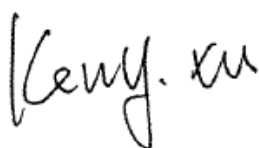


TEST REPORT

Application No.: SZEM2007006018CR
Applicant: Navico Inc.
Address of Applicant: 4500 S. 129th East Avenue, Ste. 200, Tulsa, Oklahoma, 74134 United States
Manufacturer: Navico Auckland Limited
Address of Manufacturer: Arrenway Drive, Rosedale, Auckland, 0632 New Zealand
Factory: Shenzhen Fastrain Technology Co., Ltd.
Address of Factory: No.3 Baolong 4th Rd., Baolong Industrial Area, Longgang District, Shenzhen, China
Equipment Under Test (EUT):
EUT Name: MARINE BLACK BOX DSC/AIS VHF RADIO SYSTEM
Model No.: NRS-1
Trade Mark: NAVICO
FCC ID: RAYVHFNRS1
Standard(s) : 47 CFR Part 15, Subpart C 15.247
Date of Receipt: 2020-07-03
Date of Test: 2020-10-26 to 2020-11-04
Date of Issue: 2020-11-06

Test Result:	Pass*
---------------------	--------------

* In the configuration tested, the EUT complied with the standards specified above.



Keny Xu
EMC Laboratory Manager



SGS-CSTC Standards Technical Services Co., Ltd.
Shenzhen Branch, EMC Laboratory

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Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2020-11-06		Original

Authorized for issue by:			
			
		Edison Li /Project Engineer	
			
		Eric Fu /Reviewer	



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2 Test Summary

Radio Spectrum Technical Requirement				
Item	Standard	Method	Requirement	Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.247	N/A	47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)	Pass

Radio Spectrum Matter Part				
Item	Standard	Method	Requirement	Result
Minimum 6dB Bandwidth	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.8.1	47 CFR Part 15, Subpart C 15.247a(2)	Pass
Conducted Peak Output Power	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.9.1	47 CFR Part 15, Subpart C 15.247(b)(3)	Pass
Power Spectrum Density	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.10.2	47 CFR Part 15, Subpart C 15.247(e)	Pass
Conducted Band Edges Measurement	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.13.3.2	47 CFR Part 15, Subpart C 15.247(d)	Pass
Conducted Spurious Emissions	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.11	47 CFR Part 15, Subpart C 15.247(d)	Pass
Radiated Emissions which fall in the restricted bands	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.10.5	47 CFR Part 15, Subpart C 15.209 & 15.247(d)	Pass
Radiated Spurious Emissions	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.4,6.5,6.6	47 CFR Part 15, Subpart C 15.209 & 15.247(d)	Pass

Remark:

Model No.: NRS-1

This device has two different models NRS1 and NRS2. since according to the declaration from the applicant, the electrical circuit design, layout, components used, internal wiring and functions were identical for all the above models, with only differences are the model no. and AIS board(NRS2 has AIS board inside the main unit and while NRS-1 not).

This report SZEM200700601808 is only for model NRS1(FCC ID: RAYVHFNR1).

This report SZEM200700601808 is prepared for FCC Spot Check Verification report. the format, test items and amount of spot-check test data are decided by applicant's engineering judgment; for more details please refer to declaration letter, the original report please refer to report no.:

SZEM200700601804.

Determining compliance based on the results of the compliance measurement not taking into account measurement instrumentation uncertainty.

Only record the worst test result in this report.



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3 Test Summary of spot-check test data

Item	Worst test result for original report(FCC ID:RAYVHFNRS2)	Worst test result for this report(FCC ID:RAYVHFNRS1)
Minimum 6dB Bandwidth	802.11n HT20: 16.340MHz	802.11n HT20: 16.049MHz
Conducted Peak Output Power	802.11n HT20: 17.64dBm	802.11n HT20: 16.85dBm
Power Spectrum Density	802.11n HT20: -15.23dBm	802.11n HT20: -15.43dBm
Conducted Band Edges Measurement	802.11n HT20: -21.76dBm	802.11n HT20: -21.80dBm
Conducted Spurious Emissions	802.11n HT20: -21.76dBm	802.11n HT20: -21.80dBm
Radiated Emissions which fall in the restricted bands	51.20dBuV/m	51.38dBuV/m
Radiated Spurious Emissions	32.18dBuV/m	32.80dBuV/m

Note: the worst test results are measured at maximum transmitting power.

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5 General Information

5.1 Details of E.U.T.

Power supply:	12 VDC battery system
Cable:	DC cable: longer than 300cm unshielded
Sample Type:	Mobile device
Transmitter Frequency Range:	2412MHz-2462MHz
Modulation Type:	802.11b: DSSS(CCK, DQPSK, DBPSK) 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK) 802.11n(HT20): OFDM (BPSK, QPSK, 16QAM, 64QAM)
Frequency Spacing:	5MHz
Channel Numbers:	11 Channels
WiFi Antenna Type:	Integral
WiFi Antenna Gain:	5.3dBi

5.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
DC power	ZHAOXIN	RXN-305D	REF. No.SEA2700
Coaxial Attenuator	Provided by client	TS4	HYT168793
Wired Handset	SIMRAD	HS100	/
Wired Speaker	/	SP100	/
Wired Handset	B&G	H100	/
Wired Speaker	/	SP100	/



5.3 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	$\pm 7.25 \times 10^{-8}$
2	Duty cycle	$\pm 0.37\%$
3	Occupied Bandwidth	$\pm 3\%$
4	Conduction emission	$\pm 3.0\text{dB}$ (150kHz to 30MHz)
5	RF conducted power	$\pm 0.75\text{dB}$
6	RF power density	$\pm 2.84\text{dB}$
7	Conducted Spurious emissions	$\pm 0.75\text{dB}$
8	RF Radiated power	$\pm 4.5\text{dB}$ (Below 1GHz)
		$\pm 4.8\text{dB}$ (Above 1GHz)
9	Radiated Spurious emission test	$\pm 4.5\text{dB}$ (Below 1GHz)
		$\pm 4.8\text{dB}$ (Above 1GHz)
10	Temperature test	$\pm 1^\circ\text{C}$
11	Humidity test	$\pm 3\%$
12	Supply voltages	$\pm 1\%$
13	Time	$\pm 3\%$

5.4 Test Location

All tests were performed at:

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No. 1 Workshop, M-10, Middle Section, Science & Technology Park, Shenzhen, Guangdong, China. 518057.

Tel: +86 755 2601 2053 Fax: +86 755 2671 0594

No tests were sub-contracted.

5.5 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

• A2LA (Certificate No. 3816.01)

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

• VCCI

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

• FCC –Designation Number: CN1178

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1178. Test Firm Registration Number: 406779.

• Innovation, Science and Economic Development Canada

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0006.

IC#: 4620C.

5.6 Deviation from Standards

None

5.7 Abnormalities from Standard Conditions

None



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6 Equipment List

RF Conducted Test					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Shielding Room	SAEMC	MSR733	SEM001-09	2019-06-13	2022-06-12
DC Power Supply	Rohde & Schwarz	NGSM 32/10	SEM011-04	2020-03-24	2021-03-23
Spectrum Analyzer	Rohde & Schwarz	FSU43	SEM004-08	2020-04-01	2021-03-31
Measurement Software	TST	TST PASS V1.0.5	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM031-01	2020-07-10	2021-07-09
Attenuator	Huber+Suhner	6620_SMA-50-1	SEM021-09	N/A	N/A
Signal Generator	KEYSIGHT	N5173B	SEM006-05	2020-09-24	2021-09-23
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2020-09-24	2021-09-23
Electric and Magnetic Field Analyzer	Narda	EHP-50F	SEM022-05	2019-11-28	2020-11-27
Power Sensor	KEYSIGHT	U2021XA	SEM009-20	2020-05-21	2021-05-20

Radiated Spurious Emissions(Below 1GHz)					
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. Date	Cal. Due date
3m Semi-Anechoic Chamber	ETS-LINDGREN	N/A	SEM001-01	2020-07-19	2023-07-18
MXE EMI receiver(3Hz-3.6GHz)	KEYSIGHT	N9038A	SEM004-15	2019-12-16	2020-12-15
BiConiLog Antenna (26-3000MHz)	ETS-LINDGREN	3142C	SEM003-02	2019-05-24	2022-05-23
Pre-amplifier (0.1-1300MHz)	Agilent Technologies	8447D	SEM005-01	2020-04-01	2021-03-31
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM025-01	2020-07-10	2021-07-09

Radiated Emissions which fall in the restricted bands					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
3m Semi-Anechoic Chamber	AUDIX	N/A	SEM001-02	2018-03-13	2021-03-12
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM026-01	2020-07-10	2021-07-09
EXA Spectrum Analyzer	Agilent Technologies Inc	N9010A	SEM004-12	2020-04-09	2021-04-08
Horn Antenna	Rohde & Schwarz	HF907	SEM003-07	2018-04-13	2021-04-12
Horn Antenna	Schwarzbeck	BBHA 9170	SEM003-15	2020-10-17	2023-10-16



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Pre-Amplifier	Compliance Directions Systems Inc.	PAP-0126	SEM004-11	2020-09-24	2021-09-23
Pre-amplifier	Rohde & Schwarz	CH14-H052	SEM005-17	2020-04-01	2021-03-31
Pre-amplifier	Compliance Directions Systems Inc.	PAP-2640-50	SEM005-08	2020-04-01	2021-03-31
DC Power Supply	Zhao Xin	KXN-6020D	SEM011-08	2020-09-24	2021-09-23
Active Loop Antenna	ETS-Lindgren	6502	SEM003-08	2020-08-14	2023-08-13

Radiated Spurious Emissions

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
3m Semi-Anechoic Chamber	AUDIX	N/A	SEM001-02	2018-03-13	2021-03-12
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM026-01	2020-07-10	2021-07-09
EXA Spectrum Analyzer	Agilent Technologies Inc	N9010A	SEM004-12	2020-04-09	2021-04-08
Horn Antenna	Rohde & Schwarz	HF907	SEM003-07	2018-04-13	2021-04-12
Horn Antenna	Schwarzbeck	BBHA 9170	SEM003-15	2020-10-17	2021-10-16
Pre-Amplifier	Compliance Directions Systems Inc.	PAP-0126	SEM004-11	2020-09-24	2021-09-23
Pre-amplifier	Rohde & Schwarz	CH14-H052	SEM005-17	2020-04-01	2021-03-31
Pre-amplifier	Compliance Directions Systems Inc.	PAP-2640-50	SEM005-08	2020-04-01	2021-03-31
DC Power Supply	Zhao Xin	KXN-6020D	SEM011-08	2020-09-24	2021-09-23
Active Loop Antenna	ETS-Lindgren	6502	SEM003-08	2020-08-14	2023-08-13

General used equipment

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Humidity/ Temperature Indicator	Shanghai Meteorological Industry Factory	ZJ1-2B	SEM002-03	2020-09-26	2021-09-25
Humidity/ Temperature Indicator	Shanghai Meteorological Industry Factory	ZJ1-2B	SEM002-04	2020-09-26	2021-09-25
Humidity/ Temperature Indicator	Mingle	N/A	SEM002-08	2020-09-26	2021-09-25
Barometer	Changchun Meteorological Industry Factory	DYM3	SEM002-01	2020-04-07	2021-04-06



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Shenzhen Branch 中国·深圳·科技园中区M-10栋一号厂房 邮编: 518057 t (86-755) 26012053 f (86-755) 26710594 sgs.china@sgs.com

7 Radio Spectrum Technical Requirement

7.1 Antenna Requirement

7.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)

7.1.2 Conclusion

Standard Requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna:

The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 5.3dBi.

Antenna location: Refer to internal photo.

8 Radio Spectrum Matter Test Results

8.1 Minimum 6dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.247a(2)
Test Method: ANSI C63.10 (2013) Section 11.8.1
Limit: ≥ 500 kHz

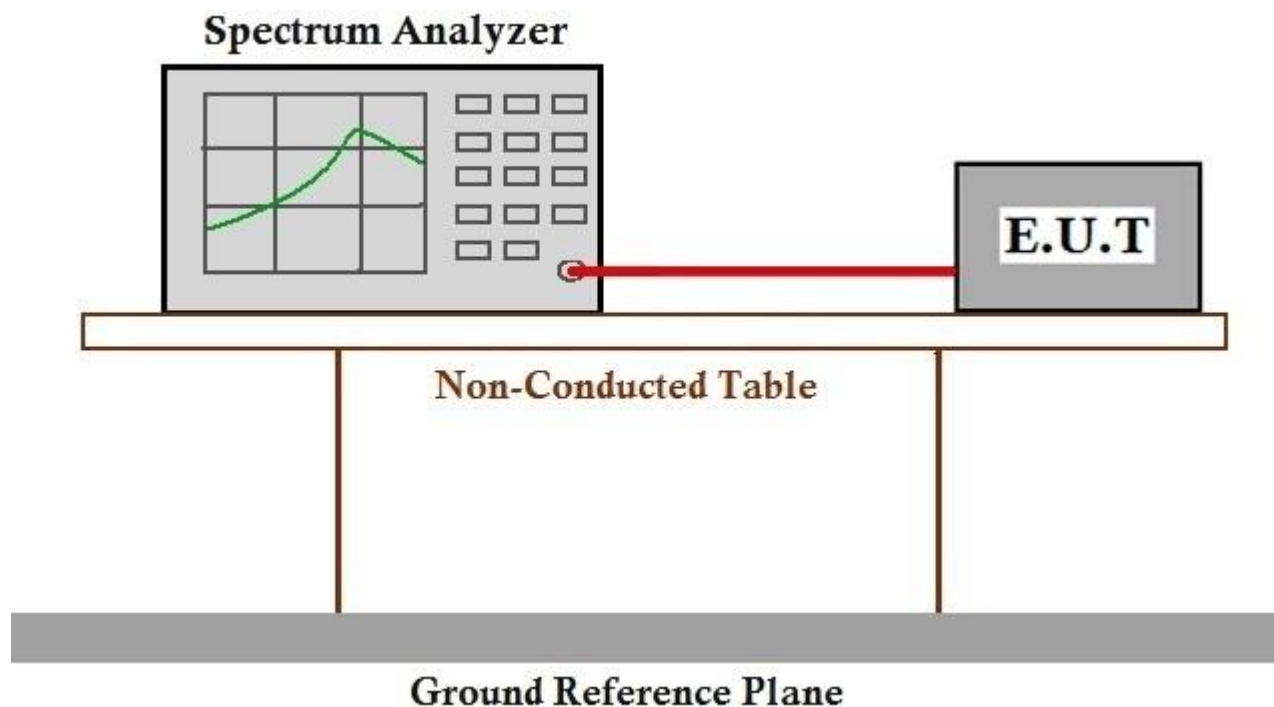
8.1.1 E.U.T. Operation

Operating Environment:

Temperature: 25.1 °C Humidity: 53.8 % RH Atmospheric Pressure: 1010 mbar

Test mode: b:TX mode_Keep the EUT in continuously transmitting mode with all modulation types. All data rates for each modulation type have been tested and found the data rate @ 1Mbps is the worst case of IEEE 802.11b; data rate @ 6Mbps is the worst case of IEEE 802.11g; data rate @ 6.5Mbps is the worst case of IEEE 802.11n(HT20). Only the data of worst case is recorded in the report.

8.1.2 Test Setup Diagram



8.1.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

8.2 Conducted Peak Output Power

Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(3)

Test Method: ANSI C63.10 (2013) Section 11.9.1

Limit:

Frequency range(MHz)	Output power of the intentional radiator(watt)
902-928	1 for ≥ 50 hopping channels
	0.25 for $25 \leq$ hopping channels < 50
	1 for digital modulation
2400-2483.5	1 for ≥ 75 non-overlapping hopping channels
	0.125 for all other frequency hopping systems
	1 for digital modulation
5725-5850	1 for frequency hopping systems and digital modulation

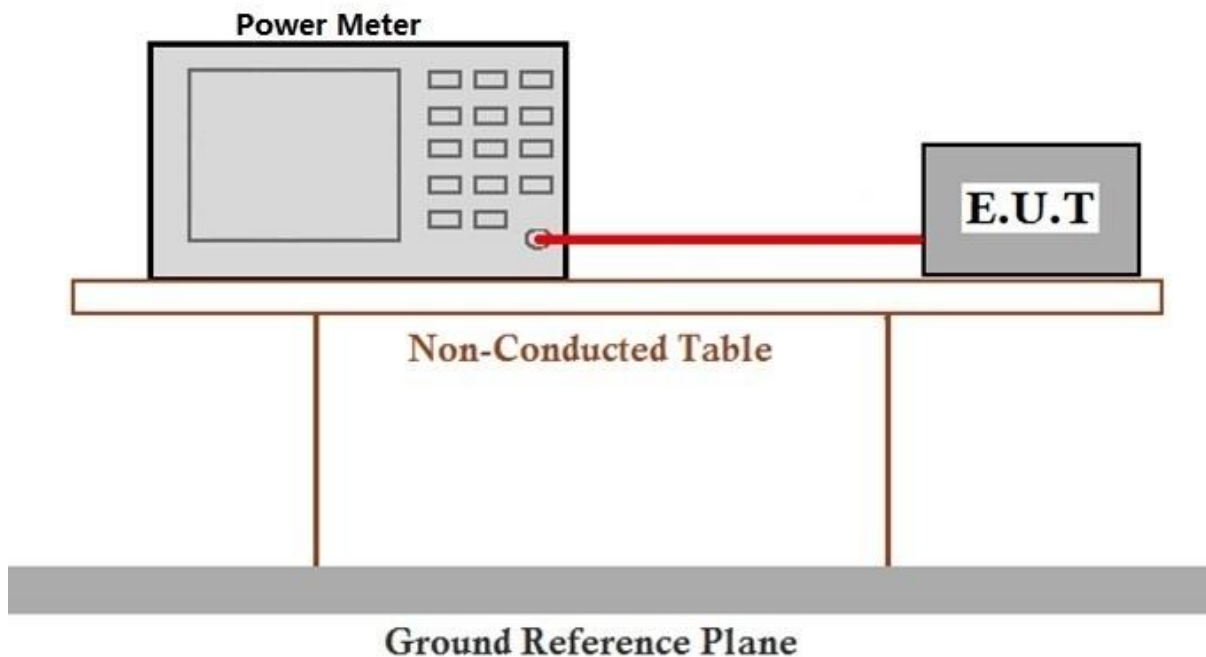
8.2.1 E.U.T. Operation

Operating Environment:

Temperature: 25.1 °C Humidity: 53.8 % RH Atmospheric Pressure: 1010 mbar

Test mode: b:TX mode_Keep the EUT in continuously transmitting mode with all modulation types. All data rates for each modulation type have been tested and found the data rate @ 1Mbps is the worst case of IEEE 802.11b; data rate @ 6Mbps is the worst case of IEEE 802.11g; data rate @ 6.5Mbps is the worst case of IEEE 802.11n(HT20). Only the data of worst case is recorded in the report.

