**FCC LISTED, REGISTRATION NUMBER: 905266**

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

**AT4 wireless, S.A.**
Parque Tecnológico de Andalucía,
c/ Severo Ochoa nº 2
29590 Campanillas/ Málaga/ España
Tel. 952 61 91 00 - Fax 952 61 91 13
MÁLAGA, C.I.F. A29 507 456
Registro Mercantil de Málaga,Tomo 1169,
Libro 82, Folio 133, Hoja MA3729

# TEST REPORT (MODIFICATION 1)

## REFERENCE STANDARD:

## USA FCC Part 15.247, 15.209

## CANADA RSS-210, RSS-Gen

**Radio Frequency Devices. Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz.**

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

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

| | |
|---|---|
| **MIE** ..... : | 38067RRF.002A1 |
| Approved by (name / position & signature) ..... : | A. Llamas / RF Lab. Manager |
| Elaboration date ..... : | 2013-03-15 |

Alejandro Llamas Rodríguez
Firmado digitalmente por Alejandro Llamas Rodríguez
Fecha: 2013.03.15 15:21:29 +01'00'

| | |
|---|---|
| **Identification of item tested** ..... : | 7260HMW |
| Trademark ..... : | INTEL |
| Model and/or type reference ..... : | 7260HMW |
| Serial number ..... : | TA#: G83347-004<br>WF MAC:001500B666C9<br>BD MAC: 001500B666CD |
| Other identification of the product ..... : | Commercial name: 7260HMW<br>HW version: QS<br>SW version: Intel Pro Set V16<br>For OEM factory installation:<br>FCC ID: PD97260H<br>IC: 1000M-7260H<br>For user installation:<br>FCC ID: PD97260HU<br>IC: 1000M-7260H |
| Features ..... : | No provided data |
| Description ..... : | 802.11a/b/g/n/ac wireless LAN + BT PCIe half-mini card |

| | |
|---|---|
| **Applicant** ..... : | INTEL CORPORTATION |
| 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 15.247 10-1-11 Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz.<br><br>USA FCC Part 15.209 10-1-11 Edition: Radiated emission limits; general requirements.<br><br>Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v02 dated 10/04/2012.<br><br>Guidance for Emission Testing of Transmitters with Multiple Outputs in the Same Band 662911 D01 Multiple Transmitter Output v01r02 dated 9/26/2012.<br><br>ANSI C63.10-2009: American National Standard for Testing Unlicensed Wireless Devices. |
| 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**. .....: FDT11_12

## INDEX

## Competences and guarantees

AT4 wireless 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 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 |
|---|---|---|---|---|
| 38067/33 | 802.11a/b/g/n/ac wireless LAN + BT PCIe half-mini card | 7260HMW | TA#: G83347-004<br>WFMAC:001500B666C9<br>BDMAC:001500B666CD | 08/01/2013 |

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 |
| 38067/34 | Reference Antenna | Universe | WIMAX/WLAN | --- | 08/01/2013 |
| 38067/35 | Reference Antenna | Universe | WIMAX/WLAN | --- | 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 |
| 1302 | Board 35mmx35mm | --- | --- | --- | --- |
| --- | USB cable | --- | --- | --- | --- |

## Usage of samples

Sample S/02 is composed of the following elements:

| Control Nº | Description | Model | Serial Nº | Date of reception |
|---|---|---|---|---|
| 38067/33 | 802.11a/b/g/n/ac wireless LAN + BT PCIe half-mini card | 7260HMW | TA#: G83347-004<br>WFMAC:001500B666C9<br>BDMAC:001500B666CD | 08/01/2013 |

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 2013-01-15 and finished on 2013-01-30.

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 |

## Modifications to the reference test report

It was introduced the following modifications in respect to the test report number 38067RRF.002 related with the same samples, in the next clauses and sub-clauses:

| CLAUSES / SUB-CLAUSES | MODIFICATION | JUSTIFICATION |
|---|---|---|
| Appendix A, B and C. TEST CONDITIONS | Deletion of wrong reference to standard ANSI C63.4: 2009 | Typo in report |
| Appendix A. Page 46 | Change of values for Lowest and Highest frequencies in tables | Typo in report |

## Summary

Considering the results of the performed test according to standard USA FCC Parts 15.247 / 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.- No comments.

## Testing verdicts

Not applicable .....: NA

Pass.....: P

Fail .....: F

Not measured.....: NM

## 1. WiFi 2.4 GHz (802.11b/g/n20/n40)

| FCC PART 15 PARAGRAPH / RSS-210 | | VERDICT | | | |
|---|---|---|---|---|---|
| | | NA | P | F | NM |
| Section 15.247 Subclause (a) (2) / RSS-210 A8.2. (a) | 6 dB Bandwidth | | P | | |
| Section 15.247 Subclause (b) / RSS-210 A8.4. (4) ..... | Maximum output power and antenna gain | | P | | |
| Section 15.247 Subclause (d) / RSS-210 A8.5. ..... | Emission limitations conducted (Transmitter) | | P | | |
| Section 15.247 Subclause (d) / RSS-210 A8.5. ..... | Band-edge emissions compliance (Transmitter) | | P | | |
| Section 15.247 Subclause (e) / RSS-210 A8.2. (b) | Power spectral density | | P | | |
| Section 15.247 Subclause (d) / RSS-210 A8.5. ..... | Emission limitations radiated (Transmitter) | | P | | |

## 2. WiFi 5.725 – 5.825 GHz (802.11a/n20/n40/ac80)

| FCC PART 15 PARAGRAPH / RSS-210 | | VERDICT | | | |
|---|---|---|---|---|---|
| | | NA | P | F | NM |
| Section 15.247 Subclause (a) (2) / RSS-210 A8.2. (a) | 6 dB Bandwidth | | P | | |
| Section 15.247 Subclause (b) / RSS-210 A8.4. (4) ..... | Maximum output power and antenna gain | | P | | |
| Section 15.247 Subclause (d) / RSS-210 A8.5. ..... | Emission limitations conducted (Transmitter) | | P | | |
| Section 15.247 Subclause (d) / RSS-210 A8.5. ..... | Band-edge emissions compliance (Transmitter) | | P | | |
| Section 15.247 Subclause (e) / RSS-210 A8.2. (b) | Power spectral density | | P | | |
| Section 15.247 Subclause (d) / RSS-210 A8.5. ..... | Emission limitations radiated (Transmitter) | | P | | |

## 3. Bluetooth Low Energy

| FCC PART 15 PARAGRAPH / RSS-210 | | VERDICT | | | |
|---|---|---|---|---|---|
| | | NA | P | F | NM |
| Section 15.247 Subclause (a) (2) / RSS-210 A8.2. (a) | 6 dB Bandwidth | | P | | |
| Section 15.247 Subclause (b) / RSS-210 A8.4. (4) ..... | Maximum output power and antenna gain | | P | | |
| Section 15.247 Subclause (d) / RSS-210 A8.5. ..... | Emission limitations conducted (Transmitter) | | P | | |
| Section 15.247 Subclause (d) / RSS-210 A8.5. ..... | Band-edge emissions compliance (Transmitter) | | P | | |
| Section 15.247 Subclause (e) / RSS-210 A8.2. (b) | Power spectral density | | P | | |
| Section 15.247 Subclause (d) / RSS-210 A8.5. ..... | Emission limitations radiated (Transmitter) | | P | | |

# APPENDIX A: Test results
# “WiFi 2.4 GHz (802.11b/g/n20/n40)”

**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 dBi

**TEST FREQUENCIES:**

For WiFi 802.11b/g/n20:

Lowest channel (1): 2412 MHz

Middle channel (6): 2437 MHz

Highest channel (11): 2462 MHz

For WiFi 802.11n40:

Lowest channel (3): 2422 MHz

Middle channel (6): 2437 MHz

Highest channel (9): 2452 MHz

The test set-up was made in accordance to the general provisions of FCC DTS Measurement KDB 558074 D01 DTS Meas Guidance v02.

For 802.11b/g modes the EUT can transmit at both CHAIN A and CHAIN B RF outputs individually but not simultaneously.

For 802.11n modes 802.11n20 (20 MHz channel bandwidth) and 802.11n40 (40MHz channel bandwidth) the EUT can transmit at both CHAIN A and CHAIN B RF outputs individually and simultaneously.

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.

WiFi 2.4 GHz: 802.11b, 802.11g, 802.11n20 (20 MHz channel bandwidth) and 802.11n40 (40MHz channel bandwidth).

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. Single transmission at each chain and simultaneous transmission at both chains modes were fully evaluated.

The PC was using the Intel test utility DRTU Version “OEDRTU 558x86” DRTU 1.6.1.558.

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 data rates of 1Mb/s for 802.11b, 6Mb/s for 802.11g, HT4 (SISO)/HT8 (MIMO) for 802.11n20 and n40 were selected based on preliminary testing that identified those rates corresponding to the worst cases for output power and band edge levels at restricted bands.

The conducted RF output power at each chain 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. | SISO Chain A (dBm) | SISO Chain B (dBm) | MIMO at both ports A and B (dBm) |
|---|---|---|---|---|---|
| 802.11b | 20 | 1 / 2412 | 15.5 | 14 | n/a |
| | | 6 / 2437 | 15.5 | 14 | n/a |
| | | 11 / 2462 | 15.5 | 14 | n/a |
| 802.11g | 20 | 1 / 2412 | 13.5 | 12 | n/a |
| | | 2 / 2417 | 16 | 15 | n/a |
| | | 6 / 2437 | 16.5 | 15.5 | n/a |
| | | 10 / 2457 | 16 | 15.5 | n/a |
| | | 11 / 2462 | 13.5 | 13.5 | n/a |
| 802.11n | 20 | 1 / 2412 | 13.5 | 12 | 12.50 |
| | | 2 / 2417 | 16 | 15 | 13.50 |
| | | 6 / 2437 | 16.5 | 15.5 | 13.50 |
| | | 10 / 2457 | 16 | 15.5 | 13.50 |
| | | 11 / 2462 | 13.5 | 13.5 | 13.50 |
| 802.11n* | 40 | 3 / 2422 | 12 | 10 | 8.50 |
| | | 4 / 2427 | 12.5 | 11 | 9.50 |
| | | 5 / 2432 | 15 | 13 | 12.00 |
| | | 6 / 2437 | 16.5 | 13.5 | 13.00 |
| | | 7 / 2442 | 15.5 | 14.5 | 13.50 |
| | | 8 / 2447 | 14.5 | 13.5 | 13.00 |
| | | 9 / 2452 | 13 | 13 | 12.00 |

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is connected to the spectrum analyser using a calibrated low loss RF cable. The reading in the spectrum analyser is compensated with the cable loss at each measurement frequency.

RADIATED MEASUREMENTS

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1m for the frequency range 1 GHz-25 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

For radiated emissions in the range 1 GHz-25 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 and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

## Occupied Bandwidth

RESULTS

1. WiFi 2.4GHz 802.11 b mode

Occupied Bandwidth (see next plots).

| | Lowest frequency 2412 MHz | | Middle frequency 2437 MHz | | Highest frequency 2462 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| 99% bandwidth (MHz) | 14.279 | 14.183 | 14.279 | 14.231 | 14.327 | 14.183 |
| Measurement uncertainty (kHz) | ±21.7 | | | | | |

2. WiFi 2.4GHz 802.11 g mode

Occupied Bandwidth (see next plots).

| | Lowest frequency 2412 MHz | | Middle frequency 2437 MHz | | Highest frequency 2462 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| 99% bandwidth (MHz) | 17.308 | 17.211 | 18.461 | 18.990 | 17.308 | 17.356 |
| Measurement uncertainty (kHz) | ±21.7 | | | | | |

3. WiFi 2.4GHz 802.11 n20 mode

Occupied Bandwidth (see next plots).

| | Lowest frequency 2412 MHz | | Middle frequency 2437 MHz | | Highest frequency 2462 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| 99% bandwidth (MHz) | 18.125 | 18.125 | 19.183 | 19.519 | 18.173 | 18.269 |
| Measurement uncertainty (kHz) | ±21.7 | | | | | |

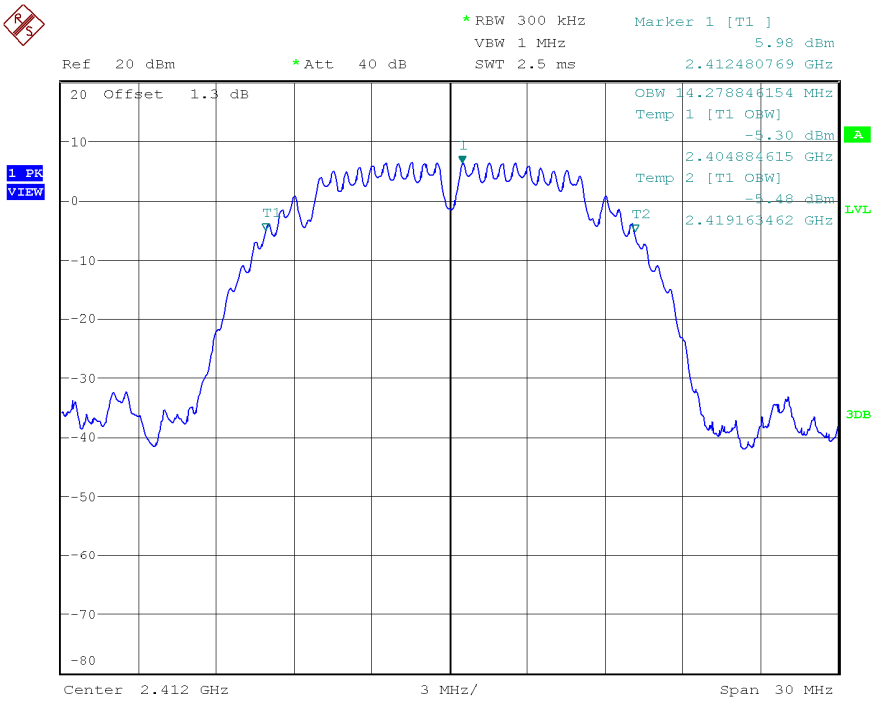
4. WiFi 2.4GHz 802.11 n40 mode

Occupied Bandwidth (see next plots).

| | Lowest frequency 2422 MHz | | Middle frequency 2437 MHz | | Highest frequency 2452 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| 99% bandwidth (MHz) | 36.138 | 36.138 | 36.538 | 36.298 | 36.138 | 36.138 |
| Measurement uncertainty (kHz) | ±21.7 | | | | | |

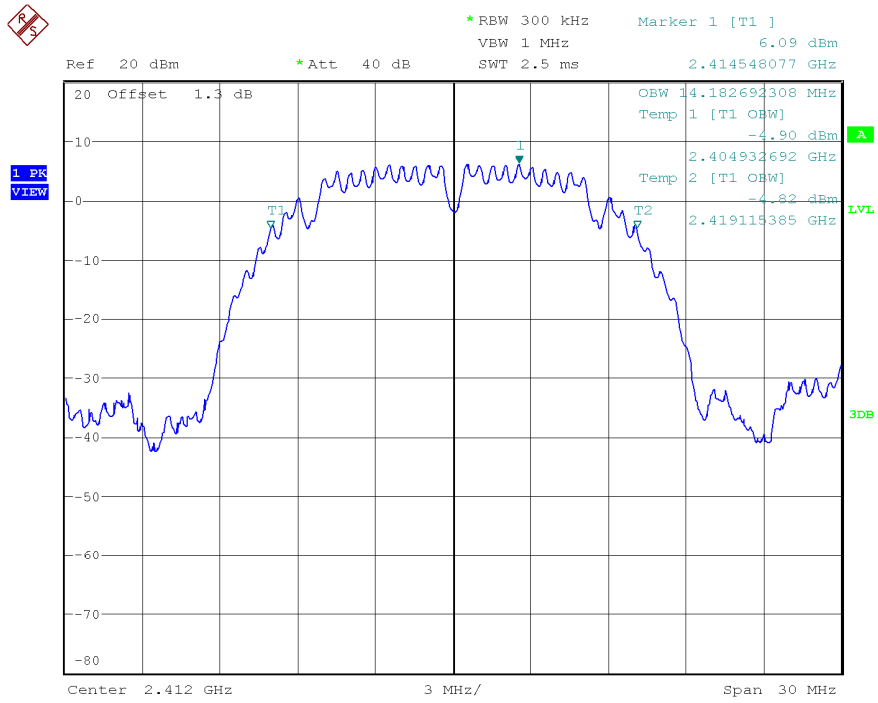
1. WiFi 2.4GHz 802.11 b mode

Lowest Channel: 2412 MHz. Chain A



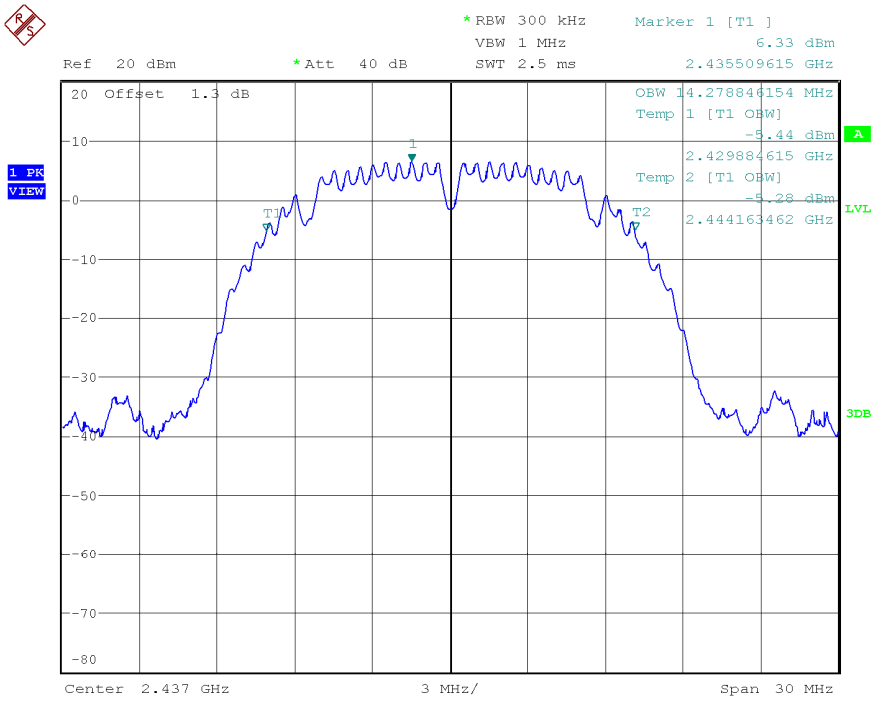

Date: 25.JAN.2013 10:41:50

Lowest Channel: 2412 MHz. Chain B.



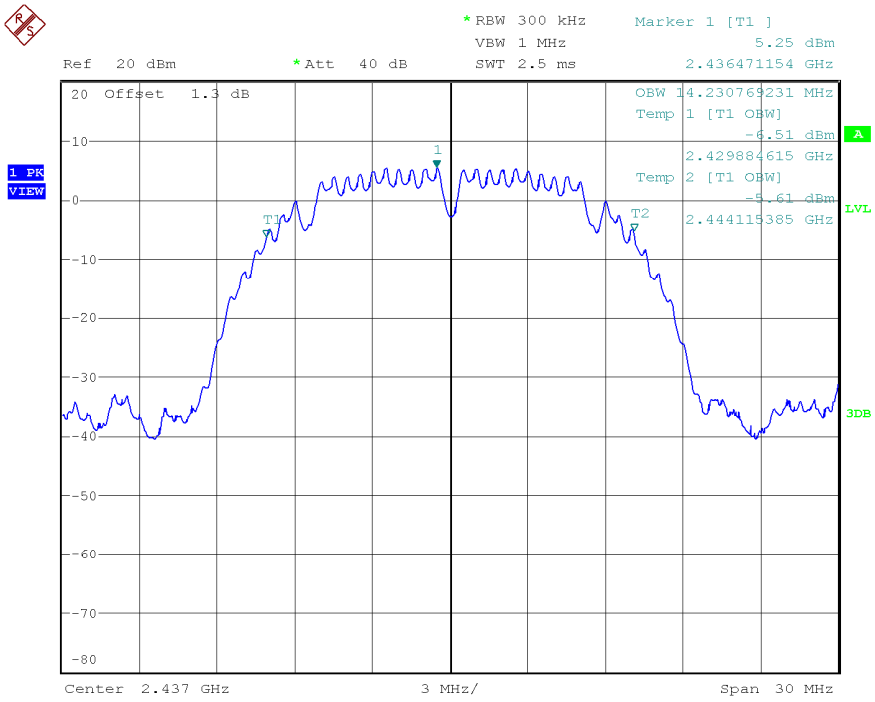

Date: 25.JAN.2013 11:01:31

Middle Channel: 2437 MHz. Chain A



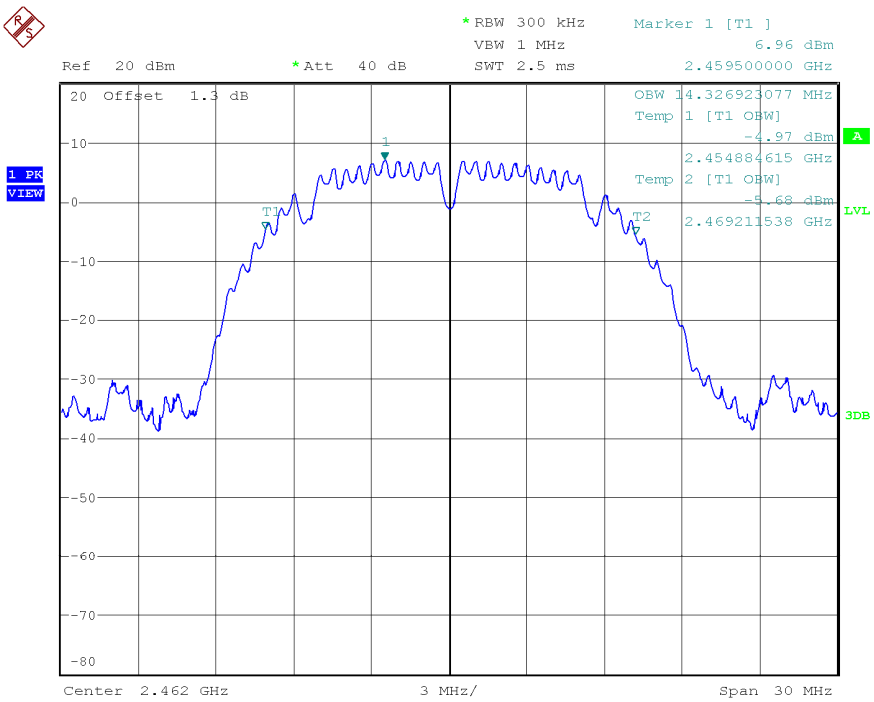

Date: 25.JAN.2013 10:43:06

Middle Channel: 2437 MHz. Chain B



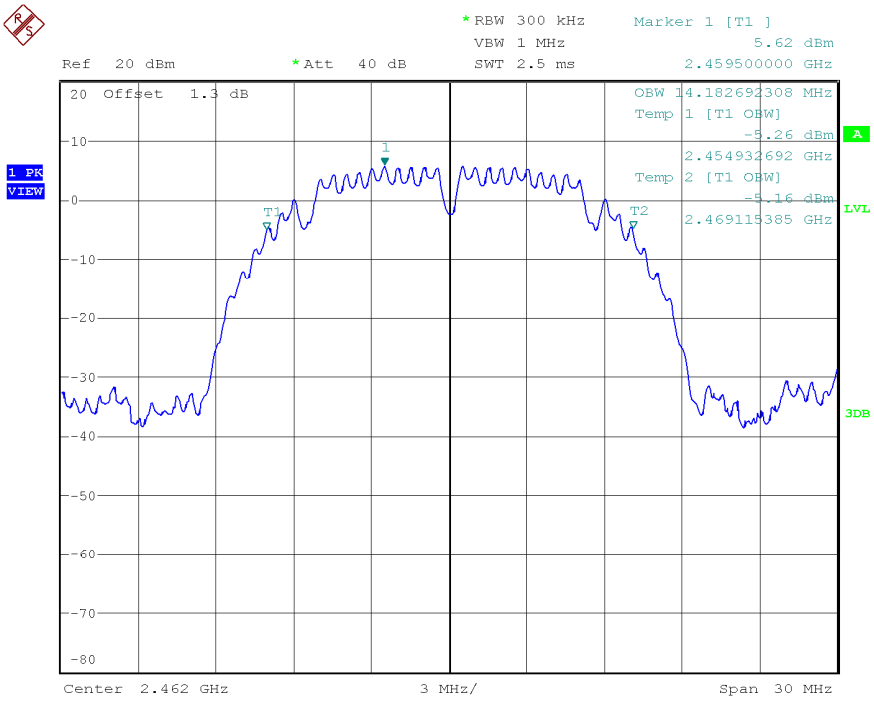

Date: 25.JAN.2013 11:02:56

Highest Channel: 2462 MHz. Chain A.




Date: 25.JAN.2013 10:44:40

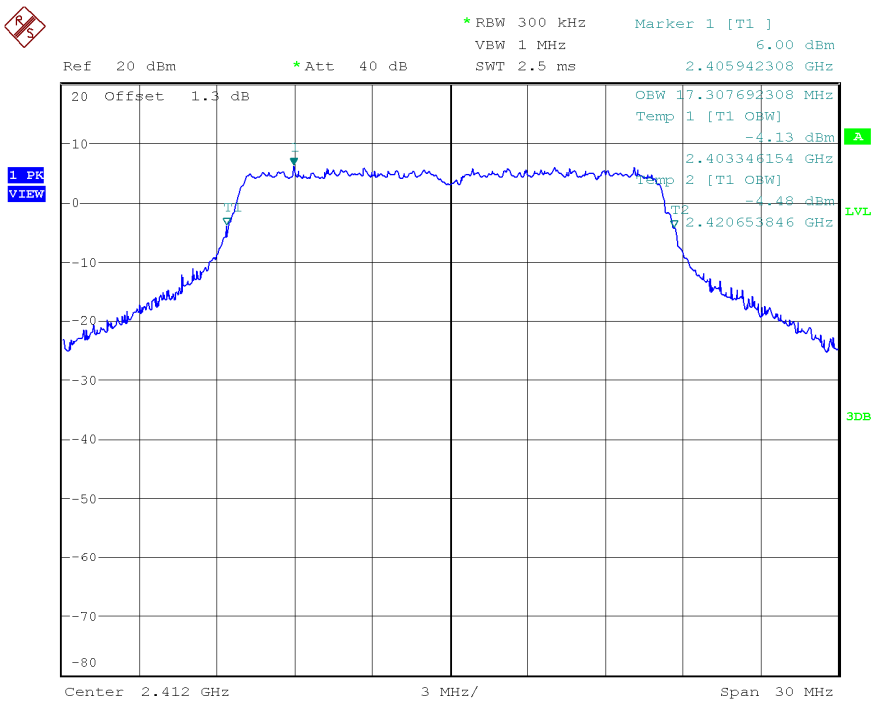
Highest Channel: 2462 MHz. Chain B.




Date: 25.JAN.2013 11:04:09

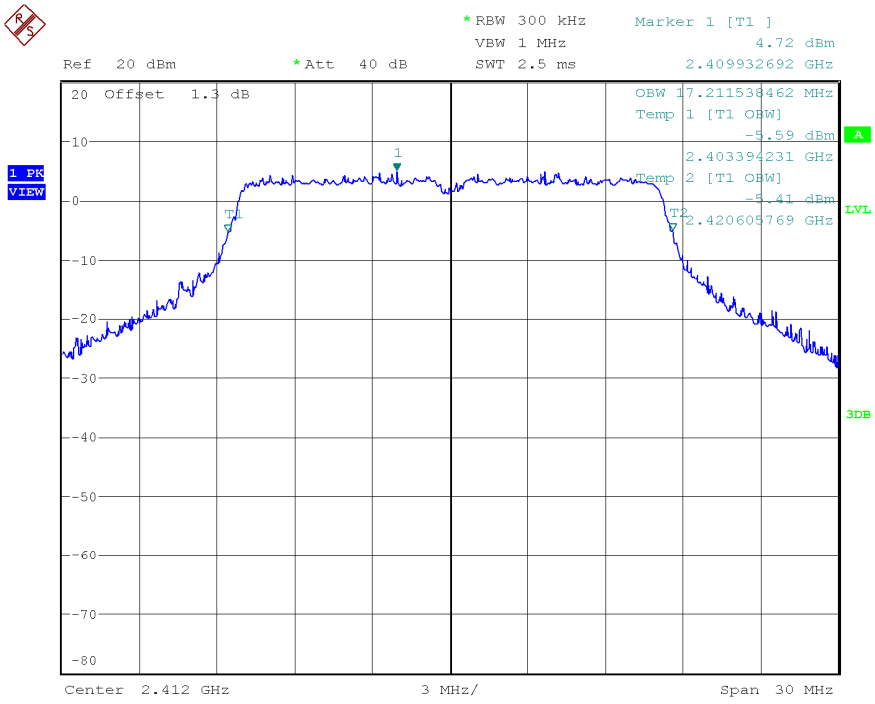
2. WiFi 2.4GHz 802.11 g mode

Lowest Channel: 2412 MHz. Chain A



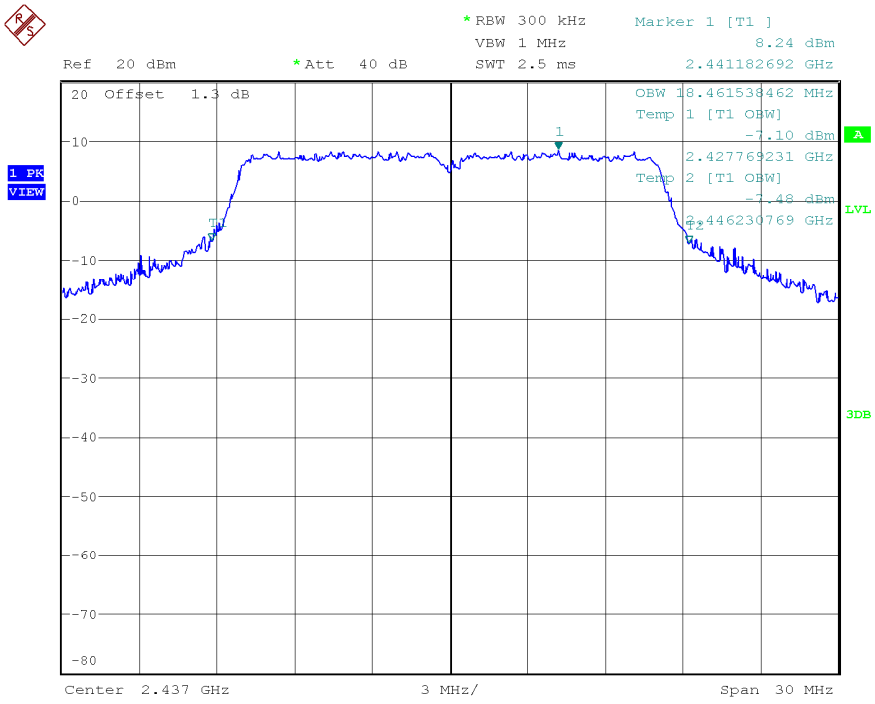

Date: 25.JAN.2013 10:46:48

Lowest Channel: 2412 MHz. Chain B



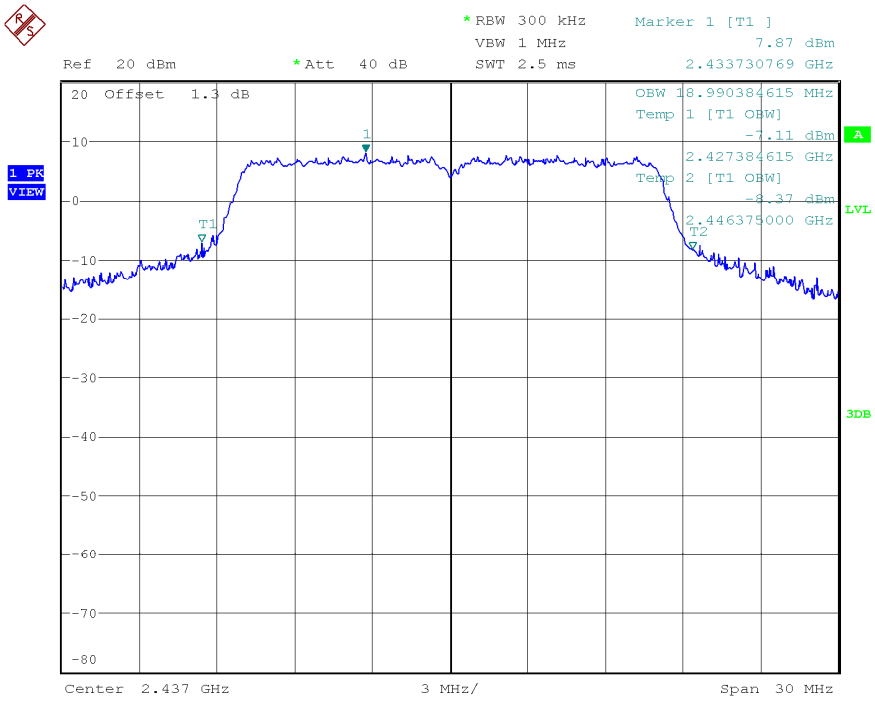

Date: 25.JAN.2013 11:05:39

Middle Channel: 2437 MHz. Chain A



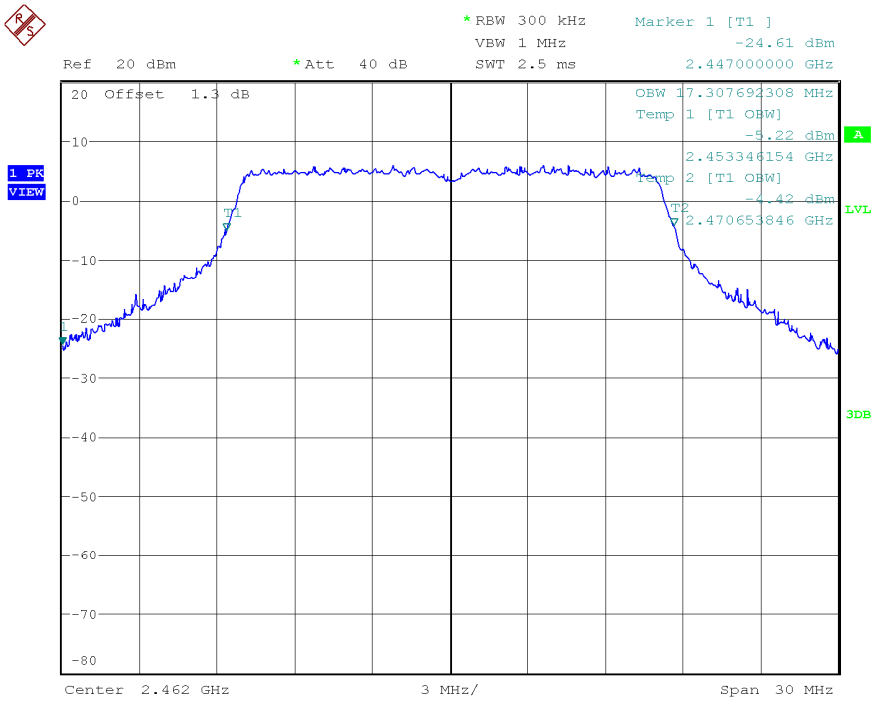

Date: 25.JAN.2013 10:50:28

Middle Channel: 2437 MHz. Chain B



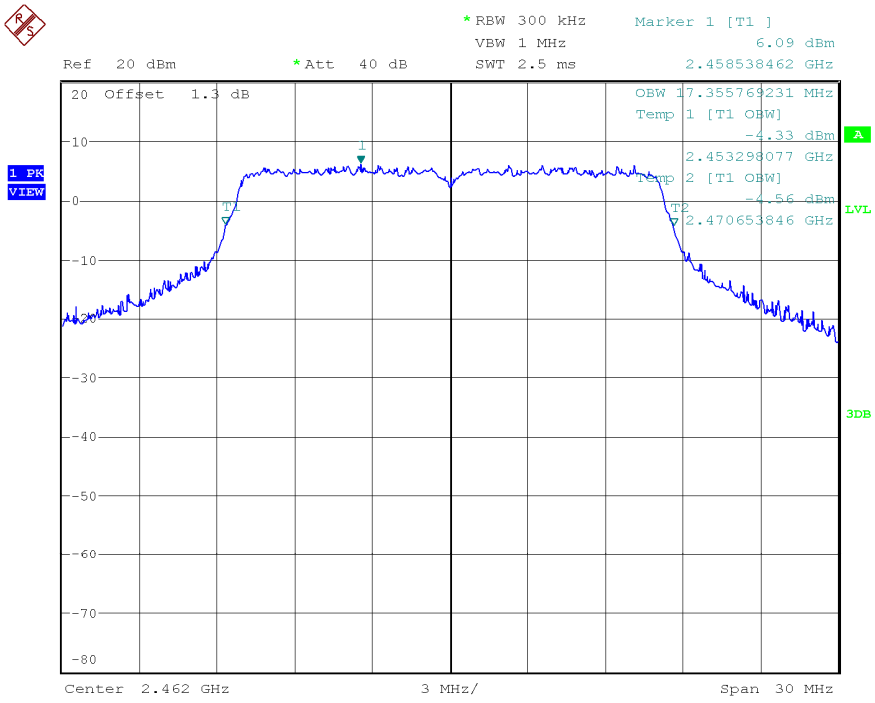

Date: 25.JAN.2013 11:07:16

Highest Channel: 2462 MHz. Chain A.




Date: 25.JAN.2013 10:52:36

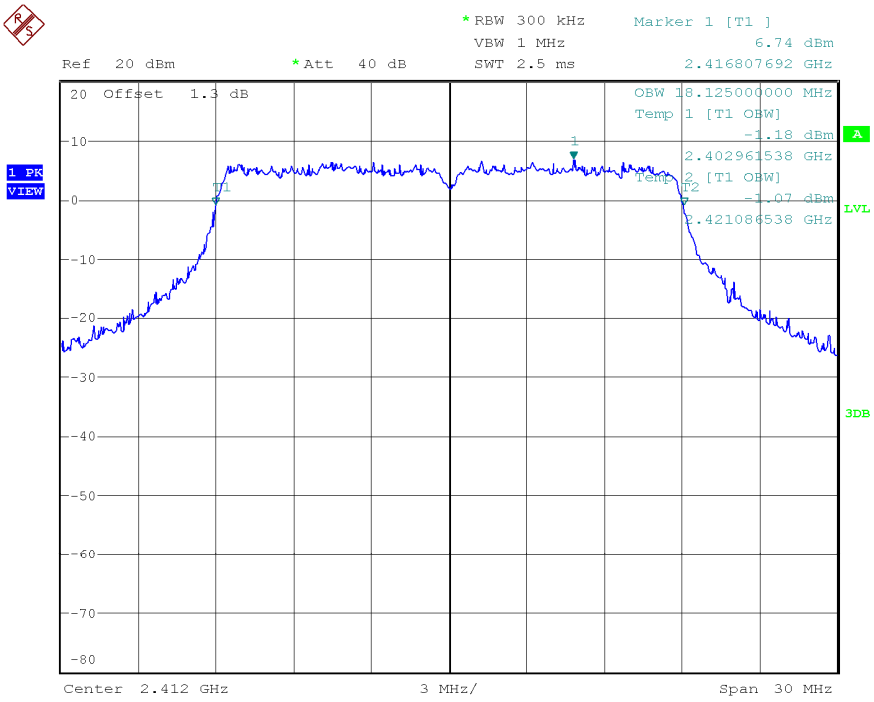
Highest Channel: 2462 MHz. Chain B.




Date: 25.JAN.2013 11:09:05

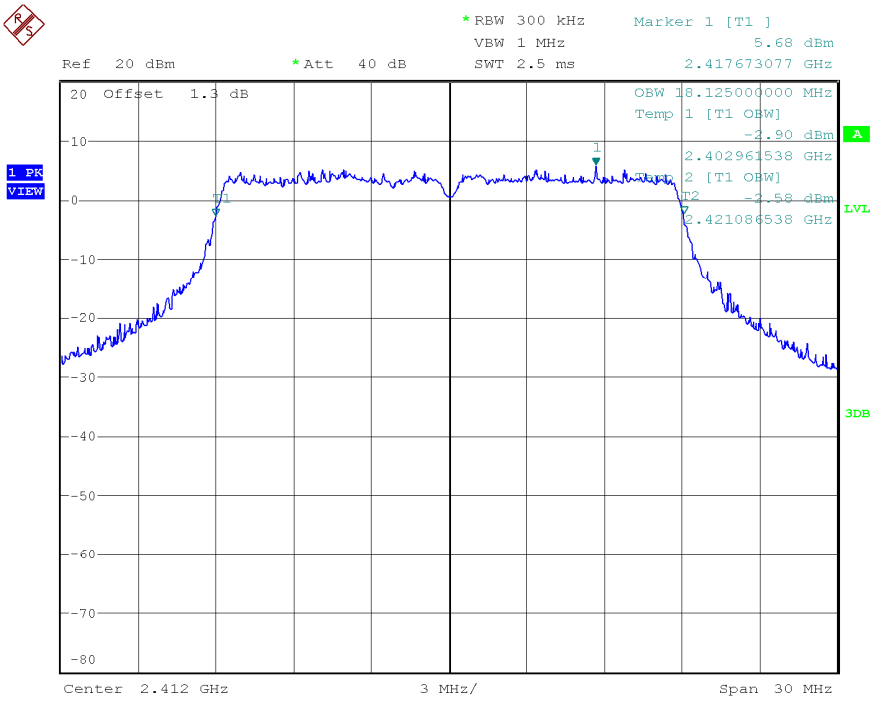
3. WiFi 2.4GHz 802.11 n20 mode

Lowest Channel: 2412 MHz. Chain A



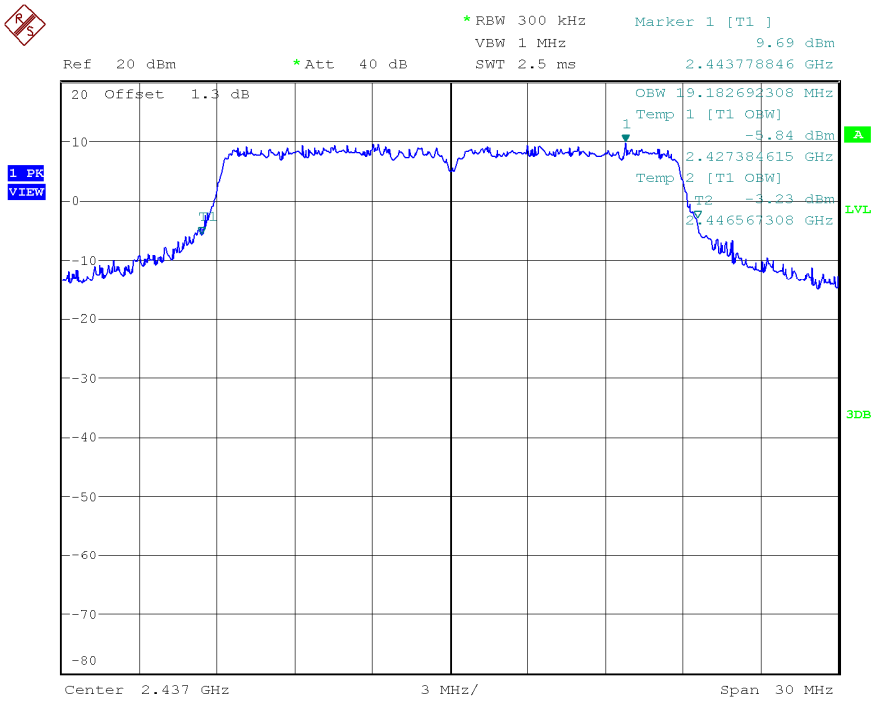

Date: 25.JAN.2013 10:54:36

Lowest Channel: 2412 MHz. Chain B



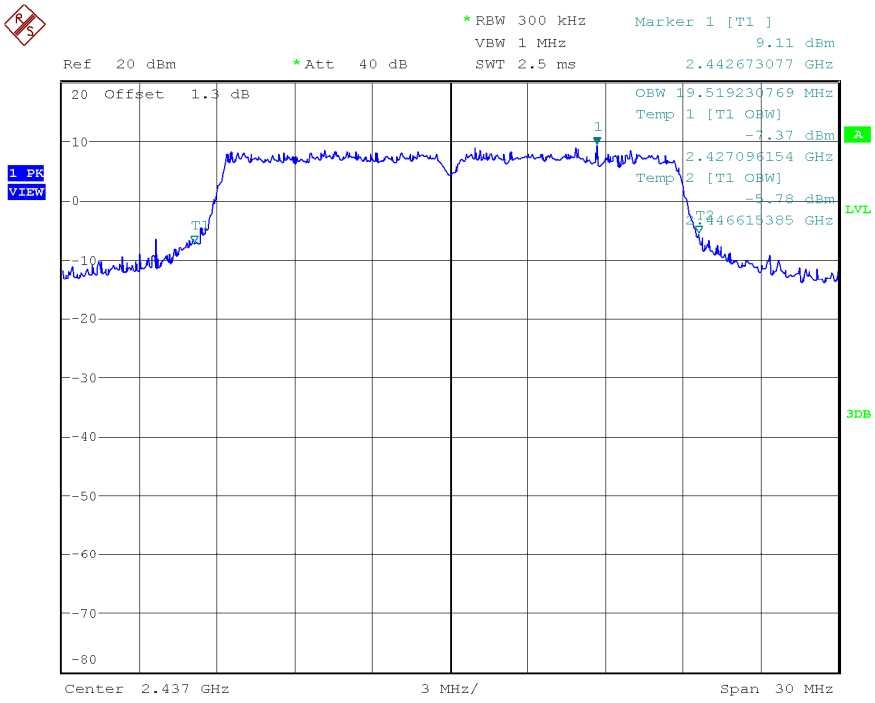

Date: 25.JAN.2013 11:10:51

Middle Channel: 2437 MHz. Chain A



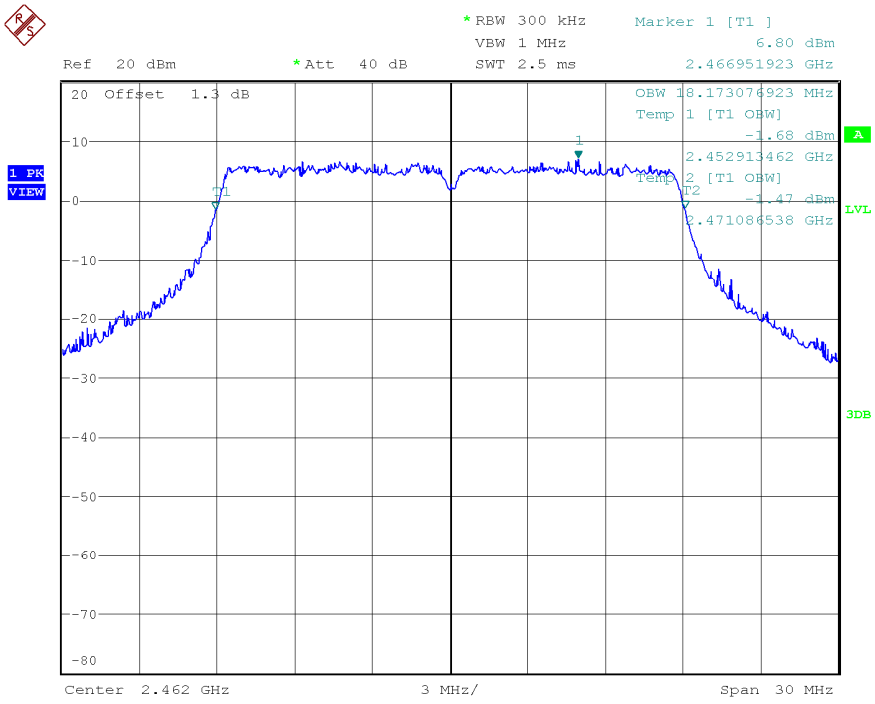

Date: 25.JAN.2013 10:56:31

Middle Channel: 2437 MHz. Chain B



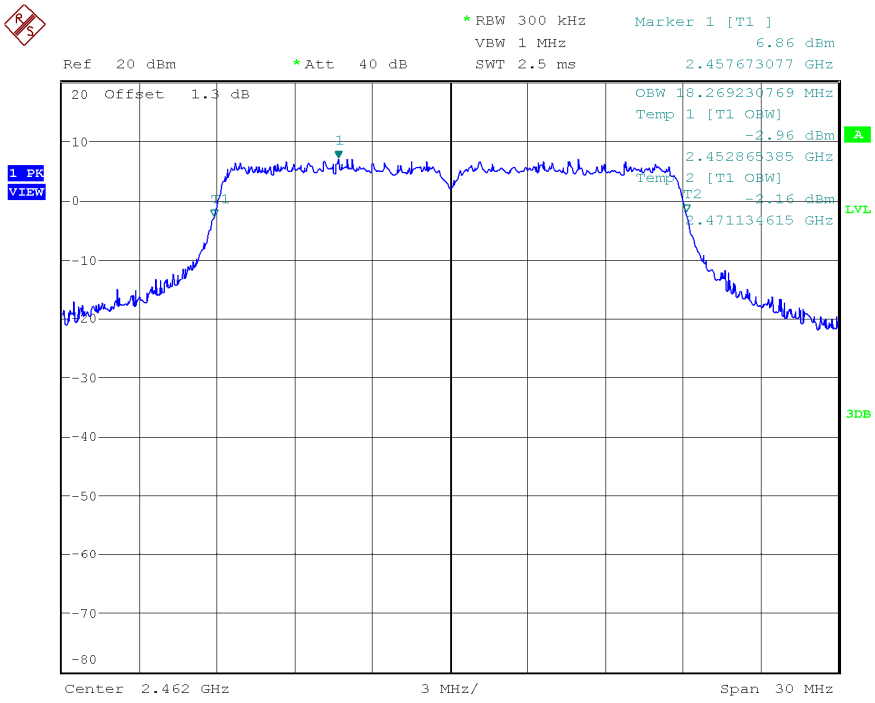

Date: 25.JAN.2013 11:12:30

Highest Channel: 2462 MHz. Chain A.




Date: 25.JAN.2013 10:58:31

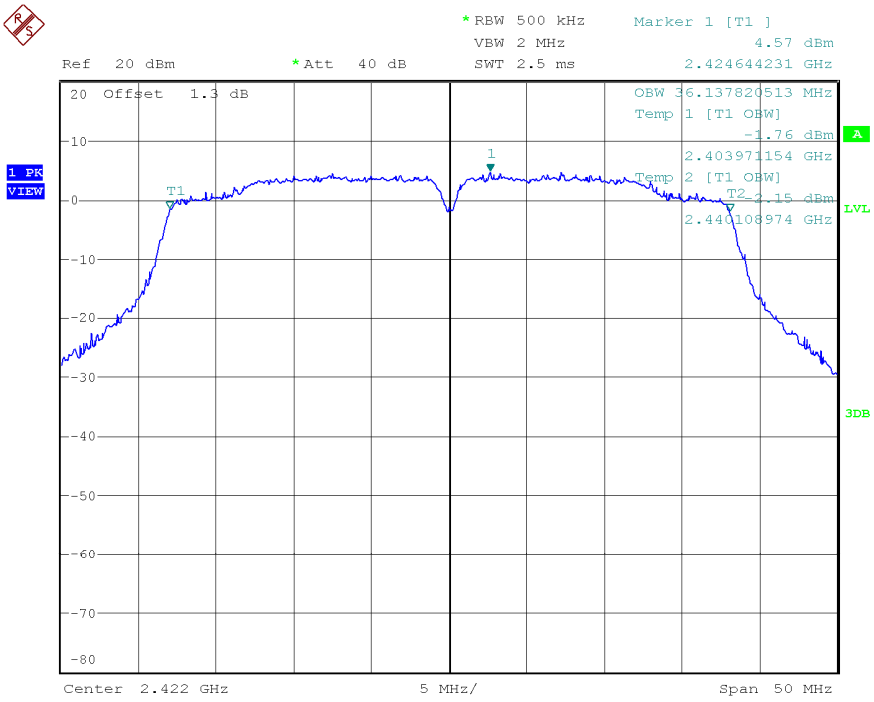
Highest Channel: 2462 MHz. Chain B.




Date: 25.JAN.2013 11:14:31

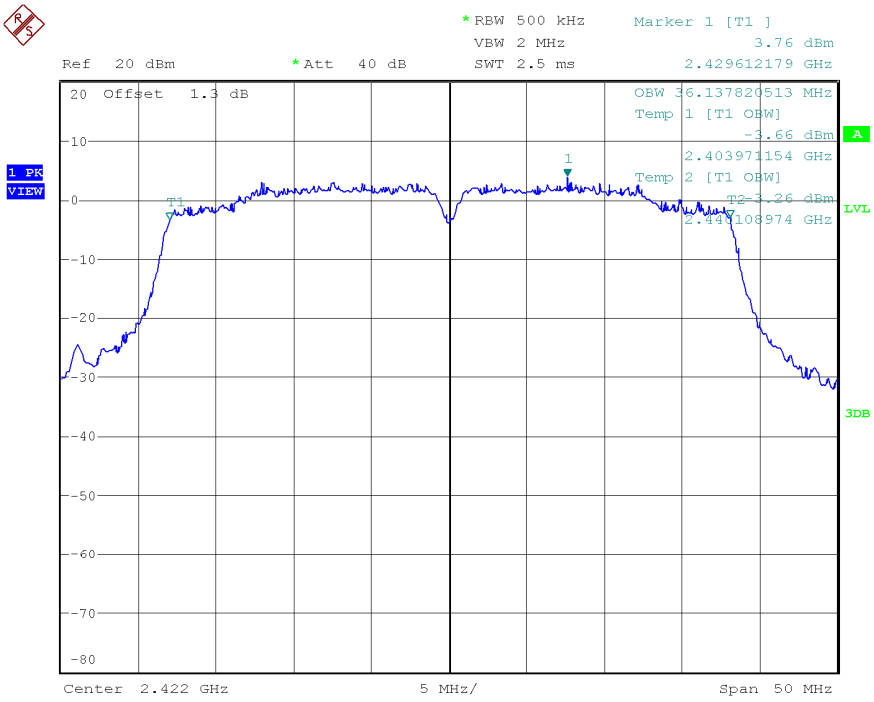
4. WiFi 2.4GHz 802.11 n40 mode

Lowest Channel: 2422 MHz. Chain A



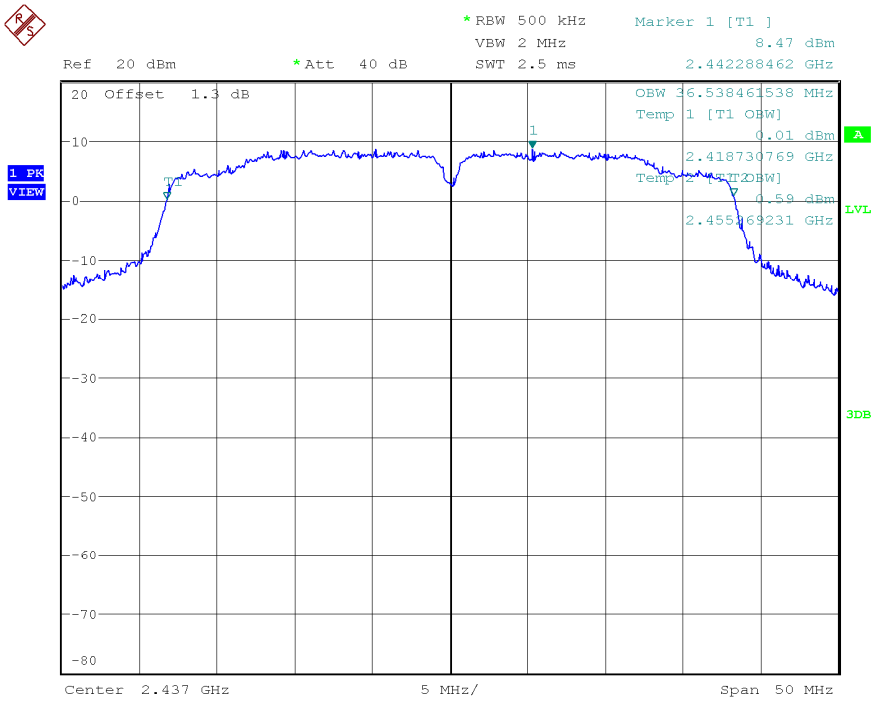

Date: 25.JAN.2013 11:41:14

Lowest Channel: 2422 MHz. Chain B



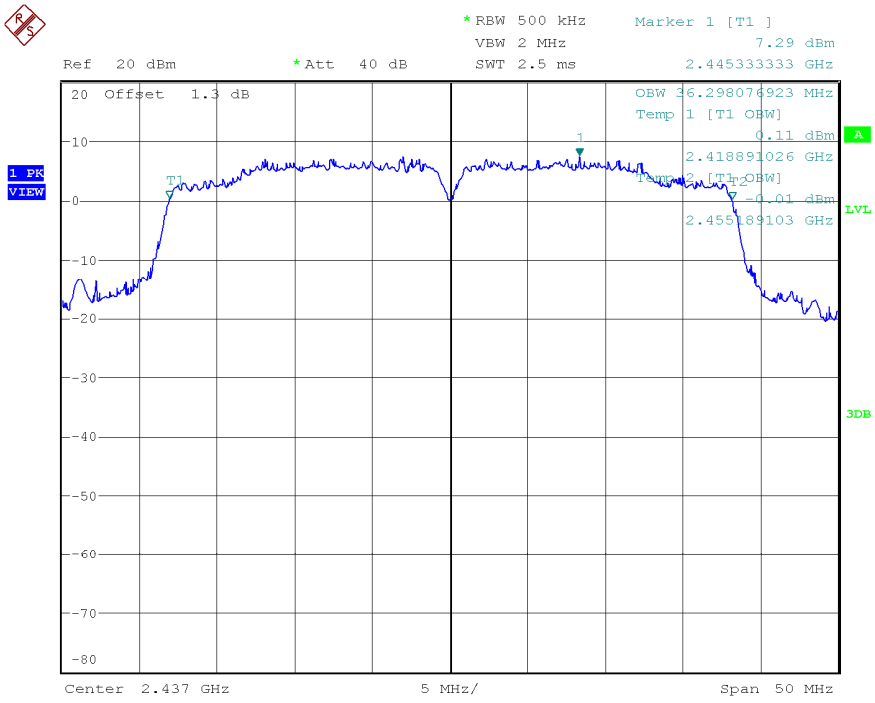

Date: 25.JAN.2013 11:28:11

Middle Channel: 2437 MHz. Chain A



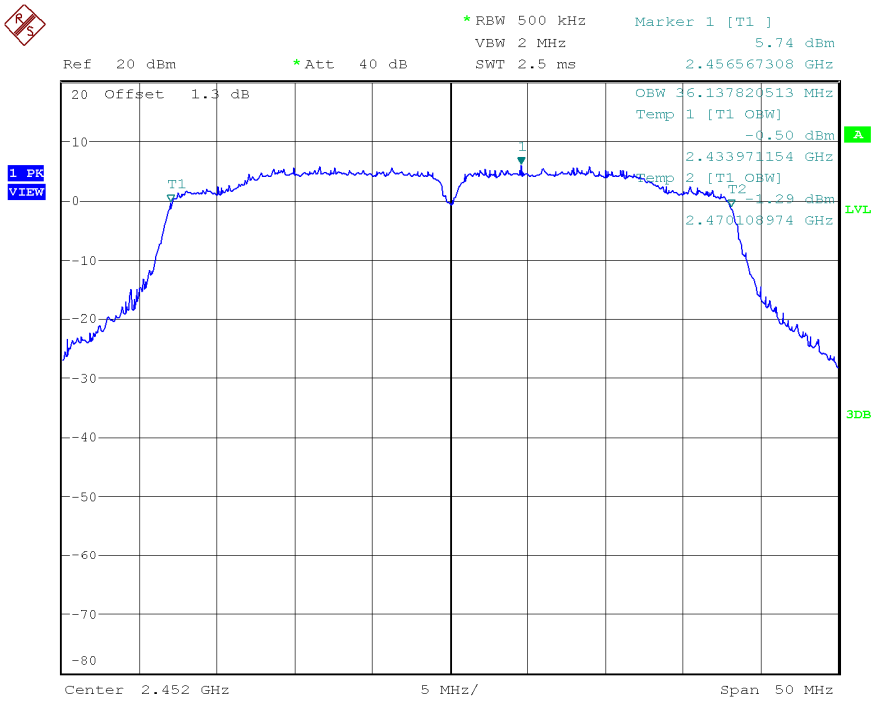

Date: 25.JAN.2013 11:38:35

Middle Channel: 2437 MHz. Chain B



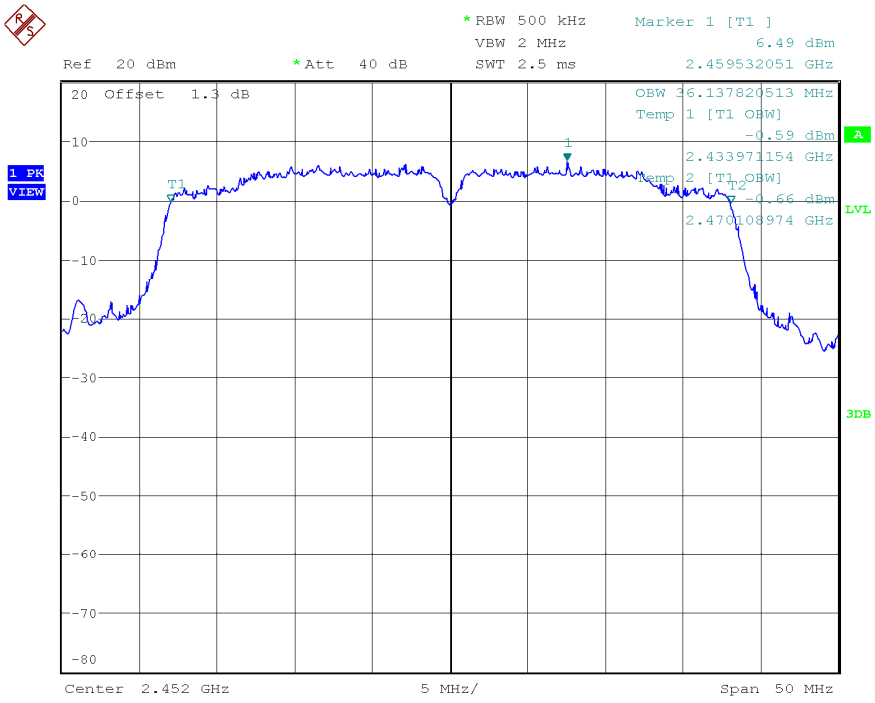

Date: 25.JAN.2013 11:30:16

Highest Channel: 2452 MHz. Chain A.




Date: 25.JAN.2013 11:37:07

Highest Channel: 2452 MHz. Chain B.




Date: 25.JAN.2013 11:32:06

## Section 15.247 Subclause (a) (2) / RSS-210 A8.2. (a). 6 dB Bandwidth

SPECIFICATION

The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

1. WiFi 2.4GHz 802.11 b mode

6 dB Bandwidth (see next plots).

| | Lowest frequency 2412 MHz | | Middle frequency 2437 MHz | | Highest frequency 2462 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| 6 dB Spectrum bandwidth (MHz) | 12.115 | 12.115 | 12.115 | 12.083 | 12.115 | 12.083 |
| Measurement uncertainty (kHz) | ±89 | | | | | |

Verdict: PASS

2. WiFi 2.4GHz 802.11 g mode

6 dB Bandwidth (see next plots).

| | Lowest frequency 2412 MHz | | Middle frequency 2437 MHz | | Highest frequency 2462 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| 6 dB Spectrum bandwidth (MHz) | 16.410 | 16.410 | 16.282 | 16.378 | 16.378 | 16.378 |
| Measurement uncertainty (kHz) | ±89 | | | | | |

Verdict: PASS

3. WiFi 2.4GHz 802.11 n20 mode

6 dB Bandwidth (see next plots).

| | Lowest frequency 2412 MHz | | Middle frequency 2437 MHz | | Highest frequency 2462 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| 6 dB Spectrum bandwidth (MHz) | 17.756 | 17.756 | 17.756 | 17.724 | 17.820 | 17.756 |
| Measurement uncertainty (kHz) | ±89 | | | | | |

Verdict: PASS

4. WiFi 2.4GHz 802.11 n40 mode

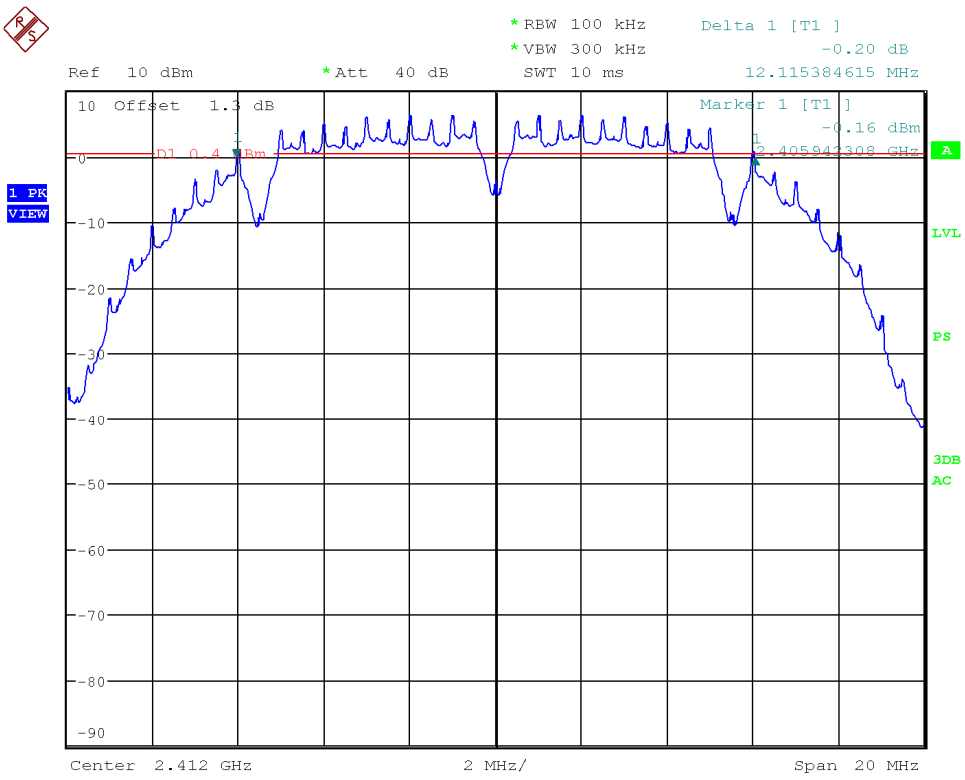
6 dB Bandwidth (see next plots).

| | Lowest frequency 2422 MHz | | Middle frequency 2437 MHz | | Highest frequency 2452 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| 6 dB Spectrum bandwidth (MHz) | 35.128 | 35.128 | 35.000 | 35.128 | 35.256 | 35.192 |
| Measurement uncertainty (kHz) | ±89 | | | | | |

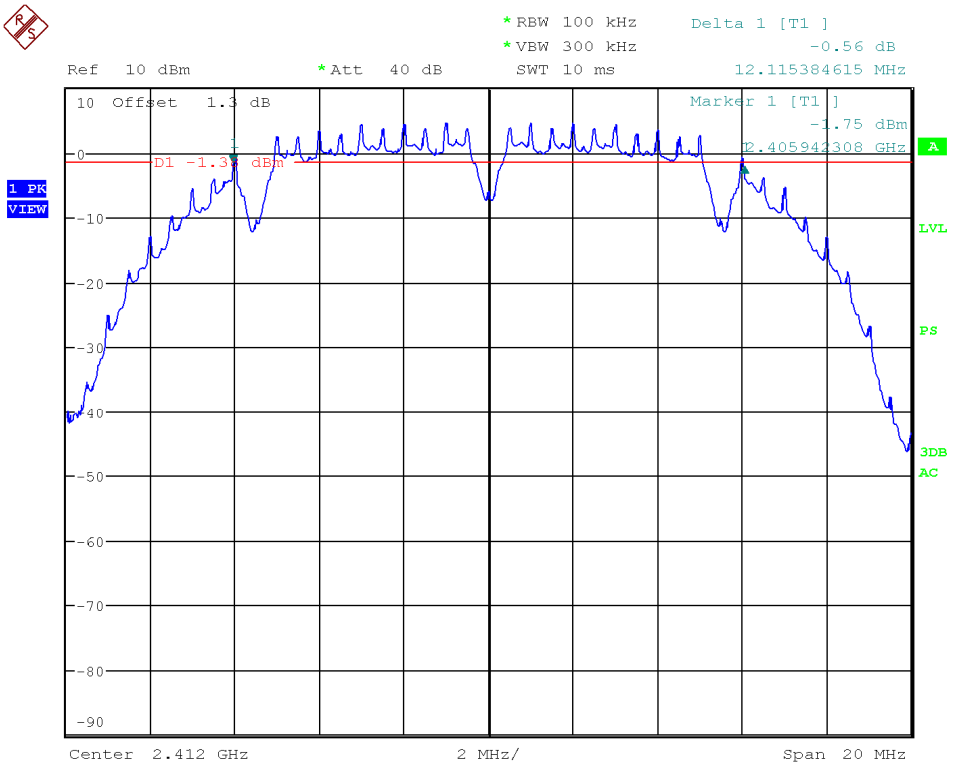
Verdict: PASS

1. WiFi 2.4GHz 802.11 b mode

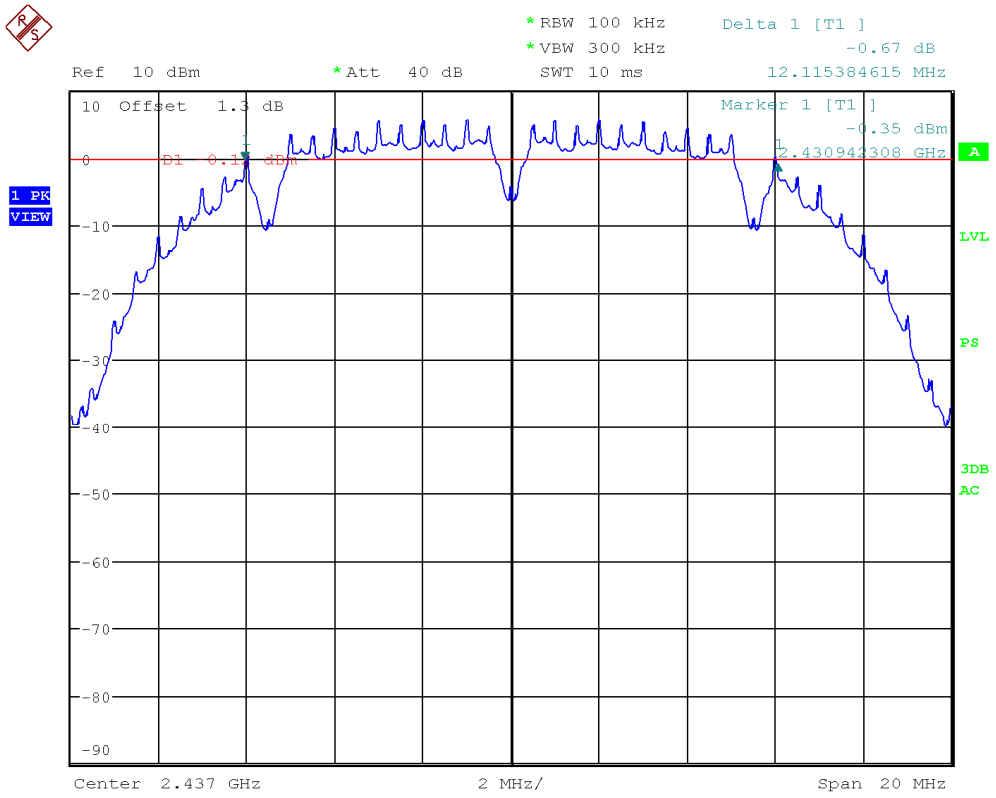
Lowest Channel: 2412 MHz. Chain A.



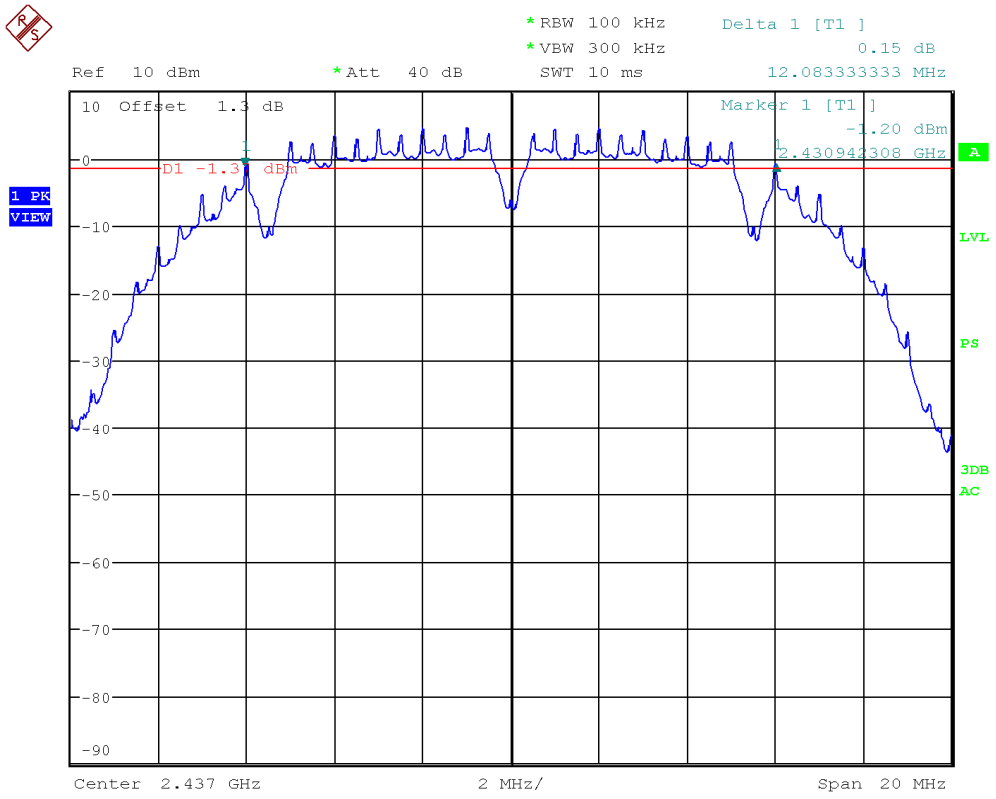

Lowest Channel: 2412 MHz. Chain B.



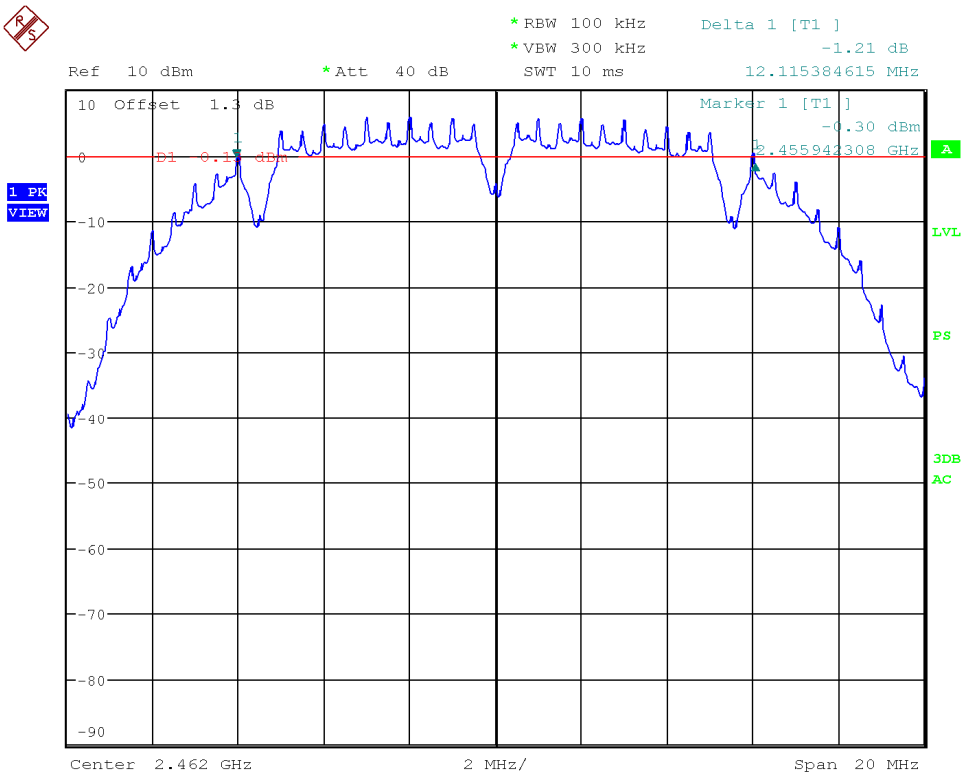
Middle Channel: 2437 MHz. Chain A



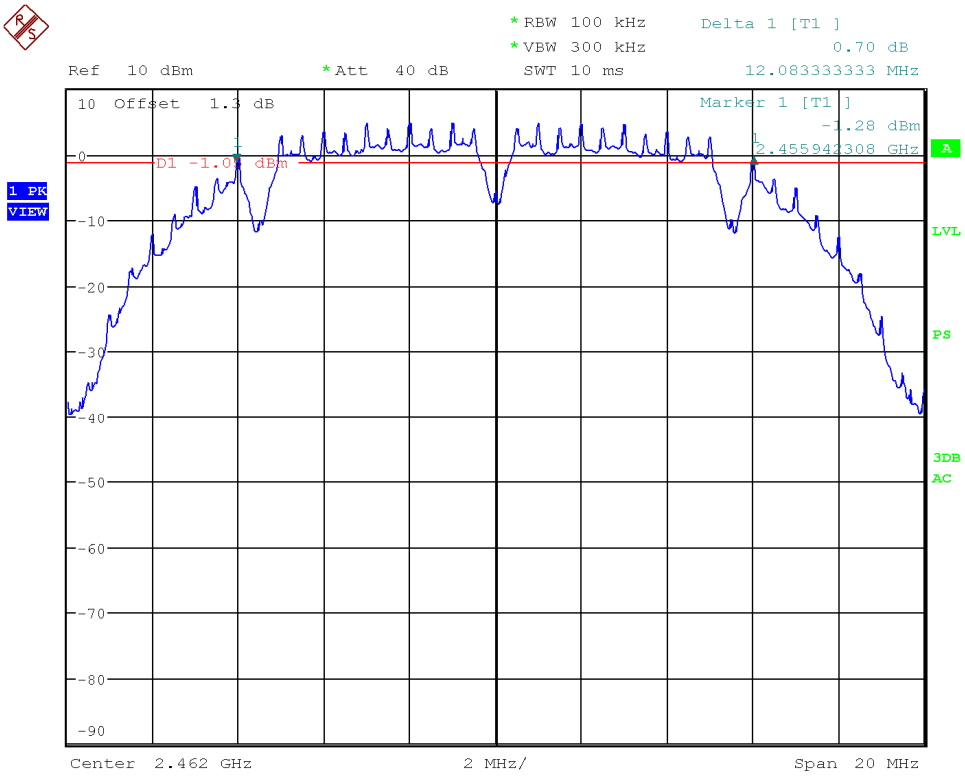

Middle Channel: 2437 MHz. Chain B



Highest Channel: 2462 MHz. Chain A.

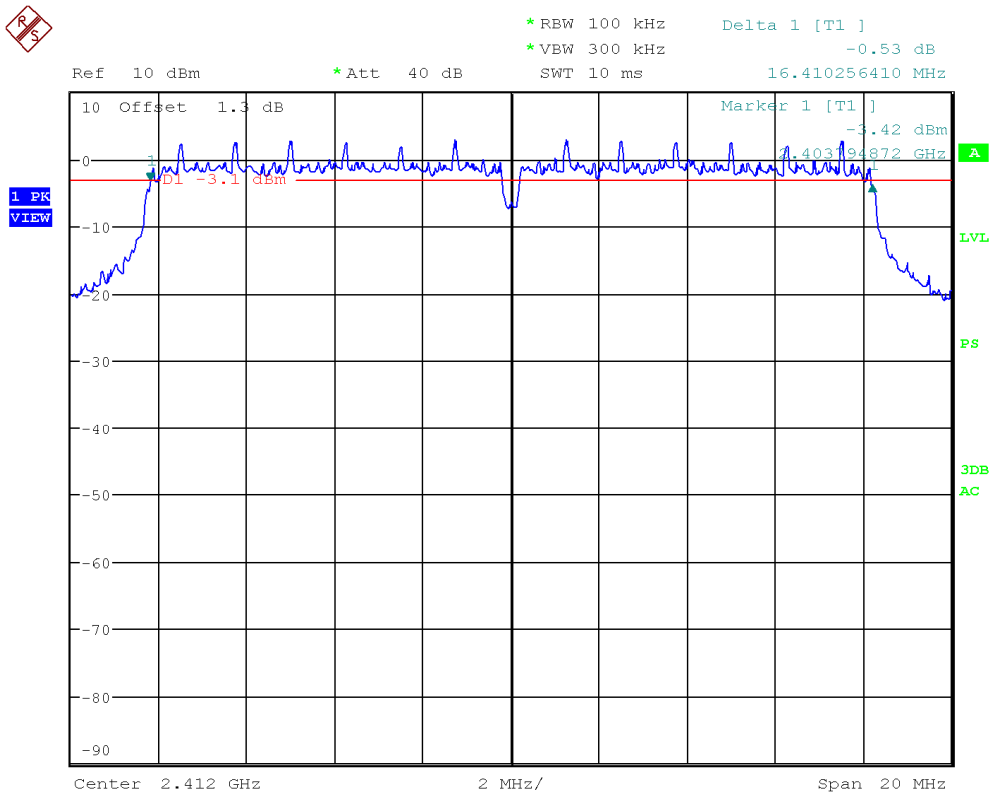



Highest Channel: 2462 MHz. Chain B.

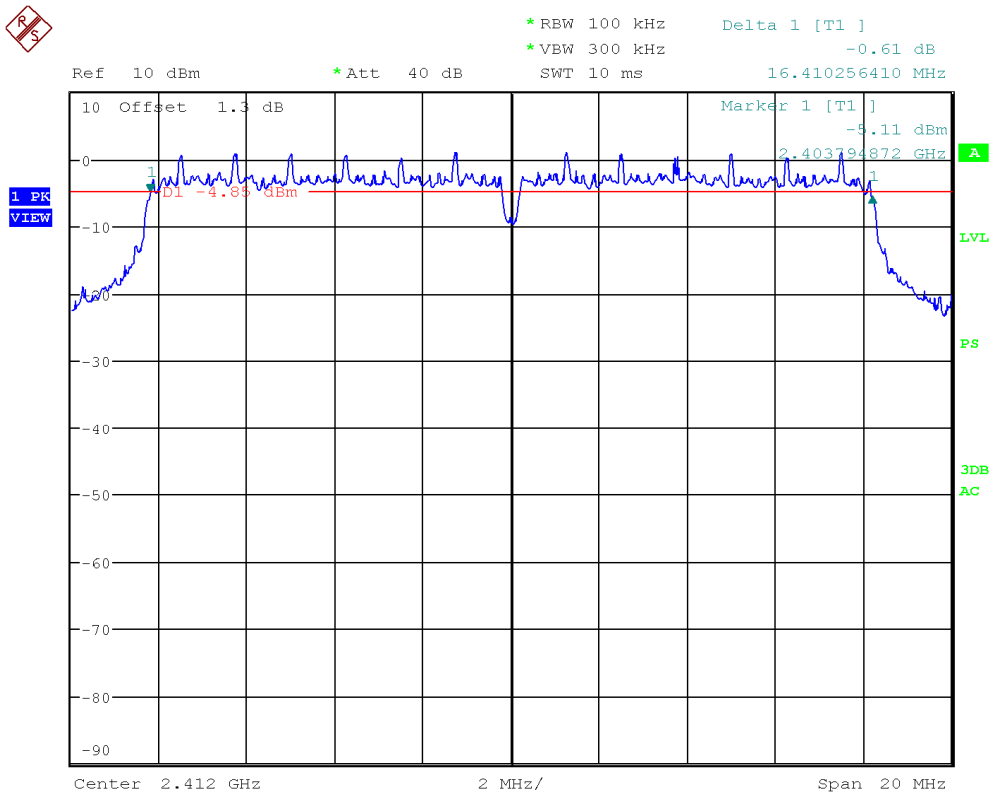


2. WiFi 2.4GHz 802.11 g mode

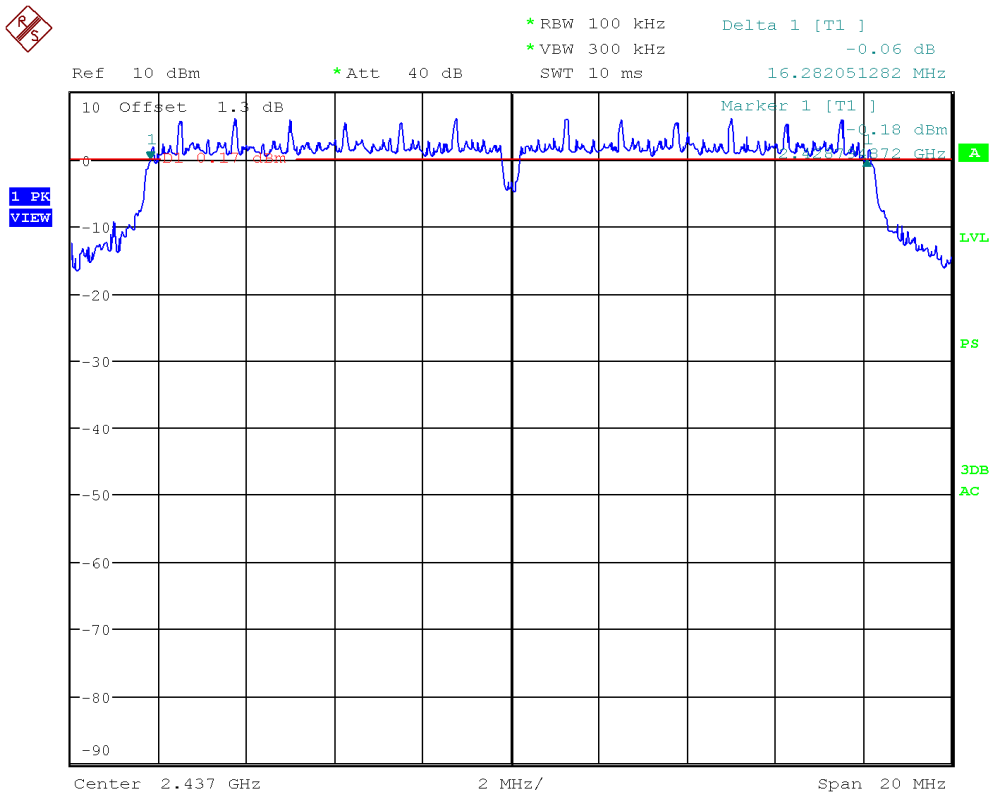
Lowest Channel: 2412 MHz. Chain A



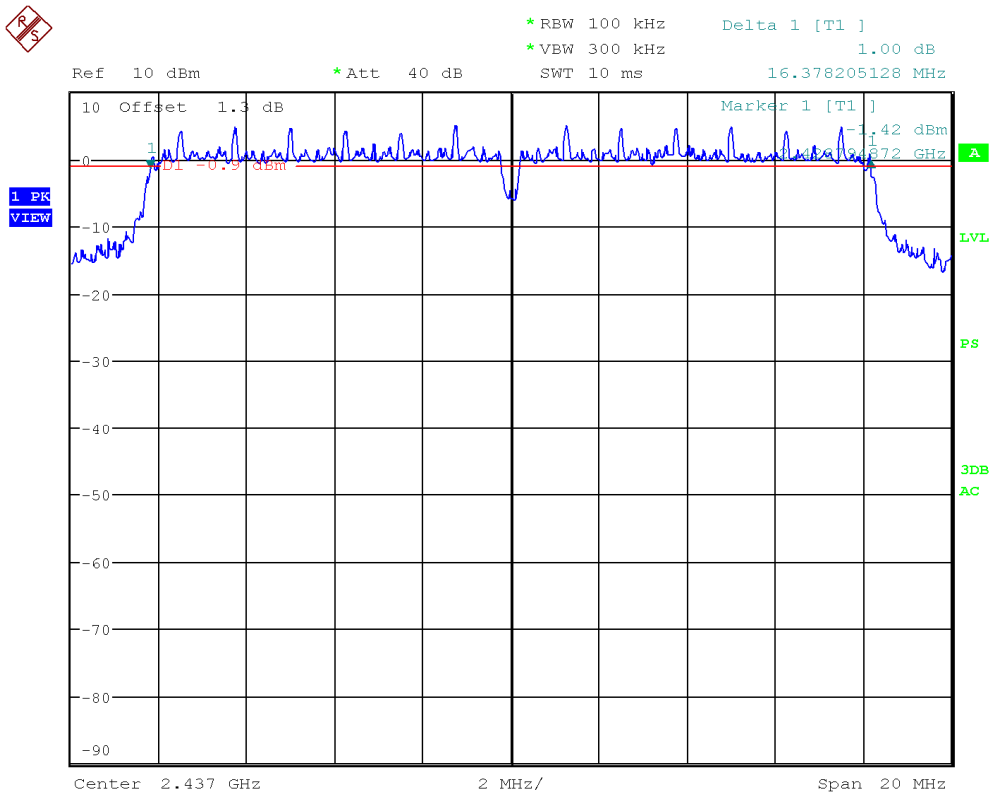

Lowest Channel: 2412 MHz. Chain B



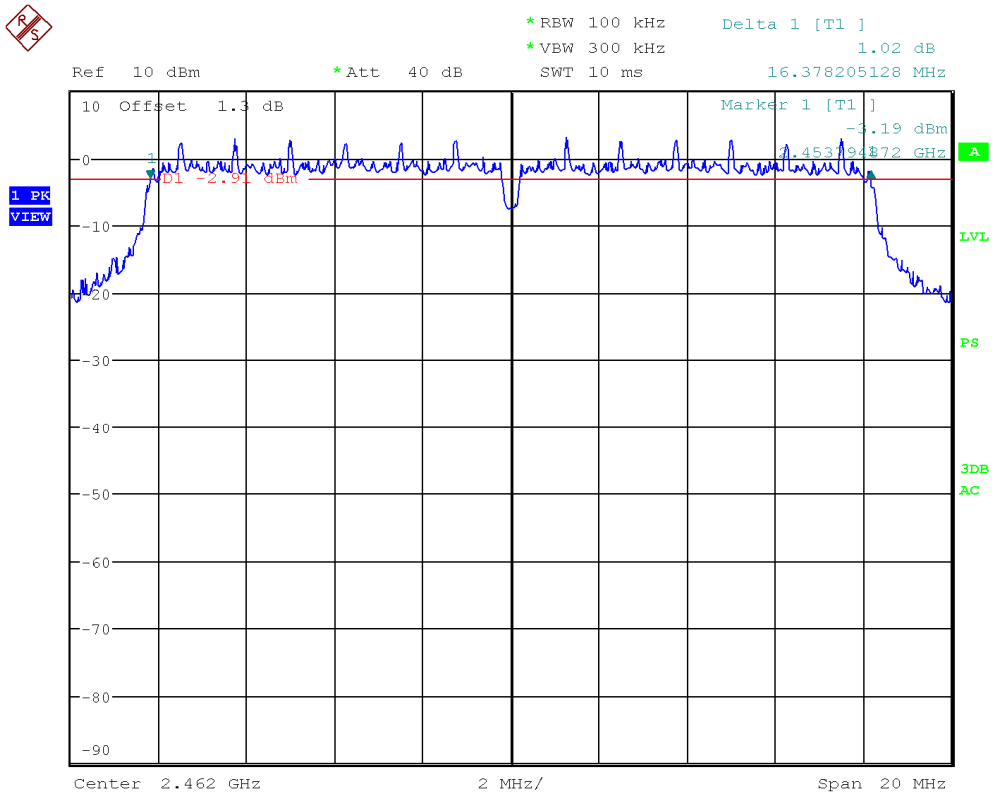
Middle Channel: 2437 MHz. Chain A



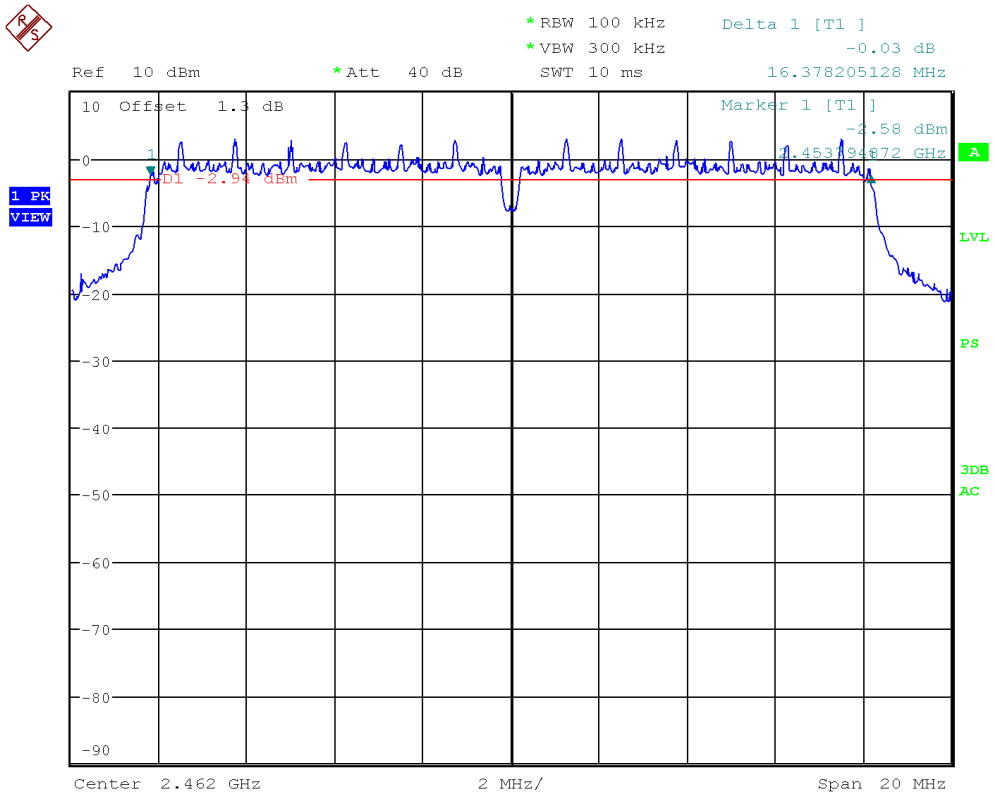

Middle Channel: 2437 MHz. Chain B



Highest Channel: 2462 MHz. Chain A

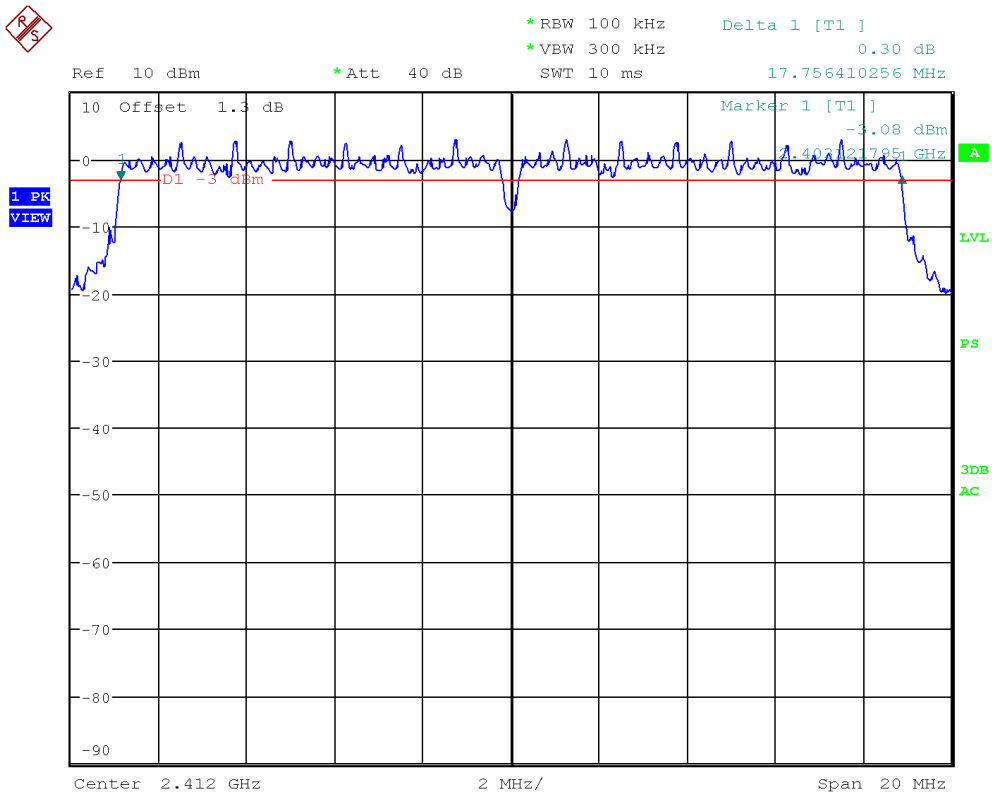



Highest Channel: 2462 MHz. Chain B

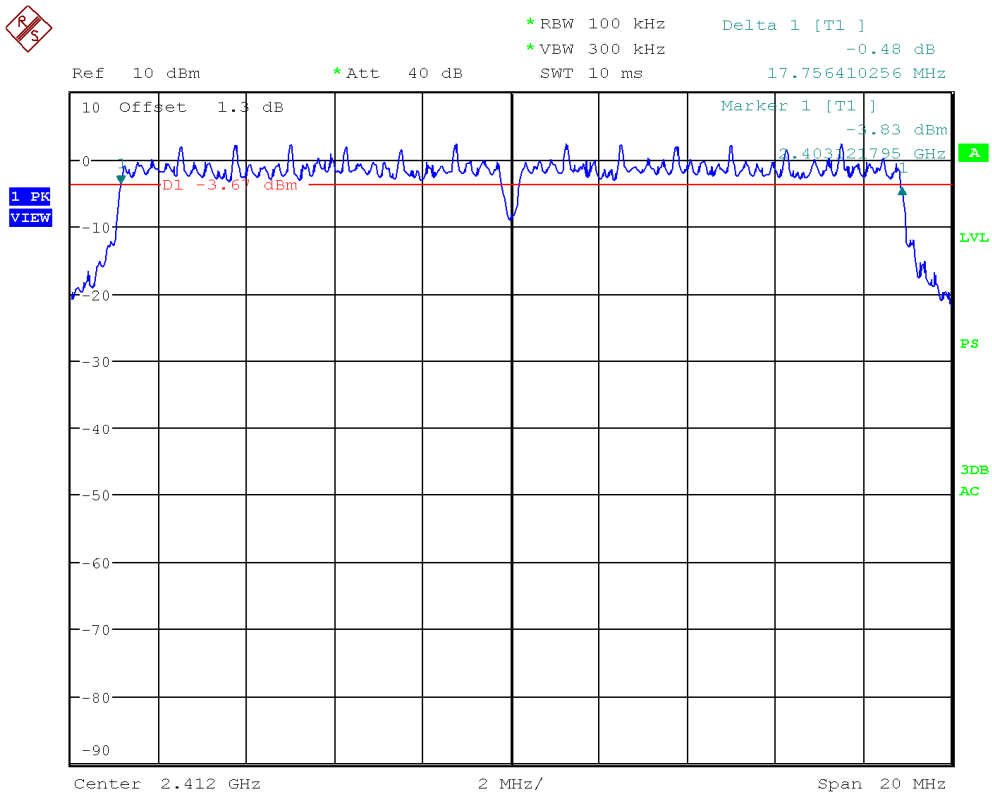


3. WiFi 2.4GHz 802.11 n20 mode

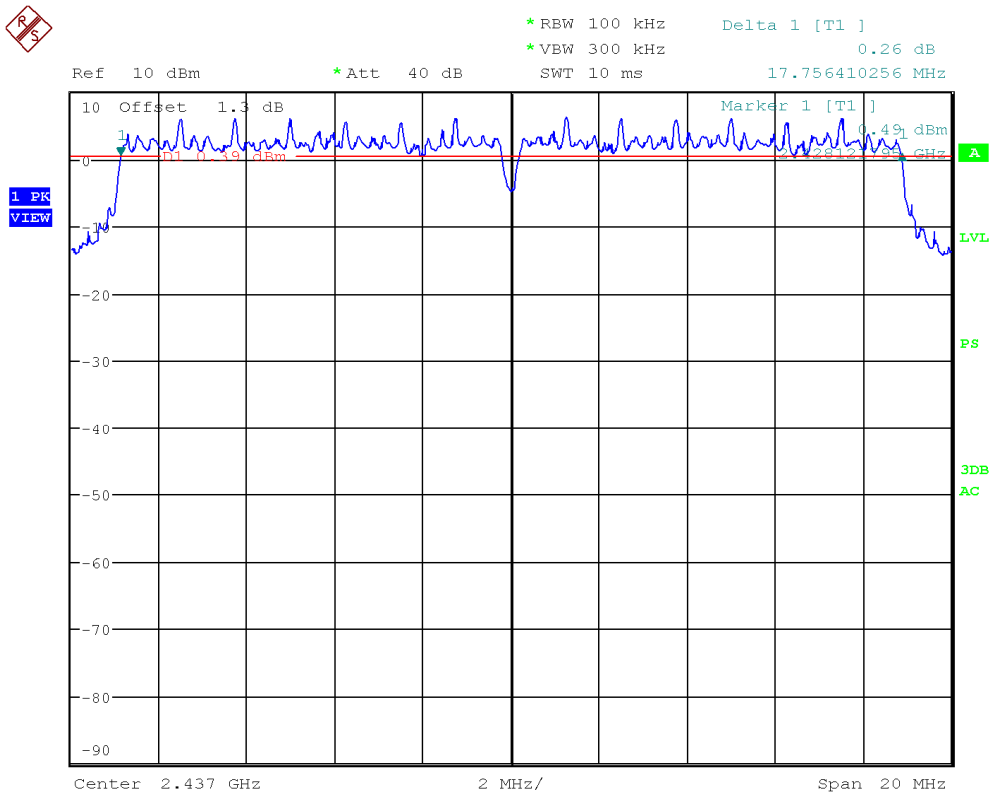
Lowest Channel: 2412 MHz. Chain A



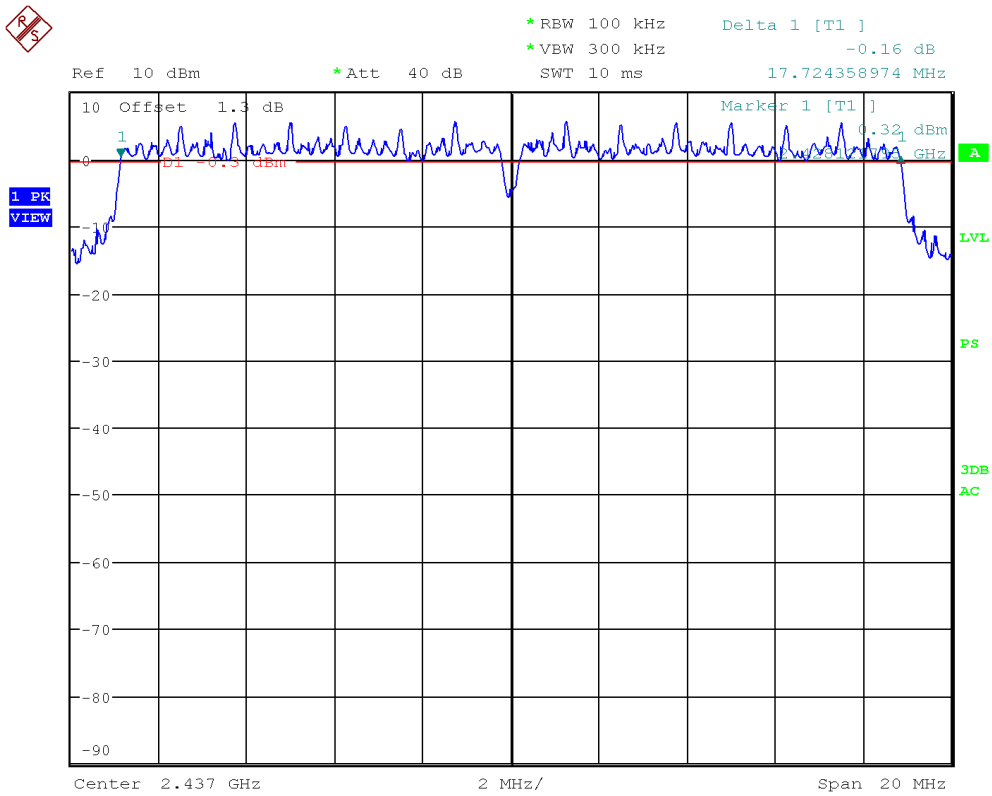

Lowest Channel: 2412 MHz. Chain B



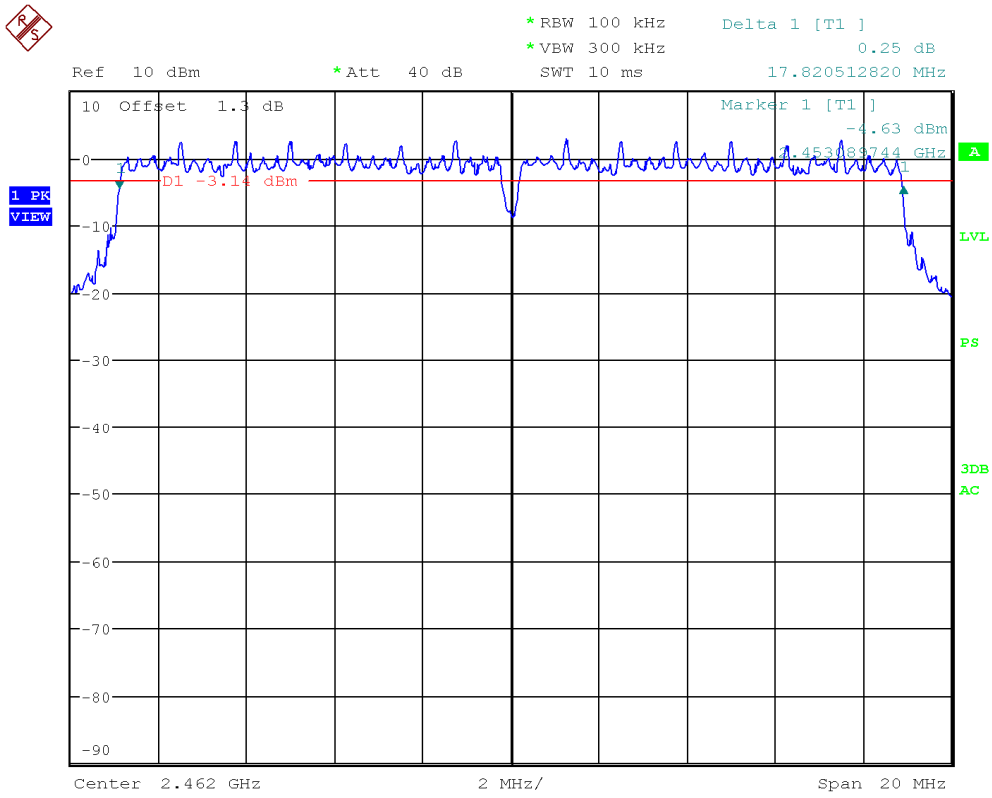
Middle Channel: 2437 MHz. Chain A



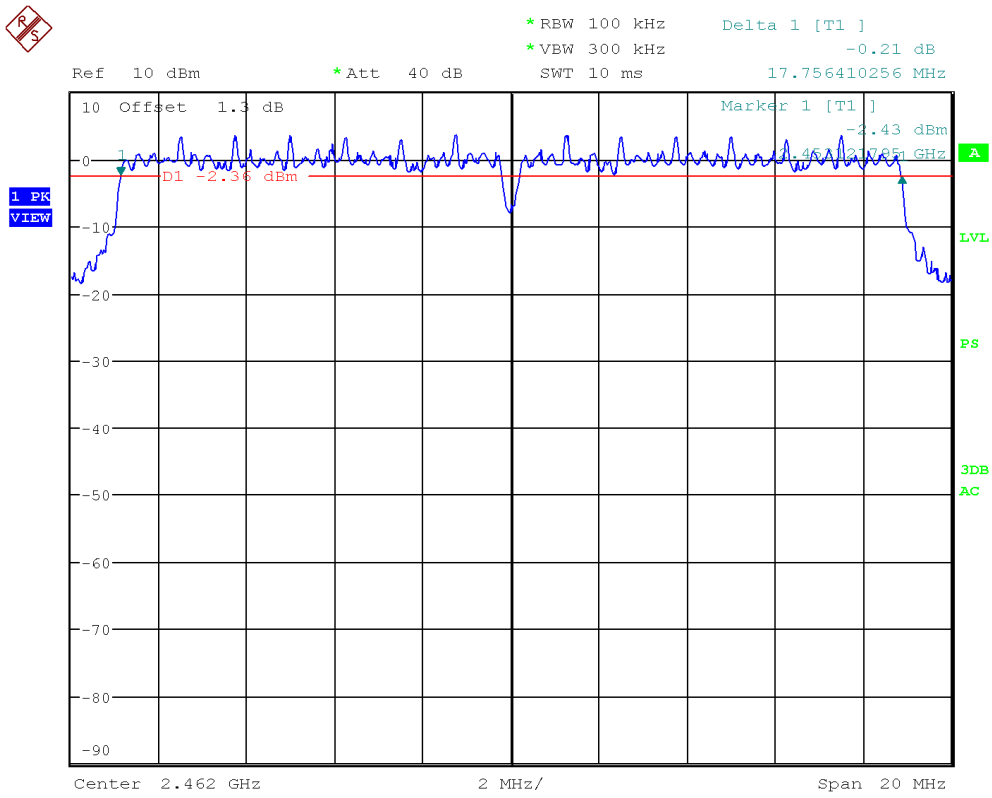

Middle Channel: 2437 MHz. Chain B



Highest Channel: 2462 MHz. Chain A

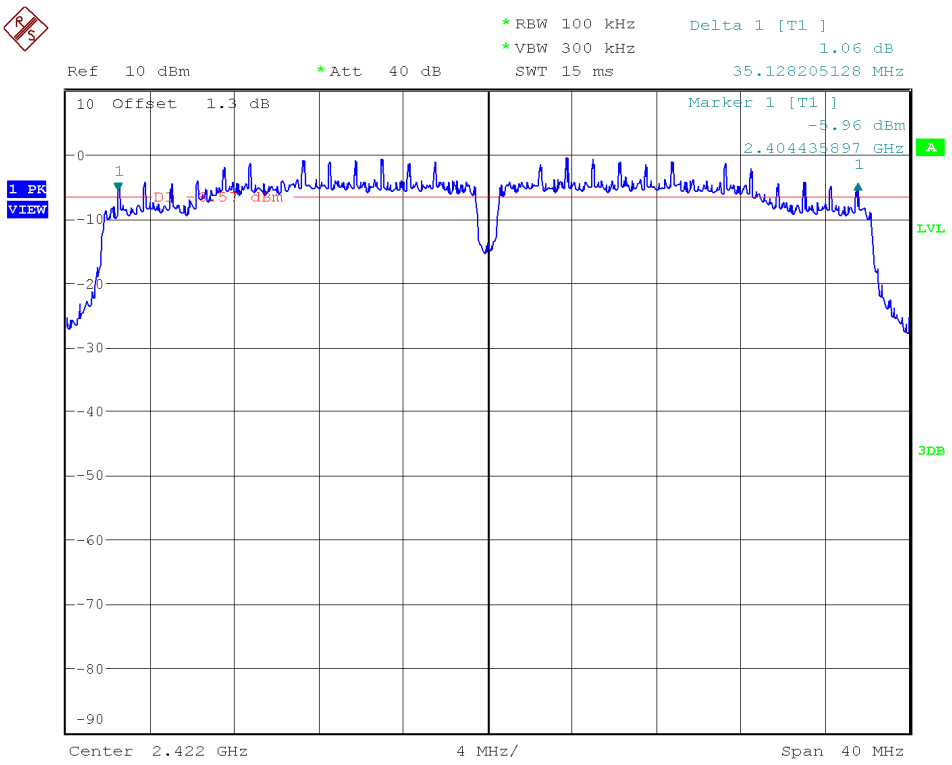



Highest Channel: 2462 MHz. Chain B

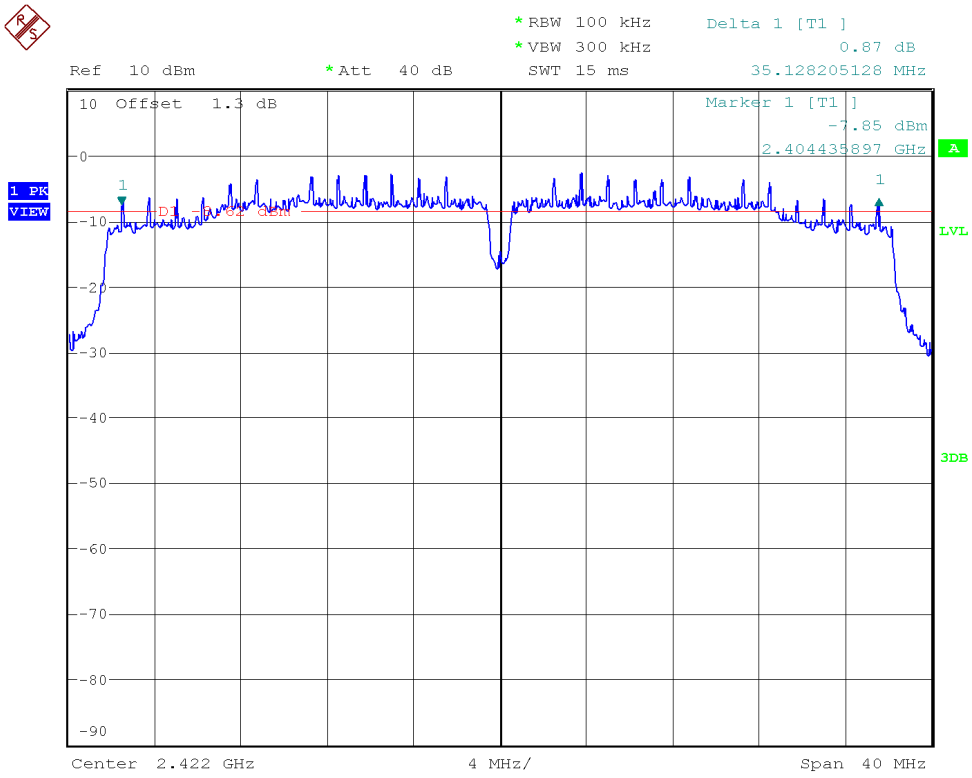


4. WiFi 2.4GHz 802.11 n40 mode

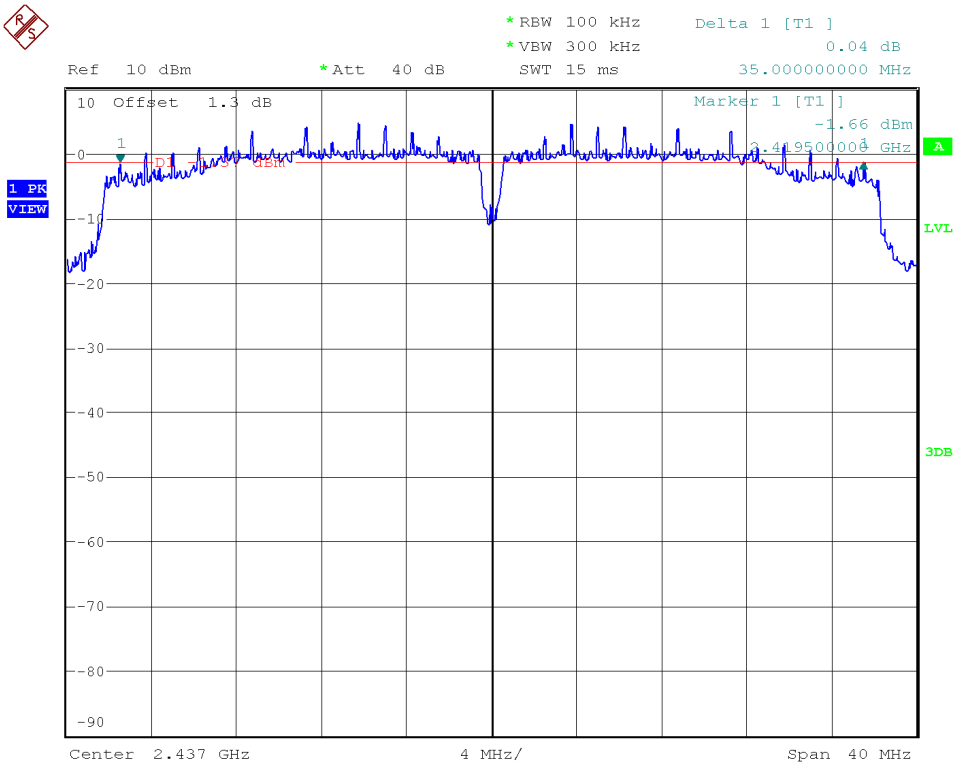
Lowest Channel: 2422 MHz. Chain A



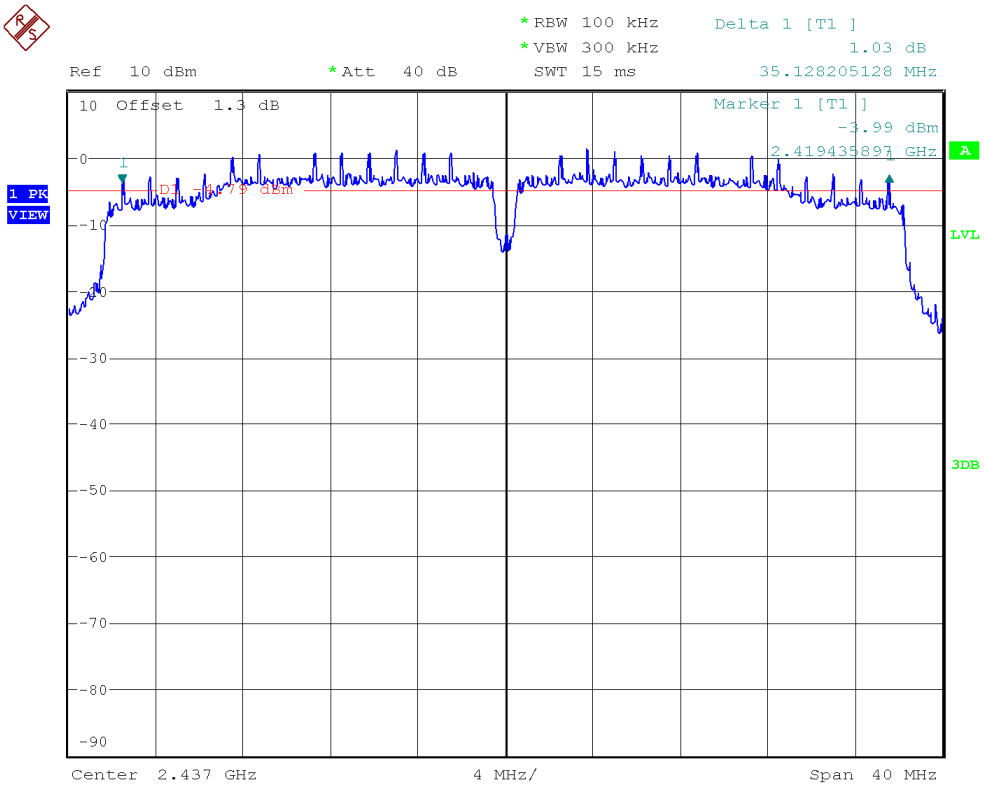

Lowest Channel: 2422 MHz. Chain B



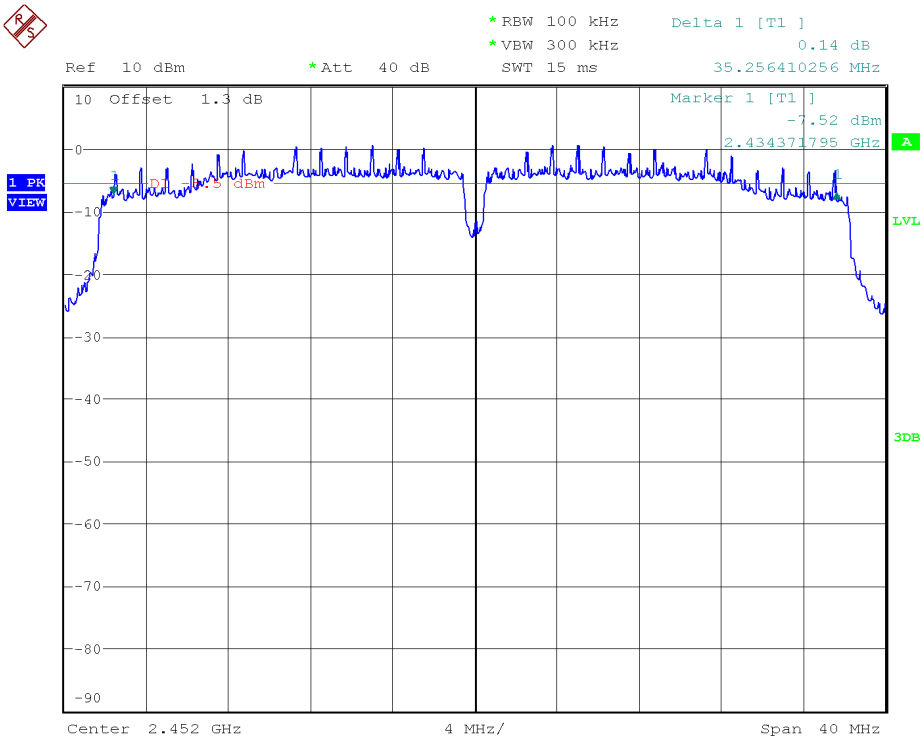
Middle Channel: 2437 MHz. Chain A



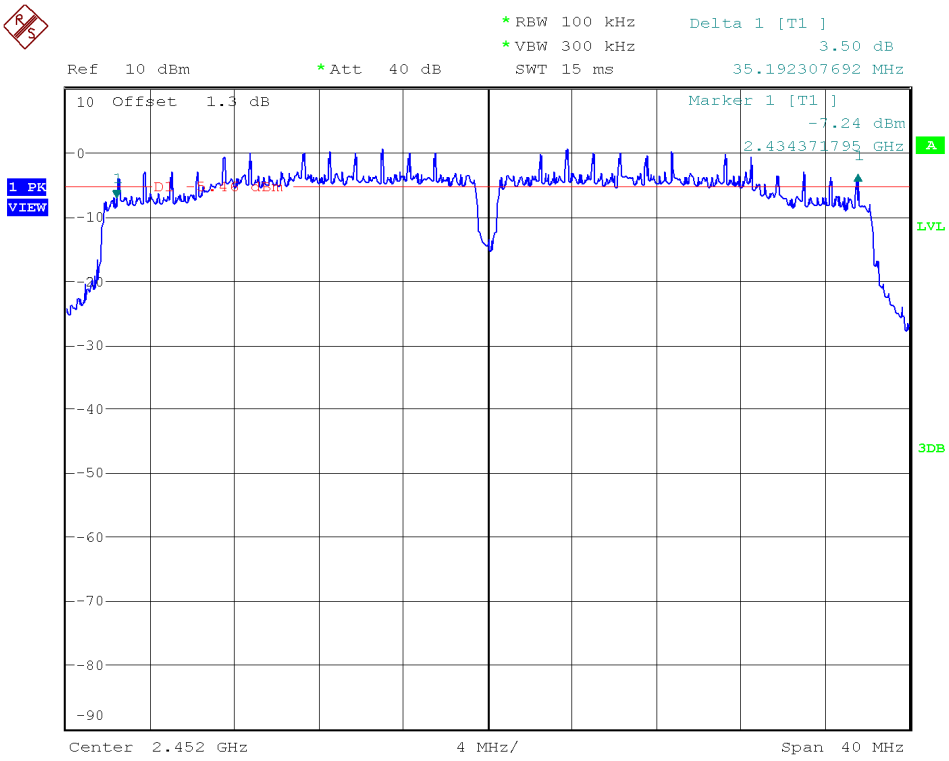

Middle Channel: 2437 MHz. Chain B



Highest Channel: 2452 MHz. Chain A




Highest Channel: 2452 MHz. Chain B



## Section 15.247 Subclause (b) / RSS-210 A8.4. (4). Maximum output power and antenna gain

SPECIFICATION

The maximum peak conducted output power of the intentional radiator shall not exceed 1 watt (30 dBm). The e.i.r.p. shall not exceed 4 W (36 dBm) (Canada).

