FCC - TEST REPORT

Report Number	:	**68.710.24.0279.01**	Date of Issue:	2024-09-18
Model	:	**X1000**		
Product Type	:	Robotic Vacuum Cleaner		
Applicant	:	Zhiyi (Zhongshan) Technology Co., Ltd.		
Address	:	No. 39, Donghui Road, Cuiheng New District, 528400 Zhongshan, Guangdong, PEOPLE'S REPUBLIC OF CHINA		
Manufacturer	:	Zhiyi (Zhongshan) Technology Co., Ltd.		
Address	:	No. 39, Donghui Road, Cuiheng New District, 528400 Zhongshan, Guangdong, PEOPLE'S REPUBLIC OF CHINA		
Test Result	:	■ **Positive** ☐ **Negative**		
Total pages including Appendices	:	**48**		

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1 Table of Contents

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2 Details about the Test Laboratory

Details about the Test Laboratory
Test Site 1

Company name:	TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch Building 12 & 13, Zhiheng Wisdomland Business Park, Guankou Erlu, Nantou, Nanshan District, Shenzhen, Guangdong, China
Telephone:	86 755 8828 6998
Fax:	86 755 8828 5299
FCC Registration No.:	514049
FCC Designation Number:	CN5009

3 Description of the Equipment Under Test

Product:	Robotic Vacuum Cleaner
Model no.:	X1000
FCC ID:	2BD8J-X1000
Options and accessories:	ADAPTER: Manufacturer: Dongguan Guanjin Electronics Technology Co., Ltd. Model: K65A320200E2 Input: 100-240V~, 50/60Hz, 1.5A Output: 32.0V⎓, 2.0A, 64.0W Docking Station: Manufacturer: Zhiyi (Zhongshan) Technology Co., Ltd. Model: X1000 Input: 32V⎓, 2000mA
Ratings:	Charging Input: 32V⎓, 2000mA Battery: 25.2V⎓, 4700mAh
RF Transmission Frequency:	2412MHz - 2462MHz for 2.4GHz Wi-Fi
No. of Operated Channel:	11 for 2.4GHz Wi-Fi
Modulation:	802.11b: BPSK, QPSK, CCK 802.11g: BPSK, QPSK, 16-QAM, 64-QAM 802.11n: BPSK, QPSK, 16-QAM, 64-QAM
Antenna Type:	Integrated FPC antenna
Antenna Gain:	1.48 dBi for 2.4GHz Wi-Fi
Description of the EUT:	The EUT is a Robotic Vacuum Cleaner supports 2.4GHz Wi-Fi and 5GHz U-NII bands Wi-Fi functions: 2412MHz - 2462MHz for 2.4GHz Wi-Fi; 5180MHz – 5320MHz, 5500MHz – 5700MHz, 5745MHz – 5825MHz for 5GHz Wi-Fi.
Remark:	This report is only for 2.4GHz Wi-Fi.

NOTE 1: The above EUT's information is declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

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4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2023 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to KDB 558074 D01 15.247 Meas Guidance v05r02 Measurement Guidance and ANSI C63.10-2020.

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5 Summary of Test Results

Technical Requirements						
FCC Part 15 Subpart C						
Test Condition		Test Site	Test Result			Test Environment
			Pass	Fail	N/A	
§15.207	Conducted emission AC power port	Site 1	☒	☐	☐	T: 23.1℃ H: 52.8%
§15.247 (b) (3)	Conducted peak output power	Site 1	☒	☐	☐	T: 22.4℃ H: 53.2%
§15.247(a)(2)	6dB bandwidth	Site 1	☒	☐	☐	T: 23.2℃ H: 51.5%
§15.247(e)	Power spectral density	Site 1	☒	☐	☐	T: 23.2℃ H: 51.5%
§15.247(d)	Spurious RF conducted emissions	Site 1	☒	☐	☐	T: 23.2℃ H: 51.5%
§15.247(d)	Band edge	Site 1	☒	☐	☐	T: 23.2℃ H: 51.5%
§15.247(d) & §15.209 & §15.205	Spurious radiated emissions for transmitter	Site 1	☒	☐	☐	T: 24.7℃ H: 49.3%
§15.203	Antenna requirement	See note 2	☒	☐	☐	--

Note 1: N/A=Not Applicable.
Note 2: The EUT uses an Integrated FPC antenna, which gains are 1.48dBi for 2.4GHz WIFI. In accordance with §15.203, it is considered sufficiently to comply with the provisions of this section.
Note 3: T: Temperature, H: Humidity.

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6 General Remarks

The conducted emissions of X1000 were tested with a Docking Station, and the input voltage is 120VAC/60Hz; The RF tests of X1000 were tested with battery operation, the battery voltage is 25.2VDC.

This submittal(s) (test report) is intended for FCC ID: 2BD8J-X1000, complies with Section 15.207, 15.209, 15.205, 15.247 of the FCC Part 15, Subpart C rules.

SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

☐ - **Not** Performed

The Equipment under Test

■ - **Fulfills** the general approval requirements.

☐ - **Does not** fulfill the general approval requirements.

Sample Received Date:	2024-07-30
Testing Start Date:	2024-08-08
Testing End Date:	2024-09-03

- TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch –

Reviewed by:	Prepared by:	Tested by:
Jessie He	Myron Yu	Carry Cai
Project Manager	Project Engineer	Test Engineer

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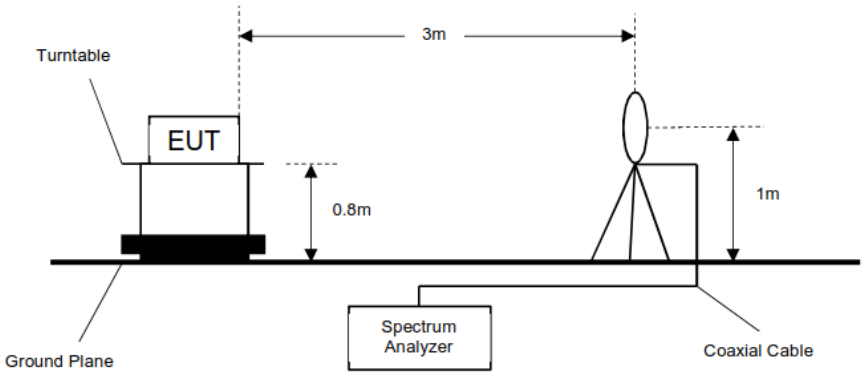
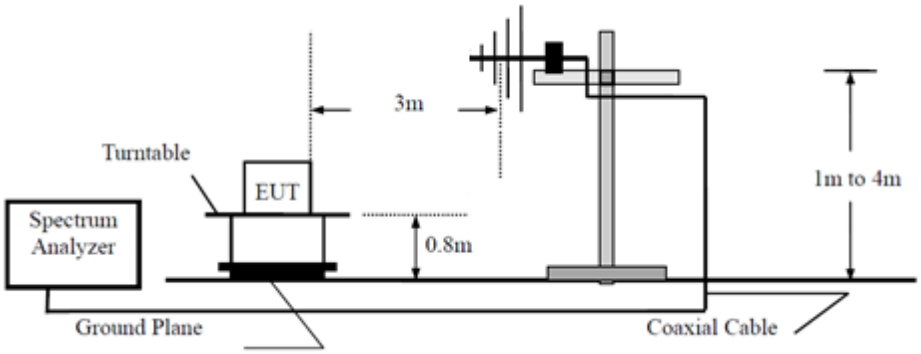
7 Test Setups

7.1 Radiated test setups

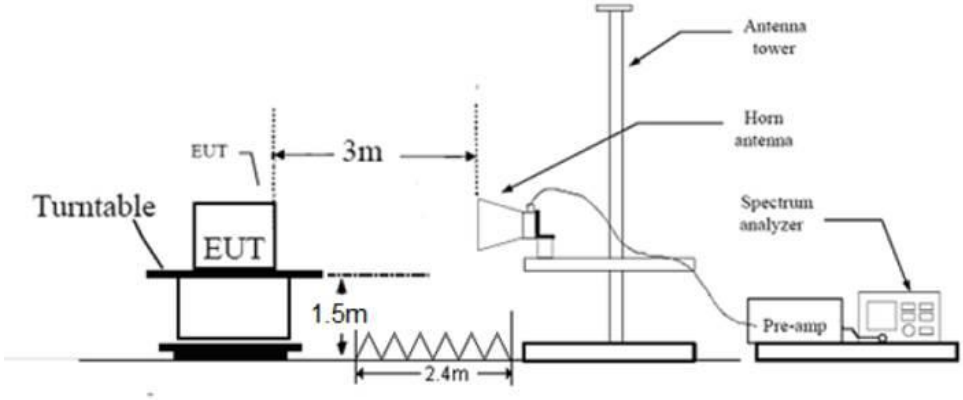
9kHz - 30MHz



Below 1GHz



Above 1GHz



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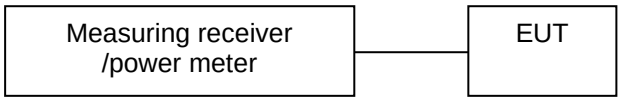
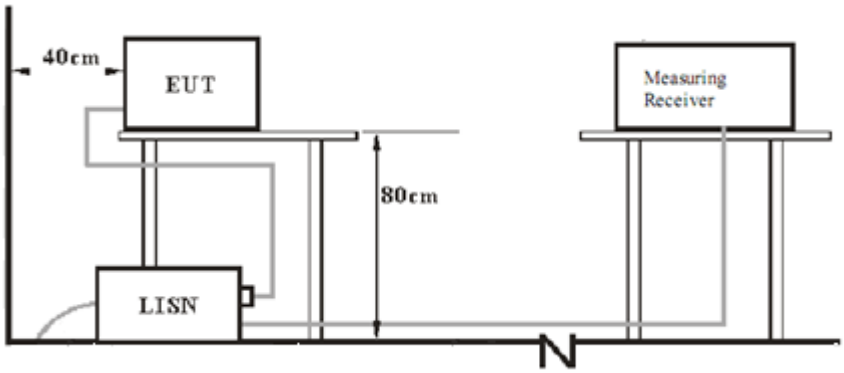
7.2 Conducted RF test setups



7.3 AC Power Line Conducted Emission test setups



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8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MODEL NO.	MANUFACTURER	S/N
Laptop	X220	ThinkPad	EMC-158
ADAPTER	K65A320200E2	Zhiyi (Zhongshan) Technology Co., Ltd.	---
Docking Station	X1000	Dongguan Guanjin Electronics Technology Co., Ltd.	---

Test Software Information:

Test Software Version	Adb tool	
Mode	Setting TX Power	Data Rate
802.11b	Default parameters	11b 1 Mbps
802.11g	Default parameters	11g 6 Mbps
802.11n HT20	Default parameters	MCS0 6.5 Mbps

The system was configured to channel 1, 6, and 11 for 802.11b/802.11g/802.11n-HT20:

Test mode	Channel	Frequency (MHz)
TX	1	2412
TX	6	2437
TX	11	2462

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9 Technical Requirement

9.1 Conducted Emission

Test Method

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. Both sides of AC line were checked for maximum conducted interference.
6. The frequency range from 150 kHz to 30 MHz was searched.
7. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

Limit

According to §15.207, conducted emissions limit as below:

Frequency MHz	QP Limit dBµV	AV Limit dBµV
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

Remark: “*” Decreasing linearly with logarithm of the frequency

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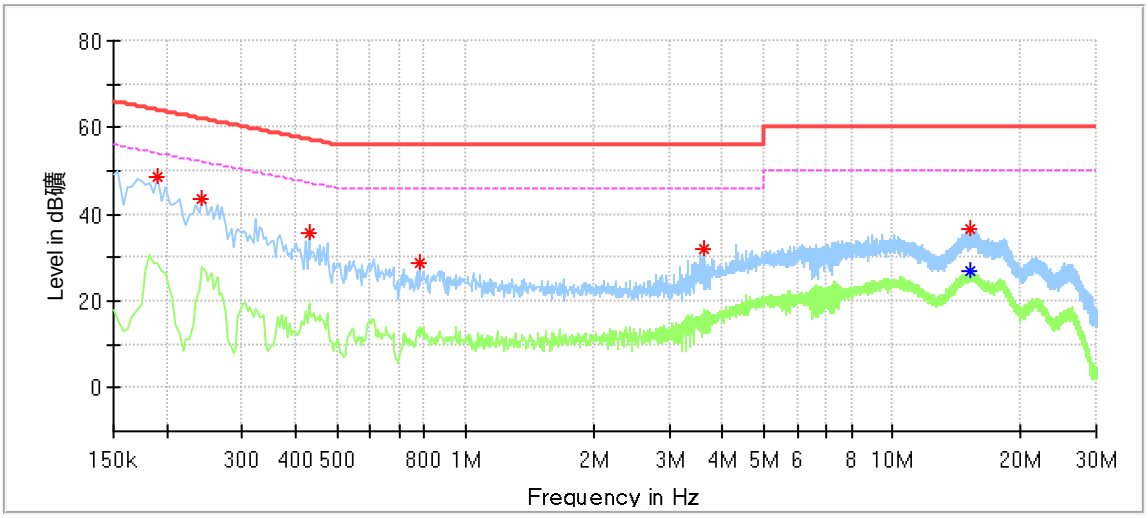
Conducted Emission

Product Type	:	Robotic Vacuum Cleaner
M/N	:	X1000
Operating Condition	:	Charging + WIFI communication mode
Test Specification	:	L
Comment	:	AC 120V/60Hz



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.190000	48.70	---	64.04	15.34	L1	9.67
0.242000	43.55	---	62.03	18.47	L1	9.68
0.430000	35.50	---	57.25	21.75	L1	9.67
0.782000	28.69	---	56.00	27.31	L1	9.69
3.602000	32.06	---	56.00	23.94	L1	9.78
15.210000	36.81	---	60.00	23.19	L1	9.97
15.246000	---	27.03	50.00	22.97	L1	9.97

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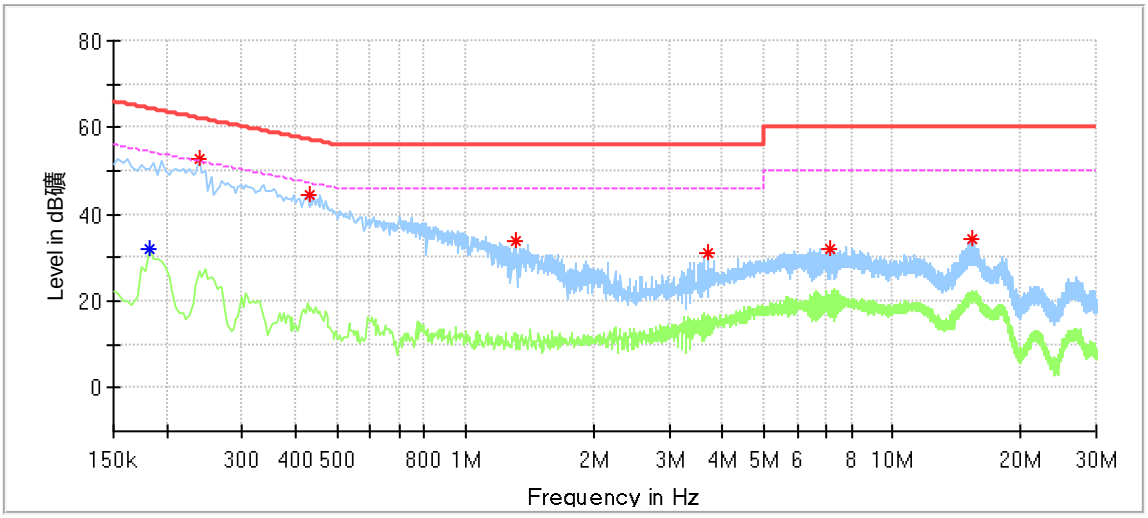
Conducted Emission

