

TEST REPORT

Reference No...... : WTF22D04074006W002
FCC ID : BRWSPMR20500
Applicant..... : Horizon Hobby, LLC.
Address..... : 2904 Research Rd., Champaign, IL, 61822 United States
Manufacturer : Horizon Hobby, LLC.
Address..... : 2904 Research Rd., Champaign, IL, 61822 United States
Product..... : NX20 20 Channel Transmitter
Model(s) : SPMR20500, SPMR205001(alternate stickconfig),
SPMR20500EU (EU only version), SPMR20500 Regular US,
SPMR20500EU EU Version
Standards : FCC CFR47 Part 15 Section 15.249
Date of Receipt sample : 2022-04-20
Date of Test : 2022-04-20 to 2022-07-18
Date of Issue..... : 2022-08-30
Test Result..... : **Pass**

Remarks:

The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

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3 Revision History

Test Report No.	Date of Receipt Sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTF22D04074006W002	2022-04-20	2022-04-20 to 2022-07-18	2022-08-30	Original	-	Valid

4 General Information

4.1 General Description of E.U.T

Product:	NX20 20 Channel Transmitter
Model(s):	SPMR20500, SPMR205001(alternate stickconfig), SPMR20500EU (EU only version), SPMR20500 Regular US, SPMR20500EU EU Version
Model Differences:	Only the model names are different for different market requirement. The test sample's model name is SPMR20500.
Hardware Version:	Rev K
Software Version:	1.0

4.2 Details of E.U.T.

Operation Frequency:	2404-2476MHz
2.4G Transmitter Module:	2.4G Waco
Type of Modulation:	FHSS
Antenna installation:	internal permanent antenna
Antenna Gain:	0dBi
Ratings:	Cylindrical Li-Ion Battery 3.7V 1S 3P 10500mAh 38.85Wh

4.3 Channel List

2.4G(Wac)

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	2404	2	2407	3	2411	4	2414
5	2417	6	2420	7	2424	8	2427
9	2430	10	2433	11	2437	12	2440
13	2443	14	2446	15	2450	16	2453
17	2456	18	2459	19	2463	20	2466
21	2469	22	2473	23	2476		

4.4 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Test mode	Lower channel	Middle channel	Upper channel
Transmitting	2404 MHz	2440MHz	2476MHz

4.5 Test Facility

The test facility has a test site registered with the following organizations:

ISED CAB identifier: CN0013. Test Firm Registration No.: 7760A.

Waltek Testing Group Co., Ltd. Has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files. Registration number 7760A, October 15, 2016.

FCC Designation No.: CN1201. Test Firm Registration No.: 523476.

Waltek Testing Group Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration number 523476, September 10, 2019.

5 Test Summary

Test Items	Test Requirement	Result
Conducted Emissions	15.207	PASS
Radiated Emission	15.249(a) 15.209 15.205(a)	PASS
Periodic Operation	15.35(c)	PASS
Outside Restricted band	15.249 15.205 15.209	PASS
20dB Bandwidth	15:215(c)	PASS
Antenna Requirement	15.203	PASS

6 Equipment Used during Test

6.1 Equipments List

Conducted Emissions Test Site 1#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMI Test Receiver	R&S	ESCI	100947	2021-07-26	2022-07-25
2.	LISN	R&S	ENV216	101215	2021-07-26	2022-07-25
3.	Cable	Top	TYPE16(3.5M)	-	2021-07-26	2022-07-25
3m Semi-anechoic Chamber for Radiation Emissions Test site 1#						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	Spectrum Analyzer	R&S	FSP	100091	2021-04-26 2022-04-28	2022-04-25 2023-04-27
2	Amplifier	Agilent	8447D	2944A10178	2021-04-26 2022-04-28	2022-04-25 2023-04-27
4	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	2021-08-23	2022-08-22
5	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	2021-04-26 2022-04-28	2022-04-25 2023-04-27
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	2021-04-30 2022-04-29	2022-04-29 2023-04-28
7	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	2021-07-30	2022-07-29
8	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	2021-07-26	2022-07-25
9	Coaxial Cable (above 1GHz)	Top	1GHz-18GHz	NA	2021-04-26 2022-04-28	2022-04-25 2023-04-27
3m Semi-anechoic Chamber for Radiation Emissions Test site 2#						
Item	Equipment	Manufacturer	Model No.	Serial No	Last Calibration Date	Calibration Due Date
1	Test Receiver	R&S	ESCI	101296	2021-04-26 2022-04-28	2022-04-25 2023-04-27
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	2021-04-26 2022-04-28	2022-04-25 2023-04-27
3	Active Loop Antenna	Com-Power Corp.	AL-130R	10160007	2022-05-05	2023-05-04
4	Amplifier	ANRITSU	MH648A	M43381	2021-04-26 2022-04-28	2022-04-25 2023-04-27
5	Cable	HUBER+SUHNER	CBL2	525178	2021-04-26 2022-04-28	2022-04-25 2023-04-27
RF Conducted Testing						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMC Analyzer (9k~26.5GHz)	Agilent	E7405A	MY45114943	2021-04-26 2022-04-28	2022-04-25 2023-04-27

2.	Spectrum Analyzer (9k~6GHz)	R&S	FSL6	100959	2021-04-26 2022-04-28	2022-04-25 2023-04-27
3.	Signal Analyzer (9k~26.5GHz)	Agilent	N9010A	MY50520207	2021-04-26 2022-04-28	2022-04-25 2023-04-27
4.	Humidity Chamber	GF	GTH-225-40- 1P	IAA061213	2021-04-26 2022-04-28	2022-04-25 2023-04-27

6.2 Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-6}$
RF Power	± 1.0 dB
RF Power Density	± 2.2 dB
Radiated Spurious Emissions test	± 5.03 dB (Bilog antenna 30M~1000MHz)
	± 5.47 dB (Horn antenna 1000M~25000MHz)

6.3 Test Equipment Calibration

All the test equipments used are valid and calibrated by GUANG ZHOU GRG METROLOGY & TEST CO., L TD. address is No.163, Pingyun Rd. West of Huangpu Ave, Tianhe District, Guangzhou, Guangdong, China.

