
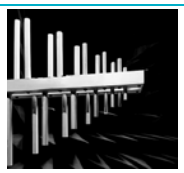
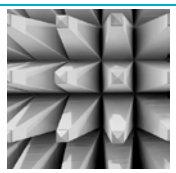

CTC advanced
member of RWTÜV group

Bundesnetzagentur

BNetzA-CAB-02/21-102

TEST REPORT

Test report no.: 1-9749/19-02-02-B

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: http://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 (2005) 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

Neratec Solutions AG
Rosswiesstrasse 29
8608 Bubikon / SWITZERLAND
Phone: +41 55 253 2078
Contact: Michael Aeschbacher
e-mail: michael.aeschbacher@neratec.com
Phone: +41 55 253 20 73

Manufacturer

Neratec Solutions AG
Rosswiesstrasse 29
8608 Bubikon / SWITZERLAND

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
RSS - 247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices
RSS - Gen Issue 5	Spectrum Management and Telecommunications Radio Standards Specification - General Requirements for Compliance of Radio Apparatus

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

Test Item

Kind of test item:	**WLAN Module**
Model name:	**DT50RF MK2**
FCC ID:	**2AEJD-103902-1-DT50**
IC:	**9301A-1039021DT50**
Frequency:	U-NII-3 band 5725 MHz to 5850 MHz
Technology tested:	WLAN
Antenna:	2 external directional antennas
Power supply:	24.0 V to DC by external power supply
Temperature range:	-40°C to +85°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
2020.05.05 15:11:20 +02'00'

Andreas Luckenbill
Head of Department
Radio Communications

Test performed:

cn=Alexander Becker, o=CTC advanced GmbH, ou=BCK-191017, email=mail@ctcadvanced.com, c=DE
2020.05.05 15:25:26 +02'00'

Alexander Becker
Testing 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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This test report replaces the test report with the number 1-9749/19-02-02-A and dated 2020-04-28.

2.2 Application details

Date of receipt of order:	2020-03-10
Date of receipt of test item:	2020-03-17
Start of test:	2020-03-19
End of test:	2020-05-04
Person(s) present during the test:	-/-

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
RSS - 247 Issue 2	February 2017	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices
RSS - Gen Issue 5	April 2018	Spectrum Management and Telecommunications Radio Standards Specification - General Requirements for Compliance of Radio Apparatus

Guidance	Version	Description
KDB 789033 D02	v02r02	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-12076-01-04.pdf
D-PL-12076-01-05	Telecommunication FCC requirements https://www.dakks.de/as/ast/d/D-PL-12076-01-05.pdf

4 Test environment

Temperature	:	T_{nom} T_{max} T_{min}	+22 °C during room temperature tests No test under extreme temperature conditions required. No test under extreme temperature conditions required.
Relative humidity content	:		46 %
Barometric pressure	:		1011 hpa
Power supply	:	V_{nom} V_{max} V_{min}	24.0 V DC by external power supply No test under extreme voltage conditions required. No test under extreme voltage conditions required.

5 Test item

5.1 General description

Kind of test item	:	WLAN Module
Type identification	:	DT50RF MK2
HMN	:	-/-
PMN	:	DT50RF_MK2_1
HVIN	:	DT50RF_MK2_1
FVIN	:	6.6
S/N serial number	:	006000037020060
Hardware status	:	MK2
Software status	:	6.6
Frequency band	:	U-NII-3 band 5725 MHz to 5850 MHz
Type of radio transmission Use of frequency spectrum	: :	OFDM
Type of modulation	:	BPSK, QPSK, 16 – QAM, 64 – QAM
Number of channels	:	5 with 20 MHz channel bandwidth
Antenna	:	2 external directional antennas Type: SPA-5600/40/14/0/V_2 with 14 dBi
Power supply	:	24.0 V to DC by external power supply
Temperature range	:	-40°C to +85°C

5.2 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: 1-9749/19-02-01_AnnexA
1-9749/19-02-01_AnnexB
1-9749/19-02-01_AnnexD

6 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).

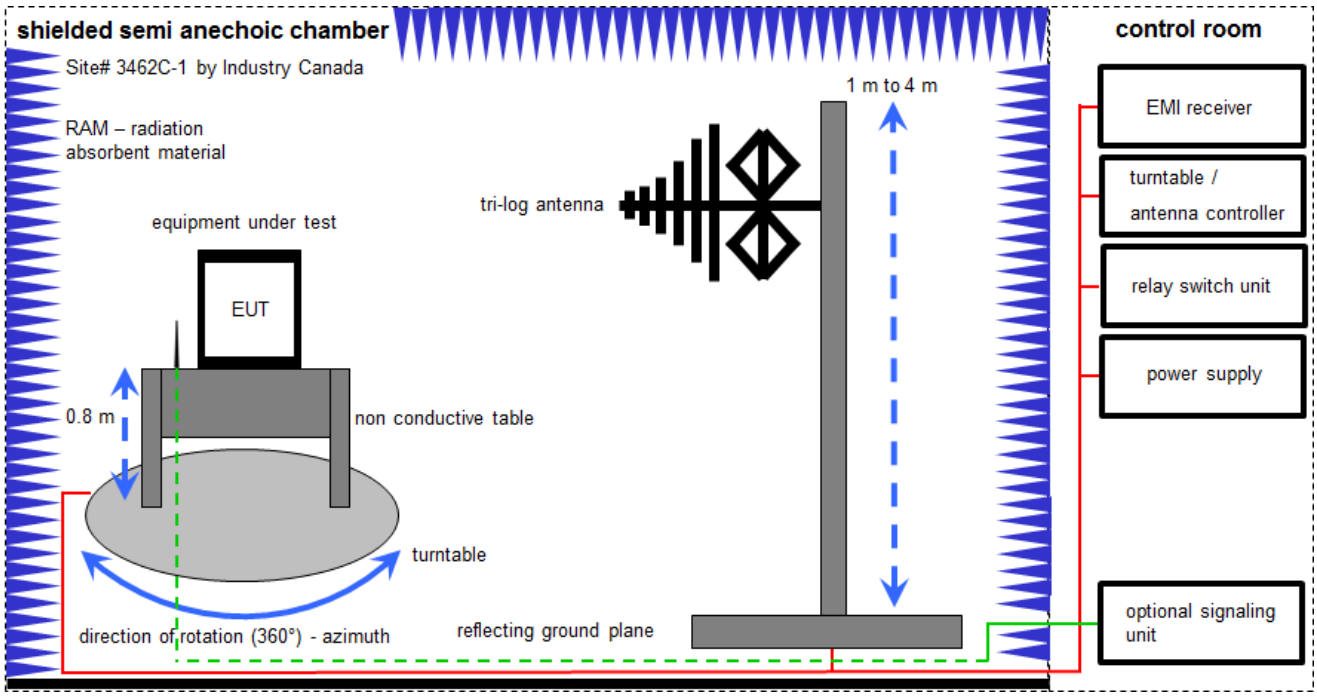
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

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

6.1 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: 10.30.0

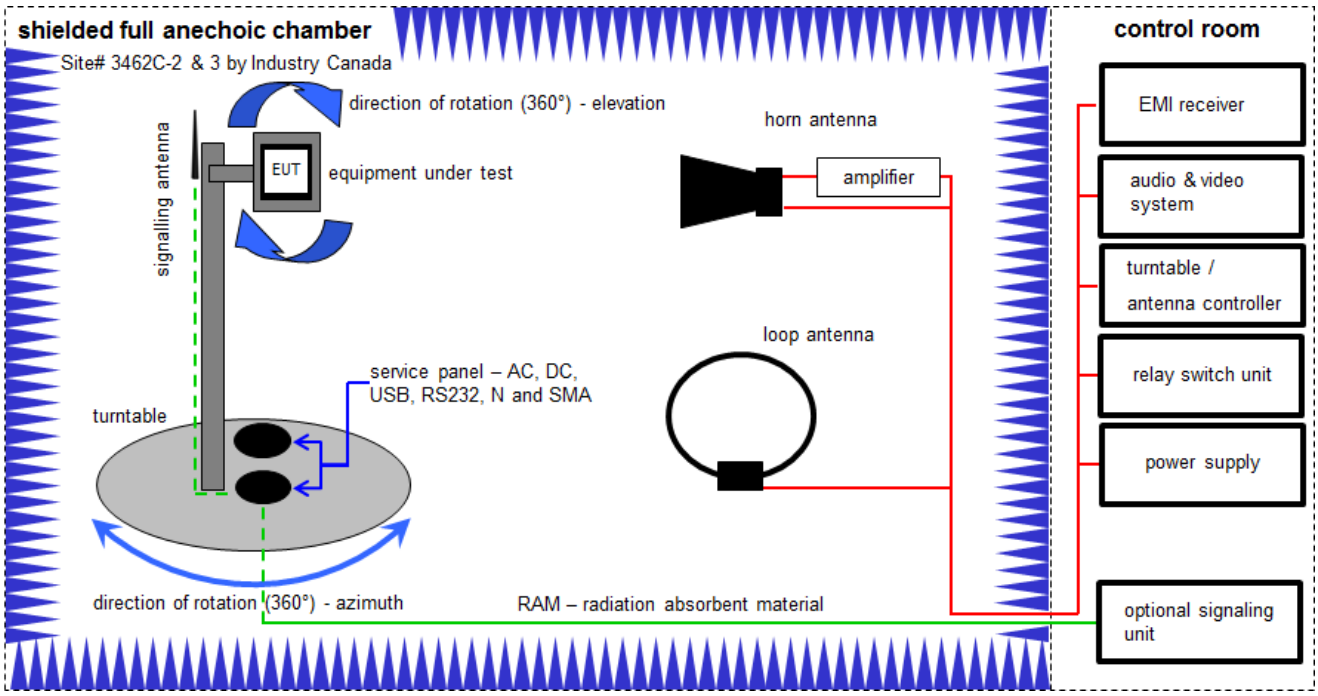
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

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	-/-	300000551	ne	-/-	-/-
3	A	EMI Test Receiver	ESR3	Rohde & Schwarz	102587	000000000	k	21.05.2019	20.05.2020
4	A	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
5	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
6	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
7	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	371	300003854	vlKl!	24.11.2017	23.11.2020
8	A	Power Supply DC	N5767A	Agilent Technologies	US14J1569P	300004851	vlKl!	13.12.2018	12.12.2020

6.2 Shielded fully anechoic chamber



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

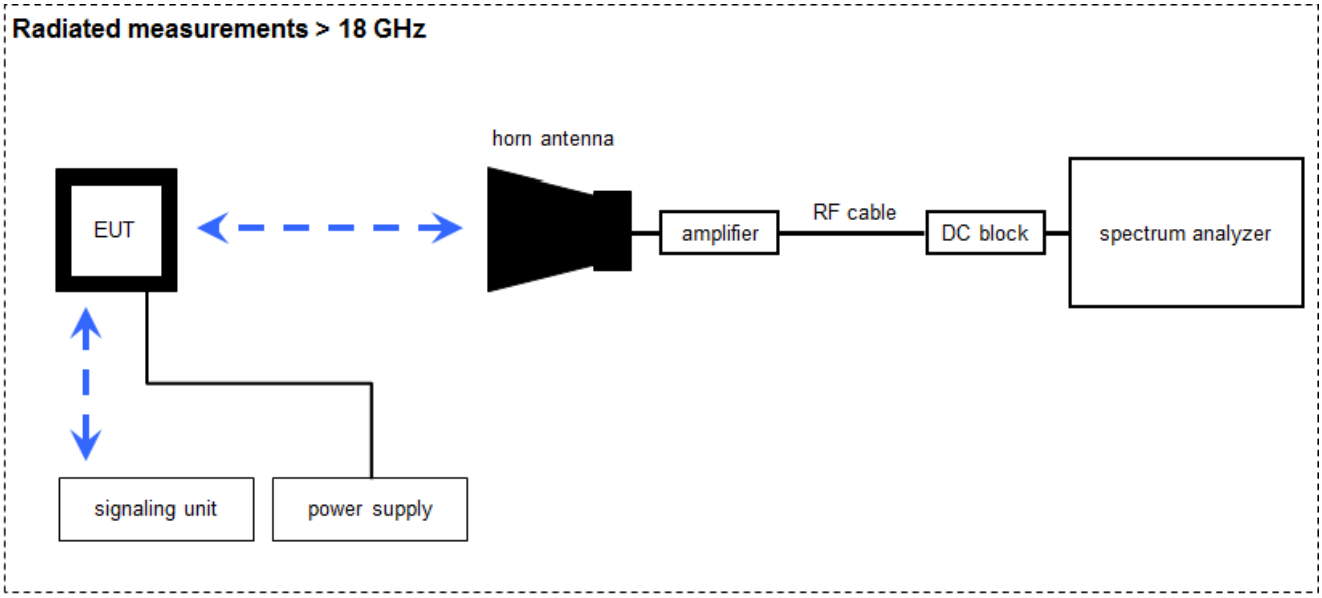
FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

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.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A, B	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vIKI!	13.06.2019	12.06.2021
2	A, B	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9107-3696	300001604	vIKI!	27.02.2019	26.02.2021
3	A, B	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2920A04590	300001041	vIKI!	14.12.2017	13.12.2020
4	A, B	Highpass Filter	WHK1.1/15G-10SS	Wainwright	37	400000148	ne	-/-	-/-
5	A, B	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789	ne	-/-	-/-
6	A, B	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22051	300004483	ev	-/-	-/-
7	A, B	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000032	300004510	ne	-/-	-/-
8	A, B	Computer	Intel Core i3 3220/3,3 GHz, Prozessor		2V2403033A5421	300004591	ne	-/-	-/-
9	A, B	NEXIO EMV-Software	BAT EMC V3.19.1.19	EMCO		300004682	ne	-/-	-/-
10	A, B	Anechoic chamber		TDK		300003726	ne	-/-	-/-
11	A, B	EMI Test Receiver 9kHz-26,5GHz	ESR26	R&S	101376	300005063	k	10.12.2019	09.12.2020
12	A	Band Reject Filter	WRCJV12-5695-5725-5850-5880-40SS	Wainwright	5	300005169	ev	-/-	-/-
13	A, B	RF Amplifier	AFS4-00100800-28-20P-4-R	MITEQ	2008992	300005204	ne	-/-	-/-

6.3 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)

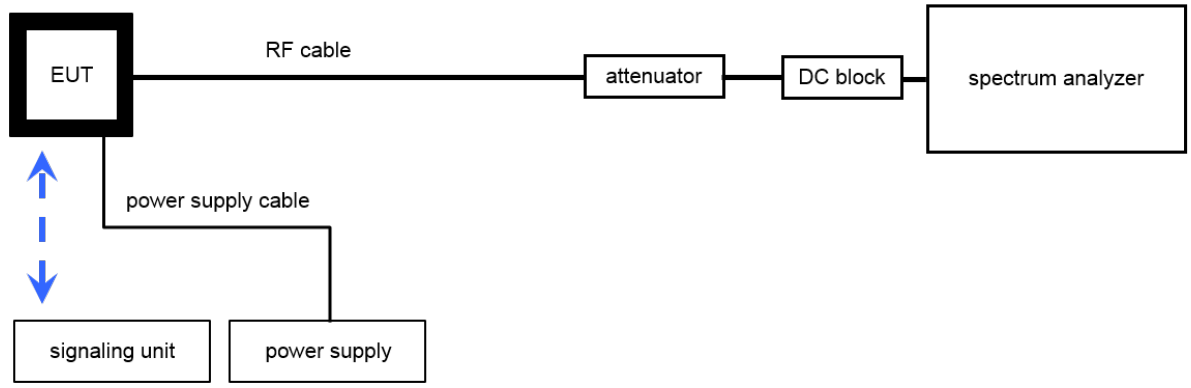
Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-60.1) [dB] + 36.74 [dB/m] = 16.64 [dBµV/m] (6.79 µV/m)

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!	-/-	-/-
3	A	Std. Gain Horn Antenna 26.5-40.0 GHz	V637	Narda	82-16	300000510	vlKl!	-/-	-/-
4	A	Amplifier 2-40 GHz	JS32-02004000-57-5P	MITEQ	1777200	300004541	ev	-/-	-/-
5	A	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	17.12.2019	16.12.2020
6	A	RF-Cable	ST18/SMAm/SMAm/48	Huber & Suhner	Batch no. 600918	400001182	ev	-/-	-/-
7	A	RF-Cable	ST18/SMAm/SMAm/48	Huber & Suhner	Batch no. 127377	400001183	ev	-/-	-/-
8	A	DC-Blocker 0.1-40 GHz	8141A	Inmet	-/-	400001185	ev	-/-	-/-

6.4 Conducted measurements with peak power meter & spectrum analyzer

Conducted measurements normal conditions



WLAN tester version: 1.1.13; LabView2015

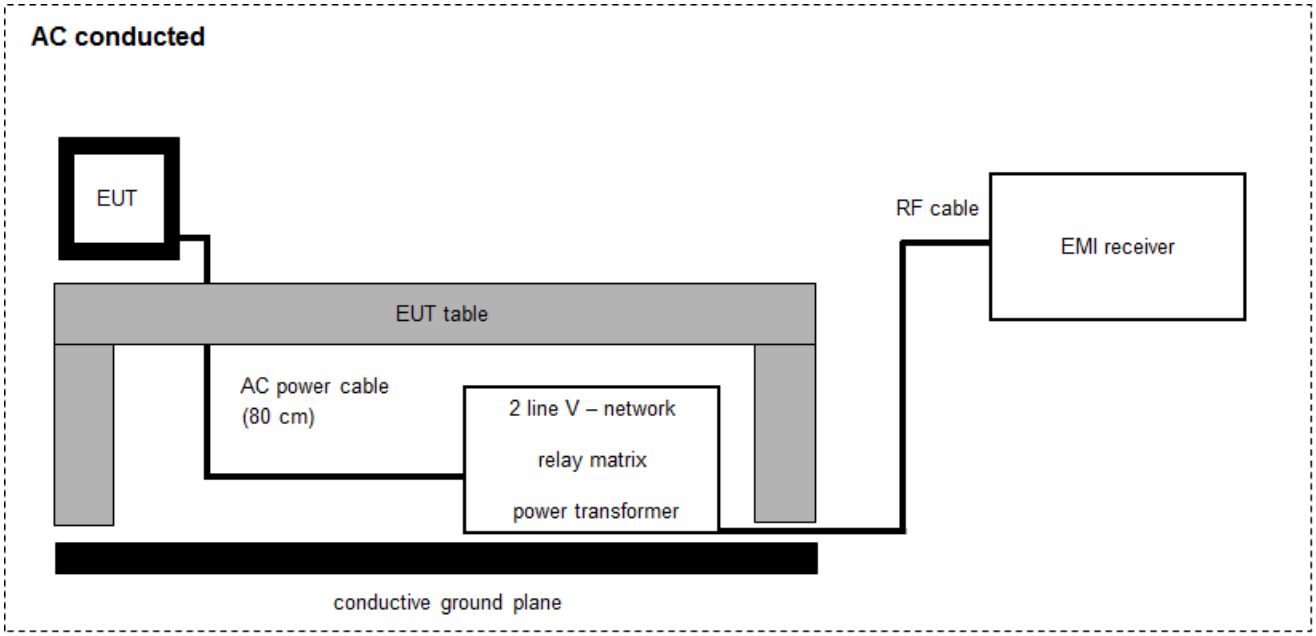
OP = AV + CA
(OP-output power; AV-analyzer value; CA-loss signal path)

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

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	DC-Blocker 0.1-40 GHz	8141A	Inmet	-/-	400001185	ev	-/-	-/-
2	A	Hygro-Thermometer	-/-, 5-45°C, 20-100%rF	Thies Clima	-/-	400000108	ev	11.05.2018	10.05.2020
3	A	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	17.12.2019	16.12.2020
4	A	PC Tester R005	Intel Core i3 3220/3,3 GHz, Prozessor	-/-	2V2403033A4523	300004589	ne	-/-	-/-
5	A	Teststand	Teststand Custom Sequence Editor	National Instruments GmbH	-/-	300004590	ne	-/-	-/-
6	A	RF-Cable	ST18/SMAm/SMAm/60	Huber & Suhner	Batch no. 606844	400001181	ev	-/-	-/-
7	A	Coax Attenuator 10 dB 2W 0-40 GHz	MCL BW-K10-2W44+	Mini Circuits	-/-	400001186	ev	-/-	-/-
8	A	Synchron Power Meter	SPM-4	CTC	1	300005580	ev	-/-	-/-
9	A	DC-Blocker	WA7046	Weinschel Associates	-/-	400001310	ev	-/-	-/-

6.5 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.	Lab / Item	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	R&S	892475/017	300002209	vlKl!	11.12.2019	10.12.2021
2	A	RF-Filter-section	85420E	HP	3427A00162	300002214	NK!	-/-	-/-
3	A	Hochpass 150 kHz	EZ-25	R&S	100010	300003798	ev	-/-	-/-
4	A	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	10.12.2019	09.12.2020

7 Sequence of testing

7.1 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.

7.2 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.

7.3 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.

7.4 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.

8 Measurement uncertainty

Measurement uncertainty		
Test case	**Uncertainty**	
Antenna gain	± 3 dB	
Power spectral density	± 1.15 dB	
Spectrum bandwidth	± 100 kHz (depends on the used RBW)	
Occupied bandwidth	± 100 kHz (depends on the used RBW)	
Maximum output power	± 1.15 dB conducted ± 3 dB radiated	
Minimum emissions bandwidth	± 100 kHz (depends on the used RBW)	
Band edge compliance radiated	± 3 dB	
Spurious emissions conducted	> 3.6 GHz	± 1.15 dB
	> 7 GHz	± 1.15 dB
	> 18 GHz	± 1.89 dB
	≥ 40 GHz	± 3.12 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	

9 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 Part 15 RSS 247, Issue 2	See table	2020-05-05	-/-

Test specification clause	Test case	Temperature conditions	Power source voltages	C	NC	NA	NP	Remark
-/-	Output power verification (cond.)	Nominal	Nominal	-/-				-/-
-/-	Antenna gain	Nominal	Nominal	-/-				-/-
U-NII Part 15	Duty cycle	Nominal	Nominal	-/-				-/-
§15.407(a) RSS - 247 (6.2.1.1) RSS - 247 (6.2.2.1) RSS - 247 (6.2.3.1) RSS - 247 (6.2.4.1)	Maximum output power (conducted & radiated)	Nominal	Nominal	☒	☐	☐	☐	-/-
§15.407(a) RSS - 247 (6.2.1.1) RSS - 247 (6.2.2.1) RSS - 247 (6.2.3.1) RSS - 247 (6.2.4.1)	Power spectral density	Nominal	Nominal	☒	☐	☐	☐	-/-
RSS - 247 (6.2.4.1)	Spectrum bandwidth 6dB bandwidth	Nominal	Nominal	☒	☐	☐	☐	-/-
§15.407(a) RSS - 247 (6.2.1.2)	Spectrum bandwidth 26dB bandwidth	Nominal	Nominal	☒	☐	☐	☐	-/-
RSS Gen clause 6.6	Spectrum bandwidth 99% bandwidth	Nominal	Nominal	-/-				-/-
§15.205 RSS - 247 (6.2.1.2) RSS - 247 (6.2.2.2) RSS - 247 (6.2.3.2) RSS - 247 (6.2.4.2)	Band edge compliance radiated	Nominal	Nominal	☐	☐	☒	☐	-/-
§15.407(b) RSS - 247 (6.2.1.2) RSS - 247 (6.2.2.2) RSS - 247 (6.2.3.2) RSS - 247 (6.2.4.2)	TX spurious emissions radiated	Nominal	Nominal	☒	☐	☐	☐	-/-
§15.109 RSS-Gen	RX spurious emissions radiated	Nominal	Nominal	☒	☐	☐	☐	-/-
§15.209(a) RSS-Gen	Spurious emissions radiated < 30 MHz	Nominal	Nominal	☒	☐	☐	☐	-/-
§15.107(a) §15.207	Spurious emissions conducted emissions < 30 MHz	Nominal	Nominal	☒	☐	☐	☐	-/-

Notes:

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

10 Additional comments

Reference documents: Configuration_Instruction_FCC

Special test descriptions: -/-

Configuration descriptions: 2 active chains with power setting tp=20 and Neratec CAVITY BP Filter 105072
The device supports a-mode and n20-mode.

Provided channels:

Channels with 20 MHz channel bandwidth:

U-NII-3 (5725 MHz to 5850 MHz) center frequency					
f_c / MHz	**5745**	5765	**5785**	5805	**5825**

Note: The channels used for the tests were marked in bold in the list.

Test mode:

☐ No test mode available.
Iperf was used to ping another device with the largest support packet size

☒ 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.

11 Measurement results

11.1 Identify worst case data rate

Measurement:

All modes of the module will be measured with an average power meter to identify the maximum transmission power on mid channel. In the case that only one or two channels are available, only these will be measured.

In further tests only the identified worst case modulation scheme or bandwidth will be measured.

Measurement parameters:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	3 MHz
Video bandwidth:	3 MHz
Trace mode:	Max hold
Used test setup:	See chapter 6.4 – A
Measurement uncertainty:	See chapter 8

Results:

OFDM – mode	Modulation scheme / bandwidth					
	U-NII-1 & U-NII-2A		U-NII-2C		U-NII-3	
	Low channel	high channel	Low channel	high channel	Low channel	high channel
20 MHz channel bandwidth	-/-	-/-	-/-	-/-	6 Mbit/s	6 Mbit/s

11.2 Antenna gain

Limits:

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

Declared antenna gain:

Huber & Suhner SPA-5600/40/14/0/V_2 with 14 dBi

Note:
All measurement results are only valid with the antenna setup Neratec CAVITY BP Filter 105072 + Huber & Suhner SPA-5600/40/14/0/V_2

Results:

The conducted output power limit should be reduced from 30 dBm to 22 dBm based on the high antenna gain. The maximum power spectral density limit should be reduced from 30 dBm to 22 dBm based on the high antenna gain.

11.3 Duty cycle

Description:

The duty cycle is necessary to compute the maximum power during an actual transmission. The shown plots and values are to show an example of the measurement procedure. The real value is measured direct during the power measurement or power density measurement. The correction value is shown in each plot of these measurements.

Measurement:

Measurement parameter	
According to: KDB789033 D02, B.	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	10 MHz
Video bandwidth:	10 MHz
Span:	Zero
Trace mode:	Video trigger / view / single sweep
Used test setup:	See chapter 6.4 – A
Measurement uncertainty:	See chapter 8

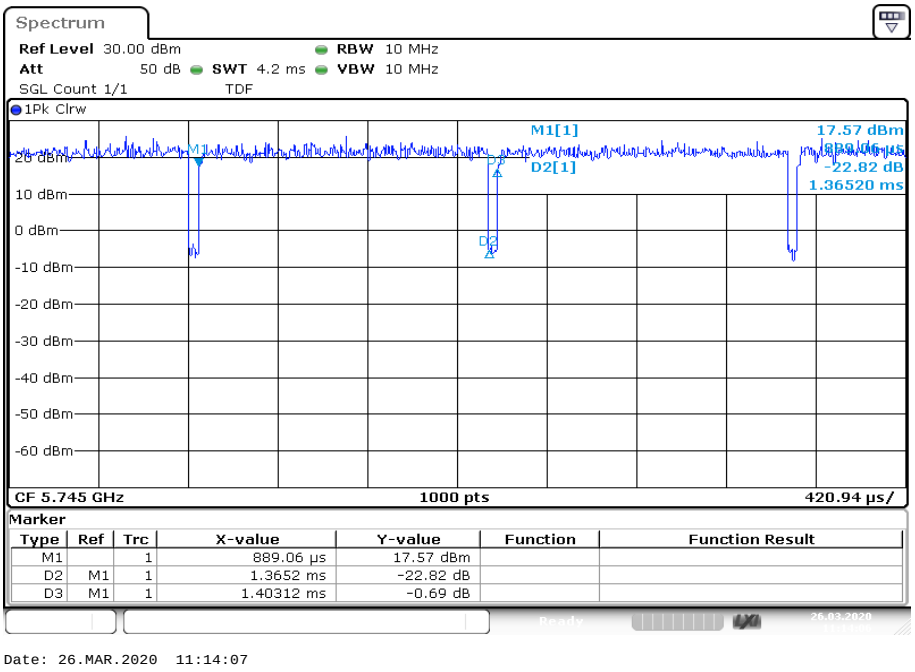
Results:

Duty cycle and correction factor:

OFDM – mode	Calculation method			
	T_{on} ($D2_{plot}$) * 100 / $T_{complete}$ ($D3_{plot}$) = duty cycle 10 * log(duty cycle) = correction factor			
	T_{on} ($D2_{plot}$)	**$T_{complete}$ ($D3_{plot}$)**	**Duty cycle**	**Correction factor**
20 MHz channel bandwidth	1.3652 ms	1.4031 ms	97.3 %	0.12 dB

Plots:

Plot 1: duty cycle of the transmitter; 20 MHz; lowest channel



Duty cycle and correction factor (example for one channel & one antenna port). The correction factor will be measured and calculated for all channels and antennas during the measurement session.

11.4 Maximum output power

11.4.1 Maximum output power according to FCC requirements

Description:

Measurement of the maximum output power conducted

Measurement:

Measurement parameter	
According to: KDB789033 D02, E.2.e.	
Detector:	RMS
Sweep time:	≥10*(swp points)*(total on/off time)
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Span:	> EBW
Trace mode:	Max hold
Analyzer function	Band power / channel power Interval > 26 dB EBW
Used test setup:	See chapter 6.4 – A
Measurement uncertainty:	See chapter 8

Limits:

Radiated output power	Conducted output power for mobile equipment
Conducted power + 6 dBi antenna gain	5.725-5.85 GHz with 30 dBm / 1 W
Re-calculated limit for 14 dBi antenna gain	22 dBm / 158 mW

Results: a-mode

Maximum output power conducted [dBm]			
ANT 1	**U-NII-3 (5725 MHz to 5850 MHz)**		
	Lowest channel	Middle channel	Highest channel
	17.12	17.38	16.26
ANT 2	**U-NII-3 (5725 MHz to 5850 MHz)**		
	Lowest channel	Middle channel	Highest channel
	16.69	16.92	16.54

	Maximum output power conducted calculated [dBm]		
ANT 1 + 2	**U-NII-3 (5725 MHz to 5850 MHz)**		
	Lowest channel	Middle channel	Highest channel
	19.92	20.17	19.41

Results:

The conducted output power limit should be reduced from 30 dBm to 22 dBm based on the high antenna gain. The maximum power spectral density limit should be reduced from 30 dBm to 22 dBm based on the high antenna gain.

Results: n20-mode

Maximum output power conducted [dBm]			
ANT 1	**U-NII-3 (5725 MHz to 5850 MHz)**		
	Lowest channel	Middle channel	Highest channel
	17.1	17.6	18.0
ANT 2	**U-NII-3 (5725 MHz to 5850 MHz)**		
	Lowest channel	Middle channel	Highest channel
	17.4	18.2	17.5

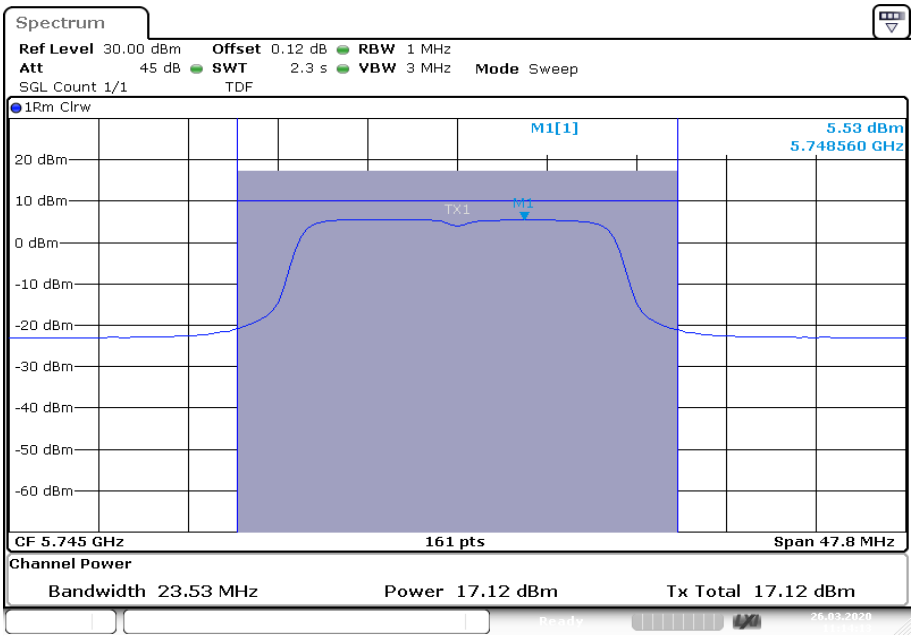
ANT 1 + 2	**Maximum output power conducted calculated [dBm]**		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	20.3	20.9	20.8

Results:

The conducted output power limit should be reduced from 30 dBm to 22 dBm based on the high antenna gain. The maximum power spectral density limit should be reduced from 30 dBm to 22 dBm based on the high antenna gain.

