

RF Test Report

Project Number: 4975321

Proposal: SUW-202108001433

Report Number: 4975321EMC09

Revision Level: 2

Client: Deere & Company

Equipment Under Test: JLink™ 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.

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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.

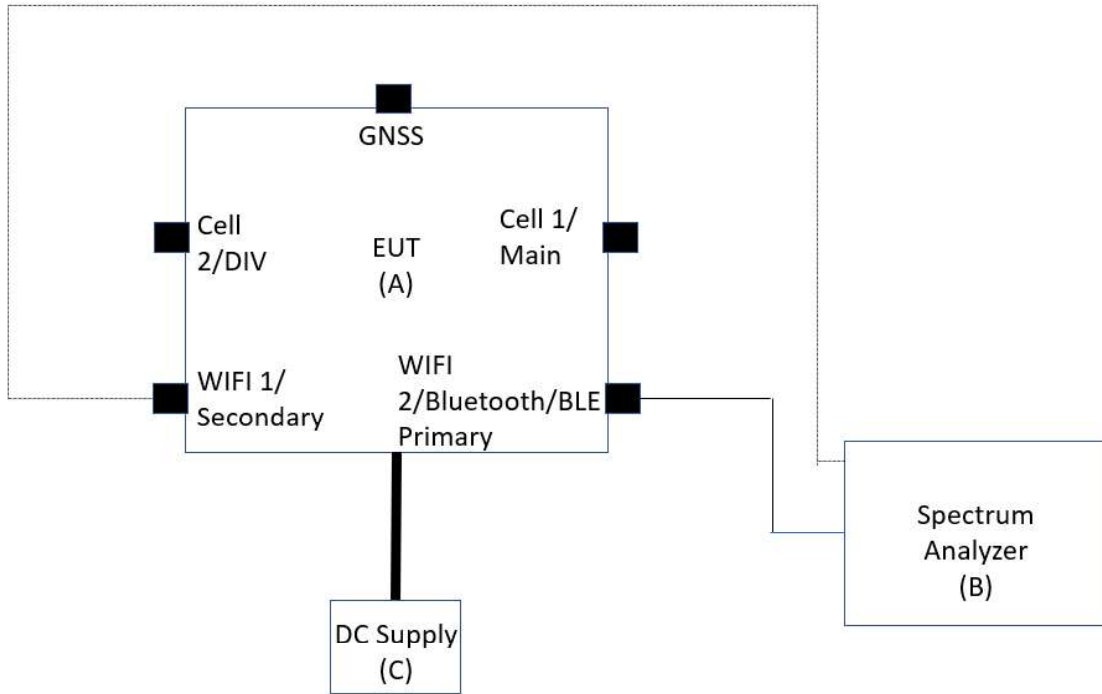
2.4 *Operating Modes and Conditions*

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:

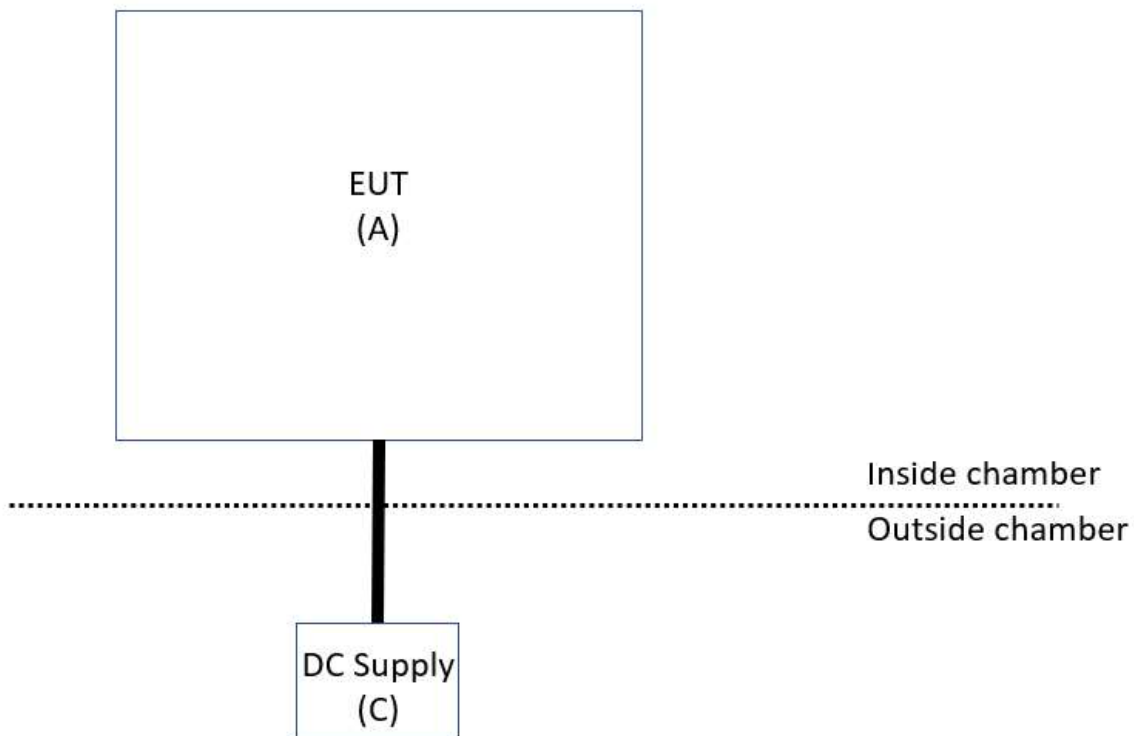
- 802.11b, 5Mbps
- 802.11g, 6Mbps
- 802.11nHT20, MCS6
- 802.11nHT40, MCS4

The WL command power setting for all testing was 20000.

2.5 EUT Connection Block Diagram – Conducted Measurements



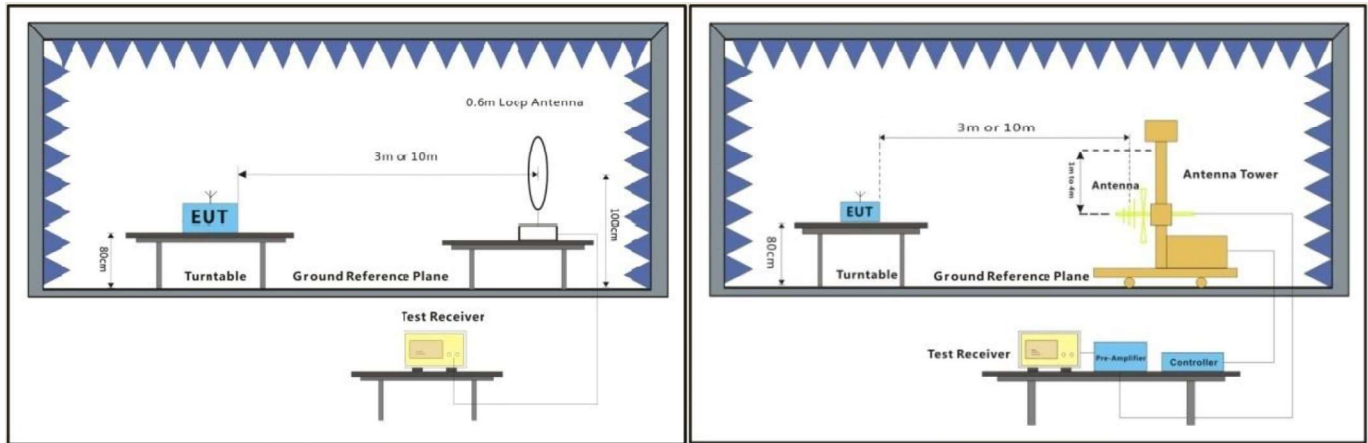
2.6 EUT Connection Block Diagram – Radiated Measurements



2.7 System Configurations

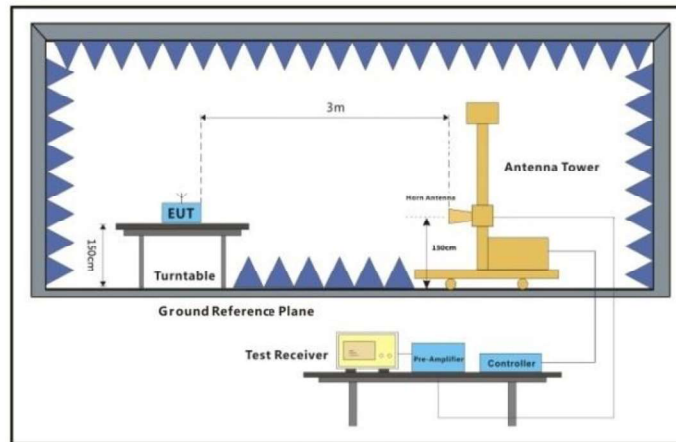
| Device reference | Manufacturer | Description | Model Number | Serial Number |
|------------------|-----------------|----------------------|--------------|---|
| A | Deere & Company | JDLink™ M Modem - 4G | MA4M | PCMA4MA101508 (Conducted) PCMA4MA101503 (Radiated) |
| B | KEYSIGHT | EXA Signal Analyzer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

2.8 Configuration Diagrams (Radiated)



Below 30MHz

30MHz-1GHz



Above 1GHz

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:

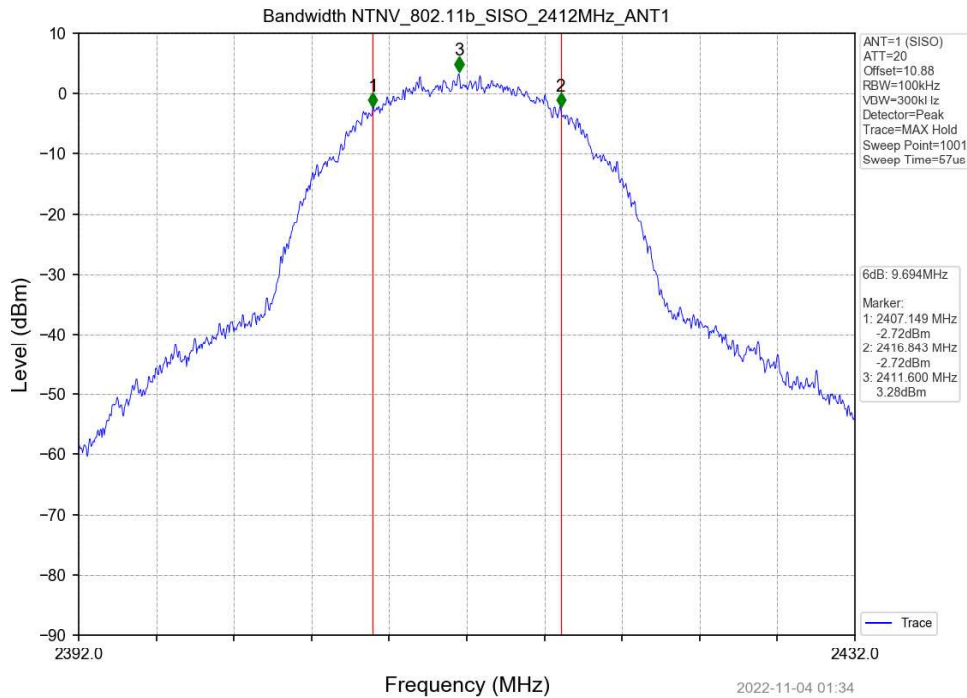
TSTPASS Version: 1.1.0, build 2020.11.15.01

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)