8.2.2 Test Setup Diagram



8.2.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



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Attention: To check the authenticity of testing / inspection report & certificate, please contact us at telephone: (86-755) 8307 1443, or email: CN.Doccheck@sgs.com

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8.3 Power Spectrum Density

Test Requirement: 47 CFR Part 15, Subpart C 15.247(e)
Test Method: ANSI C63.10 (2013) Section 11.10.2
Limit: $\leq 8\text{dBm}$ in any 3 kHz band during any time interval of continuous transmission

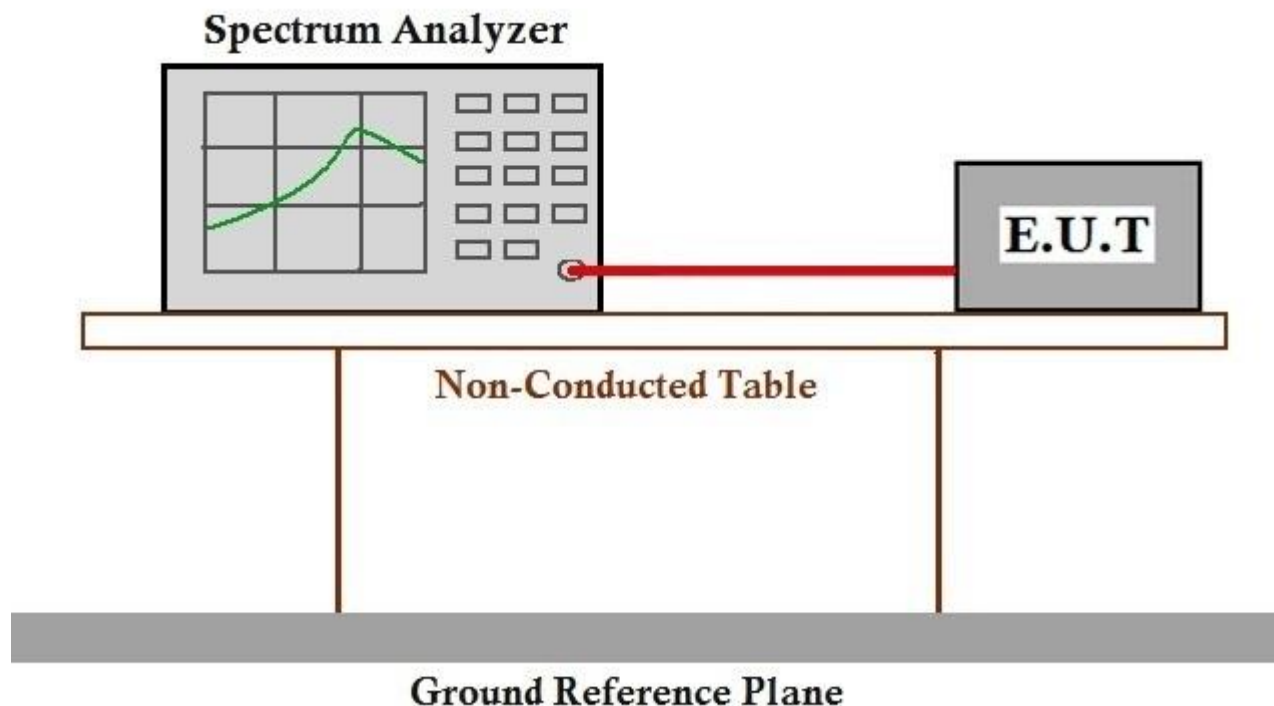
8.3.1 E.U.T. Operation

Operating Environment:

Temperature: 25.1 °C Humidity: 53.9 % RH Atmospheric Pressure: 1010 mbar

Test mode: b:TX mode_Keep the EUT in continuously transmitting mode with all modulation types. All data rates for each modulation type have been tested and found the data rate @ 1Mbps is the worst case of IEEE 802.11b; data rate @ 6Mbps is the worst case of IEEE 802.11g; data rate @ 6.5Mbps is the worst case of IEEE 802.11n(HT20). Only the data of worst case is recorded in the report.

8.3.2 Test Setup Diagram



8.3.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

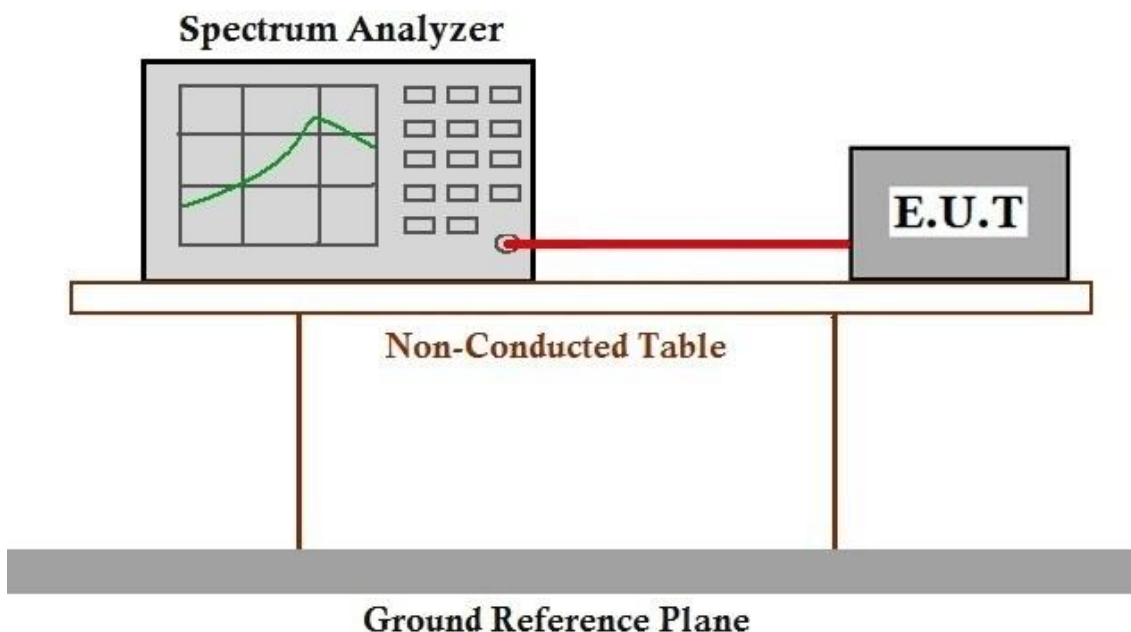
8.4 Conducted Band Edges Measurement

Test Requirement	47 CFR Part 15, Subpart C 15.247(d)
Test Method:	ANSI C63.10 (2013) Section 11.13.3.2
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general 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) (see §15.205(c))

8.4.1 E.U.T. Operation

Operating Environment:			
Temperature:	25.1 °C	Humidity:	53.9 % RH Atmospheric Pressure: 1010 mbar
Test mode:	b:TX mode_Keep the EUT in continuously transmitting mode with all modulation types. All data rates for each modulation type have been tested and found the data rate @ 1Mbps is the worst case of IEEE 802.11b; data rate @ 6Mbps is the worst case of IEEE 802.11g; data rate @ 6.5Mbps is the worst case of IEEE 802.11n(HT20). Only the data of worst case is recorded in the report.		

8.4.2 Test Setup Diagram



8.4.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



8.5 Conducted Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.247(d)

Test Method: ANSI C63.10 (2013) Section 11.11

Limit: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general 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) (see §15.205(c))

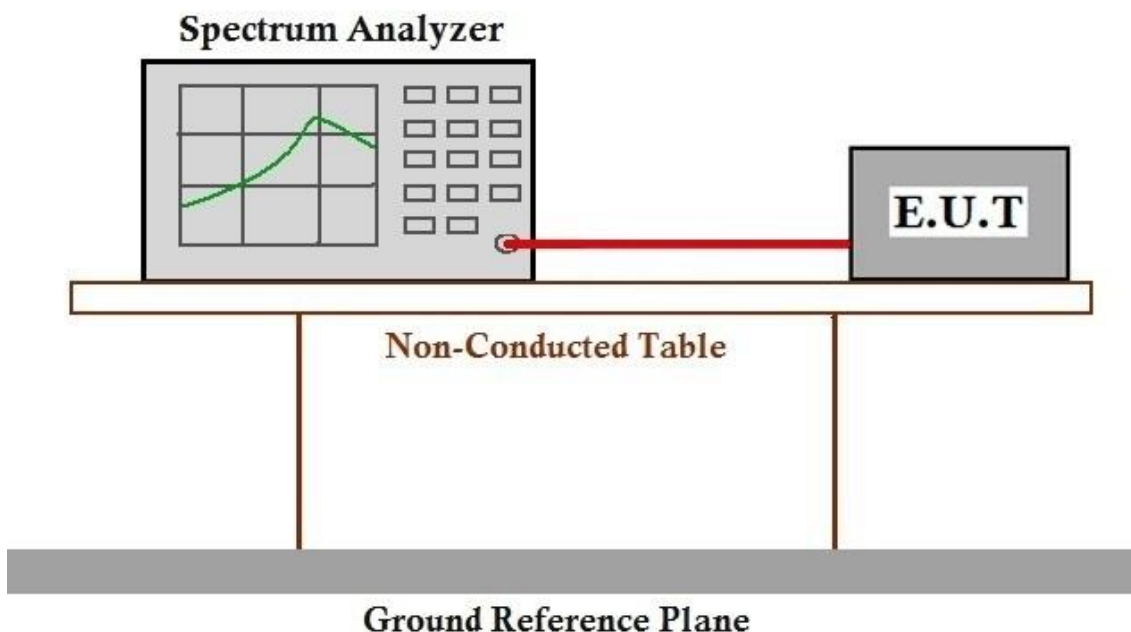
8.5.1 E.U.T. Operation

Operating Environment:

Temperature: 25.1 °C Humidity: 53.9 % RH Atmospheric Pressure: 1010 mbar

Test mode: b:TX mode_Keep the EUT in continuously transmitting mode with all modulation types. All data rates for each modulation type have been tested and found the data rate @ 1Mbps is the worst case of IEEE 802.11b; data rate @ 6Mbps is the worst case of IEEE 802.11g; data rate @ 6.5Mbps is the worst case of IEEE 802.11n(HT20). Only the data of worst case is recorded in the report.

8.5.2 Test Setup Diagram



8.5.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



8.6 Radiated Emissions which fall in the restricted bands

Test Requirement 47 CFR Part 15, Subpart C 15.209 & 15.247(d)

Test Method: ANSI C63.10 (2013) Section 6.10.5

Measurement Distance: 3m

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

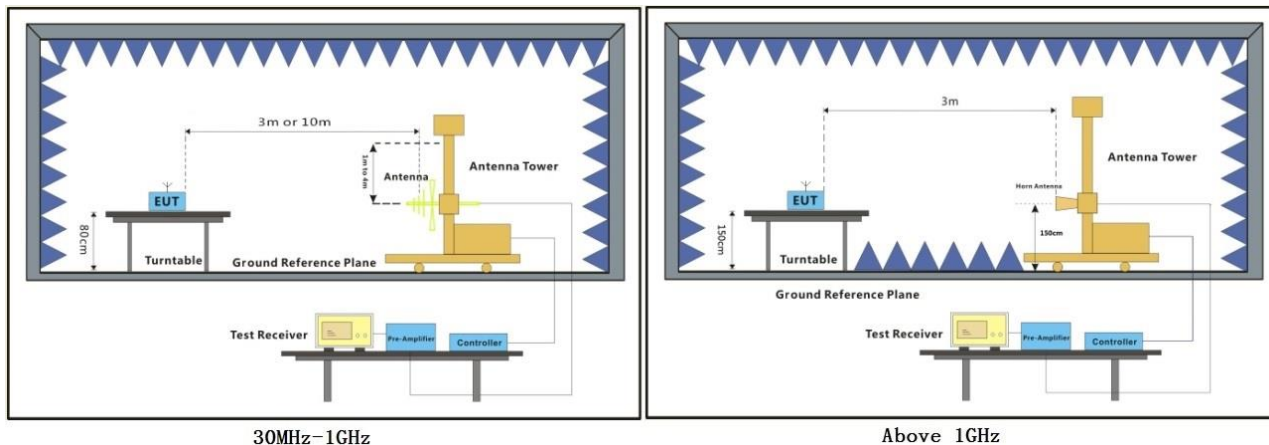
8.6.1 E.U.T. Operation

Operating Environment:

Temperature: 23.4 °C Humidity: 60.6 % RH Atmospheric Pressure: 1010 mbar

Test mode: b:TX mode_Keep the EUT in continuously transmitting mode with all modulation types. All data rates for each modulation type have been tested and found the data rate @ 1Mbps is the worst case of IEEE 802.11b; data rate @ 6Mbps is the worst case of IEEE 802.11g; data rate @ 6.5Mbps is the worst case of IEEE 802.11n(HT20). Only the data of worst case is recorded in the report.

8.6.2 Test Setup Diagram



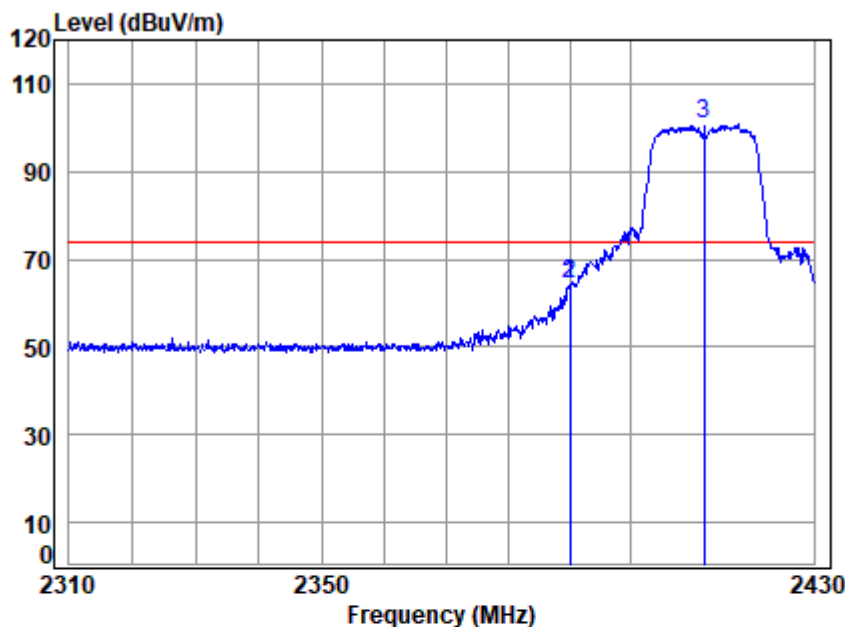
8.6.3 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height 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.
- e. 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 (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark:

- 1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.
- 2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Final Test Level = Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor
- 3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
- 4) For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

Test mode: b; Polarity: Horizontal; Modulation:802.11n; Bandwidth:20MHz; Channel:Low

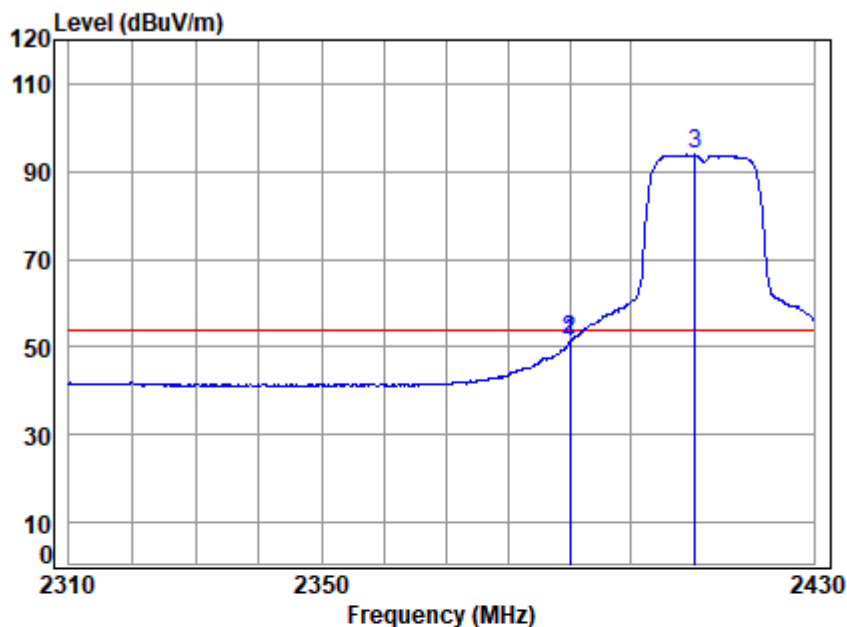


Site : chamber
Condition: 3m HORIZONTAL
Job No : 06018CR/06019CR
Mode : 2412 Band edge
Note : 2.4G WIFI 11N20

