

TEST REPORT

Test report no.: 1-6334/18-01-03-A



Testing laboratory

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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 with the registration number: D-PL-12076-01-03

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Manufacturer

CPAC Systems AB

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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

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: Charging Interface Control Unit

Model name: CPAC-1054

FCC ID: AHV-CPAC1054

IC: 10111A-CPAC1054

Frequency: UNII-bands:
5250 MHz to 5350 MHz & 5470 MHz to 5725 MHz

Technology tested: WLAN

Antenna: External antenna

Power supply: 24 V 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:



David Lang
Lab Manager
Radio Communications & EMC

Test performed:



Marco Bertolino
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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 1-6334/18-01-03 and dated 2018-08-06.

2.2 Application details

Date of receipt of order:	2018-06-04
Date of receipt of test item:	2018-07-09
Start of test:	2018-07-09
End of test:	2018-07-16
Person(s) present during the test:	-/-

2.3 Test laboratories sub-contracted

None

3 Test standard/s and references

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	General Requirements for Compliance of Radio Apparatus

Guidance	Version	Description
UNII: 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

4 Test environment

Temperature	:	T_{nom} T_{max} T_{min}	+22 °C during room temperature tests No tests under extreme temperature conditions required. No tests under extreme temperature conditions required.
Relative humidity content	:		38 %
Barometric pressure	:		1023 hPa
Power supply	:	V_{nom} V_{max} V_{min}	24 V DC by external power supply No tests under extreme voltage conditions required. No tests under extreme voltage conditions required.

5 Test item

5.1 General description

Kind of test item	:	Charging Interface Control Unit
Type identification	:	CPAC-1054
HMN	:	-/-
PMN	:	CPAC-1054
HVIN	:	CPAC-1054
FVIN	:	1.0.0
S/N serial number	:	Rad. 00002609 Cond. 00002602
HW hardware status	:	Not provided!
SW software status	:	Not provided!
Frequency band	:	UNII-bands: 5250 MHz to 5350 MHz & 5470 MHz to 5725 MHz
Type of radio transmission	:	OFDM
Use of frequency spectrum	:	
Type of modulation	:	(D)BPSK, (D)QPSK, 16 – QAM, 64 – QAM
Antenna	:	External antenna; Huber+Suhner type 1354.17.0001 with 7.5m coaxial feed cable
Power supply	:	24.0 V 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:

1-6334/18-01-01_AnnexA
 1-6334/18-01-01_AnnexB
 1-6334/18-01-01_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).

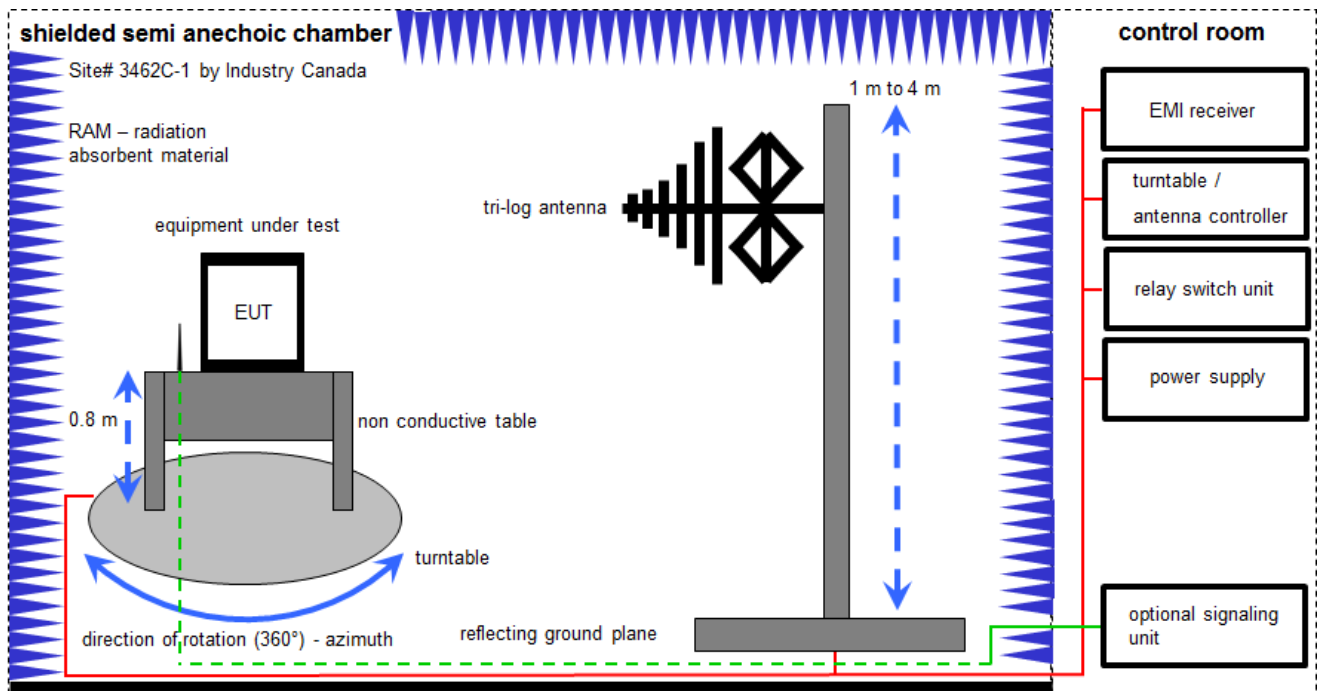
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

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
vlk!	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)

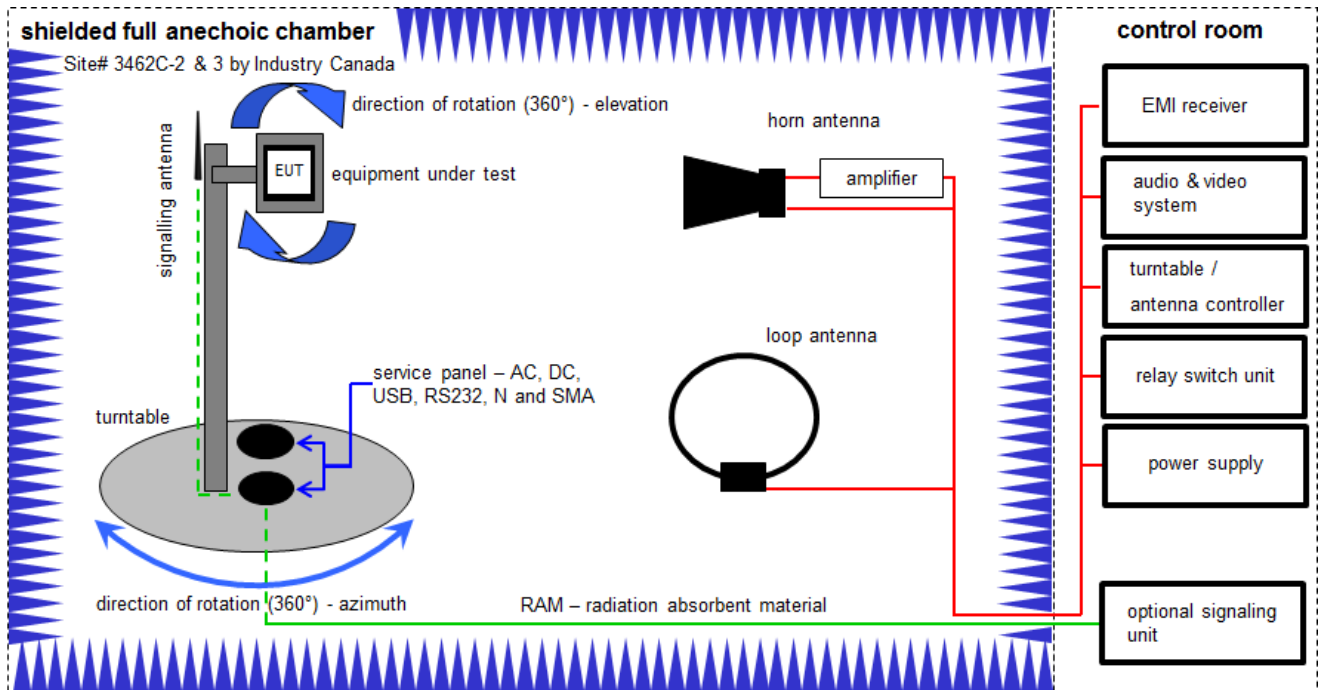
Example calculation:

$$FS [dB\mu V/m] = 12.35 [dB\mu V/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dB\mu V/m] (35.69 \mu V/m)$$

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	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2920A04466	300000580	ne	-/-	-/-
3	A	Meßkabine 1	HF-Absorberhalle	MWB AG 300023		300000551	ne	-/-	-/-
4	A	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	15.12.2017	14.12.2018
5	A	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
6	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
7	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-

6.2 Shielded fully anechoic chamber



Measurement distance: horn antenna 3 meter; loop antenna 3 meter
 BAT-EMC software version: 3.16.0.49

FS = UR + CA + AF

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

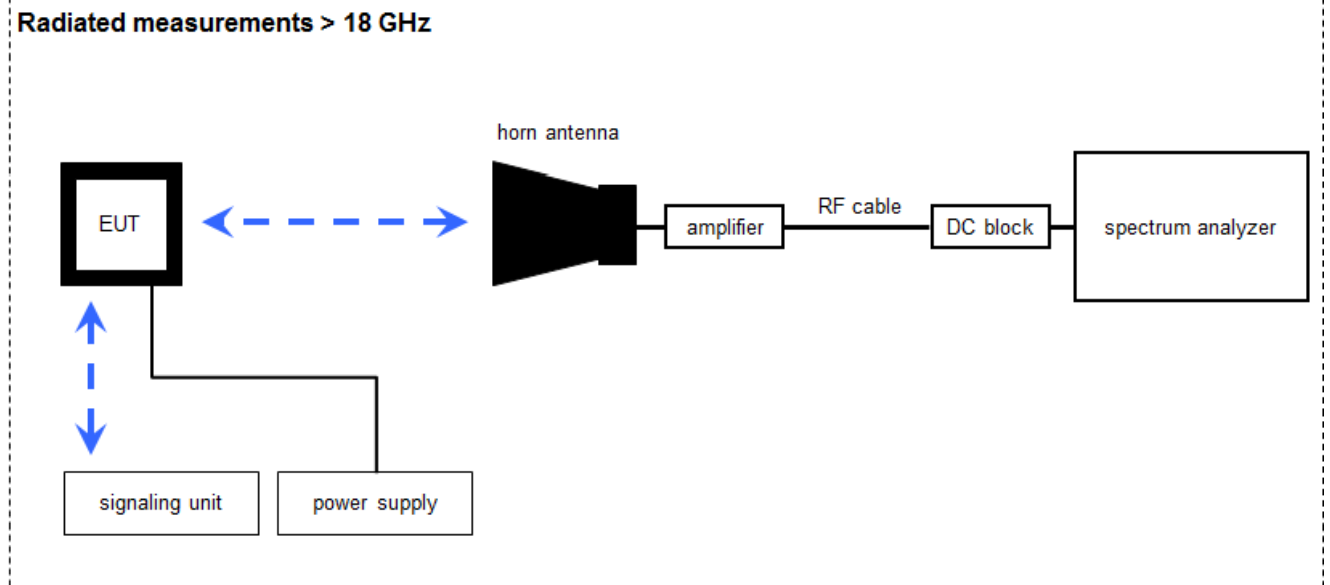
Example calculation:

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	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	vKI!	12.12.2017	11.12.2020
2	B	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vKI!	07.07.2017	06.07.2019
3	A+B	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
4	A	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9107-3697	300001605	vKI!	14.02.2017	13.02.2019
5	A+B	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
6	A+B	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	20.12.2017	19.12.2018
7	A	Highpass Filter WHK1.1/15G-10SS	WHK1.1/15G-10SS	Wainwright	3	300003255	ev	-/-	-/-
8	A	Highpass Filter WHKX7.0/18G-8SS	WHKX7.0/18G-8SS	Wainwright	19	300003790	ne	-/-	-/-
9	A	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
10	A	Broadband Amplifier 5-13 GHz	CBLU5135235	CERNEX	22010	300004491	ev	-/-	-/-
11	A+B	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
12	A+B	NEXIO EMV-Software	BAT EMC V3.16.0.49	EMCO	-/-	300004682	ne	-/-	-/-
13	A+B	PC	ExOne	F+W	-/-	300004703	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:

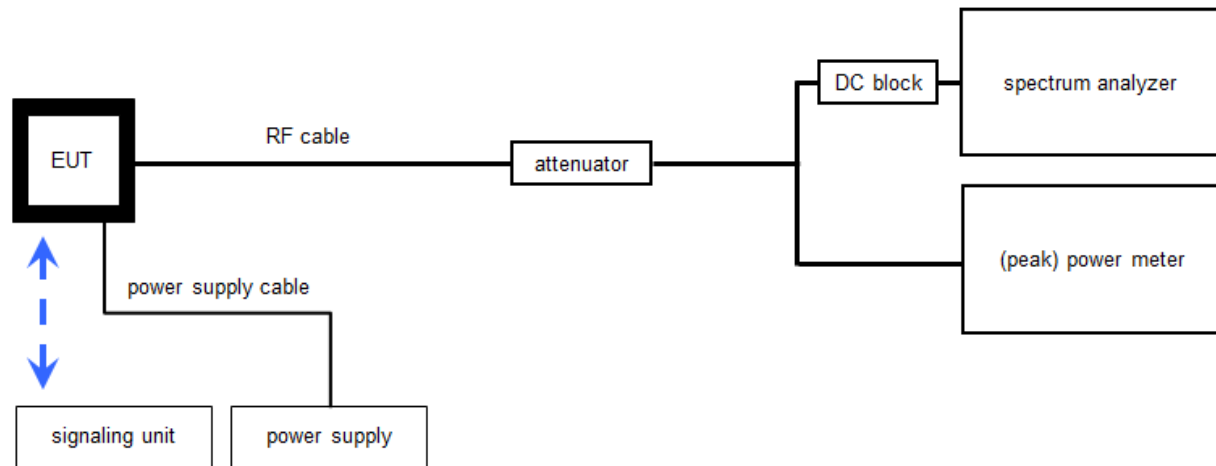
FS [dBμV/m] = 40.0 [dBμV/m] + (-60.1) [dB] + 36.74 [dB/m] = 16.64 [dBμV/m] (6.79 μV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Std. Gain Horn Antenna 18.0-26.5 GHz	638	Narda	-/-	300000486	vKI!	13.12.2017	12.12.2019
2	A	Std. Gain Horn Antenna 26.5-40.0 GHz	V637	Narda	82-16	300000510	vKI!	13.12.2017	12.12.2019
3	A	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	16.01.2018	15.01.2019
4	A	Amplifier 2-40 GHz	JS32-02004000-57-5P	MITEQ	1777200	300004541	ev	-/-	-/-
5	A	RF-Cable	ST18/SMAm/SMAm/48	Huber & Suhner	Batch no. 600918	400001182	ev	-/-	-/-
6	A	RF-Cable	ST18/SMAm/SMAm/48	Huber & Suhner	Batch no. 127377	400001183	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	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	16.01.2018	15.01.2019
2	A	DC-Blocker 0.1-40 GHz	8141A	Inmet	-/-	400001185	ev	-/-	-/-
3	A	Hygro-Thermometer	-/-, 5-45°C, 20-100%rF	Thies Clima	-/-	400000108	ev	11.05.2018	10.05.2020
4	A	PC-WLAN Tester	Intel Core i3 3220/3,3 GHz, Prozessor	-/-	2V2403033A4523	300004589	ne	-/-	-/-
	A	Teststand	Teststand Custom Sequence Editor	National Instruments GmbH	-/-	300004590	ne	-/-	-/-
5	A	RF-Cable	ST18/SMAM/SMAM/60	Huber & Suhner	Batch no. 606844	400001181	ev	-/-	-/-
6	A	Coax Attenuator 10 dB 2W 0-40 GHz	MCL BW-K10-2W44+	Mini Circuits	-/-	400001186	ev	-/-	-/-

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 $\pm 45^\circ$ 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	2018-10-05	-/-

Test specification clause	Test case	Temperature conditions	Power source voltages	C	NC	NA	NP	Remark
-/-	Output power verification (cond.)	Nominal	Nominal	-/-				Declared
-/-	Antenna gain	Nominal	Nominal	-/-				Declared
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	☒	☐	☐	☐	-/-
§15.407 RSS - 247 (6.3)	DFS	Nominal	Nominal	☐	☐	☐	☒	-/-

Notes:

C:	Compliant	NC:	Not compliant	NA:	Not applicable	NP:	Not performed
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10 Additional comments

Reference documents: Antenna Data Sheet: HUBER+SUHNER SENCITY SPOT-L WiFi Antenna (1354.17.0001).

Special test descriptions: The measurement of emissions at an elevation angle higher 30° from horizon does not apply in the frequency range tested.

Configuration descriptions: a-mode:
 at+uprodwtx=1,52,4,16,15000,20
 at+uprodwtx=1,60,4,16,15000,20
 at+uprodwtx=1,64,4,16,15000,20

 at+uprodwtx=1,100,4,16,15000,20
 at+uprodwtx=1,120,4,16,15000,20
 at+uprodwtx=1,140,4,16,15000,20

n/ac HT20 – mode:
 at+uprodwtx=1,52,13,16,15000,20
 at+uprodwtx=1,60,13,16,15000,20
 at+uprodwtx=1,64,13,16,15000,20

at+uprodwtx=1,100,13,16,15000,20
 at+uprodwtx=1,120,13,16,15000,20
 at+uprodwtx=1,140,13,16,15000,20

Rx-Mode:
 at+uprodwrx=0,100,13

Provided channels:

Channels with 20 MHz channel bandwidth:

U-NII-1 & U-NII-2A (5150 MHz to 5250 MHz & 5250 MHz to 5350 MHz) channel number & centre frequency								
channel	36	40	44	48	52	56	60	64
f _c / MHz	5180	5200	5220	5240	5260	5280	5300	5320

U-NII-2C (5470 MHz to 5725 MHz) channel number & centre 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

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

Worst case data rates as declared by the manufacturer:

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
a – mode	Mbit/s	Mbit/s	6 Mbit/s	6 Mbit/s	Mbit/s	Mbit/s
n/ac HT20 – mode	MCS	MCS	MCS0	MCS0	MCS	MCS

11.2 Antenna gain

Maximum antenna gain: 23dBi (as declared by the manufacturer, see referenced documents in section 9)

Considering the attenuation of the provided antenna cable the gain of the system is calculated as follows.

$$G_s = G_a - A_c$$

$$5.3\text{dBi} = 23\text{dBi} - 17.8\text{dB}$$

Where is:

G_s = Gain System (applied to all conducted measurements)

G_a = Gain Antenna (as declared)

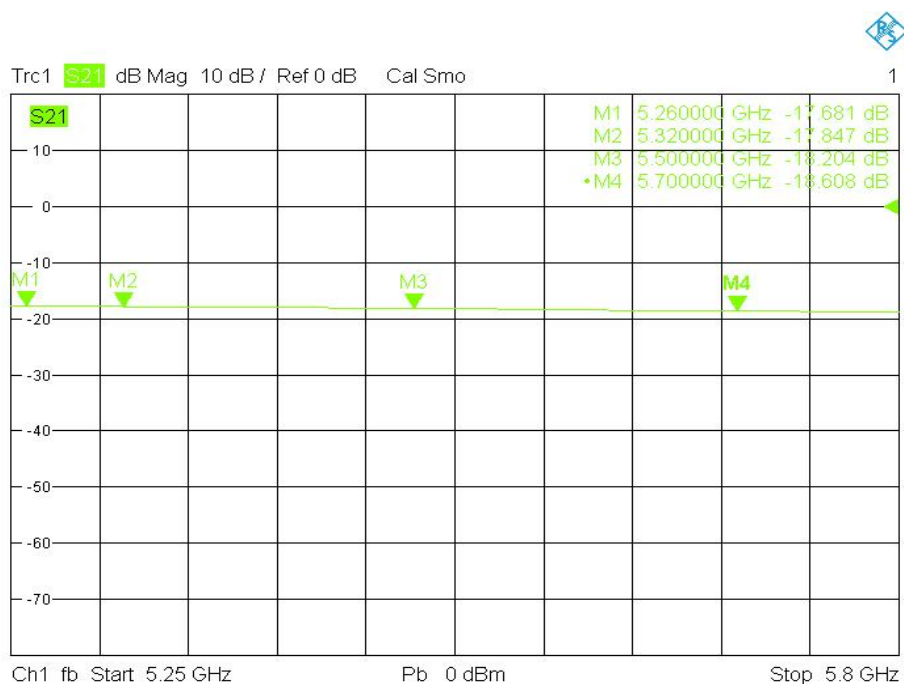
A_c = Cable Attenuation (as measured)

Result:

OFDM	antenna gain			
channel & sub band	lower sub band		higher sub band	
	lowest channel - 5260 MHz	highest channel - 5320 MHz	lowest channel - 5500 MHz	highest channel - 5700 MHz
According antenna datasheet & cable loss measurement	5.3	5.2	4.8	4.4

The highest gain of 5.3dBi is considered for all results based on conducted measurements.

Plot 1: cable loss (7.5 m cable + connector)



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

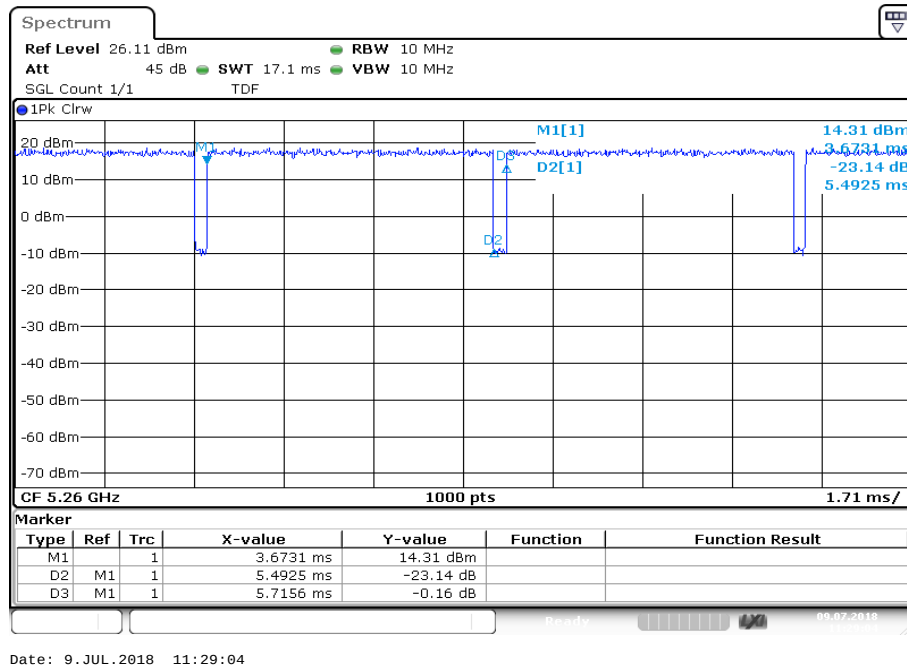
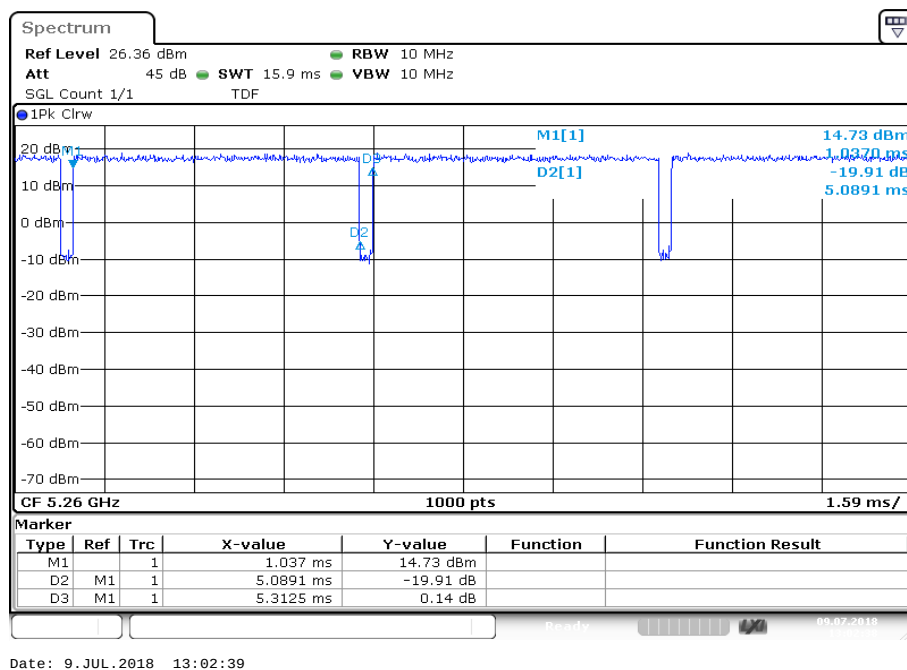
Results:

Duty cycle and correction factor:

OFDM – mode	Calculation method			
	$T_{on} (D2_{plot}) * 100 / T_{complete} (D3_{plot}) = \text{duty cycle}$ $10 * \log(\text{duty cycle}) = \text{correction factor}$			
	$T_{on} (D2_{plot})$	$T_{complete} (D3_{plot})$	Duty cycle	Correction factor
a – mode	5.5ms	5.7ms	96.0%	0.2dB
n/ac HT20 – mode	5.1ms	5.3ms	96.0%	0.2dB

Plots:

Duty cycle and correction factor (example for one channel & one antenna port):

Plot 1: duty cycle of the transmitter; a – mode**Plot 2:** duty cycle of the transmitter; n/ac HT20 – mode

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:	$\geq 10 \cdot (\text{swp points}) \cdot (\text{total on/off time})$
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:

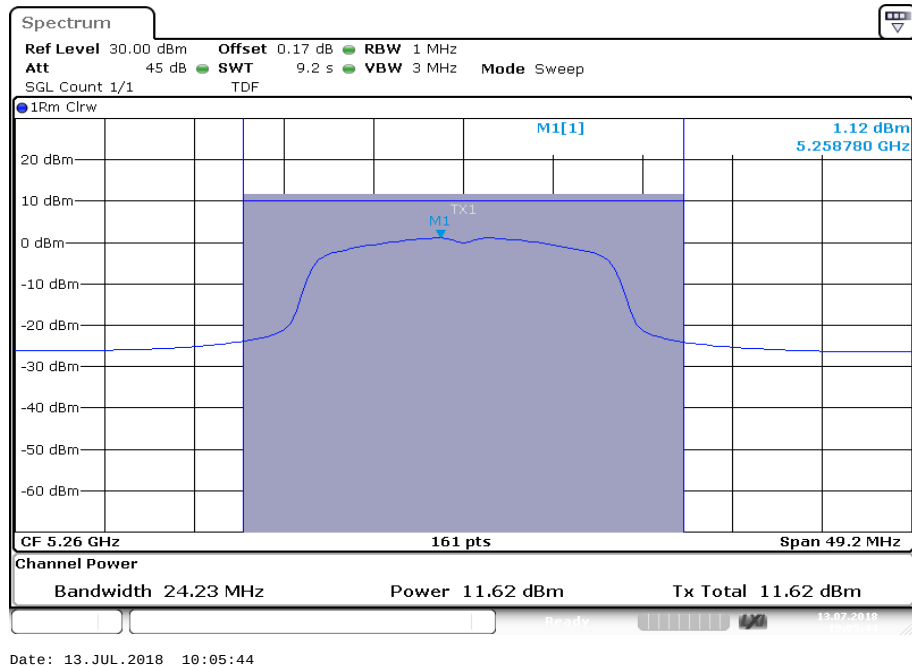
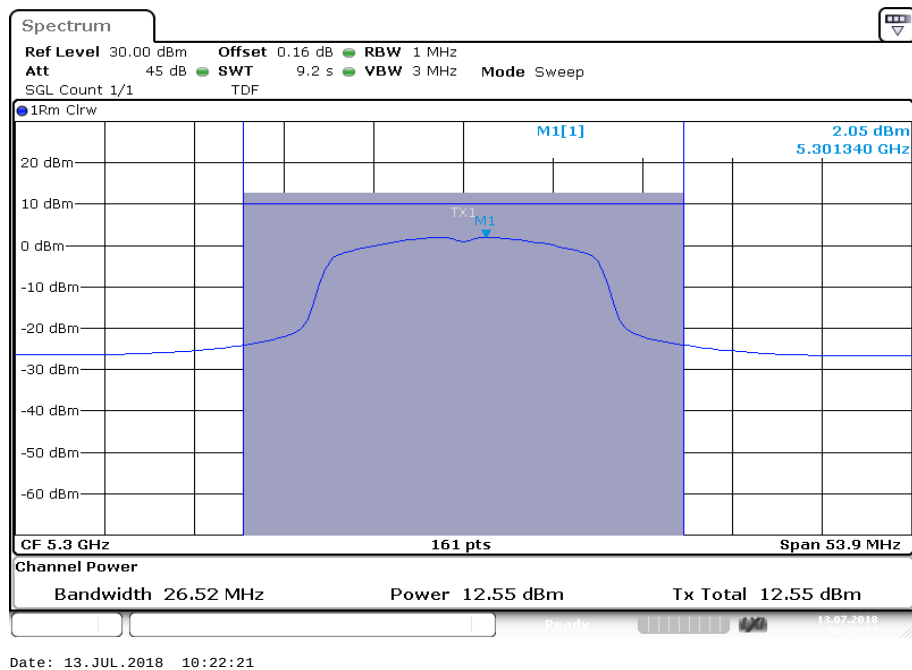
Radiated output power	Conducted output power for mobile equipment
Conducted power + 6 dBi antenna gain	250mW or 11 dBm + 10 log Bandwidth 5.250-5.350 GHz 250mW or 11 dBm + 10 log Bandwidth 5.470-5.725 GHz (where Bandwidth is the 26dB Bandwidth [MHz])

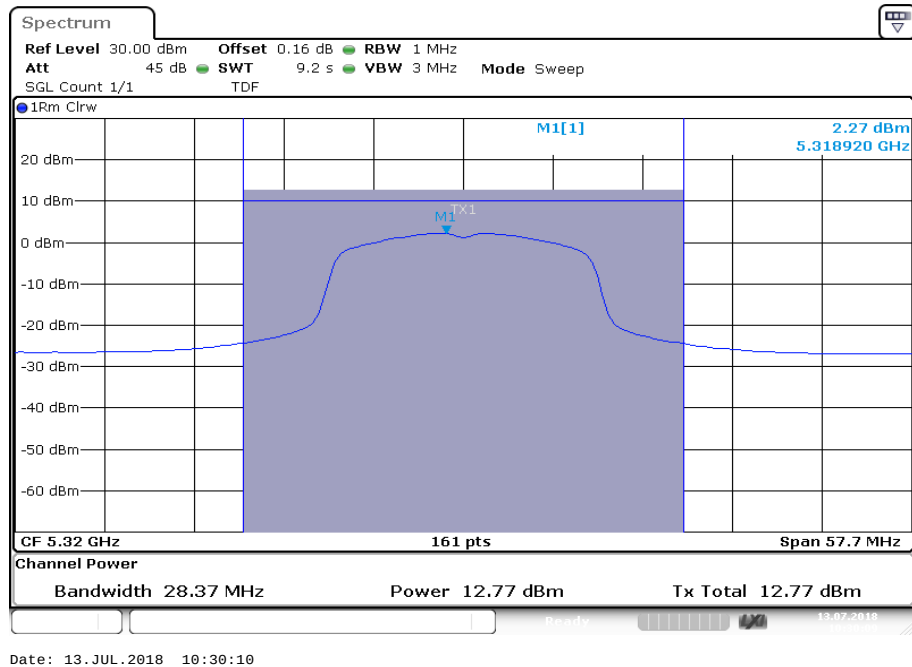
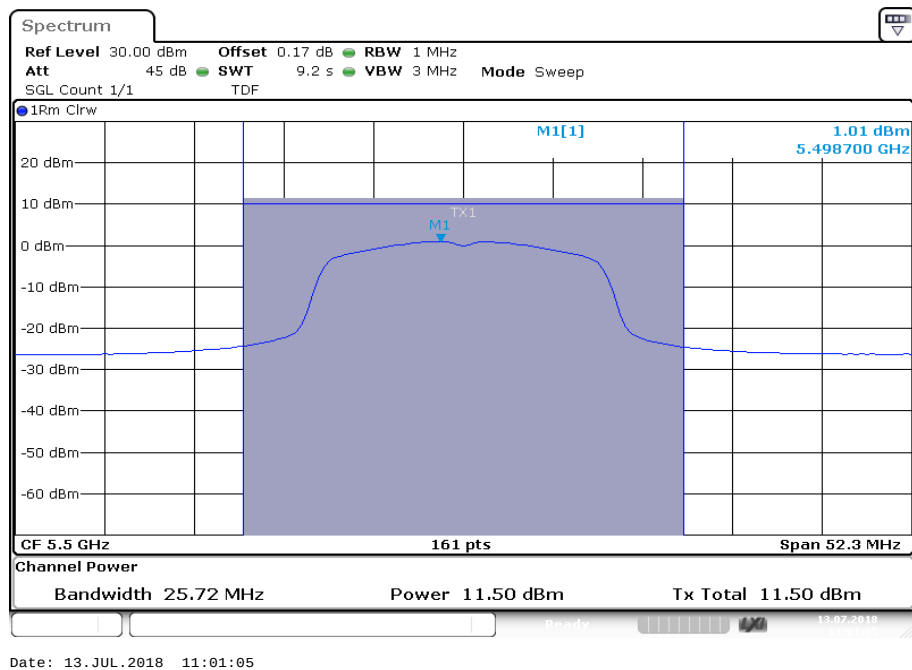
Results:

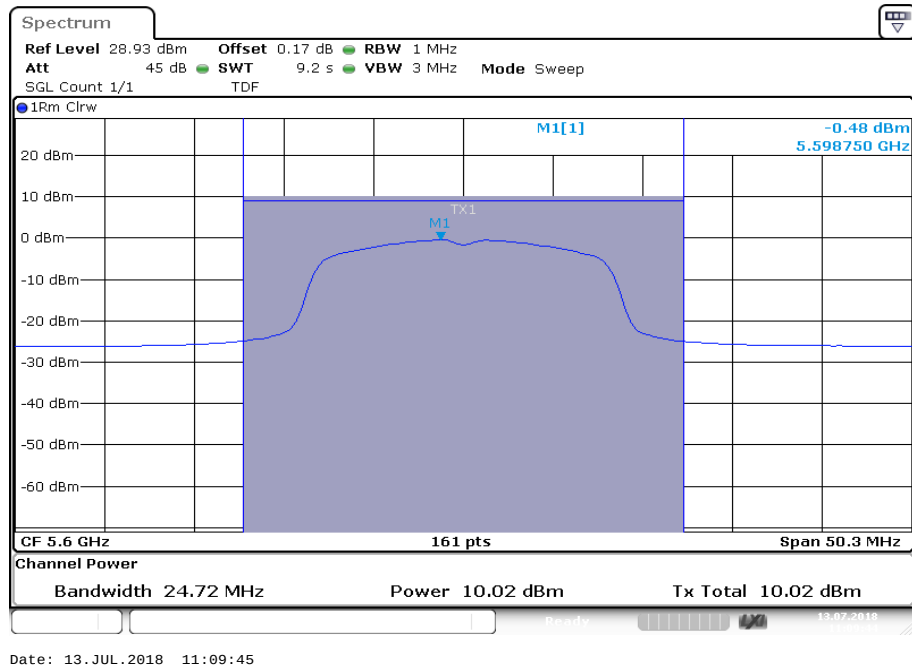
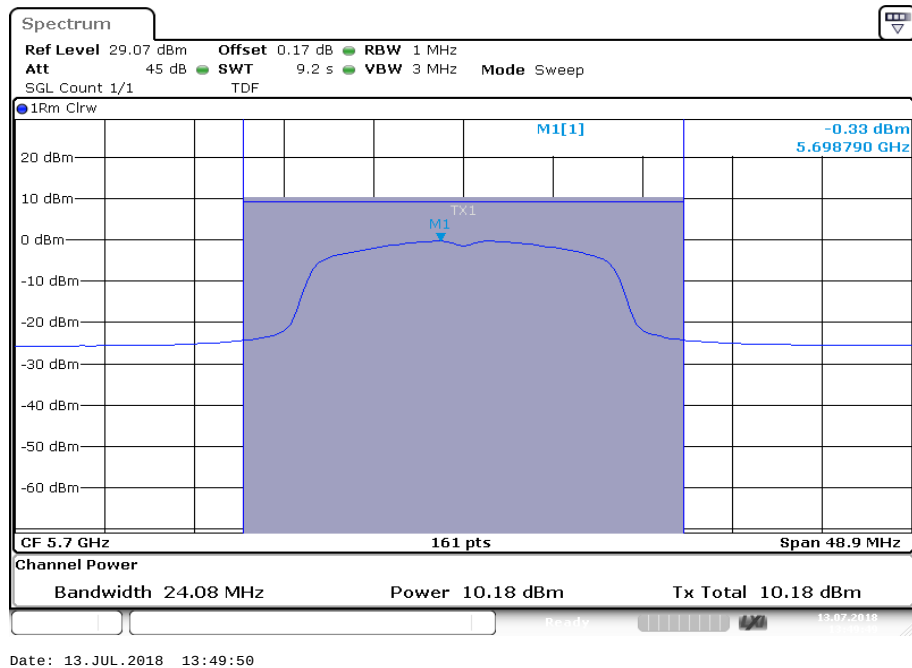
a	Maximum output power conducted [dBm]		
	U-NII-1 (5150 MHz to 5250 MHz)		
	Lowest channel	Middle channel	Highest channel
	-/-	-/-	-/-
	U-NII-2A (5250 MHz to 5350 MHz)		
	Lowest channel	Middle channel	Highest channel
	11.6	12.6	12.8
	U-NII-2C (5470 MHz to 5725 MHz)		
	Lowest channel	Middle channel	Highest channel
	11.5	10.0	10.2
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	-/-	-/-	-/-