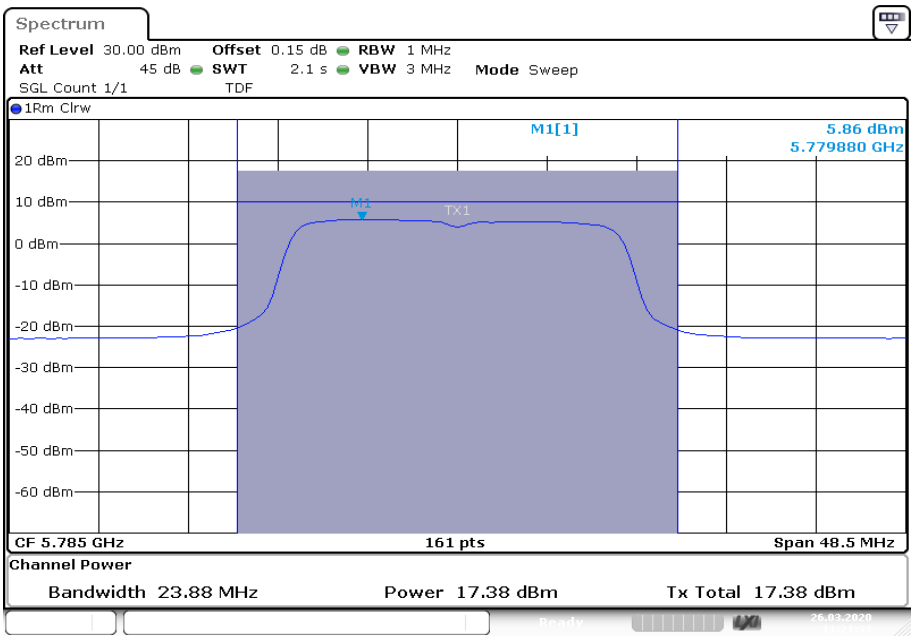
Plots: antenna 1, a-mode

Plot 1: U-NII-3; lowest channel



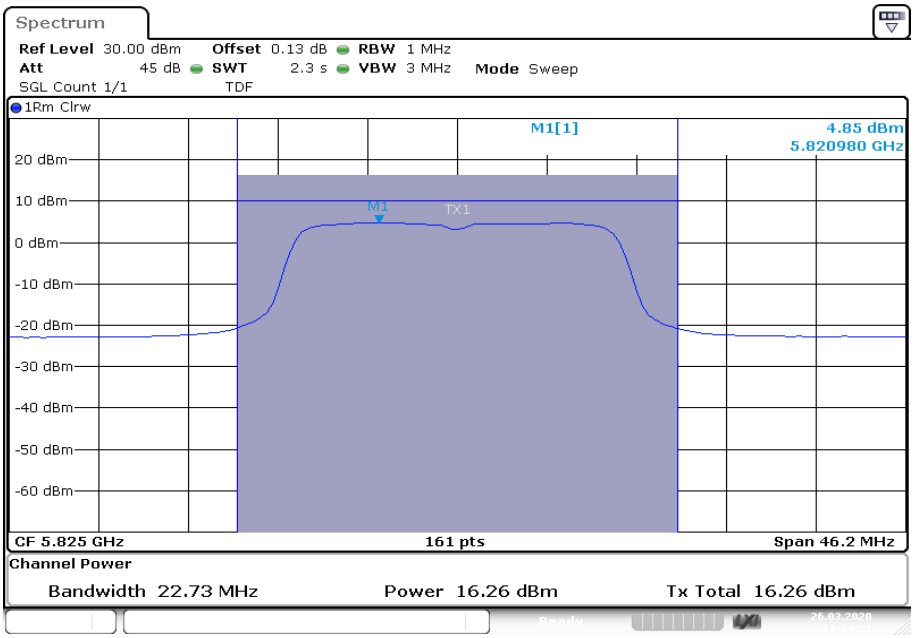
Date: 26.MAR.2020 11:14:13

Plot 2: U-NII-3; middle channel



Date: 26.MAR.2020 11:21:34

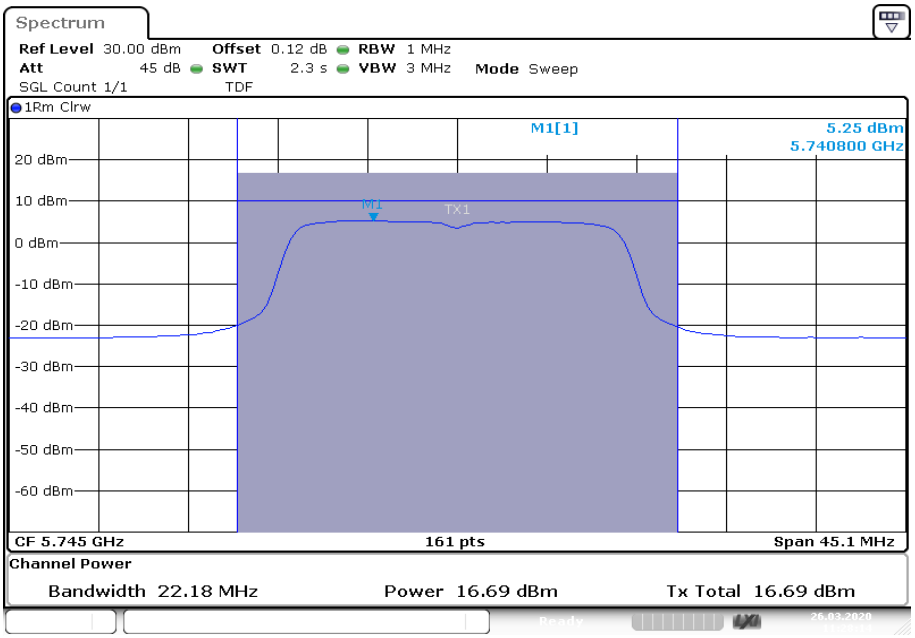
Plot 3: U-NII-3; highest channel



Date: 26.MAR.2020 11:24:21

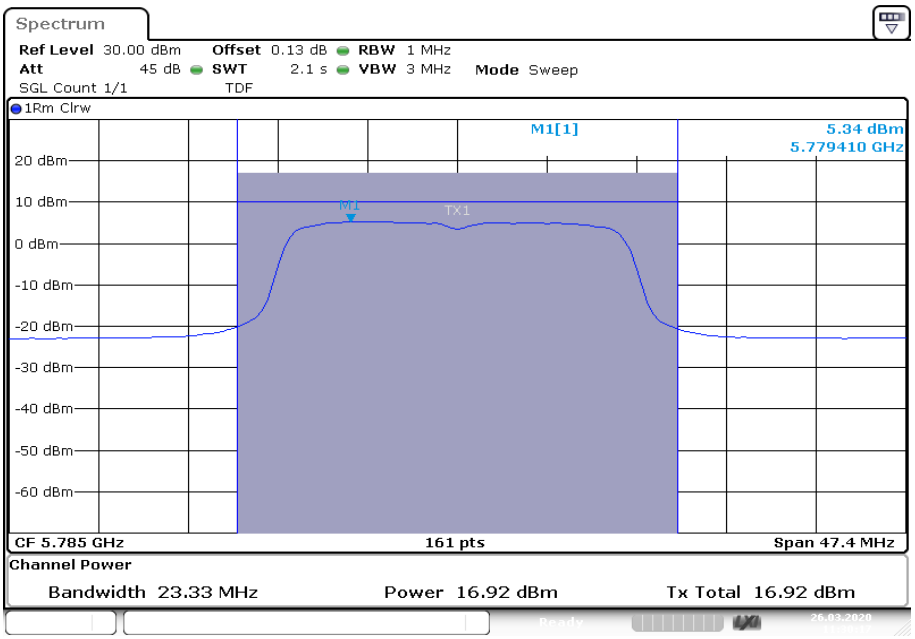
Plots: antenna 2, a-mode

Plot 1: U-NII-3; lowest channel



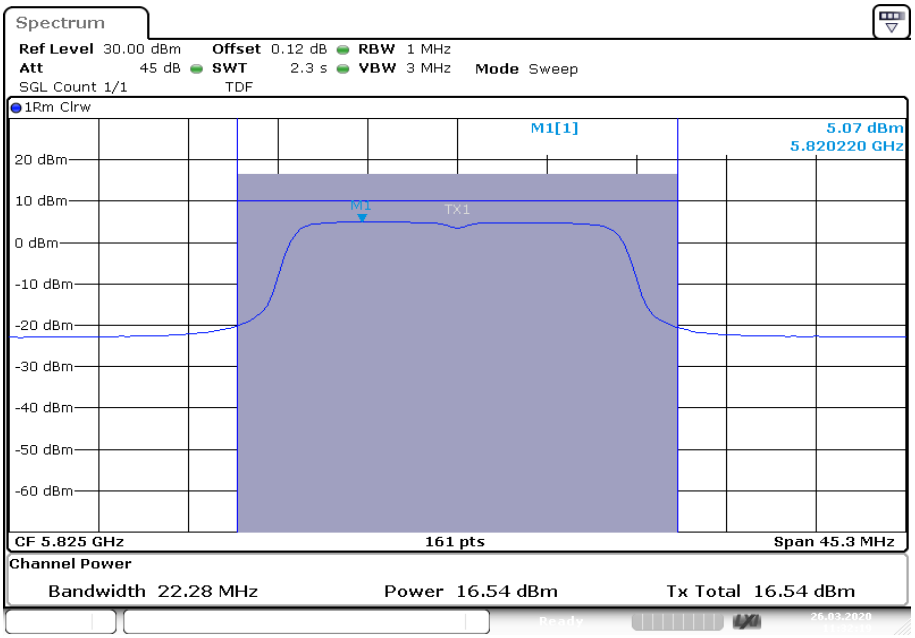
Date: 26.MAR.2020 11:28:15

Plot 2: U-NII-3; middle channel



Date: 26.MAR.2020 11:30:18

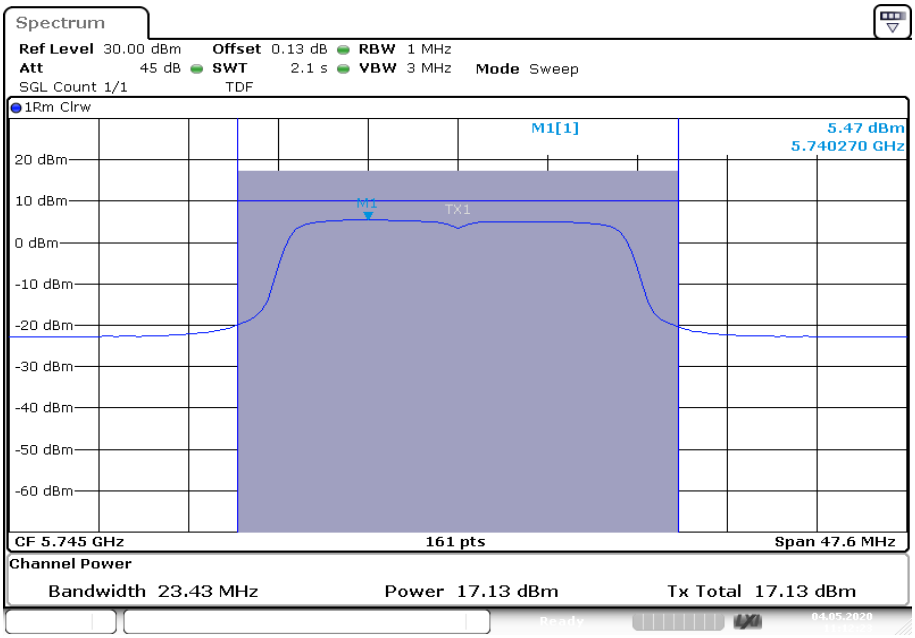
Plot 3: U-NII-3; highest channel



Date: 26.MAR.2020 11:32:20

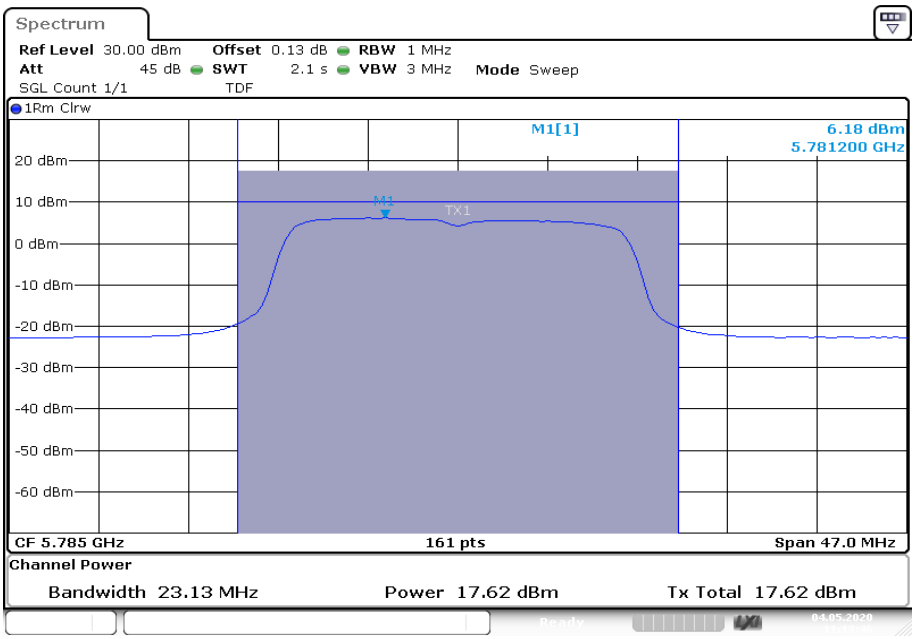
Plots: antenna 1, n20-mode

Plot 1: U-NII-3; lowest channel



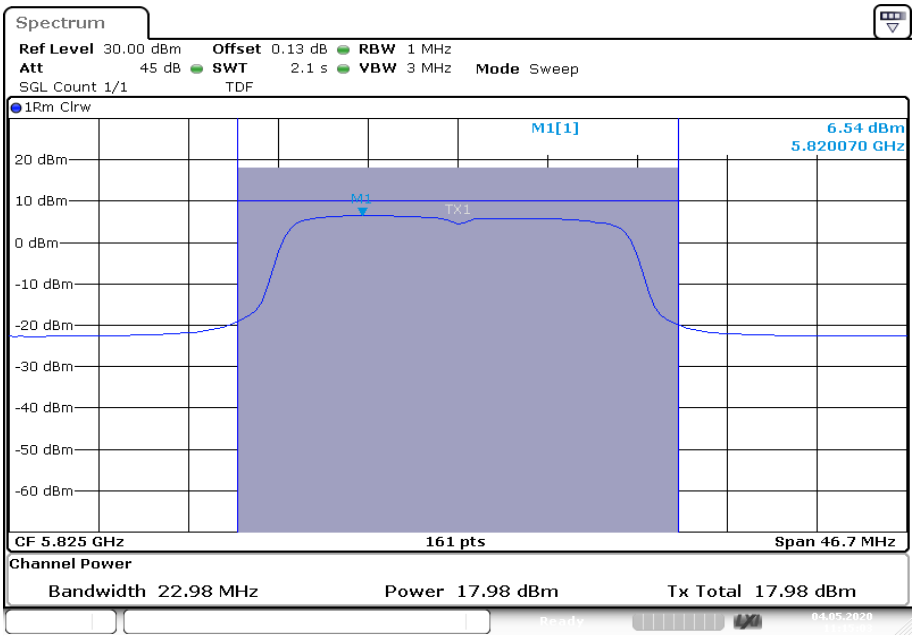
Date: 4.MAY.2020 11:12:24

Plot 2: U-NII-3; middle channel



Date: 4.MAY.2020 11:13:47

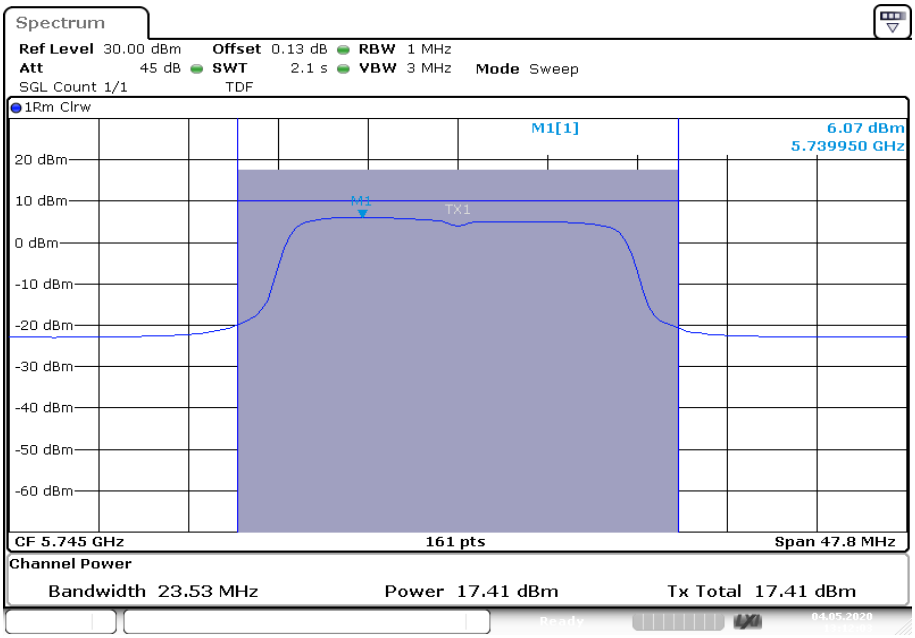
Plot 3: U-NII-3; highest channel



Date: 4.MAY.2020 11:15:04

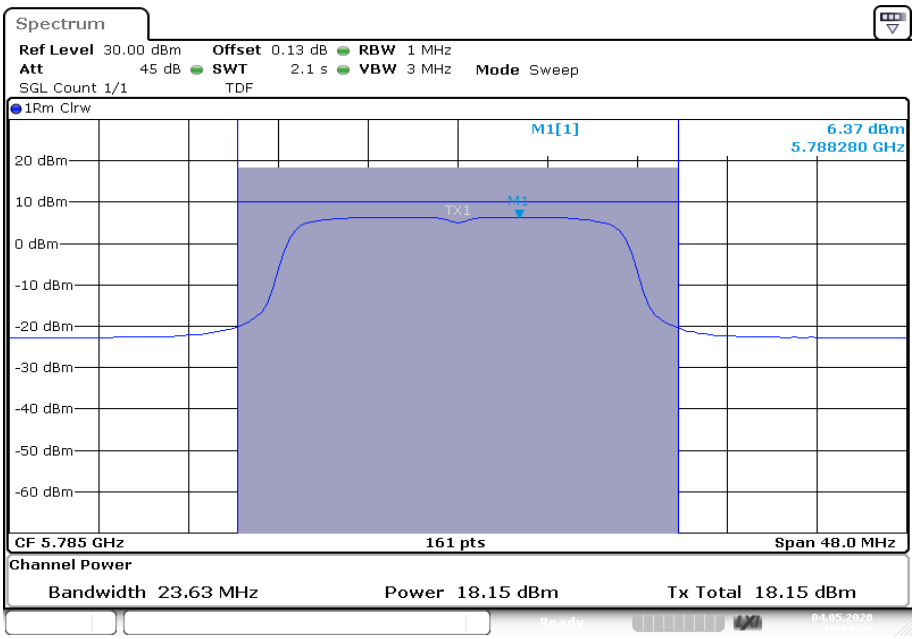
Plots: antenna 2, n20-mode

Plot 1: U-NII-3; lowest channel



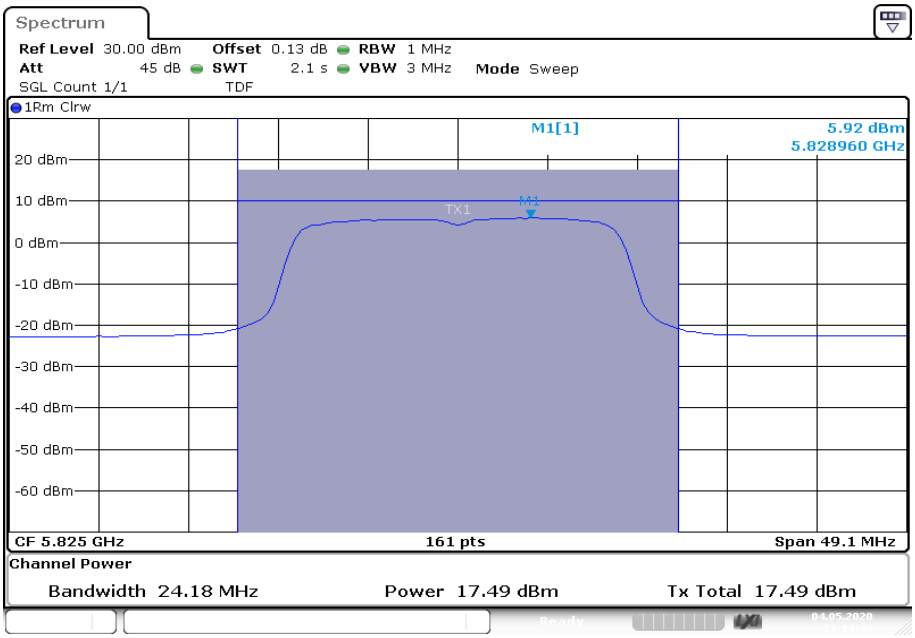
Date: 4.MAY.2020 13:12:03

Plot 2: U-NII-3; middle channel



Date: 4.MAY.2020 13:13:22

Plot 3: U-NII-3; highest channel



Date: 4.MAY.2020 13:14:50

11.4.2 Maximum output power according to IC requirements

Description:

Measurement of the maximum output power conduced + radiated

Measurement:

Measurement parameter	
Detector:	RMS
Sweep time:	≥10*(swp points)*(total on/off time)
Resolution bandwidth:	1 MHz
Video bandwidth:	≥ 3 MHz
Span:	> EBW
Trace mode:	Max hold
Analyzer function	Band power / channel power Interval > 99% OBW
Used test setup:	See chapter 6.4 – A
Measurement uncertainty:	See chapter 8

Limits:

Radiated output power	Conducted output power for mobile equipment
Conducted power + 6 dBi antenna gain 5.725-5.825 GHz	5.725-5.85 GHz with 30 dBm / 1 W
Re-calculated limit for 14 dBi antenna gain	22 dBm / 158 mW

Results: a-mode

Maximum output power conducted [dBm]			
ANT 1	**U-NII-3 (5725 MHz to 5850 MHz)**		
	Lowest channel	Middle channel	Highest channel
	17.01	17.32	16.19
ANT 2	**U-NII-3 (5725 MHz to 5850 MHz)**		
	Lowest channel	Middle channel	Highest channel
	16.61	16.98	16.42

Maximum output power conducted calculated [dBm]			
ANT 1 + 2	**U-NII-3 (5725 MHz to 5850 MHz)**		
	Lowest channel	Middle channel	Highest channel
	19.82	20.16	19.32

Results:

The conducted output power limit should be reduced from 30 dBm to 22 dBm based on the high antenna gain. The maximum power spectral density limit should be reduced from 30 dBm to 22 dBm based on the high antenna gain.

Results: n20-mode

Maximum output power conducted [dBm]			
ANT 1	**U-NII-3 (5725 MHz to 5850 MHz)**		
	Lowest channel	Middle channel	Highest channel
	17.0	17.7	17.9
ANT 2	**U-NII-3 (5725 MHz to 5850 MHz)**		
	Lowest channel	Middle channel	Highest channel
	17.3	18.0	17.7

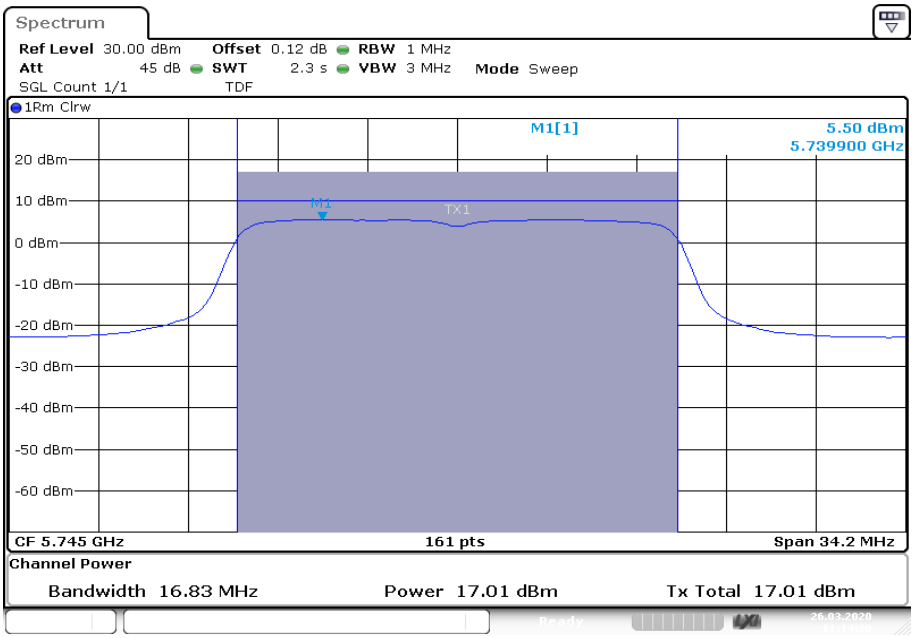
Maximum output power conducted calculated [dBm]			
ANT 1 + 2	**U-NII-3 (5725 MHz to 5850 MHz)**		
	Lowest channel	Middle channel	Highest channel
	20.2	20.9	20.8

Results:

The conducted output power limit should be reduced from 30 dBm to 22 dBm based on the high antenna gain. The maximum power spectral density limit should be reduced from 30 dBm to 22 dBm based on the high antenna gain.

