

TEST REPORT

| | |
|------------------------|---|
| EUT Description | WLAN and BT, 1x1 PCIe M.2 2230 adapter card |
| Brand Name | Intel® Wireless-AC 9461 |
| Model Name | 9461NGW |
| FCC ID | PD99461NG |
| ISED ID | 1000M-9461NG |
| Date of Test Start/End | 2017-07-28 / 2017-08-30 |
| Features | 802.11 a/b/g/n/ac Wireless LAN + Bluetooth 5 (see section 5) |

| | |
|----------------------|---|
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| | |
|---------------------|---|
| Reference Standards | FCC CFR Title 47 Part 15 E RSS-247 issue 2, RSS-Gen issue 4 (see section 1) |
|---------------------|---|

| | |
|----------------------------|--|
| Test Report identification | 170727-01.TR02 |
| Revision Control | Rev. 00 This test report revision replaces any previous test report revision (see section 8) |

The test results relate only to the samples tested.
The test report shall not be reproduced in full, without written approval of the laboratory.

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1. Standards, reference documents and applicable test methods

1. FCC 47 CFR part 15 – Subpart E – Unlicensed National Information Infrastructure Devices.
2. FCC 47 CFR part 15 - Subpart C – §15.207 Conducted emission limits.
3. FCC 47 CFR part 15 - Subpart C – §15.209 Radiated emission limits; general requirements.
4. FCC OET KDB 789033 D02 General U-NII Test Procedures New Rules v01r04 – Guidelines for compliance testing of Unlicensed National Information Infrastructure (U-NII) Devices (Part 15, Subpart E)
5. FCC OET KDB 644545 D03 Guidance for IEEE 802.11ac v01 - GUIDANCE FOR IEEE Std 802.11ac™ DEVICES EMISSION TESTING.
6. ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
7. RSS-247 Issue 2 - Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.
8. RSS-Gen Issue 4 - General Requirements for Compliance of Radio Apparatus.

2. General conditions, competences and guarantees

- ✓ Intel Mobile Communications France SAS Wireless RF Lab (Intel WRF Lab) is an ISO/IEC 17025:2005 testing laboratory accredited by the American Association for Laboratory Accreditation (A2LA) with the certificate number 3478.01.
- ✓ Intel Mobile Communications France SAS Wireless RF Lab (Intel WRF Lab) is an Accredited Test Firm recognized by the FCC, with Designation Number FR0011.
- ✓ Intel Mobile Communications France SAS Wireless RF Lab (Intel WRF Lab) is a Registered Test Site listed by ISED, with ISED Assigned Code 1000Y.
- ✓ Intel WRF Lab only provides testing services and is committed to providing reliable, unbiased test results and interpretations.
- ✓ Intel WRF Lab is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.
- ✓ Intel WRF Lab has developed calibration and proficiency programs for its measurement equipment to ensure correlated and reliable results to its customers.
- ✓ This report is only referred to the item that has undergone the test.
- ✓ This report does not imply an approval of the product by the Certification Bodies or competent Authorities.

3. Environmental Conditions

- ✓ At the site where the measurements were performed the following limits were not exceeded during the tests:

| | |
|-------------|------------|
| Temperature | 22°C ± 1°C |
| Humidity | 55% ± 14% |

4. Test samples

| Sample | Control # | Description | Model | Serial # | Date of receipt | Note |
|--------|---------------|----------------|----------------|------------------|-----------------|--|
| #01 | 170727-01.S01 | Module | 9461NGW | WFM 3413E86AD85D | 2017-07-28 | Used for conducted tests |
| | 170524-02.S15 | Extender Board | PCB00609_01 | 6092416-442 | 2017-05-30 | |
| | 170000-01.S04 | Laptop | Latitude E5470 | DMRKMC2 | 2017-05-10 | |
| #02 | 170727-01.S06 | Module | 9461NGW | WFM 3413E86AD7B3 | 2017-07-28 | Used for radiated tests |
| | 170220-02.S03 | Extender Board | PCB00609_01 | 6092416-446 | 2017-02-20 | |
| | 170000-01.S13 | Laptop | Latitude E5470 | FT6LMC2 | 2017-04-25 | |
| #03 | 170727-01.S04 | Module | 9461NGW | WFM 3413E86AD7BD | 2017-07-28 | Used for AC power-line conducted emission measurements |
| | 170524-02.S13 | Extender Board | PCB00609_01 | 6092416-418 | 2017-02-20 | |
| | 170000-01.S02 | Laptop | Latitude E5470 | 21HTPF2 | 2017-04-25 | |

5. EUT Features

| | | | |
|------------------------|---|------------------------------|--|
| Brand Name | Intel® Wireless-AC 9461 | | |
| Model Name | 9461NGW | | |
| FCC/IC ID | PD99461NG | | |
| ISED ID | 1000M-9461NG | | |
| Software Version | 10.1730.0-05594 | | |
| Driver Version | 99.0.28.6 | | |
| Prototype / Production | Production | | |
| Supported Radios | 802.11b/g/n | 2.4GHz (2400.0 – 2483.5 MHz) | |
| | 802.11a/n/ac | 5.2GHz (5150.0 – 5350.0 MHz) | |
| | | 5.6GHz (5470.0 – 5725.0 MHz) | |
| | | 5.8GHz (5725.0 – 5850.0 MHz) | |
| | Bluetooth 5 | 2.4GHz (2400.0 – 2483.5 MHz) | |
| Antenna Information | WLAN/BT: Slot antenna. WiFi 2.4GHz & 5GHz and BT (DRTU CHAIN A) | | |

6. Remarks and comments

N/A

7. Test Verdicts summary

7.1. 802.11 a/n/ac – U-NII-2C

| FCC part | RSS part | Test name | Verdict |
|------------------------------|--|---|---------|
| 15.407 (a) (2) | RSS-247 Clause 6.2.3.1 | Power Limits. Maximum output power | P |
| 15.407 (a) (2) | RSS-247 Clause 6.2.3.1 | Peak power spectral density | P |
| 15.407 (b) (3) 15.209 (a) | RSS-247 Clause 6.2.3.2 RSS-GEN Clause 8.9 | Undesirable emissions limits: Band Edge (conducted) | P |
| 15.407 (b) (3) 15.209 (a) | RSS-247 Clause 6.2.3.2 RSS-GEN Clause 8.9 | Undesirable emissions limits (radiated) | P |
| 15.407 (6) 15.207 | RSS-GEN Clause 8.8 | AC power-line conducted emission | P |

8. Document Revision History

| Revision # | Date | Modified by | Revision Details |
|------------|------------|-------------|------------------|
| Rev. 00 | 2017-09-08 | BLavenant | First Issue |

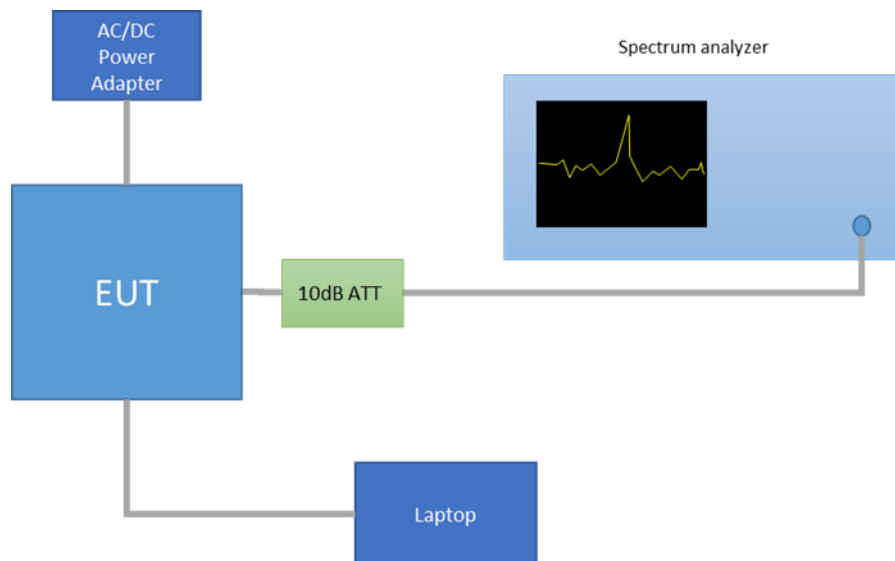
Annex A. Test & System Description

A.1 Measurement System

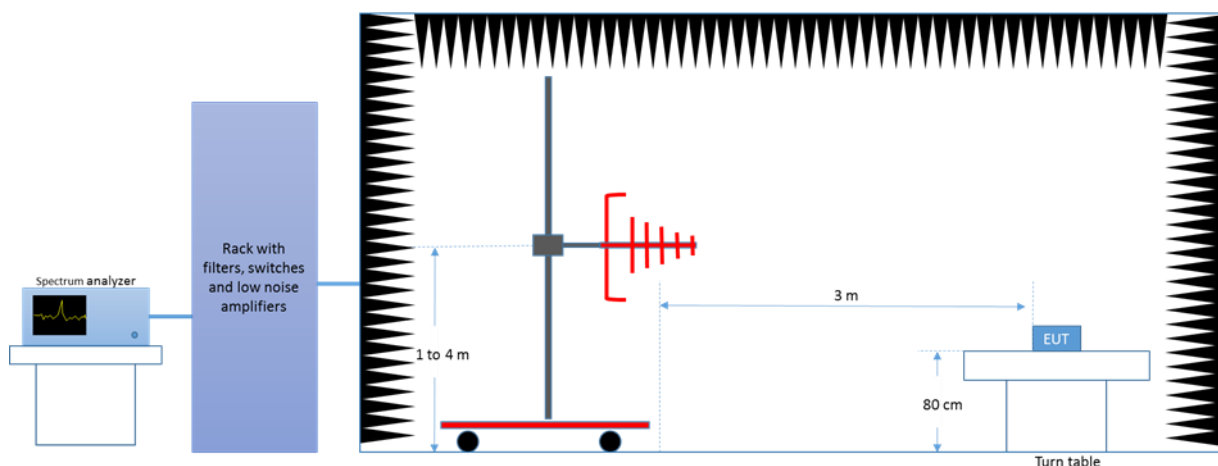
Measurements were performed using the following setups, made in accordance to the general provisions of FCC KDB 789033 D02 General UNII Test Procedures.

The DUT was installed in a test fixture and this test fixture is connected to a laptop computer and AC/DC power adapter. The laptop computer was used to configure the EUT to continuously transmit at a specified output power using all different modes and modulation schemes, using the Intel proprietary tool DRTU.

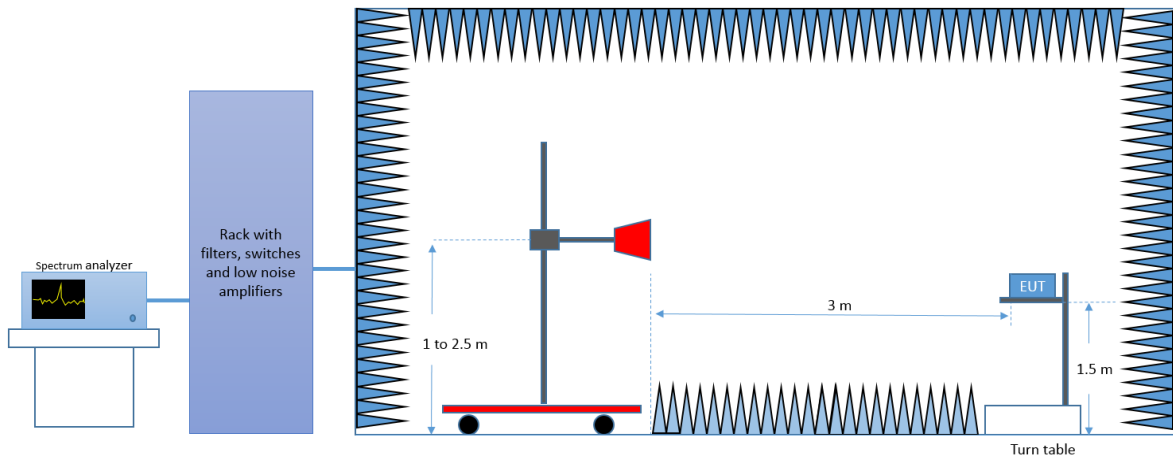
Conducted Setup



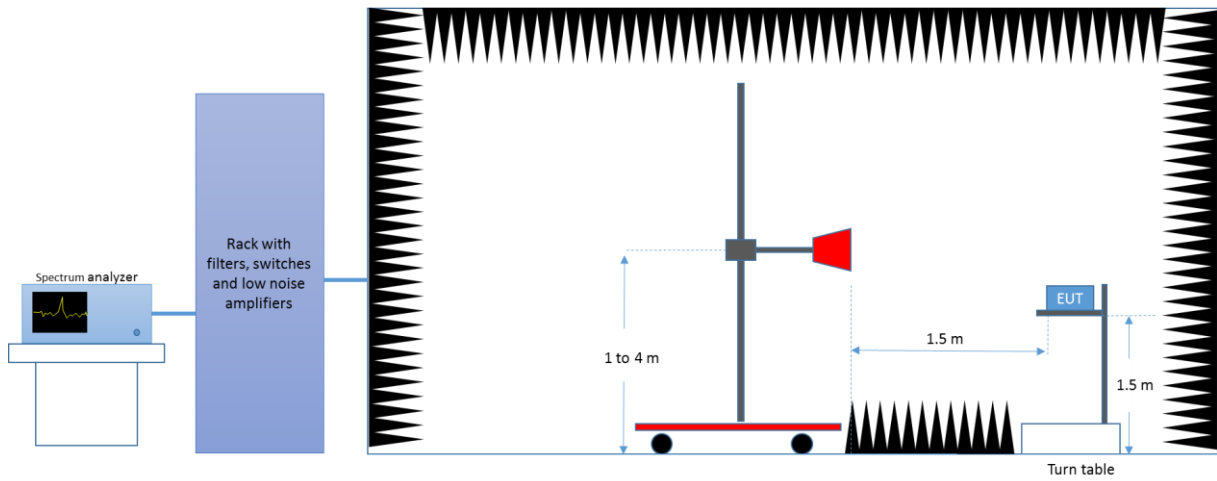
Radiated Setup < 1GHz



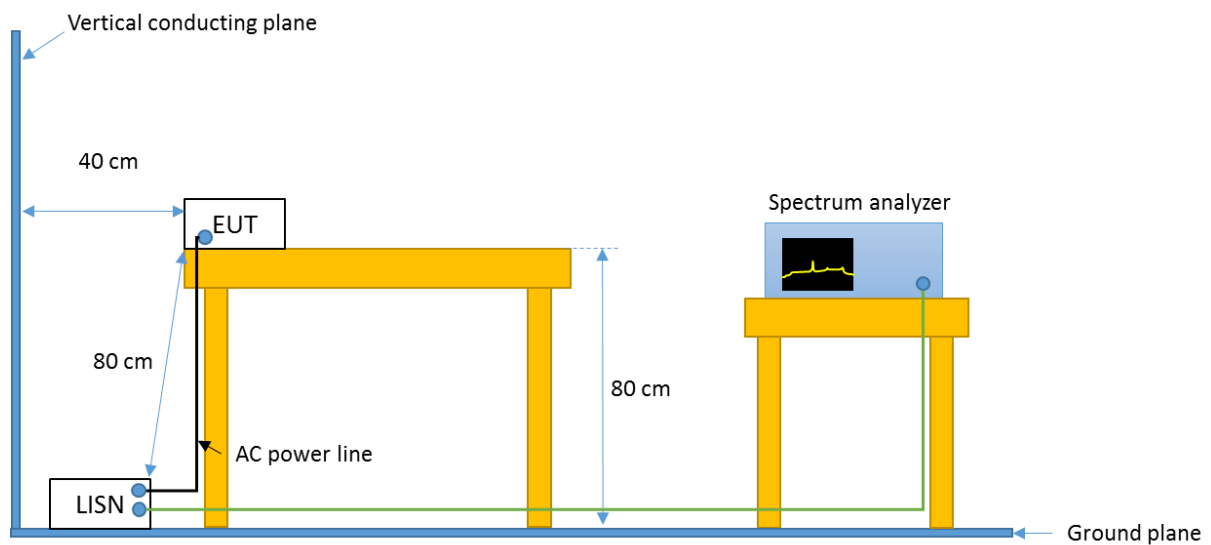
Radiated Setup 1 GHz – 18 GHz



Radiated Setup 18 GHz – 40 GHz



AC power-line conducted emission Setup 150 kHz – 30 MHz



A.2 Test Equipment List

Conducted Setup

| ID# | Device | Type/Model | Serial # | Manufacturer | Cal. Date | Cal. Due Date |
|------|-------------------|------------|----------|-----------------|------------|---------------|
| 0316 | Spectrum analyzer | FSV30 | 103309 | Rohde & Schwarz | 2017-01-30 | 2019-01-30 |

