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RF Test Report

Test Report Number	HID-24050731-LC-FCC-IC-RF-WLAN2.4G
FCC ID	JQ6-BLUFIAC01
IC	2236B-BLUFIAC01
Applicant	HID Global Corporation
Applicant Address	611 Center Ridge Drive, Austin, TX, 78753, USA
Product Name	BLE and WiFi Gateway
Model (s)	BluFi-AC01
Date of Receipt	06/21/2024
Date of Test	06/21/2024- 07/10/2024
Report Issue Date	07/17/2024
Test Standards	47 CFR Part 15.247 RSS 247 Issue 3, Aug 2023 RSS-Gen Issue 5, Feb 2021
Test Result	**PASS**

Issued by:

Vista Compliance Laboratories
1261 Puerta Del Sol, San Clemente, CA 92673 USA
www.vista-compliance.com

Lining	
Lining Li (Test Engineer)	**David Zhang (Technical Manager)**

REVISION HISTORY

Report Number	Version	Description	Issued Date
HID-24050731-LC-FCC-IC-RF-WLAN2.4G	01	Initial report	07/17/2024

TABLE OF CONTENTS

1 Test Summary

Test Item	Test Requirement	Test Method	Result
Antenna Requirement	47 CFR Part 15.247 RSS-247 Issue 3, Aug 2023	ANSI C63.10 (2020)	Pass
DTS (6 dB) Channel Bandwidth	47 CFR Part 15.247 RSS-247 Issue 3, Aug 2023	ANSI C63.10 (2020)	Pass
Occupied Bandwidth	RSS-Gen Issue 5, Feb 2021	RSS-Gen Issue 5, Feb 2021	Pass
Conducted Maximum Output Power	47 CFR Part 15.247 RSS-247 Issue 3, Aug 2023	ANSI C63.10 (2020)	Pass
Power Spectral Density	47 CFR Part 15.247 RSS-247 Issue 3, Aug 2023	ANSI C63.10 (2020)	Pass
Conducted Band-Edge & Unwanted Emissions	47 CFR Part 15.247 RSS-247 Issue 3, Aug 2023	ANSI C63.10 (2020)	Pass
Radiated Emissions & Unwanted Emissions into Restricted Frequency Bands	47 CFR Part 15.247 RSS-247 Issue 3, Aug 2023	ANSI C63.10 (2020)	Pass
AC Power Line Conducted Emissions	47 CFR Part 15.247 RSS-Gen Issue 5, Feb 2021	ANSI C63.10 (2020)	Pass

2 General Information

2.1 Applicant

Applicant	HID Global Corporation
Applicant address	611 Center Ridge Drive, Austin, TX, 78753, USA
Manufacturer	HID Global Corporation
Manufacturer Address	611 Center Ridge Drive, Austin, TX, 78753, USA

2.2 Product information

Product Name	BLE and WiFi Gateway
Product Description	BluFi-ACUS BLE and WiFi Gateway
Model Number	BluFi-AC01
Family Models	N/A
Serial Number	HID-21050342-LC-E001 (WIFI RF conducted test sample) HID-21050342-LC-E002 (WIFI RF Radiated test sample)
Frequency Band	BLE: 2402-2480MHz 2.4G: 2412-2462MHz 5G: U-NII-1: 5150-5250MHz U-NII-2A: 5250-5350MHz U-NII-2C: 5470-5725MHz U-NII-3: 5725-5850MHz
Type of modulation	BT_LE: GFSK 2.4G 11b/g/n: CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM 5G 11a/n/ac: 256QAM, 64QAM, 16QAM, QPSK, BPSK
Equipment Class	DTS
Antenna Information	PCB trace antenna, Antenna Gain: 2.4GHz, 3 dBi 5GHz, 2.5dBi
Clock Frequencies	N/A
Input Power	120VAC, 60Hz
Power Adapter Manufacturer/Model	N/A
Power Adapter SN	N/A
Hardware version	N/A
Software version	N/A
Additional Info	Test sample is modified with external SMA connector for direct RF conducted measurement

2.3 Test standard and method

Test standard	47 CFR Part 15.247 RSS 247 Issue 3, Aug 2023
Test method	ANSI C63.10-2020 558074 D01 15.247 Meas Guidance v05r02

3 Test Site Information

Lab performing tests	Vista Laboratories, Inc.
Lab Address	1261 Puerta Del Sol, San Clemente, CA 92673 USA
Phone Number	+1 (949) 393-1123
Website	www.vista-compliance.com

Test Condition	Temperature	Humidity	Atmospheric Pressure
RF Testing	25.6°C	65.3%	996.3 mbar
Radiated Emission Testing	25.6°C	65.3%	996.3 mbar

4 Modification of EUT / Deviations from Standards

EUT test sample has external SMA connector for direct RF conducted measurement.
It also has a USB to UART cable for programming purpose, to set EUT into test mode. No deviation from standards.

5 Test Configuration and Operation

5.1 EUT Test Configuration

The EUT is an engineering test sample loaded with RF testing firmware specifically designed to support the RF TX/RX measurement in different aspects.

The following software was used for testing and to monitor EUT performance

Software	Description
EMISoft Vasona	EMC/RF Spurious emission test software used during testing
Dmtest.exe	dmtest rev1
Linux console	To set WLAN into continuous TX and RX mode under different modulation, data rate and channel, etc.

5.2 Supporting Equipment

Description	Manufacturer	Model #	Serial #	Remark
Laptop	Dell	XPS13-9333	G1H5102	N/A
USB to UART adapter	DSD TECH	SH-U09C5	N/A	Provided by client

5.3 Duty cycle Measurement

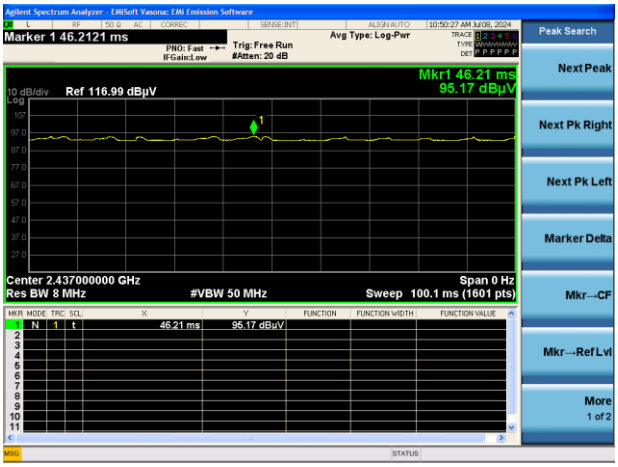
If Duty cycle of test signal is < 98 %, duty factor is required.

Mode	Duty Cycle (%)	DCF (dB)
802.11b	100%	0
802.11g	100%	0
802.11n (HT20)	100%	0

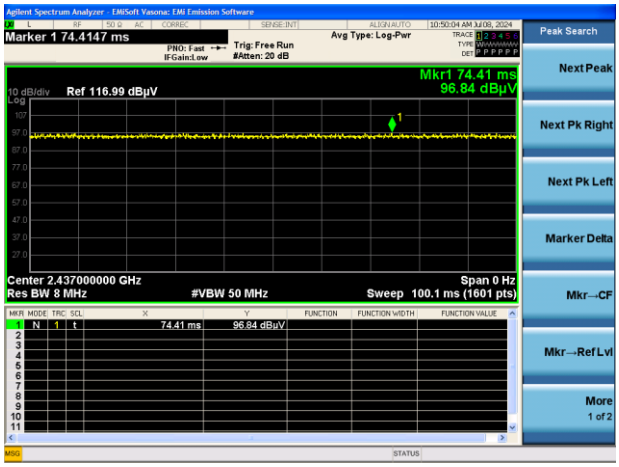
Note: Duty cycle = T_{on}/T_{period}*100%

DCF = 10*log(1/D)

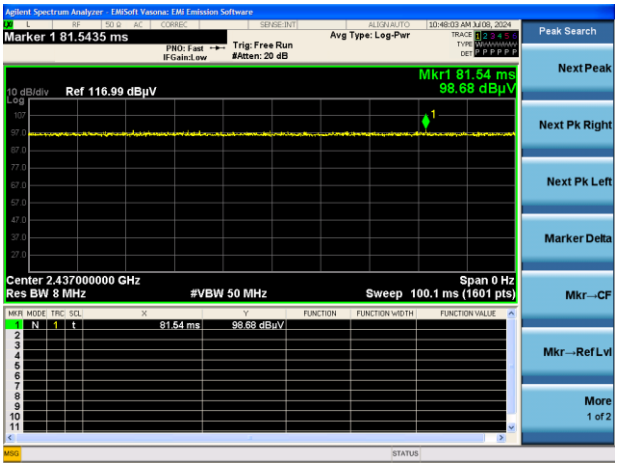
Where, D = T_{on}/T_{period}



Duty cycle_802.11b



Duty cycle_802.11g



Duty cycle_802.11n

6 Uncertainty of Measurement

Test item	Measurement Uncertainty (dB)
RF Output Power (Conducted)	±1.2 dB
Power Spectral Density	±0.9 dB
Unwanted Emission (conducted)	±2.6 dB
Occupied Channel Bandwidth	±5 %
Radiated Emission (9KHz-30MHz)	±3.5 dB
Radiated Emission (30MHz-1GHz)	±4.6 dB
Radiated Emission (1-18GHz)	±4.9 dB
Radiated Emission (18-40GHz)	±3.5 dB

7 Test Results

7.1 Antenna Requirement

7.1.1 Requirement

Per § 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

7.1.2 Result

Analysis:

- EUT has a PCB trace atenna which is soldered onto the main board. The antenna gain is 3.0 dBi for 2.4GHz band, 2.5dBi for 5GHz band. This meets the requirement of permanent attachment.

Conclusion:

- EUT complies with antenna requirement in § 15.203.

7.2 DTS (6 dB) Bandwidth

7.2.1 Requirement

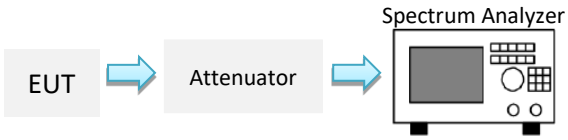
§ 15.247 (a)(2)

Systems using digital modulation techniques may operate in the 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz bands. The minimum 6 dB bandwidth shall be at least 500 KHz.

RSS-247 §5.2

Systems using digital modulation techniques may operate in the 902-928MHz and 2400-2483.5MHz bands. The minimum 6 dB bandwidth shall be at least 500 KHz.

7.2.2 Test Setup



7.2.3 Test Procedure

According to section 8.2, option 2, in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.8 of ANSI C63.10-2020:

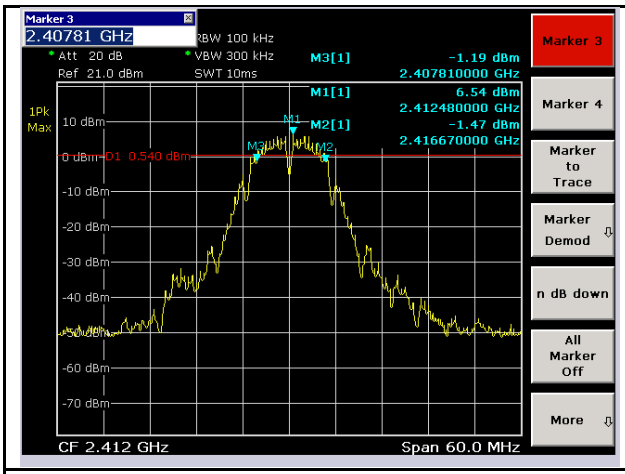
The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 × RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Use automatic bandwidth measurement capability on instrument to obtain BW result.

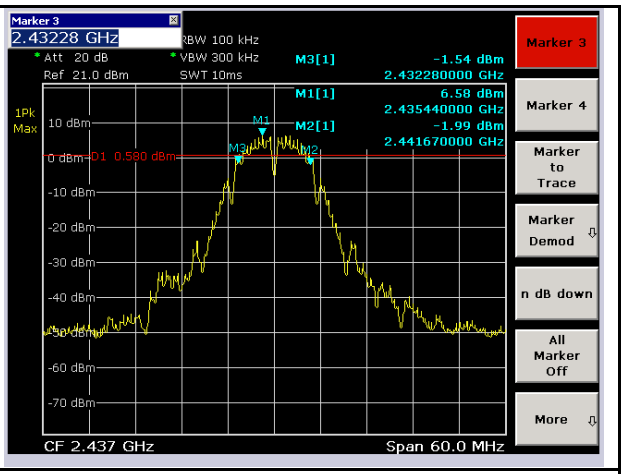
7.2.4 Test Result

Mode	Data rate	Frequency (MHz)	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Result
802.11b	1Mbps	2412	8.86	0.5	Pass
		2437	9.39	0.5	Pass
		2462	8.86	0.5	Pass
802.11g	6Mbps	2412	15.4	0.5	Pass
		2437	15.98	0.5	Pass
		2462	15.32	0.5	Pass
802.11n20	MCS0	2412	15.32	0.5	Pass
		2437	14.19	0.5	Pass
		2462	15.32	0.5	Pass

