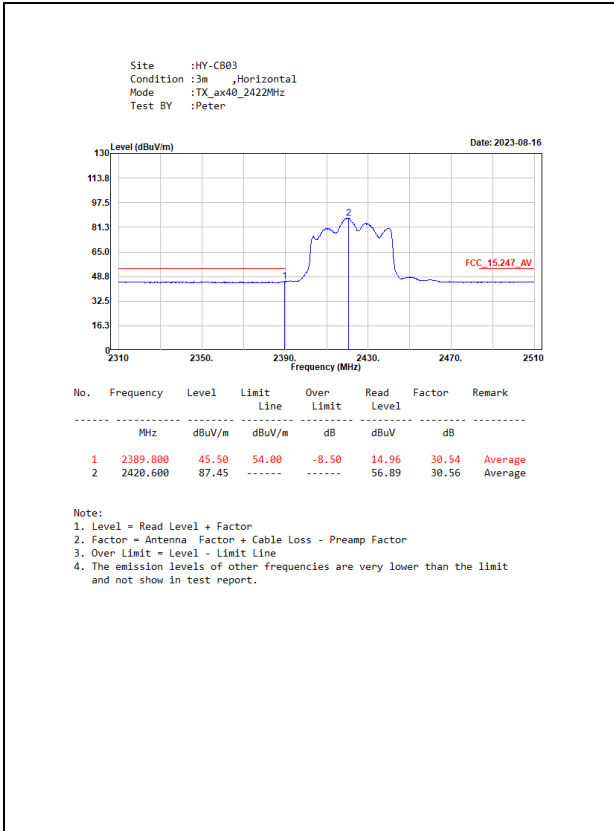


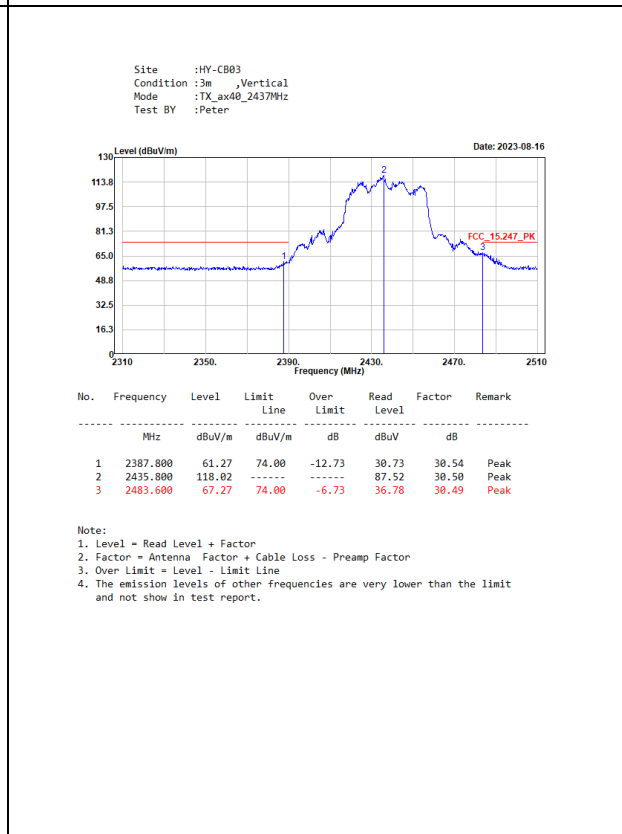
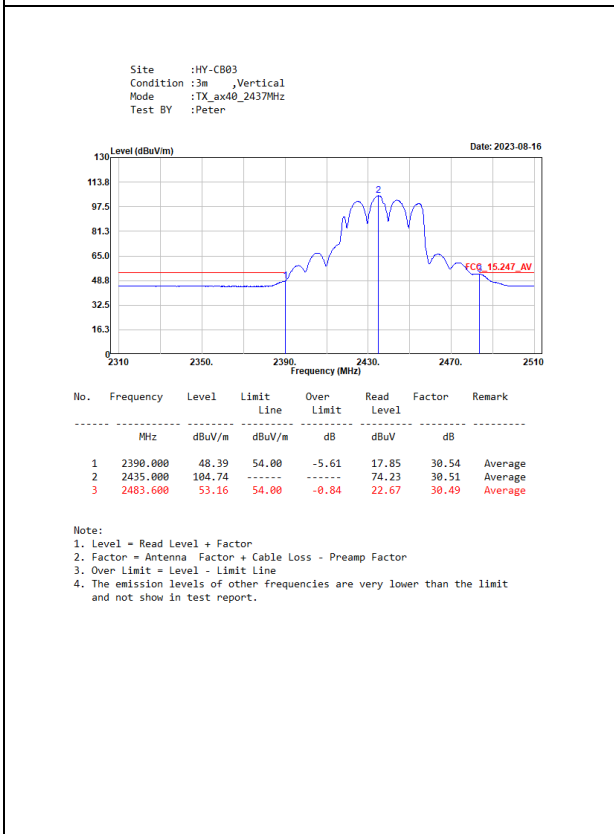
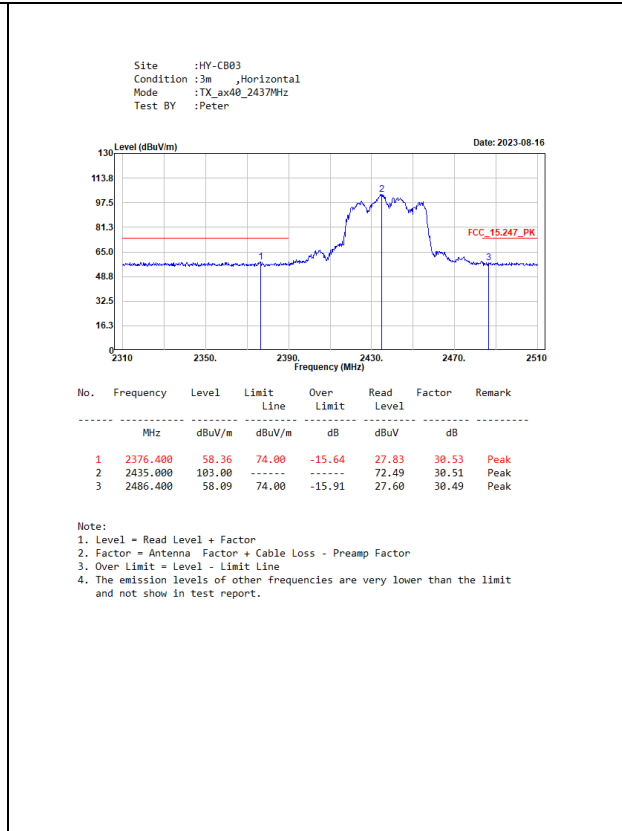
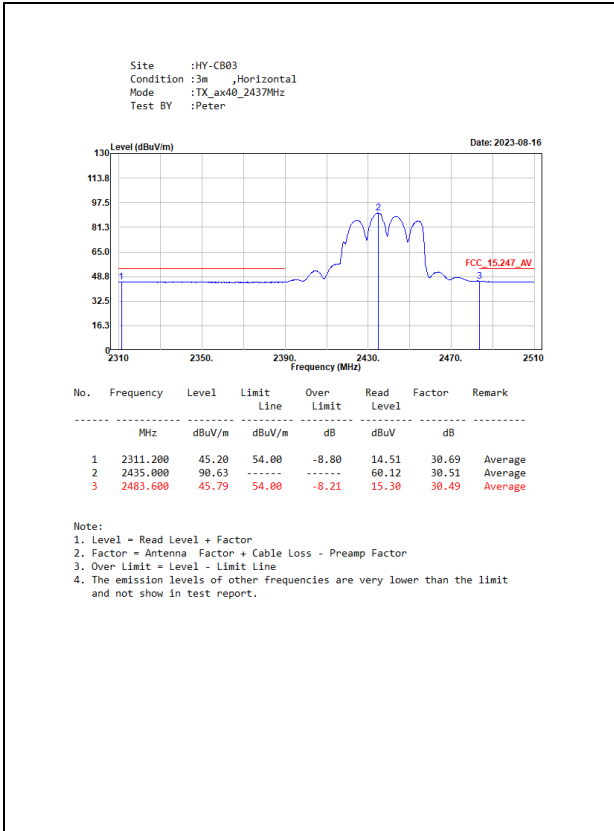


