

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 |

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.

Test distance:

9k to 30 MHz – Near field prescan to determine if there were any emissions

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

| | | |
|--------------------------|------------|------------|
| Environmental Conditions | 30-1000MHz | 1-12.75GHz |
| Temperature: | 22.2 °C | 23.5 °C |
| Relative Humidity: | 34.1 % | 30.5 % |
| Atmospheric Pressure: | 98.9 kPa | 97.9 kPa |

7.4 Test Equipment

30-1000MHz

Test End Date: 10-Apr-2023

Tester: EW

| 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 | TR-48-25P | Echelon | 22034 | 23-Jan-2022 | 23-Jan-2024 |
| RF CABLE | SF106 | HUBER & SUHNER | B079713 | 25-Aug-2022 | 25-Aug-2023 |
| RF CABLE NM TO NM, 0.01-18GHZ | 90-195-157 | TELEDYNE STORM MICROWAVE | 20121 | 9-Feb-2023 | 9-Feb-2024 |
| RF CABLE RIGHT ANGLE NM TO NM, 0.01-18GHZ | 90-076-020 | TELEDYNE STORM MICROWAVE | 20132 | 13-Mar-2023 | 13-Mar-2024 |
| LOW NOISE AMPLIFIER | ZKL-2+ | MINI-CIRCUITS | B079800 | 14-Sep-2022 | 14-Sep-2023 |
| EMI TEST RECEIVER | ESW44 | ROHDE & SCHWARZ | 22032 | 24-Nov-2022 | 24-Nov-2023 |

Above 1GHz

Test End Date: 4-Apr-2023

Tester: ZH, EW

13-Apr-2023

| Equipment | Model | Manufacturer | Asset | Cal Date | Cal Due Date |
|---|------------|--------------------------|---------|-------------|--------------|
| ANTENNA, DRG HORN (MEDIUM) | 3117 | ETS LINDGREN | B079699 | 29-Jul-2022 | 29-Jul-2024 |
| RF CABLE NM TO NF, 0.01-18GHZ | TR-48-25P | TELEDYNE STORM MICROWAVE | 20118 | 13-Mar-2023 | 13-Mar-2024 |
| RF CABLE, NM TO NM. | 90-195-157 | TELEDYNE STORM MICROWAVE | 21019 | 14-Mar-2023 | 14-Mar-2024 |
| RF CABLE RIGHT ANGLE NM TO NM, 0.01-18GHZ | 90-076-020 | TELEDYNE STORM MICROWAVE | 20132 | 13-Mar-2023 | 13-Mar-2024 |
| LOW NOISE AMPLIFIER | TS-PR18 | ROHDE & SCHWARZ | B094463 | 13-Jul-2022 | 13-Jul-2023 |
| EMI TEST RECEIVER | ESW44 | ROHDE & SCHWARZ | 22032 | 24-Nov-2022 | 24-Nov-2023 |
| FILTER, HIGH PASS, >2800MHZ | HPM50111 | MICRO-TRONICS | 22017 | 16-Jun-2022 | 16-Jun-2023 |

Software Profile:

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

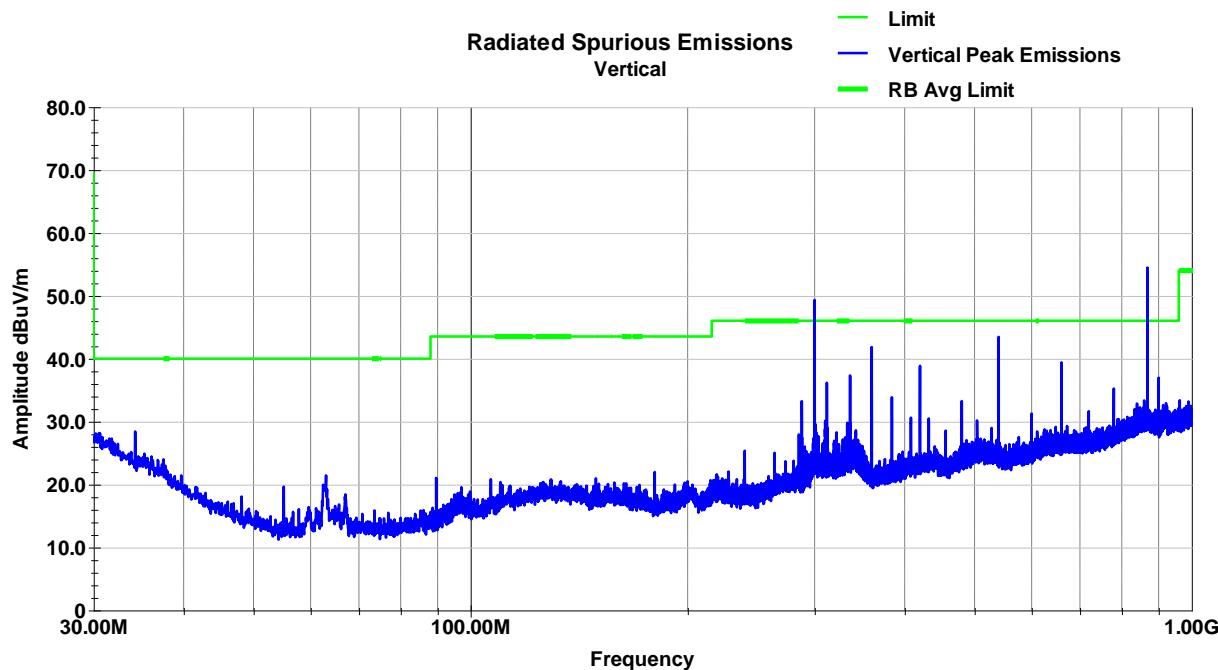
“RSE 1-18 GHz T7 210212” TILE! profile dated 12 February 2021

7.5 Test Data – Peak Plots

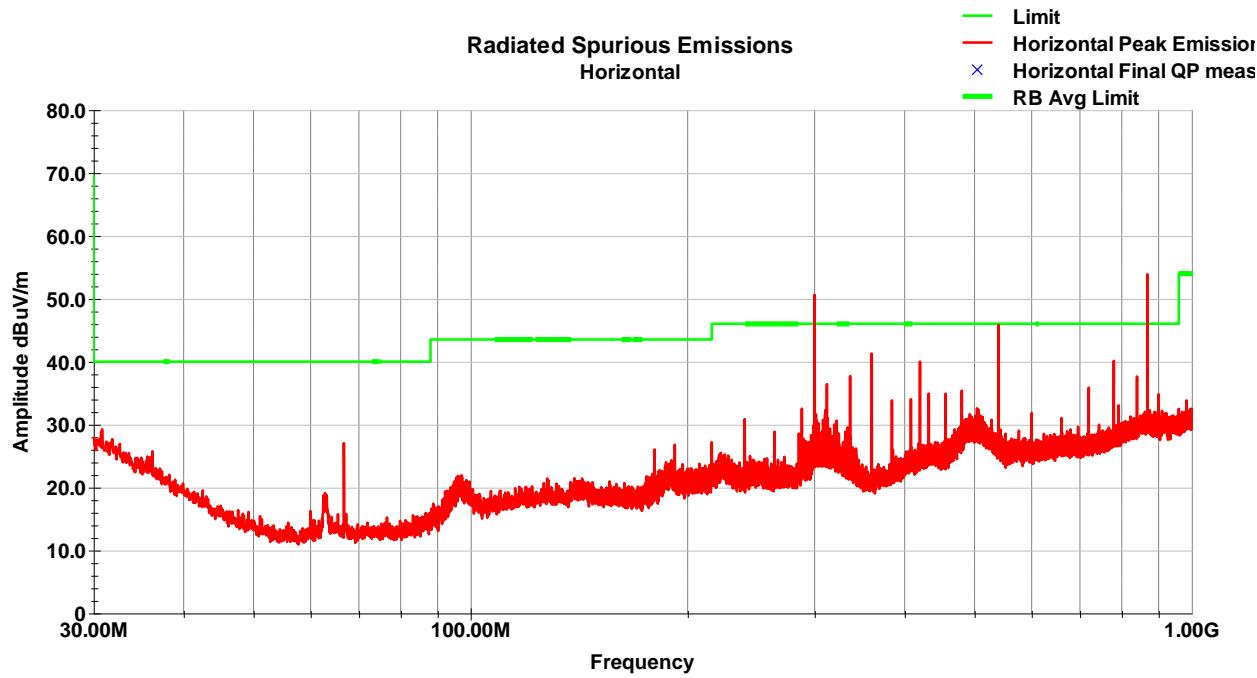
No emissions were detected in the 9kHz to 30MHz frequency range.

In the 30-1000MHz range there was little deviation with respect to axis, modulation or channel (worst case shown).

Vertical Radiated Spurious Emissions Plot – 30-1000MHz (802.11g MCH)

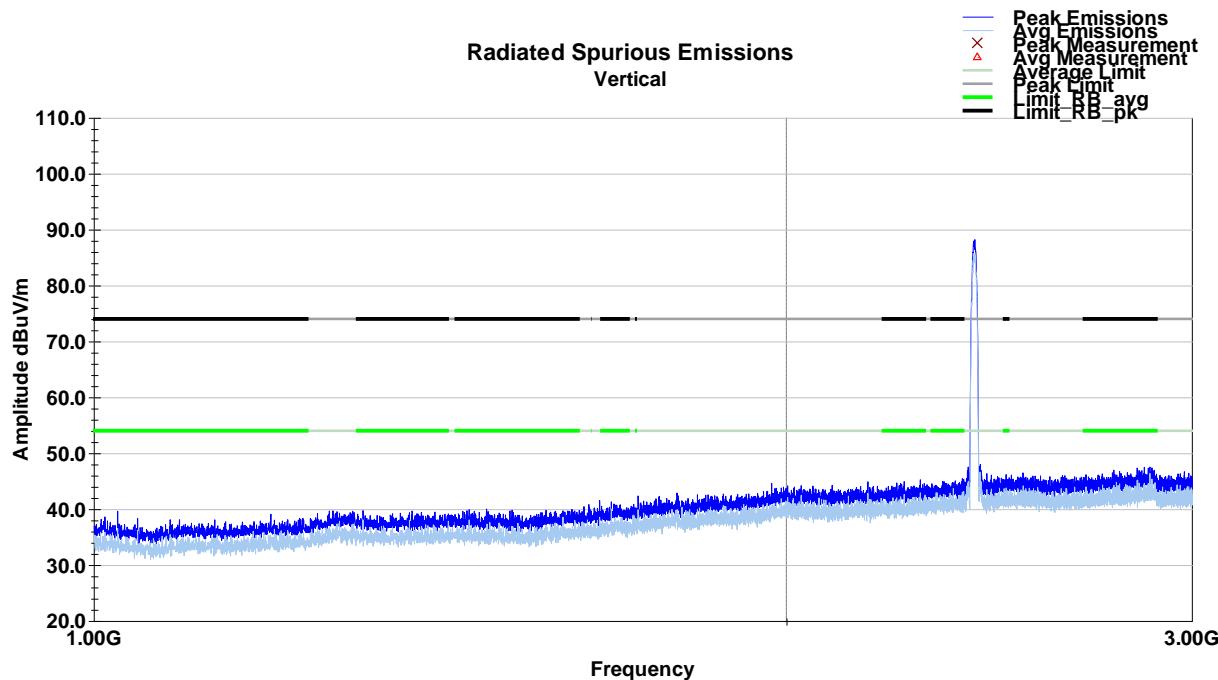


Horizontal Radiated Spurious Emissions Plot – 30-1000MHz (802.11g MCH)

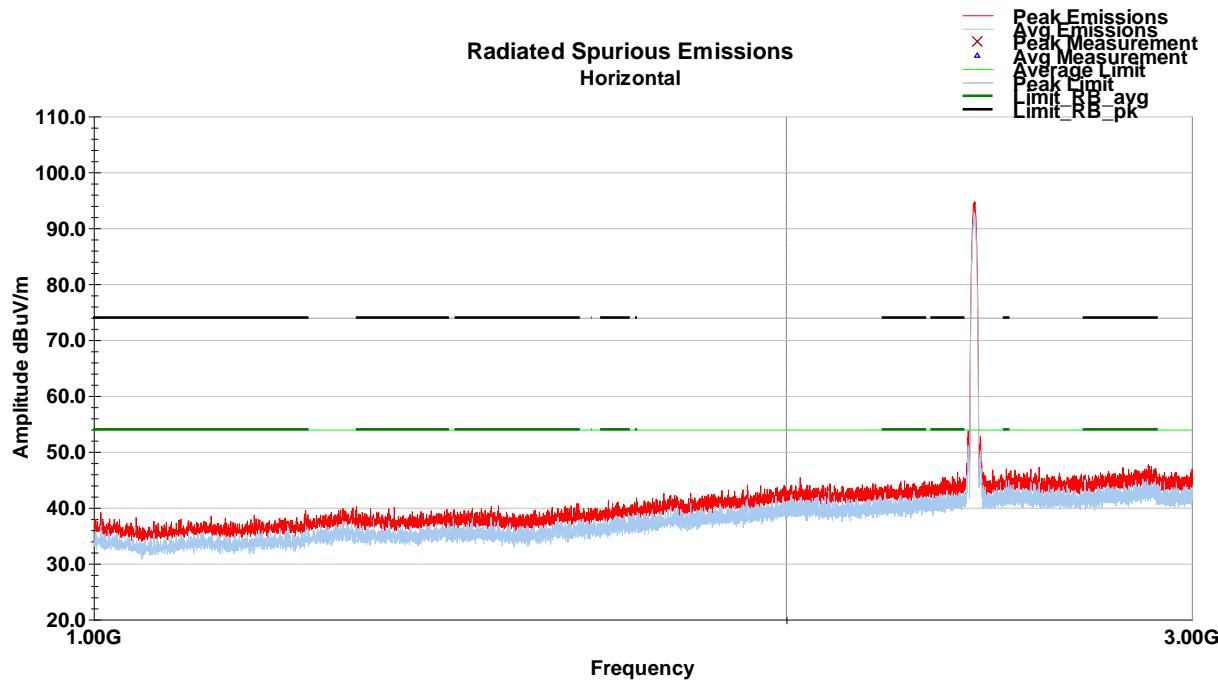


All emissions above were either not in restricted bands or were verified to be non-radio emissions.