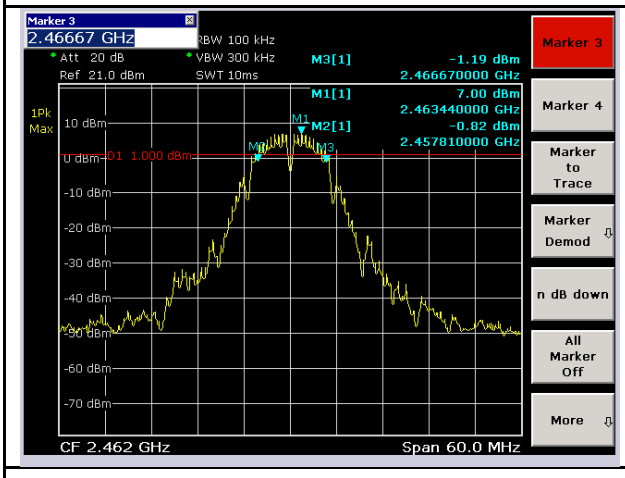
7.2.5 Test Plots



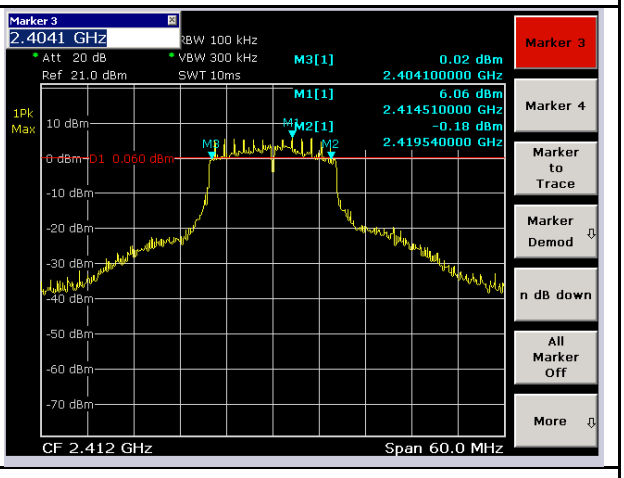
DTS BW_802.11b_Low CH



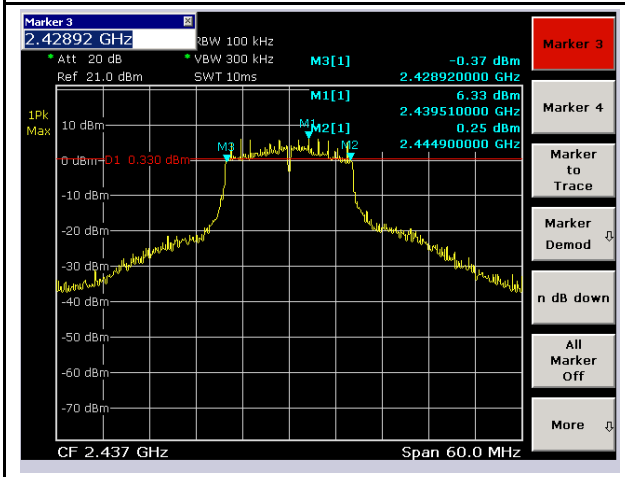
DTS BW_802.11b_Mid CH



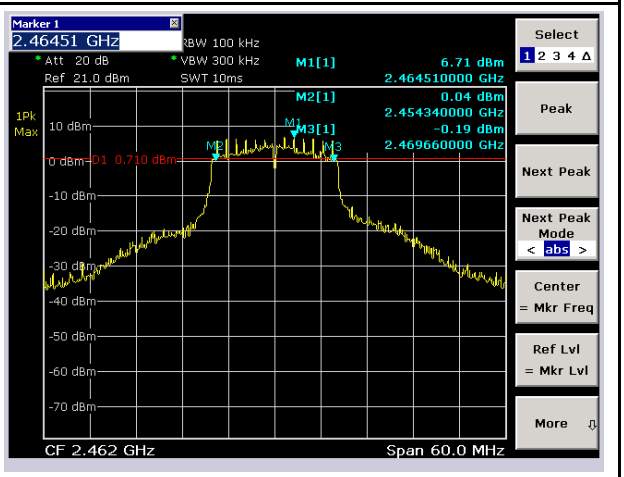
DTS BW_802.11b_High CH



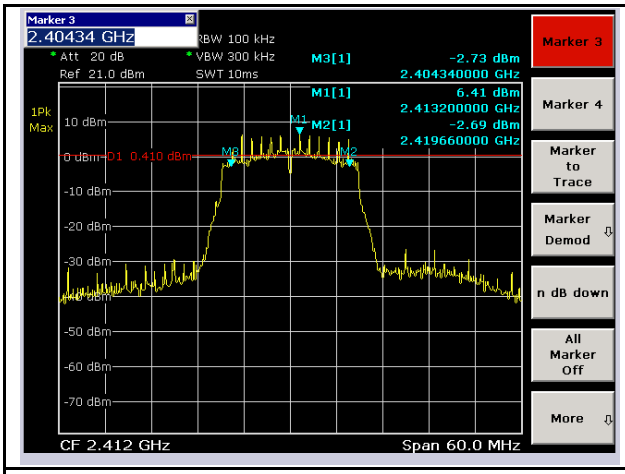
DTS BW_802.11g_Low CH



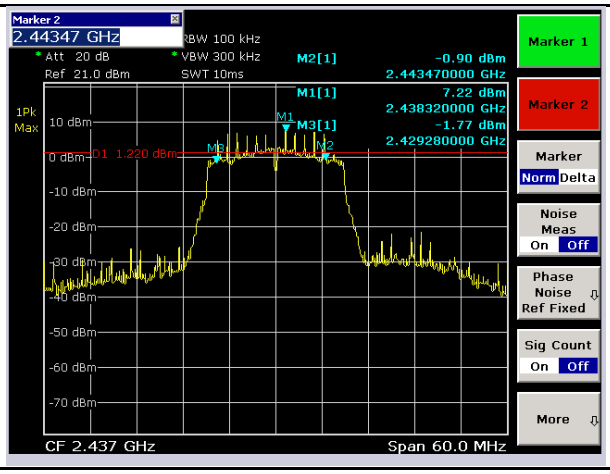
DTS BW_802.11g_Mid CH



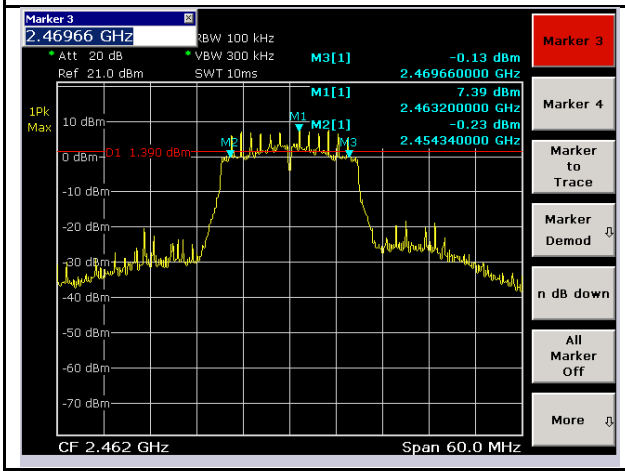
DTS BW_802.11g_High CH



DTS BW_802.11n20_Low CH



DTS BW_802.11 n20_Mid CH



DTS BW_802.11 n20_High CH

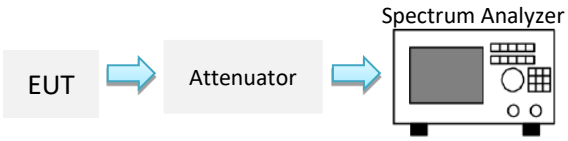
7.3 Occupied Bandwidth (99%)

7.3.1 Requirement

RSS-Gen §6.7

The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

7.3.2 Test Setup



7.3.3 Test Procedure

According to section RSS-Gen §6.7

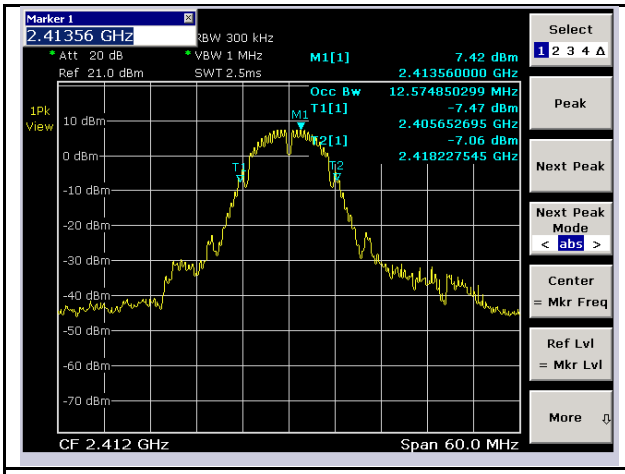
The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 × RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

1. Set RBW = 1% to 5% of the actual occupied BW.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Span = large enough to capture all products of the modulation process
7. Allow the trace to stabilize.
8. Use automatic bandwidth measurement capability on instrument to obtain BW result.

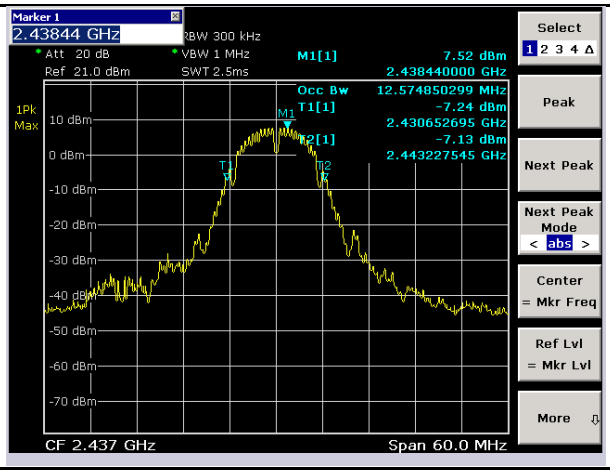
7.3.4 Test Result

Mode	Data rate	Frequency (MHz)	Measured 99% OBW (MHz)	Limit (MHz)	Result
802.11b	1Mbps	2412	12.575	N/A	N/A
		2437	12.575	N/A	N/A
		2462	12.575	N/A	N/A
802.11g	6Mbps	2412	17.605	N/A	N/A
		2437	17.725	N/A	N/A
		2462	18.323	N/A	N/A
802.11n20	MCS0	2412	18.084	N/A	N/A
		2437	18.084	N/A	N/A
		2462	18.204	N/A	N/A

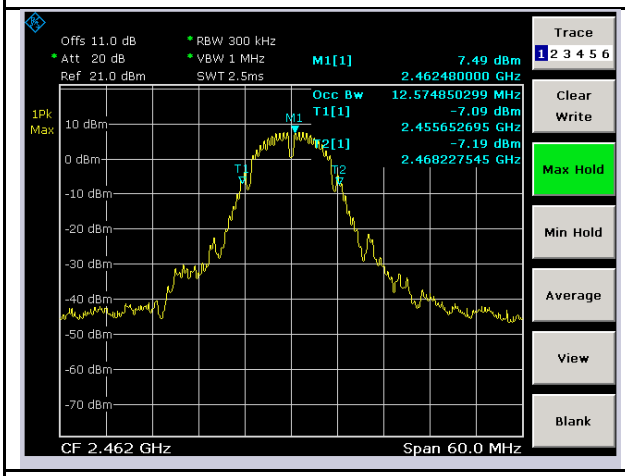
7.3.5 Test Plots



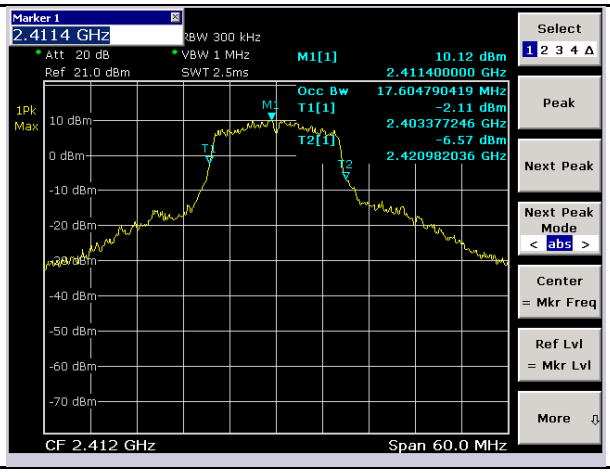
99%_802.11b_Low CH



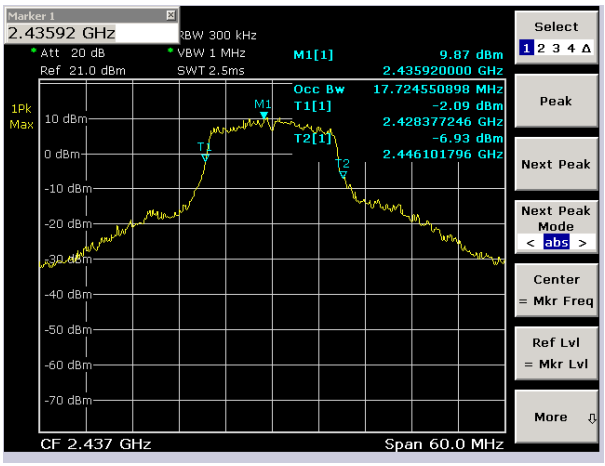
99%_802.11b_Mid CH



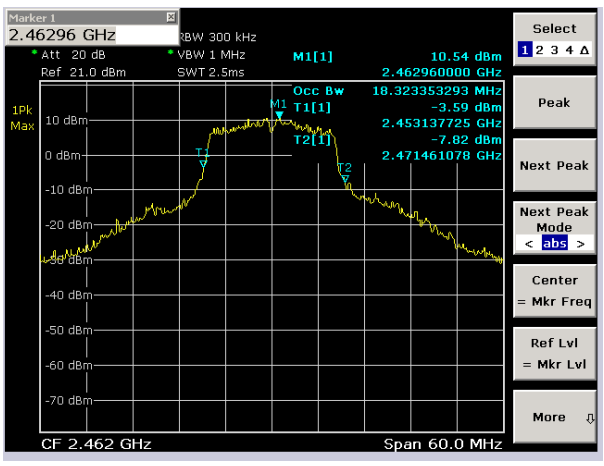
99%_802.11b_High CH



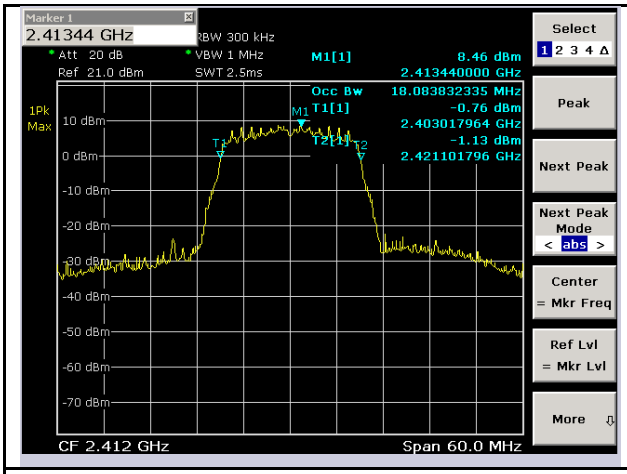
99%_802.11g_Low CH



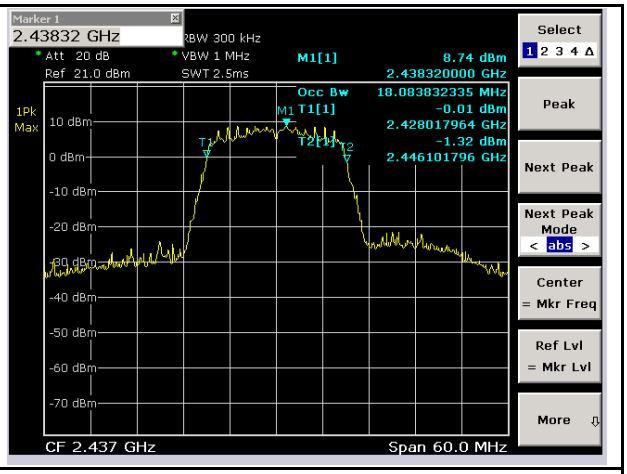
99%_802.11g_Mid CH



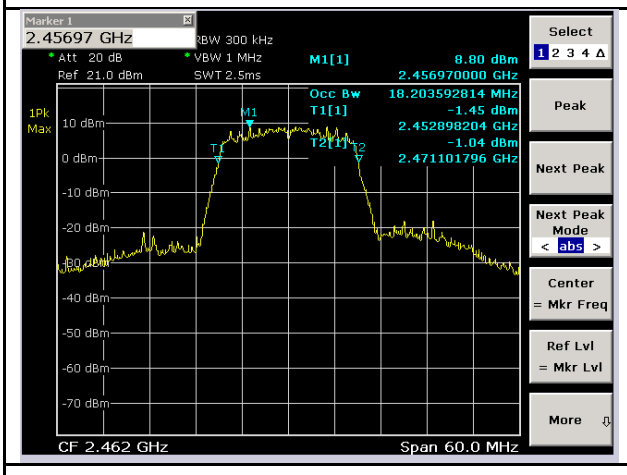
99%_802.11g_High CH



99%_802.11n20_Low CH



99%_802.11n20_Mid CH



99%_802.11n20_High CH

7.4 Maximum Output Power

7.4.1 Requirement

§ 15.247 (b)(3), RSS-247 §5.4

DTSs using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: the maximum output power is 1 Watt.