RESULTS

The maximum Peak Conducted Output Power was measured using the channel integration method according to point 8.1.2. Option 2 of Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v02 dated 10/04/2012.

In the measure-and-sum approach for MIMO mode, the conducted emission level (*e.g.*, transmit power or power in specified bandwidth) is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in linear power units (mW—not dBm).

The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power.
For MIMO mode, the Guidance on directional Gain calculations according to the Guidance for Emission Testing of Transmitters with Multiple Outputs in the Same Band 662911 D01 Multiple Transmitter Output v01r02 dated 9/26/2012 was used.
The number of transmit antennas ($N_{ANT}$) are 2 and the number of spatial streams (Nss) are 2 and therefore the Array Gain is 0 dB.

1. WiFi 2.4GHz 802.11 b mode

MAXIMUM OUTPUT POWER. (See next plot of worst case: Highest power level).

Maximum declared antenna gain: 3 dBi.

| | Lowest frequency 2412 MHz | | Middle frequency 2437 MHz | | Highest frequency 2462 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| Maximum conducted power (dBm) | 18.61 | 17.64 | 19.17 | 17.62 | 18.95 | 17.84 |
| Maximum EIRP power (dBm) | 21.61 | 20.64 | 22.17 | 20.62 | 21.95 | 20.84 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

Verdict: PASS

2. WiFi 2.4GHz 802.11 g mode

MAXIMUM OUTPUT POWER. (See next plot of worst case: Highest power level).

Maximum declared antenna gain: 3 dBi.

| | Lowest frequency 2412 MHz | | Middle frequency 2437 MHz | | Highest frequency 2462 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| Maximum conducted power (dBm) | 22.09 | 21.34 | 25.66 | 24.59 | 23.24 | 23.47 |
| Maximum EIRP power (dBm) | 25.09 | 24.34 | 28.66 | 27.59 | 26.24 | 26.47 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

Verdict: PASS

3. WiFi 2.4GHz 802.11 n20 mode

MAXIMUM OUTPUT POWER. (See next plot of worst case: Highest power level).

Maximum declared antenna gain: 3 dBi.

| SISO | Lowest frequency 2412 MHz | | Middle frequency 2437 MHz | | Highest frequency 2462 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| Maximum conducted power (dBm) | 23.29 | 21.59 | 26.01 | 24.83 | 23.36 | 23.45 |
| Maximum EIRP power (dBm) | 26.29 | 24.59 | 29.01 | 27.83 | 26.36 | 26.45 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

| MIMO | Lowest frequency 2412 MHz | | Middle frequency 2437 MHz | | Highest frequency 2462 MHz | |
|---|---|---|---|---|---|---|
| | Chain A+B | | Chain A+B | | Chain A+B | |
| | Port A | Port B | Port A | Port B | Port A | Port B |
| Maximum conducted power (dBm) | 22.50 | 21.67 | 23.14 | 22.80 | 22.95 | 22.62 |
| | Port A+B | | Port A+B | | Port A+B | |
| Maximum conducted power (dBm) | 25.12 | | 25.98 | | 25.80 | |
| Maximum EIRP power (dBm) | 28.12 | | 28.98 | | 28.80 | |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

Verdict: PASS

4. WiFi 2.4GHz 802.11 n40 mode

MAXIMUM OUTPUT POWER. (See next plot of worst case: Highest power level).

Maximum declared antenna gain: 3 dBi.

| SISO | Lowest frequency 2422 MHz | | Middle frequency 2437 MHz | | Highest frequency 2452 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| Maximum conducted power (dBm) | 22.70 | 20.79 | 26.78 | 23.95 | 23.87 | 23.28 |
| Maximum EIRP power (dBm) | 25.70 | 23.79 | 29.78 | 26.95 | 26.87 | 26.28 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

| MIMO | Lowest frequency 2422 MHz | | Middle frequency 2437 MHz | | Highest frequency 2452 MHz | |
|---|---|---|---|---|---|---|
| | Chain A+B | | Chain A+B | | Chain A+B | |
| | Port A | Port B | Port A | Port B | Port A | Port B |
| Maximum conducted power (dBm) | 18.87 | 18.78 | 23.53 | 22.79 | 22.30 | 21.98 |
| | Port A+B | | Port A+B | | Port A+B | |
| Maximum conducted power (dBm) | 21.84 | | 26.19 | | 25.15 | |
| Maximum EIRP power (dBm) | 24.84 | | 29.19 | | 28.15 | |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

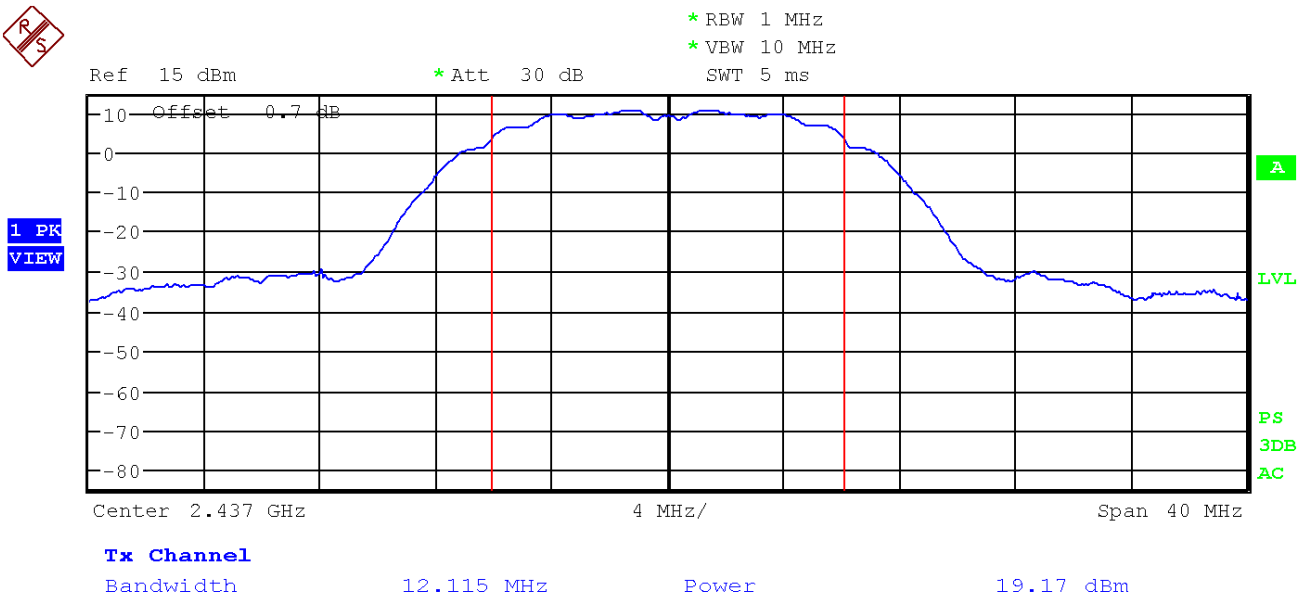
Verdict: PASS

The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values.

1. CONDUCTED PEAK POWER.

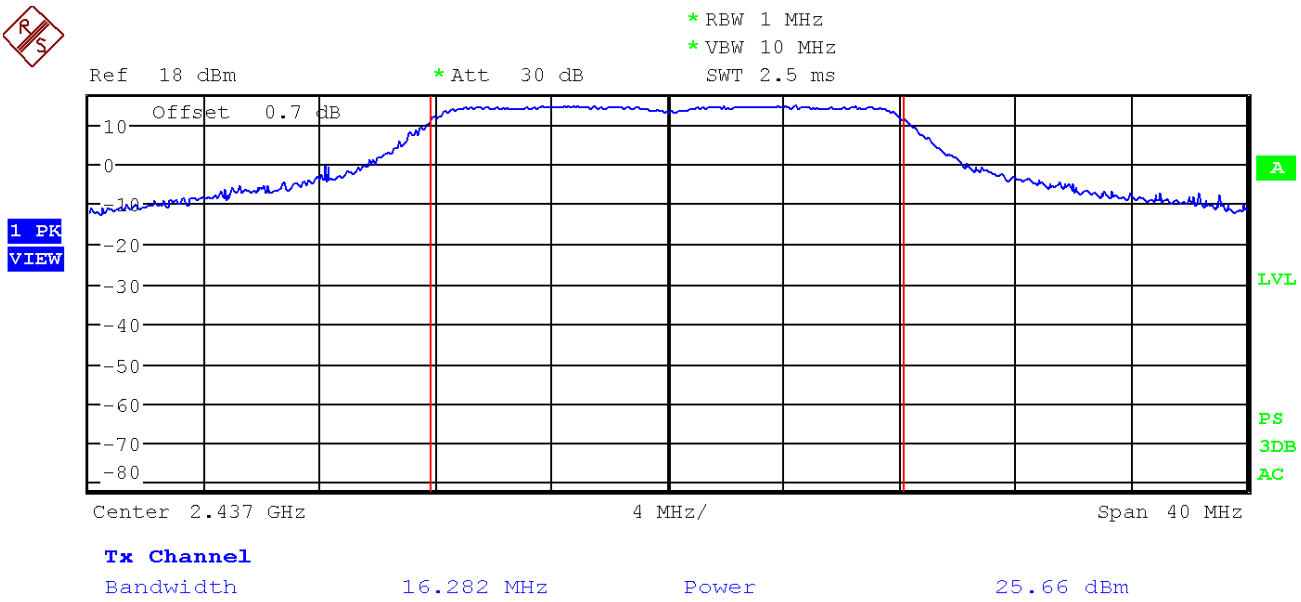
1. WiFi 2.4GHz 802.11 b mode

Middle frequency 2437 MHz. Chain A.



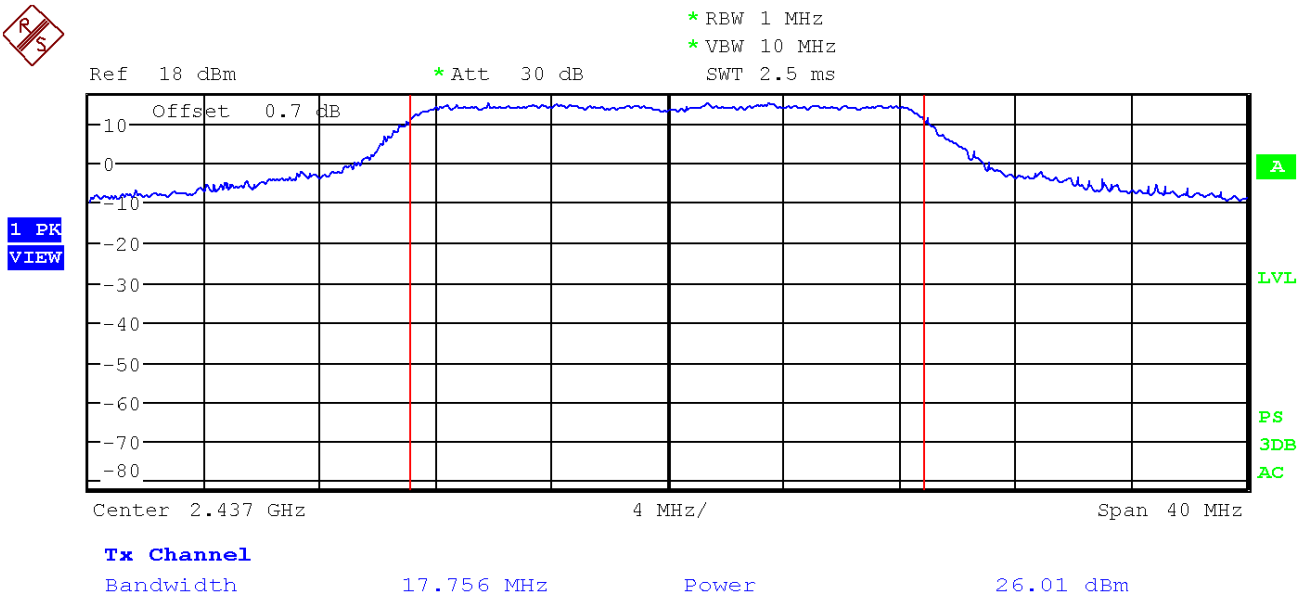

2. WiFi 2.4GHz 802.11 g mode

Middle frequency 2437 MHz. Chain A.

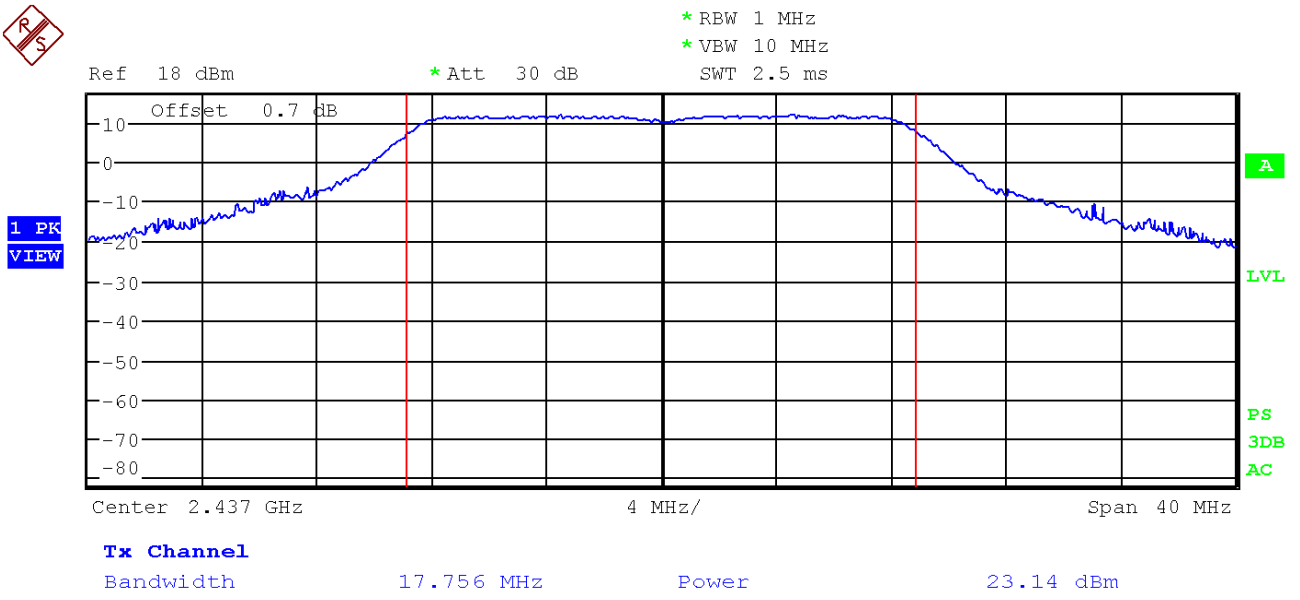


3. WiFi 2.4GHz 802.11 n20 mode

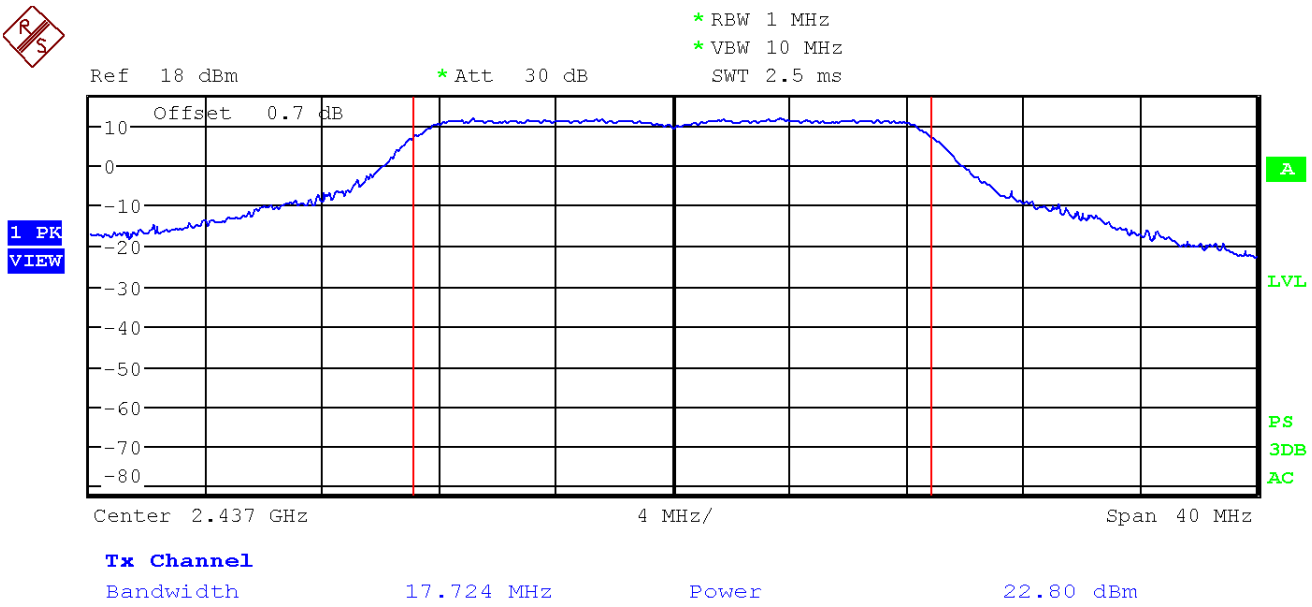
SISO mode. Middle frequency 2437 MHz. Chain A.




MIMO mode. Middle frequency 2437 MHz. Chain A.

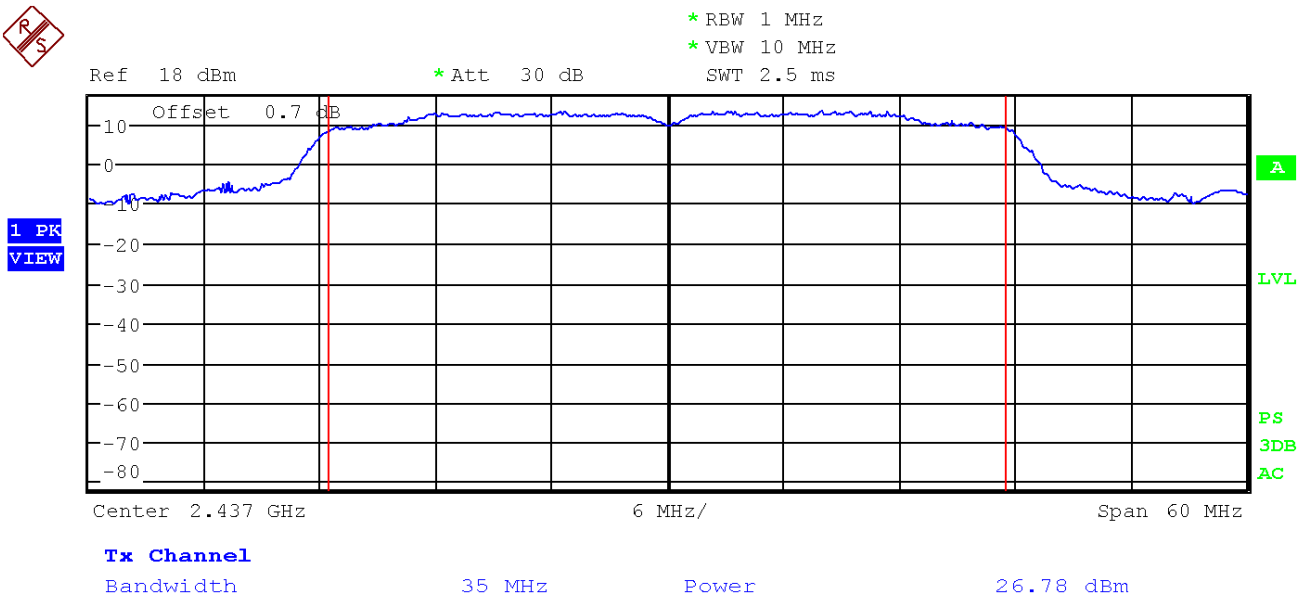


MIMO mode. Middle frequency 2437 MHz. Chain B.

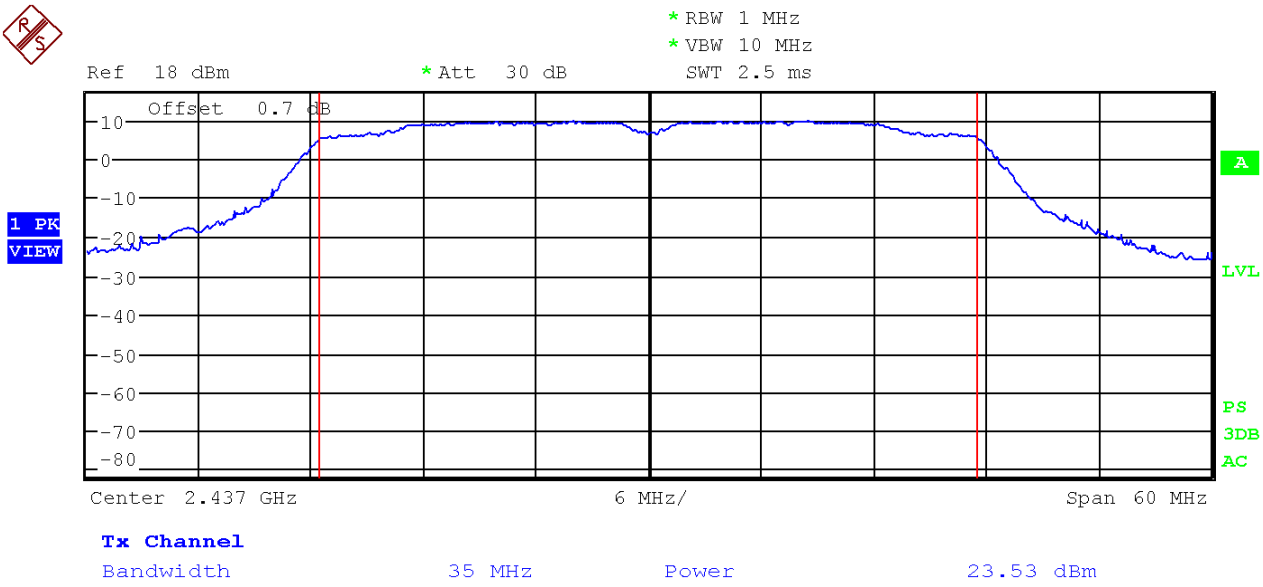



4. WiFi 2.4GHz 802.11 n40 mode

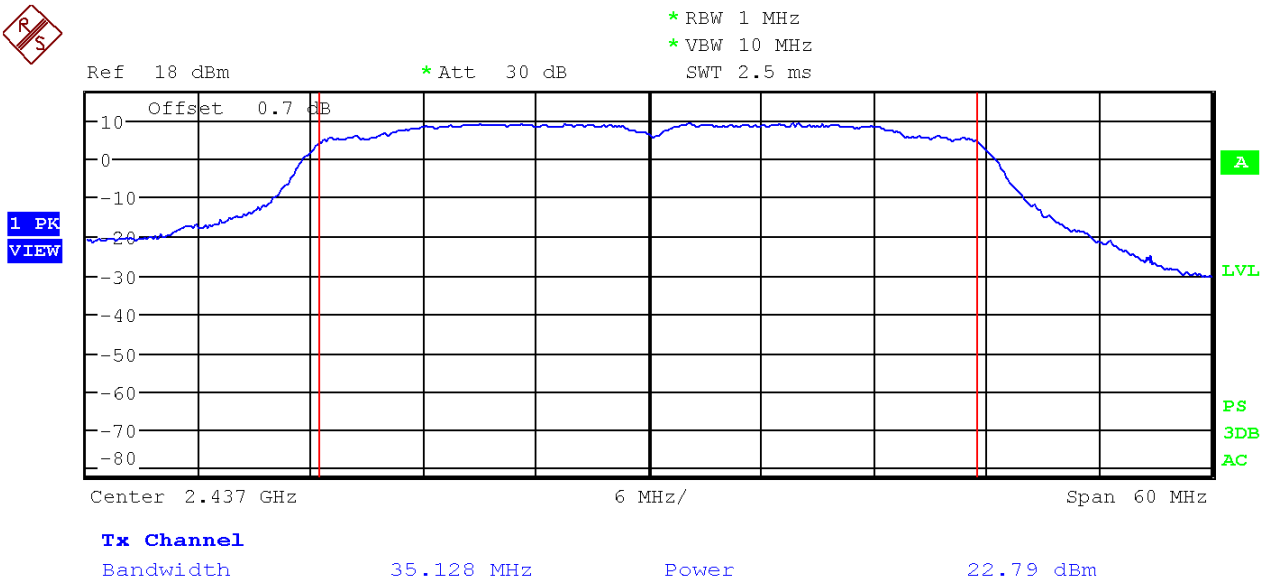
SISO mode. Middle frequency 2437 MHz. Chain A.



MIMO mode. Middle frequency 2437 MHz. Chain A.




MIMO mode. Middle frequency 2437 MHz. Chain B.



## Section 15.247 Subclause (d) / RSS-210 A8.5. Emission limitations conducted (Transmitter)

SPECIFICATION

In any 100 kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

RESULTS: (See next plots)

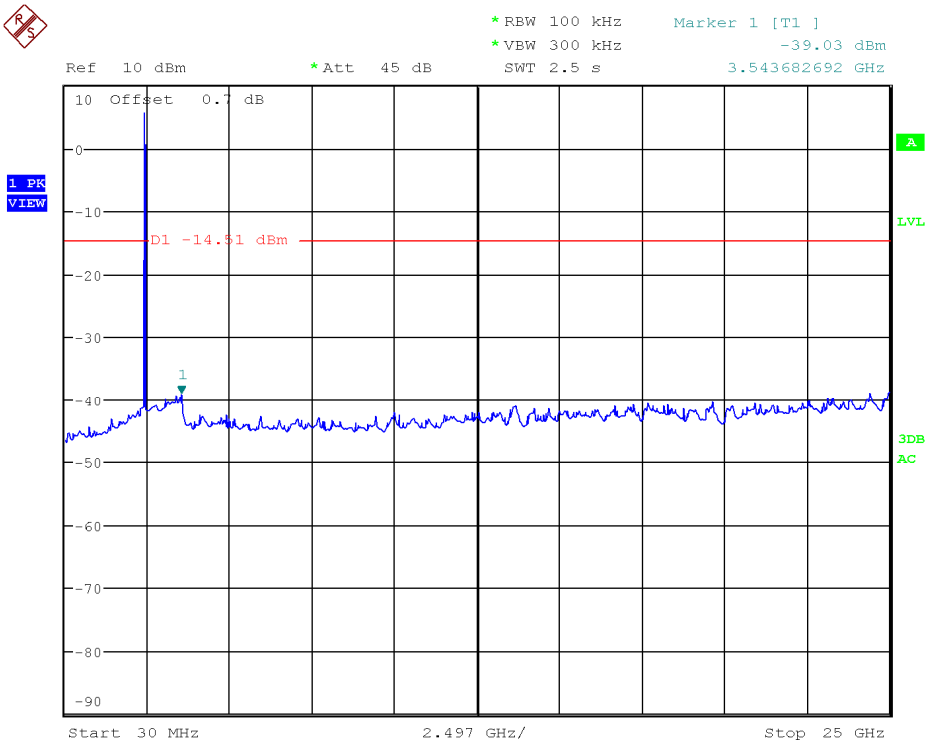
1. WiFi 2.4GHz 802.11 b mode

Reference Level Measurement

| | Lowest frequency 2412 MHz | | Middle frequency 2437 MHz | | Highest frequency 2462 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| Reference Level Measurement (dBm) | 5.49 | 5.51 | 6.45 | 5.19 | 6.34 | 5.13 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

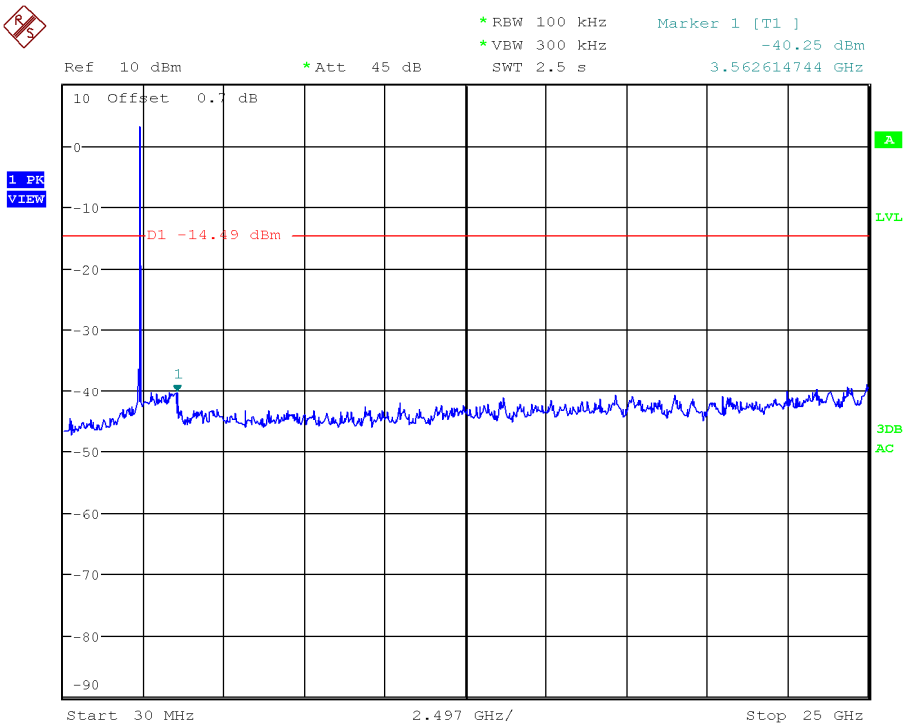
Verdict: PASS

Lowest Channel: 2412 MHz. Chain A. Unwanted Emissions Level Measurement



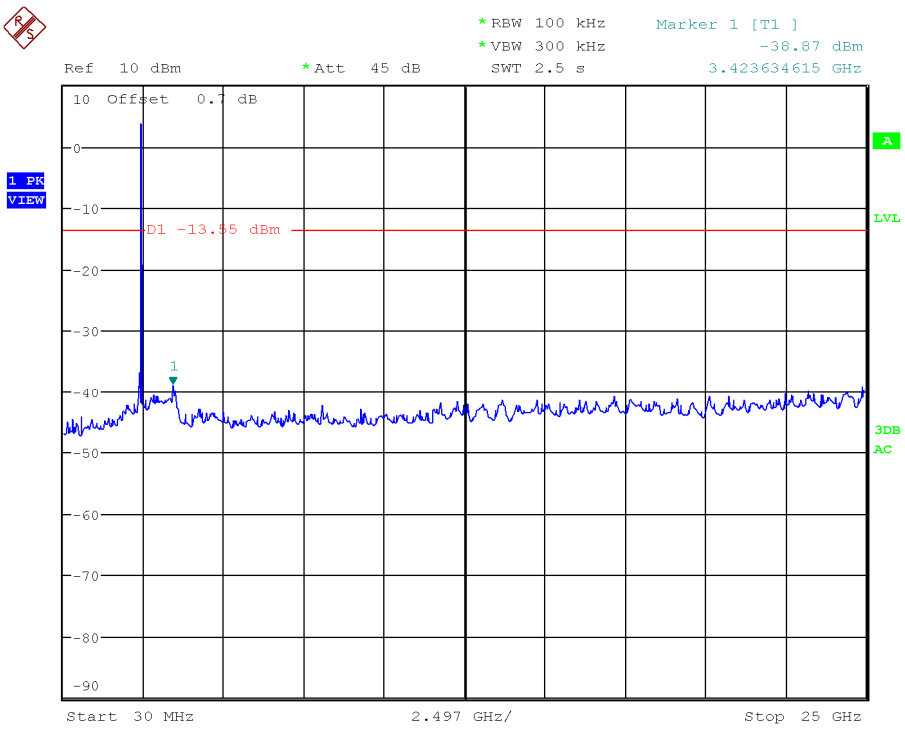

Note: The peak above the limit is the carrier frequency.

Lowest Channel: 2412 MHz. Chain B. Unwanted Emissions Level Measurement



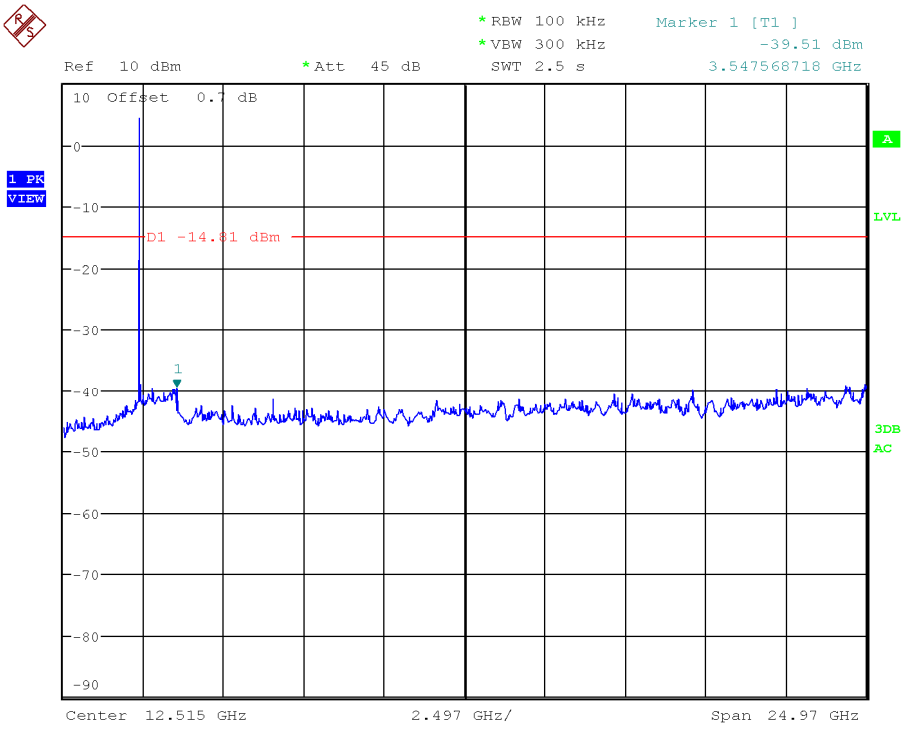

Note: The peak above the limit is the carrier frequency.

Middle Channel: 2437 MHz. Chain A. Unwanted Emissions Level Measurement



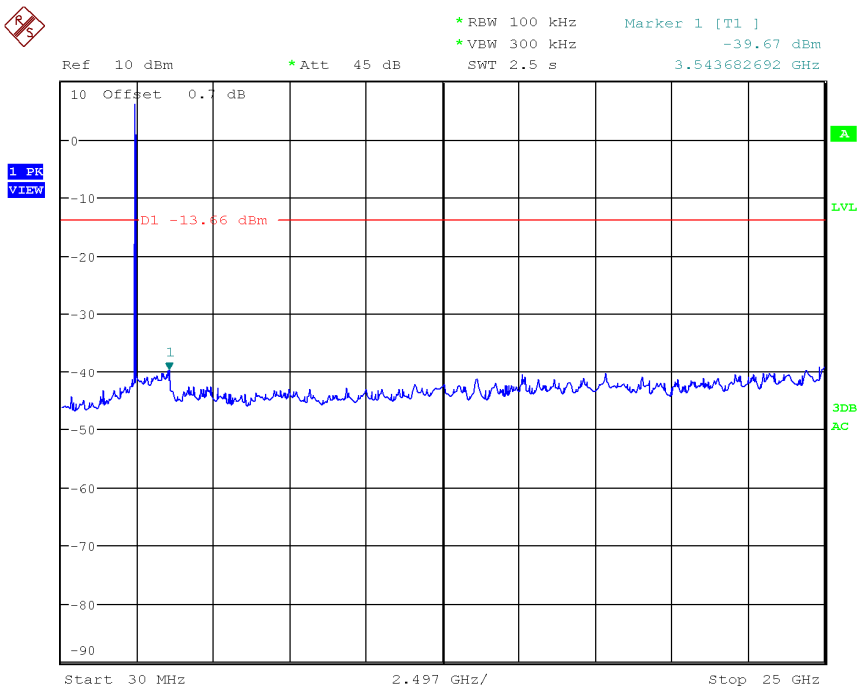

Note: The peak above the limit is the carrier frequency.

Middle Channel: 2437 MHz. Chain B. Unwanted Emissions Level Measurement



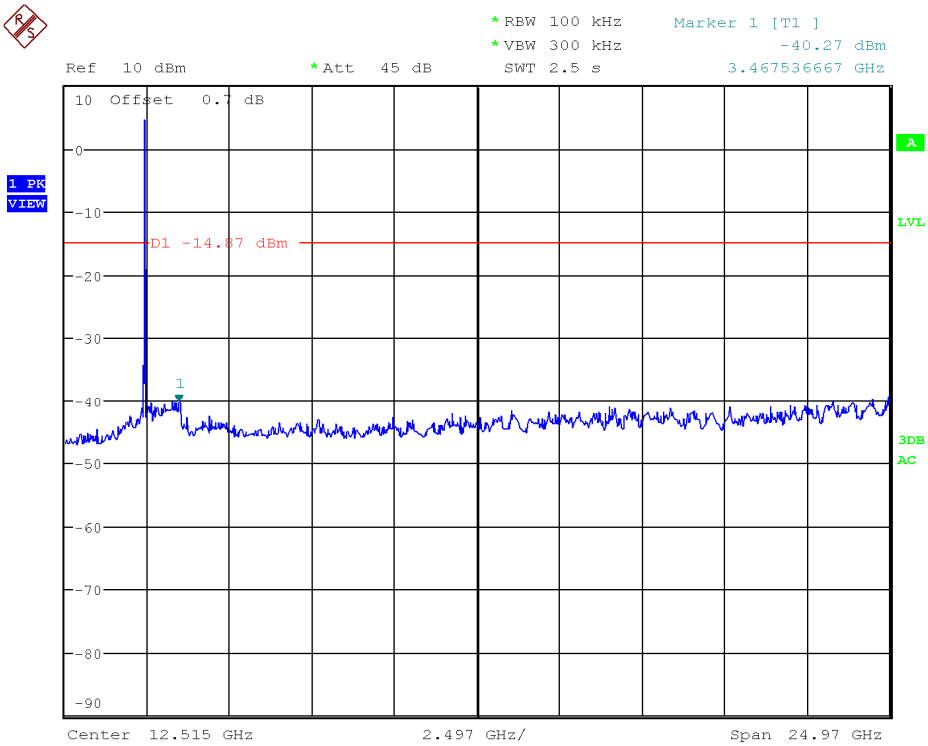

Note: The peak above the limit is the carrier frequency.

Highest Channel: 2462 MHz. Chain A. Unwanted Emissions Level Measurement




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

Highest Channel: 2462 MHz. Chain B. Unwanted Emissions Level Measurement




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

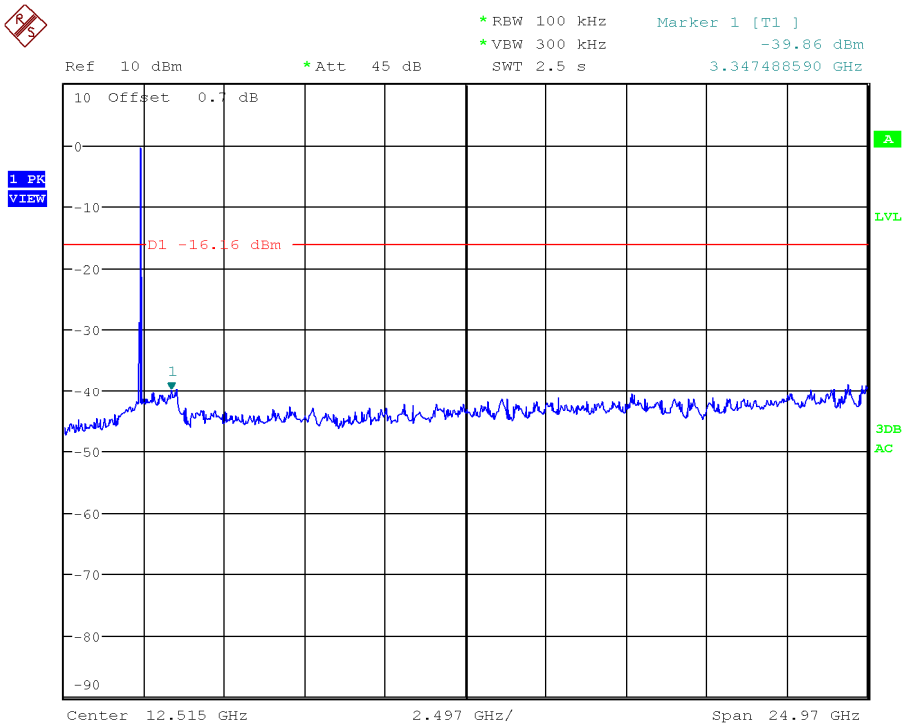
2. WiFi 2.4GHz 802.11 g mode

Reference Level Measurement

| | Lowest frequency 2412 MHz | | Middle frequency 2437 MHz | | Highest frequency 2462 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| Reference Level Measurement (dBm) | 3.84 | 2.19 | 5.66 | 5.65 | 3.29 | 5.55 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

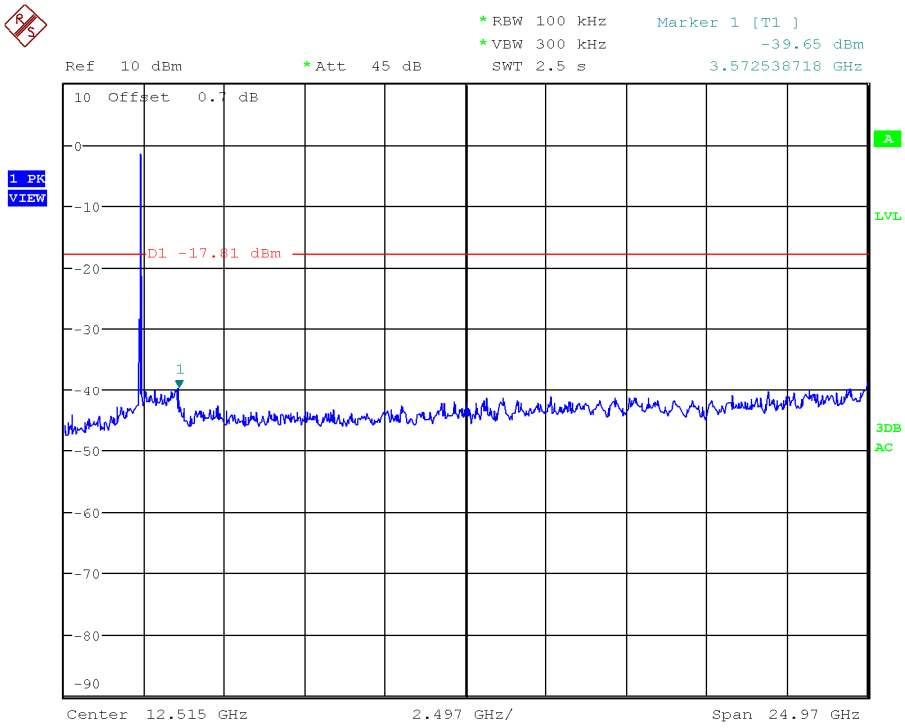
Verdict: PASS

Lowest Channel: 2412 MHz. Chain A. Unwanted Emissions Level Measurement



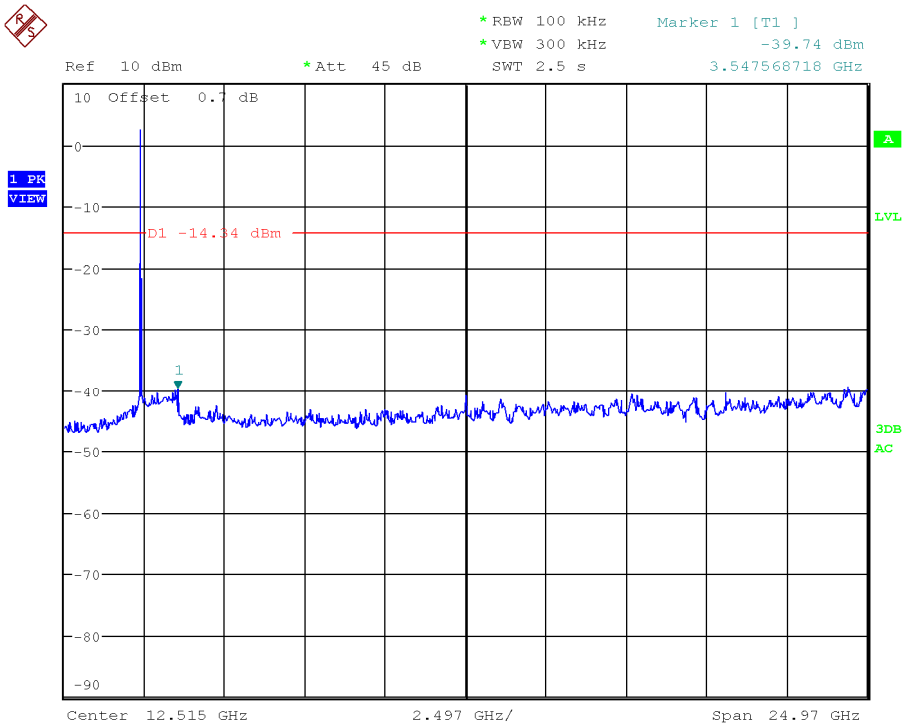

Note: The peak above the limit is the carrier frequency.

Lowest Channel: 2412 MHz. Chain B. Unwanted Emissions Level Measurement



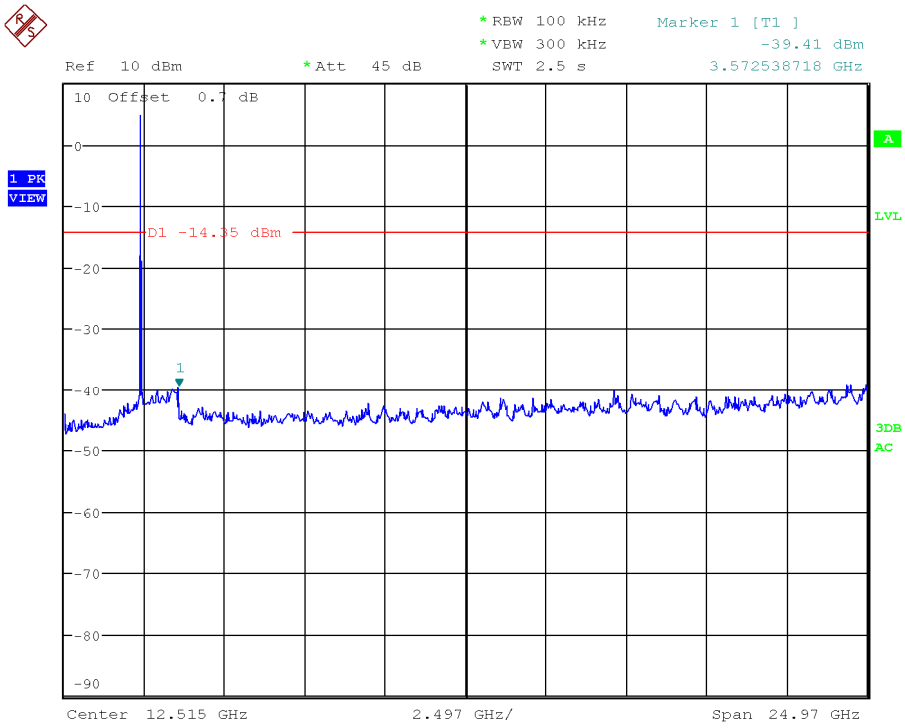

Note: The peak above the limit is the carrier frequency.

Middle Channel: 2437 MHz. Chain A. Unwanted Emissions Level Measurement



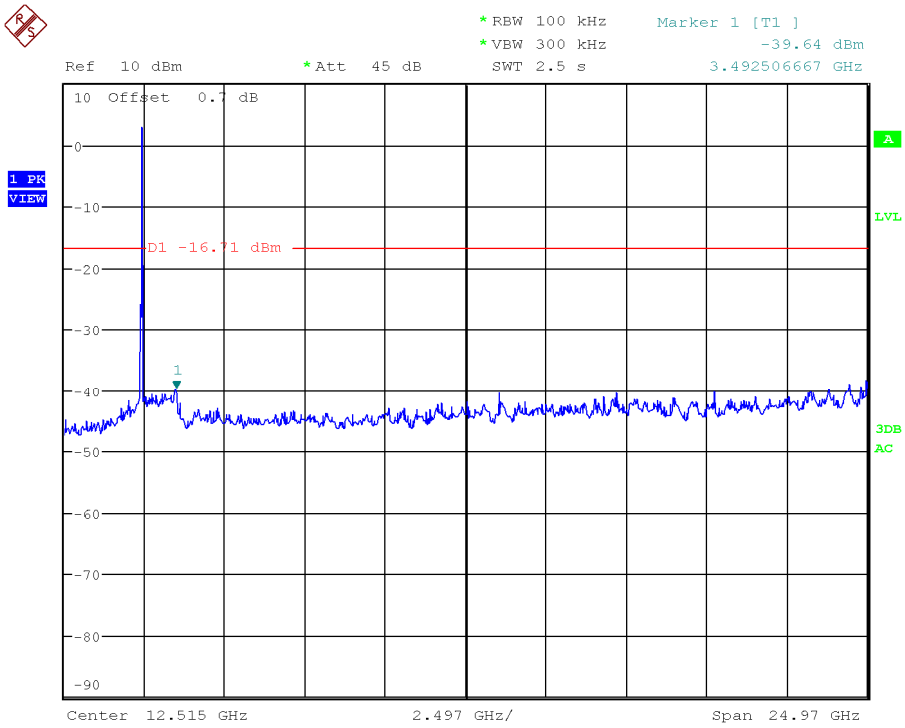

Note: The peak above the limit is the carrier frequency.

Middle Channel: 2437 MHz. Chain B. Unwanted Emissions Level Measurement



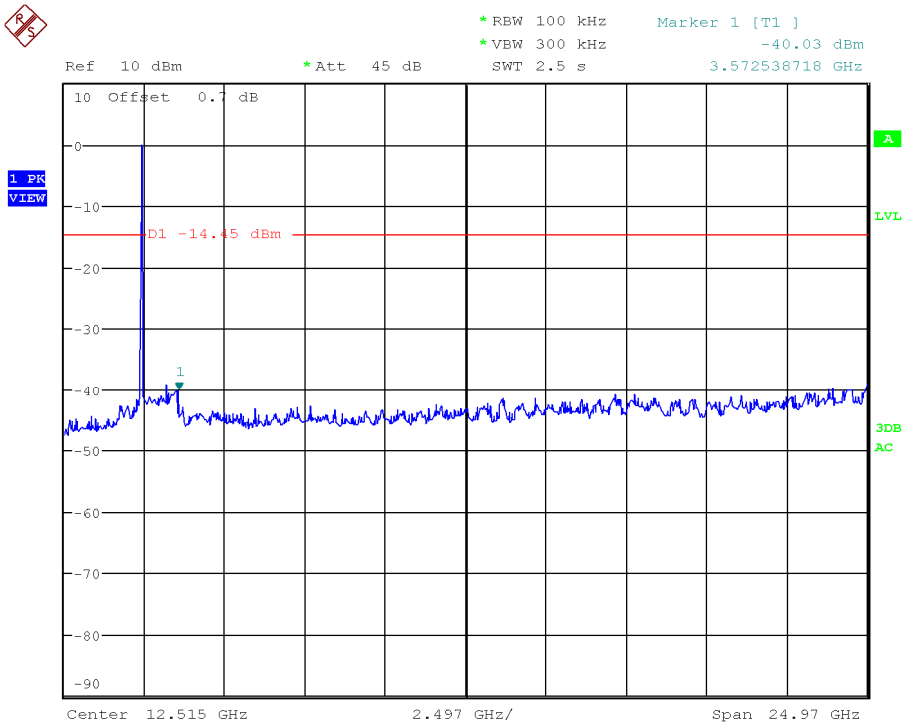

Note: The peak above the limit is the carrier frequency.

Highest Channel: 2462 MHz. Chain A. Unwanted Emissions Level Measurement




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

Highest Channel: 2462 MHz. Chain B. Unwanted Emissions Level Measurement




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

3. WiFi 2.4GHz 802.11 n20 mode

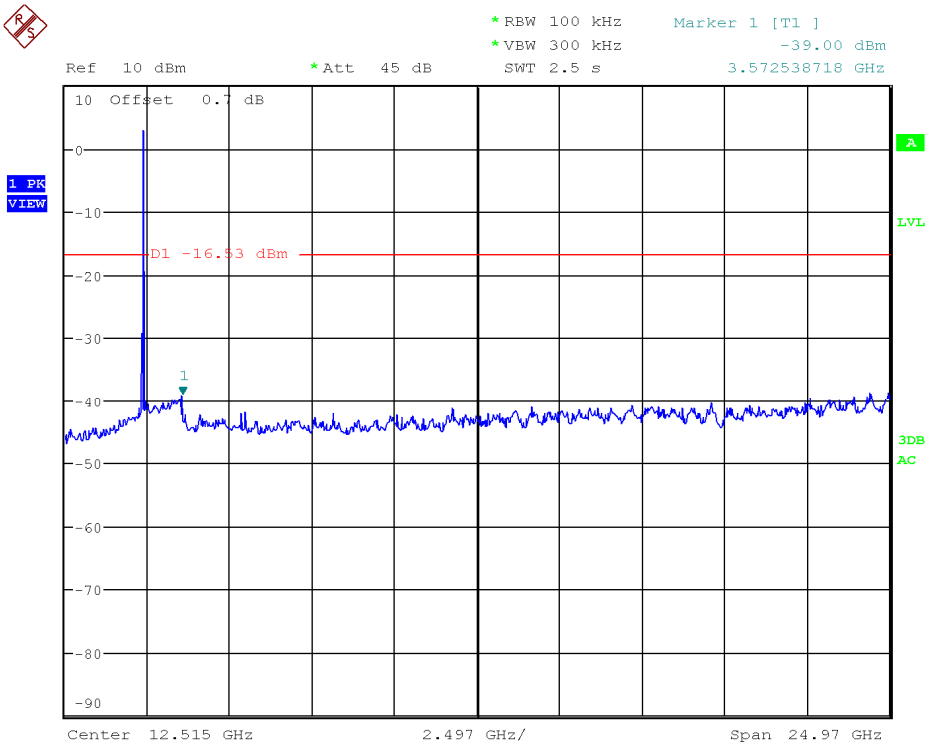
Reference Level Measurement

| | Lowest frequency 2412 MHz | | Middle frequency 2437 MHz | | Highest frequency 2462 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| Reference Level Measurement (dBm) | 3.47 | 1.69 (*) | 6.52 | 5.65 | 3.69 | 5.89 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

(*): Power adjusted as for MIMO mode which a bit higher than in SISO mode at this antenna port.

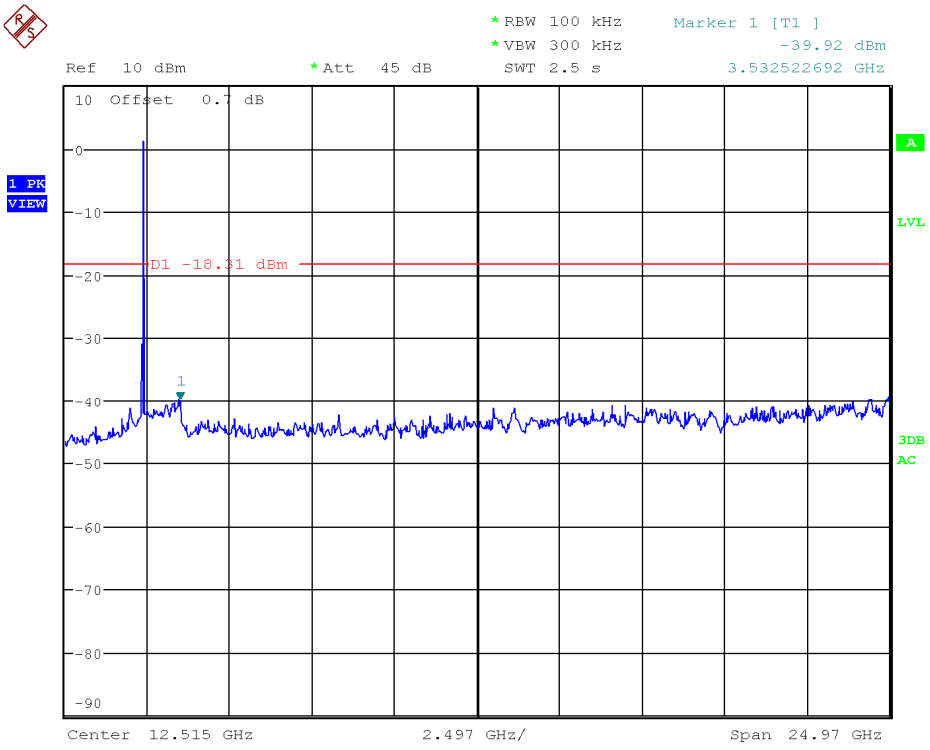
Verdict: PASS

Lowest Channel: 2412 MHz. Chain A. Unwanted Emissions Level Measurement



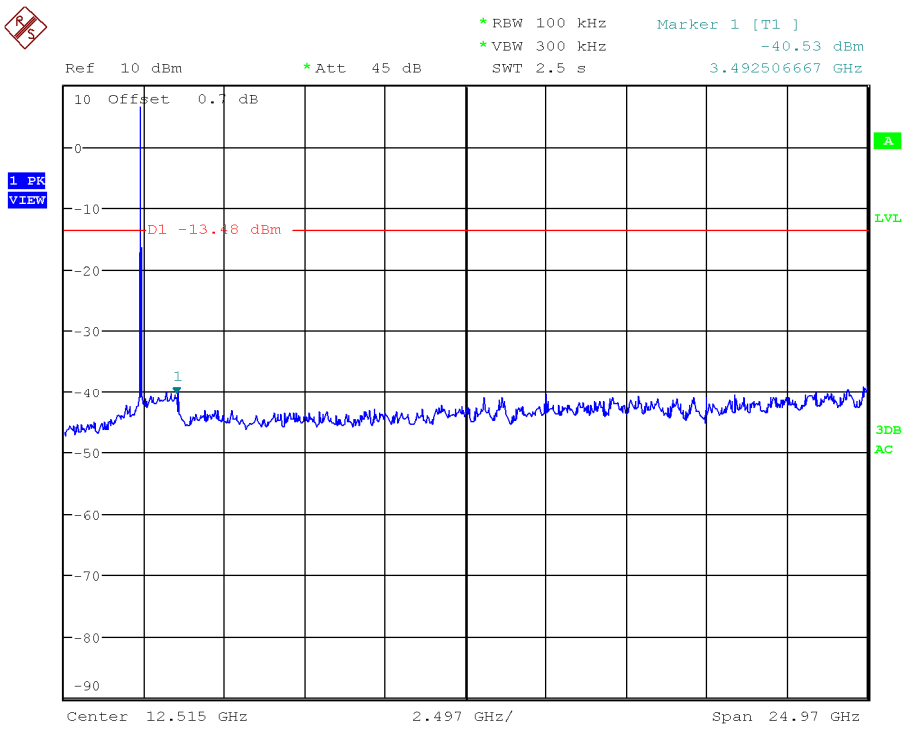

Note: The peak above the limit is the carrier frequency.

Lowest Channel: 2412 MHz. Chain B. Unwanted Emissions Level Measurement



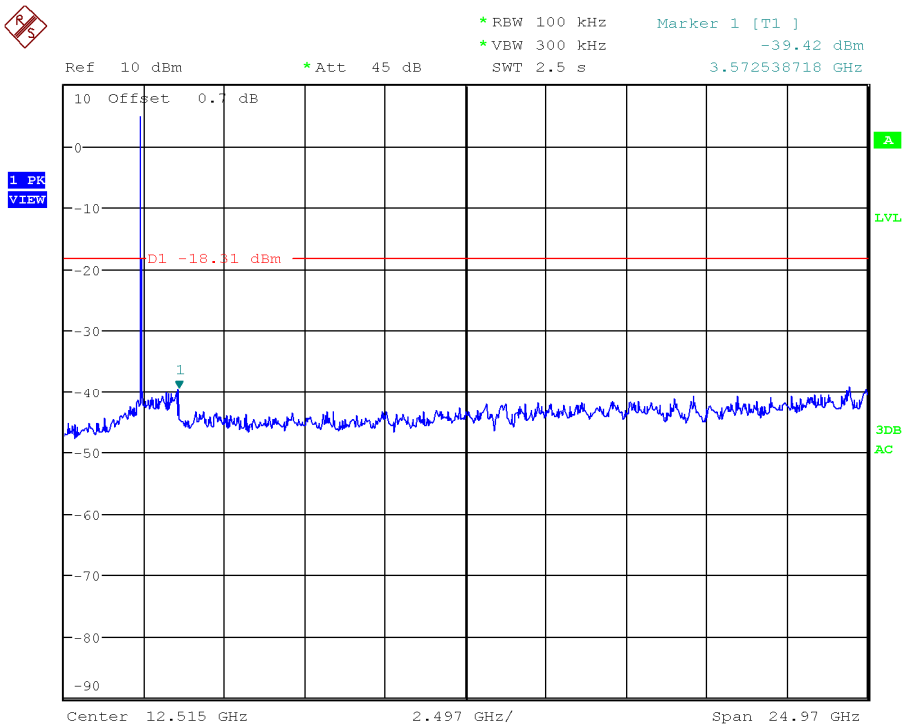

Note: The peak above the limit is the carrier frequency.

Middle Channel: 2437 MHz. Chain A. Unwanted Emissions Level Measurement



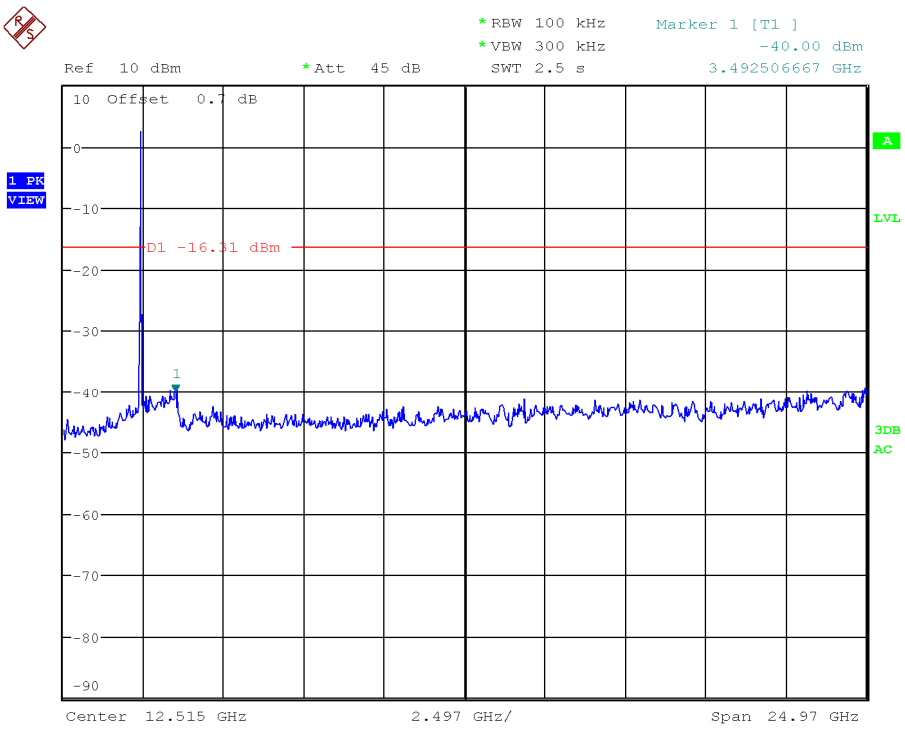

Note: The peak above the limit is the carrier frequency.

Middle Channel: 2437 MHz. Chain B. Unwanted Emissions Level Measurement



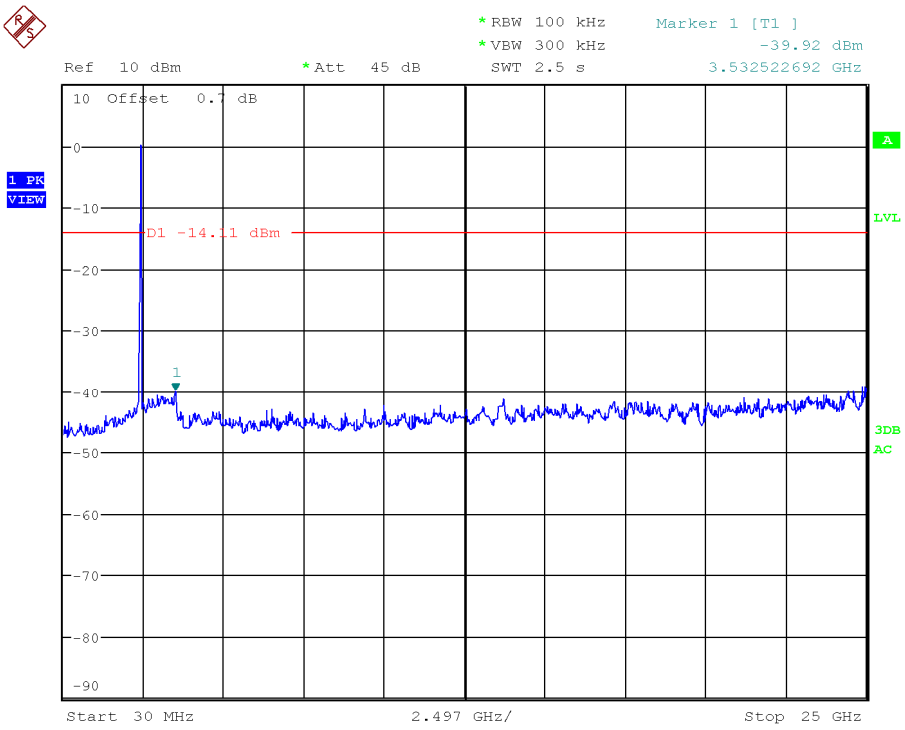

Note: The peak above the limit is the carrier frequency.

Highest Channel: 2462 MHz. Chain A. Unwanted Emissions Level Measurement




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

Highest Channel: 2462 MHz. Chain B. Unwanted Emissions Level Measurement




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

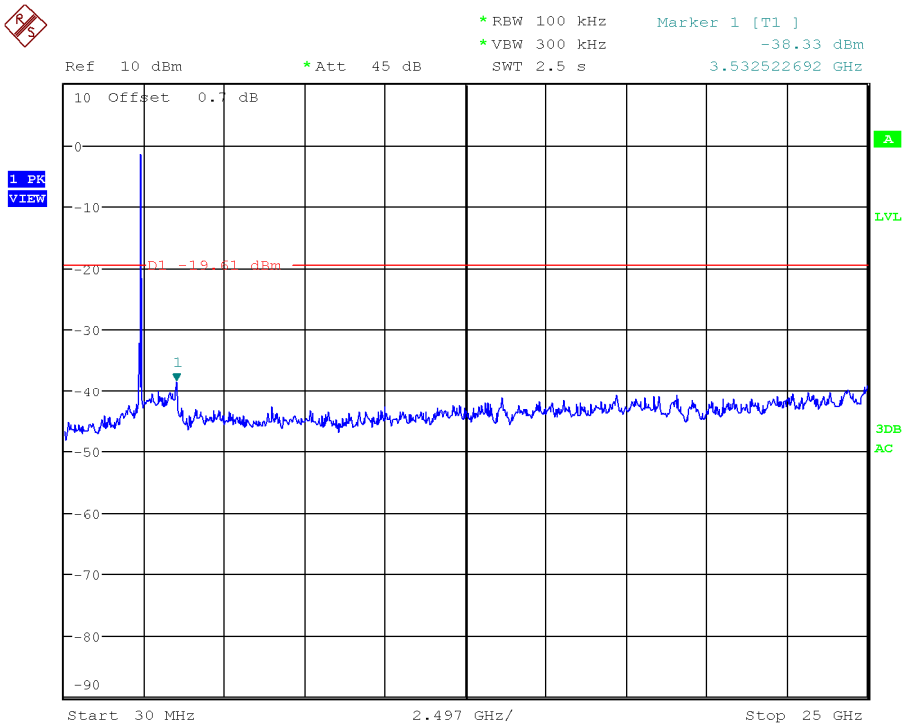
4. WiFi 2.4GHz 802.11 n40 mode

Reference Level Measurement

| | Lowest frequency 2422 MHz | | Middle frequency 2437 MHz | | Highest frequency 2452 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| Reference Level Measurement (dBm) | 0.39 | -1.63 | 5.19 | 1.36 | 1.43 | 1.18 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

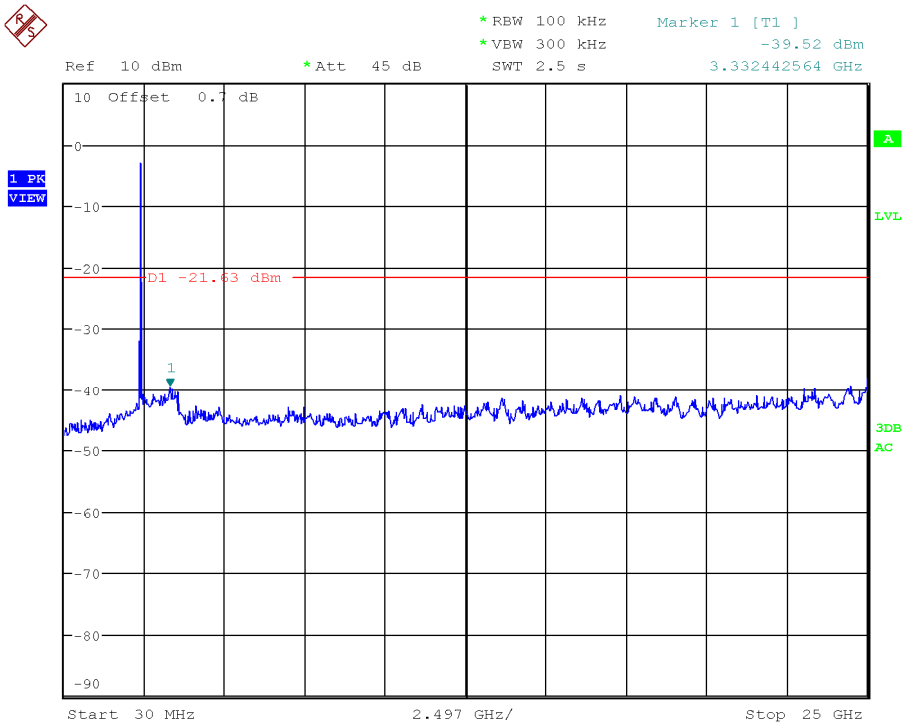
Verdict: PASS

Lowest Channel: 2422 MHz. Chain A. Unwanted Emissions Level Measurement



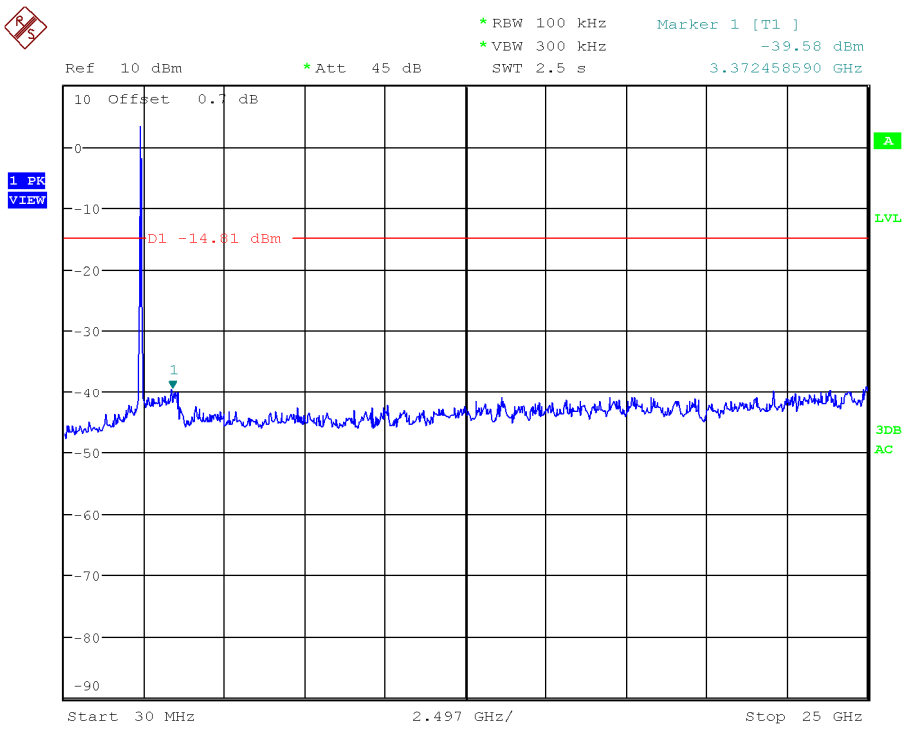

Note: The peak above the limit is the carrier frequency.

Lowest Channel: 2422 MHz. Chain B. Unwanted Emissions Level Measurement



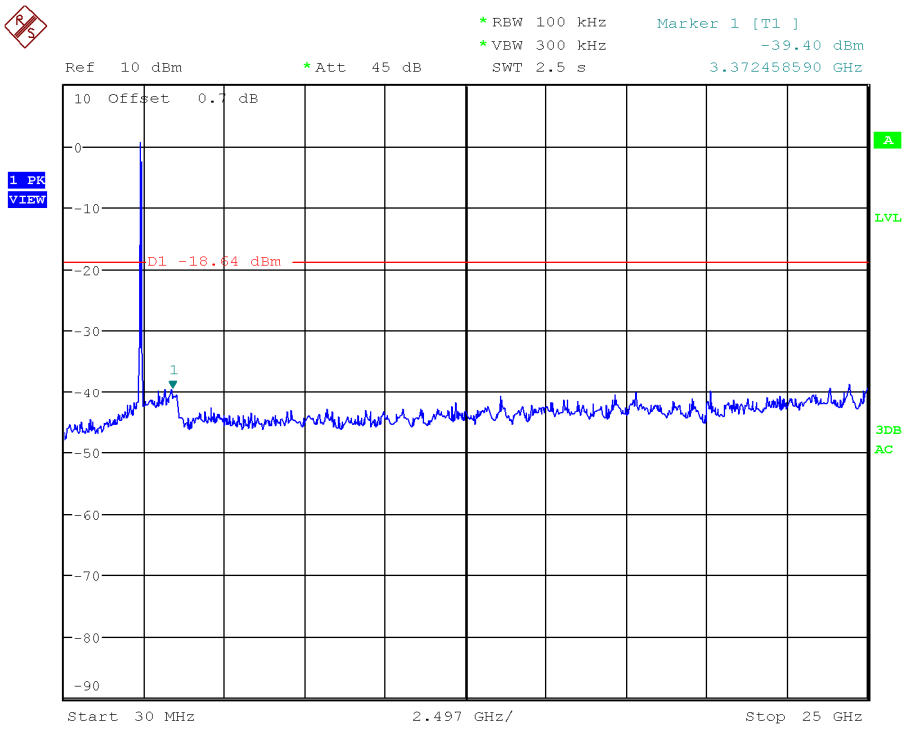

Note: The peak above the limit is the carrier frequency.

Middle Channel: 2437 MHz. Chain A. Unwanted Emissions Level Measurement



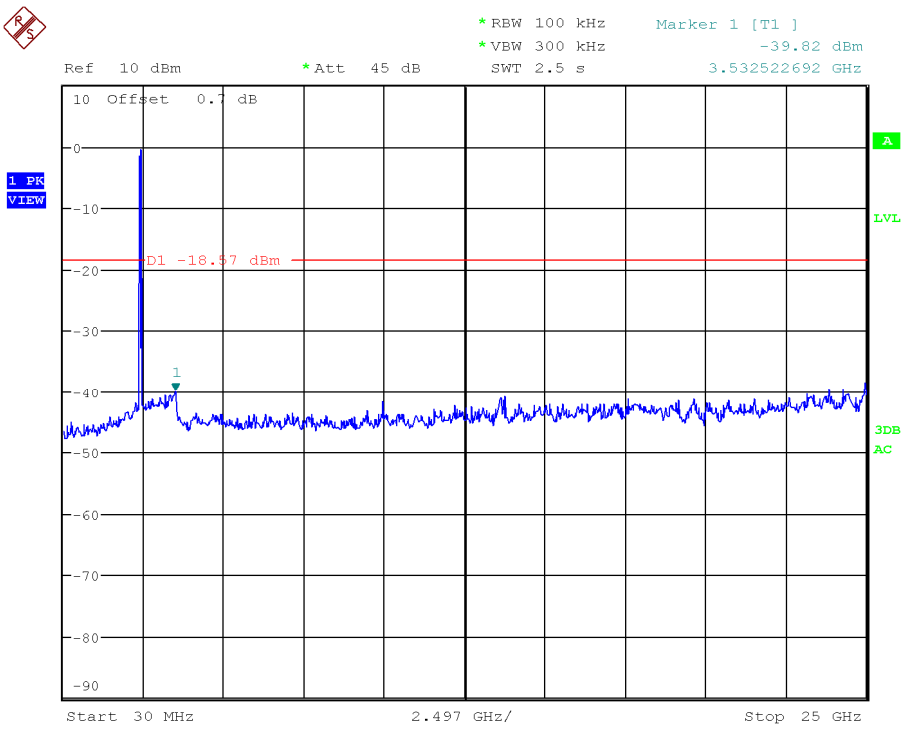

Note: The peak above the limit is the carrier frequency.

Middle Channel: 2437 MHz. Chain B. Unwanted Emissions Level Measurement



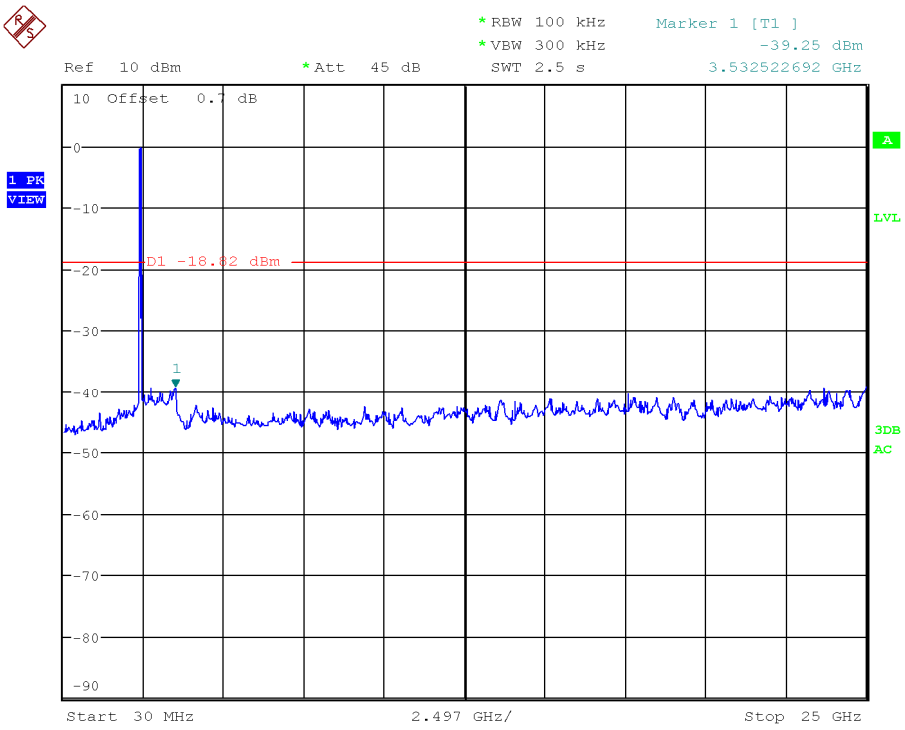

Note: The peak above the limit is the carrier frequency.

Highest Channel: 2452 MHz. Chain A. Unwanted Emissions Level Measurement




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

Highest Channel: 2452 MHz. Chain B. Unwanted Emissions Level Measurement




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

## Section 15.247 Subclause (d) / RSS-210 A8.5. Band-edge emissions compliance (Transmitter)

SPECIFICATION

Emissions outside the frequency band in which the intentional radiator is operating shall be at least 20dB below the highest level of the desired power.

RESULTS:

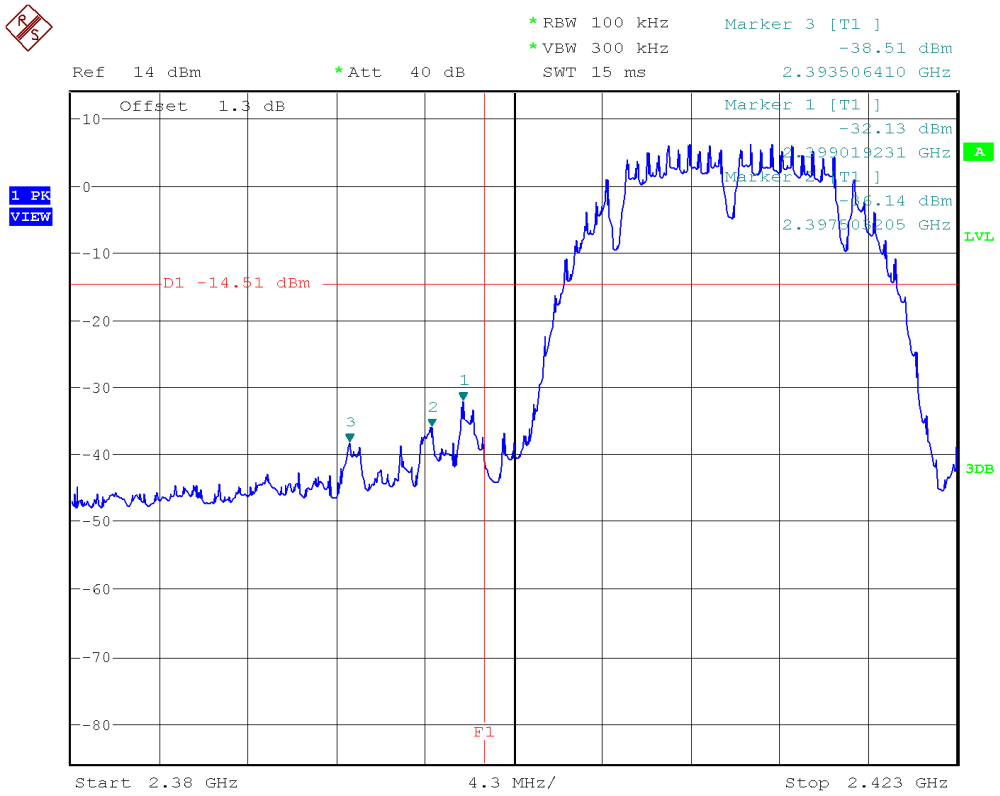
Note: Radiated measurements were used to show compliance with the limits in the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

**LOW FREQUENCY SECTION 2412 MHz. CONDUCTED.**

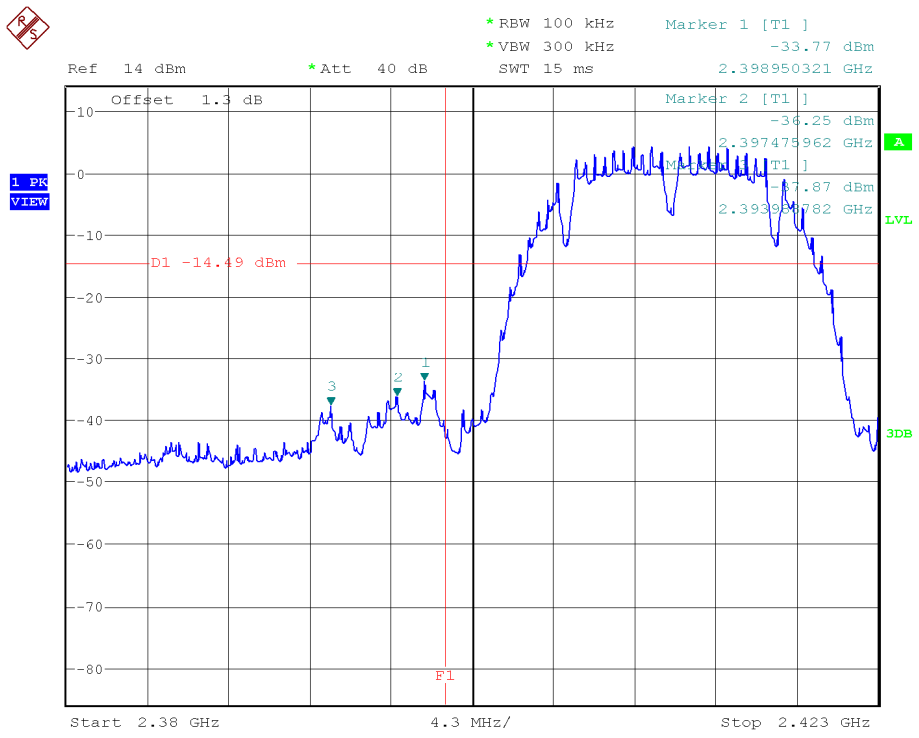
1. WiFi 2.4GHz 802.11 b mode

See next plots.

Chain A



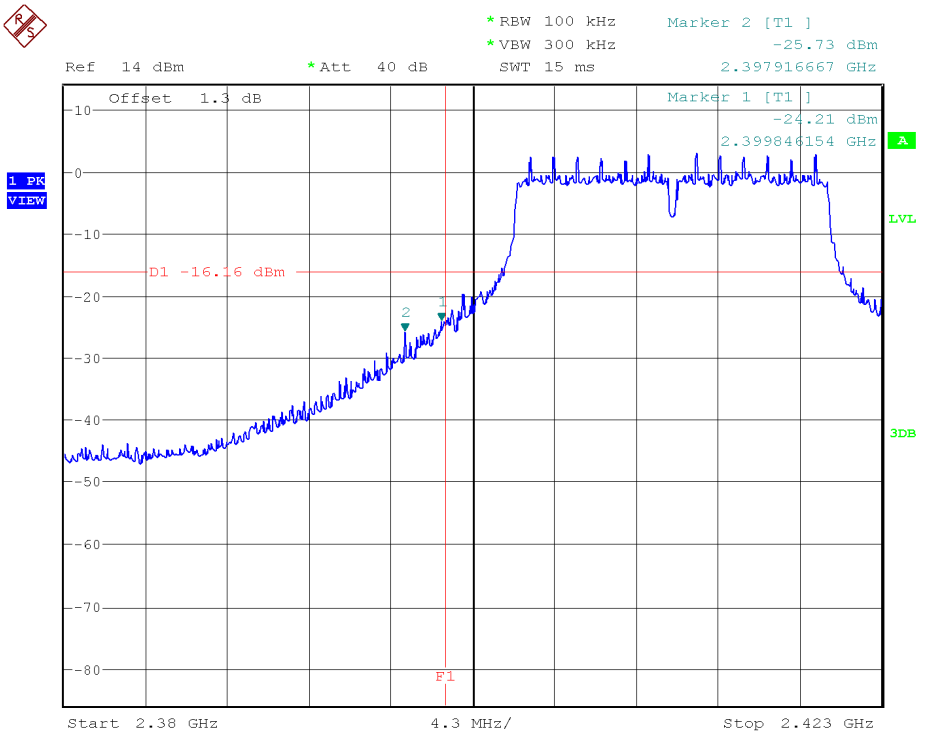
Chain B



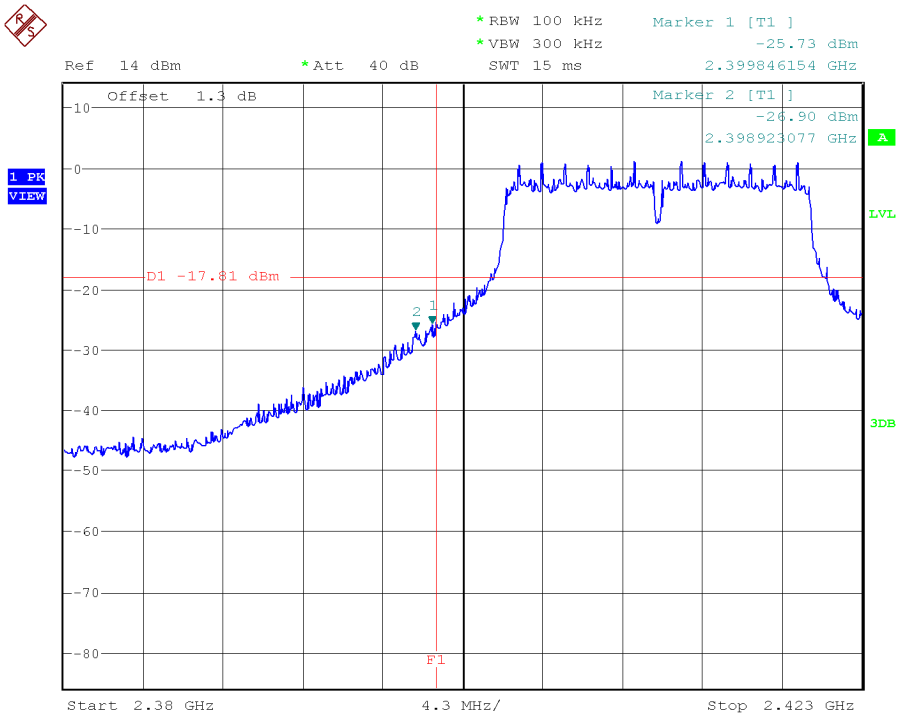

Verdict: PASS

2. WiFi 2.4GHz 802.11 g mode

Chain A



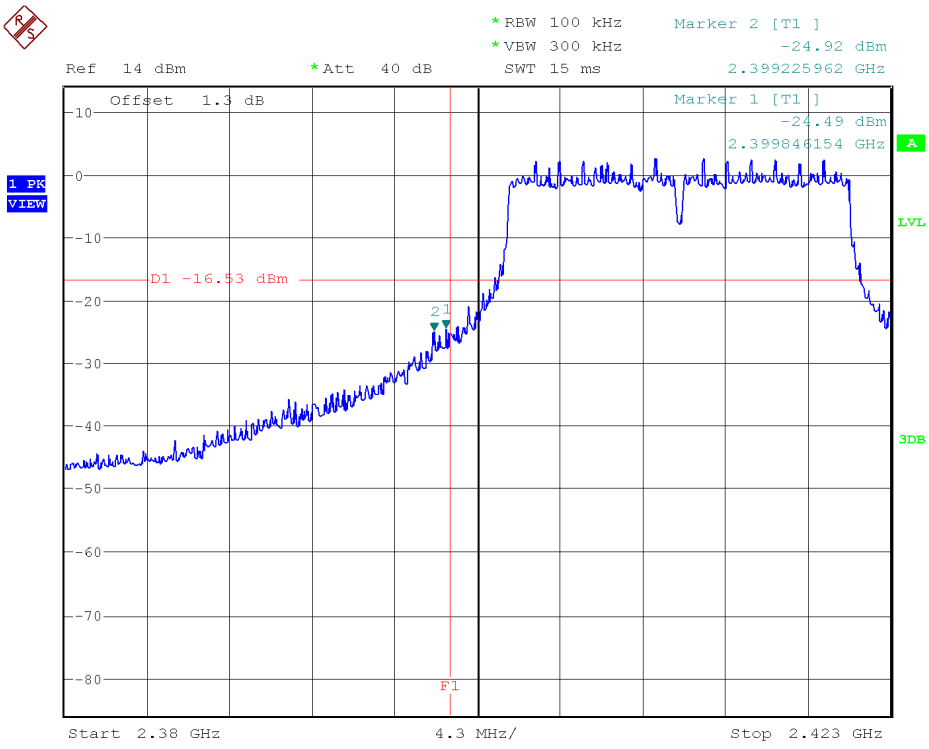
Chain B



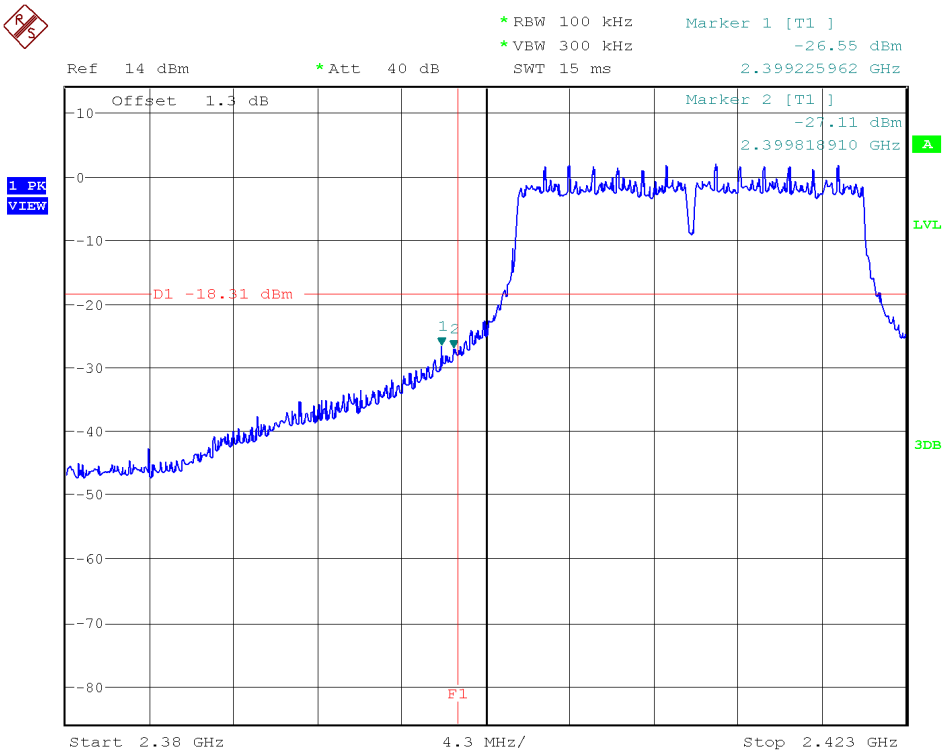

Verdict: PASS

3. WiFi 2.4GHz 802.11 n20 mode

Chain A



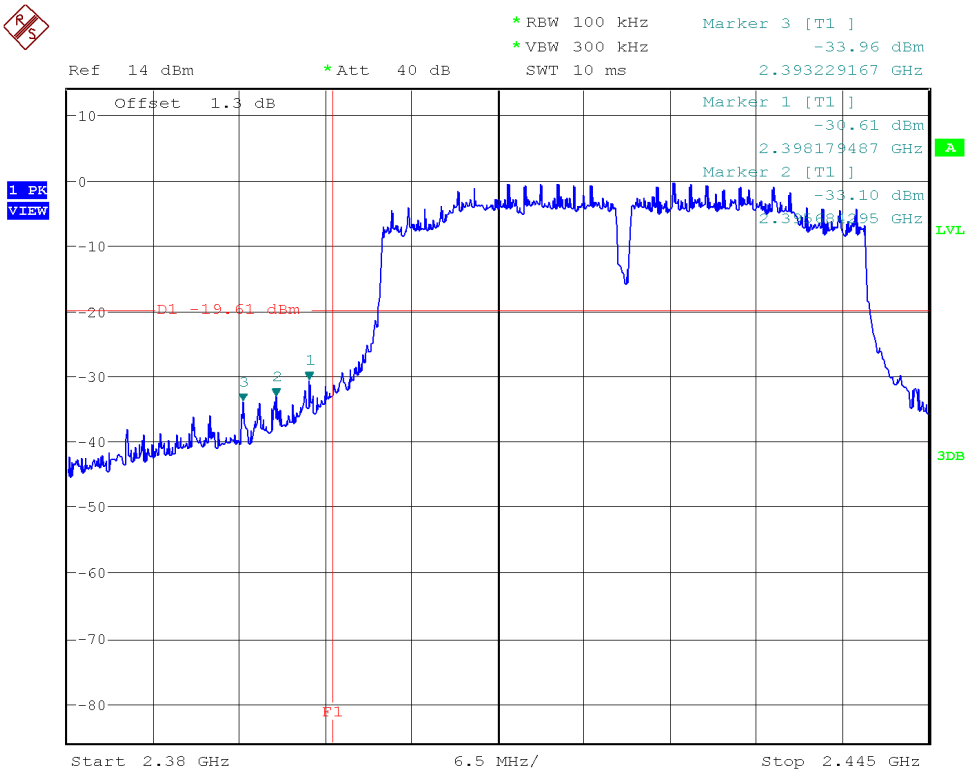
Chain B



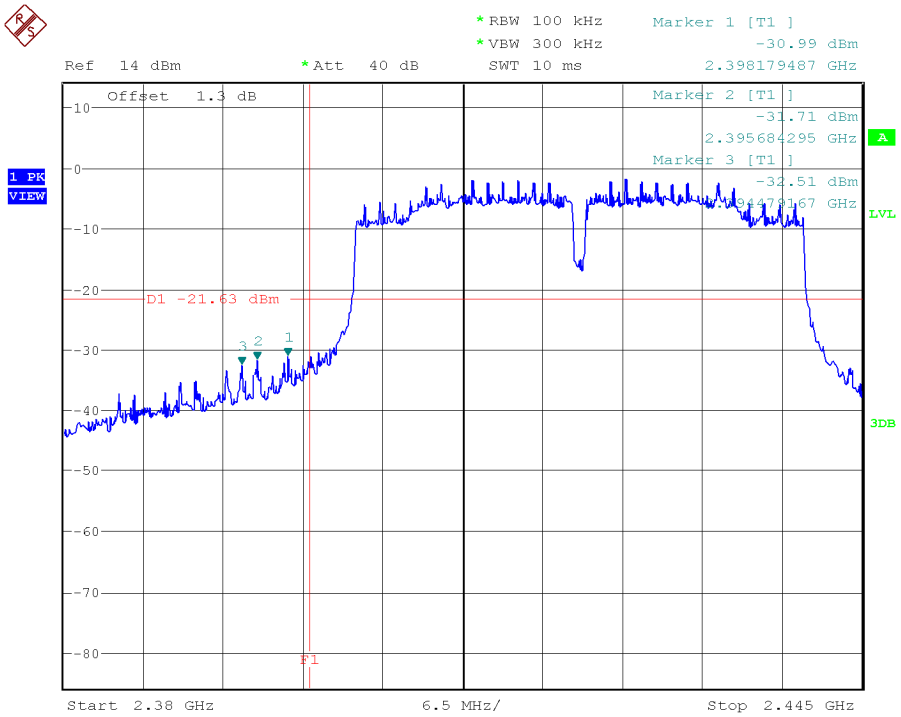

Verdict: PASS

4. WiFi 2.4GHz 802.11 n40 mode

Chain A



Chain B




Verdict: PASS

## Section 15.247 Subclause (e) / RSS-210 A8.5. Power spectral density

SPECIFICATION

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

RESULTS

The maximum power spectral density level was measured using the method according to point 9.1. Option 1 of Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v02 dated 10/04/2012.

