**FCC LISTED, REGISTRATION NUMBER: 905266**

**IC LISTED REGISTRATION NUMBER**
**IC 4621A-1**

**AT4 wireless, S.A.**
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Libro 82, Folio 133, Hoja MA3729

# TEST REPORT

## REFERENCE STANDARD:

## USA FCC Part 15.407 (U-NII), 15.209

## CANADA RSS-210, RSS-Gen

**Unlicensed National Information Infrastructure Devices. General technical requirements.**

**Licence-Exempt Radio Apparatus (All Frequency Bands): Category I Equipment.**

**General Requirements and Information for the Certification of Radio Apparatus.**

| | |
|---|---|
| **NIE** ..... : | 38880BRRF.003 |
| Approved by (name / position & signature) ..... : | A. Llamas / RF Lab. Manager |
| Elaboration date ..... : | 2013-06-17 |

Alejandro Llamas Rodríguez
Firmado digitalmente por Alejandro Llamas Rodríguez
Fecha: 2013.06.25 15:03:59 +02'00'

| | |
|---|---|
| **Identification of item tested** ..... : | 3160HMW |
| Trademark ..... : | INTEL |
| Model and/or type reference ..... : | 3160HMW |
| Serial number ..... : | TA#: G98549-001<br>WF MAC:001500BD59CA<br>BD MAC: 001500BD59CE |
| Other identification of the product ..... : | Commercial name: 3160HMW<br>HW Version: QS<br>SW Version:<br>Test SW: DRTU_1_6_1_628<br>Op SW: Wifi_ProSet_0340G<br>For OEM factory installation:<br>FCC ID: PD93160H<br>IC: 1000M-3160H<br>For user installation:<br>FCC ID: PD93160HU<br>IC: 1000M-3160H |
| Features ..... : | 802.11 a/b/g/n/ac + BT 4.0 |
| Description ..... : | 1x1 PCIe Half Mini-card adapter |

| | |
|---|---|
| **Applicant** ..... : | INTEL MOBILE COMMUNICATIONS |
| Address ..... : | 100 Center Point Circle, Suite 200, Columbia, South Carolina 29210 USA |
| CIF/NIF/Passport ..... : | No provided data |
| Contact person: | Steven Hackett |
| Telephone / Fax ..... : | Tel: 803-216-2344/ FAX: 803-216-2176 |

| | | |
|---|---|---|
| e-mail: ..... | : | steven.c.hackett@intel.com |
| **Test samples supplier** ..... | : | Same as applicant |
| **Manufacturer** ..... | : | Same as applicant |

| | |
|---|---|
| **Test method requested** .....: | See Standard |
| Standard .....: | USA FCC Part 15.407 (10–1–10 Edition). Unlicensed National Information Infrastructure Devices. General technical requirements.<br><br>USA FCC Part 15.209 (10-1-10 Edition): Radiated emission limits; general requirements.<br><br>Guidance for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices 789033 D01 General UNII Test Procedures v01r03 dated April 8, 2013.<br><br>Guidance for IEEE 802.11ac and Pre-ac Device Emission Testing 644545 D01 Guidance for IEEE 802.11ac v01 r01 dated 04/08/2013.<br><br>ANSI C63.10-2009: American National Standard for Testing Unlicensed Wireless Devices.<br><br>CANADA RSS-210 Issue 8 (December 2010). Licence-Exempt Radio Apparatus (All Frequency Bands): Category I Equipment.<br><br>CANADA RSS-Gen Issue 3 (December 2010). General Requirements and Information for the Certification of Radio Apparatus. |
| Test procedure .....: | PERF034 |
| Non-standardized test method .....: | N/A |
| Used instrumentation .....: | Conducted Measurements |

| | | Last Cal. date | Cal. due date |
|---|---|---|---|
| 1. | Spectrum Analyzer Agilent E4440A | 2012/02 | 2014/02 |
| 2. | EMI Test Receiver R&S ESU40 | 2012/03 | 2014/03 |
| 3. | Universal Power Meter R&S NRP-Z11 | 2012/12 | 2014/12 |

Radiated Measurements

| | | Last Cal. date | Cal. due date |
|---|---|---|---|
| 1. | Semianechoic Absorber Lined Chamber IR 11. BS | N.A. | N.A. |
| 2. | Control Chamber IR 12.BC | N.A. | N.A. |
| 3. | Hybrid Bilog antenna Sunol Sciences Corporation JB6 | 2011/05 | 2014/05 |
| 4. | Antenna mast EM 1072 NMT | N.A. | N.A. |
| 5. | Rotating table EM 1084-4. ON | N.A. | N.A. |
| 6. | Double-ridge Guide Horn antenna 1-18 GHz HP 11966E | 2011/05 | 2014/05 |
| 7. | Double-ridge Guide Horn antenna 18-40 GHz Agilent 119665J | 2011/09 | 2014/09 |
| 8. | EMI Test Receiver R&S ESIB26 | 2011/11 | 2013/11 |
| 9. | RF pre-amplifier Miteq JS4-12002600-30-5A. | 2012/07 | 2014/07 |
| 10. | Multi Device Controller EMCO 2090 | N.A. | N.A. |
| 11. | Spectrum Analyzer Agilent E4440A | 2012/02 | 2014/02 |
| 12. | RF pre-amplifier Miteq AFS5-04001300-15-10P-6. | 2012/07 | 2014/07 |
| 13. | RF pre-amplifier Schaffner CPA 9231. | 2011/06 | 2013/06 |
| 14. | EMI Test Receiver R&S ESU40 | 2012/03 | 2014/03 |

| | |
|---|---|
| **Report template No**. .....: | FDT08_14 |

## INDEX

## Competences and guarantees

AT4 wireless, S.A. is a laboratory with a measurement facility in compliance with the requirements of Section 2.948 of the FCC rules and has been added to the list of facilities whose measurements data will be accepted in conjuction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Registration Number: 905266.

AT4 wireless, S.A. is a laboratory with a measurement site in compliance with the requirements of RSS 212, Issue 1 (Provisional) and has been added to the list of filed sites of the Canadian Certification and Engineering Bureau. Reference File Number: IC 4621A-1.

In order to assure the traceability to other national and international laboratories, AT4 wireless has a calibration and maintenance programme for its measurement equipment.

AT4 wireless guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at AT4 wireless at the time of performance of the test.

AT4 wireless 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.

## General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of AT4 wireless.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of AT4 wireless and the Accreditation Bodies.

## Uncertainty

Uncertainty (factor k=2) was calculated according to the AT4 wireless internal documents:

PODT000: : Procedimiento para el cálculo de incertidumbres de medida

## Usage of samples

Samples undergoing test have been selected by: **the client**.

Sample S/01 is composed of the following elements:

| Control Nº | Description | Model | Serial Nº | Date of reception |
|---|---|---|---|---|
| 38880B/03 | 802.11a/b/g/n/ac wireless LAN + BT PCIe half-mini card | 3160HMW | TA#: G98549-001<br>WF MAC:001500BD59CA<br>BD MAC: 001500BD59CE | 17/05/2013 |

Auxiliary elements used with the sample S/01:

| Control Nº | Description | Manufacture | Model | Serial Nº | Date of reception |
|---|---|---|---|---|---|
| 38067/28 | Laptop PC | DELL | Latitude E5420 | CTFQQL1 | 08/01/2013 |
| 38067/29 | Cable of the AC/DC Adapter | DELL | --- | --- | 08/01/2013 |
| 38067/30 | AC/DC Adapter | DELL | LA90PM111 | --- | 08/01/2013 |
| 38880B/11 | Reference Antenna | SkyCross | WIMAX/WLAN | --- | 17/05/2013 |
| 38880B/12 | Reference Antenna | SkyCross | WIMAX/WLAN | --- | 17/05/2013 |
| 38067/36 | M2/NGFF extender cable | --- | --- | --- | 08/01/2013 |
| 38067/37 | HMC/NGFF Testing board | INTEL | PCB00390 | 3902412-252 | 11/01/2013 |
| 38067/38 | Adapter of the AC/DC Board Testing | SINPRO | SPU60-102 | 07990464 1249 | 11/01/2013 |
| 1302 | Board 35mmx35mm | --- | --- | --- | --- |

## Usage of samples

Sample S/02 is composed of the following elements:

| Control Nº | Description | Model | Serial Nº | Date of reception |
|---|---|---|---|---|
| 38880B/03 | 802.11a/b/g/n/ac wireless LAN + BT PCIe half-mini card | 3160HMW | TA#: G98549-001<br>WF MAC:001500BD59CA<br>BD MAC: 001500BD59CE | 17/05/2013 |

Auxiliary elements used with the sample S/02:

| Control Nº | Description | Manufacture | Model | Serial Nº | Date of reception |
|---|---|---|---|---|---|
| 38067/28 | Laptop PC | DELL | Latitude E5420 | CTFQQL1 | 08/01/2013 |
| 38067/29 | Cable of the AC/DC Adapter | DELL | --- | --- | 08/01/2013 |
| 38067/30 | AC/DC Adapter | DELL | LA90PM111 | --- | 08/01/2013 |
| 38067/36 | M2/NGFF extender cable | --- | --- | --- | 08/01/2013 |
| 38067/37 | HMC/NGFF Testing board | INTEL | PCB00390 | 3902412-252 | 11/01/2013 |
| 38067/38 | Adapter of the AC/DC Board Testing | SINPRO | SPU60-102 | 07990464 1249 | 11/01/2013 |
| --- | USB cable | --- | --- | --- | --- |

1. Sample S/01 has undergone following test(s).
   All radiated tests indicated in appendix A, B and C.

2. Sample S/02 has undergone following test(s).
   All conducted tests indicated in appendix A, B and C.

## Testing period

The performed test started on 2013-05-31 and finished on 2013-06-07.

The tests have been performed at AT4 wireless.

## Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

| | |
|---|---|
| Temperature | Min. = 19.6 ºC<br>Max. = 21.3 ºC |
| Relative humidity | Min. = 47.4%<br>Max. = 49.3 % |
| Shielding effectiveness | > 100 dB |
| Electric insulation | > 10 kΩ |
| Reference resistance to earth | < 0,5 Ω |

In the semianechoic chamber (21 meters x 11 meters x 8 meters), the following limits were not exceeded during the test.

| | |
|---|---|
| Temperature | Min. = 19.1 ºC<br>Max. = 19.5 ºC |
| Relative humidity | Min. = 48 %<br>Max. = 49 % |
| Air pressure | Min. = 1020 mbar<br>Max. = 1020 mbar |
| Shielding effectiveness | > 100 dB |
| Electric insulation | > 10 kΩ |
| Reference resistance to earth | < 0,5 Ω |
| Normal site attenuation (NSA) | < ±4 dB at 10 m distance between item under test and receiver antenna, (30 MHz to 1000 MHz) |
| Field homogeneity | More than 75% of illuminated surface is between 0 and 6 dB (26 MHz to 1000 MHz). |

In the chamber for conducted measurements the following limits were not exceeded during the test:

| | |
|---|---|
| Temperature | Min. = 24.3 ºC<br>Max. = 25.2 ºC |
| Relative humidity | Min. = 49.6 %<br>Max. = 50.4% |
| Air pressure | Min. = 1020 mbar<br>Max. = 1020 mbar |
| Shielding effectiveness | > 100 dB |
| Electric insulation | > 10 kΩ |
| Reference resistance to earth | < 0,5 Ω |

## Summary

Considering the results of the performed test according to standard USA FCC Parts 15.407, and 15.209 / RSS-210, the item under test is **IN COMPLIANCE** with the requested specifications specified in the standard.

NOTE: The results presented in this Test Report apply only to the particular item under test established in page 1 of this document, as presented for test on the date(s) shown in section, "USAGE OF SAMPLES, TESTING PERIOD AND ENVIRONMENTAL CONDITIONS".

## Remarks and comments

1: The calculated E.I.R.P. is less than 500 mW (27 dBm) and therefore a TPC mechanism is not required.

2: The compliance is checked through a description of how this requirement is met that is provided by the applicant.

3: Refer to separate test report 38880BRRF.004.

## Testing verdicts

Not applicable ..... : NA

Pass..... : P

Fail ..... : F

Not measured..... : NM

### I. 5.15 GHz -5.25 GHz Band.

| FCC PART 15 PARAGRAPH / RSS-210 | | VERDICT | | | |
|---|---|---|---|---|---|
| | | NA | P | F | NM |
| 15.407 (a) (1) / RSS-210 A9.2. (1) | Power limits. Maximum output power | | P | | |
| 15.407 (a) (1) / RSS-210 A9.2. (1) | Peak power spectral density | | P | | |
| 15.407 (b) (1), (7) / RSS-210 A9.2. (1). | Radiated Band-edge emissions compliance (Transmitter). | | P | | |
| 15.407 (b) (1), (6), (7) / RSS-210 A9.2. (1). | Undesirable radiated emissions (Transmitter) | | P | | |
| 15.407 (g) | Frequency stability | | | | NM[2] |

2: See remarks and comments.

**II. 5.25 GHz -5.35 GHz Band.**

| FCC PART 15 PARAGRAPH / RSS-210 | | VERDICT | | | |
|---|---|---|---|---|---|
| | | NA | P | F | NM |
| 15.407 (a) (2) / RSS-210 A9.2. (2) | Power limits. Maximum output power | | P | | |
| 15.407 (a) (2) / RSS-210 A9.2. (2) | Peak power spectral density | | P | | |
| 15.407 (b) (2), (7) / RSS-210 A9.2. (2). | Radiated Band-edge emissions compliance (Transmitter). | | P | | |
| 15.407 (b) (2), (6), (7) / RSS-210 A9.2. (2). | Undesirable radiated emissions (Transmitter) | | P | | |
| 15.407 (g) | Frequency stability | | | | NM[2] |
| 15.407 (h) (1) / RSS-210 A9.2. (2). | Transmit Power Control (TPC) | NA[1] | | | |
| 15.407 (h) (2) / RSS-210 A9.2. (2). | Dynamic Frequency Selection (DFS) | | P[3] | | |

1, 2, 3: See remarks and comments.

**III. 5.47 GHz -5.725 GHz Band.**

| FCC PART 15 PARAGRAPH / RSS-210 | | VERDICT | | | |
|---|---|---|---|---|---|
| | | NA | P | F | NM |
| 15.407 (a) (2) / RSS-210 A9.2. (3) | Power limits. Maximum output power | | P | | |
| 15.407 (a) (2) / RSS-210 A9.2. (3) | Peak power spectral density | | P | | |
| 15.407 (b) (3), (7) / RSS-210 A9.2. (3). | Radiated Band-edge emissions compliance (Transmitter). | | P | | |
| 15.407 (b) (3), (6), (7) / RSS-210 A9.2. (3). | Undesirable radiated emissions (Transmitter) | | P | | |
| 15.407 (g) | Frequency stability | | | | NM[2] |
| 15.407 (h) (1) / RSS-210 A9.2. (3). | Transmit Power Control (TPC) | NA[1] | | | |
| 15.407 (h) (2) / RSS-210 A9.2. (3). | Dynamic Frequency Selection (DFS) | | P[3] | | |

1, 2, 3: See remarks and comments.

**IV. Common requirements for all bands.**

| FCC PART 15 PARAGRAPH / RSS-210 | | VERDICT | | | |
|---|---|---|---|---|---|
| | | NA | P | F | NM |
| 15.407 (a) (6) | Peak excursion ratio of the modulation envelope | | P | | |
| 15.407 (c) / RSS-210 A9.4. (4). | Transmission in case of absence of information to transmit, or operational failure. | | | | NM[2] |

2: See remarks and comments.

# APPENDIX A: Test results for 5.15 GHz – 5.25 GHz band

**INDEX**

## TEST CONDITIONS

Power supply (V):

$V_{nominal}$ = 3.3 Vdc

Type of power supply = DC voltage from HMC/NGFC test board.

Type of antenna = External attachable PIFA antenna.

Declared Gain for antenna = 3.6 dBi

**Operating frequencies in the sub-band 5.15-5.25 GHz.**

-For IEEE 802.11a, the equipment uses channels 36, 40, 44, 48.

-For IEEE 802.11n, there are two bandwidths:

For 20 MHz bandwidth the equipment uses channels 36, 40, 44, 48.
For 40 MHz bandwidth the equipment uses channels 38, 46.

-For IEEE 802.11ac, there are three bandwidths:

For 20 MHz bandwidth the equipment uses channels 36, 40, 44, 48.
For 40 MHz bandwidth the equipment uses channels 38, 46.
For 80 MHz bandwidth the equipment uses channel 42.

**TEST FREQUENCIES:**

For WiFi a/n20/ac20:

Lowest channel (36): 5180 MHz

Middle channel (40): 5200 MHz

Highest channel (48): 5240 MHz

For WiFi n40/ac40:

Lowest channel (28): 5190 MHz

Highest channel (46): 5230 MHz

For WiFi ac80:

Middle channel (42): 5210 MHz

The test set-up was made in accordance to the general provisions of ANSI C63.4: 2009 and FCC KDB 789033 D01 General UNII Test Procedures v01r03.

For 802.11a mode the EUT can only transmit at MAIN RF output.

For 802.11n/ac modes 802.11n20/ac20 (20 MHz channel bandwidth), 802.11n40/ac40 (40MHz channel bandwidth) and 802.11ac80 (80MHz channel bandwidth) mode the EUT can only transmit at MAIN RF output.

For radio testing purposes the card was installed in a test fixture. The test fixture is connected to a laptop computer and dc power supplied. The laptop computer was used to configure the EUT to continuously transmit at a specified output power with different modes and modulation schemes.

The data rates of 6Mb/s for 802.11a, HT0 for 802.11n20/ac20 and n40/ac40, and VHT0 for 802.11 ac80 were selected based on preliminary testing that identified those rates corresponding to the worst cases for output power and spurious levels at the band edges.

The field strength at the band edges was evaluated for each mode and on each chain individually on the lowest and highest channels at the rated power for the channel under test. Where the power at the edge channels was lower than the power at the center channels additional measurements were made at the adjacent channels.

The PC was using the Intel test utility DRTU Version DRTU 1.6.1.628.

During transmitter test the EUT was being controlled by the Intel DRTU tool to operate in a continuous transmit mode on the test channels as required and in each of the different modulation modes.

The conducted RF output power at MAIN RF output 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 calibrated average power meter. Measured values for adjustment were within -0.2 dB/+0.3 dB respect to the Target values.

**RF conducted output power target values**

| | Mode | BW (MHz) | Channel / Freq (MHz). | Power level at Main RF output (dBm) |
|---|---|---|---|---|
| **5.15-5.25GHz Band** | 802.11a | 20 | 36 / 5180 | 14,5 |
| | | | 40 / 5200 | 15.5 |
| | | | 48 / 5240 | 15 |
| | 802.11n | 20 | 36 / 5180 | 14,5 |
| | | | 40 / 5200 | 15.5 |
| | | | 48 / 5240 | 15 |
| | 802.11n* | 40 | 38 / 5190 | 10,5 |
| | | | 46 / 5230 | 16,5 |
| | 802.11ac | 80 | 42 / 5210 | 9 |

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is connected to the spectrum analyzer using low loss RF cables with sma type connectors. The reading in the spectrum analyzer is corrected taking into account the cable loss.

RADIATED MEASUREMENTS

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 1m for the frequency range 1 GHz-40 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

For radiated emissions in the range 1 GHz-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The equipment under test was set up on a non-conductive (wooden) platform one meter above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º.

Measurements were made in both horizontal and vertical planes of polarization.

**99 % and 26 dB Bandwidth**

RESULTS

**1. 802.11a mode** (see next plots).

| | Lowest frequency 5180 MHz | Middle frequency 5200 MHz | Highest frequency 5240 MHz |
|---|---|---|---|
| 99% bandwidth (MHz) | 18.280 | 19.100 | 19.150 |
| 26 dB bandwidth (MHz) | 28.735 | 31.198 | 33.385 |
| Measurement uncertainty (kHz) | ±21.7 | | |

**2. 802.11 n20 MHz and 802.11 ac20 MHz modes.** (see next plots).

| | Lowest frequency 5180 MHz | Middle frequency 5200 MHz | Highest frequency 5240 MHz |
|---|---|---|---|
| 99% bandwidth (MHz) | 19.450 | 20.100 | 20.900 |
| 26 dB bandwidth (MHz) | 29.792 | 34.984 | 36.748 |
| Measurement uncertainty (kHz) | ±21.7 | | |

Note: the test was performed with 802.11 n20 MHz mode which is the same modulation scheme as 802.11 ac 20 MHz.

**3. 802.11 n40 MHz and 802.11 ac 40 MHz modes.** (see next plots).

| | Lowest frequency 5190 MHz | Highest frequency 5230 MHz |
|---|---|---|
| 99% bandwidth (MHz) | 36.900 | 37.300 |
| 26 dB bandwidth (MHz) | 47.363 | 60.728 |
| Measurement uncertainty (kHz) | ±21.7 | |

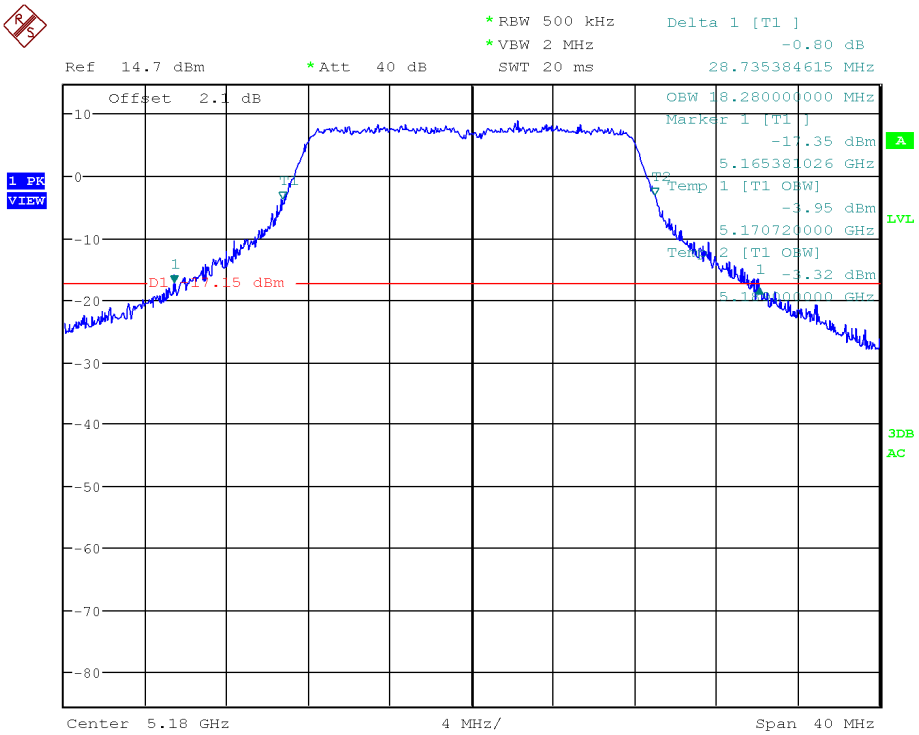
Note: the test was performed with 802.11 n40 MHz mode which is the same modulation scheme as 802.11 ac 40 MHz.

**4. 802.11 ac 80 MHz mode.** (see next plots).

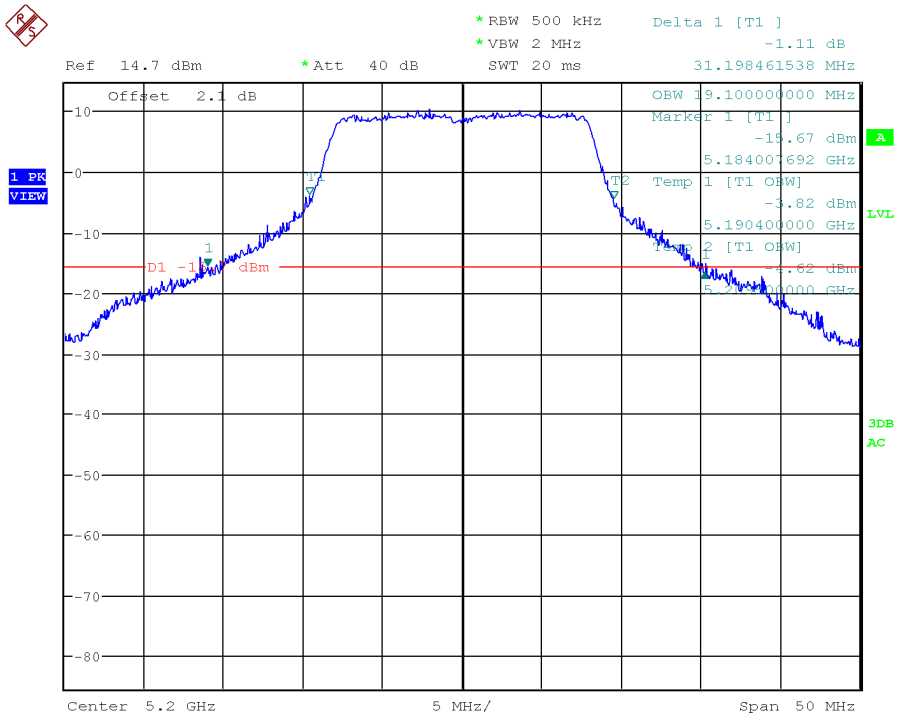
| | Frequency<br>5210 MHz |
|---|---|
| 99% bandwidth (MHz) | 75.450 |
| 26 dB bandwidth (MHz) | 102.329 |
| Measurement uncertainty (kHz) | ±21.7 |

**802.11a mode**

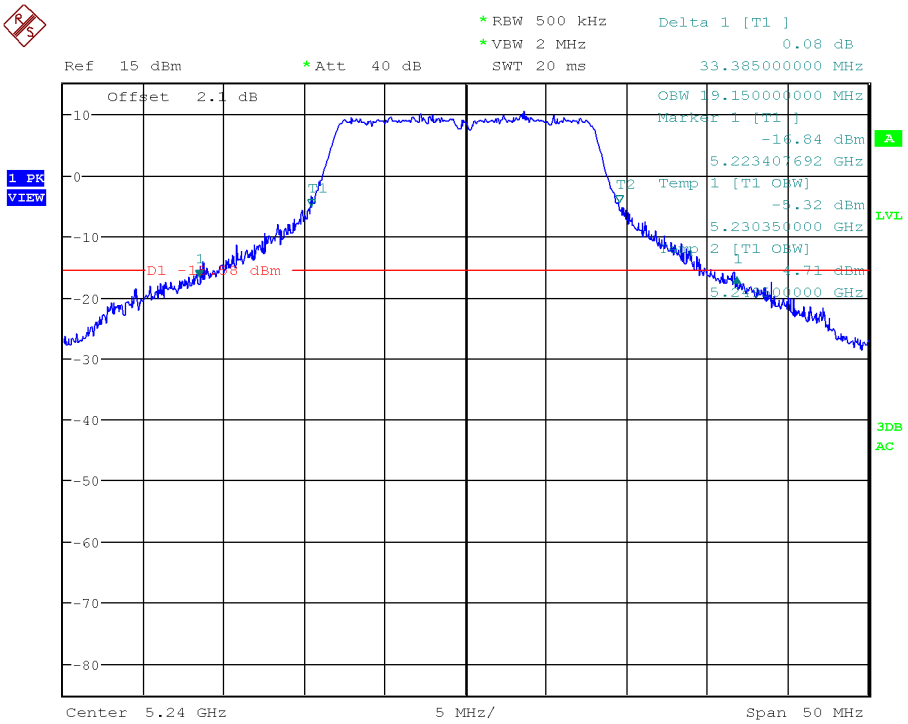
Lowest Channel



Middle Channel

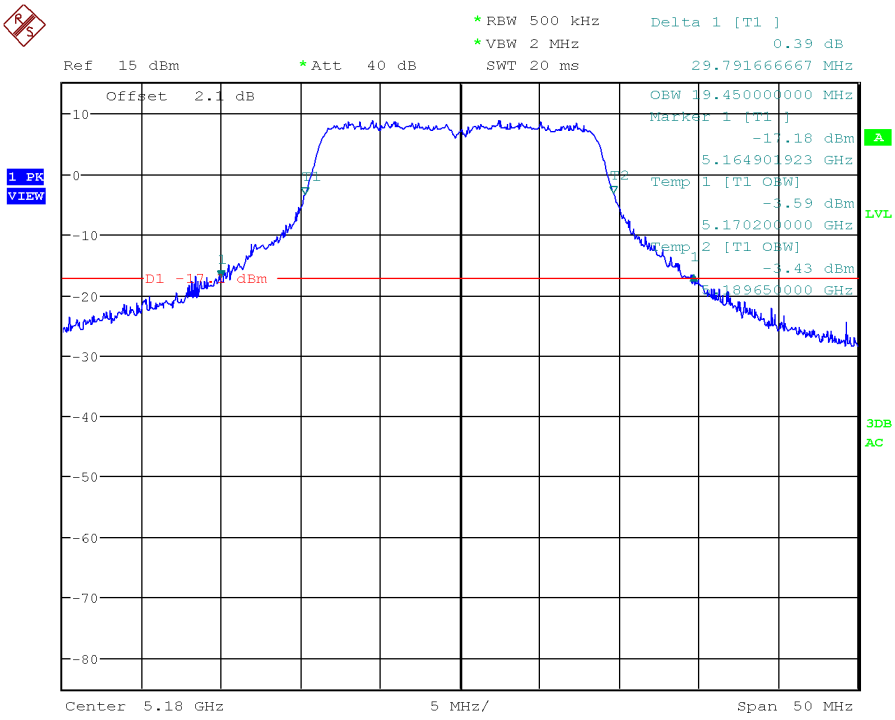



Highest Channel

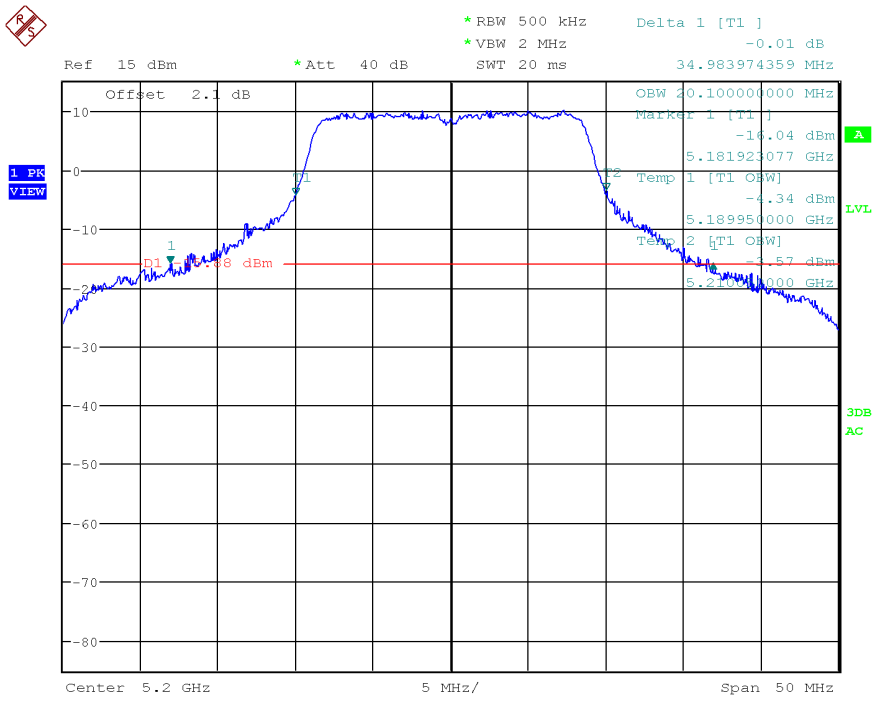


## 802.11 n20 MHz and 802.11 ac 20 MHz modes

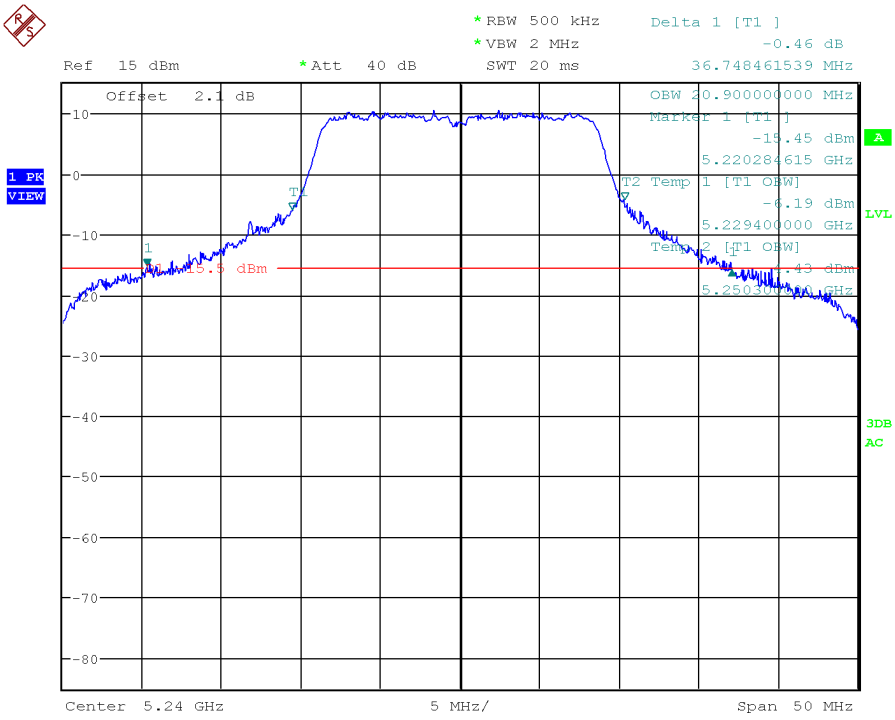
Lowest Channel




Middle Channel

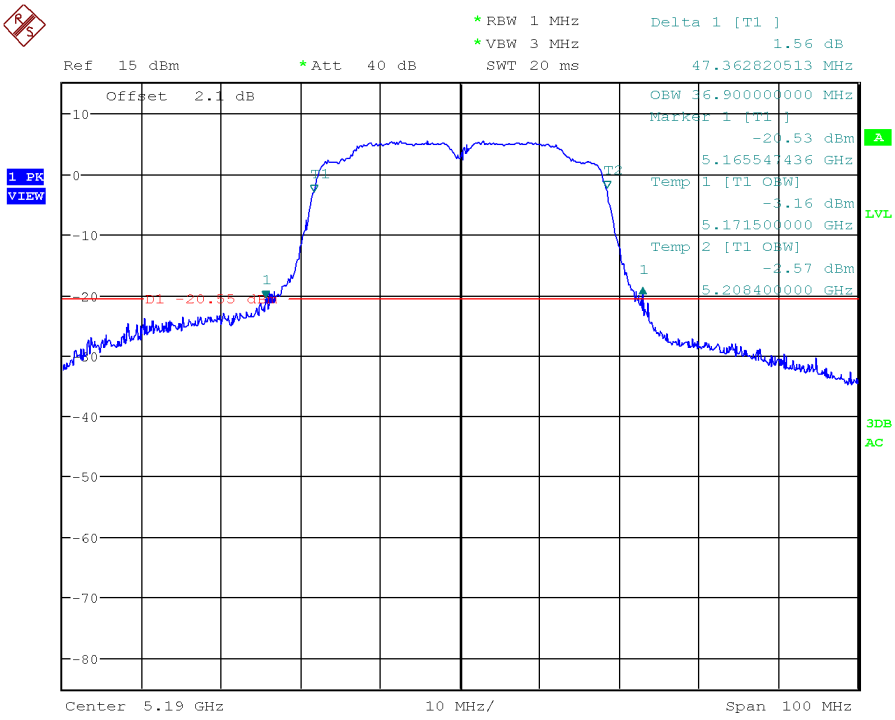


Highest Channel

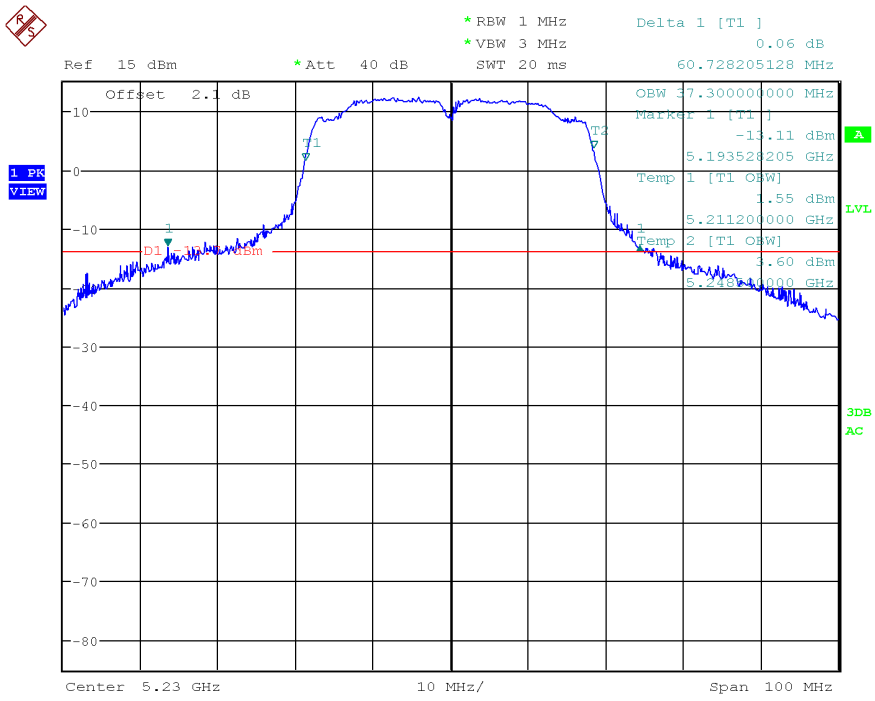



## 802.11 n40 MHz and 802.11 ac 40 MHz modes

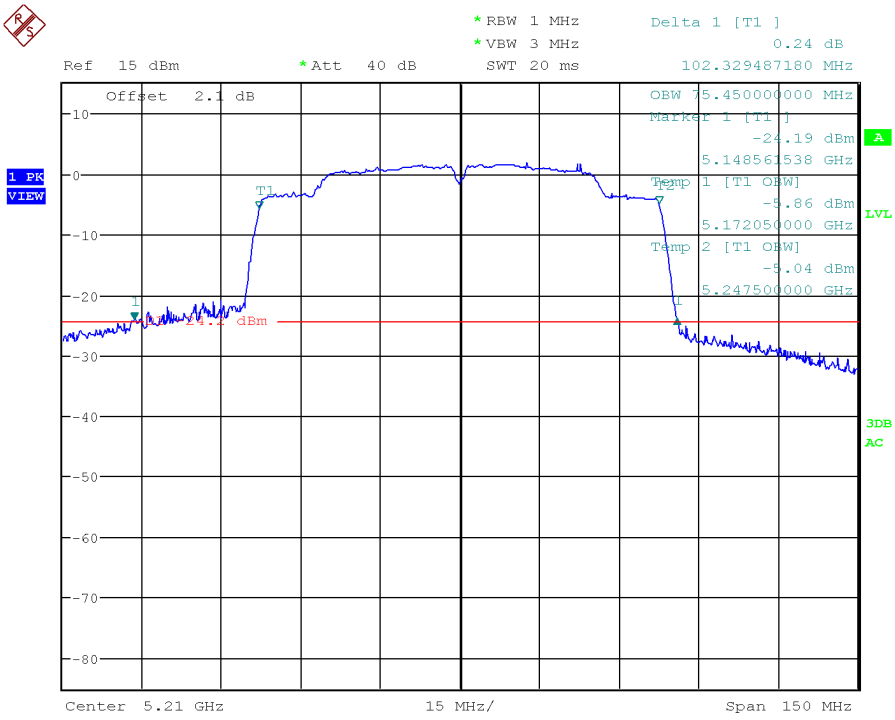
Lowest Channel



Highest Channel




## 802.11 ac 80 MHz mode



**Section 15.407 Subclause (a) (1) / RSS-210 A9.2. (1). Maximum output power, Peak power spectral density and antenna gain**

SPECIFICATION

FCC 15.407: For the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW (17 dBm) or 4 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. In addition, the peak power spectral density shall not exceed 4 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS-210: The maximum e.i.r.p. shall not exceed 200 mW (23 dBm) or 10 + 10 log10 B, dBm, whichever power is less. B is the 99% emission bandwidth in MHz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

Within the emission bandwidth, when the peak spectral density per MHz over any continuous transmission exceeds the average (10 log10 B) value by more than 3 dB, the permissible power spectral density shall be reduced by the excess amount.

RESULTS

The maximum conducted output power was measured using the channel power integration method according to point E) 2) b) (Method SA-1) of Guidance 789033 D01.

The peak power spectral density (PPSD) was measured using the method according to point F) (Method SA-1) of Guidance 789033 D01.

The e.i.r.p. levels are calculated by adding the declared maximum antenna gain (dBi).

**1. 802.11a mode** (see next plots).

Maximum declared antenna gain = 3.6 dBi

| Frequency | Maximum conducted output power (dBm) | Maximum output power e.i.r.p. (dBm) | PPSD/MHz (dBm) | PPSD/MHz e.i.r.p. (dBm) |
|---|---|---|---|---|
| 5180 MHz | 14.56 | 18.16 | 3.59 | 7.19 |
| 5200 MHz | 14.92 | 18.52 | 3.96 | 7.56 |
| 5240 MHz | 15.01 | 18.61 | 3.97 | 7.57 |

Measurement uncertainty = ±1.5 dB

Verdict: Pass

**2. 802.11 n20 MHz and 802.11 ac 20 MHz modes.** (see next plots).

Note: the test was performed with 802.11 n20 MHz mode which is the same modulation scheme as 802.11 ac 20 MHz.

Maximum declared antenna gain = 3.6 dBi

| Frequency | Maximum conducted output power (dBm) | Maximum output power e.i.r.p. (dBm) | PPSD/MHz (dBm) | PPSD/MHz e.i.r.p. (dBm) |
|---|---|---|---|---|
| 5180 MHz | 14.60 | 18.20 | 3.30 | 6.90 |
| 5200 MHz | 15.22 | 18.82 | 3.96 | 7.56 |
| 5240 MHz | 15.08 | 18.68 | 3.99 | 7.59 |

Measurement uncertainty = ±1.5 dB

Verdict: Pass

**3. 802.11 n40 MHz and 802.11 ac 40 MHz modes.** (see next plots).

Note: the test was performed with 802.11 n40 MHz mode which is the same modulation scheme as 802.11 ac 40 MHz.

Maximum declared antenna gain = 3.6 dBi

| Frequency | Maximum conducted output power (dBm) | Maximum output power e.i.r.p. (dBm) | PPSD/MHz (dBm) | PPSD/MHz e.i.r.p. (dBm) |
|---|---|---|---|---|
| 5190 MHz | 10.27 | 13.87 | -3.18 | 0.42 |
| 5230 MHz | 16.54 | 20.14 | 3.21 | 6.81 |

Measurement uncertainty = ±1.5 dB

Verdict: Pass

**4. 802.11 ac 80 MHz mode.** (see next plots).

Maximum declared antenna gain = 3.6 dBi

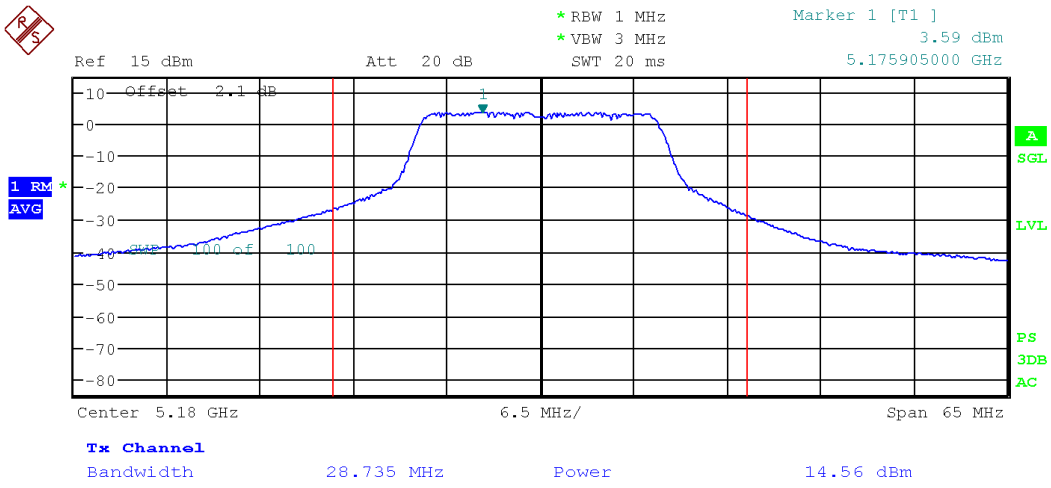
| Frequency | Maximum conducted output power (dBm) | Maximum output power e.i.r.p. (dBm) | PPSD/MHz (dBm) | PPSD/MHz e.i.r.p. (dBm) |
|---|---|---|---|---|
| 5210 MHz | 8.57 | 12.17 | -6.69 | -3.09 |

Measurement uncertainty = ±1.5 dB

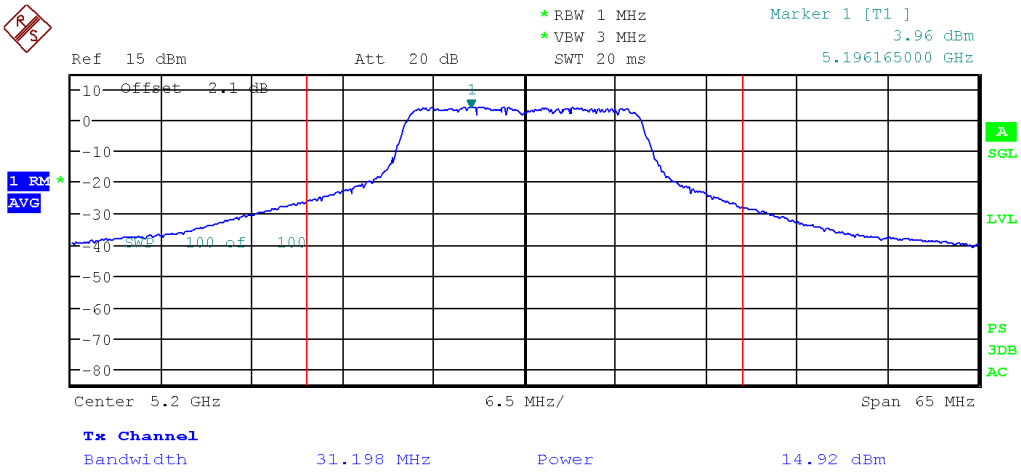
Verdict: Pass

**802.11a mode**

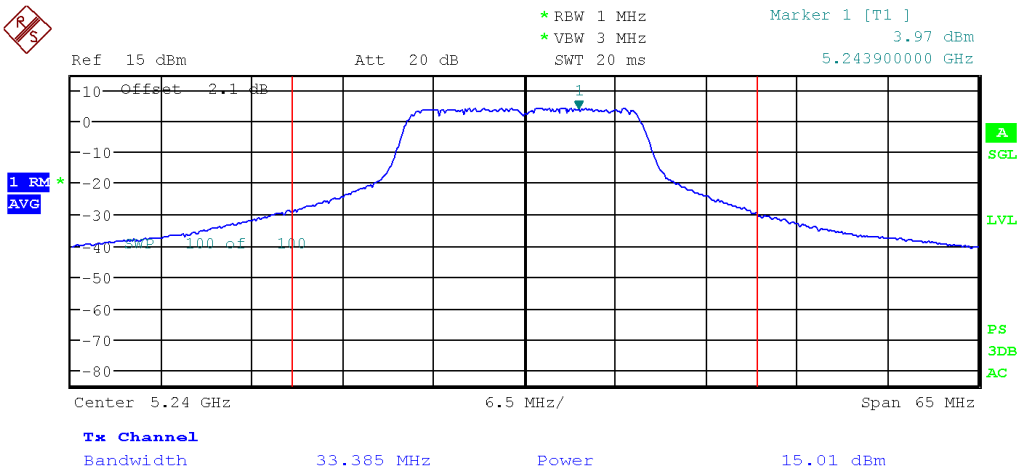
Lowest Channel



Middle Channel

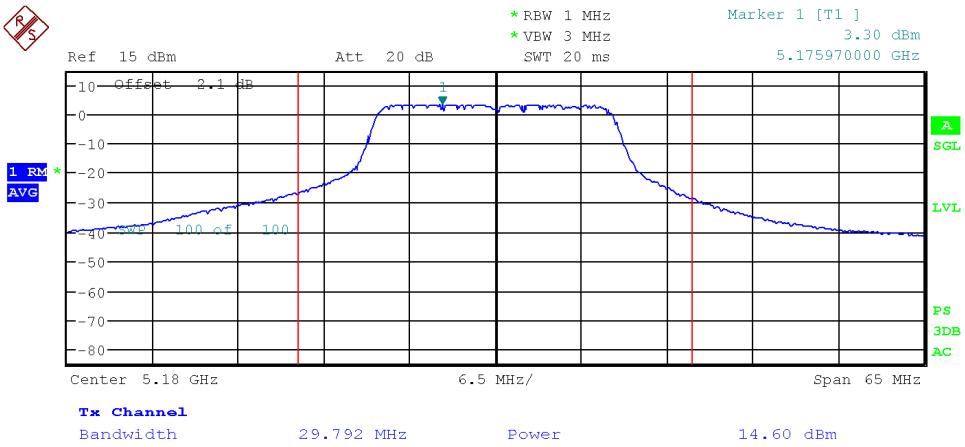



Highest Channel

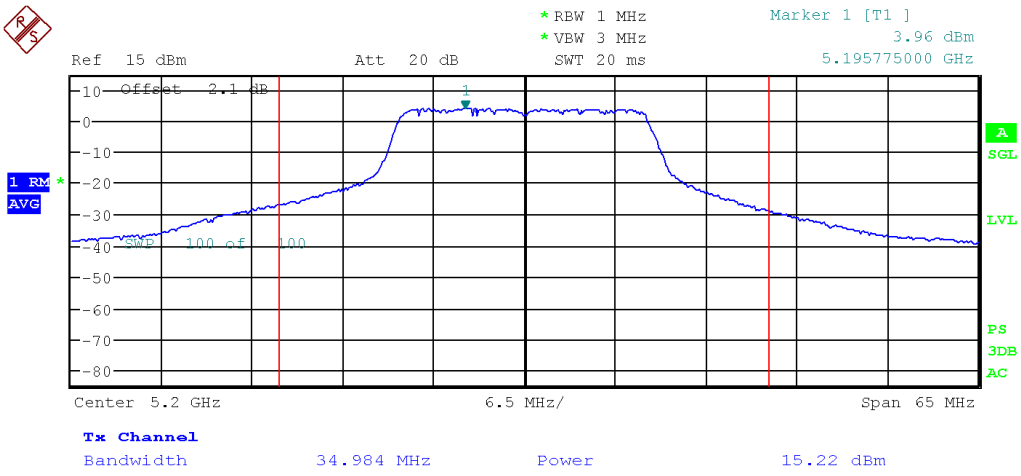


## 802.11 n20 MHz and 802.11 ac 20 MHz modes

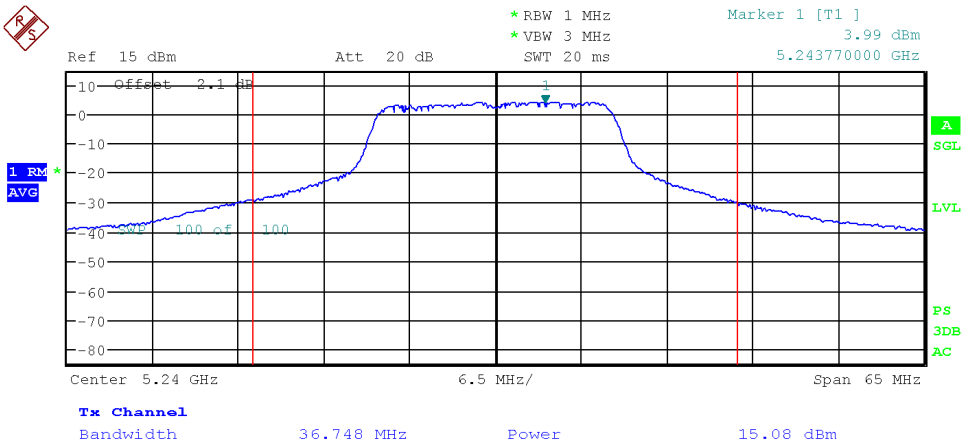
Lowest Channel




Middle Channel

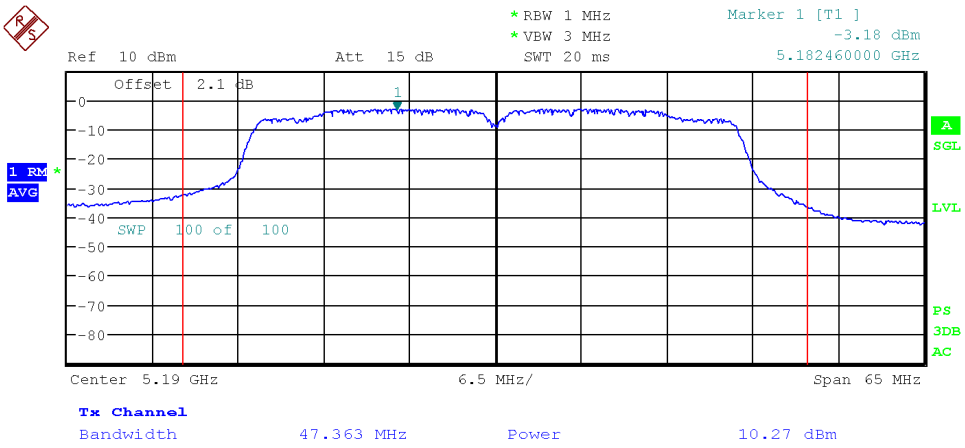


Highest Channel

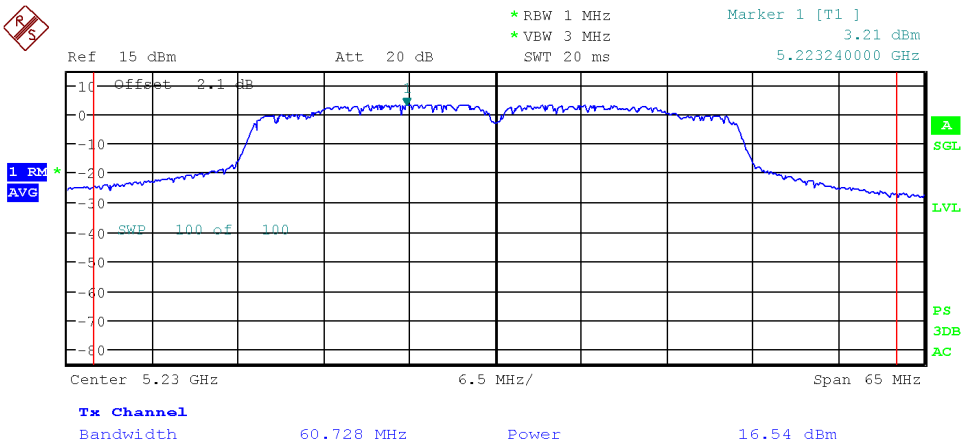



## 802.11 n40 MHz and 802.11 ac 40 MHz modes

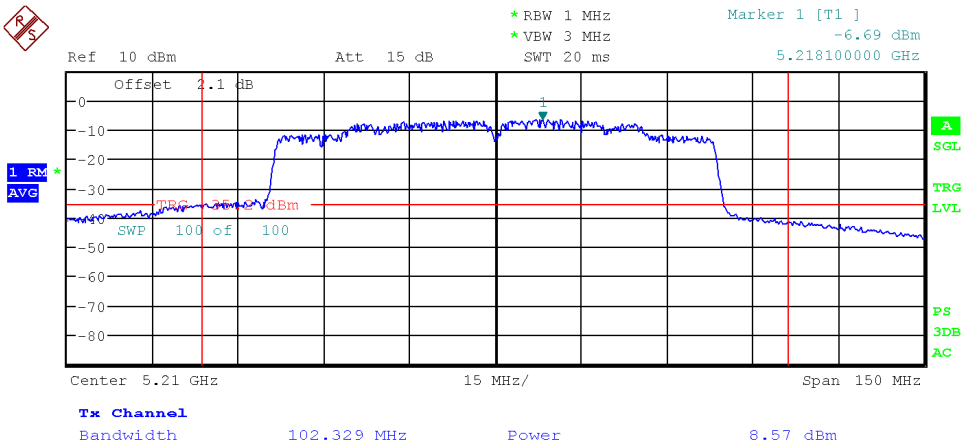
Lowest Channel



Highest Channel




## 802.11 ac 80 MHz mode



## Section 15.407 Subclause (a) (6). Peak excursion ratio of the modulation envelope

SPECIFICATION

The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

RESULTS

The peak excursion was measured using the method according to point F) of Guidance 789033 D01.