Results:

n/ac HT20	Maximum output power conducted [dBm]		
	U-NII-1 (5150 MHz to 5250 MHz)		
	Lowest channel	Middle channel	Highest channel
	-/-	-/-	-/-
	U-NII-2A (5250 MHz to 5350 MHz)		
	Lowest channel	Middle channel	Highest channel
	11.6	12.7	12.9
	U-NII-2C (5470 MHz to 5725 MHz)		
	Lowest channel	Middle channel	Highest channel
	11.7	10.1	10.3
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	-/-	-/-	-/-

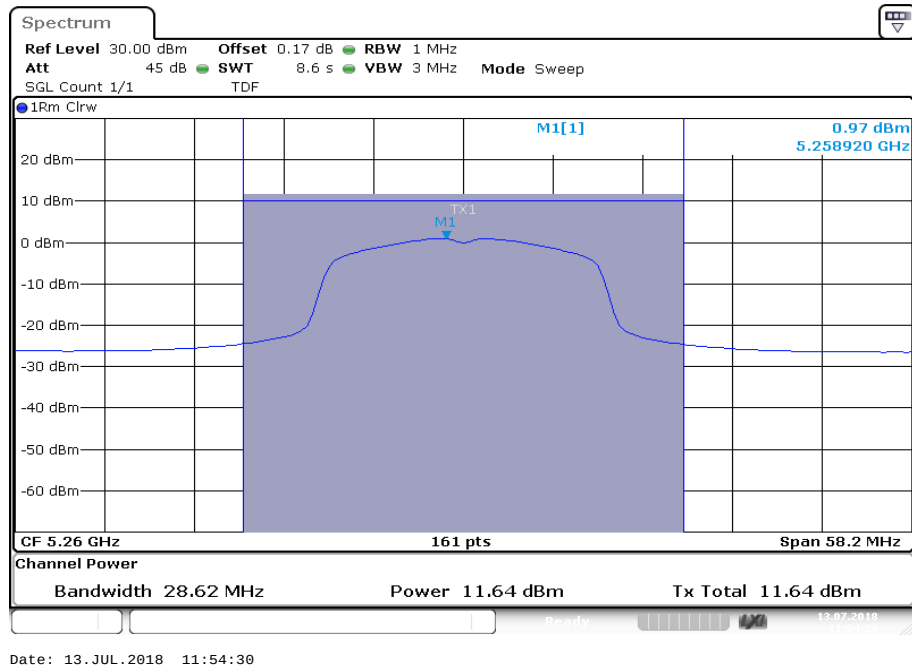
Plots: a – mode**Plot 1:** U-NII-2A; lowest channel**Plot 2:** U-NII-2A; middle channel

Plot 3: U-NII-2A; highest channel**Plot 4:** U-NII-2C; lowest channel

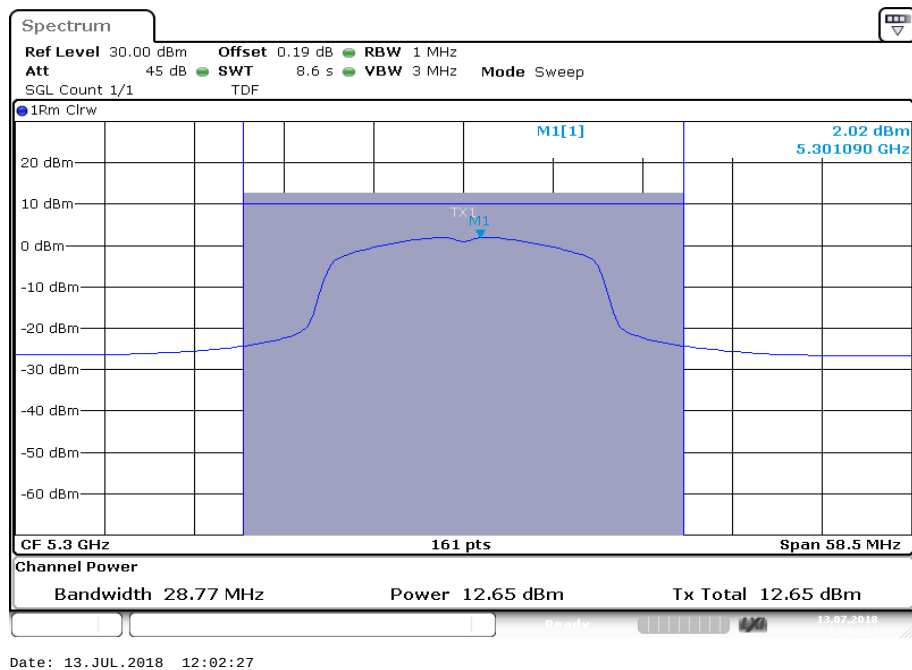
Plot 5: U-NII-2C; middle channel**Plot 6:** U-NII-2C; highest channel

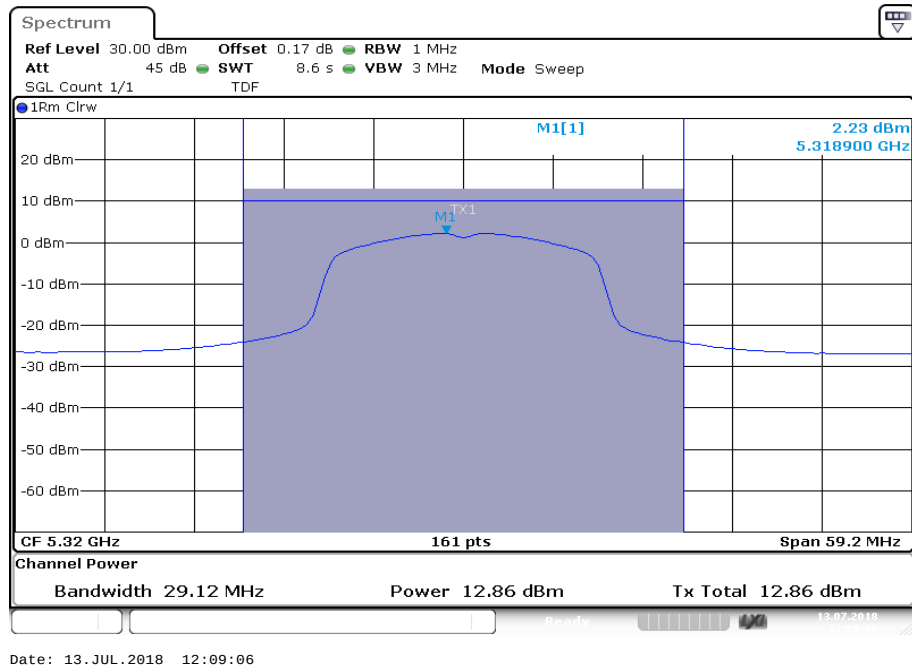
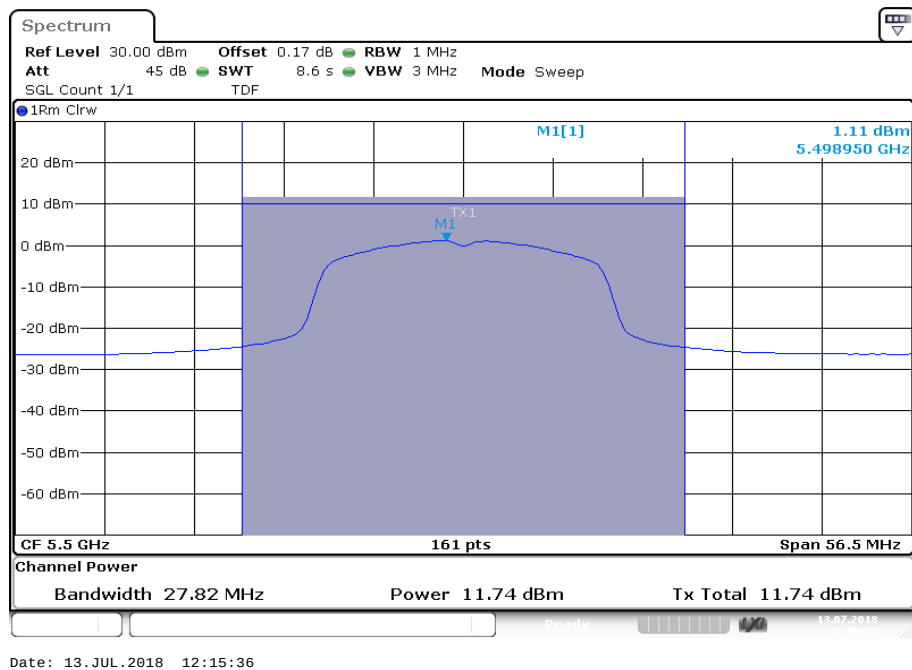
Plots: n/ac HT20 – mode

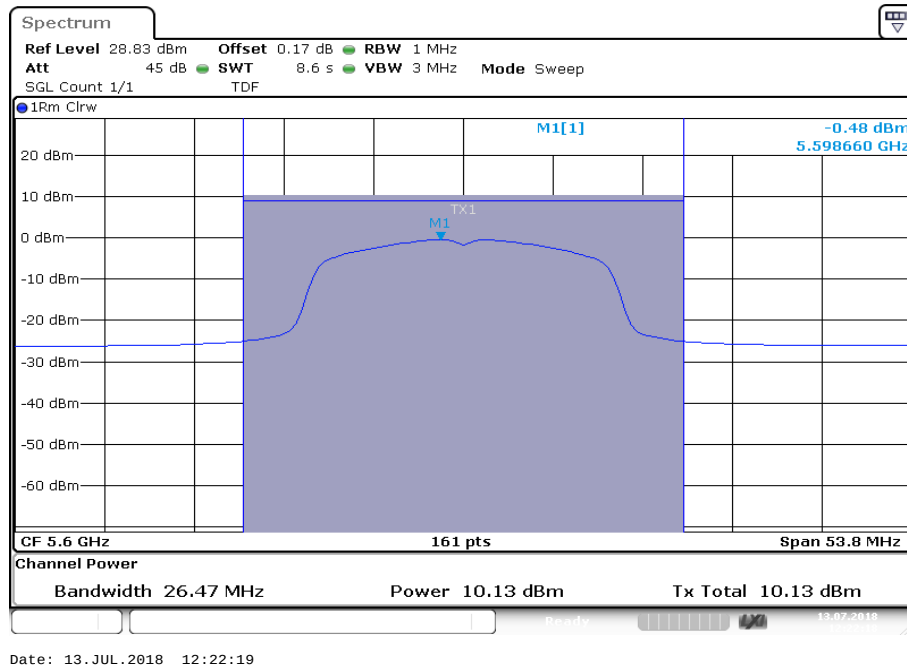
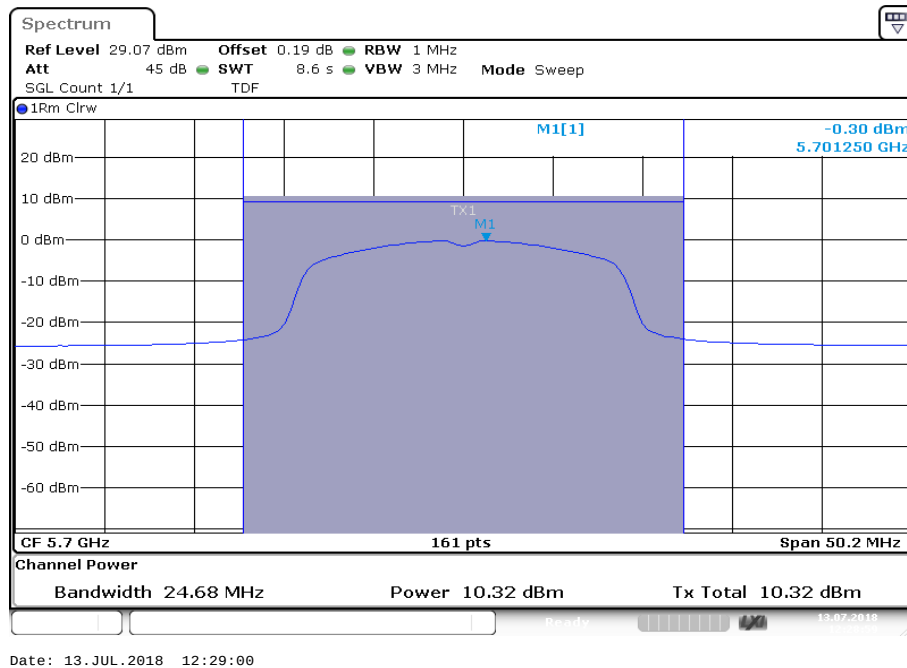
Plot 1: U-NII-2A; lowest channel



