

TEST REPORT

Reference No...... : WTF21D12149221W006 V2
FCC ID : BRWSPMR14000
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..... : iX14
Model(s) : SPMR14000, SPMR140001
Standards : FCC CFR47 Part 15 Section 15.249
Date of Receipt sample : 2021-12-30
Date of Test : 2021-12-30 to 2022-03-01
Date of Issue..... : 2022-03-31
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.

Prepared By:

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3 Revision History

Test Report No.	Date of Receipt Sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTF21D12149221W 006	2021-12-30	2021-12-30 to 2022-03-01	2022-03-01	Original	-	Replaced
WTF21D12149221W 006 V1	2021-12-30	2021-12-30 to 2022-03-01	2022-03-23	Version 1	Updated	Replaced
WTF21D12149221W 006 V2	2021-12-30	2021-12-30 to 2022-03-01	2022-03-31	Version 2	Updated	Valid

4 General Information

4.1 General Description of E.U.T

Product:	iX14
Model(s):	SPMR14000, SPMR140001
Model Differences:	Only the model name are difference. Model SPMR14000 was tested in this report.
2.4G Transmitter Module:	2.4G
Type of Modulation:	GFSK
Frequency Range:	2402-2478MHz
Antenna installation:	internal permanent antenna

4.2 Details of E.U.T.

Operation Frequency:	2402-2478MHz
Antenna Gain:	1.0dBi
Ratings:	Battery DC 3.7V, 10500mAh

4.3 Channel List

2.4G(Waco)

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
0	2402	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	2446	14	2450	15	2456
16	2459	17	2463	18	2466	19	2469
20	2473	21	2476	22	2478	/	/

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	2402 MHz	2440MHz	2478MHz

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	1Year
2.	LISN	R&S	ENV216	101215	2021-07-26	1Year
3.	Cable	Top	TYPE16(3.5M)	-	2021-07-26	1Year
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	1Year
2	Amplifier	Agilent	8447D	2944A10178	2021-07-26	1Year
3	Active Loop Antenna	Beijing Dazhi	ZN30900A	0703	2021-08-23	1Year
4	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	2021-04-26	1Year
5	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	2021-04-30	1Year
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	2021-07-30	1Year
7	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	2021-07-26	1Year
8	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	2021-04-26	1Year
9	Coaxial Cable (above 1GHz)	Top	1GHz-18GHz	NA	2021-04-26	1Year
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	2021-07-26	1Year
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	2021-07-26	1Year
3	Amplifier	ANRITSU	MH648A	M43381	2021-07-26	1Year
4	Cable	HUBER+SUHNER	CBL2	525178	2021-07-26	1Year
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	1Year
2.	Spectrum Analyzer	R&S	FSL6	100959	2021-07-29	1Year

	(9k-6GHz)					
3.	Signal Analyzer (9k~26.5GHz)	Agilent	N9010A	MY50520207	2021-04-19	1Year
4.	Humidity Chamber	GF	GTH-225-40-1P	IAA061213	2021-04-26	1Year

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., LTD. 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 :

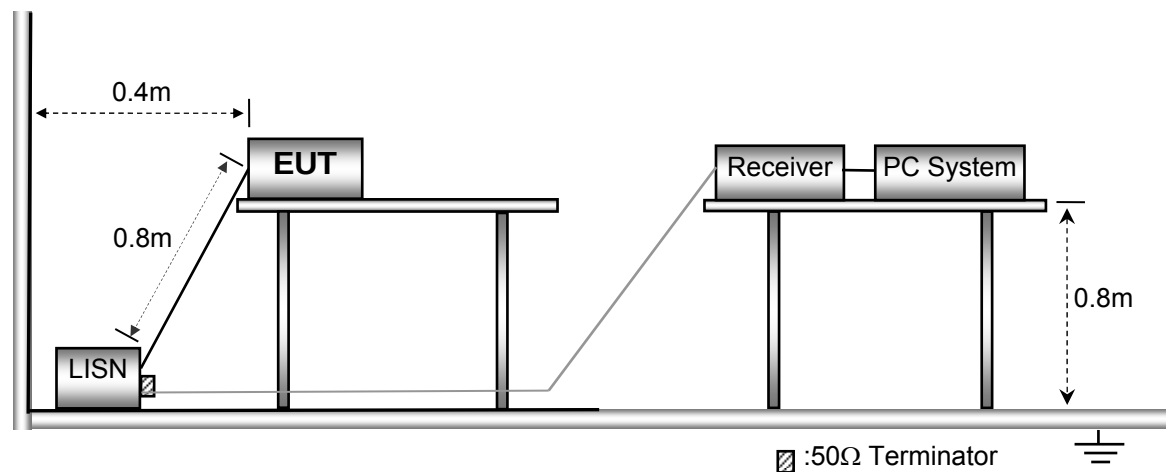
Temperature:	25.5 °C
Humidity:	51 % RH
Atmospheric Pressure:	101.2kPa

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.