**1. 802.11a mode** (see next plots).

| Frequency | Peak of spectrum (dBm) | Measured PPSD/MHz (dBm) | Peak excursion (dB) |
|---|---|---|---|
| 5200 MHz | 13.42 | 3.96 | 9.46 |

Measurement uncertainty = ±1.5 dB

Verdict: Pass

**2. 802.11 n20 MHz and 802.11 ac 20 MHz modes.** (see next plots).

Note: the test was performed with 802.11 n20 MHz mode which is the same modulation scheme as 802.11 ac 20 MHz.

| Frequency | Peak of spectrum (dBm) | Measured PPSD/MHz (dBm) | Peak excursion (dB) |
|---|---|---|---|
| 5200 MHz | 13.29 | 3.96 | 9.33 |

Measurement uncertainty = ±1.5 dB

Verdict: Pass

**3. 802.11 n40 MHz and 802.11 ac 40 MHz modes.** (see next plots).

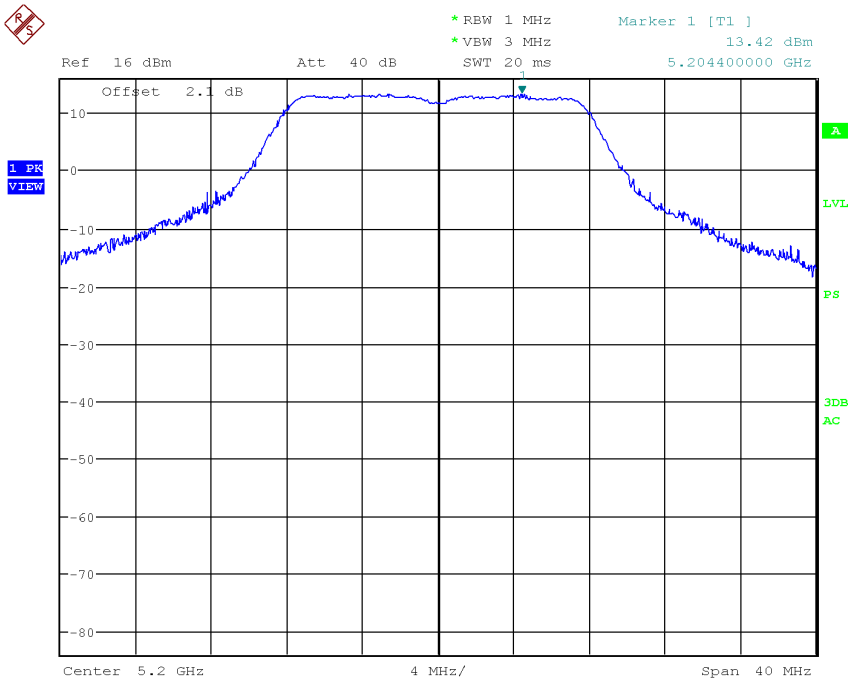
Note: the test was performed with 802.11 n40 MHz mode which is the same modulation scheme as 802.11 ac 40 MHz.

| Frequency | Peak of spectrum (dBm) | Measured PPSD/MHz (dBm) | Peak excursion (dB) |
|---|---|---|---|
| 5230 MHz | 12.20 | 3.21 | 8.99 |

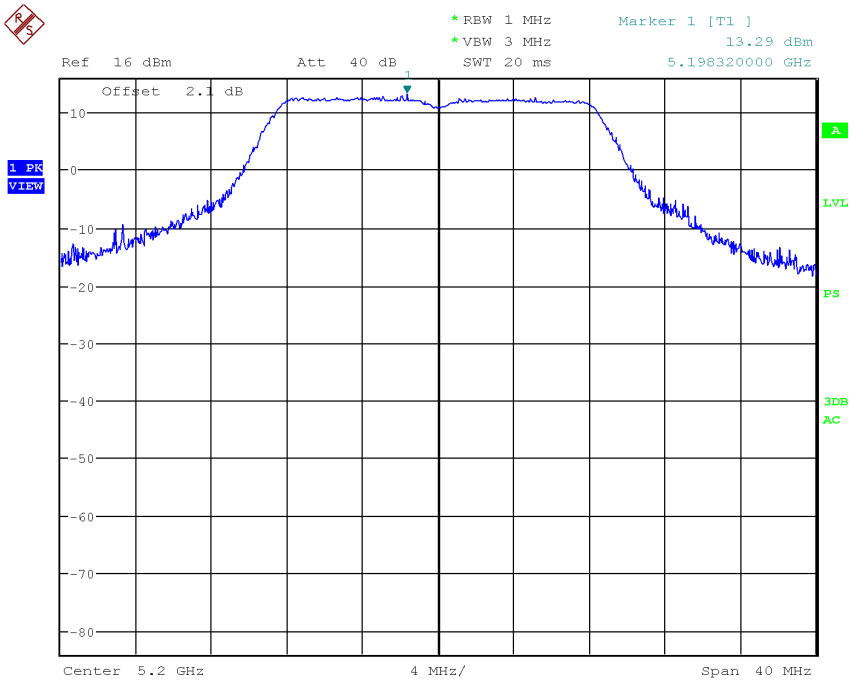
**4. 802.11 ac 80 MHz mode.** (see next plots).

| Frequency | Peak of spectrum (dBm) | Measured PPSD/MHz (dBm) | Peak excursion (dB) |
|---|---|---|---|
| 5210 MHz | 1.67 | -6.69 | 8.36 |

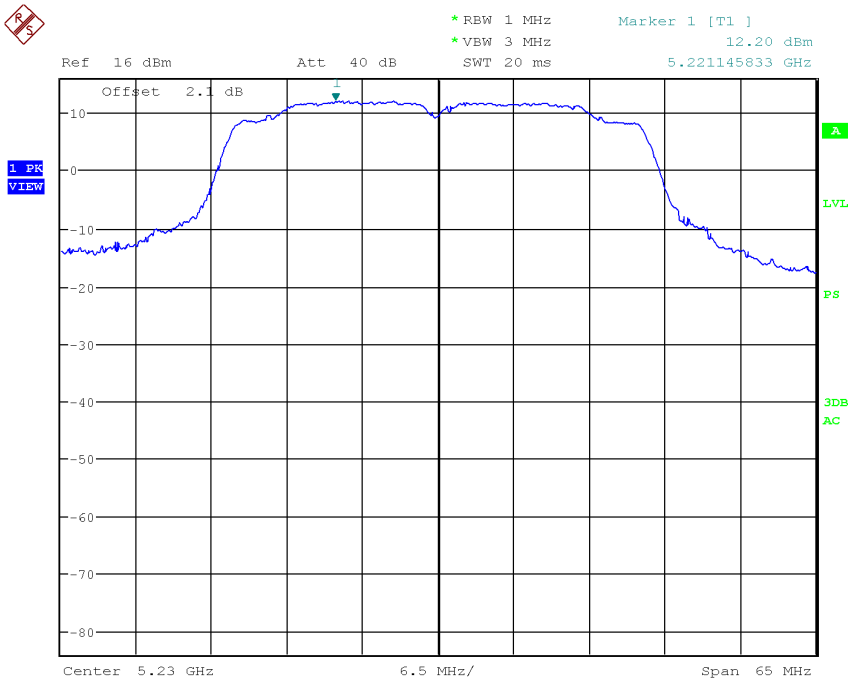
## 802.11a mode



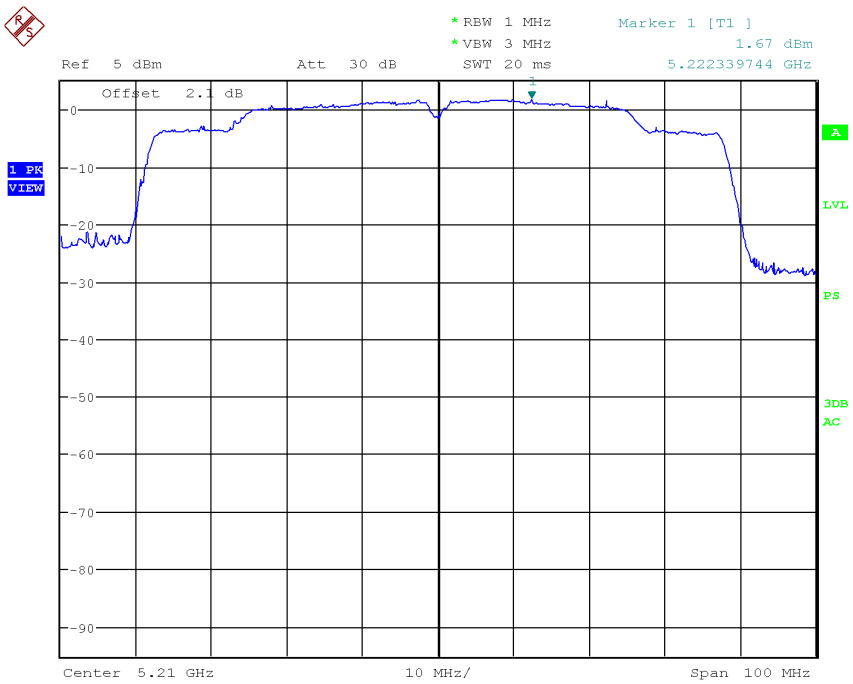

## 802.11 n20 MHz and 802.11 ac 20 MHz modes



## 802.11 n40 MHz and 802.11 ac 40 MHz modes




## 802.11 ac 80 MHz mode



SPECIFICATION

For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz (68.23 dBµV/m at 3 m distance).

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) (see §15.205(c)):

| Frequency Range (MHz) | Field strength (µV/m) | Field strength (dBµV/m) | Measurement distance (m) |
|---|---|---|---|
| 0.009-0.490 | 2400/F(kHz) | - | 300 |
| 0.490-1.705 | 24000/F(kHz) | - | 300 |
| 1.705 - 30.0 | 30 | - | 30 |
| 30 - 88 | 100 | 40 | 3 |
| 88 - 216 | 150 | 43.5 | 3 |
| 216 - 960 | 200 | 46 | 3 |
| 960 - 40000 | 500 | 54 | 3 |

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.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

All tests were performed in a semi-anechoic chamber at a distance of 1m for the frequency range 1 GHz-40 GHz.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

**Frequency range 30 MHz-1 GHz**

The spurious signals detected do not depend on either the operating channel or the modulation mode.

Highest spurious levels:

| Spurious frequency (MHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 143.47750 | V | Quasi-Peak | 29.95 | ± 3.8 |
| 165.24038 | V | Quasi-Peak | 30.45 | ± 3.8 |
| 232.08333 | V | Quasi-Peak | 31.65 | ± 3.8 |
| 298.92630 | V | Quasi-Peak | 29.49 | ± 3.8 |
| 650.24040 | V | Quasi-Peak | 30.50 | ± 3.8 |

All other peaks are more than 20 dB below the limit.

**Frequency range 1 GHz-40 GHz**

The results in the next tables show the maximum measured levels in the 1-40 GHz range including the restricted band 4.5-5.15 GHz (see next plots).

For OFDM modulation modes (802.11g, 802.11n20, 802.11n40 and 802.11ac80), a preliminary measurement in the central channel in the range 1-26 GHz was performed to determine the worst case. The lowest and highest channels were measured for out-of-band emissions for the worst case (802.11a).

The field strength at the band edges was evaluated for each mode and on each chain individually on the lowest and highest channels at the rated power for the channel under test. Where the power at the edge channels was lower than the power at the center channels additional measurements were made at the adjacent channels.

Spurious signals with peak levels above the average limit (54 dBµV/m at 3 m) are measured with average detector for checking compliance with the average limit.

1. WiFi 5GHz 802.11 a mode

Lowest frequency 5180 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside restricted band 4.5-5.15 GHz.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.15000 | V | Peak | 65.13 | ± 4.09 |
| | | Average | 51.46 | ± 4.09 |
| 15.542625 | V | Peak | 40.86 | ± 4.09 |
| 20.70002 | V | Peak | 50.44 | ± 4.09 |

Middle frequency 5200 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside restricted band 4.5-5.15 GHz.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.14959 | V | Peak | 60.14 | ± 4.09 |
| | | Average | 48.4 | ± 4.09 |
| 15.59777 | V | Peak | 43.05 | ± 4.09 |
| 20.80002 | V | Peak | 50.53 | ± 4.09 |

Highest frequency 5240 MHz. Out-of-band spurious emissions in the 1-40 GHz range.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 10.48088 | V | Peak | 48.16 | ± 4.09 |
| 15.71966 | V | Peak | 43.27 | ± 4.09 |

Verdict: PASS

2. WiFi 5GHz 802.11 n20 mode

Lowest frequency 5180 MHz. Out-of-band spurious emissions inside restricted band 4.5-5.15 GHz.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.15 | V | Peak | 64.73 | ± 4.09 |
| | | Average | 52.36 | ± 4.09 |

Middle frequency 5200 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside restricted band 4.5-5.15 GHz.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.15 | V | Peak | 61.87 | ± 4.09 |
| | | Average | 48.86 | ± 4.09 |
| 15.601386 | V | Peak | 40.58 | ± 4.09 |
| 20.799996 | V | Peak | 51.09 | ± 4.09 |

Verdict: PASS

3. WiFi 5GHz 802.11 n40 mode

Lowest frequency 5190 MHz. Out-of-band spurious emissions inside restricted band 4.5-5.15 GHz.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.15 | V | Peak | 63.69 | ± 4.09 |
| | | Average | 51.7 | ± 4.09 |

Highest frequency 5230 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside restricted band 4.5-5.15 GHz

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.15 | V | Peak | 62.81 | ± 4.09 |
| | | Average | 51.6 | ± 4.09 |
| 10.46297 | V | Peak | 46.22 | ± 4.09 |
| 15.69588 | V | Peak | 41.00 | ± 4.09 |

Verdict: PASS

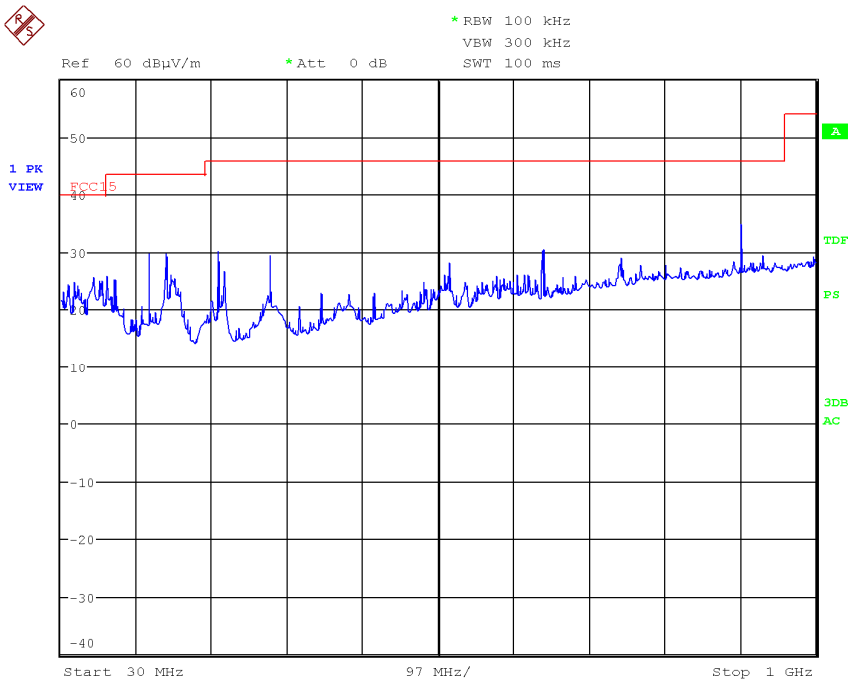
4. WiFi 5GHz 802.11 ac80 mode

Middle frequency 5210 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside restricted band 4.5-5.15 GHz.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.15 | V | Peak | 65.32 | ± 4.09 |
| | | Average | 53.17 | ± 4.09 |

Verdict: PASS

**FREQUENCY RANGE 30 MHz-1000 MHz.**

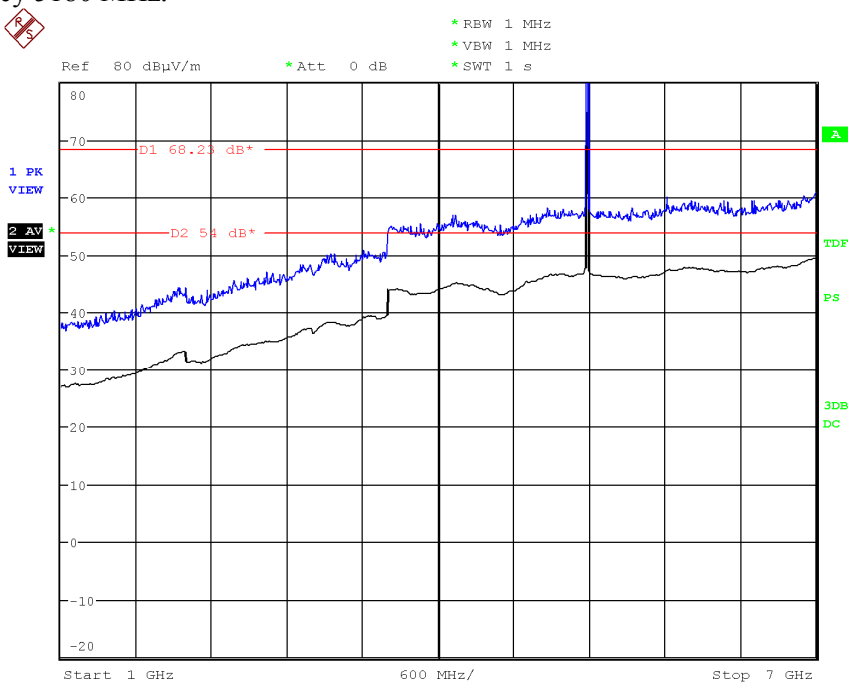



(This plot is valid for all three channels and all modulation modes).

**FREQUENCY RANGE 1 GHz to 7 GHz.**

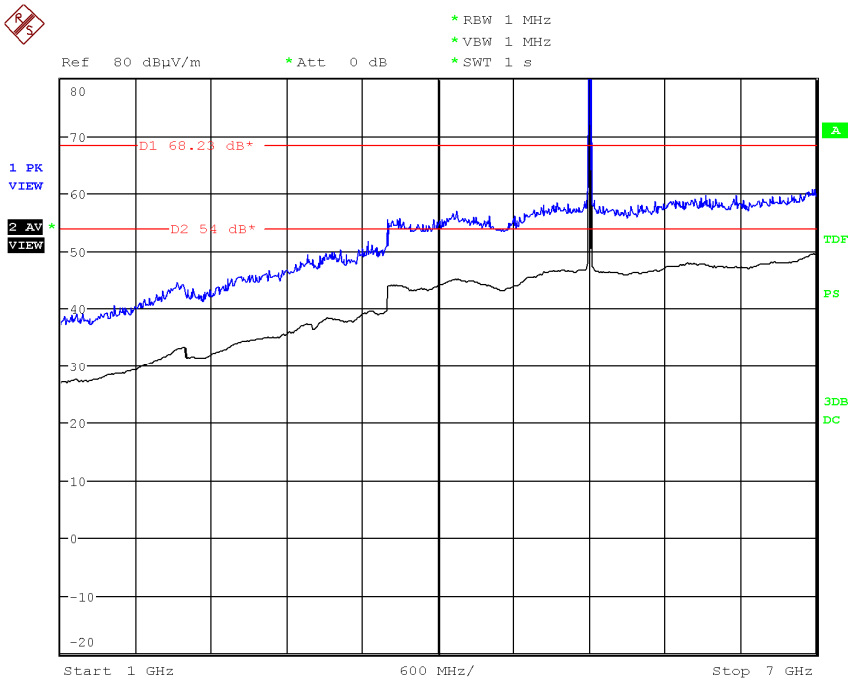
1. WiFi 5GHz 802.11 a mode

Lowest frequency 5180 MHz.



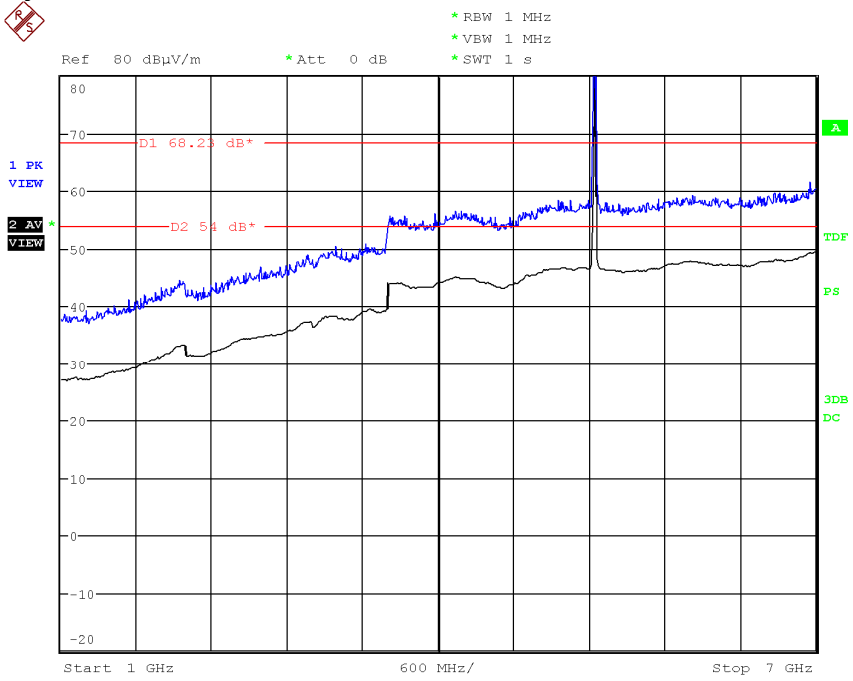

Note: The peak above the limit is the carrier frequency.

Middle frequency 5200 MHz.




Note: The peak above the limit is the carrier frequency.

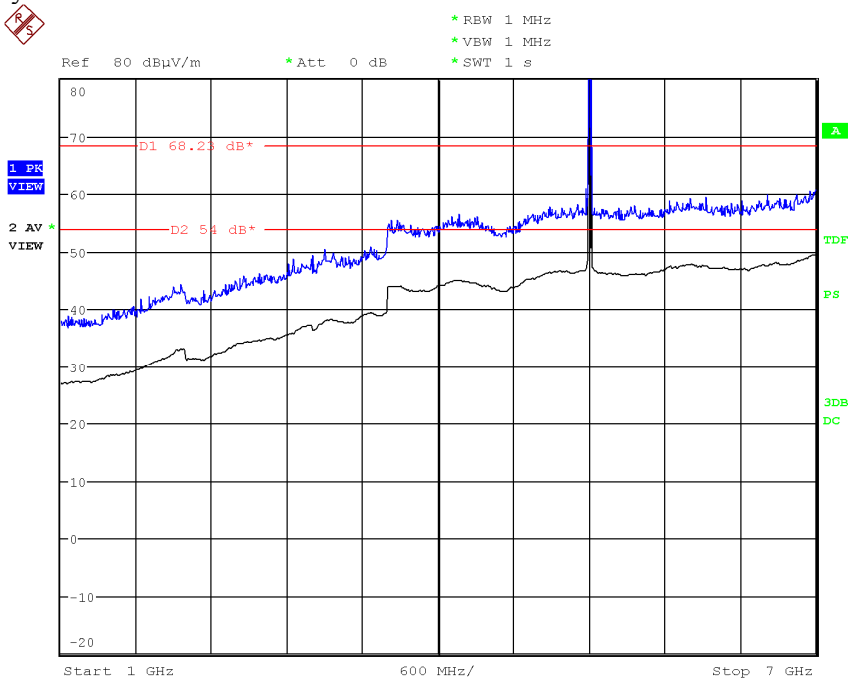
Highest  frequency 5240 MHz.




Note: The peak above the limit is the carrier frequency.

2. WiFi 5GHz 802.11 n20 mode

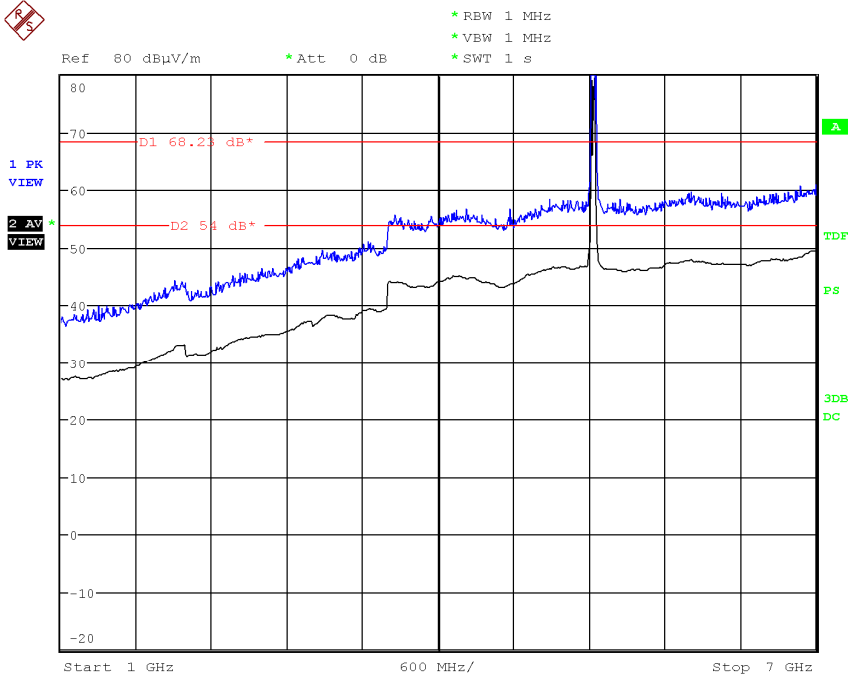
Middle frequency 5200 MHz.




Note: The peak above the limit is the carrier frequency.

3. WiFi 5GHz 802.11 n40 mode

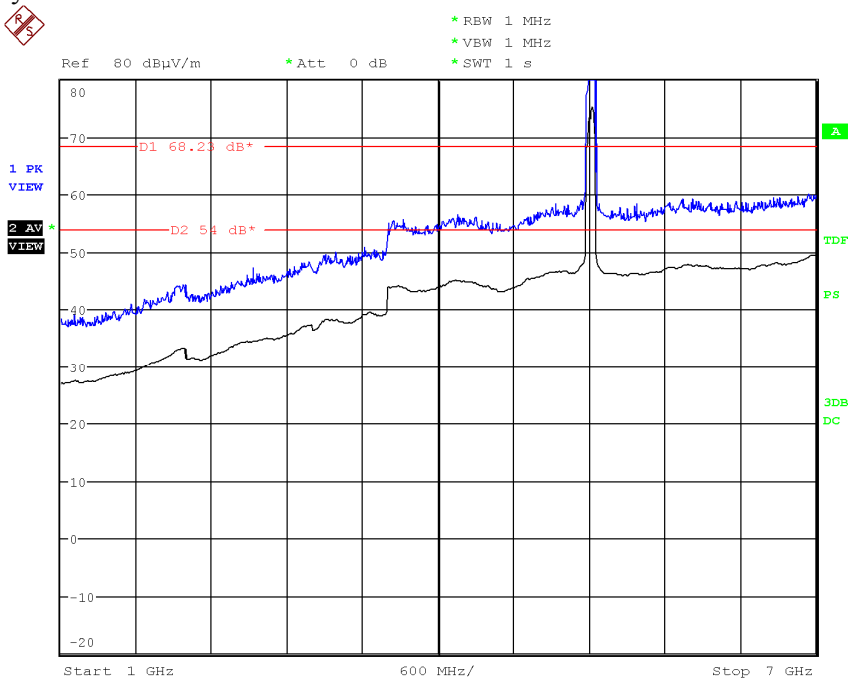
Highest frequency 5230 MHz.




Note: The peak above the limit is the carrier frequency.

4. WiFi 5GHz 802.11 ac80 mode

Middle frequency 5210 MHz.

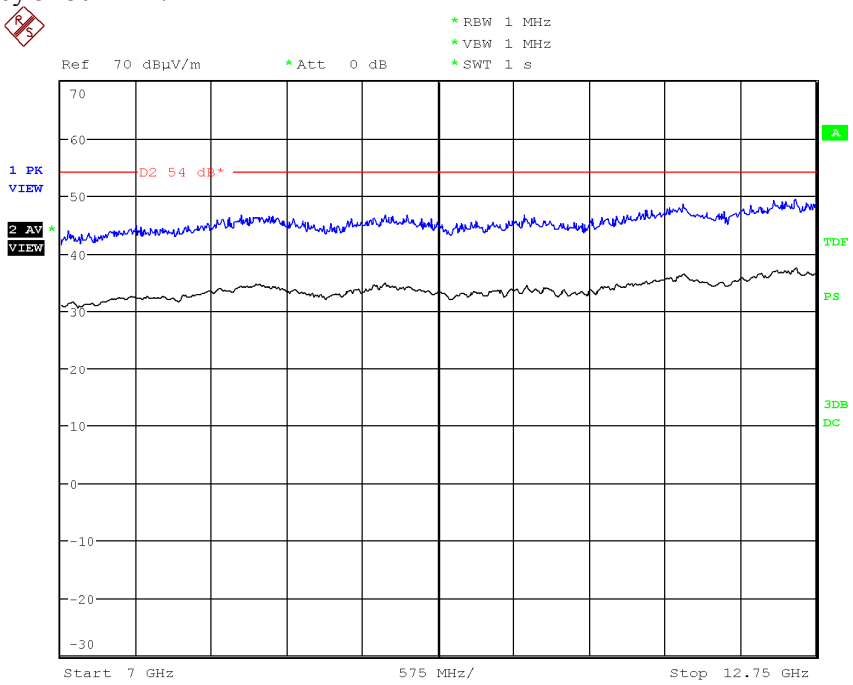



Note: The peak above the limit is the carrier frequency.

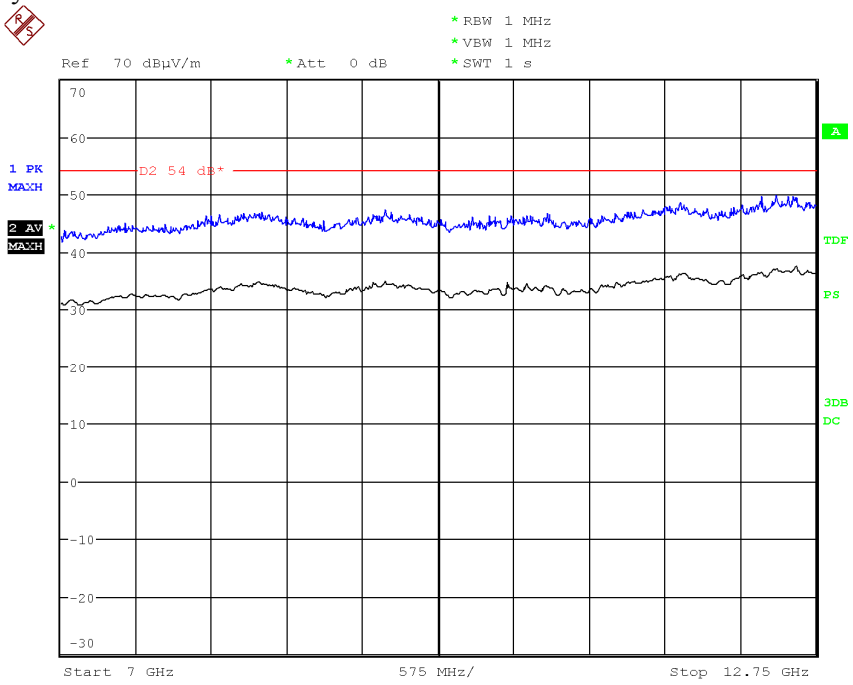
**FREQUENCY RANGE 7 GHz to 12.75 GHz.**

1. WiFi 5GHz 802.11 a mode

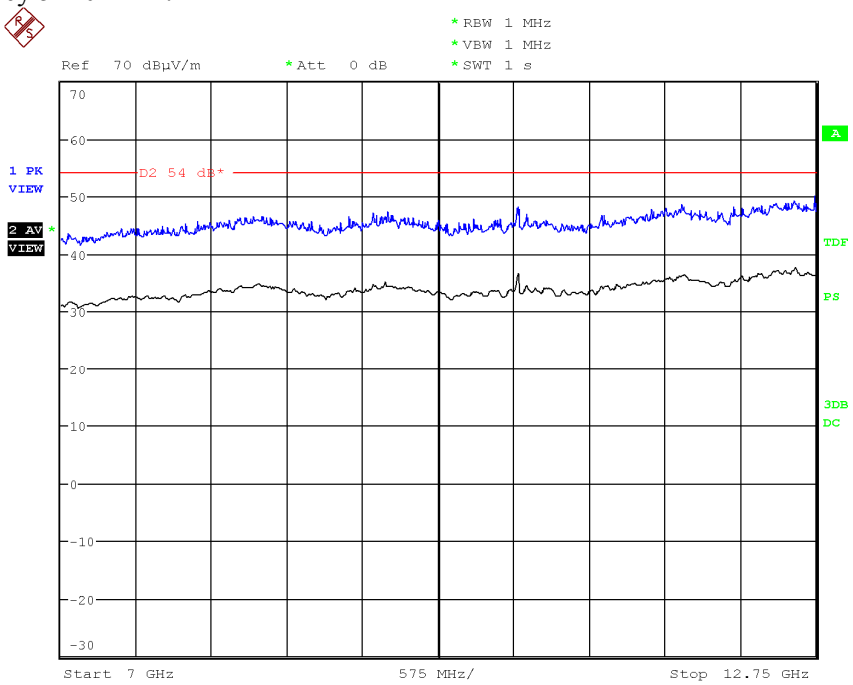
Lowest frequency 5180 MHz.




Middle frequency 5200 MHz.

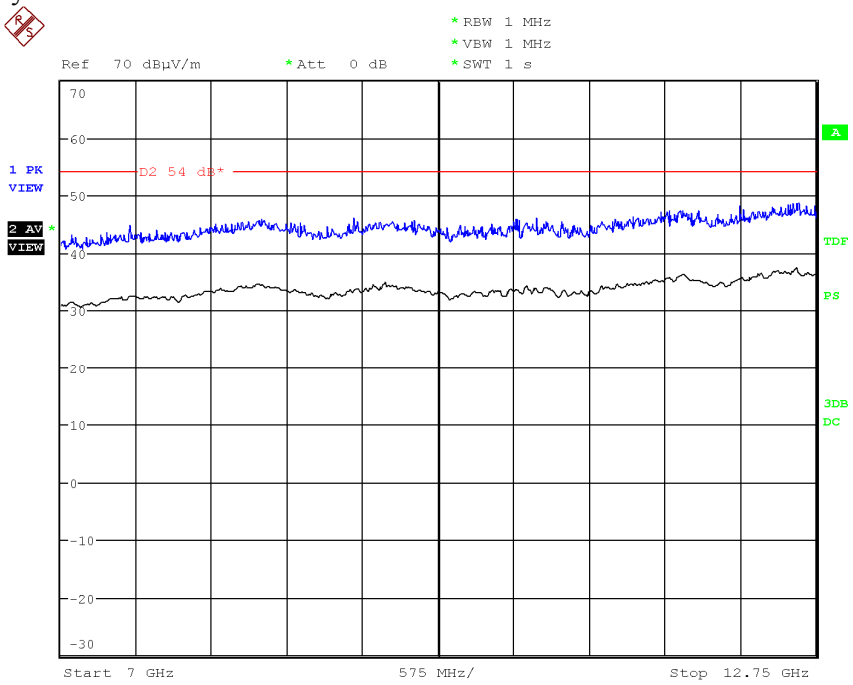


Highest frequency 5240 MHz.



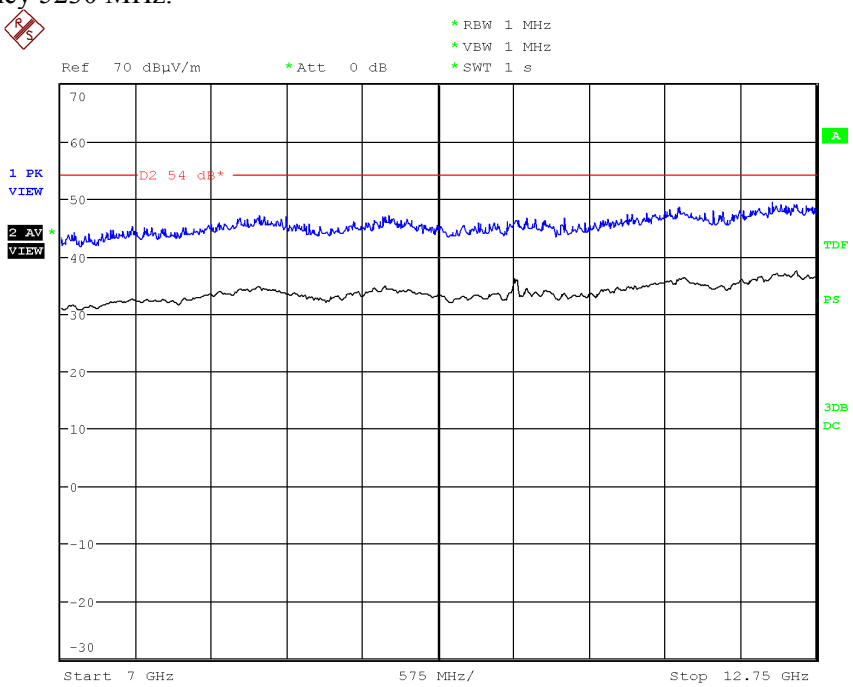

2. WiFi 5GHz 802.11 n20 mode

Middle frequency 5200 MHz.



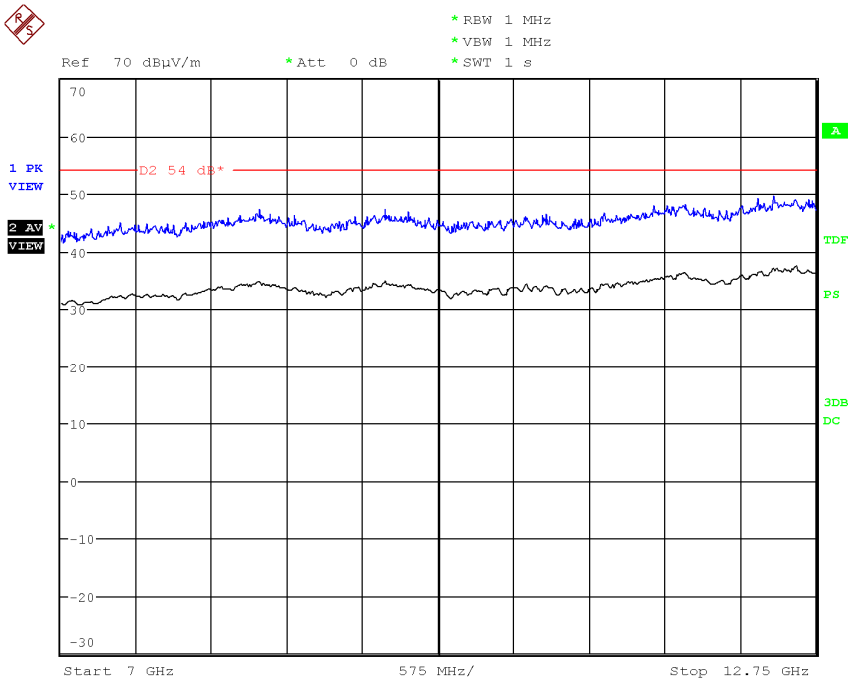
3. WiFi 5GHz 802.11 n40 mode

Highest frequency 5230 MHz.




4. WiFi 5GHz 802.11 ac80 mode

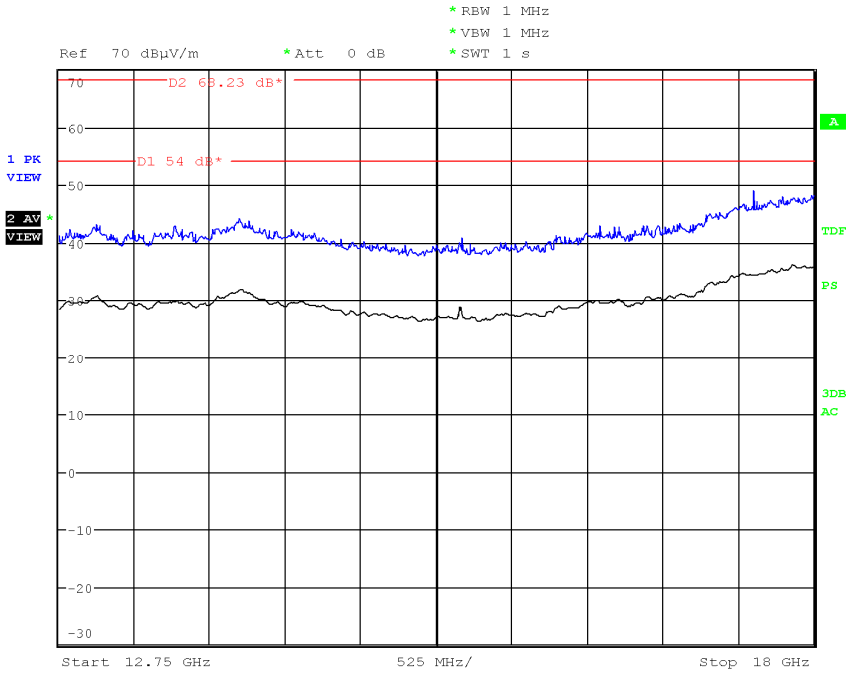
Middle frequency 5210 MHz.



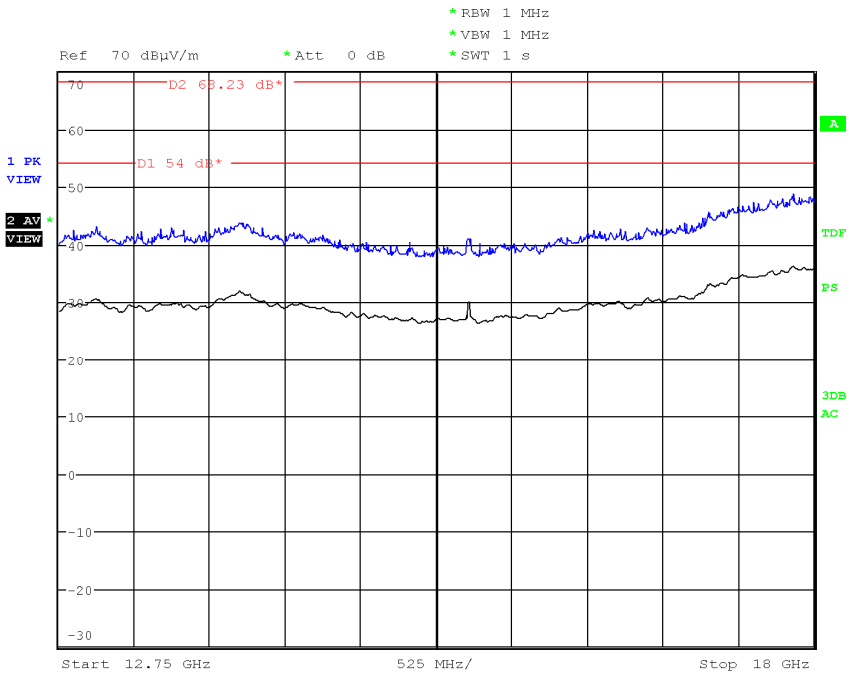
**FREQUENCY RANGE 12.75 GHz to 18GHz.**

1. WiFi 5GHz 802.11 a mode

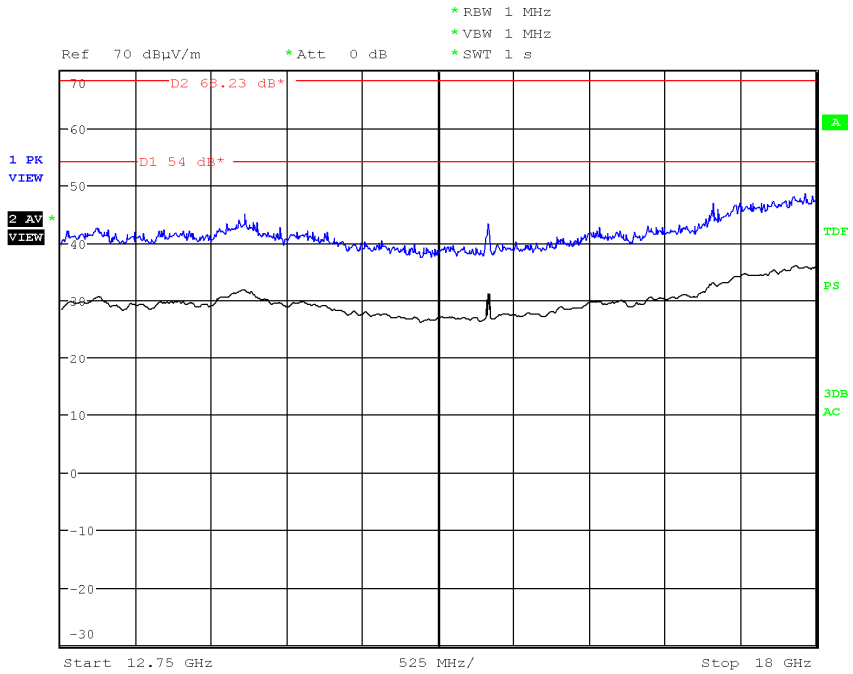
Lowest frequency 5180 MHz.




Middle frequency 5200 MHz.

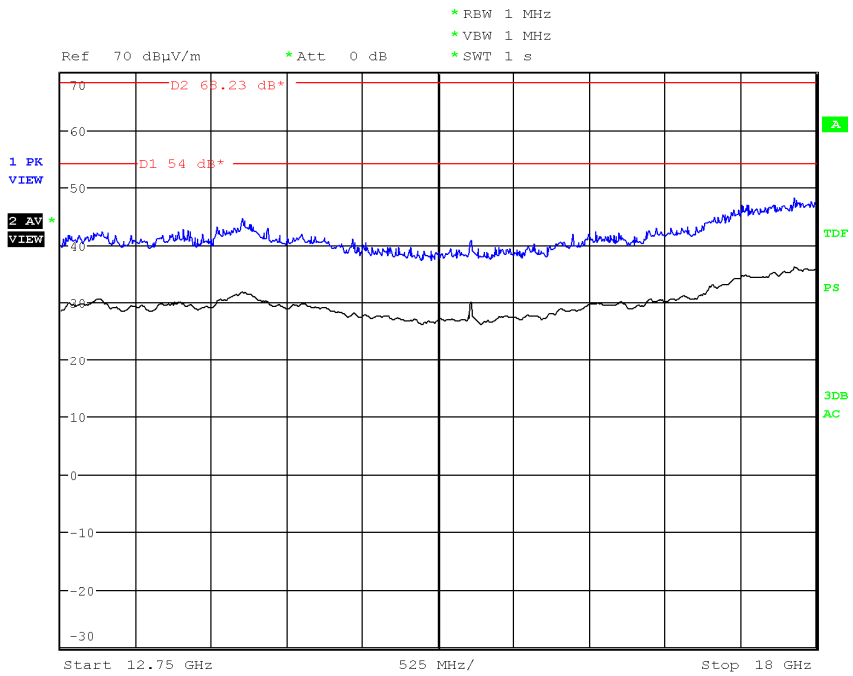


Highest  frequency 5240 MHz.



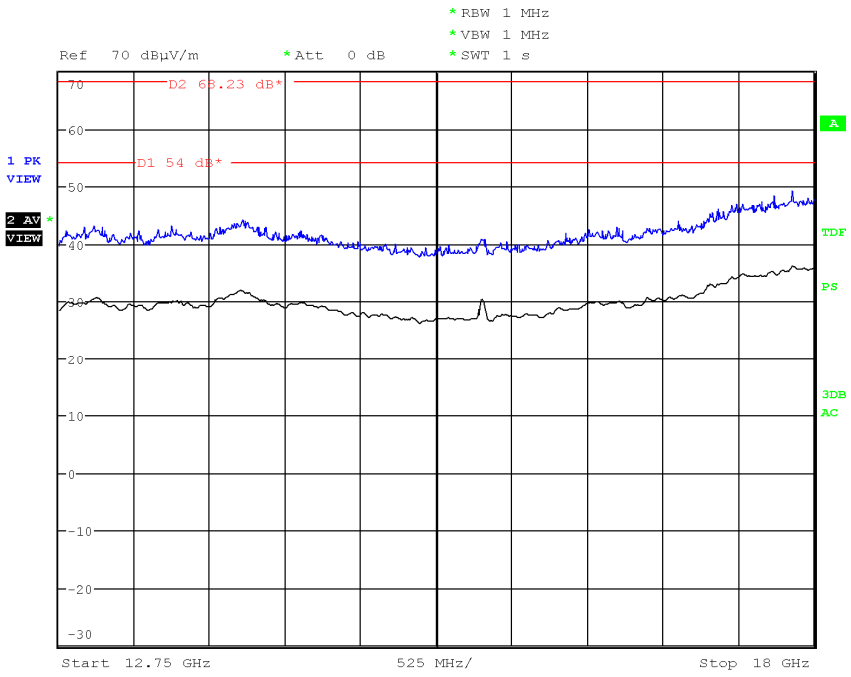

2. WiFi 5GHz 802.11 n20 mode

Middle frequency 5200 MHz.



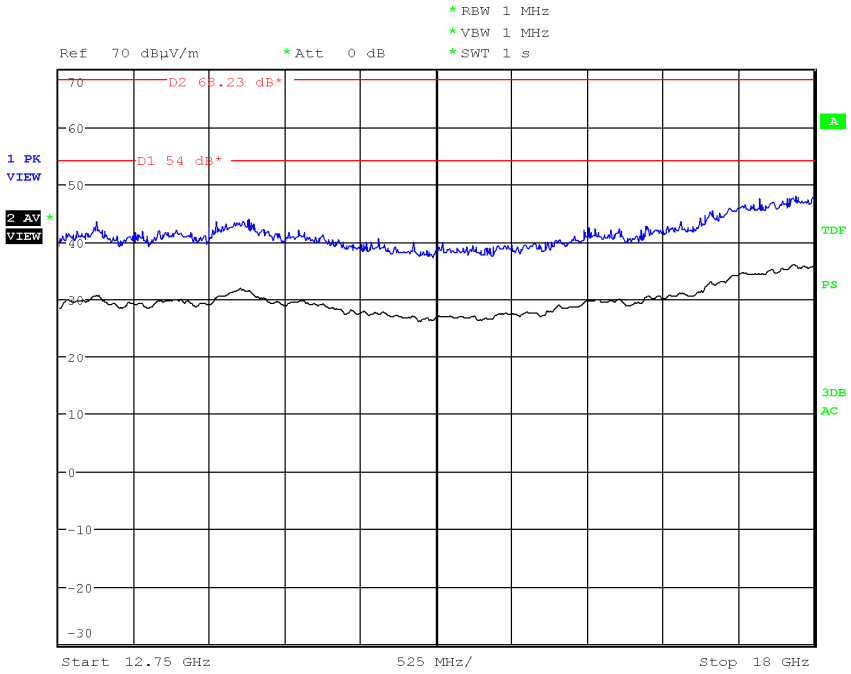
3. WiFi 5GHz 802.11 n40 mode

Highest frequency 5230 MHz.




4. WiFi 5GHz 802.11 ac80 mode

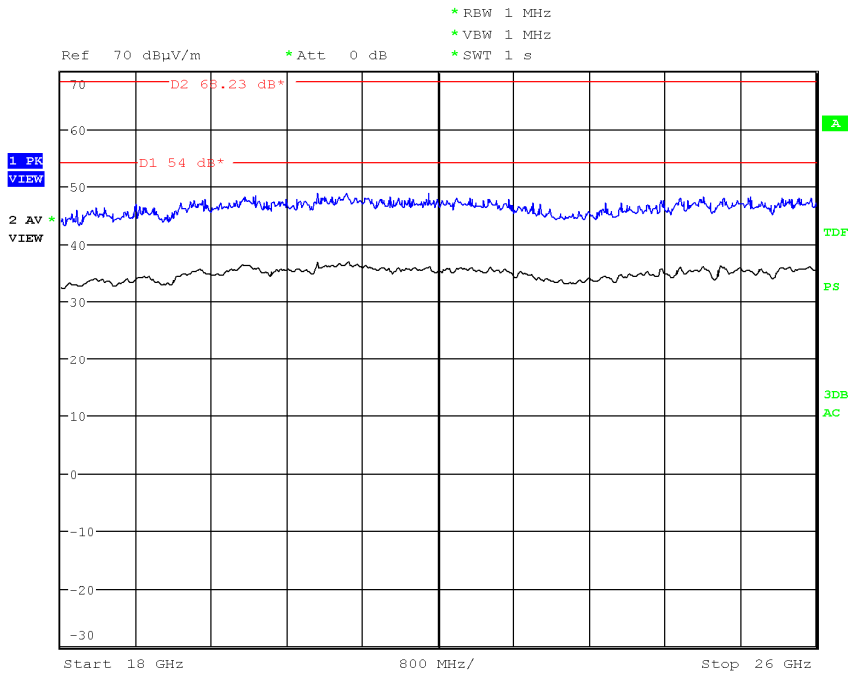
Middle frequency 5210 MHz.