		Cable	Ant	Preamp	Read		Limit	Over	
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	2389.968	4.34	28.52	40.97	72.49	64.38	74.00	-9.62	peak
2	2390.000	4.34	28.52	40.97	72.49	64.38	74.00	-9.62	peak
3 *	2412.000	4.39	28.56	40.98	108.75	100.72	74.00	26.72	peak



Test mode: b; Polarity: Horizontal; Modulation:802.11n; Bandwidth:20MHz; Channel:Low

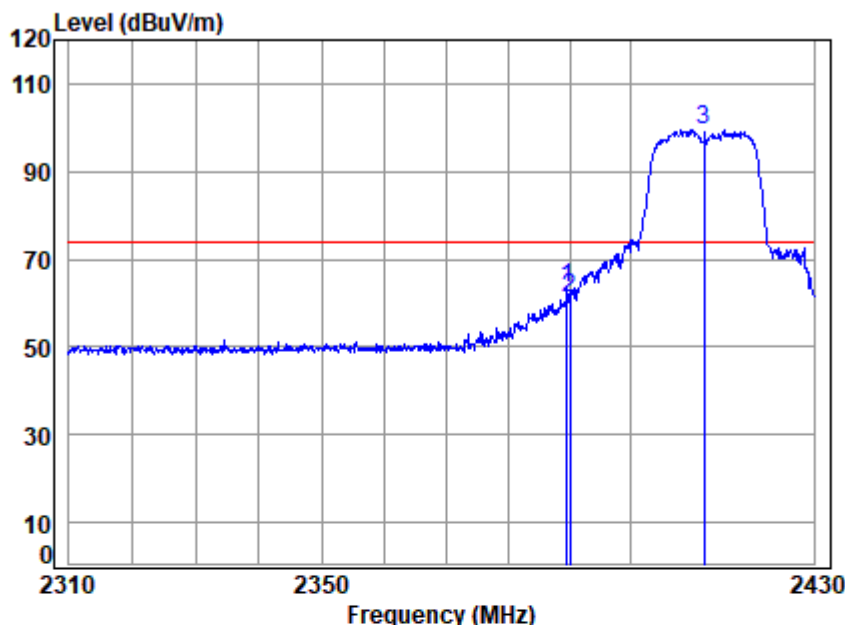


Site : chamber
Condition: 3m HORIZONTAL
Job No : 06018CR/06019CR
Mode : 2412 Band edge
Note : 2.4G WIFI 11N20

		Cable	Ant	Preamp	Read	Limit	Over	
	Freq	Loss	Factor	Factor	Level	Line	Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2389.968	4.34	28.52	40.97	59.44	51.33	54.00	-2.67 Average
2	2390.000	4.34	28.52	40.97	59.49	51.38	54.00	-2.62 Average
3 *	2410.389	4.38	28.55	40.98	101.86	93.81	54.00	39.81 Average



Test mode: b; Polarity: Vertical; Modulation:802.11n; Bandwidth:20MHz; Channel:Low

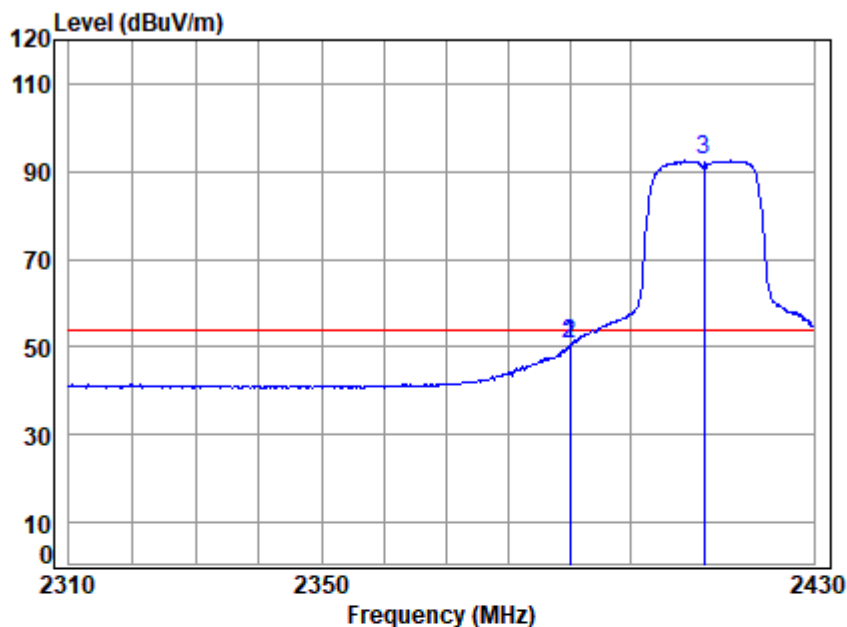


Site : chamber
Condition: 3m VERTICAL
Job No : 06018CR/06019CR
Mode : 2412 Band edge
Note : 2.4G WIFI 11N20

		Cable	Ant	Preamp	Read	Limit	Over	
	Freq	Loss	Factor	Factor	Level	Line	Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2389.605	4.34	28.52	40.97	71.52	63.41	74.00	-10.59 peak
2	2390.000	4.34	28.52	40.97	69.25	61.14	74.00	-12.86 peak
3 *	2412.000	4.37	28.55	40.98	107.66	99.60	74.00	25.60 peak



Test mode: b; Polarity: Vertical; Modulation:802.11n; Bandwidth:20MHz; Channel:Low

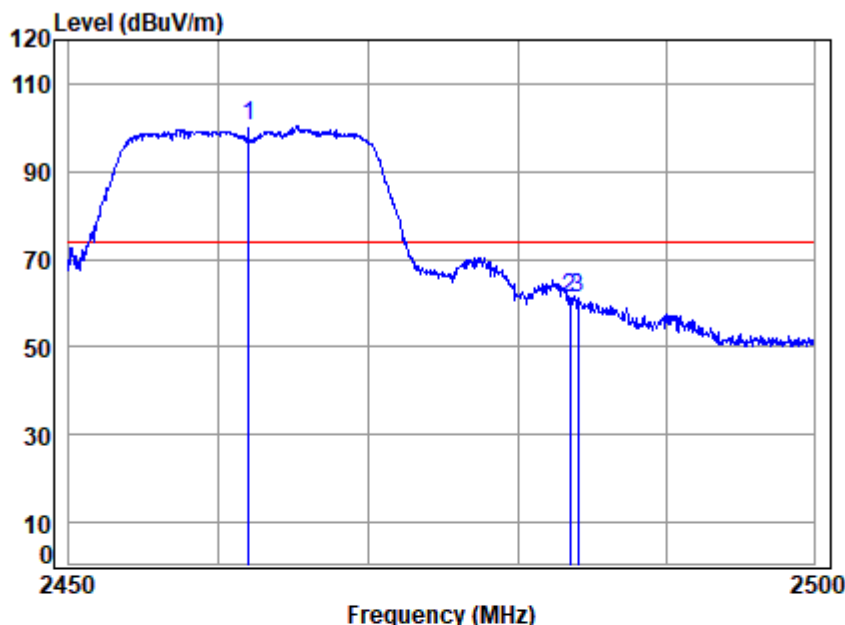


Site : chamber
Condition: 3m VERTICAL
Job No : 06018CR/06019CR
Mode : 2412 Band edge
Note : 2.4G WIFI 11N20

		Cable	Ant	Preamp	Read	Limit	Over	
	Freq	Loss	Factor	Factor	Level	Line	Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2389.968	4.34	28.52	40.97	58.57	50.46	54.00	-3.54 Average
2	2390.000	4.34	28.52	40.97	58.56	50.45	54.00	-3.55 Average
3 *	2412.000	4.38	28.55	40.98	100.52	92.47	54.00	38.47 Average



Test mode: b; Polarity: Horizontal; Modulation:802.11n; Bandwidth:20MHz; Channel:High

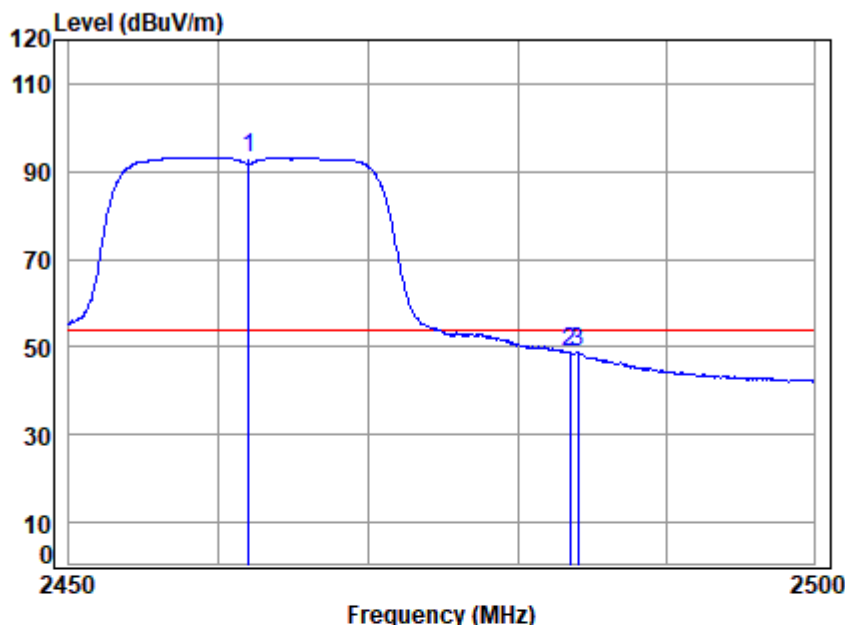


Site : chamber
Condition: 3m HORIZONTAL
Job No : 06018CR/06019CR
Mode : 2462 Band edge
Note : 2.4G WIFI 11N20

		Cable	Ant	Preamp	Read	Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1 *	2462.000	4.47	28.64	41.00	108.20	100.31	74.00	26.31 peak
2	2483.500	4.49	28.67	41.01	69.02	61.17	74.00	-12.83 peak
3	2484.091	4.50	28.67	41.01	69.06	61.22	74.00	-12.78 peak



Test mode: b; Polarity: Horizontal; Modulation:802.11n; Bandwidth:20MHz; Channel:High

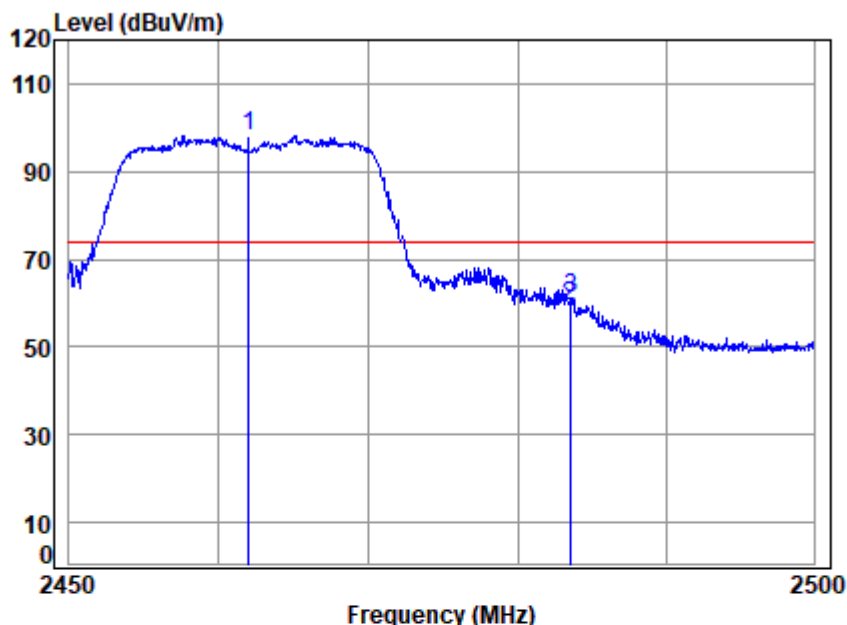


Site : chamber
Condition: 3m HORIZONTAL
Job No : 06018CR/06019CR
Mode : 2462 Band edge
Note : 2.4G WIFI 11N20

		Cable	Ant	Preamp	Read	Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1 *	2462.000	4.46	28.63	41.00	101.19	93.28	54.00	39.28 Average
2	2483.500	4.49	28.67	41.01	56.75	48.90	54.00	-5.10 Average
3	2484.091	4.50	28.67	41.01	56.81	48.97	54.00	-5.03 Average



Test mode: b; Polarity: Vertical; Modulation:802.11n; Bandwidth:20MHz; Channel:High

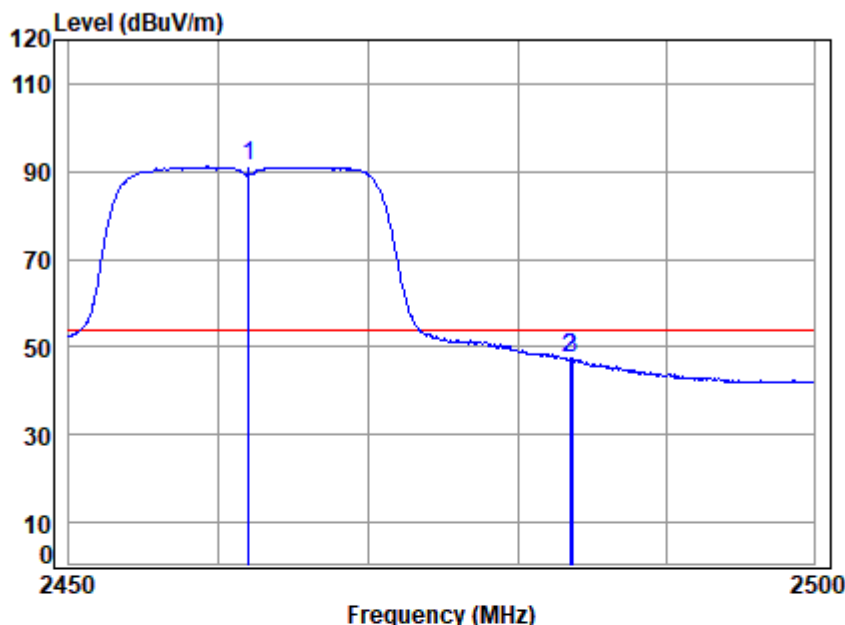


Site : chamber
Condition: 3m VERTICAL
Job No : 06018CR/06019CR
Mode : 2462 Band edge
Note : 2.4G WIFI 11N20

		Cable	Ant	Preamp	Read	Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1 *	2462.000	4.45	28.63	41.00	106.03	98.11	74.00	24.11 peak
2	2483.500	4.49	28.67	41.01	67.28	59.43	74.00	-14.57 peak
3	2483.589	4.49	28.67	41.01	69.05	61.20	74.00	-12.80 Peak



Test mode: b; Polarity: Vertical; Modulation:802.11n; Bandwidth:20MHz; Channel:High



Site : chamber
Condition: 3m VERTICAL
Job No : 06018CR/06019CR
Mode : 2462 Band edge
Note : 2.4G WIFI 11N20

		Cable	Ant	Preamp	Read	Limit	Over	
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1 *	2462.000	4.46	28.63	41.00	98.98	91.07	54.00	37.07 Average
2	2483.500	4.49	28.67	41.01	55.15	47.30	54.00	-6.70 Average
3	2483.639	4.49	28.67	41.01	55.18	47.33	54.00	-6.67 Average



