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# Wireless test report – 368276-3TRFWL

Applicant:

Mikrotikls SIA

Product name:

WLAN 802.11a/n/ac and 802.11b/g/n router

Model:

RBLHGG-5HPacD2HPnD-XL-US

Model variant:

FCC ID:

TV7LHG5HPACD2HPD

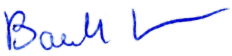
IC Registration number:

7442A-LHG5ACD2HPD

Specifications:

- FCC 47 CFR Part 15 Subpart E, §15.407
  Unlicensed National Information Infrastructure Devises
- RSS-247, Issue 2, Section 6, Feb 2017
  Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Date of issue: November, 19 2019

| | | | |
|---|---|---|---|
| Test engineer(s): | Daniele Guarnone, Wireless/EMC Specialist | Signature: |  |
| Reviewed by: | Paolo Barbieri, Wireless/EMC Specialist | Signature: |  |

| | |
|---|---|
| Company name | Nemko Spa |
| Address | Via del Carroccio, 4 |
| City | I 20853 Biassono (Italy) |
| Province | Via del Carroccio, 4 |
| Postal code | Biassono |
| Country | MB |
| Telephone | 20853 |
| Facsimile | Italy |
| Toll free | +039 039 2201201 |
| Website | +39 039 220 1221 |
| Site number | FCC Test Firm Registration Number: 682159<br>ISED#: 9109A |

| | |
|---|---|
| Tested by | Daniele Guarnone |
| Reviewed by | Paolo Barbieri |
| Review date | April 5, 2019 |
| Reviewer signature | |

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

# Table of contents

# **Section 1.** Report summary

## 1.1 Applicant and manufacturer

| | |
|---|---|
| Company name | Mikrotikls SIA |
| Address | Brivibas gatve 214i LV-1039 Riga Latvia |

## 1.2 Test specifications

| | |
|---|---|
| FCC 47 CFR Part 15, Subpart E, Clause 15.407<br>RSS-247, Issue 2, February 2017 | Unlicensed National Information Infrastructure Devises<br>Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices |

## 1.3 Test methods

| | |
|---|---|
| 789033 D02 General UNII Test Procedures New Rules v02r01 (Dec 14, 2017) | Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E |
| FCC 16-24 (March 2, 2016) | Memorandum opinion and order for U-NII-3 (5.725–5.85 GHz) band |
| ANSI C63.10 v2013 | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices |
| RSS-Gen, Issue 5, April 2018 | General Requirements for Compliance of Radio Apparatus |

## 1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See “Summary of test results” for full details.

## 1.5 Exclusions

None

## 1.6 Test report revision history

| Revision # | Details of changes made to test report |
|---|---|
| TRF | Original report issued |

# **Section 2.** Summary of test results

## 2.1 FCC Part 15 Subpart C, general requirements test results

| Part | Test description | Verdict |
|---|---|---|
| §15.31(e) | Variation of power source | Pass[1] |
| §15.203 | Antenna requirement | Pass[2] |

Notes: [1] Measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, was performed with the supply voltage varied between 85 % and 115 % of the nominal rated supply voltage. No noticeable output power variation was observed
[2]The Antennas uses a unique coupling to the intentional radiator.

## 2.2 FCC Part 15 Subpart E, test results

| Part | Test description | Verdict |
|---|---|---|
| §15.403(i) | Emission bandwidth | Pass |
| §15.407(a)(1) | Power and density limits within 5.15–5.25 GHz band | Not applicable |
| §15.407(a)(2) | Power and density limits within 5.25–5.35 GHz and 5.47–5.725 GHz bands | Not applicable |
| §15.407(a)(3) | Power and density limits within 5.725–5.85 GHz band | Pass |
| §15.407(b)(1) | Undesirable emission limits for 5.15–5.25 GHz band | Not applicable |
| §15.407(b)(2) | Undesirable emission limits for 5.25–5.35 GHz band | Not applicable |
| §15.407(b)(3) | Undesirable emission limits for 5.47–5.725 GHz bands | Not applicable |
| §15.407(b)(4) | Undesirable emission limits for 5.725–5.85 GHz band | Pass |
| §15.407(b)(6) | Conducted limits for U-NII devices using an AC power line | Pass |
| §15.407(e) | Minimum 6 dB bandwidth of U-NII devices within the 5.725–5.85 GHz band | Pass |
| §15.407(g) | Frequency stability | Pass |
| §15.407(h)(1)[1] | Transmit power control (TPC) | Not applicable |
| §15.407(h)(2)[1] | Dynamic Frequency Selection (DFS) | Not applicable |

Notes: [1] DFS and TPC requirements are only applicable to 5.25–5.35 GHz and 5.47–5.725 GHz bands

## 2.3 RSS-Gen, Issue 4, test results

| Part | Test description | Verdict |
|---|---|---|
| 6.6 | Occupied Bandwidth | Pass |
| 7.1.2[1] | Receiver radiated emission limits | Not applicable |
| 7.1.3[1] | Receiver conducted emission limits | Not applicable |
| 8.8 | Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus | Pass |
| 8.11[2] | Frequency stability | -- |

Notes: [1] According to sections 5.2 and 5.3 of RSS-Gen, Issue 4: if EUT does not have a stand-alone receiver neither scanner receiver, then it exempt from receiver requirements.
[2] According to section 8.11 of RSS-Gen, Issue 4: if the frequency stability of the licence-exempt radio apparatus is not specified in the applicable standard (RSS), measurement of the frequency stability is not required

## 2.4 ISED RSS-247, Issue 2, test results

| Section | Test description | Verdict |
|---|---|---|
| 6.1 (1)[1] | Types of Modulation | Pass |
| 6.2.1 (1) | Power limits for 5150–5250 MHz band | Not applicable |
| 6.2.2 (1) | Power limits for 5250–5350 MHz band | Not applicable |
| 6.2.3 (1) | Power limits for 5470–5600 MHz and 5650–5725 MHz bands | Not applicable |
| 6.2.4 (1) | Power limits for 5725–5850 MHz band | Pass |
| 6.2.4 (1) | Minimum 6 dB bandwidth | Pass |
| 6.2.1 (2) | Unwanted emission limits for 5150–5250 MHz band | Not applicable |
| 6.2.2 (2) | Unwanted emission limits for 5250–5350 MHz band | Not applicable |
| 6.2.2 (2) | TPC requirements for devices with a maximum e.i.r.p. greater than 500 mW | Not applicable |
| 6.2.2 (3) | E.i.r.p. at different elevations restrictions for 5250–5350 MHz band | Not applicable |
| 6.2.3 (2) | Unwanted emission limits for 5470–5600 MHz and 5650–5725 MHz bands | Not applicable |
| 6.2.4 (2) | Unwanted emission limits for 5725–5850 MHz band | Pass |
| 6.3 | Dynamic Frequency Selection (DFS) for devices operating in the bands 5250–5350 MHz, 5470–5600 MHz and 5650–5725 MHz | Not applicable |

Notes: [1] The EUT employs digital modulations: 802.11a/n

# **Section 3.** Equipment under test (EUT) details

## 3.1 Sample information

| | |
|---|---|
| Receipt date | February 21, 2019 |
| Nemko sample ID number | Item #2 |

## 3.2 EUT information

| | |
|---|---|
| Product name | WLAN 802.11a/n/ac and 802.11b/g/n router |
| Model | RBLHGG-5HPacD2HPnD-XL-US |
| Model variant | -- |
| Serial number | -- |

## 3.3 Technical information

| | |
|---|---|
| Applicant IC company number | 7442A |
| IC UPN number | LHG5ACD2HPD |
| All used IC test site(s) Reg. number | 9109A |
| RSS number and Issue number | RSS-247 Issue 2, Section 6, February 2017 |
| Frequency band | 5725–5850 MHz |
| Frequency Min (MHz) | 5745 (20 MHz channel), 5755 (40 MHz channel), 5787 (80 MHz channel) |
| Frequency Max (MHz) | 5825 (20 MHz channel), 5795 (40 MHz channel), 5787 (80 MHz channel) |
| Measured BW (kHz) (26 dB) | 19500 (20 MHz channel), 38240 (40 MHz channel), 84560 (80 MHz channel), |
| Measured BW (kHz) (6 dB) | 16000 (20 MHz channel), 35120 (40 MHz channel), 76500 (80 MHz channel), |
| Type of modulation | 802.11a/n |
| Emission classification (F1D, G1D, D1D) | W7D |
| **Transmitter spurious, Units @ distance** | 31.2 dBµV/m at 96.96MHz, @ 3 m |
| Power requirements | 24 $V_{DC,}$ via 120 $V_{AC}$ adapter or battery |
| Antenna information | The EUT uses a unique antenna coupling.<br>EUT has 2 antenna configurations. The max antenna peak gain is 18 dBi at 2.4 GHz band and 27 dBi at 5 GHz WIFI bands. |

## 3.4 Product description and theory of operation

The LHG is an outdoor wireless router with with an integrated dual polarization grid antenna

## 3.5 EUT exercise details

EUT was set to continuously transmit mode during tests, by test software provided by client.
These tools/scripts configure the radio modules to enable continuous transmission with the ability to adjust modulation, frequency and output power as required.

## 3.6 EUT setup diagram

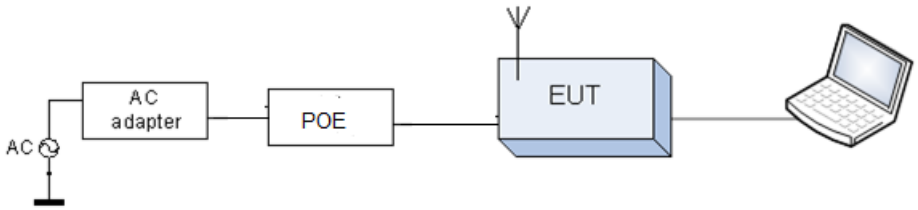



***Figure 3.6-1:*** *Setup diagram*

## 3.7 EUT sub assemblies

***Table 3.7-1:*** *EUT sub assemblies*

| Description | Brand name | Model/Part number | Serial number |
|---|---|---|---|
| Power supply | Fullpower | SAW 30-240-1200G R2A | |
| Gigabit POE | Mikrotik | -- | -- |
| | | | |

# **Section 4.** Engineering considerations

## 4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

## 4.2 Technical judgment

Differences between the variants are as below. REGATE-10-12 was chosen as representative worst-case.

## 4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

# **Section 5.** Test conditions

## 5.1 Atmospheric conditions

| | |
|---|---|
| 18÷33 °C | 18÷33 °C |
| 30÷60 % | 30÷60 % |
| 980÷1060 hPa | 980÷1060 hPa |

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

## 5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

# **Section 6.** Measurement uncertainty

## 6.1 Uncertainty of measurement

UKAS Lab 34 and TIA-603-B have been used as guidance for measurement uncertainty reasonable estimations with regards to previous experience and validation of data. Nemko Canada, Inc. follows these test methods in order to satisfy ISO/IEC 17025 requirements for estimation of uncertainty of measurement for wireless products.
Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

***Table 6.1-1: Measurement uncertainty***

| EUT | Type | Test | Range and Setup features | Measurement Uncertainty | Notes |
|---|---|---|---|---|---|
| Transmitter | Conducted | Frequency error | 0.001 MHz ÷ 40 GHz | 0.08 ppm | (1) |
| | | Carrier power<br>RF Output Power | 10 kHz ÷ 30 MHz | 1.0 dB | (1) |
| | | | 30 MHz ÷ 18 GHz | 1.5 dB | (1) |
| | | | 18 MHz ÷ 40 GHz | 3.0 dB | (1) |
| | | Adjacent channel power | 1 MHz ÷ 18 GHz | 1.6 dB | (1) |
| | | Conducted spurious emissions | 10 kHz ÷ 26 GHz | 3.0 dB | (1) |
| | | | 26 GHz ÷ 40 GHz | 4.5 dB | (1) |
| | | Intermodulation attenuation | 1 MHz ÷ 18 GHz | 2.2 dB | (1) |
| | | Attack time – frequency behaviour | 1 MHz ÷ 18 GHz | 2.0 ms | (1) |
| | | Attack time – power behaviour | 1 MHz ÷ 18 GHz | 2.5 ms | (1) |
| | | Release time – frequency behaviour | 1 MHz ÷ 18 GHz | 2.0 ms | (1) |
| | | Release time – power behaviour | 1 MHz ÷ 18 GHz | 2.5 ms | (1) |
| | | Transient behaviour of the transmitter– Transient frequency behaviour | 1 MHz ÷ 18 GHz | 0.2 kHz | (1) |
| | | Transient behaviour of the transmitter – Power level slope | 1 MHz ÷ 18 GHz | 9% | (1) |
| | | Frequency deviation - Maximum permissible frequency deviation | 0.001 MHz ÷ 18 GHz | 1.3% | (1) |
| | | Frequency deviation - Response of the transmitter to modulation frequencies above 3 kHz | 0.001 MHz ÷ 18 GHz | 0.5 dB | (1) |
| | | Dwell time | - | 3% | (1) |
| | | Hopping Frequency Separation | 0.01 MHz ÷ 18 GHz | 1% | (1) |
| | | Occupied Channel Bandwidth | 0.01 MHz ÷ 18 GHz | 2% | (1) |
| | | Modulation Bandwidth | 0.01 MHz ÷ 18 GHz | 2% | (1) |
| | Radiated | Radiated spurious emissions | 10 kHz ÷ 26.5 GHz | 6.0 dB | (1) |
| | | | 26.5 GHz ÷ 40 GHz | 8.0 dB | (1) |
| | | Effective radiated power transmitter | 10 kHz ÷ 26.5 GHz | 6.0 dB | (1) |
| | | | 26,5 GHz ÷ 40 GHz | 8.0 dB | (1) |
| Receiver | Radiated | Radiated spurious emissions | 10 kHz ÷ 26.5 GHz | 6.0 dB | (1) |
| | | | 26.5 GHz ÷ 40 GHz | 8.0 dB | (1) |
| | | Sensitivity measurement | 1 MHz ÷ 18 GHz | 6.0 dB | (1) |
| | Conducted | Conducted spurious emissions | 10 kHz ÷ 26 GHz | 3.0 dB | (1) |
| | | | 26 GHz ÷ 40 GHz | 4.5 dB | (1) |
| (1) The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2 which has been derived from the assumed normal probability distribution with infinite degrees of freedom and for a coverage probability of 95 % | | | | | |

# **Section 7.** Test equipment

## 7.1 Test equipment list

***Table 7.1-1: Equipment list***

| Equipment | Manufacturer | Model no. | Asset no. | Cal cycle | Next cal. |
|---|---|---|---|---|---|
| EMI receiver 2 Hz ÷ 44 GHz | R&S | ESW44 | 101620 | 2018/05 | 2020/08 |
| Broadband preamplifier | Schwarzbeck | BBV 9718 | 9718-137 | 2018/08 | 2019/08 |
| Trilog Broadband Antenna | Schwarzbeck | VULB 9162 | 9162-025 | 2018/07 | 2021/07 |
| Semi-anechoic chamber | Nemko | 10m semi-anechoic chamber | 530 | 2018/09 | 2021/09 |
| Antenna mast | R&S | HCM | 836 529/05 | NCR | NCR |
| Controller | R&S | HCC | 836 620/7 | NCR | NCR |
| EMI receiver 9 kHz ÷ 3 GHz | R&S | ESCI | 100888 | 2018/09 | 2020/10 |
| LISN 9 kHz ÷ 30 MHz | R&S | ESH2-Z5 | 872 460/041 | 2018/09 | 2020/09 |
| Climatic Chamber | ESPEC | ARS 1100 | 4100000067 | 2018/11 | 2019/11 |
| EMI receiver 20 Hz ÷ 8 GHz | R&S | ESU8 | 100202 | 2019/01 | 2020/01 |
| Bilog antenna 1 ÷18 GHz | Schwarzbeck | STLP 9148-123 | 123 | 2018/09 | 2021/09 |
| Double Ridged Waveguide Horn | RF SPIN | DRH40 | 061106a40 | 2017/02 | 2020/02 |
| Wide band Amplifier 18 GHz ÷ 40 GHz | MITEQ | AMF-5F-18004000-37-8P | 128061 | 2018/09 | 2020/09 |
| High pass filter | Wainwright Instruments | WHNX6-2555-3500-26500-60CC | 01 | 2018/10 | 2020/10 |

Note: NCR - no calibration required, VOU - verify on use

# Section 8. Testing data

## 8.1 FCC 15.403(i) Emission bandwidth, 15.407(e) 6 dB bandwidth

### 8.1.1 Definitions and limits

**FCC:**
15.403(i) For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.
15.407(e) **Within the 5.725–5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.**

### 8.1.2 Test summary

| | |
|---|---|
| Test start date | July 31, 2019 |
| Test engineer | Daniele Guarnone |

### 8.1.3 Observations, settings and special notes

Spectrum analyzer settings:

| | |
|---|---|
| Resolution bandwidth | approximately 1% of EBW (for 26 dB BW), 100 kHz (for 6 dB BW) |
| Video bandwidth | > RBW |
| Detector mode | Peak |
| Trace mode | Max Hold |

### 8.1.4 Test data

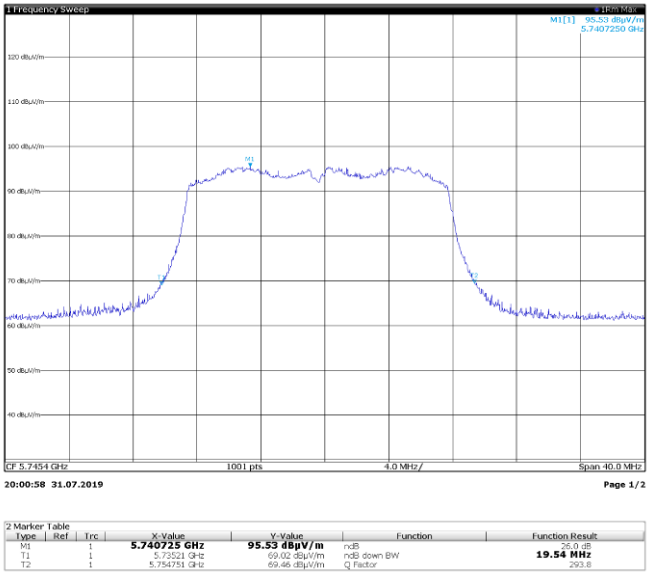
***Table 8.1-1:*** *26 dB bandwidth results*

| Modulation | Frequency, MHz | 26 dB bandwidth, MHz |
|---|---|---|
| 802.11a | 5745 | 19.34 |
| | 5785 | 19.34 |
| | 5825 | 19.50 |
| 802.11n HT20 | 5745 | 19.38 |
| | 5785 | 19.50 |
| | 5825 | 18.65 |
| 802.11n HT40 | 5755 | 38.23 |
| | 5795 | 38.24 |
| 802.11ac | 5787 | 85.56 |

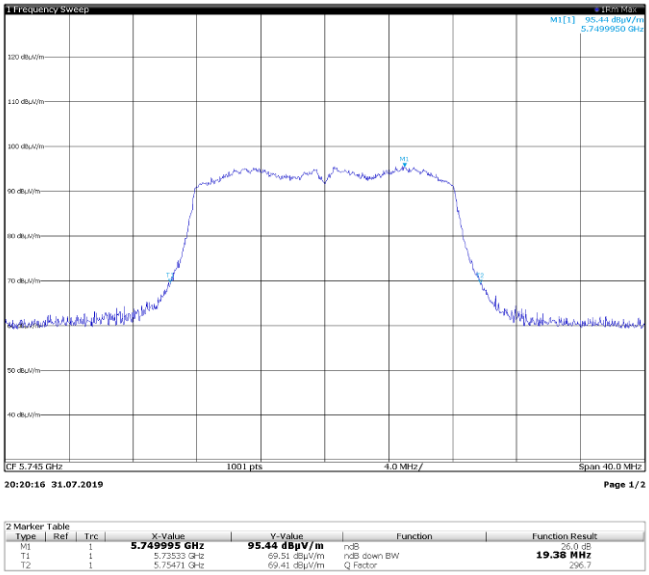
***Table 8.1-2:*** *6 dB bandwidth results*

| Modulation | Frequency, MHz | 6 dB bandwidth, MHz | Minimum limit, MHz | Minimum margin, MHz |
|---|---|---|---|---|
| 802.11a | 5745 | 15.48 | 0.5 | 16.34 |
| | 5785 | 15.14 | 0.5 | 16.30 |
| | 5825 | 15.14 | 0.5 | 16.34 |
| 802.11n HT20 | 5745 | 16.00 | 0.5 | 16.34 |
| | 5785 | 15.12 | 0.5 | 16.38 |
| | 5825 | 15.12 | 0.5 | 16.5 |
| 802.11n HT40 | 5755 | 35.00 | 0.5 | 36.5 |
| | 5795 | 35.12 | 0.5 | 36.5 |
| 802.11ac | 5787 | 76.5 | 0.5 | 77 |

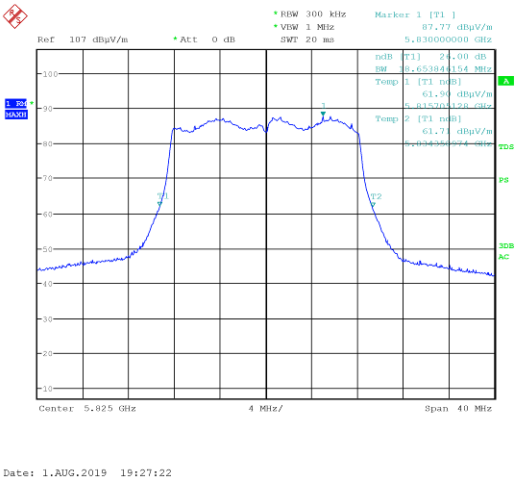
Low channel



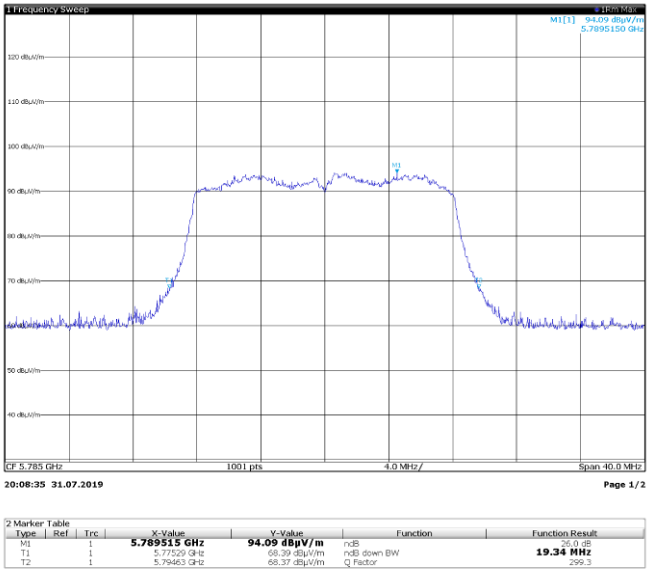

*26 dB bandwidth on 802.11a, sample plot*



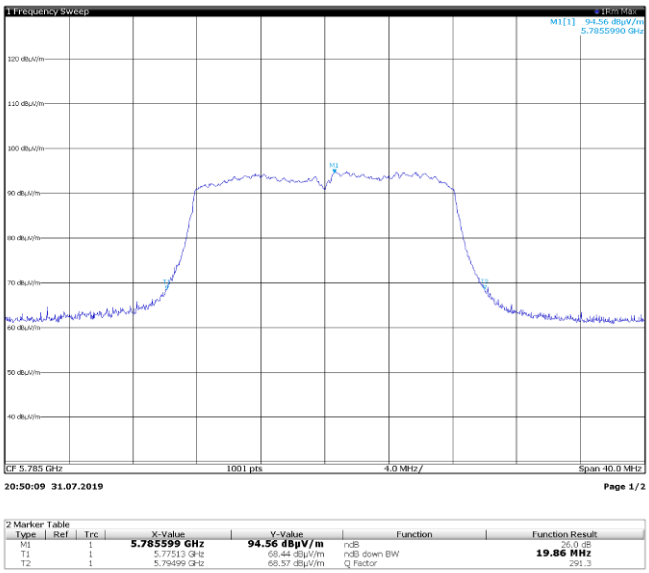

*26 dB bandwidth on 802.11n HT20, sample plot*



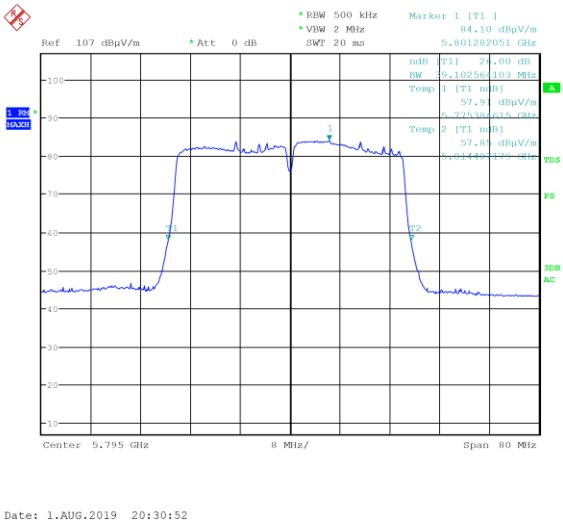

*26 dB bandwidth on 802.11n HT40, sample plot*



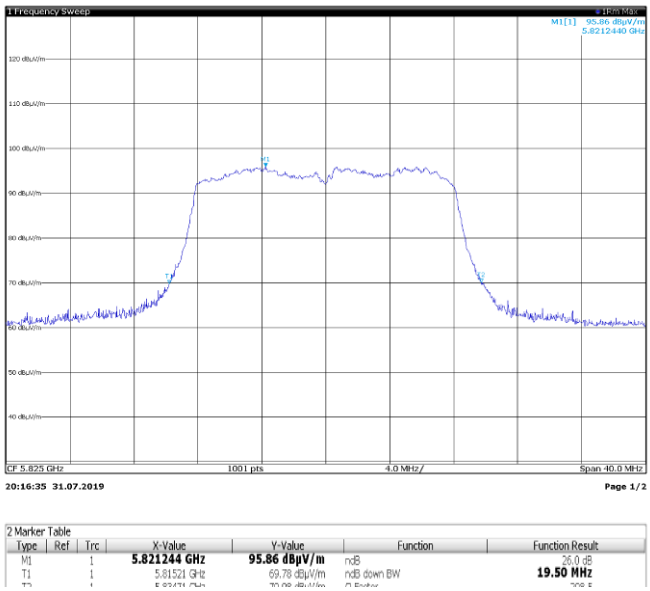

*26 dB bandwidth on 802.11a, sample plot*




*26 dB bandwidth on 802.11n HT20, sample plot*



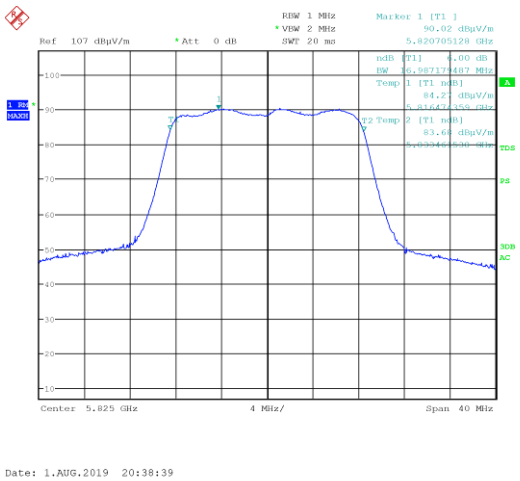

*26 dB bandwidth on 802.11n HT40, sample plot*



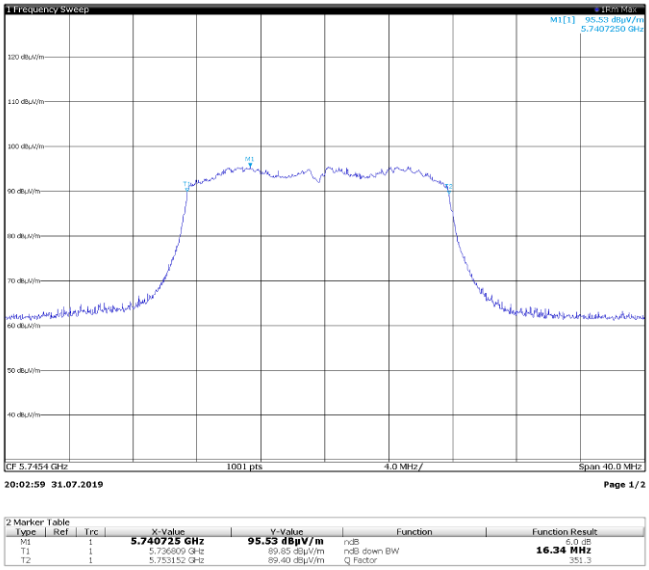

2 Marker Table

| Type | Ref | Trc | X-Value | Y-Value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | **5.821244 GHz** | **95.86 dBµV/m** | ndB | 26.0 dB |
| T1 | | 1 | 5.81521 GHz | 69.78 dBµV/m | ndB down BW | **19.50 MHz** |