Radiated Setup-1

| ID# | Device | Type/Model | Serial # | Manufacturer | Cal. Date | Cal. Due Date |
|------|-----------------------------------|------------|------------|-----------------|------------|---------------|
| 0133 | Spectrum analyzer | FSV40 | 101358 | Rohde & Schwarz | 2016-04-15 | 2018-04-15 |
| 0137 | Log antenna 30 MHz – 1 GHz | 3142E | 00156946 | ETS Lindgren | 2015-12-11 | 2017-12-11 |
| 0139 | Horn Antenna 18 GHz - 26.5 GHz | 114514 | 00167100 | ETS Lindgren | 2016-03-16 | 2018-03-16 |
| 0140 | Horn Antenna 26.5 GHz - 40 GHz | 120722 | 00169638 | ETS Lindgren | 2016-07-26 | 2018-07-26 |
| 0135 | Semi Anechoic chamber | FACT 3 | 5720 | ETS Lindgren | 2016-04-28 | 2018-04-28 |
| 0530 | Measurement Software | EMC32 | 100623 | Rohde & Schwarz | N/A | N/A |
| 0296 | Power Supply | 6673A | MY41000318 | Agilent | N/A | N/A |
| 0346 | Multimeter | 34401A | US36054685 | HP | 2016-02-04 | 2018-02-04 |

Radiated Setup-2

| ID# | Device | Type/Model | Serial # | Manufacturer | Cal. Date | Cal. Due Date |
|------|--|------------|----------|-----------------|------------|---------------|
| 0420 | Spectrum analyzer | FSV40 | 101556 | Rohde & Schwarz | 2016-04-15 | 2018-04-15 |
| 0138 | Horn antenna 1 GHz – 6.4 GHz | 3117 | 00152266 | ETS Lindgren | 2016-03-14 | 2018-03-14 |
| 0141 | Double Ridge Horn Antenna 1 GHz – 18 GHz | 3117 | 00157736 | ETS Lindgren | 2016-04-13 | 2018-04-13 |
| 0409 | PreAmplifier | 3117-PA | 00157993 | ETS Lindgren | N/A | N/A |
| 0337 | Full Anechoic chamber | RFD_FA_100 | 5996 | ETS Lindgren | 2016-04-28 | 2018-04-28 |
| 0329 | Measurement Software | EMC32 | 100401 | Rohde & Schwarz | N/A | N/A |

N/A: Not Applicable

Radiated Setup - shared equipments

| ID# | Device | Type/Model | Serial # | Manufacturer | Cal. Date | Cal. Due Date |
|------|--------------|------------|----------|-----------------|------------|---------------|
| 0014 | Power Sensor | NRP-Z57 | 101280 | Rohde & Schwarz | 2017-04-25 | 2019-04-25 |

N/A: Not Applicable

AC power-line conducted emission Setup

| ID# | Device | Type/Model | Serial Number | Manufacturer | Cal. Date | Cal. Due Date |
|------|----------------------|------------|---------------|-----------------|------------|---------------|
| 0027 | Measurement software | EMC32 | 1300.7010.02 | Rohde & Schwarz | NA | NA |
| 0317 | Spectrum Analyzer | FSV30 | 103308 | Rohde & Schwarz | 2017-08-05 | 2019-08-05 |
| 0532 | LISN | ENV216 | 101321 | Rohde & Schwarz | 2016-09-13 | 2018-09-13 |
| 0607 | LISN | ENV216 | 101342 | Rohde & Schwarz | 2017-09-06 | 2018-09-06 |
| 0538 | Transformer | Monophase | TIMM3.15 | Montelem | NA | NA |
| 095 | Millivoltmeter | 2000 | 4009301 | KEITHLEY | 2015-10-26 | 2017-10-26 |
| 0624 | AC power source | 61604 | SM135546 | CHROMA | NA | NA |
| 0346 | Multimeter | 34401A | US36054685 | HP | 2016-02-04 | 2018-02-04 |

N/A: Not Applicable

A.3 Measurement Uncertainty Evaluation

The system uncertainty evaluation is shown in the below table:

| Measurement type | Uncertainty [\pm dB] |
|----------------------------------|-------------------------|
| Conducted Power | ± 1.0 |
| Conducted Spurious Emission | ± 2.9 |
| Radiated tests <1GHz | ± 3.8 |
| Radiated tests 1GHz - 40 GHz | ± 4.7 |
| AC power-line conducted emission | ± 1.45 |

Annex B. Test Results U-NII-2C

B.1 Test Conditions

The conducted RF output power at chain A was adjusted according to the client's supplied Target values (see following table) using the Intel DRTU tool and measuring the power by using a spectrum analyser with the channel integration method according to point II) E) 2) e) (Method SA-2 Alternative) of Guidance 789033 D02. Measured values for adjustment were within +/- 0.25 dB from the declared Target values.

| U-NII-2C | | | | | Conducted Power Target Value (dBm) |
|----------|----------|-----------|---------|-------------|------------------------------------|
| Mode | BW (MHz) | Data Rate | CH # | Freq. (MHz) | SISO Chain A |
| 802.11a | 20 | 6Mbps | 100 | 5500 | 19.00 |
| | | | 120 | 5600 | 21.00 |
| | | | 140 | 5700 | 19.00 |
| 802.11n | 20 | HT0 | 100 | 5500 | 19.00 |
| | | | 120 | 5600 | 21.00 |
| | | | 140 | 5700 | 19.00 |
| | 40 | HT0 | 102F | 5510 | 17.00 |
| | | | 118F | 5590 | 22.00 |
| | | | 134F | 5670 | 20.00 |
| 802.11ac | 80 | VHT0 | 106ac80 | 5530 | 18.00 |
| | | | 122ac80 | 5610 | 22.00 |

| Overlapped channels between UNII-2C and UNII-3 | | | | | Conducted Power Target Value (dBm) |
|--|----------|-----------|---------|-------------|------------------------------------|
| Mode | BW (MHz) | Data Rate | CH # | Freq. (MHz) | SISO Chain A |
| 802.11n | 20 | HT0 | 144 | 5720 | 21.5 |
| | 40 | HT0 | 142F | 5710 | 21 |
| 802.11ac | 80 | VHT0 | 138ac80 | 5690 | 20.5 |

The following data rates were selected based on preliminary testing that identified those rates as the worst cases for output power and spurious levels at the band edges:

802.11a → 6Mbps

802.11n20 and 802.11n40 (SISO) → HT0

802.11ac80 (SISO) → VHT0

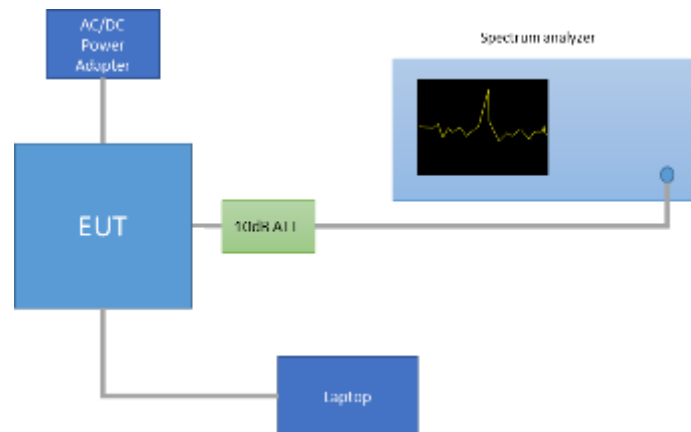
Alternative channels to the lowest and highest channels per band have been also tested for Band Edge compliance.

B.2 Test Results Tables

B.2.1 26dB & 99% Bandwidth

Test procedure

The setup below was used to measure the 26dB & 99% Bandwidth. The antenna terminal of the EUT is connected to the spectrum analyzer through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss.



For the overlapped channels between U-NII-2C and U-NII-3 bands, and according to FCC KDB 644545 D03, the boundary frequency between the bands is used as one edge for defining the portion of the 26dB bandwidth that falls within a particular U-NII band. This rule is only applicable for the 26dB bandwidth and for those channels marked as overlapped.

Results tables

U-NII-2C channels

| Mode | Rate | Antenna | Channel | Frequency [MHz] | 26dB BW [MHz] | 99% BW [MHz] |
|------------|-------|--------------|---------|-----------------|---------------|--------------|
| 802.11a | 6Mbps | SISO CHAIN A | 100 | 5500 | 24.22 | 16.84 |
| | | | 120 | 5600 | 27.48 | 17.44 |
| | | | 140 | 5700 | 24.57 | 16.80 |
| 802.11n20 | HT0 | | 100 | 5500 | 24.87 | 17.92 |
| | | | 120 | 5600 | 28.33 | 18.28 |
| | | | 140 | 5700 | 24.92 | 17.92 |
| 802.11n40 | HT0 | | 102F | 5510 | 44.95 | 36.56 |
| | | | 118F | 5590 | 85.23 | 38.48 |
| | | | 134F | 5670 | 45.59 | 36.72 |
| 802.11ac80 | VHT0 | | 106ac80 | 5530 | 85.78 | 75.24 |
| | | | 122ac80 | 5610 | 86.92 | 75.24 |

Max Value

Overlapped channels between U-NII-2C and U-NII-3

| Mode | Rate | Antenna | Channel | Freq. [MHz] | 26dB BW UNII-2C [MHz] |
|------------|------|--------------|---------|-------------|-----------------------|
| 802.11n20 | HT0 | SISO CHAIN A | 144 | 5720 | 19.87 |
| 802.11n40 | HT0 | SISO CHAIN A | 142F | 5710 | 38.71 |
| 802.11ac80 | VHT0 | SISO CHAIN A | 138ac80 | 5690 | 78.03 |

Max Value

B.2.2 Power Limits. Maximum Output power & Maximum power spectral Density

Test limits

| Part | Limits |
|-----------------------------|--|
| FCC 15.407 (a) (2) | For the 5.25–5.35 GHz and 5.47–5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz. In addition, the peak power spectral density shall not exceed 11 dBm in any 1 megahertz band. |
| RSS-247 Clause 6.2.3 (1) | <p>The maximum conducted output power shall not exceed 250 mW or $11 + 10 \log_{10} B$, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.</p> <p>The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10} B$, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.</p> |

Test procedure

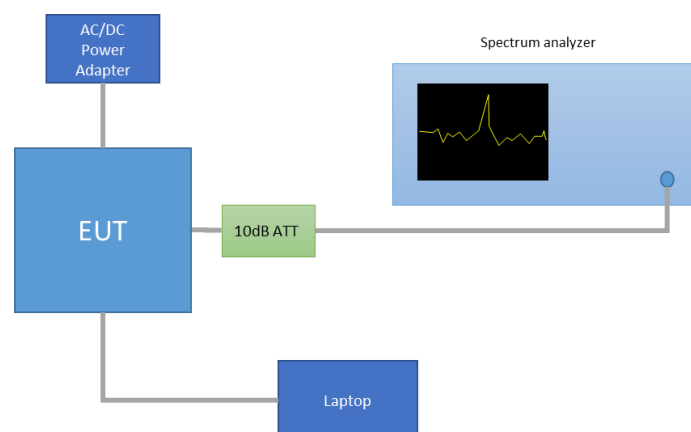
The Maximum Conducted Output Power was measured using the channel integration method according to point E) 2) e) (Method SA-2 Alternative) of KDB 789033 D02.

The maximum power spectral density (PSD) was measured using the method according to point F) (Method SA-2 Alternative) of KDB 789033 D02.

The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power.

The setup below was used to measure the maximum conducted output power and power spectral density. The antenna terminal of the EUT is connected to the spectrum analyser through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss.

The declared maximum antenna gain is 5dBi.



For the overlapped channels between U-NII-2C and U-NII-3, and according to FCC KDB 644545 D03, the power is computed based on the portion of the emission bandwidth contained within that band. This rule is only applicable for those channels marked as overlapped

Results tables

Duty cycle

| Mode | Rate | Antenna | Transmission Duration [ms] | Transmission Period [ms] | Duty Cycle [%] |
|------------|-------|---------|----------------------------|--------------------------|----------------|
| 802.11a | 6Mbps | SISO-A | 2.036 | 2.071 | 98.31% |
| 802.11n20 | HT0 | SISO-A | 1.894 | 1.929 | 98.19% |
| 802.11n40 | HT0 | SISO-A | 0.937 | 0.969 | 96.70% |
| 802.11ac80 | VHT0 | SISO-A | 0.458 | 0.493 | 92.90% |

Maximum output power – U-NII-2C Channels

| Mode | Rate | Channel | Freq. [MHz] | Antenna | Average Conducted Output Power [dBm] | Maximum* Conducted Output Power [dBm] | Maximum* Conducted Output Power [mW] | Max of EIRP [dBm] |
|------------|-------|---------|-------------|--------------|--------------------------------------|---------------------------------------|--------------------------------------|-------------------|
| 802.11a | 6Mbps | 100 | 5500 | SISO CHAIN A | 19.24 | 19.24 | 83.95 | 24.24 |
| | | 120 | 5600 | SISO CHAIN A | 21.15 | 21.15 | 130.32 | 26.15 |
| | | 140 | 5700 | SISO CHAIN A | 19.15 | 19.15 | 82.22 | 24.15 |
| 802.11n20 | HT0 | 100 | 5500 | SISO CHAIN A | 19.14 | 19.14 | 82.04 | 24.14 |
| | | 120 | 5600 | SISO CHAIN A | 21.04 | 21.04 | 127.06 | 26.04 |
| | | 140 | 5700 | SISO CHAIN A | 19.07 | 19.07 | 80.72 | 24.07 |
| 802.11n40 | HT0 | 102F | 5510 | SISO CHAIN A | 17.08 | 17.23 | 52.79 | 22.23 |
| | | 118F | 5590 | SISO CHAIN A | 21.77 | 21.92 | 155.45 | 26.92 |
| | | 134F | 5670 | SISO CHAIN A | 19.63 | 19.78 | 94.97 | 24.78 |
| 802.11ac80 | VHT0 | 106ac80 | 5610 | SISO CHAIN A | 17.82 | 18.14 | 65.16 | 23.14 |
| | | 122ac80 | 5570 | SISO CHAIN A | 21.69 | 22.01 | 158.85 | 27.01 |

* Maximum values are the duty cycle compensated values calculated from the average (measured) values

Max Value

Min Value

Maximum output power – Overlapped channels between U-NII-2C and U-NII-3

| Mode | Rate | Channel | Freq. [MHz] | Antenna | Average Cond. Output Power - UNII- 2C [dBm] | Max.* Cond. Output Power - UNII-2C [dBm] | Max.* Cond. Output Power - UNII-2C [mW] | Max.* EIRP UNII2C [dBm] |
|------------|------|---------|----------------|--------------|--|---|--|----------------------------------|
| 802.11n20 | HT0 | 144 | 5720 | SISO CHAIN A | 20.21 | 20.29 | 106.89 | 25.29 |
| 802.11n40 | HT0 | 142F | 5710 | SISO CHAIN A | 20.21 | 20.36 | 108.54 | 25.36 |
| 802.11ac80 | VHT0 | 138ac80 | 5690 | SISO CHAIN A | 20.31 | 20.63 | 115.61 | 25.63 |

* Maximum values are the duty cycle compensated values calculated from the measured average values
Max Value

Maximum Power Spectral Density (PSD) – U-NII-2C channels

| Mode | Rate | Channel | Freq. [MHz] | Antenna | Average conducted PSD [dBm/MHz] | Maximum* conducted PSD [dBm/MHz] |
|------------|-------|---------|-------------|--------------|---------------------------------|----------------------------------|
| 802.11a | 6Mbps | 100 | 5500 | SISO CHAIN A | 7.54 | 7.54 |
| | | 120 | 5600 | SISO CHAIN A | 9.45 | 9.45 |
| | | 140 | 5700 | SISO CHAIN A | 7.46 | 7.46 |
| 802.11n20 | HT0 | 100 | 5500 | SISO CHAIN A | 7.16 | 7.16 |
| | | 120 | 5600 | SISO CHAIN A | 9.02 | 9.02 |
| | | 140 | 5700 | SISO CHAIN A | 7.08 | 7.08 |
| 802.11n40 | HT0 | 102F | 5510 | SISO CHAIN A | 1.98 | 2.13 |
| | | 118F | 5590 | SISO CHAIN A | 6.68 | 6.83 |
| | | 134F | 5670 | SISO CHAIN A | 4.53 | 4.68 |
| 802.11ac80 | VHT0 | 106ac80 | 5610 | SISO CHAIN A | 0.41 | 0.73 |
| | | 122ac80 | 5570 | SISO CHAIN A | 4.3 | 4.62 |

* Maximum values are the duty cycle compensated values calculated from the average (measured) values

Maximum Power Spectral Density (PSD) – Overlapped channels between U-NII-2C and U-NII-3

| Mode | Rate | Channel | Freq. [MHz] | Antenna | Average Cond. Output Power - UNII-2C [dBm] | Max.* Cond. Output Power - UNII-2C [dBm] |
|------------|------|---------|-------------|--------------|--|--|
| 802.11n20 | HT0 | 144 | 5720 | SISO CHAIN A | 9.19 | 9.27 |
| 802.11n40 | HT0 | 142F | 5710 | SISO CHAIN A | 5.45 | 5.60 |
| 802.11ac80 | VHT0 | 138ac80 | 5690 | SISO CHAIN A | 3.03 | 3.35 |

* Maximum values are the duty cycle compensated values calculated from the average (measured) values

B.2.3 Undesirable emission limits : Band Edge (Conducted)

Test limits

| FCC part | RSS part | Limits |
|-------------------|--------------------------------|--|
| 15.407 (b) (3) | RSS-247 Clause 6.2.3 (2) | For transmitters operating in the 5.47–5.725 GHz band: all emissions outside of the 5.47–5.725 GHz band shall not exceed an EIRP of -27 dBm/MHz. |
| 15.209 | RSS-GEN, Clause 8.9 | Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a): |
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Test procedure

The setup below was used to measure undesirable emissions on the Band Edge domain. The antenna terminal of the EUT is connected to the spectrum analyzer through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss and the declared Antenna Gain.