8.7 Radiated Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.209 & 15.247(d)

Test Method: ANSI C63.10 (2013) Section 6.4,6.5,6.6

Measurement Distance: 3m

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

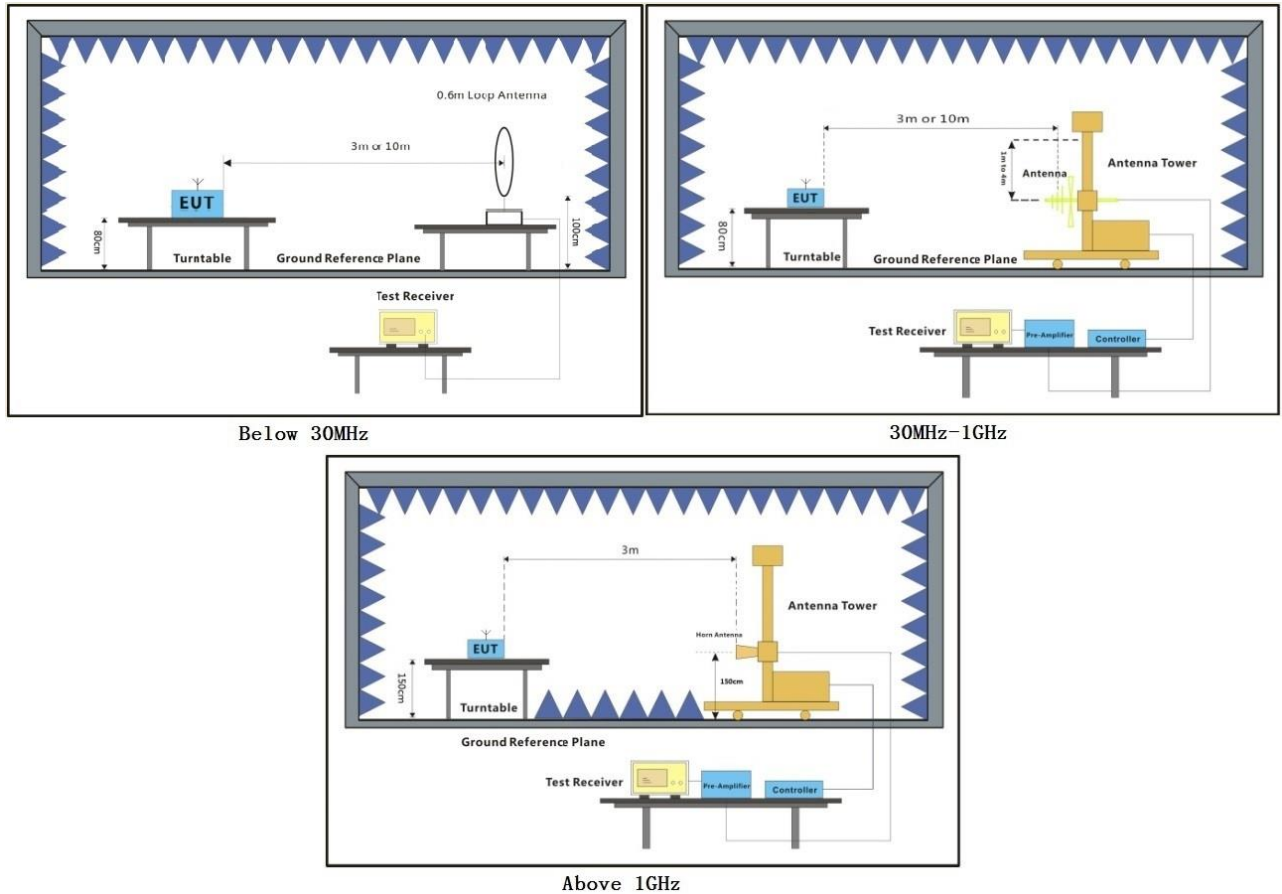
8.7.1 E.U.T. Operation

Operating Environment:

Temperature: 23.4 °C Humidity: 60.6 % RH Atmospheric Pressure: 1010 mbar

Test mode: b:TX mode_Keep the EUT in continuously transmitting mode with all modulation types. All data rates for each modulation type have been tested and found the data rate @ 1Mbps is the worst case of IEEE 802.11b; data rate @ 6Mbps is the worst case of IEEE 802.11g; data rate @ 6.5Mbps is the worst case of IEEE 802.11n(HT20). Only the data of worst case is recorded in the report.

8.7.2 Test Setup Diagram



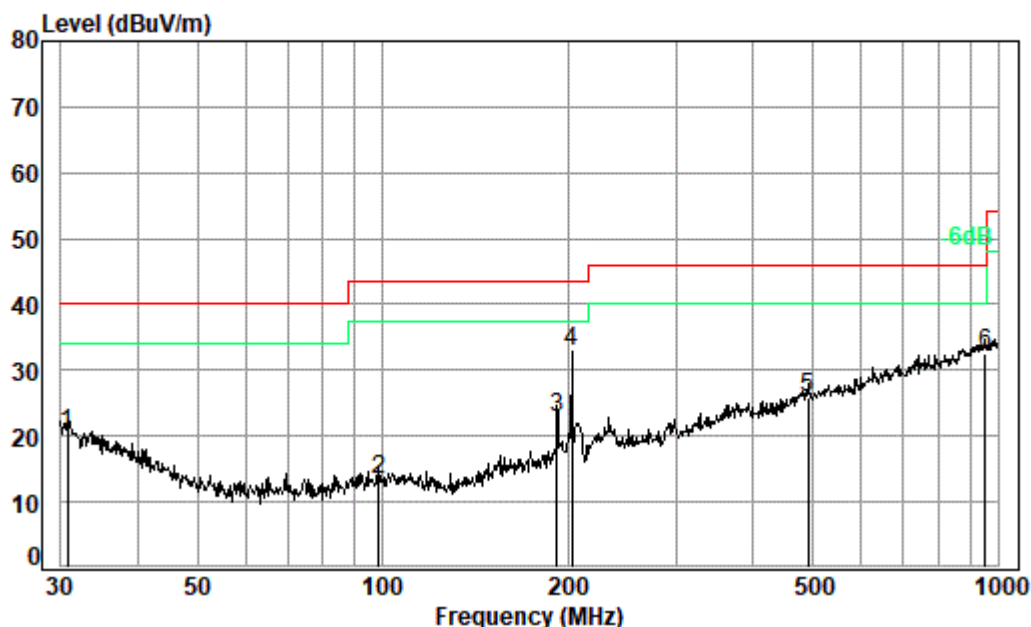
8.7.3 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height 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.
- e. 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 (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark:

- 1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.
- 2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Final Test Level = Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor
- 3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
- 4) For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

Test mode: b; Polarity: Horizontal



Condition: 3m HORIZONTAL

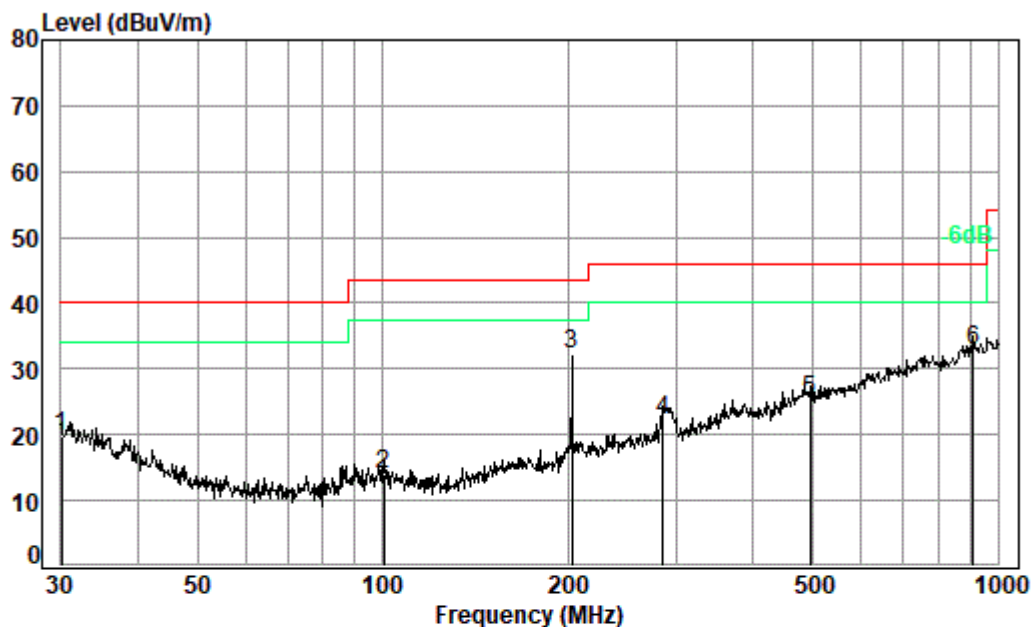
Job No. : 06018CR

Test Mode: b

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	30.75	0.61	22.43	27.73	25.12	20.43	40.00	-19.57	
2	98.49	1.13	13.85	27.61	25.98	13.35	43.50	-30.15	
3	191.75	1.19	15.55	27.17	33.20	22.77	43.50	-20.73	
4 pp	202.81	1.23	15.66	27.13	43.04	32.80	43.50	-10.70	
5	490.74	2.48	24.28	27.76	26.91	25.91	46.00	-20.09	
6	952.09	3.55	29.38	26.90	26.52	32.55	46.00	-13.45	



Test mode: b; Polarity: Vertical



Condition: 3m VERTICAL

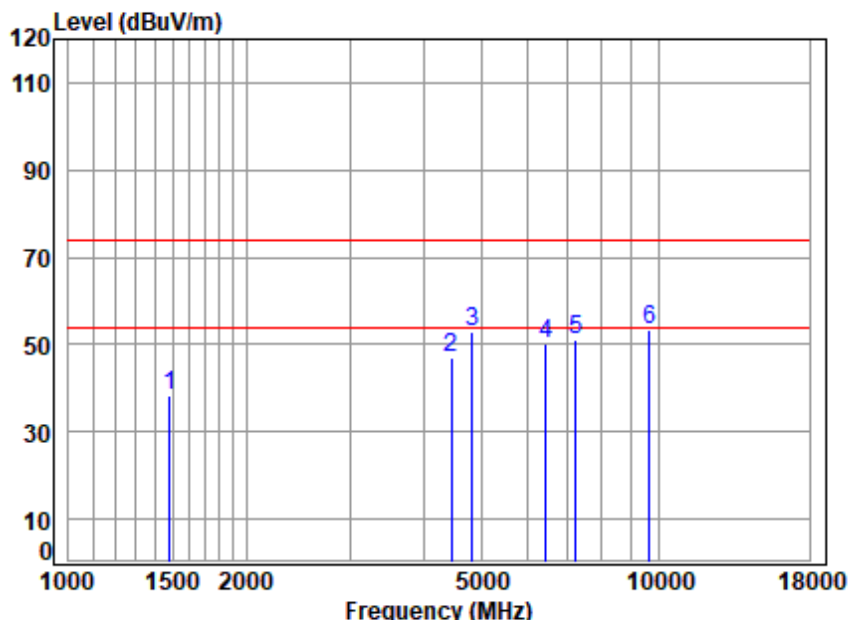
Job No. : 06018CR

Test Mode: b

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	30.11	0.60	22.92	27.74	24.11	19.89	40.00	-20.11	QP
2	100.58	1.10	13.98	27.61	26.52	13.99	43.50	-29.51	QP
3 pp	202.81	1.23	15.66	27.13	42.42	32.18	43.50	-11.32	QP
4	285.98	1.91	18.34	26.90	28.88	22.23	46.00	-23.77	QP
5	494.20	2.49	24.22	27.78	26.45	25.38	46.00	-20.62	QP
6	912.86	3.51	29.09	27.10	27.38	32.88	46.00	-13.12	QP



Test mode: b; Polarity: Horizontal; Modulation:802.11b; Bandwidth:20MHz; Channel:Low

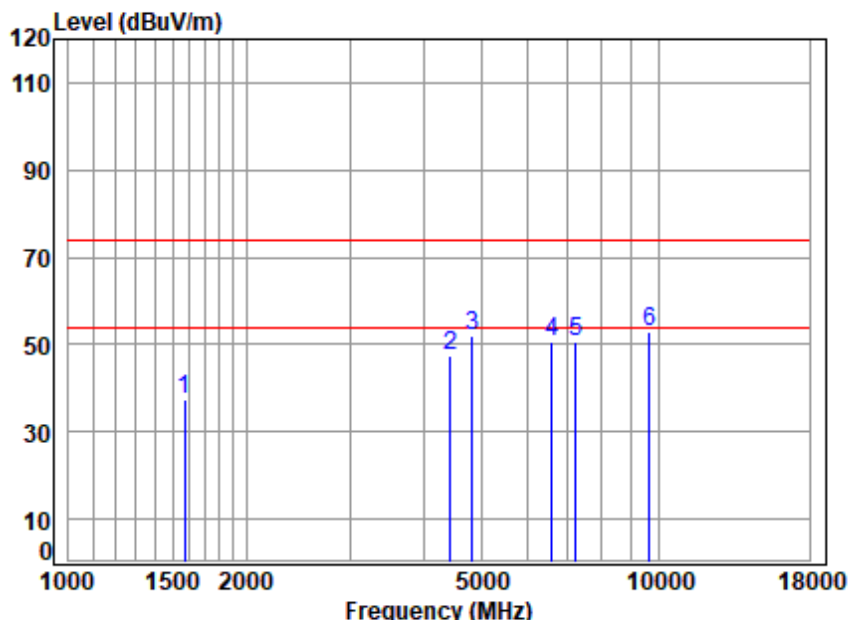


Site : chamber
Condition: 3m HORIZONTAL
Job No : 06018CR/06019CR
Mode : 2412 TX SE
Note : 2.4G WIFI 11B

		Cable	Ant	Preamp	Read		Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1485.841	3.24	25.75	40.50	49.76	38.25	74.00	-35.75	peak
2	4456.315	6.72	33.53	42.52	49.13	46.86	74.00	-27.14	peak
3	4824.000	7.12	34.00	42.78	54.39	52.73	74.00	-21.27	peak
4	6451.353	8.28	35.55	41.98	48.53	50.38	74.00	-23.62	peak
5	7236.000	8.77	36.09	41.56	47.58	50.88	74.00	-23.12	peak
6	9648.000	10.79	37.69	38.51	43.20	53.17	74.00	-20.83	peak



Test mode: b; Polarity: Vertical; Modulation:802.11b; Bandwidth:20MHz; Channel:Low

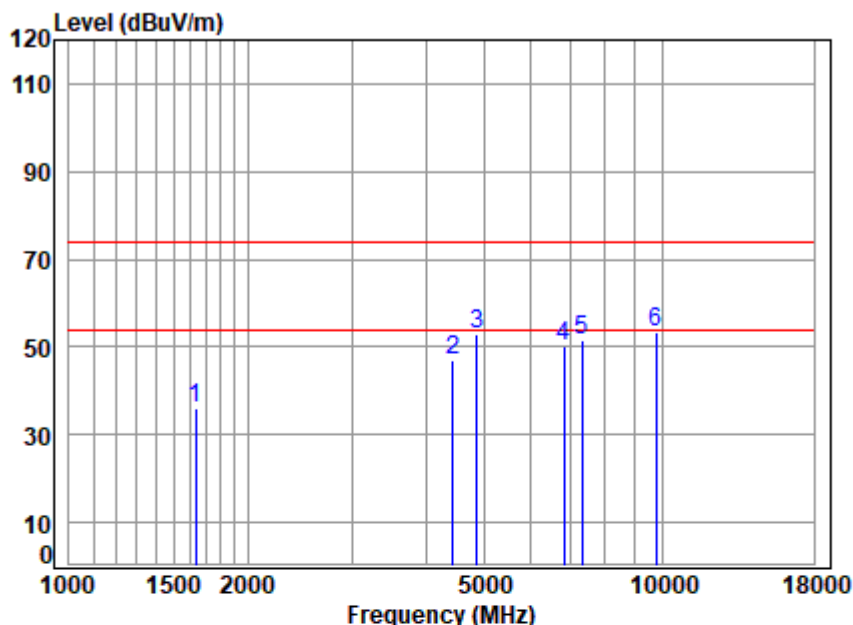


Site : chamber
Condition: 3m VERTICAL
Job No : 06018CR/06019CR
Mode : 2412 TX SE
Note : 2.4G WIFI 11B

		Cable	Ant	Preamp	Read		Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1574.265	3.33	26.14	40.55	48.47	37.39	74.00	-36.61	peak
2	4443.453	6.71	33.50	42.51	49.80	47.50	74.00	-26.50	peak
3	4824.000	7.12	34.00	42.78	53.49	51.83	74.00	-22.17	peak
4	6583.209	8.32	35.65	41.91	48.41	50.47	74.00	-23.53	peak
5	7236.000	8.77	36.09	41.56	47.48	50.78	74.00	-23.22	peak
6	9648.000	10.79	37.69	38.51	43.02	52.99	74.00	-21.01	peak



Test mode: b; Polarity: Horizontal; Modulation:802.11b; Bandwidth:20MHz; Channel:middle

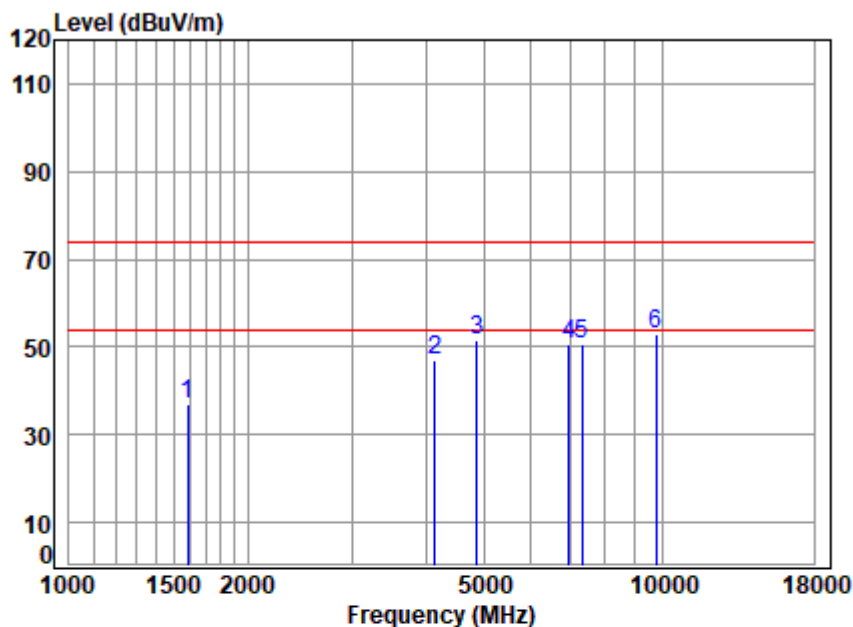


Site : chamber
Condition: 3m HORIZONTAL
Job No : 06018CR/06019CR
Mode : 2437 TX SE
Note : 2.4G WIFI 11B