7 Conducted Emission

Test Requirement:	FCC CFR 47 Part 15 Section 15.207
Test Method:	ANSI 63.10: 2013
Test Result:	PASS
Frequency Range:	150kHz to 30MHz
Class/Severity:	Class B
Limit:	66-56 dB μ V between 0.15MHz & 0.5MHz 56 dB μ V between 0.5MHz & 5MHz 60 dB μ V between 5MHz & 30MHz
Detector:	Peak for pre-scan (9kHz Resolution Bandwidth)

7.1 E.U.T. Operation

Operating Environment :

Temperature: 25.5 °C

Humidity: 51 % RH

Atmospheric Pressure: 101.2kPa

EUT Operation : The test was performed in Transmitting mode, the test data were shown in the report.

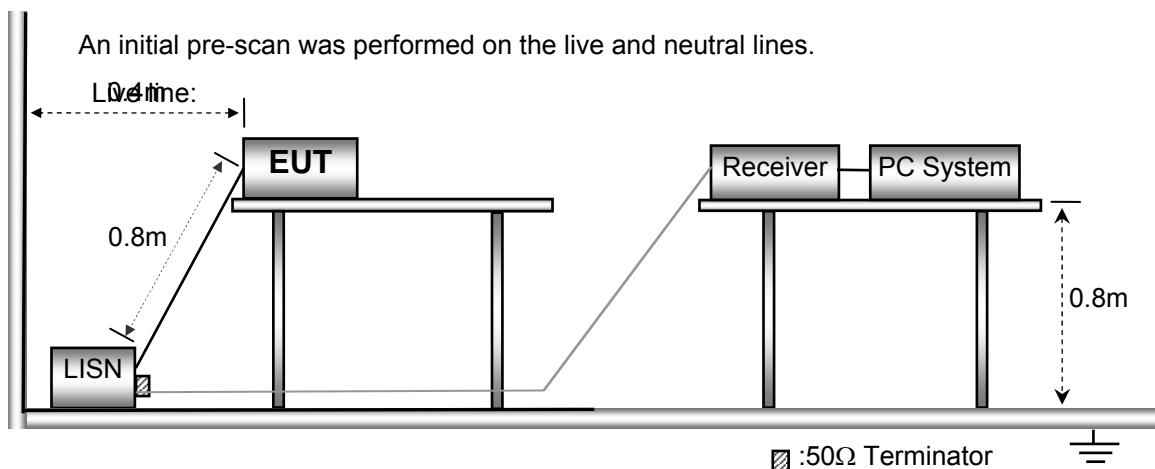
7.2 EUT Setup

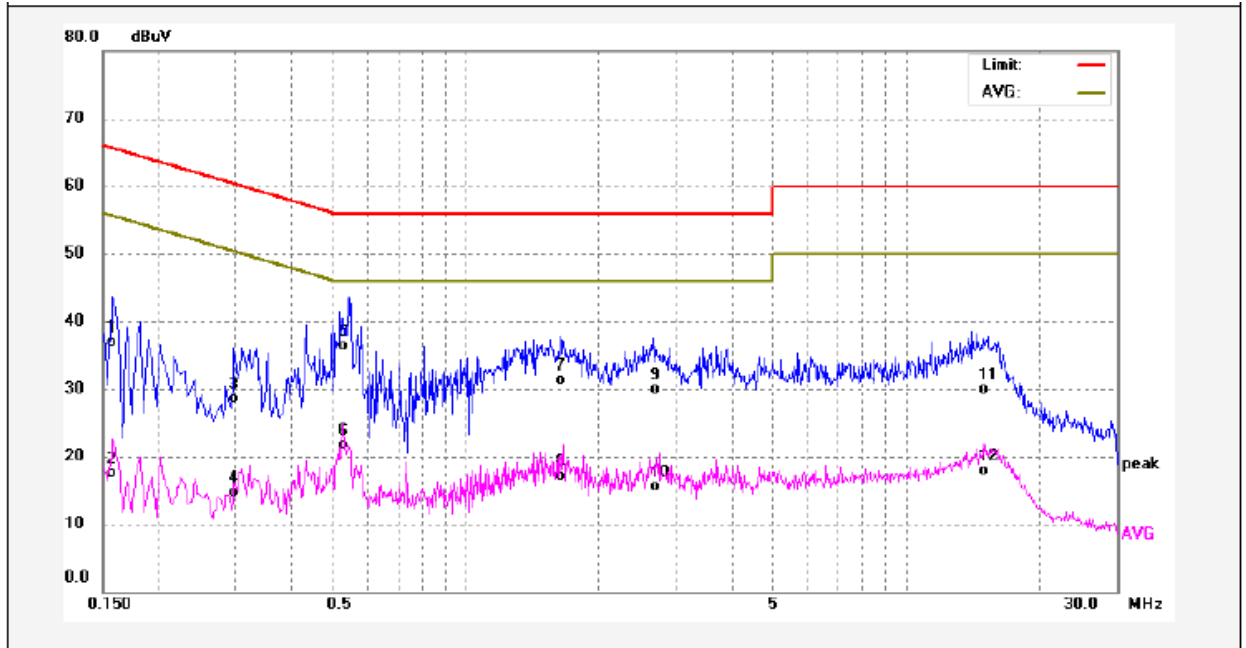
The EUT was placed on the test table in shielding room.