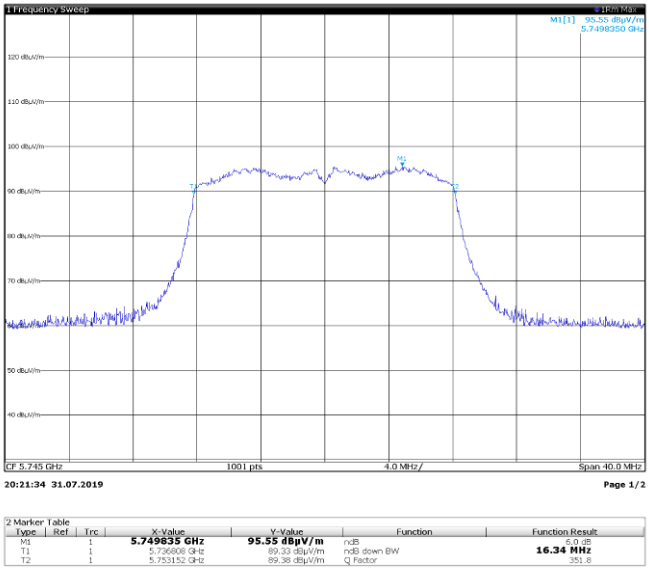
*26 dB bandwidth on 802.11a, sample plot*



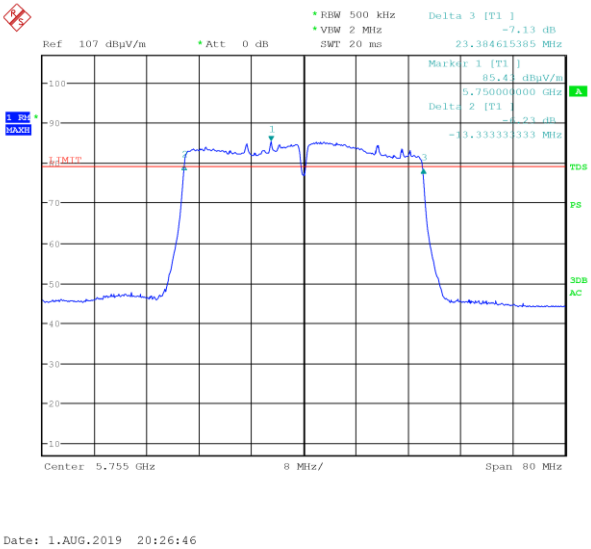

*26 dB bandwidth on 802.11n HT20, sample plot*



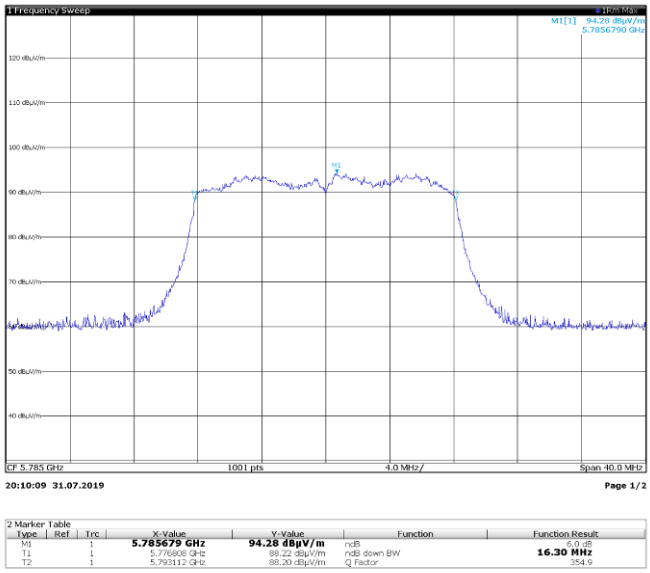

*6 dB bandwidth on 802.11a, sample plot*



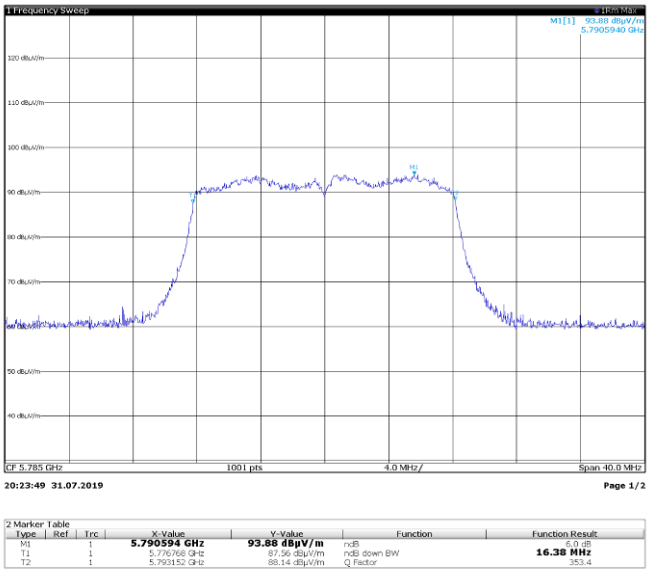

*6 dB bandwidth on 802.11n HT20, sample plot*



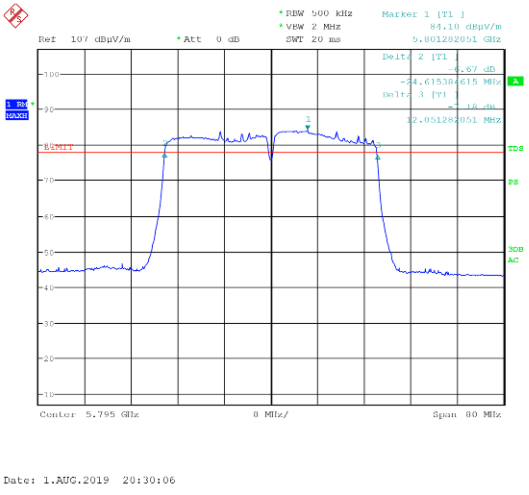

*6 dB bandwidth on 802.11n HT40, sample plot*



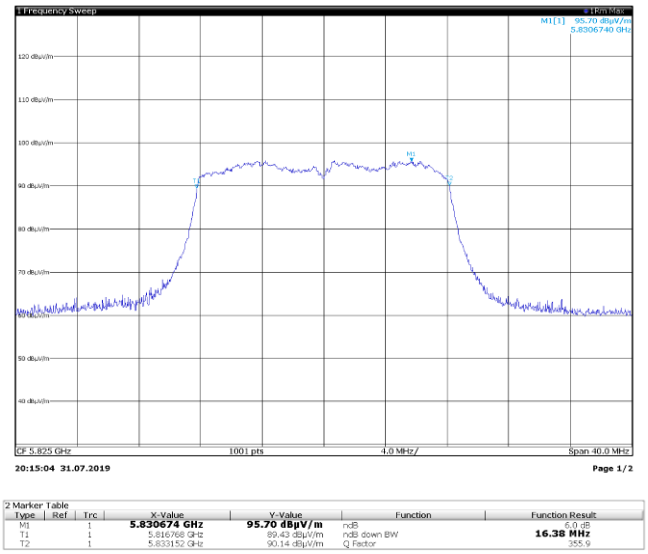

*6 dB bandwidth on 802.11a, sample plot*



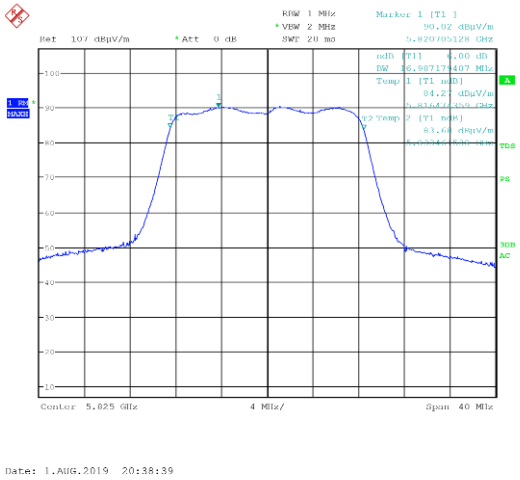

*6 dB bandwidth on 802.11n HT20, sample plot*



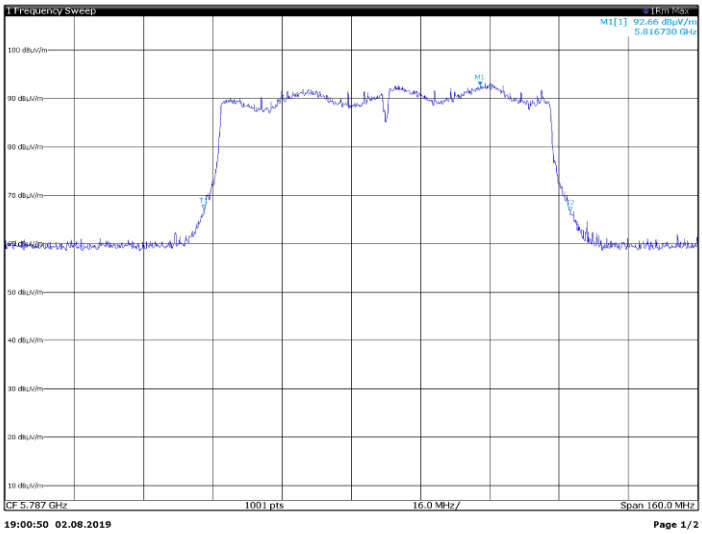

*6 dB bandwidth on 802.11n HT40, sample plot*




*6 dB bandwidth on 802.11a, sample plot*



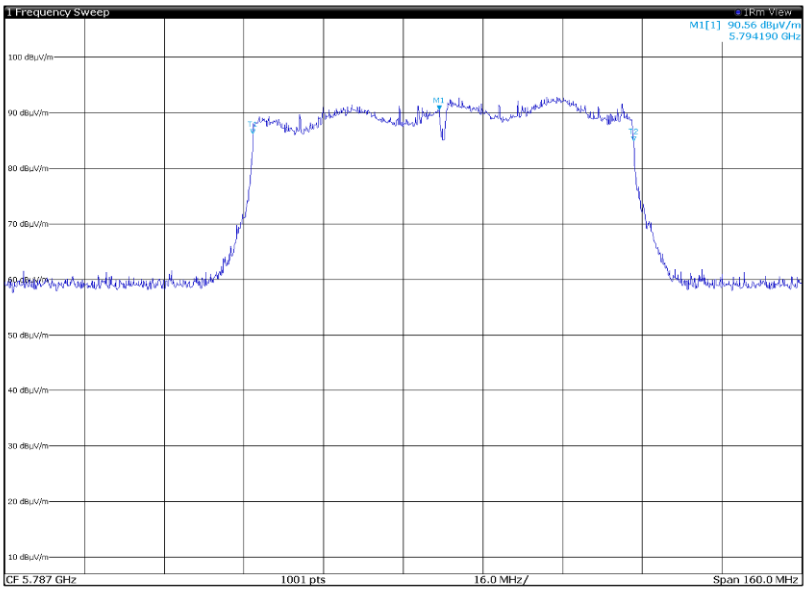

*6 dB bandwidth on 802.11n HT20, sample plot*




2 Marker Table

| Type | Ref | Trc | X-Value | Y-Value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | **5.81673 GHz** | **92.66 dBµV/m** | ndB | 26.0 dB |
| T1 | | 1 | 5.75295 GHz | 67.17 dBµV/m | ndB down BW | **84.56 MHz** |
| T2 | | 1 | 5.83751 GHz | 66.70 dBµV/m | Q Factor | 68.8 |

***26 dB bandwidth on 802.11a, 80 MHz***




2 Marker Table

| Type | Ref | Trc | X-Value | Y-Value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | **5.79419 GHz** | **90.56 dBµV/m** | ndB | 6.0 dB |
| T1 | | 1 | 5.75679 GHz | 86.18 dBµV/m | ndB down BW | **76.40 MHz** |
| T2 | | 1 | 5.83319 GHz | 84.97 dBµV/m | Q Factor | 75.8 |

***6 dB bandwidth on 802.11a, 80 MHz***

## 8.2 RSS-Gen 6.6 Occupied bandwidth

### 8.2.1 Definitions and limits

The emission bandwidth (×dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated × dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3× the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

### 8.2.2 Test summary

| | |
|---|---|
| Test start date | April 5, 2019 |
| Test engineer | Daniele Guarnone |

### 8.2.3 Observations, settings and special notes

Spectrum analyzer settings:

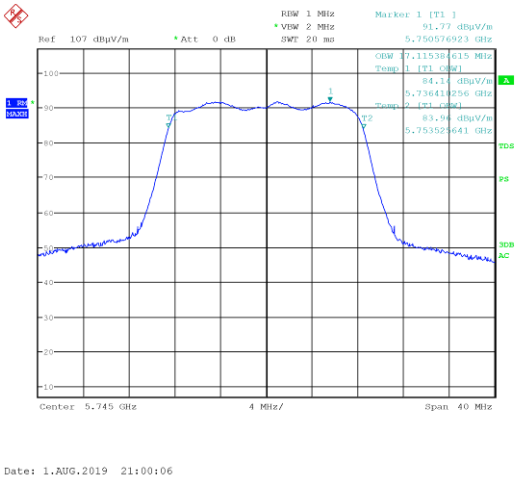
| | |
|---|---|
| Resolution bandwidth: | 1 % to 5 % of OBW |
| Video bandwidth: | ≥3 × RBW |
| Detector mode: | Peak |
| Trace mode: | Max Hold |

### 8.2.4 Test data

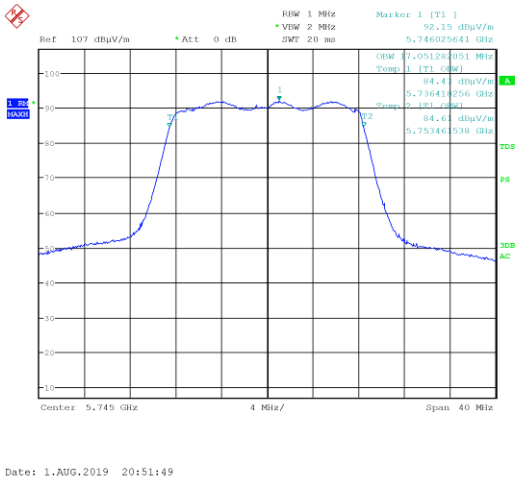
***Table 8.2-1:*** *99 % bandwidth results*

| Modulation | Frequency, MHz | 99 % bandwidth, MHz |
|---|---|---|
| 802.11a | 5745 | 16.6 |
| | 5785 | 16.6 |
| | 5825 | 16.5 |
| 802.11n HT20 | 5745 | 17.6 |
| | 5785 | 16.6 |
| | 5825 | 16.5 |
| 802.11n HT40 | 5755 | 36.4 |
| | 5795 | 36.1 |
| 802.11n HT80 | 5787 | 75.8 |

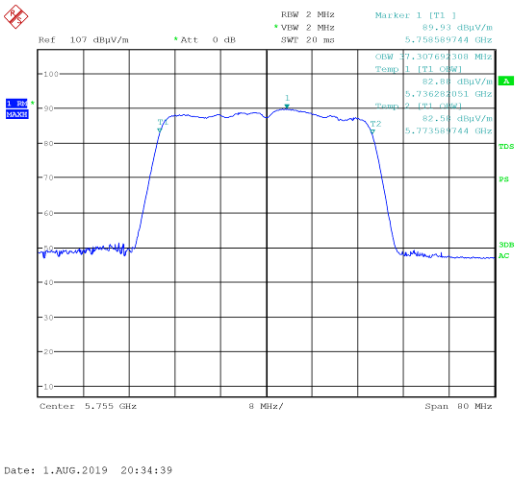
## 8.2.4 Test data, continued



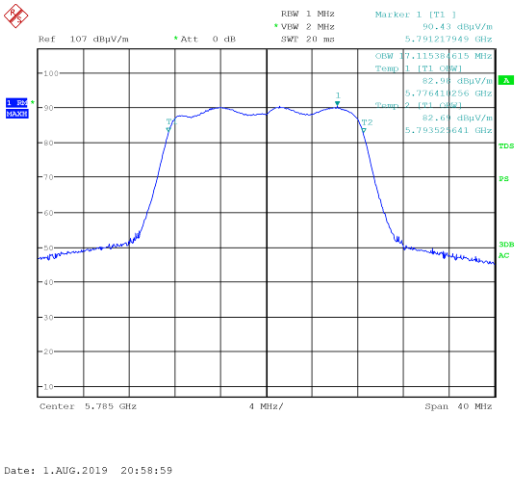

*99 % bandwidth on 802.11a, sample plot*



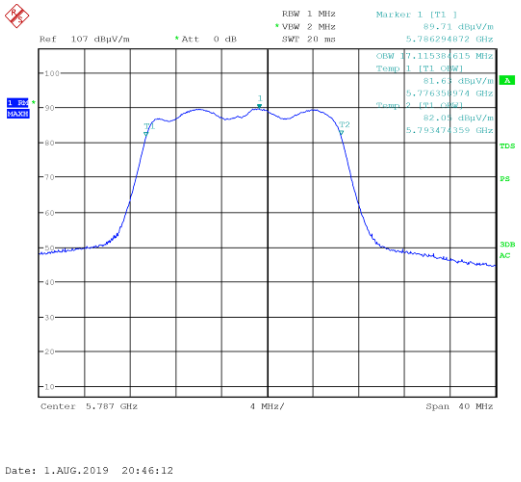

*99 % bandwidth on 802.11n HT20, sample plot*



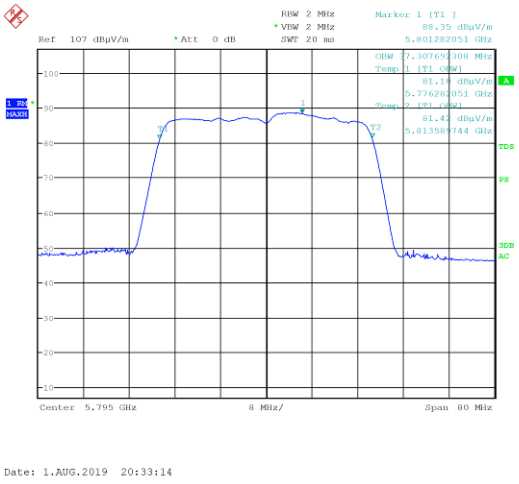

*99 % bandwidth 802.11n HT40, sample plot*



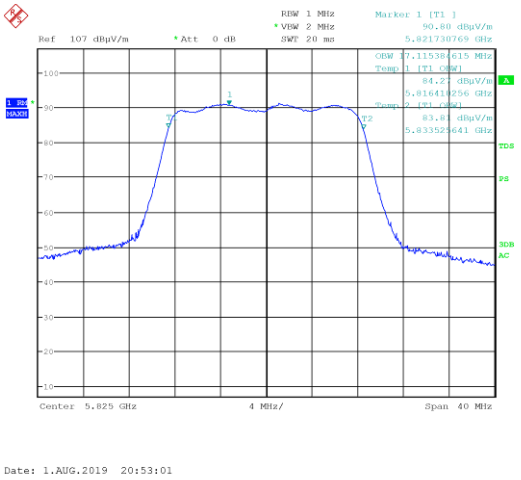

*99 % bandwidth on 802.11a, sample plot*



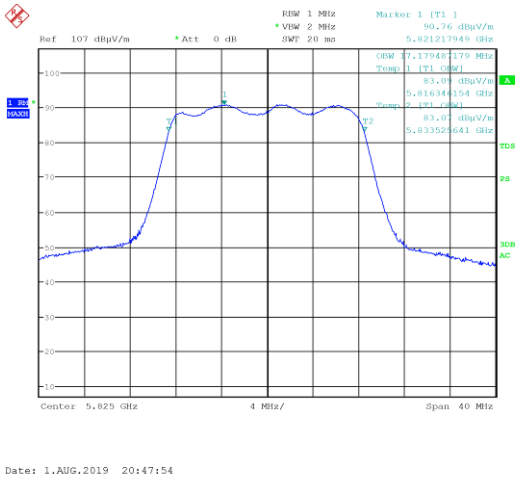

*99 % bandwidth on 802.11n HT20, sample plot*



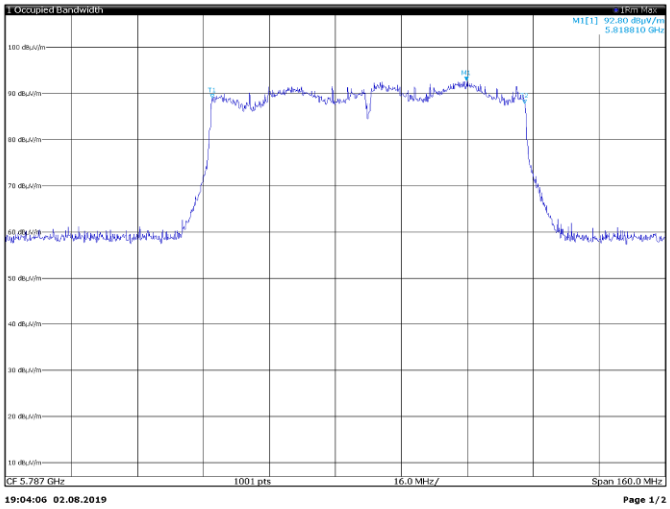

*99 % bandwidth 802.11n HT40, sample plot*




*99 % bandwidth on 802.11a, sample plot*




*99 % bandwidth on 802.11n HT20, sample plot*




**99 % bandwidth on 802.11aC, sample plot**

## 8.3 FCC 15.407(a)(3) and RSS-247 6.2.4.1 5.725–5.85 GHz band output power and spectral density limits

### 8.3.1 Definitions and limits

**FCC:**
For the band 5.725–5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

**ISED:**
The maximum conducted output power shall not exceed 1 W. The power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

### 8.3.2 Test summary

| | |
|---|---|
| Test start date: | April 5, 2019 |
| Test engineer: | Daniele Guarnone |

### 8.3.3 Observations, settings and special notes

As per manufacturer declaration, EUT is for indoor use only. EUT was configured to continuous transmit mode during tests.
Output power was tested using RMS power meter.
The highest and lowest data rate setting have been investigated, only the worst-cases were presented.

Spectrum analyzer settings for PSD measurement:

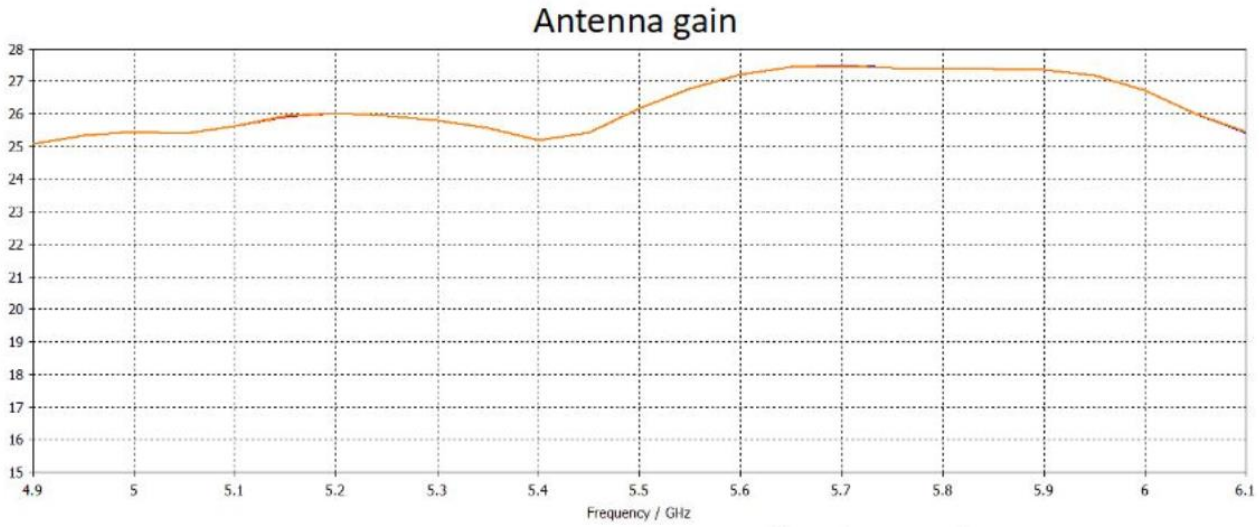
| | |
|---|---|
| Resolution bandwidth | 500 kHz |
| Video bandwidth | 2 MHz |
| Frequency span | > EBW |
| Detector mode | RMS |
| Trace mode | Power Averaging over 100 sweeps |

the MIMO mode is turn on during the tests

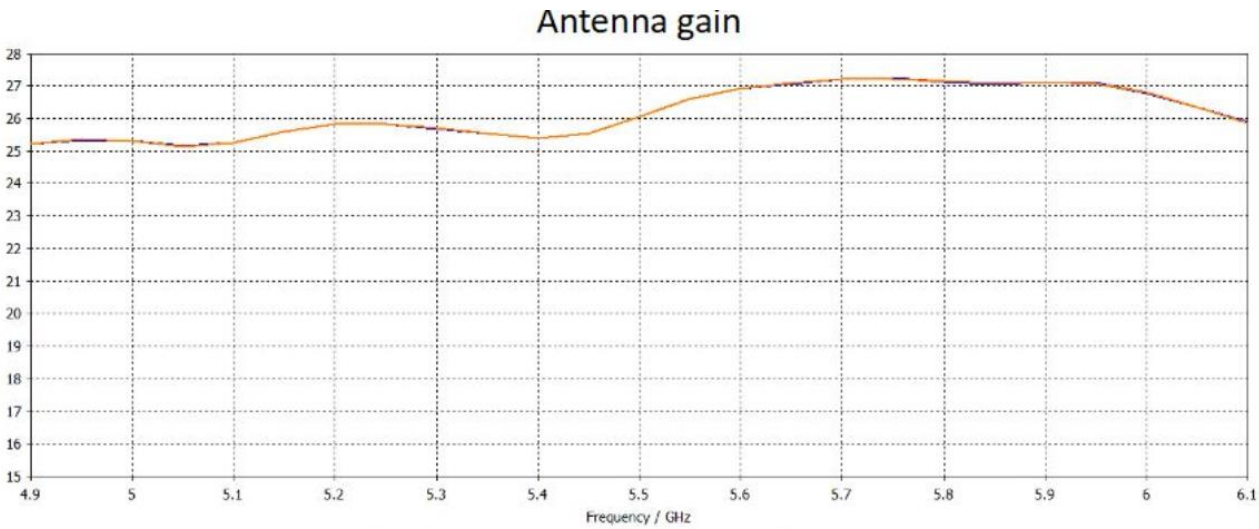
EIRP CALCULATION

$EIRP = P_{combined} + antenna\ directional\ gain$

Max antenna gain: 27.5 (see below the gain measurement provided by manufacturer)




LHG_XL_52_5 GHz_gain-graphic_horz-pol




LHG_XL_52_5 GHz_gain-graphic_horz-pol

DIRECTIONAL GAIN

According to KDB 662911 (F)(2)(e)(i):

Directional antenna gain $G_{DIR} = G_{MAX} + 10*Log (N_{ANT}/N_{SS})$, where $N_{SS}$ is the number of independent spatial streams of data and $G_{MAX}$ is the gain of the antenna having the highest gain (in dBi).

Device supports spatial multiplexing/cyclic delay diversity in MIMO configurations and single stream legacy modes. Antenna gain for both chains is the same. Signals between chains are correlated. Then $N_{ANT} = 2$ and $N_{SS} = 1$:

$G_{DIR}$ = 27.5 dBi + 10∗Log (2/1) = 30.5 dBi.

Total antenna gain was calculated as follows: $Directional\ gain = 10\log[(10^{\frac{G1}{20}} + 10^{\frac{G2}{20}})^2 / N_{ANT}]$

OUTPUT POWER/EIRP/PSD LIMIT ADJUSTMENT

Output power/EIRP/PSD limit – (Total antenna gain – 6 dBi).
FCC Output power limit is 30 dBm – (30.5 - 6) = 30 dBm – 24.5 = 5.5 dBm
FCC PSD limit is 17 dBm/MHz – (30.5 - 6) = 17 dBm/MHz – 24.5 = -7.5 dBm/MHz

ISED e.i.r.p limit is 200 mW (23 dBm) or 10 + 10∗Log (B), dBm, whichever power is less.

ISED PSD limit is 10 dBm/MHz e.i.r.p

E-FIELD CALCULATION
According to KDB 558074 and ANSI C63.10:

$EIRP_{dBm} = S_{dB\mu V/m} + 20*Log(d_m) - 104.7$

Example of calculation:
$EIRP_{dBm=}$104.4 dBuV/m+20*log10(3)-104.7=9.2

**Output power/EIRP/PSD limit adjustment (in case antenna gain is more than 6 dBi): Output power/EIRP/PSD limit – (Total antenna gain – 6 dBi).**
**EIRP = E + 20xlog (d) -104.7**
**E= E field (dBuV/m)**
**D= distance (m)**

According clause 14.5 of ANSI C63.10 where radiated measurements are used for determining compliance with conducted limits, the following steps are required to ensure that the total emission power or PSD is determined for equipment driving cross-polarized antennas:
a) Measure radiated emissions with vertical and horizontal polarizations of the measurement antenna.
b) Convert each radiated measurement to transmit power or PSD based on the antenna gain.
c) Sum the powers or PSDs across the two polarizations.

