

FCC - TEST REPORT

Report Number : **68.910.24.0034.01** Date of Issue: 2024-07-26

Model : **X380, X380W, X380S, X381, X381S, X382, X382S, G9, V9, G9 Pro, V9 Pro, V9 Plus**

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 : **66**

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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.:	X380, X380W, X380S, X381, X381S, X382, X382S, G9, V9, G9 Pro, V9 Pro, V9 Plus
FCC ID:	2BD8J-X380
Ratings:	For X380, X380W, X381, X382, G9 and V9: 19V --- , 0.6A (for robotic vacuum cleaner); 100-240V $\sim$, 50/60Hz, 0.35A (for AC adapter) For X380S, X381S, X382S, G9 Pro, V9 Pro and V9 Plus: 19V --- , 0.6A (for robotic vacuum cleaner); 120VAC, 60Hz, 550W (for Dust collector station) Battery: 14.4Vdc, 2550mAh
Accessories:	Dust collector station & Docking station & AC adapter
RF Transmission Frequency:	2412MHz-2462MHz for 802.11b/g/n20; 2422MHz-2452MHz for 802.11n40
No. of Operated Channel:	11 for 802.11b/g/n20; 7 for 802.11n40
Modulation:	802.11b: CCK, DSSS 802.11g/n20/n40: BPSK, QPSK, 16-QAM, 64-QAM
Antenna Type:	PCB antenna
Antenna Gain:	0.86 dBi
Description of the EUT:	The EUT is a Robotic Vacuum Cleaner supports 2.4GHz Wi-Fi function.

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

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.

5 Summary of Test Results

Technical Requirements			
FCC Part 15 Subpart C 10-1-2023 Edition			
Test Condition		Test Result	Test Site
§15.207	Conducted emission AC power port	Pass	Site 1
§15.247 (b) (3)	Conducted output power	Pass	Site 1
§15.247(e)	Power spectral density	Pass	Site 1
§15.247(a)(2)	6dB bandwidth	Pass	Site 1
§15.247(a)(1)	20dB Occupied bandwidth	N/A	--
§15.247(a)(1)	Carrier frequency separation	N/A	--
§15.247(a)(1)(iii)	Number of hopping frequencies	N/A	--
§15.247(a)(1)(iii)	Dwell Time	N/A	--
§15.247(d)	Spurious RF conducted emissions	Pass	Site 1
§15.247(d)	Band edge	Pass	Site 1
§15.247(d) & §15.209 & §15.205	Spurious radiated emissions for transmitter	Pass	Site 1
§15.203	Antenna requirement	Pass See note 1	--

Remark 1: N/A – Not Applicable.

Note 1: The EUT uses an integrated PCB antenna, which gain is 0.86dBi. In accordance to §15.203, it is considered sufficiently to comply with the provisions of this section.

6 General Remarks

Model differences as below:

Item	Model No.	Charging unit	Remark:
a	X380, X380W, X381, X382, G9, V9	AC adapter	X380 and other models (X380W, X381, X382, G9, V9) are the same except the different appearance and model name.
b	X380S, X381S, X382S, G9 Pro, V9 Pro, V9 Plus	Dust collector station	X380 and X380S are the same except the charging unit, different appearance and model name. All models in this item b are the same except the different appearance and model name.

All models have same schematics, PCB layout and RF module, only the charging accessories is different.

Unless otherwise specified, the model X380 was chosen as representative model to perform all the tests, and the model X380S was performed the conducted emission test to verify the difference of charging method.

The conducted emissions of X380 were tested with AC adapter, and the input voltage is 120VAC/60Hz; The conducted emissions of X380S were tested with dust collector station, and the input voltage is 120VAC/60Hz;

The RF tests of X380 were tested with battery operation, Battery voltage is 14.4VDC.

This submittal(s) (test report) is intended for FCC ID: 2BD8J-X380, 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 6 were

■ - Performed

□ - **Not** Performed

The Equipment under Test

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

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

Sample Received Date: 2024-05-07

Testing Start Date: 2024-05-28

Testing End Date: 2024-06-15

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

Reviewed by:



Jessie He
Project Manager

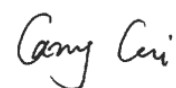


Prepared by:



Myron Yu
Project Engineer

Tested by:

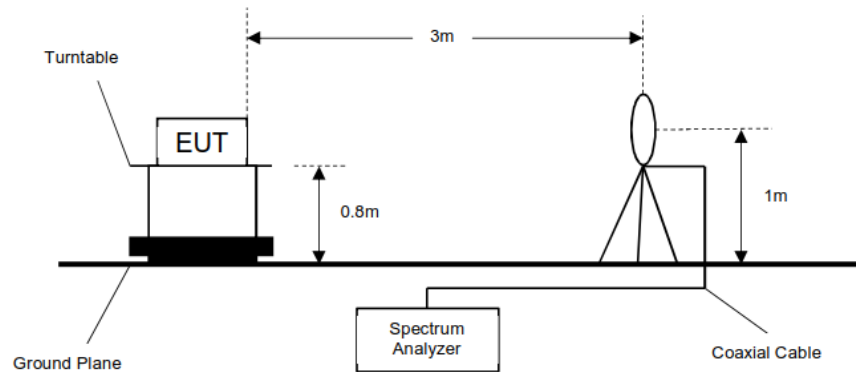


Carry Cai
Test Engineer

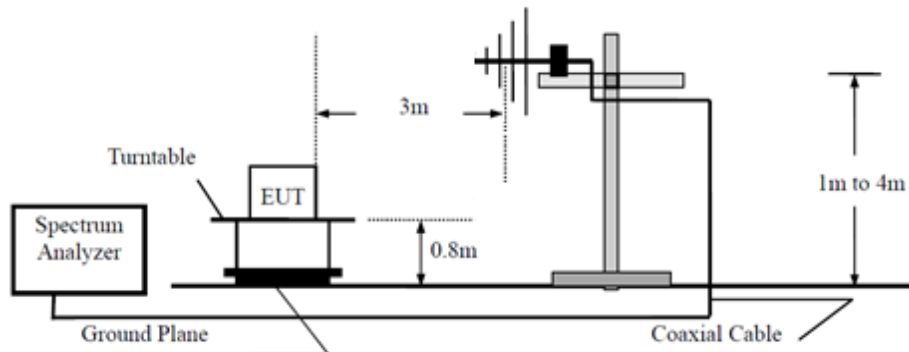
7 Test Setups

7.1 Radiated Test Setups

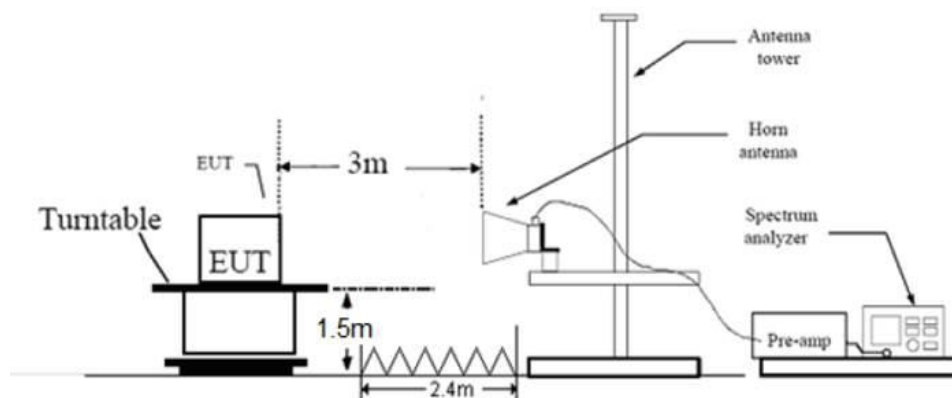
9kHz - 30MHz



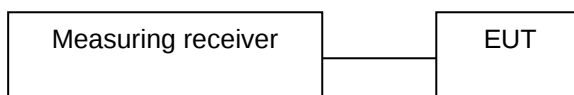
Below 1GHz



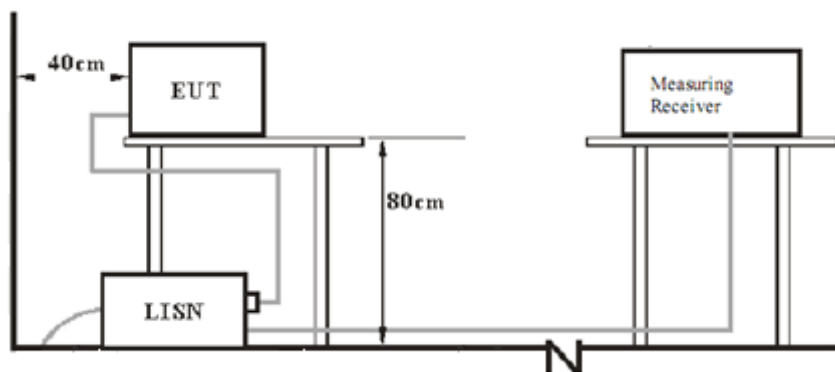
Above 1GHz



7.2 Conducted RF Test Setups



7.3 AC Power Line Conducted Emission Test Setups



8 Systems Test Configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.	S/N
LAPTOP	LENOVO	X240	L34015282

The system was configured to channel 1, 6, and 11 for 802.11b/802.11g/802.11n HT20, and configured to channel 3, 6, and 9 for 802.11n HT40.

Test Software Information:

Test Software Version	uarthut_20180709.bin	
Mode	Setting TX Power	Packet Type
802.11b	Power Index: 0x2C	11b 1 Mbps
802.11g	Power Index: default	11g 6 Mbps
802.11n HT20	Power Index: default	MCS0 6.5 Mbps
802.11n HT40	Power Index: default	MCS0 13.5 Mbps

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

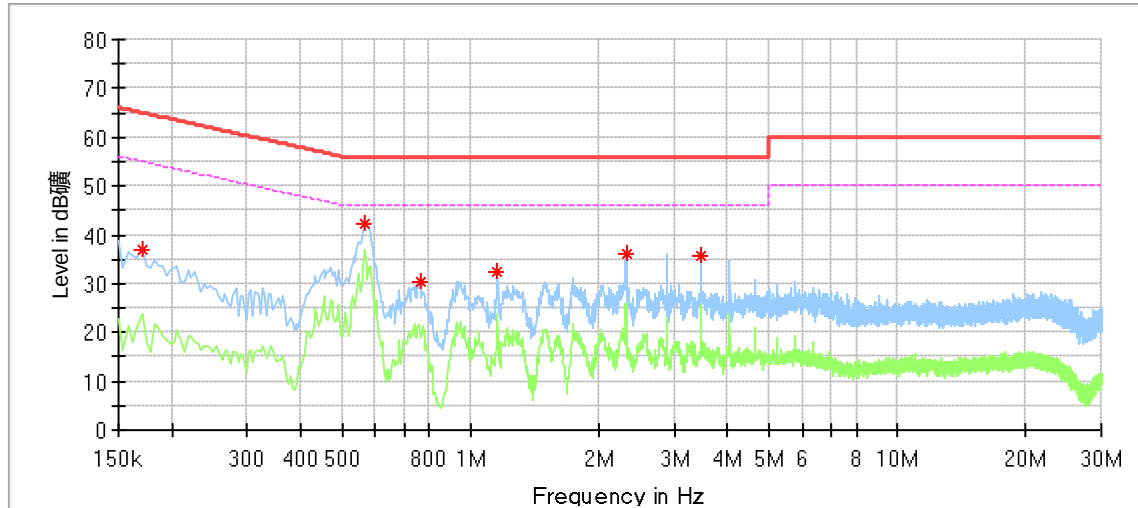
According to §15.207, conducted emissions limit as below:

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

*Decreasing linearly with logarithm of the frequency

Conducted Emission

Product Type : Robotic Vacuum Cleaner
 M/N : X380
 Operating Condition : Charging (by Docking station & AC adapter) + Wi-Fi transmission
 Test Specification : Power Line, Live
 Comment : AC 120V/60Hz



Critical Freqs

Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.170000	36.91	---	64.96	28.05	L1	9.54
0.566000	42.19	---	56.00	13.81	L1	9.60
0.762000	30.16	---	56.00	25.84	L1	9.60
1.158000	32.49	---	56.00	23.51	L1	9.60
2.314000	36.21	---	56.00	19.79	L1	9.63
3.466000	35.75	---	56.00	20.25	L1	9.67

Remark:

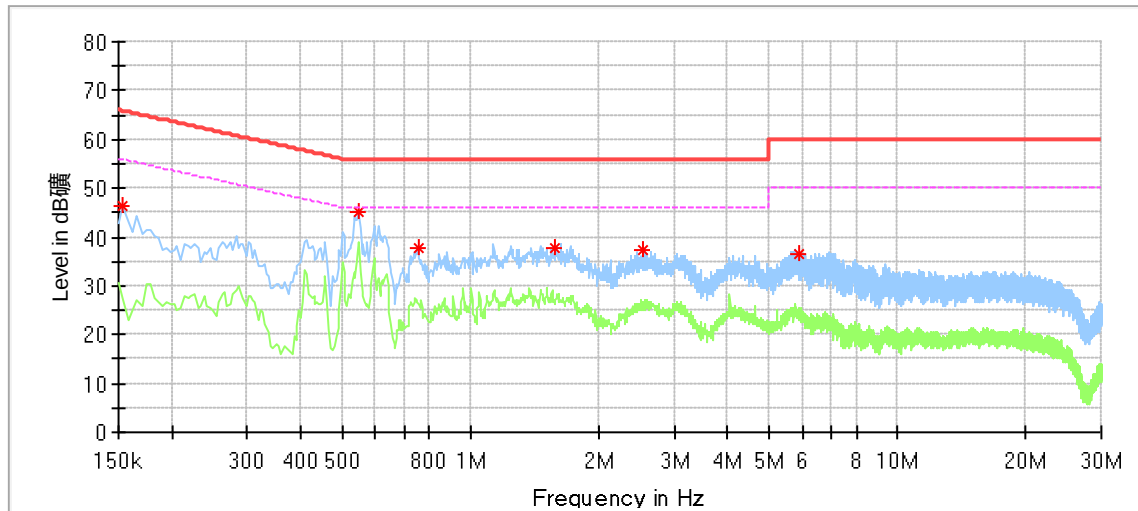
Level=Reading Level + Correction Factor

Correction Factor=Cable Loss + LISN Factor

(The Reading Level is recorded by software which is not shown in the sheet)

Conducted Emission

Product Type : Robotic Vacuum Cleaner
 M/N : X380
 Operating Condition : Charging (by Docking station & AC adapter) + Wi-Fi transmission
 Test Specification : Power Line, Neutral
 Comment : AC 120V/60Hz



Critical Freqs

Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.154000	46.17	---	65.78	19.62	N	9.55
0.546000	45.12	---	56.00	10.88	N	9.62
0.754000	37.76	---	56.00	18.24	N	9.63
1.582000	37.89	---	56.00	18.11	N	9.64
2.526000	37.17	---	56.00	18.83	N	9.67
5.870000	36.57	---	60.00	23.43	N	9.81

Remark:

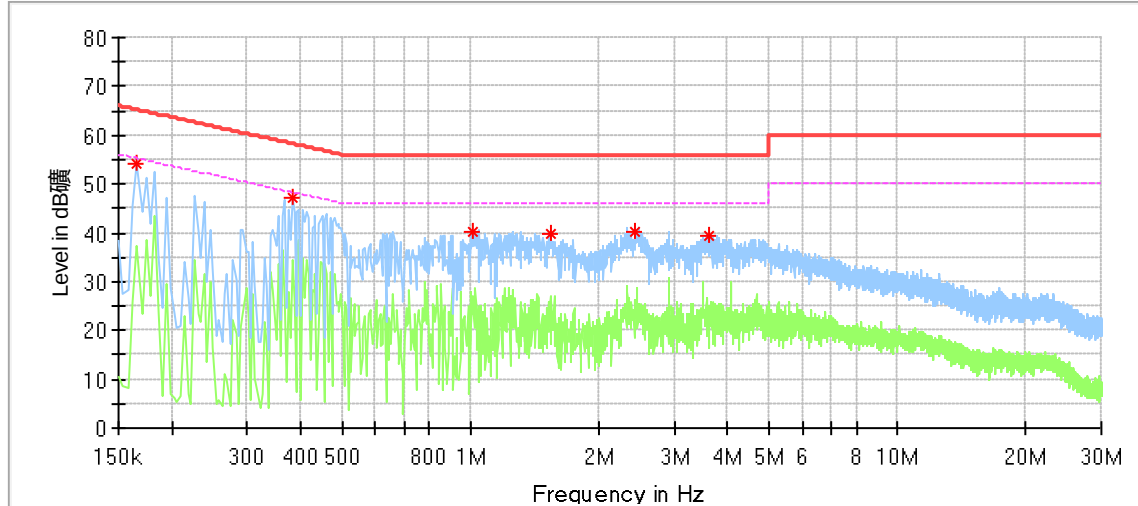
Level=Reading Level + Correction Factor

Correction Factor=Cable Loss + LISN Factor

(The Reading Level is recorded by software which is not shown in the sheet)

Conducted Emission

Product Type : Robotic Vacuum Cleaner
 M/N : X380S
 Operating Condition : Charging (by Dust collector station) + Wi-Fi transmission
 Test Specification : Power Line, Live
 Comment : AC 120V/60Hz



Critical Freqs

Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.166000	54.24	---	65.16	10.92	L1	9.54
0.382000	47.15	---	58.24	11.09	L1	9.58
1.018000	40.26	---	56.00	15.74	L1	9.60
1.538000	39.69	---	56.00	16.31	L1	9.61
2.430000	40.26	---	56.00	15.74	L1	9.63
3.606000	39.57	---	56.00	16.43	L1	9.68

Remark:

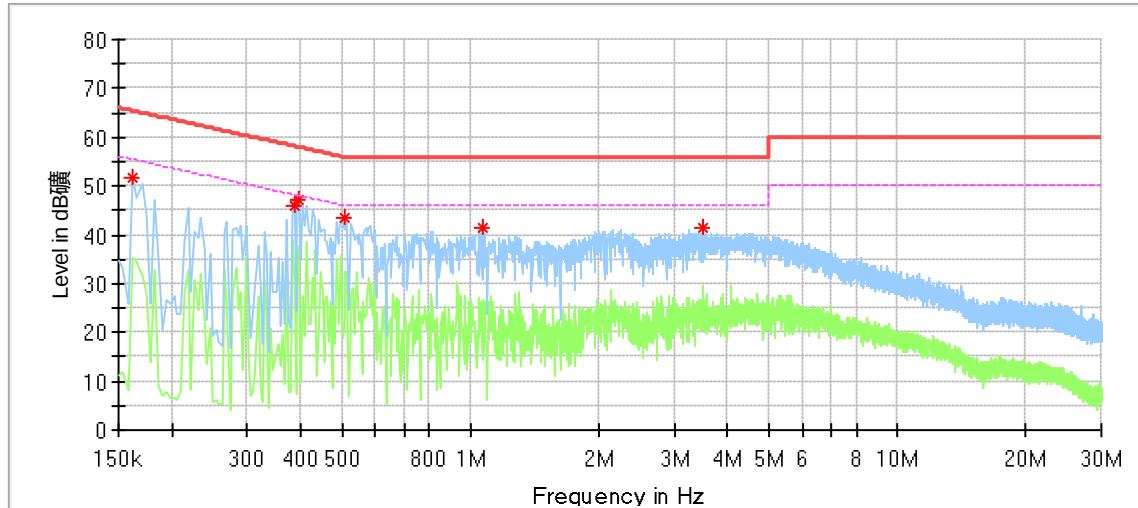
Level=Reading Level + Correction Factor

Correction Factor=Cable Loss + LISN Factor

(The Reading Level is recorded by software which is not shown in the sheet)

Conducted Emission

Product Type : Robotic Vacuum Cleaner
 M/N : X380S
 Operating Condition : Charging (by Dust collector station) + Wi-Fi transmission
 Test Specification : Power Line, Neutral
 Comment : AC 120V/60Hz



Critical Freqs

Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.162000	51.83	---	65.36	13.53	N	9.57
0.386000	46.11	---	58.15	12.04	N	9.61
0.398000	47.08	---	57.90	10.82	N	9.61
0.510000	43.41	---	56.00	12.59	N	9.62
1.070000	41.41	---	56.00	14.59	N	9.63
3.502000	41.41	---	56.00	14.59	N	9.71

Remark:

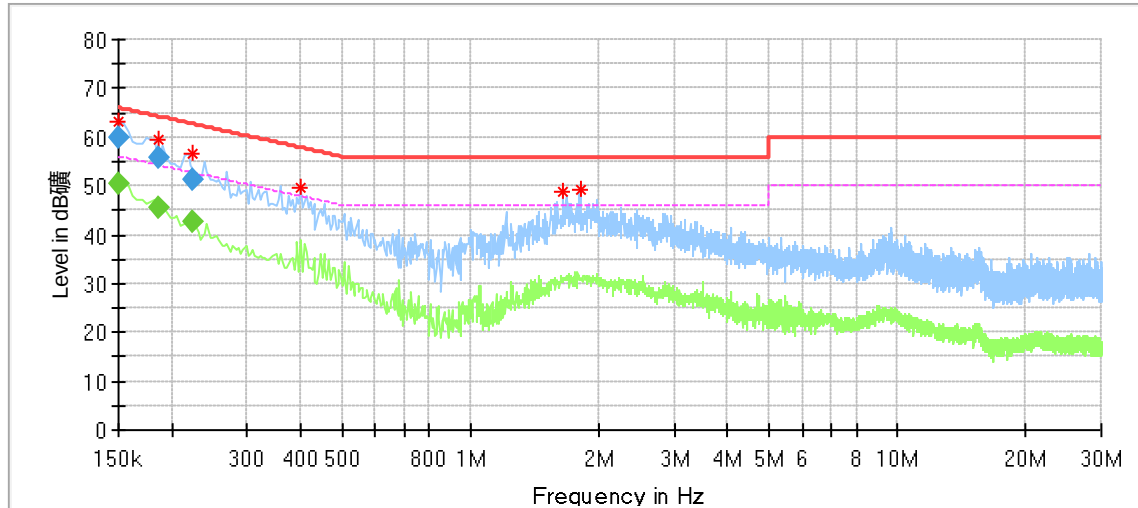
Level=Reading Level + Correction Factor

Correction Factor=Cable Loss + LISN Factor

(The Reading Level is recorded by software which is not shown in the sheet)