7.3 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

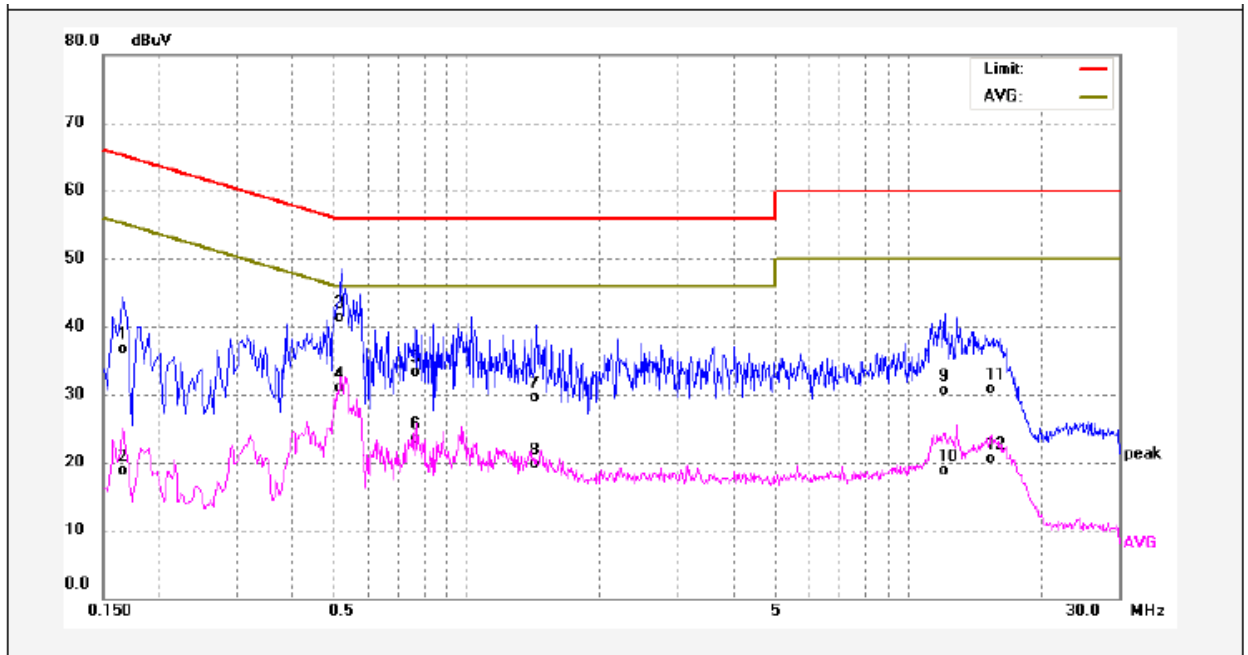
7.4 Conducted Emission Test Result





No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1580	24.88	12.02	36.90	65.56	-28.66	QP	
2	0.1580	5.41	12.02	17.43	55.56	-38.13	AVG	
3	0.2980	16.81	11.74	28.55	60.30	-31.75	QP	
4	0.2980	2.91	11.74	14.65	50.30	-35.65	AVG	
5	0.5260	24.56	11.76	36.32	56.00	-19.68	QP	
6	0.5260	10.01	11.76	21.77	46.00	-24.23	AVG	
7	1.6380	19.32	11.90	31.22	56.00	-24.78	QP	
8	1.6380	5.22	11.90	17.12	46.00	-28.88	AVG	
9	2.6619	17.78	12.04	29.82	56.00	-26.18	QP	
10	2.6619	3.52	12.04	15.56	46.00	-30.44	AVG	
11	14.9580	18.16	11.80	29.96	60.00	-30.04	QP	
12	14.9580	6.03	11.80	17.83	50.00	-32.17	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1660	25.20	11.47	36.67	65.15	-28.48	QP	
2	0.1660	7.28	11.47	18.75	55.15	-36.40	AVG	
3	0.5180	30.05	11.16	41.21	56.00	-14.79	QP	
4	0.5180	19.68	11.16	30.84	46.00	-15.16	AVG	
5	0.7700	21.92	11.30	33.22	56.00	-22.78	QP	
6	0.7700	12.25	11.30	23.55	46.00	-22.45	AVG	
7	1.4340	18.15	11.30	29.45	56.00	-26.55	QP	
8	1.4340	8.35	11.30	19.65	46.00	-26.35	AVG	
9	12.0940	18.86	11.56	30.42	60.00	-29.58	QP	
10	12.0940	7.13	11.56	18.69	50.00	-31.31	AVG	
11	15.4940	19.33	11.47	30.80	60.00	-29.20	QP	
12	15.4940	9.11	11.47	20.58	50.00	-29.42	AVG	

8 Radiation Emission Test

Test Requirement: FCC Part15 Paragraph 15.249&15.209&15.205

Test Method: ANSI 63.10: 2013

Measurement Distance: 3m

Test Result: PASS

15.249(a)Limit:

Fundamental frequency	Field strength of fundamental		Field strength of harmonics	
	mV/m	dBuV/m	uV/m	dBuV/m
902-928 MHz	50	94	500	54
2400-2483.5 MHz	50	94	500	54
5725-5875 MHz	50	94	500	54
24.0-24.25 GHz	250	108	2500	68

15.209 Limit:

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	$2400/F(\text{kHz})$	300	$10000 * 2400/F(\text{kHz})$	$20\log^{(2400/F(\text{kHz}))} + 80$
0.490 ~ 1.705	$24000/F(\text{kHz})$	30	$100 * 24000/F(\text{kHz})$	$20\log^{(24000/F(\text{kHz}))} + 40$
1.705 ~ 30	30	30	$100 * 30$	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

Note: RF Voltage(dBuV)= $20 \log_{10}$ RF Voltage(uV)

8.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

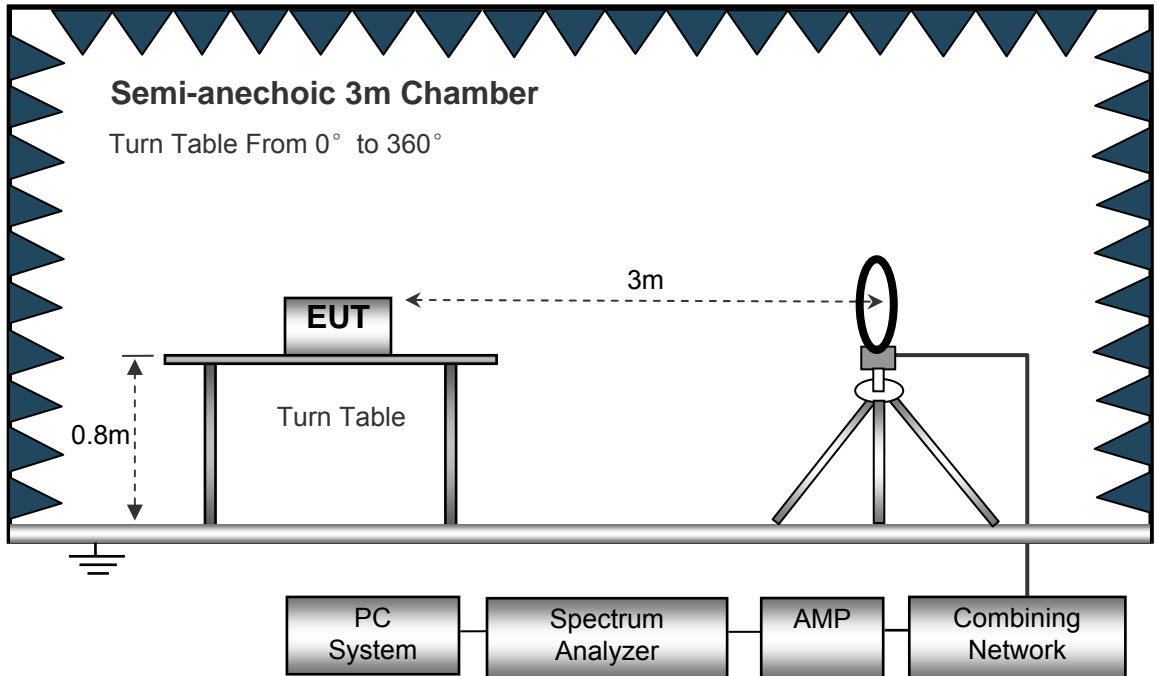
EUT Operation :