Plot 2: U-NII-2A; middle channel



Plot 3: U-NII-2A; highest channel**Plot 4:** U-NII-2C; lowest channel

Plot 5: U-NII-2C; middle channel**Plot 6:** U-NII-2C; highest channel

11.4.2 Maximum output power according to IC requirements

Description:

Measurement of the maximum output power conducted + radiated

Measurement:

Measurement parameter	
Detector:	RMS
Sweep time:	$\geq 10 * (\text{swp points}) * (\text{total on/off time})$
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:

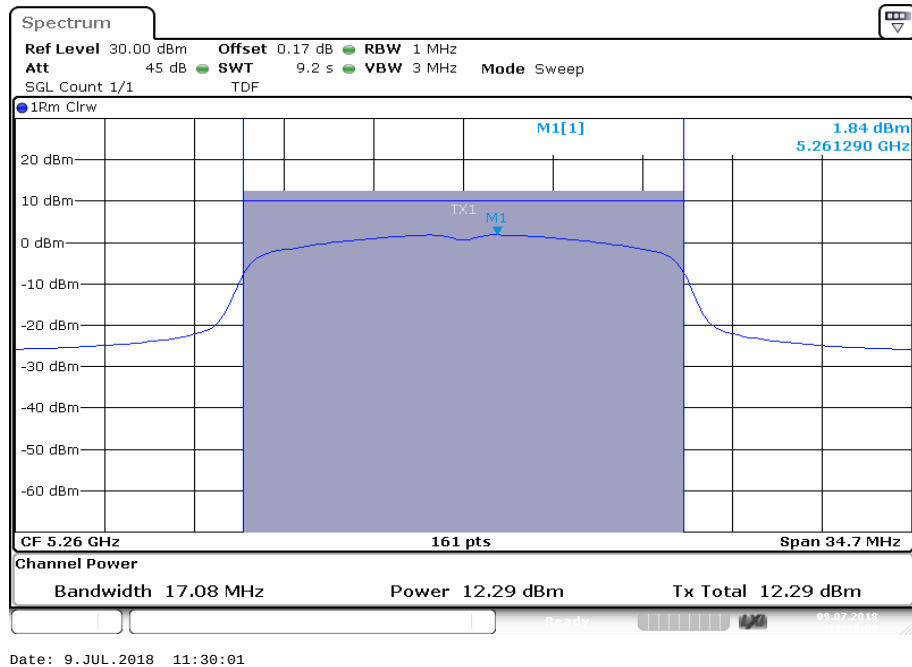
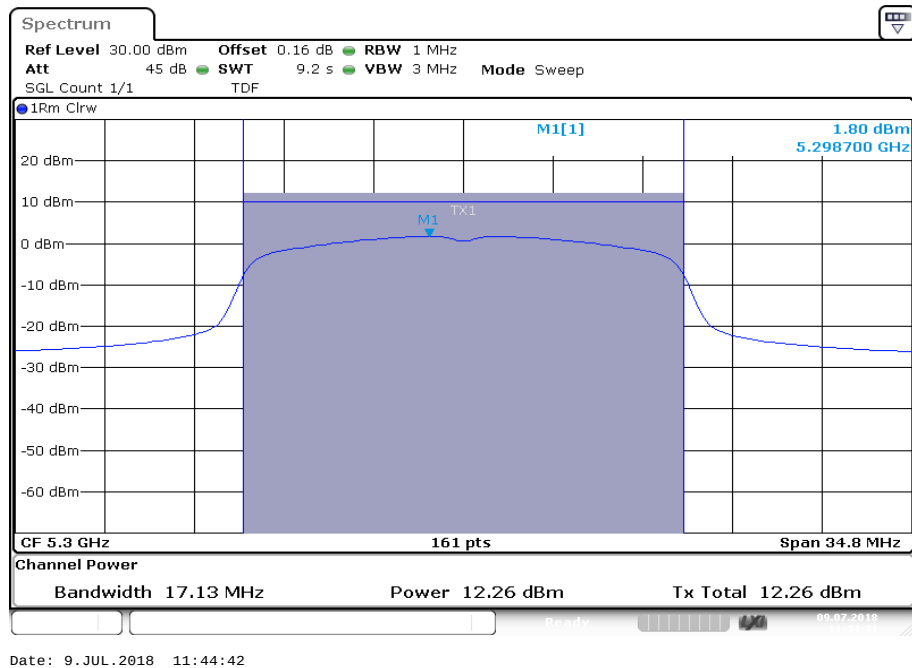
Radiated output power	Conducted output power for mobile equipment
The lesser one of 1 W or 17 dBm + 10 log Bandwidth 5.250-5.350 GHz 1 W or 17 dBm + 10 log Bandwidth 5.470-5.725 GHz (where Bandwidth is the 99% Bandwidth [MHz])	The lesser one of 250mW or 11 dBm + 10 log Bandwidth 5.250-5.350 GHz 250mW or 11 dBm + 10 log Bandwidth 5.470-5.725 GHz (where Bandwidth is the 99% Bandwidth [MHz])

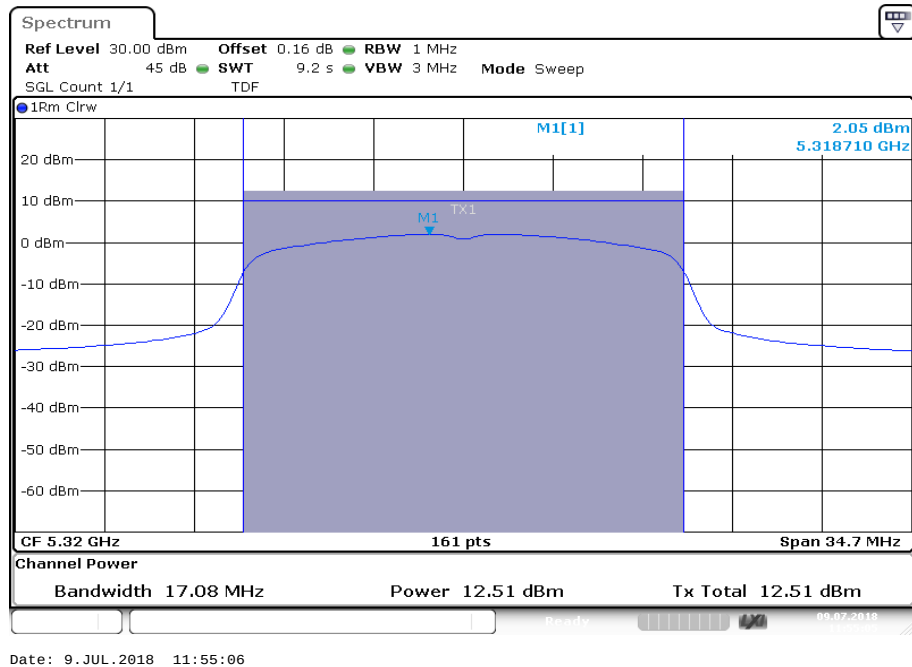
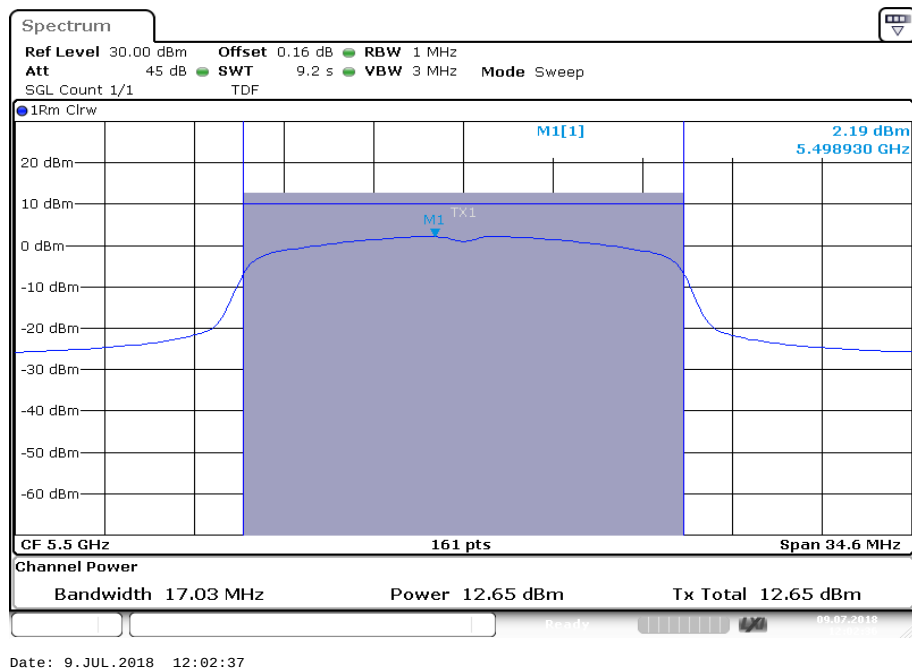
Results:

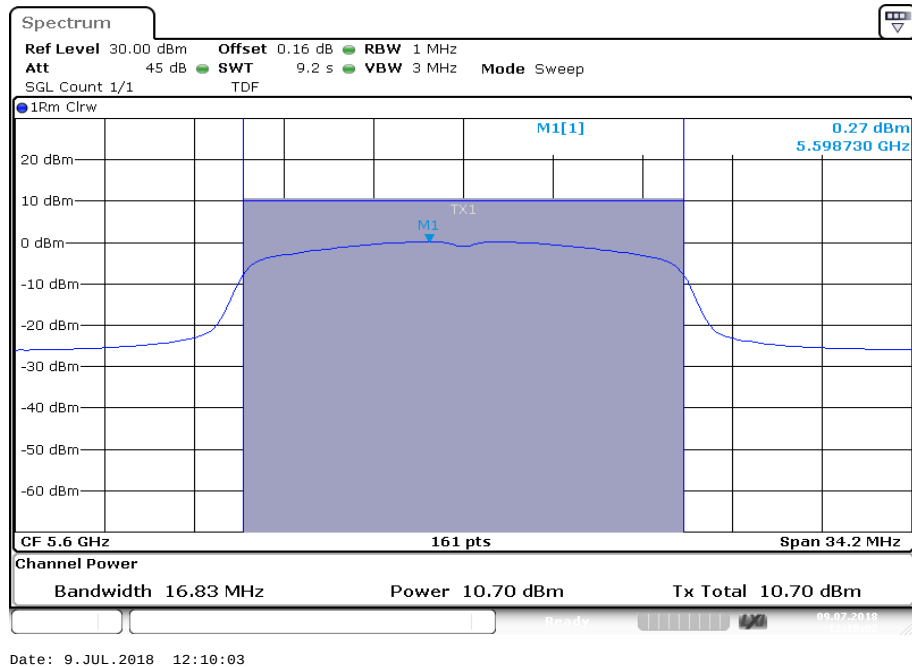
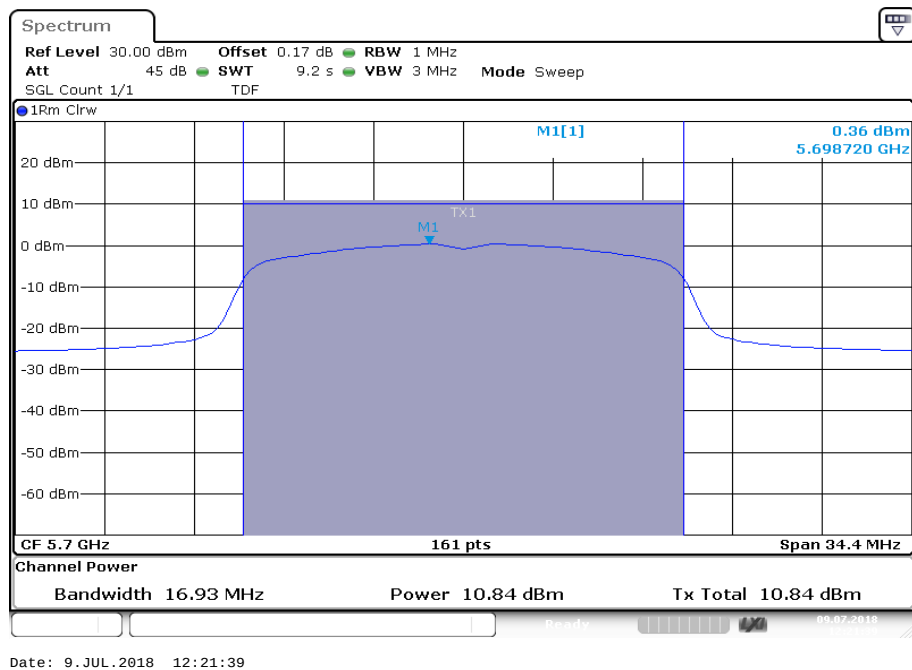
a	Maximum output power [dBm]		
	U-NII-1 (5150 MHz to 5250 MHz)		
	Lowest channel	Middle channel	Highest channel
	Conducted		
	-/-	-/-	-/-
	Radiated (calculated – see chapter antenna gain)		
	-/-	-/-	-/-
	U-NII-2A (5250 MHz to 5350 MHz)		
	Lowest channel	Middle channel	Highest channel
	Conducted		
	12.3	12.3	12.5
	Radiated (calculated – see chapter antenna gain)		
	17.6	17.6	17.8
	U-NII-2C (5470 MHz to 5725 MHz)		
	Lowest channel	Middle channel	Highest channel
	Conducted		
	12.7	10.7	10.8
	Radiated (calculated – see chapter antenna gain)		
	18.0	16.0	16.1
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	Conducted		
	-/-	-/-	-/-
	Radiated (calculated – see chapter antenna gain)		
	-/-	-/-	-/-

Results:

n/ac HT20	Maximum output power [dBm]		
	U-NII-1 (5150 MHz to 5250 MHz)		
	Lowest channel	Middle channel	Highest channel
	Conducted		
	-/-	-/-	-/-
	Radiated (calculated – see chapter antenna gain)		
	-/-	-/-	-/-
	U-NII-2A (5250 MHz to 5350 MHz)		
	Lowest channel	Middle channel	Highest channel
	Conducted		
	12.5	12.6	12.7
	Radiated (calculated – see chapter antenna gain)		
	17.8	17.9	18.0
	U-NII-2C (5470 MHz to 5725 MHz)		
	Lowest channel	Middle channel	Highest channel
	Conducted		
	12.7	10.8	11.0
	Radiated (calculated – see chapter antenna gain)		
	18.0	16.1	16.3
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	Conducted		
	-/-	-/-	-/-
	Radiated (calculated – see chapter antenna gain)		
	-/-	-/-	-/-

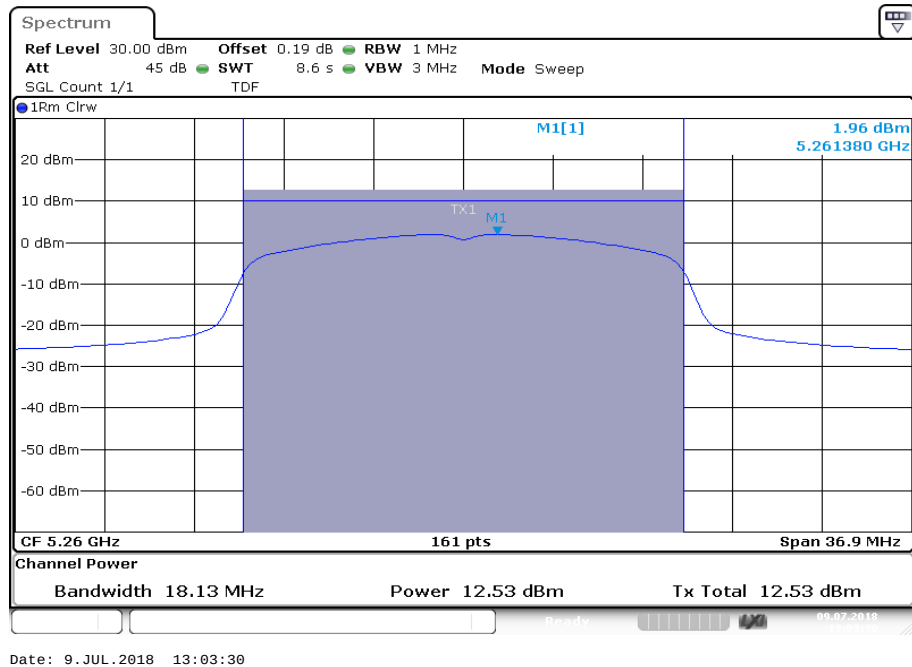
Plots: a – mode**Plot 1:** U-NII-2A; lowest channel**Plot 2:** U-NII-2A; middle channel

Plot 3: U-NII-2A; highest channel**Plot 4:** U-NII-2C; lowest channel

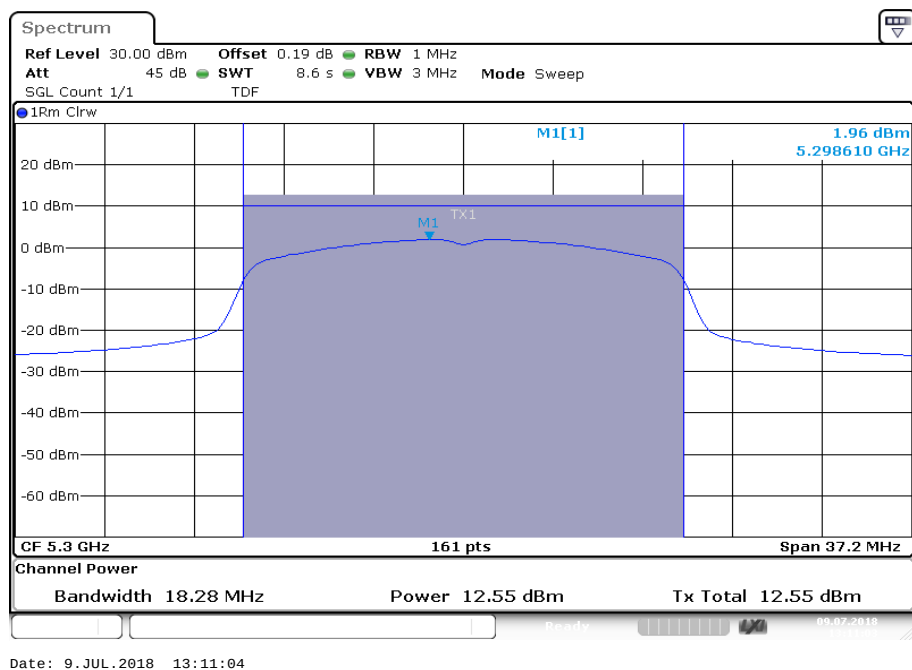
Plot 5: U-NII-2C; middle channel**Plot 6:** U-NII-2C; highest channel

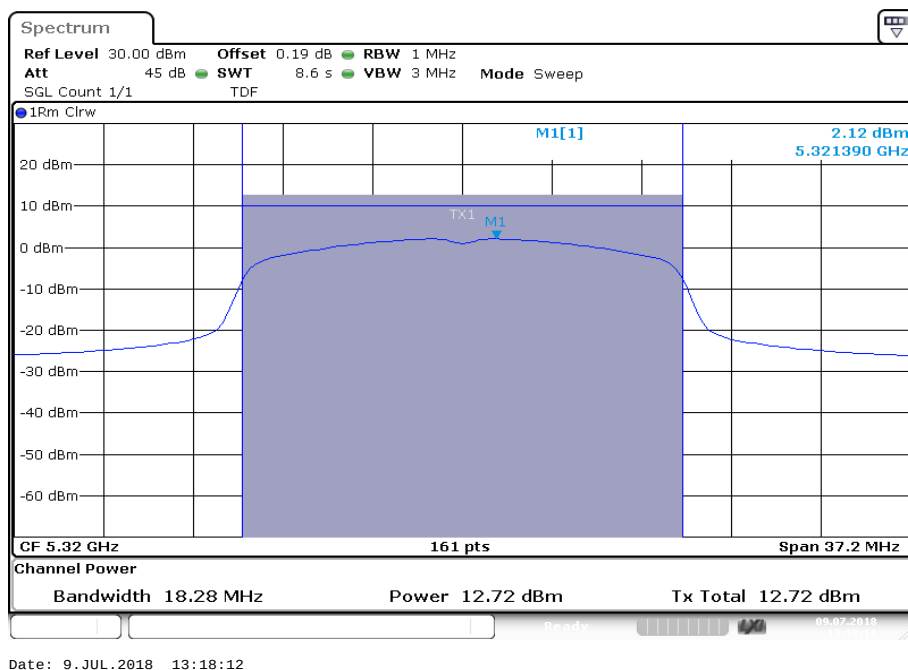
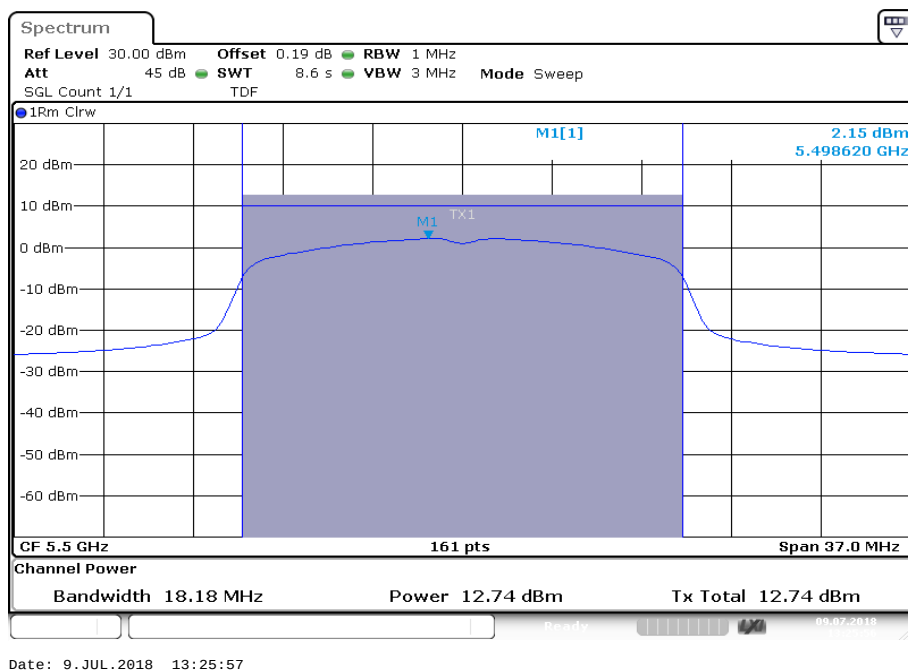
Plots: n/ac HT20 – mode

