

RF Test Report

Project Number: 4975321**Proposal: SUW-202108001433****Report Number: 4975321EMC09****Revision Level: 2****Client: Deere & Company****Equipment Under Test: JDLINK™ M Modem - 4G****Model Number: MA4M****FCC ID: OV5-MA4M****IC ID: 11137A-MA4M****Applicable Standards: ANSI C63.10: 2013 (FCC Part 15 Subpart C, § 15.247)****RSS-247, Issue 2****RSS-GEN Issue 5****Report issued on: 28 February 2023****Test Result: Compliant**

FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER: 3212.01

Report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

Prepared by:


Andrew Bluhm, Jr RF/EMC Engineer

Reviewed by:


Martin Taylor, Sr RF/EMC Engineer

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1 Summary of Test Results

Test Description	Test Specification		Test Result
Bandwidth	15.247(a)(2)	RSS-247 5.2(a) RSS-GEN 6.7	Compliant
Peak Output Power	15.247(b)(3)	RSS-247 5.4 (d)	Compliant
Power Spectral Density	15.247(e)	RSS-247 5.2 (b)	Compliant
Conducted Spurious Emissions / Band Edge	15.247(d)	RSS-247 5.5	Compliant
Field Strength of Spurious Radiation	15.247(d)	RSS-247 5.5	Compliant
Emissions in Restricted Frequency Bands	15.205, 15.209	RSS-GEN 8.9, 8.10	Compliant
Antenna Requirement	15.203	RSS-GEN 6.8	Compliant ²
AC Powerline Conducted Emissions	15.107, 15.207	RSS-GEN 8.8	NA ¹

1) The device has no facility for connection to the AC mains.

2) All antennas are internal.

1.1 Modifications Required for Compliance

None

2 General Information

2.1 Client Information

Name: Deere & Company dba John Deere Intelligent Solutions
Address: 9505 Northpark Drive
City, State, Zip, Country: Urbandale, IA 50131 USA

2.2 Test Laboratory

Name: SGS North America, Inc.
Address: 620 Old Peachtree Road NW, Suite 100
City, State, Zip, Country: Suwanee, GA 30024, USA

Accrediting Body: A2LA
Type of lab: Testing Laboratory
Certificate Number: 3212.01
Designation Number: US1126
CAB Identifier: US0186

2.3 General Information of EUT

Product Description: JDLINK™ M Modem - 4G
Model Number: MA4M
Serial Numbers: PCMA4MA101503 (Radiated); PCMA4MA101508 (Conducted)

Frequency Range: 2412 – 2462 MHz
Data Modes: 802.11b, 802.11g, 802.11nHT20, 802.11nHT40
Antenna Gain*: Internal WF1/Secondary (WLAN only) – 1.4dBi
Internal WF2/Primary (WLAN and Bluetooth) – 4dBi

Rated Voltage: 9 – 32Vdc
Test Voltage: 12Vdc
Sample Received Date: 22 October 2022
Dates of testing: 04 – 29 November 2022

*Data was not measured by SGS laboratory and therefore not responsible for accuracy. Data obtained via customer, specification sheet, previous filing or other.

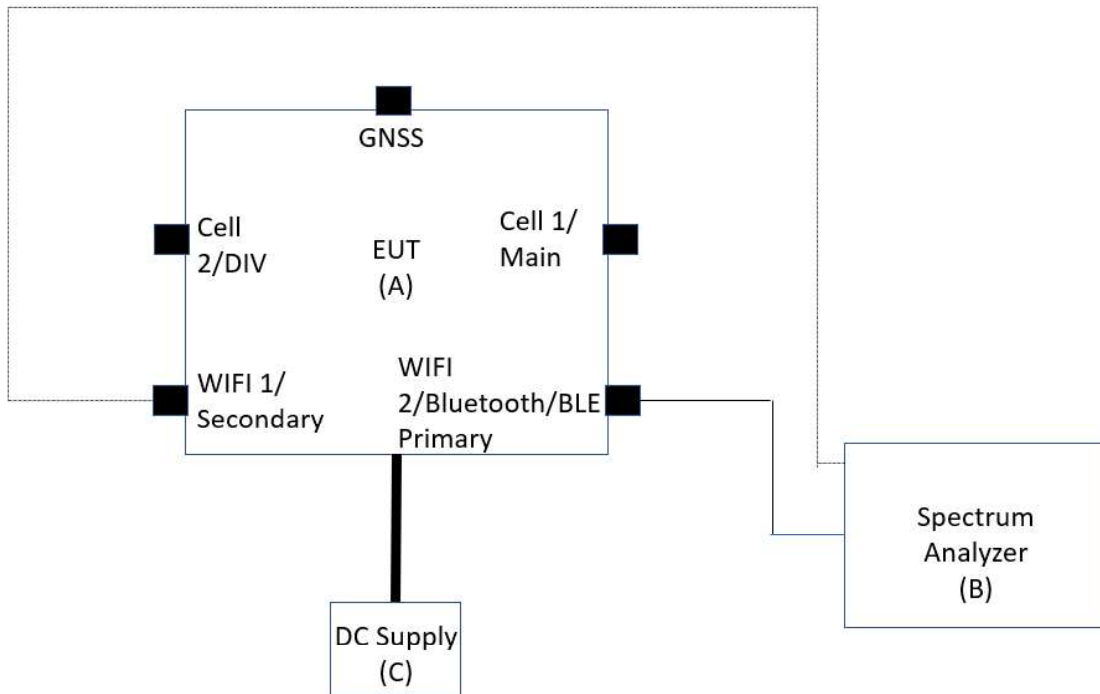
2.4 *Operating Modes and Conditions*

Using WL commands through the Linux backbone, the EUT was programmed to transmit on low, middle and high channels in all necessary modulation and modes of operation. The worst-case data rates were determined to be:

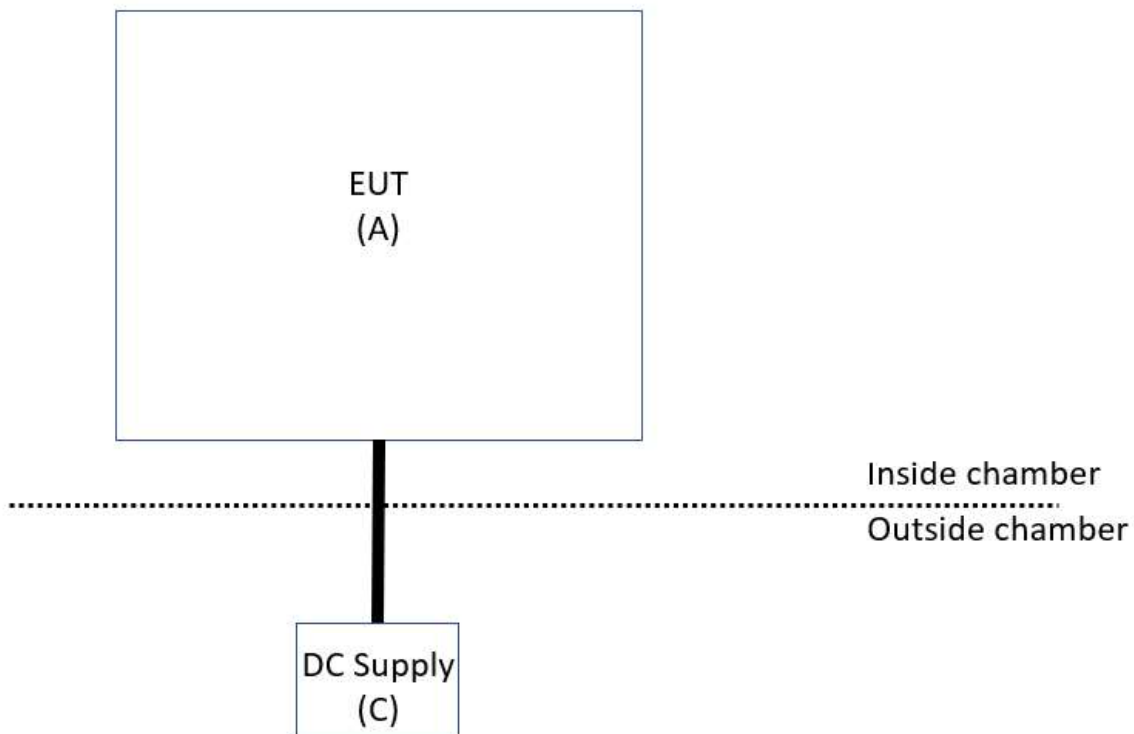
- 802.11b, 5Mbps
- 802.11g, 6Mbps
- 802.11nHT20, MCS6
- 802.11nHT40, MCS4

The WL command power setting for all testing was 20000.

2.5 EUT Connection Block Diagram – Conducted Measurements



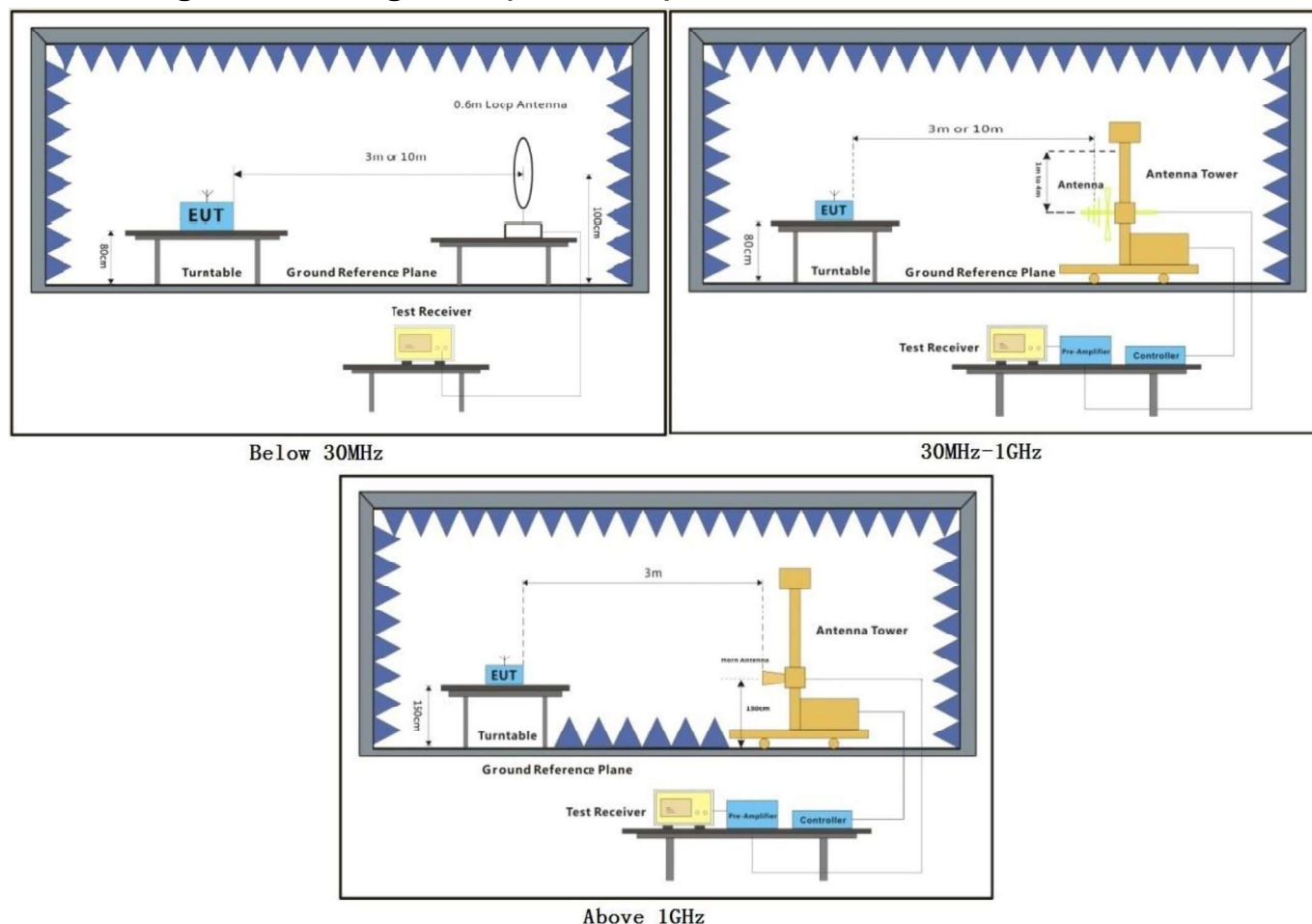
2.6 EUT Connection Block Diagram – Radiated Measurements



2.7 System Configurations

Device reference	Manufacturer	Description	Model Number	Serial Number
A	Deere & Company	JDLink™ M Modem - 4G	MA4M	PCMA4MA101508 (Conducted) PCMA4MA101503 (Radiated)
B	KEYSIGHT	EXA Signal Analyzer	N9010B	MY57110193
C	Rigol	DC Power Supply	DP711	DP7A202200419

2.8 Configuration Diagrams (Radiated)



3 Bandwidth

3.1 Test Result

Test Description	Test Specification		Test Result
6 dB Bandwidth 99% Occupied Bandwidth	15.247(a)(2)	RSS-247 5.2(a) RSS-GEN 6.7	Compliant

3.2 Test Method

The procedures from ANSI C63.10: 2013 clause 11.8 and 558074 D01 DTS Meas Guidance v05r2 were used to determine the 6 dB bandwidth.

The procedures from ANSI C63.10: 2013 clause 6.9.2 were used to measure the 99% Occupied Bandwidth.