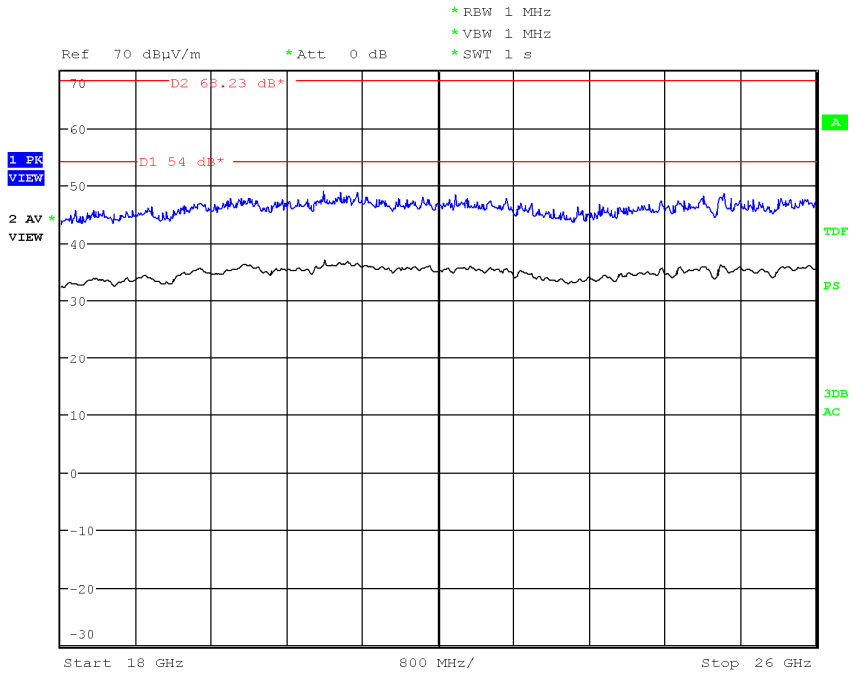
**FREQUENCY RANGE 18 GHz to 26 GHz.**

1. WiFi 5GHz 802.11 a mode

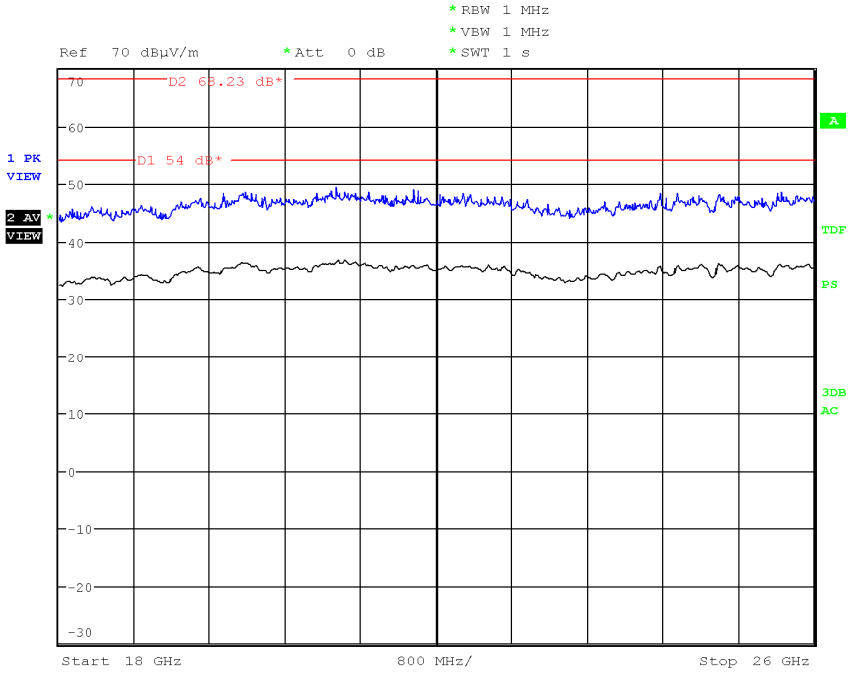
Lowest frequency 5180 MHz.




Middle frequency 5200 MHz.

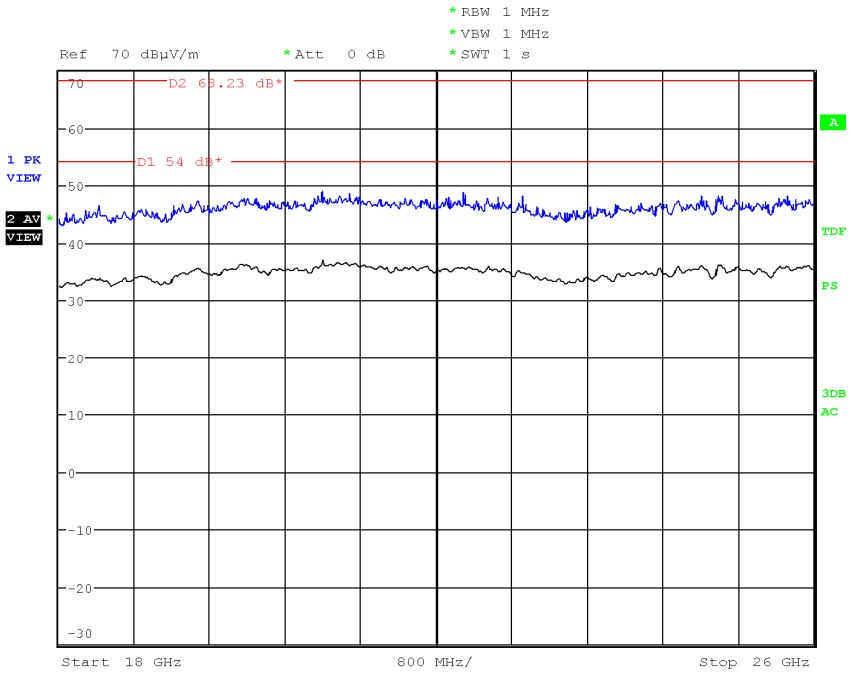


Highest frequency 5240 MHz.



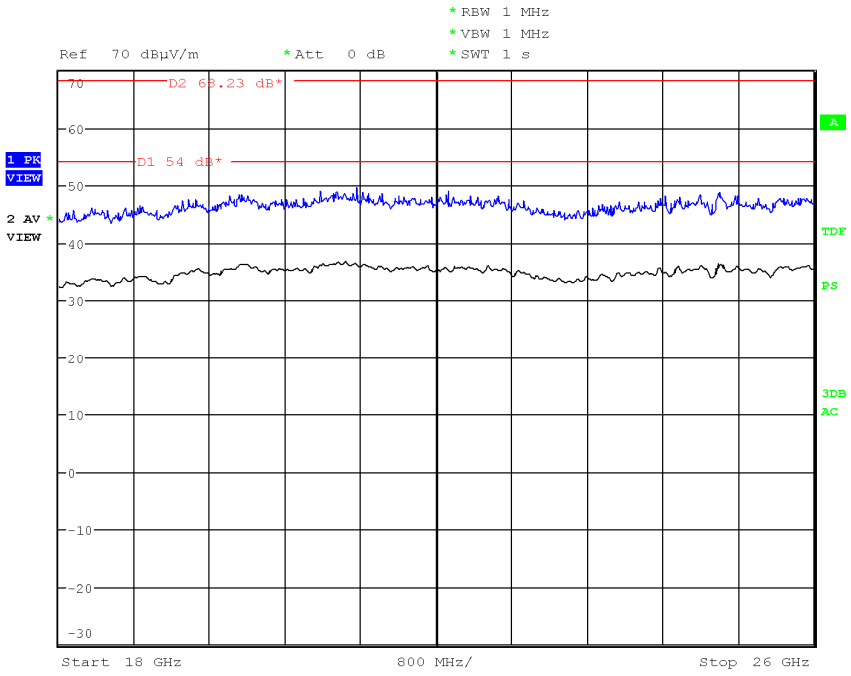

2. WiFi 5GHz 802.11 n20 mode

Middle frequency 5200 MHz.



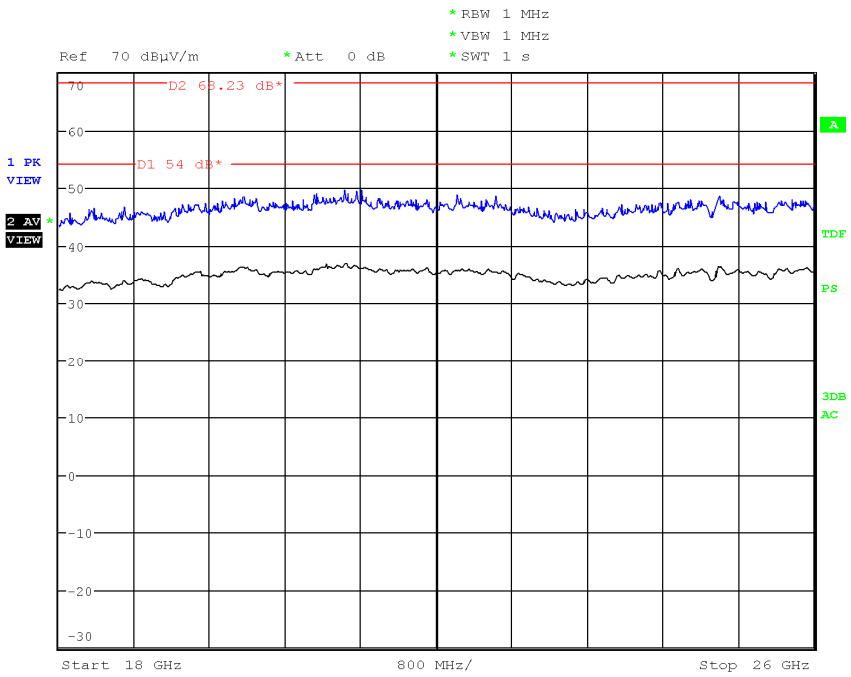
3. WiFi 5GHz 802.11 n40 mode

Lowest frequency 5190 MHz.



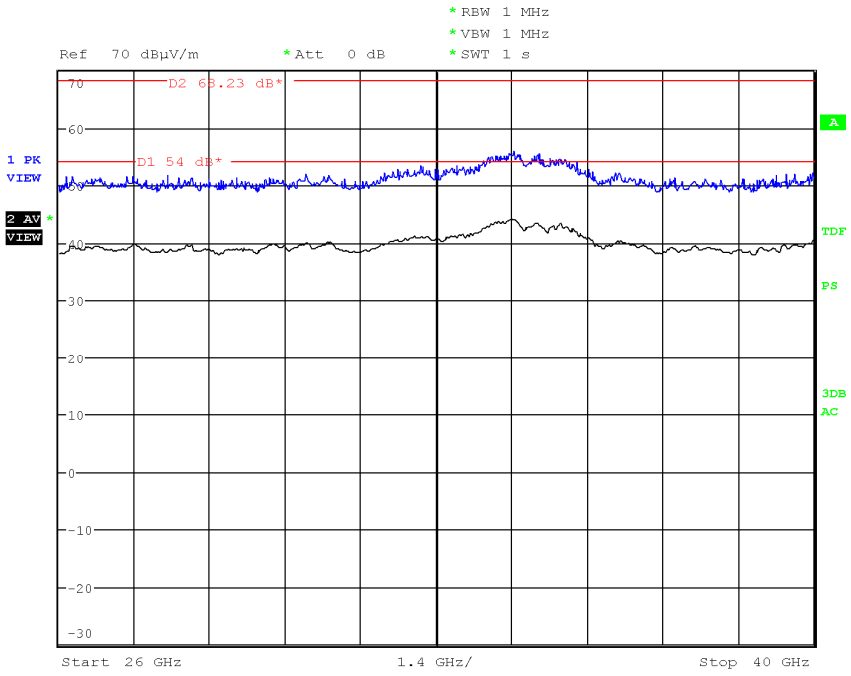

4. WiFi 5GHz 802.11 ac80 mode

Middle frequency 5210 MHz.



**FREQUENCY RANGE 26 GHz 40GHz.**

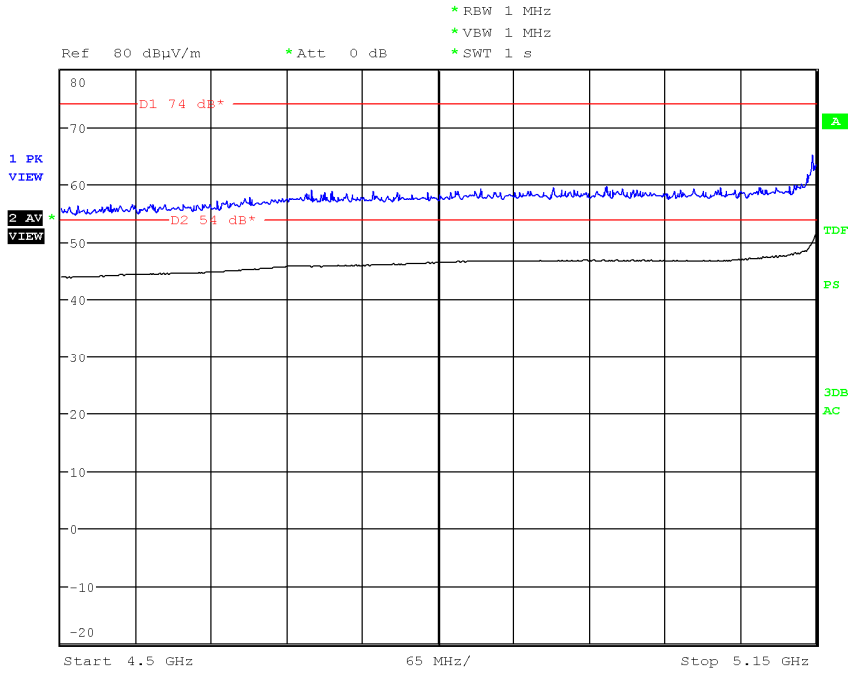
No spurious signals were found in all modulations and channels tested.



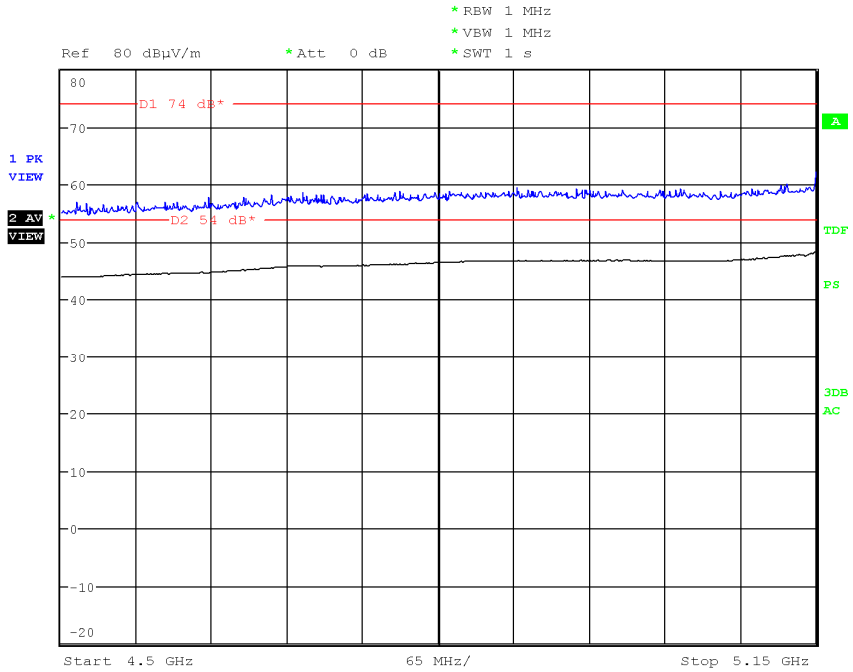
**Radiated spurious emissions at band-edges and inside restricted band 4.5 – 5.15 GHz.**

1. WiFi 5GHz 802.11 a mode

Lowest frequency 5180 MHz.

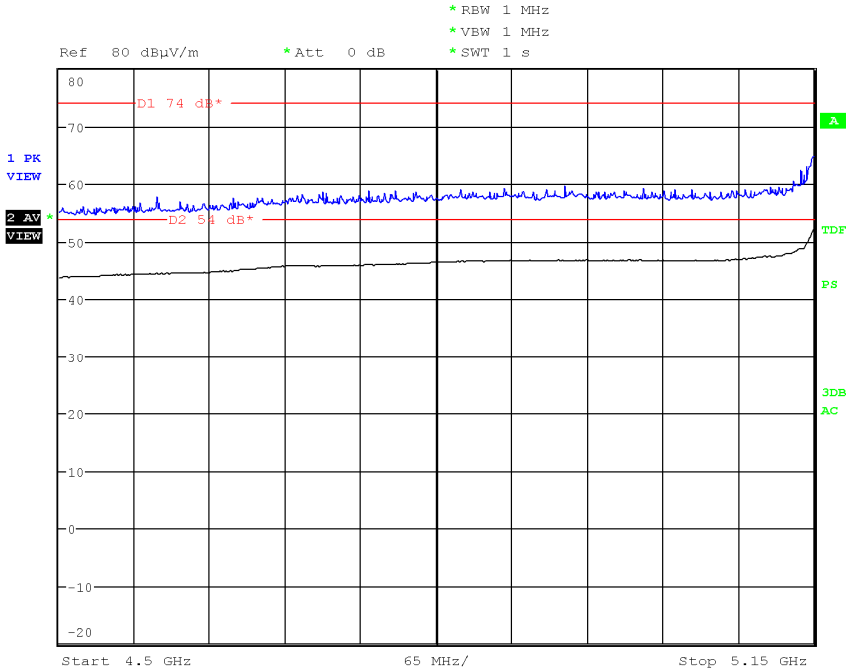



Middle frequency 5200 MHz.

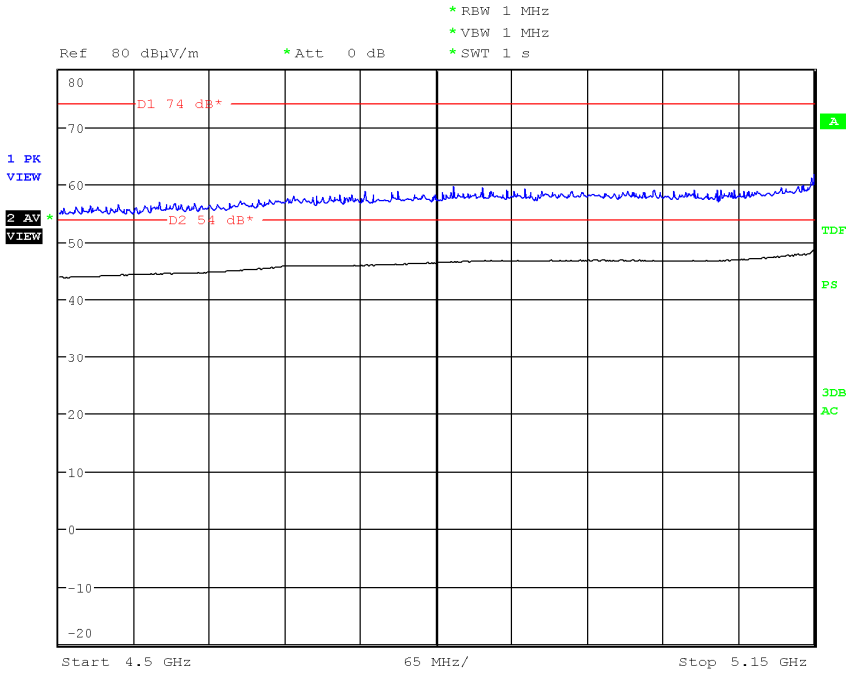


2. WiFi 5GHz 802.11 n20 mode

Lowest frequency 5180 MHz.

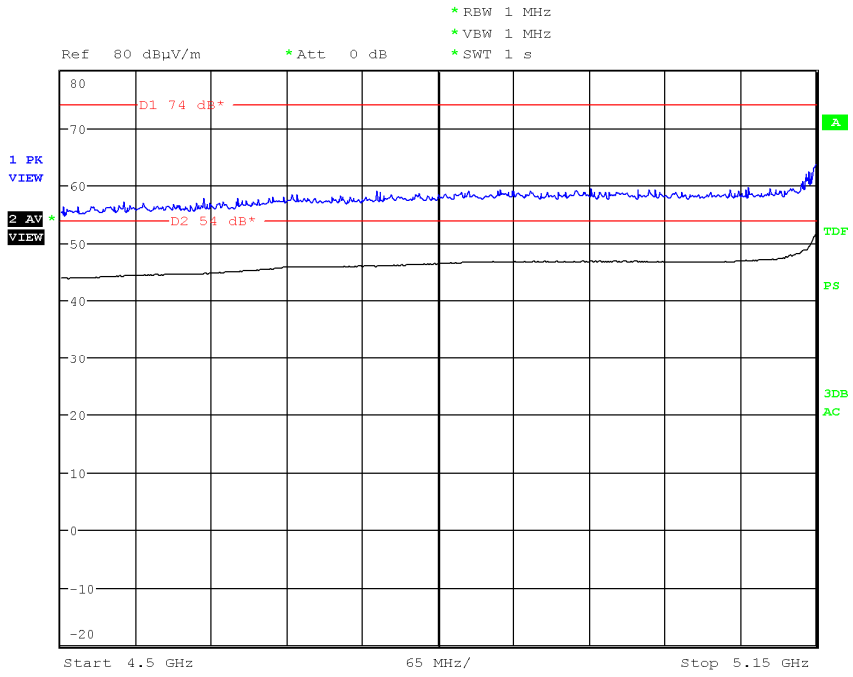



Middle frequency 5200 MHz.

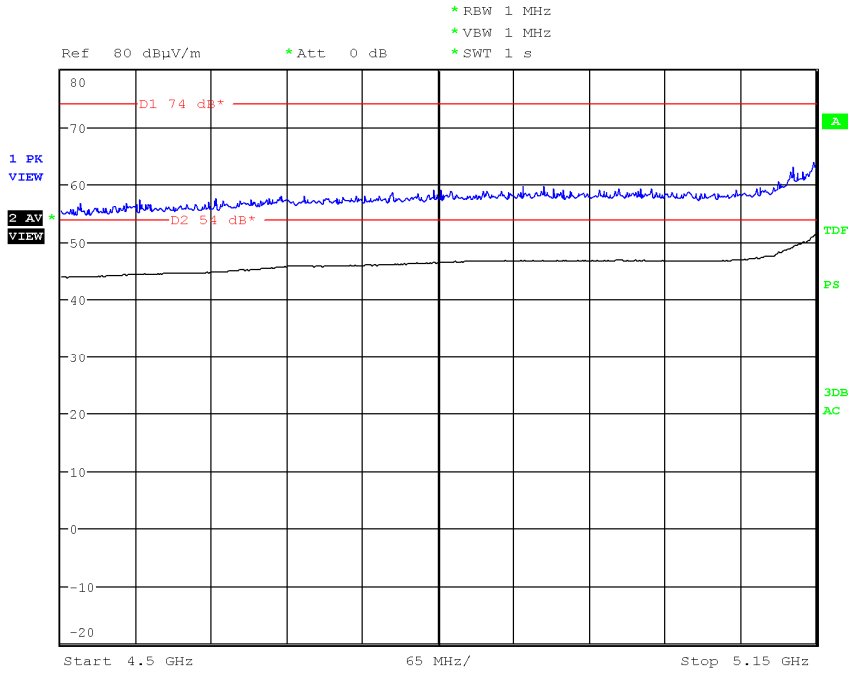


3. WiFi 5GHz 802.11 n40 mode

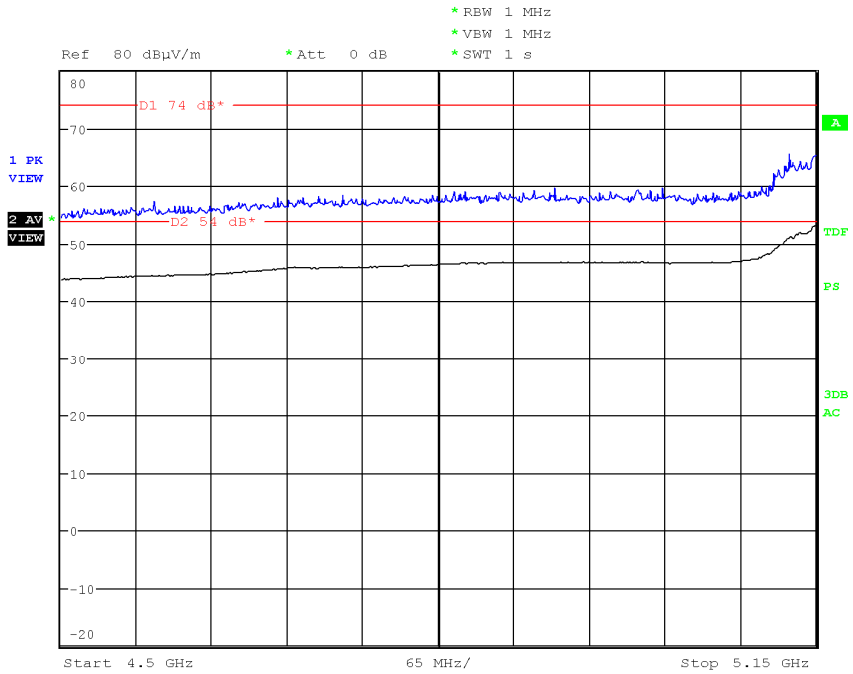
Lowest frequency 5190 MHz.




Highest Channel 5230MHz



4. WiFi 5GHz 802.11 ac80 mode



# APPENDIX B: Test results for 5.25 GHz – 5.35 GHz band

**INDEX**

## TEST CONDITIONS

Power supply (V):

$V_{nominal}$ = 3.3 Vdc

Type of power supply = DC voltage from HMC/NGFC test board.

Type of antenna = External attachable PIFA antenna.

Declared Gain for antenna = 3.7 dBi

**Operating frequencies in the sub-band 5.25-5.35 GHz.**

-For IEEE 802.11a, the equipment uses channels 52, 56, 60, 64.

-For IEEE 802.11n, there are two bandwidths:

For 20 MHz bandwidth the equipment uses channels 52, 56, 60, 64.
For 40 MHz bandwidth the equipment uses channels 54, 62.

-For IEEE 802.11ac, there are three bandwidths:

For 20 MHz bandwidth the equipment uses channels 52, 56, 60, 64.
For 40 MHz bandwidth the equipment uses channels 54, 62.
For 80 MHz bandwidth the equipment uses channel 58.

**TEST FREQUENCIES:**

For WiFi a/n20/ac20:

Lowest channel (52): 5260 MHz

Middle channel (60): 5300 MHz

Highest channel (64): 5320 MHz

For WiFi n40/ac40:

Lowest channel (54): 5270 MHz

Highest channel (62): 5310 MHz

For WiFi ac80:

Middle channel (58): 5290 MHz

The test set-up was made in accordance to the general provisions of ANSI C63.4: 2009 and FCC KDB 789033 D01 General UNII Test Procedures v01r03.

For 802.11a mode the EUT can only transmit at MAIN RF output.

For 802.11n/ac modes 802.11n20/ac20 (20 MHz channel bandwidth), 802.11n40/ac40 (40MHz channel bandwidth) and 802.11ac80 (80MHz channel bandwidth) mode the EUT can only transmit at MAIN RF output.

For radio testing purposes the card was installed in a test fixture. The test fixture is connected to a laptop computer and dc power supplied. The laptop computer was used to configure the EUT to continuously transmit at a specified output power with different modes and modulation schemes.

The data rates of 6Mb/s for 802.11a, HT0 for 802.11n20/ac20 and n40/ac40, and VHT0 for 802.11 ac80 were selected based on preliminary testing that identified those rates corresponding to the worst cases for output power and spurious levels at the band edges.

The field strength at the band edges was evaluated for each mode and on each chain individually on the lowest and highest channels at the rated power for the channel under test. Where the power at the edge channels was lower than the power at the center channels additional measurements were made at the adjacent channels.

The PC was using the Intel test utility DRTU Version DRTU 1.6.1.628.

During transmitter test the EUT was being controlled by the Intel DRTU tool to operate in a continuous transmit mode on the test channels as required and in each of the different modulation modes.

The conducted RF output power at MAIN RF output 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 calibrated average power meter. Measured values for adjustment were within -0.2 dB/+0.3 dB respect to the Target values.

**RF conducted output power target values**

| | Mode | BW (MHz) | Channel / Freq (MHz). | Power level at Main RF output (dBm) |
|---|---|---|---|---|
| **5.25-5.35GHz Band** | 802.11a | 20 | 52 / 5260 | 16,5 |
| | | | 56 / 5280 | 16,5 |
| | | | 60 / 5300 | 16,5 |
| | | | 64 / 5320 | 14,5 |
| | 802.11n | 20 | 52 / 5260 | 16,5 |
| | | | 56 / 5280 | 16,5 |
| | | | 60 / 5300 | 16,5 |
| | | | 64 / 5320 | 14,5 |
| | 802.11n* | 40 | 54 / 5270 | 10,5 |
| | | | 62 / 5310 | 12 |
| | 802.11ac | 80 | 58 / 5290 | 11,5 |

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is connected to the spectrum analyzer using low loss RF cables with sma type connectors. The reading in the spectrum analyzer is corrected taking into account the cable loss.

RADIATED MEASUREMENTS

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 1m for the frequency range 1 GHz-40 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

For radiated emissions in the range 1 GHz-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The equipment under test was set up on a non-conductive (wooden) platform one meter above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º.

Measurements were made in both horizontal and vertical planes of polarization.

## 99 % and 26 dB Bandwidth

RESULTS

**1. 802.11a mode** (see next plots).

| | Lowest frequency 5260 MHz | Middle frequency 5300 MHz | Highest frequency 5320 MHz |
|---|---|---|---|
| 99% bandwidth (MHz) | 19.850 | 20.450 | 18.550 |
| 26 dB bandwidth (MHz) | 33.900 | 34.254 | 28.597 |
| Measurement uncertainty (kHz) | ±21.7 | | |

**2. 802.11 n20 MHz and 802.11 ac 20 MHz modes.** (see next plots).

| | Lowest frequency 5260 MHz | Middle frequency 5300 MHz | Highest frequency 5320 MHz |
|---|---|---|---|
| 99% bandwidth (MHz) | 20.400 | 21.500 | 19.350 |
| 26 dB bandwidth (MHz) | 34.125 | 38.255 | 30.692 |
| Measurement uncertainty (kHz) | ±21.7 | | |

Note: the test was performed with 802.11 n20 MHz mode which is the same modulation scheme as 802.11 ac 20 MHz.

**3. 802.11 n40 MHz and 802.11 ac 40 MHz modes.** (see next plots).

| | Lowest frequency 5270 MHz | Highest frequency 5310 MHz |
|---|---|---|
| 99% bandwidth (MHz) | 36.500 | 36.600 |
| 26 dB bandwidth (MHz) | 44.184 | 45.162 |
| Measurement uncertainty (kHz) | ±21.7 | |

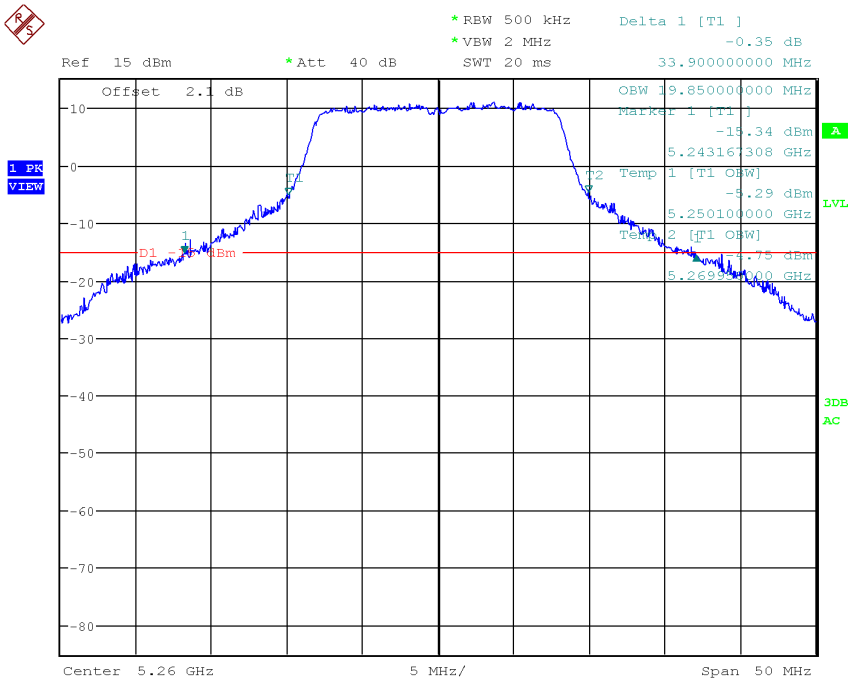
Note: the test was performed with 802.11 n40 MHz mode which is the same modulation scheme as 802.11 ac 40 MHz.

**4. 802.11 ac 80 MHz mode.** (see next plots).

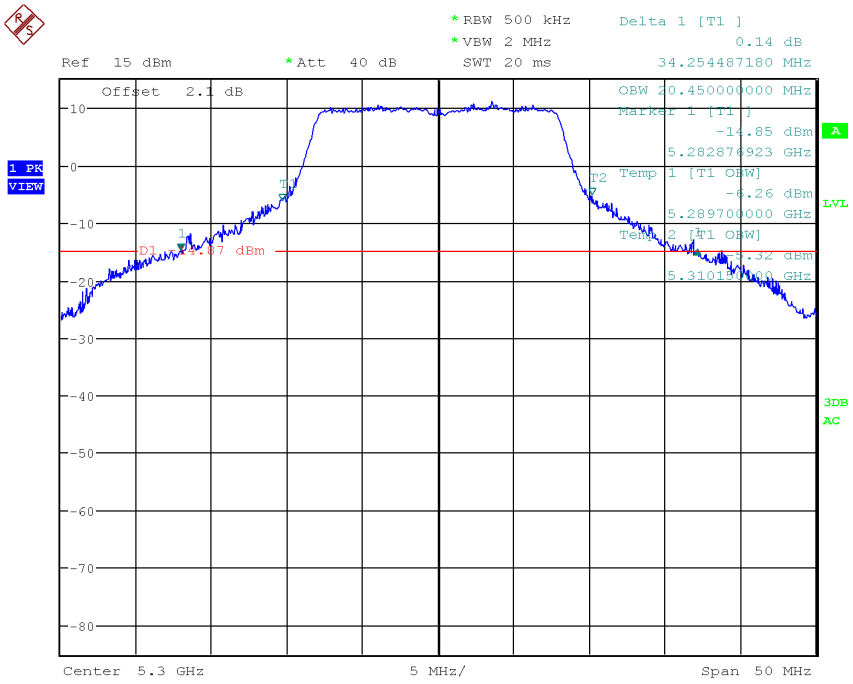
| | Frequency<br>5290 MHz |
|---|---|
| 99% bandwidth (MHz) | 75.150 |
| 26 dB bandwidth (MHz) | 102.771 |
| Measurement uncertainty (kHz) | ±21.7 |

**802.11a mode**

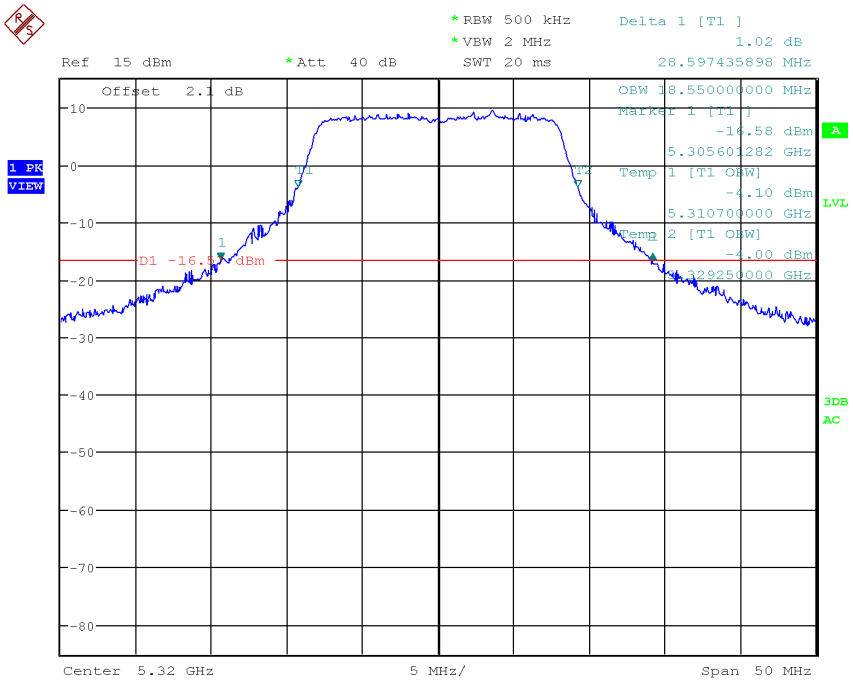
Lowest Channel



Middle Channel

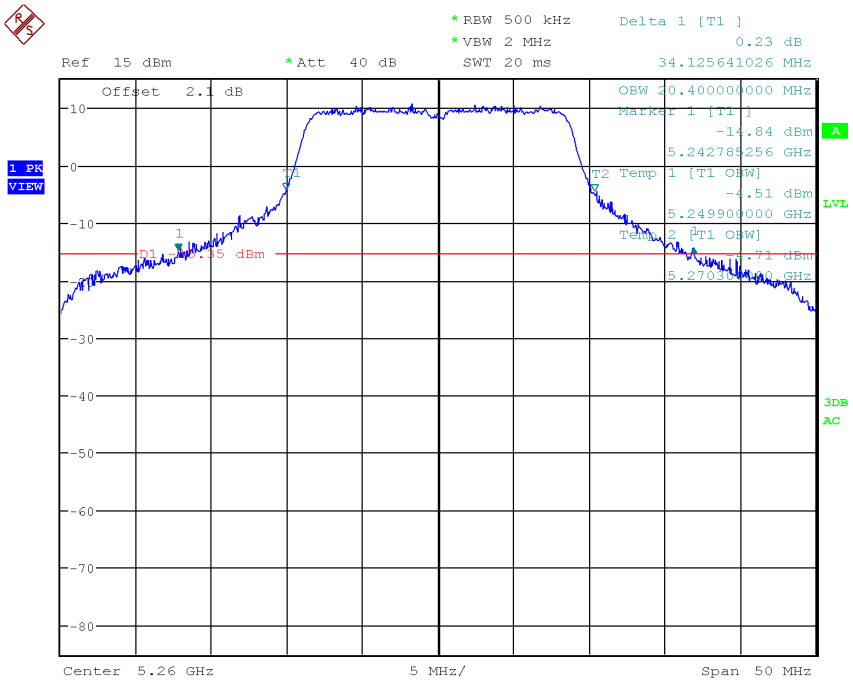



Highest Channel

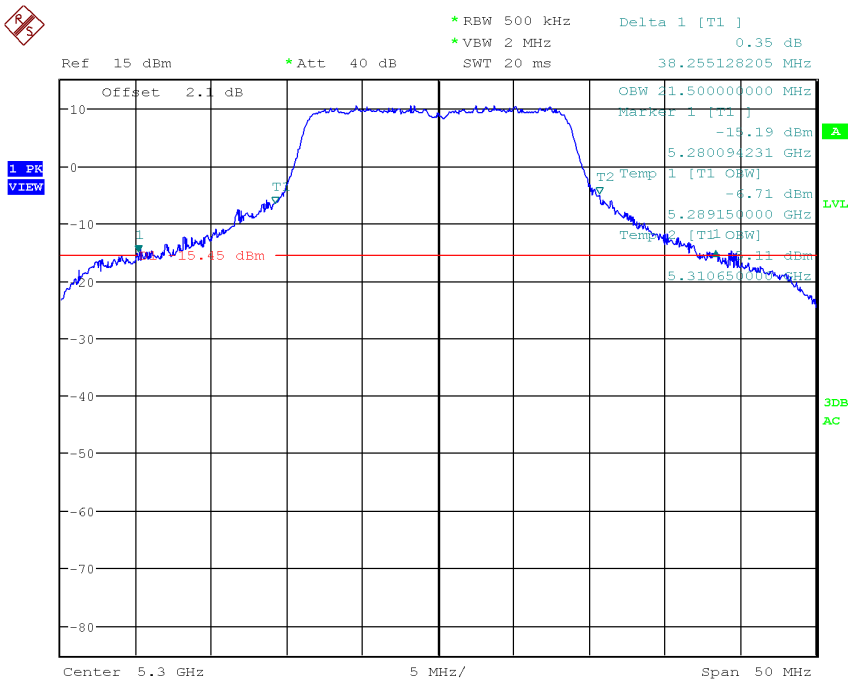


**802.11 n20 MHz and 802.11 ac 20 MHz modes**

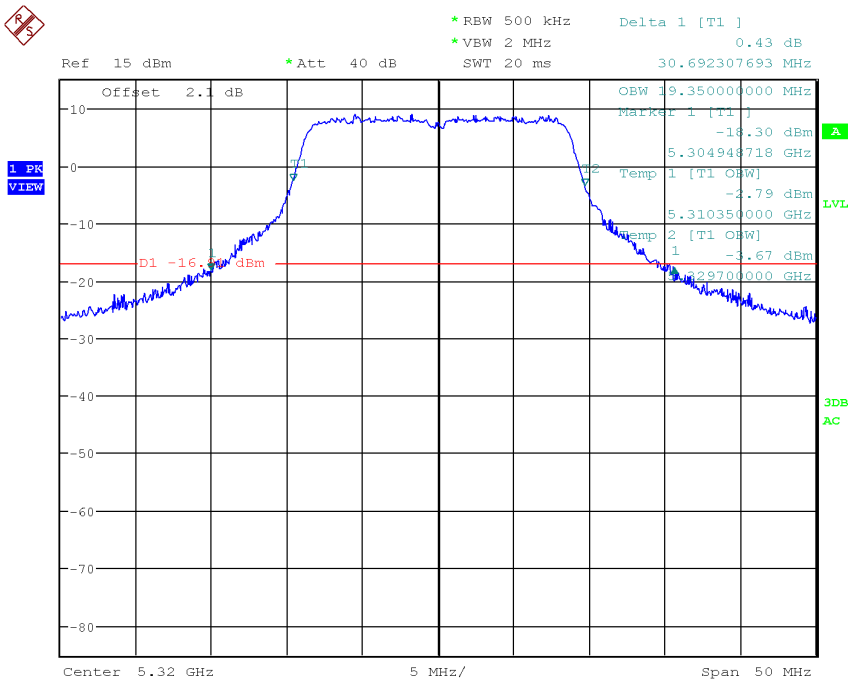
Lowest Channel




Middle Channel

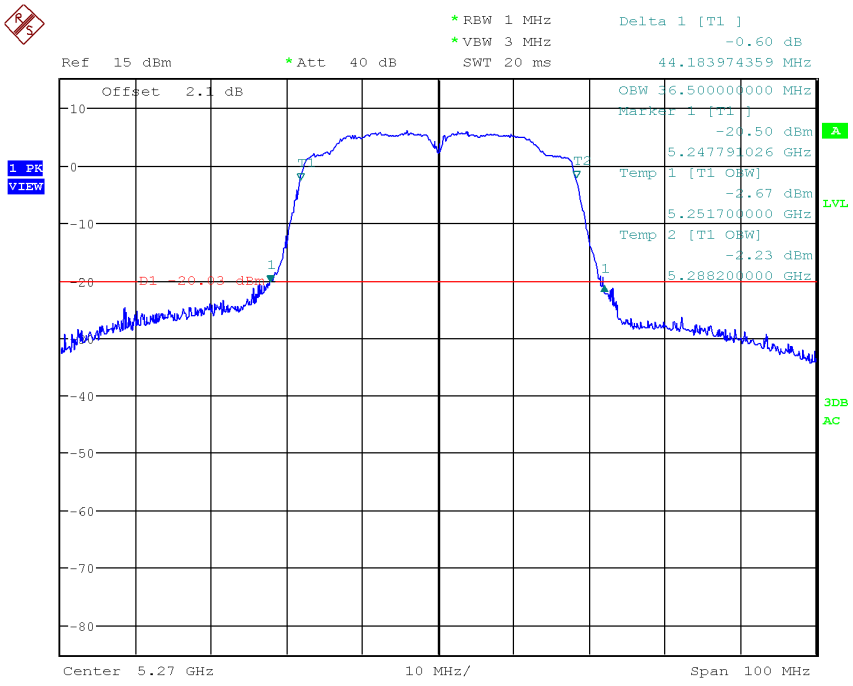


Highest Channel

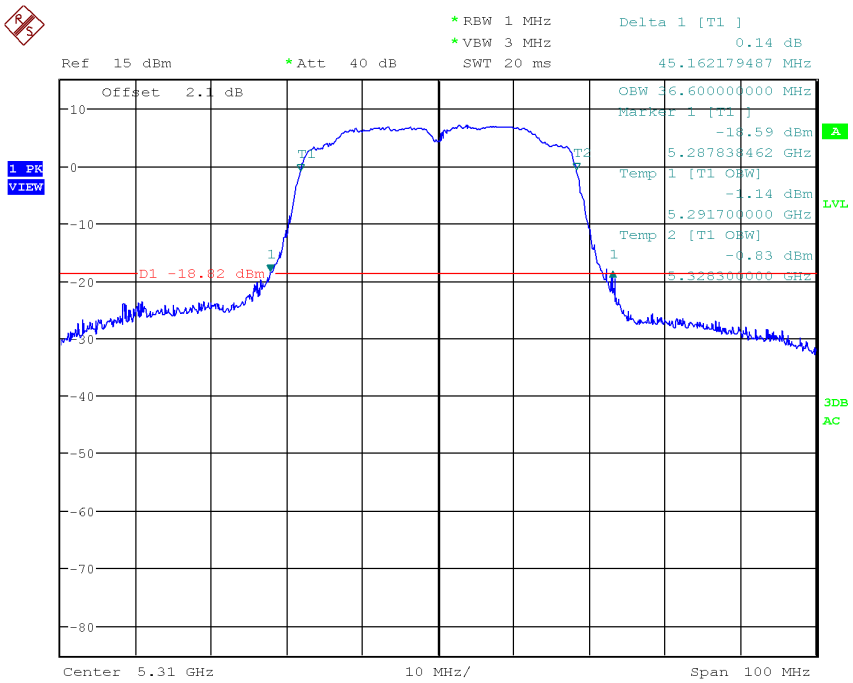



## 802.11 n40 MHz and 802.11 ac 40 MHz modes

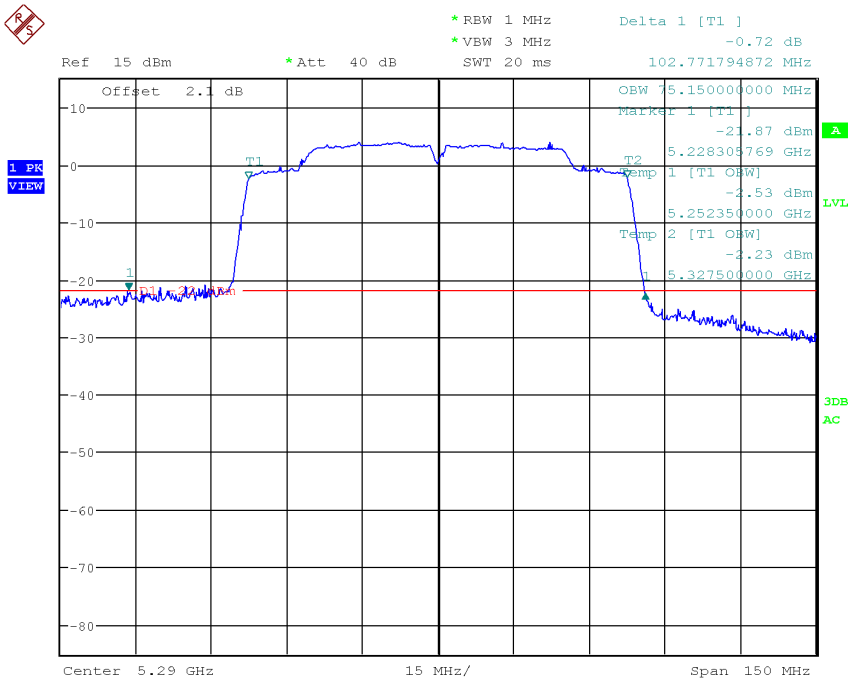
Lowest Channel



Highest Channel




## 802.11 ac 80 MHz mode



**Section 15.407 Subclause (a) (2) / RSS-210 A9.2. (2). Maximum output power, Peak power spectral density and antenna gain**

SPECIFICATION

FCC 15.407: 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 (23.98 dBm) or 11 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. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS-210: The maximum conducted output power shall not exceed 250 mW (23.98 dBm) or 11 + 10 log10 B, dBm, whichever power is less. The power spectral density shall not exceed 11dBm in any 1.0 MHz band. The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10log B, dBm, whichever power is less. B is the 99% emission bandwidth in MHz.

Within the emission bandwidth, when the peak spectral density per MHz over any continuous transmission exceeds the average (10 log10 B) value by more than 3 dB, the permissible power spectral density shall be reduced by the excess amount.

RESULTS

The maximum conducted output power was measured using the channel power integration method according to point E) 2) b) (Method SA-1) of Guidance 789033 D01.

The peak power spectral density (PPSD) was measured using the method according to point F) (Method SA-1) of Guidance 789033 D01.

The e.i.r.p. levels are calculated by adding the declared maximum antenna gain (dBi).

**1. 802.11a mode** (see next plots).

Maximum declared antenna gain = 3.7 dBi

| Frequency | PPSD/MHz (dBm) | PPSD/MHz e.i.r.p. (dBm) | Maximum conducted output power (dBm) | Maximum output power e.i.r.p. (dBm) |
|---|---|---|---|---|
| 5260 MHz | 5.27 | 8.97 | 16.25 | 19.95 |
| 5300 MHz | 5.29 | 8.99 | 16.33 | 20.03 |
| 5320 MHz | 3.07 | 6.77 | 14.14 | 17.84 |

Measurement uncertainty = ±1.5 dB

Verdict: Pass

**2. 802.11 n20 MHz and 802.11 ac 20 MHz modes.** (see next plots).

Note: the test was performed with 802.11 n20 MHz mode which is the same modulation scheme as 802.11 ac 20 MHz.

Maximum declared antenna gain = 3.7 dBi

| Frequency | PPSD/MHz (dBm) | PPSD/MHz e.i.r.p. (dBm) | Maximum conducted output power (dBm) | Maximum output power e.i.r.p. (dBm) |
|---|---|---|---|---|
| 5260 MHz | 4.84 | 8.54 | 16.12 | 19.82 |
| 5300 MHz | 4.93 | 8.63 | 16.17 | 19.87 |
| 5320 MHz | 2.93 | 6.63 | 14.28 | 17.98 |

Measurement uncertainty = ±1.5 dB

Verdict: Pass

**3. 802.11 n40 MHz and 802.11 ac 40 MHz modes.** (see next plots).

Note: the test was performed with 802.11 n40 MHz mode which is the same modulation scheme as 802.11 ac 40 MHz.

Maximum declared antenna gain = 3.7 dBi

| Frequency | PPSD/MHz (dBm) | PPSD/MHz e.i.r.p. (dBm) | Maximum conducted output power (dBm) | Maximum output power e.i.r.p. (dBm) |
|---|---|---|---|---|
| 5270 MHz | -3.28 | 0.42 | 9.89 | 13.59 |
| 5310 MHz | -1.91 | 1.79 | 11.28 | 14.98 |

Measurement uncertainty = ±1.5 dB

Verdict: Pass

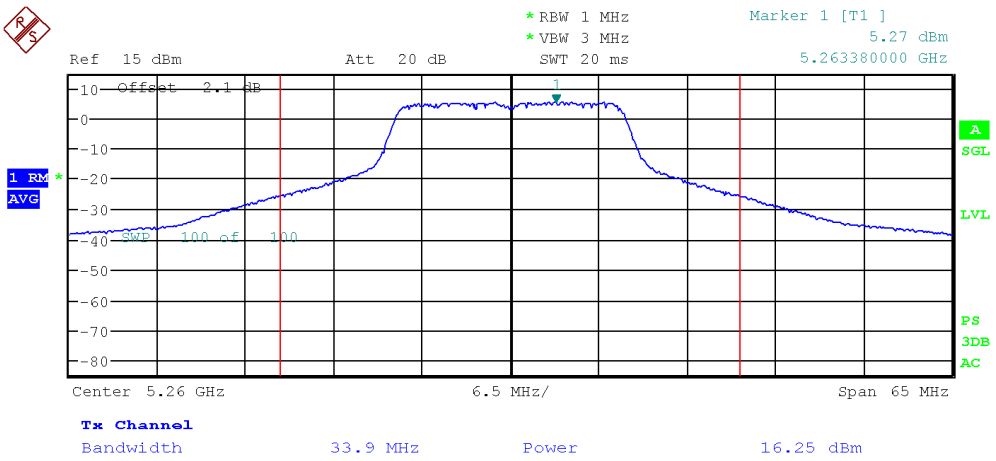
**4. 802.11 ac 80 MHz mode.** (see next plots).