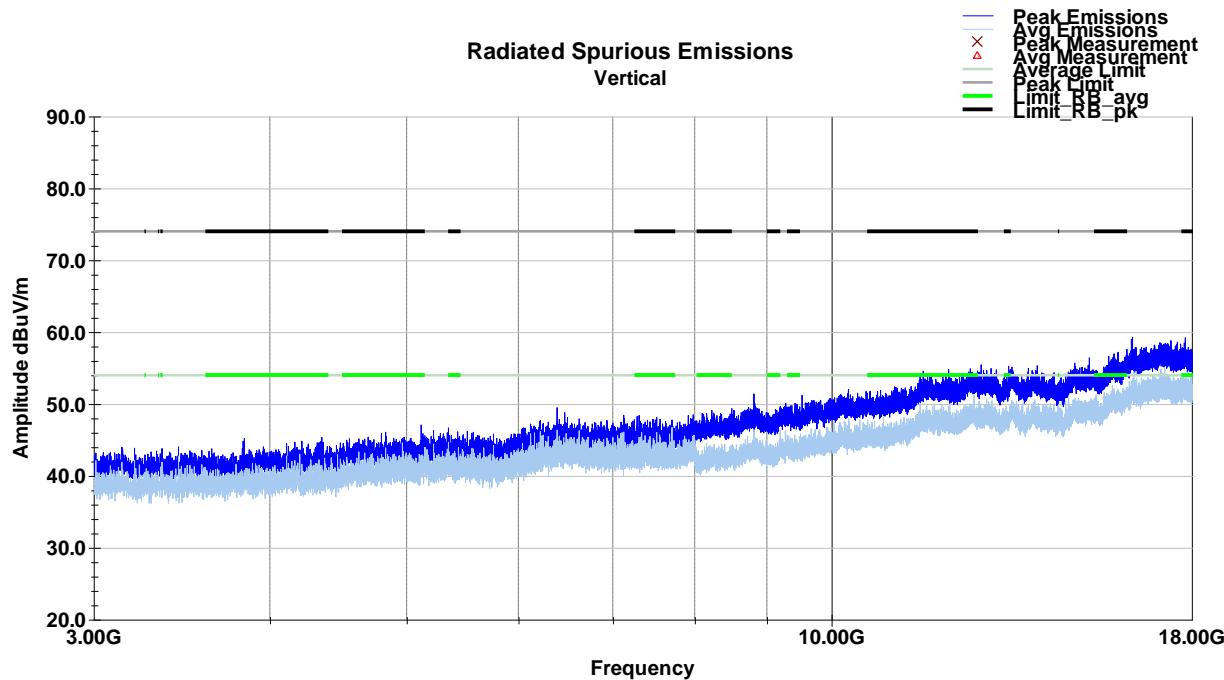
Vertical Radiated Spurious Emissions Plot – 1-3GHz (802.11b LCH)



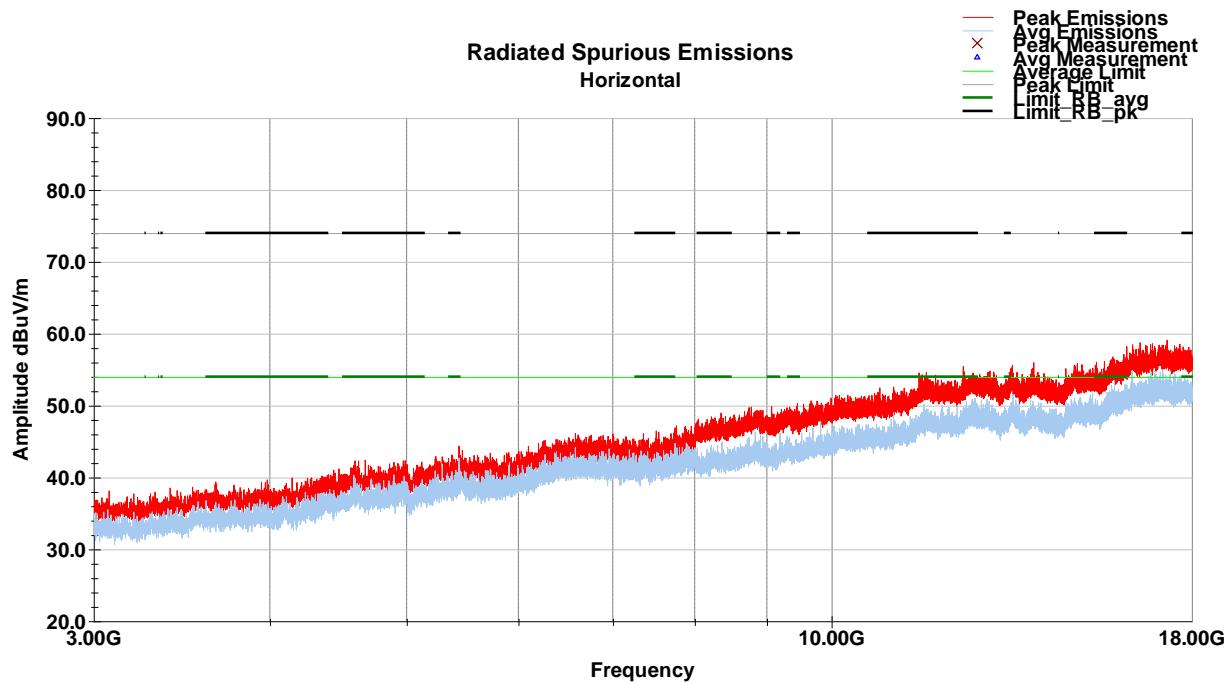
Horizontal Radiated Spurious Emissions Plot – 1-3GHz (802.11b LCH)



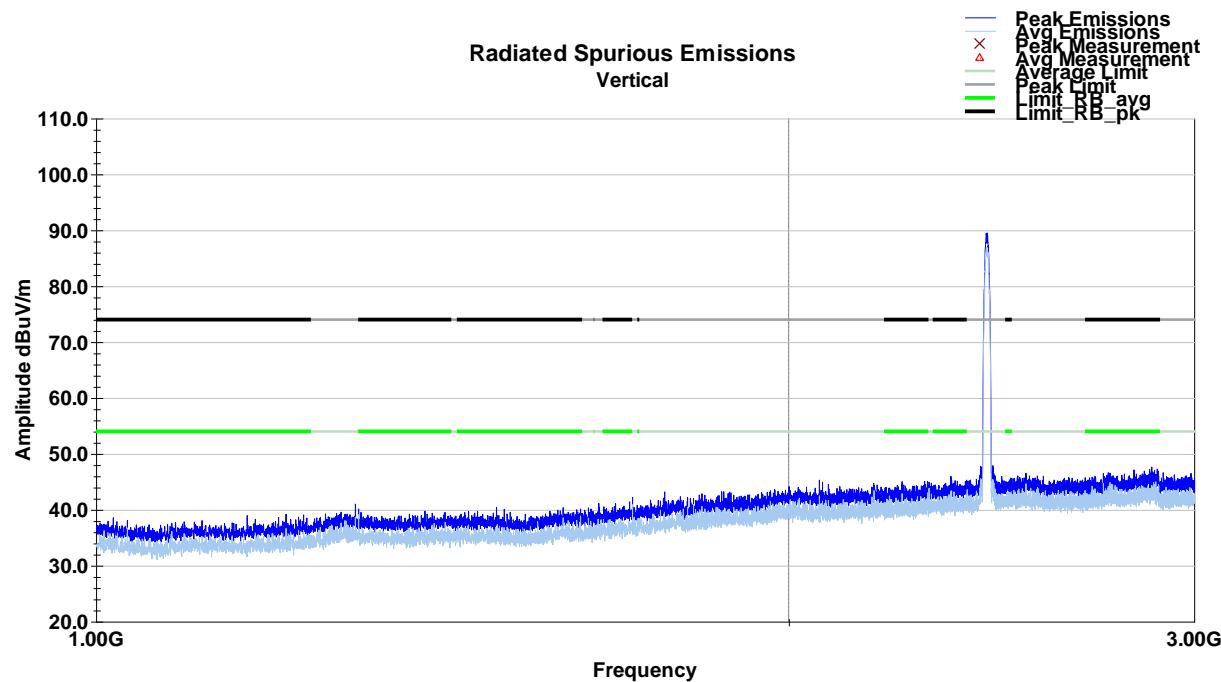
Vertical Radiated Spurious Emissions Plot – 3-18GHz (802.11b LCH)



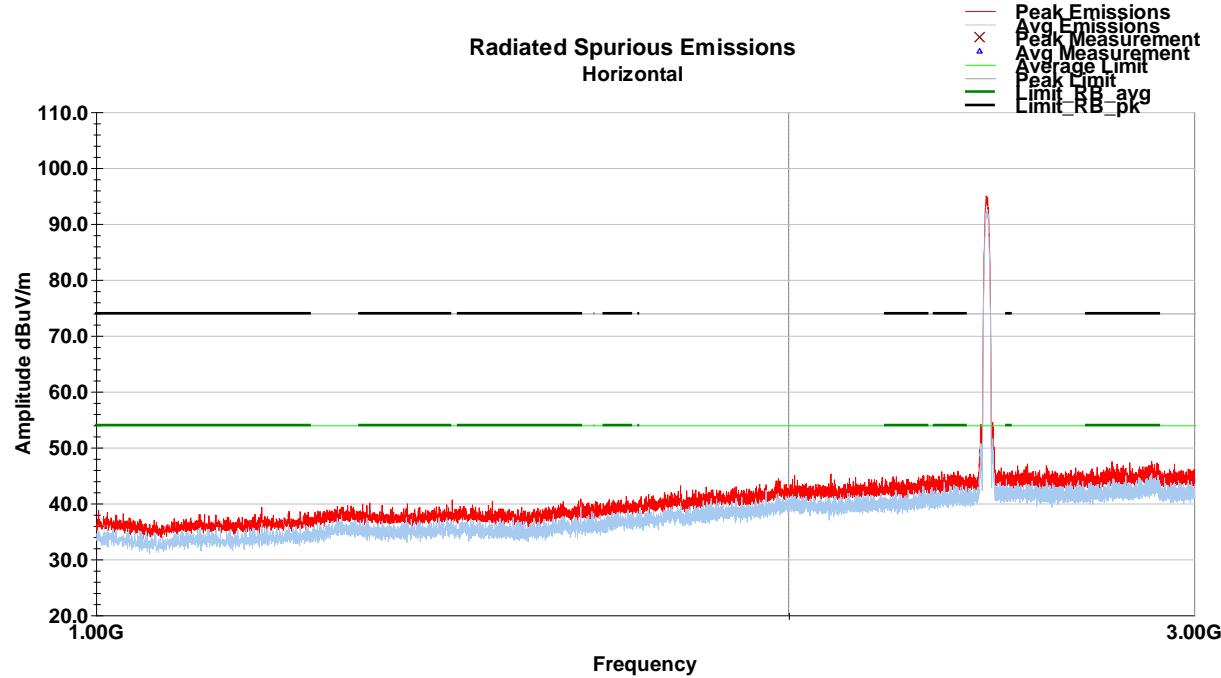
Horizontal Radiated Spurious Emissions Plot – 3-18GHz (802.11b LCH)



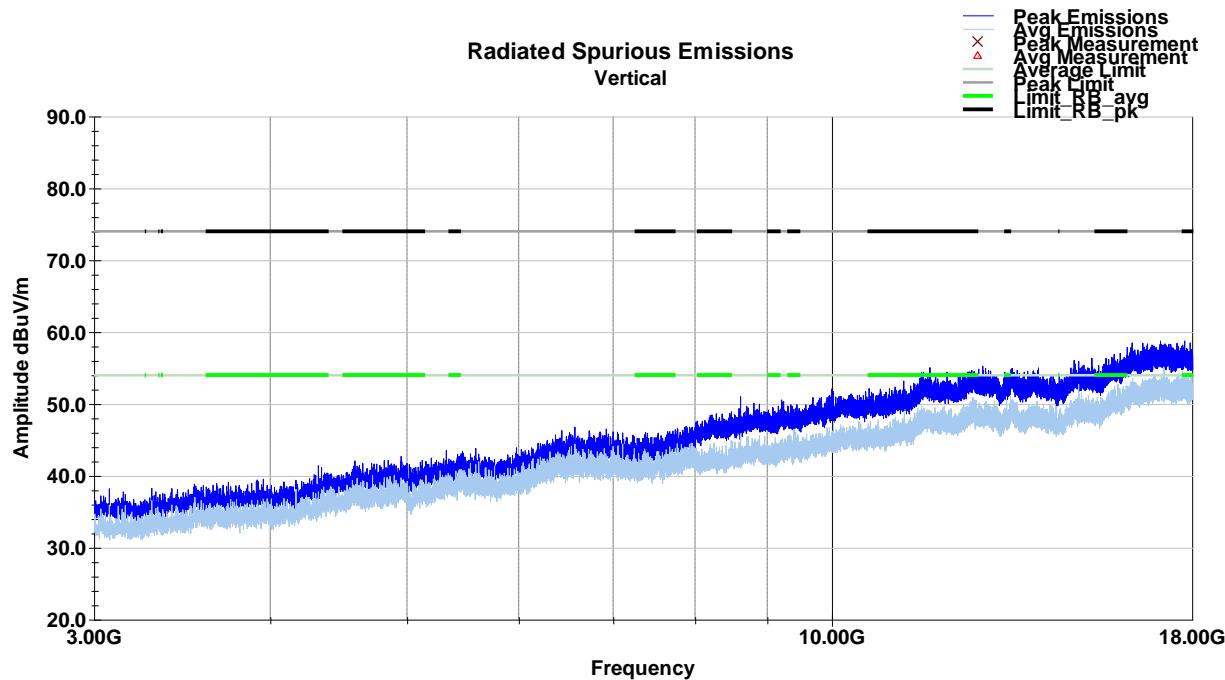
Vertical Radiated Spurious Emissions Plot – 1-3GHz (802.11b MCH)



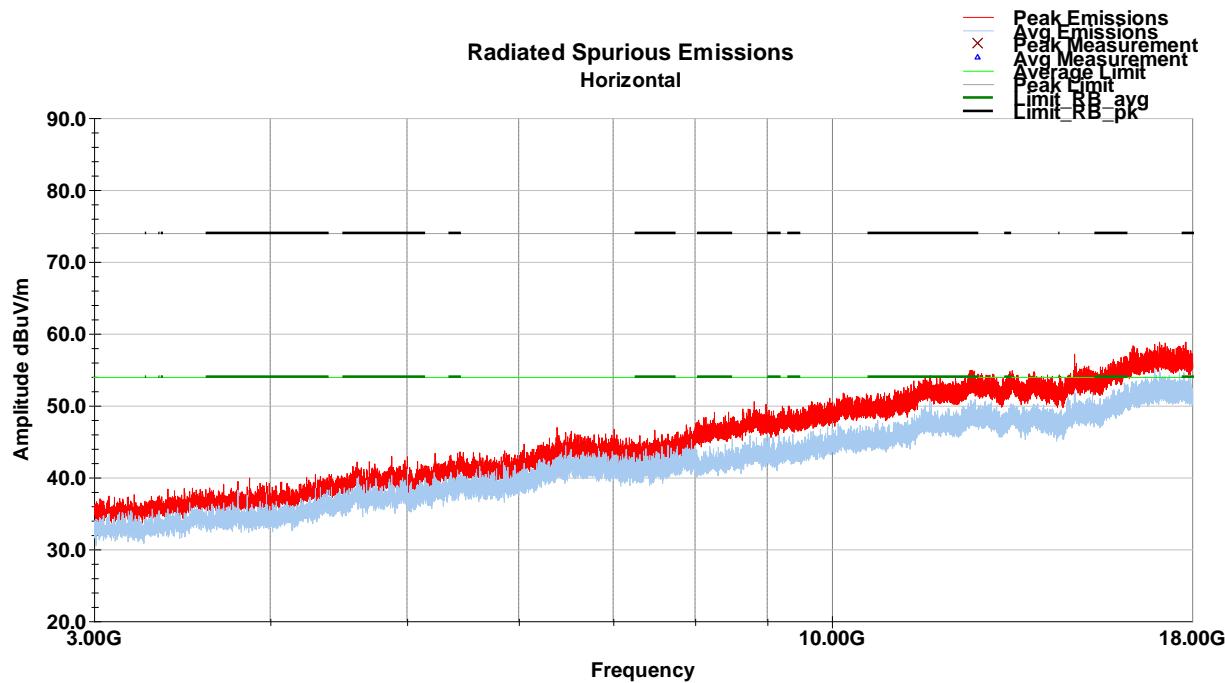
Horizontal Radiated Spurious Emissions Plot – 1-3GHz (802.11b MCH)



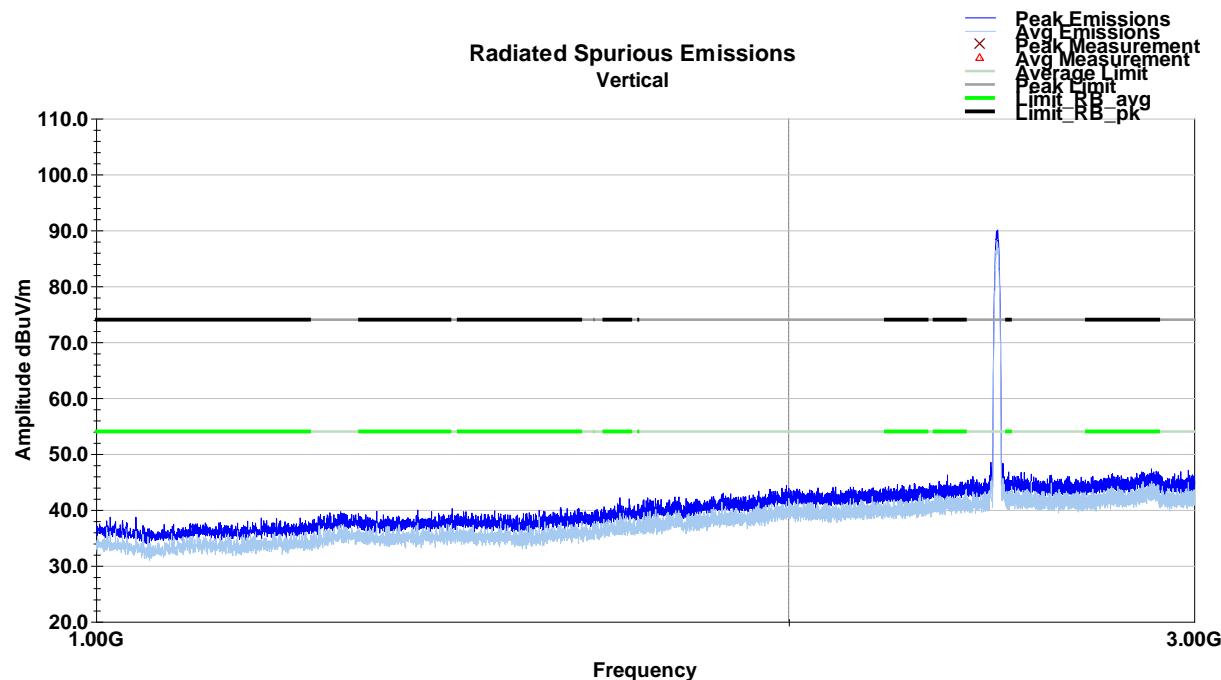
Vertical Radiated Spurious Emissions Plot – 3-18GHz (802.11b MCH)