Conducted Emission

Product Type : Robotic Vacuum Cleaner
 M/N : X380S
 Operating Condition : Dust collecting (by Dust collector station) + Wi-Fi transmission
 Test Specification : Power Line, Live
 Comment : AC 120V/60Hz



Critical Freqs

Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.150000	63.36	---	65.78	2.42	L1	9.52
0.186500	59.42	---	64.39	4.98	L1	9.54
0.222500	56.76	---	62.90	6.13	L1	9.55
0.402000	49.57	---	57.81	8.24	L1	9.58
1.650000	48.77	---	56.00	7.23	L1	9.61
1.806000	49.19	---	56.00	6.81	L1	9.61

Final Result

Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.150000	---	50.55	56.00	5.45	L1	9.52
0.150000	59.86	---	66.00	6.14	L1	9.52
0.186500	---	45.70	54.19	8.49	L1	9.54
0.186500	55.71	---	64.19	8.48	L1	9.54
0.222500	---	42.66	52.73	10.07	L1	9.55
0.222500	51.47	---	62.73	11.25	L1	9.55

Remark:

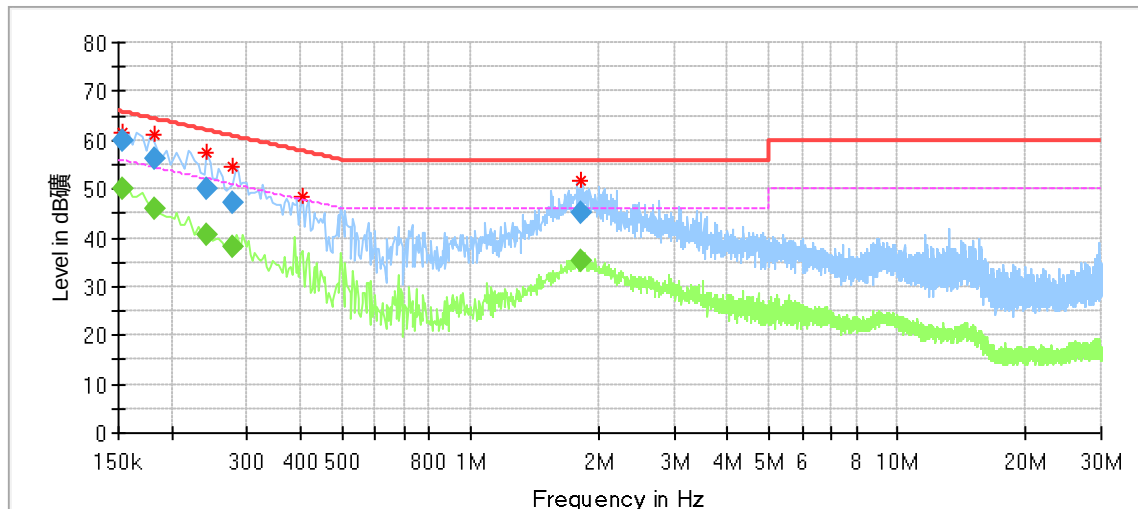
Level=Reading Level + Correction Factor

Correction Factor=Cable Loss + LISN Factor

(The Reading Level is recorded by software which is not shown in the sheet)

Conducted Emission

Product Type : Robotic Vacuum Cleaner
 M/N : X380S
 Operating Condition : Dust collecting (by Dust collector station) + Wi-Fi transmission
 Test Specification : Power Line, Neutral
 Comment : AC 120V/60Hz



Critical Freqs

Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.153500	61.57	---	65.57	4.00	N	9.56
0.181500	60.94	---	64.58	3.63	N	9.57
0.241500	57.36	---	62.03	4.67	N	9.58
0.277500	54.47	---	60.76	6.29	N	9.59
0.406000	48.57	---	57.73	9.16	N	9.61
1.813500	51.52	---	56.00	4.48	N	9.65

Final Result

Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.153500	---	49.93	55.81	5.88	N	9.55
0.153500	60.07	---	65.81	5.74	N	9.55
0.181500	---	46.06	54.42	8.35	N	9.57
0.181500	56.03	---	64.42	8.39	N	9.57
0.241500	---	40.55	52.04	11.49	N	9.58
0.241500	50.03	---	62.04	12.01	N	9.58
0.277500	---	38.32	50.89	12.57	N	9.59
0.277500	47.14	---	60.89	13.75	N	9.59
1.813500	---	35.46	46.00	10.54	N	9.65
1.813500	44.94	---	56.00	11.06	N	9.65

Remark:

Level=Reading Level + Correction Factor

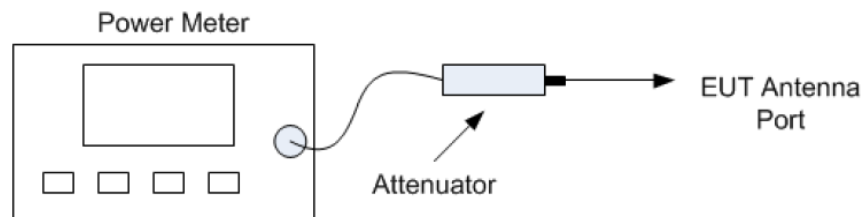
Correction Factor=Cable Loss + LISN Factor

(The Reading Level is recorded by software which is not shown in the sheet)

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

Limits

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	12.33	≤30	Pass
		2437	12.41	≤30	Pass
		2462	13.03	≤30	Pass
802.11g	SISO	2412	17.76	≤30	Pass
		2437	18.07	≤30	Pass
		2462	18.82	≤30	Pass
802.11n (HT20)	SISO	2412	17.42	≤30	Pass
		2437	17.91	≤30	Pass
		2462	18.67	≤30	Pass
802.11n (HT40)	SISO	2422	17.08	≤30	Pass
		2437	17.58	≤30	Pass
		2452	18.00	≤30	Pass

9.3 6dB Bandwidth

Test Method

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 $\geq$ 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

Limit [kHz]

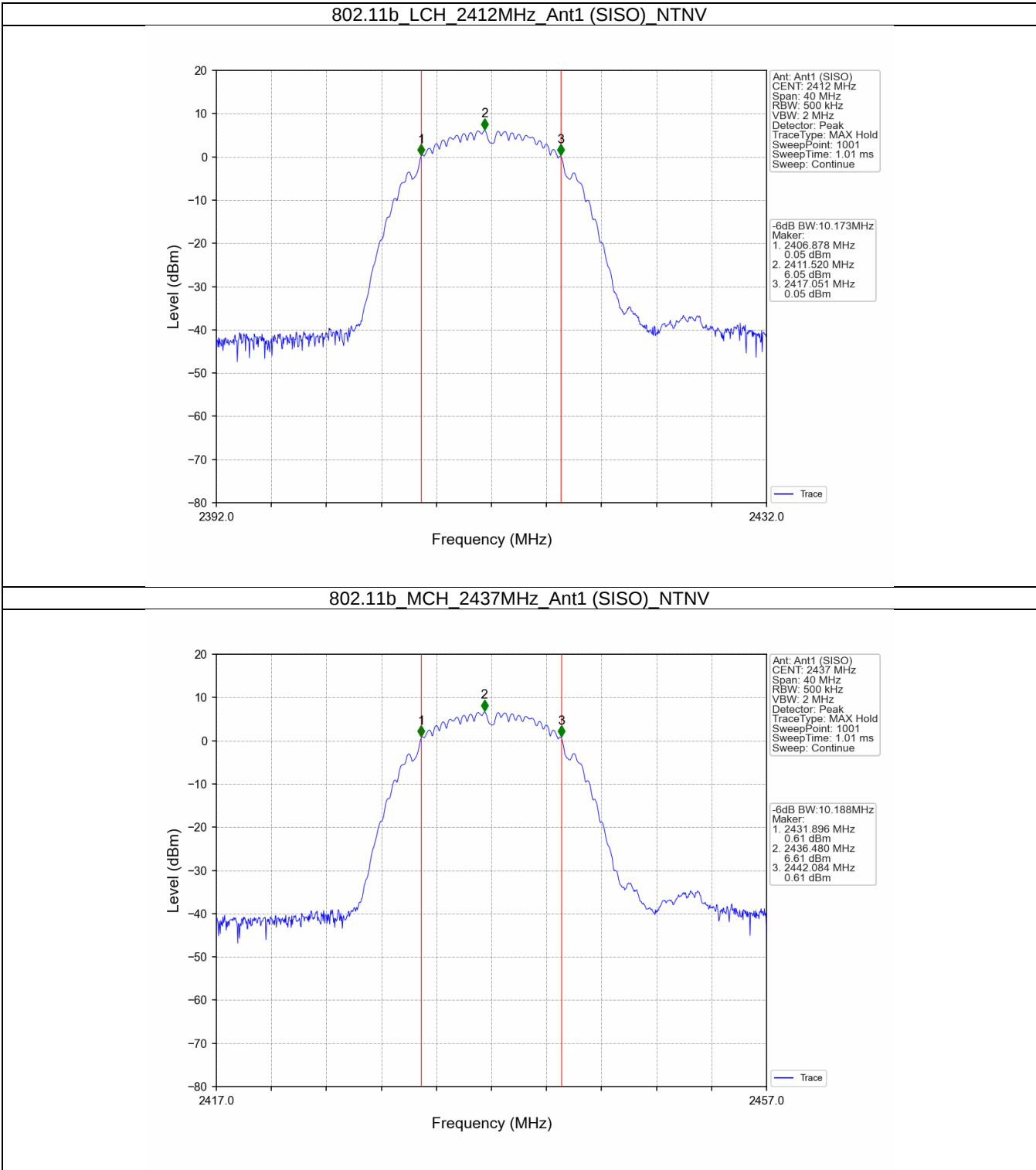
≥ 500

Test results

Mode	TX Type	Frequency (MHz)	6dB Bandwidth (MHz)		Verdict
			Result	Limit	
802.11b	SISO	2412	10.173	≥ 0.5	Pass
		2437	10.188	≥ 0.5	Pass
		2462	10.175	≥ 0.5	Pass
802.11g	SISO	2412	16.245	≥ 0.5	Pass
		2437	16.169	≥ 0.5	Pass
		2462	16.260	≥ 0.5	Pass
802.11n (HT20)	SISO	2412	17.134	≥ 0.5	Pass
		2437	17.227	≥ 0.5	Pass
		2462	17.127	≥ 0.5	Pass
802.11n (HT40)	SISO	2422	35.461	≥ 0.5	Pass
		2437	35.819	≥ 0.5	Pass
		2452	35.401	≥ 0.5	Pass