The test was performed in transmitting mode, the test data were shown in the report.

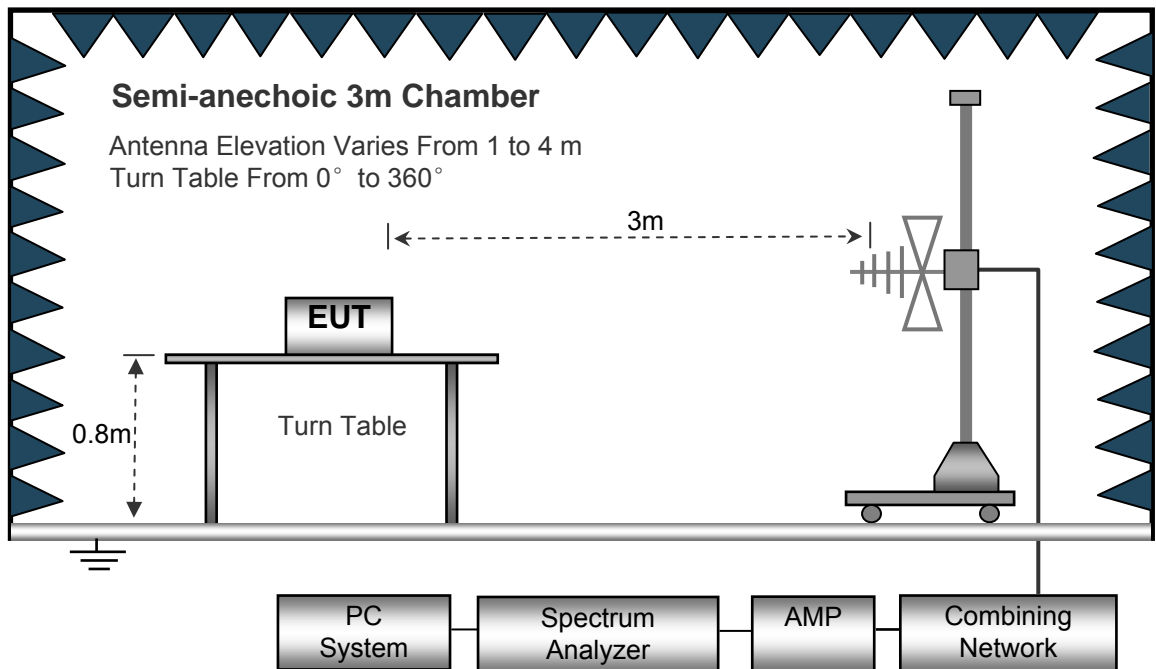
8.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10.

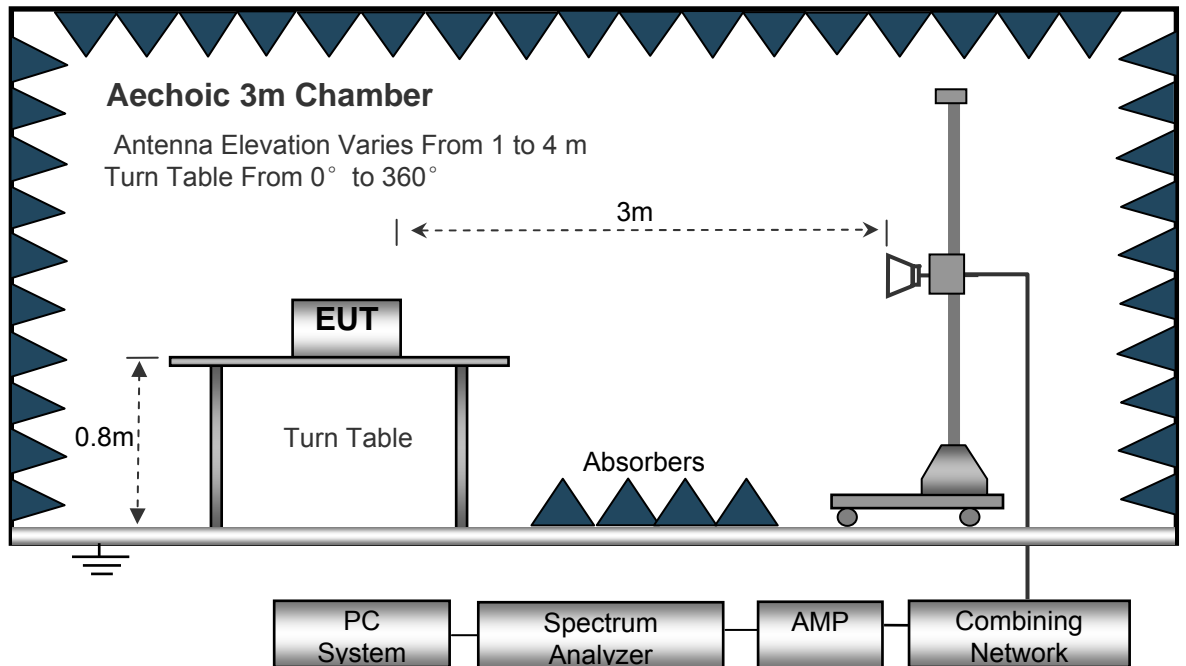
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30MHz to 1GHz.