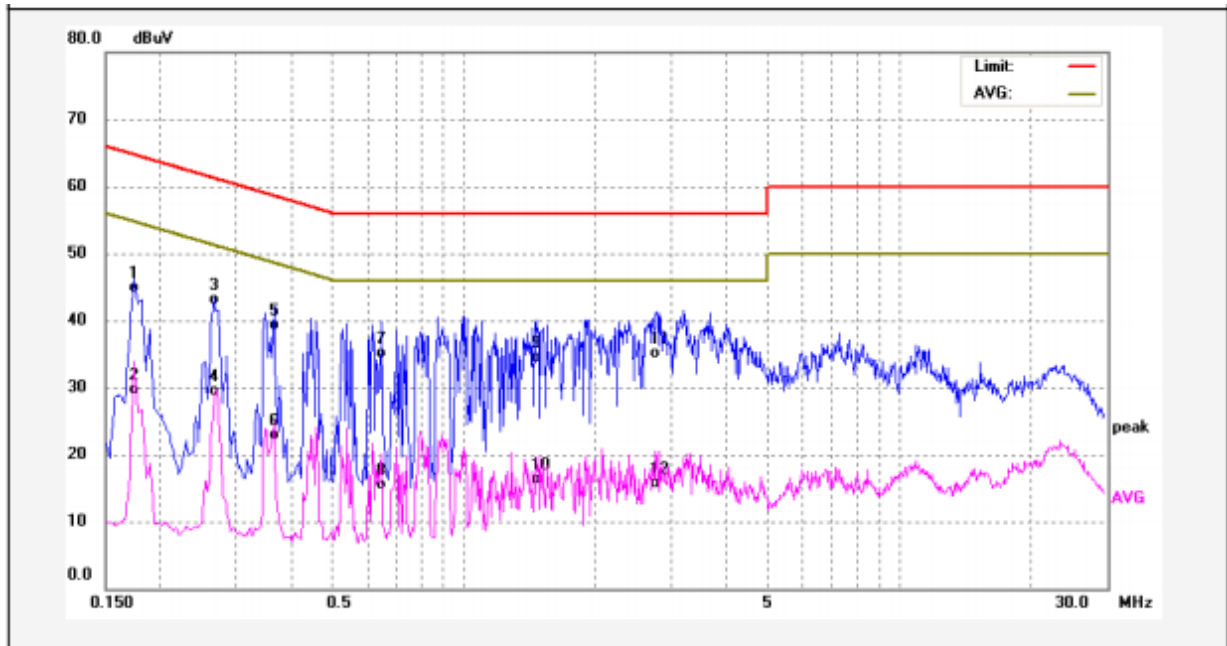
7.3 Measurement Description

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

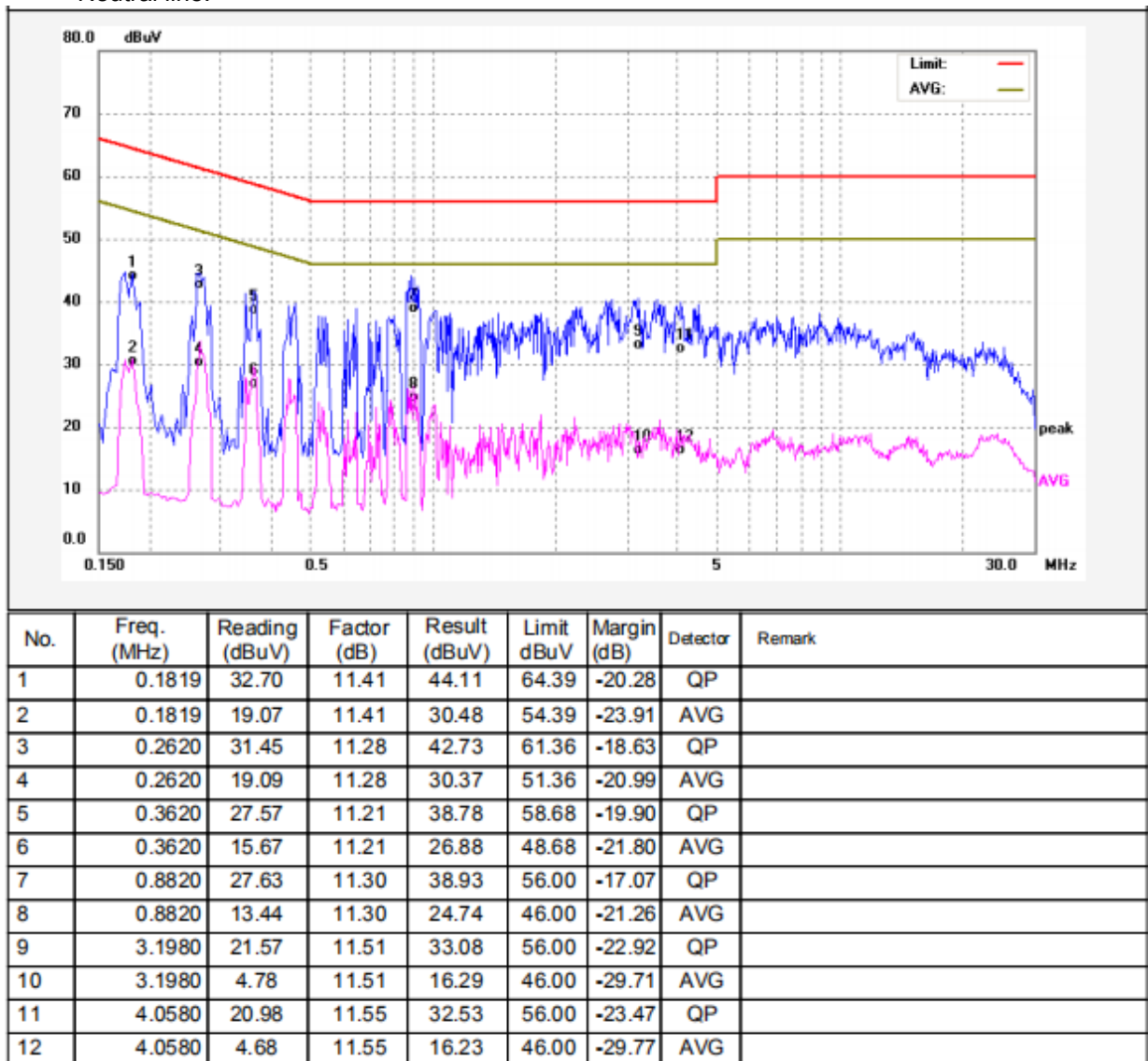
An initial pre-scan was performed on the live and neutral lines.