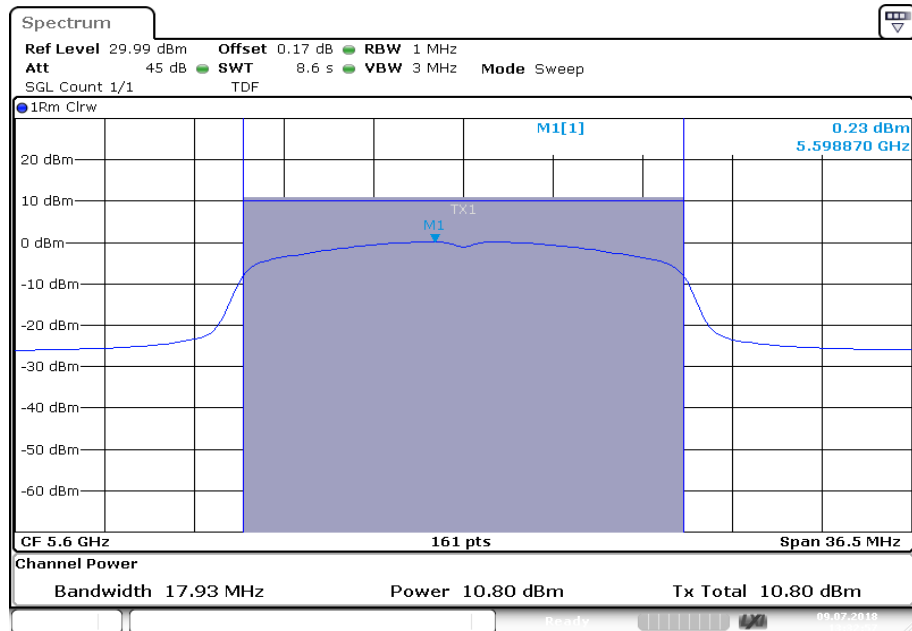
Plot 1: U-NII-2A; lowest channel



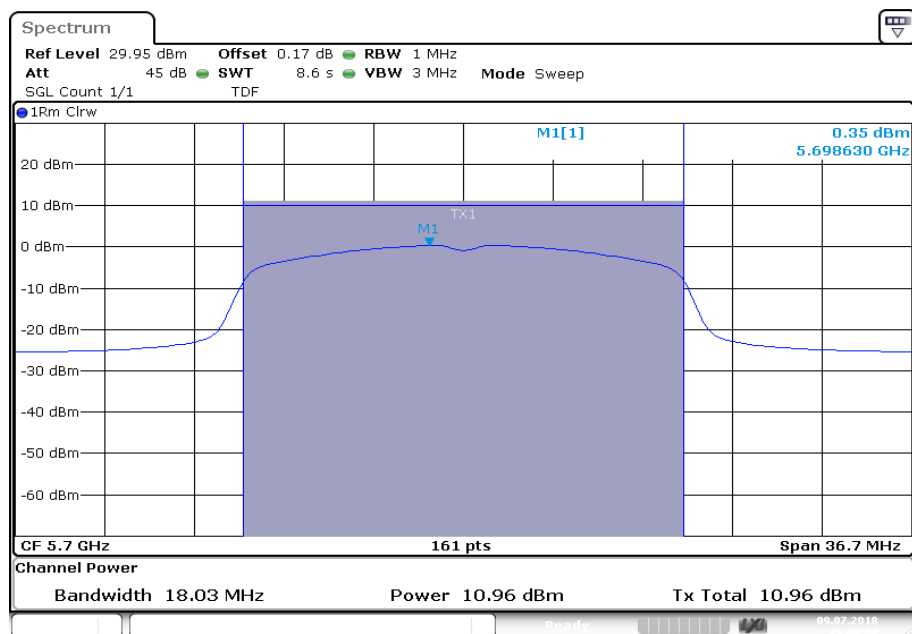
Plot 2: U-NII-2A; middle channel



Plot 3: U-NII-2A; highest channel**Plot 4:** U-NII-2C; lowest channel

Plot 5: U-NII-2C; middle channel

Date: 9. JUL. 2018 13:32:58

Plot 6: U-NII-2C; highest channel

Date: 9. JUL. 2018 13:40:04

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:	$\geq 10 \cdot (\text{swp points}) \cdot (\text{total on/off time})$
Resolution bandwidth:	1 MHz for U-NII-1/2A & 2C 500 kHz for U-NII-3
Video bandwidth:	$\geq 3 \cdot \text{RBW}$
Span:	$> \text{EBW}$
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 ≤ 11 dBm in any 1 MHz band (band 5250 – 5350 MHz) power spectral density conducted ≤ 11 dBm in any 1 MHz band (band 5470 – 5725 MHz)

Results:

a	Power spectral density (dBm/1MHz or dBm/500kHz)		
	U-NII-1 (5150 MHz to 5250 MHz)		
	Lowest channel	Middle channel	Highest channel
	-/-	-/-	-/-
	U-NII-2A (5250 MHz to 5350 MHz)		
	Lowest channel	Middle channel	Highest channel
	1.1	2.1	2.3
	U-NII-2C (5470 MHz to 5725 MHz)		
	Lowest channel	Middle channel	Highest channel
	1.1	-0.5	-0.3
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	-/-	-/-	-/-

Results:

n/ac HT20	Power spectral density (dBm/1MHz or dBm/500kHz)		
	U-NII-1 (5150 MHz to 5250 MHz)		
	Lowest channel	Middle channel	Highest channel
	-/-	-/-	-/-
	U-NII-2A (5250 MHz to 5350 MHz)		
	Lowest channel	Middle channel	Highest channel
	1.0	2.0	2.2
	U-NII-2C (5470 MHz to 5725 MHz)		
	Lowest channel	Middle channel	Highest channel
	1.1	-0.5	-0.3
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	-/-	-/-	-/-

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:	$\geq 10 * (\text{swp points}) * (\text{total on/off time})$
Resolution bandwidth:	1 MHz for U-NII-1/2A & 2C 500 kHz for U-NII-3
Video bandwidth:	$\geq 3 \times \text{RBW}$
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 ≤ 11 dBm in any 1 MHz band (band 5250 – 5350 MHz) power spectral density conducted ≤ 11 dBm in any 1 MHz band (band 5470 – 5725 MHz)

Results:

a	Power spectral density (dBm/1MHz or dBm/500kHz)		
	U-NII-1 (5150 MHz to 5250 MHz)		
	Lowest channel	Middle channel	Highest channel
	Conducted		
	-/-	-/-	-/-
	Radiated (calculated – see chapter antenna gain)		
	-/-	-/-	-/-
	U-NII-2A (5250 MHz to 5350 MHz)		
	Lowest channel	Middle channel	Highest channel
	1.8	1.8	2.1
	U-NII-2C (5470 MHz to 5725 MHz)		
	Lowest channel	Middle channel	Highest channel
	2.2	0.3	0.4
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	-/-	-/-	-/-

Results:

n/ac HT20	Power spectral density (dBm/1MHz or dBm/500kHz)		
	U-NII-1 (5150 MHz to 5250 MHz)		
	Lowest channel	Middle channel	Highest channel
	Conducted		
	-/-	-/-	-/-
	Radiated (calculated – see chapter antenna gain)		
	-/-	-/-	-/-
	U-NII-2A (5250 MHz to 5350 MHz)		
	Lowest channel	Middle channel	Highest channel
	2.0	2.0	2.1
	U-NII-2C (5470 MHz to 5725 MHz)		
	Lowest channel	Middle channel	Highest channel
	2.2	0.2	0.4
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	-/-	-/-	-/-

11.6 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:

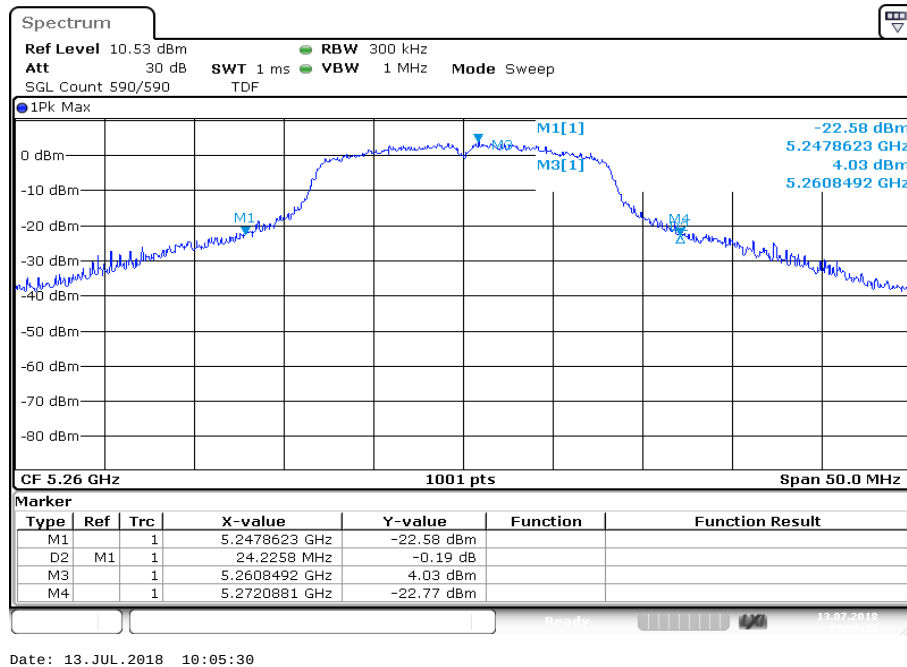
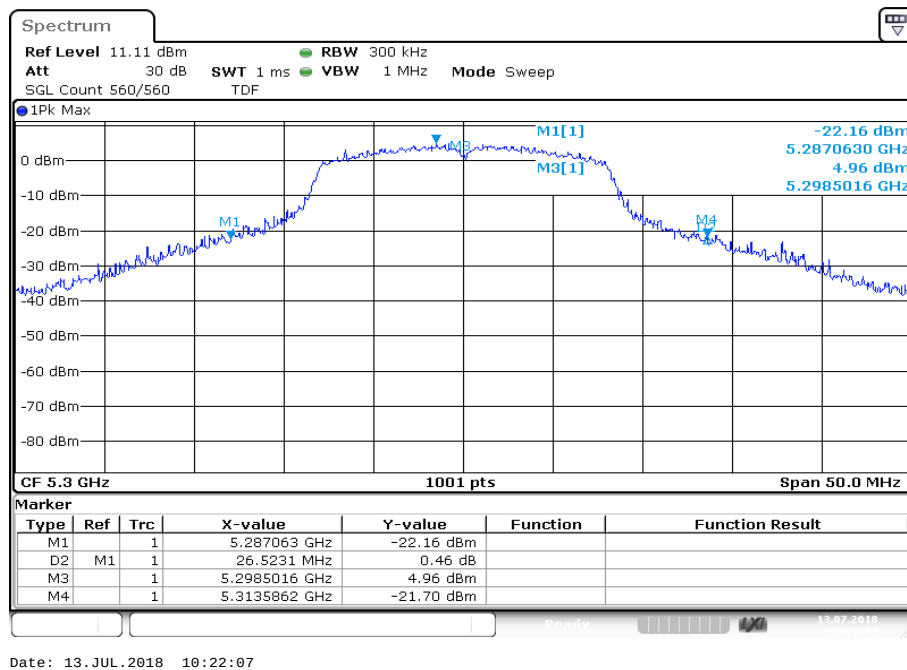
Spectrum Bandwidth – 26 dB Bandwidth
IC: Any unwanted emissions that fall into the band 5250-5350 MHz shall be attenuated below the channel power by at least 26 dB, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth (i.e. 99% bandwidth), above 5250 MHz. The 26 dB bandwidth 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.

