
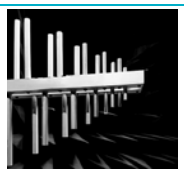
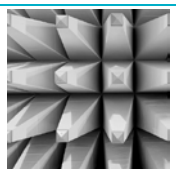

CTC advanced
member of RWTÜV group

Bundesnetzagentur

BNetzA-CAB-02/21-102

TEST REPORT

Test report no.: 1-3977/22-01-05

Testing laboratory

CTC advanced GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: https://www.ctcadvanced.com
e-mail: mail@ctcadvanced.com

Accredited Testing Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate starting with the registration number: D-PL-12076-01.

Applicant

SAGEMCOM BROADBAND SAS
250, route de l´ Empereur
92848 Rueil-Malmaison Cedex / FRANCE
Phone: -/-
Contact: Ludovic Bomba
e-mail: ludovic.bomba-ext@sagemcom.com

Manufacturer

SAGEMCOM BROADBAND SAS
250, route de l´ Empereur
92848 Rueil-Malmaison Cedex / FRANCE

Test standard/s

FCC - Title 47 CFR Part 15	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

For further applied test standards please refer to section 3 of this test report.

Test Item

Kind of test item:	**Gateway**
Model name:	**F5688W**
FCC ID:	**VW3FAST5688W**
Frequency:	UNII bands: 5150 MHz to 5250 MHz; 5250 MHz to 5350 MHz; 5470 MHz to 5725 MHz; 5725 MHz to 5850 MHz
Technology tested:	WLAN
Antenna:	4 integrated antennas
Power supply:	120 V AC by power supply unit
Temperature range:	0°C to +50°C

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

Test report authorized:

cn=Andreas Luckenbill, o=CTC advanced GmbH, ou=LUC-180217, email=andreas.luckenbill@ctcadvanced.com, c=DE
2022.05.27 14:14:15 +02'00'

Andreas Luckenbill
Head of Department
Radio Communications

Test performed:

cn=Michael Dorongovski, o=CTC advanced GmbH, ou=DOR-210422, email=Michael.Dorongovski@ctcadvanced.com, c=DE
2022.05.27 11:23:31 +02'00'

Michael Dorongovski
Lab Manager
Radio Communications

1 Table of contents

2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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2.2 Application details

Date of receipt of order:	2022-02-08
Date of receipt of test item:	2022-02-16
Start of test:*	2022-02-21
End of test:*	2022-05-10
Person(s) present during the test:	-/-

*Date of each measurement, if not shown in the plot, can be requested. Dates are stored in the measurement software.

2.3 Test laboratories sub-contracted

None

3 Test standard/s, references and accreditations

Test standard	Date	Description
FCC - Title 47 CFR Part 15		FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

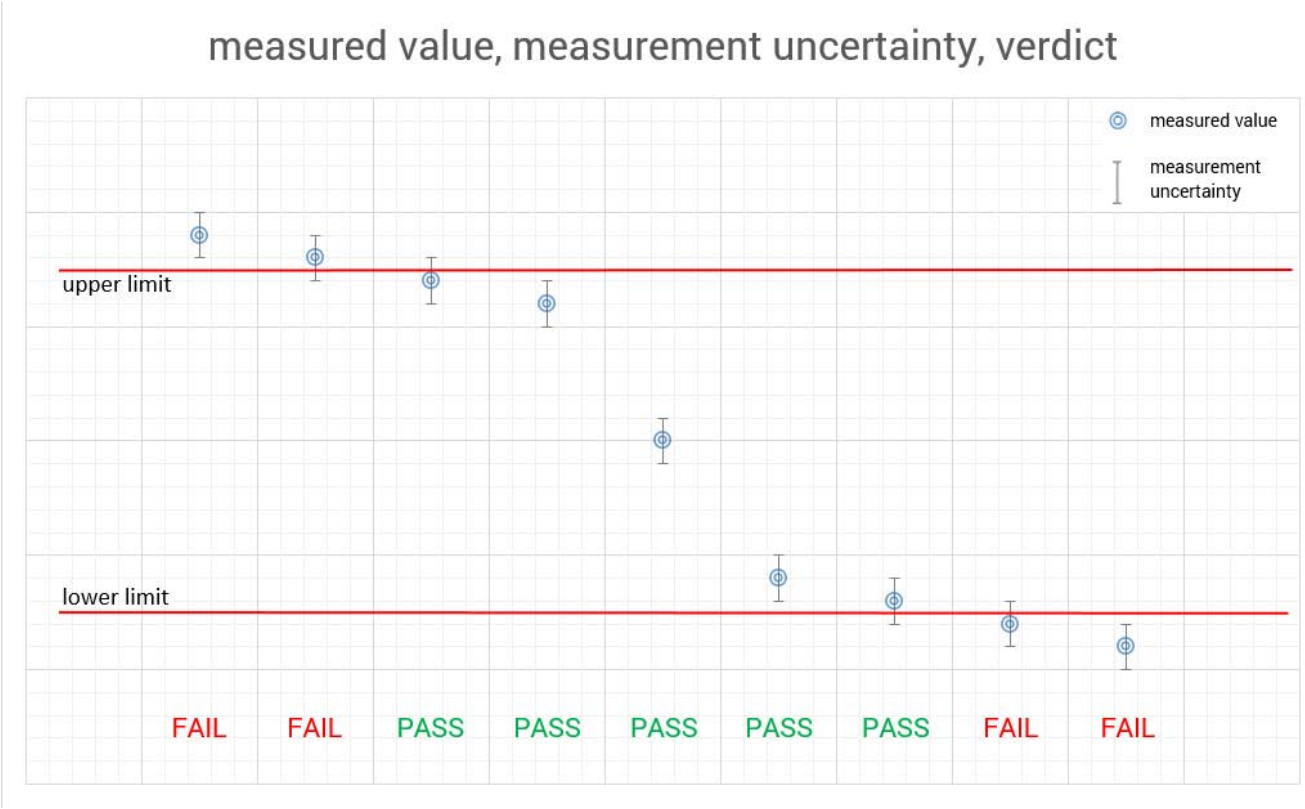
Guidance	Version	Description
KDB 789033 D02	v02r01	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E
ANSI C63.4-2014	-/-	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10-2013	-/-	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
KDB 662911 D01	v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

Accreditation	Description
D-PL-12076-01-04	Telecommunication and EMC Canada https://www.dakks.de/as/ast/d/D-PL-12076-01-04e.pdf
D-PL-12076-01-05	Telecommunication FCC requirements https://www.dakks.de/as/ast/d/D-PL-12076-01-05e.pdf

FCC designation number: DE0002

4 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3.
The measurement uncertainty is mentioned in this test report, see chapter 9, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."



5 Test environment

Temperature	:	T_{nom} T_{max} T_{min}	+22 °C during room temperature tests No tests under extreme environmental conditions required. No tests under extreme environmental conditions required.
Relative humidity content	:		45 %
Barometric pressure	:		1021 hpa
Power supply	:	V_{nom} V_{max} V_{min}	120 V AC by power supply unit No tests under extreme environmental conditions required. No tests under extreme environmental conditions required.

6 Test item

6.1 General description

Kind of test item	:	Gateway
Model name	:	F5688W
S/N serial number	:	Rad. DM2202059000016 Cond. DM2201959000008
Hardware status	:	V1.0
Software status	:	NA
Firmware status	:	SGJi10000C
Frequency band	:	UNII bands: 5150 MHz to 5250 MHz; 5250 MHz to 5350 MHz; 5470 MHz to 5725 MHz; 5725 MHz to 5850 MHz
Type of radio transmission Use of frequency spectrum	: :	OFDM
Type of modulation	:	CCK, (D)BPSK, (D)QPSK, 16 – QAM, 64 – QAM, 256 – QAM
Number of channels	:	24 with 20 MHz channel bandwidth 11 with 40 MHz channel bandwidth 5 with 80 MHz channel bandwidth
Antenna	:	4 integrated antennas
Power supply	:	120 V AC by power supply unit
Temperature range	:	0°C to +50°C

6.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup and EUT photos are included in test report: 1-3977/22-01-01_AnnexA
1-3977/22-01-01_AnnexB
1-3977/22-01-01_AnnexD

7 Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

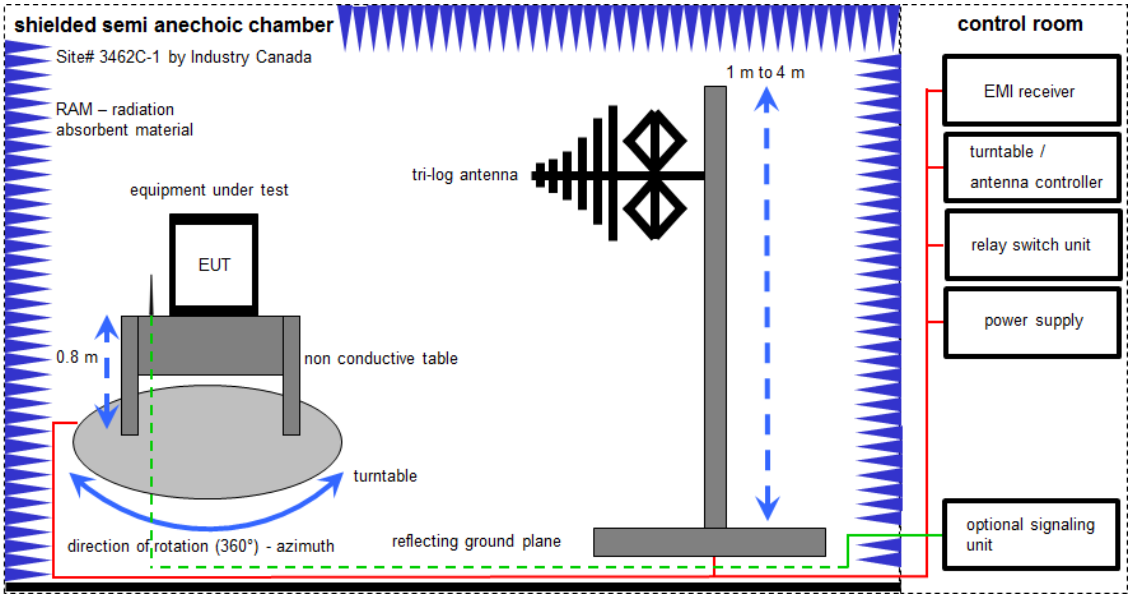
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

Agenda: Kind of Calibration

k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlkl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

7.1 Shielded semi anechoic chamber

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 30 MHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are conform to specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: tri-log antenna 10 meter; EMC32 software version: 10.59.00

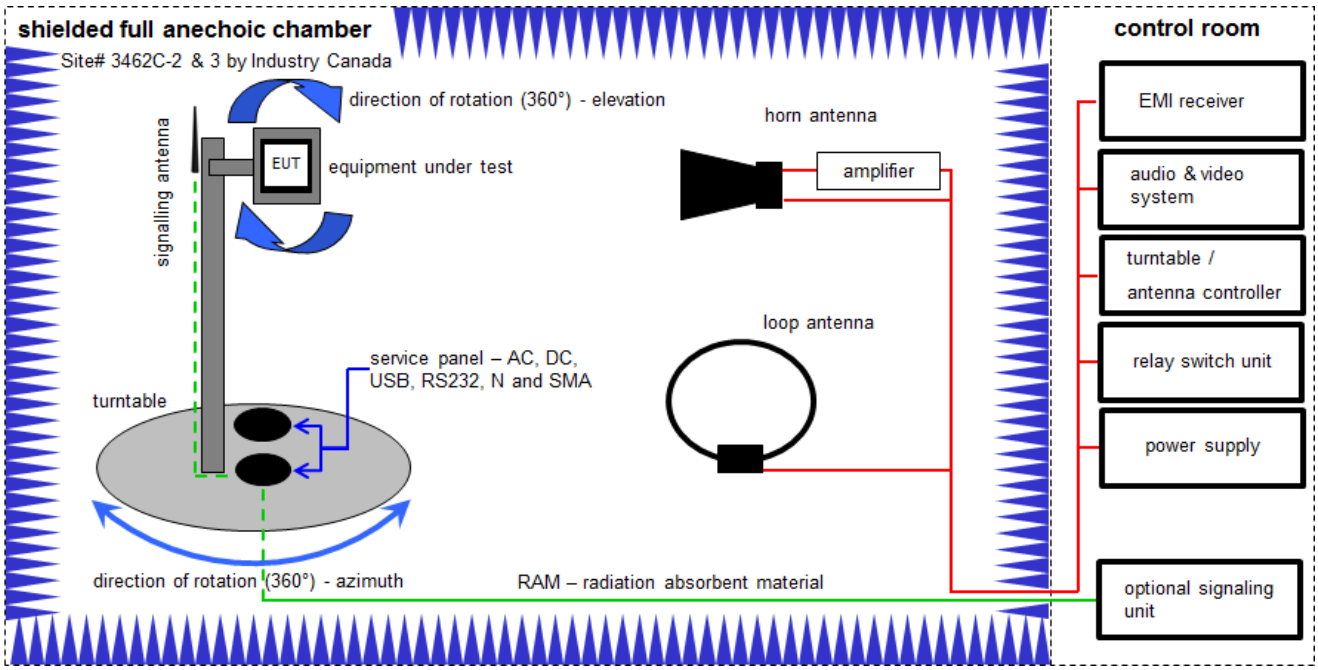
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dBµV/m] (35.69 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-
2	A	Meßkabine 1	HF-Absorberhalle	MWB AG 300023	Batch no. 699714	300000551	ne	-/-	-/-
3	A	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
4	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
5	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
6	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	295	300003787	vlKl!	21.04.2021	20.04.2023
7	A	EMI Test Receiver	ESR3	Rohde & Schwarz	102587	300005771	k	10.12.2020	09.06.2022

7.2 Shielded fully anechoic chamber



Measurement distance: horn antenna 3 meter; loop antenna 3 meter

FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

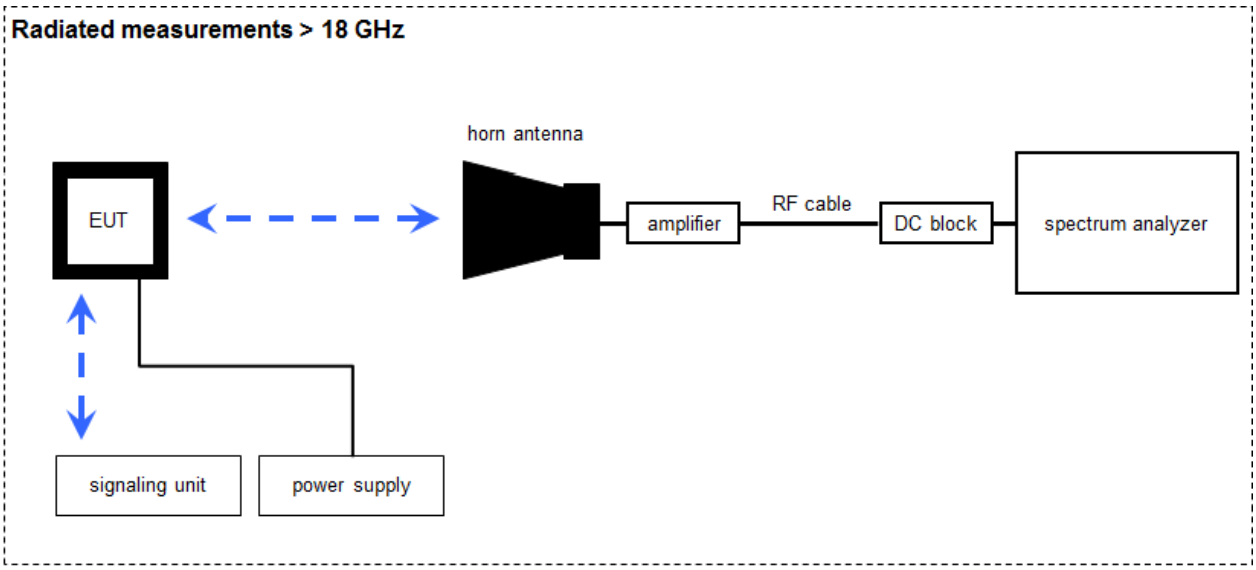
Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dBµV/m] (71.61 µV/m)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	C	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vIKI!	01.07.2021	31.07.2023
2	A, B	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9107-3696	300001604	vIKI!	12.03.2021	11.03.2023
3	A	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789	ne	-/-	-/-
4	A, B	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22051	300004483	ev	-/-	-/-
5	A, B, C	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000032	300004510	ne	-/-	-/-
6	A, B, C	Computer	Intel Core i3 3220/3,3 GHz, Prozessor		2V2403033A5421	300004591	ne	-/-	-/-
7	A, B, C	NEXIO EMV-Software	BAT EMC V3.21.0.27	EMCO		300004682	ne	-/-	-/-
8	A, B, C	Anechoic chamber		TDK		300003726	ne	-/-	-/-
9	A, B, C	EMI Test Receiver 9kHz-26,5GHz	ESR26	Rohde & Schwarz	101376	300005063	k	15.12.2021	31.12.2022
10	A	Band Reject Filter	WRCJV12-5120-5150-5350-5380-40SS	Wainwright	5	300005168	ev	-/-	-/-
11	A	Band Reject Filter	WRCJV12-5695-5725-5850-5880-40SS	Wainwright	5	300005169	ev	-/-	-/-

12	A	Band Reject Filter	WRCJV16-5440-5470-5725-5755-40SS	Wainwright	9	300005170	ev	-/-	-/-
13	A, B	RF-Amplifier	AMF-6F06001800-30-10P-R	NARDA-MITEQ Inc	2011571	300005240	ev	-/-	-/-

7.3 Radiated measurements > 18 GHz



Measurement distance: horn antenna 50 cm

FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss signal path & distance correction; AF-antenna factor)

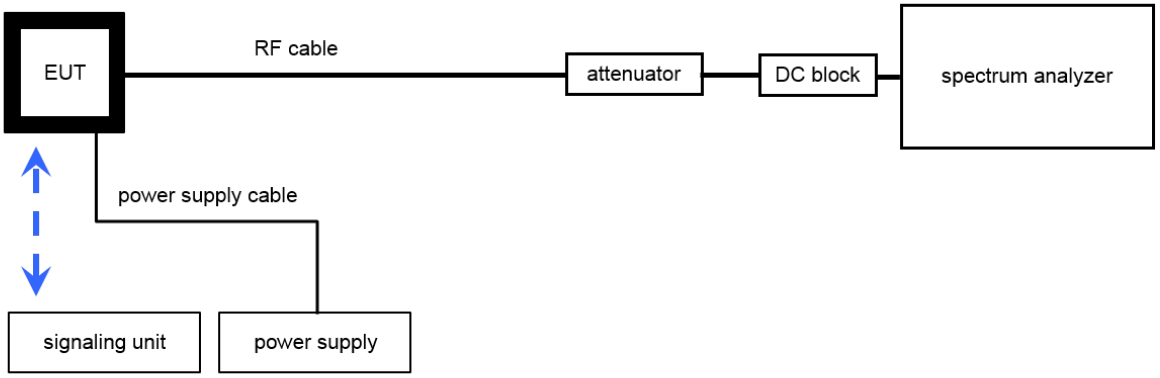
Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-60.1) [dB] + 36.74 [dB/m] = 16.64 [dBµV/m] (6.79 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Microwave System Amplifier, 0.5-26.5 GHz	83017A	HP	00419	300002268	ev	-/-	-/-
2	A	Std. Gain Horn Antenna 18.0-26.5 GHz	638	Narda	01096	300000486	vlKl!	17.01.2022	31.01.2024
3	A	Std. Gain Horn Antenna 26.5-40.0 GHz	V637	Narda	82-16	300000510	vlKl!	17.01.2022	31.01.2024
4	A	Broadband Low Noise Amplifier 18-50 GHz	CBL18503070-XX	CERNEX	19338	300004273	ev	-/-	-/-
5	A	RF-Cable	ST18/SMAm/SMAm /48	Huber & Suhner	Batch no. 600918	400001182	ev	-/-	-/-
6	A	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	25.01.2022	31.01.2023

7.4 Conducted measurements

Conducted measurements normal conditions



OP = AV + CA
(OP-output power; AV-analyzer value; CA-loss signal path)

Example calculation:
OP [dBm] = 6.0 [dBm] + 11.7 [dB] = 17.7 [dBm] (58.88 mW)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Hygro-Thermometer	-/-, 5-45°C, 20-100%rF	Thies Clima	-/-	400000109	ev	13.08.2020	12.08.2022
2	A	USB/GPIB interface	82357B	Agilent Technologies	MY52103346	300004390	ne	-/-	-/-
3	A	PC Laboratory	Exone	Fröhlich + Walter	S2642279-03 / 10	300004179	ne	-/-	-/-
4	A	Signal analyzer	FSV30	Rohde&Schwarz	1321.3008K30/ 103809	300005359	vIKI!	08.12.2020	07.12.2022
5	A	Tester Software RadioStar (C.BER2 for BT Conformance)	Version 1.0.0.X	CTC advanced GmbH	0001	400001380	ne	-/-	-/-

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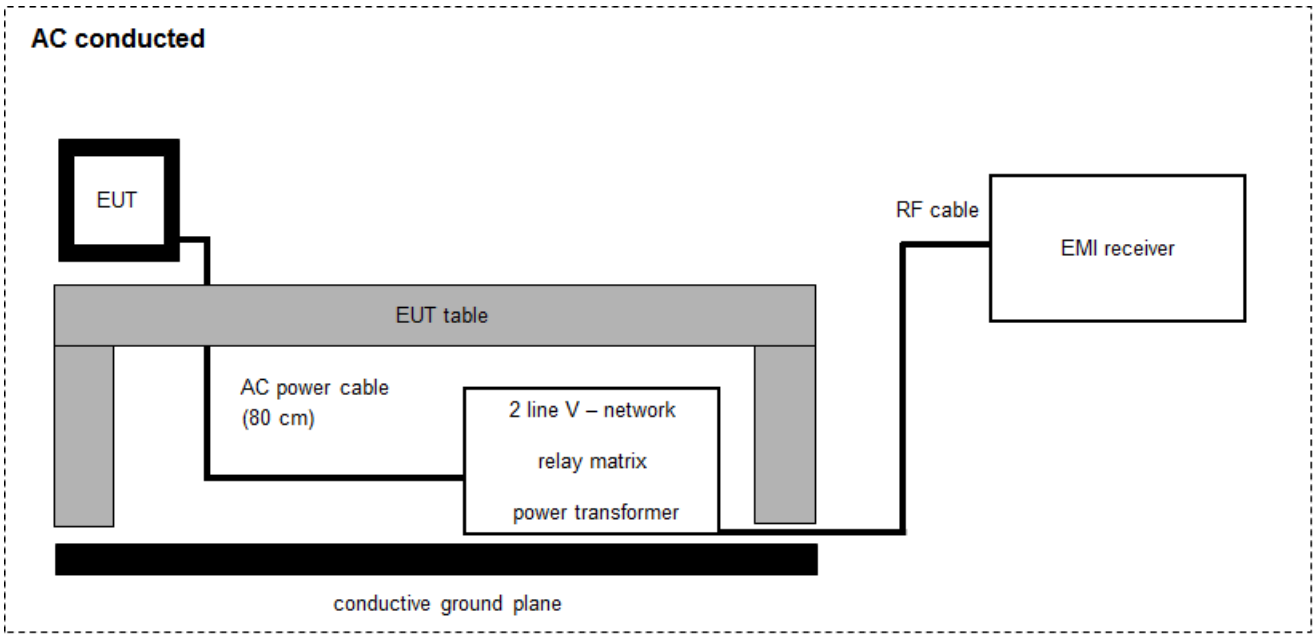
7.5 AC conducted



FS = UR + CF + VC
(FS-field strength; UR-voltage at the receiver; CR-loss of the cable and filter; VC-correction factor of the ISN)

Example calculation:
FS [dBµV/m] = 37.62 [dBµV/m] + 9.90 [dB] + 0.23 [dB] = 47.75 [dBµV/m] (244.06 µV/m)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Two-line V-Network (LISN) 9 kHz to 30 MHz	ESH3-Z5	Rohde & Schwarz	892475/017	300002209	vIKI!	14.12.2021	13.12.2023
2	A	RF-Filter-section	85420E	HP	3427A00162	300002214	NK!	-/-	-/-
3	A	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	09.12.2021	08.12.2022
4	A	Analyzer-Reference-System (Harmonics and Flicker)	ARS 16/1	SPS	A3509 07/0 0205	300003314	vIKI!	29.12.2021	28.12.2023
5	A	Hochpass 150 kHz	EZ-25	R&S	100010	300003798	ev	-/-	-/-
6	A	PC	TecLine	F+W		300003532	ne	-/-	-/-
7	A	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-

8 Sequence of testing

8.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, it is placed on a table with 0.8 m height.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement*

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

Final measurement

- Identified emissions during the pre-measurement are maximized by the software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated about its vertical axis for maximum response at each azimuth about the EUT. (For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT)
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the premeasurement and the limit is stored.

*)Note: The sequence will be repeated three times with different EUT orientations.

8.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position ± 45° and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

8.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

8.4 Sequence of testing radiated spurious above 18 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet.
- The measurement distance is as appropriate (e.g. 0.5 m).
- The EUT is set into operation.

Premeasurement

- The test antenna is handheld and moved carefully over the EUT to cover the EUT's whole sphere and different polarizations of the antenna.

Final measurement

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

9 Measurement uncertainty

Measurement uncertainty		
Test case	**Uncertainty**	
Antenna gain	± 3 dB	
Power spectral density	± 1.56 dB	
DTS bandwidth	± 100 kHz (depends on the used RBW)	
Occupied bandwidth	± 100 kHz (depends on the used RBW)	
Maximum output power conducted	± 1.56 dB	
Detailed spurious emissions @ the band edge - conducted	± 1.56 dB	
Band edge compliance radiated	± 3 dB	
Spurious emissions conducted	> 3.6 GHz	± 1.56 dB
	> 7 GHz	± 1.56 dB
	> 18 GHz	± 2.31 dB
	≥ 40 GHz	± 2.97 dB
Spurious emissions radiated below 30 MHz	± 3 dB	
Spurious emissions radiated 30 MHz to 1 GHz	± 3 dB	
Spurious emissions radiated 1 GHz to 12.75 GHz	± 3.7 dB	
Spurious emissions radiated above 12.75 GHz	± 4.5 dB	
Spurious emissions conducted below 30 MHz (AC conducted)	± 2.6 dB	

10 Summary of measurement results

☐	No deviations from the technical specifications were ascertained
☐	There were deviations from the technical specifications ascertained
☒	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC Identifier	Description	Verdict	Date	Remark
RF-Testing	CFR Title 47 Part 15	See table	2022-05-27	-/-

Test specification clause	Test case	C	NC	NA	NP	Remark
-/-	Output power verification (cond.)	-/-				Declared
-/-	Antenna gain	-/-				Declared
U-NII Part 15	Duty cycle	-/-				-/-
§15.407(a)	Maximum output power	☒	☐	☐	☐	-/-
§15.407(a)	Power spectral density	☒	☐	☐	☐	-/-
§15.407(e)	Spectrum bandwidth 6dB bandwidth	☒	☐	☐	☐	-/-
§15.407(a)	Spectrum bandwidth 26dB bandwidth	☒	☐	☐	☐	-/-
§15.407(a)	Spectrum bandwidth 99% bandwidth	-/-				-/-
§15.205	Band edge compliance radiated	☒	☐	☐	☐	-/-
§15.407(b)	TX spurious emissions radiated	☒	☐	☐	☐	-/-
§15.209(a)	Spurious emissions radiated < 30 MHz	☒	☐	☐	☐	-/-
§15.107(a) §15.207	Spurious emissions conducted emissions< 30 MHz	☒	☐	☐	☐	-/-
§15.407	DFS	-/-				See report 1-3977/22-01-06

Notes:

C:	Compliant	NC:	Not compliant	NA:	Not applicable	NP:	Not performed

11 Additional comments

Reference documents:

DFS report: 1-3977/22-01-06
F5688W_wifi_certif_FCC_Ed02.xlsx
Customer Questionnaire_F5688W_Sagemcom_v3.docx
F5866W Certification Radio Wi-Fi 5GHz (How To Do).pdf
WifiCommands.pdf
Annex list:
1-3977_22-01-05_Annex_MR_A1.pdf (a-mode)
1-3977_22-01-05_Annex_MR_A2.pdf (nHT20-mode)
1-3977_22-01-05_Annex_MR_A3.pdf (nHT40-mode)
1-3977_22-01-05_Annex_MR_A4.pdf (acVHT20-mode)
1-3977_22-01-05_Annex_MR_A5.pdf (acVHT40-mode)
1-3977_22-01-05_Annex_MR_A6.pdf (acVHT80-mode)
1-3977_22-01-05_Annex_MR_A8.pdf (axHE20-mode)
1-3977_22-01-05_Annex_MR_A9.pdf (axHE40-mode)
1-3977_22-01-05_Annex_MR_A10.pdf (axHE80-mode)
1-3977_22-01-05_Annex_MR_A12.pdf (Chapter 12.6 results, all modes)
1-3977_22-01-05_Annex_MR_A13.pdf (40 MHz modes with reduced power setting for channel 46)

Special test descriptions:

All tests were performed with the EUT transmitting on all ports/antennas simultaneously with >98% duty cycle.

Configuration descriptions:

Supported modes:
a-mode
nHT20-mode
nHT40-mode
acVHT20-mode
acVHT40-mode
acVHT80-mode
axHE20-mode
axHE40-mode
axHE80-mode

EUT selection:

☐ Only one device available

☐ Devices selected by the customer

☒ Devices selected by the laboratory (Randomly)

Provided channels and used power settings for all modes:

a-mode:

U-NII-1 & U-NII-2A (5150 MHz to 5250 MHz & 5250 MHz to 5350 MHz) channel number & center frequency								
channel	**36**	**40**	44	**48**	**52**	56	**60**	**64**
f_c / MHz	**5180**	**5200**	5220	**5240**	**5260**	5280	**5300**	**5320**
Power setting	**40**	**46**	46	**46**	**34**	34	**34**	**34**

U-NII-2C (5470 MHz to 5725 MHz) channel number & center frequency											
channel	**100**	104	108	112	116	**120**	124	128	132	136	**140**
f_c / MHz	**5500**	5520	5540	5560	5580	**5600**	5620	5640	5660	5680	**5700**
Power setting	**34**	34	34	34	34	**34**	34	34	34	34	**34**

U-NII-3 (5725 MHz to 5850 MHz) channel number & center frequency					
channel	**149**	153	**157**	161	**165**
f_c / MHz	**5745**	5765	**5785**	5805	**5825**
Power setting	**48**	48	**48**	48	**48**

nHT20-mode:

U-NII-1 & U-NII-2A (5150 MHz to 5250 MHz & 5250 MHz to 5350 MHz) channel number & center frequency								
channel	**36**	**40**	44	**48**	**52**	56	**60**	**64**
f_c / MHz	**5180**	**5200**	5220	**5240**	**5260**	5280	**5300**	**5320**
Power setting	**42**	**46**	46	**46**	**34**	34	**34**	**34**

U-NII-2C (5470 MHz to 5725 MHz) channel number & center frequency											
channel	**100**	104	108	112	116	**120**	124	128	132	136	**140**
f_c / MHz	**5500**	5520	5540	5560	5580	**5600**	5620	5640	5660	5680	**5700**
Power setting	**34**	34	34	34	34	**34**	34	34	34	34	**34**

U-NII-3 (5725 MHz to 5850 MHz) channel number & center frequency					
channel	**149**	153	**157**	161	**165**
f_c / MHz	**5745**	5765	**5785**	5805	**5825**
Power setting	**48**	48	**48**	48	**48**

acVHT20-mode:

U-NII-1 & U-NII-2A (5150 MHz to 5250 MHz & 5250 MHz to 5350 MHz) channel number & center frequency								
channel	**36**	**40**	44	**48**	**52**	56	**60**	**64**
f_c / MHz	**5180**	**5200**	5220	**5240**	**5260**	5280	**5300**	**5320**
Power setting	**40**	**46**	46	**46**	**34**	34	**34**	**34**

U-NII-2C (5470 MHz to 5725 MHz) channel number & center frequency											
channel	**100**	104	108	112	116	**120**	124	128	132	136	**140**
f_c / MHz	**5500**	5520	5540	5560	5580	**5600**	5620	5640	5660	5680	**5700**
Power setting	**34**	34	34	34	34	**34**	34	34	34	34	**34**

U-NII-3 (5725 MHz to 5850 MHz) channel number & center frequency					
channel	**149**	153	**157**	161	**165**
f_c / MHz	**5745**	5765	**5785**	5805	**5825**
Power setting	**48**	48	**48**	48	**48**

axHE20-mode:

U-NII-1 & U-NII-2A (5150 MHz to 5250 MHz & 5250 MHz to 5350 MHz) channel number & center frequency								
channel	**36**	**40**	44	**48**	**52**	56	**60**	**64**
f_c / MHz	**5180**	**5200**	5220	**5240**	**5260**	5280	**5300**	**5320**
Power setting	**40**	**46**	46	**46**	**34**	34	**34**	**34**

U-NII-2C (5470 MHz to 5725 MHz) channel number & center frequency											
channel	**100**	104	108	112	116	**120**	124	128	132	136	**140**
f_c / MHz	**5500**	5520	5540	5560	5580	**5600**	5620	5640	5660	5680	**5700**
Power setting	**34**	34	34	34	34	**34**	34	34	34	34	**34**

U-NII-3 (5725 MHz to 5850 MHz) channel number & center frequency					
channel	**149**	153	**157**	161	**165**
f_c / MHz	**5745**	5765	**5785**	5805	**5825**
Power setting	**48**	48	**48**	48	**48**

nHT40-mode:

U-NII-1 & U-NII-2A (5150 MHz to 5250 MHz & 5250 MHz to 5350 MHz) channel number & center frequency				
channel	**38**	**46**	**54**	**62**
f_c / MHz	**5190**	**5230**	**5270**	**5310**
Power setting	**40**	**46**	**36**	**36**

U-NII-2C (5470 MHz to 5725 MHz) channel number & center frequency					
channel	**102**	110	**118**	126	**134**
f_c / MHz	**5510**	5550	**5590**	5630	**5670**
Power setting	**36**	36	**36**	36	**36**

U-NII-3 (5725 MHz to 5850 MHz) channel number & center frequency		
channel	**151**	**159**
f_c / MHz	**5755**	**5795**
Power setting	**48**	**48**

acVHT40-mode:

U-NII-1 & U-NII-2A (5150 MHz to 5250 MHz & 5250 MHz to 5350 MHz) channel number & center frequency				
channel	**38**	**46**	**54**	**62**
f_c / MHz	**5190**	**5230**	**5270**	**5310**
Power setting	**40**	**46**	**36**	**36**

U-NII-2C (5470 MHz to 5725 MHz) channel number & center frequency					
channel	**102**	110	**118**	126	**134**
f_c / MHz	**5510**	5550	**5590**	5630	**5670**
Power setting	**36**	36	**36**	36	**36**

U-NII-3 (5725 MHz to 5850 MHz) channel number & center frequency		
channel	**151**	**159**
f_c / MHz	**5755**	**5795**
Power setting	**48**	**48**

axHE40-mode:

U-NII-1 & U-NII-2A (5150 MHz to 5250 MHz & 5250 MHz to 5350 MHz) channel number & center frequency				
channel	**38**	**46**	**54**	**62**
f_c / MHz	**5190**	**5230**	**5270**	**5310**
Power setting	**36**	**46**	**36**	**36**

U-NII-2C (5470 MHz to 5725 MHz) channel number & center frequency					
channel	**102**	110	**118**	126	**134**
f_c / MHz	**5510**	5550	**5590**	5630	**5670**
Power setting	**36**	36	**36**	36	**36**

U-NII-3 (5725 MHz to 5850 MHz) channel number & center frequency		
channel	**151**	**159**
f_c / MHz	**5755**	**5795**
Power setting	**48**	**48**

acVHT80-mode:

U-NII-1 & U-NII-2A (5150 MHz to 5250 MHz & 5250 MHz to 5350 MHz) channel number & center frequency		
channel	**42**	**58**
f_c / MHz	**5210**	**5290**
Power setting	**38**	**32**

U-NII-2C (5470 MHz to 5725 MHz) channel number & center frequency		
channel	**106**	**122**
f_c / MHz	**5530**	**5610**
Power setting	**36**	**36**

U-NII-3 (5725 MHz to 5850 MHz) channel number & center frequency	
channel	**155**
f_c / MHz	**5775**
Power setting	**48**

axHE80-mode:

U-NII-1 & U-NII-2A (5150 MHz to 5250 MHz & 5250 MHz to 5350 MHz) channel number & center frequency		
channel	**42**	**58**
f_c / MHz	**5210**	**5290**
Power setting	**36**	**32**

U-NII-2C (5470 MHz to 5725 MHz) channel number & center frequency		
channel	**106**	**122**
f_c / MHz	**5530**	**5610**
Power setting	**36**	**36**

U-NII-3 (5725 MHz to 5850 MHz) channel number & center frequency	
channel	**155**
f_c / MHz	**5775**
Power setting	**48**

Test mode:

☐ No test mode available.
Iperf is used to transmit data to a companion device

☒ Special software is used.
EUT is transmitting pseudo random data by itself

Antennas and transmit operating modes:

☐ Operating mode 1 (single antenna)
- Equipment with 1 antenna,
- Equipment with 2 diversity antennas operating in switched diversity mode by which at any moment in time only 1 antenna is used,
- Smart antenna system with 2 or more transmit/receive chains, but operating in a mode where only 1 transmit/receive chain is used)

☐ Operating mode 2 (multiple antennas, no beamforming)
- Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously but without beamforming.

☒ Operating mode 3 (multiple antennas, with beamforming)
- Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously with beamforming.
  In addition to the antenna assembly gain (G), the beamforming gain (Y) may have to be taken into account when performing the measurements.