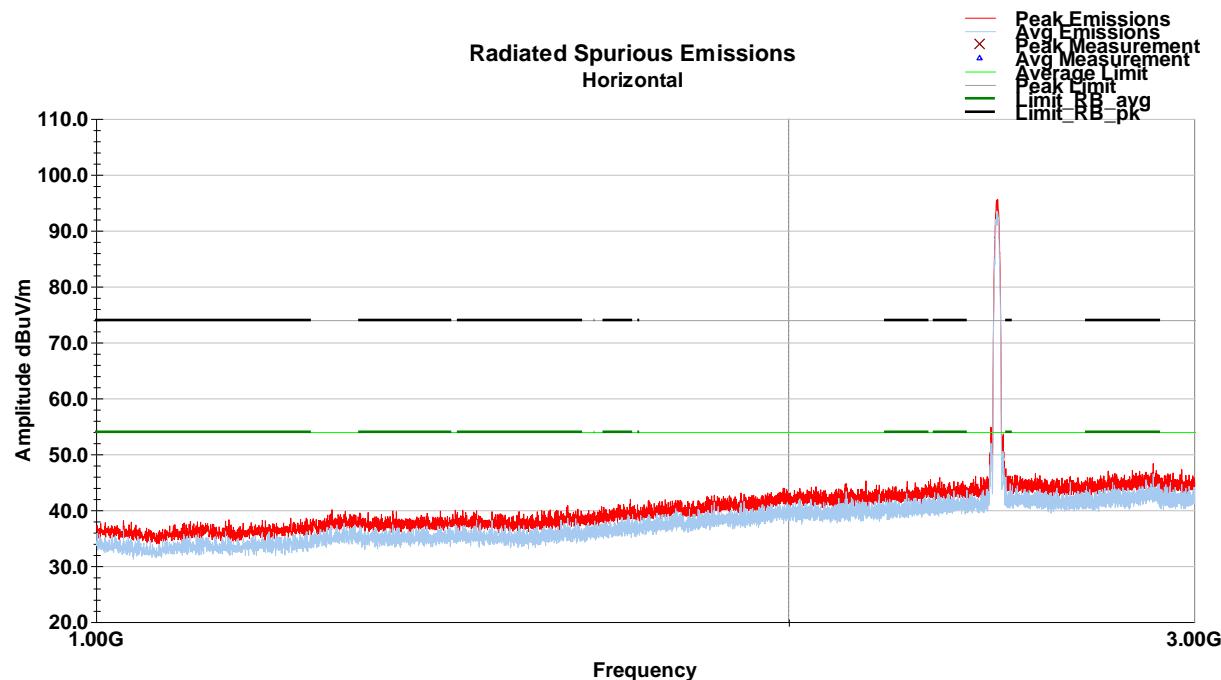
Horizontal Radiated Spurious Emissions Plot – 3-18GHz (802.11b MCH)



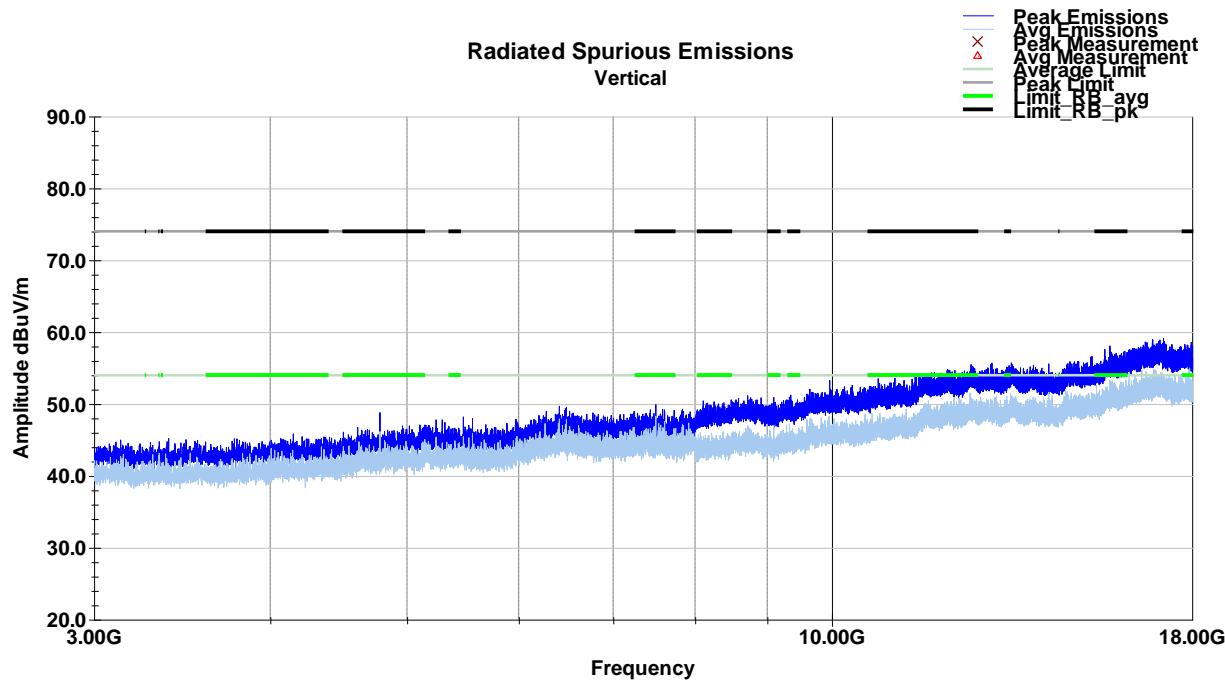
Vertical Radiated Spurious Emissions Plot – 1-3GHz (802.11b HCH)



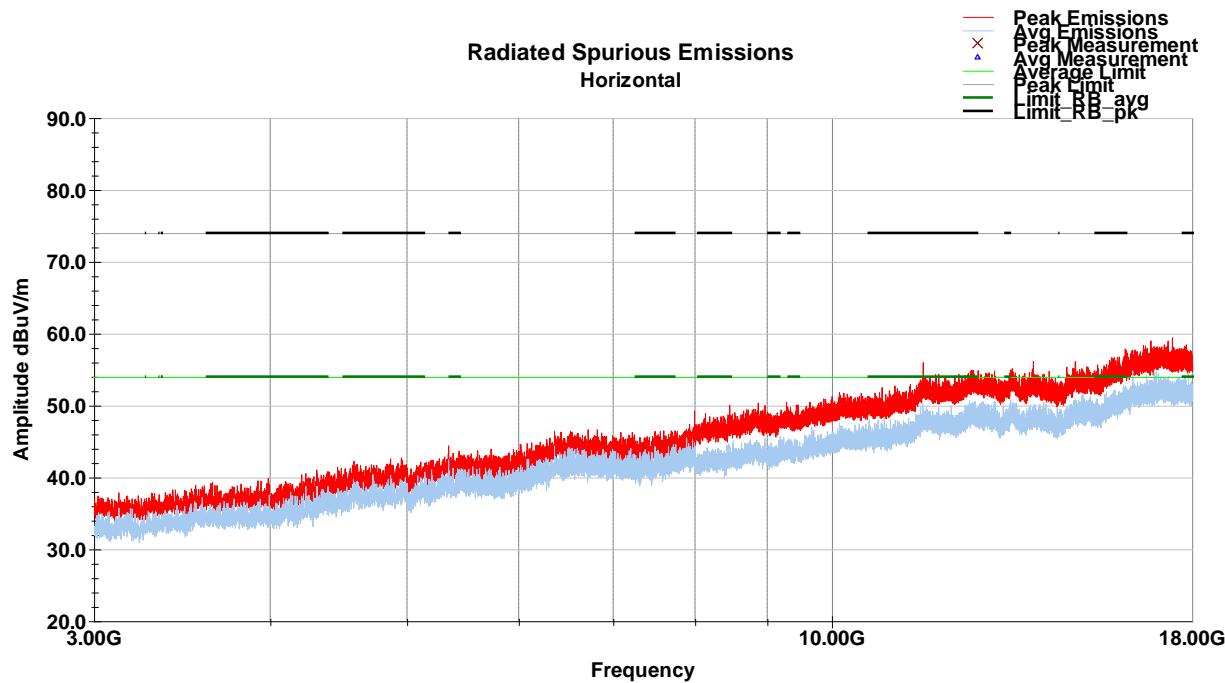
Horizontal Radiated Spurious Emissions Plot – 1-3GHz (802.11b HCH)



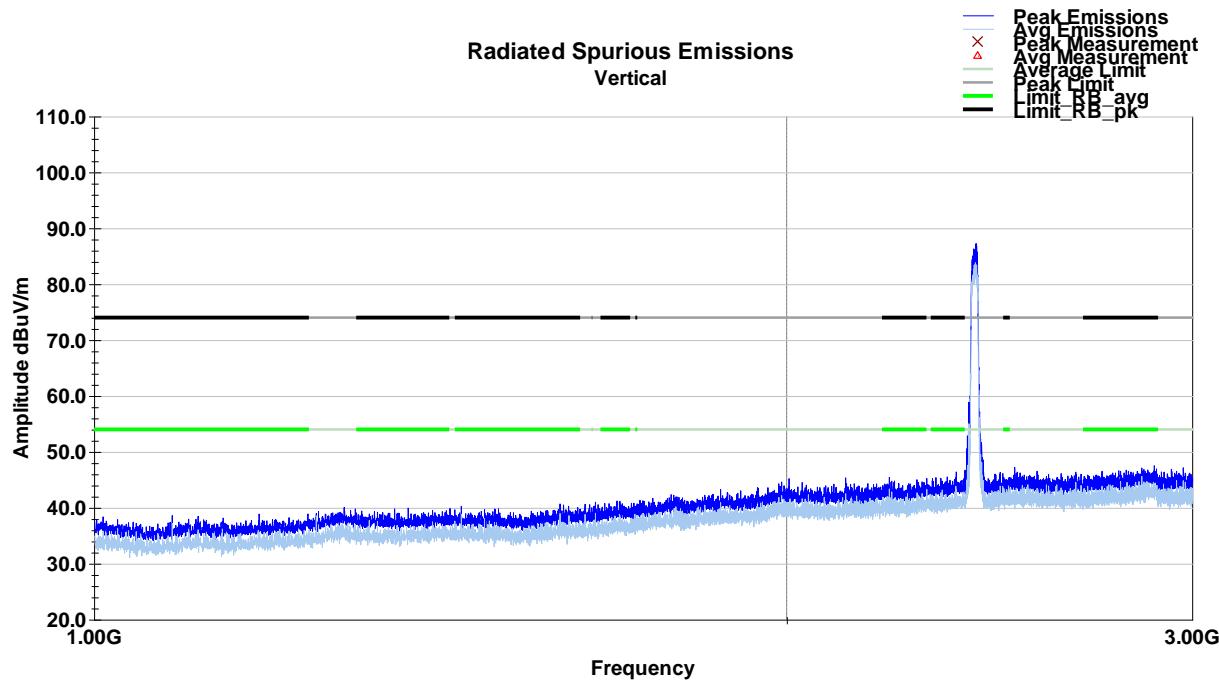
Vertical Radiated Spurious Emissions Plot – 3-18GHz (802.11b HCH)



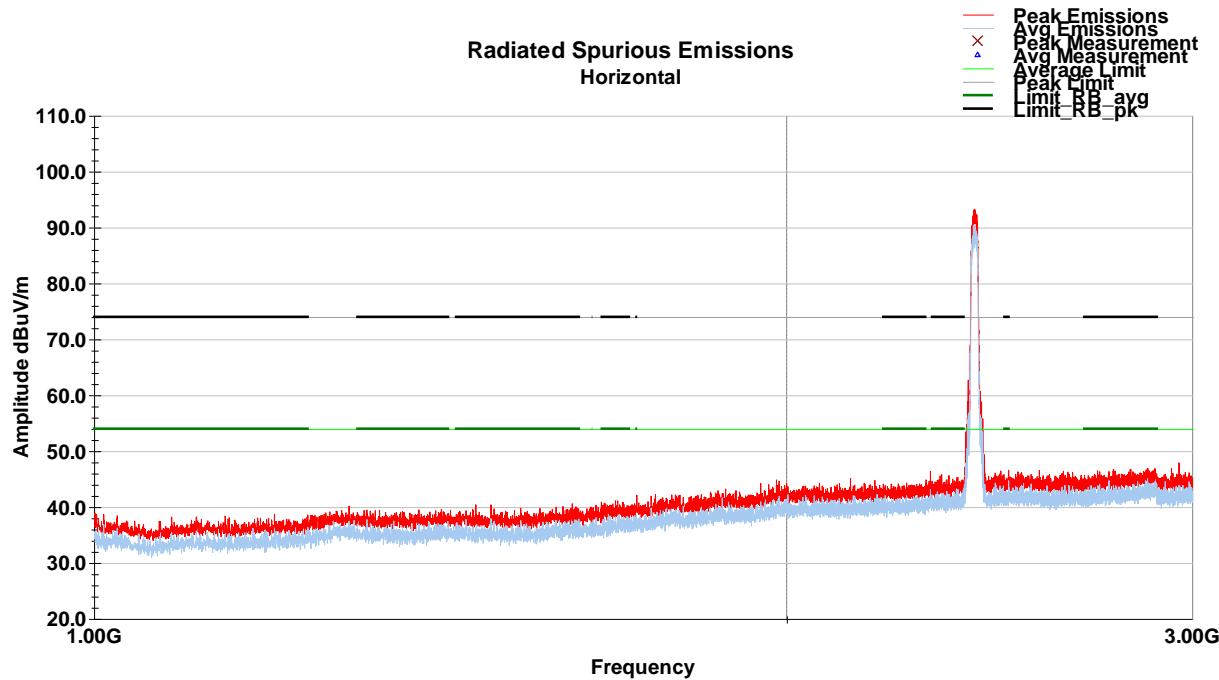
Horizontal Radiated Spurious Emissions Plot – 3-18GHz (802.11b HCH)



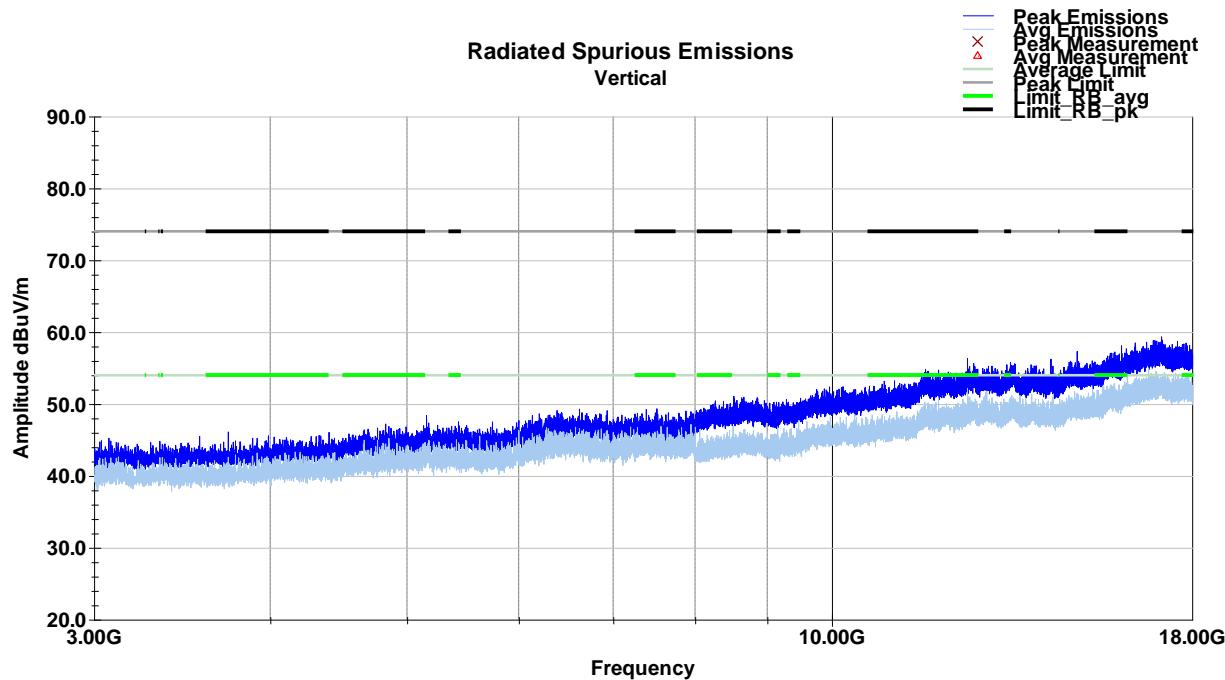
Vertical Radiated Spurious Emissions Plot – 1-3GHz (802.11g LCH)