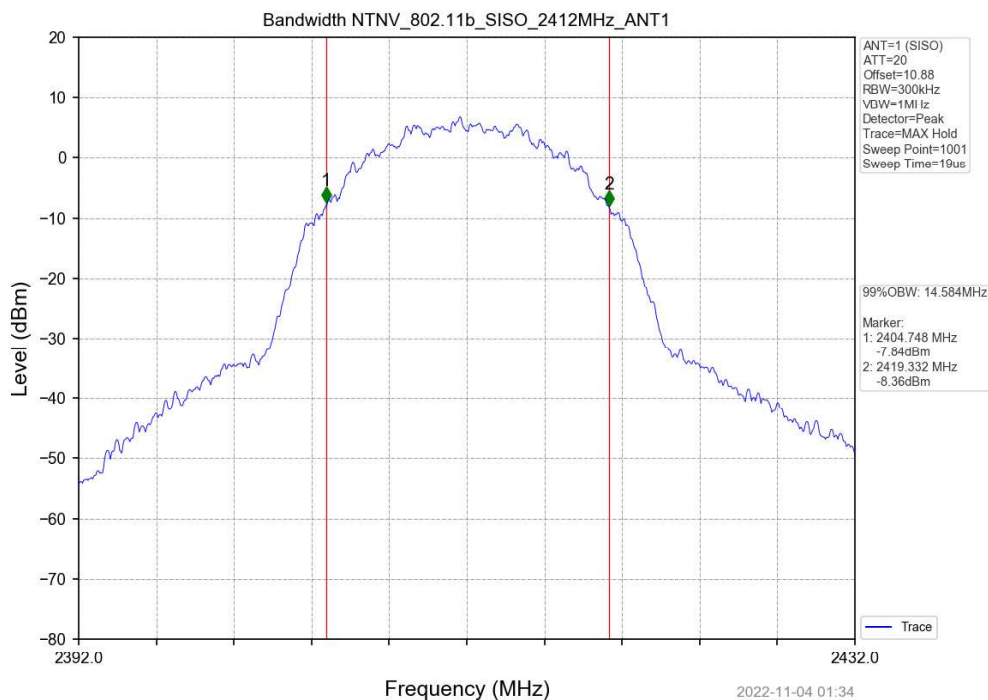


3.6 Test Data – 99% Bandwidth

| 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

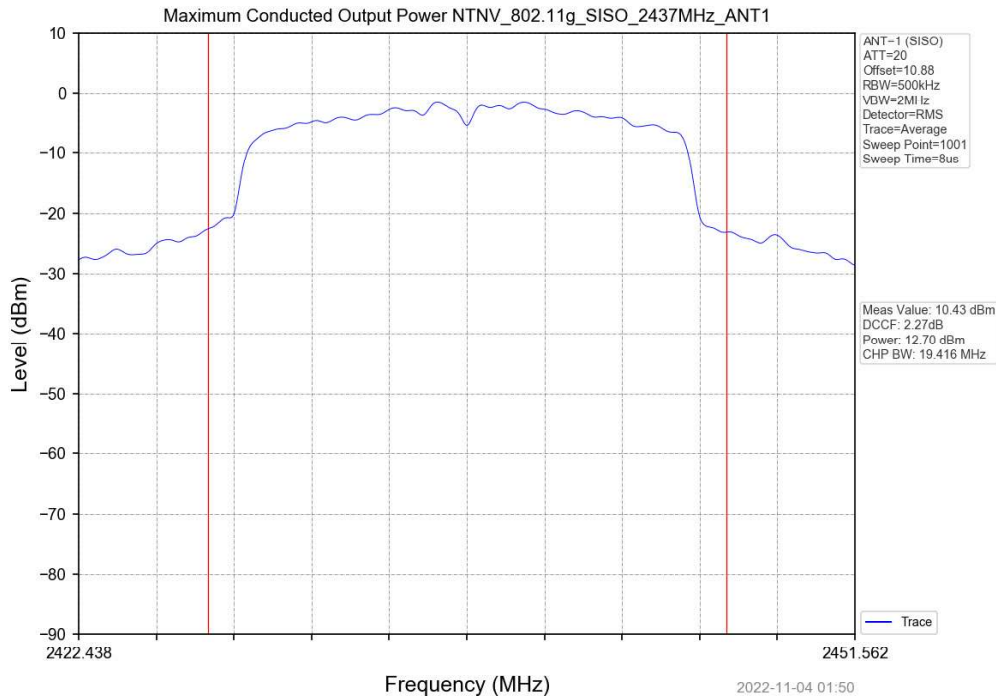
Directional gain = $10 \log[(10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20})^2 / N_{ANT}]$ dBi [Note the “20”s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

(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

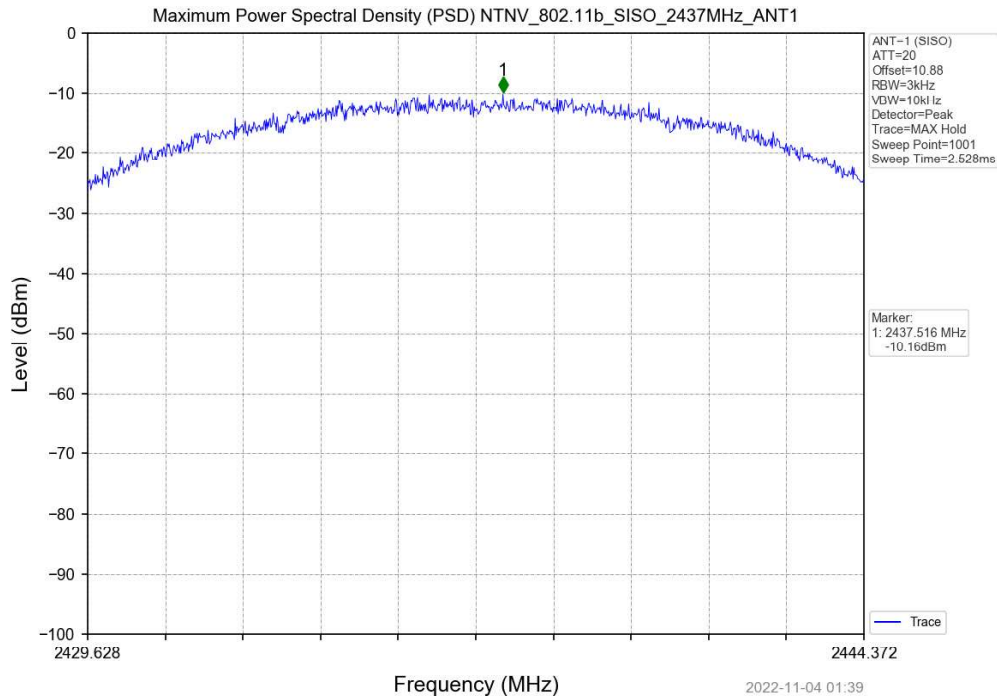
| Frequency (MHz) | TX Type | ANT No. | Peak PSD (dBm/3kHz) | Limit (dBm/3kHz) | Verdict |
|-----------------|-----------|---------|---------------------|------------------|---------|
| 2412 | 802.11b | WF2 | -10.80 | ≤8 | PASS |
| 2437 | 802.11b | WF2 | -10.16 | ≤8 | PASS |
| 2462 | 802.11b | WF2 | -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

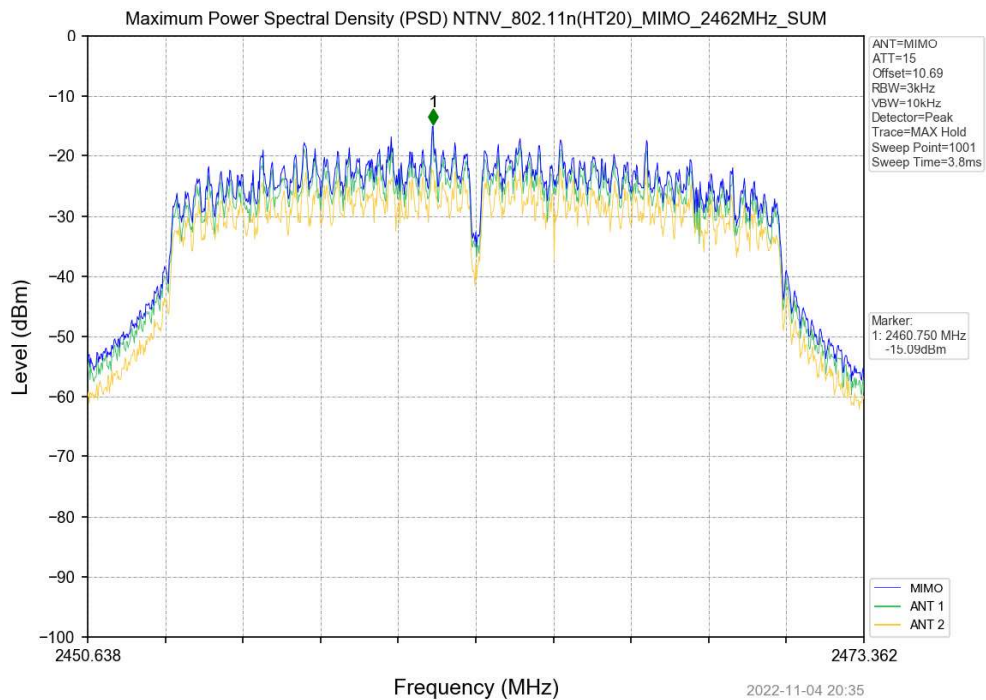
| Test Mode | Frequency (MHz) | Tx Type | Maximum Power Spectral Density (dBm/3KHz) | | | Limits (dBm/3kHz) | Verdict |
|---------------|-----------------|---------|---|--------|--------|-------------------|---------|
| | | | Ant 1 | Ant 2 | Total | | |
| 802.11n(HT20) | 2412 | MIMO | -16.76 | -22.29 | -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 |
| 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

6.5 Test Data - SISO

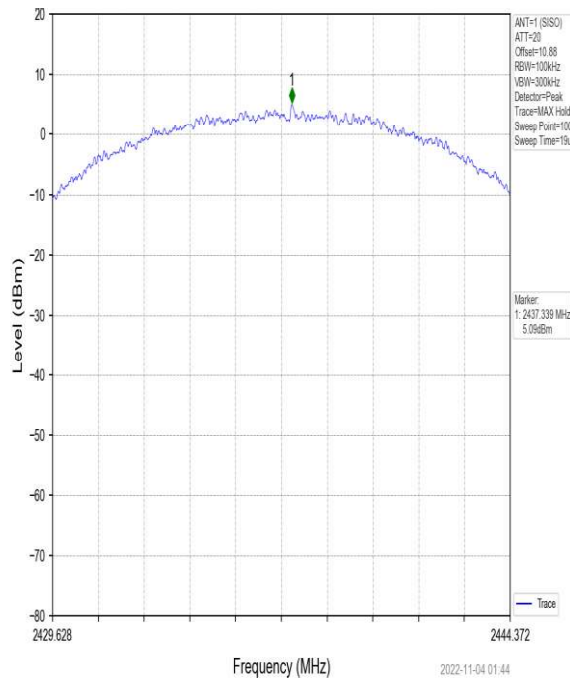
| Frequency (MHz) | TX Type | ANT No. | Spurious Conducted Emission (dBm) | Limit (dBm) | Verdict |
|-----------------|-----------|---------|-----------------------------------|-------------|---------|
| 2412 | 802.11b | WF2 | Refer to test graph | -24.91 | PASS |
| 2437 | 802.11b | WF2 | Refer to test 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