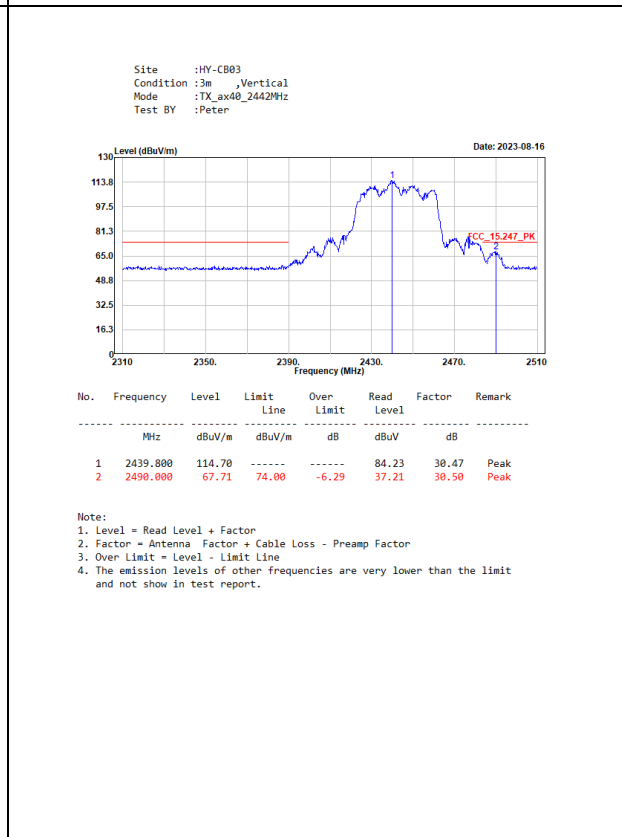
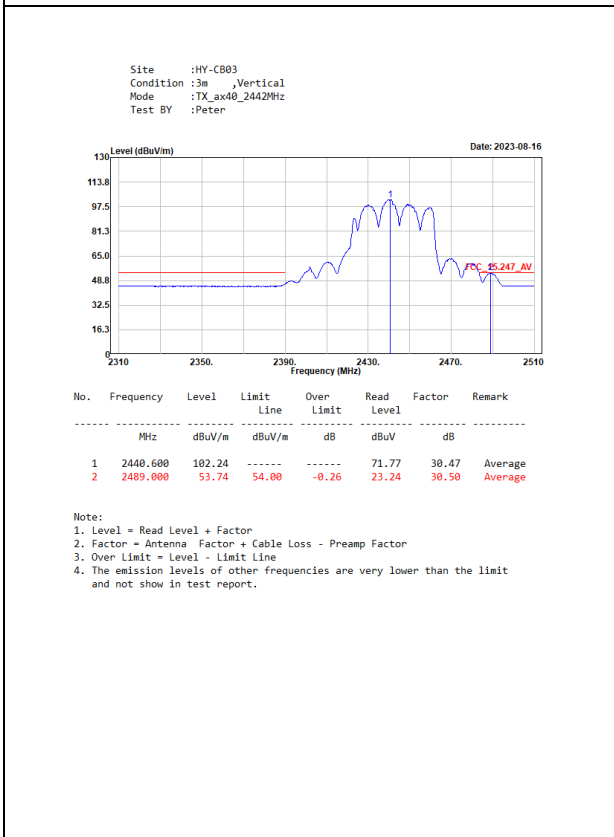
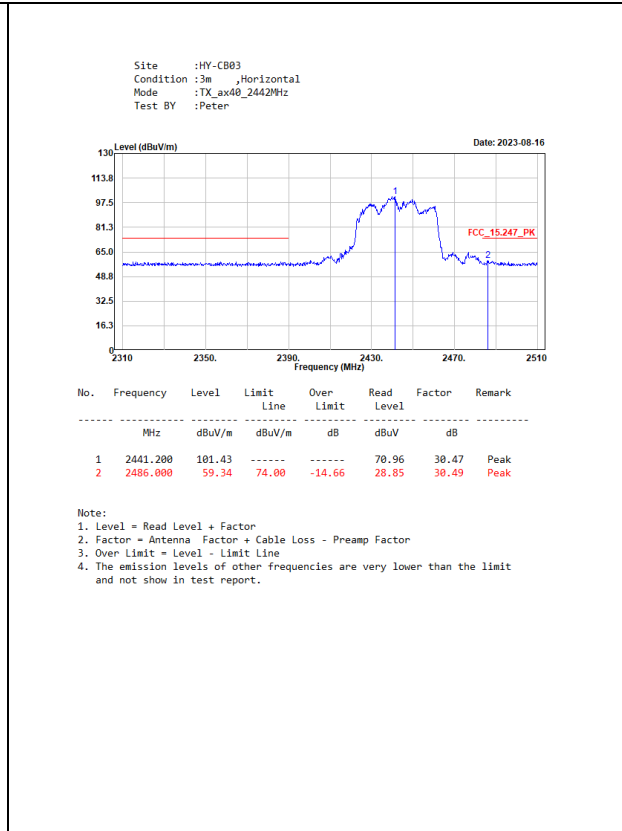
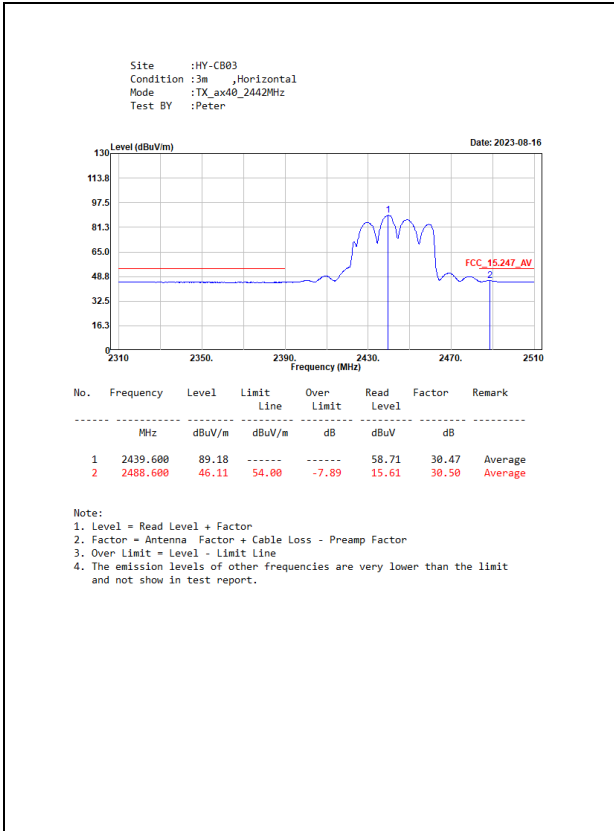