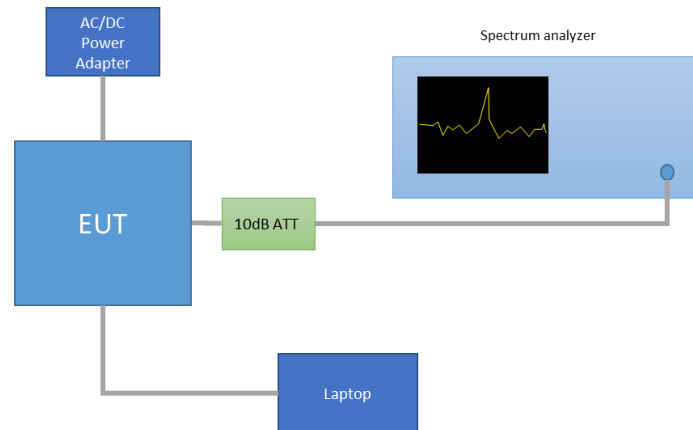
For Band Edge measurements in average mode on the low frequency section, the Video Bandwidth Method was used according to section G) 6) (KDB 789033 D02), with the following parameters:

- When the duty cycle is > 98 %, VBW = 10Hz
- When the duty cycle is < 98 %, VBW > 1/T, where T is defined in section II.B.1.a

For the BE High, we use the integration method as defined in the band edge measurements section (paragraph II.G.3.d) of KDB 789033 D02.

In case of Band Edge measurements falling in restricted bands, the declared Antenna Gain is also compensated in the graph.

The declared maximum antenna gain is 5dBi.



The following limits in dBm were applied for the average detector after the conversion from the limits detailed above in dBμV/m, according to FCC 47 CFR part 15 - Subpart C – §15.209(a). The limits in dBm for peak detector are 20dB above the indicated values in the table.

| §15.209(a) | | | Converted values | |
|------------------|--------------|-----------------------------------|--------------------------------------|-------------|
| Freq Range (MHz) | Distance (m) | Field strength (microvolts/meter) | Field strength (dB microvolts/meter) | Power (dBm) |
| 960-25000 | 3 | 500 | 53.98 | -41.25 |

See Section B.3.4 for the screenshot results.

B.2.4 Radiated spurious emission

Standard references

| FCC part | RSS part | Limits | | | | | | | | | | | | | | | | | | | | |
|------------------|--------------------------------|---|--------------------|-----------------------|-------------------------|--------------------|-------|-----|----|---|--------|-----|------|---|---------|-----|----|---|-----------|-----|----|---|
| 15.407 (b) (3) | RSS-247 Clause 6.2.3 (2) | For transmitters operating in the 5.47–5.725 GHz band: all emissions outside of the 5.47–5.725 GHz band shall not exceed an EIRP of -27 dBm/MHz. | | | | | | | | | | | | | | | | | | | | |
| 15.209 | RSS-GEN, Clause 8.9 | <p>Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a):</p> <table><tr><th>Freq Range (MHz)</th><th>Field Strength (μV/m)</th><th>Field Strength (dBμV/m)</th><th>Meas. Distance (m)</th></tr><tr><td>30-88</td><td>100</td><td>40</td><td>3</td></tr><tr><td>88-216</td><td>150</td><td>43.5</td><td>3</td></tr><tr><td>216-960</td><td>200</td><td>46</td><td>3</td></tr><tr><td>Above 960</td><td>500</td><td>54</td><td>3</td></tr></table> <p>The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.</p> <p>For average radiated emission measurements above 1000 MHz, there is also a limit specified when measuring with peak detector function, corresponding to 20 dB above the indicated values in the table.</p> | Freq Range (MHz) | Field Strength (μV/m) | Field Strength (dBμV/m) | Meas. Distance (m) | 30-88 | 100 | 40 | 3 | 88-216 | 150 | 43.5 | 3 | 216-960 | 200 | 46 | 3 | Above 960 | 500 | 54 | 3 |
| Freq Range (MHz) | Field Strength (μV/m) | Field Strength (dBμV/m) | Meas. Distance (m) | | | | | | | | | | | | | | | | | | | |
| 30-88 | 100 | 40 | 3 | | | | | | | | | | | | | | | | | | | |
| 88-216 | 150 | 43.5 | 3 | | | | | | | | | | | | | | | | | | | |
| 216-960 | 200 | 46 | 3 | | | | | | | | | | | | | | | | | | | |
| Above 960 | 500 | 54 | 3 | | | | | | | | | | | | | | | | | | | |

Test procedure

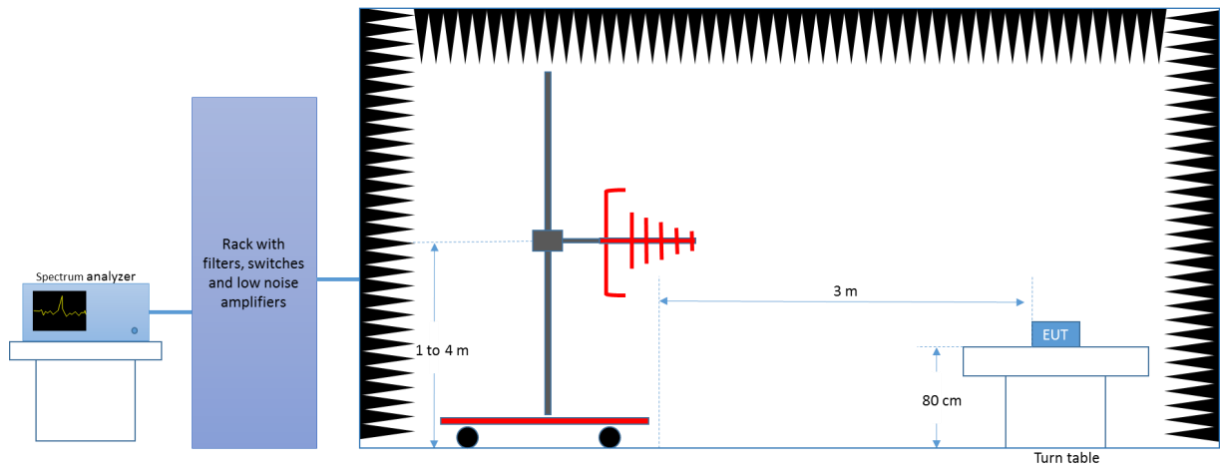
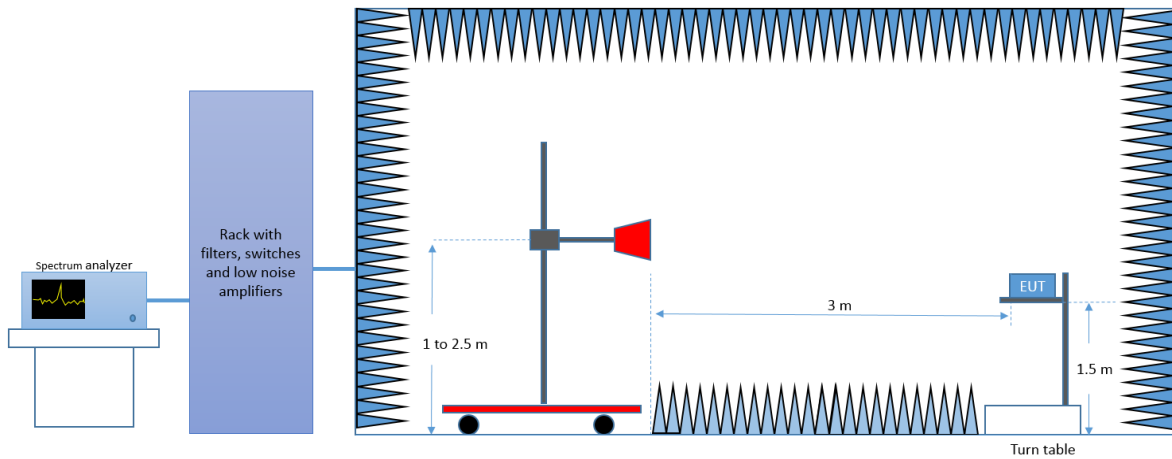
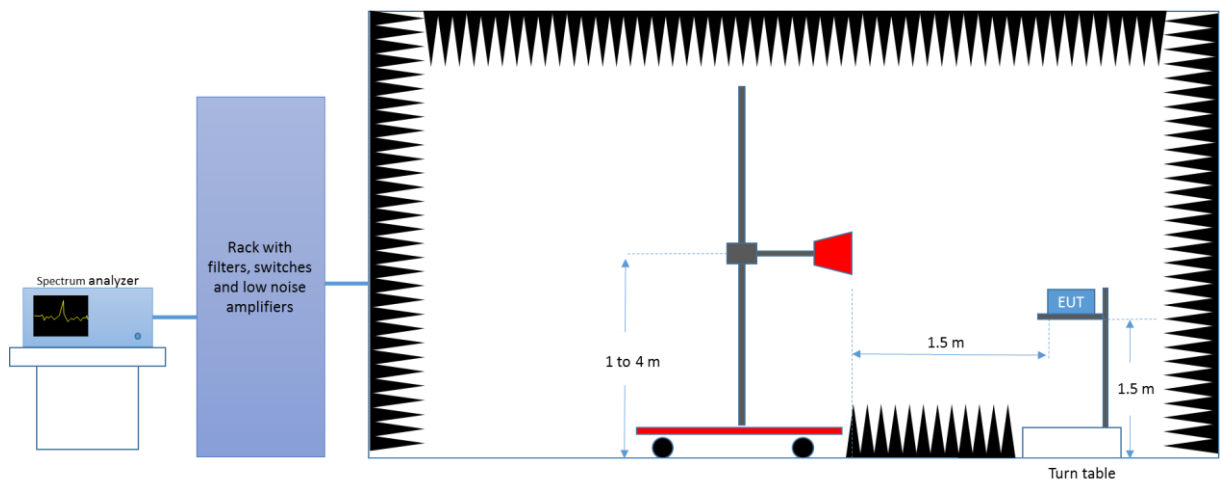
The setup below was used to measure the radiated spurious emissions.

Depending of the frequency range and bands being tested, different antennas and filters were used.

The final measurement is done by varying the antenna height, the EUT azimuth over 360° and for both Vertical and Horizontal polarizations.

The radiated spurious emission was measured on the worst case configuration selected from the chapter B.2.2 and using the low, middle and high channel.

Test Report N° 170727-01.TR02

Radiated Setup < 1GHz

Radiated Setup 1 GHz - 18 GHz

Radiated Setup 18 GHz - 40 GHz


Test Results

30 MHz – 40 GHz, 802.11a, 6Mbps, Chain A

Radiated Spurious – CH100

| Frequency | MaxPeak | Avg | Limit | Margin |
|-----------|---------|--------|--------|--------|
| MHz | dBμV/m | dBμV/m | dBμV/m | dB |
| 62.5 | 31.4 | --- | 40.0 | 8.6 |
| 6026.4 | --- | 48.6 | 54.0 | 5.4 |
| 6065.0 | 60.1 | --- | 74.0 | 13.9 |
| 16488.9 | 56.2 | --- | 74.0 | 17.8 |
| 16502.7 | --- | 44.7 | 54.0 | 9.3 |
| 21999.7 | --- | 40.3 | 54.0 | 13.7 |
| 22000.2 | 45.4 | --- | 74.0 | 28.6 |
| 35082.1 | --- | 34.2 | 54.0 | 19.9 |
| 35082.1 | 45.8 | --- | 74.0 | 28.2 |

Radiated Spurious – CH120

| Frequency | MaxPeak | Avg | Limit | Margin |
|-----------|---------|--------|--------|--------|
| MHz | dBμV/m | dBμV/m | dBμV/m | dB |
| 62.5 | 31.1 | --- | 40.0 | 8.9 |
| 6053.9 | --- | 48.7 | 54.0 | 5.3 |
| 6091.0 | 61.1 | --- | 74.0 | 12.9 |
| 17522.2 | --- | 45.5 | 54.0 | 8.5 |
| 17531.1 | 57.2 | --- | 74.0 | 16.8 |
| 22400.2 | --- | 44.2 | 54.0 | 9.8 |
| 22400.2 | 49.6 | --- | 74.0 | 24.4 |
| 33607.8 | --- | 37.0 | 54.0 | 17.0 |
| 33611.6 | 46.6 | --- | 74.0 | 27.4 |

Radiated Spurious – CH140

| Frequency | MaxPeak | Avg | Limit | Margin |
|-----------|---------|--------|--------|--------|
| MHz | dBμV/m | dBμV/m | dBμV/m | dB |
| 62.4 | 32.0 | --- | 40.0 | 8.0 |
| 6054.2 | --- | 48.5 | 54.0 | 5.6 |
| 6134.4 | 60.5 | --- | 74.0 | 13.6 |
| 17097.0 | 58.2 | --- | 74.0 | 15.8 |
| 17101.9 | --- | 46.8 | 54.0 | 7.2 |
| 22800.1 | 48.6 | --- | 74.0 | 25.4 |
| 22800.1 | --- | 45.9 | 54.0 | 8.1 |
| 34196.9 | --- | 36.5 | 54.0 | 17.5 |
| 34209.5 | 46.3 | --- | 74.0 | 27.8 |

30 MHz – 40 GHz, 802.11n20, HT0, Chain A

Radiated Spurious – CH100

| Frequency | MaxPeak | Avg | Limit | Margin |
|-----------|---------|--------|--------|--------|
| MHz | dBμV/m | dBμV/m | dBμV/m | dB |
| 47.4 | 33.3 | --- | 40.0 | 6.7 |
| 6059.3 | 60.9 | --- | 74.0 | 13.1 |
| 6064.5 | --- | 49.3 | 54.0 | 4.8 |
| 16504.9 | --- | 45.2 | 54.0 | 8.8 |
| 16508.5 | 55.5 | --- | 74.0 | 18.5 |
| 21999.7 | --- | 39.7 | 54.0 | 14.3 |
| 21999.7 | 45.9 | --- | 74.0 | 28.1 |
| 38059.9 | 45.3 | --- | 74.0 | 28.7 |
| 38102.3 | --- | 34.7 | 54.0 | 19.3 |

Radiated Spurious – CH120

| Frequency | MaxPeak | Avg | Limit | Margin |
|-----------|---------|--------|--------|--------|
| MHz | dBμV/m | dBμV/m | dBμV/m | dB |
| 53.0 | 31.7 | --- | 40.0 | 8.4 |
| 6046.8 | 61.1 | --- | 74.0 | 12.9 |
| 6059.8 | --- | 49.4 | 54.0 | 4.6 |
| 17636.8 | 57.6 | --- | 74.0 | 16.4 |
| 17644.4 | --- | 46.0 | 54.0 | 8.0 |
| 22399.2 | 51.7 | --- | 74.0 | 22.4 |
| 22400.2 | --- | 43.6 | 54.0 | 10.4 |
| 33598.1 | --- | 36.5 | 54.0 | 17.5 |
| 33603.9 | 47.7 | --- | 74.0 | 26.3 |