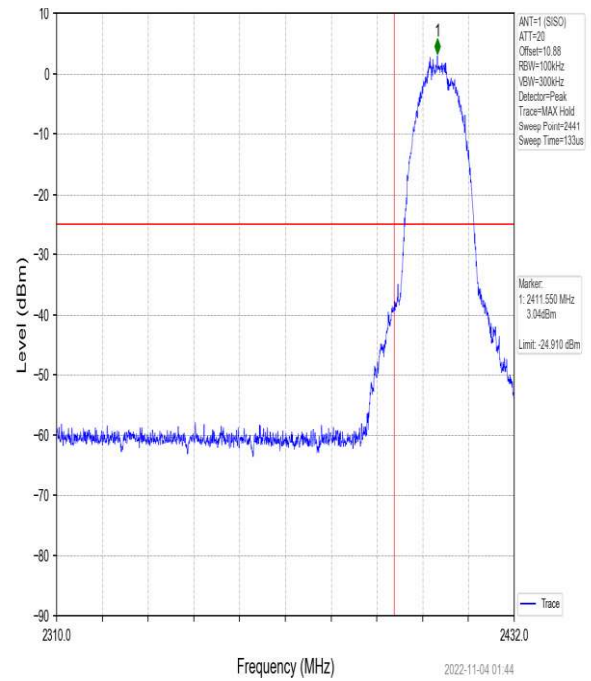
| Test Mode | Frequency (MHz) | TX Type | ANT No. | Spurious Conducted Emission (dBm) | Limits (dBm) | Verdict |
|---------------|-----------------|---------|---------|-----------------------------------|--------------|---------|
| 802.11n(HT20) | 2412 | MIMO | MIMO | Refer to test graph | -33.82 | PASS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

802.11b – WF2 (ANT1)

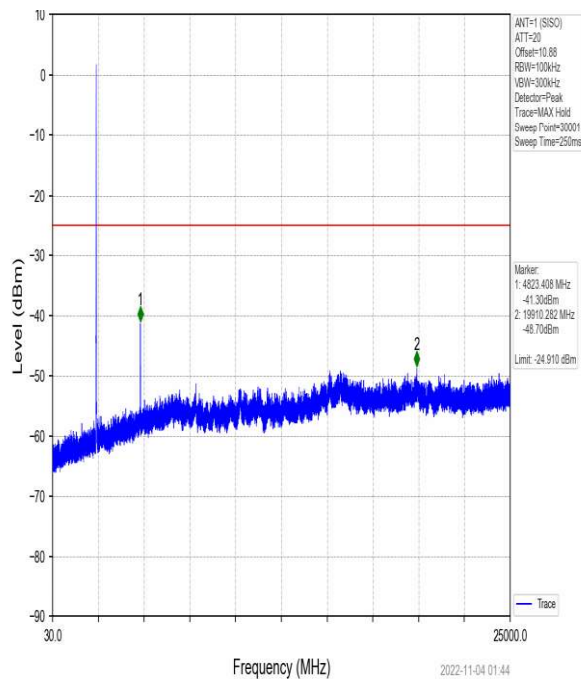
In-Band Reference – 2437MHz



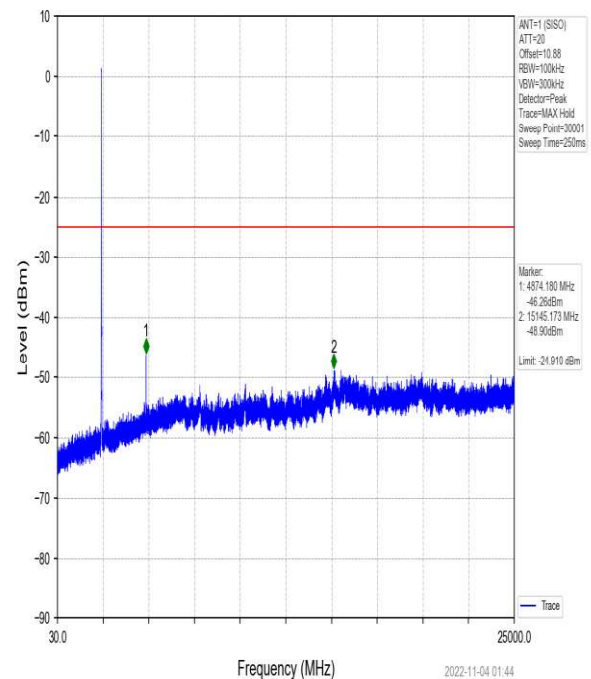
Lower Band Edge - Low Channel (2412MHz)



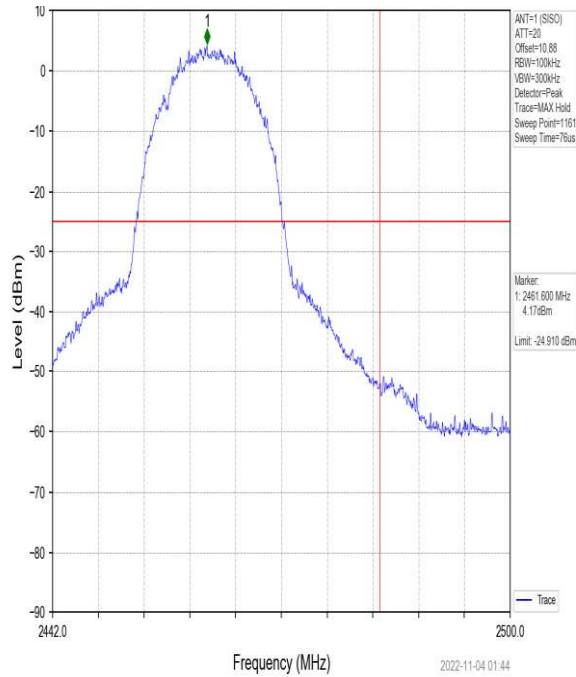
Full Spectrum - Low Channel (2412MHz)



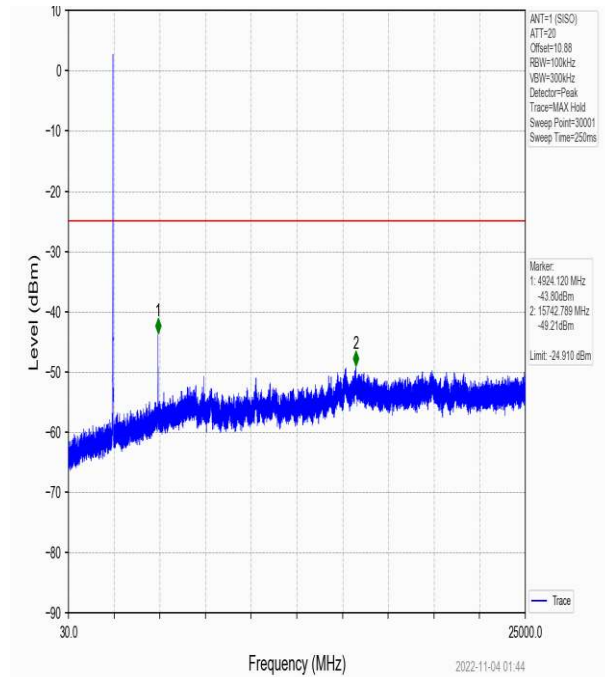
Full Spectrum - Mid Channel (2437MHz)



Upper Band Edge – High Channel (2462MHz)

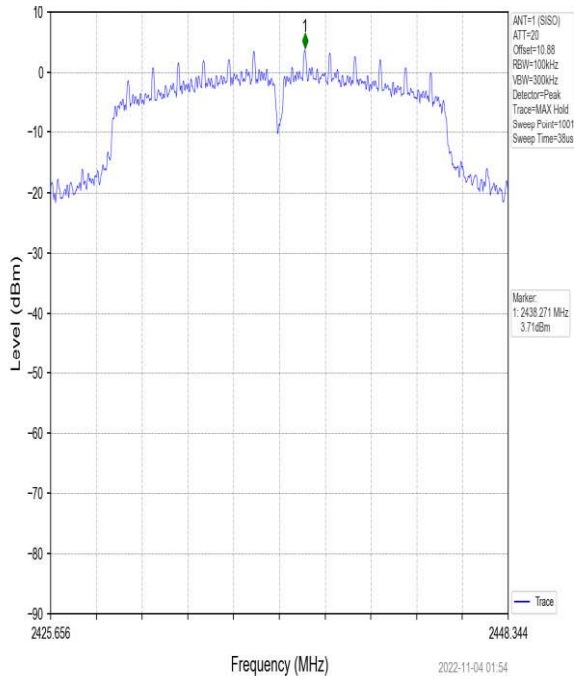


Full Spectrum - High Channel (2462MHz)

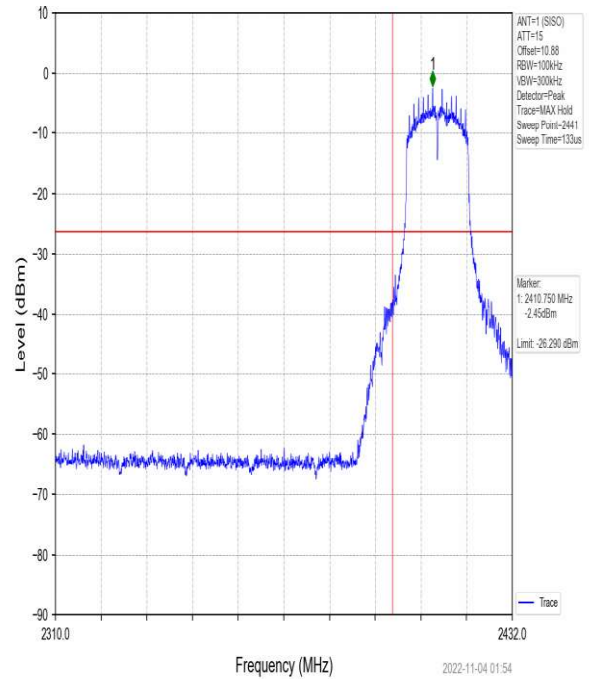


802.11g – WF2 (ANT1)

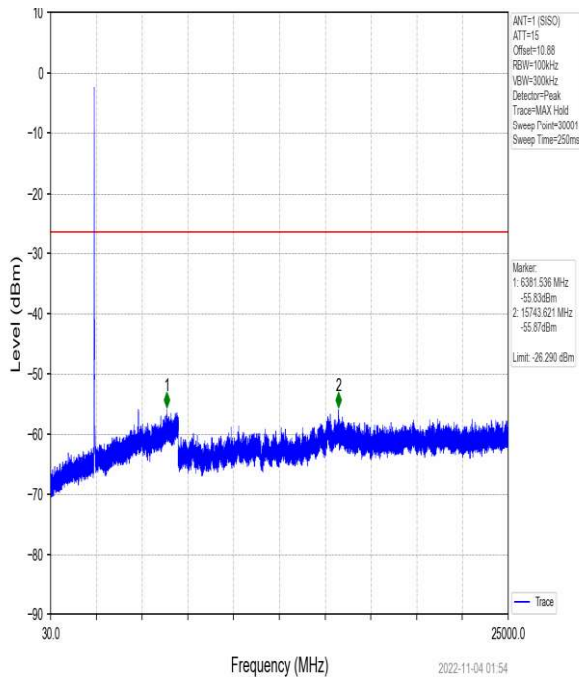
In-Band Reference – 2437MHz



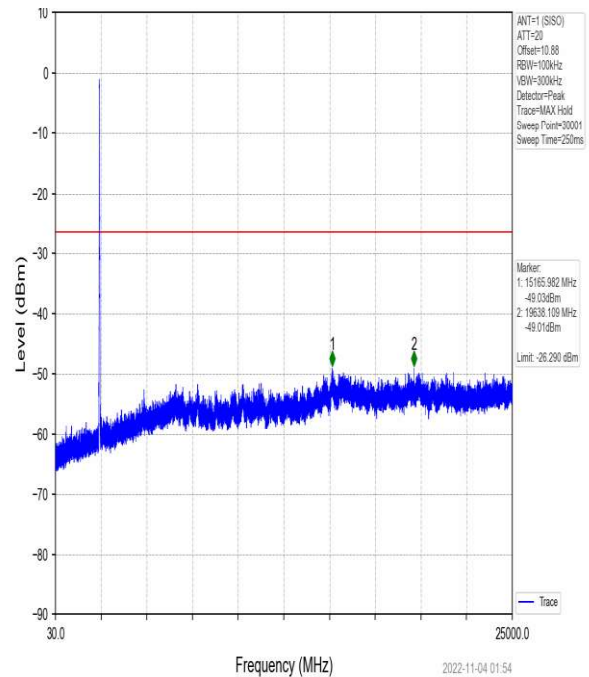
Lower Band Edge - Low Channel (2412MHz)