### 8.3.4 Test data

Fcc Total power (Sum of E Field in vertical and horizontal polarization) to dBm EIRP (Total E Field – antenna gain -20*log10(3)-104.7 dB

| Modulation | Frequency, | Conducted output power, dBm | | | | EIRP, | EIRP limit, | |
|---|---|---|---|---|---|---|---|---|
| | MHz | Measured | Limit | Margin, dB | Antenna gain, dBi | dBm | dBm | EIRP margin, dB |
| 802.11a | 5745 | -19.8 | 5.5 | -25.3 | 30.5 | 10.7 | 36.0 | -25.3 |
| | 5785 | -21.1 | 5.5 | -26.6 | 30.5 | 9.4 | 36.0 | -26.6 |
| | 5825 | -19.9 | 5.5 | -25.4 | 30.5 | 10.6 | 36.0 | -25.4 |
| 802.11n HT20 | 5745 | -20.3 | 5.5 | -25.8 | 30.5 | 10.2 | 36.0 | -25.8 |
| | 5785 | -21.8 | 5.5 | -27.3 | 30.5 | 8.7 | 36.0 | -27.3 |
| | 5825 | -19.9 | 5.5 | -25.4 | 30.5 | 10.6 | 36.0 | -25.4 |
| 802.11n HT40 | 5755 | -20.4 | 5.5 | -25.9 | 30.5 | 10.1 | 36.0 | -25.9 |
| | 5795 | -21.5 | 5.5 | -27.0 | 30.5 | 9.0 | 36.0 | -27.0 |
| 802.11ac 80 | 5787 | -14.3 | 5.5 | -19.8 | 30.5 | 16.2 | 36.0 | -19.8 |

Vertical polarization

| Modulation | Frequency, MHz | dBm Measured | dBm Limit | Margin, dB | Antenna gain, dBi | EIRP, dBm | EIRP limit, dBm | EIRP margin, dB | dBuV/m |
|---|---|---|---|---|---|---|---|---|---|
| 802.11a | 5745 | -25.3 | 5.5 | -30.8 | 30.5 | 5.2 | 36.0 | -30.8 | 100.3 |
| | 5785 | -26.9 | 5.5 | -32.4 | 30.5 | 3.6 | 36.0 | -32.4 | 98.7 |
| | 5825 | -25.6 | 5.5 | -31.1 | 30.5 | 4.9 | 36.0 | -31.1 | 100.1 |
| 802.11n HT20 | 5745 | -26.9 | 5.5 | -32.4 | 30.5 | 3.6 | 36.0 | -32.4 | 98.7 |
| | 5785 | -30.9 | 5.5 | -36.4 | 30.5 | -0.4 | 36.0 | -36.4 | 94.8 |
| | 5825 | -25.6 | 5.5 | -31.1 | 30.5 | 4.9 | 36.0 | -31.1 | 100.1 |
| 802.11n HT40 | 5755 | -25.7 | 5.5 | -31.2 | 30.5 | 4.8 | 36.0 | -31.2 | 99.9 |
| | 5795 | -27.1 | 5.5 | -32.6 | 30.5 | 3.4 | 36.0 | -32.6 | 98.6 |
| 802.11ac 80 | 5787 | -20.2 | 5.5 | -25.7 | 30.5 | 10.3 | 36.0 | -25.7 | 105.5 |

Horizontal polarization

| Modulation | Frequency, MHz | dBm Measured | dBm Limit | Margin, dB | Antenna gain, dBi | EIRP, dBm | EIRP limit, dBm | EIRP margin, dB | dBuV/m |
|---|---|---|---|---|---|---|---|---|---|
| 802.11a | 5745 | -21.3 | 5.5 | -26.8 | 30.5 | 9.2 | 36.0 | -26.8 | 104.4 |
| | 5785 | -22.4 | 5.5 | -27.9 | 30.5 | 8.1 | 36.0 | -27.9 | 103.2 |
| | 5825 | -21.2 | 5.5 | -26.7 | 30.5 | 9.3 | 36.0 | -26.7 | 104.4 |
| 802.11n HT20 | 5745 | -21.4 | 5.5 | -26.9 | 30.5 | 9.1 | 36.0 | -26.9 | 104.3 |
| | 5785 | -22.4 | 5.5 | -27.9 | 30.5 | 8.1 | 36.0 | -27.9 | 103.3 |
| | 5825 | -21.2 | 5.5 | -26.7 | 30.5 | 9.3 | 36.0 | -26.7 | 104.4 |
| 802.11n HT40 | 5755 | -21.9 | 5.5 | -27.4 | 30.5 | 8.6 | 36.0 | -27.4 | 103.7 |
| | 5795 | -22.9 | 5.5 | -28.4 | 30.5 | 7.6 | 36.0 | -28.4 | 102.8 |
| 802.11ac 80 | 5787 | -15.6 | 5.5 | -21.1 | 30.5 | 14.9 | 36.0 | -21.1 | 110.1 |

**Test method KDB 558074 and ANSI C63.10**

***FCC Psd*** *measurements (Sum of E Field in vertical and horizontal polarization) to dBm EIRP (Total E Field – antenna gain -20*log10(3)-104.7 dB*

Total power (Sum of E Field in vertical and horizontal polarization) to dBm EIRP (Total E Field – antenna gain -20*log10(3)-104.7 dB

| Modulation | Frequency, | Conducted output power, dBm/MHz | | | | EIRP, |
|---|---|---|---|---|---|---|
| | MHz | Measured | Limit | Margin, dB | Antenna gain, dBi | dBm/MHz |
| 802.11a | 5745 | -30.20 | -7.5 | -22.70 | 30.5 | 0.30 |
| | 5785 | -31.10 | -7.5 | -23.60 | 30.5 | -0.60 |
| | 5825 | -30.20 | -7.5 | -22.70 | 30.5 | 0.30 |
| 802.11n HT20 | 5745 | -30.35 | -7.5 | -22.85 | 30.5 | 0.15 |
| | 5785 | -31.10 | -7.5 | -23.60 | 30.5 | -0.60 |
| | 5825 | -30.24 | -7.5 | -22.74 | 30.5 | 0.26 |
| 802.11n HT40 | 5755 | -33.66 | -7.5 | -26.16 | 30.5 | -3.16 |
| | 5795 | -32.51 | -7.5 | -25.01 | 30.5 | -2.01 |
| | | | -7.5 | | 30.5 | |
| 802.11ac 80 | 5787 | -34.21 | -7.5 | -26.71 | 30.5 | -3.71 |

Horizontal polarization

| Modulation | Frequency, | dBm | | Margin, dB | Antenna gain, dBi | EIRP, | EIRP limit, | EIRP margin, dB | E Field dBuV/m |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | Measured | Limit | | | dBm | dBm | | |
| 802.11a | 5745 | -32.29 | -7.5 | -24.79 | 30.5 | -1.79 | -- | -- | 93.37 |
| | 5785 | -32.66 | -7.5 | -25.16 | 30.5 | -2.16 | -- | -- | 93 |
| | 5825 | -31.72 | -7.5 | -24.22 | 30.5 | -1.22 | -- | -- | 93.94 |
| 802.11n HT20 | 5745 | -32.24 | -7.5 | -24.74 | 30.5 | -1.74 | -- | -- | 93.42 |
| | 5785 | -32.66 | -7.5 | -25.16 | 30.5 | -2.16 | -- | -- | 93 |
| | 5825 | -31.74 | -7.5 | -24.24 | 30.5 | -1.24 | -- | -- | 93.92 |
| 802.11n HT40 | 5755 | -35.20 | -7.5 | -27.70 | 30.5 | -4.70 | -- | -- | 90.46 |
| | 5795 | -35.46 | -7.5 | -27.96 | 30.5 | -4.96 | -- | -- | 90.2 |
| | | | -7.5 | | | | -- | -- | |
| 802.11ac 80 | 5787 | -35.57 | -7.5 | -28.07 | 30.5 | -5.07 | -- | -- | 90.09 |

Vertical polarization

| Modulation | Frequency, | dBm | | Margin, dB | Antenna gain, dBi | EIRP, | EIRP limit, | EIRP margin, dB | E Field dBuV/m |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | Measured | Limit | | | dBm | dBm | | |
| 802.11a | 5745 | -34.38 | -7.5 | -26.88 | 30.5 | -3.88 | -- | -- | 91.28 |
| | 5785 | -36.30 | -7.5 | -28.80 | 30.5 | -5.80 | -- | -- | 89.36 |
| | 5825 | -35.51 | -7.5 | -28.01 | 30.5 | -5.01 | -- | -- | 90.15 |
| 802.11n HT20 | 5745 | -34.88 | -7.5 | -27.38 | 30.5 | -4.38 | -- | -- | 90.78 |
| | 5785 | -36.30 | -7.5 | -28.80 | 30.5 | -5.80 | -- | -- | 89.36 |
| | 5825 | -35.58 | -7.5 | -28.08 | 30.5 | -5.08 | -- | -- | 90.08 |
| 802.11n HT40 | 5755 | -38.93 | -7.5 | -31.43 | 30.5 | -8.43 | -- | -- | 86.73 |
| | 5795 | -35.58 | -7.5 | -28.08 | 30.5 | -5.08 | -- | -- | 90.08 |
| | | | -7.5 | | 30.5 | | -- | -- | |
| 802.11ac 80 | 5787 | -39.91 | -7.5 | -32.41 | 30.5 | -9.41 | -- | -- | 85.75 |

ISED e.i.r.p limit is 200 mW (23 dBm) or 10 + 10∗Log (B), dBm, whichever power is less.

ISED PSD limit is 10 dBm/MHz e.i.r.p

FCC Psd **measurements** (Sum of E Field in vertical and horizontal polarization) to dBm EIRP (Total E Field – antenna gain -20*log10(3)-104.7 dB

| Modulation | Frequency, | Conducted output power, dBm | | | Antenna gain, | EIRP, | EIRP limit, | EIRP margin, |
|---|---|---|---|---|---|---|---|---|
| | MHz | Measured | Limit | Margin, dB | dBi | dBm | dBm | dB |
| 802.11a | 5745 | -19.8 | -- | -- | 30.5 | 10.7 | 22.1 | -11.4 |
| | 5785 | -21.1 | -- | -- | 30.5 | 9.4 | 22.1 | -12.7 |
| | 5825 | -19.9 | -- | -- | 30.5 | 10.6 | 22.1 | -11.5 |
| 802.11n HT20 | 5745 | -20.3 | -- | -- | 30.5 | 10.2 | 22.1 | -11.9 |
| | 5785 | -21.8 | -- | -- | 30.5 | 8.7 | 22.1 | -13.4 |
| | 5825 | -19.9 | -- | -- | 30.5 | 10.6 | 22.1 | -11.5 |
| 802.11n HT40 | 5755 | -20.4 | -- | -- | 30.5 | 10.1 | 23.0 | -12.9 |
| | 5795 | -21.5 | -- | -- | 30.5 | 9.0 | 23.0 | -14.0 |
| | | | -- | -- | | | | |
| 802.11ac 80 | 5787 | -14.3 | -- | -- | 30.5 | 16.2 | 23.0 | -6.8 |

VERTICAL POLARIZATION

| Modulation | Frequency, | dBm | | | Antenna | EIRP, | EIRP limit, | EIRP | |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | Measured | Limit | Margin, dB | gain, dBi | dBm | dBm | margin, dB | dBuV/m |
| 802.11a | 5745 | -25.3 | -- | -- | 30.5 | 5.2 | 22.1 | -16.9 | 100.3 |
| | 5785 | -26.9 | -- | -- | 30.5 | 3.6 | 22.1 | -18.5 | 98.7 |
| | 5825 | -25.6 | -- | -- | 30.5 | 4.9 | 22.1 | -17.2 | 100.1 |
| 802.11n HT20 | 5745 | -26.9 | -- | -- | 30.5 | 3.6 | 22.1 | -18.5 | 98.7 |
| | 5785 | -30.9 | -- | -- | 30.5 | -0.4 | 22.1 | -22.5 | 94.8 |
| | 5825 | -25.6 | -- | -- | 30.5 | 4.9 | 22.1 | -17.2 | 100.1 |
| 802.11n HT40 | 5755 | -25.7 | -- | -- | 30.5 | 4.8 | 22.1 | -17.3 | 99.9 |
| | 5795 | -27.1 | -- | -- | 30.5 | 3.4 | 23.0 | -19.6 | 98.6 |
| | | | -- | -- | | | 23.0 | | |
| 802.11ac 80 | 5787 | -20.0 | -- | -- | 30.5 | 10.5 | 23.0 | -12.7 | 105.5 |

Horizontal polarization

| Modulation | Frequency, | dBm | | | Antenna | EIRP, | EIRP limit, | EIRP | |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | Measured | Limit | Margin, dB | gain, dBi | dBm | dBm | margin, dB | dBuV/m |
| 802.11a | 5745 | -21.3 | -- | -- | 30.5 | 9.2 | 22.1 | -12.9 | 104.4 |
| | 5785 | -22.4 | -- | -- | 30.5 | 8.1 | 22.1 | -14.0 | 103.2 |
| | 5825 | -21.2 | -- | -- | 30.5 | 9.3 | 22.1 | -12.8 | 104.4 |
| 802.11n HT20 | 5745 | -21.4 | -- | -- | 30.5 | 9.1 | 22.1 | -13.0 | 104.3 |
| | 5785 | -22.4 | -- | -- | 30.5 | 8.1 | 22.1 | -14.0 | 103.3 |
| | 5825 | -21.2 | -- | -- | 30.5 | 9.3 | 22.1 | -12.8 | 104.4 |
| 802.11n HT40 | 5755 | -21.9 | -- | -- | 30.5 | 8.6 | 22.1 | -13.5 | 103.7 |
| | 5795 | -22.9 | -- | -- | 30.5 | 7.6 | 23.0 | -15.4 | 102.8 |
| | | | -- | -- | | | 23.0 | | |
| 802.11ac 80 | 5787 | -15.6 | -- | -- | 30.5 | 14.9 | 23.0 | -8.1 | 110.1 |

ISED PSD limit is 10 dBm/MHz e.i.r.p

ISED Psd measurements (Sum of E Field in vertical and horizontal polarization) to dBm EIRP (Total E Field – antenna gain -20*log10(3)-104.7 dB

| Modulation | Frequency, | Conducted output power, dBm/MHz | | | | EIRP, | EIRP limit, | |
|---|---|---|---|---|---|---|---|---|
| | MHz | Measured | Limit | Margin, dB | Antenna gain, dBi | dBm/MHz | dBm/MHz | EIRP margin, dB |
| 802.11a | 5745 | -30.20 | -- | -- | 30.5 | 0.30 | 10 | -9.70 |
| | 5785 | -31.10 | -- | -- | 30.5 | -0.60 | 10 | -10.60 |
| | 5825 | -30.20 | -- | -- | 30.5 | 0.30 | 10 | -9.70 |
| 802.11n HT20 | 5745 | -30.35 | -- | -- | 30.5 | 0.15 | 10 | -9.85 |
| | 5785 | -31.10 | -- | -- | 30.5 | -0.60 | 10 | -10.60 |
| | 5825 | -30.24 | -- | -- | 30.5 | 0.26 | 10 | -9.74 |
| 802.11n HT40 | 5755 | -33.66 | -- | -- | 30.5 | -3.16 | 10 | -13.16 |
| | 5795 | -32.51 | -- | -- | 30.5 | -2.01 | 10 | -12.01 |
| | | | -- | -- | 30.5 | | 10 | -10.00 |
| 802.11ac 80 | 5787 | -34.21 | -- | -- | 30.5 | -3.71 | 10 | -13.71 |
| | | | -- | -- | | | | |

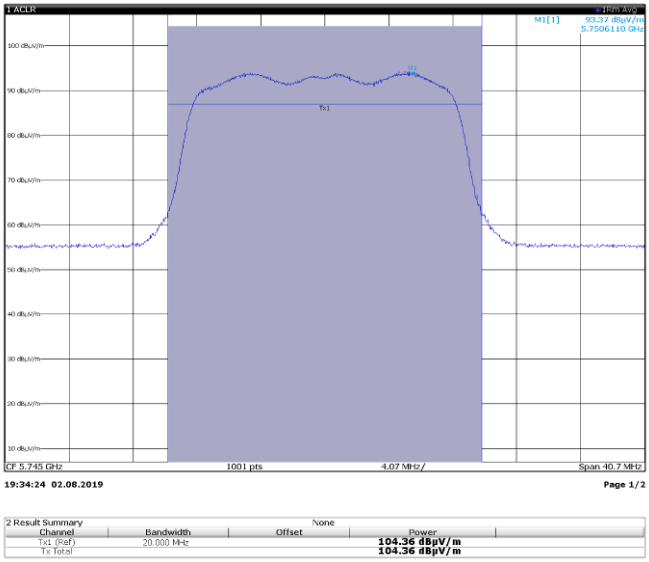
VERTICAL POLARIZATION

| Modulation | Frequency, | dBm/MHz | | Margin, | Antenna | EIRP, | EIRP limit, | EIRP margin, | |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | Measured | Limit | dB | gain, dBi | dBm/MHz | dBm/MHz | dB | dBuV/m/MHz |
| 802.11a | 5745 | -34.38 | -- | -- | 30.5 | -3.88 | 10 | -13.88 | 91.28 |
| | 5785 | -36.30 | -- | -- | 30.5 | -5.80 | 10 | -15.80 | 89.36 |
| | 5825 | -35.51 | -- | -- | 30.5 | -5.01 | 10 | -15.01 | 90.15 |
| 802.11n HT20 | 5745 | -34.88 | -- | -- | 30.5 | -4.38 | 10 | -14.38 | 90.78 |
| | 5785 | -36.30 | -- | -- | 30.5 | -5.80 | 10 | -15.80 | 89.36 |
| | 5825 | -35.58 | -- | -- | 30.5 | -5.08 | 10 | -15.08 | 90.08 |
| 802.11n HT40 | 5755 | -38.93 | -- | -- | 30.5 | -8.43 | 10 | -18.43 | 86.73 |
| | 5795 | -35.58 | -- | -- | 30.5 | -5.08 | 10 | -15.08 | 90.08 |
| | | | -- | -- | 30.5 | | 10 | -10.00 | |
| 802.11ac 80 | 5787 | -39.91 | -- | -- | 30.5 | -9.41 | 10 | -19.41 | 85.75 |
| | | | -- | -- | | | | | |

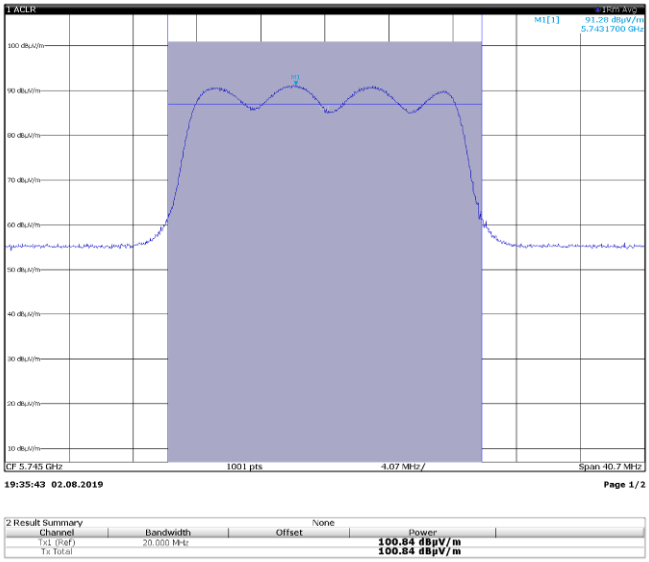
Horizontal polarization

| Modulation | Frequency, | dBm/MHz | | Margin, | Antenna | EIRP, | EIRP limit, | EIRP margin, | |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | Measured | Limit | dB | gain, dBi | dBm/MHz | dBm/MHz | dB | dBuV/m/MHz |
| 802.11a | 5745 | -32.29 | | | 30.5 | -1.79 | 10 | -11.79 | 93.37 |
| | 5785 | -32.66 | | | 30.5 | -2.16 | 10 | -12.16 | 93 |
| | 5825 | -31.72 | | | 30.5 | -1.22 | 10 | -11.22 | 93.94 |
| 802.11n HT20 | 5745 | -32.24 | | | 30.5 | -1.74 | 10 | -11.74 | 93.42 |
| | 5785 | -32.66 | | | 30.5 | -2.16 | 10 | -12.16 | 93 |
| | 5825 | -31.74 | | | 30.5 | -1.24 | 10 | -11.24 | 93.92 |
| 802.11n HT40 | 5755 | -35.20 | | | 30.5 | -4.70 | 10 | -14.70 | 90.46 |
| | 5795 | -35.46 | | | 30.5 | -4.96 | 10 | -14.96 | 90.2 |
| | | | | | | | 10 | -10.00 | |
| 802.11ac 80 | 5787 | -35.57 | | | 30.5 | -5.07 | 10 | -15.07 | 90.09 |

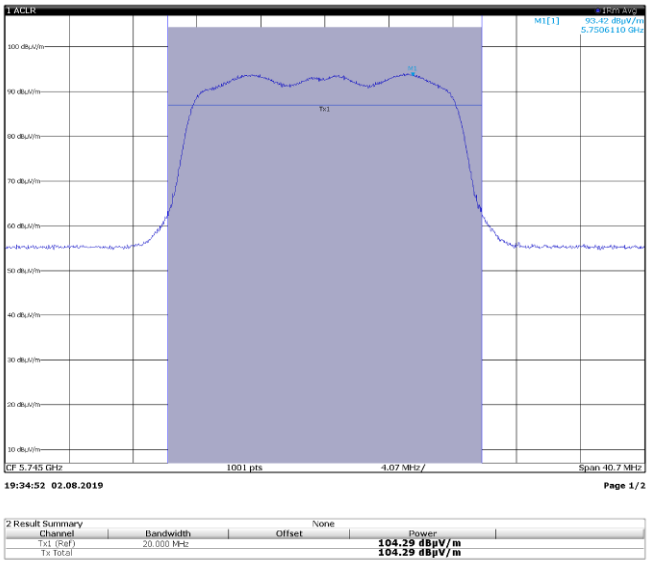
detector = RMS (power averaging).