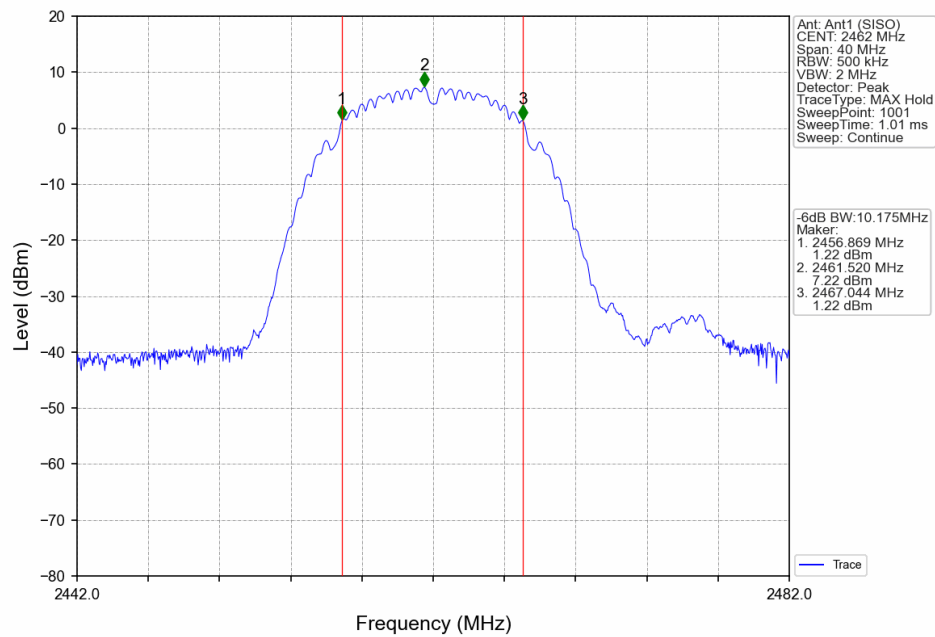


Test Graphs

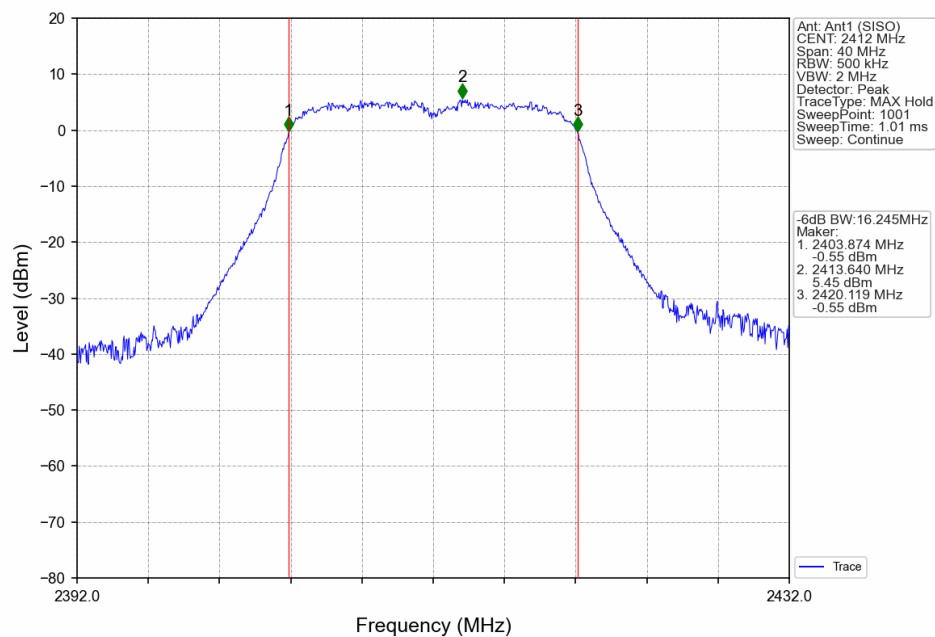




802.11b_HCH_2462MHz_Ant1 (SISO)_NTNV

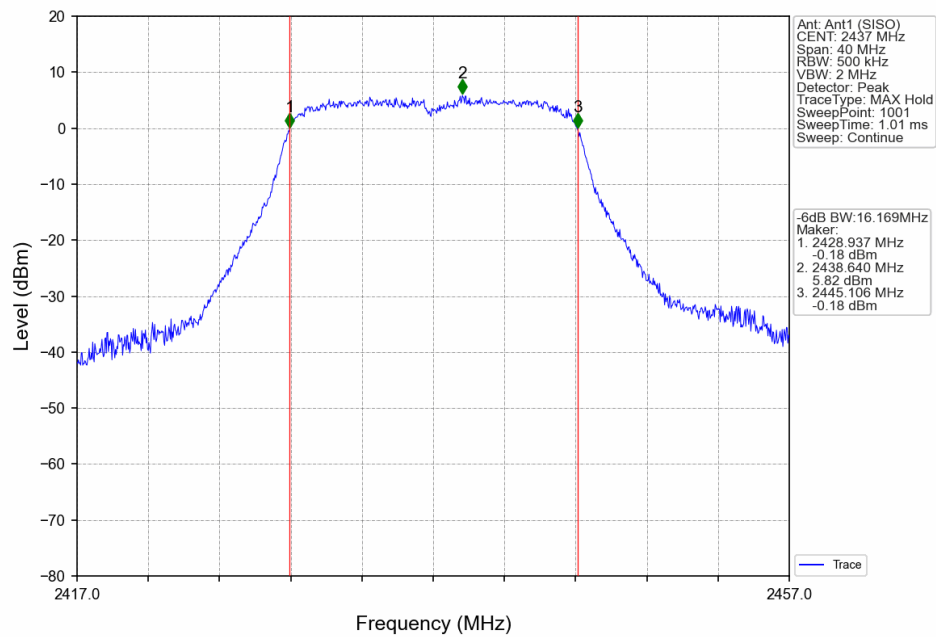


802.11g_LCH_2412MHz_Ant1 (SISO)_NTNV

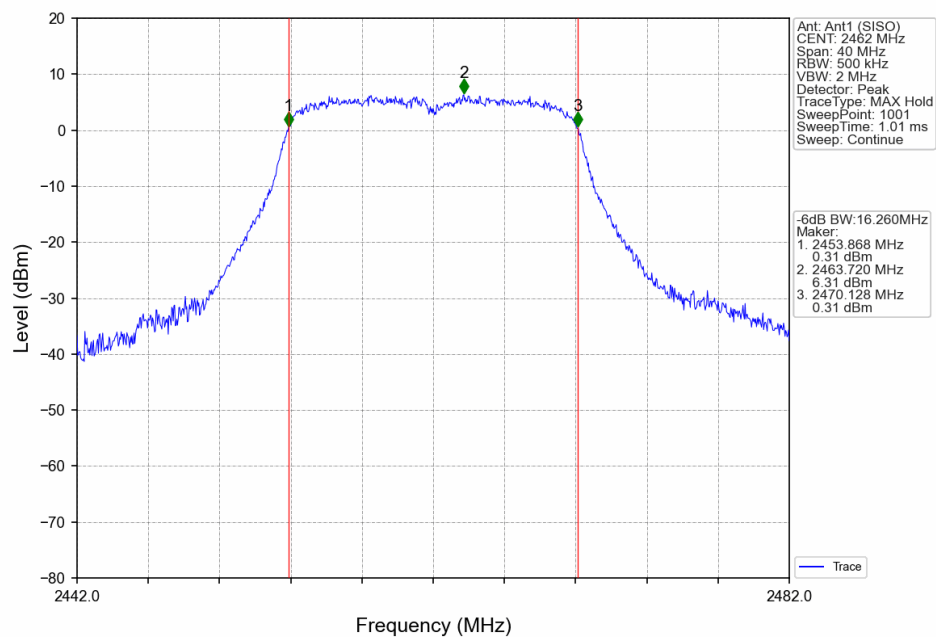




802.11g_MCH_2437MHz_Ant1 (SISO)_NTNV

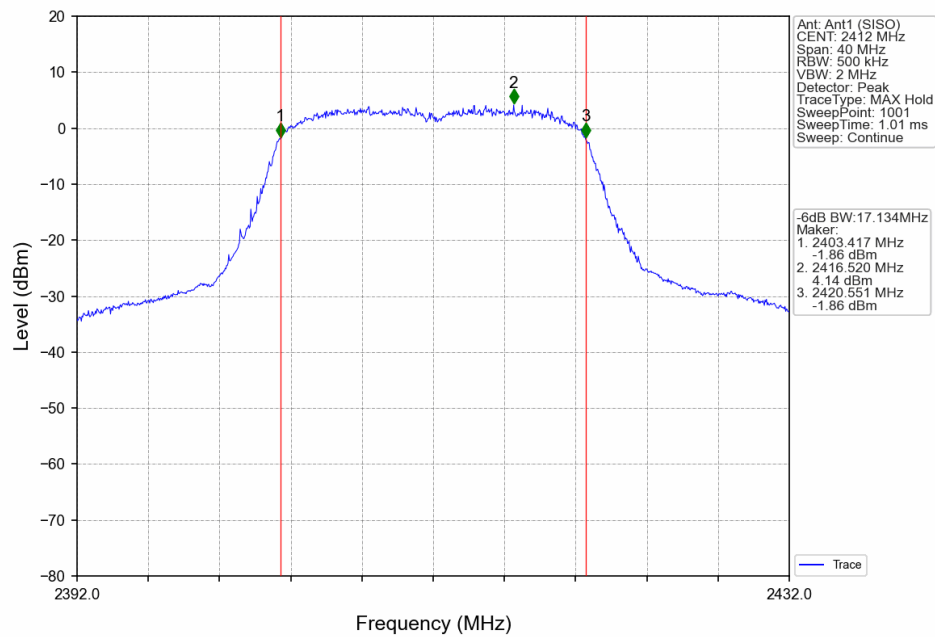


802.11g_HCH_2462MHz_Ant1 (SISO)_NTNV

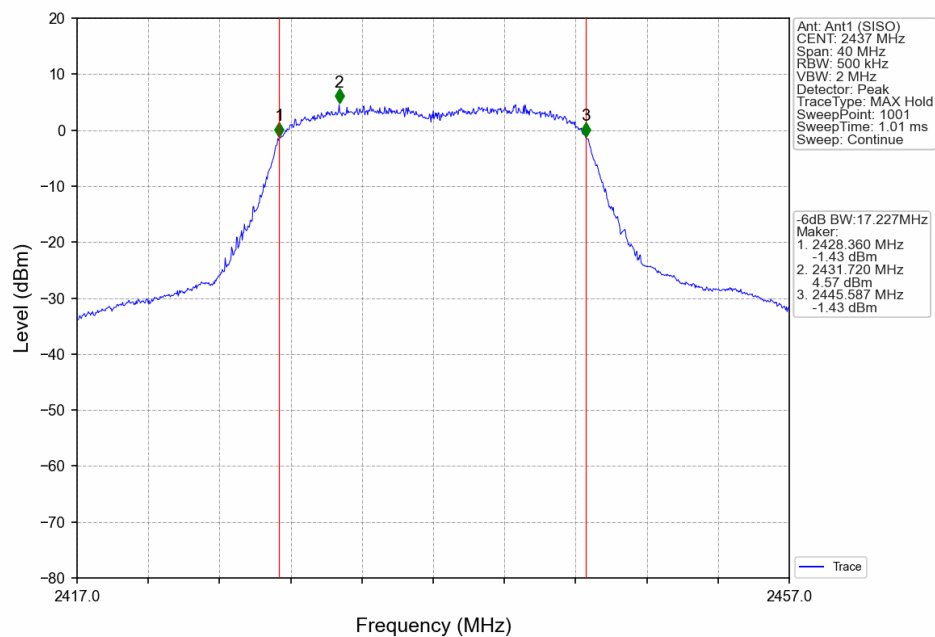




802.11n(HT20)_LCH_2412MHz_Ant1 (SISO)_NTNV

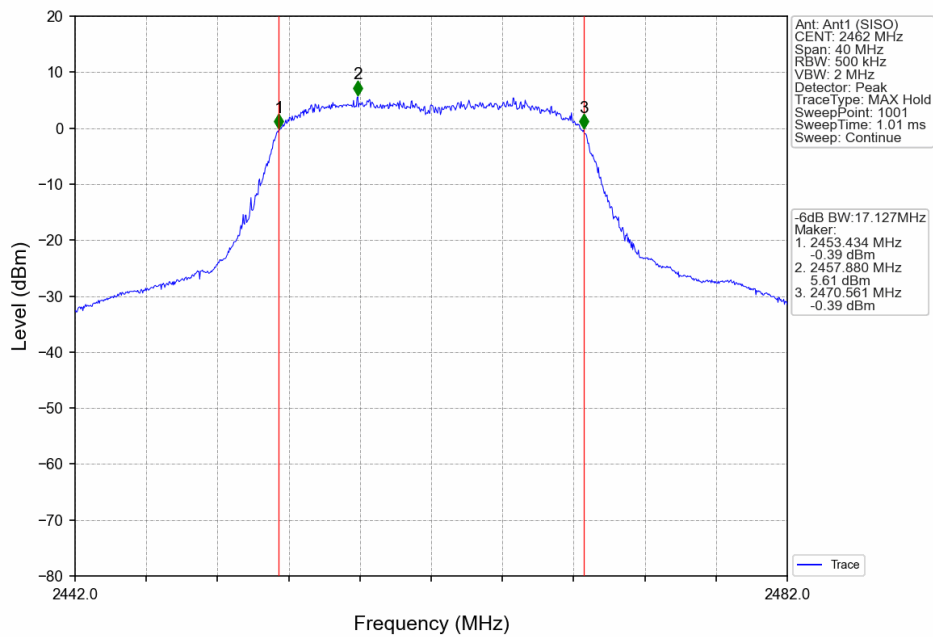


802.11n(HT20)_MCH_2437MHz_Ant1 (SISO)_NTNV

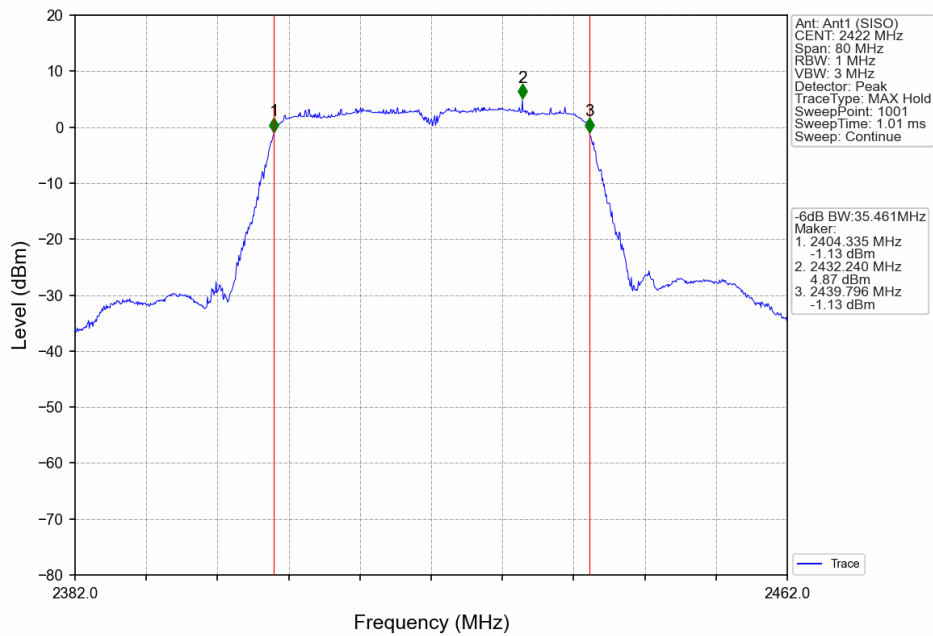




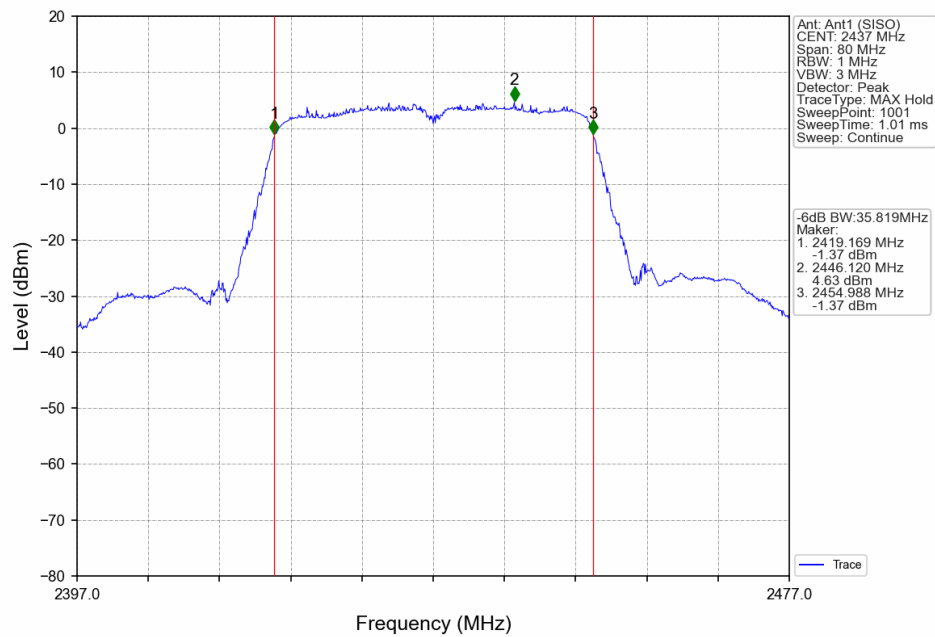
802.11n(HT20)_HCH_2462MHz_Ant1 (SISO)_NTNV



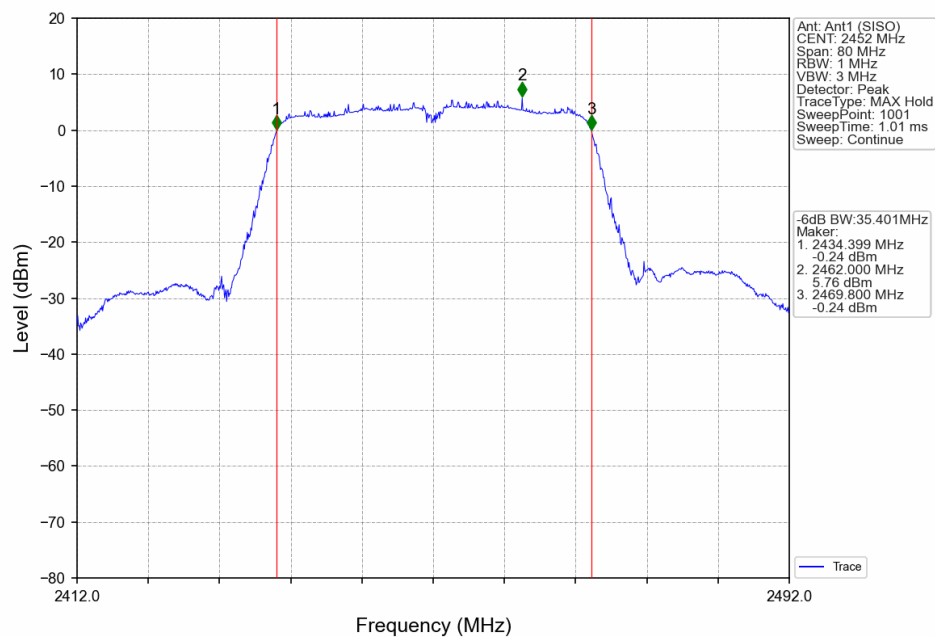
802.11n(HT40)_LCH_2422MHz_Ant1 (SISO)_NTNV



802.11n(HT40)_MCH_2437MHz_Ant1 (SISO)_NTNV



802.11n(HT40)_HCH_2452MHz_Ant1 (SISO)_NTNV



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 $\geq$ 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

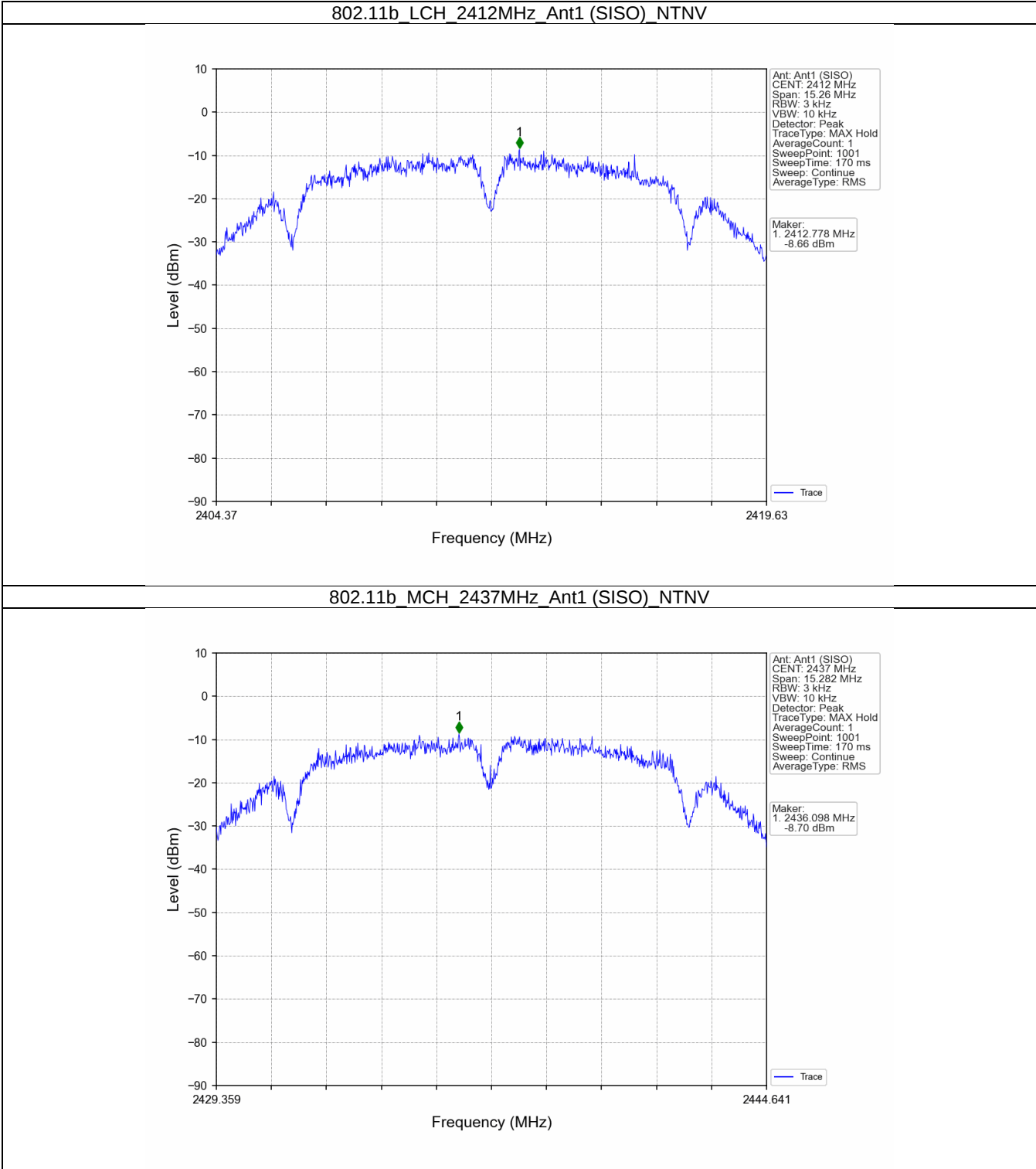
Limit [dBm/3kHz]

≤ 8

Test Results

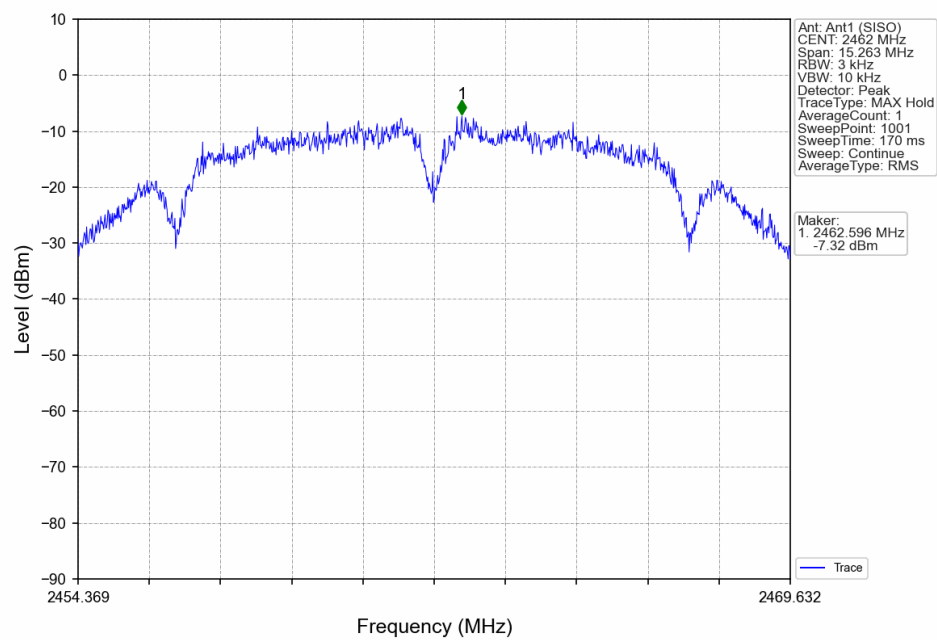
Mode	TX Type	Frequency (MHz)	Maximum PSD (dBm/3kHz)		Verdict
			Result	Limit	
802.11b	SISO	2412	-8.66	≤ 8	Pass
		2437	-8.70	≤ 8	Pass
		2462	-7.32	≤ 8	Pass
802.11g	SISO	2412	-13.96	≤ 8	Pass
		2437	-13.35	≤ 8	Pass
		2462	-13.73	≤ 8	Pass
802.11n (HT20)	SISO	2412	-15.75	≤ 8	Pass
		2437	-14.92	≤ 8	Pass
		2462	-14.91	≤ 8	Pass
802.11n (HT40)	SISO	2422	-19.54	≤ 8	Pass
		2437	-18.81	≤ 8	Pass
		2452	-17.63	≤ 8	Pass