3.3 Test Site

EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.6 °C

Relative Humidity: 48.4 %

Atmospheric Pressure: 98.98 kPa

3.4 Test Equipment

Test End Date: 4-Nov-2022

Tester: AB

Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
ATTENUATOR, 10DB	BW-S10W2	MINI-CIRCUITS	15031	3-Oct-2022	3-Oct-2023
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20108	16-Mar-2022	16-Mar-2023
USB WIDEBAND POWER SENSOR	U2021XA	TSTPASS (KEYSIGHT TECHNOLOGIES)	20168C	24-Aug-2022	24-Aug-2023
USB WIDEBAND POWER SENSOR	U2021XA	TSTPASS (KEYSIGHT TECHNOLOGIES)	20168D	24-Sep-2022	24-Sep-2023
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	7-Dec-2022	7-Dec-2023
ATTENUATOR, 10DB	BW-S10W2	MINI-CIRCUITS	15032	3-Oct-2022	3-Oct-2023
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20107	16-Mar-2022	16-Mar-2023
RF CABLE (TS8997)	141	HUBER & SUHNER	B095588	5-Jul-2022	5-Jul-2023
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095593	12-May-2022	12-May-2023
DC POWER SUPPLY, PROGRAMMABLE	DP711	RIGOL	18027	CNR	CNR
TSTPASS SWITCHBOX	SB1	TSTPASS	20168	CNR	CNR

Software Profile:

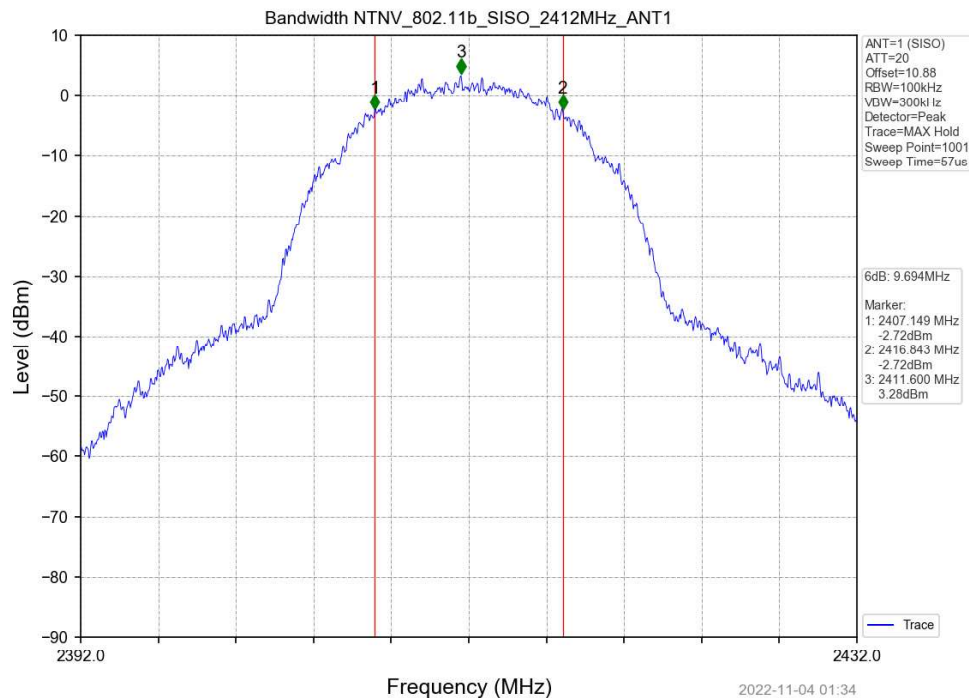
TSTPASS Version: 1.1.0, build 2020.11.15.01

3.5 Test Data – 6dB Bandwidth

Frequency (MHz)	Mode	ANT No.	6dB BW (MHz)	Limit (MHz)	Verdict
2412	802.11b	WF2	9.694	≥0.5	PASS
2437	802.11b	WF2	9.829	≥0.5	PASS
2462	802.11b	WF2	10.316	≥0.5	PASS
2412	802.11g	WF2	15.149	≥0.5	PASS
2437	802.11g	WF2	15.125	≥0.5	PASS
2462	802.11g	WF2	15.166	≥0.5	PASS
2412	802.11n20	WF2	15.369	≥0.5	PASS
2437	802.11n20	WF2	15.363	≥0.5	PASS
2462	802.11n20	WF2	15.465	≥0.5	PASS
2422	802.11n40	WF2	33.916	≥0.5	PASS
2437	802.11n40	WF2	33.883	≥0.5	PASS
2452	802.11n40	WF2	31.402	≥0.5	PASS
2412	802.11n20	WF1	15.138	≥0.5	PASS
2437	802.11n20	WF1	15.130	≥0.5	PASS
2462	802.11n20	WF1	15.141	≥0.5	PASS

Sample Plot

Low Channel – 802.11b (2412MHz)

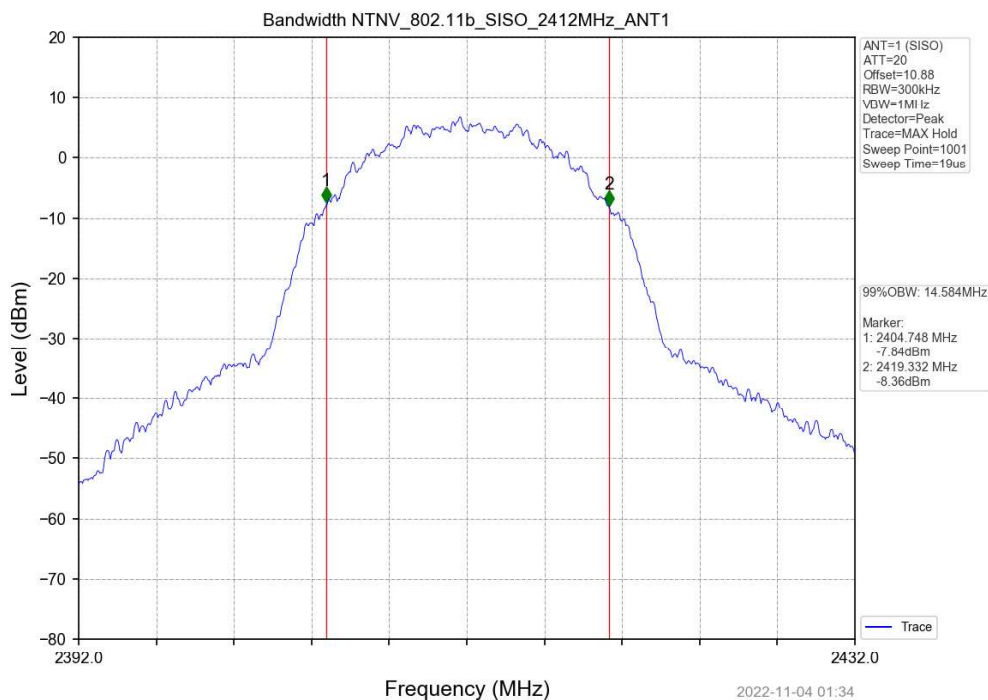


3.6 Test Data – 99% Bandwidth

Frequency (MHz)	TX Type	ANT No.	99% OBW (MHz)	Verdict
2412	802.11b	WF2	14.584	Reported
2437	802.11b	WF2	14.596	Reported
2462	802.11b	WF2	14.531	Reported
2412	802.11g	WF2	16.398	Reported
2437	802.11g	WF2	19.416	Reported
2462	802.11g	WF2	16.464	Reported
2412	802.11n20	WF2	17.586	Reported
2437	802.11n20	WF2	17.845	Reported
2462	802.11n20	WF2	17.541	Reported
2422	802.11n40	WF2	35.891	Reported
2437	802.11n40	WF2	36.229	Reported
2452	802.11n40	WF2	35.764	Reported
2412	802.11n20	WF1	17.407	Reported
2437	802.11n20	WF1	17.553	Reported
2462	802.11n20	WF1	17.433	Reported

Sample Plot

Low Channel – 802.11b (2412MHz)



4 Peak Output Power

4.1 Test Result

Test Description	Test Specification		Test Result
Peak Output Power	15.247(b)(3)	RSS-247 S5.4 (d)	Compliant

4.2 Test Method

Fundamental peak power measurements were recorded using the procedures from ANSI C63.10: 2013 clause 11.9 and KDB 558074 D01 Measurement Guidance v05r2.

Limit

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. For using antennas with greater than 6dBi of gain, the limit is reduced in dB by the amount the gain exceeds 6dBi (e.g. for a 7.4dBi antenna, the limit is reduced from 30dBm to 28.6dBm)

4.3 Test Site

EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.6 °C

Relative Humidity: 48.4 %

Atmospheric Pressure: 98.98 kPa

4.4 Test Equipment

Test End Date: 4-Nov-2022

Tester: AB

Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
ATTENUATOR, 10DB	BW-S10W2	MINI-CIRCUITS	15031	3-Oct-2022	3-Oct-2023
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20108	16-Mar-2022	16-Mar-2023
USB WIDEBAND POWER SENSOR	U2021XA	TSTPASS (KEYSIGHT TECHNOLOGIES)	20168C	24-Aug-2022	24-Aug-2023
USB WIDEBAND POWER SENSOR	U2021XA	TSTPASS (KEYSIGHT TECHNOLOGIES)	20168D	24-Sep-2022	24-Sep-2023
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	7-Dec-2022	7-Dec-2023
ATTENUATOR, 10DB	BW-S10W2	MINI-CIRCUITS	15032	3-Oct-2022	3-Oct-2023
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20107	16-Mar-2022	16-Mar-2023
RF CABLE (TS8997)	141	HUBER & SUHNER	B095588	5-Jul-2022	5-Jul-2023
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095593	12-May-2022	12-May-2023
DC POWER SUPPLY, PROGRAMMABLE	DP711	RIGOL	18027	CNR	CNR
TSTPASS SWITCHBOX	SB1	TSTPASS	20168	CNR	CNR

Software Profile:

TSTPASS Version: 1.1.0, build 2020.11.15.01

4.5 Test Data - SISO

Frequency (MHz)	TX Type	ANT No.	Peak Output Power (dBm)	Limit (dBm)	Verdict
2412	802.11b	WF2	11.17	30	PASS
2437	802.11b	WF2	12.03	30	PASS
2462	802.11b	WF2	12.04	30	PASS
2412	802.11g	WF2	7.38	30	PASS
2437	802.11g	WF2	12.70	30	PASS
2462	802.11g	WF2	8.12	30	PASS
2412	802.11n20	WF2	8.01	30	PASS
2437	802.11n20	WF2	10.43	30	PASS
2462	802.11n20	WF2	8.93	30	PASS
2422	802.11n40	WF2	6.46	30	PASS
2437	802.11n40	WF2	10.86	30	PASS
2452	802.11n40	WF2	6.81	30	PASS
2412	802.11n20	WF1	11.01	30	PASS
2437	802.11n20	WF1	11.53	30	PASS
2462	802.11n20	WF1	11.18	30	PASS

4.6 Test Data - MIMO

Test Mode	Frequency (MHz)	Tx Type	Measured Average Output Power (dBm)			Limits (dBm)	Verdict
			Ant 1	Ant 2	Total		
802.11n(HT20)	2412	MIMO	10.09	5.31	11.34	30	PASS
	2437	MIMO	8.31	4.90	9.94	30	PASS
	2462	MIMO	10.18	6.04	11.60	30	PASS

Antenna gain for WF1 is 1.4dBi

Antenna gain for WF2 is 4.0dBi

Directional gain for WF1 and WF2 is 5.8dBi (correlated)

Formulas below are referenced from KDB 662911 DO1 Multiple Transmitter Output

(i) If transmit signals are *correlated*, then

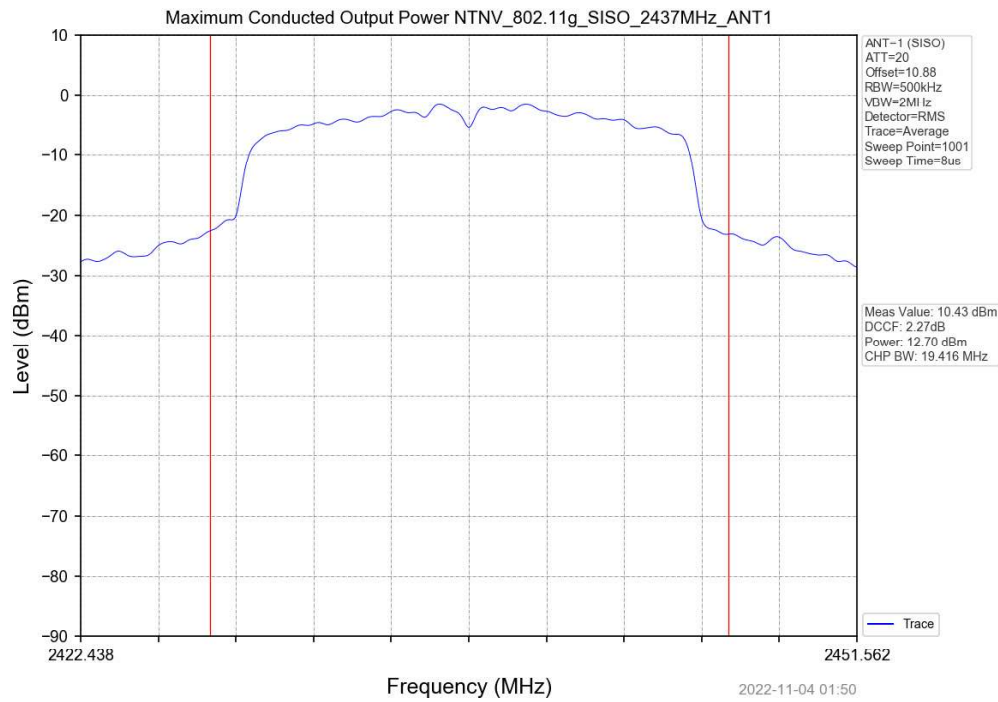
Directional gain = $10 \log[(10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20})^2 / N_{ANT}]$ dBi [Note the “20”s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

(ii) If all transmit signals are *completely uncorrelated*, then

Directional gain = $10 \log[(10^{G_1/10} + 10^{G_2/10} + \dots + 10^{G_N/10}) / N_{ANT}]$ dBi

Sample Plot

Mid Channel – 802.11g, Port WF2 (2437MHz)



5 Power Spectral Density

5.1 Test Result

Test Description	Test Specification		Test Result
Power Spectral Density	15.247(e)	RSS-247 S5.2 (b)	Compliant

5.2 Test Method

Power spectral density measurements were recorded using the procedures from ANSI C63.10: 2013 clause 11.10 and KDB 558074 D01 Measurement Guidance v05r2.

Limit

The limit is 8 dBm.