For MIMO mode, the *Measure and add 10 log(NANT) dB*, (where *NANT* is the number of outputs) technique was used according to the Guidance for Emission Testing of Transmitters with Multiple Outputs in the Same Band 662911 D01 Multiple Transmitter Output v01r02 dated 9/26/2012.
With this technique, spectrum measurements are performed at each output of the device, and the quantity *10 log(NANT)* dB is added to each spectrum value before comparing to the emission limit. Number of outputs = 2.

1. WiFi 2.4GHz 802.11 b mode

Power spectral density (See next plot of worst case = highest level).

| | Lowest frequency 2412 MHz | | Middle frequency 2437 MHz | | Highest frequency 2462 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| Power spectral density (dBm) in 3 kHz bandwidth | -8.85 | -9.42 | -8.82 | -9.53 | -8.06 | -9.52 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

Verdict: PASS

2. WiFi 2.4GHz 802.11 g mode

Power spectral density (See next plot of worst case = highest level).

| | Lowest frequency 2412 MHz | | Middle frequency 2437 MHz | | Highest frequency 2462 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| Power spectral density (dBm) in 3 kHz bandwidth | -10.75 | -12.33 | -8.81 | -8.80 | -10.68 | -10.50 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

Verdict: PASS

3. WiFi 2.4GHz 802.11 n20 mode

Power spectral density (See next plot of worst case = highest level).

| SISO | Lowest frequency 2412 MHz | | Middle frequency 2437 MHz | | Highest frequency 2462 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| Power spectral density (dBm) in 3 kHz bandwidth | -9.93 | -11.94 | -8.28 | -8.42 | -10.88 | -10.83 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

| MIMO | Lowest frequency 2412 MHz | | Middle frequency 2437 MHz | | Highest frequency 2462 MHz | |
|---|---|---|---|---|---|---|
| | Chain A+B | | Chain A+B | | Chain A+B | |
| | Port A | Port B | Port A | Port B | Port A | Port B |
| Power spectral density (dBm) in 3 kHz bandwidth | -10.55 | -12.60 | -10.62 | -10.16 | -11.01 | -11.85 |
| Power spectral density (dBm) in 3 kHz bandwidth + 10*Log(2) | -7.55 | -9.60 | -7.62 | -7.16 | -8.01 | -8.85 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

Verdict: PASS

4. WiFi 2.4GHz 802.11 n40 mode

Power spectral density (See next plot of worst case= highest level).

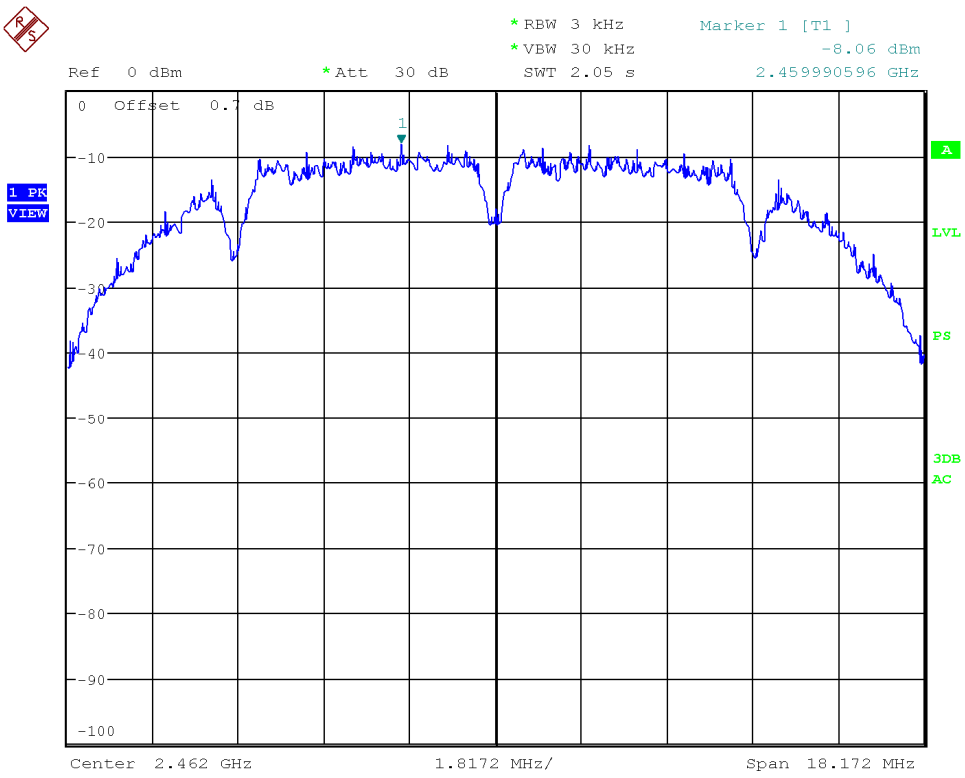
| SISO | Lowest frequency 2422 MHz | | Middle frequency 2437 MHz | | Highest frequency 2452 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| Power spectral density (dBm) in 3 kHz bandwidth | -14.46 | -15.58 | -9.45 | -12.69 | -14.12 | -12.52 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

| MIMO | Lowest frequency 2412 MHz | | Middle frequency 2437 MHz | | Highest frequency 2462 MHz | |
|---|---|---|---|---|---|---|
| | Chain A+B | | Chain A+B | | Chain A+B | |
| | Port A | Port B | Port A | Port B | Port A | Port B |
| Power spectral density (dBm) in 3 kHz bandwidth | -18.40 | -18.49 | -14.56 | -12.21 | -14.25 | -13.39 |
| Power spectral density (dBm) in 3 kHz bandwidth + 10*Log(2) | -15.40 | -15.49 | -11.56 | -9.21 | -11.25 | -10.39 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

Verdict: PASS

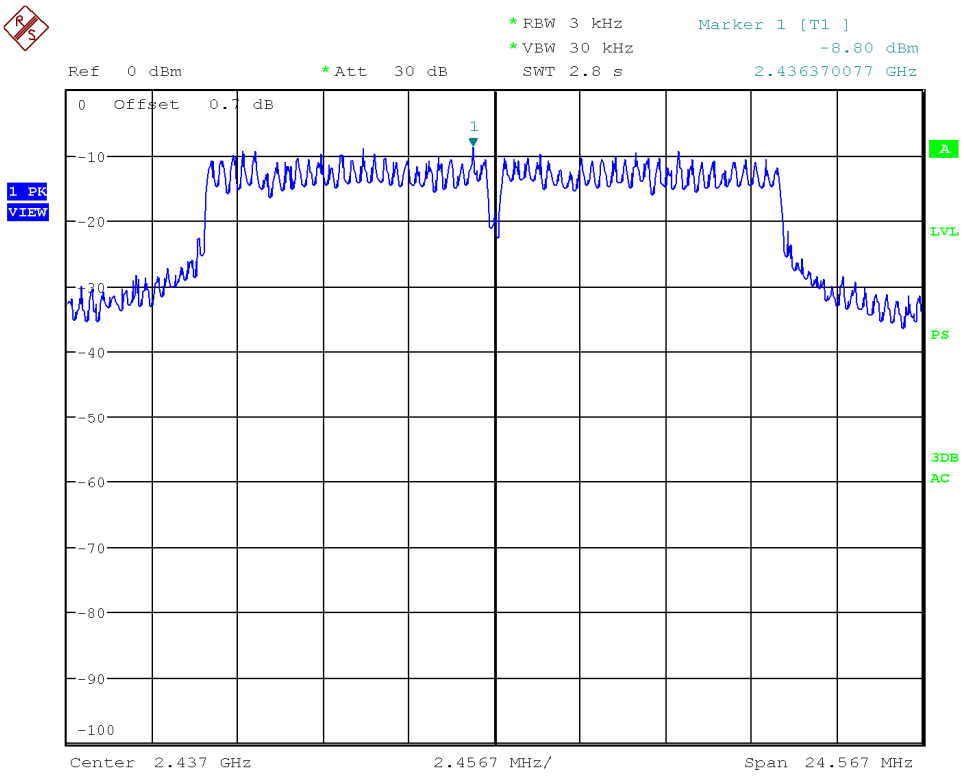
1. WiFi 2.4GHz 802.11 b mode

Highest Channel: 2462 MHz. Chain A.



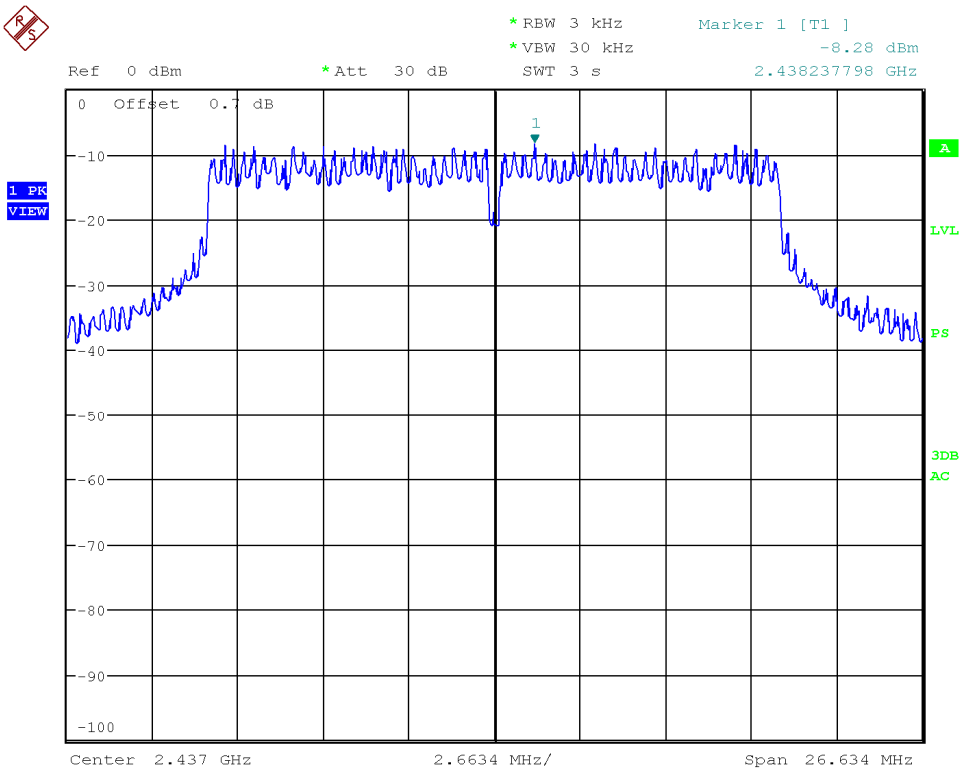

2. WiFi 2.4GHz 802.11 g mode

Middle Channel: 2437 MHz. Chain B.

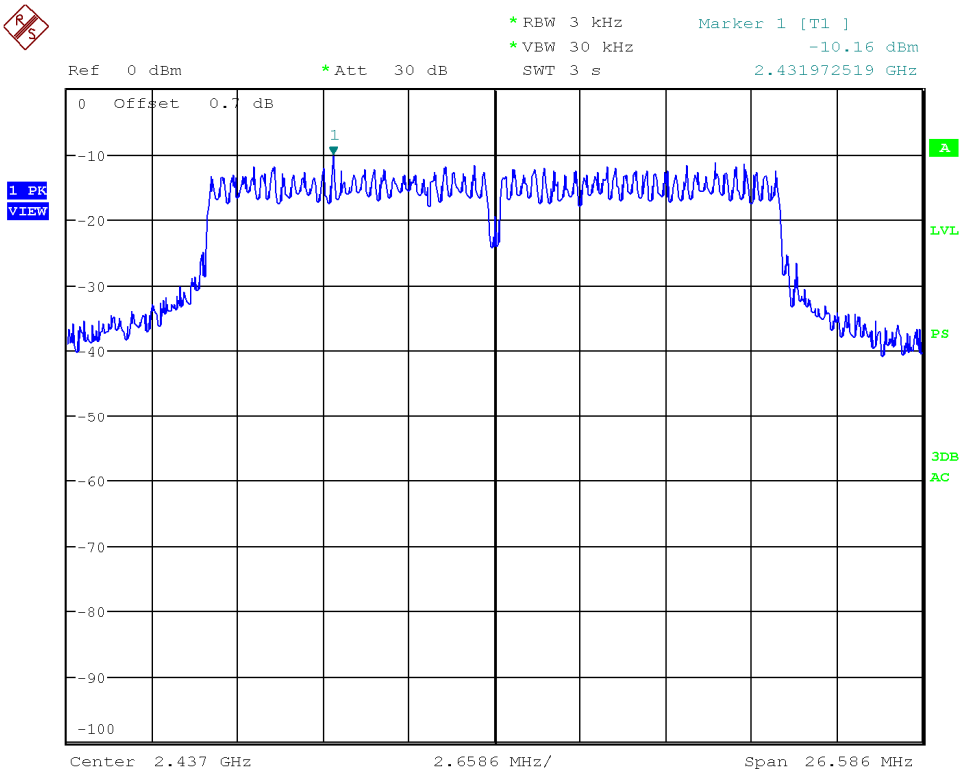


3. WiFi 2.4GHz 802.11 n20 mode

SISO. Middle Channel: 2437 MHz. Chain A.

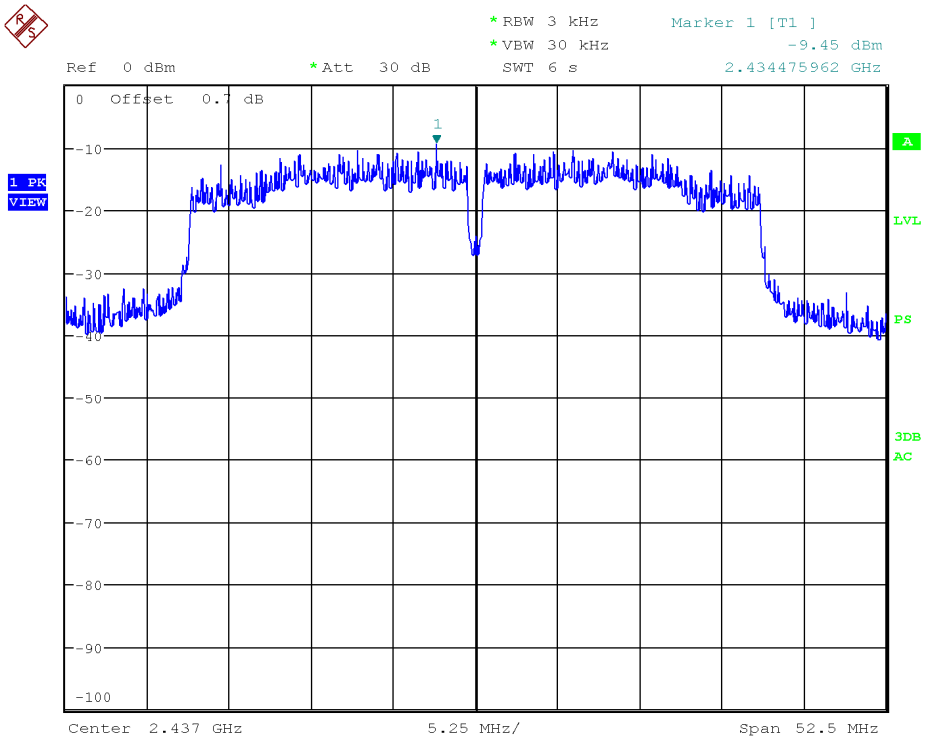



MIMO. Middle Channel: 2437 MHz. Chain A+B. Port B.

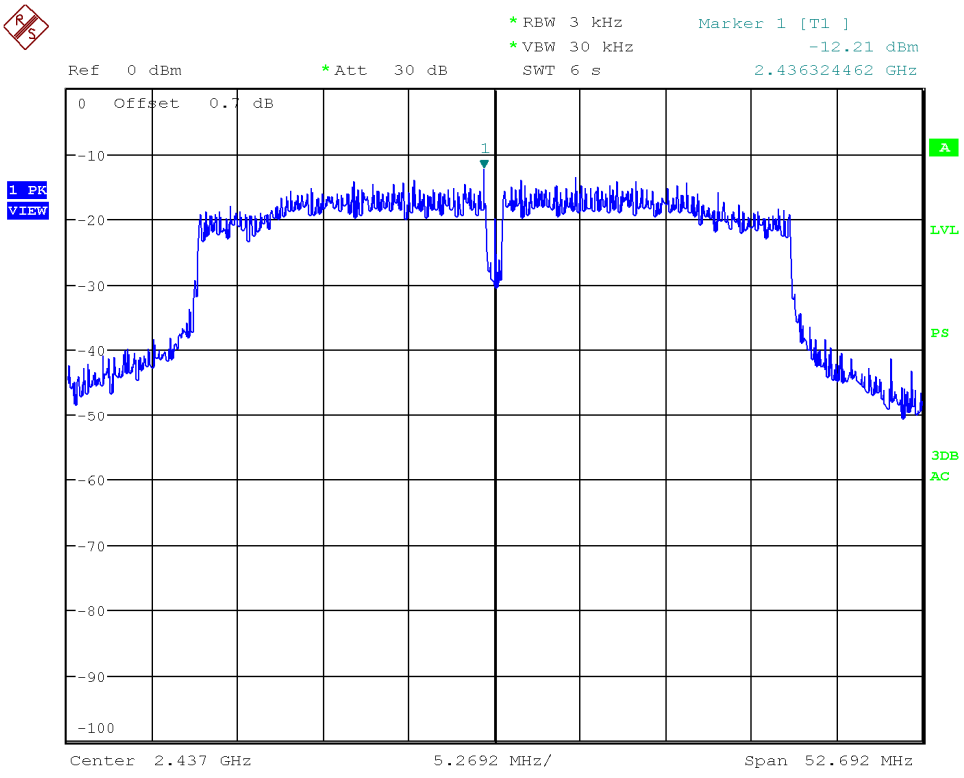


4. WiFi 2.4GHz 802.11 n40 mode

SISO. Middle Channel: 2437 MHz. Chain A.




MIMO. Middle Channel: 2437 MHz. Chain A+B. Port B.



## Section 15.247 Subclause (d) / RSS-210 A8.5. Emission limitations radiated (Transmitter)

SPECIFICATION

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 - 25000 | 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 and the antenna height was varied from 1 to 4 meters 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 3 m for the frequency range 30 MHz-1000 MHz and at distance of 1m for the frequency range 1 GHz-25 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.

The equipment transmits continuously in the selected channel so it is not necessary a duty cycle correction factor.

**Frequency range 30 MHz-1000 MHz**.

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) |
|---|---|---|---|---|
| 61.1022 | V | Quasi-Peak | 20.38 | ± 3.8 |
| 166.0720 | V | Quasi-Peak | 30.07 | ± 3.8 |
| 142.7454 | V | Quasi-Peak | 25.22 | ± 3.8 |
| 527.6352 | V | Quasi-Peak | 26.14 | ± 3.8 |

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

**Frequency range 1 GHz-25 GHz**

The results in the next tables show the maximum measured levels in the 1-25 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz (see next plots).

For OFDM modulation modes (802.11g, 802.11n20 and 802.11n40), a preliminary measurement in the central channel in the range 1-12.75 GHz was performed to determine the worst case. The lowest and highest channels were measured for out-of-band emissions for the worst case (802.11g).

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. Single transmission at each chain and simultaneous transmission at both chains modes were fully evaluated.

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 2.4GHz 802.11 b mode

1.1. CHANNEL 1: LOWEST (2412 MHz). Out-of-band spurious emissions in the 1-25 GHz range and inside restricted bands 2.31-2.39 GH.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.38540 | H | Peak | 53.63 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.38548 | H | Peak | 51.38 | ± 4.09 |
| 4.82404 | V | Peak | 43.91 | ± 4.09 |

1.2. CHANNEL 6: MIDDLE (2437 MHz). Out-of-band spurious emissions in the 1-25 GHz range and inside restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.38870 | H | Peak | 51.60 | ± 4.09 |
| 4.87411 | V | Peak | 45.13 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 4.87416 | V | Peak | 45.94 | ± 4.09 |

1.3. CHANNEL 11: HIGHEST (2462 MHz). Out-of-band spurious emissions in the 1-25 GHz range and inside restricted band 2.4835-2.5 GHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.48801 | H | Peak | 52.76 | ± 4.09 |
| 4.92384 | V | Peak | 46.14 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.48735 | H | Peak | 51.29 | ± 4.09 |
| 4.92396 | V | Peak | 47.23 | ± 4.09 |

Verdict: PASS

2. WiFi 2.4GHz 802.11 g mode (worst case OFDM)

2.1. CHANNEL 1: LOWEST (2412 MHz). Out-of-band spurious emissions in the 1-25 GHz range and inside restricted band 2.31-2.39 GHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.38976 | H | Peak | 63.48 | ± 4.09 |
| | | Average | 46.42 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.38992 | H | Peak | 64.54 | ± 4.09 |
| | | Average | 48.64 | ± 4.09 |
| 4.82673 | V | Peak | 41.90 | ± 4.09 |

2.2. CHANNEL 2 (2417 MHz). Spurious emissions in restricted band 2.31-2.39 GHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.39000 | H | Peak | 58.95 | ± 4.09 |
| | | Average | 46.35 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.38952 | H | Peak | 55.56 | ± 4.09 |
| | | Average | 42.28 | ± 4.09 |

2.3. CHANNEL 6: MIDDLE (2437 MHz). Out-of-band spurious emissions in the 1-25 GHz range and inside restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.38960 | H | Peak | 52.95 | ± 4.09 |
| 2.48378 | H | Peak | 52.66 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.38968 | H | Peak | 54.01 | ± 4.09 |
| | | Average | 42.93 | ± 4.09 |
| 2.48362 | H | Peak | 51.95 | ± 4.09 |
| 4.87187 | V | Peak | 44.95 | ± 4.09 |
| 7.31465 | V | Peak | 47.58 | ± 4.09 |

2.4. CHANNEL 10 (2457 MHz). Spurious emissions in restricted band 2.4835-2.5 GHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.483638 | H | Peak | 58.75 | ± 4.09 |
| | | Average | 43.97 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.49006 | H | Peak | 58.80 | ± 4.09 |
| | | Average | 40.00 | ± 4.09 |

2.5. CHANNEL 11: HIGHEST (2462 MHz). Out-of-band spurious emissions in the 1-25 GHz range and inside restricted band 2.4835-2.5 GHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.483731 | H | Peak | 59.13 | ± 4.09 |
| | | Average | 43.46 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.48378 | H | Peak | 62.49 | ± 4.09 |
| | | Average | 46.81 | ± 4.09 |
| 4.93106 | V | Peak | 45.78 | ± 4.09 |
| 7.38557 | V | Peak | 48.23 | ± 4.09 |

Verdict: PASS

3. WiFi 2.4GHz 802.11 n20 mode

3.1. CHANNEL 1 (2412 MHz). Spurious emissions in restricted band 2.31-2.39 GHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.39000 | H | Peak | 68.12 | ± 4.09 |
| | | Average | 50.47 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.39000 | H | Peak | 66.62 | ± 4.09 |
| | | Average | 49.97 | ± 4.09 |

Chain A+B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.38920 | H | Peak | 62.20 | ± 4.09 |
| | | Average | 43.78 | ± 4.09 |

3.2. CHANNEL 2 (2417 MHz). Spurious emissions in restricted band 2.31-2.39 GHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.39000 | H | Peak | 62.96 | ± 4.09 |
| | | Average | 48.73 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.39000 | H | Peak | 65.52 | ± 4.09 |
| | | Average | 47.90 | ± 4.09 |

Chain A+B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.389391 | H | Peak | 64.71 | ± 4.09 |
| | | Average | 49.76 | ± 4.09 |

3.3. CHANNEL 6: MIDDLE (2437 MHz). Out-of-band spurious emissions in the 1-25 GHz range and inside restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

Chain A

No peaks found above the background noise.

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 4.87240 | V | Peak | 42.81 | ± 4.09 |
| 7.31100 | V | Peak | 47.10 | ± 4.09 |

Chain A+B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.38968 | H | Peak | 55.96 | ± 4.09 |
| | | Average | 43.65 | ± 4.09 |
| 2.48353 | H | Peak | 54.64 | ± 4.09 |
| | | Average | 43.19 | ± 4.09 |
| 4.87112 | V | Peak | 46.12 | ± 4.09 |

3.4. CHANNEL 10 (2457 MHz). Spurious emissions in restricted band 2.4835-2.5 GHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.48356 | H | Peak | 63.11 | ± 4.09 |
| | | Average | 48.10 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.48356 | H | Peak | 59.57 | ± 4.09 |
| | | Average | 46.67 | ± 4.09 |

Chain A+B: The power adjustment is the same as with channel 11.

3.5. CHANNEL 11 (2462 MHz). Spurious emissions in restricted band 2.4835-2.5 GHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.48350 | H | Peak | 61.68 | ± 4.09 |
| | | Average | 47.17 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.48355 | H | Peak | 70.32 | ± 4.09 |
| | | Average | 51.94 | ± 4.09 |

Chain A+B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.48353 | H | Peak | 64.82 | ± 4.09 |
| | | Average | 53.08 | ± 4.09 |

4. WiFi 2.4GHz 802.11 n40 mode

4.1. CHANNEL 3 (2422 MHz). Spurious emissions in restricted band 2.31-2.39 GHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.39000 | H | Peak | 64.65 | ± 4.09 |
| | | Average | 49.75 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.39000 | H | Peak | 65.12 | ± 4.09 |
| | | Average | 50.38 | ± 4.09 |

Chain A+B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.38968 | H | Peak | 58.15 | ± 4.09 |
| | | Average | 47.78 | ± 4.09 |

4.2. CHANNEL 4 (2427 MHz). Spurious emissions in restricted band 2.31-2.39 GHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.38980 | H | Peak | 61.55 | ± 4.09 |
| | | Average | 48.34 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.38980 | H | Peak | 64.6 | ± 4.09 |
| | | Average | 51.4 | ± 4.09 |

Chain A+B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.38987 | H | Peak | 55.41 | ± 4.09 |
| | | Average | 41.08 | ± 4.09 |

4.3. CHANNEL 5 (2432 MHz). Spurious emissions in restricted band 2.31-2.39 GHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.39000 | H | Peak | 69.12 | ± 4.09 |
| | | Average | 53.02 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.38947 | H | Peak | 66.9 | ± 4.09 |
| | | Average | 51.01 | ± 4.09 |

Chain A+B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.38987 | H | Peak | 61.23 | ± 4.09 |
| | | Average | 46.06 | ± 4.09 |

4.4. CHANNEL 6: MIDDLE (2437 MHz). Out-of-band spurious emissions in the 1-25 GHz range and inside restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.39000 | H | Peak | 71.30 | ± 4.09 |
| | | Average | 53.96 | ± 4.09 |
| 2.4835 | H | Peak | 68.72 | ± 4.09 |
| | | Average | 53.27 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.39000 | H | Peak | 64.85 | ± 4.09 |
| | | Average | 49.31 | ± 4.09 |
| 2.48460 | H | Peak | 63.27 | ± 4.09 |
| | | Average | 47.31 | ± 4.09 |

Chain A+B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.38912 | H | Peak | 61.53 | ± 4.09 |
| | | Average | 51.01 | ± 4.09 |
| 2.48363 | H | Peak | 62.67 | ± 4.09 |
| | | Average | 51.44 | ± 4.09 |
| 4.86897 | V | Peak | 44.84 | ± 4.09 |

4.5. CHANNEL 7 (2442 MHz). Spurious emissions in restricted band 2.4835-2.5 GHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.483516 | H | Peak | 69.12 | ± 4.09 |
| | | Average | 53.36 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.48350 | H | Peak | 65.91 | ± 4.09 |
| | | Average | 51.42 | ± 4.09 |

Chain A+B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.48617 | H | Peak | 58.63 | ± 4.09 |
| | | Average | 43.05 | ± 4.09 |

4.6. CHANNEL 8 (2447 MHz). Spurious emissions in restricted band 2.4835-2.5 GHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.48350 | H | Peak | 65.10 | ± 4.09 |
| | | Average | 51.36 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.48350 | H | Peak | 70.25 | ± 4.09 |
| | | Average | 52.62 | ± 4.09 |

Chain A+B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.484081 | H | Peak | 63.86 | ± 4.09 |
| | | Average | 49.25 | ± 4.09 |

4.7. CHANNEL 9 (2452 MHz). Spurious emissions in restricted band 2.4835-2.5 GHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.48350 | H | Peak | 61.25 | ± 4.09 |
| | | Average | 49.66 | ± 4.09 |

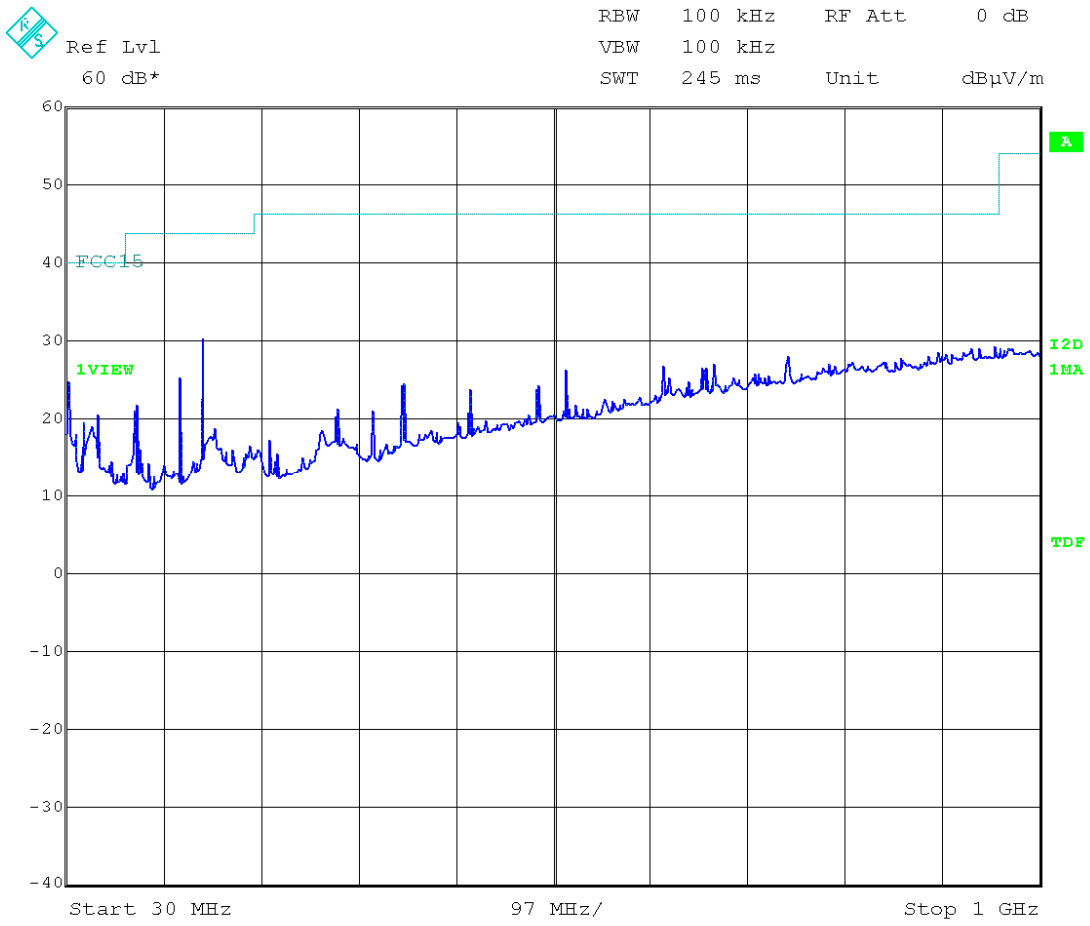
Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.48370 | H | Peak | 67.04 | ± 4.09 |
| | | Average | 50.37 | ± 4.09 |

Chain A+B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.48352 | H | Peak | 65.98 | ± 4.09 |
| | | Average | 53.90 | ± 4.09 |

FREQUENCY RANGE 30 MHz-1000 MHz.

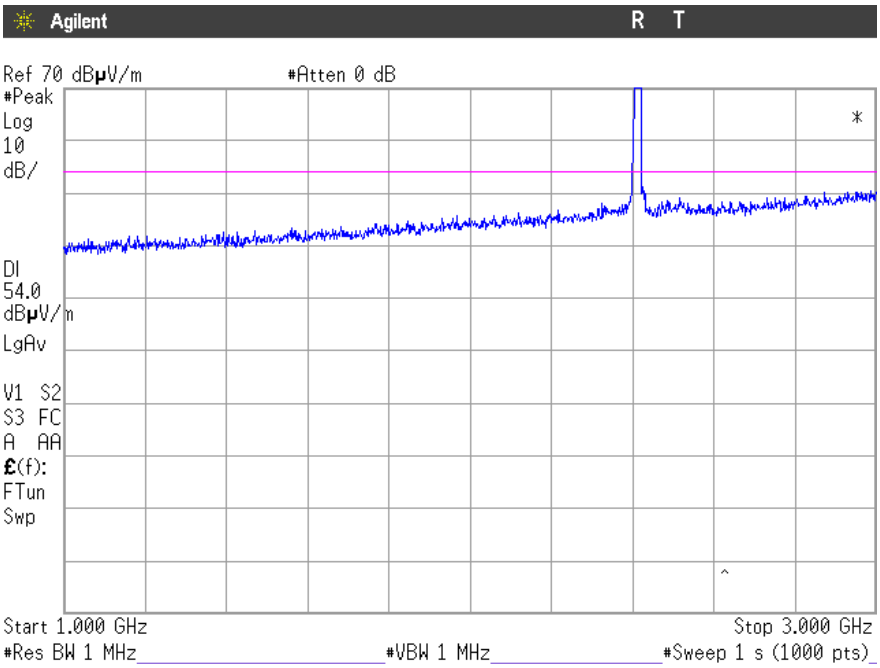



(This plot is valid for all three channels and all modulation modes).

FREQUENCY RANGE 1 GHz to 3 GHz.

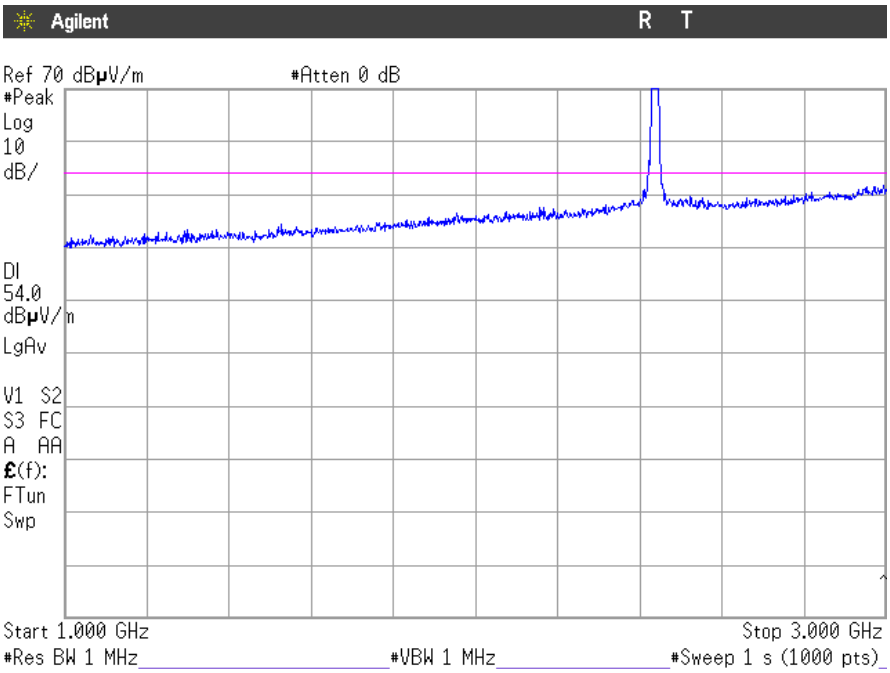
1. WiFi 2.4GHz 802.11 b mode

**CHANNEL 1 (2412 MHz).** Only the carrier was detected in both chains.



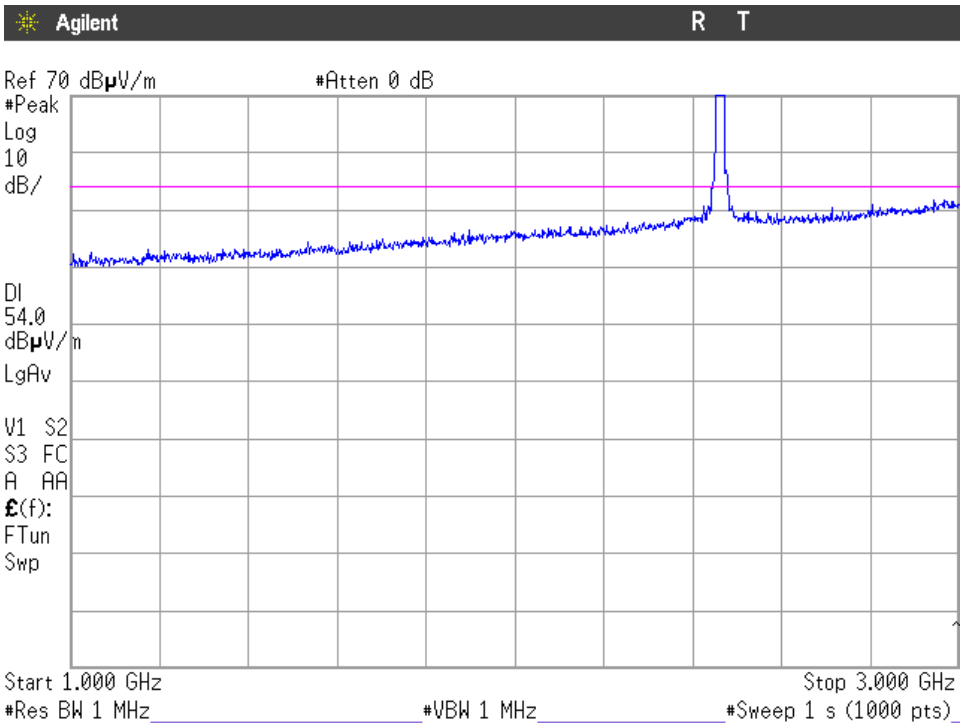

Note: The peak above the limit is the carrier frequency. This plot is valid for both Chain A and Chain B.

**CHANNEL 6 (2437 MHz).** Only the carrier was detected in both chains.




Note: The peak above the limit is the carrier frequency. This plot is valid for both Chain A and Chain B.

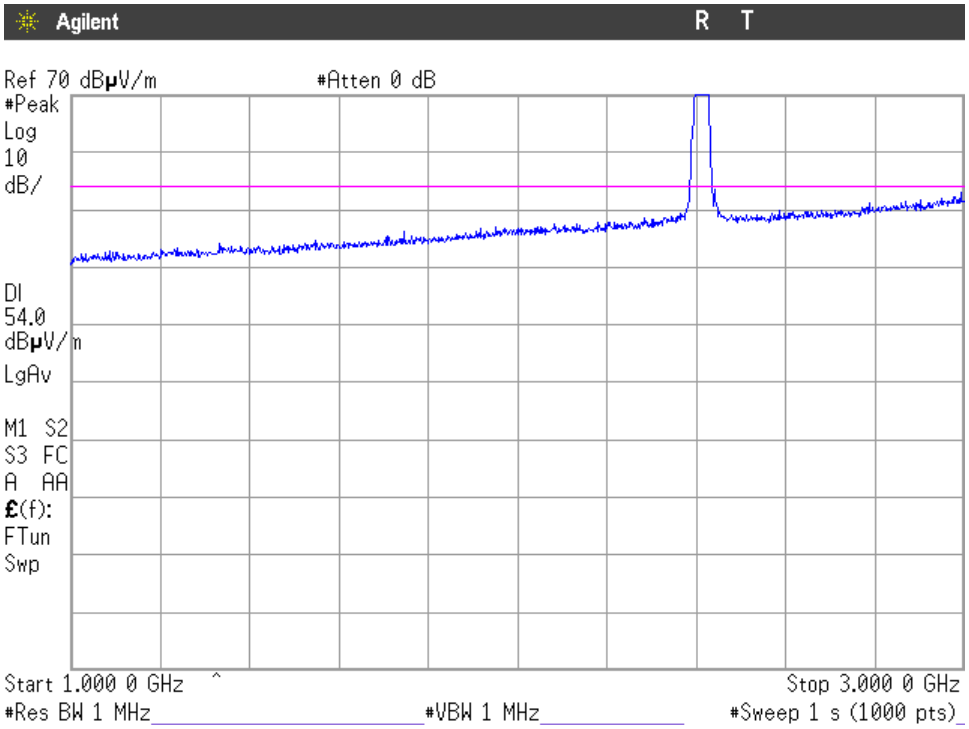
**CHANNEL 11 (2462 MHz).** Only the carrier was detected in both chains.




Note: The peak above the limit is the carrier frequency. This plot is valid for both Chain A and Chain B.

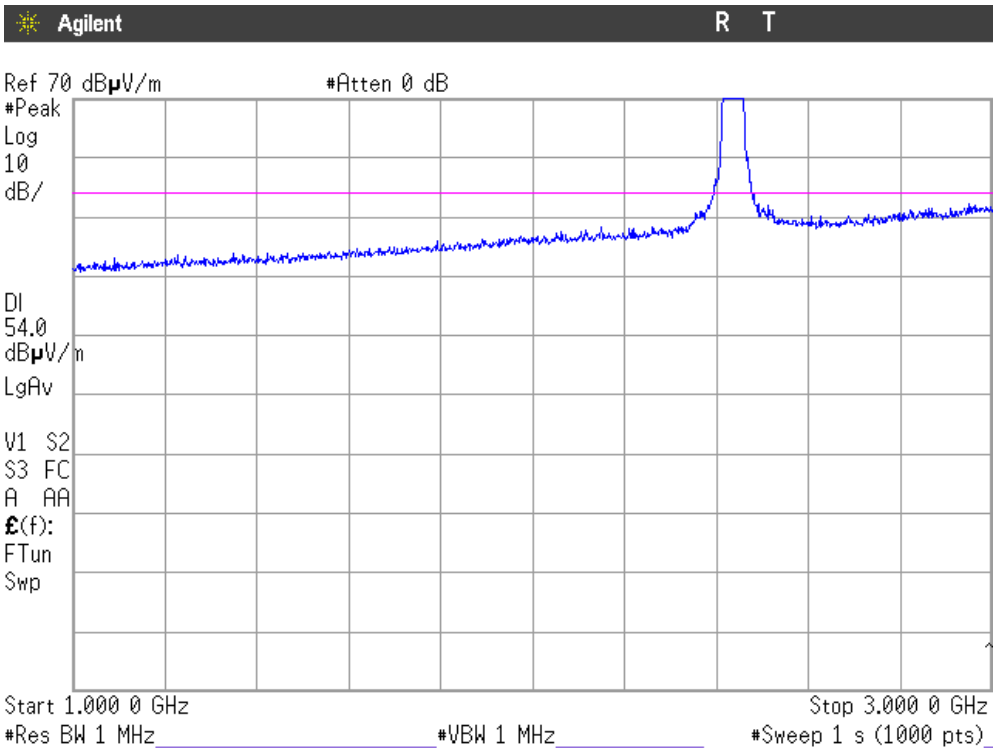
2. WiFi 2.4GHz 802.11 g mode

**CHANNEL 1 (2412 MHz).** Only the carrier was detected in both chains.



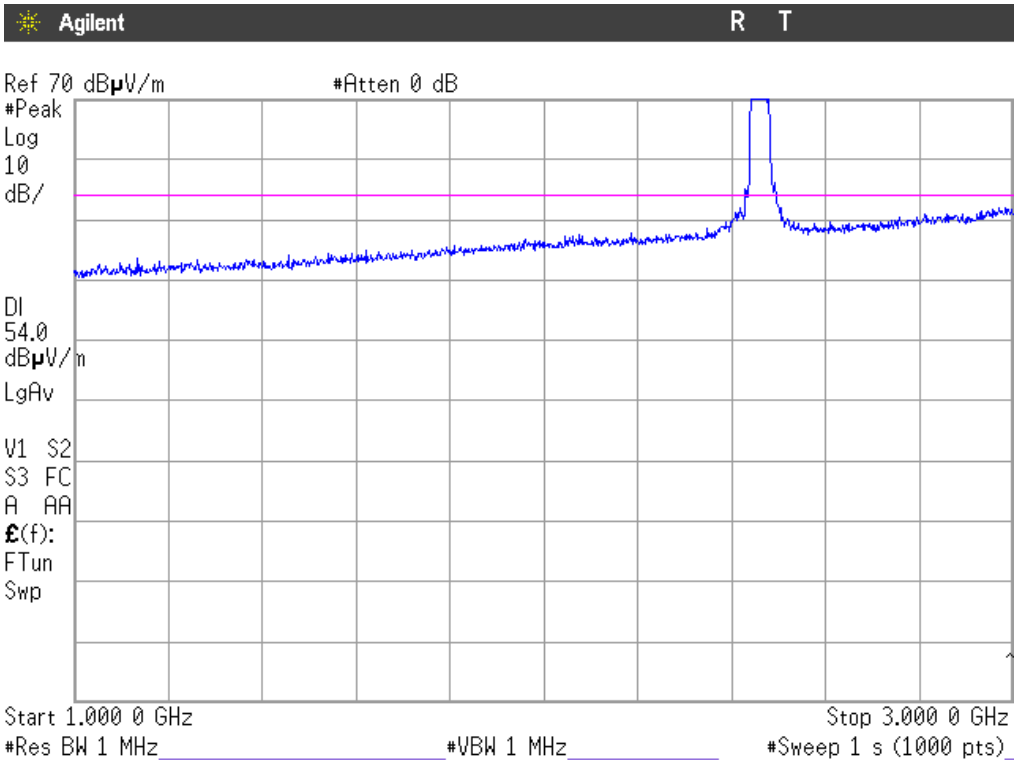

Note: The peak above the limit is the carrier frequency. This plot is valid for both Chain A and Chain B.

**CHANNEL 6 (2437 MHz).** Only the carrier was detected in both chains.




Note: The peak above the limit is the carrier frequency. This plot is valid for both Chain A and Chain B.

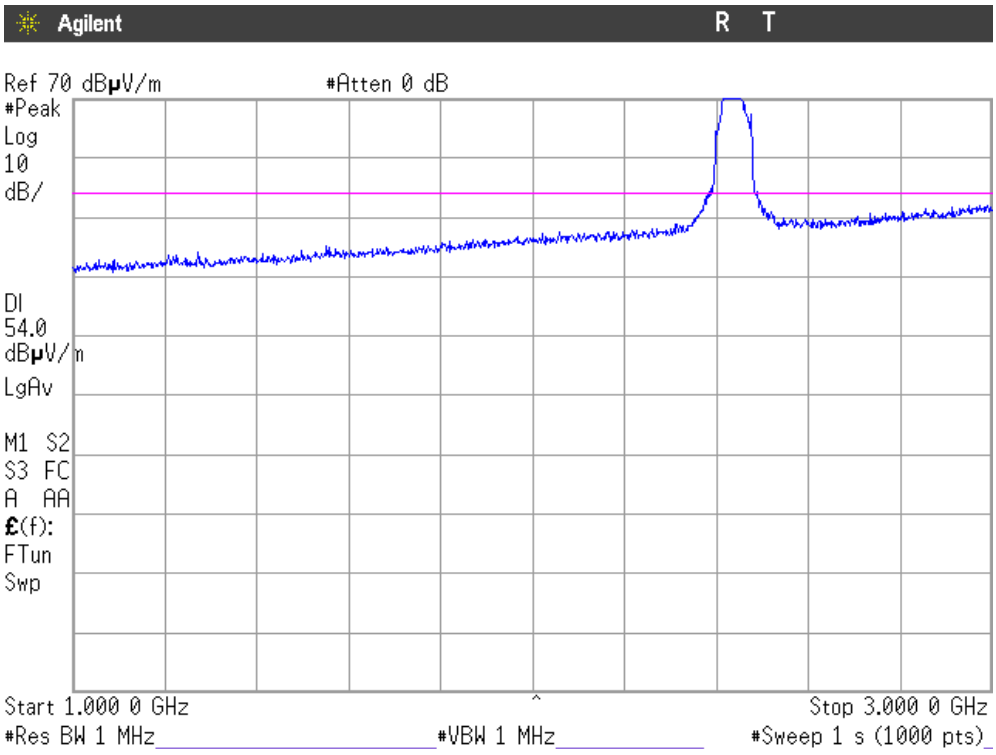
**CHANNEL 11 (2462 MHz).** Only the carrier was detected in both chains.




Note: The peak above the limit is the carrier frequency. This plot is valid for both Chain A and Chain B.

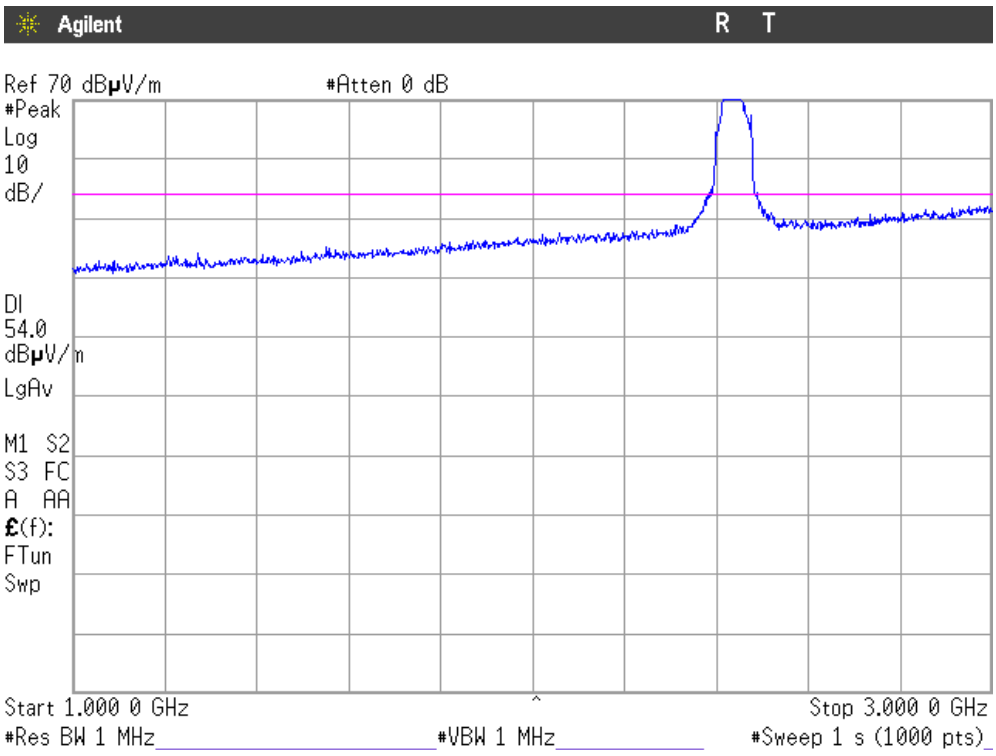
3. WiFi 2.4GHz 802.11 n20 mode

**CHANNEL 6 (2437 MHz).** Only the carrier was detected in both chains.




Note: The peak above the limit is the carrier frequency. This plot is valid for both Chain A and Chain B.

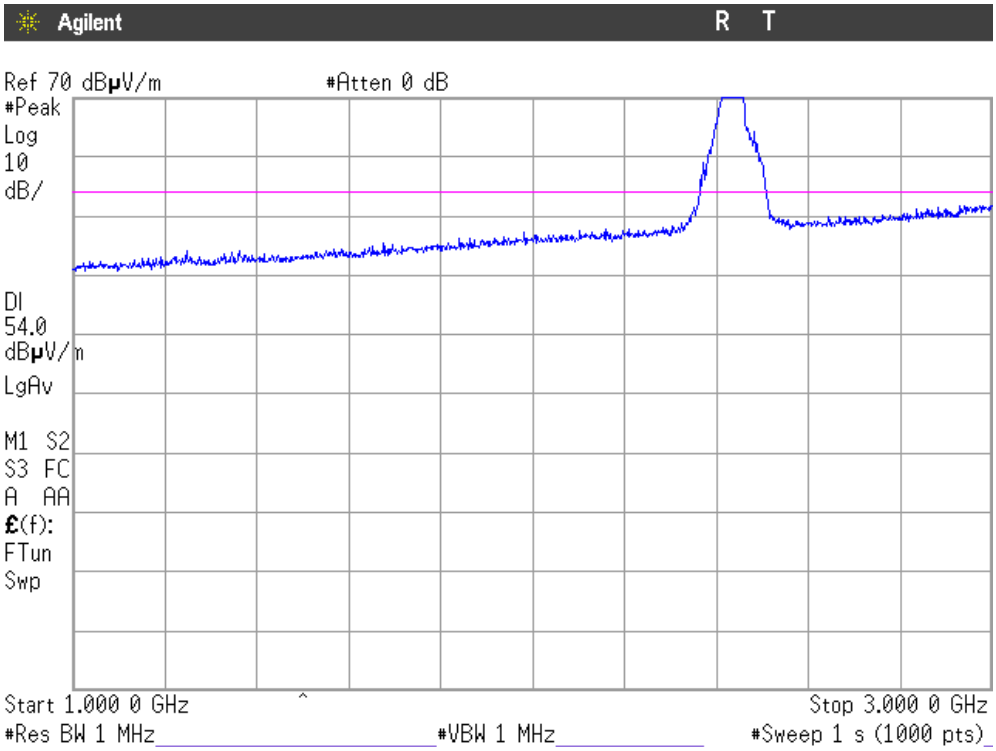
**Chain A+B.**




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

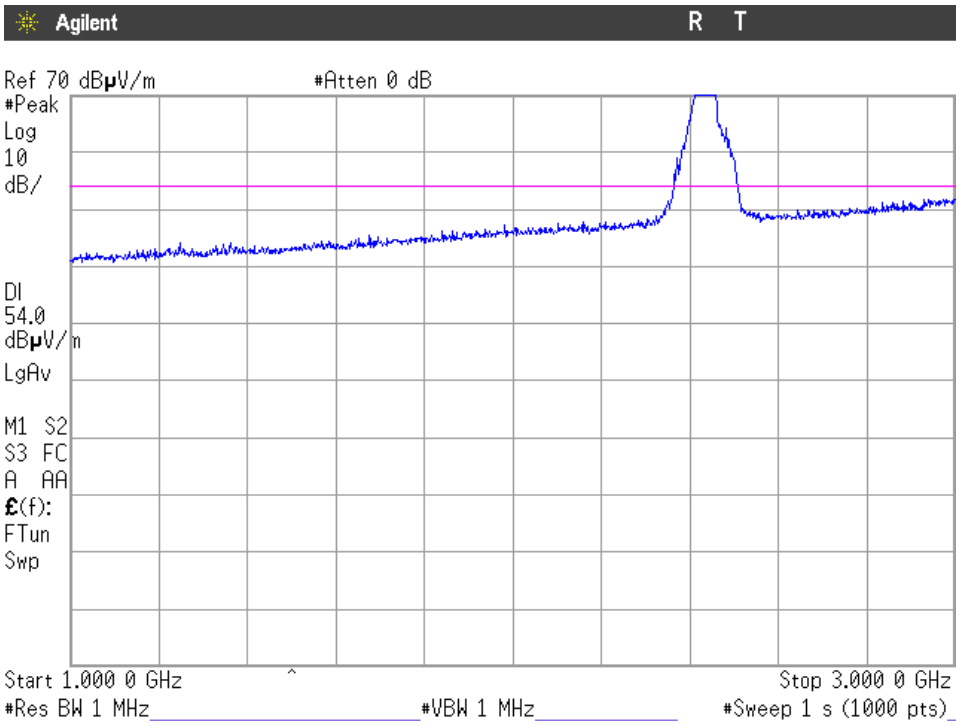
4. WiFi 2.4GHz 802.11 n40 mode

**CHANNEL 6 (2437 MHz).** Only the carrier was detected in both chains.




Note: The peak above the limit is the carrier frequency. This plot is valid for both Chain A and Chain B.

**Chain A+B.**



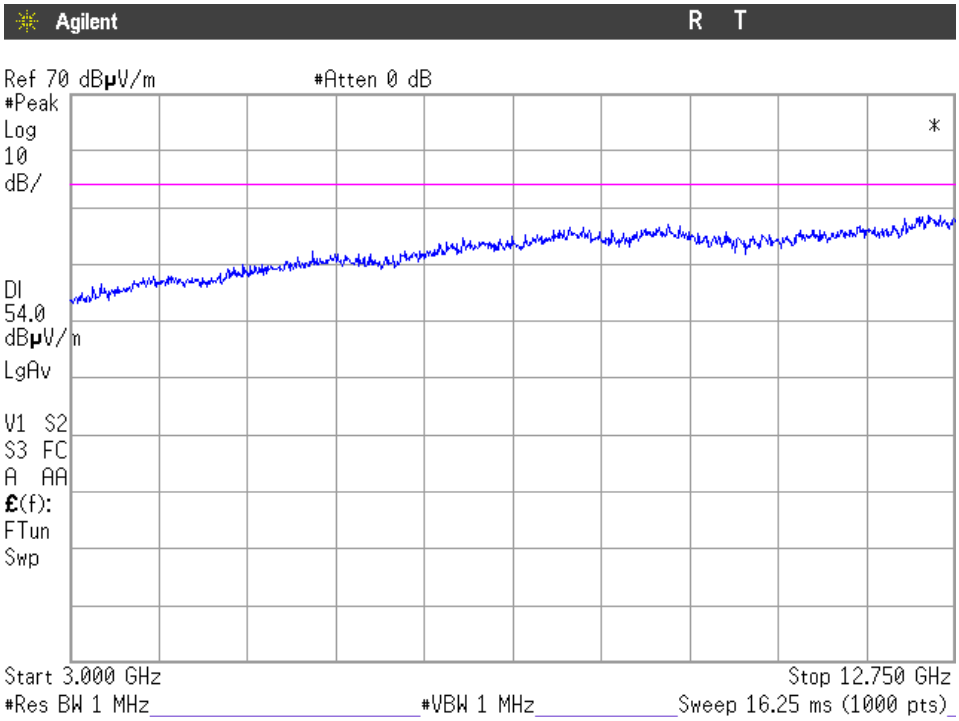

Note: The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 GHz to 12.75 GHz.

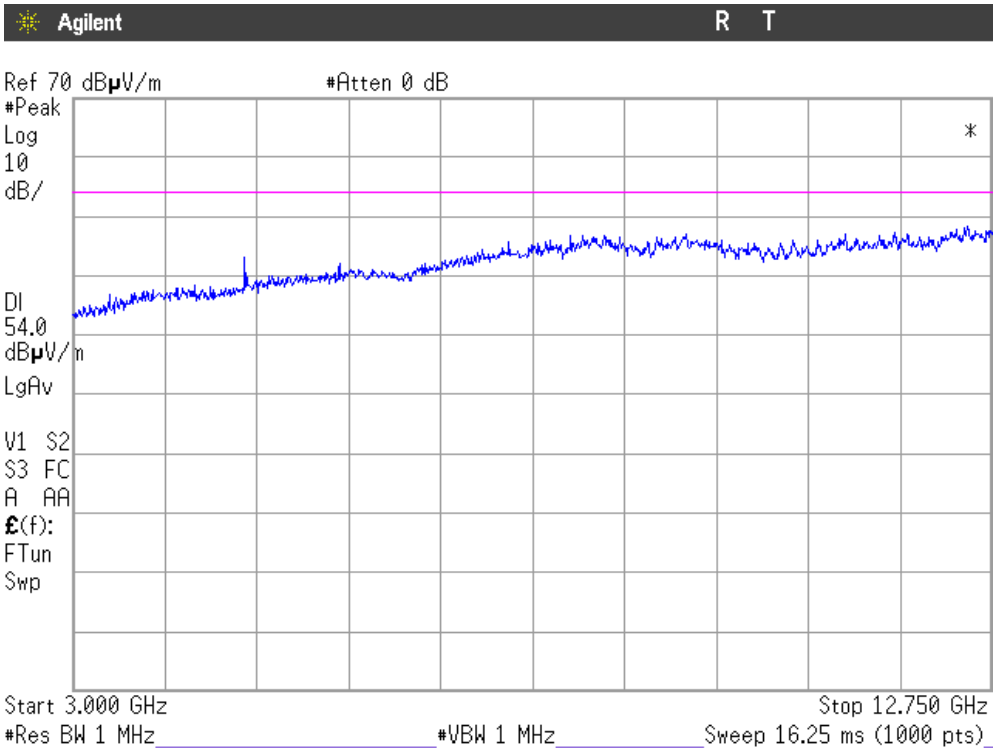
1. WiFi 2.4GHz 802.11 b mode

**CHANNEL 1 (2412 MHz).**

**Chain A**

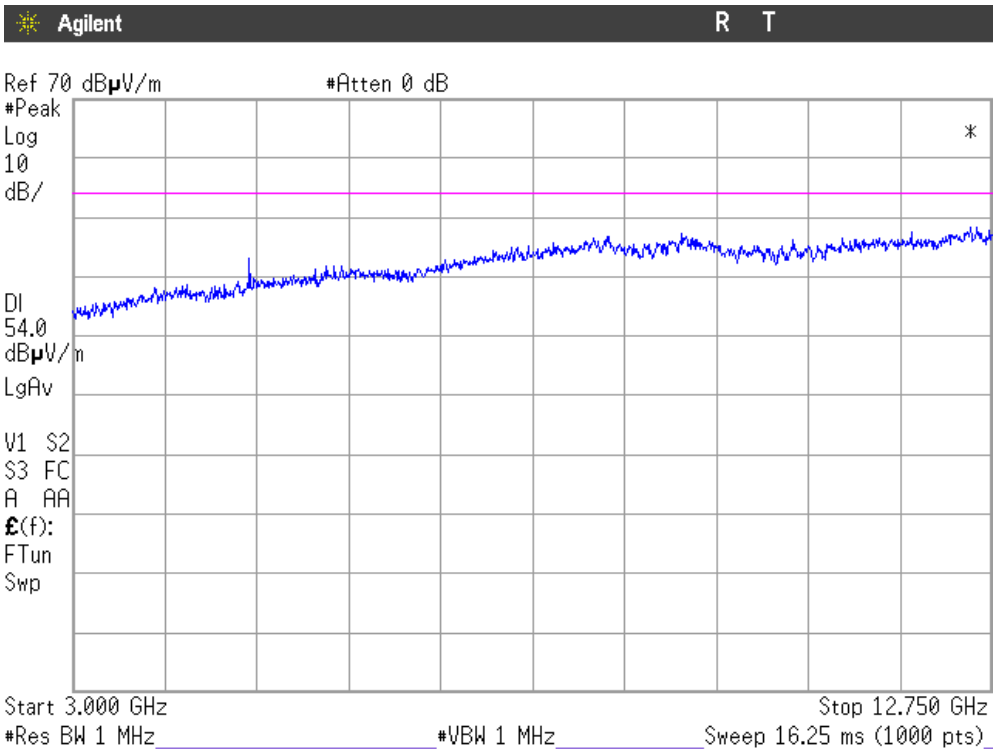



**Chain B**

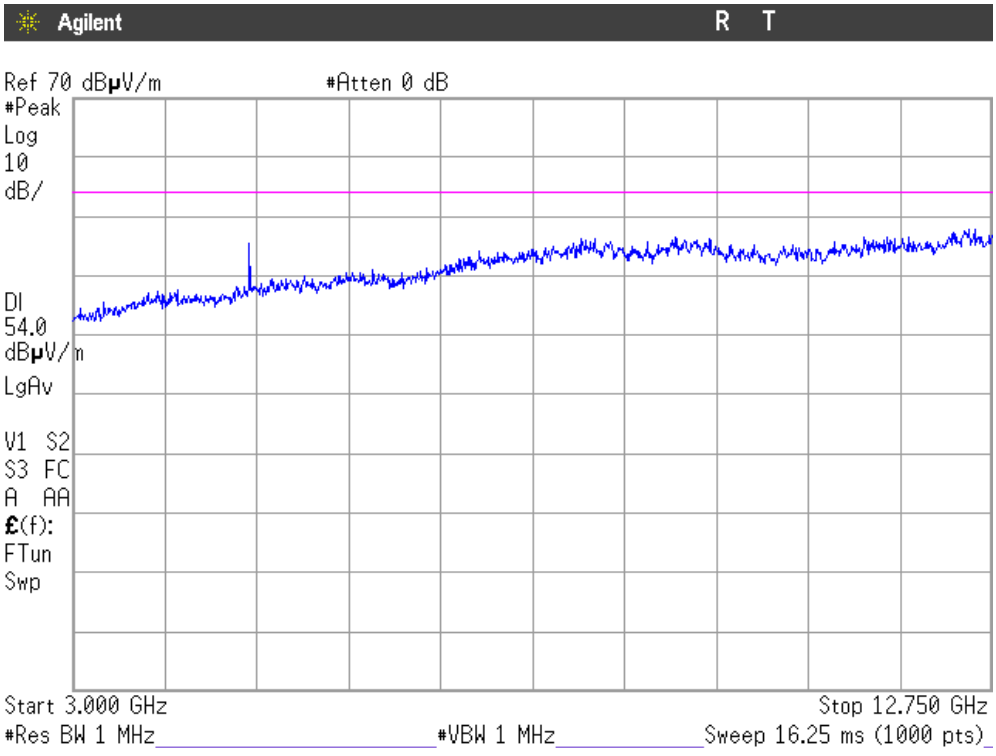


**CHANNEL 6 (2437 MHz).**

**Chain A**

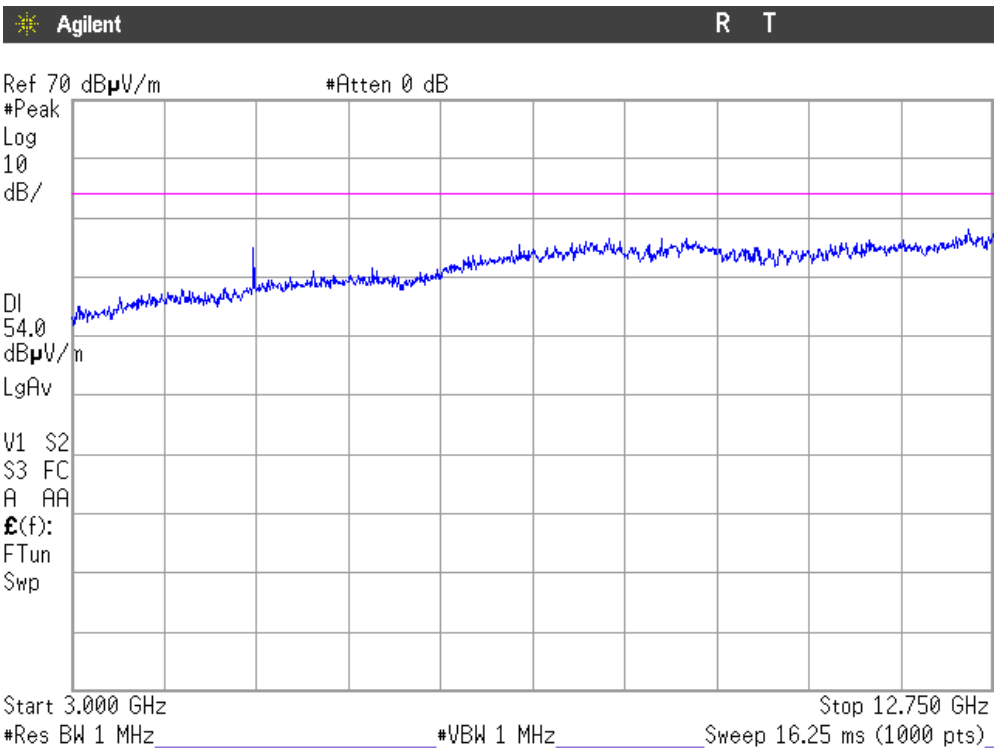



**Chain B**

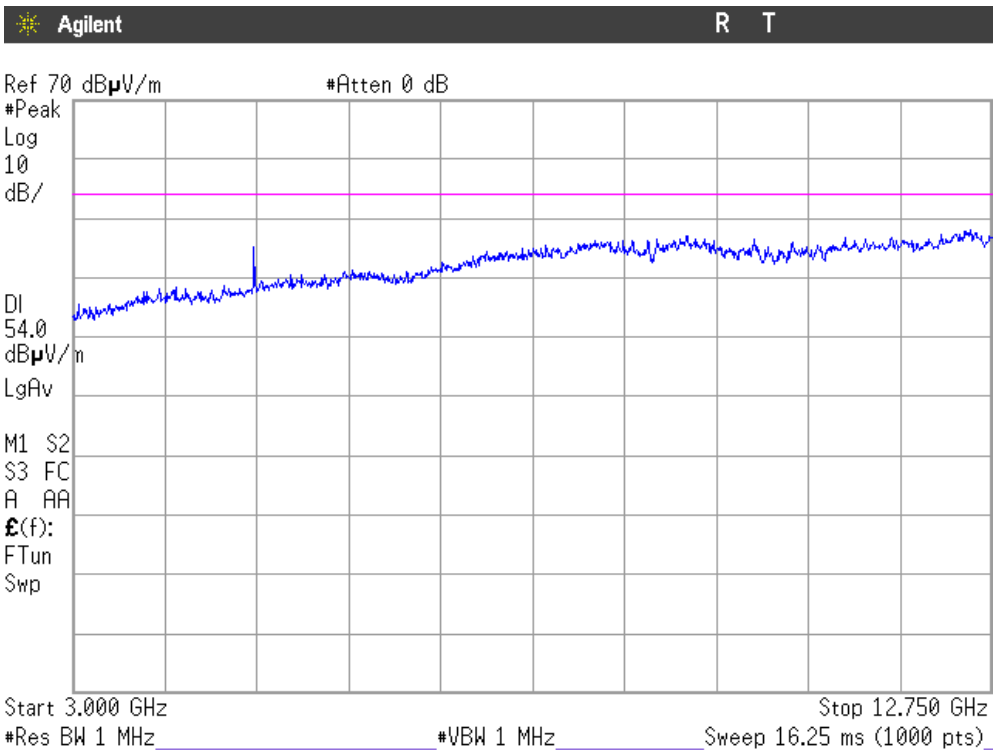


**CHANNEL 11 (2462 MHz).**

**Chain A**



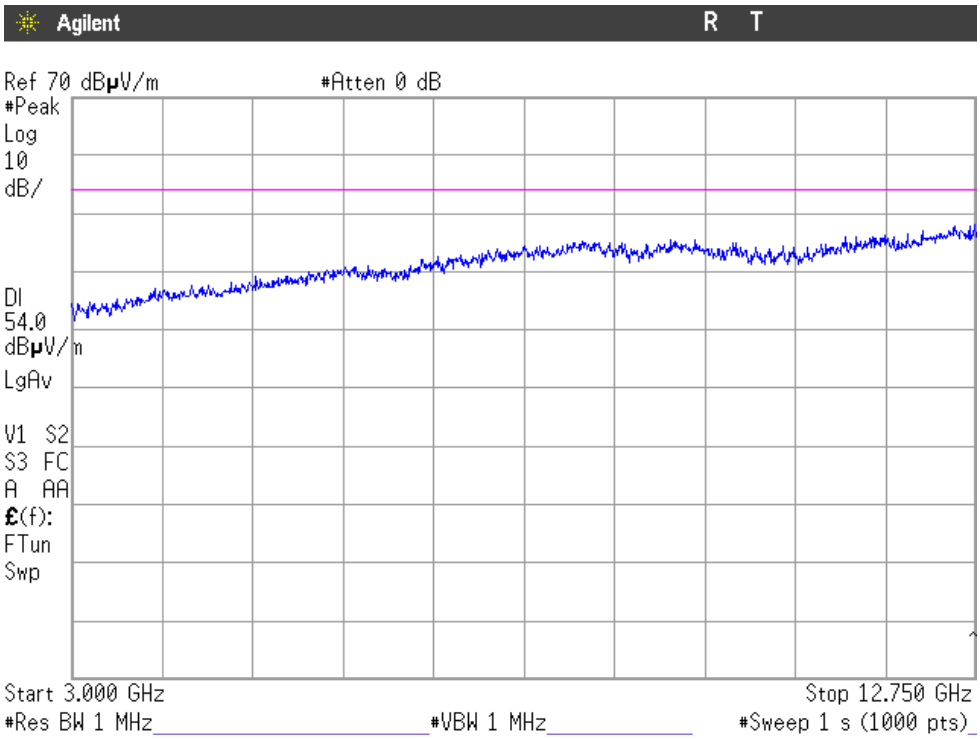

**Chain B**



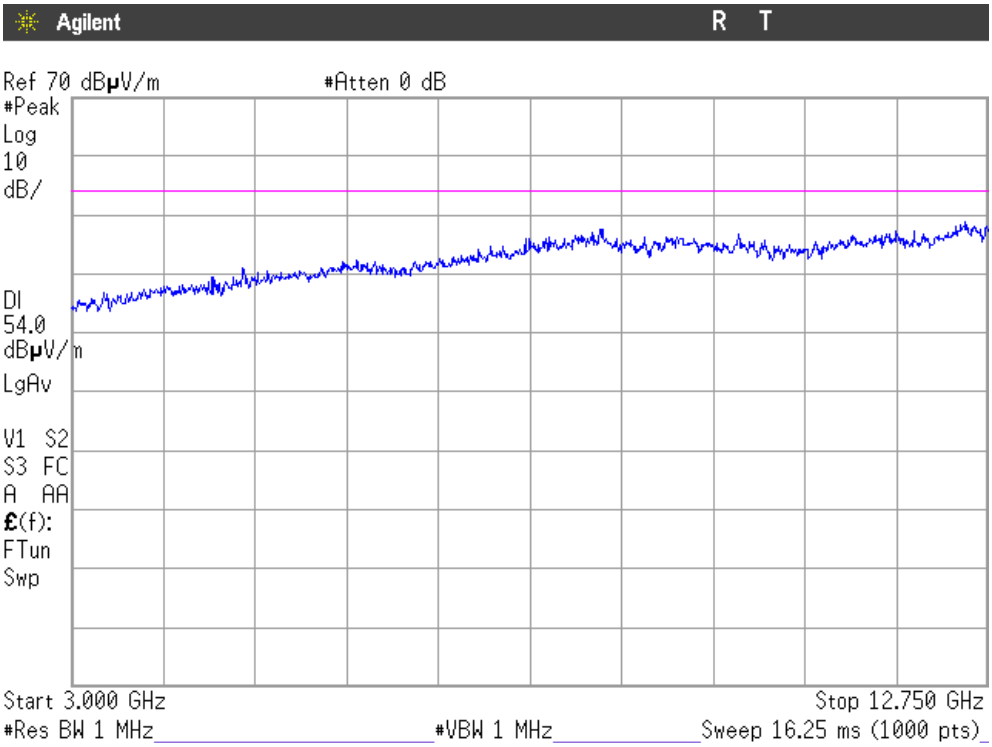
2. WiFi 2.4GHz 802.11 g mode (worst case)

**CHANNEL 1 (2412 MHz).**

**Chain A**

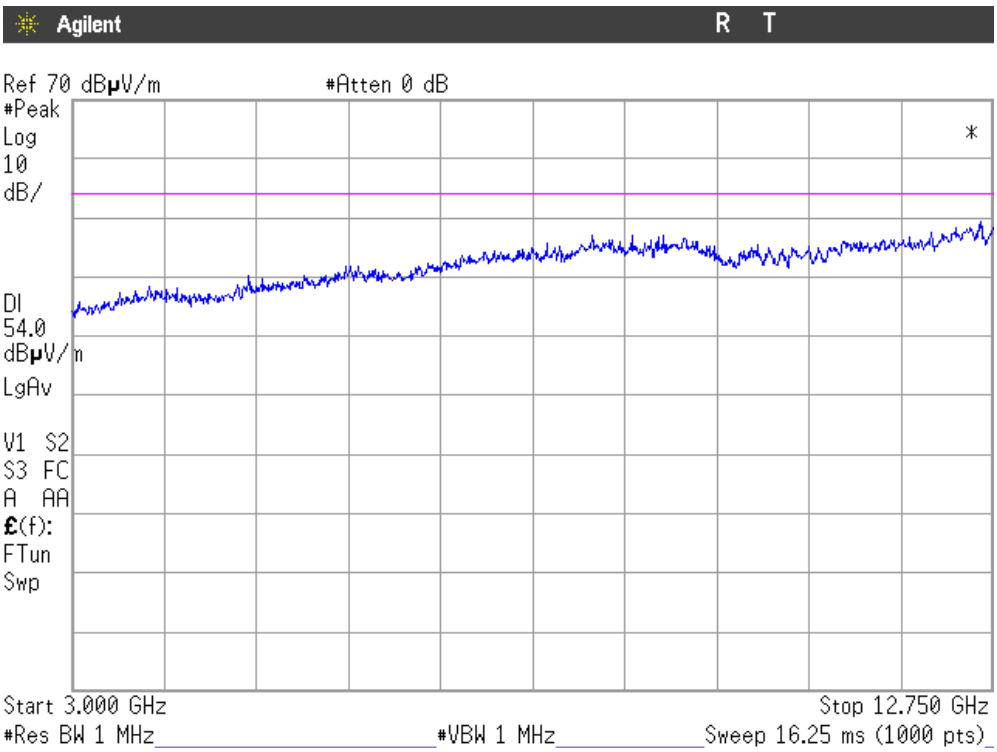



**Chain B**

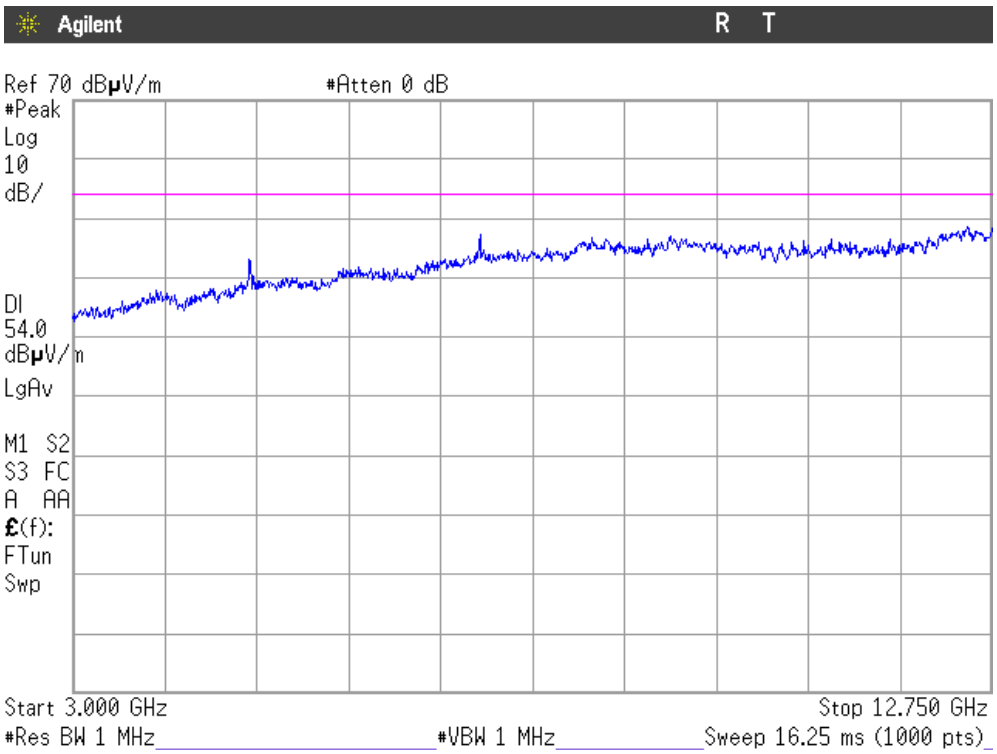


**CHANNEL 6 (2437 MHz).**

**Chain A.**

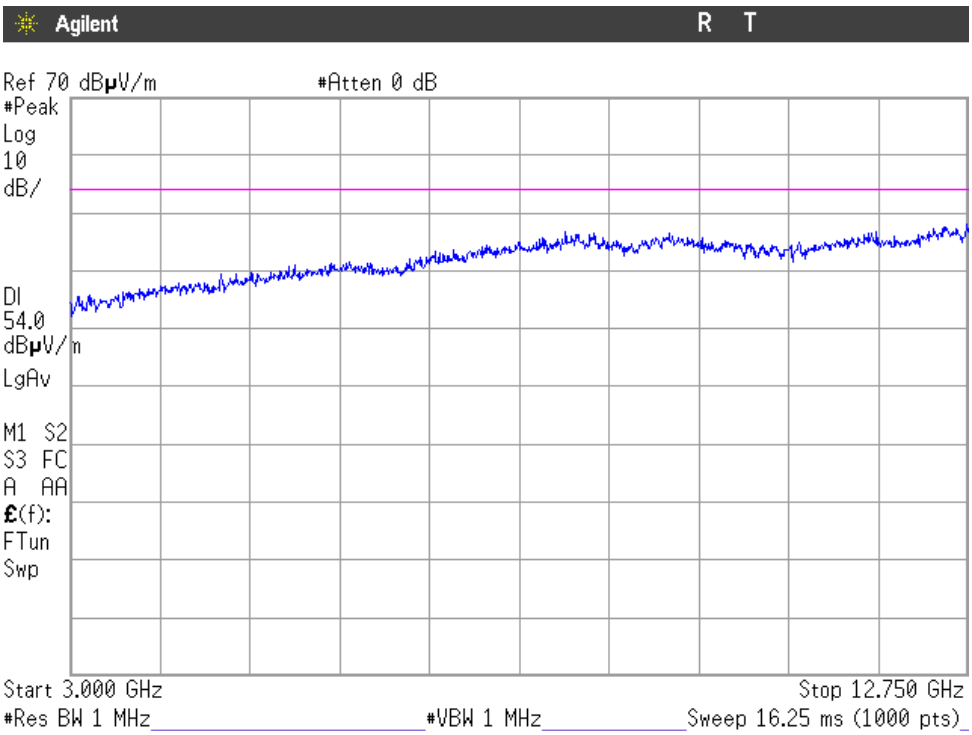



**Chain B.**

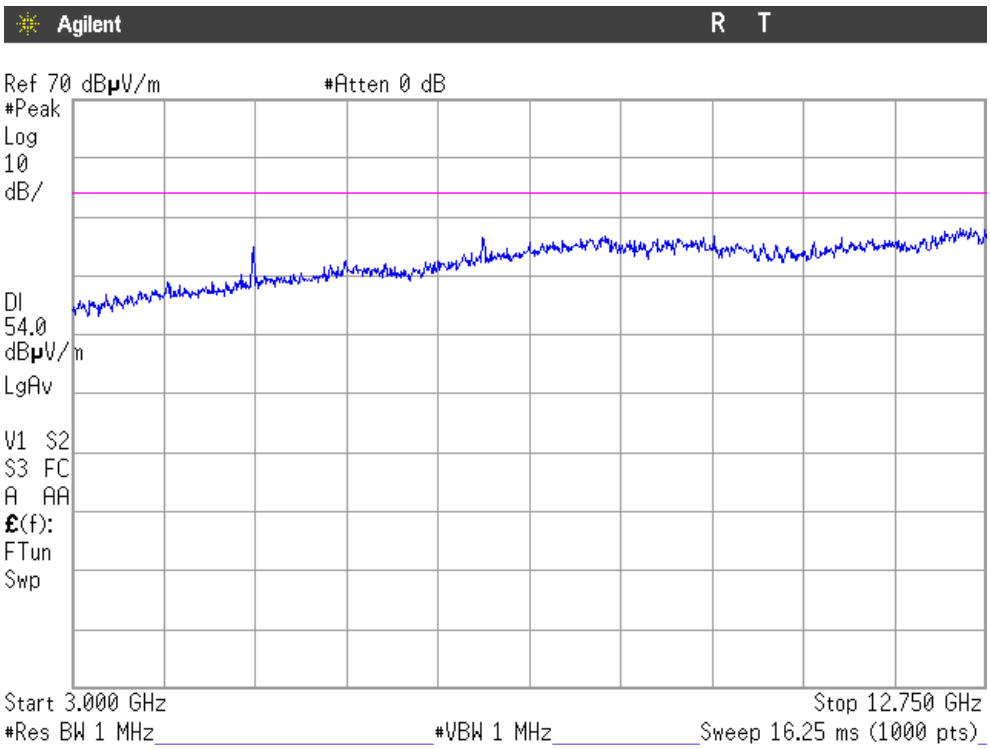


**CHANNEL 11 (2462 MHz).**

**Chain A**



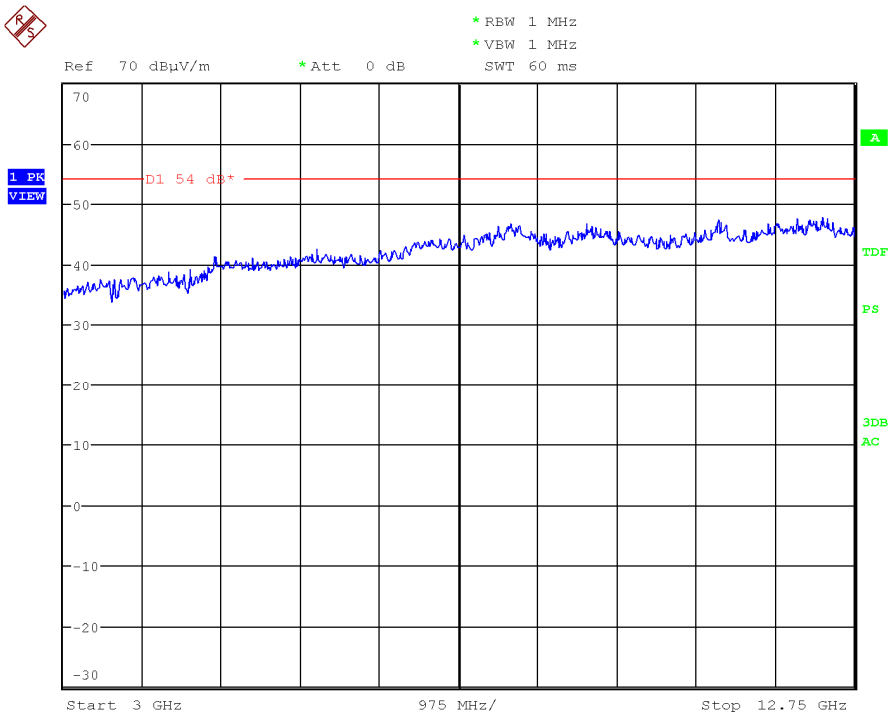

**Chain B**



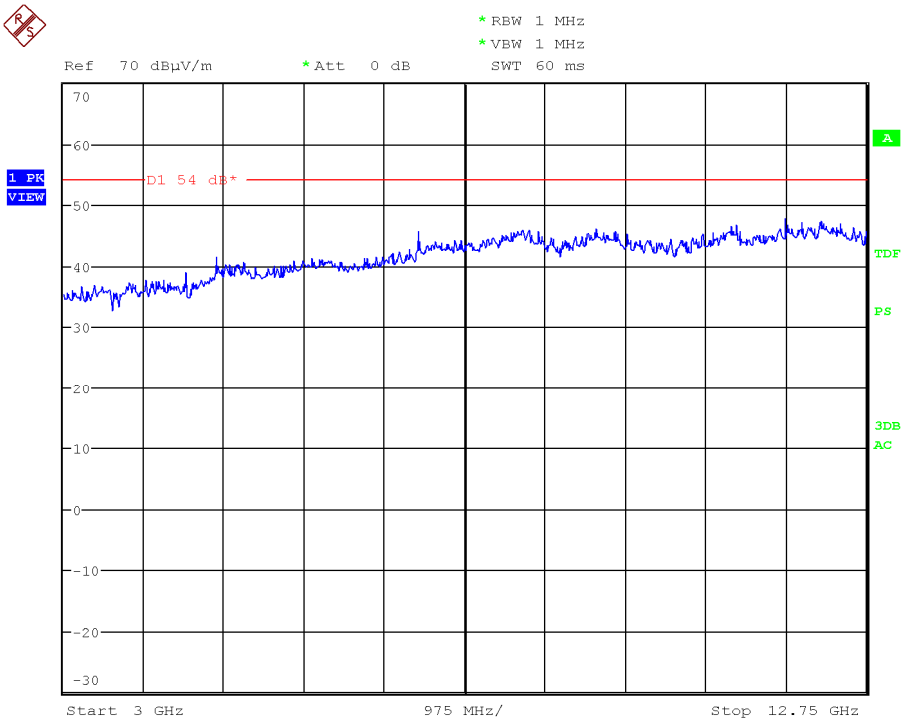
3. WiFi 2.4GHz 802.11 n20 mode

**CHANNEL 6 (2437 MHz).**

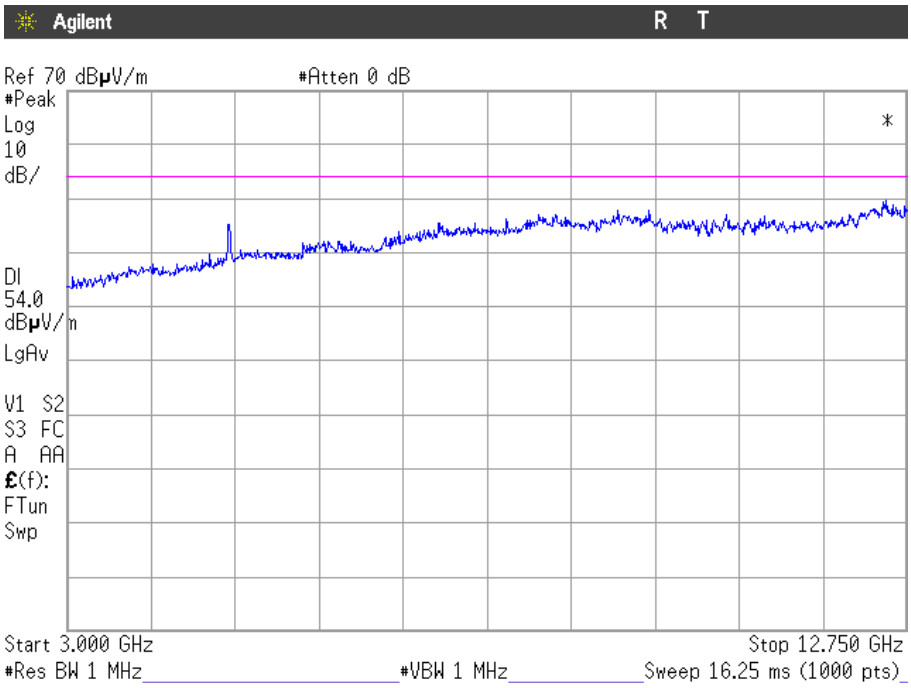
**Chain A.**




**Chain B.**



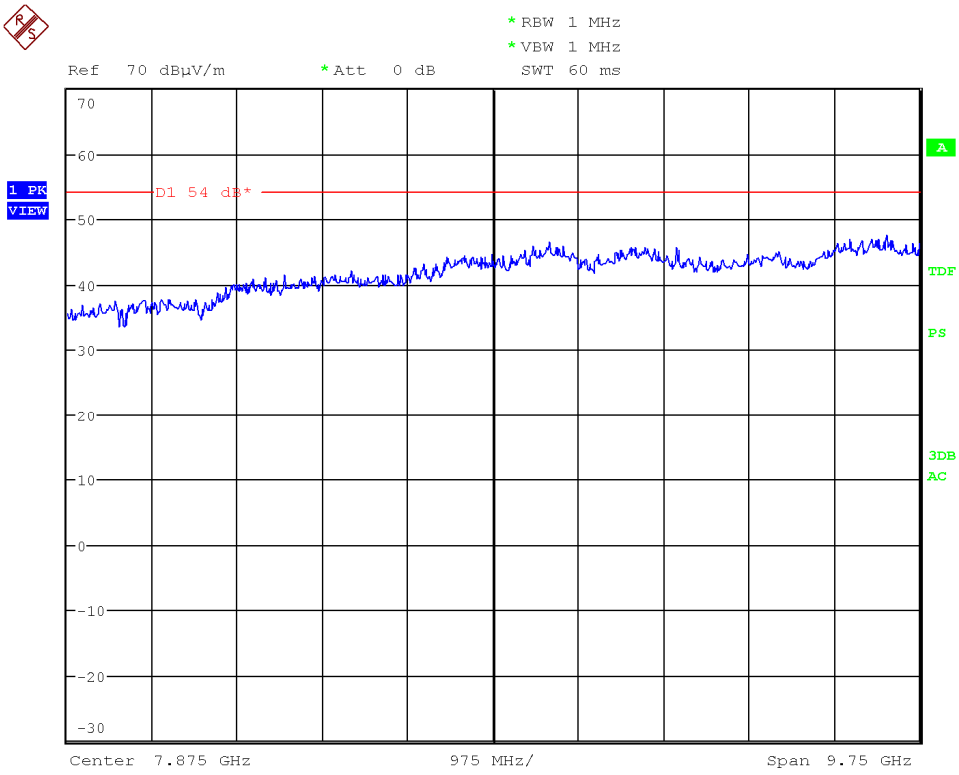
**Chain A+B.**



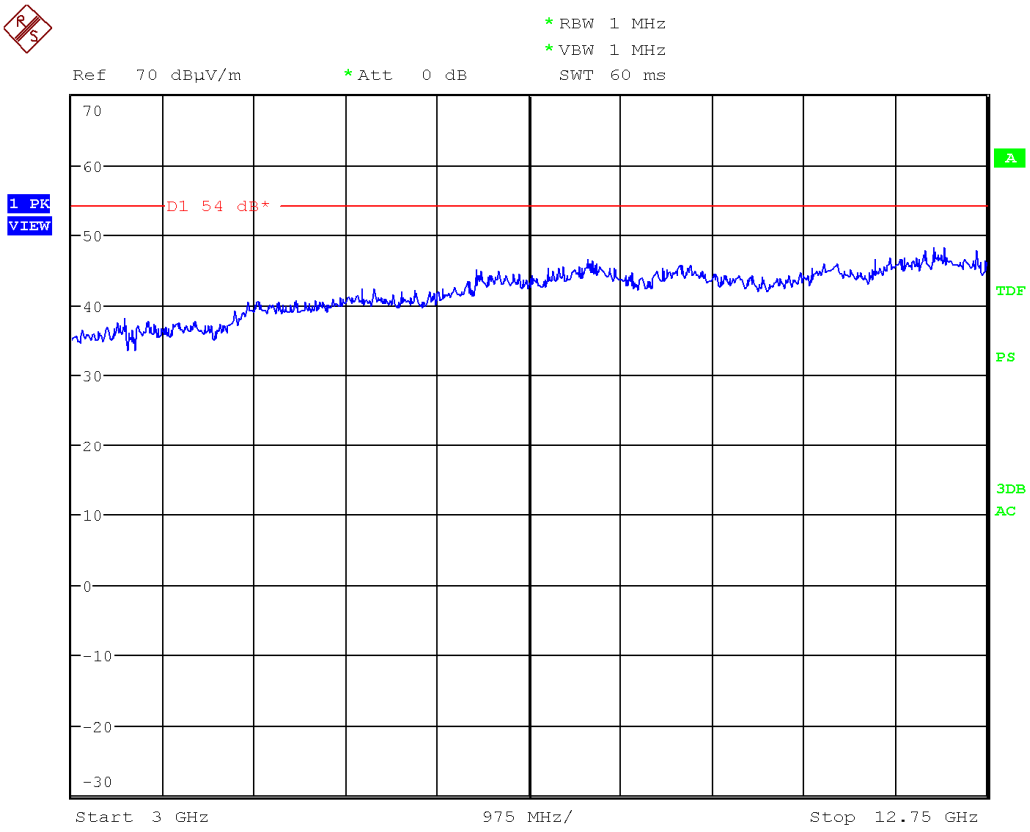

4. WiFi 2.4GHz 802.11 n40 mode

**CHANNEL 6 (2437 MHz).**

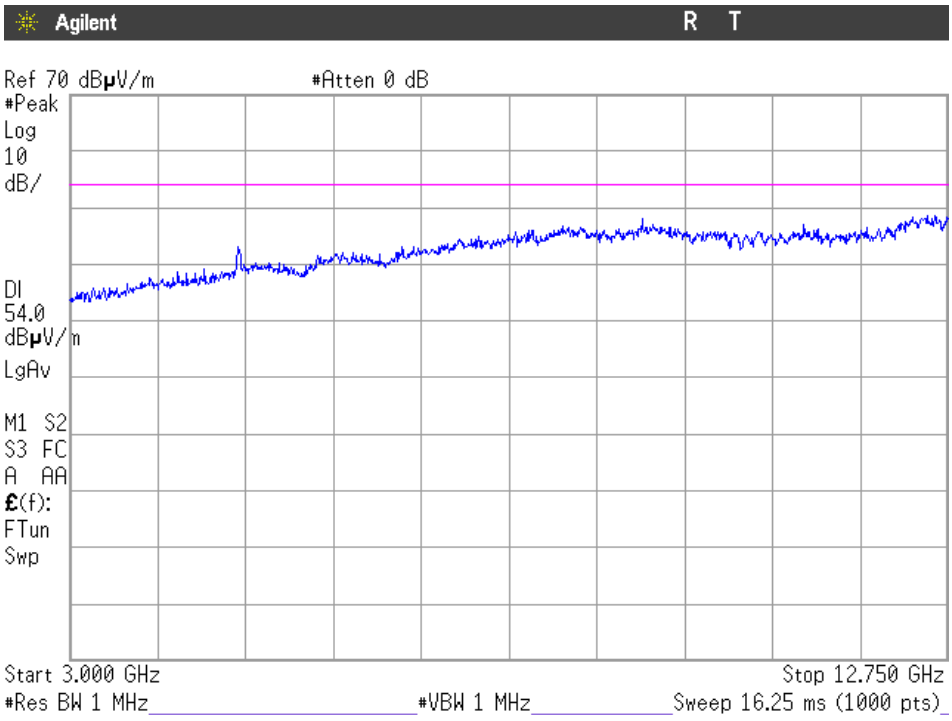
**Chain A.**



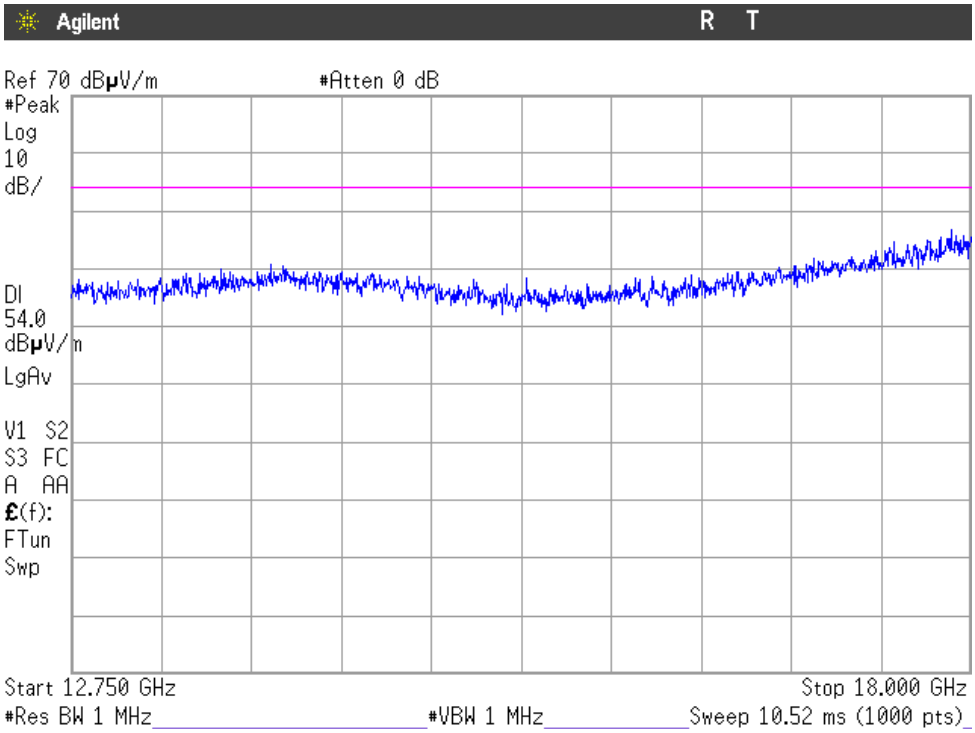
## Chain B




## Chain A+B

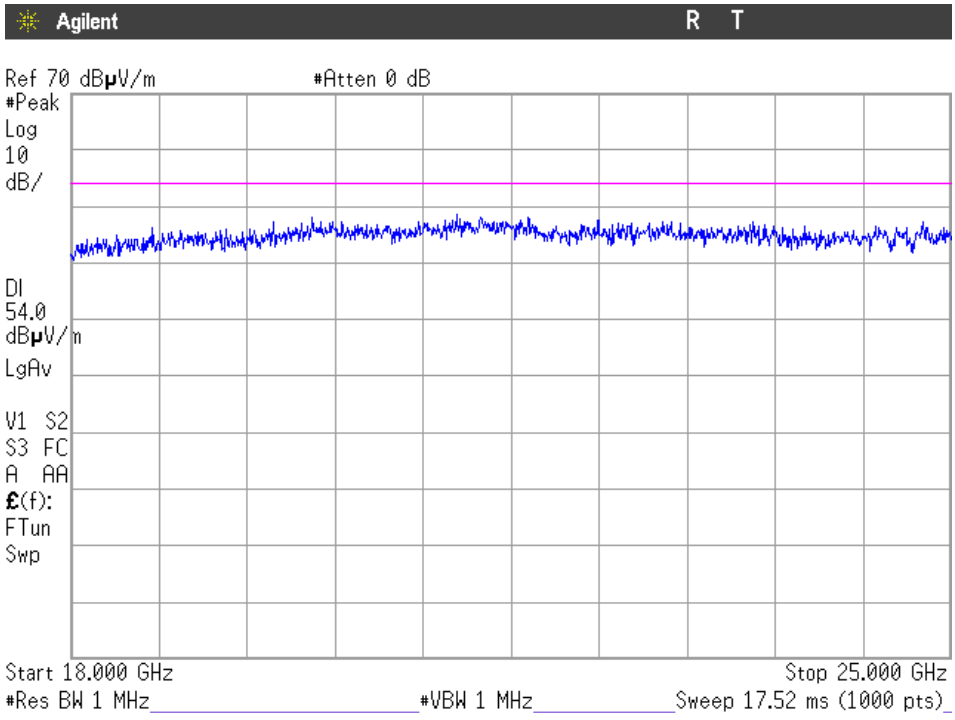


FREQUENCY RANGE 12.75 GHz to 18 GHz. No spurious signals were detected in all modulation modes and channels tested.




(This plot is valid for SISO and MIMO modes).

FREQUENCY RANGE 18 GHz to 25 GHz. No spurious signals were detected.




(This plot is valid for SISO and MIMO modes).