Product Type	:	Robotic Vacuum Cleaner
M/N	:	X1000
Operating Condition	:	Charging + WIFI communication mode
Test Specification	:	N
Comment	:	AC 120V/60Hz



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.182000	---	31.93	54.39	22.47	N	9.67
0.238000	52.96	---	62.17	9.20	N	9.67
0.434000	44.51	---	57.18	12.67	N	9.67
1.306000	33.92	---	56.00	22.08	N	9.69
3.686000	31.13	---	56.00	24.87	N	9.75
7.126000	32.09	---	60.00	27.91	N	9.86
15.310000	34.31	---	60.00	25.69	N	9.98

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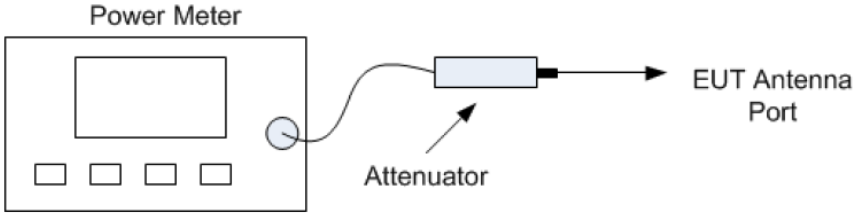
9.2 Conducted Output Power

Test Method

1) The EUT is configured to transmit continuously, or to transmit with a constant duty cycle.
2) At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.
3) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.

4) Measure the peak power of the transmitter. This measurement is a peak over both the ON and OFF periods of the transmitter.



Power meter conducted test setup

Limit

According to §15.247 (b) (3), conducted output power limit as below:

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤1	≤30

Test Results

Mode	TX Type	Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)		Verdict
			Results	Limit	
802.11b	SISO	2412	18.52	<=30	Pass
		2437	18.66	<=30	Pass
		2462	18.90	<=30	Pass
802.11g	SISO	2412	21.96	<=30	Pass
		2437	21.82	<=30	Pass
		2462	22.21	<=30	Pass
802.11n (HT20)	SISO	2412	20.47	<=30	Pass
		2437	20.38	<=30	Pass
		2462	20.74	<=30	Pass

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9.3 6 dB Bandwidth

Test Method for 6 dB Bandwidth

1. The RF output of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
   RBW=1% to 5% of the occupied bandwidth but not less than 100kHz, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Use the automatic bandwidth measurement capability of an instrument, use the X dB bandwidth mode with X set to 6 dB.
5. Allow the trace to stabilize, record the 6 dB Bandwidth value.

Limit

6dB bandwidth Limit [kHz]	99% bandwidth Limit [kHz]
≥500	--

Test result

6dB bandwidth

Mode	TX Type	Frequency (MHz)	6dB Bandwidth (MHz)		Verdict
			Results	Limit	
802.11b	SISO	2412	9.173	>=0.5	Pass
		2437	9.153	>=0.5	Pass
		2462	9.251	>=0.5	Pass
802.11g	SISO	2412	16.068	>=0.5	Pass
		2437	14.450	>=0.5	Pass
		2462	16.087	>=0.5	Pass
802.11n (HT20)	SISO	2412	17.016	>=0.5	Pass
		2437	15.243	>=0.5	Pass
		2462	17.087	>=0.5	Pass

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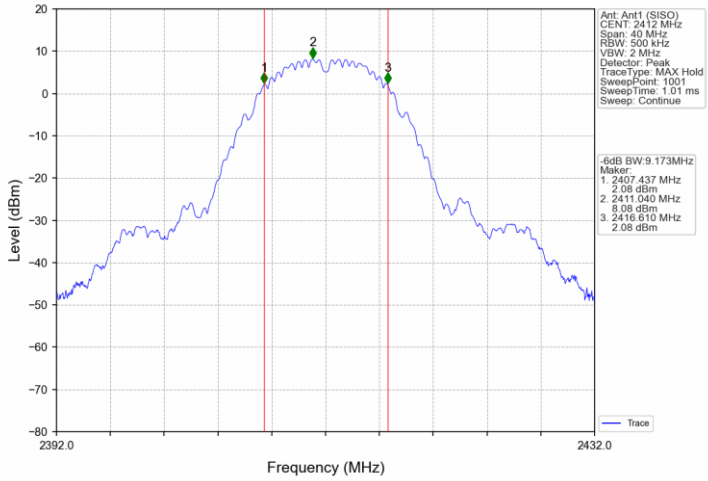
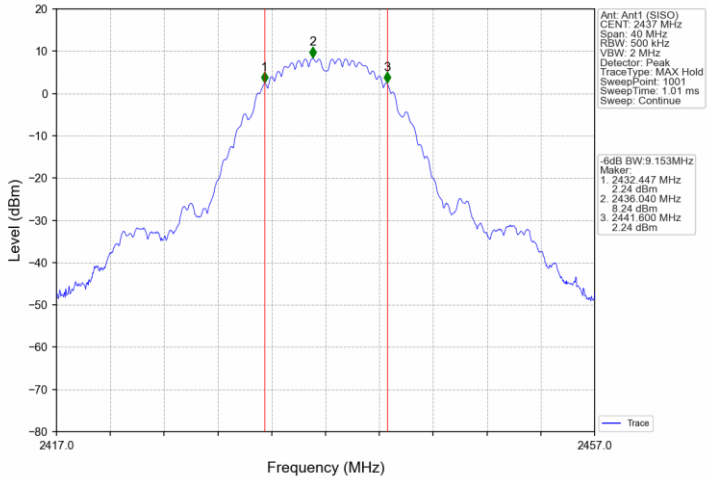
Test Graphs

6dB bandwidth

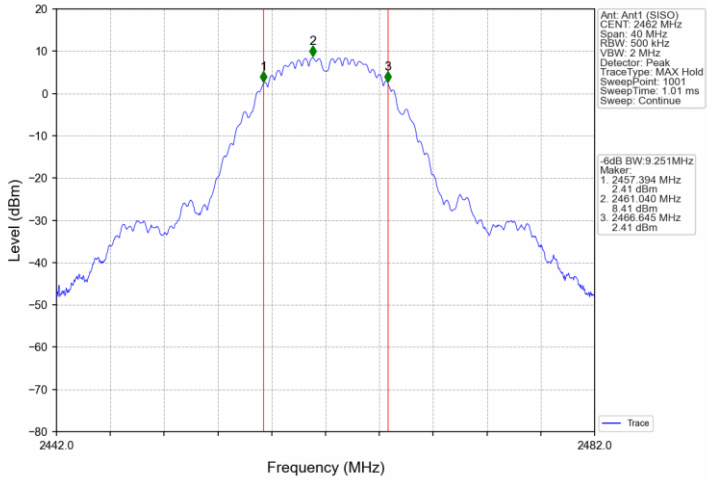
802.11b_LCH_2412MHz_Ant1 (SISO)_NTNV



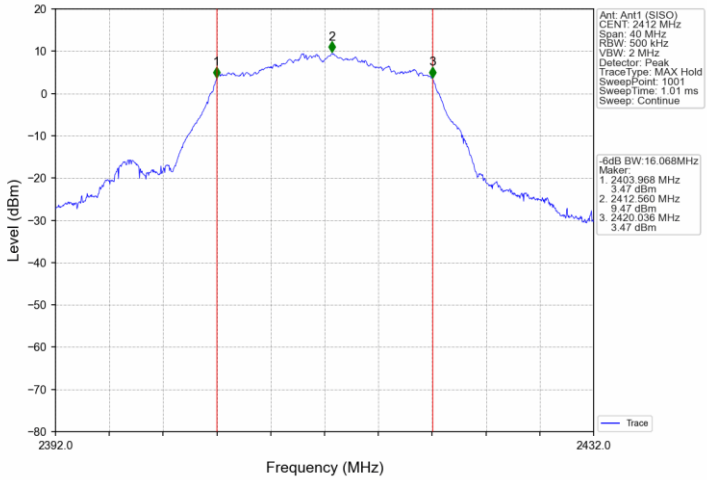
802.11b_MCH_2437MHz_Ant1 (SISO)_NTNV



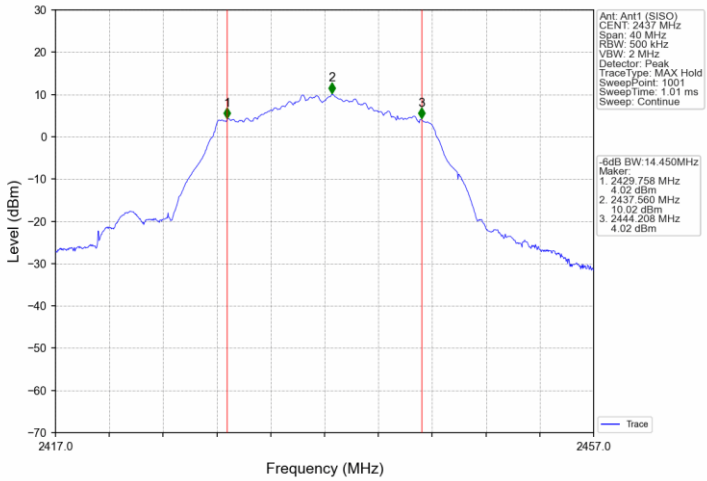
802.11b_HCH_2462MHz_Ant1 (SISO)_NTNV



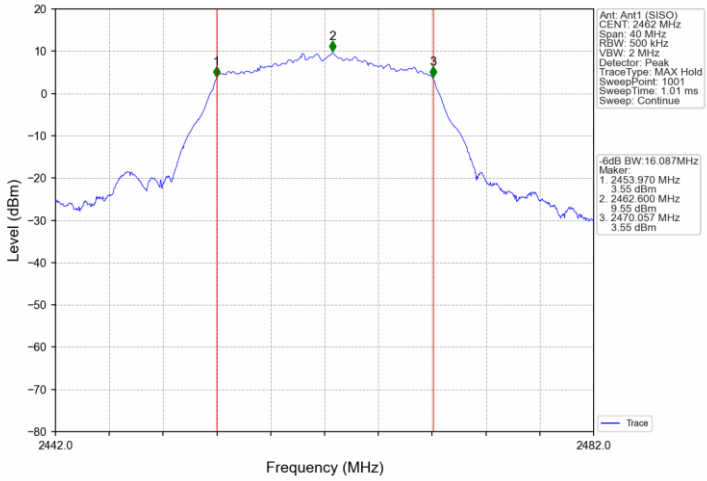
802.11g_LCH_2412MHz_Ant1 (SISO)_NTNV



802.11g_MCH_2437MHz_Ant1 (SISO)_NTNV



802.11g_HCH_2462MHz_Ant1 (SISO)_NTNV



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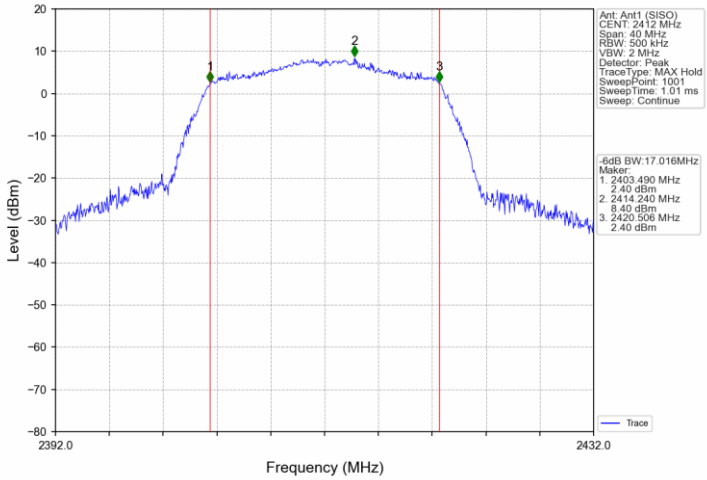
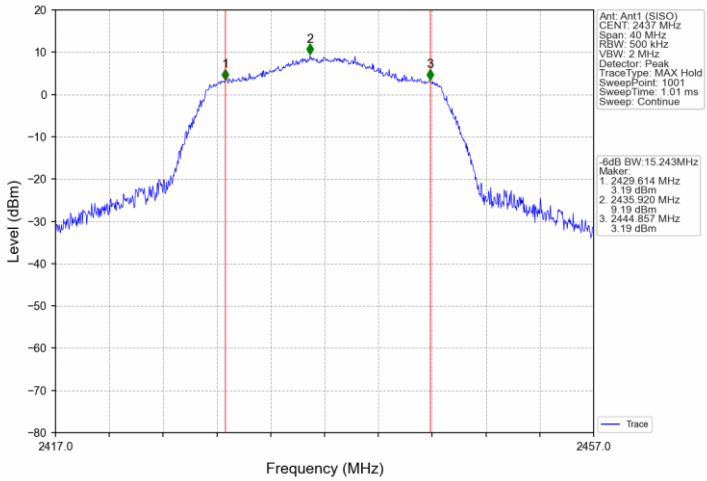
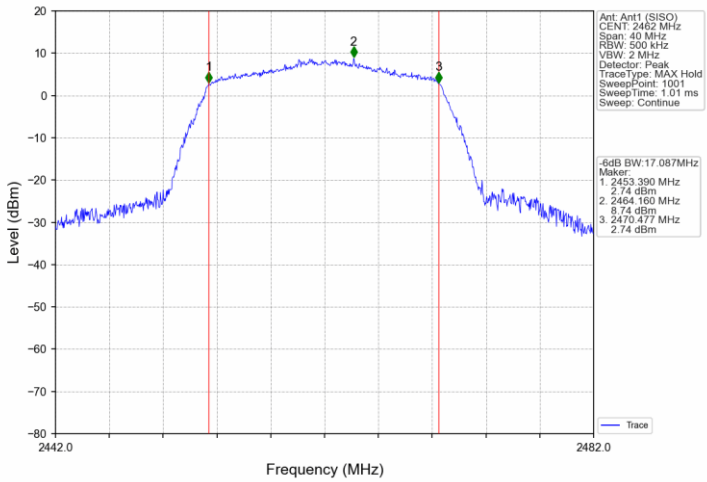
802.11n(HT20)_LCH_2412MHz_Ant1 (SISO)_NTNV



802.11n(HT20)_MCH_2437MHz_Ant1 (SISO)_NTNV



802.11n(HT20)_HCH_2462MHz_Ant1 (SISO)_NTNV



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9.4 Power spectral density

Test Method

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance:

1. The RF output of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
4. Set analyzer center frequency to DTS channel center frequency. RBW=3kHz, VBW≥3RBW, Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
5. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
6. Repeat above procedures until other frequencies measured were completed.