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1740	32.82	12.00	44.82	64.76	-19.94	QP	
2	0.1740	17.67	12.00	29.67	54.76	-25.09	AVG	
3	0.2660	31.21	11.81	43.02	61.24	-18.22	QP	
4	0.2660	17.73	11.81	29.54	51.24	-21.70	AVG	
5	0.3660	27.53	11.74	39.27	58.59	-19.32	QP	
6	0.3660	11.07	11.74	22.81	48.59	-25.78	AVG	
7	0.6460	23.17	11.86	35.03	56.00	-20.97	QP	
8	0.6460	3.66	11.86	15.52	46.00	-30.48	AVG	
9	1.4660	22.69	11.90	34.59	56.00	-21.41	QP	
10	1.4660	4.44	11.90	16.34	46.00	-29.66	AVG	
11	2.7700	23.01	12.06	35.07	56.00	-20.93	QP	
12	2.7700	3.70	12.06	15.76	46.00	-30.24	AVG	

Neutral line:



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(kHz)	300	10000 * 2400/F(kHz)	$20\log^{(2400/F(kHz))} + 80$
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	$20\log^{(24000/F(kHz))} + 40$
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 log₁₀ RF Voltage(uV)

8.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

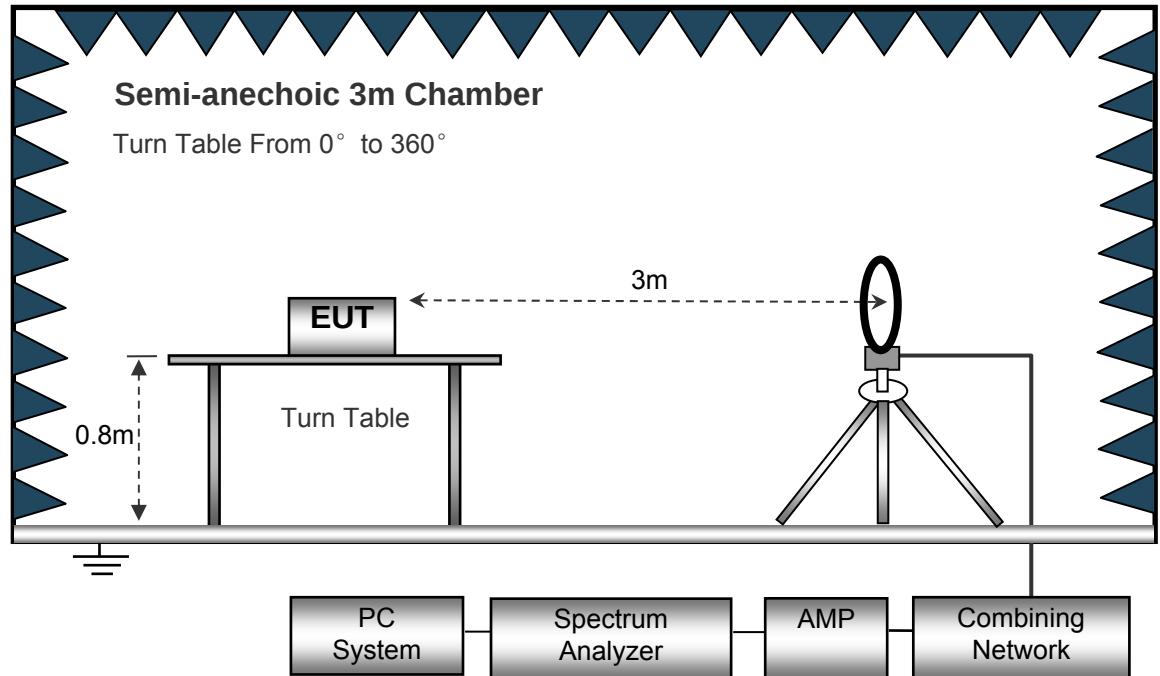
EUT Operation :