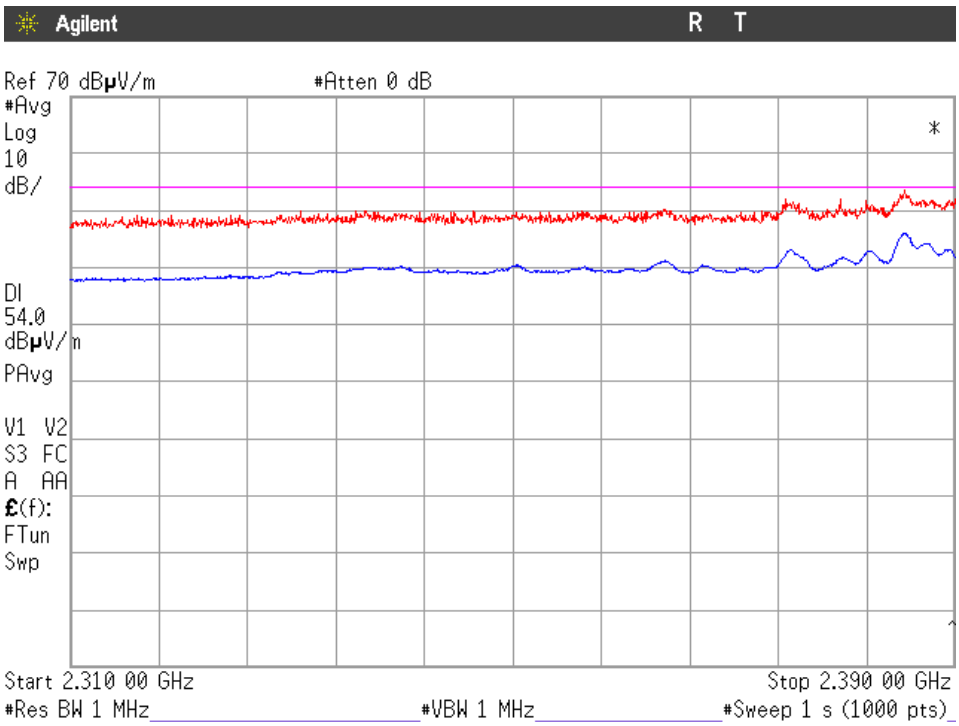
**Radiated spurious emissions at band-edges and inside restricted bands 2.31-2.39 GHz and 2.4835 – 2.5 GHz.**

FREQUENCY RANGE 2.31 GHz to 2.39 GHz. (RESTRICTED BAND)

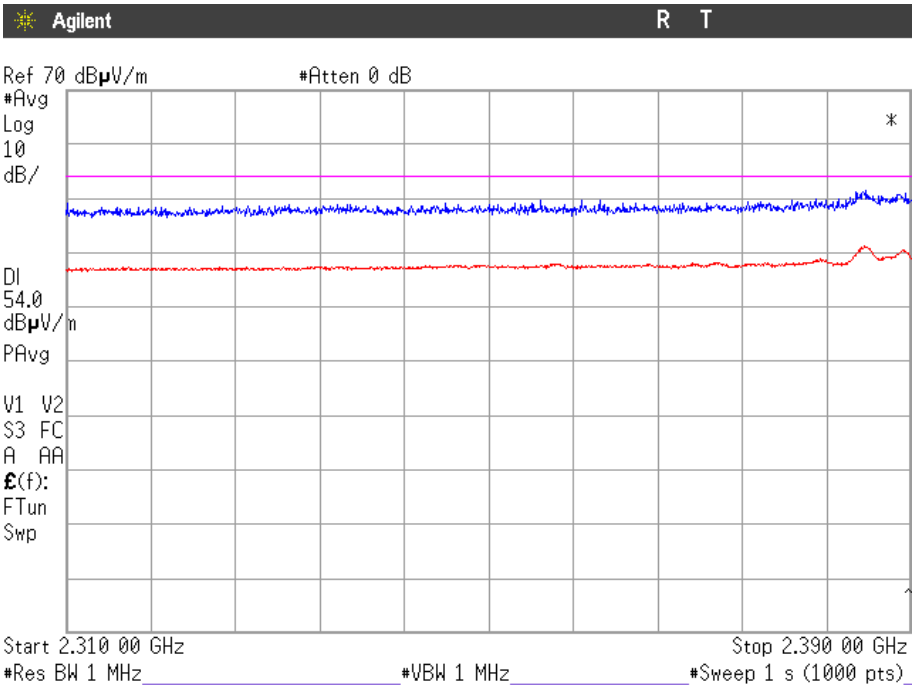
1. WiFi 2.4GHz 802.11 b mode

**CHANNEL 1 (2412 MHz).**

**Chain A**

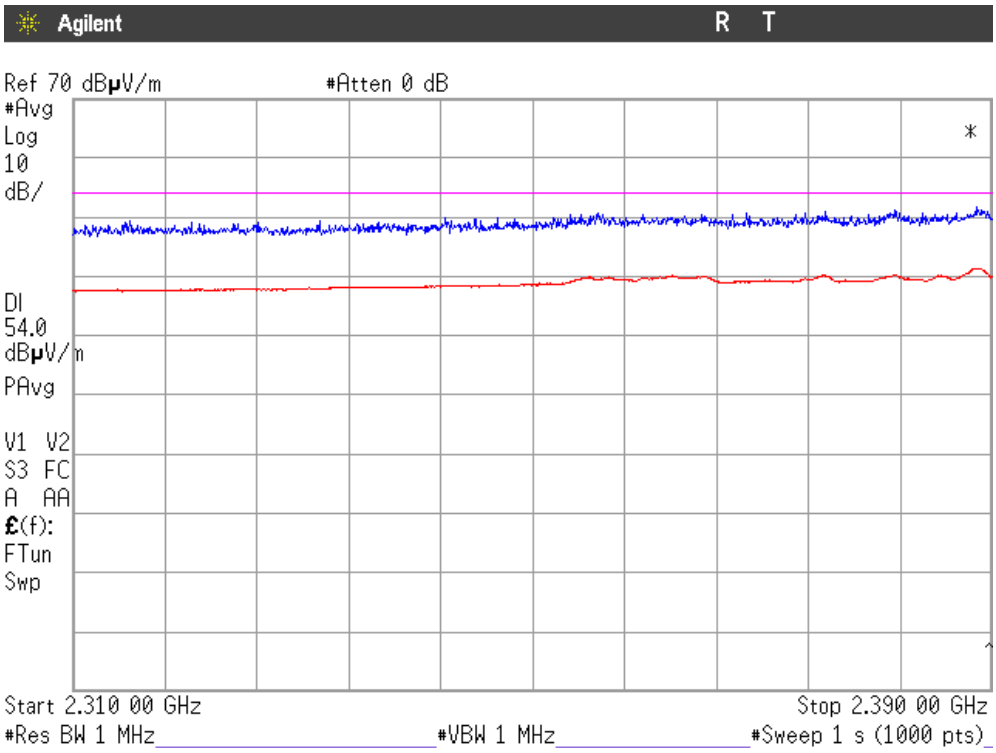



**Chain B**

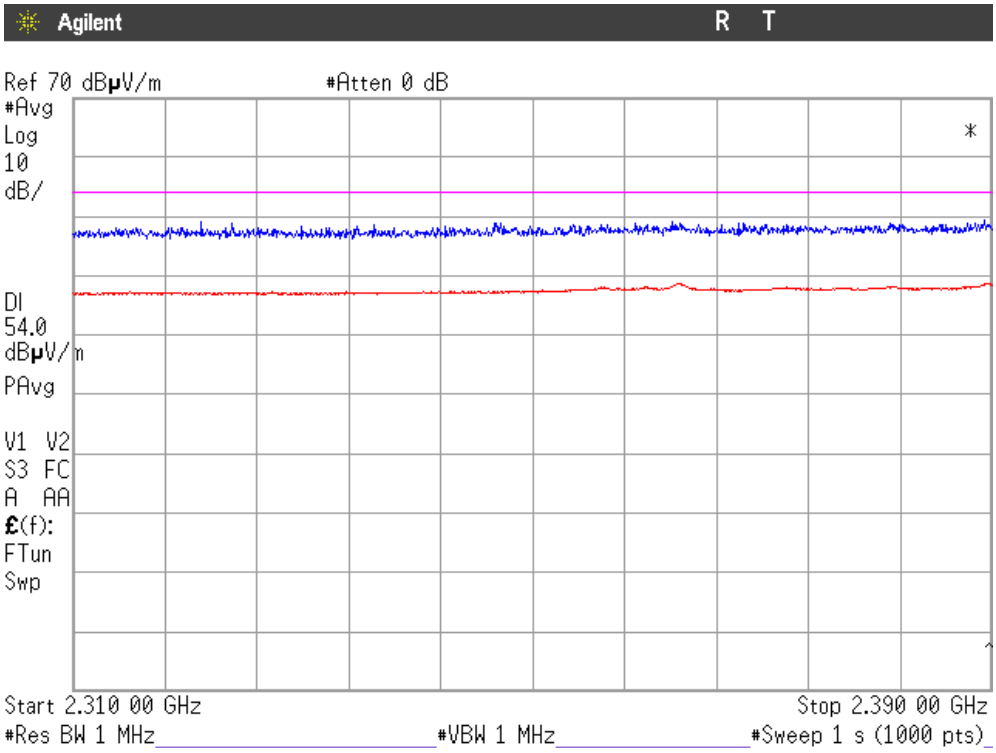


**CHANNEL 6 (2437 MHz).**

**Chain A**

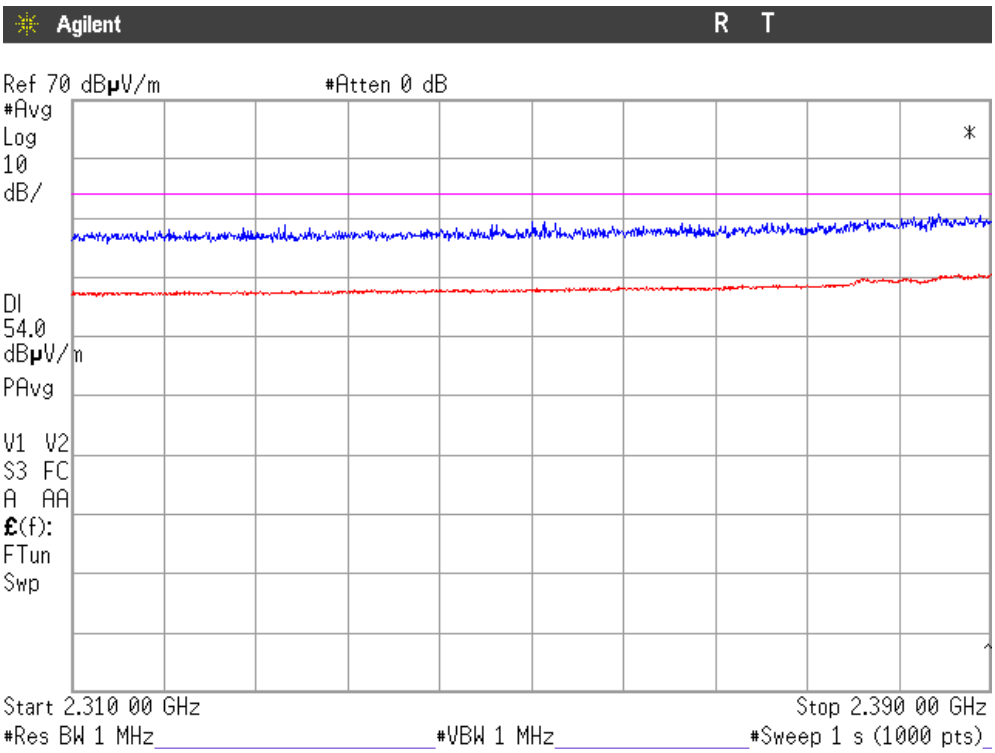



**Chain B**

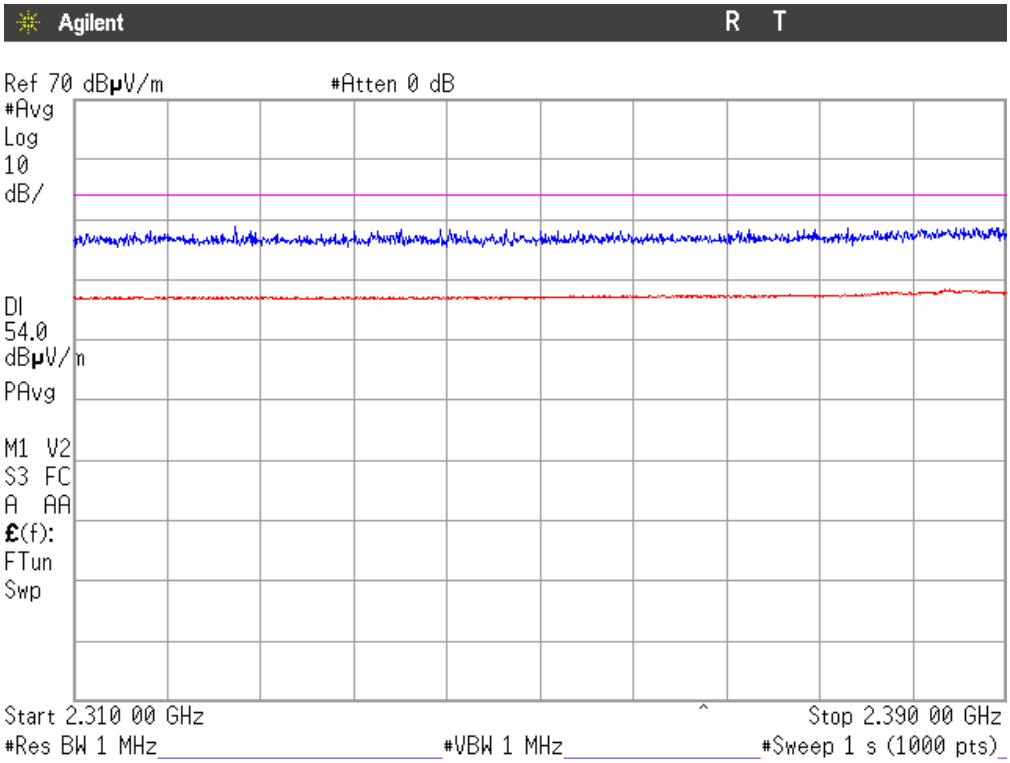


**CHANNEL 11 (2462 MHz).**

**Chain A**



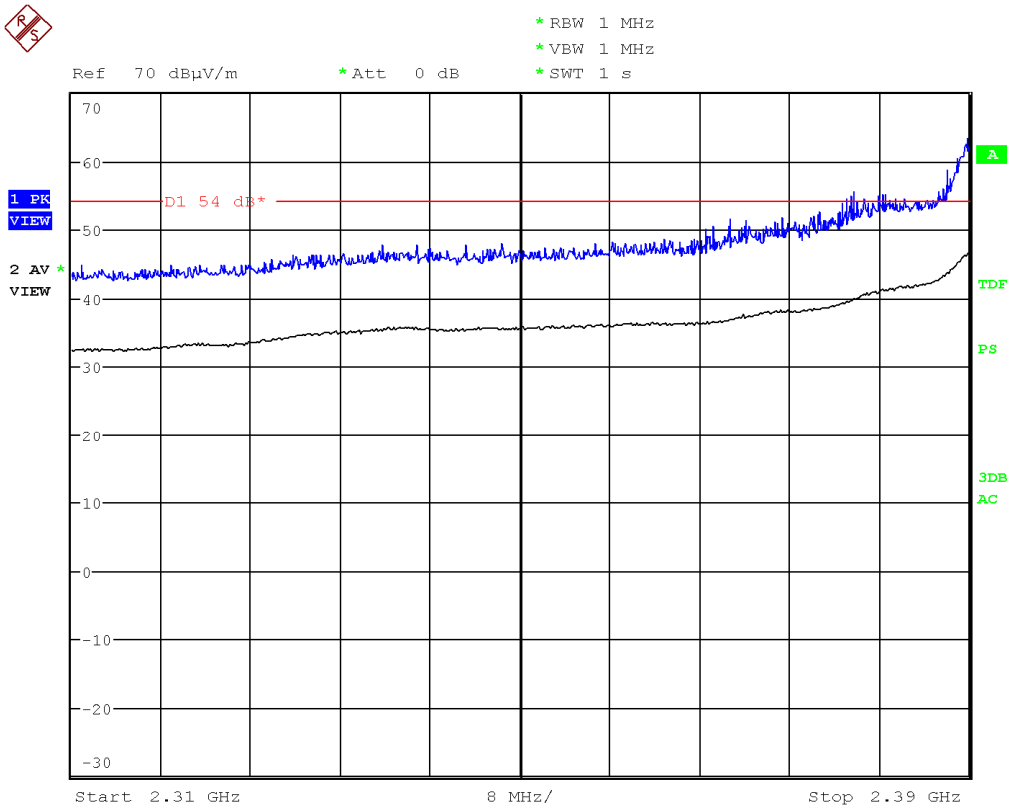

**Chain B**



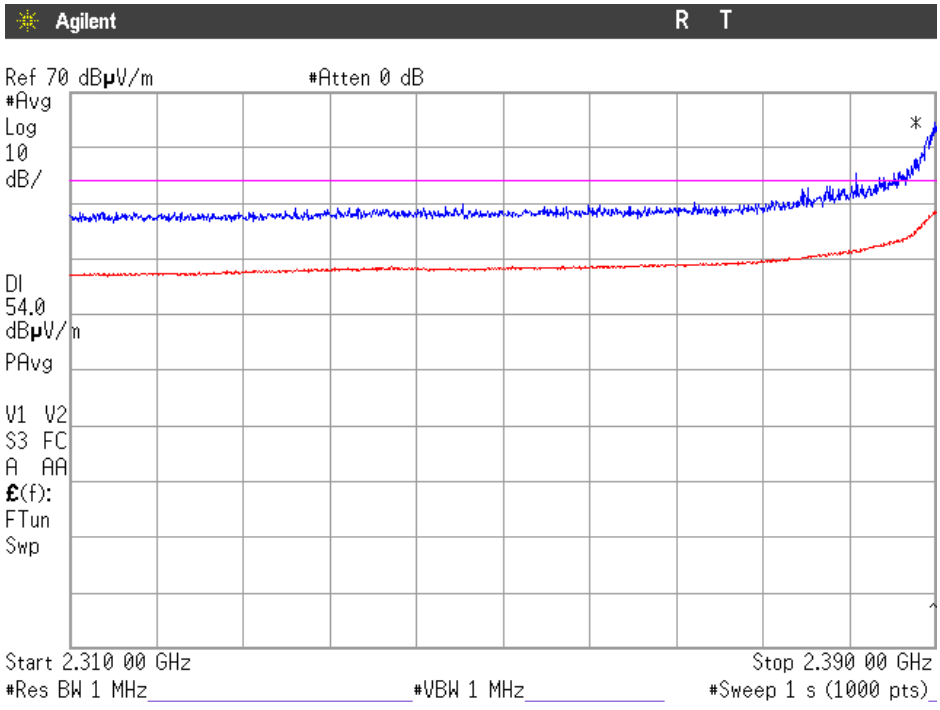
2. WiFi 2.4GHz 802.11 g mode

**CHANNEL 1 (2412 MHz).**

**Chain A**

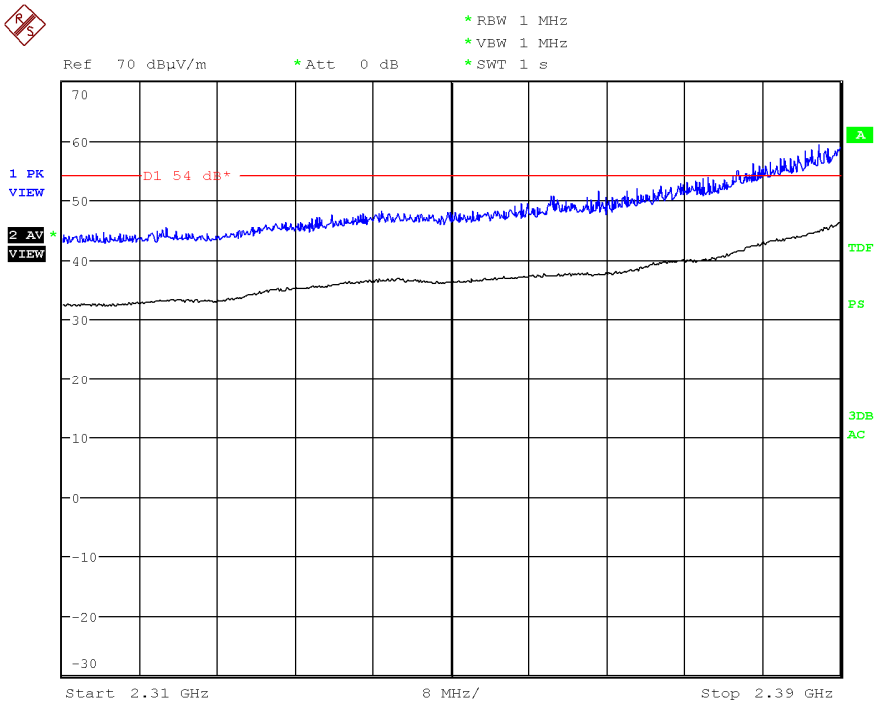



**Chain B**

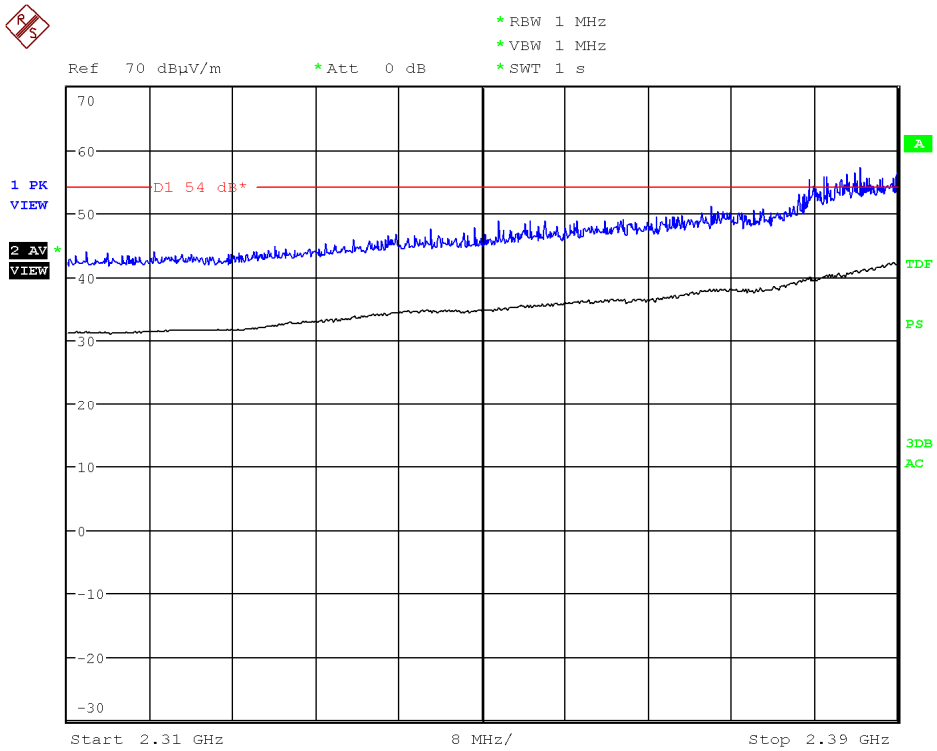


**CHANNEL 2 (2417 MHz).**

**Chain A**

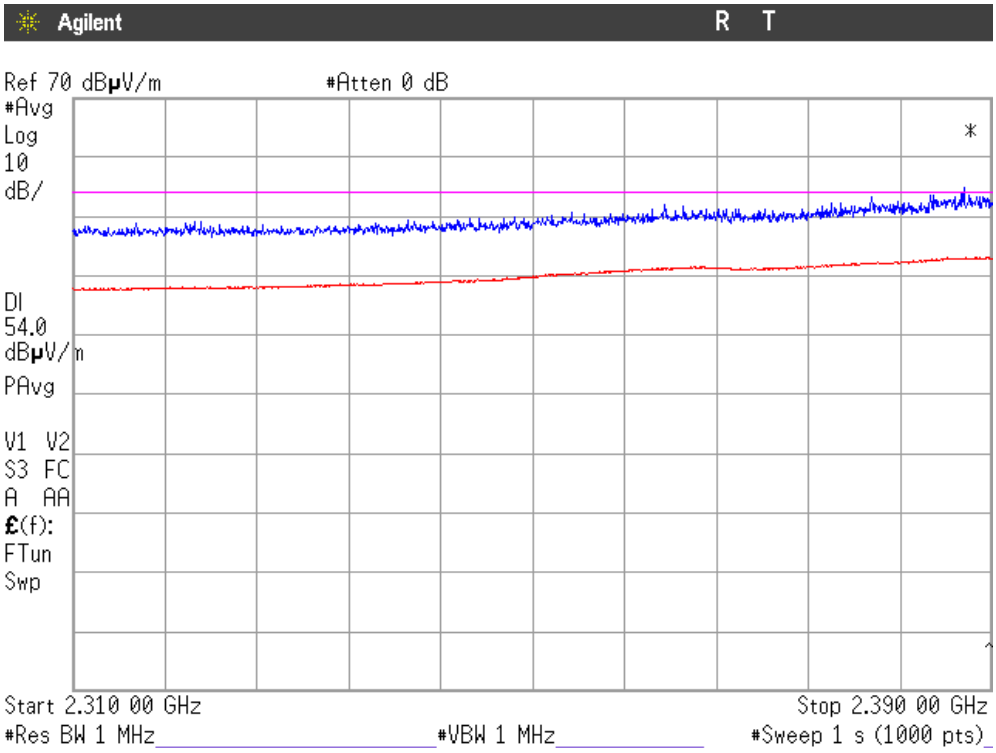



**Chain B**

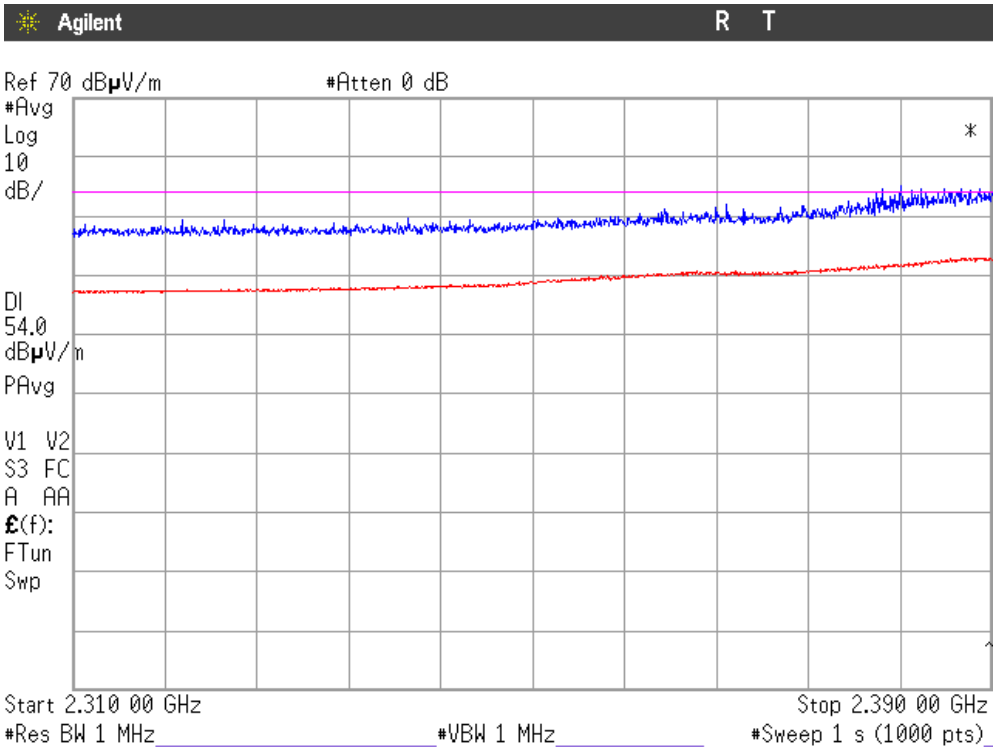


**CHANNEL 6 (2437 MHz).**

**Chain A**



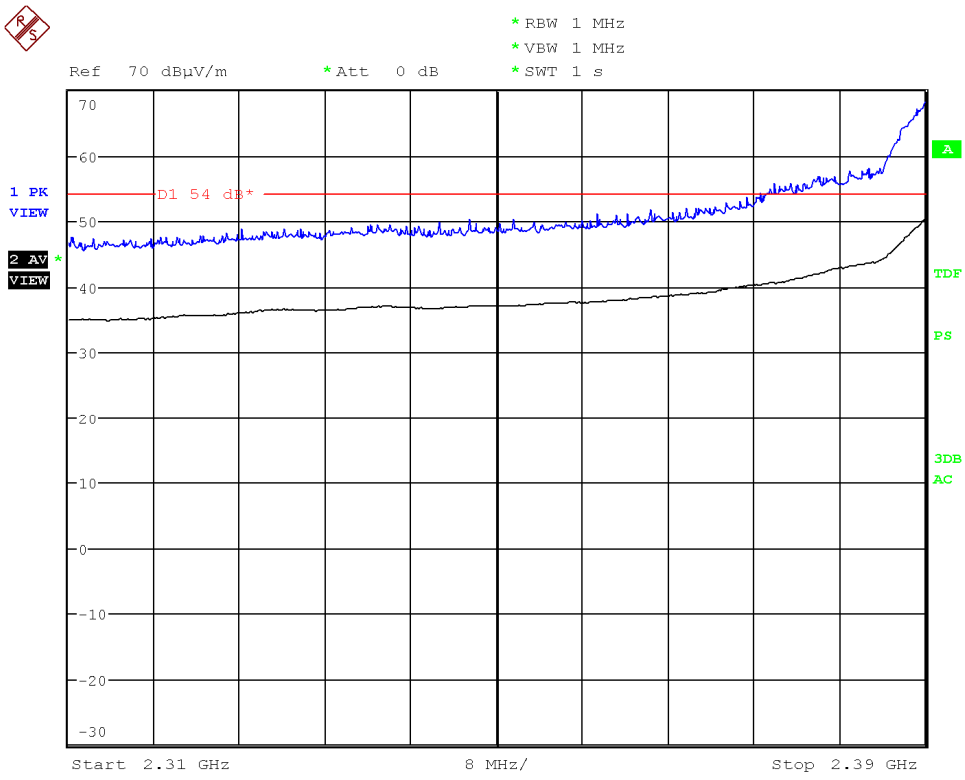

**Chain B**



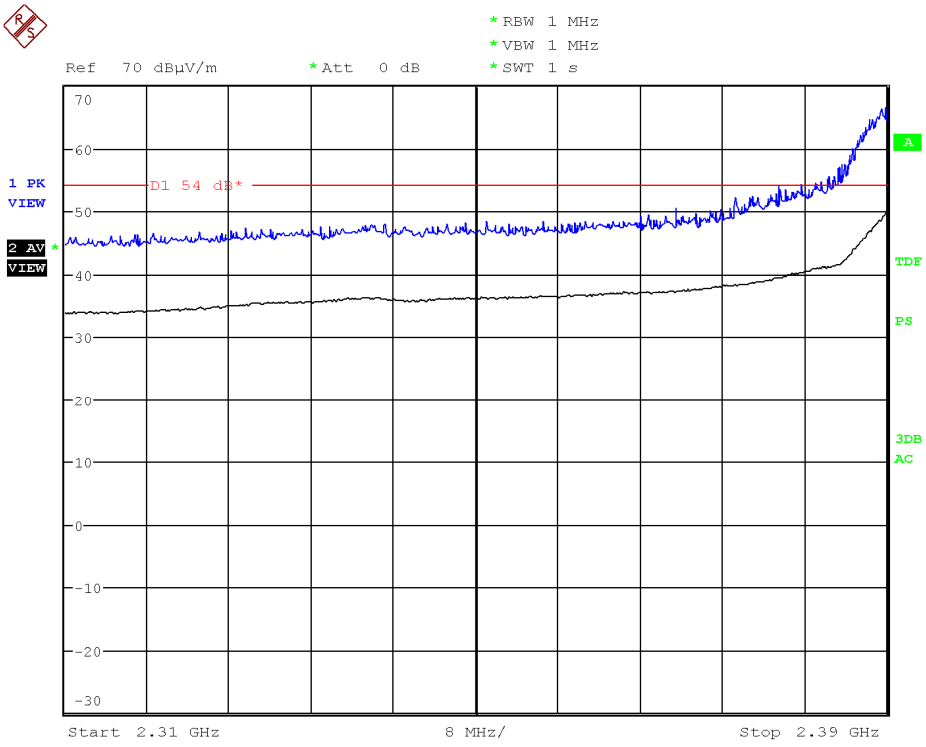
3. WiFi 2.4GHz 802.11 n20 mode

**CHANNEL 1 (2412 MHz).**

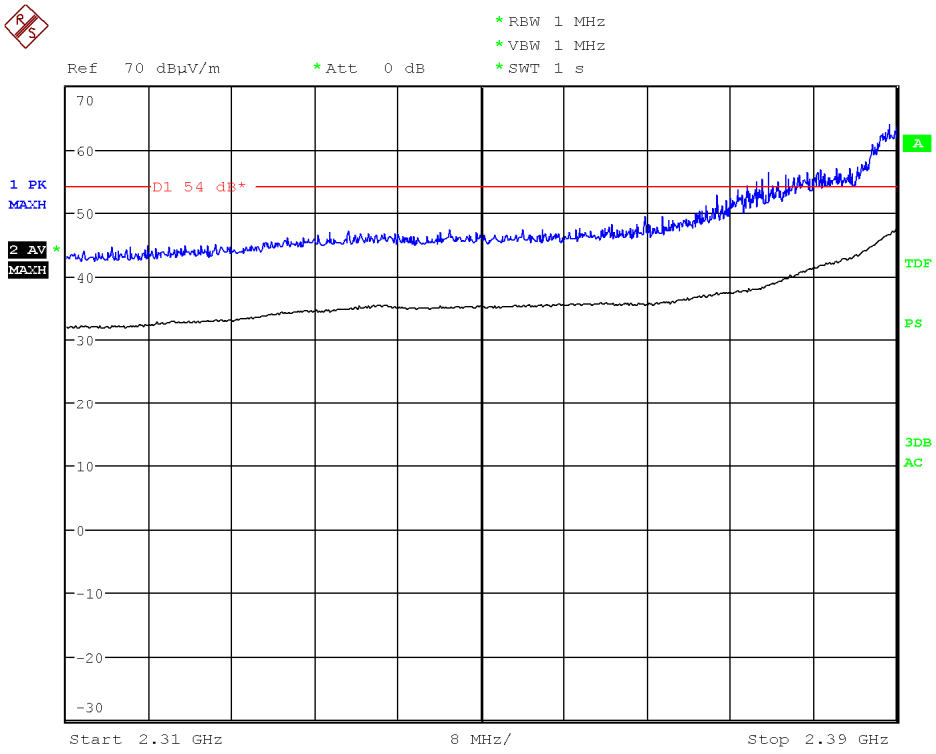
**Chain A**




**Chain B**

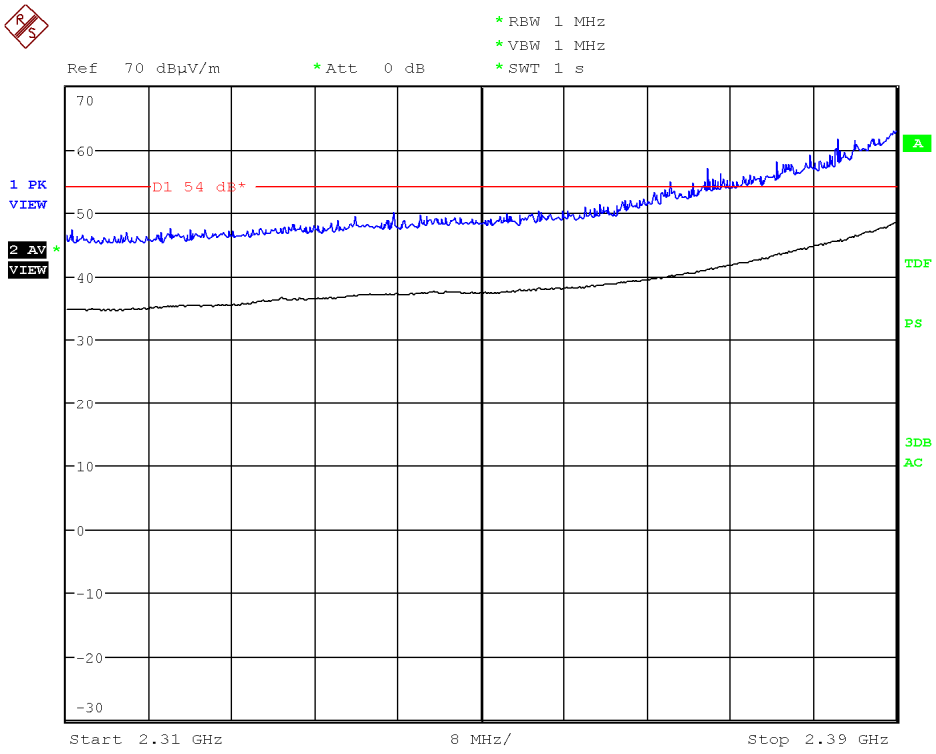


**Chain A+B**

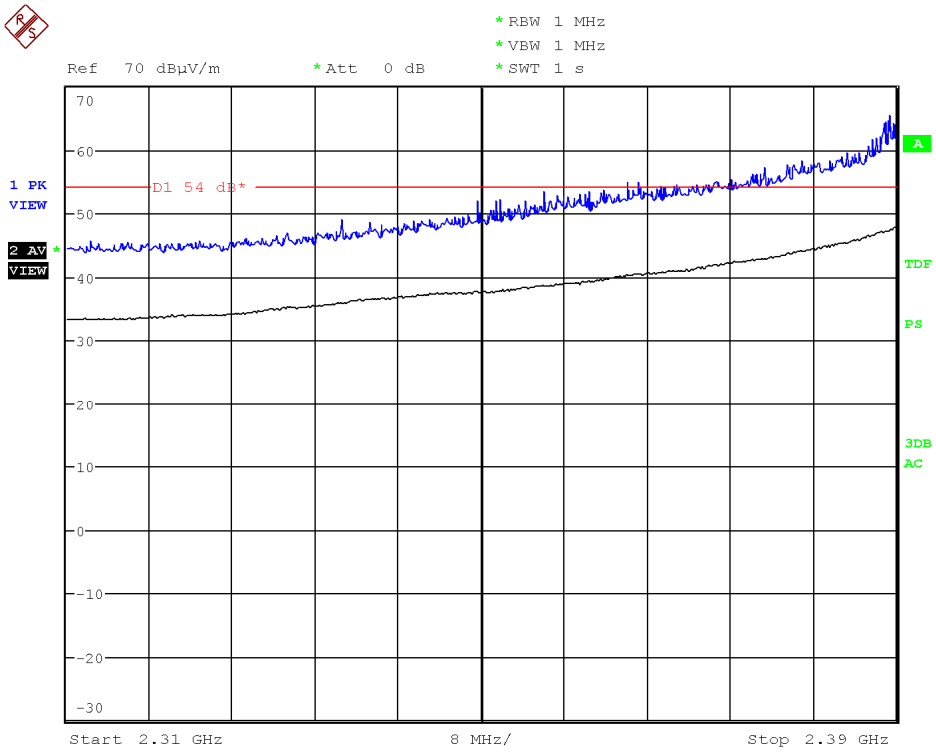



**CHANNEL 2 (2417 MHz).**

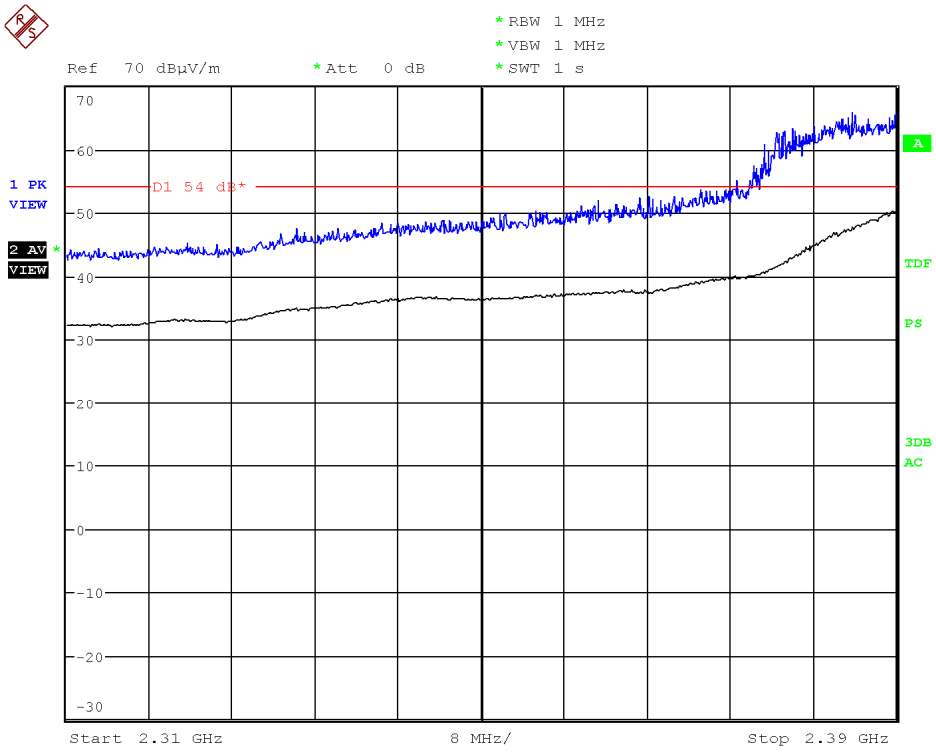
**Chain A**



## Chain B

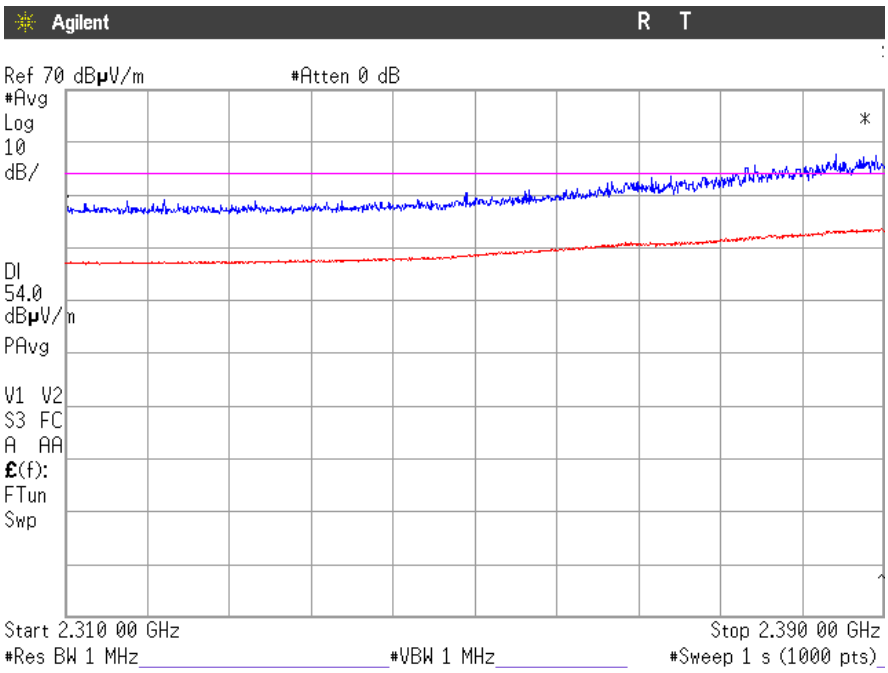



## Chain A+B



**CHANNEL 6 (2437 MHz).**

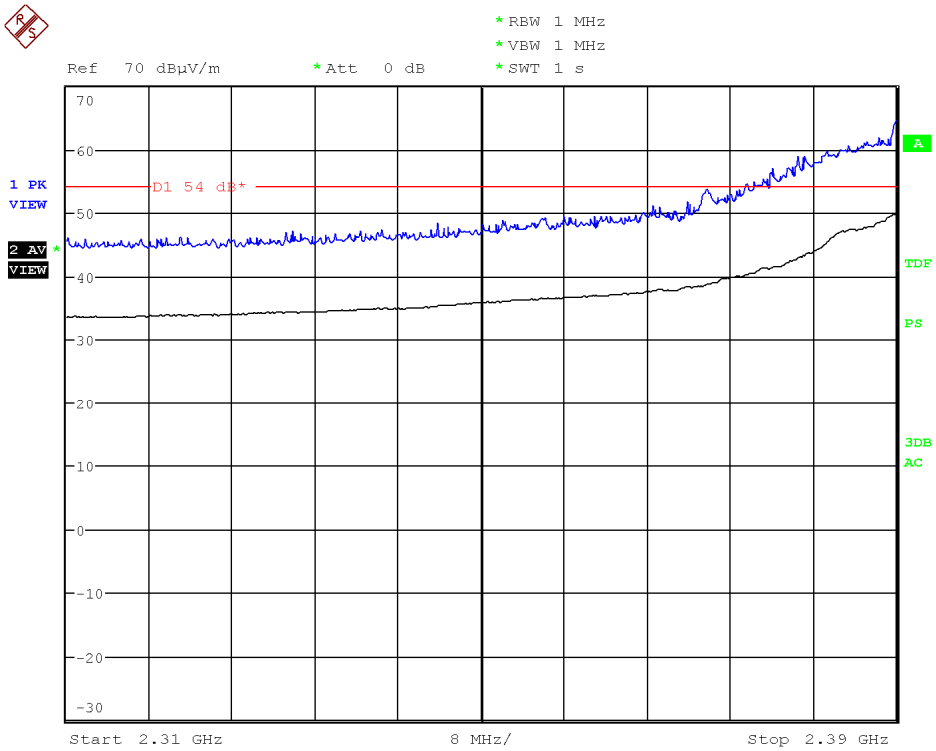
**Chain A+B**



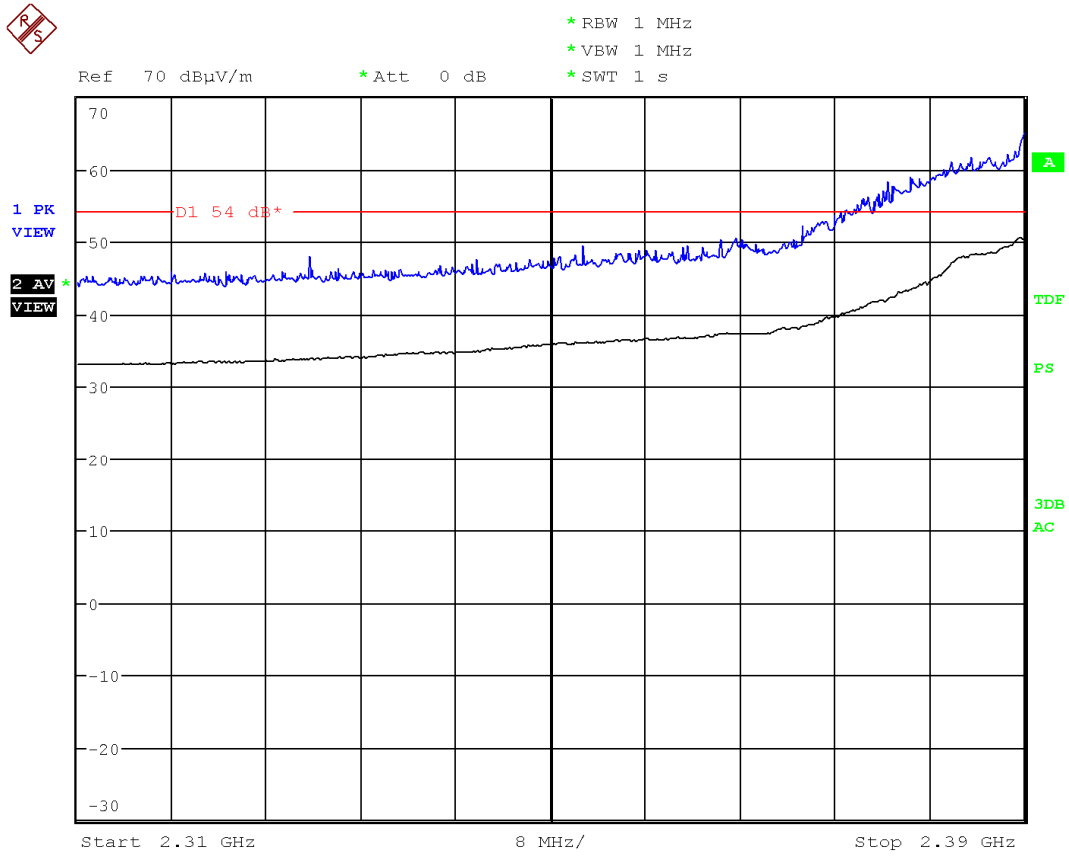

4. WiFi 2.4GHz 802.11 n40 mode

**CHANNEL 3 (2422 MHz).**

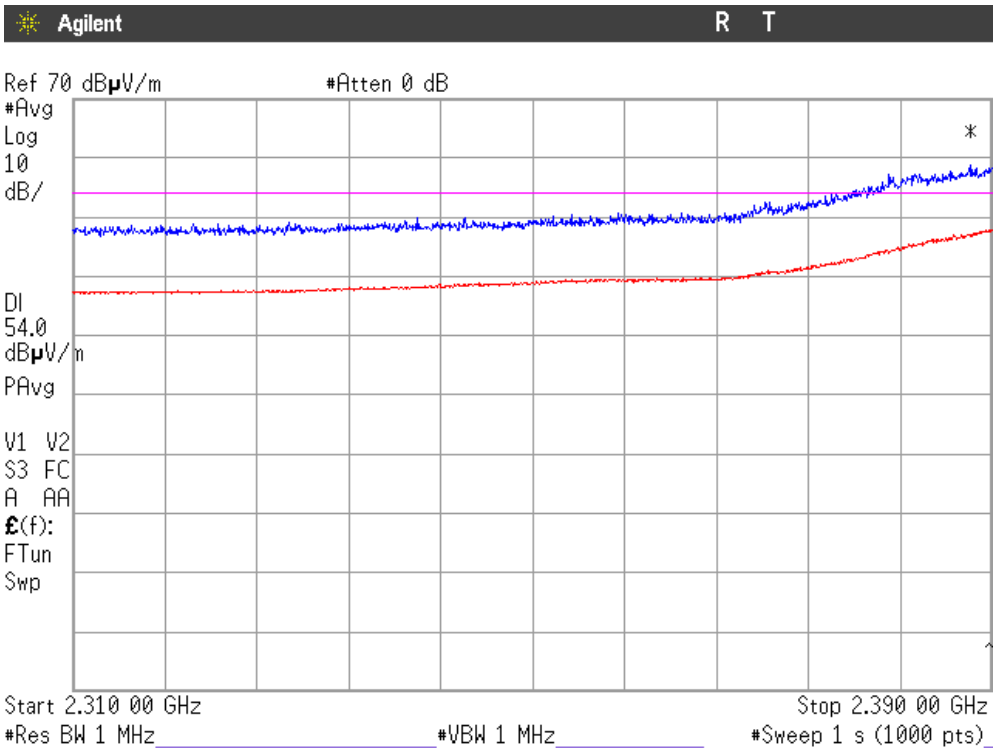
**Chain A**



## Chain B

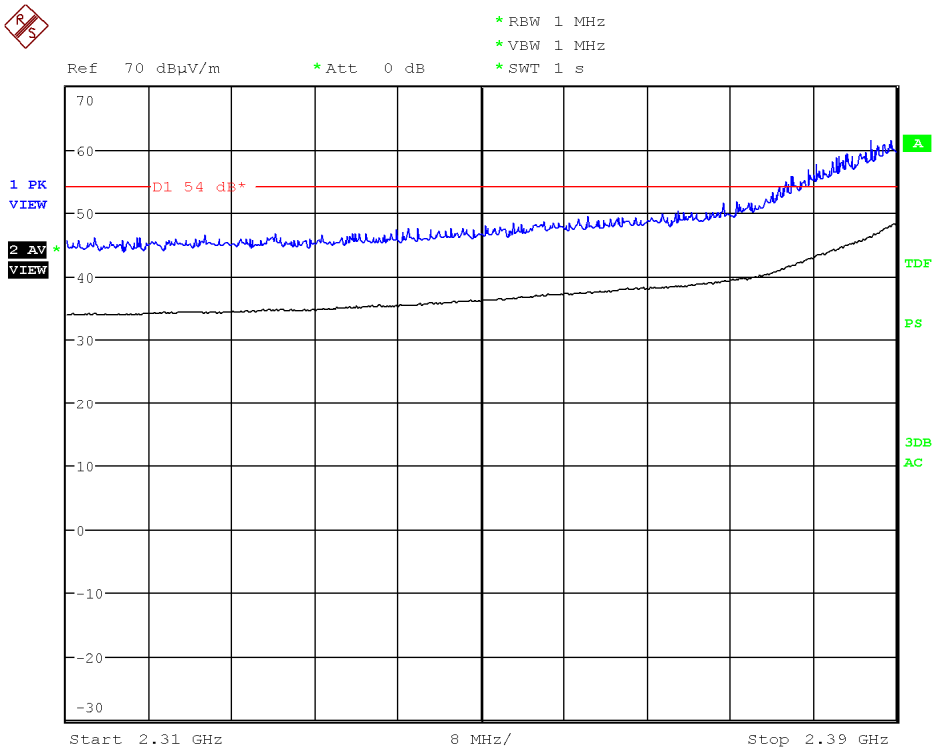



## Chain A+B

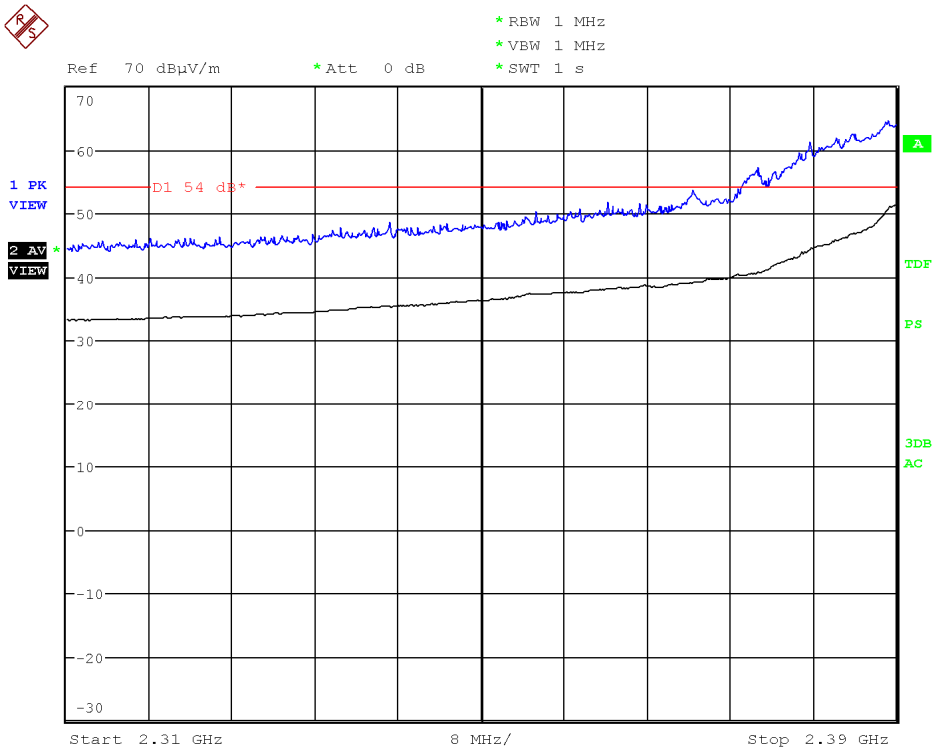


**CHANNEL 4 (2427 MHz).**

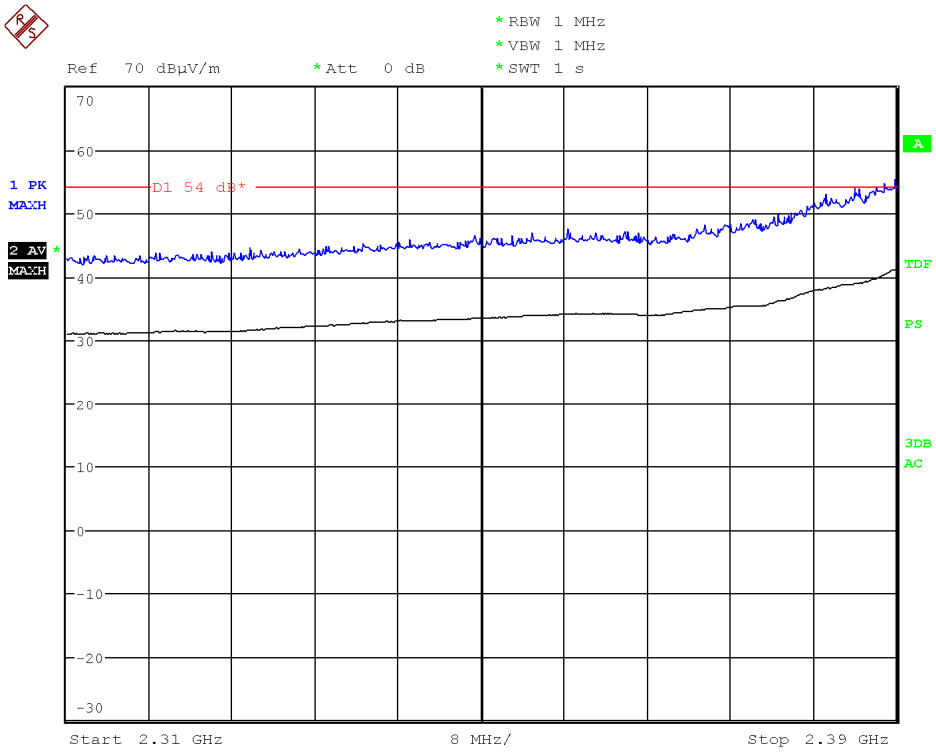
**Chain A**




**Chain B**

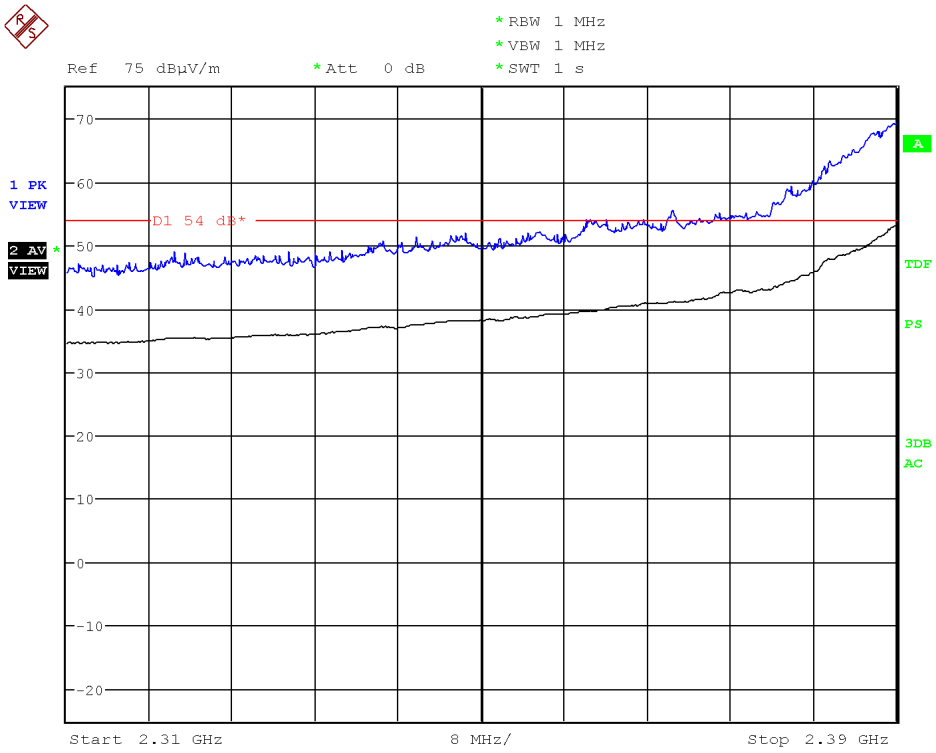


**Chain A+B**

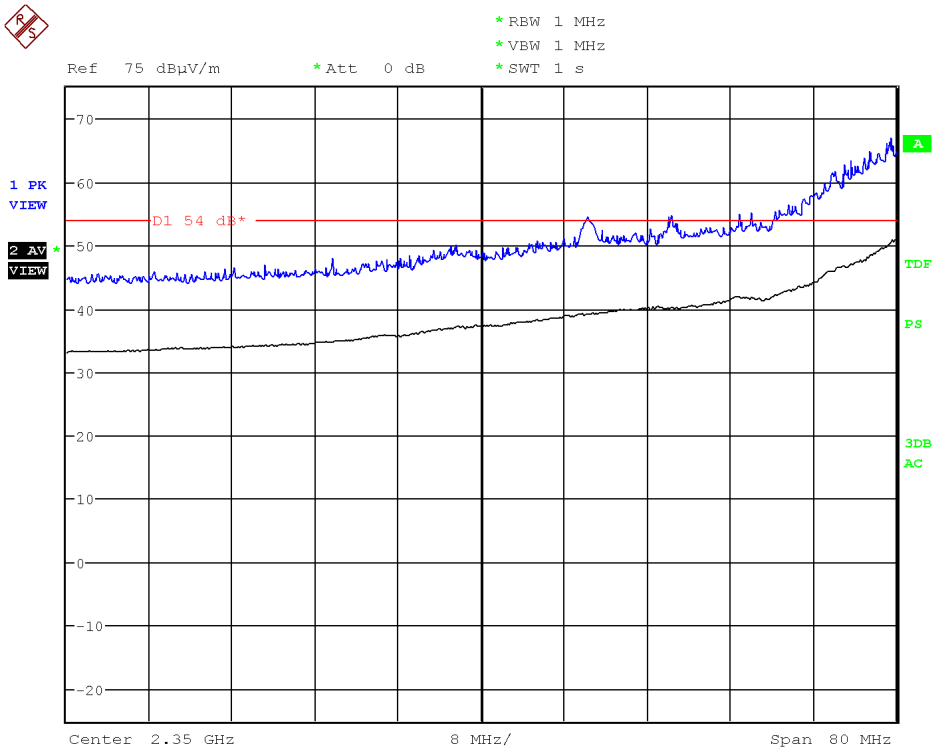



**CHANNEL 5 (2432 MHz).**

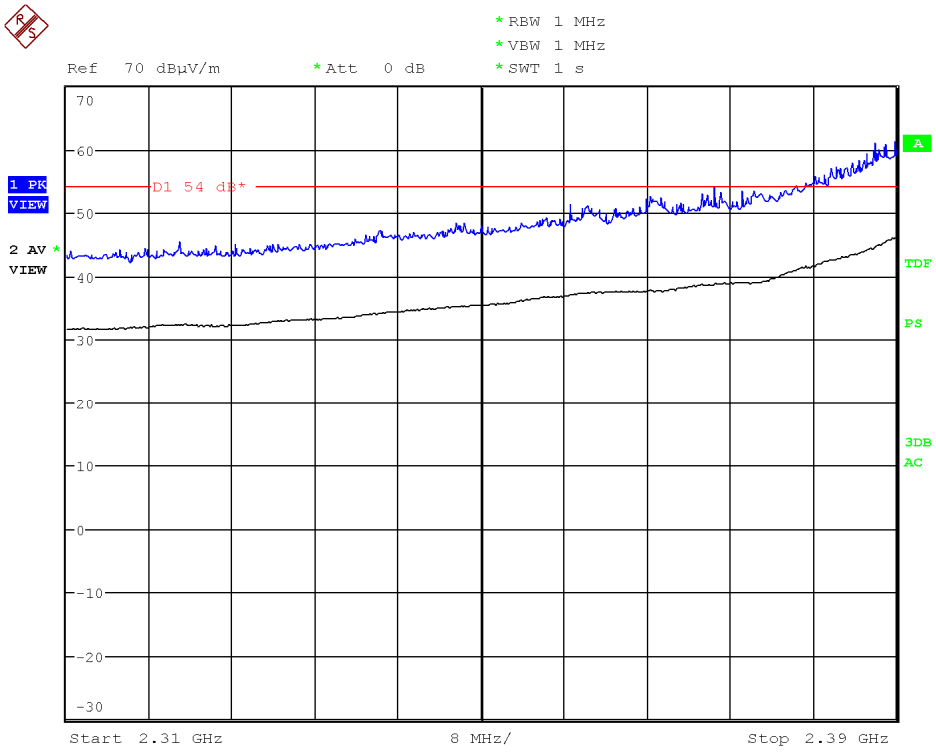
**Chain A**



## Chain B

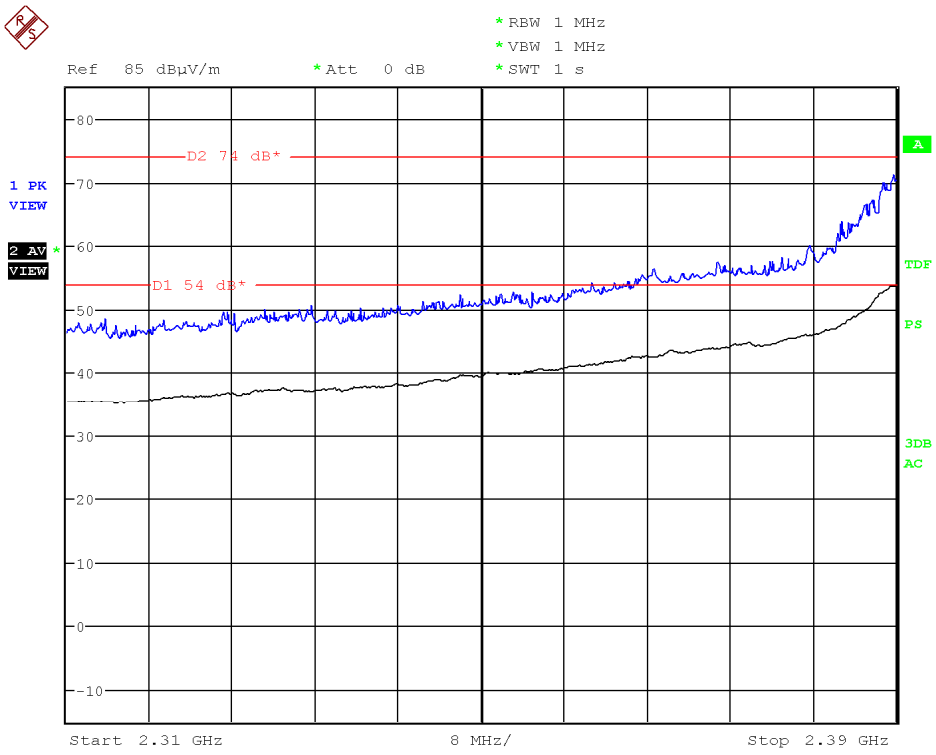



## Chain A+B

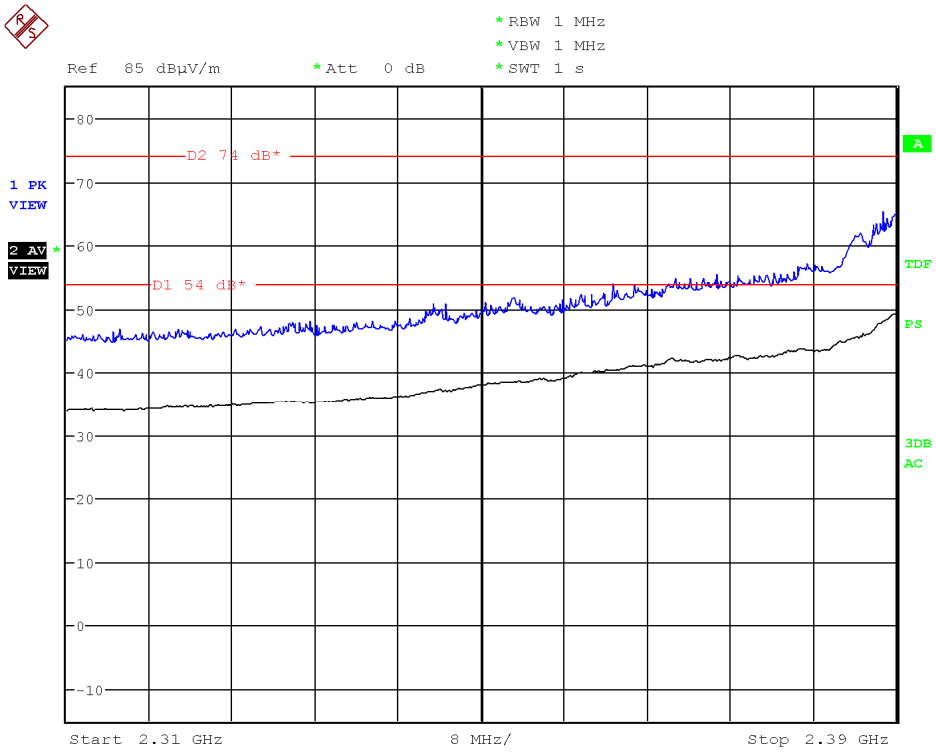


**CHANNEL 6 (2437 MHz).**

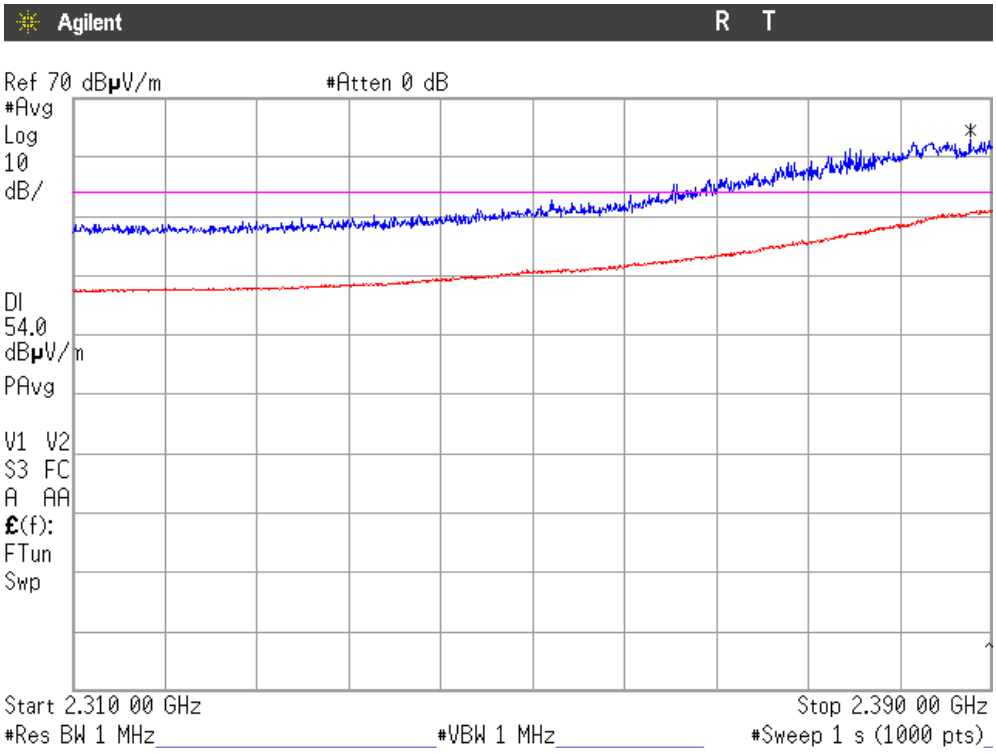
**Chain A**




**Chain B**



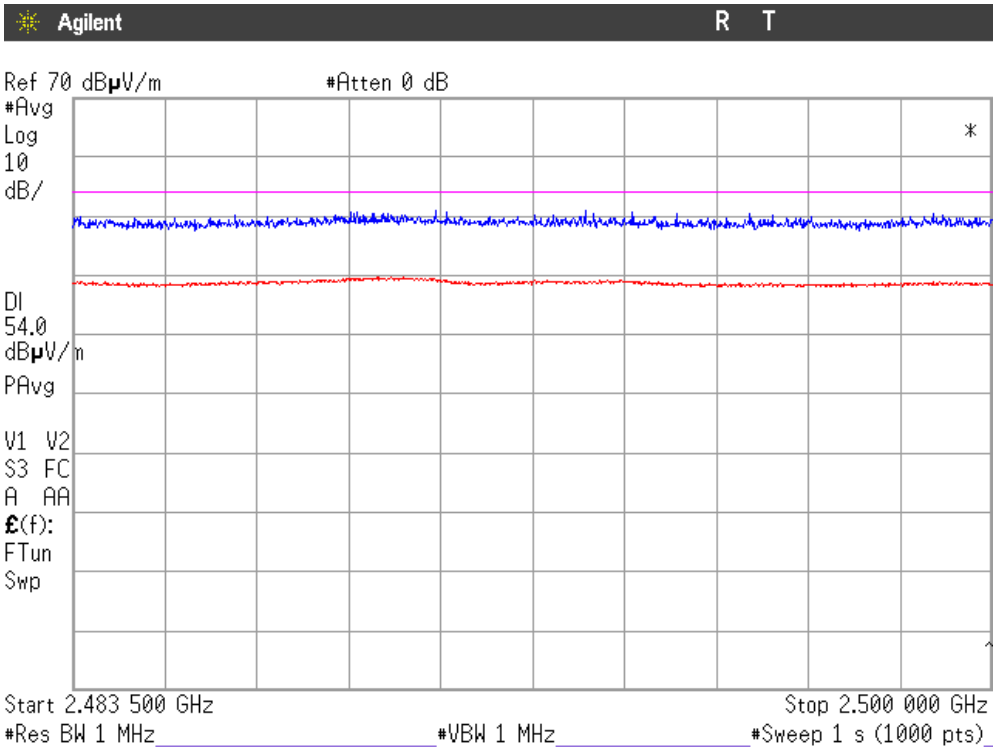
**Chain A+B**


Agilent
R T
Ref 70 dBµV/m
#Atten 0 dB
#Avg
Log
10
dB/
Dl
54.0
dBµV/m
PAvg
V1 V2
S3 FC
A AA
£(f):
FTun
Swp
Start 2.310 00 GHz
Stop 2.390 00 GHz
#Res BW 1 MHz
#VBW 1 MHz
#Sweep 1 s (1000 pts)