Limit

Limit [dBm/3kHz]
≤ 8

Test Results

Mode	TX Type	Frequency (MHz)	Maximum PSD (dBm/3kHz)		Verdict
			Results	Limit	
802.11b	SISO	2412	-5.98	<=8	Pass
		2437	-5.22	<=8	Pass
		2462	-6.52	<=8	Pass
802.11g	SISO	2412	-9.83	<=8	Pass
		2437	-9.08	<=8	Pass
		2462	-8.75	<=8	Pass
802.11n (HT20)	SISO	2412	-10.80	<=8	Pass
		2437	-10.93	<=8	Pass
		2462	-11.94	<=8	Pass

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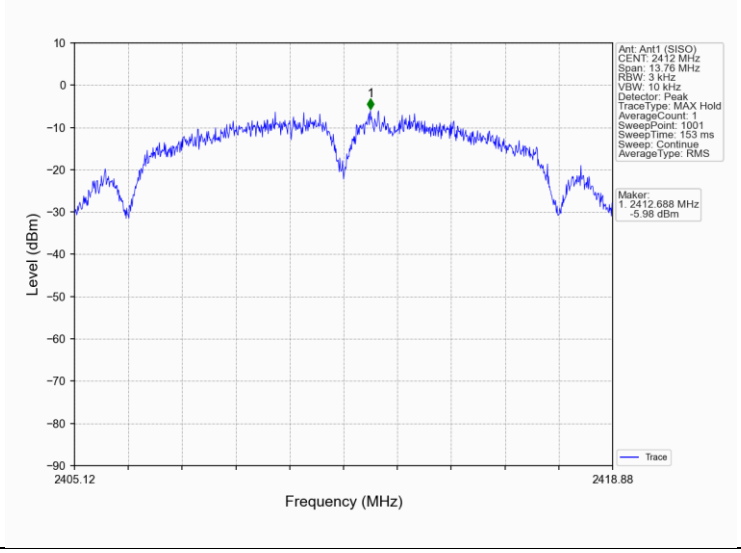
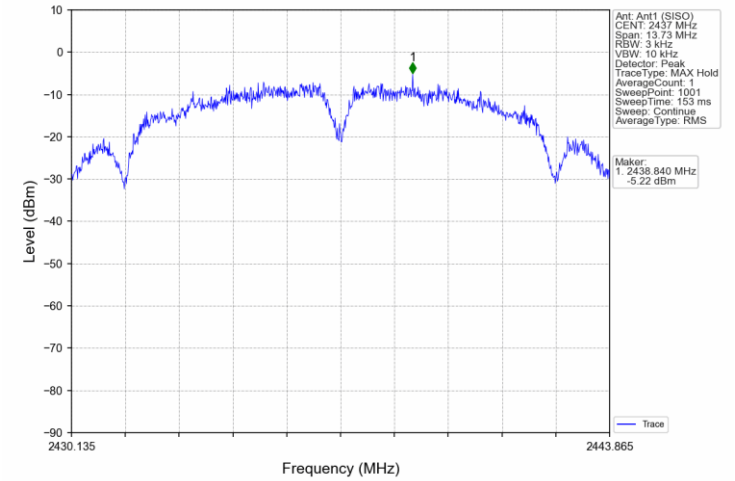
Test Graphs

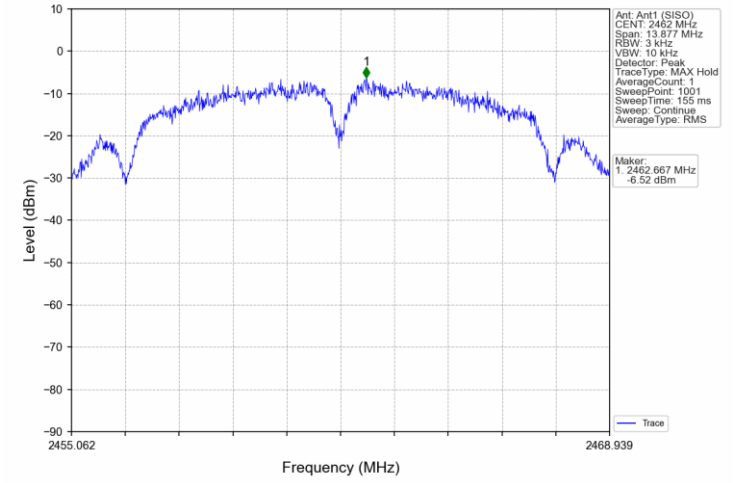
802.11b_LCH_2412MHz_Ant1 (SISO)_NTNV



802.11b_MCH_2437MHz_Ant1 (SISO)_NTNV



802.11b_HCH_2462MHz_Ant1 (SISO)_NTNV



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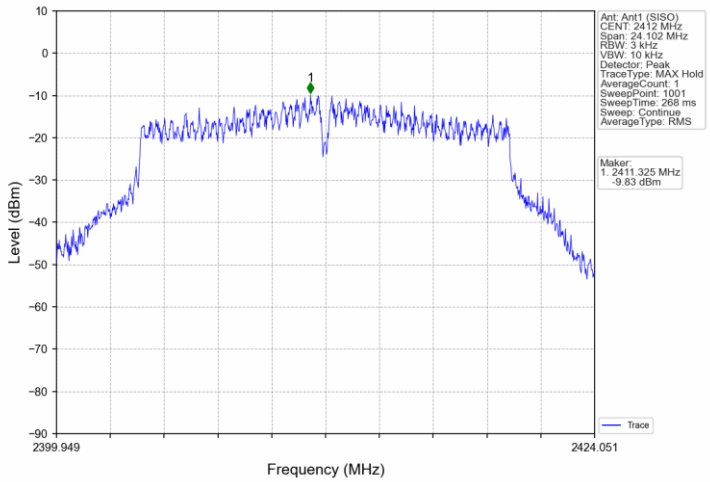
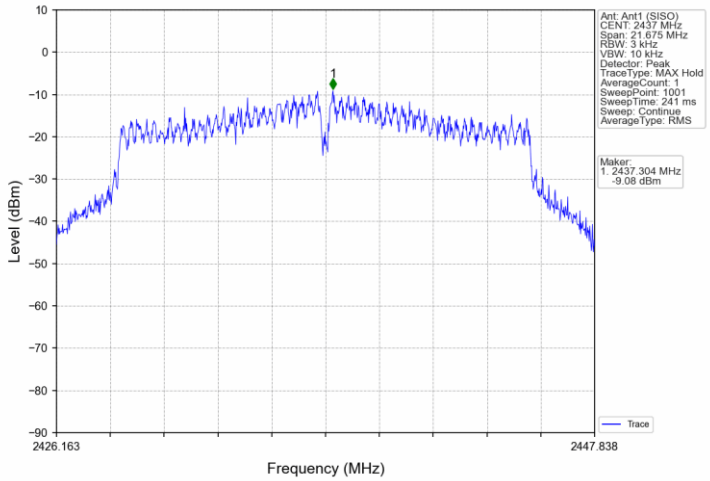
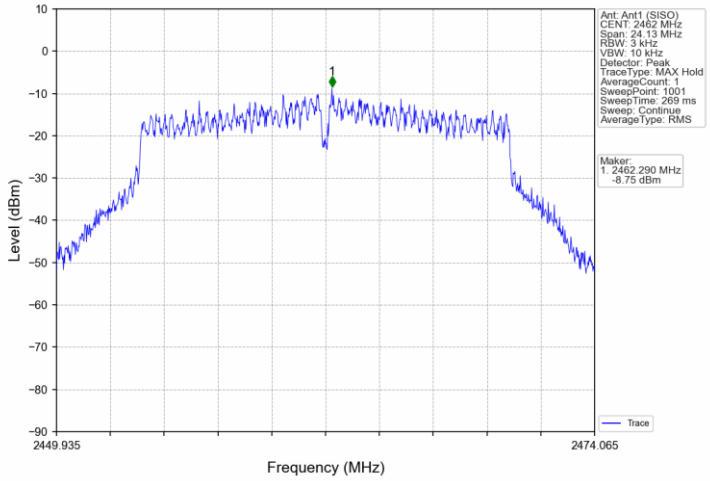
802.11g_LCH_2412MHz_Ant1 (SISO)_NTNV



802.11g_MCH_2437MHz_Ant1 (SISO)_NTNV



802.11g_HCH_2462MHz_Ant1 (SISO)_NTNV



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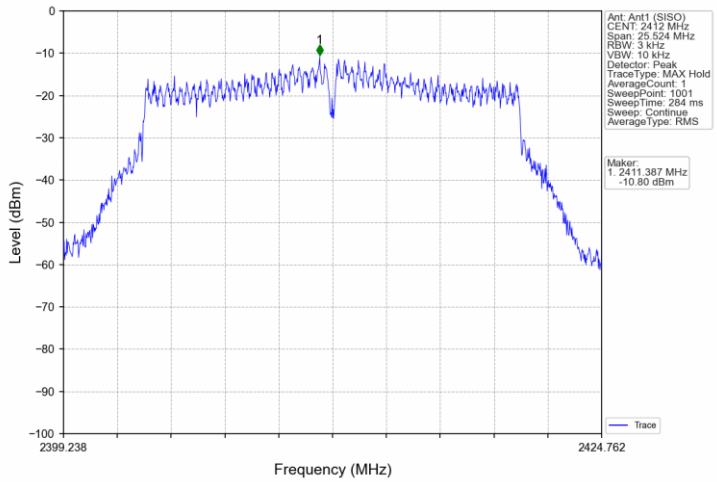
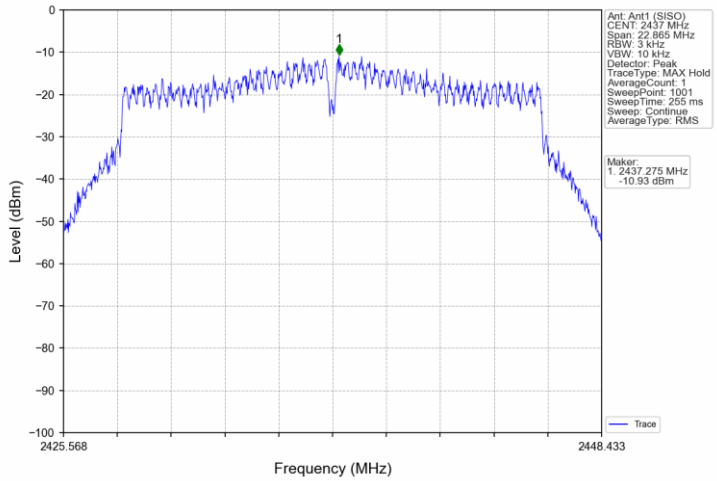
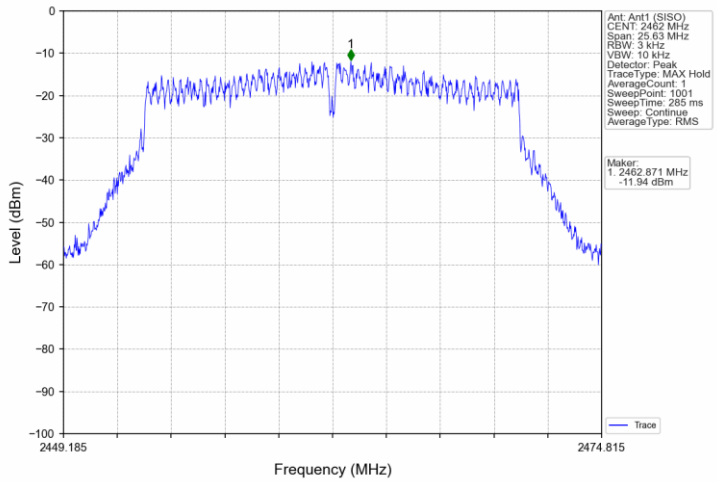
802.11n(HT20)_LCH_2412MHz_Ant1 (SISO)_NTNV



802.11n(HT20)_MCH_2437MHz_Ant1 (SISO)_NTNV



802.11n(HT20)_HCH_2462MHz_Ant1 (SISO)_NTNV



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9.5 Spurious RF conducted emissions

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
   RBW = 100 kHz, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
5. The level displayed must comply with the limit specified in this Section. Submit these plots.
6. Repeat above procedures until all frequencies measured were complete.

Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20

Test Result

Mode	Frequency (MHz)	Level of Reference (dBm)	Limit (dBm)	Verdict
802.11b	2412	7.66	-12.34	Pass
	2437	7.73	-12.27	Pass
	2462	8.07	-11.93	Pass
802.11g	2412	2.42	-17.58	Pass
	2437	2.74	-17.26	Pass
	2462	3.07	-16.93	Pass
802.11n (HT20)	2412	1.18	-18.82	Pass
	2437	1.36	-18.64	Pass
	2462	1.65	-18.35	Pass
Note1: Refer to FCC Part 15.247 (d) and ANSI C63.10-2020, the channel contains the maximum PSD level was used to establish the reference level.				