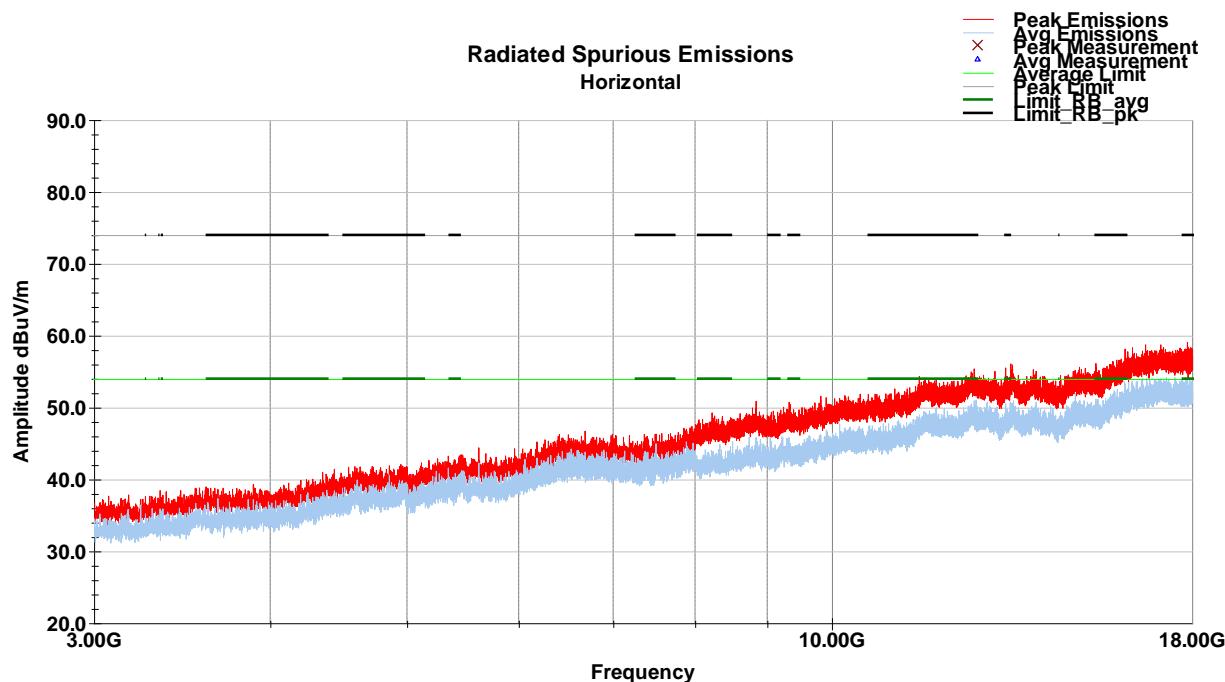
Horizontal Radiated Spurious Emissions Plot – 1-3GHz (802.11g LCH)



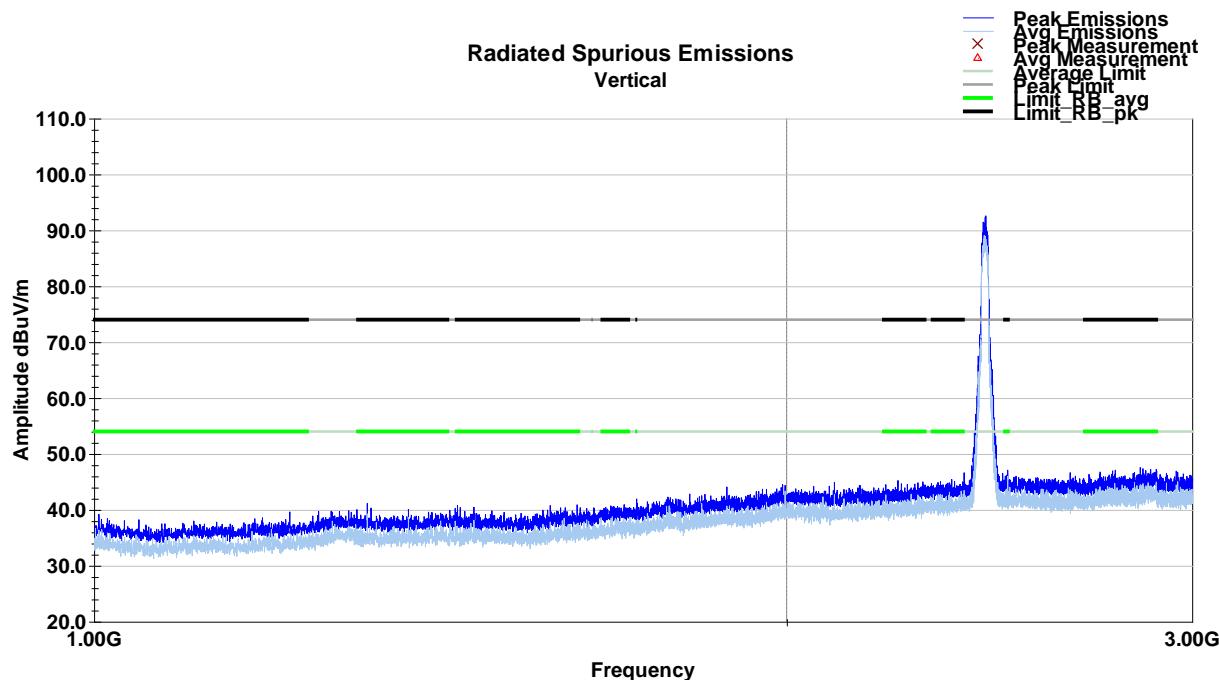
Vertical Radiated Spurious Emissions Plot – 3-18GHz (802.11g LCH)



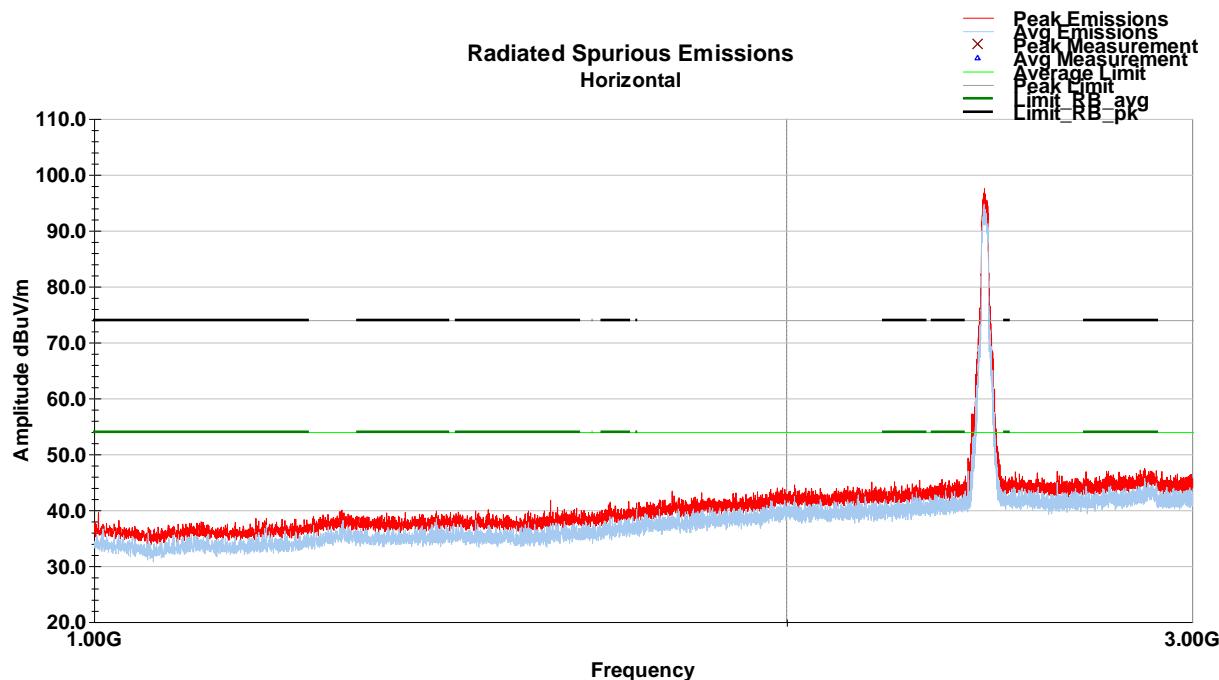
Horizontal Radiated Spurious Emissions Plot – 3-18GHz (802.11g LCH)



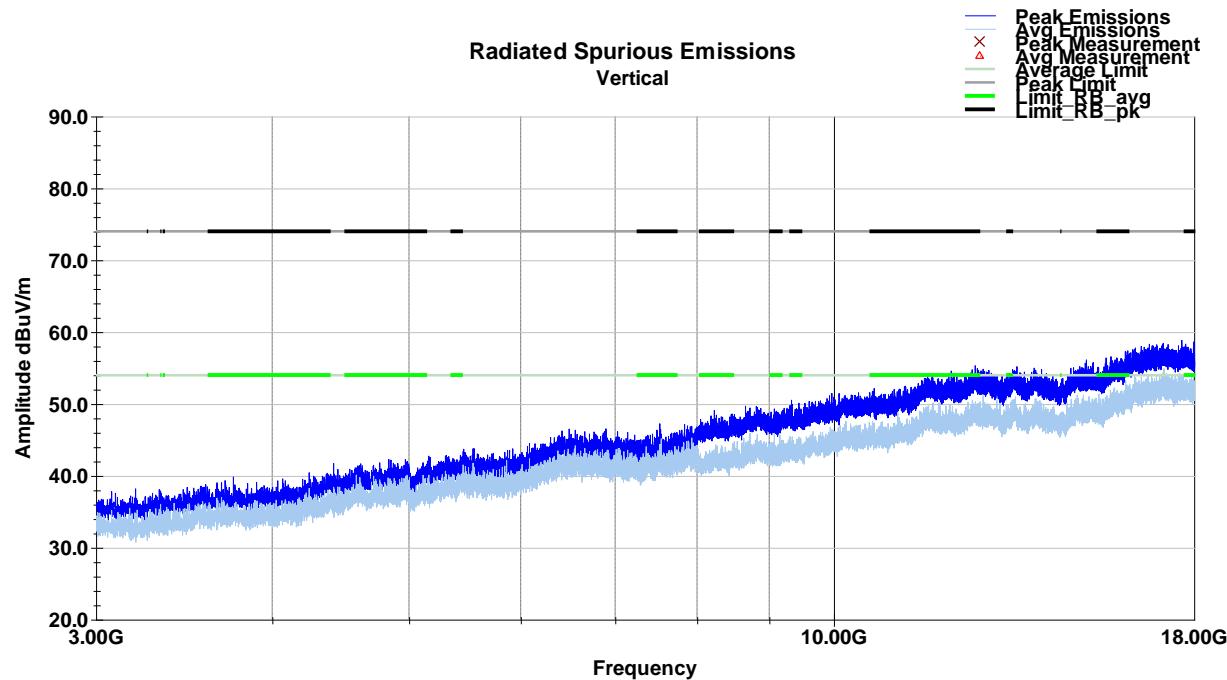
Vertical Radiated Spurious Emissions Plot – 1-3GHz (802.11g MCH)



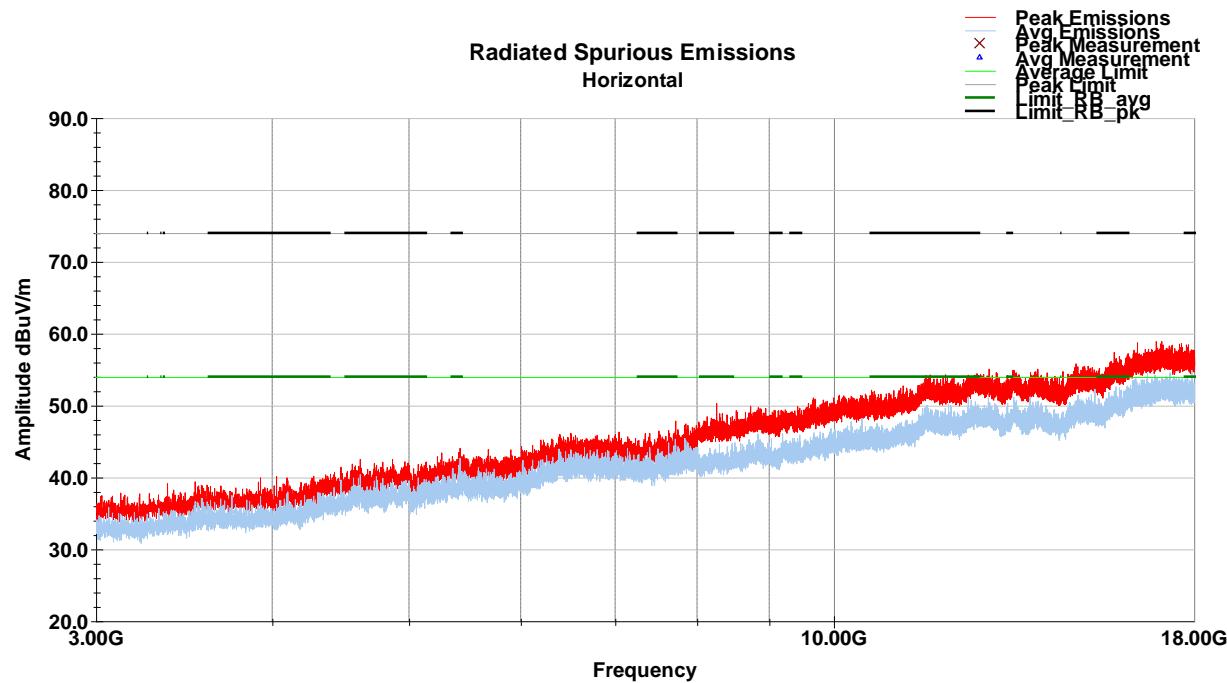
Horizontal Radiated Spurious Emissions Plot – 1-3GHz (802.11g MCH)



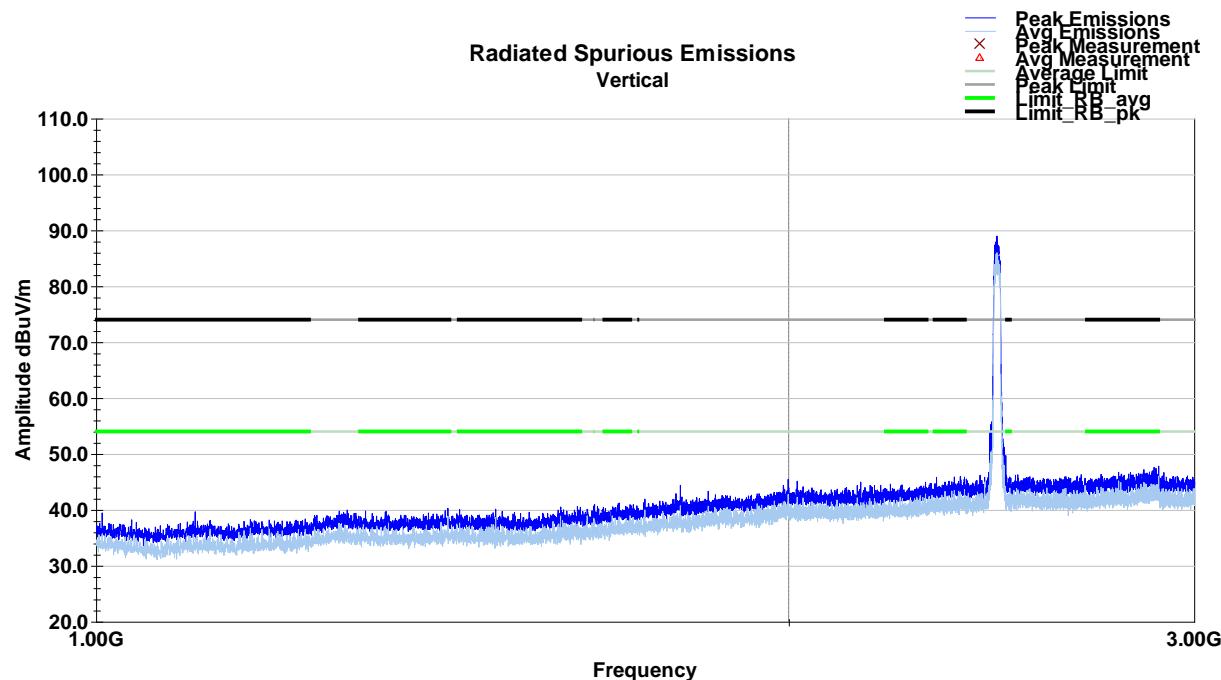
Vertical Radiated Spurious Emissions Plot – 3-18GHz (802.11g MCH)