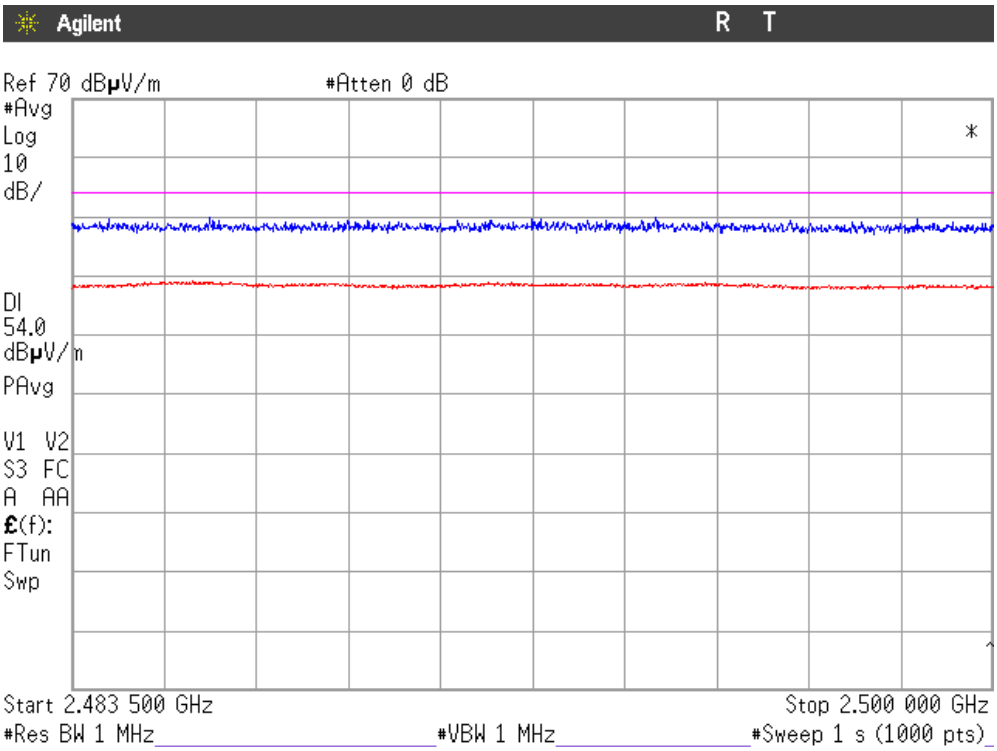
1. WiFi 2.4GHz 802.11 b mode

**CHANNEL 1 (2412 MHz).**

**Chain A**

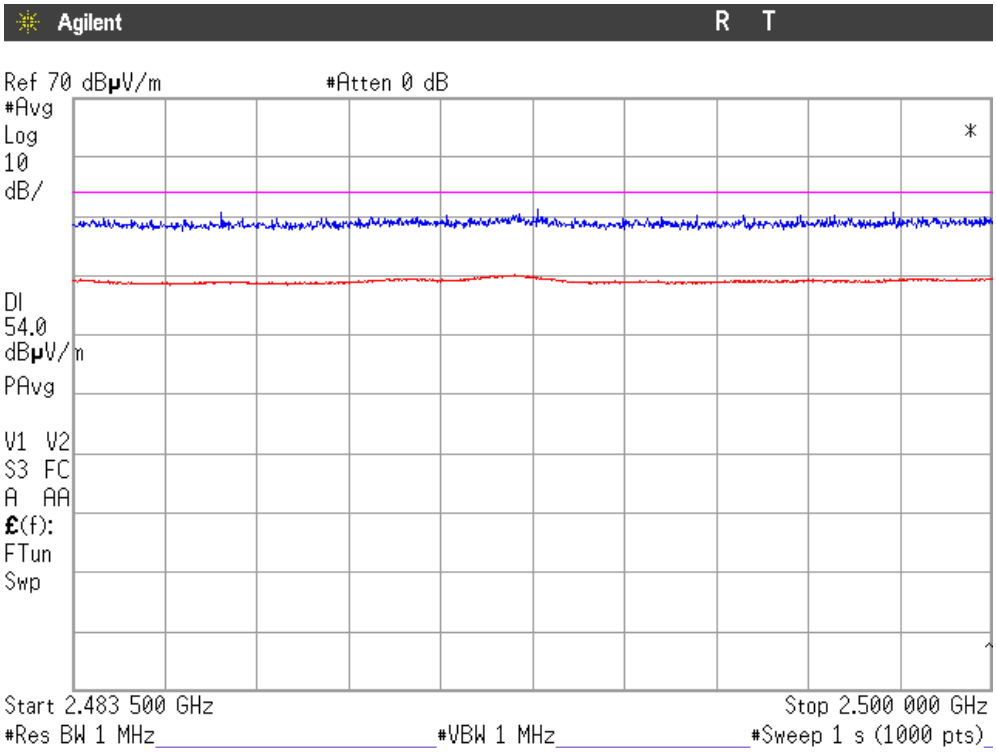



**Chain B**

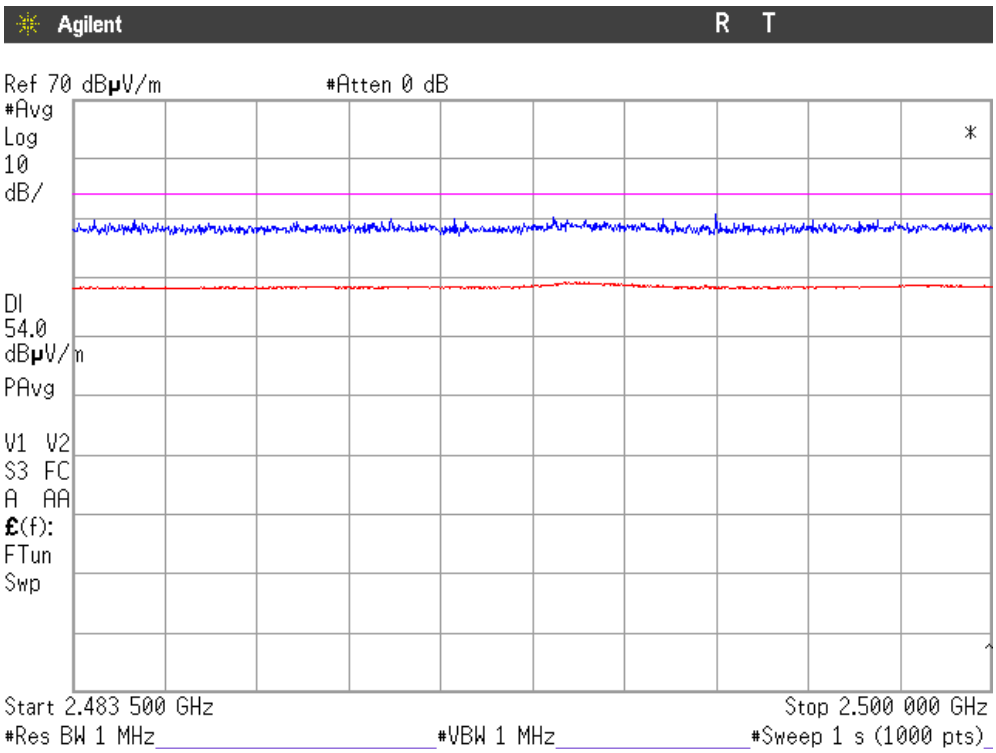


**CHANNEL 6 (2437 MHz).**

**Chain A**

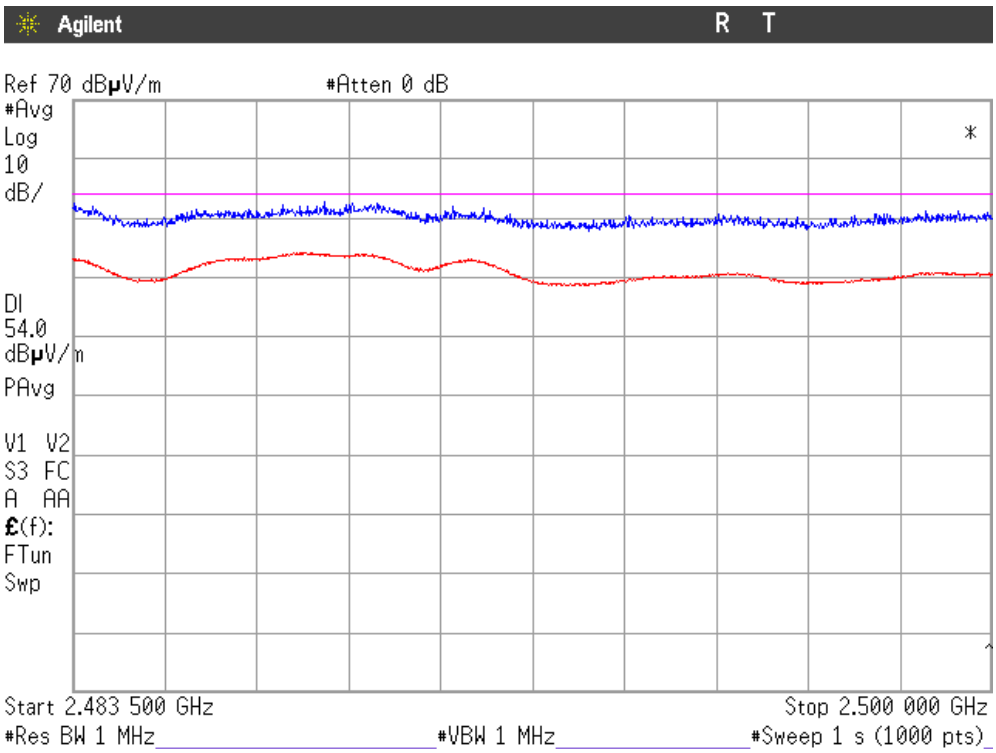



**Chain B**

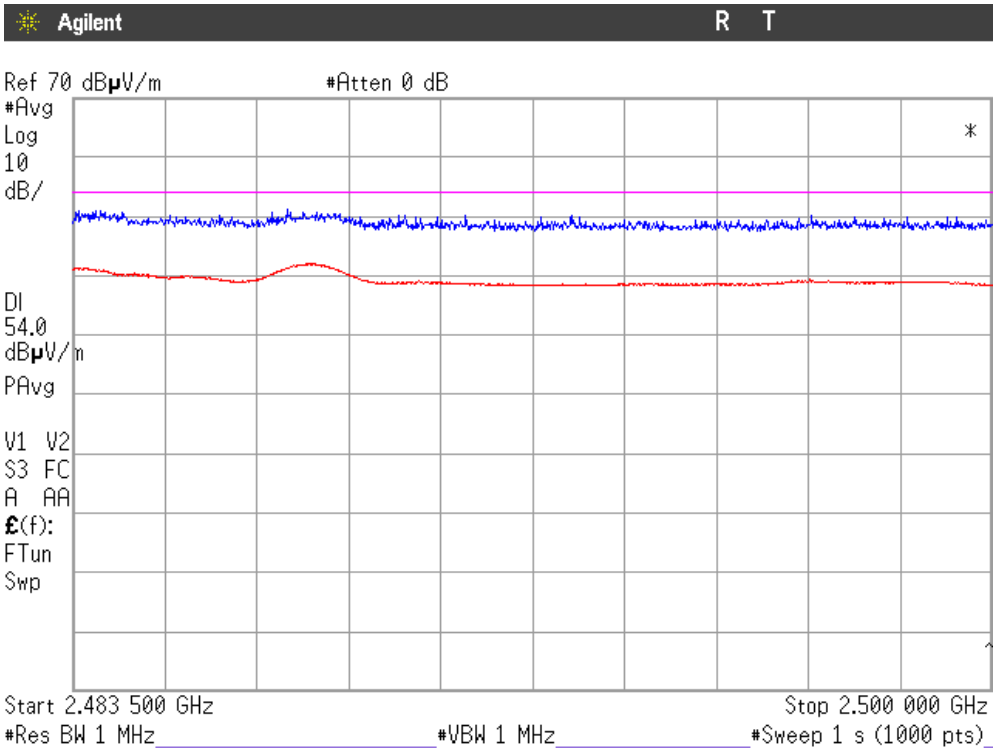


**CHANNEL 11 (2462 MHz).**

**Chain A**



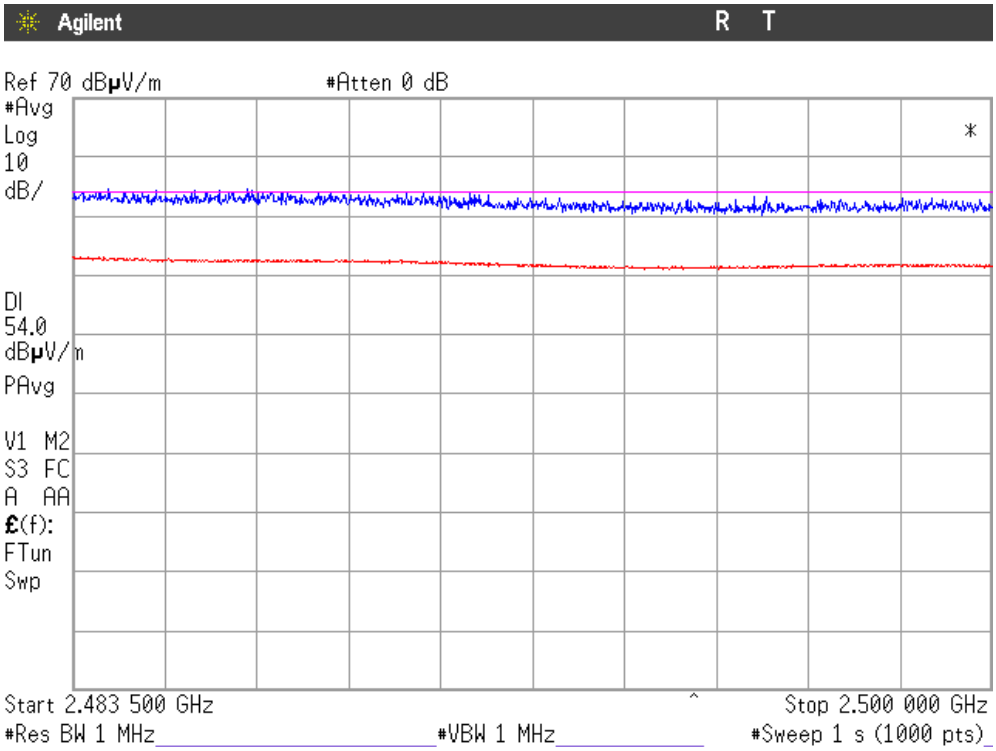

**Chain B**



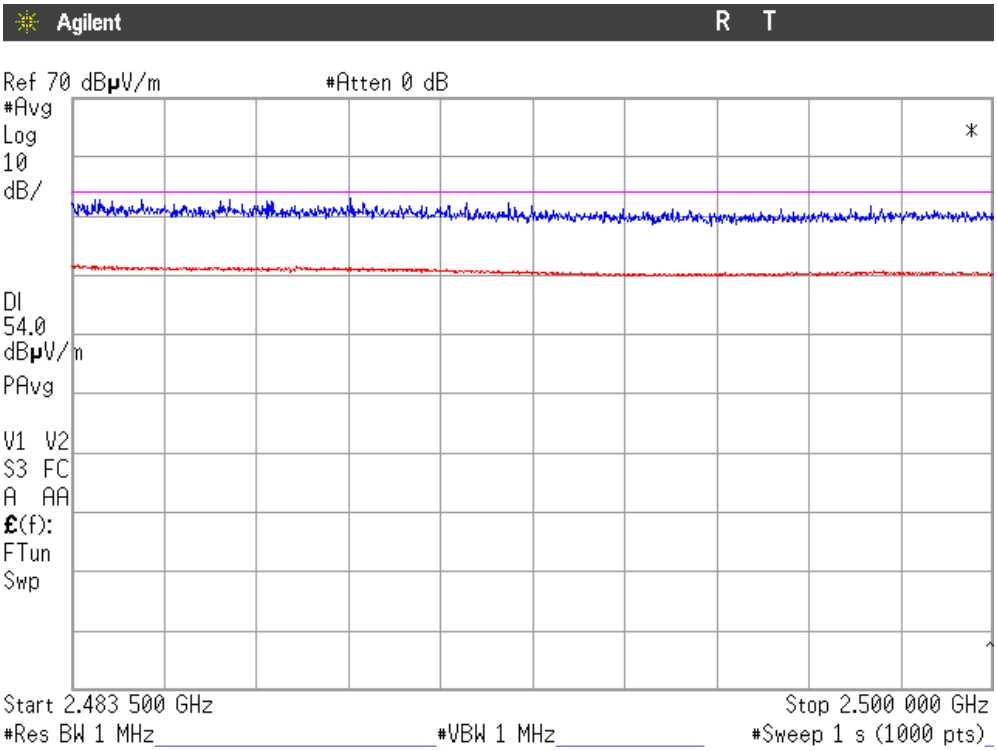
2. WiFi 2.4GHz 802.11 g mode

**CHANNEL 6 (2437 MHz).**

**Chain A**

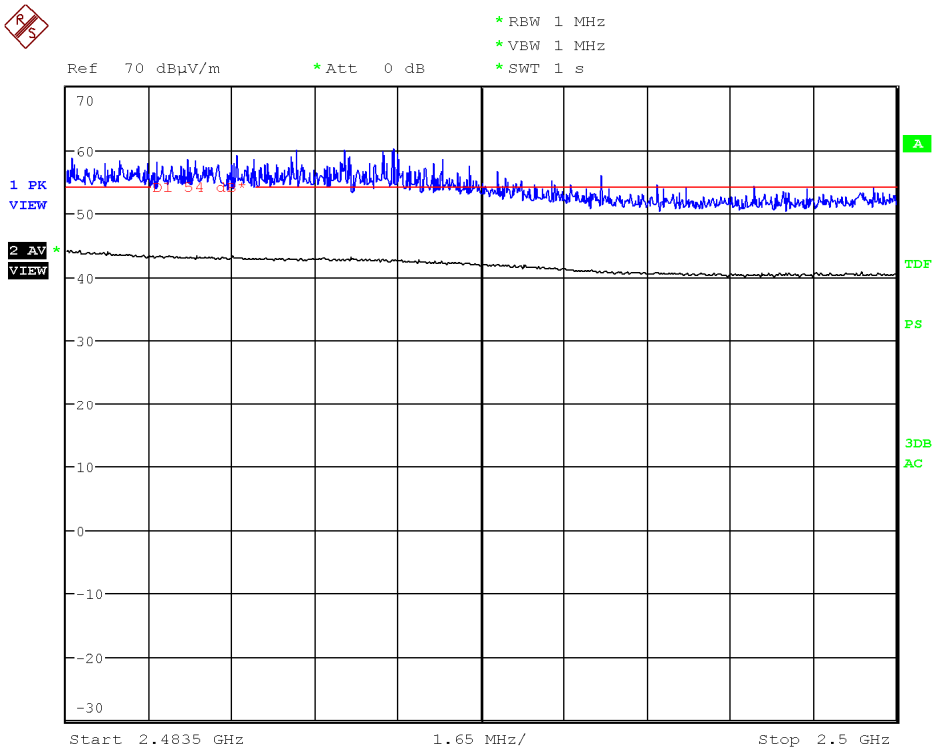



**Chain B**

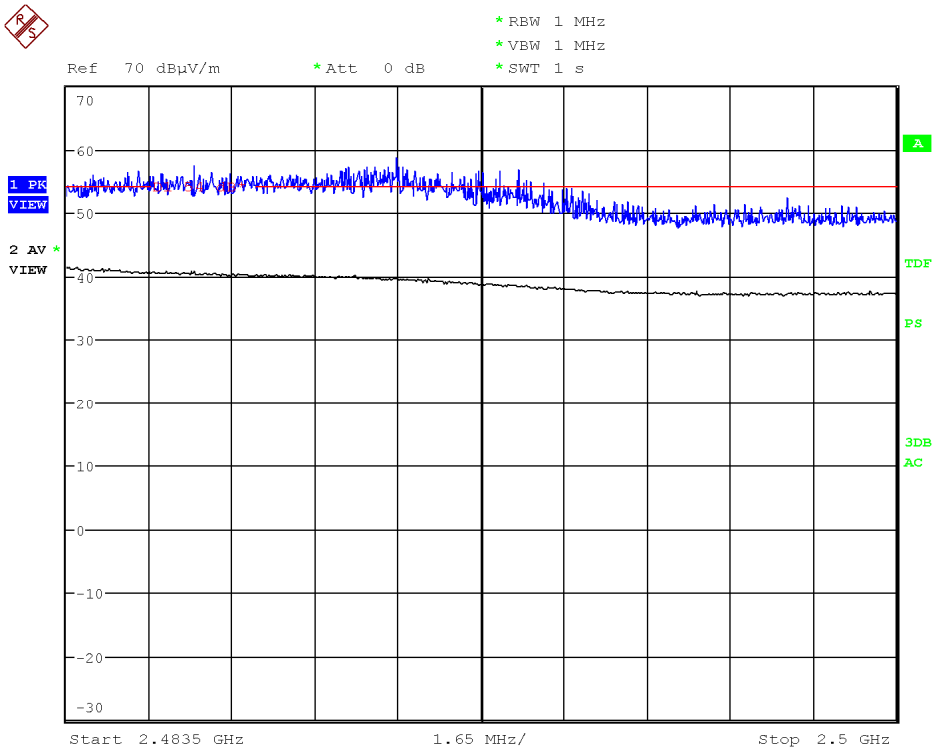


**CHANNEL 10 (2457 MHz).**

**Chain A**

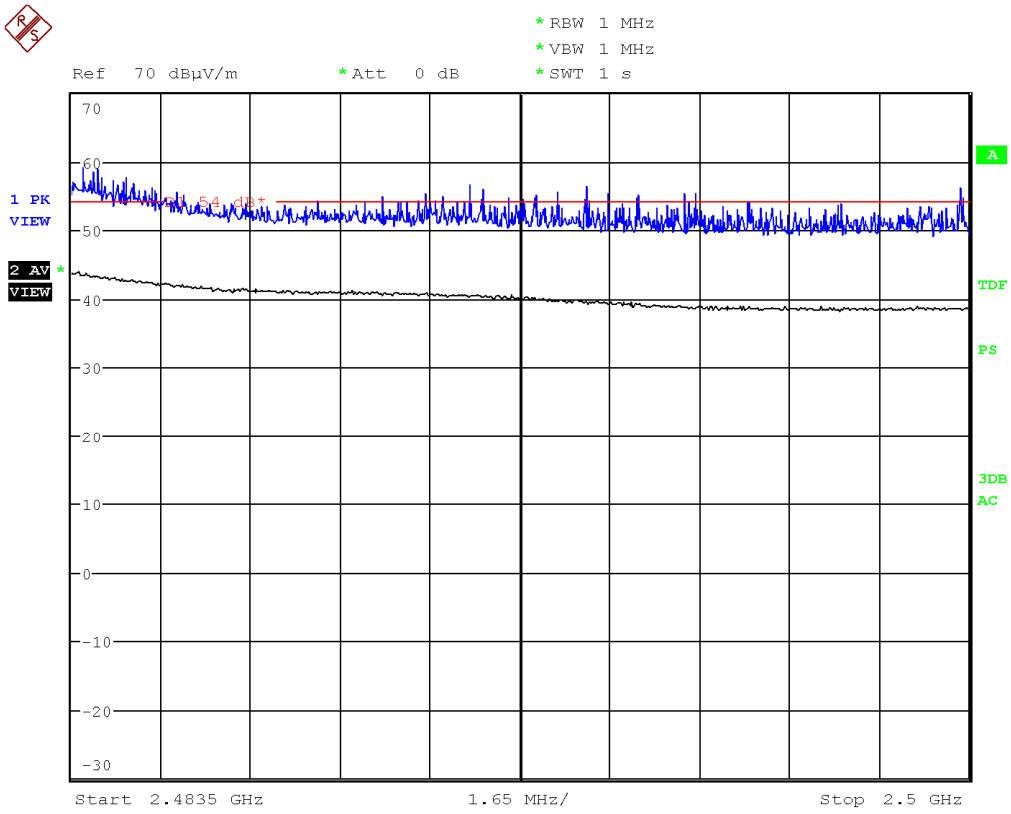



**Chain B**

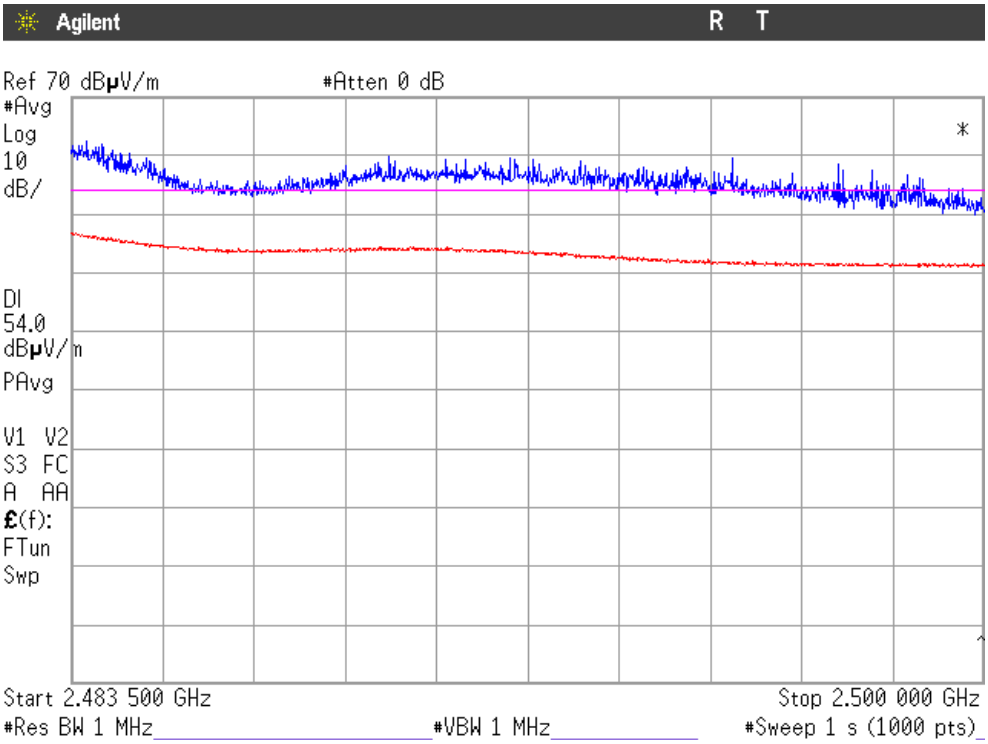


**CHANNEL 11 (2462 MHz).**

**Chain A**



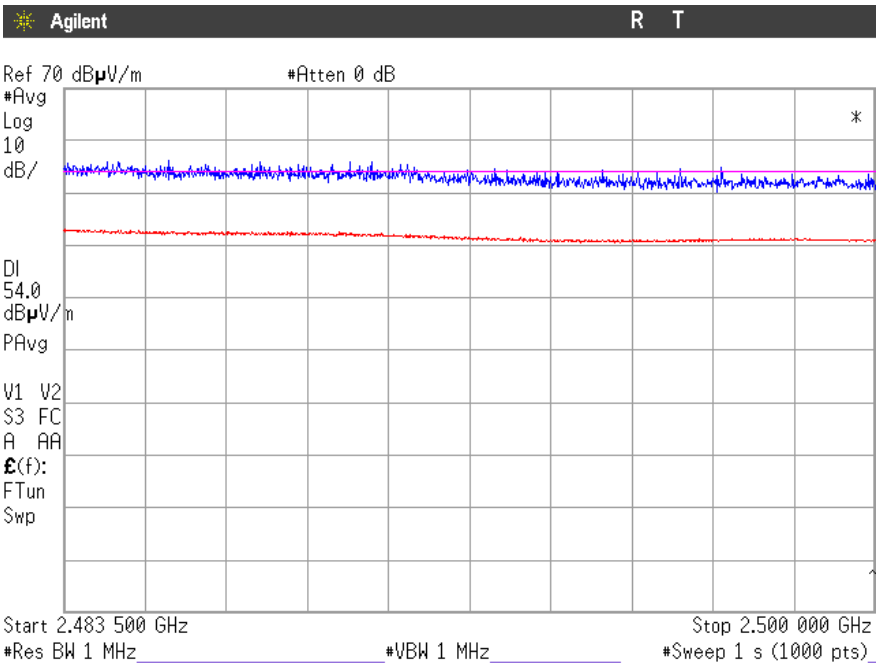

**Chain B**



3. WiFi 2.4GHz 802.11 n20 mode

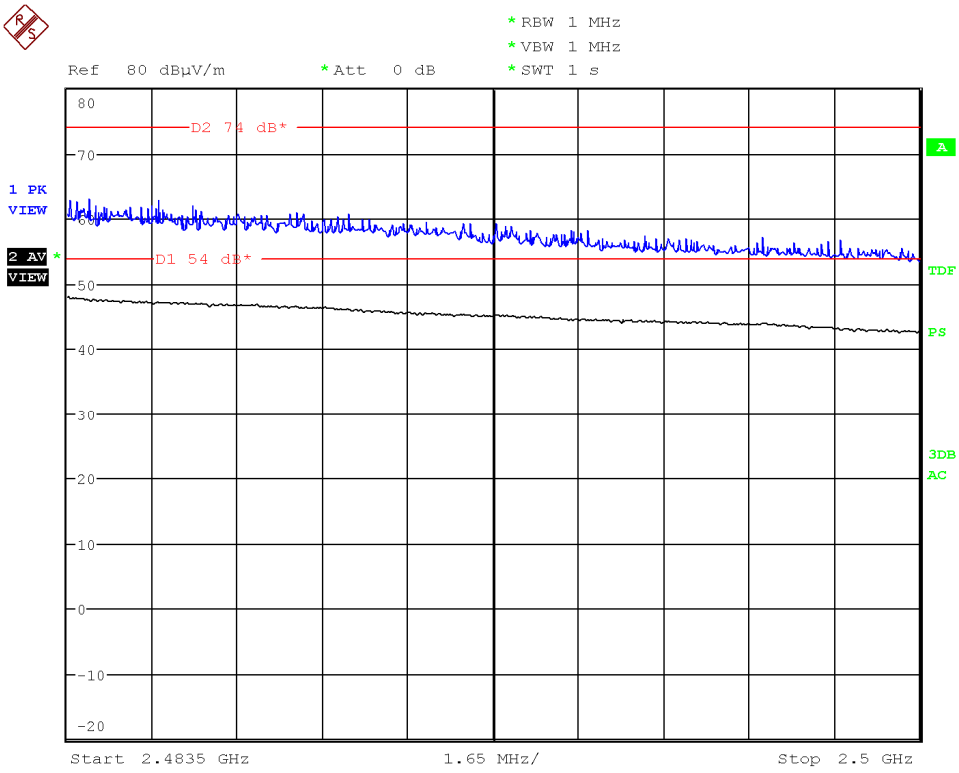
**CHANNEL 6 (2437 MHz).**

**Chain A+B**

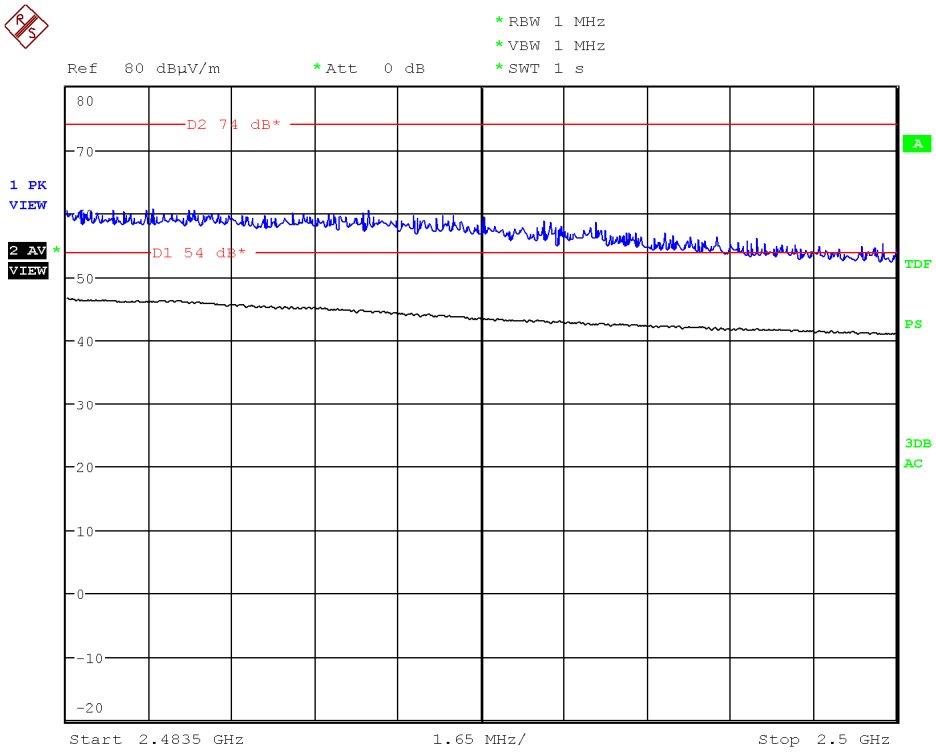



**CHANNEL 10 (2457 MHz).**

**Chain A**

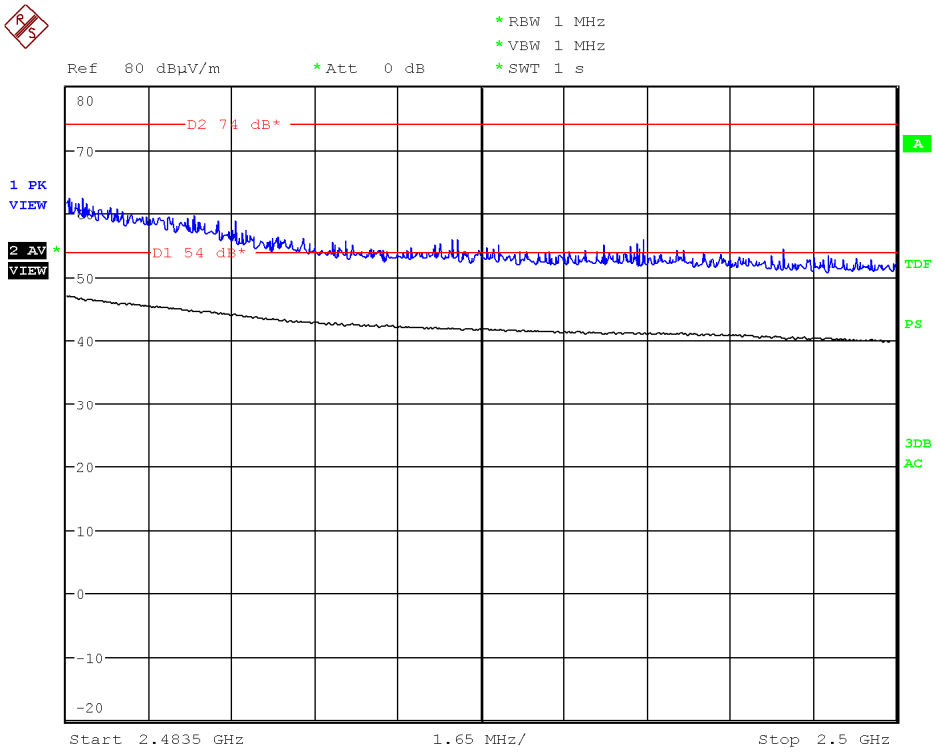


**Chain B**

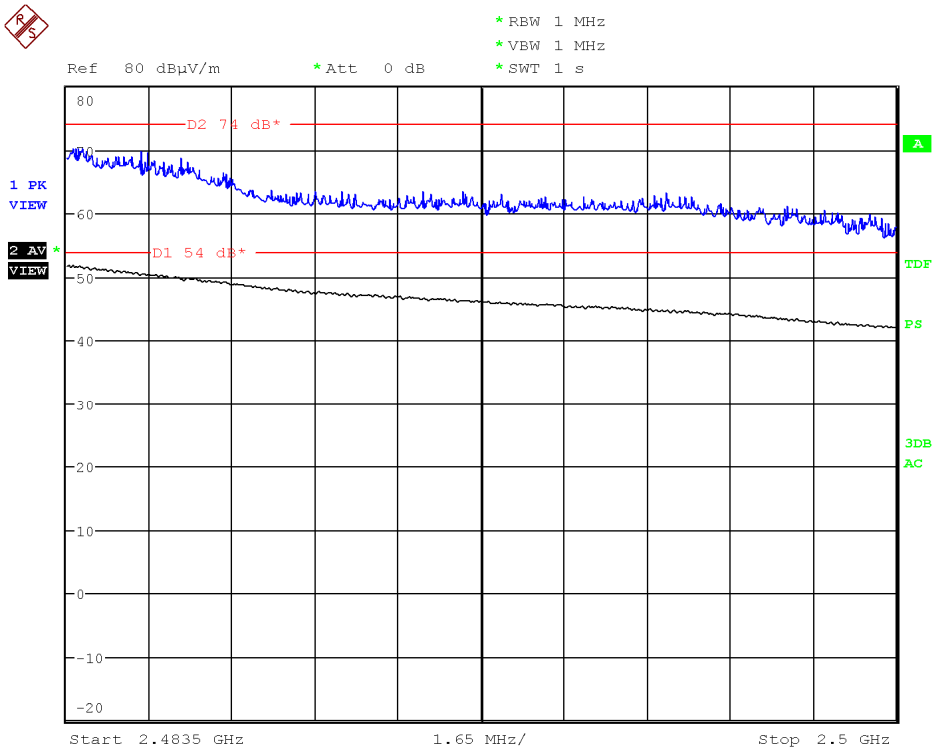



**CHANNEL 11 (2462 MHz).**

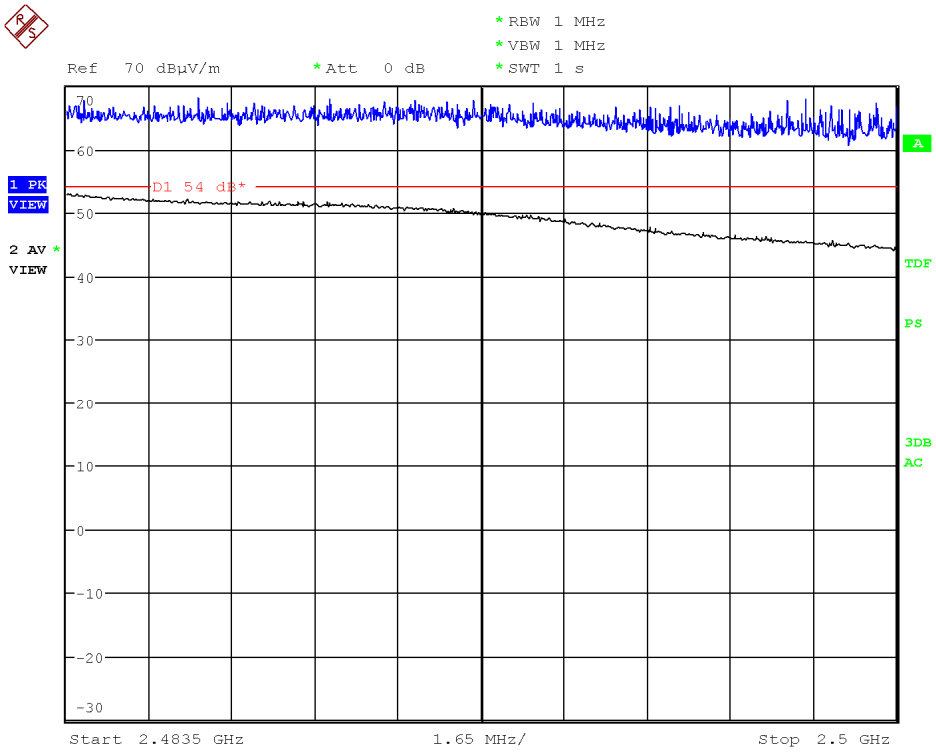
**Chain A**



## Chain B



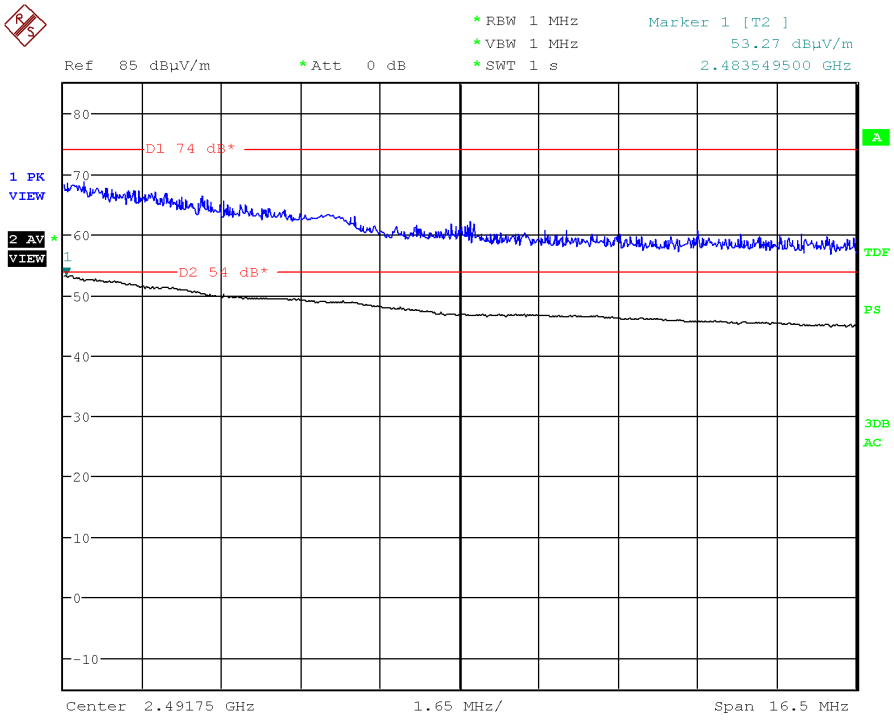

## Chain A+B



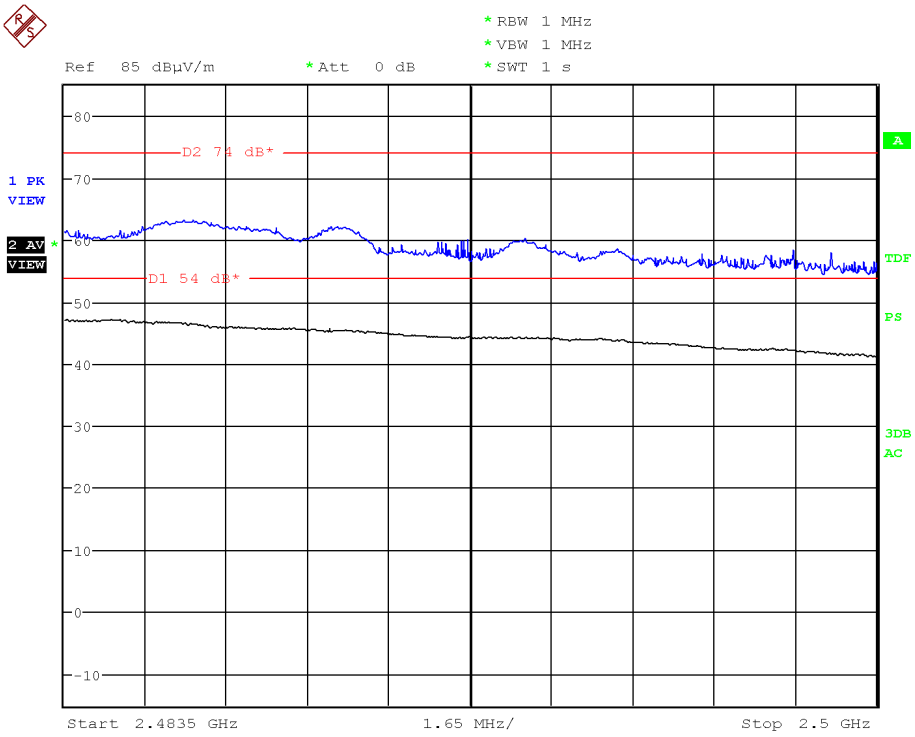
4. WiFi 2.4GHz 802.11 n40 mode

**CHANNEL 6 (2437 MHz).**

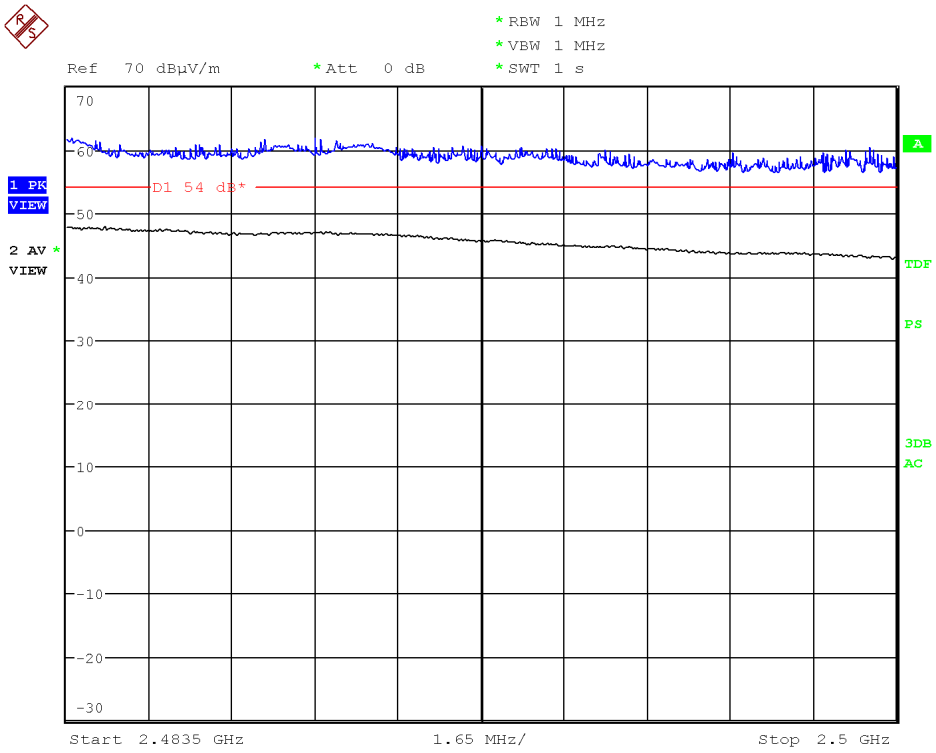
**Chain A**




**Chain B**

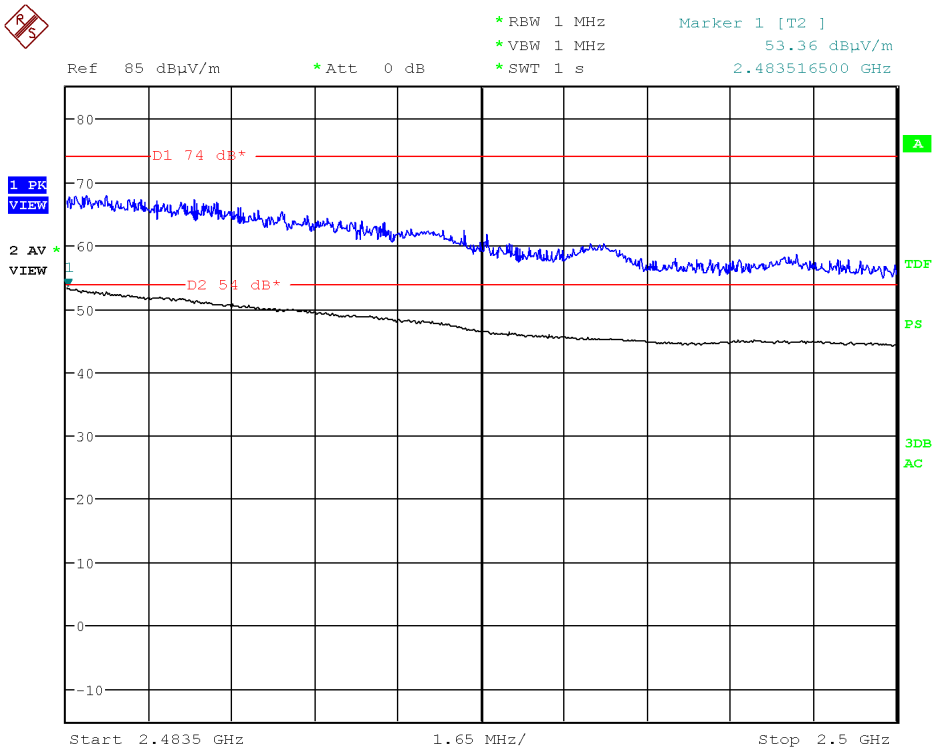


**Chain A+B**

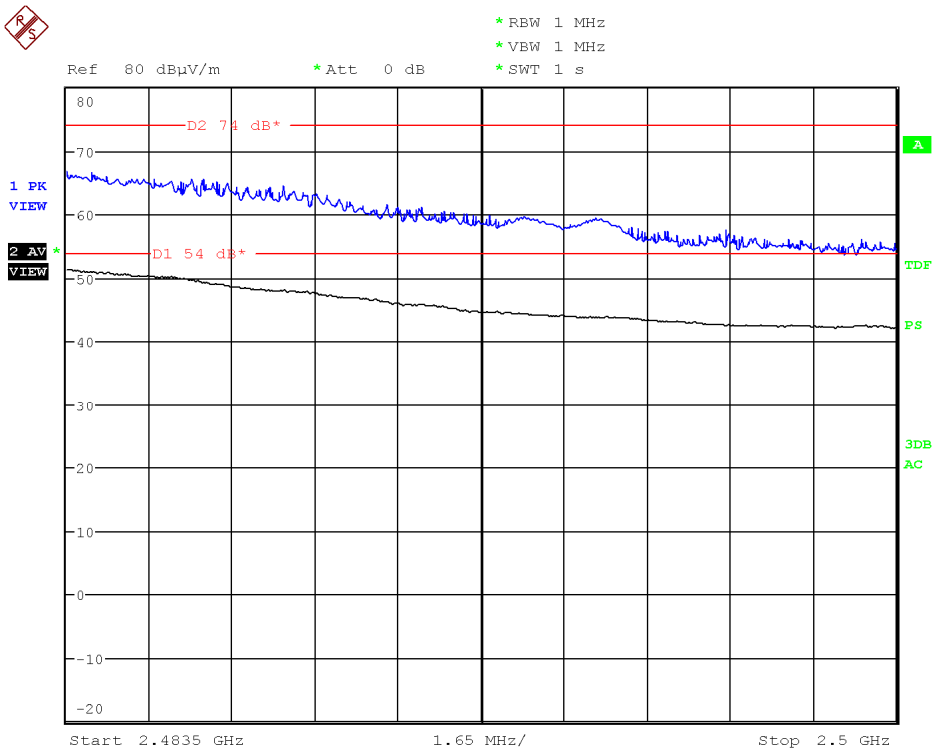



**CHANNEL 7 (2442 MHz).**

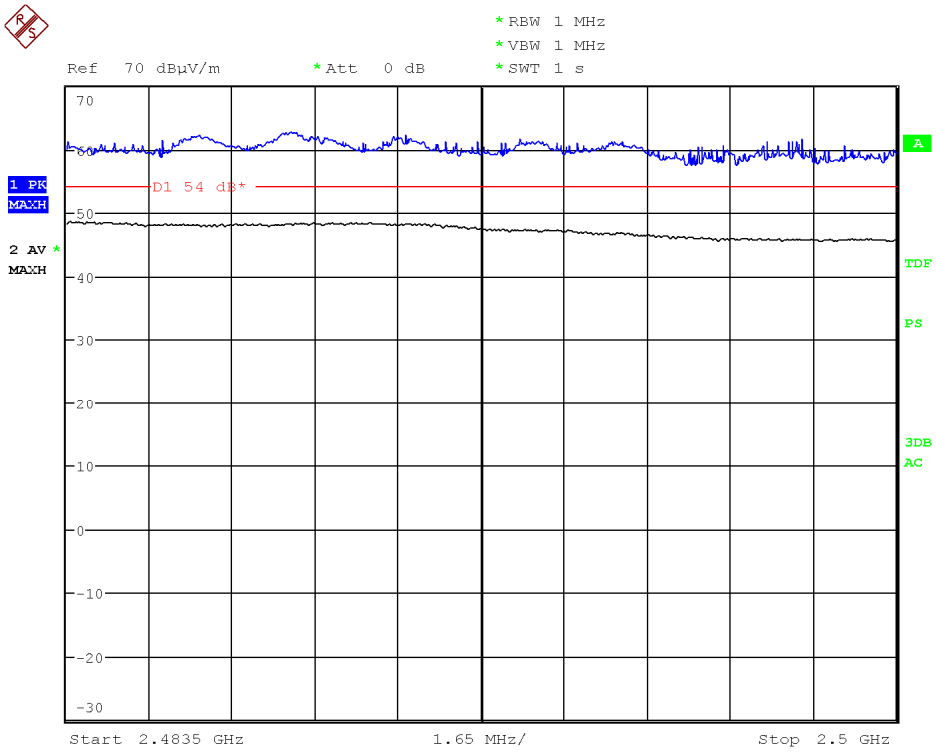
**Chain A**



## Chain B

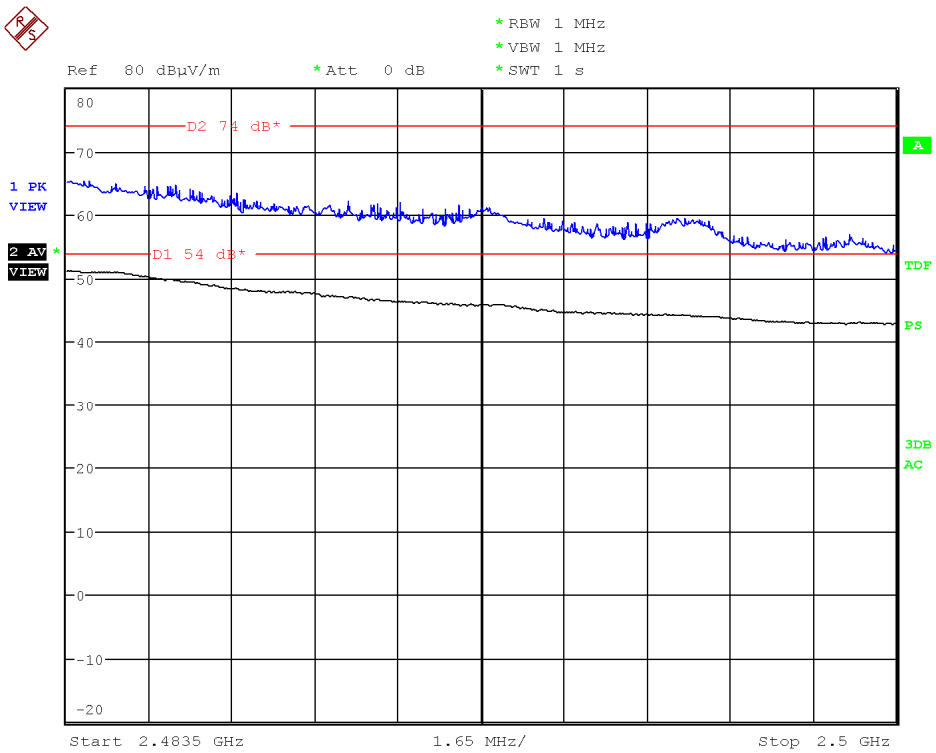



## Chain A+B

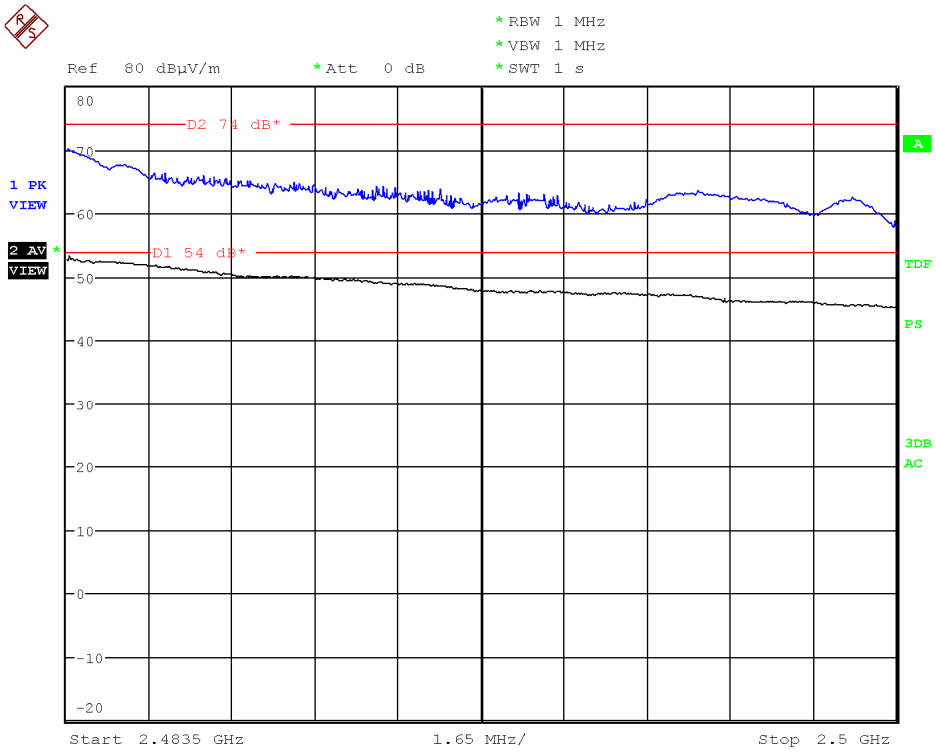


**CHANNEL 8 (2447 MHz).**

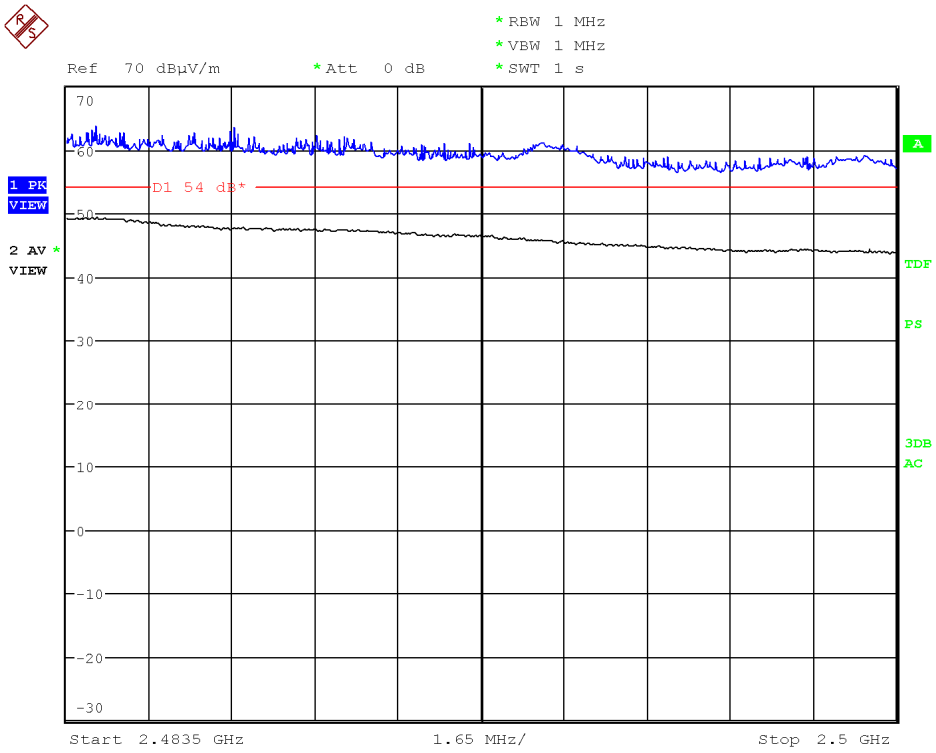
**Chain A**




**Chain B**

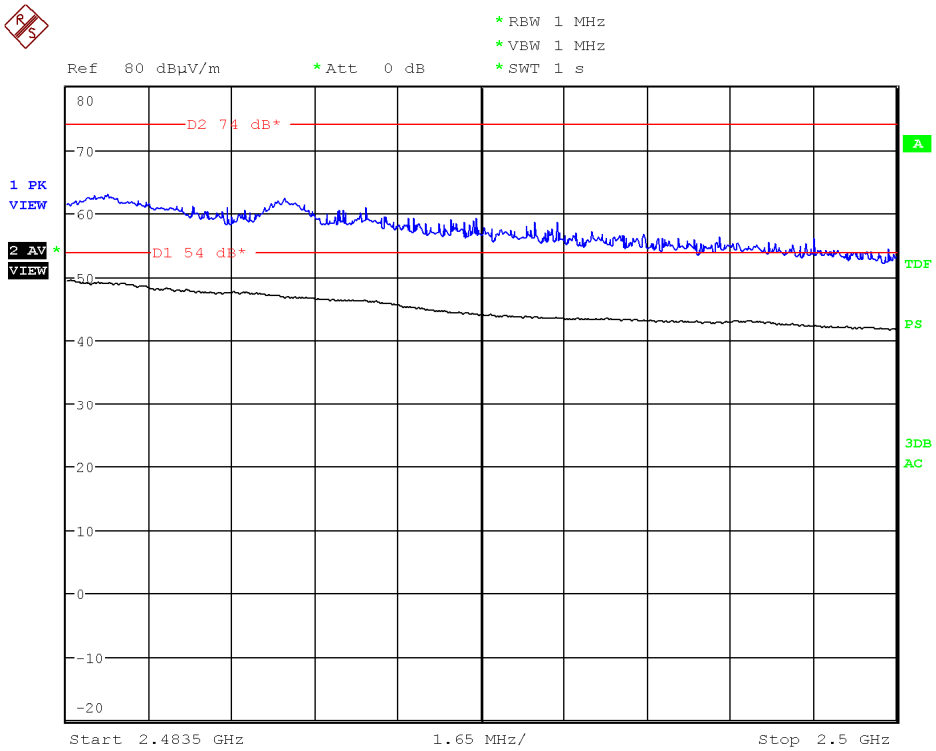


**Chain A+B**

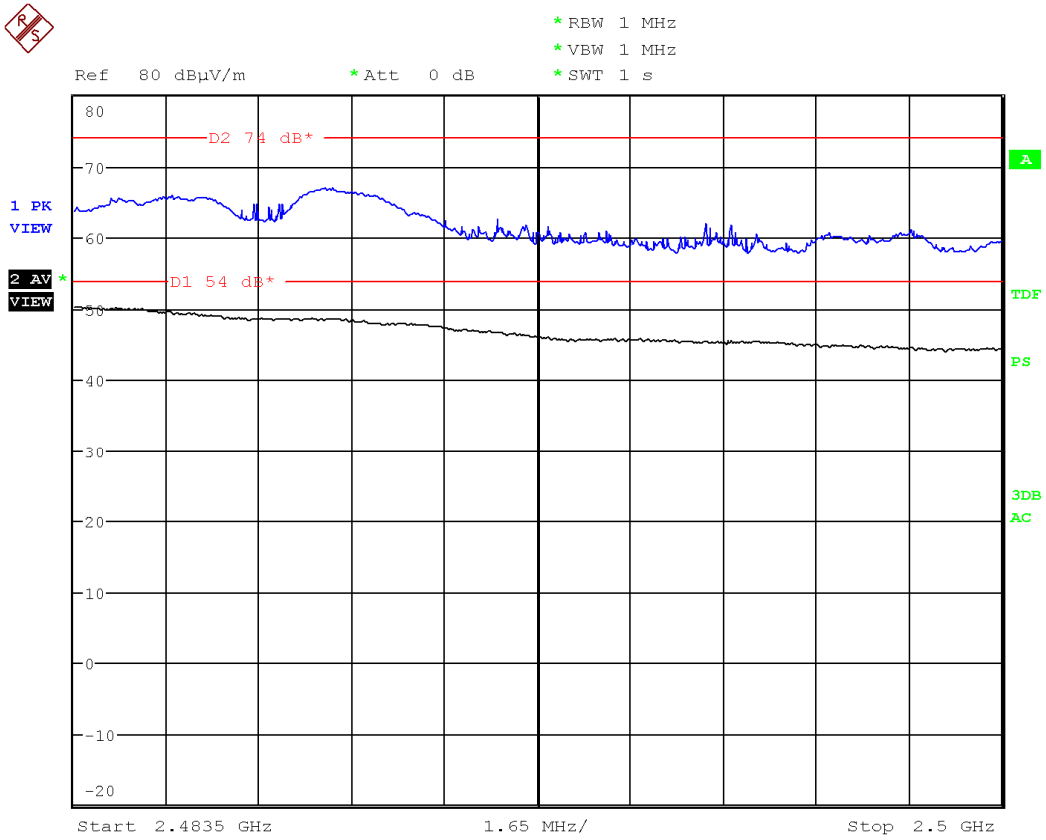



**CHANNEL 9 (2452 MHz).**

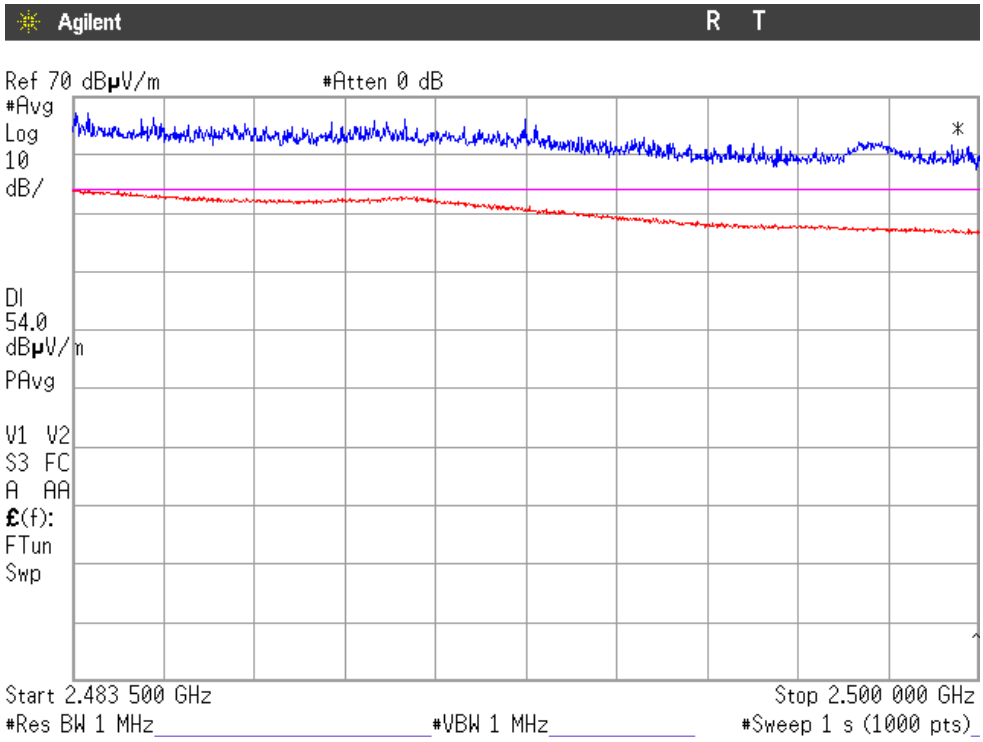
**Chain A**



## Chain B




## Chain A+B



# APPENDIX B: Test results

# “WiFi 5.725-5.825 GHz (802.11a/n20/n40/ac80)”

**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 = 5 dBi

**Operating frequencies in the sub-band 5.725-5.825 GHz.**

-For IEEE 802.11a, the equipment uses channels 149,153,157,161,165.

-For IEEE 802.11n, there are two bandwidths:

For 20 MHz bandwidth the equipment uses channels 149,153,157,161,165.
For 40 MHz bandwidth the equipment uses channels 151 and 159.

-For IEEE 802.11ac80 (80 MHz bandwidth) the equipment uses channel 155.

**TEST FREQUENCIES:**

For WiFi a/n20:

Lowest channel (149): 5745 MHz

Middle channel (157): 5785 MHz

Highest channel (165): 5825 MHz

For WiFi n40:

Lowest channel (151): 5755 MHz

Highest channel (159): 5795 MHz

For WiFi ac80:

Middle channel (155): 5775 MHz

The test set-up was made in accordance to the general provisions of FCC DTS Measurement KDB 558074 D01 DTS Meas Guidance v02.

For 802.11a mode the EUT can transmit at both CHAIN A and CHAIN B RF outputs individually, but not simultaneously.

For 802.11n modes 802.11n20 (20 MHz channel bandwidth), 802.11n40 (40MHz channel bandwidth) and 802.11ac80 (80MHz channel bandwidth) mode the EUT can transmit at both CHAIN A and CHAIN B RF outputs individually and simultaneously.

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 PC was using the Intel test utility DRTU Version "OEDRTU 558x86" DRTU 1.6.1.558.

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 data rates of 6Mb/s for 802.11a, HT4 (SISO)/HT8 (MIMO) for 802.11n20 and n40, and VHT6 (SISO)/(MIMO) 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 conducted RF output power at each chain 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. | SISO Chain A (dBm) | SISO Chain B (dBm) | MIMO at both ports A and B (dBm) |
|---|---|---|---|---|---|
| 802.11a | 20 | 149 / 5745 | 16.5 | 16.5 | n/a |
| | | 157 / 5785 | 16.5 | 16.5 | n/a |
| | | 165 / 5825 | 16.5 | 16.5 | n/a |
| 802.11n | 20 | 149 / 5745 | 16.5 | 16.5 | 13.50 |
| | | 157 / 5785 | 16.5 | 16.5 | 13.50 |
| | | 165 / 5825 | 16.5 | 16.5 | 13.50 |
| 802.11n* | 40 | 151 / 5755 | 16.5 | 16.5 | 13.50 |
| | | 159 / 5795 | 16.5 | 16.5 | 13.50 |
| 802.11ac | 80 | 155 / 5775 | 14 | 14 | 13.50 |

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is connected to the spectrum analyser using a calibrated low loss RF cable. The reading in the spectrum analyser is compensated with the cable loss at each measurement frequency.

RADIATED MEASUREMENTS

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and 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 and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

## Occupied Bandwidth

RESULTS

1. WiFi 5GHz 802.11 a mode

Occupied Bandwidth (see next plots).

| | Lowest frequency 5745 MHz | | Middle frequency 5785 MHz | | Highest frequency 5825 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| 99% bandwidth (MHz) | 17.836 | 17.644 | 18.317 | 17.692 | 19.952 | 17.788 |
| Measurement uncertainty (kHz) | ±21.7 | | | | | |

2. WiFi 5GHz 802.11 n20 mode

Occupied Bandwidth (see next plots).

| | Lowest frequency 5745 MHz | | Middle frequency 5785 MHz | | Highest frequency 5825 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| 99% bandwidth (MHz) | 19.038 | 18.510 | 19.135 | 18.606 | 20.288 | 18.702 |
| Measurement uncertainty (kHz) | ±21.7 | | | | | |

3. WiFi 5GHz 802.11 n40 mode

Occupied Bandwidth (see next plots).

| | Lowest frequency 5755 MHz | | Highest frequency 5795 MHz | |
|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B |
| 99% bandwidth (MHz) | 37.019 | 36.458 | 36.458 | 36.298 |
| Measurement uncertainty (kHz) | ±21.7 | | | |

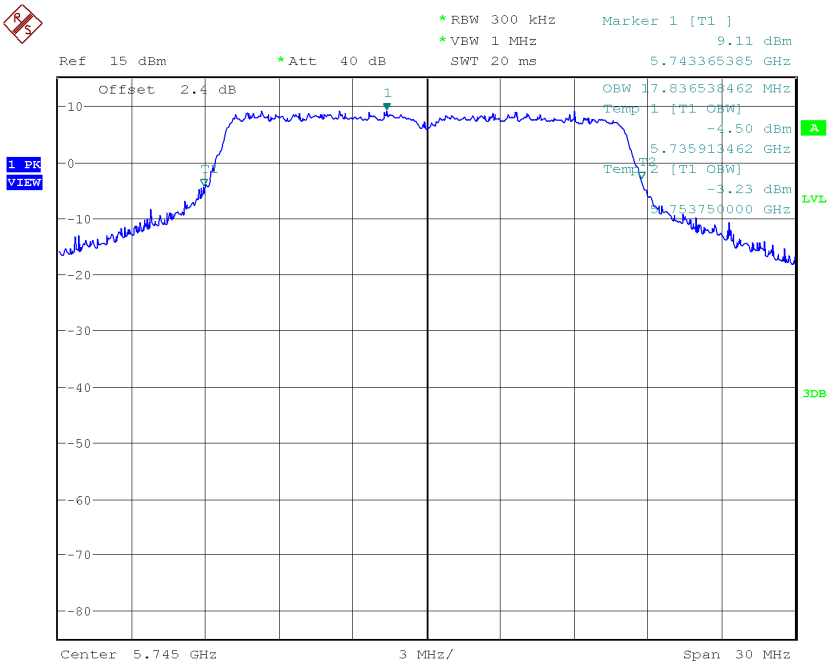
4. WiFi 5GHz 802.11 ac80 mode

Occupied Bandwidth (see next plots).

| | Middle frequency 5775 MHz | |
|---|---|---|
| | Chain A | Chain B |
| 99% bandwidth (MHz) | 75.160 | 75.160 |
| Measurement uncertainty (kHz) | ±21.7 | |

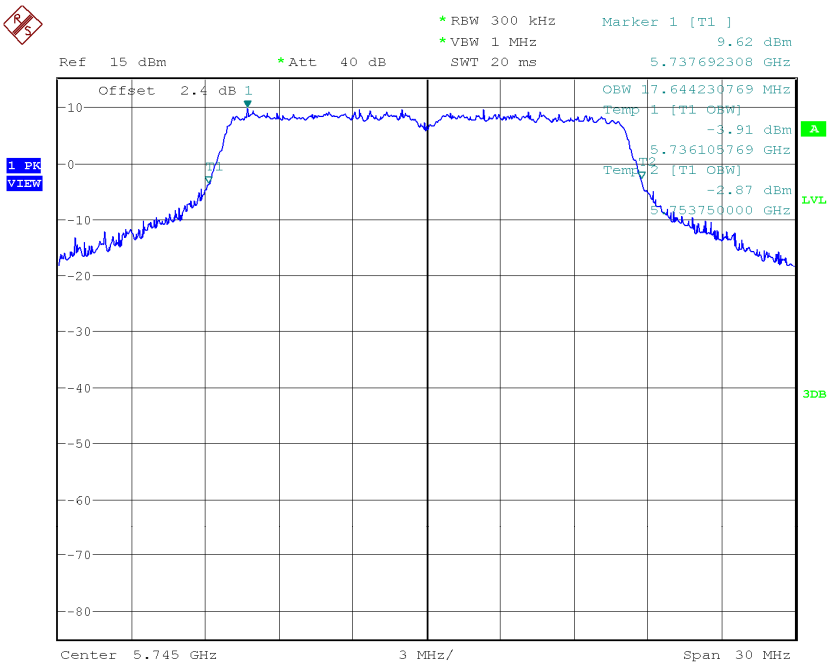
1. WiFi 5GHz 802.11 a mode

Lowest Channel: 5745 MHz. Chain A



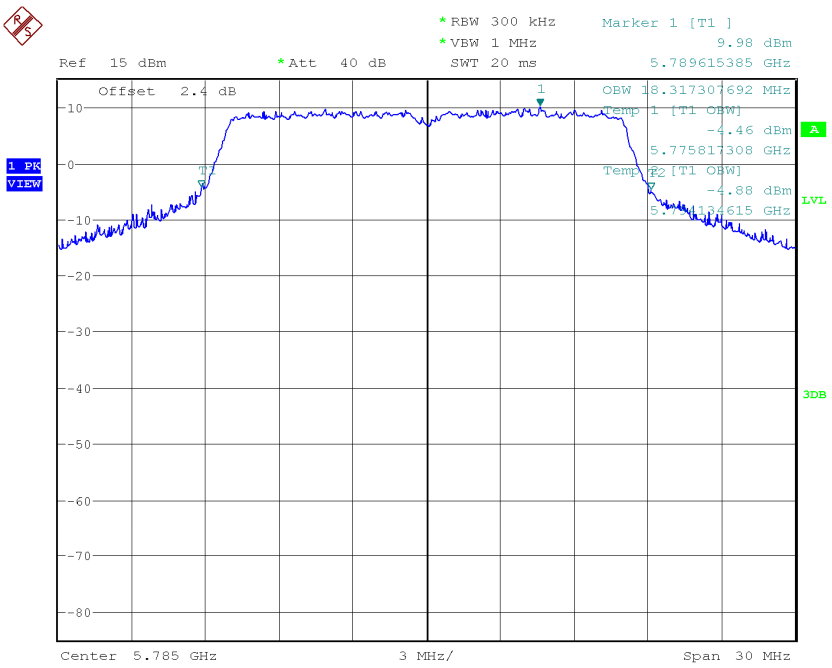

Date: 25.JAN.2013 13:26:38

Lowest Channel: 5745 MHz. Chain B



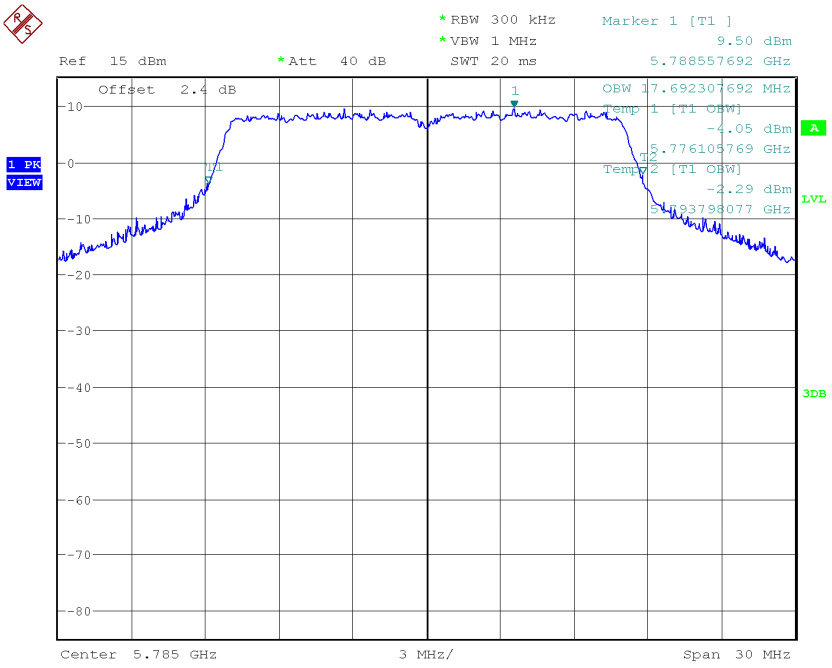

Date: 25.JAN.2013 13:54:59

Middle Channel: 5785 MHz. Chain A



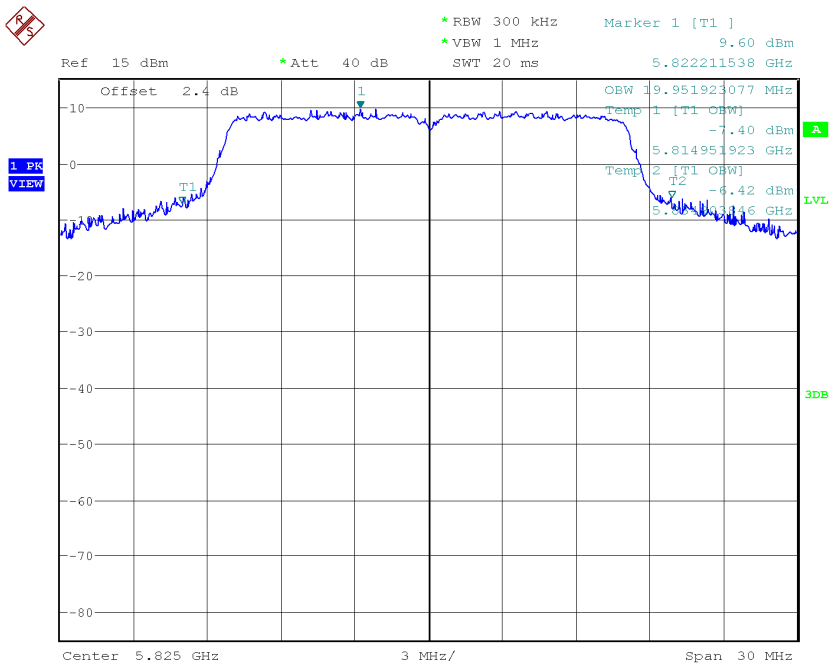

Date: 25.JAN.2013 13:28:13

Middle Channel: 5785 MHz. Chain B



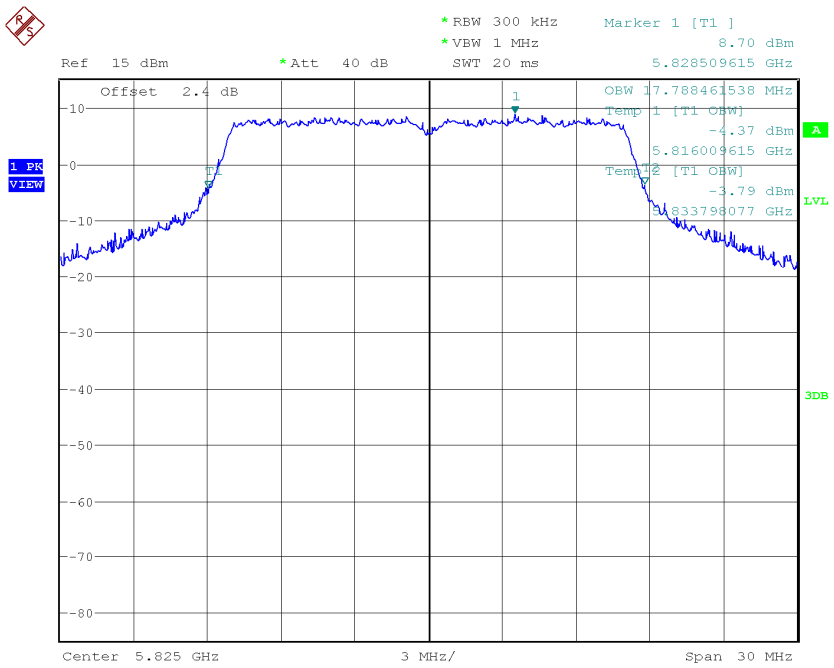

Date: 25.JAN.2013 13:56:23

Highest Channel: 5825 MHz. Chain A




Date: 25.JAN.2013 13:30:09

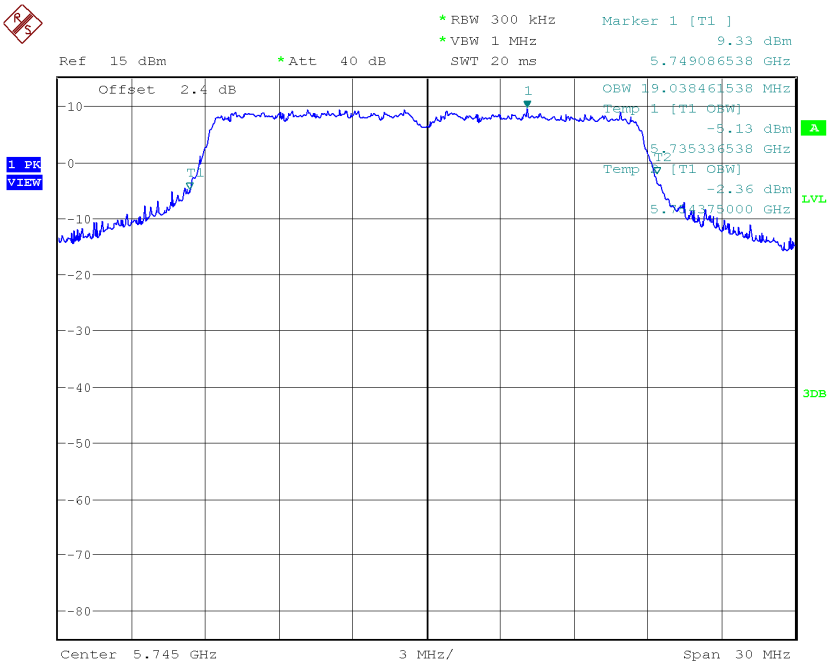
Highest Channel: 5825 MHz. Chain B




Date: 25.JAN.2013 13:57:44

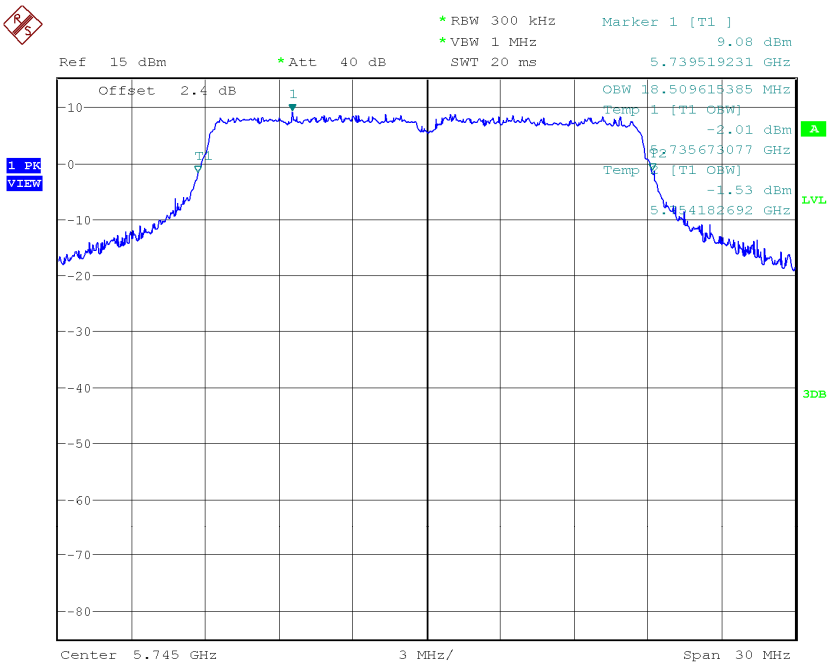
2. WiFi 5GHz 802.11 n20 mode

Lowest Channel: 5745 MHz. Chain A



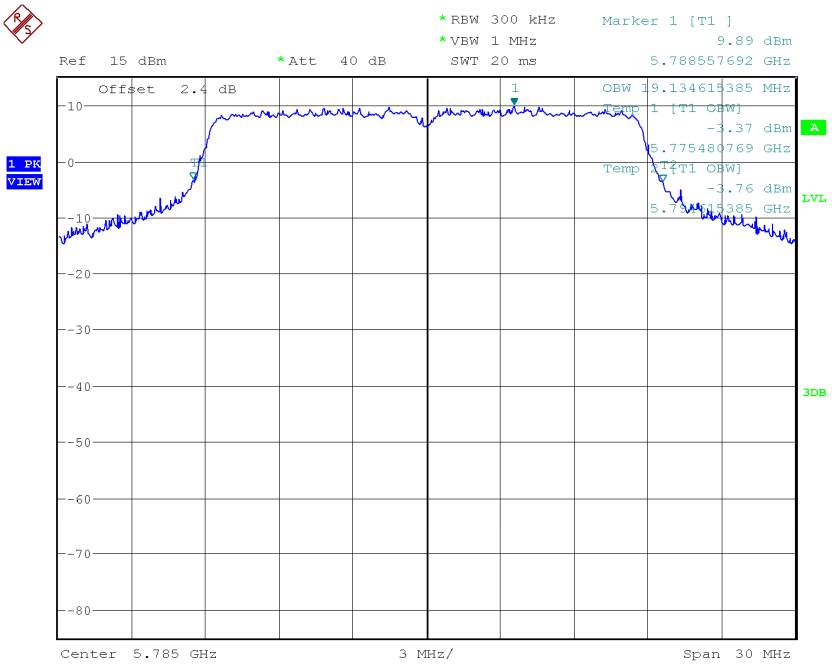

Date: 25.JAN.2013 13:32:05

Lowest Channel: 5745 MHz. Chain B



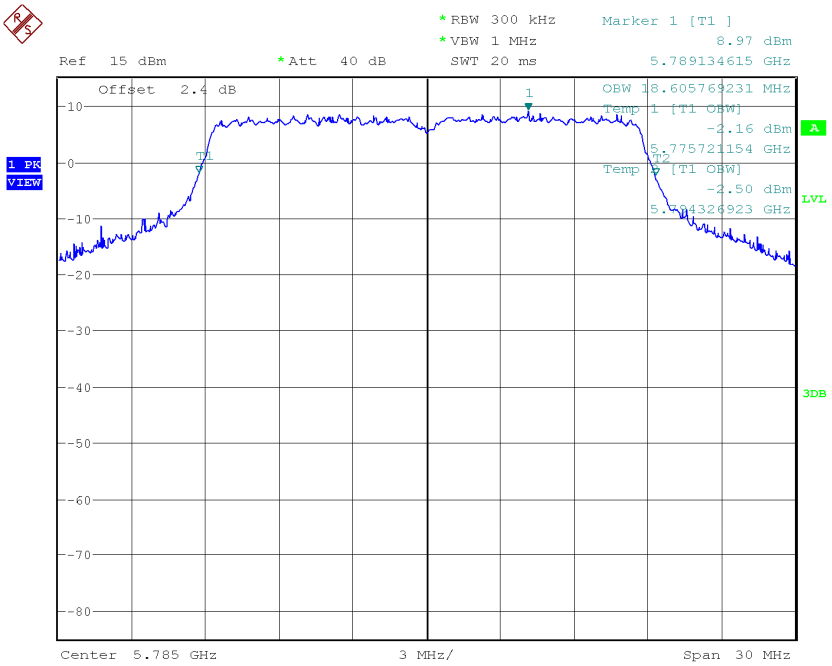

Date: 25.JAN.2013 14:01:55

Middle Channel: 5785 MHz. Chain A



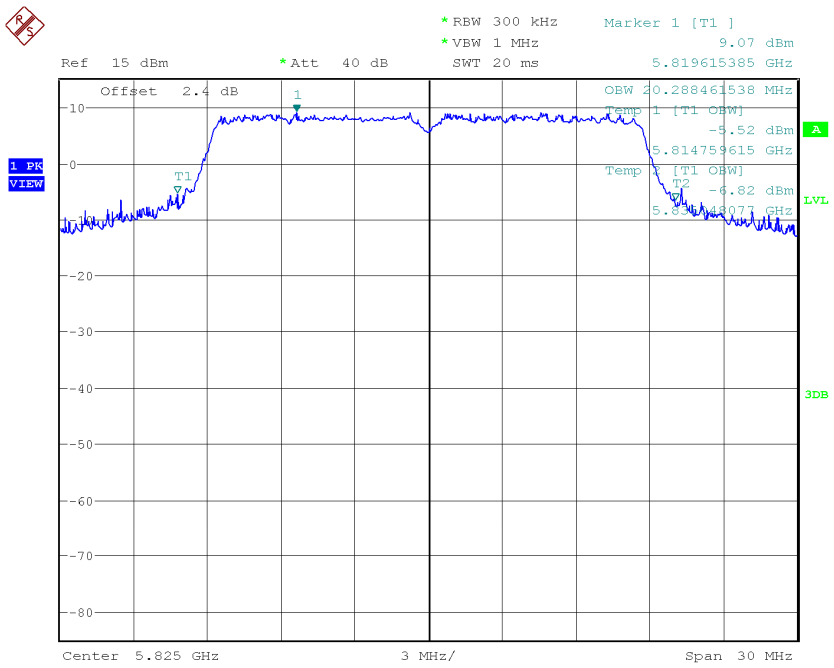

Date: 25.JAN.2013 13:33:34

Middle Channel: 5785 MHz. Chain B



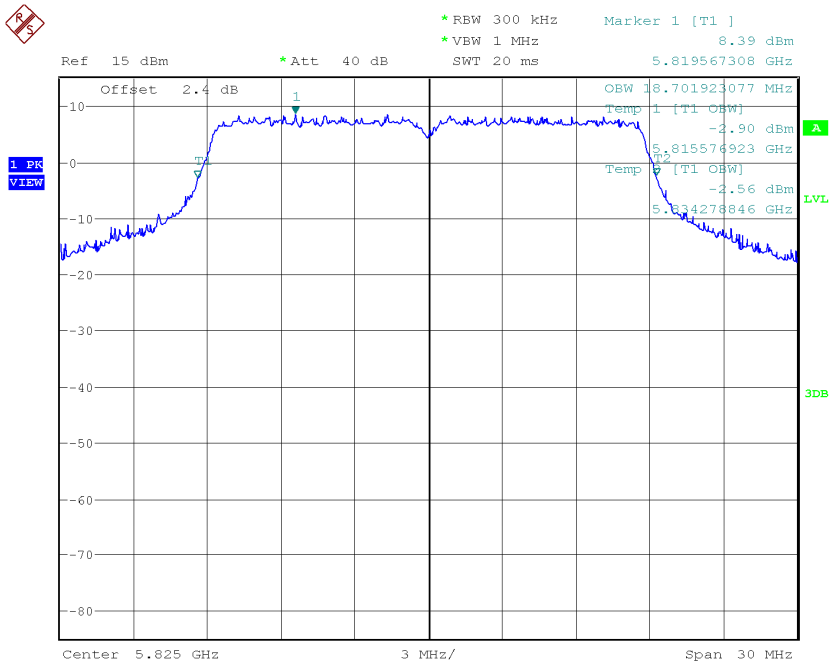

Date: 25.JAN.2013 14:03:28

Highest Channel: 5825 MHz. Chain A




Date: 25.JAN.2013 13:35:26

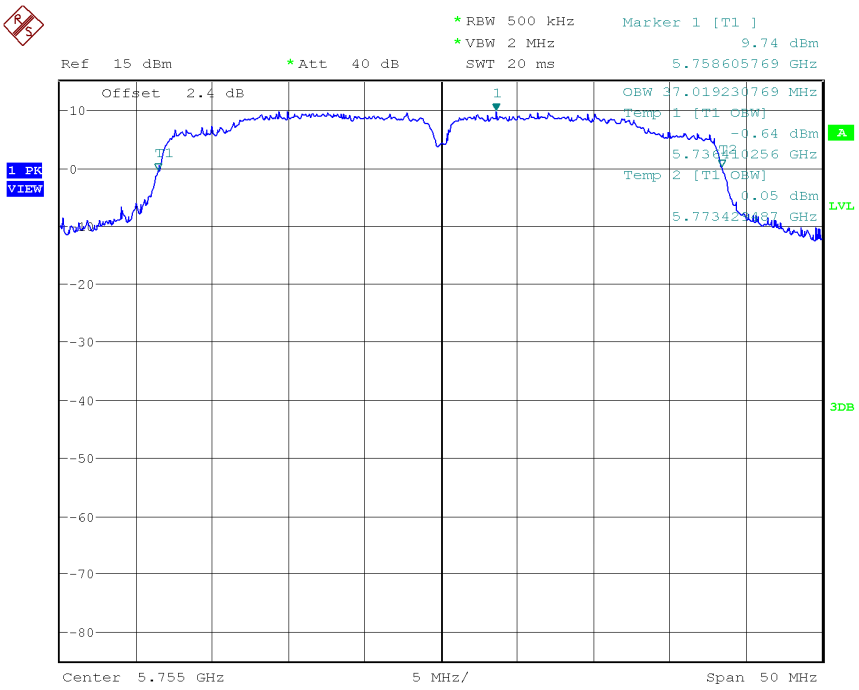
Highest Channel: 5825 MHz. Chain B




Date: 25.JAN.2013 14:05:06

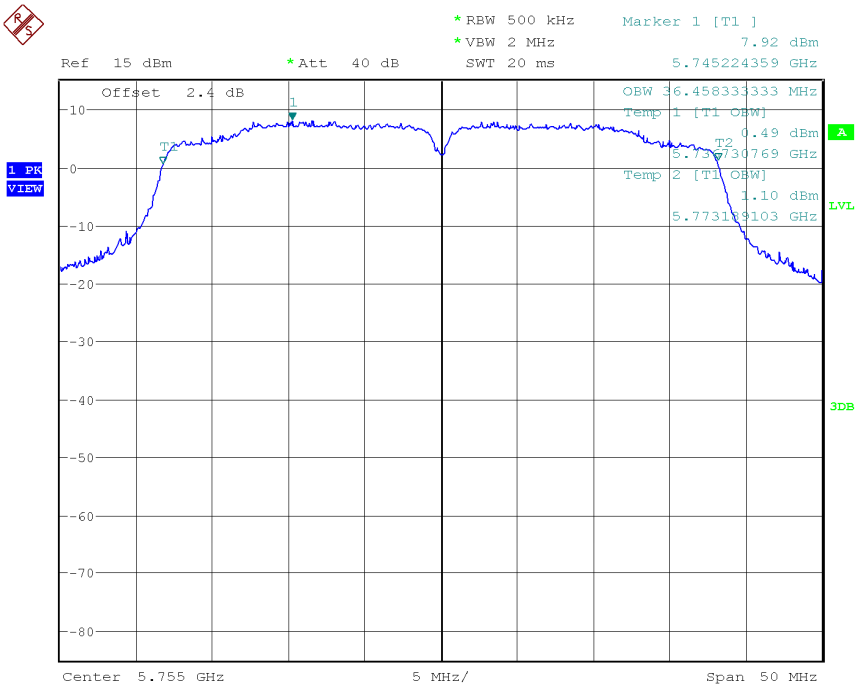
3. WiFi 5GHz 802.11 n40 mode

Lowest Channel: 5755 MHz. Chain A



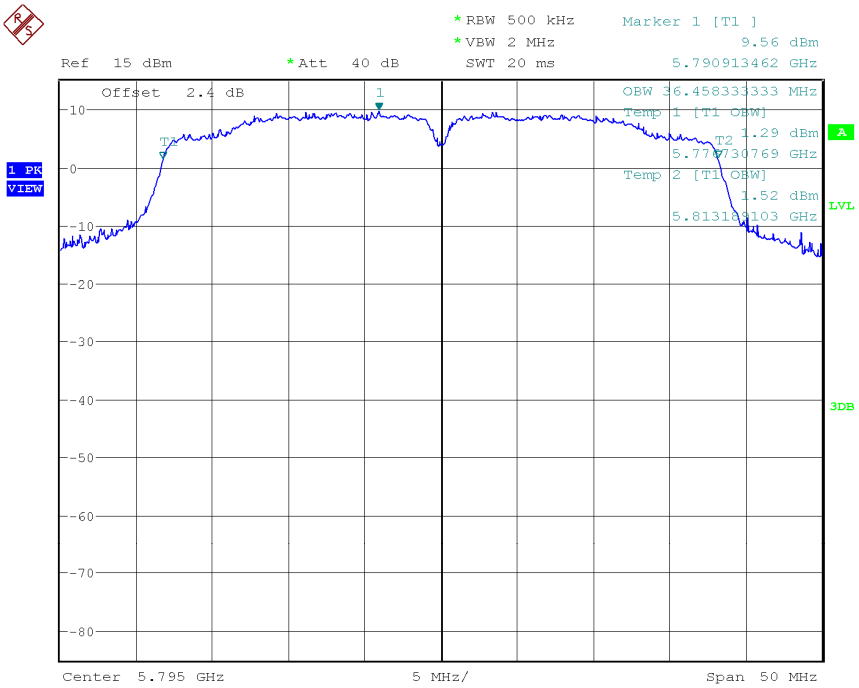

Date: 25.JAN.2013 13:38:02

Lowest Channel: 5755 MHz. Chain B



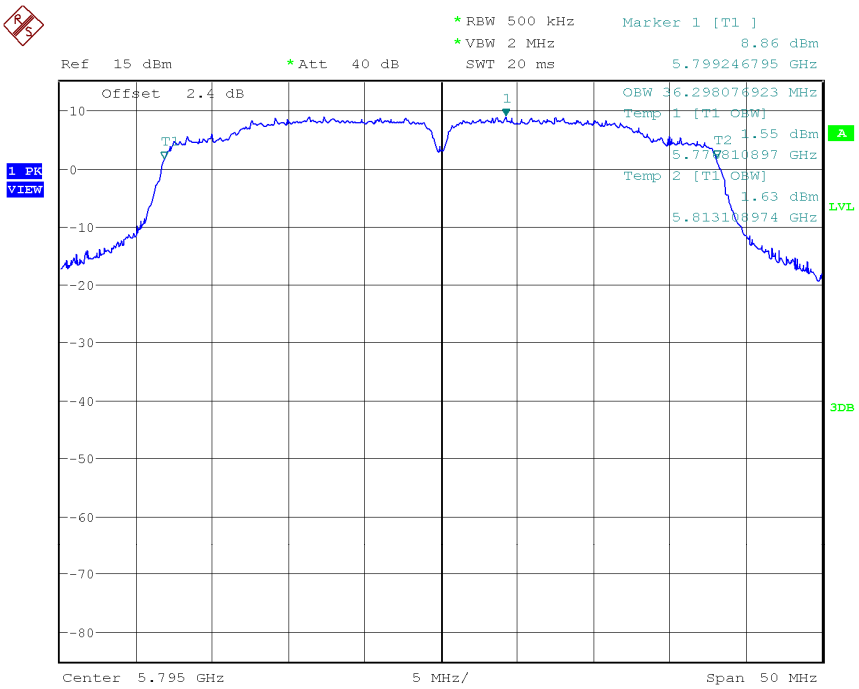

Date: 25.JAN.2013 13:43:45

Highest Channel: 5795 MHz. Chain A




Date: 25.JAN.2013 13:39:41

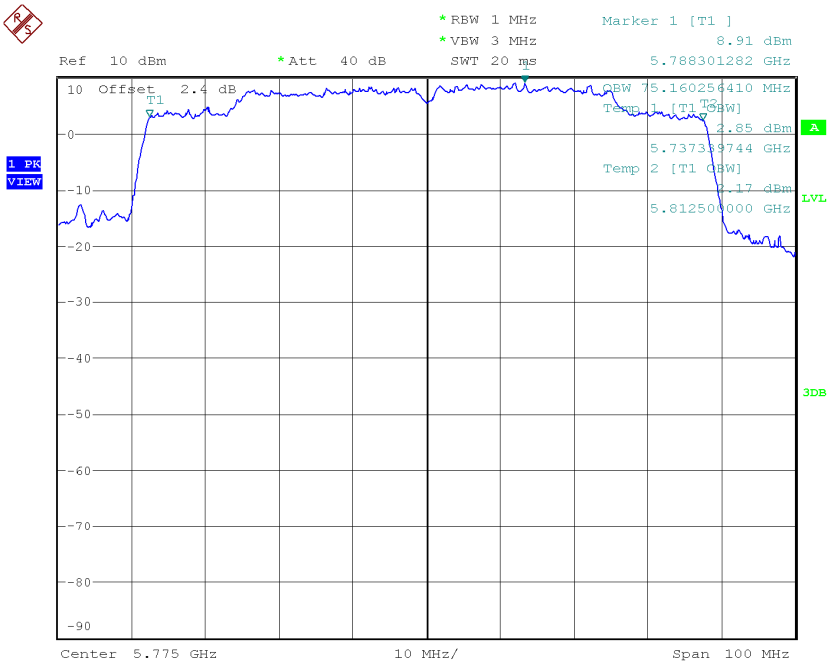
Highest Channel: 5795 MHz. Chain B




Date: 25.JAN.2013 13:41:38

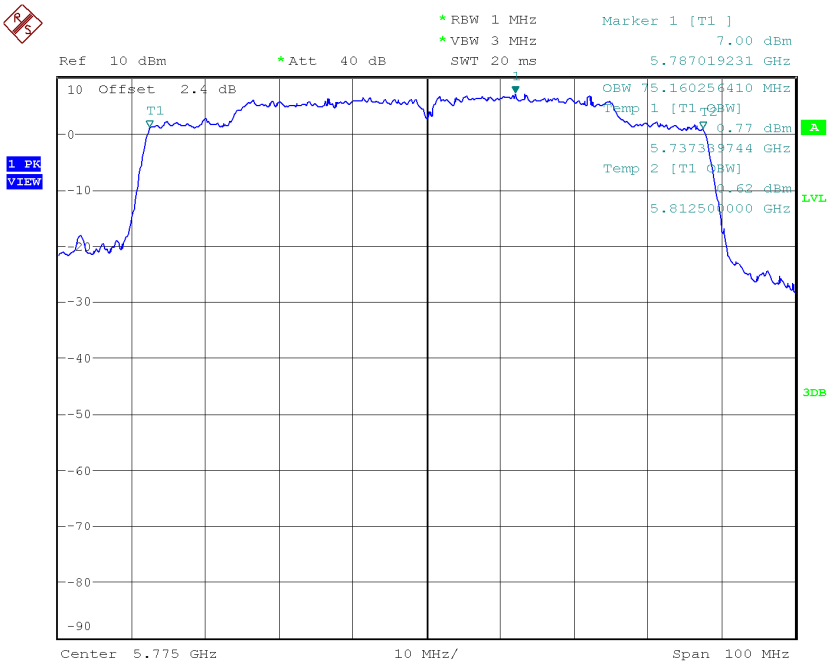
4. WiFi 5GHz 802.11 ac80 mode

Middle Channel: 5775 MHz. Chain A




Date: 28.JAN.2013 10:13:15

Middle Channel: 5775 MHz. Chain B




Date: 28.JAN.2013 10:10:56

## Section 15.247 Subclause (a) (2) / RSS-210 A8.2. (a). 6 dB Bandwidth

SPECIFICATION

The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

6 dB Bandwidth (see next plots).

1. WiFi 5GHz 802.11 a mode

| | Lowest frequency 5745 MHz | | Middle frequency 5785 MHz | | Highest frequency 5825 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| 6 dB Spectrum bandwidth (MHz) | 16.378 | 16.410 | 16.378 | 16.378 | 16.378 | 16.442 |
| Measurement uncertainty (kHz) | ±89 | | | | | |

2. WiFi 5GHz 802.11 n20 mode

| | Lowest frequency 5745 MHz | | Middle frequency 5785 MHz | | Highest frequency 5825 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| 6 dB Spectrum bandwidth (MHz) | 17.628 | 17.628 | 17.660 | 17.660 | 17.660 | 17.660 |
| Measurement uncertainty (kHz) | ±89 | | | | | |

3. WiFi 5GHz 802.11 n40 mode

| | Lowest frequency 5755 MHz | | Highest frequency 5795 MHz | |
|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B |
| 6 dB Spectrum bandwidth (MHz) | 35.192 | 35.192 | 35.128 | 35.192 |
| Measurement uncertainty (kHz) | ±21.7 | | | |

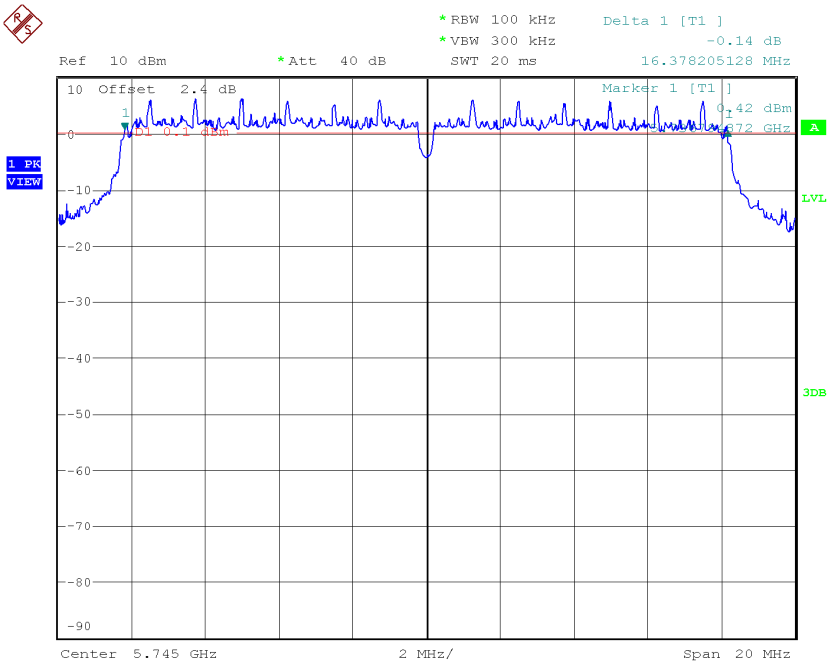
4. WiFi 5GHz 802.11 ac80 mode

| | Middle frequency 5775 MHz | |
|---|---|---|
| | Chain A | Chain B |
| 6 dB Spectrum bandwidth (MHz) | 75.128 | 75.128 |
| Measurement uncertainty (kHz) | ±21.7 | |

Verdict: PASS

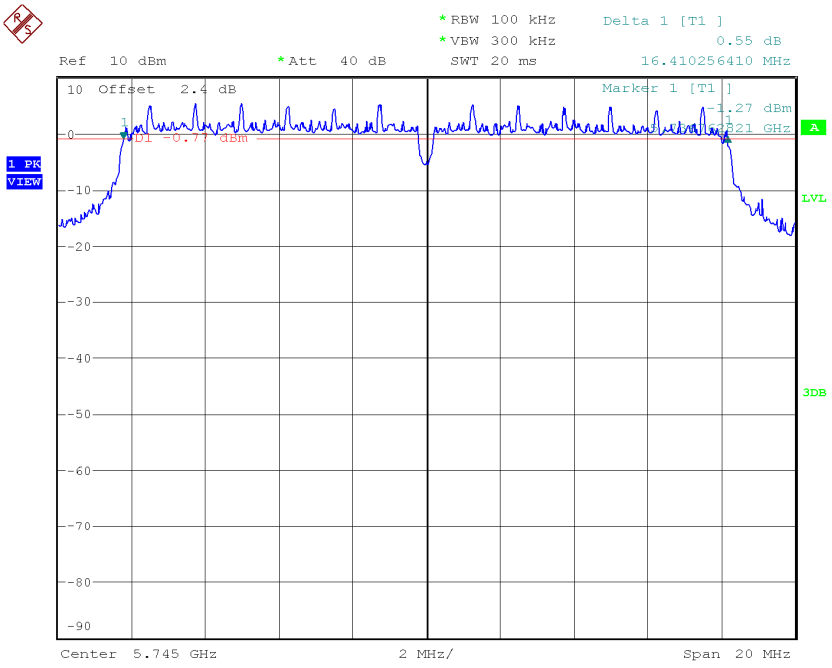
1. WiFi 5GHz 802.11 a mode

Lowest Channel: 5745 MHz. Chain A



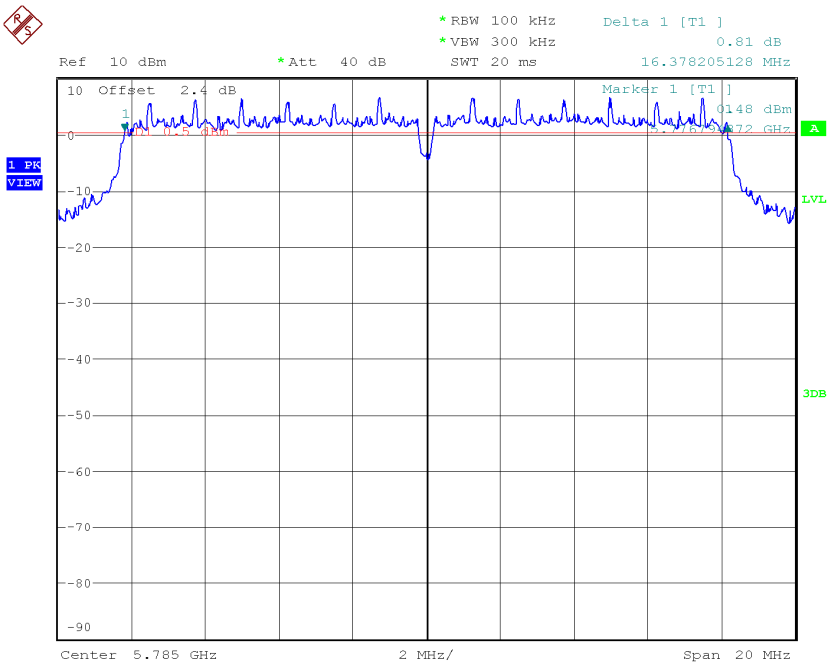

Date: 25.JAN.2013 12:57:47

Lowest Channel: 5745 MHz. Chain B



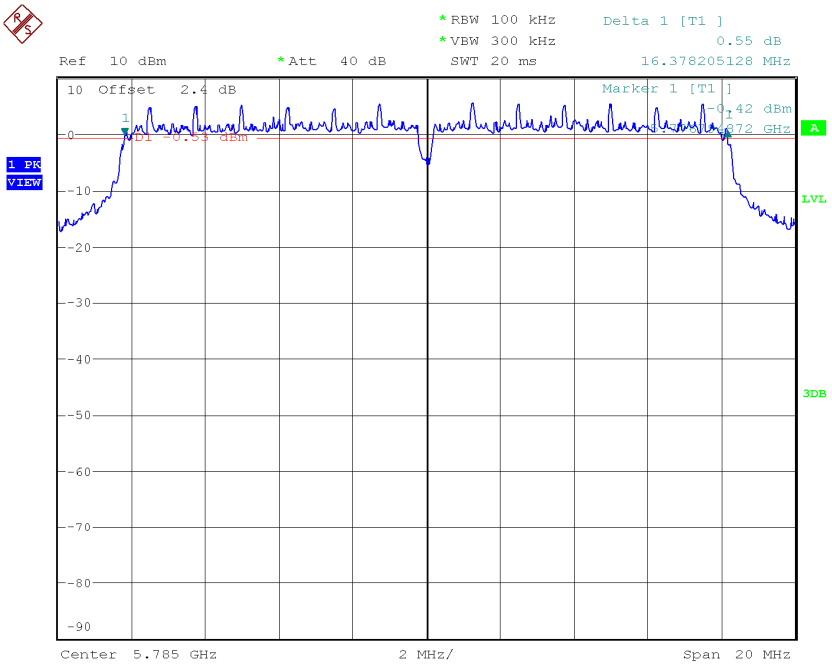

Date: 25.JAN.2013 12:24:47

Middle Channel: 5785 MHz. Chain A



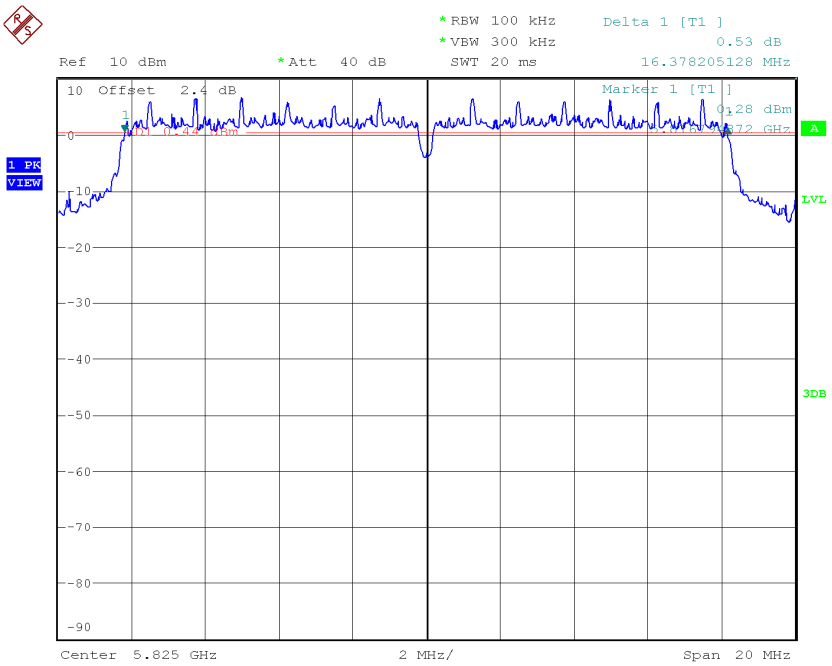

Date: 25.JAN.2013 13:01:04

Middle Channel: 5785 MHz. Chain B



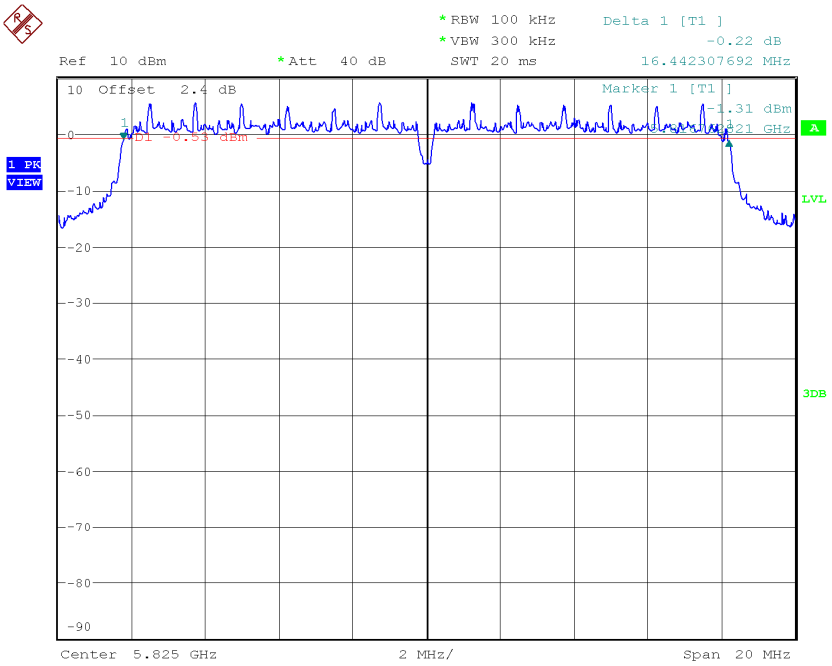

Date: 25.JAN.2013 12:22:12

Highest Channel: 5825 MHz. Chain A




Date: 25.JAN.2013 13:05:59

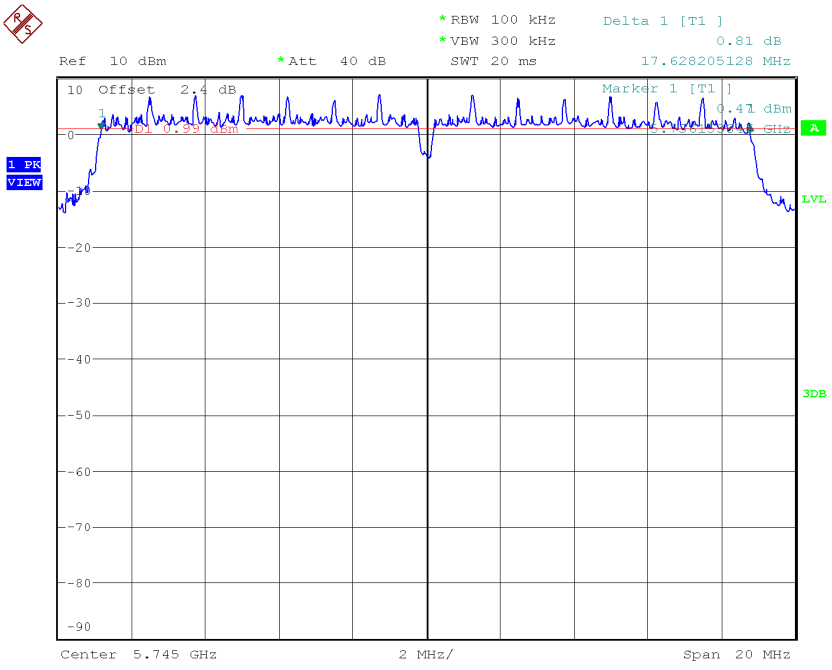
Highest Channel: 5825 MHz. Chain B




Date: 25.JAN.2013 12:27:38

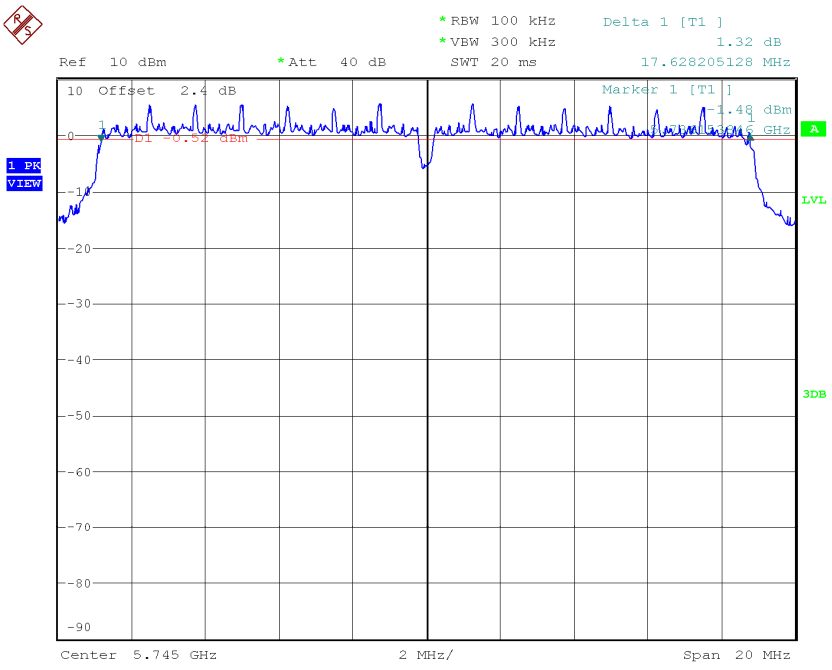
2. WiFi 5GHz 802.11 n20 mode

Lowest Channel: 5745 MHz. Chain A



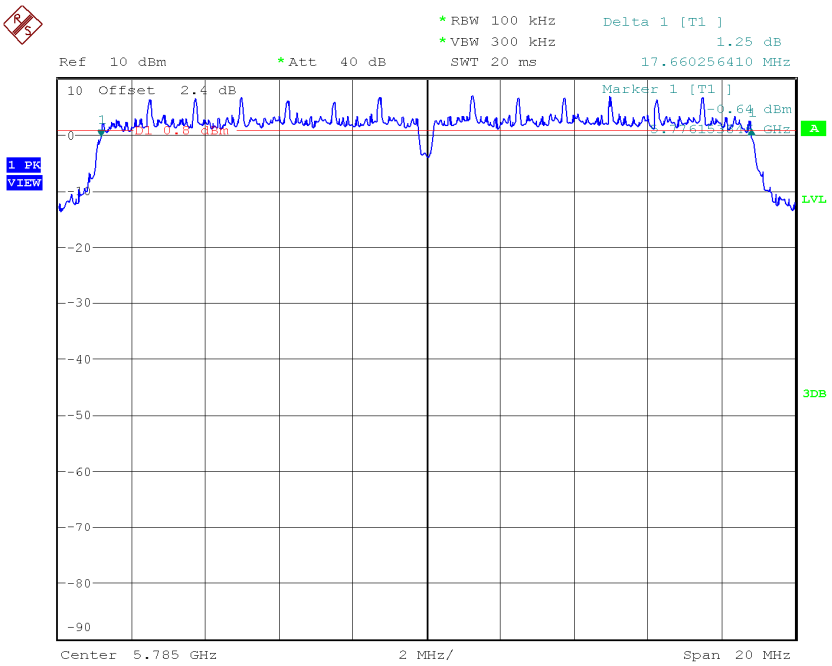

Date: 25.JAN.2013 13:15:26

Lowest Channel: 5745 MHz. Chain B



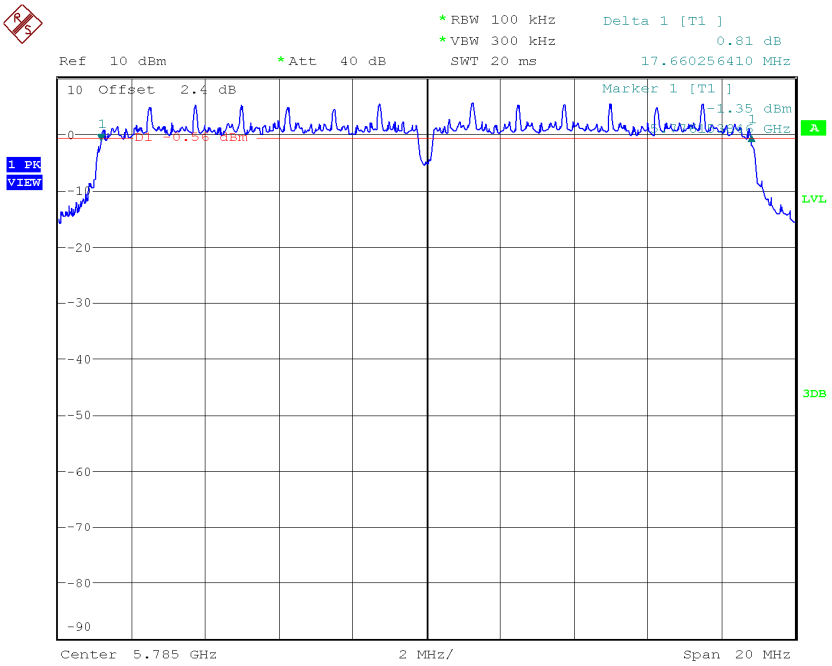

Date: 25.JAN.2013 12:38:34

Middle Channel: 5785 MHz. Chain A



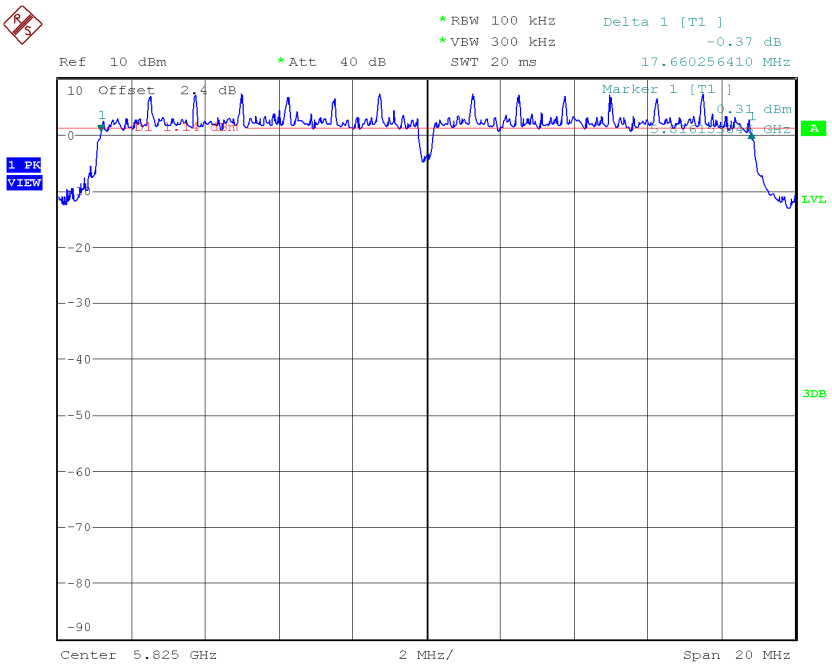

Date: 25.JAN.2013 13:12:08

Middle Channel: 5785 MHz. Chain B



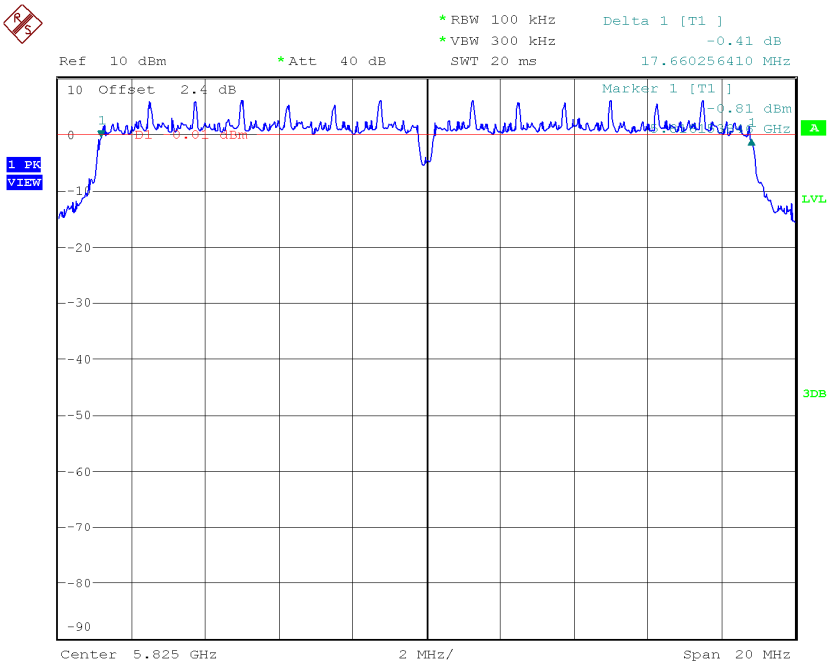

Date: 25.JAN.2013 12:35:27

Highest Channel: 5825 MHz. Chain A




Date: 25.JAN.2013 13:08:58

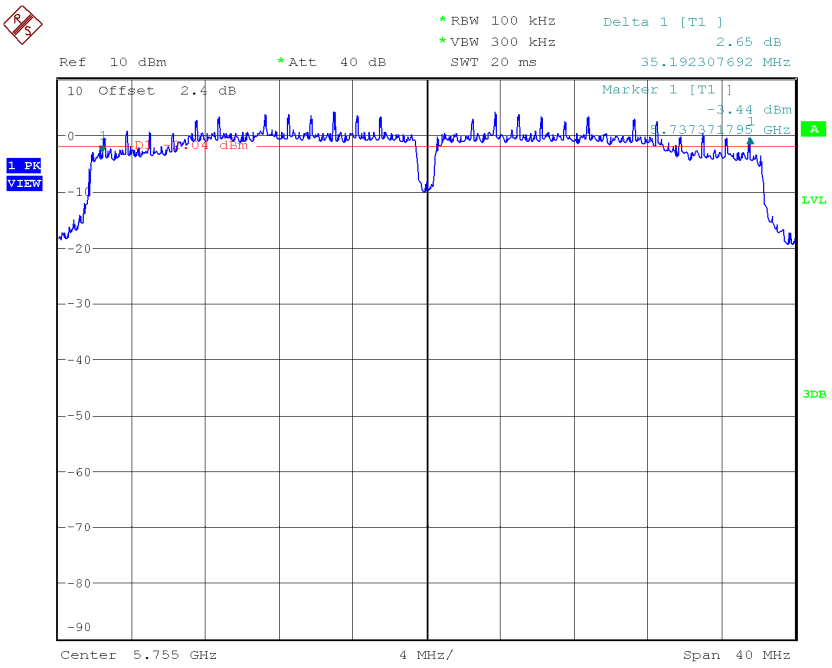
Highest Channel: 5825 MHz. Chain B




Date: 25.JAN.2013 12:31:03

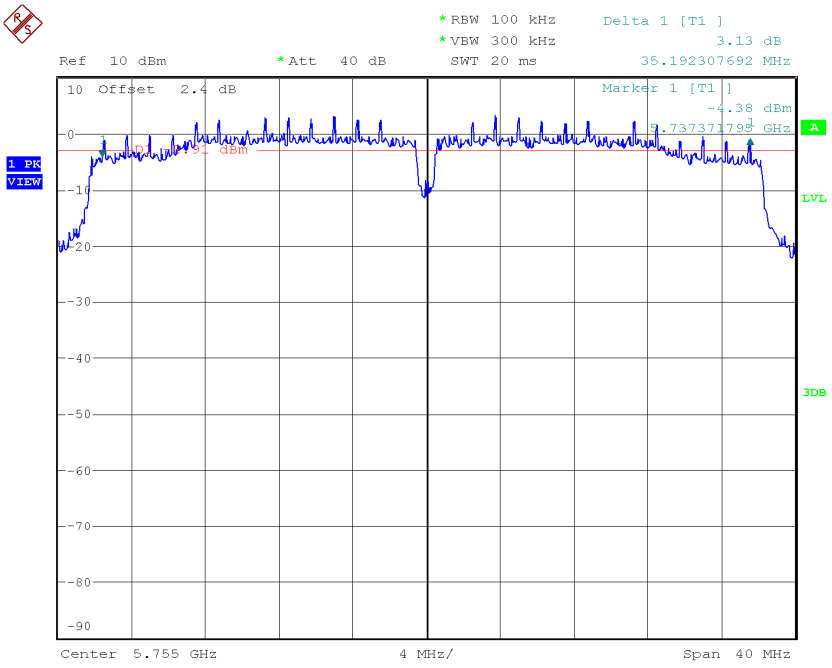
3. WiFi 5GHz 802.11 n40 mode

Lowest Channel: 5755 MHz. Chain A



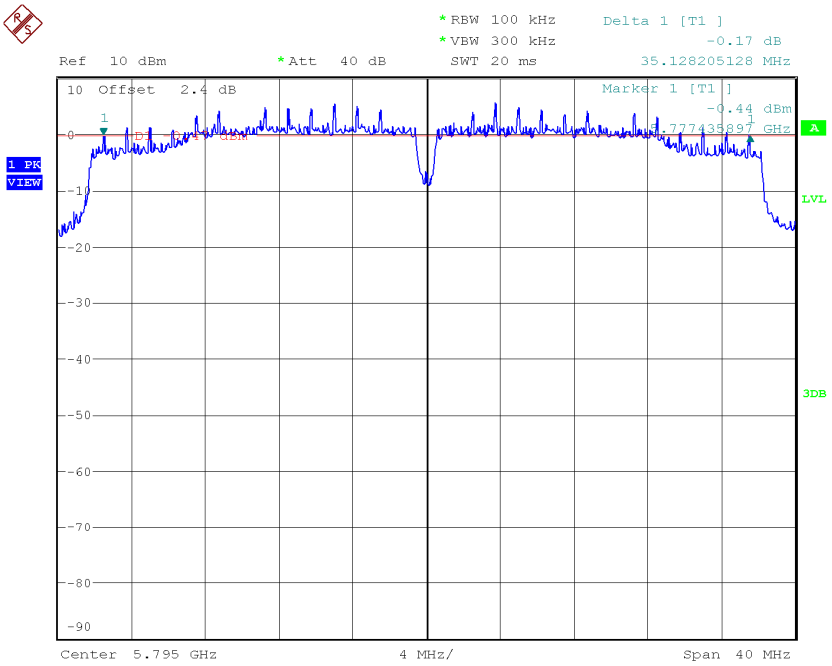

Date: 25.JAN.2013 12:52:56

Lowest Channel: 5755 MHz. Chain B



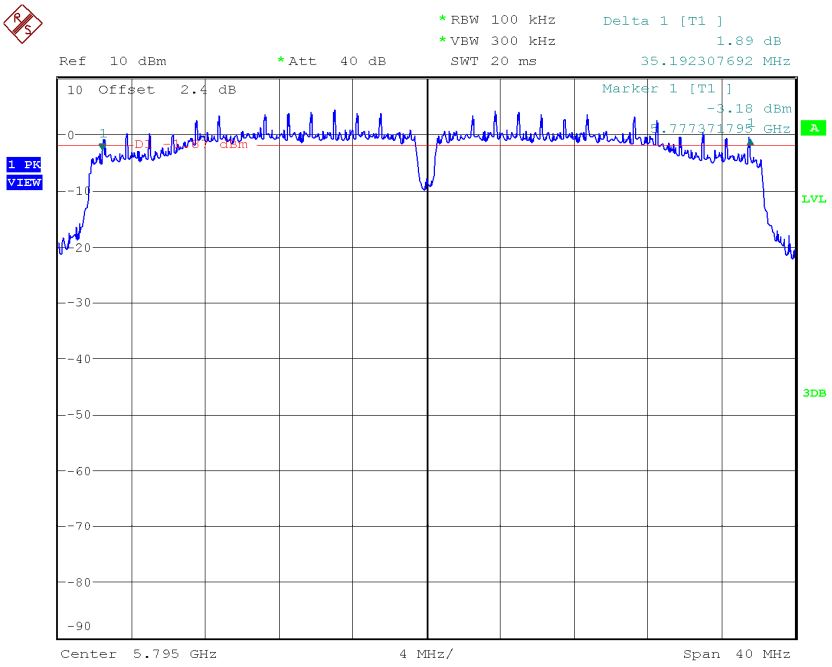

Date: 25.JAN.2013 12:42:43

Highest Channel: 5795 MHz. Chain A




Date: 25.JAN.2013 12:49:41

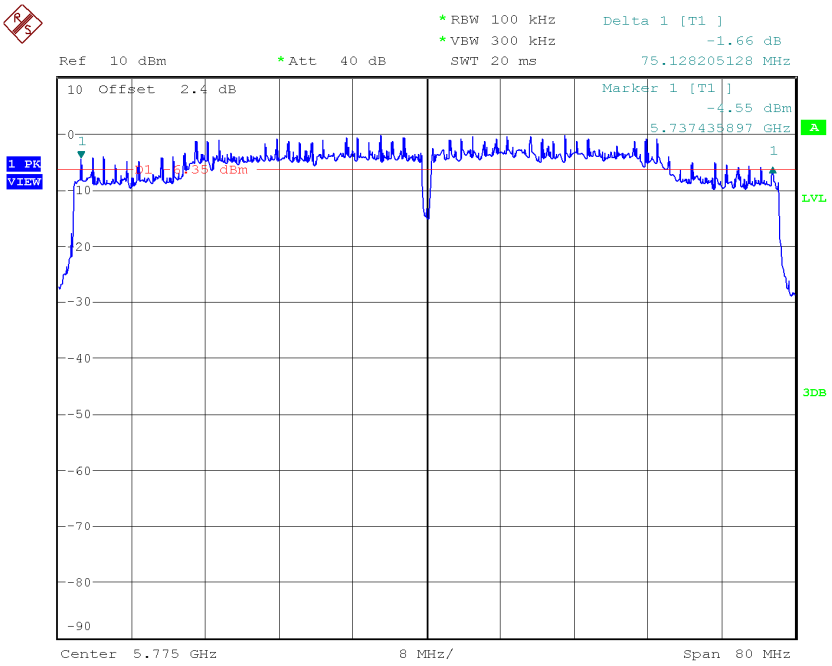
Highest Channel: 5795 MHz. Chain B




Date: 25.JAN.2013 12:45:39

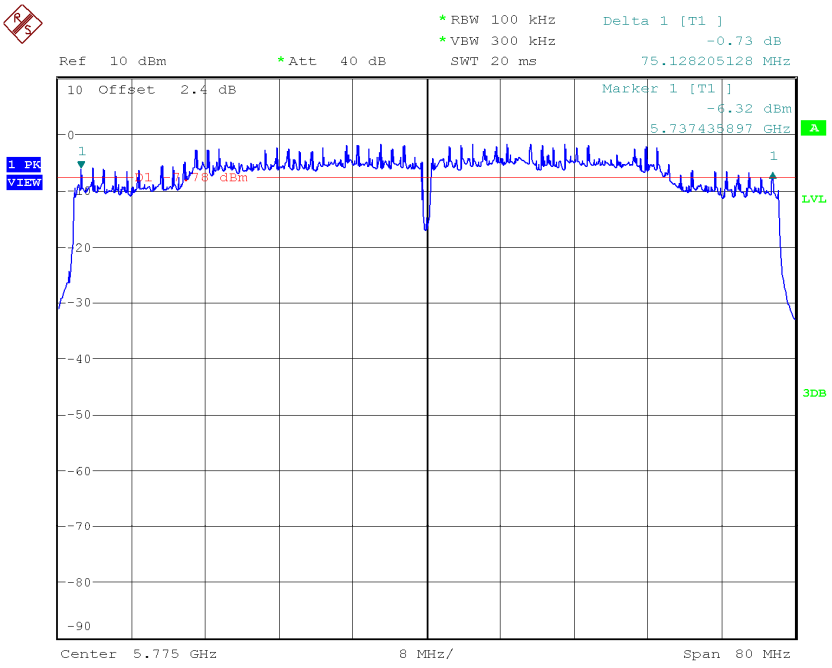
4. WiFi 5GHz 802.11 ac80 mode

Middle Channel: 5775 MHz. Chain A




Date: 28.JAN.2013 10:02:26

Middle Channel: 5775 MHz. Chain B




Date: 28.JAN.2013 10:07:40

## Section 15.247 Subclause (b) / RSS-210 A8.4. (4). Maximum output power and antenna gain

SPECIFICATION

The maximum peak conducted output power of the intentional radiator shall not exceed 1 watt (30 dBm). The e.i.r.p. shall not exceed 4 W (36 dBm) (Canada).

RESULTS

The maximum Peak Conducted Output Power was measured using the channel integration method according to point 8.1.2. Option 2 of Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v02 dated 10/04/2012.

In the measure-and-sum approach for MIMO mode, the conducted emission level (*e.g.*, transmit power or power in specified bandwidth) is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in linear power units (mW—not dBm).

The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power.
For MIMO mode, the Guidance on directional Gain calculations according to the Guidance for Emission Testing of Transmitters with Multiple Outputs in the Same Band 662911 D01 Multiple Transmitter Output v01r02 dated 9/26/2012 was used.
The number of transmit antennas ($N_{ANT}$) are 2 and the number of spatial streams (Nss) are 2 and therefore the Array Gain is 0 dB.

MAXIMUM OUTPUT POWER. (See next plots of worst case: highest power).

Declared maximum antenna gain: 5 dBi.