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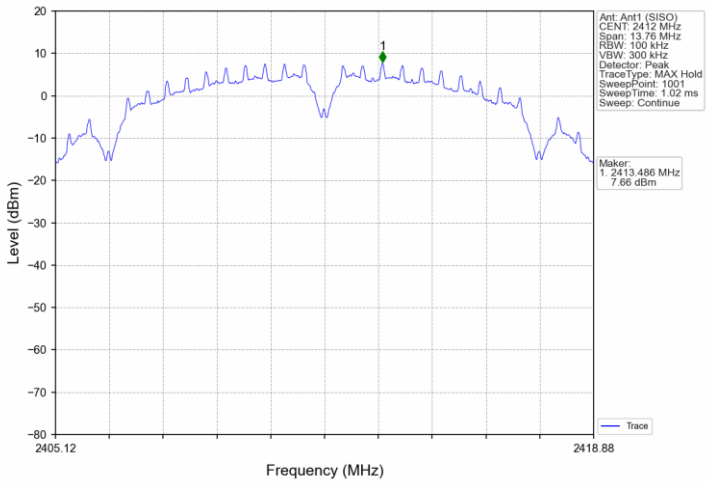
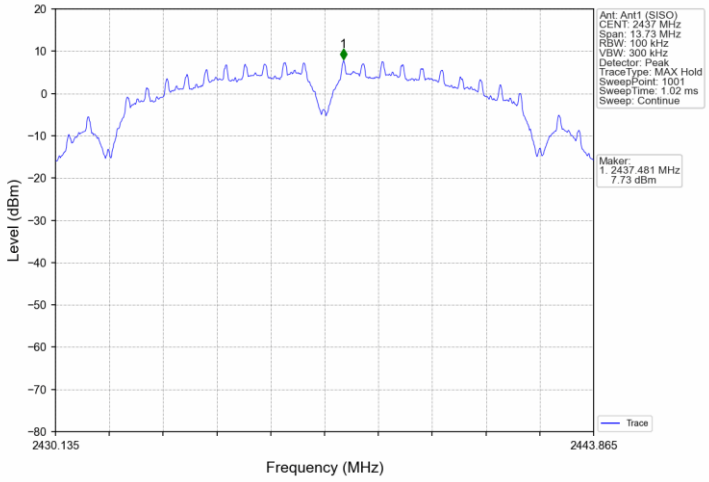
Test Graphs Reference Level

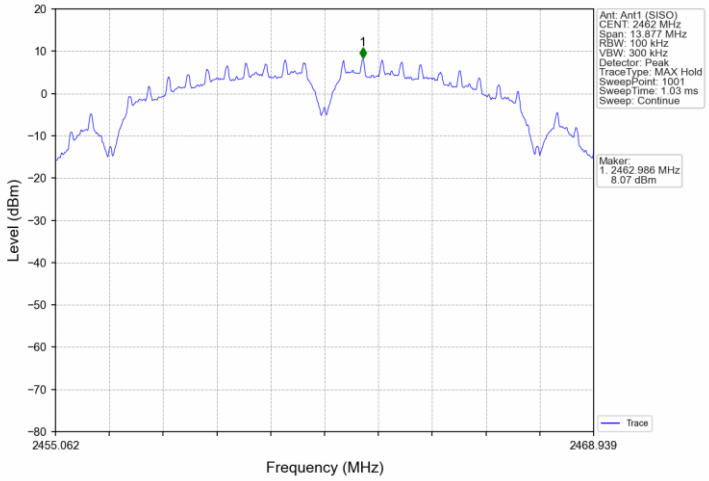
802.11b_LCH_2412MHz_Ant1 (SISO)_NTNV



802.11b_MCH_2437MHz_Ant1 (SISO)_NTNV



802.11b_HCH_2462MHz_Ant1 (SISO)_NTNV



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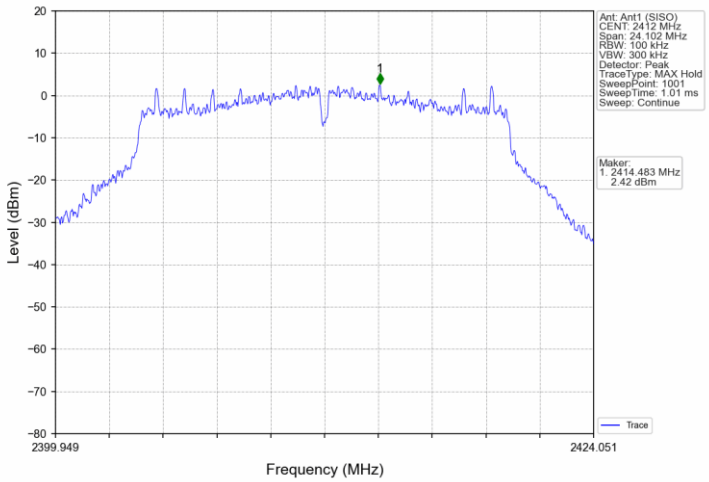
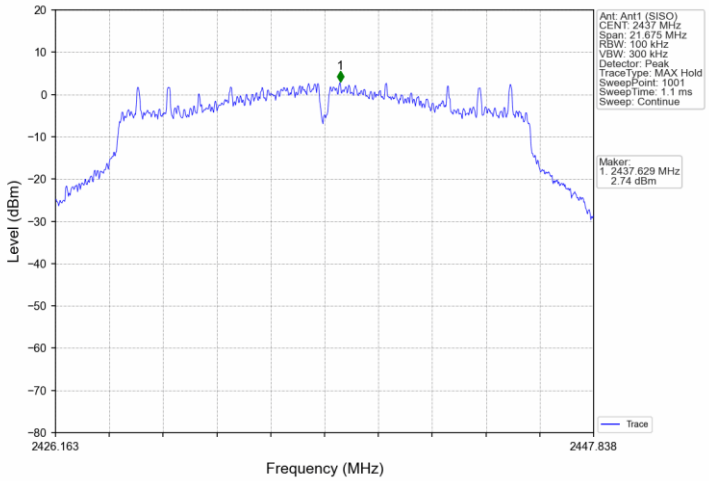
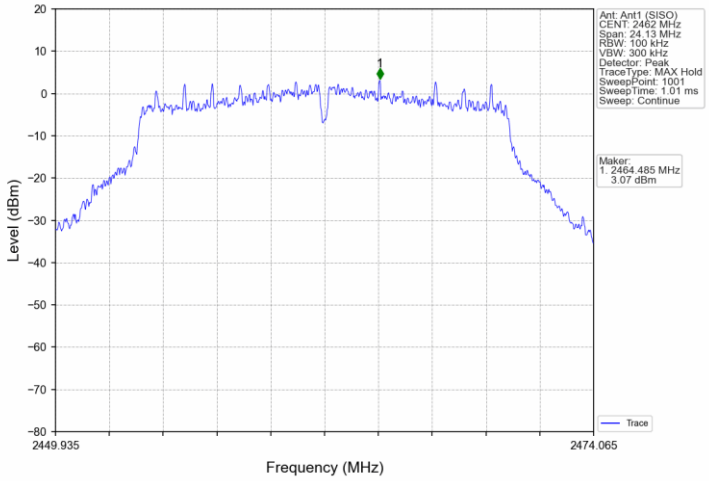
802.11g_LCH_2412MHz_Ant1 (SISO)_NTNV



802.11g_MCH_2437MHz_Ant1 (SISO)_NTNV



802.11g_HCH_2462MHz_Ant1 (SISO)_NTNV



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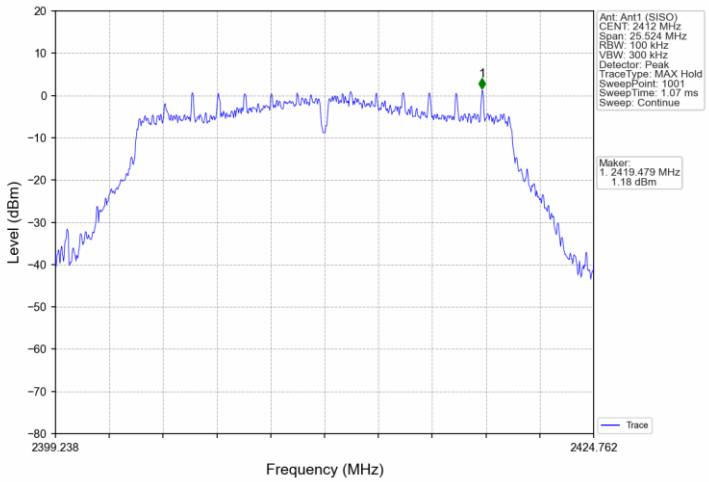
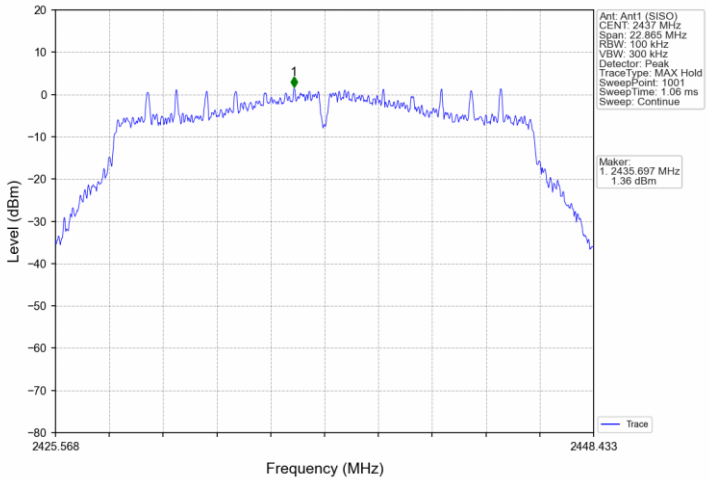
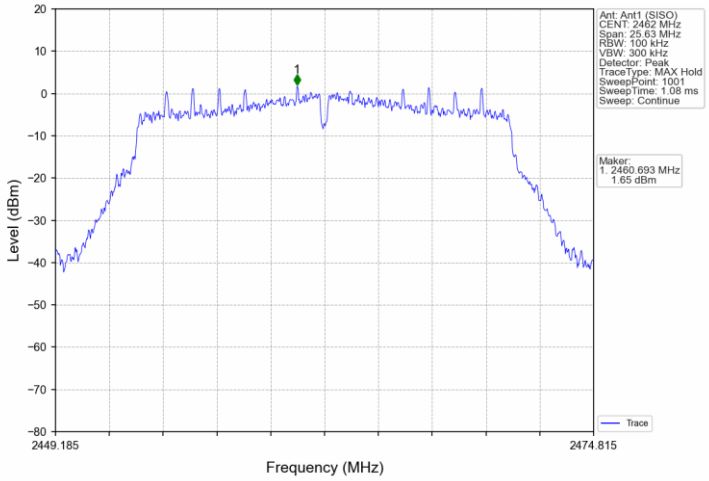
802.11n(HT20)_LCH_2412MHz_Ant1 (SISO)_NTNV



802.11n(HT20)_MCH_2437MHz_Ant1 (SISO)_NTNV



802.11n(HT20)_HCH_2462MHz_Ant1 (SISO)_NTNV



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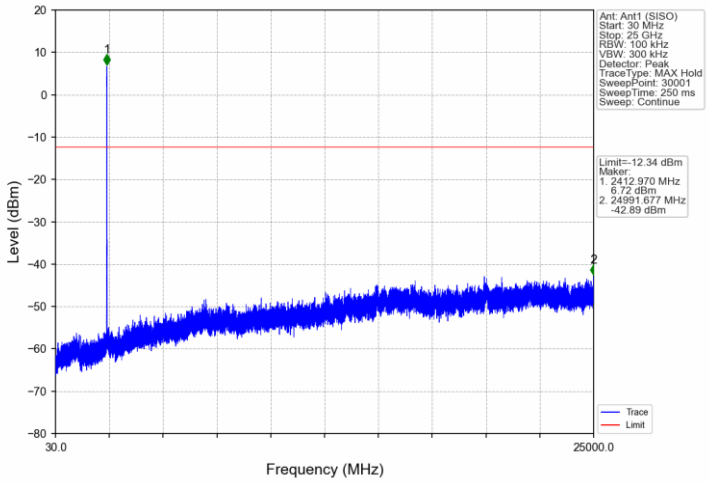
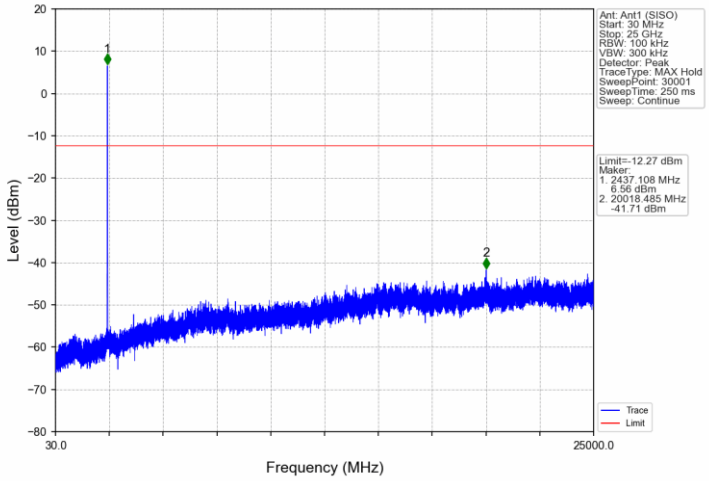
Test Graphs Conducted Spurious Emissions