Test Graphs

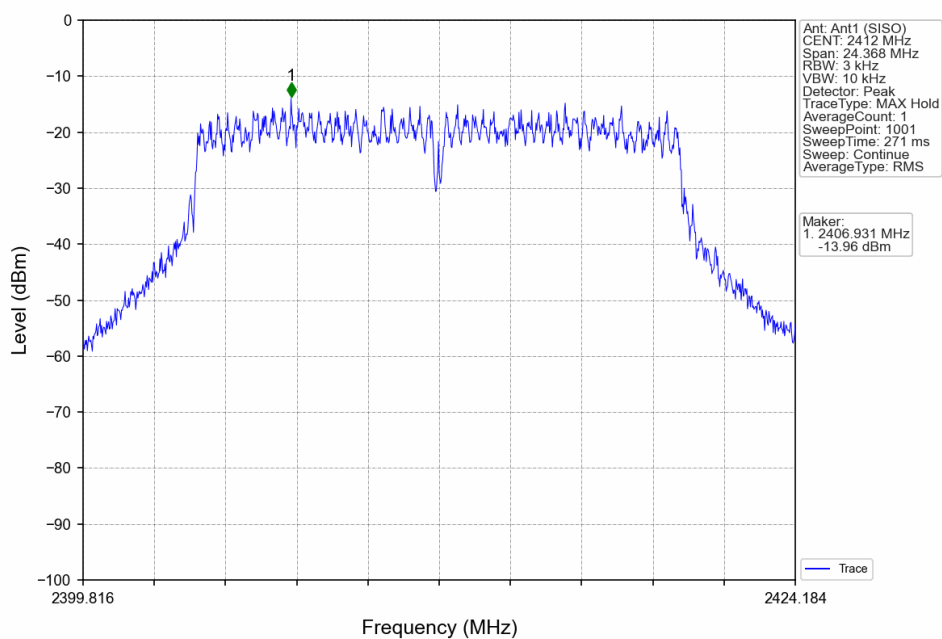




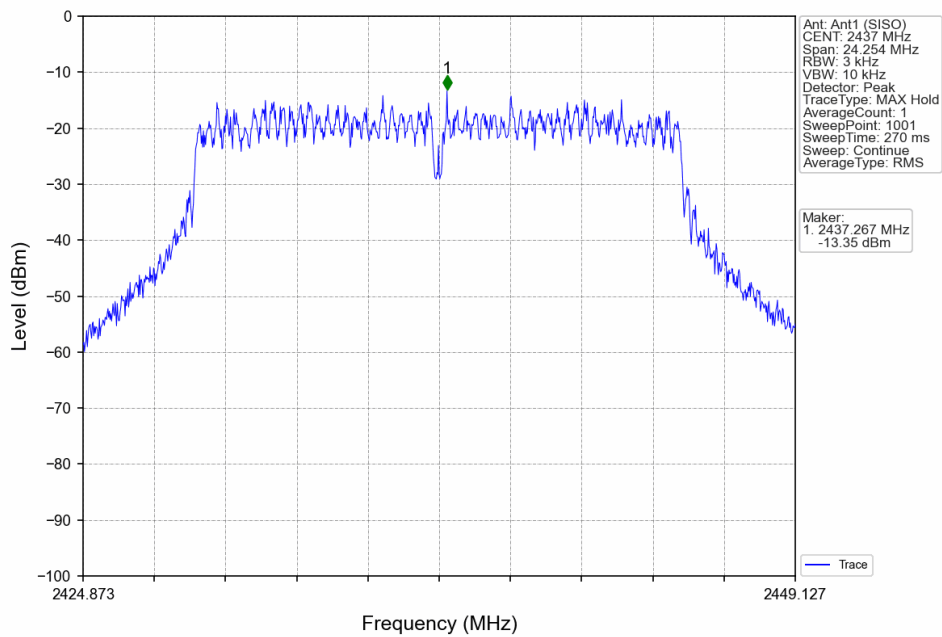
802.11b_HCH_2462MHz_Ant1 (SISO)_NTNV



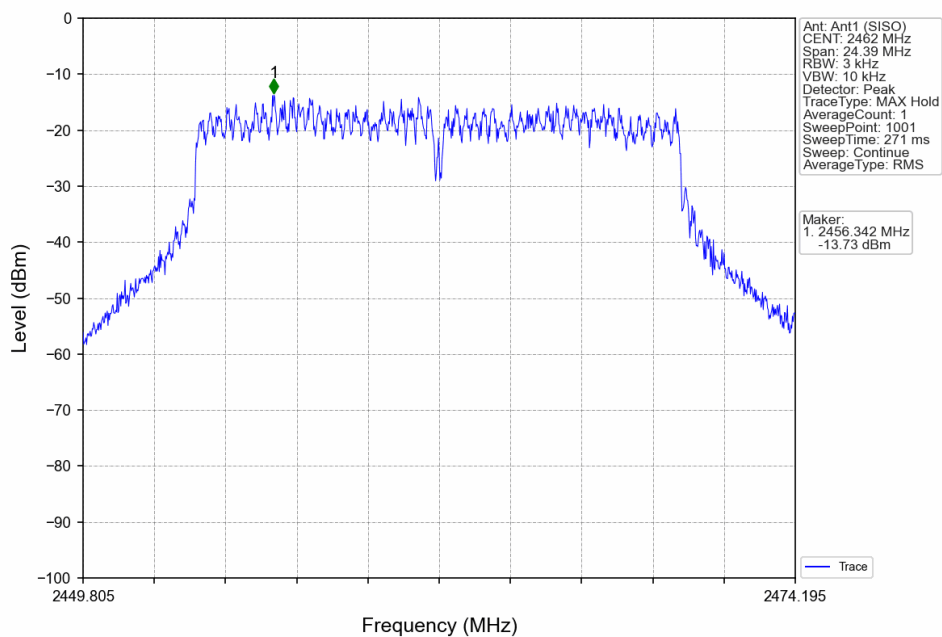
802.11g_LCH_2412MHz_Ant1 (SISO)_NTNV



802.11g_MCH_2437MHz_Ant1 (SISO)_NTNV

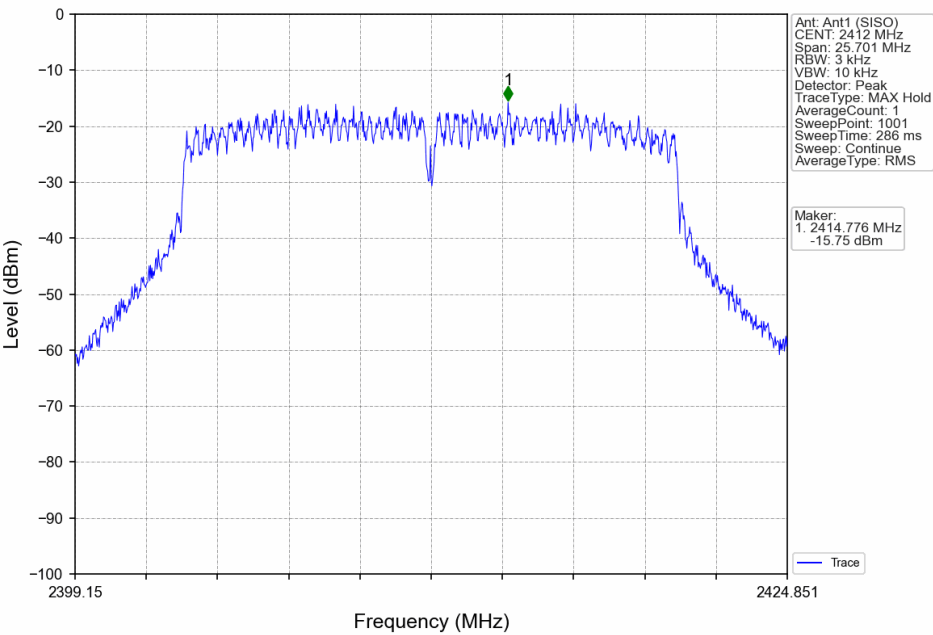


802.11g_HCH_2462MHz_Ant1 (SISO)_NTNV

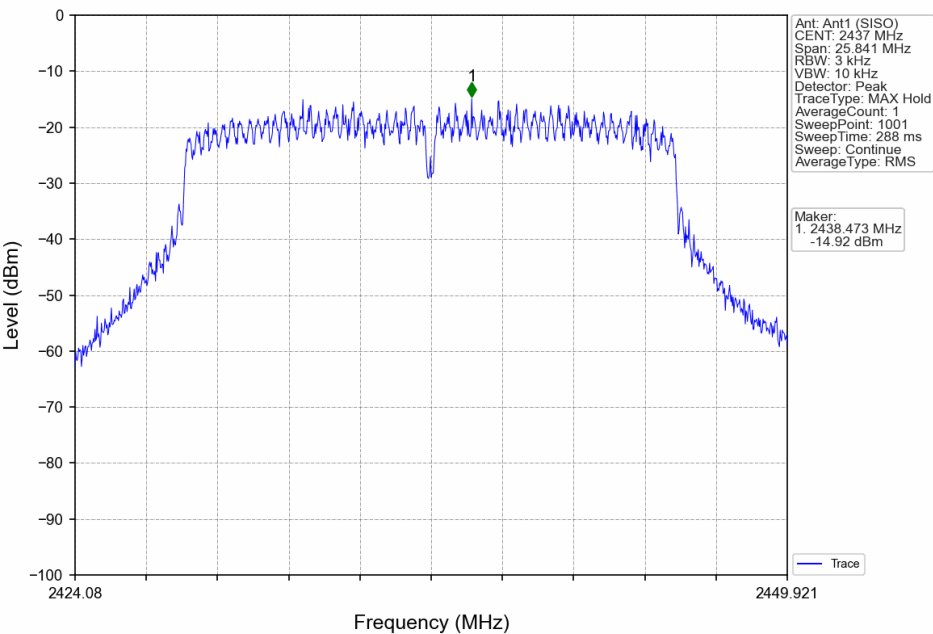




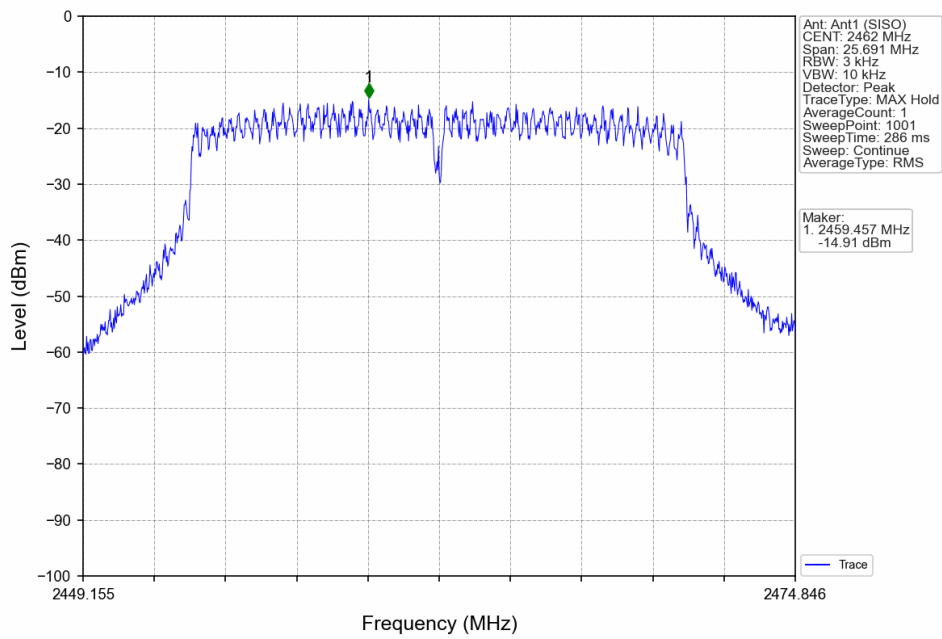
802.11n(HT20)_LCH_2412MHz_Ant1 (SISO)_NTNV



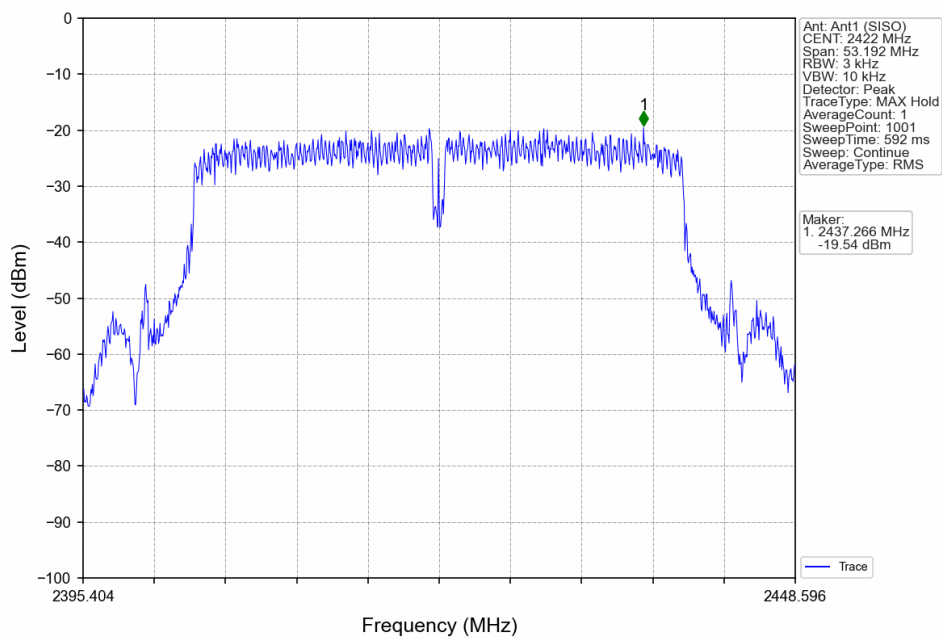
802.11n(HT20)_MCH_2437MHz_Ant1 (SISO)_NTNV



802.11n(HT20)_HCH_2462MHz_Ant1 (SISO)_NTNV

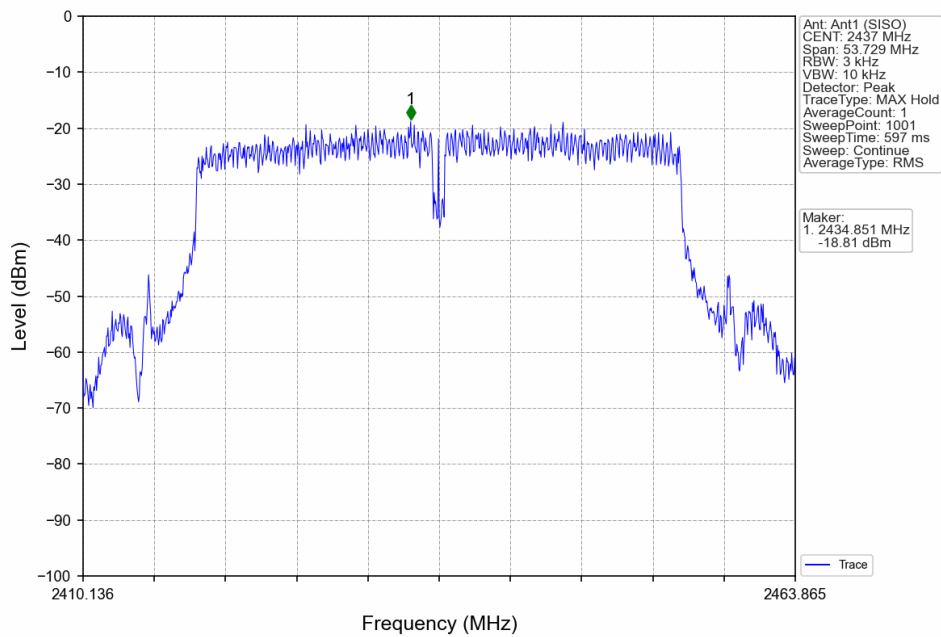


802.11n(HT40)_LCH_2422MHz_Ant1 (SISO)_NTNV

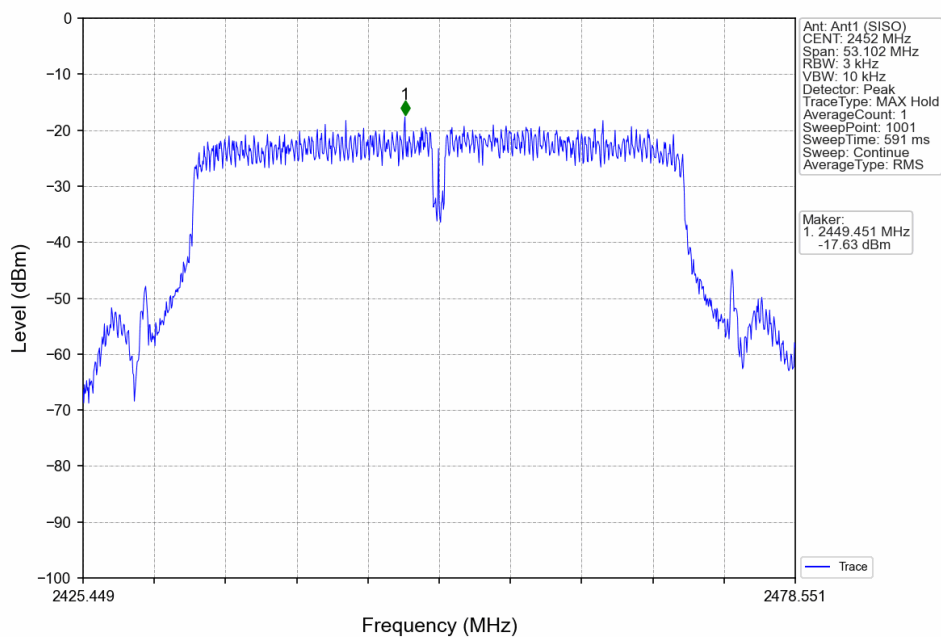




802.11n(HT40)_MCH_2437MHz_Ant1 (SISO)_NTNV



802.11n(HT40)_HCH_2452MHz_Ant1 (SISO)_NTNV



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 results

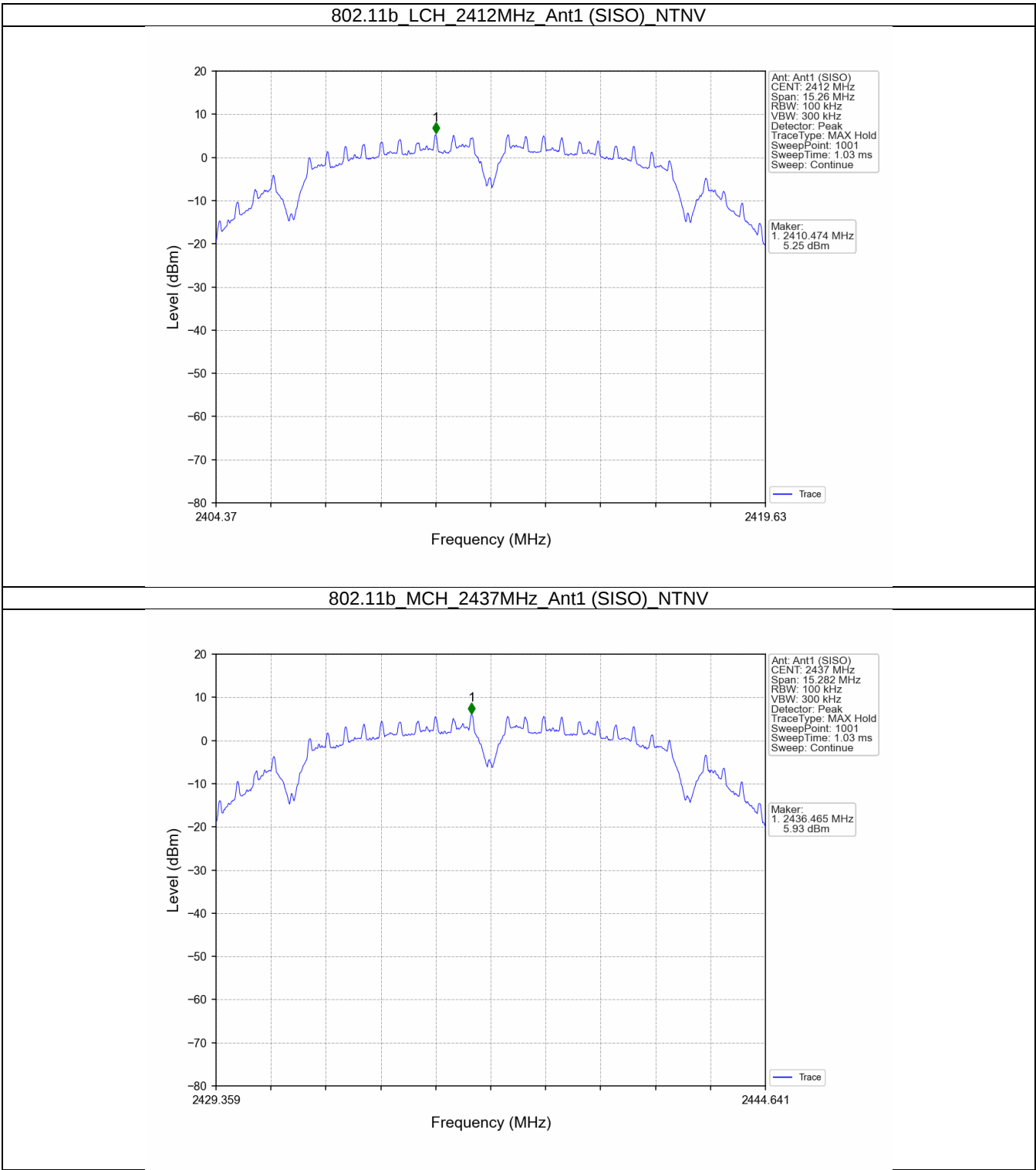
Mode	TX Type	Frequency (MHz)	Level of Reference (dBm)	Limit (dBm)	Verdict
802.11b	SISO	2412	5.25	-14.75	Pass
		2437	5.93	-14.07	Pass
		2462	6.28	-13.72	Pass
802.11g	SISO	2412	-1.57	-21.57	Pass
		2437	-1.22	-21.22	Pass
		2462	-0.50	-20.50	Pass
802.11n (HT20)	SISO	2412	-1.93	-21.93	Pass
		2437	-1.21	-21.21	Pass
		2462	-0.82	-20.82	Pass
802.11n (HT40)	SISO	2422	-5.09	-25.09	Pass
		2437	-4.57	-24.57	Pass
		2452	-3.90	-23.90	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.