Radiated Spurious – CH140

| Frequency | MaxPeak | Avg | Limit | Margin |
|-----------|---------|--------|--------|--------|
| MHz | dBμV/m | dBμV/m | dBμV/m | dB |
| 38.1 | 33.8 | --- | 40.0 | 6.3 |
| 6064.7 | --- | 49.3 | 54.0 | 4.7 |
| 6071.8 | 60.7 | --- | 74.0 | 13.3 |
| 17096.1 | --- | 46.7 | 54.0 | 7.3 |
| 17097.4 | 58.7 | --- | 74.0 | 15.4 |
| 22800.1 | 49.3 | --- | 74.0 | 24.7 |
| 22800.1 | --- | 46.3 | 54.0 | 7.7 |
| 35009.3 | --- | 35.4 | 54.0 | 18.6 |
| 35028.1 | 45.7 | --- | 74.0 | 28.3 |

30 MHz – 40 GHz, 802.11n40, HT0, Chain A

Radiated Spurious – CH102F

| Frequency | MaxPeak | Avg | Limit | Margin |
|-----------|---------|--------|--------|--------|
| MHz | dBμV/m | dBμV/m | dBμV/m | dB |
| 62.5 | 32.0 | --- | 40.0 | 8.0 |
| 6070.4 | --- | 49.3 | 54.0 | 4.7 |
| 6070.8 | 61.7 | --- | 74.0 | 12.3 |
| 17648.0 | 58.4 | --- | 74.0 | 15.6 |
| 17650.7 | --- | 45.9 | 54.0 | 8.1 |
| 22039.9 | --- | 41.6 | 54.0 | 12.4 |
| 22039.9 | 45.4 | --- | 74.0 | 28.6 |
| 35011.8 | --- | 35.3 | 54.0 | 18.7 |
| 35056.6 | 45.6 | --- | 74.0 | 28.4 |

Radiated Spurious – CH118F

| Frequency | MaxPeak | Avg | Limit | Margin |
|-----------|---------|--------|--------|--------|
| MHz | dBμV/m | dBμV/m | dBμV/m | dB |
| 55.0 | 33.0 | --- | 40.0 | 7.0 |
| 6023.5 | 61.2 | --- | 74.0 | 12.9 |
| 6025.7 | --- | 48.3 | 54.0 | 5.7 |
| 17031.8 | 56.4 | --- | 74.0 | 17.6 |
| 17032.3 | --- | 44.4 | 54.0 | 9.6 |
| 22360.0 | --- | 42.3 | 54.0 | 11.7 |
| 22360.0 | 47.2 | --- | 74.0 | 26.8 |
| 35001.1 | --- | 35.0 | 54.0 | 19.0 |
| 35015.6 | 45.7 | --- | 74.0 | 28.4 |

Radiated Spurious – CH134F

| Frequency | MaxPeak | Avg | Limit | Margin |
|-----------|---------|--------|--------|--------|
| MHz | dBμV/m | dBμV/m | dBμV/m | dB |
| 47.2 | 31.9 | --- | 40.0 | 8.1 |
| 6065.2 | 60.6 | --- | 74.0 | 13.4 |
| 6065.7 | --- | 48.9 | 54.0 | 5.1 |
| 17012.7 | 56.9 | --- | 74.0 | 17.1 |
| 17013.1 | --- | 46.3 | 54.0 | 7.7 |
| 22680.2 | --- | 45.2 | 54.0 | 8.8 |
| 22680.2 | 48.1 | --- | 74.0 | 25.9 |
| 37799.0 | --- | 34.7 | 54.0 | 19.4 |
| 37823.6 | 45.3 | --- | 74.0 | 28.7 |

30 MHz – 40 GHz, 802.11ac80, HT0, Chain A

Radiated Spurious – CH106ac80

| Frequency | MaxPeak | Avg | Limit | Margin |
|-----------|---------|--------|--------|--------|
| MHz | dBµV/m | dBµV/m | dBµV/m | dB |
| 46.4 | 34.0 | --- | 40.0 | 6.0 |
| 6085.8 | --- | 49.5 | 54.0 | 4.5 |
| 6087.3 | 61.3 | --- | 74.0 | 12.7 |
| 17039.4 | --- | 44.4 | 54.0 | 9.7 |
| 17045.7 | 56.0 | --- | 74.0 | 18.0 |
| 22119.7 | 45.3 | --- | 74.0 | 28.7 |
| 22120.1 | --- | 40.2 | 54.0 | 13.9 |
| 35011.8 | 45.6 | --- | 74.0 | 28.4 |
| 35023.8 | --- | 35.0 | 54.0 | 19.0 |

Radiated Spurious – CH122ac80

| Frequency | MaxPeak | Avg | Limit | Margin |
|-----------|---------|--------|--------|--------|
| MHz | dBµV/m | dBµV/m | dBµV/m | dB |
| 62.5 | 30.4 | --- | 40.0 | 9.6 |
| 6209.3 | 60.8 | --- | 74.0 | 13.2 |
| 6211.0 | --- | 48.9 | 54.0 | 5.1 |
| 17043.4 | 56.5 | --- | 74.0 | 17.5 |
| 17048.4 | --- | 44.7 | 54.0 | 9.3 |
| 22439.8 | --- | 43.1 | 54.0 | 10.9 |
| 22440.3 | 46.9 | --- | 74.0 | 27.1 |
| 35013.2 | 45.8 | --- | 74.0 | 28.2 |
| 35014.6 | --- | 35.3 | 54.0 | 18.7 |

Radiated Spurious – CH138ac80

| Frequency | MaxPeak | Avg | Limit | Margin |
|-----------|---------|--------|--------|--------|
| MHz | dBμV/m | dBμV/m | dBμV/m | dB |
| 62.5 | 31.3 | --- | 40.0 | 8.8 |
| 6110.4 | 61.0 | --- | 74.0 | 13.0 |
| 6110.9 | --- | 48.8 | 54.0 | 5.2 |
| 17049.7 | 56.2 | --- | 74.0 | 17.8 |
| 17070.7 | --- | 46.1 | 54.0 | 7.9 |
| 22760.0 | --- | 46.0 | 54.0 | 8.0 |
| 22760.0 | 48.8 | --- | 74.0 | 25.2 |
| 37799.0 | --- | 34.7 | 54.0 | 19.4 |
| 37823.6 | 45.3 | --- | 74.0 | 28.7 |

B.2.5 AC power-line conducted emission

Standard references:

| FCC part | RSS part | Limits | | | | | | | | | | | | | | |
|-----------------------------|------------------------------|---|-----------------------------|------------------------------|--|------------|---------|----------|-----------|-----------|-------|----|----|------|----|----|
| 15.207 15.407 (6) | RSS-GEN, Clause 8.8 | <p>Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.</p> <table> <tr> <th rowspan="2">Frequency of emission (MHz)</th><th colspan="2">Conducted limit (dBμV)</th></tr> <tr> <th>Quasi-peak</th><th>Average</th></tr> <tr> <td>0.15-0.5</td><td>66 to 56*</td><td>56 to 46*</td></tr> <tr> <td>0.5-5</td><td>56</td><td>46</td></tr> <tr> <td>5-30</td><td>60</td><td>50</td></tr> </table> <p>*Decreases with the logarithm of the frequency.</p> | Frequency of emission (MHz) | Conducted limit (dB μ V) | | Quasi-peak | Average | 0.15-0.5 | 66 to 56* | 56 to 46* | 0.5-5 | 56 | 46 | 5-30 | 60 | 50 |
| Frequency of emission (MHz) | Conducted limit (dB μ V) | | | | | | | | | | | | | | | |
| | Quasi-peak | Average | | | | | | | | | | | | | | |
| 0.15-0.5 | 66 to 56* | 56 to 46* | | | | | | | | | | | | | | |
| 0.5-5 | 56 | 46 | | | | | | | | | | | | | | |
| 5-30 | 60 | 50 | | | | | | | | | | | | | | |

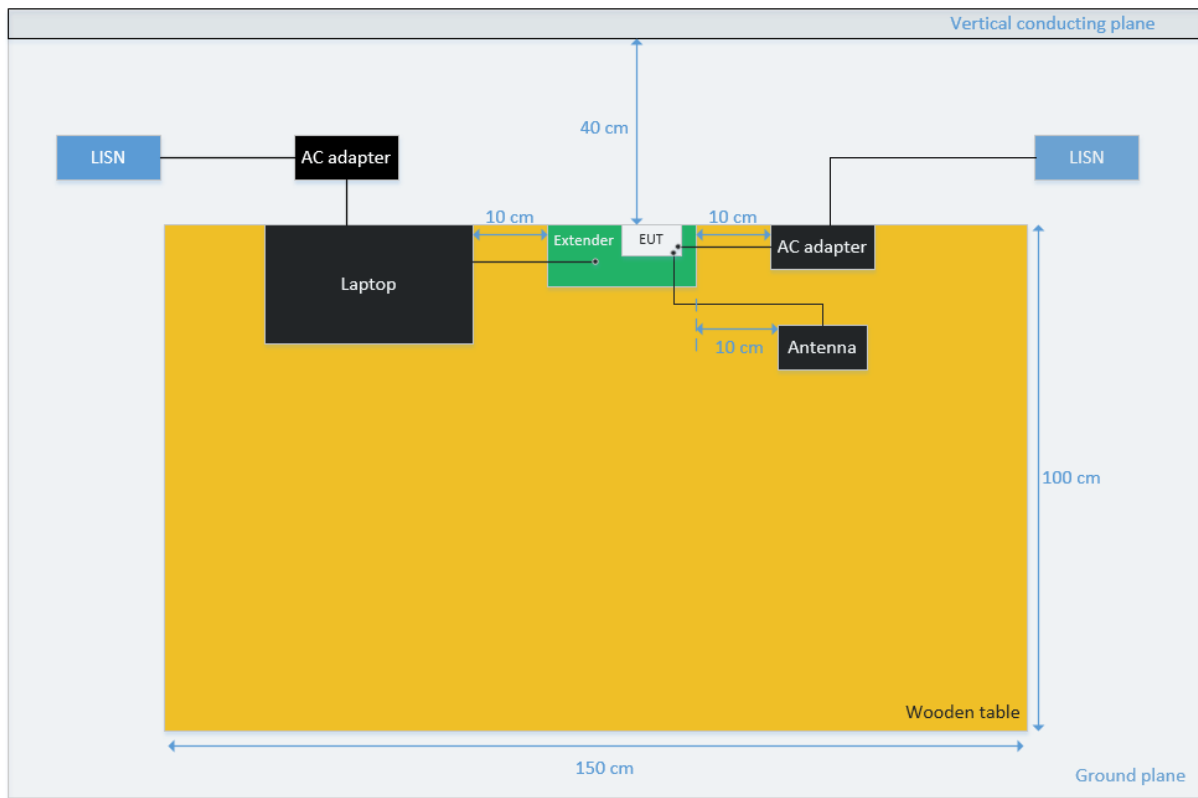
Test procedure:

The EUT and peripherals are placed on a wooden table with a nominal size of 1.0 m by 1.5 m, raised 80 cm above the reference ground plane. The EUT is connected to AC-Power line through a Line Impedance Stabilization Network (LISN) to accommodate a 50 Ω /50 μ H coupling impedance for the measurement system. The EUT control PC is considered as a peripheral and therefore is connected to a second LISN which has the measurement port connected to a 50 ohms impedance.

Each measurement is done for each current-carrying conductor (Line and Neutral) at the end plug of the EUT power cord. The EUT is tested for several transmission modes (frequency channel, modulation, etc.) and the result providing the maximum measured emission is reported.

The exploratory measurement is done over the frequency range from 150 kHz to 30 MHz, while the measurement receiver is recording the Peak and Average signal at 10 kHz steps in Max Hold mode. The cables manipulation is performed within the range of likely configurations to determine the maximum emission. Once the EUT cable configuration, arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit is found the six highest AC power-line conducted emissions relative to 20 dB of the limit are reported as the final measurement. If fewer than six emission frequencies are within 20 dB of the limit, the noise level is reported. For the final measurement, the measurement receiver records the Quasi Peak values with 9 kHz resolution bandwidth and the average values with 10 kHz resolution bandwidth.

EUT arrangement for AC power-line conducted emission tests



Sample Calculation:

The measured level at the spectrum analyzer in dBuV is corrected by a transducer factor taking into account the losses of the RF cable and the LISN as follows:

$$\text{Conducted Emission level (dBuV)} = \text{SA}_{\text{Level}} + \text{RFCable}_{\text{Losses}} + \text{LISN}_{\text{Losses}}$$

Where:

SA_{Level} is the voltage level displayed on the measurement receiver, in dBuV.

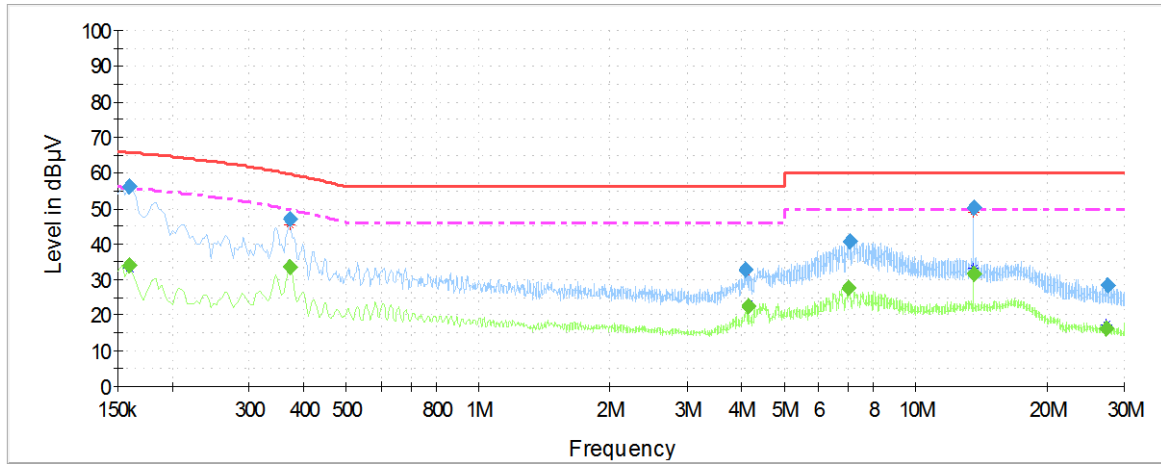
$\text{RFCable}_{\text{Losses}}$ is the value of the cable losses between the LISN and the measurement receiver, in dB.

$\text{LISN}_{\text{Losses}}$ is the value of the insertion losses of the LISN, in dB.

Test Results:

150kHz – 30MHz, all mode

AC power-line conducted – Phase L1

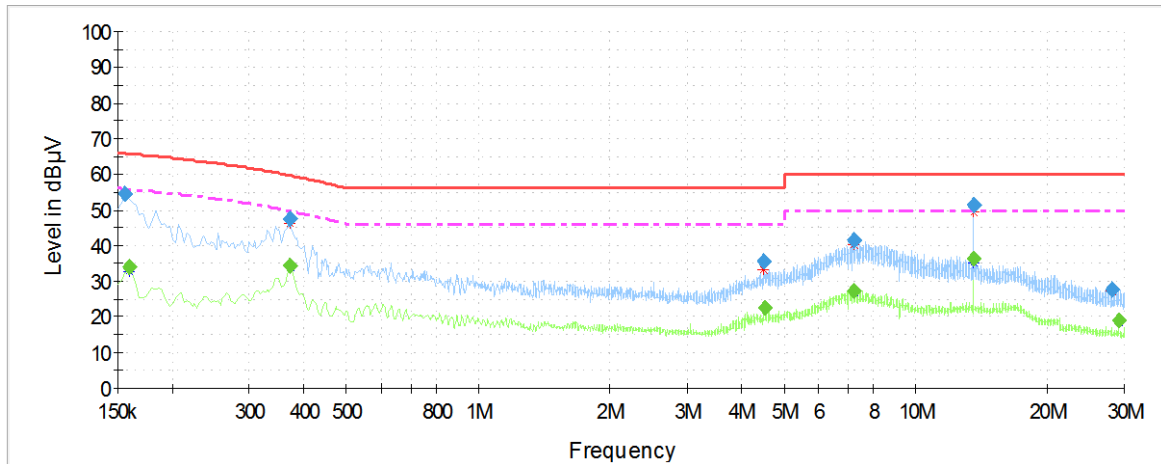


— Peak measurements — Avg measurements — Limit FCC Quasi-Peak - - - Limit FCC Avg

| Frequency | Max Peak | Avg | Limit | Margin |
|-----------|----------|-------|-------|--------|
| MHz | dBµV | dBµV | dBµV | dB |
| 0.1529 | 55.81 | -- | 65.83 | 10.02 |
| 0.1529 | -- | 31.96 | 55.83 | 23.87 |
| 0.3679 | 47.40 | -- | 59.77 | 12.37 |
| 0.3679 | -- | 32.71 | 49.77 | 17.06 |
| 4.496 | 34.72 | -- | 56.00 | 21.29 |
| 4.496 | -- | 22.50 | 46.00 | 23.50 |
| 7.505 | 41.88 | -- | 60.00 | 18.12 |
| 7.505 | -- | 27.78 | 50.00 | 22.22 |
| 13.561 | 54.96 | -- | 60.00 | 5.04 |
| 13.561 | -- | 36.55 | 50.00 | 13.45 |
| 20.474 | 31.02 | -- | 60.00 | 28.98 |
| 20.474 | -- | 19.04 | 50.00 | 30.96 |

Note: The emissions found do not change with the modulation and/or frequency.