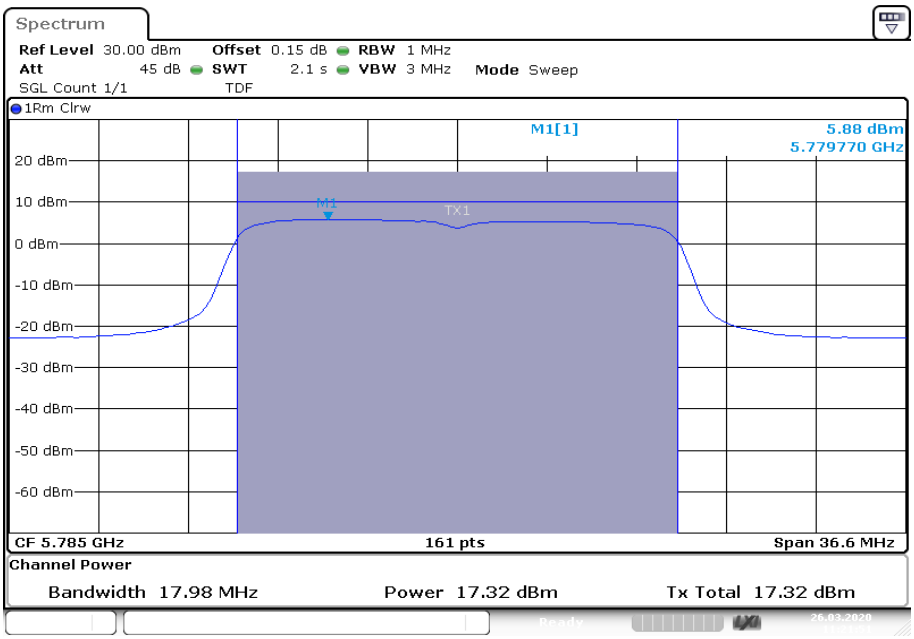
Plots: antenna 1, a-mode

Plot 1: U-NII-3; lowest channel



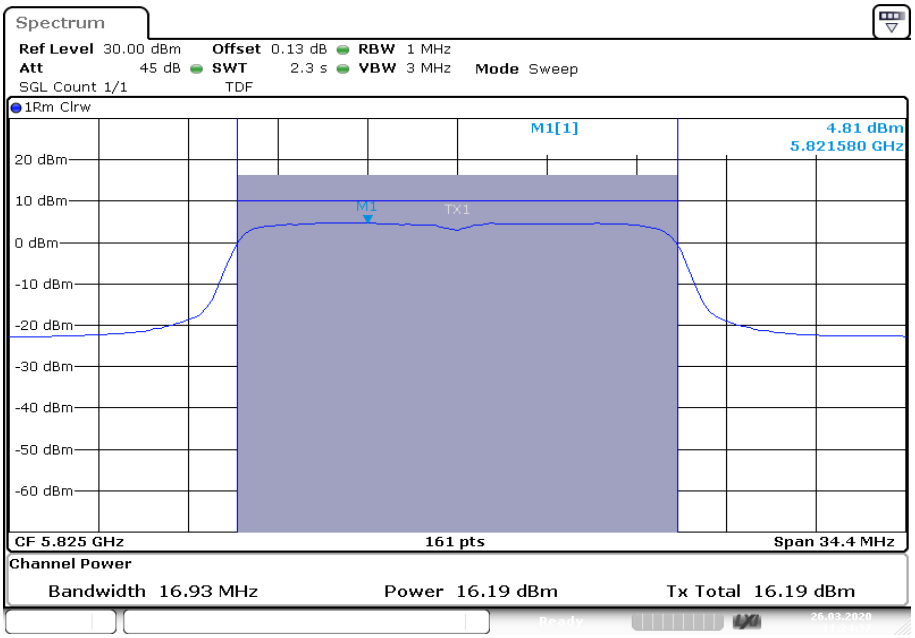
Date: 26.MAR.2020 11:14:30

Plot 2: U-NII-3; middle channel



Date: 26.MAR.2020 11:21:52

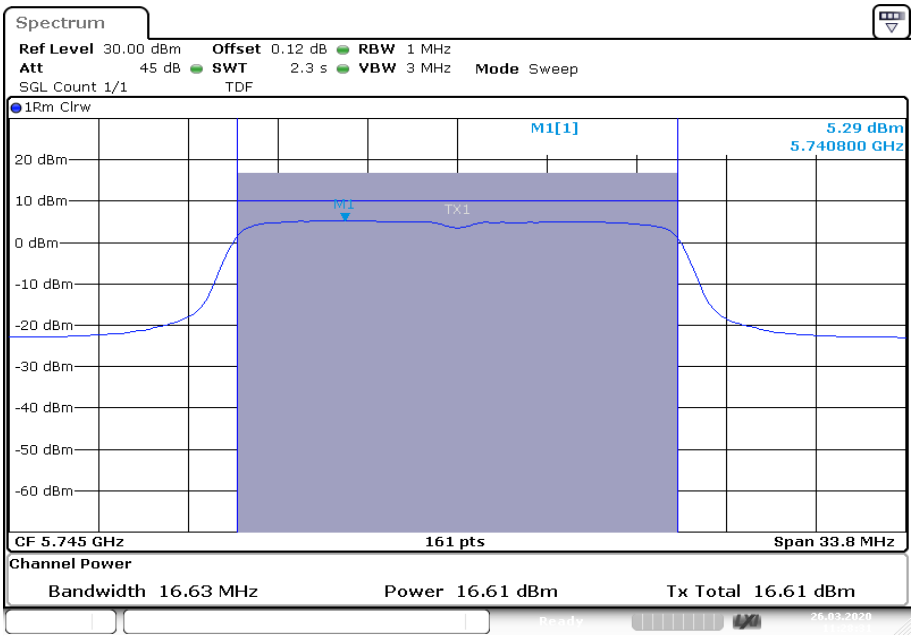
Plot 3: U-NII-3; highest channel



Date: 26.MAR.2020 11:24:38

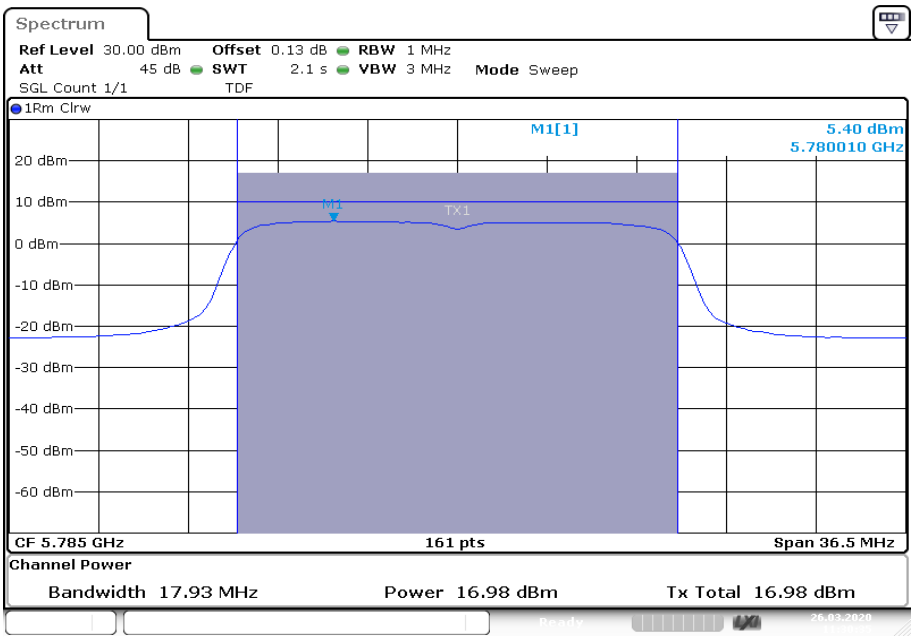
Plots: antenna 2, a-mode

Plot 1: U-NII-3; lowest channel



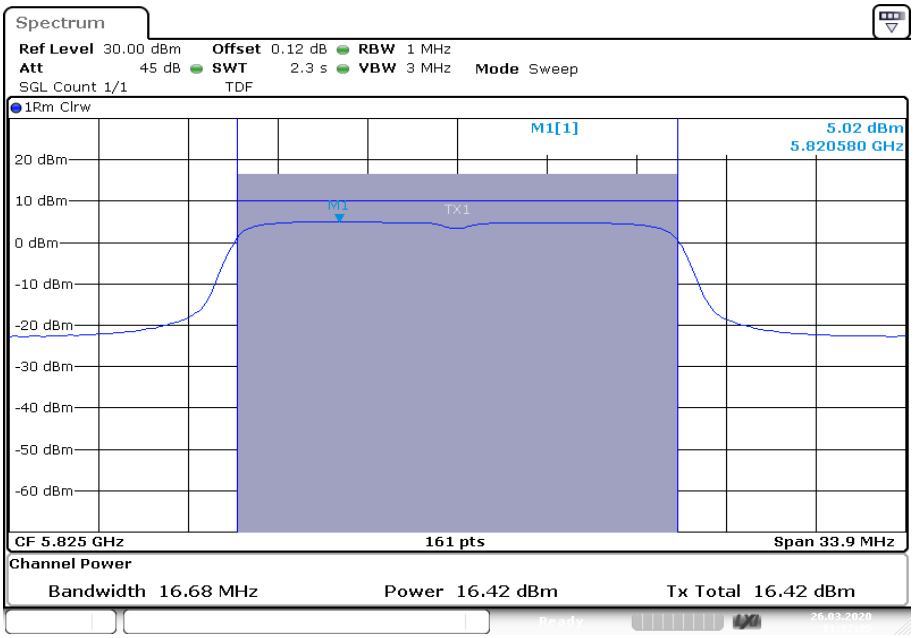
Date: 26.MAR.2020 11:28:32

Plot 2: U-NII-3; middle channel



Date: 26.MAR.2020 11:30:36

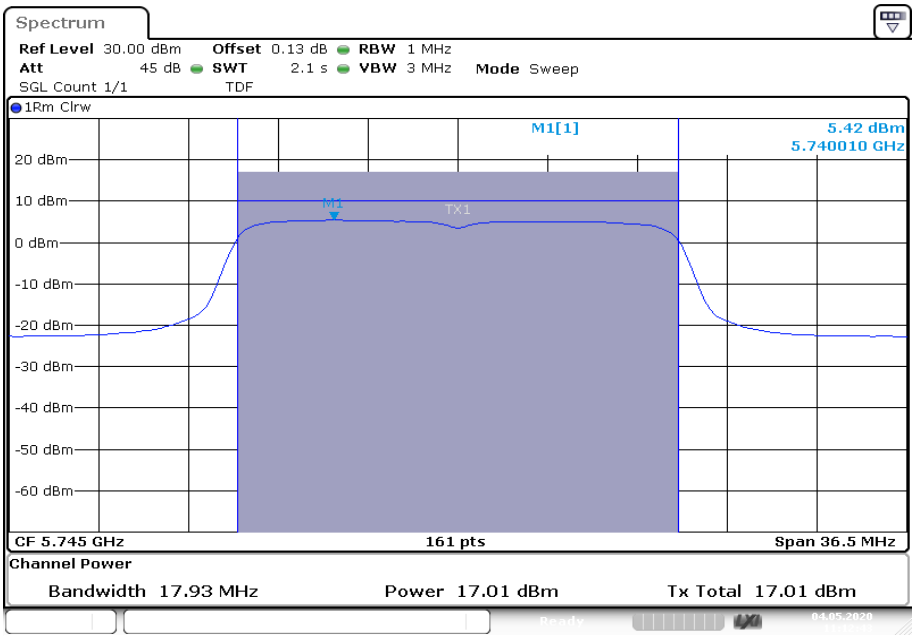
Plot 3: U-NII-3; highest channel



Date: 26.MAR.2020 11:32:36

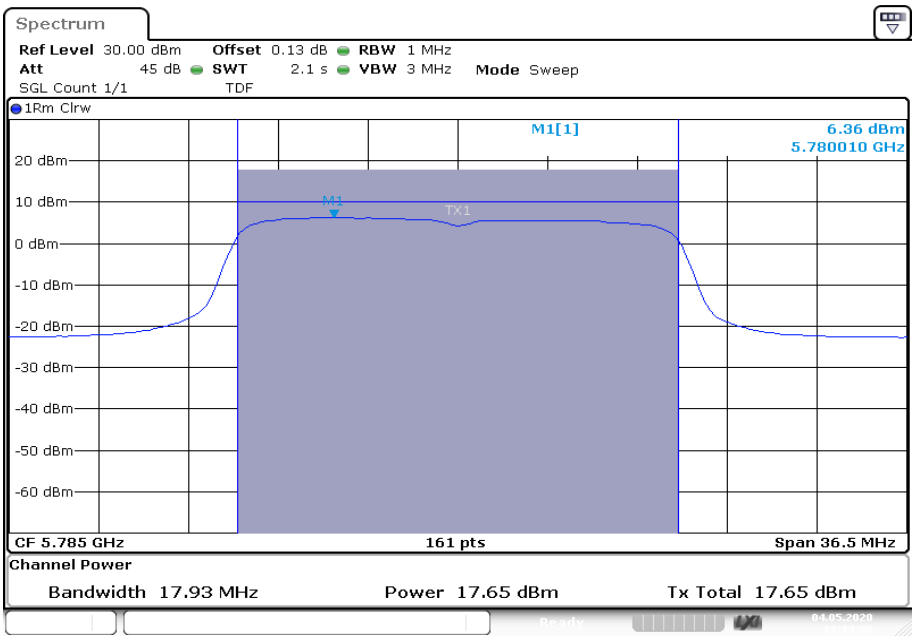
Plots: antenna 1, n20-mode

Plot 1: U-NII-3; lowest channel



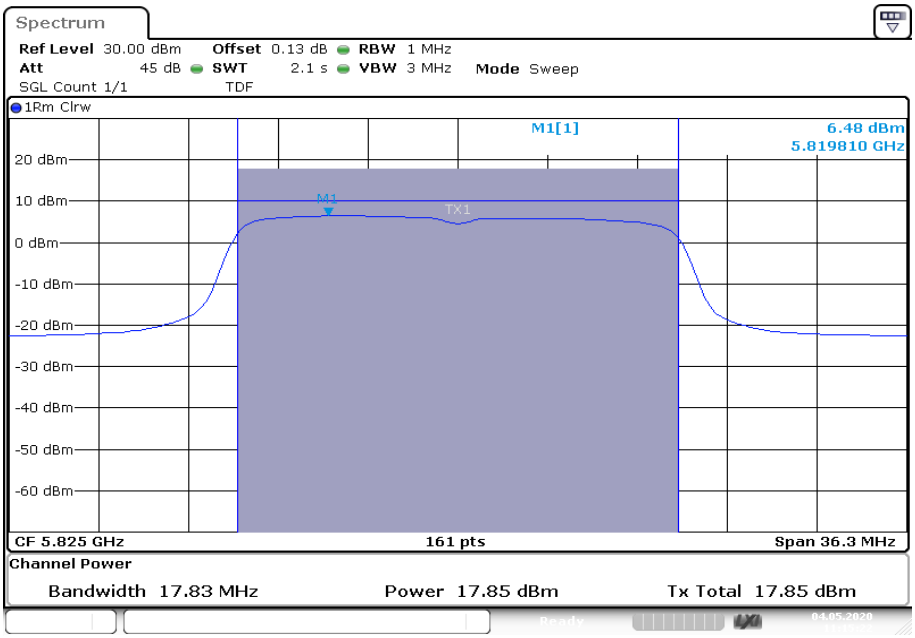
Date: 4.MAY.2020 11:12:43

Plot 2: U-NII-3; middle channel



Date: 4.MAY.2020 11:14:07

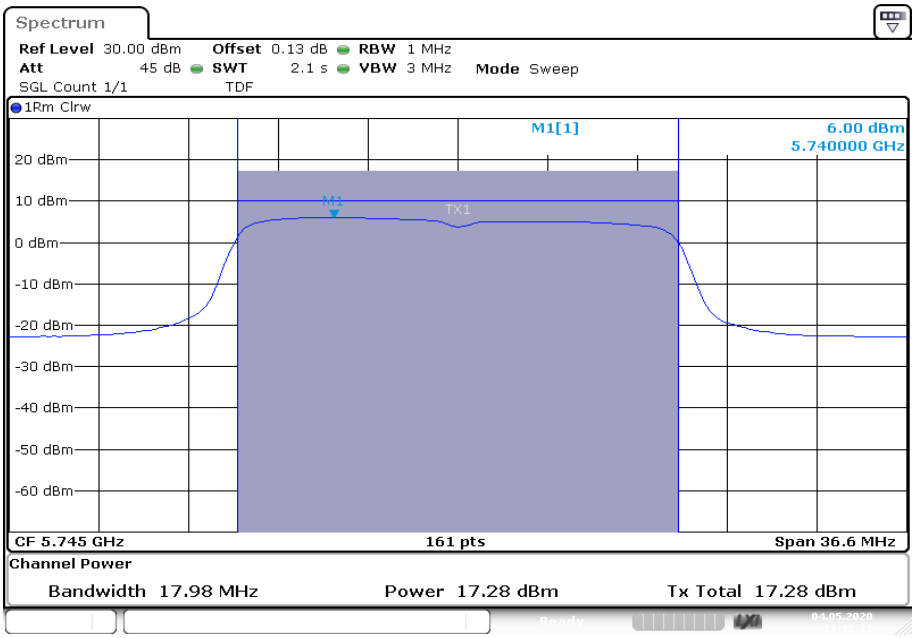
Plot 3: U-NII-3; highest channel



Date: 4.MAY.2020 11:15:22

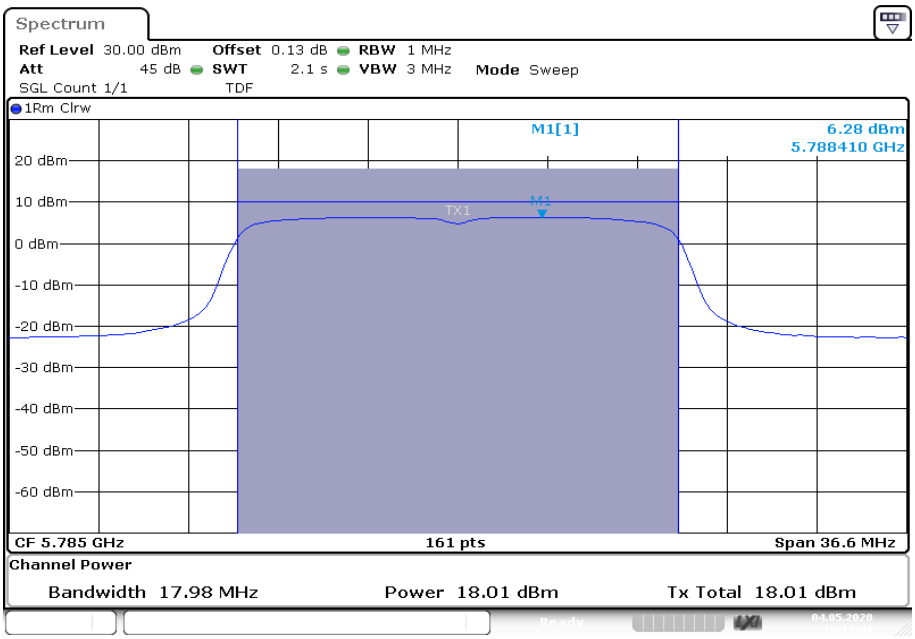
Plots: antenna 2, n20-mode

Plot 1: U-NII-3; lowest channel



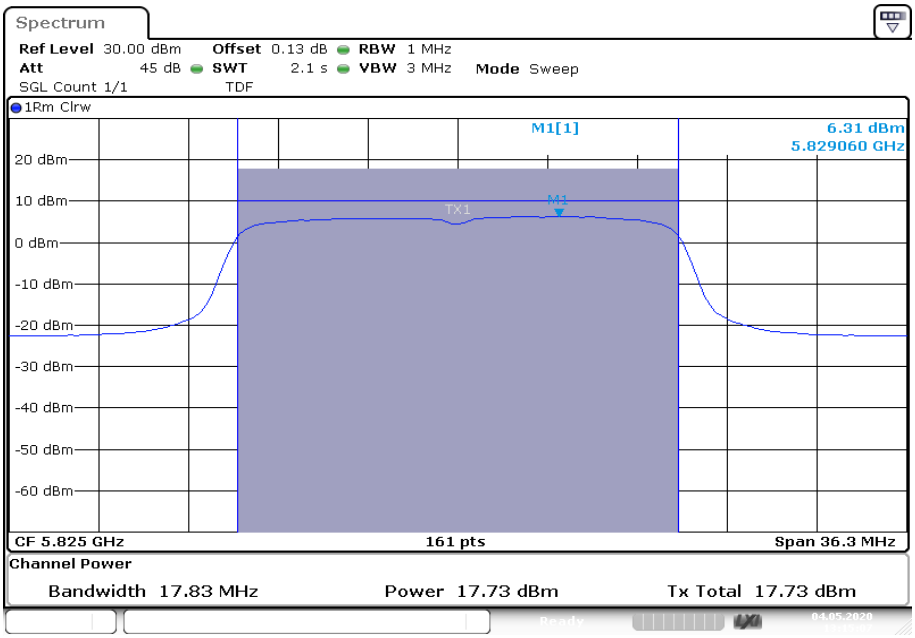
Date: 4.MAY.2020 13:12:21

Plot 2: U-NII-3; middle channel



Date: 4.MAY.2020 13:13:41

Plot 3: U-NII-3; highest channel



Date: 4.MAY.2020 13:15:07

11.5 Power spectral density

11.5.1 Power spectral density according to FCC requirements

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.	
Detector:	RMS
Sweep time:	≥10*(swp points)*(total on/off time)
Resolution bandwidth:	1 MHz for U-NII-1/2A & 2C 500 kHz for U-NII-3
Video bandwidth:	≥ 3xRBW
Span:	> EBW
Trace mode:	Max hold
Used test setup:	See chapter 6.4 – A
Measurement uncertainty:	See chapter 8

Limits:

Power Spectral Density
power spectral density conducted ≤ 30 dBm in any 500 kHz band (band 5725 – 5850 MHz)
Re-calculated limit for antenna gain > 6 dBi; 30 dBm – 8 dB = 22 dBm

Results: a-mode

Ant 1	Power spectral density (dBm/500kHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	2.60	2.91	2.01

Ant 2	Power spectral density (dBm/500kHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	2.34	2.49	2.10

Ant 1 + 2	Power spectral density calculated (dBm/500kHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	5.77	5.72	5.07

Results:

The conducted output power limit should be reduced from 30 dBm to 22 dBm based on the high antenna gain. The maximum power spectral density limit should be reduced from 30 dBm to 22 dBm based on the high antenna gain.

Results: n20-mode

Ant 1	Power spectral density (dBm/500kHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	2.6	3.5	3.6

Ant 2	Power spectral density (dBm/500kHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	3.0	3.4	3.4

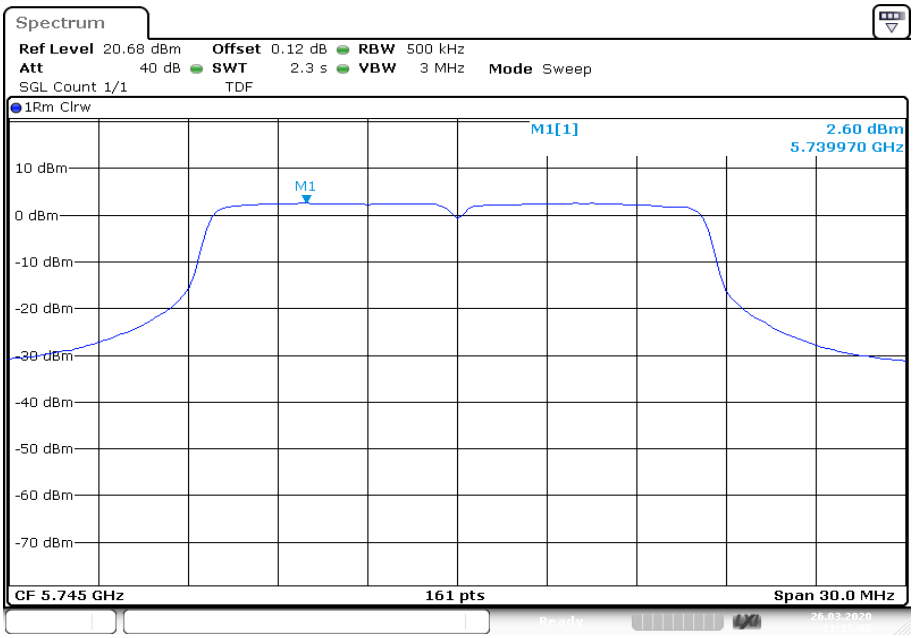
Ant 1 + 2	Power spectral density calculated (dBm/500kHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	5.8	6.5	6.5

Results:

The conducted output power limit should be reduced from 30 dBm to 22 dBm based on the high antenna gain. The maximum power spectral density limit should be reduced from 30 dBm to 22 dBm based on the high antenna gain.