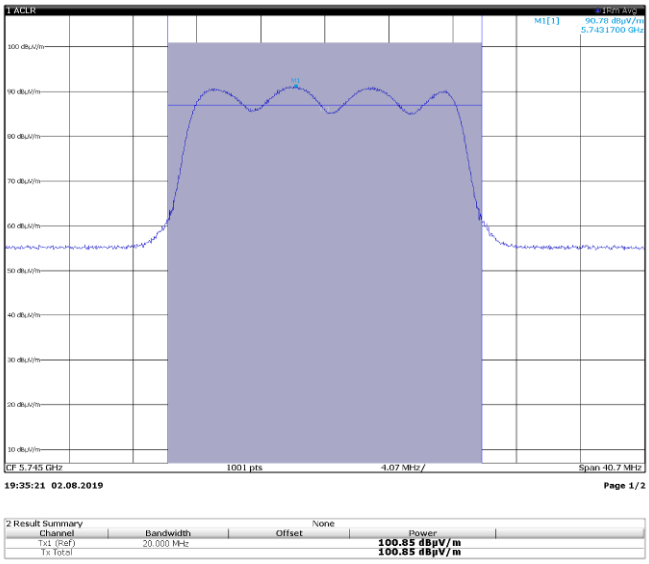

*eirp on 802.11a Sample plot horizontal*



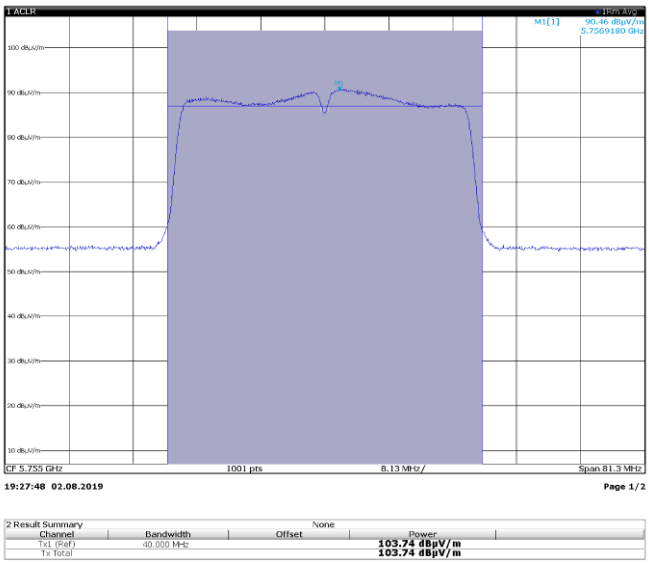

*eirp on 802.11a Sample plot vertical*



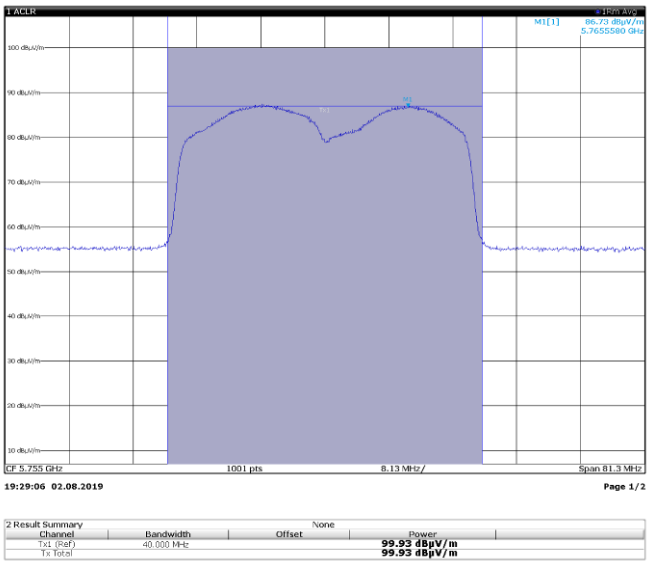

*eirp on 802.11Nht20 Sample plot horizontal*



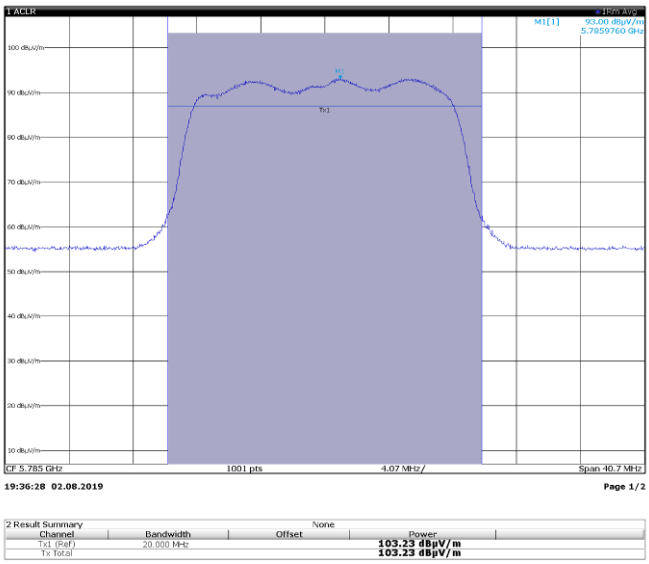

*eirp on 802.11Nht20 Sample plot vertical*



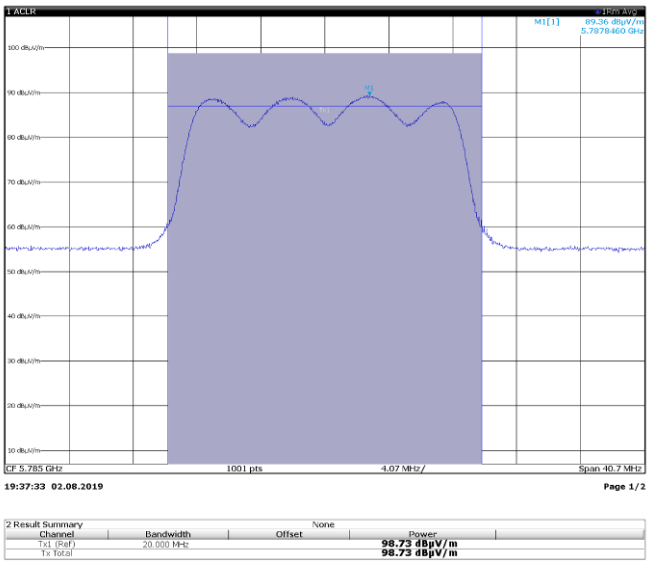

*eirp on 802.11Nht40 Sample plot horizontal*



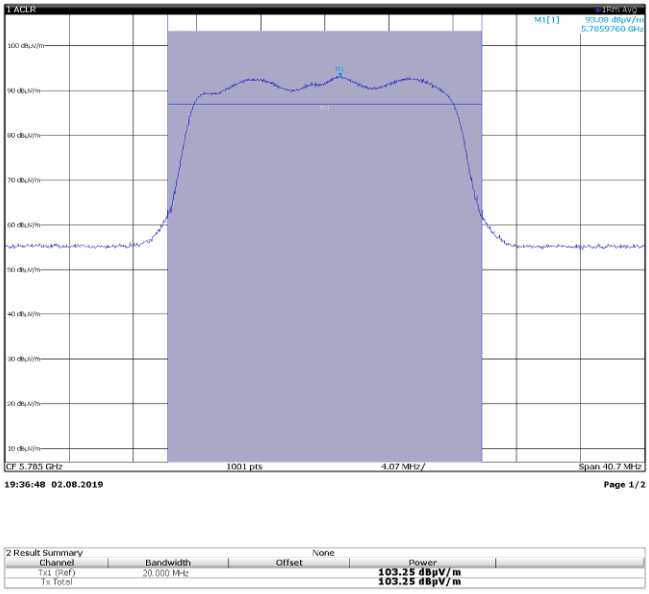

*eirp on 802.11Nht40 Sample plot vertical*



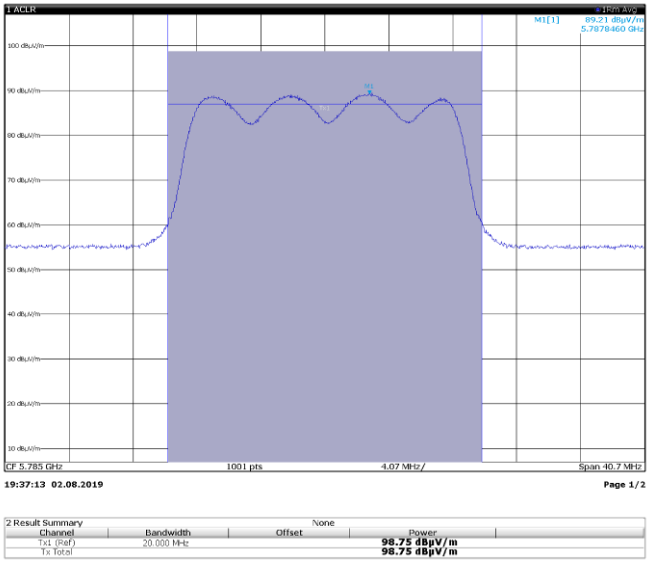

*eirp on 802.11a Sample plot horizontal*



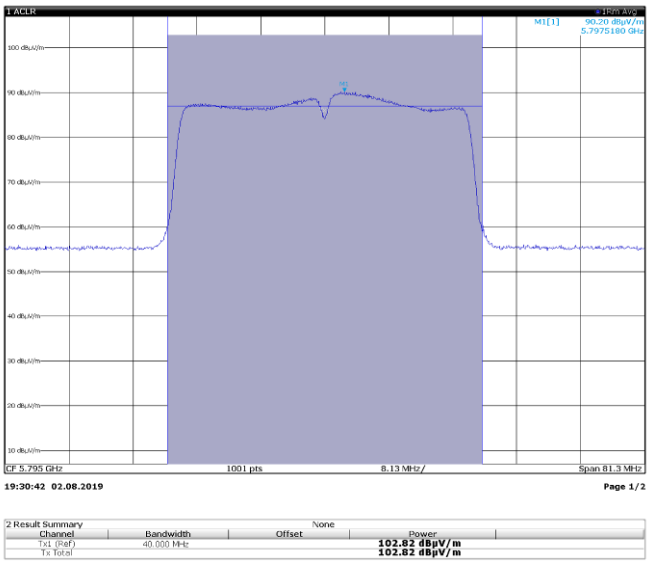

*eirp on 802.11a Sample plot vertical*



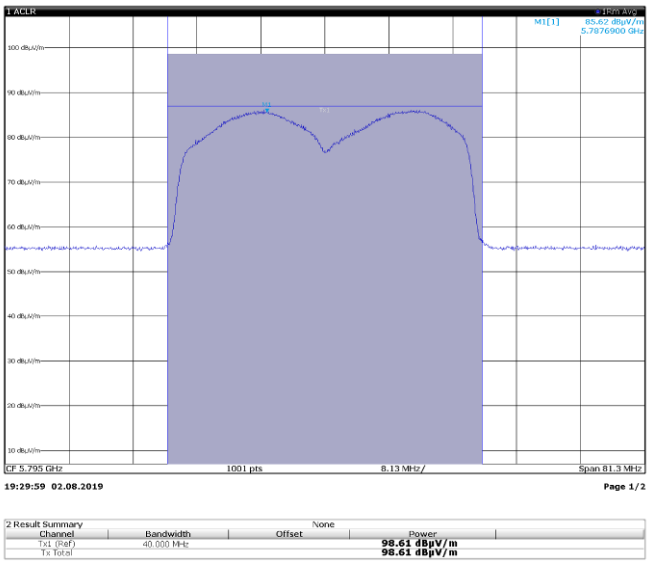

*eirp on 802.11Nht20 Sample plot horizontal*



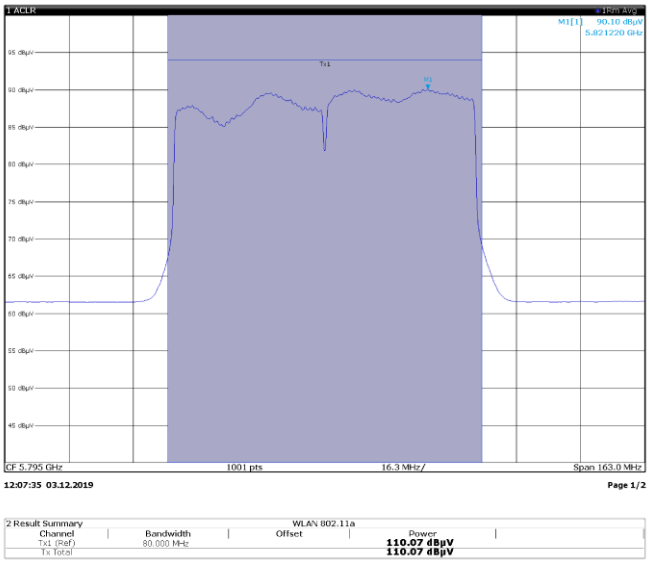

*eirp on 802.11Nht20 Sample plot vertical*



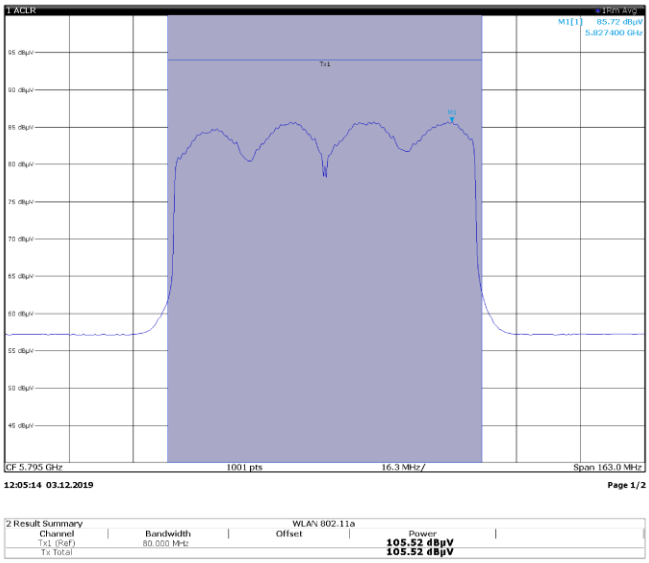

*eirp on 802.11Nht40 Sample plot horizontal*



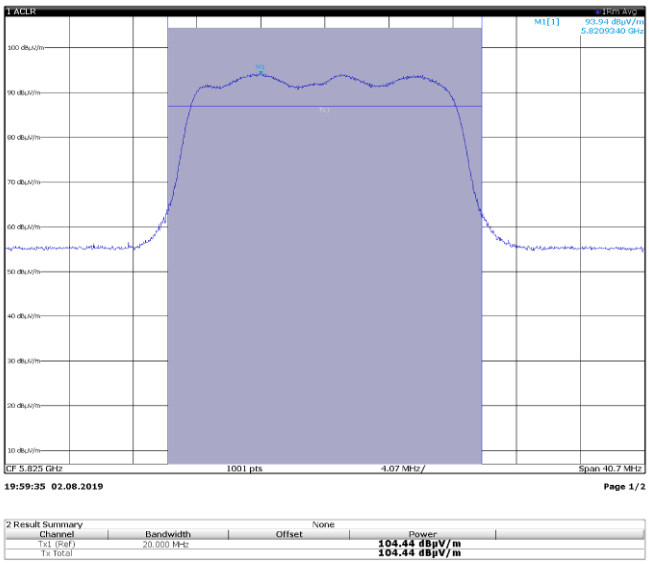

*eirp on 802.11Nht40 Sample plot vertical*



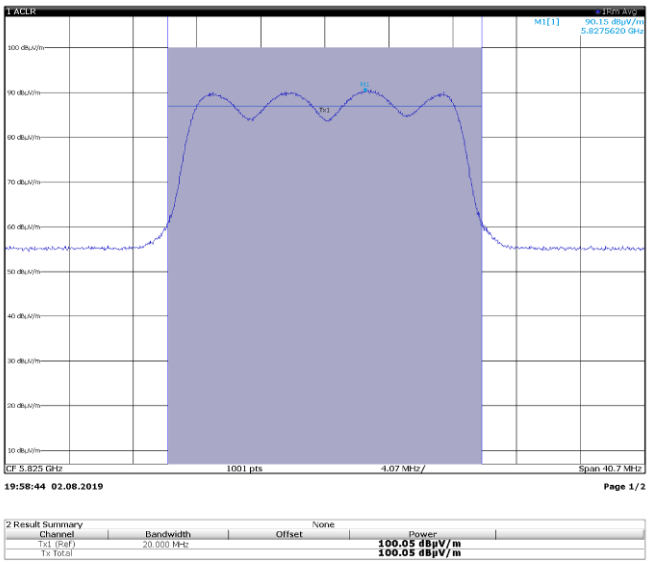

***eirp on 802.11ac (80MHz) Sample plot horizontal***



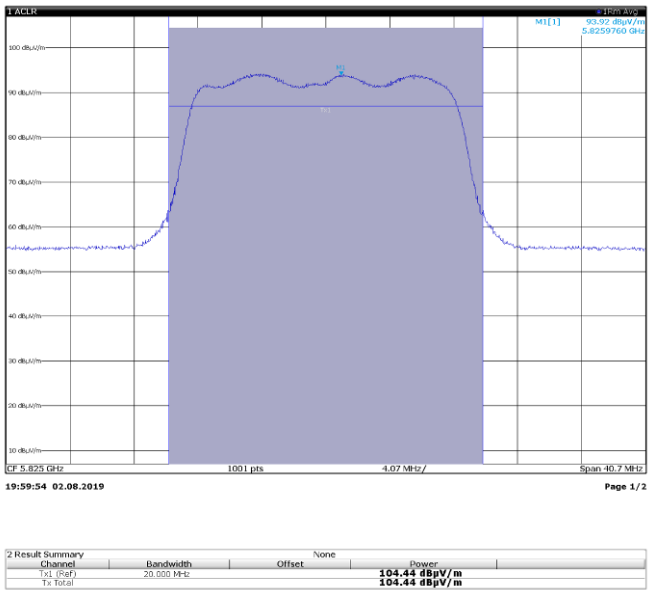

***eirp on 802.11ac (80 MHz) Sample plot vertical***




*Psd eirp on 802.11a Sample plot horizontal*



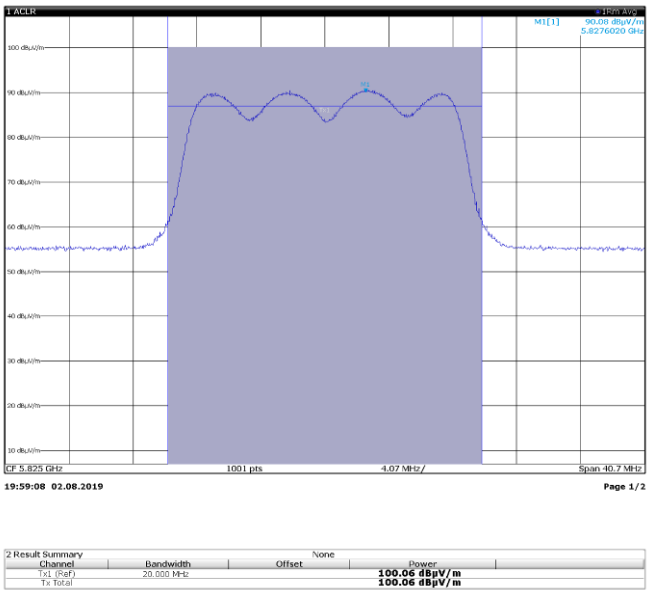

*Psd eirp on 802.11a Sample plot vertical*







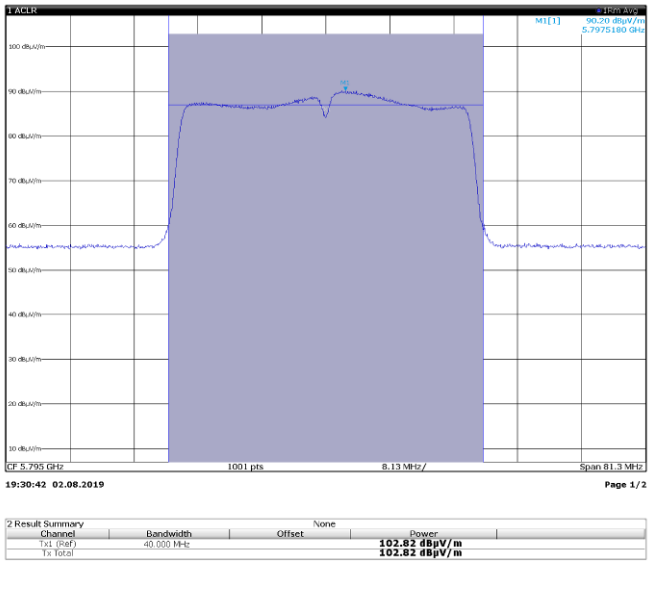
*Psd eirp on 802.11Nht20 Sample plot horizontal*





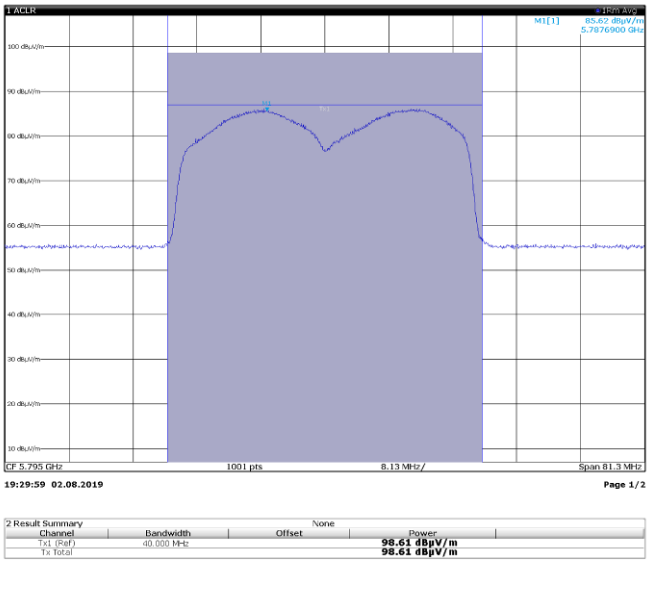


*Psd eirp on 802.11Nht20 Sample plot vertical*









## 8.4 FCC 15.407(b) and RSS-247 6.2.4.2 Spurious (out-of-band) emissions

### 8.4.1 Definitions and limits

**FCC:**

(i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.
(ii) Devices certified before March 2, 2017 with antenna gain greater than 10 dBi may demonstrate compliance with the emission limits in § 15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease by March 2, 2018. Devices certified before March 2, 2018 with antenna gain of 10 dBi or less may demonstrate compliance with the emission limits in § 15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease before March 2, 2020.

For radiated emission:

−27 dBm/MHz at 75 MHz are 68.2 dBuV/m at 3m;
10 dBm/MHz are 105.2 dBuV/m at 3m,
15.6 dBm/MHz are 110.8 dBuV/m at 3m
27 dBm/MHz are 122.2 dBuV/m

**ISED:**
Devices operating in the band 5725-5850 MHz with antenna gain greater than 10 dBi can have unwanted emissions that comply with either the limits in this section or in section 5.5 until six (6) months after the publication date of this standard for certification. Certified devices that do not comply with emission limits in this section shall not be manufactured, imported, distributed, leased, offered for sale or sold after April 1, 2018.

Devices operating in the band 5725-5850 MHz with antenna gain of 10 dBi or less can have unwanted emissions that comply with either the limits in this section or in section 5.5 until April 1, 2018 for certification. Certified devices that do not comply with emission limits in this section shall not be manufactured, imported, distributed, leased, offered for sale or sold after April 1, 2020.

Devices operating in the band 5725-5850 MHz shall have e.i.r.p. of unwanted emissions comply with the following:

a. 27 dBm/MHz at frequencies from the band edges decreasing linearly to 15.6 dBm/MHz at 5 MHz above or below the band edges;
b. 15.6 dBm/MHz at 5 MHz above or below the band edges decreasing linearly to 10 dBm/MHz at 25 MHz above or below the band edges;
c. 10 dBm/MHz at 25 MHz above or below the band edges decreasing linearly to −27 dBm/MHz at 75 MHz above or below the band edges; and
d.−27 dBm/MHz at frequencies more than 75 MHz above or below the band edges.

***Table 8.4-1:*** *FCC §15.209 and RSS-Gen – Radiated emission limits*

| Frequency, MHz | Field strength of emissions µV/m | Field strength of emissions dBµV/m | Measurement distance, m |
|---|---|---|---|
| 0.009–0.490 | 2400/F *(F in kHz)* | $67.6 - 20 \times \log_{10}$(F) *(F in kHz)* | 300 |
| 0.490–1.705 | 24000/F *(F in kHz)* | $87.6 - 20 \times \log_{10}$(F) *(F in kHz)* | 30 |
| 1.705–30.0 | 30 | 29.5 | 30 |
| 30–88 | 100 | 40.0 | 3 |
| 88–216 | 150 | 43.5 | 3 |
| 216–960 | 200 | 46.0 | 3 |
| above 960 | 500 | 54.0 | 3 |

Notes: In the emission table above, the tighter limit applies at the band edges.
For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test

***Table 8.4-2:*** *ISED restricted frequency bands*

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090–0.110 | 12.51975–12.52025 | 399.9–410 | 5.35–5.46 |
| 2.1735–2.1905 | 12.57675–12.57725 | 608–614 | 7.25–7.75 |
| 3.020–3.026 | 13.36–13.41 | 960–1427 | 8.025–8.5 |
| 4.125–4.128 | 16.42–16.423 | 1435–1626.5 | 9.0–9.2 |
| 4.17725–4.17775 | 16.69475–16.69525 | 1645.5–1646.5 | 9.3–9.5 |
| 4.20725–4.20775 | 16.80425–16.80475 | 1660–1710 | 10.6–12.7 |
| 5.677-5.683 | 25.5–25.67 | 1718.8–1722.2 | 13.25–13.4 |
| 6.215–6.218 | 37.5–38.25 | 2200–2300 | 14.47–14.5 |
| 6.26775–6.26825 | 73–74.6 | 2310–2390 | 15.35–16.2 |
| 6.31175–6.31225 | 74.8–75.2 | 2655–2900 | 17.7–21.4 |
| 8.291–8.294 | 108–138 | 3260–3267 | 22.01–23.12 |
| 8.362–8.366 | 156.52475–156.52525 | 3332–3339 | 23.6–24.0 |
| 8.37625–8.38675 | 156.7–156.9 | 3345.8–3358 | 31.2–31.8 |
| 8.41425–8.41475 | 240–285 | 3500–4400 | 36.43–36.5 |
| 12.29–12.293 | 322–335.4 | 4500–5150 | Above 38.6 |

Note: Certain frequency bands listed in Table 8.4-2 and above 38.6 GHz are designated for low-power license-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard

***Table 8.4-3:*** *FCC restricted frequency bands*

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090–0.110 | 16.42–16.423 | 399.9–410 | 4.5–5.15 |
| 0.495–0.505 | 16.69475–16.69525 | 608–614 | 5.35–5.46 |
| 2.1735–2.1905 | 16.80425–16.80475 | 960–1240 | 7.25–7.75 |
| 4.125–4.128 | 25.5–25.67 | 1300–1427 | 8.025–8.5 |
| 4.17725–4.17775 | 37.5–38.25 | 1435–1626.5 | 9.0–9.2 |
| 4.20725–4.20775 | 73–74.6 | 1645.5–1646.5 | 9.3–9.5 |
| 6.215–6.218 | 74.8–75.2 | 1660–1710 | 10.6–12.7 |
| 6.26775–6.26825 | 108–121.94 | 1718.8–1722.2 | 13.25–13.4 |
| 6.31175–6.31225 | 123–138 | 2200–2300 | 14.47–14.5 |
| 8.291–8.294 | 149.9–150.05 | 2310–2390 | 15.35–16.2 |
| 8.362–8.366 | 156.52475–156.52525 | 2483.5–2500 | 17.7–21.4 |
| 8.37625–8.38675 | 156.7–156.9 | 2690–2900 | 22.01–23.12 |
| 8.41425–8.41475 | 162.0125–167.17 | 3260–3267 | 23.6–24.0 |
| 12.29–12.293 | 167.72–173.2 | 3332–3339 | 31.2–31.8 |
| 12.51975–12.52025 | 240–285 | 3345.8–3358 | 36.43–36.5 |
| 12.57675–12.57725 | 322–335.4 | 3600–4400 | Above 38.6 |
| 13.36–13.41 | | | |

## 8.4.2 Test summary

| | |
|---|---|
| Test start date: | April 02 2019 |
| Test engineer: | Daniele Guarnone |

### 8.4.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to 40 GHz while the EUT was continuously transmitting.
Radiated measurements below 18 GHz were performed at a distance of 3 m. Radiated measurements above 18 GHz were performed at a distance of 1 m. Cabinet radiation were performed while the antenna connector was terminated with 50 Ω load. Below 1 GHz and above 18 GHz, no emissions related to RF transmitter were detected within 6 dB below the limit.

Spectrum analyser for peak conducted measurements within restricted bands below 1 GHz:

| | |
|---|---|
| Resolution bandwidth: | 100 kHz |
| Video bandwidth: | 300 kHz |
| Detector mode: | Peak |
| Trace mode: | Max Hold |

Spectrum analyser for peak conducted measurements within restricted bands above 1 GHz:

| | |
|---|---|
| Resolution bandwidth: | 1 MHz |
| Video bandwidth: | 3 MHz |
| Detector mode: | Peak |
| Trace mode: | Max Hold |

Spectrum analyser for average conducted measurements within restricted bands above 1 GHz for frequencies where peak results were above the average limit:

| | |
|---|---|
| Resolution bandwidth: | 1 MHz |
| Video bandwidth: | 3 MHz |
| Detector mode: | RMS |
| Trace mode: | Power average |
| Number of averaging traces: | 100 |

Spectrum analyser for peak conducted measurements outside restricted bands:

| | |
|---|---|
| Resolution bandwidth: | 1 MHz |
| Video bandwidth: | 3 MHz |
| Detector mode: | Peak |
| Trace mode: | Max Hold |

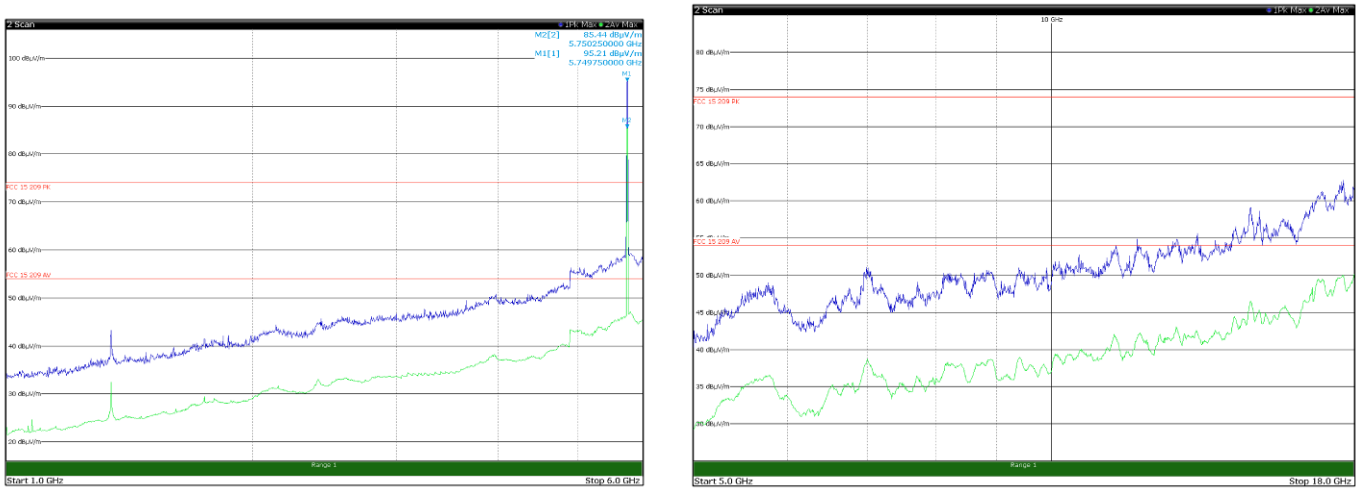
Spectrum analyzer settings for radiated measurements within restricted bands below 1 GHz:

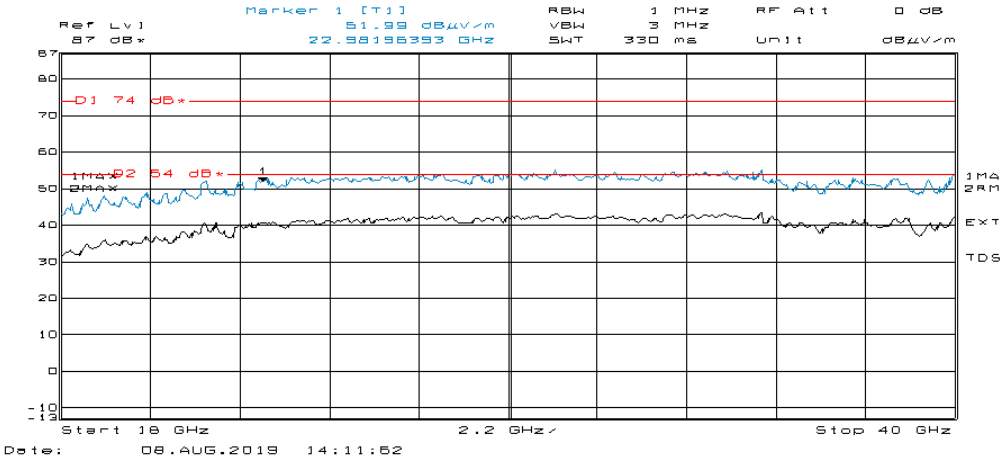
| | |
|---|---|
| Resolution bandwidth: | 100 kHz |
| Video bandwidth: | 300 kHz |
| Detector mode: | Peak |
| Trace mode: | Max Hold |

Spectrum analyzer settings for peak radiated measurements within restricted bands above 1 GHz:

| | |
|---|---|
| Resolution bandwidth: | 1 MHz |
| Video bandwidth: | 3 MHz |
| Detector mode: | Peak |
| Trace mode: | Max Hold |

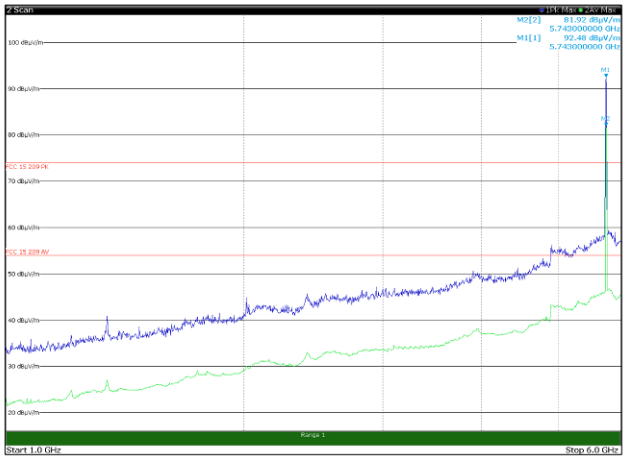
### 8.4.4 Test data

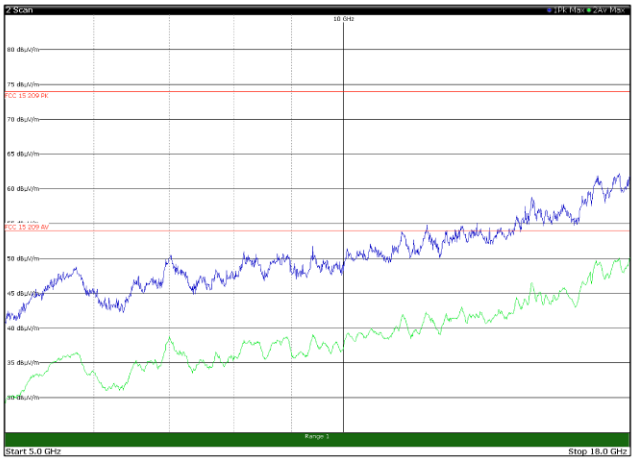


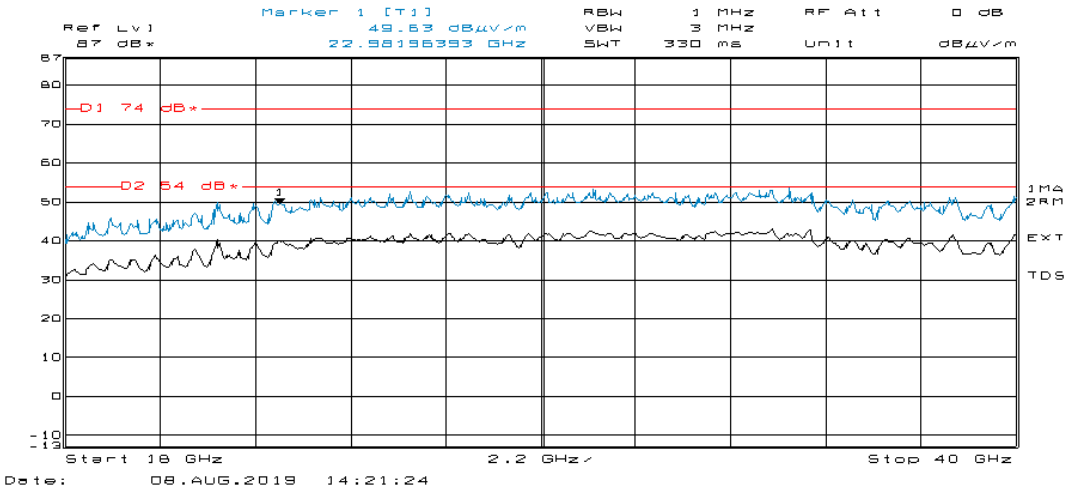



Spurious emissions outside restricted band, Tx on 5745 MHz, 802.11a horizontal

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector | Remarks |
|---|---|---|---|---|---|
| -- | -- | -- | --- | -- | |