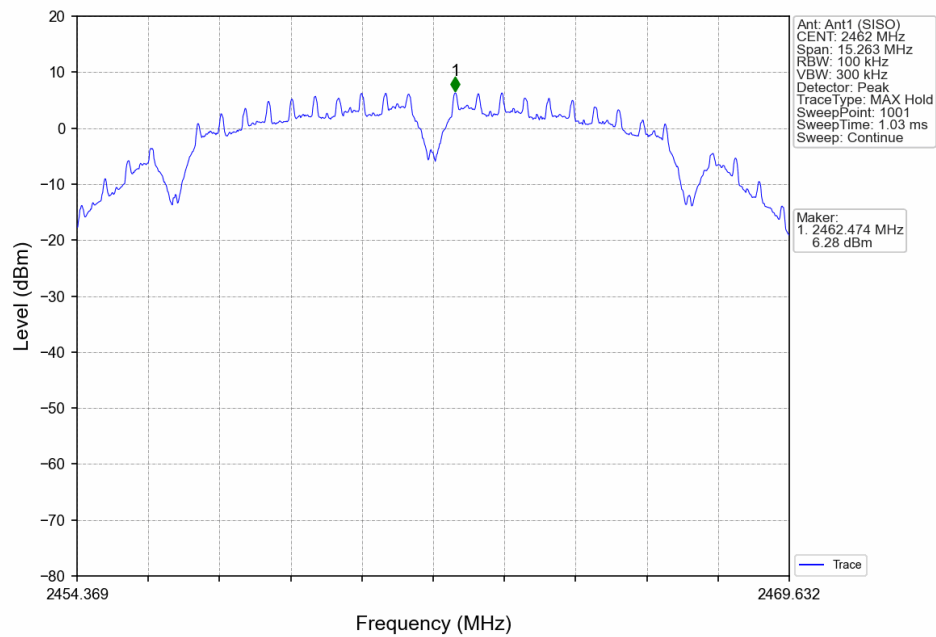
Test Graphs

Reference level

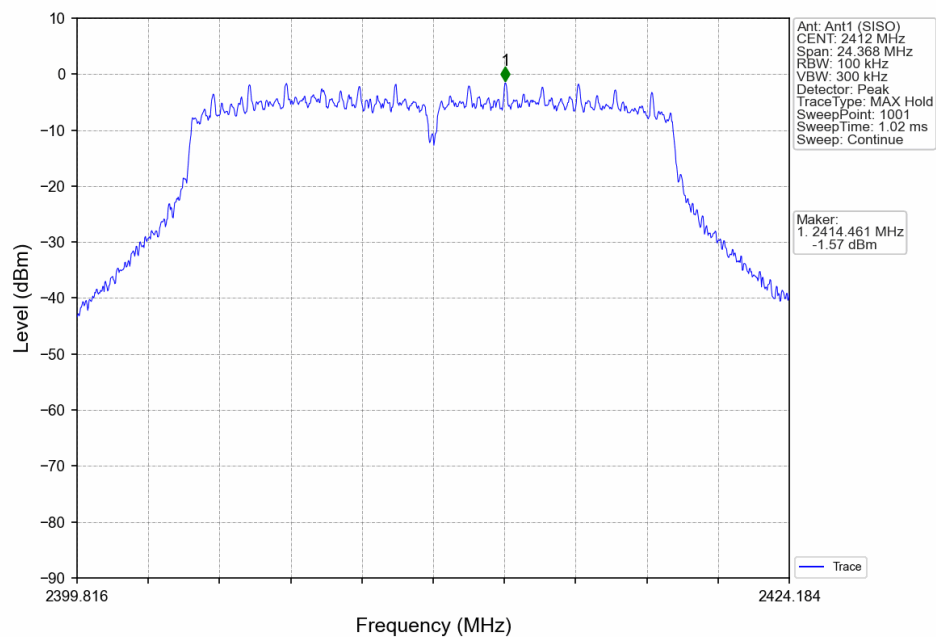




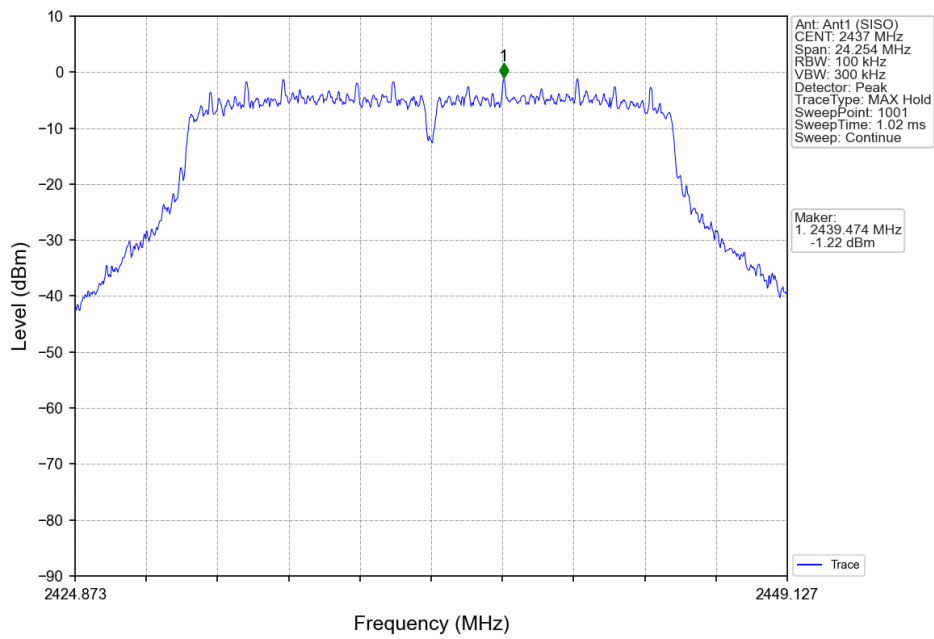
802.11b_HCH_2462MHz_Ant1 (SISO)_NTNV



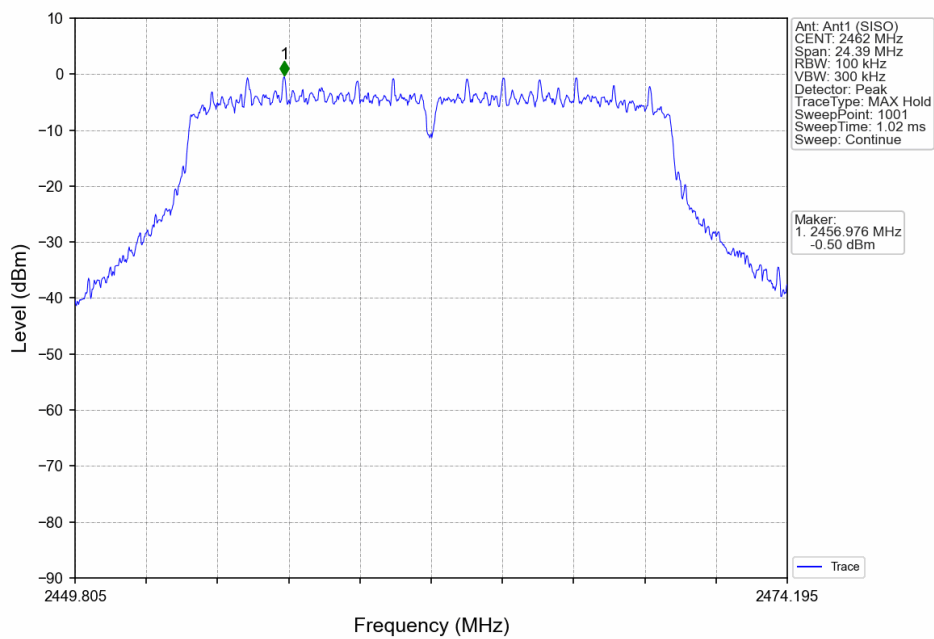
802.11g_LCH_2412MHz_Ant1 (SISO)_NTNV



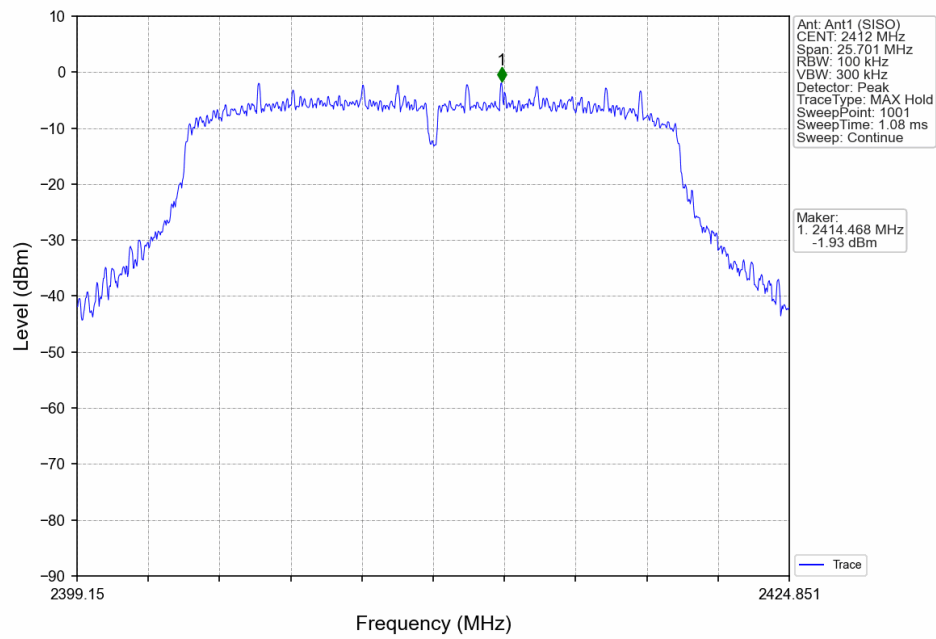
802.11g_MCH_2437MHz_Ant1 (SISO)_NTNV



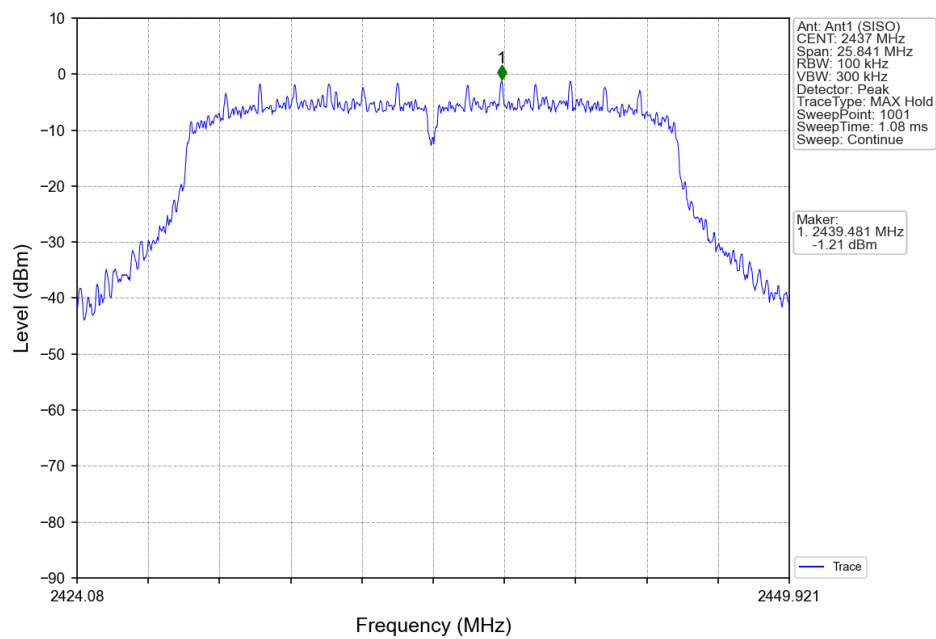
802.11g_HCH_2462MHz_Ant1 (SISO)_NTNV



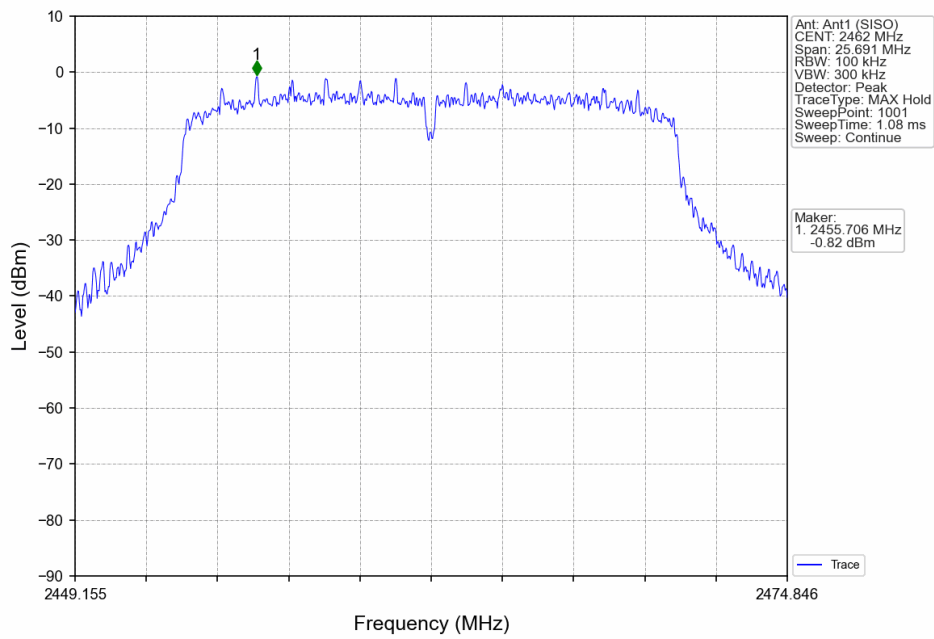
802.11n(HT20)_LCH_2412MHz_Ant1 (SISO)_NTNV



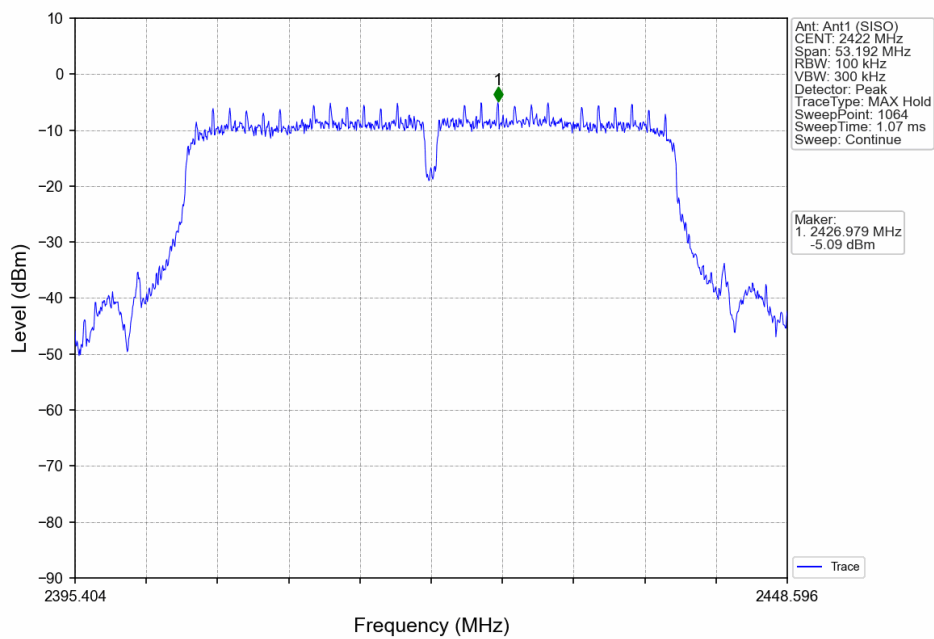
802.11n(HT20)_MCH_2437MHz_Ant1 (SISO)_NTNV



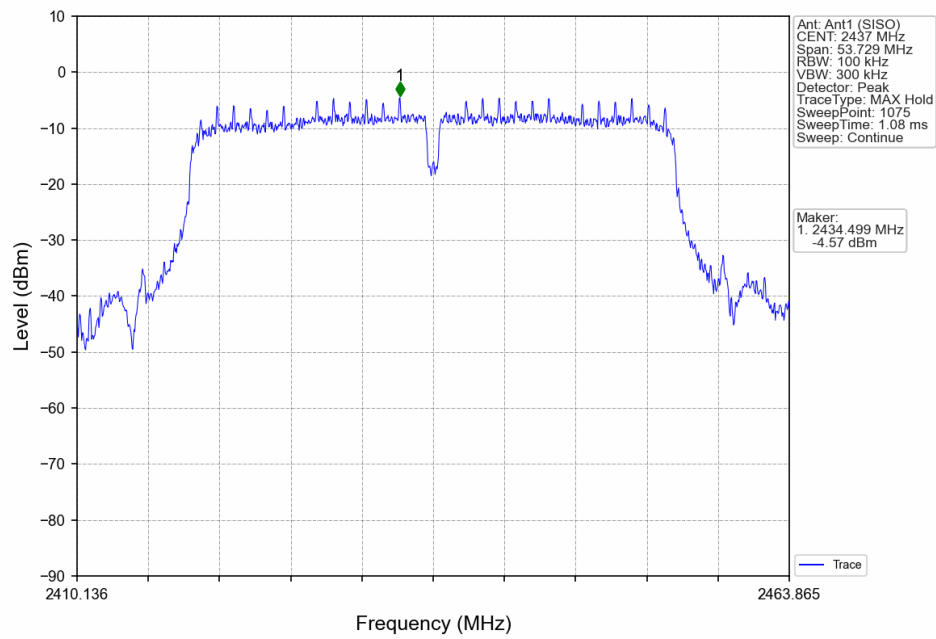
802.11n(HT20)_HCH_2462MHz_Ant1 (SISO)_NTNV



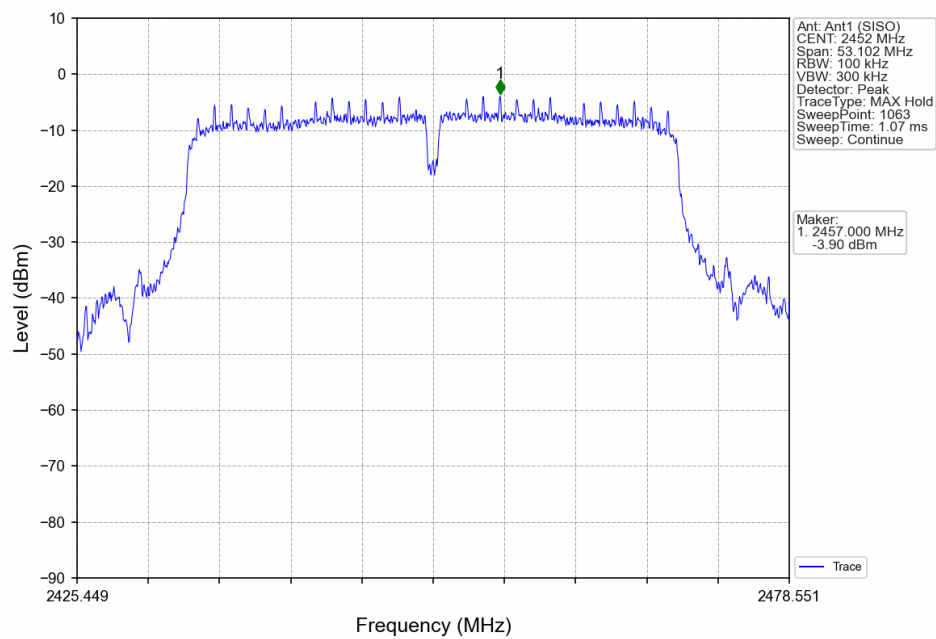
802.11n(HT40)_LCH_2422MHz_Ant1 (SISO)_NTNV