5.3 Test Site

EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.6 °C

Relative Humidity: 48.4 %

Atmospheric Pressure: 98.98 kPa

5.4 Test Equipment

Test End Date: 4-Nov-2022

Tester: AB

Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
ATTENUATOR, 10DB	BW-S10W2	MINI-CIRCUITS	15031	3-Oct-2022	3-Oct-2023
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20108	16-Mar-2022	16-Mar-2023
USB WIDEBAND POWER SENSOR	U2021XA	TSTPASS (KEYSIGHT TECHNOLOGIES)	20168C	24-Aug-2022	24-Aug-2023
USB WIDEBAND POWER SENSOR	U2021XA	TSTPASS (KEYSIGHT TECHNOLOGIES)	20168D	24-Sep-2022	24-Sep-2023
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	7-Dec-2022	7-Dec-2023
ATTENUATOR, 10DB	BW-S10W2	MINI-CIRCUITS	15032	3-Oct-2022	3-Oct-2023
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20107	16-Mar-2022	16-Mar-2023
RF CABLE (TS8997)	141	HUBER & SUHNER	B095588	5-Jul-2022	5-Jul-2023
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095593	12-May-2022	12-May-2023
DC POWER SUPPLY, PROGRAMMABLE	DP711	RIGOL	18027	CNR	CNR
TSTPASS SWITCHBOX	SB1	TSTPASS	20168	CNR	CNR

Software Profile:

TSTPASS Version: 1.1.0, build 2020.11.15.01

5.5 Test Data - SISO

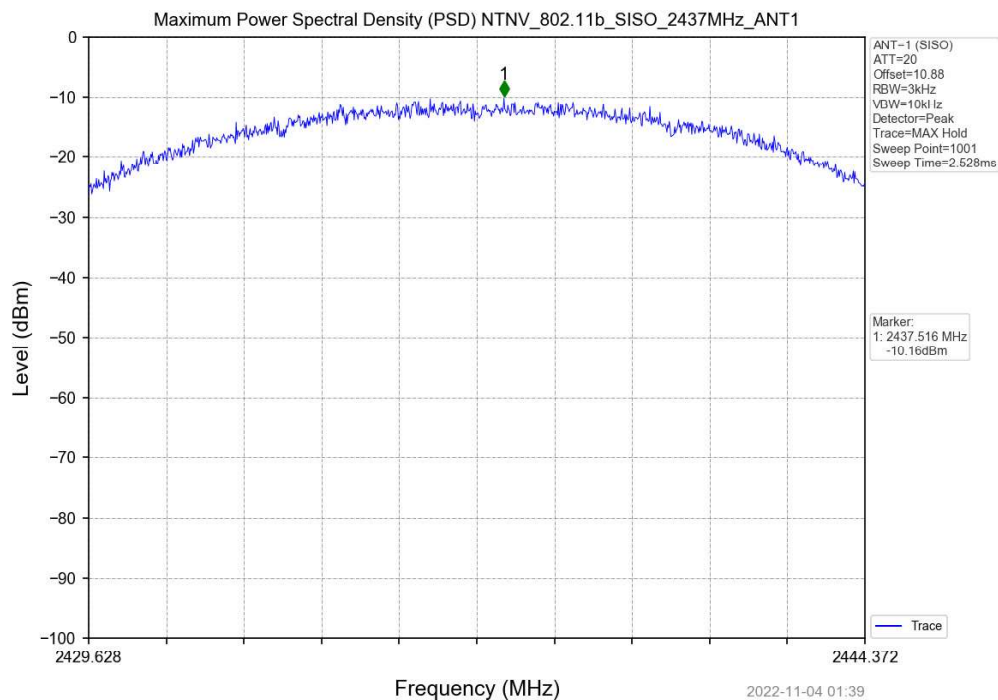
Frequency (MHz)	TX Type	ANT No.	Peak PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
2412	802.11b	WF2	-10.80	≤8	PASS
2437	802.11b	WF2	-10.16	≤8	PASS
2462	802.11b	WF2	-9.84	≤8	PASS
2412	802.11g	WF2	-16.19	≤8	PASS
2437	802.11g	WF2	-10.95	≤8	PASS
2462	802.11g	WF2	-15.46	≤8	PASS
2412	802.11n20	WF2	-16.02	≤8	PASS
2437	802.11n20	WF2	-15.19	≤8	PASS
2462	802.11n20	WF2	-16.37	≤8	PASS
2422	802.11n40	WF2	-21.83	≤8	PASS
2437	802.11n40	WF2	-17.41	≤8	PASS
2452	802.11n40	WF2	-21.02	≤8	PASS
2412	802.11n20	WF1	-13.01	≤8	PASS
2437	802.11n20	WF1	-12.37	≤8	PASS
2462	802.11n20	WF1	-11.86	≤8	PASS

5.6 Test Data - MIMO

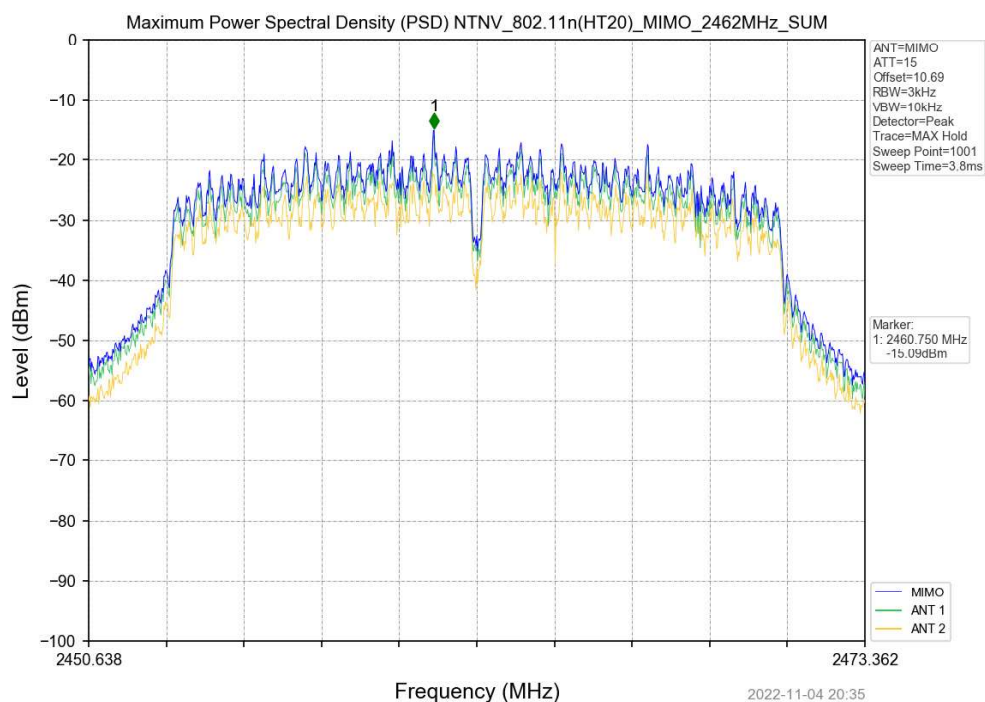
Test Mode	Frequency (MHz)	Tx Type	Maximum Power Spectral Density (dBm/3KHz)			Limits (dBm/3kHz)	Verdict
			Ant 1	Ant 2	Total		
802.11n(HT20)	2412	MIMO	-16.76	-22.29	-15.81	≤8	PASS
	2437	MIMO	-17.49	-20.88	-16.15	≤8	PASS
	2462	MIMO	-15.98	-21.95	-15.09	≤8	PASS

Sample Plots

Mid Channel – 802.11b, Port WF2 (2437MHz)



High Channel – 802.11nHT20, WF2+WF1 (2462MHz) - SUM



6 Conducted Spurious Emissions / Band Edge

6.1 Test Result

Test Description	Test Specification		Test Result
Conducted Spurious Emissions	15.247(d)	RSS-247 S5.5	Compliant

6.2 Test Method

Spurious emissions in non-restricted frequency bands were recorded using the methods defined in ANSI C63.10: 2013 clause 11.11 and KDB 558074 D01 Measurement Guidance v05r2.

Lowest, middle, and highest channels were investigated.

Because the maximum conducted peak output power was used to determine compliance with the output power limits, the limit in any 100 kHz band outside of the authorized band is 20 dB below the maximum in-band peak level.

6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.6 °C

Relative Humidity: 48.4 %

Atmospheric Pressure: 98.98 kPa

6.4 Test Equipment

Test End Date: 4-Nov-2022

Tester: AB

Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
ATTENUATOR, 10DB	BW-S10W2	MINI-CIRCUITS	15031	3-Oct-2022	3-Oct-2023
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20108	16-Mar-2022	16-Mar-2023
USB WIDEBAND POWER SENSOR	U2021XA	TSTPASS (KEYSIGHT TECHNOLOGIES)	20168C	24-Aug-2022	24-Aug-2023
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RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20107	16-Mar-2022	16-Mar-2023
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DC POWER SUPPLY, PROGRAMMABLE	DP711	RIGOL	18027	CNR	CNR
TSTPASS SWITCHBOX	SB1	TSTPASS	20168	CNR	CNR

Software Profile:

TSTPASS Version: 1.1.0, build 2020.11.15.01

6.5 Test Data - SISO

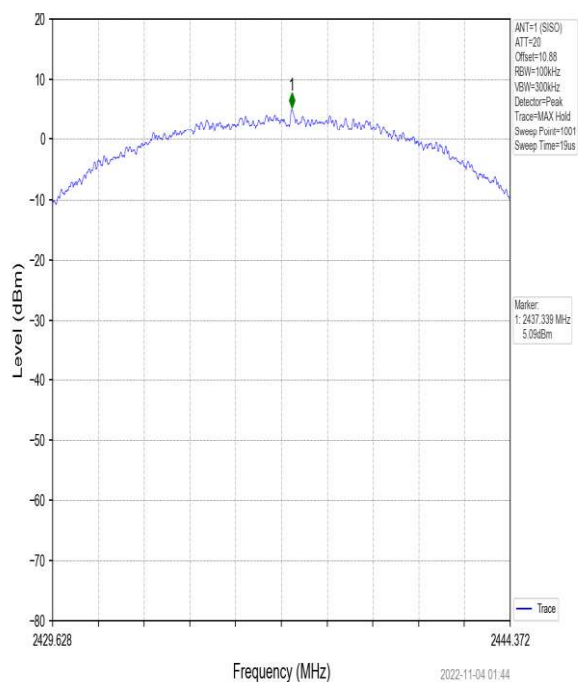
Frequency (MHz)	TX Type	ANT No.	Spurious Conducted Emission (dBm)	Limit (dBm)	Verdict
2412	802.11b	WF2	Refer to test graph	-24.91	PASS
2437	802.11b	WF2	Refer to test graph	-24.91	PASS
2462	802.11b	WF2	Refer to test graph	-24.91	PASS
2412	802.11g	WF2	Refer to test graph	-26.29	PASS
2437	802.11g	WF2	Refer to test graph	-26.29	PASS
2462	802.11g	WF2	Refer to test graph	-26.29	PASS
2412	802.11n20	WF2	Refer to test graph	-29.40	PASS
2437	802.11n20	WF2	Refer to test graph	-29.40	PASS
2462	802.11n20	WF2	Refer to test graph	-29.40	PASS
2422	802.11n40	WF2	Refer to test graph	-31.16	PASS
2437	802.11n40	WF2	Refer to test graph	-31.16	PASS
2452	802.11n40	WF2	Refer to test graph	-31.16	PASS
2412	802.11n20	WF1	Refer to test graph	-28.17	PASS
2437	802.11n20	WF1	Refer to test graph	-28.17	PASS
2462	802.11n20	WF1	Refer to test graph	-28.17	PASS

6.6 Test Data - MIMO

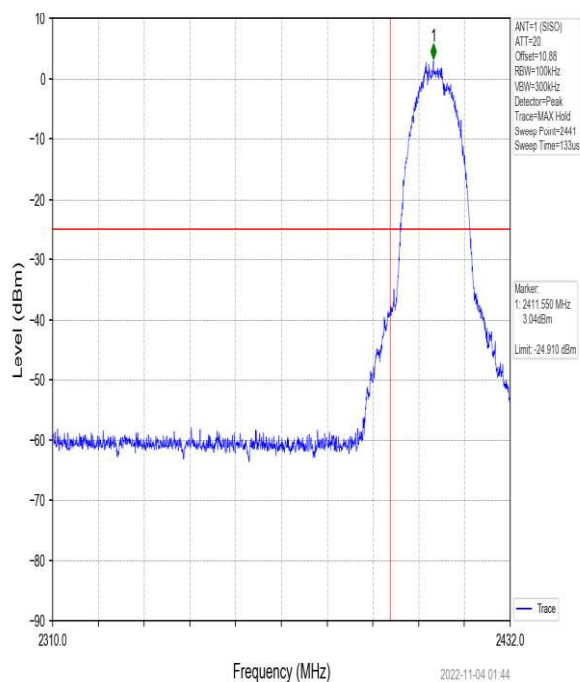
Test Mode	Frequency (MHz)	TX Type	ANT No.	Spurious Conducted Emission (dBm)	Limits (dBm)	Verdict
802.11n(HT20)	2412	MIMO	MIMO	Refer to test graph	-33.82	PASS
	2437	MIMO	MIMO	Refer to test graph	-33.82	PASS
	2462	MIMO	MIMO	Refer to test graph	-33.82	PASS

802.11b – WF2 (ANT1)

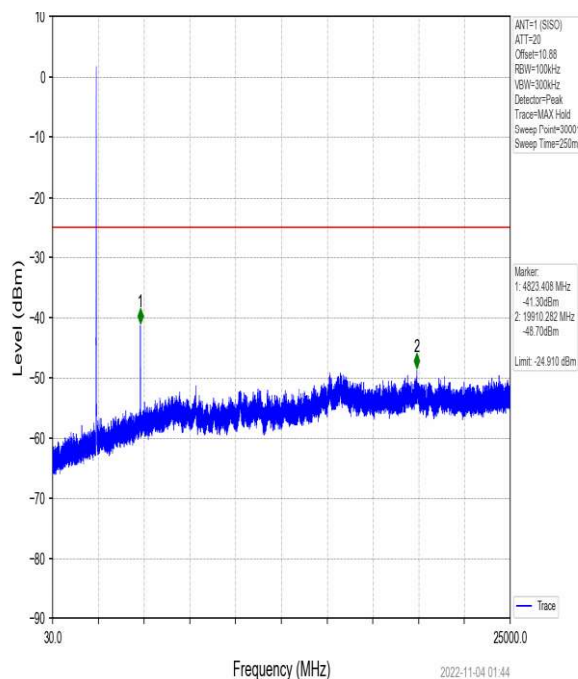
In-Band Reference – 2437MHz



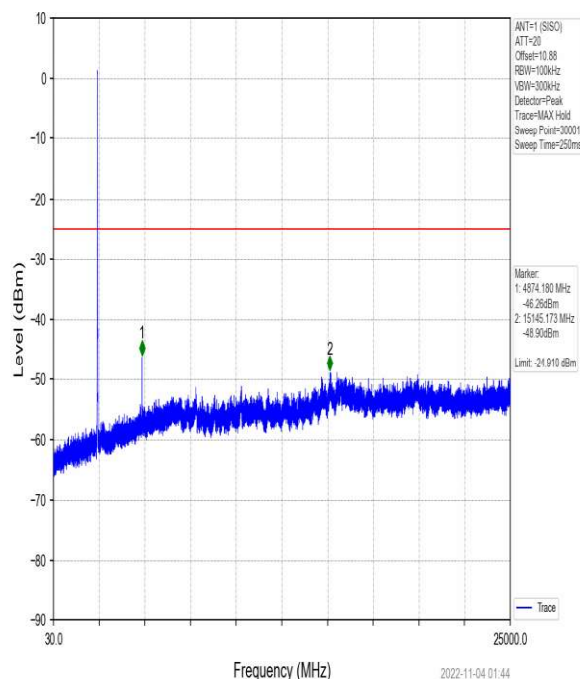
Lower Band Edge - Low Channel (2412MHz)