		Cable	Ant	Preamp	Read	Limit	Over	
	Freq	Loss	Factor	Factor	Level	Line	Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	1634.543	3.38	26.40	40.59	46.96	36.15	74.00	-37.85 peak
2	4443.453	6.71	33.50	42.51	49.36	47.06	74.00	-26.94 peak
3	4874.000	7.17	34.05	42.82	54.55	52.95	74.00	-21.05 peak
4	6835.278	8.46	35.80	41.77	47.82	50.31	74.00	-23.69 peak
5	7311.000	8.84	36.15	41.53	47.96	51.42	74.00	-22.58 peak
6	9748.000	10.76	37.75	38.37	43.08	53.22	74.00	-20.78 peak



Test mode: b; Polarity: Vertical; Modulation:802.11b; Bandwidth:20MHz; Channel:middle



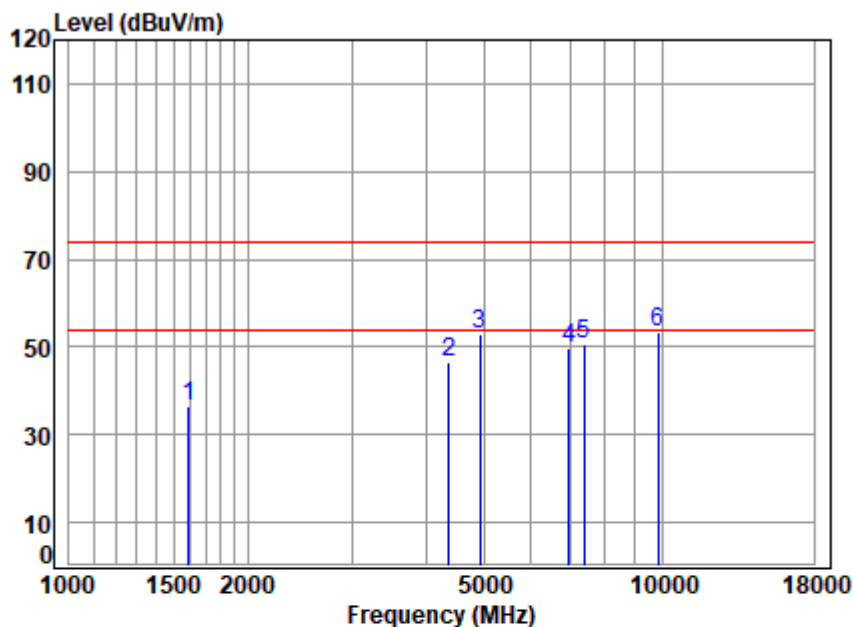
Site : chamber
Condition: 3m VERTICAL
Job No : 06018CR/06019CR
Mode : 2437 TX SE
Note : 2.4G WIFI 11B

		Cable	Ant	Preamp	Read	Limit	Over	
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	1583.392	3.33	26.18	40.56	48.19	37.14	74.00	-36.86 peak
2	4133.699	6.41	32.95	42.27	49.80	46.89	74.00	-27.11 peak
3	4874.000	7.17	34.05	42.82	53.25	51.65	74.00	-22.35 peak
4	6954.852	8.52	35.87	41.71	48.05	50.73	74.00	-23.27 peak
5	7311.000	8.84	36.15	41.53	47.40	50.86	74.00	-23.14 peak
6	9748.000	10.76	37.75	38.37	42.95	53.09	74.00	-20.91 peak



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Test mode: b; Polarity: Horizontal; Modulation:802.11b; Bandwidth:20MHz; Channel:High

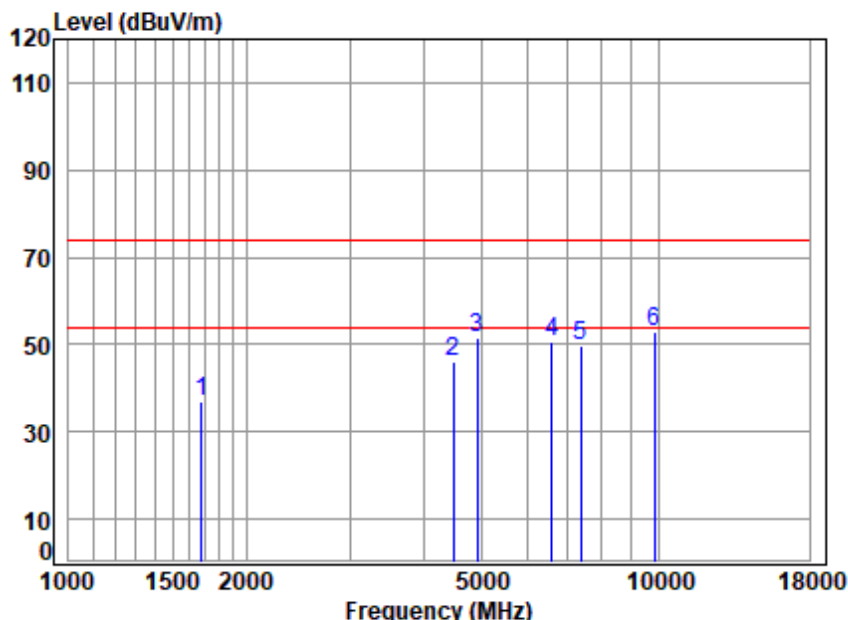


Site : chamber
Condition: 3m HORIZONTAL
Job No : 06018CR/06019CR
Mode : 2462 TX SE
Note : 2.4G WIFI 11B

		Cable	Ant	Preamp	Read		Limit	Over	
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1592.571	3.34	26.22	40.57	47.60	36.59	74.00	-37.41	peak
2	4367.058	6.64	33.37	42.45	49.07	46.63	74.00	-27.37	peak
3	4924.000	7.22	34.11	42.85	54.44	52.92	74.00	-21.08	peak
4	6954.852	8.52	35.87	41.71	46.97	49.65	74.00	-24.35	peak
5	7386.000	8.91	36.21	41.49	46.85	50.48	74.00	-23.52	peak
6	9848.000	10.73	37.81	38.22	42.93	53.25	74.00	-20.75	peak



Test mode: b; Polarity: Vertical; Modulation:802.11b; Bandwidth:20MHz; Channel:High



Site : chamber
Condition: 3m VERTICAL
Job No : 06018CR/06019CR
Mode : 2462 TX SE
Note : 2.4G WIFI 11B

		Cable	Ant	Preamp	Read		Limit	Over	
Freq		Loss	Factor	Factor	Level	Level	Line	Limit	Remark
MHz		dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1	1677.621	3.41	26.58	40.62	47.54	36.91	74.00	-37.09	peak
2	4482.150	6.74	33.57	42.54	48.51	46.28	74.00	-27.72	peak
3	4924.000	7.22	34.11	42.85	53.14	51.62	74.00	-22.38	peak
4	6583.209	8.32	35.65	41.91	48.38	50.44	74.00	-23.56	peak
5	7386.000	8.91	36.21	41.49	45.93	49.56	74.00	-24.44	peak
6	9848.000	10.73	37.81	38.22	42.79	53.11	74.00	-20.89	peak



9 Photographs

9.1 Setup photos.

Please refer to setup photos.

9.2 EUT Constructional Details (EUT Photos)

Please Refer to external and internal photos for details.



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10 Appendix

10.1 Appendix 15.247

1. Duty Cycle

1.1 Test Result

Test mode:	Channel Frequency(MHz)	TX Type	ANT No.	T_on (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11g	2412	SISO	1	0.691	0.795	86.92	0.61
	2437	SISO	1	0.692	0.796	86.93	0.61
	2462	SISO	1	0.692	0.796	86.93	0.61



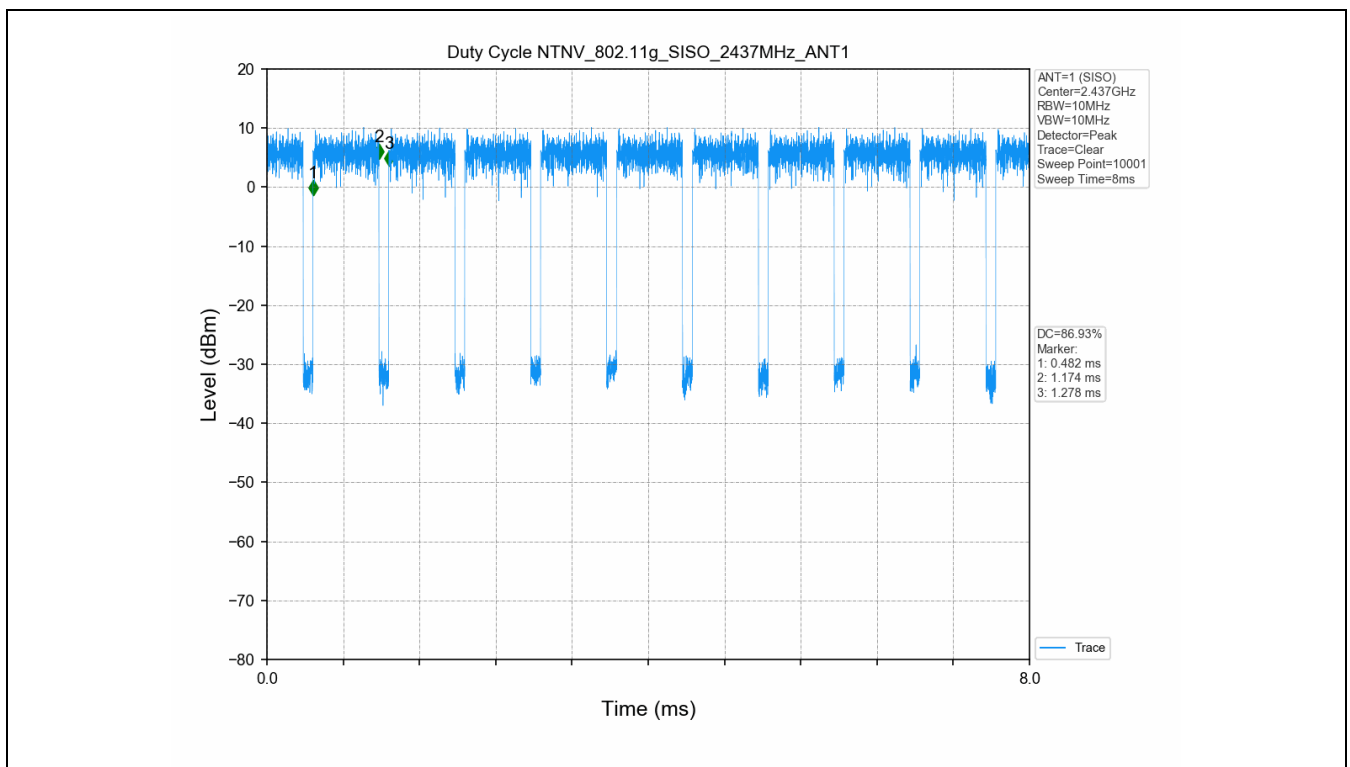
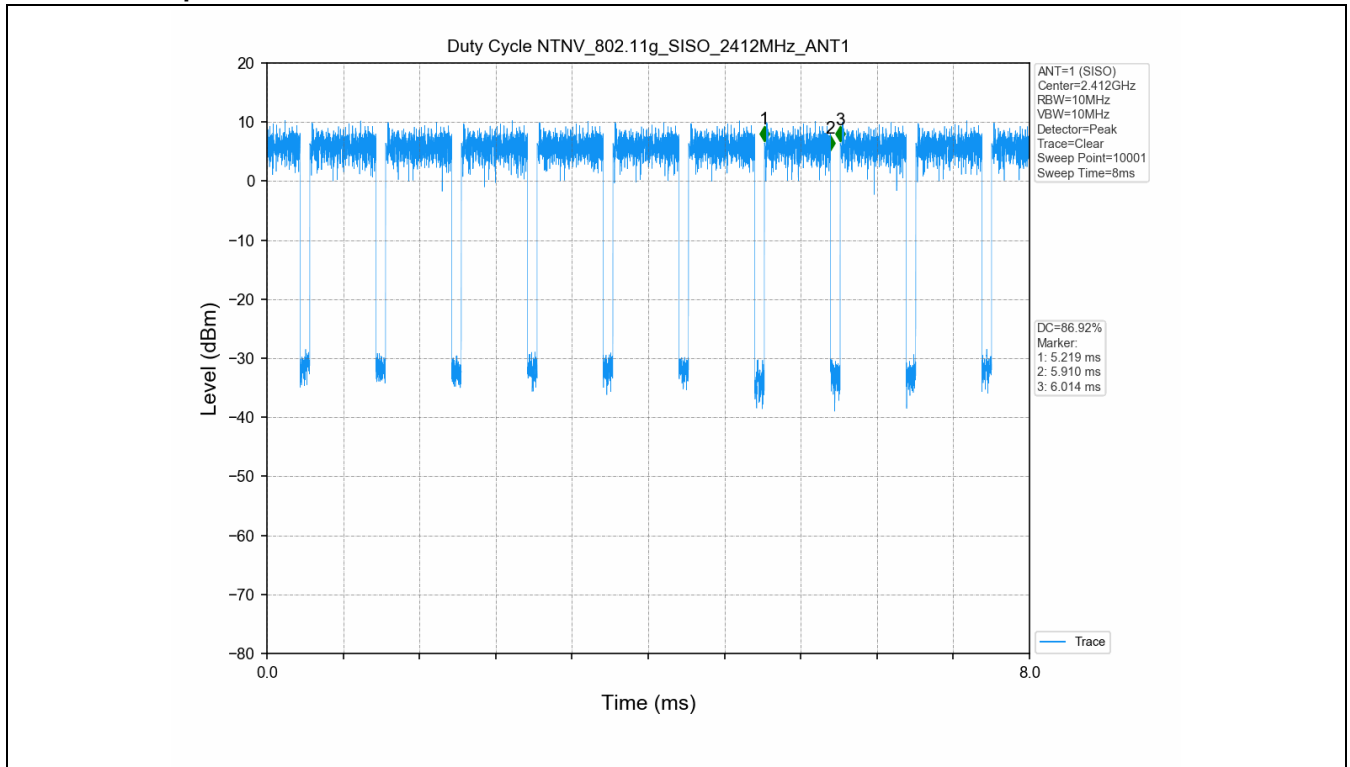
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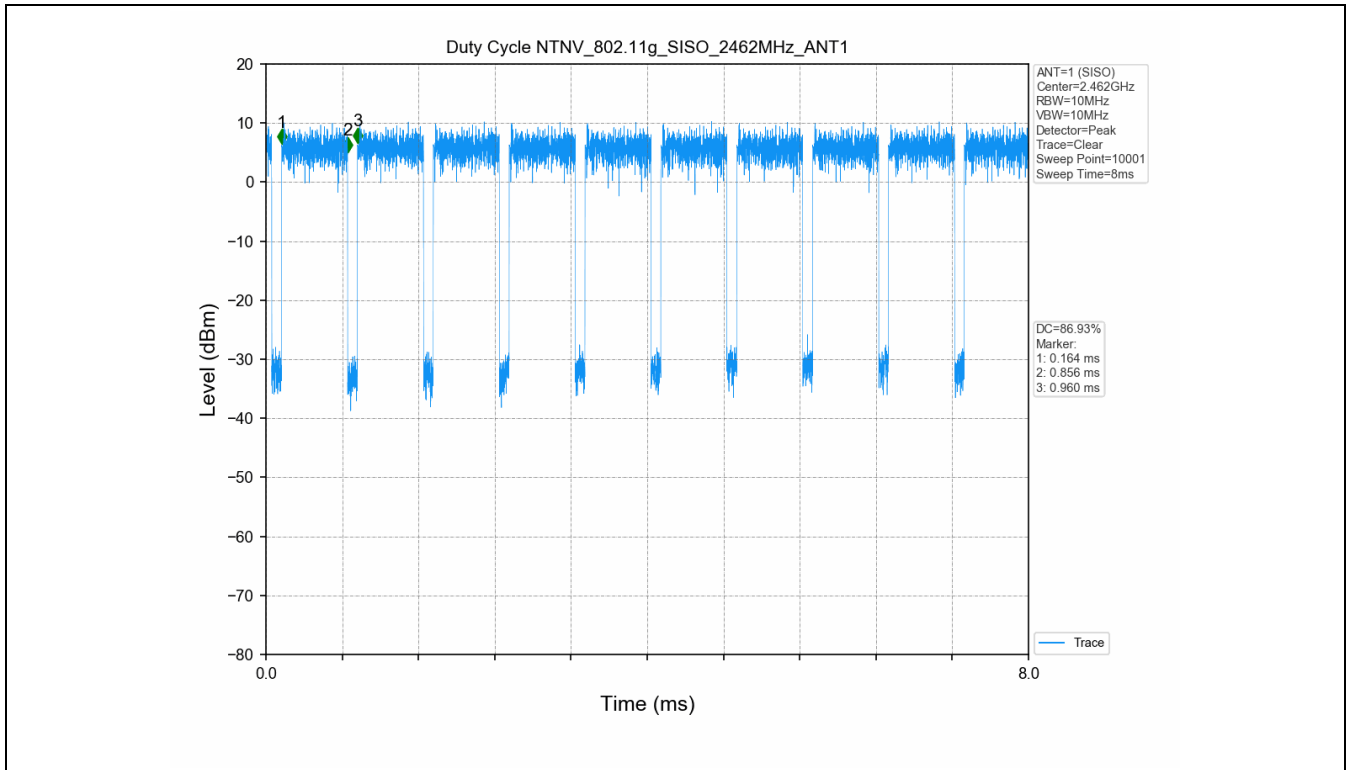
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1.2 Test Graph