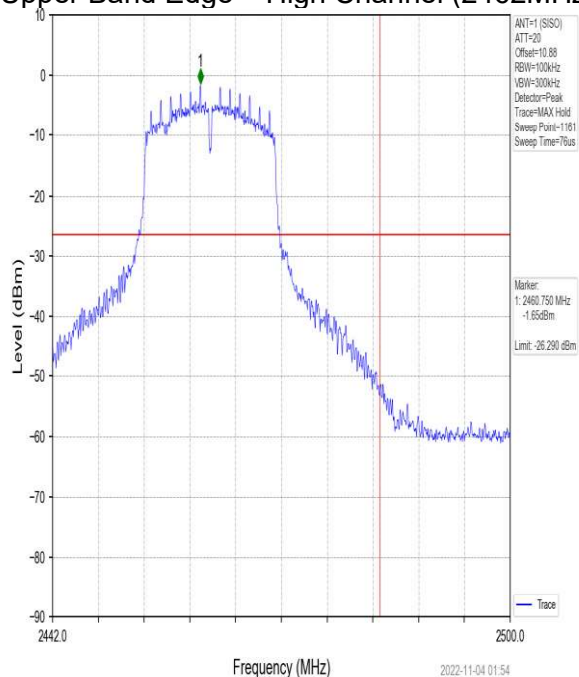
Full Spectrum - Low Channel (2412MHz)



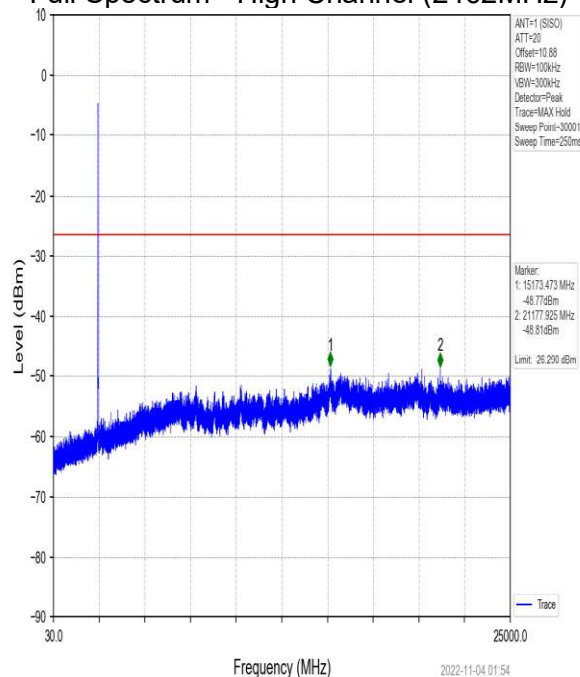
Full Spectrum - Mid Channel (2437MHz)



Upper Band Edge – High Channel (2462MHz)

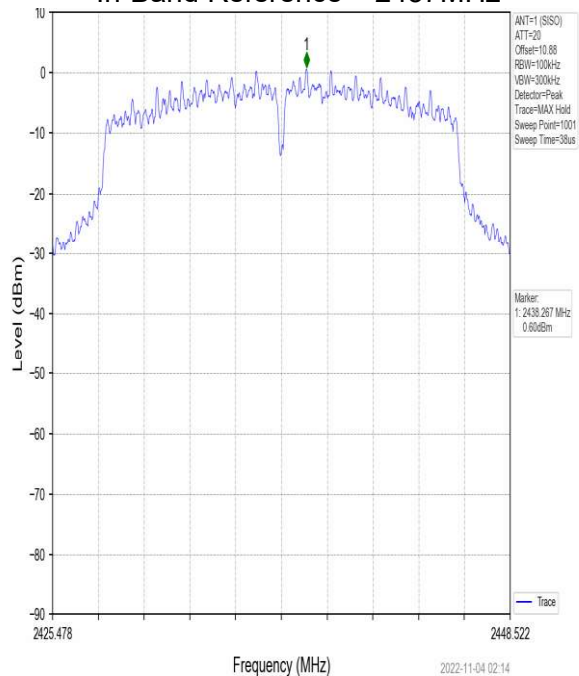


Full Spectrum - High Channel (2462MHz)

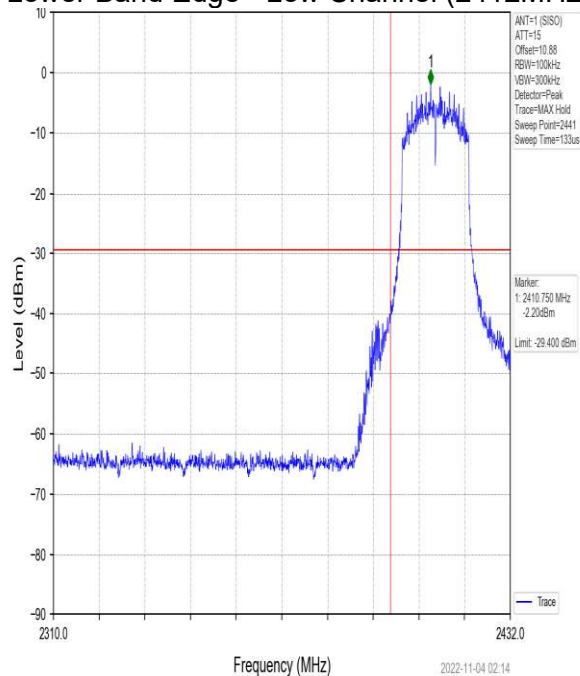


802.11n(HT20) – WF2(ANT1)

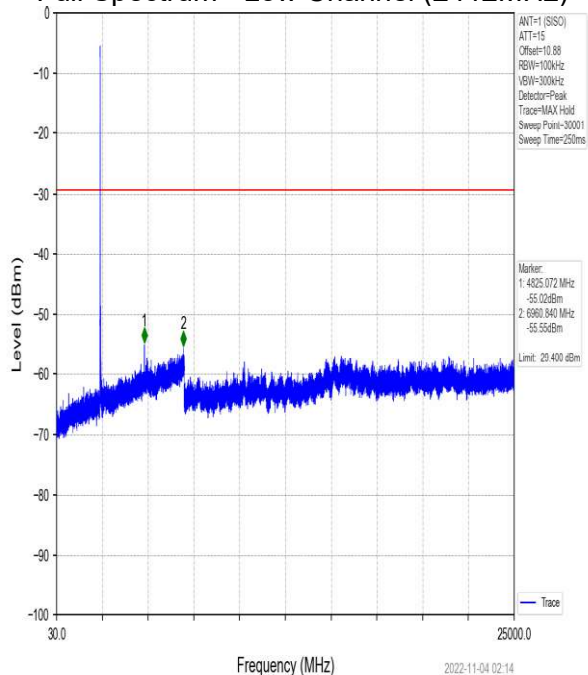
In-Band Reference – 2437MHz



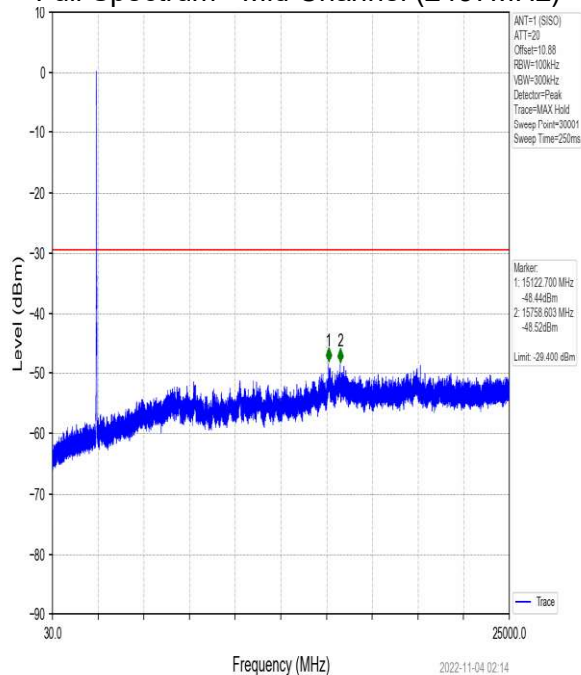
Lower Band Edge - Low Channel (2412MHz)



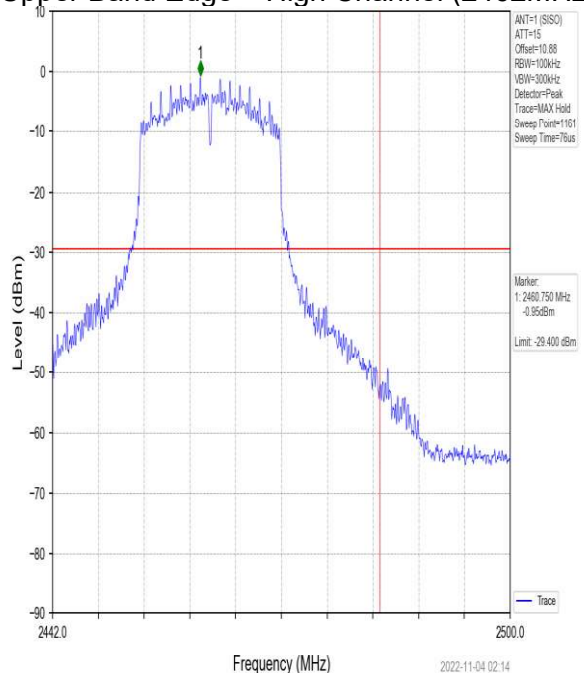
Full Spectrum - Low Channel (2412MHz)



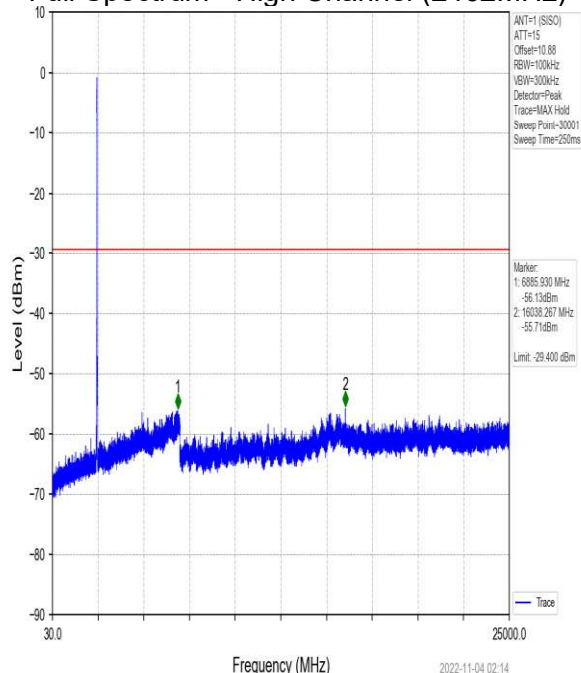
Full Spectrum - Mid Channel (2437MHz)