AC power-line conducted – Neutral N



— Peak measurements — Avg measurements — Limit FCC Quasi-Peak - - - Limit FCC Avg

| Frequency | Max Peak | Avg | Limit | Margin |
|-----------|----------|-------|-------|--------|
| MHz | dBµV | dBµV | dBµV | dB |
| 0.1559 | 57.37 | -- | 65.83 | 8.46 |
| 0.1559 | -- | 34.31 | 55.83 | 21.52 |
| 0.3708 | 48.11 | -- | 59.69 | 11.58 |
| 0.3708 | -- | 34.67 | 49.69 | 15.02 |
| 3.824 | 31.26 | -- | 56.00 | 24.74 |
| 3.824 | -- | 20.45 | 46.00 | 25.55 |
| 7.299 | 41.74 | -- | 60.00 | 18.26 |
| 7.305 | -- | 28.71 | 50.00 | 21.29 |
| 13.552 | 47.29 | -- | 60.00 | 12.71 |
| 13.576 | -- | 31.98 | 50.00 | 18.02 |
| 20.98 | 32.52 | -- | 60.00 | 27.48 |
| 20.98 | -- | 19.47 | 50.00 | 30.53 |

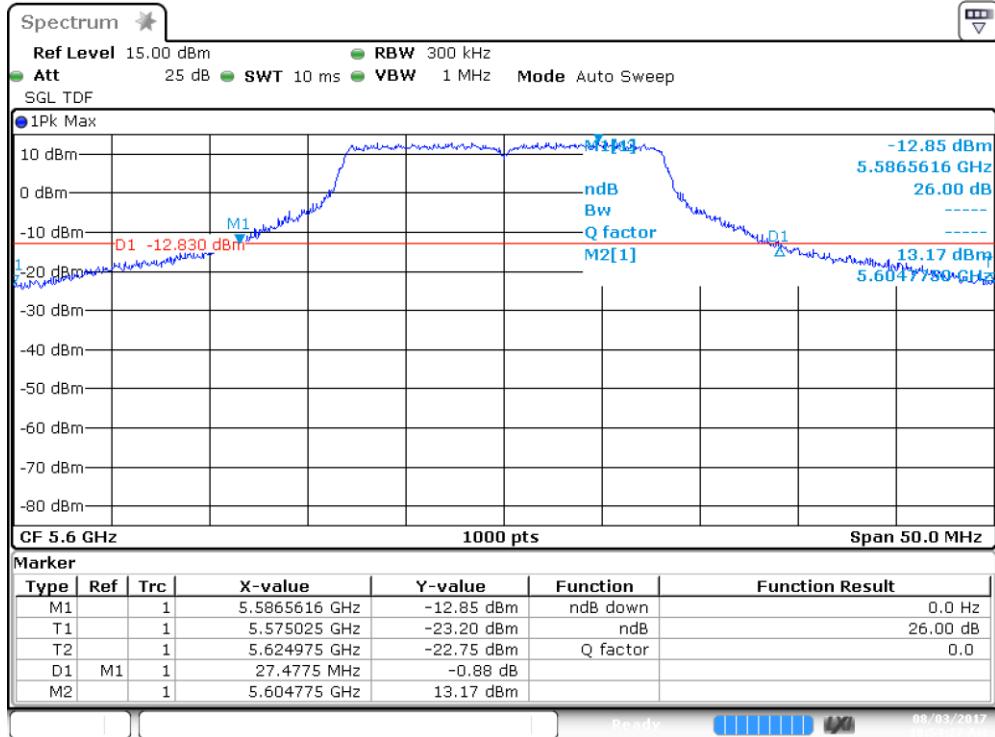
Note: The emissions found do not change with the modulation and/or frequency.