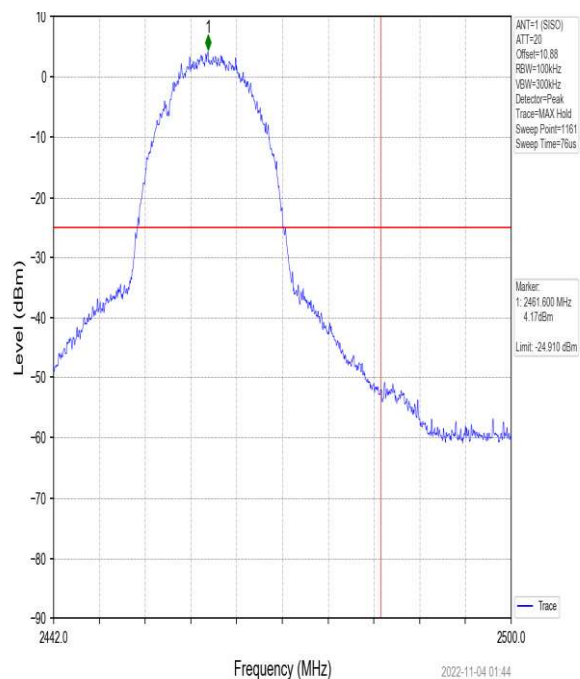
Full Spectrum - Low Channel (2412MHz)



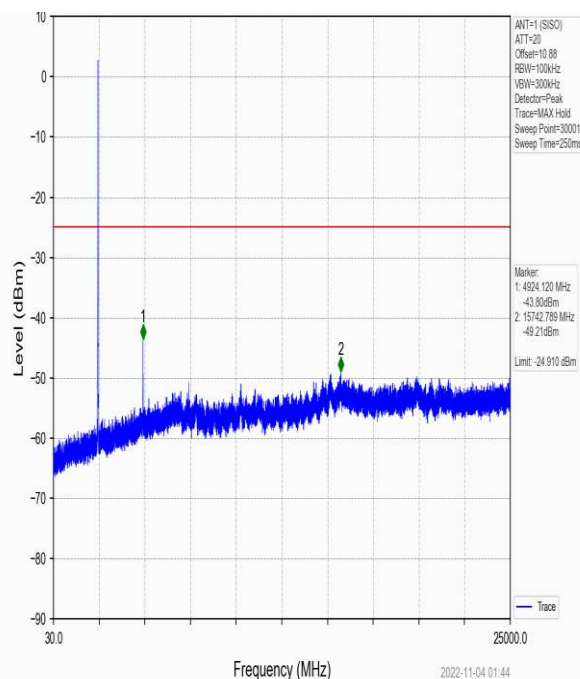
Full Spectrum - Mid Channel (2437MHz)



Upper Band Edge – High Channel (2462MHz)

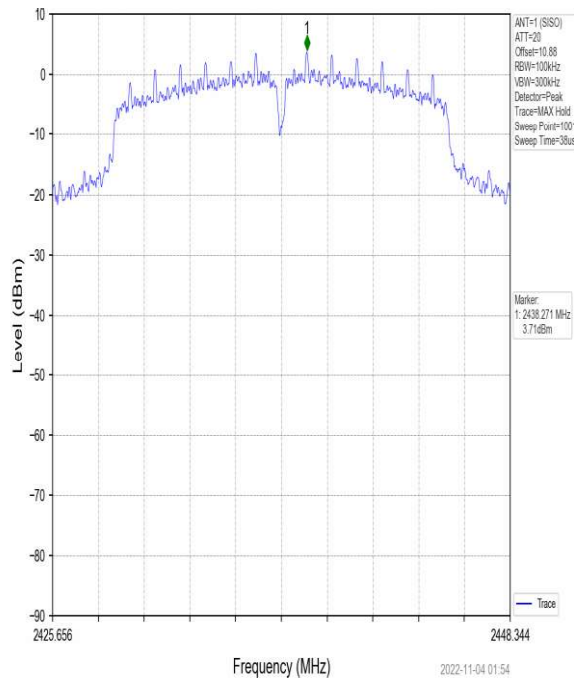


Full Spectrum - High Channel (2462MHz)

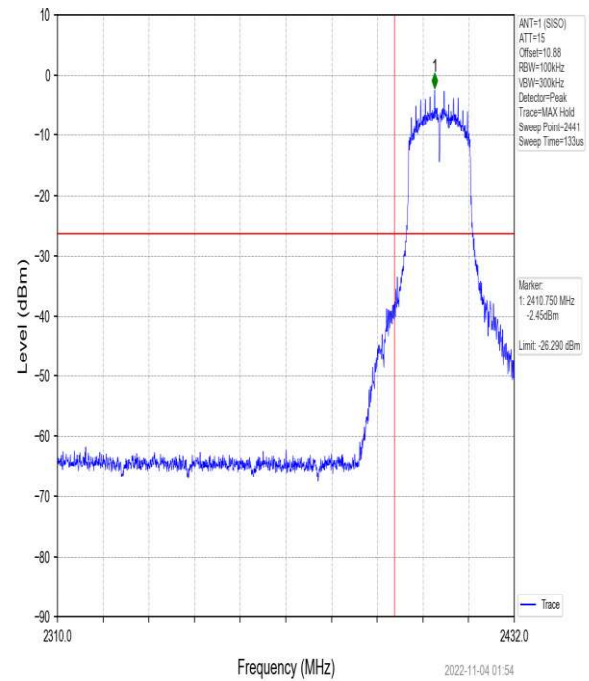


802.11g – WF2 (ANT1)

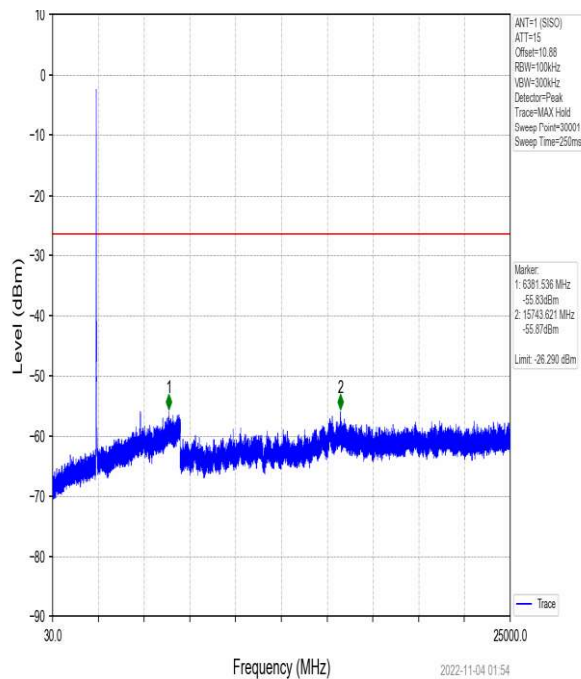
In-Band Reference – 2437MHz



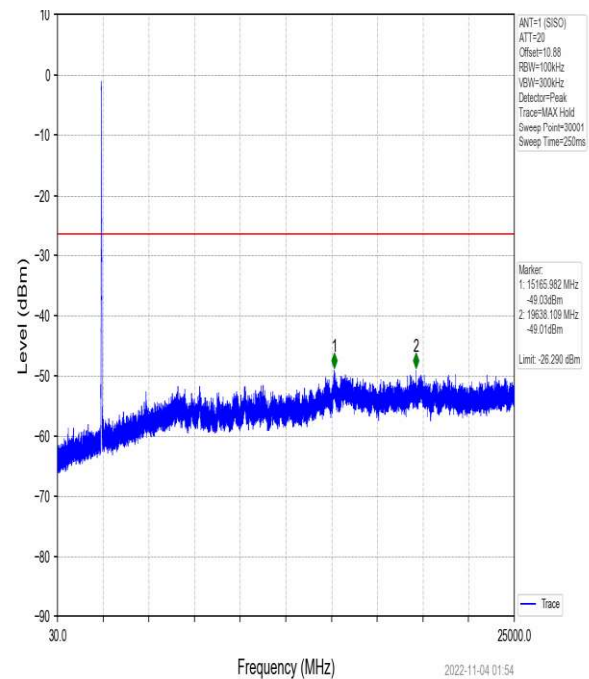
Lower Band Edge - Low Channel (2412MHz)



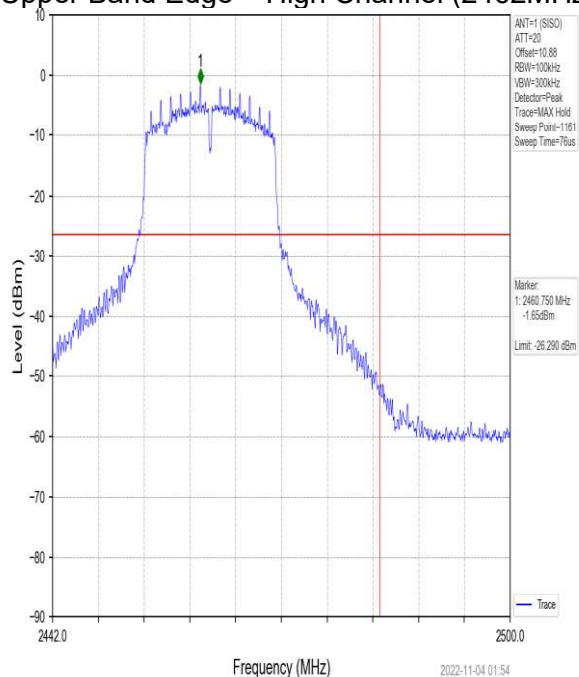
Full Spectrum - Low Channel (2412MHz)



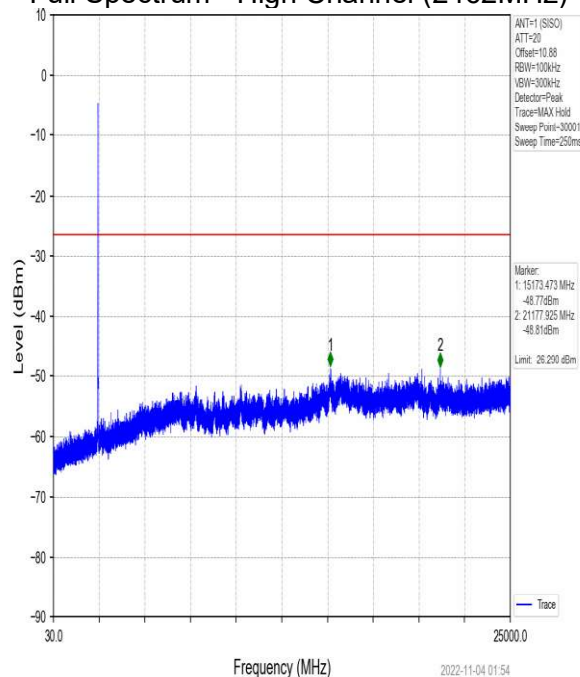
Full Spectrum - Mid Channel (2437MHz)



Upper Band Edge – High Channel (2462MHz)

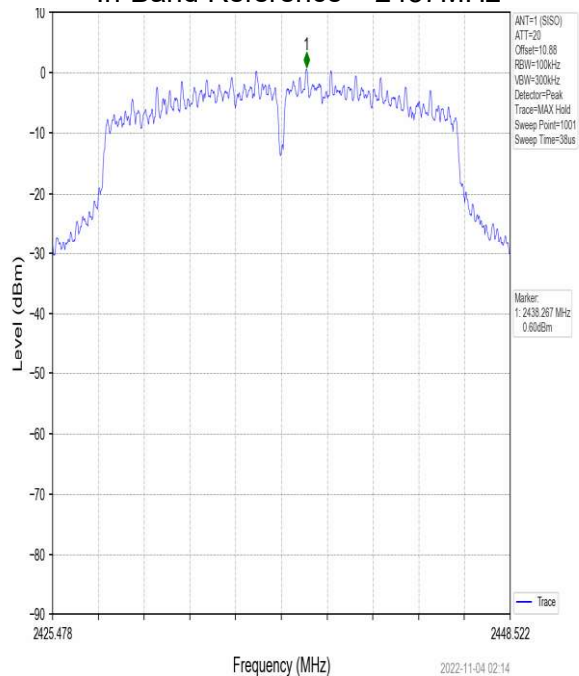


Full Spectrum - High Channel (2462MHz)

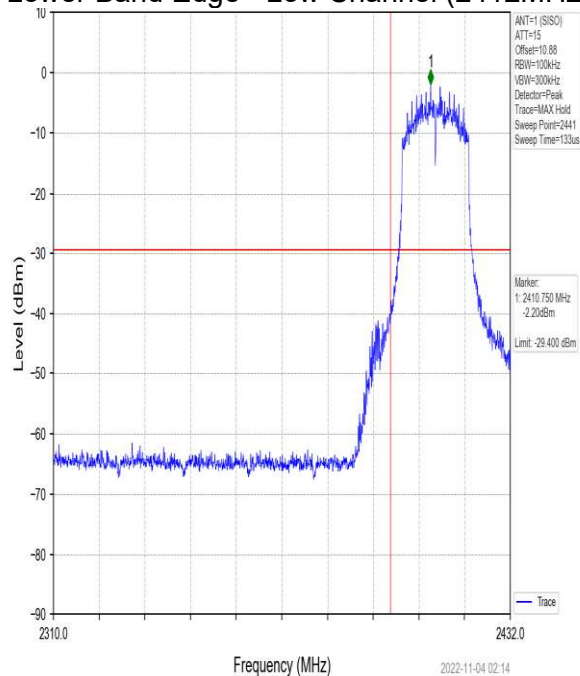


802.11n(HT20) – WF2(ANT1)