Upper Band Edge – High Channel (2462MHz)

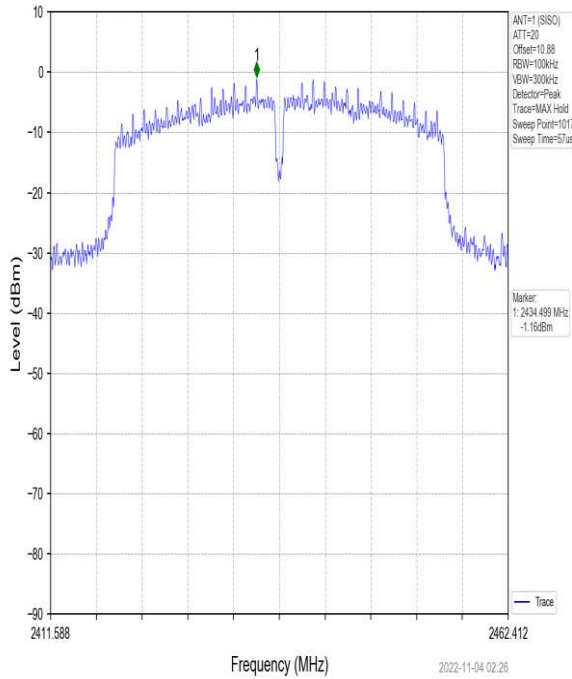


Full Spectrum - High Channel (2462MHz)

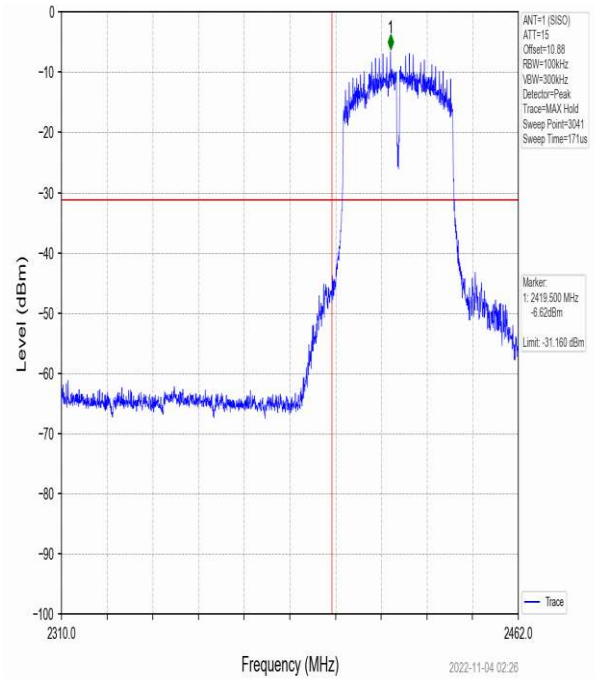


802.11n(HT40) – WF2(ANT1)

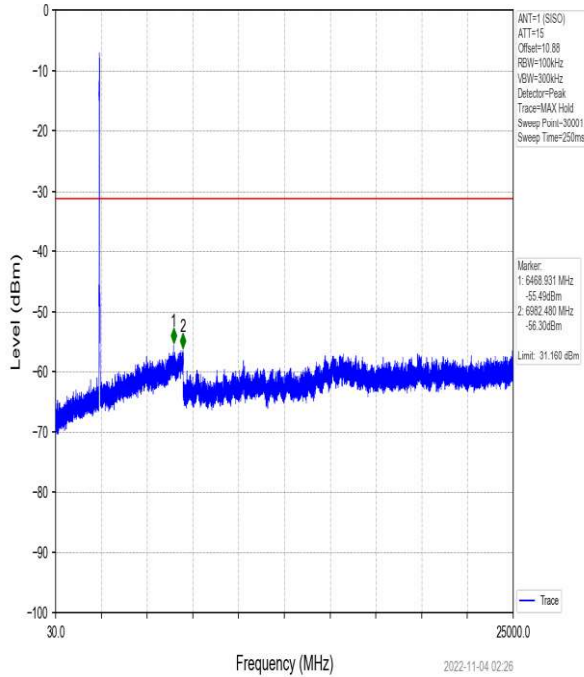
In-Band Reference – 2437MHz



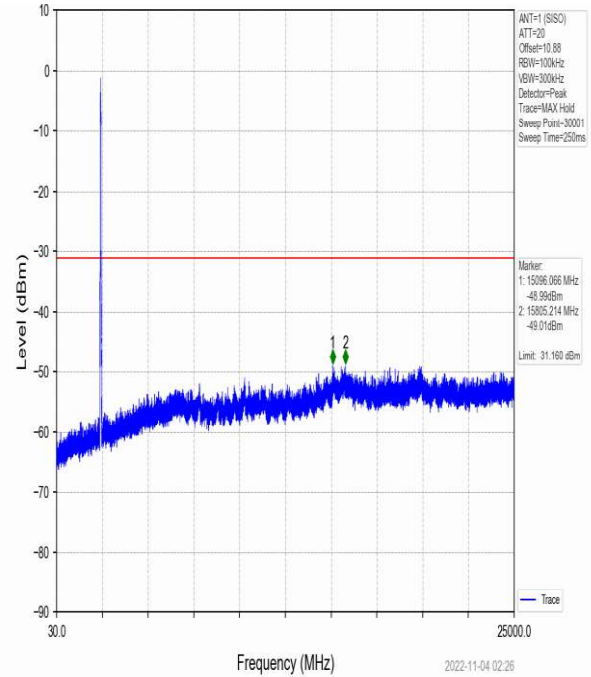
Lower Band Edge - Low Channel (2422MHz)



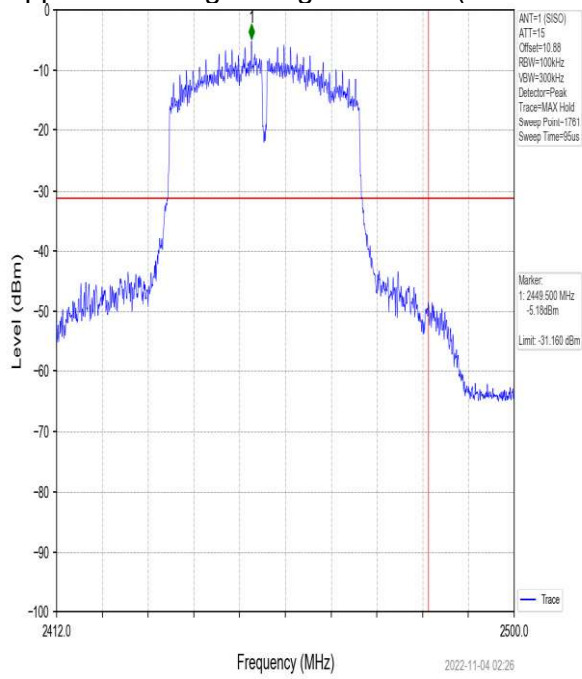
Full Spectrum - Low Channel (2422MHz)



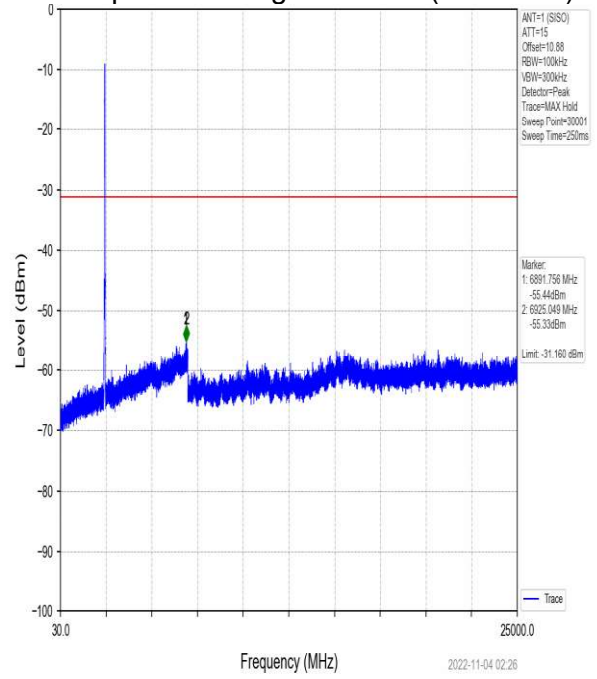
Full Spectrum - Mid Channel (2437MHz)



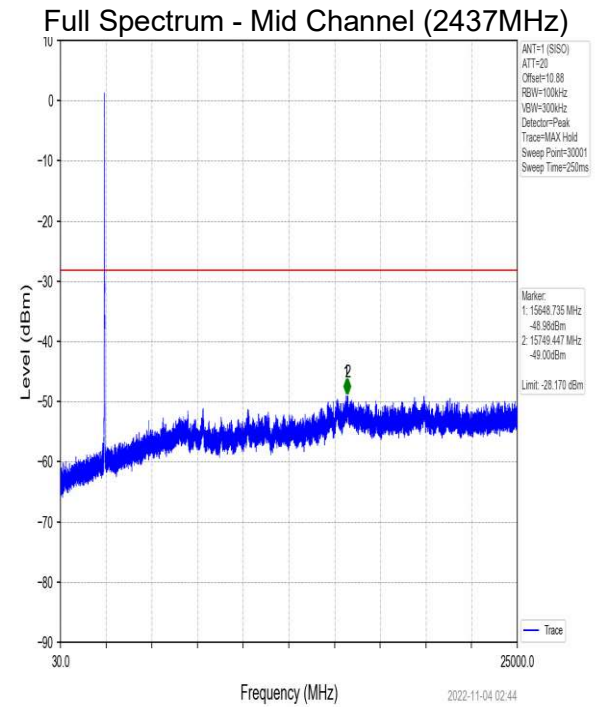
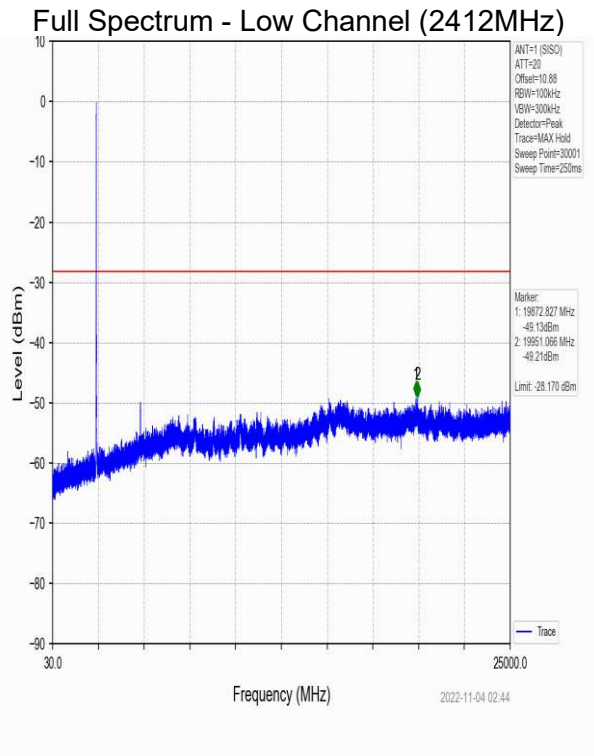
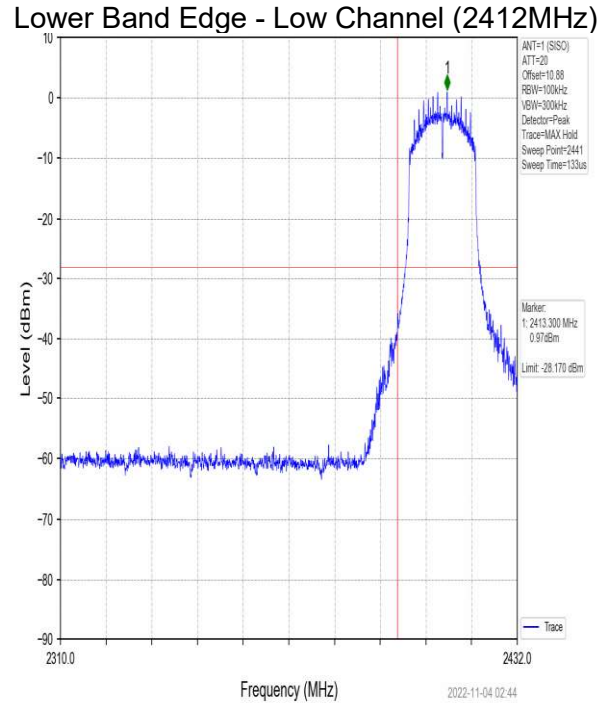
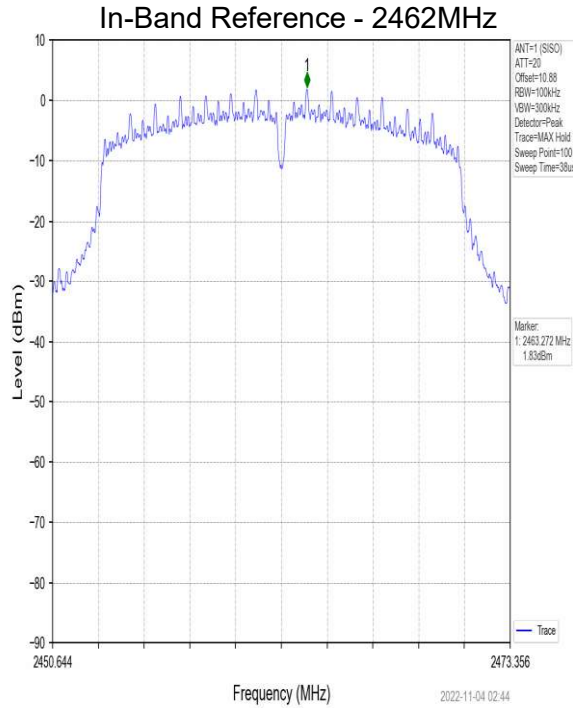
Upper Band Edge – High Channel (2452MHz)