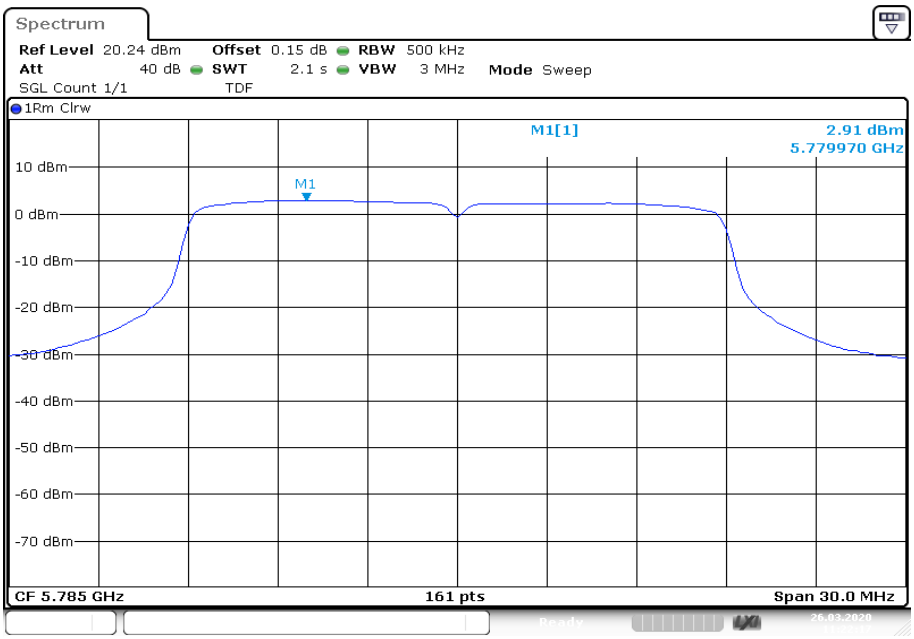
Plots: antenna 1, a-mode

Plot 1: U-NII-3; lowest channel



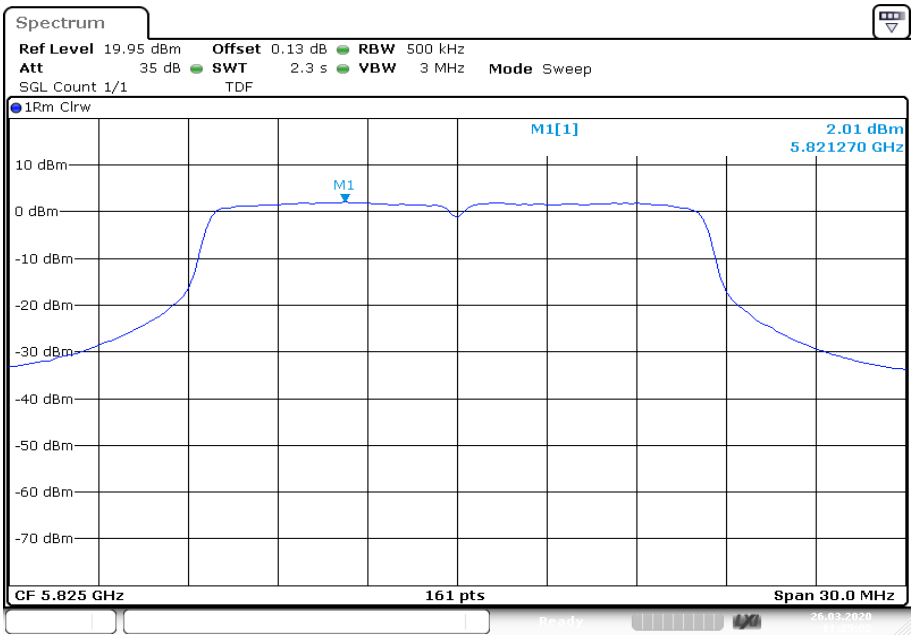
Date: 26.MAR.2020 11:15:06

Plot 2: U-NII-3; middle channel



Date: 26.MAR.2020 11:22:18

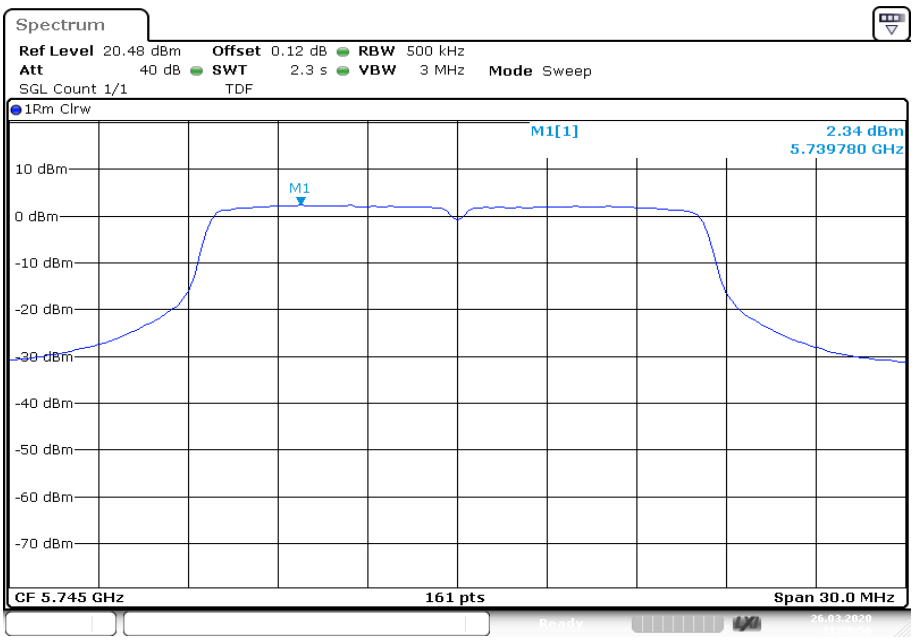
Plot 3: U-NII-3; highest channel



Date: 26.MAR.2020 11:25:03

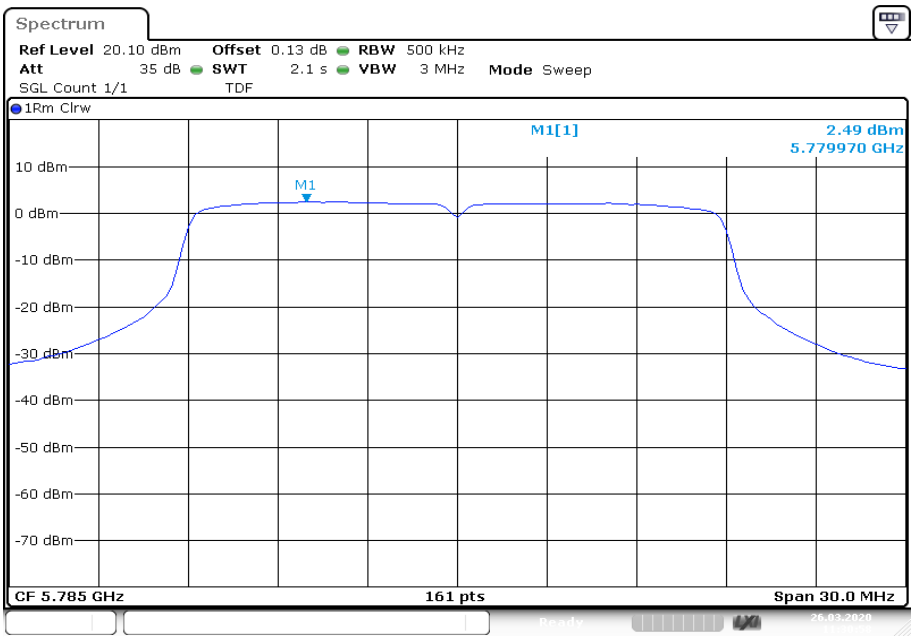
Plots: antenna 2, a-mode

Plot 1: U-NII-3; lowest channel



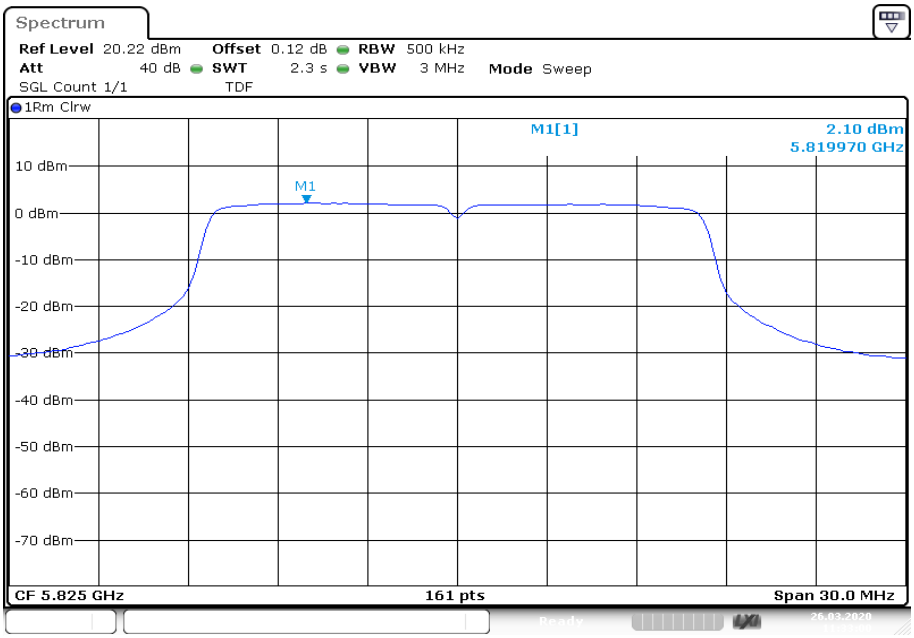
Date: 26.MAR.2020 11:28:57

Plot 2: U-NII-3; middle channel



Date: 26.MAR.2020 11:30:59

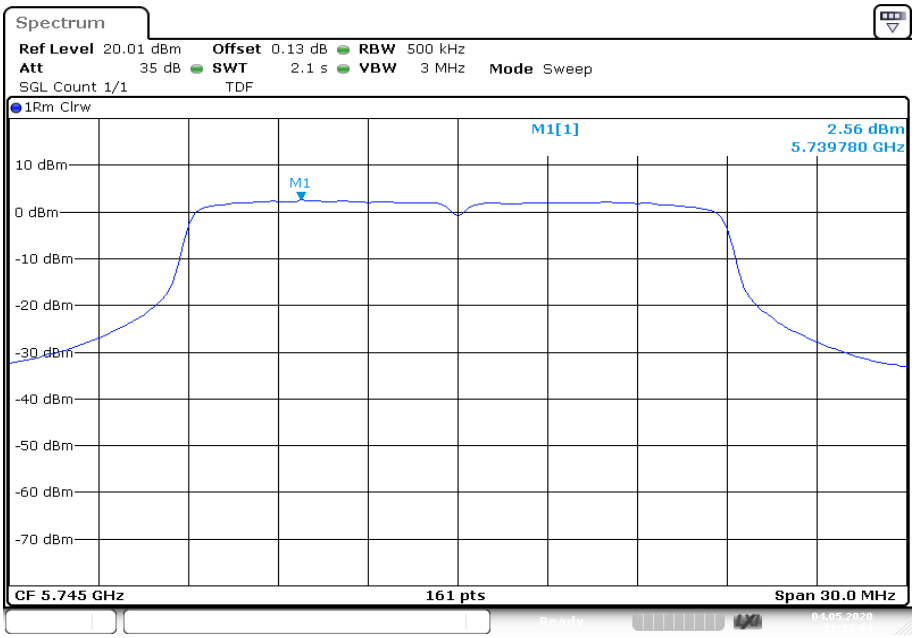
Plot 3: U-NII-3; highest channel



Date: 26.MAR.2020 11:33:00

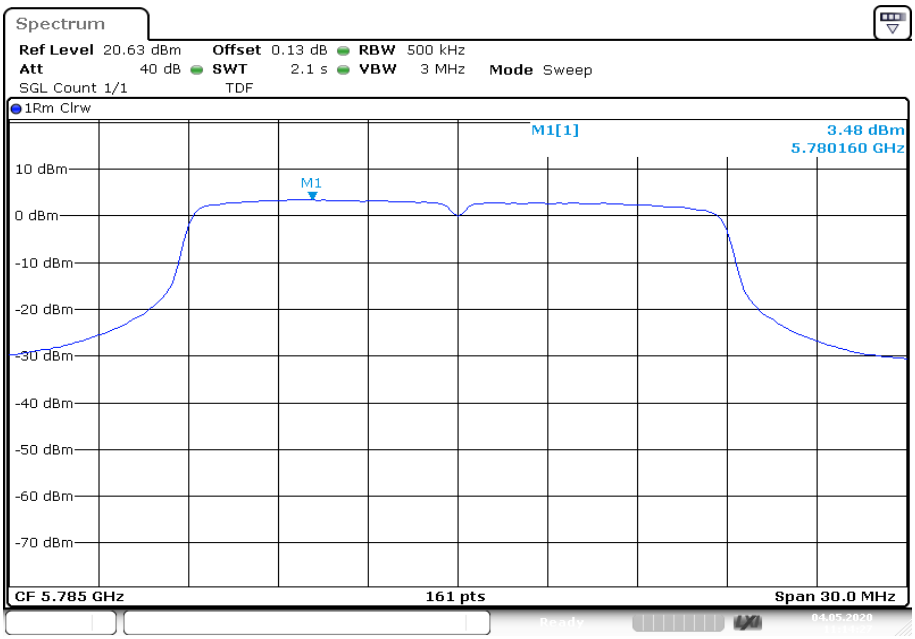
Plots: antenna 1, n20-mode

Plot 1: U-NII-3; lowest channel



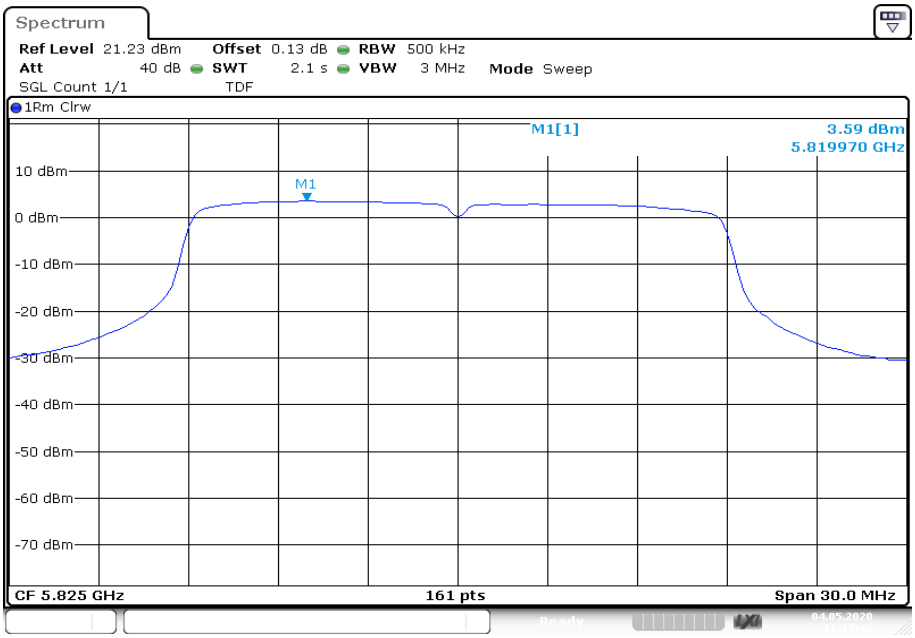
Date: 4.MAY.2020 11:13:05

Plot 2: U-NII-3; middle channel



Date: 4.MAY.2020 11:14:28

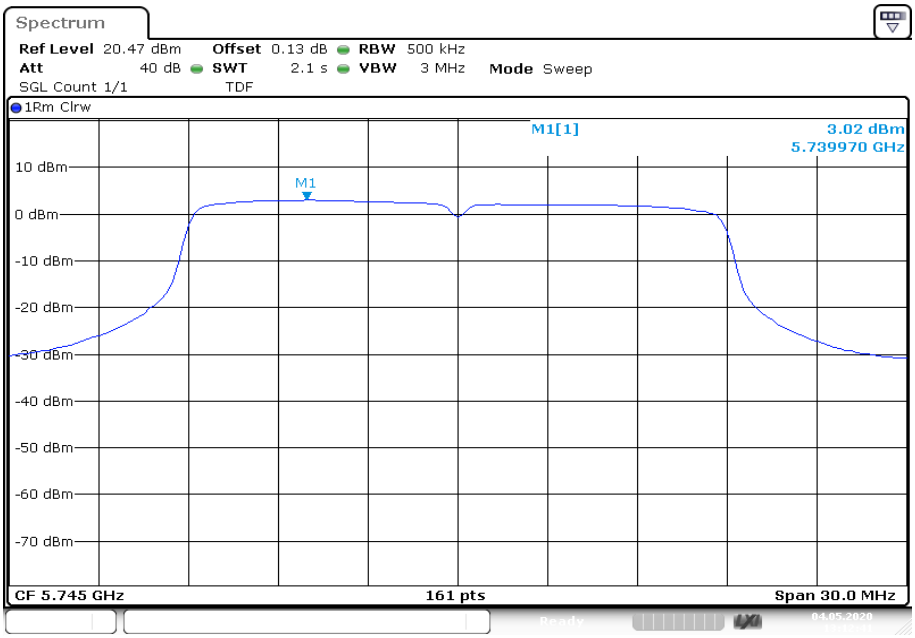
Plot 3: U-NII-3; highest channel



Date: 4.MAY.2020 11:15:43

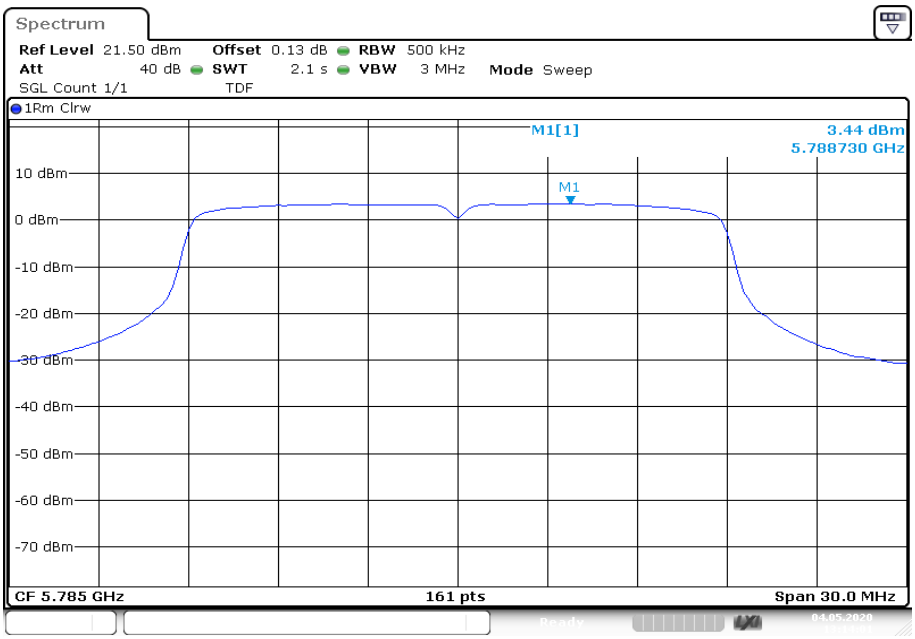
Plots: antenna 2, n20-mode

Plot 1: U-NII-3; lowest channel



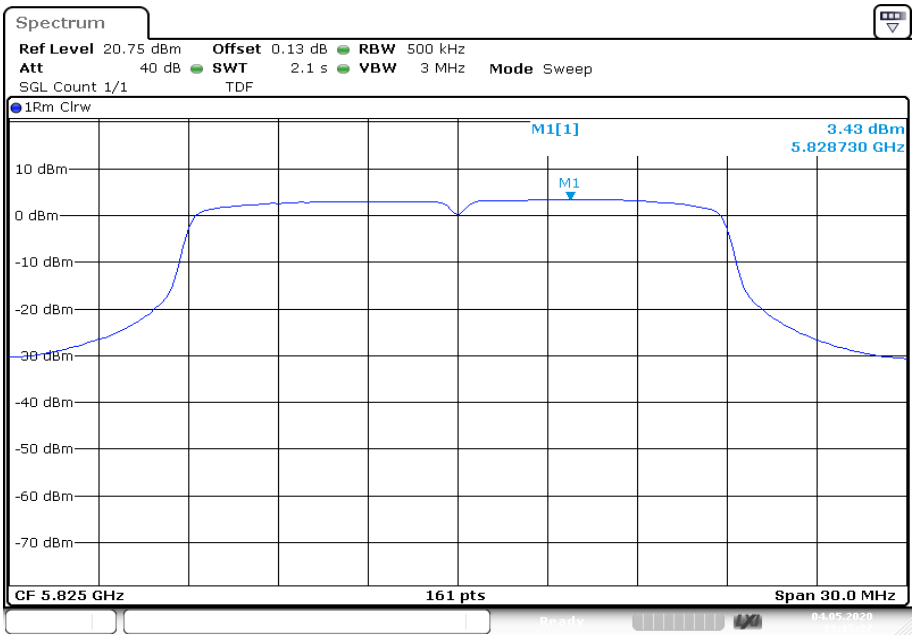
Date: 4.MAY.2020 13:12:42

Plot 2: U-NII-3; middle channel



Date: 4.MAY.2020 13:14:02

Plot 3: U-NII-3; highest channel



Date: 4.MAY.2020 13:15:28

11.5.2 Power spectral density according to IC requirements

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	
Detector:	RMS
Sweep time:	≥10*(swp points)*(total on/off time)
Resolution bandwidth:	500 kHz for U-NII-3
Video bandwidth:	≥ 3xRBW
Span:	> EBW
Trace mode:	Max hold
Used test setup:	See chapter 6.4 – A
Measurement uncertainty:	See chapter 8

Limits:

Power Spectral Density
power spectral density conducted ≤ 30 dBm in any 500 kHz band (band 5725 – 5850 MHz)
Re-calculated limit for antenna gain > 6 dBi; 30 dBm – 8 dB = 22 dBm

Results: a-mode

ANT 1	Power spectral density (dBm/500kHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	2.51	2.95	1.94

ANT 2	Power spectral density (dBm/500kHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	2.50	2.49	2.07

ANT 1 + 2	Power spectral density calculated (dBm/500kHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	5.52	5.74	5.02

Results:

The conducted output power limit should be reduced from 30 dBm to 22 dBm based on the high antenna gain. The maximum power spectral density limit should be reduced from 30 dBm to 22 dBm based on the high antenna gain.

Results: n20-mode

ANT 1	Power spectral density (dBm/500kHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	2.4	3.5	3.6

ANT 2	Power spectral density (dBm/500kHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	3.0	3.5	3.4

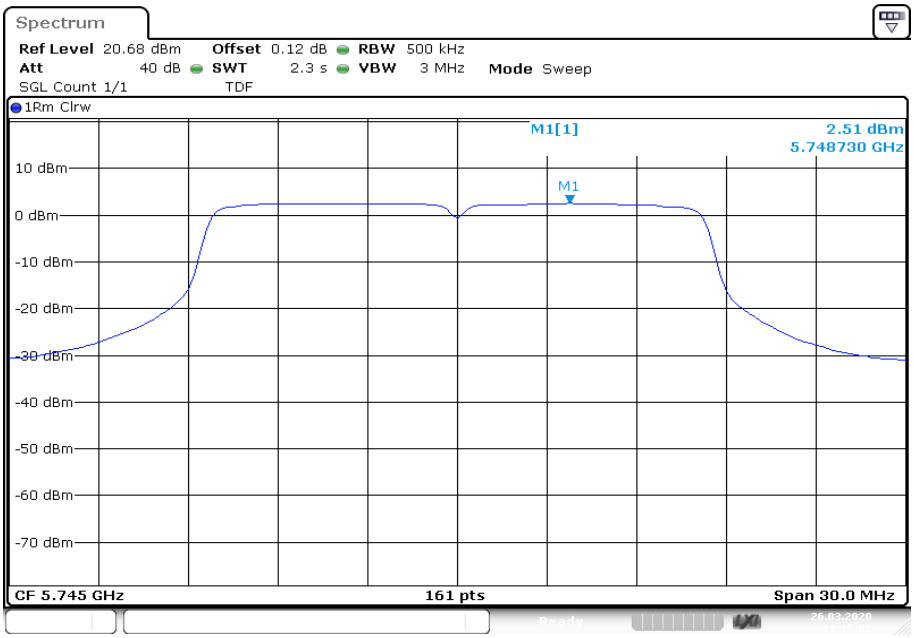
ANT 1 + 2	Power spectral density calculated (dBm/500kHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	5.7	6.5	6.5

Results:

The conducted output power limit should be reduced from 30 dBm to 22 dBm based on the high antenna gain. The maximum power spectral density limit should be reduced from 30 dBm to 22 dBm based on the high antenna gain.

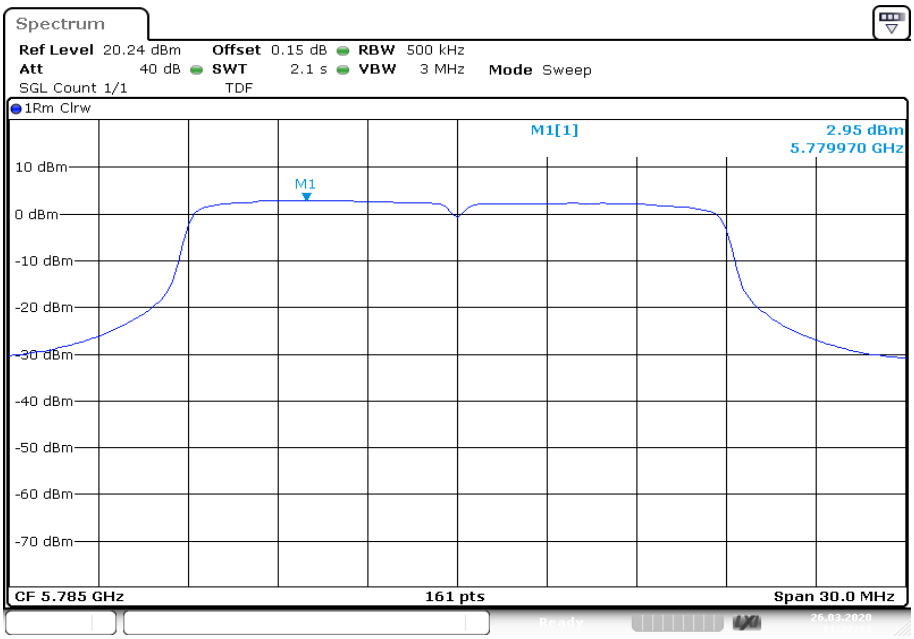
Plots: antenna 1, a-mode

Plot 1: U-NII-3; lowest channel



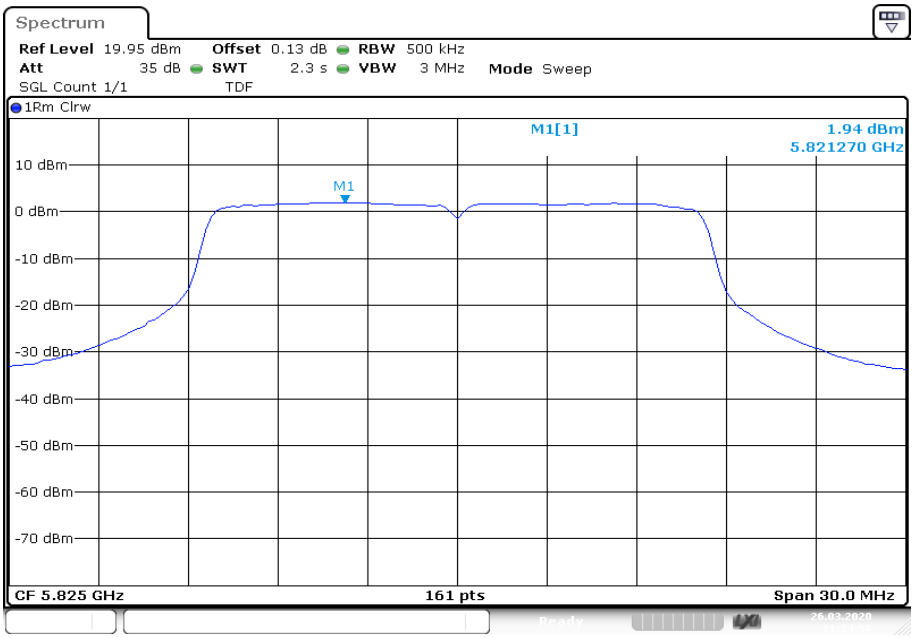
Date: 26.MAR.2020 11:15:03

Plot 2: U-NII-3; middle channel



Date: 26.MAR.2020 11:22:14

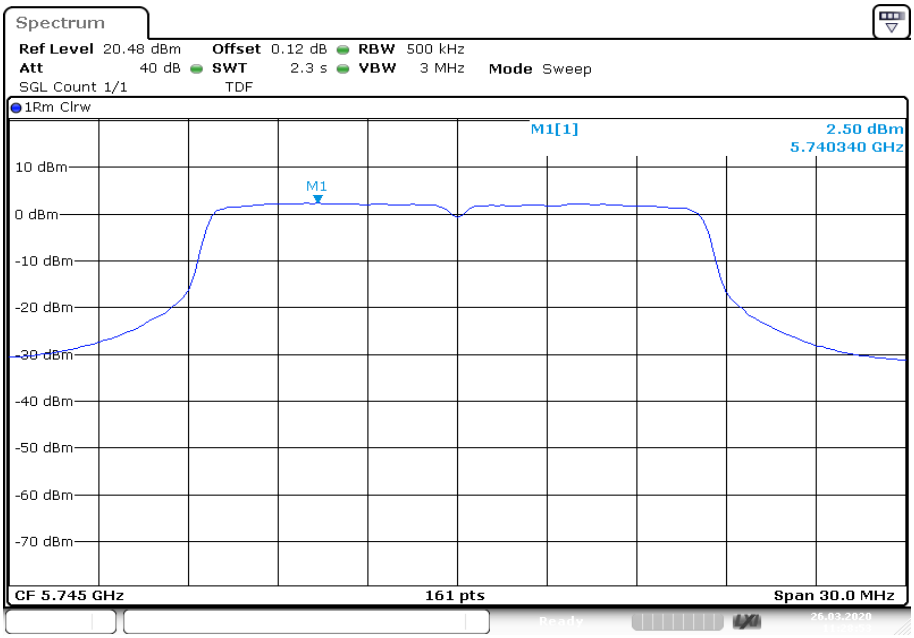
Plot 3: U-NII-3; highest channel



Date: 26.MAR.2020 11:24:59

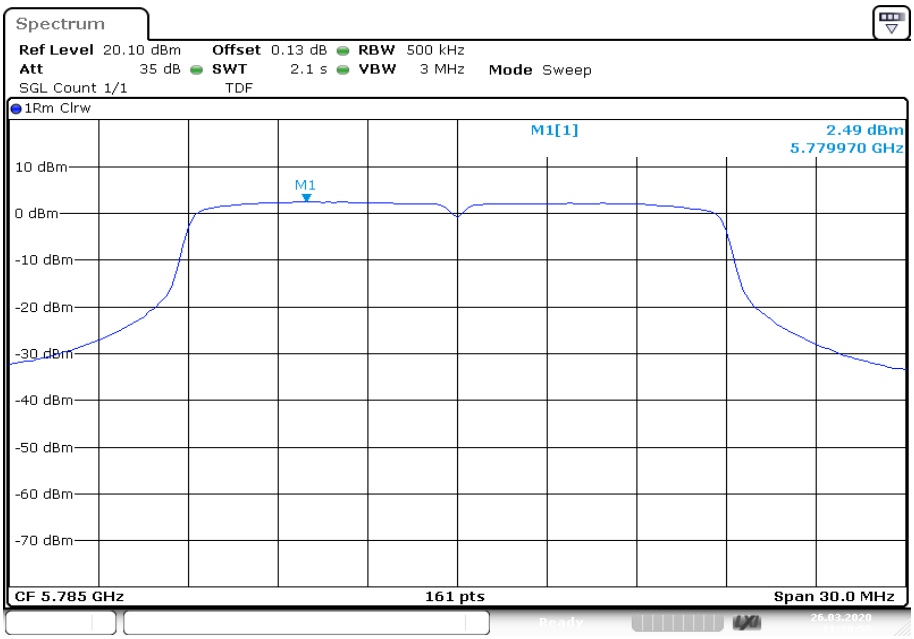
Plots: antenna 2, a-mode

Plot 1: U-NII-3; lowest channel



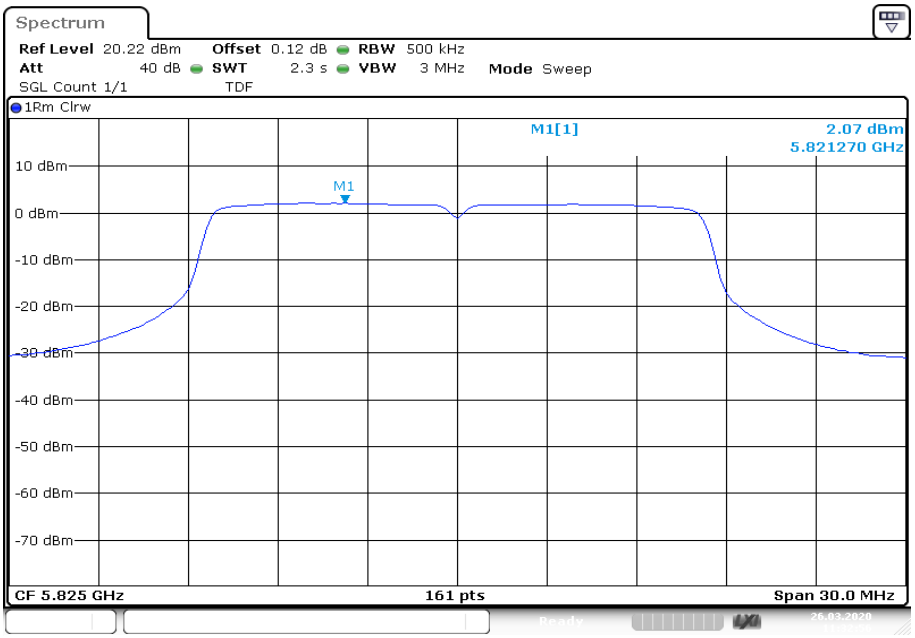
Date: 26.MAR.2020 11:28:53

Plot 2: U-NII-3; middle channel



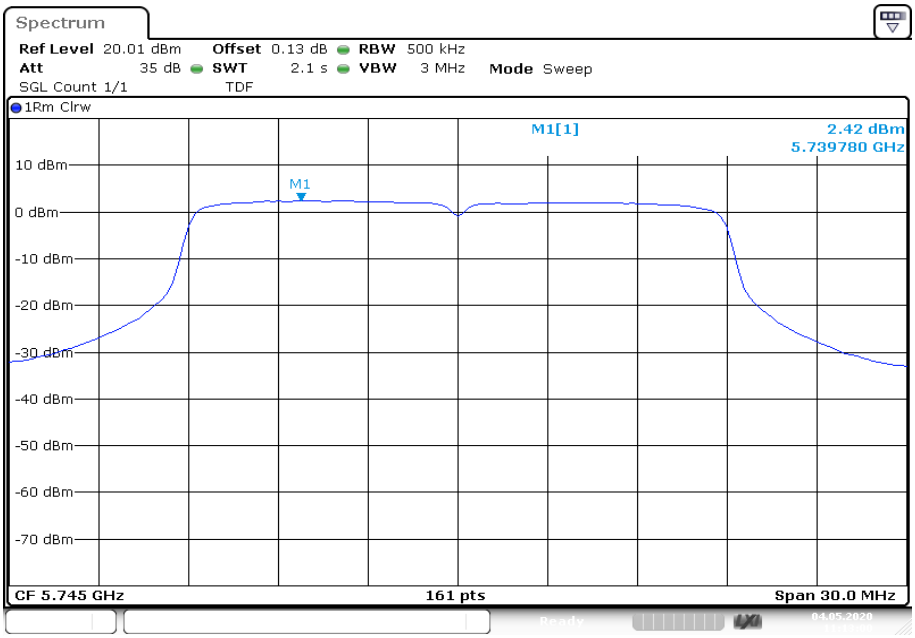
Date: 26.MAR.2020 11:30:56

Plot 3: U-NII-3; highest channel



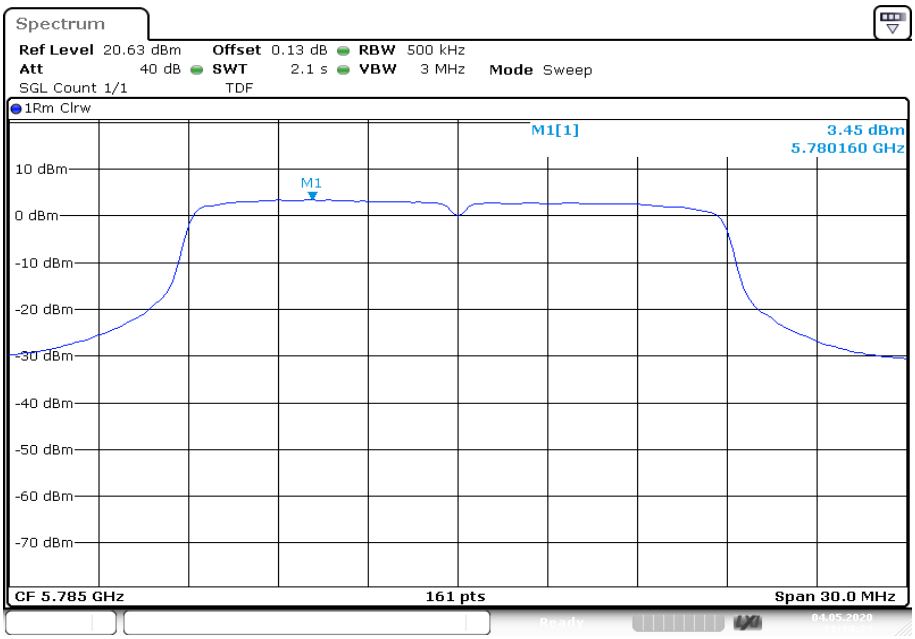
Plots: antenna 1, n20-mode

Plot 1: U-NII-3; lowest channel



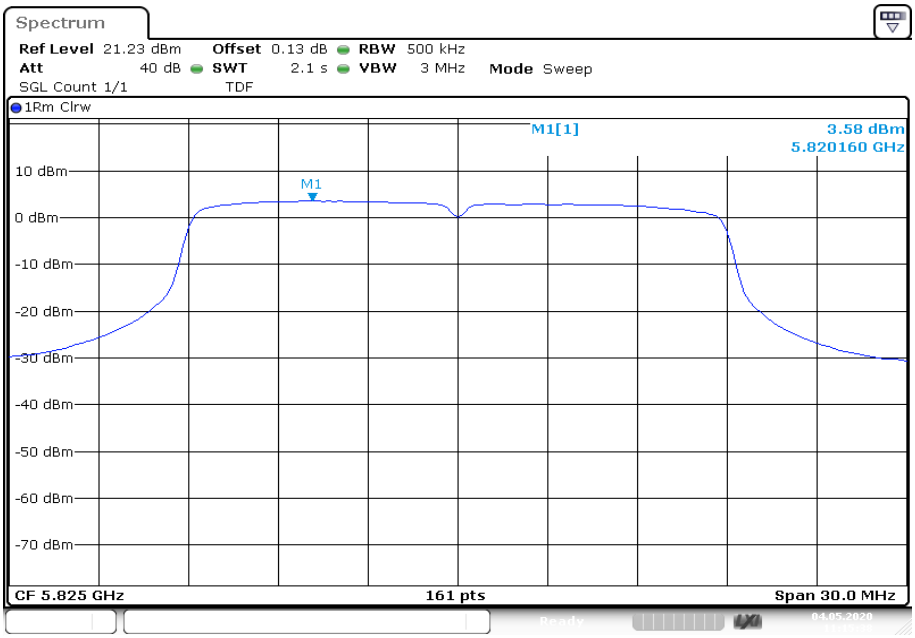
Date: 4.MAY.2020 11:13:00

Plot 2: U-NII-3; middle channel



Date: 4.MAY.2020 11:14:24

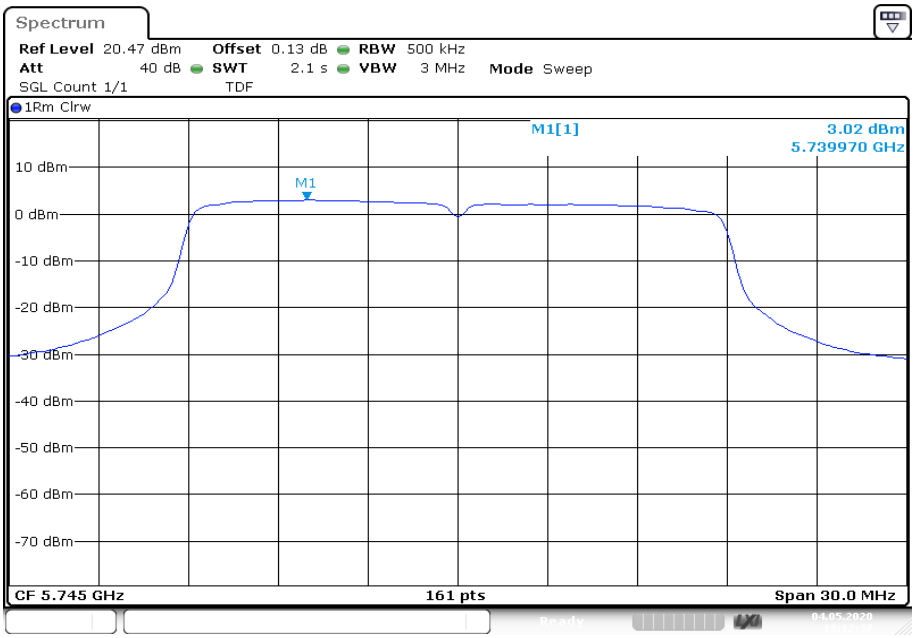
Plot 3: U-NII-3; highest channel



Date: 4.MAY.2020 11:15:39

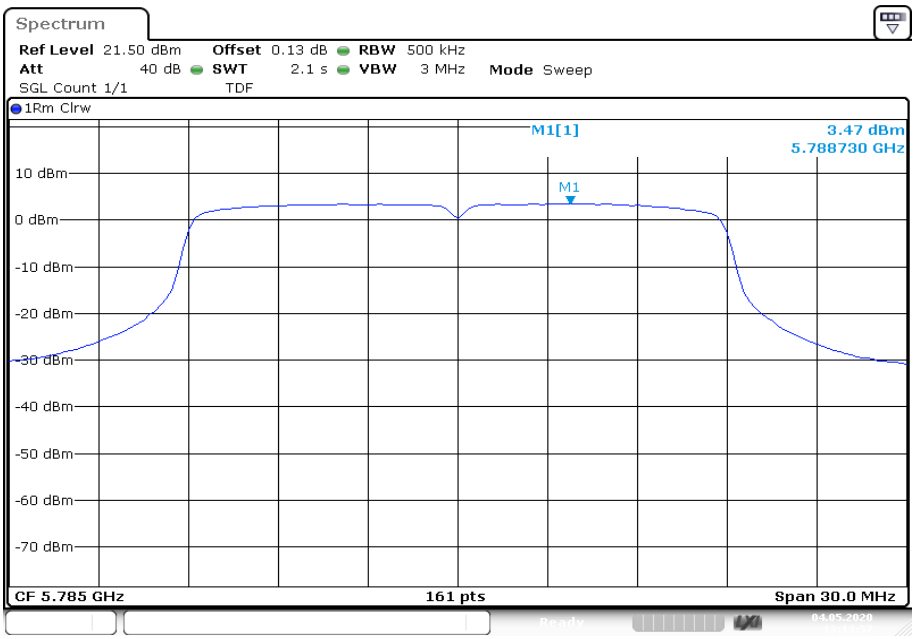
Plots: antenna 2, n20-mode

Plot 1: U-NII-3; lowest channel



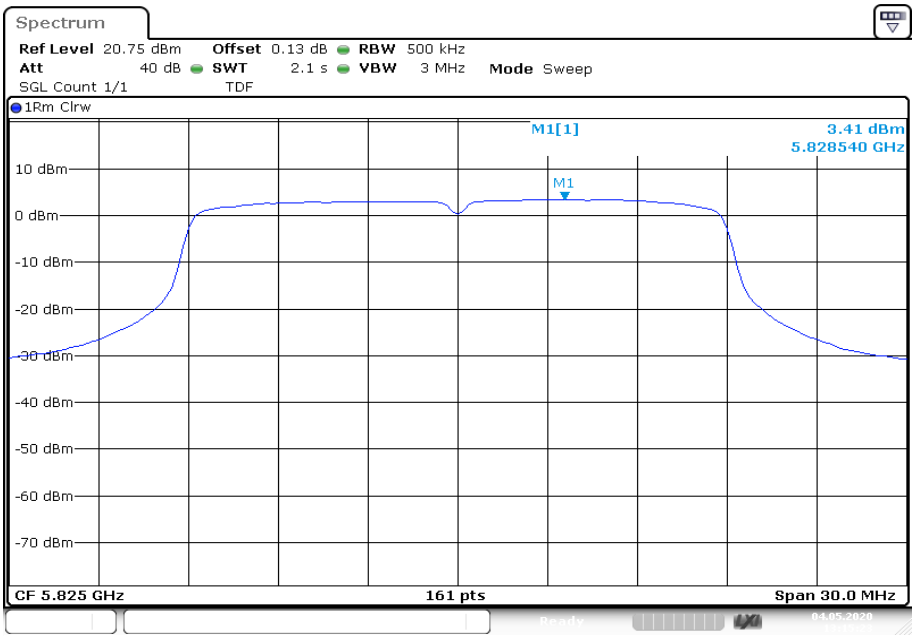
Date: 4.MAY.2020 13:12:38

Plot 2: U-NII-3; middle channel



Date: 4.MAY.2020 13:13:58

Plot 3: U-NII-3; highest channel



Date: 4.MAY.2020 13:15:24

11.6 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.	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Span:	40 MHz
Measurement procedure:	Using marker to find -6dBc frequencies
Trace mode:	Max hold (allow trace to stabilize)
Used test setup:	See chapter 6.4 – A
Measurement uncertainty:	See chapter 8