Maximum declared antenna gain = 3.7 dBi

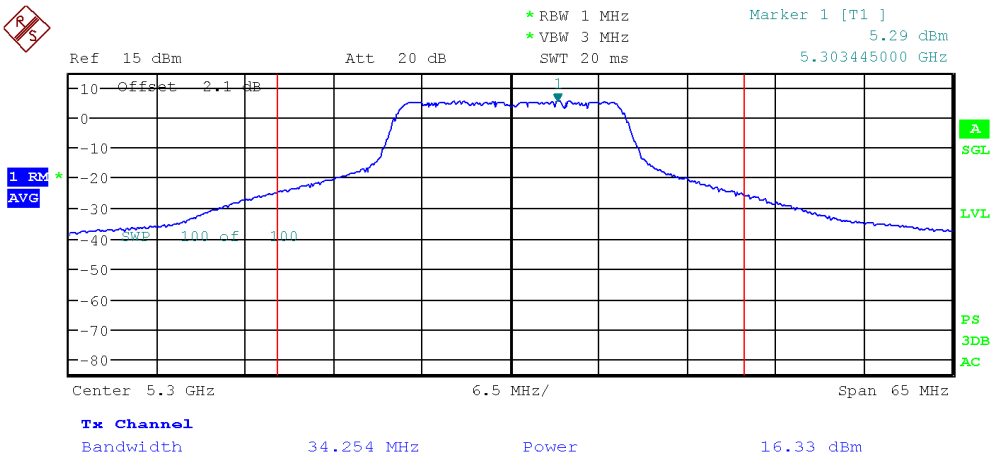
| Frequency | PPSD/MHz (dBm) | PPSD/MHz e.i.r.p. (dBm) | Maximum conducted output power (dBm) | Maximum output power e.i.r.p. (dBm) |
|---|---|---|---|---|
| 5290 MHz | -4.50 | -0.80 | 10.83 | 14.53 |

## 802.11a mode

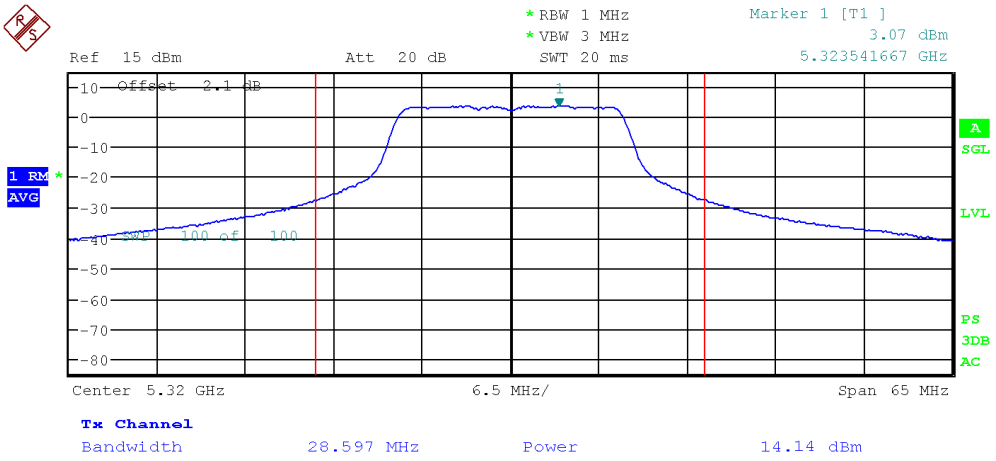
Lowest Channel




Middle Channel

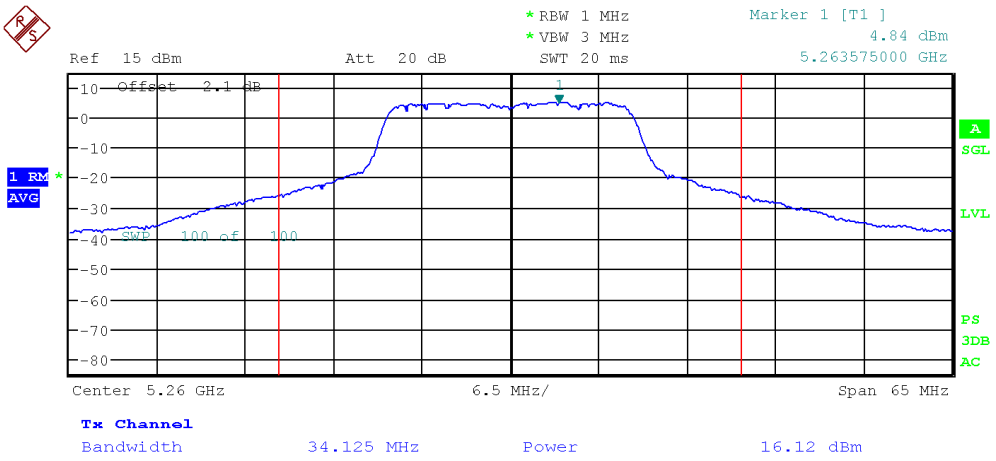


Highest Channel

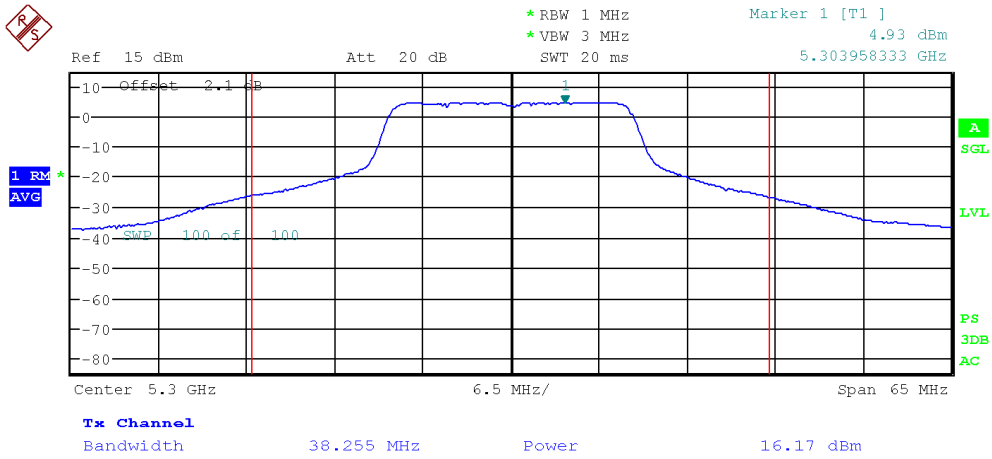



## 802.11 n20 MHz and 802.11 ac 20 MHz modes

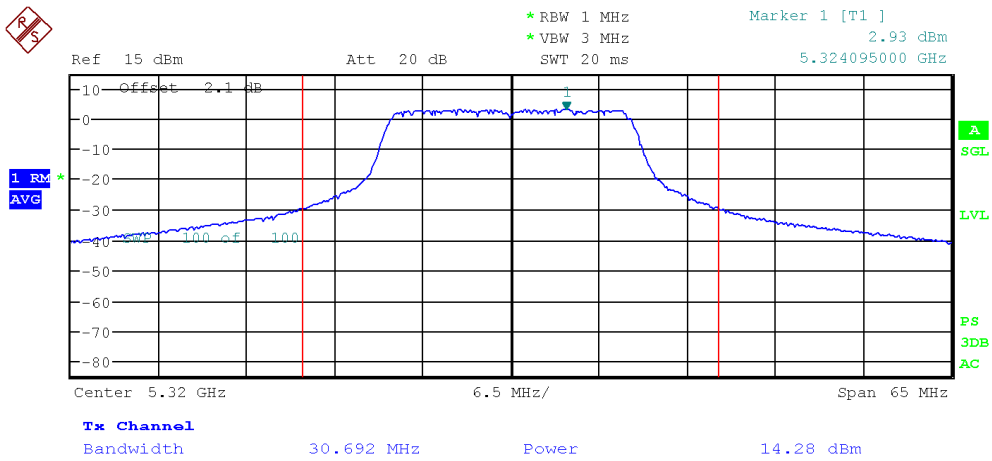
Lowest Channel



Middle Channel

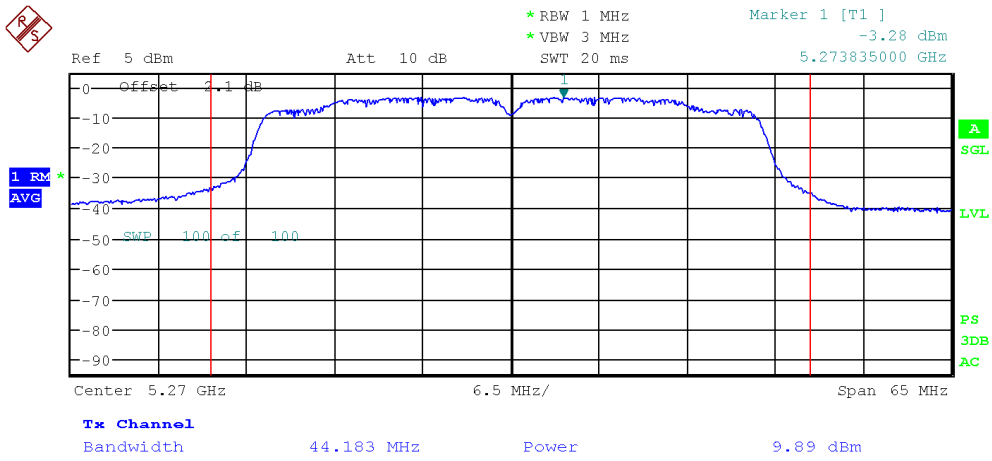



Highest Channel

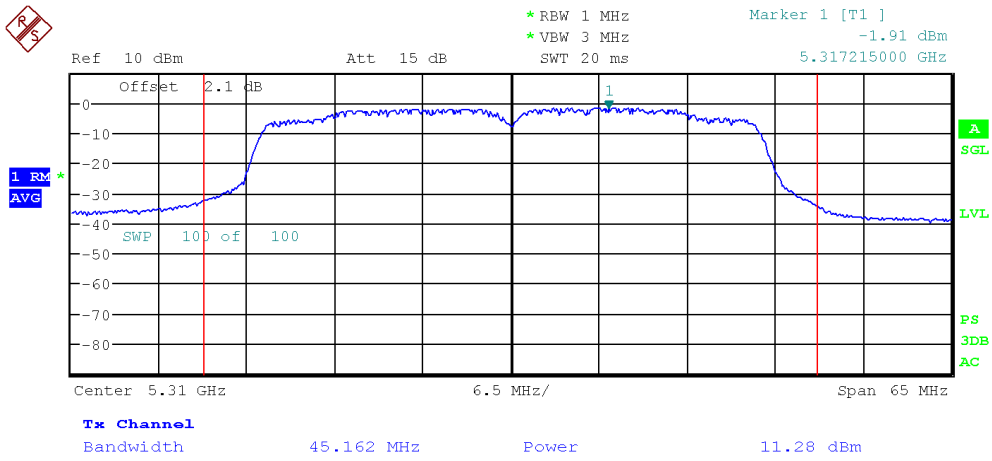


## 802.11 n40 MHz and 802.11 ac 40 MHz modes

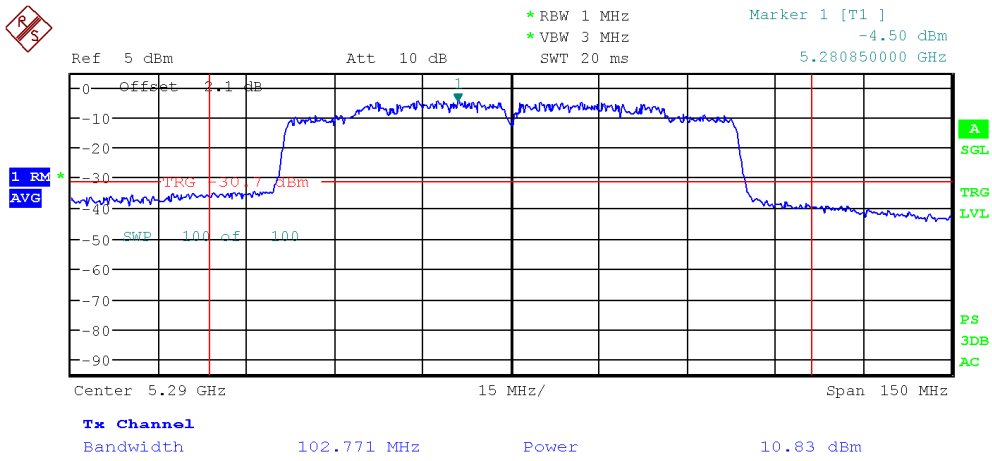
Lowest Channel




Highest Channel



## 802.11 ac 80 MHz mode



**Section 15.407 Subclause (b) (2) / RSS-210 A9.2. (2). Undesirable radiated emissions (Transmitter) 1 to 40 GHz**

SPECIFICATION

For transmitters operating in the 5.25-5.35 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz (68.23 dBµV/m at 3 m distance). Devices operating in the 5.25-5.35 GHz band that generate emissions in the 5.15-5.25 GHz band must meet all applicable technical requirements for operation in the 5.15-5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5.15-5.25 GHz band.

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) (see §15.205(c)):

| Frequency Range (MHz) | Field strength (µV/m) | Field strength (dBµV/m) | Measurement distance (m) |
|---|---|---|---|
| 0.009-0.490 | 2400/F(kHz) | - | 300 |
| 0.490-1.705 | 24000/F(kHz) | - | 300 |
| 1.705 - 30.0 | 30 | - | 30 |
| 30 - 88 | 100 | 40 | 3 |
| 88 - 216 | 150 | 43.5 | 3 |
| 216 - 960 | 200 | 46 | 3 |
| 960 - 40000 | 500 | 54 | 3 |

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.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

All tests were performed in a semi-anechoic chamber at a distance of 1m for the frequency range 1 GHz-40 GHz.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

**Frequency range 30 MHz-1 GHz**

The spurious signals detected do not depend on either the operating channel or the modulation mode.

See test results in Appendix A for details.

**Frequency range 1 GHz-40 GHz**

The results in the next tables show the maximum measured levels in the 1-40 GHz range including the restricted band 5.35-5.46 GHz (see next plots).

For OFDM modulation modes (802.11g, 802.11n20, 802.11n40 and 802.11ac80), a preliminary measurement in the central channel in the range 1-26 GHz was performed to determine the worst case. The lowest and highest channels were measured for out-of-band emissions for the worst case (802.11n20).

The field strength at the band edges was evaluated for each mode and on each chain individually on the lowest and highest channels at the rated power for the channel under test. Where the power at the edge channels was lower than the power at the center channels additional measurements were made at the adjacent channels.

Spurious signals with peak levels above the average limit (54 dBµV/m at 3 m) are measured with average detector for checking compliance with the average limit.

1. WiFi 5GHz 802.11 a mode

Lowest frequency 5260 MHz. Out-of-band spurious emissions in the 1-40 GHz range.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 15.780890 | V | Peak | 43.49 | ± 4.09 |

Middle frequency 5300 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside restricted band 5.35-5.46 GHz.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.46038 | V | Peak | 59.93 | ± 4.09 |
| | | Average | 48.10 | ± 4.09 |
| 10.60680 | V | Peak | 46.60 | ± 4.09 |
| 15.89797 | V | Peak | 41.92 | ± 4.09 |

Highest frequency 5320 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside restricted band 5.35-5.46 GHz.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.46038 | V | Peak | 59.44 | ± 4.09 |
| | | Average | 47.06 | ± 4.09 |
| 21.27998 | V | Peak | 49.73 | ± 4.09 |

Verdict: PASS

2. WiFi 5GHz 802.11 n20 mode.

Lowest frequency 5260 MHz. Out-of-band spurious emissions in the 1-40 GHz range.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 10.520548 | V | Peak | 46.53 | ± 4.09 |
| 15.781111 | V | Peak | 41.77 | ± 4.09 |
| 21.039995 | V | Peak | 49.94 | ± 4.09 |

Middle frequency 5300MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside restricted band 5.35-5.46 GHz.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.46250 | V | Peak | 59.99 | ± 4.09 |
| | | Average | 47.1 | ± 4.09 |
| 10.613654 | V | Peak | 46.94 | ± 4.09 |
| 15.900031 | V | Peak | 42.31 | ± 4.09 |
| 21.19992 | V | Peak | 50.62 | ± 4.09 |

Highest frequency 5320 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside restricted band 5.35-5.46 GHz.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.35019 | V | Peak | 61.51 | ± 4.09 |
| | | Average | 50.51 | ± 4.09 |
| 21.27998 | V | Peak | 51.18 | ± 4.09 |

Verdict: PASS

3. WiFi 5GHz 802.11 n40 mode

Lowest frequency 5260 MHz. Out-of-band spurious emissions inside restricted band 5.35-5.46 GHz.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.46173 | V | Peak | 59.72 | ± 4.09 |
| | | Average | 47.07 | ± 4.09 |

Verdict: PASS

Highest frequency 5310 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside restricted band 5.35-5.46 GHz.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.35192 | V | Peak | 59.81 | ± 4.09 |
| | | Average | 49.44 | ± 4.09 |
| 21.23984 | V | Peak | 50.78 | ± 4.09 |

Verdict: PASS

4. WiFi 5GHz 802.11 ac80 mode

Middle frequency 5290 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside restricted band 5.35-5.46 GHz.

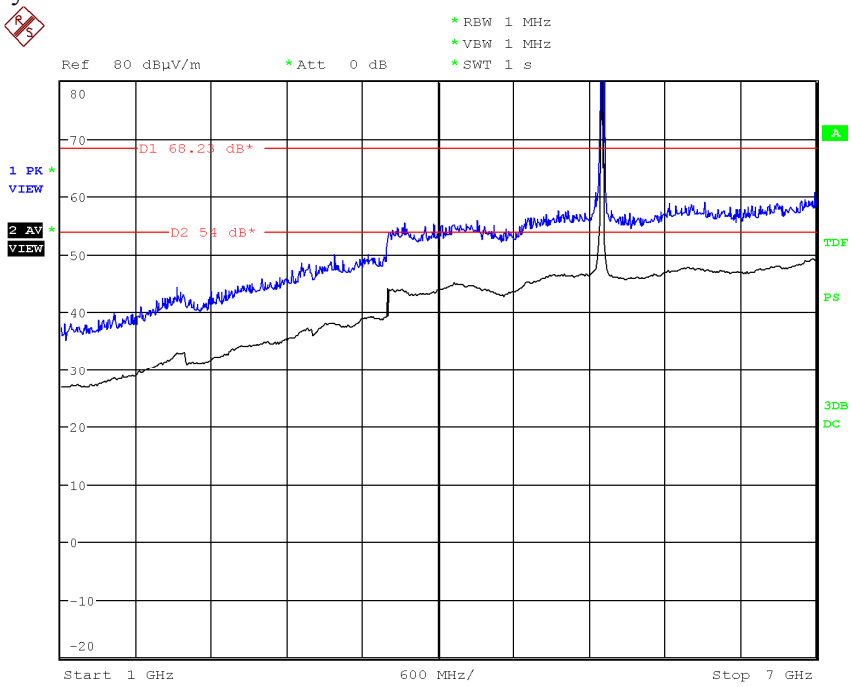
| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.35308 | V | Peak | 60.44 | ± 4.09 |
| | | Average | 50.04 | ± 4.09 |
| 21.15998 | V | Peak | 49.48 | ± 4.09 |

Verdict: PASS

**FREQUENCY RANGE 1 GHz to 7 GHz.**

1. WiFi 5GHz 802.11 a mode

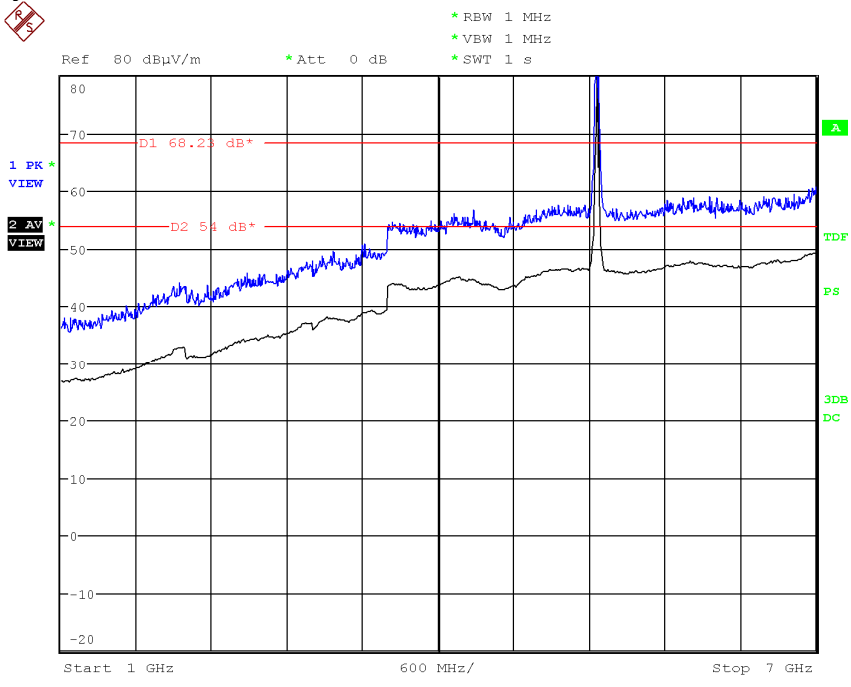
Middle frequency 5300 MHz.




Note: The peak above the limit is the carrier frequency..

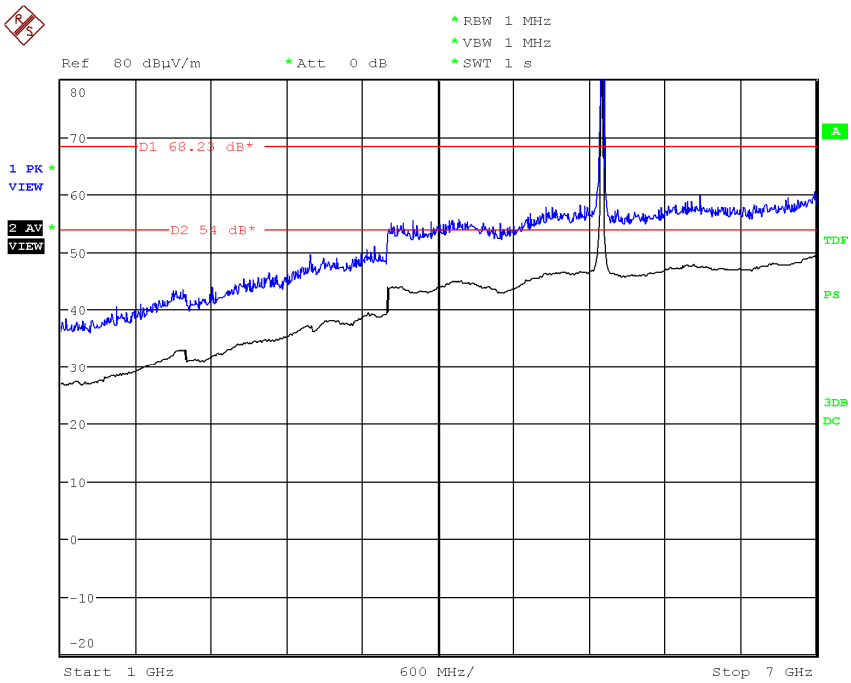
2. WiFi 5GHz 802.11 n20 mode

Lowest frequency 5260 MHz.



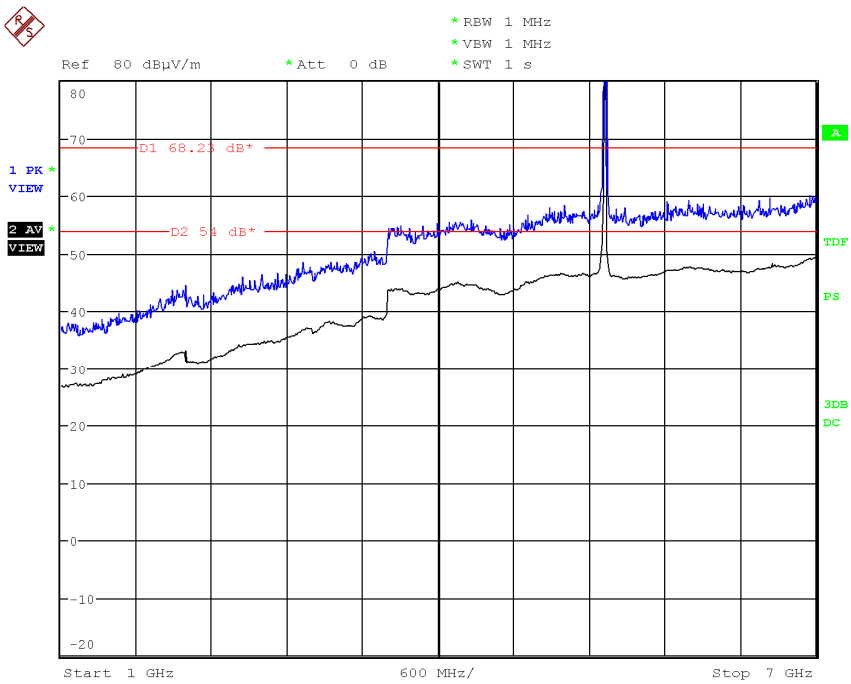

Note: The peak above the limit is the carrier frequency..

Middle frequency 5300 MHz.




Note: The peak above the limit is the carrier frequency..

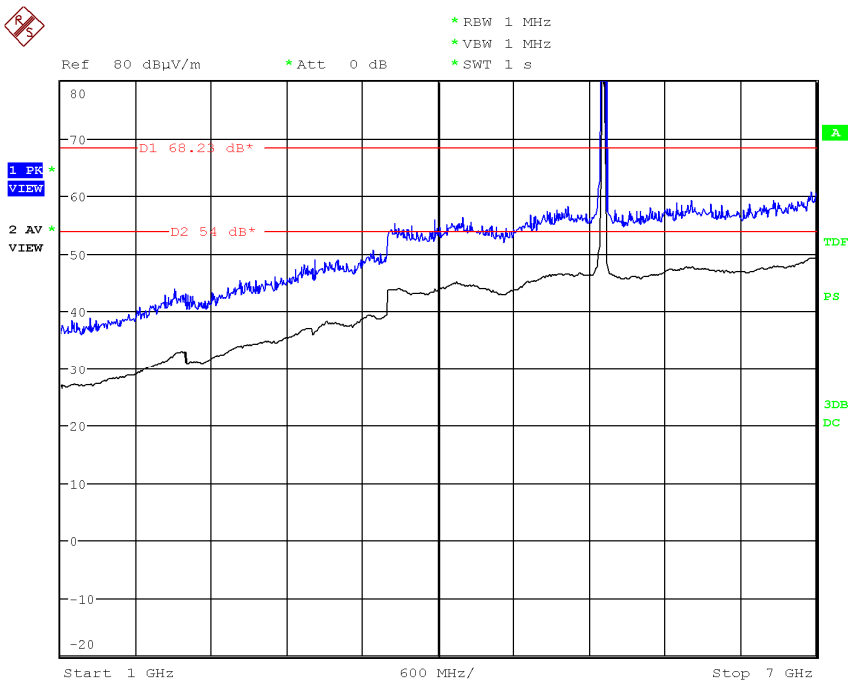
Highest  frequency 5320 MHz.




Note: The peak above the limit is the carrier frequency..

3. WiFi 5GHz 802.11 n40 mode

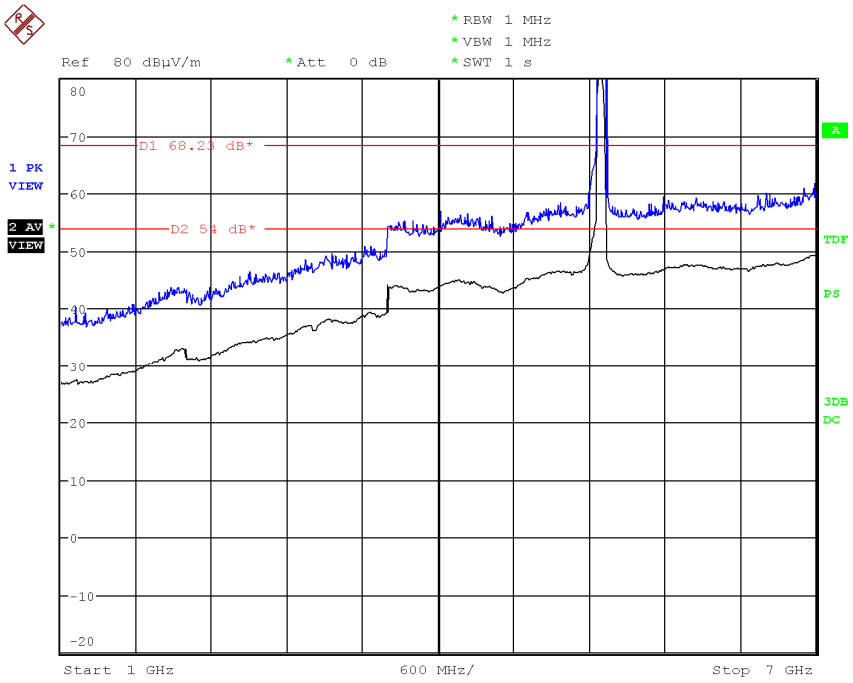
Highest frequency 5310 MHz.




Note: The peak above the limit is the carrier frequency.

4. WiFi 5GHz 802.11 ac80 mode

Middle frequency 5290 MHz.

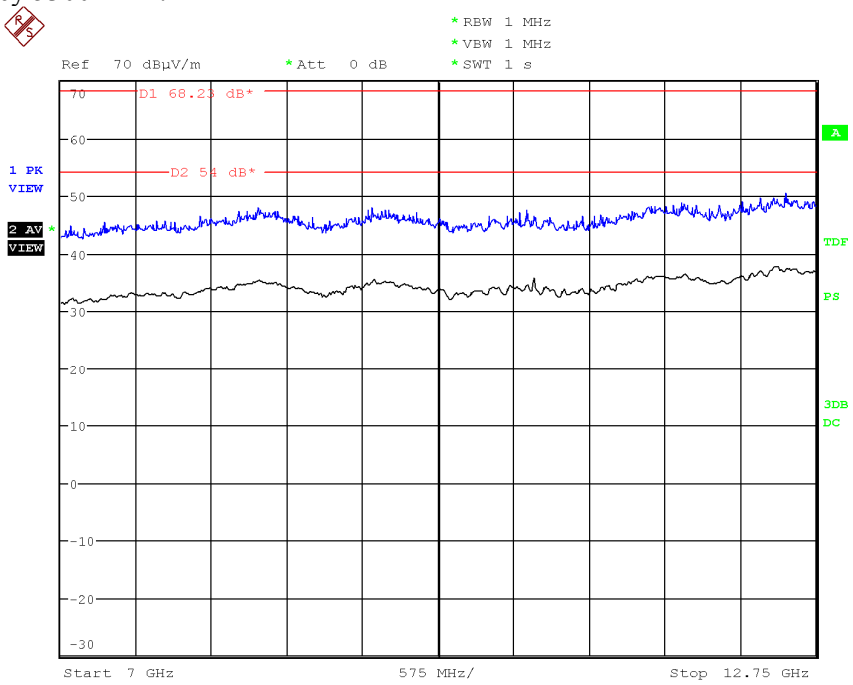



Note: The peak above the limit is the carrier frequency.

**FREQUENCY RANGE 7 GHz to 12.75 GHz.**

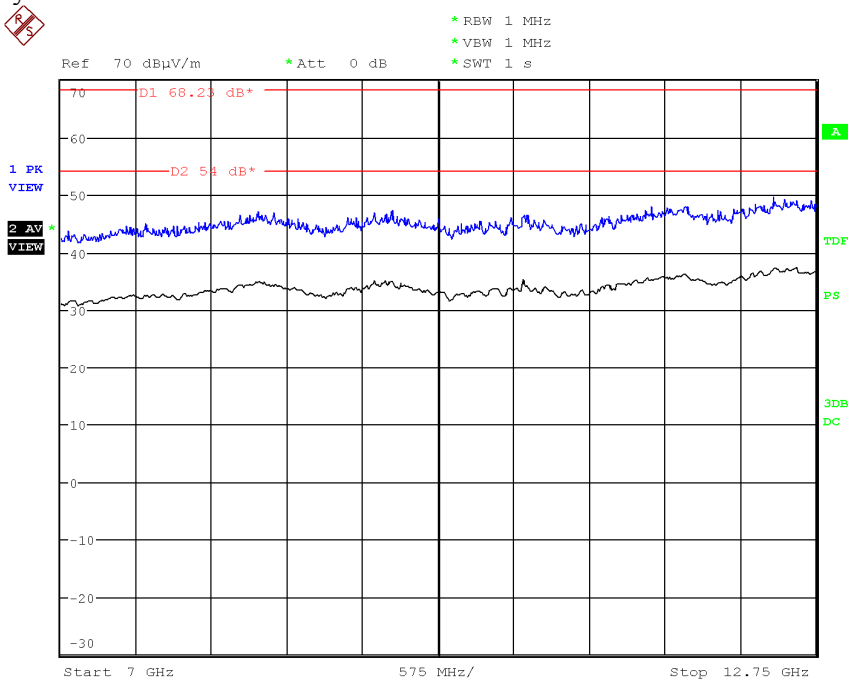
1. WiFi 5GHz 802.11 a mode

Middle frequency 5300 MHz.

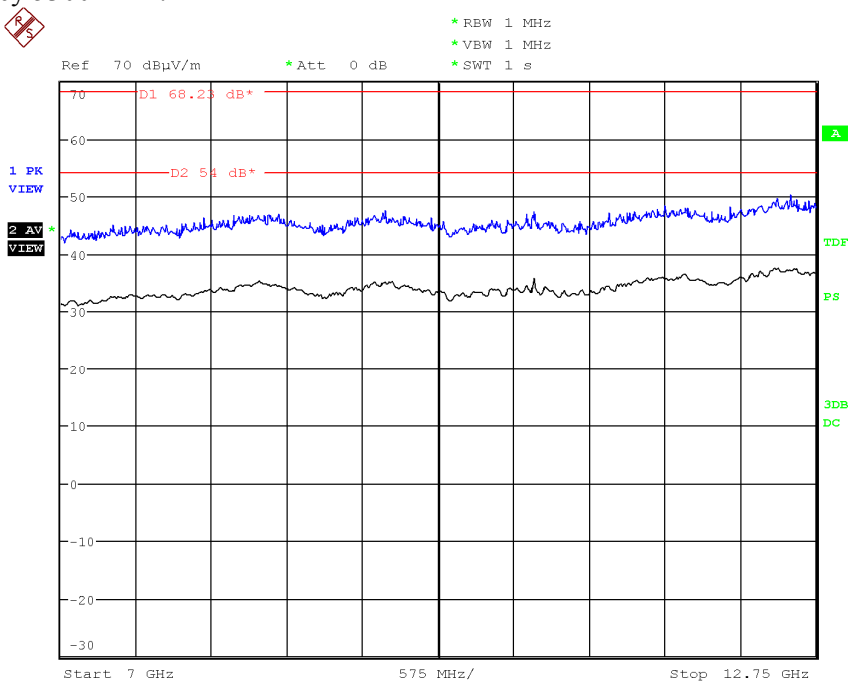



2. WiFi 5GHz 802.11 n20 mode

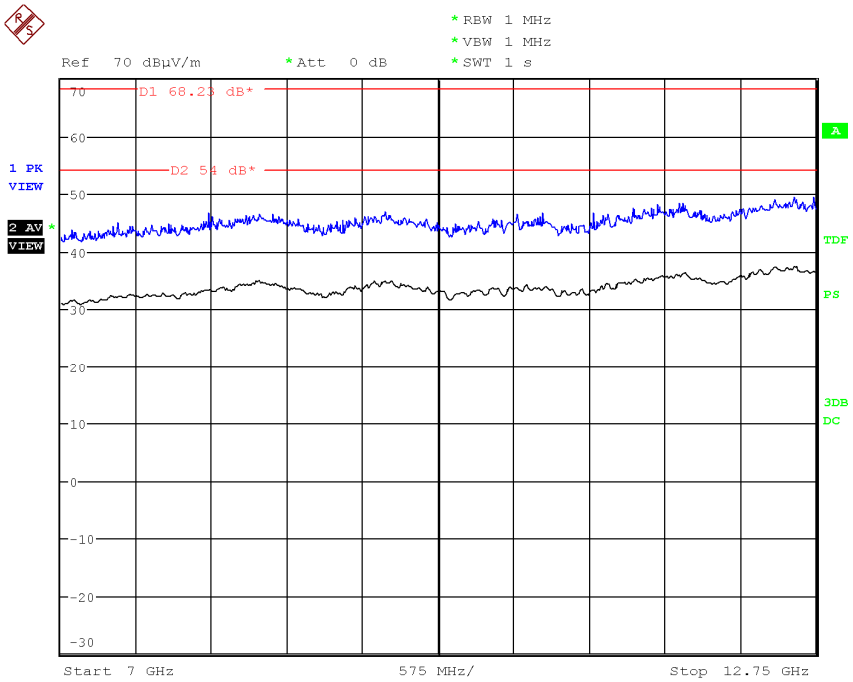
Lowest frequency 5260 MHz.



Middle frequency 5300 MHz.

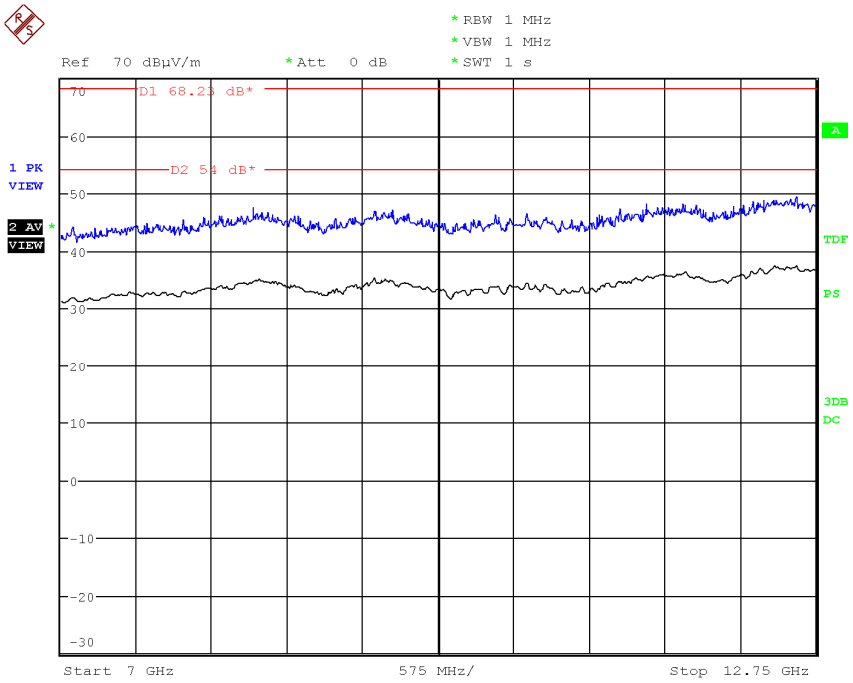



Highest frequency 5320 MHz.



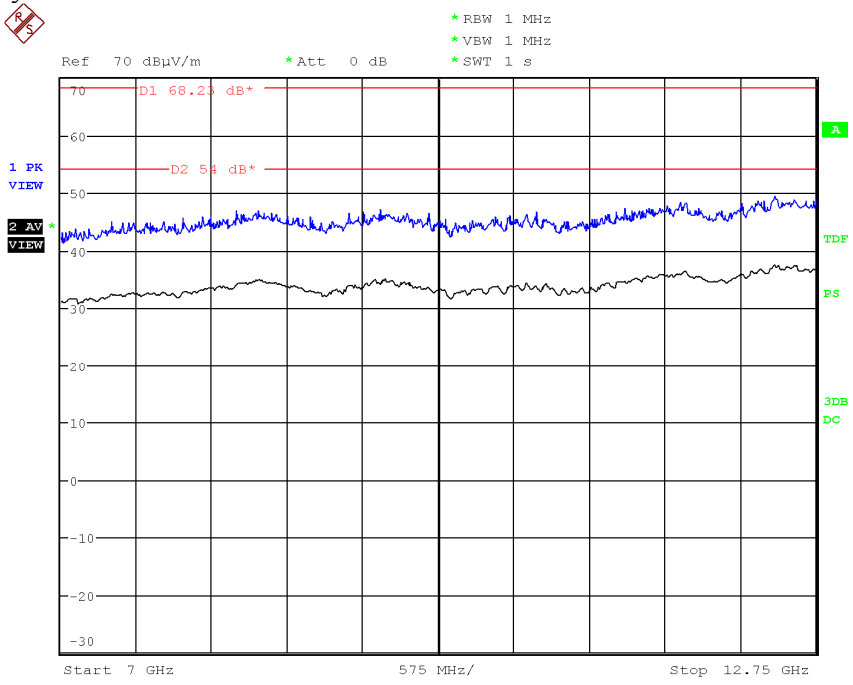
3. WiFi 5GHz 802.11 n40 mode

Highest frequency 5310 MHz.




4. WiFi 5GHz 802.11 ac80 mode

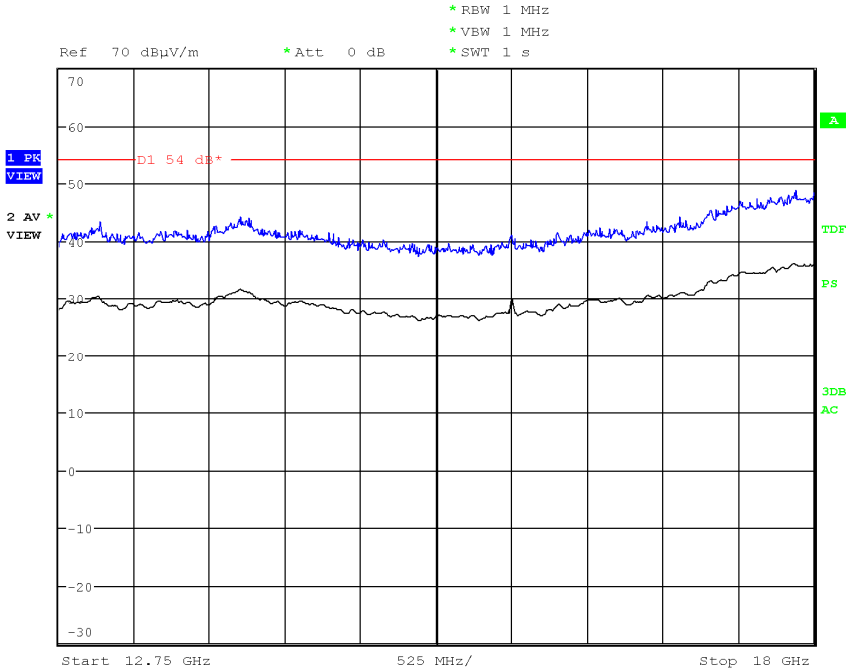
Middle frequency 5290 MHz



**FREQUENCY RANGE 12.75 GHz to 18GHz.**

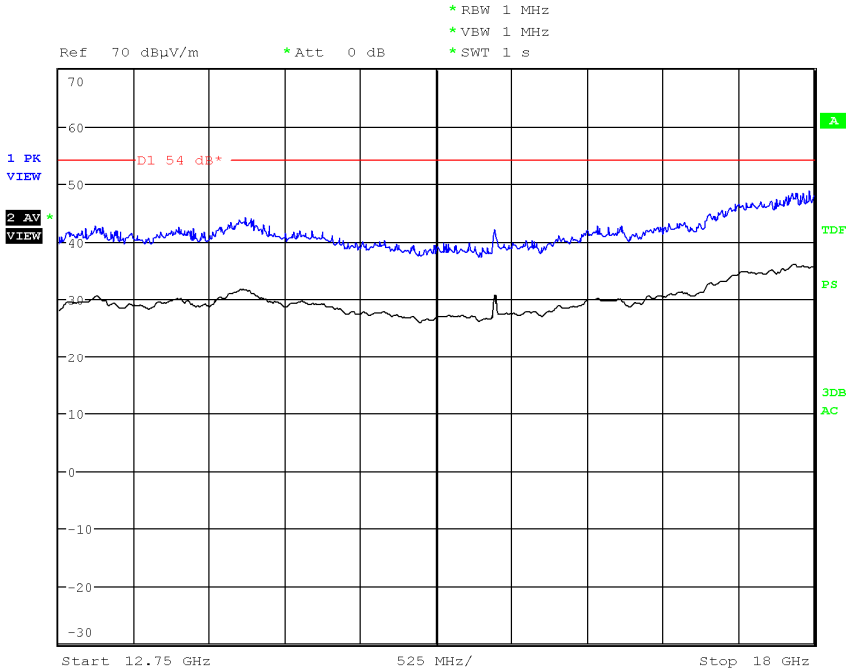
1. WiFi 5GHz 802.11 a mode

Middle frequency 5300 MHz.

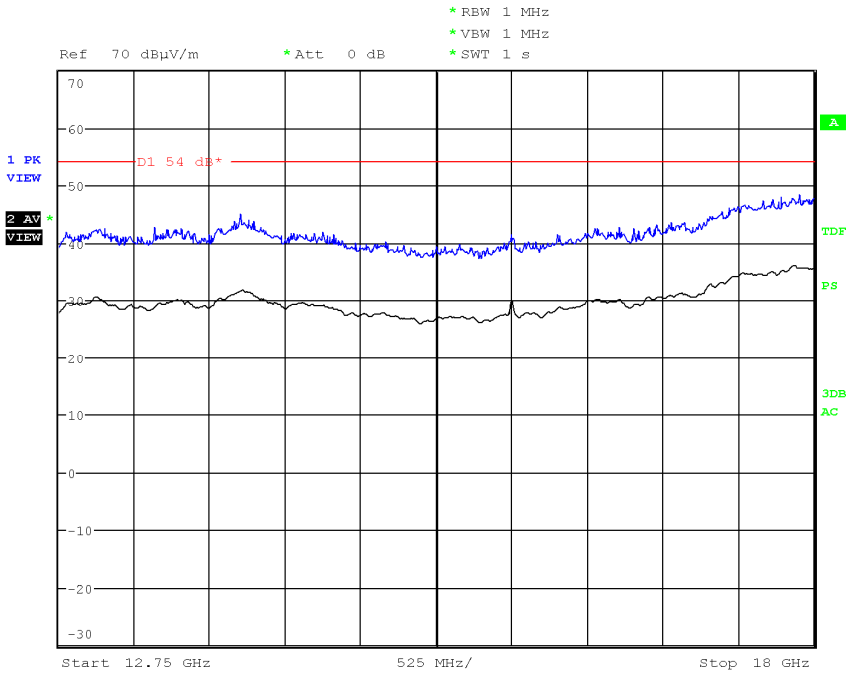



2. WiFi 5GHz 802.11 n20 mode

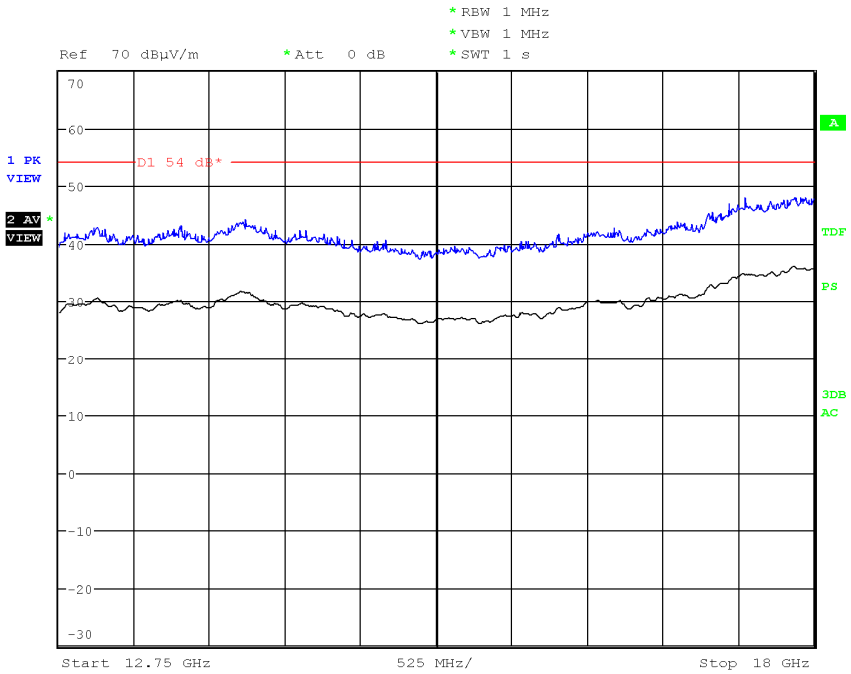
Lowest frequency 5260 MHz.



Middle frequency 5300 MHz.

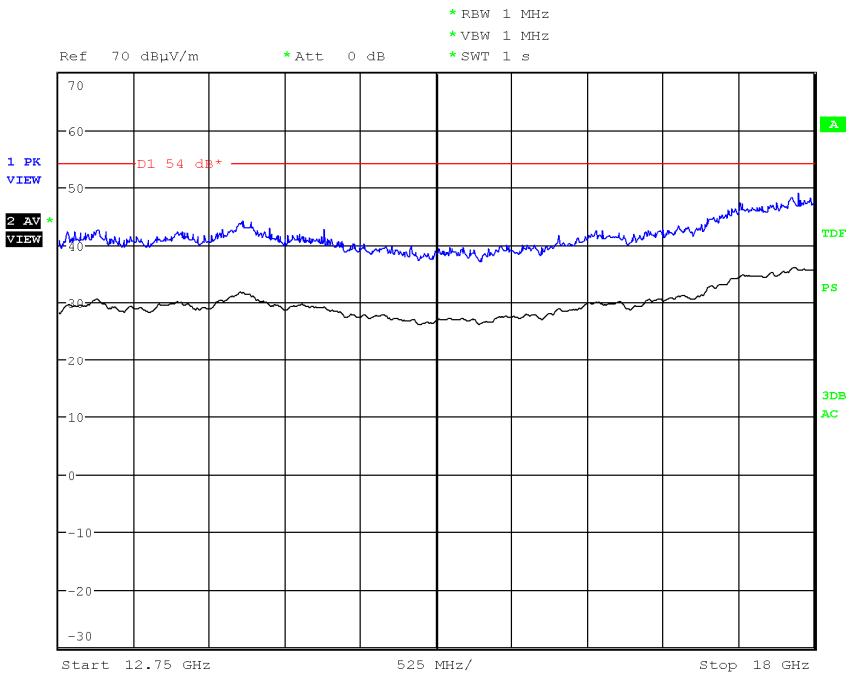



Highest frequency 5320 MHz.



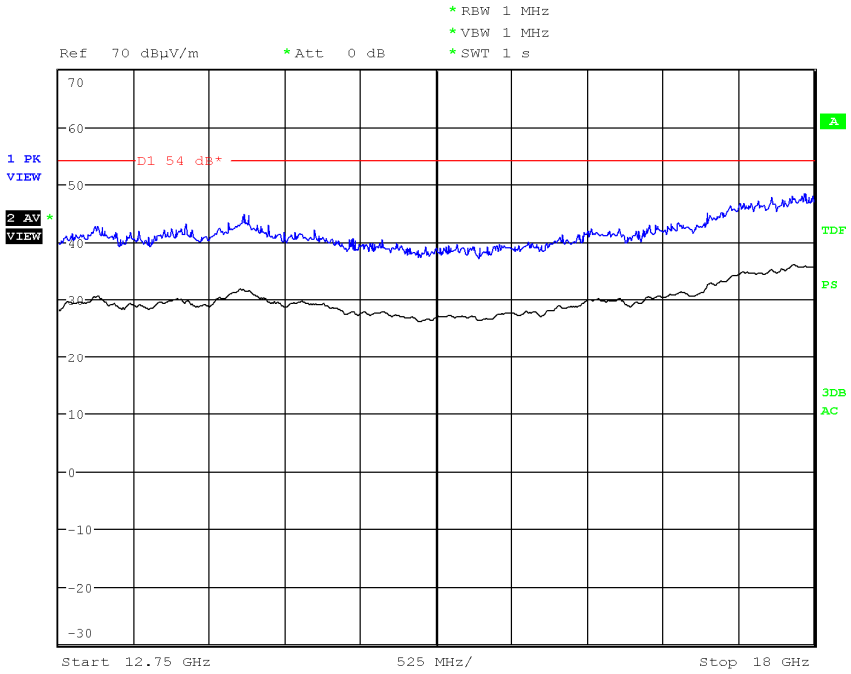
3. WiFi 5GHz 802.11 n40 mode

Highest frequency 5310MHz.




4. WiFi 5GHz 802.11 ac80 mode

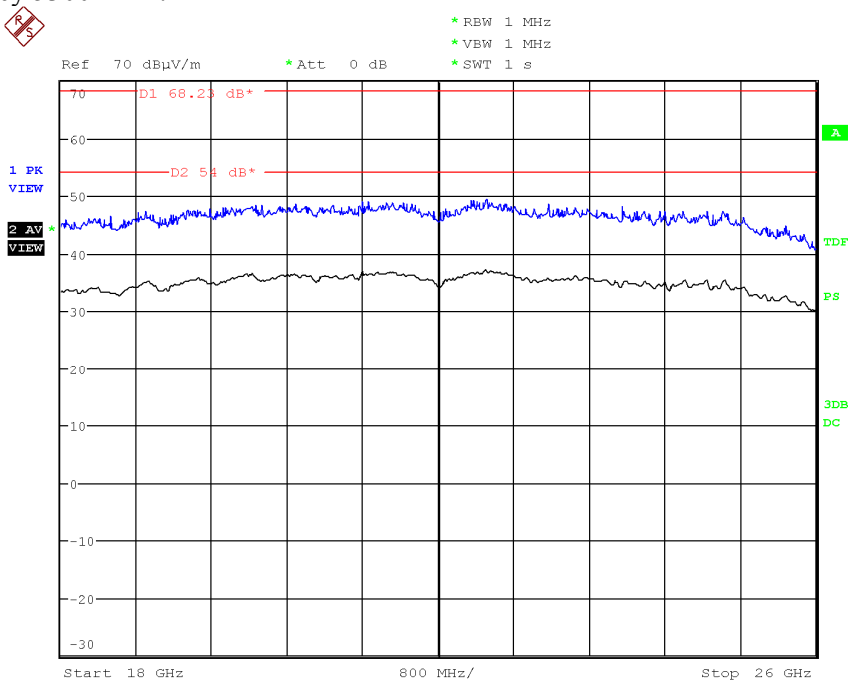
Middle frequency 5290 MHz



**FREQUENCY RANGE 18 GHz to 26GHz.**

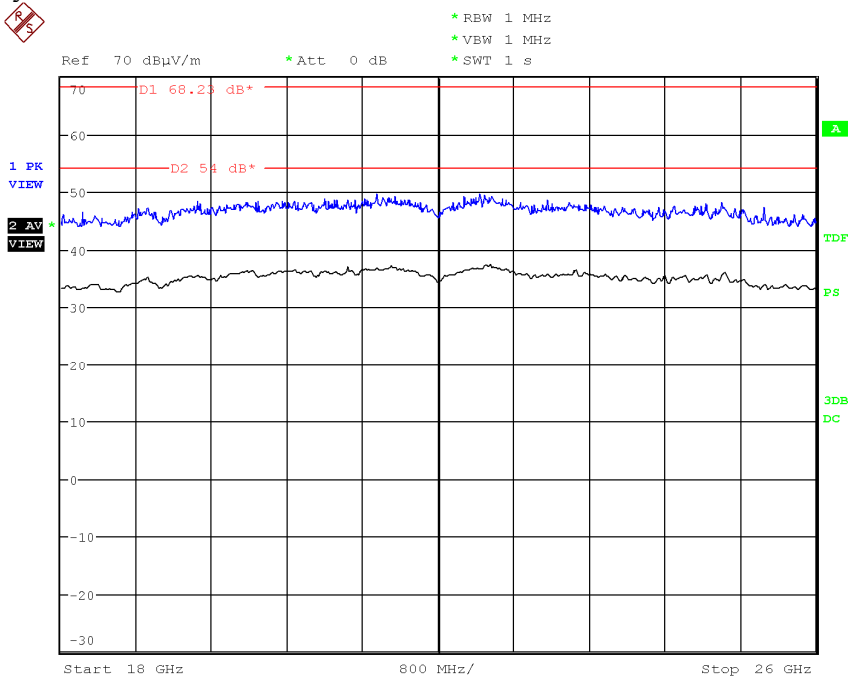
1. WiFi 5GHz 802.11 a mode

Middle frequency 5300 MHz.

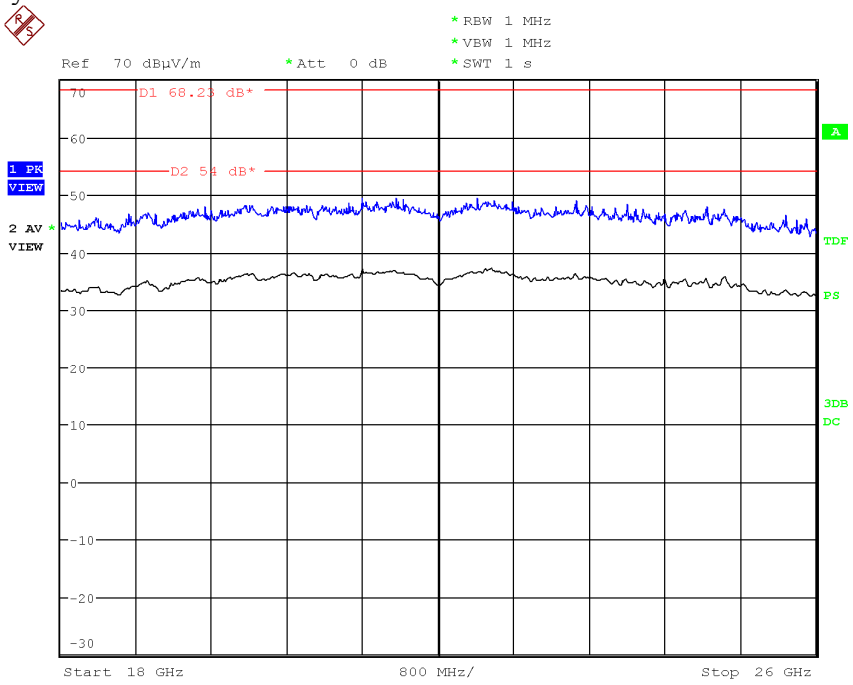



2. WiFi 5GHz 802.11 n20 mode

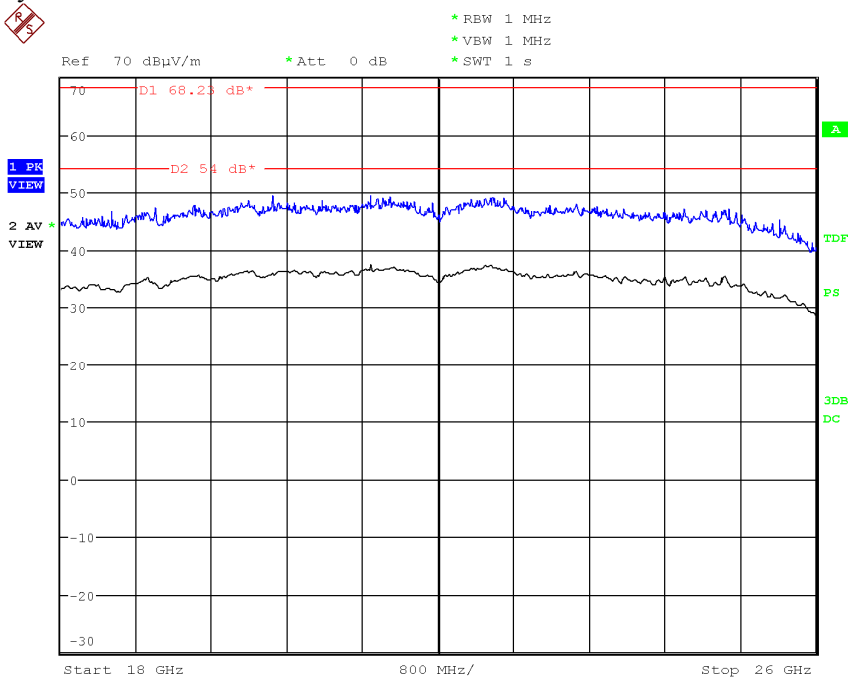
Lowest frequency 5260 MHz.