If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

7.4.2 Test Setup

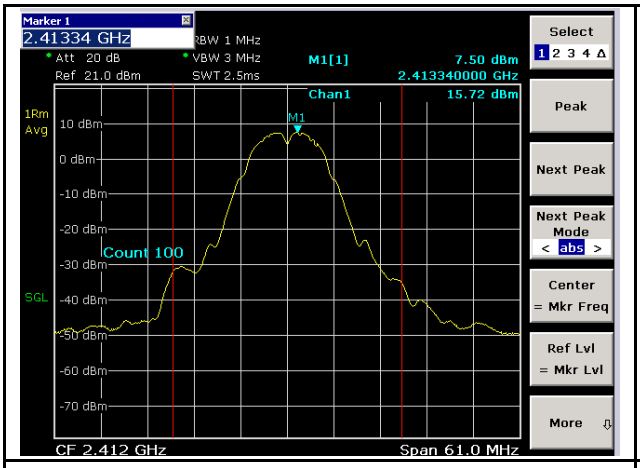
7.4.3 Test Procedure

Power measurement is according to clause 11.9.2.2.2 of ANSI C63.10-2020 AVGSA-1 Maximum conducted (average) output power measurement method.

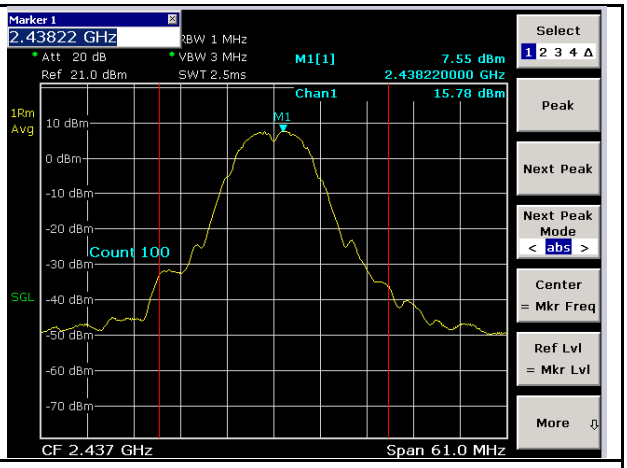
7.4.4 Test Result

Mode	Data rate	Frequency (MHz)	Measured Average Output Power (dBm)	Max Output Power (dBm)	Result
802.11b	1Mbps	2412	15.72	30	Pass
		2437	15.78	30	Pass
		2462	15.97	30	Pass
802.11g	6Mbps	2412	16.44	30	Pass
		2437	16.46	30	Pass
		2462	16.83	30	Pass
802.11n20	MCS0	2412	15.03	30	Pass
		2437	15.49	30	Pass
		2462	15.64	30	Pass

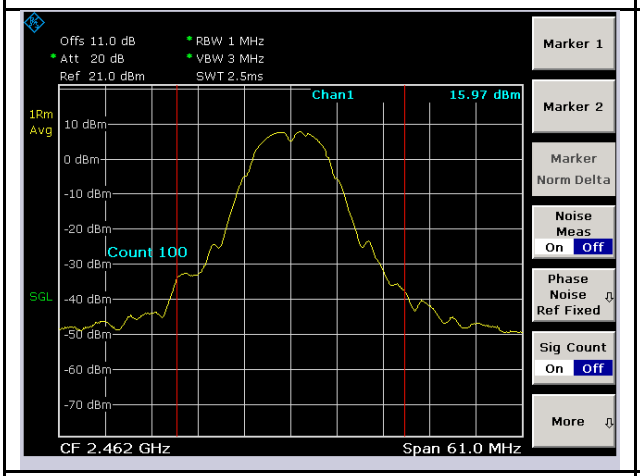
7.4.5 Test Plots



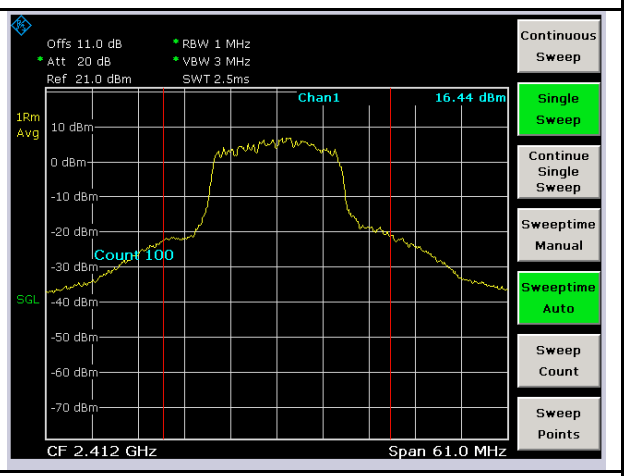
Output Power_802.11b_Low CH



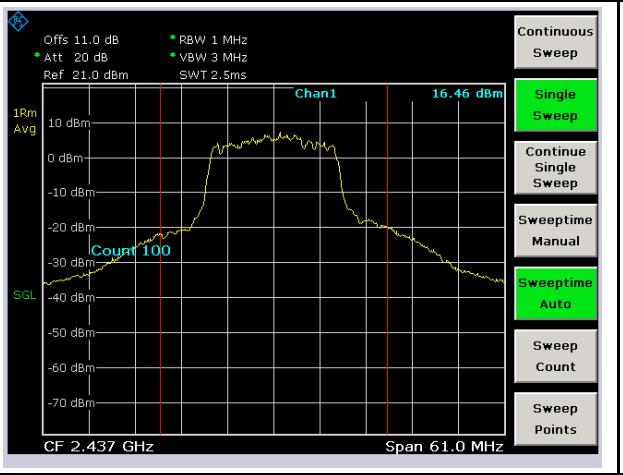
Output Power_802.11b_Mid CH



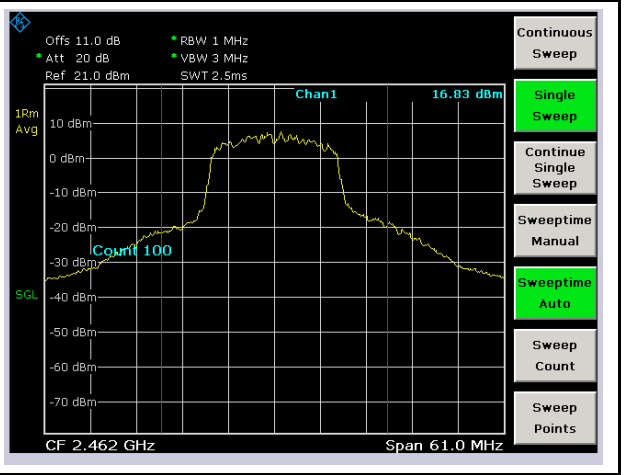
Output Power_802.11b_High CH



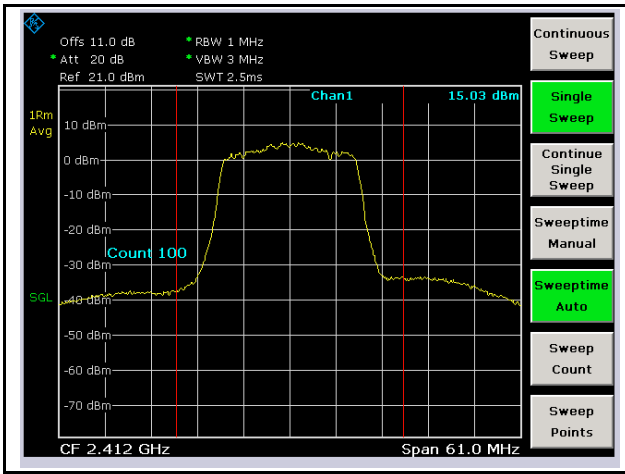
Output Power_802.11g_Low CH



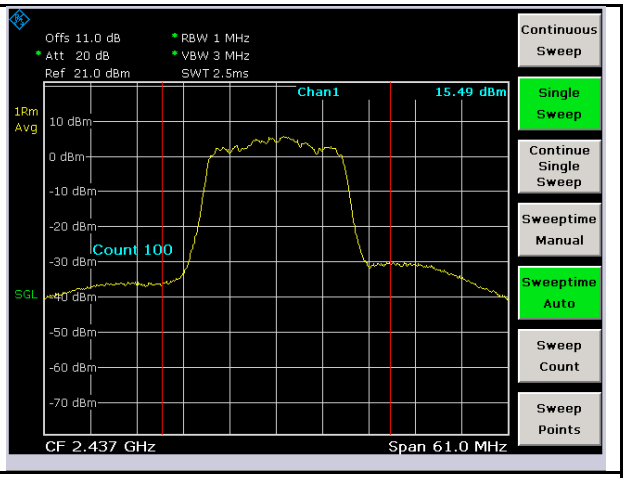
Output Power_802.11g_Mid CH



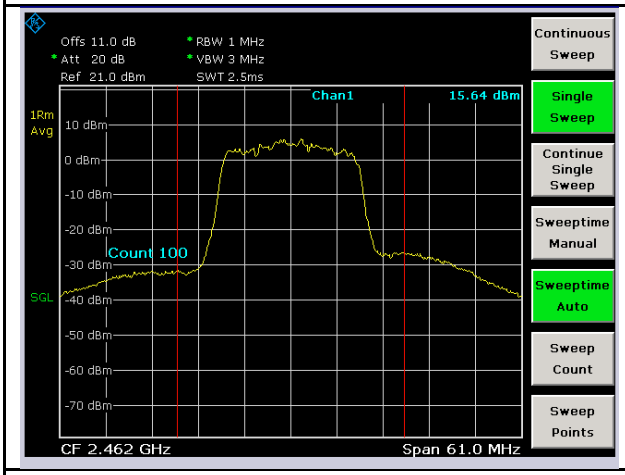
Output Power_802.11g_High CH



Output Power_802.11n20_Low CH



Output Power_802.11n20_Mid CH



Output Power_802.11n20_High CH

7.5 Power Spectral Density

7.5.1 Requirement

§ 15.247 (e), RSS-247 §5.2

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power is used to determine the power spectral density.

7.5.2 Test Setup

7.5.3 Test Procedure

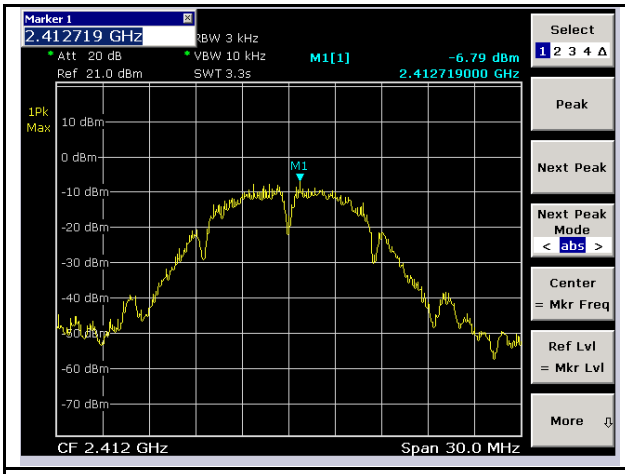
According to section 8.4 in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.10.2 PKPSD of ANSI C63.10-2020:

1. Set analyser centre frequency to DTS channel centre frequency.
2. Set the span to 1.5 X DTS bandwidth.
3. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

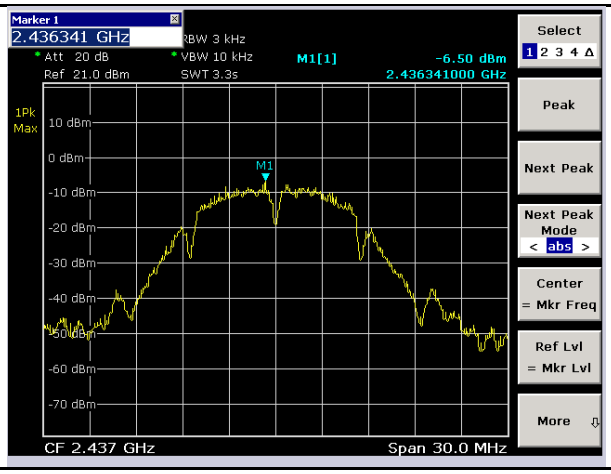
7.5.4 Test Result

Mode	Data rate	Frequency (MHz)	Measured PSD (dBm/3KHz)	Max PSD (dBm/3KHz)	Result
802.11b	1Mbps	2412	-6.79	8	Pass
		2437	-6.50	8	Pass
		2462	-7.00	8	Pass
802.11g	6Mbps	2412	-7.35	8	Pass
		2437	-6.43	8	Pass
		2462	-6.25	8	Pass
802.11n20	MCS0	2412	-9.58	8	Pass
		2437	-8.15	8	Pass
		2462	-7.38	8	Pass