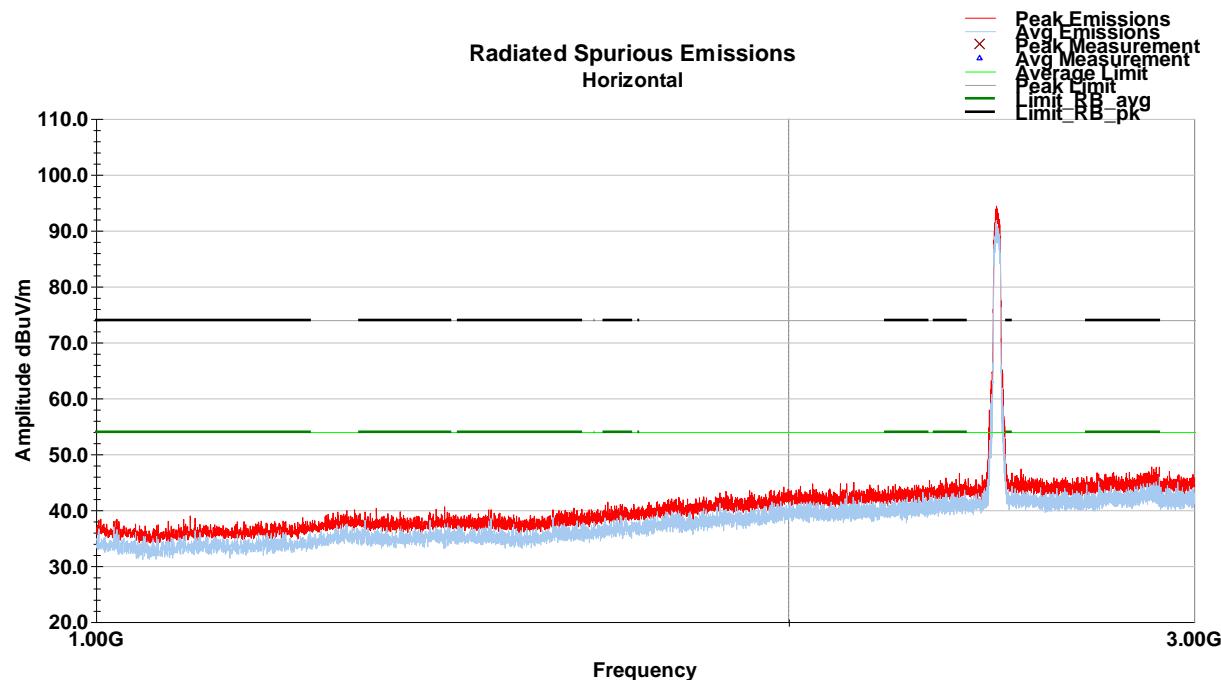
Horizontal Radiated Spurious Emissions Plot – 3-18GHz (802.11g MCH)



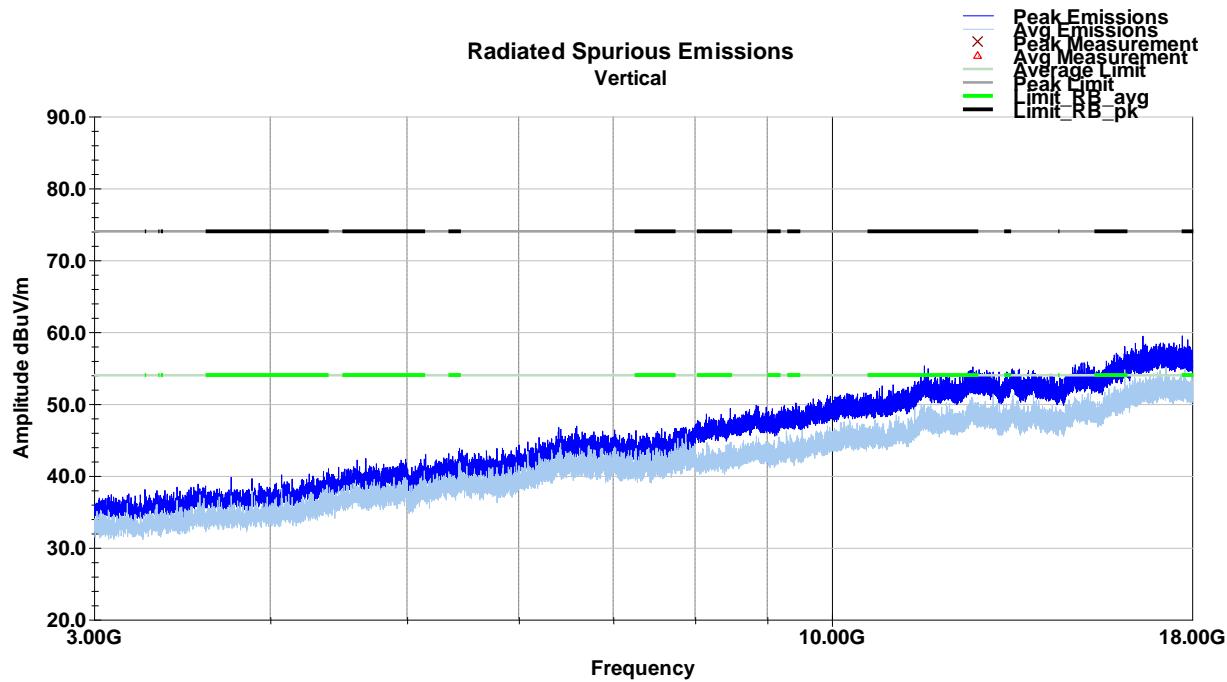
Vertical Radiated Spurious Emissions Plot – 1-3GHz (802.11g HCH)



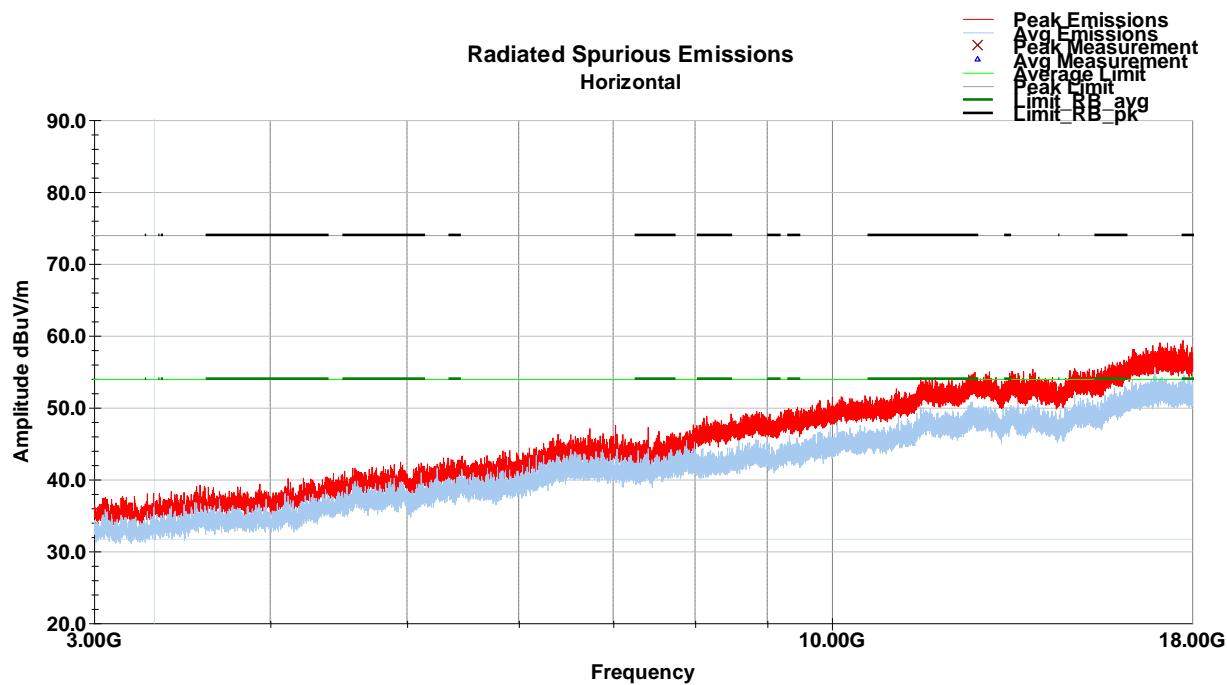
Horizontal Radiated Spurious Emissions Plot – 1-3GHz (802.11g HCH)



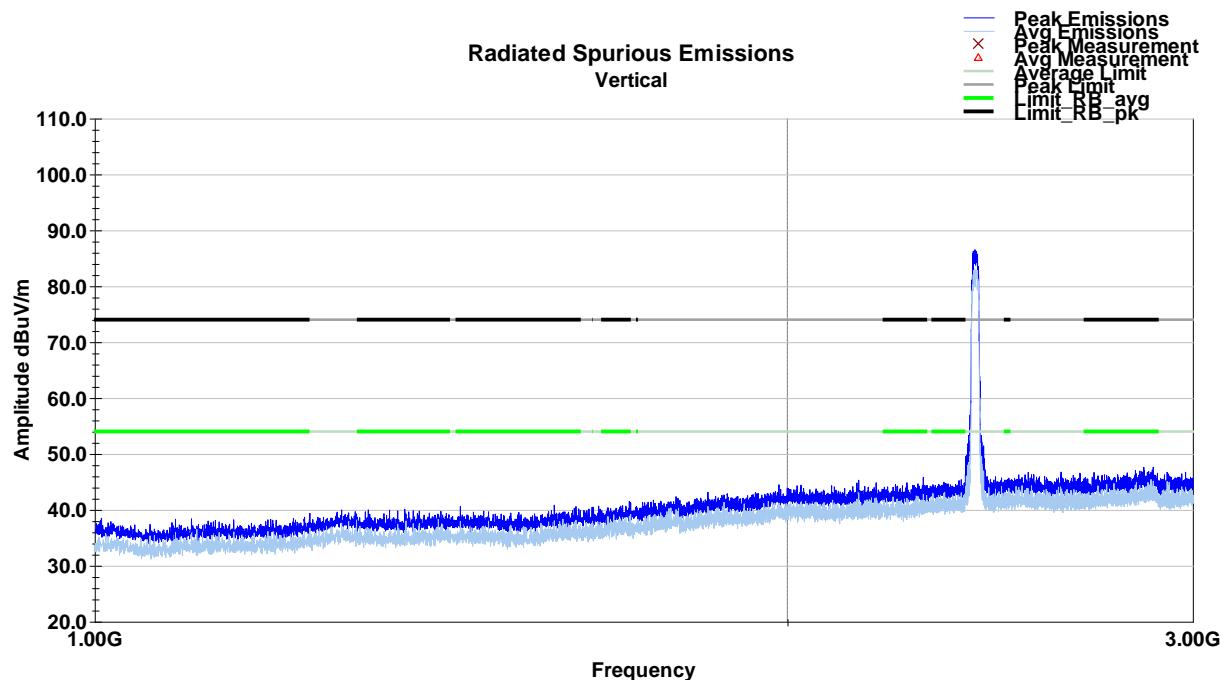
Vertical Radiated Spurious Emissions Plot – 3-18GHz (802.11g HCH)



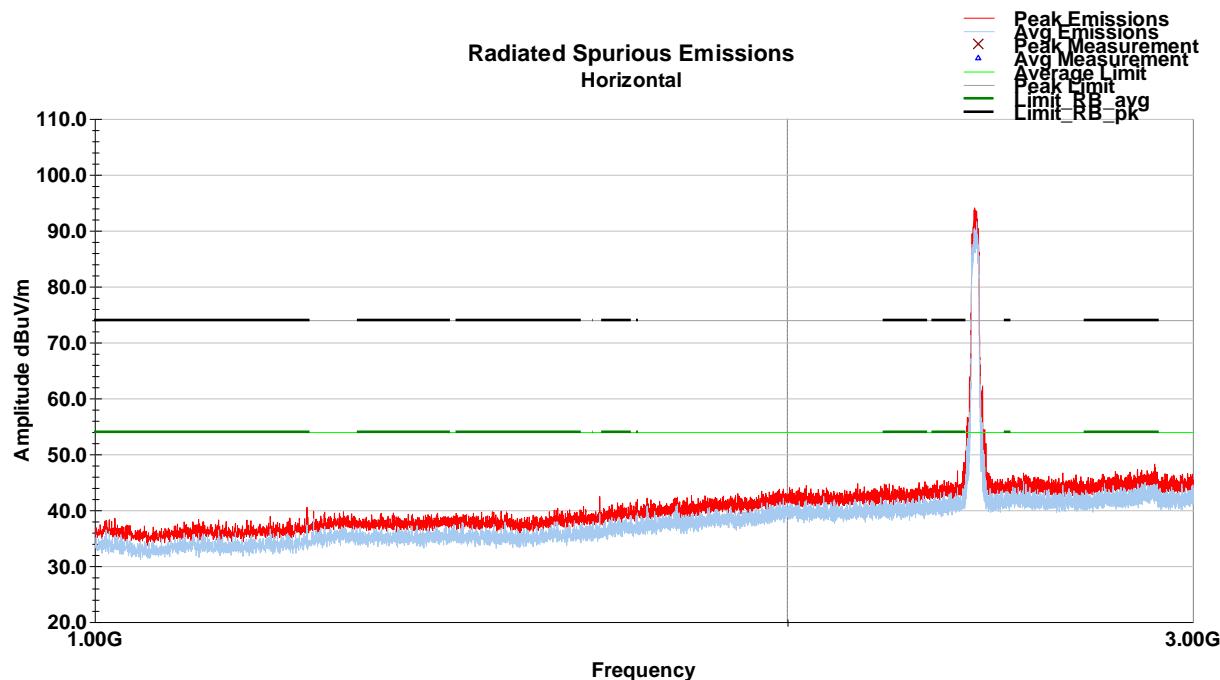
Horizontal Radiated Spurious Emissions Plot – 3-18GHz (802.11g HCH)



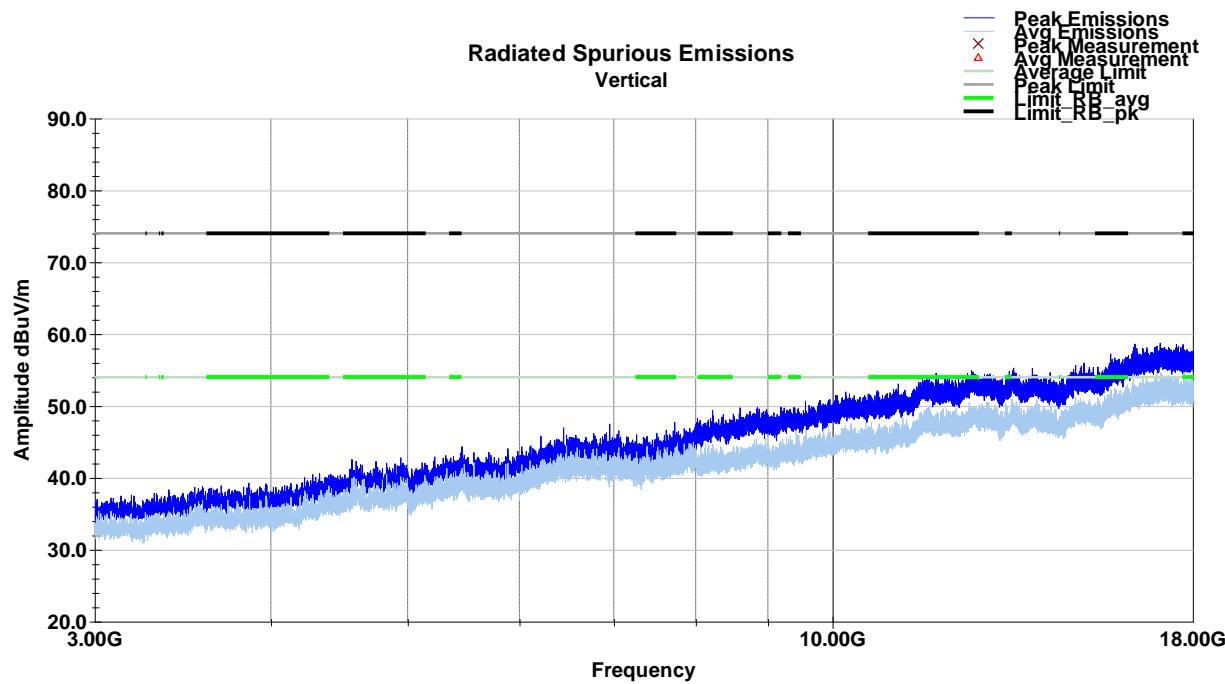
Vertical Radiated Spurious Emissions Plot – 1-3GHz (802.11n LCH)