1. WiFi 5GHz 802.11 a mode

| | Lowest frequency 5745 MHz | | Middle frequency 5785 MHz | | Highest frequency 5825 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| Maximum conducted power (dBm) | 25.33 | 25.07 | 24.58 | 24.93 | 26.13 | 25.65 |
| Maximum EIRP power (dBm) | 30.33 | 30.07 | 29.58 | 29.93 | 31.13 | 30.65 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

2. WiFi 5GHz 802.11 n20 mode

| SISO | Lowest frequency 5745 MHz | | Middle frequency 5785 MHz | | Highest frequency 5825 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| Maximum conducted power (dBm) | 25.55 | 25.44 | 25.73 | 25.67 | 25.66 | 25.96 |
| Maximum EIRP power (dBm) | 30.55 | 30.44 | 30.73 | 30.67 | 30.66 | 30.96 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

| MIMO | Lowest frequency 5745 MHz | | Middle frequency 5785 MHz | | Highest frequency 5825 MHz | |
|---|---|---|---|---|---|---|
| | Chain A+B | | Chain A+B | | Chain A+B | |
| | Port A | Port B | Port A | Port B | Port A | Port B |
| Maximum conducted power (dBm) | 24.36 | 23.18 | 24.35 | 23.29 | 23.72 | 23.31 |
| | Port A+B | | Port A+B | | Port A+B | |
| Maximum conducted power (dBm) | 26.82 | | 26.86 | | 26.53 | |
| Maximum EIRP power (dBm) | 31.82 | | 31.86 | | 31.53 | |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

3. WiFi 5GHz 802.11 n40 mode

| SISO | Lowest frequency 5755 MHz | | Highest frequency 5795 MHz | |
|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B |
| Maximum conducted power (dBm) | 25.54 | 25.94 | 25.55 | 26.06 |
| Maximum EIRP power (dBm) | 30.54 | 30.94 | 30.55 | 31.06 |
| Measurement uncertainty (dB) | ±1.5 | | | |

| MIMO | Lowest frequency 5755 MHz | | Highest frequency 5795 MHz | |
|---|---|---|---|---|
| | Chain A+B | | Chain A+B | |
| | Port A | Port B | Port A | Port B |
| Maximum conducted power (dBm) | 24.88 | 23.33 | 23.56 | 23.41 |
| | Port A+B | | Port A+B | |
| Maximum conducted power (dBm) | 27.18 | | 26.5 | |
| Maximum EIRP power (dBm) | 32.18 | | 31.5 | |
| Measurement uncertainty (dB) | ±1.5 | | | |

4. WiFi 5GHz 802.11 ac80 mode

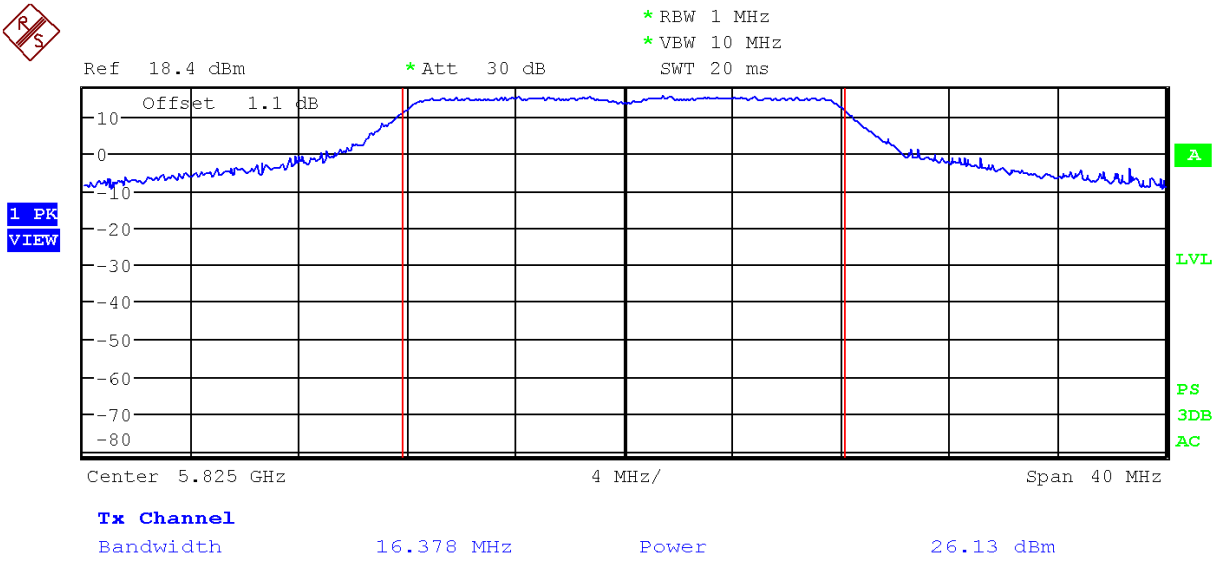
| SISO | Middle frequency 5775 MHz | |
|---|---|---|
| | Chain A | Chain B |
| Maximum conducted power (dBm) | 23.25 | 23.34 |
| Maximum EIRP power (dBm) | 28.25 | 28.34 |
| Measurement uncertainty (dB) | ±1.5 | |

| MIMO | Middle frequency 5775 MHz | |
|---|---|---|
| | Chain A+B | |
| | Port A | Port B |
| Maximum conducted power (dBm) | 24.51 | 23.47 |
| | Port A+B | |
| Maximum conducted power (dBm) | 27.03 | |
| Maximum EIRP power (dBm) | 32.03 | |
| Measurement uncertainty (dB) | ±1.5 | |

Verdict: PASS

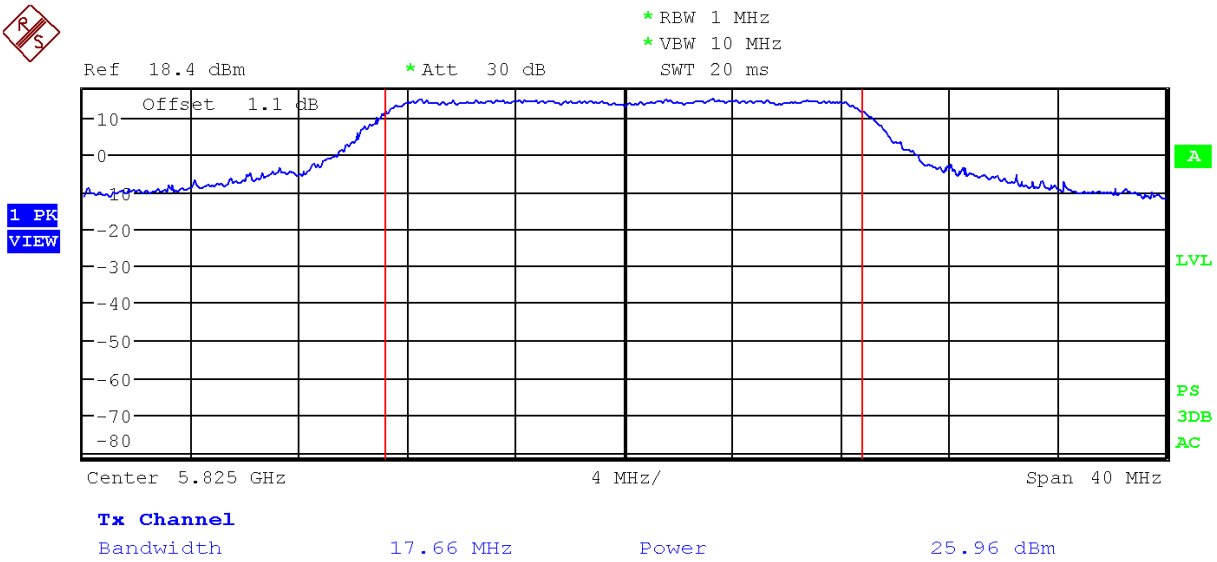
1. WiFi 5GHz 802.11 a mode

Highest Channel: 5825 MHz. Chain A

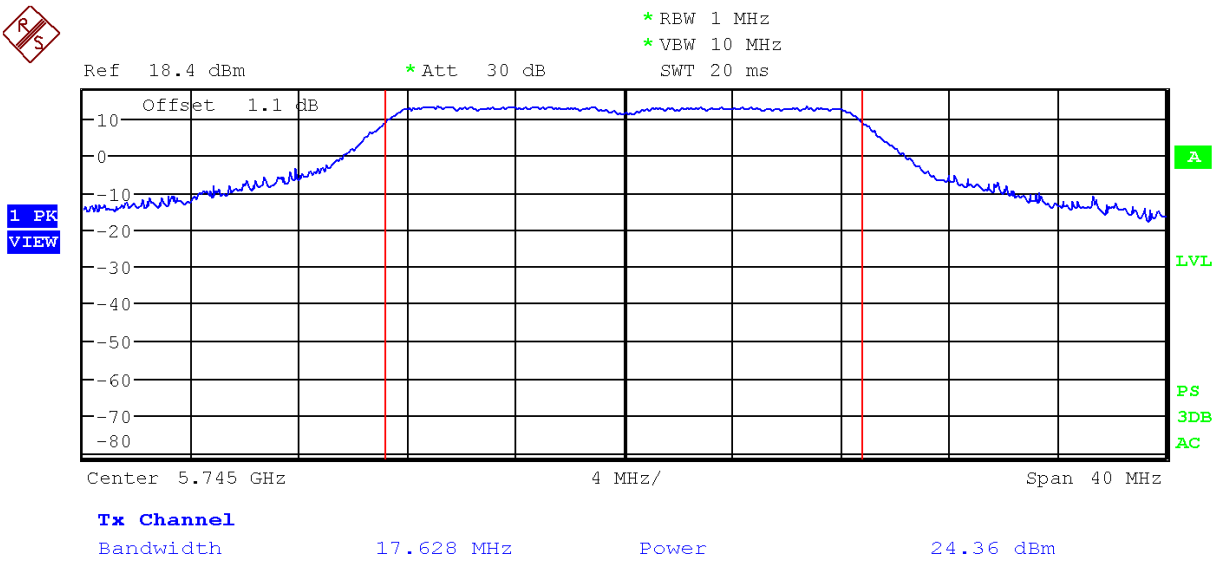



2. WiFi 5GHz 802.11 n20 mode

SISO. Highest Channel: 5825 MHz. Chain B

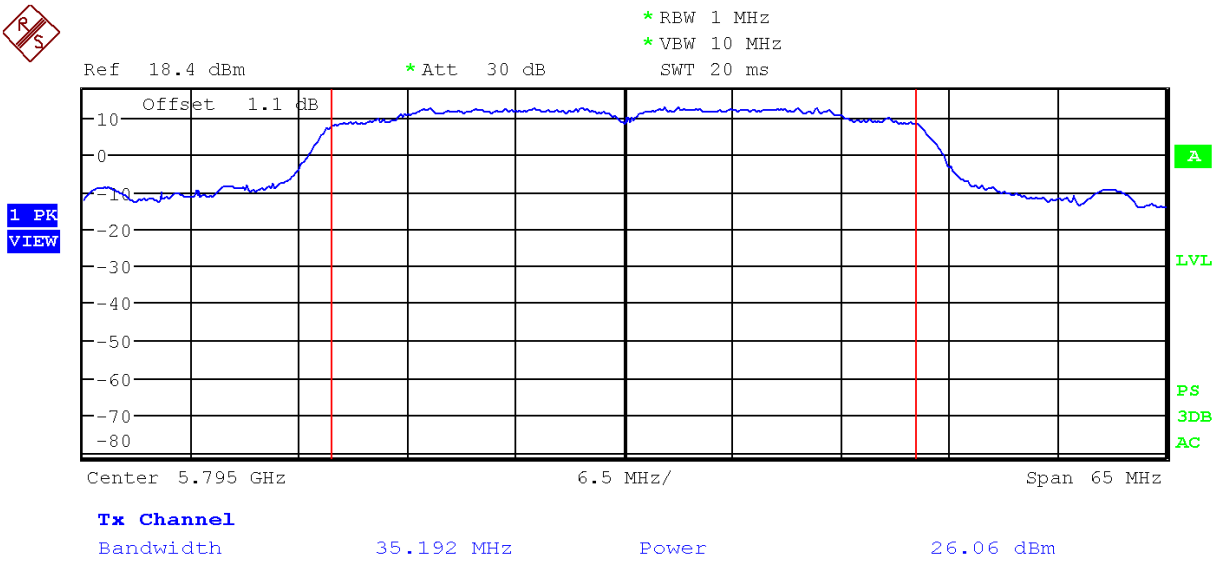


MIMO. Lowest Channel: 5785 MHz. Chain A+B. Port A

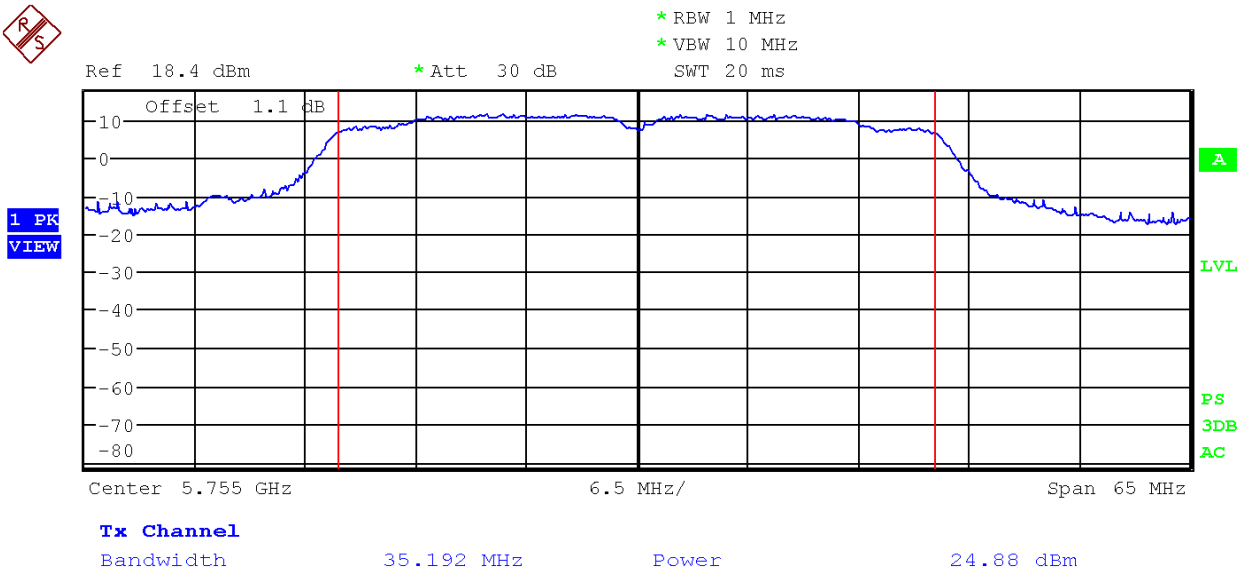



3. WiFi 5GHz 802.11 n40 mode

SISO. Highest Channel: 5795 MHz. Chain B

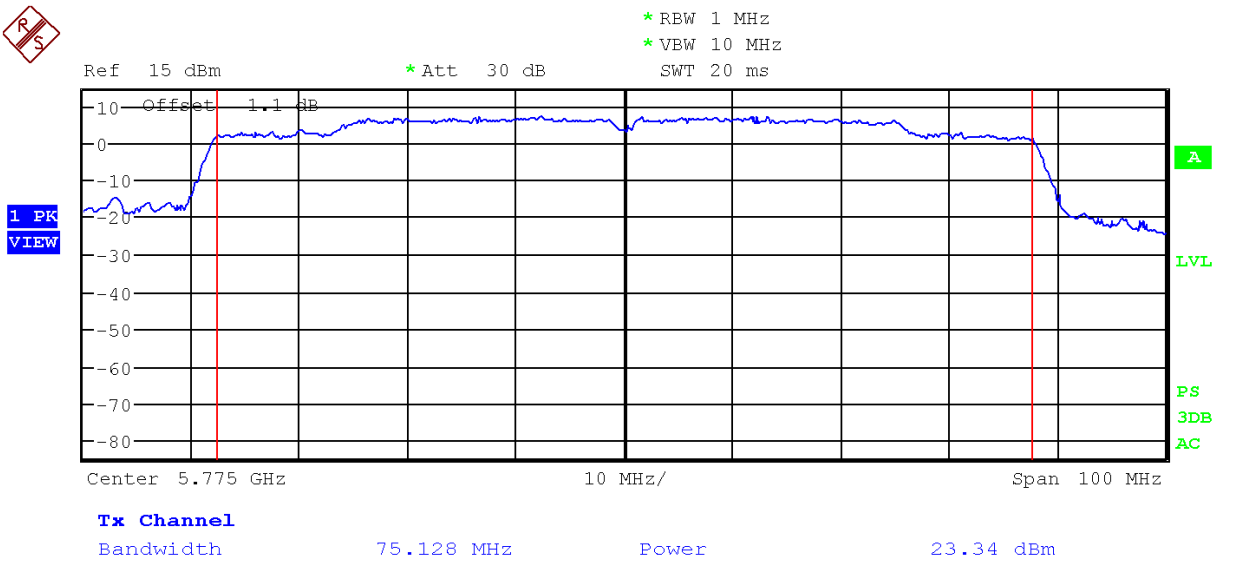


MIMO. Lowest Channel: 5755 MHz. Chain A+B. Port A

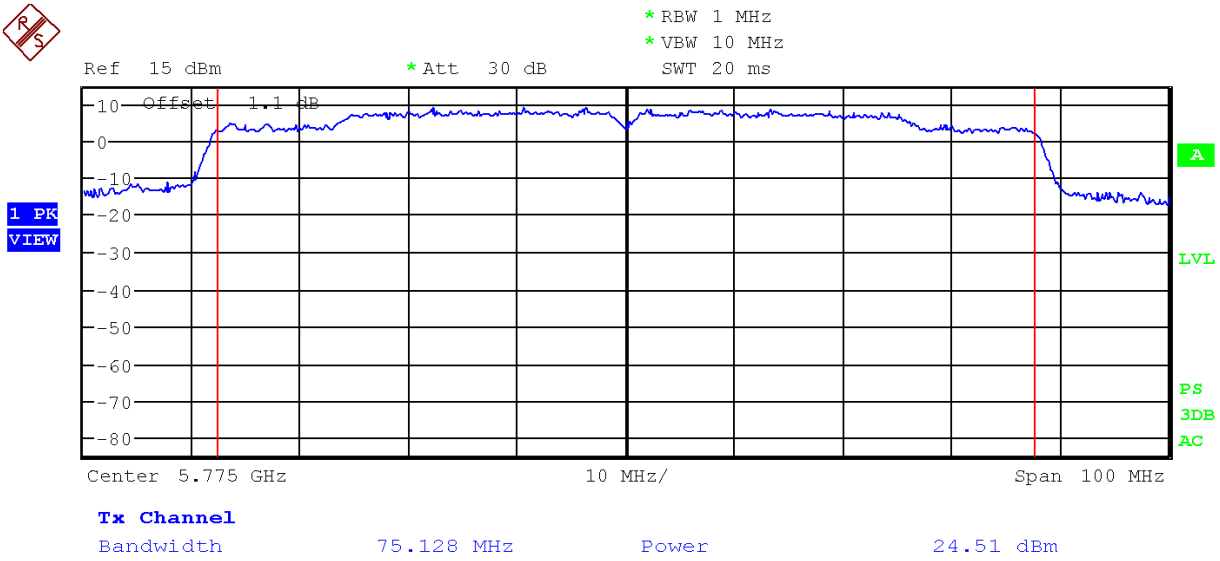



4. WiFi 5GHz 802.11 ac80 mode

SISO. Middle Channel: 5775 MHz. Chain B.



MIMO. Middle Channel: 5775 MHz. Chain A+B. Port A



## Section 15.247 Subclause (d) / RSS-210 A8.5. Emission limitations conducted (Transmitter)

SPECIFICATION

In any 100 kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

1. WiFi 5GHz 802.11 a mode

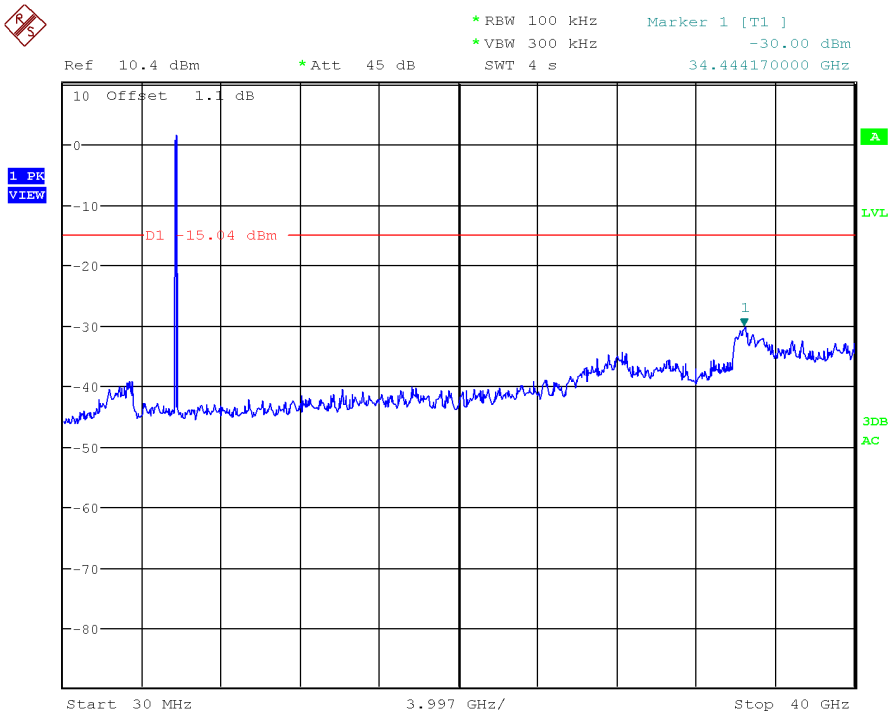
Reference Level Measurement

| | Lowest frequency 5745 MHz | | Middle frequency 5785 MHz | | Highest frequency 5825 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| Reference Level Measurement (dBm) | 4.96 | 5.43 | 5.00 | 5.48 | 6.42 | 6.21 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

RESULTS: (See next plots)

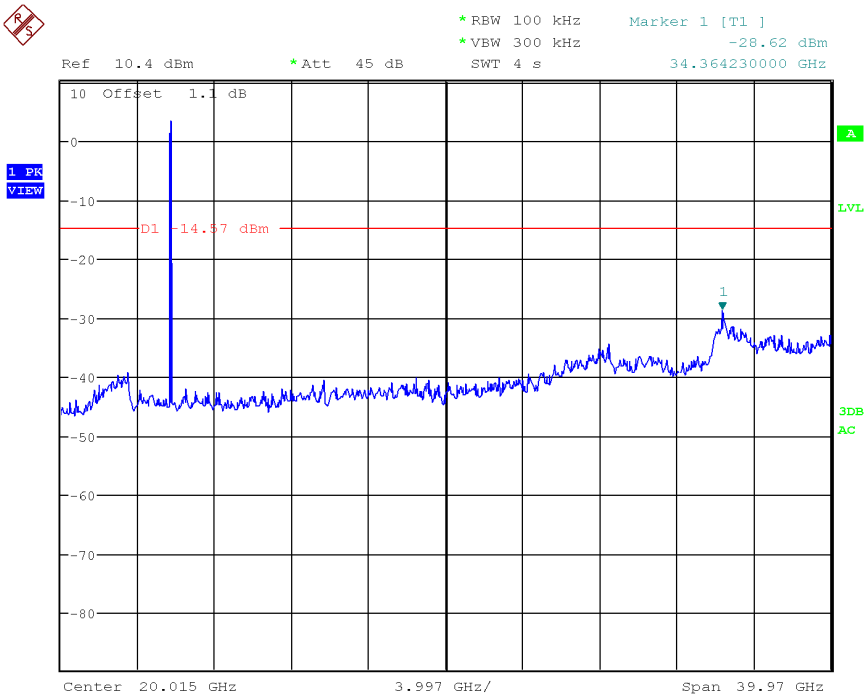
Verdict: PASS

Lowest Channel: 5745 MHz. Chain A. Unwanted Emissions Level Measurement



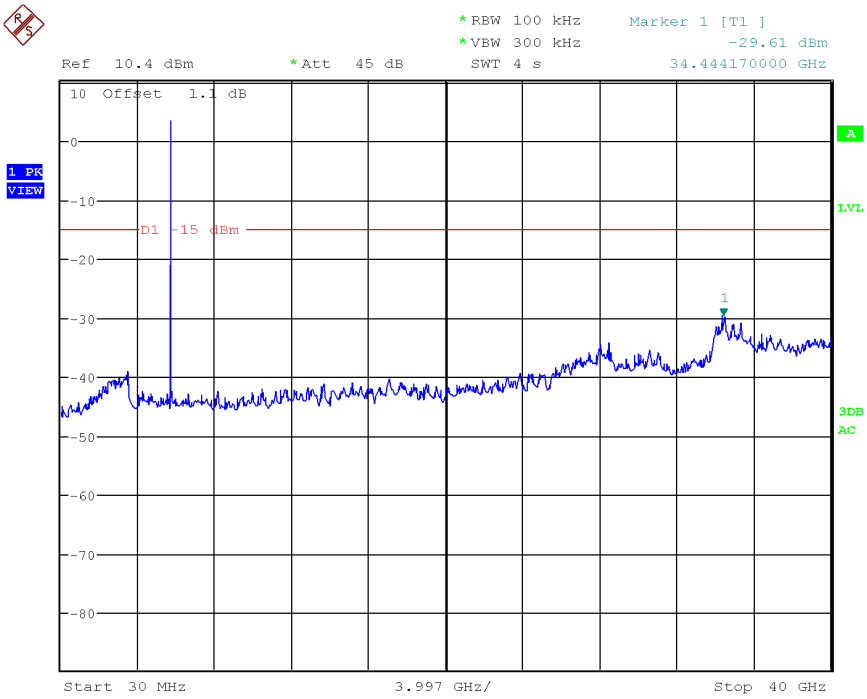

Note: The peak above the limit is the carrier frequency.

Lowest Channel: 5745 MHz. Chain B. Unwanted Emissions Level Measurement



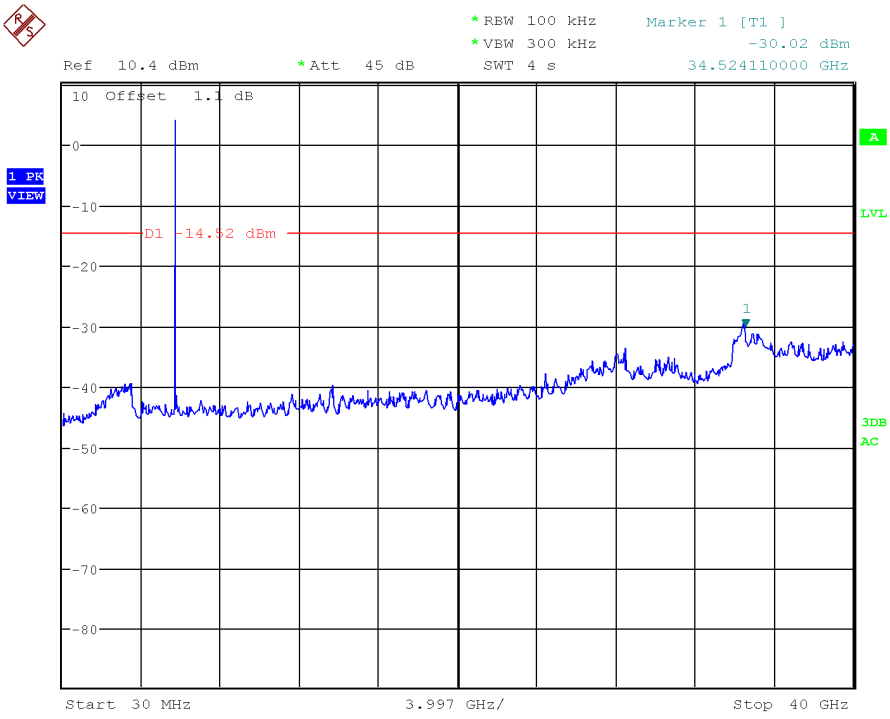

Note: The peak above the limit is the carrier frequency.

Middle Channel: 5785 MHz. Chain A. Unwanted Emissions Level Measurement



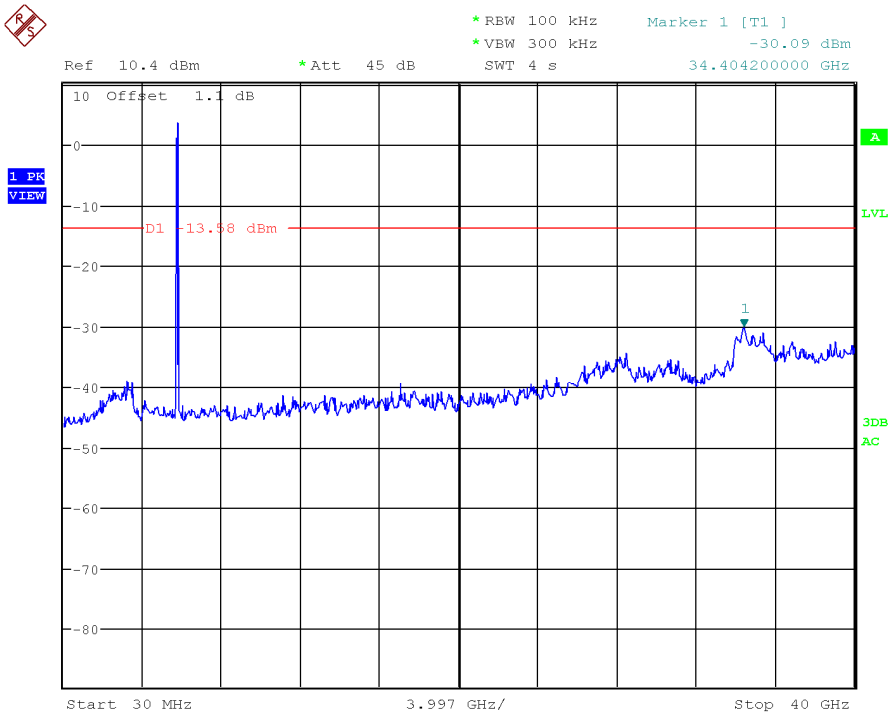

Note: The peak above the limit is the carrier frequency.

Middle Channel: 5785 MHz. Chain B. Unwanted Emissions Level Measurement



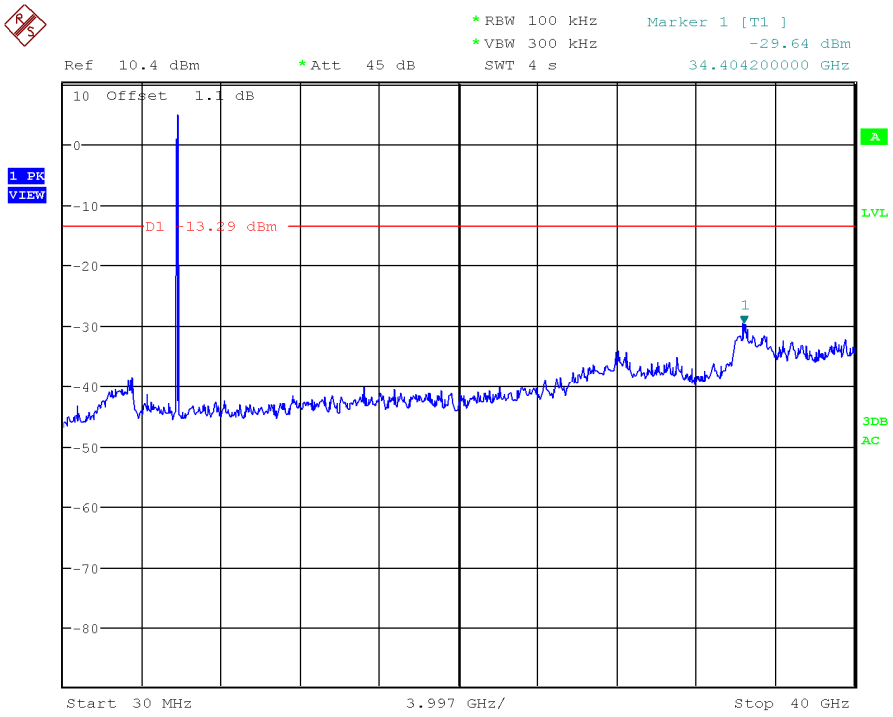

Note: The peak above the limit is the carrier frequency.

Highest Channel: 5825 MHz. Chain A. Unwanted Emissions Level Measurement




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

Highest Channel: 5825 MHz. Chain B. Unwanted Emissions Level Measurement




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

2. WiFi 5GHz 802.11 n20 mode

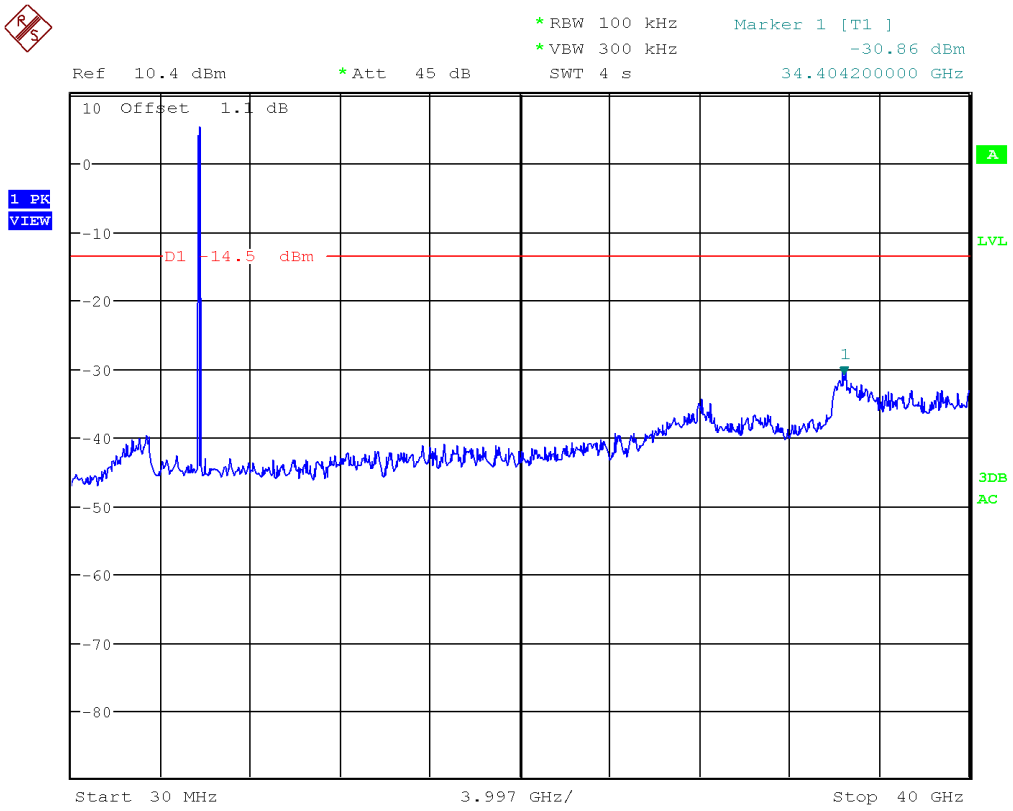
Reference Level Measurement

| | Lowest frequency 5745 MHz | | Middle frequency 5785 MHz | | Highest frequency 5825 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| Reference Level Measurement (dBm) | 5.50 | 5.55 | 5.11 | 5.53 | 6.11 | 7.18 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

RESULTS: (See next plots)

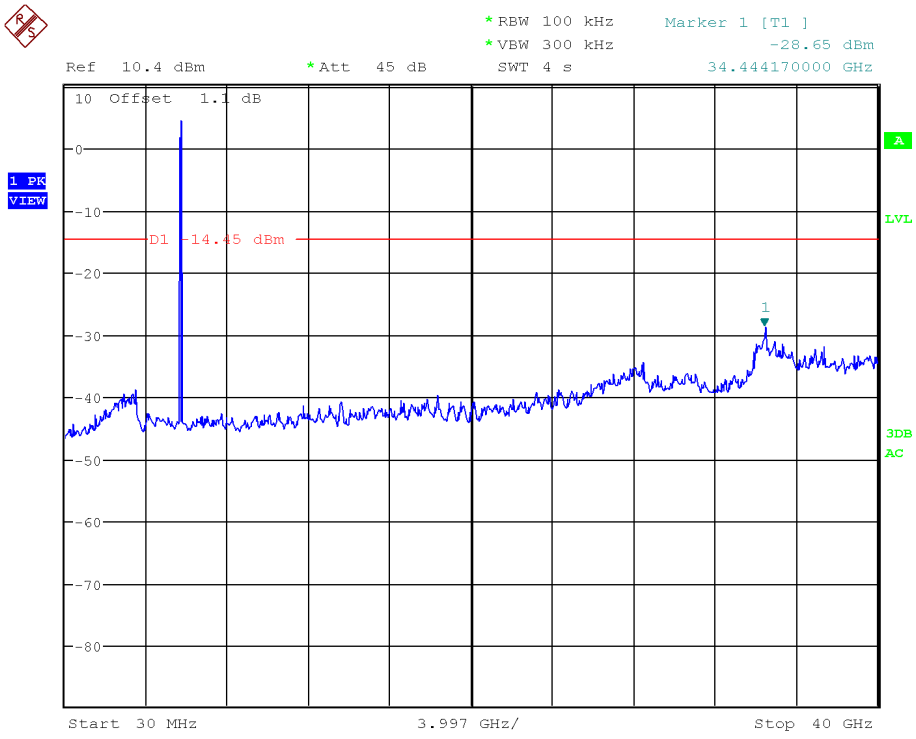
Verdict: PASS

Lowest Channel: 5745 MHz. Chain A. Unwanted Emissions Level Measurement



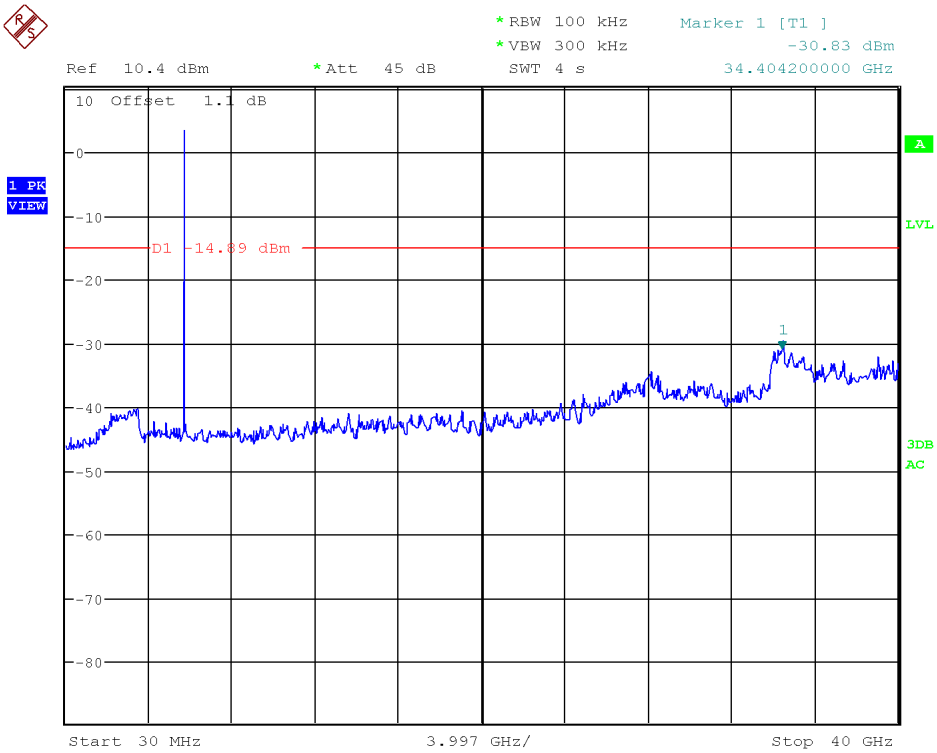

Note: The peak above the limit is the carrier frequency.

Lowest Channel: 5745 MHz. Chain B. Unwanted Emissions Level Measurement



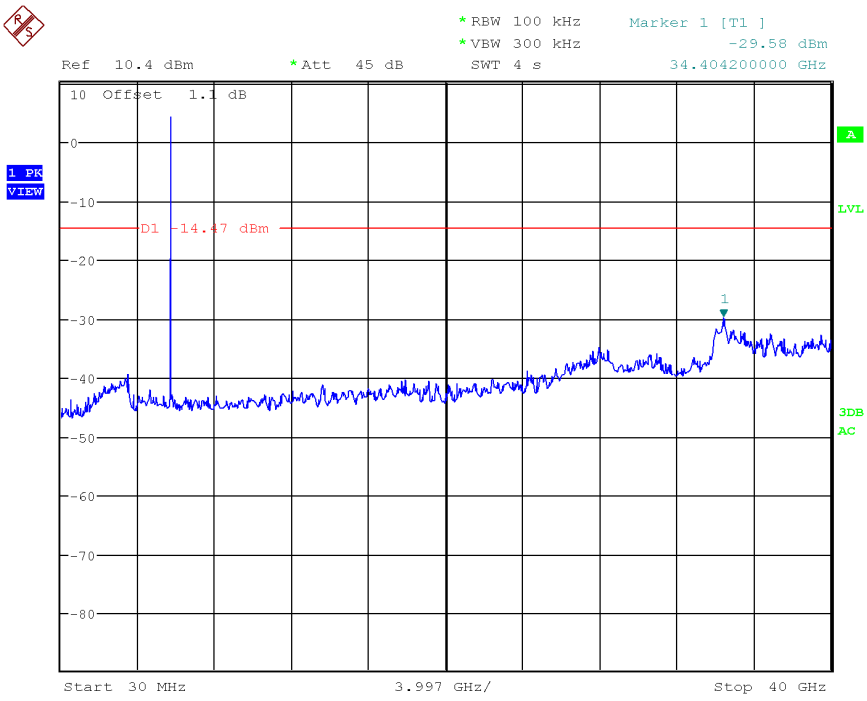

Note: The peak above the limit is the carrier frequency.

Middle Channel: 5785 MHz. Chain A. Unwanted Emissions Level Measurement



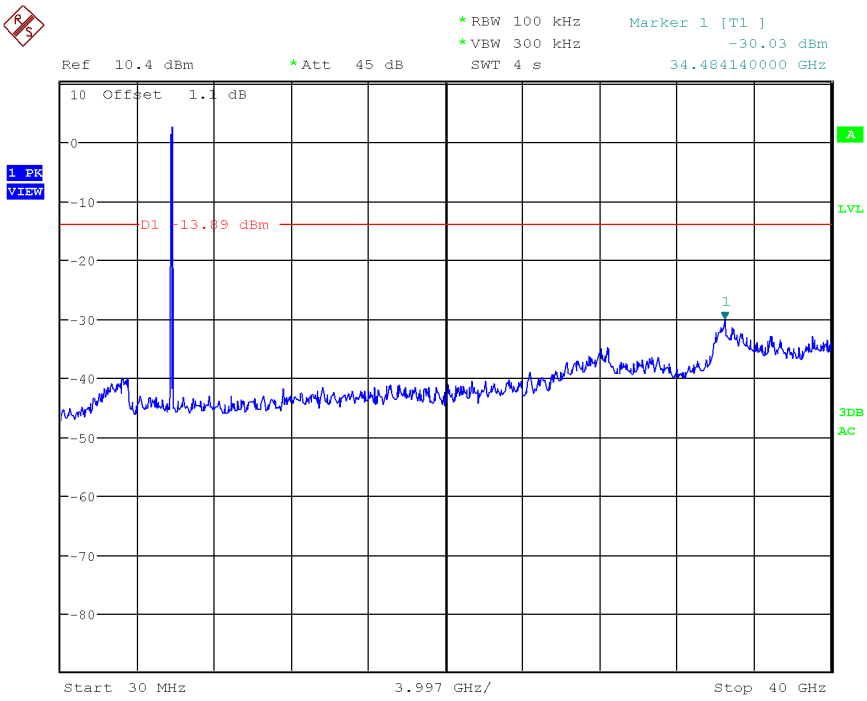

Note: The peak above the limit is the carrier frequency.

Middle Channel: 5785 MHz. Chain B. Unwanted Emissions Level Measurement



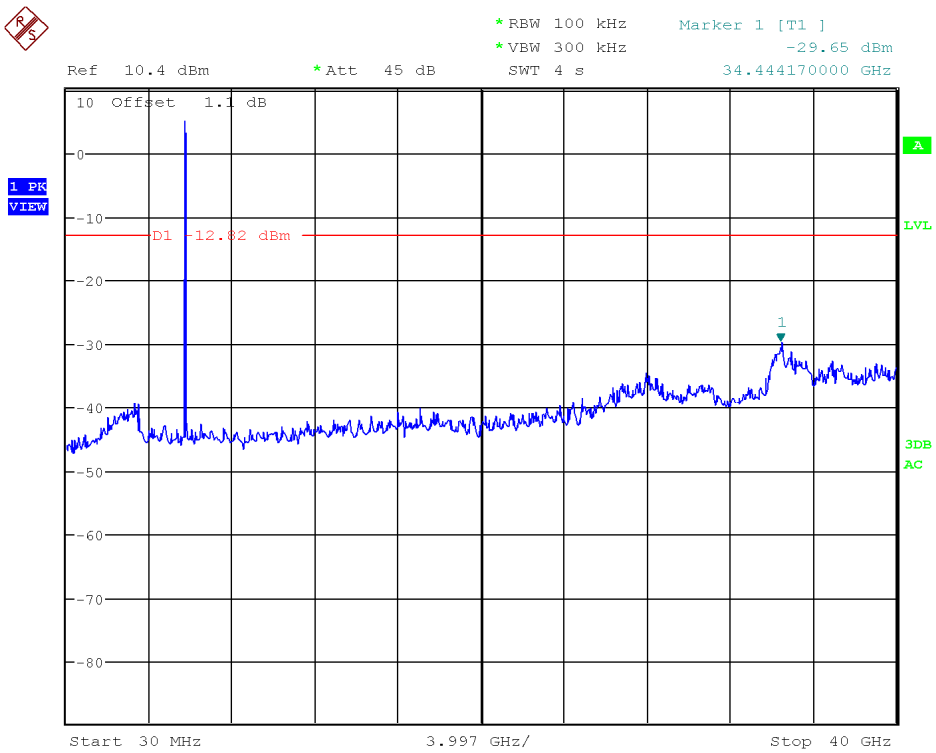

Note: The peak above the limit is the carrier frequency.

Highest Channel: 5825 MHz. Chain A. Unwanted Emissions Level Measurement




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

Highest Channel: 5825 MHz. Chain B. Unwanted Emissions Level Measurement




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

3. WiFi 5GHz 802.11 n40 mode

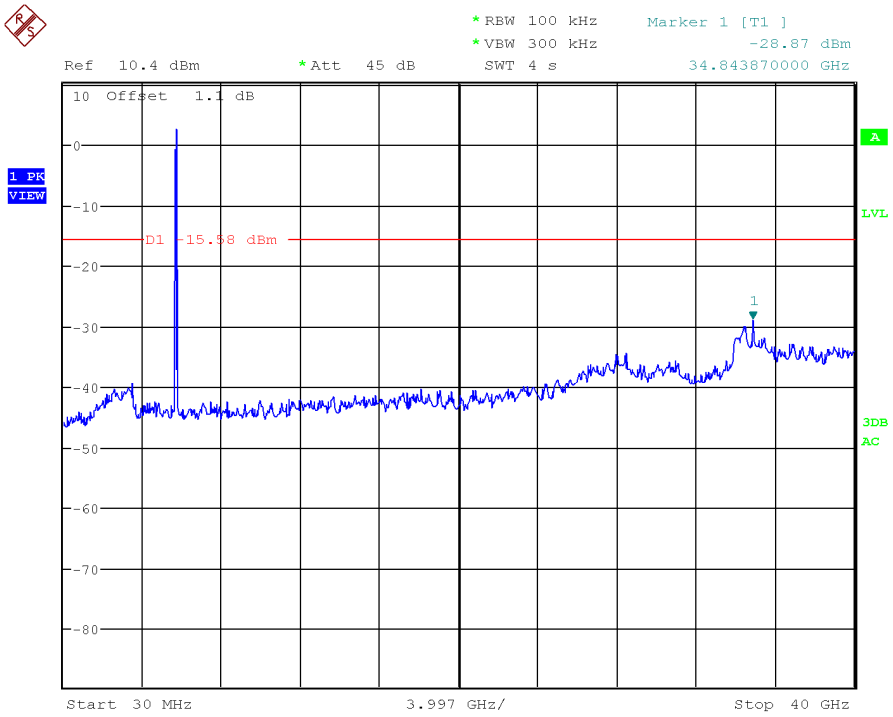
Reference Level Measurement

| | Lowest frequency 5755 MHz | | Highest frequency 5795 MHz | |
|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B |
| Reference Level Measurement (dBm) | 4.42 | 3.66 | 4.10 | 4.36 |
| Measurement uncertainty (dB) | ±1.5 | | | |

RESULTS: (See next plots)

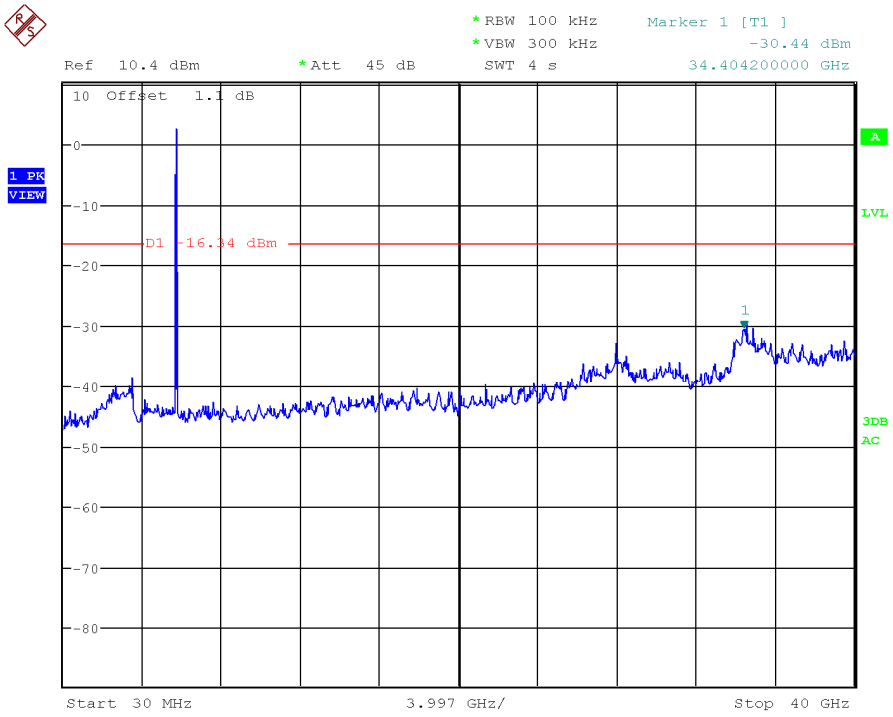
Verdict: PASS

Lowest Channel: 5755 MHz. Chain A. Unwanted Emissions Level Measurement



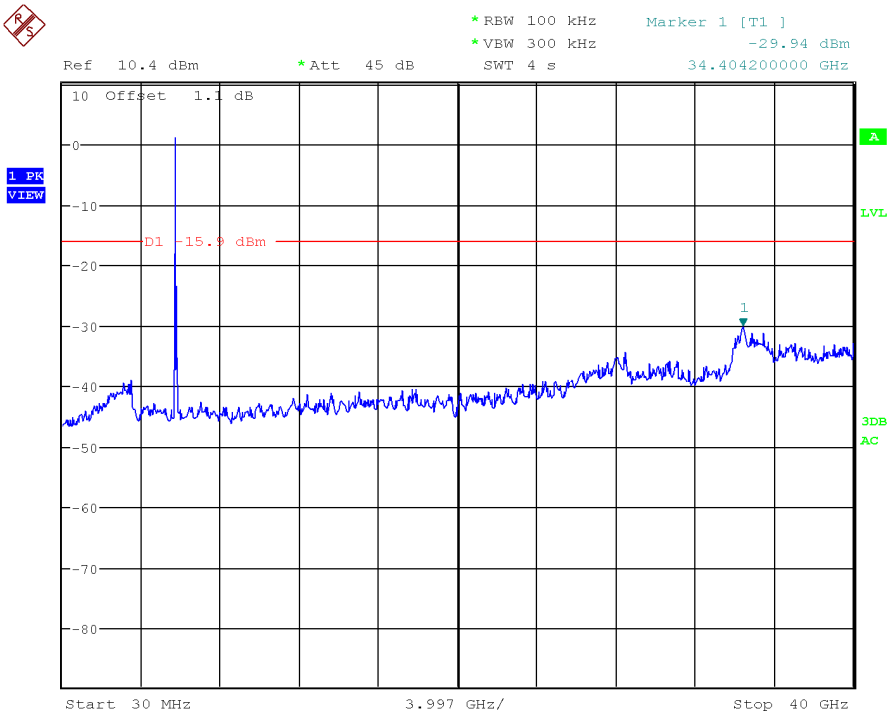

Note: The peak above the limit is the carrier frequency.

Lowest Channel: 5755 MHz. Chain B. Unwanted Emissions Level Measurement



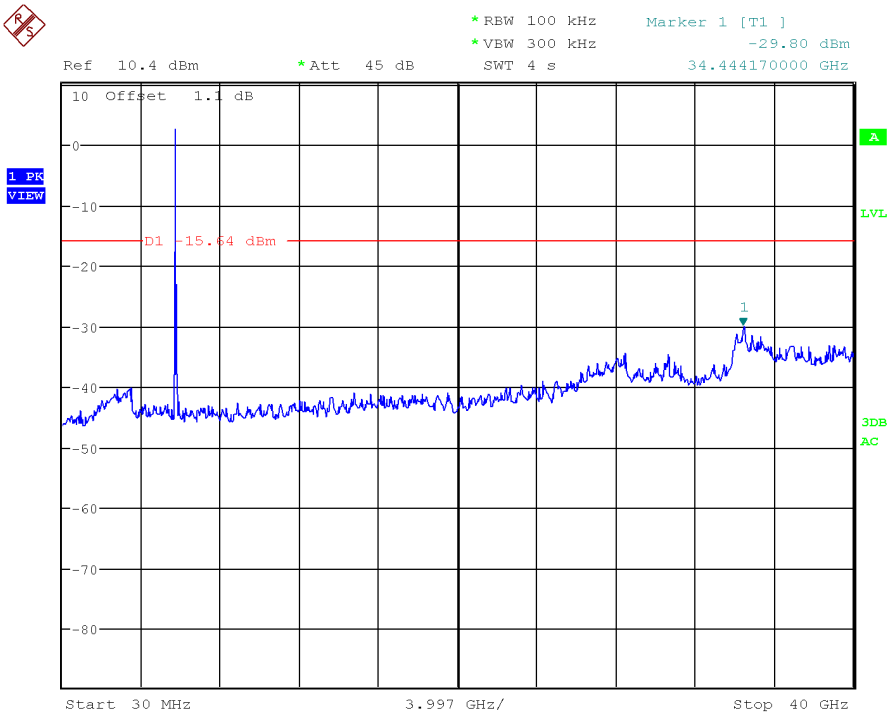

Note: The peak above the limit is the carrier frequency.

Highest Channel: 5795 MHz. Chain A. Unwanted Emissions Level Measurement




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

Highest Channel: 5795 MHz. Chain B. Unwanted Emissions Level Measurement




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

4. WiFi 5GHz 802.11 ac80 mode

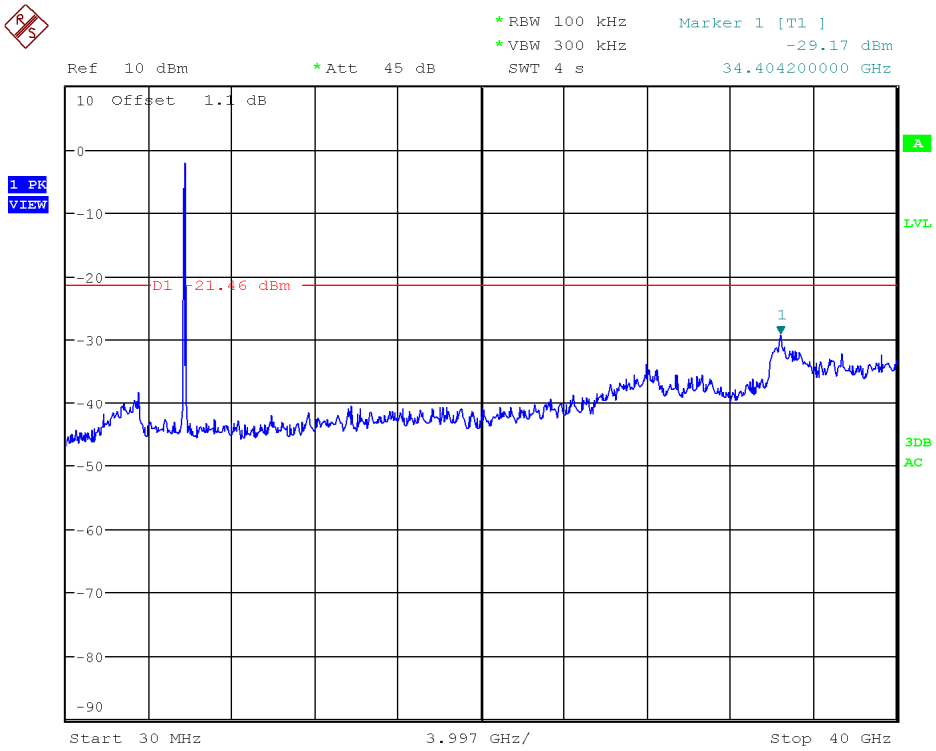
Reference Level Measurement

| | Middle frequency 5775 MHz | |
|---|---|---|
| | Chain A | Chain B |
| Reference Level Measurement (dBm) | -1.46 | -1.81 |
| Measurement uncertainty (dB) | ±1.5 | |

RESULTS: (See next plots)

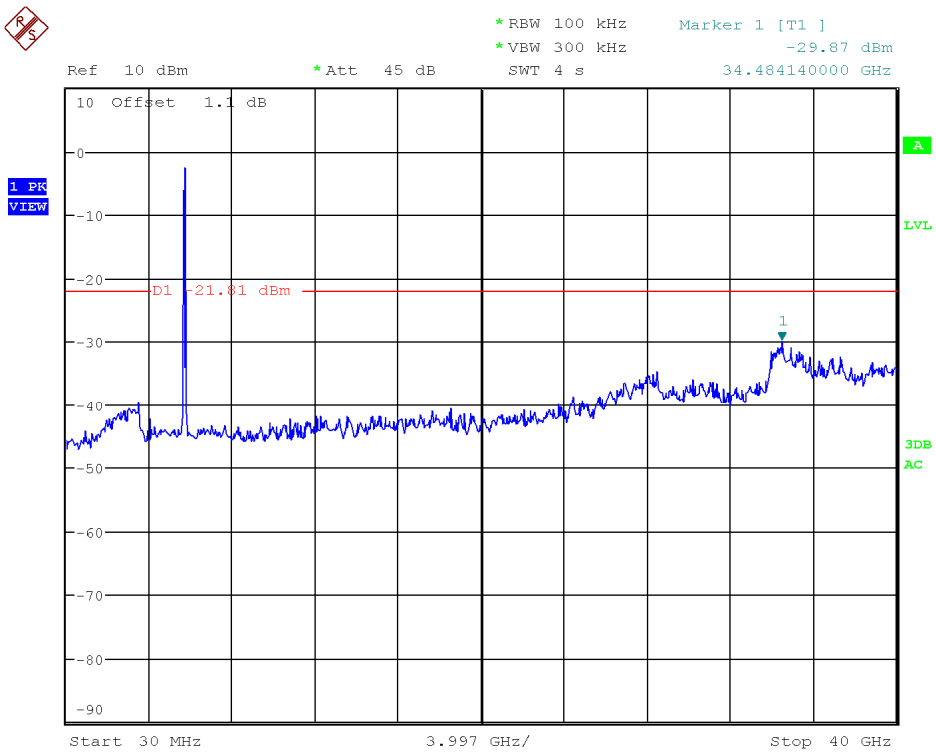
Verdict: PASS

Middle Channel: 5775 MHz. Chain A. Unwanted Emissions Level Measurement




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

Middle Channel: 5775 MHz. Chain B. Unwanted Emissions Level Measurement




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

## Section 15.247 Subclause (d) / RSS-210 A8.5. Band-edge emissions compliance (Transmitter)

SPECIFICATION

Emissions outside the frequency band in which the intentional radiator is operating shall be at least 20dB below the highest level of the desired power.

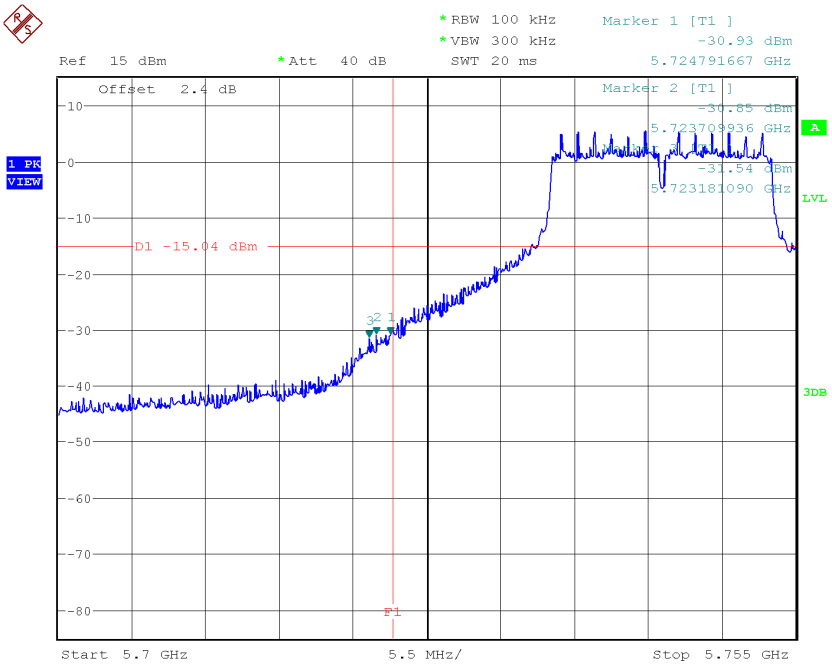
RESULTS:

1. WiFi 5GHz 802.11 a mode

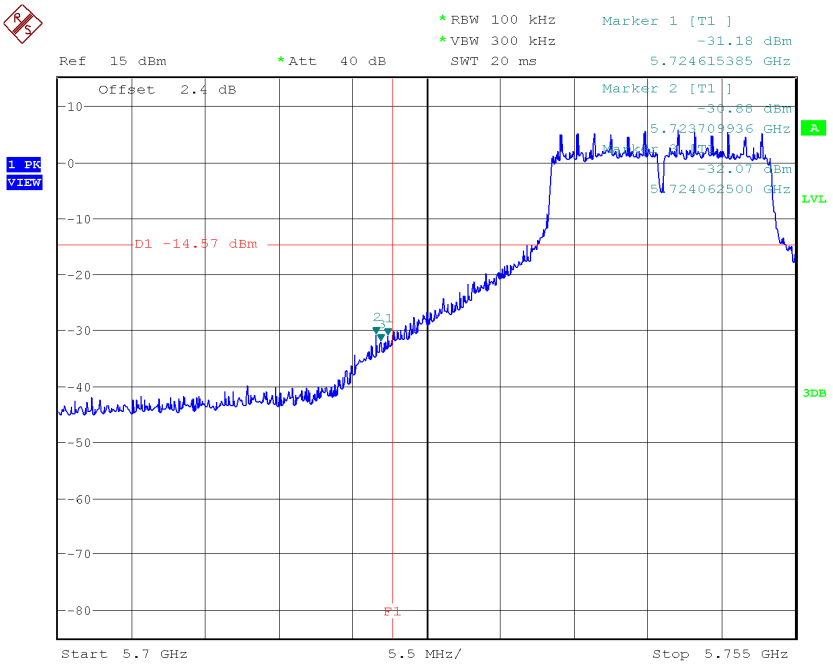
**LOW FREQUENCY SECTION 5745 MHz. CONDUCTED.**

See next plots.

Chain A



Chain B

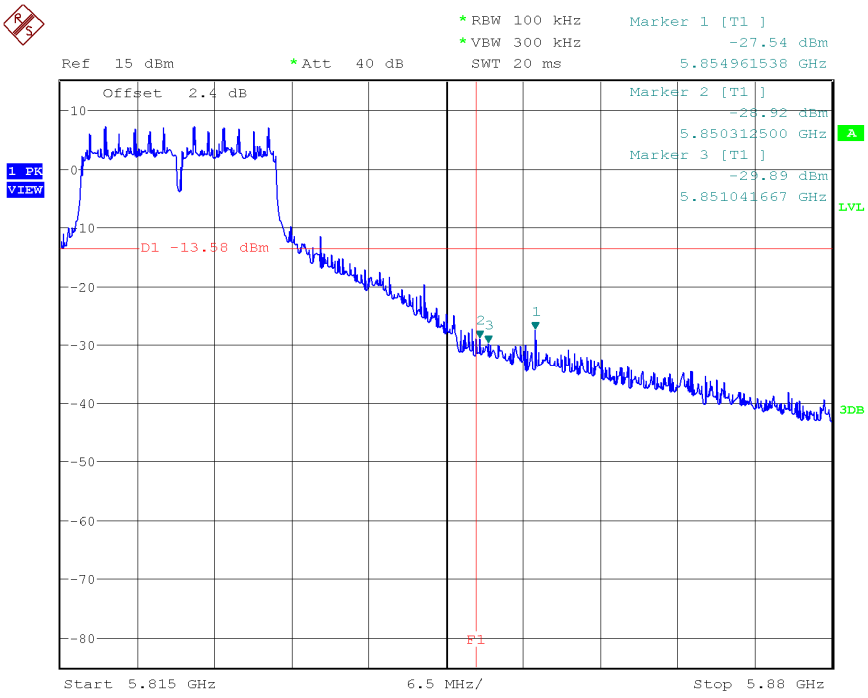



Date: 30.JAN.2013 10:32:16

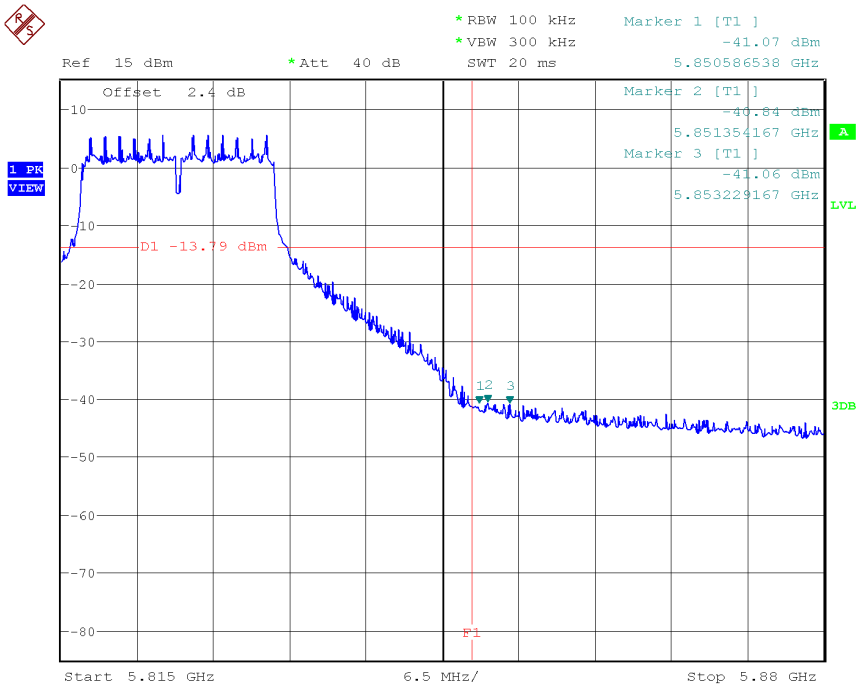
**HIGH FREQUENCY SECTION 5825 MHz. CONDUCTED.**

See next plots.

Chain A



Chain B

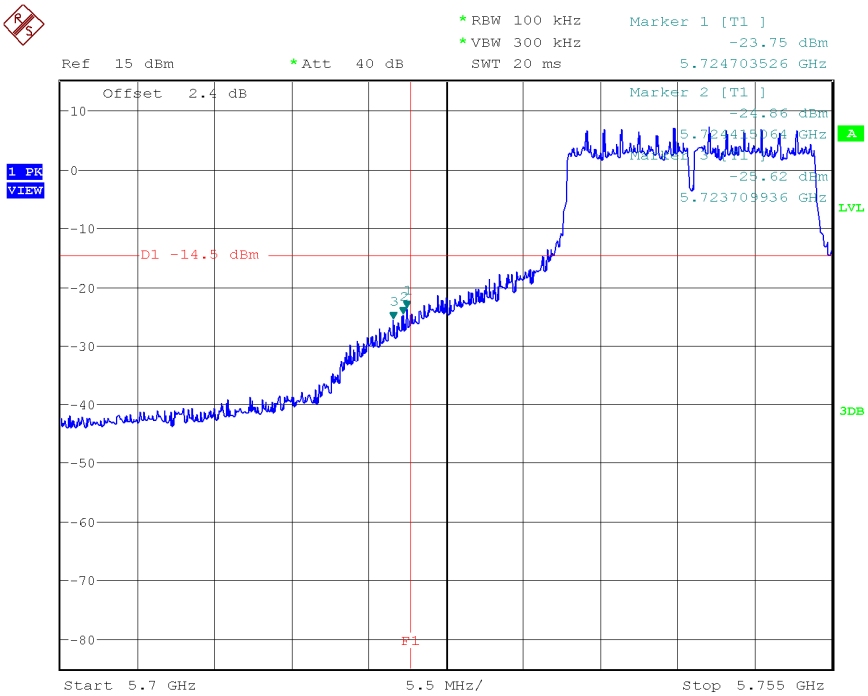



2. WiFi 5GHz 802.11 n20 mode

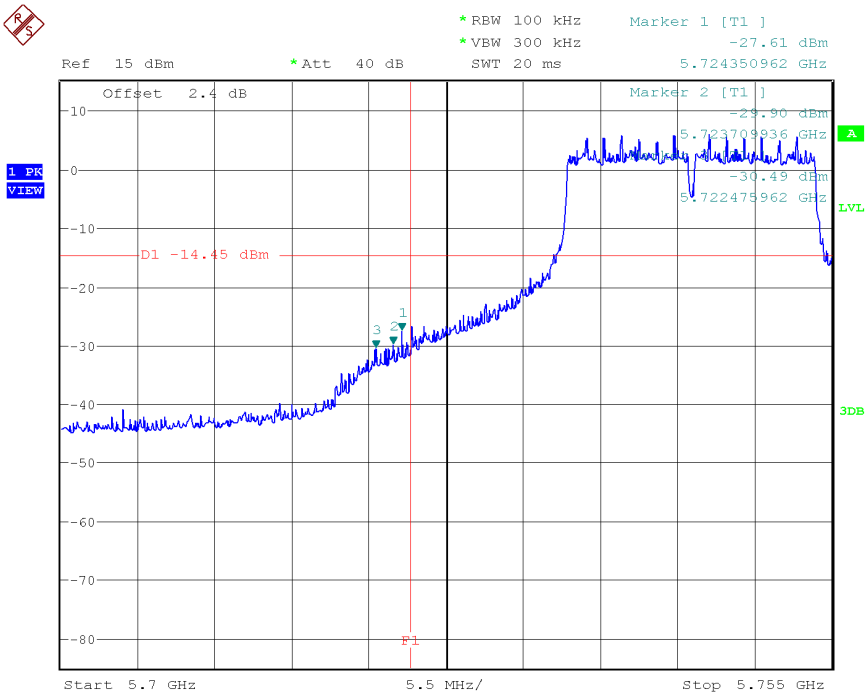
**LOW FREQUENCY SECTION 5745 MHz. CONDUCTED.**

See next plots.

Chain A



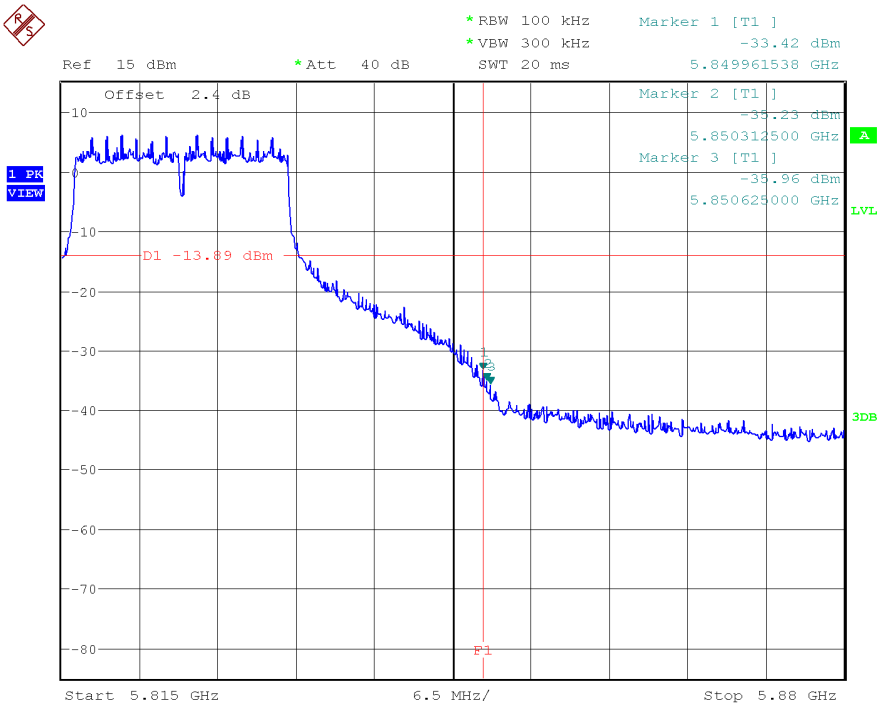
Chain B



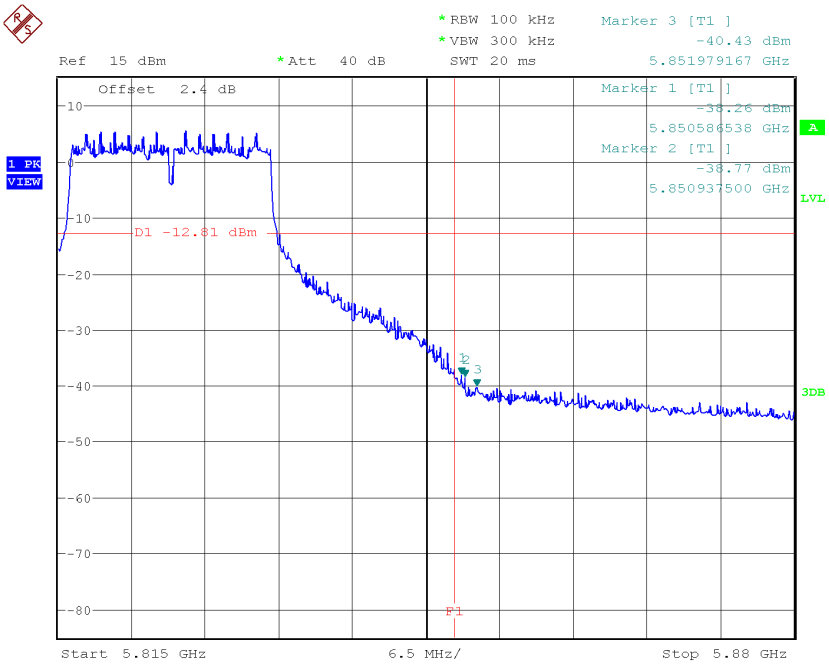

**HIGH FREQUENCY SECTION 5825 MHz. CONDUCTED.**

See next plots.

Chain A



Chain B

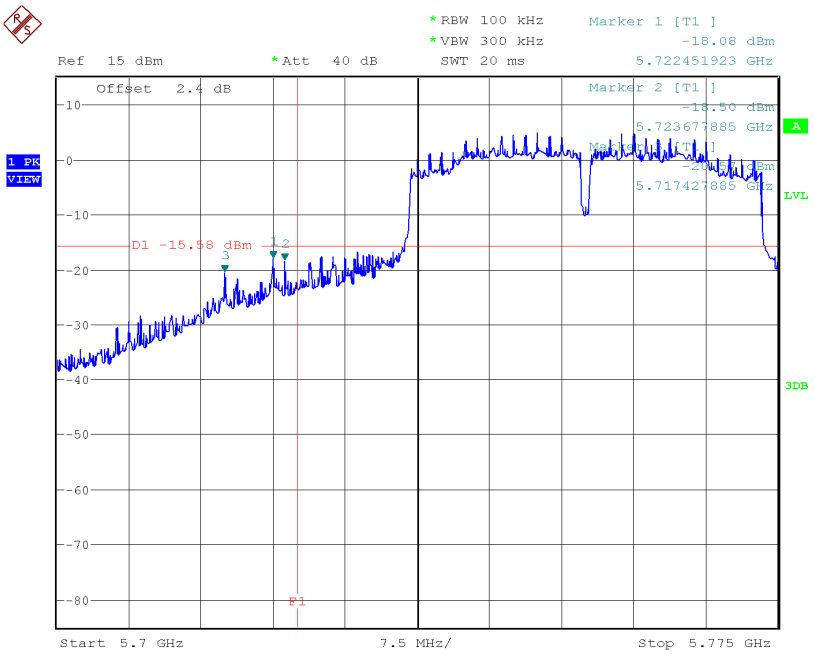



3. WiFi 5GHz 802.11 n40 mode

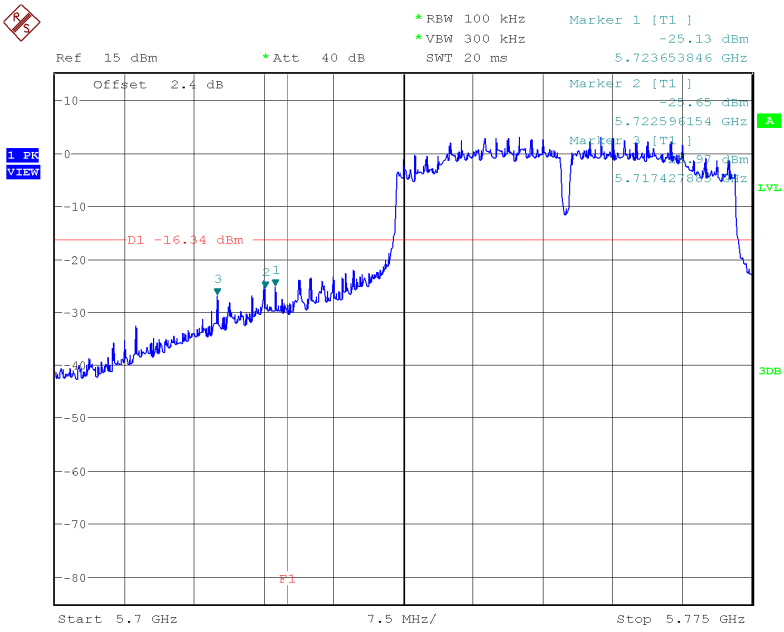
**LOW FREQUENCY SECTION 5755 MHz. CONDUCTED.**

See next plots.

Chain A



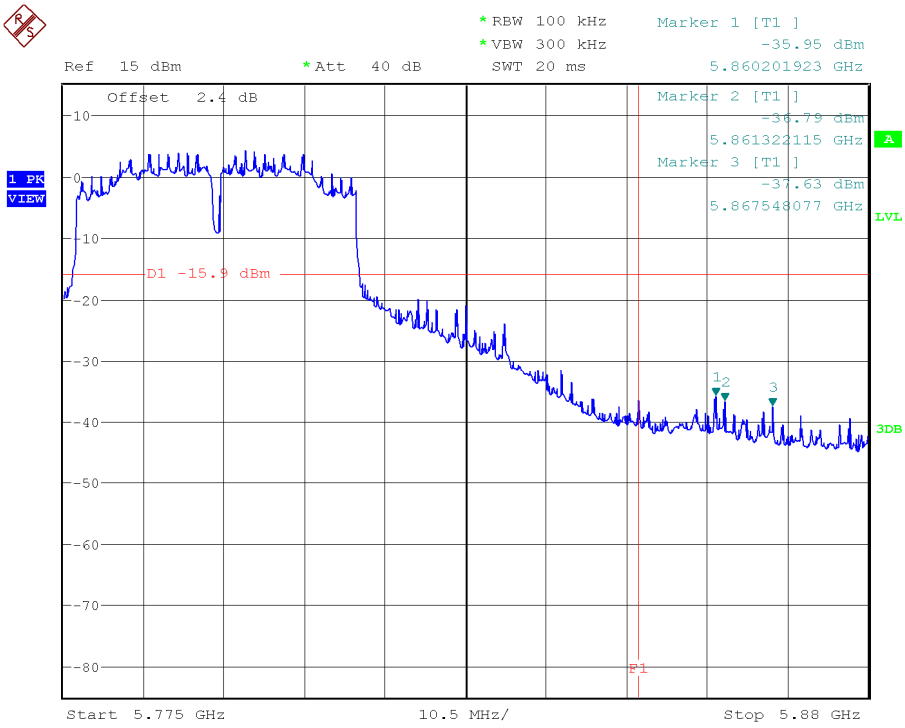
Chain B



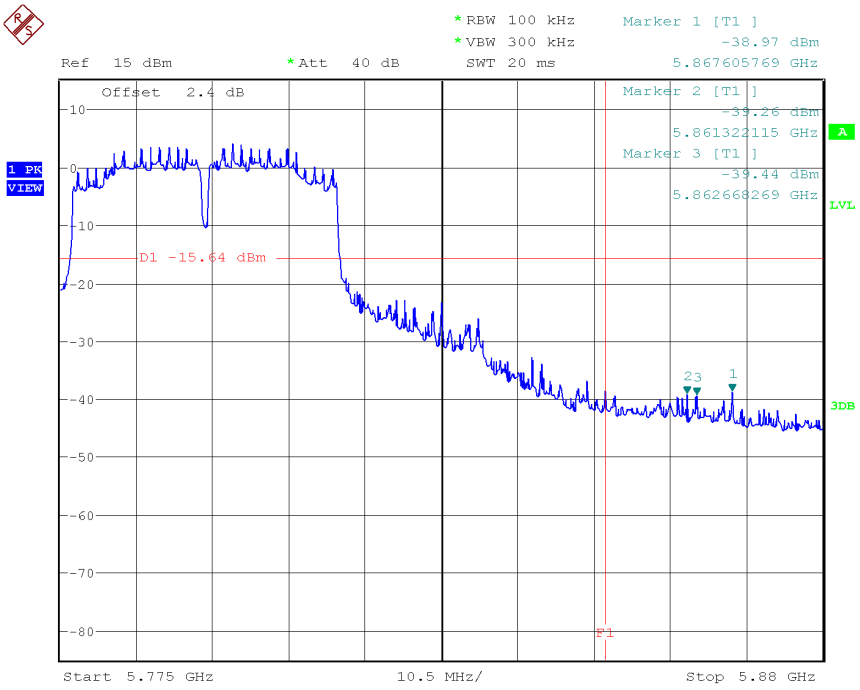

**HIGH FREQUENCY SECTION 5795 MHz. CONDUCTED.**

See next plots.

Chain A



Chain B

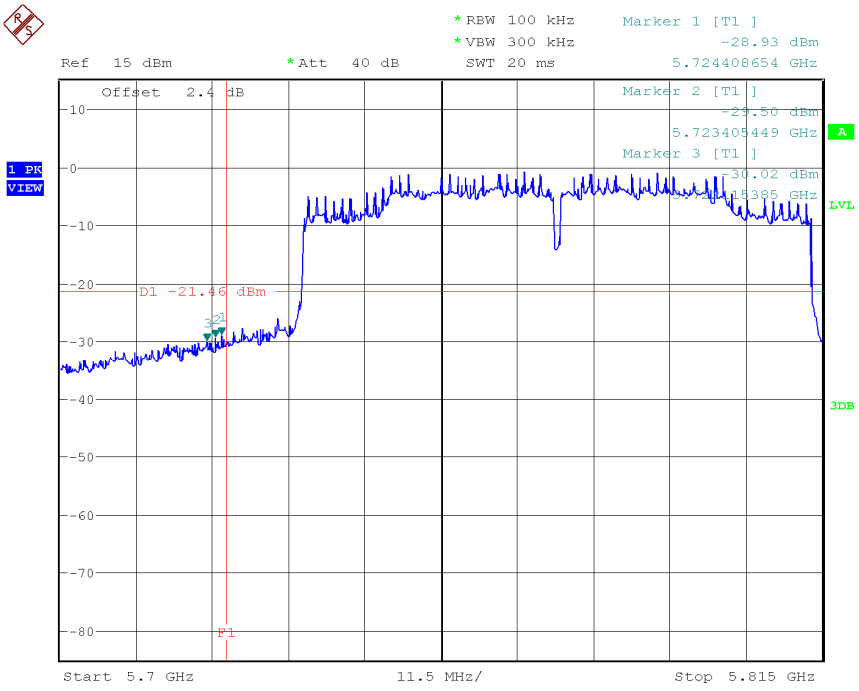



4. WiFi 5GHz 802.11 ac80 mode

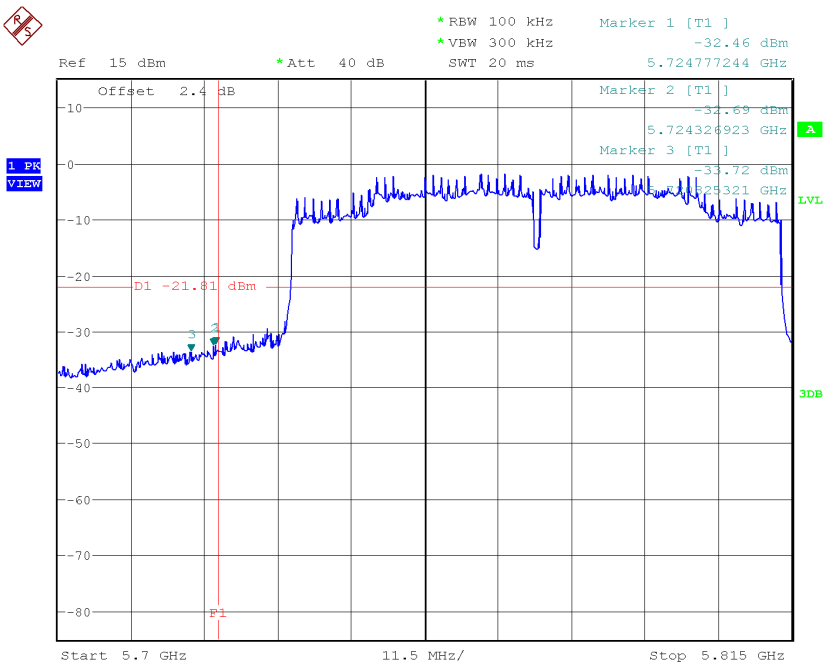
**LOW FREQUENCY SECTION 5755 MHz. CONDUCTED.**

See next plots.

Chain A



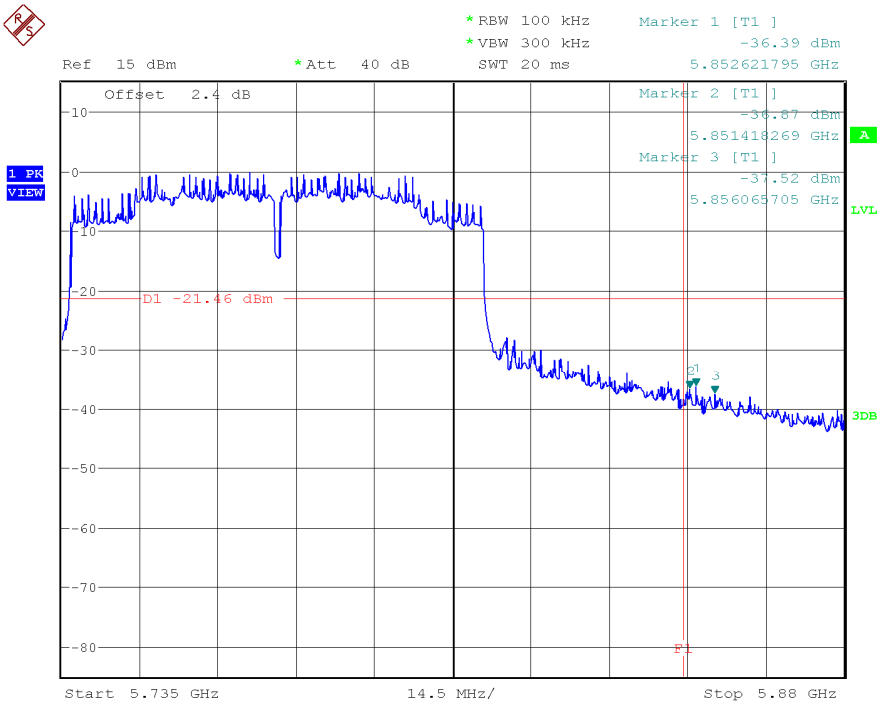
Chain B



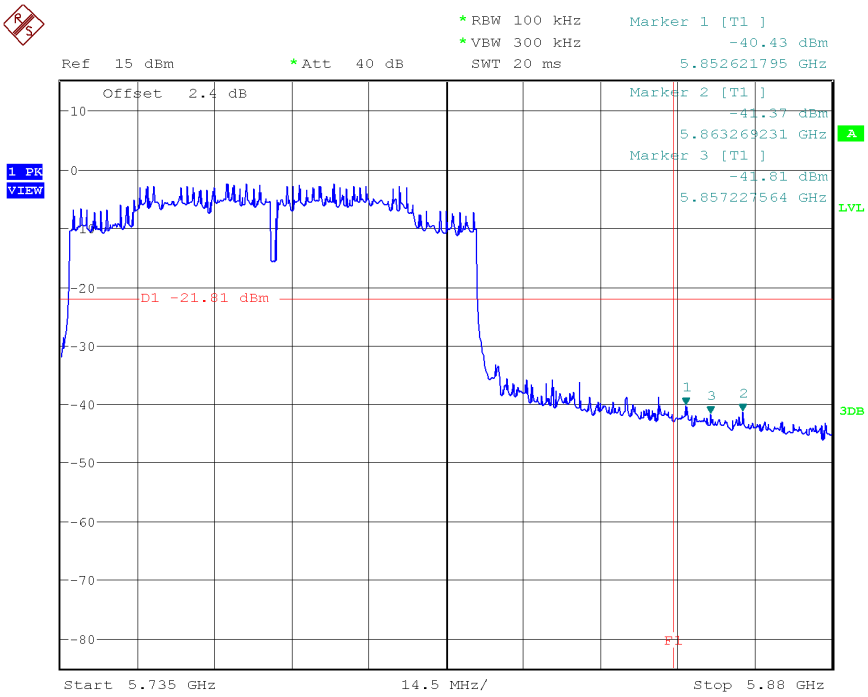

**HIGH FREQUENCY SECTION 5775 MHz. CONDUCTED.**

See next plots.

Chain A



Chain B


RBW 100 kHz
VBW 300 kHz
SWT 20 ms
Marker 1 [T1 ]
-40.43 dBm
5.852621795 GHz
Ref 15 dBm
Att 40 dB
Offset 2.4 dB
Marker 2 [T1 ]
-41.37 dBm
5.863269231 GHz
Marker 3 [T1 ]
-41.81 dBm
5.857227564 GHz
1 PK
VIEW
A
LVL
3DB
D1 -21.81 dBm
10
0
-20
-30
-40
-50
-60
-70
-80
Start 5.735 GHz
14.5 MHz/
Stop 5.88 GHz

## Section 15.247 Subclause (e) / RSS-210 A8.5. Power spectral density

SPECIFICATION

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

RESULTS

The maximum power spectral density level was measured using the method according to point 9.1. Option 1 of Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v02 dated 10/04/2012.

For MIMO mode, the *Measure and add 10 log(NANT) dB*, (where *NANT* is the number of outputs) technique was used according to the Guidance for Emission Testing of Transmitters with Multiple Outputs in the Same Band 662911 D01 Multiple Transmitter Output v01r02 dated 9/26/2012.
With this technique, spectrum measurements are performed at each output of the device, and the quantity *10 log(NANT)* dB is added to each spectrum value before comparing to the emission limit. Number of outputs = 2.

1. WiFi 5GHz 802.11 a mode

Power spectral density (See next plot of worst case = highest level).

| | Lowest frequency 5745 MHz | | Middle frequency 5785 MHz | | Highest frequency 5825 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| Power spectral density (dBm) in 3 kHz bandwidth | -8.78 | -8.87 | -9.12 | -8.95 | -8.60 | -7.39 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

Verdict: PASS

2. WiFi 5GHz 802.11 n20 mode

Power spectral density (See next plot of worst case = highest level).

| SISO | Lowest frequency 5745 MHz | | Middle frequency 5785 MHz | | Highest frequency 5825 MHz | |
|---|---|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B | Chain A | Chain B |
| Power spectral density (dBm) in 3 kHz bandwidth | -8.06 | -8.68 | -8.75 | -9.14 | -8.59 | -8.46 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

| MIMO | Lowest frequency 5745 MHz | | Middle frequency 5785 MHz | | Highest frequency 5825 MHz | |
|---|---|---|---|---|---|---|
| | Chain A+B | | Chain A+B | | Chain A+B | |
| | Port A | Port B | Port A | Port B | Port A | Port B |
| Power spectral density (dBm) in 3 kHz bandwidth | -10.08 | -11.27 | -11.24 | -11.29 | -9.99 | -10.64 |
| Power spectral density (dBm) in 3 kHz bandwidth + 10*Log(2) | -7.08 | -8.27 | -8.24 | -8.29 | -6.99 | -7.64 |
| Measurement uncertainty (dB) | ±1.5 | | | | | |

Verdict: PASS

3. WiFi 5GHz 802.11 n40 mode

Power spectral density (See next plot of worst case = highest level).

| SISO | Lowest frequency 5755 MHz | | Highest frequency 5795 MHz | |
|---|---|---|---|---|
| | Chain A | Chain B | Chain A | Chain B |
| Power spectral density (dBm) in 3 kHz bandwidth | -10.90 | -9.87 | -10.53 | -10.91 |
| Measurement uncertainty (dB) | ±1.5 | | | |

| MIMO | Lowest frequency 5755 MHz | | Highest frequency 5795 MHz | |
|---|---|---|---|---|
| | Chain A+B | | Chain A+B | |
| | Port A | Port B | Port A | Port B |
| Power spectral density (dBm) in 3 kHz bandwidth | -12.26 | -13.41 | -13.12 | -12.53 |
| Power spectral density (dBm) in 3 kHz bandwidth + 10*Log(2) | -9.26 | -10.41 | -10.12 | -9.53 |
| Measurement uncertainty (dB) | ±1.5 | | | |

Verdict: PASS

4. WiFi 5GHz 802.11 ac80 mode

Power spectral density (See next plot of worst case = highest level).

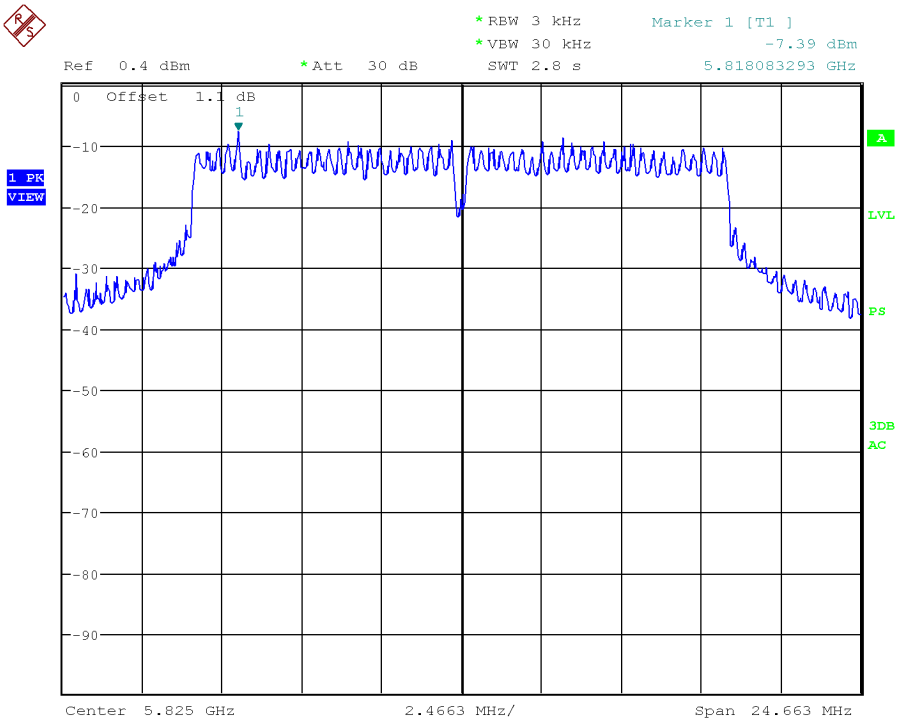
| SISO | Middle frequency 5775 MHz | |
|---|---|---|
| | Chain A | Chain B |
| Power spectral density (dBm) in 3 kHz bandwidth | -13.12 | -13.41 |
| Measurement uncertainty (dB) | ±1.5 | |

| MIMO | Lowest frequency 5755 MHz | |
|---|---|---|
| | Chain A+B | |
| | Port A | Port B |
| Power spectral density (dBm) in 3 kHz bandwidth | -12.35 | -11.81 |
| Power spectral density (dBm) in 3 kHz bandwidth + 10*Log(2) | -9.35 | -8.81 |
| Measurement uncertainty (dB) | ±1.5 | |

Verdict: PASS

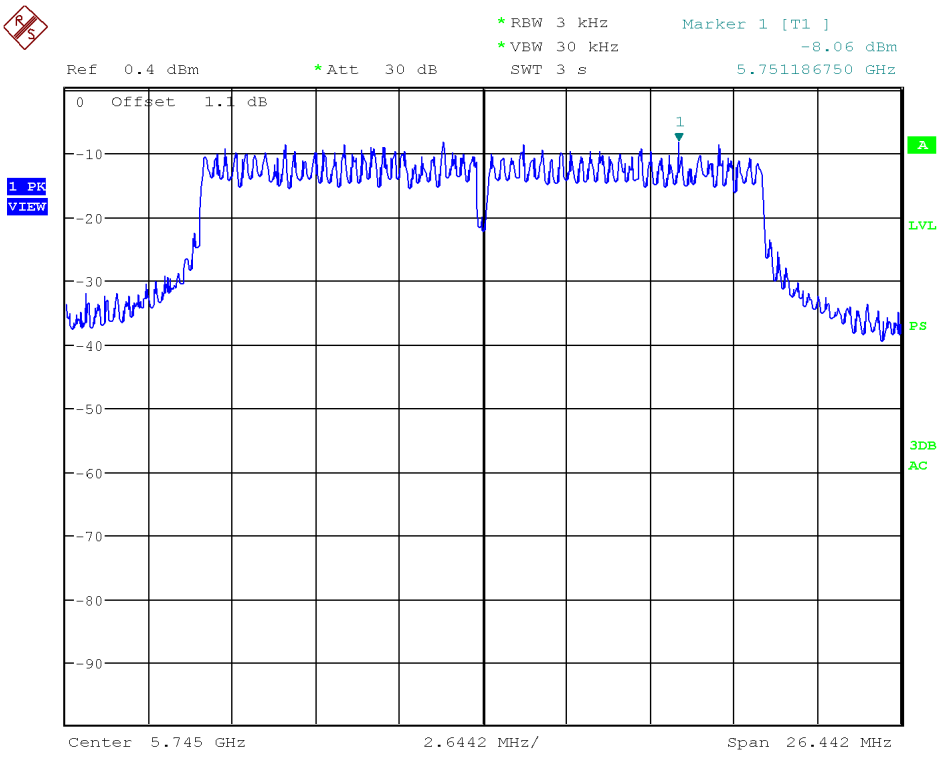
1. WiFi 5GHz 802.11 a mode

Highest Channel: 5825 MHz. Chain B.

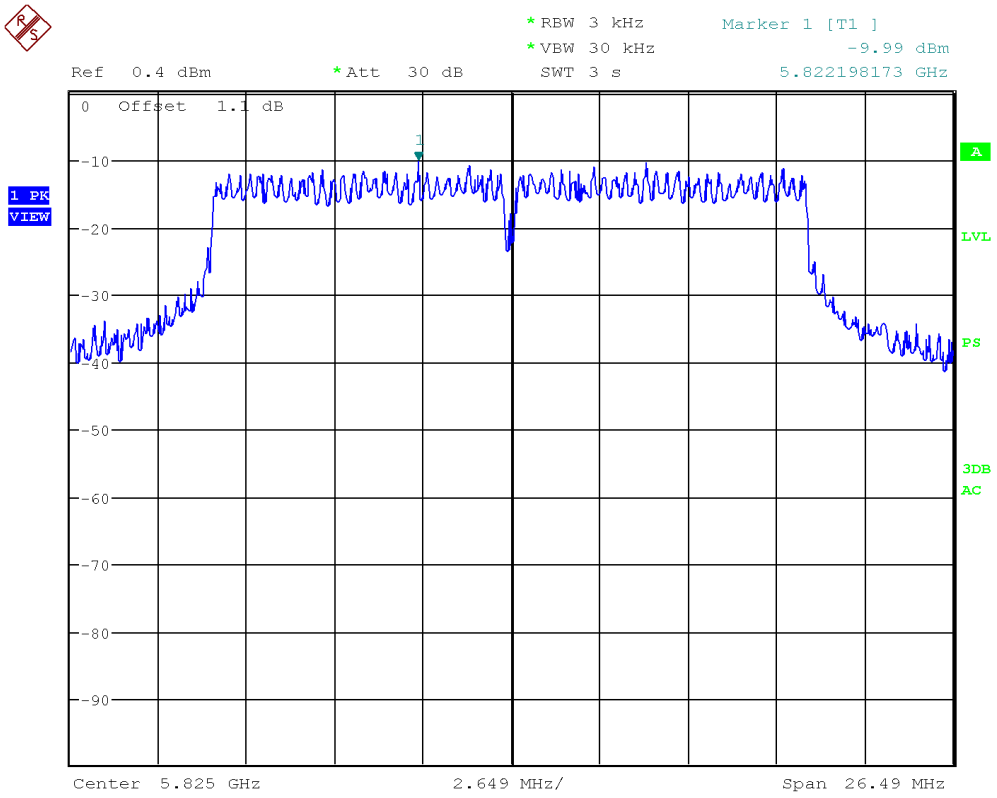



2. WiFi 5GHz 802.11 n20 mode

SISO. Lowest Channel: 5745 MHz. Chain A.

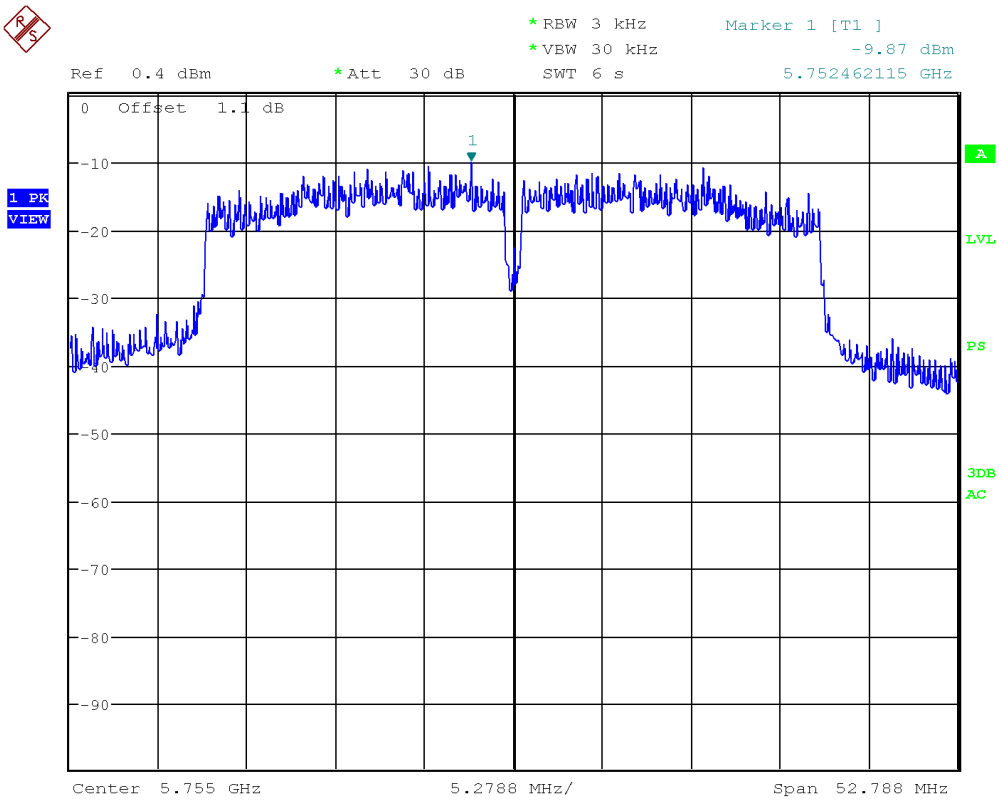


MIMO. Highest Channel: 5825 MHz. Chain A+B. Port A.

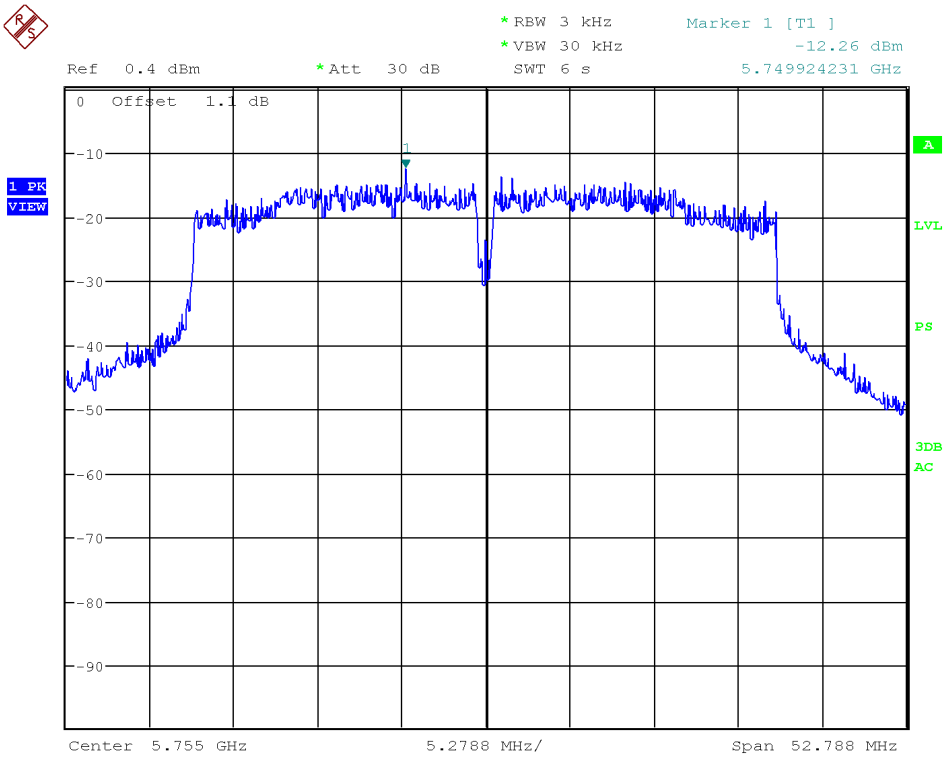



3. WiFi 5GHz 802.11 n40 mode

SISO. Lowest frequency 5755 MHz. Chain B.

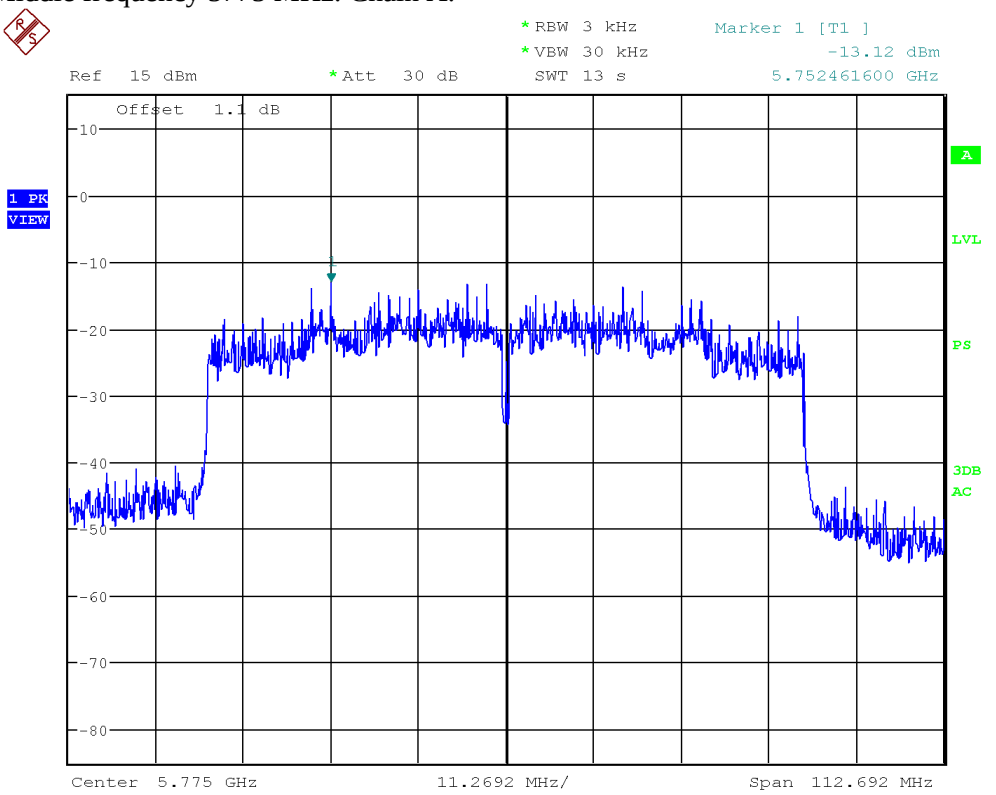


MIMO. Lowest frequency 5755 MHz. Chain A+B. Port A.

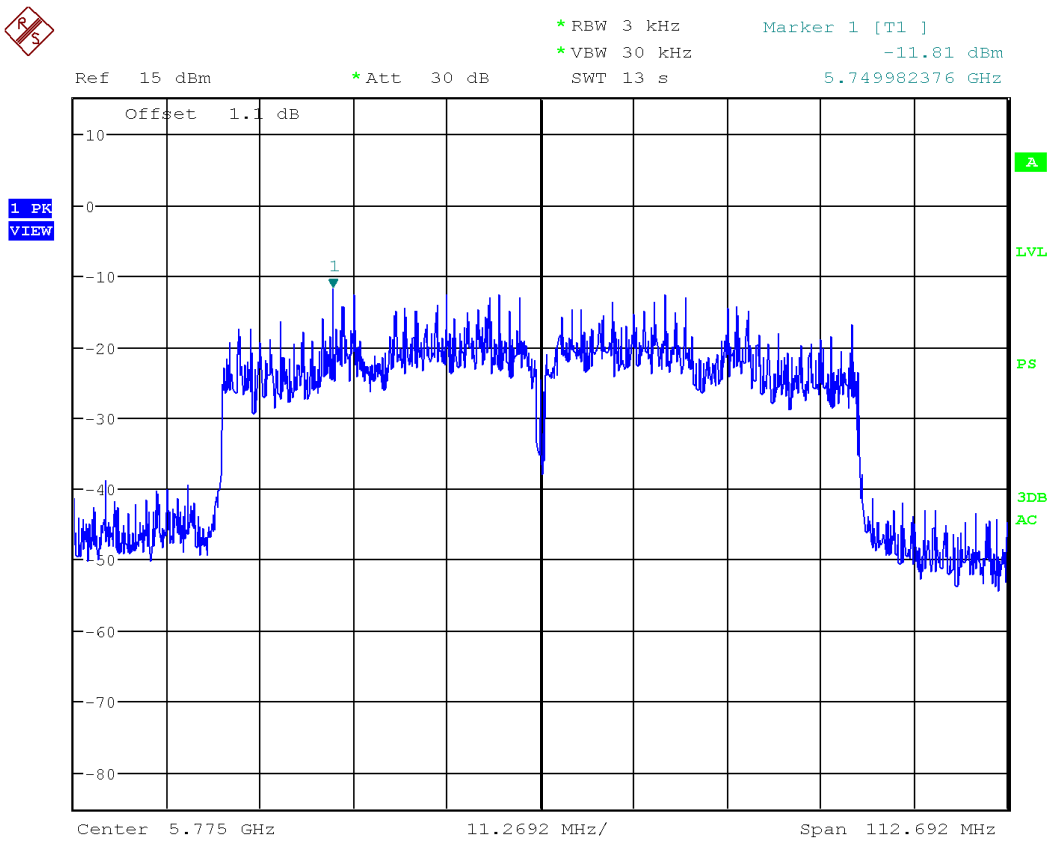



4. WiFi 5GHz 802.11 ac80 mode

SISO. Middle frequency 5775 MHz. Chain A.



MIMO. Middle frequency 5775 MHz. Chain A+B. Port B.



## Section 15.247 Subclause (d) / RSS-210 A8.5. Emission limitations radiated (Transmitter)

SPECIFICATION

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 and the antenna height was varied from 1 to 4 meters 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 3 m for the frequency range 30 MHz-1000 MHz and at 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.

The equipment transmits continuously in the selected channel so it is not necessary a duty cycle correction factor.

**Frequency range 30 MHz-1000 MHz**.

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) |
|---|---|---|---|---|
| 30.000 | V | Quasi-Peak | 36.26 | ± 3.8 |
| 99.9796 | V | Quasi-Peak | 25.29 | ± 3.8 |
| 166.0720 | V | Quasi-Peak | 24.19 | ± 3.8 |
| 142.7454 | V | Quasi-Peak | 28.09 | ± 3.8 |
| 364.3486 | V | Quasi-Peak | 22.53 | ± 3.8 |
| 498.4769 | V | Quasi-Peak | 23.45 | ± 3.8 |

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

**Frequency range 1 GHz-40 GHz.**

For the 4 OFDM modulation modes (802.11a, 802.11n20, 802.11n40 a 802.11ac80), a preliminary measurement in the central channel was performed in the range 1-12.75 GHz to determine the worst case. The lowest and highest channels were measured for out-of-band emissions for the worst case (802.11a).

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 5745 MHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 11.4960 | V | Peak | 44.18 | ± 4.09 |
| 17.2407 | V | Peak | 46.43 | ± 4.09 |
| 22.9840 | V | Peak | 52.18 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 11.4866 | V | Peak | 48.85 | ± 4.09 |
| 17.2390 | V | Peak | 45.13 | ± 4.09 |
| 22.9840 | V | Peak | 51.84 | ± 4.09 |

Middle frequency 5785 MHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 17.3596 | V | Peak | 46.86 | ± 4.09 |
| 23.1440 | V | Peak | 53.13 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 11.5730 | V | Peak | 49.28 | ± 4.09 |
| 17.3544 | V | Peak | 47.21 | ± 4.09 |
| 23.1440 | V | Peak | 52.67 | ± 4.09 |

Highest frequency 5825 MHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 11.6536 | V | Peak | 48.30 | ± 4.09 |
| 17.4815 | V | Peak | 48.92 | ± 4.09 |
| 23.3040 | V | Peak | 52.10 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 11.6501 | V | Peak | 49.85 | ± 4.09 |
| 17.4815 | V | Peak | 46.66 | ± 4.09 |
| 23.3040 | V | Peak | 52.38 | ± 4.09 |

2. WiFi 5GHz 802.11 n20 mode

Middle frequency 5785 MHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 17.3595 | V | Peak | 49.75 | ± 4.09 |
| 23.1440 | V | Peak | 53.62 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 17.3566 | V | Peak | 46.82 | ± 4.09 |
| 23.1440 | V | Peak | 53.00 | ± 4.09 |

Chain A+B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 17.3554 | V | Peak | 45.76 | ± 4.09 |
| 23.1440 | V | Peak | 54.10 | ± 4.09 |
| | | Average | 49.66 | ± 4.09 |

3. WiFi 5GHz 802.11 n40 mode

Middle  frequency 5785 MHz.