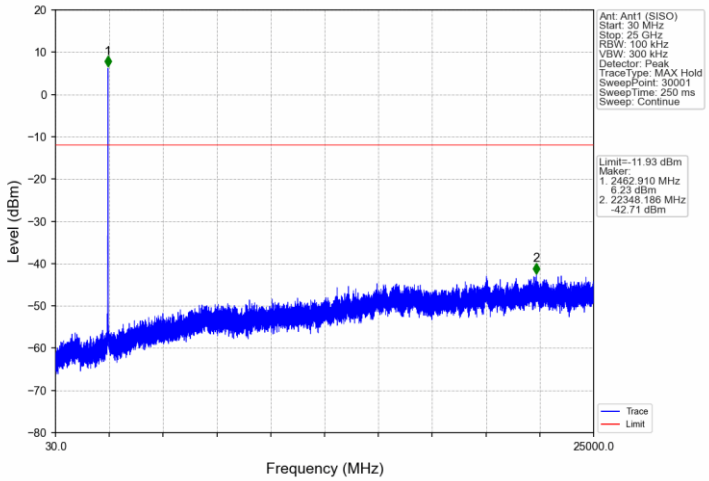
802.11b_LCH_2412MHz_Ant1 (SISO)_NTNV



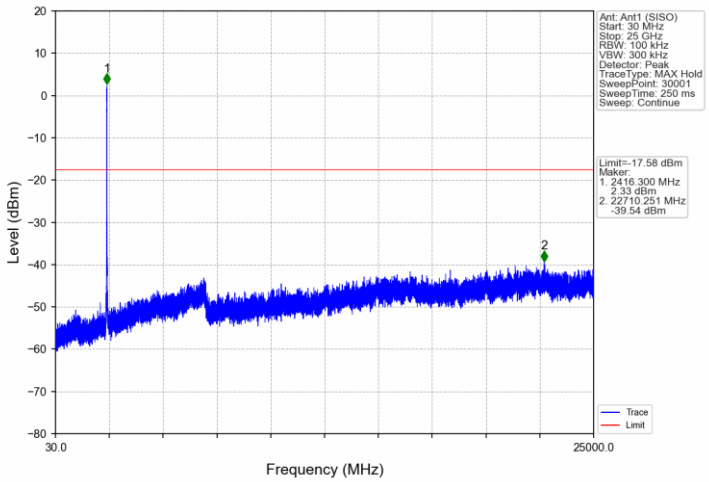
802.11b_MCH_2437MHz_Ant1 (SISO)_NTNV



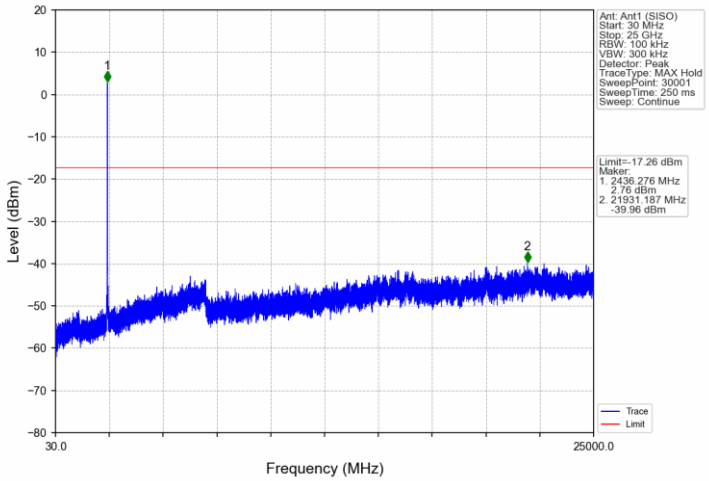
802.11b_HCH_2462MHz_Ant1 (SISO)_NTNV



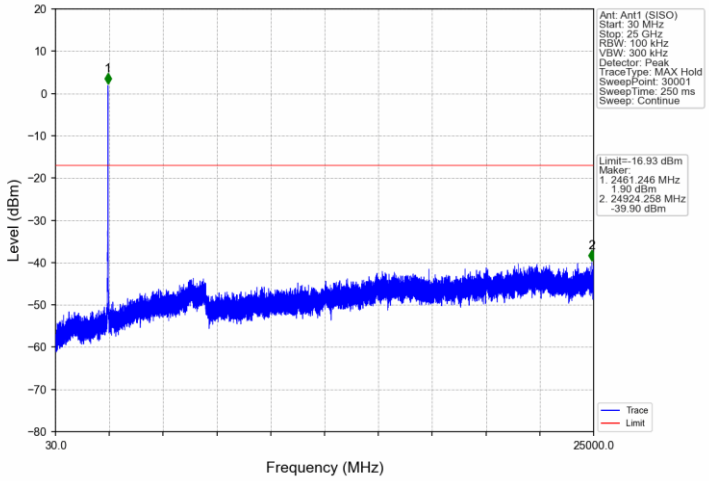
802.11g_LCH_2412MHz_Ant1 (SISO)_NTNV



802.11g_MCH_2437MHz_Ant1 (SISO)_NTNV



802.11g_HCH_2462MHz_Ant1 (SISO)_NTNV



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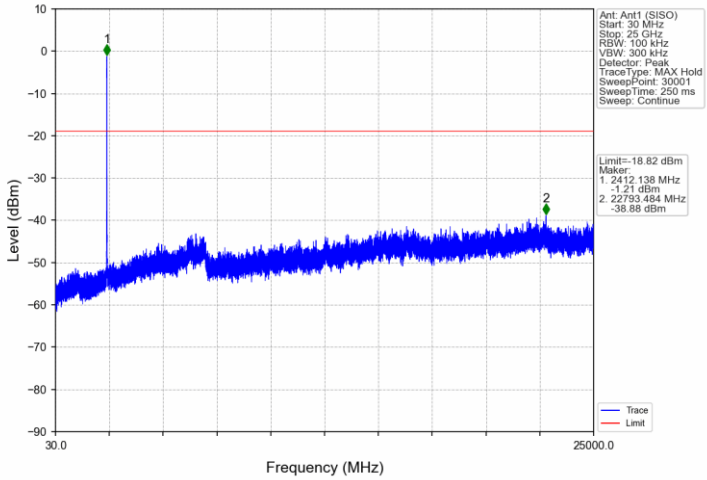
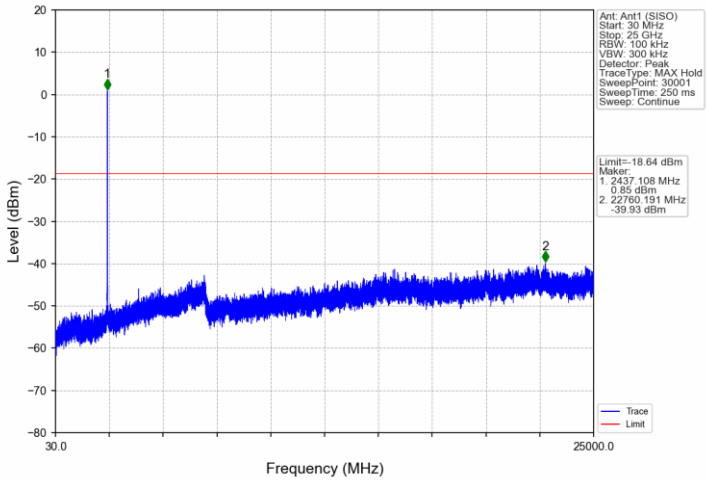
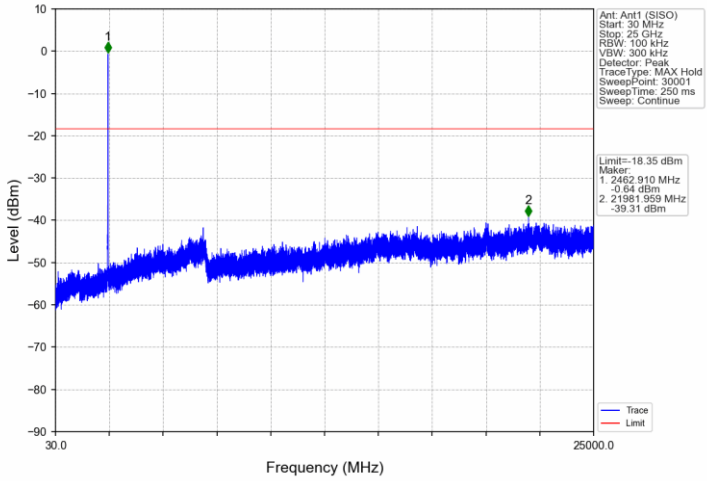
802.11n(HT20)_LCH_2412MHz_Ant1 (SISO)_NTNV



802.11n(HT20)_MCH_2437MHz_Ant1 (SISO)_NTNV



802.11n(HT20)_HCH_2462MHz_Ant1 (SISO)_NTNV



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9.6 Band edge testing

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peak level of the in-band emission and all spurious
   RBW = 100 kHz, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize, use the peak and delta measurement to record the result.
5. The level displayed must comply with the limit specified in this Section.
6. Repeat above procedures until all frequencies measured were complete and submit all the plots.

Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that 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 § 15.247(b)(3), the attenuation required shall be 30 dB instead of 20 dB.

Frequency Range MHz	Limit (dBc)
30-25000	-20

Test result

Mode	Frequency (MHz)	Level of Reference (dBm)	Limit (dBm)	Verdict
802.11b	2412	7.66	-12.34	Pass
	2462	8.07	-11.93	Pass
802.11g	2412	2.42	-17.58	Pass
	2462	3.07	-16.93	Pass
802.11n (HT20)	2412	1.18	-18.82	Pass
	2462	1.65	-18.35	Pass

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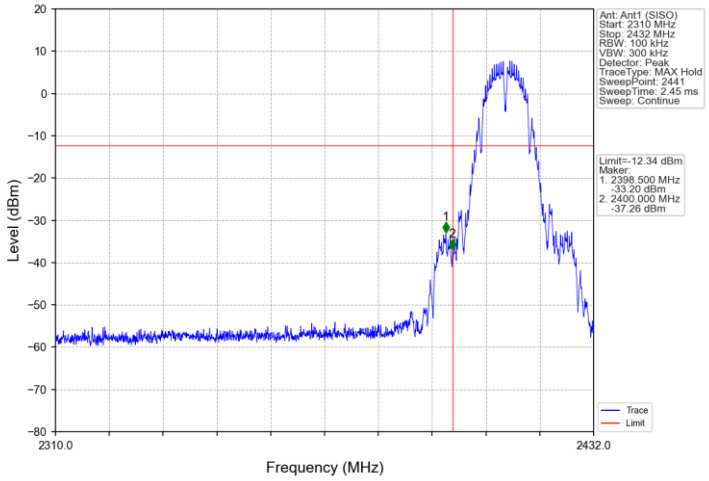
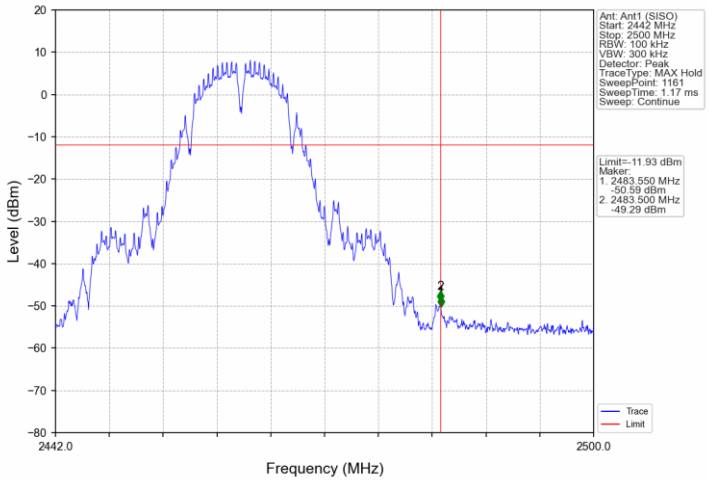
Test Graphs

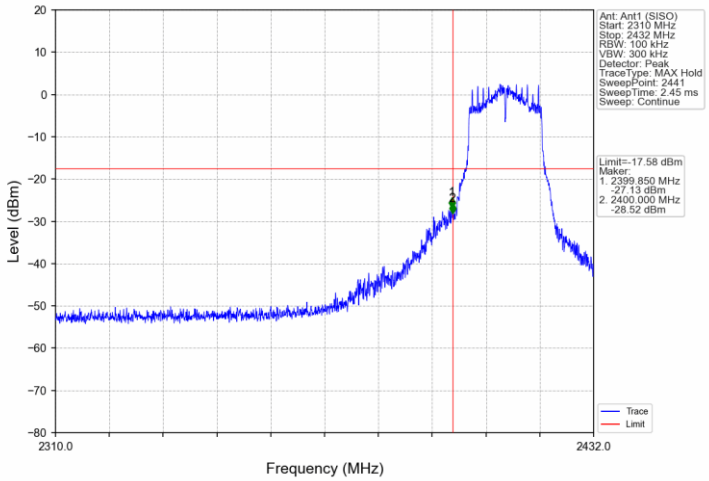
802.11b_LCH_2412MHz_Ant1 (SISO)_NTNV



802.11b_HCH_2462MHz_Ant1 (SISO)_NTNV



802.11g_LCH_2412MHz_Ant1 (SISO)_NTNV



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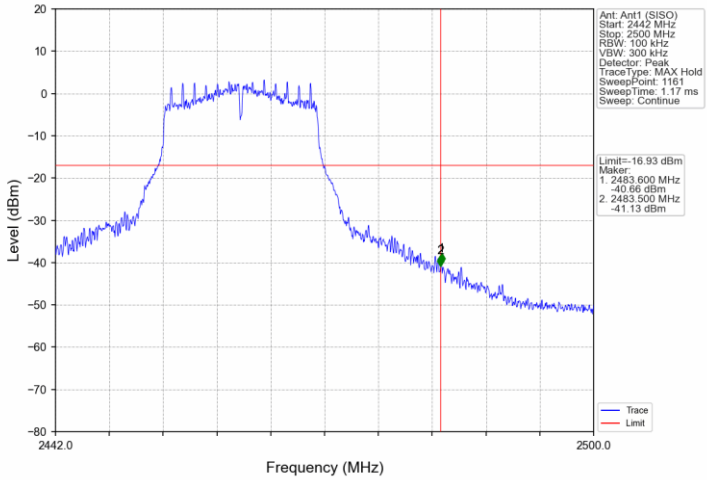
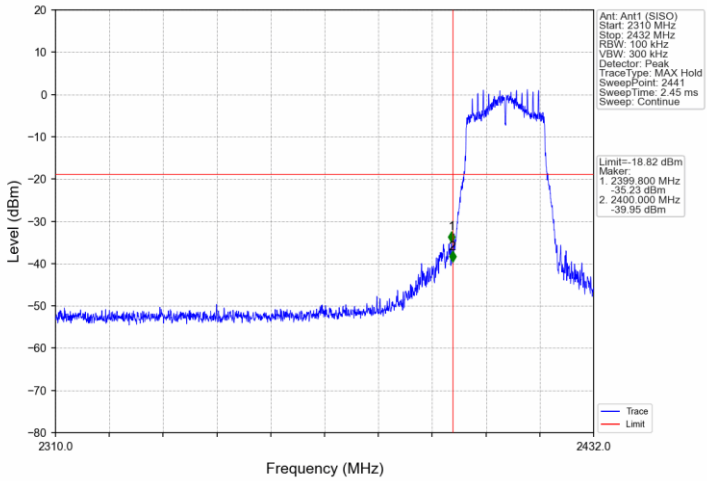
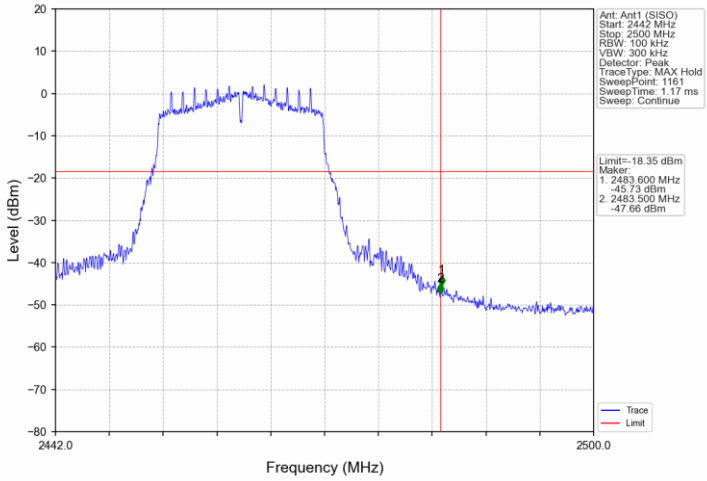
802.11g_HCH_2462MHz_Ant1 (SISO)_NTNV



802.11n(HT20)_LCH_2412MHz_Ant1 (SISO)_NTNV



802.11n(HT20)_HCH_2462MHz_Ant1 (SISO)_NTNV



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9.7 Spurious radiated emissions for transmitter

Test Method

1. The EUT was place on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
3. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. Use the following spectrum analyzer settings According to C63.10:

1) Procedure for Unwanted Emissions Measurements Below 1000 MHz
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 KHz to 120KHz, VBW≥RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

2) For Peak unwanted emissions Above 1GHz:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 1MHz, VBW≥RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

3) Procedures for average unwanted emissions measurements above 1000 MHz
a) RBW = 1MHz.
b) VBW \ [3 × RBW].
c) Detector = RMS (power averaging), if [span / (# of points in sweep)] \ RBW / 2. Satisfying this condition can require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, then the detector mode shall be set to peak.
d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.)
e) Sweep time = auto.
f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of 1 / D, where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)
g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:
1) If power averaging (rms) mode was used in the preceding step e), then the correction factor is [10 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 3 dB shall be added to the measured emission levels.