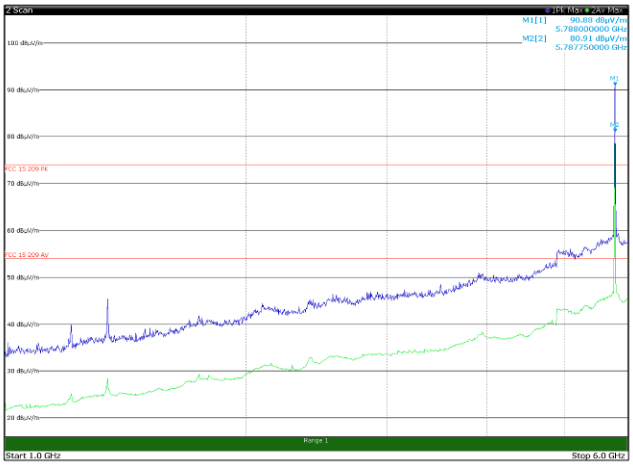


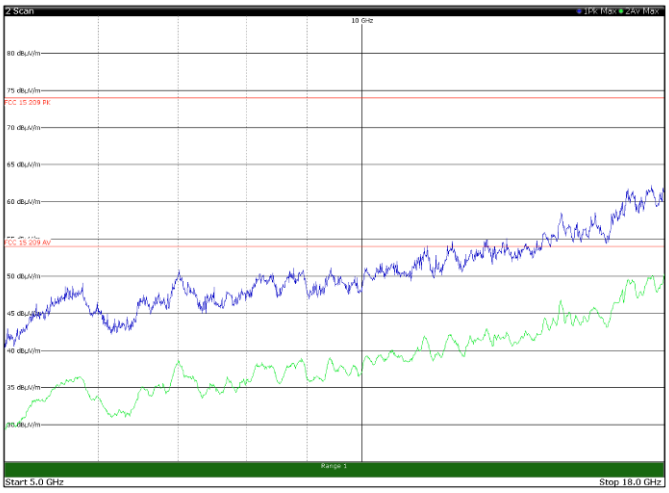


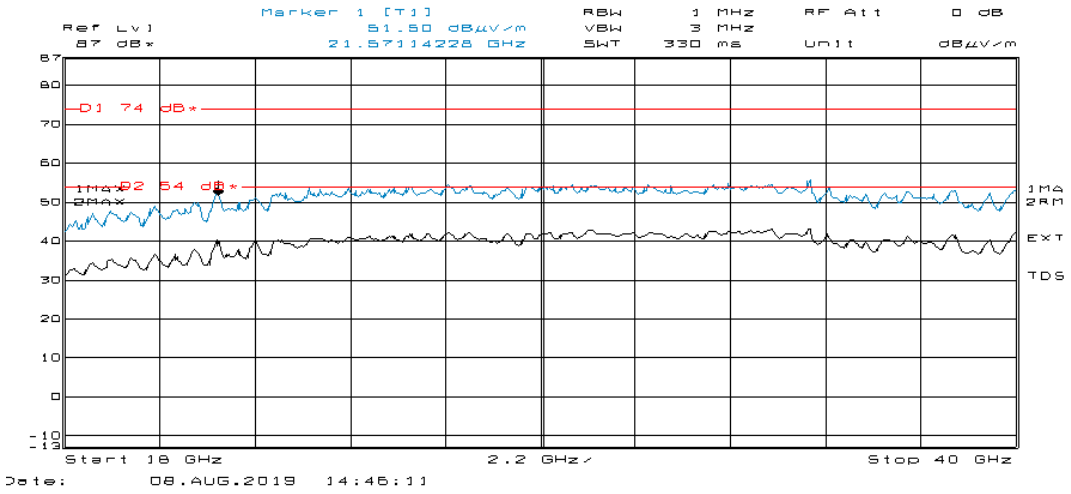



Spurious emissions outside restricted bands, Tx on 5745 MHz, 802.11a vertical

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector | Remarks |
|---|---|---|---|---|---|
| -- | -- | -- | --- | -- | |

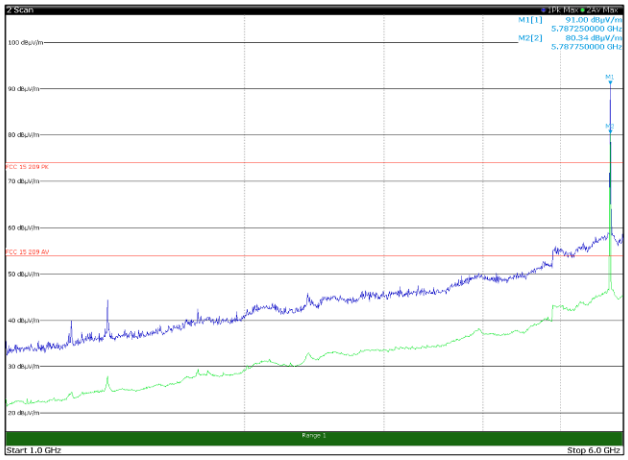


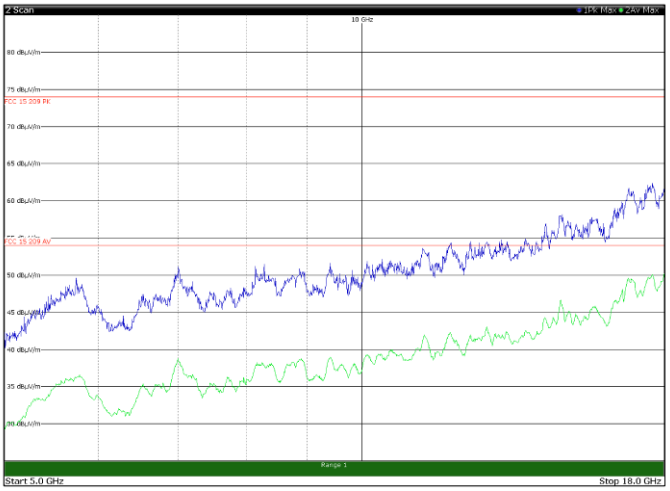



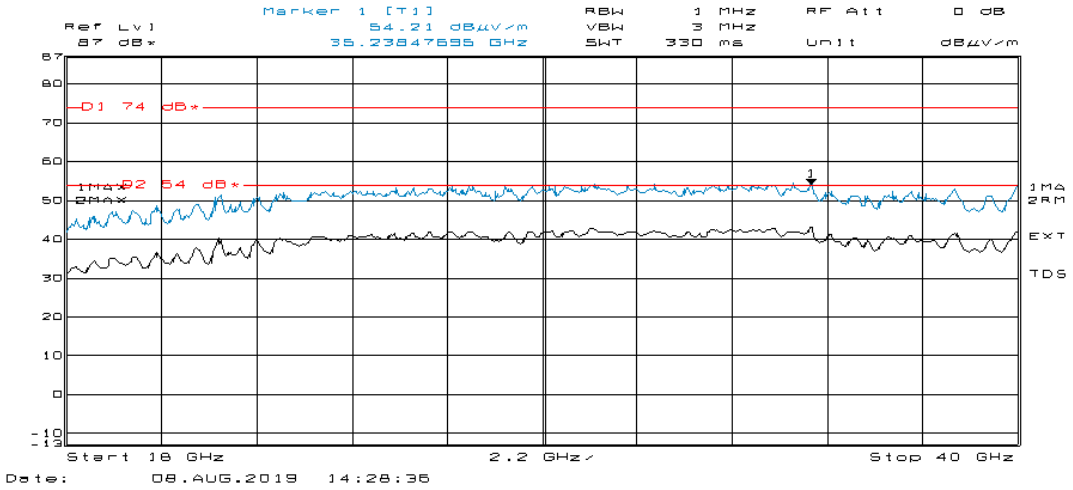




Spurious emissions outside restricted bands, Tx on 5785 MHz, 802.11a horizontal

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector | Remarks |
|---|---|---|---|---|---|
| -- | -- | -- | --- | -- | |

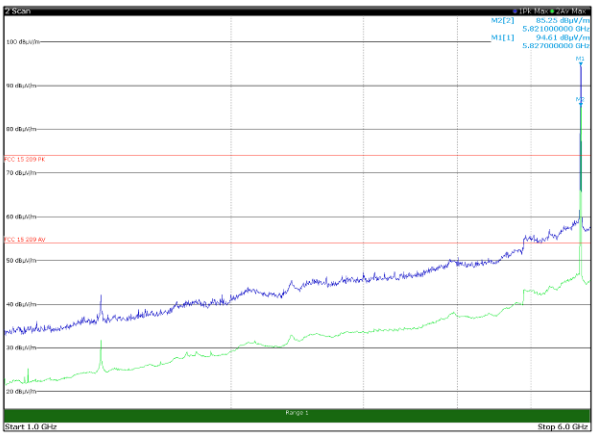


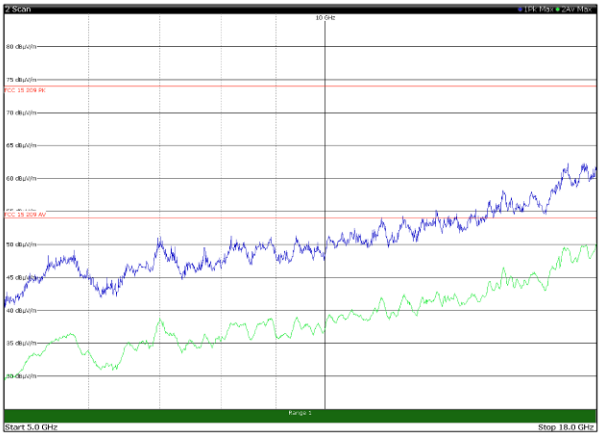



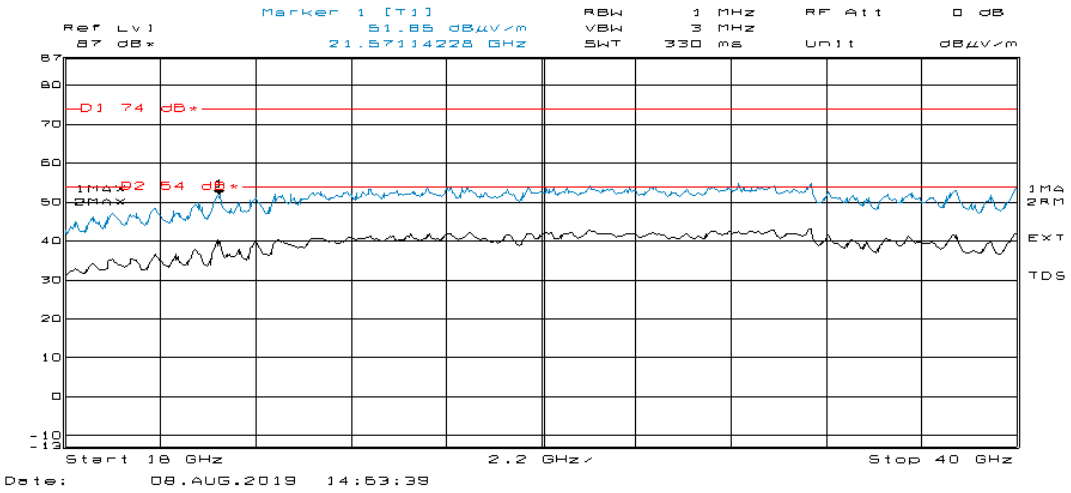




Spurious emissions outside restricted bands, Tx on 5785 MHz, 802.11a vertical

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector | Remarks |
|---|---|---|---|---|---|
| -- | -- | -- | --- | -- | |

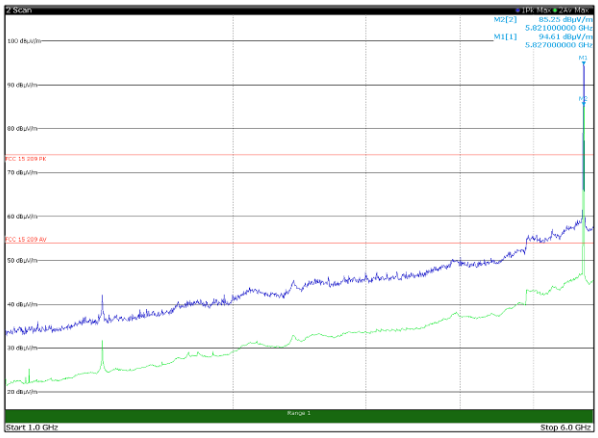


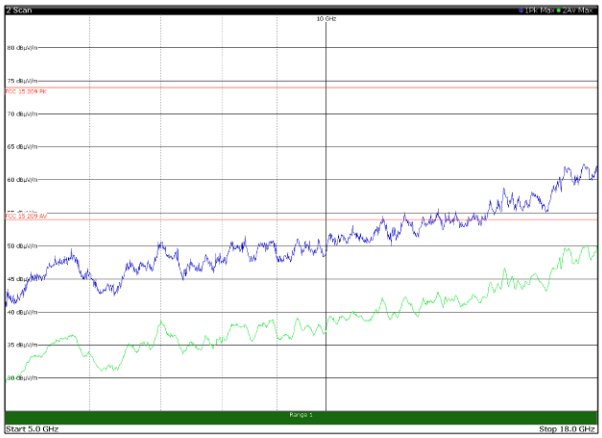


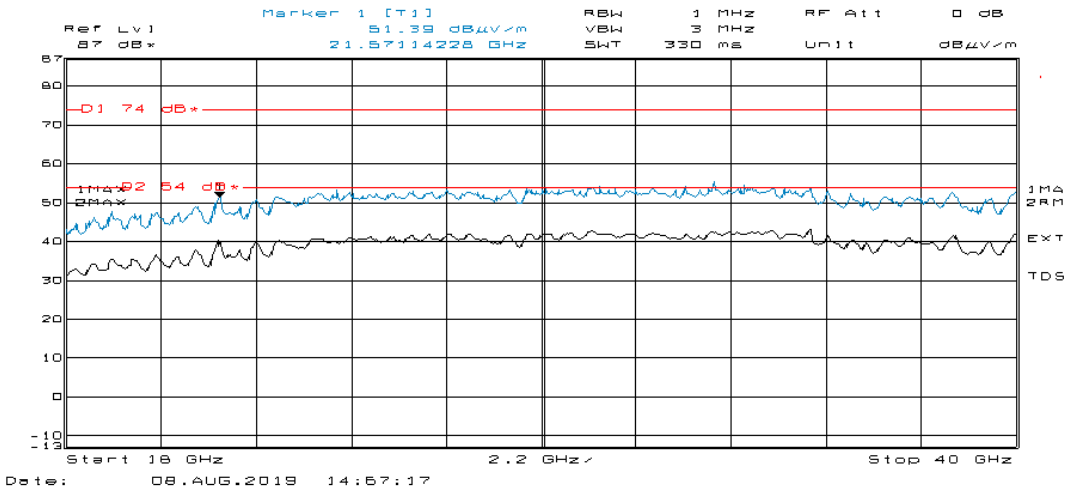



Spurious emissions outside restricted bands, Tx on 5825 MHz, 802.11a horizontal

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector | Remarks |
|---|---|---|---|---|---|
| -- | -- | -- | --- | -- | |

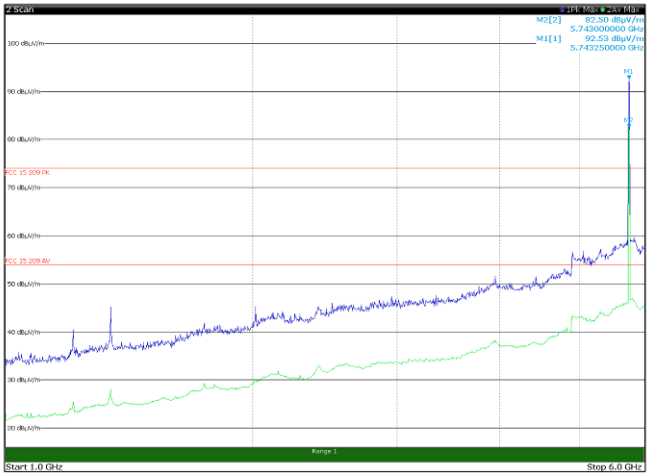


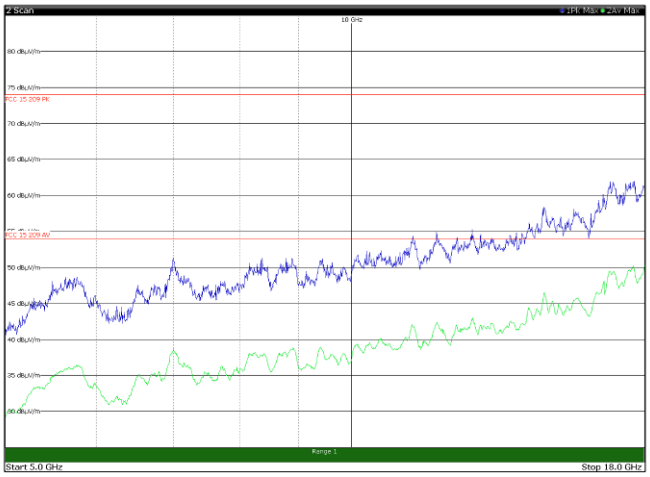


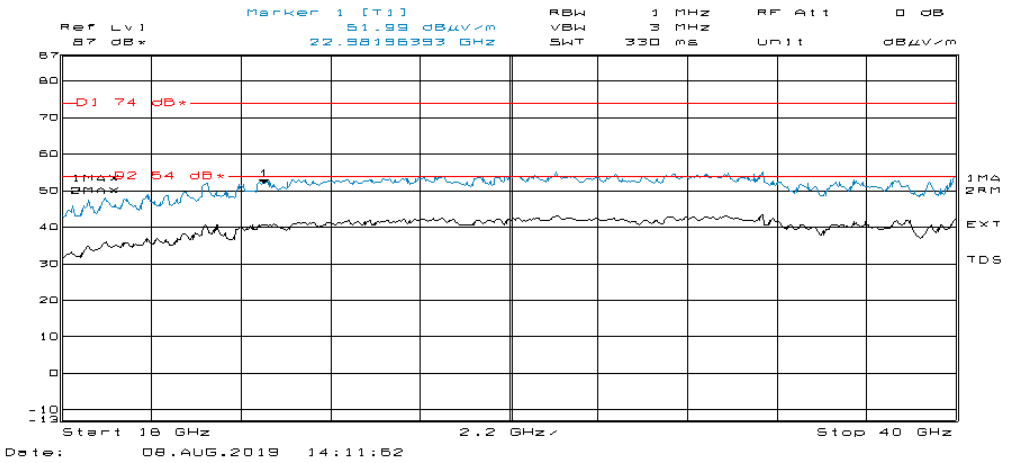



Spurious emissions outside restricted bands, Tx on 5825 MHz, 802.11a vertical

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector | Remarks |
|---|---|---|---|---|---|
| -- | -- | -- | --- | -- | |

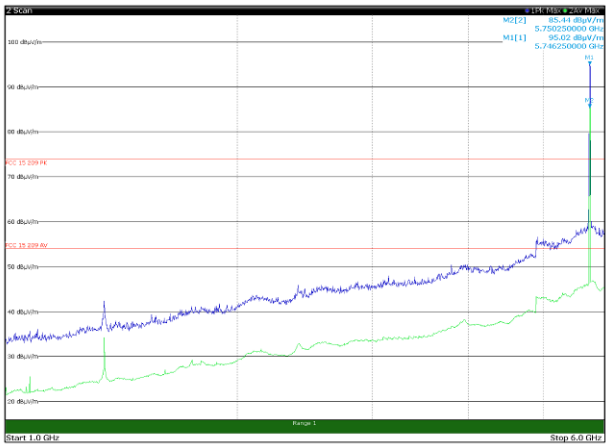


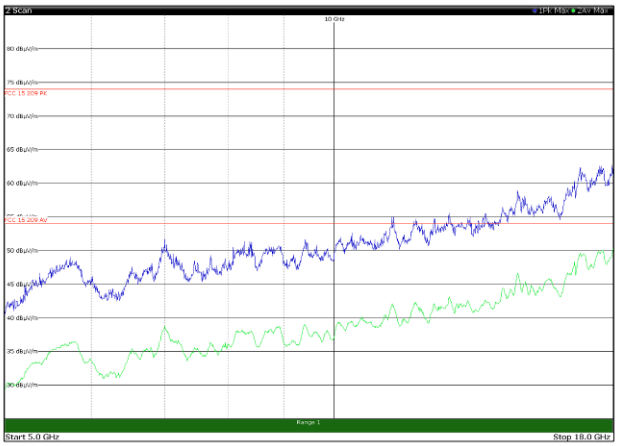



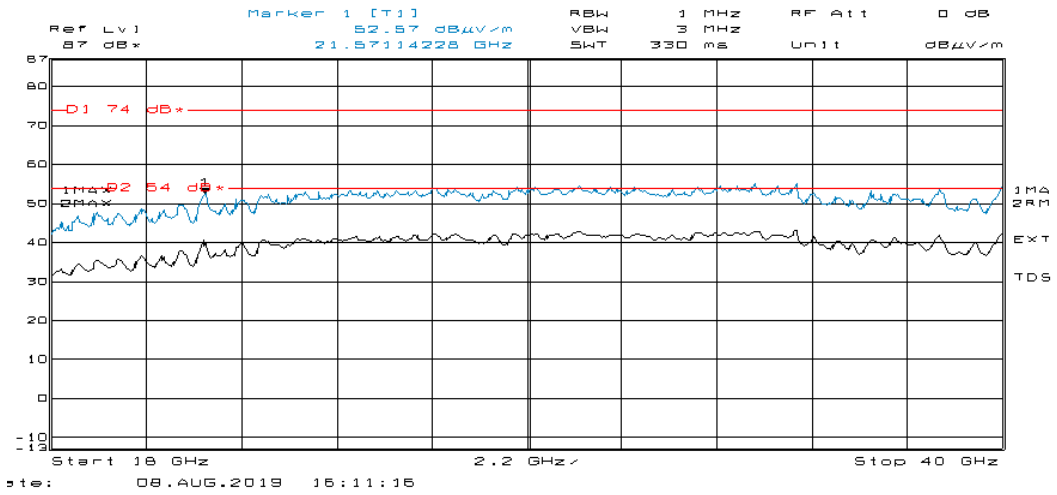




Spurious emissions outside restricted band, Tx on 5745 MHz, 802.11 nHt20 horizontal

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector | Remarks |
|---|---|---|---|---|---|
| -- | -- | -- | --- | -- | |

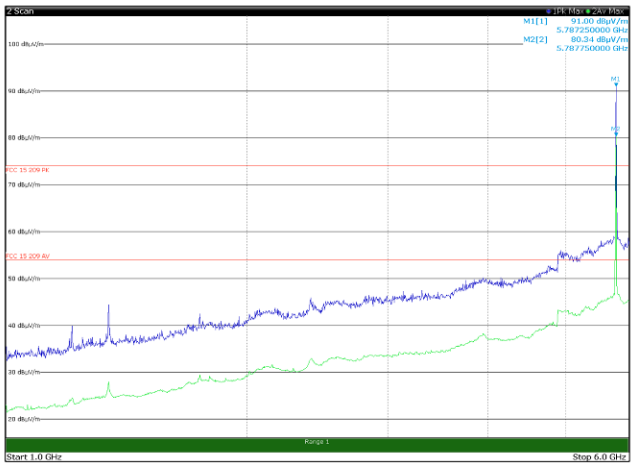


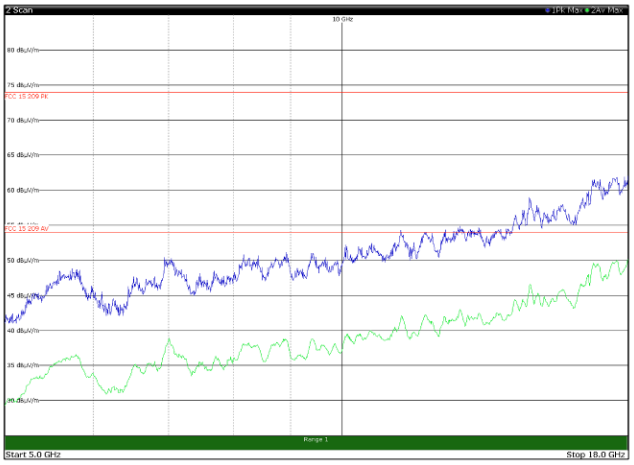


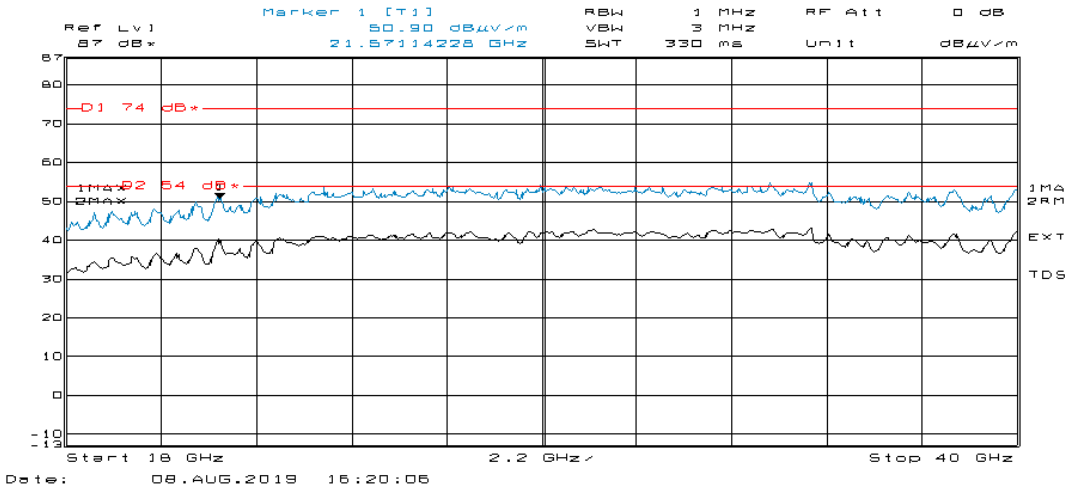



Spurious emissions outside restricted bands, Tx on 5745 MHz, 802.11 nHt20 vertical

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector | Remarks |
|---|---|---|---|---|---|
| -- | -- | -- | --- | -- | |

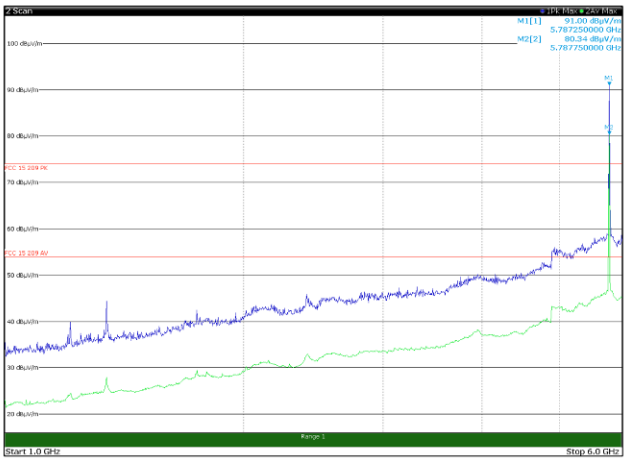


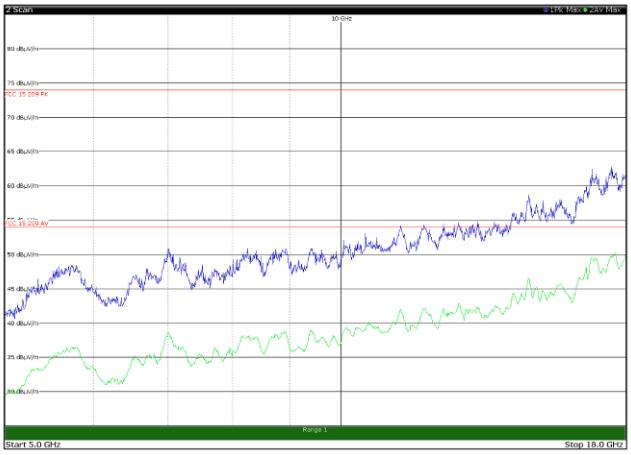


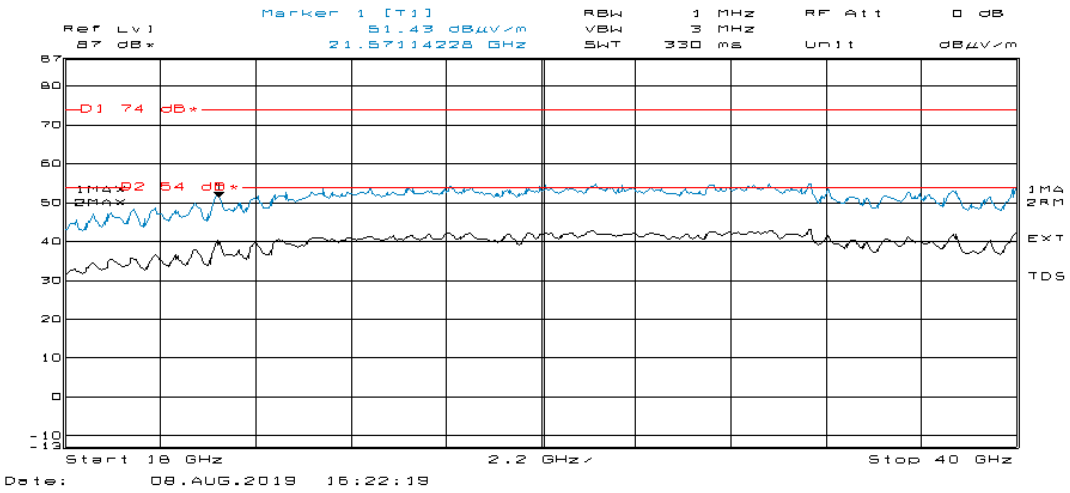



Spurious emissions outside restricted bands, Tx on 5785 MHz, 802.11 nHt20 horizontal