Limits:

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

Results: a-mode

ANT 1	6 dB emission bandwidth (MHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	16.36	17.59	16.36

ANT 2	6 dB emission bandwidth (MHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	16.39	17.35	16.39

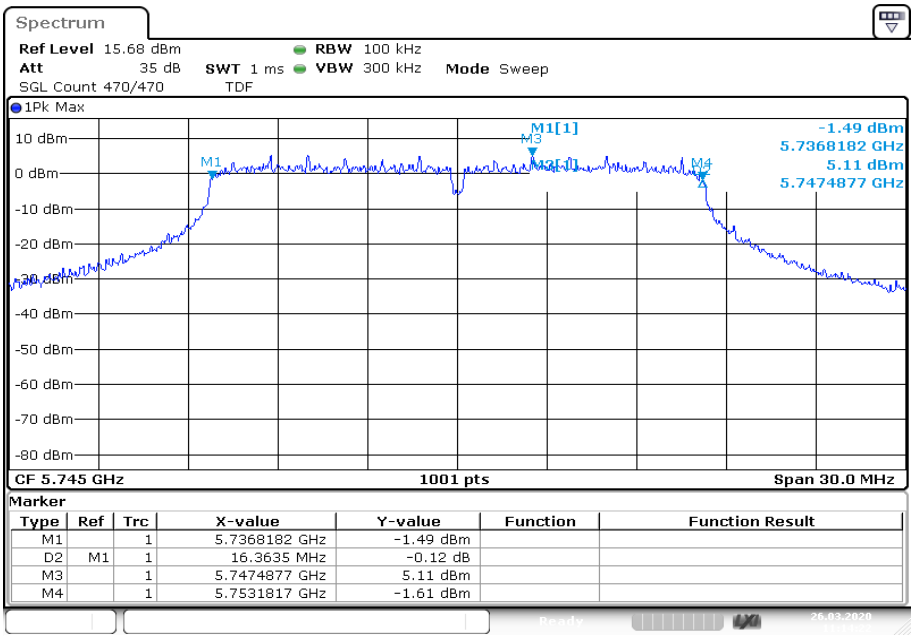
Results: n20-mode

ANT 1	6 dB emission bandwidth (MHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	17.62	17.38	17.35

ANT 2	6 dB emission bandwidth (MHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	16.99	17.32	17.59

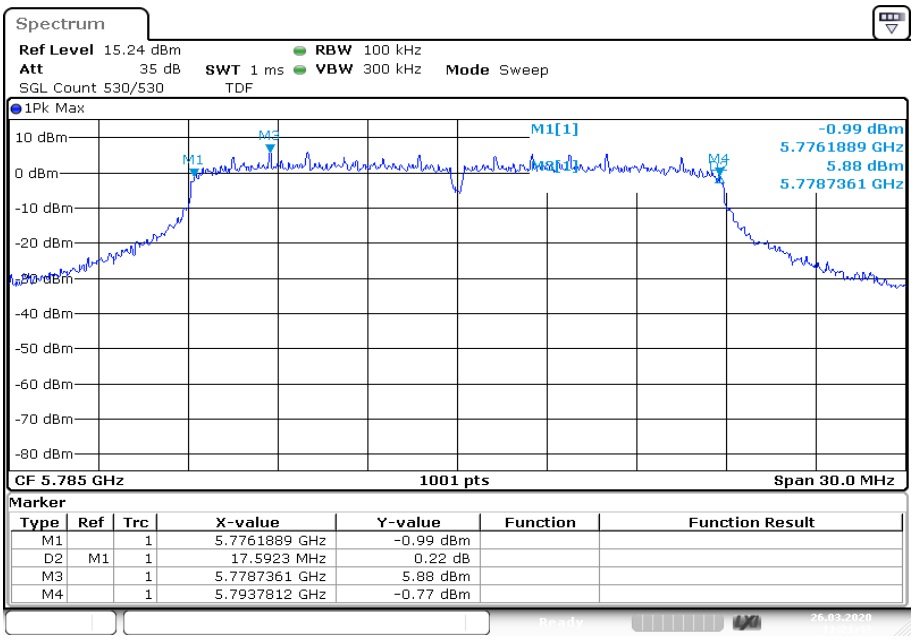
Plots: antenna 1, a-mode

Plot 1: U-NII-3; lowest channel



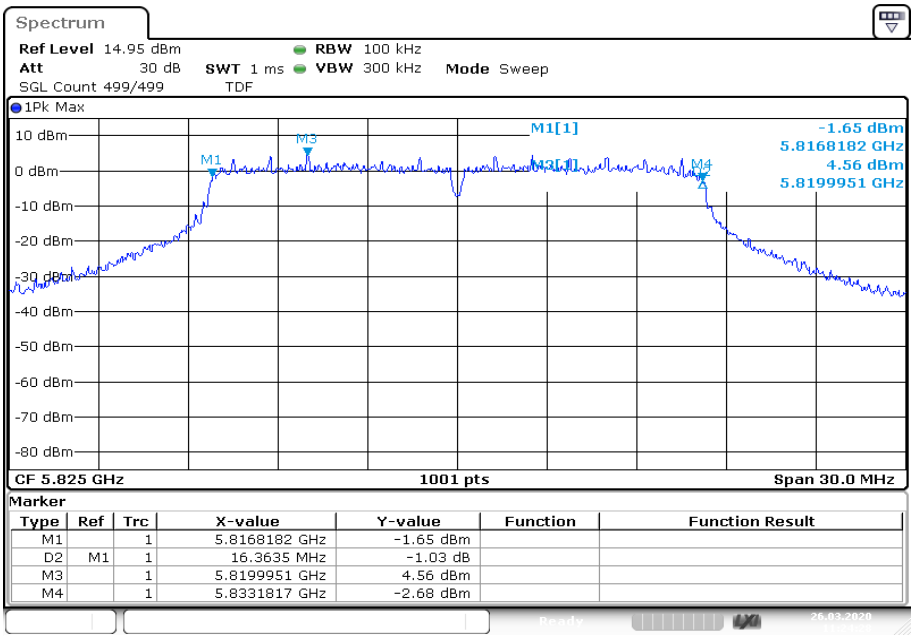
Date: 26.MAR.2020 11:14:23

Plot 2: U-NII-3; middle channel



Date: 26.MAR.2020 11:21:44

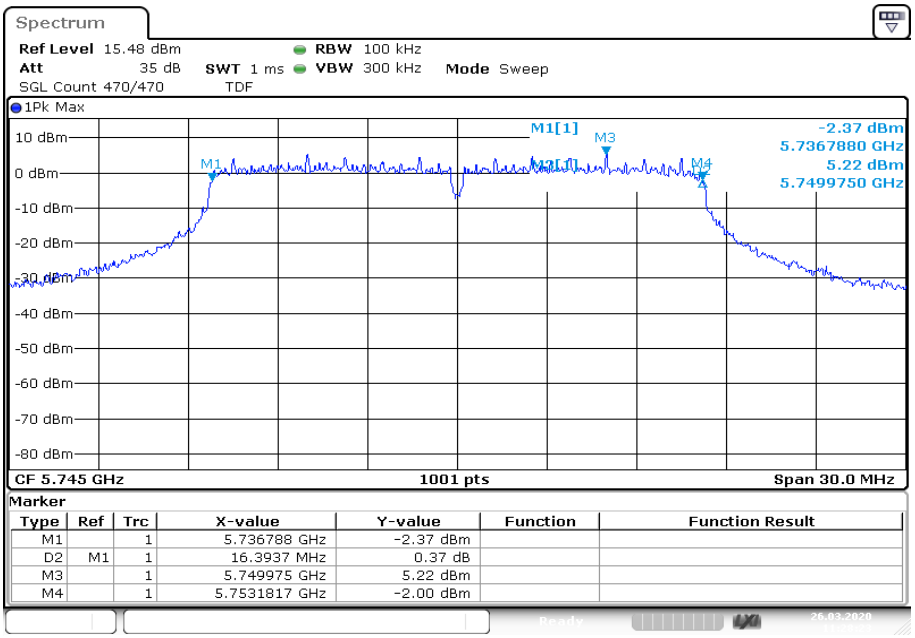
Plot 3: U-NII-3; highest channel



Date: 26.MAR.2020 11:24:29

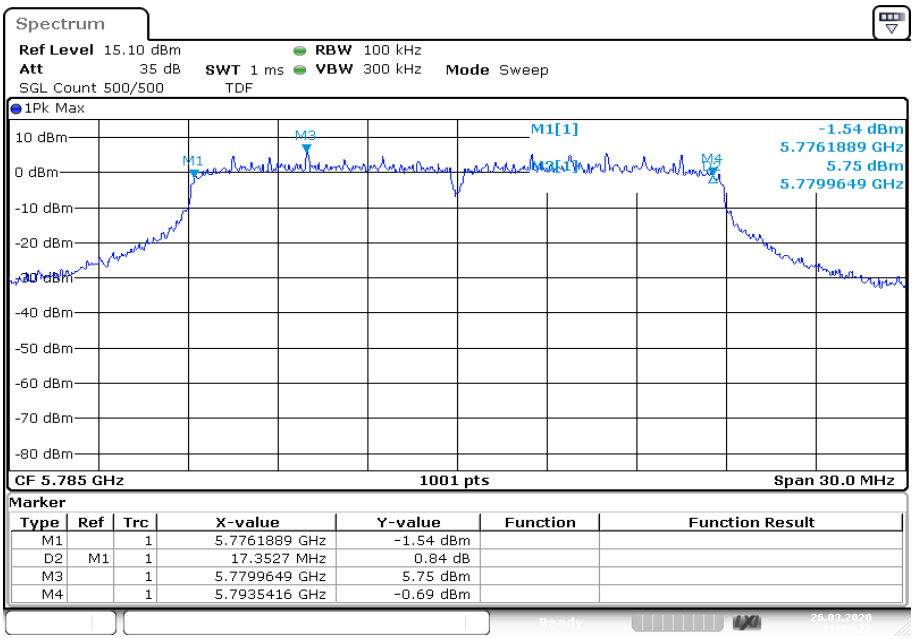
Plots: antenna 2, a-mode

Plot 1: U-NII-3; lowest channel



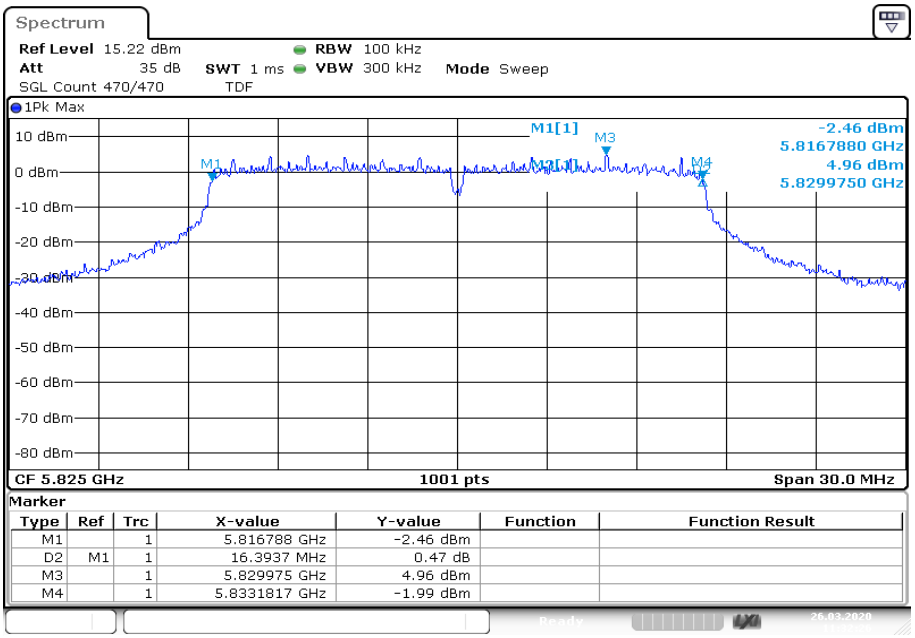
Date: 26.MAR.2020 11:28:24

Plot 2: U-NII-3; middle channel



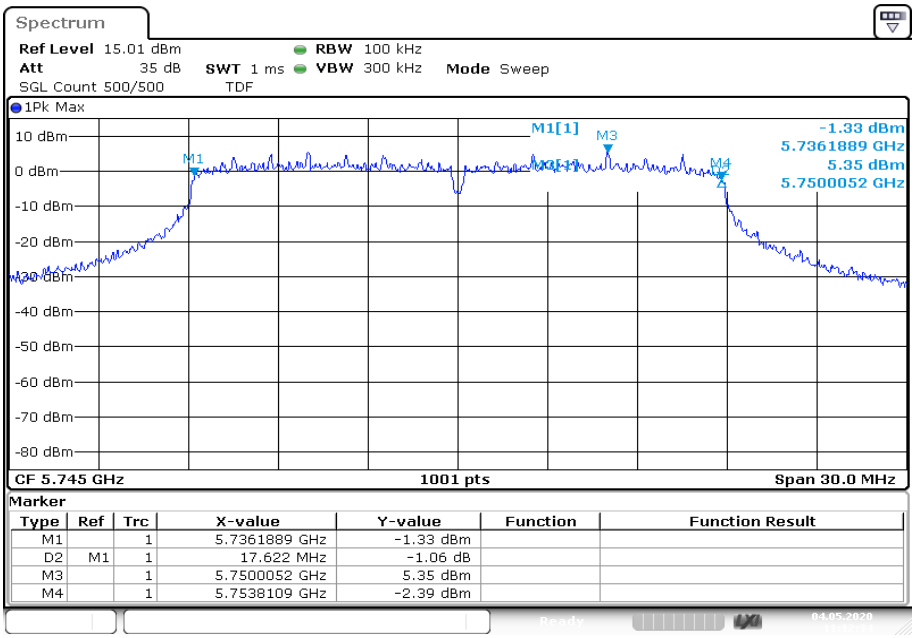
Date: 26.MAR.2020 11:30:28

Plot 3: U-NII-3; highest channel



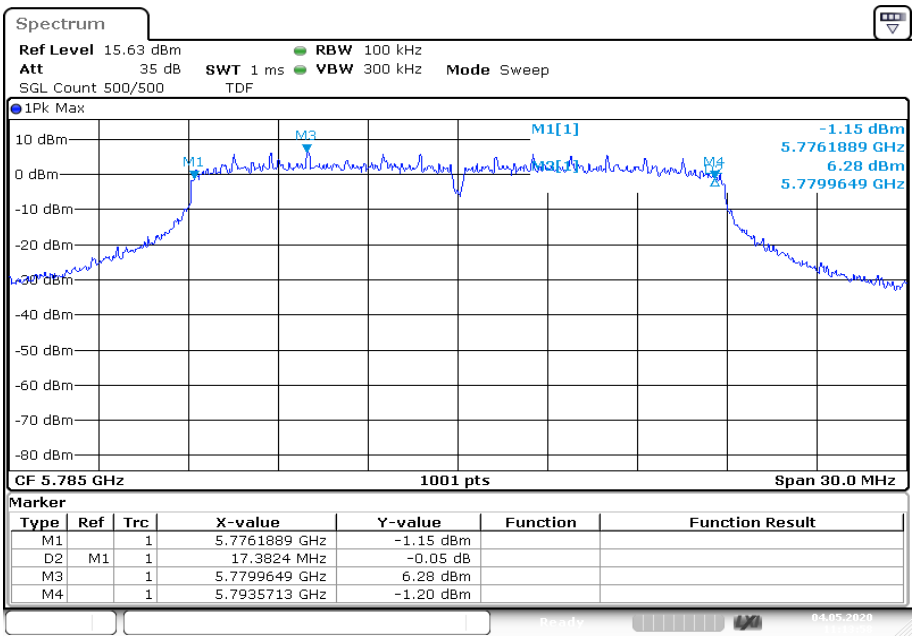
Plots: antenna 1, n20-mode

Plot 1: U-NII-3; lowest channel



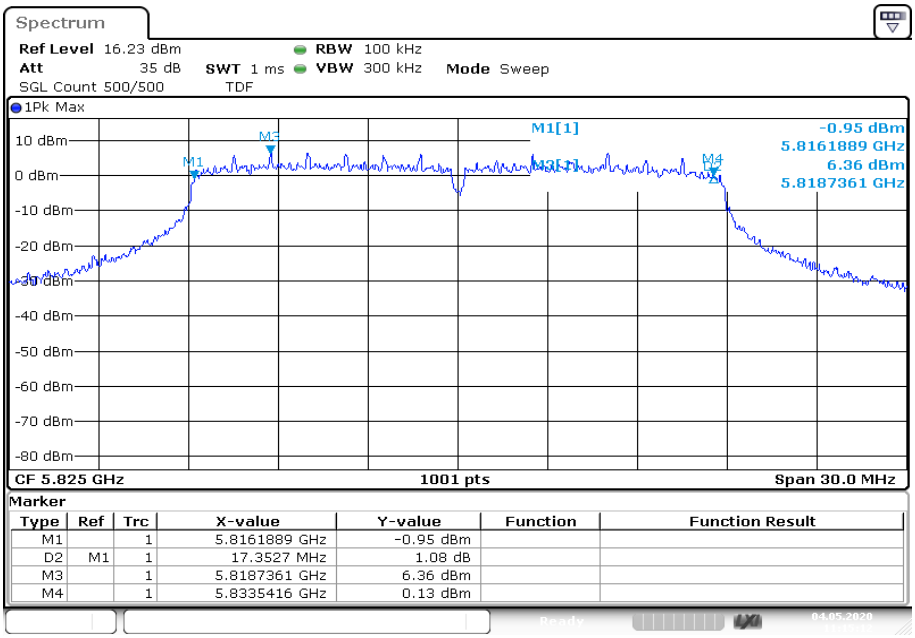
Date: 4.MAY.2020 11:12:34

Plot 2: U-NII-3; middle channel



Date: 4.MAY.2020 11:13:58

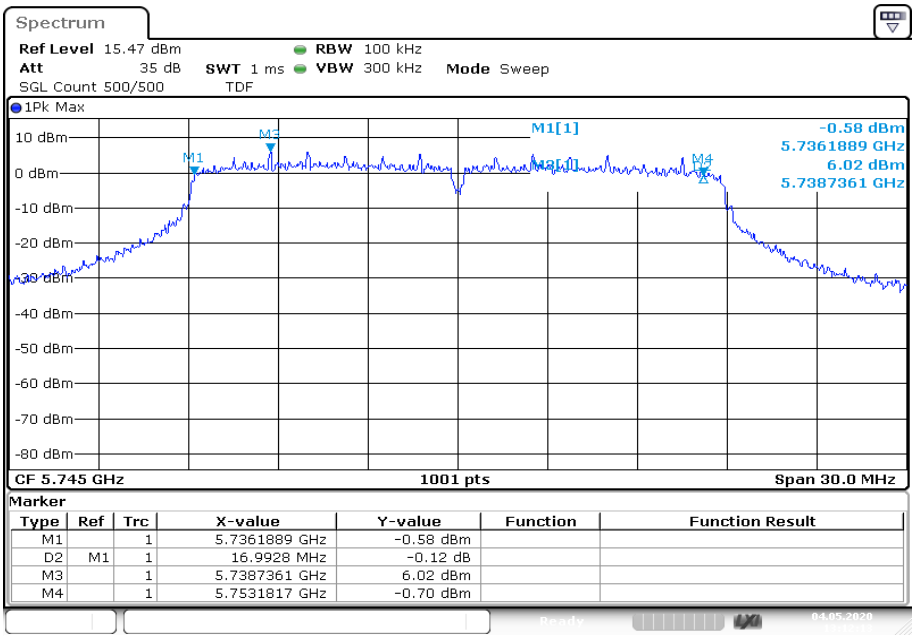
Plot 3: U-NII-3; highest channel



Date: 4.MAY.2020 11:15:13

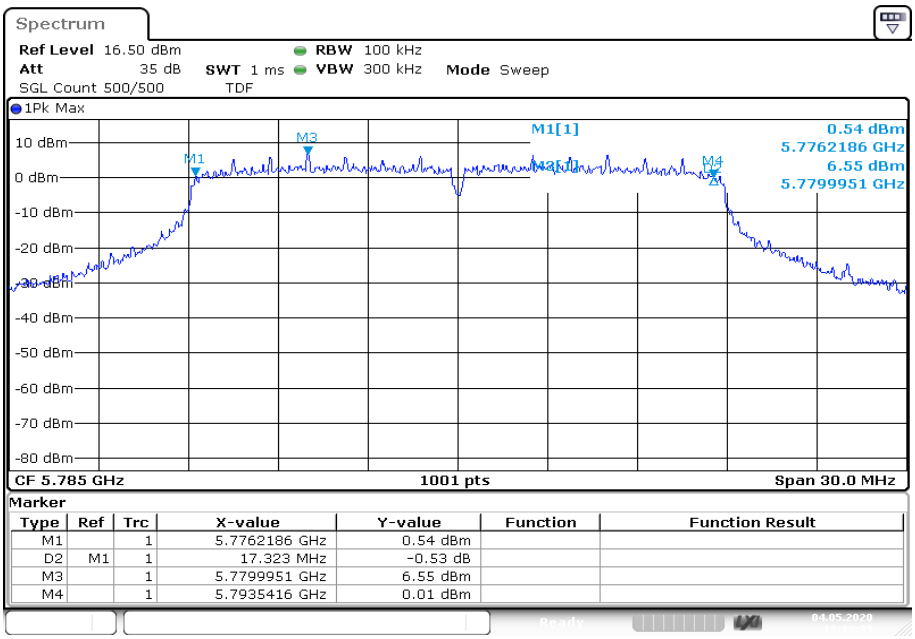
Plots: antenna 2, n20-mode

Plot 1: U-NII-3; lowest channel



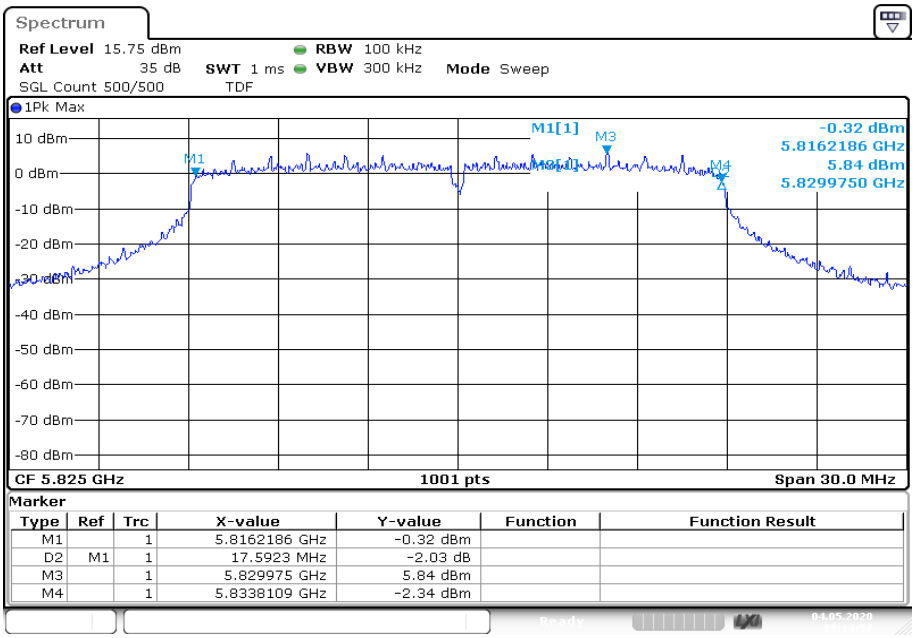
Date: 4.MAY.2020 13:12:13

Plot 2: U-NII-3; middle channel



Date: 4.MAY.2020 13:13:33

Plot 3: U-NII-3; highest channel



Date: 4.MAY.2020 13:14:58

11.7 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.	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1% EBW
Video bandwidth:	≥ RBW
Span:	> Complete signal
Trace mode:	Max hold
Used test setup:	See chapter 6.4 – A
Measurement uncertainty:	See chapter 8

Limits:

Spectrum Bandwidth – 26 dB Bandwidth
The whole 26 dB bandwidth shall fall into the specific band

Results: a-mode

ANT 1	26 dB bandwidth (MHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	23.53	23.88	22.73
	Lowest frequency		Highest frequency
	5733.0		5836.1

ANT 2	26 dB bandwidth (MHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	22.18	23.33	22.28
	Lowest frequency		Highest frequency
	5733.9		5836.2

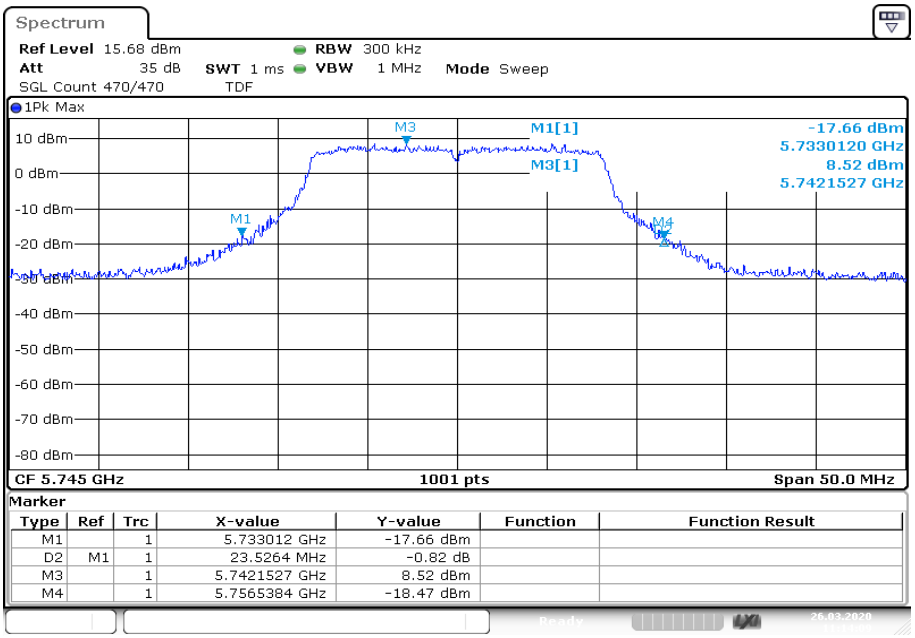
Results: n20-mode

ANT 1	26 dB bandwidth (MHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	23.43	23.13	22.98
	Lowest frequency		Highest frequency
	5733.1		5836.4

ANT 2	26 dB bandwidth (MHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	23.53	23.63	24.18
	Lowest frequency		Highest frequency
	5733.0		5836.7