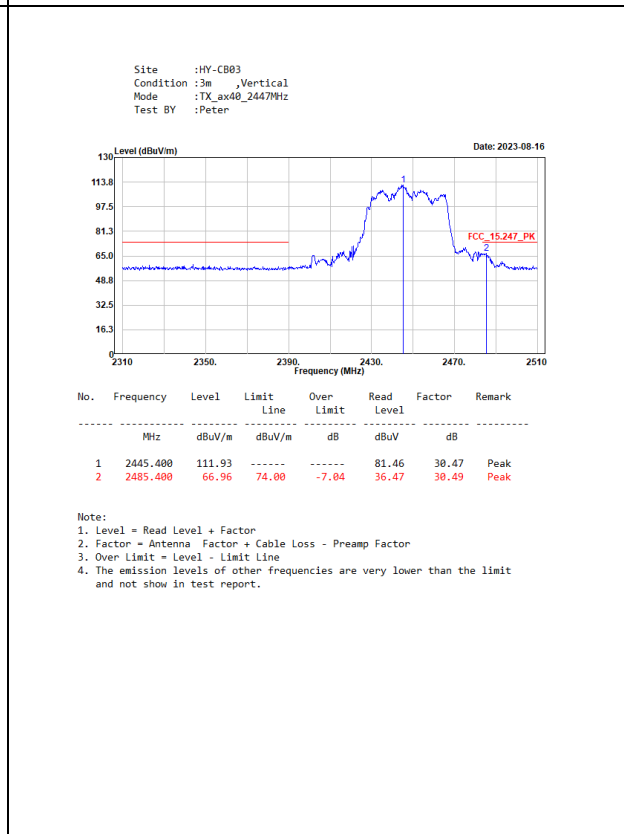
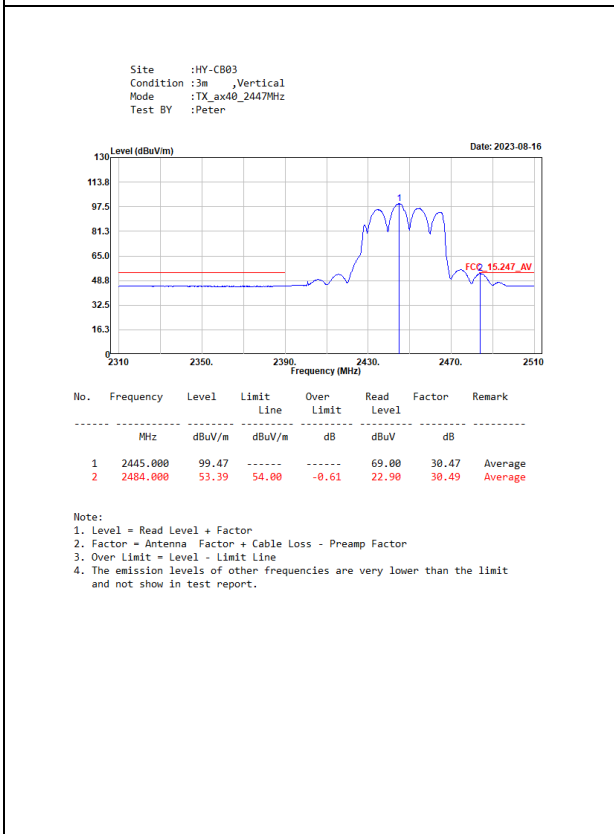
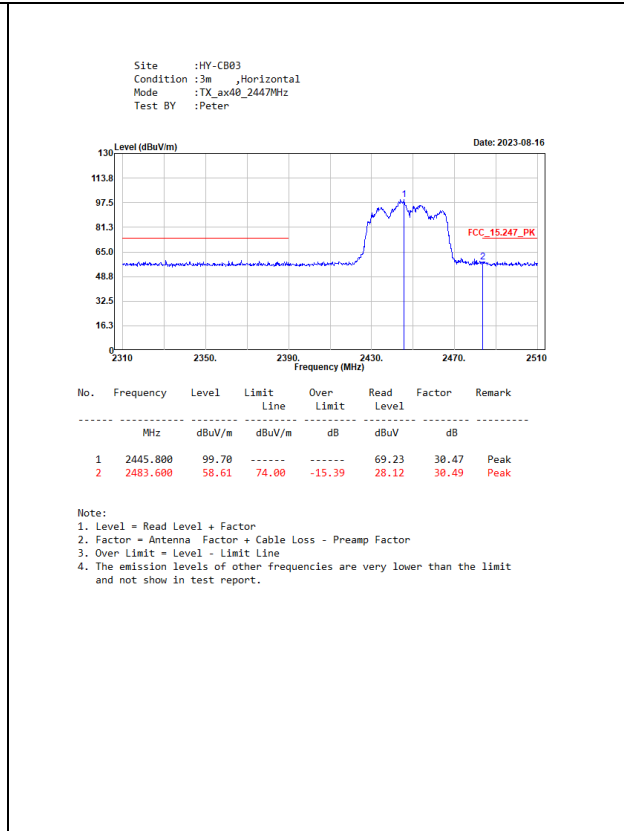
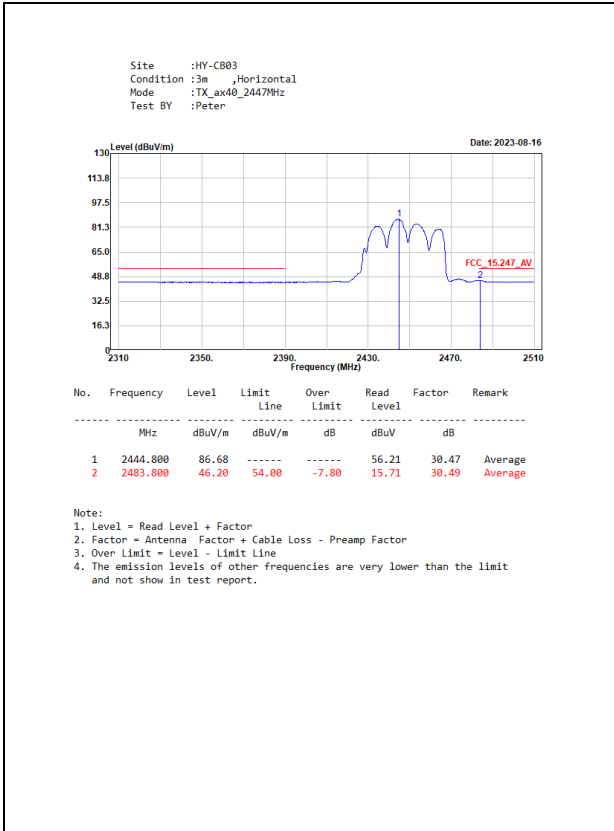