802.11n(HT40)_MCH_2437MHz_Ant1 (SISO)_NTNV

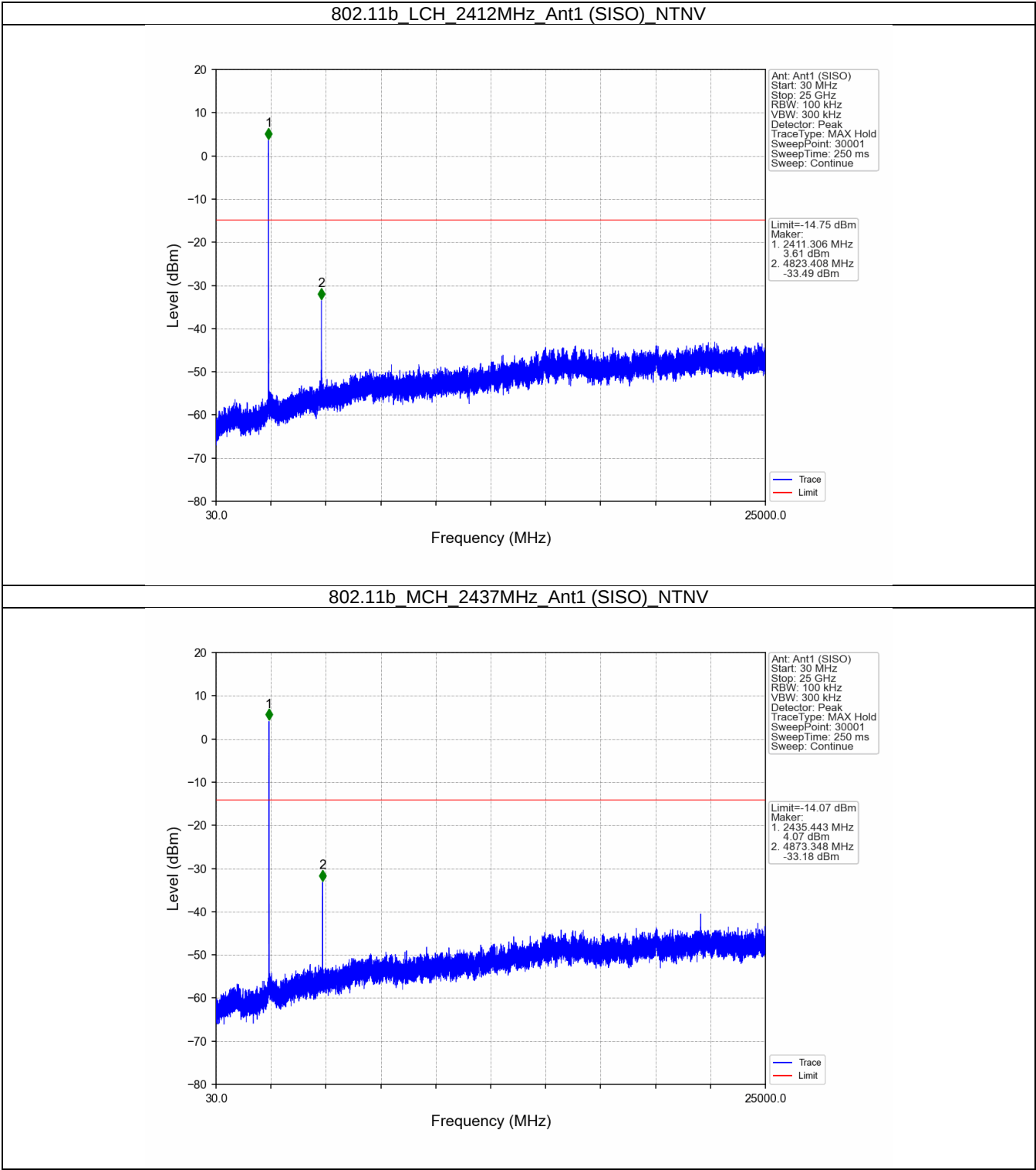


802.11n(HT40)_HCH_2452MHz_Ant1 (SISO)_NTNV



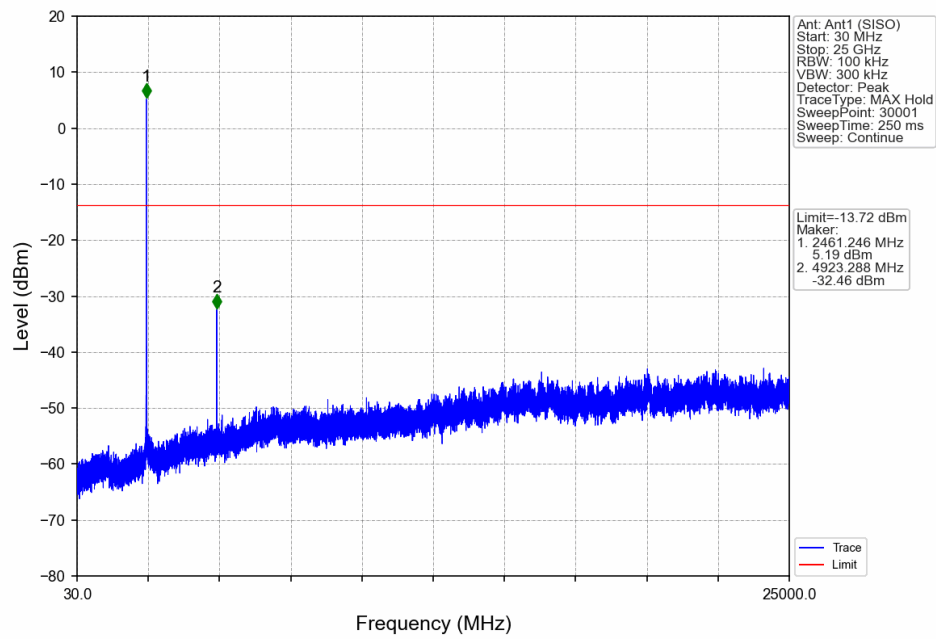


Conducted spurious emissions

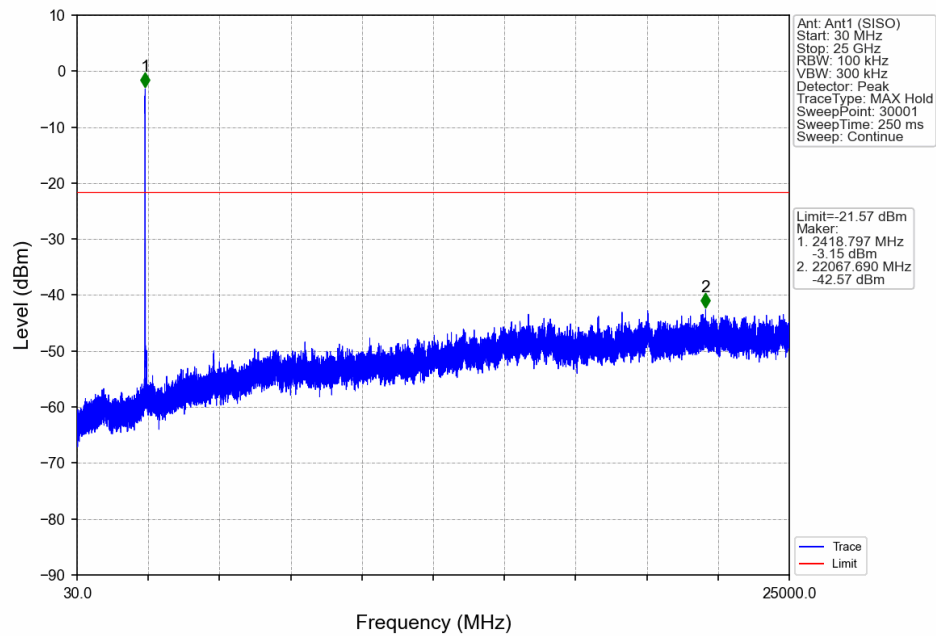




802.11b_HCH_2462MHz_Ant1 (SISO)_NTNV

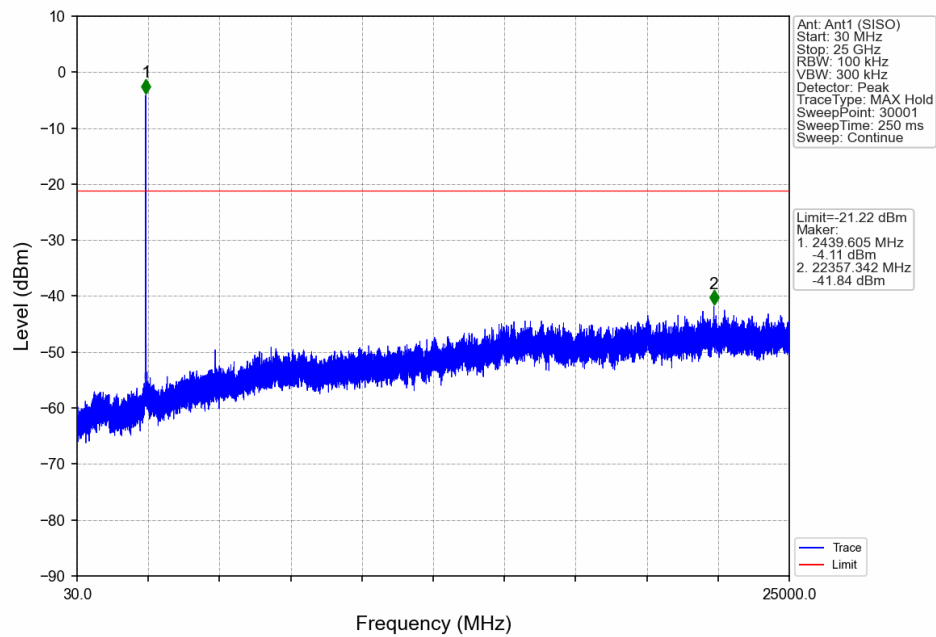


802.11g_LCH_2412MHz_Ant1 (SISO)_NTNV

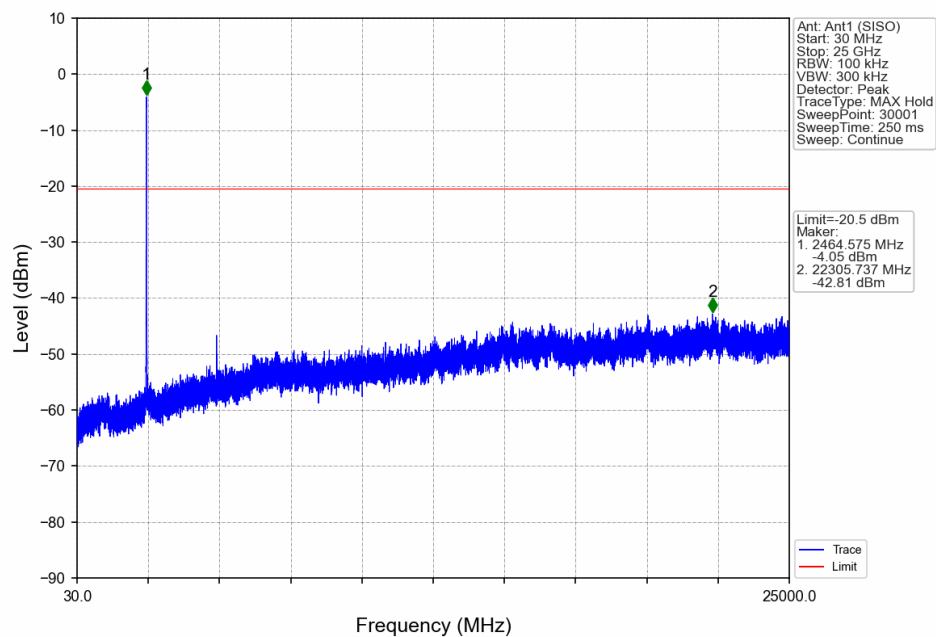




802.11g_MCH_2437MHz_Ant1 (SISO)_NTNV

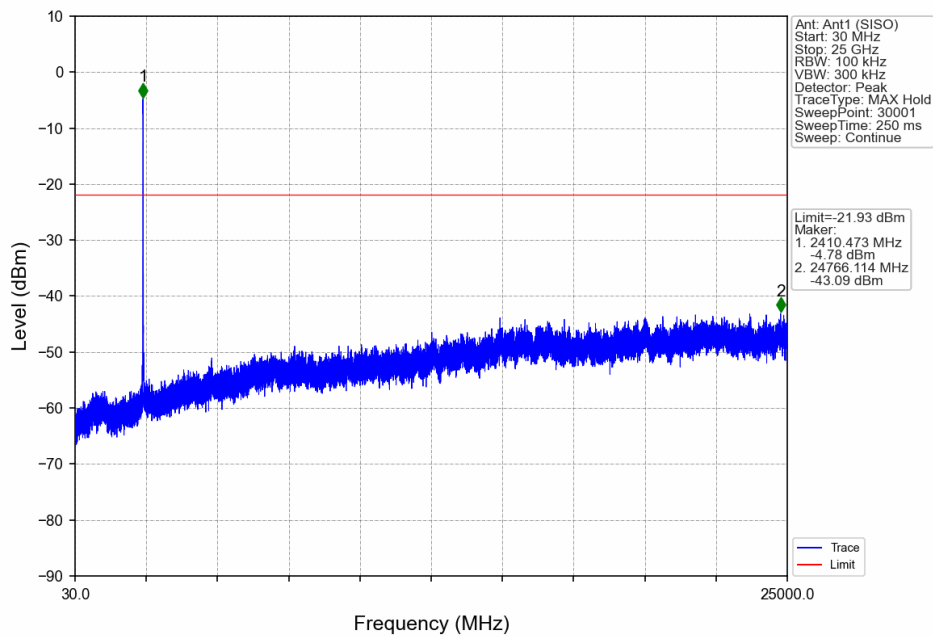


802.11g_HCH_2462MHz_Ant1 (SISO)_NTNV

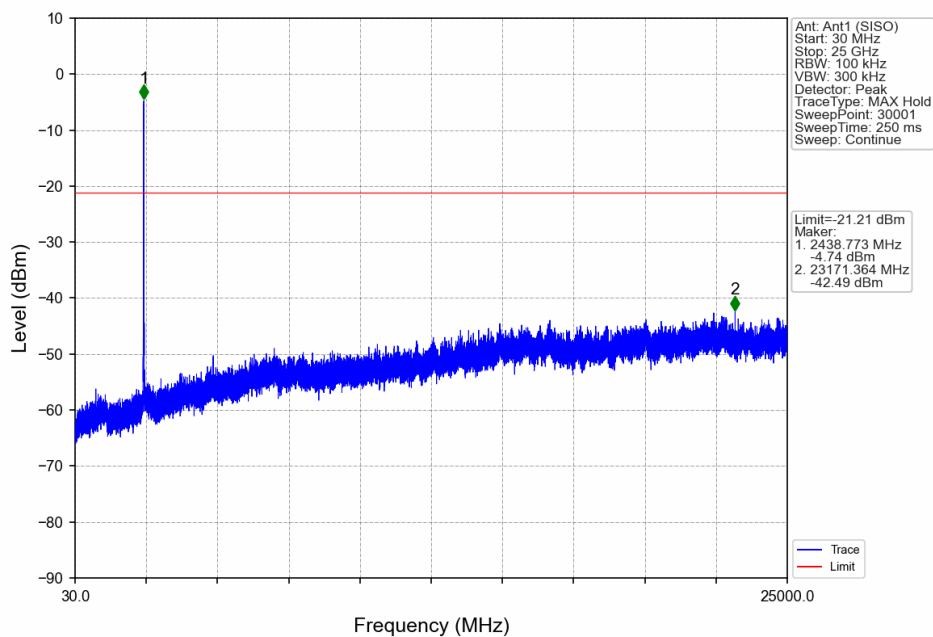




802.11n(HT20)_LCH_2412MHz_Ant1 (SISO)_NTNV

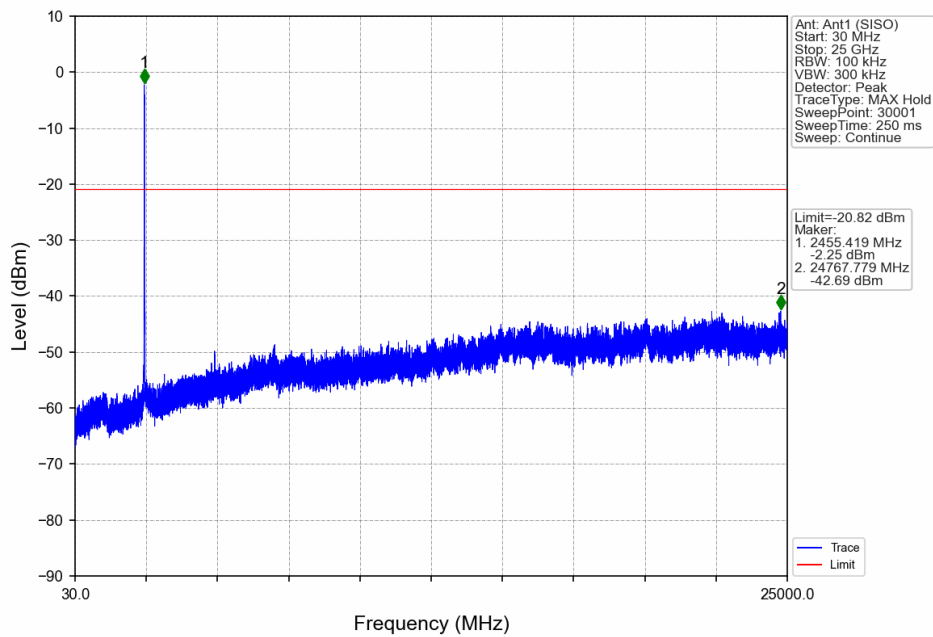


802.11n(HT20)_MCH_2437MHz_Ant1 (SISO)_NTNV

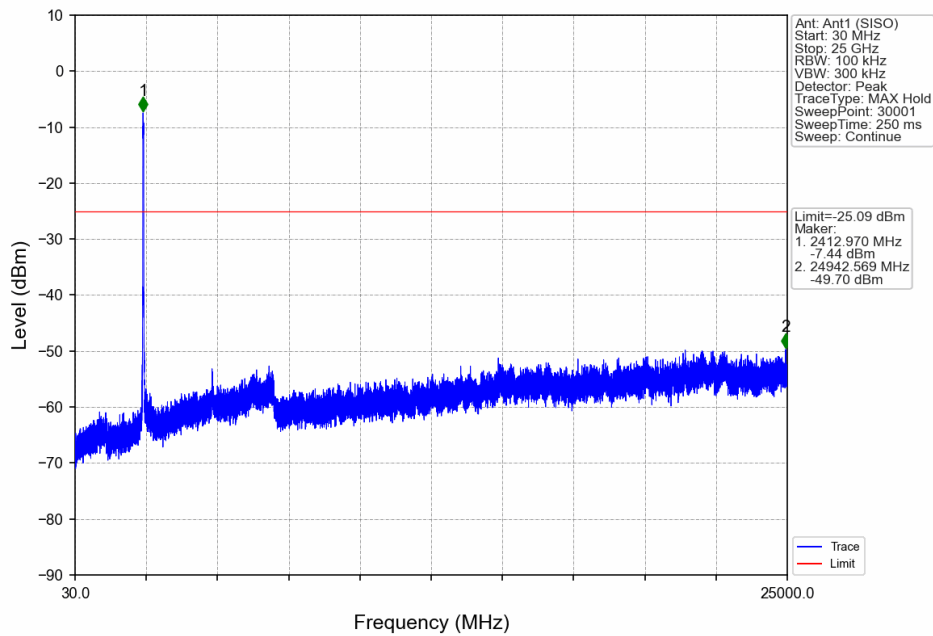




802.11n(HT20)_HCH_2462MHz_Ant1 (SISO)_NTNV

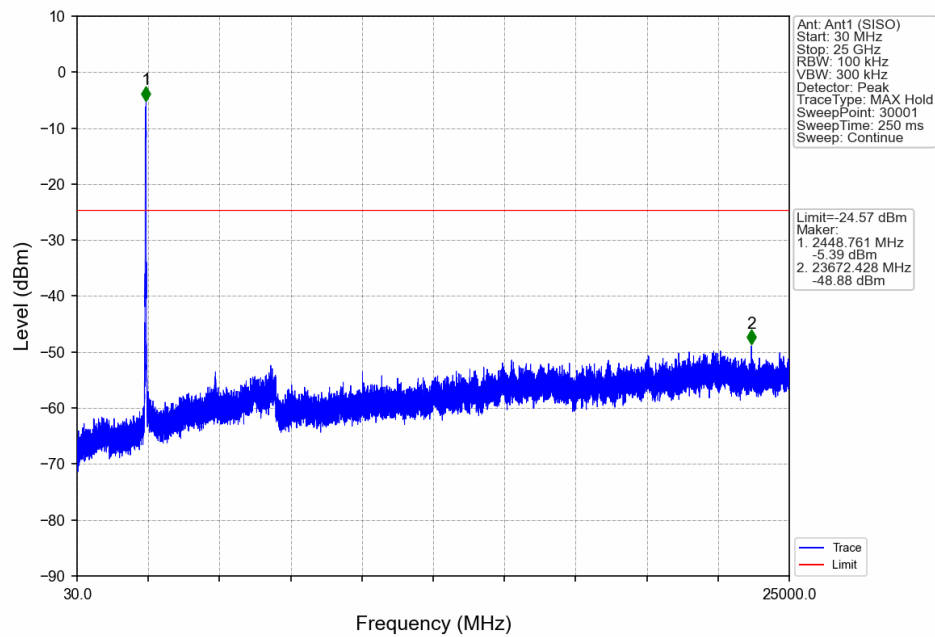


802.11n(HT40)_LCH_2422MHz_Ant1 (SISO)_NTNV

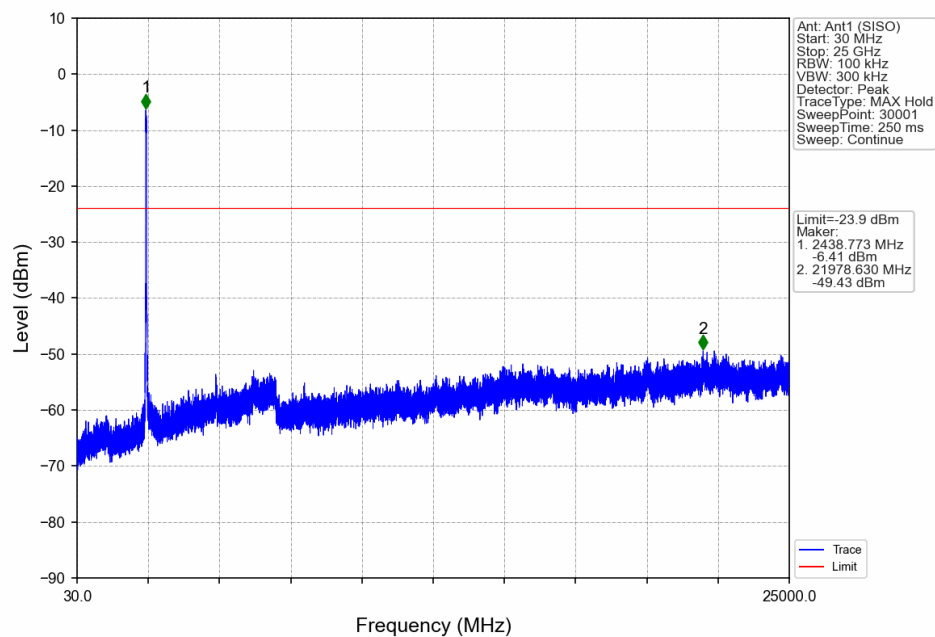




802.11n(HT40)_MCH_2437MHz_Ant1 (SISO)_NTNV



802.11n(HT40)_HCH_2452MHz_Ant1 (SISO)_NTNV



9.6 Band Edge

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 $\geq$ 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.

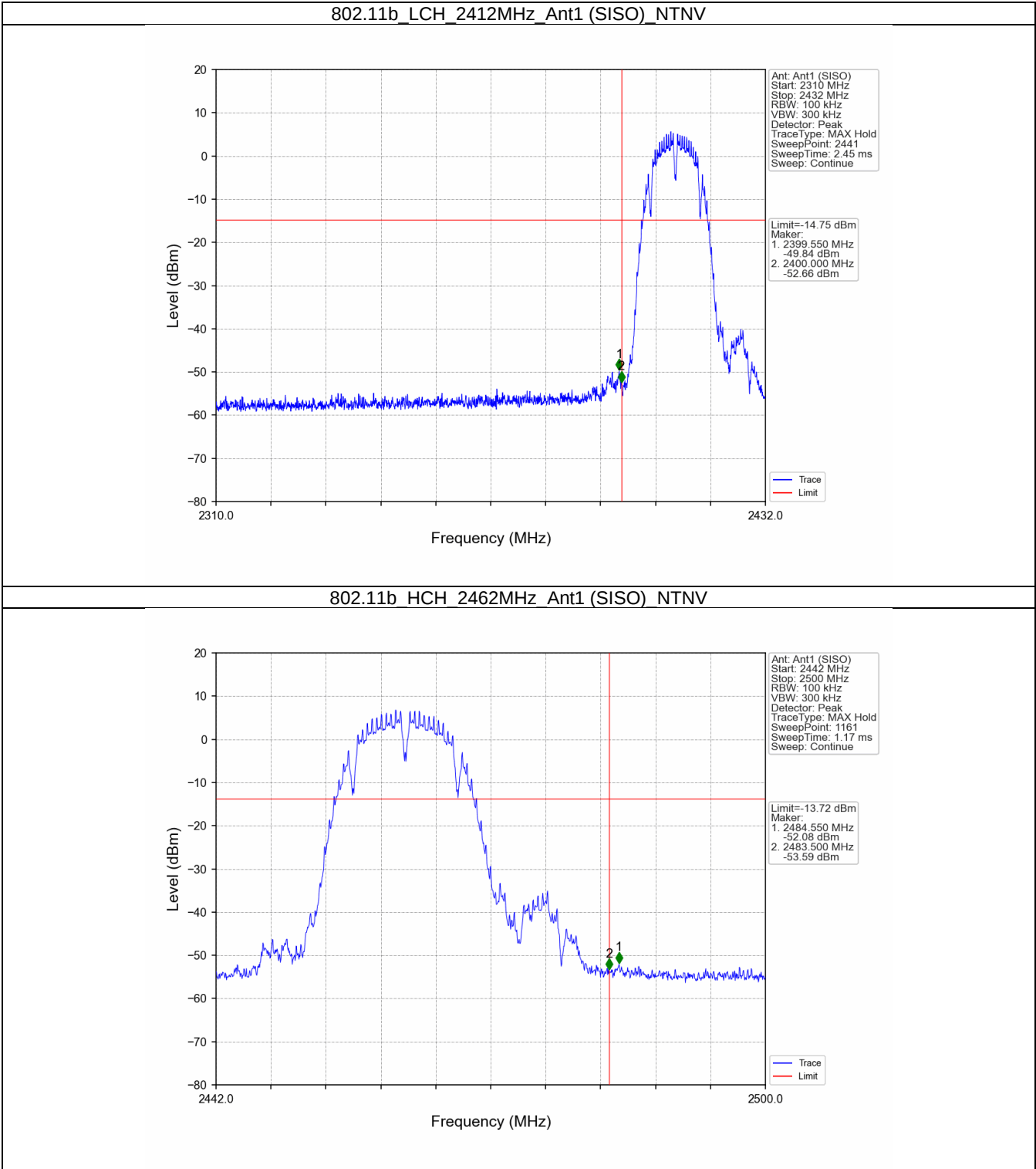
Frequency Range MHz	Limit (dBc)
30-25000	-20