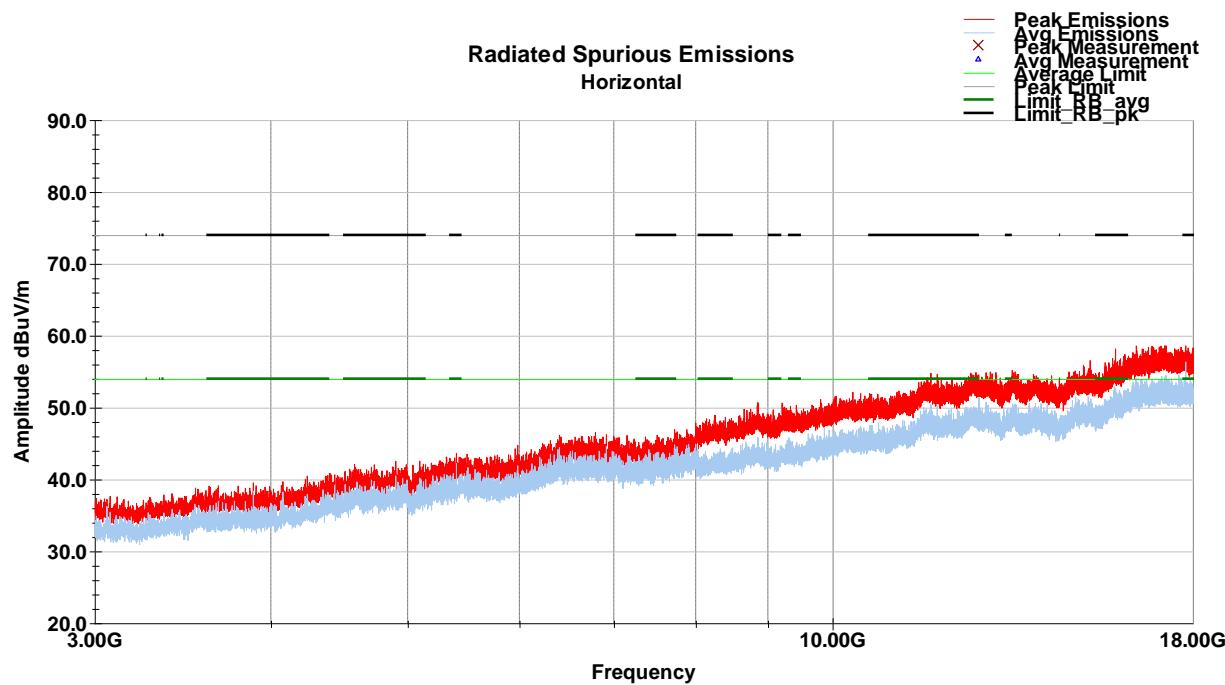
Horizontal Radiated Spurious Emissions Plot – 1-3GHz (802.11n LCH)



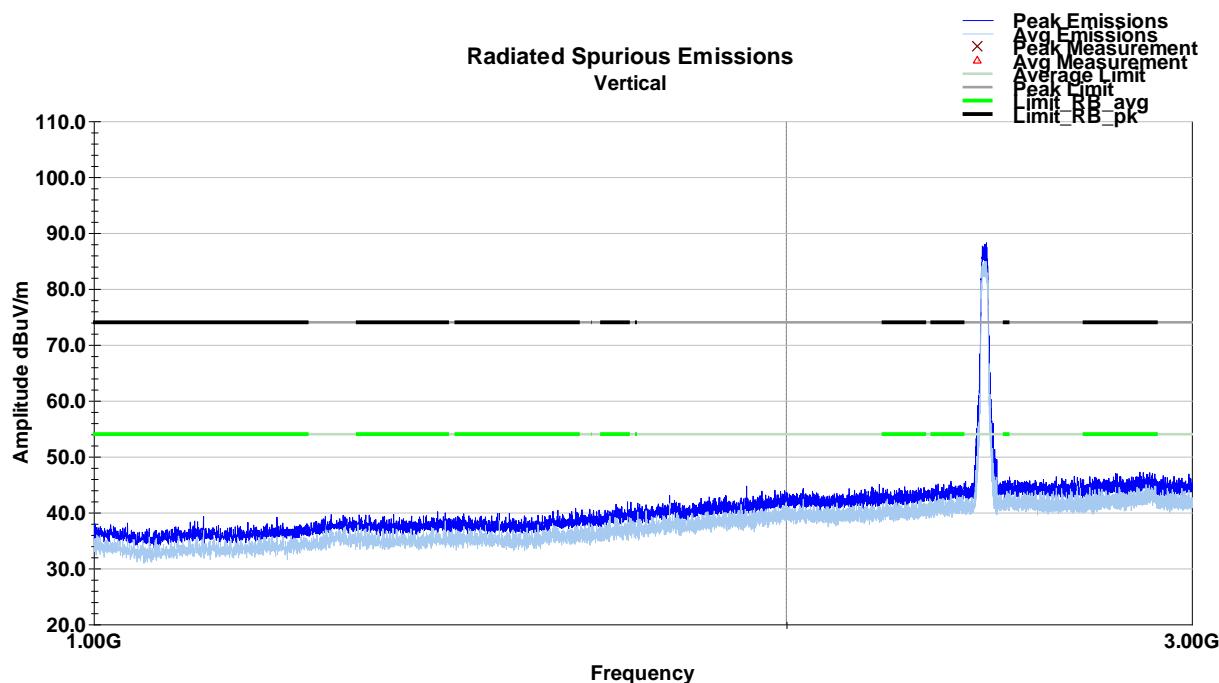
Vertical Radiated Spurious Emissions Plot – 3-18GHz (802.11n LCH)



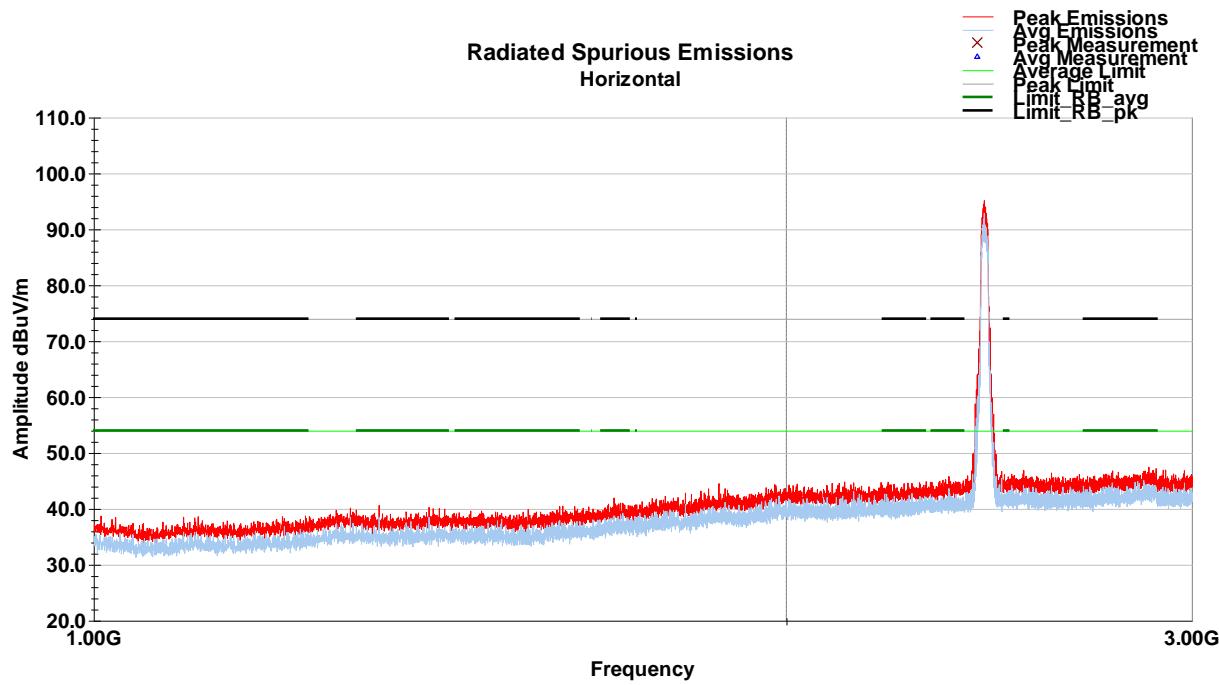
Horizontal Radiated Spurious Emissions Plot – 3-18GHz (802.11n LCH)



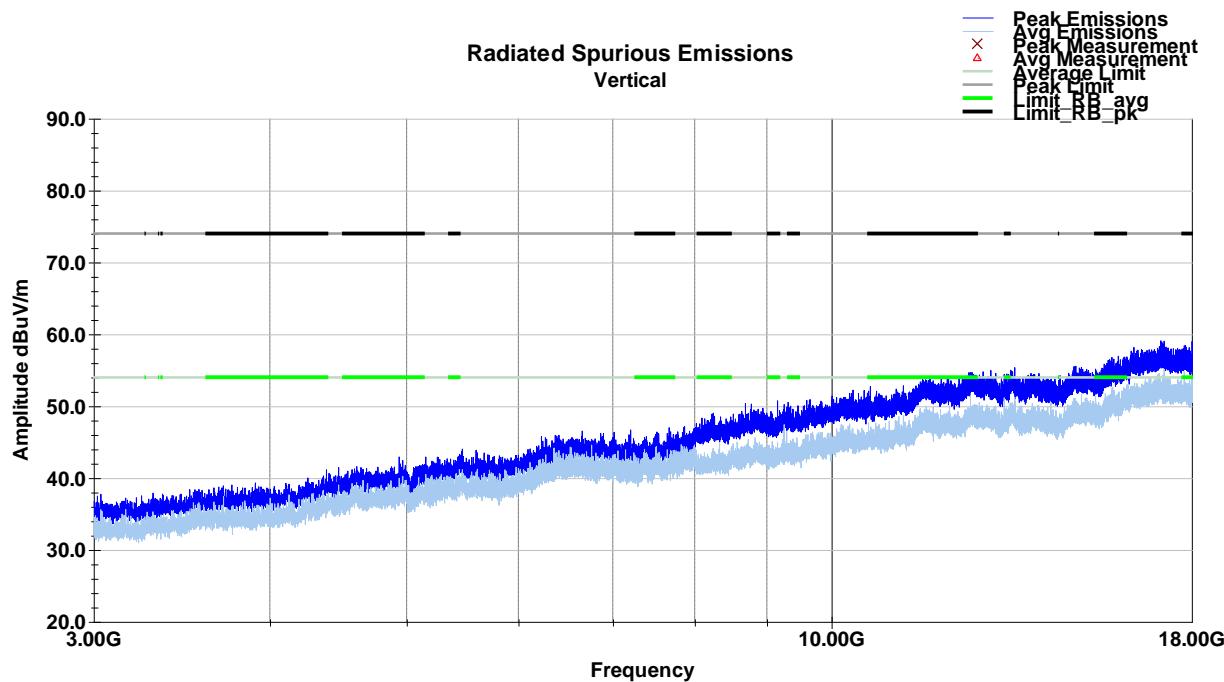
Vertical Radiated Spurious Emissions Plot – 1-3GHz (802.11n MCH)



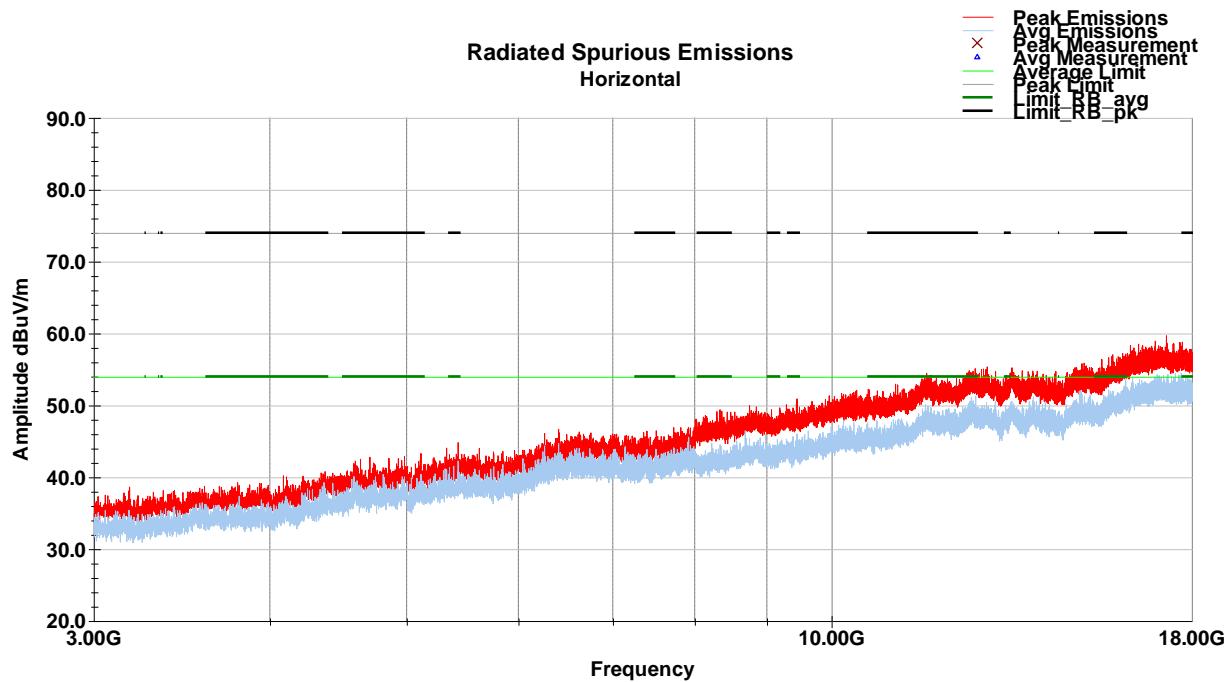
Horizontal Radiated Spurious Emissions Plot – 1-3GHz (802.11n MCH)



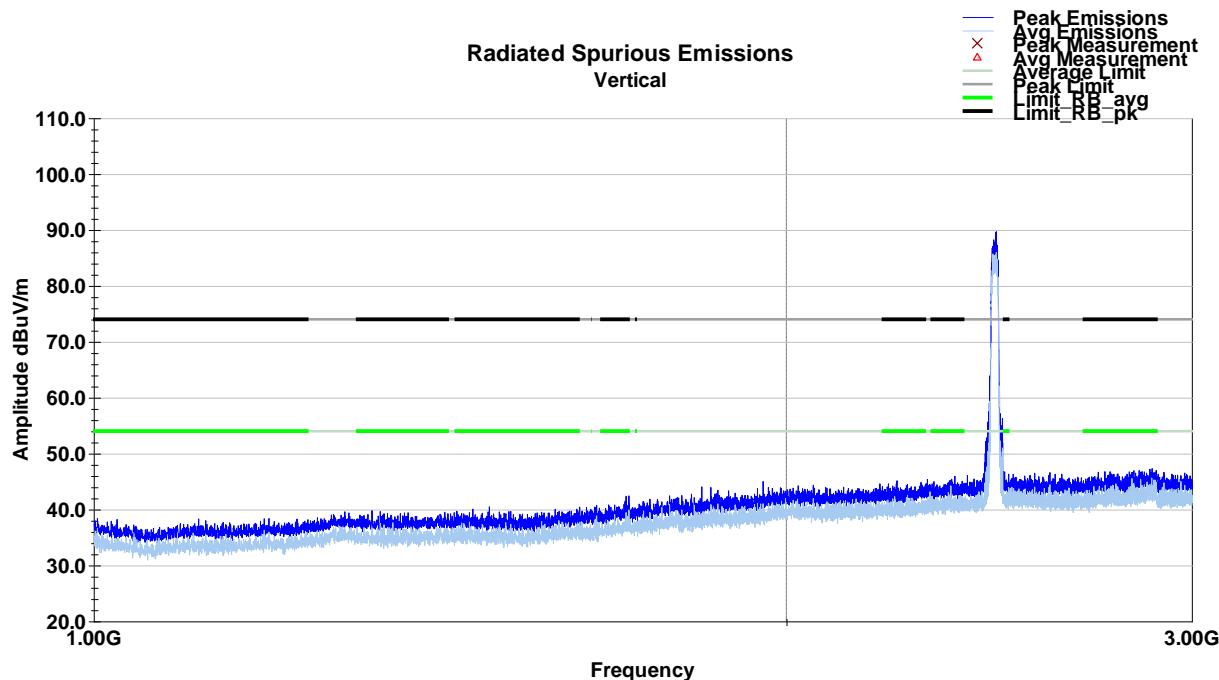
Vertical Radiated Spurious Emissions Plot – 3-18GHz (802.11n MCH)