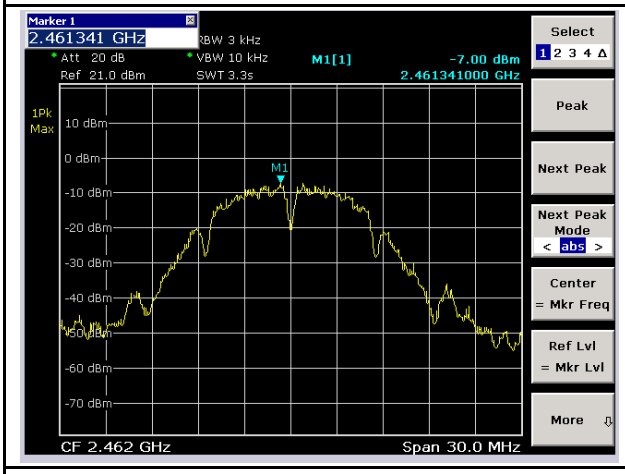
7.5.5 Test Plots



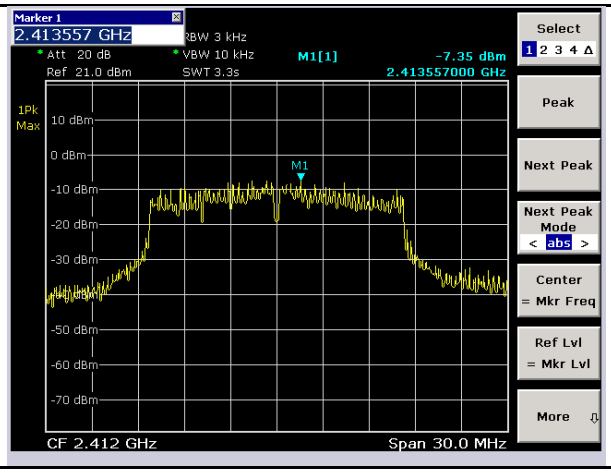
PSD-802.11b-Low CH



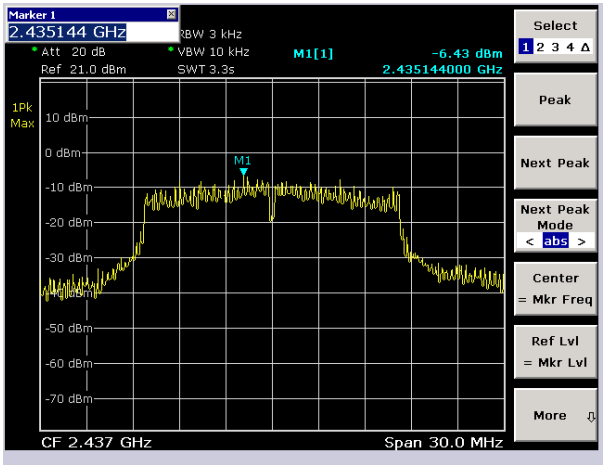
PSD-802.11b-Mid CH



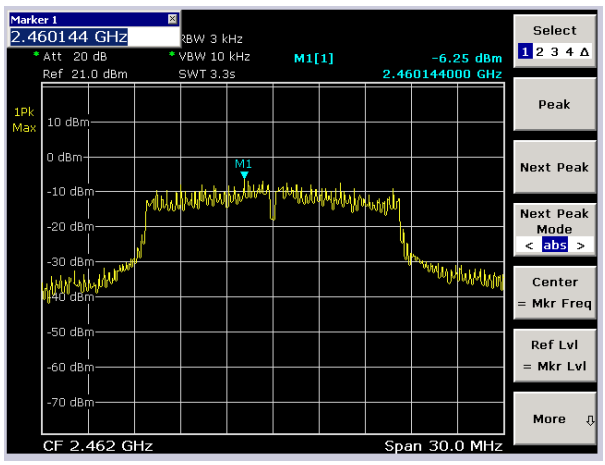
PSD-802.11b-High CH



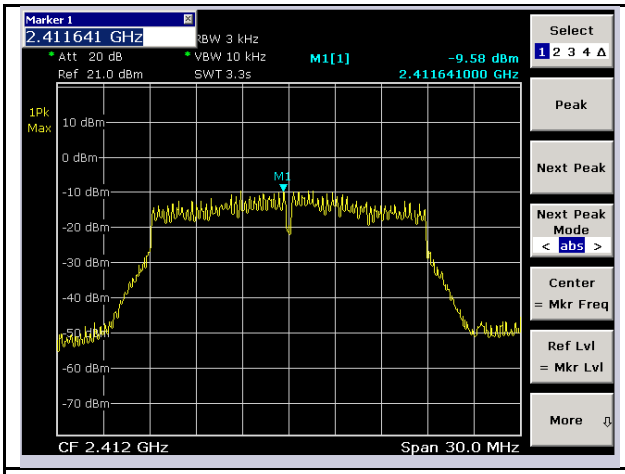
PSD-802.11g-Low CH



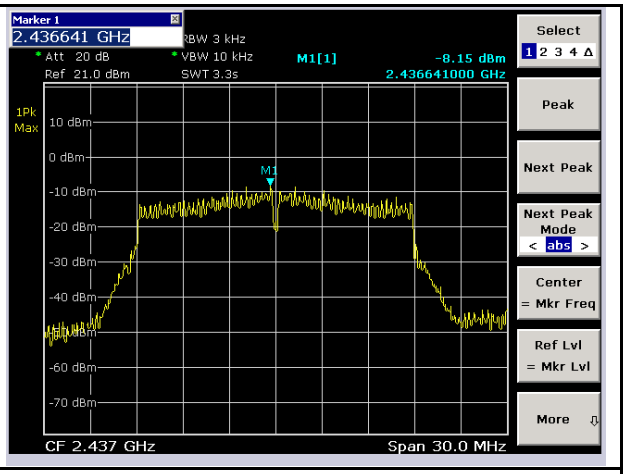
PSD-802.11g-Mid CH



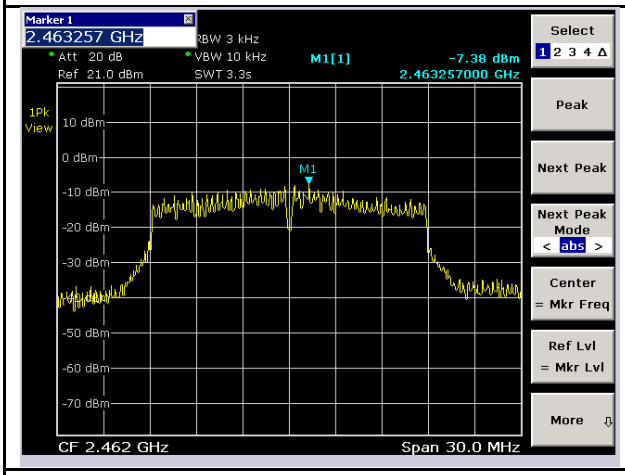
PSD-802.11b-High CH



PSD-802.11n20-Low CH



PSD-802.11n20-Mid CH



PSD-802.11n20-High CH

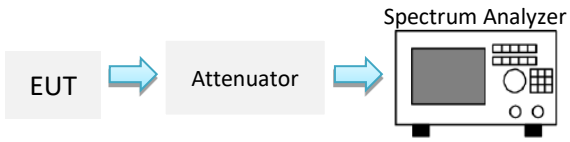
7.6 Conducted Band-Edge

7.6.1 Requirement

§ 15.247 (d), RSS-247 §5.5

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 a radiated 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, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

7.6.2 Test Setup



7.6.3 Test Procedure

According to ANSI C63.10-2020 clause 11.13

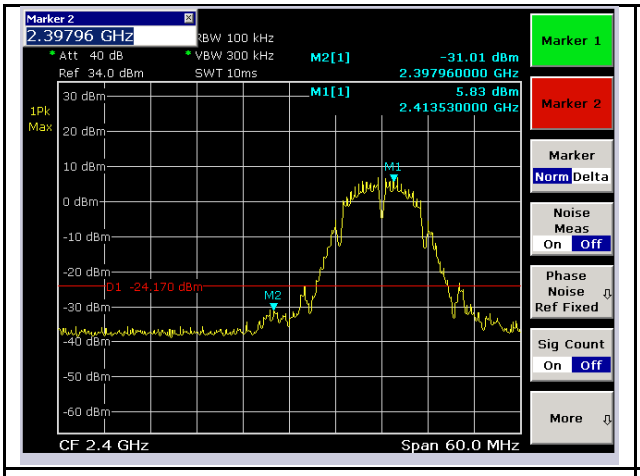
1. The RF output of EUT was connected to the spectrum analyser by RF cable and attenuator. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW=100 KHZ, VBW=300 KHZ, Peak Detector. Unwanted Emissions measured in any 100 khz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 db relative to the maximum in-band peak PSD level in 100 KHZ when maximum peak conducted output power procedure is used. 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 per 15.247(d).
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete and record the results in the test report.

7.6.4 Test Result

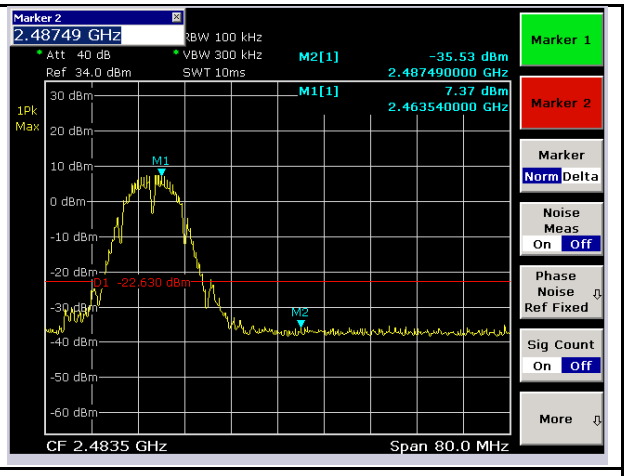
Conducted Band edge

Test Data

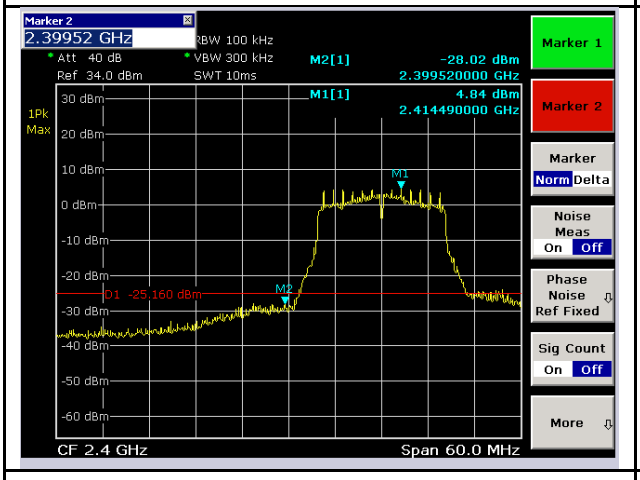
Mode	Data rate	Frequency (MHz)	Ref level (dBm)	Measured result (dBm)	Δ, dB (Limit=-30db)	Result
802.11b	1Mbps	2412	5.83	-31.01	-36.84	Pass
		2462	7.37	-35.53	-42.90	Pass
802.11g	6Mbps	2412	4.84	-28.02	-32.86	Pass
		2462	7.10	-27.82	-34.92	Pass
802.11n(20M)	MCS0	2412	6.48	-29.72	-36.20	Pass
		2462	8.21	-26.34	-34.55	Pass



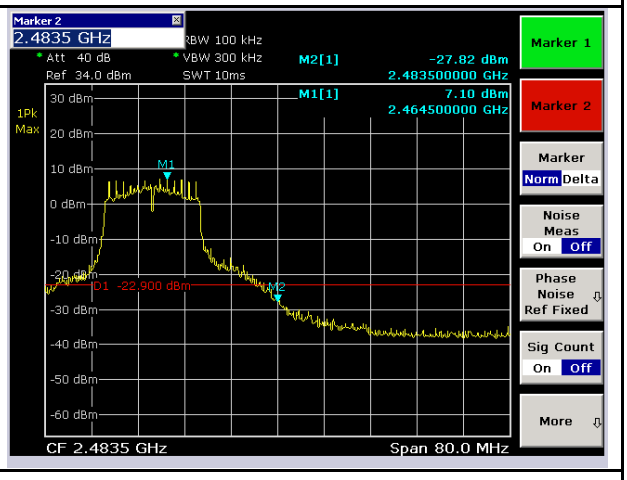
Band Edge-802.11b -Low CH



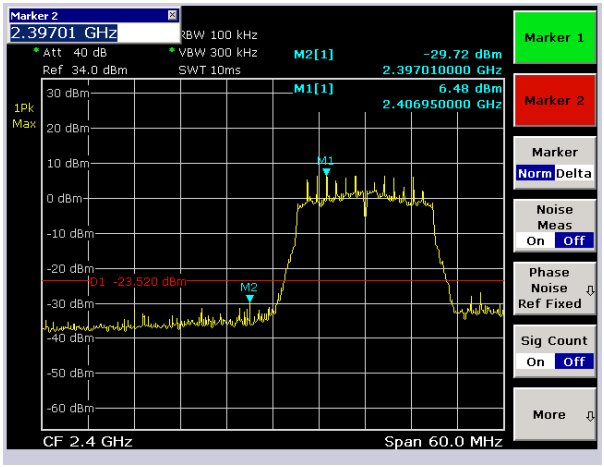
Band Edge-802.11b -High CH



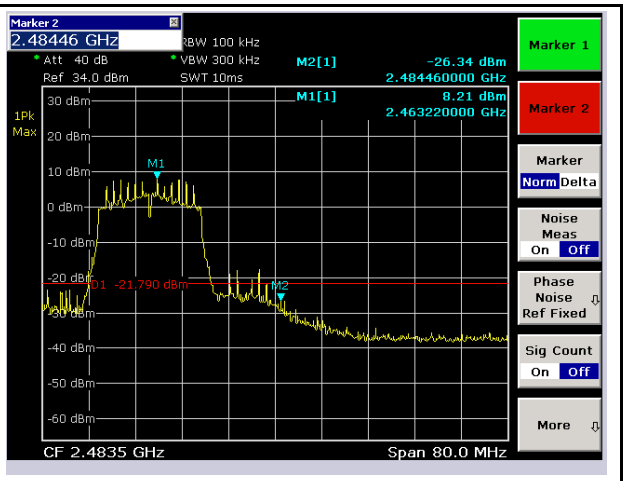
Band Edge-802.11g -Low CH



Band Edge-802.11g -High CH



Band Edge-802.11n20 -Low CH



Band Edge-802.11n20 -High CH

7.7 Radiated Spurious Emissions into Restricted Frequency Bands

7.7.1 Requirement

§ 15.247 (d), RSS-247 §5.5

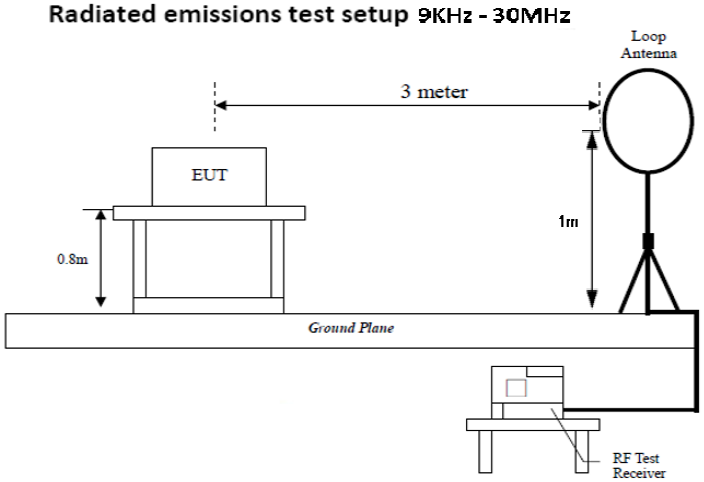
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the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