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

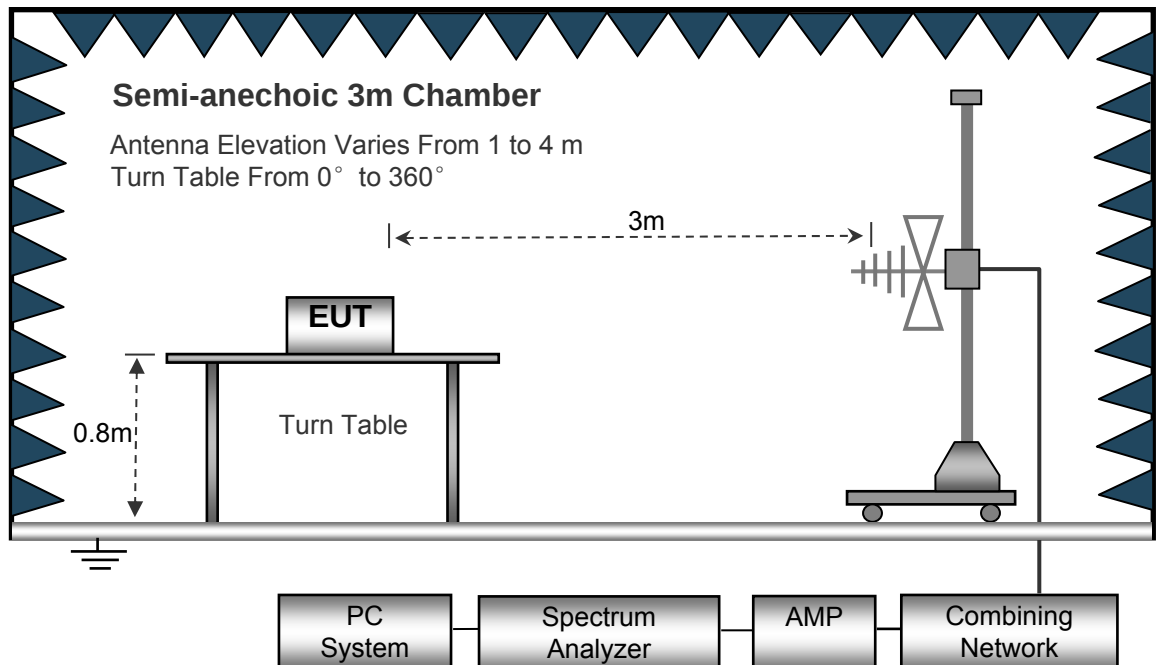
8.2 Test Setup

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

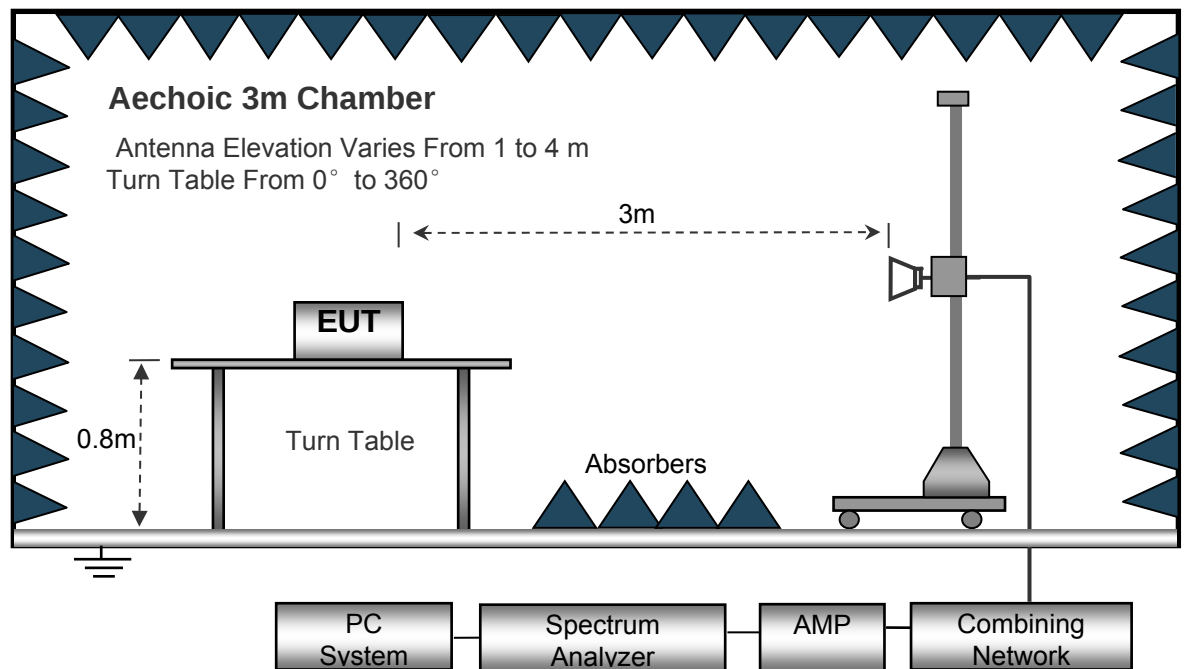
The test setup for emission measurement below 30MHz.