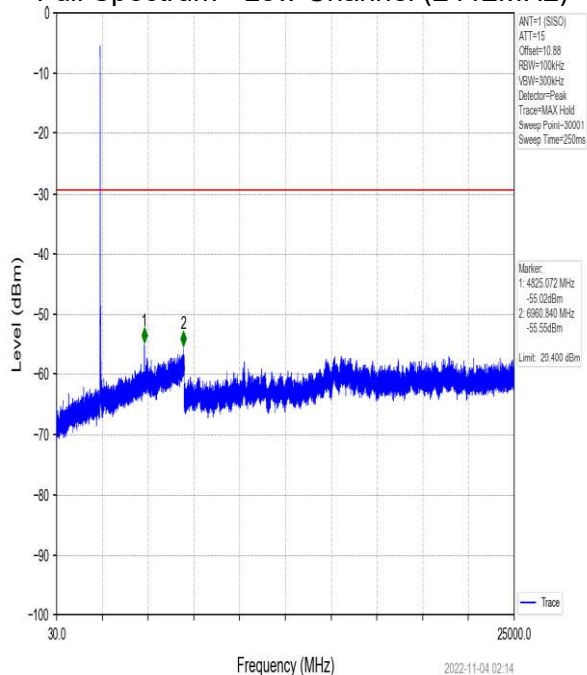
In-Band Reference – 2437MHz



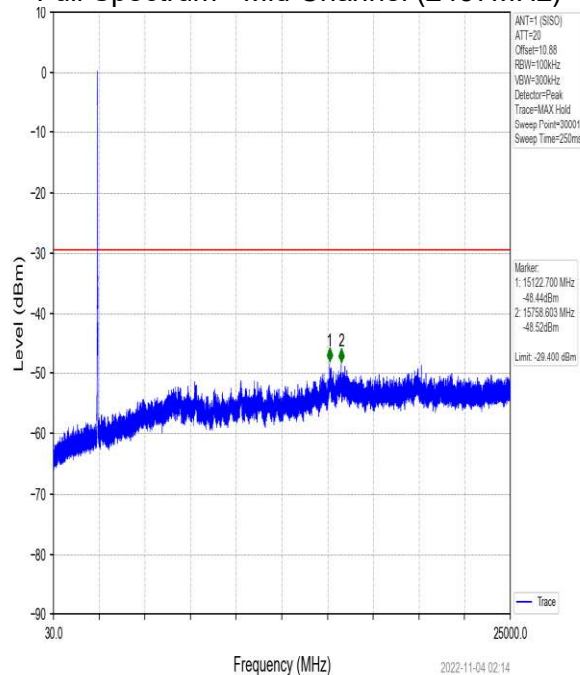
Lower Band Edge - Low Channel (2412MHz)



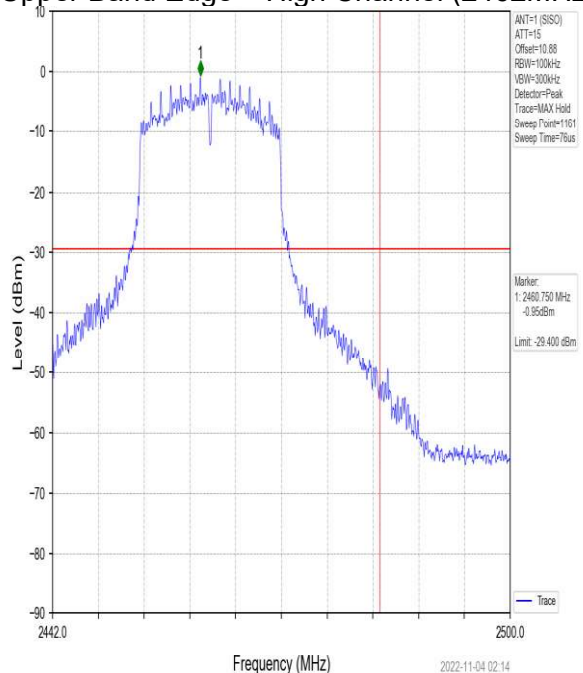
Full Spectrum - Low Channel (2412MHz)



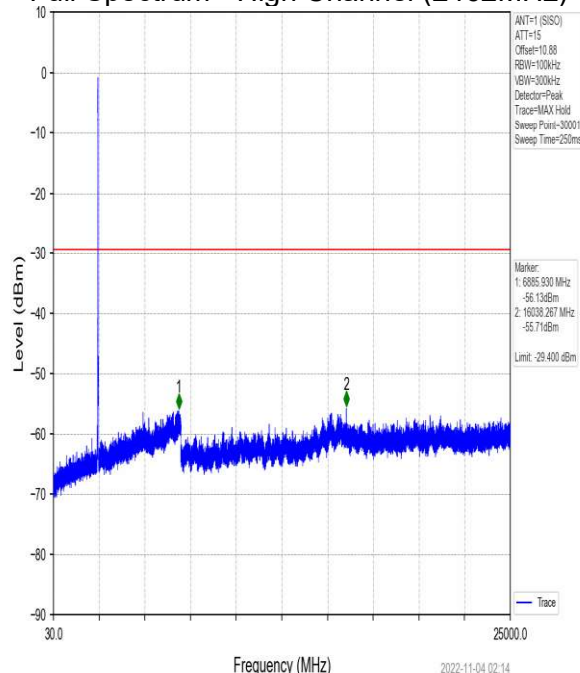
Full Spectrum - Mid Channel (2437MHz)



Upper Band Edge - High Channel (2462MHz)

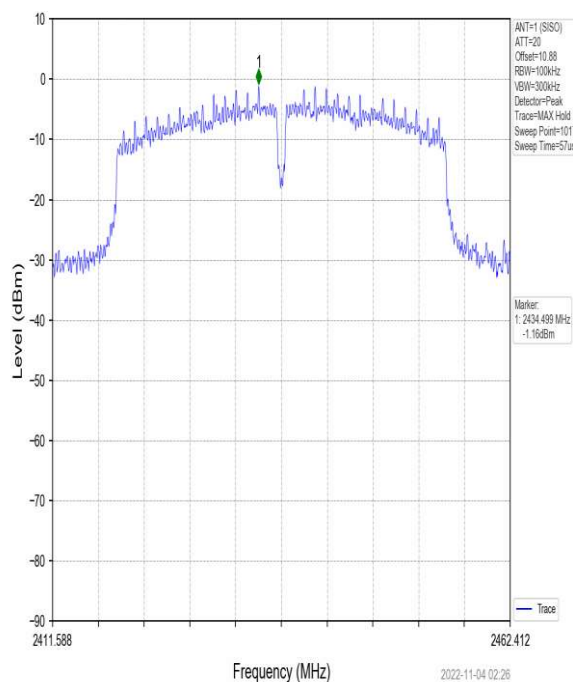


Full Spectrum - High Channel (2462MHz)

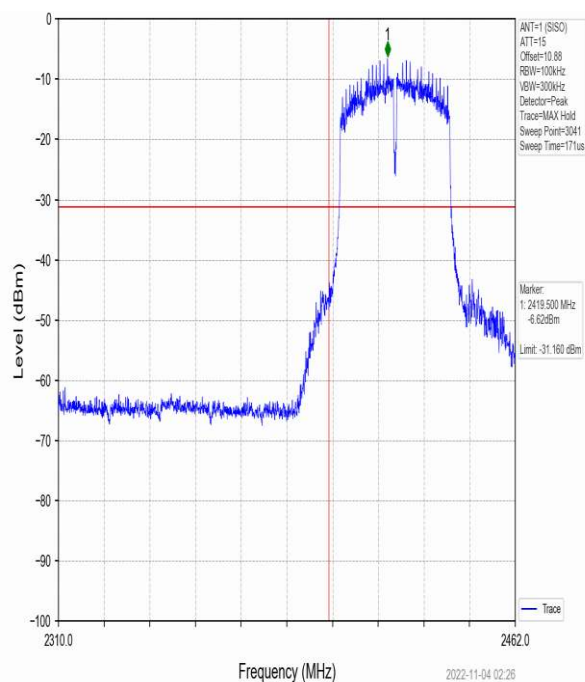


802.11n(HT40) – WF2(ANT1)

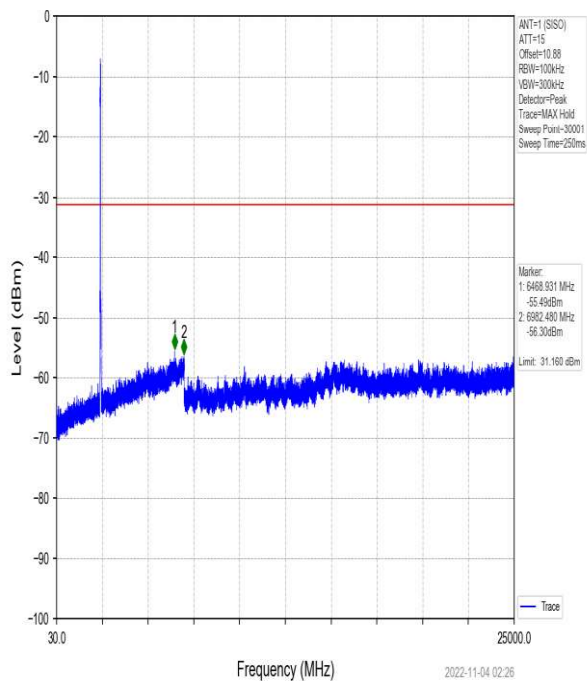
In-Band Reference – 2437MHz



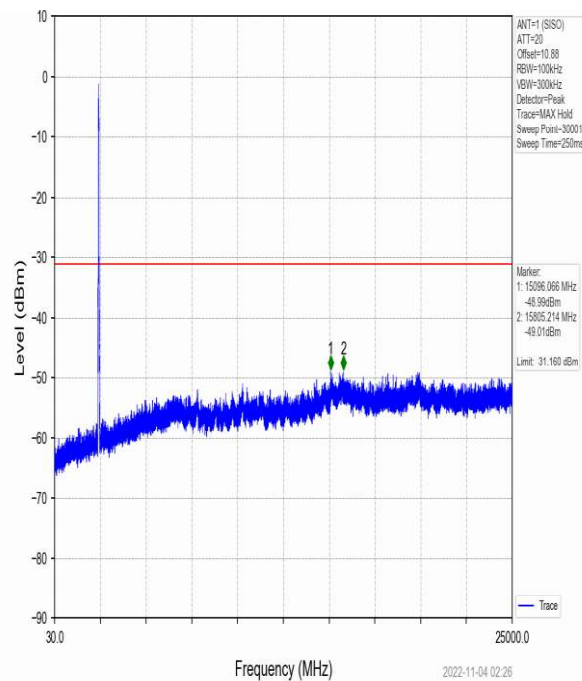
Lower Band Edge - Low Channel (2422MHz)



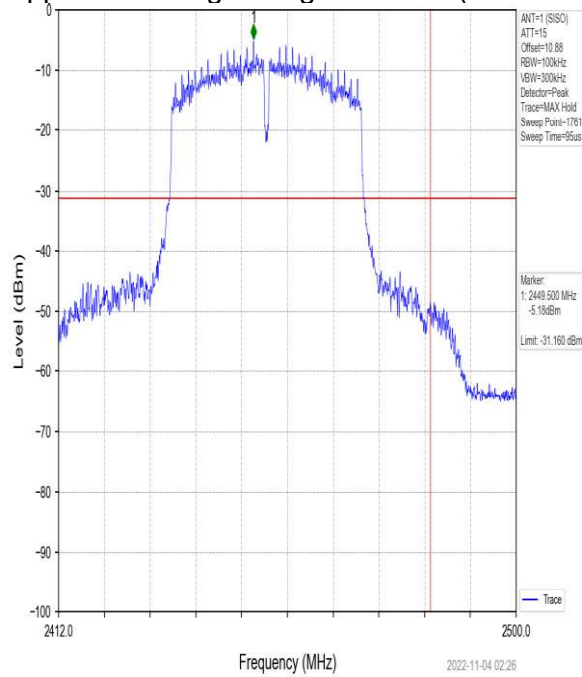
Full Spectrum - Low Channel (2422MHz)



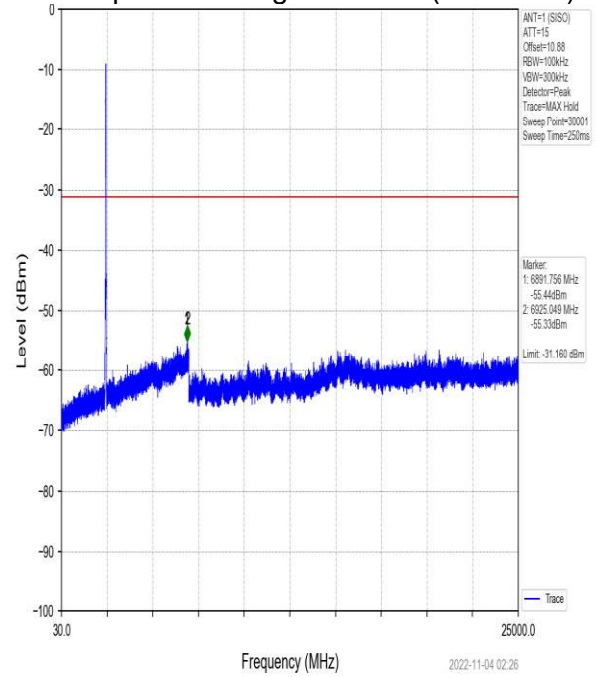
Full Spectrum - Mid Channel (2437MHz)