Middle frequency 5300 MHz.

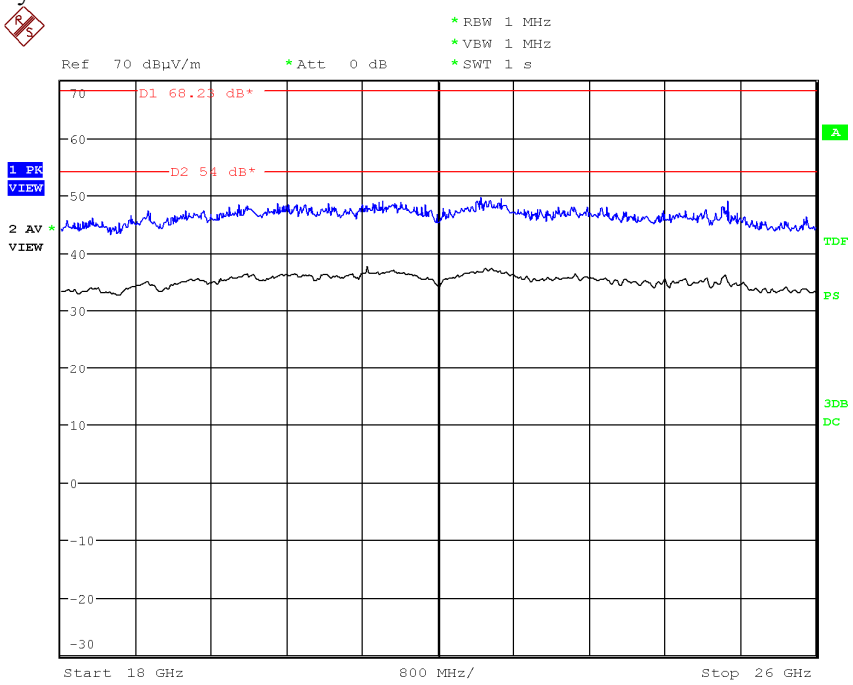



Highest frequency 5320 MHz.



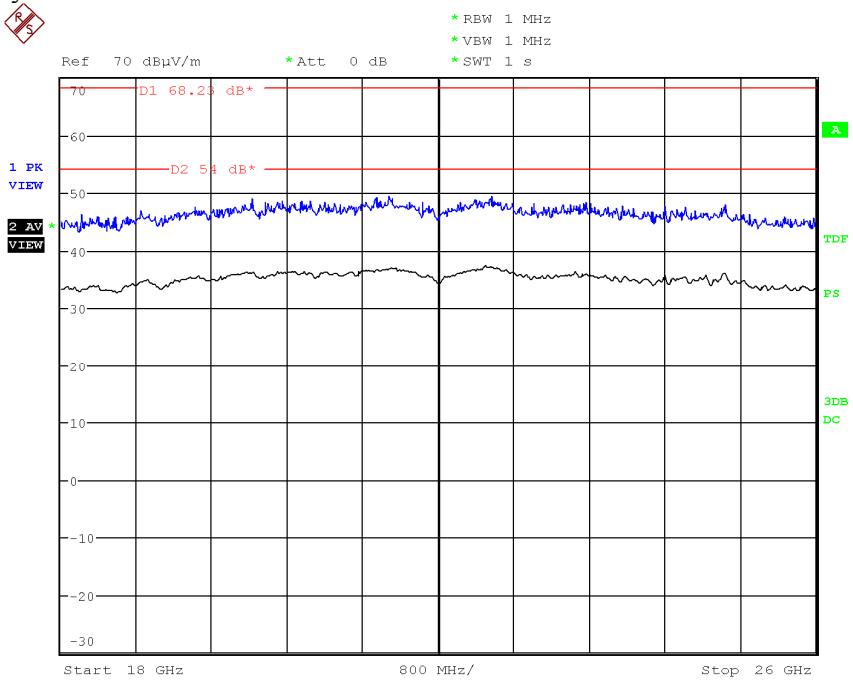
3. WiFi 5GHz 802.11 n40 mode

Highest frequency 5310 MHz.



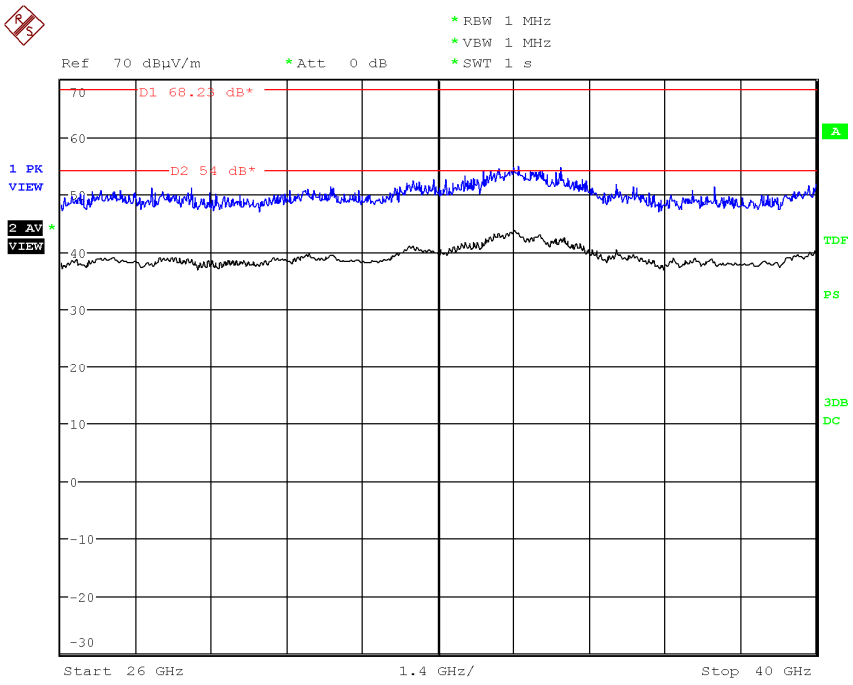

4. WiFi 5GHz 802.11 ac80 mode

Middle frequency 5290 MHz



**FREQUENCY RANGE 26 GHz 40GHz.**

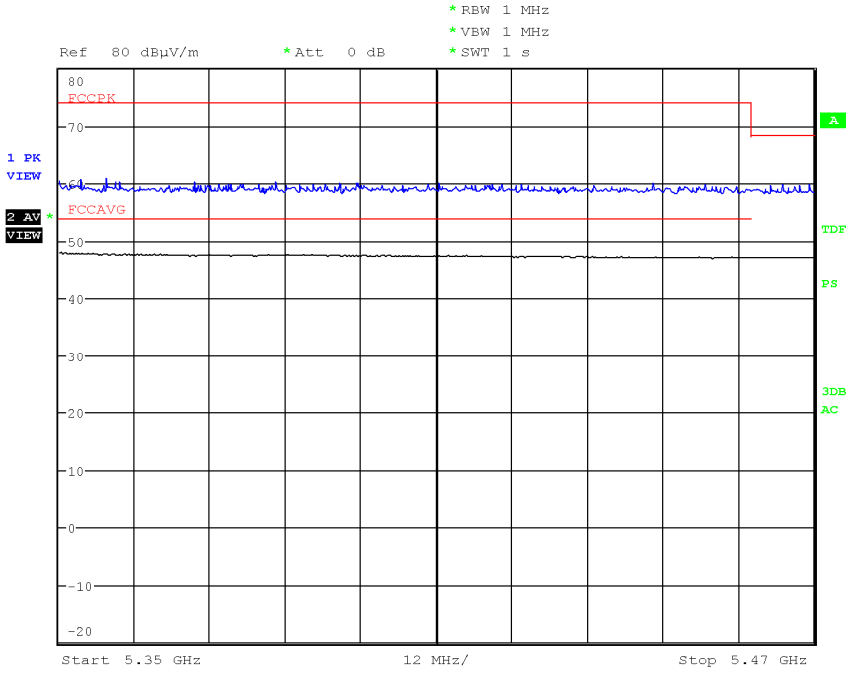
No spurious signals were found in all modulations and channels tested.



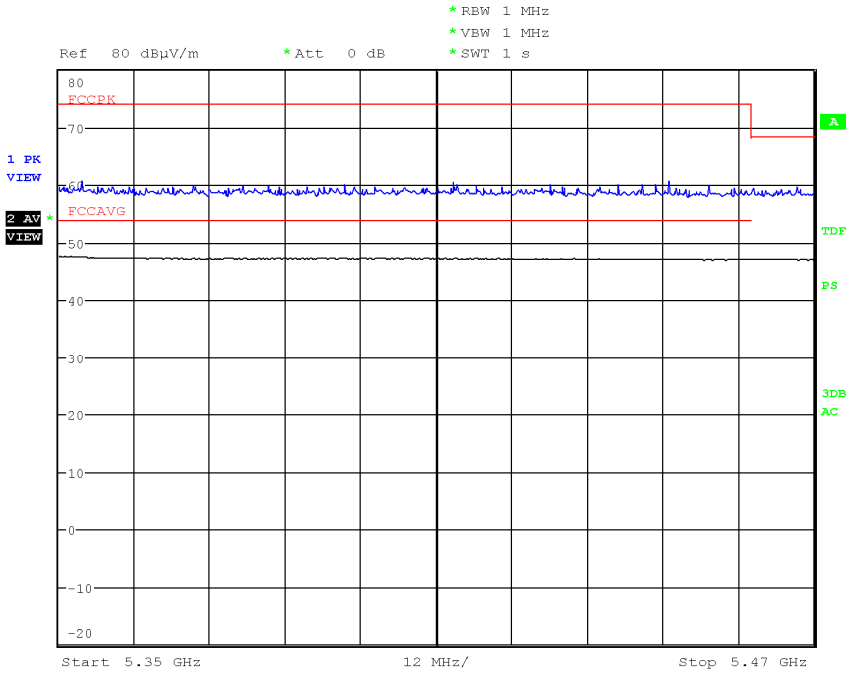
**Radiated spurious emissions at band-edges and inside restricted band 5.35 – 5.46 GHz.**

1. WiFi 5GHz 802.11 a mode

Middle frequency 5300 MHz.

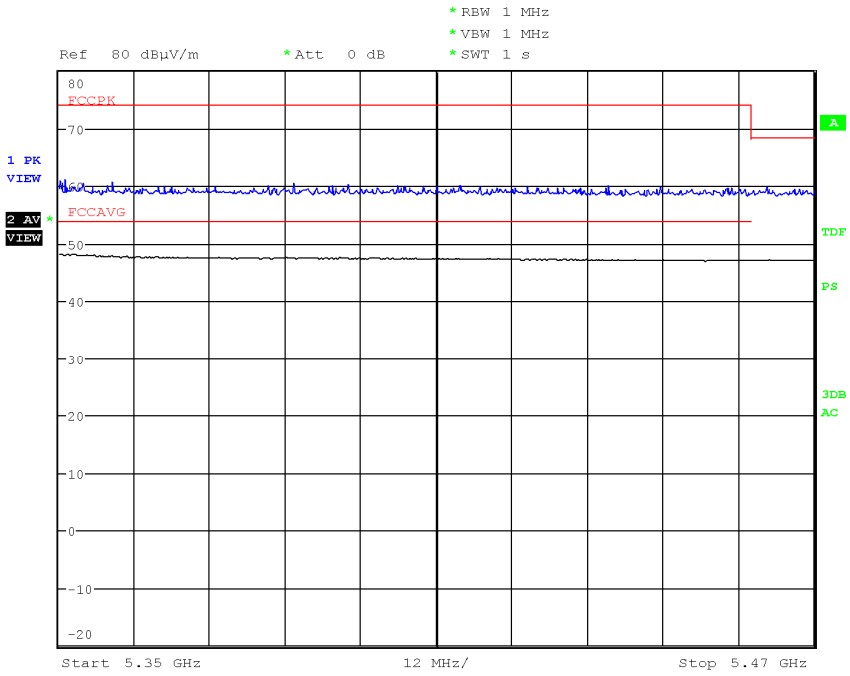



Highest frequency 5320 MHz.

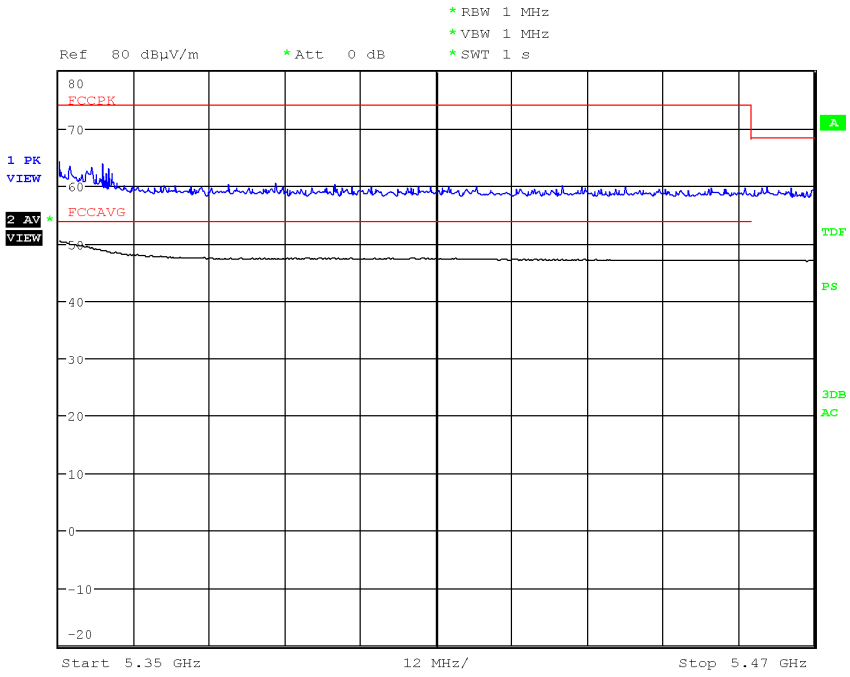


2. WiFi 5GHz 802.11 n20 mode

Middle frequency 5300 MHz.

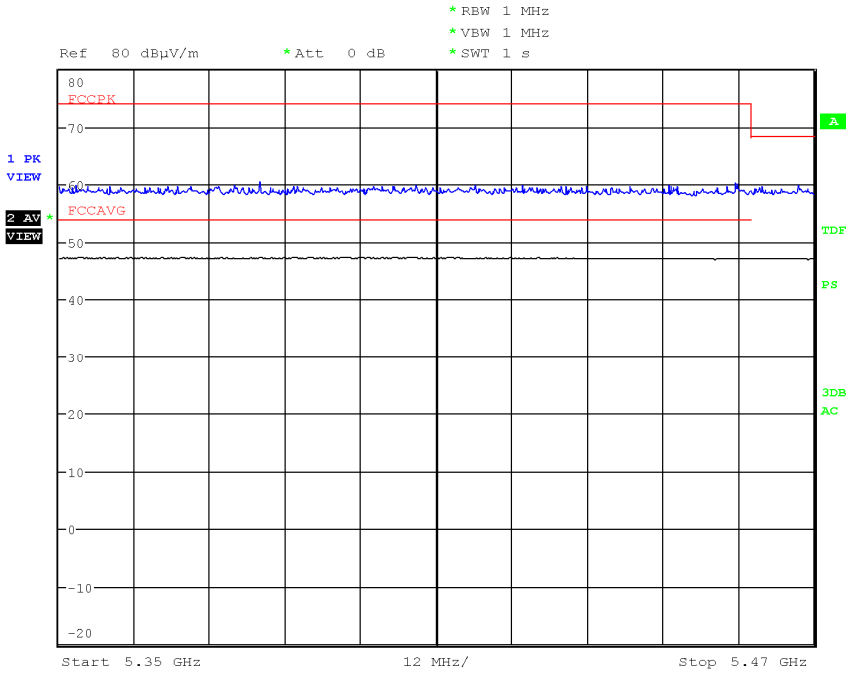



Highest frequency 5320 MHz.

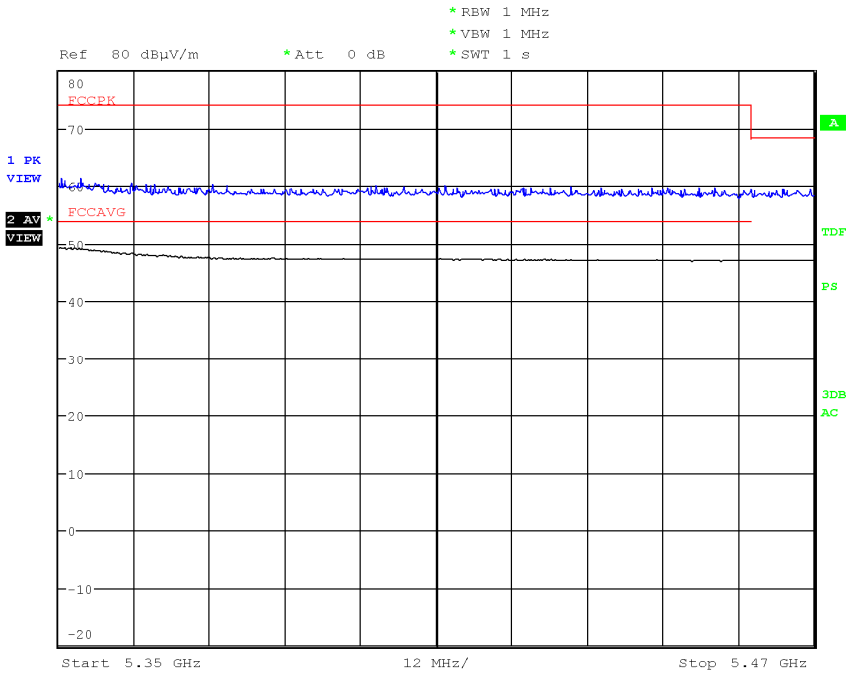


3. WiFi 5GHz 802.11 n40 mode

Lowest frequency 5270 MHz.

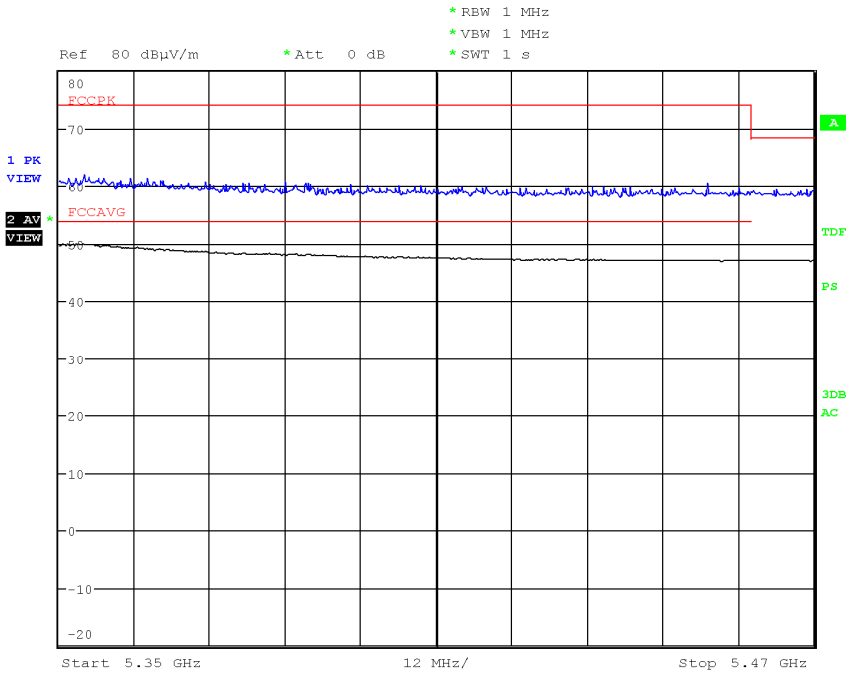



Highest frequency 5310 MHz.



4. WiFi 5GHz 802.11 ac80 mode

Middle frequency 5290 MHz.



# APPENDIX C: Test results for 5.47 GHz – 5.725 GHz band

INDEX

## TEST CONDITIONS

Power supply (V):

$V_{nominal}$ = 3.3 Vdc

Type of power supply = DC voltage from HMC/NGFC test board.

Type of antenna = External attachable PIFA antenna.

Declared Gain for antenna = 4.8 dBi

**Operating frequencies in the sub-band 5.47-5.725 GHz.**

-For IEEE 802.11a, the equipment uses channels 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140.

-For IEEE 802.11n, there are two bandwidths:

For 20 MHz bandwidth the equipment uses channels 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140.
For 40 MHz bandwidth the equipment uses channels 102, 110, 118, 126, 134.

-For IEEE 802.11ac, there are three bandwidths:

For 20 MHz bandwidth the equipment uses channels 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 144.
For 40 MHz bandwidth the equipment uses channels 102, 110, 118, 126, 134,142.
For 80 MHz bandwidth the equipment uses channels 106, 122, 138.

**TEST FREQUENCIES:**

For WiFi a/n20/ac20:

Lowest channel (100): 5500 MHz

Middle channel (120): 5600 MHz

Highest channel (140) 5700 MHz for 802.11n20 and 5720 MHz (144) for 802.11ac20

For WiFi n40/ac40:

Lowest channel (102): 5510 MHz

Middle channel (118): 5590 MHz

Highest channel (134) 5670 MHz for 802.11n40 and 5710 MHz (142) for 802.11ac40

For WiFi ac80:

Lowest channel (106): 5530 MHz

Middle channel (122): 5610 MHz

Highest channel (138): 5690 MHz

The test set-up was made in accordance to the general provisions of ANSI C63.4: 2009 and FCC KDB 789033 D01 General UNII Test Procedures v01r03.

For 802.11a mode the EUT can only transmit at MAIN RF output.

For 802.11n/ac modes 802.11n20/ac20 (20 MHz channel bandwidth), 802.11n40/ac40 (40MHz channel bandwidth) and 802.11ac80 (80MHz channel bandwidth) mode the EUT can only transmit at MAIN RF output.

For radio testing purposes the card was installed in a test fixture. The test fixture is connected to a laptop computer and dc power supplied. The laptop computer was used to configure the EUT to continuously transmit at a specified output power with different modes and modulation schemes.

The data rates of 6Mb/s for 802.11a, HT0 for 802.11n20/ac20 and n40/ac40, and VHT0 for 802.11 ac80 were selected based on preliminary testing that identified those rates corresponding to the worst cases for output power and spurious levels at the band edges.

The field strength at the band edges was evaluated for each mode and on each chain individually on the lowest and highest channels at the rated power for the channel under test. Where the power at the edge channels was lower than the power at the center channels additional measurements were made at the adjacent channels.

The PC was using the Intel test utility DRTU Version DRTU 1.6.1.628.

During transmitter test the EUT was being controlled by the Intel DRTU tool to operate in a continuous transmit mode on the test channels as required and in each of the different modulation modes.

The conducted RF output power at MAIN RF output 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 calibrated average power meter. Measured values for adjustment were within -0.2 dB/+0.3 dB respect to the Target values.

**RF conducted output power target values**

| | Mode | BW (MHz) | Channel / Freq. | Power level at Main RF output (dBm) |
|---|---|---|---|---|
| **5.47–5.725 GHz Band** | | | | |
| | 802.11a | 20 | 100 / 5500 | 14,5 |
| | | | 104 / 5520 | 16,5 |
| | | | 120 / 5600 | 16,5 |
| | | | 136 /5680 | 16,5 |
| | | | 140 / 5700 | 14 |
| | 802.11n | 20 | 100 / 5500 | 14,5 |
| | | | 104 / 5520 | 16,5 |
| | | | 120 / 5600 | 16,5 |
| | | | 136 /5680 | 16,5 |
| | | | 140 / 5700 | 14 |
| | 802.11n* | 40 | 102 / 5510 | 11,5 |
| | | | 110 / 5550 | 16,5 |
| | | | 118 / 5590 | 16,5 |
| | | | 134 / 5670 | 16,5 |
| | 802.11ac | 20 | 144 / 5720 | 16,5 |
| | | | | |
| | 802.11ac | 40 | 142 /5710 | 16,5 |
| | | | | |
| | 802.11ac | 80 | 106 / 5530 | 10 |
| | | | 122 / 5610 | 15 |
| | | | 138 / 5690 | 15 |

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is connected to the spectrum analyzer using low loss RF cables with sma type connectors. The reading in the spectrum analyzer is corrected taking into account the cable loss.

RADIATED MEASUREMENTS

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 1m for the frequency range 1 GHz-40 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

For radiated emissions in the range 1 GHz-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The equipment under test was set up on a non-conductive (wooden) platform one meter above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º.

Measurements were made in both horizontal and vertical planes of polarization.

## 99 % and 26 dB Bandwidth

RESULTS

**1. 802.11a mode** (see next plots).

| | Lowest frequency 5500 MHz | Middle frequency 5600 MHz | Highest frequency 5700 MHz |
|---|---|---|---|
| 99% bandwidth (MHz) | 18.400 | 21.550 | 18.250 |
| 26 dB bandwidth (MHz) | 28.709 | 37.980 | 27.644 |
| Measurement uncertainty (kHz) | ±21.7 | | |

**2. 802.11 n20 MHz and 802.11 ac 20 MHz (except channel 144) modes.** (see next plots).

| | Lowest frequency 5500 MHz | Middle frequency 5600 MHz | Highest frequency 5700 MHz |
|---|---|---|---|
| 99% bandwidth (MHz) | 19.300 | 22.200 | 19.200 |
| 26 dB bandwidth (MHz) | 29.442 | 43.589 | 29.006 |
| Measurement uncertainty (kHz) | ±21.7 | | |

Note: the test was performed with 802.11 n20 MHz mode which is the same modulation scheme as 802.11 ac 20 MHz.

802.11 ac 20MHz (channel 144):

| | Frequency 5720 MHz |
|---|---|
| 99% bandwidth (MHz) | 22.400 |
| 26 dB bandwidth (MHz) | 26.697 in UNII_3; 14.249 in UNII_4 and 40.946 (total) |
| Measurement uncertainty (kHz) | ±21.7 |

**3. 802.11 n40 MHz and 802.11 ac 40 MHz (except channel 142) modes.** (see next plots).

| | Lowest frequency 5510 MHz | Middle frequency 5590 MHz | Highest frequency 5670 MHz |
|---|---|---|---|
| 99% bandwidth (MHz) | 36.500 | 37.500 | 37.200 |
| 26 dB bandwidth (MHz) | 44.385 | 62.428 | 54.581 |
| Measurement uncertainty (kHz) | ±21.7 | | |

Note: the test was performed with 802.11 n40 MHz mode which is the same modulation scheme as 802.11 ac 40 MHz.

802.11 ac 40MHz (channel 142):

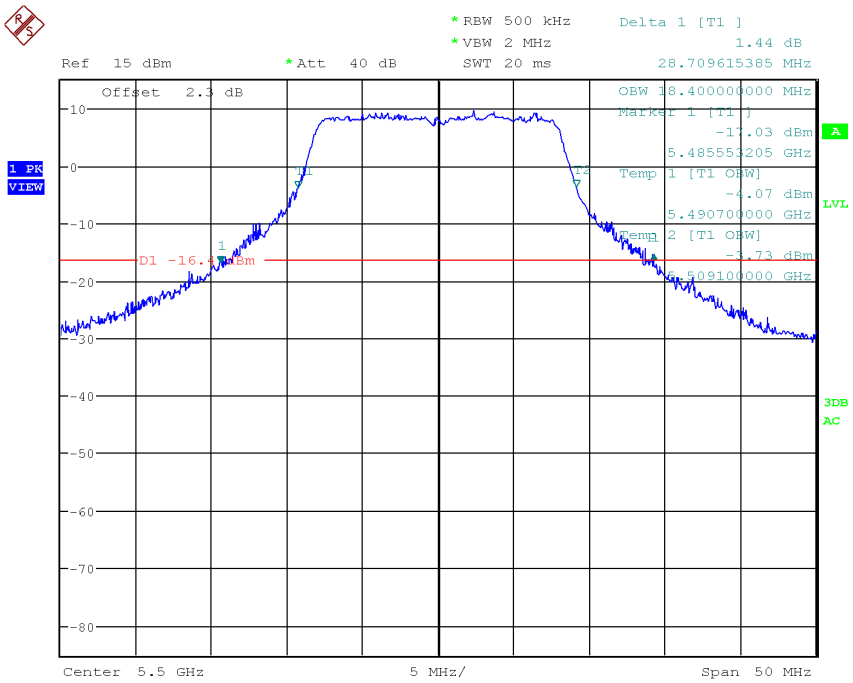
| | Frequency 5710 MHz |
|---|---|
| 99% bandwidth (MHz) | 37.300 |
| 26 dB bandwidth (MHz) | 50.590 in UNII_3, 10.308 in UNII_4 and 60.898 (Total) |
| Measurement uncertainty (kHz) | ±21.7 |

**4. 802.11 ac 80 MHz mode.** (see next plots).

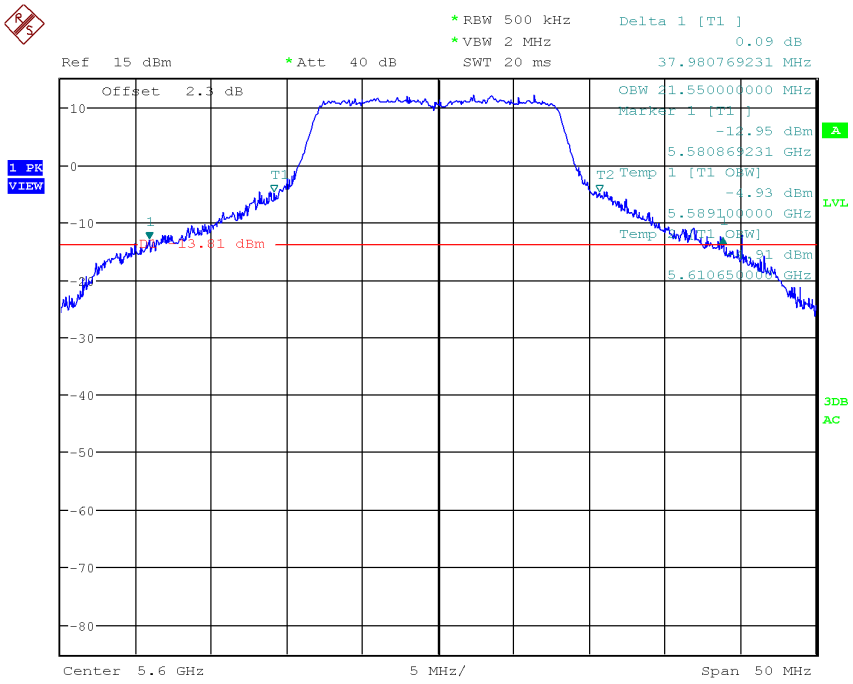
| | Lowest frequency 5530 MHz | Highest frequency 5610 MHz | Highest frequency 5690 MHz |
|---|---|---|---|
| 99% bandwidth (MHz) | 75.150 | 75.600 | 75.300 |
| 26 dB bandwidth (MHz) | 86.304 | 102.019 | 95.188 in UNII_3; 7.215 in UNII_4 and 102.403 (Total) |
| Measurement uncertainty (kHz) | ±21.7 | | |

**802.11a mode**

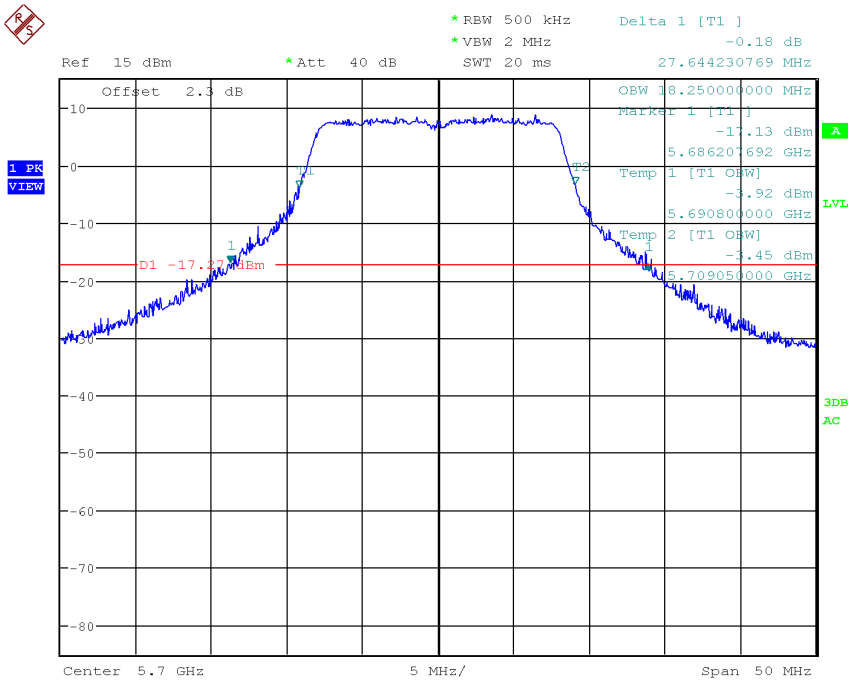
Lowest Channel




Middle Channel

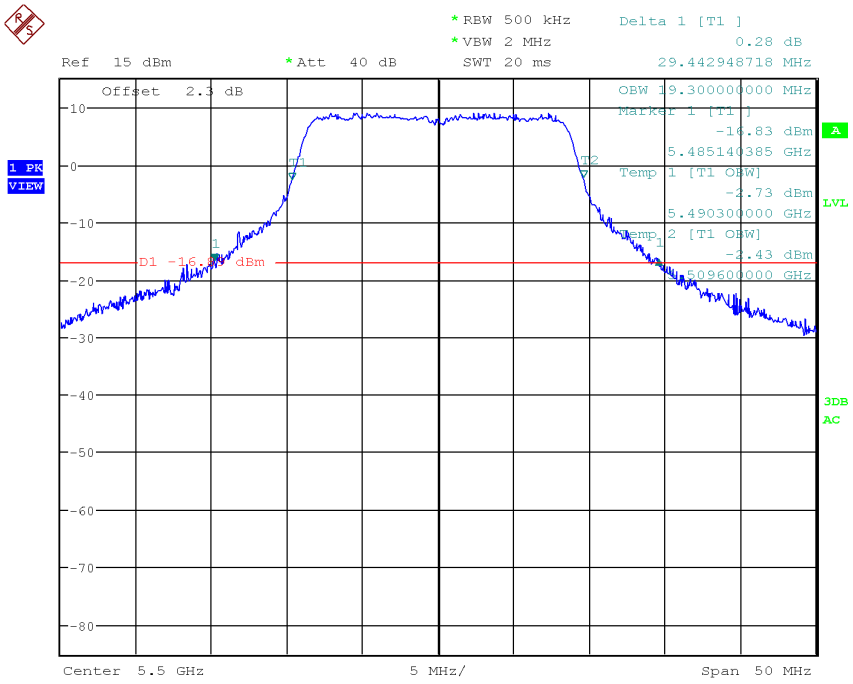


Highest Channel

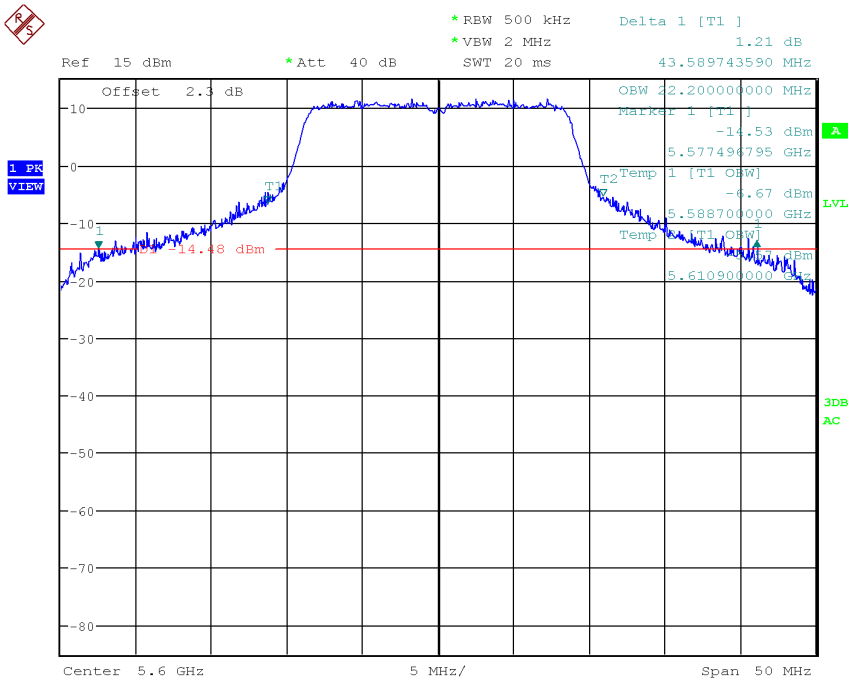



## 802.11 n20 MHz and 802.11 ac 20 MHz modes (except channel 144)

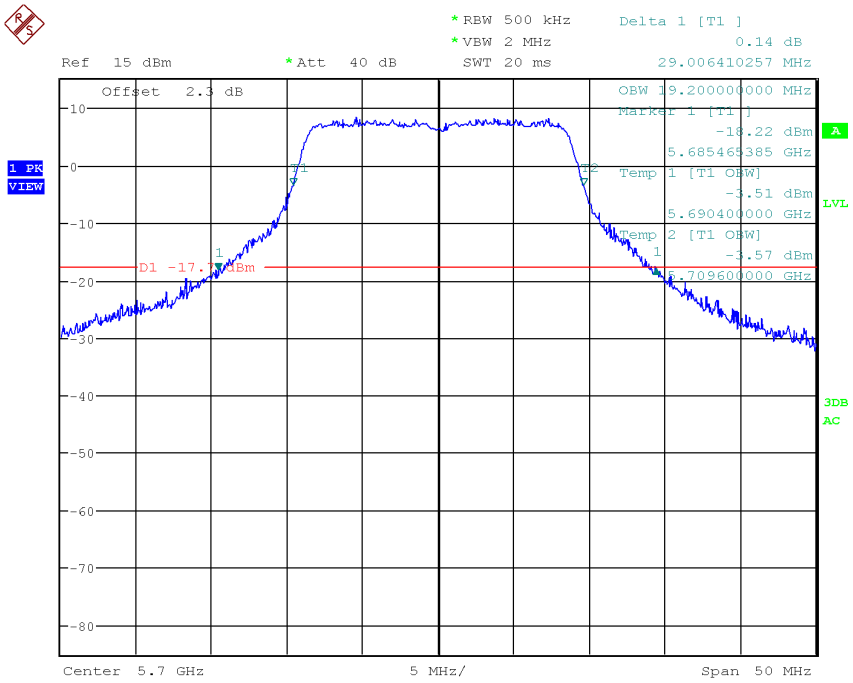
Lowest Channel



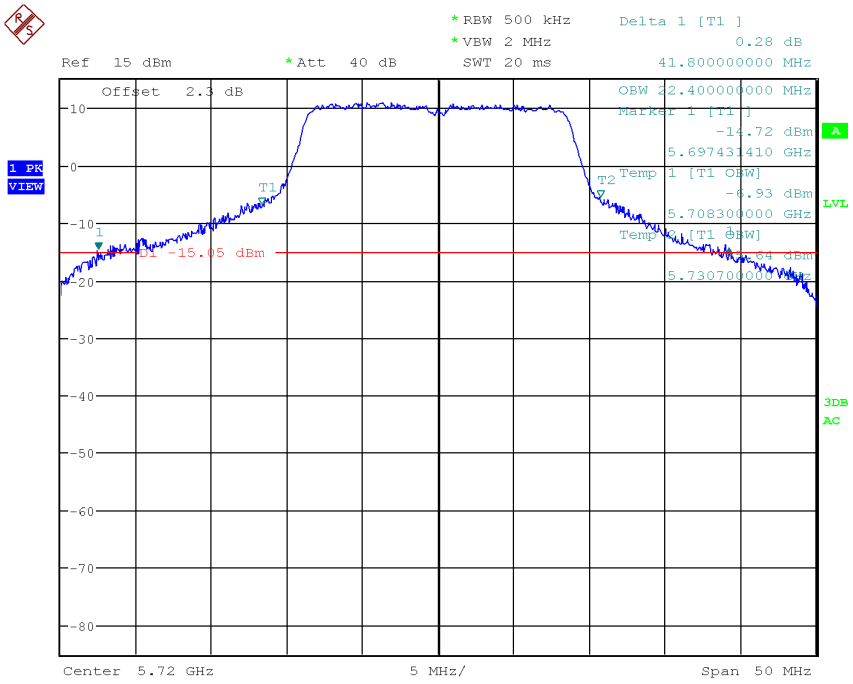
Middle Channel



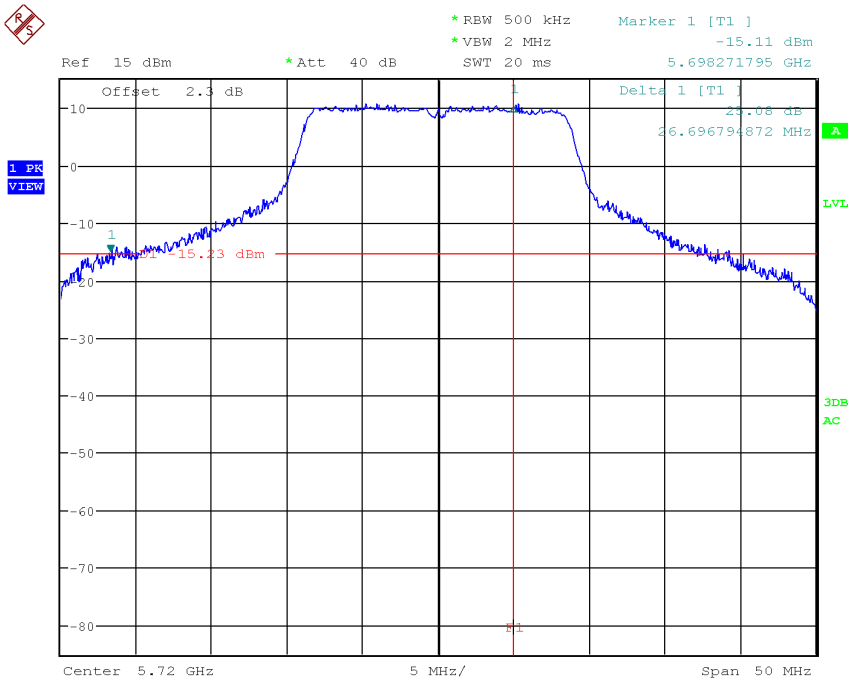

Highest Channel



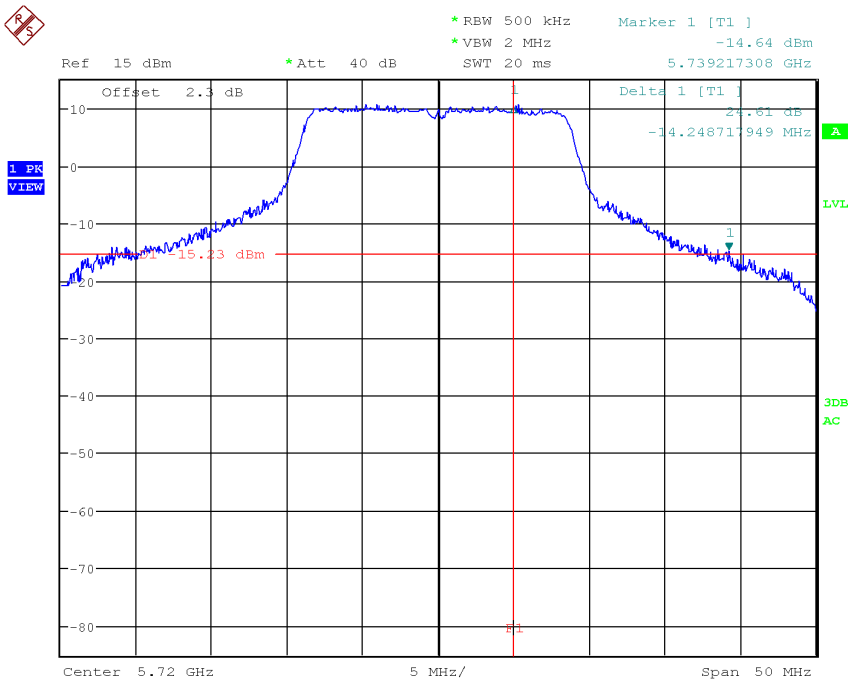
802.11 ac 20MHz: Channel 144. Total Bandwidth




26 dB BW inside UNII_3 sub-band:

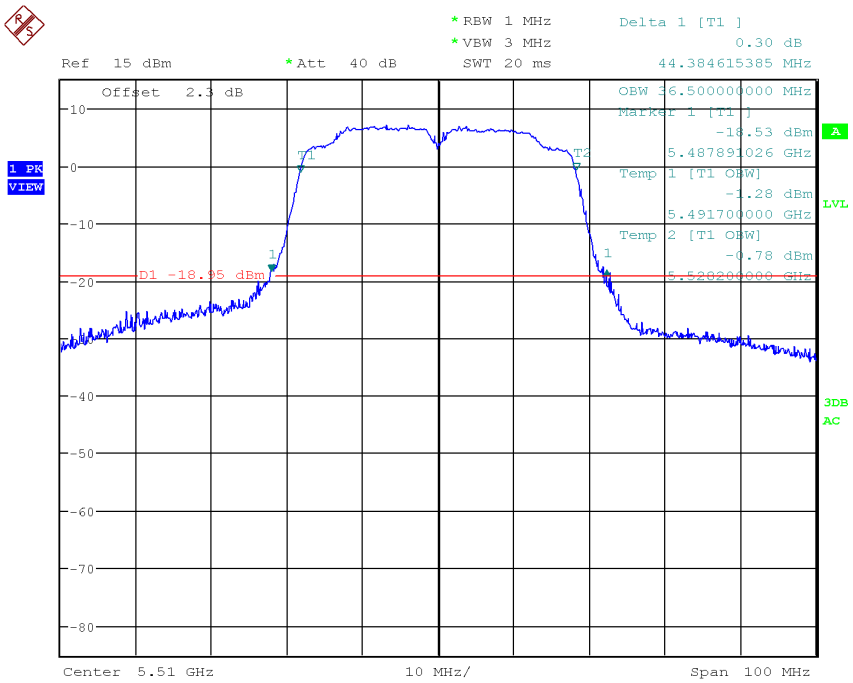


26 dB BW inside UNII_4 sub-band:

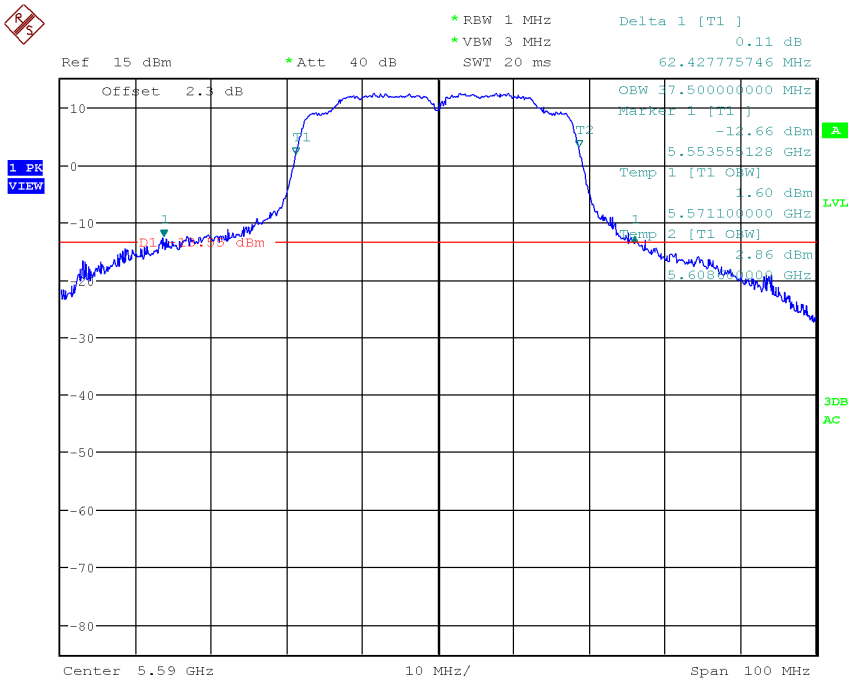


## 802.11 n40 MHz and 802.11 ac 40 MHz modes (except channel 142)

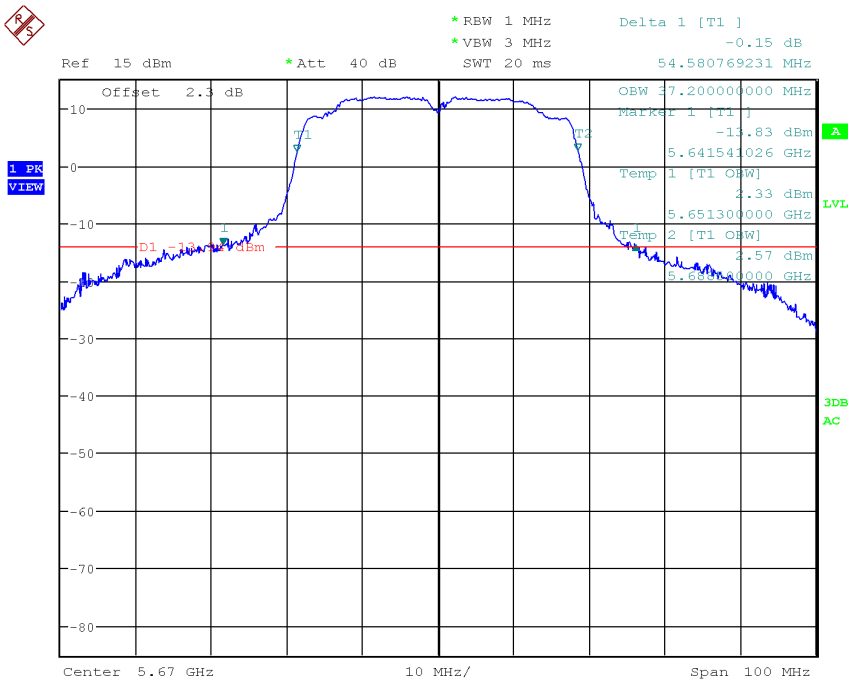
Lowest Channel



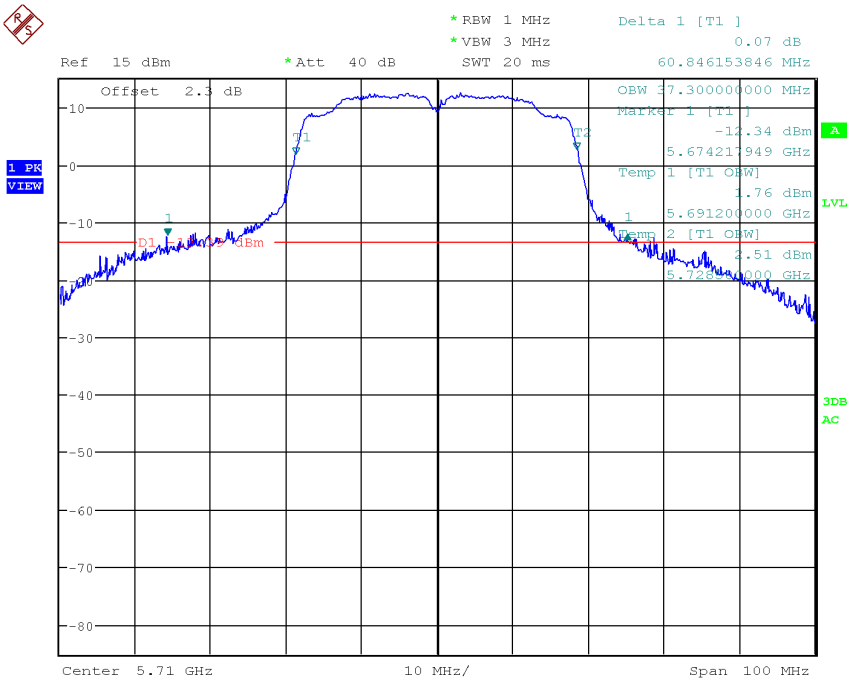

Middle Channel



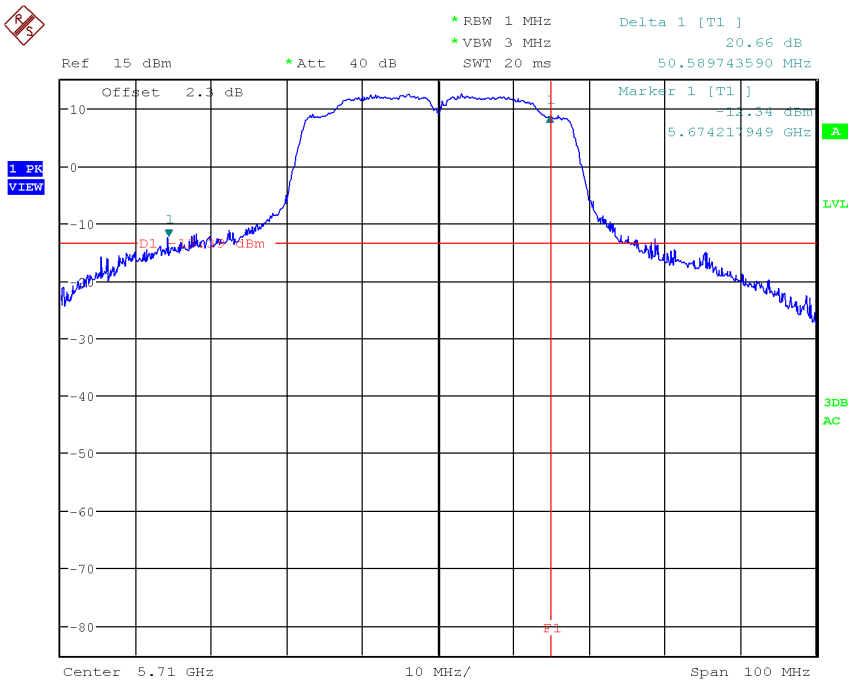
Highest Channel



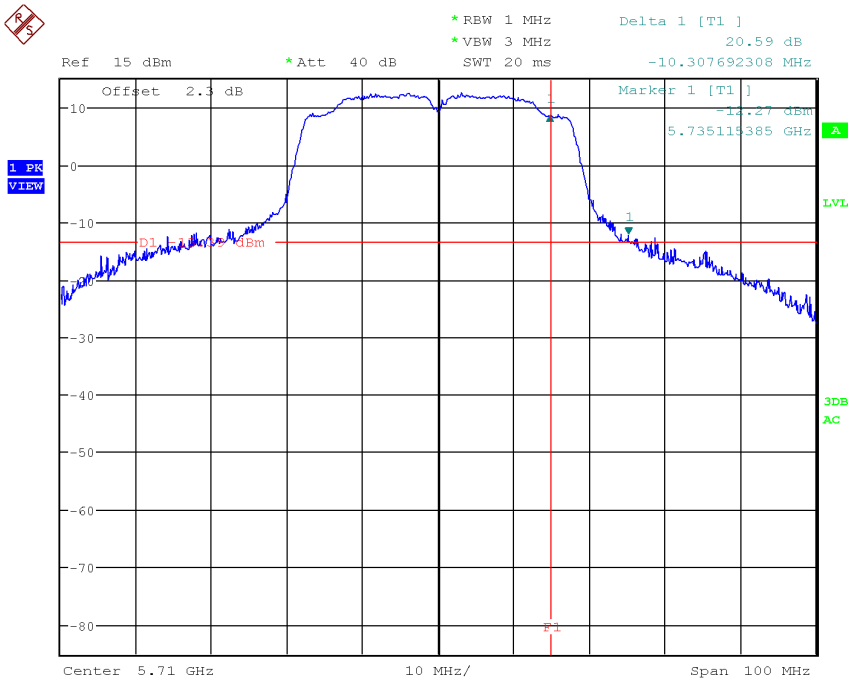

802.11 ac 40MHz: Channel 142. Total Bandwidth



26 dB BW inside UNII_3 sub-band:

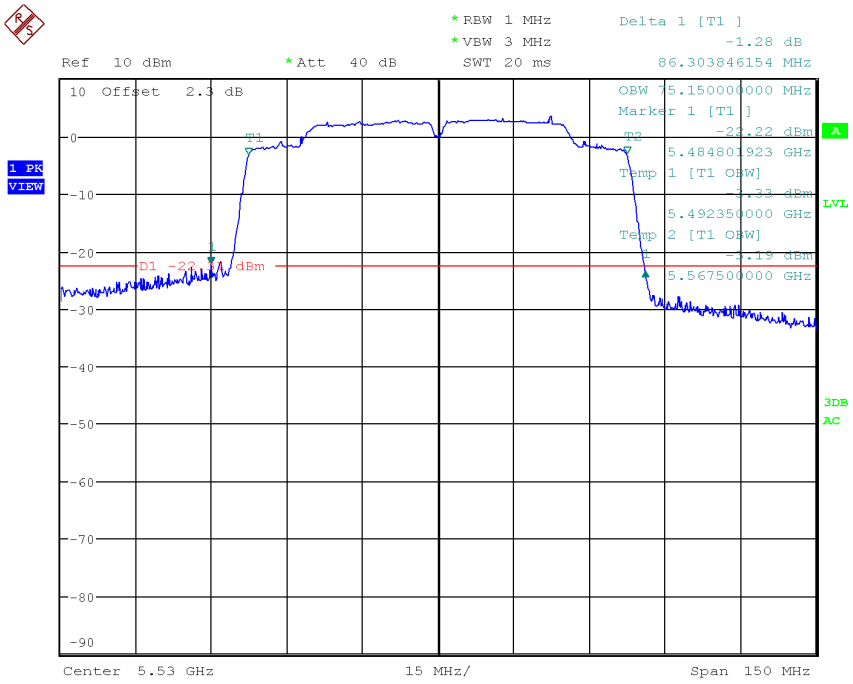



26 dB BW inside UNII_4 sub-band:

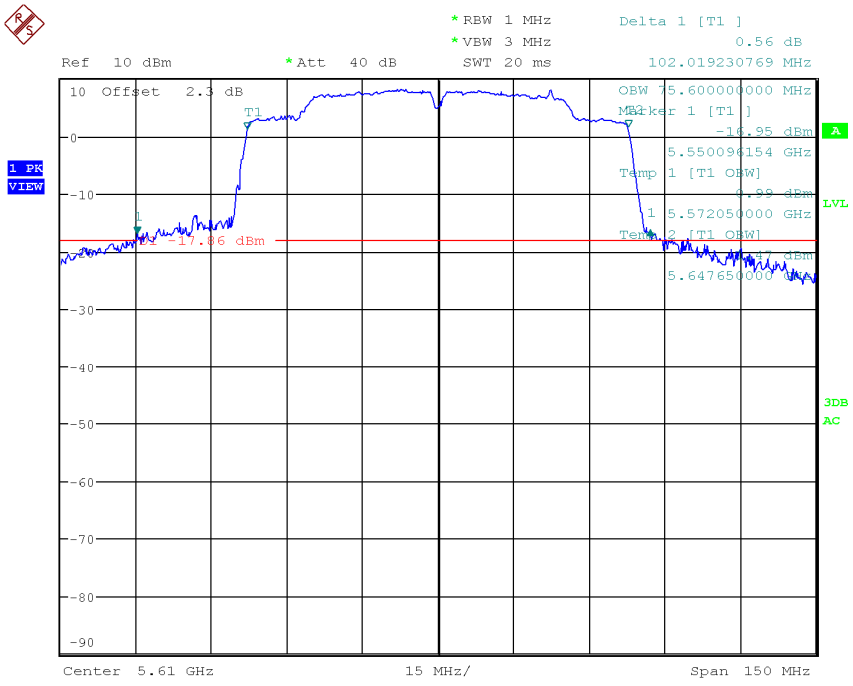


## 802.11 ac 80 MHz mode (except channel 138)

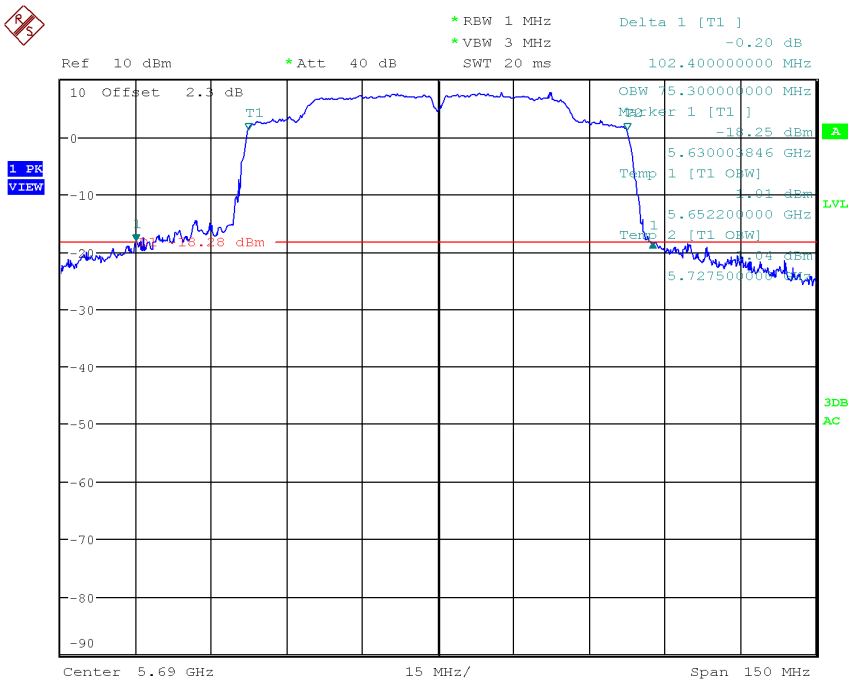
Lowest Channel



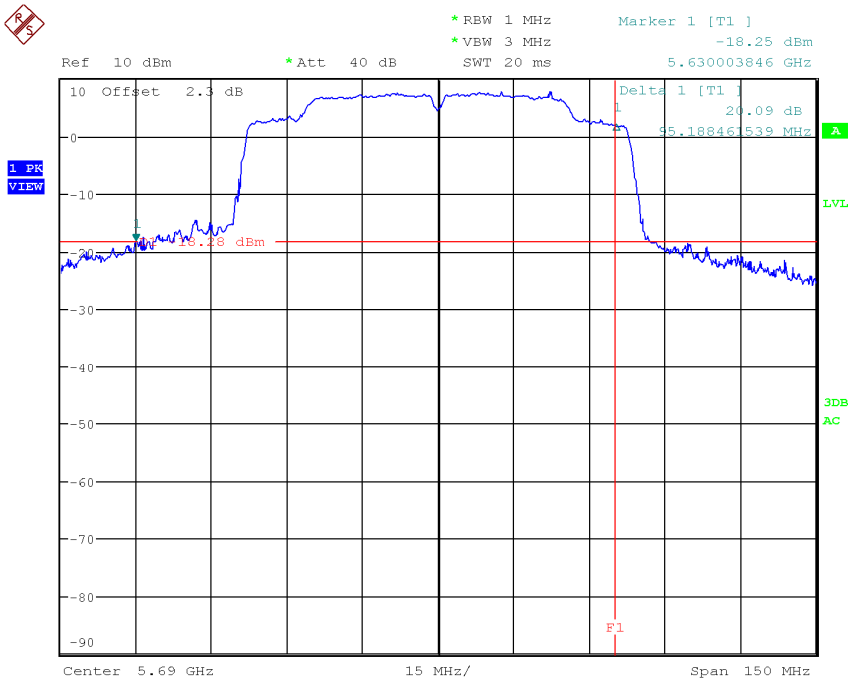

Middle Channel



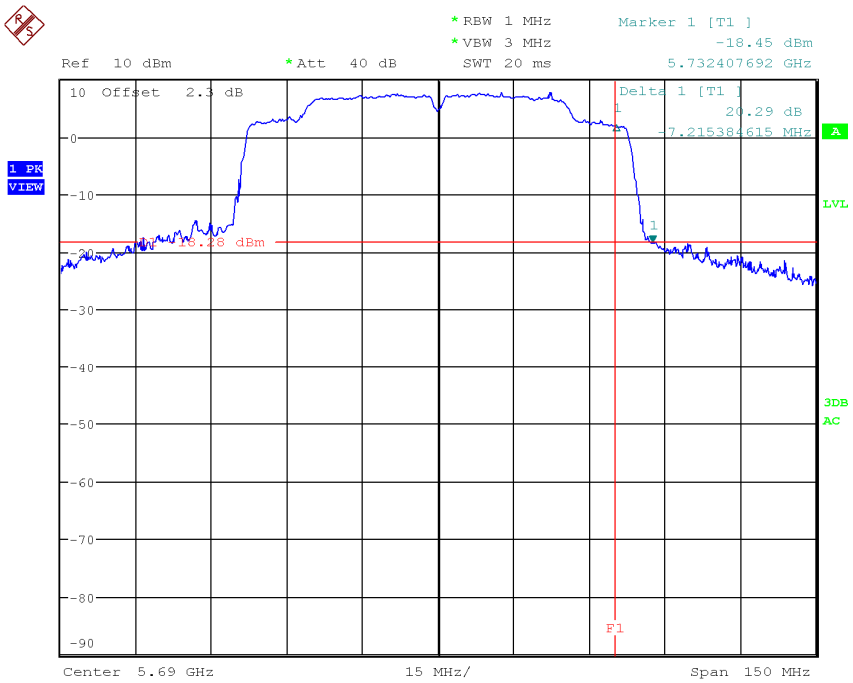
802.11 ac 80MHz: Channel 138. Total Bandwidth.




26 dB BW inside UNII_3 sub-band:



26 dB BW inside UNII_4 sub-band:



**Section 15.407 Subclause (a) (2) / RSS-210 A9.2. (3). Maximum output power, Peak power spectral density and antenna gain**

SPECIFICATION

FCC 15.407: 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 (23.97 dBm) or 11 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. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the band 5.725–5.825 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 1 W (30 dBm) or 17 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. In addition, the peak power spectral density shall not exceed 17 dBm in any 1–MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS-210: For the band 5.47-5.725 GHz the maximum conducted output power shall not exceed 250 mW (23.97 dBm) or 10 + 10 log10 B, dBm, whichever power is less. The power spectral density shall not exceed 11dBm in any 1.0 MHz band. The maximum e.i.r.p. shall not exceed 1.0 W (30 dBm) or 17 + 10log B, dBm, whichever power is less. B is the 99% emission bandwidth in MHz.

For the band 5.725–5.825 GHz the maximum conducted output power shall not exceed 1.0 W (30 dBm) or 17 + 10 log10 B, dBm, whichever power is less. The power spectral density shall not exceed 17 dBm in any 1.0 MHz band. The maximum e.i.r.p. shall not exceed 4.0 W or 23 + 10 log10 B, dBm, whichever power is less. B is the 99% emission bandwidth in MHz.

Within the emission bandwidth, when the peak spectral density per MHz over any continuous transmission exceeds the average (10 log10 B) value by more than 3 dB, the permissible power spectral density shall be reduced by the excess amount.

RESULTS

The maximum conducted output power was measured using the channel power integration method according to point E) 2) b) (Method SA-1) of Guidance 789033 D01.

For channel 144 ac20MHz, channel 142 ac40 MHz and channel 138 ac80MHz the maximum conducted output power was measured using the method according to point H) 2) b) (ii) (Integration across the entire U-NII band) of the Guidance for IEEE 802.11ac and Pre-ac Device Emissions Testing “Guidance 644545 V01 for IEEE802.11ac”.

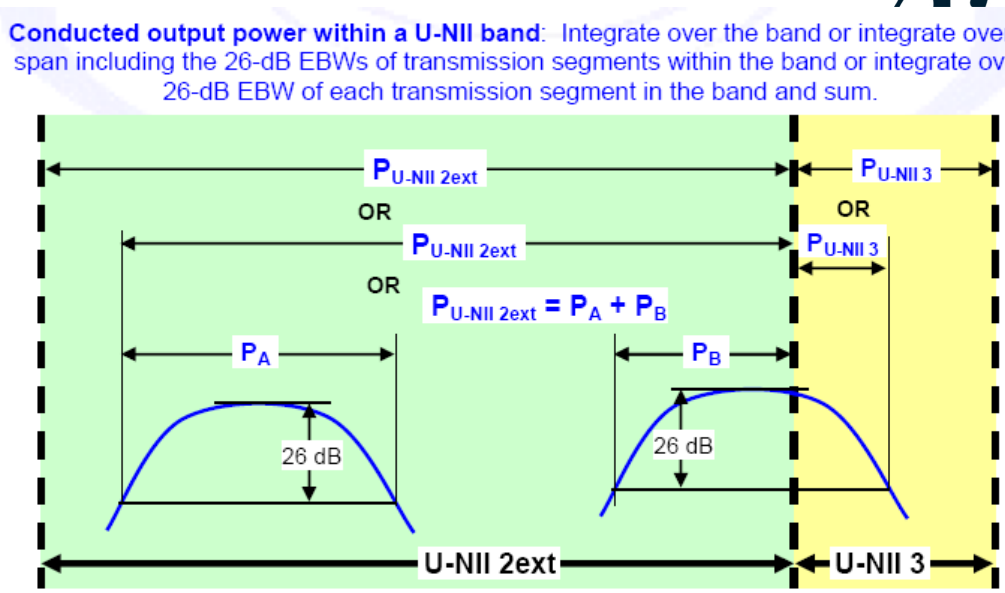



**Figure 6. Conducted Output Power Measurement Examples**

The peak power spectral density (PPSD) was measured using the method according to point F) (Method SA-1) of Guidance 789033 D01

The e.i.r.p. levels are calculated by adding the declared maximum antenna gain (dBi).

**1. 802.11a mode** (see next plots).

Maximum declared antenna gain = 4.8 dBi

| Frequency | PPSD/MHz (dBm) | PPSD/MHz e.i.r.p. (dBm) | Maximum conducted output power (dBm) | Maximum output power e.i.r.p. (dBm) |
|---|---|---|---|---|
| 5500 MHz | 3.34 | 8.14 | 14.66 | 19.46 |
| 5600 MHz | 5.67 | 10.47 | 16.68 | 21.48 |
| 5700 MHz | 3.15 | 7.95 | 14.17 | 18.97 |

Measurement uncertainty = ±1.5 dB

Verdict: Pass

**2. 802.11 n20 MHz and 802.11 ac 20 MHz modes (except channel 144).** (see next plots).

Note: the test was performed with 802.11 n20 MHz mode which is the same modulation scheme as 802.11 ac 20 MHz.

Maximum declared antenna gain = 4.8 dBi

| Frequency | PPSD/MHz (dBm) | PPSD/MHz e.i.r.p. (dBm) | Maximum conducted output power (dBm) | Maximum output power e.i.r.p. (dBm) |
|---|---|---|---|---|
| 5500 MHz | 3.24 | 8.04 | 14.54 | 19.34 |
| 5600 MHz | 5.39 | 10.19 | 16.66 | 21.46 |
| 5700 MHz | 2.78 | 7.58 | 14.14 | 18.94 |

Measurement uncertainty = ±1.5 dB

Verdict: Pass

**802.11 ac 20MHz. Channel 144**

Maximum declared antenna gain = 4.8 dBi

| Frequency | PPSD/MHz (dBm) per sub-band | | PPSD/MHz e.i.r.p. (dBm) per sub-band | | Maximum conducted output power (dBm) per sub-band | | Maximum output power e.i.r.p. (dBm) per sub-band | |
|---|---|---|---|---|---|---|---|---|
| | UNII_3 | UNII_4 | UNII_3 | UNII_4 | UNII_3 | UNII_4 | UNII_3 | UNII_4 |
| 5720 MHz | 5.38 | 4.16 | 10.18 | 8.96 | 15.58 | 9.41 | 20.38 | 14.21 |

Measurement uncertainty = ±1.5 dB

Verdict: Pass

**3. 802.11 n40 MHz and 802.11 ac 40 MHz modes (except channel 142).** (see next plots).

Note: the test was performed with 802.11 n40 MHz mode which is the same modulation scheme as 802.11 ac 40 MHz.

Maximum declared antenna gain = 4.8 dBi

| Frequency | PPSD/MHz (dBm) | PPSD/MHz e.i.r.p. (dBm) | Maximum conducted output power (dBm) | Maximum output power e.i.r.p. (dBm) |
|---|---|---|---|---|
| 5510 MHz | -1.68 | 3.12 | 11.56 | 16.36 |
| 5590 MHz | 3.19 | 7.99 | 16.55 | 21.35 |
| 5670 MHz | 3.13 | 7.93 | 16.40 | 21.20 |

Measurement uncertainty = ±1.5 dB

Verdict: Pass

**802.11 ac 40MHz. Channel 142.**

Maximum declared antenna gain = 4.8 dBi

| Frequency | PPSD/MHz (dBm) per sub-band | | PPSD/MHz e.i.r.p. (dBm) per sub-band | | Maximum conducted output power (dBm) per sub-band | | Maximum output power e.i.r.p. (dBm) per sub-band | |
|---|---|---|---|---|---|---|---|---|
| | UNII_3 | UNII_4 | UNII_3 | UNII_4 | UNII_3 | UNII_4 | UNII_3 | UNII_4 |
| 5710 MHz | 2.83 | -1.19 | 7.63 | 3.61 | 15.90 | 2.90 | 20.70 | 7.70 |

Measurement uncertainty = ±1.5 dB

Verdict: Pass

**4. 802.11 ac 80 MHz mode (except channel 138).** (see next plots).

Maximum declared antenna gain = 4.8 dBi

| Frequency | PPSD/MHz (dBm) | PPSD/MHz e.i.r.p. (dBm) | Maximum conducted output power (dBm) | Maximum output power e.i.r.p. (dBm) |
|---|---|---|---|---|
| 5530 MHz | -5.79 | -0.99 | 9.56 | 14.36 |
| 5610 MHz | -0.68 | 4.12 | 14.65 | 19.45 |

Measurement uncertainty = ±1.5 dB

Verdict: Pass

**802.11 ac 80MHz. Channel 138.**

Maximum declared antenna gain = 4.8 dBi

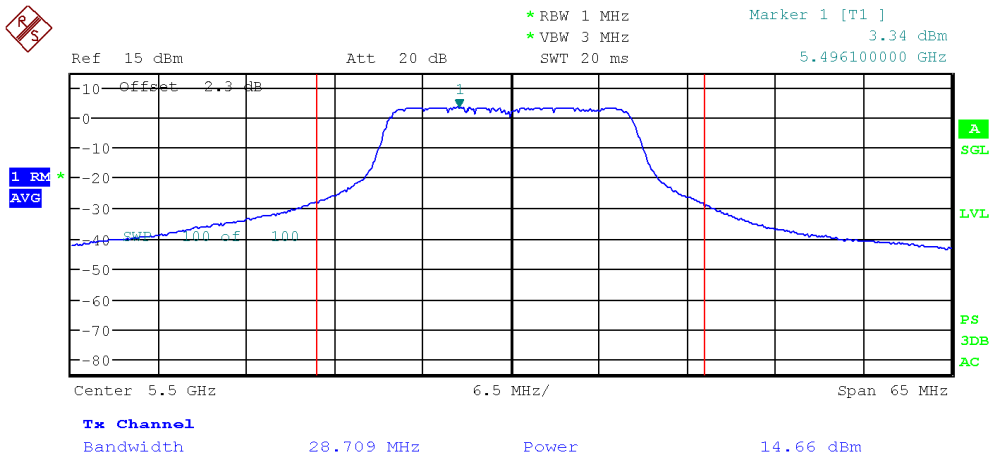
| Frequency | PPSD/MHz (dBm) per sub-band | | PPSD/MHz e.i.r.p. (dBm) per sub-band | | Maximum conducted output power (dBm) per sub-band | | Maximum output power e.i.r.p. (dBm) per sub-band | |
|---|---|---|---|---|---|---|---|---|
| | UNII_3 | UNII_4 | UNII_3 | UNII_4 | UNII_3 | UNII_4 | UNII_3 | UNII_4 |
| 5690 MHz | -1.29 | -6.97 | 3.51 | -2.17 | 14.51 | -2.85 | 19.31 | 1.95 |

Measurement uncertainty = ±1.5 dB

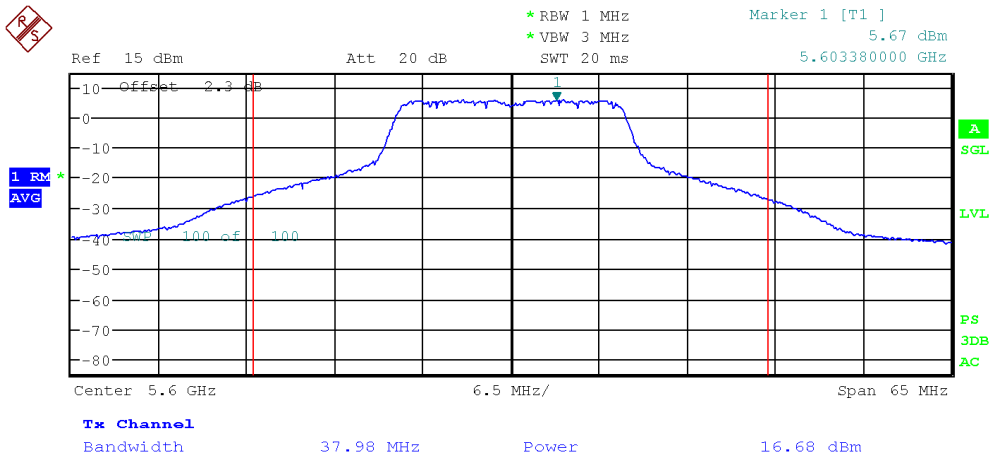
Verdict: Pass

## 802.11a mode

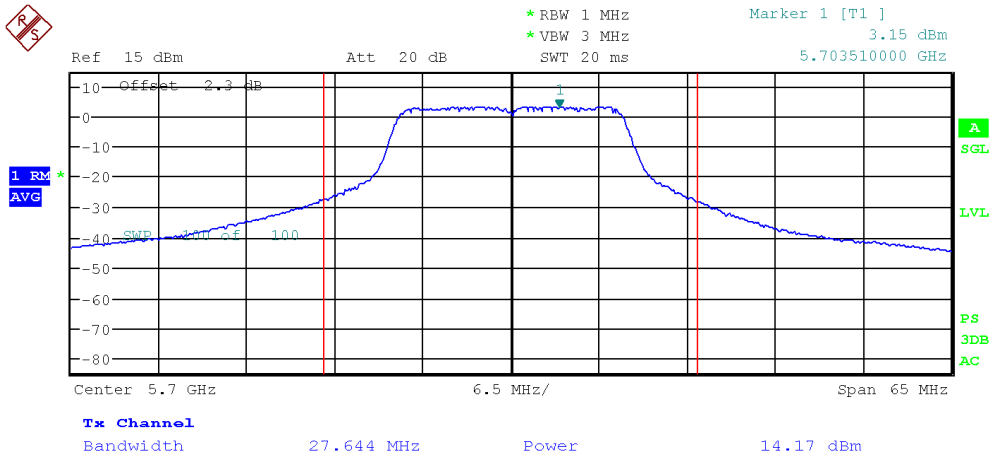
Lowest Channel




Middle Channel

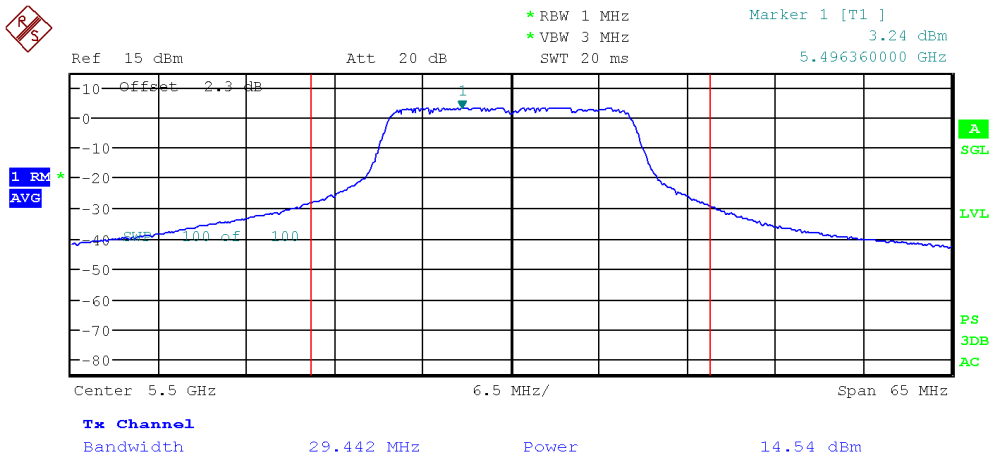


Highest Channel

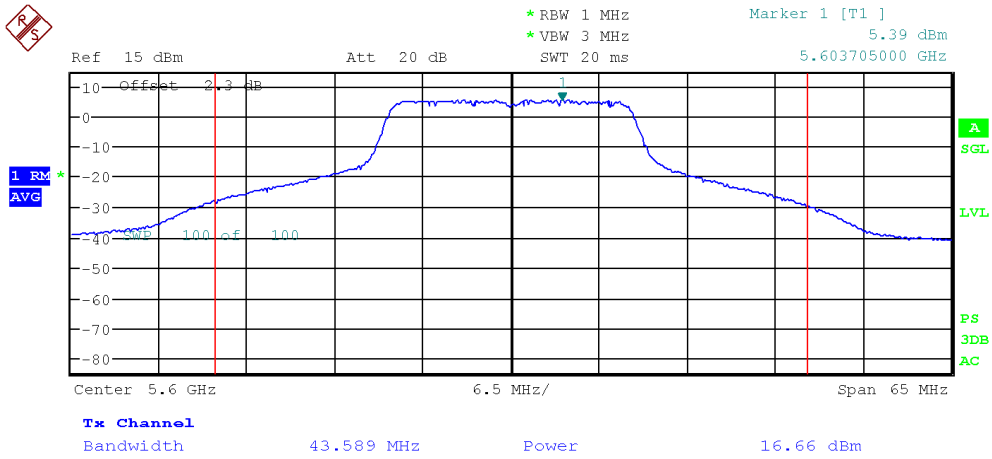



## 802.11 n20 MHz modes (except channel 144)

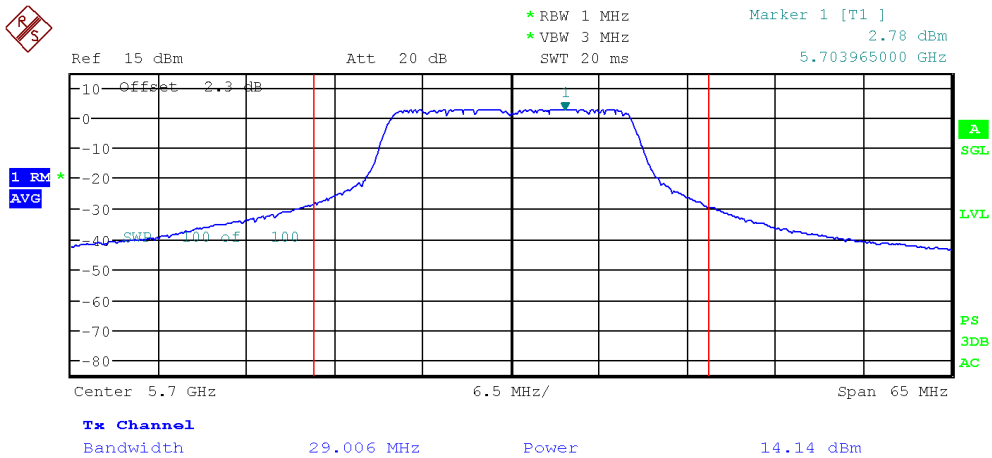
Lowest Channel



Middle Channel

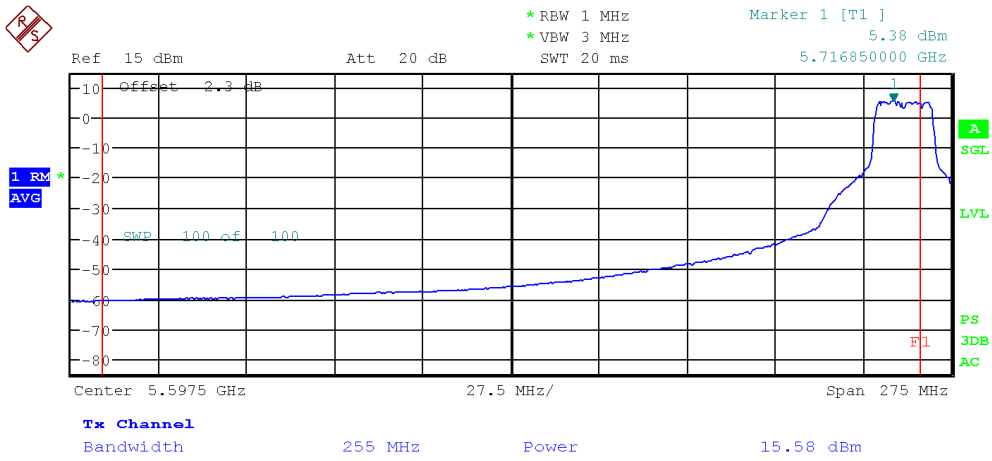



Highest Channel

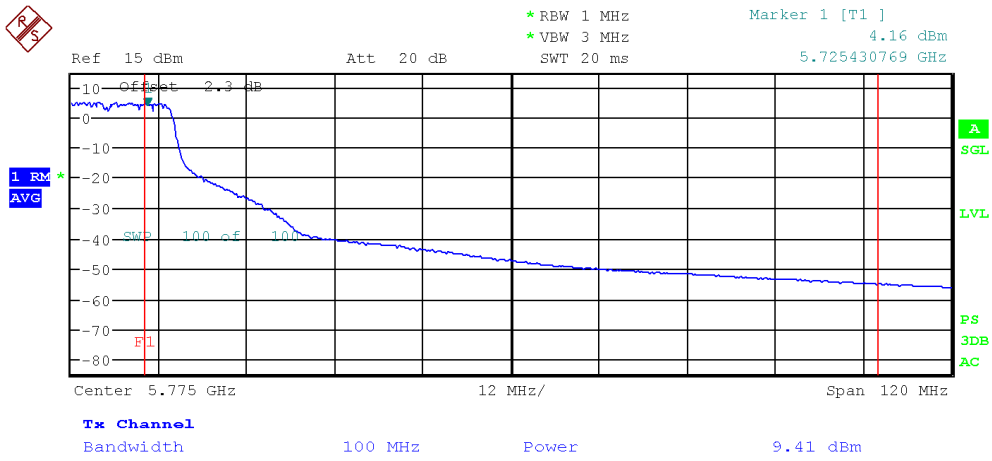


**802.11 ac 20MHz : Channel 144**

Power and PPSD in sub-band UNII_3:

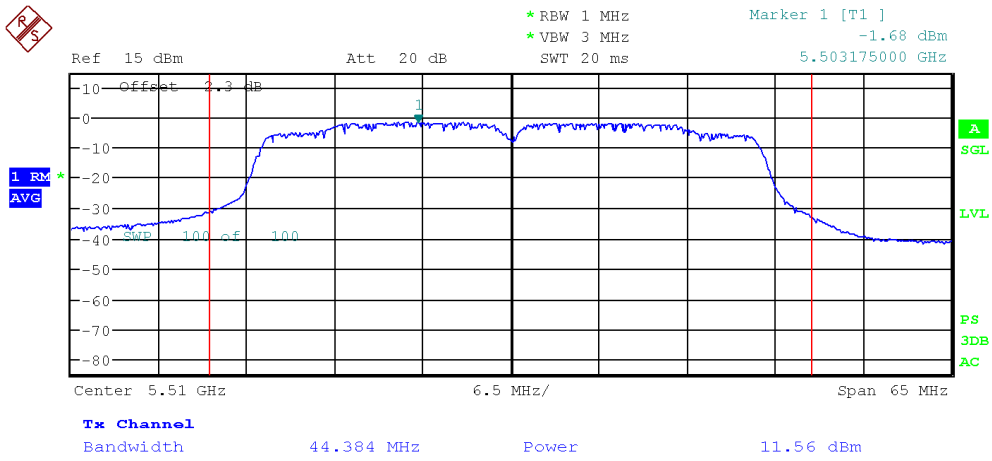



Power and PPSD in sub-band UNII_4:

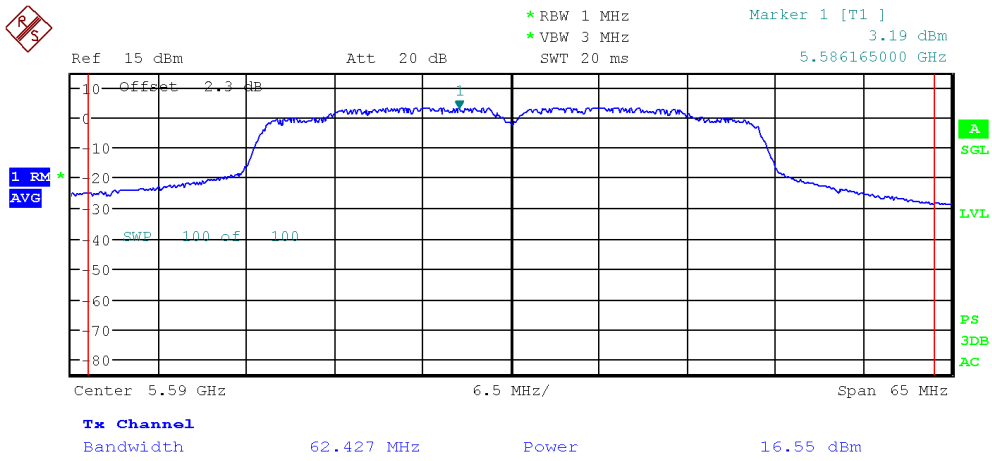


## 802.11 n40 MHz modes (except channel 142)

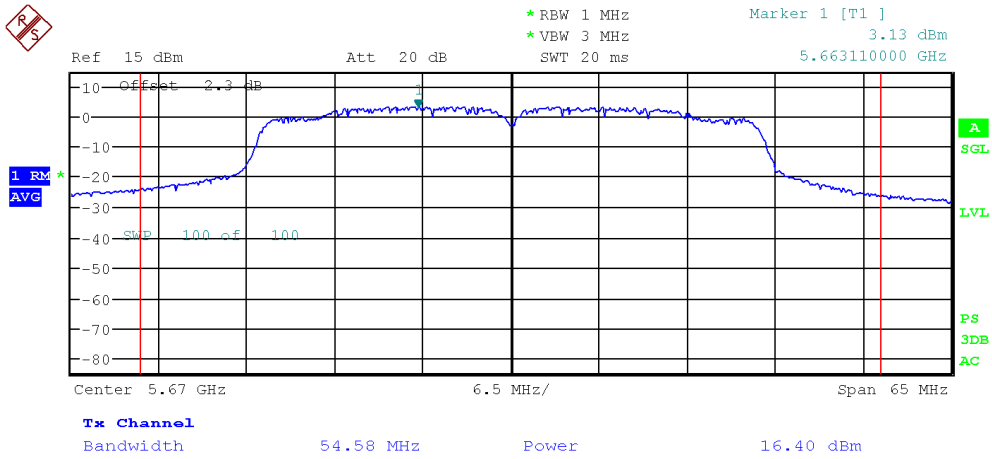
Lowest Channel




Middle Channel

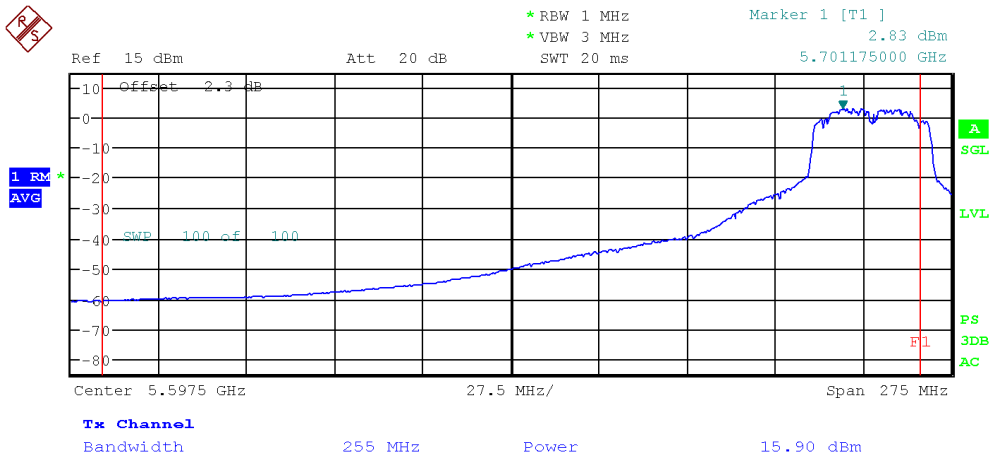


Highest Channel

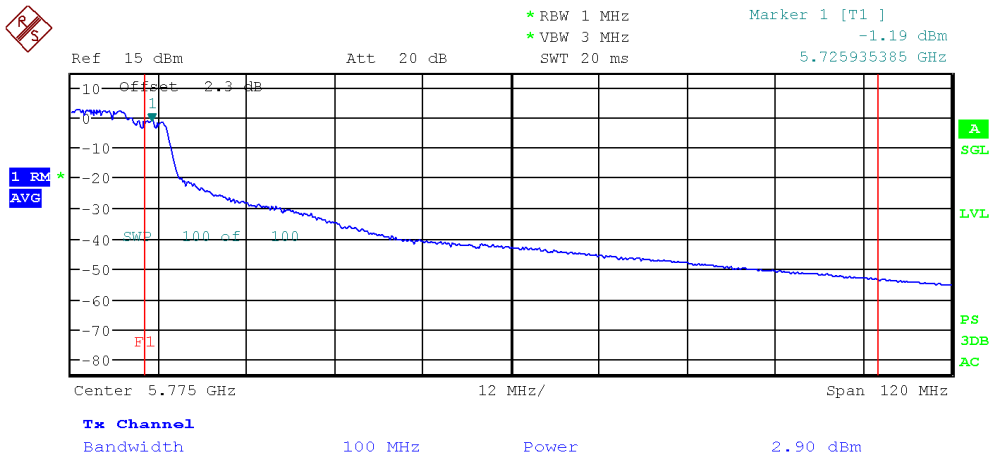



**802.11 ac 40MHz : Channel 142**

Power and PPSD in sub-band UNII_3:

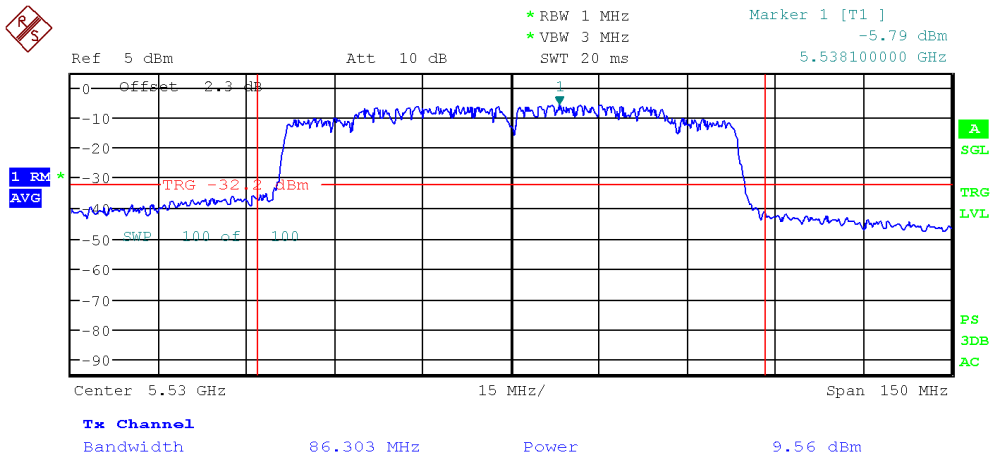


Power and PPSD in sub-band UNII_4:

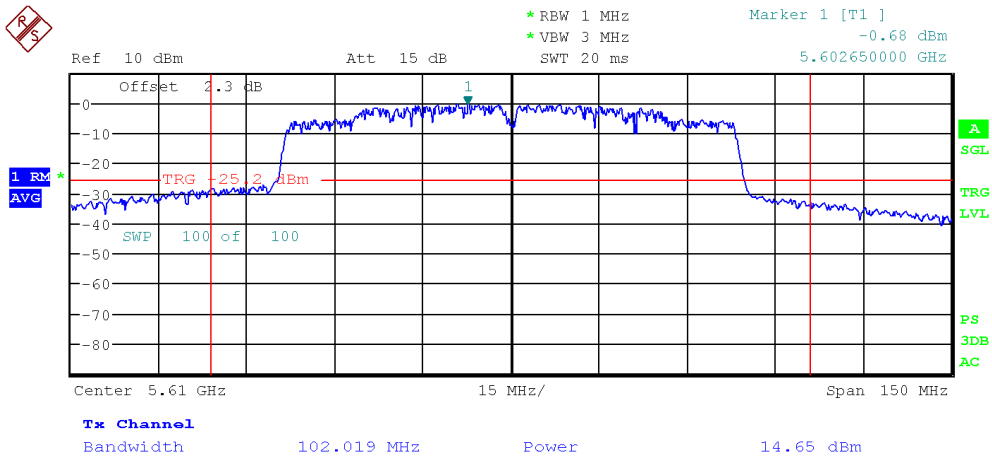


## 802.11 ac80 MHz modes (except channel 138)

Lowest Channel

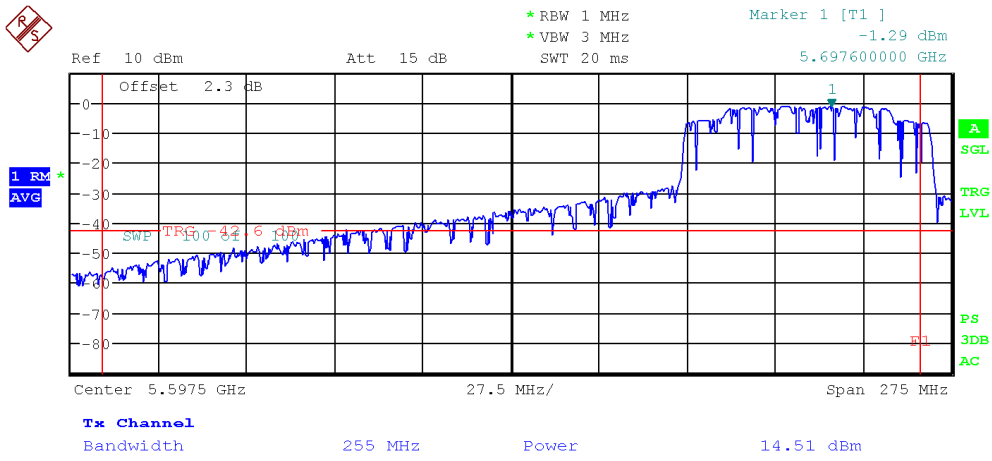



Highest Channel

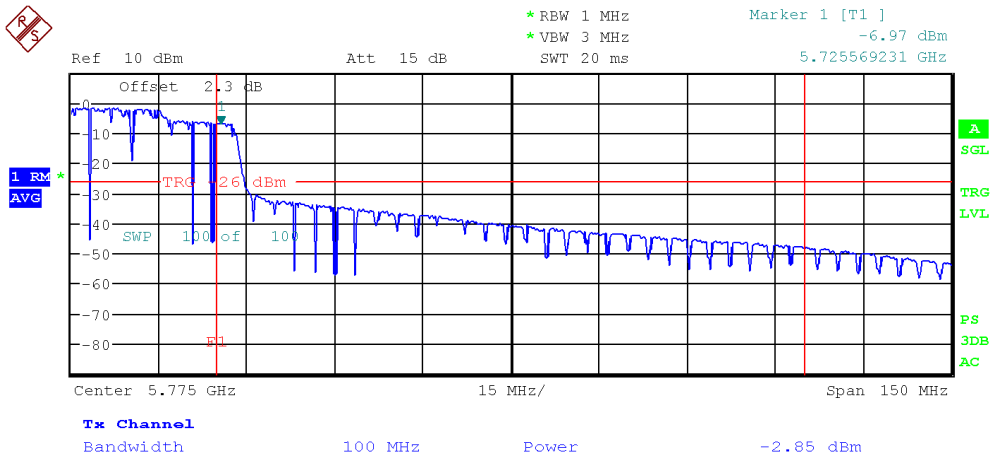


**802.11 ac80MHz : Channel 138**

Power and PPSD in sub-band UNII_3:




Power and PPSD in sub-band UNII_4:



**Section 15.407 Subclause (b) (3) / RSS-210 A9.2. (3). Undesirable radiated emissions (Transmitter) 1 to 40 GHz**

SPECIFICATION

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 (68.23 dBµV/m at 3 m distance).

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) (see §15.205(c)):

| Frequency Range (MHz) | Field strength (µV/m) | Field strength (dBµV/m) | Measurement distance (m) |
|---|---|---|---|
| 0.009-0.490 | 2400/F(kHz) | - | 300 |
| 0.490-1.705 | 24000/F(kHz) | - | 300 |
| 1.705 - 30.0 | 30 | - | 30 |
| 30 - 88 | 100 | 40 | 3 |
| 88 - 216 | 150 | 43.5 | 3 |
| 216 - 960 | 200 | 46 | 3 |
| 960 - 40000 | 500 | 54 | 3 |

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.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

All tests were performed in a semi-anechoic chamber at a distance of 1m for the frequency range 1 GHz-40 GHz.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

**Frequency range 30 MHz-1 GHz**

The spurious signals detected do not depend on either the operating channel or the modulation mode.

See test results in Appendix A for details.

**Frequency range 1 GHz-40 GHz**

The results in the next tables show the maximum measured levels in the 1-40 GHz range including the restricted band 5.35-5.46 GHz and adjacent bands 5.46-5.47 GHz and 5.725-5.825 GHz (see next plots).

For OFDM modulation modes (802.11g, 802.11n20, 802.11n40 and 802.11ac80), a preliminary measurement in the central channel in the range 1-18 GHz was performed to determine the worst case. The lowest channel was measured for out-of-band emissions for the worst case (802.11a). The highest channel was measured for out-of-band emissions for channel 144 (ac20 mode 5720 MHz) since the adjusted transmit power is higher than channel 140 (802.11a mode 5700 MHz).

The field strength at the band edges was evaluated for each mode and on each chain individually on the lowest and highest channels at the rated power for the channel under test. Where the power at the edge channels was lower than the power at the center channels additional measurements were made at the adjacent channels.

Spurious signals with peak levels above the average limit (54 dBµV/m at 3 m) are measured with average detector for checking compliance with the average limit.

1. WiFi 5GHz 802.11 a mode.

Lowest frequency (100) 5500 MHz. Out-of-band spurious emissions inside restricted band 5.35-5.46 GHz and 5.46-5.47 adjacent band.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.47 | V | Peak | 61.06 | ± 4.09 |
| | | Average | 48.91 | ± 4.09 |

Middle frequency (120) 5600 MHz. Out-of-band spurious emissions in the 1-40 GHz range.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 11.19883 | V | Peak | 47.03 | ± 4.09 |
| 16.80255 | V | Peak | 44.19 | ± 4.09 |
| 22.39999 | V | Peak | 50.82 | ± 4.09 |

Highest frequency (140) 5700 MHz. Out-of-band spurious emissions in the 1-40 GHz range and spurious emissions inside adjacent band 5.725-5.825 GHz.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.725 | H | Peak | 59.41 | ± 4.09 |
| | | Average | 48.04 | ± 4.09 |
| 11.400298 | V | Peak | 49.05 | ± 4.09 |
| 22.79996 | V | Peak | 50.51 | ± 4.09 |

Channel 104 (5520 MHz): Out-of-band spurious emissions inside restricted band 5.35-5.46 GHz and 5.46-5.47 adjacent band.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.468269 | V | Peak | 59.51 | ± 4.09 |
| | | Average | 47.76 | ± 4.09 |

Channel 136 (5680 MHz). Out-of-band spurious emissions inside adjacent band 5.725-5.825 GHz.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.82244 | H | Peak | 60.92 | ± 4.09 |
| | | Average | 47.86 | ± 4.09 |

Verdict: PASS

2. WiFi 5GHz 802.11 n20 mode

Lowest frequency (100) 5500 MHz. Out-of-band spurious emissions inside restricted band 5.35-5.46 GHz and 5.46-5.47 adjacent band.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.469615 | V | Peak | 60.49 | ± 4.09 |
| | | Average | 49.14 | ± 4.09 |

Middle frequency (120) 5600MHz. Out-of-band spurious emissions in the 1-40 GHz range.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 11.20568 | V | Peak | 47.99 | ± 4.09 |
| 22.39999 | V | Peak | 50.59 | ± 4.09 |

Highest frequency (140) 5700 MHz. Out-of-band spurious emissions inside adjacent band 5.725-5.825 GHz.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.81635 | V | Peak | 61.57 | ± 4.09 |
| | | Average | 47.48 | ± 4.09 |

Channel 104 (5520 MHz): Out-of-band spurious emissions inside restricted band 5.35-5.46 GHz and 5.46-5.47 adjacent band.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.464035 | V | Peak | 59.23 | ± 4.09 |
| | | Average | 47.93 | ± 4.09 |

Channel 136 (5680 MHz). Out-of-band spurious emissions inside adjacent band 5.725-5.825 GHz.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.76330 | V | Peak | 60.63 | ± 4.09 |
| | | Average | 47.24 | ± 4.09 |

802.11 ac 20MHz:

Channel 144 (5720 MHz). Out-of-band spurious emissions in the 1-40 GHz range.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 11.4390 | V | Peak | 49.28 | ± 4.09 |
| 22.87991 | V | Peak | 51.54 | ± 4.09 |

Verdict: PASS

3. WiFi 5GHz 802.11 n40 mode

Lowest frequency (102) 5510MHz. Out-of-band spurious emissions inside restricted band 5.35-5.46 GHz and 5.46-5.47 adjacent band. Highest levels in bands.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.47 | V | Peak | 60.78 | ± 4.09 |
| | V | Average | 49.72 | ± 4.09 |

Middle frequency (118) 5590 MHz. Out-of-band spurious emissions in the 1-40 GHz range.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 11.17804 | V | Peak | 46.80 | ± 4.09 |
| 22.35983 | V | Peak | 50.61 | ± 4.09 |

Highest frequency (134) 5670MHz. Out-of-band spurious emissions inside adjacent band 5.725-5.825 GHz.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.81667 | V | Peak | 60.92 | ± 4.09 |
| | | Average | 47.83 | ± 4.09 |

Channel 110 (5550 MHz). 5510MHz. Out-of-band spurious emissions inside restricted band 5.35-5.46 GHz and 5.46-5.47 adjacent band. Highest spurious levels in bands.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.45981 | V | Peak | 60.79 | ± 4.09 |
| | | Average | 48.81 | ± 4.09 |

Verdict: PASS

4. WiFi 5GHz 802.11 ac80 mode

Lowest frequency (106) 5530MHz. Out-of-band spurious emissions inside restricted band 5.35-5.46 GHz and 5.46-5.47 adjacent band. Highest spurious levels in bands.

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.461153 | V | Peak | 64.07 | ± 4.09 |
| | | Average | 51.38 | ± 4.09 |

Middle frequency (122) 5610MHz. Out-of-band spurious emissions in the 1-40 GHz range and emissions inside restricted band 5.35-5.46 GHz and 5.46-5.47 GHz / 5.725-5.825 GHz adjacent bands.

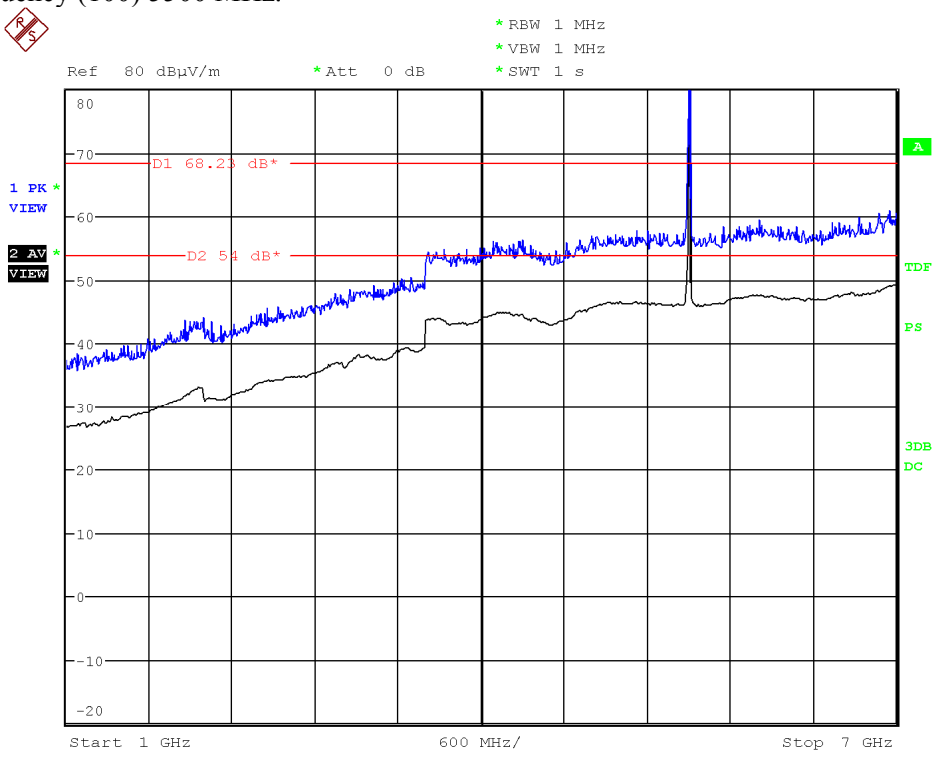
| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 5.44231 | V | Peak | 60.25 | ± 4.09 |
| | | Average | 47.25 | ± 4.09 |
| 11.23237 | V | Peak | 45.75 | ± 4.09 |
| 22.43988 | V | Peak | 50.61 | ± 4.09 |

Verdict: PASS

**FREQUENCY RANGE 1 GHz to 7 GHz.**

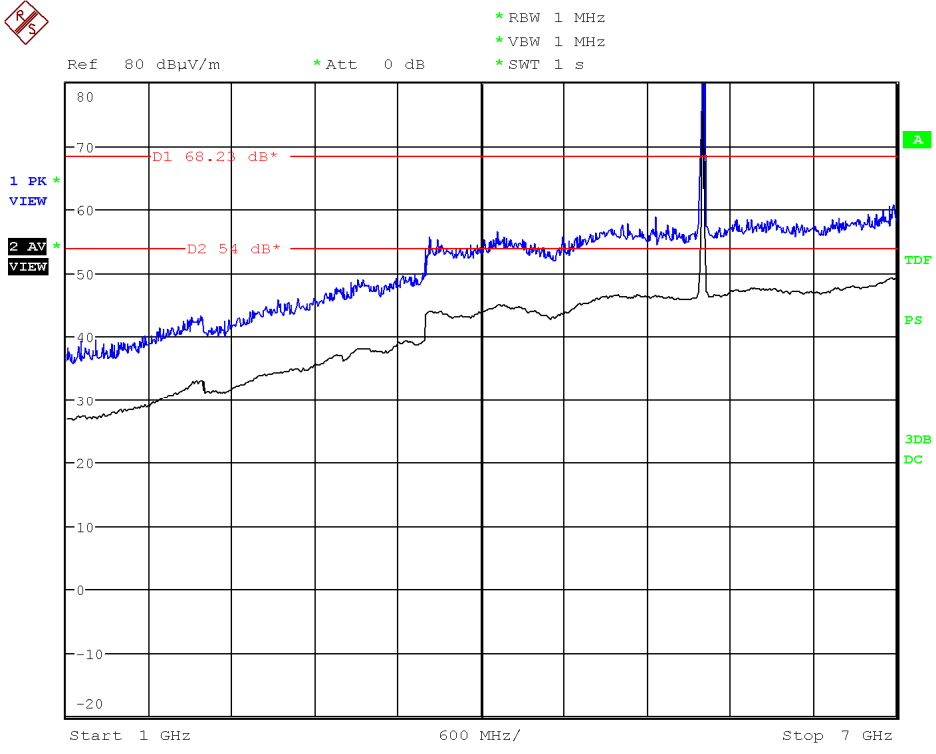
1. WiFi 5GHz 802.11 a mode

Lowest frequency (100) 5500 MHz.