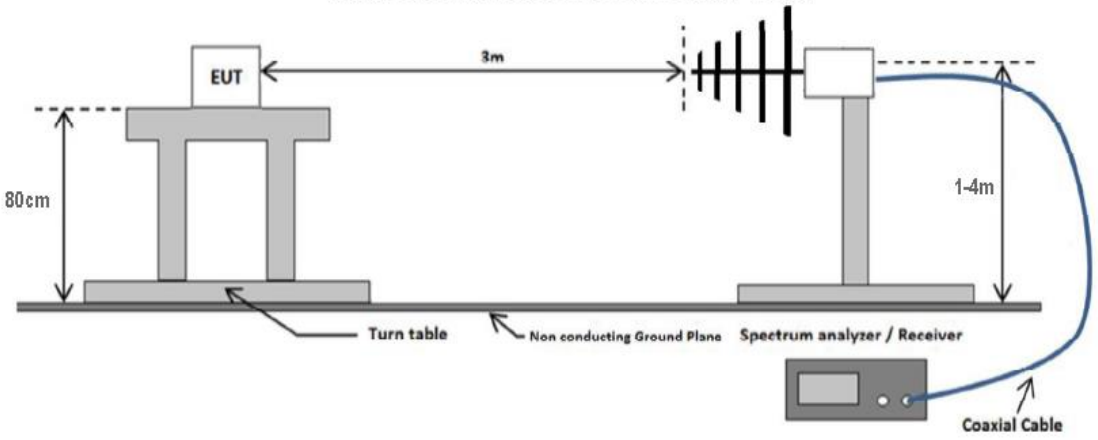
Frequency Range (MHZ)	Field Strength (μV/m)
0.009~0.490	2400/F(KHz)
0.490~1.705	24000/F(KHz)
1.705~30.0	30
30 – 88	100
88 – 216	150
216 960	200
Above 960	500

7.7.2 Test Setup

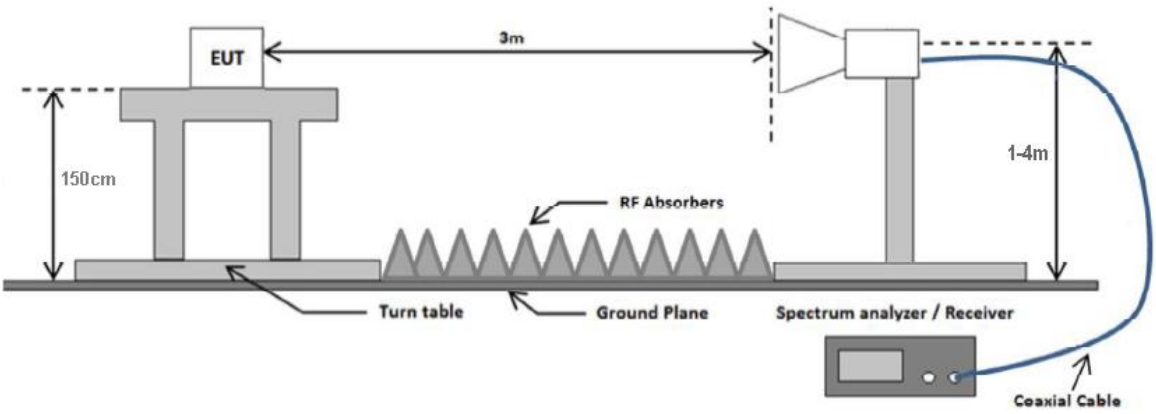
Radiated emissions test setup 9KHz - 30MHz



Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



7.7.3 Test Procedure

According to section 8.6 in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.12.2.7 Radiated spurious emission measurements in ANSI C63.10-2020 as well as the procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 was followed. Boresight antenna mast was used during the scanning to point to EUT to maximize the emission. The process will be repeated in 3 EUT orientations.

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
   a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
   b. The EUT was then rotated to the direction that gave the maximum emission.
   c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 300 Hz for frequency below 150KHz.
4. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for frequency between 150KHz – 30MHz.
5. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-Peak detection at frequency between 30MHz - 1GHz.
6. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak and average measurement at frequency above 1GHz.
7. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.

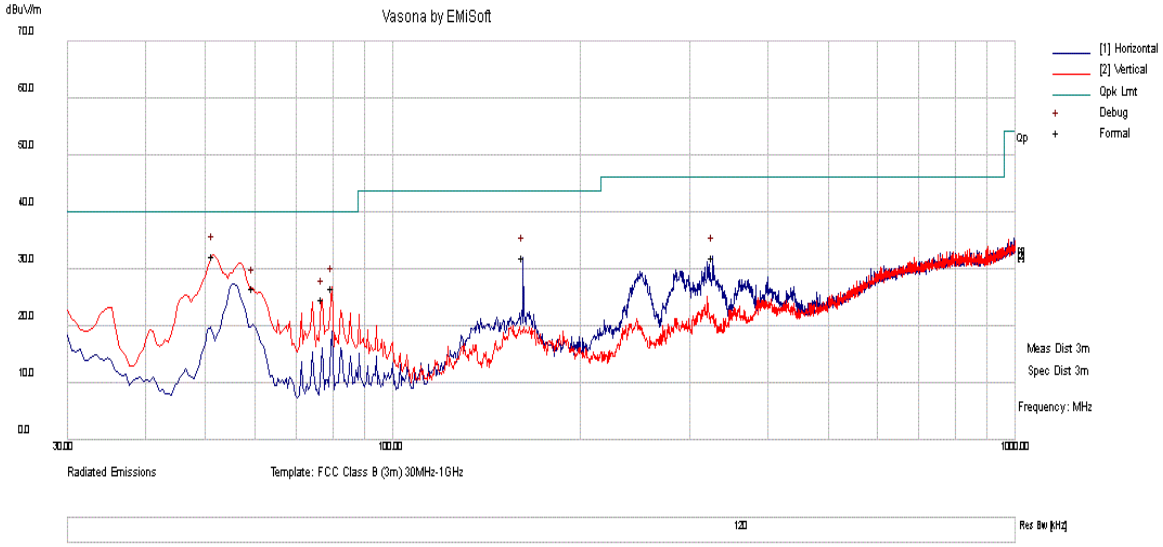
7.7.4 Test Result

Radiated Emission between 9KHz – 30MHz test result

Note: between 9KHz - 30MHz, no substantial emission close to limits. Different modes have been verified.

RADIATED EMISSIONS BELOW 1 GHZ

Test Standard:	FCC15.247, 15.209, RSS 247	Mode:	802.11b Mode
Frequency Range:	30 MHz - 1 GHz	Test Date:	07/09/2024
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Lining
Remark:	Mid channel	Test Result:	Pass



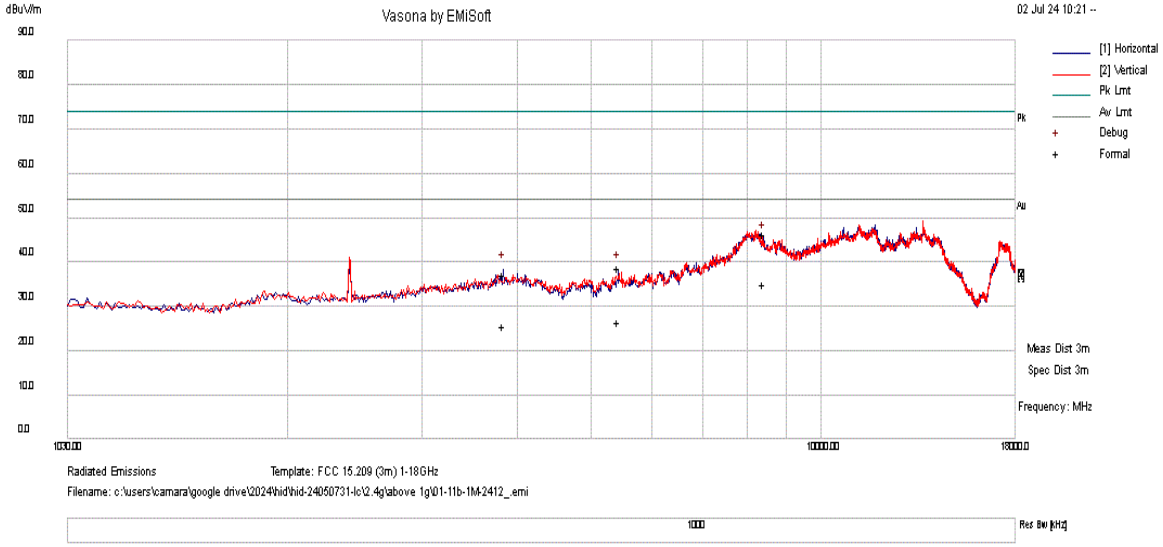
No.	Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	51.37	46.27	2.82	-21.16	27.93	Quasi Max	V	102	199	40.00	-12.07	Pass
2	161.73	32.58	4.37	-17.52	19.43	Quasi Max	H	138	62	43.50	-24.07	Pass
3	80.0	43.00	3.32	-20.74	25.58	Quasi Max	V	111	98	40.00	-14.42	Pass
4	59.34	41.92	2.98	-21.05	23.85	Quasi Max	V	100	0	40.00	-16.15	Pass
5	326.33	37.80	5.88	-11.65	32.03	Quasi Max	H	100	0	46.00	-13.97	Pass
6	77.05	42.02	3.27	-20.66	24.63	Quasi Max	V	100	0	40.00	-15.37	Pass

Remarks:

1. Level (dBuV/m) = Raw (dBuV) + Cable loss(dB) + AF (dB/m).
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

RADIATED EMISSIONS 1 - 18 GHZ

Test Standard:	15.209, 15.247, RSS-247	Mode:	11b, 2412MHz
Frequency Range:	1 GHz - 18 GHz	Test Date:	07/02/2024
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Minoush
Remark:	N/A	Test Result:	Pass

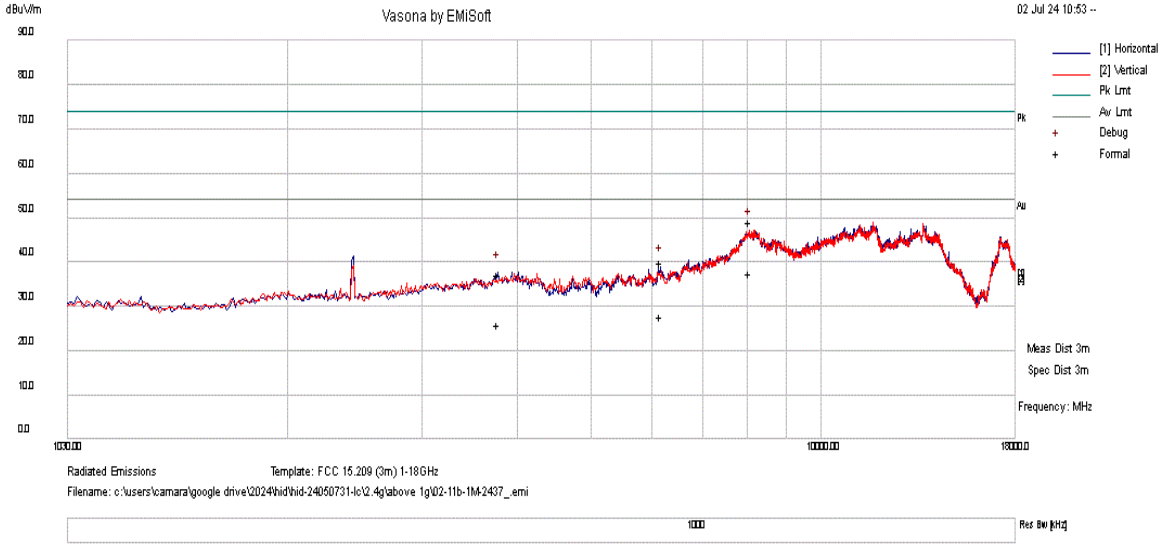


No.	Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	8431.19	18.62	14.20	13.64	46.46	Peak Max	H	330	132	74.00	-27.54	Pass
2	3841.9	22.67	9.24	5.47	37.38	Peak Max	H	363	94	74.00	-36.62	Pass
3	5437.93	22.11	10.60	6.05	38.76	Peak Max	H	192	141	74.00	-35.24	Pass
4	8431.19	7.22	14.20	13.64	35.06	Average Max	H	330	132	54.00	-18.94	Pass
5	3841.9	11.05	9.24	5.47	25.76	Average Max	H	363	94	54.00	-28.24	Pass
6	5437.93	9.98	10.60	6.05	26.63	Average Max	H	192	141	54.00	-27.37	Pass

Remarks:

1. Level (dBuV/m) = Raw (dBuV) + Cable loss(dB) + AF (dB/m).
2. AF(dB/m) = Antenna Factor (dB/m) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

Test Standard:	15.209, 15.247, RSS-247	Mode:	11b, 2437MHz
Frequency Range:	1 GHz - 18 GHz	Test Date:	07/02/2024
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Minoush
Remark:	N/A	Test Result:	Pass