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2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is [20 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.
3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission(AV) at frequency above 1GHz.

Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that 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 § 15.247(b)(3), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in § 15.209(a) 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).

Frequency MHz	Field Strength μV/m	Field Strength dBμV/m	Detector	Measurement distance meters
0.009-0.490	2400/F(kHz)	48.5-13.8	AV	300
0.490-1.705	24000/F(kHz)	33.8-23.0	QP	30
1.705-30	30	29.5	QP	30
30-88	100	40	QP	3
88-216	150	43.5	QP	3
216-960	200	46	QP	3
960-1000	500	54	QP	3
Above 1000	500	54	AV	3
Above 1000	5000	74	PK	3

Note 1: Limit 3m(dBμV/m)=Limit 300m(dBμV/m)+40Log(300m/3m) (Below 30MHz)
Note 2: Limit 3m(dBμV/m)=Limit 30m(dBμV/m)+40Log(30m/3m) (Below 30MHz)

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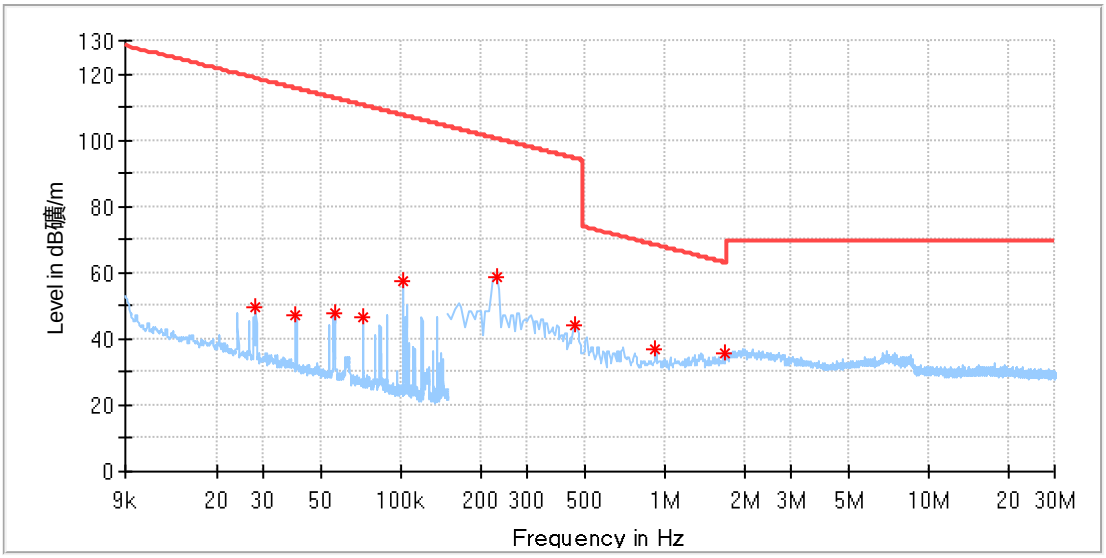
Spurious radiated emissions for transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Only the worst case (802.11b) test result is listed in the report.

Transmitting spurious emission test result as below:

Emission 9kHz-30MHz



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Azimuth (deg)	Corr. (dB/m)
0.028082	49.49	118.62	69.13	H	261.0	19.93
0.039973	47.00	115.56	68.55	H	0.0	19.92
0.055953	47.64	112.64	65.00	H	0.0	19.96
0.072027	46.67	110.45	63.77	H	0.0	19.94
0.101543	57.52	107.46	49.94	H	325.0	19.95
0.229600	58.44	100.38	41.94	H	0.0	19.91
0.458450	44.01	94.38	50.37	H	0.0	19.95
0.921125	36.62	68.32	31.70	H	0.0	20.01
1.687275	35.63	63.06	27.43	H	356.0	20.03

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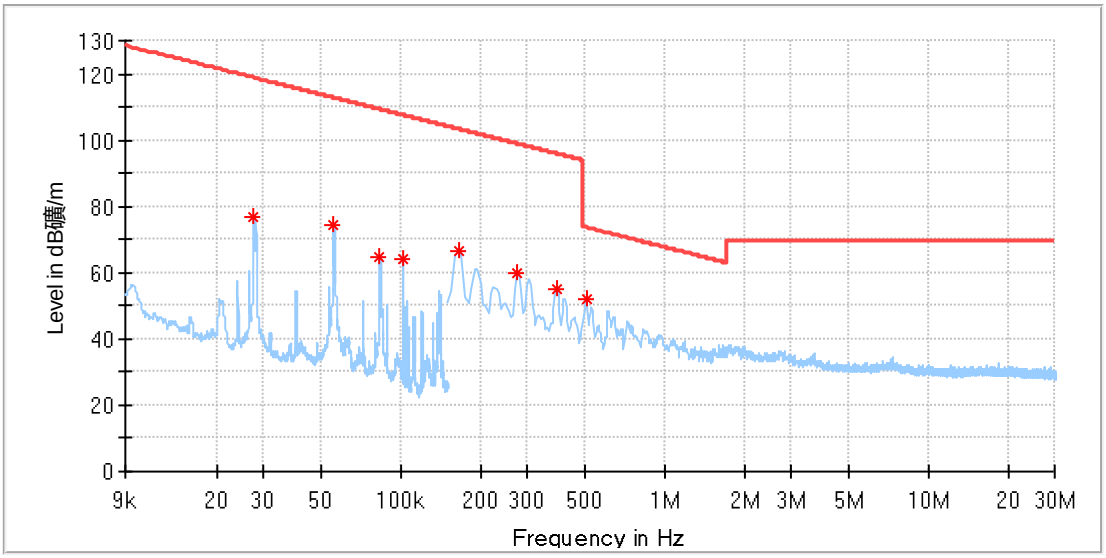

Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Azimuth (deg)	Corr. (dB/m)
0.027706	76.74	118.74	42.00	V	58.0	19.93
0.055436	74.55	112.72	38.17	V	114.0	19.96
0.083166	64.68	109.20	44.52	V	42.0	19.95
0.101590	64.37	107.46	43.09	V	114.0	19.95
0.164925	66.57	103.25	36.68	V	268.0	19.92
0.274375	59.71	98.83	39.12	V	102.0	19.93
0.388800	55.03	95.81	40.78	V	214.0	19.94
0.503225	52.16	73.57	21.41	V	102.0	19.95

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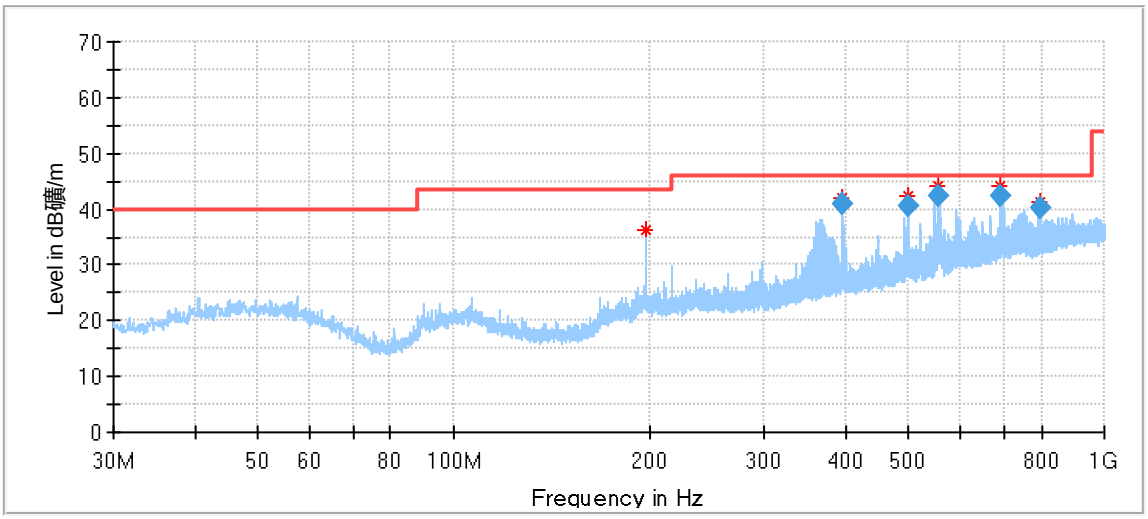
Emission 30MHz-1GHz



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
197.702222	36.19	43.50	7.31	200.0	H	0.0	16.00
395.474444	42.07	46.00	3.93	200.0	H	304.0	20.80
498.617778	42.25	46.00	3.75	200.0	H	286.0	22.68
556.979444	44.28	46.00	1.72	100.0	H	357.0	23.71
691.540000	43.99	46.00	2.01	100.0	H	83.0	25.93
795.437778	41.37	46.00	4.63	100.0	H	120.0	27.13

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
395.474444	40.77	46.00	5.23	200.0	H	304.0	20.80
498.617778	40.66	46.00	5.34	200.0	H	286.0	22.68
556.979444	42.43	46.00	3.57	100.0	H	357.0	23.71
691.540000	42.36	46.00	3.64	100.0	H	83.0	25.93
795.437778	40.11	46.00	5.89	100.0	H	120.0	27.13

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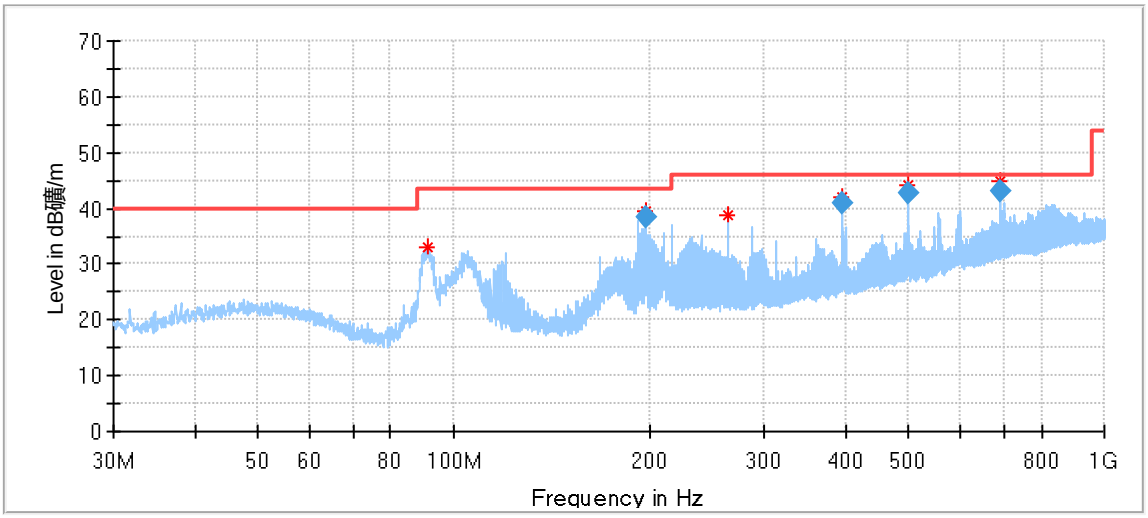


Critical_Freqs

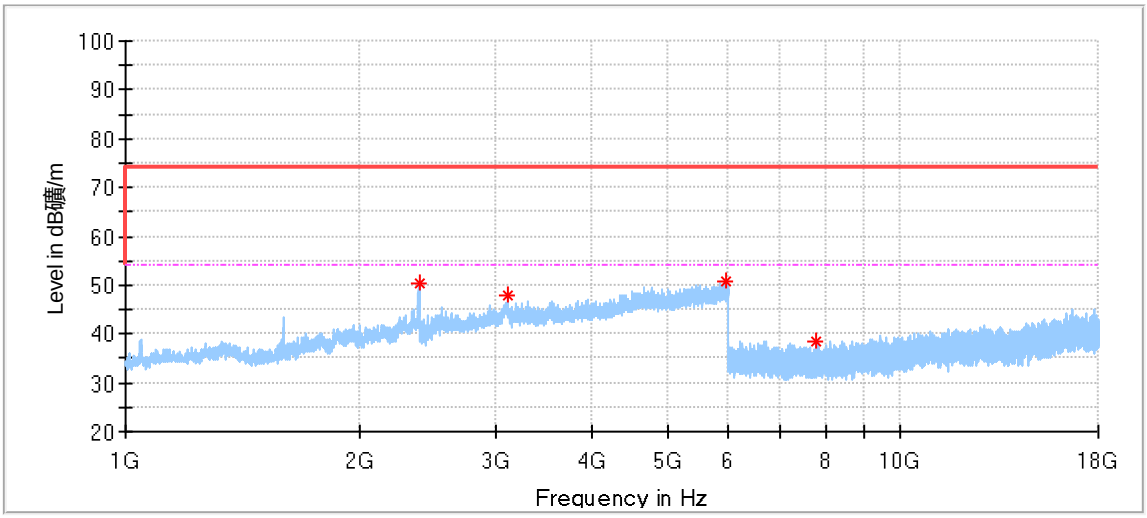
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
91.002222	32.93	43.50	10.57	100.0	V	251.0	14.16
197.971667	39.58	43.50	3.92	100.0	V	63.0	15.95
263.985556*	38.83	46.00	7.17	100.0	V	91.0	17.48
396.013333	42.02	46.00	3.98	100.0	V	304.0	20.81
499.480000	44.20	46.00	1.80	100.0	V	173.0	22.67
691.971111	44.84	46.00	1.16	100.0	V	262.0	25.93

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
197.971667	38.32	43.50	5.18	100.0	V	63.0	15.95
396.013333	40.76	46.00	5.24	100.0	V	304.0	20.81
499.480000	42.74	46.00	3.26	100.0	V	173.0	22.67
691.971111	42.91	46.00	3.09	100.0	V	262.0	25.93

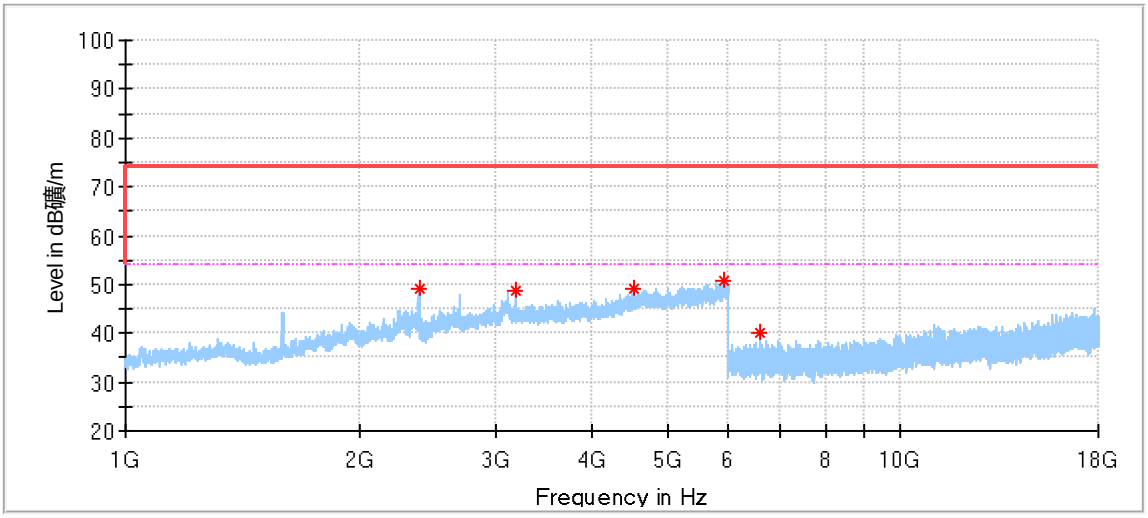
Emission 1GHz-18GHz

Transmitting mode 802.11b_2412MHz



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2390.000000*	50.24	74.00	23.76	150.0	H	27.0	-2.49
3107.500000	47.93	74.00	26.07	150.0	H	136.0	1.32
5970.000000	50.70	74.00	23.30	150.0	H	27.0	7.03
7776.000000	38.58	74.00	35.42	150.0	H	328.0	5.89