The test setup for emission measurement above 1 GHz.



8.3 Spectrum Analyzer Setup

Below 30MHz

Sweep Speed Auto
 IF Bandwidth..... 10kHz
 Video Bandwidth 10kHz
 Resolution Bandwidth 10kHz

30MHz ~ 1GHz

Sweep Speed Auto
 Detector PK
 Resolution Bandwidth..... 100kHz
 Video Bandwidth 300kHz

Above 1GHz

Sweep Speed Auto
 Detector PK
 Resolution Bandwidth..... 1MHz
 Video Bandwidth 3MHz
 Detector Ave.
 Resolution Bandwidth..... 1MHz
 Video Bandwidth 10Hz

8.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane for below 1GHz and 1.5m above 1GHz.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.

8.5 Test Result

Test Frequency : 9KHz~ 30MHz

The measurements were more than 20 dB below the limit and not reported.

Test Frequency: 30MHz ~ 40GHz

Worst mode-GFSK 2404MHz

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.249/209/205	
				Height	Polar			Limit	Margin
(MHz)	(dB μ V)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB/m)	(dB μ V/m)	(dB μ V/m)	(dB)
2404	92.18	PK	89	1.2	H	-2.23	89.95	114	-24.05
2404	91.78	PK	264	1.1	V	-2.23	89.55	114	-24.45
4808	60.25	PK	312	1.8	H	-13.08	47.17	74	-26.83
4808	61.74	PK	215	1	V	-13.08	48.66	74	-25.34
7212	45.2	PK	78	1.6	H	0.09	45.29	74	-28.71
7212	45.6	PK	64	1.3	V	0.09	45.69	74	-28.31
9616	32.14	PK	32	1.8	H	3.01	35.15	74	-38.85
9616	32.16	PK	72	1.5	V	3.01	35.17	74	-38.83
12020	22.36	PK	54	1.6	H	5.39	27.75	74	-46.25
12020	21.45	PK	132	1.1	V	5.39	26.84	74	-47.16

AV = Peak +20Log10(duty cycle) =PK+(-17.88) [refer to section 8 for more detail]

Frequency	PK	Turn table Angle	RX Antenna		Duty cycle Factor	AV	FCC Part 15.249/209/205	
			Height	Polar			Limit	Margin
(MHz)	(dBμV/m)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2404	89.95	89	1.2	H	-17.87	72.07	94	-21.93
2404	89.55	264	1.1	V	-17.87	71.67	94	-22.33
4808	47.17	312	1.8	H	-17.87	29.29	54	-24.71
4808	48.66	215	1	V	-17.87	30.78	54	-23.22
7212	45.29	78	1.6	H	-17.87	27.41	54	-26.59
7212	45.69	64	1.3	V	-17.87	27.81	54	-26.19
9616	35.15	32	1.8	H	-17.87	17.27	54	-36.73
9616	35.17	72	1.5	V	-17.87	17.29	54	-36.71
12020	27.75	54	1.6	H	-17.87	9.87	54	-44.13
12020	26.84	132	1.1	V	-17.87	8.96	54	-45.04

9 Periodic Operation

The duty cycle was determined by the following equation:

To calculate the actual field intensity, the duty cycle correction factor in decibel is needed for later use and can be obtained from following conversion

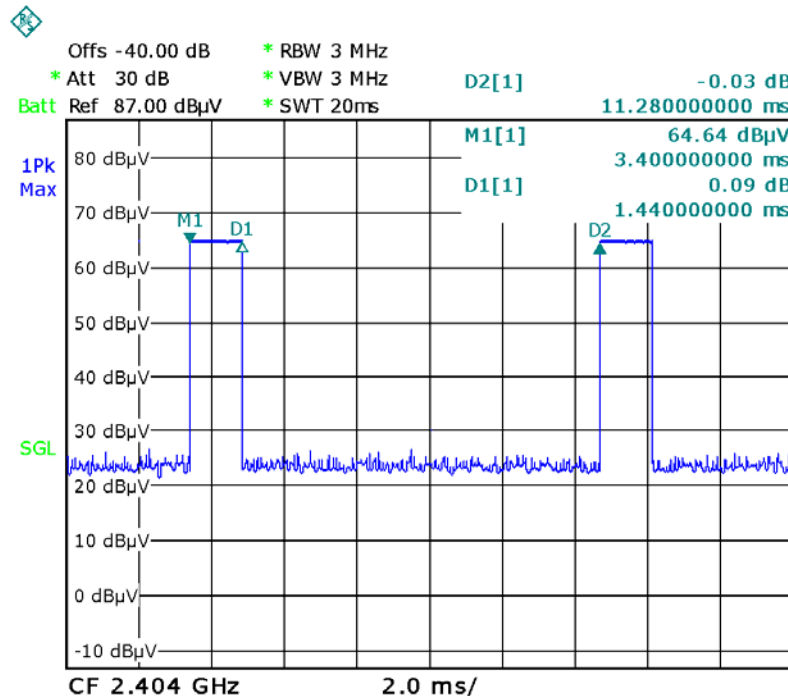
$$\text{Duty Cycle(\%)} = \text{Total On interval in a complete pulse train} / \text{Length of a complete pulse train} * \%$$

$$\text{Duty Cycle Correction Factor(dB)} = 20 * \text{Log}_{10}(\text{Duty Cycle})$$

Total transmission time(ms)	1.44
Length of a complete transmission period(ms)	11.28
Duty Cycle(%)	12.77
Duty Cycle Correction Factor(dB)	-17.88

Refer to the duty cycle plot (as below)

Test plots



10 Restricted band

Test Requirement: FCC Part15 Paragraph 15.205
 Test Method: ANSI C63.10: 2013
 Test Result: N/A