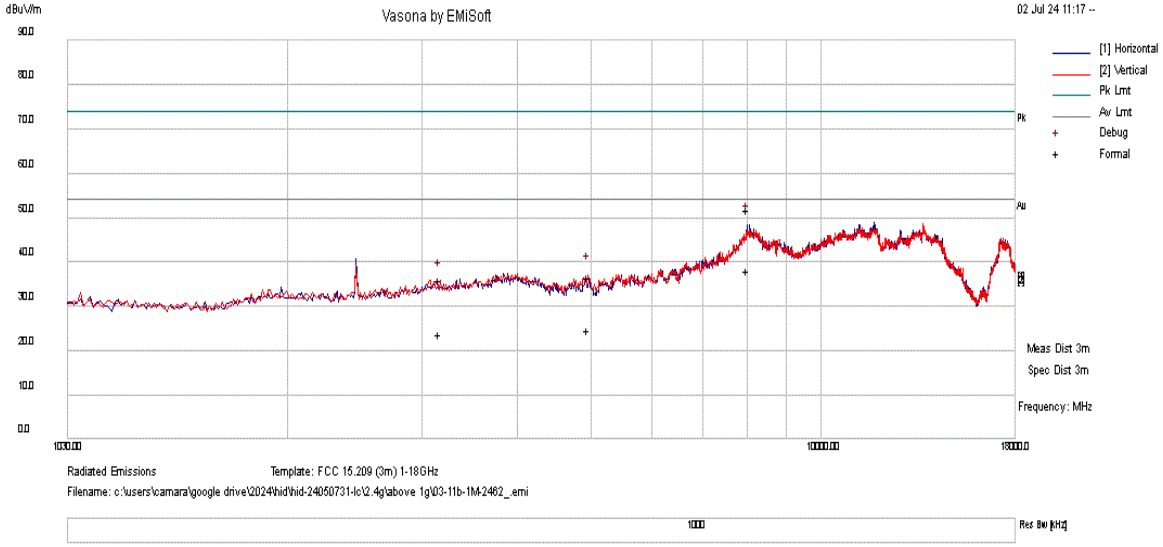


No.	Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	8073.85	18.99	14.24	15.77	49.00	Peak Max	V	152	198	74.00	-25.00	Pass
2	6176.3	21.25	11.83	6.81	39.89	Peak Max	H	217	206	74.00	-34.11	Pass
3	3776.65	23.18	8.94	5.18	37.30	Peak Max	H	241	256	74.00	-36.70	Pass
4	8073.85	7.48	14.24	15.77	37.49	Average Max	V	152	198	54.00	-16.51	Pass
5	6176.3	9.26	11.83	6.81	27.90	Average Max	H	217	206	54.00	-26.10	Pass
6	3776.65	11.70	8.94	5.18	25.82	Average Max	H	241	256	54.00	-28.18	Pass

Remarks:

1. Level (dBuV/m) = Raw (dBuV) + Cable loss(dB) + AF (dB/m).
2. AF(dB/m) = Antenna Factor (dB/m) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

Test Standard:	15.209, 15.247, RSS-247	Mode:	11b, 2462MHz
Frequency Range:	1 GHz - 18 GHz	Test Date:	07/02/2024
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Minoush
Remark:	N/A	Test Result:	Pass

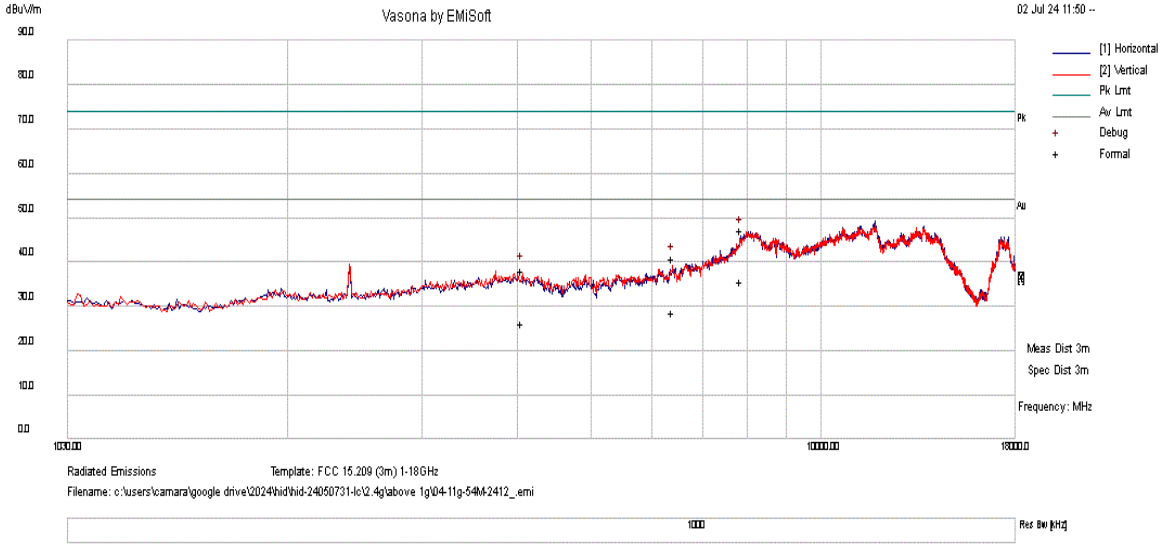


No.	Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	8009.11	21.75	14.27	15.85	51.87	Peak Max	H	392	125	74.00	-22.13	Pass
2	4953.36	21.68	9.44	5.57	36.69	Peak Max	H	247	0	74.00	-37.31	Pass
3	3171.74	24.99	7.85	3.15	35.99	Peak Max	H	206	132	74.00	-38.01	Pass
4	8009.11	7.95	14.27	15.85	38.07	Average Max	H	392	125	54.00	-15.93	Pass
5	4953.36	9.64	9.44	5.57	24.65	Average Max	H	247	0	54.00	-29.35	Pass
6	3171.74	12.91	7.85	3.15	23.91	Average Max	H	206	132	54.00	-30.09	Pass

Remarks:

1. Level (dBuV/m) = Raw (dBuV) + Cable loss(dB) + AF (dB/m).
2. AF(dB/m) = Antenna Factor (dB/m) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

Test Standard:	15.209, 15.247, RSS-247	Mode:	11g, 2412MHz
Frequency Range:	1 GHz - 18 GHz	Test Date:	07/02/2024
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Minoush
Remark:	N/A	Test Result:	Pass

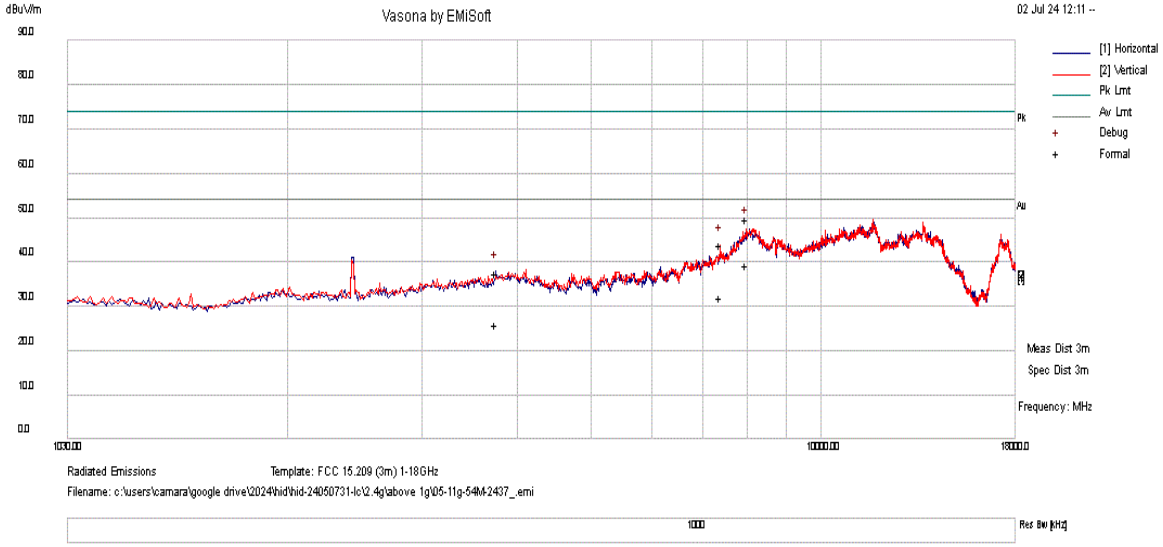


No.	Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	7865.59	19.54	13.97	13.93	47.44	Peak Max	H	219	0	74.00	-26.56	Pass
2	6395.19	21.98	12.09	6.82	40.89	Peak Max	V	245	57	74.00	-33.11	Pass
3	4066.43	23.34	9.86	5.02	38.22	Peak Max	V	176	112	74.00	-35.78	Pass
4	7865.59	7.80	13.97	13.93	35.70	Average Max	H	219	0	54.00	-18.30	Pass
5	6395.19	9.76	12.09	6.82	28.67	Average Max	V	245	57	54.00	-25.33	Pass
6	4066.43	11.51	9.86	5.02	26.39	Average Max	V	176	112	54.00	-27.61	Pass

Remarks:

1. Level (dBuV/m) = Raw (dBuV) + Cable loss(dB) + AF (dB/m).
2. AF(dB/m) = Antenna Factor (dB/m) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

Test Standard:	15.209, 15.247, RSS-247	Mode:	11g, 2437MHz
Frequency Range:	1 GHz - 18 GHz	Test Date:	07/02/2024
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Minoush
Remark:	N/A	Test Result:	Pass

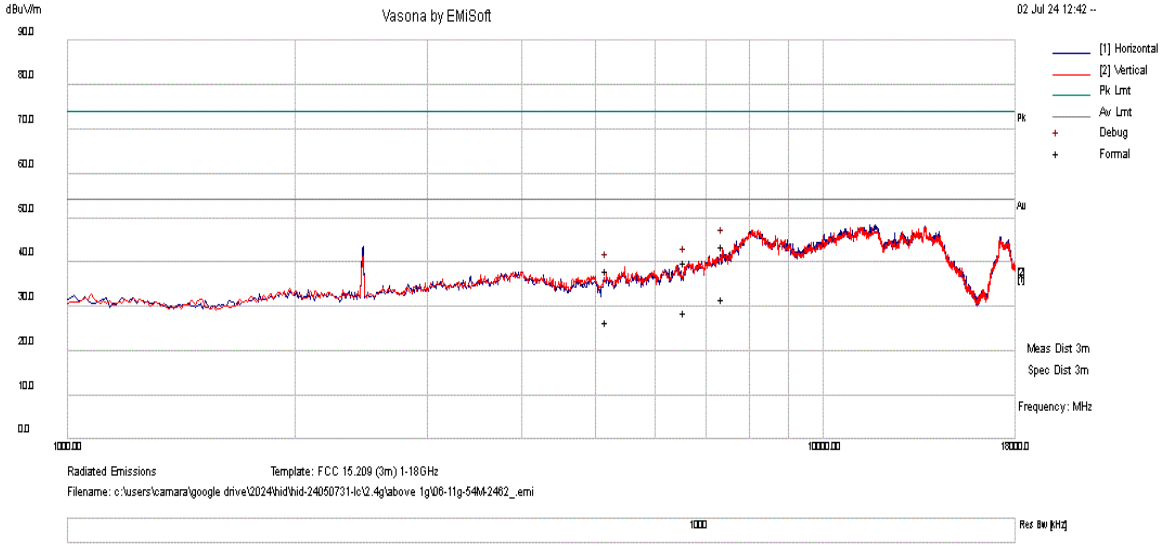


No.	Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	7989.2	19.82	14.25	15.70	49.77	Peak Max	V	358	0	74.00	-24.23	Pass
2	7392.68	20.99	13.06	9.91	43.96	Peak Max	H	140	253	74.00	-30.04	Pass
3	3757.57	23.68	8.84	5.05	37.57	Peak Max	H	228	260	74.00	-36.43	Pass
4	7989.2	9.36	14.25	15.70	39.31	Average Max	V	358	0	54.00	-14.69	Pass
5	7392.68	9.03	13.06	9.91	32.00	Average Max	H	140	253	54.00	-22.00	Pass
6	3757.57	12.04	8.84	5.05	25.93	Average Max	H	228	260	54.00	-28.07	Pass

Remarks:

1. Level (dBuV/m) = Raw (dBuV) + Cable loss(dB) + AF (dB/m).
2. AF(dB/m) = Antenna Factor (dB/m) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

Test Standard:	15.209, 15.247, RSS-247	Mode:	11g, 2462MHz
Frequency Range:	1 GHz - 18 GHz	Test Date:	07/02/2024
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Minoush
Remark:	N/A	Test Result:	Pass

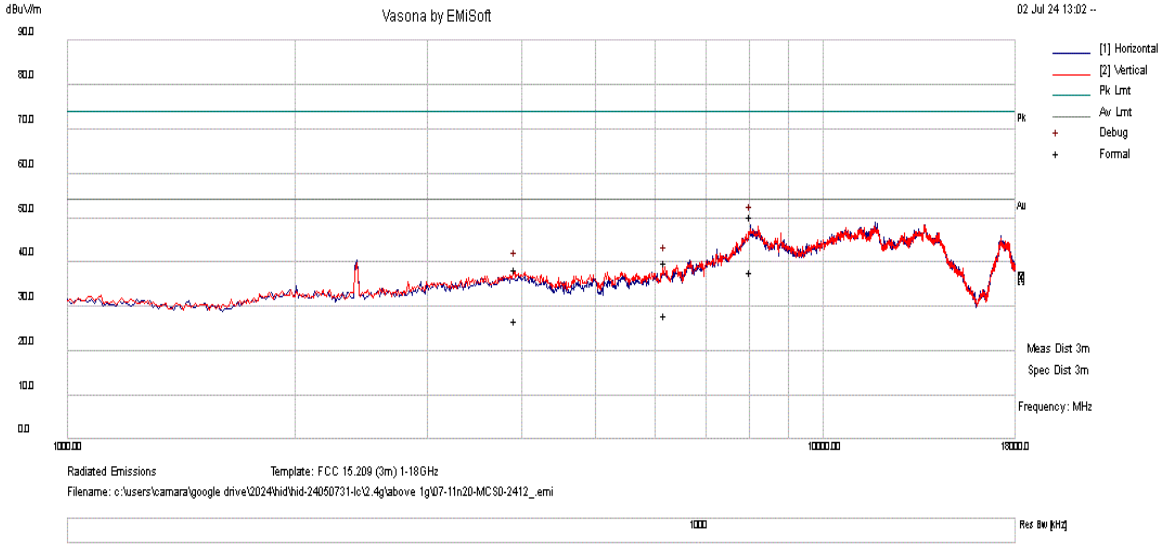


No.	Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	7375.0	20.88	13.02	9.87	43.77	Peak Max	V	366	327	74.00	-30.23	Pass
2	6564.98	20.36	12.20	7.47	40.03	Peak Max	H	232	0	74.00	-33.97	Pass
3	5174.63	22.20	9.87	5.98	38.05	Peak Max	V	259	0	74.00	-35.95	Pass
4	7375.0	8.95	13.02	9.87	31.84	Average Max	V	366	327	54.00	-22.16	Pass
5	6564.98	8.92	12.20	7.47	28.59	Average Max	H	232	0	54.00	-25.41	Pass
6	5174.63	10.58	9.87	5.98	26.43	Average Max	V	259	0	54.00	-27.57	Pass