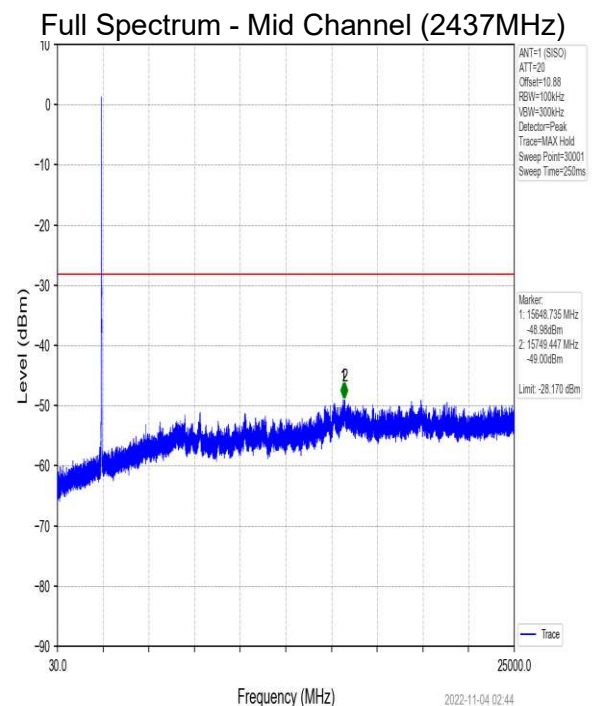
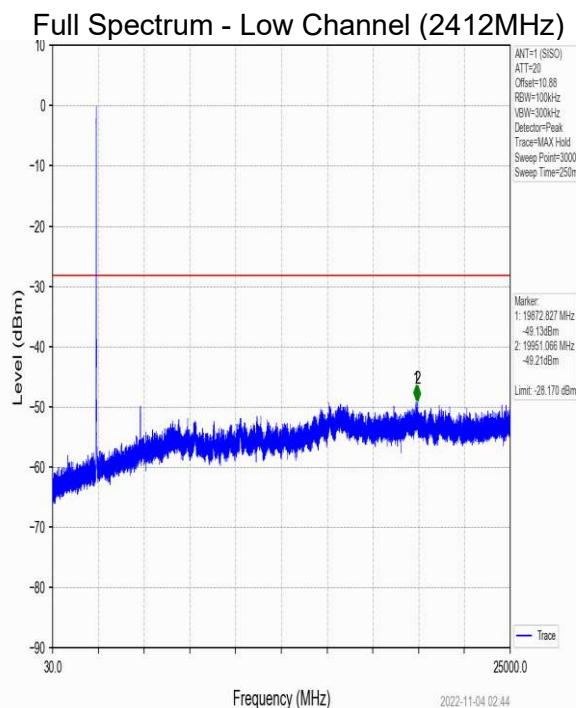
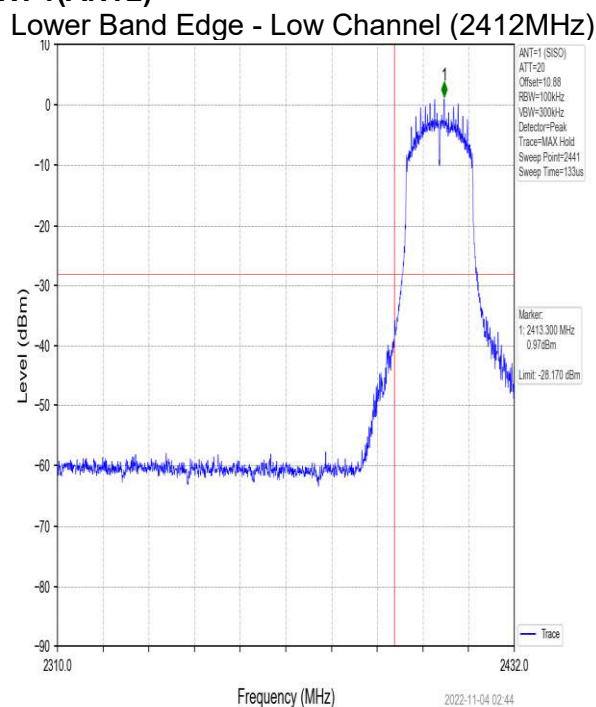
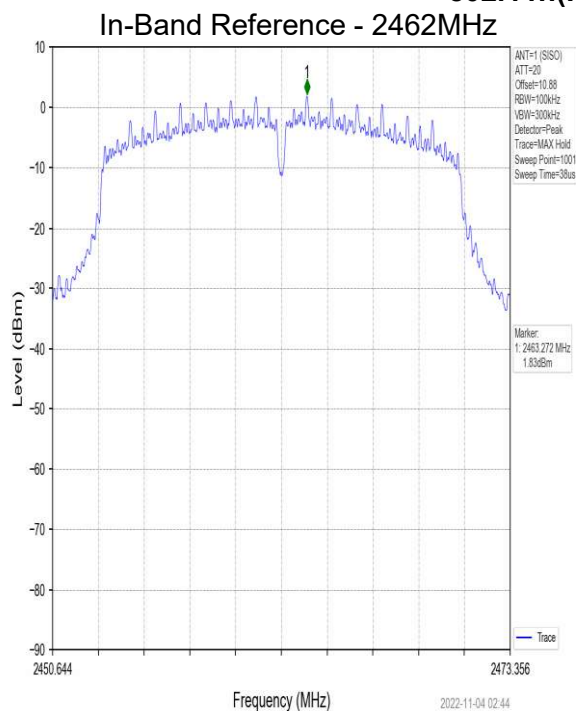
Upper Band Edge – High Channel (2452MHz)



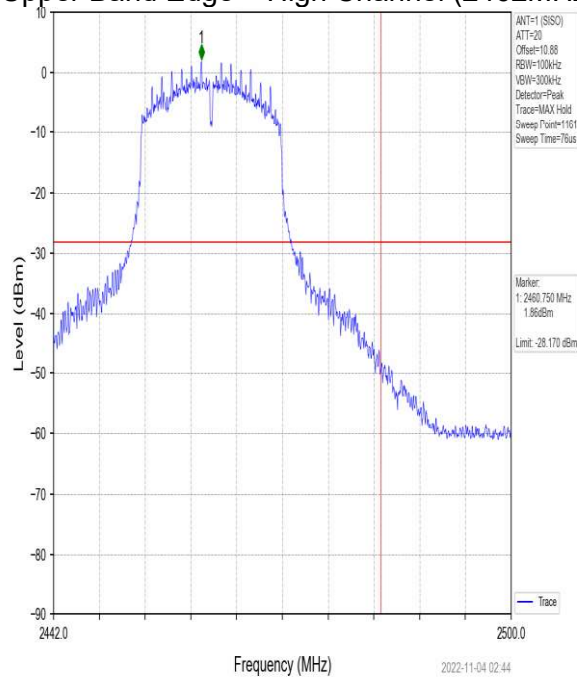
Full Spectrum - High Channel (2452MHz)



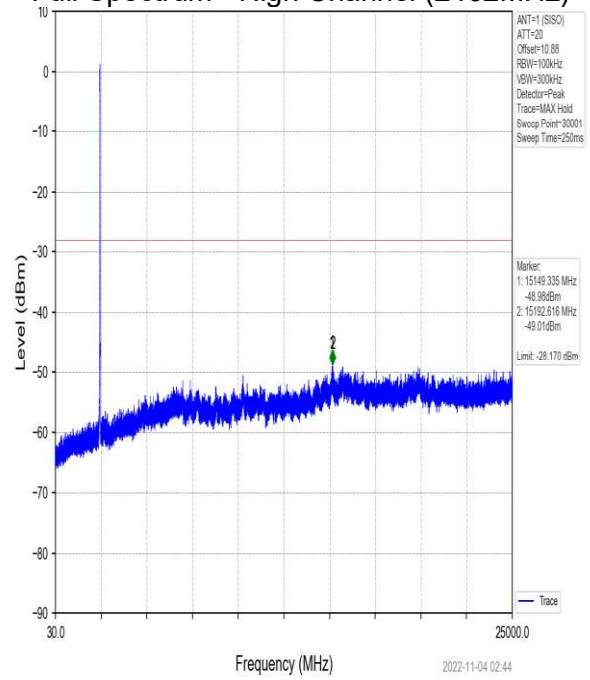
802.11n(HT20) – WF1(ANT2)



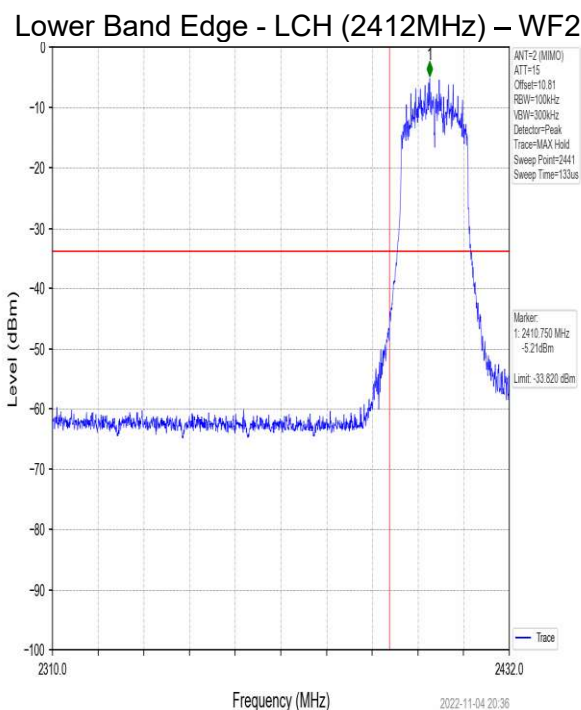
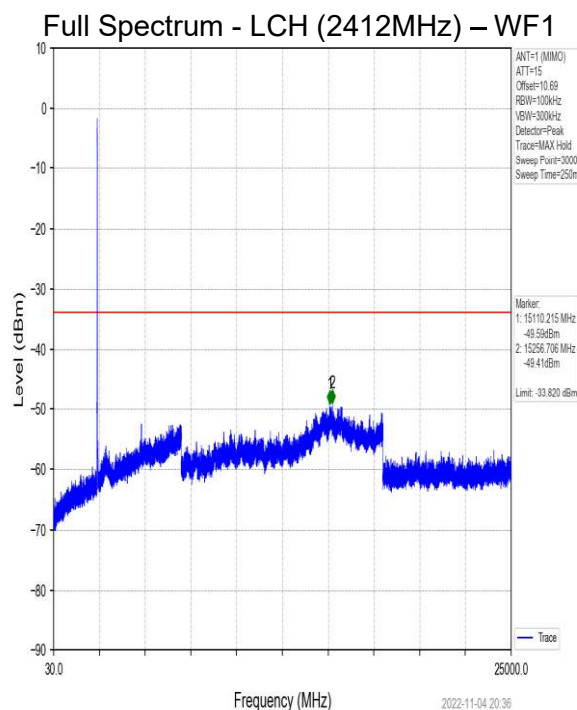
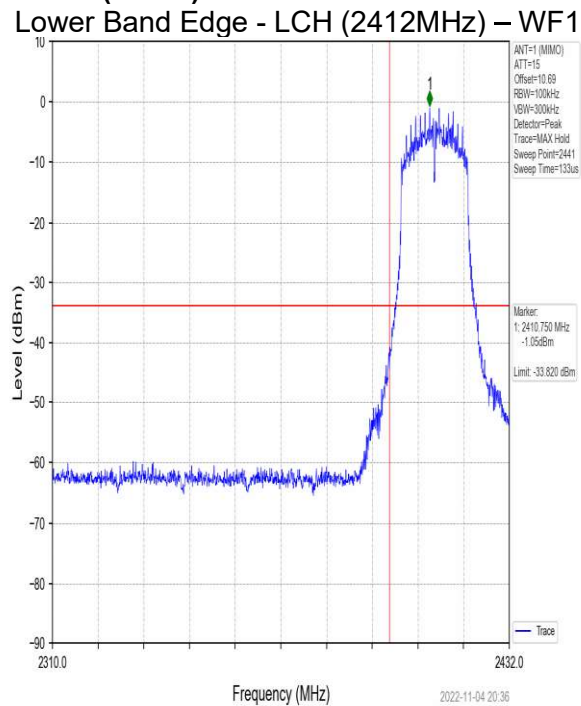
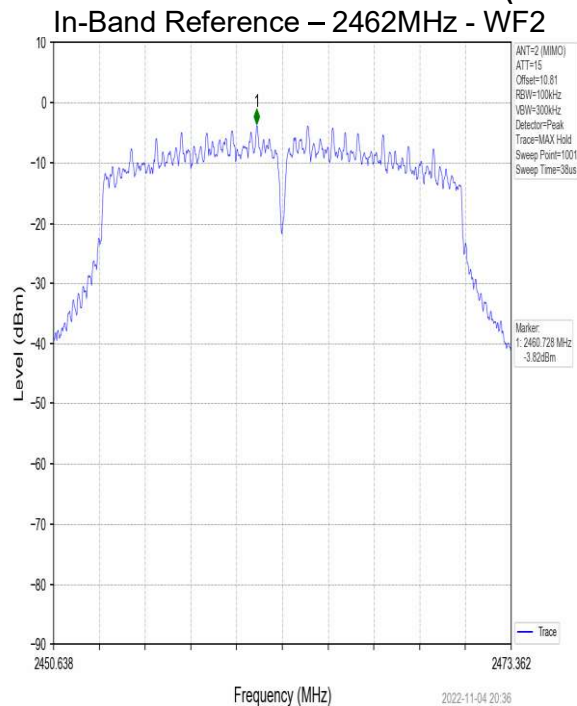
Upper Band Edge – High Channel (2462MHz)



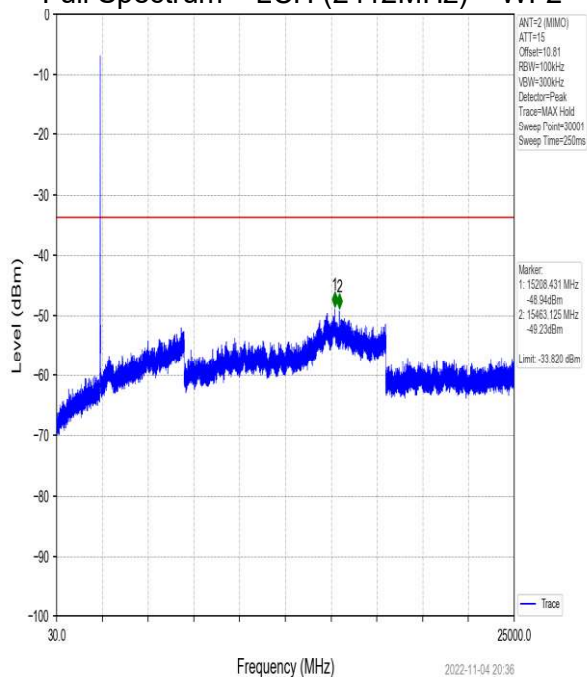
Full Spectrum - High Channel (2462MHz)



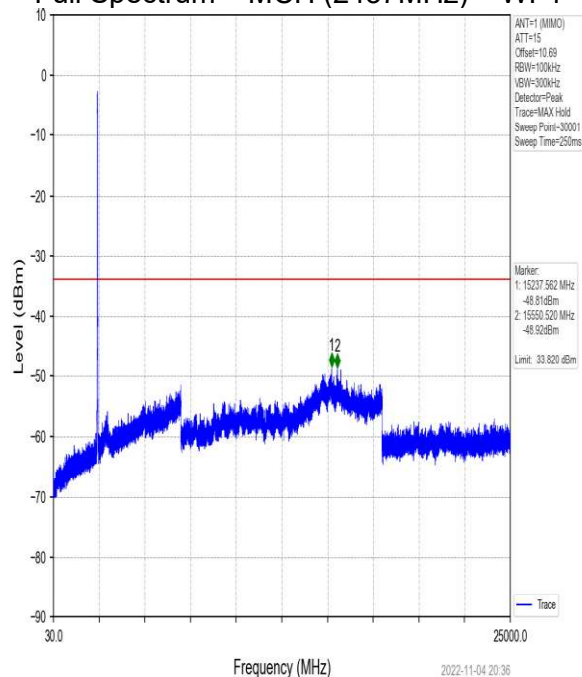
802.11n(HT20) – WF2 + WF1 (MIMO)