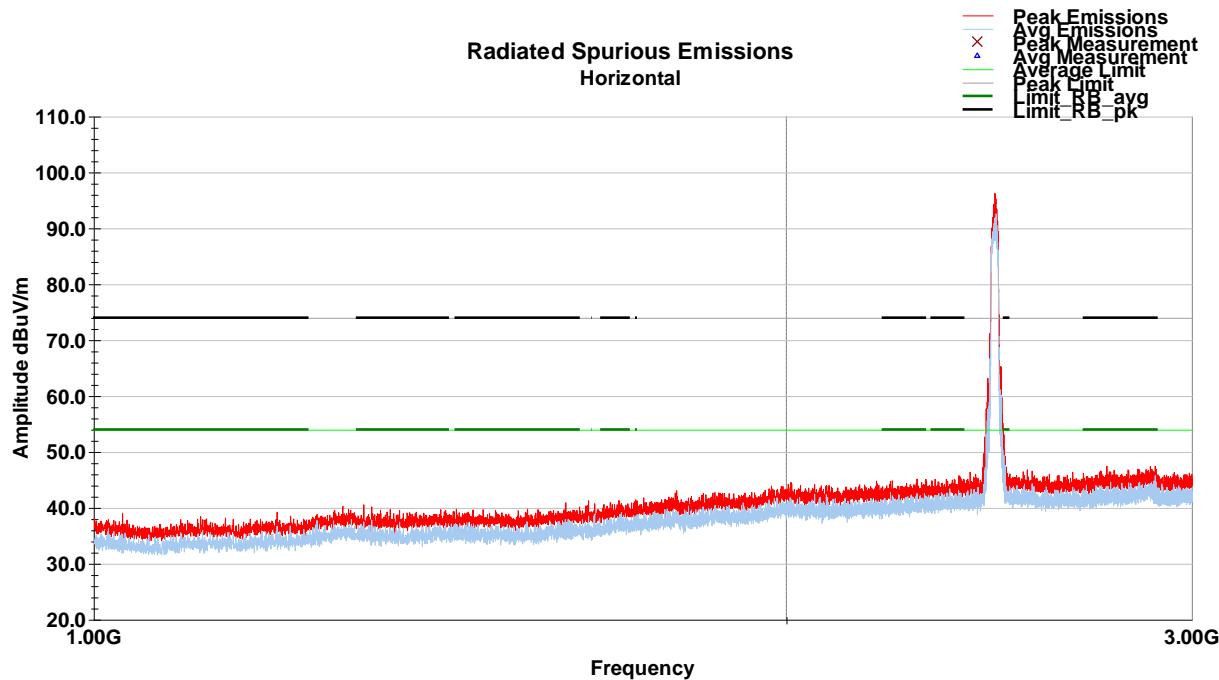
Horizontal Radiated Spurious Emissions Plot – 3-18GHz (802.11n MCH)



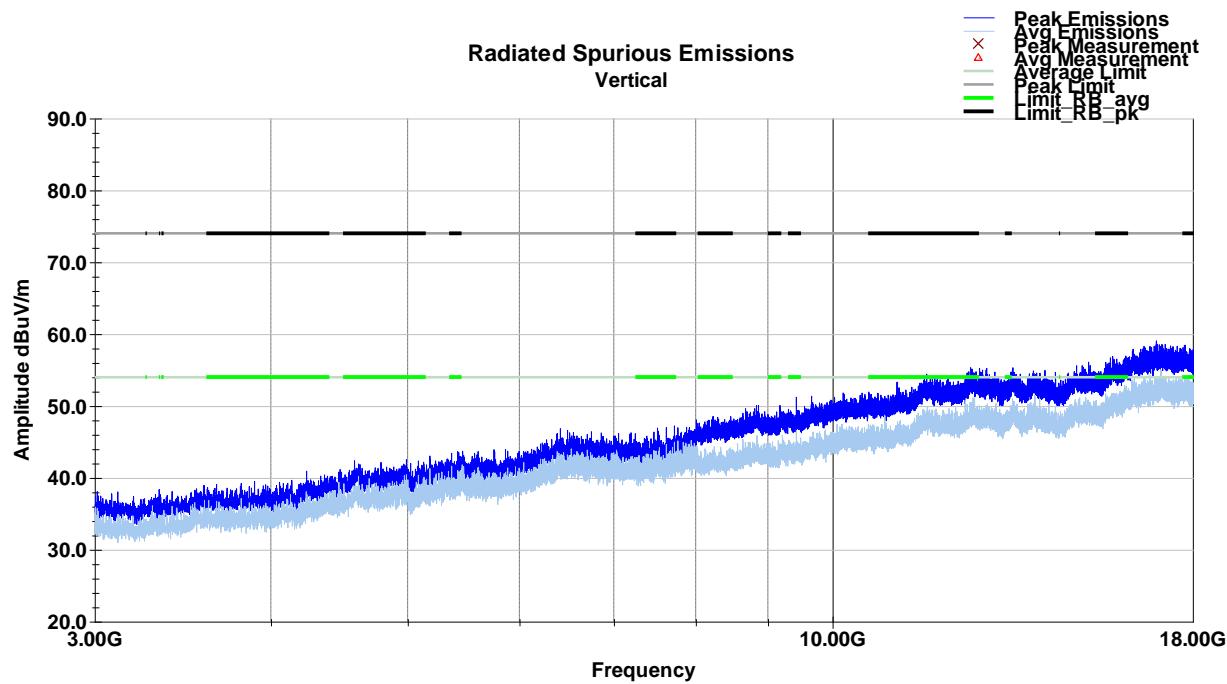
Vertical Radiated Spurious Emissions Plot – 1-3GHz (802.11n HCH)



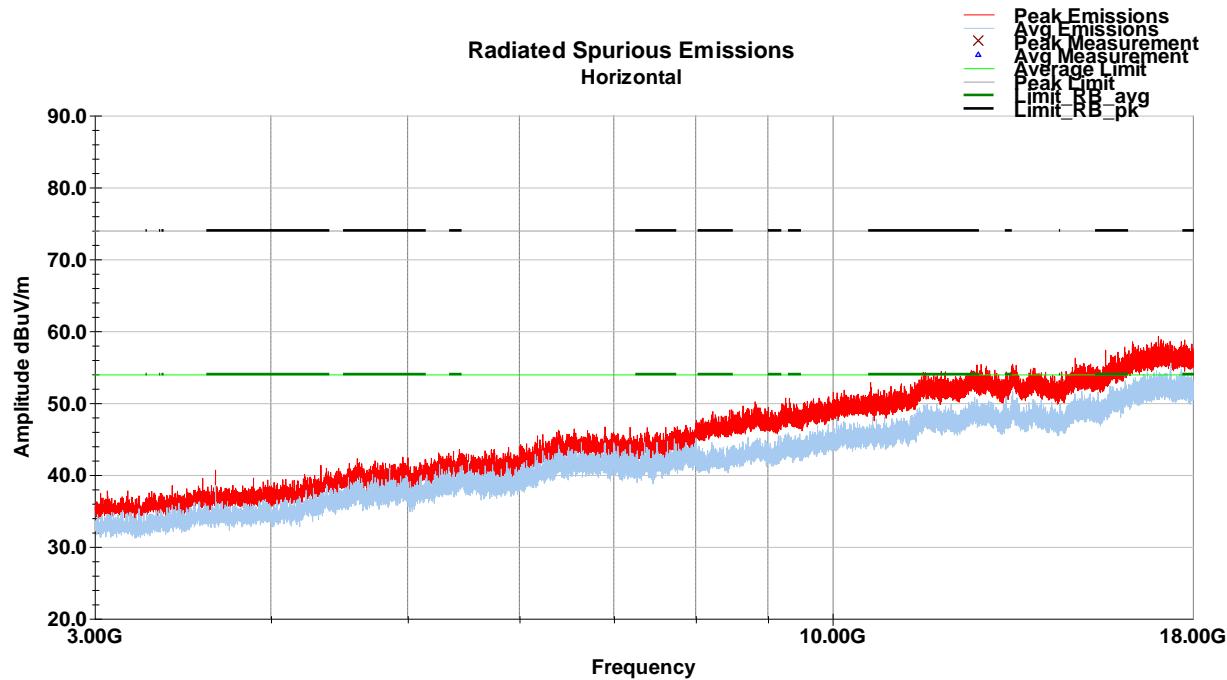
Horizontal Radiated Spurious Emissions Plot – 1-3GHz (802.11n HCH)



Vertical Radiated Spurious Emissions Plot – 3-18GHz (802.11n HCH)



Horizontal Radiated Spurious Emissions Plot – 3-18GHz (802.11n HCH)



There were no discernible emissions from 18 to 26 GHz.

8 Band Edge Emissions in Restricted Frequency Bands

8.1 Test Result

| Test Description | Test Specification | Test Result |
|---|--------------------|----------------------|
| Band Edge Emissions in Restricted Frequency Bands | 15.205 / 15.209 | RSS-GEN S8.9 / S8.10 |

8.2 Test Method

Measurements were made using the conducted methods defined in ANSI C63.10, Section 11.12.2.

The test system reported the following duty-cycles used for correcting the average measurements:

| Ant1 | | | | | | | |
|----------------|---------|-----------------|-----------|-------------|----------------|-----------------------------------|-----------------------|
| Mode | TX Type | Frequency (MHz) | T_on (ms) | Period (ms) | Duty Cycle (%) | Duty Cycle Correction Factor (dB) | Max. DC Variation (%) |
| 802.11b | SISO | 2412 | 32.950 | 33.138 | 99.43 | 0.02 | 0.00 |
| | | 2437 | 32.950 | 33.150 | 99.40 | 0.03 | 0.04 |
| | | 2462 | 32.950 | 33.150 | 99.40 | 0.03 | 0.04 |
| 802.11g | SISO | 2412 | 5.487 | 5.531 | 99.20 | 0.03 | 0.27 |
| | | 2437 | 5.481 | 5.701 | 96.14 | 0.17 | 0.14 |
| | | 2462 | 5.481 | 5.702 | 96.12 | 0.17 | 0.14 |
| 802.11n (HT20) | SISO | 2412 | 0.496 | 0.717 | 69.18 | 1.60 | 0.12 |
| | | 2437 | 0.496 | 0.717 | 69.18 | 1.60 | 0.12 |
| | | 2462 | 0.496 | 0.716 | 69.27 | 1.59 | 0.12 |
| 802.11n (HT40) | SISO | 2422 | 0.258 | 0.478 | 53.97 | 2.68 | 0.07 |
| | | 2437 | 0.258 | 0.478 | 53.97 | 2.68 | 0.13 |
| | | 2452 | 0.258 | 0.478 | 53.97 | 2.68 | 0.13 |
| 802.11n (HT20) | MIMO | 2412 | 0.359 | 0.579 | 62.00 | 2.08 | 0.13 |
| | | 2437 | 0.358 | 0.579 | 61.83 | 2.09 | 0.13 |
| | | 2462 | 0.359 | 0.579 | 62.00 | 2.08 | 0.13 |

8.3 Test Site

Environmental Conditions

Temperature: 20.3 °C

Relative Humidity: 33.6 %

Atmospheric Pressure: 98.2 kPa

8.4 Test Equipment

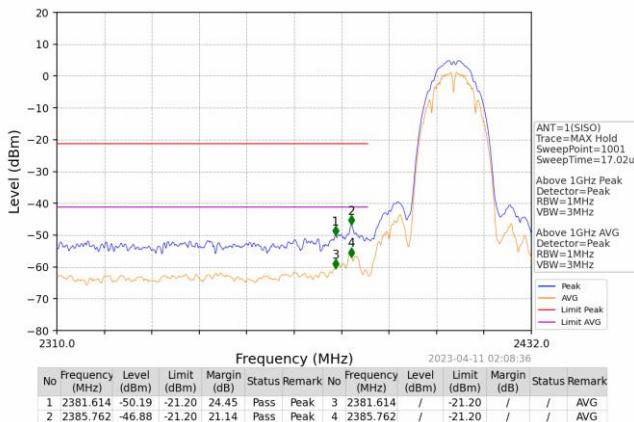
| Equipment | Model | Manufacturer | Asset | Cal Date | Cal Due Date |
|---------------------------------|--------------|--------------------------|---------|-------------|--------------|
| SIGNAL ANALYZER (TS8997) | FSV30 | ROHDE & SCHWARZ | B085749 | 7-Dec-2022 | 7-Dec-2023 |
| RF CABLE SMA TO SMA, 0.01-40GHZ | 084-0505-059 | TELEDYNE STORM MICROWAVE | 20108 | 13-Mar-2023 | 13-Mar-2024 |
| RF CABLE SMA TO SMA, 0.01-40GHZ | 084-0505-059 | TELEDYNE STORM MICROWAVE | 20109 | 13-Mar-2023 | 13-Mar-2024 |
| TSTPASS SWITCHBOX | SB2 | TSTPASS | 23009 | CNR | CNR |

Software Profile:

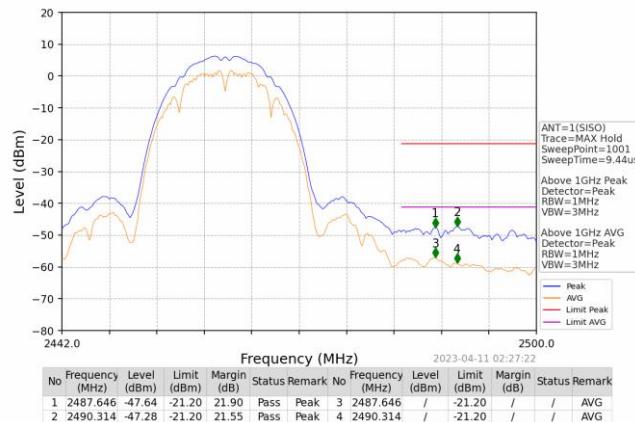
TSTPASS Version: 2.0

8.5 Test Data – Restricted Band Edges - SISO

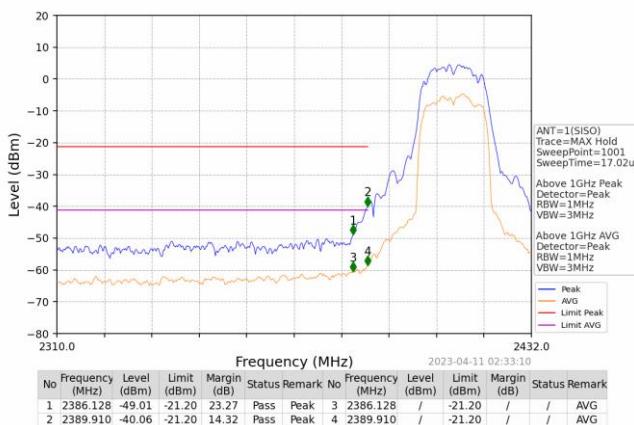
Low Channel(2412MHz) – 802.11b



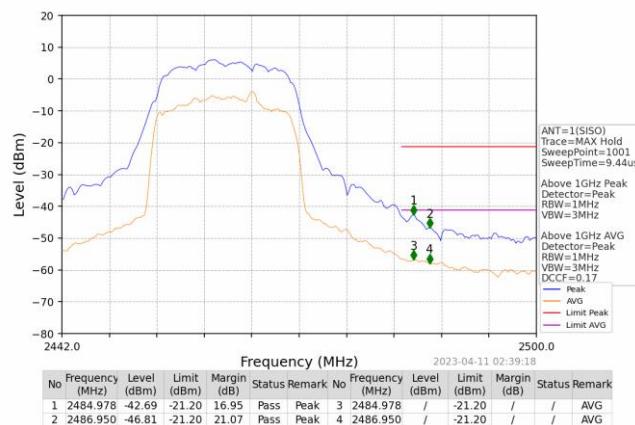
High Channel(2462MHz) – 802.11b



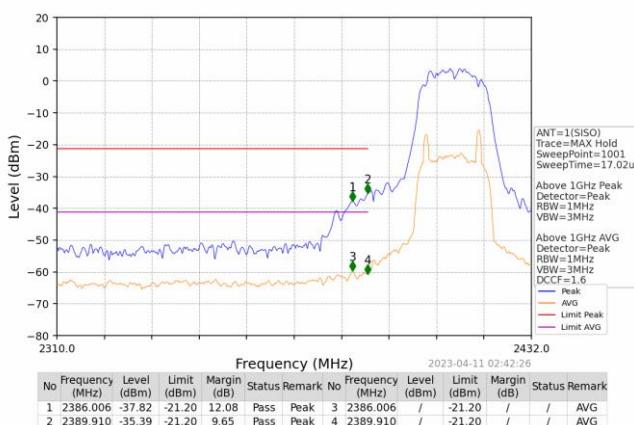
Low Channel(2412MHz) – 802.11g



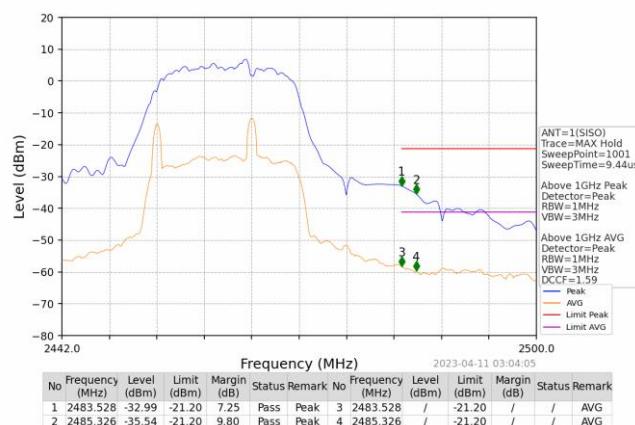
High Channel(2462MHz) – 802.11g



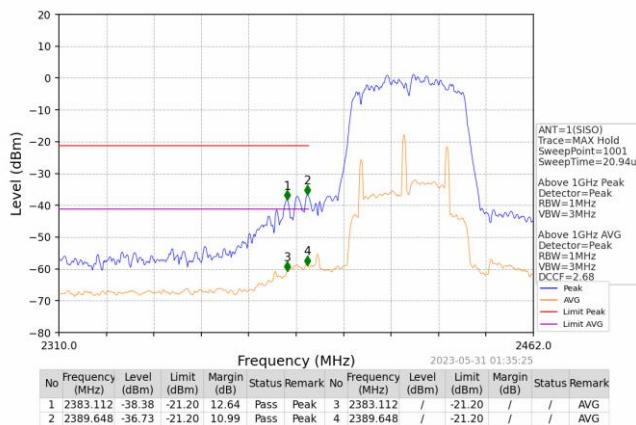
Low Channel(2412MHz) – 802.11n(HT20)



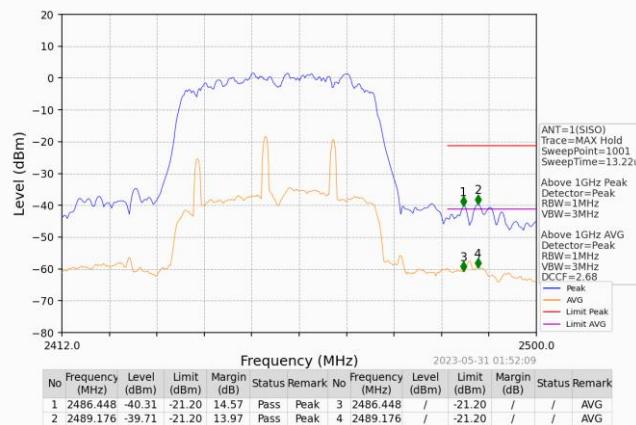
High Channel(2462MHz) – 802.11n(HT20)



Low Channel(2422MHz) – 802.11n(HT40)

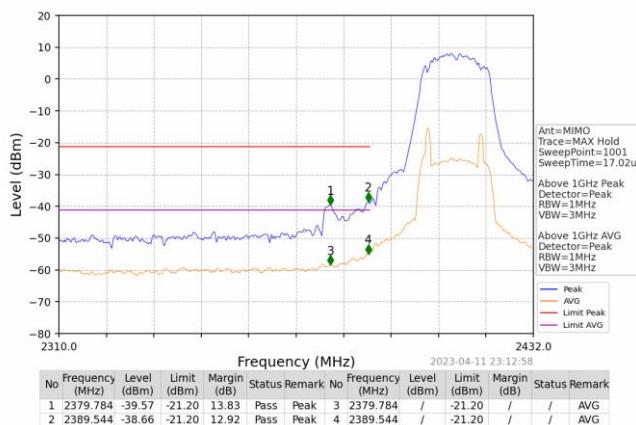


High Channel(2452MHz) – 802.11n(HT40)

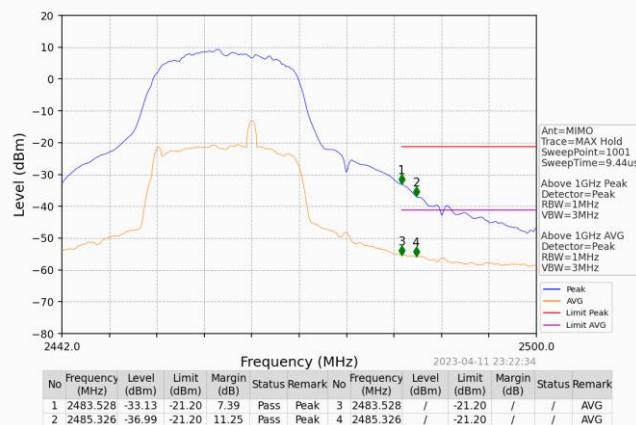


8.6 Test Data – Restricted Band Edges - MIMO

Low Channel(2412MHz) – 802.11n(HT20)



High Channel(2462MHz) – 802.11n(HT20)



9 AC Powerline Conducted Emissions

9.1 Test Result

| Test Description | Test Specification | Test Result |
|----------------------------------|--------------------|--------------|
| AC Powerline Conducted Emissions | 15.207 | RSS-GEN S8.8 |

9.2 Test Method

With the receiver's resolution bandwidth was set to 9 kHz, exploratory scans were performed over the measuring frequency range (0.15 MHz to 30 MHz) using a max hold mode incorporating a Peak detector and Average detector and using the TILE! software. The final test data was measured using a Quasi-Peak detector and Average detector and compared against the limits indicated in the table below.

| Frequency Range | Limits (dBuV) |
|-----------------|-----------------------------|
| 0.15 to 0.5 MHz | Avg 56 to 46 QP 66 to 56 |
| 0.5 to 5 MHz | Avg 46 Pk 56 |
| 5 to 30 MHz | Avg 50 Pk 60 |

9.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions:

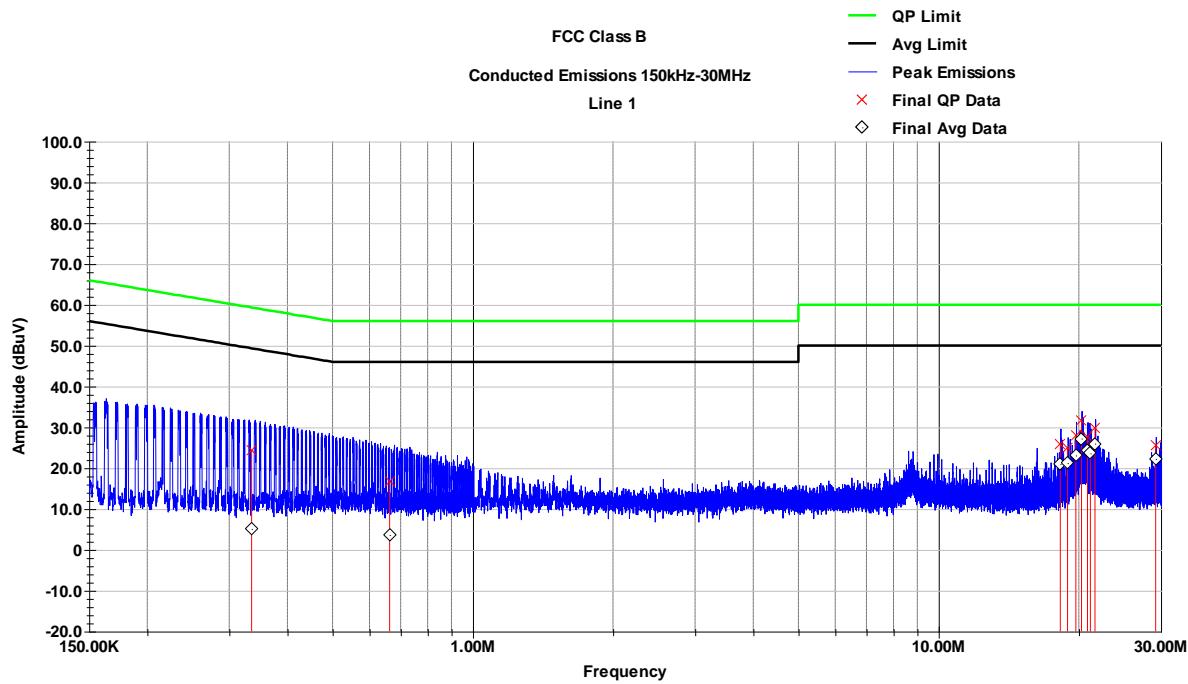
Temperature: 22.7 °C
Relative Humidity: 38.8 %
Atmospheric Pressure 97.8 kPa

9.4 Test Equipment

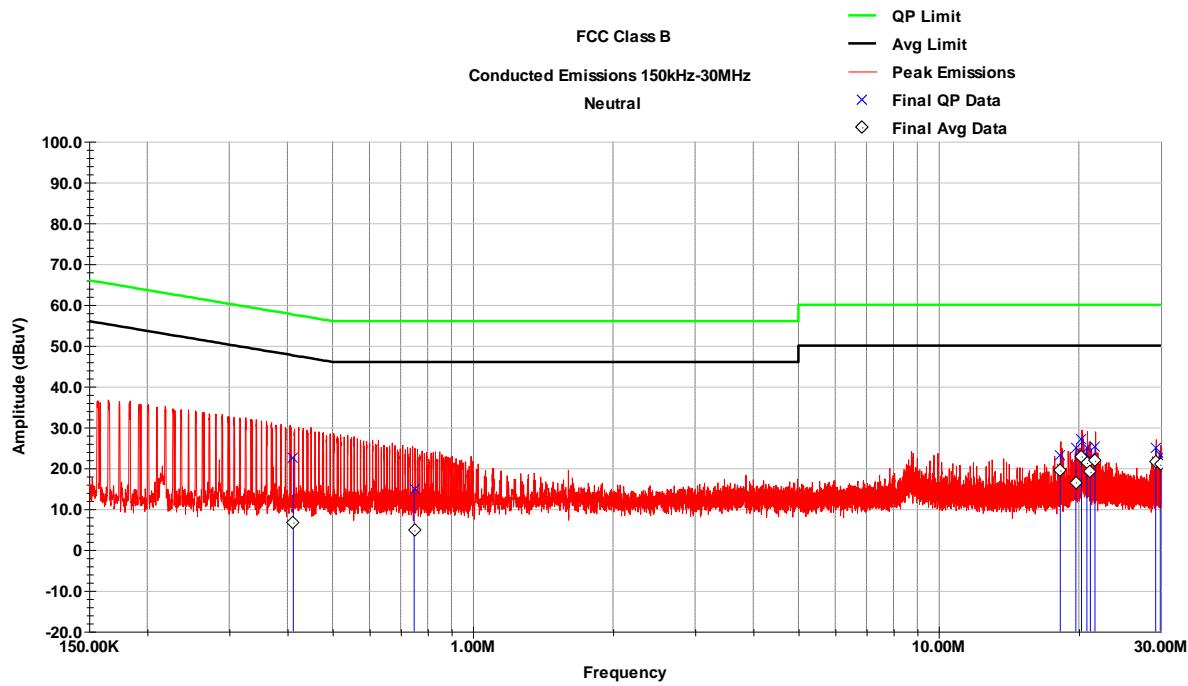
| Equipment | Model | Manufacturer | Asset | Cal Date | Cal Due Date |
|--------------------------------------|------------|-----------------|---------|-------------|--------------|
| LINE IMPEDANCE STABILIZATION NETWORK | NNB 51 | TESEQ | B085882 | 15-Apr-2022 | 15-Apr-2023 |
| RF CABLE | UC-N-MM-78 | MAURY MICROWAVE | 17017 | 25-Aug-2022 | 25-Aug-2023 |
| EMI TEST RECEIVER | ESW44 | ROHDE & SCHWARZ | 22032 | 24-Nov-2022 | 24-Nov-2023 |

Software: Conducted Emissions 230206.til

9.5 Test Data



| Frequency MHz | QP Value dBuV | QP Limit dBuV | QP Margin dB | Avg Value dBuV | Avg Limit dBuV | Avg Margin dB |
|------------------|------------------|------------------|-----------------|-------------------|-------------------|------------------|
| 0.335 | 24.3 | 59.3 | -35.0 | 5.1 | 49.3 | -44.2 |
| 0.663 | 16.7 | 56.0 | -39.3 | 3.6 | 46.0 | -42.4 |
| 18.244 | 25.8 | 60.0 | -34.2 | 21.0 | 50.0 | -29.0 |
| 18.913 | 24.9 | 60.0 | -35.1 | 21.2 | 50.0 | -28.8 |
| 19.708 | 28.1 | 60.0 | -31.9 | 23.1 | 50.0 | -26.9 |
| 20.257 | 31.5 | 60.0 | -28.5 | 27.2 | 50.0 | -22.8 |
| 20.868 | 27.8 | 60.0 | -32.2 | 24.3 | 50.0 | -25.7 |
| 21.174 | 26.3 | 60.0 | -33.7 | 23.6 | 50.0 | -26.4 |
| 21.663 | 29.7 | 60.0 | -30.3 | 26.0 | 50.0 | -24.0 |
| 29.235 | 25.5 | 60.0 | -34.5 | 22.3 | 50.0 | -27.7 |



| Frequency MHz | QP Value dBuV | QP Limit dBuV | QP Margin dB | Avg Value dBuV | Avg Limit dBuV | Avg Margin dB |
|------------------|------------------|------------------|-----------------|-------------------|-------------------|------------------|
| 0.412 | 22.5 | 57.6 | -35.1 | 6.7 | 47.6 | -40.9 |
| 0.749 | 15.1 | 56.0 | -40.9 | 4.7 | 46.0 | -41.3 |
| 18.244 | 23.1 | 60.0 | -36.9 | 19.4 | 50.0 | -30.6 |
| 19.709 | 24.9 | 60.0 | -35.1 | 16.5 | 50.0 | -33.5 |
| 20.261 | 27.2 | 60.0 | -32.8 | 22.9 | 50.0 | -27.1 |
| 20.811 | 25.1 | 60.0 | -34.9 | 21.3 | 50.0 | -28.7 |
| 21.174 | 22.6 | 60.0 | -37.4 | 19.1 | 50.0 | -30.9 |
| 21.662 | 25.3 | 60.0 | -34.7 | 21.8 | 50.0 | -28.2 |
| 29.235 | 24.9 | 60.0 | -35.1 | 21.7 | 50.0 | -28.3 |
| 29.907 | 23.1 | 60.0 | -36.9 | 20.8 | 50.0 | -29.2 |

10 Measurement Uncertainty

The measurement uncertainty figures are be calculated in accordance with TR 100 028-1 [2] and correspond to an expansion factor (coverage factor) $k = 2$ (which provide confidence levels of 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

| Parameter | Expanded Uncertainty for Normal k factor equal to 2 | |
|-------------------------------|---|--------------------------|
| | Required | Laboratory Actual |
| Radio Frequency | $\pm 1 \times 10^{-5}$ | $\pm 9.8 \times 10^{-8}$ |
| total RF power, conducted | ± 1.5 dB | ± 1.2 dB |
| RF power density, conducted | ± 3 dB | ± 0.7 dB |
| spurious emissions, conducted | ± 3 dB | ± 2.1 dB |
| all emissions, radiated | ± 6 dB | ± 4.8 dB |
| temperature | ± 1 °C | ± 0.5 °C |
| humidity | ± 5 % | ± 3.5 % |
| DC and low frequency voltages | ± 3 % | ± 0.4 % |

11 Revision History

| Revision Level | Description of changes | Revision Date |
|----------------|--|------------------|
| 0 | Initial release | 31 May 2023 |
| 1 | <ul style="list-style-type: none">- Updated RSS-247 reference to latest issue on title page- Clarified antenna type in section 1- Added note about HT40 MIMO not being supported in section 4.6- Added notes on prescan testing <30MHz in sections 7.2 & 7.5 | 17 November 2023 |
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