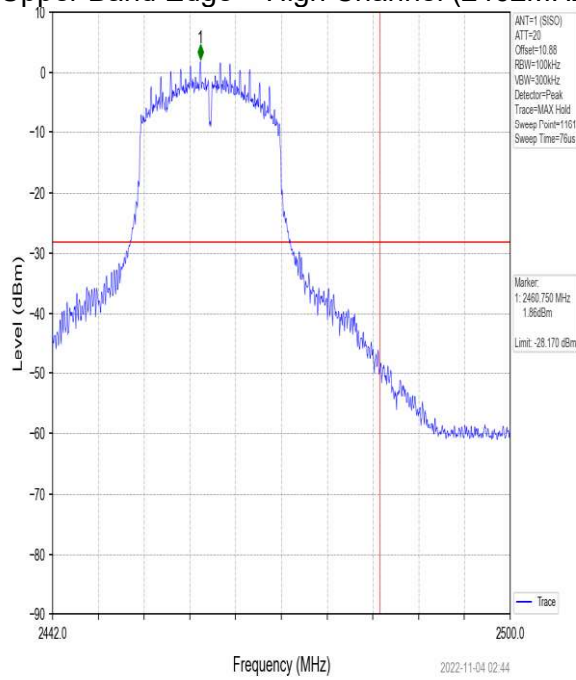
Full Spectrum - High Channel (2452MHz)



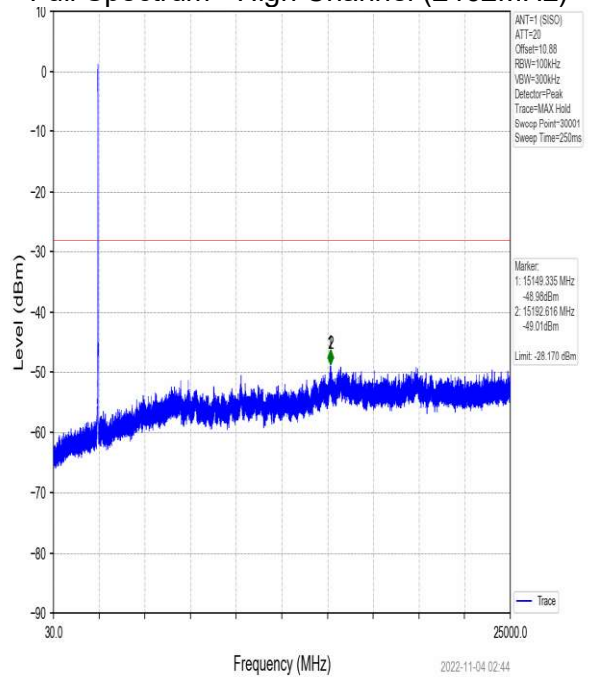
802.11n(HT20) – WF1(ANT2)



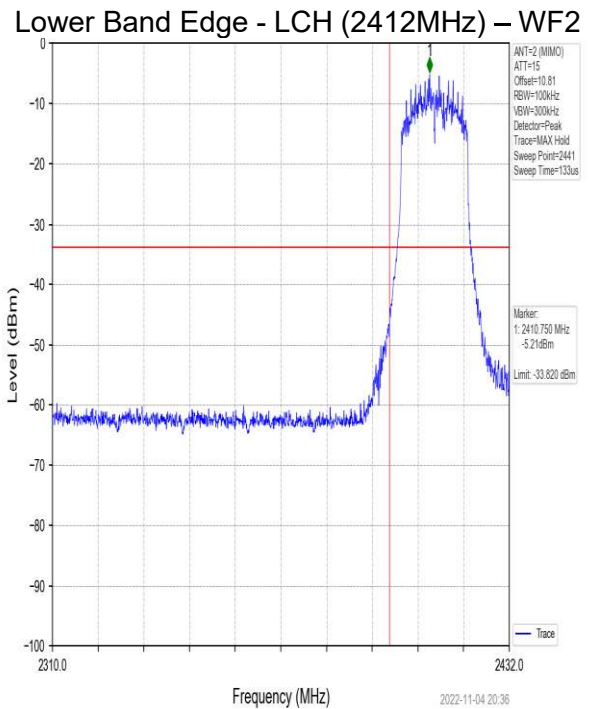
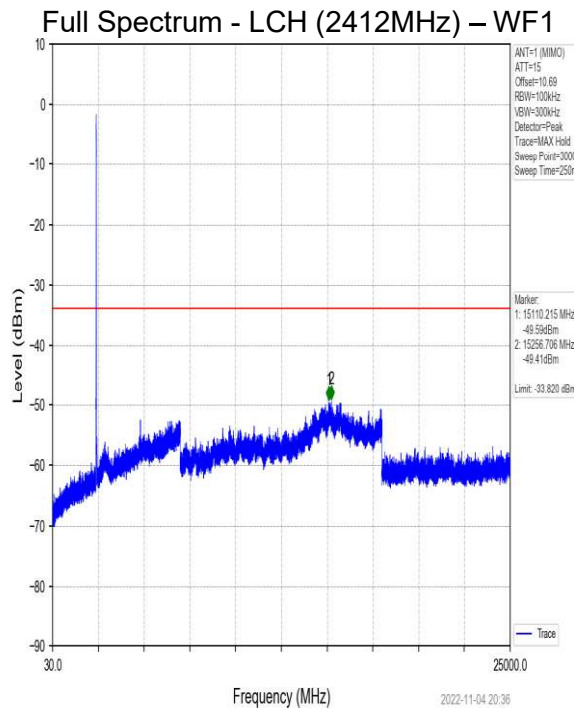
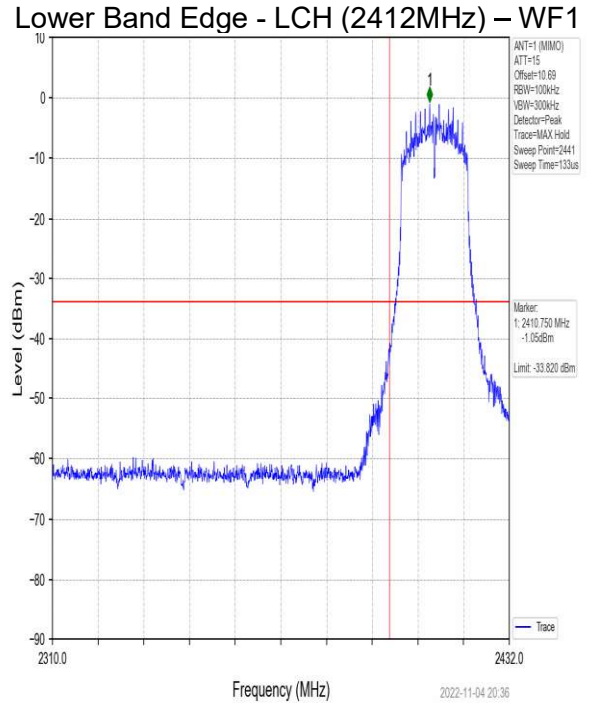
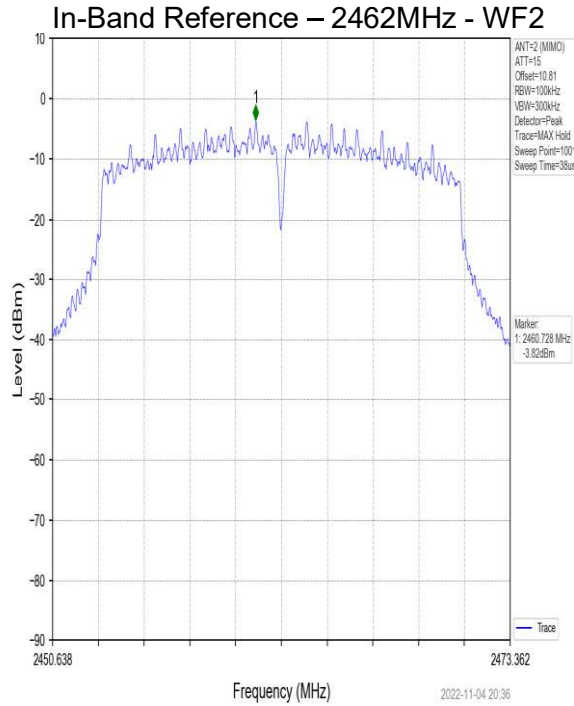
Upper Band Edge – High Channel (2462MHz)



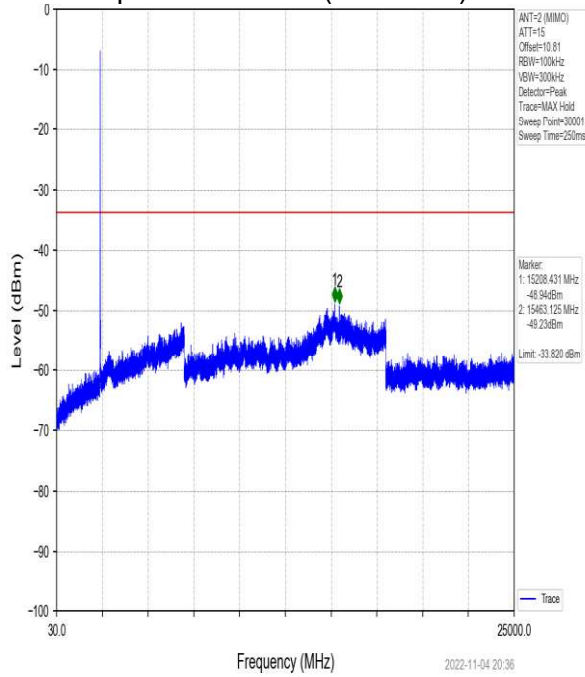
Full Spectrum - High Channel (2462MHz)