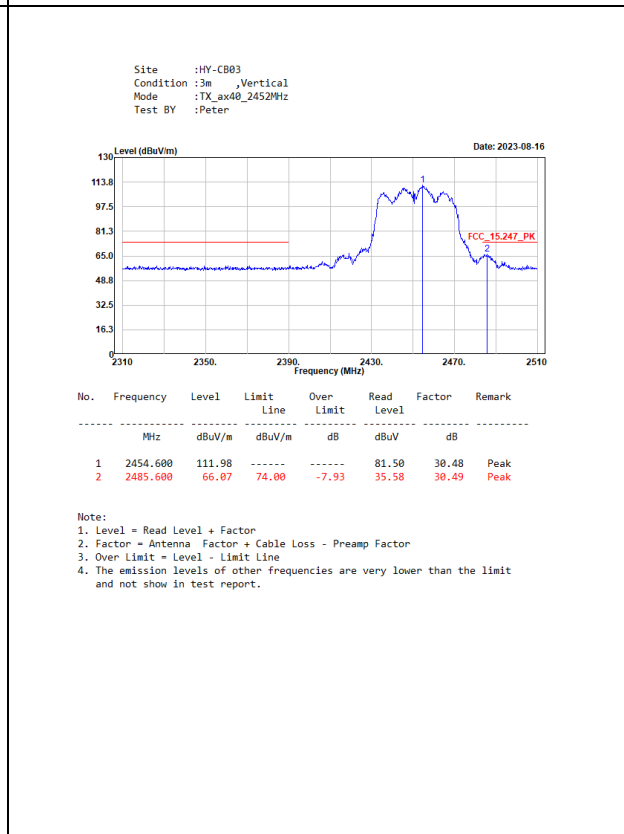
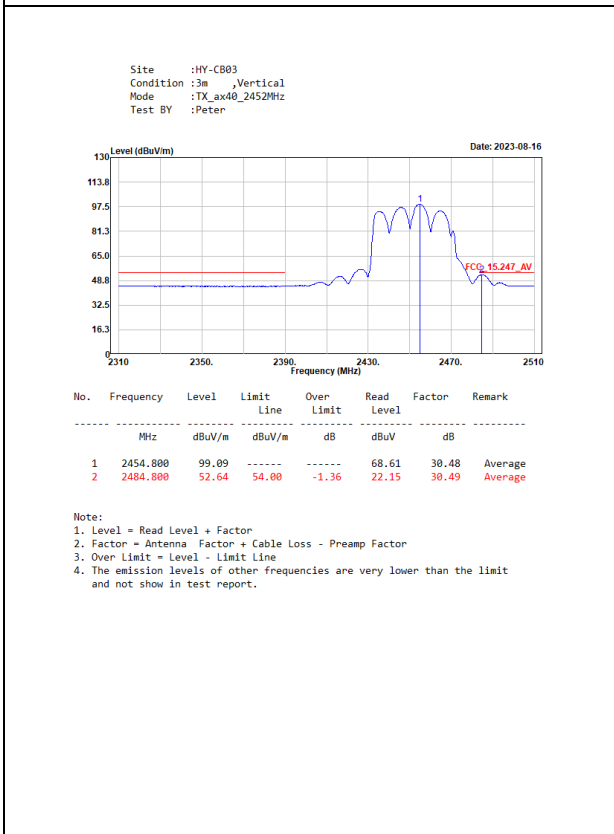
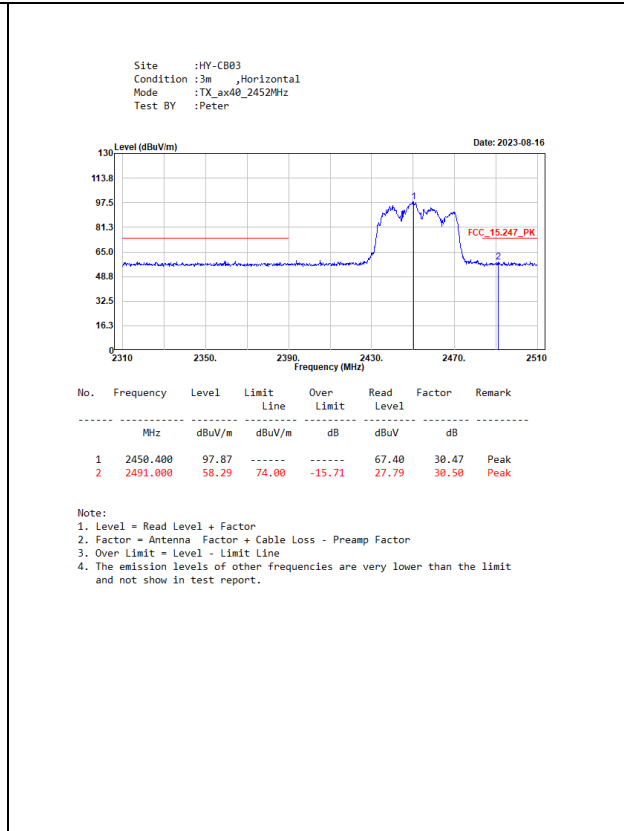
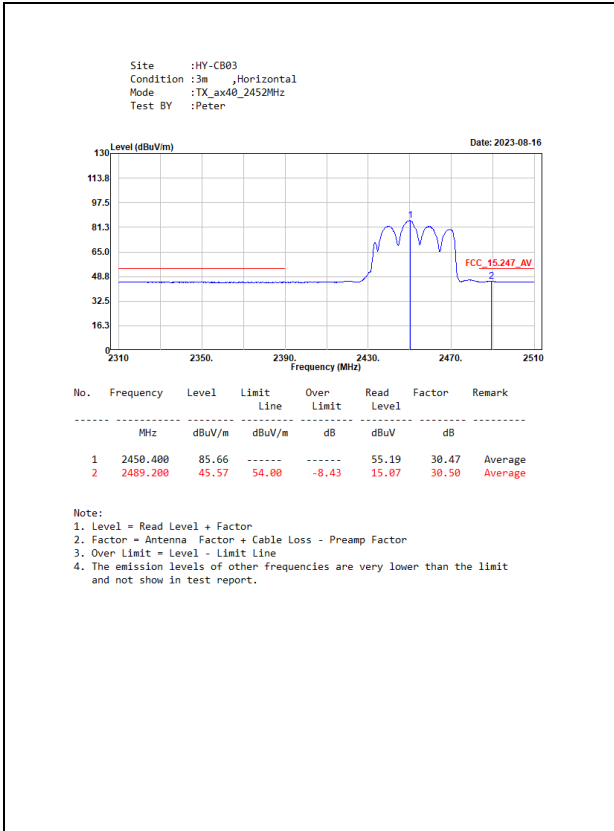






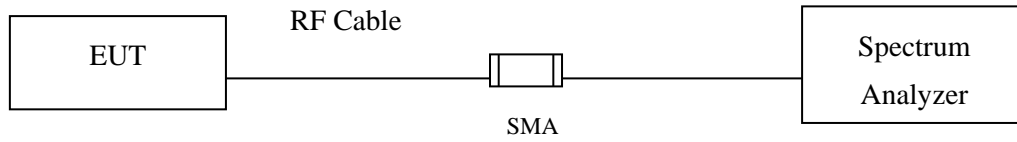






7. 6dB Bandwidth

7.1. Test Setup



7.2. Limits

The minimum bandwidth shall be at least 500 kHz.