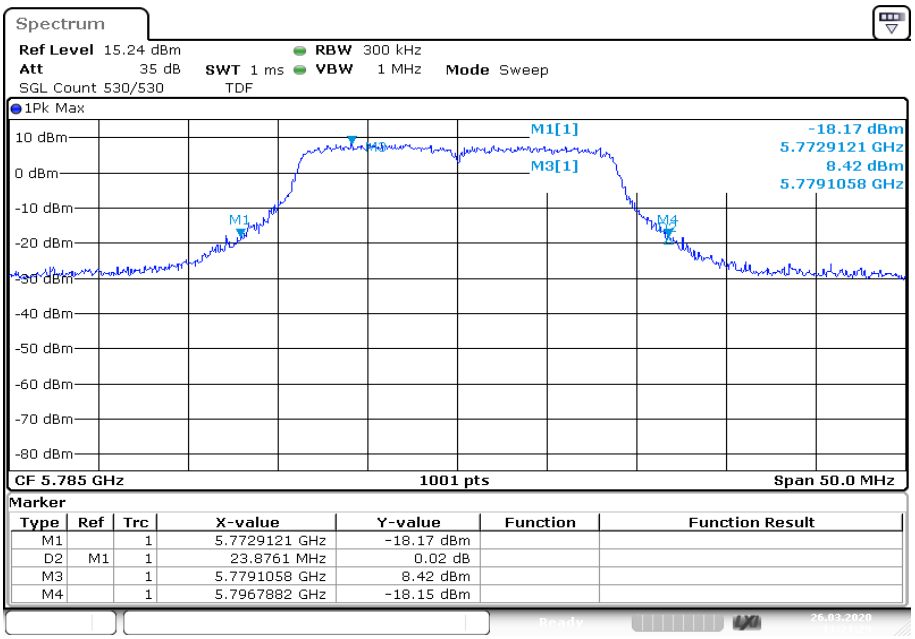
Plots: antenna 1, a-mode

Plot 1: U-NII-3; lowest channel



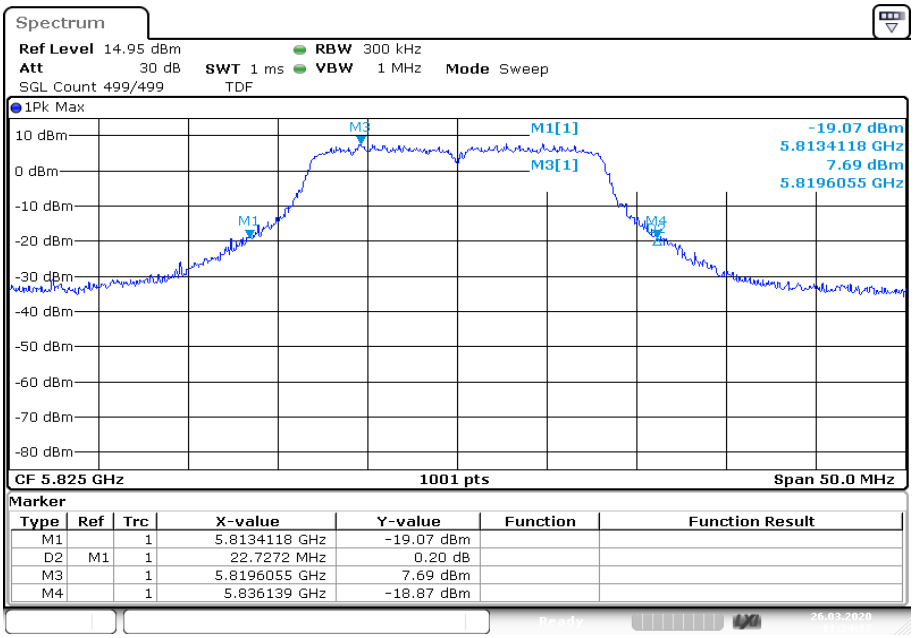
Date: 26.MAR.2020 11:14:09

Plot 2: U-NII-3; middle channel



Date: 26.MAR.2020 11:21:30

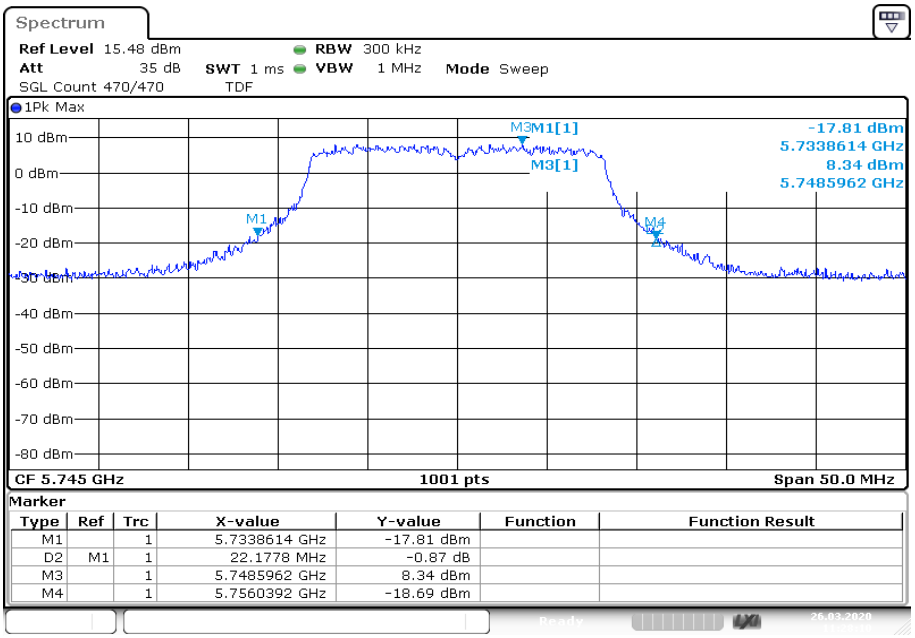
Plot 3: U-NII-3; highest channel



Date: 26.MAR.2020 11:24:17

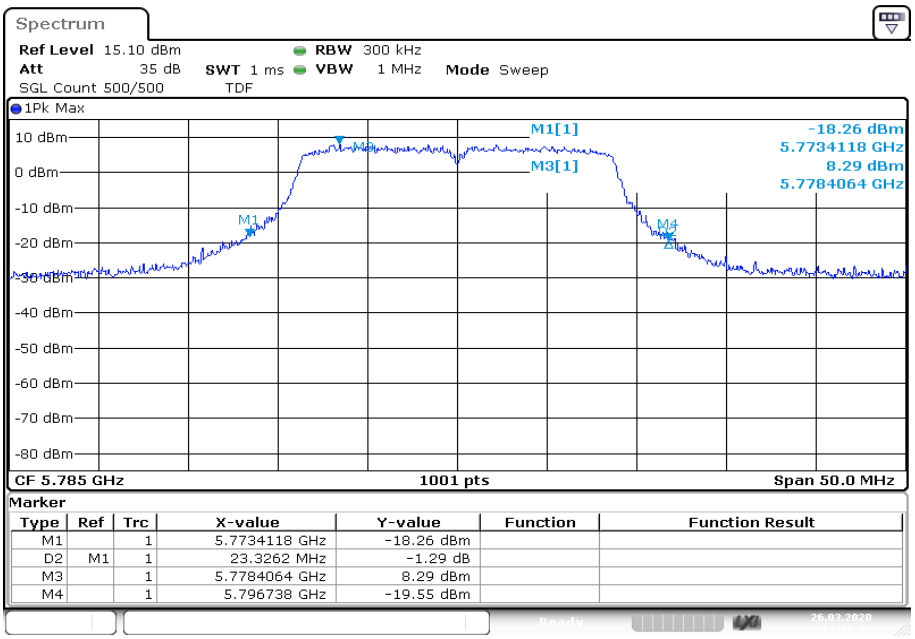
Plots: antenna 2, a-mode

Plot 1: U-NII-3; lowest channel



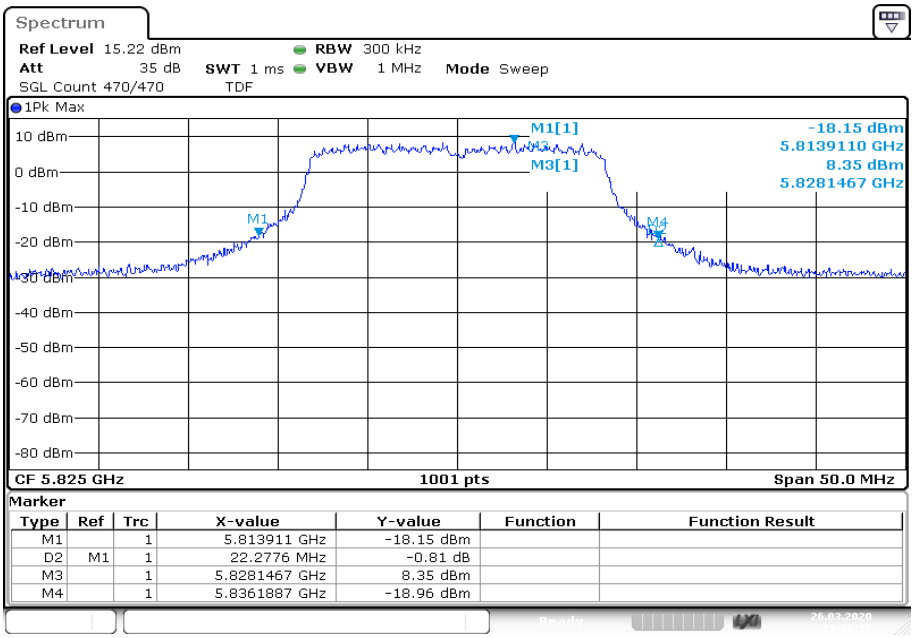
Date: 26.MAR.2020 11:28:11

Plot 2: U-NII-3; middle channel



Date: 26.MAR.2020 11:30:14

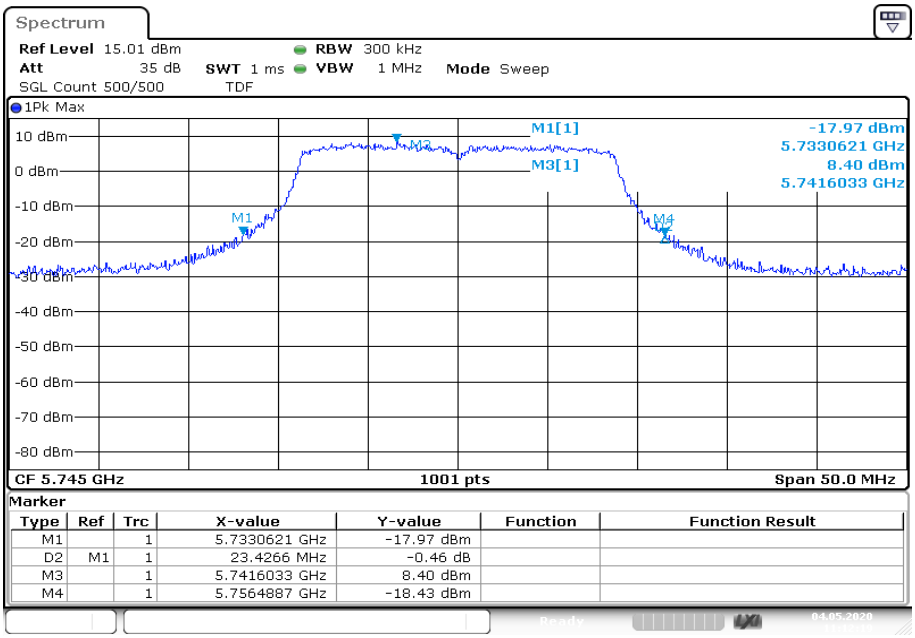
Plot 3: U-NII-3; highest channel



Date: 26.MAR.2020 11:32:16

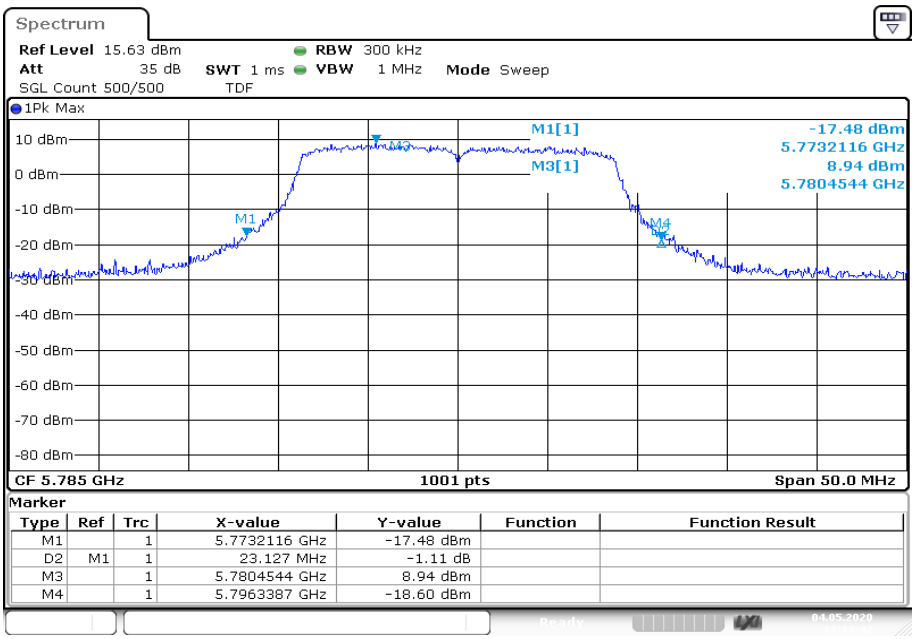
Plots: antenna 1, n20-mode

Plot 1: U-NII-3; lowest channel



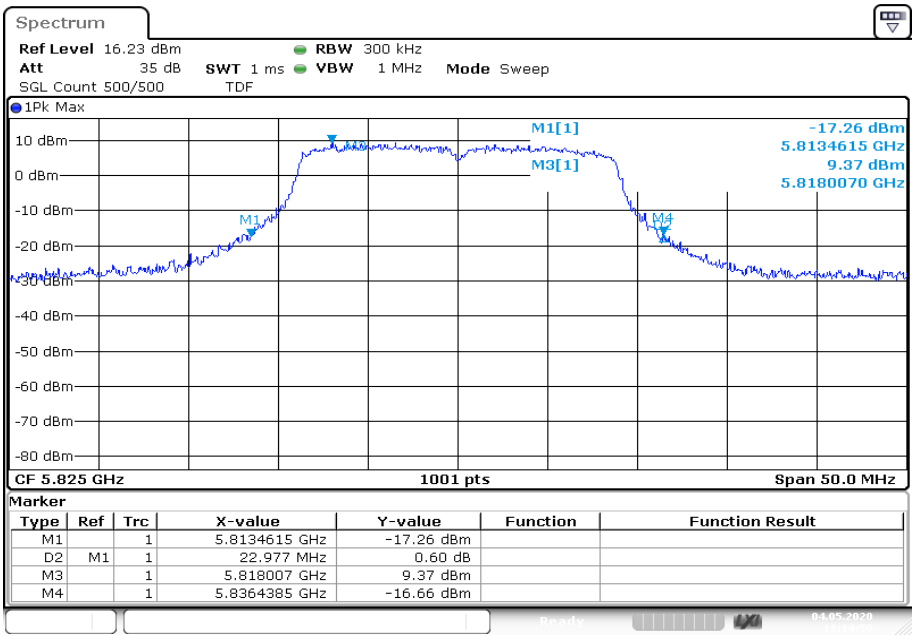
Date: 4.MAY.2020 11:12:19

Plot 2: U-NII-3; middle channel



Date: 4.MAY.2020 11:13:43

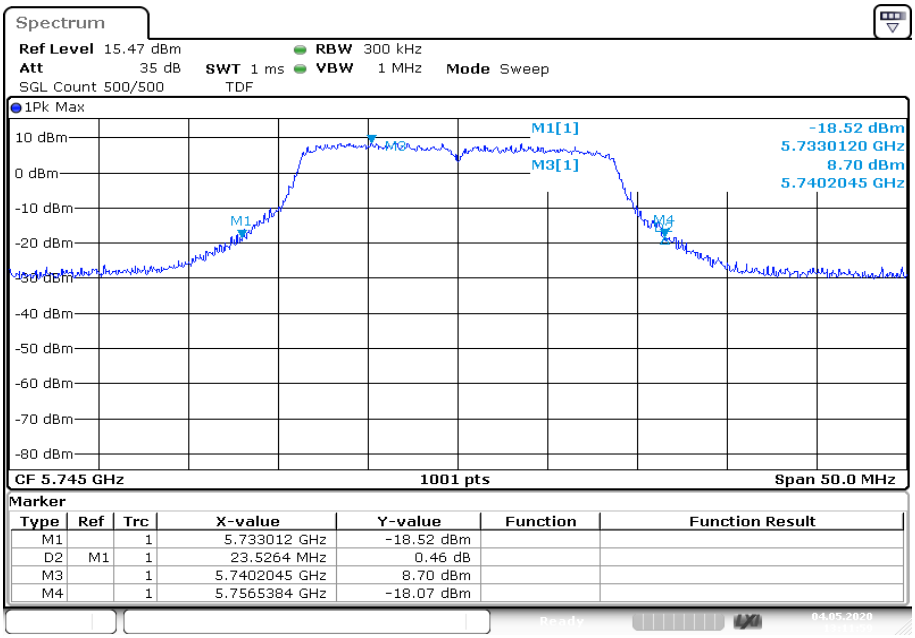
Plot 3: U-NII-3; highest channel



Date: 4.MAY.2020 11:15:00

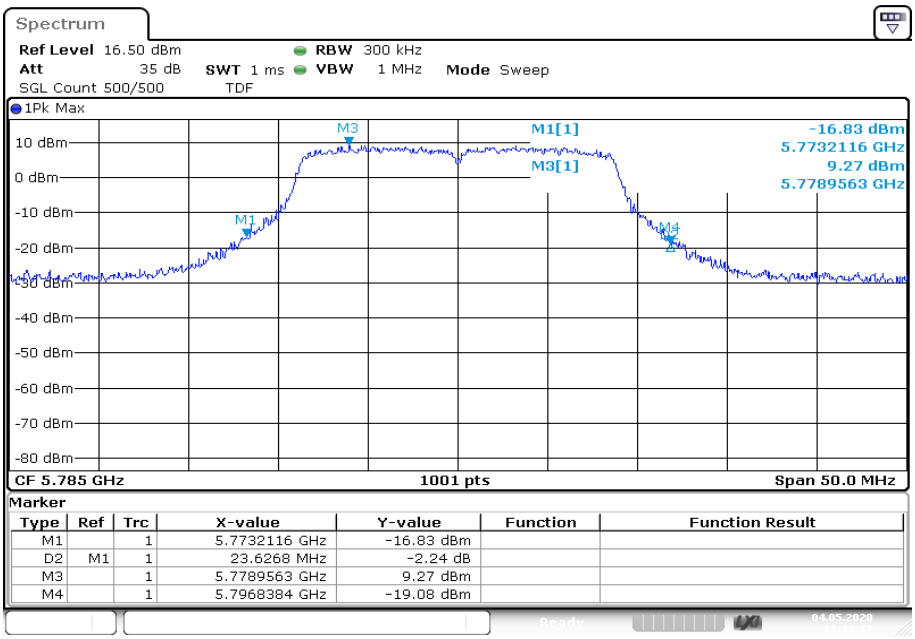
Plots: antenna 2, n20-mode

Plot 1: U-NII-3; lowest channel



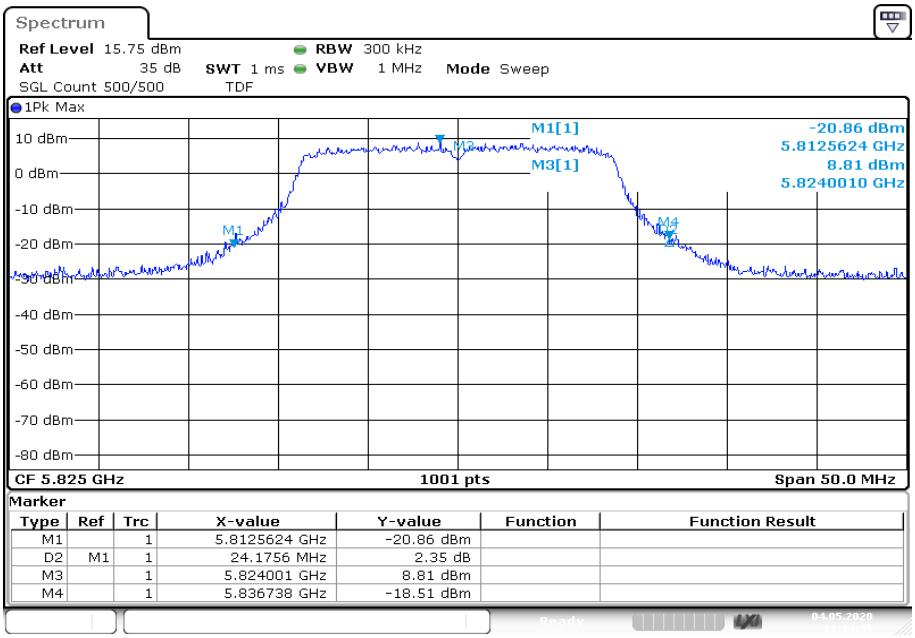
Date: 4.MAY.2020 13:11:59

Plot 2: U-NII-3; middle channel



Date: 4.MAY.2020 13:13:18

Plot 3: U-NII-3; highest channel



Date: 4.MAY.2020 13:14:46

11.8 Occupied bandwidth / 99% emission bandwidth

Description:

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

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	300 kHz / 500 kHz
Video bandwidth:	1 MHz / 3 MHz
Span:	50 MHz / 100 MHz
Measurement procedure:	Measurement of the 99% bandwidth using the integration function of the analyzer
Trace mode:	Max hold (allow trace to stabilize)
Test setup:	See sub clause 6.4 – A
Measurement uncertainty:	See sub clause 8

Usage:

-/-	IC
OBW is necessary for Emission Designator	

Results: a-mode

ANT 1	99% bandwidth (kHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	16833	17982	16933

ANT 2	99% bandwidth (kHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	16633	17932	16683

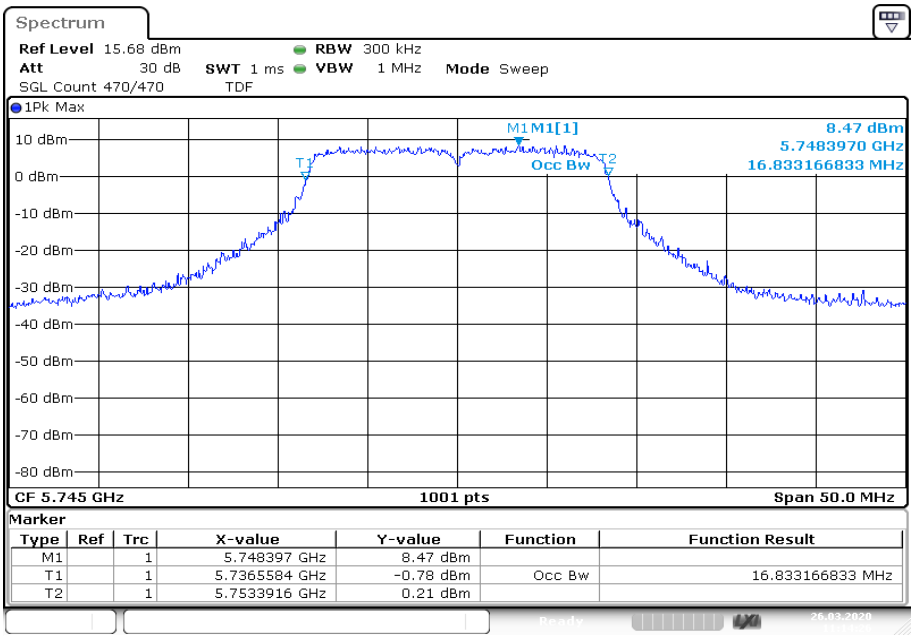
Results: n20-mode

ANT 1	99% bandwidth (kHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	17932	17932	17832

ANT 2	99% bandwidth (kHz)		
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	17982	17982	17832