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 17.385 | V | Peak | 49.60 | ± 4.09 |
| 23.184 | V | Peak | 53.59 | ± 4.09 |

Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 23.184 | V | Peak | 53.4 | ± 4.09 |

Chain A+B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 23.184 | V | Peak | 53.37 | ± 4.09 |

4. WiFi 5GHz 802.11 ac80 mode

Middle frequency 5775 MHz

Chain A

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 23.104 | V | Peak | 53.05 | ± 4.09 |

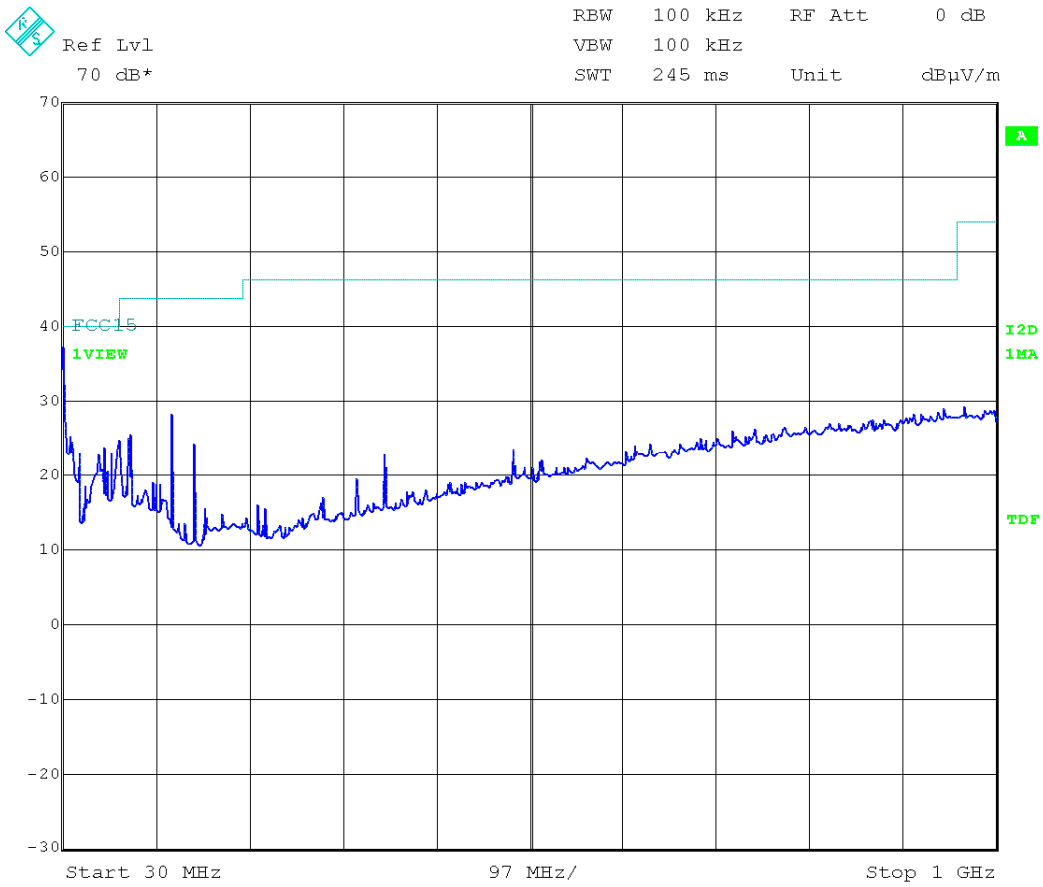
Chain B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 23.104 | V | Peak | 53.90 | ± 4.09 |

Chain A+B

| Spurious frequency (GHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 23.104 | V | Peak | 53.69 | ± 4.09 |

FREQUENCY RANGE 30 MHz-1000 MHz.

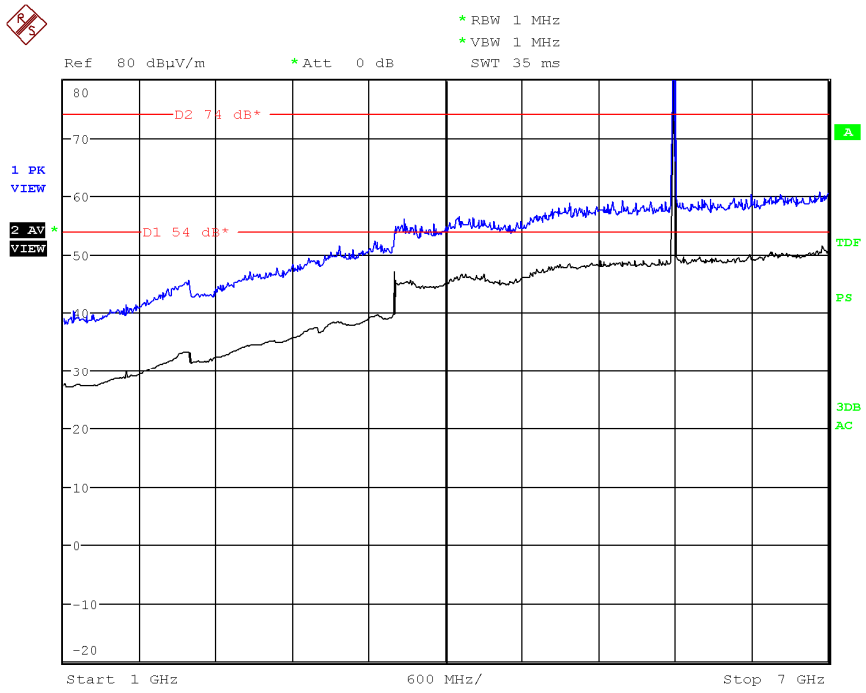



(This plot is valid for all three channels and all modulation modes).

FREQUENCY RANGE 1 GHz to 7 GHz.

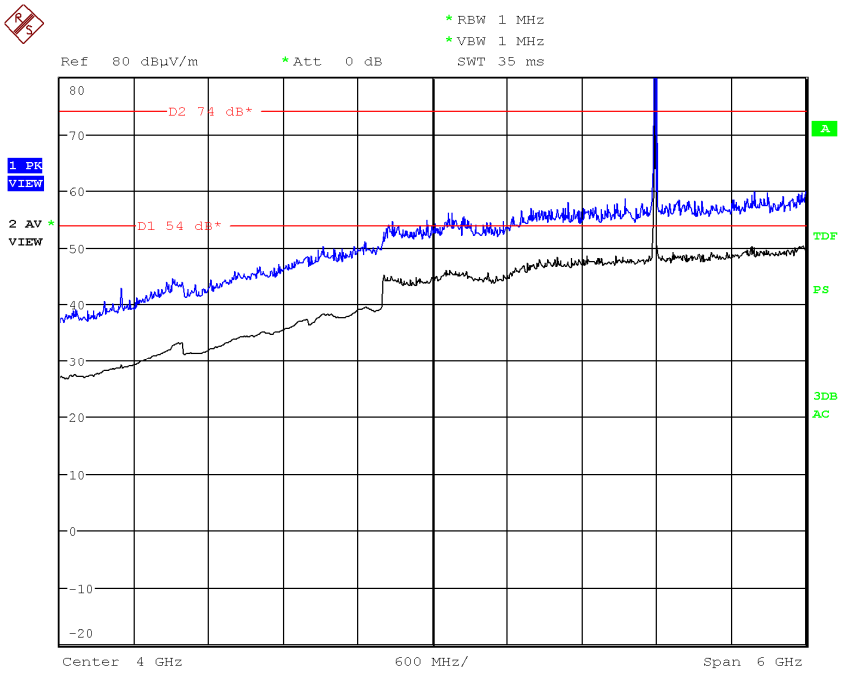
1. WiFi 5GHz 802.11 a mode

Lowest Channel: 5745 MHz. Chain A



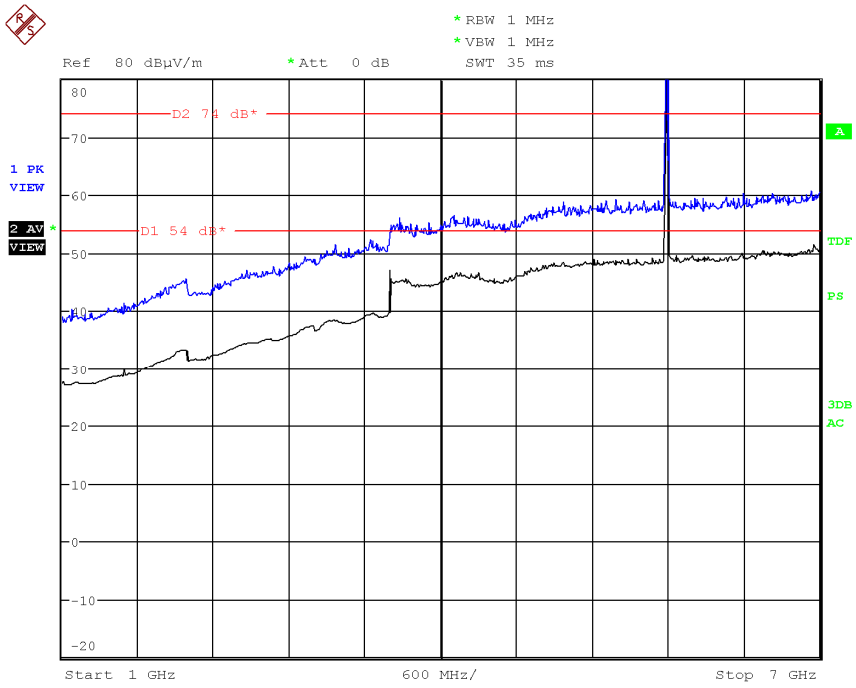

Note: The peak above the limit is the carrier frequency.

Lowest Channel: 5745 MHz. Chain B



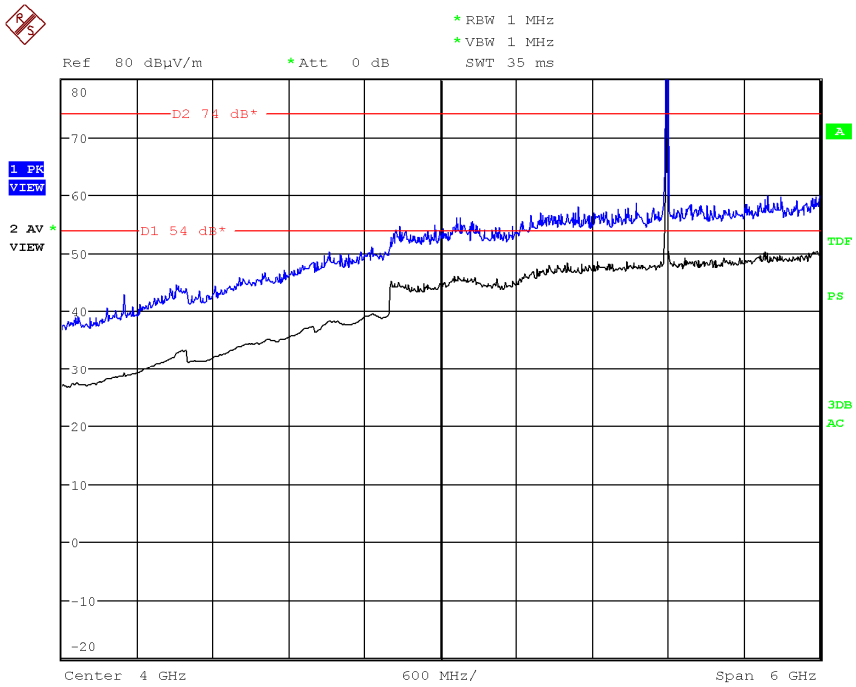

Note: The peak above the limit is the carrier frequency.

Middle Channel: 5785 MHz. Chain A



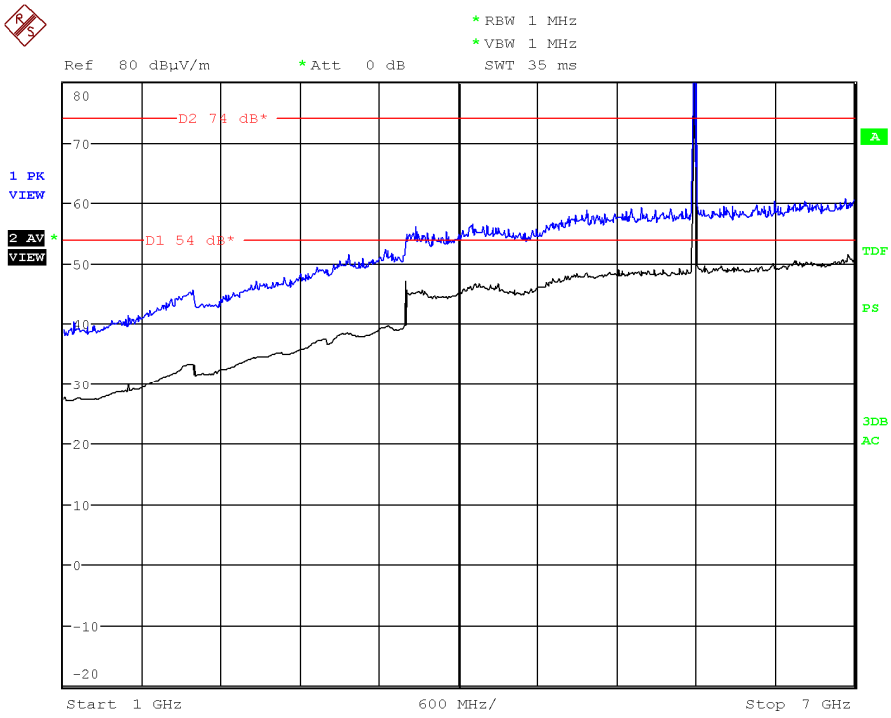

Note: The peak above the limit is the carrier frequency.

Middle Channel: 5785 MHz. Chain B



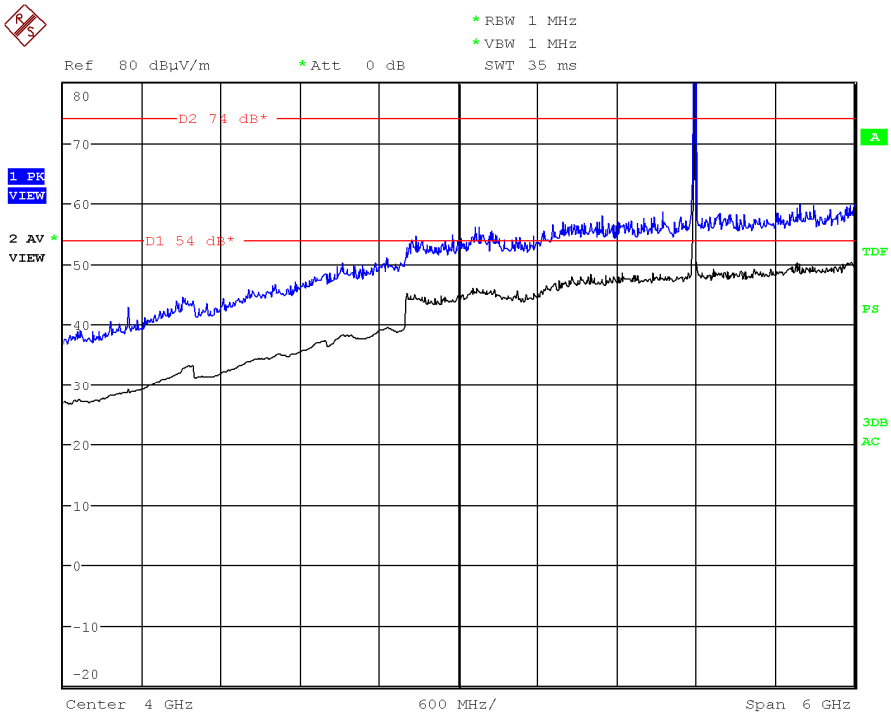

Note: The peak above the limit is the carrier frequency.

Highest Channel: 5825 MHz. Chain A




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

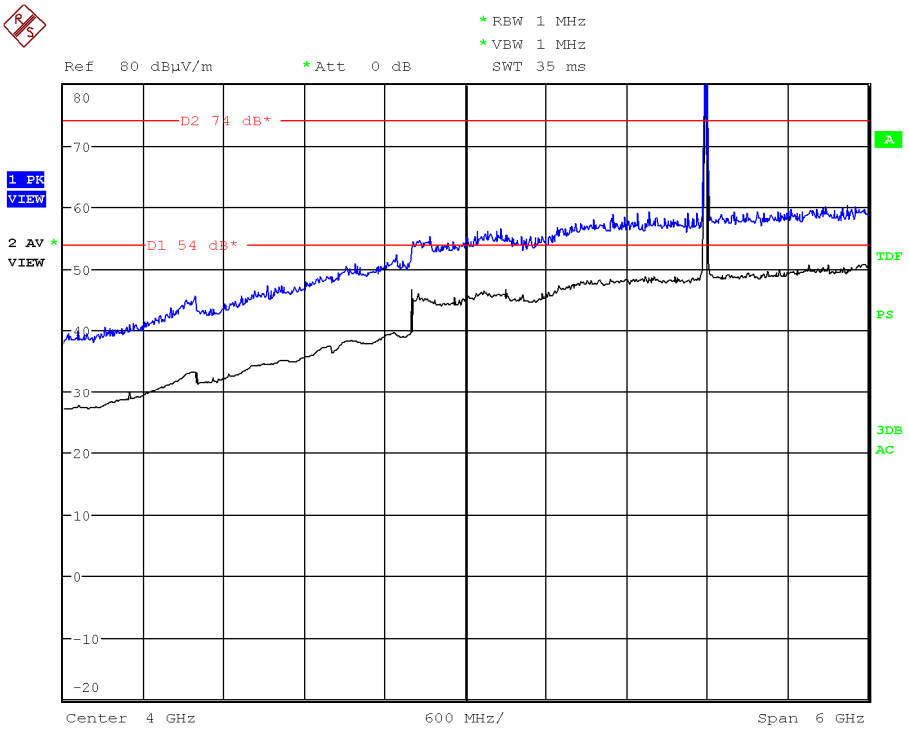
Highest Channel: 5825 MHz. Chain B




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

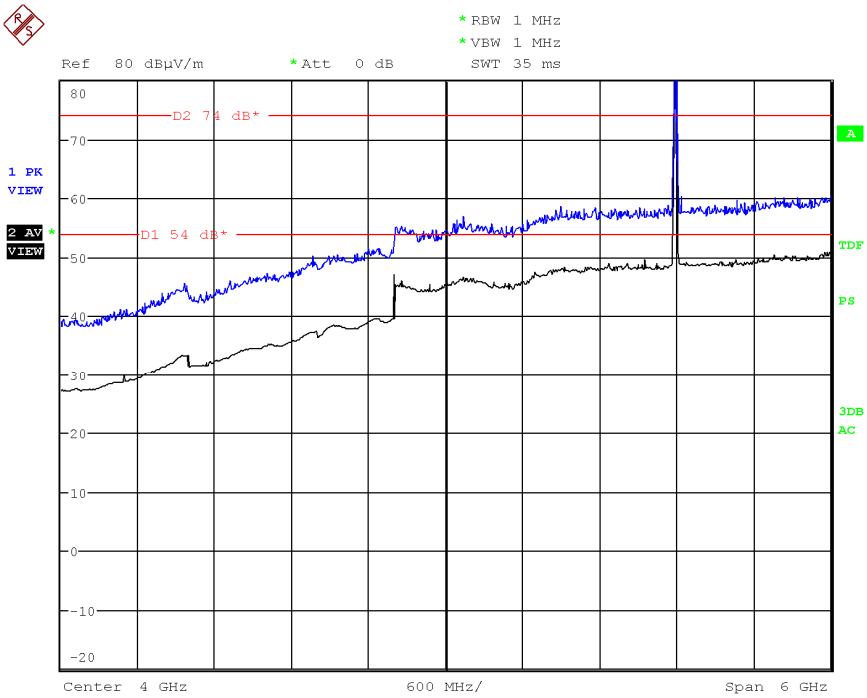
2. WiFi 5GHz 802.11 n20 mode

Middle Channel: 5785 MHz. Chain A



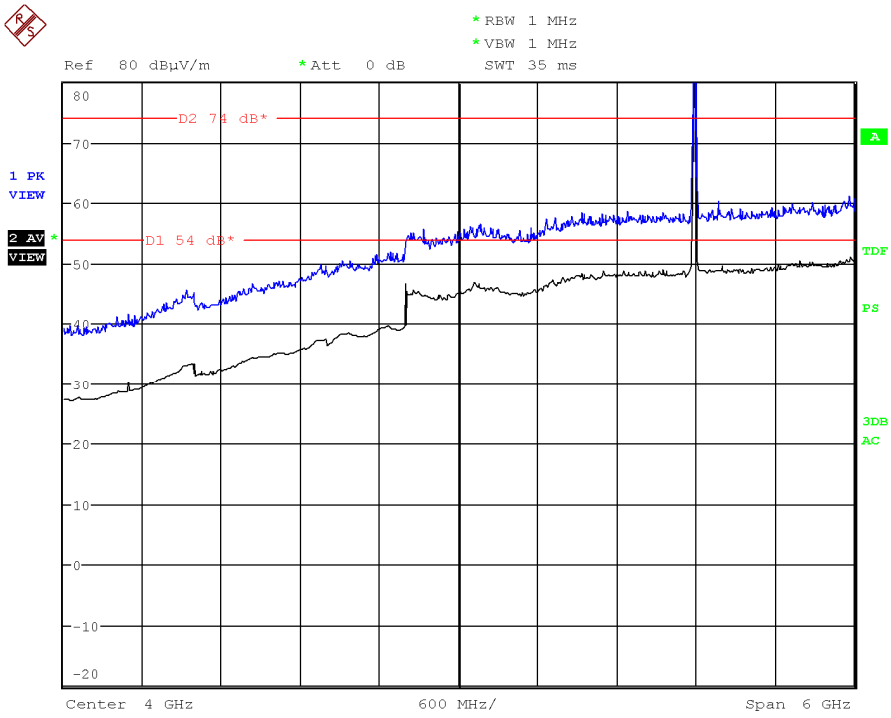

Note: The peak above the limit is the carrier frequency.

Middle Channel: 5785 MHz. Chain B




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

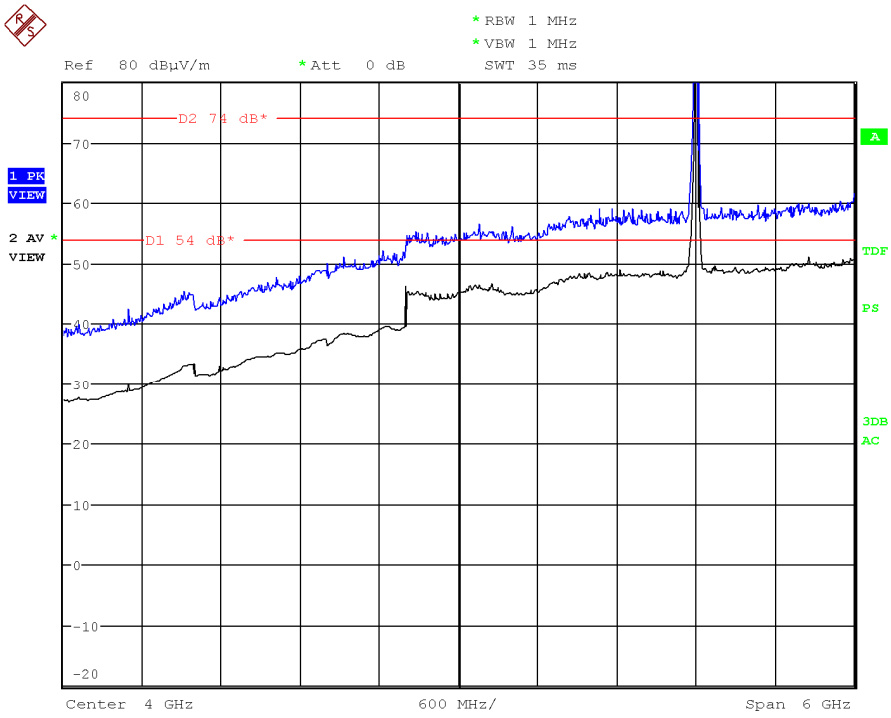
Middle Channel: 5785 MHz. Chain A+B




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

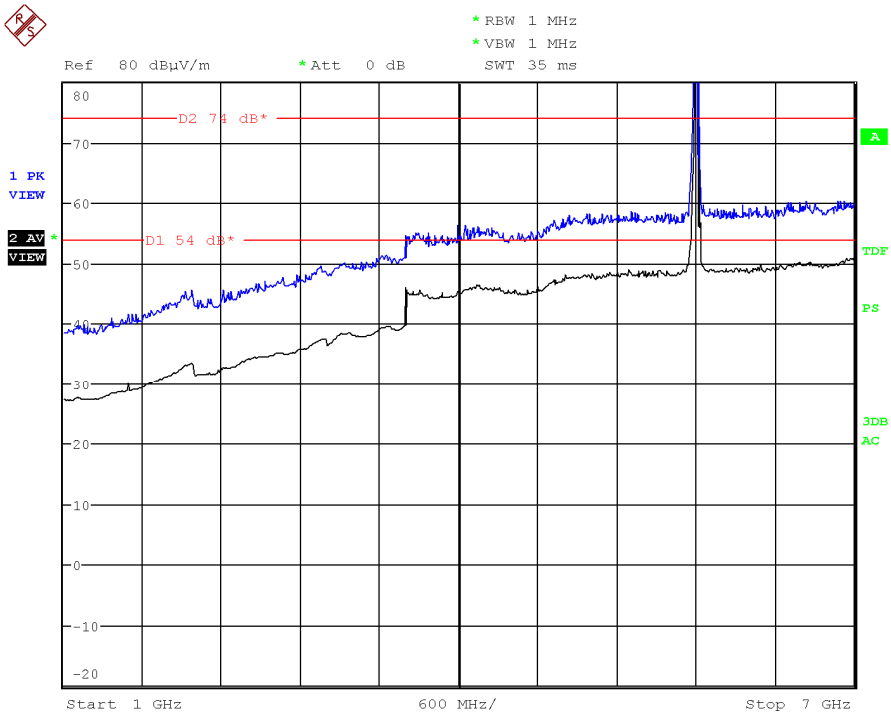
3. WiFi 5GHz 802.11 n40 mode

Highest Channel: 5795 MHz. Chain A



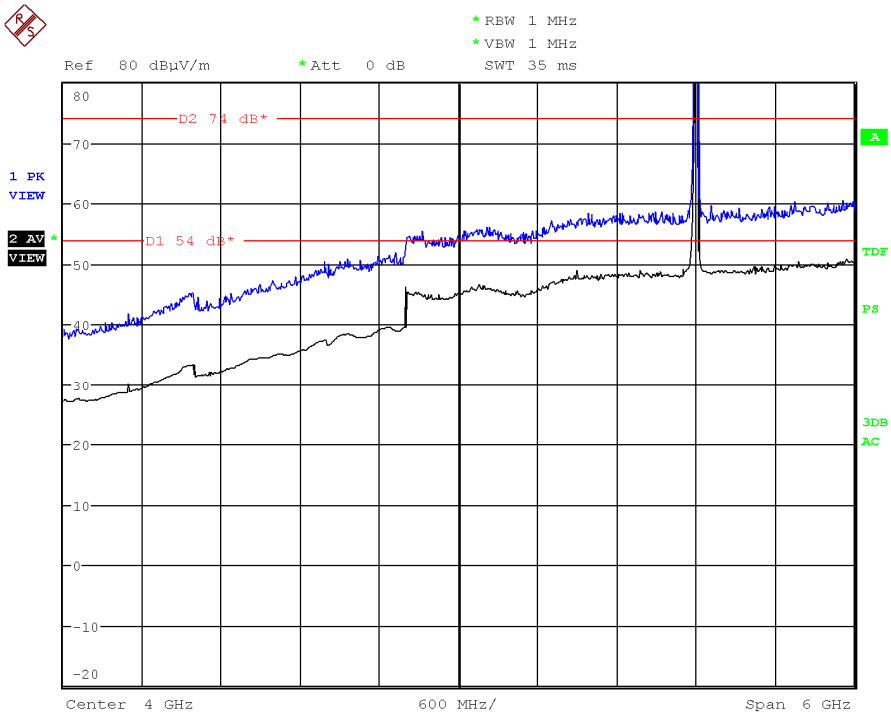

Note: The peak above the limit is the carrier frequency.

Highest Channel: 5795 MHz. Chain B




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

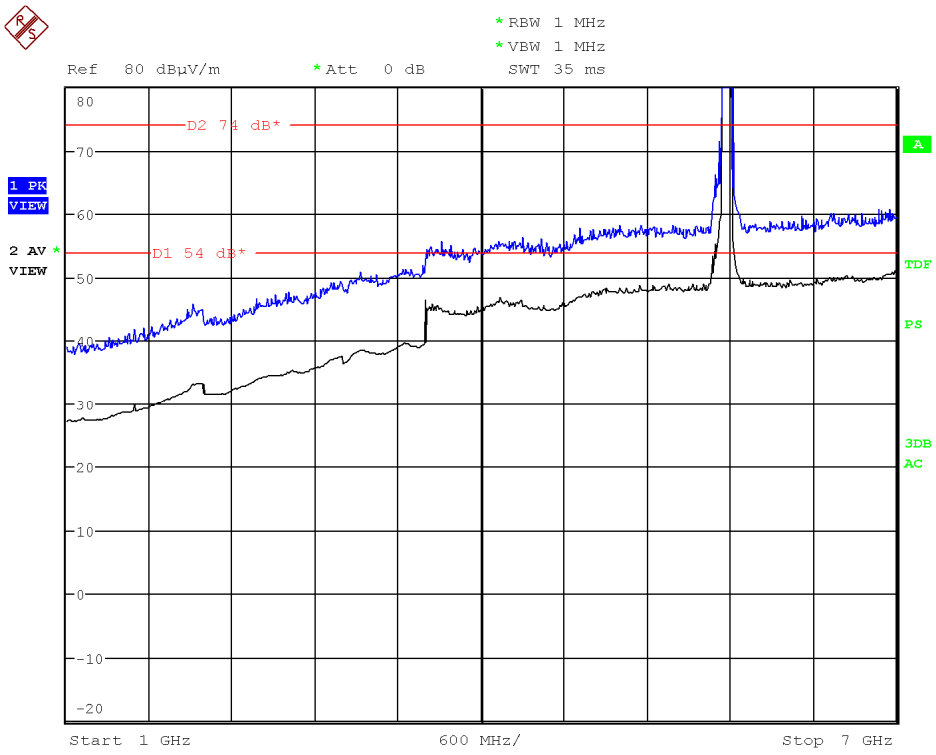
Highest Channel: 5795 MHz. Chain A+B




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

4. WiFi 5GHz 802.11 ac80 mode

Middle Channel: 5775 MHz.

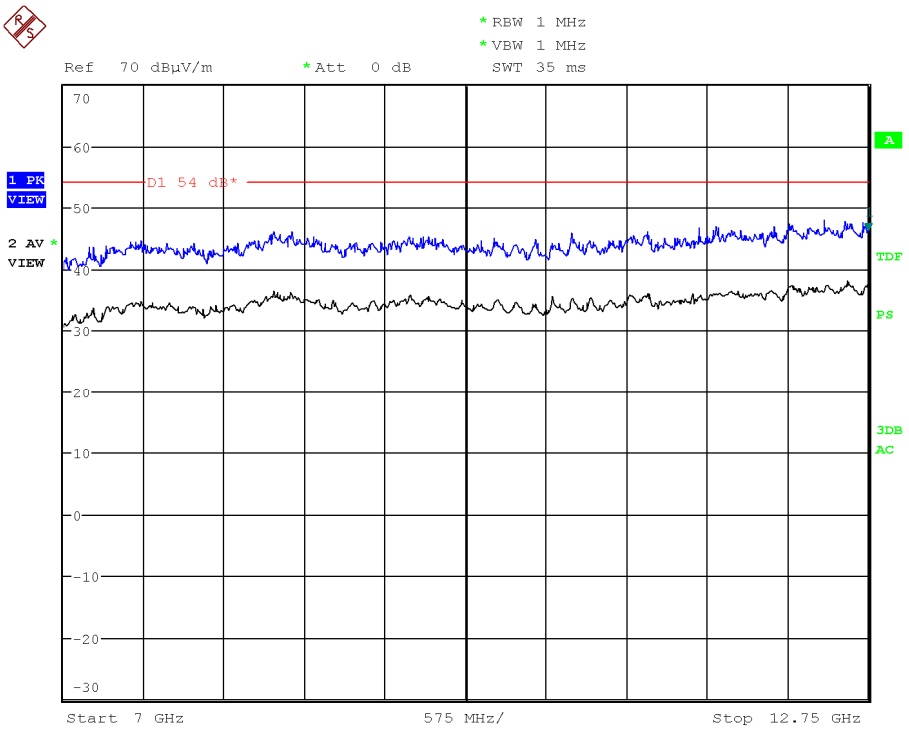



Note: The peak above the limit is the carrier frequency. This plot is valid for Chain A, Chain B and Chain A+B.

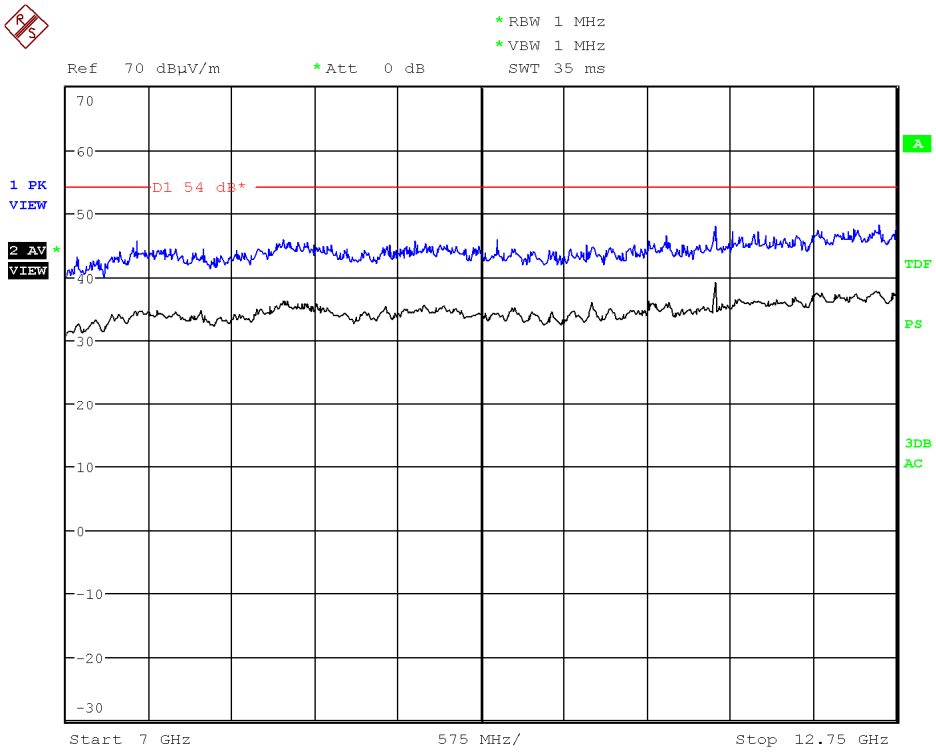
FREQUENCY RANGE 7 GHz to 12 GHz.

1. WiFi 5GHz 802.11 a mode

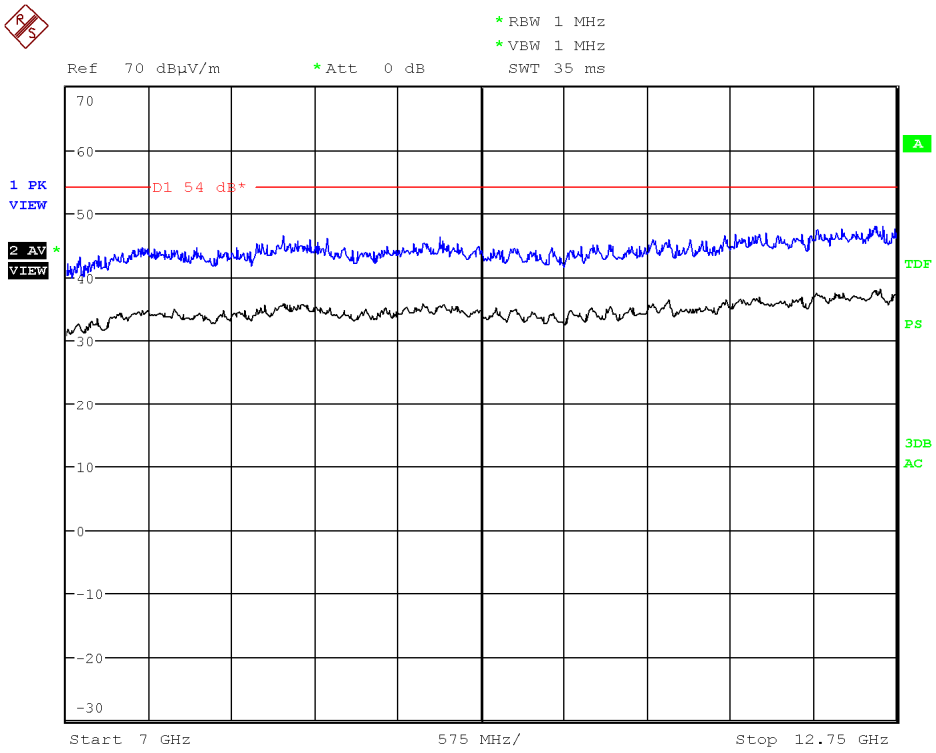
Lowest Channel: 5745 MHz. Chain A



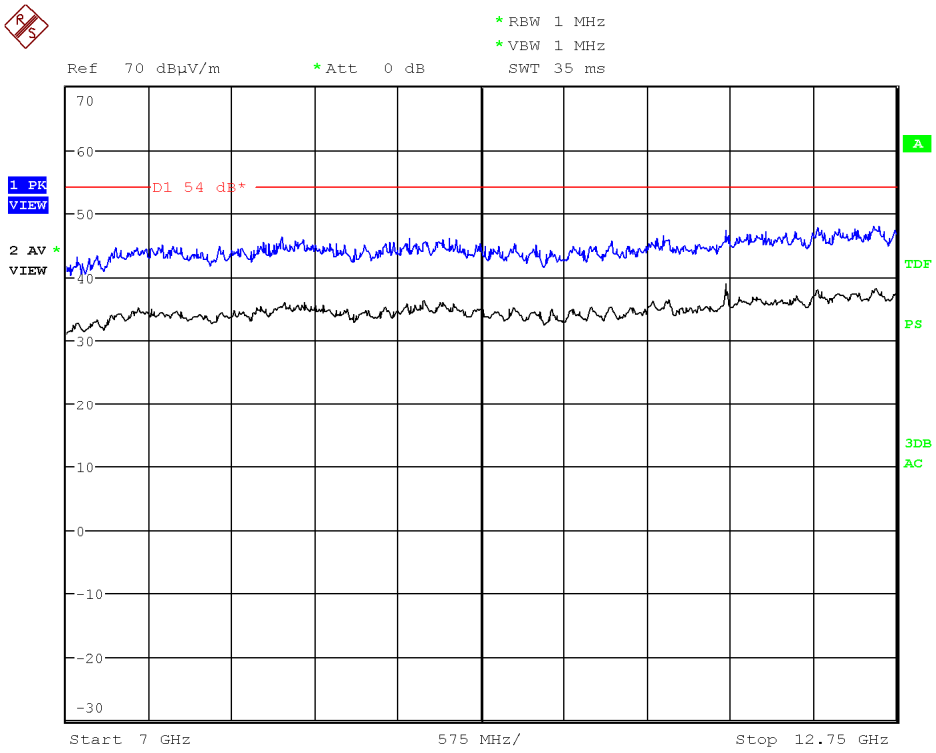

Lowest Channel: 5745 MHz. Chain B



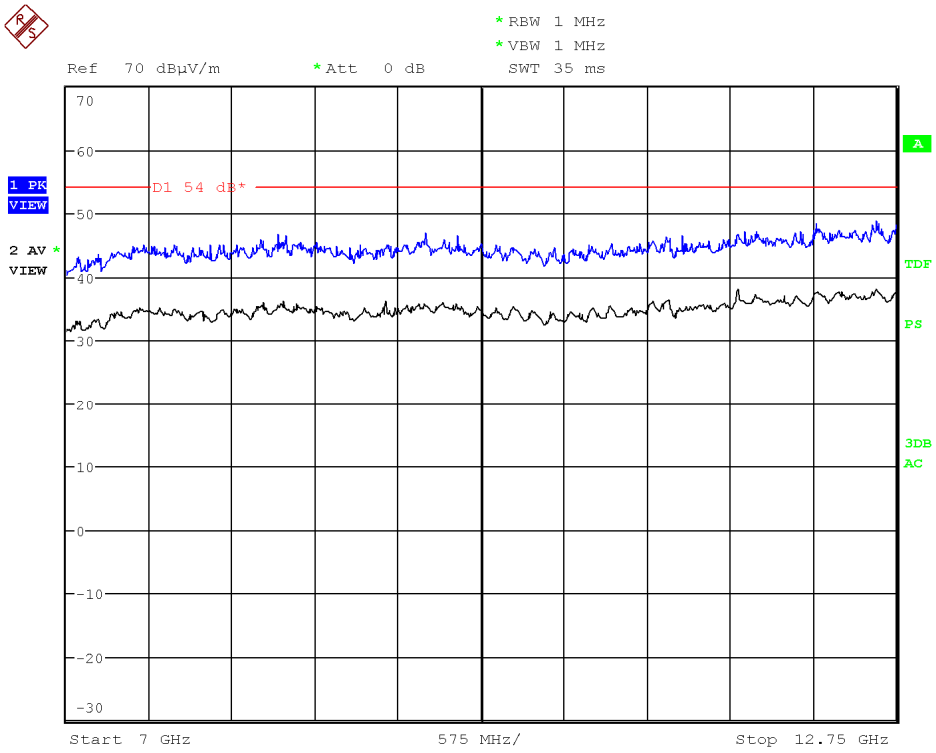
Middle Channel: 5785 MHz. Chain A



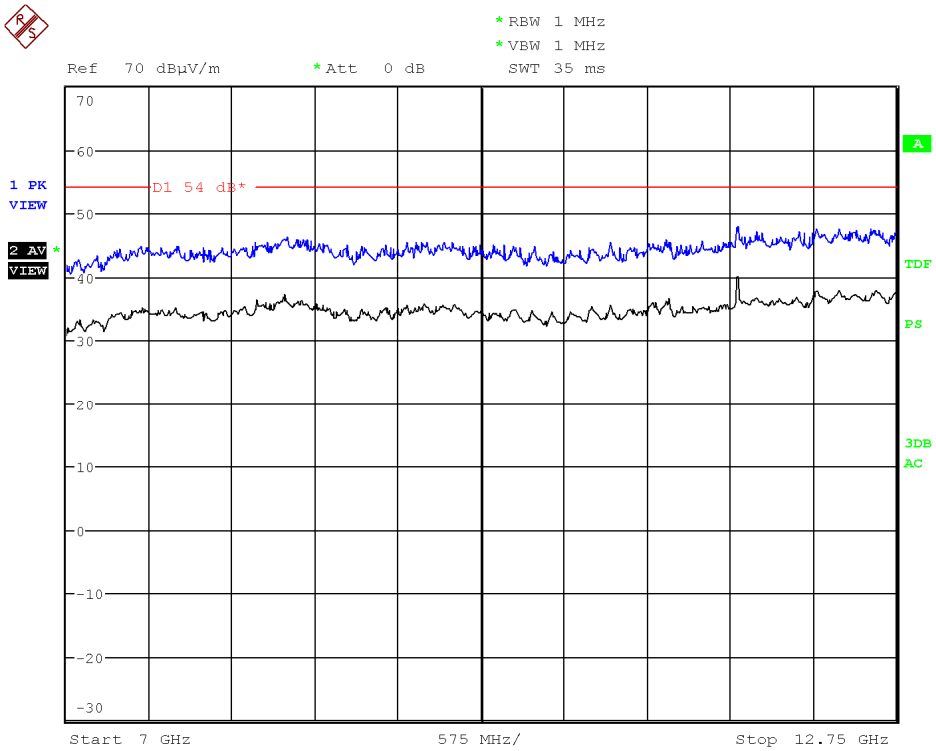

Middle Channel: 5785 MHz. Chain B



Highest Channel: 5825 MHz. Chain A

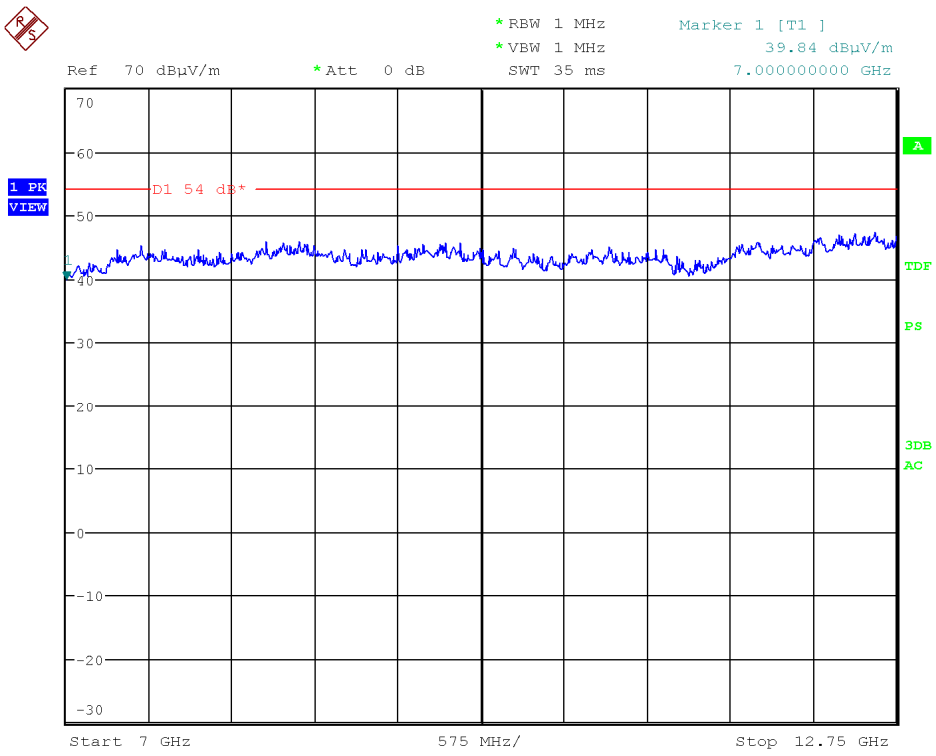



Highest Channel: 5825 MHz. Chain B

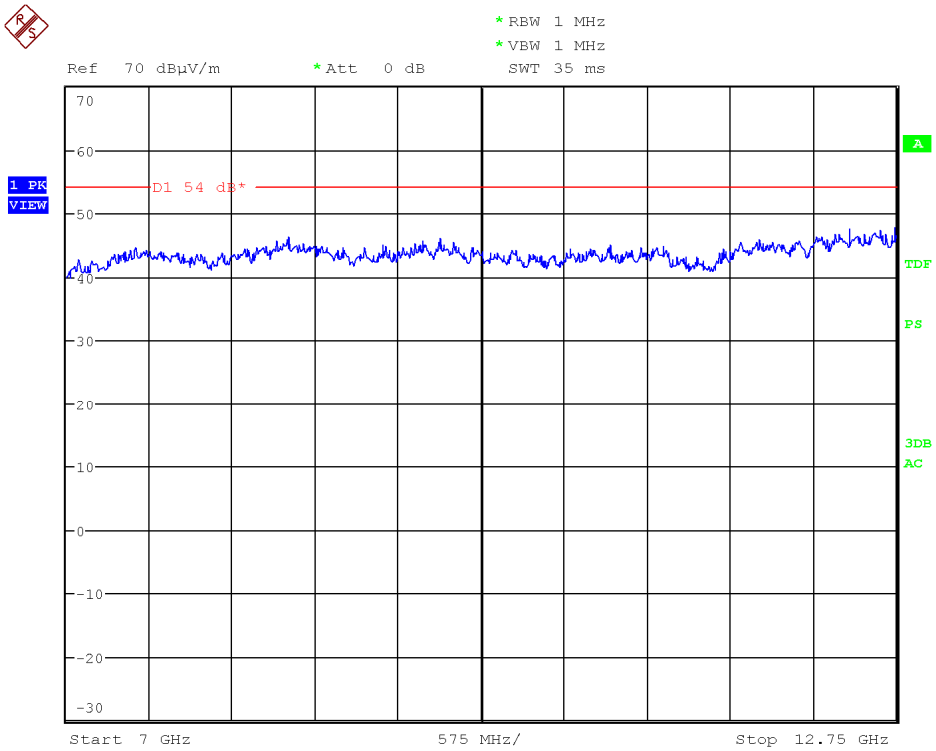


2. WiFi 5GHz 802.11 n20 mode

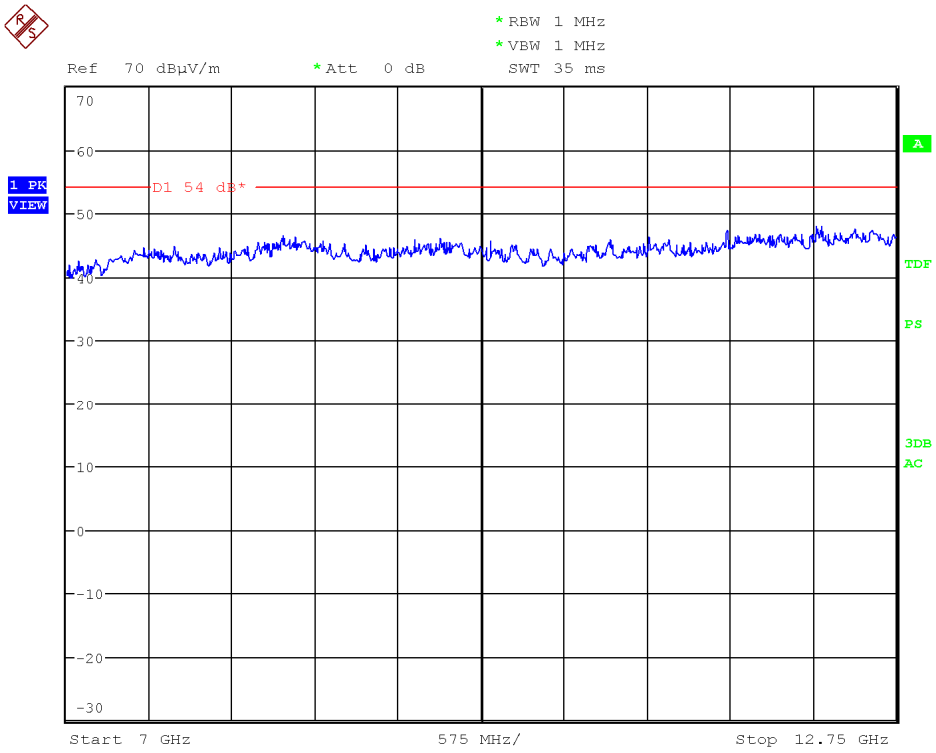
Middle Channel: 5785 MHz. Chain A




Middle Channel: 5785 MHz. Chain B

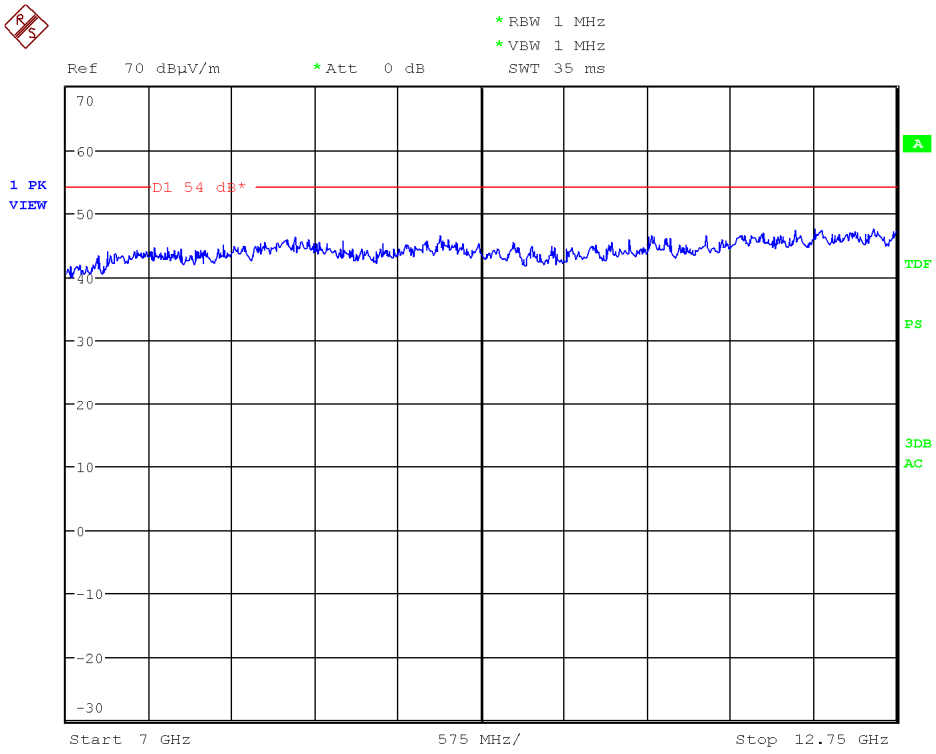


Middle Channel: 5785 MHz. Chain A+B

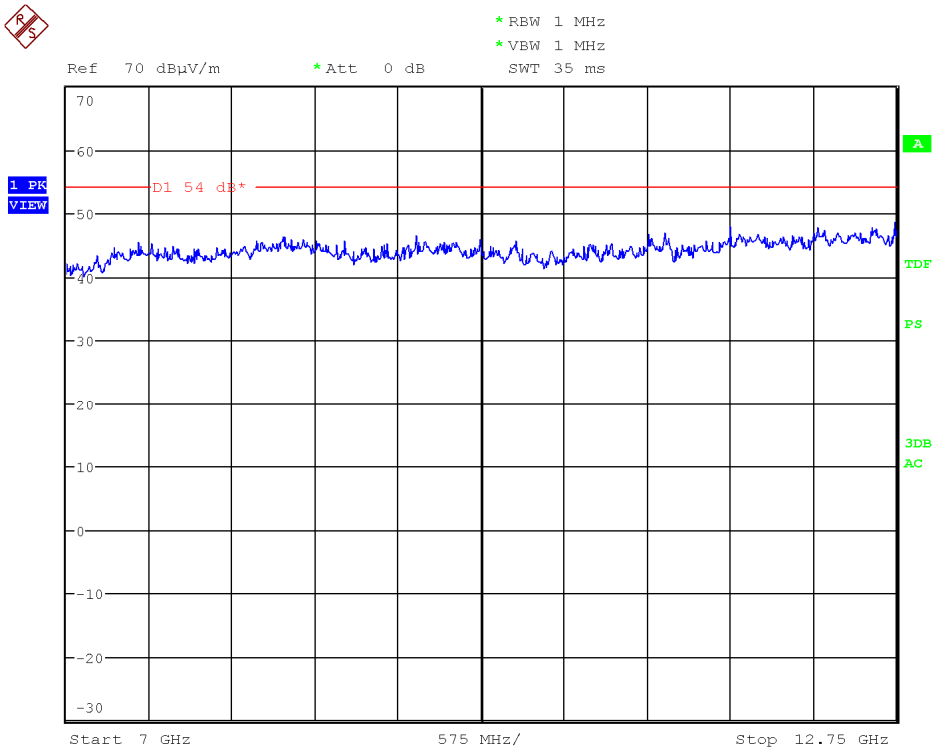



3. WiFi 5GHz 802.11 n40 mode

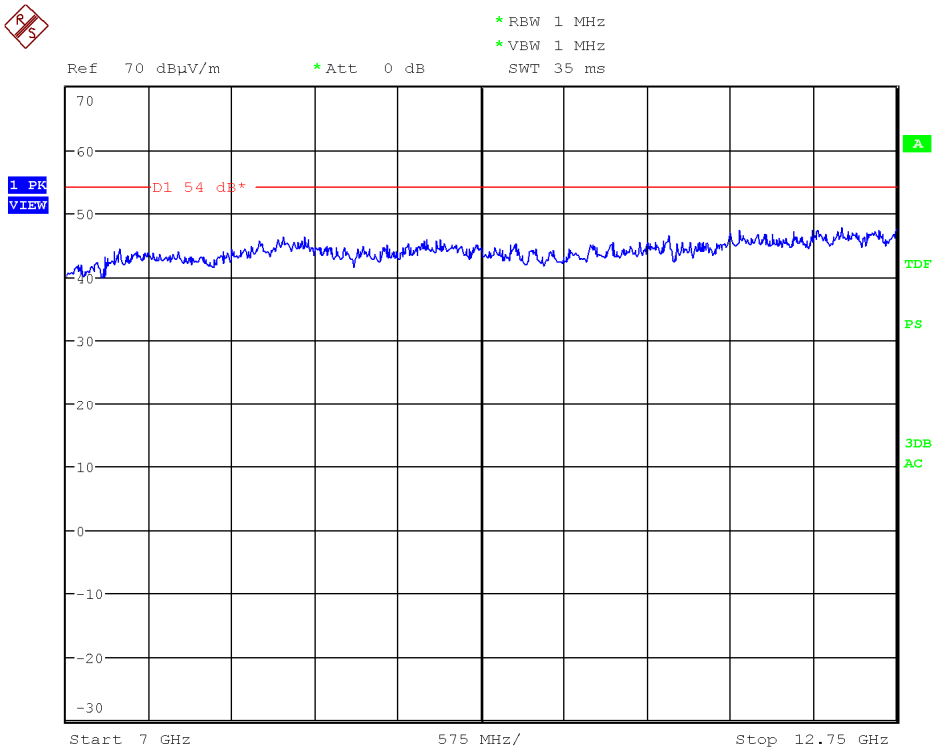
Highest Channel: 5795 MHz. Chain A



Highest Channel: 5795 MHz. Chain B

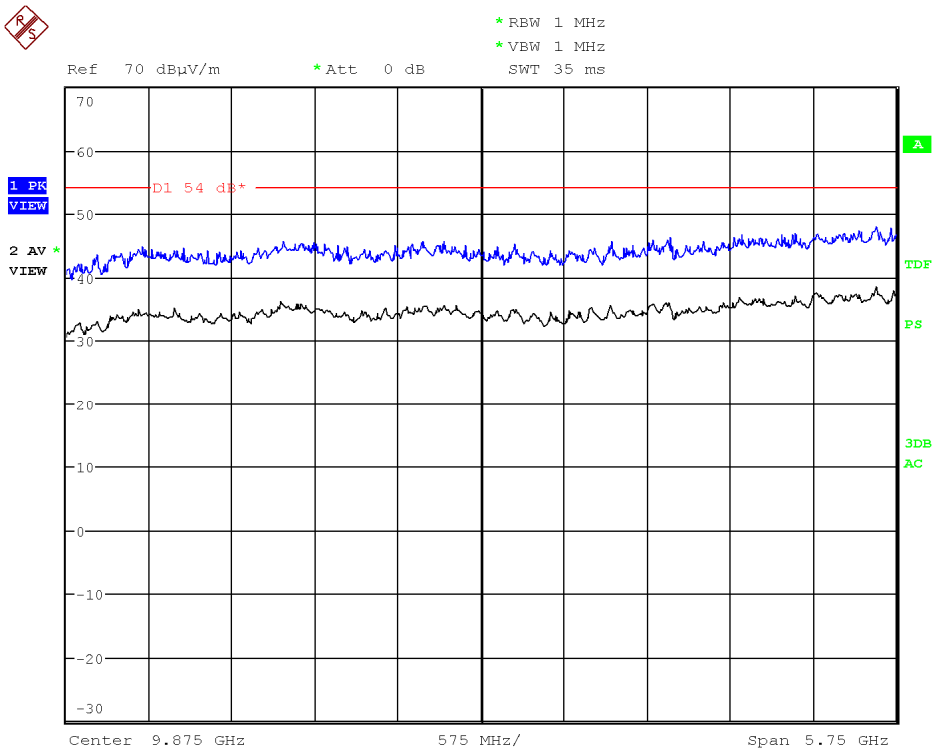



Highest Channel: 5795 MHz. Chain A+B

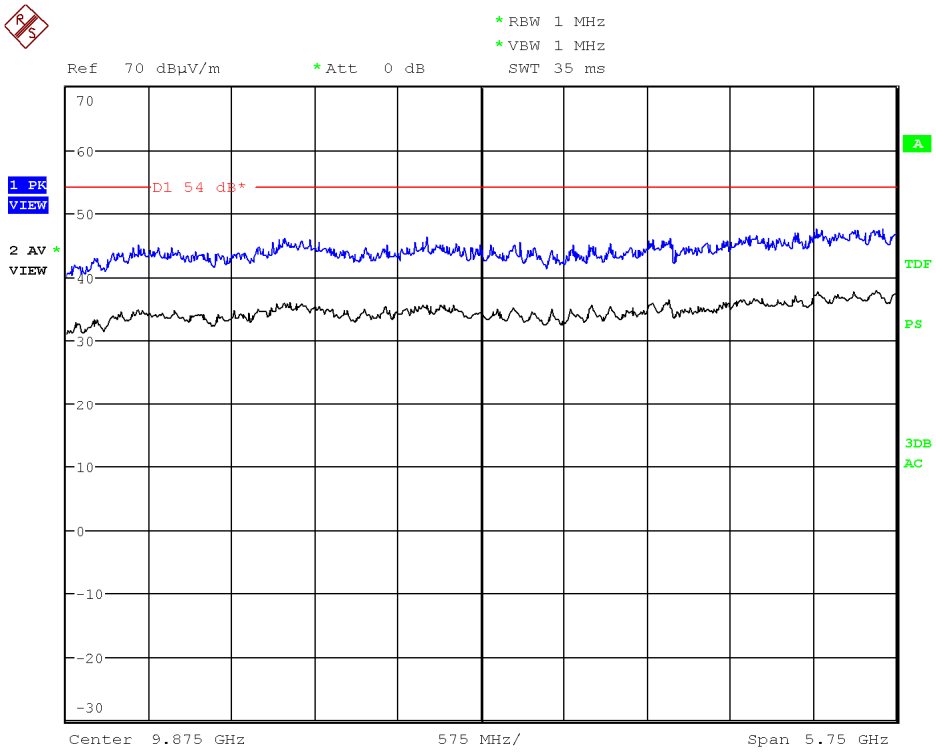


4. WiFi 5GHz 802.11 ac80 mode

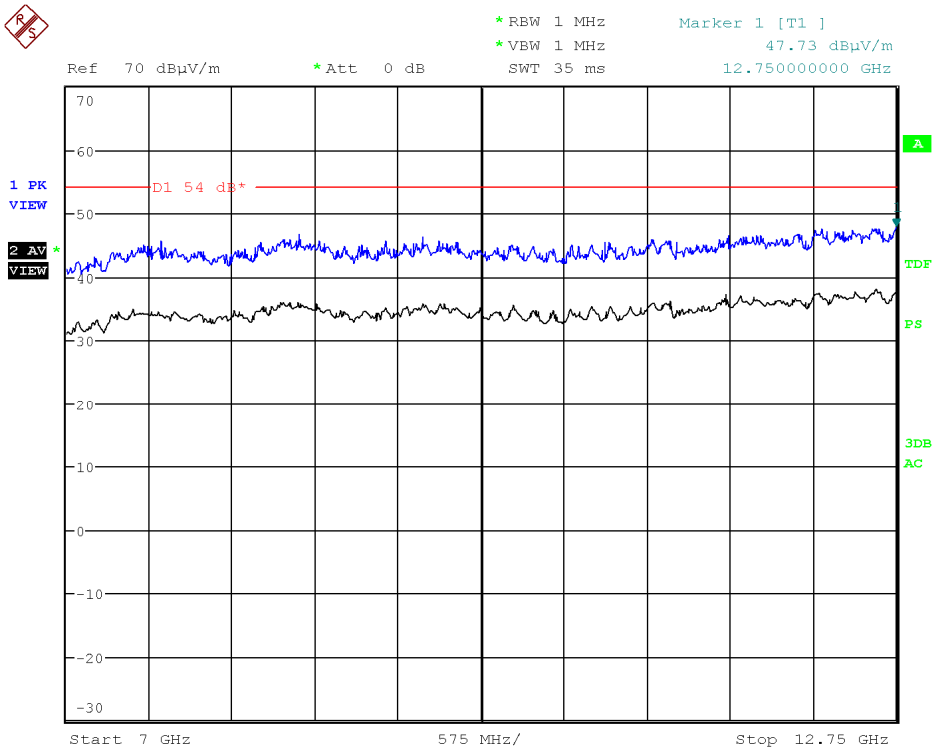
Middle Channel: 5775 MHz. Chain A.




Middle Channel: 5775 MHz. Chain B.



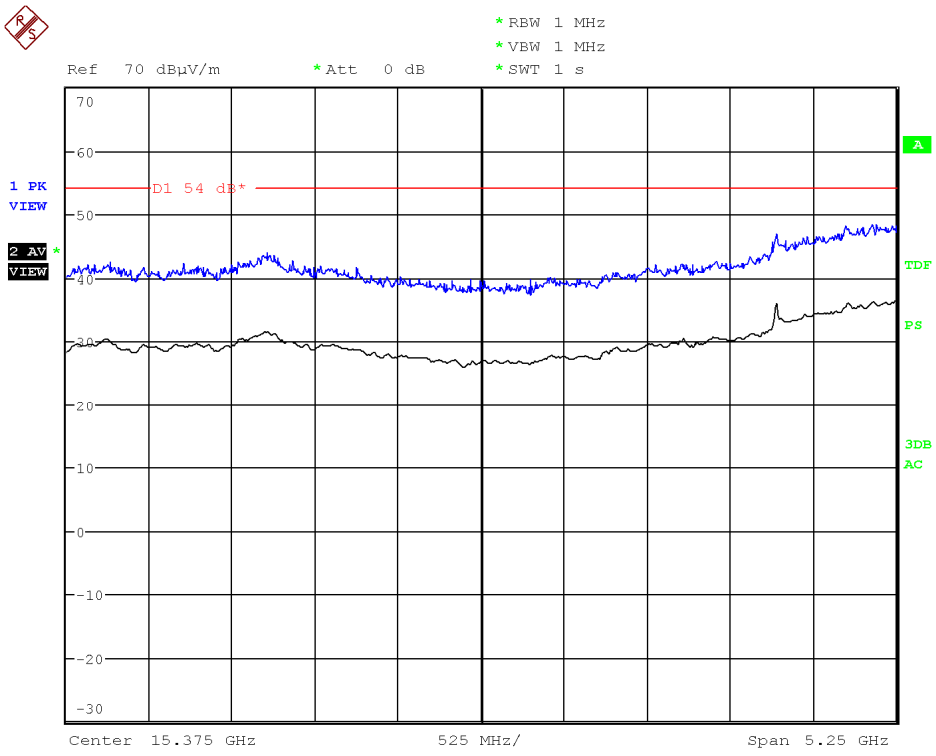
Middle Channel: 5775 MHz. Chain A+B.



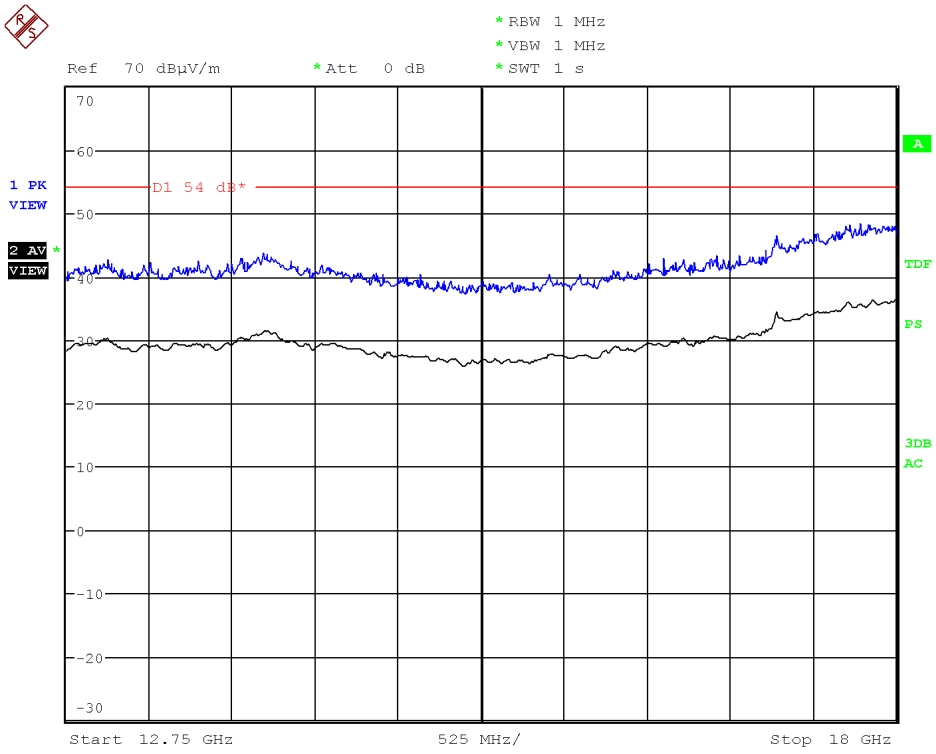
FREQUENCY RANGE 12 GHz to 18 GHz.

1. WiFi 5GHz 802.11 a mode

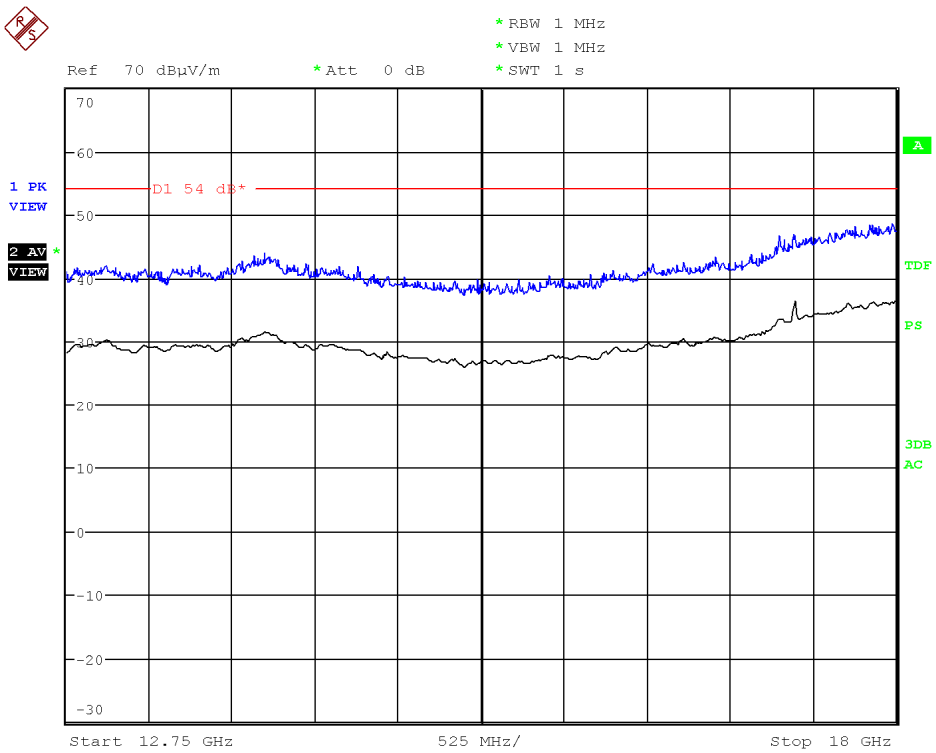
Lowest Channel: 5745 MHz. Chain A



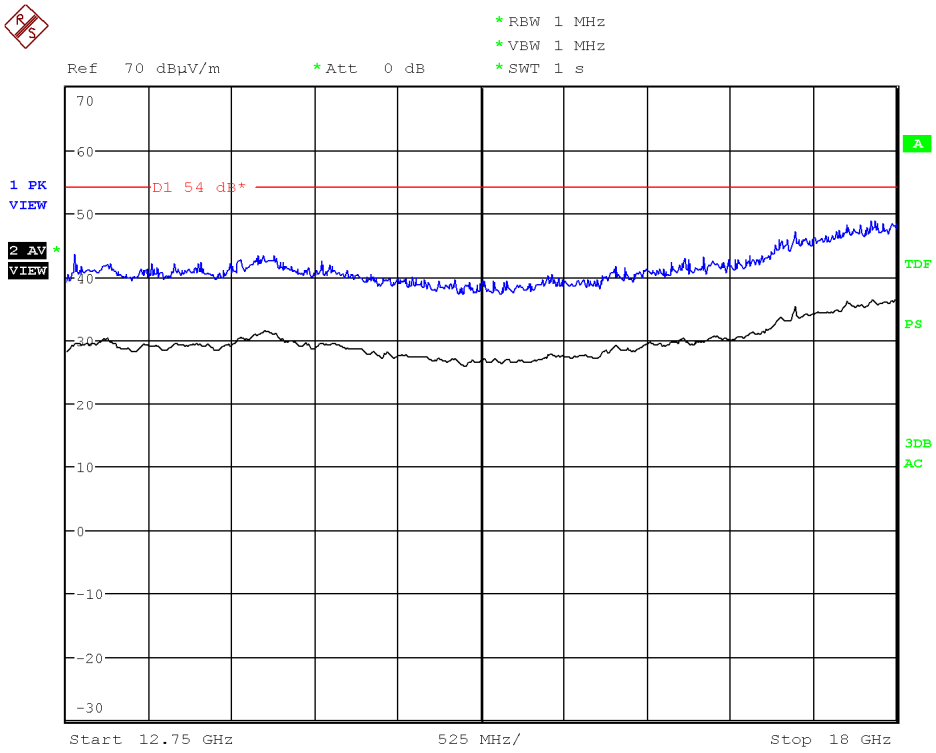

Lowest Channel: 5745 MHz. Chain B



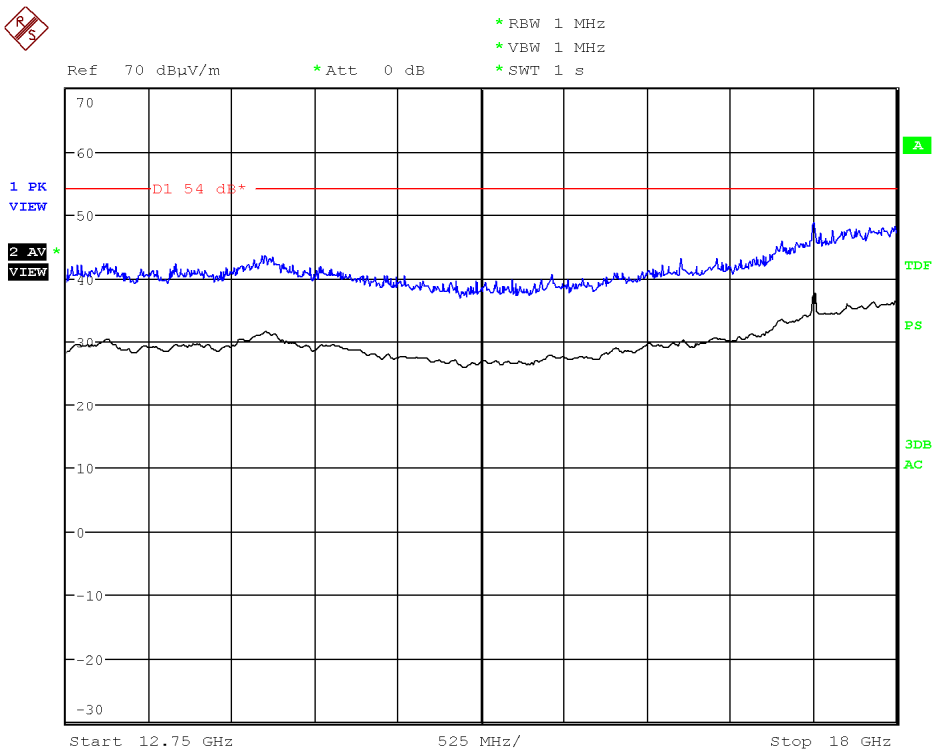
Middle Channel: 5785 MHz. Chain A



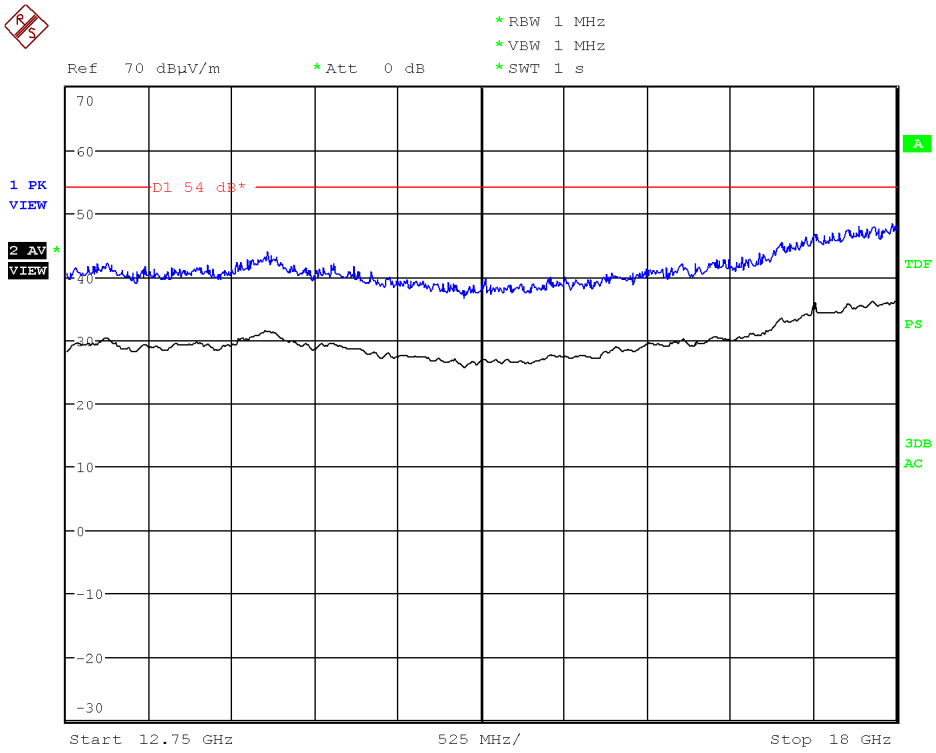

Middle Channel: 5785 MHz. Chain B



Highest Channel: 5825 MHz. Chain A

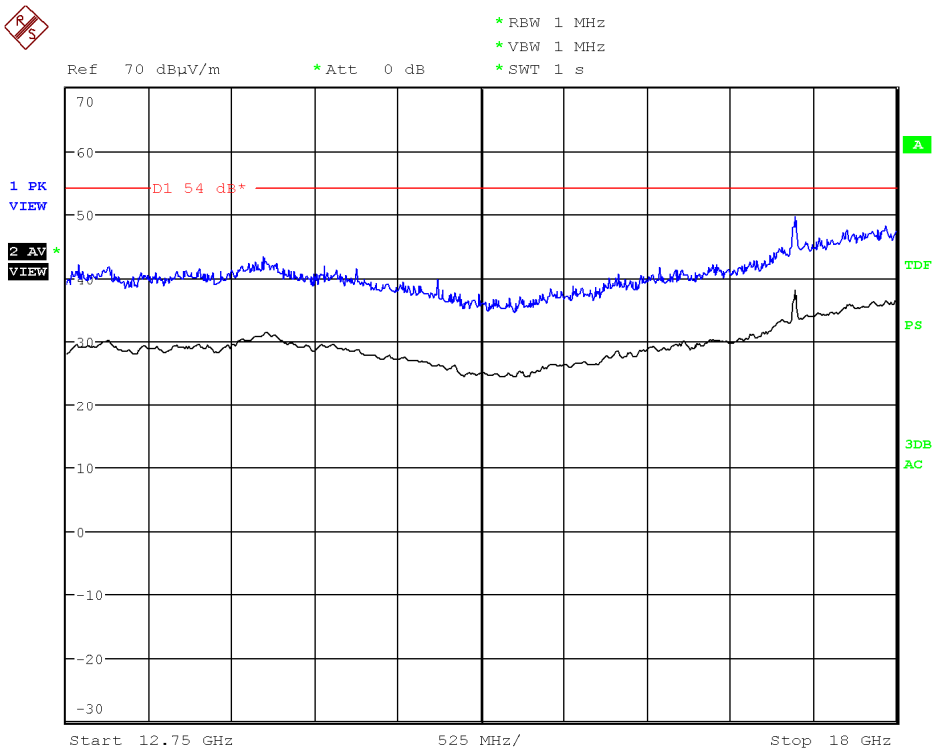



Highest Channel: 5825 MHz. Chain B

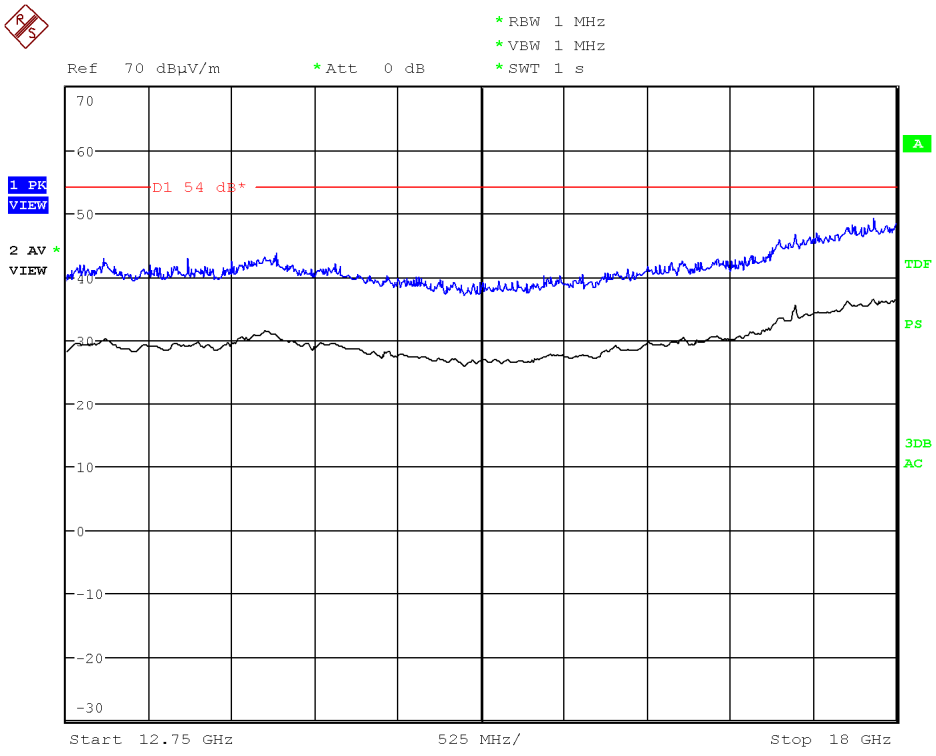


2. WiFi 5GHz 802.11 n20 mode

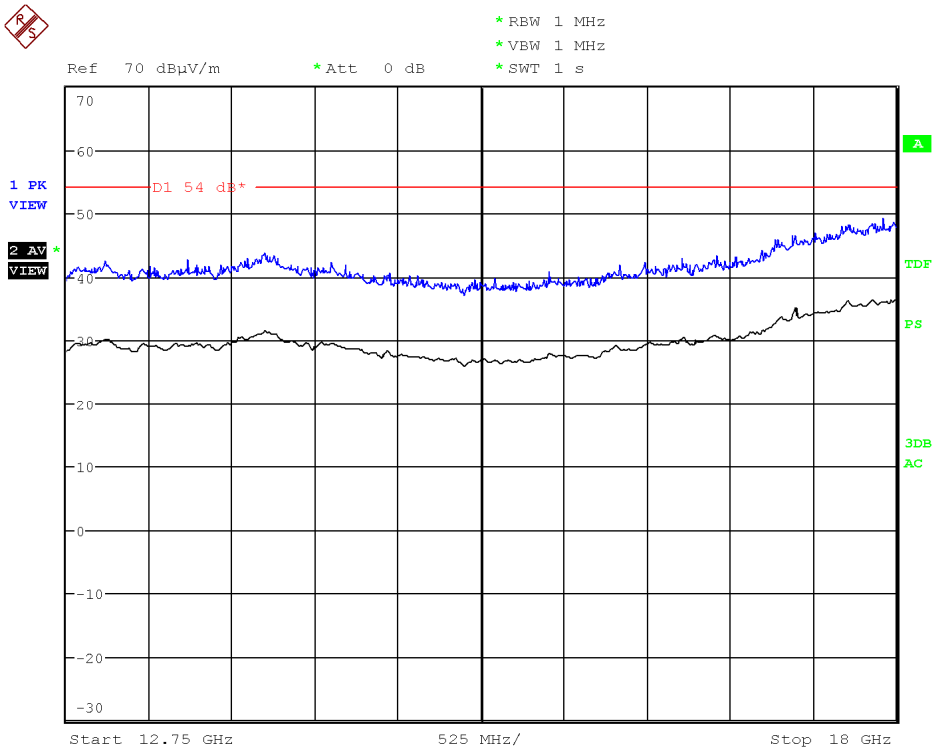
Middle Channel: 5785 MHz. Chain A




Middle Channel: 5785 MHz. Chain B

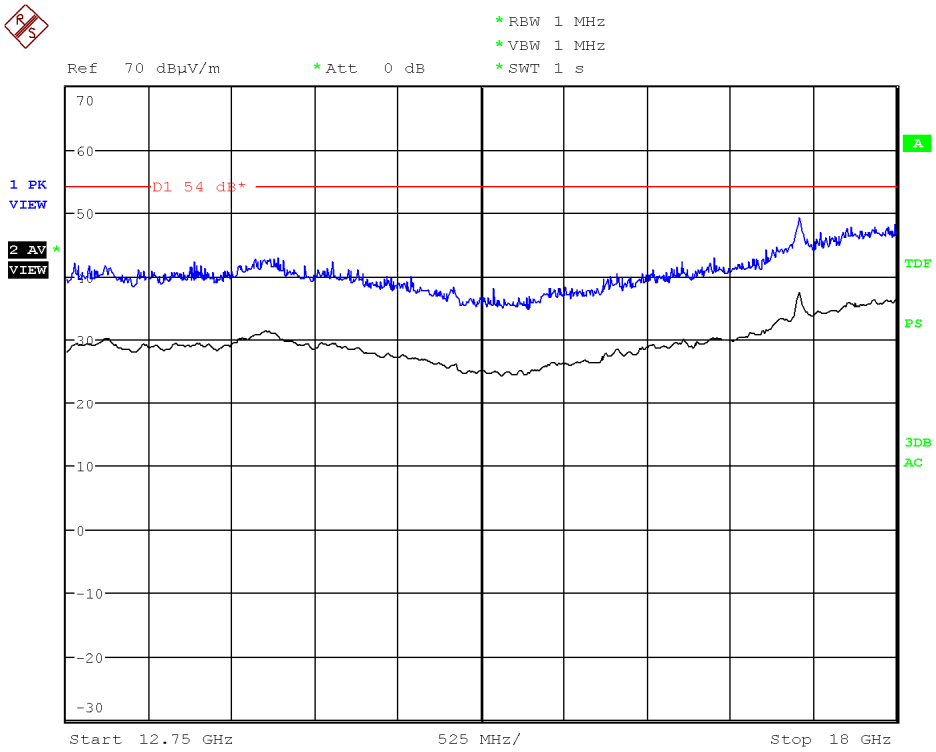


Middle Channel: 5785 MHz. Chain A+B

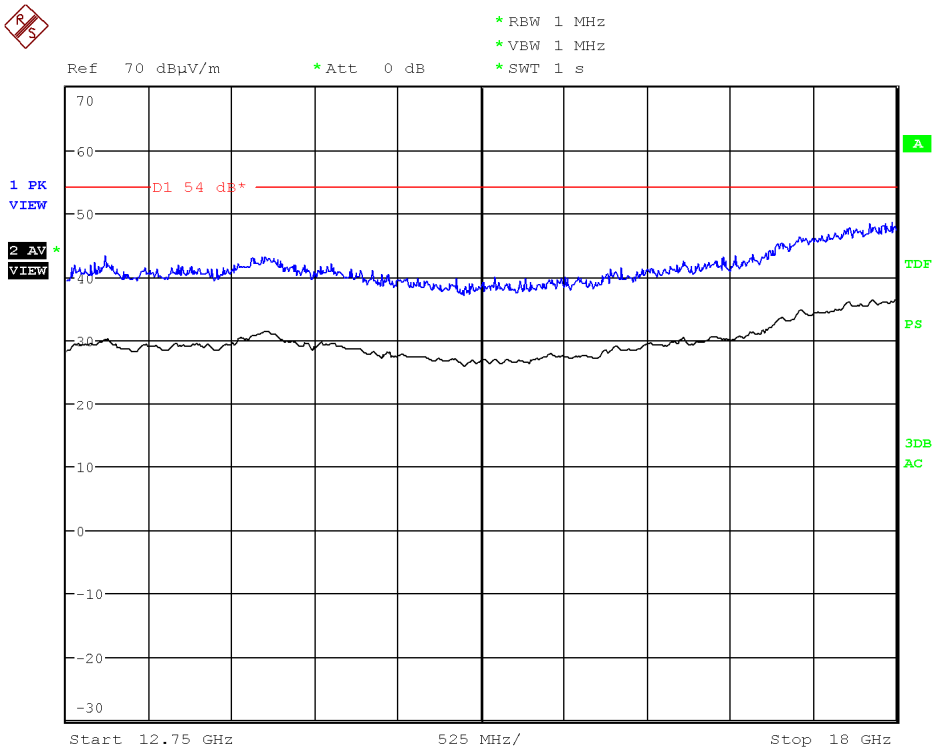



3. WiFi 5GHz 802.11 n40 mode

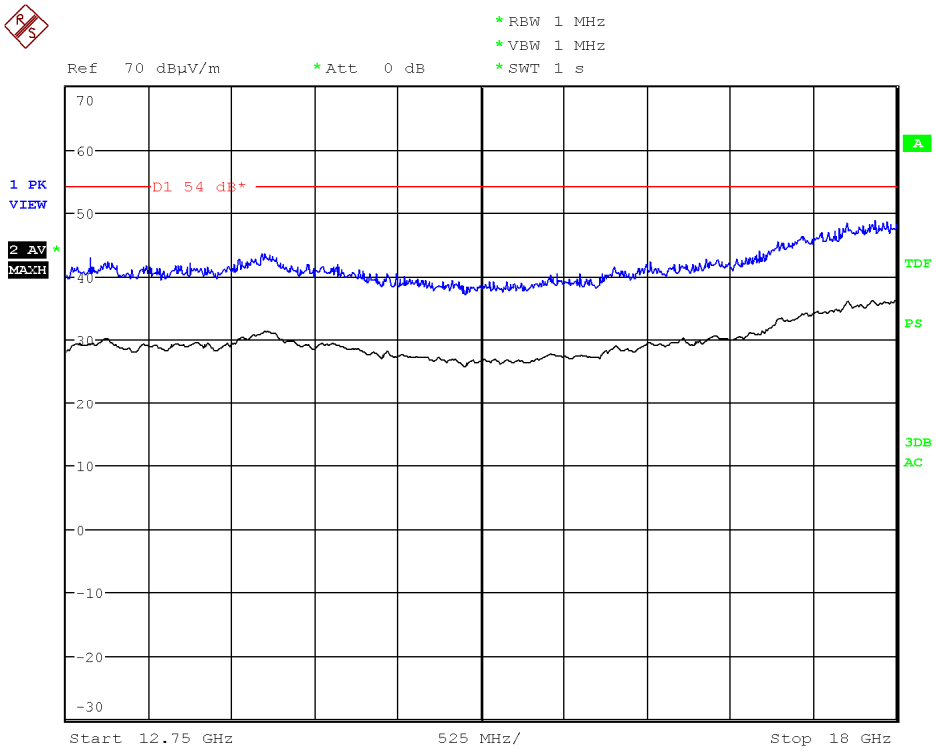
Highest Channel: 5795 MHz. Chain A



Highest Channel: 5795 MHz. Chain B

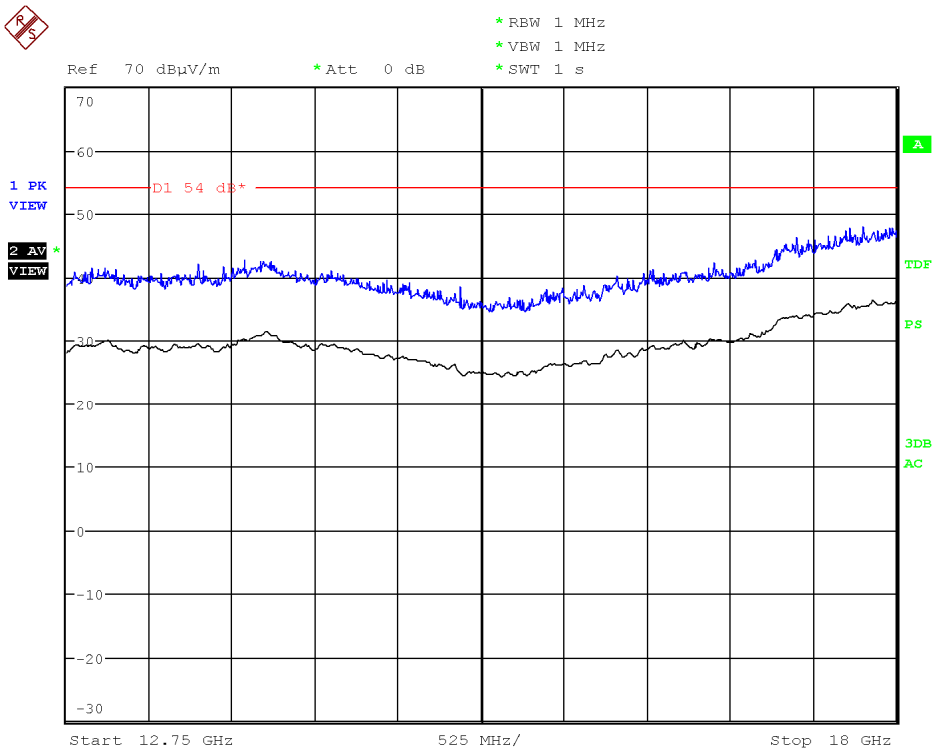



Highest Channel: 5795 MHz. Chain A+B

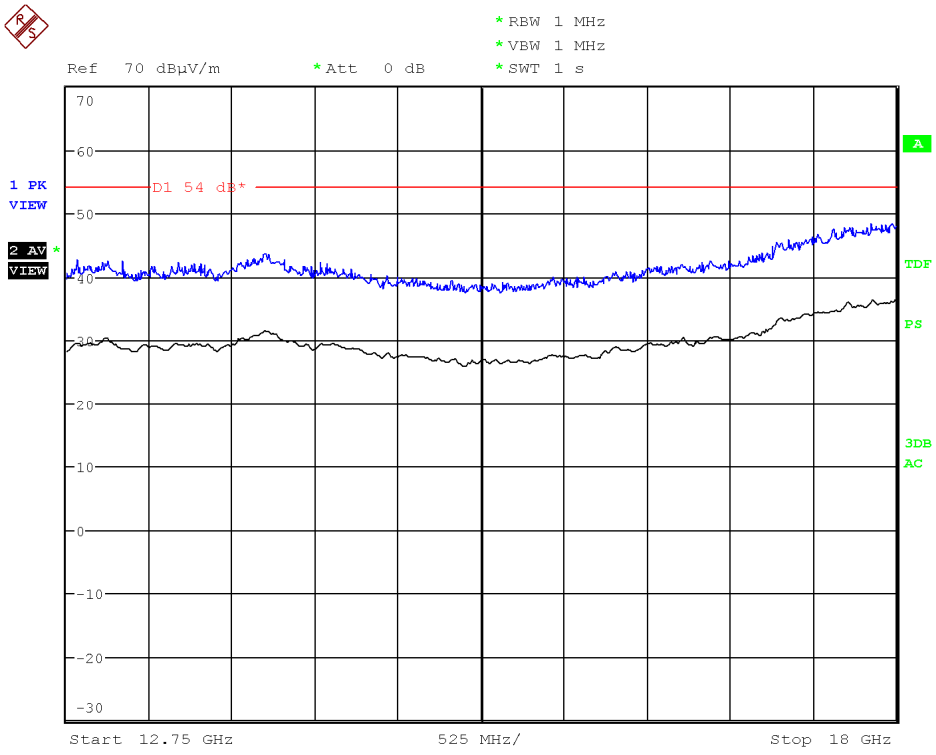


4. WiFi 5GHz 802.11 ac80 mode

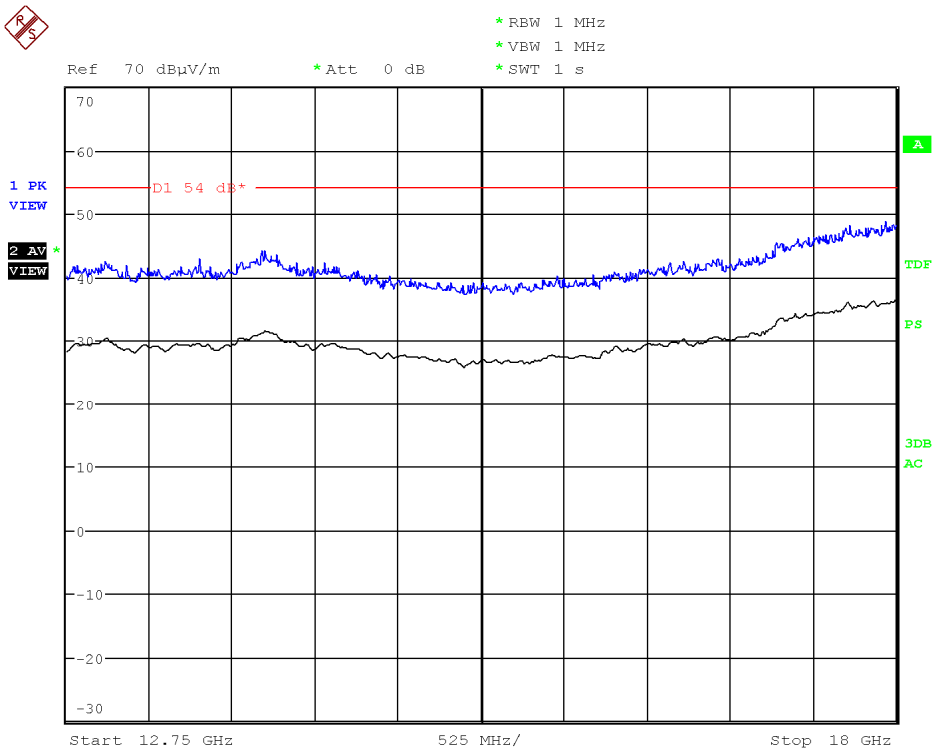
Middle Channel: 5775 MHz. Chain A.




Middle Channel: 5775 MHz. Chain B.



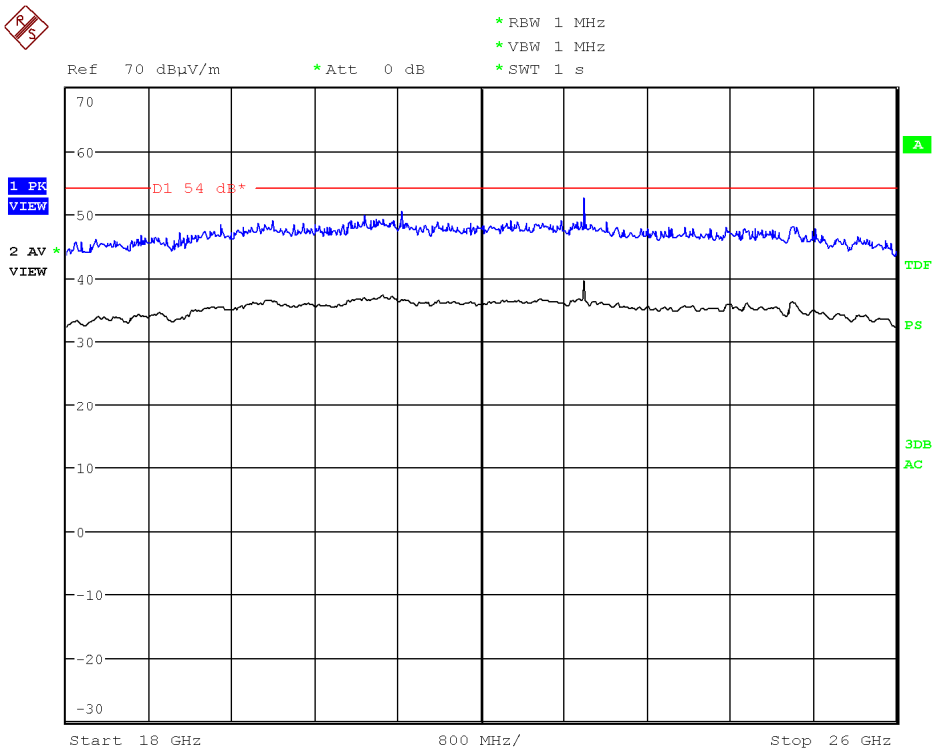
Middle Channel: 5775 MHz. Chain A+B.



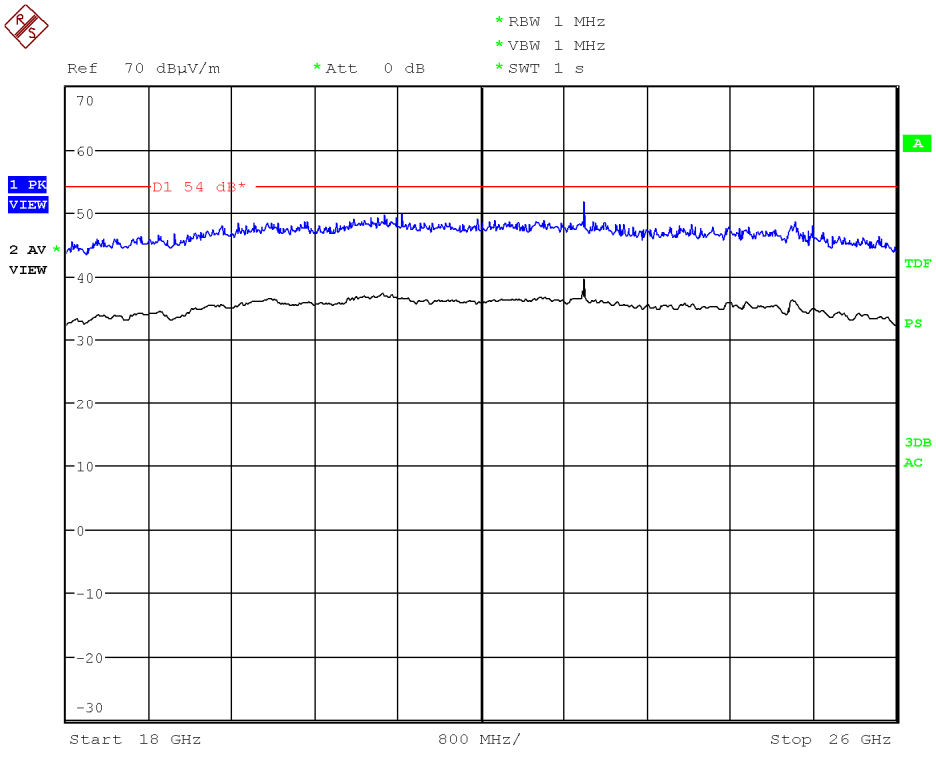
FREQUENCY RANGE 18 GHz to 26 GHz.