B.3 Test Results Screenshots

B.3.1 26dB Bandwidth

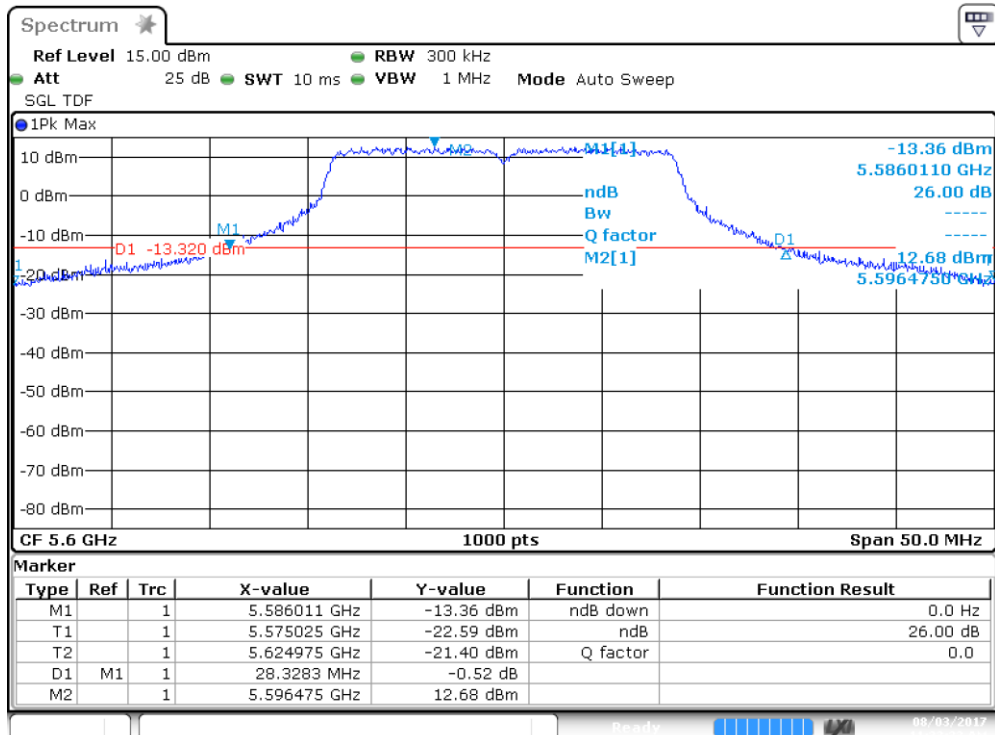
SISO-A, 802.11a, 6Mbps

Channel 120



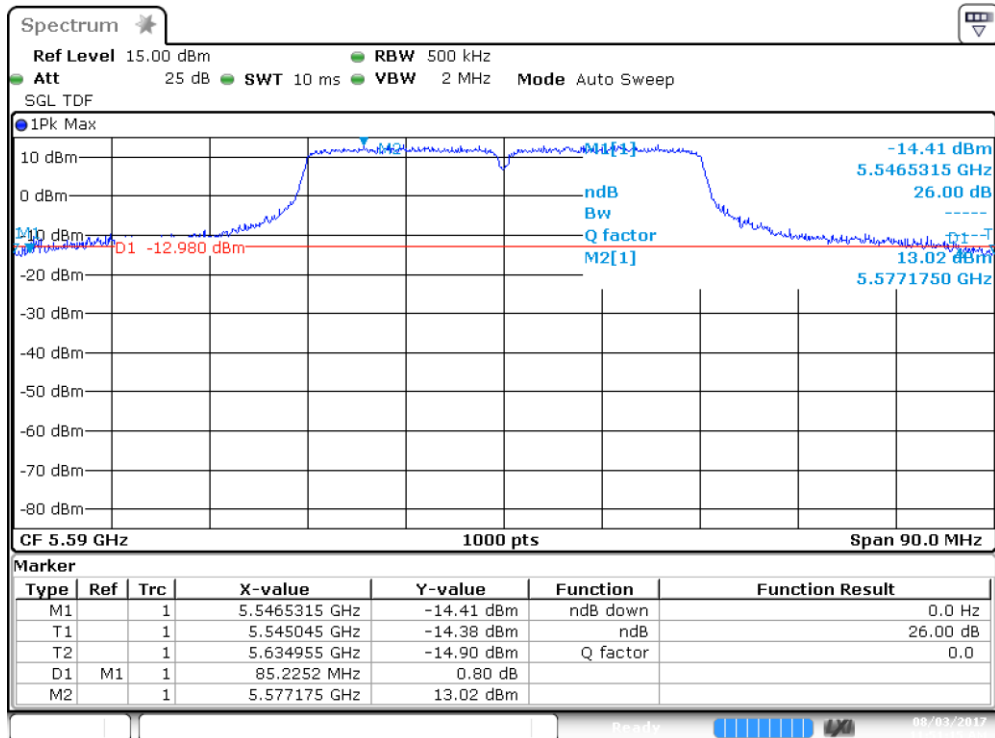
SISO-A, 802.11n20, HT0

Channel 120



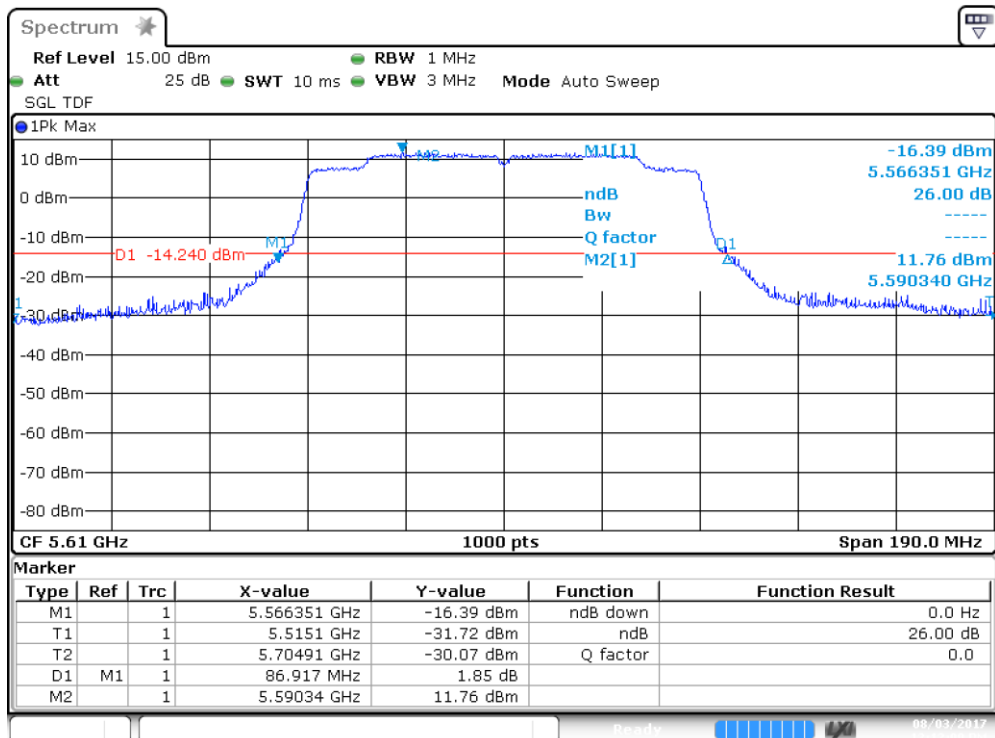
SISO-A, 802.11n40, HT0

Channel 118F



SISO-A, 802.11ac80, VHT0

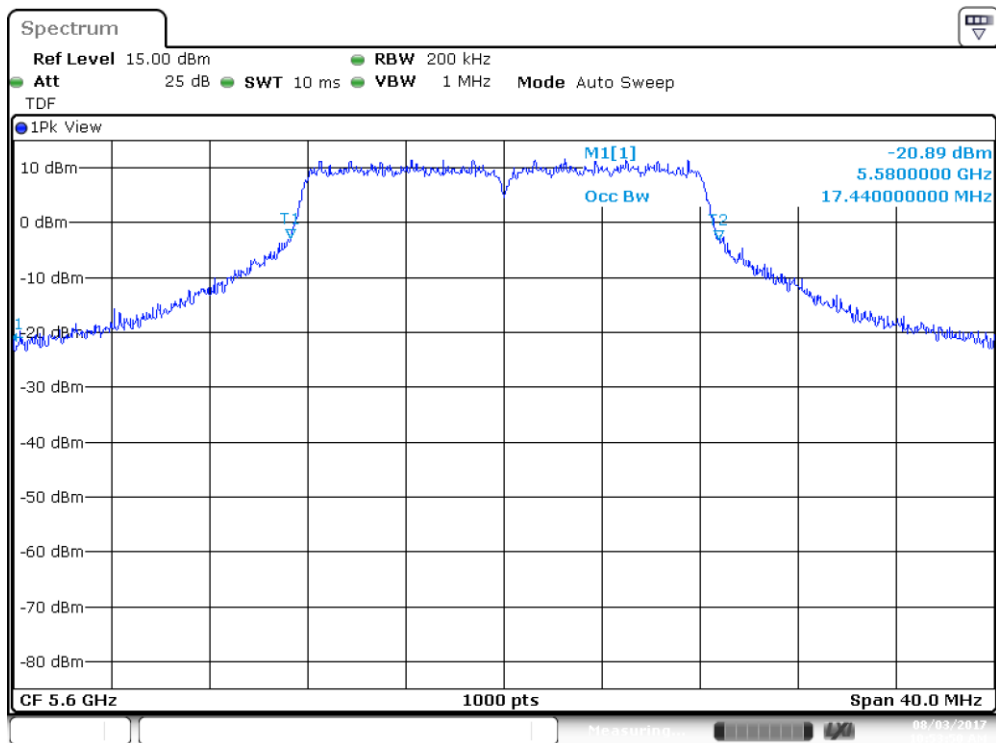
Channel 122ac80



B.3.2 99% Bandwidth

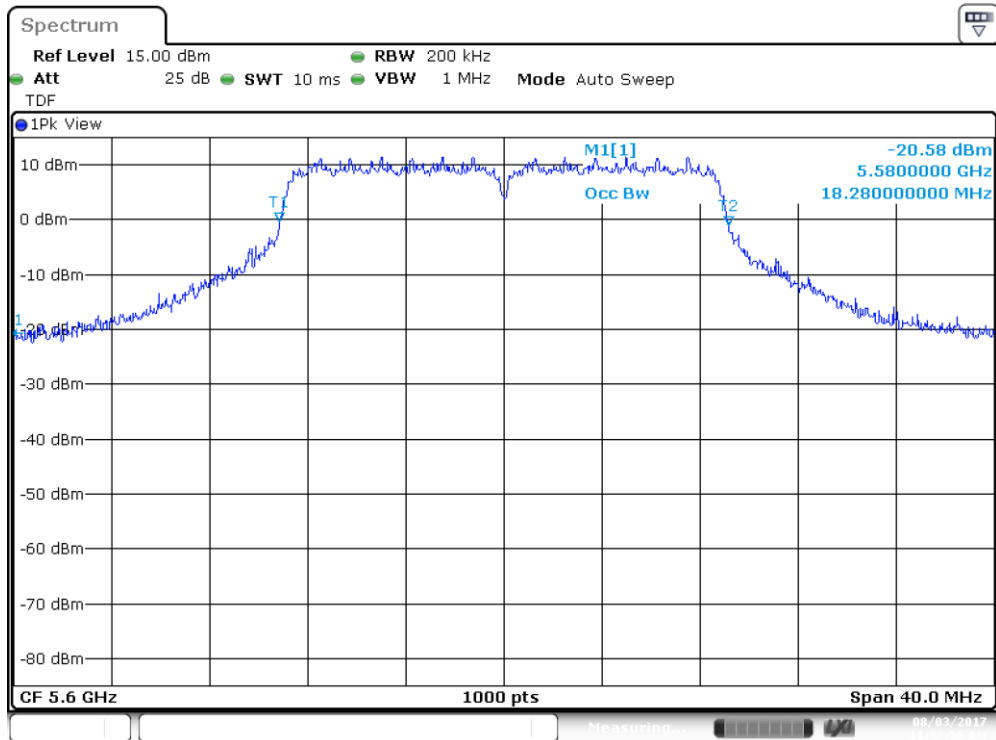
SISO-A, 802.11a, 6Mbps

Channel 120



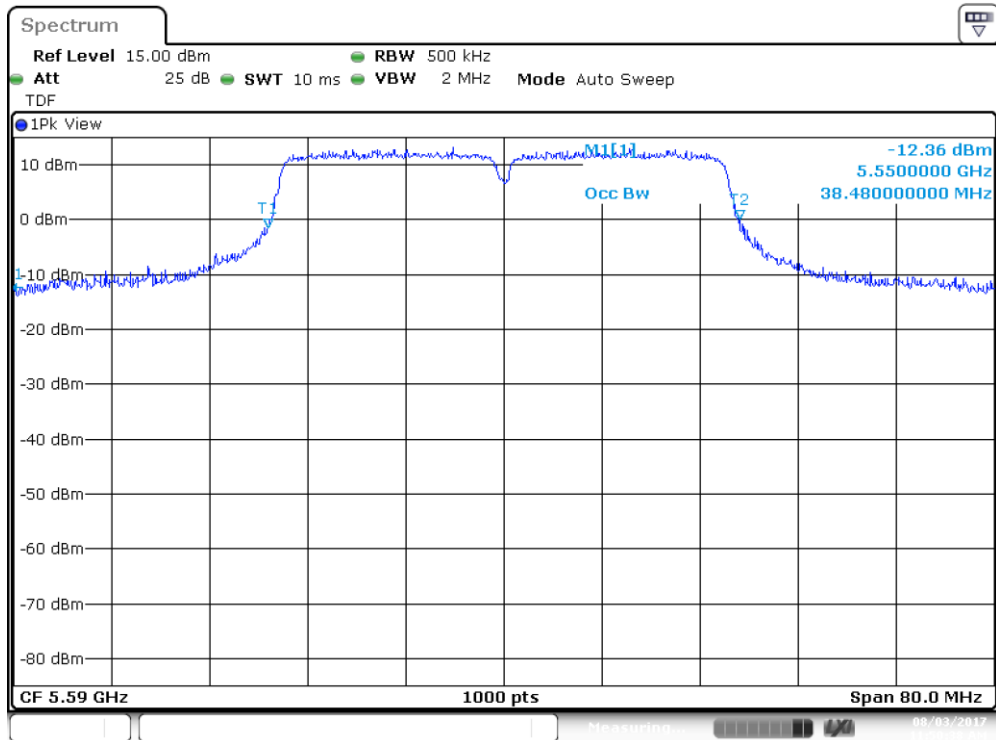
SISO-A, 802.11n20, HT0

Channel 120



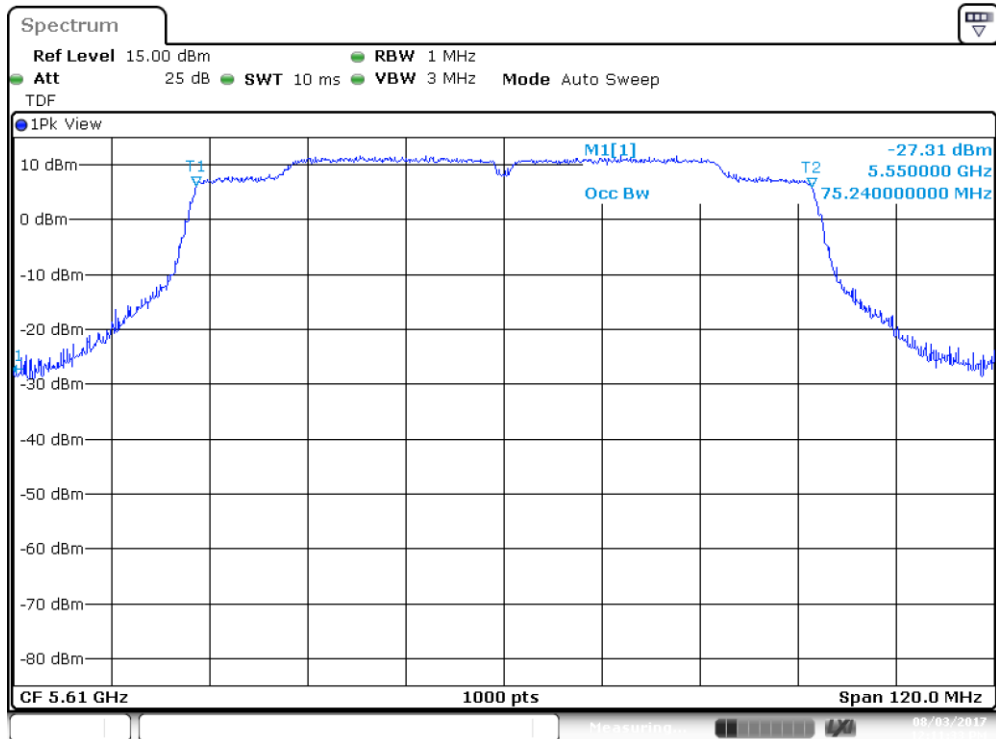
SISO-A, 802.11n40, HT0

Channel 118F



SISO-A, 802.11ac80, VHT0

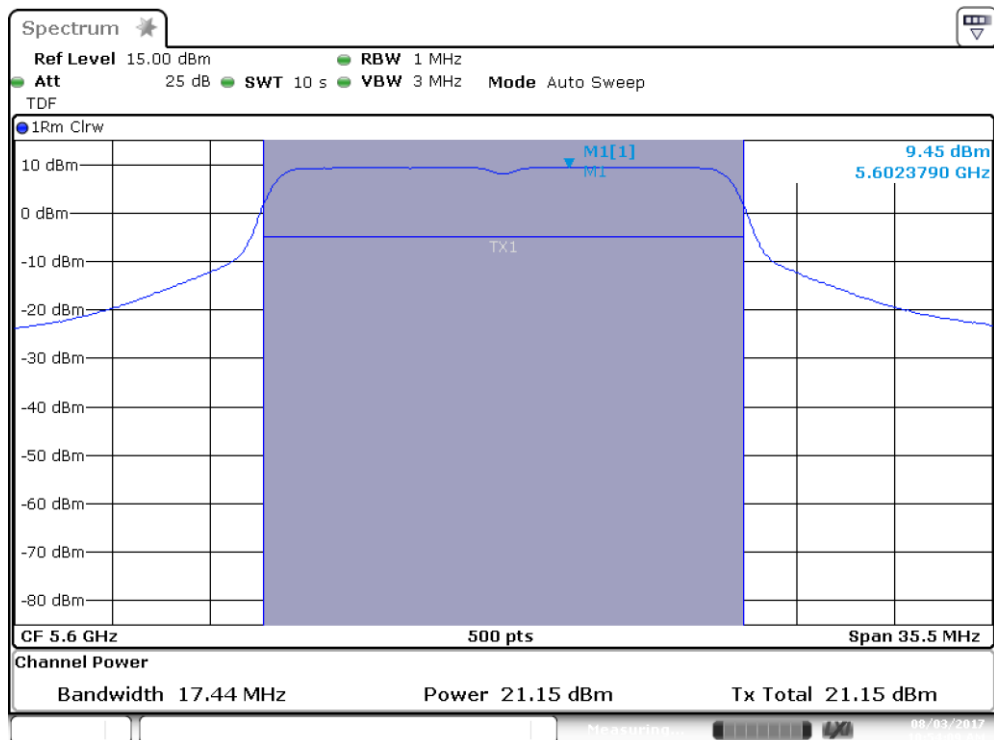
Channel 122ac80



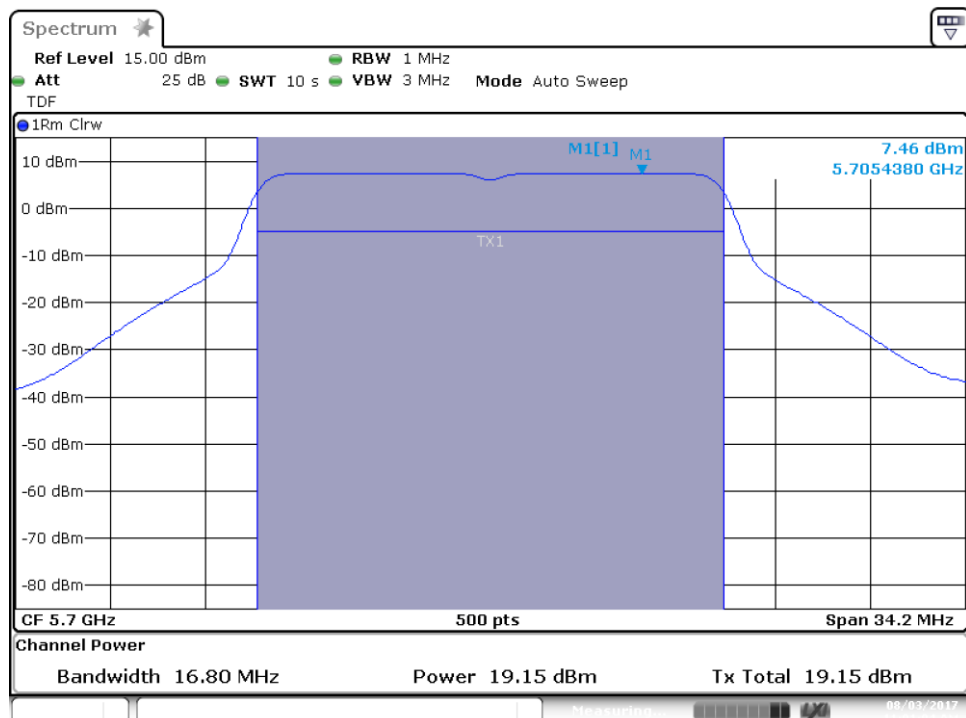
B.3.3 Maximum Output Power & Maximum power spectral Density