12 Measurement results

12.1 Identify worst case data rate

Declared by manufacturer:

a-mode: 6 Mbps

nHT20/acVHT20 / axHE20: MCS0

nHT40/acVHT40 / axHE40: MCS0

acVHT80/axHE80: MCS0

12.2 Antenna gain

Limits:

Antenna Gain
6 dBi / > 6 dBi output power and power density reduction required

Declared by manufacturer:

Results:

Combined gain for 4x4 MIMO	**UNII-1 & UNII-2A**	**UNII-2C**	**UNII-3**
Gain [dBi] / Declared	0.8	0.9	0.9

Beamforming gain for 4x4 MIMO	**UNII-1 & UNII-2A**	**UNII-2C**	**UNII-3**
Gain [dBi] / Declared	4.8	4.2	4.5

Conclusion: The sum of combined gain and beamforming gain is always lower than 6 dBi.

12.3 Duty cycle

Results:

Duty cycle: >98% for all modes and channels

12.4 Maximum output power

Measurement parameter	
According to: KDB789033 D02, E.2.e.	
External result file(s)	1-XXXX_19-XX-XX_Annex_MR_A_1.pdf FCC Part 15.407 Max Output Power and PSD
Used test setup:	See chapter 7.4 – A
Measurement uncertainty:	See chapter 9
Standard parts:	FCC: § 15.407 (a)

Limits:

Limits	
Radiated output power	Conducted output power
Band 5150 MHz – 5250 MHz	
Conducted power + 6 dBi antenna gain	**For an outdoor access point:** output power ≤ 1W/30dBm* The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm) **For an indoor access point** output power ≤ 1W/30dBm* **For fixed point-to-point access points** output power ≤ 1W/30dBm **For client devices** output power ≤ 250 mW/24dBm*
Band 5250MHz – 5350 MHz	
Conducted power + 6 dBi antenna gain	Minimum of 24dBm or 11 dBm + 10*log(BW)*
Band 5470MHz – 5725 MHz	
Conducted power + 6 dBi antenna gain	Minimum of 24dBm or 11 dBm + 10*log(BW)*
Band 5725MHz – 5850 MHz	
Conducted power + 6 dBi antenna gain	30 dBm*

*If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Results:

802.11a Maximum output power [dBm]												
Channel	36	40	48	52	60	64	100	120	140	149	157	165
Port 1	20.7	22.0	20.8	14.7	14.2	14.4	12.0	12.9	14.8	19.7	20.9	20.8
Port 2	16.8	18.7	20.5	16.0	16.2	16.0	9.9	13.2	14.7	21.9	23.0	23.8
Port 3	19.0	20.8	21.7	16.2	16.1	16.1	9.5	14.3	16.0	22.8	21.3	21.8
Port 4	20.1	21.7	22.0	15.4	14.9	14.0	12.7	13.7	14.5	21.1	21.0	20.1
SUM	25.4	27.0	27.3	21.6	21.4	21.2	17.3	19.6	21.1	27.5	27.7	27.9

802.11n HT20 Maximum output power [dBm]												
Channel	36	40	48	52	60	64	100	120	140	149	157	165
Port 1	21.3	21.6	20.3	14.7	14.1	14.0	11.9	11.7	14.4	19.8	20.0	21.3
Port 2	17.4	18.5	20.3	15.8	15.9	15.7	9.9	13.1	14.5	20.5	22.6	23.6
Port 3	19.7	20.6	21.5	16.1	15.9	15.8	9.3	13.6	16.1	21.5	21.1	21.5
Port 4	20.7	21.6	21.8	15.2	14.6	13.8	12.2	13.4	14.2	21.3	20.8	19.7
SUM	26.0	26.8	27.0	21.5	21.2	20.9	17.0	19.0	20.9	26.8	27.3	27.8

802.11n HT40 Maximum output power [dBm]									
Channel	38	46	54	62	102	118	134	151	159
Port 1	20.5	22.1	15.3	14.8	14.5	15.1	16.5	21.0	20.9
Port 2	16.9	20.8	17.3	17.4	13.5	15.2	15.9	23.1	24.1
Port 3	19.3	22.9	18.6	18.1	13.3	17.8	18.6	22.6	21.7
Port 4	20.3	23.5	17.5	16.1	16.0	16.3	17.1	21.7	20.4
SUM	25.5	28.5	23.3	22.8	20.5	22.3	23.2	28.2	28.0

802.11ac VHT20 Maximum output power [dBm]												
Channel	36	40	48	52	60	64	100	120	140	149	157	165
Port 1	20.6	21.7	20.6	14.2	13.6	14.5	11.7	12.4	14.7	18.9	21.3	21.6
Port 2	16.5	18.7	20.4	15.7	16.0	15.9	10.3	12.9	14.4	21.9	23.0	23.4
Port 3	18.8	20.6	21.3	15.8	15.8	15.6	9.4	13.5	15.7	22.6	21.1	20.5
Port 4	19.9	21.6	21.9	15.3	14.6	13.7	12.2	13.5	14.2	20.8	20.8	19.9
SUM	25.2	26.8	27.1	21.3	21.1	21.0	17.1	19.1	20.8	27.3	27.7	27.6

802.11ac VHT40 Maximum output power [dBm]									
Channel	38	46	54	62	102	118	134	151	159
Port 1	20.5	22.1	15.3	14.8	14.5	15.1	16.5	21.1	20.9
Port 2	17.0	20.7	17.3	17.3	13.5	15.2	15.9	23.2	24.1
Port 3	19.1	22.8	18.3	17.8	13.3	17.7	18.2	22.7	21.7
Port 4	20.3	23.7	17.5	16.1	16.0	16.4	16.9	21.7	20.4
SUM	25.5	28.5	23.3	22.7	20.5	22.3	23.0	28.3	28.0

802.11ac VHT80 Maximum output power [dBm]					
Channel	42	58	106	122	155
Port 1	18.4	12.8	14.5	15.7	20.9
Port 2	16.3	15.2	13.9	15.6	23.2
Port 3	18.7	16.3	14.6	17.5	21.9
Port 4	19.2	14.7	16.4	16.2	21.1
SUM	24.3	20.9	21.0	22.3	27.9

802.11ax HE20 Maximum output power [dBm]												
Channel	36	40	48	52	60	64	100	120	140	149	157	165
Port 1	20.8	21.9	20.8	14.7	14.4	14.6	12.2	13.4	14.7	20.1	20.8	21.3
Port 2	16.8	18.7	20.4	16.0	16.2	15.9	9.7	13.0	14.8	24.2	21.1	23.9
Port 3	18.9	20.7	21.5	16.2	16.1	15.9	9.4	14.1	16.3	23.4	21.9	20.3
Port 4	20.3	21.8	22.2	15.5	15.1	14.1	12.8	14.0	14.8	22.3	21.0	20.1
SUM	25.5	27.0	27.3	21.7	21.5	21.2	17.3	19.7	21.2	28.8	27.2	27.7

802.11ax HE40 Maximum output power [dBm]									
Channel	38	46	54	62	102	118	134	151	159
Port 1	18.9	22.4	15.6	15.1	14.7	15.2	16.6	21.2	21.2
Port 2	15.3	20.9	17.5	17.5	13.4	15.4	16.3	23.4	24.2
Port 3	17.5	23.0	18.7	18.3	13.7	17.9	18.6	23.1	22.1
Port 4	18.6	24.2	17.7	16.4	16.2	16.6	17.4	21.8	20.6
SUM	23.8	28.8	23.5	23.0	20.7	22.4	23.3	28.5	28.3

802.11ax HE80 Maximum output power [dBm]					
Channel	42	58	106	122	155
Port 1	18.0	13.3	14.7	15.8	21.2
Port 2	15.7	15.5	14.1	15.5	23.4
Port 3	18.4	16.7	15.0	18.3	22.6
Port 4	18.8	15.0	16.6	16.6	21.3
SUM	23.9	21.3	21.2	22.7	28.2

12.5 Power spectral density

Description:

Measurement of the power spectral density of a digital modulated system. The measurement is repeated at the lowest, middle and highest channel.

Measurement:

Measurement parameter	
According to: KDB789033 D02, F.	
External result file(s)	1-3977_22-01-05_Annex_MR_A1 to A11 FCC Part 15.407 Max Output Power and PSD
Used test setup:	See chapter 7.4 – A
Measurement uncertainty:	See chapter 9
Standard parts:	FCC: § 15.407 (a)

Limits:

Power Spectral Density
Band 5150 MHz – 5250 MHz
For an outdoor access point power spectral density conducted ≤ 17 dBm in any 1 MHz band* For an indoor access point power spectral density conducted ≤ 17 dBm in any 1 MHz band* For fixed point-to-point access points power spectral density conducted ≤ 17 dBm in any 1 MHz band** For client devices point power spectral density conducted ≤ 11 dBm in any 1 MHz band* *If transmitting antennas of directional gain greater than 6 dBi are used the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi **Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi.
Band 5250MHz – 5350 MHz
power spectral density conducted ≤ 11 dBm in any 1 MHz band* *If transmitting antennas of directional gain greater than 6 dBi are used the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi
Band 5470MHz – 5725 MHz
power spectral density conducted ≤ 11 dBm in any 1 MHz band* *If transmitting antennas of directional gain greater than 6 dBi are used the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi
Band 5725MHz – 5850 MHz
power spectral density conducted ≤ 30 dBm in any 500 kHz band If transmitting antennas of directional gain greater than 6 dBi are used the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi

Results:

802.11a Power spectral density [dBm/1MHz] or [dBm/500kHz]												
Channel	36	40	48	52	60	64	100	120	140	149	157	165
Port 1	9.3	10.4	9.4	3.2	3.3	3.8	1.6	2.6	4.2	6.1	7.2	6.9
Port 2	5.8	7.5	9.3	4.9	5.0	5.3	-0.8	2.1	4.5	8.2	8.8	10.0
Port 3	7.7	9.3	10.6	4.9	4.6	4.8	-1.9	3.2	5.0	9.2	7.2	8.5
Port 4	9.1	10.4	10.9	4.2	3.7	2.9	2.1	3.3	4.6	7.9	7.4	6.6
SUM	14.2	15.6	16.1	10.4	10.2	10.3	6.6	8.8	10.6	14.0	13.7	14.2

802.11n HT20 Power spectral density [dBm/1MHz] or [dBm/500kHz]												
Channel	36	40	48	52	60	64	100	120	140	149	157	165
Port 1	9.6	9.7	8.6	3.1	3.0	2.8	1.0	1.1	4.0	5.7	6.4	7.5
Port 2	5.7	7.2	9.2	4.4	4.5	4.6	-1.1	3.3	4.4	6.4	8.5	8.8
Port 3	8.3	8.9	9.8	4.3	4.2	4.3	-2.5	1.8	5.0	7.1	6.5	6.9
Port 4	9.2	10.0	10.4	3.7	3.1	2.4	1.4	3.1	3.9	7.9	7.4	6.1
SUM	14.5	15.1	15.6	9.9	9.8	9.6	6.0	8.4	10.4	12.9	13.3	13.5

802.11n HT40 Power spectral density [dBm/1MHz] or [dBm/500kHz]									
Channel	38	46	54	62	102	118	134	151	159
Port 1	6.0	7.9	1.8	0.8	1.8	2.1	3.0	4.7	4.4
Port 2	2.9	7.1	4.0	3.4	0.5	2.0	2.8	6.9	7.6
Port 3	5.0	8.4	4.2	3.4	-0.6	4.2	4.6	5.8	4.5
Port 4	6.0	9.1	3.8	2.2	2.4	3.7	4.0	5.9	4.0
SUM	11.2	14.2	9.6	8.6	7.2	9.1	9.7	11.9	11.4

802.11ac VHT20 Power spectral density [dBm/1MHz] or [dBm/500kHz]												
Channel	36	40	48	52	60	64	100	120	140	149	157	165
Port 1	8.9	9.9	9.1	2.8	2.2	3.5	1.0	2.3	4.4	5.5	7.2	7.4
Port 2	5.1	7.3	9.3	4.1	4.3	4.7	-0.8	2.8	4.3	8.0	9.4	9.4
Port 3	7.2	9.2	9.7	4.1	4.3	4.0	-2.3	1.7	4.7	8.1	6.9	6.3
Port 4	8.3	10.1	10.5	3.9	3.2	2.2	1.2	3.1	3.9	6.7	7.0	6.2
SUM	13.6	15.3	15.7	9.8	9.6	9.7	6.0	8.5	10.4	13.2	13.8	13.5

802.11ac VHT40 Power spectral density [dBm/1MHz] or [dBm/500kHz]									
Channel	38	46	54	62	102	118	134	151	159
Port 1	5.9	7.9	1.7	0.8	1.8	2.1	3.0	4.6	4.4
Port 2	3.0	6.6	3.9	3.4	0.5	2.0	2.9	6.9	7.6
Port 3	4.8	8.4	3.9	3.0	-0.6	4.1	4.2	6.2	4.6
Port 4	6.0	9.4	3.8	2.1	2.4	3.7	3.7	5.9	3.9
SUM	11.1	14.2	9.4	8.5	7.2	9.1	9.5	12.0	11.4

802.11ac VHT80 Power spectral density [dBm/1MHz] or [dBm/500kHz]					
Channel	42	58	106	122	155
Port 1	1.1	-4.0	-1.7	0.9	1.6
Port 2	-0.7	-1.8	-1.9	0.1	3.6
Port 3	1.1	-0.5	-1.6	0.8	1.3
Port 4	1.8	-2.5	-0.3	0.5	2.0
SUM	6.9	4.0	4.7	6.6	8.2

802.11ax HE20 Power spectral density [dBm/1MHz] or [dBm/500kHz]												
Channel	36	40	48	52	60	64	100	120	140	149	157	165
Port 1	8.7	9.9	9.3	2.8	2.7	3.1	1.1	2.2	4.2	6.4	7.2	7.3
Port 2	5.1	7.2	8.4	4.5	4.9	4.5	-1.4	2.6	4.4	9.8	7.3	10.0
Port 3	6.9	8.7	9.5	4.6	4.2	4.0	-2.2	2.5	4.2	8.7	6.9	6.4
Port 4	8.4	10.0	10.6	3.8	3.3	2.5	1.9	3.6	4.6	7.7	7.2	6.3
SUM	13.5	15.1	15.5	10.0	9.9	9.6	6.2	8.8	10.4	14.3	13.2	13.8

802.11ax HE40 Power spectral density [dBm/1MHz] or [dBm/500kHz]									
Channel	38	46	54	62	102	118	134	151	159
Port 1	4.2	7.9	1.9	0.9	1.4	2.1	2.9	4.6	4.4
Port 2	1.1	6.9	3.9	3.4	-0.4	2.0	3.0	6.9	7.5
Port 3	3.0	8.4	4.2	3.3	-0.3	4.0	4.4	6.1	4.8
Port 4	4.1	9.7	3.9	2.2	2.2	3.7	4.0	5.7	3.9
SUM	9.3	14.4	9.6	8.6	6.9	9.1	9.6	11.9	11.4

802.11ax HE80 Power spectral density [dBm/1MHz] or [dBm/500kHz]					
Channel	42	58	106	122	155
Port 1	0.6	-3.6	-1.5	0.5	1.9
Port 2	-1.2	-1.5	-1.7	0.8	3.5
Port 3	0.5	-0.2	-1.3	1.0	1.9
Port 4	1.3	-2.2	-0.2	0.8	2.1
SUM	6.4	4.3	4.9	6.8	8.4

12.6 Minimum emission bandwidth for the band 5.725-5.85 GHz

Description:

Measurement of the 6 dB bandwidth of the modulated signal.

Measurement:

Measurement parameter	
According to: KDB789033 D02, C.2.	
External result file(s)	1-3977_22-01-05_Annex_MR_A12 FCC Part 15.407 & ISED Minimum Emission BW
Used test setup:	See chapter 7.4 – A
Measurement uncertainty:	See chapter 9

Limits:

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

Results:

802.11a 6 dB bandwidth [MHz]			
Channel	149	157	165
Port 1	15.7	15.4	16.4
Port 2	16.4	15.9	15.8
Port 3	15.9	16.0	15.8
Port 4	16.0	15.7	16.3

802.11n HT20 6 dB bandwidth [MHz]			
Channel	149	157	165
Port 1	16.4	16.4	17.3
Port 2	15.4	15.3	16.6
Port 3	17.3	17.2	16.7
Port 4	16.3	16.4	16.9

802.11n HT40 6 dB bandwidth [MHz]		
Channel	151	159
Port 1	35.7	35.4
Port 2	35.4	36.4
Port 3	33.4	33.9
Port 4	33.9	35.2

802.11ac VHT20 6 dB bandwidth [MHz]			
Channel	149	157	165
Port 1	16.4	16.7	16.9
Port 2	17.2	15.1	16.4
Port 3	16.4	16.4	16.7
Port 4	17.0	16.1	16.4

802.11ac VHT40 6 dB bandwidth [MHz]		
Channel	151	159
Port 1	34.4	35.1
Port 2	35.7	36.3
Port 3	35.0	35.1
Port 4	34.4	35.7

802.11ac VHT80 6 dB bandwidth [MHz]	
Channel	155
Port 1	75.0
Port 2	75.2
Port 3	75.2
Port 4	72.8

802.11ax HE20 6 dB bandwidth [MHz]			
Channel	149	157	165
Port 1	19.0	18.3	18.7
Port 2	18.9	19.0	16.3
Port 3	18.3	18.9	17.8
Port 4	18.1	16.4	18.7

802.11ax HE40 6 dB bandwidth [MHz]		
Channel	151	159
Port 1	35.3	37.8
Port 2	36.3	36.7
Port 3	36.3	35.8
Port 4	35.0	37.6

802.11ax HE80 6 dB bandwidth [MHz]	
Channel	155
Port 1	71.4
Port 2	75.2
Port 3	76.2
Port 4	74.6

12.7 Spectrum bandwidth / 26 dB bandwidth

Description:

Measurement of the 26 dB bandwidth of the modulated signal.

Measurement:

Measurement parameter	
According to: KDB789033 D02, C.1.	
External result file(s)	1-3977_22-01-05_Annex_MR_A1 to A11 FCC Part 15.407 & ISED Bandwidths
Used test setup:	See chapter 7.4 – A
Measurement uncertainty:	See chapter 9

Limits:

Spectrum Bandwidth – 26 dB Bandwidth
IC: Any unwanted emissions that fall into the band 5250-5350 MHz shall be attenuated below the channel power by at least 26 dB, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth (i.e. 99% bandwidth), above 5250 MHz. The 26 dB bandwidth may fall into the 5250-5350 MHz band; however, if the occupied bandwidth also falls within the 5250-5350 MHz band, the transmission is considered as intentional and the devices shall comply with all requirements in the band 5250-5350 MHz including implementing dynamic frequency selection (DFS) and TPC, on the portion of the emission that resides in the 5250-5350 MHz band. **FCC:** Radar Detection Function of Dynamic Frequency Selection (DFS). U-NII devices operating with any part of its 26 dB emission bandwidth in the 5.25-5.35 GHz and 5.47-5.725 GHz bands shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems.

Results:

802.11a 26 dB bandwidth [MHz]												
Channel	36	40	48	52	60	64	100	120	140	149	157	165
Port 1	20.2	23.3	19.7	19.6	19.6	19.2	19.8	19.7	19.3	22.6	21.6	21.2
Port 2	19.4	19.9	22.5	19.4	19.2	19.3	19.1	19.3	19.6	34.2	31.5	34.9
Port 3	19.5	34.2	35.5	19.5	19.6	19.4	19.5	19.4	19.4	30.3	22.1	20.2
Port 4	20.1	36.0	29.9	19.4	19.4	19.4	19.4	19.0	19.0	22.2	19.4	19.2

802.11n HT20 26 dB bandwidth [MHz]												
Channel	36	40	48	52	60	64	100	120	140	149	157	165
Port 1	21.9	21.7	21.3	20.4	20.3	20.8	20.8	21.0	20.4	29.1	21.9	23.0
Port 2	20.9	20.9	24.1	20.8	20.7	20.6	20.2	20.0	20.0	26.3	22.8	35.1
Port 3	20.6	34.5	36.0	20.6	20.8	20.8	20.9	20.9	20.5	26.6	22.1	21.4
Port 4	21.8	40.1	30.5	21.1	20.7	20.7	20.6	20.4	20.7	22.2	20.6	20.3

802.11n HT40 26 dB bandwidth [MHz]									
Channel	38	46	54	62	102	118	134	151	159
Port 1	40.7	41.4	39.9	40.3	40.0	40.1	40.3	65.5	64.4
Port 2	40.4	40.6	40.0	40.2	39.2	39.5	40.4	81.7	87.4
Port 3	40.4	81.8	40.7	40.7	40.5	40.0	40.3	67.2	50.2
Port 4	40.8	77.0	39.9	40.1	39.8	39.2	39.8	40.5	39.7

802.11ac VHT20 26 dB bandwidth [MHz]												
Channel	36	40	48	52	60	64	100	120	140	149	157	165
Port 1	21.4	24.3	21.2	20.8	20.9	20.4	20.9	20.5	20.1	22.4	32.0	25.1
Port 2	20.5	21.0	22.6	20.6	20.9	20.7	21.2	20.4	20.3	30.5	30.0	29.1
Port 3	20.7	33.4	36.4	20.7	20.9	20.8	20.8	20.9	20.5	30.1	21.7	20.3
Port 4	20.7	37.8	33.3	20.4	20.6	20.7	20.6	20.3	20.4	23.2	21.0	20.4

802.11ac VHT40 26 dB bandwidth [MHz]									
Channel	38	46	54	62	102	118	134	151	159
Port 1	41.0	42.3	40.2	40.4	39.8	40.0	40.4	66.4	61.5
Port 2	40.7	42.5	40.0	40.3	39.1	39.5	40.0	83.6	86.3
Port 3	40.6	82.7	40.7	40.7	40.8	39.9	40.5	85.1	44.1
Port 4	40.8	74.9	39.8	39.9	39.8	39.5	39.7	40.4	39.7

802.11ac VHT80 26 dB bandwidth [MHz]					
Channel	42	58	106	122	155
Port 1	82.4	81.6	81.6	81.0	130.2
Port 2	81.2	81.4	80.2	81.2	154.2
Port 3	82.0	81.8	82.0	80.8	144.4
Port 4	81.4	81.2	81.2	81.2	81.2

802.11ax HE20 26 dB bandwidth [MHz]												
Channel	36	40	48	52	60	64	100	120	140	149	157	165
Port 1	21.8	25.4	21.6	21.1	21.7	21.5	21.4	21.7	21.0	32.3	22.0	32.1
Port 2	21.5	21.7	24.1	21.5	21.1	21.0	21.0	21.0	20.9	50.0	31.8	21.1
Port 3	21.5	33.4	38.2	21.2	21.3	21.3	21.5	21.3	21.6	37.1	29.3	21.4
Port 4	22.0	39.6	35.9	21.5	21.2	21.2	21.3	21.0	21.3	38.3	21.5	21.0

802.11ax HE40 26 dB bandwidth [MHz]									
Channel	38	46	54	62	102	118	134	151	159
Port 1	41.3	43.5	40.3	40.9	40.6	40.1	40.8	65.9	62.3
Port 2	41.1	41.1	40.7	40.6	40.1	40.4	40.5	84.6	85.7
Port 3	41.0	82.8	41.1	41.1	40.9	40.6	41.1	78.5	49.6
Port 4	41.0	81.8	40.7	41.1	41.3	40.1	40.7	41.1	40.5

802.11ax HE80 26 dB bandwidth [MHz]					
Channel	42	58	106	122	155
Port 1	82.0	82.0	81.8	81.6	114.4
Port 2	82.2	82.8	81.4	81.4	157.8
Port 3	82.2	82.2	82.0	82.0	141.8
Port 4	82.2	82.2	82.4	81.6	82.4

12.8 Occupied bandwidth / 99% emission bandwidth

Description:

Measurement of the 99% bandwidth of the modulated signal acc. RSS-GEN.

Measurement:

Measurement parameter	
External result file(s)	1-3977_22-01-05_Annex_MR_A1 to A11 FCC Part 15.407 & ISED Bandwidths
Test setup:	See chapter 7.4 – A
Measurement uncertainty:	See chapter 9

Usage:

-/-	ISED
OBW is necessary for Emission Designator	

Results:

802.11a 99% bandwidth [MHz]												
Channel	36	40	48	52	60	64	100	120	140	149	157	165
Port 1	16.5	16.7	16.5	16.5	16.5	16.4	16.5	16.6	16.5	16.7	16.5	16.6
Port 2	16.4	16.6	16.7	16.4	16.5	16.4	16.3	16.4	16.7	19.2	17.0	18.2
Port 3	16.4	17.3	18.0	16.4	16.5	16.5	16.4	16.4	16.4	17.1	16.6	16.5
Port 4	16.5	19.5	17.0	16.4	16.5	16.4	16.4	16.4	16.4	16.6	16.5	16.4

802.11n HT20 99% bandwidth [MHz]												
Channel	36	40	48	52	60	64	100	120	140	149	157	165
Port 1	17.7	17.9	17.7	17.6	17.5	17.6	17.7	17.8	17.5	17.8	17.8	17.7
Port 2	17.6	17.6	17.7	17.6	17.6	17.6	17.5	17.4	17.5	17.6	17.7	18.5
Port 3	17.6	18.3	18.8	17.6	17.6	17.6	17.6	17.7	17.6	18.0	17.8	17.7
Port 4	17.7	19.8	18.0	17.6	17.6	17.6	17.6	17.6	17.6	17.7	17.6	17.6

802.11n HT40 99% bandwidth [MHz]									
Channel	38	46	54	62	102	118	134	151	159
Port 1	36.2	36.3	35.9	36.0	36.0	36.0	36.0	36.5	36.5
Port 2	36.3	36.3	36.1	36.2	35.6	35.8	36.3	43.1	53.0
Port 3	36.2	40.5	36.3	36.2	36.3	36.0	36.2	36.9	36.3
Port 4	36.1	37.3	36.0	36.0	36.0	35.8	36.0	36.2	36.0

802.11ac VHT20 99% bandwidth [MHz]												
Channel	36	40	48	52	60	64	100	120	140	149	157	165
Port 1	17.6	17.8	17.6	17.6	17.7	17.5	17.7	17.6	17.5	17.9	17.9	17.7
Port 2	17.6	17.6	17.7	17.6	17.6	17.6	17.7	17.6	17.5	18.8	18.0	18.0
Port 3	17.6	18.4	18.7	17.6	17.6	17.6	17.6	17.7	17.6	18.1	17.6	17.5
Port 4	17.6	20.4	18.1	17.6	17.6	17.6	17.6	17.6	17.7	17.7	17.6	17.6

802.11ac VHT40 99% bandwidth [MHz]									
Channel	38	46	54	62	102	118	134	151	159
Port 1	36.2	36.3	35.9	36.0	36.0	36.0	36.1	36.7	36.5
Port 2	36.3	36.4	36.1	36.2	35.6	35.8	36.3	44.8	53.3
Port 3	36.2	41.6	36.3	36.3	36.4	36.0	36.2	39.0	36.3
Port 4	36.2	37.2	36.0	36.1	36.0	35.9	36.1	36.0	36.0

802.11ac VHT80 99% bandwidth [MHz]					
Channel	42	58	106	122	155
Port 1	75.1	75.1	75.1	74.7	75.5
Port 2	75.1	75.3	74.3	75.3	82.9
Port 3	75.3	75.3	75.5	74.5	76.5
Port 4	74.9	75.2	75.3	74.9	75.1

802.11ax HE20 99% bandwidth [MHz]												
Channel	36	40	48	52	60	64	100	120	140	149	157	165
Port 1	19.0	19.1	18.9	18.9	19.0	19.0	19.0	19.1	18.9	19.5	19.0	19.3
Port 2	19.0	19.0	19.1	19.0	18.9	18.9	18.7	19.0	18.9	32.3	19.3	19.0
Port 3	19.0	19.4	19.4	18.9	18.9	18.9	19.0	18.9	19.0	20.3	19.1	18.9
Port 4	19.0	20.4	19.3	19.0	18.9	18.9	18.9	19.0	19.1	19.6	19.0	18.9

802.11ax HE40 99% bandwidth [MHz]									
Channel	38	46	54	62	102	118	134	151	159
Port 1	37.8	38.0	37.7	37.7	37.5	37.5	37.6	38.6	38.1
Port 2	37.9	37.9	37.7	37.8	37.4	37.6	37.9	43.8	49.4
Port 3	37.8	40.5	37.9	37.9	38.0	37.7	37.9	38.5	37.9
Port 4	37.7	39.1	37.7	37.8	37.7	37.6	37.9	37.9	37.7

802.11ax HE80 99% bandwidth [MHz]					
Channel	42	58	106	122	155
Port 1	76.7	76.9	76.7	76.9	77.7
Port 2	77.1	77.1	76.3	76.5	84.5
Port 3	76.9	77.1	77.5	76.7	78.1
Port 4	77.1	76.9	76.9	76.7	76.9

12.9 Band edge compliance radiated

Description:

Measurement of the radiated band edge compliance. The EUT is turned in the position that results in the maximum level at the band edge. Then a sweep over the corresponding restricted band is performed. The EUT is set to the lowest channel for the lower restricted band and to the highest channel for the upper restricted band. Measurement distance is 3m.

Measurement:

Measurement parameter	
Detector:	Peak / RMS
Sweep time:	Auto
Resolution bandwidth:	1 MHz
Video bandwidth:	≥ 3 x RBW
Span:	See plots!
Trace mode:	Max Hold
Test setup:	See sub clause 7.2 – B
Measurement uncertainty:	See chapter 9

Limits:

Band Edge Compliance Radiated
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or 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, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)).
74 dBµV/m (peak) 54 dBµV/m (average)

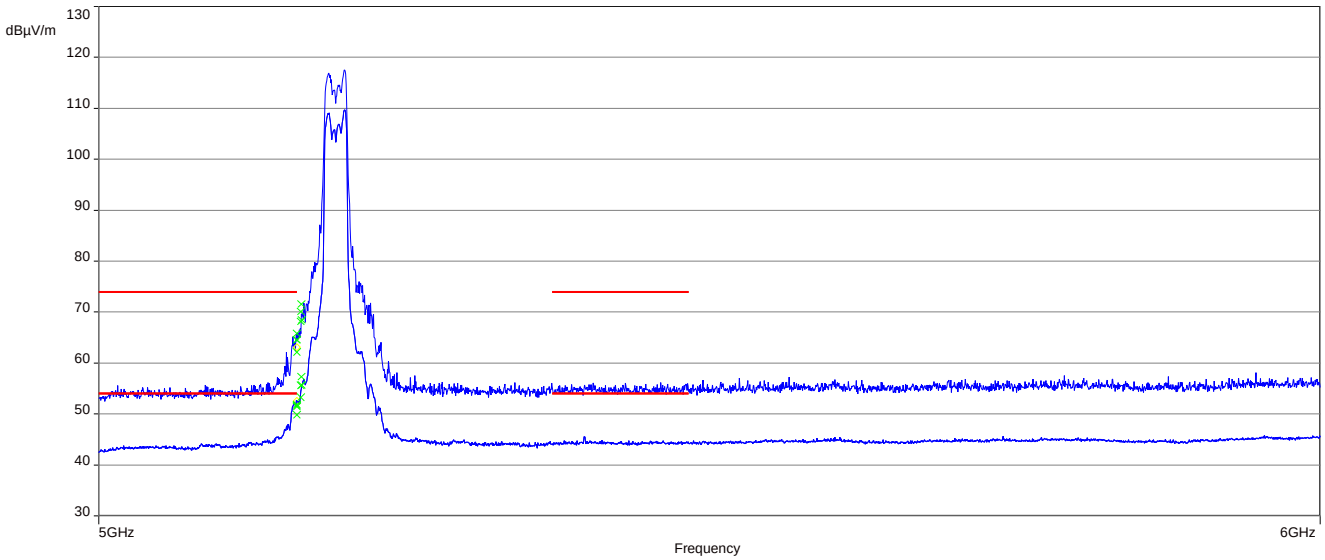
Results:

Band Edge Compliance radiated	Emission frequency [MHz]	Detector	Level [dBuV/m]
Lower band edge; U-NII-1; lowest channel, 802.11a	5150	Peak	65.9
		AVG	51.9
Upper band edge; U-NII-2A; highest channel, 802.11a	5350	Peak	58.7
		AVG	47.1
Lower band edge; U-NII-2C; lowest channel, 802.11a	5460	Peak	57.5
		AVG	46.1
Lower band edge; U-NII-1; lowest channel, 802.11n HT20	5150	Peak	72.3
		AVG	53.2
Upper band edge; U-NII-2A; highest channel, 802.11n HT20	5350	Peak	57.3
		AVG	45.7
Lower band edge; U-NII-2C; lowest channel, 802.11n HT20	5460	Peak	56.7
		AVG	45.6
Lower band edge; U-NII-1; lowest channel, 802.11n HT40	5150	Peak	71.2
		AVG	53.0
Upper band edge; U-NII-2A; highest channel, 802.11n HT40	5350	Peak	67.0
		AVG	52.3
Lower band edge; U-NII-2C; lowest channel, 802.11n HT40	5460	Peak	59.0
		AVG	47.2
Lower band edge; U-NII-1; lowest channel, 802.11ac VHT20	5150	Peak	67.2
		AVG	52.9
Upper band edge; U-NII-2A; highest channel, 802.11ac VHT20	5350	Peak	58.9
		AVG	47.3
Lower band edge; U-NII-2C; lowest channel, 802.11ac VHT20	5460	Peak	57.5
		AVG	45.9
Lower band edge; U-NII-1; lowest channel, 802.11ac VHT40	5150	Peak	71.5
		AVG	53.1
Upper band edge; U-NII-2A; highest channel, 802.11ac VHT40	5350	Peak	64.7
		AVG	52.6
Lower band edge; U-NII-2C; lowest channel, 802.11ac VHT40	5460	Peak	59.0
		AVG	47.2
Lower band edge; U-NII-1; lowest channel, 802.11ac VHT80	5150	Peak	73.2
		AVG	52.8
Upper band edge; U-NII-2A; highest channel, 802.11ac VHT80	5350	Peak	69.0
		AVG	52.0
	5355	Peak	71.2
		AVG	53.6
Lower band edge; U-NII-2C; lowest channel, 802.11ac VHT80	5460	Peak	69.2
		AVG	53.7
Lower band edge; U-NII-1; lowest channel, 802.11ax HE20	5150	Peak	72.4
		AVG	52.9
Upper band edge; U-NII-2A; highest channel, 802.11ax HE20	5350	Peak	58.9
		AVG	46.9
Lower band edge; U-NII-2C; lowest channel, 802.11ax HE20	5460	Peak	58.5
		AVG	46.5

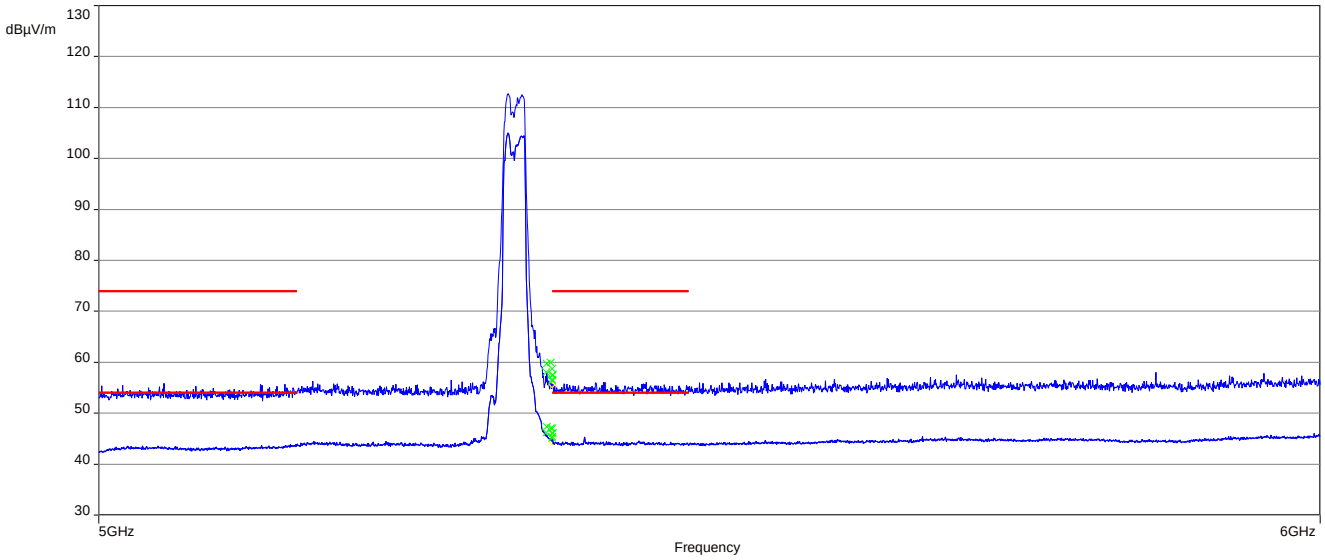
Lower band edge; U-NII-1; lowest channel, 802.11ax HE40	5150	Peak	72.8
		AVG	51.3
Upper band edge; U-NII-2A; highest channel, 802.11ax HE40	5350	Peak	69.0
		AVG	53.7
	5355	Peak	65.2
		AVG	52.8
Lower band edge; U-NII-2C; lowest channel, 802.11ax HE40	5460	Peak	53.6
		AVG	49.0
Lower band edge; U-NII-1; lowest channel, 802.11ax HE80	5150	Peak	73.6
		AVG	53.8
Upper band edge; U-NII-2A; highest channel, 802.11ax HE80	5350	Peak	69.2
		AVG	53.0
	5355	Peak	71.7
		AVG	53.8
	5360	Peak	72.2
		AVG	53.8
Lower band edge; U-NII-2C; lowest channel, 802.11ax HE80	5455	Peak	69.4
		AVG	53.4
	5460	Peak	67.1
		AVG	52.8

Plots:

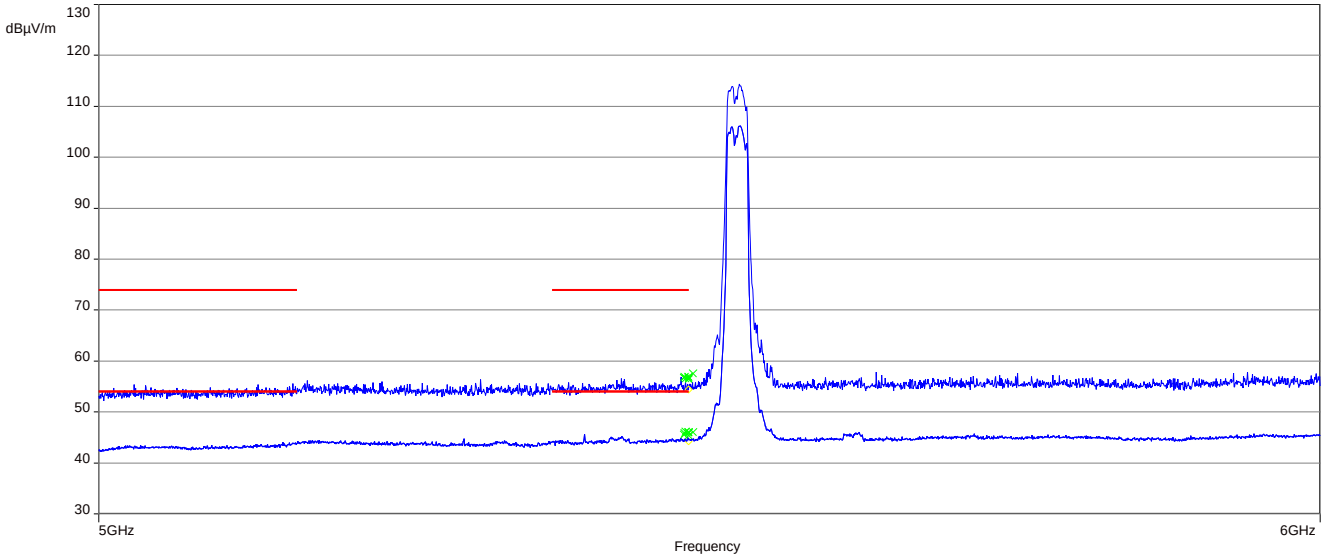
Plot 1: lower band edge; U-NII-1; lowest channel, 802.11a



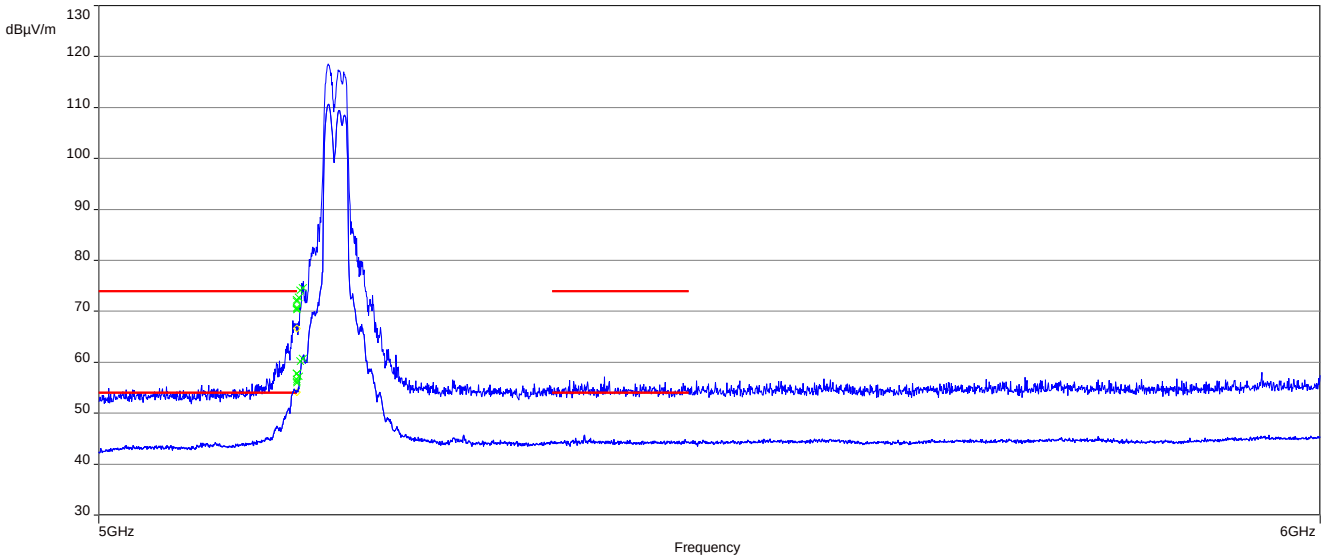
Plot 2: upper band edge; U-NII-2A; highest channel, 802.11a



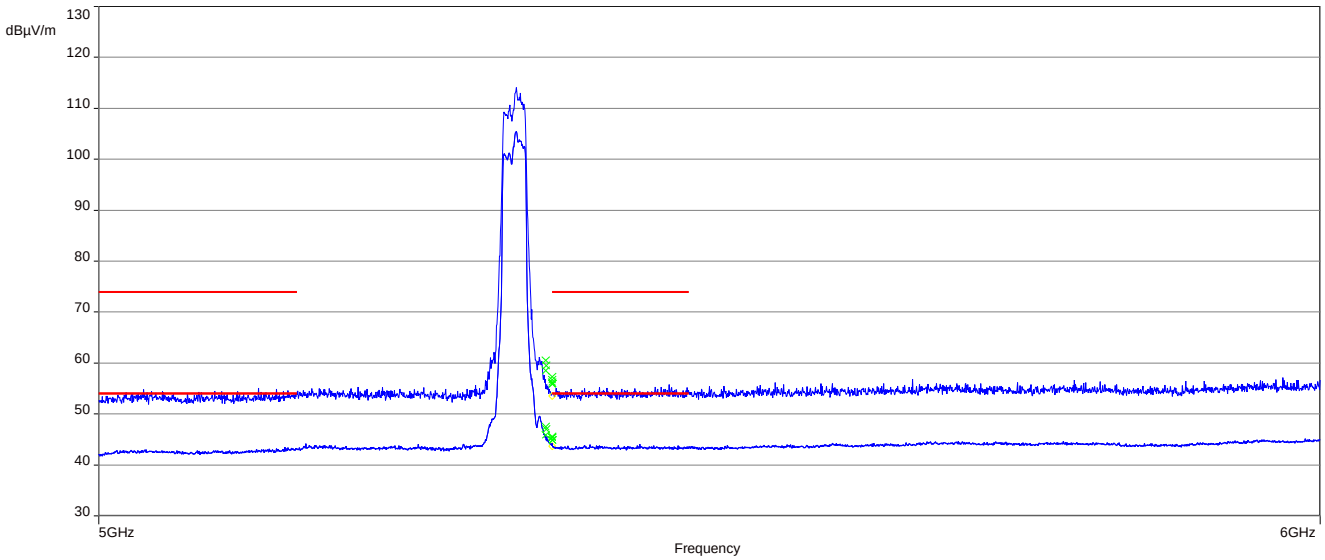
Plot 3: lower band edge; U-NII-2C; lowest channel, 802.11a



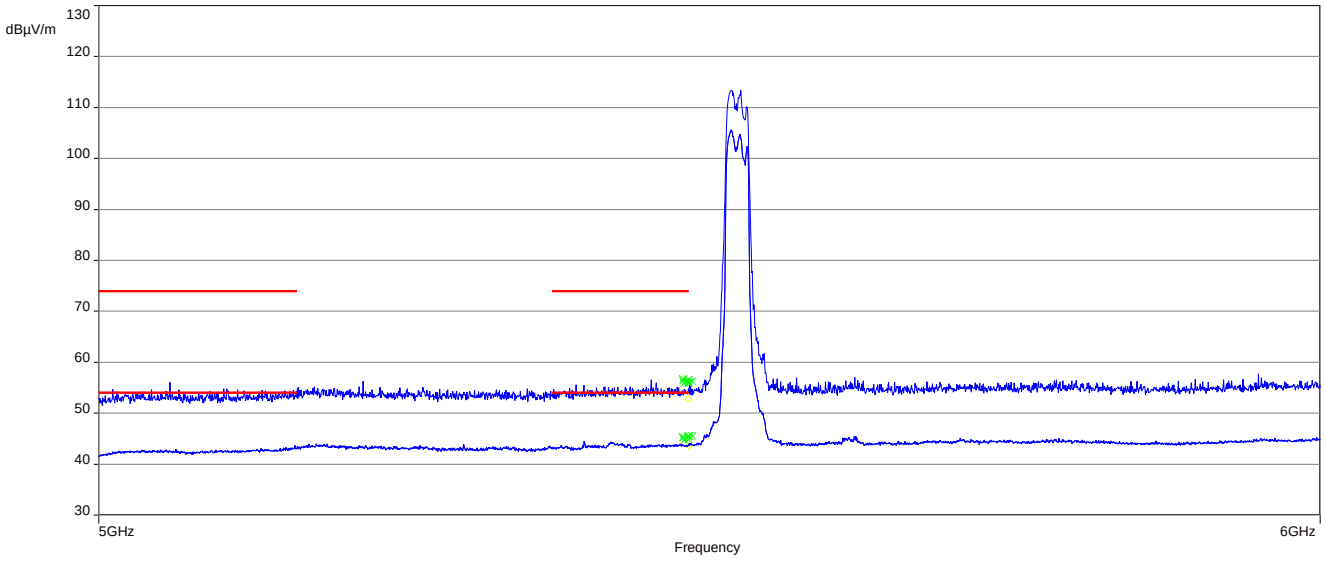
Plot 4: lower band edge; U-NII-1; lowest channel, 802.11n HT20



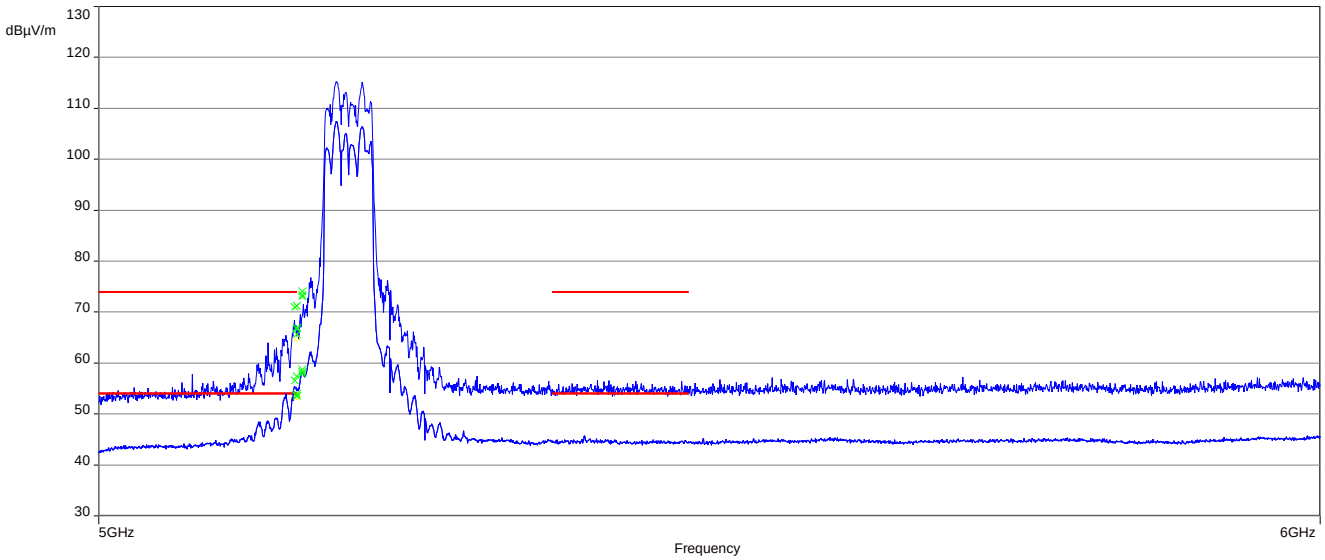
Plot 5: upper band edge; U-NII-2A; highest channel, 802.11n HT20



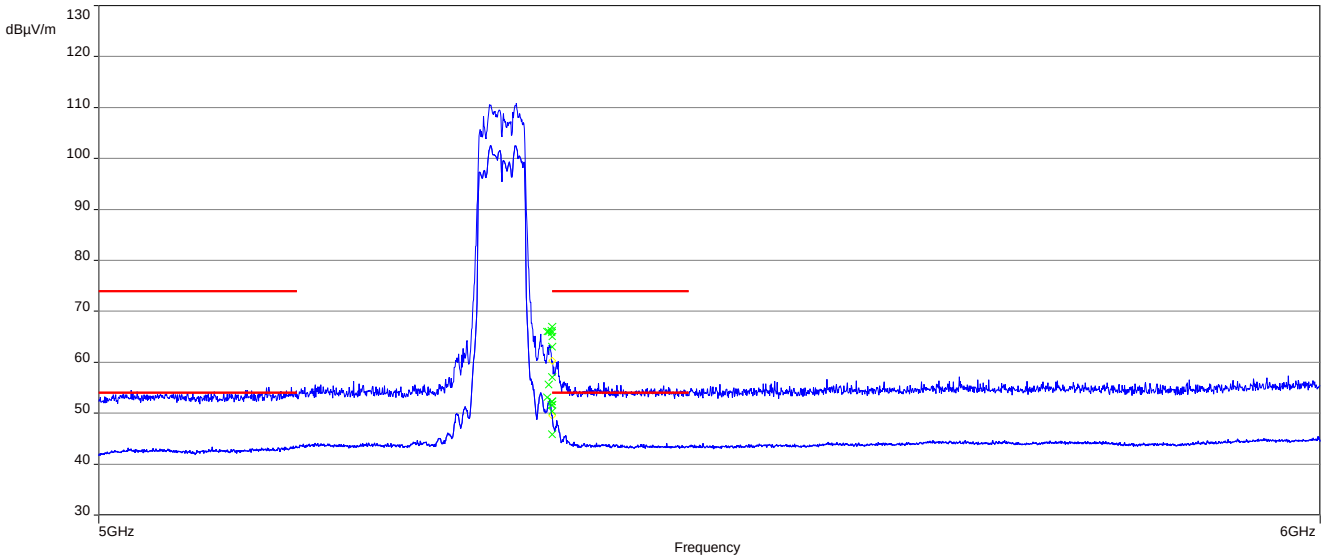
Plot 6: lower band edge; U-NII-2C; lowest channel, 802.11n HT20



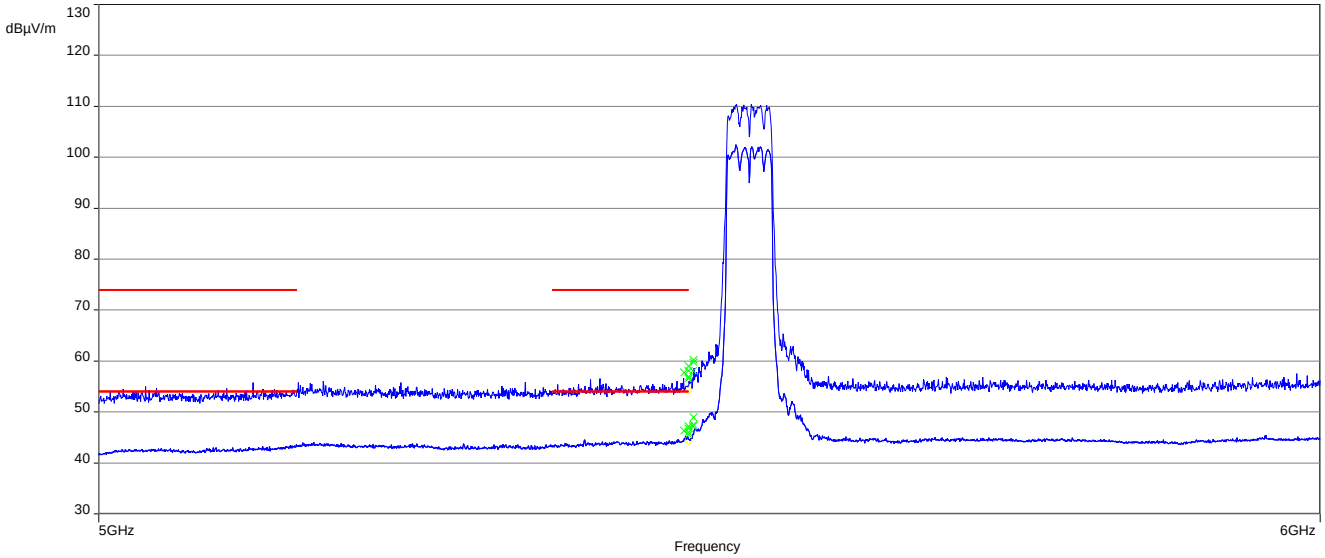
Plot 7: lower band edge; U-NII-1; lowest channel, 802.11n HT40



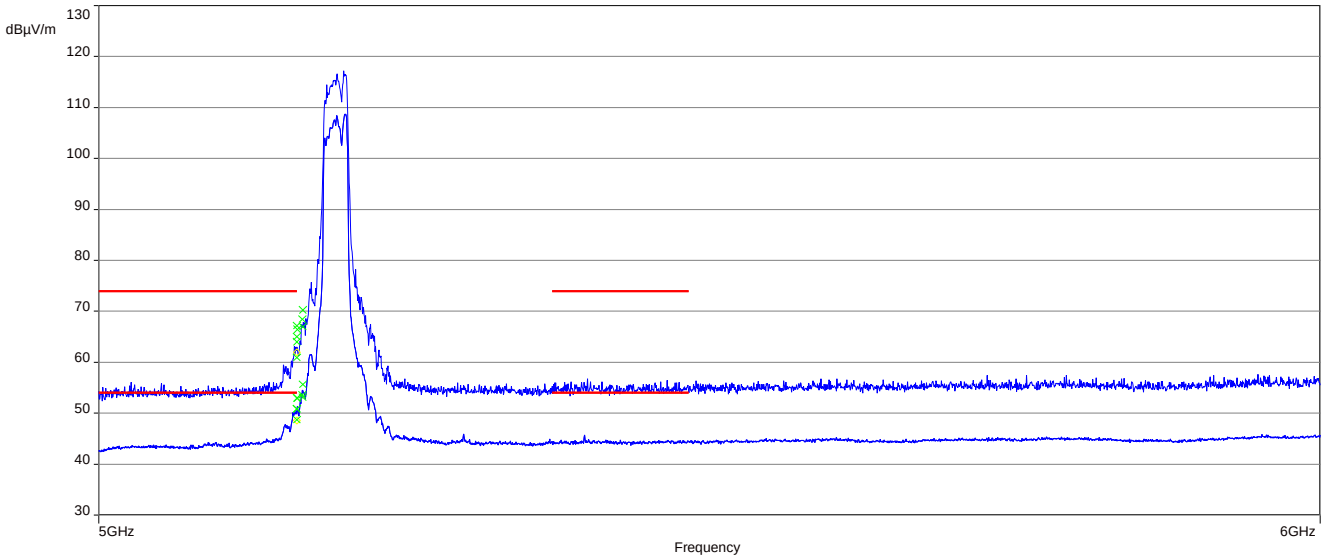
Plot 8: upper band edge; U-NII-2A; highest channel, 802.11n HT40



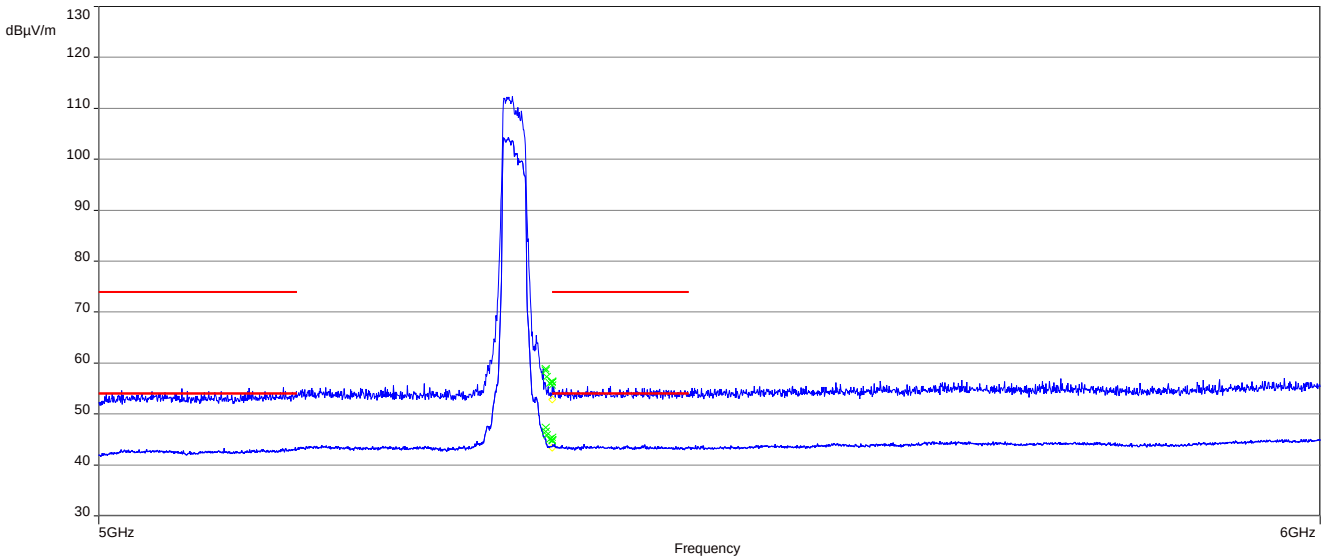
Plot 9: lower band edge; U-NII-2C; lowest channel, 802.11n HT40



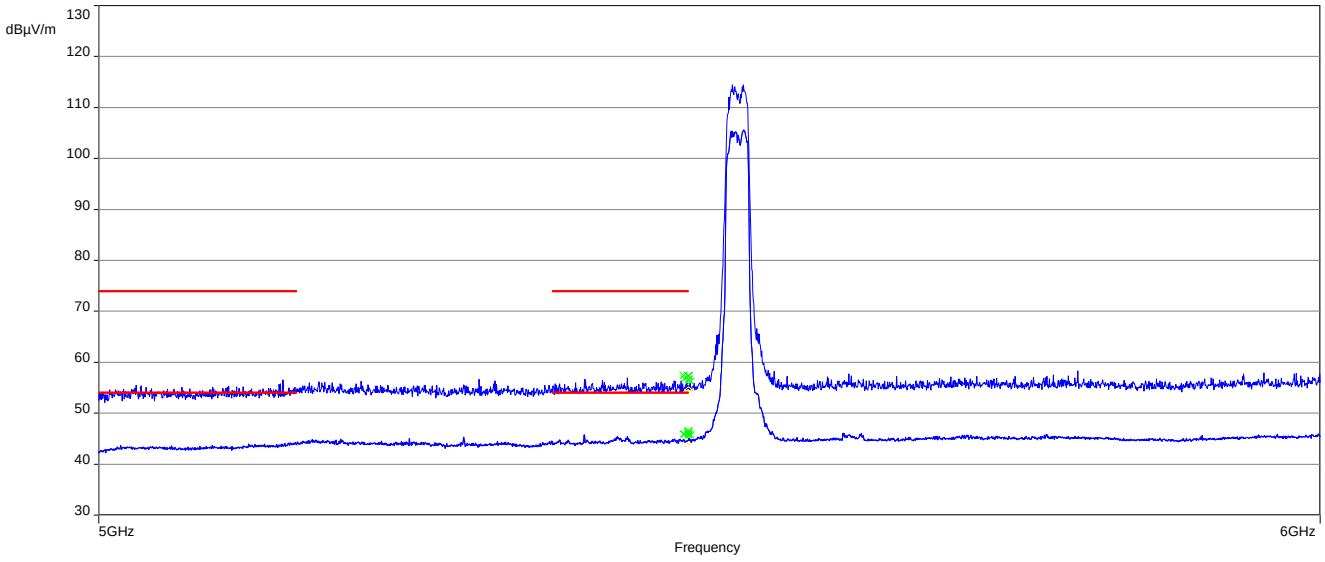
Plot 10: lower band edge; U-NII-1; lowest channel, 802.11ac VHT20



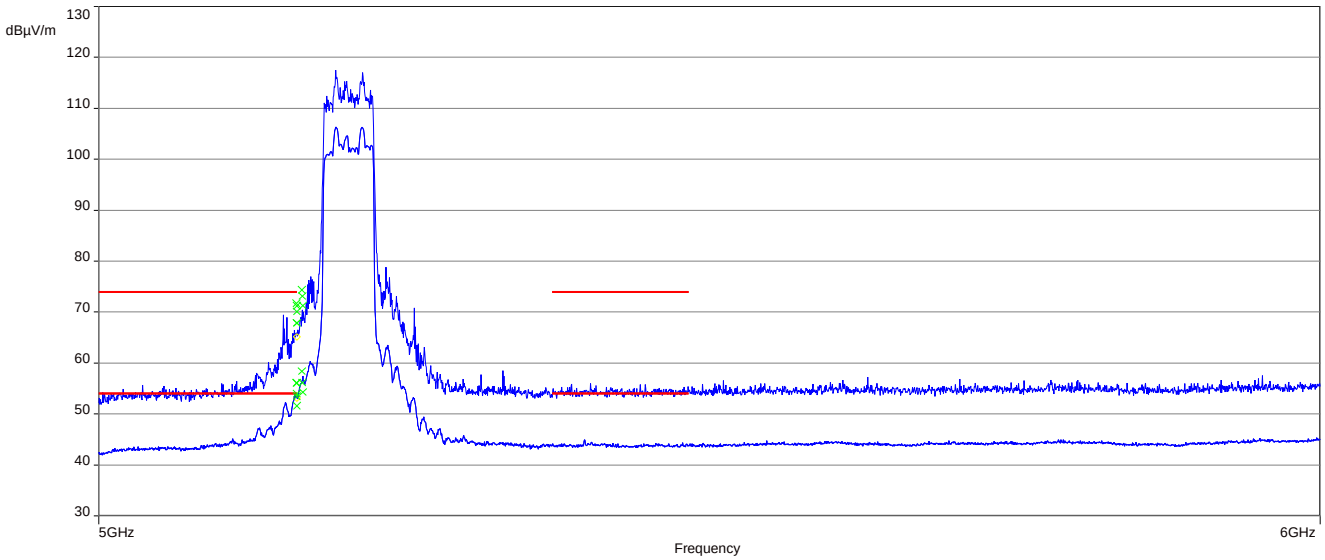
Plot 11: upper band edge; U-NII-2A; highest channel, 802.11ac VHT20



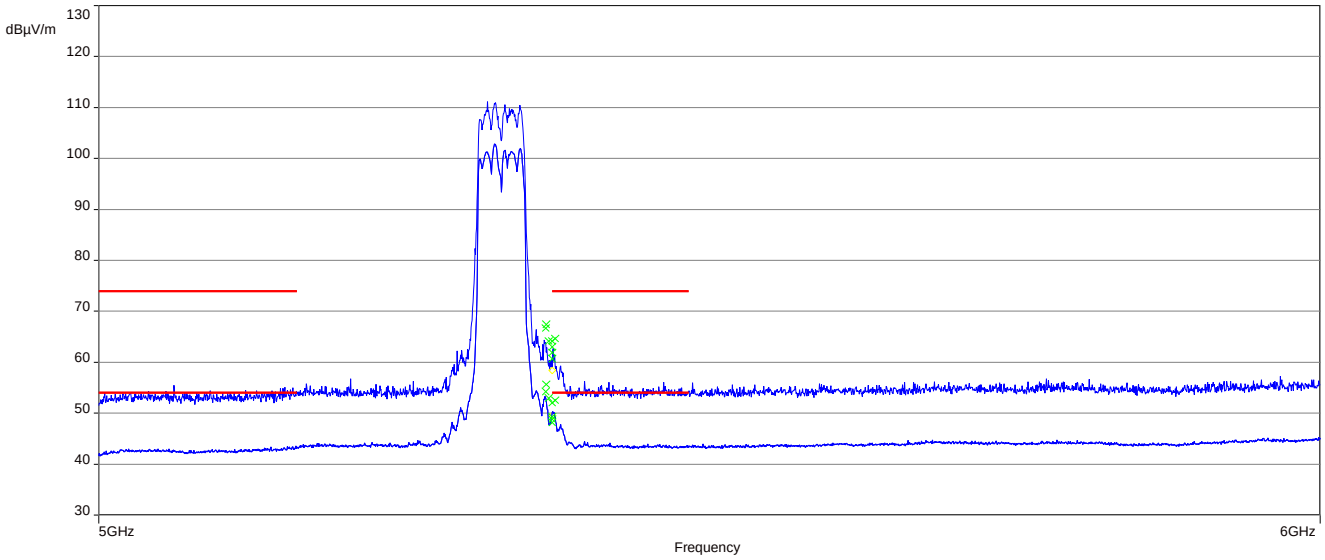
Plot 12: lower band edge; U-NII-2C; lowest channel, 802.11ac VHT20



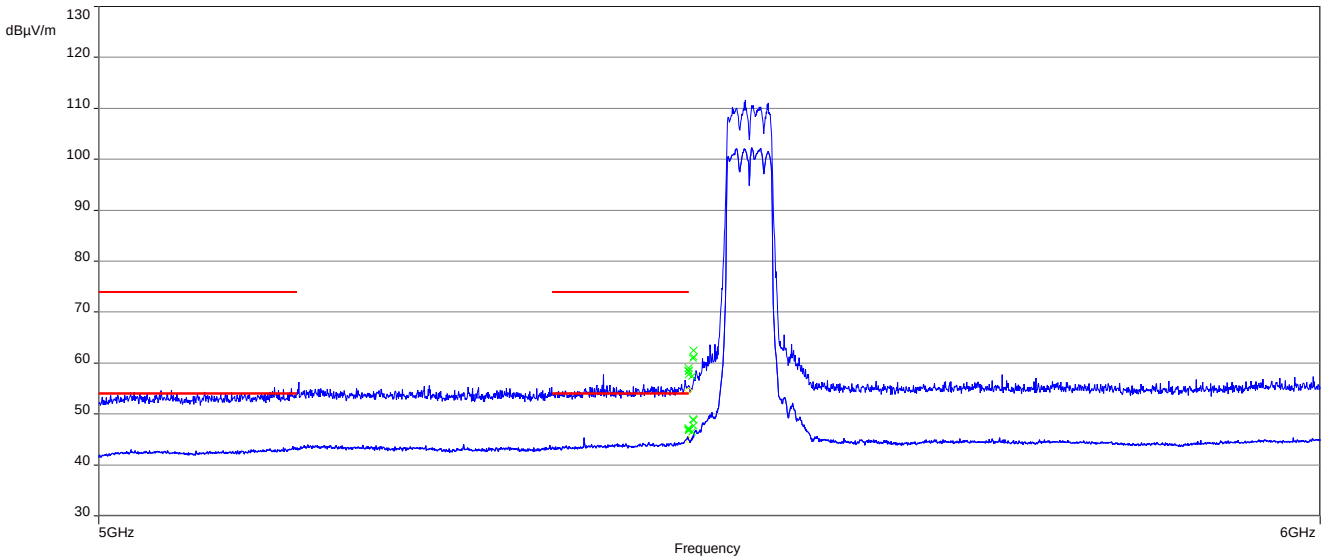
Plot 13: lower band edge; U-NII-1; lowest channel, 802.11ac VHT40



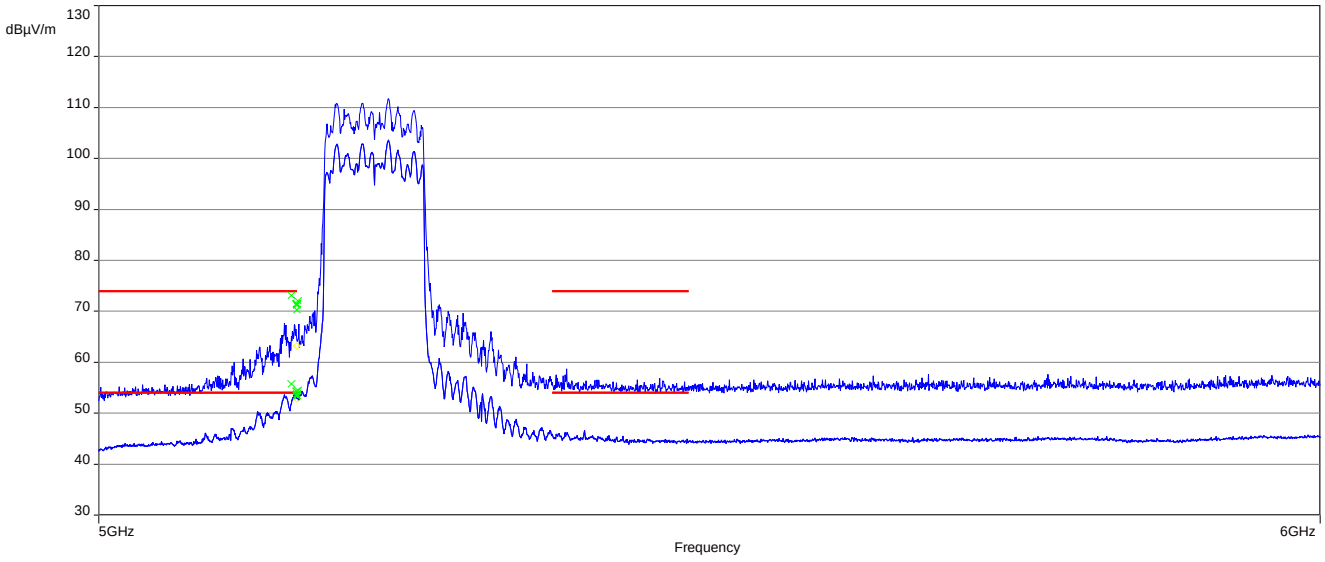
Plot 14: upper band edge; U-NII-2A; highest channel, 802.11ac VHT40



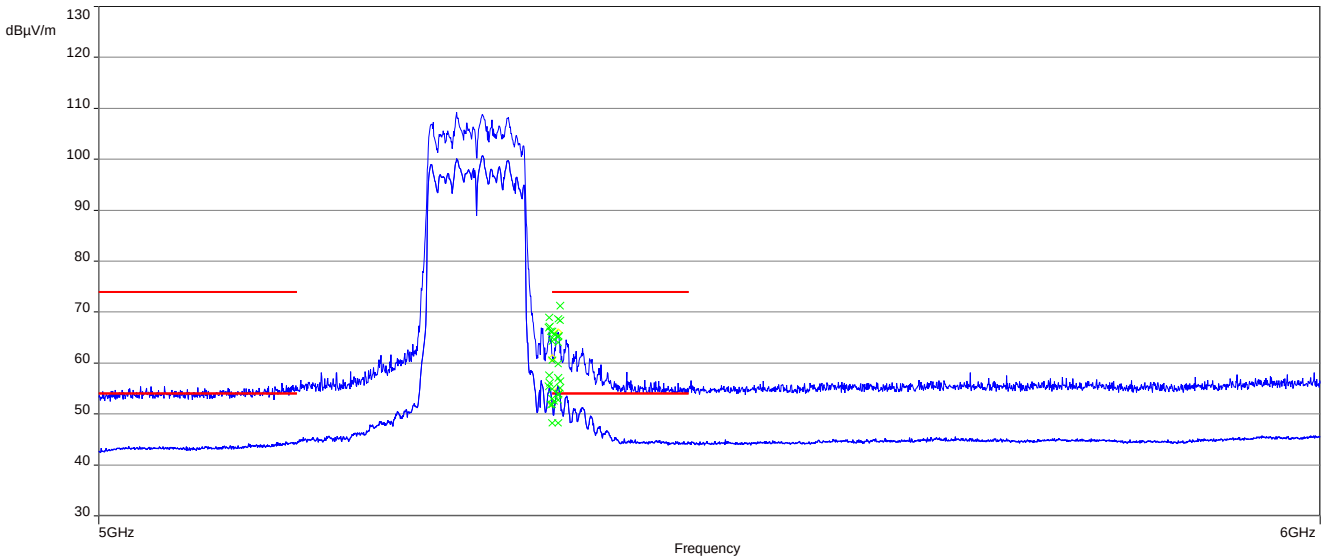
Plot 15: lower band edge; U-NII-2C; lowest channel, 802.11ac VHT40



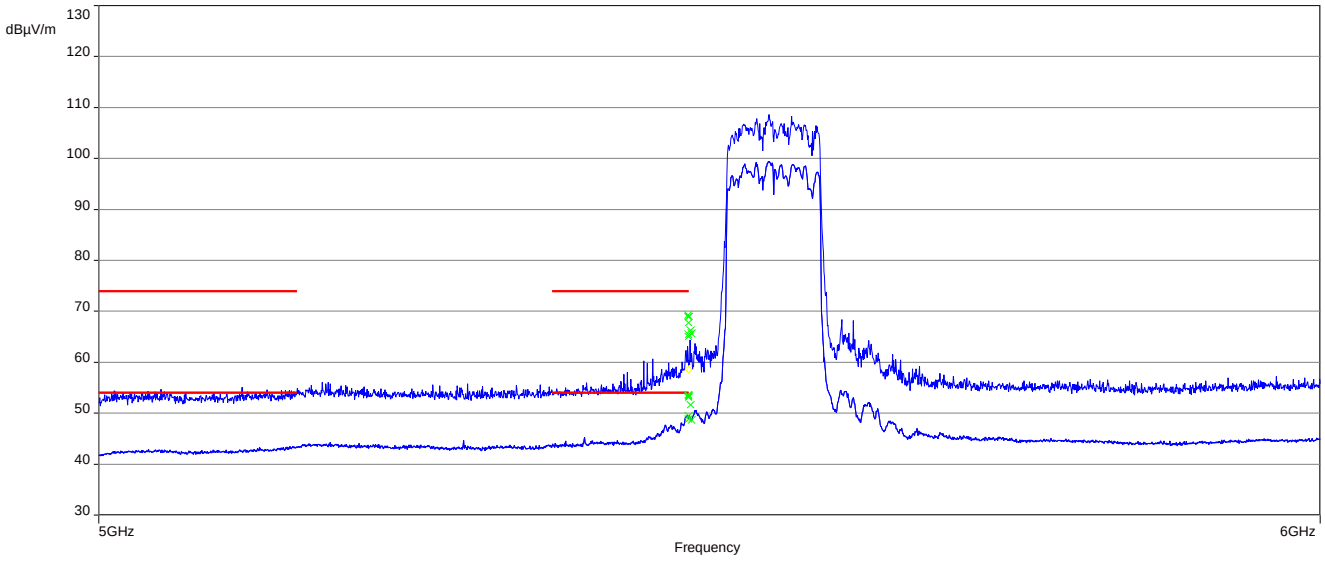
Plot 16: lower band edge; U-NII-1; lowest channel, 802.11ac VHT80