Remarks:

1. Level (dBuV/m) = Raw (dBuV) + Cable loss(dB) + AF (dB/m).
2. AF(dB/m) = Antenna Factor (dB/m) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

Test Standard:	15.209, 15.247, RSS-247	Mode:	11n, 2412MHz
Frequency Range:	1 GHz - 18 GHz	Test Date:	07/02/2024
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Minoush
Remark:	N/A	Test Result:	Pass

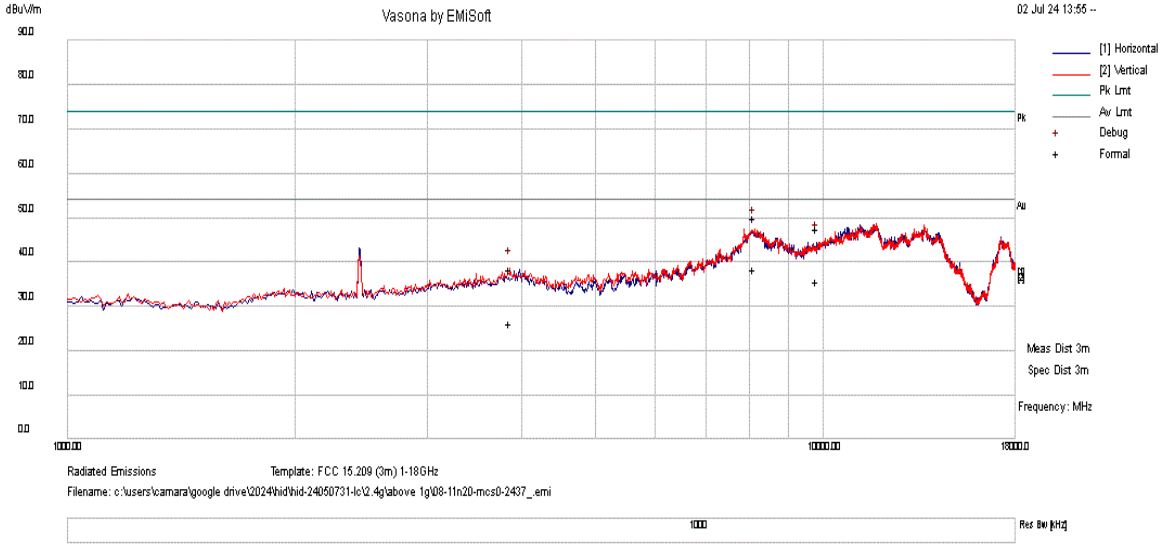


No.	Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	8023.66	20.38	14.26	15.84	50.48	Peak Max	H	397	258	74.00	-23.52	Pass
2	6182.29	21.19	11.83	6.81	39.83	Peak Max	V	372	0	74.00	-34.17	Pass
3	3921.01	23.50	9.60	5.48	38.58	Peak Max	V	306	359	74.00	-35.42	Pass
4	8023.66	7.89	14.26	15.84	37.99	Average Max	H	397	258	54.00	-16.01	Pass
5	6182.29	9.46	11.83	6.81	28.10	Average Max	V	372	0	54.00	-25.90	Pass
6	3921.01	11.69	9.60	5.48	26.77	Average Max	V	306	359	54.00	-27.23	Pass

Remarks:

1. Level (dBuV/m) = Raw (dBuV) + Cable loss(dB) + AF (dB/m).
2. AF(dB/m) = Antenna Factor (dB/m) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

Test Standard:	15.209, 15.247, RSS-247	Mode:	11n, 2437MHz _
Frequency Range:	1 GHz - 18 GHz	Test Date:	07/02/2024
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Minoush
Remark:	N/A	Test Result:	Pass

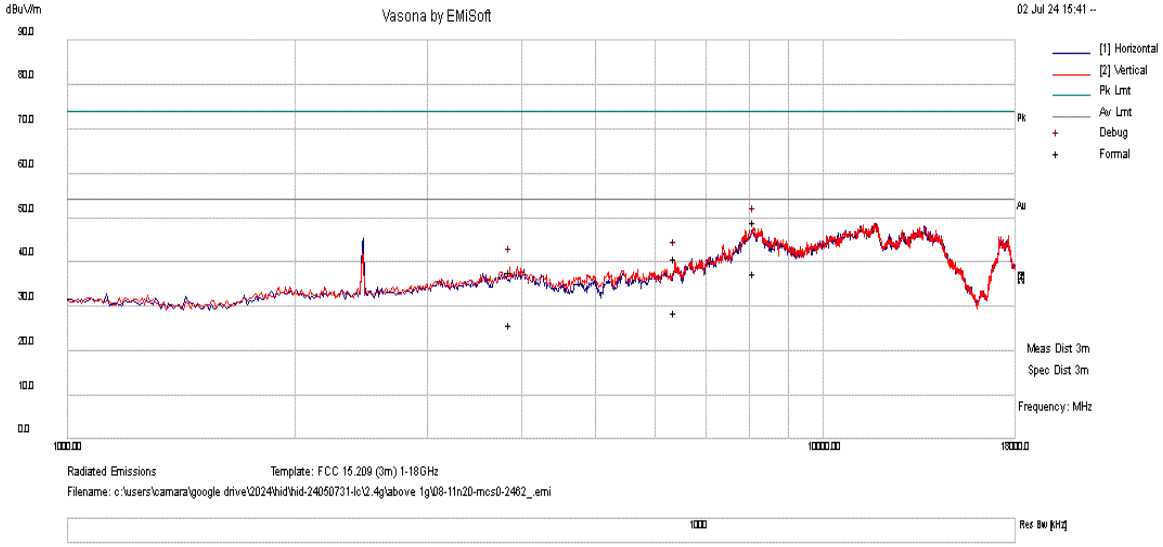


No.	Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	8118.9	20.02	14.22	15.69	49.93	Peak Max	V	250	88	74.00	-24.07	Pass
2	9829.69	18.81	16.35	12.46	47.62	Peak Max	H	271	92	74.00	-26.38	Pass
3	3856.1	23.72	9.31	5.50	38.53	Peak Max	V	295	8	74.00	-35.47	Pass
4	8118.9	8.58	14.22	15.69	38.49	Average Max	V	250	88	54.00	-15.51	Pass
5	9829.69	6.80	16.35	12.46	35.61	Average Max	H	271	92	54.00	-18.39	Pass
6	3856.1	11.37	9.31	5.50	26.18	Average Max	V	295	8	54.00	-27.82	Pass

Remarks:

1. Level (dBuV/m) = Raw (dBuV) + Cable loss(dB) + AF (dB/m).
2. AF(dB/m) = Antenna Factor (dB/m) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

Test Standard:	15.209, 15.247, RSS-247	Mode:	11n, 2462MHz
Frequency Range:	1 GHz - 18 GHz	Test Date:	07/02/2024
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Minoush
Remark:	N/A	Test Result:	Pass



No.	Frequency MHz	Raw dBuV	Cable Loss	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
1	8109.66	19.19	14.22	15.70	49.11	Peak Max	V	171	0	74.00	-24.89	Pass
2	6376.41	22.04	12.06	6.79	40.89	Peak Max	V	231	20	74.00	-33.11	Pass
3	3858.17	23.05	9.32	5.50	37.87	Peak Max	V	166	198	74.00	-36.13	Pass
4	8109.66	7.49	14.22	15.70	37.41	Average Max	V	171	0	54.00	-16.59	Pass
5	6376.41	9.70	12.06	6.79	28.55	Average Max	V	231	20	54.00	-25.45	Pass
6	3858.17	11.25	9.32	5.50	26.07	Average Max	V	166	198	54.00	-27.93	Pass

Remarks:

1. Level (dBuV/m) = Raw (dBuV) + Cable loss(dB) + AF (dB/m).
2. AF(dB/m) = Antenna Factor (dB/m) - Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

Radiated Emission between 18GHz – 40GHz test result

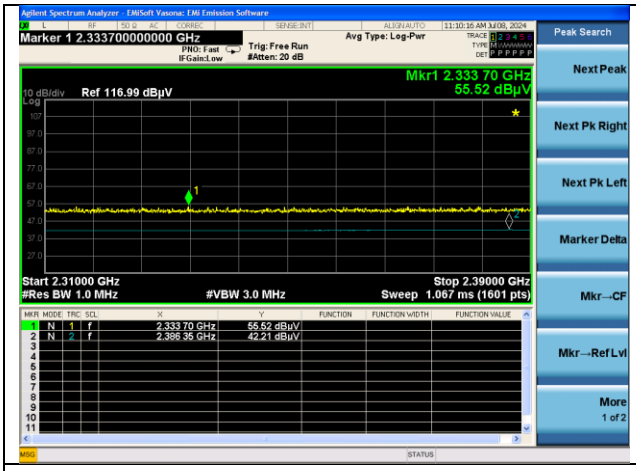
Note: no substantial emission close to limits. Different modes have been verified.

Restricted Band Measurement Result

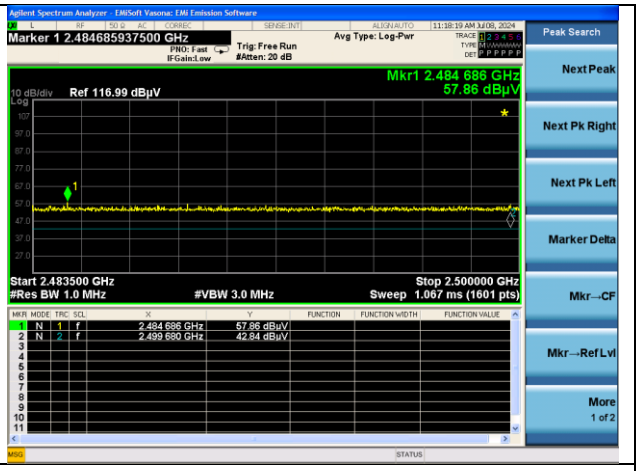
Test result:

Mode	Frequency MHz	Level (dBuV/m)	Measurement Type	Limit (dBuV/m)	Margin (dB)	Pass/Fail
802.11b	2333.70	55.52	Peak Max	74	-18.48	Pass
	2484.686	57.86	Peak Max	74	-16.14	Pass
	2386.35	42.21	Average Max	54	-11.79	Pass
	2499.680	42.84	Average Max	54	-11.16	Pass
802.11g	2389.70	59.37	Peak Max	74	-14.63	Pass
	2483.541	64.20	Peak Max	74	-9.8	Pass
	2390.00	43.71	Average Max	54	-10.29	Pass
	2499.680	43.28	Average Max	54	-10.72	Pass
802.11n	2387.35	56.91	Peak Max	74	-17.09	Pass
	2484.201	69.41	Peak Max	74	-4.59	Pass
	2389.95	44.04	Average Max	54	-9.96	Pass
	2483.510	52.25	Average Max	54	-1.75	Pass

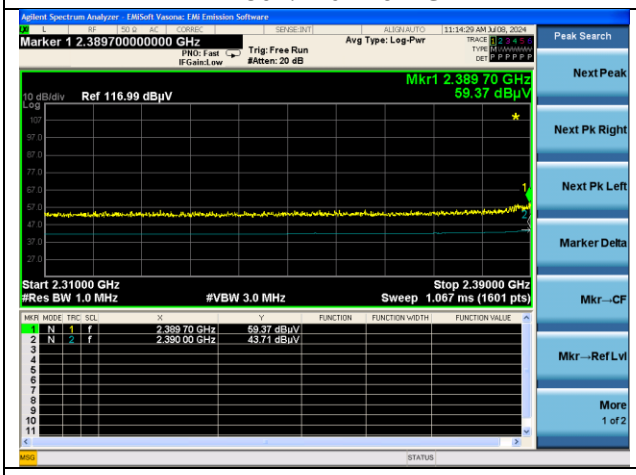
Test Plots



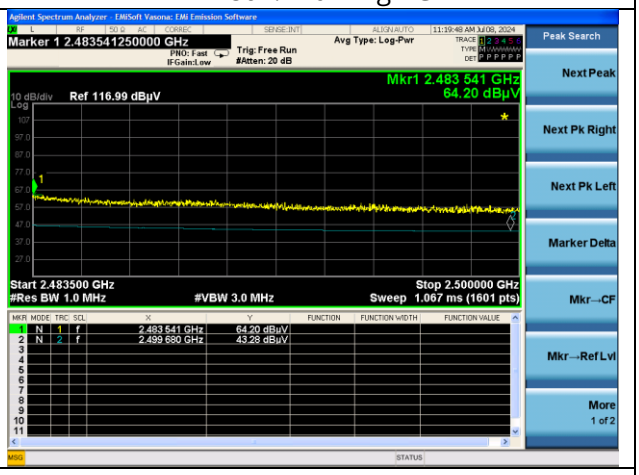
RB– 802.11b - Low CH



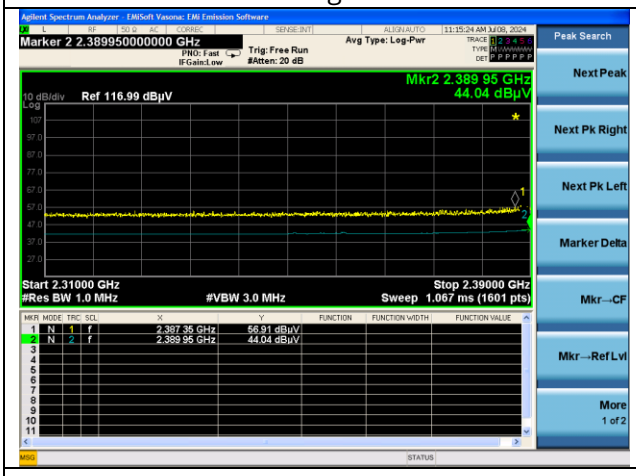
RB– 802.11b - High CH



RB– 802.11g - Low CH



RB– 802.11g - High CH



RB– 802.11n20 - Low CH

RB– 802.11n20 - High CH

7.8 Conducted Emissions

7.8.1 Requirement

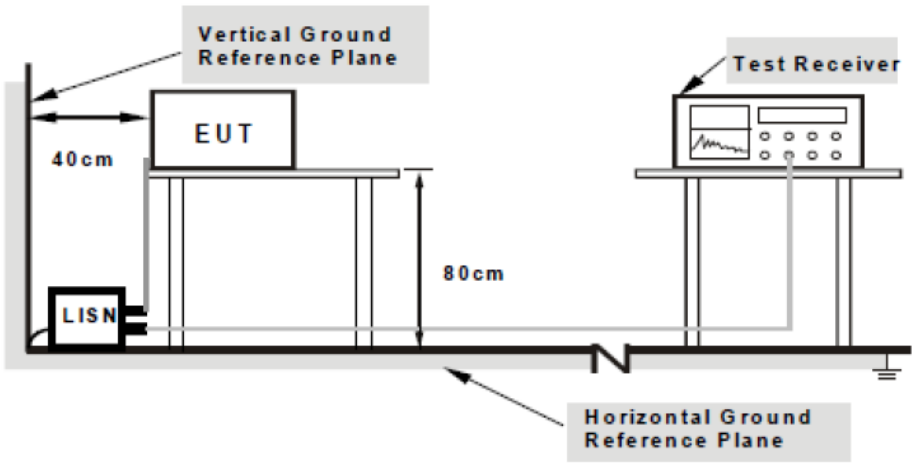
Per § 15.207 (a), RSS Gen 8.8

An intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Limits for Conducted Emissions at the Mains Ports