1. WiFi 5GHz 802.11 a mode

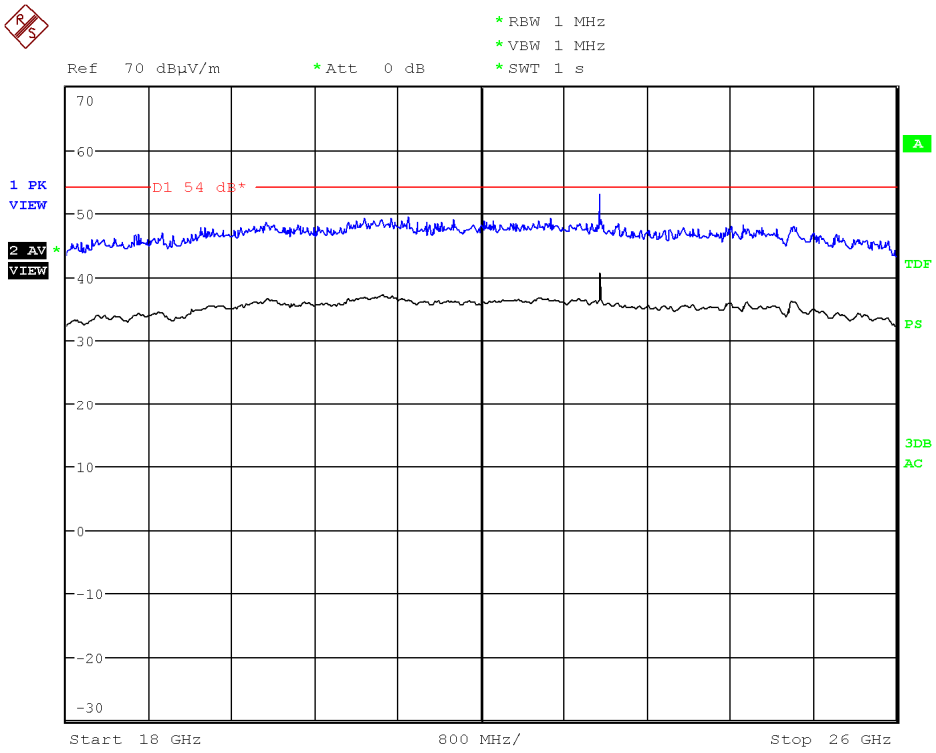
Lowest Channel: 5745 MHz. Chain A



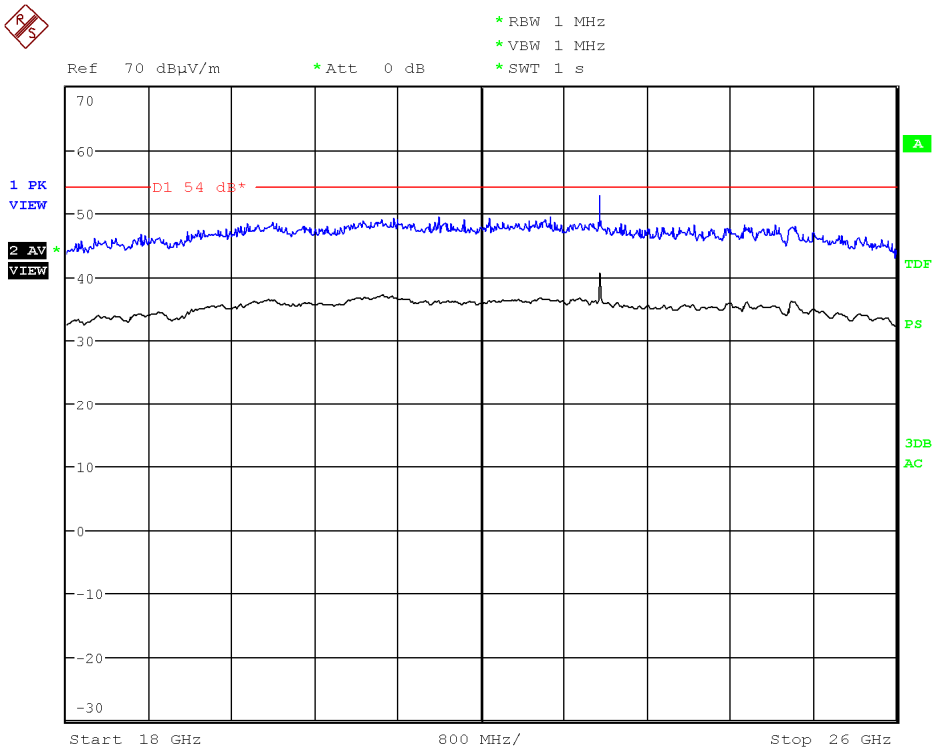

Lowest Channel: 5745 MHz. Chain B



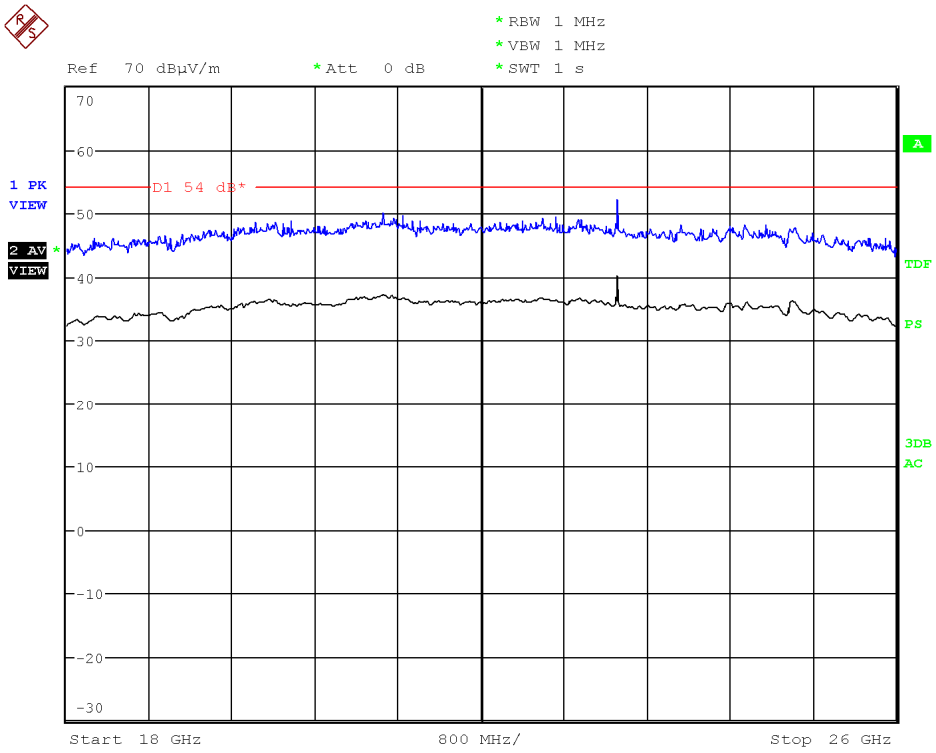
Middle Channel: 5785 MHz. Chain A



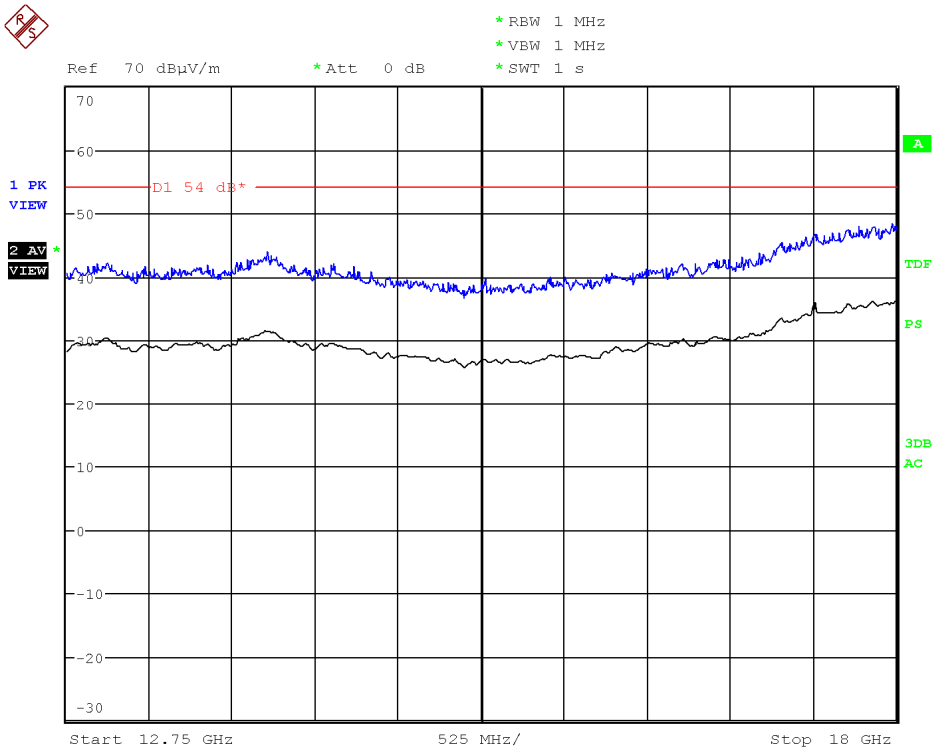

Middle Channel: 5785 MHz. Chain B



Highest Channel: 5825 MHz. Chain A

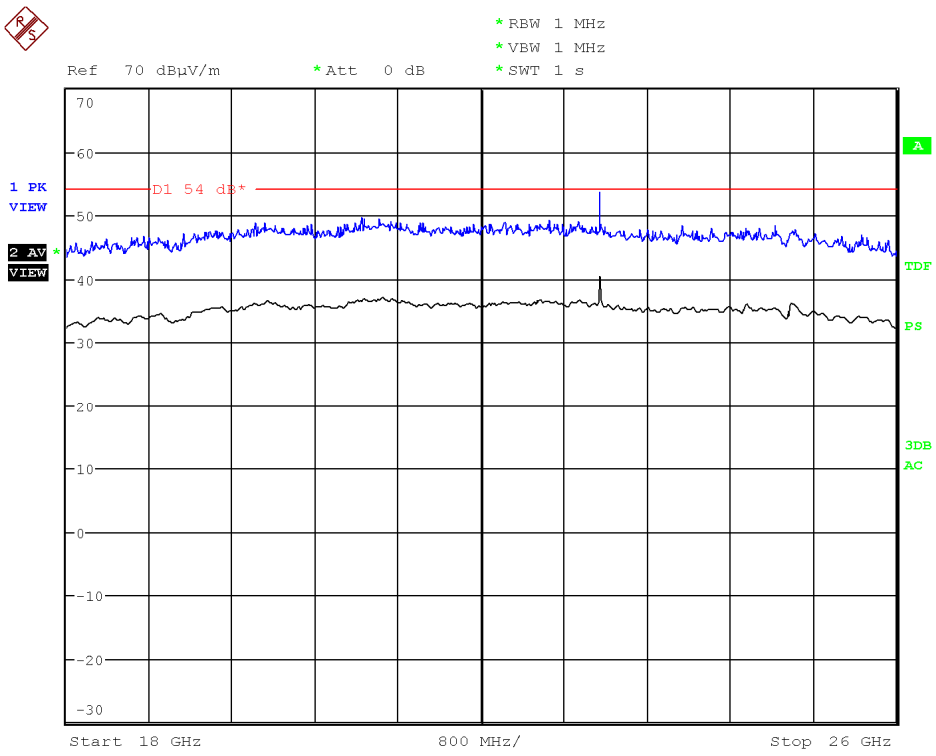



Highest Channel: 5825 MHz. Chain B

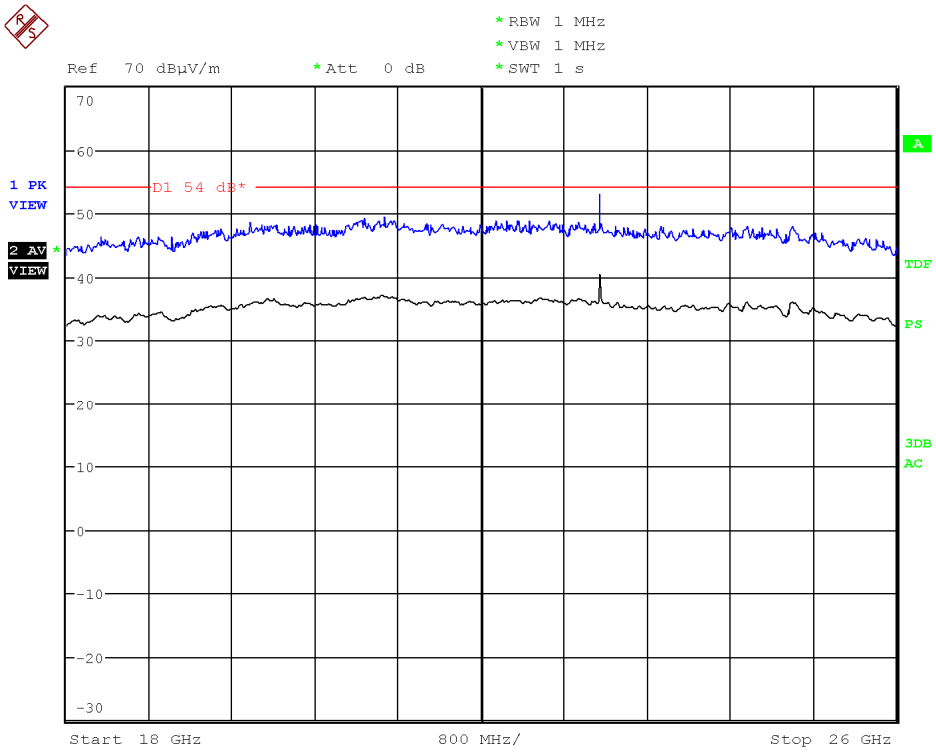


2. WiFi 5GHz 802.11 n20 mode

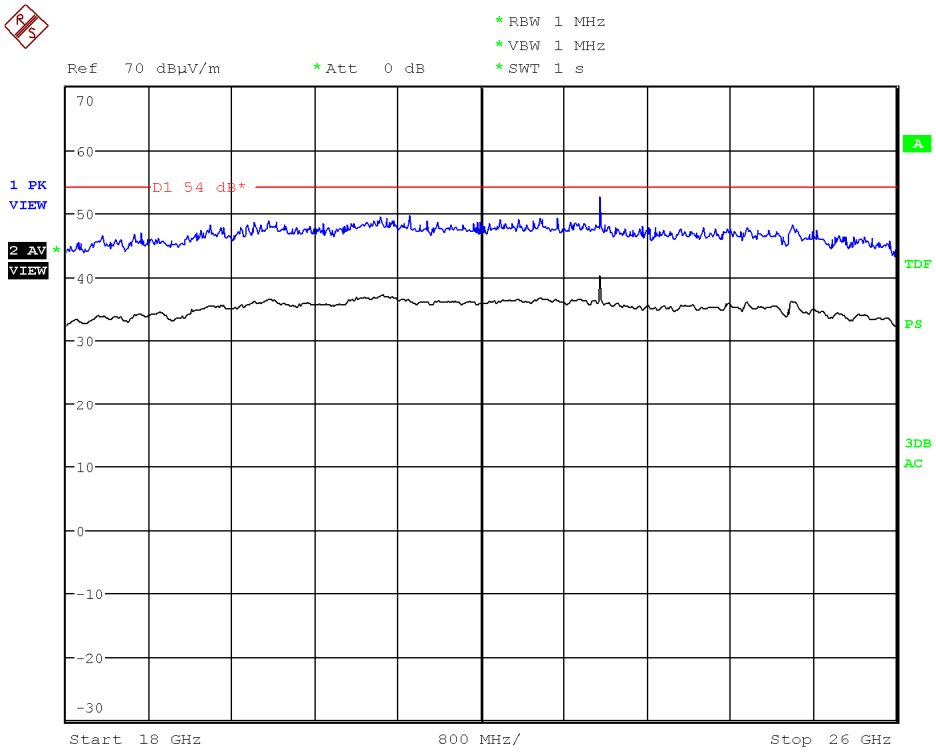
Middle Channel: 5785 MHz. Chain A




Middle Channel: 5785 MHz. Chain B

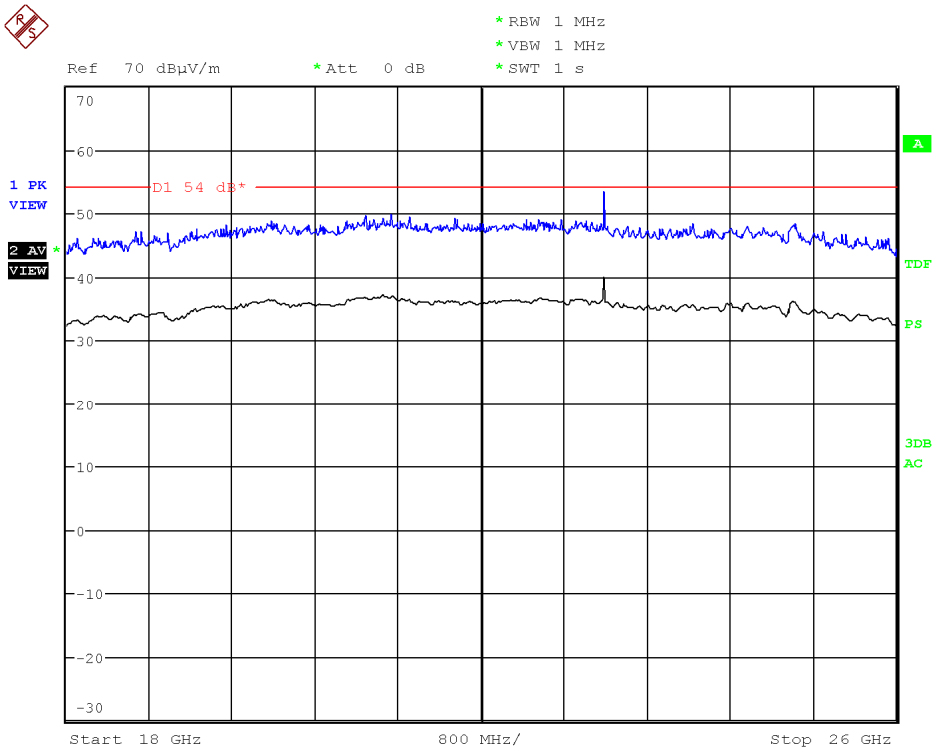


Middle Channel: 5785 MHz. Chain A+B

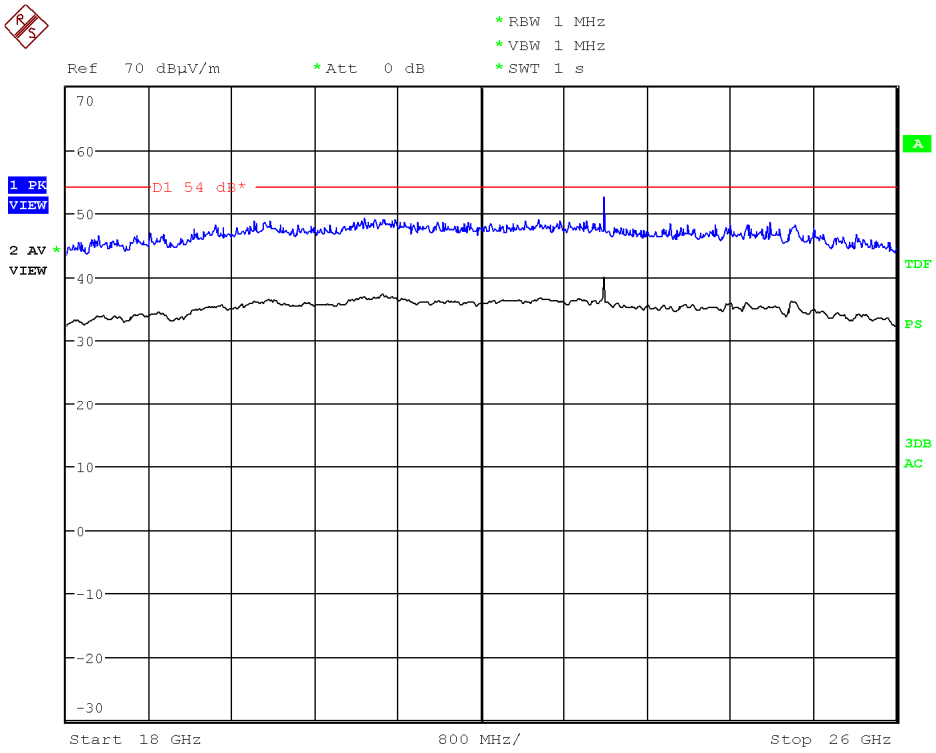



3. WiFi 5GHz 802.11 n40 mode

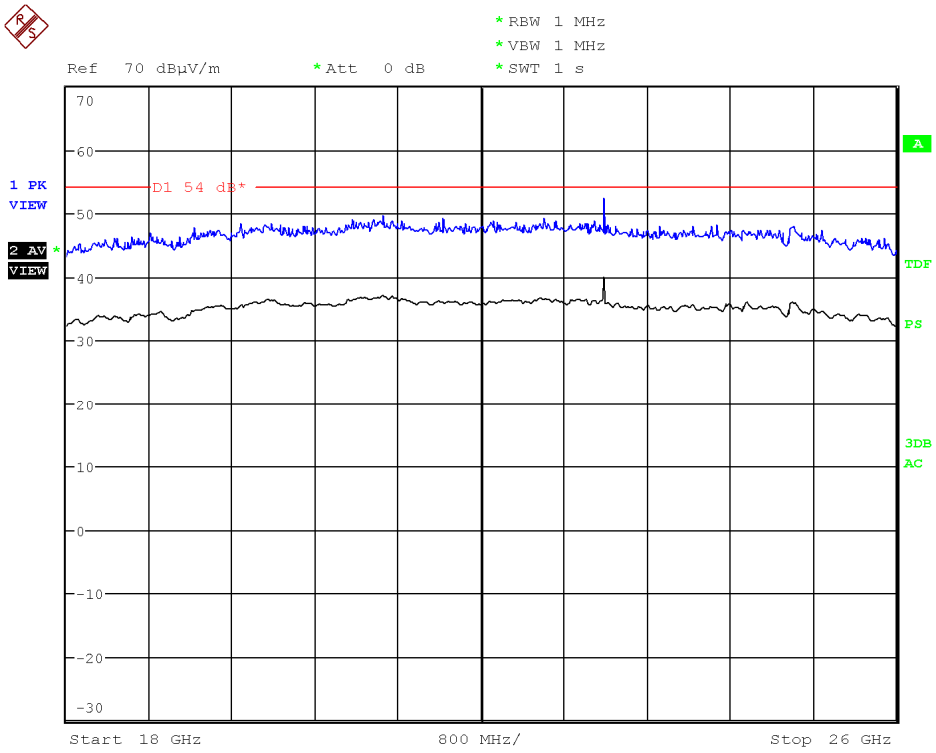
Highest Channel: 5795 MHz. Chain A



Highest Channel: 5795 MHz. Chain B

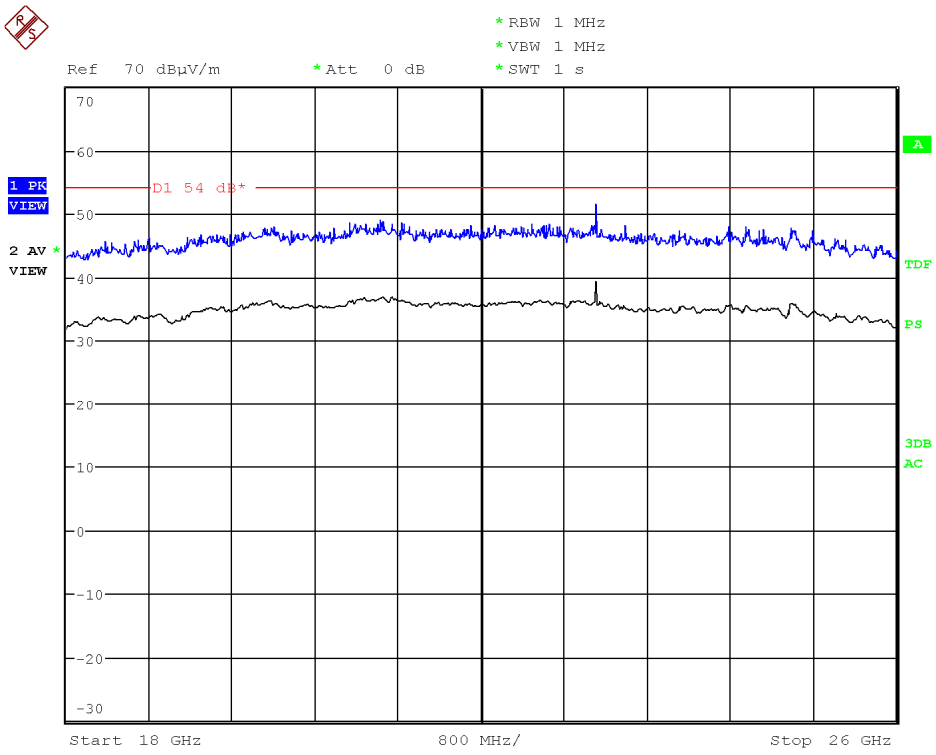



Highest Channel: 5795 MHz. Chain A+B

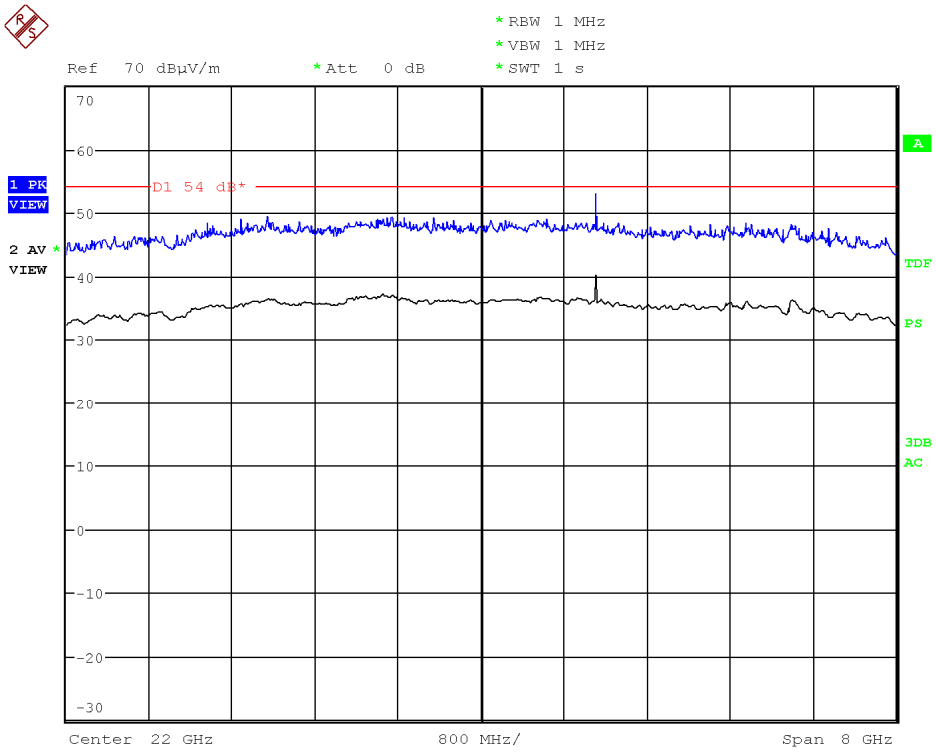


4. WiFi 5GHz 802.11 ac80 mode

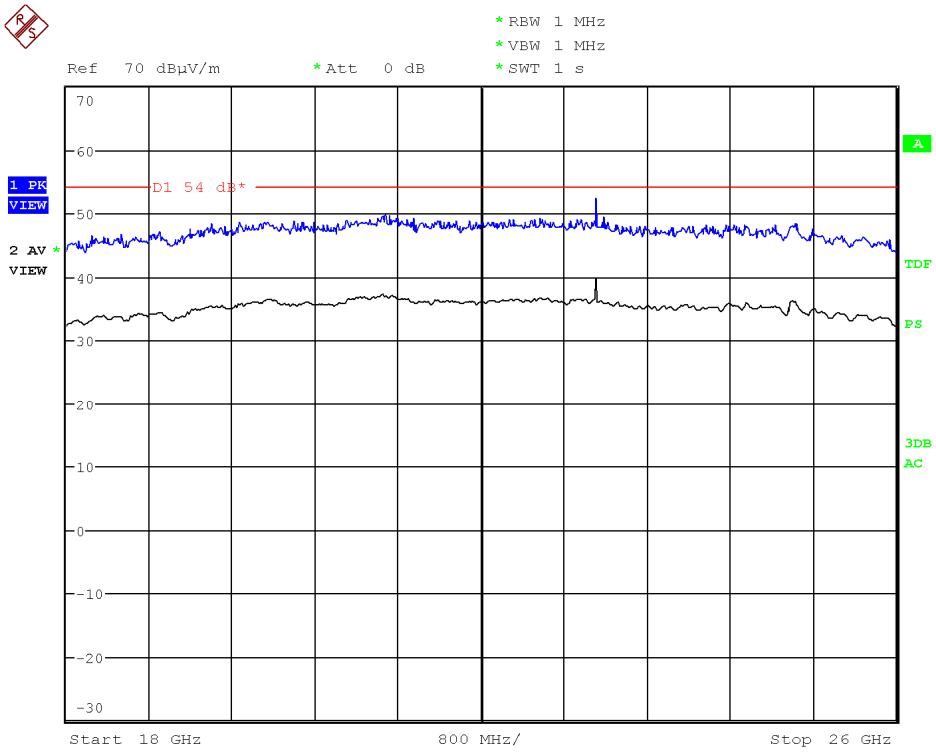
Middle Channel: 5775 MHz. Chain A.




Middle Channel: 5775 MHz. Chain B.

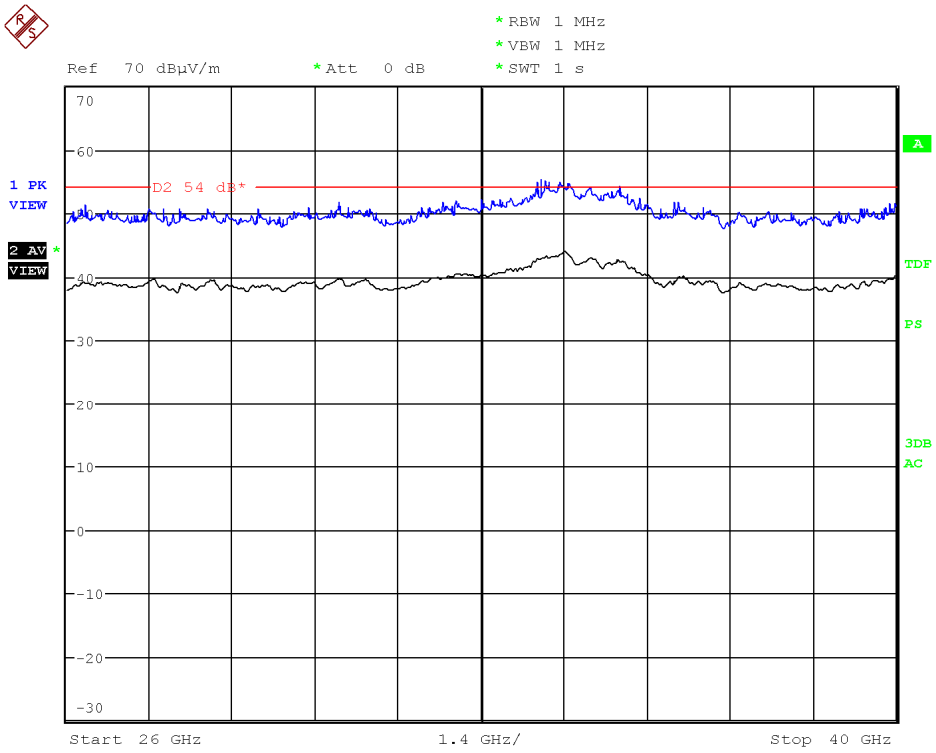


Middle Channel: 5775 MHz. Chain A+B.



FREQUENCY RANGE 26 GHz to 40 GHz.

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




(This plot is valid for both SISO and MIMO modes).

# APPENDIX C: Test results
# “Bluetooth Low Energy”

**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 dBi

TEST FREQUENCIES:

Lowest channel: 2402 MHz

Middle channel: 2440 MHz

Highest channel: 2480 MHz

For Bluetooth LE operation mode the transmission is at CHAIN B 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.

The PC was using the Intel test utility DRTU Version "OEDRTU 558x86" DRTU 1.6.1.558.

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and connected to the spectrum analyzer using a low loss calibrated RF cable. The measurement readings are corrected with the cable loss (dB).

RADIATED MEASUREMENTS

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1m for the frequency range 1 GHz-25 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

For radiated emissions in the range 1 GHz-25 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 and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

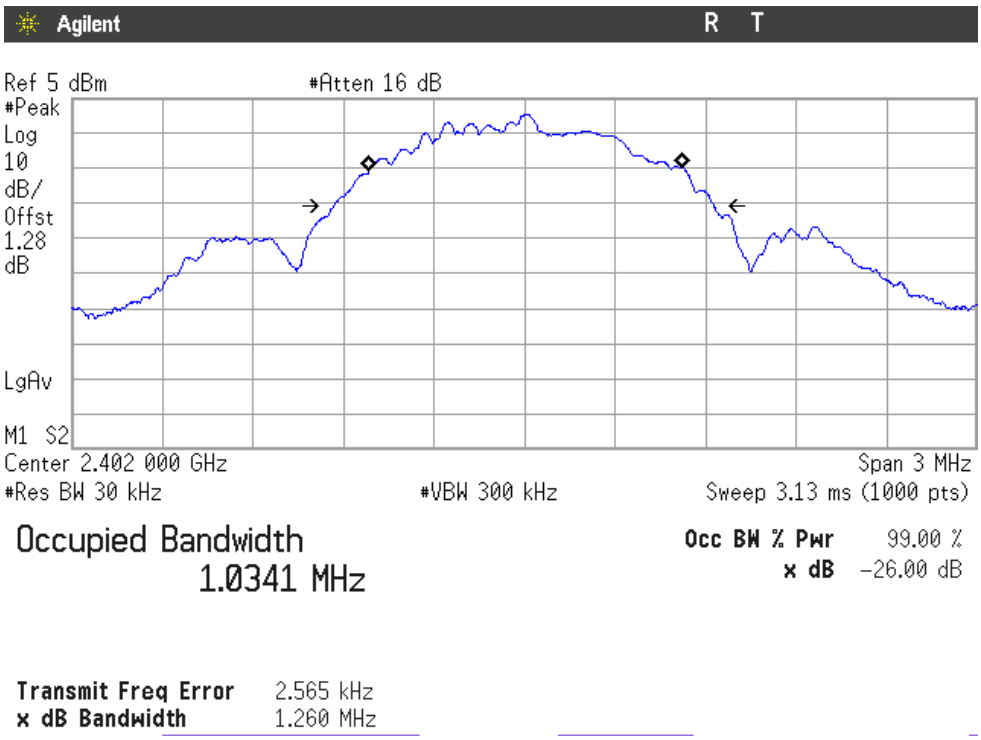
## Occupied bandwidth

RESULTS

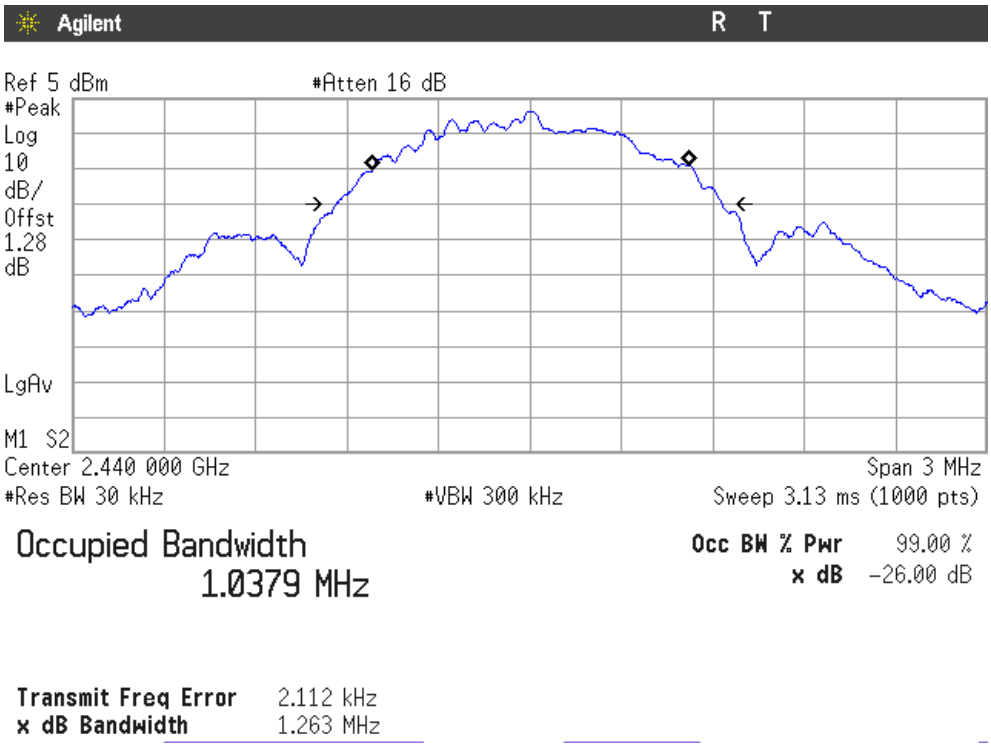
(see next plots).

| | Lowest frequency 2402 MHz | Middle frequency 2440 MHz | Highest frequency 2480 MHz |
|---|---|---|---|
| 99% bandwidth (MHz) | 1.034 | 1.038 | 1.031 |
| -26 dBc bandwidth (MHz) | 1.260 | 1.263 | 1.257 |
| Measurement uncertainty (kHz) | ±21.7 | | |

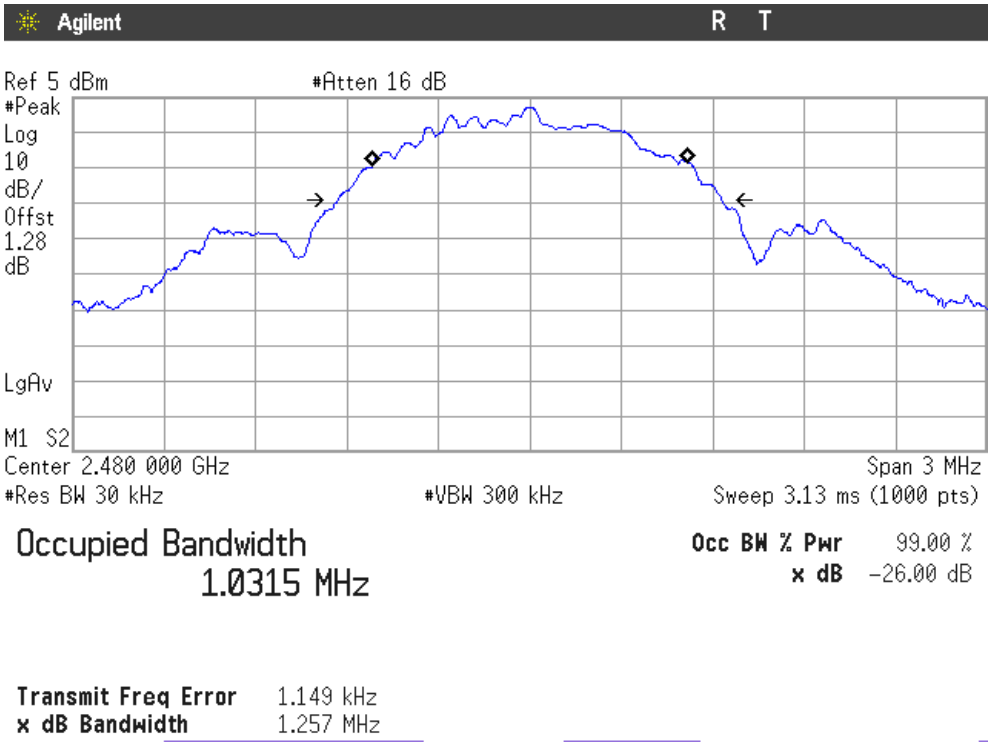
Lowest Channel




Middel Channel



Highest channel



## Section 15.247 Subclause (a) (2) / RSS-210 A8.2. (a). 6 dB Bandwidth

SPECIFICATION

The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

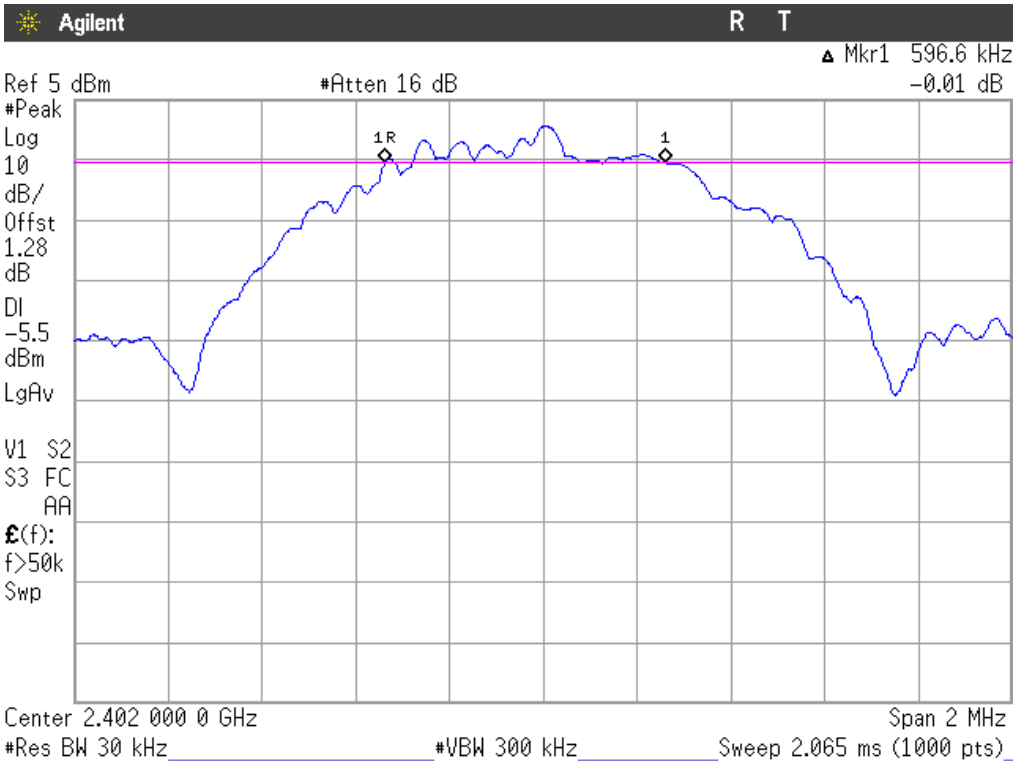
6 dB Bandwidth (see next plots).

| | Lowest frequency 2402 MHz | Middle frequency 2440 MHz | Highest frequency 2480 MHz |
|---|---|---|---|
| 6 dB Spectrum bandwidth (kHz) | 596.6 | 594.6 | 606.6 |
| Measurement uncertainty (kHz) | ±21.7 | | |

Verdict: PASS

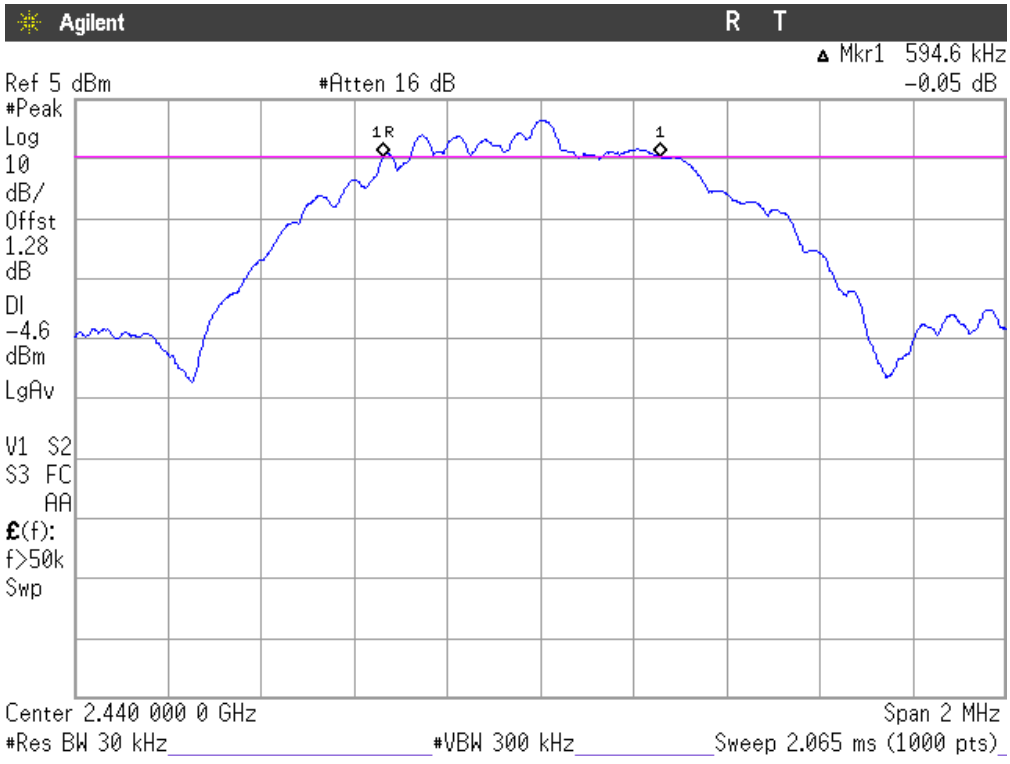
6 dB BANDWIDTH.

Lowest Channel



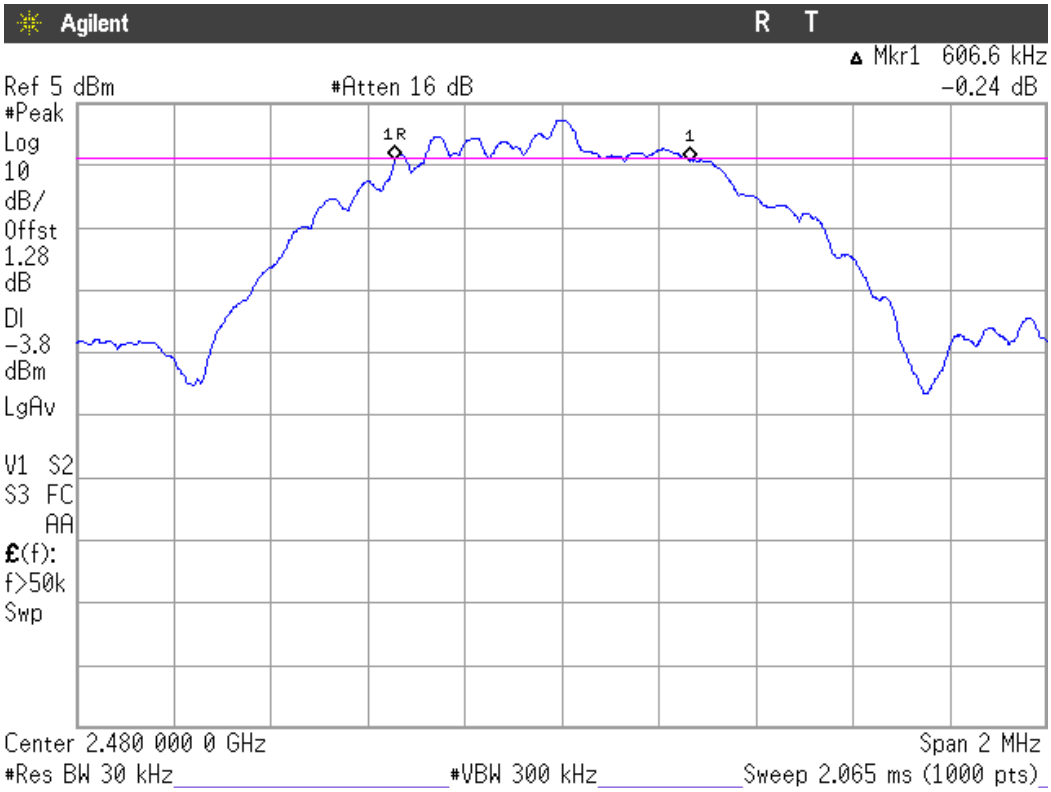

6 dB BANDWIDTH.

Middle Channel



6 dB BANDWIDTH.

Highest Channel



## Section 15.247 Subclause (b) / RSS-210 A8.4. (4). Maximum output power and antenna gain

SPECIFICATION

For systems using digital modulation in the 2400-2483.5 MHz band: 1 watt (30 dBm).
The e.i.r.p. shall not exceed 4 W (36 dBm) (Canada).

RESULTS

The maximum Peak Conducted Output Power was measured using the method according to point 8.1.1. Option 1 (RBW ≥ DTS BW) of Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v02 dated 10/04/2012.

MAXIMUM OUTPUT POWER. See next plots.

Maximum declared antenna gain: 3 dBi.

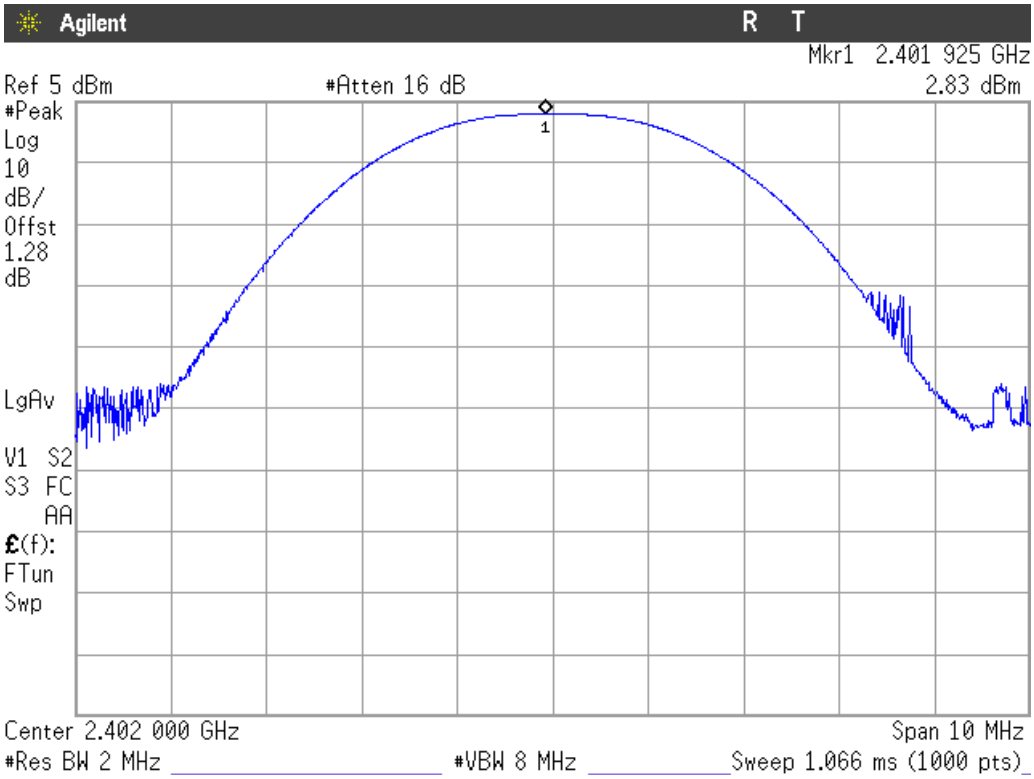
| | Lowest frequency 2402 MHz | Middle frequency 2440 MHz | Highest frequency 2480 MHz |
|---|---|---|---|
| Maximum conducted power (dBm) | 2.83 | 3.64 | 4.54 |
| Maximum EIRP power (dBm) | 5.83 | 6.64 | 7.54 |
| Measurement uncertainty (dB) | ±1.5 | | |

The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values.

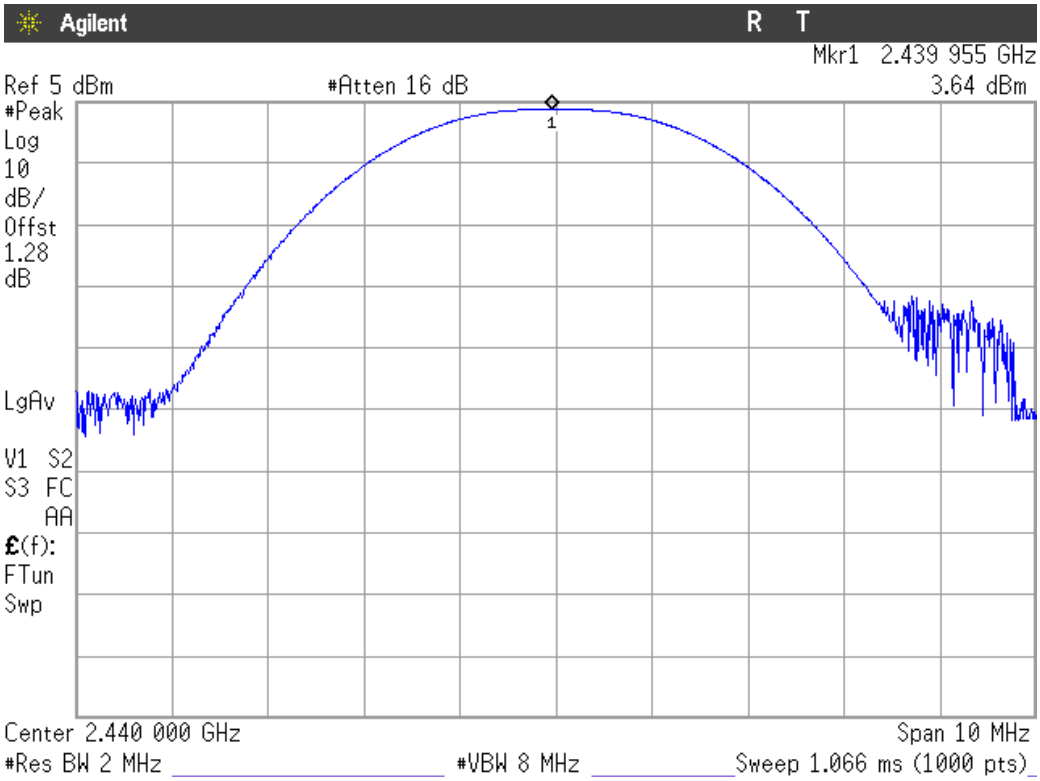
Verdict: PASS

1. CONDUCTED PEAK POWER.

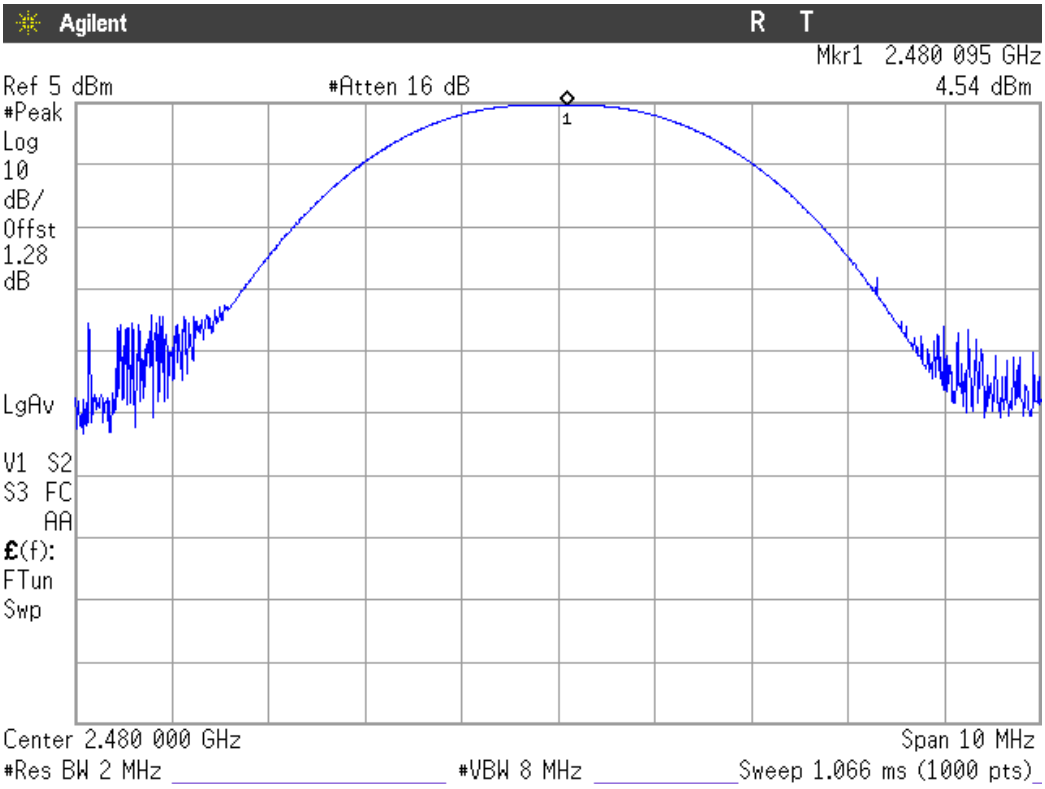
Lowest frequency




Middle frequency



Highest frequency



**Section 15.247 Subclause (d) / RSS-210 A8.5. Emission limitations conducted (Transmitter)**

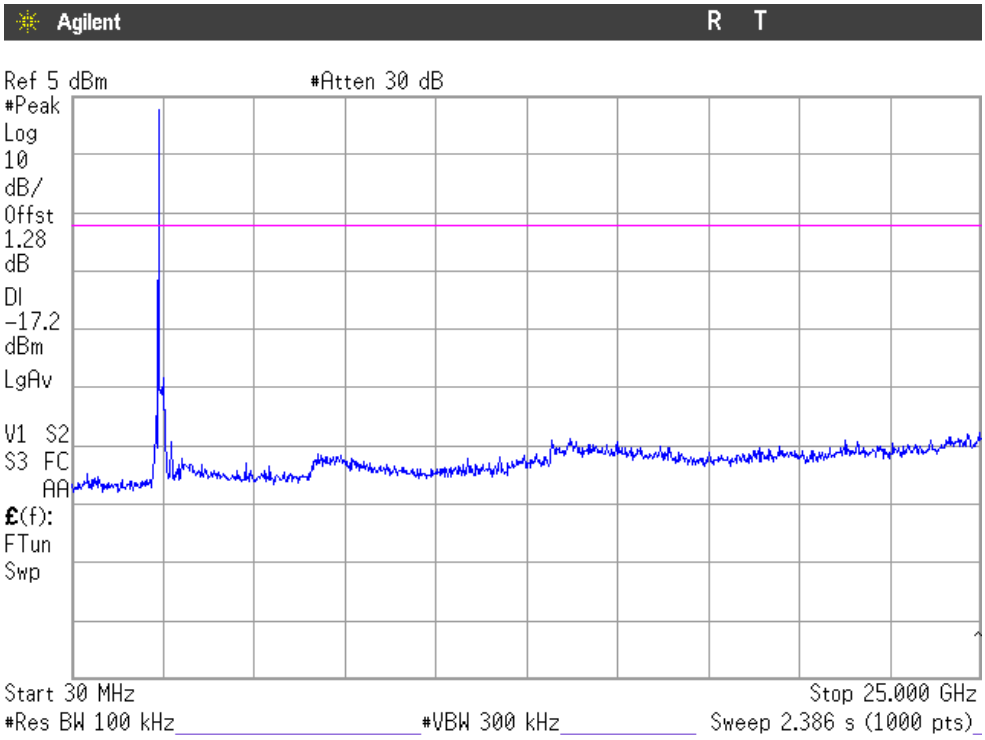
SPECIFICATION

In any 100 kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

RESULTS:

Lowest Channel

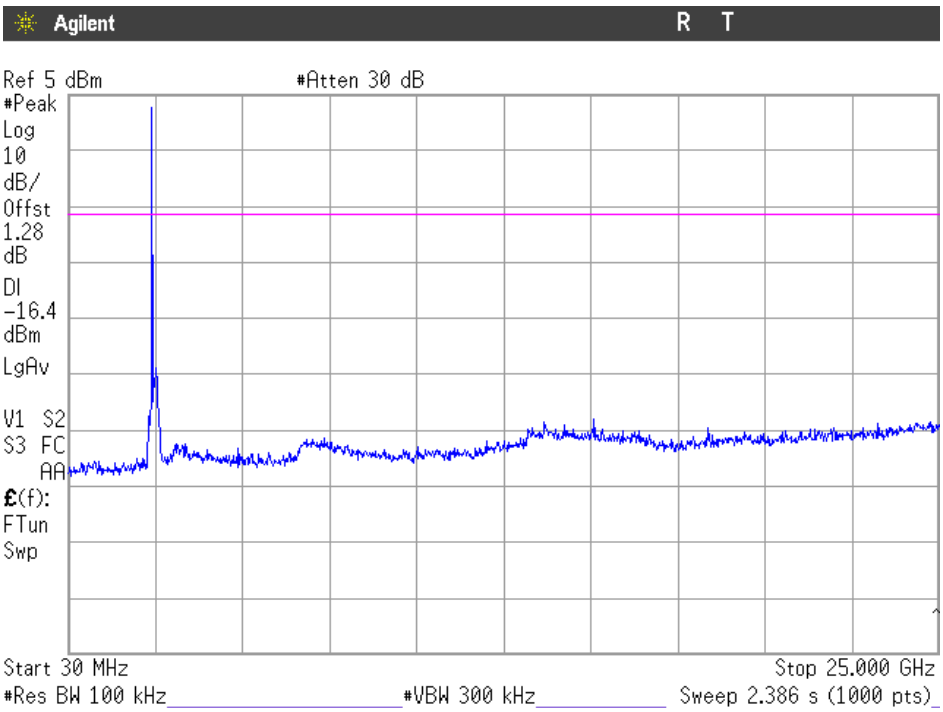
Carrier reference level measurement = 2.76 dBm




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

Middle Channel

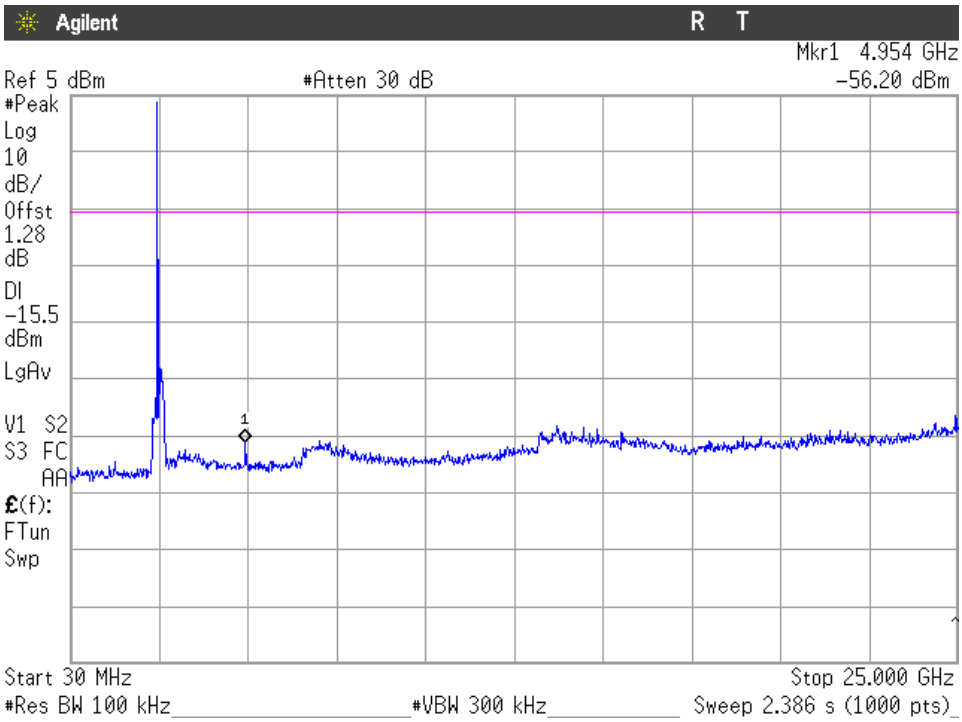
Carrier reference level measurement = 3.59 dBm




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

Highest Channel

Carrier reference level measurement = 4.47 dBm




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

Verdict: PASS

**Section 15.247 Subclause (d) / RSS-210 A8.5. Band-edge emissions compliance (Transmitter)**

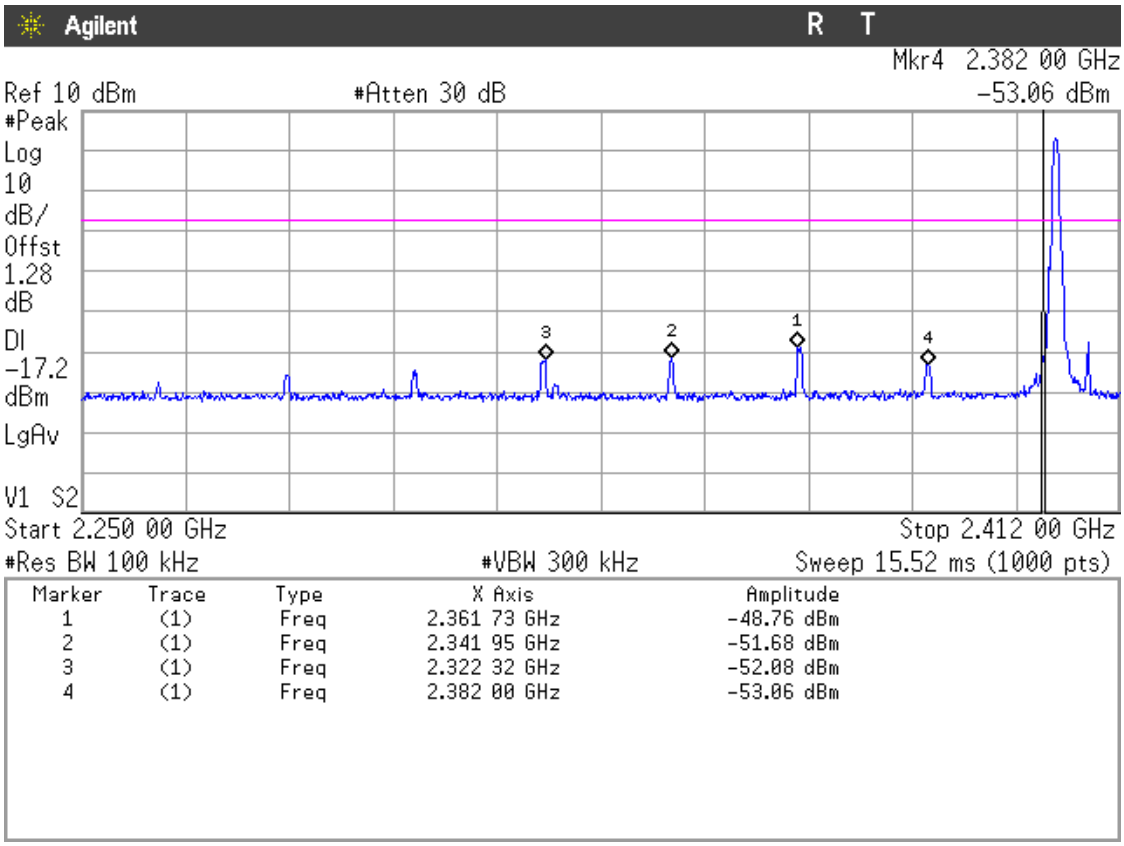
SPECIFICATION

Emissions outside the frequency band in which the intentional radiator is operating shall be at least 20dB below the highest level of the desired power.

RESULTS:

1. LOW FREQUENCY SECTION. CONDUCTED.

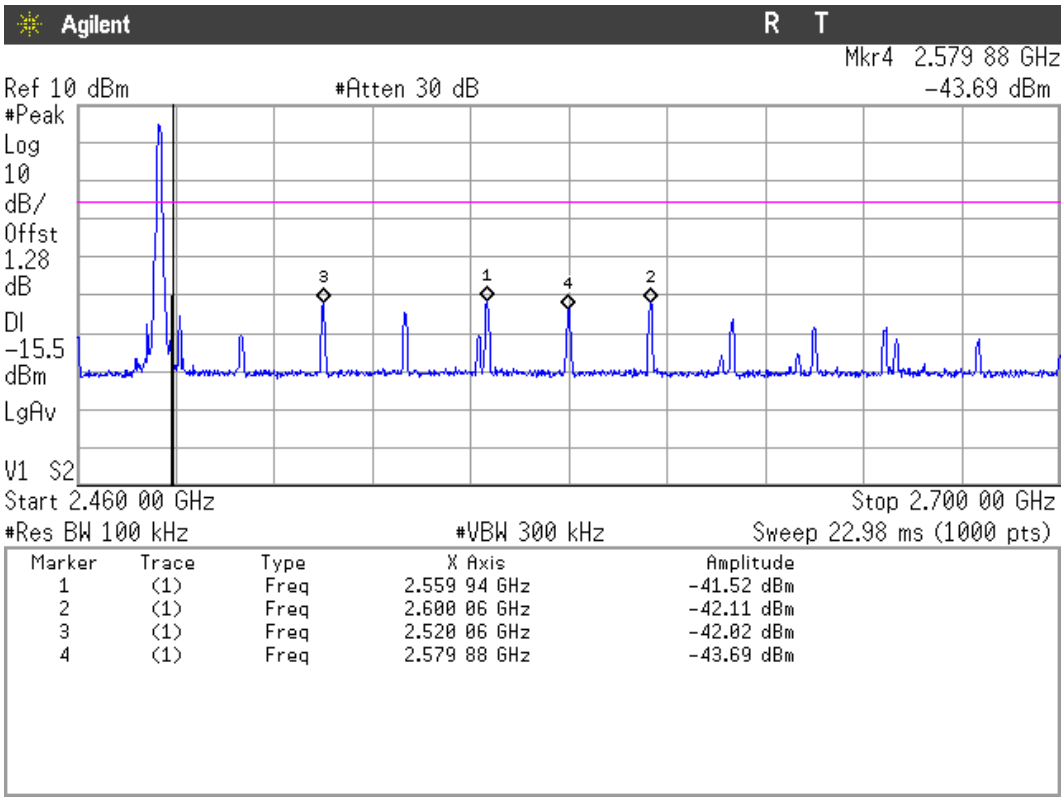
See next plot.




Verdict: PASS

2. HIGH FREQUENCY SECTION. CONDUCTED.

See next plot.




Verdict: PASS

## Section 15.247 Subclause (e) / RSS-210 A8.5. Power spectral density

SPECIFICATION

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

RESULTS

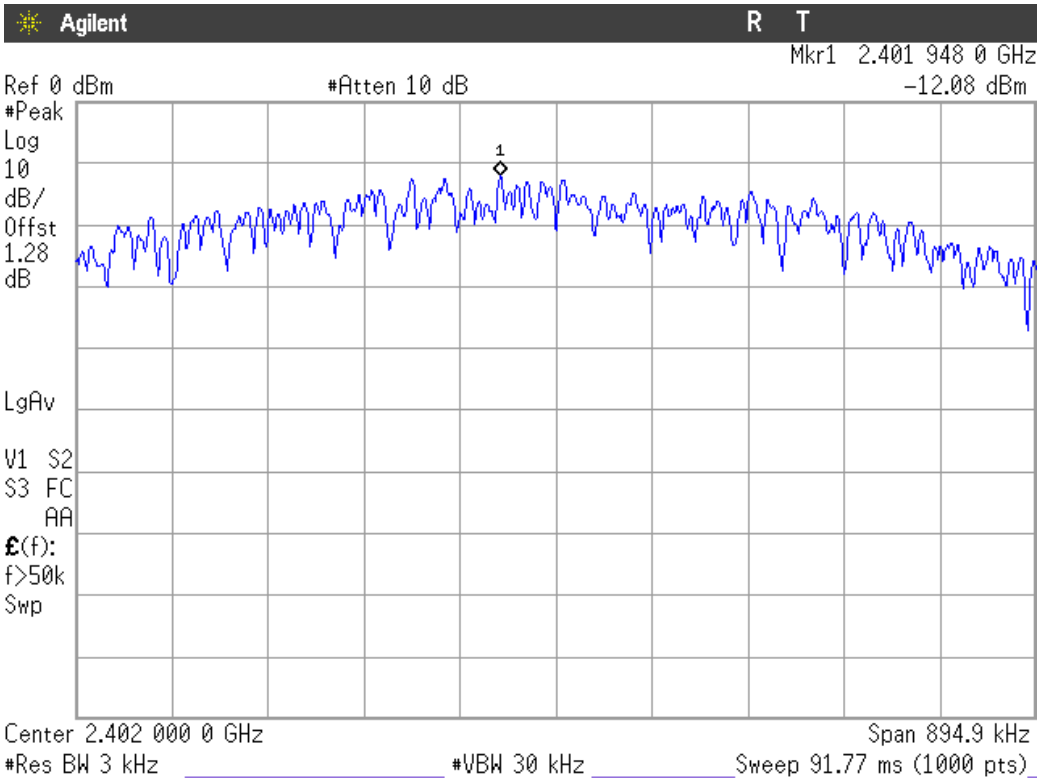
Power spectral density (see next plots).

| | Lowest frequency 2402 MHz | Middle frequency 2440 MHz | Highest frequency 2480 MHz |
|---|---|---|---|
| Power spectral density (dBm) in 3 kHz bandwidth | -12.08 | -11.75 | -10.79 |
| Measurement uncertainty (dB) | ±1.5 | | |

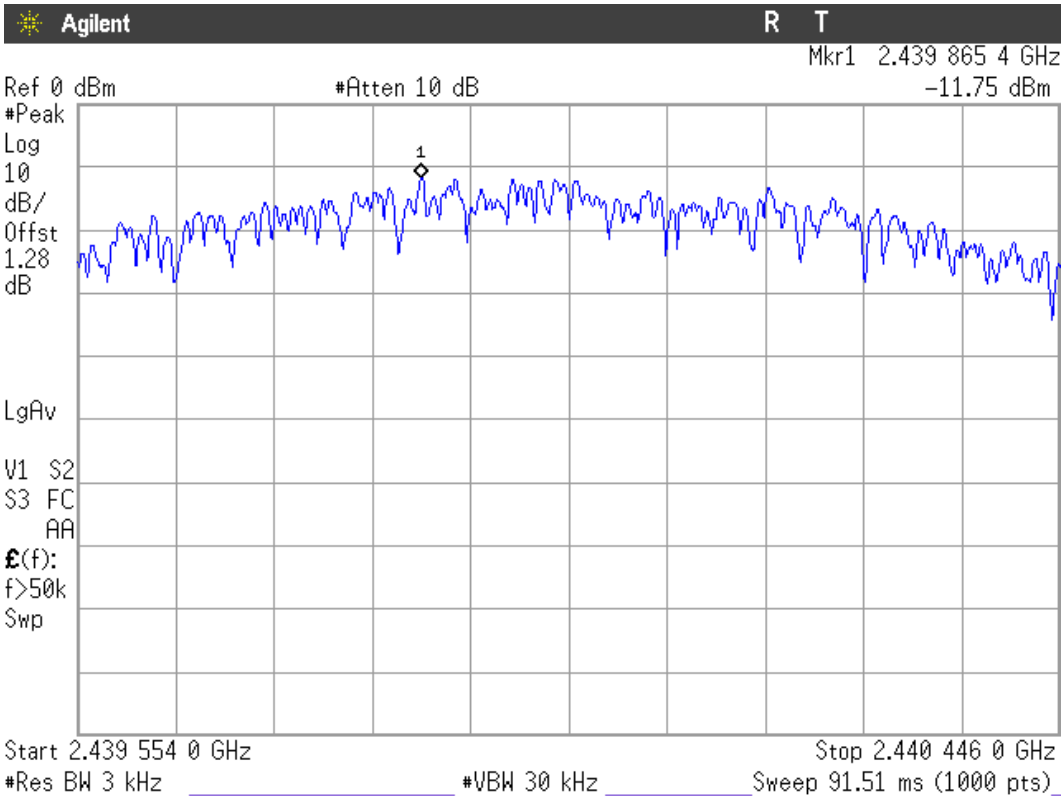
Verdict: PASS

Power spectral density.

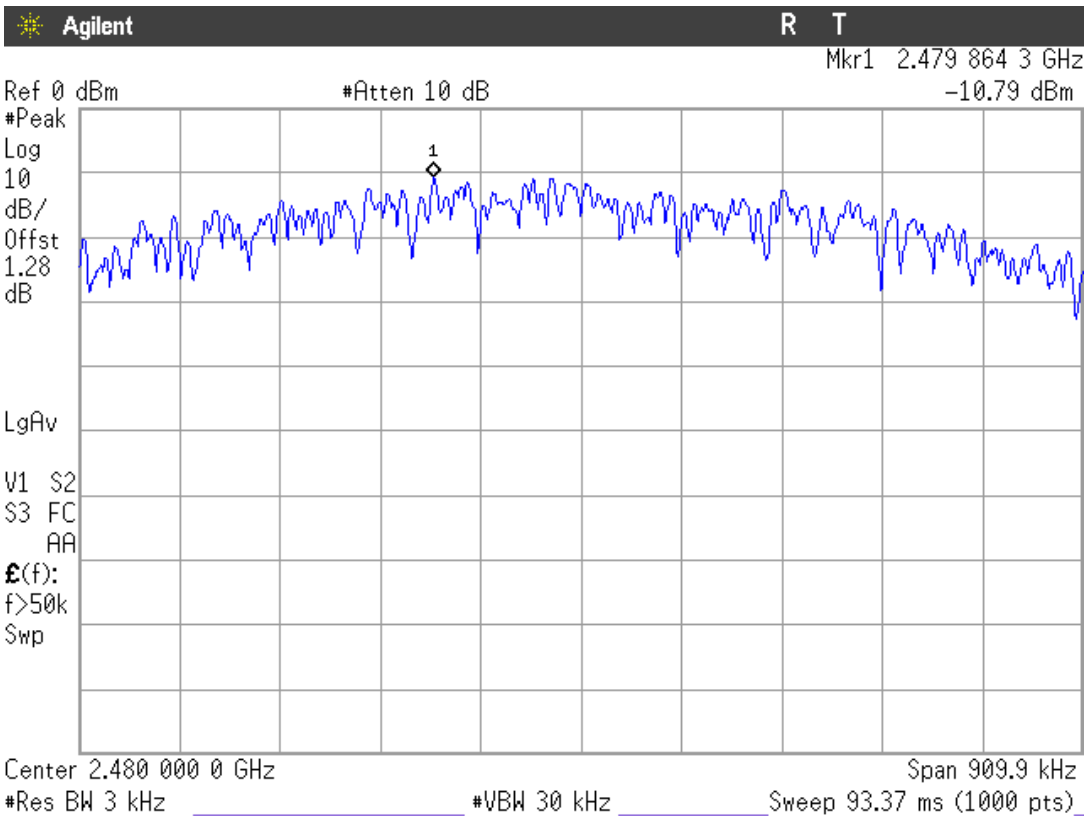
Lowest Channel




Middle Channel



Highest Channel



## Section 15.247 Subclause (d) / RSS-210 A8.5. Emission limitations radiated (Transmitter)

SPECIFICATION

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 - 25000 | 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 and the antenna height was varied from 1 to 4 meters 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 3 m for the frequency range 30 MHz-1000 MHz and at distance of 1m for the frequency range 1 GHz-25 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.

The equipment transmits continuously in the selected channel so it is not necessary a duty cycle correction factor.

**Frequency range 30 MHz-1000 MHz**.

The spurious signals detected do not depend on the operating channel.

Highest spurious levels:

| Spurious frequency (MHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 30.0025 | V | Quasi-Peak | 21.39 | ± 3.8 |
| 690.9218 | H | Quasi-Peak | 27.08 | ± 3.8 |

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

**Frequency range 1 GHz-25 GHz**

1. CHANNEL: LOWEST (2402 MHz). All maximized peak levels are below the average limit.

| Spurious frequency (MHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.44181 | H | Peak | 50.61 | ± 4.09 |
| 2.46243 | H | Peak | 50.80 | ± 4.09 |
| 2.50247 | H | Peak | 52.32 | ± 4.09 |
| 2.52209 | H | Peak | 52.50 | ± 4.09 |
| 3.08829 | H | Peak | 42.60 | ± 4.09 |

2. CHANNEL: MIDDLE (2440 MHz). All maximized peak levels are below the average limit.

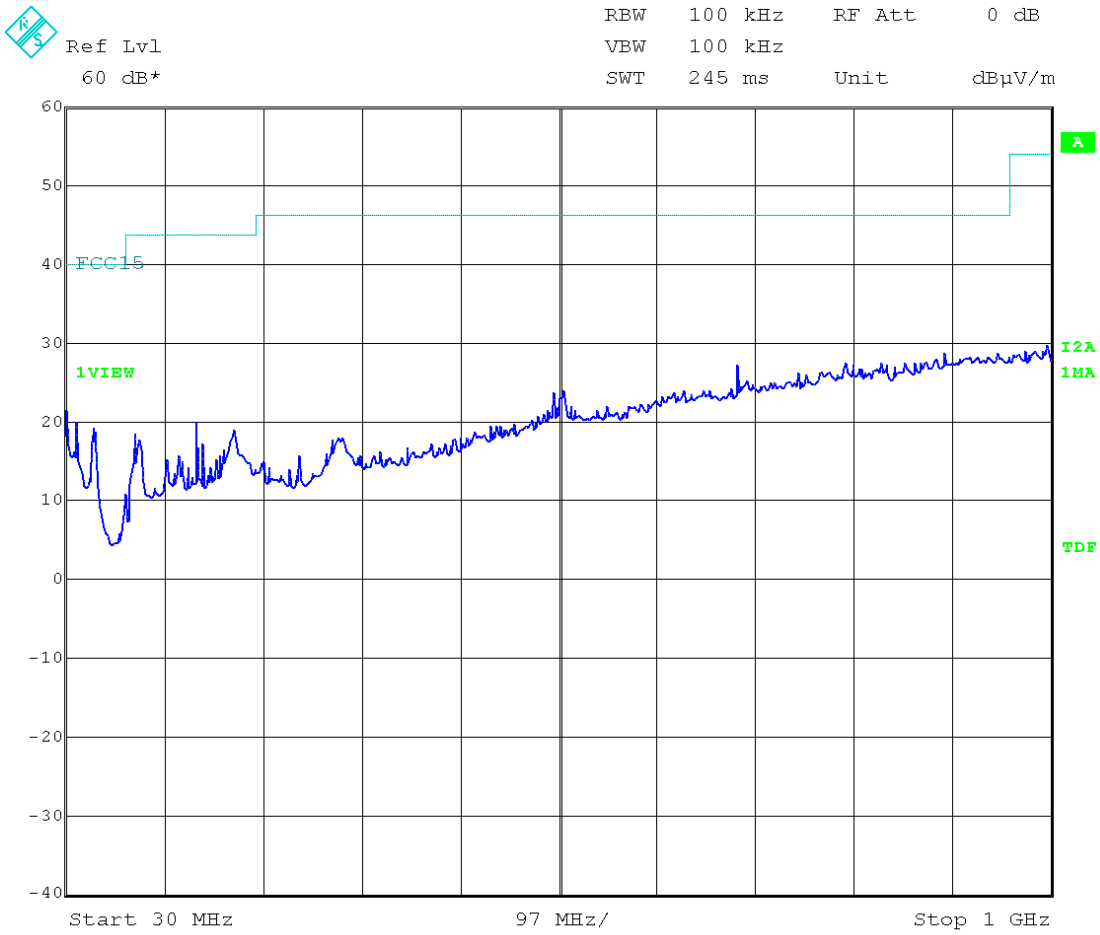
| Spurious frequency (MHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.46252 | H | Peak | 50.12 | ± 4.09 |
| 2.50255 | H | Average | 51.16 | ± 4.09 |
| 2.52287 | H | Peak | 52.04 | ± 4.09 |
| 3.08829 | H | Average | 42.83 | ± 4.09 |

3. CHANNEL: HIGHEST (2480 MHz). All maximized peak levels are below the average limit.

| Spurious frequency (MHz) | Polarization | Detector | Emission Level (dBµV/m) | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.51971 | H | Peak | 51.32 | ± 4.09 |
| 2.54013 | H | Peak | 49.70 | ± 4.09 |
| 2.57987 | H | Peak | 50.95 | ± 4.09 |
| 2.59989 | H | Peak | 51.88 | ± 4.09 |
| 3.08841 | H | Peak | 41.49 | ± 4.09 |

Verdict: PASS

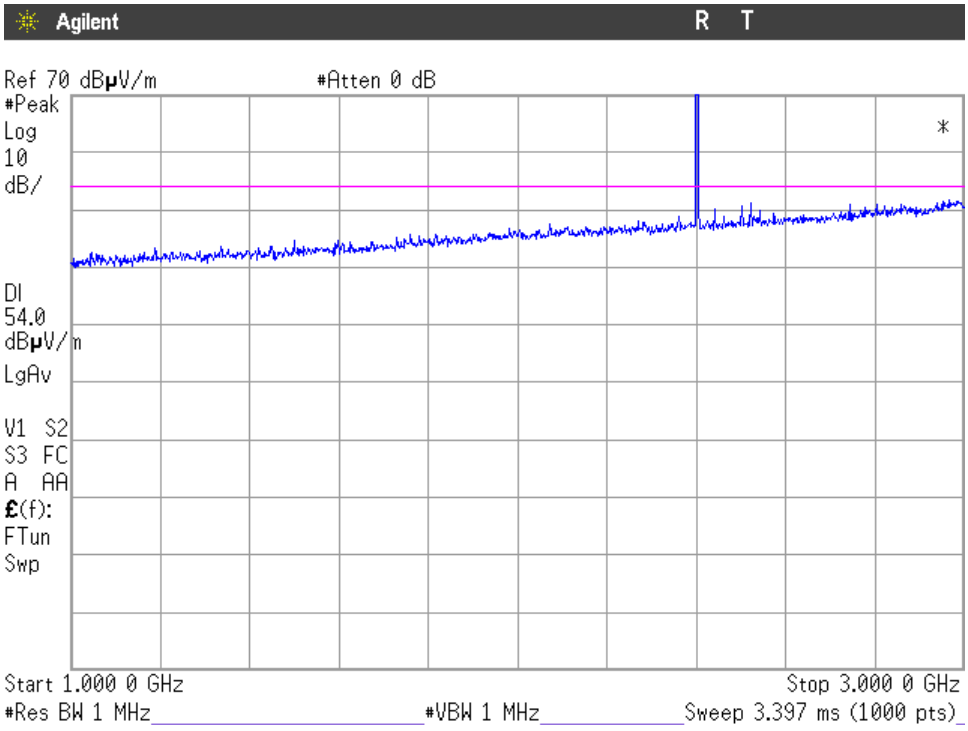
FREQUENCY RANGE 30 MHz-1000 MHz.




(This plot is valid for all three channels).

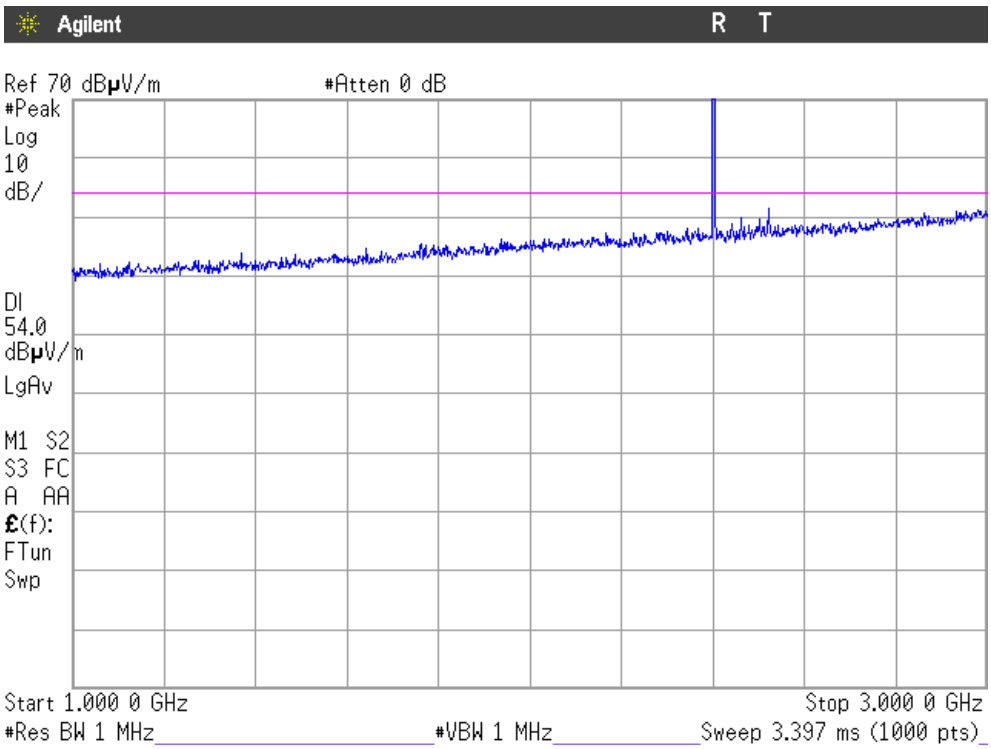
FREQUENCY RANGE 1 GHz to 3 GHz.

**CHANNEL: Lowest (2402 MHz).**



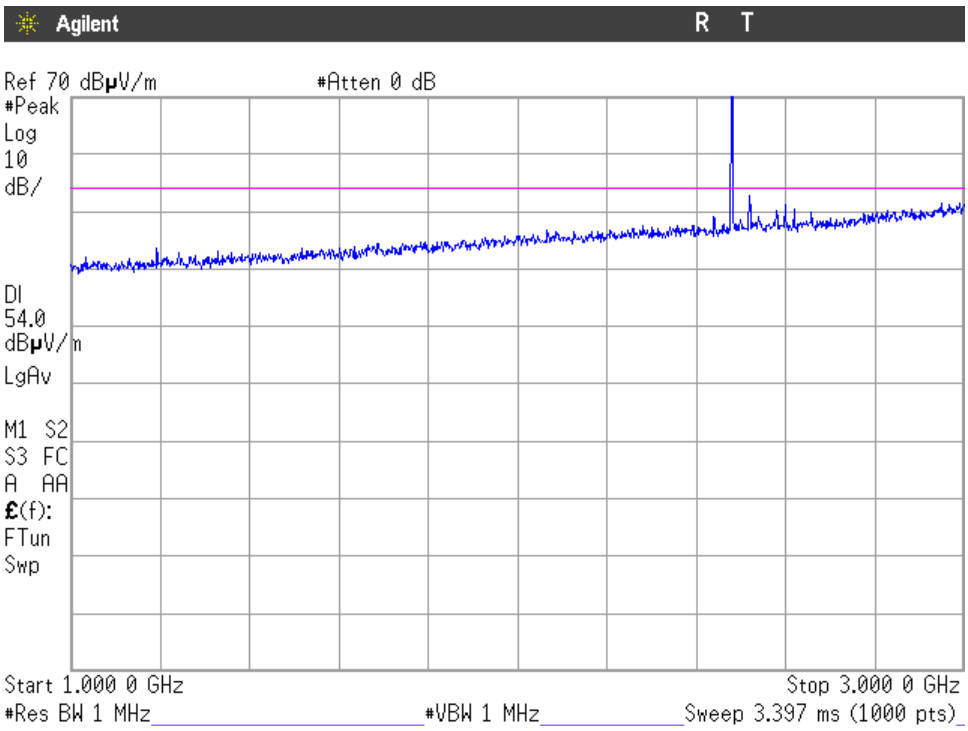

Note: The peak shown in the plot above the limit is the carrier frequency.

**CHANNEL: Middle (2440 MHz).**




Note: The peak shown in the plot above the limit is the carrier frequency.

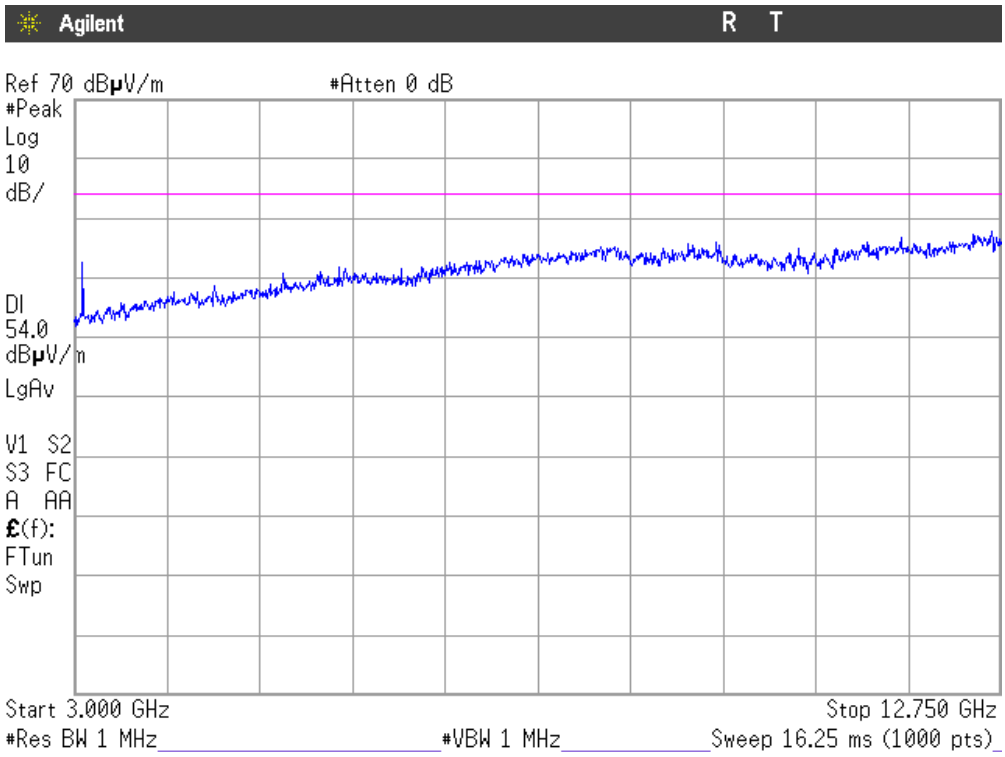
**CHANNEL: Highest (2480 MHz).**



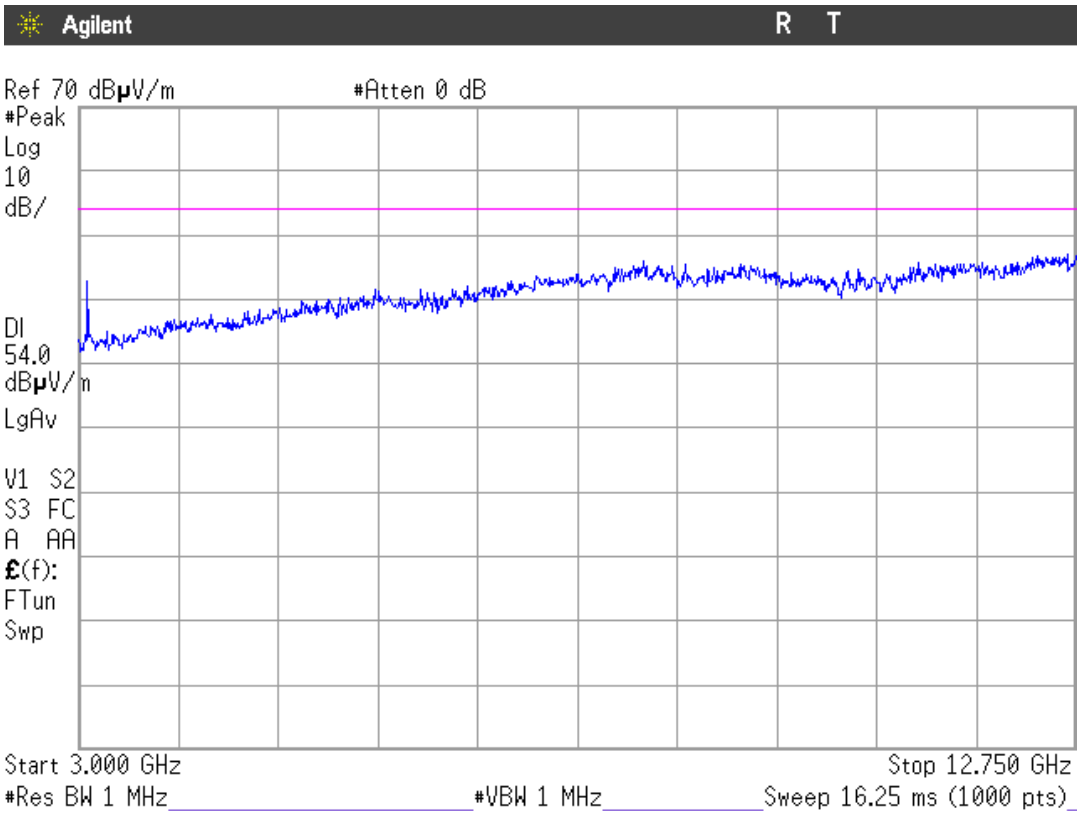

Note: The peak shown in the plot above the limit is the carrier frequency.

FREQUENCY RANGE 3 GHz to 12.75 GHz.

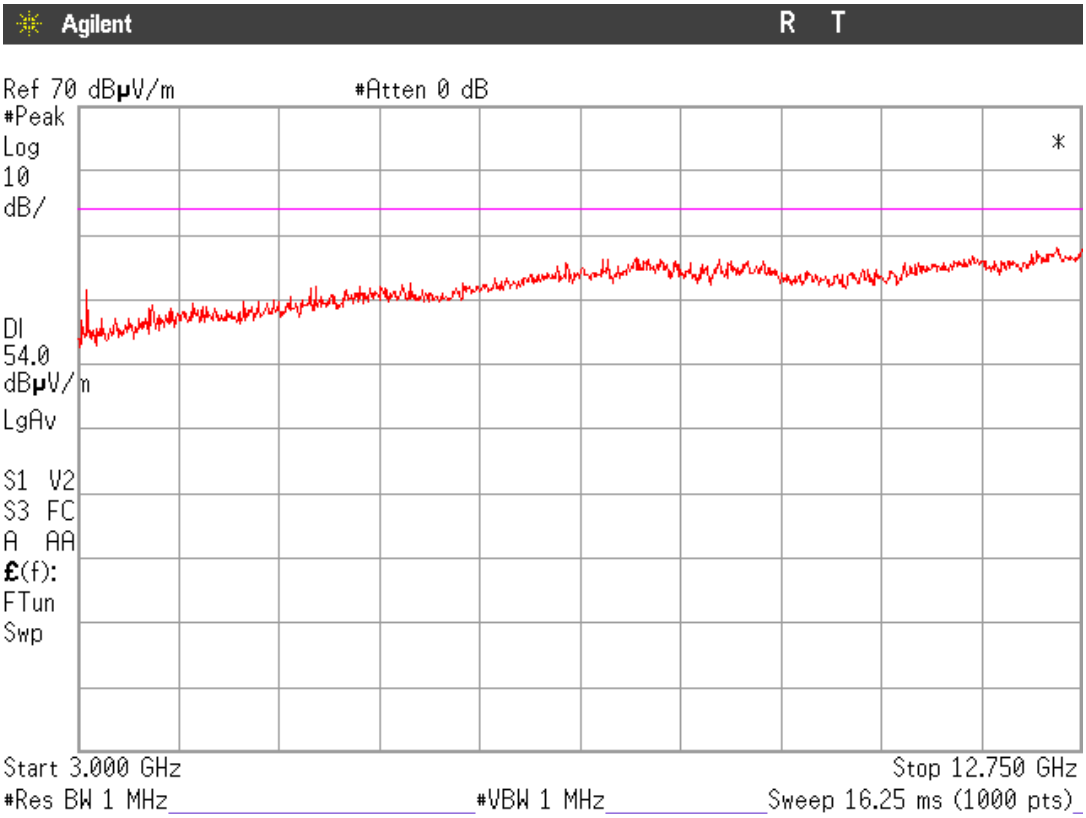
**CHANNEL: Lowest (2402 MHz).**



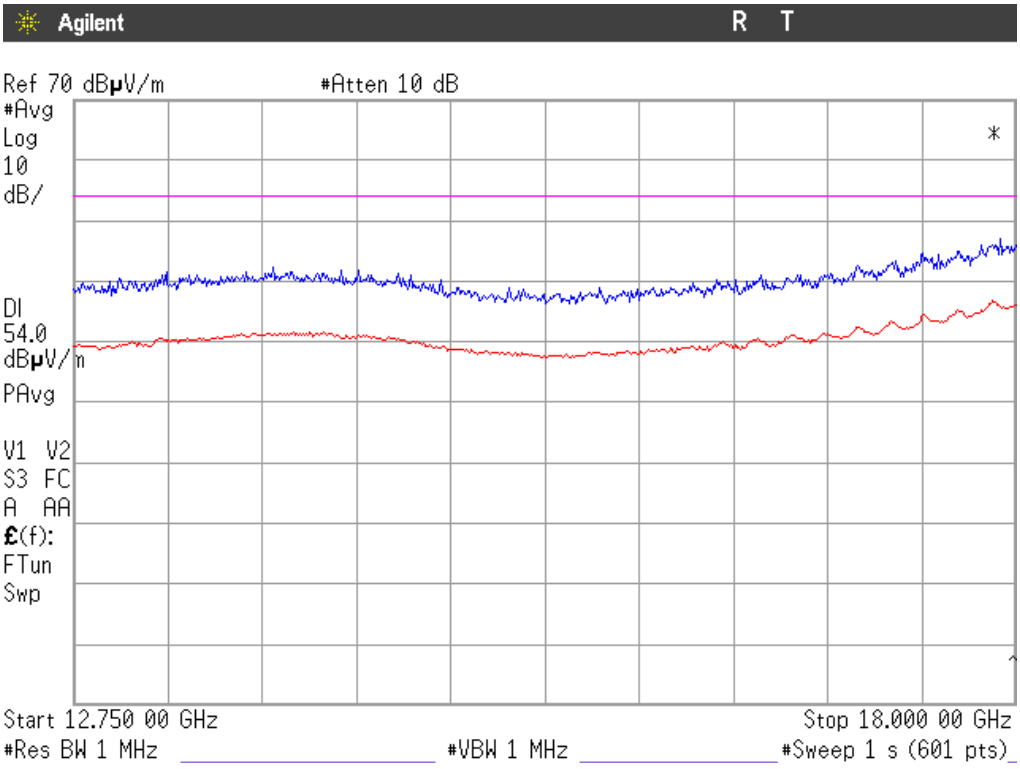
**CHANNEL: Middle (2440 MHz).**




**CHANNEL: Highest (2480 MHz).**

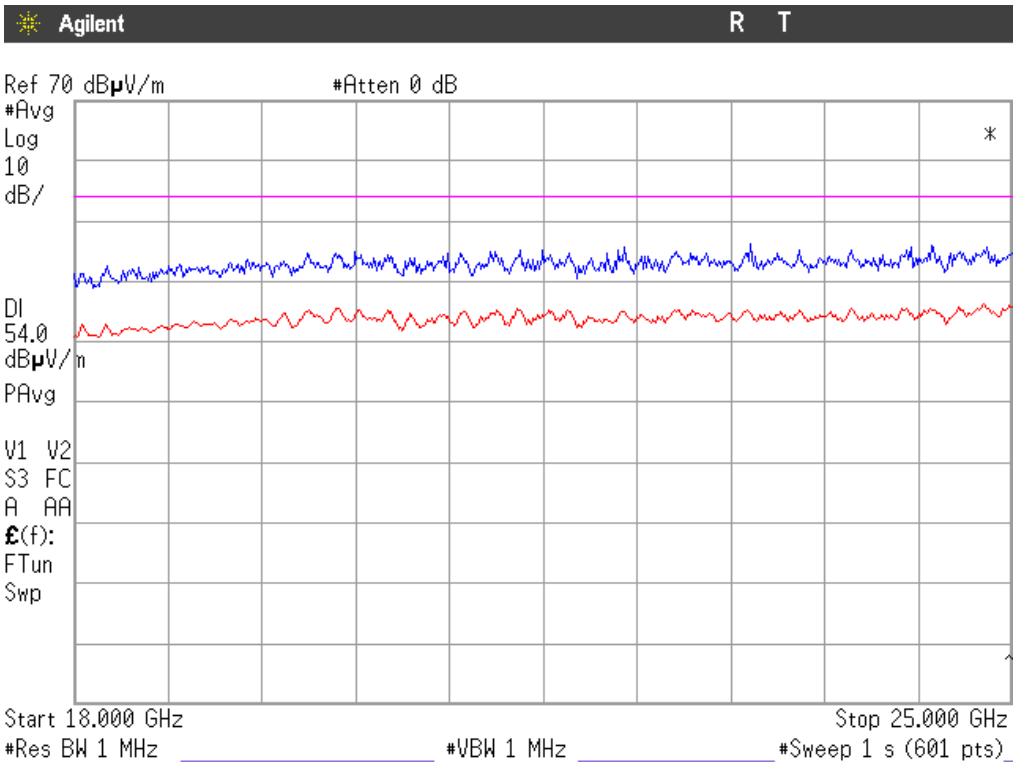


FREQUENCY RANGE 12.75 GHz to 18 GHz.




(This plot is valid for all three channels).

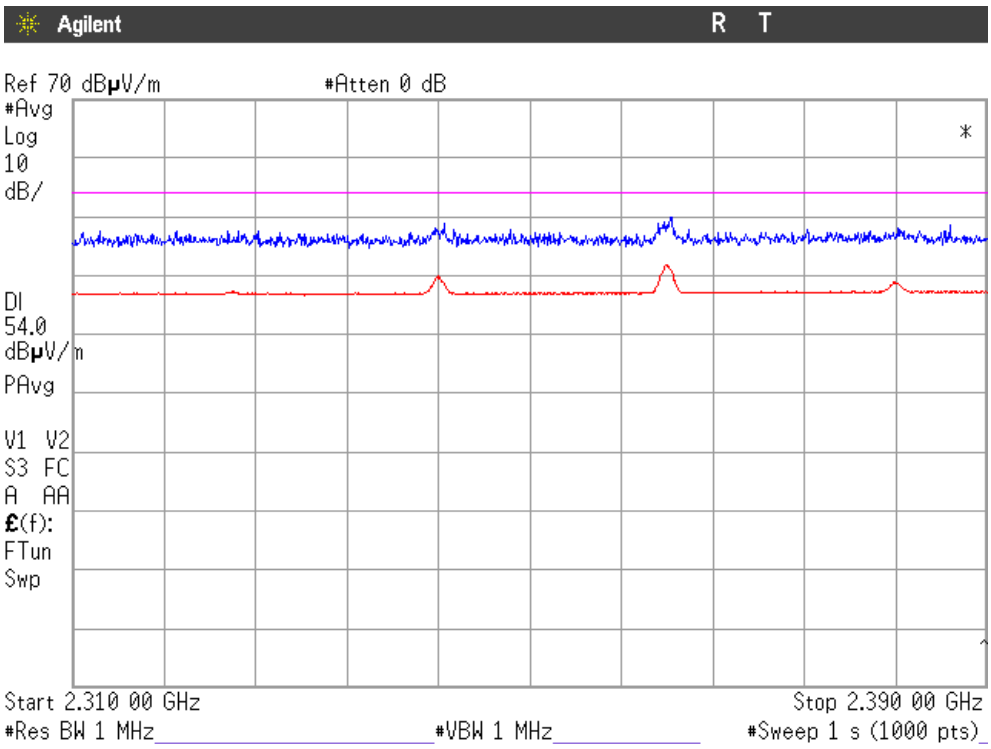
FREQUENCY RANGE 18 GHz to 25 GHz.



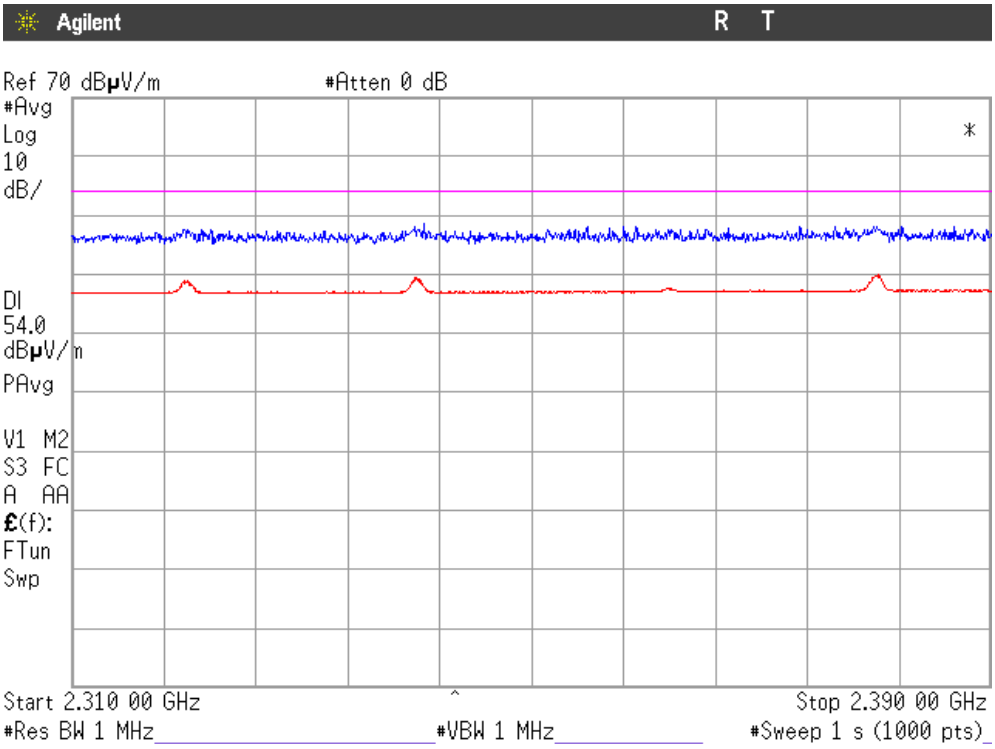

(This plot is valid for all three channels).

FREQUENCY RANGE 2.31 GHz to 2.39 GHz. (RESTRICTED BAND)

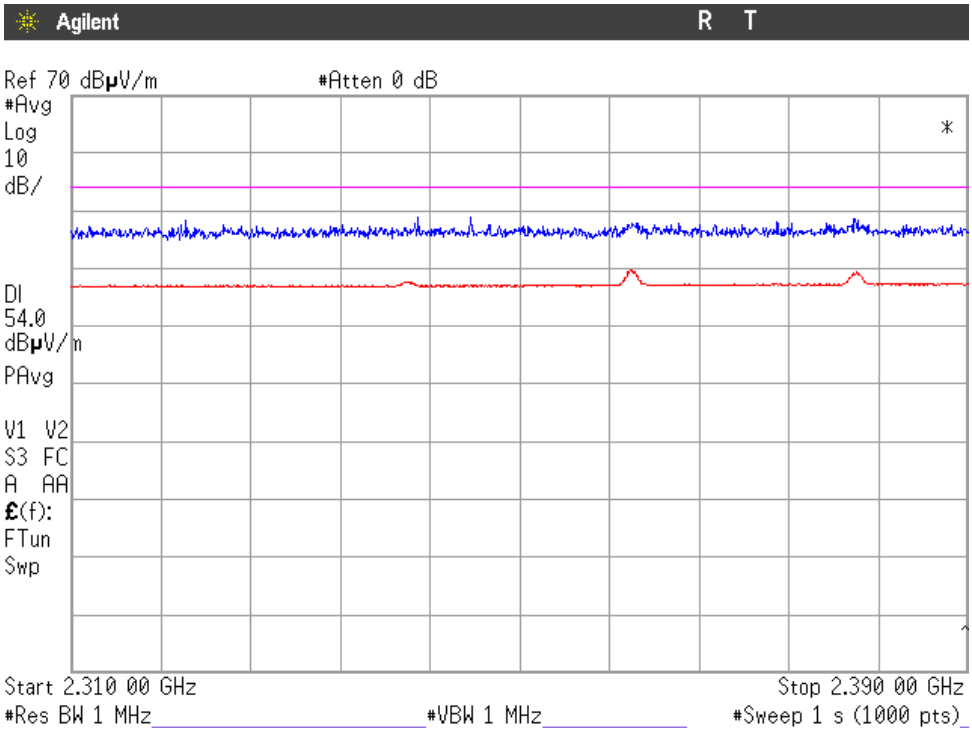
**CHANNEL: Lowest (2402 MHz).**




**CHANNEL: Middle (2440 MHz).**

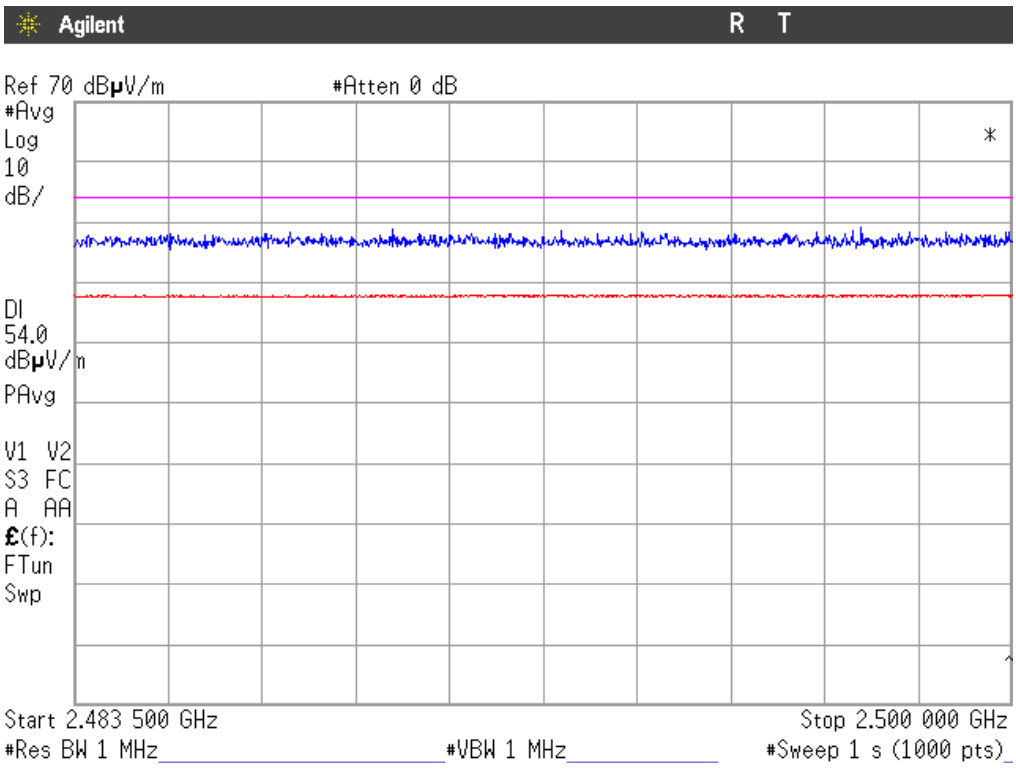


**CHANNEL: Highest (2480 MHz).**

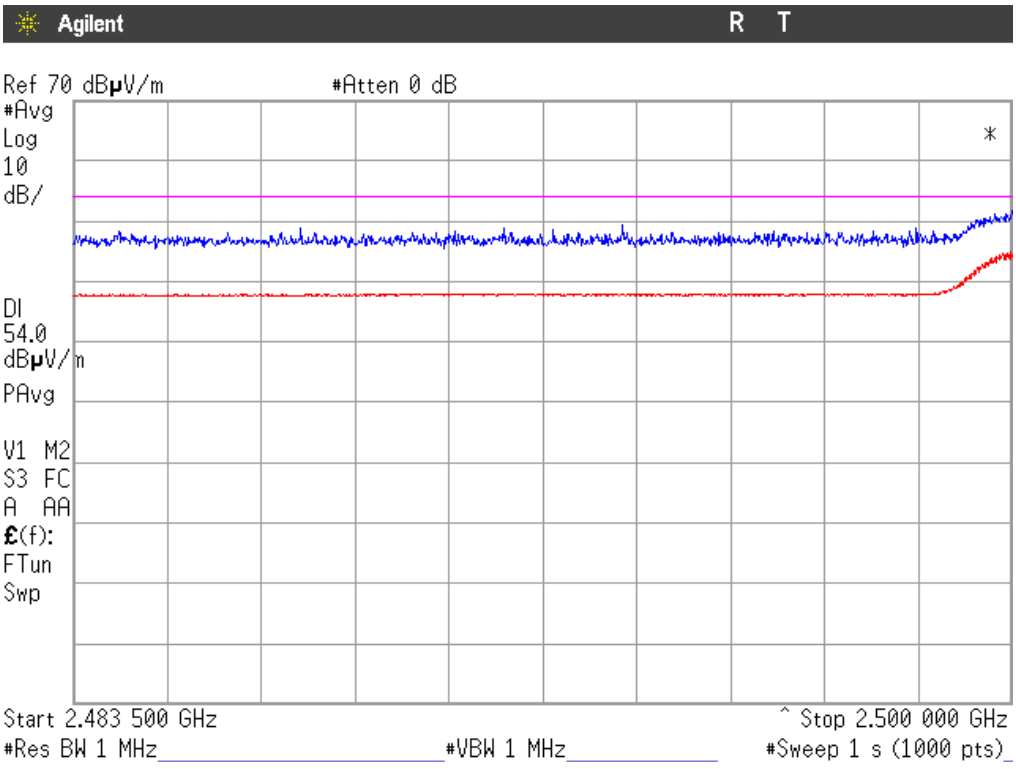



FREQUENCY RANGE 2.4835 GHz to 2.5 GHz. (RESTRICTED BAND)

**CHANNEL: Lowest (2402 MHz).**



**CHANNEL: Middle (2440 MHz).**




**CHANNEL: Highest (2480 MHz).**