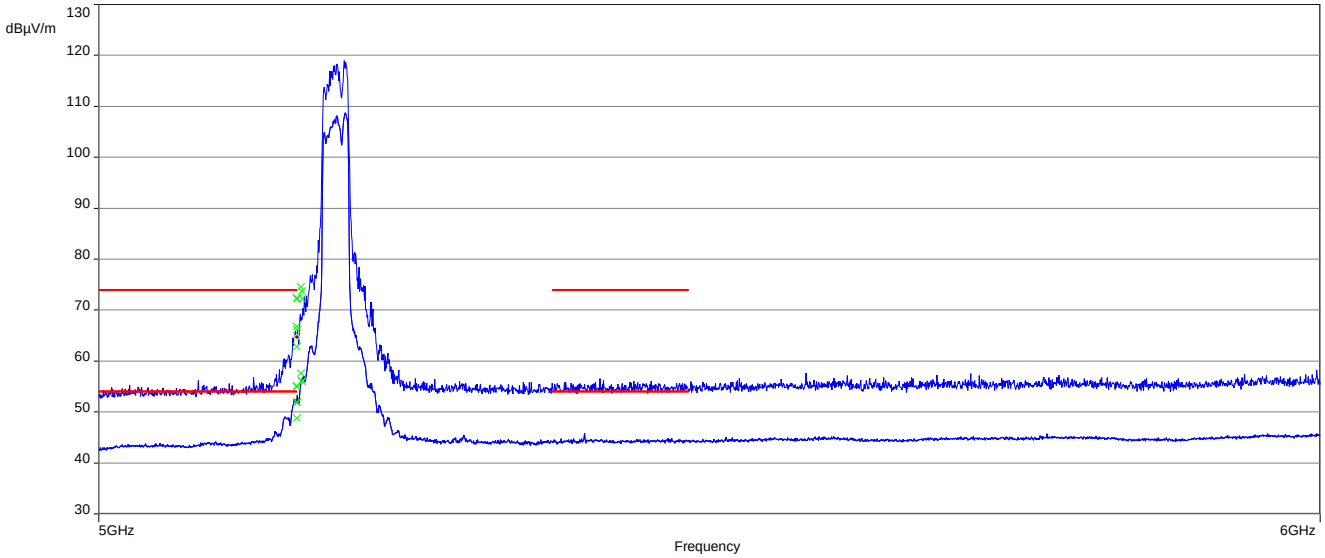
Plot 17: upper band edge; U-NII-2A; highest channel, 802.11ac VHT80



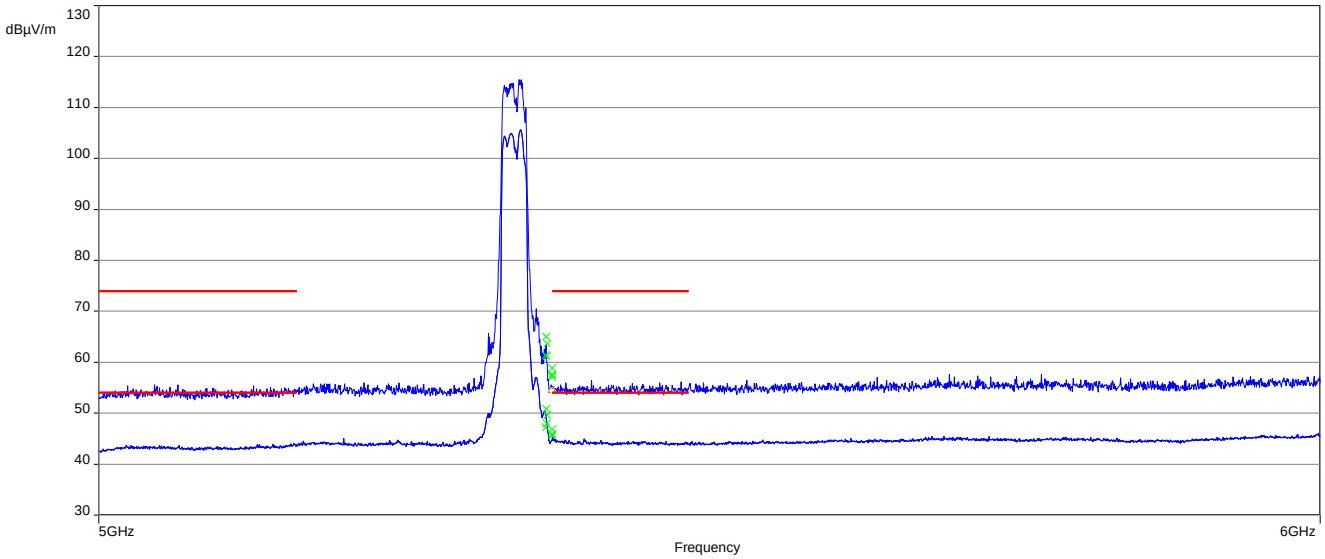
Plot 18: lower band edge; U-NII-2C; lowest channel, 802.11ac VHT80



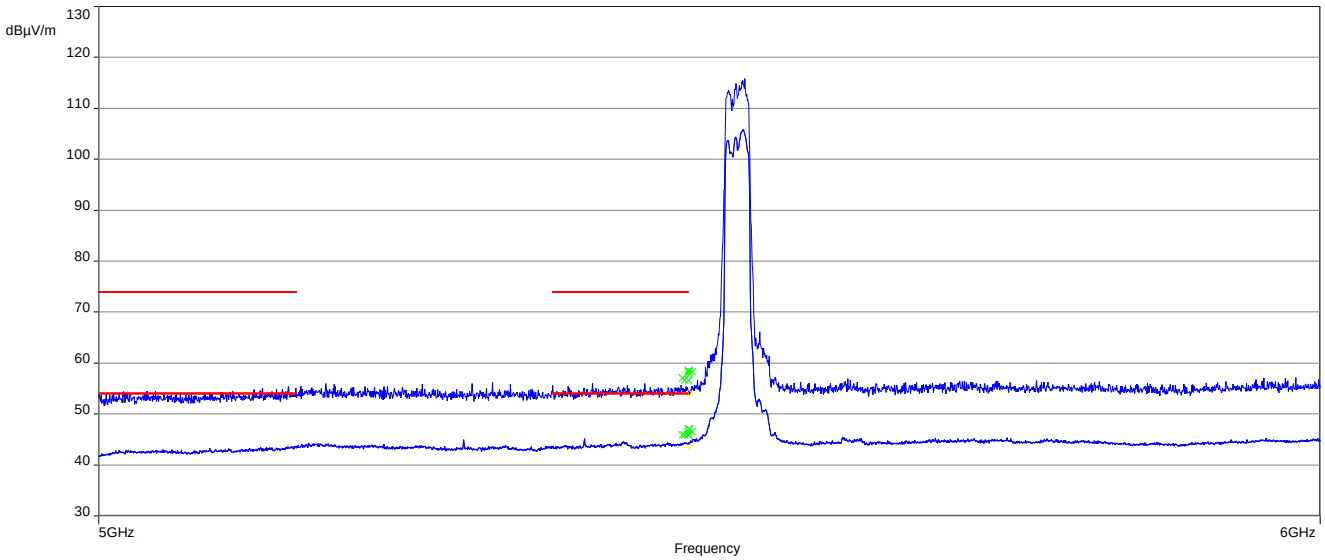
Plot 19: lower band edge; U-NII-1; lowest channel, 802.11ax HE20



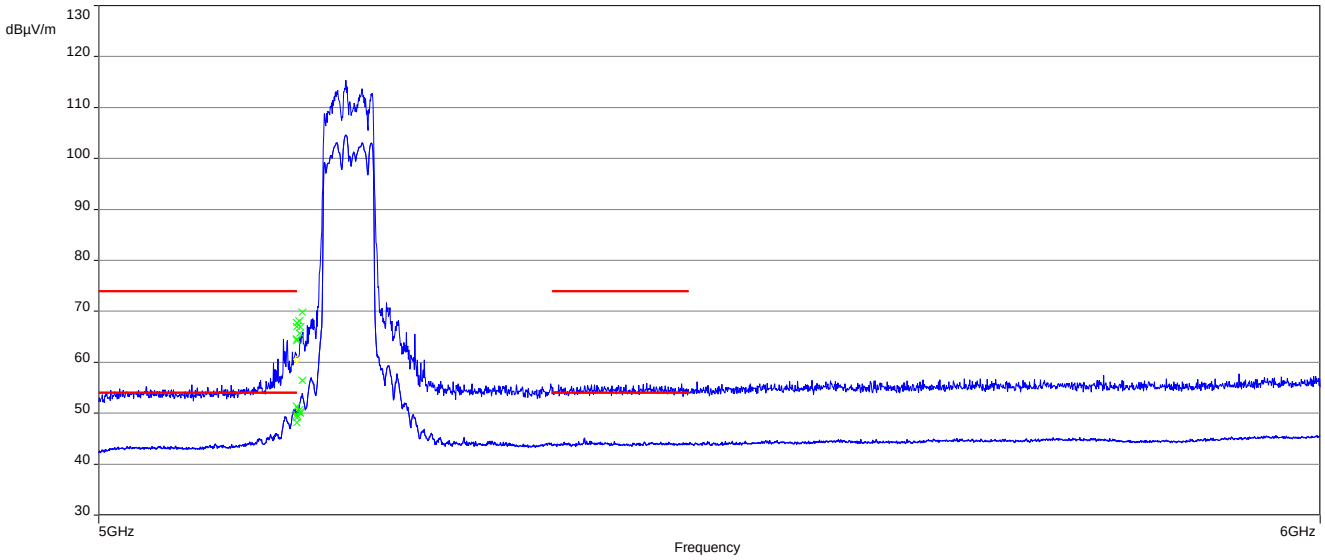
Plot 20: upper band edge; U-NII-2A; highest channel, 802.11ax HE20



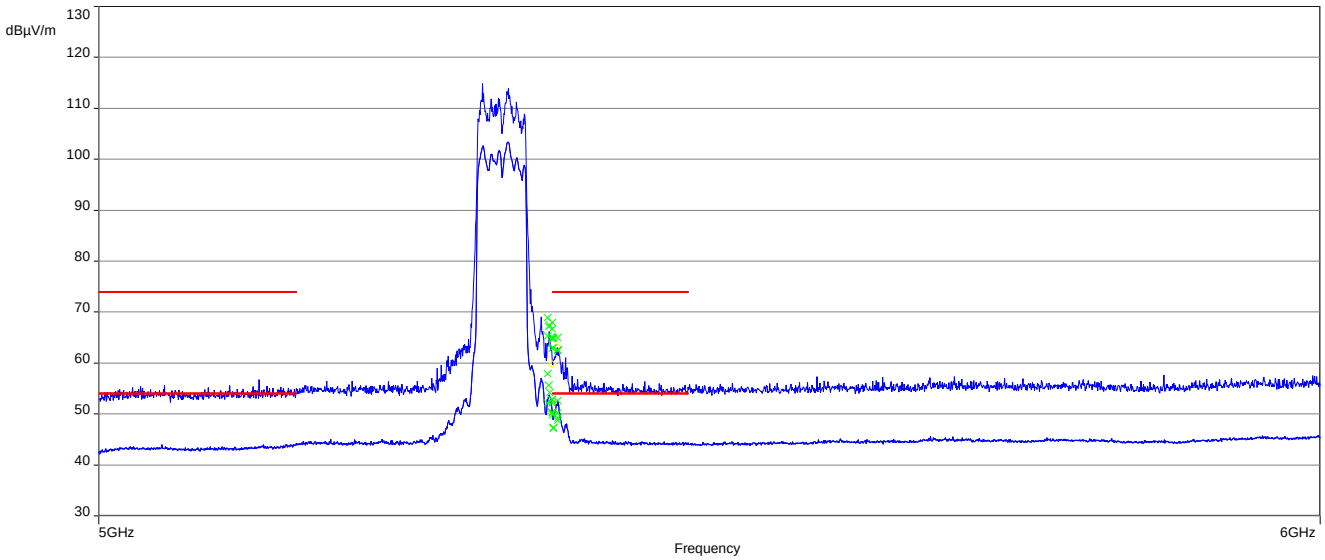
Plot 21: lower band edge; U-NII-2C; lowest channel, 802.11ax HE20



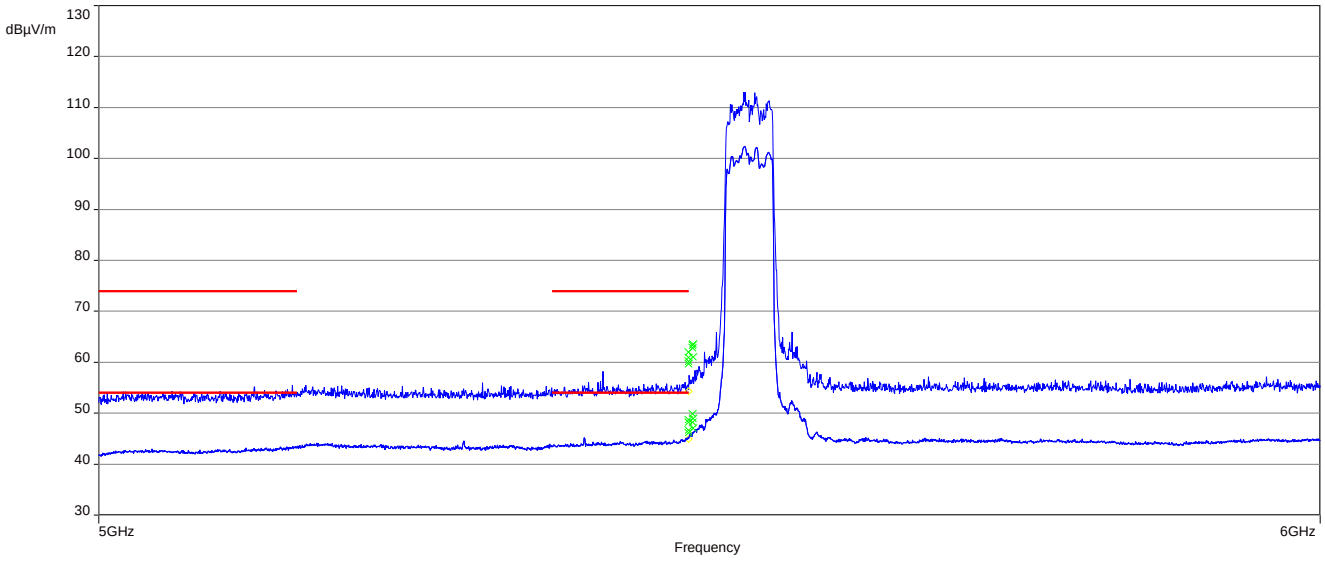
Plot 22: lower band edge; U-NII-1; lowest channel, 802.11ax HE40



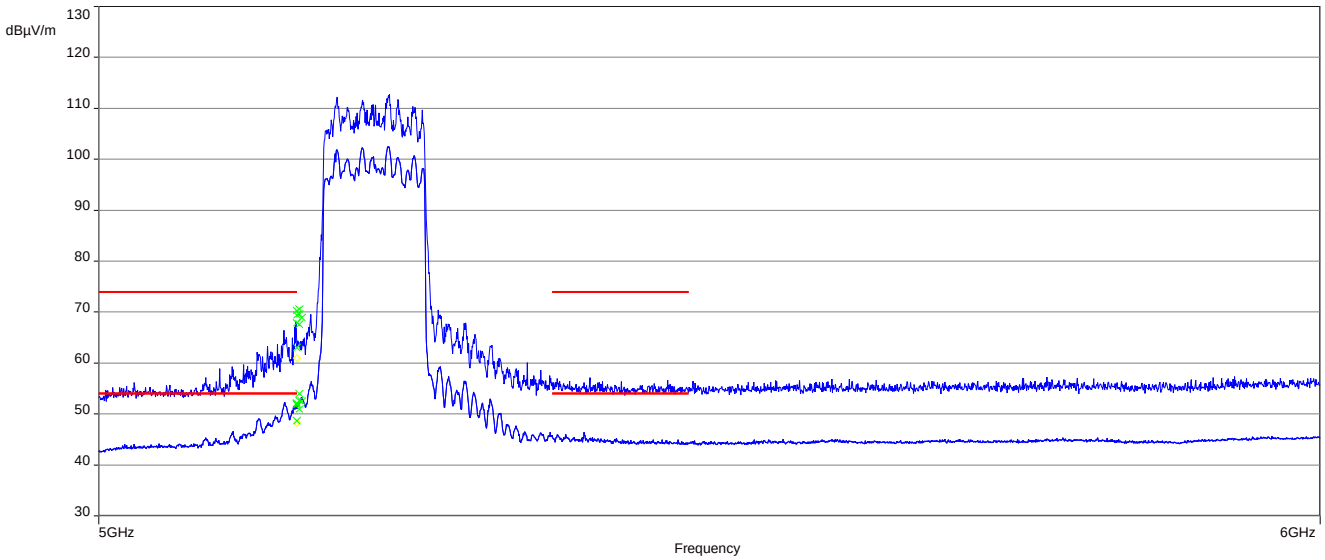
Plot 23: upper band edge; U-NII-2A; highest channel, 802.11ax HE40



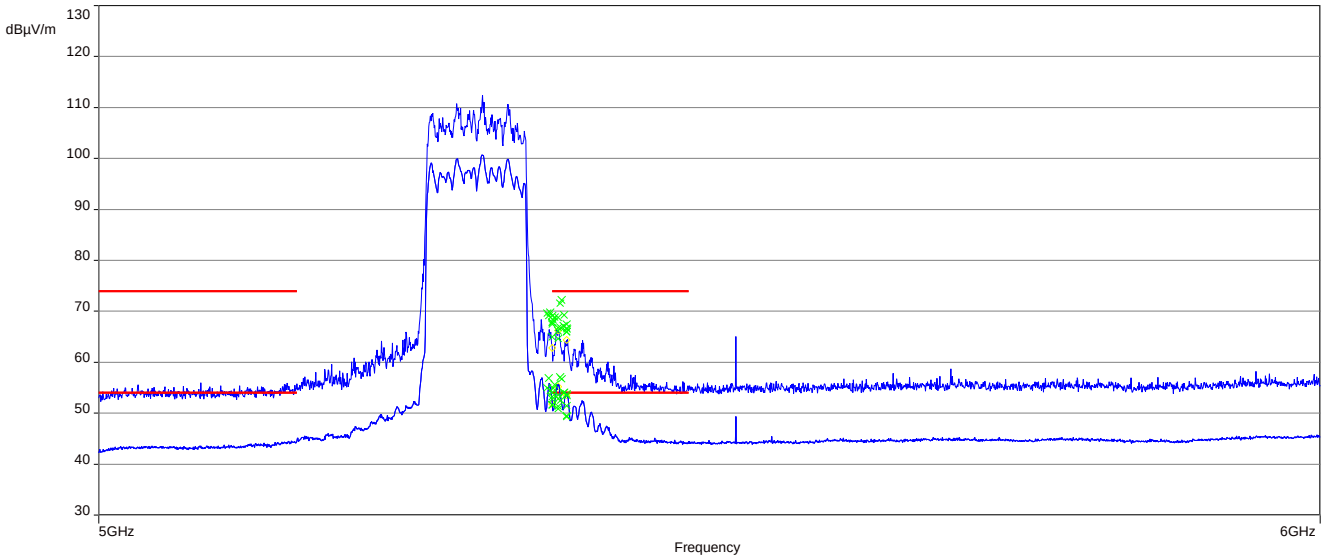
Plot 24: lower band edge; U-NII-2C; lowest channel, 802.11ax HE40



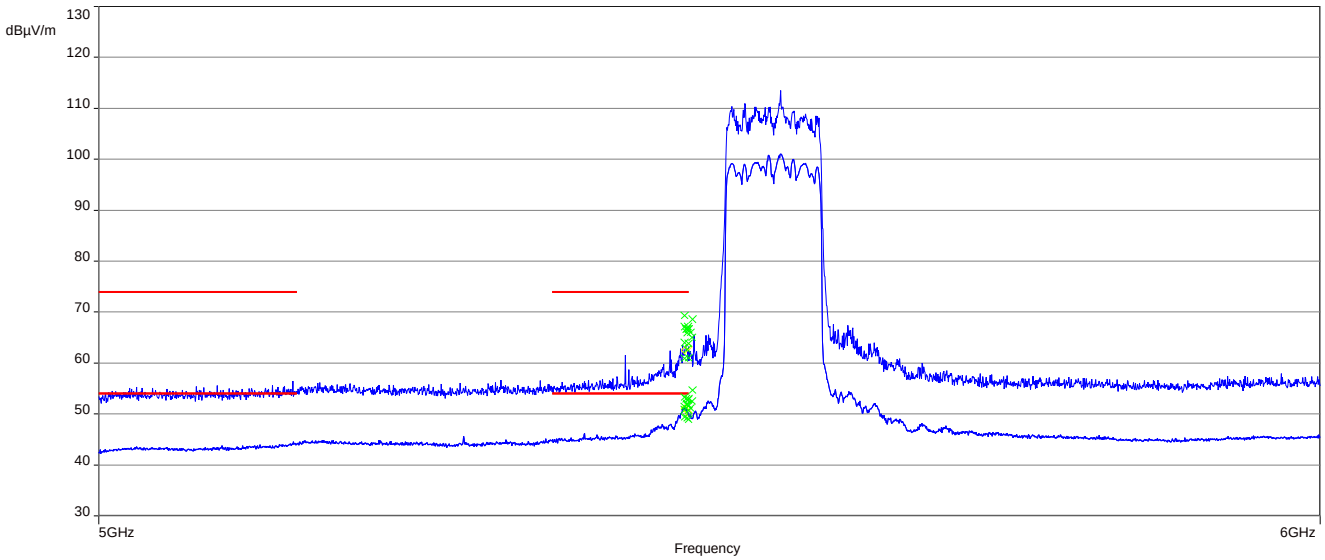
Plot 25: lower band edge; U-NII-1; lowest channel, 802.11ax HE80



Plot 26: upper band edge; U-NII-2A; highest channel, 802.11ax HE80



Plot 27: lower band edge; U-NII-2C; lowest channel, 802.11ax HE80



12.10 Spurious emissions radiated below 30 MHz

Description:

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The limits are re-calculated to a measurement distance of 3 m with 40 dB/decade according CFR Part 2.

Measurement:

Measurement parameter	
Detector:	Peak / Quasi Peak
Sweep time:	Auto
Video bandwidth:	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Resolution bandwidth:	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span:	9 kHz to 30 MHz
Trace mode:	Max Hold
Test setup:	See sub clause 7.2 – C
Measurement uncertainty:	See chapter 9

Limits:

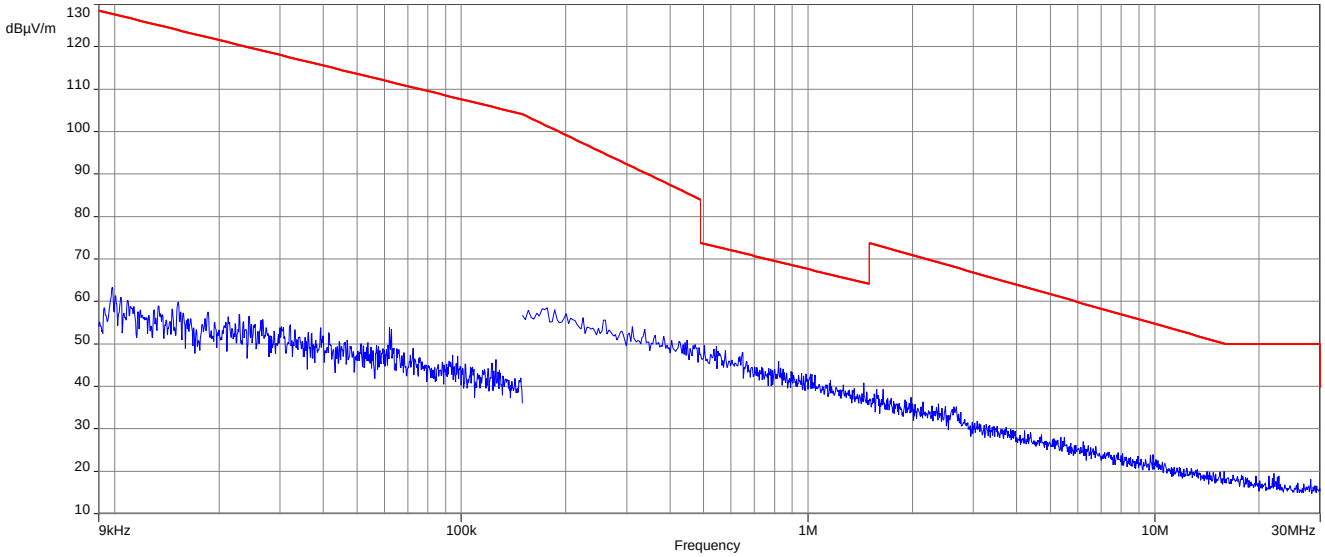
Spurious Emissions Radiated < 30 MHz		
Frequency (MHz)	Field Strength (dBµV/m)	Measurement distance
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30

Results:

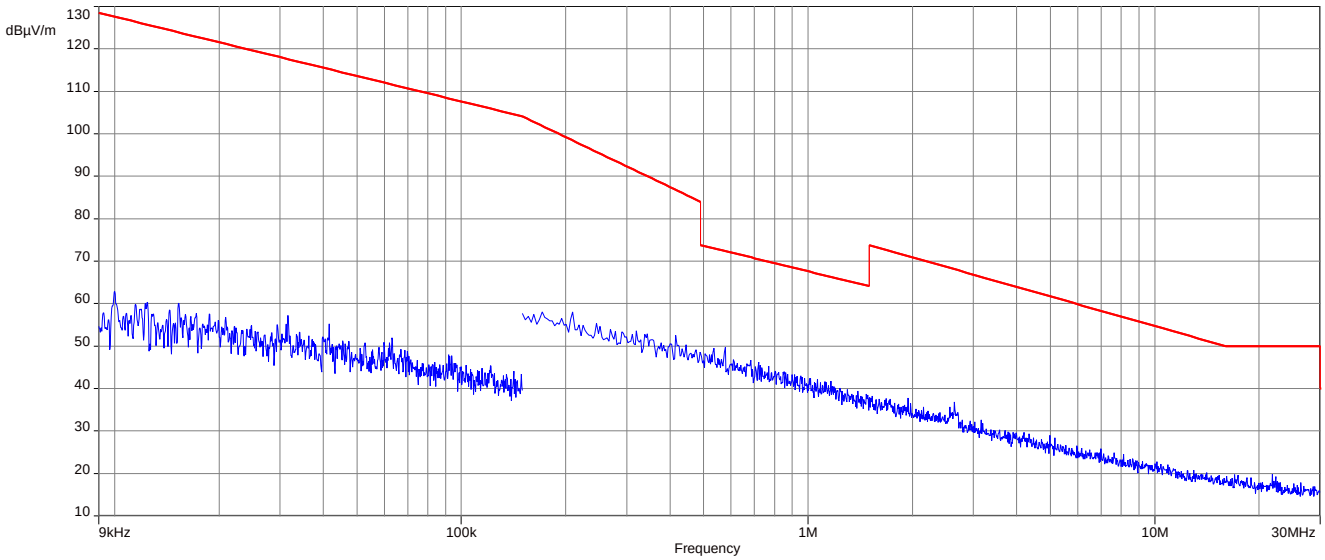
Spurious Emissions Radiated < 30 MHz [dBµV/m]		
F [MHz]	Detector	Level [dBµV/m]
All detected emissions are more than 20 dB below the limit.		

Plots: 20 MHz channel bandwidth

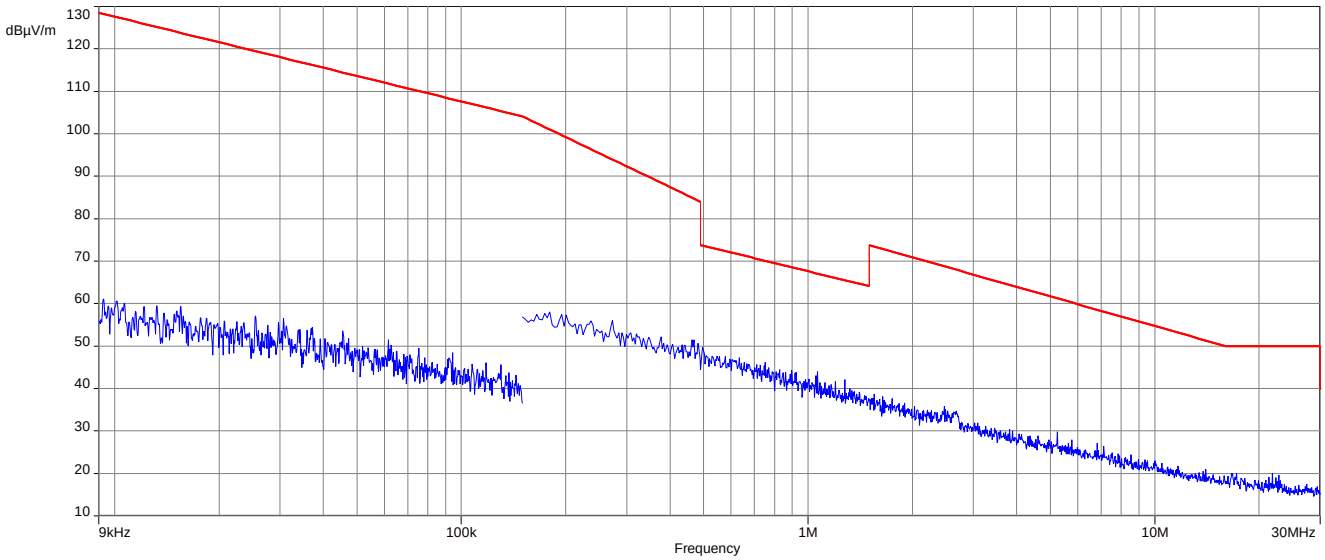
Plot 1: 9 kHz to 30 MHz, U-NII-1; lowest channel



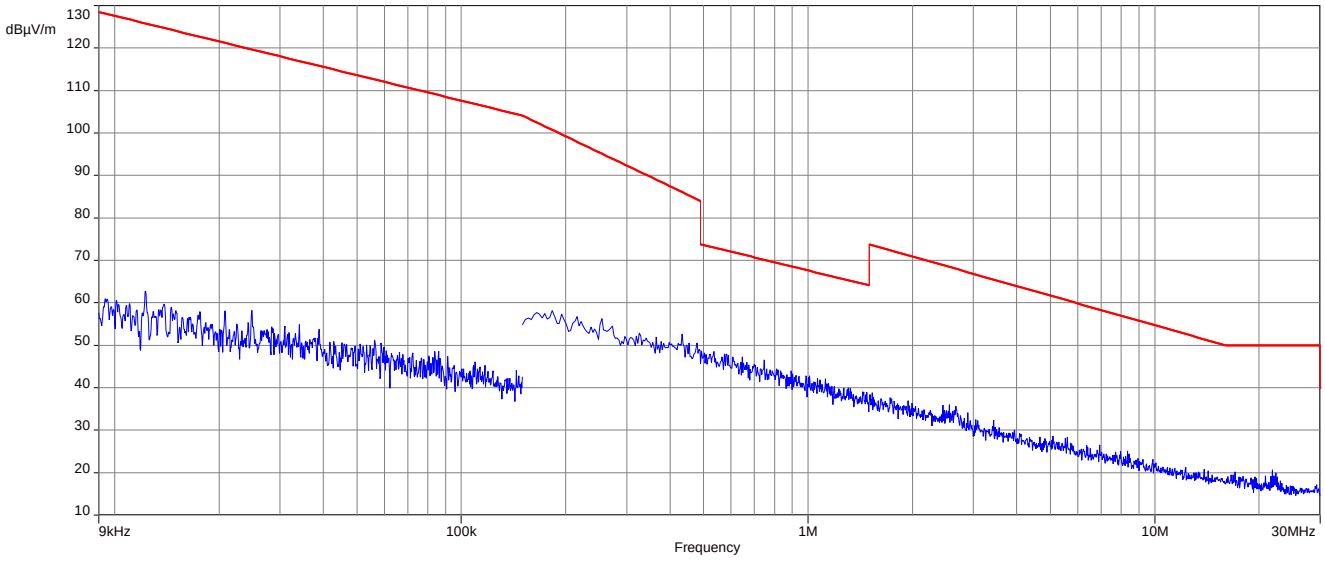
Plot 2: 9 kHz to 30 MHz, U-NII-1; middle channel



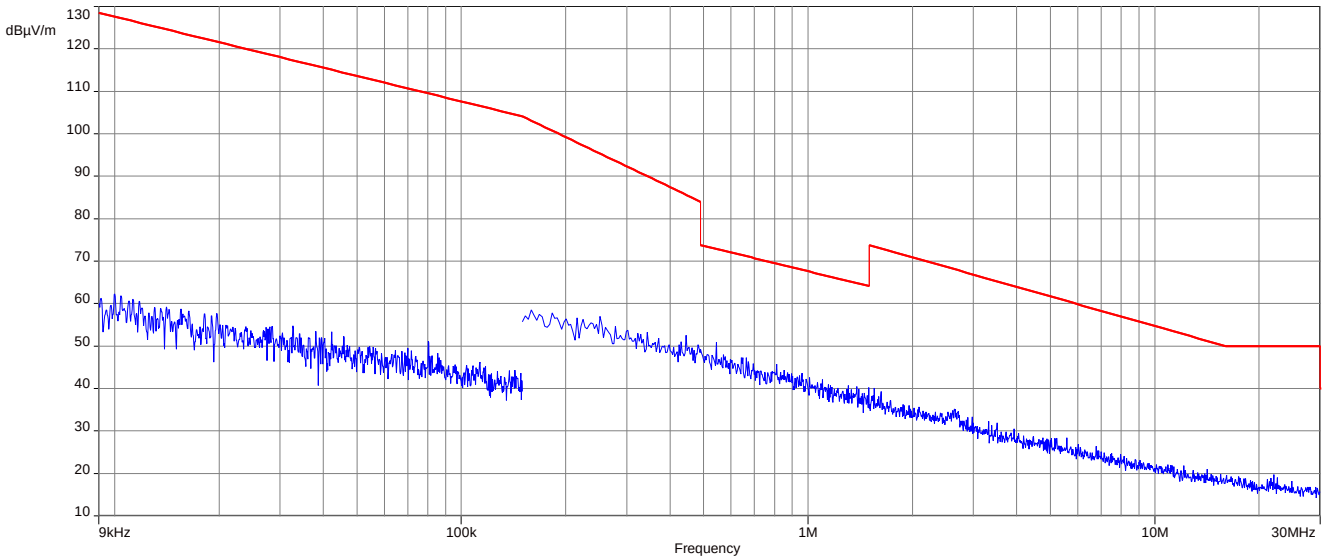
Plot 3: 9 kHz to 30 MHz, U-NII-1; highest channel



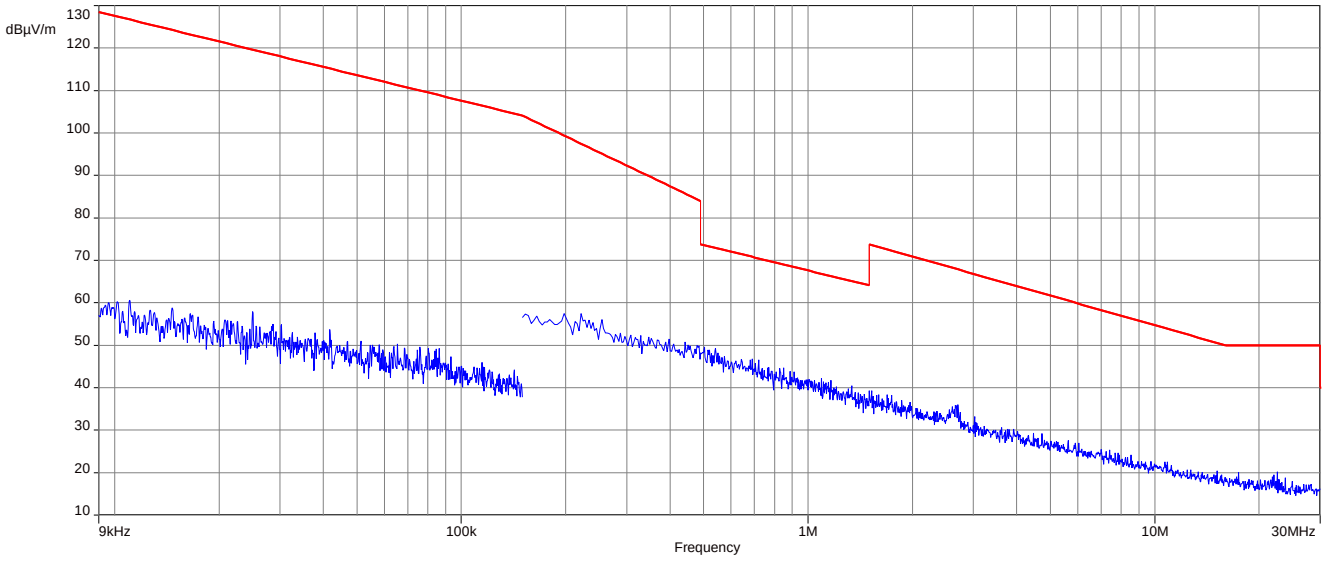
Plot 4: 9 kHz to 30 MHz, U-NII-2A; lowest channel