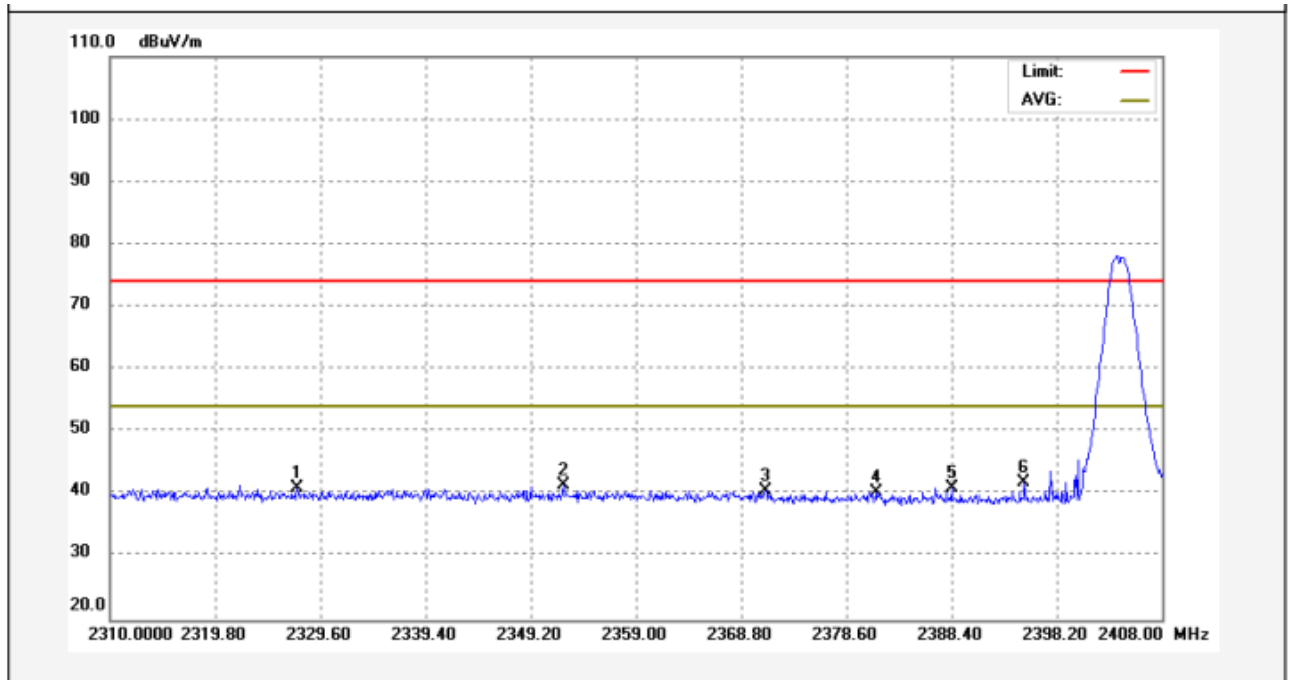
10.1 Requirments:

emissions that fall in the restricted bands(15.205).Above 1000MHz, compliance with the emissions limits in section 15.209 shall be demonstrated based on the average value of the measured emissions,The provisions in section 15.35apply to these measurements.

10.2 Test Result

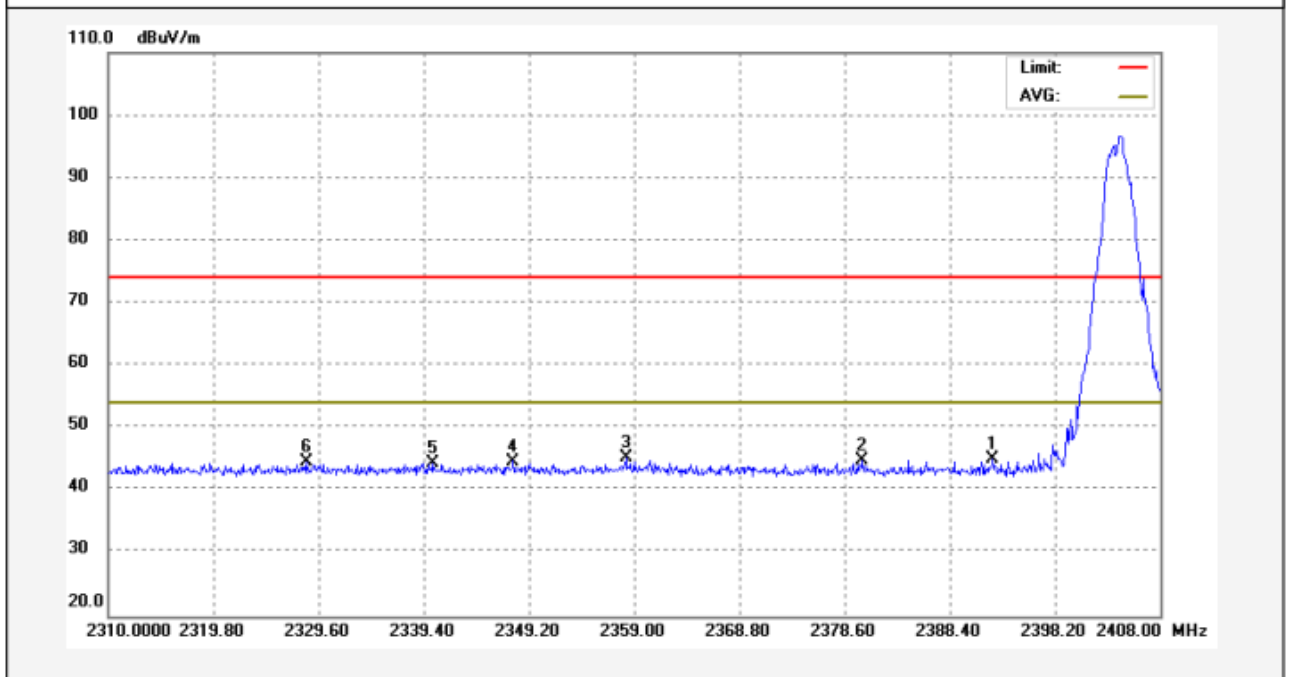
Mode: Continuously Transmitting(Left 2404)

Antenna Polarization: Vertical



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2327.444	52.55	-11.58	40.97	74.00	-33.03	peak	
2	2352.238	53.05	-11.67	41.38	74.00	-32.62	peak	
3	2371.054	52.29	-11.73	40.56	74.00	-33.44	peak	
4	2381.442	52.11	-11.78	40.33	74.00	-33.67	peak	
5	2388.400	52.83	-11.79	41.04	74.00	-32.96	peak	
6	2395.162	53.83	-11.83	42.00	74.00	-32.00	peak	