7.3. Test Procedure

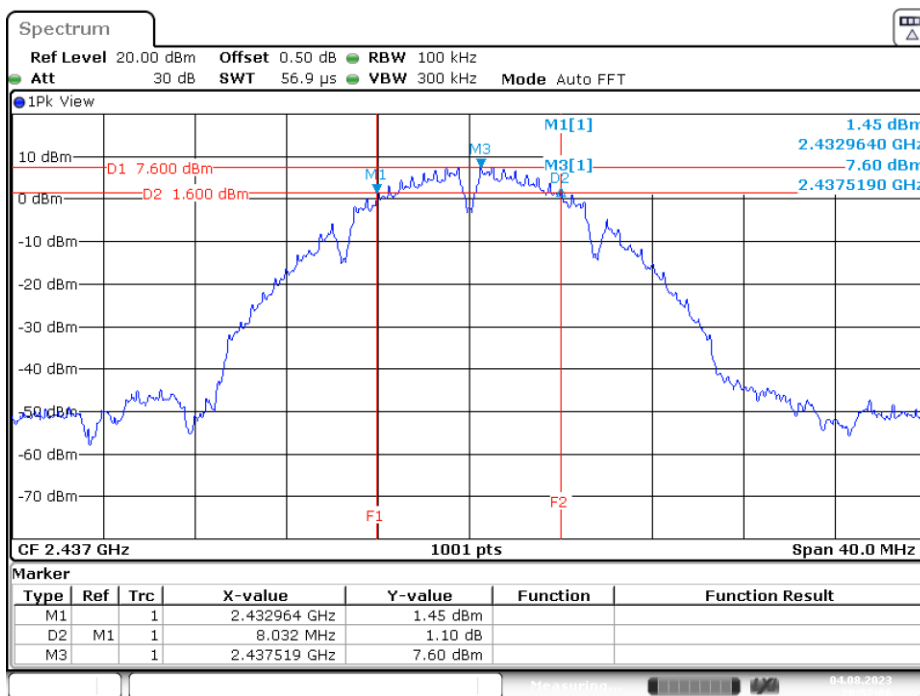
The EUT was tested according to ANSI C63.10 Section 11.8 for compliance to FCC 47CFR 15.247 requirements.

7.4. Test Result of 6dB Bandwidth

Product : Celer, Celer-5G, Celer-LTE1, Celer-LTE2
 Test Item : 6dB Bandwidth Data
 Test Mode : Transmit (802.11b)

Channel No.	Frequency (MHz)	Chain	Measurement Level (kHz)	Required Limit (kHz)	Result
01	2412	A	8032	>500	Pass
06	2437	A	8032	>500	Pass
11	2462	A	8072	>500	Pass
01	2412	B	8072	>500	Pass
06	2437	B	7113	>500	Pass
11	2462	B	8072	>500	Pass

Channel 06 (Chain A):

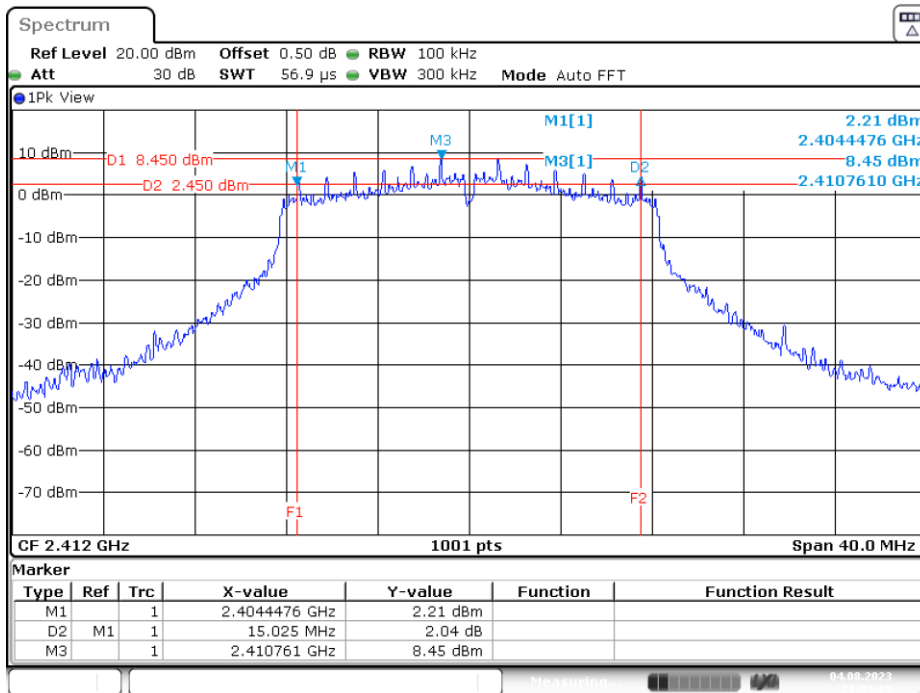


Date: 4.AUG.2023 20:52:06

Product : Celer, Celer-5G, Celer-LTE1, Celer-LTE2
 Test Item : 6dB Bandwidth Data
 Test Mode : Transmit (802.11g)

Channel No.	Frequency (MHz)	Chain	Measurement Level (kHz)	Required Limit (kHz)	Result
01	2412	A	15105	>500	Pass
06	2437	A	15105	>500	Pass
11	2462	A	15105	>500	Pass
01	2412	B	15025	>500	Pass
06	2437	B	15065	>500	Pass
11	2462	B	15025	>500	Pass

Channel 01 (Chain B):

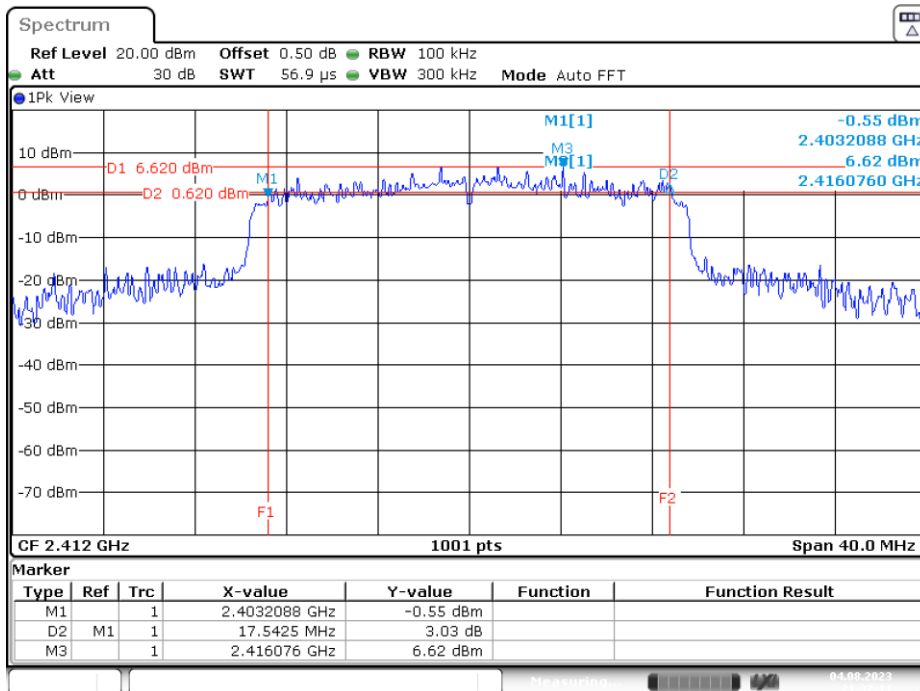


Date: 4.AUG.2023 21:09:09

Product : Celer, Celer-5G, Celer-LTE1, Celer-LTE2
 Test Item : 6dB Bandwidth Data
 Test Mode : Transmit (802.11ax-20BW)