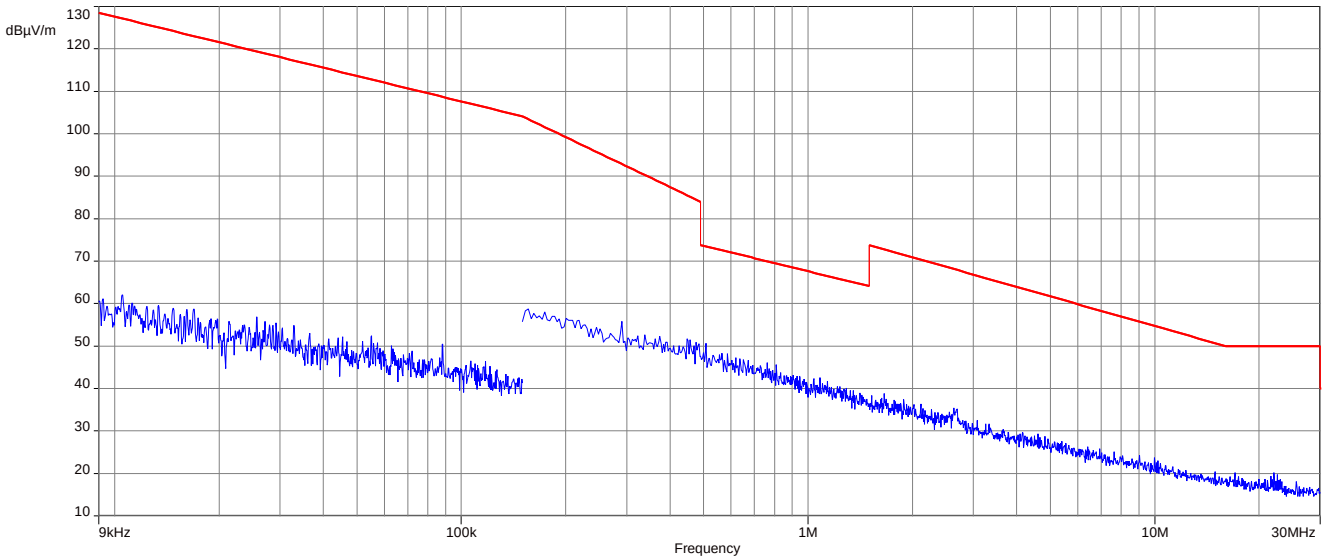
Plot 5: 9 kHz to 30 MHz, U-NII-2A; middle channel



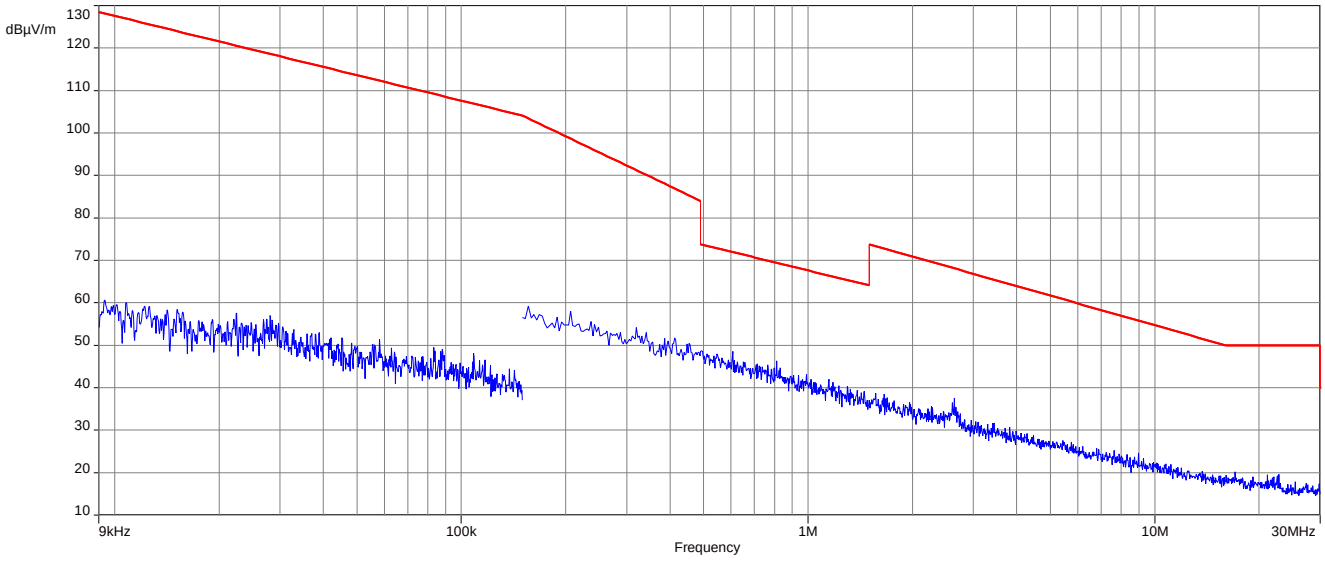
Plot 6: 9 kHz to 30 MHz, U-NII-2A; highest channel



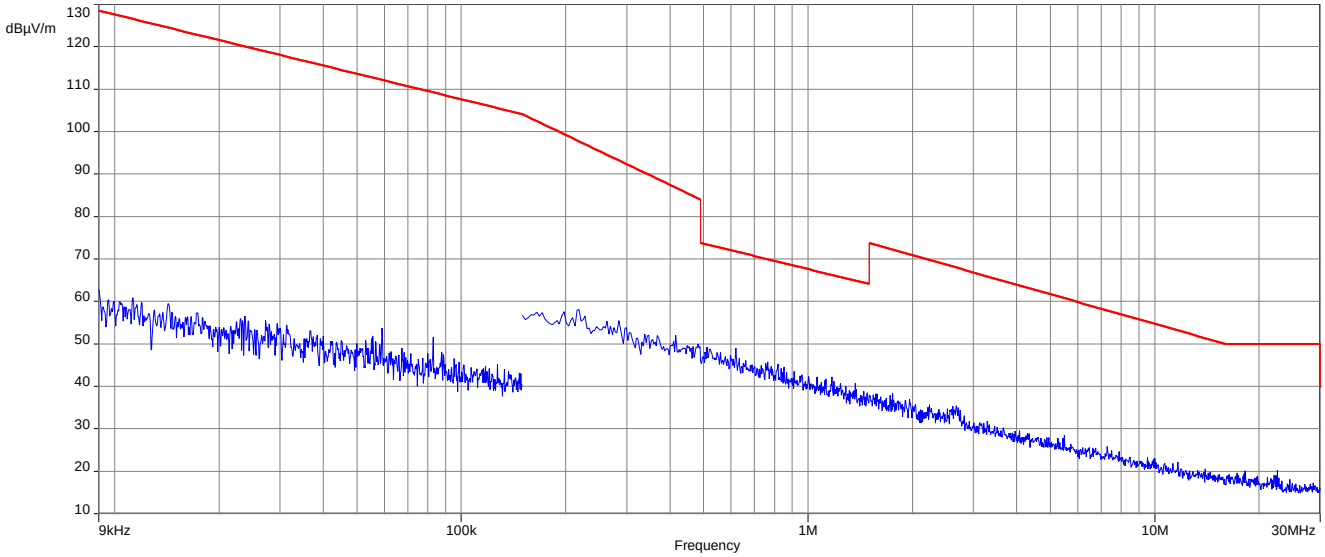
Plot 7: 9 kHz to 30 MHz, U-NII-2C; lowest channel



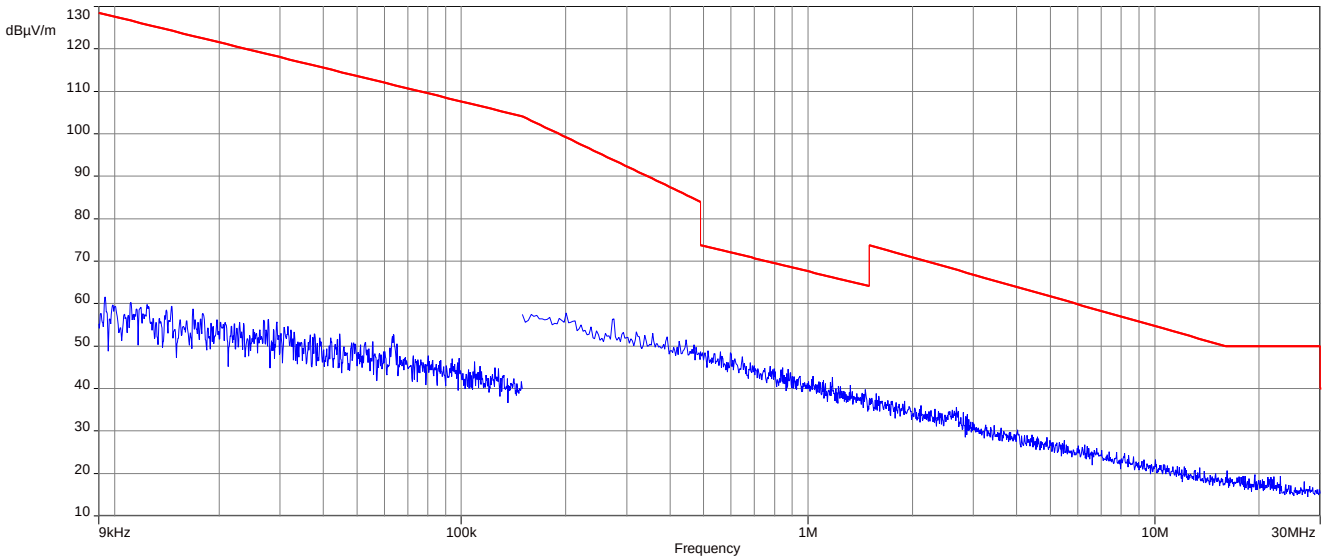
Plot 8: 9 kHz to 30 MHz, U-NII-2C; middle channel



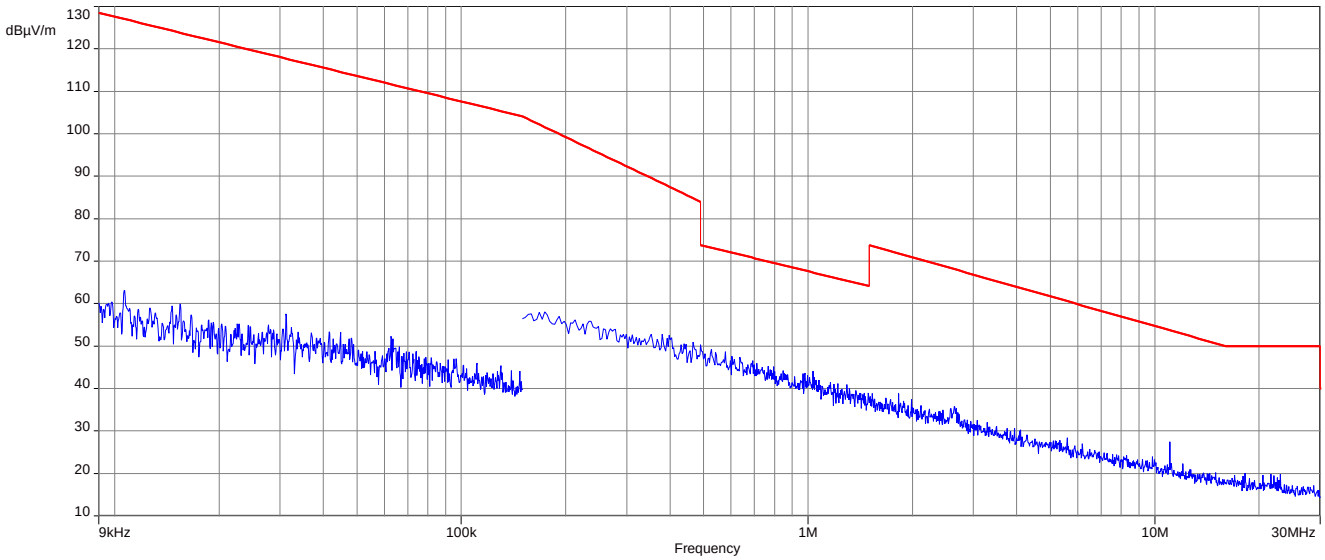
Plot 9: 9 kHz to 30 MHz, U-NII-2C; highest channel



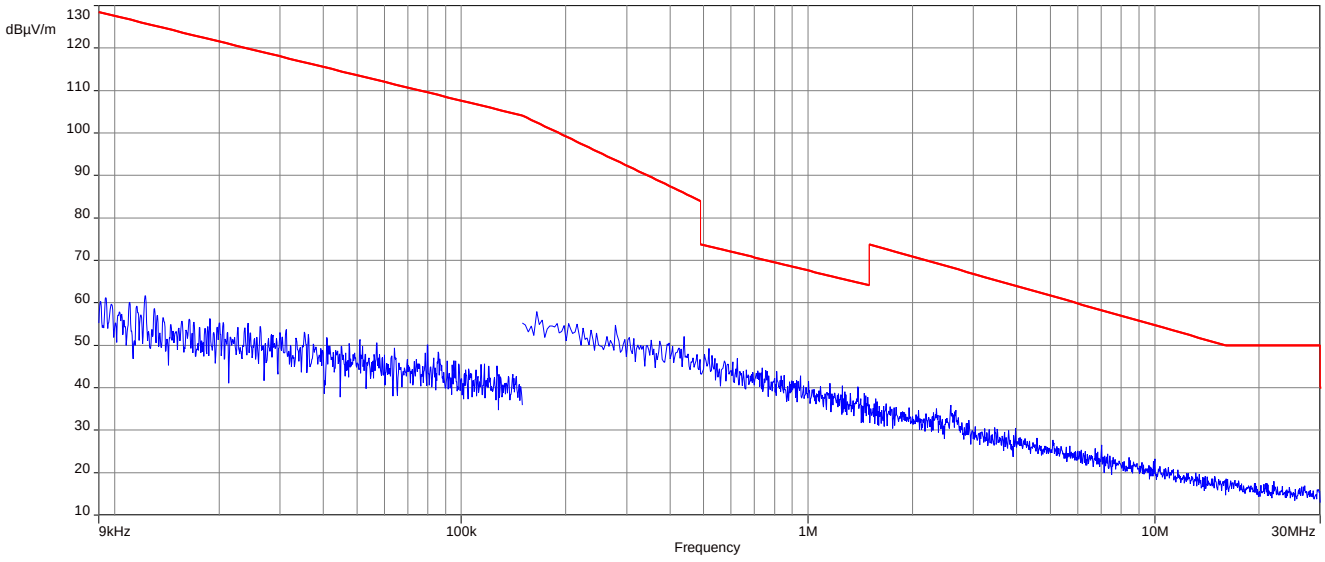
Plot 10: 9 kHz to 30 MHz, U-NII-3; lowest channel



Plot 11: 9 kHz to 30 MHz, U-NII-3; middle channel

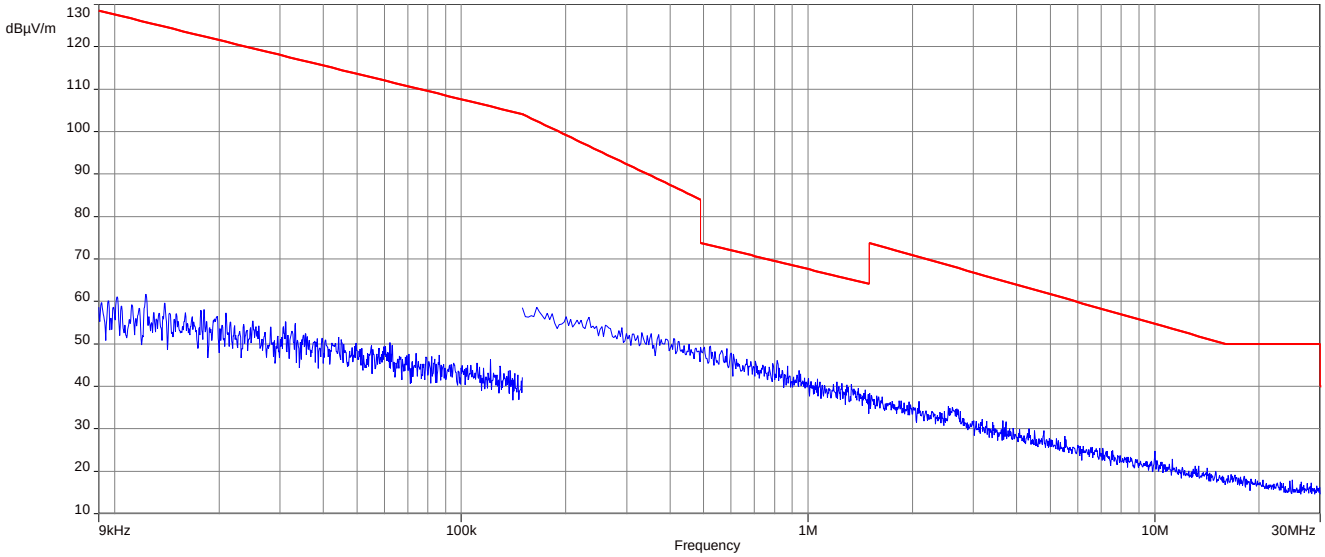


Plot 12: 9 kHz to 30 MHz, U-NII-3; highest channel

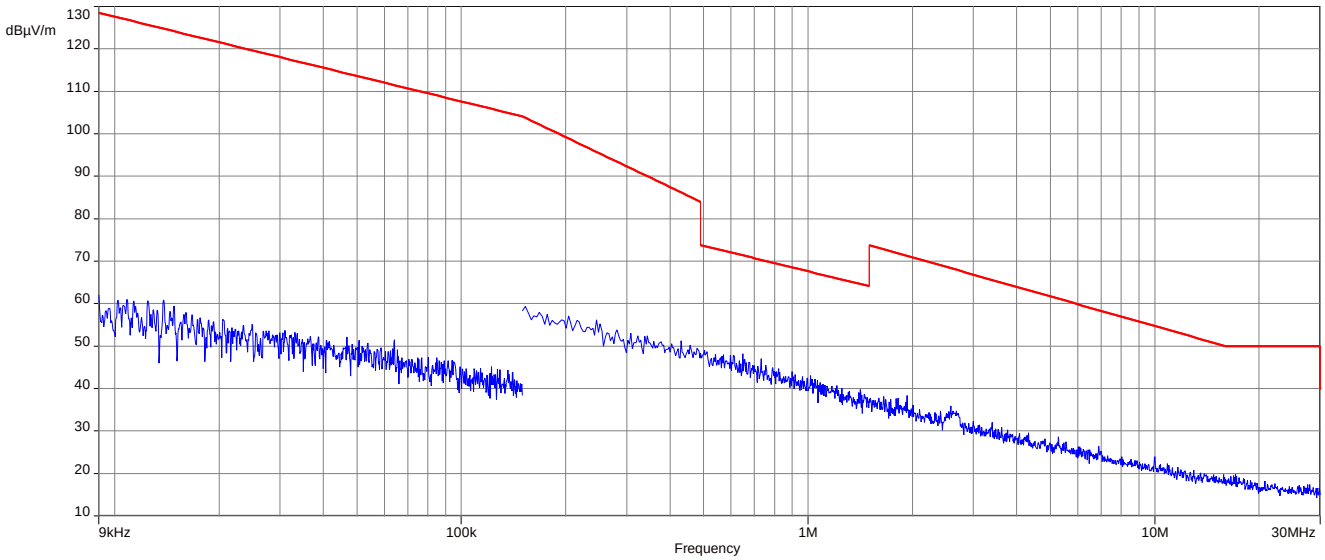


Plots: 40 MHz channel bandwidth

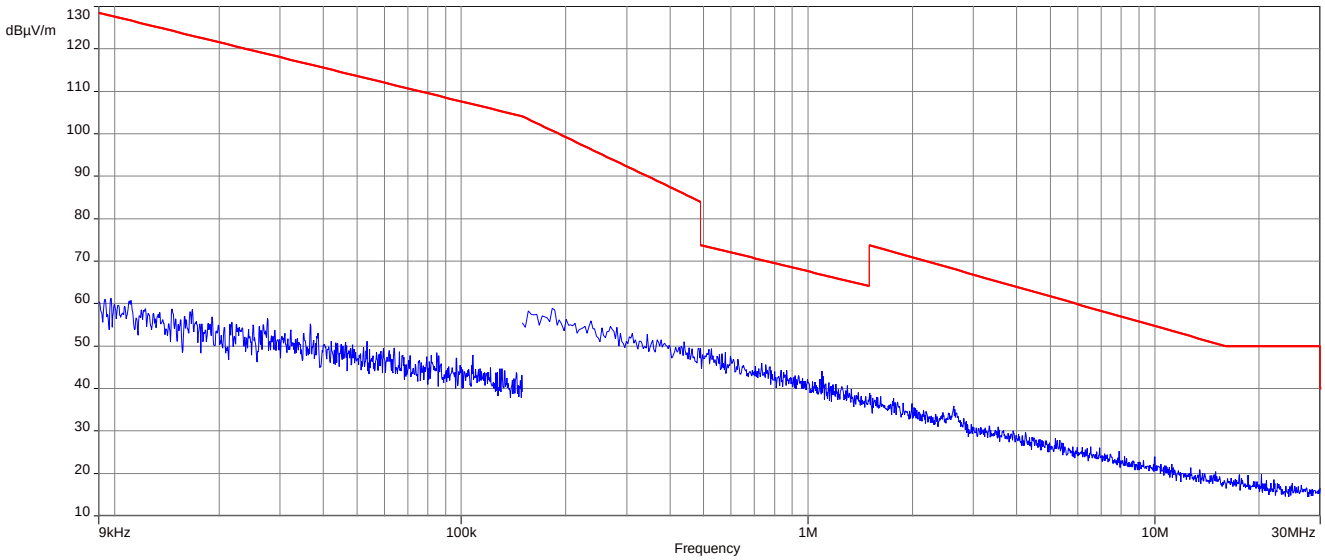
Plot 1: 9 kHz to 30 MHz, U-NII-1; lowest channel



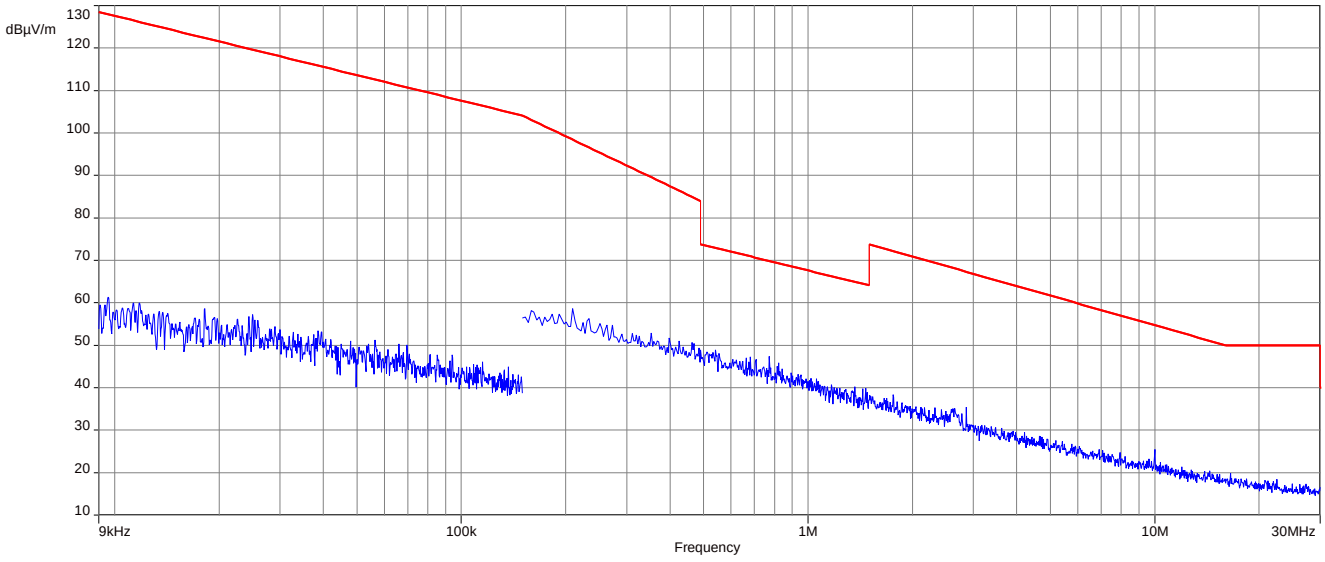
Plot 2: 9 kHz to 30 MHz, U-NII-1; highest channel



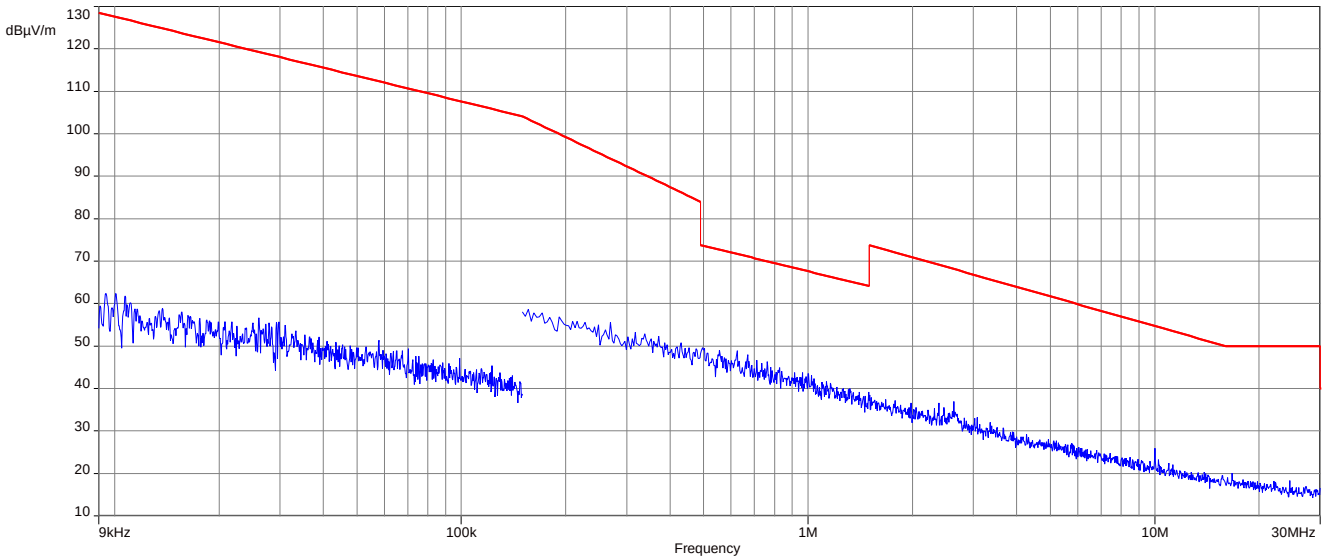
Plot 3: 9 kHz to 30 MHz, U-NII-2A; lowest channel



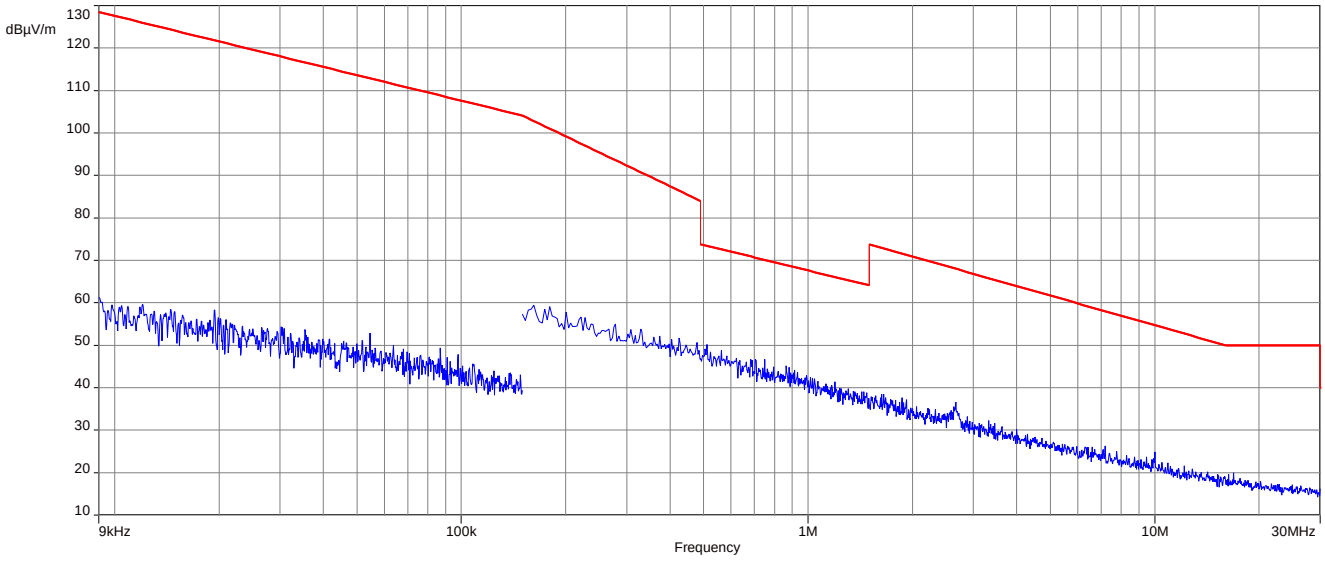
Plot 4: 9 kHz to 30 MHz, U-NII-2A; highest channel



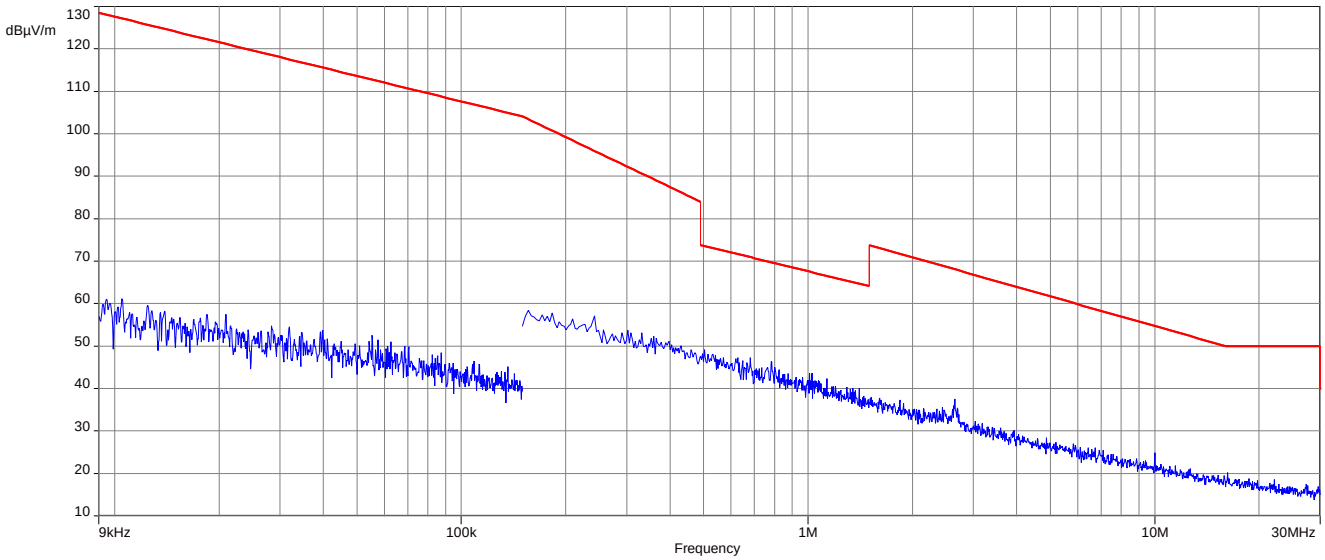
Plot 5: 9 kHz to 30 MHz, U-NII-2C; lowest channel



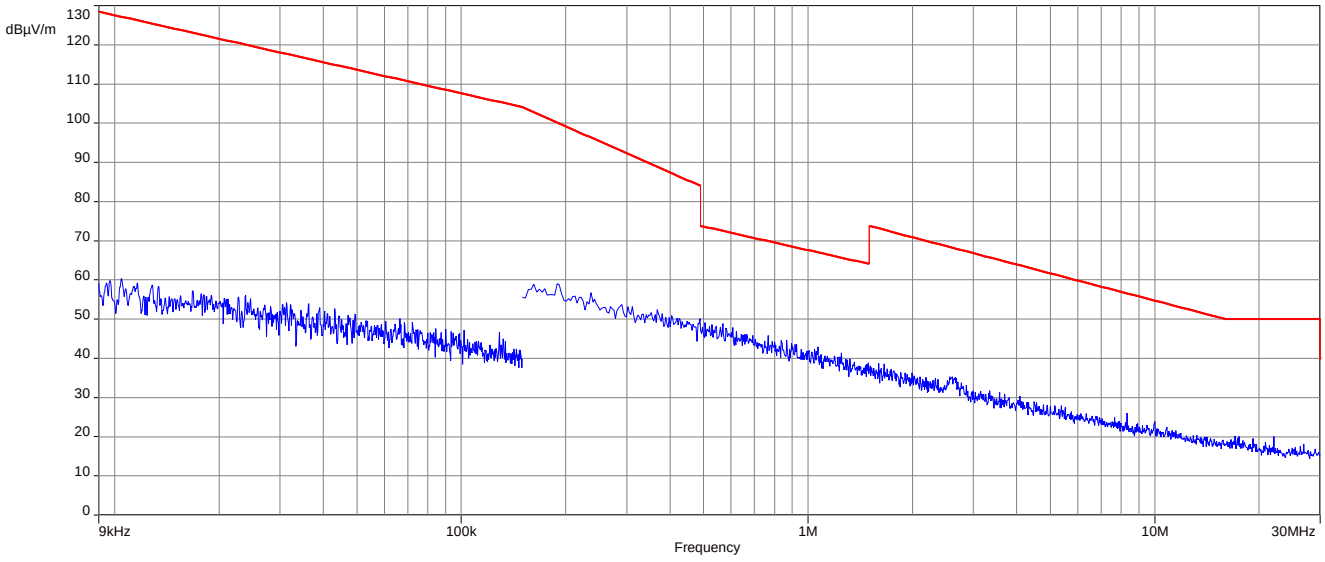
Plot 6: 9 kHz to 30 MHz, U-NII-2C; middle channel



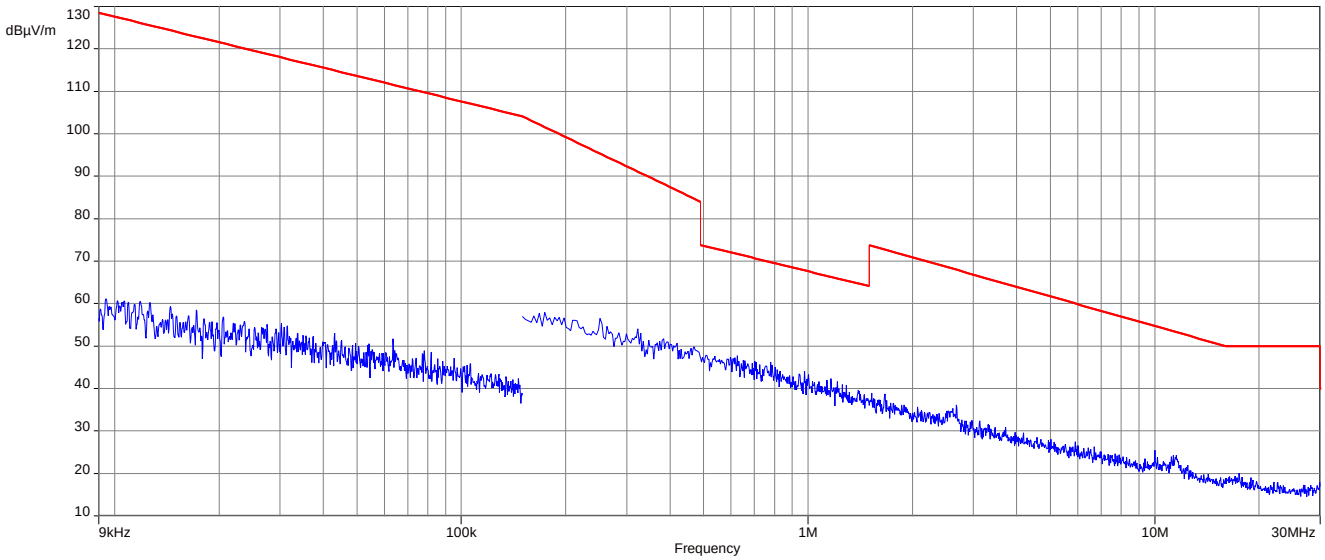
Plot 7: 9 kHz to 30 MHz, U-NII-2C; highest channel