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 SpeedAuto
 IF Bandwidth.....10kHz
 Video Bandwidth10kHz
 Resolution Bandwidth10kHz

30MHz ~ 1GHz

Sweep SpeedAuto
 DetectorPK
 Resolution Bandwidth.....100kHz
 Video Bandwidth300kHz

Above 1GHz

Sweep SpeedAuto
 DetectorPK
 Resolution Bandwidth.....1MHz
 Video Bandwidth3MHz
 DetectorAve.
 Resolution Bandwidth.....1MHz
 Video Bandwidth10Hz

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 2402MHz

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.249/209/205	
				Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)
2402.00	95.18	PK	81	1.1	H	-2.23	92.95	114	-21.05
2402.00	91.78	PK	269	1.4	V	-2.23	89.55	114	-24.45
360.00	72.56	PK	302	1.9	H	-13.08	59.48	94.67	-35.19
360.00	61.74	PK	146	1.0	V	-13.08	48.66	94.67	-46.01
720.00	61.22	PK	69	1.3	H	0.09	61.31	74.00	-12.69
720.00	60.60	PK	157	1.3	V	0.09	60.69	74.00	-13.31
1080.00	58.49	PK	32	1.9	H	3.01	61.50	74.00	-12.50
1080.00	56.57	PK	72	1.5	V	3.01	59.58	74.00	-14.42
1440.00	50.02	PK	127	1.6	H	5.39	55.41	74.00	-18.59
1440.00	55.66	PK	132	1.7	V	5.39	61.05	74.00	-12.95

AV = Peak +20Log10(duty cycle) =PK+(-17.66) [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)
2402.00	92.95	81	1.1	H	-17.66	75.29	94.00	-18.71
2402.00	89.55	269	1.4	V	-17.66	71.89	94.00	-22.11
360.00	59.48	302	1.9	H	-17.66	41.82	74.67	-32.85
360.00	48.66	146	1.0	V	-17.66	31	74.67	-43.67
720.00	61.31	69	1.3	H	-17.66	43.65	54.00	-10.35
720.00	60.69	157	1.3	V	-17.66	43.03	54.00	-10.97
1080.00	61.50	32	1.9	H	-17.66	43.84	54.00	-10.16
1080.00	59.58	72	1.5	V	-17.66	41.92	54.00	-12.08
1440.00	55.41	127	1.6	H	-17.66	37.75	54.00	-16.25
1440.00	61.05	132	1.7	V	-17.66	43.39	54.00	-10.61

9 Periodic Operation

The duty cycle was determined by the following equation:

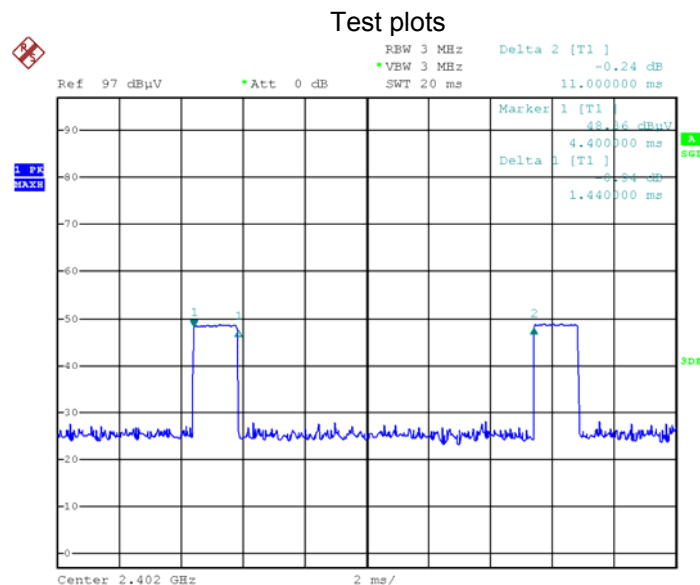
To calculate the actual field intensity, the duty cycle correction factor in decibel is needed for later use and can be obtained from following conversion

Duty Cycle(%)=Total On interval in a complete pulse train/ Length of a complete pulse train * %

Duty Cycle Correction Factor(dB)=20 * Log₁₀(Duty Cycle)

Total transmission time(ms)	1.44
Length of a complete transmission period(ms)	11.00
Duty Cycle(%)	13.09
Duty Cycle Correction Factor(dB)	-17.66

Refer to the duty cycle plot (as below)