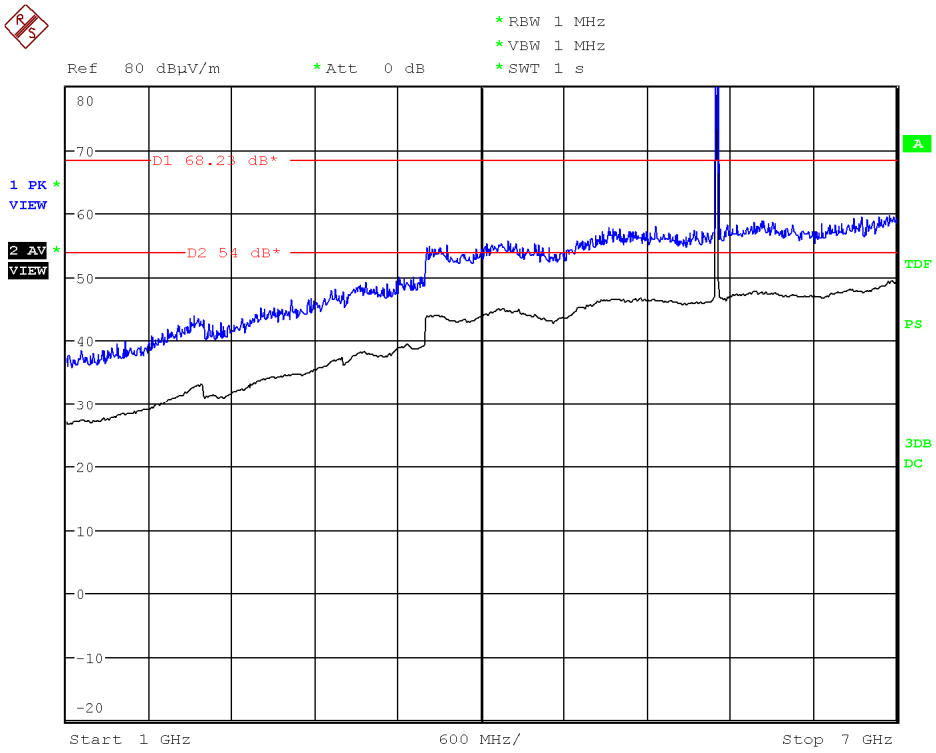

Note: The peak above the limit is the carrier frequency.

Middle frequency (120) 5600 MHz.




Note: The peak above the limit is the carrier frequency.

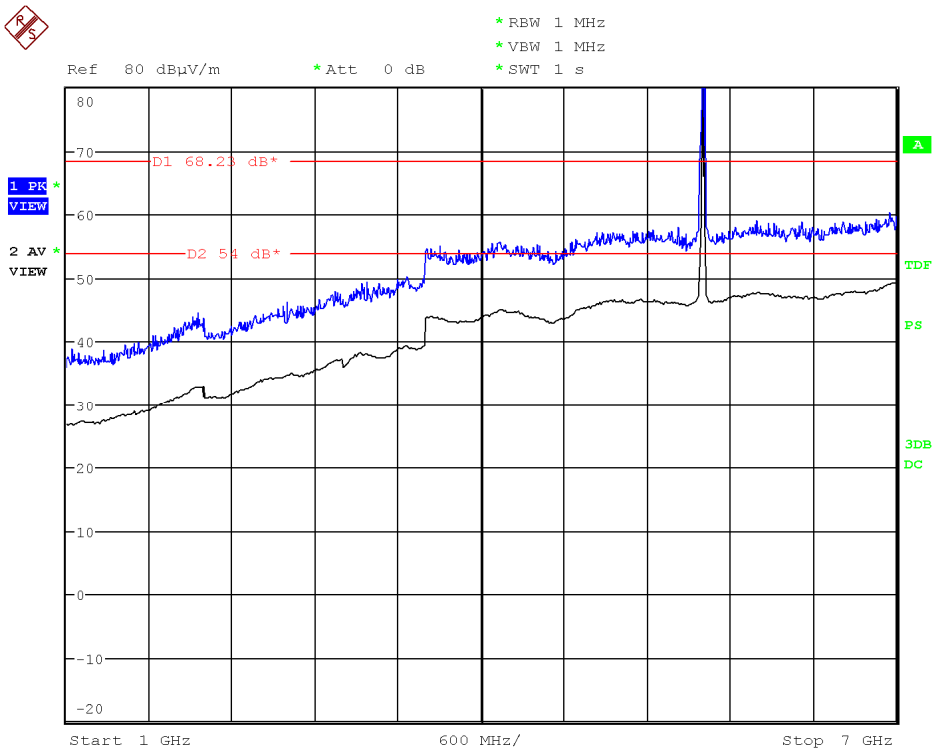
Middle frequency (140) 5700 MHz.




Note: The peak above the limit is the carrier frequency.

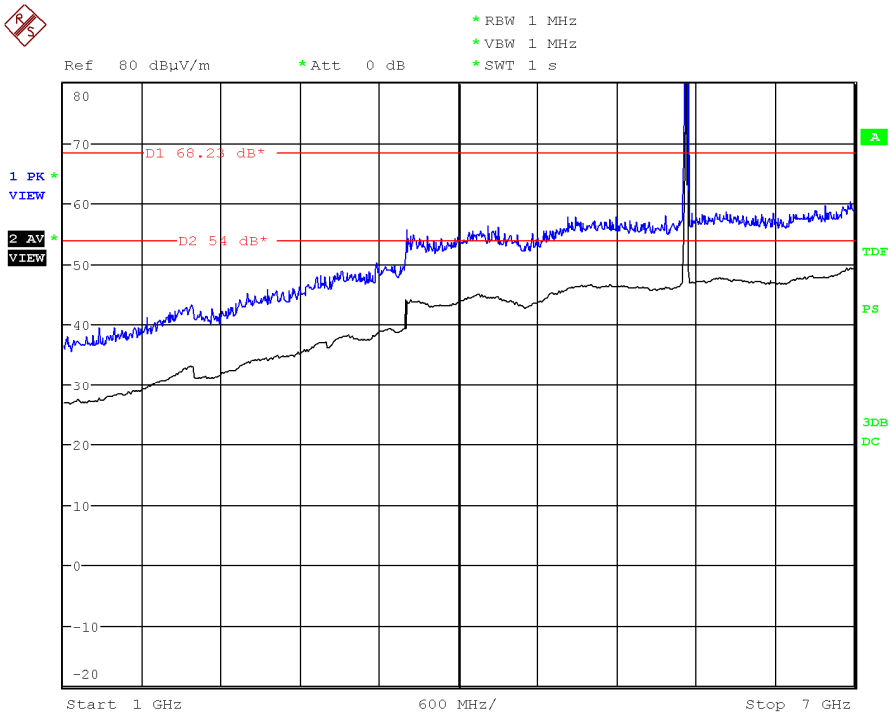
2. WiFi 5GHz 802.11 n20 mode

Middle frequency (120) 5600 MHz.




Note: The peak above the limit is the carrier frequency.

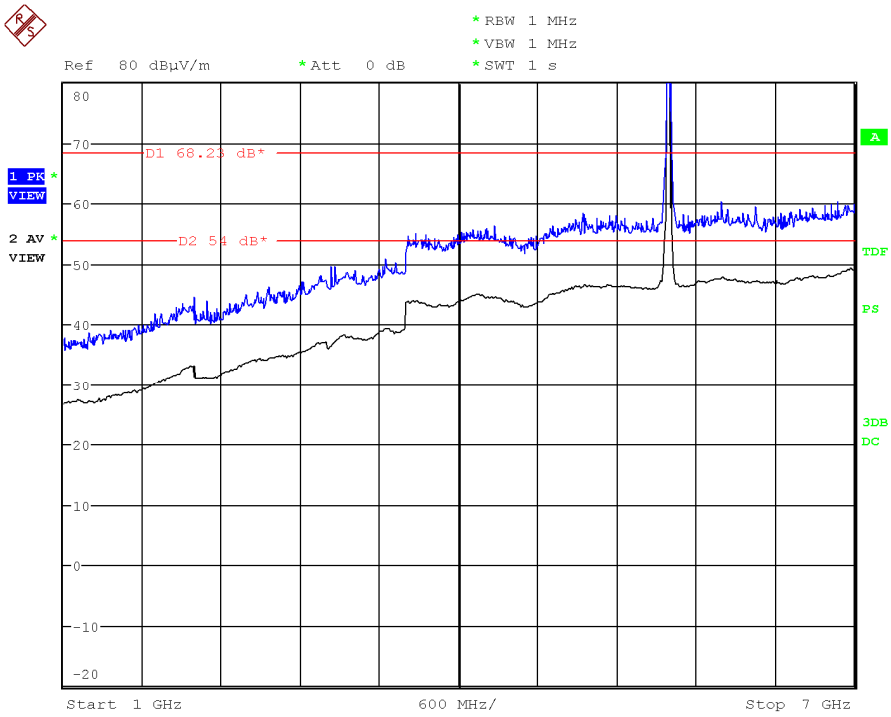
802.11ac20 mode: CH 144 5720 MHz.




Note: The peak above the limit is the carrier frequency.

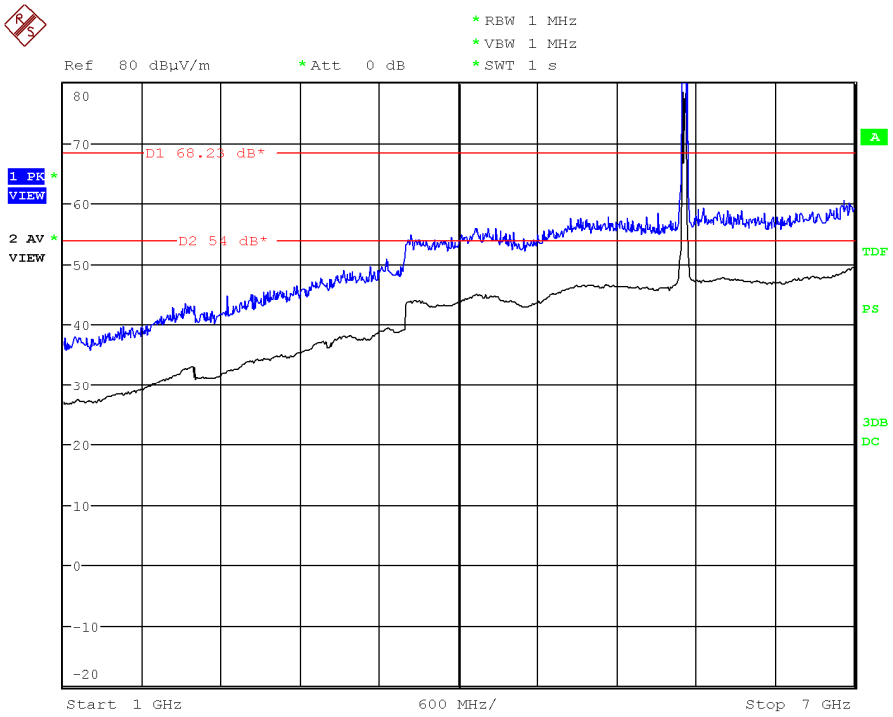
3. WiFi 5GHz 802.11 n40 mode

Middle frequency (118) 5590 MHz.




Note: The peak above the limit is the carrier frequency.

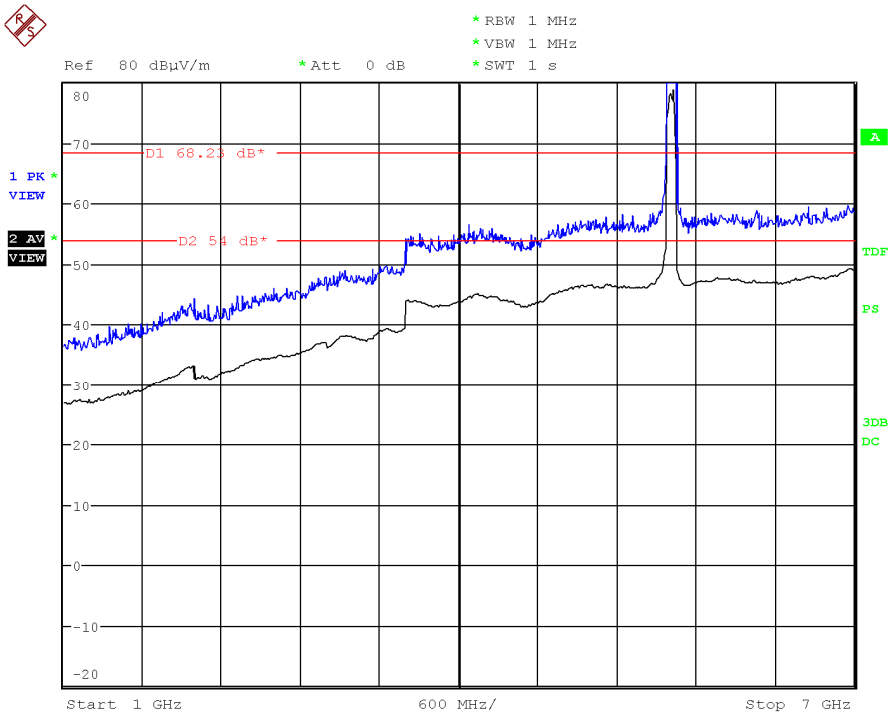
802.11ac40 mode: CH 142 5710 MHz.




Note: The peak above the limit is the carrier frequency.

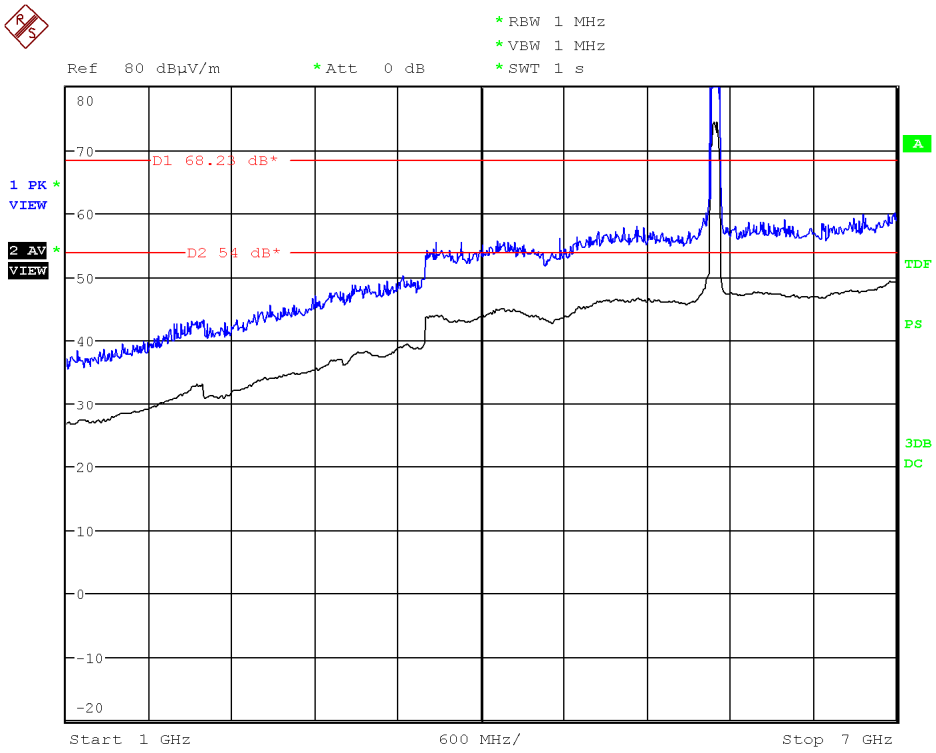
4. WiFi 5GHz 802.11 ac80 mode

Middle frequency (122) 5610 MHz.




Note: The peak above the limit is the carrier frequency.

802.11ac80 mode: CH 138 5690 MHz.

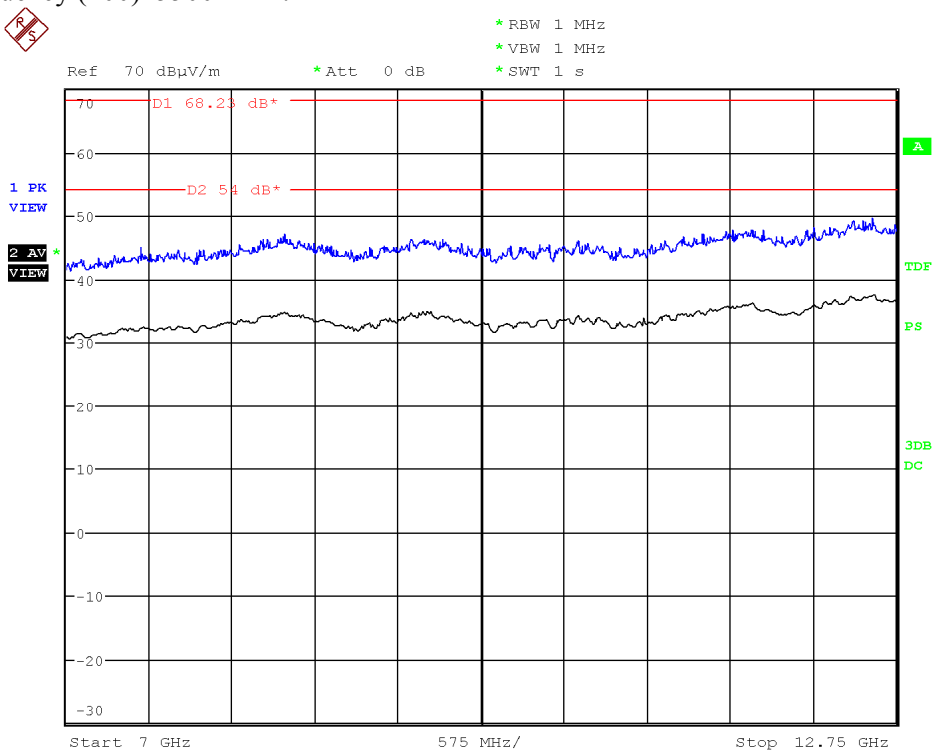



Note: The peak above the limit is the carrier frequency.

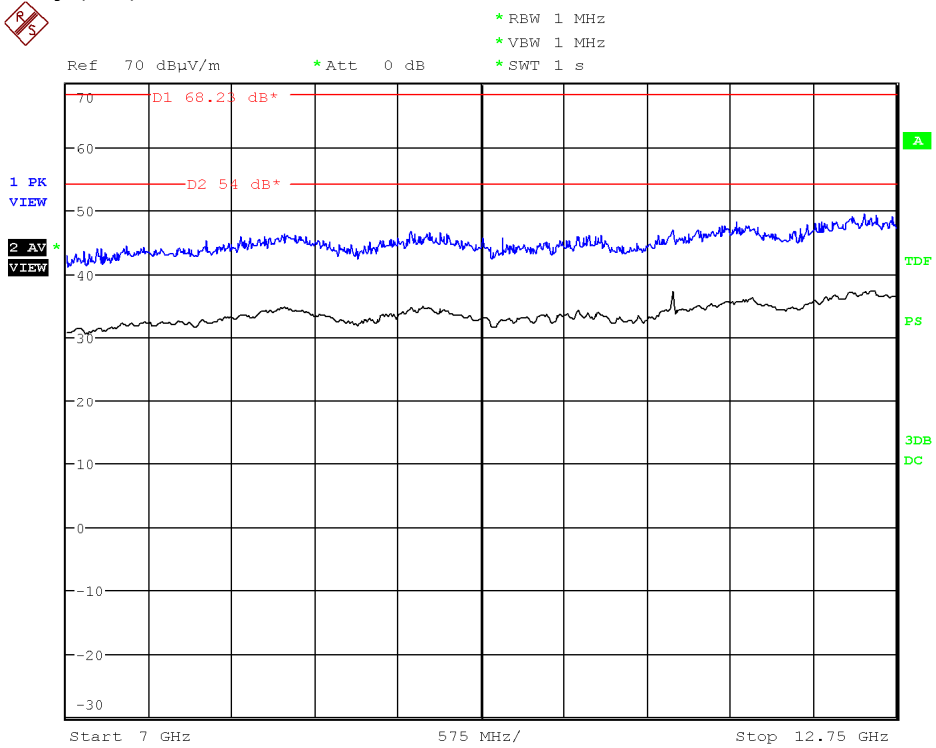
**FREQUENCY RANGE 7 GHz to 12.75 GHz.**

1. WiFi 5GHz 802.11 a mode

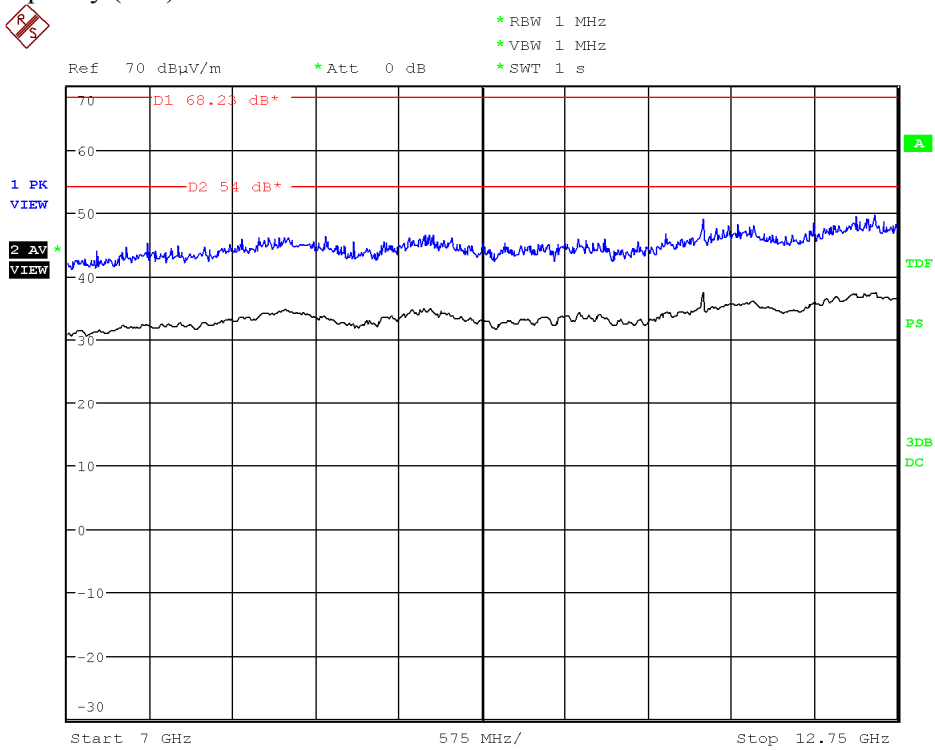
Lowest frequency (100) 5500 MHz.



Middle frequency (120) 5600 MHz.

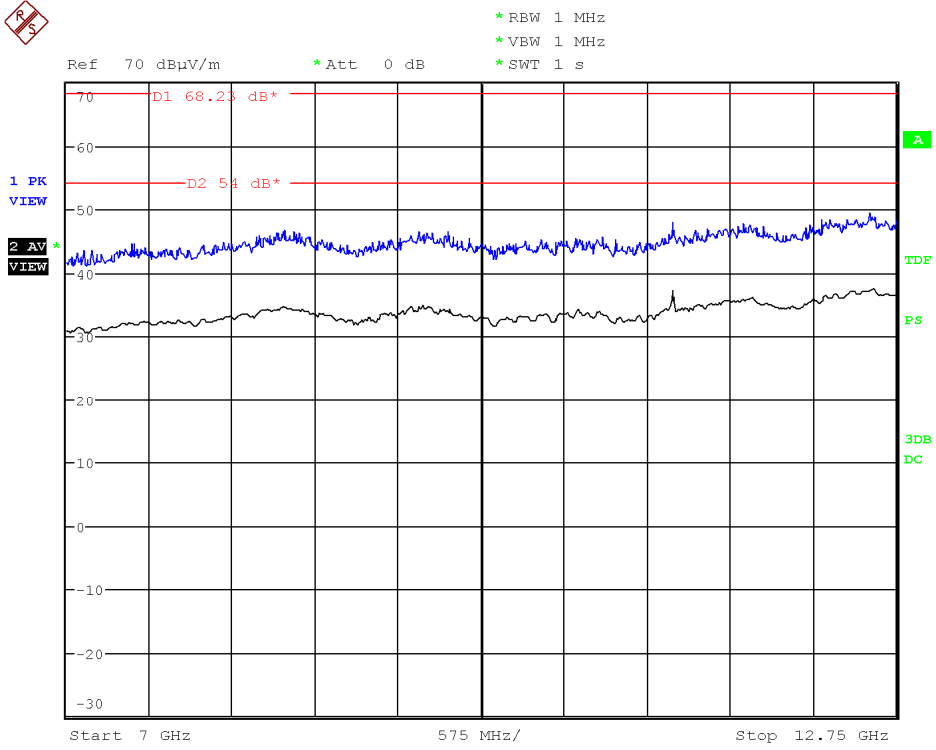



Highest frequency (140) 5700 MHz.

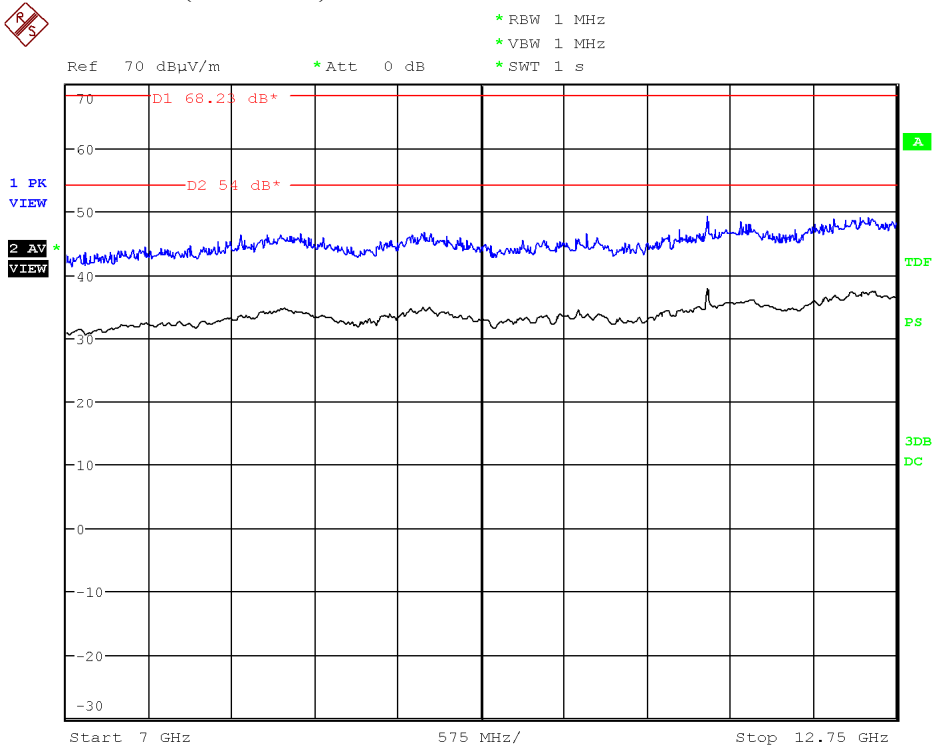


2. WiFi 5GHz 802.11 n20 mode

Middle frequency (120) 5600 MHz.

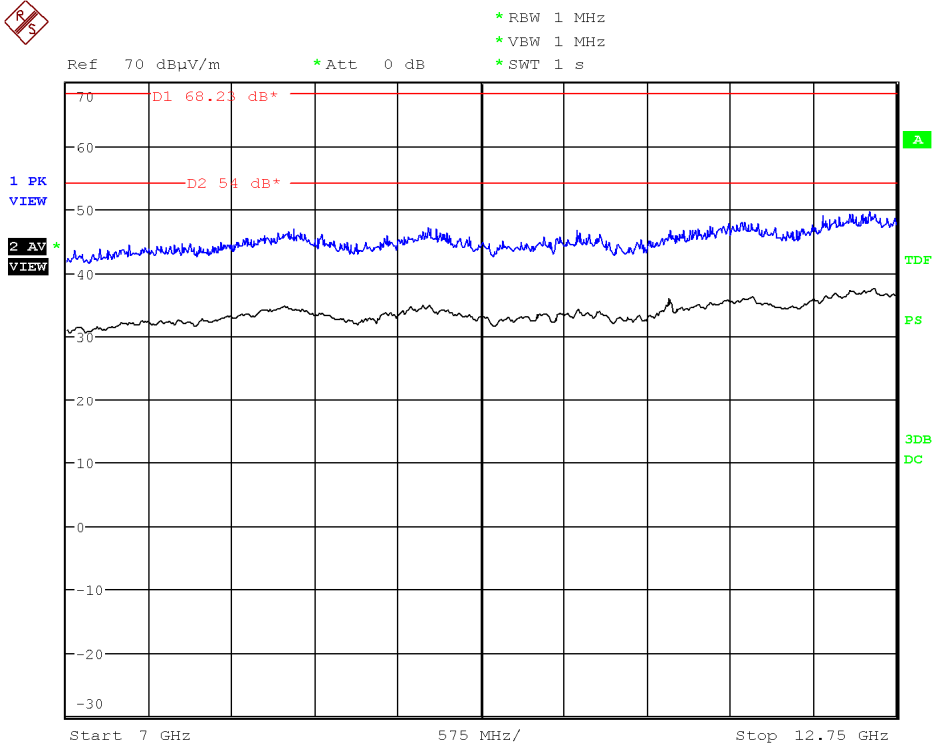



802.11ac20 mode: CH 144 (5720 MHz)

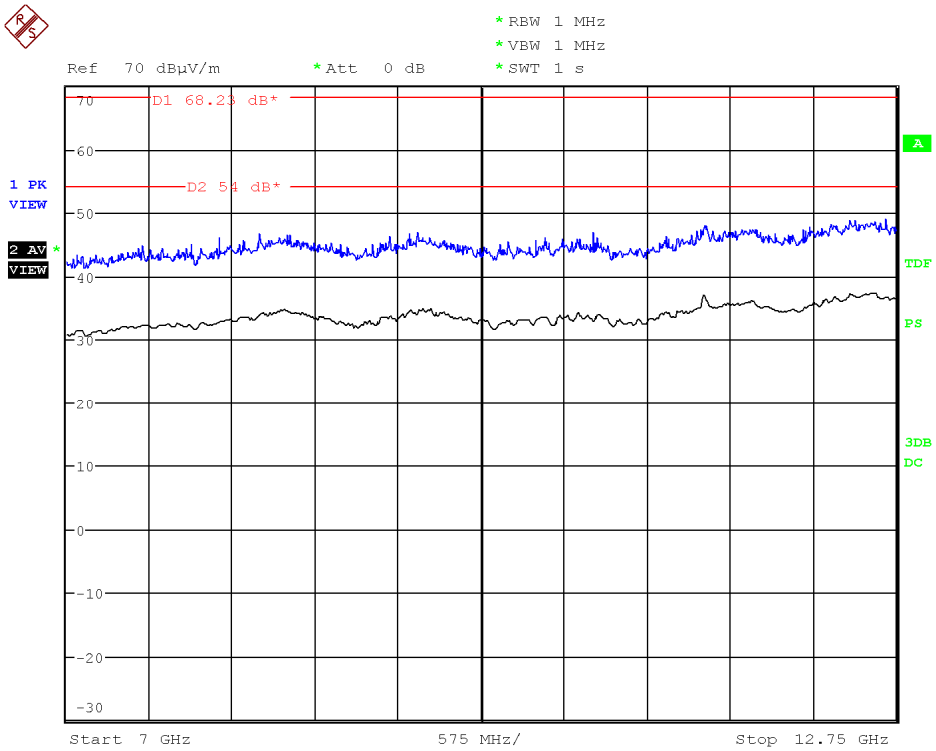


3. WiFi 5GHz 802.11 n40 mode

Middle frequency (118) 5590 MHz.

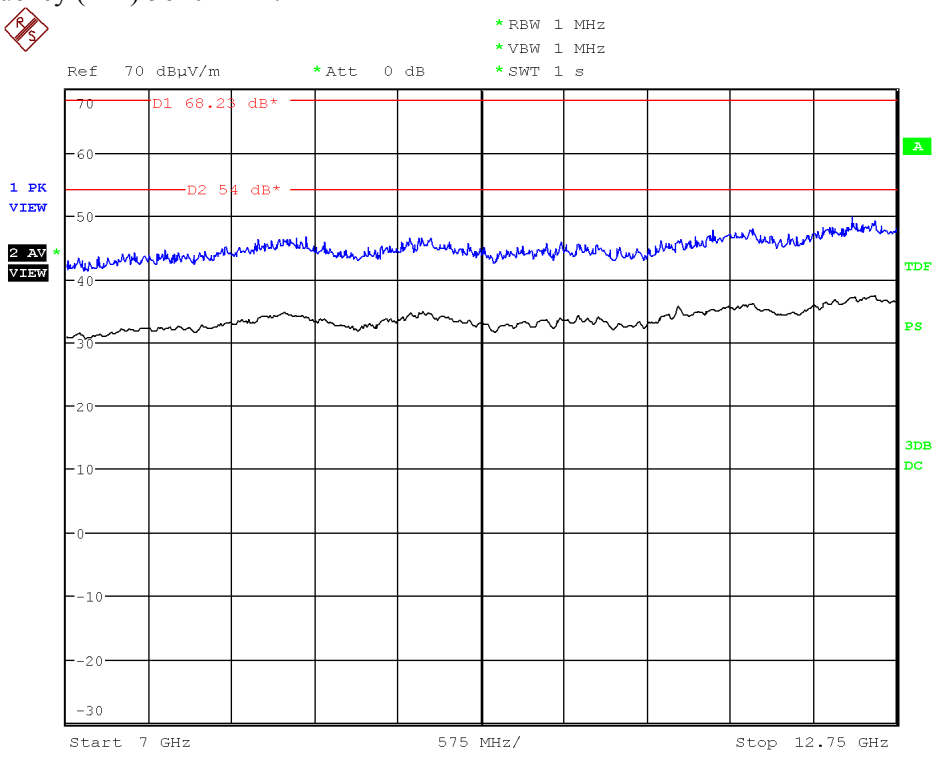



802.11ac40 mode: CH 142 5710 MHz.

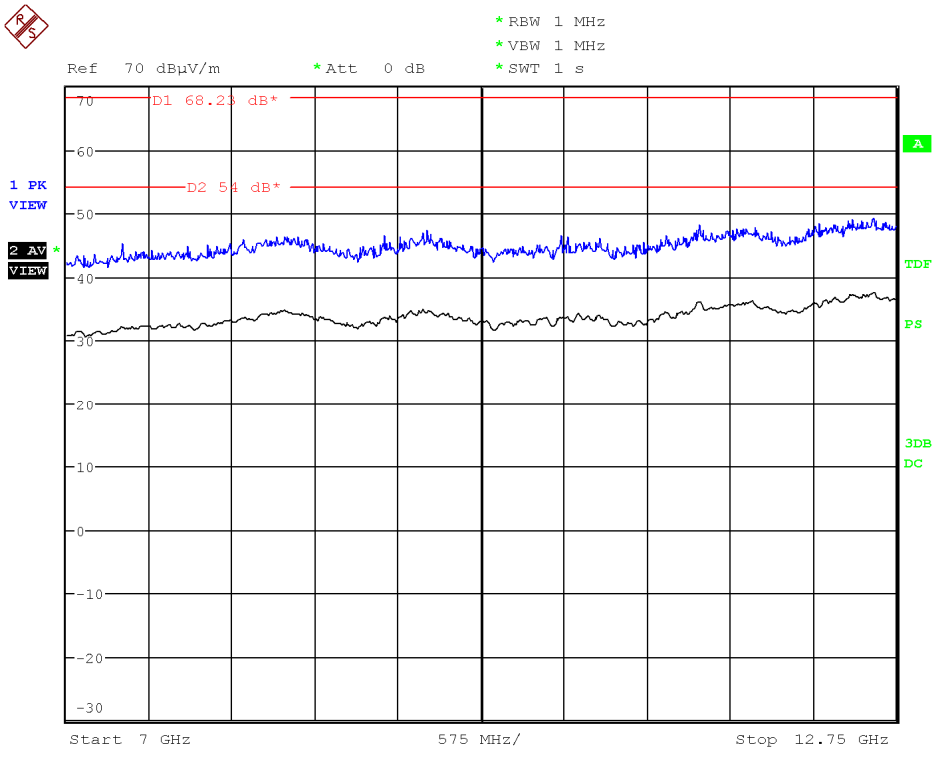


4. WiFi 5GHz 802.11 ac80 mode

Middle frequency (122) 5610 MHz.



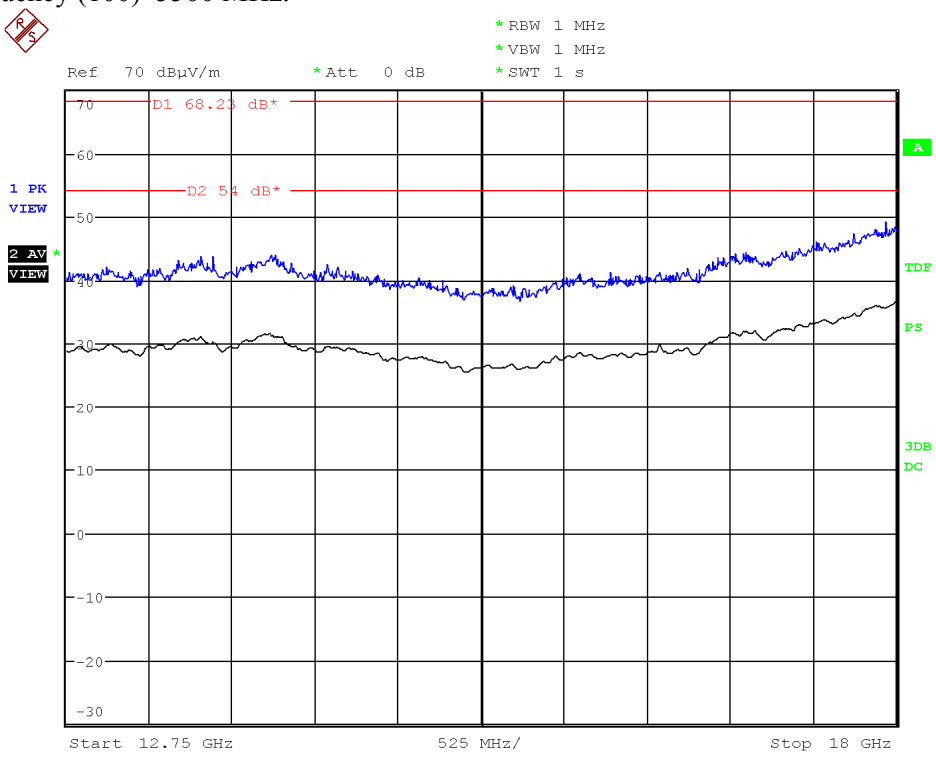

802.11ac80 mode: CH 138 5690 MHz.



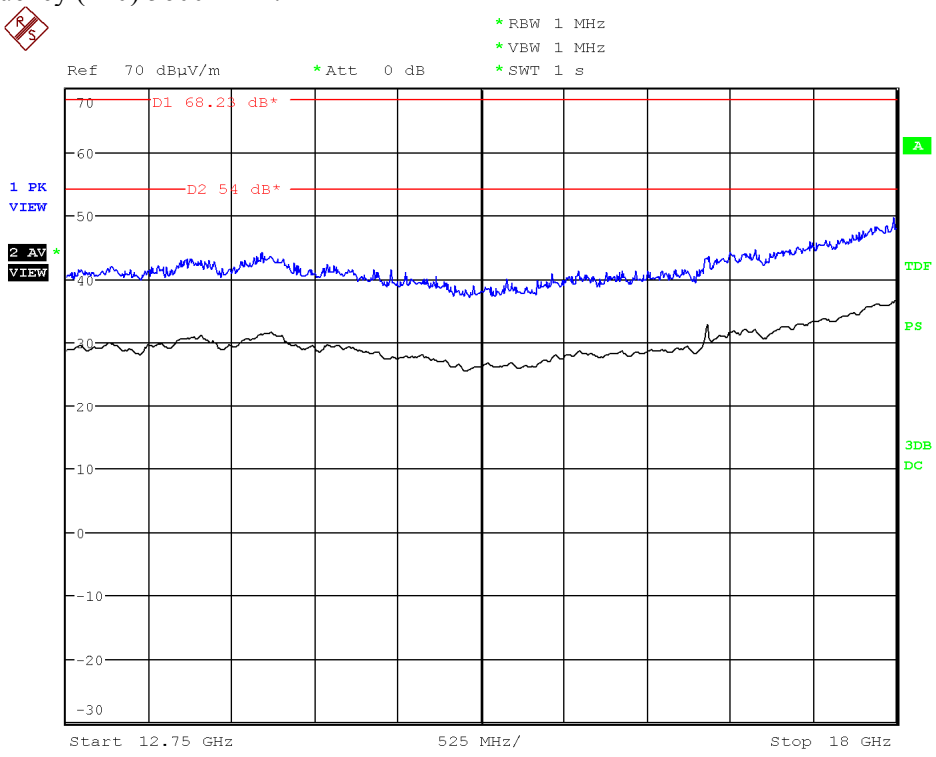
**FREQUENCY RANGE 12.75 GHz to 18 GHz.**

1. WiFi 5GHz 802.11 a mode

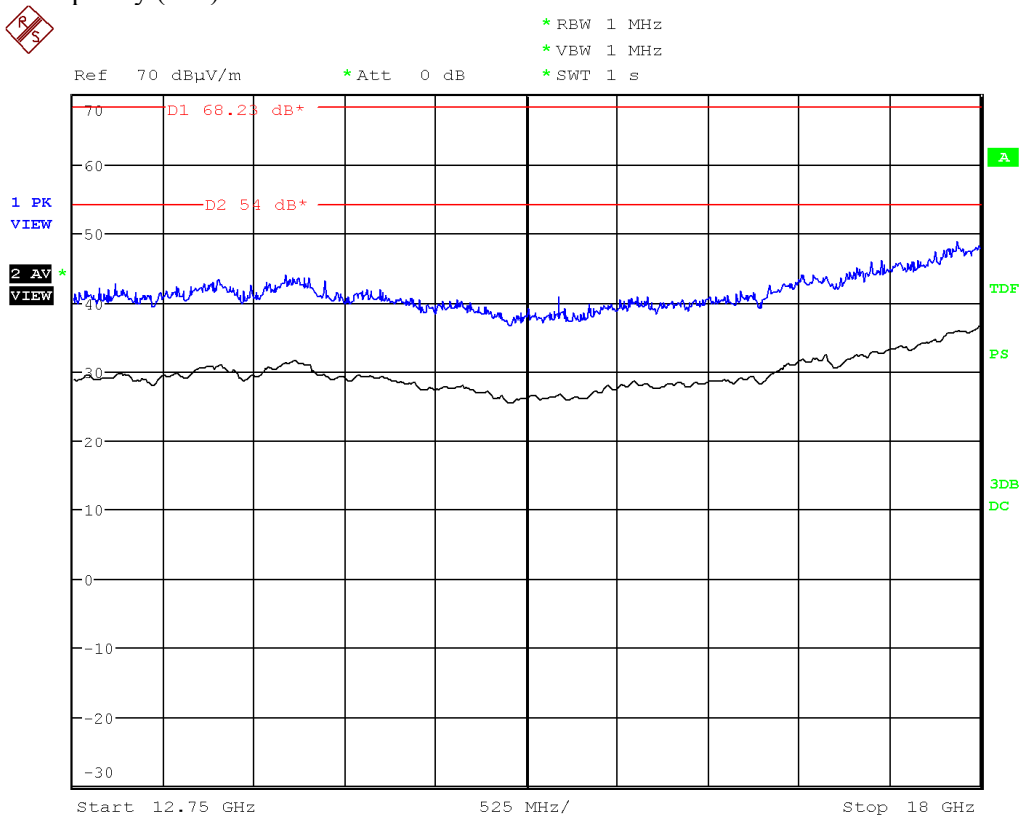
Lowest frequency (100)  5500 MHz.




Middle frequency (120) 5600 MHz.

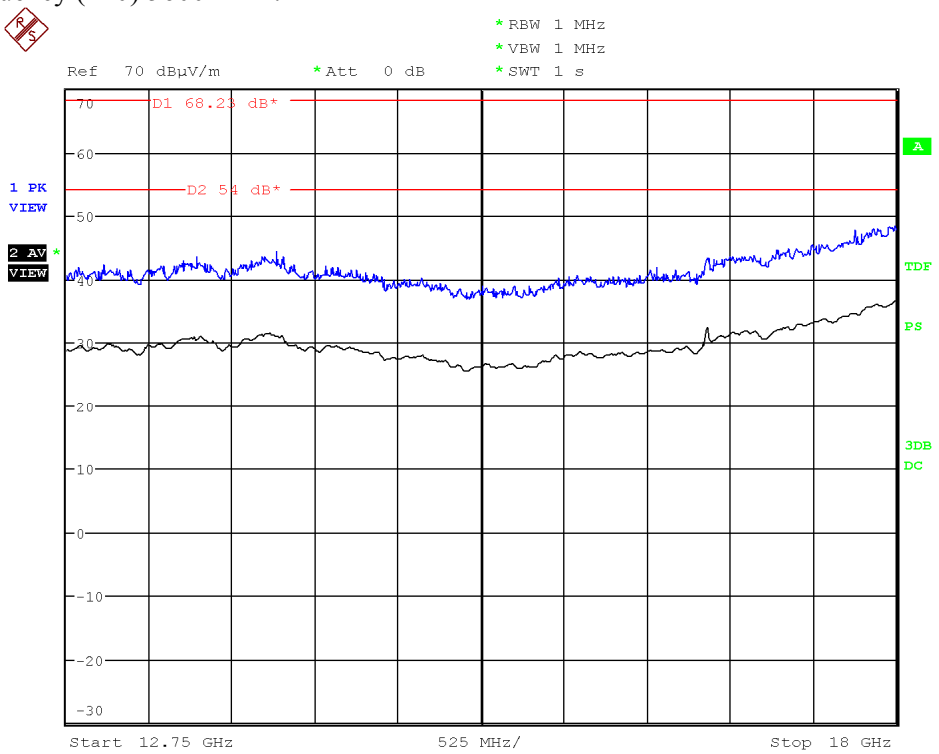


Highest frequency (140) 5700 MHz.

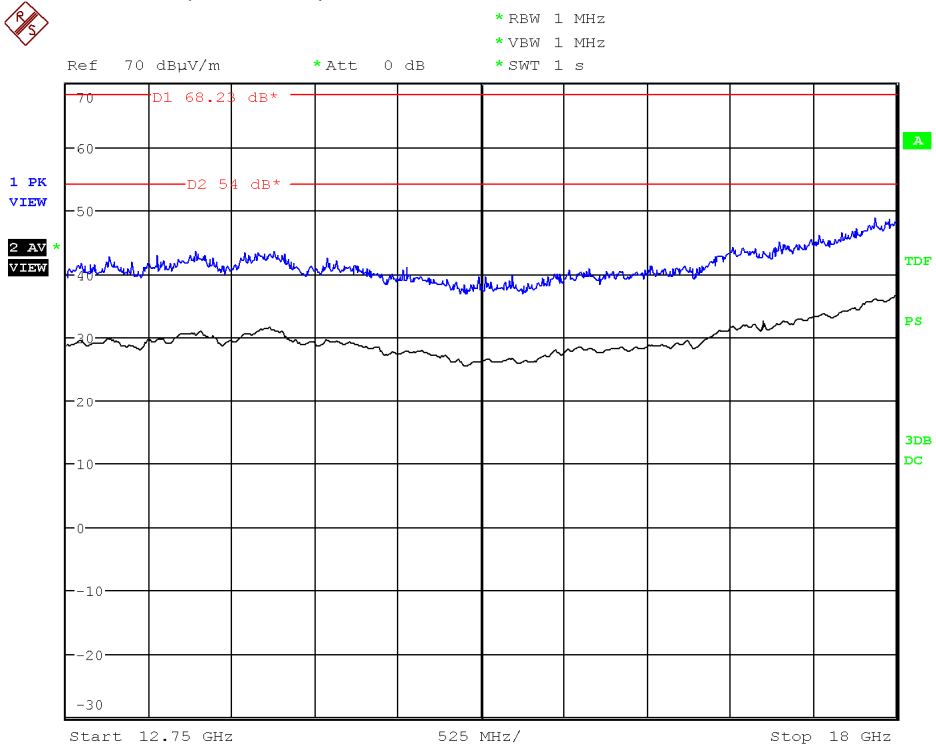



2. WiFi 5GHz 802.11 n20 mode

Middle frequency (120) 5600 MHz.

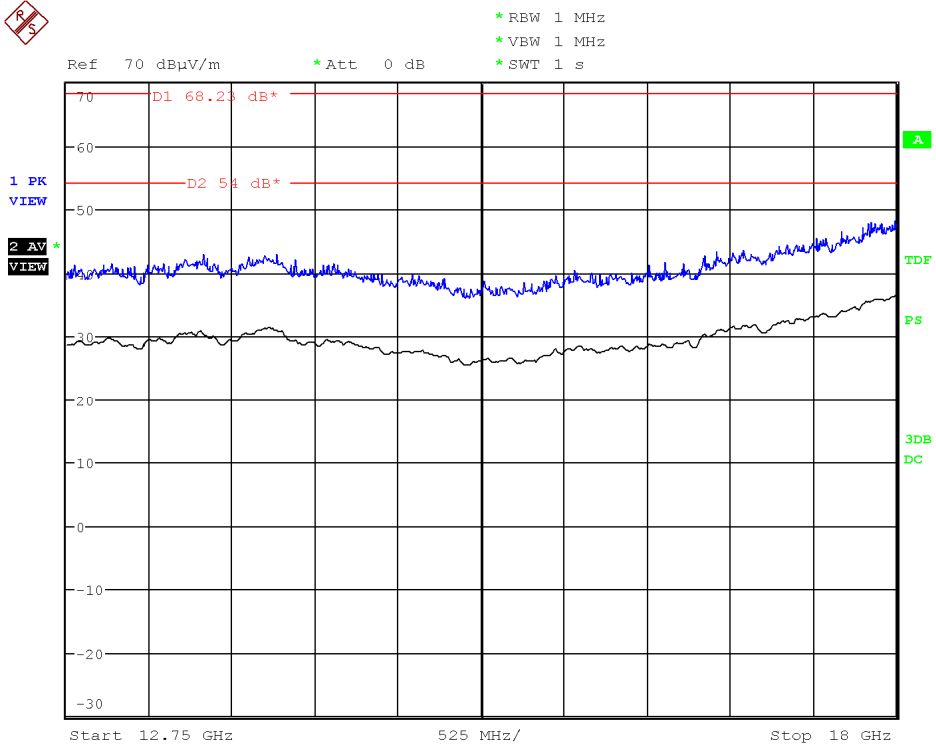


802.11ac20 mode: CH 144 (5720 MHz)

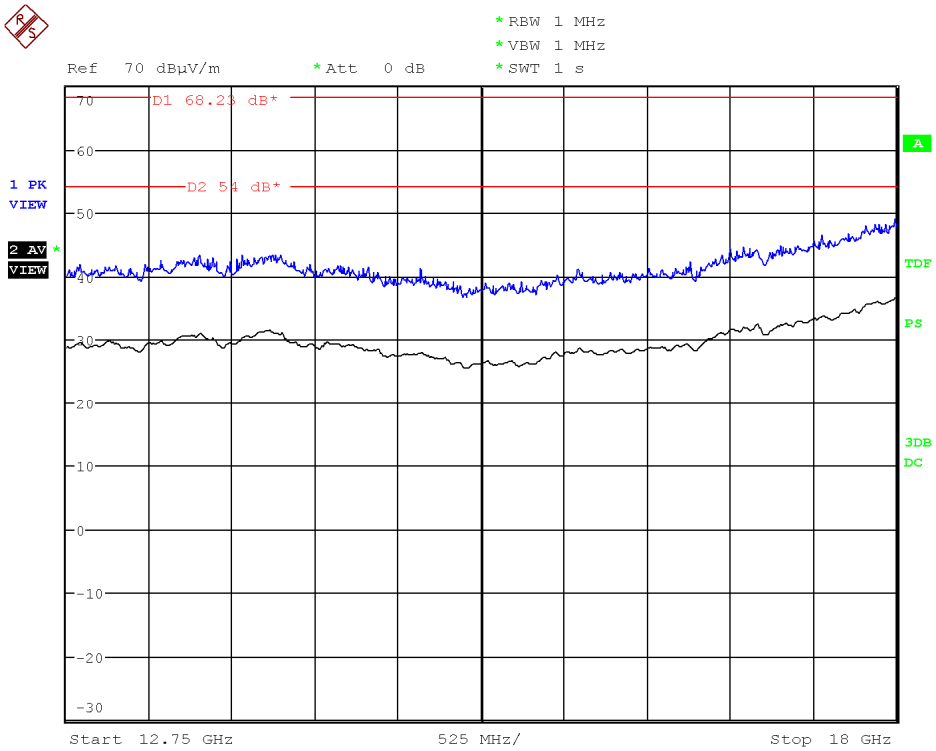


3. WiFi 5GHz 802.11 n40 mode

Middle frequency (118) 5590 MHz.

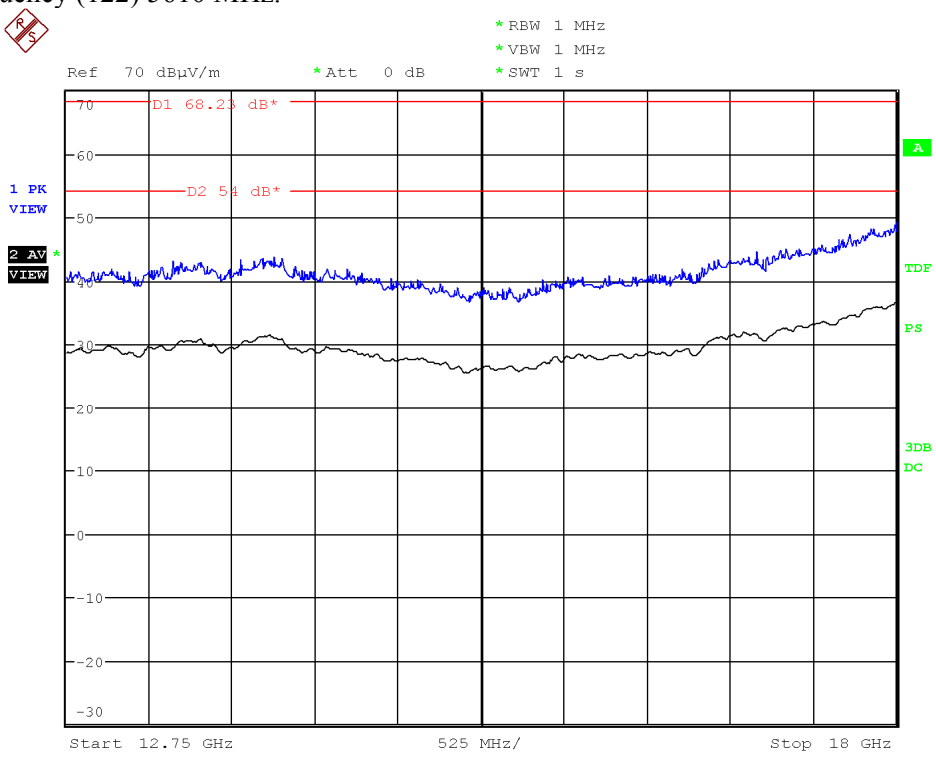



802.11ac40 mode: CH 142 5710 MHz.