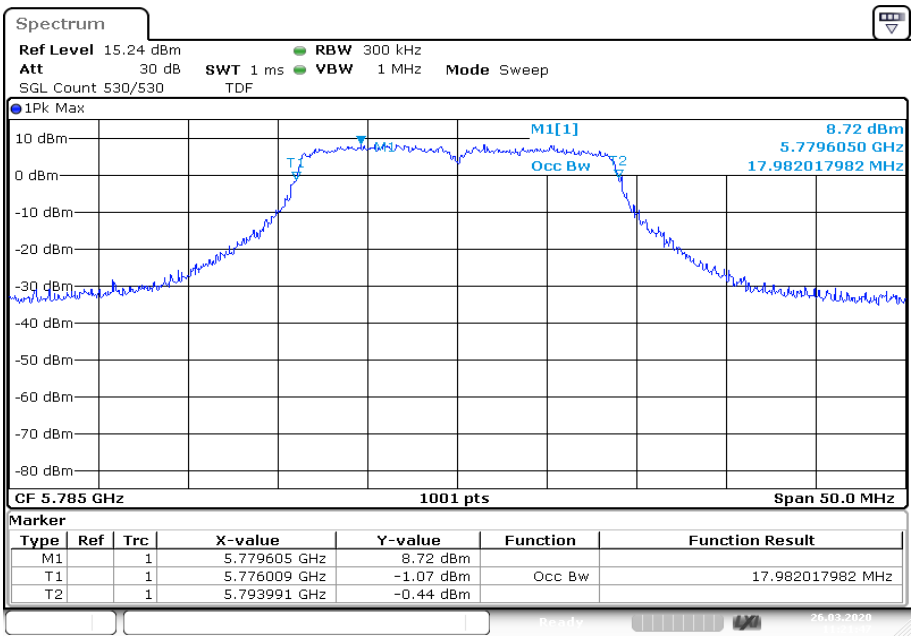
Plots: antenna 1, a-mode

Plot 1: U-NII-3; lowest channel



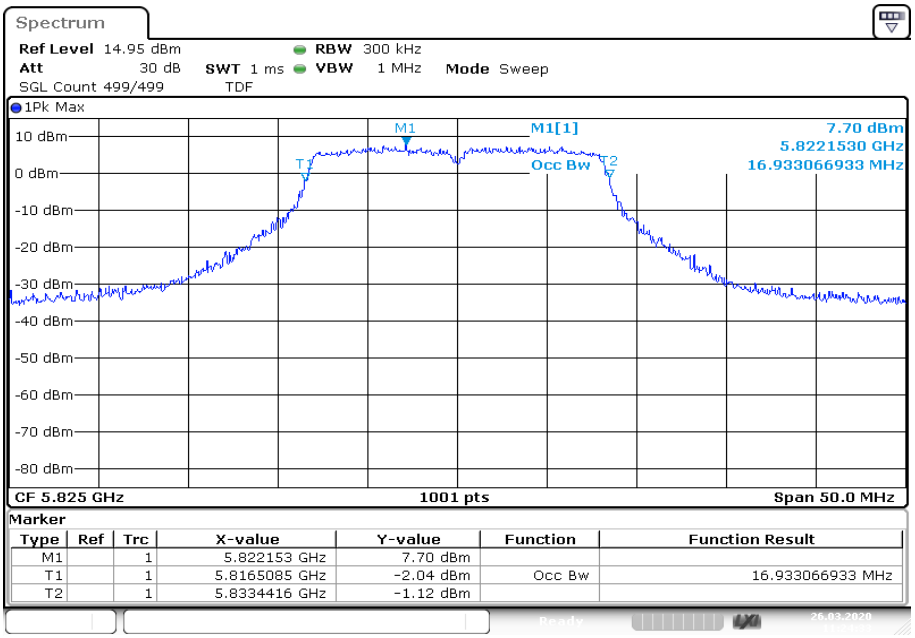
Date: 26.MAR.2020 11:14:26

Plot 2: U-NII-3; middle channel



Date: 26.MAR.2020 11:21:48

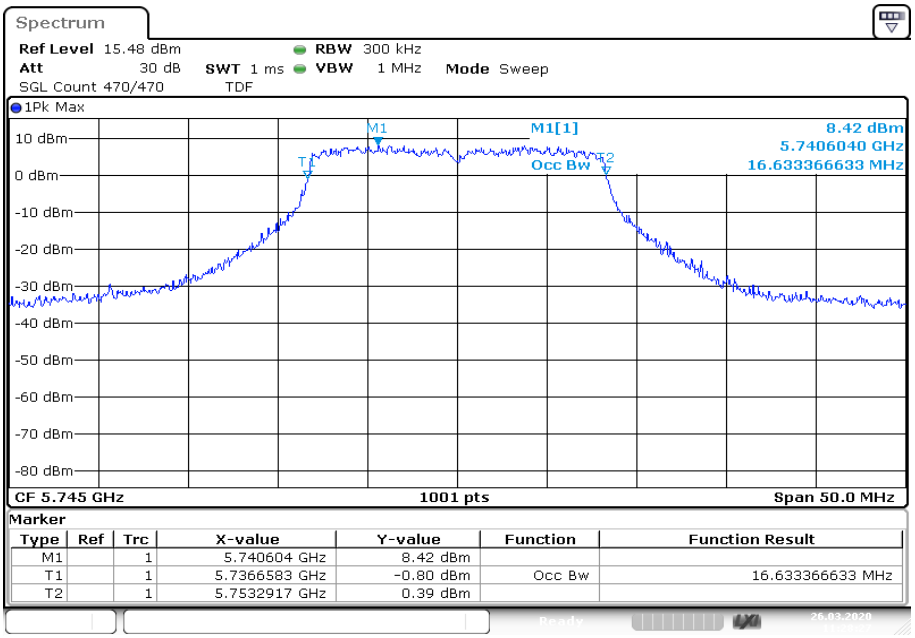
Plot 3: U-NII-3; highest channel



Date: 26.MAR.2020 11:24:34

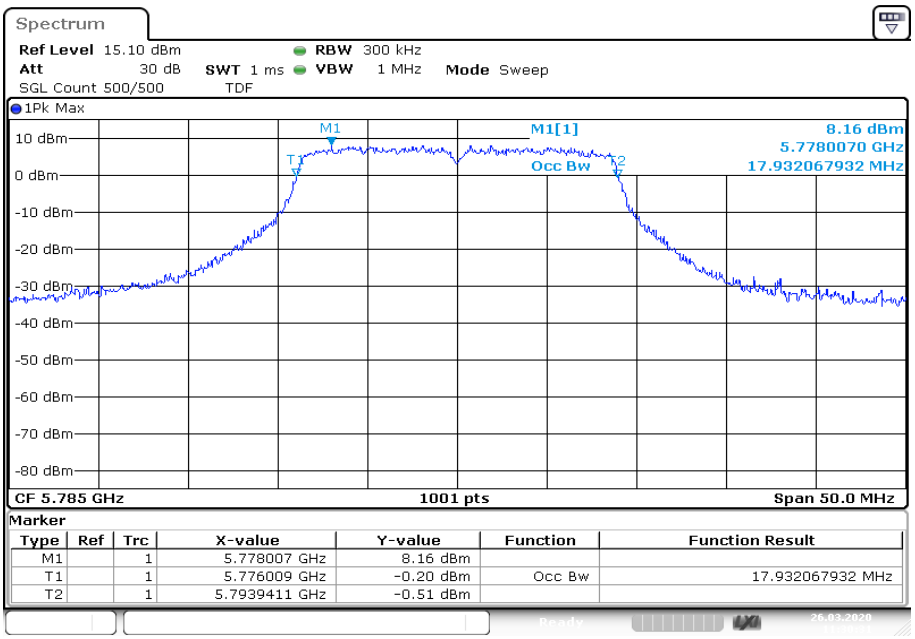
Plots: antenna 2, a-mode

Plot 1: U-NII-3; lowest channel



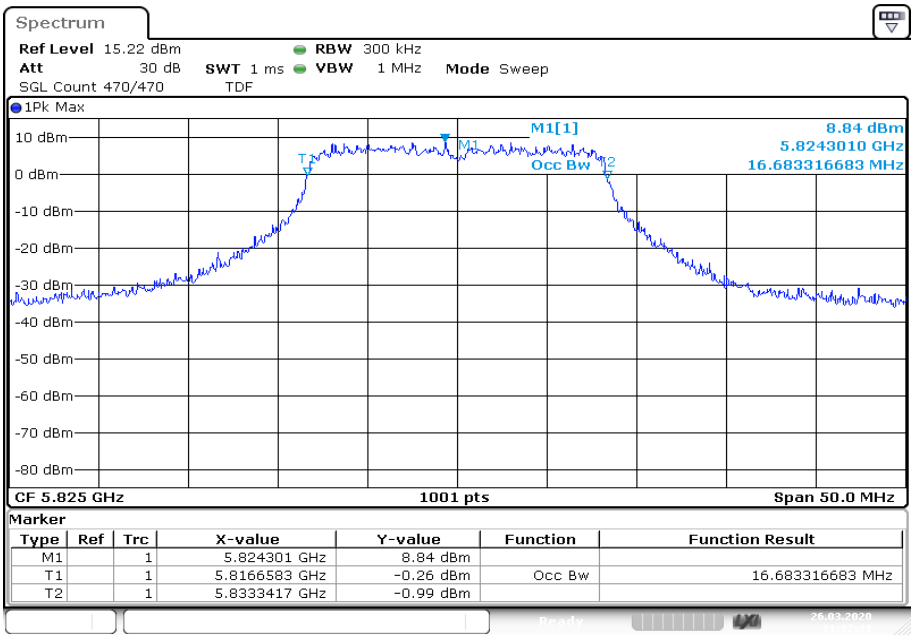
Date: 26.MAR.2020 11:28:28

Plot 2: U-NII-3; middle channel



Date: 26.MAR.2020 11:30:32

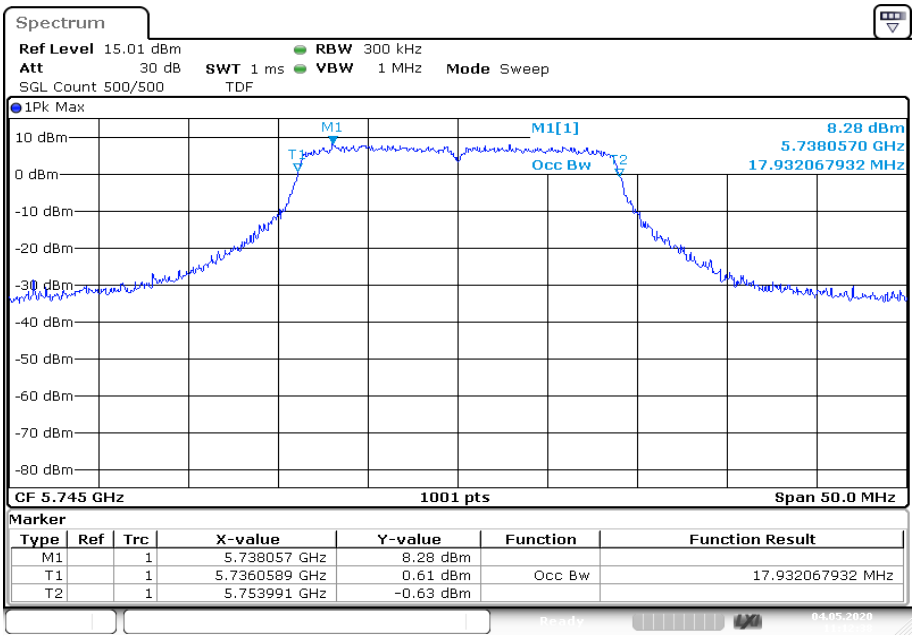
Plot 3: U-NII-3; highest channel



Date: 26.MAR.2020 11:32:32

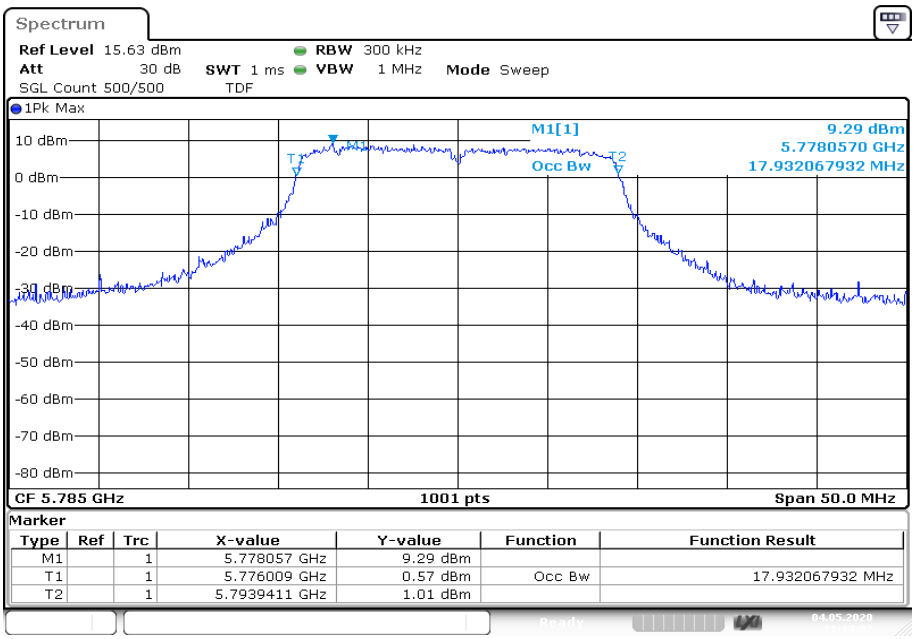
Plots: antenna 1, n20-mode

Plot 1: U-NII-3; lowest channel



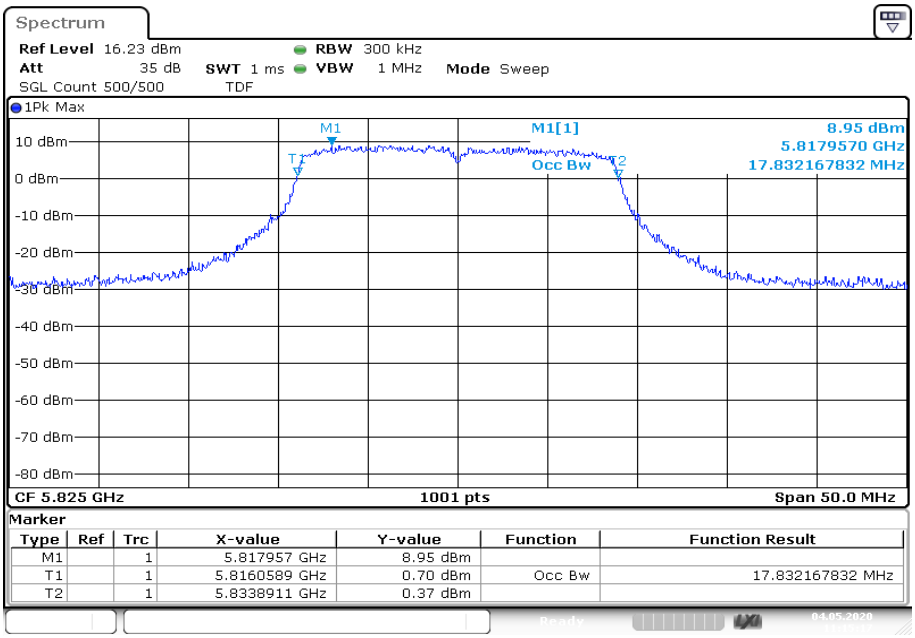
Date: 4.MAY.2020 11:12:39

Plot 2: U-NII-3; middle channel



Date: 4.MAY.2020 11:14:02

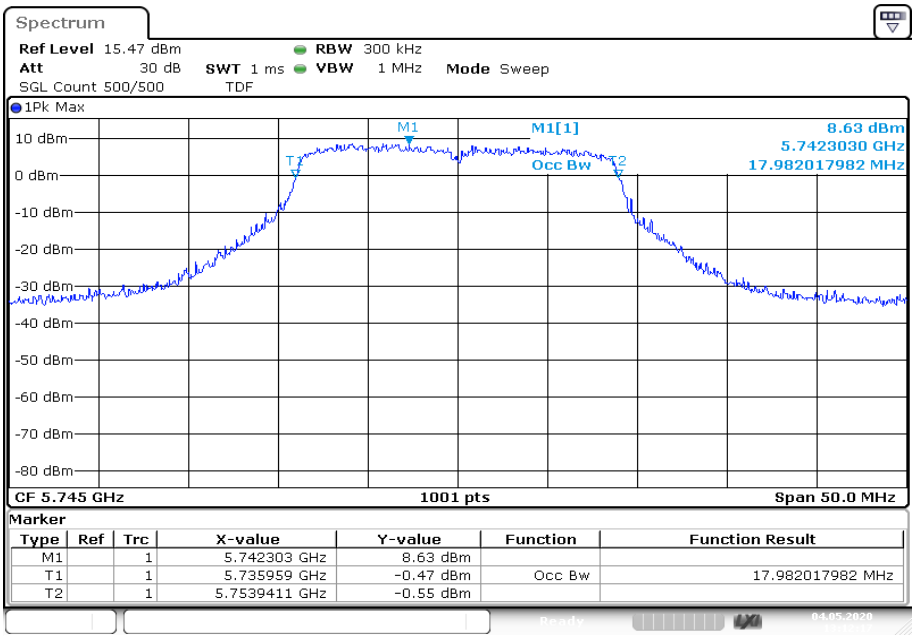
Plot 3: U-NII-3; highest channel



Date: 4.MAY.2020 11:15:18

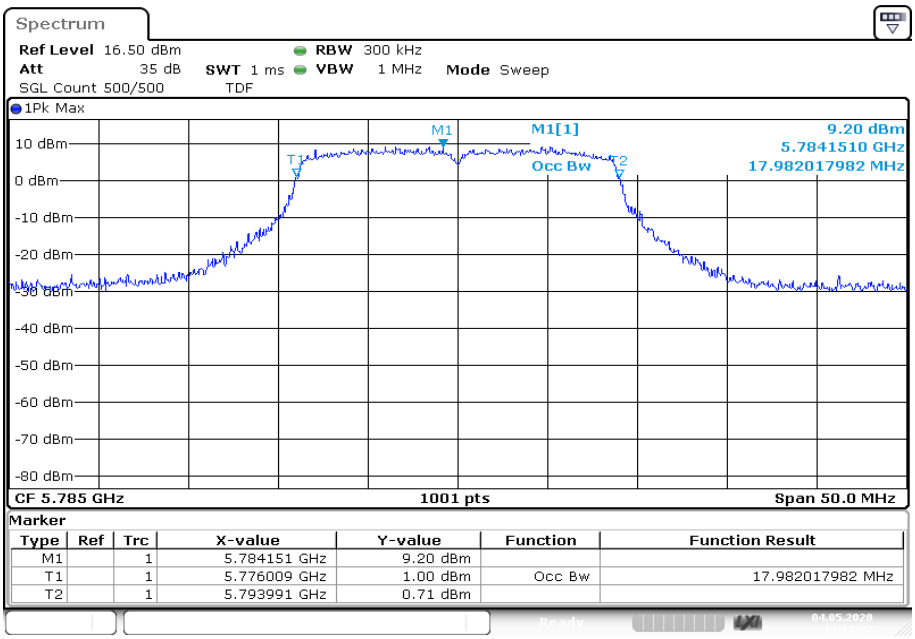
Plots: antenna 2, n20-mode

Plot 1: U-NII-3; lowest channel



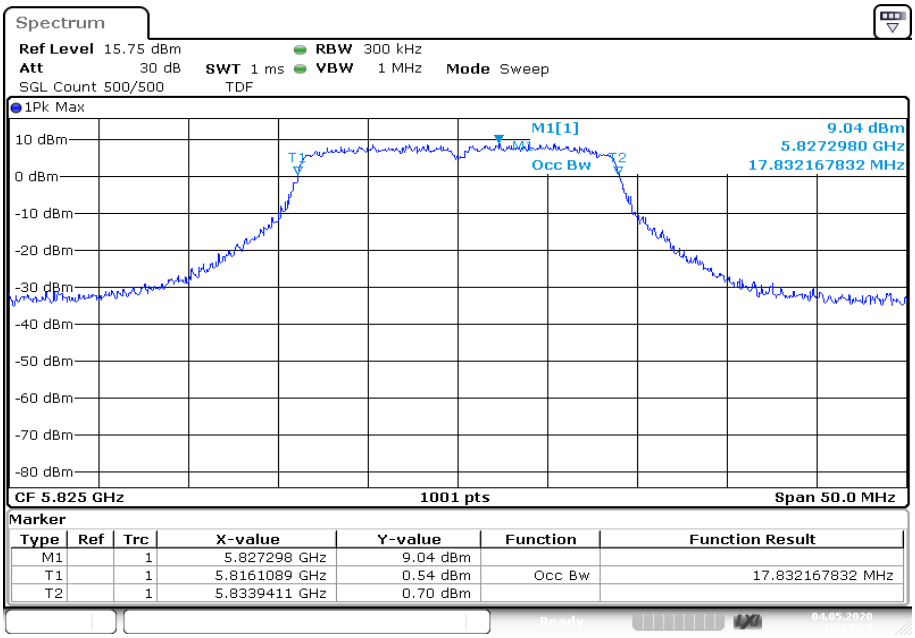
Date: 4.MAY.2020 13:12:17

Plot 2: U-NII-3; middle channel



Date: 4.MAY.2020 13:13:37

Plot 3: U-NII-3; highest channel



Date: 4.MAY.2020 13:15:03

11.9 Spurious emissions radiated < 30 MHz

Description:

Measurement of the radiated spurious emissions in transmit mode and receive mode below 30 MHz. The EUT is set first to middle channel. This measurement is representative for all channels and modes. If critical peaks are found the lowest channel and the highest channel will be measured too. Then the EUT is set to receive or idle mode. 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 chapter 6.2 – B
Measurement uncertainty:	See chapter 8

Limits:

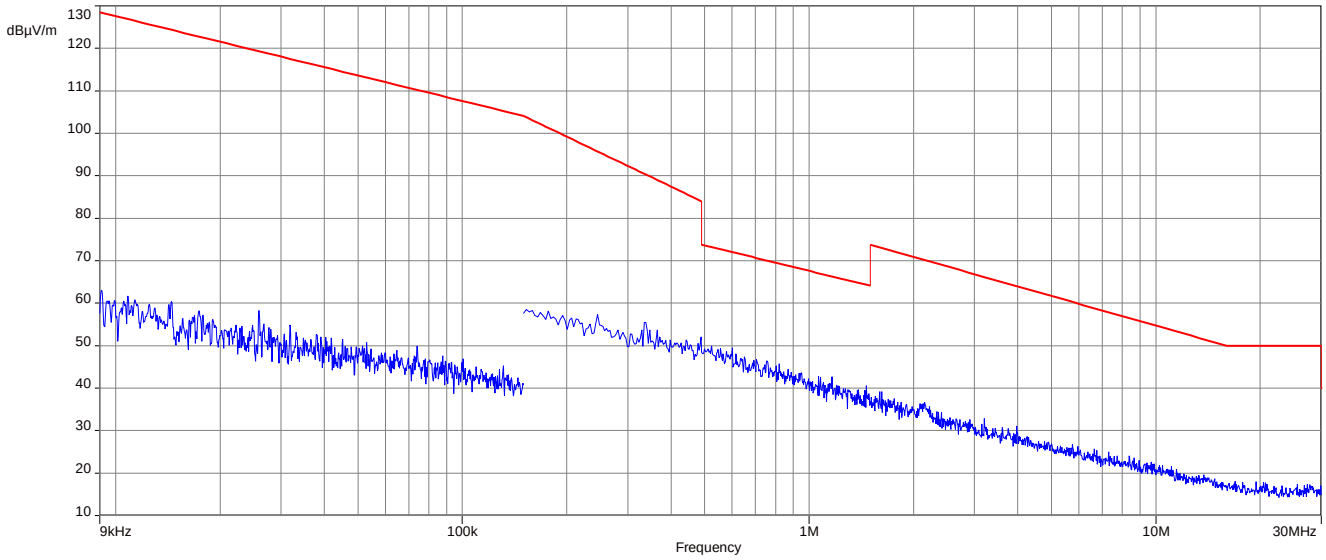
Spurious Emissions Radiated < 30 MHz		
Frequency (MHz)	Field Strength (dBµV/m)	Measurement distance
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30

Results: **both antennas are transmitting simultaneous**

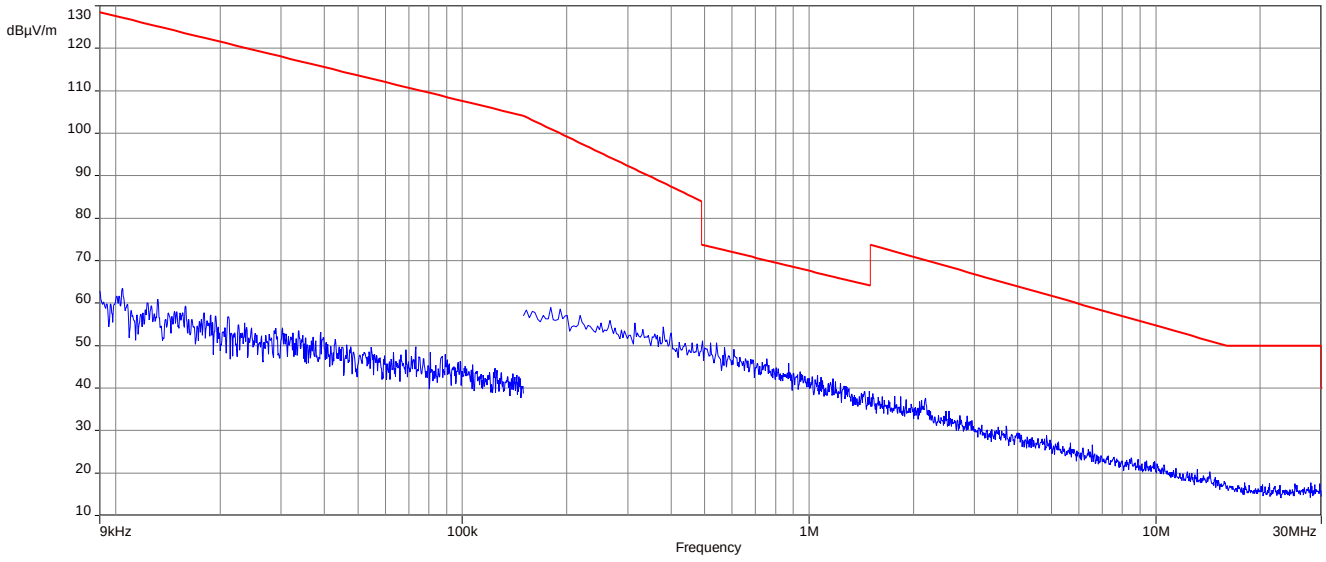
Spurious Emissions Radiated < 30 MHz [dBµV/m]		
F [MHz]	Detector	Level [dBµV/m]
All detected emissions are more than 20 dB below the limit.		

Plots:

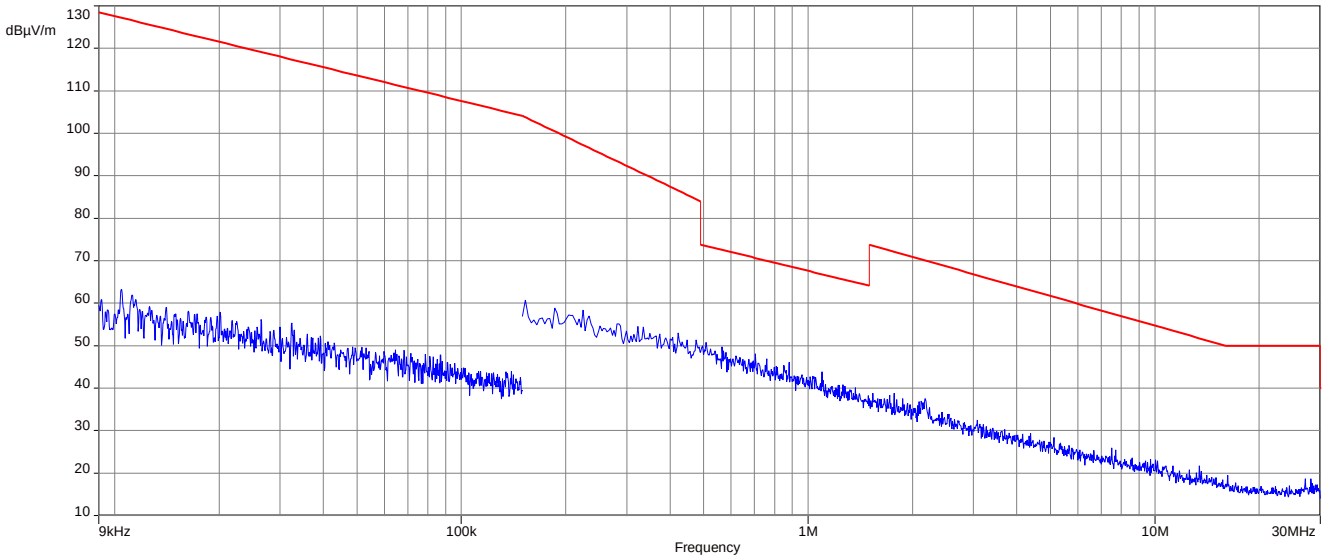
Plot 1: 9 kHz to 30 MHz, U-NII-3; lowest channel



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



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



11.10 TX spurious emissions radiated

Description:

Measurement of the radiated spurious emissions in transmit mode. The measurement is performed at lowest, middle and highest channel.

Measurement:

Measurement parameter	
Detector:	Quasi Peak below 1 GHz (alternative Peak) Peak above 1 GHz / RMS
Sweep time:	Auto
Resolution bandwidth:	F < 1 GHz: 100 kHz F > 1 GHz: 1 MHz
Video bandwidth:	F < 1 GHz: 100 kHz F > 1 GHz: ≥ 3 MHz / 1 MHz
Span:	30 MHz to 40 GHz
Trace mode:	Max Hold / Average with 100 counts + 20 log (1 / X) for duty cycle lower than 100 %
Test setup:	See chapter 6.1 – A See chapter 6.2 – A See chapter 6.3 – A
Measurement uncertainty:	See sub clause 8

Limits:

TX Spurious Emissions Radiated		
§15.209		
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 ≙ 68.2 dBµV/m @ 3m	

$$E_{lim} = 20 \times log_{10}\left(\frac{\sqrt{30 \times P_{lim}}}{d}\right) + 120$$

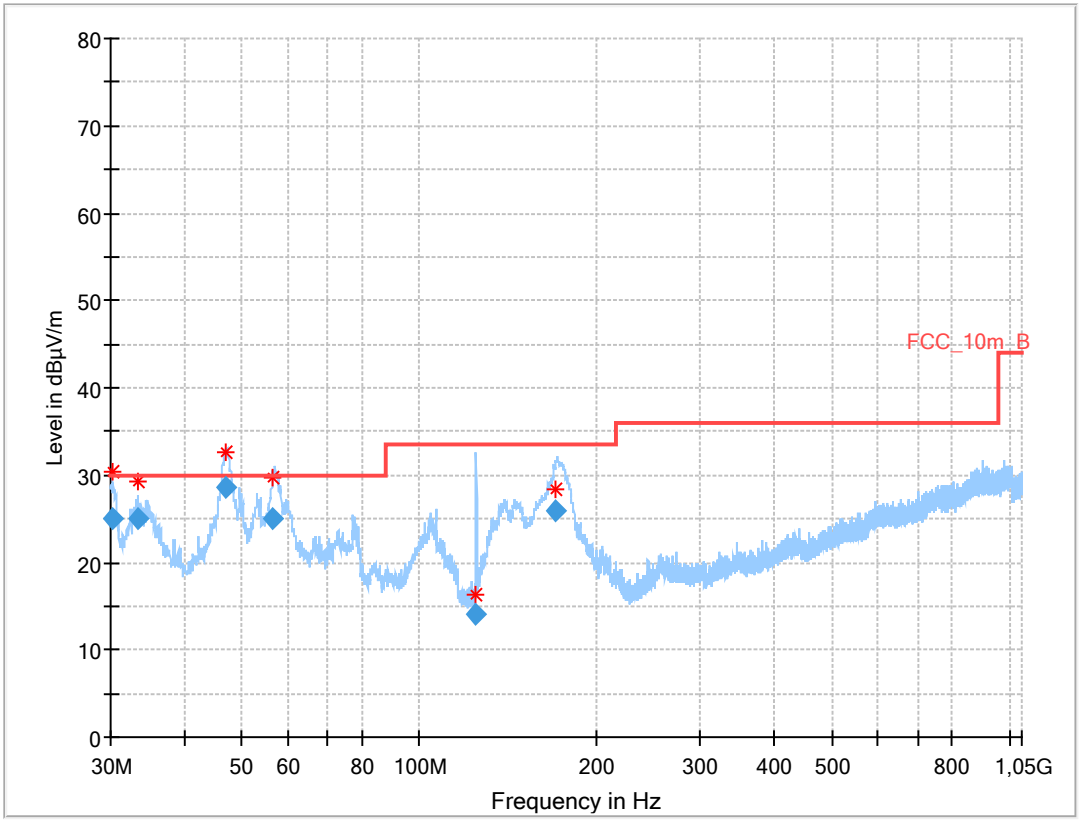
where
E_{lim} = electric field strength limit, in dB (µV/m)
P_{lim} = EIRP limit, in watts (-27dBm ≈ 0.000002 W)
d = measurement distance, in meters

Results: **both antennas are transmitting simultaneous**

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]
All detected emissions are more than 10 dB below the limit.								
-/-	Peak	-/-	2299	Peak	52.8	11651	Peak	55.0
	AVG	-/-		AVG	40.6		AVG	41.4
-/-	Peak	-/-	11569	Peak	55.6	-/-	Peak	-/-
	AVG	-/-		AVG	42.8		AVG	-/-
-/-	Peak	-/-	-/-	Peak	-/-	-/-	Peak	-/-
	AVG	-/-		AVG	-/-		AVG	-/-
For emissions above 18 GHz please take look at the plots.			For emissions above 18 GHz please take look at the plots.			For emissions above 18 GHz please take look at the plots.		

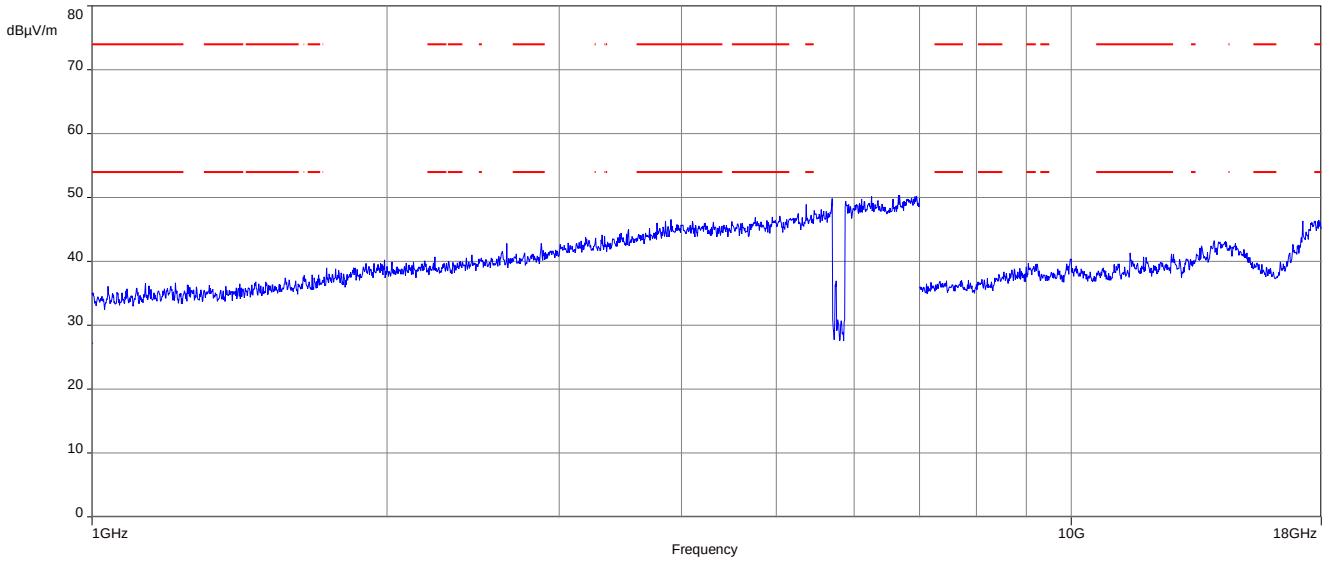
Plots:

Plot 1: 30 MHz to 1 GHz; vertical & horizontal polarization; U-NII-3; lowest channel



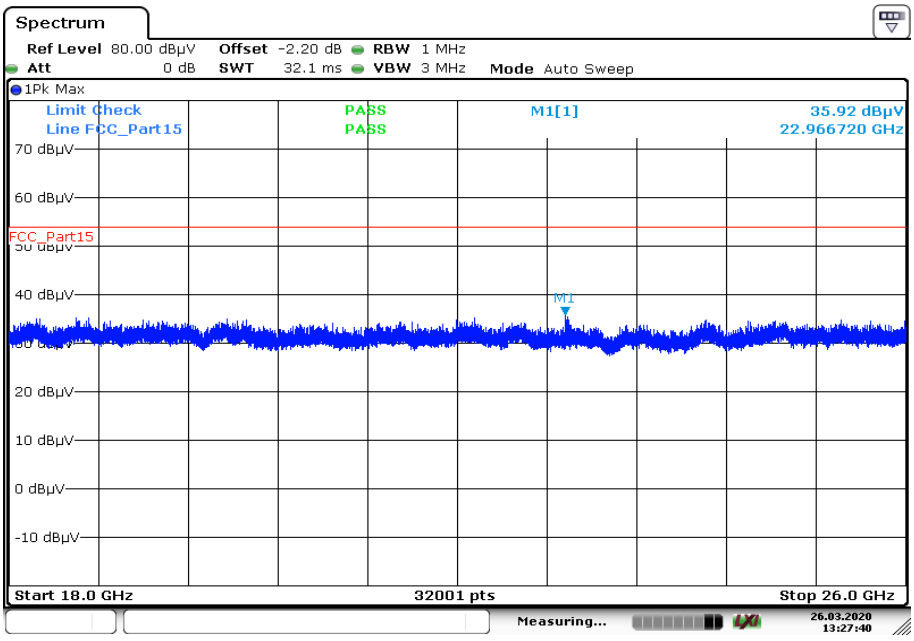
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.152	24.93	30.0	5.1	1000	120	98.0	V	202	12
33.434	25.13	30.0	4.9	1000	120	170.0	V	101	12
47.127	28.71	30.0	1.3	1000	120	102.0	V	22	14
56.615	25.06	30.0	4.9	1000	120	170.0	V	-21	15
125.008	14.18	33.5	19.3	1000	120	114.0	V	-22	9
170.052	25.82	33.5	7.7	1000	120	101.0	V	-21	10

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



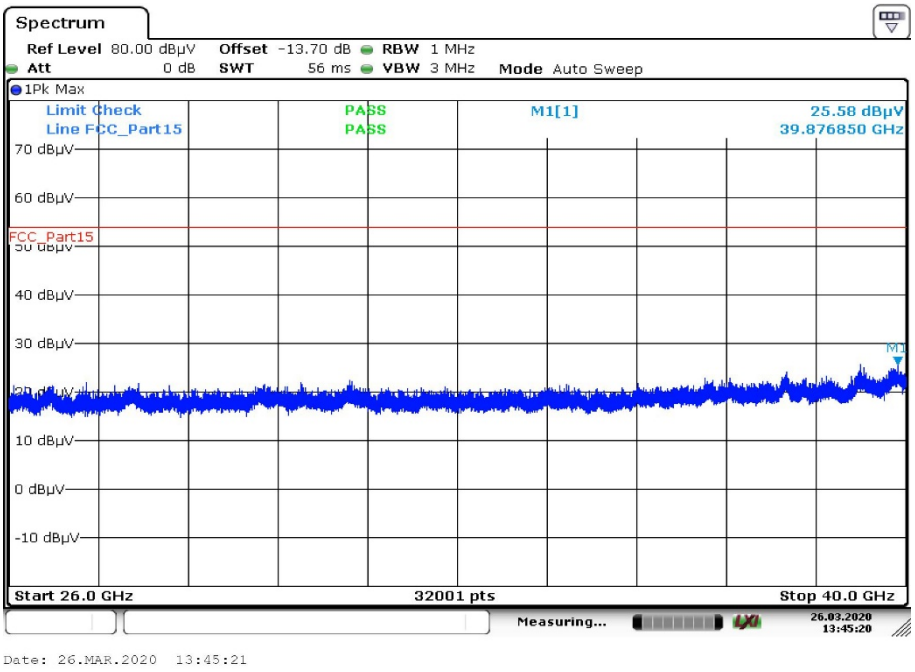
The carrier signal is notched with a 5 GHz band rejection filter.

Plot 3: 18 GHz to 26 GHz; vertical & horizontal polarization; U-NII-3; lowest channel

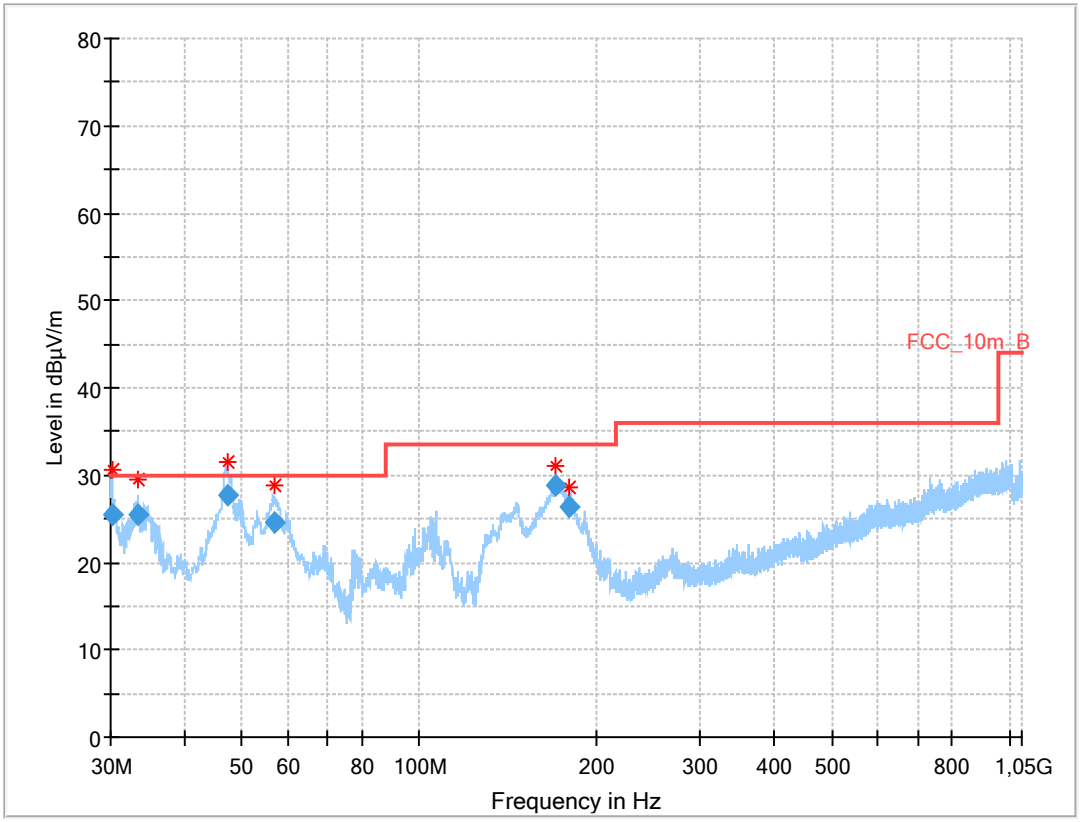


Date: 26.MAR.2020 13:27:40

Plot 4: 26 GHz to 40 GHz; vertical & horizontal polarization; U-NII-3; lowest channel

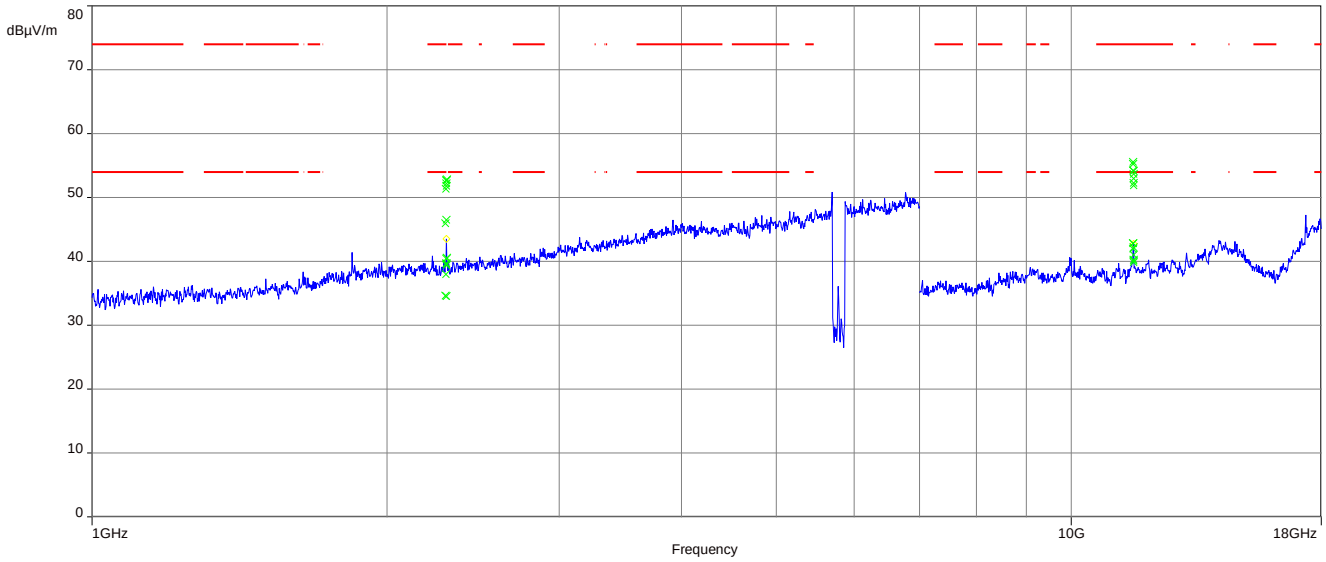


Plot 5: 30 MHz to 1 GHz; vertical & horizontal polarization; U-NII-3; middle channel



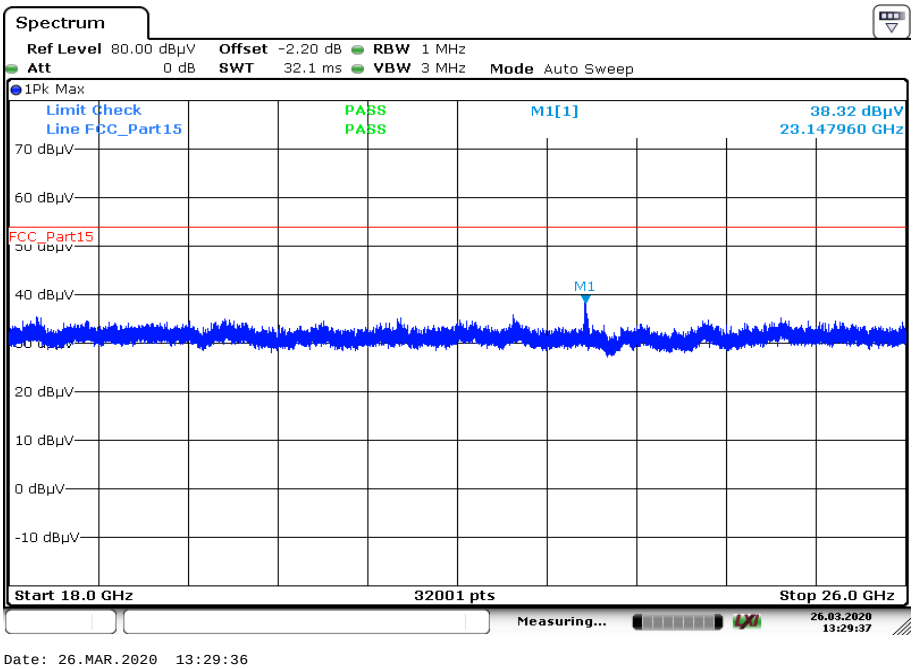
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.160	25.51	30.0	4.5	1000	120	170.0	V	95	12
33.426	25.57	30.0	4.4	1000	120	106.0	V	96	12
47.363	27.81	30.0	2.2	1000	120	102.0	V	273	14
56.808	24.54	30.0	5.5	1000	120	170.0	V	-14	15
170.425	28.74	33.5	4.8	1000	120	101.0	V	292	10
179.826	26.28	33.5	7.2	1000	120	98.0	V	292	10

Plot 6: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-3; middle channel



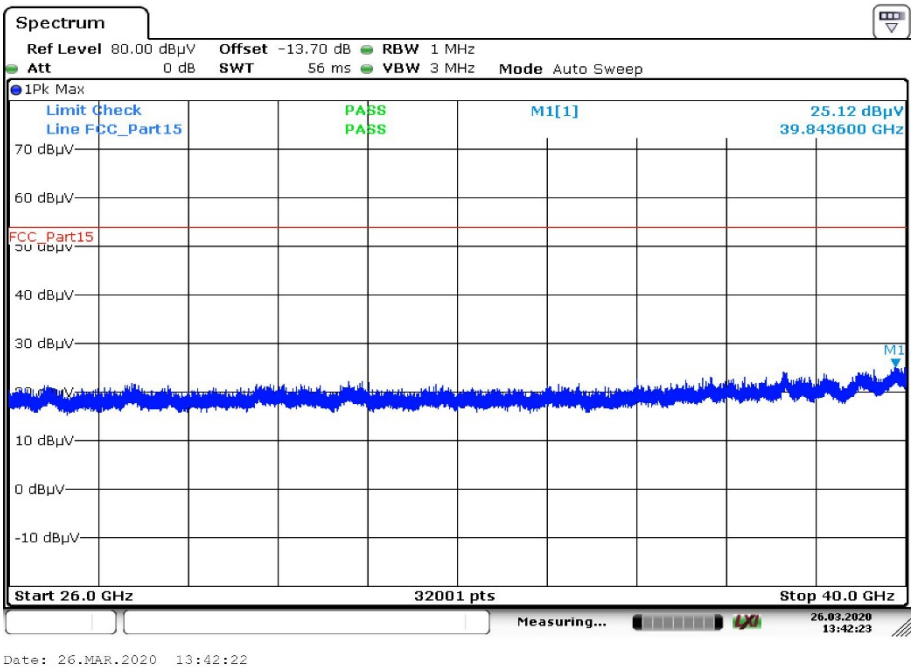
The carrier signal is notched with a 5 GHz band rejection filter.