2. Bandwidth

2.1 Test Result

Test mode:	Frequency (MHz)	TX Type	ANT No.	6dB Bandwidth	Verdict
				Test Result (MHz)	
802.11n(HT20)	2412	SISO	1	15.863	PASS
	2437	SISO	1	16.049	PASS
	2462	SISO	1	16.042	PASS

Test mode:	Frequency (MHz)	TX Type	ANT No.	99% Occupied Bandwidth	
				Test Result (MHz)	
802.11n(HT20)	2412	SISO	1	17.598	Only for Report Use
	2437	SISO	1	17.538	Only for Report Use
	2462	SISO	1	17.487	Only for Report Use



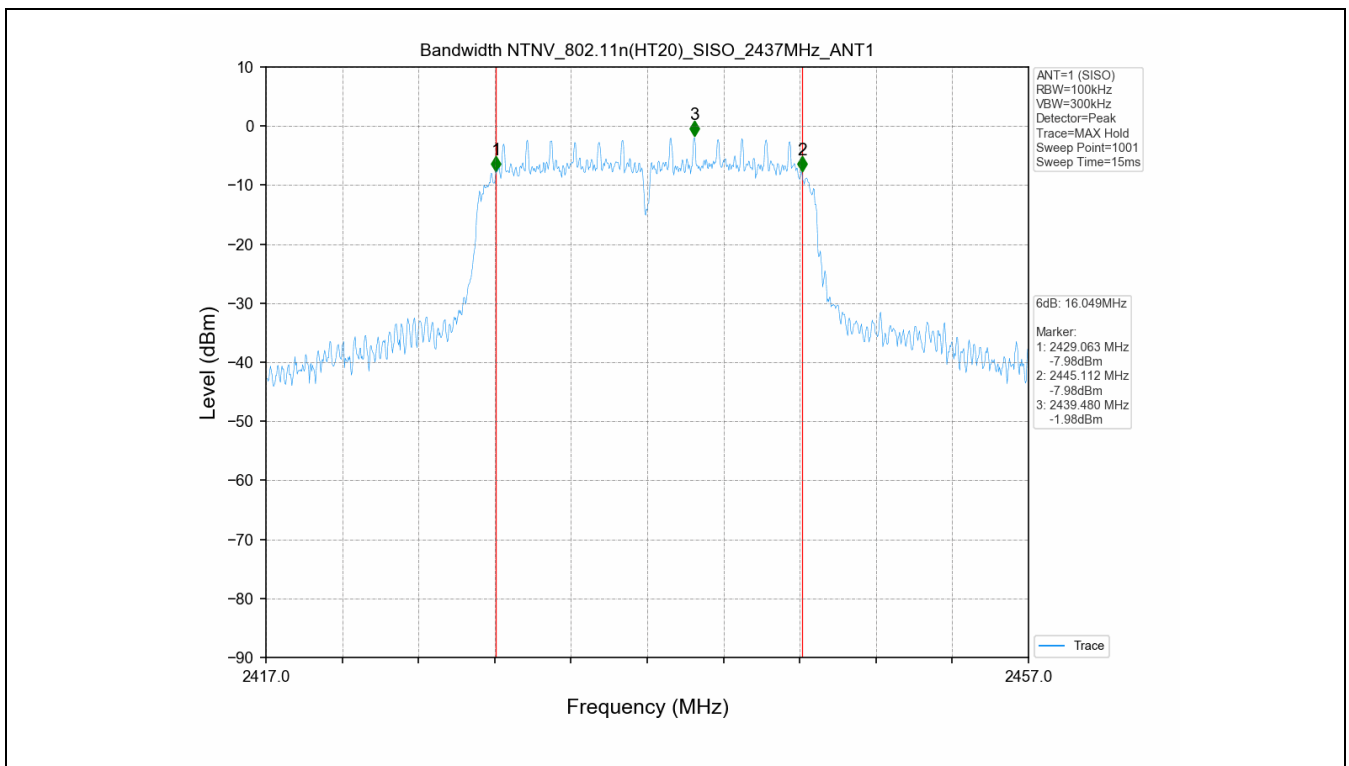
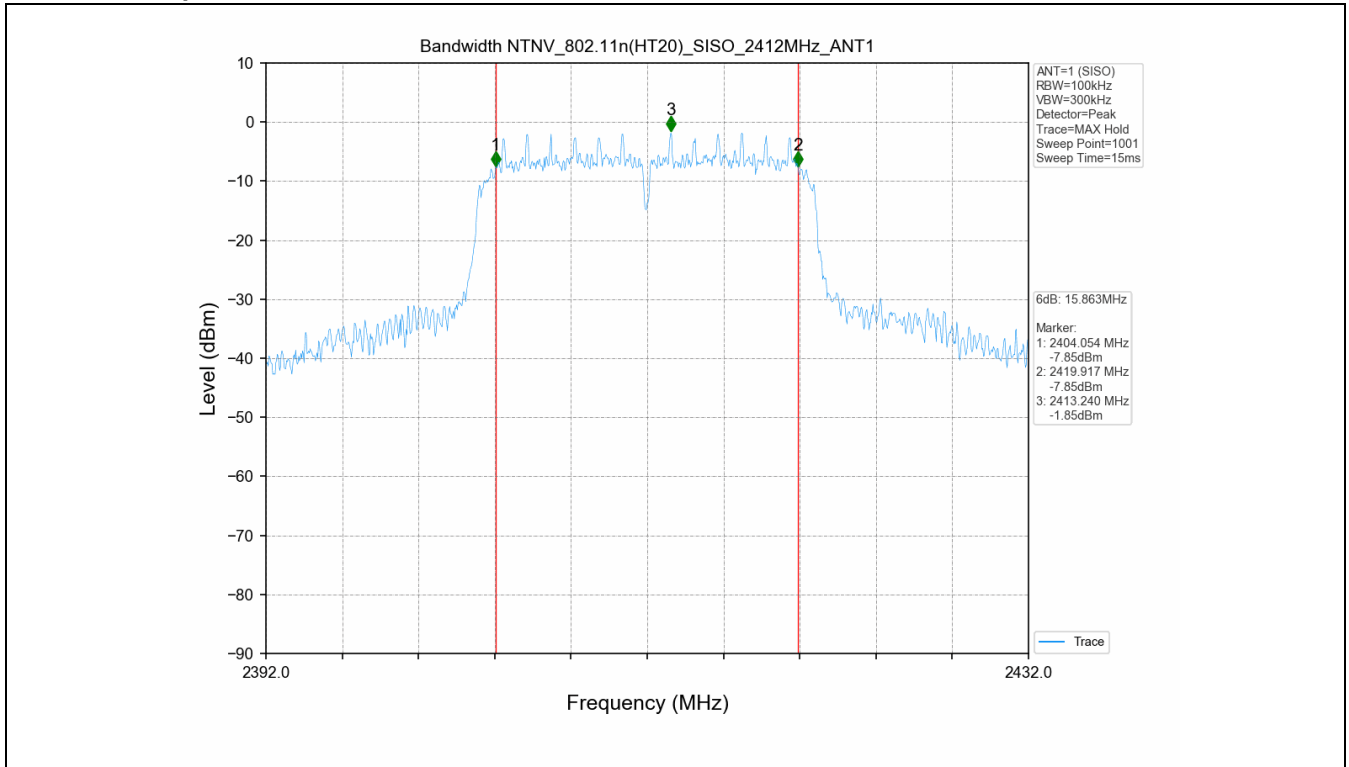
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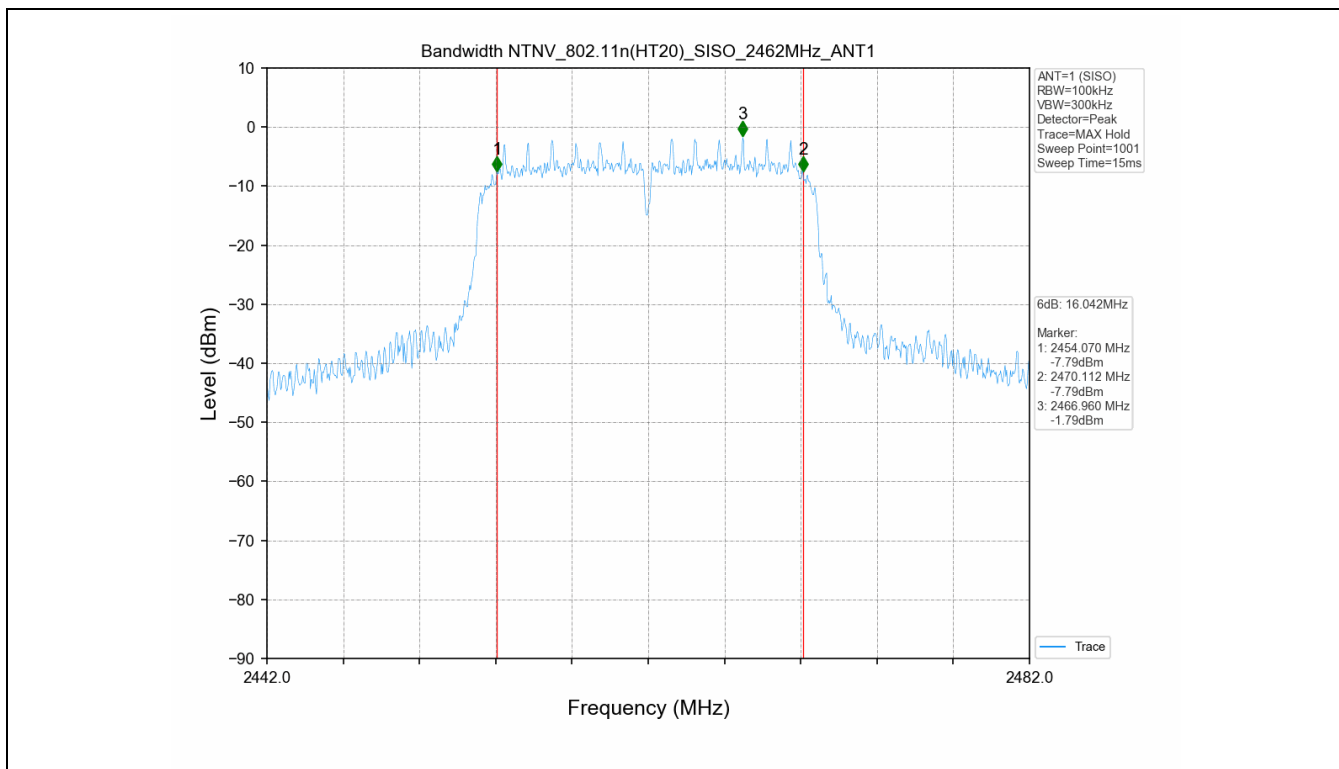
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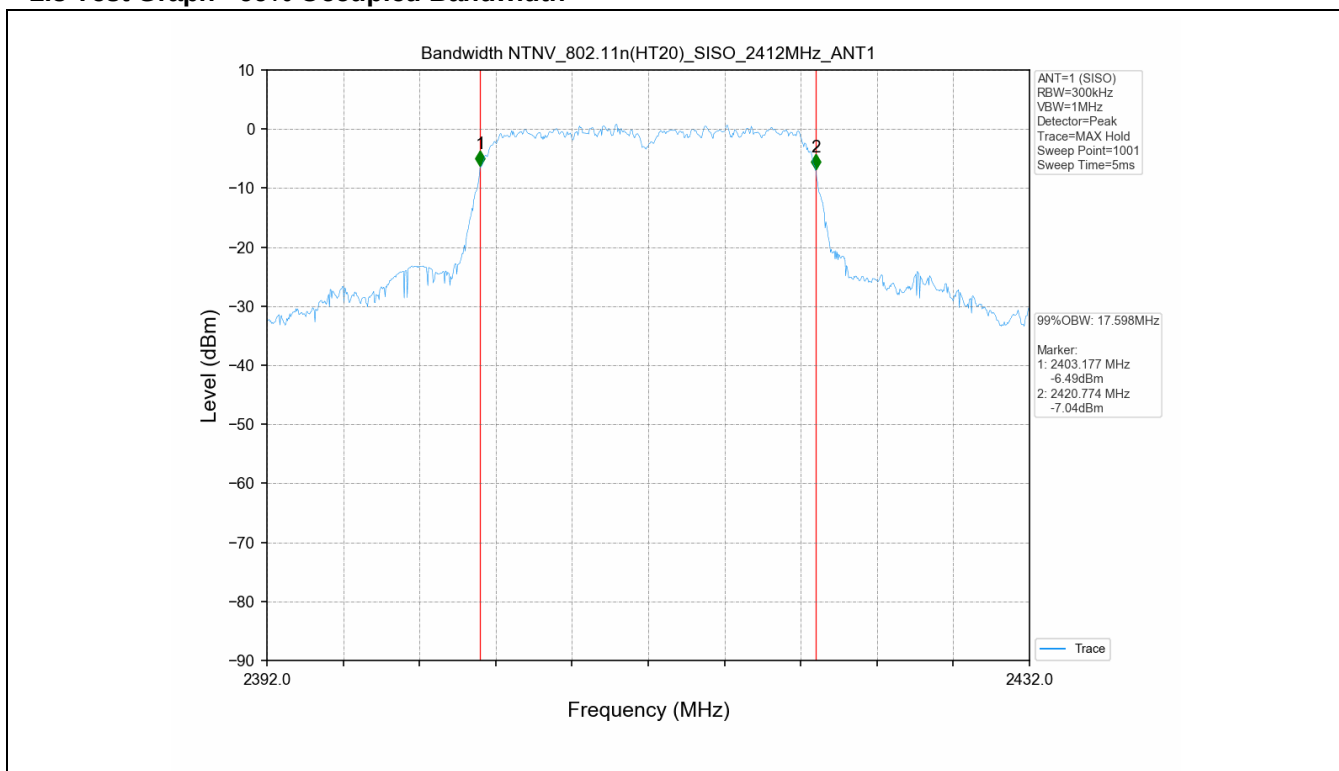
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2.2 Test Graph - 6dB Bandwidth