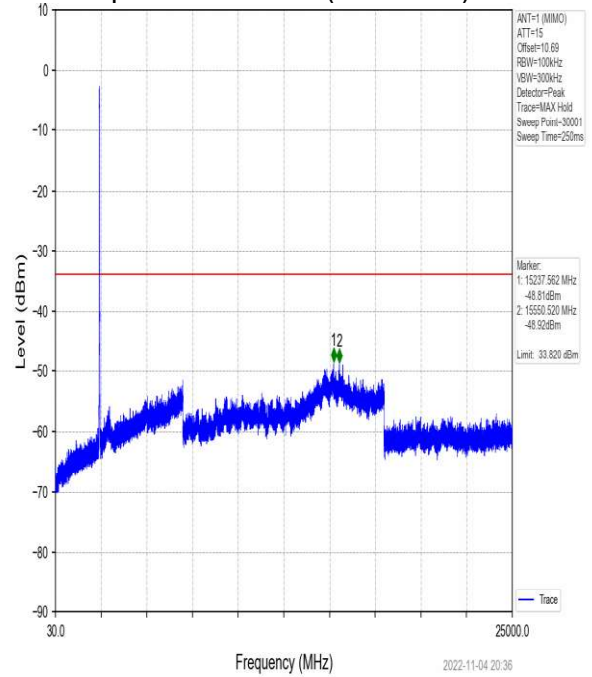
802.11n(HT20) – WF2 + WF1 (MIMO)



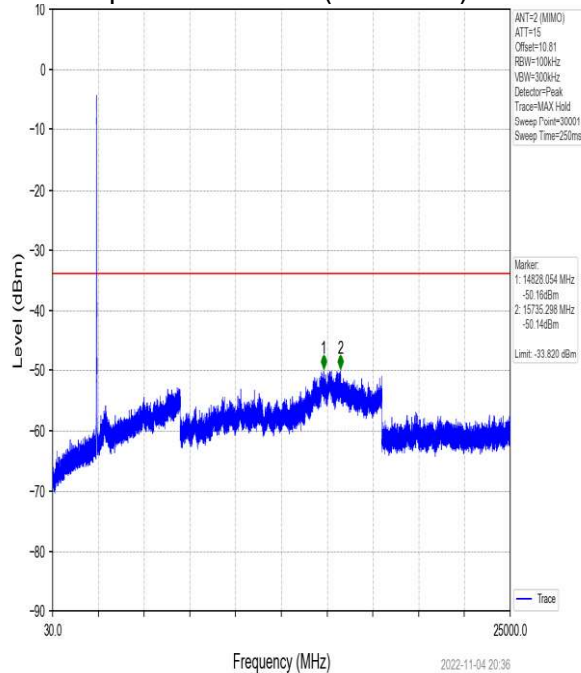
Full Spectrum – LCH (2412MHz) – WF2



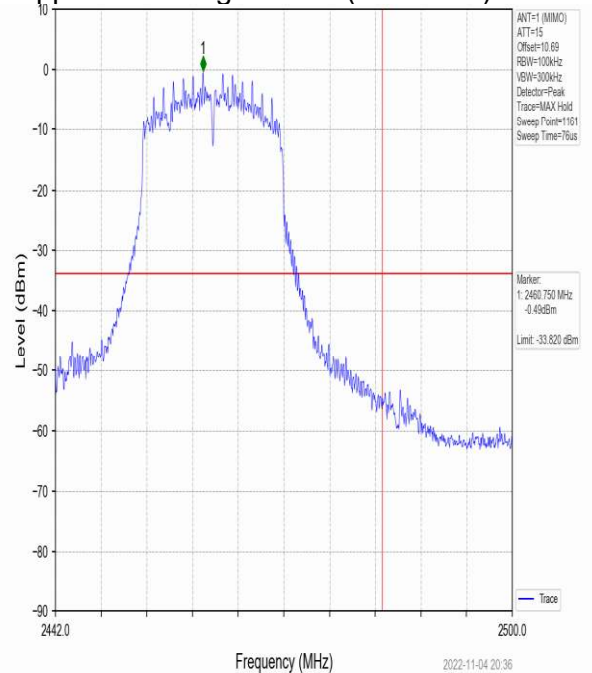
Full Spectrum – MCH (2437MHz) – WF1



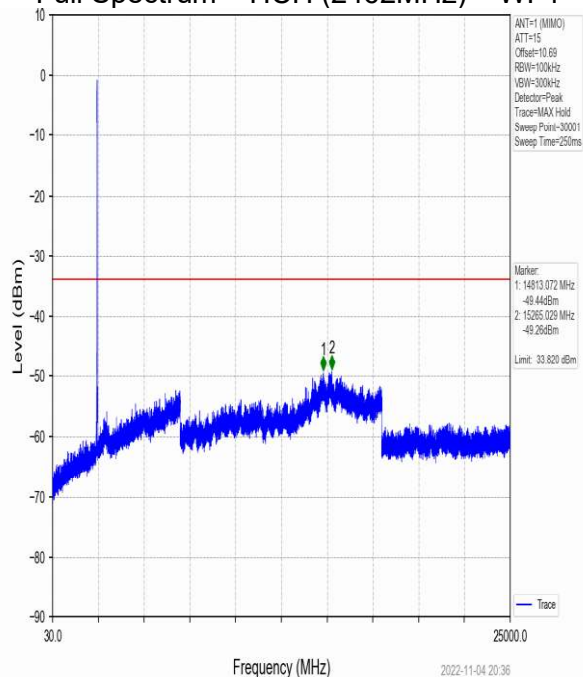
Full Spectrum – MCH (2437MHz) – WF2



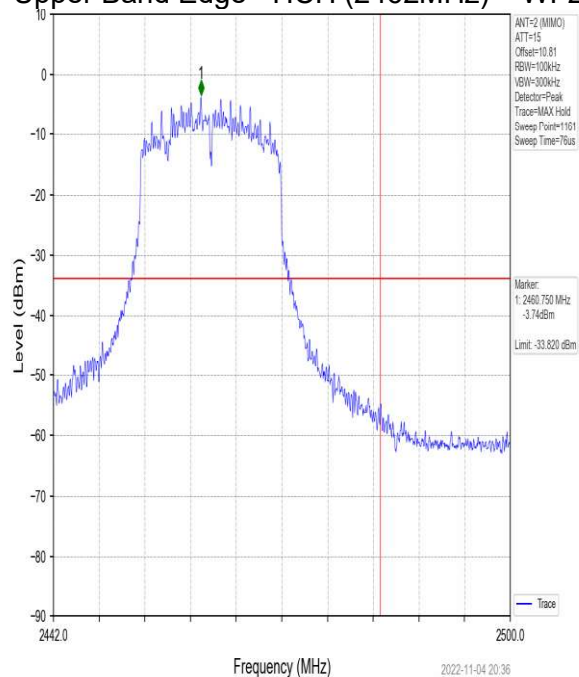
Upper Band Edge - HCH (2462MHz) – WF1



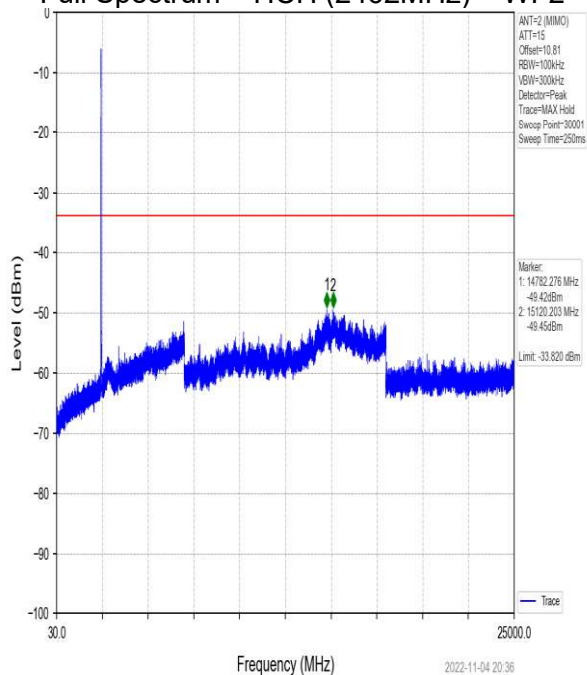
Full Spectrum – HCH (2462MHz) – WF1



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:

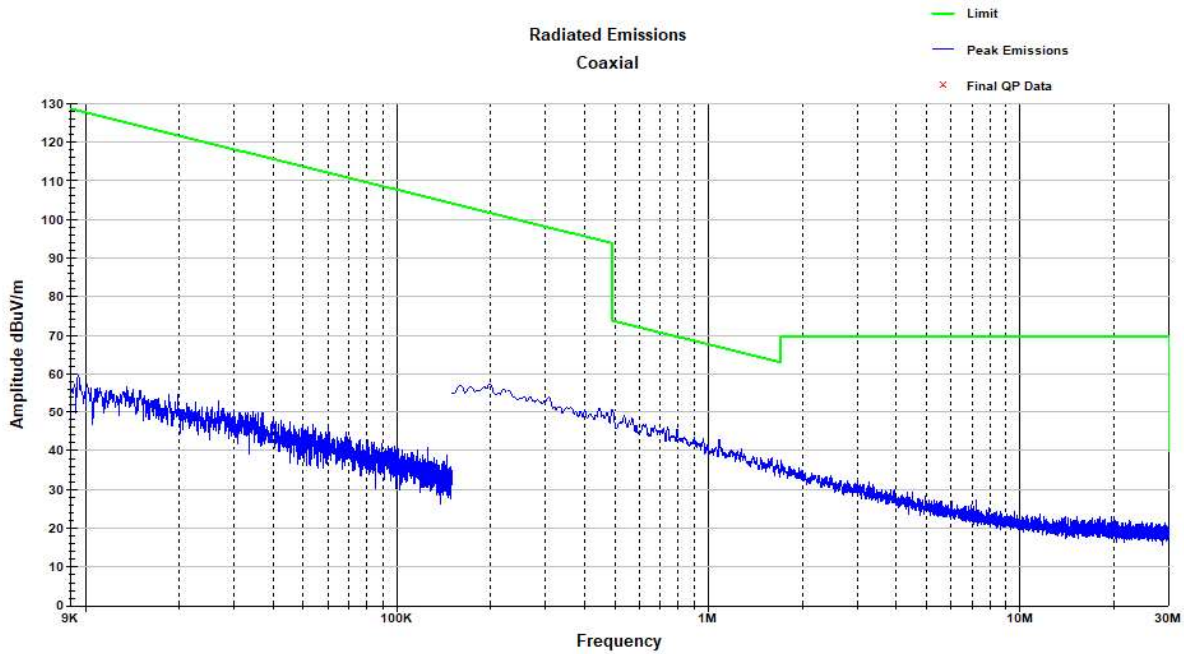
“RSE 9k - 30M 220804” TILE! profile dated 04 August 2022