Channel No.	Frequency (MHz)	Chain	Measurement Level (kHz)	Required Limit (kHz)	Result
01	2412	A	17543	>500	Pass
06	2437	A	13786	>500	Pass
11	2462	A	15105	>500	Pass
01	2412	B	15025	>500	Pass
06	2437	B	13826	>500	Pass
11	2462	B	16304	>500	Pass

Channel 01 (Chain A):

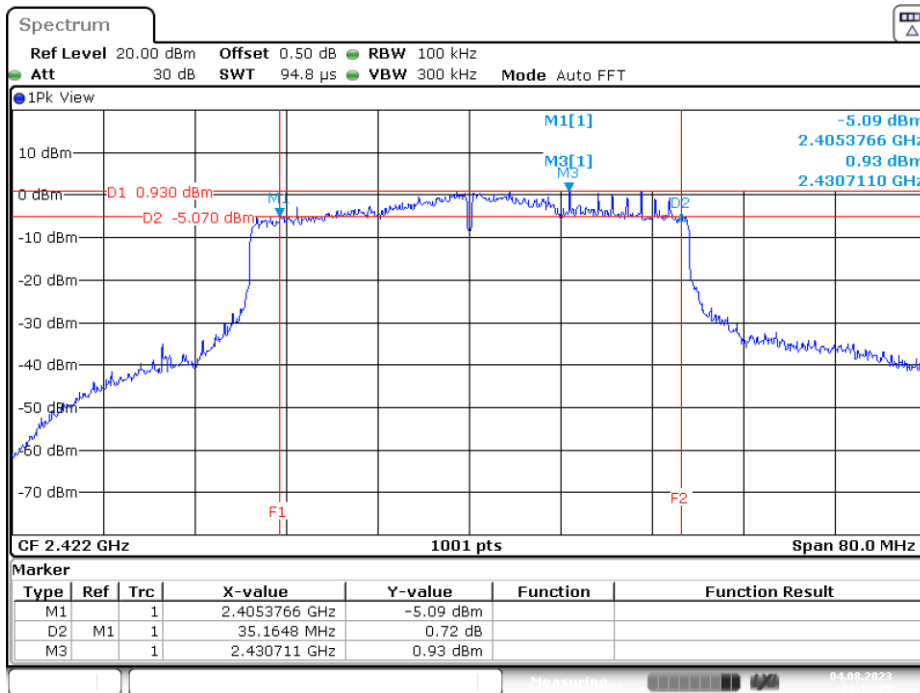


Date: 4.AUG.2023 21:37:11

Product : Celer, Celer-5G, Celer-LTE1, Celer-LTE2
 Test Item : 6dB Bandwidth Data
 Test Mode : Transmit (802.11ax-40BW)

Channel No.	Frequency (MHz)	Chain	Measurement Level (kHz)	Required Limit (kHz)	Result
03	2422	A	35165	>500	Pass
06	2437	A	36444	>500	Pass
09	2452	A	36444	>500	Pass
03	2422	B	36204	>500	Pass
06	2437	B	30050	>500	Pass
09	2452	B	32528	>500	Pass

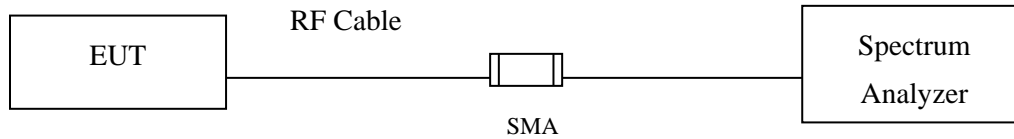
Channel 03 (Chain A):



Date: 4.AUG.2023 23:18:26

8. Power Density

8.1. Test Setup



8.2. Limits

The peak power spectral density conducted from the intentional radiated to the antenna shall not be greater than +8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.3. Test Procedure

The EUT was setup according to ANSI C63.10, 2013; tested according to DTS test procedure of KDB 558074 for compliance to FCC 47CFR 15.247 requirements.

The maximum power spectral density using C63.10 Section 11.10.2 Method PKPSD (peak PSD)

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

2400MHz: PSD Directional gain = 5.45 dBi, Limit= 8dBm

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

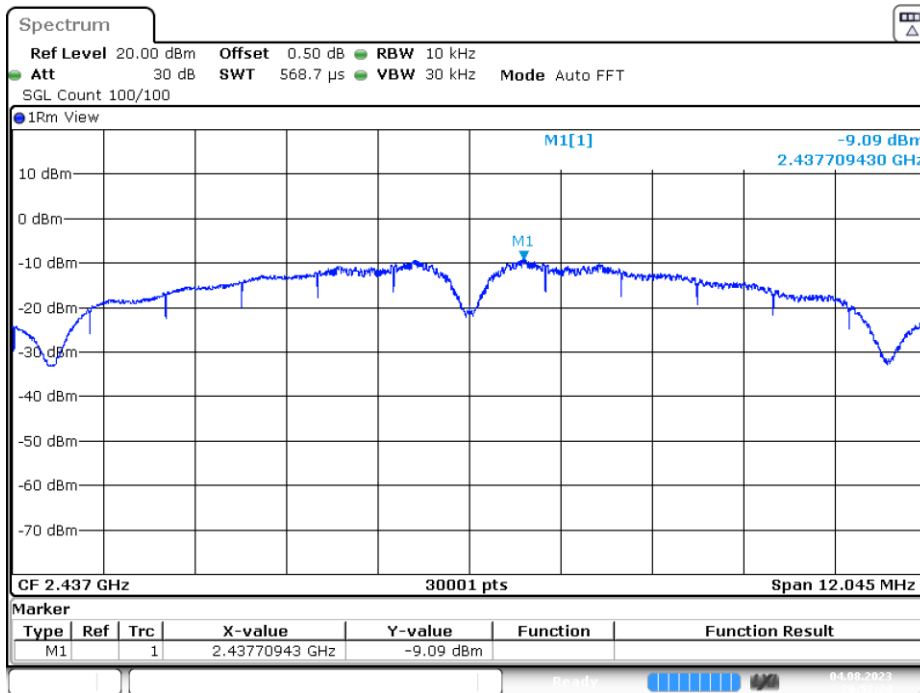
8.4. Test Result of Power Density

Product : Celer, Celer-5G, Celer-LTE1, Celer-LTE2
 Test Item : Power Density Data
 Test Mode : Transmit (802.11b)