2.3 Test Graph - 99% Occupied Bandwidth

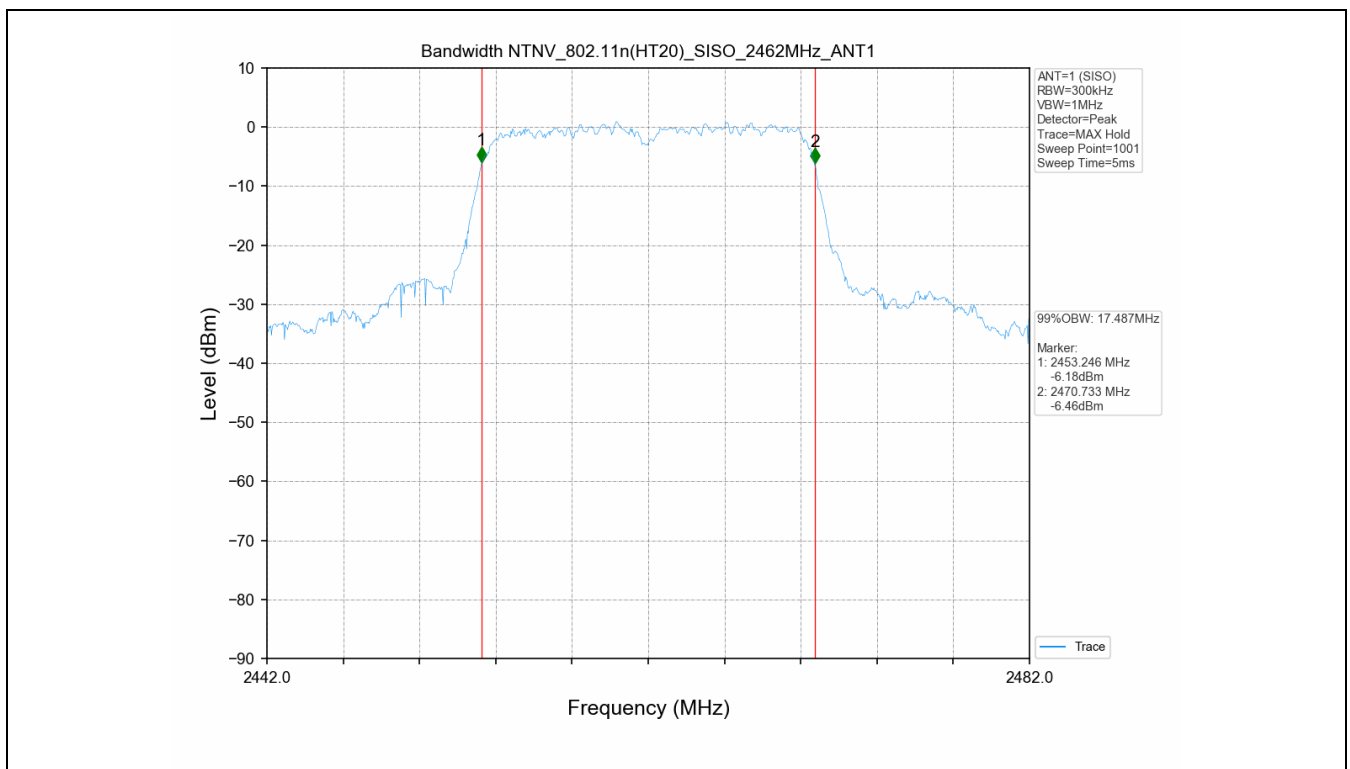
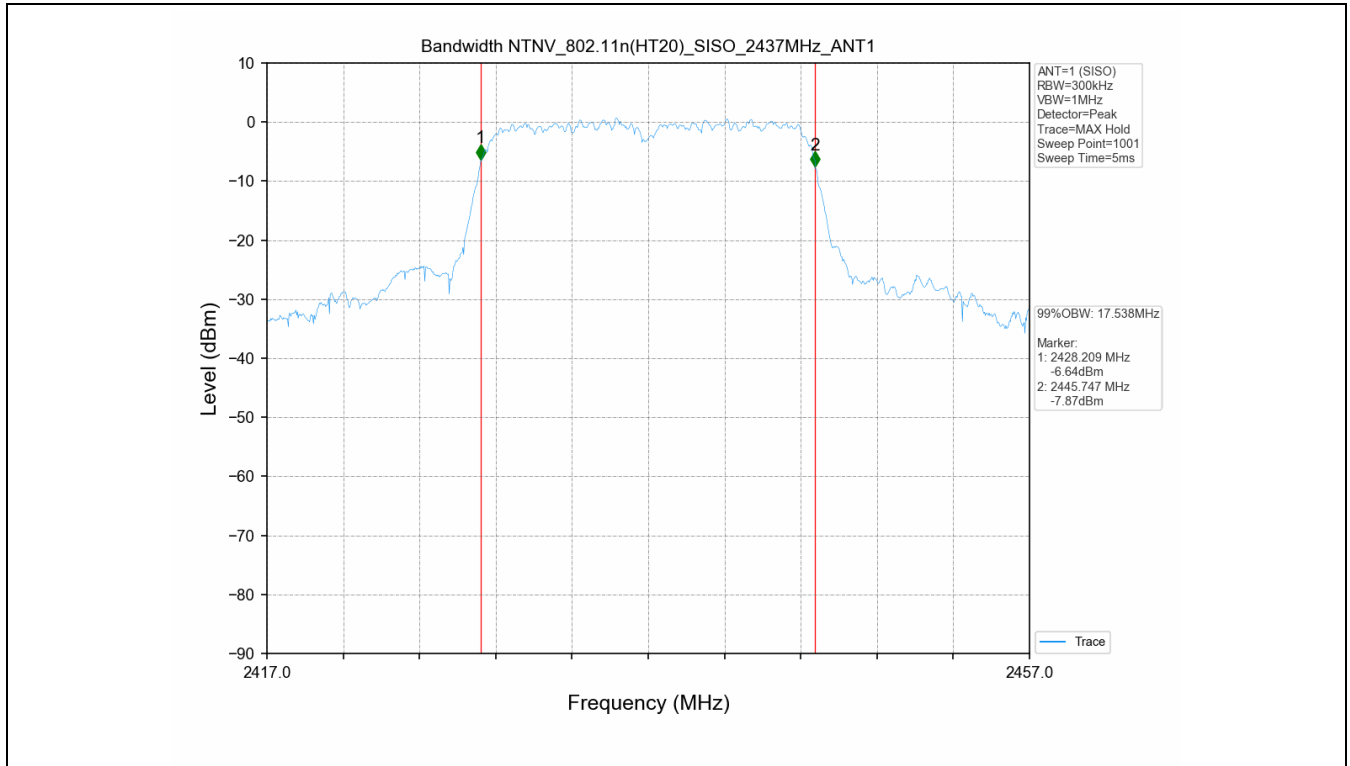


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3. Maximum Conducted Output Power

3.1 Test Result

Test mode:	Frequency (MHz)	Tx Type	Measured Peak Output Power (dBm)	Limits (dBm)	Verdict
			Ant 1		
802.11n(HT20)	2412	SISO	16.85	30	PASS
	2437	SISO	16.54	30	PASS
	2462	SISO	16.09	30	PASS

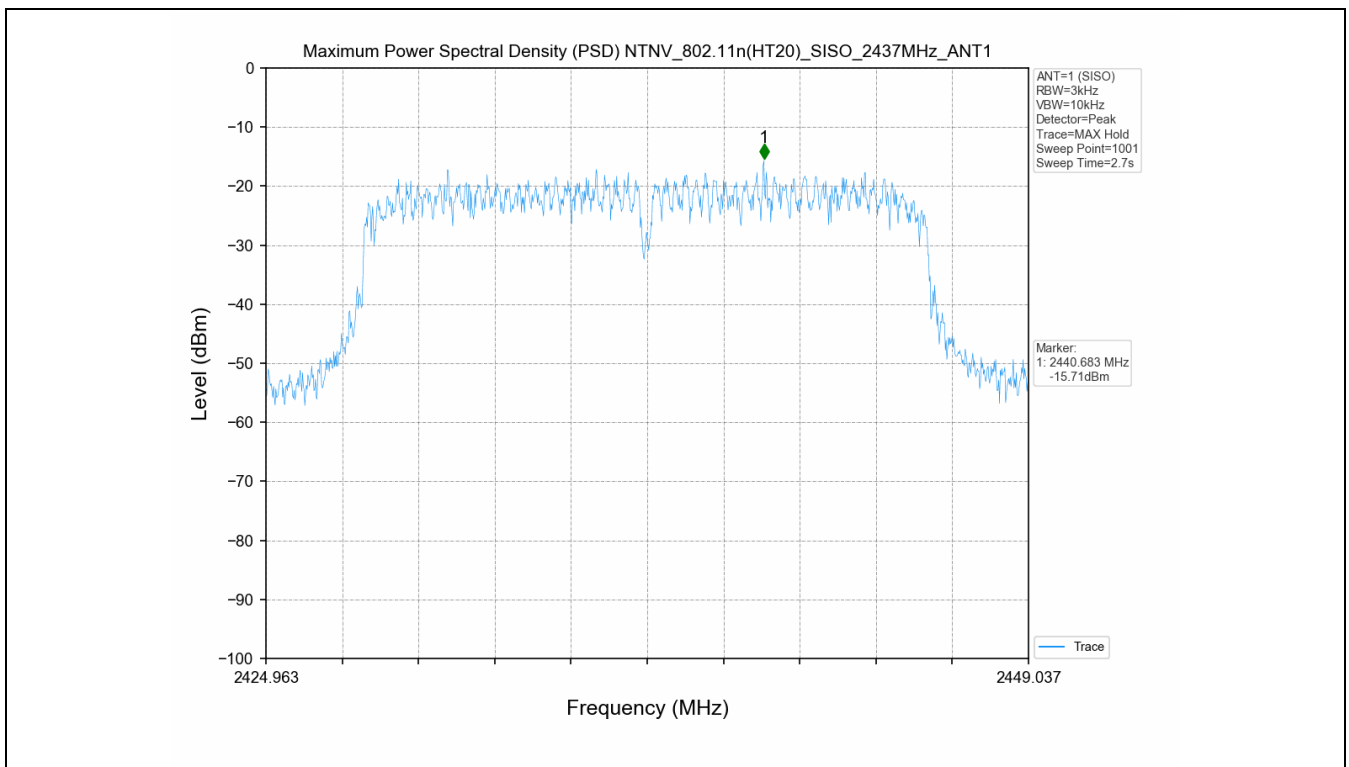
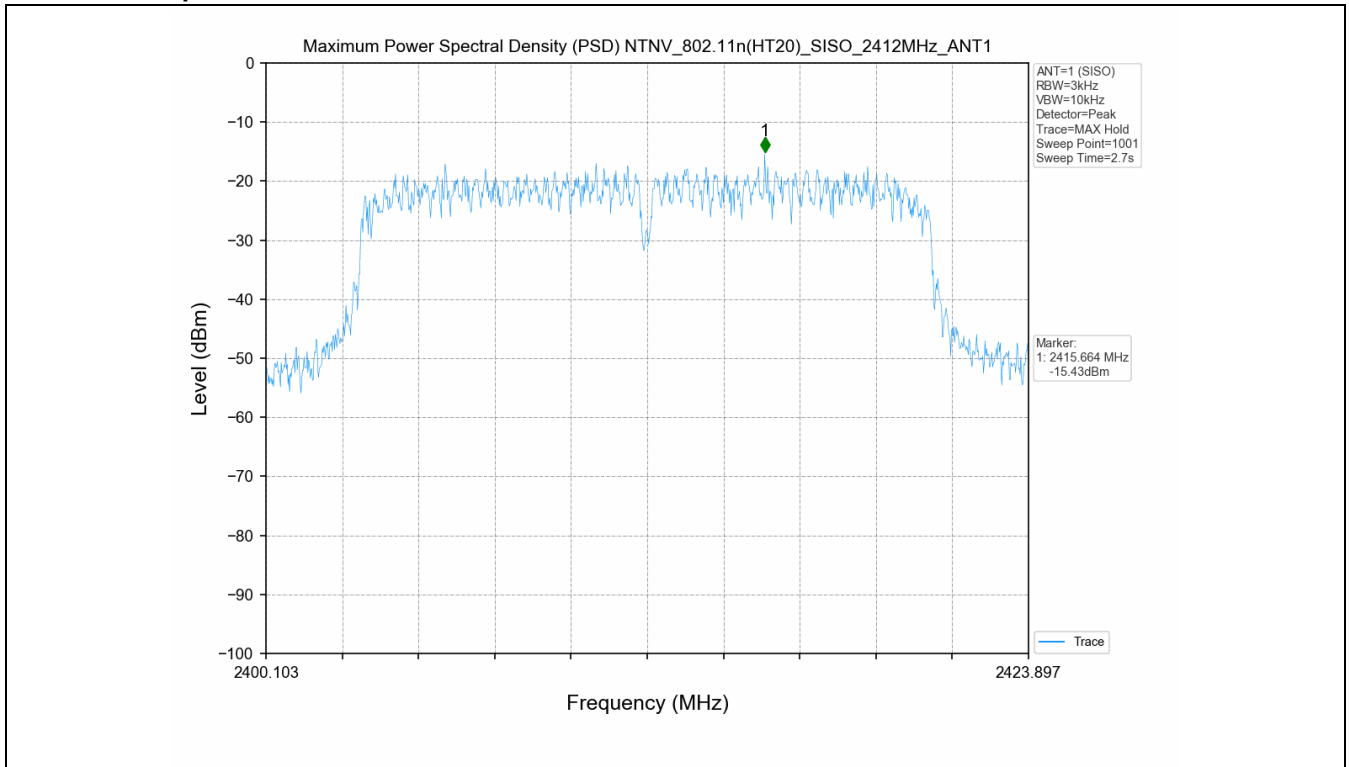
4. Maximum Power Spectral Density (PSD)

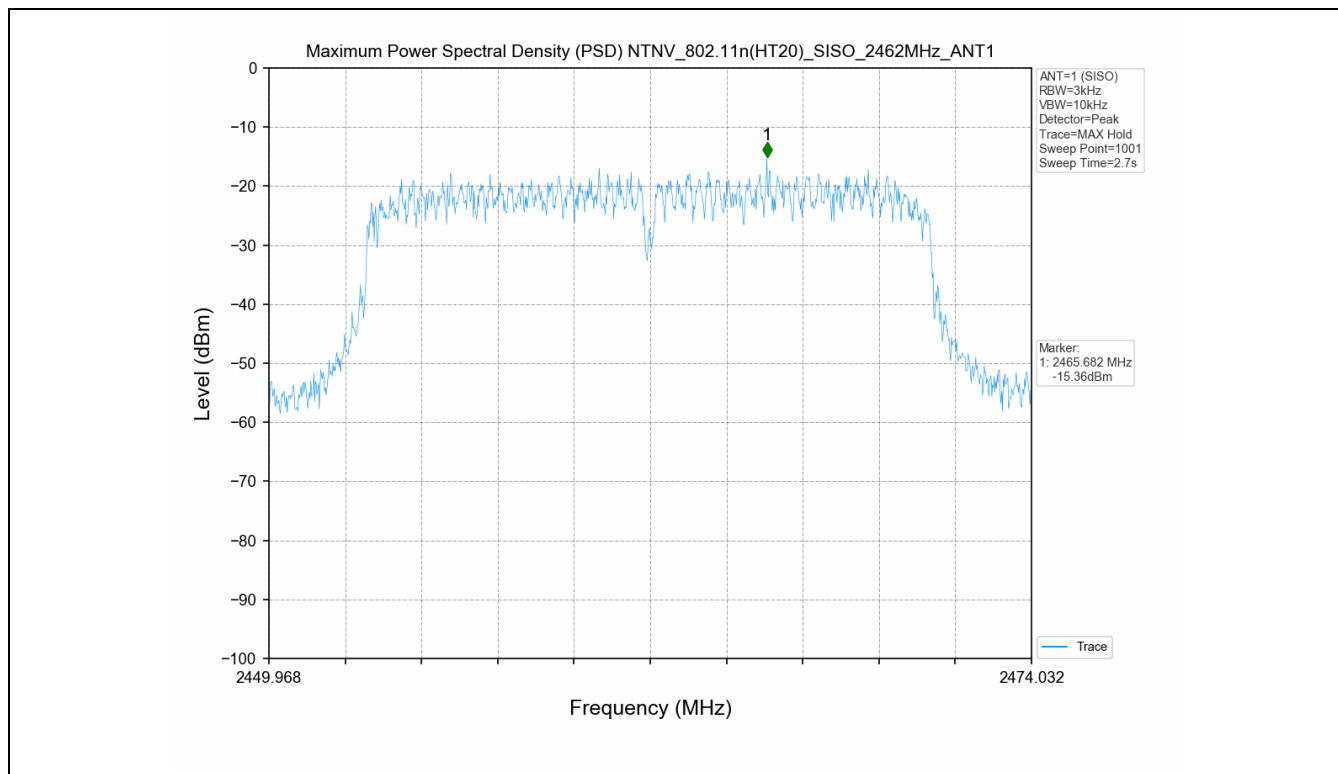
4.1 Test Result

Test mode:	Frequency (MHz)	Tx Type	Maximum Power Spectral Density (dBm/3KHz)	Limits (dBm/3kHz)	Verdict
			Ant 1		
802.11n(HT20)	2412	SISO	-15.43	≤8	PASS
	2437	SISO	-15.71	≤8	PASS
	2462	SISO	-15.36	≤8	PASS



4.2 Test Graph





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5. Unwanted Emissions in Non-restricted Frequency Bands

5.1 Test Result

Test mode:	Frequency (MHz)	TX Type	ANT No.	Spurious Conducted Emission (dBm)	Limits (dBm)	Verdict
802.11n(HT20)	2412	SISO	1	Refer to test graph	-21.80	PASS
	2437	SISO	1	Refer to test graph	-21.80	PASS
	2462	SISO	1	Refer to test graph	-21.80	PASS