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector | Remarks |
|---|---|---|---|---|---|
| -- | -- | -- | --- | -- | |

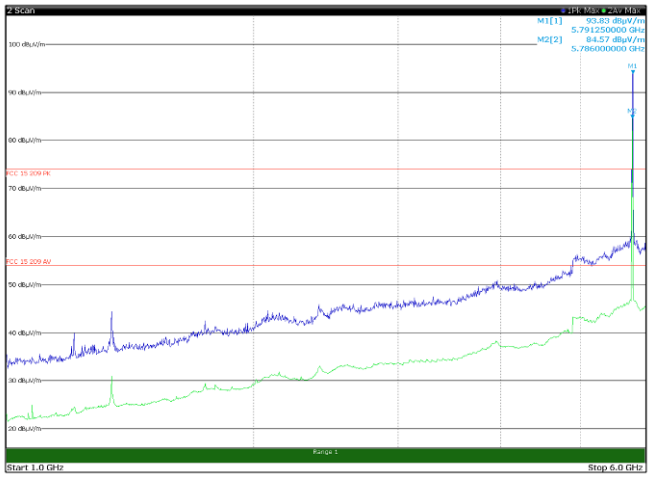


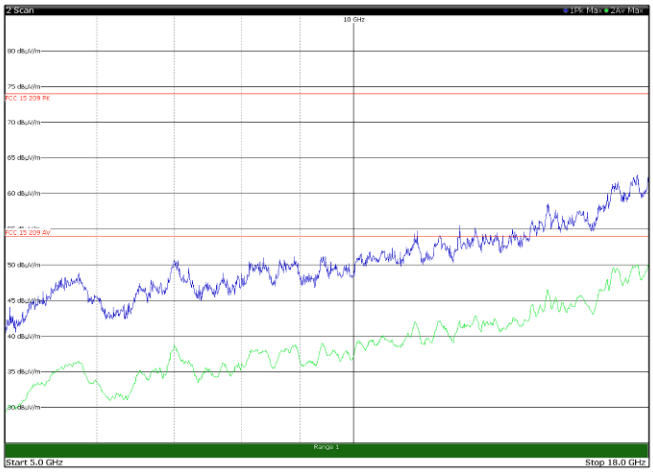


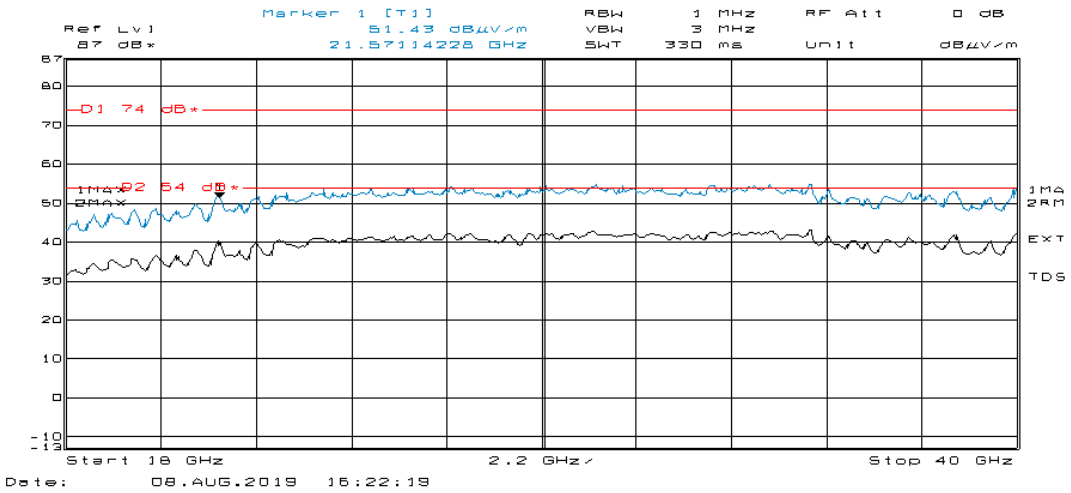



Spurious emissions outside restricted bands, Tx on 5785 MHz, 802.11 nHt20 vertical

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector | Remarks |
|---|---|---|---|---|---|
| -- | -- | -- | --- | -- | |

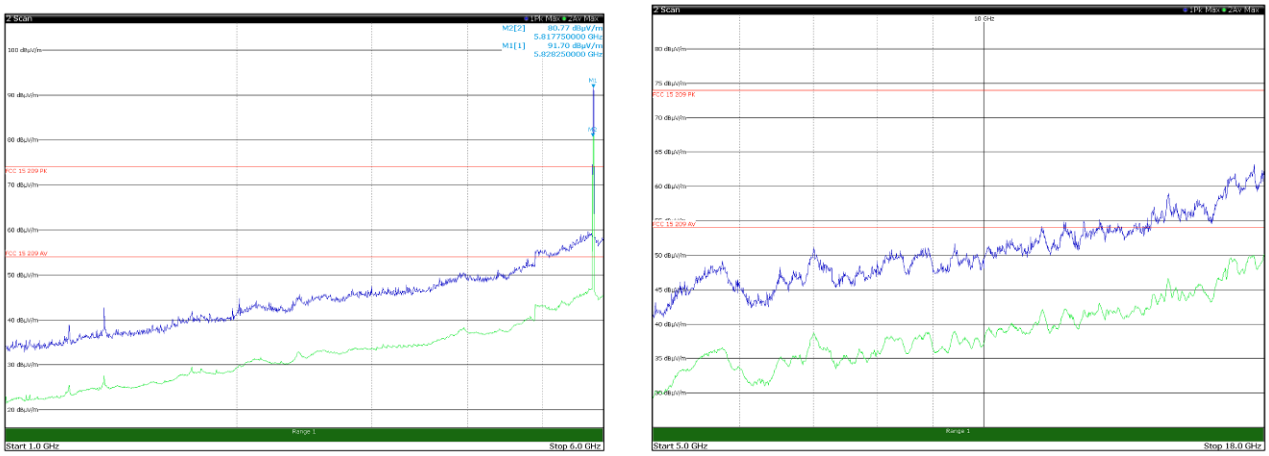


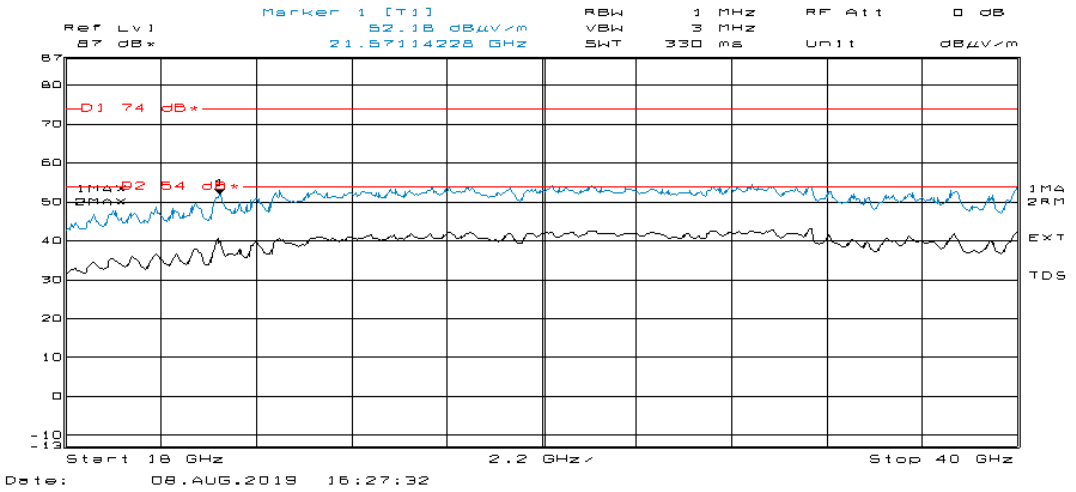




Spurious emissions outside restricted bands, Tx on 5825 MHz, 802.11nHT20 horizontal

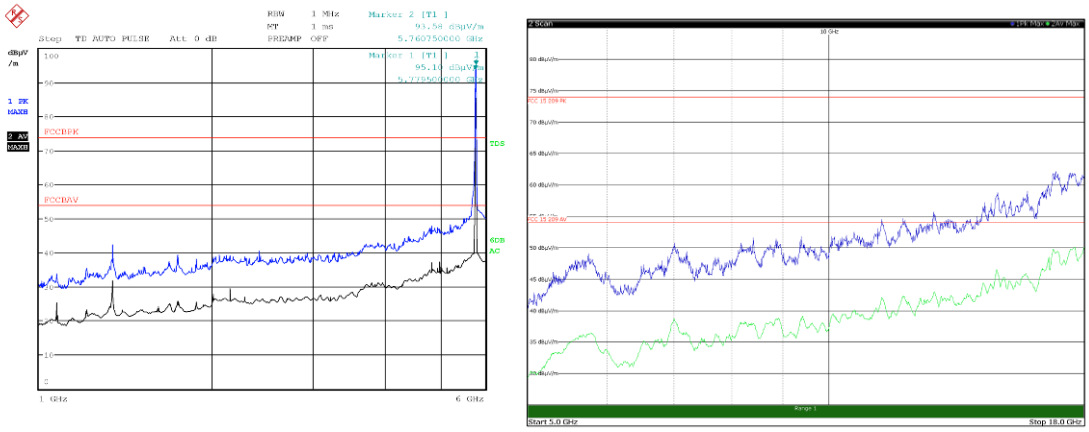
| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector | Remarks |
|---|---|---|---|---|---|
| -- | -- | -- | --- | -- | |

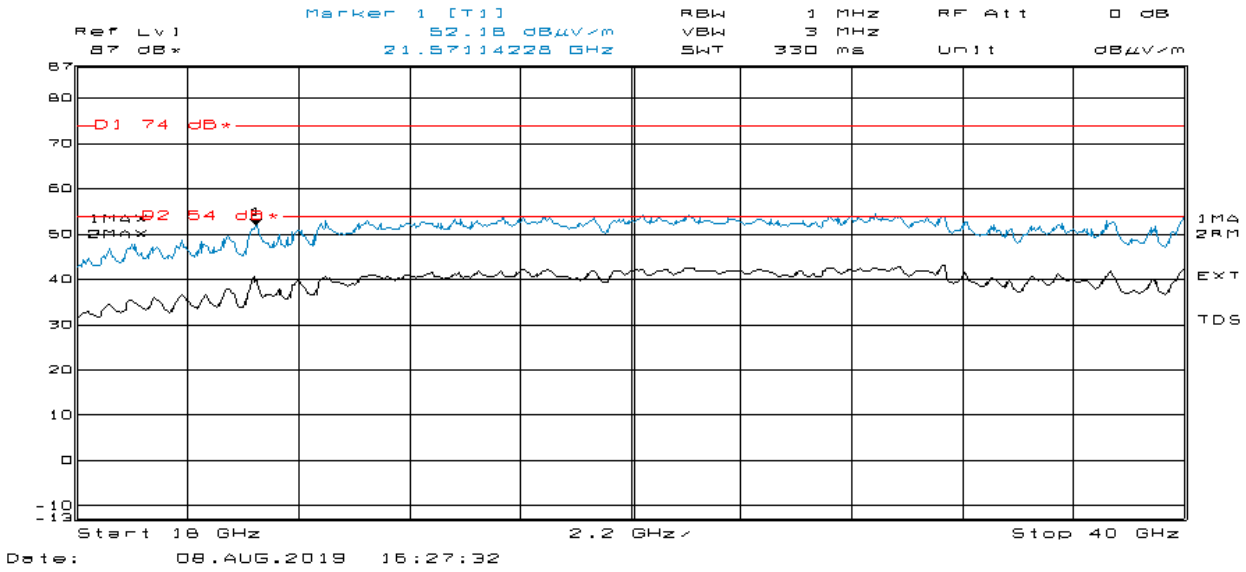




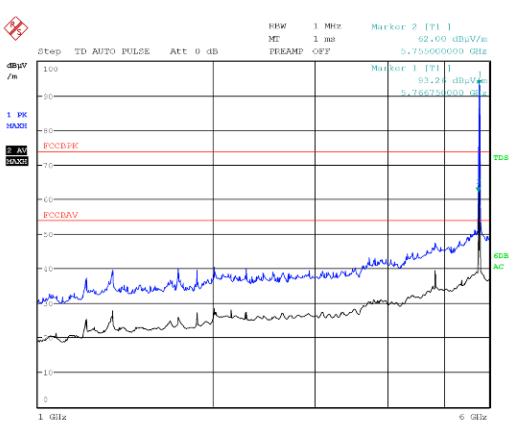

Spurious emissions outside restricted bands, Tx on 5825 MHz, 802.11nHT20 vertical

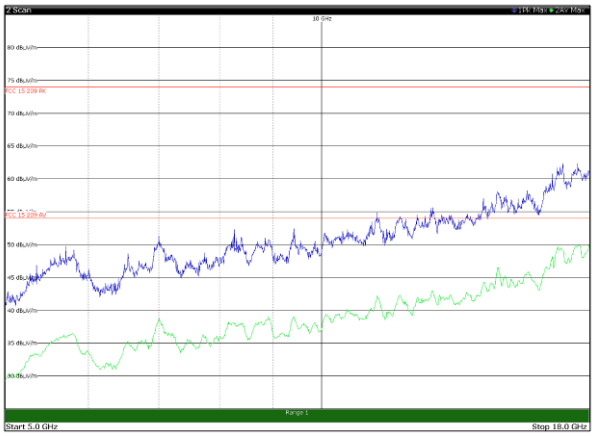
| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector | Remarks |
|---|---|---|---|---|---|
| -- | -- | -- | --- | -- | |

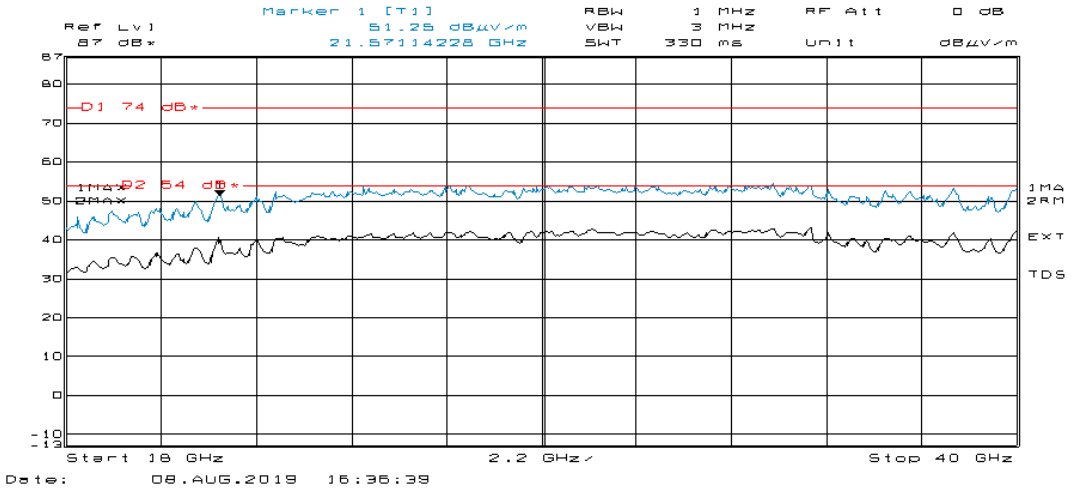




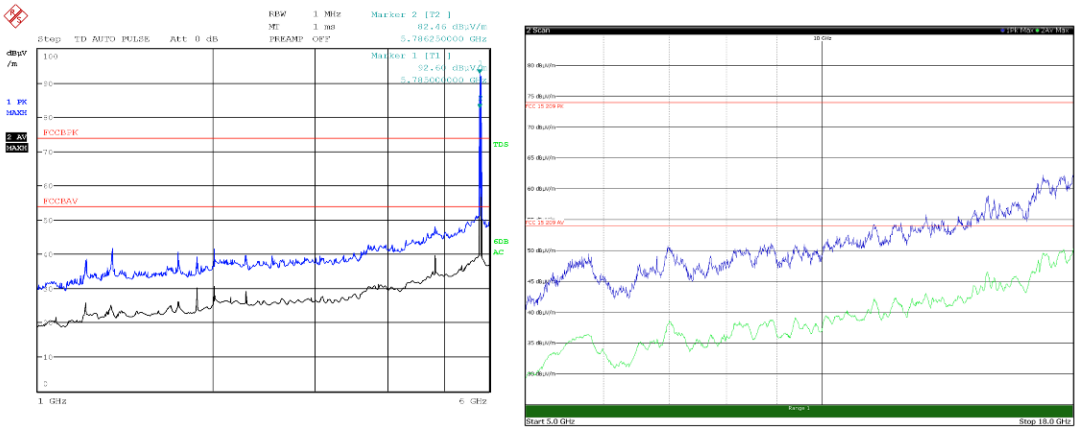

Spurious emissions outside restricted bands, Tx on 5755 MHz, 802.11Nht40 horizontal

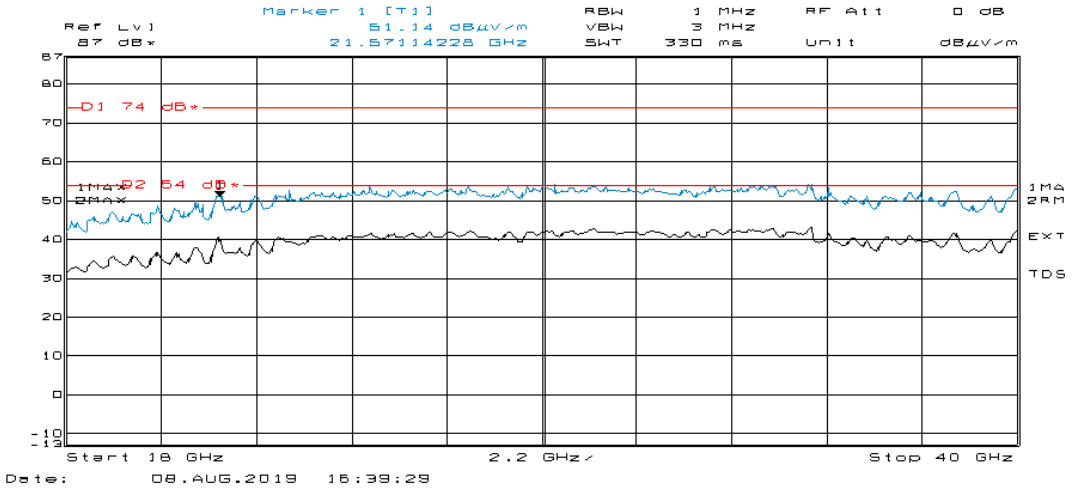


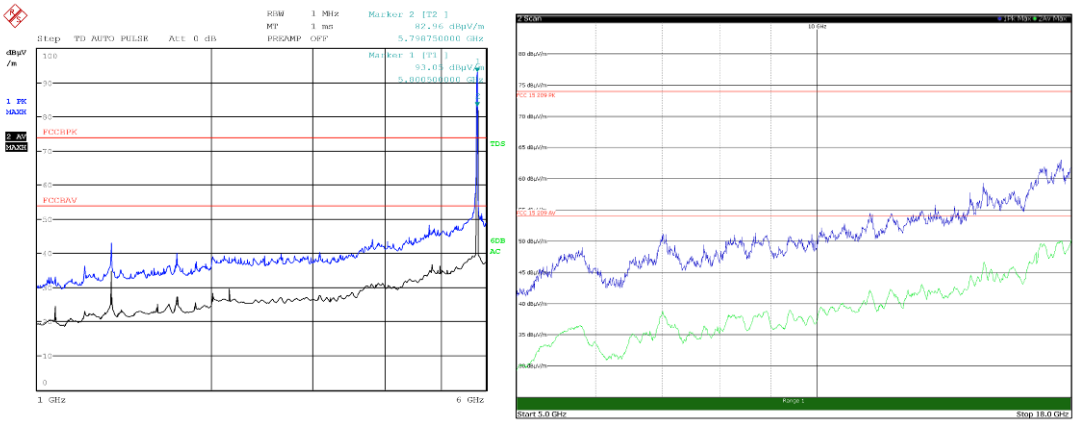



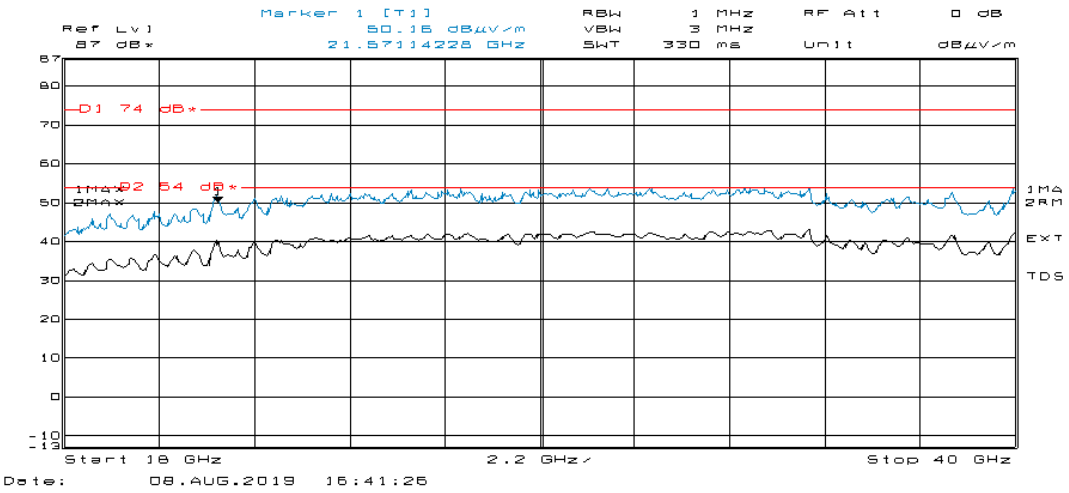

Spurious emissions outside restricted bands, Tx on 5755 MHz, 802.11Nht40 vertical



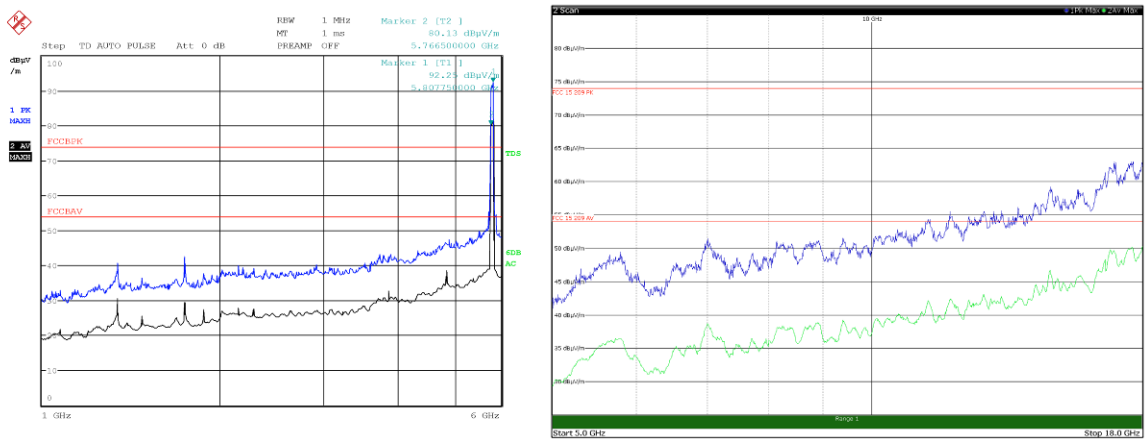


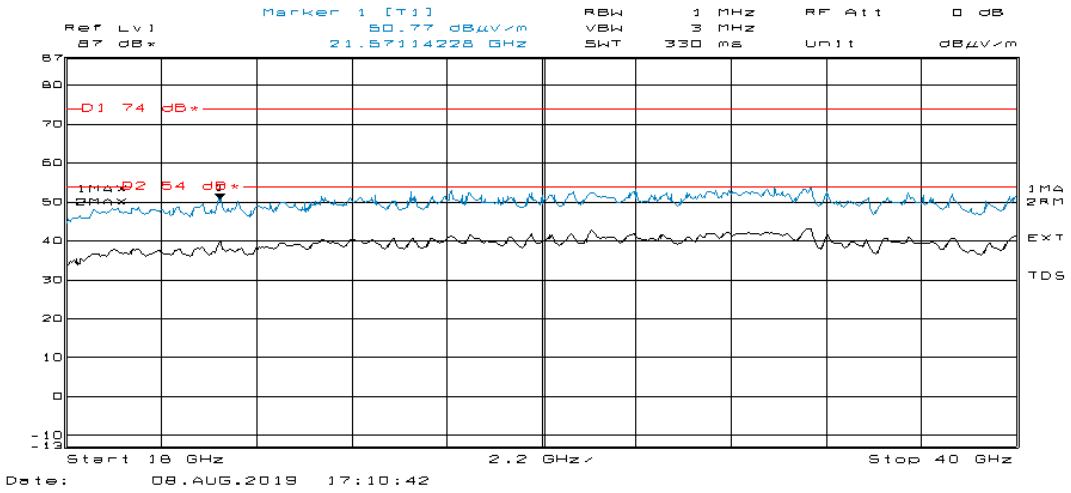

Spurious emissions outside restricted bands, Tx on 5795 MHz, 802.11Nht40 vertical



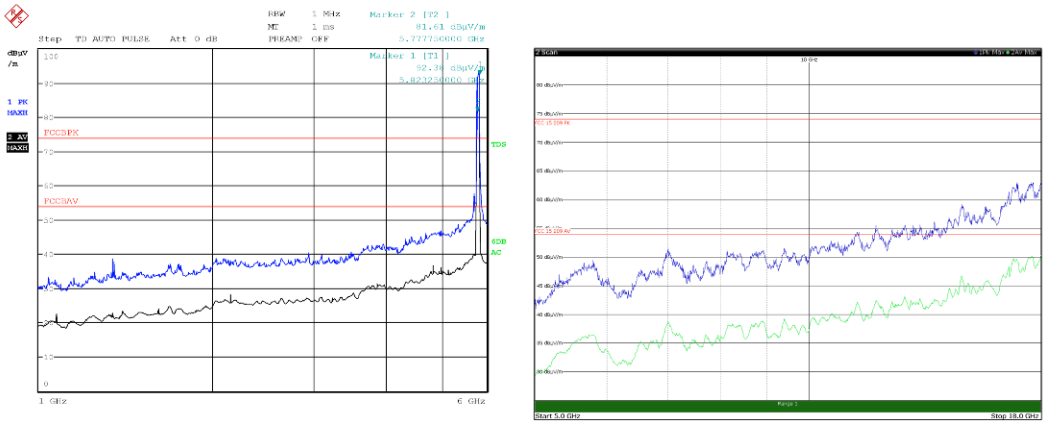



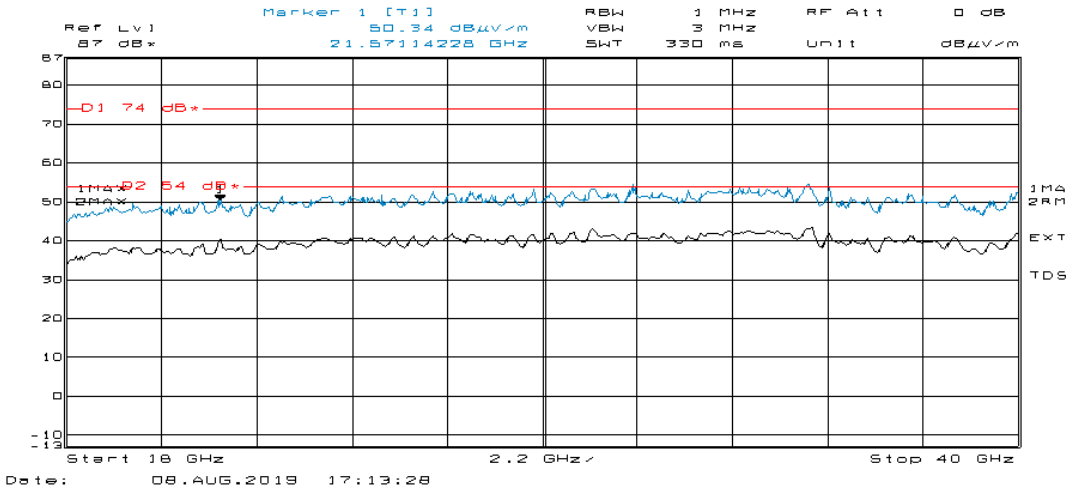

Spurious emissions outside restricted bands, Tx on 5795 MHz, 802.11Nht40 horizontal