Plot 8: 9 kHz to 30 MHz, U-NII-3; lowest channel

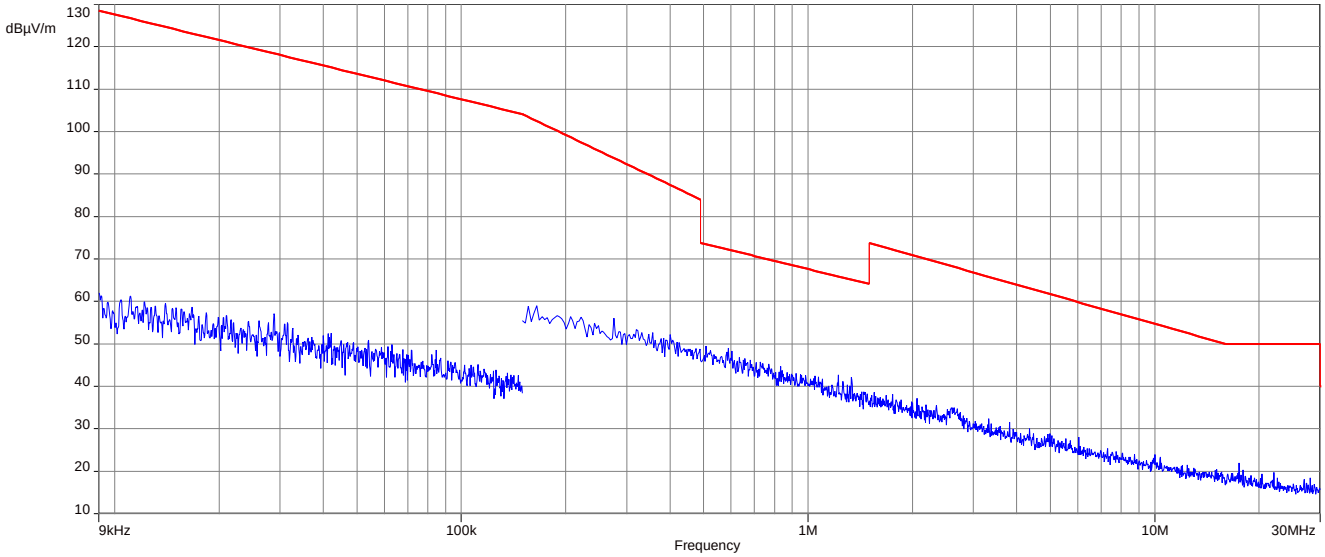


Plot 9: 9 kHz to 30 MHz, U-NII-3; highest channel

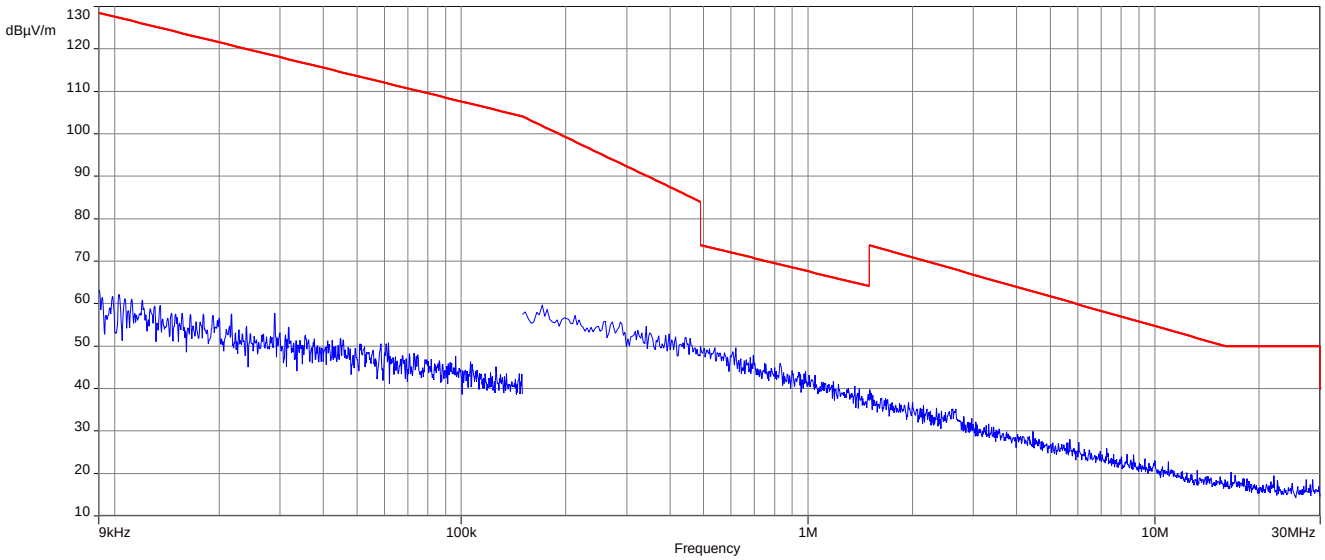


Plots: 80 MHz channel bandwidth

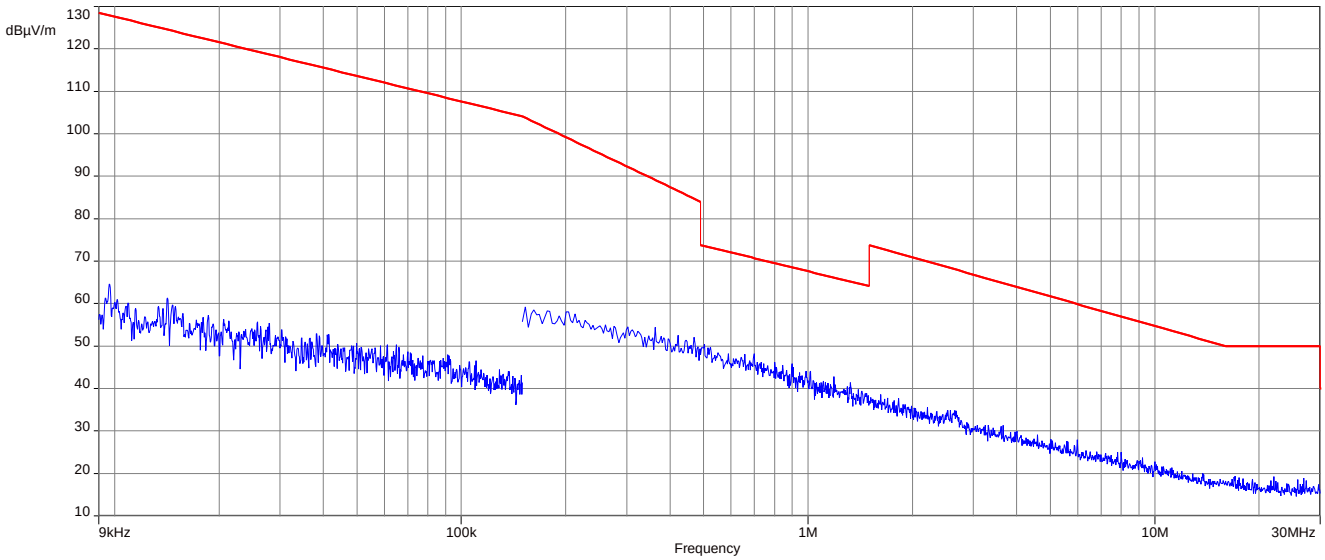
Plot 1: 9 kHz to 30 MHz, U-NII-1; middle channel



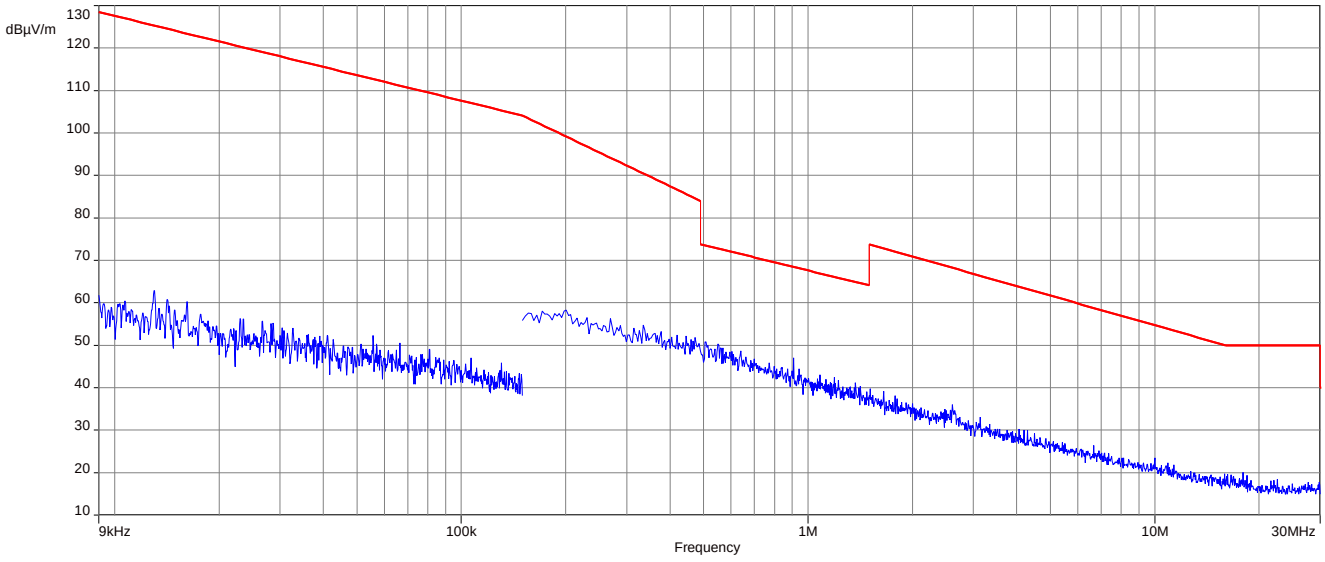
Plot 2: 9 kHz to 30 MHz, U-NII-2A; middle channel



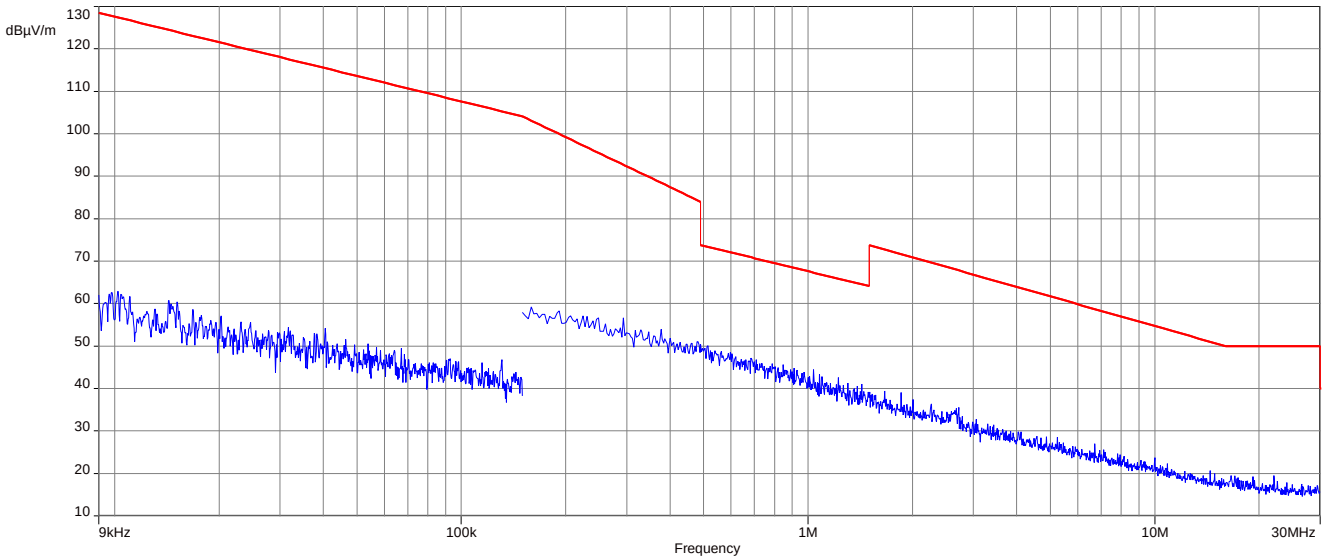
Plot 3: 9 kHz to 30 MHz, U-NII-2C; lowest channel



Plot 4: 9 kHz to 30 MHz, U-NII-2C; highest channel



Plot 5: 9 kHz to 30 MHz, U-NII-3; middle channel



12.11 Spurious emissions radiated 30 MHz to 1 GHz

Description:

Measurement of the radiated spurious emissions and cabinet radiations below 1 GHz.

Measurement:

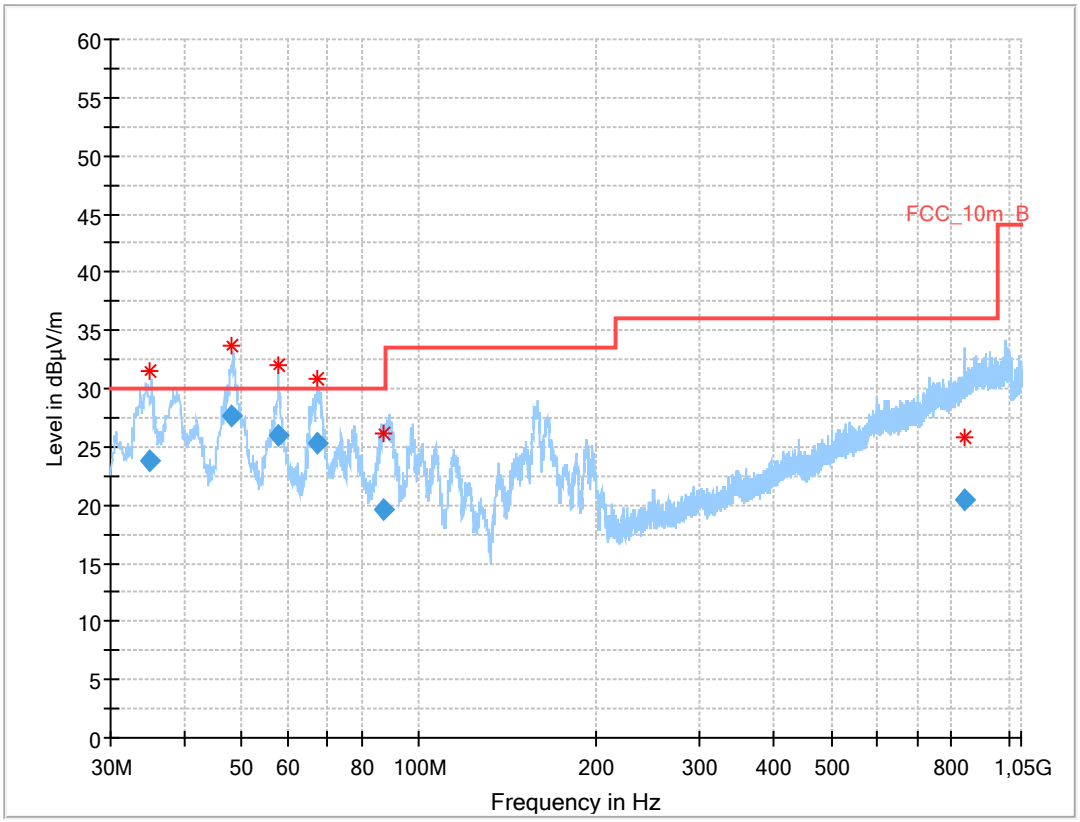
Measurement parameter	
Detector:	Quasi Peak
Sweep time:	Auto
Resolution bandwidth:	120 kHz
Video bandwidth:	500 kHz
Span:	30 MHz to 1 GHz
Test setup:	See sub clause 7.1 – A
Measurement uncertainty:	See chapter 9

Limits:

TX Spurious Emissions Radiated		
§15.209 / RSS-247		
Frequency (MHz)	Field Strength (dBµV/m)	Measurement distance
30 - 88	30.0	10
88 – 216	33.5	10
216 – 960	36.0	10
Above 960	54.0	3
§15.407		
Outside the restricted bands!	-27 dBm / MHz	

Plots:

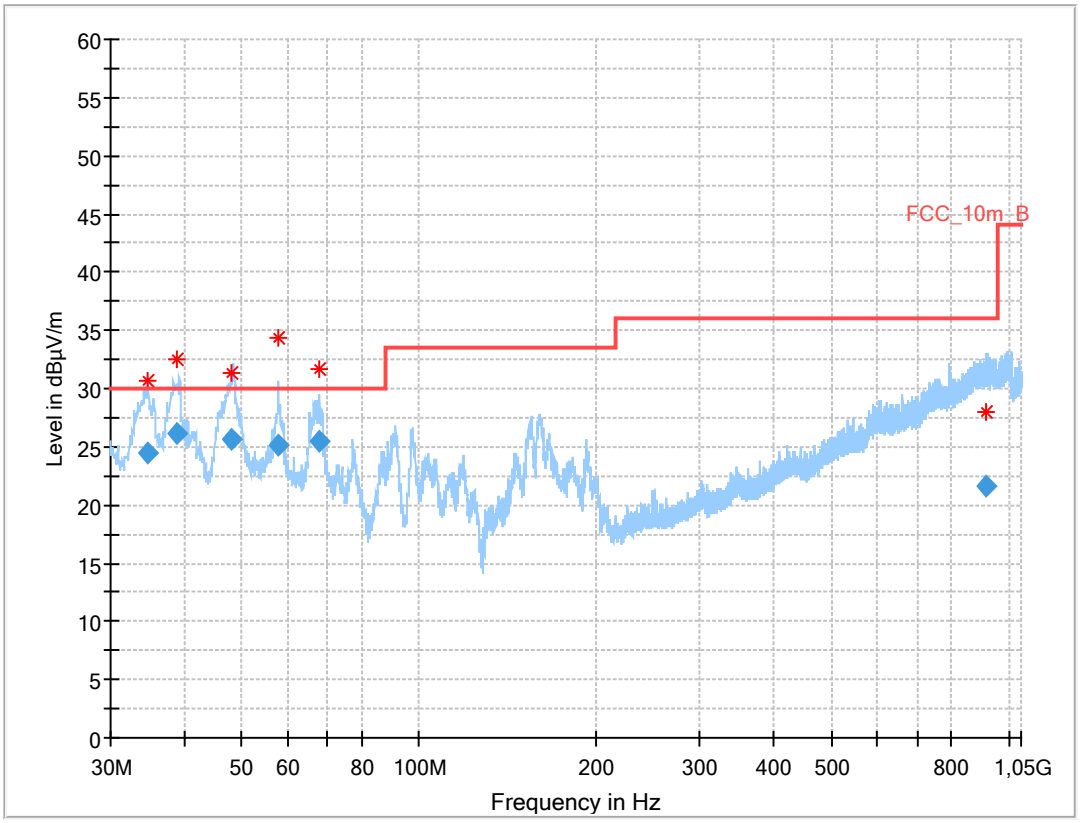
Plot 1: 30 MHz to 1 GHz; vertical & horizontal polarization; valid for all channels of all 20 MHz modes



Results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
34.818	23.75	30.0	6.3	1000	120.0	169.0	V	347	14
48.262	27.61	30.0	2.4	1000	120.0	103.0	V	341	16
57.777	25.96	30.0	4.0	1000	120.0	224.0	V	313	15
67.210	25.24	30.0	4.8	1000	120.0	220.0	V	250	11
86.999	19.55	30.0	10.5	1000	120.0	335.0	V	16	11
840.345	20.43	36.0	15.6	1000	120.0	200.0	H	331	24

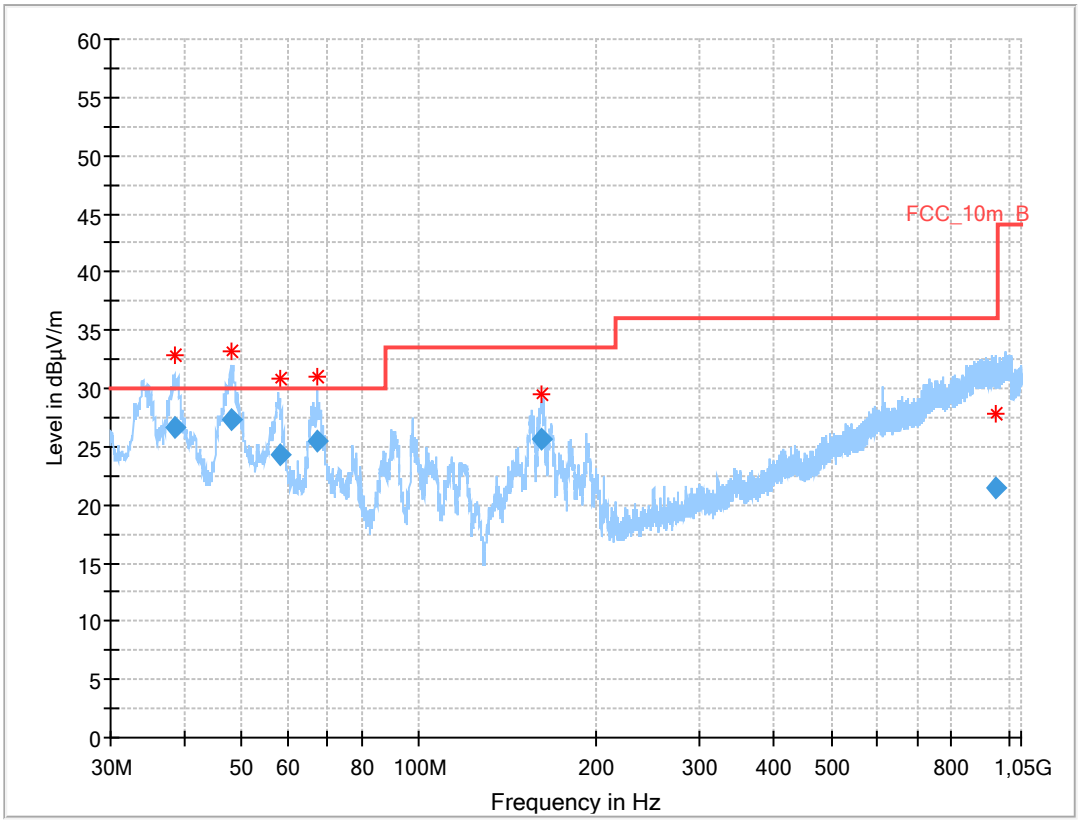
Plot 2: 30 MHz to 1 GHz; vertical & horizontal polarization; valid for all channels of all 40 MHz modes



Results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
34.635	24.46	30.0	5.5	1000	120.0	200.0	V	2	14
38.777	26.08	30.0	3.9	1000	120.0	200.0	V	259	15
47.960	25.70	30.0	4.3	1000	120.0	103.0	V	143	16
57.760	25.10	30.0	4.9	1000	120.0	323.0	V	315	15
67.758	25.47	30.0	4.5	1000	120.0	242.0	V	309	10
916.688	21.56	36.0	14.4	1000	120.0	200.0	H	45	26

Plot 3: 30 MHz to 1 GHz; vertical & horizontal polarization; valid for all channels of all 80 MHz modes



Results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
38.628	26.63	30.0	3.4	1000	120.0	170.0	V	162	15
48.150	27.39	30.0	2.6	1000	120.0	103.0	V	315	16
58.138	24.35	30.0	5.7	1000	120.0	304.0	V	340	15
67.295	25.50	30.0	4.5	1000	120.0	225.0	V	295	11
161.636	25.59	33.5	7.9	1000	120.0	110.0	V	305	10
948.355	21.47	36.0	14.5	1000	120.0	136.0	V	180	25

12.12 Spurious emissions radiated 1 GHz to 40 GHz

Description:

Measurement of the radiated spurious emissions and cabinet radiations from 1 GHz to 40 GHz.

Measurement:

Measurement parameter	
Detector:	Peak/AVG
Sweep time:	Auto
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Span:	1 GHz to 40 GHz
Trace mode:	Max Hold / Average with 100 counts + 20 log (1 / X) for duty cycle lower than 100 %
Test setup:	See sub clause 7.2 – A See sub clause 7.3 – A
Measurement uncertainty:	See chapter 9

Limits:

TX Spurious Emissions Radiated		
§15.209		
Frequency (MHz)	Field Strength (dBµV/m)	Measurement distance
Above 960	54.0 (AVG) 74 (Peak)	3
§15.407		
Outside the restricted bands!	-27 dBm / MHz	

NOTE: For emissions between 5 and 6 GHz please see the results in Chapter 12.9.

Results: 20 MHz channel bandwidth

TX Spurious Emissions Radiated [dBµV/m] / dBm								
U-NII-1 (5150 MHz to 5250 MHz)								
Lowest channel			Middle channel			Highest channel		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
1079	Peak	46.9	1079	Peak	46.9	15726	Peak	60.0
	AVG	28.6		AVG	28.6		AVG	44.0
15533	Peak	57.8	15589	Peak	58.8	-/-	Peak	-/-
	AVG	41.2		AVG	42.7		AVG	-/-

TX Spurious Emissions Radiated [dBµV/m] / dBm								
U-NII-2A (5250 MHz to 5350 MHz)								
Lowest channel			Middle channel			Highest channel		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
-/-	Peak	-/-	-/-	Peak	-/-	-/-	Peak	-/-
	AVG	-/-		AVG	-/-		AVG	-/-
-/-	Peak	-/-	-/-	Peak	-/-	-/-	Peak	-/-
	AVG	-/-		AVG	-/-		AVG	-/-

TX Spurious Emissions Radiated [dBµV/m] / dBm								
U-NII-2C (5470 MHz to 5725 MHz)								
Lowest channel			Middle channel			Highest channel		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
-/-	Peak	-/-	7466	Peak	49.4	7600	Peak	46.3
	AVG	-/-		AVG	44.5		AVG	39.4
-/-	Peak	-/-	11200	Peak	53.5	11400	Peak	51.2
	AVG	-/-		AVG	47.9		AVG	41.1

TX Spurious Emissions Radiated [dBµV/m] / dBm								
U-NII-3 (5725 MHz to 5850 MHz)								
Lowest channel			Middle channel			Highest channel		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
11490	Peak	54.1	11573	Peak	56.8	11653	Peak	55.3
	AVG	43.5		AVG	45.1		AVG	46.2
17242	Peak	64.1	17348	Peak	62.6	17467	Peak	57.2
	AVG	50.6		AVG	49.2		AVG	41.6

Results: 40 MHz channel bandwidth

TX Spurious Emissions Radiated [dBµV/m] / dBm								
U-NII-1 (5150 MHz to 5250 MHz)								
Lowest channel			Middle channel			Highest channel		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
15578	Peak	51.8		Peak		15682	Peak	56.2
	AVG	38.5		AVG			AVG	42.6
-/-	Peak	-/-		Peak		-/-	Peak	-/-
	AVG	-/-		AVG			AVG	-/-

TX Spurious Emissions Radiated [dBµV/m] / dBm								
U-NII-2A (5250 MHz to 5350 MHz)								
Lowest channel			Middle channel			Highest channel		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
-/-	Peak	-/-		Peak		-/-	Peak	-/-
	AVG	-/-		AVG			AVG	-/-
-/-	Peak	-/-		Peak		-/-	Peak	-/-
	AVG	-/-		AVG			AVG	-/-

TX Spurious Emissions Radiated [dBµV/m] / dBm								
U-NII-2C (5470 MHz to 5725 MHz)								
Lowest channel			Middle channel			Highest channel		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
7347	Peak	46.1	7453	Peak	47.9	7560	Peak	47.0
	AVG	37.1		AVG	42.4		AVG	40.4
11022	Peak	50.5	11180	Peak	51.7	11340	Peak	51.9
	AVG	38.6		AVG	42.9		AVG	44.9

TX Spurious Emissions Radiated [dBµV/m] / dBm								
U-NII-3 (5725 MHz to 5850 MHz)								
Lowest channel			Middle channel			Highest channel		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
11510	Peak	54.3		Peak		11590	Peak	54.3
	AVG	44.3		AVG			AVG	44.6
17259	Peak	58.4		Peak		17376	Peak	59.7
	AVG	46.1		AVG			AVG	46.8

Results: 80 MHz channel bandwidth

TX Spurious Emissions Radiated [dBµV/m] / dBm		
U-NII-1 (5150 MHz to 5250 MHz)		
Middle channel		
F [MHz]	Detector	Level [dBµV/m]
-/-	Peak	-/-
	AVG	-/-
-/-	Peak	-/-
	AVG	-/-

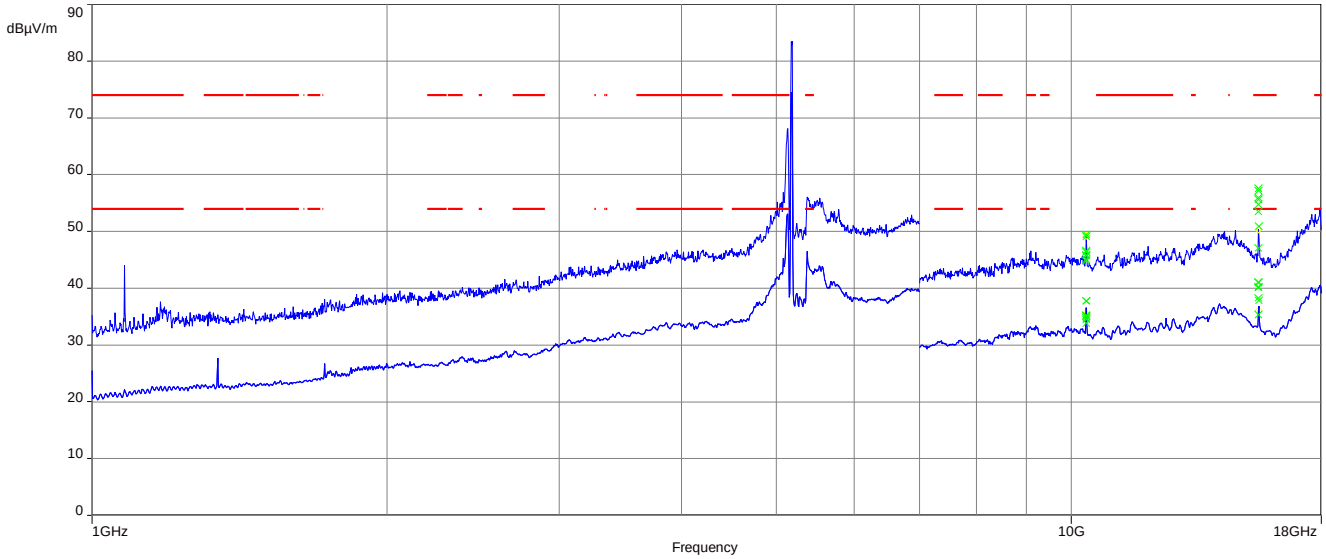
TX Spurious Emissions Radiated [dBµV/m] / dBm		
U-NII-2A (5250 MHz to 5350 MHz)		
Middle channel		
F [MHz]	Detector	Level [dBµV/m]
-/-	Peak	-/-
	AVG	-/-
-/-	Peak	-/-
	AVG	-/-

TX Spurious Emissions Radiated [dBµV/m] / dBm					
U-NII-2C (5470 MHz to 5725 MHz)					
Lowest channel			Highest channel		
7373	Peak	47.5	7480	Peak	50.1
	AVG	41.1		AVG	46.1
11060	Peak	49.9	11220	Peak	53.7
	AVG	41.8		AVG	50.0

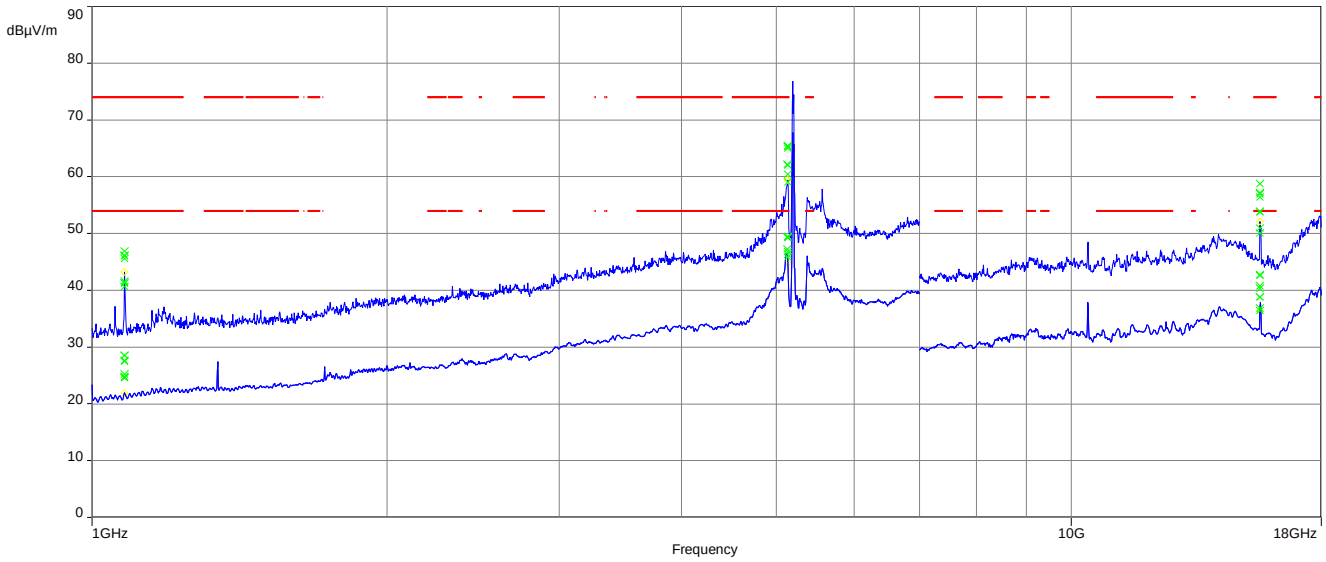
TX Spurious Emissions Radiated [dBµV/m] / dBm		
U-NII-3 (5725 MHz to 5850 MHz)		
Middle channel		
F [MHz]	Detector	Level [dBµV/m]
11550	Peak	55.8
	AVG	48.1
17327	Peak	57.0
	AVG	44.4

Plots: 20 MHz channel bandwidth

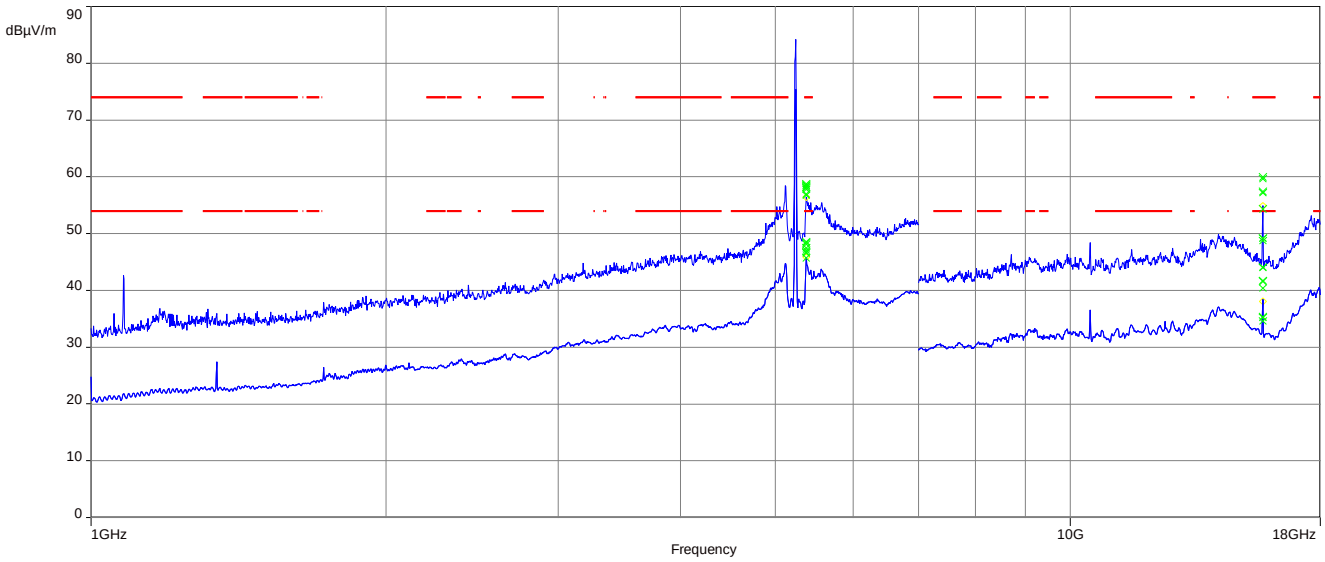
Plot 1: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-1; lowest channel



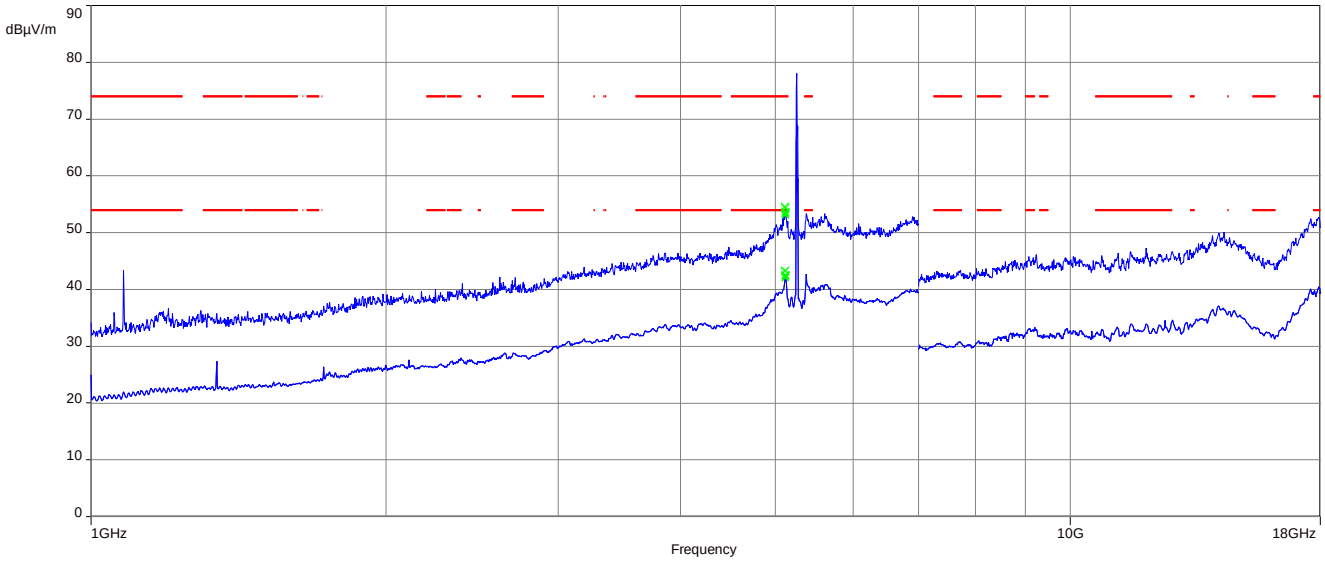
Plot 2: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-1; middle channel