Date: 9.MAR.2022 16:49:58

10 Restricted band

Test Requirement: FCC Part15 Paragraph 15.205

Test Method: ANSI C63.10: 2013

Test Result: N/A

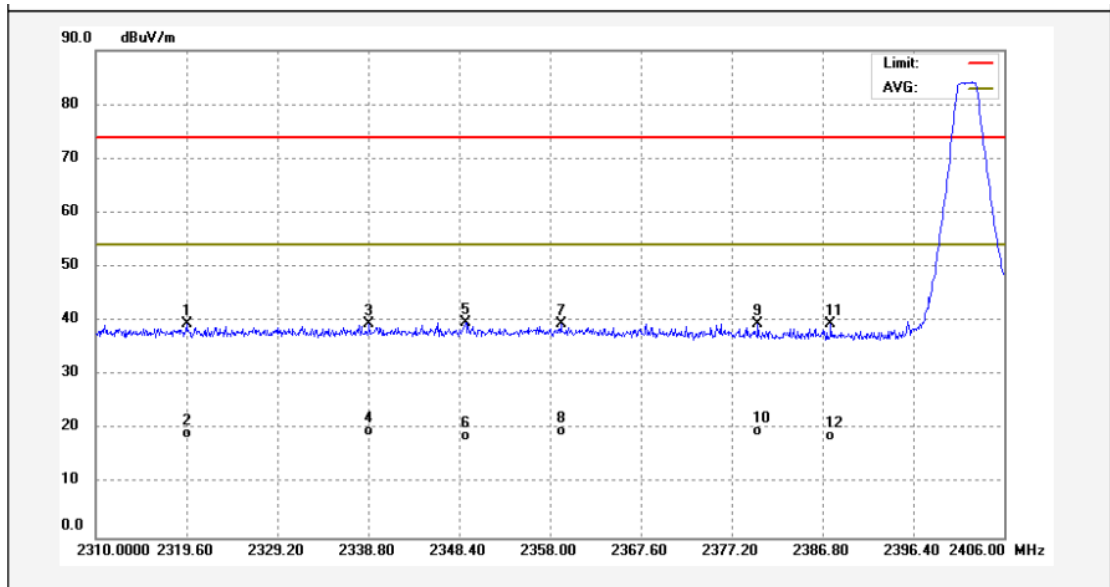
10.1 Requirments:

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

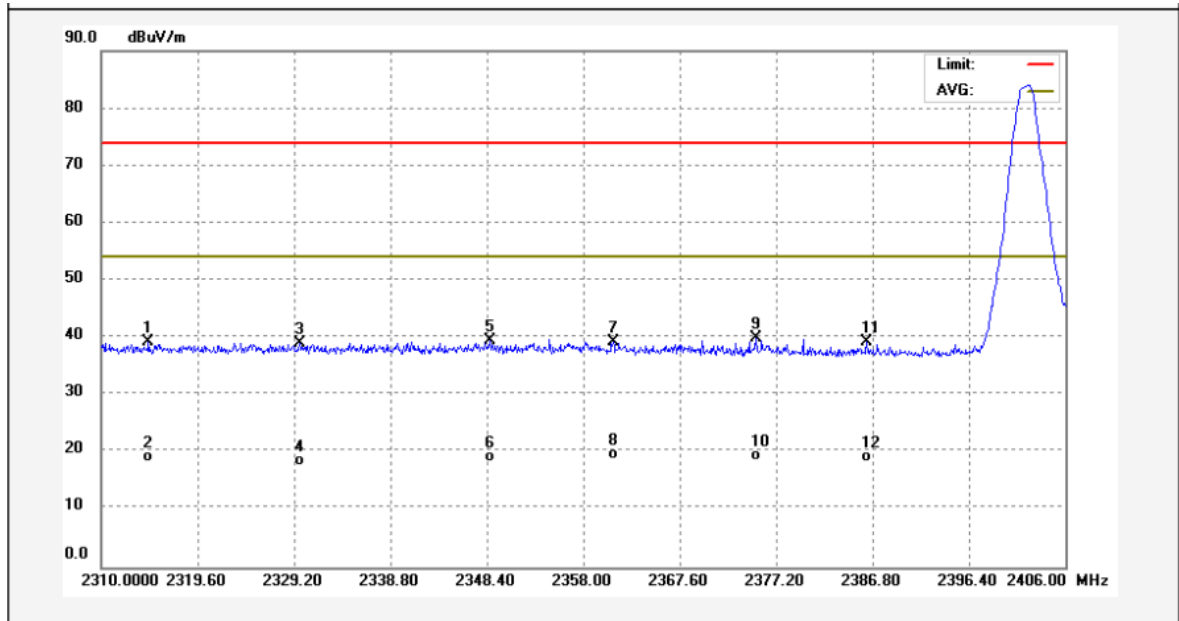
Mode: Continuously Transmitting(Left 2402)

Antenna Polarization: Vertical



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2319.600	50.98	-11.55	39.43	74.00	-34.57	peak	
2	2319.600	30.85	-11.55	19.30	54.00	-34.70	AVG	
3	2338.896	51.21	-11.62	39.59	74.00	-34.41	peak	
4	2338.896	31.22	-11.62	19.60	54.00	-34.40	AVG	
5	2349.072	51.31	-11.65	39.66	74.00	-34.34	peak	
6	2349.072	30.45	-11.65	18.80	54.00	-35.20	AVG	
7	2359.152	51.15	-11.69	39.46	74.00	-34.54	peak	
8	2359.152	31.39	-11.69	19.70	54.00	-34.30	AVG	
9	2379.984	51.28	-11.77	39.51	74.00	-34.49	peak	
10	2379.984	31.57	-11.77	19.80	54.00	-34.20	AVG	
11	2387.664	51.23	-11.79	39.44	74.00	-34.56	peak	
12	2387.664	30.69	-11.79	18.90	54.00	-35.10	AVG	