Spurious emissions outside restricted bands, Tx on 5787 MHz, 802.11ac vertical



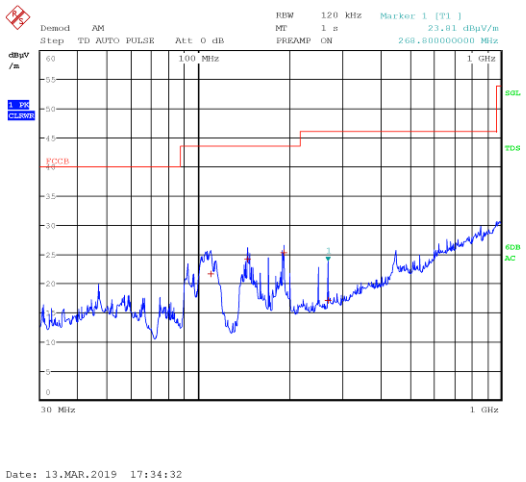



Spurious emissions outside restricted bands, Tx on 5787 MHz, 802.11ac horizontal

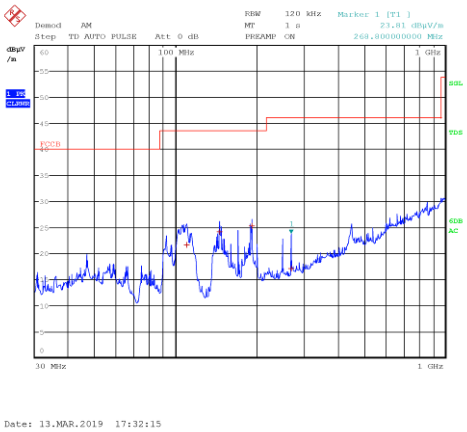
**Also other modulations have been investigated: not appreciable variation of the results were obtained**

Section 8 Radiated measurement 802.11n HT40 horizontal polarization

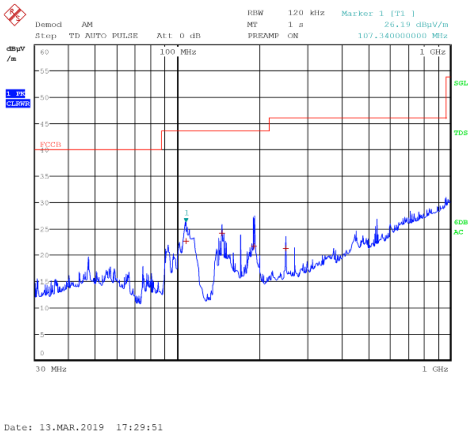
Low channel




Mid channel



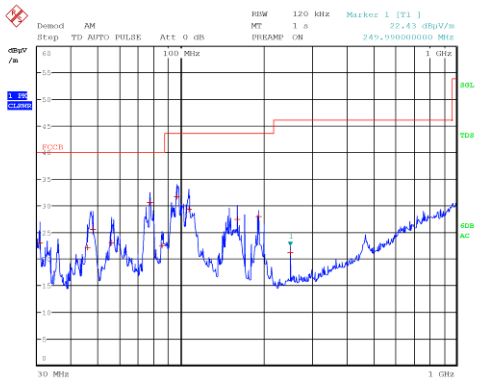

High channel



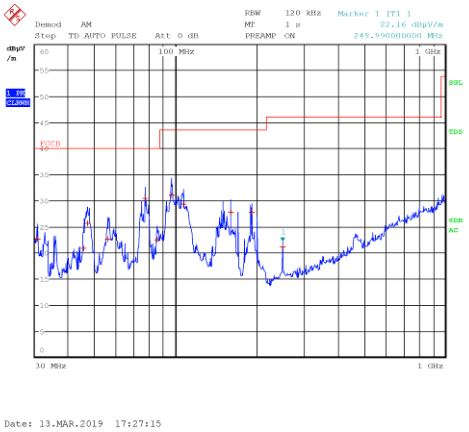

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|
| 109.8000 | 21.7 | 43.5 | -21.8 | QP |
| 145.2600 | 24.2 | 43.5 | -19.3 | QP |
| 192.0000 | 25.3 | 43.5 | -18.2 | QP |
| 268.8000 | 17.1 | 46.0 | -28.9 | QP |
| 109.8000 | 21.7 | 43.5 | -21.8 | QP |

Section 8 Radiated measurement 802.11n HT40 vertical polarization

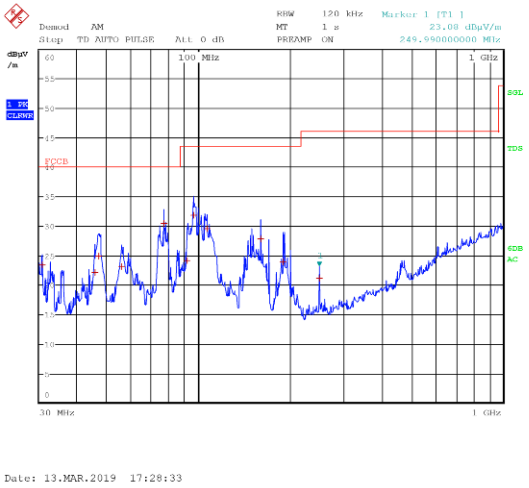
Low channel




Mid channel

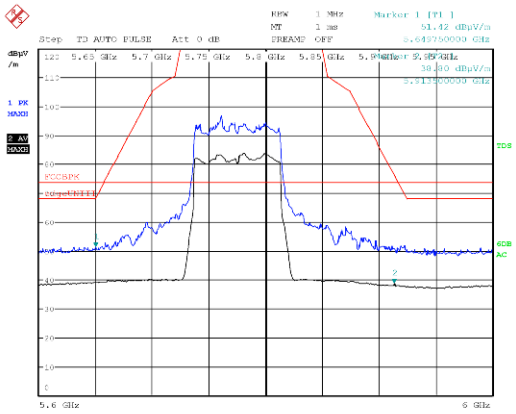



High channel



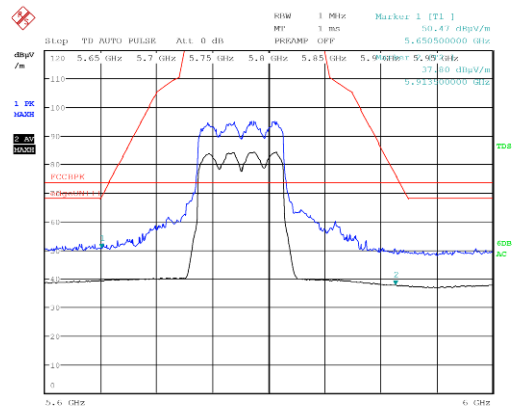

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|
| 30.5700 | 22.7 | 40.0 | -17.3 | QP |
| 45.6000 | 21.0 | 40.0 | -19.0 | QP |
| 47.0100 | 25.7 | 40.0 | -14.3 | QP |
| 56.0700 | 22.7 | 40.0 | -17.3 | QP |
| 77.1900 | 30.5 | 40.0 | -9.5 | QP |
| 85.5000 | 22.5 | 40.0 | -17.5 | QP |
| 96.6900 | 31.2 | 43.5 | -12.3 | QP |
| 106.7100 | 29.4 | 43.5 | -14.1 | QP |
| 159.9900 | 27.9 | 43.5 | -15.6 | QP |
| 192.0000 | 27.9 | 43.5 | -15.6 | QP |
| 249.9900 | 21.1 | 46.0 | -24.9 | QP |

802.11AC 80MHZ BAND EDGE horizontal



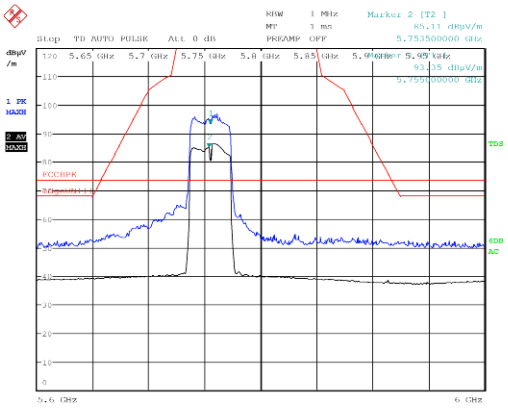

Date: 9.AUG.2019 18:43:44

802.11AC 80MHZ BAND EDGE vertical



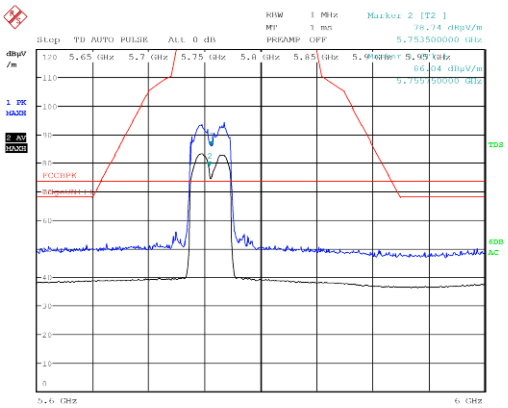

Date: 9.AUG.2019 18:46:05

802.11 Nht40 BAND EDGE horizontal



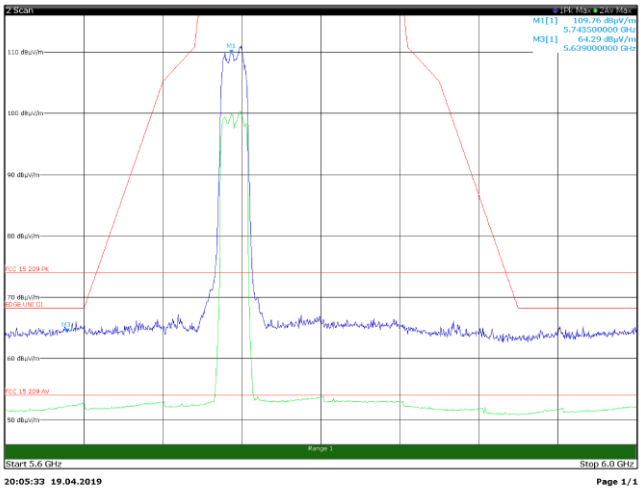

Date: 9.AUG.2019 19:03:14

802.11 Nht40 BAND EDGE vertical

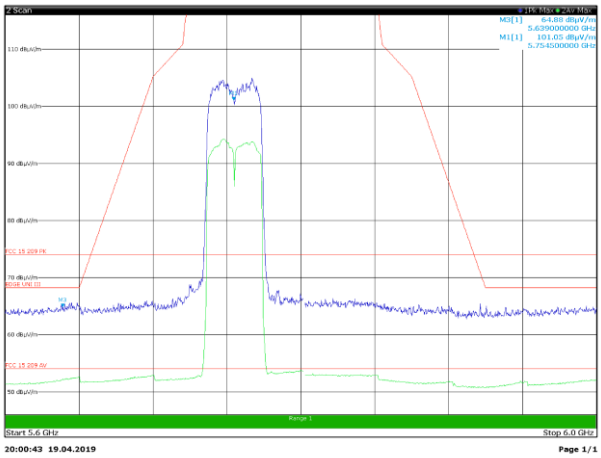



Date: 9.AUG.2019 19:05:37

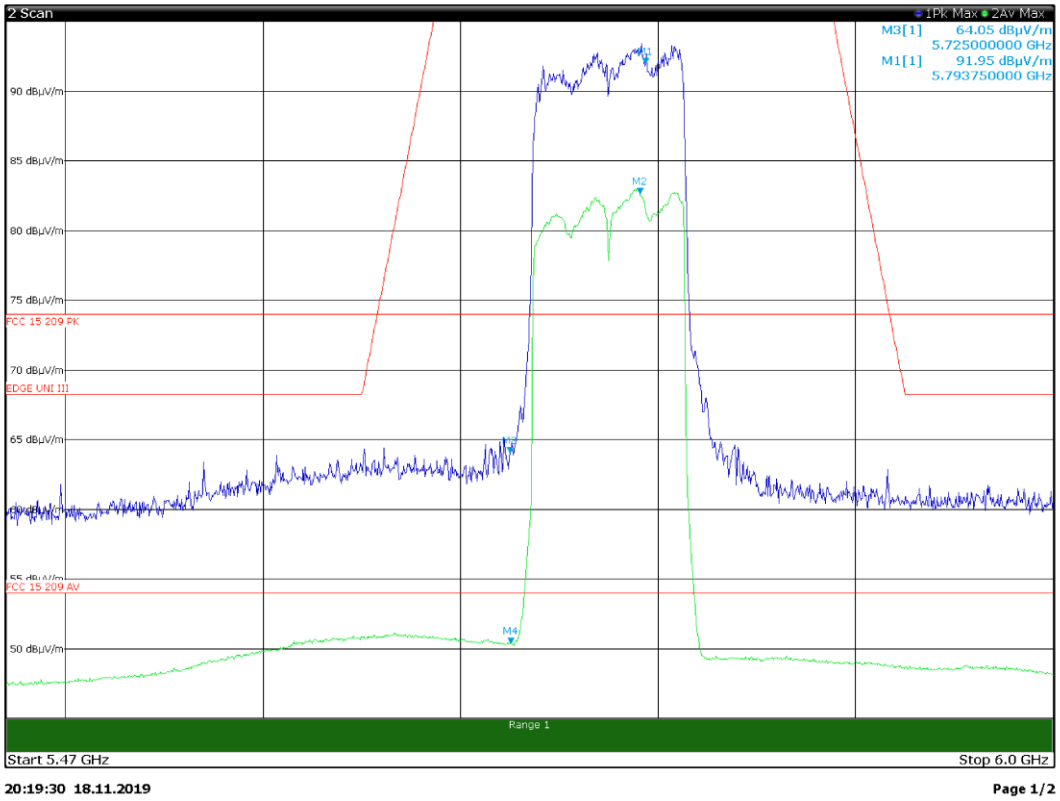
802.11 Nht20BAND EDGE horizontal




802.11 Nht20BAND EDGE vertical



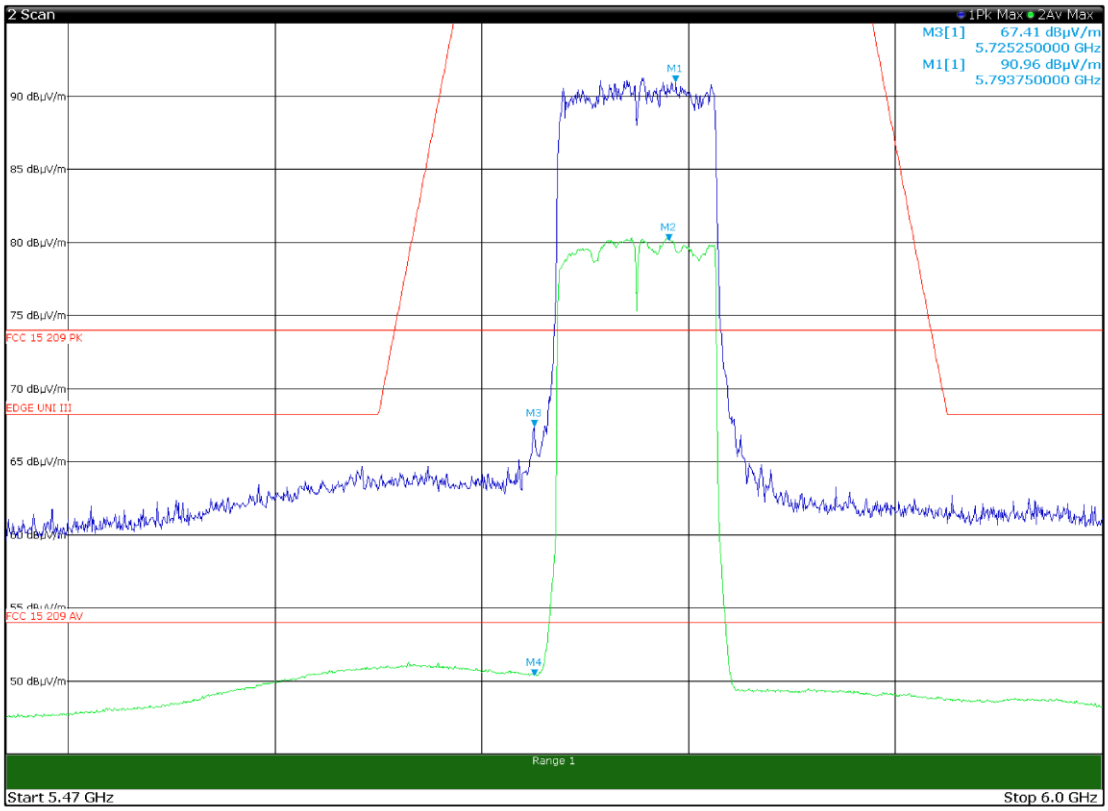
802.11 AC 80 MHz band, horizontal




3 Marker Table

| Wnd | Type | Ref | Trc | X-value | Y-value |
|---|---|---|---|---|---|
| Scan | M1 | | 1 | **5.79375 GHz** | **91.95 dBµV/m** |
| Scan | M2 | | 2 | **5.79075 GHz** | **82.64 dBµV/m** |
| Scan | M3 | | 1 | **5.725 GHz** | **64.05 dBµV/m** |
| Scan | M4 | | 2 | **5.72525 GHz** | **50.39 dBµV/m** |

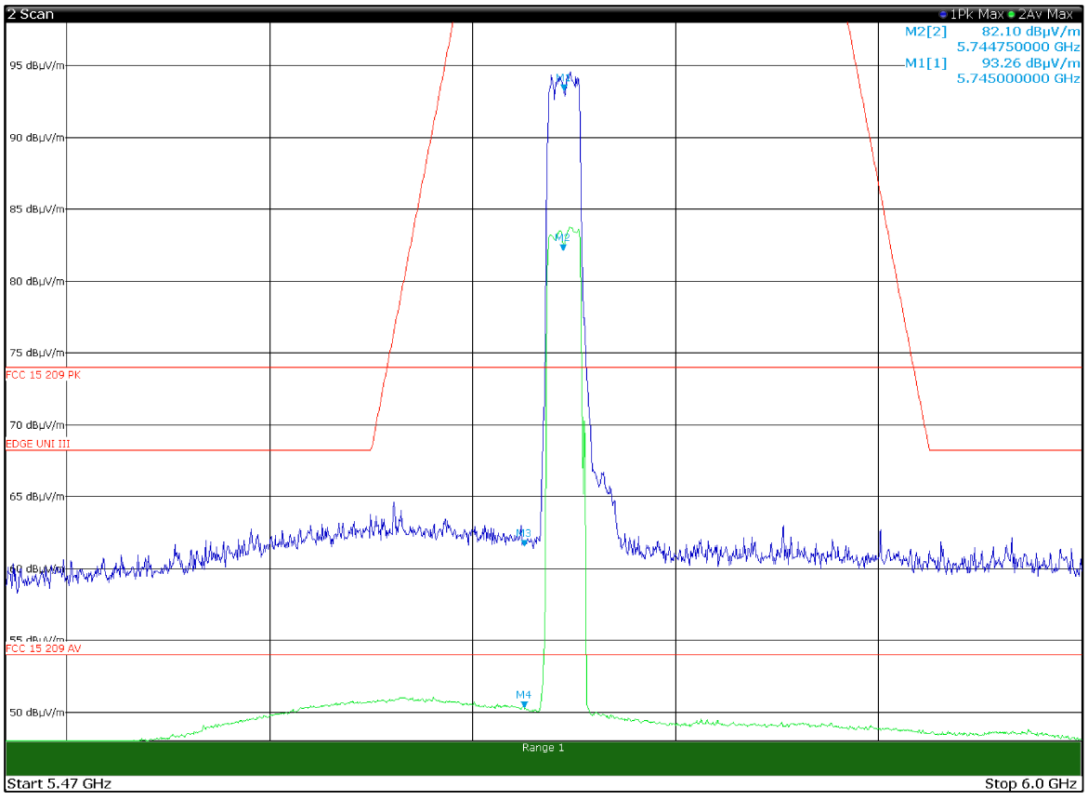
802.11 AC 80 MHz band, vertical




3 Marker Table

| Wnd | Type | Ref | Trc | X-value | Y-value |
|---|---|---|---|---|---|
| Scan | M1 | | 1 | **5.79375 GHz** | **90.96 dBµV/m** |
| Scan | M2 | | 2 | **5.7905 GHz** | **80.14 dBµV/m** |
| Scan | M3 | | 1 | **5.72525 GHz** | **67.41 dBµV/m** |
| Scan | M4 | | 2 | **5.72525 GHz** | **50.35 dBµV/m** |

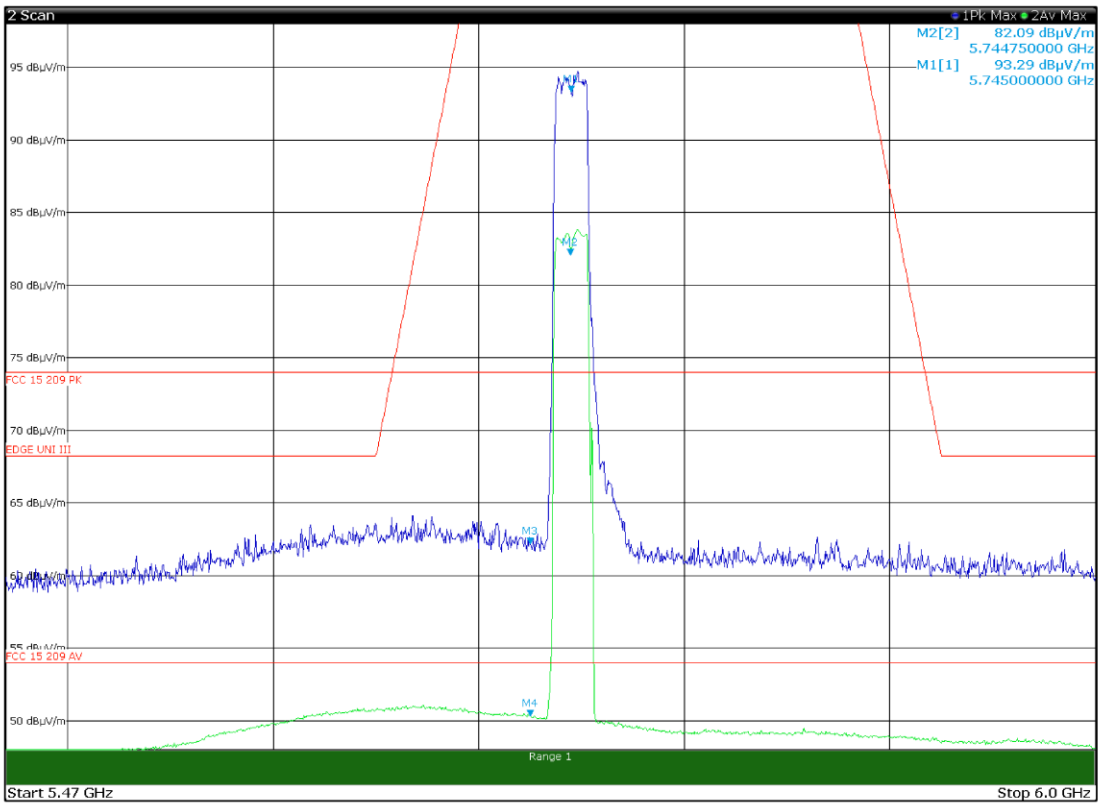
802.11nHT20 vertical




3 Marker Table

| Wnd | Type | Ref | Trc | X-value | Y-value |
|---|---|---|---|---|---|
| Scan | M1 | | 1 | **5.745 GHz** | **93.26 dBµV/m** |
| Scan | M2 | | 2 | **5.74475 GHz** | **82.1 dBµV/m** |
| Scan | M3 | | 1 | **5.72525 GHz** | **61.58 dBµV/m** |
| Scan | M4 | | 2 | **5.72525 GHz** | **50.29 dBµV/m** |

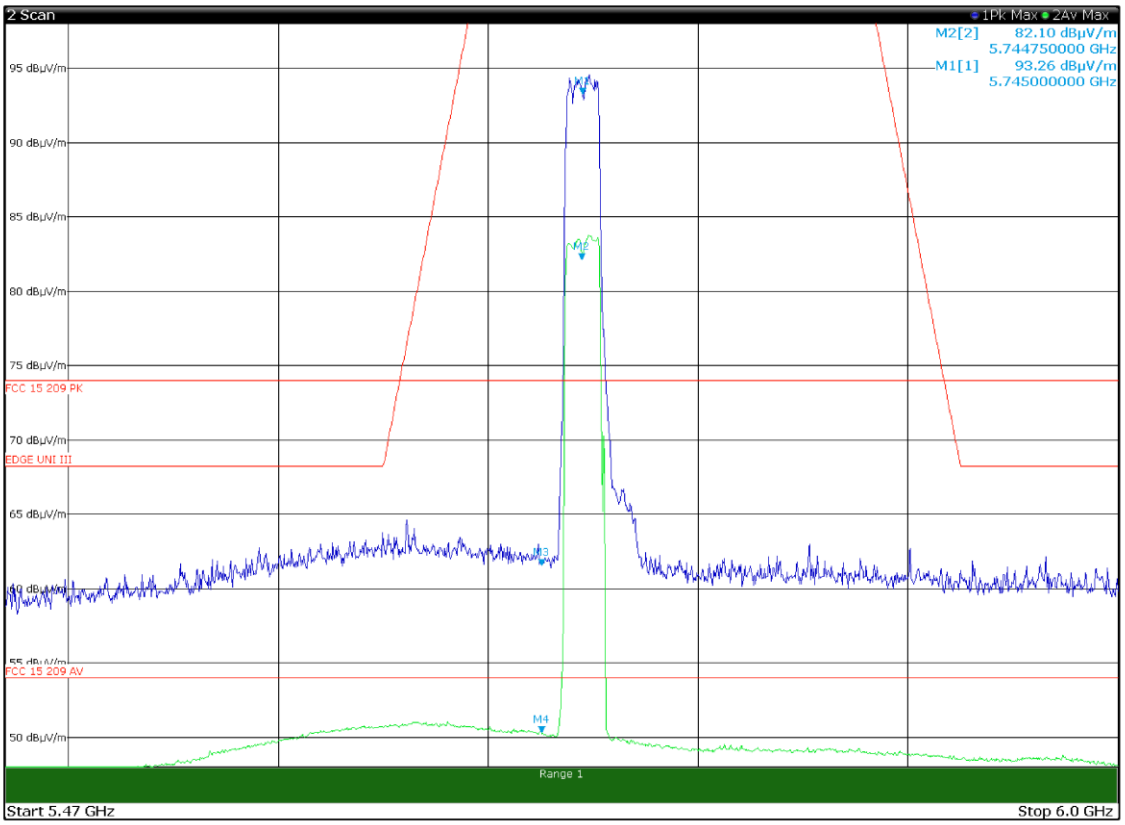
802.11nHT20 horizontal




3 Marker Table

| Wnd | Type | Ref | Trc | X-value | Y-value |
|---|---|---|---|---|---|
| Scan | M1 | | 1 | **5.745 GHz** | **93.29 dBµV/m** |
| Scan | M2 | | 2 | **5.74475 GHz** | **82.09 dBµV/m** |
| Scan | M3 | | 1 | **5.725 GHz** | **62.2 dBµV/m** |
| Scan | M4 | | 2 | **5.725 GHz** | **50.31 dBµV/m** |