Plot 7: 18 GHz to 26 GHz; vertical & horizontal polarization; U-NII-3; middle channel

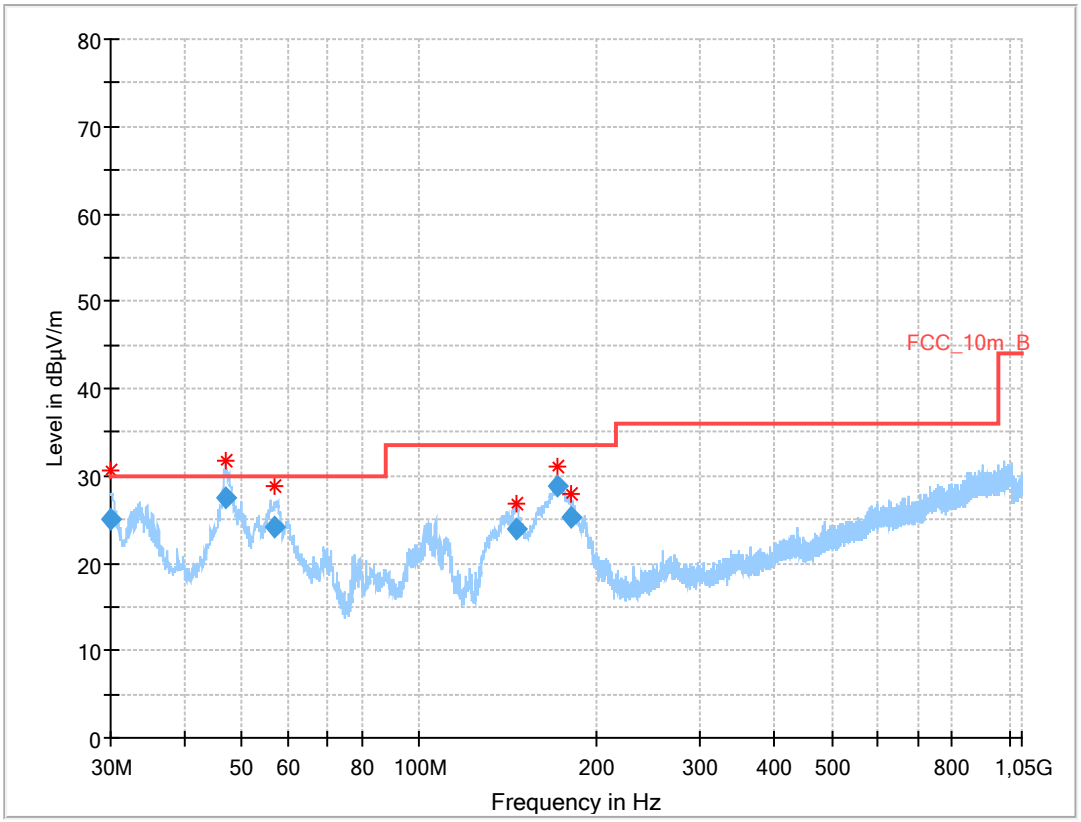


Date: 26.MAR.2020 13:29:36

Plot 8: 26 GHz to 40 GHz; vertical & horizontal polarization; U-NII-3; middle channel

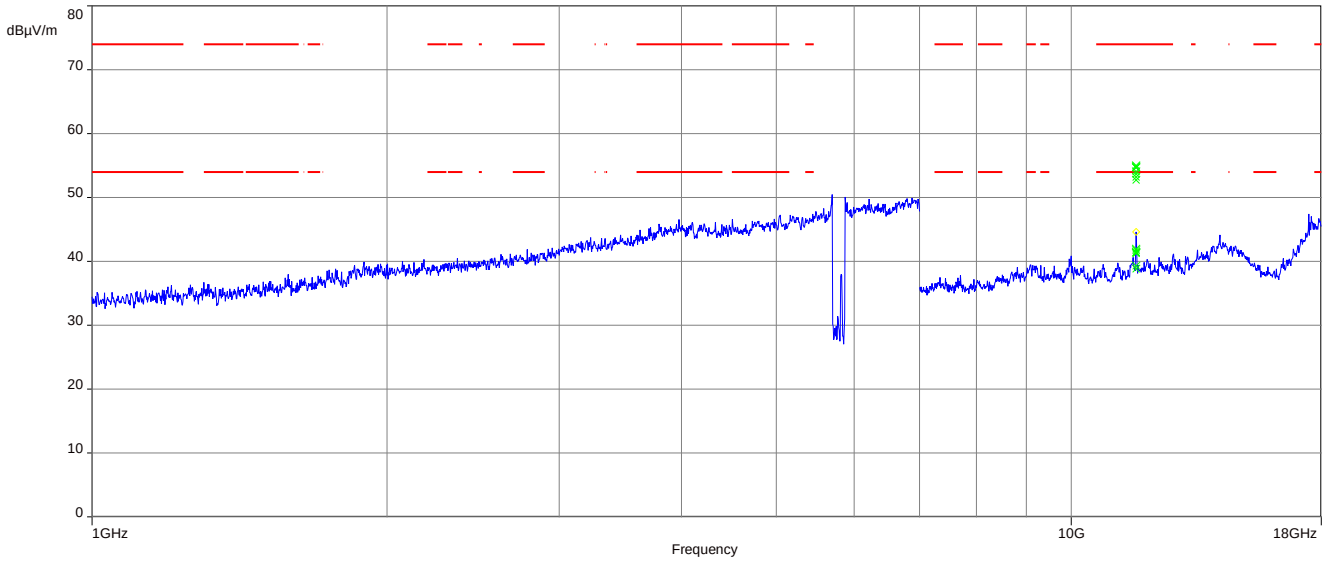


Plot 9: 30 MHz to 1 GHz; vertical & horizontal polarization; U-NII-3; highest channel



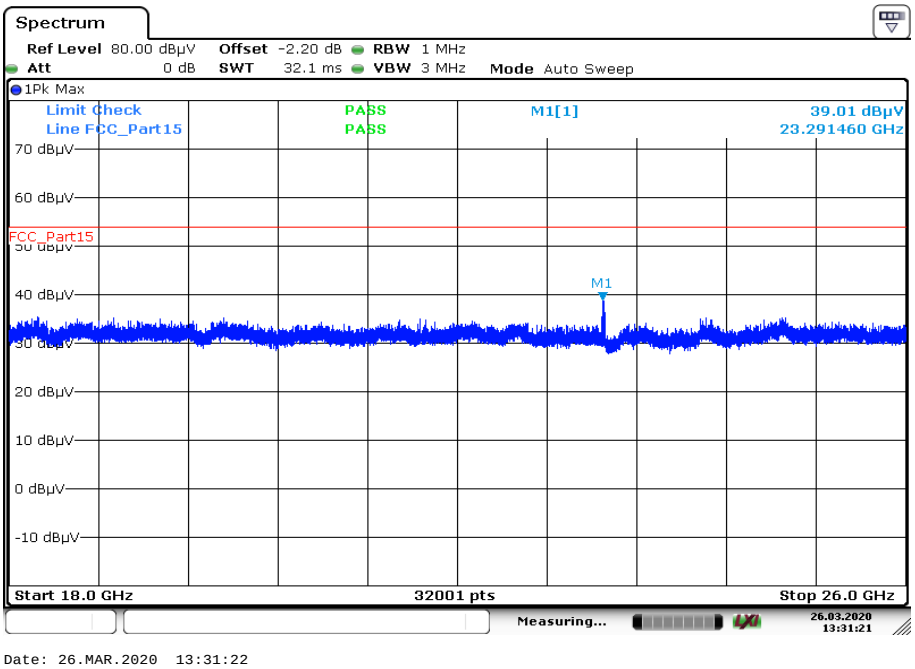
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.108	25.10	30.0	4.9	1000	120	104.0	V	22	12
47.020	27.58	30.0	2.4	1000	120	101.0	V	22	14
56.722	24.21	30.0	5.8	1000	120	170.0	V	-16	15
145.740	23.87	33.5	9.6	1000	120	101.0	V	202	9
171.812	28.77	33.5	4.7	1000	120	101.0	V	292	10
180.327	25.19	33.5	8.3	1000	120	102.0	V	278	10

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

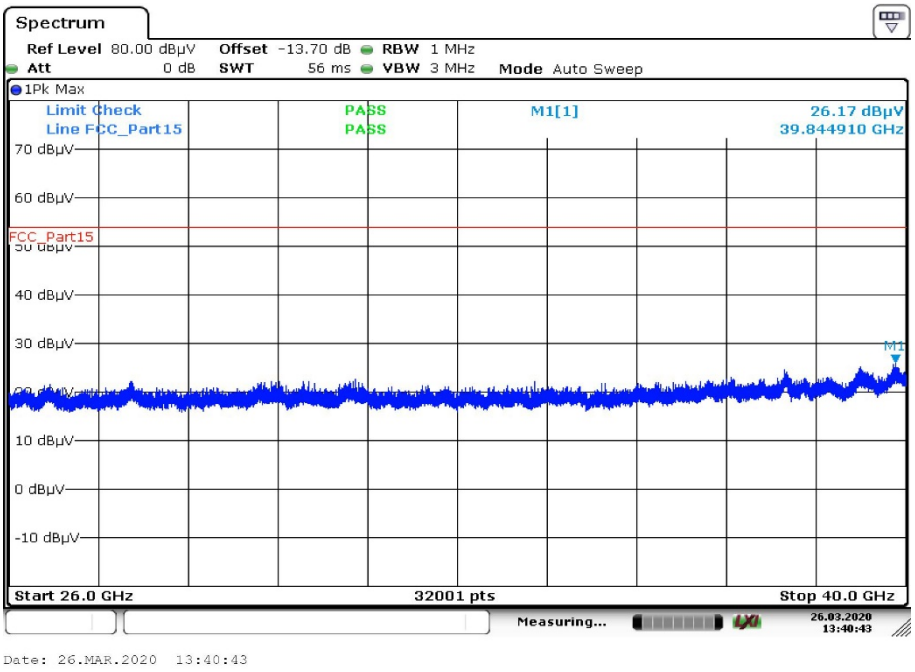


The carrier signal is notched with a 5 GHz band rejection filter.

Plot 11: 18 GHz to 26 GHz; vertical & horizontal polarization; U-NII-3; highest channel



Plot 12: 26 GHz to 40 GHz; vertical & horizontal polarization; U-NII-3; highest channel



11.11 RX spurious emissions radiated

Description:

Measurement of the radiated spurious emissions in idle/receive mode.

Measurement:

Measurement parameter	
Detector:	Quasi Peak below 1 GHz (alternative Peak) Peak above 1 GHz / RMS
Sweep time:	Auto
Resolution bandwidth:	F < 1 GHz: 100 kHz F > 1 GHz: 1 MHz
Video bandwidth:	F < 1 GHz: 100 kHz F > 1 GHz: ≥ 3 MHz
Span:	30 MHz to 40 GHz
Trace mode:	Max Hold / Average with 100 counts + 20 log (1 / X) for duty cycle lower than 100 %
Test setup:	See chapter 6.2 – B
Measurement uncertainty:	See chapter 8

Limits:

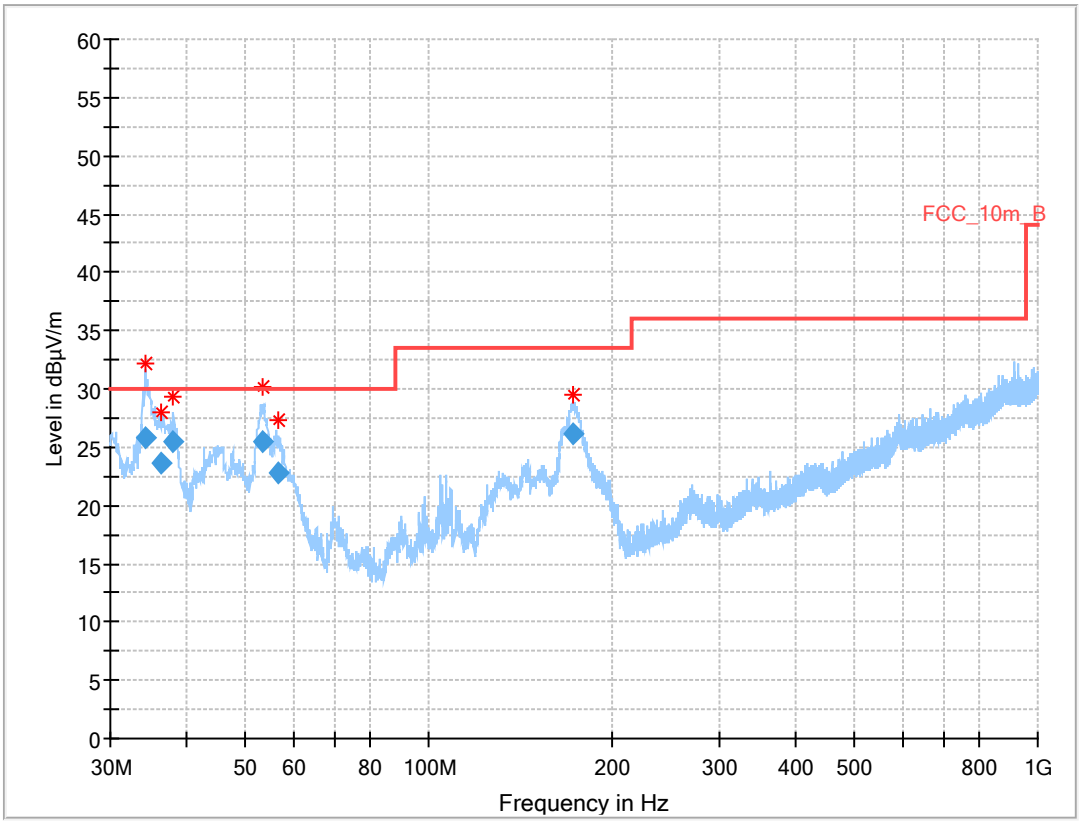
RX Spurious Emissions Radiated		
Frequency (MHz)	Field Strength (dBµV/m)	Measurement distance
30 - 88	30.0	10
88 – 216	33.5	10
216 – 960	36.0	10
Above 960	54.0	3

Results:

see tables below the plots.

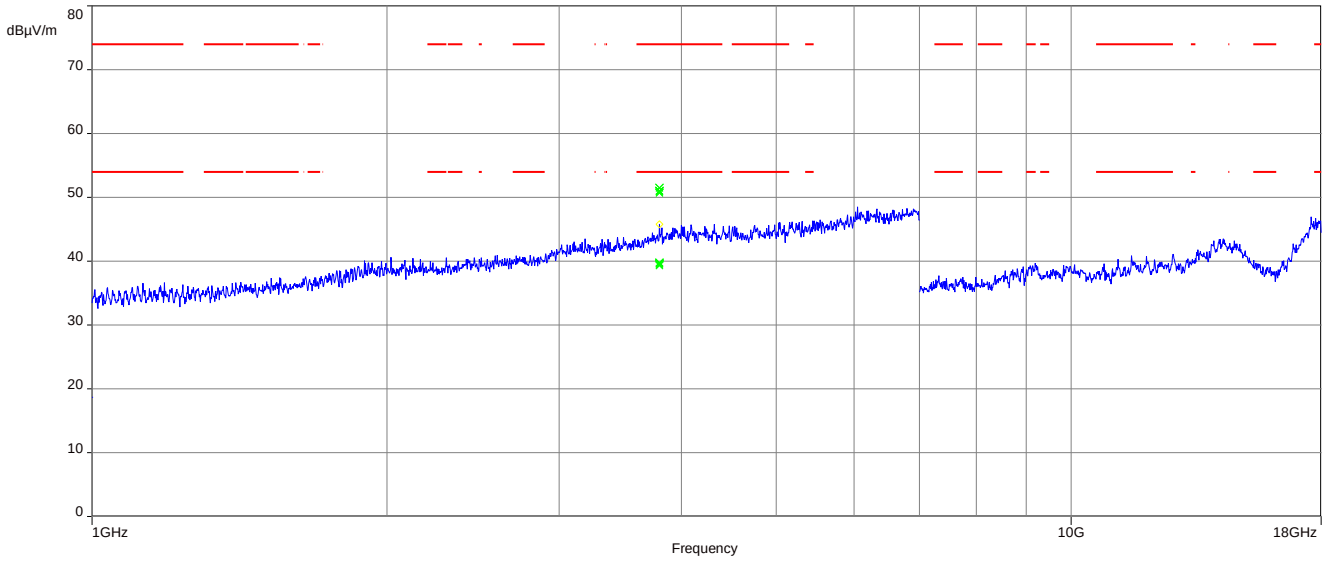
Plots:

Plot 1: 30 MHz to 1 GHz, vertical & horizontal polarization

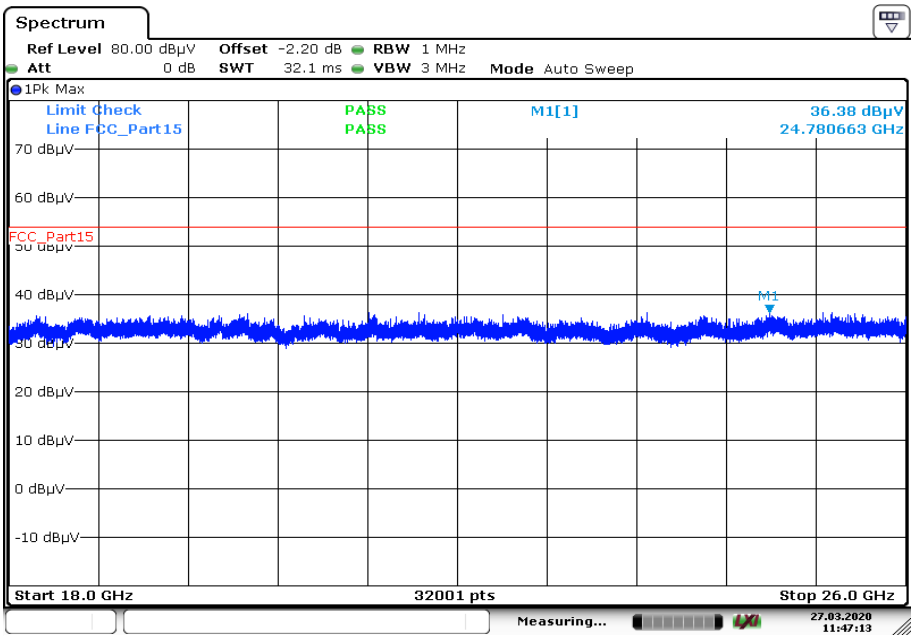


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
34.280	25.77	30.0	4.2	1000	120	117.0	V	120	12
36.455	23.64	30.0	6.4	1000	120	160.0	V	82	13
38.090	25.48	30.0	4.5	1000	120	98.0	V	297	13
53.201	25.43	30.0	4.6	1000	120	98.0	V	0	14
56.763	22.87	30.0	7.1	1000	120	160.0	V	352	15
171.944	26.16	33.5	7.3	1000	120	102.0	V	-4	10

Plot 2: 1 GHz to 18 GHz, vertical & horizontal polarization

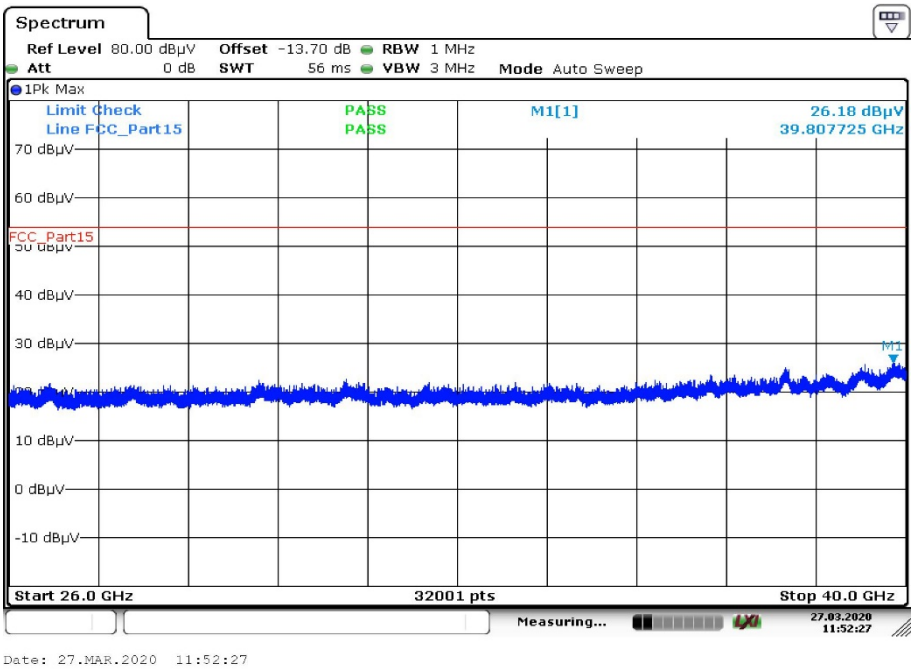


Plot 3: 18 GHz to 26 GHz, vertical & horizontal polarization



Date: 27.MAR.2020 11:47:13

Plot 4: 26 GHz to 40 GHz, vertical & horizontal polarization



11.12 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 6.5 – A
Measurement uncertainty:	See sub clause 8

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

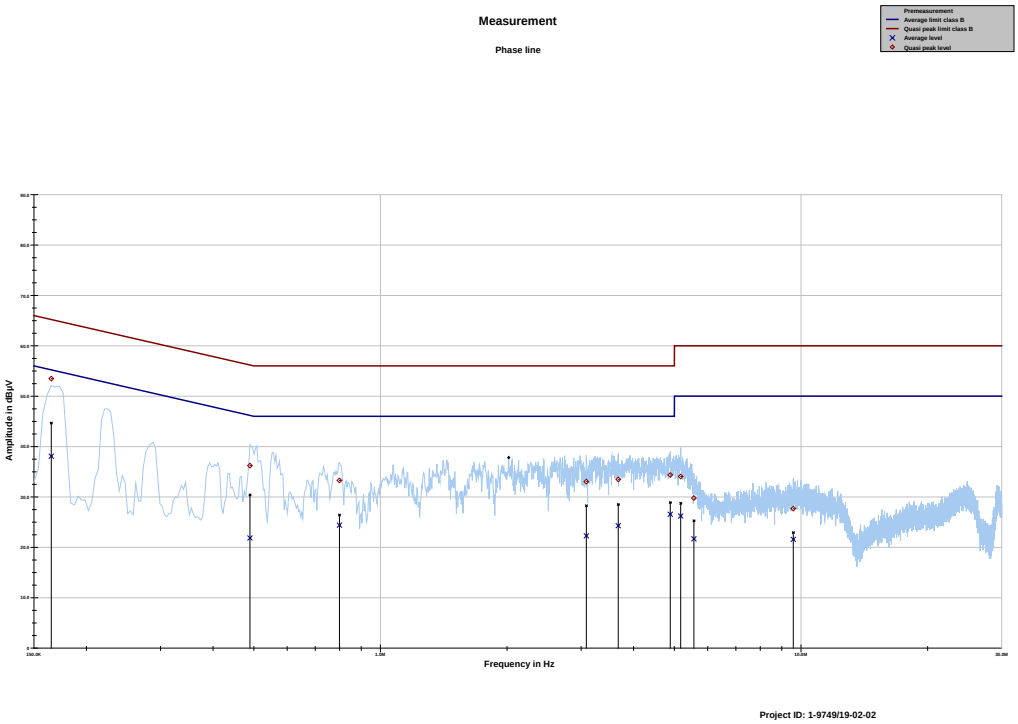
*Decreases with the logarithm of the frequency

Results:

see tables below the plots.

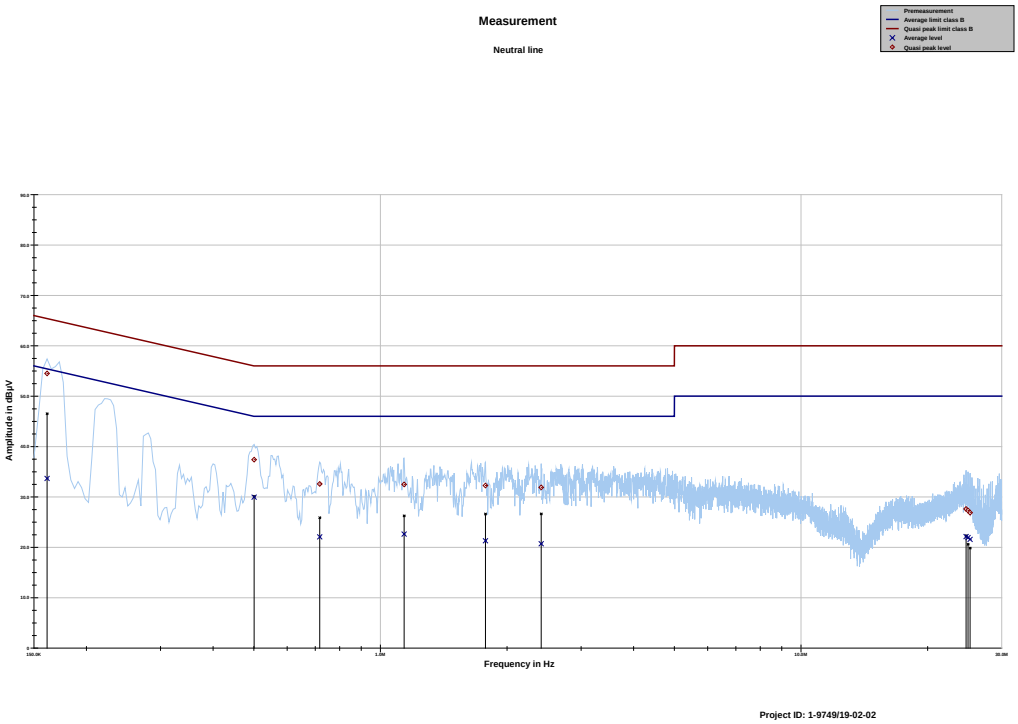
Plots:

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
0.164925	53.48	11.73	65.212	38.08	17.49	55.574
0.489544	36.20	19.97	56.176	21.86	24.44	46.299
0.799238	33.28	22.72	56.000	24.39	21.61	46.000
3.086494	33.03	22.97	56.000	22.27	23.73	46.000
3.676031	33.47	22.53	56.000	24.28	21.72	46.000
4.888687	34.35	21.65	56.000	26.56	19.44	46.000
5.175994	34.05	25.95	60.000	26.22	23.78	50.000
5.564044	29.77	30.23	60.000	21.68	28.32	50.000
9.586331	27.68	32.32	60.000	21.57	28.43	50.000

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
0.161194	54.50	10.90	65.402	33.67	22.01	55.680
0.500737	37.39	18.61	56.000	29.96	16.04	46.000
0.717150	32.57	23.43	56.000	22.07	23.93	46.000
1.138781	32.48	23.52	56.000	22.62	23.38	46.000
1.776825	32.26	23.74	56.000	21.29	24.71	46.000
2.411138	31.90	24.10	56.000	20.70	25.30	46.000
24.682969	27.61	32.39	60.000	22.12	27.88	50.000
24.955350	27.30	32.70	60.000	21.93	28.07	50.000
25.235194	26.88	33.12	60.000	21.57	28.43	50.000

12 Observations

No observations except those reported with the single test cases have been made.

Annex A 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

Annex B Document history

Version	Applied changes	Date of release
-/-	Initial release	2020-04-02
A	FCC ID, IC ID, PMN and HVIN changed	2020-04-28
B	Results for n20-mode added.	2020-05-05

Annex C Accreditation Certificate – D-PL-12076-01-04

first page	last page
	

Note: The current certificate annex is published on the website (link see below) of the Accreditation Body DAkkS or may be received by CTC advanced GmbH on request

https://www.dakks.de/as/ast/d/D-PL-12076-01-04.pdf

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

first page	last page
	

Note: The current certificate annex is published on the website (link see below) of the Accreditation Body DAkkS or may be received by CTC advanced GmbH on request

https://www.dakks.de/as/ast/d/D-PL-12076-01-05.pdf

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