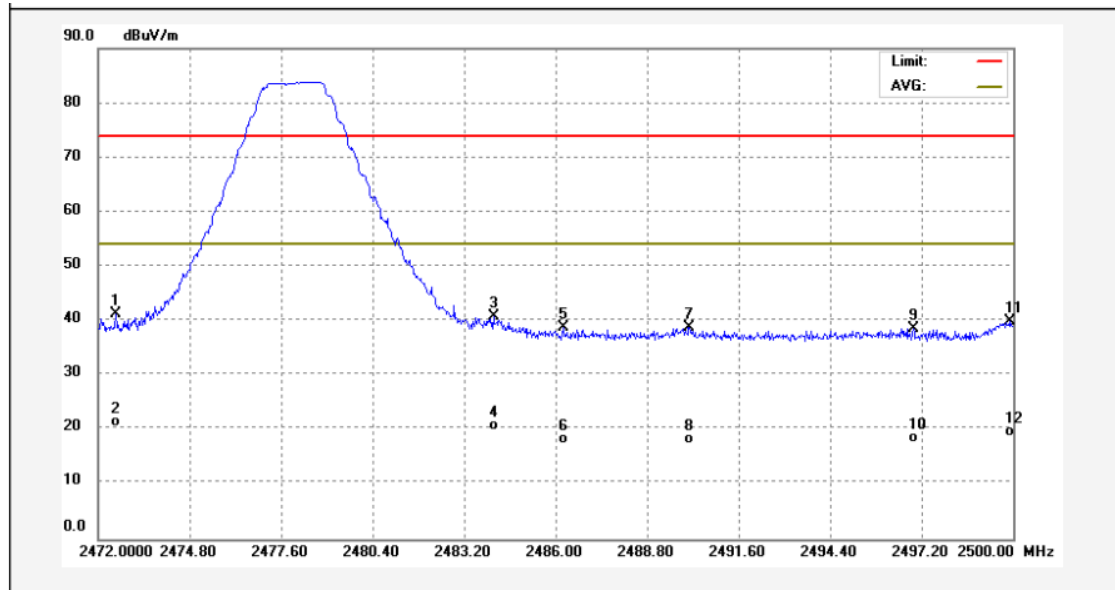
Antenna Polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2314.704	47.52	-8.15	39.37	74.00	-34.63	peak	
2	2314.704	27.35	-8.15	19.20	54.00	-34.80	AVG	
3	2329.776	47.11	-8.13	38.98	74.00	-35.02	peak	
4	2329.776	26.73	-8.13	18.60	54.00	-35.40	AVG	
5	2348.688	47.51	-8.10	39.41	74.00	-34.59	peak	
6	2348.688	27.40	-8.10	19.30	54.00	-34.70	AVG	
7	2360.976	47.40	-8.09	39.31	74.00	-34.69	peak	
8	2360.976	27.89	-8.09	19.80	54.00	-34.20	AVG	
9	2375.184	48.06	-8.07	39.99	74.00	-34.01	peak	
10	2375.184	27.57	-8.07	19.50	54.00	-34.50	AVG	
11	2386.224	47.27	-8.06	39.21	74.00	-34.79	peak	
12	2386.224	27.26	-8.06	19.20	54.00	-34.80	AVG	

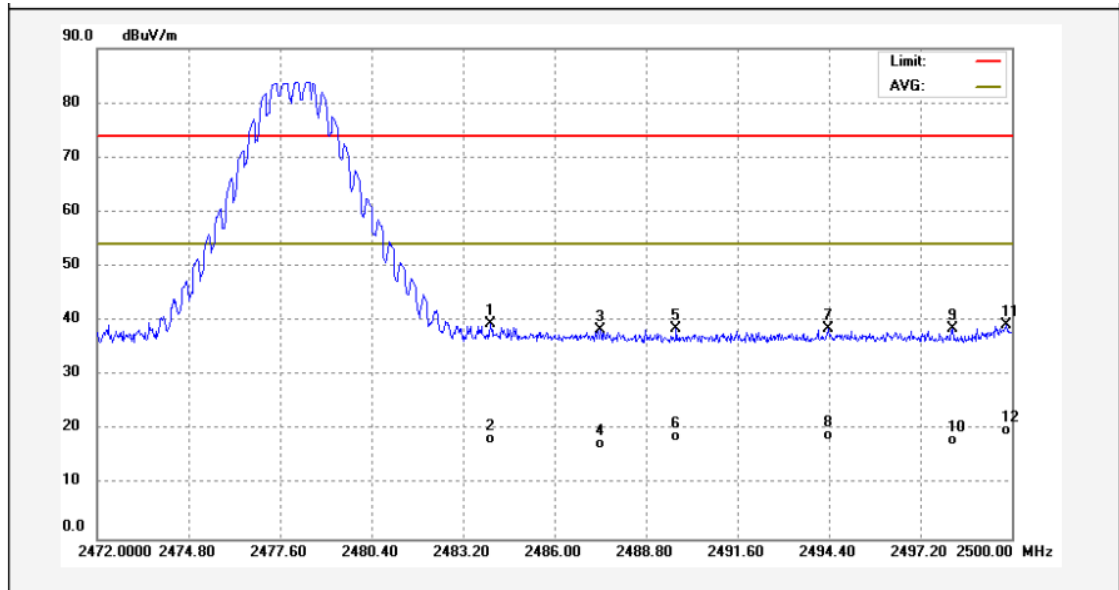
Mode: Continuously Transmitting(Right 2478)