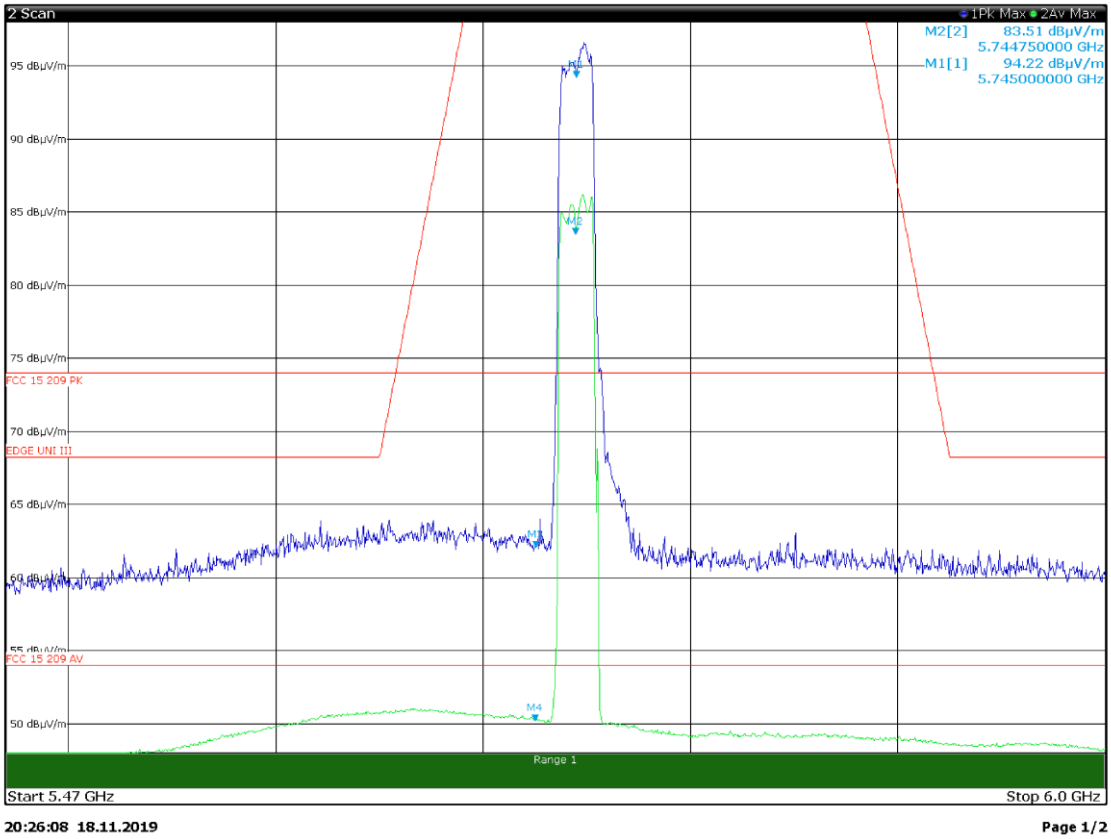
802.11 a vertical




3 Marker Table

| Wnd | Type | Ref | Trc | X-value | Y-value |
|---|---|---|---|---|---|
| Scan | M1 | | 1 | **5.745 GHz** | **93.26 dBµV/m** |
| Scan | M2 | | 2 | **5.74475 GHz** | **82.1 dBµV/m** |
| Scan | M3 | | 1 | **5.72525 GHz** | **61.58 dBµV/m** |
| Scan | M4 | | 2 | **5.72525 GHz** | **50.29 dBµV/m** |

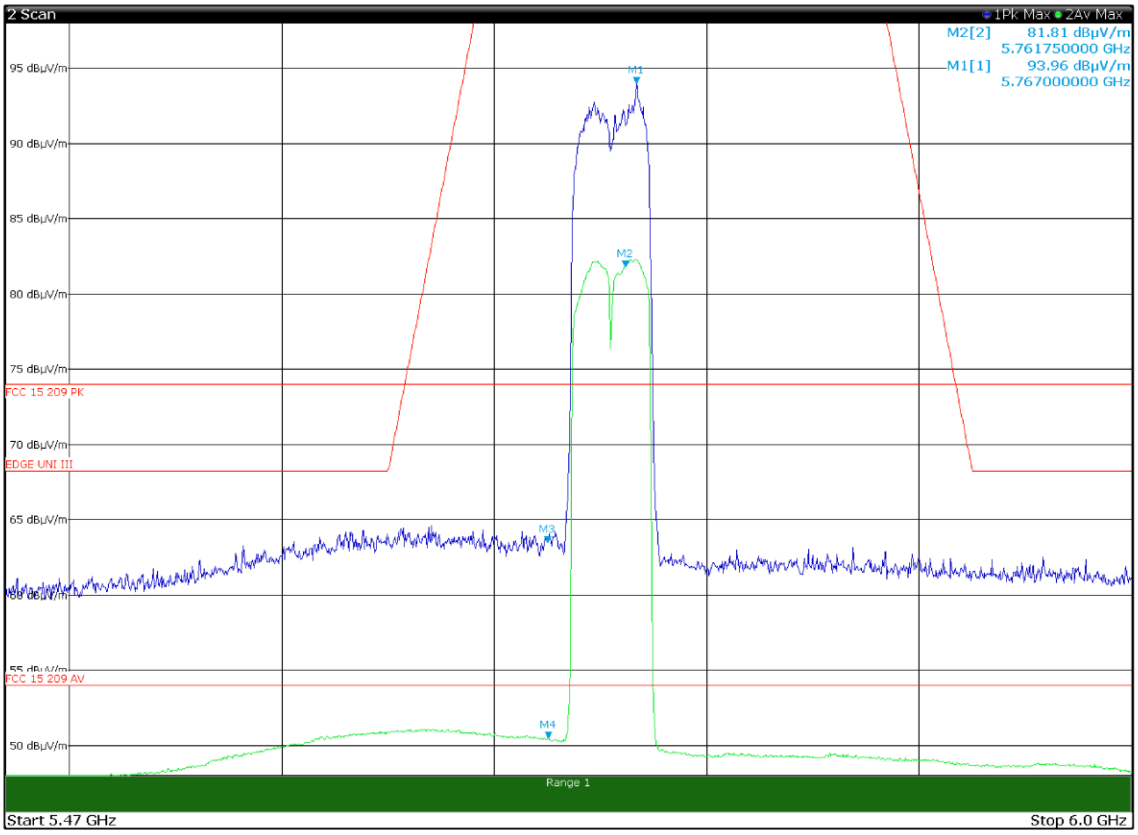
802.11 a horizontal




3 Marker Table

| Wnd | Type | Ref | Trc | X-value | Y-value |
|---|---|---|---|---|---|
| Scan | M1 | | 1 | **5.745 GHz** | **94.22 dBµV/m** |
| Scan | M2 | | 2 | **5.74475 GHz** | **83.51 dBµV/m** |
| Scan | M3 | | 1 | **5.72525 GHz** | **62.07 dBµV/m** |
| Scan | M4 | | 2 | **5.725 GHz** | **50.21 dBµV/m** |

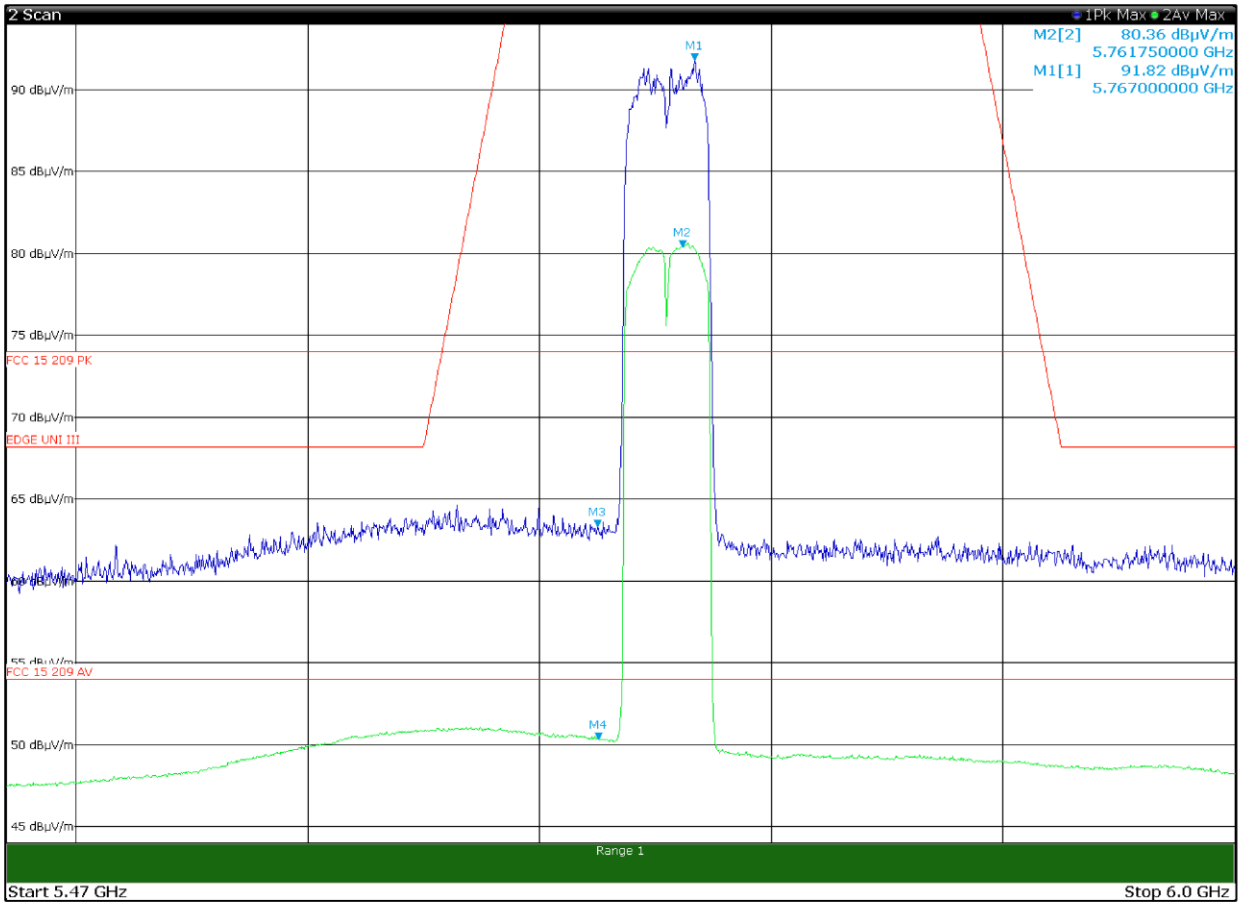
802.11 n Ht40 MHz horizontal




3 Marker Table

| Wnd | Type | Ref | Trc | X-value | Y-value |
|---|---|---|---|---|---|
| Scan | M1 | | 1 | **5.767 GHz** | **93.96 dBµV/m** |
| Scan | M2 | | 2 | **5.76175 GHz** | **81.81 dBµV/m** |
| Scan | M3 | | 1 | **5.725 GHz** | **63.5 dBµV/m** |
| Scan | M4 | | 2 | **5.72525 GHz** | **50.48 dBµV/m** |

802.11 nHT40 MHz vertical




**20:31:41 18.11.2019** **Page 1/2**

3 Marker Table

| Wnd | Type | Ref | Trc | X-value | Y-value |
|---|---|---|---|---|---|
| Scan | M1 | | 1 | **5.767 GHz** | **91.82 dBµV/m** |
| Scan | M2 | | 2 | **5.76175 GHz** | **80.36 dBµV/m** |
| Scan | M3 | | 1 | **5.725 GHz** | **63.3 dBµV/m** |
| Scan | M4 | | 2 | **5.72525 GHz** | **50.34 dBµV/m** |

## 8.5 FCC 15.207(a) AC power line conducted emissions limits

### 8.5.1 Definitions and limits

**FCC §15.407(6)(b):**

Any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207

**FCC §15.207(a):**
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 Ω 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.

**ISED:**
A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which 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 table below.

Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in table below. The more stringent limit applies at the frequency range boundaries.

***Table 8.5-1:*** *Conducted emissions limit*

| Frequency of emission (MHz) | Conducted limit (dBµV) | |
|---|---|---|
| | Quasi-peak | Average** |
| 0.15–0.5 | 66 to 56* | 56 to 46* |
| 0.5–5 | 56 | 46 |
| 5–30 | 60 | 50 |

Note: * - The level decreases linearly with the logarithm of the frequency.
** - A linear average detector is required.

### 8.5.2 Test summary

| | |
|---|---|
| Test start date: | April 04 2019 |
| Test engineer: | Daniele Guarnone |

### 8.5.3 Observations, settings and special notes

The EUT was set up as tabletop configuration.

The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

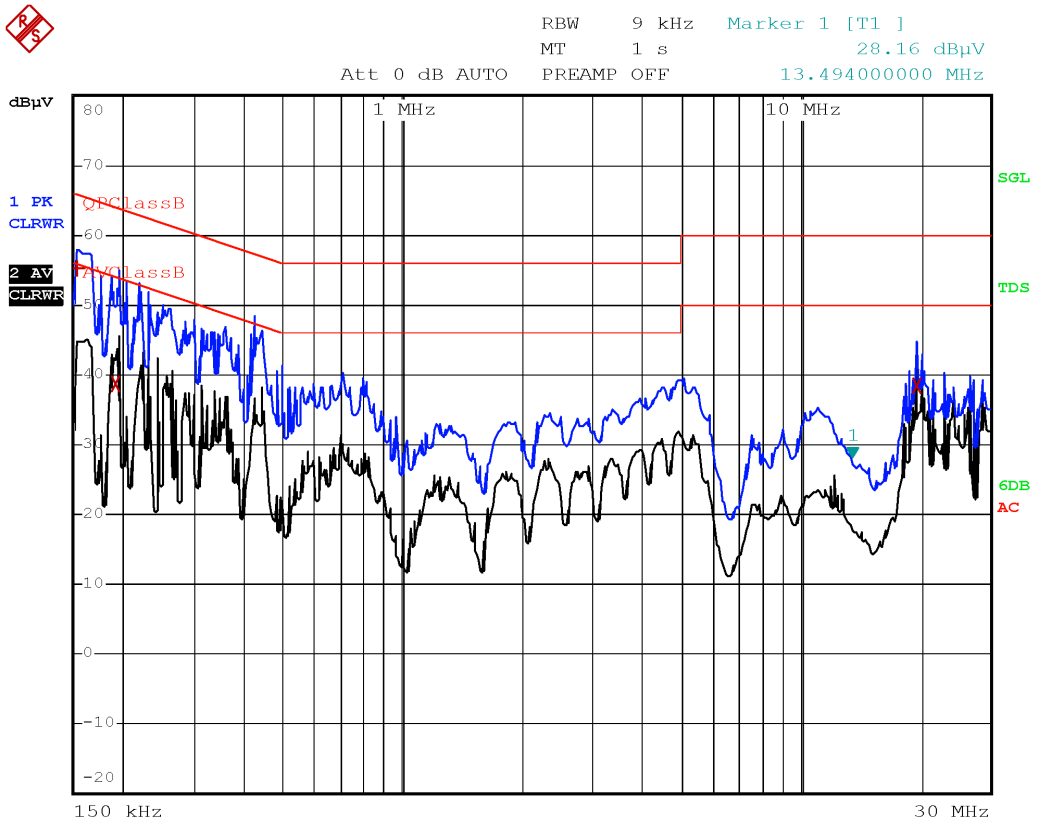
Receiver settings for preview measurements:

| | |
|---|---|
| Resolution bandwidth | 9 kHz |
| Video bandwidth | 30 kHz |
| Detector mode | Peak and Average |
| Trace mode | Max Hold |
| Measurement time | 100 ms |

Receiver settings for final measurements:

| | |
|---|---|
| Resolution bandwidth | 9 kHz |
| Video bandwidth | 30 kHz |
| Detector mode | Quasi-Peak and Average |
| Trace mode | Max Hold |
| Measurement time | 100 ms |

### 8.5.4 Test data



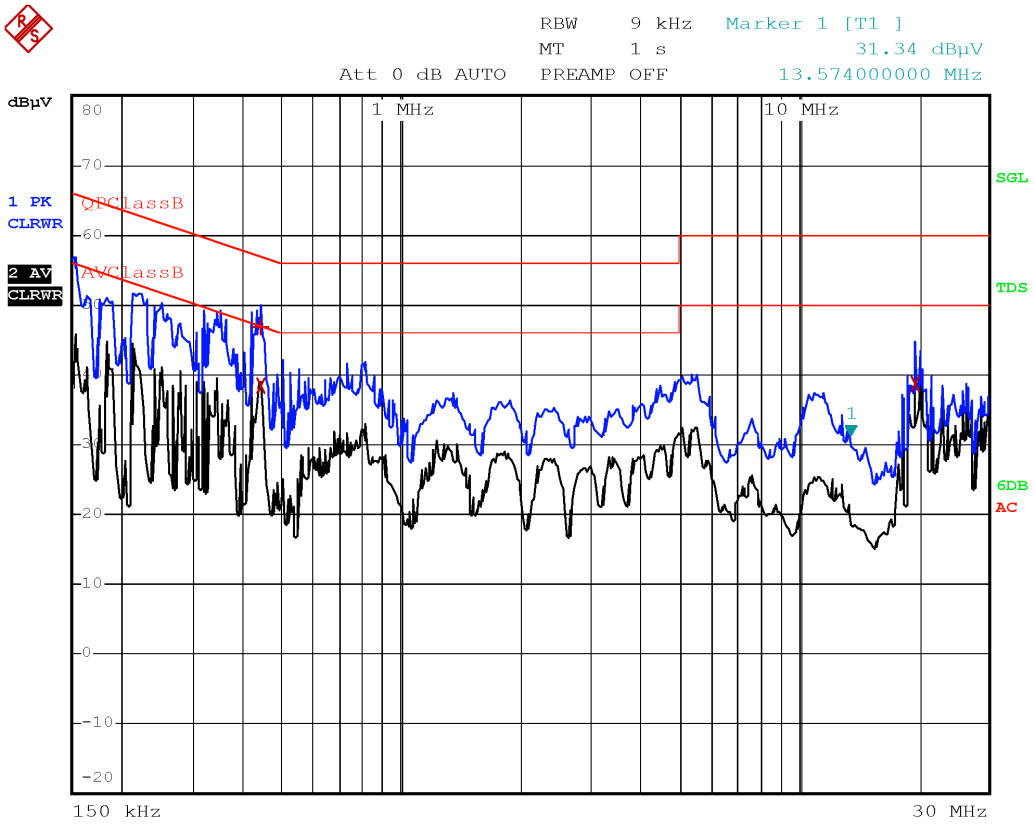

Date: 4.APR.2019 20:15:04

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|
| 0.1540 | 55.3 | 65.8 | **-10.5** | QP |
| 0.1940 | 38.7 | 53.9 | **-15.2** | Av |
| 19.7100 | 38.6 | 50.0 | **-11.4** | Av |

***Plot 8.5-1: Conducted emissions on phase line***

Notes:
[1] Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions have been recorded.

Sample calculation: 37.1 dBµV (result) = 26.6 dBµV (receiver reading) + 9.5 dB (Correction factor)




Date: 4.APR.2019 20:17:19

***Plot 8.5-2: Conducted emissions on neutral line***

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|
| 0.1540 | 55.3 | 65.8 | -10.5 | QP |
| 0.1940 | 38.7 | 53.9 | -15.2 | Av |
| 19.7100 | 38.6 | 50.0 | -11.4 | Av |

***Table 8.5-2: Quasi-Peak conducted emissions results on neutral line***

Notes:

[1] Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions have been recorded.

Sample calculation: 37.1 dBµV (result) = 26.6 dBµV (receiver reading) + 9.5 dB (Correction factor)

## 8.6 FCC 15.407(g) and RSS-Gen 8.11 Frequency stability

### 8.6.1 Definitions and limits

Manufacturers of U-NII (IC: LE-LAN) devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

### 8.6.2 Test summary

| | |
|---|---|
| Test start date: | April,05 2019 |
| Test engineer: | Yong Huang |

### 8.6.1 Observations, settings and special notes

| | |
|---|---|
| Resolution bandwidth: | 10 Hz |
| Video bandwidth: | 10 Hz |
| Detector mode: | Peak |
| Trace mode: | Max Hold |

### 8.6.2 Test data

***Table 8.6-1:*** *Frequency drift measurement*

| Test conditions Temperature, Voltage | Nominal frequency, GHz | Frequency, GHz | Drift, Hz |
|---|---|---|---|
| +85 °C, Nominal | 5.785 | -- | -- |
| +70 °C, Nominal | 5.785 | -- | -- |
| +23 °C, +15 % | 5.785 | -- | -- |
| +23 °C, Nominal | 5.785 | -- | -- |
| +23 °C, −15 % | 5.785 | -- | -- |
| -40 °C, Nominal | 5.785 | -- | -- |

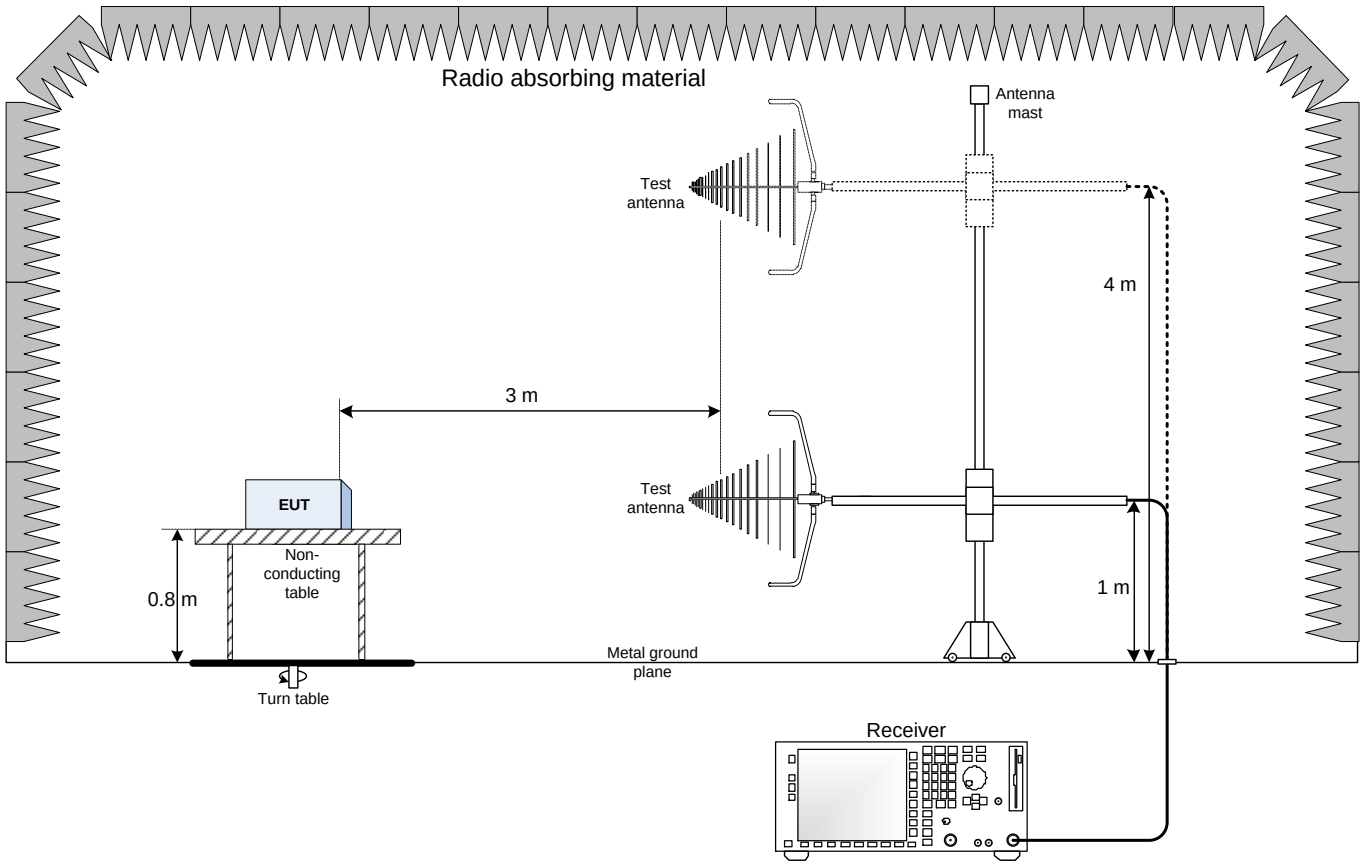
Minimum lower band edge margin is more than 1 kHz

Minimum upper band edge margin is more than 107 kHz

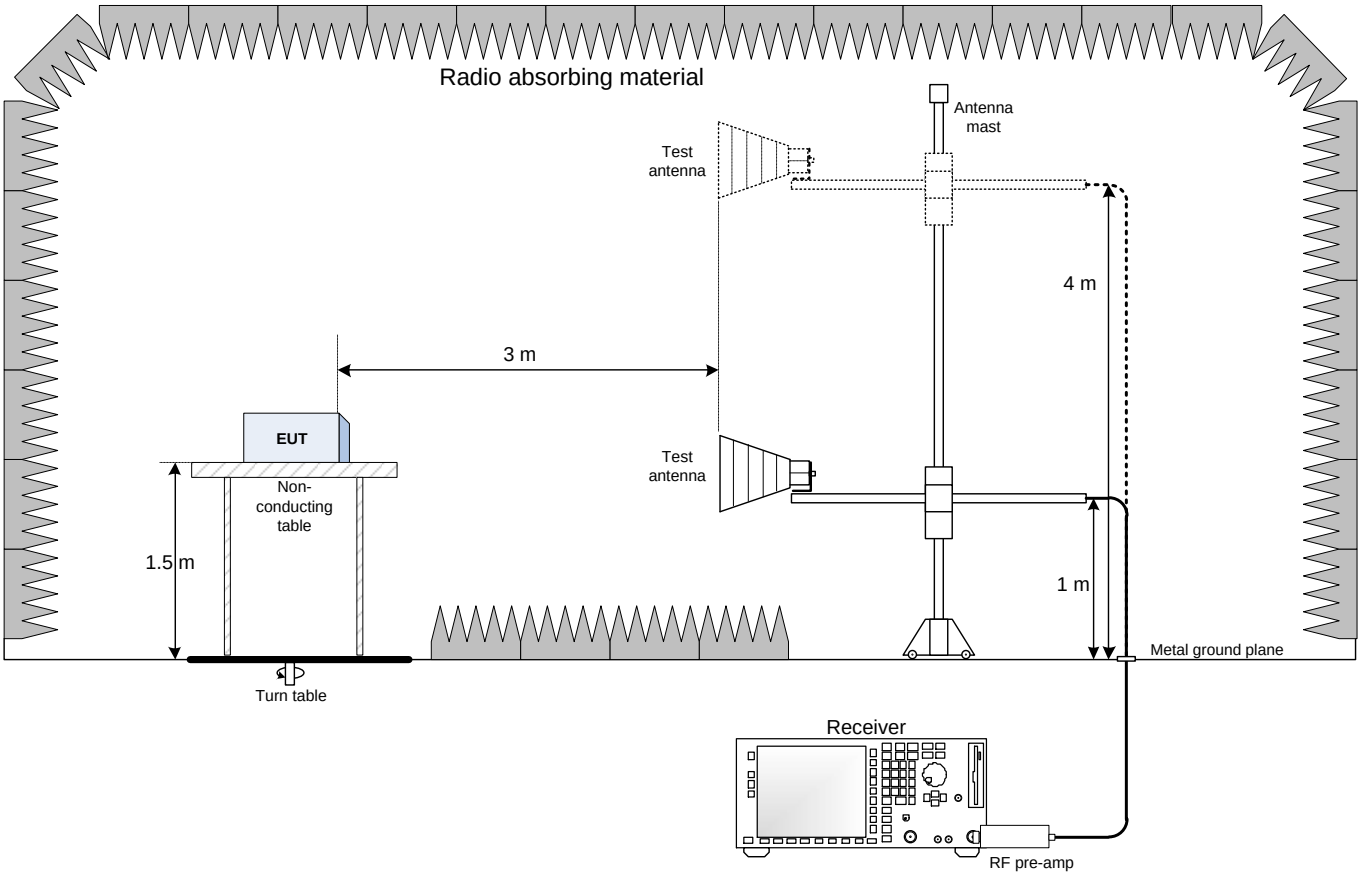
The frequency drifts in above table are within these minimum margins, the emissions are deemed to maintain within the band of operation.

# **Section 9.** Block diagrams of test set-ups

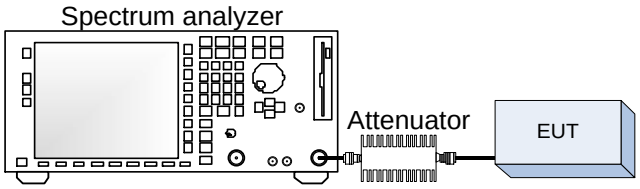
## 9.1 Radiated emissions set-up for frequencies below 1 GHz



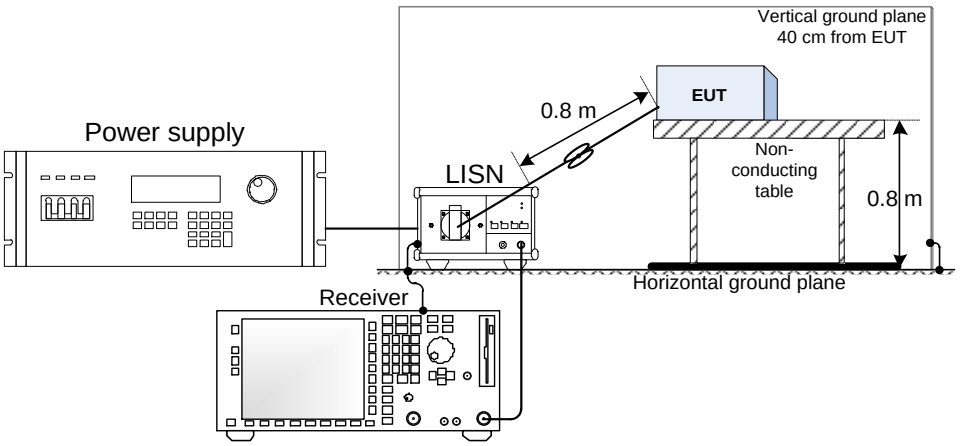
## 9.2 Radiated emissions set-up for frequencies above 1 GHz




## 9.3 Antenna port conducted measurements set-up



## 9.4 Conducted emissions on AC line set-up




(End of report)