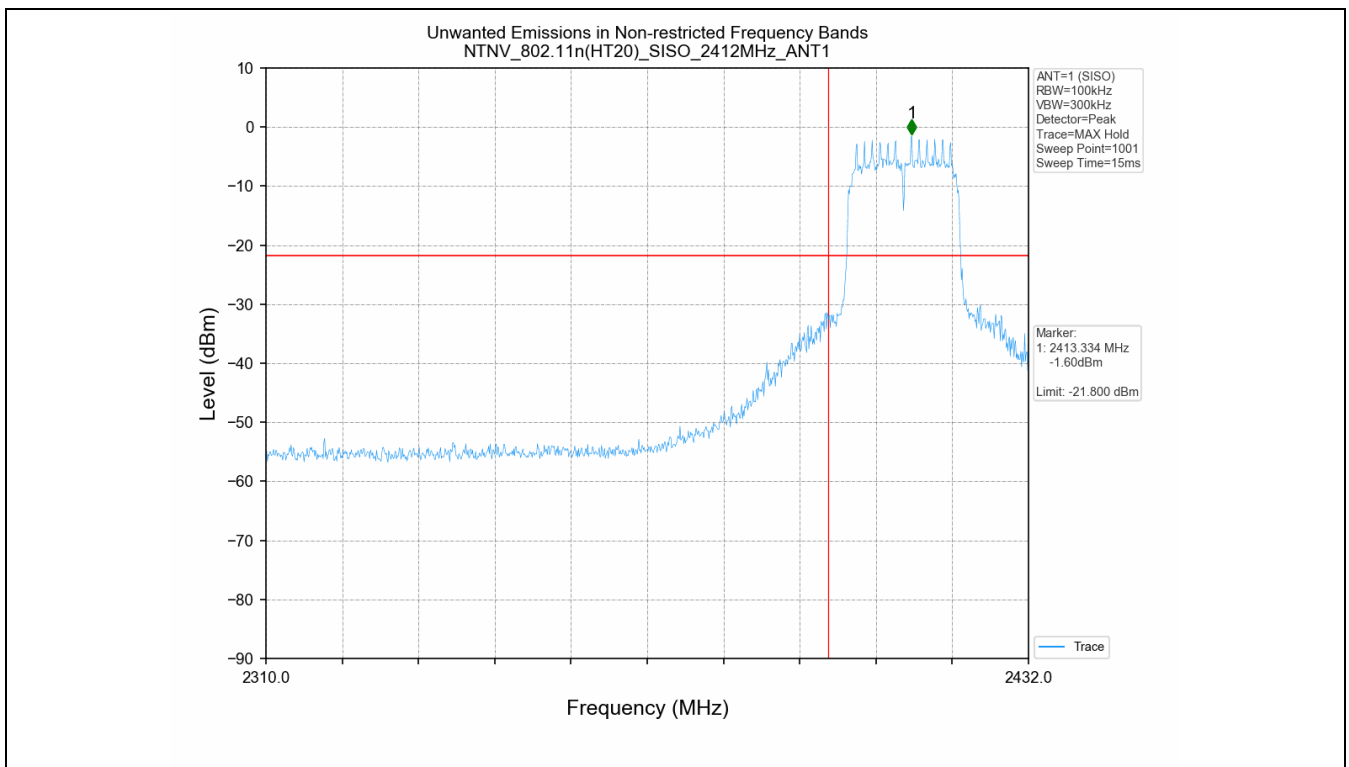
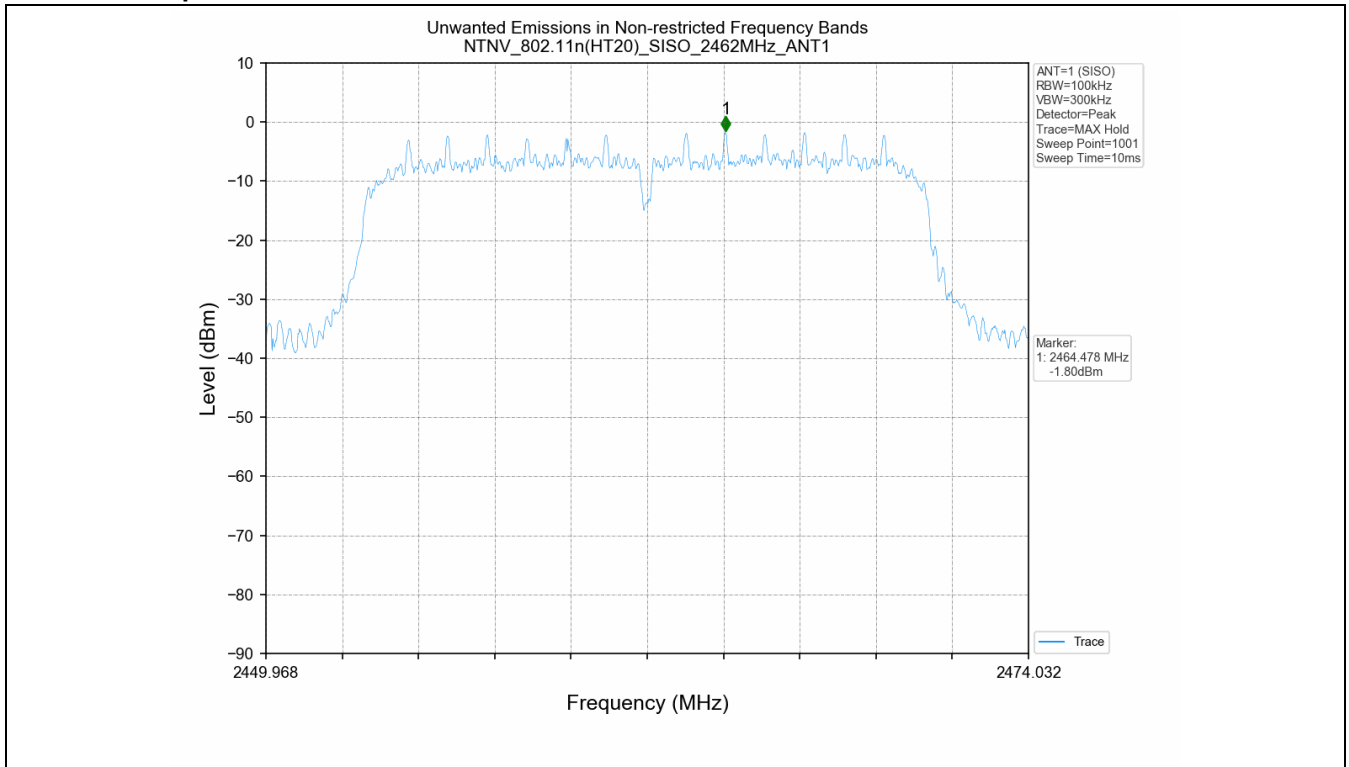


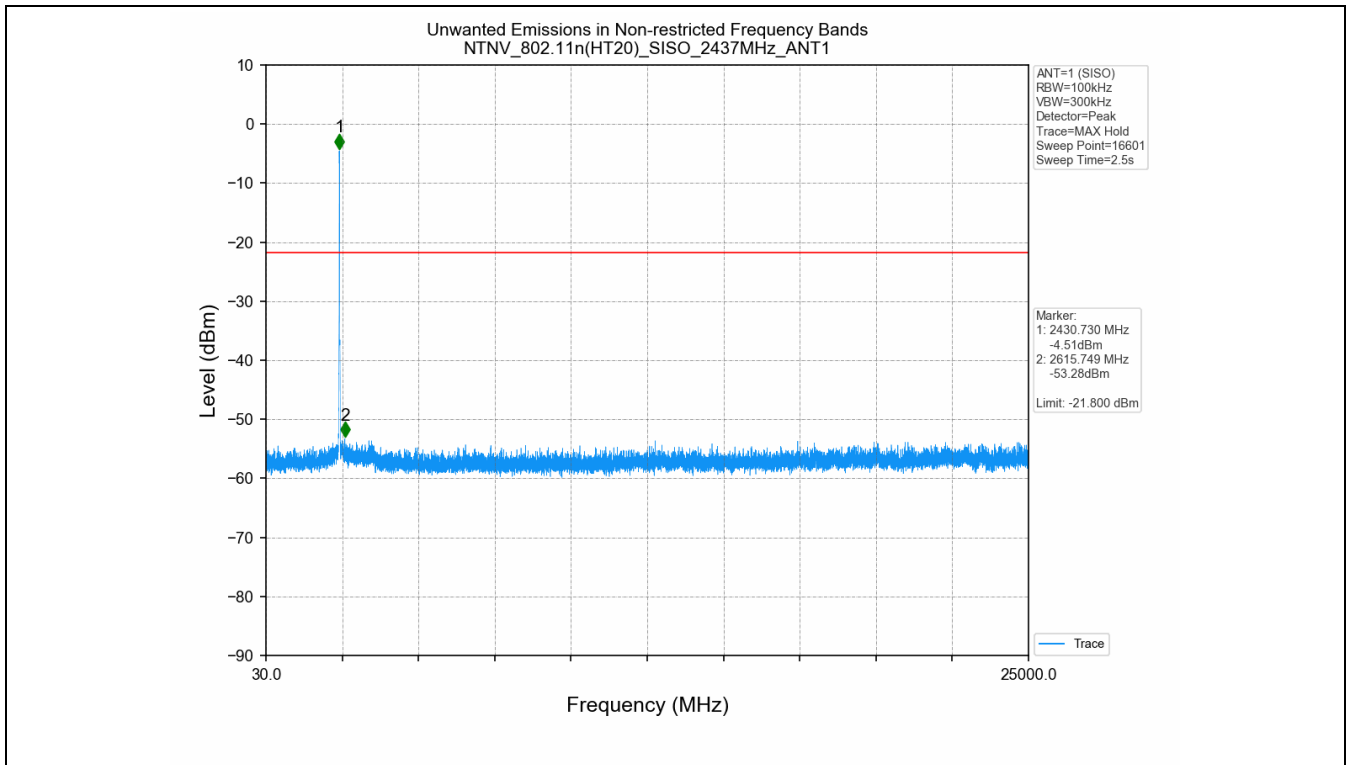
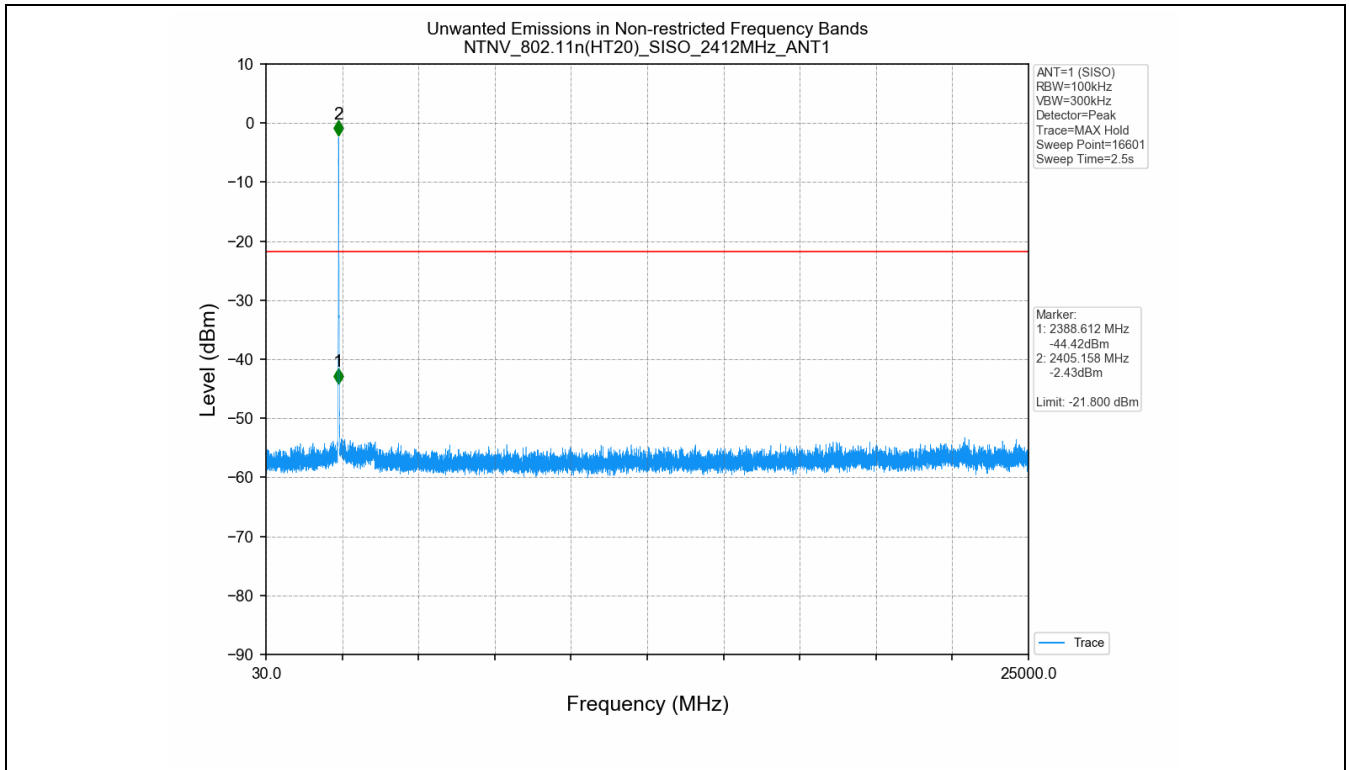
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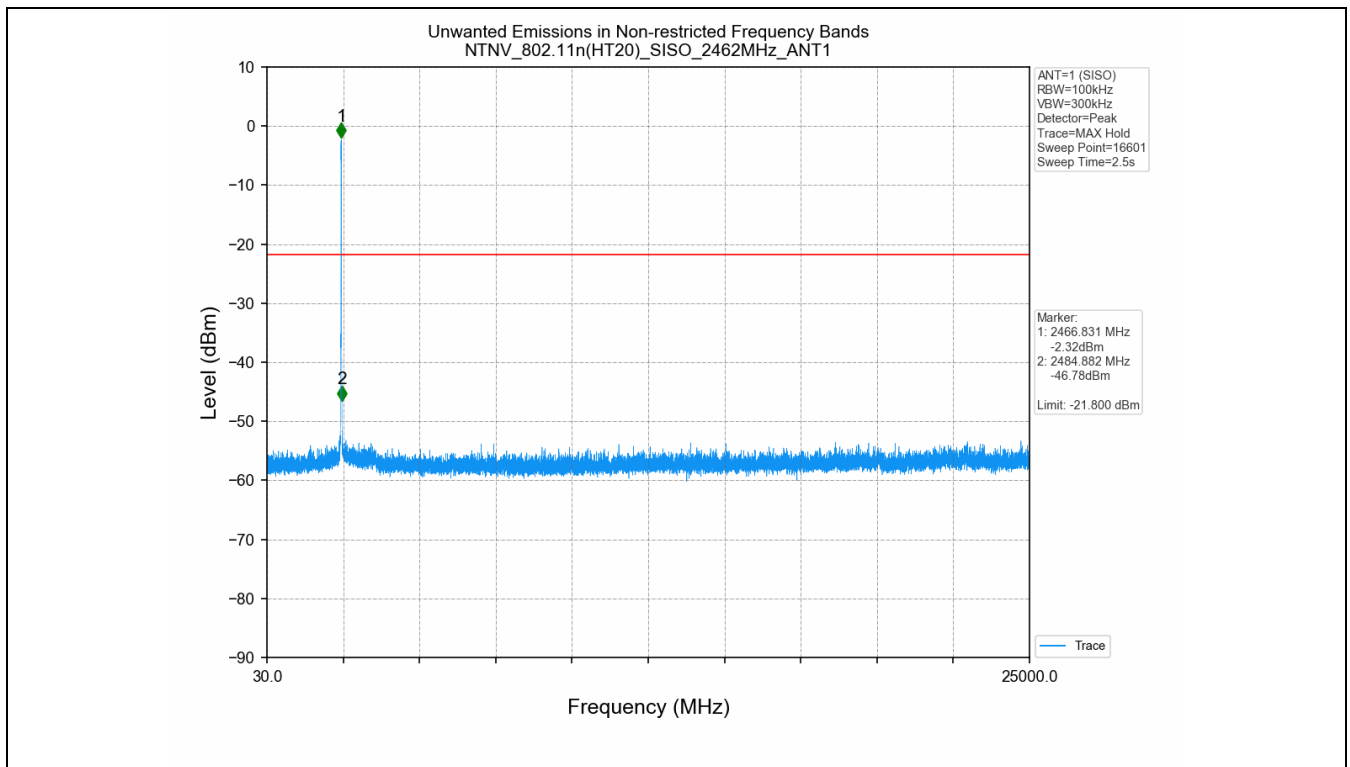
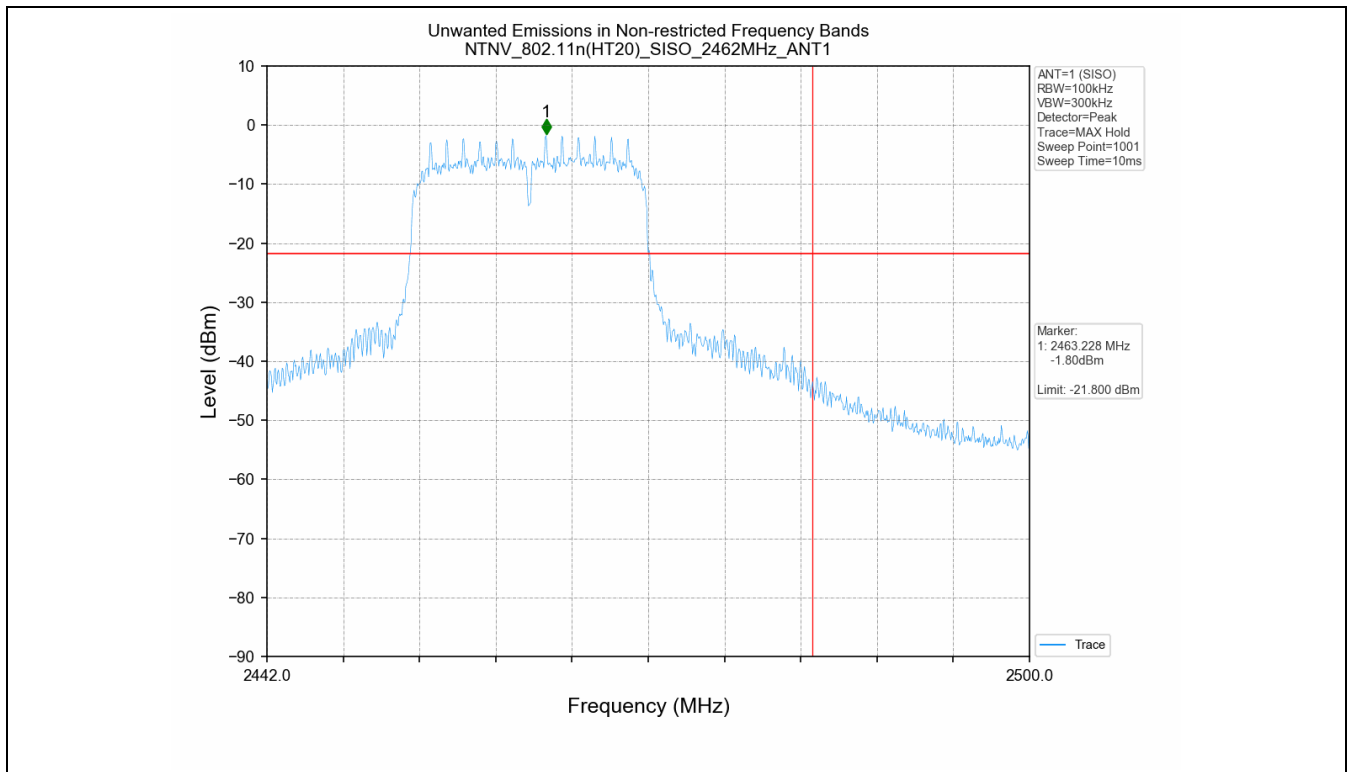
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5.2 Test Graph







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- End of the Report -



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