Channel No.	Frequency (MHz)	Data Rate (Mbps)	Chain	PPSD/MHz (dBm)	Duty factor (dBm)	Total PPSD/MHz (dBm)	Limit (dBm)	Result
01	2412	1	A	-10.450	0.325	-7.039	8	Pass
			B	-10.300				
06	2437	1	A	-9.090	0.325	-6.838	8	Pass
			B	-11.620				
11	2462	1	A	-10.600	0.325	-7.254	8	Pass
			B	-10.580				

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

Channel 06 (Chain A):



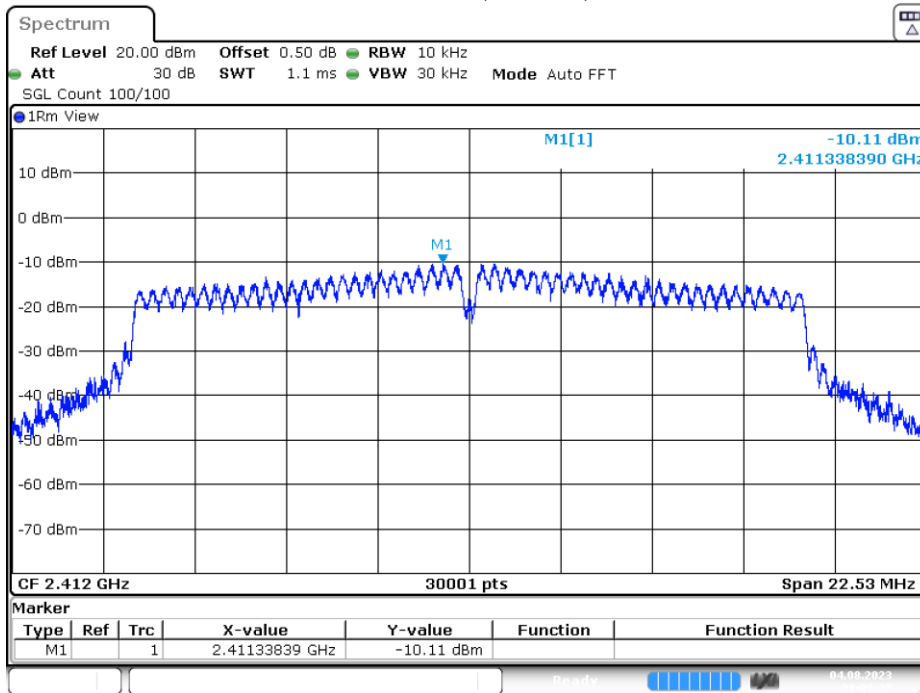
Date: 4.AUG.2023 20:52:24

Product : Celer, Celer-5G, Celer-LTE1, Celer-LTE2
 Test Item : Power Density Data
 Test Mode : Transmit (802.11g)

Channel No.	Frequency (MHz)	Data Rate (Mbps)	Chain	PPSD/MHz (dBm)	Duty factor (dBm)	Total PPSD/MHz (dBm)	Limit (dBm)	Result
01	2412	6	A	-10.750	0.483	-6.925	8	Pass
			B	-10.110				
06	2437	6	A	-12.480	0.483	-7.730	8	Pass
			B	-10.250				
11	2462	6	A	-10.130	0.483	-7.014	8	Pass
			B	-10.920				

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

Channel 01 (Chain B):



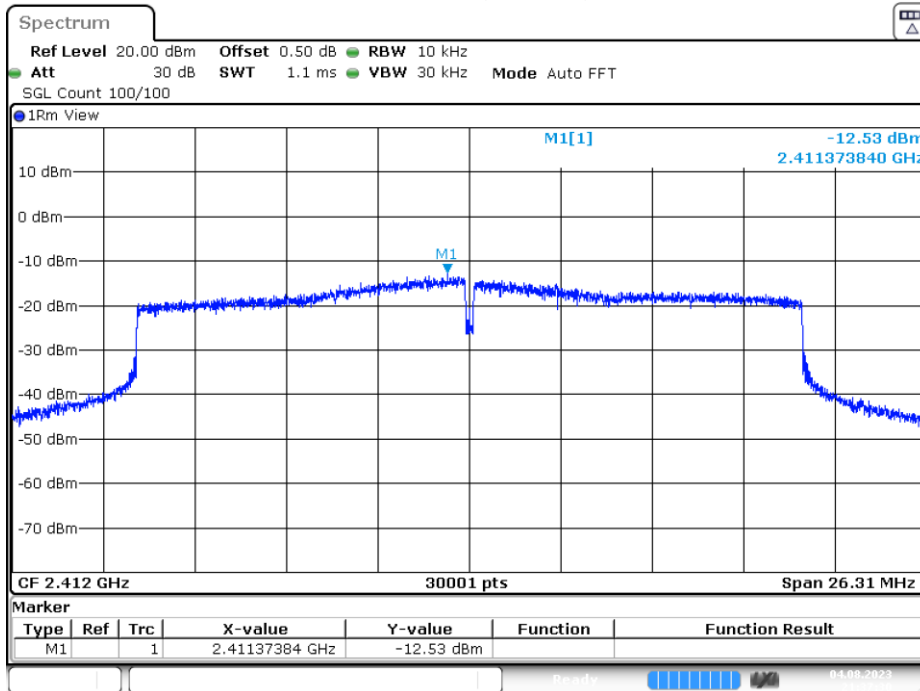
Date: 4.AUG.2023 21:09:27

Product : Celer, Celer-5G, Celer-LTE1, Celer-LTE2
 Test Item : Power Density Data
 Test Mode : Transmit (802.11ax-20BW)

Channel No.	Frequency (MHz)	Data Rate	Chain	PPSD/MHz (dBm)	Duty factor (dBm)	Total PPSD/MHz (dBm)	Limit (dBm)	Result
01	2412	MCS0	A	-12.530	0.988	-8.77	8	Pass
			B	-13.030				
06	2437	MCS0	A	-12.720	0.988	-8.95	8	Pass
			B	-13.200				
11	2462	MCS0	A	-13.390	0.988	-9.42	8	Pass
			B	-13.450				

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

Channel 01 (Chain A):



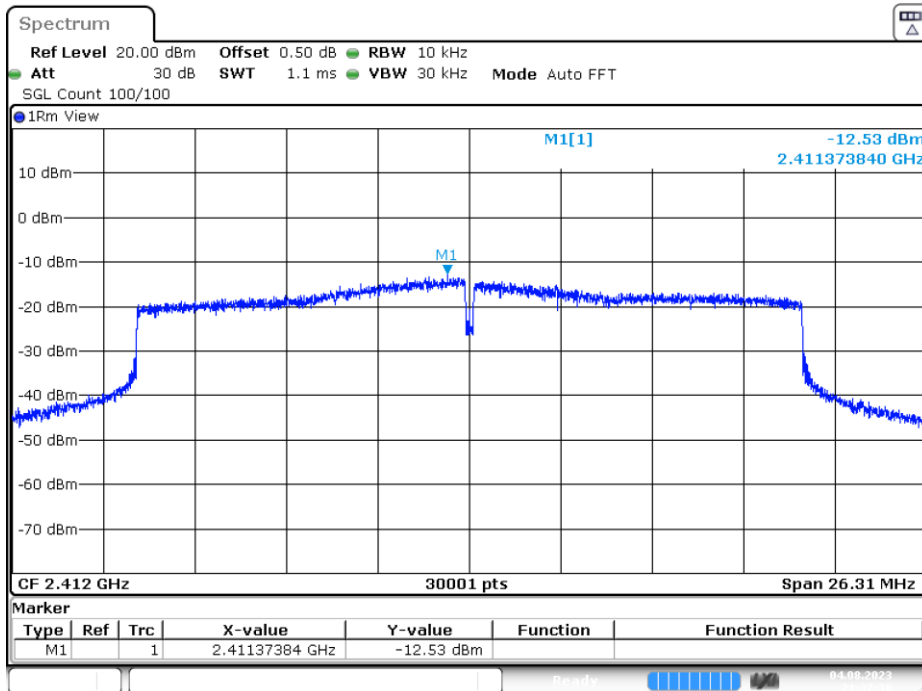
Date: 4.AUG.2023 21:37:29

Product : Celer, Celer-5G, Celer-LTE1, Celer-LTE2
 Test Item : Power Density Data
 Test Mode : Transmit (802.11ax-40BW)