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2390.000000*	49.00	74.00	25.00	150.0	V	357.0	-2.49
3189.000000	48.63	74.00	25.37	150.0	V	27.0	-0.36
4521.500000*	49.25	74.00	24.75	150.0	V	54.0	3.56
5921.500000	50.76	74.00	23.24	150.0	V	191.0	6.92
6576.500000	39.94	74.00	34.06	150.0	V	294.0	5.30

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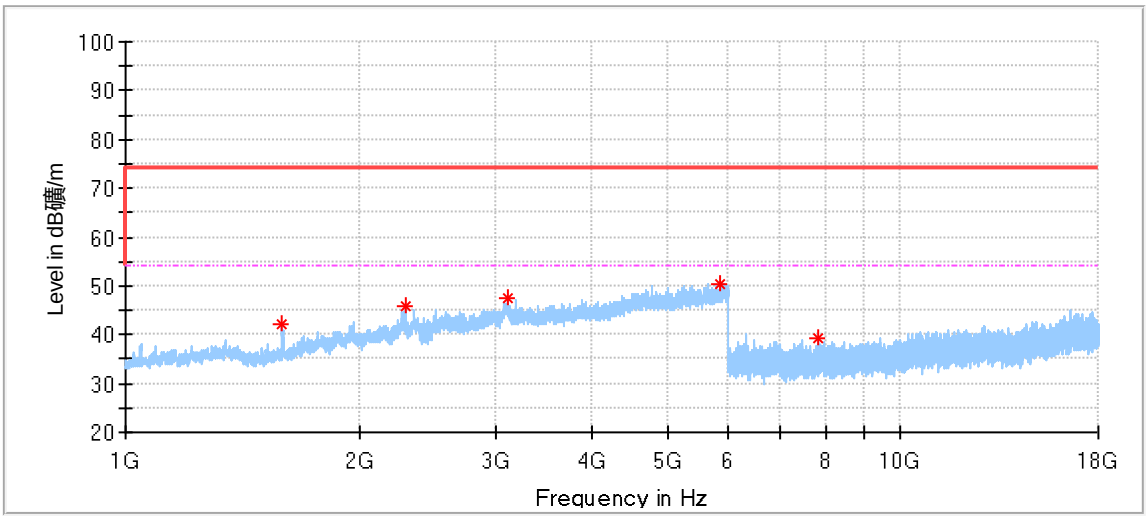
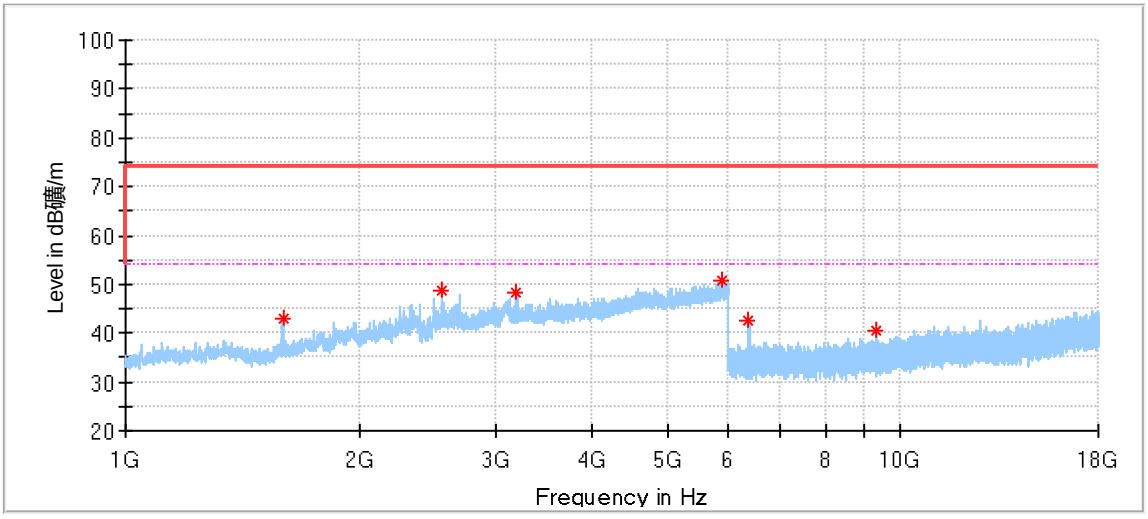
Transmitting mode 802.11b_2437MHz



Critical_Freqs

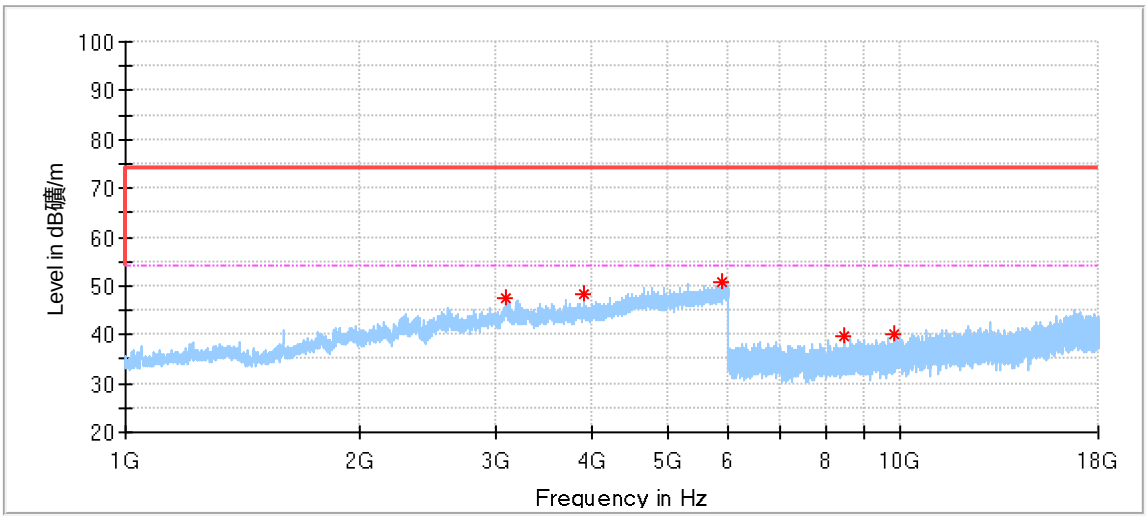
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1593.500000*	42.10	74.00	31.90	150.0	H	204.0	-8.45
2294.500000*	46.03	74.00	27.97	150.0	H	0.0	-3.25
3109.500000	47.40	74.00	26.60	150.0	H	0.0	1.25
5860.000000	50.56	74.00	23.44	150.0	H	341.0	6.66
7822.000000	39.16	74.00	34.84	150.0	H	235.0	5.96



Critical_Freqs

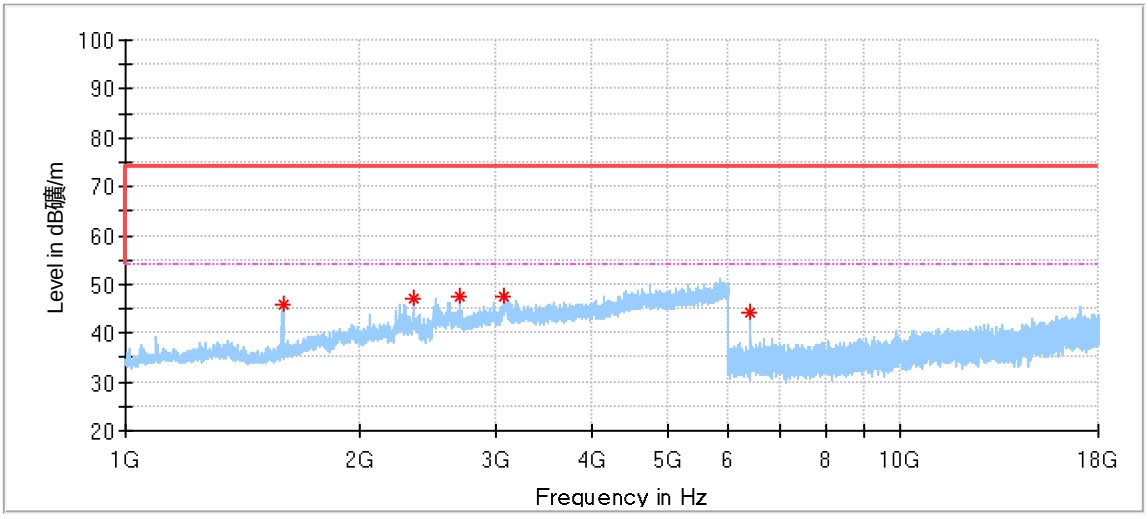
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1597.000000*	42.95	74.00	31.05	150.0	V	200.0	-8.44
2564.500000	48.66	74.00	25.34	150.0	V	0.0	-2.30
3198.500000	48.24	74.00	25.76	150.0	V	158.0	-0.36
5882.000000	50.59	74.00	23.41	150.0	V	13.0	6.81
6373.000000	42.47	74.00	31.53	150.0	V	6.0	5.10
9306.000000*	40.47	74.00	33.53	150.0	V	151.0	7.92

Transmitting mode 802.11b_2462MHz



Critical_Freqs

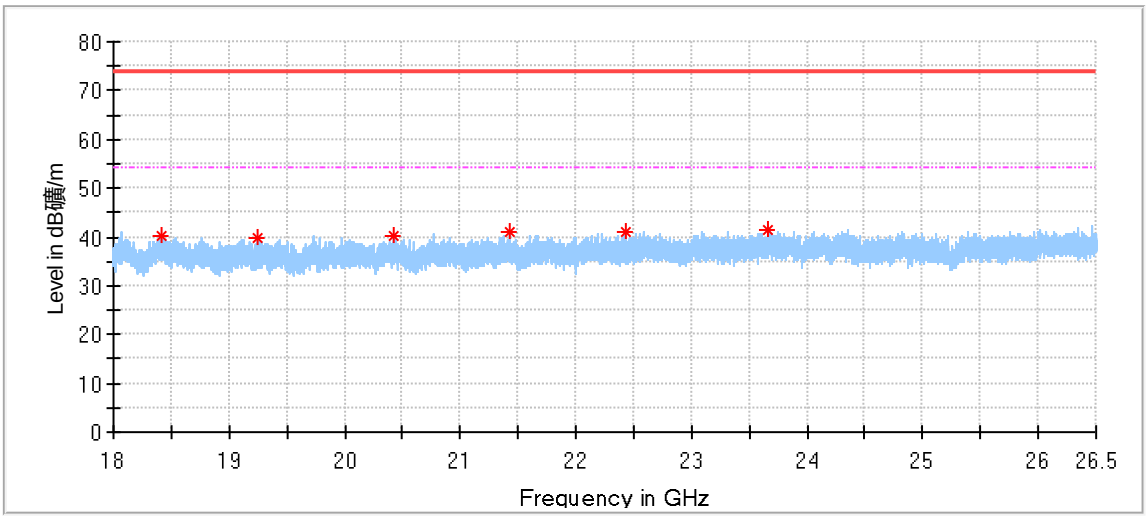
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3098.500000	47.30	74.00	26.70	150.0	H	204.0	1.52
3902.500000*	48.13	74.00	25.87	150.0	H	4.0	1.31
5868.000000	50.69	74.00	23.31	150.0	H	0.0	6.72
8474.000000*	39.89	74.00	34.11	150.0	H	100.0	6.82
9842.000000	40.02	74.00	33.98	150.0	H	184.0	8.24



Critical_Freqs

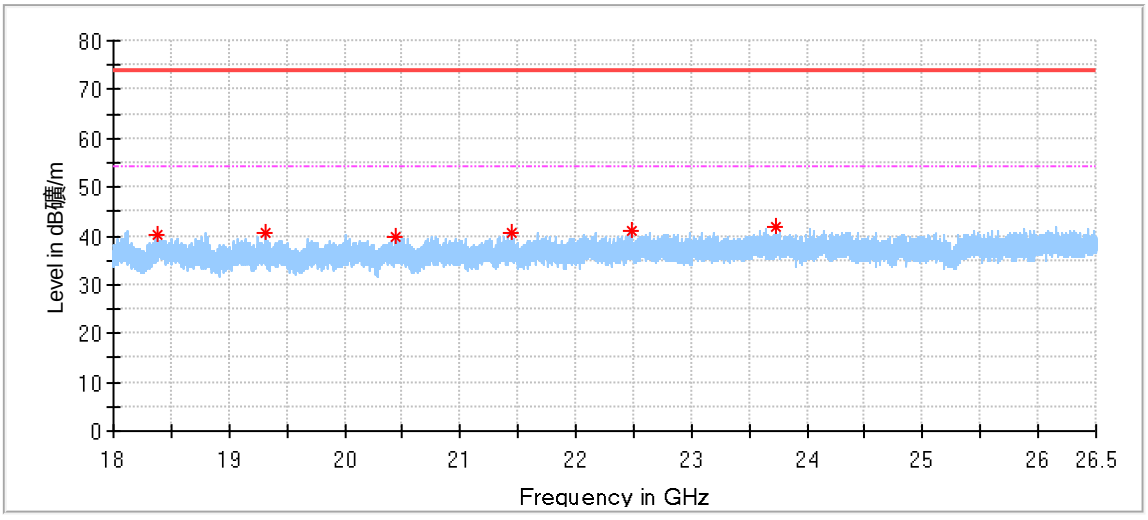
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1595.000000*	45.77	74.00	28.23	150.0	V	194.0	-8.45
2354.500000*	46.91	74.00	27.09	150.0	V	40.0	-2.74
2696.500000*	47.51	74.00	26.49	150.0	V	0.0	-2.05
3086.000000	47.57	74.00	26.43	150.0	V	353.0	1.03
6389.000000	44.11	74.00	29.89	150.0	V	70.0	5.08