SISO-A, 802.11a, 6Mbps

Channel 120

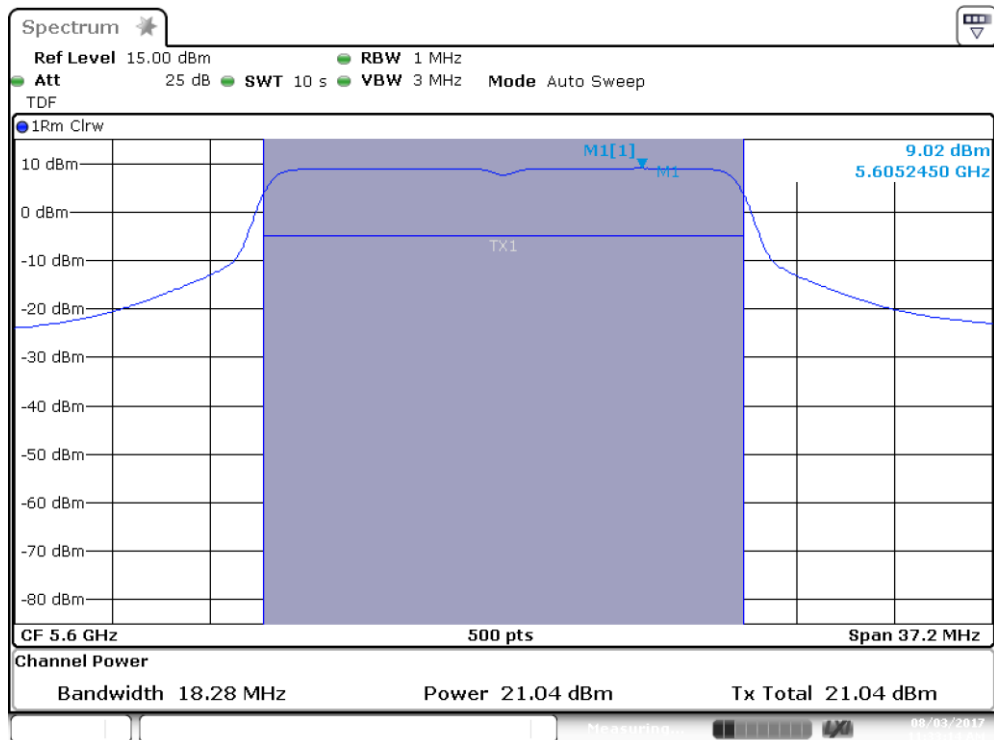


Channel 140

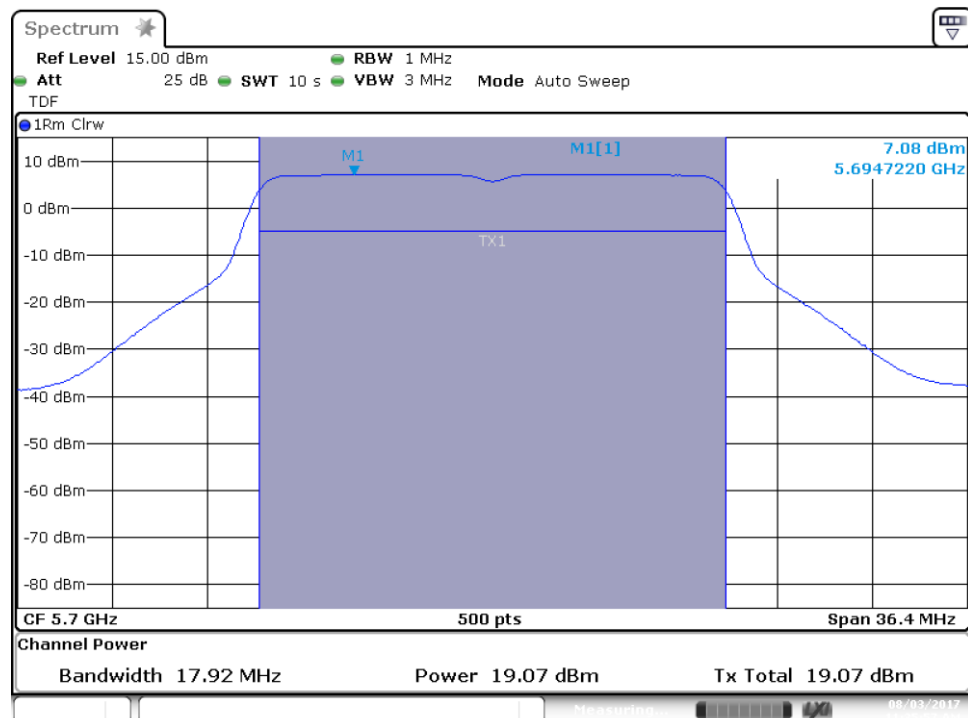


SISO-A, 802.11n20, HT0

Channel 120

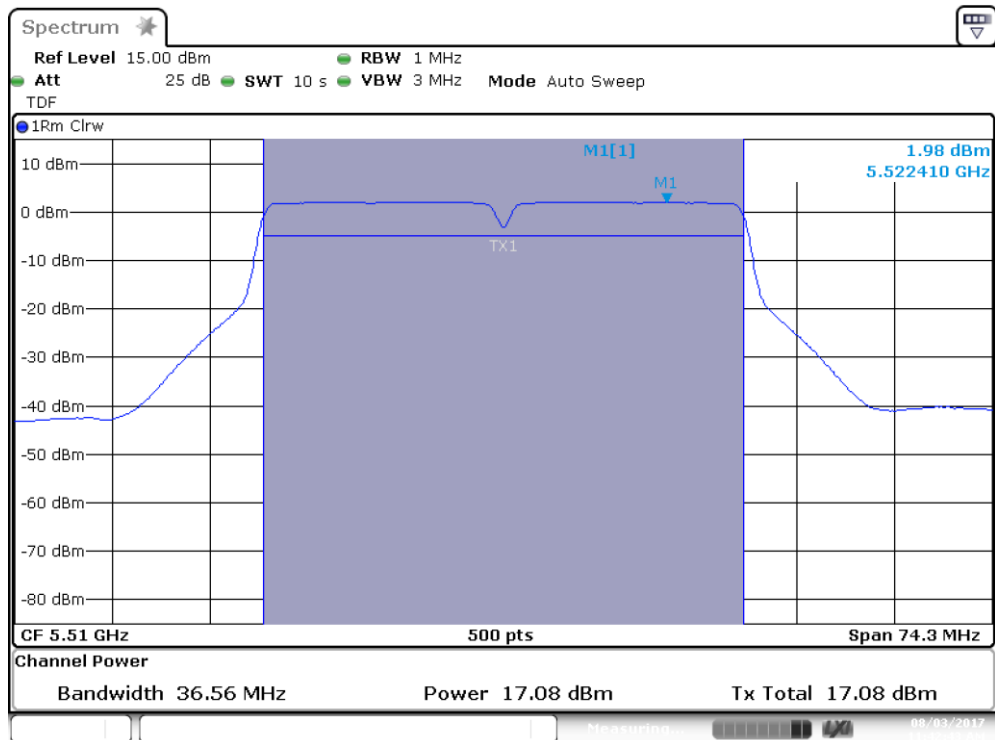


Channel 140

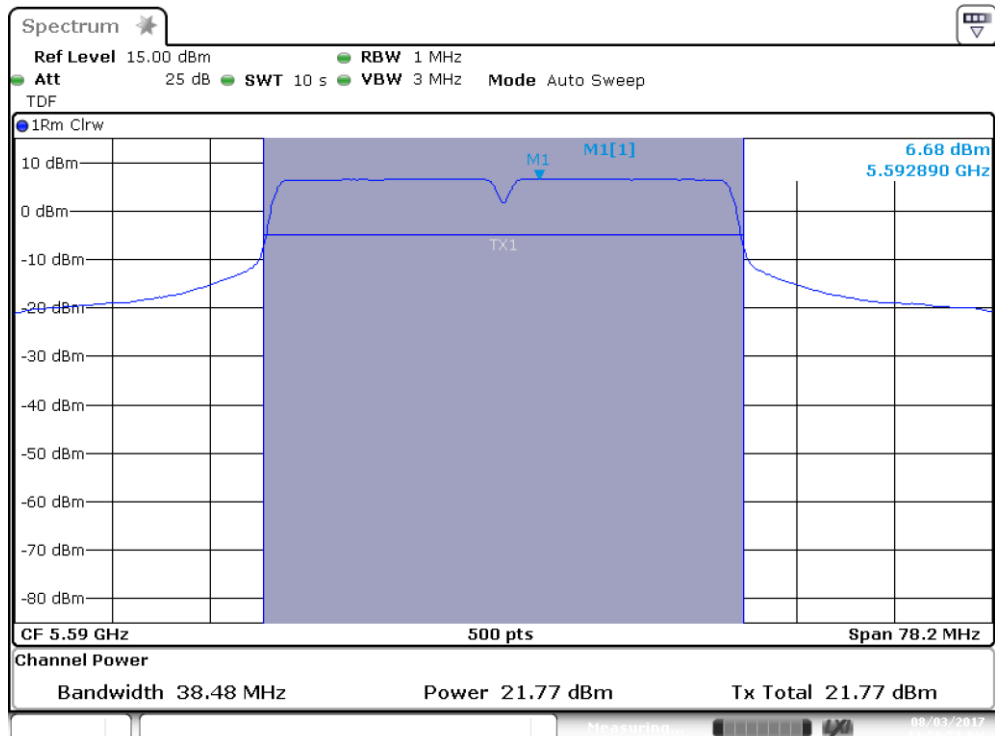


SISO-A, 802.11n40, HT0

Channel 102F

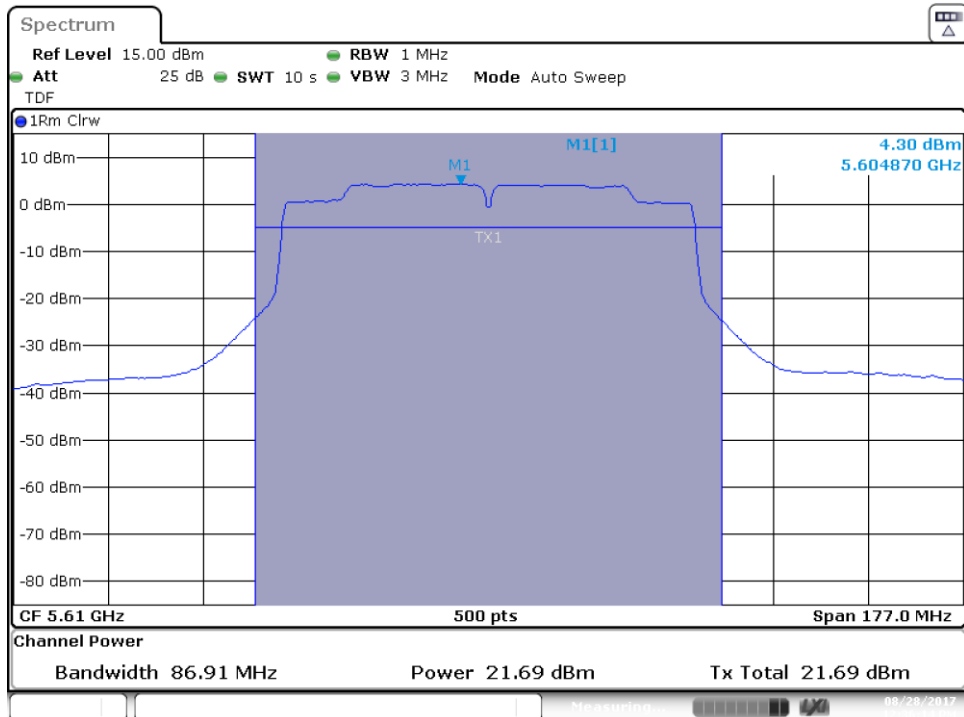


Channel 118F

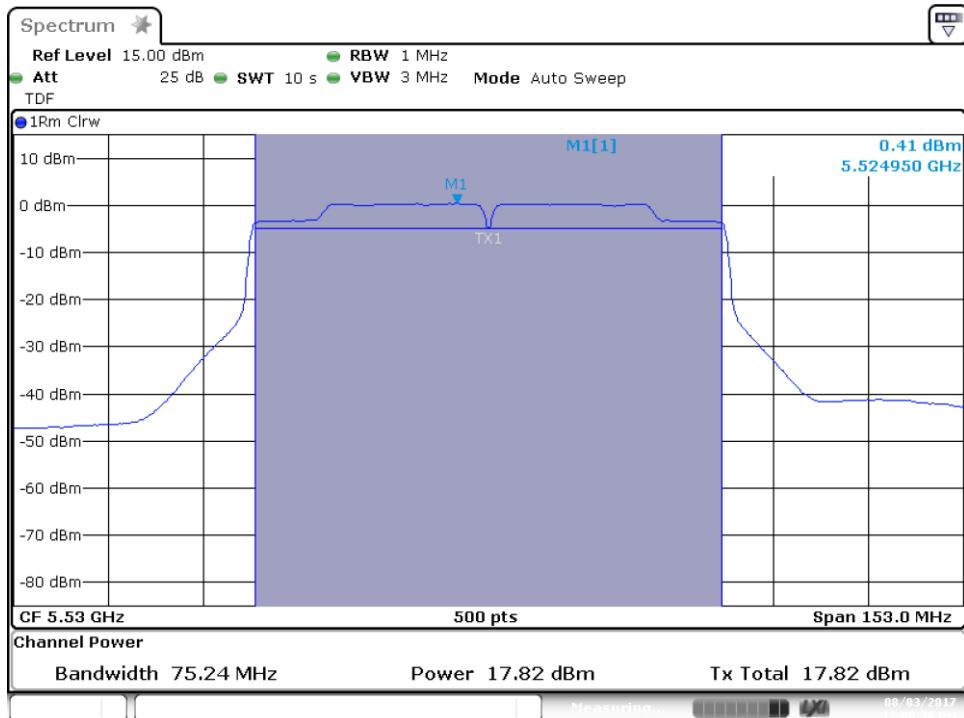


SISO-A, 802.11ac80, VHT0

Channel 122ac80



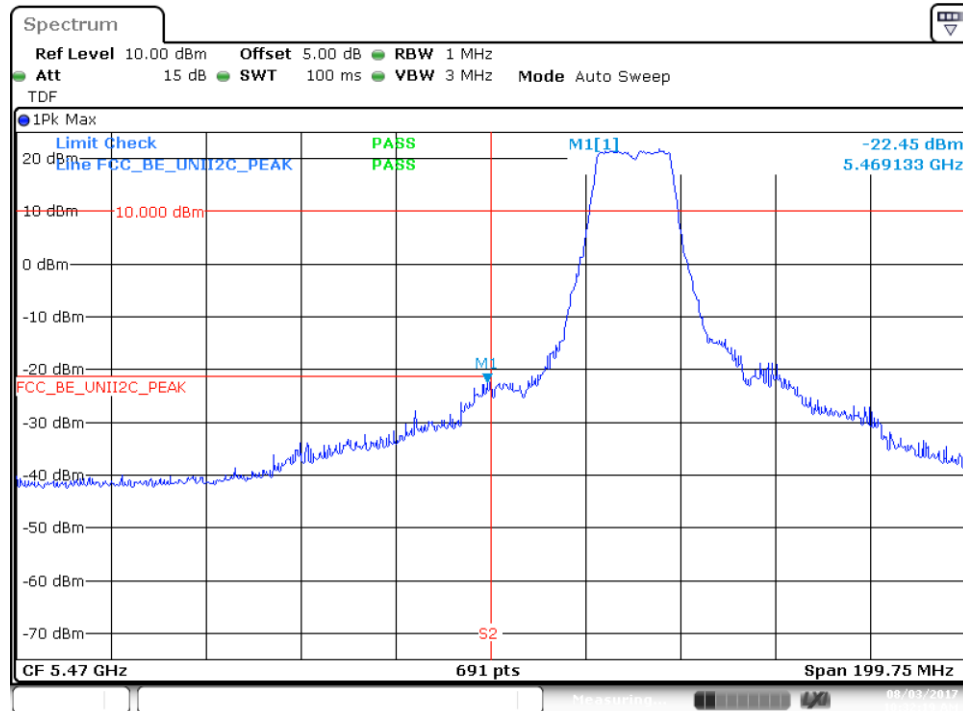
Channel 106ac80



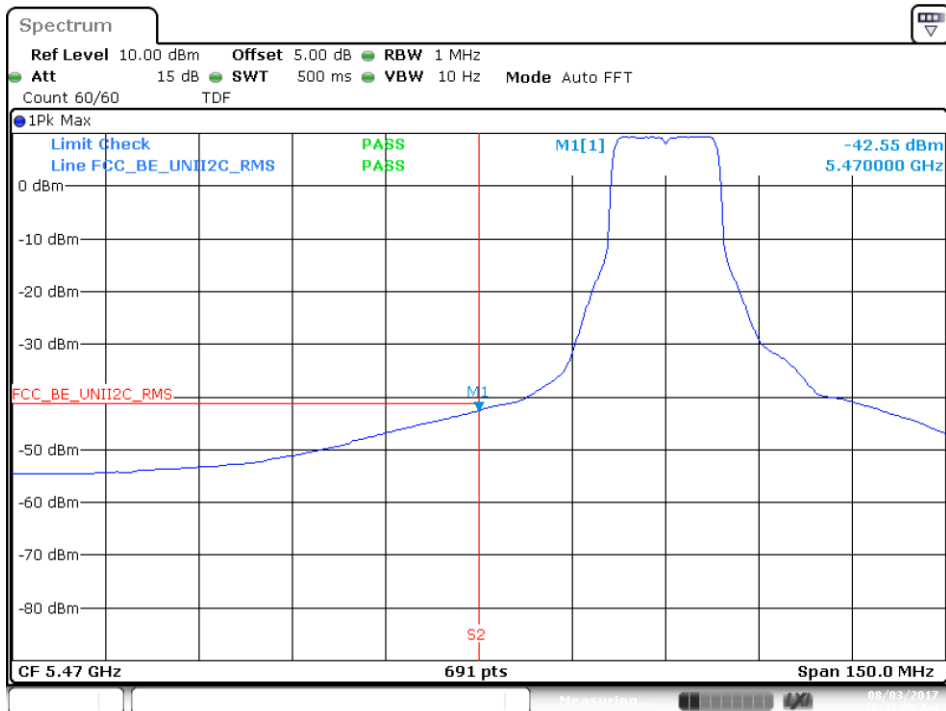
B.3.4 Undesirable emission limits : Band Edge (Conducted)