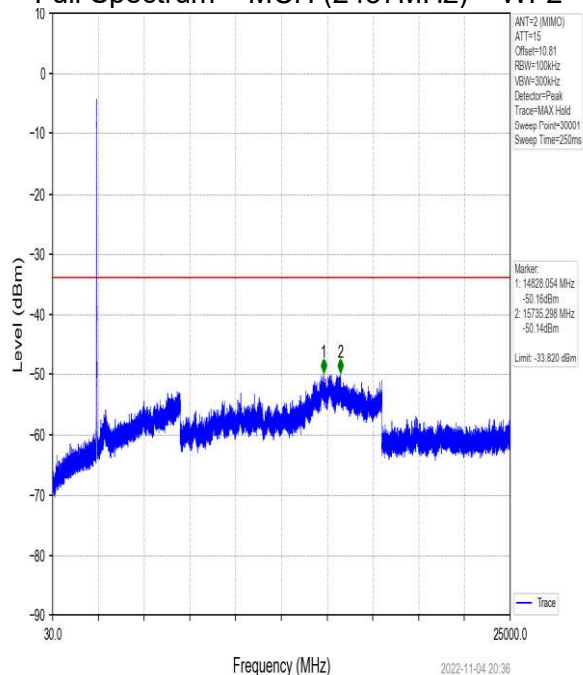
Full Spectrum – LCH (2412MHz) – WF2



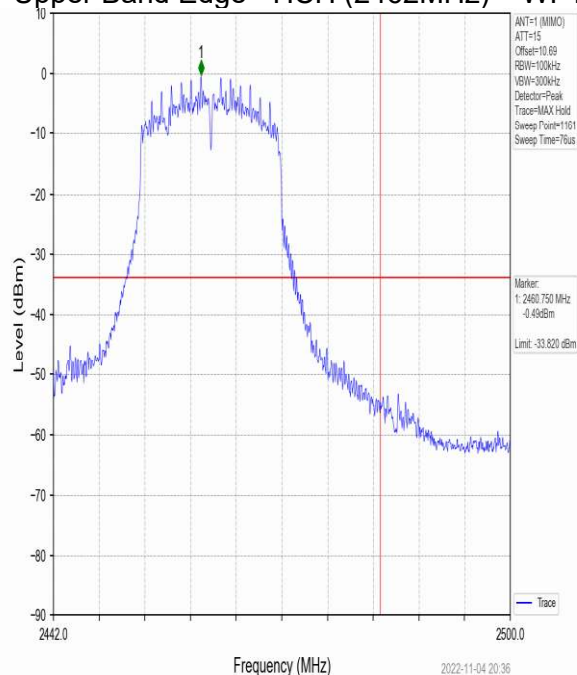
Full Spectrum – MCH (2437MHz) – WF1



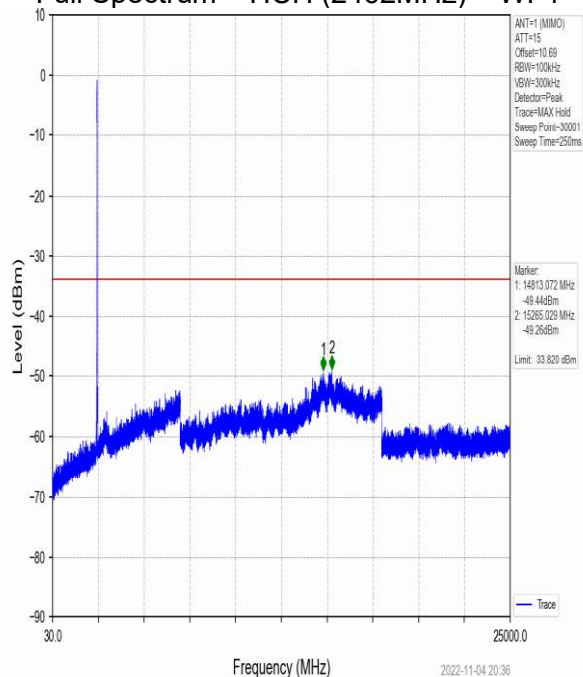
Full Spectrum – MCH (2437MHz) – WF2



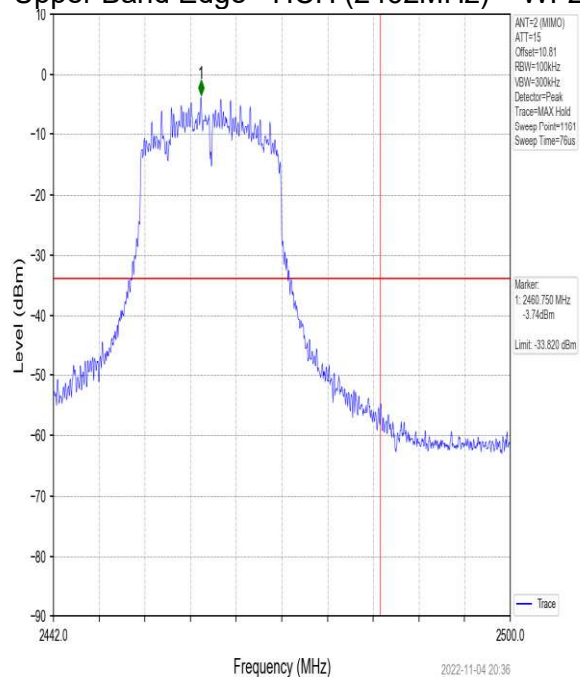
Upper Band Edge - HCH (2462MHz) – WF1



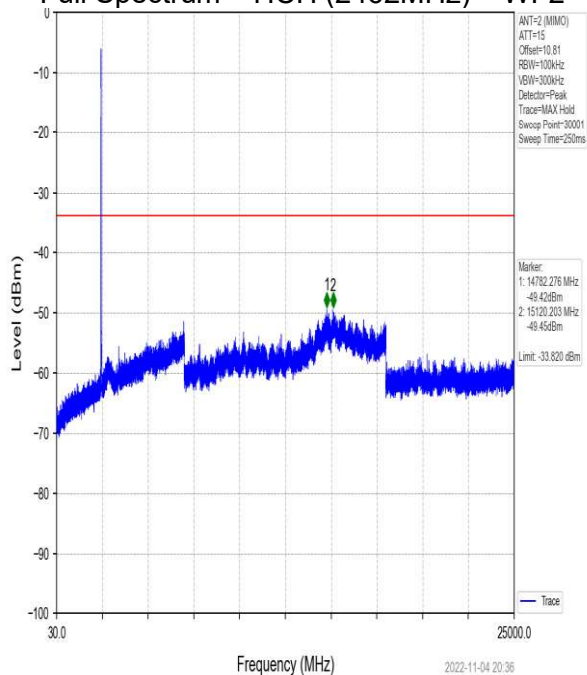
Full Spectrum – HCH (2462MHz) – WF1



Upper Band Edge - HCH (2462MHz) – WF2



Full Spectrum – HCH (2462MHz) – WF2



7 Field Strength of Spurious Radiation (Restricted Bands)

7.1 Test Result

Test Description	Test Specification		Test Result
Radiated Spurious Emissions	15.247(d) and 15.209	RSS-247 S5.5	Compliant

7.2 Test Method

The measurement methods defined in ANSI C63.10: 2013 were used.

Lowest, middle, and highest channels were investigated – the device was commanded to continuously transmit on low, middle, and high channels. The test system reported the following duty-cycles used for correcting the average measurements:

- 802.11b – 82.2% (0.9dB)
- 802.11g – 18.2% (7.4dB)

Test distance:

- 9k to 30 MHz – The EUT to measurement antenna distance was 3 meters
- 30 to 1000 MHz - The EUT to measurement antenna distance was 3 meters
- 1 to 18 GHz - The EUT to measurement antenna distance was 3 meters
- 18 to 26 GHz - The EUT to measurement antenna distance was 3 meters

Limits within restricted bands of operation:

Frequency	Limits ⁽¹⁾		Peak Limits dBuV/m
	Microvolts/m	dBuV/m	
30 - 88 MHz	100	40 ⁽²⁾	--
88 - 216 MHz	150	43.5 ⁽²⁾	--
216 - 960 MHz	200	46 ⁽²⁾	--
960 - 1000 MHz	500	54 ⁽²⁾	--
1 - 40 GHz	500	54 ⁽³⁾	74

(1) These limits are applicable to emissions outside of the intentional transmit frequency band.

(2) Quasi-peak limit

(3) Average limit

7.3 Test Site

10m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

3m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Environmental Conditions	9kHz-30MHz	30-1000MHz	1-18GHz
Temperature:	21.39°C	24.7 °C	21.22°C
Relative Humidity:	38.8%	36.9 %	40.5%
Atmospheric Pressure:	97.9 kPa	98.0 kPa	98.6kPa

7.4 Test Equipment

9kHz-30MHz

Test End Date: 28-Nov-2022

Tester: PL

Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
ANTENNA, LOOP, ACTIVE	6502	ETS LINDGREN	B085752	11-Aug-2022	11-Aug-2024
N to N RF Cable	NC12-N1N1-276	MEGAPHASE	22001	9-Jan-2023	9-Jan-2024
RF CABLE NM TO NF, 0.01-18GHZ	90-213-118	TELEDYNE STORM MICROWAVE	20117	13-Feb-2023	13-Feb-2024
RF CABLE NM TO NM, 0.01-18GHZ	90-195-079	TELEDYNE STORM MICROWAVE	20123	9-Feb-2023	9-Feb-2024
EMI TEST RECEIVER	ESW44	ROHDE & SCHWARZ	22027	13-Sep-2022	13-Sep-2023
SOFTWARE	TILE 7	ETS LINDGREN	N/A	CNR	CNR

30MHz-1000MHz

Test End Date: 18-Nov-2022

Tester: ZH

Equipment	Model	Manufacturer	Asset	Cal Date	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079690	19-Apr-2022	19-Apr-2024
N to N RF Cable	NC12-N1N1-276	MEGAPHASE	22001	9-Jan-2023	9-Jan-2024
RF CABLE NM TO NF, 0.01-18GHZ	90-213-118	TELEDYNE STORM MICROWAVE	20117	13-Feb-2023	13-Feb-2024
RF CABLE NM TO NM, 0.01-18GHZ	90-195-079	TELEDYNE STORM MICROWAVE	20123	9-Feb-2023	9-Feb-2024
RF CABLE RIGHT ANGLE NM TO NM, 0.01-18GHZ	90-076-020	TELEDYNE STORM MICROWAVE	20132	16-Mar-2022	16-Mar-2023
LOW NOISE AMPLIFIER	ZKL-2+	MINI-CIRCUITS	B079800	14-Sep-2022	14-Sep-2023
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	8-Sep-2022	8-Sep-2023
SOFTWARE	TILE 7	ETS LINDGREN	N/A	CNR	CNR

Above 1GHz

Test End Date: 10-Nov-2022

Tester: PL

Equipment	Model	Manufacturer	Asset Number	Cal Date	Cal Due Date
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	15-Aug-2022	15-Aug-2024
RF CABLE NM TO NF, 0.01-18GHZ	90-213-118	TELEDYNE STORM MICROWAVE	20118	16-Mar-2022	16-Mar-2023
RF CABLE NM TO NM, 0.01-18GHZ	90-195-118	TELEDYNE STORM MICROWAVE	20126	14-Feb-2022	14-Feb-2023
RF CABLE RIGHT ANGLE NM TO NM, 0.01-18GHZ	90-076-020	TELEDYNE STORM MICROWAVE	20131	16-Mar-2022	16-Mar-2023
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	13-Jul-2022	13-Jul-2023
EMI TEST RECEIVER	ESW44	ROHDE & SCHWARZ	22027	13-Sep-2022	13-Sep-2023
FILTER, HIGH PASS, >2800MHZ	HPM50111	MICRO-TRONICS	22017	16-Jun-2022	16-Jun-2023
ANTENNA, HORN (SMALL)	LB-180400-20-C-KF	A-INFO	15007	18-Apr-2022	18-Apr-2024
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-138	TELEDYNE STORM MICROWAVE	20111	16-Mar-2022	16-Mar-2023
RF CABLE SMA TO SMA, 0.01-40GHZ	084-0505-059	TELEDYNE STORM MICROWAVE	20108	16-Mar-2022	16-Mar-2023
LOW NOISE AMPLIFIER	NSP1840-HG	MITEQ	B087572	13-Oct-2022	13-Oct-2023
SOFTWARE	TILE 7	ETS LINDGREN	N/A	CNR	CNR

Software Profile:

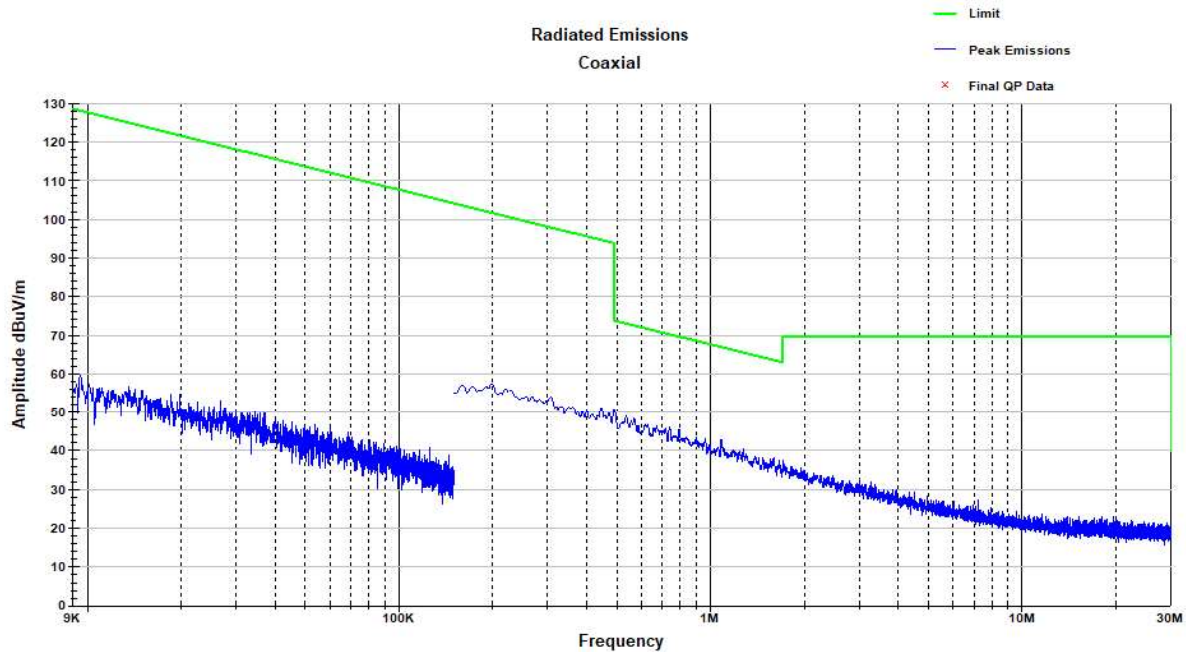
“RSE 9k - 30M 220804” TILE! profile dated 04 August 2022