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

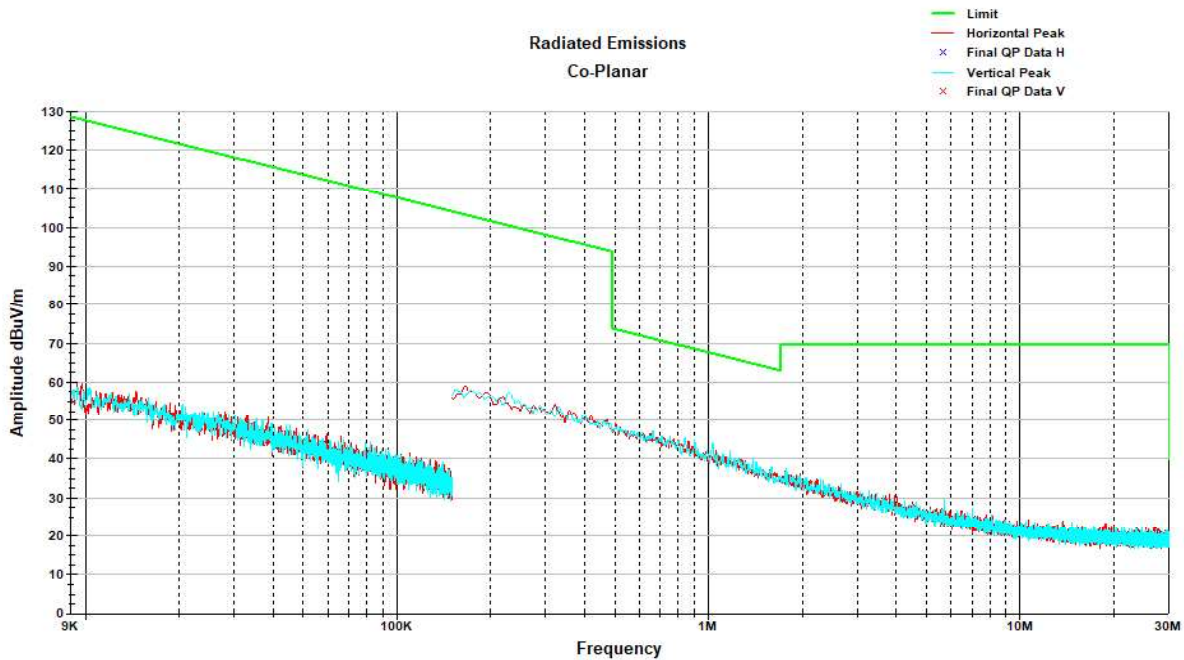
“RSE 1-18 GHz T7 210212” TILE! profile dated 12 February 2021

7.5 Test Data – Peak Plots

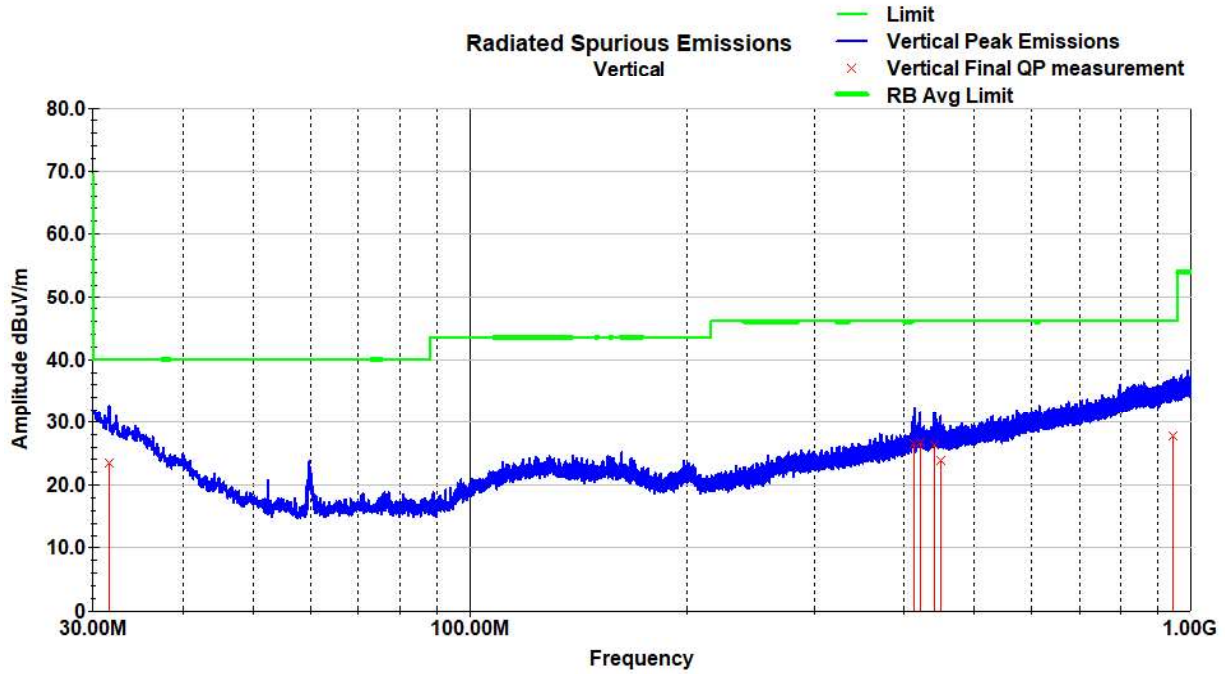
Between 9kHz and 1000MHz, there was no significant deviation with respect to axis, modulation, or channel Co-Axial Radiated Spurious Emissions – 9kHz-30MHz (802.11b LCH)



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



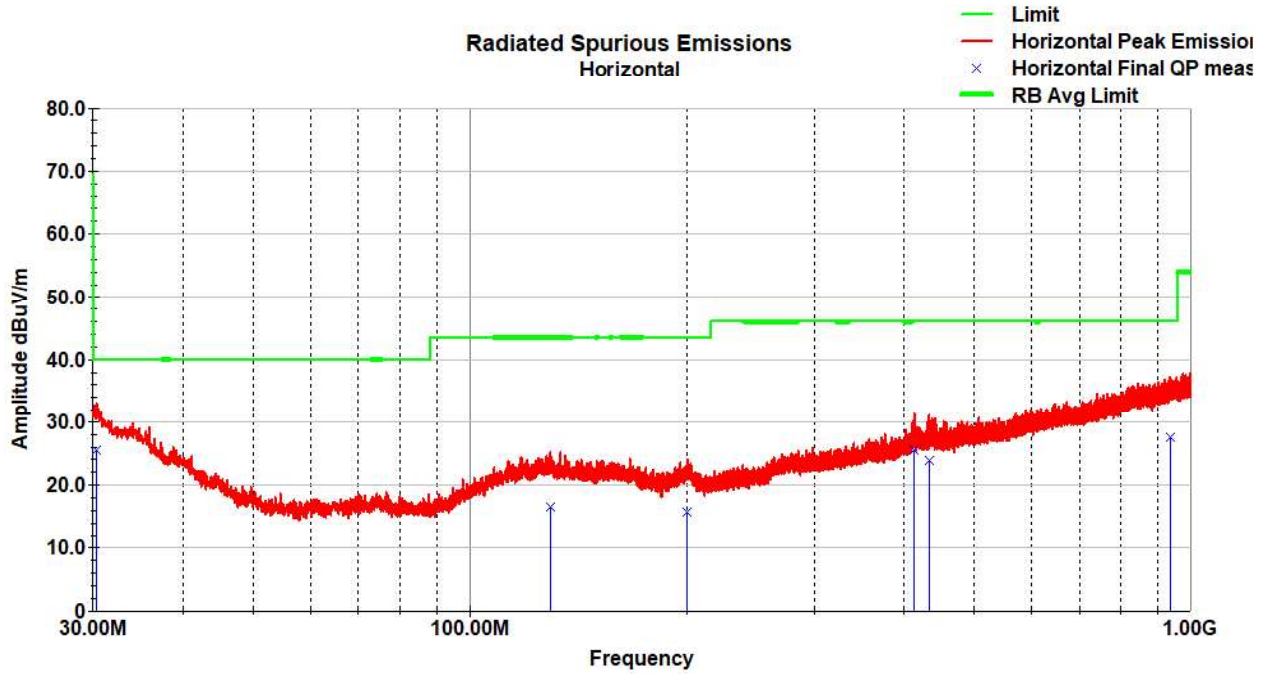
Vertical Radiated Spurious Emissions Plot – 30-1000MHz (802.11b LCH)



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 | | | | | | | | | | |

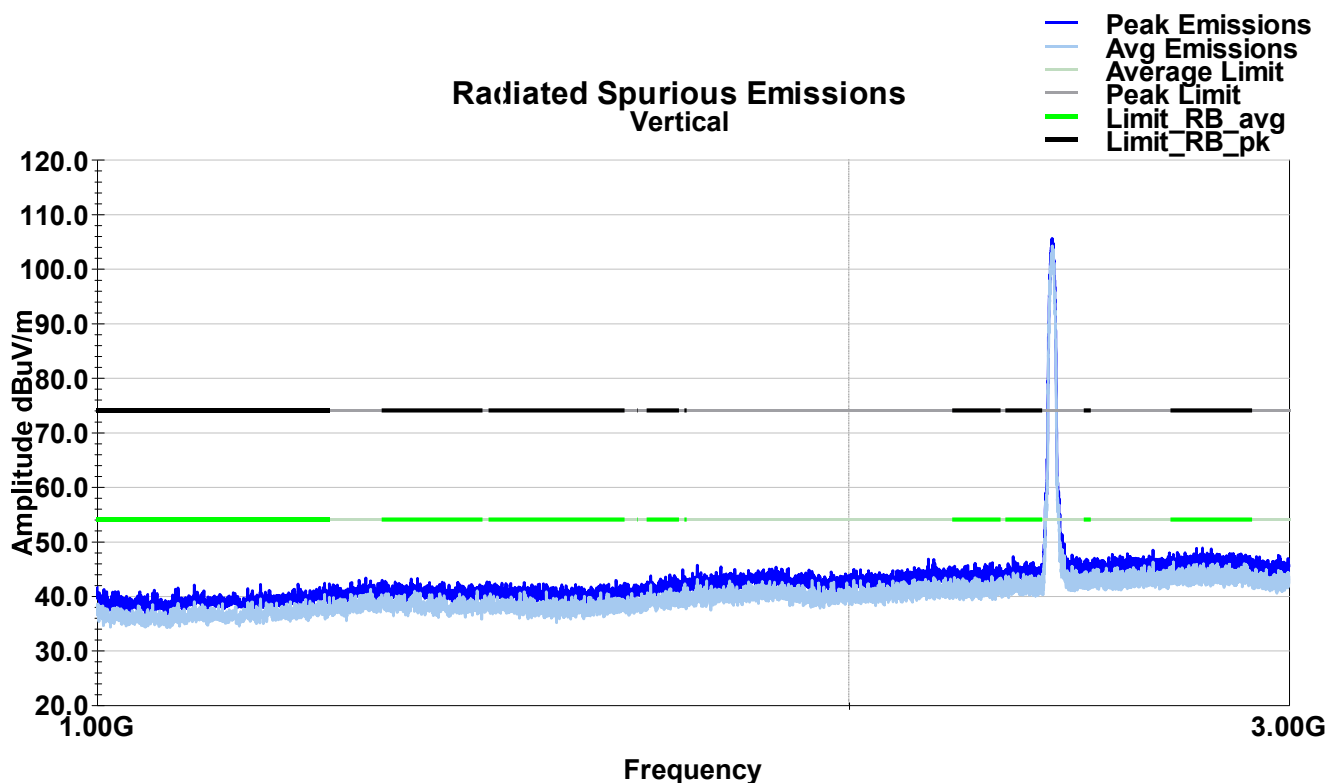
Horizontal Radiated Spurious Emissions Plot – 30-1000MHz (802.11b LCH)



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)