Section	Frequency ranges (MHz)	Limit (dBuV)	
		QP	Average
Class B devices	0.15 – 0.5	66 – 56	56 – 46
	0.5 – 5	56	46
	5 - 30	60	50
NOTE 1 The lower limit shall apply at the transition frequencies.			

7.8.2 Test setup



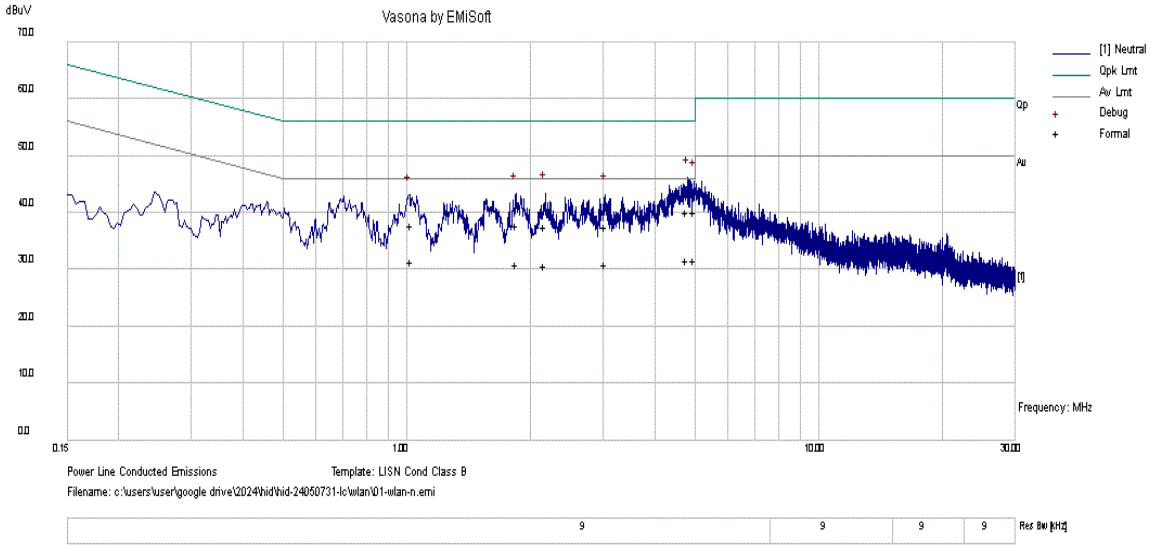
Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80cm from EUT and at least 80cm from other units and other metal planes support units.

7.8.3 Test Procedure

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.
2. The power supply for the EUT was fed through a 50Ω/50μH EUT LISN, connected to filtered mains.
3. The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable. The LISN bonded to the reference ground plane used has a direct current (dc) resistance of less than 2.5 mΩ.
4. All other supporting equipment was powered separately from another main supply.
5. The EUT was switched on and allowed to warm up to its normal operating condition.
6. A scan was made on the Live / Neutral line (for AC mains) or Earth line (for DC power) over the required frequency range using an EMI test receiver.
7. High peaks, relative to the limit line, were then selected.
8. The EMI test receiver was then tuned to the selected frequencies and the necessary measurements made with a receiver bandwidth setting of 10 kHz. For FCC tests, only Quasi-peak measurements were made; while for CISPR/EN tests, both Quasi-peak and Average measurements were made
9. All possible modes of operation were investigated. Only the worst case emissions were measured and reported. All other emissions were relatively insignificant.

7.8.4 Test Result

Test Standard:	Part 15.207, RSS Gen	Mode:	WLAN
Frequency Range:	0.15-30MHz	Test Date:	07/01/2024
Line:	Neutral	Test Personnel:	Lining
Remark:	120VAC, 60Hz	Test Result:	Pass

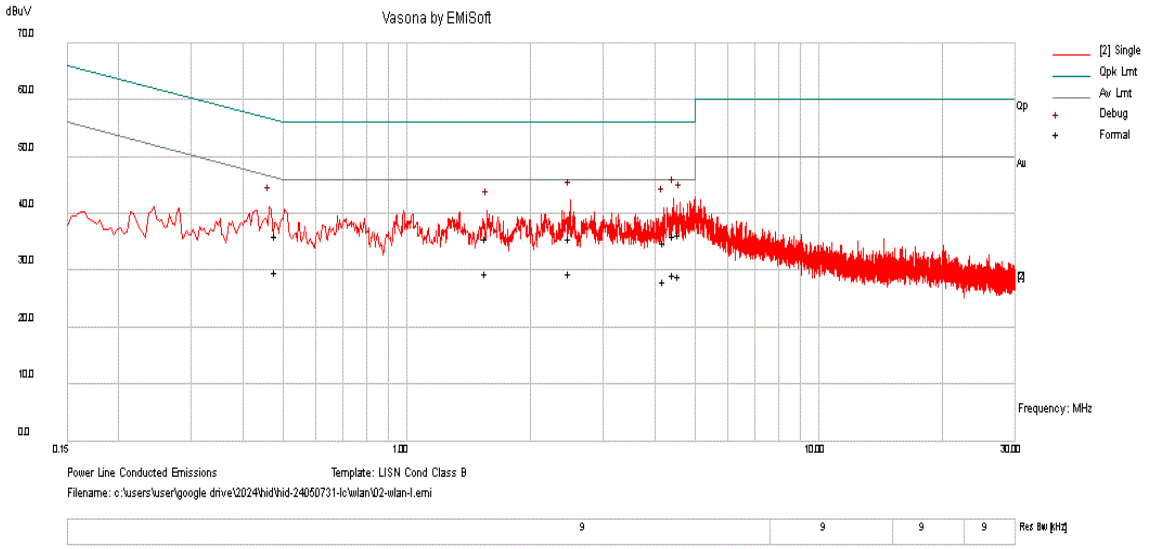


No.	Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Meas. Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail
1	4.8	29.52	10.38	0.15	40.05	Quasi Peak	Neutral	56.00	-15.95	Pass
2	4.98	29.66	10.39	0.14	40.19	Quasi Peak	Neutral	56.00	-15.81	Pass
3	2.17	27.12	10.23	0.10	37.45	Quasi Peak	Neutral	56.00	-18.55	Pass
4	1.85	27.36	10.21	0.10	37.67	Quasi Peak	Neutral	56.00	-18.33	Pass
5	3.03	27.23	10.28	0.12	37.63	Quasi Peak	Neutral	56.00	-18.37	Pass
6	1.03	27.61	10.15	0.10	37.86	Quasi Peak	Neutral	56.00	-18.14	Pass
7	4.8	21.25	10.38	0.15	31.78	Average	Neutral	46.00	-14.22	Pass
8	4.98	21.25	10.39	0.14	31.78	Average	Neutral	46.00	-14.22	Pass
9	2.17	20.49	10.23	0.10	30.82	Average	Neutral	46.00	-15.18	Pass
10	1.85	20.70	10.21	0.10	31.01	Average	Neutral	46.00	-14.99	Pass
11	3.03	20.45	10.28	0.12	30.85	Average	Neutral	46.00	-15.15	Pass
12	1.03	21.16	10.15	0.10	31.41	Average	Neutral	46.00	-14.59	Pass

REMARKS:

1. The emission levels of other frequencies were very low against the limit.
2. Factor = Inert loss of LISN
3. Margin value = Emission level - Limit value
4. Emission Level = Raw Value + Cable loss + Factors Value.

Test Standard:	Part 15.207, RSS Gen	Mode:	WLAN
Frequency Range:	0.15 - 30MHz	Test Date:	07/01/2024
Line:	Live	Test Personnel:	Lining
Remark:	120VAC, 60Hz	Test Result:	Pass



No.	Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Meas. Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail
1	4.45	25.68	10.36	0.14	36.18	Quasi Peak	Live	56.00	-19.82	Pass
2	2.49	25.31	10.25	0.11	35.67	Quasi Peak	Live	56.00	-20.33	Pass
3	4.59	25.81	10.37	0.14	36.32	Quasi Peak	Live	56.00	-19.68	Pass
4	4.2	24.42	10.35	0.14	34.91	Quasi Peak	Live	56.00	-21.09	Pass
5	0.48	25.86	10.11	0.11	36.08	Quasi Peak	Live	56.32	-20.24	Pass
6	1.56	25.40	10.19	0.10	35.69	Quasi Peak	Live	56.00	-20.31	Pass
7	4.45	18.84	10.36	0.14	29.34	Average	Live	46.00	-16.66	Pass
8	2.49	19.11	10.25	0.11	29.47	Average	Live	46.00	-16.53	Pass
9	4.59	18.61	10.37	0.14	29.12	Average	Live	46.00	-16.88	Pass
10	4.2	17.74	10.35	0.14	28.23	Average	Live	46.00	-17.77	Pass
11	0.48	19.60	10.11	0.11	29.82	Average	Live	46.32	-16.50	Pass
12	1.56	19.30	10.19	0.10	29.59	Average	Live	46.00	-16.41	Pass

REMARKS:

1. The emission levels of other frequencies were very low against the limit.
2. Factor = Inert loss of LISN
3. Margin value = Emission level - Limit value
4. Emission Level = Raw Value + Cable loss + Factors Value.

8 EUT and Test Setup Photos

Refer to FCC exhibits

9 Test Instrument List

Eqsuipment	Manufacturer	Model	Instrument Number	Cal. Date	Cal. Due
Semi-Anechoic Chamber	ETS-Lindgren	10M	VL001	10/18/2023	10/18/2024
Shielding Control Room	ETS-Lindgren	Series 81	VL006	N/A1)	N/A1)
Spectrum Analyzer	Keysight	N9020A	MY50110074	05/15/2024	05/15/2025
Spectrum Analyser (9kHz-43GHz)	Anritsu	MS2830A	6201145210	05/16/2024	05/16/2025
EMC Test Receiver	R&S	ESL6	100230	05/14/2024	05/14/2025
LISN (9KHz – 30MHz)	EMCO	3816/2	9705-1066	05/28/2024	05/28/2025
Bi-Log Antenna	ETS-Lindgren	3142E	217921	07/19/2023	07/19/2024
Horn Antenna (1-18GHz)	Electro-Metrics	EM-6961	6292	07/21/2023	07/21/2024
Horn Antenna (18-40GHz)	Com-Power	AH-840	101109	07/21/2023	07/21/2024
Preamplifier	RF Bay, Inc.	LPA-10-20	11180621	07/16/2023	07/16/2024
True RMS Multi-meter	UNI-T	UT181A	C173014829	05/15/2024	05/15/2025
Temp / Humidity / Pressure Meter	PCE Instruments	PCE-THB 40	R062028	05/17/2024	05/17/2025
RF Attenuator	Pasternack	PE7005-3	VL061	N/A2)	N/A2)
EM Center Control	ETS-Lindgren	7006-001	160136	N/A1)	N/A1)
Turn Table	ETS-Lindgren	2181-3.03	VL002	N/A1)	N/A1)
Boresight Antenna Tower	ETS-Lindgren	2171B	VL003	N/A1)	N/A1)
Loop Antenna (9k-30MHz)	Com-Power	AL-130	121012	05/17/2024	05/17/2025
RE test cable (below 6GHz)	Vista	RE-6GHz-01	RE-6GHz-01	07/16/2023	07/16/2024
RE test cable (1-18GHz)	PhaseTrack	II-240	RE-18GHz-01	07/16/2023	07/16/2024
RE test cable (>18GHz)	Sucoflex	104	344903/4	07/16/2023	07/16/2024
Pulse limiter	Com-Power	LIT-930A	531727	07/16/2023	07/16/2024
CE test cable #1	FIRST RF	FRF-C-1002-001	CE-6GHz-01	07/16/2023	07/16/2024
CE test cable#2	FIRST RF	FRF-C-1002-001	CE-6GHz-02	07/16/2023	07/16/2024
Agilent Signal Generator	MXG N5182A	N5182A	US47080548	05/15/2024	05/15/2025
Power Splitter/Combiner	Mini-Circuits	ZFSC-2-9G+	VL052	N/A1)	N/A1)
Power Splitter/Combiner	Mini-Circuits	ZFSC-2-9G+	VL053	N/A1)	N/A1)
Power Splitter/Combiner	Mini-Circuits	ZFSC-2-9G+	VL054	N/A1)	N/A1)
Power Splitter/Combiner	Mini-Circuits	ZFSC-2-9G+	VL055	N/A1)	N/A1)

Note:

1) This equipment is not for measurement purpose and only require functional verification. Calibration is not required.
2) his equipment is part of test system that to be calibrated as a system. It's verified together with the test system prior to testing.

---END---