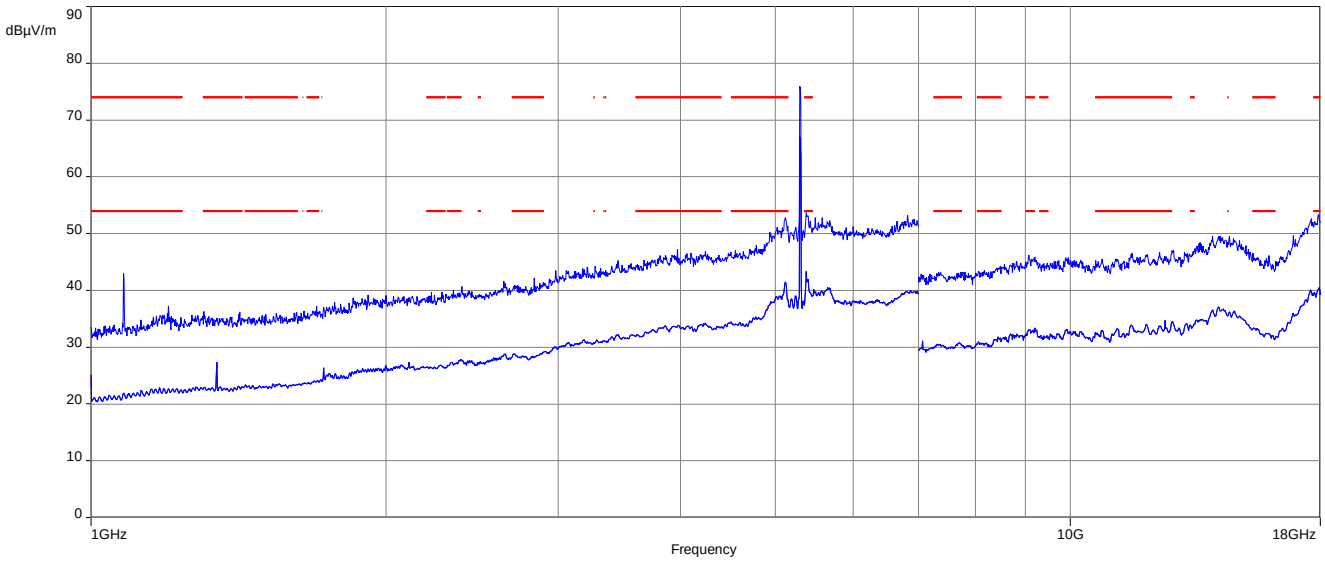
Plot 3: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-1; highest channel



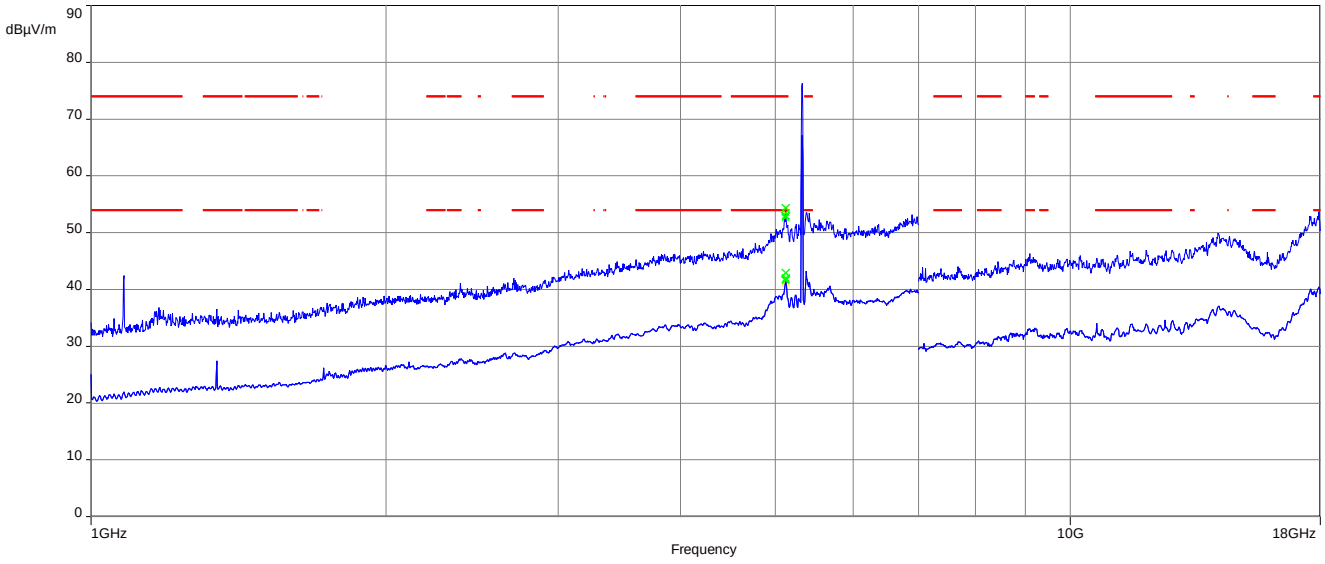
Plot 4: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2A; lowest channel



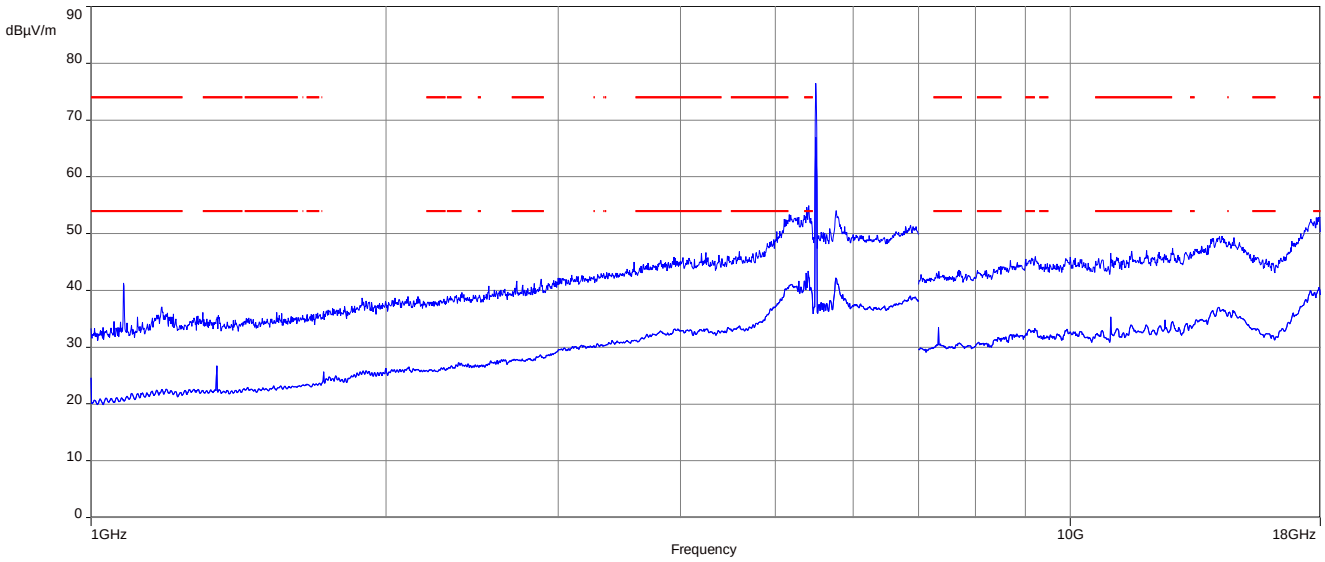
Plot 5: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2A; middle channel



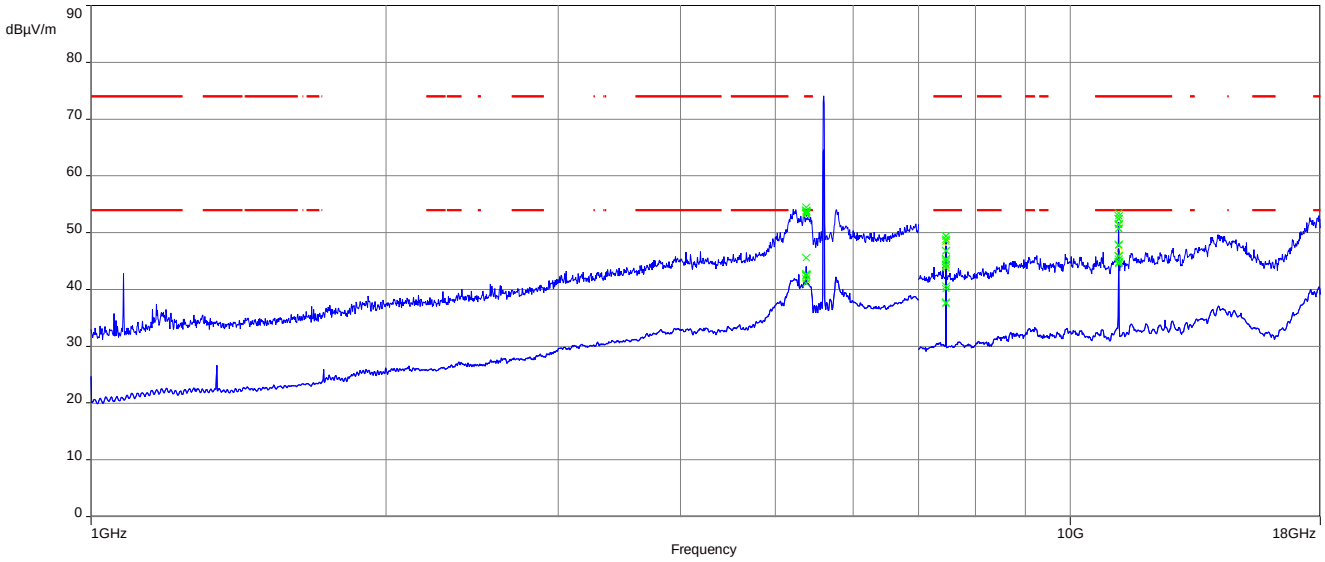
Plot 6: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2A; highest channel



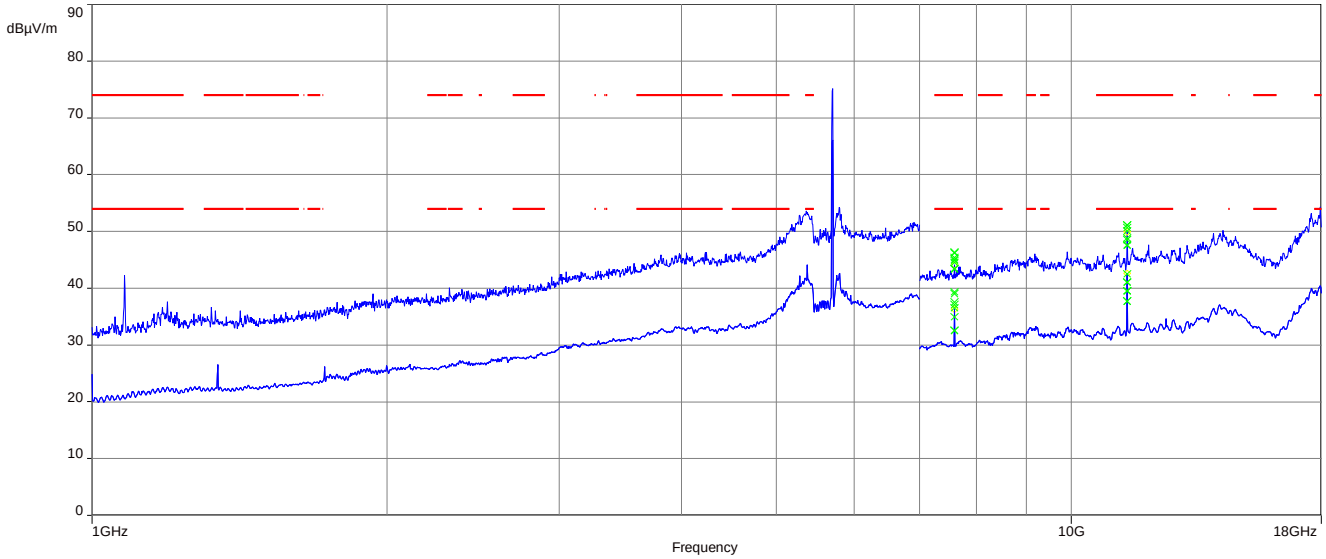
Plot 7: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2C; lowest channel



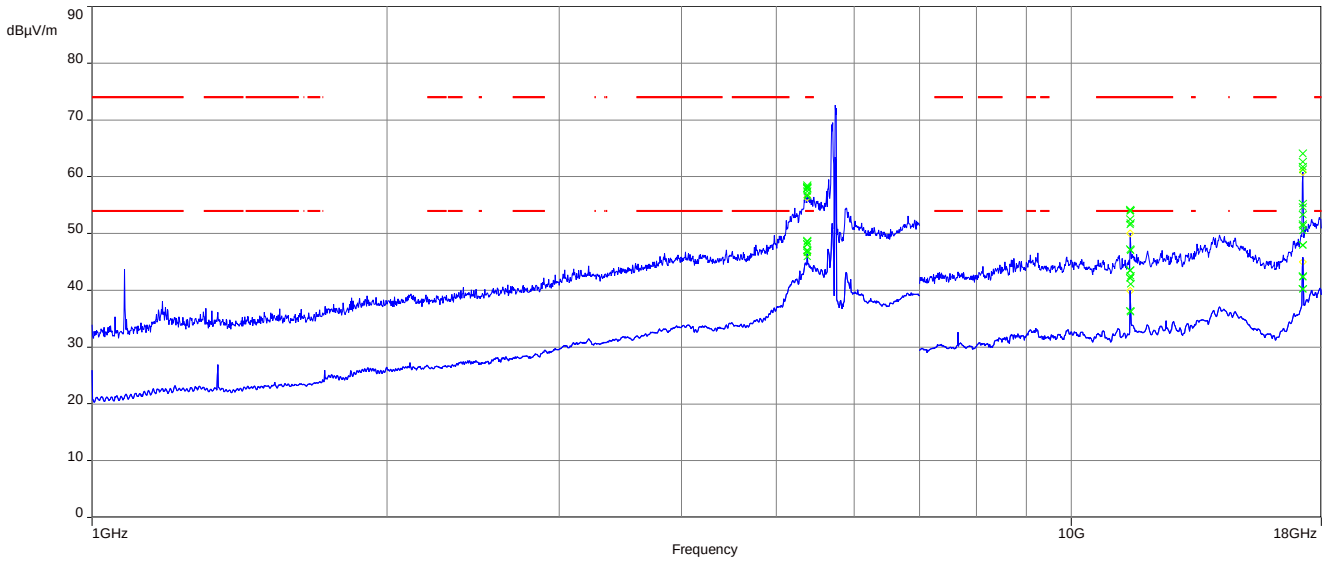
Plot 8: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2C; middle channel



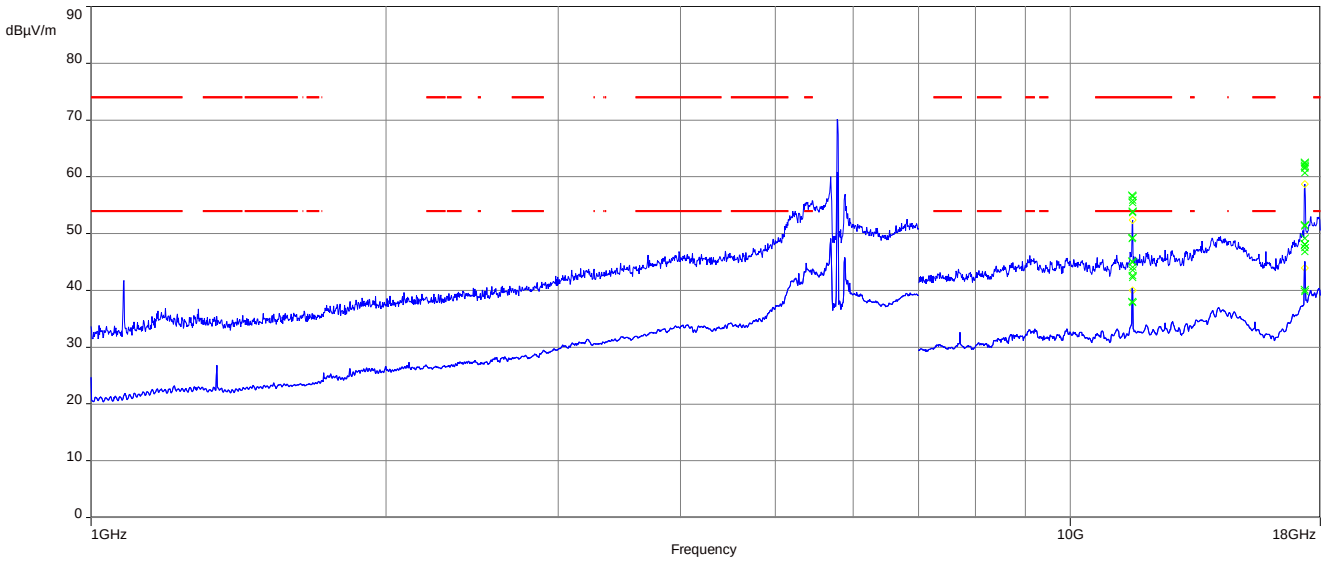
Plot 9: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2C; highest channel



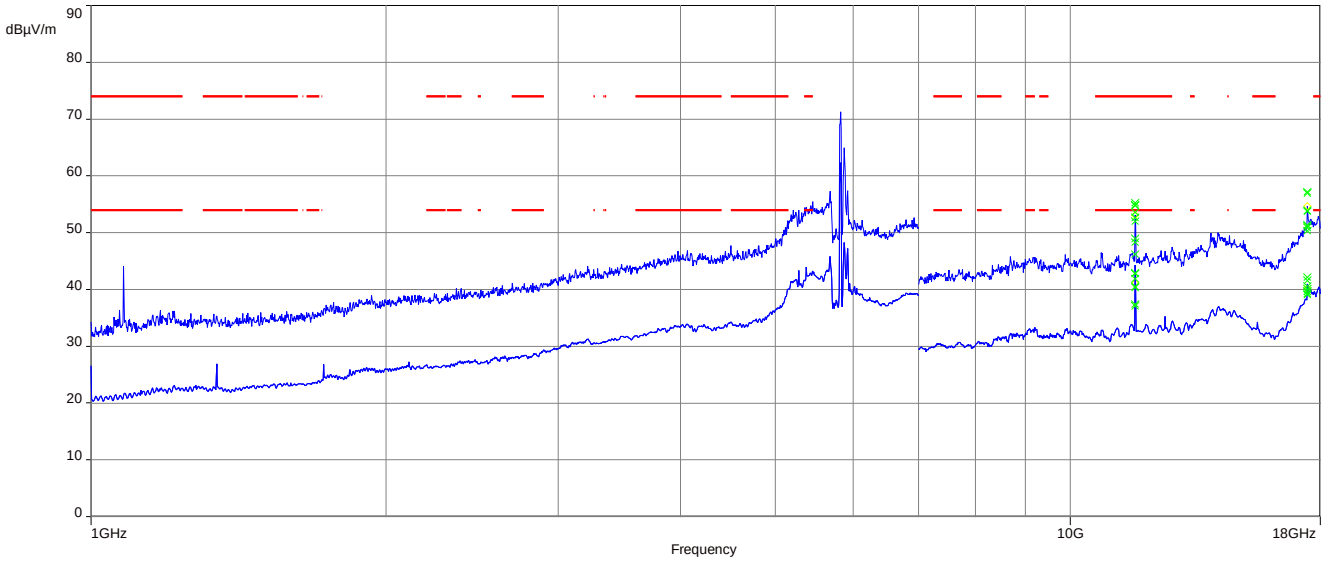
Plot 10: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-3; lowest channel



Plot 11: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-3; middle channel

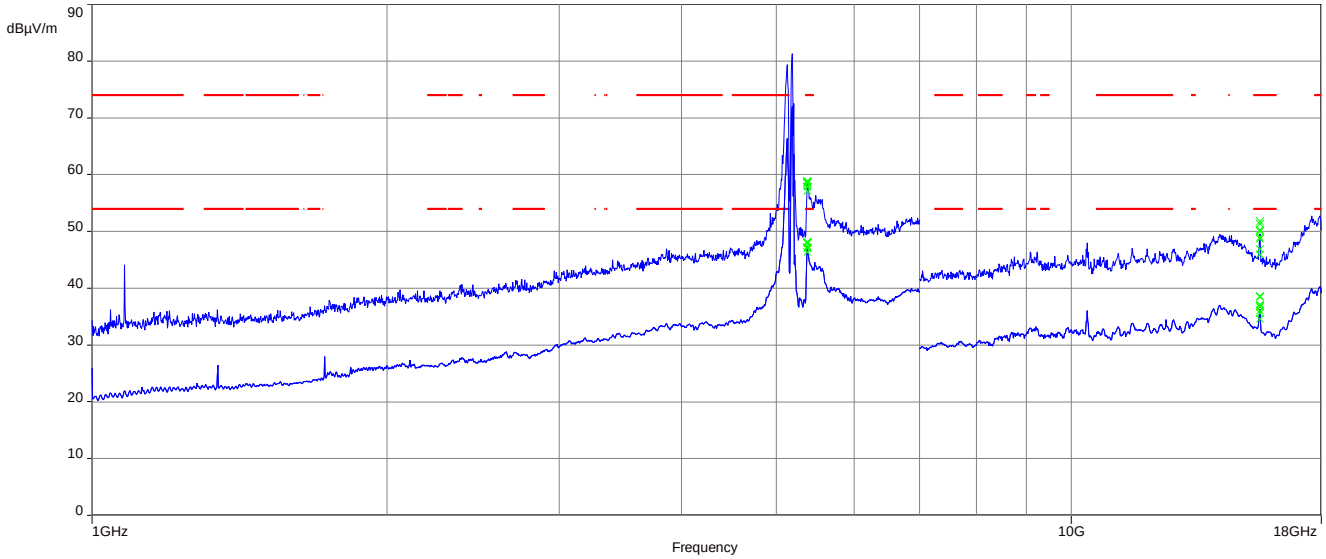


Plot 12: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-3; highest channel

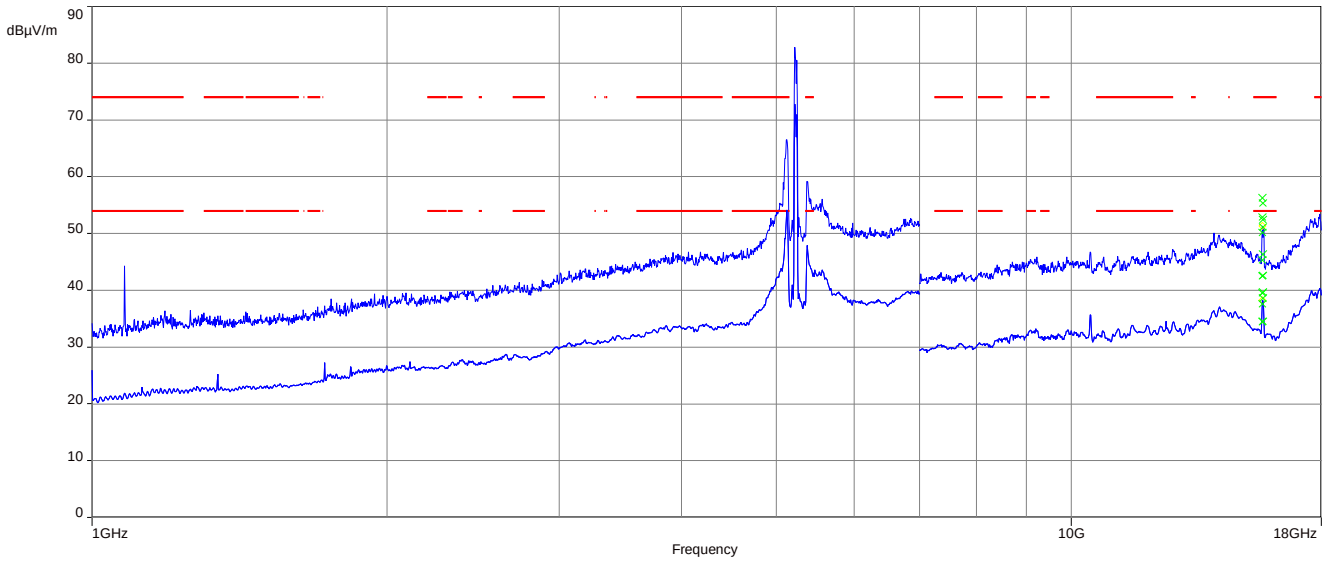


Plots: 40 MHz channel bandwidth

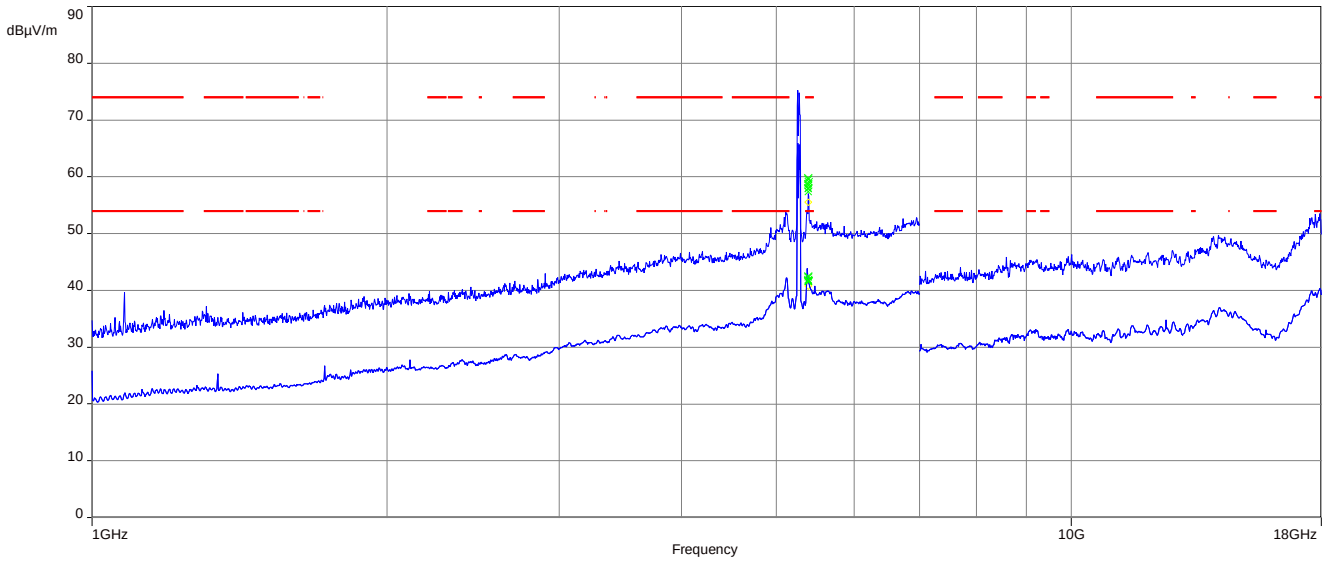
Plot 1: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-1; lowest channel



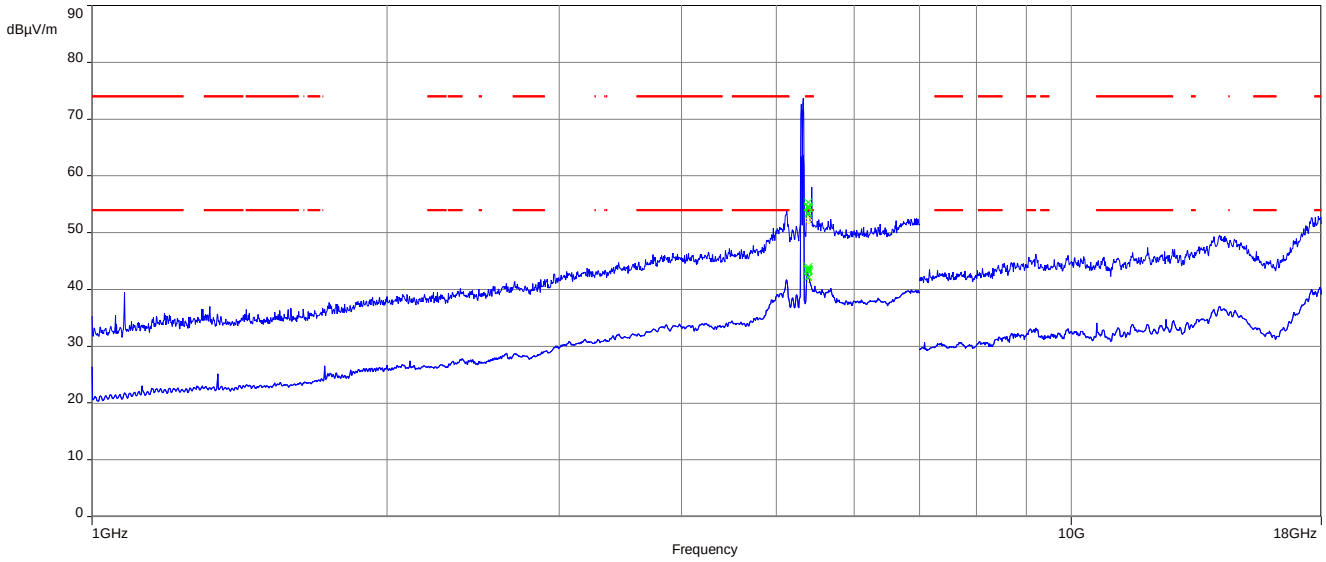
Plot 2: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-1; highest channel



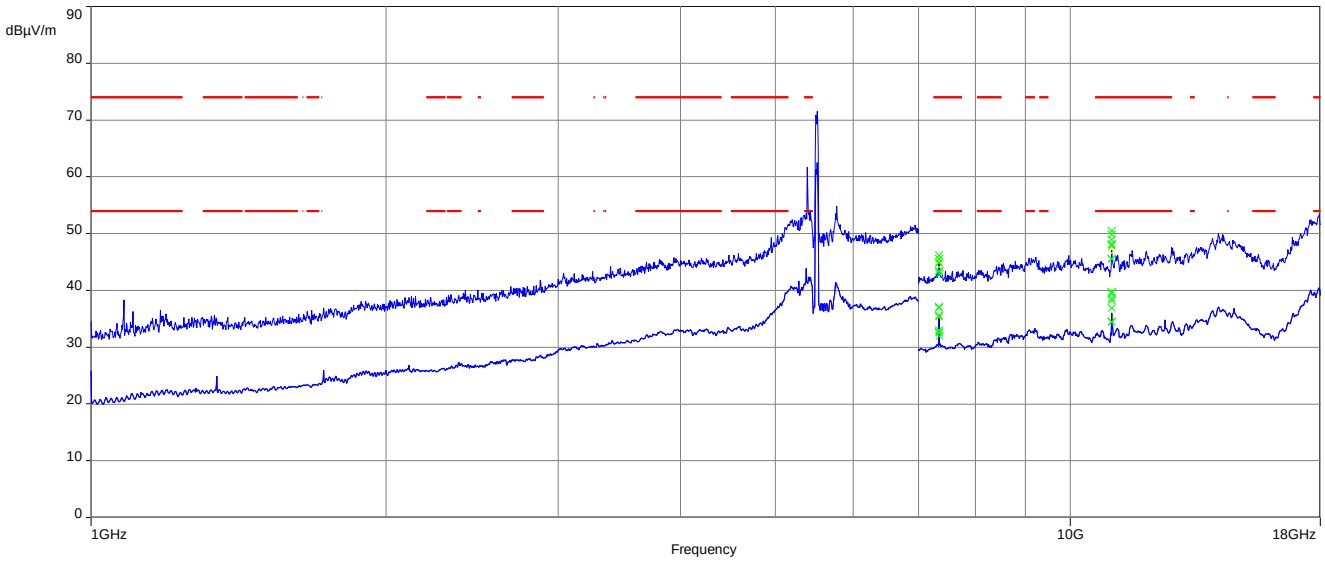
Plot 3: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2A; lowest channel



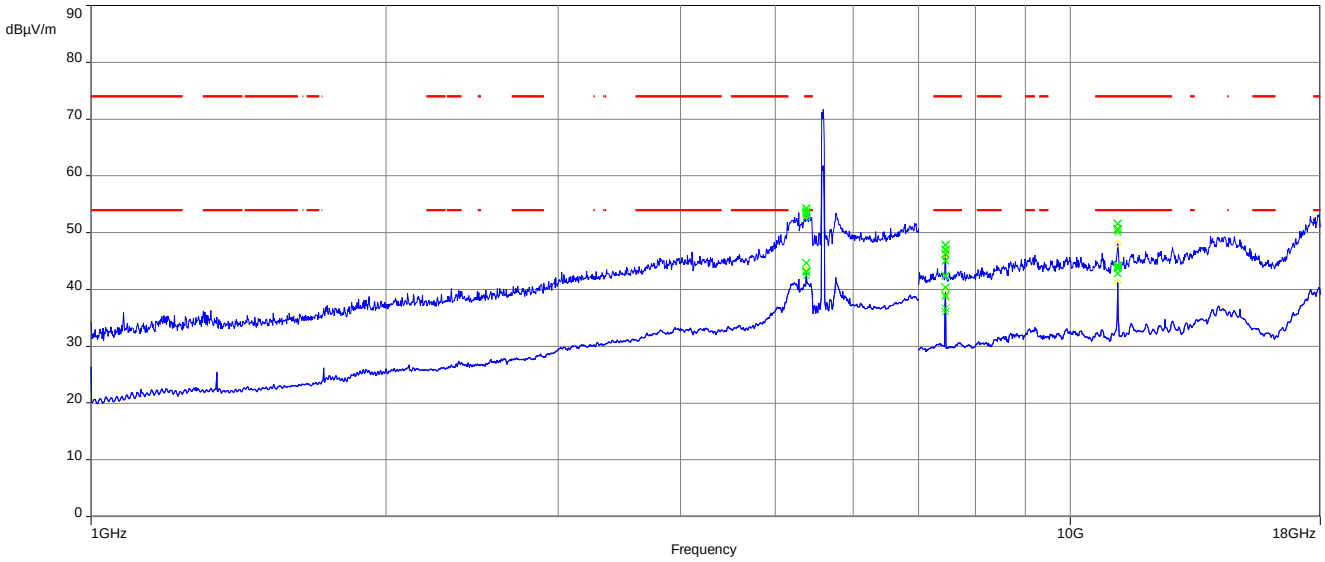
Plot 4: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2A; highest channel



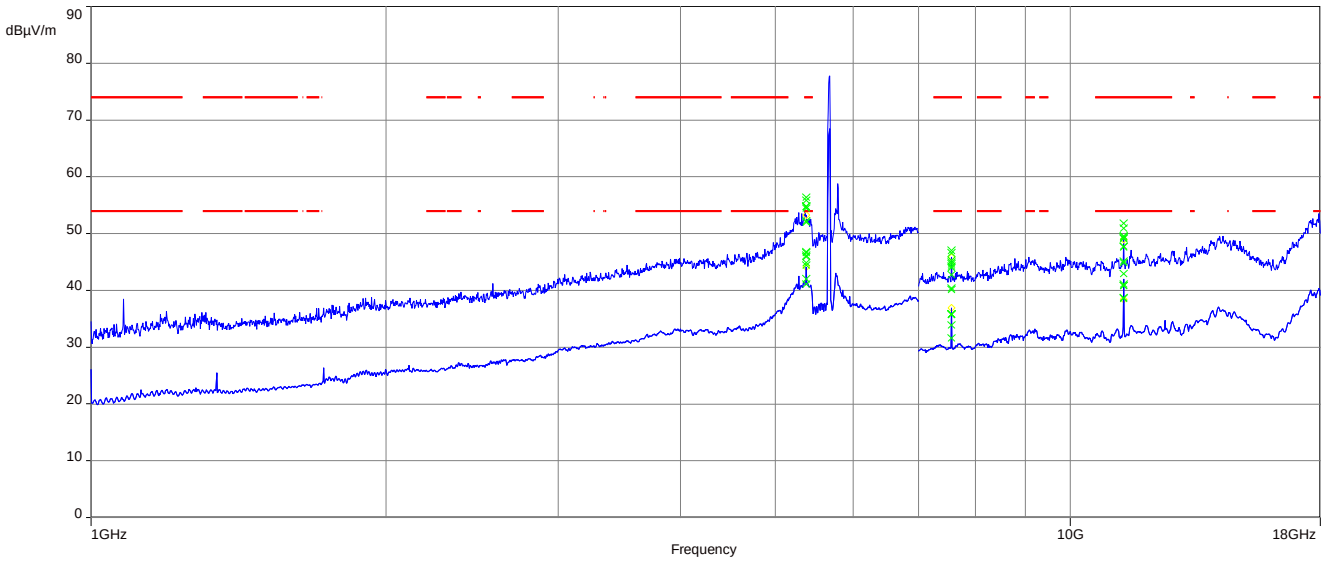
Plot 5: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2C; lowest channel



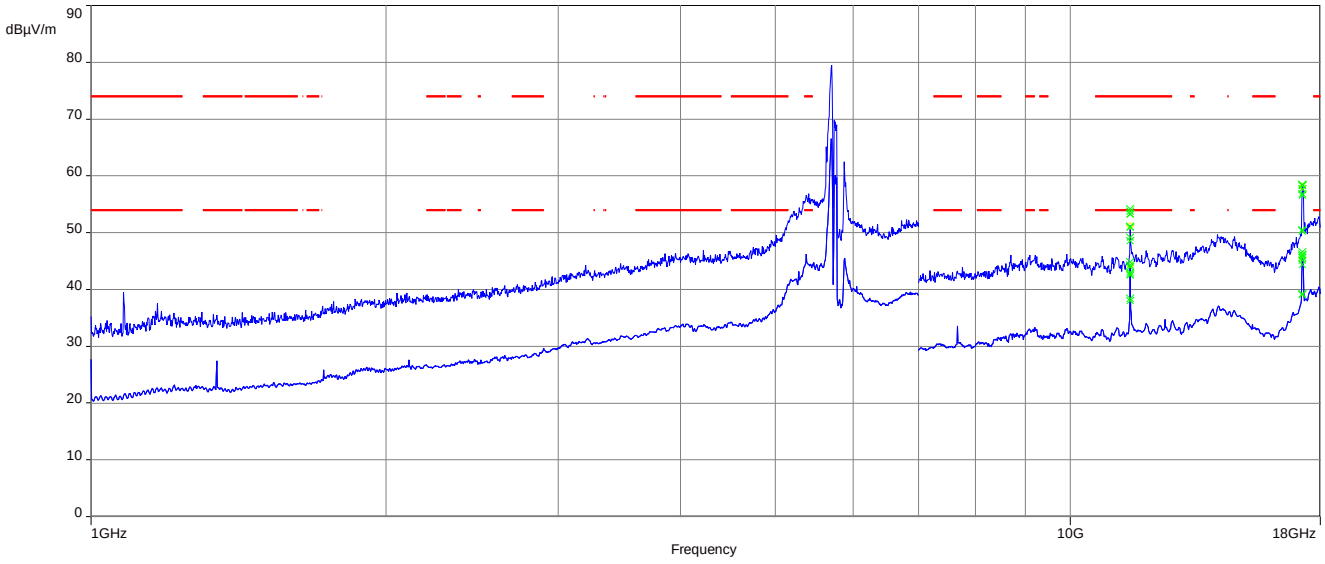
Plot 6: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2C; middle channel