“RSE 30-1000 MHz T7 220318” TILE! profile dated 18 March 2022

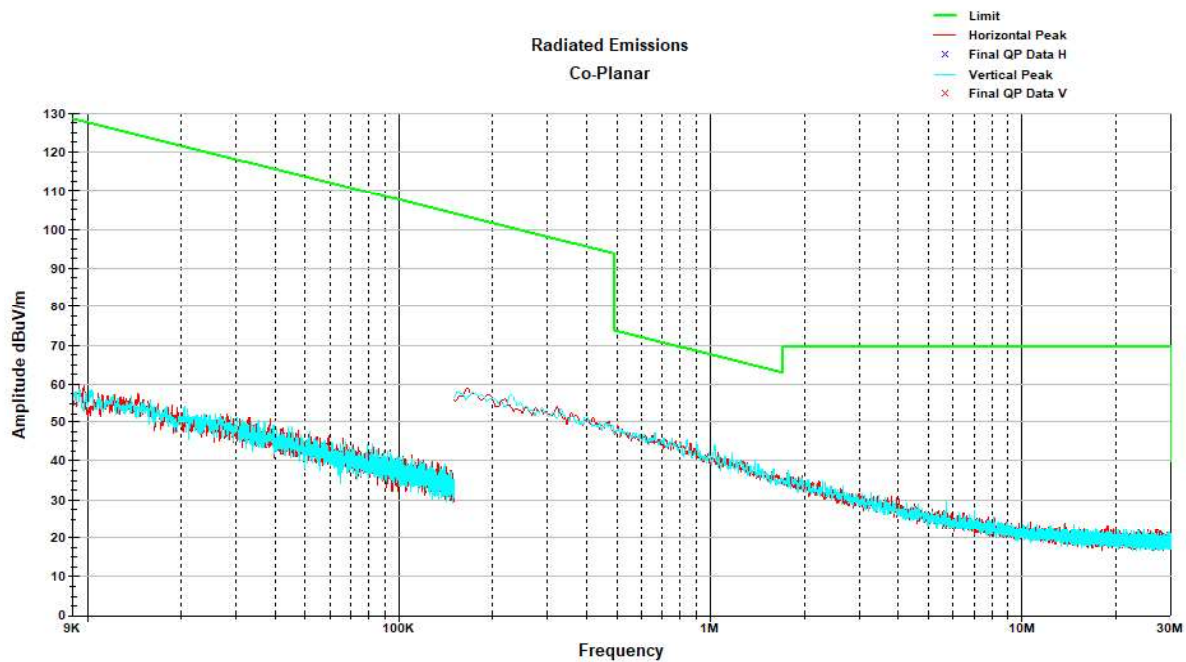
“RSE 1-18 GHz T7 210212” TILE! profile dated 12 February 2021

7.5 Test Data – Peak Plots

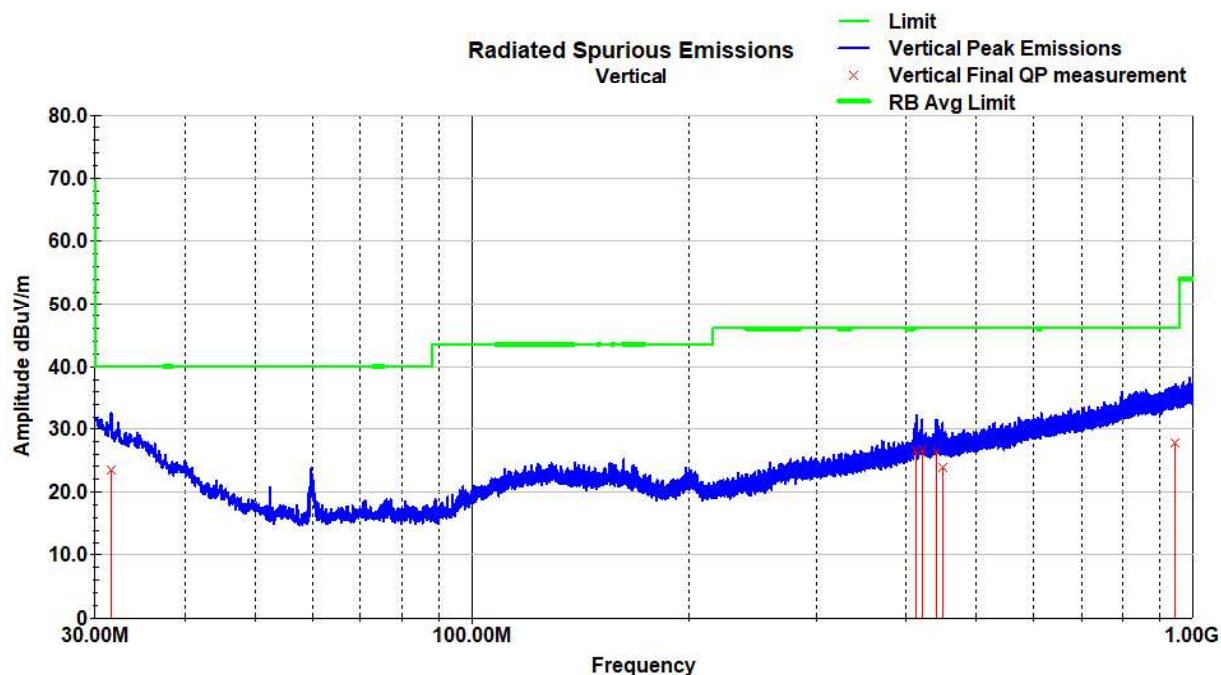
Between 9kHz and 1000MHz, there was no significant deviation with respect to axis, modulation, or channel
Co-Axial Radiated Spurious Emissions – 9kHz-30MHz (802.11b LCH)



Co-Planar Radiated Spurious Emissions – 9kHz-30MHz (802.11b LCH)



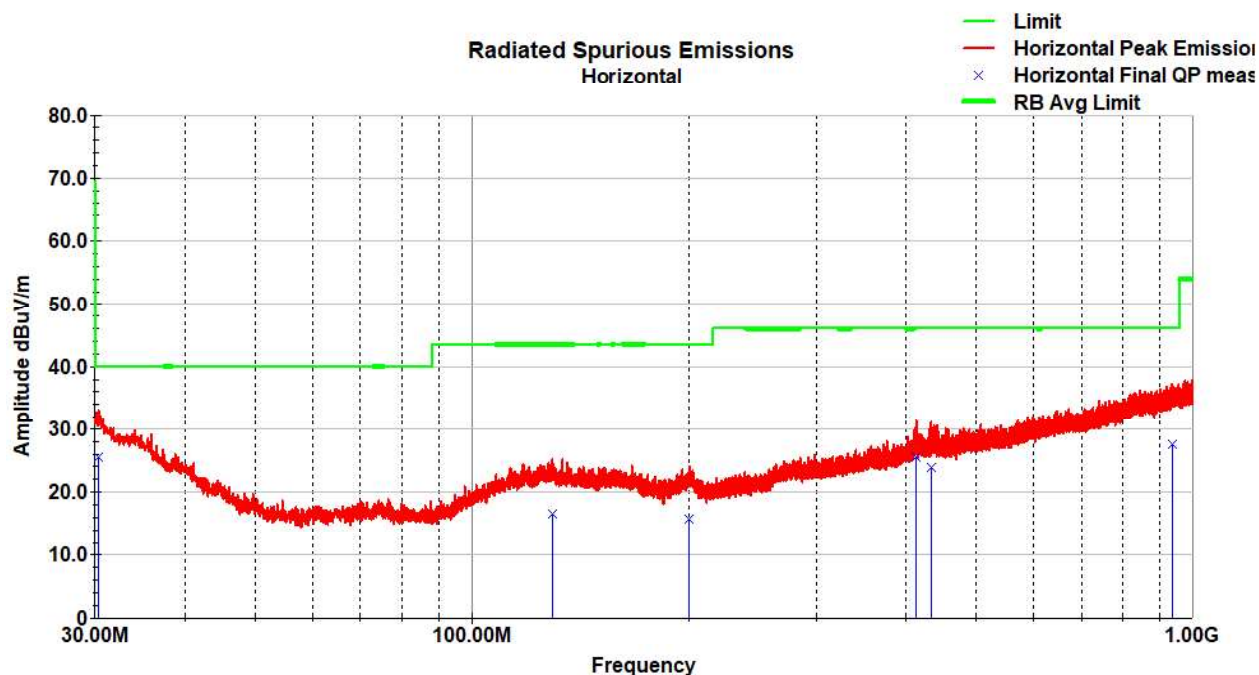
Vertical Radiated Spurious Emissions Plot – 30-1000MHz (802.11b LCH)



Vertical Radiated Spurious Emissions Data – 30-1000MHz (802.11b LCH)

Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.27	29.9	V	101.0	100.0	25.9	0.7	31.0	25.4	40.0	-14.6
410.70	33.5	V	322.0	100.0	20.4	3.1	30.3	26.6	46.0	-19.4
413.27	37.7	V	329.0	100.0	20.4	3.1	30.3	30.9	46.0	-15.1
421.27	31.4	V	322.0	100.0	20.5	3.1	30.3	24.7	46.0	-21.3
441.21	30.6	V	351.0	100.0	21.0	3.2	30.3	24.6	46.0	-21.5
867.86	25.4	V	139.0	400.0	26.6	4.4	29.4	27.0	46.0	-19.0
QP Value = Raw QP + AF + Loss - Amp										
Margin = QP Value - Limit										

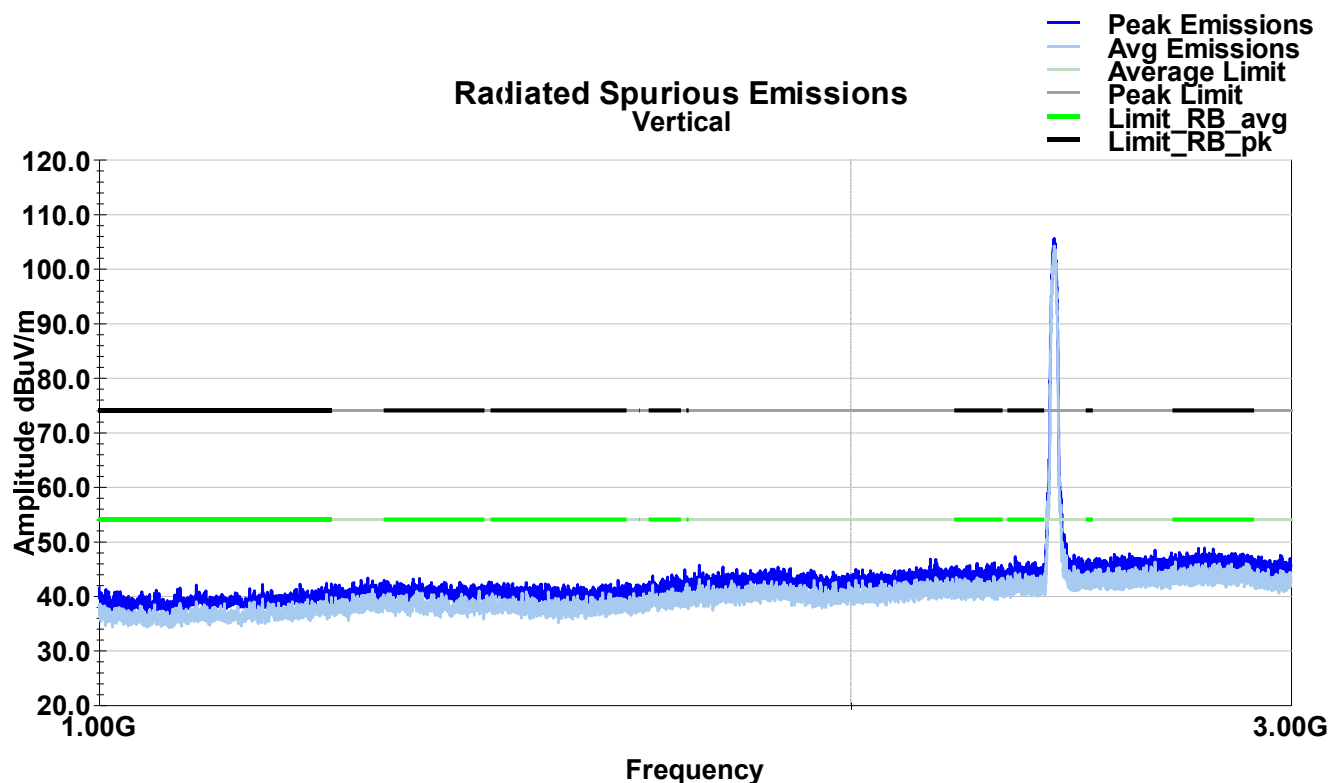
Horizontal Radiated Spurious Emissions Plot – 30-1000MHz (802.11b LCH)



Horizontal Radiated Spurious Emissions Data – 30-1000MHz (802.11b LCH)

Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.32	30.0	H	63.0	325.0	25.8	0.7	31.0	25.5	40.0	-14.5
129.21	28.0	H	160.0	100.0	17.7	1.7	30.8	16.6	43.5	-26.9
200.12	27.4	H	324.0	117.0	16.7	2.1	30.6	15.7	43.5	-27.8
413.27	32.3	H	126.0	399.0	20.4	3.1	30.3	25.5	46.0	-20.5
433.48	30.3	H	161.0	117.0	20.8	3.1	30.3	24.0	46.0	-22.0
934.98	25.1	H	153.0	271.0	27.1	4.6	29.3	27.6	46.0	-18.5
QP Value = Raw QP + AF + Loss - Amp										
Margin = QP Value - Limit										

Vertical Radiated Spurious Emissions – 1-3GHz (802.11b LCH)



Horizontal Radiated Spurious Emissions – 1-3GHz (802.11b LCH)