Test results

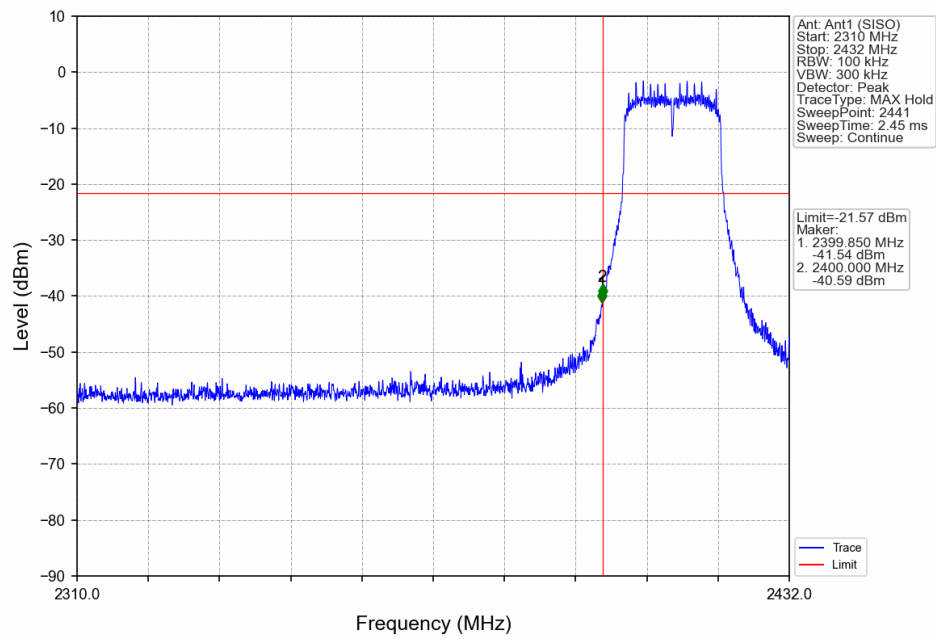
Mode	TX Type	Frequency (MHz)	Level of Reference (dBm)	Limit (dBm)	Verdict
802.11b	SISO	2412	5.25	-14.75	Pass
		2462	6.28	-13.72	Pass
802.11g	SISO	2412	-1.57	-21.57	Pass
		2462	-0.50	-20.50	Pass
802.11n (HT20)	SISO	2412	-1.93	-21.93	Pass
		2462	-0.82	-20.82	Pass
802.11n (HT40)	SISO	2422	-5.09	-25.09	Pass
		2452	-3.90	-23.90	Pass



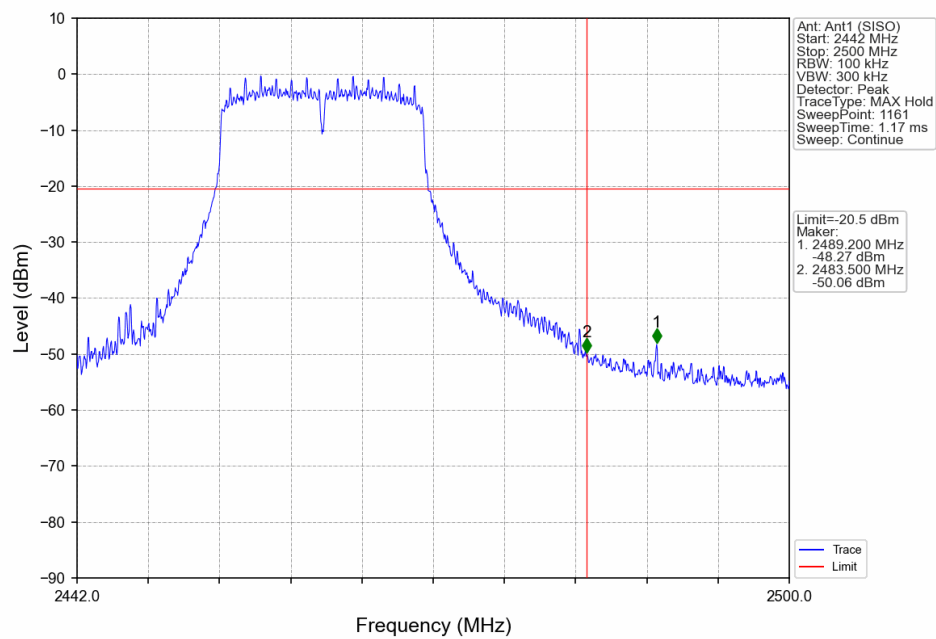
Test Graphs



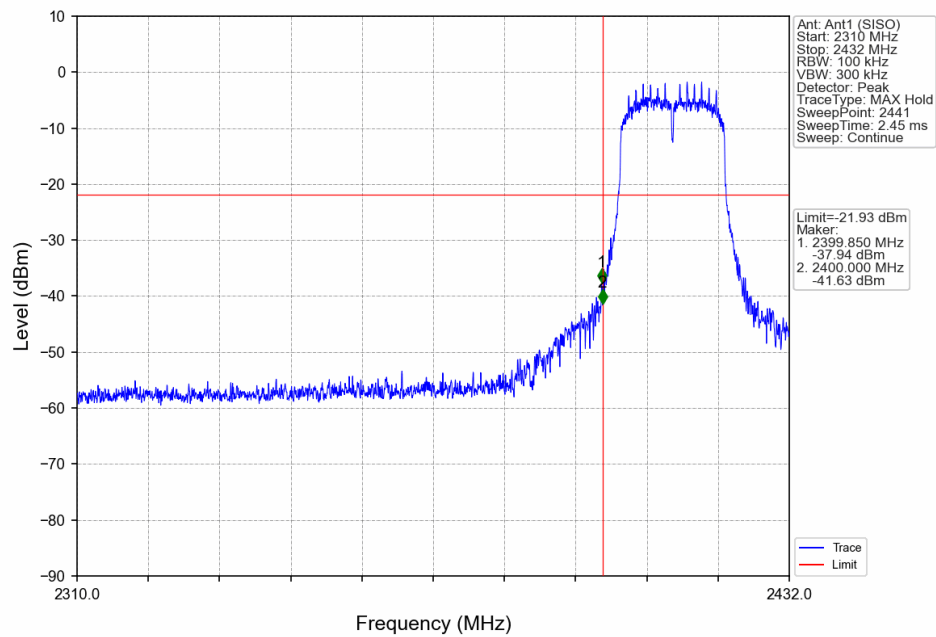
802.11g_LCH_2412MHz_Ant1 (SISO)_NTNV



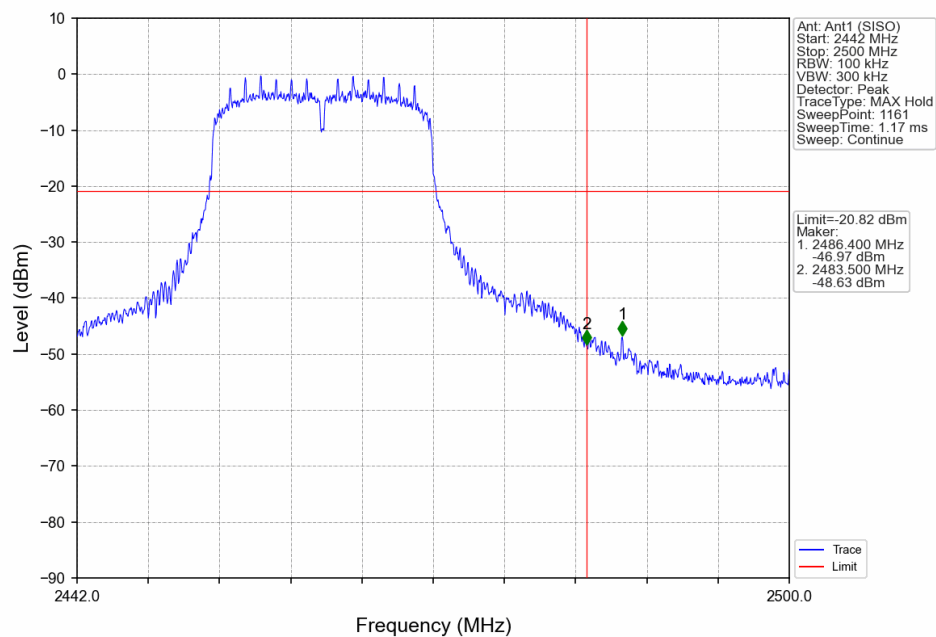
802.11g_HCH_2462MHz_Ant1 (SISO)_NTNV



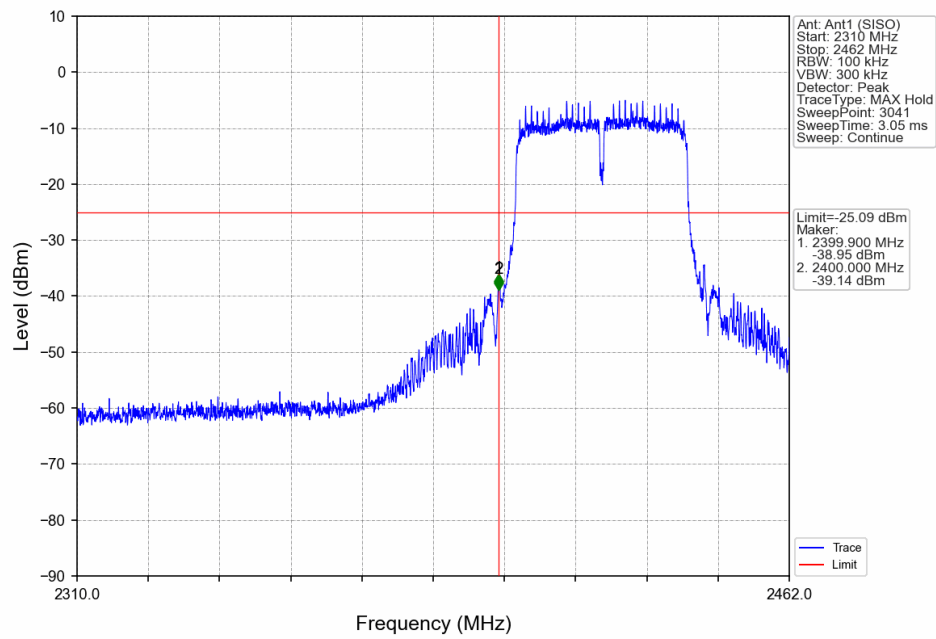
802.11n(HT20)_LCH_2412MHz_Ant1 (SISO)_NTNV



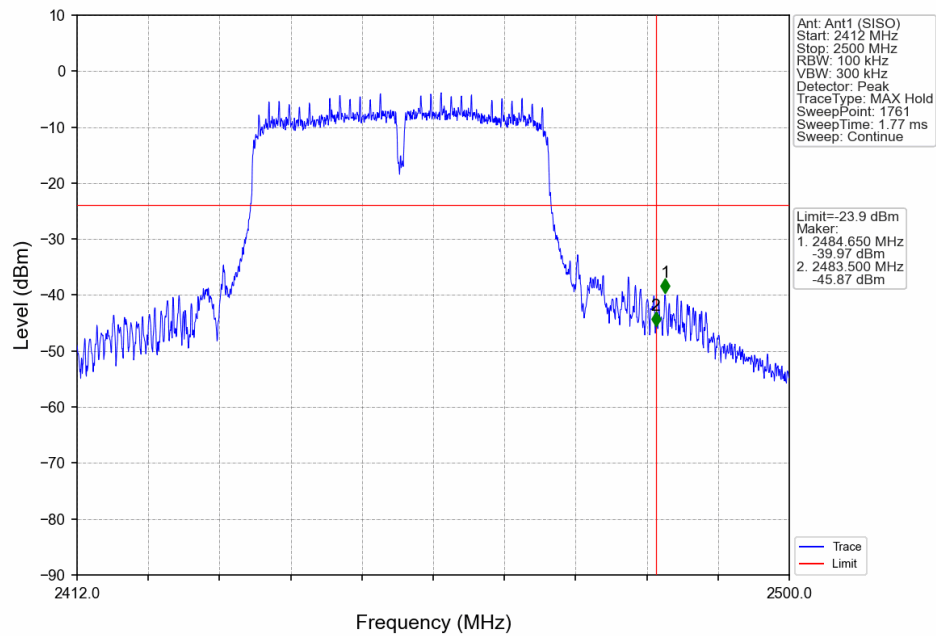
802.11n(HT20)_HCH_2462MHz_Ant1 (SISO)_NTNV



802.11n(HT40)_LCH_2422MHz_Ant1 (SISO)_NTNV



802.11n(HT40)_HCH_2452MHz_Ant1 (SISO)_NTNV



9.7 Spurious Radiated Emissions for Transmitter

Test Method

1. The EUT was placed 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.

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 $\mu\text{V/m}$	Field Strength dB $\mu\text{V/m}$	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(dB $\mu\text{V/m}$)=Limit 300m(dB $\mu\text{V/m}$)+40Log(300m/3m) (Below 30MHz)

Note 2: Limit 3m(dB $\mu\text{V/m}$)=Limit 30m(dB $\mu\text{V/m}$)+40Log(30m/3m) (Below 30MHz)

Spurious radiated emissions for transmitter

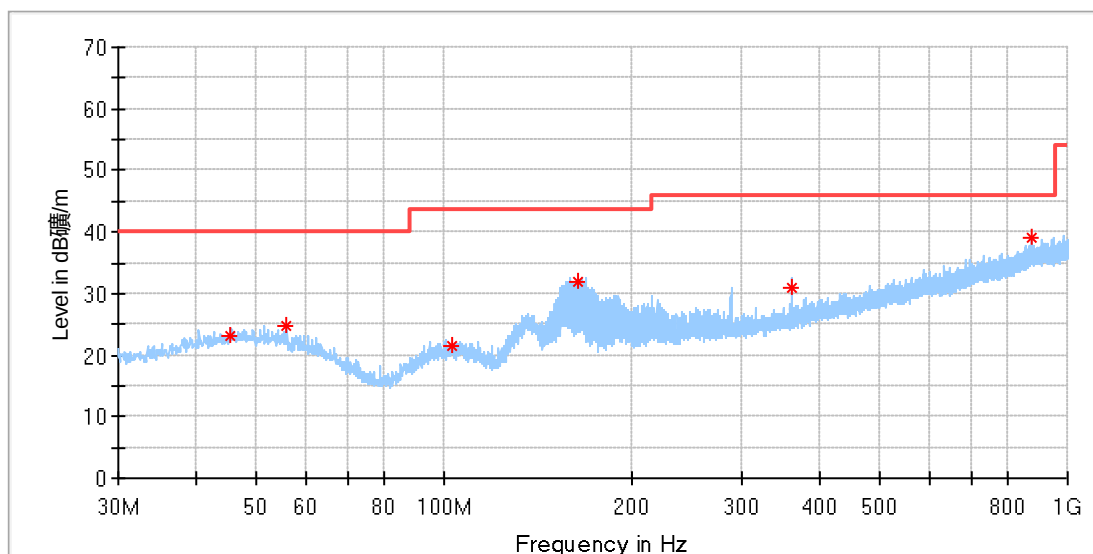
According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

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

Transmitting spurious emission test result as below:

For 30-1000MHz:

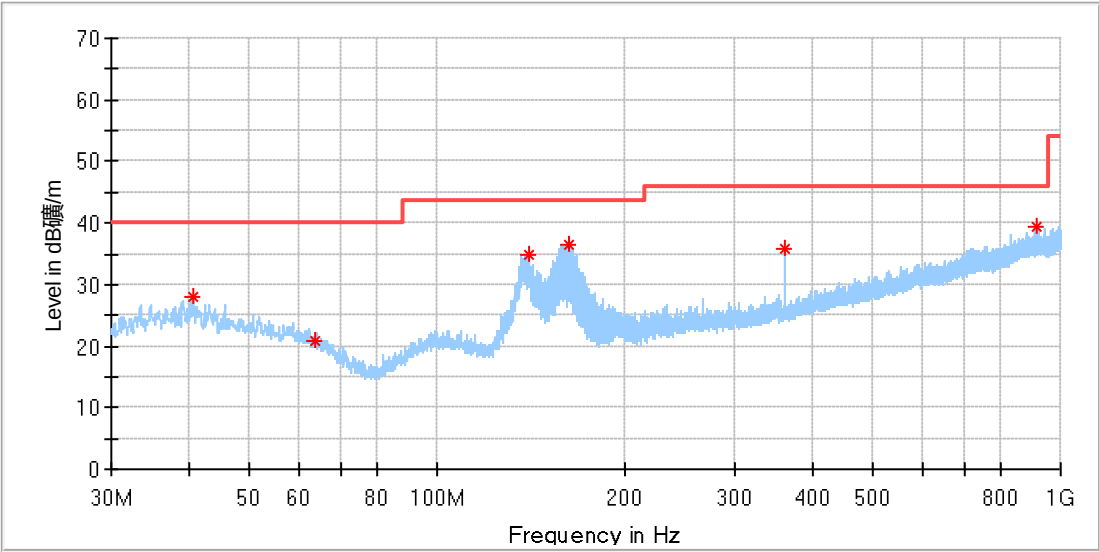
802.11b - Horizontal



Critical Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
45.277500	23.16	40.00	16.84	200.0	H	9.0	20.89
55.886875	24.91	40.00	15.09	200.0	H	338.0	20.36
103.174375	21.47	43.50	22.03	200.0	H	287.0	18.69
163.314375*	31.96	43.50	11.54	200.0	H	133.0	15.95
359.921250	30.99	46.00	15.01	100.0	H	0.0	22.35
877.780000	39.12	46.00	6.88	100.0	H	170.0	31.76

802.11b - Vertical

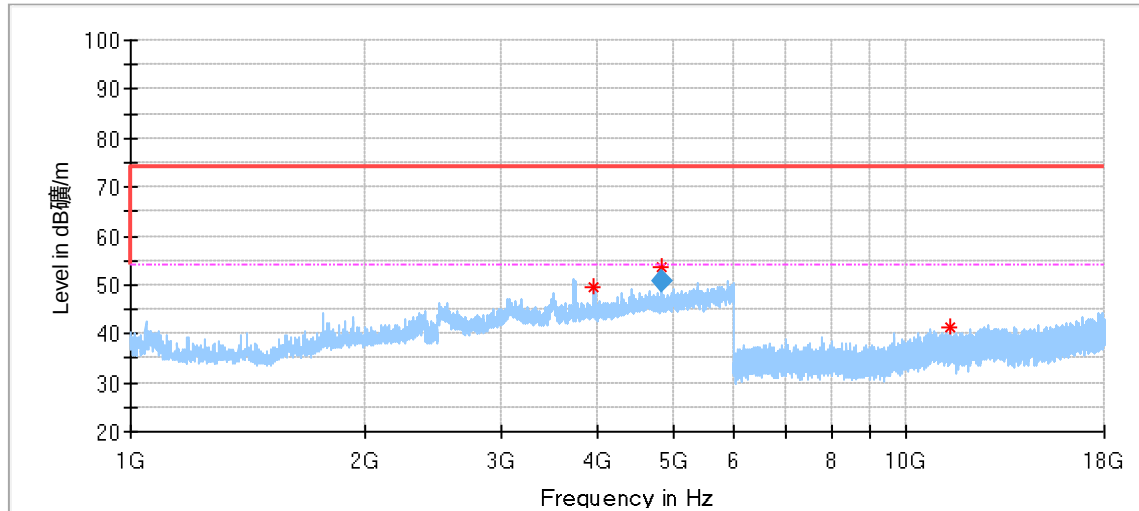


Critical Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
40.609375	27.88	40.00	12.12	100.0	V	359.0	20.02
63.586250	20.85	40.00	19.15	200.0	V	124.0	18.62
140.155625	34.89	43.50	8.61	100.0	V	169.0	15.27
162.223125*	36.44	43.50	7.06	100.0	V	92.0	15.84
359.981875	35.94	46.00	10.06	200.0	V	107.0	22.35
912.821250	39.44	46.00	6.56	100.0	V	238.0	32.36

For 1000-18000MHz:

802.11b 2412MHz - Horizontal

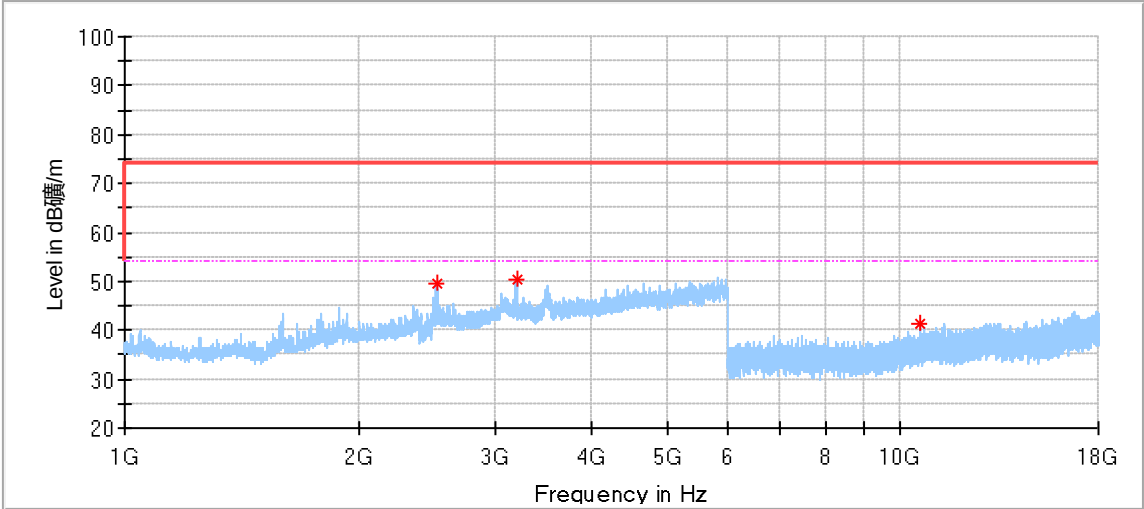
**Critical_Freqs**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3960.000000*	49.68	74.00	24.32	150.0	H	46.0	1.45
4824.000000*	53.76	74.00	20.24	150.0	H	312.0	4.05
11354.500000*	41.18	74.00	32.82	150.0	H	4.0	10.45