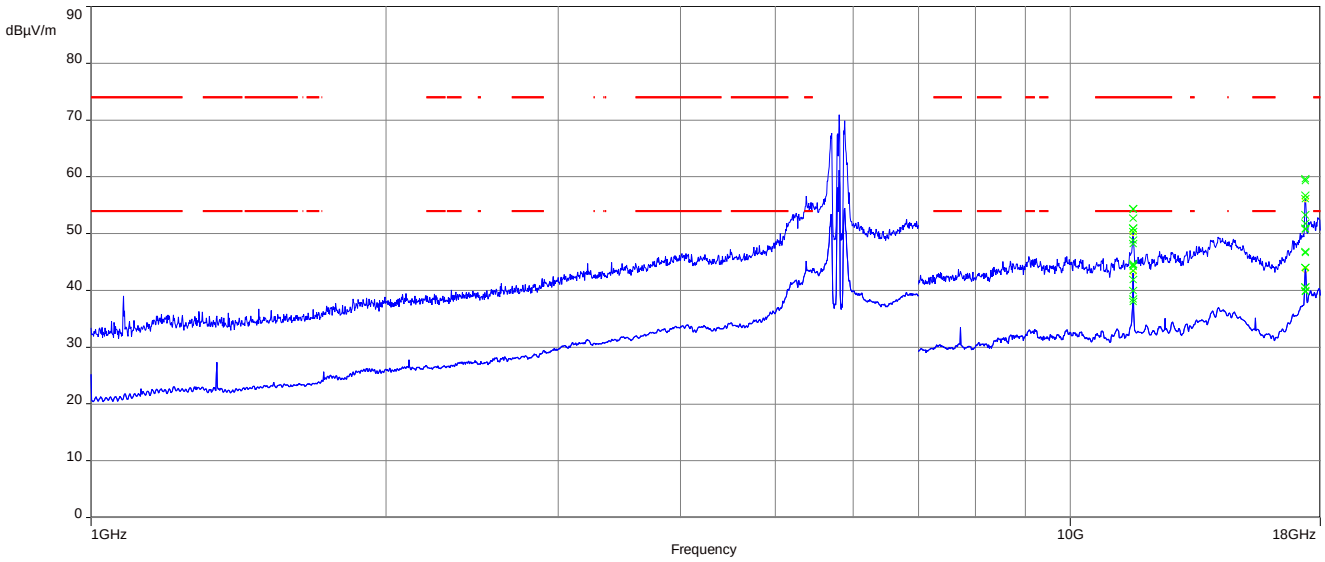
Plot 7: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2C; highest channel



Plot 8: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-3; lowest channel

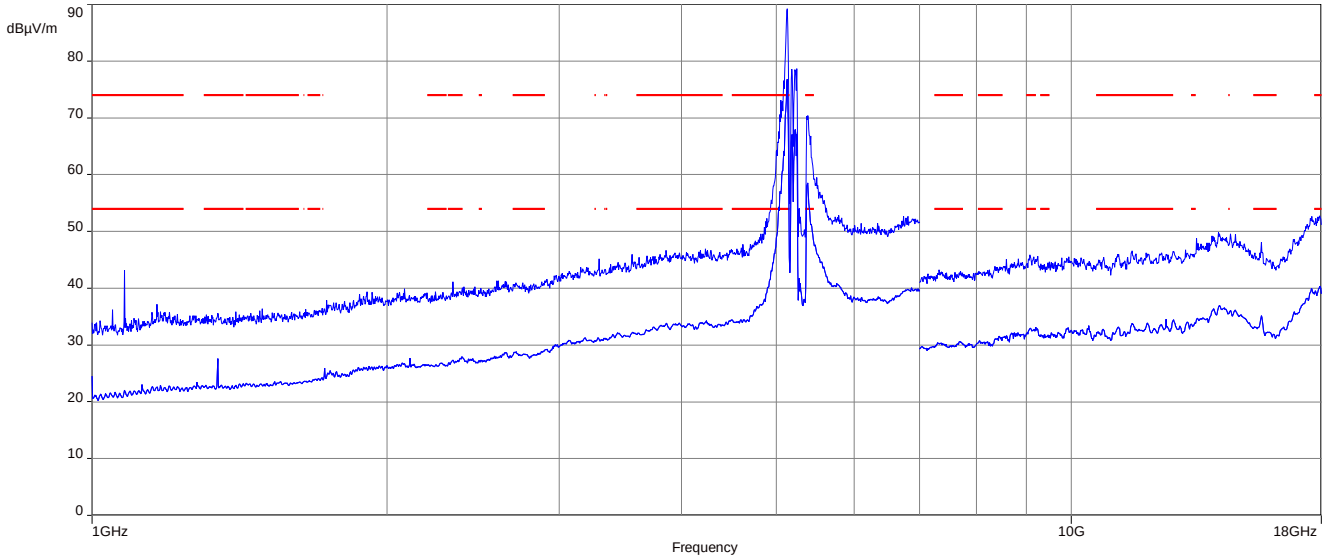


Plot 9: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-3; highest channel

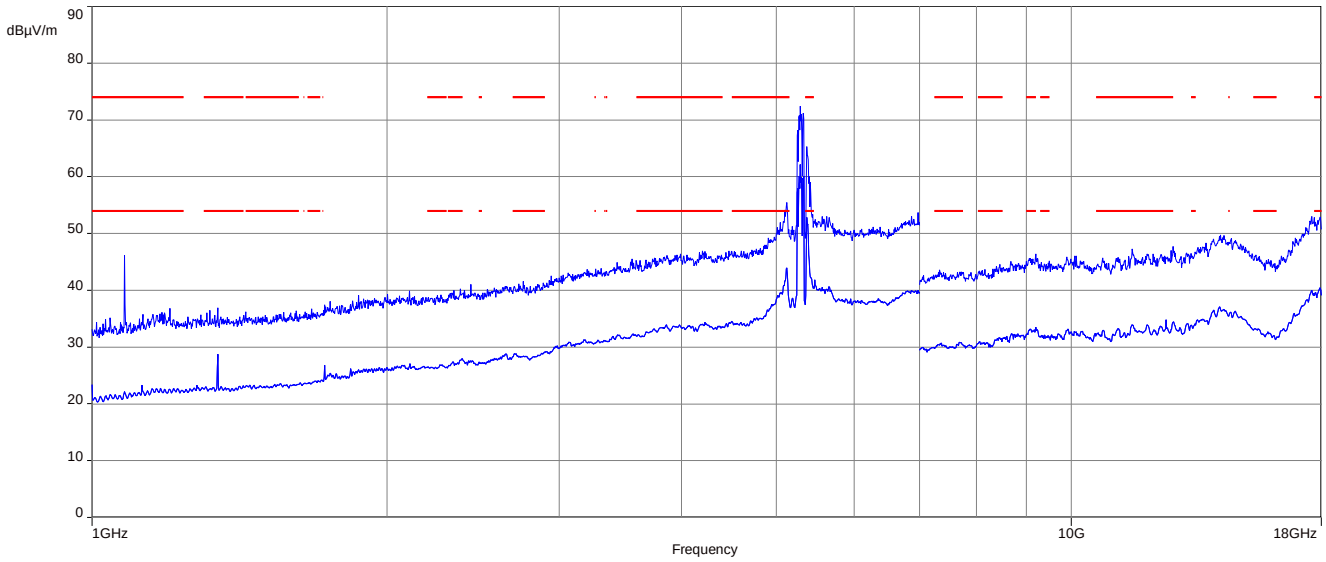


Plots: 80 MHz channel bandwidth

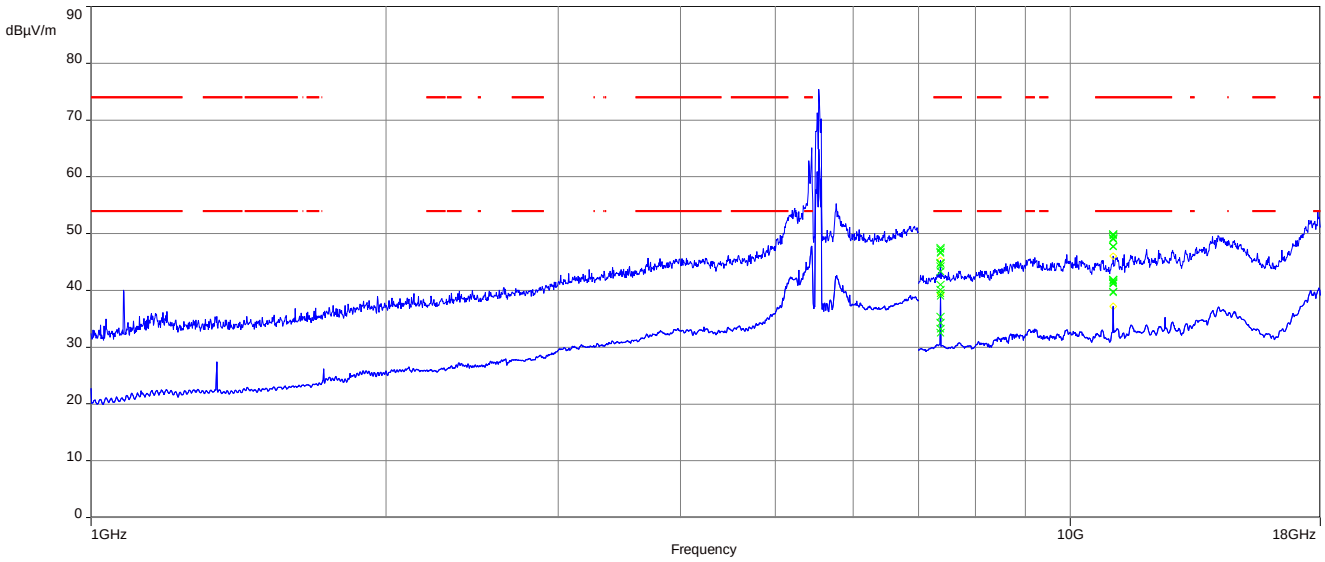
Plot 1: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-1; middle channel



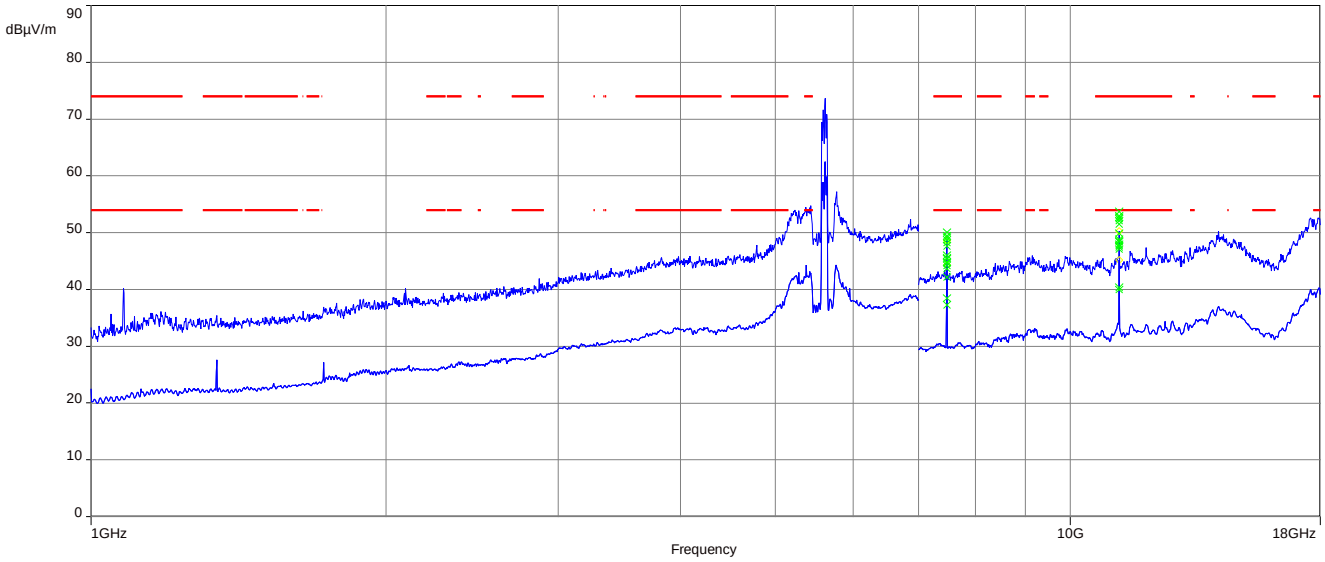
Plot 2: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2A; middle channel



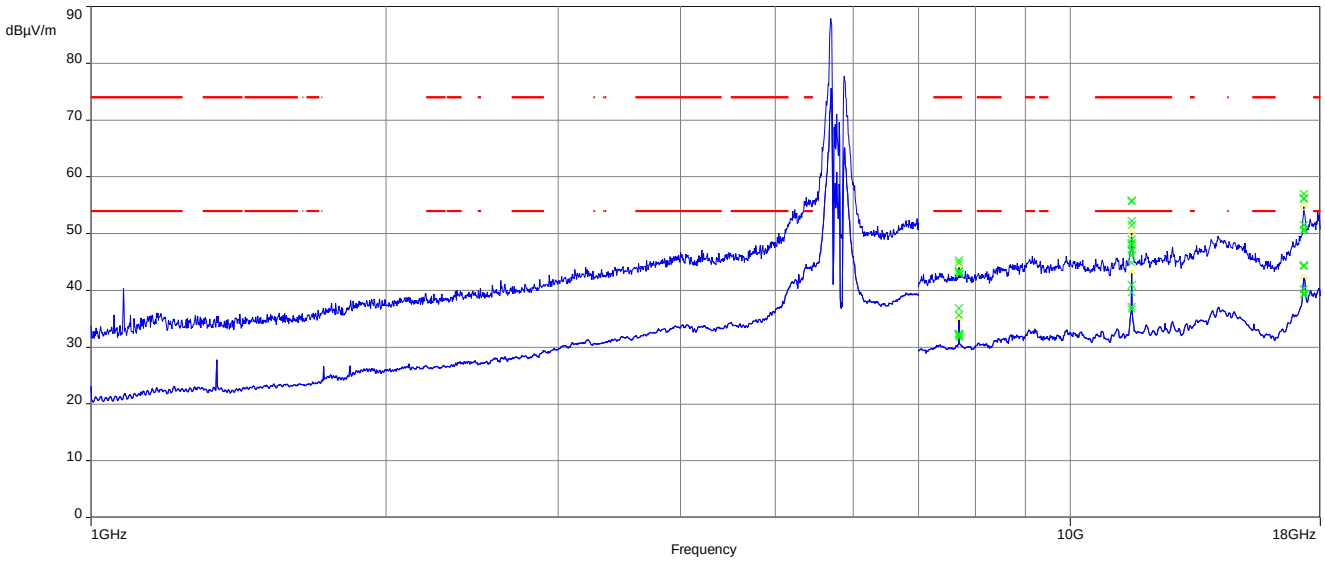
Plot 3: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2C; lowest channel



Plot 4: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2C; highest channel

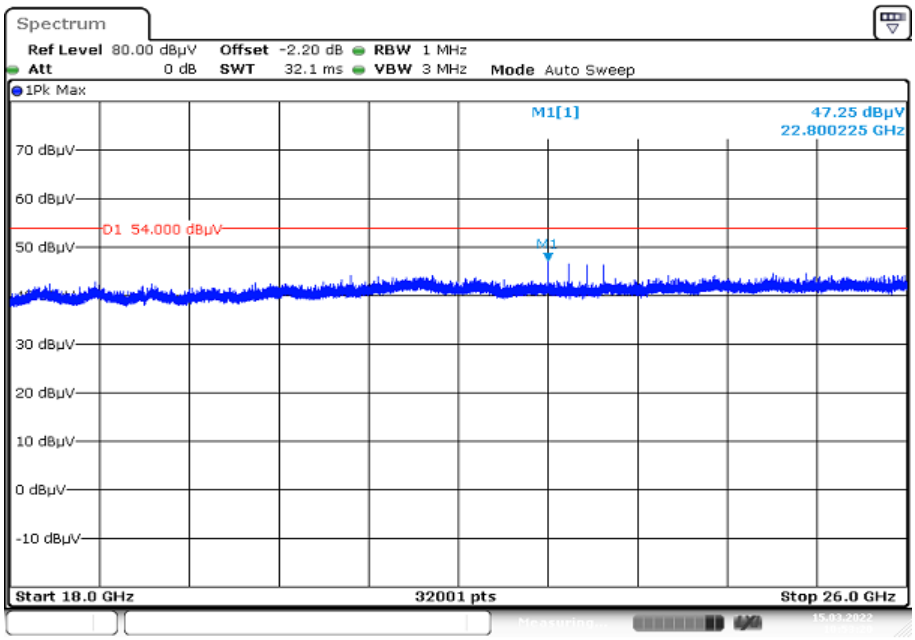


Plot 5: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-3; middle channel

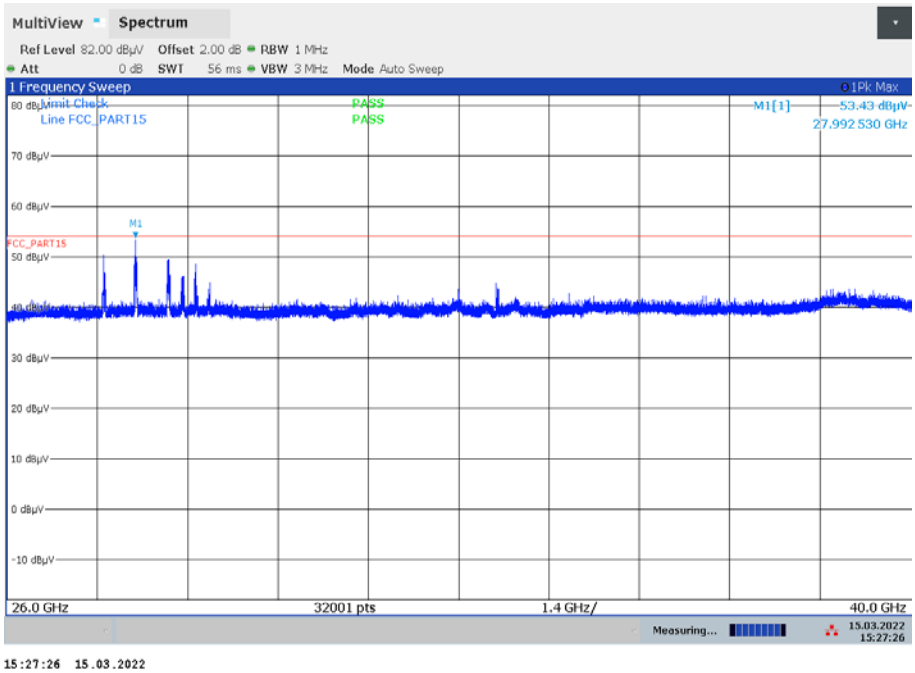


Plots: 18 GHz to 40 GHz

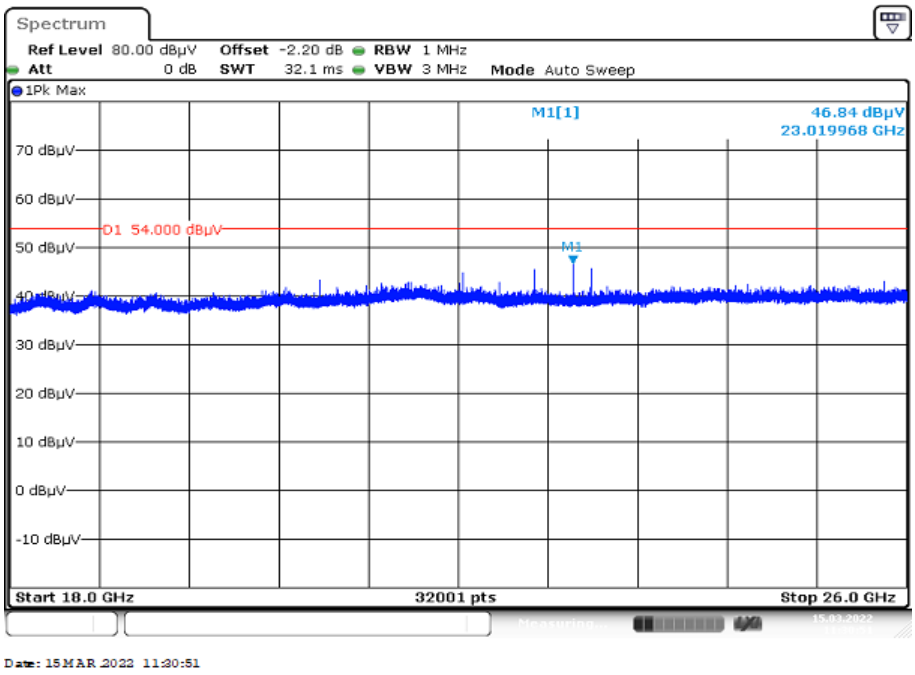
Plot 1: 18 GHz to 26 GHz, valid for all bands, channels and 20 MHz modes



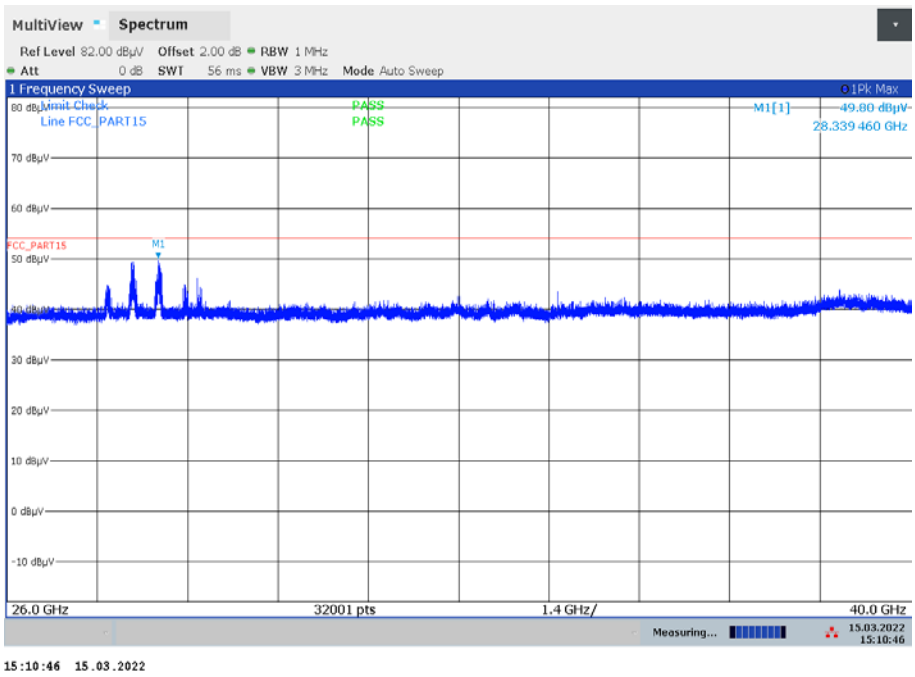
Plot 2: 26 GHz to 40 GHz, valid for all bands, channels and 20 MHz modes



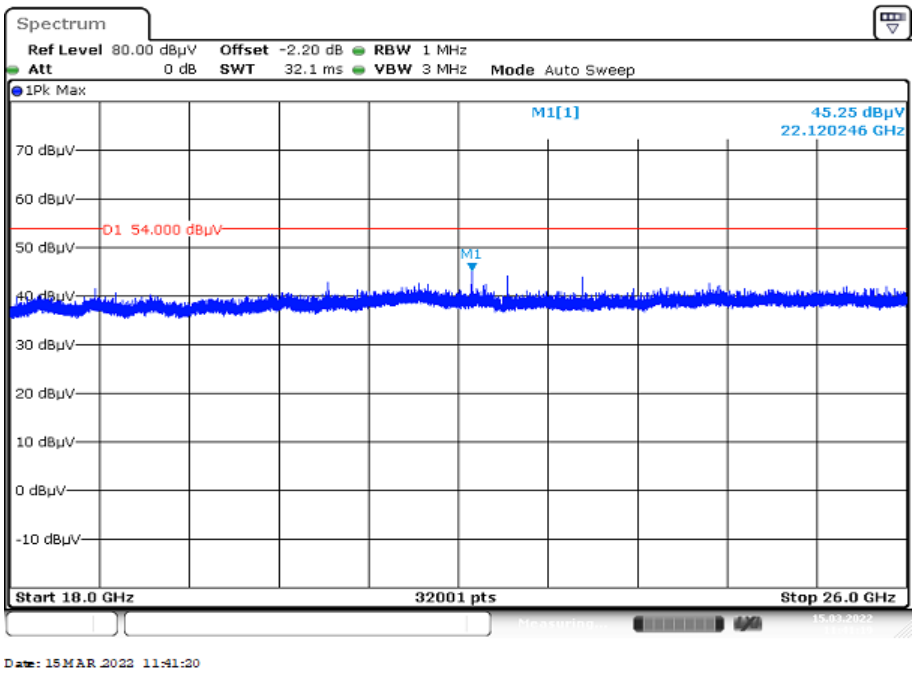
Plot 3: 18 GHz to 26 GHz, valid for all bands, channels and 40 MHz modes



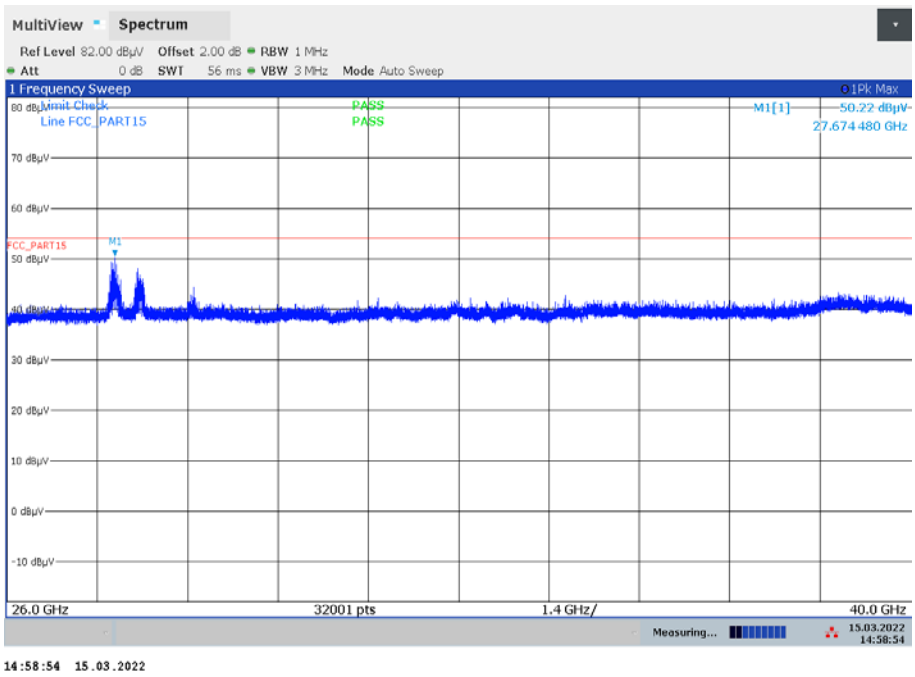
Plot 4: 26 GHz to 40 GHz, valid for all bands, channels and 40 MHz modes



Plot 5: 18 GHz to 26 GHz, valid for all bands, channels and 80 MHz modes



Plot 6: 26 GHz to 40 GHz, valid for all bands, channels and 80 MHz modes



12.13 Spurious emissions conducted < 30 MHz

Description:

Measurement of the conducted spurious emissions in transmit mode below 30 MHz. The EUT is set to middle channel. If critical peaks are found the lowest channel and the highest channel will be measured too. Both power lines, phase and neutral line, are measured. Found peaks are re-measured with average and quasi peak detection to show compliance to the limits.

Measurement:

Measurement parameter	
Detector:	Peak - Quasi Peak / Average
Sweep time:	Auto
Video bandwidth:	9 kHz
Resolution bandwidth:	100 kHz
Span:	150 kHz to 30 MHz
Trace mode:	Max Hold
Test setup:	See sub clause 7.5 – A
Measurement uncertainty:	See chapter 9

Limits:

Spurious Emissions Conducted < 30 MHz		
Frequency (MHz)	Quasi-Peak (dBµV/m)	Average (dBµV/m)
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30.0	60	50

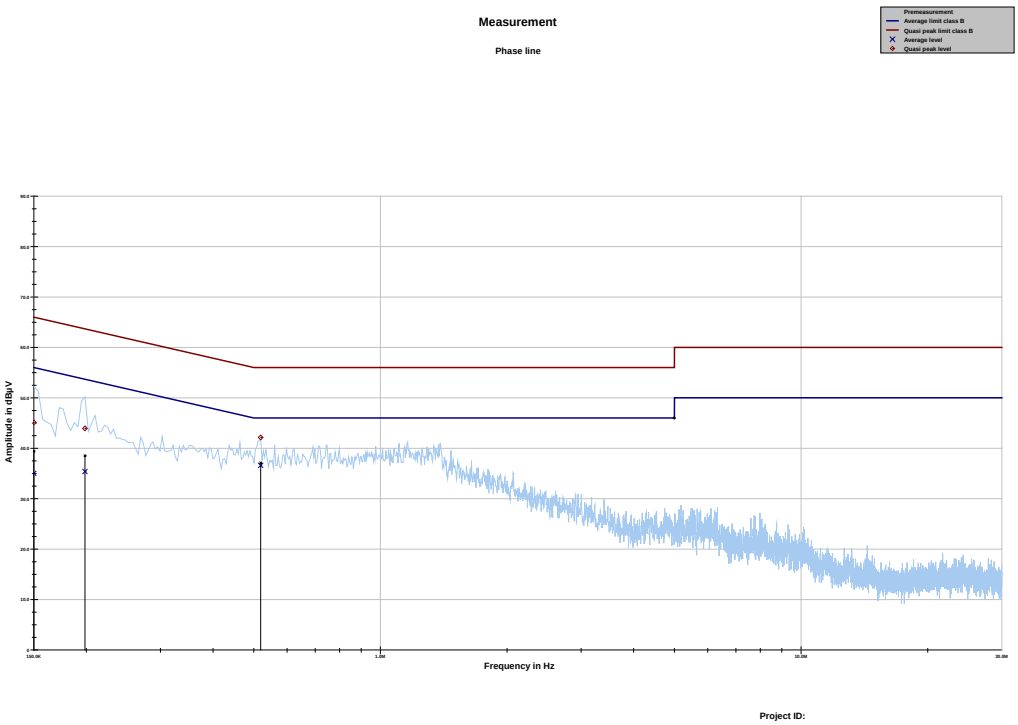
*Decreases with the logarithm of the frequency

Results:

Spurious Emissions Conducted < 30 MHz [dBµV/m]		
F [MHz]	Detector	Level [dBµV/m]
All detected emissions are more than 20 dB below the limit.		

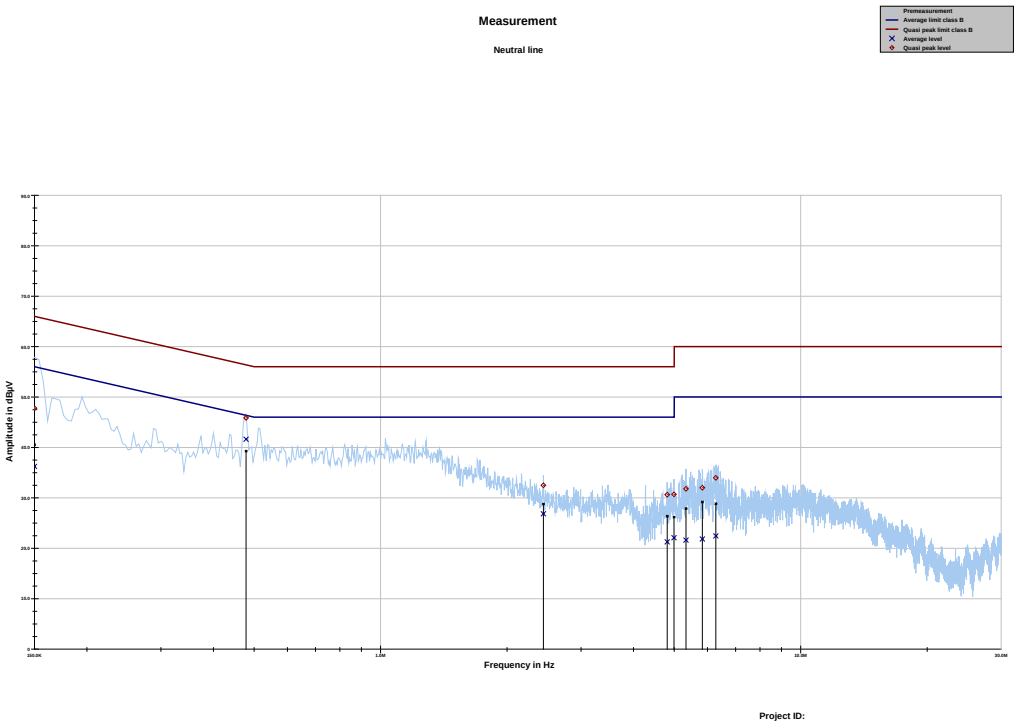
Plots:

Plot 1: 150 kHz to 30 MHz, phase line



Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.150000	45.13	20.87	66.000	35.00	21.00	56.000
0.198506	43.93	19.74	63.673	35.39	19.22	54.614
0.519394	42.14	13.86	56.000	36.60	9.40	46.000

Plot 2: 150 kHz to 30 MHz, neutral line



Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin Average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.150000	47.78	18.22	66.000	36.24	19.76	56.000
0.478350	45.84	10.53	56.368	41.61	5.01	46.619
2.440987	32.49	23.51	56.000	26.83	19.17	46.000
4.810331	30.62	25.38	56.000	21.25	24.75	46.000
4.993163	30.69	25.31	56.000	22.10	23.90	46.000
5.332706	31.78	28.22	60.000	21.62	28.38	50.000
5.832694	32.00	28.00	60.000	21.84	28.16	50.000
6.280444	33.96	26.04	60.000	22.45	27.55	50.000

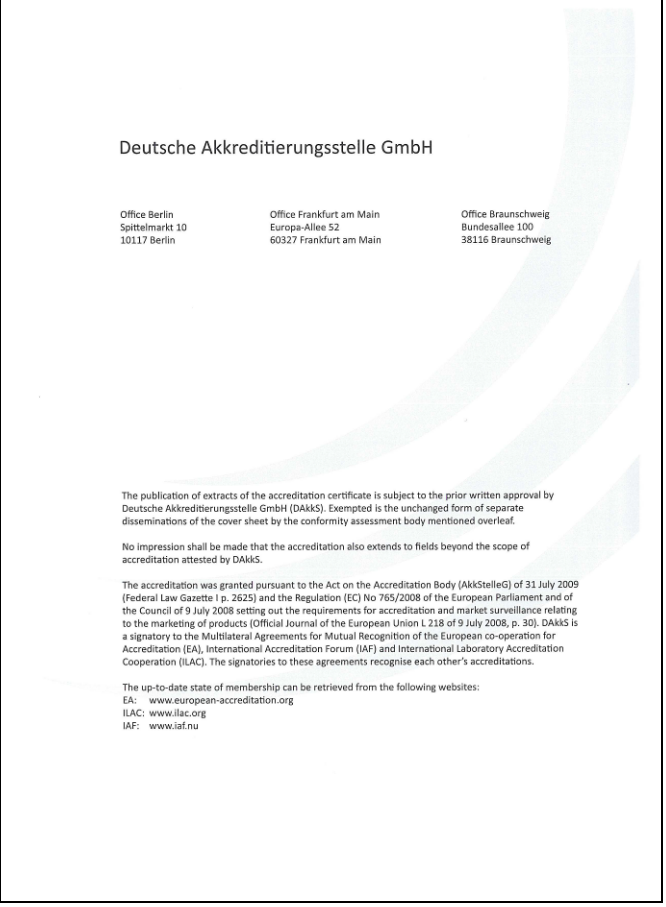
13 Glossary

EUT	Equipment under test
DUT	Device under test
UUT	Unit under test
GUE	GNSS User Equipment
ETSI	European Telecommunications Standards Institute
EN	European Standard
FCC	Federal Communications Commission
FCC ID	Company Identifier at FCC
IC	Industry Canada
PMN	Product marketing name
HMN	Host marketing name
HVIN	Hardware version identification number
FVIN	Firmware version identification number
EMC	Electromagnetic Compatibility
HW	Hardware
SW	Software
Inv. No.	Inventory number
S/N or SN	Serial number
C	Compliant
NC	Not compliant
NA	Not applicable
NP	Not performed
PP	Positive peak
QP	Quasi peak
AVG	Average
OC	Operating channel
OCW	Operating channel bandwidth
OBW	Occupied bandwidth
OOB	Out of band
DFS	Dynamic frequency selection
CAC	Channel availability check
OP	Occupancy period
NOP	Non occupancy period
DC	Duty cycle
PER	Packet error rate
CW	Clean wave
MC	Modulated carrier
WLAN	Wireless local area network
RLAN	Radio local area network
DSSS	Dynamic sequence spread spectrum
OFDM	Orthogonal frequency division multiplexing
FHSS	Frequency hopping spread spectrum
GNSS	Global Navigation Satellite System
C/N_0	Carrier to noise-density ratio, expressed in dB-Hz

14 Document history

Version	Applied changes	Date of release
-/-	Initial release	2022-05-27

15 Accreditation Certificate – D-PL-12076-01-05

first page	last page
	

Note: The current certificate annex is published on the websites (link see below).

https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-05e.pdf

or

https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-05_TCB_USA.pdf

################################ END OF TEST REPORT ################################