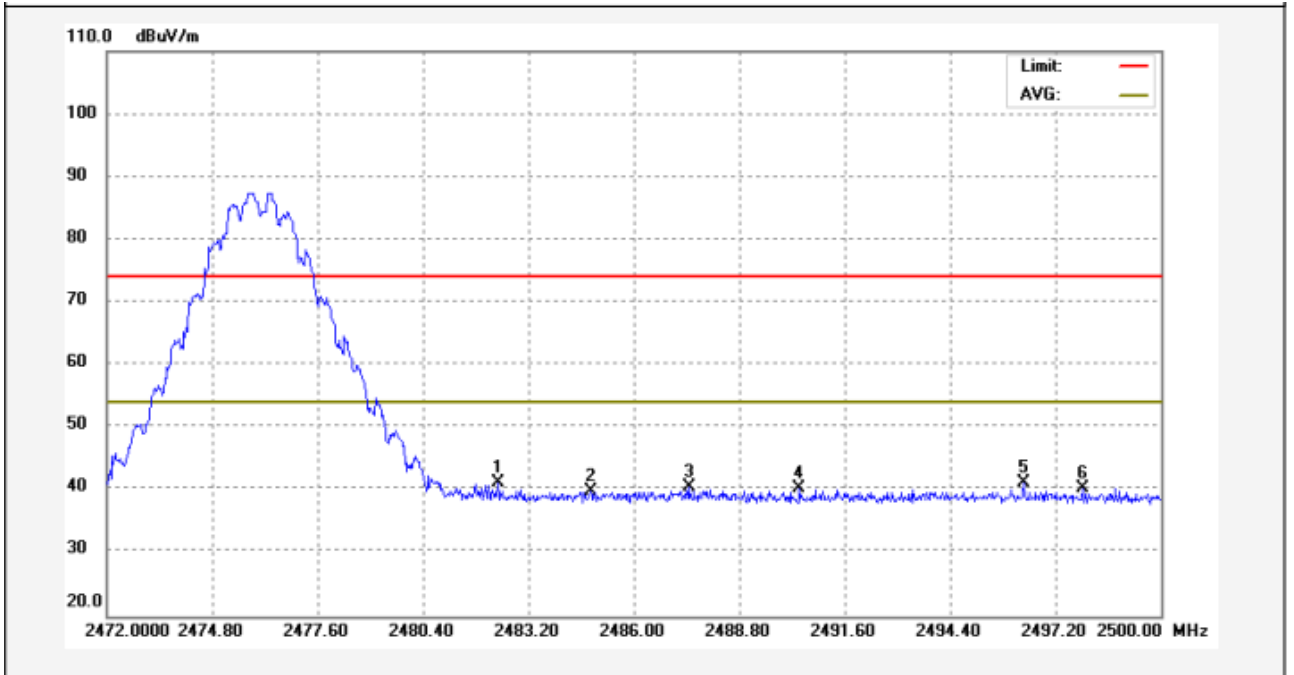
Antenna Polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2392.418	53.13	-8.06	45.07	74.00	-28.93	peak	
2	2380.266	52.94	-8.07	44.87	74.00	-29.13	peak	
3	2358.216	53.30	-8.10	45.20	74.00	-28.80	peak	
4	2347.730	52.86	-8.11	44.75	74.00	-29.25	peak	
5	2340.184	52.57	-8.13	44.44	74.00	-29.56	peak	
6	2328.424	52.68	-8.14	44.54	74.00	-29.46	peak	

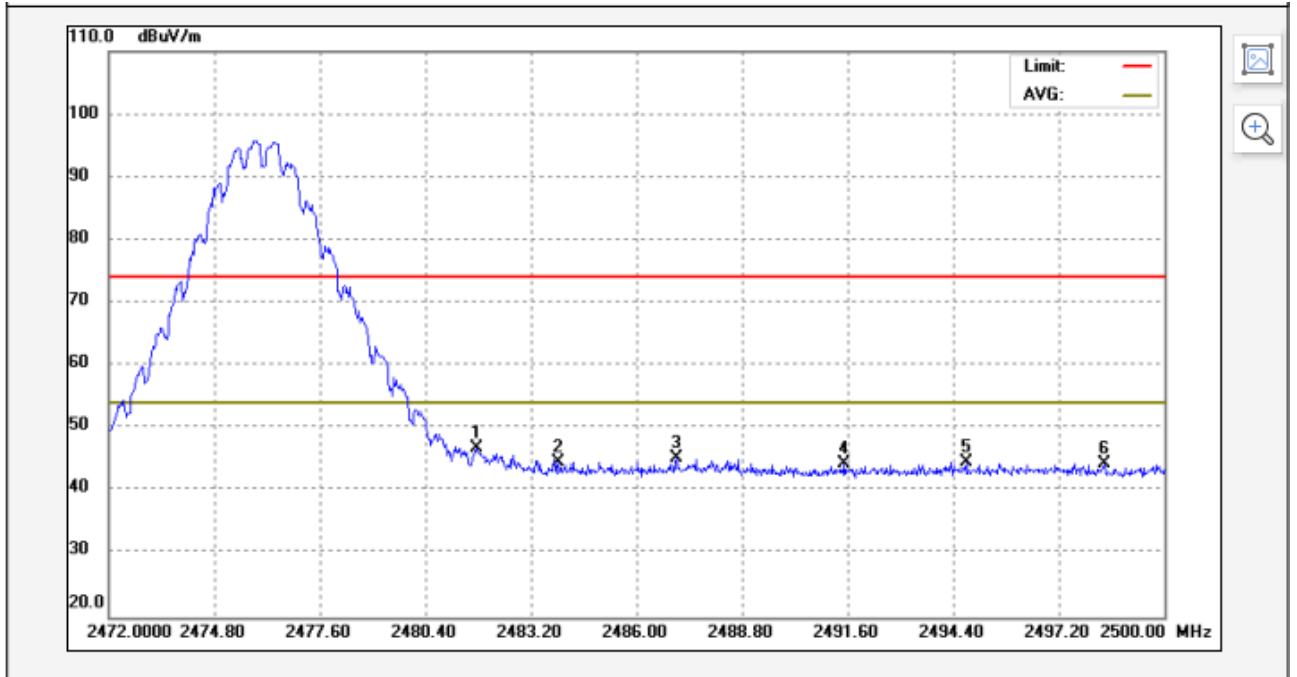
Mode: Continuously Transmitting(Right 2476)