Channel No.	Frequency (MHz)	Data Rate	Chain	PPSD/MHz (dBm)	Duty factor (dBm)	Total PPSD/MHz (dBm)	Limit (dBm)	Result
03	2422	MCS0	A	-16.370	0.964	-12.67	8	Pass
			B	-16.930				
06	2437	MCS0	A	-17.140	0.964	-12.83	8	Pass
			B	-16.490				
09	2452	MCS0	A	-17.280	0.964	-13.00	8	Pass
			B	-16.690				

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

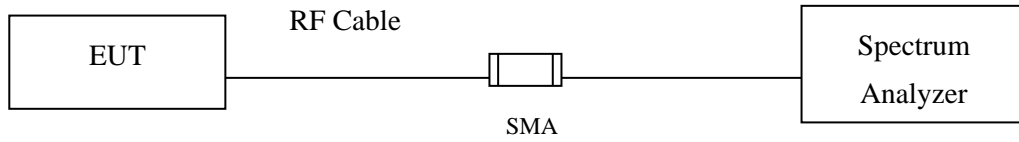
Channel 03 (Chain A):



Date: 4.AUG.2023 21:37:29

9. Duty Cycle

9.1. Test Setup



9.2. Test Procedure

The EUT was setup according to ANSI C63.10 2013; tested according to ANSI C63.10 2013 for compliance to FCC 47CFR 15.247 requirements.

9.3. Test Result of Duty Cycle

Product : Celer, Celer-5G, Celer-LTE1, Celer-LTE2
 Test Item : Duty Cycle
 Test Mode : Transmit

Duty Cycle Formula:

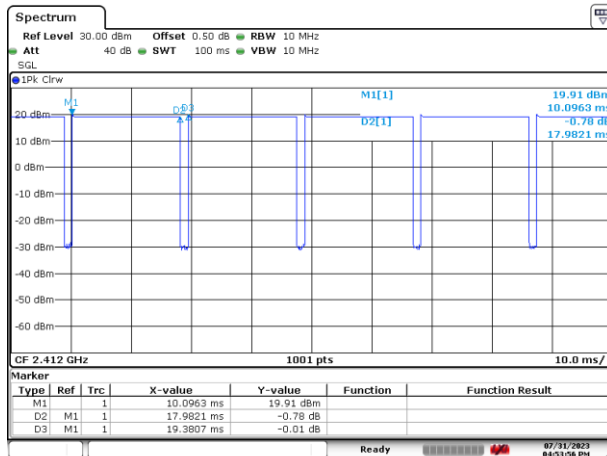
$$\text{Duty Cycle} = \text{Ton} / (\text{Ton} + \text{Toff})$$

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

Results:

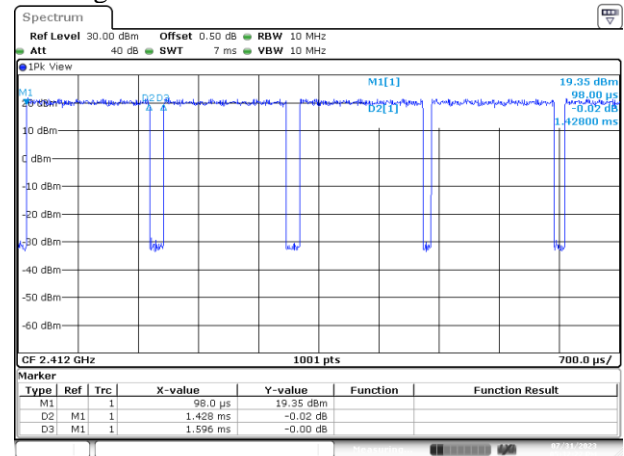
2.4GHz band	Ton (ms)	Ton + Toff (ms)	Duty Cycle (%)	Duty Factor (dB)
802.11b	17.9821	19.3807	92.78	0.33
802.11g	1.4280	1.5960	89.47	0.48
802.11ax-20 MHz	5.4000	6.7800	79.65	0.99
802.11ax-40 MHz	5.4300	6.7800	80.09	0.96

802.11b



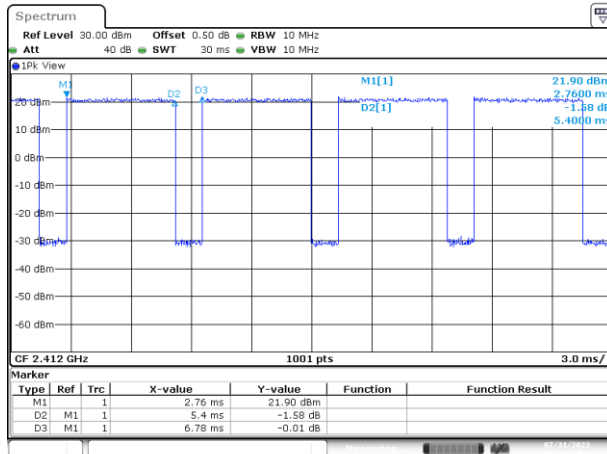
Date: 31.JUL.2023 16:53:57

802.11g



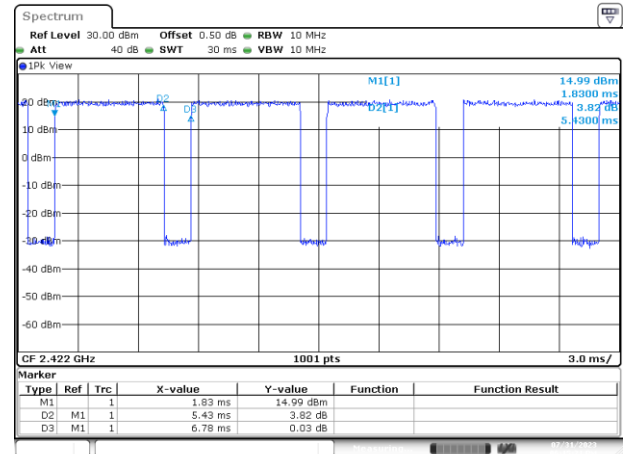
Date: 31.JUL.2023 17:32:22

802.11ax-20 MHz



Date: 31.JUL.2023 17:58:22

802.11ax-40 MHz



Date: 31.JUL.2023 18:15:22