Final_Result

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4824.000000*	50.76	54.00	3.34	150.0	H	312.0	4.05

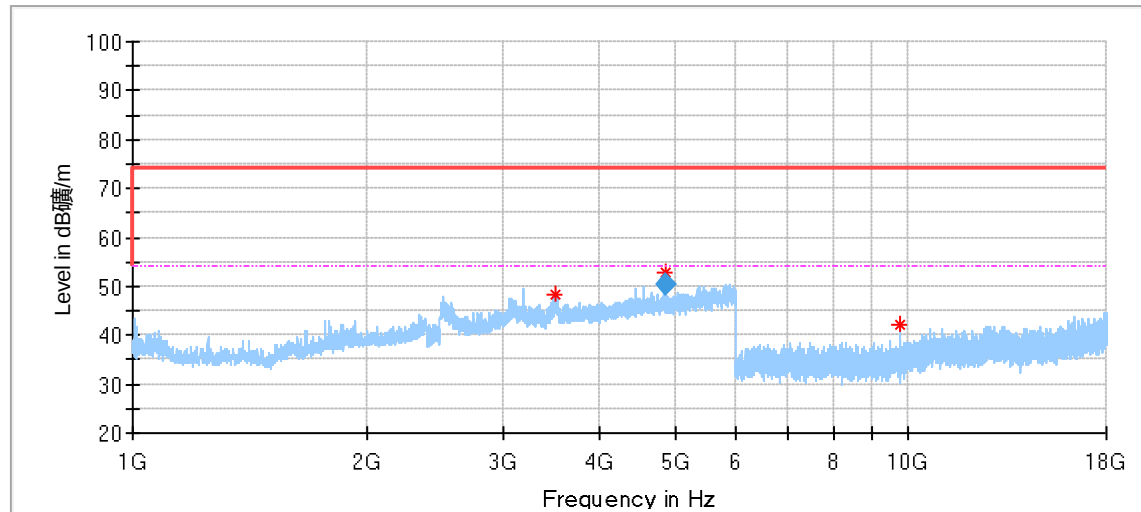
802.11b 2412MHz - Vertical



Critical Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2521.500000	49.67	74.00	24.33	150.0	V	0.0	-1.89
3199.500000	50.34	74.00	23.66	150.0	V	326.0	0.37
10600.500000*	41.38	74.00	32.62	150.0	V	58.0	9.35

802.11b 2437MHz - Horizontal



Critical_Freqs

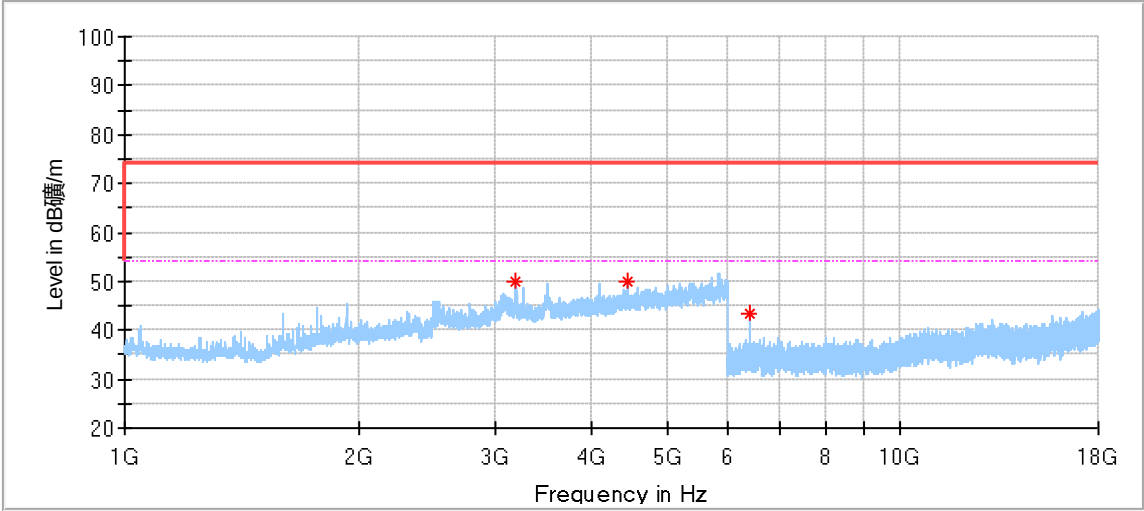
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3510.500000	48.46	74.00	25.54	150.0	H	276.0	3.17
4874.000000*	52.67	74.00	21.33	150.0	H	349.0	4.02
9748.000000	42.28	74.00	31.72	150.0	H	229.0	8.17

Final_Result

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4874.000000*	50.33	54.00	3.67	150.0	H	349.0	4.02



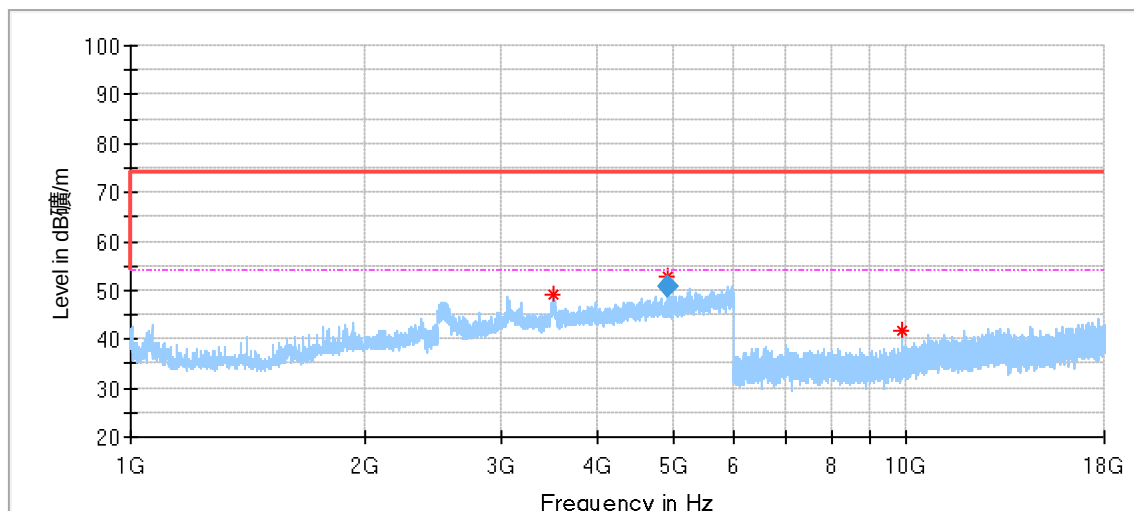
802.11b 2437MHz - Vertical



Critical Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3198.000000	50.03	74.00	23.97	150.0	V	336.0	0.38
4438.000000	49.90	74.00	24.10	150.0	V	36.0	3.15
6389.000000	43.59	74.00	30.41	150.0	V	278.0	5.33

802.11b 2462MHz - Horizontal



Critical_Freqs

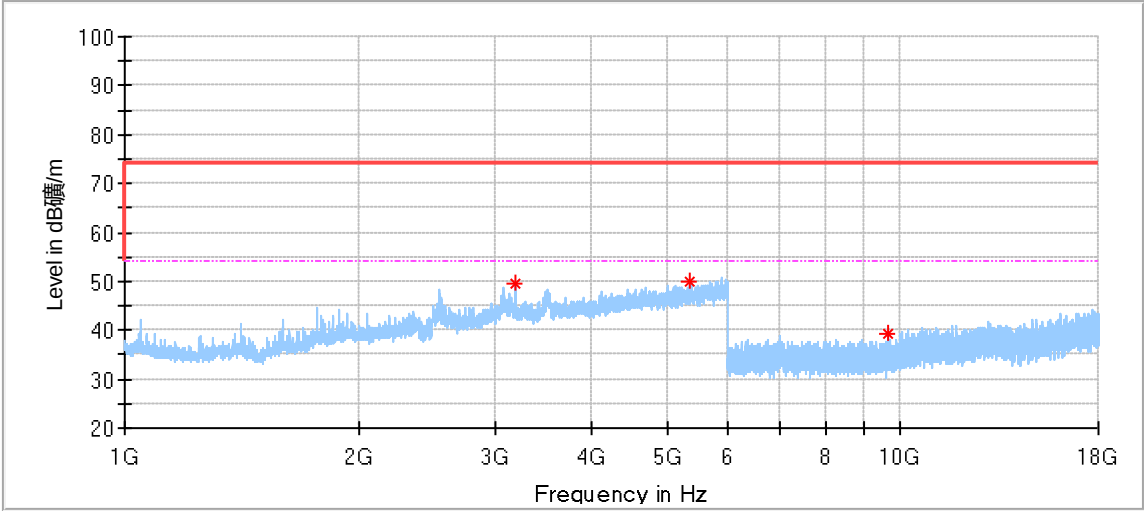
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3500.500000	49.10	74.00	24.90	150.0	H	264.0	3.73
4924.500000*	52.65	74.00	21.35	150.0	H	0.0	4.12
9848.000000	41.80	74.00	32.20	150.0	H	204.0	8.33

Final_Result

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4924.500000*	50.71	54.00	3.29	150.0	H	0.0	4.12



802.11b 2462MHz - Vertical

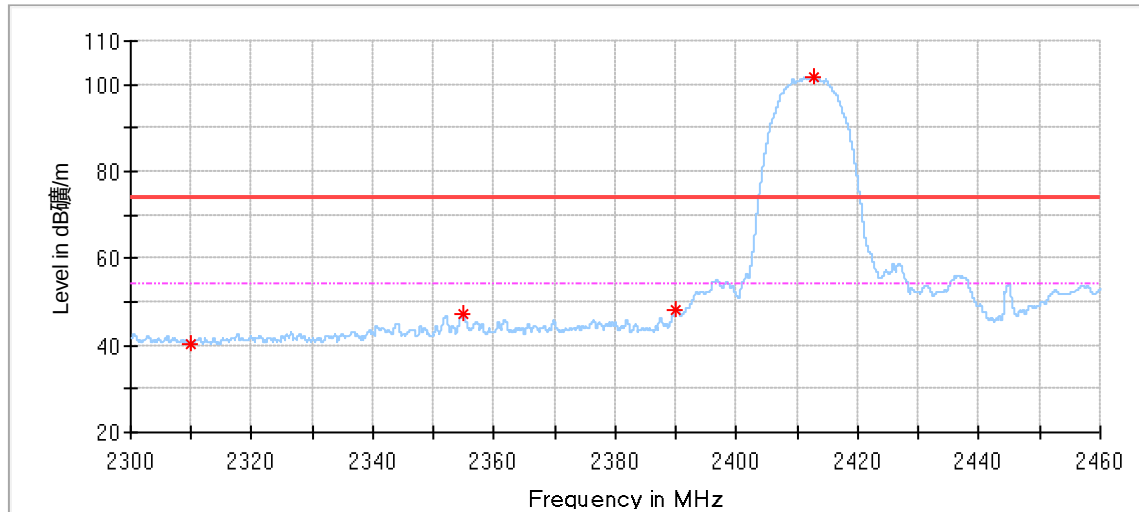


Critical Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3187.500000	49.51	74.00	24.49	150.0	V	0.0	0.44
5354.500000*	49.93	74.00	24.07	150.0	V	204.0	5.18
9613.000000	39.30	74.00	34.70	150.0	V	82.0	7.94

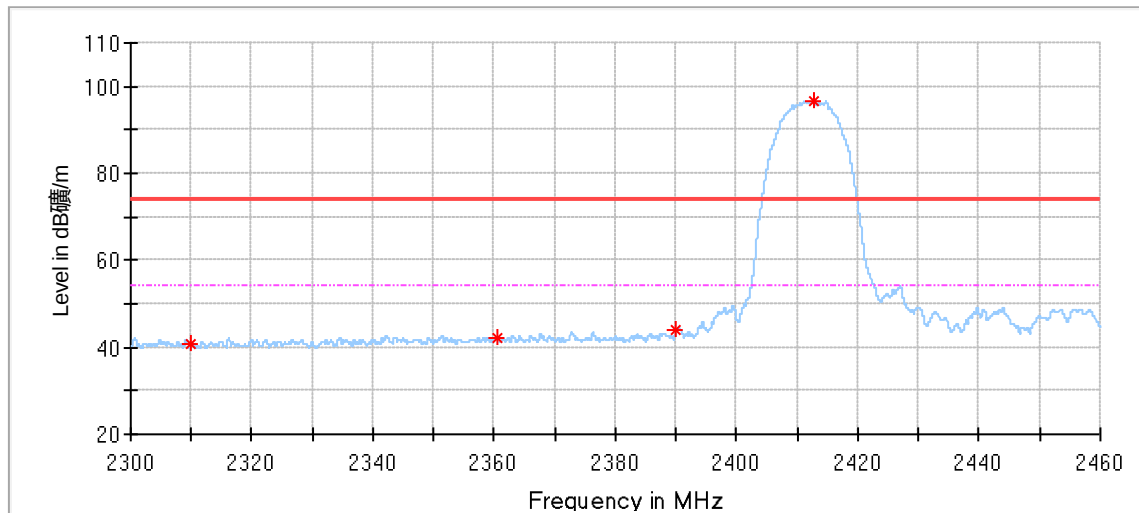
Restricted-bands band-edge of operation. test result as below:

802.11b 2412MHz – Restricted-band Band Edge



Critical_Freqs

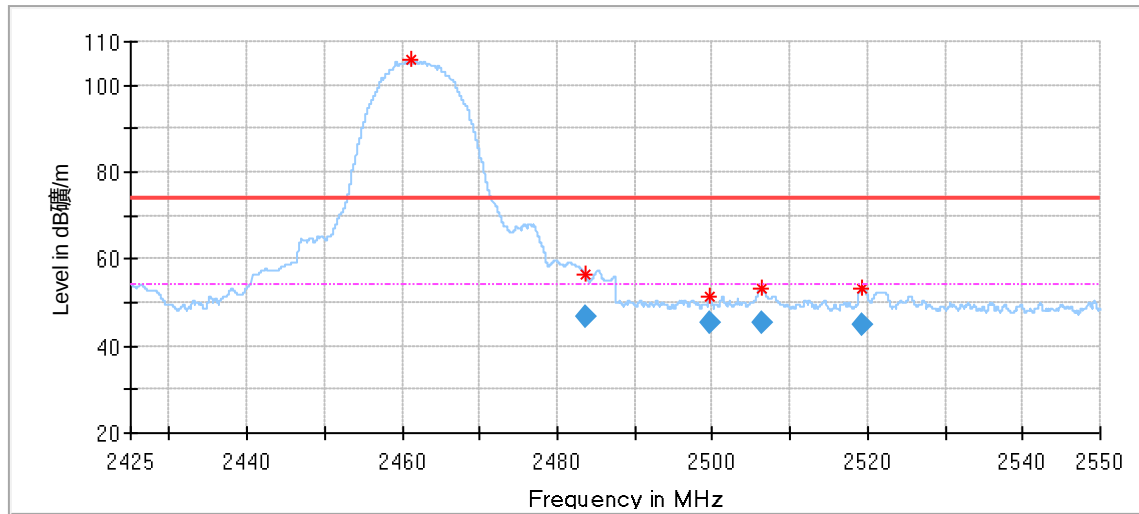
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Remark
2310.000000*	40.51	74.00	33.49	150.0	H	87.0	-4.05	Spurious
2354.768000*	47.29	74.00	26.71	150.0	H	279.0	-3.75	Spurious
2390.000000*	48.30	74.00	25.70	150.0	H	236.0	-3.36	Spurious
2412.848000	101.81	74.00	-27.81	150.0	H	279.0	-3.18	Fundamental



Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Remark
2310.000000*	40.54	74.00	33.46	150.0	V	0.0	-4.05	Spurious
2360.544000*	42.15	74.00	31.85	150.0	V	316.0	-3.66	Spurious
2390.000000*	44.23	74.00	29.77	150.0	V	275.0	-3.36	Spurious
2412.848000	96.76	74.00	-22.76	150.0	V	316.0	-3.18	Fundamental

802.11b 2462MHz Restricted-band Band Edge

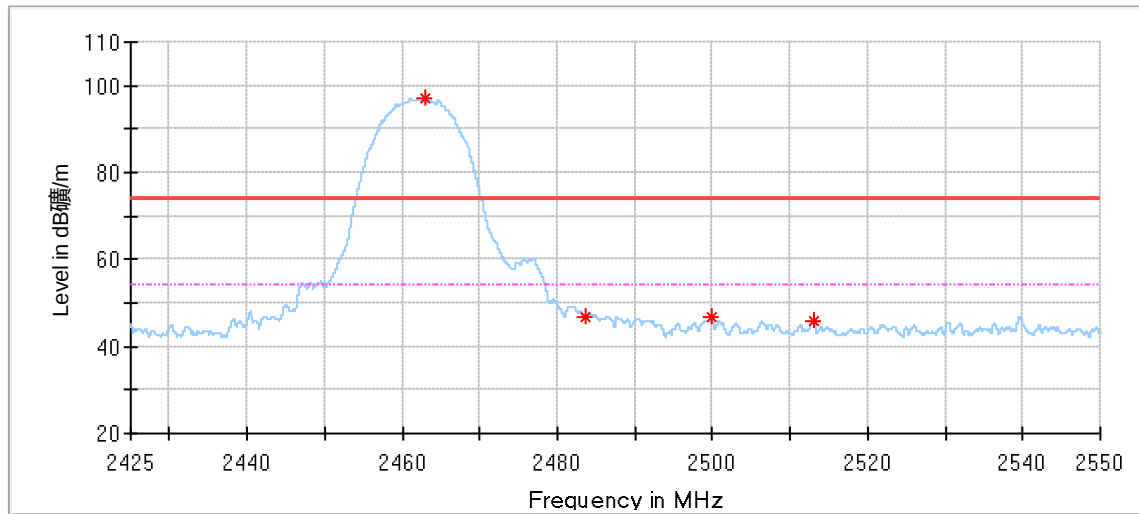


Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Remark
2461.075000	105.72	74.00	-31.72	150.0	H	182.0	-2.77	Fundamental
2483.500000*	56.32	74.00	17.68	150.0	H	64.0	-2.68	Spurious
2499.725000*	51.44	74.00	22.56	150.0	H	194.0	-2.64	Spurious
2506.400000	53.41	74.00	20.59	150.0	H	204.0	-2.60	Spurious
2519.137500	53.39	74.00	20.61	150.0	H	194.0	-2.51	Spurious

Final_Result

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Remark
2483.500000*	46.91	54.00	7.09	150.0	H	64.0	-2.68	Spurious
2499.725000*	45.24	54.00	8.76	150.0	H	194.0	-2.64	Spurious
2506.400000	45.31	54.00	8.69	150.0	H	204.0	-2.60	Spurious
2519.137500	44.96	54.00	9.04	150.0	H	194.0	-2.51	Spurious



Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Remark
2462.850000	97.13	74.00	-23.13	150.0	V	79.0	-2.76	Fundamental
2483.500000*	46.95	74.00	27.05	150.0	V	260.0	-2.68	Spurious
2499.837500*	46.62	74.00	27.38	150.0	V	314.0	-2.64	Spurious
2512.975000	45.95	74.00	28.05	150.0	V	325.0	-2.55	Spurious

Remark:

- (1) Data of measurement within frequency ranges 9kHz-30MHz and 18-26GHz are the noise floor or attenuated more than 20dB below the permissible limits or the field strength is too small to be measured, so test data does not present in this report,
- (2) Level= Reading Level + Correction Factor
- (3) 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)

10 Test Equipment List

Conducted Emission Test

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
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	Version10.35.0 2	N/A	N/A
Shielding Room	TDK	CSR #2	68-4-90-19-005	----	3	2025-10-15

Radiated Emission Test, 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	2024-8-7
Pre-amplifier	Rohde & Schwarz	SCU 18	68-4-29-14-001	102230	1	2025-5-11
Attenuator	Mini-circuits	UNAT-6+	68-4-81-21-001	15542	1	2025-5-11
Cable	HUBER-SUHNER	RG214	68-4-90-14-001-A20	----	----	----
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	Version10.35.0 2	N/A	N/A

Radiated Emission Test, 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
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
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	2024-8-1
Attenuator	Mini-circuits	UNAT-6+	68-4-81-21-002	15542	1	2025-5-11
Cable	JUNFLON	MWX221	68-4-90-19-006-A20	----	----	----
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	Version10.35.0 2	N/A	N/A

RF Conducted Test

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
Frequency Extender	TST PASS	TSTCMWEX T7	68-4-93-23-001-A01	WEX230017C	1	2025-5-12
Frequency Extender	TST PASS	TSTSGEXT7	68-4-93-23-001-A02	EX2300BA	1	2025-5-12
Cable	JUNFLON	J12J103539	68-4-90-19-003-A20	----	----	----
Test software	TST PASS	System for BT/WIFI	68-4-93-23-001-A03	Version 2.0	N/A	N/A

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)	3.14dB
Uncertainty for Radiated Emission in 3m chamber (68-4-90-14-001) 9kHz-30MHz	4.69dB
Uncertainty for Radiated Emission in new 3m chamber (68-4-90-19-006) 30MHz-1000MHz	Horizontal: 4.96dB; Vertical: 6.10dB
Uncertainty for Radiated Emission in new 3m chamber (68-4-90-19-006) 1000MHz-18000MHz	Horizontal: 5.40dB; Vertical: 5.40dB
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

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---