Antenna Polarization: Vertical



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2482.388	53.36	-12.15	41.21	74.00	-32.79	peak	
2	2484.852	52.01	-12.15	39.86	74.00	-34.14	peak	
3	2487.456	52.85	-12.17	40.68	74.00	-33.32	peak	
4	2490.396	52.58	-12.18	40.40	74.00	-33.60	peak	
5	2496.360	53.40	-12.19	41.21	74.00	-32.79	peak	
6	2497.928	52.67	-12.20	40.47	74.00	-33.53	peak	

Antenna Polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2481.744	54.80	-7.93	46.87	74.00	-27.13	peak	
2	2483.928	52.65	-7.93	44.72	74.00	-29.28	peak	
3	2487.064	53.21	-7.93	45.28	74.00	-28.72	peak	
4	2491.516	52.37	-7.92	44.45	74.00	-29.55	peak	
5	2494.736	52.52	-7.91	44.61	74.00	-29.39	peak	
6	2498.404	52.37	-7.90	44.47	74.00	-29.53	peak	

11 20 dB Bandwidth Measurement

Test Requirement: FCC CFR47 Part 15 Section 15.215(c)
 Test Method: ANSI C63.10:2013
 Test Mode: Transmitting

11.1 Test Procedure

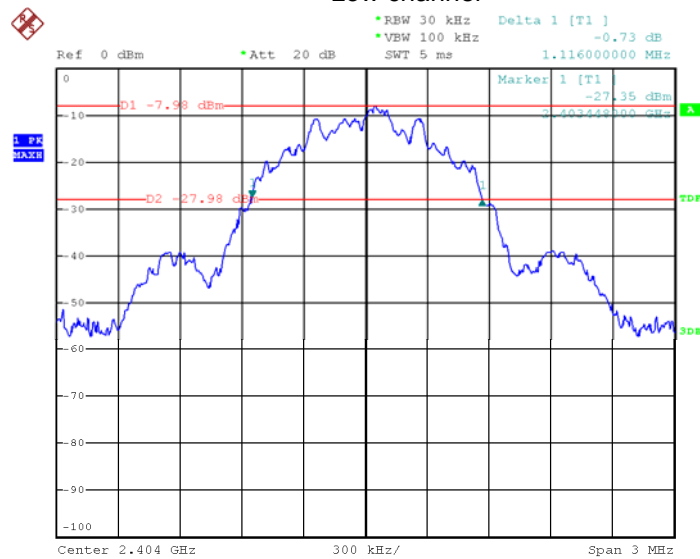
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 30KHz, VBW = 100KHz

11.2 Test Result

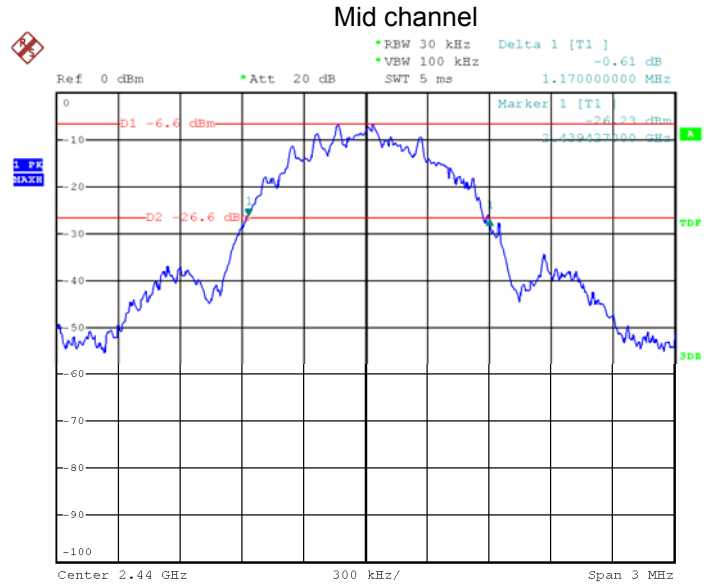
Frequency (MHz)	Bandwidth Emission (MHz)
2404	1.116
2440	1.170
2476	1.104

Test plots

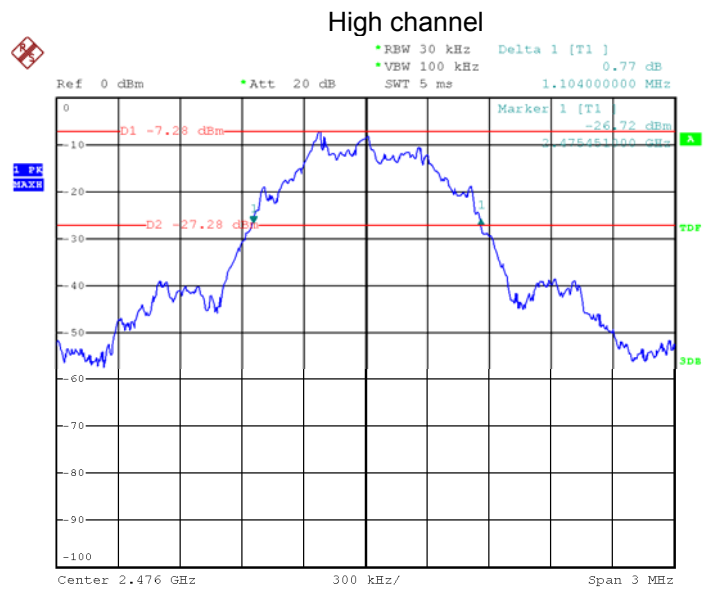
Low channel



Date: 30.JUN.2022 09:17:13



Date: 30.JUN.2022 09:28:09



Date: 30.JUN.2022 09:39:52

12 Antenna Requirement

According to the FCC Part 15 Paragraph 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. This product has a internal permanent antenna, fulfil the requirement of this section.

13 RF Exposure

Note: Please refer to SAR Test Report: WTF22X04076577W.

14 Photographs- Test Setup and EUT

Note: Please refer to appendix: Appendix-SPMR20500-Photos.

=====**End of Report**=====