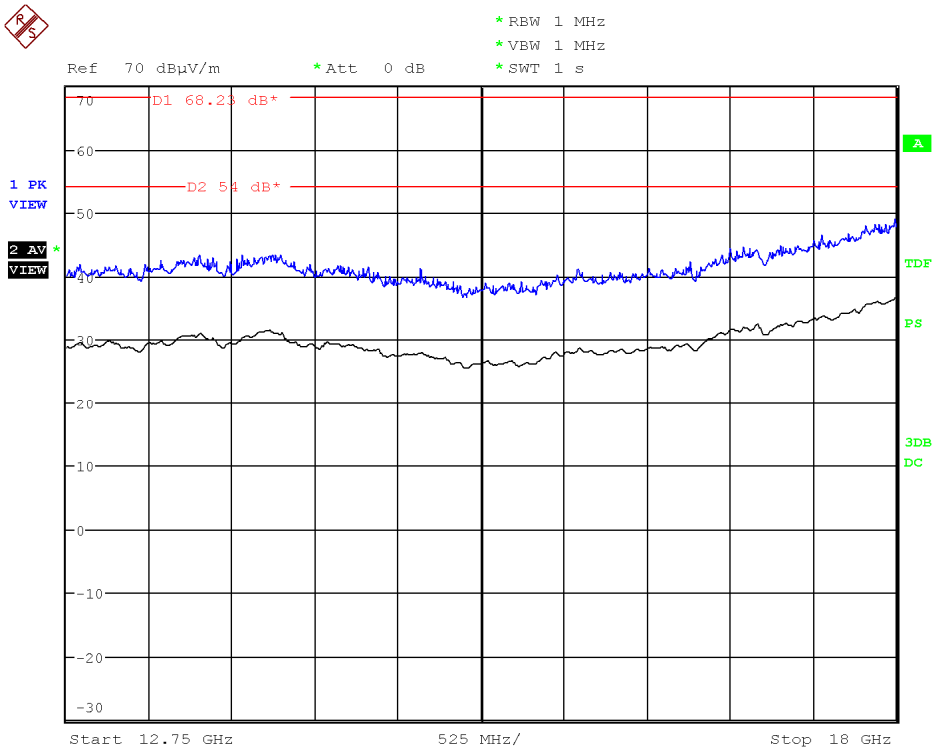


4. WiFi 5GHz 802.11 ac80 mode

Middle frequency (122) 5610 MHz.



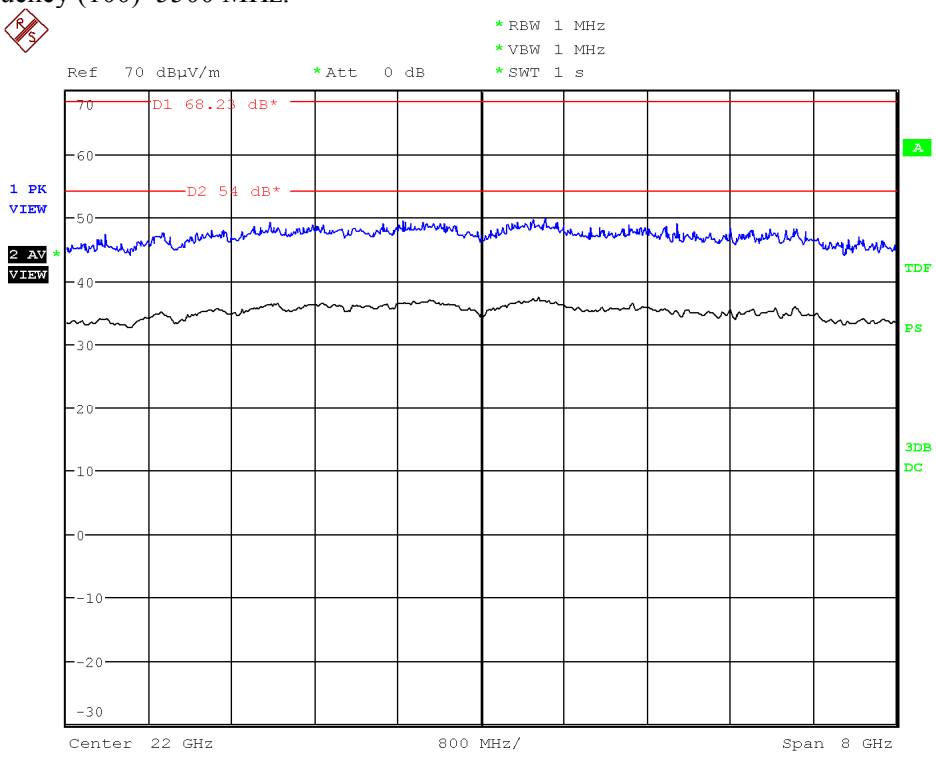

802.11ac80 mode: CH 138 5690 MHz.



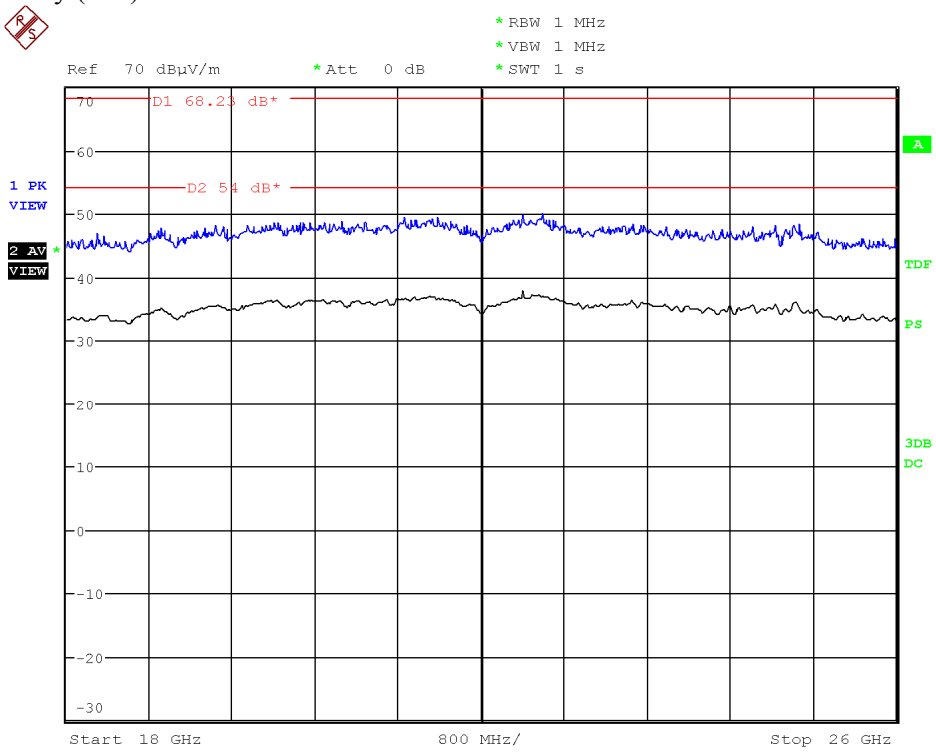
**FREQUENCY RANGE 18 GHz to 26 GHz.**

1. WiFi 5GHz 802.11 a mode

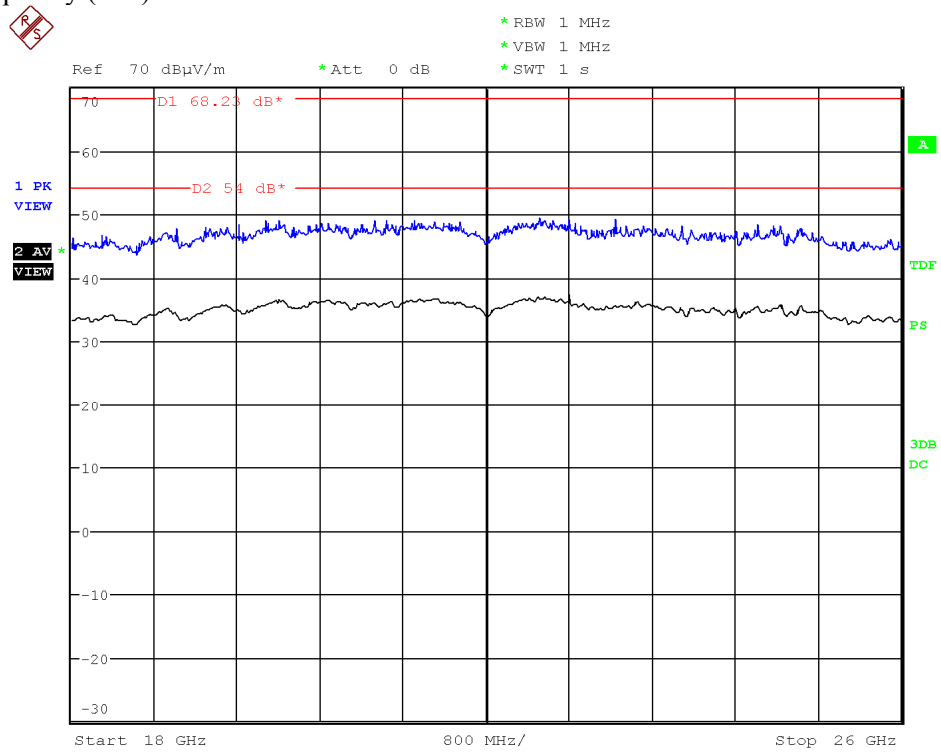
Lowest frequency (100) 5500 MHz.




Middle frequency (120) 5600 MHz.

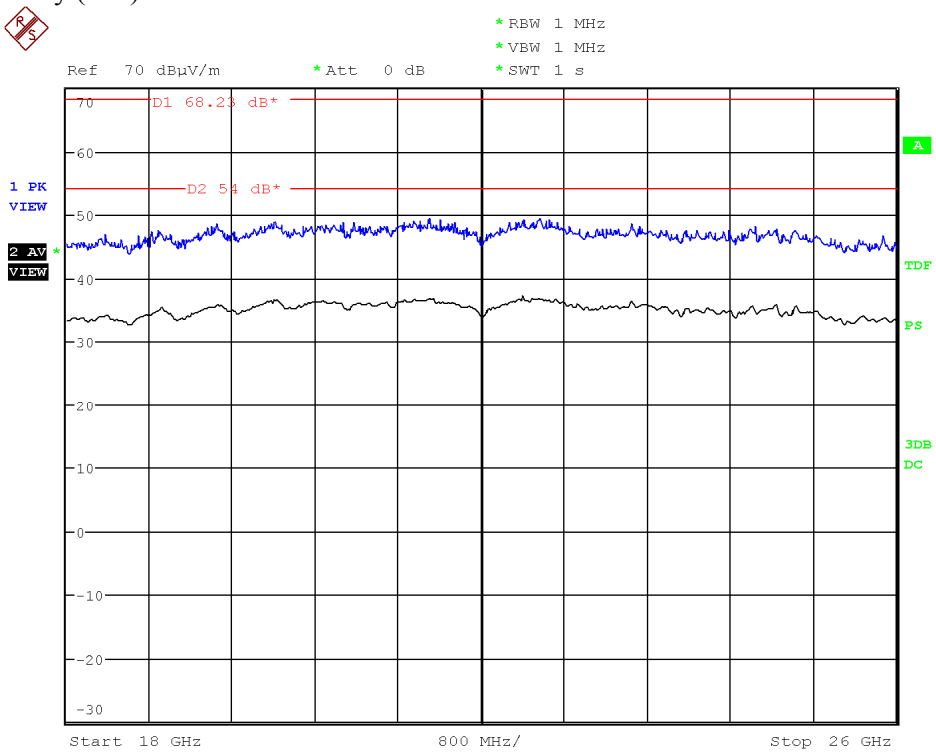


Highest frequency (140)  5700 MHz.

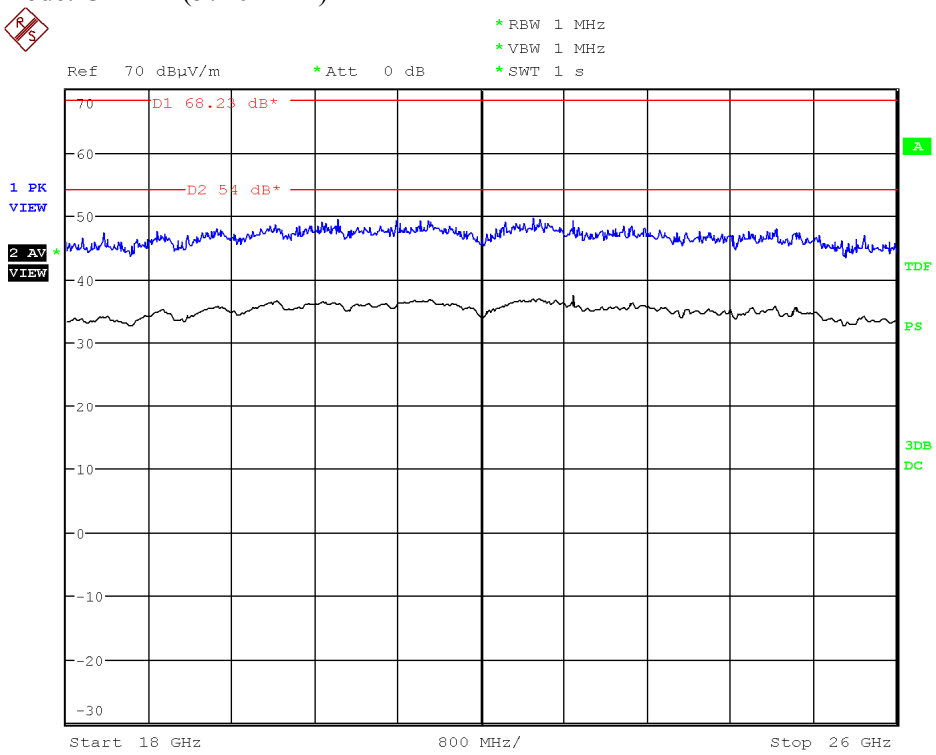



2. WiFi 5GHz 802.11 n20 mode

Middle frequency (120) 5600 MHz.

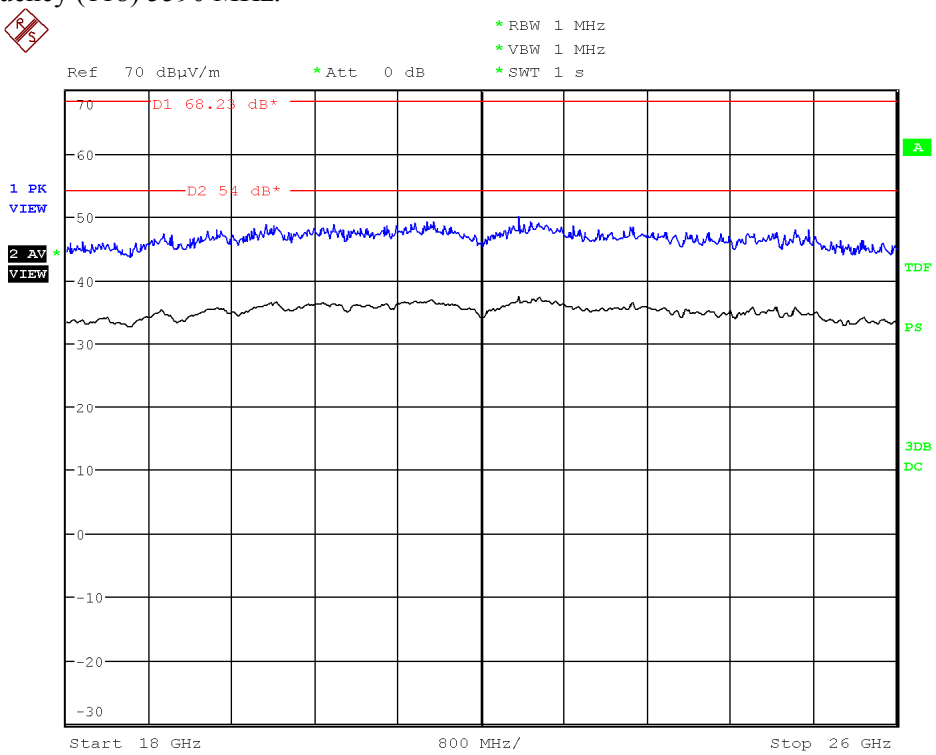


802.11ac20 mode: CH 144 (5720 MHz)

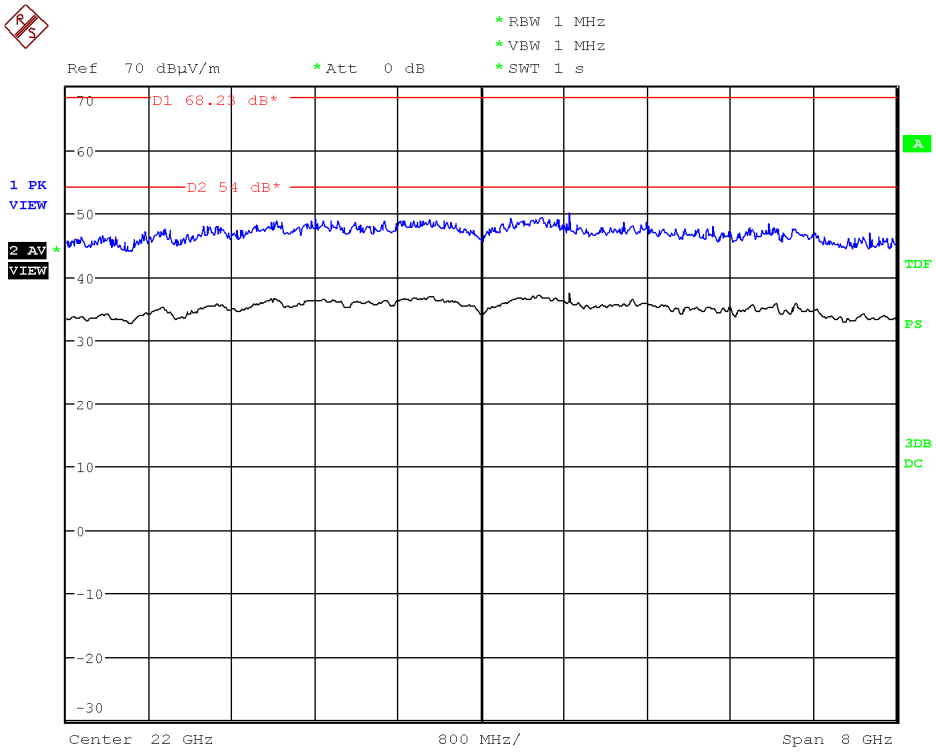



3. WiFi 5GHz 802.11 n40 mode

Middle frequency (118) 5590 MHz.

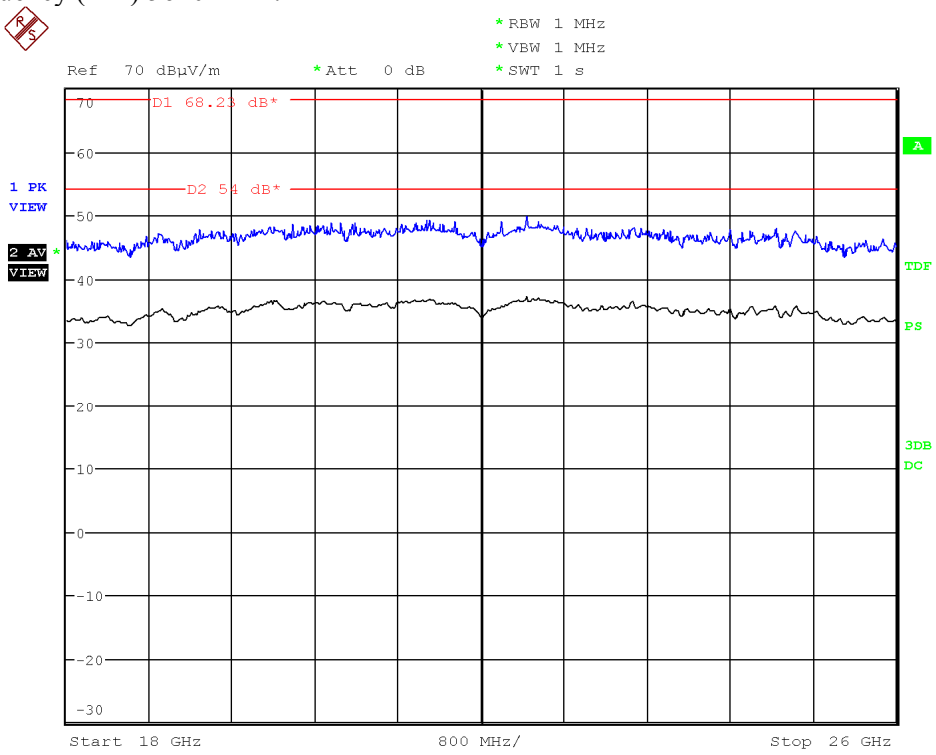


802.11ac40 mode: CH 142 5710 MHz.

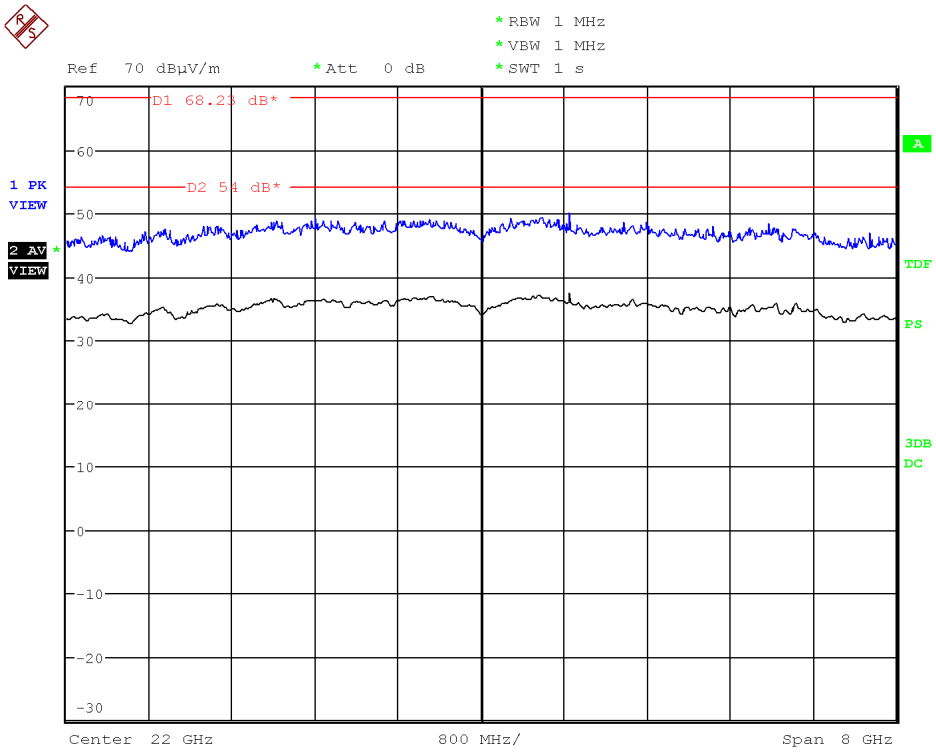



4. WiFi 5GHz 802.11 ac80 mode

Middle frequency (122) 5610 MHz.

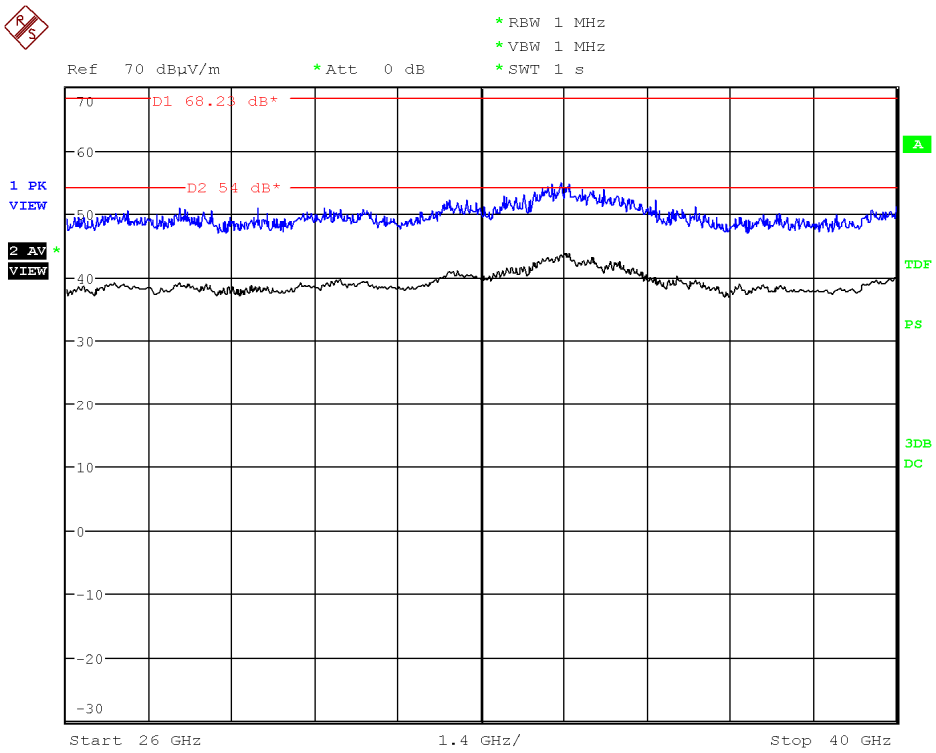


802.11ac80 mode: CH 138 5690 MHz.




**FREQUENCY RANGE 26GHz to 40GHz.**

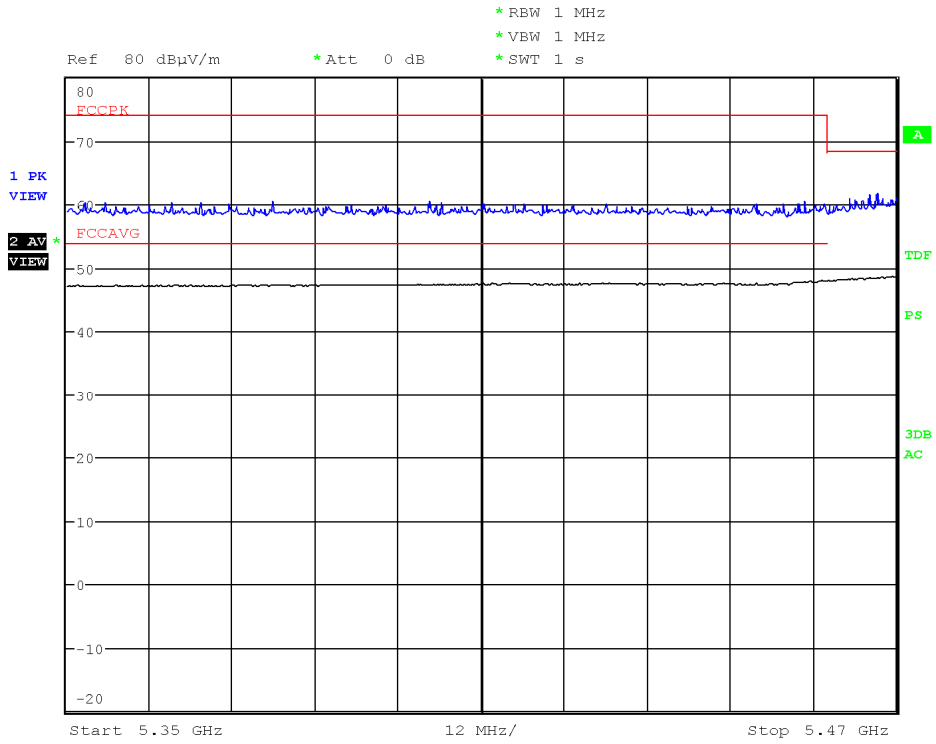
No spurious signals were found in all modulations and channels tested.



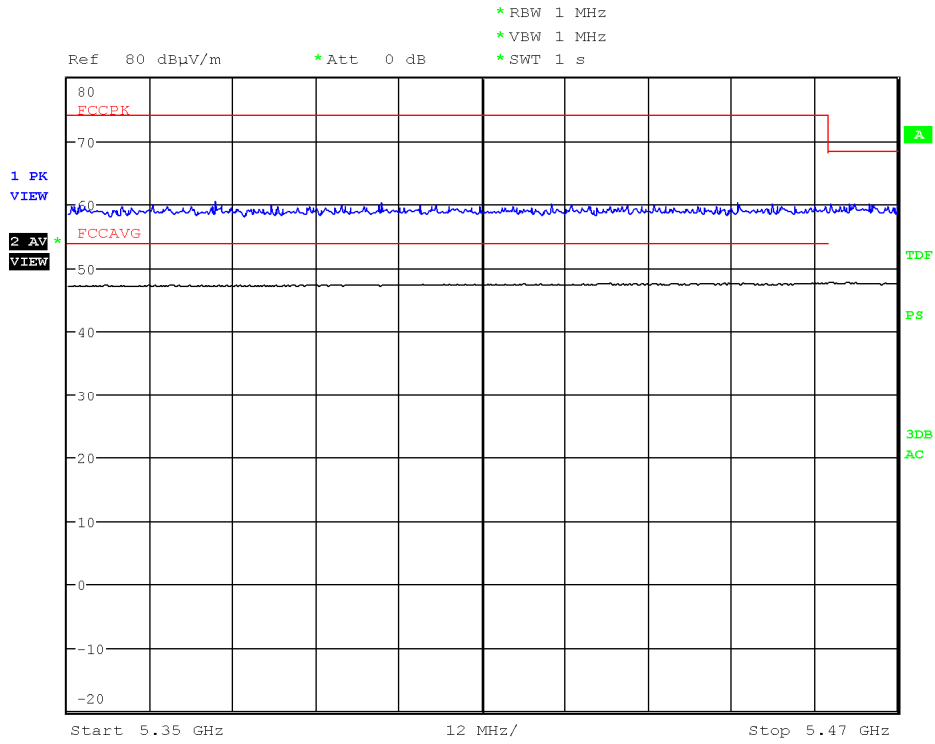
**Radiated spurious emissions at band-edges and inside restricted band 5.35 – 5.46 GHz and adjacent band 5.46 – 5.47 GHz.**

1. WiFi 5GHz 802.11 a mode

Lowest Channel (100) 5500 MHz..

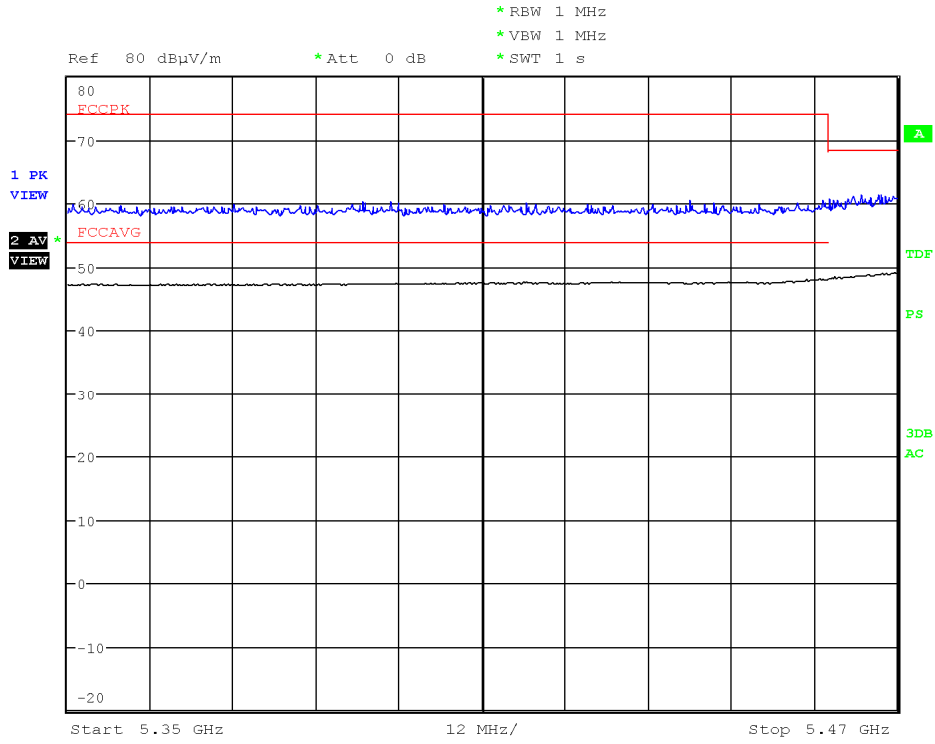



Channel 104. 5520MHz.

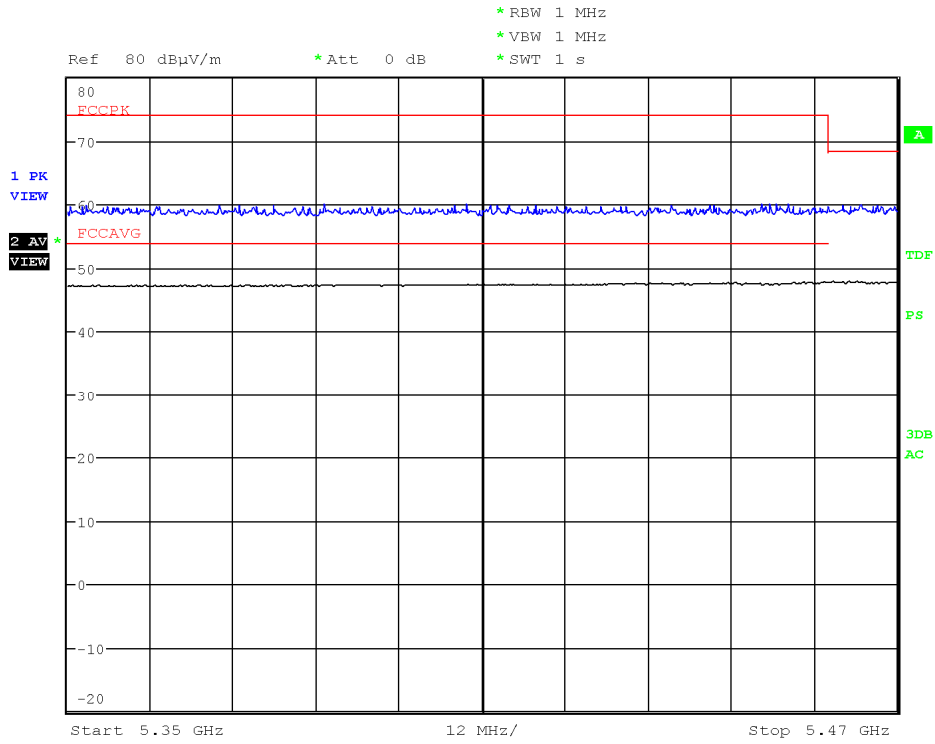


2. WiFi 5GHz 802.11 n20 mode

Lowest Channel (100) 5500MHz.

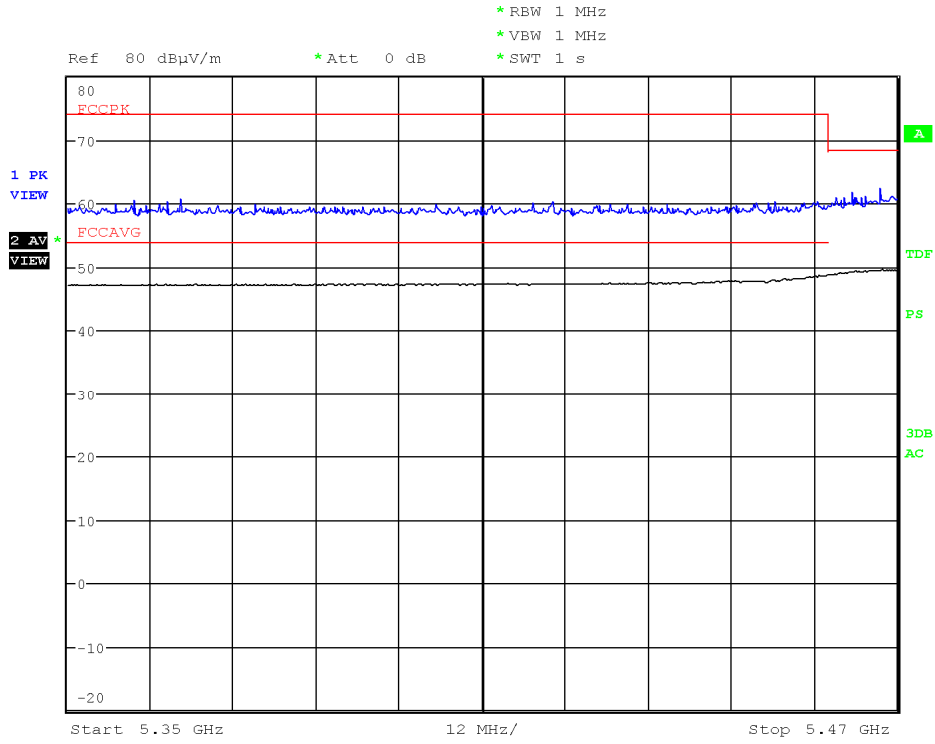



Channel 104. 5520MHz.

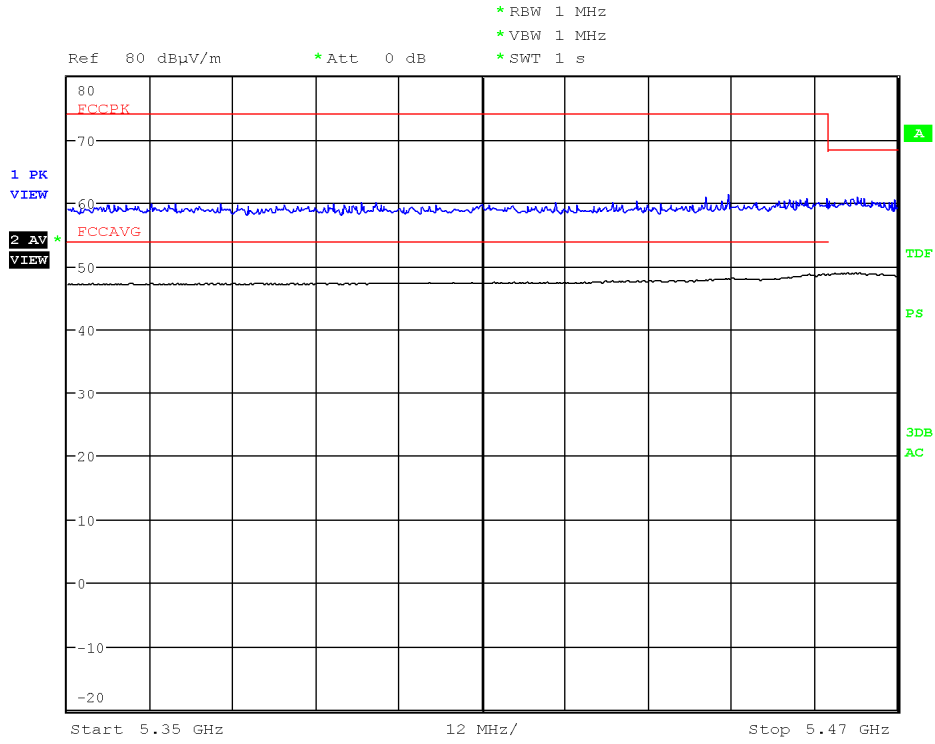


3. WiFi 5GHz 802.11 n40 mode

Lowest Channel (102) 5510MHz.

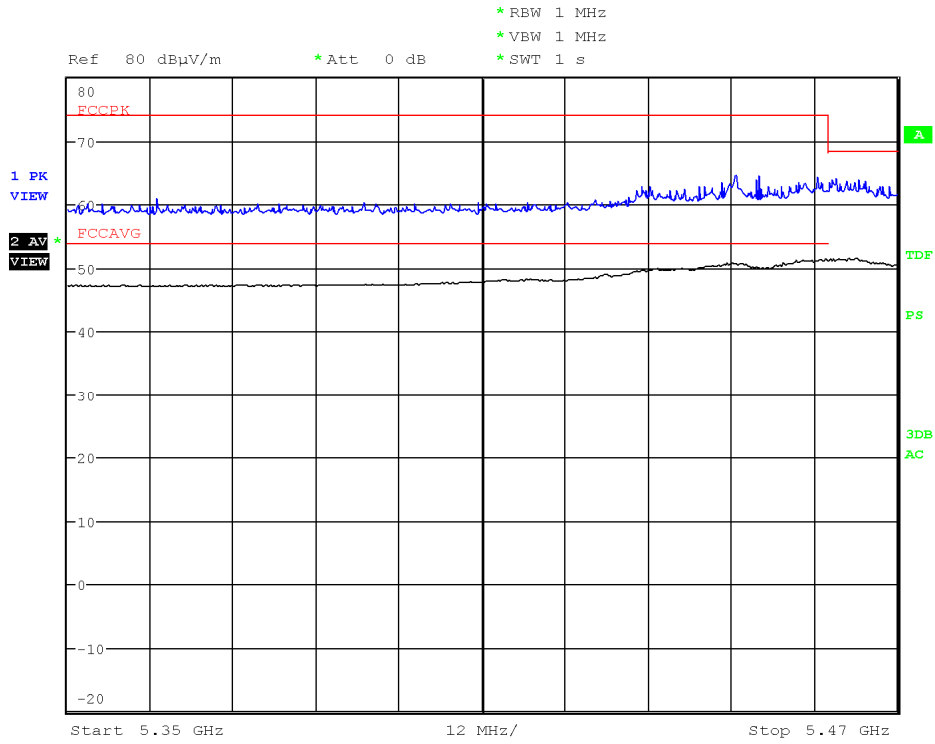



Channel 110F. 5550MHz.

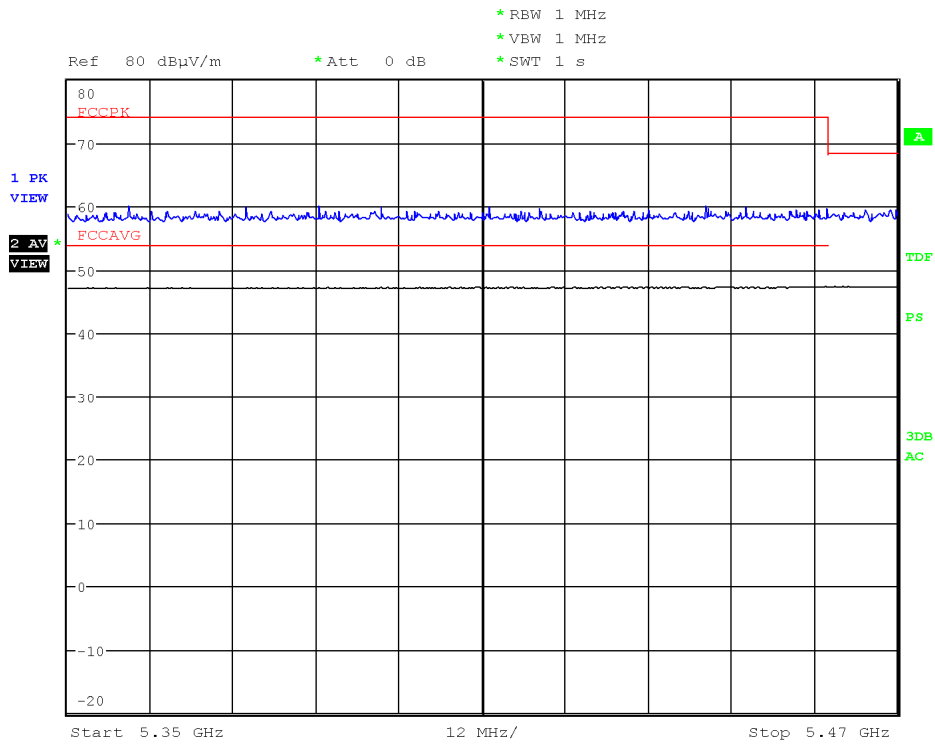


4. WiFi 5GHz 802.11 ac80 mode

Lowest Channel (106) 5530MHz.



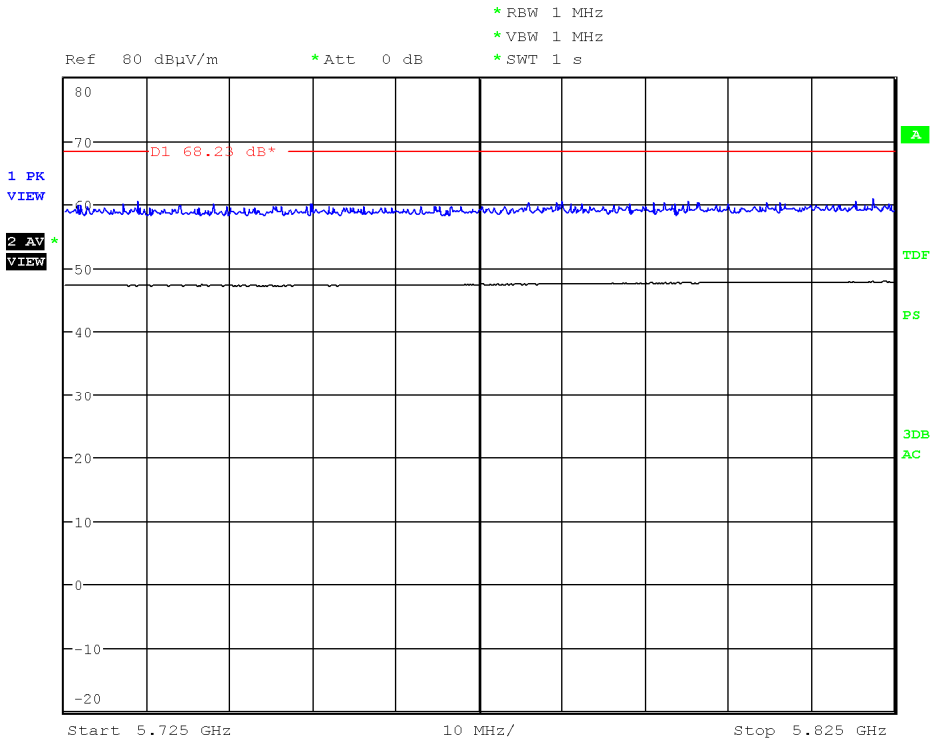

Channel 122. 5610MHz.



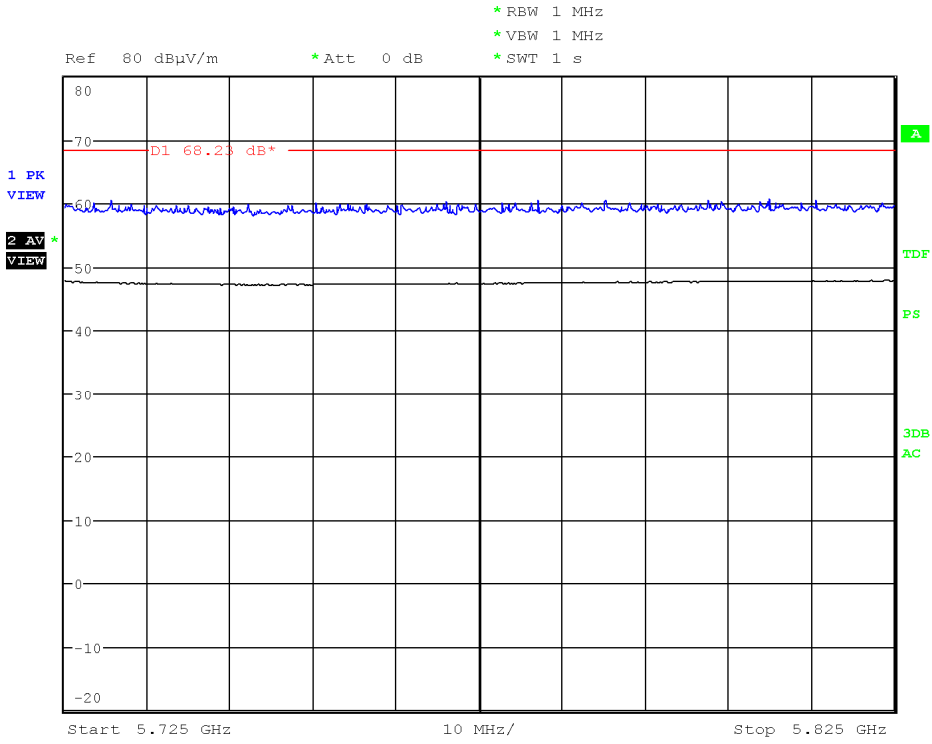
**Radiated spurious emissions at band-edges and inside adjacent band 5.725 – 5.825 GHz.**

1. WiFi 5GHz 802.11 a mode

Channel 136. 5680MHz.

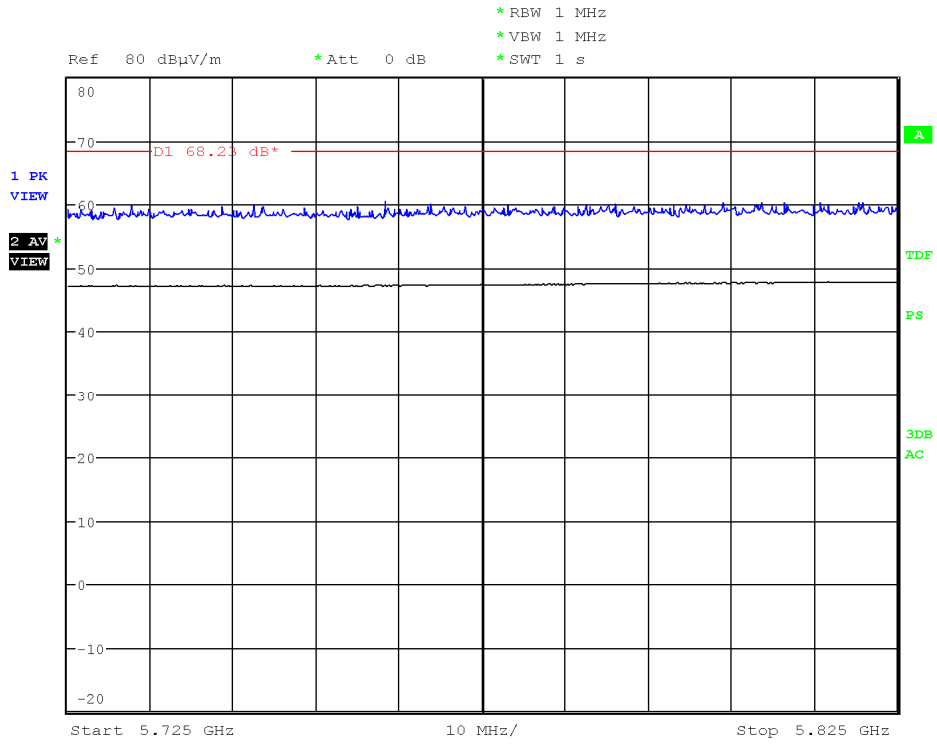



Highest Channel (140) 5700 MHz.

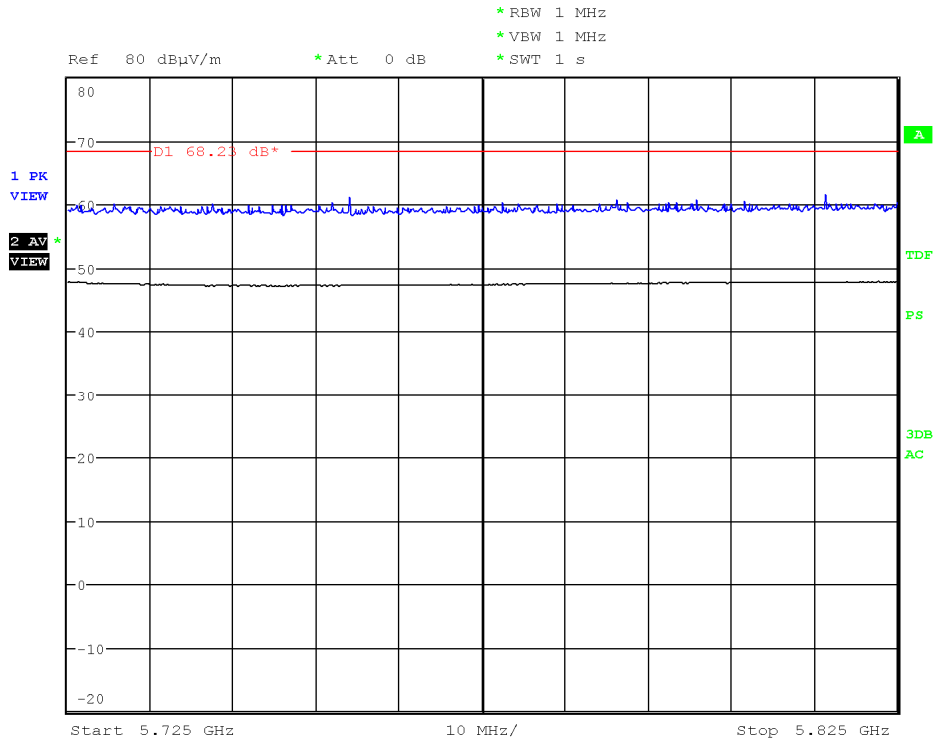


2. WiFi 5GHz 802.11 n20 mode

Channel 136. 5680MHz.

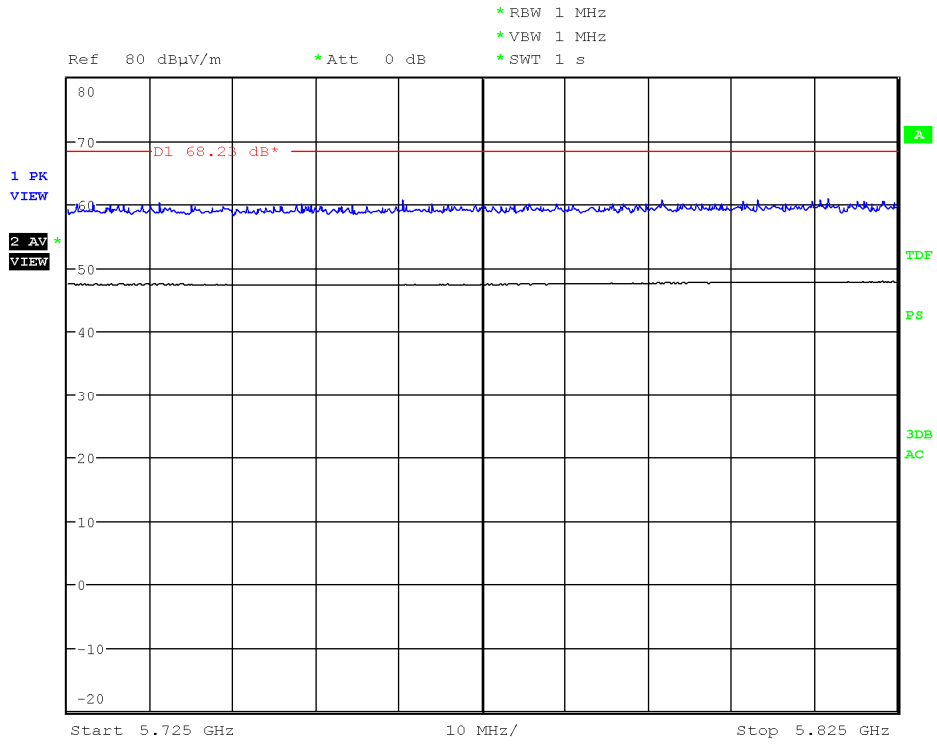



Highest Channel (140) 5700 MHz.



3. WiFi 5GHz 802.11 n40 mode

Highest Channel (134) 5670 MHz.




4. WiFi 5GHz 802.11 ac80 mode

Middle Channel (122) 5610 MHz.