Antenna Polarization: Vertical



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2472.532	53.35	-12.11	41.24	74.00	-32.76	peak	
2	2472.532	33.61	-12.11	21.50	54.00	-32.50	AVG	
3	2484.096	52.92	-12.15	40.77	74.00	-33.23	peak	
4	2484.096	32.95	-12.15	20.80	54.00	-33.20	AVG	
5	2486.224	50.91	-12.16	38.75	74.00	-35.25	peak	
6	2486.224	30.46	-12.16	18.30	54.00	-35.70	AVG	
7	2490.088	50.98	-12.18	38.80	74.00	-35.20	peak	
8	2490.088	30.58	-12.18	18.40	54.00	-35.60	AVG	
9	2496.948	50.82	-12.19	38.63	74.00	-35.37	peak	
10	2496.948	30.79	-12.19	18.60	54.00	-35.40	AVG	
11	2499.888	52.17	-12.20	39.97	74.00	-34.03	peak	
12	2499.888	32.00	-12.20	19.80	54.00	-34.20	AVG	

Antenna Polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	2484.040	47.33	-7.93	39.40	74.00	-34.60	peak	
2	2484.040	26.30	-7.93	18.37	54.00	-35.63	AVG	
3	2487.400	46.23	-7.93	38.30	74.00	-35.70	peak	
4	2487.400	25.30	-7.93	17.37	54.00	-36.63	AVG	
5	2489.724	46.62	-7.93	38.69	74.00	-35.31	peak	
6	2489.724	26.80	-7.93	18.87	54.00	-35.13	AVG	
7	2494.372	46.43	-7.91	38.52	74.00	-35.48	peak	
8	2494.372	26.90	-7.91	18.99	54.00	-35.01	AVG	
9	2498.180	46.45	-7.90	38.55	74.00	-35.45	peak	
10	2498.180	26.10	-7.90	18.20	54.00	-35.80	AVG	
11	2499.832	47.24	-7.90	39.34	74.00	-34.66	peak	
12	2499.832	27.80	-7.90	19.90	54.00	-34.10	AVG	

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

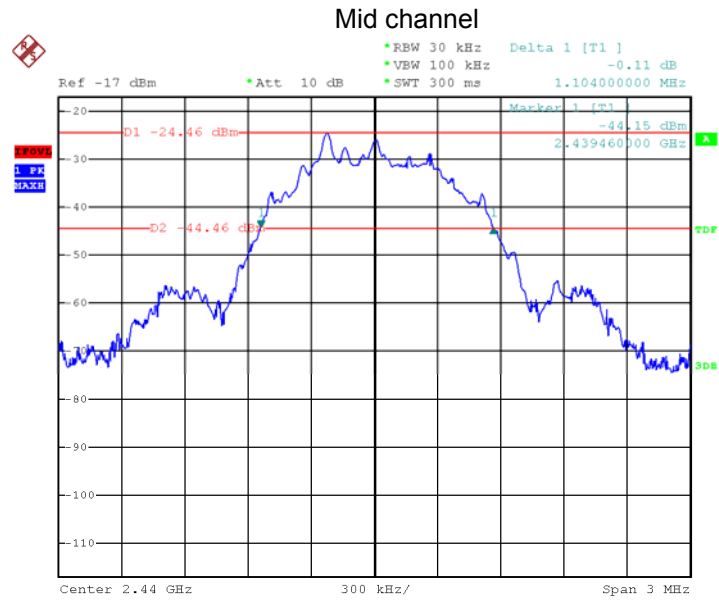
Frequency (MHz)	Bandwidth Emission (MHz)
2402	1.113
2440	1.104
2478	1.20

Test plots

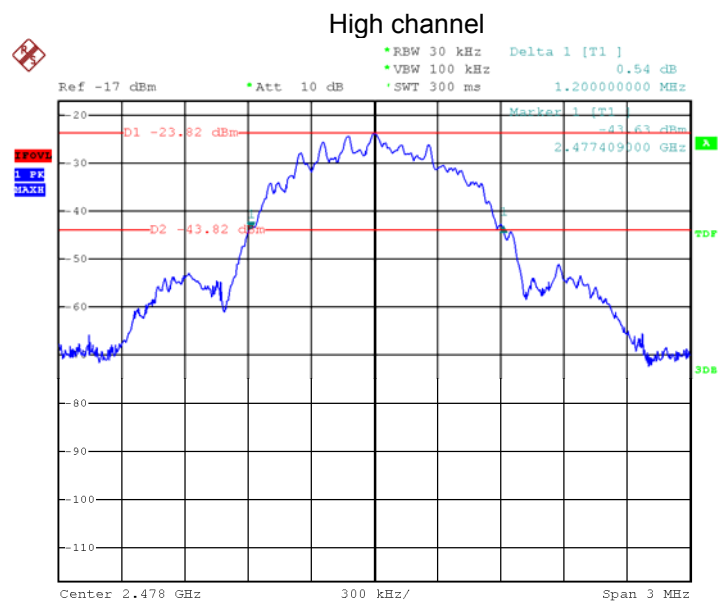
Low channel



Date: 22.JAN.2022 11:03:52



Date: 22.JAN.2022 11:01:36



Date: 22.JAN.2022 10:57:06

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: WTF21D12149221W007.

14 Photographs- Test Setup and EUT

Note: Please refer to appendix: Appendix-SPMR14000-Photos.

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