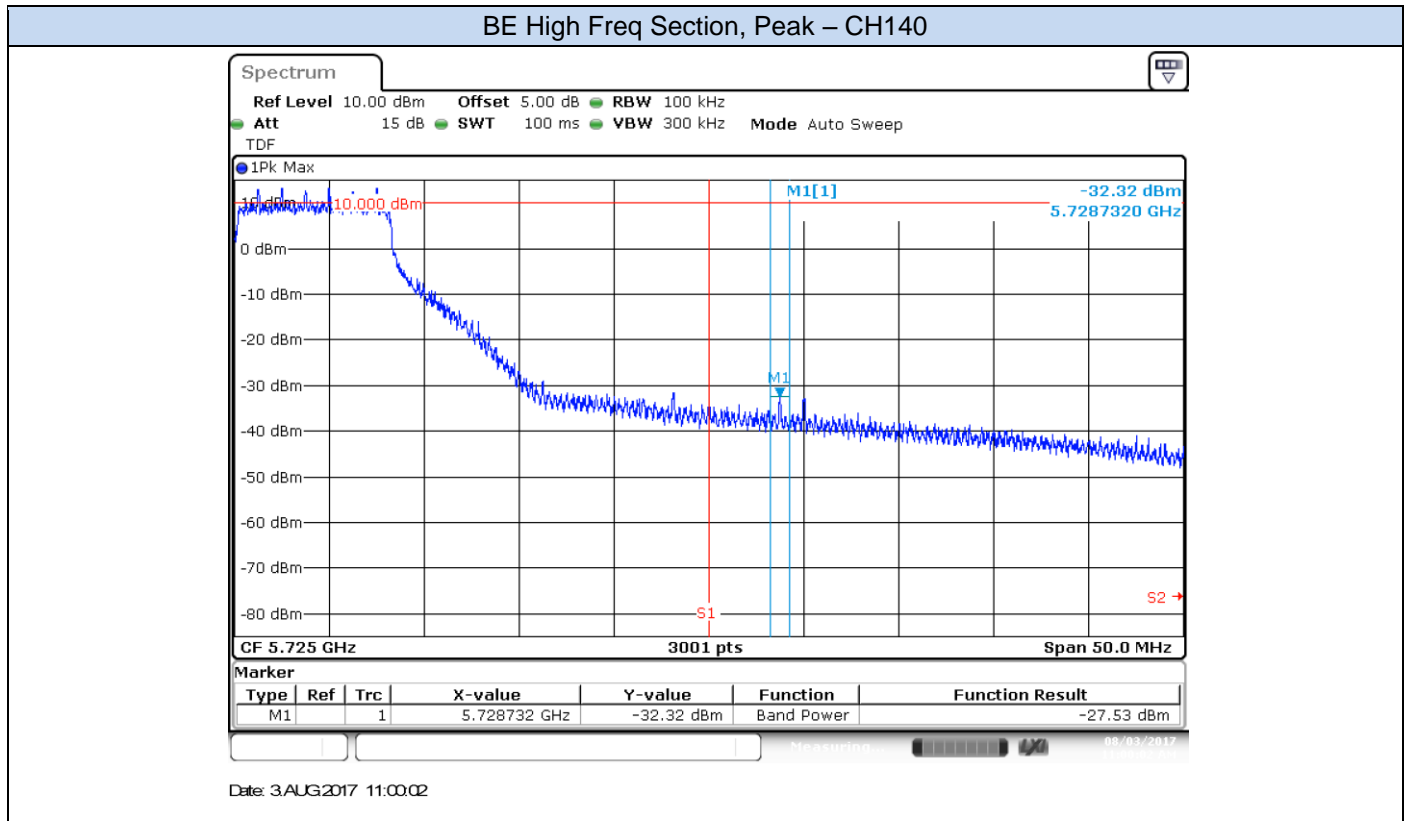
802.11a, 6Mbps – Chain A

BE Low Freq Section, Peak – CH100



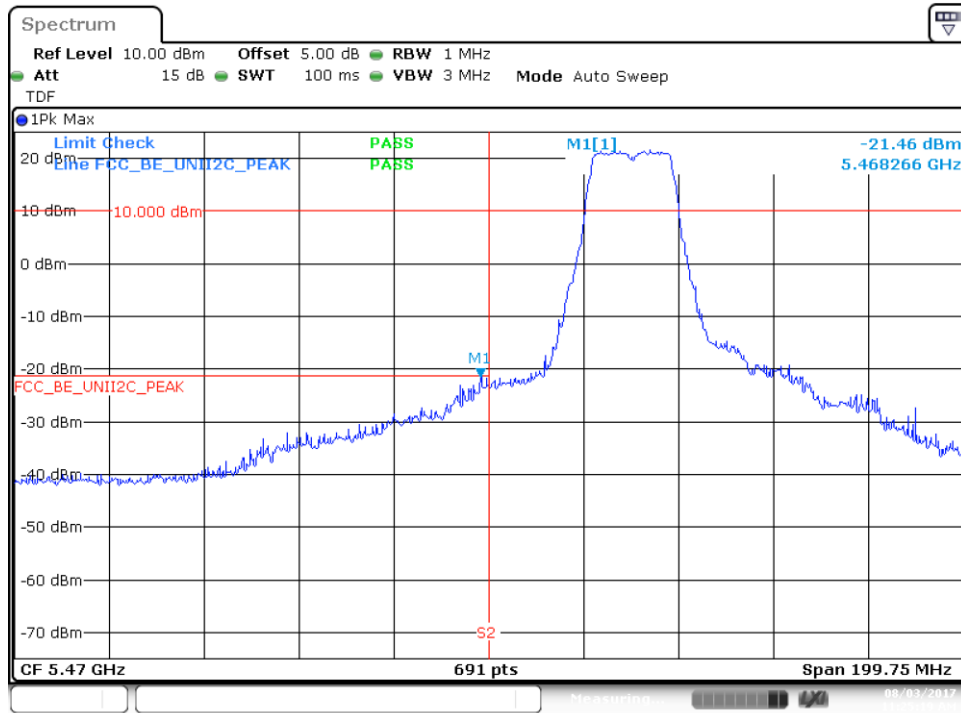
BE Low Freq Section, RMS – CH100



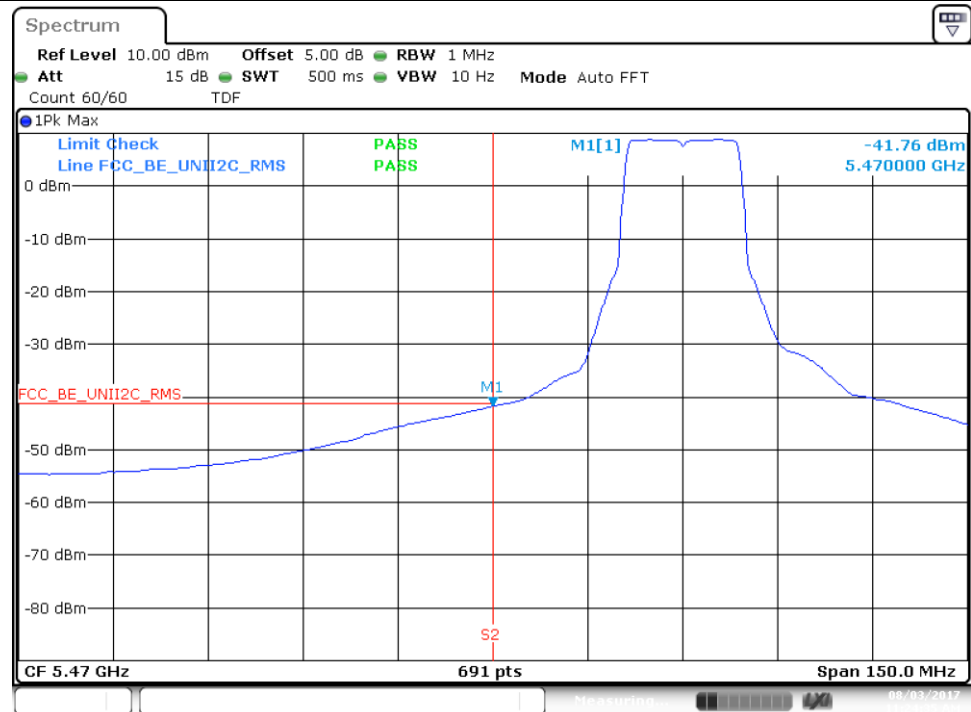


802.11n20, HT0 (SISO) – Chain A

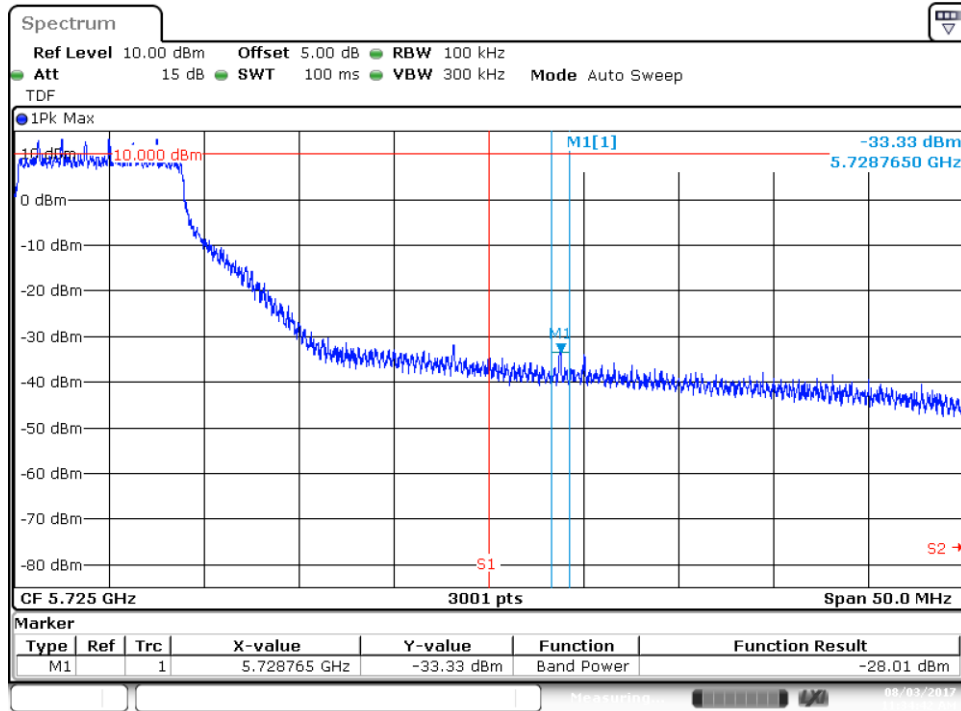
BE Low Freq Section, Peak – CH100



BE Low Freq Section, RMS – CH100



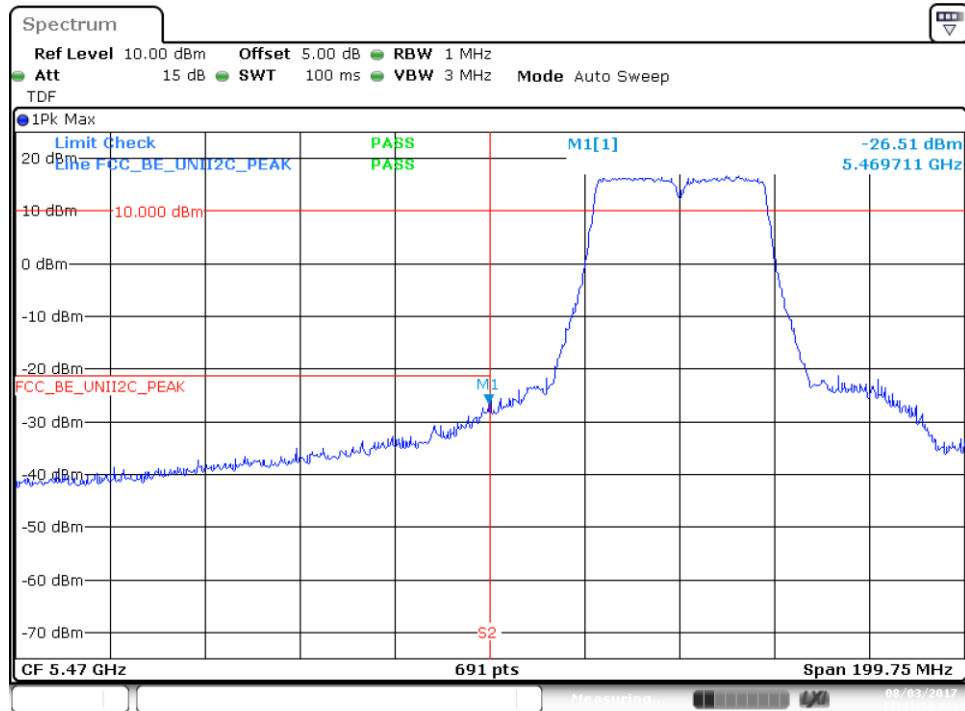
BE High Freq Section, Peak – CH140



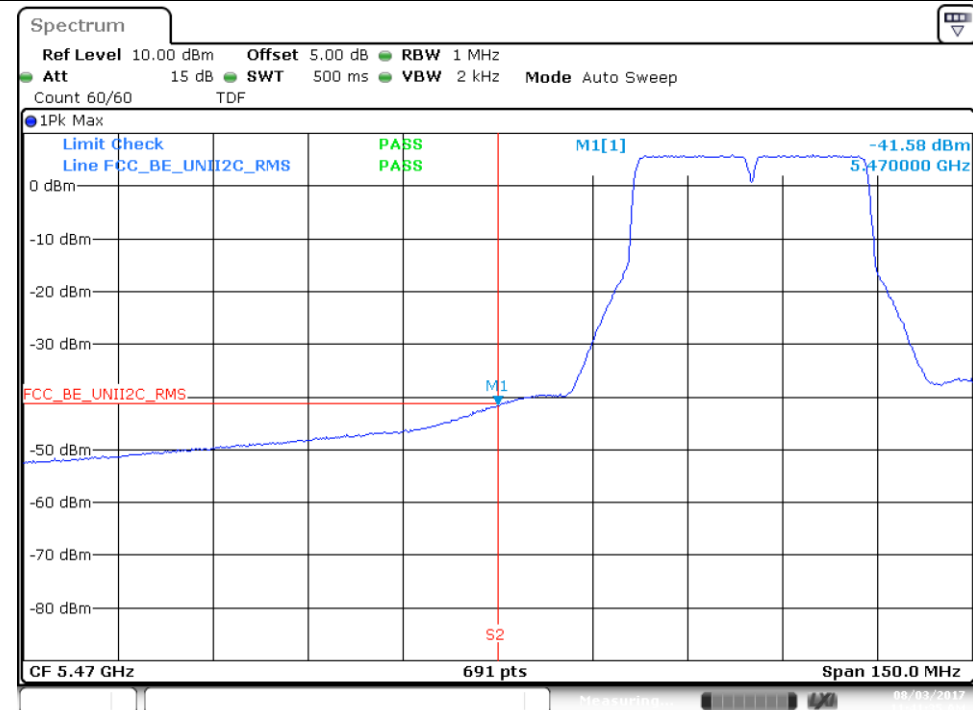
Date: 3.AUG.2017 11:34:42

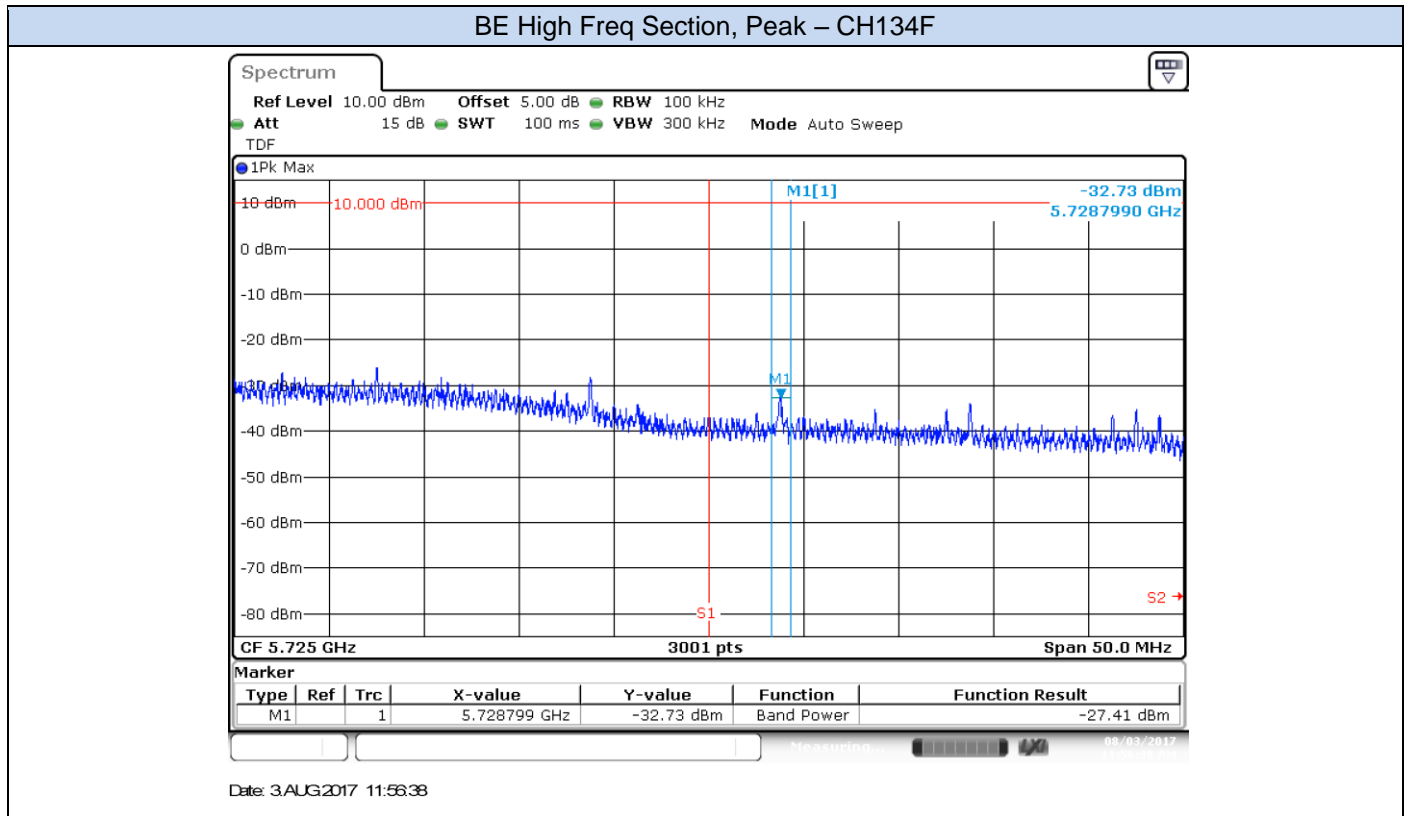
802.11n40, HT0 (SISO) – Chain A

BE Low Freq Section, Peak – CH102F



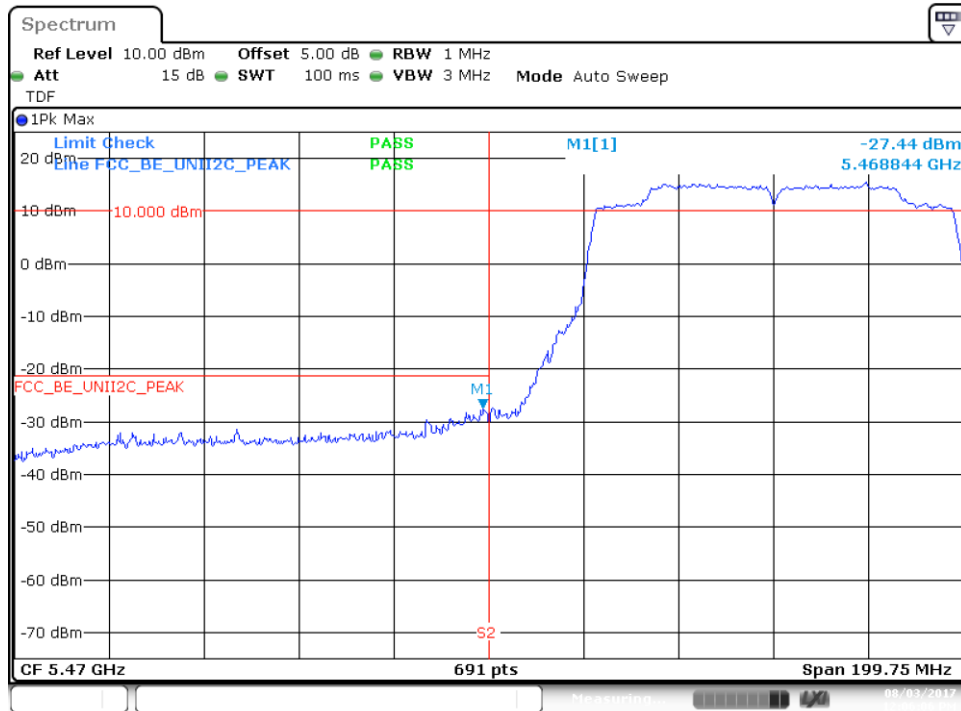
BE Low Freq Section, RMS – CH102F





802.11ac80, VHT0 (SISO) – Chain A

BE Low Freq Section, Peak – CH106ac80



BE Low Freq Section, RMS – CH106ac80