Emission 18GHz-26.5GHz



Critical_Freqs

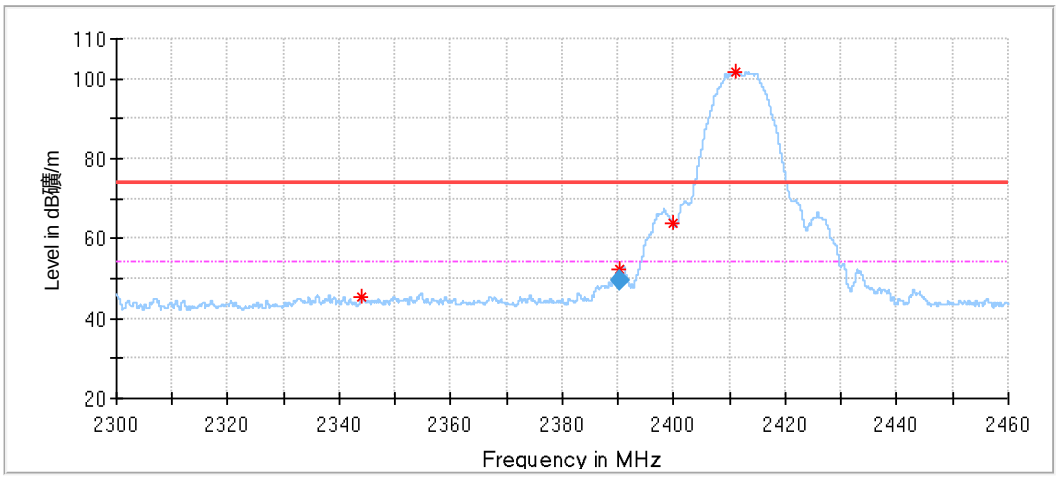
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18411.984375	40.20	74.00	33.80	150.0	H	237.0	-4.49
19251.093750	39.99	74.00	34.01	150.0	H	261.0	-4.27
20427.281250	40.39	74.00	33.61	150.0	H	285.0	-3.14
21421.781250	41.13	74.00	32.87	150.0	H	4.0	-2.04
22424.515625	41.04	74.00	32.96	150.0	H	237.0	-0.94
23655.421875	41.39	74.00	32.61	150.0	H	273.0	-0.30



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18376.125000	40.15	74.00	33.85	150.0	V	315.0	-4.53
19315.640625	40.57	74.00	33.43	150.0	V	356.0	-4.22
20434.187500	39.93	74.00	34.07	150.0	V	231.0	-3.13
21452.859375	40.65	74.00	33.35	150.0	V	37.0	-2.00
22479.500000	41.00	74.00	33.00	150.0	V	158.0	-0.84
23724.484375	41.76	74.00	32.24	150.0	V	170.0	-0.23

Restricted-band band-edge:

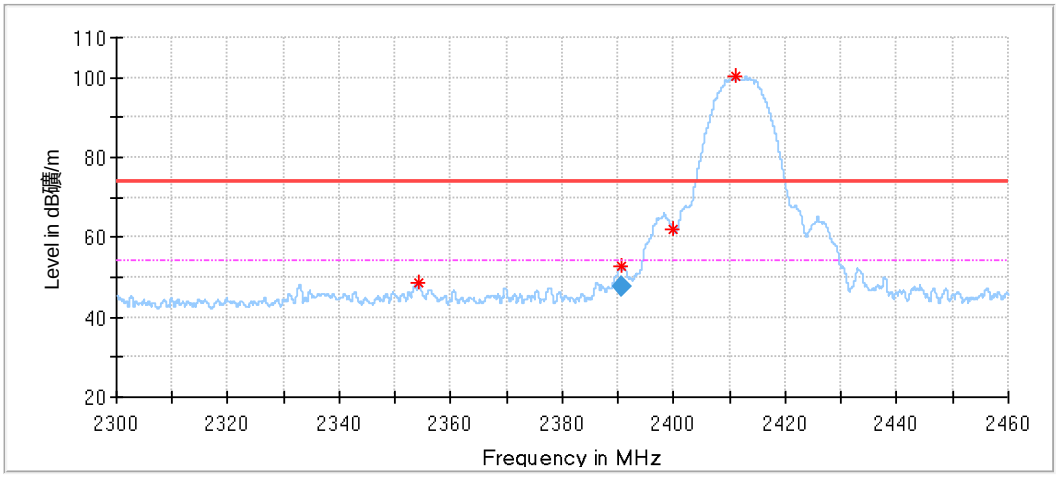


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2343.808000*	45.50	74.00	28.50	150.0	H	4.0	-3.49
2390.240000	52.30	74.00	21.70	150.0	H	31.0	-3.05
2399.856000	63.66	74.00	10.34	150.0	H	31.0	-3.03

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2390.240000	49.39	54.00	4.61	150.0	H	31.0	-3.05



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2354.368000*	48.63	74.00	25.37	150.0	V	329.0	-3.38
2390.432000	52.65	74.00	21.35	150.0	V	0.0	-3.05
2399.856000	62.03	74.00	11.97	150.0	V	15.0	-3.03

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2390.432000	47.71	54.00	6.29	150.0	V	0.0	-3.05

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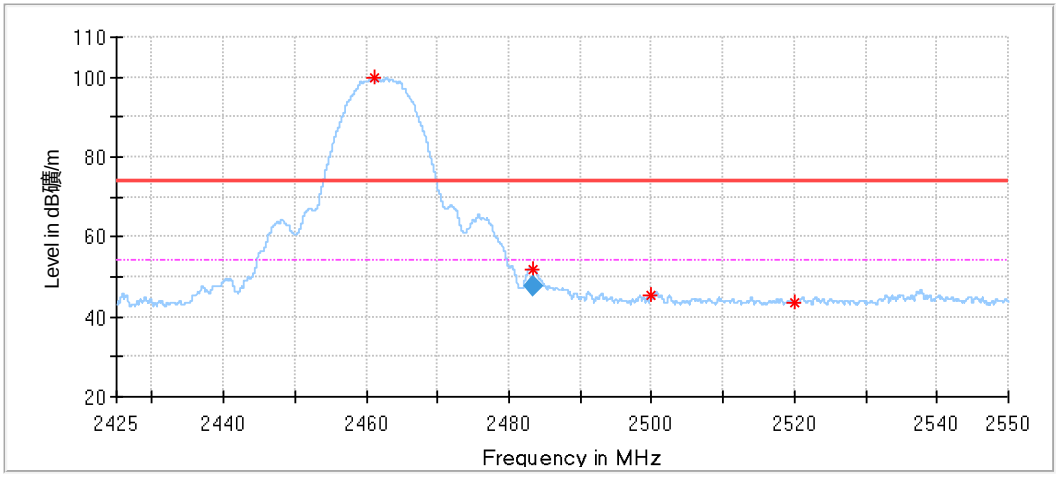
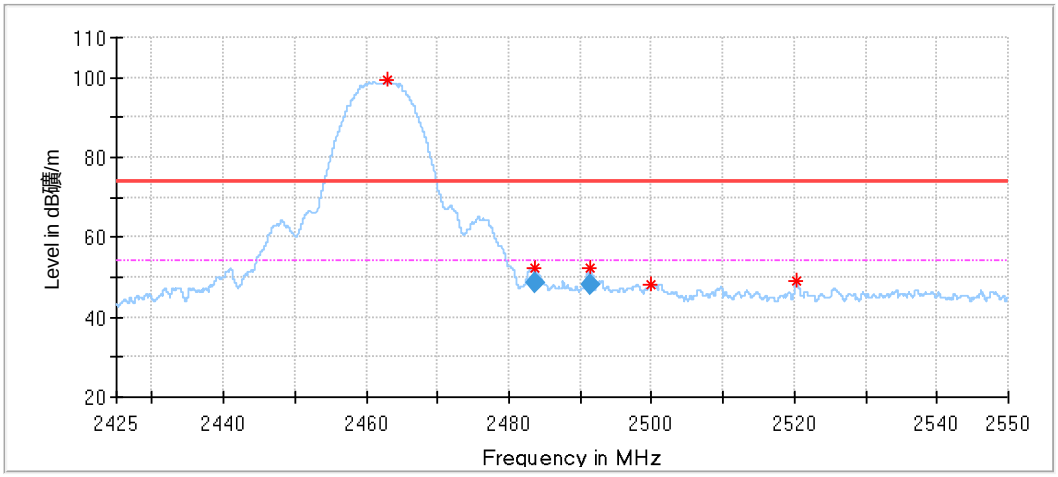


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.487500	51.87	74.00	22.13	150.0	H	41.0	-3.06
2499.937500*	45.55	74.00	28.45	150.0	H	0.0	-3.16
2520.162500	43.74	74.00	30.26	150.0	H	88.0	-3.10

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.487500	47.69	54.00	6.31	150.0	H	41.0	-3.06



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.600000*	52.35	74.00	21.65	150.0	V	171.0	-3.06
2491.287500*	52.43	74.00	21.57	150.0	V	0.0	-3.11
2499.837500*	48.23	74.00	25.77	150.0	V	0.0	-3.16
2520.375000	49.01	74.00	24.99	150.0	V	0.0	-3.10

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.600000*	48.62	54.00	5.38	150.0	V	171.0	-3.06
2491.287500*	48.05	54.00	5.95	150.0	V	0.0	-3.11

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Remark:
(1) "*" means the emission(s) appear within the restrict bands shall follow the requirement of § 15.205.
(2) Only the worst case of 9kHz-30MHz and 18MHz-26.5MHz spurious emission test data was shown in the report.
(3) Level= Reading Level + Correction Factor
(4) Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
(The Reading Level is recorded by software which is not shown in the sheet)

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10 Test Equipment List

Conducted Emission Test (AMN)(CSR #2)

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 3	68-4-74-19-002	102590	1	2025-5-13
LISN	Rohde & Schwarz	ENV216	68-4-87-19-001	102472	1	2025-5-12
LISN	Rohde & Schwarz	ENV4200	68-4-87-14-001	100249	1	2025-5-13
Attenuator	Shanghai Huaxiang	TS2-26-3	68-4-81-16-003	080928189	1	2025-5-11
Cable	OUQIAO	RG142	68-4-90-19-005-A20	----	----	----
Test software	Rohde & Schwarz	EMC32	68-4-90-19-005-A01	Version10.35.02	N/A	N/A
Shielding Room	TDK	CSR #2	68-4-90-19-005	----	3	2025-10-15

Radiated Emission Test (9kHz-30MHz) (SAC-3 #1)

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 7	68-4-74-19-001	102176	1	2025-5-13
Loop Antenna	Rohde & Schwarz	HFH2-Z2	68-4-80-14-006	100398	1	2025-7-24
Cable	HUBER-SUHNER	RG214	68-4-90-14-001-A21	----	----	----
3m Semi-anechoic chamber	TDK	SAC-3 #1	68-4-90-14-001	----	3	2026-10-25
Test software	Rohde & Schwarz	EMC32	68-4-90-14-001-A10	Version10.35.02	N/A	N/A

Radiated Emission Test (30MHz-1GHz) (SAC-3 #2)

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 26	68-4-74-14-002	101269	1	2025-5-13
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9162	68-4-80-19-003	284	1	2025-2-22
Attenuator	Mini-circuits	UNAT-6+	68-4-81-21-002	15542	1	2025-5-11
Cable	OUQIAO	18DLB5-NMNM-7000	68-4-90-19-006-A22	----	----	----
3m Semi-anechoic chamber	TDK	SAC-3 #2	68-4-90-19-006	----	3	2026-10-25
Test software	Rohde & Schwarz	EMC32	68-4-90-19-006-A01	Version10.35.02	N/A	N/A

Radiated Emission Test (1GHz-18GHz) (SAC-3 #2)

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 26	68-4-74-14-002	101269	1	2025-5-13
Wave Guide Antenna	ETS	3117	68-4-80-19-001	00218954	1	2025-4-10
Pre-amplifier	Rohde & Schwarz	SCU 18F	68-4-29-19-001	100745	1	2025-5-11
Pre-amplifier	Rohde & Schwarz	SCU 18F	68-4-29-19-002	100746	1	2025-5-11

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Cable	OUQIAO	18DLB5-NMNM-7000	68-4-90-19-006-A22	----	----	----
3m Semi-anechoic chamber	TDK	SAC-3 #2	68-4-90-19-006	----	3	2026-10-25
Test software	Rohde & Schwarz	EMC32	68-4-90-19-006-A01	Version10.35.02	N/A	N/A

Radiated Emission Test (18GHz-40GHz) (SAC-3 #2)

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 26	68-4-74-14-002	101269	1	2025-5-13
Sideband Horn Antenna	Q-PAR	QWH-SL-18-40-K-SG	68-4-80-14-008	12827	1	2025-7-2
Pre-amplifier	Rohde & Schwarz	SCU 40A	68-4-29-14-002	100432	1	2025-7-17
Cable	JUNFLON	MWX241	68-4-90-19-006-A21	----	----	----
3m Semi-anechoic chamber	TDK	SAC-3 #2	68-4-90-19-006	----	3	2026-10-25
Test software	Rohde & Schwarz	EMC32	68-4-90-19-006-A01	Version10.35.02	N/A	N/A

RF Test System

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
Signal Analyzer	Rohde & Schwarz	FSV40	68-4-74-14-004	101030	1	2025-5-11
RF Meas. and Switch Matrix Unit	TST PASS	TSCB3023R2	68-4-93-23-001	2811685c	1	2025-5-11
Cable	JUNFLON	J12J103539	68-4-90-19-003-A20	----	----	----
Cable	JUNFLON	J12J103539	68-4-90-19-003-A21	----	----	----
Cable	JUNFLON	J12J103539	68-4-90-19-003-A22	----	----	----
Test software	TST PASS	TST PASS	68-4-93-23-001-A03	Version 2.0	N/A	N/A
Test software	Tonscend	JS1120-3	68-4-74-14-006-A13	Version 2.6.77.0518	N/A	N/A
Shielding Room	TDK	TS8997	68-4-90-19-003	----	3	2025-10-15

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11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Conducted Emission in new shielding room (68-4-90-19-005) 150kHz-30MHz (for test using AMN ENV216)	3.15dB
Uncertainty for Radiated Emission in 3m chamber (68-4-90-14-001) 9kHz-30MHz	4.70dB
Uncertainty for Radiated Emission in new 3m chamber (68-4-90-19-006) 30MHz-1000MHz	Horizontal: 4.63dB; Vertical: 4.78dB
Uncertainty for Radiated Emission in new 3m chamber (68-4-90-19-006) 1000MHz-18000MHz	Horizontal: 5.38dB; Vertical: 5.38dB
Uncertainty for Radiated Emission in new 3m chamber (68-4-90-19-006) above 18000MHz	5.29dB
Uncertainty for Conducted RF test with TS 8997	RF Power Conducted: 1.31dB Frequency test involved: 0.6×10^{-8} or 1%

Measurement Uncertainty Decision Rule:
Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2023, clause 4.3.3 and 4.3.4.

--- END OF REPORT---

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