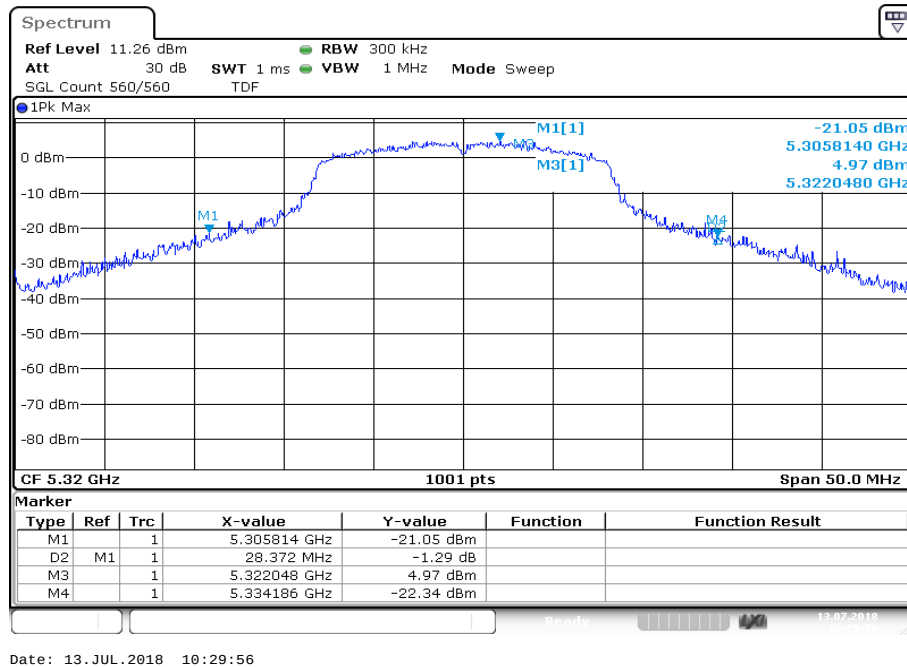
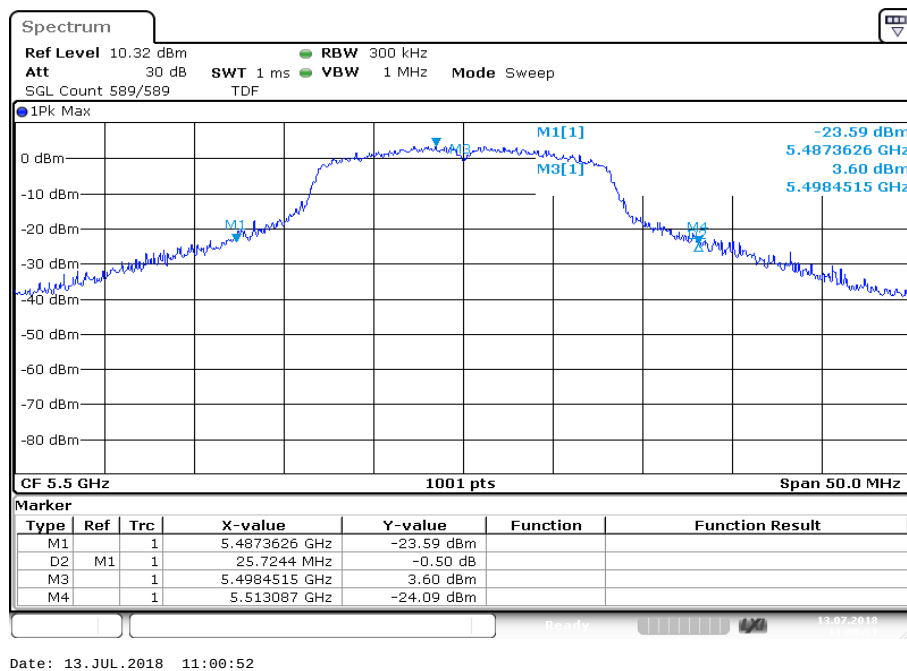
Results:

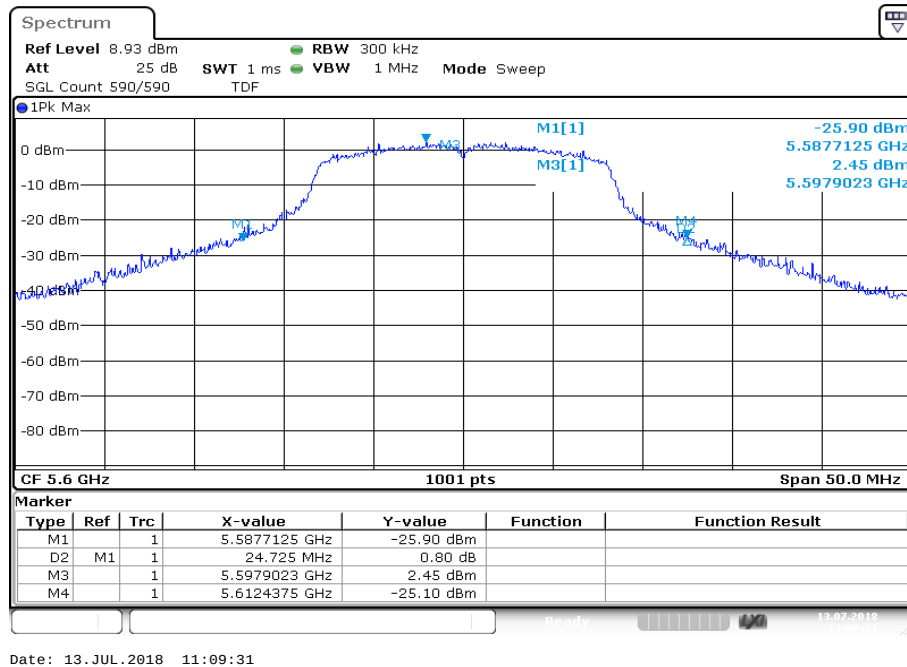
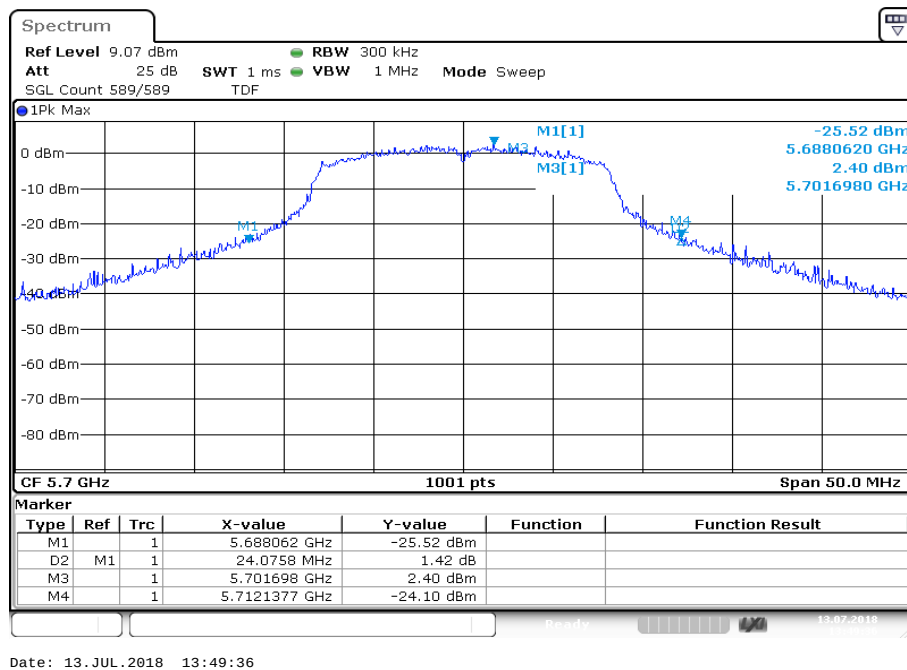
a	26 dB bandwidth (MHz)		
	U-NII-1 (5150 MHz to 5250 MHz)		
	Lowest channel	Middle channel	Highest channel
	-/-	-/-	-/-
	Lowest frequency		Highest frequency
	-/-		-/-
	U-NII-2A (5250 MHz to 5350 MHz)		
	Lowest channel	Middle channel	Highest channel
	24.2	26.5	28.4
	U-NII-2C (5470 MHz to 5725 MHz)		
	Lowest channel	Middle channel	Highest channel
	25.7	24.7	24.1
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	-/-	-/-	-/-
	Lowest frequency		Highest frequency
	-/-		-/-

Results:

n/ac HT20	26 dB bandwidth (MHz)		
	U-NII-1 (5150 MHz to 5250 MHz)		
	Lowest channel	Middle channel	Highest channel
	-/-	-/-	-/-
	Lowest frequency		Highest frequency
	-/-		-/-
	U-NII-2A (5250 MHz to 5350 MHz)		
	Lowest channel	Middle channel	Highest channel
	28.6	28.8	29.1
	U-NII-2C (5470 MHz to 5725 MHz)		
	Lowest channel	Middle channel	Highest channel
	27.8	26.5	24.7
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	-/-	-/-	-/-
	Lowest frequency		Highest frequency
	-/-		-/-

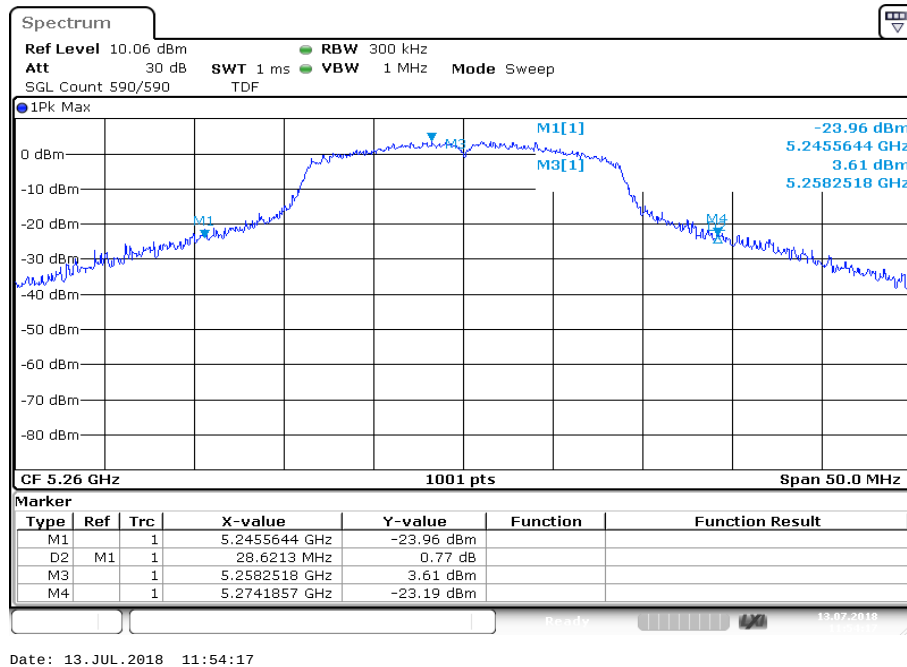
Plots: a – mode**Plot 1:** U-NII-2A; lowest channel**Plot 2:** U-NII-2A; middle channel

Plot 3: U-NII-2A; highest channel**Plot 4:** U-NII-2C; lowest channel

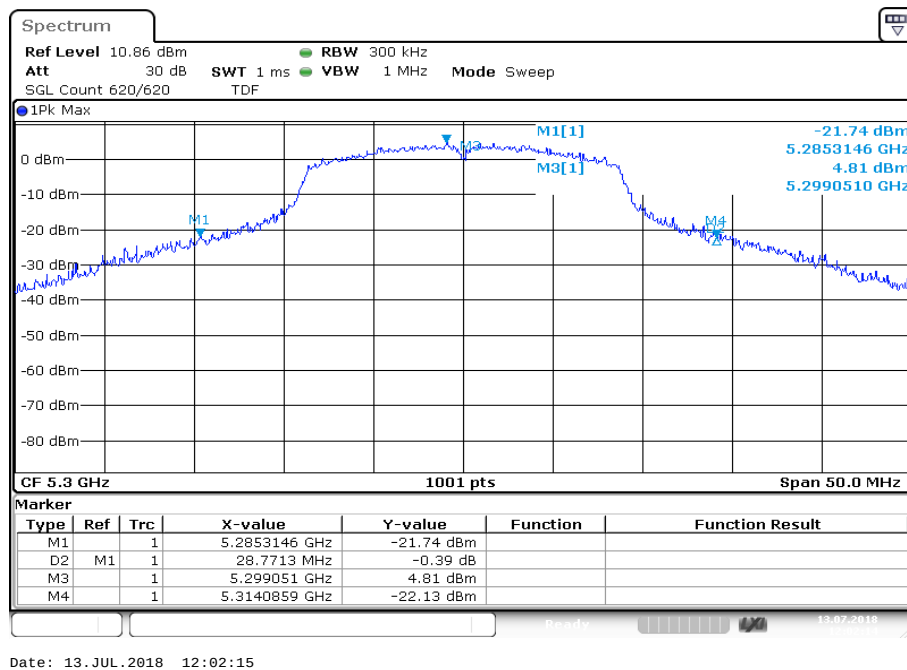
Plot 5: U-NII-2C; middle channel**Plot 6:** U-NII-2C; highest channel

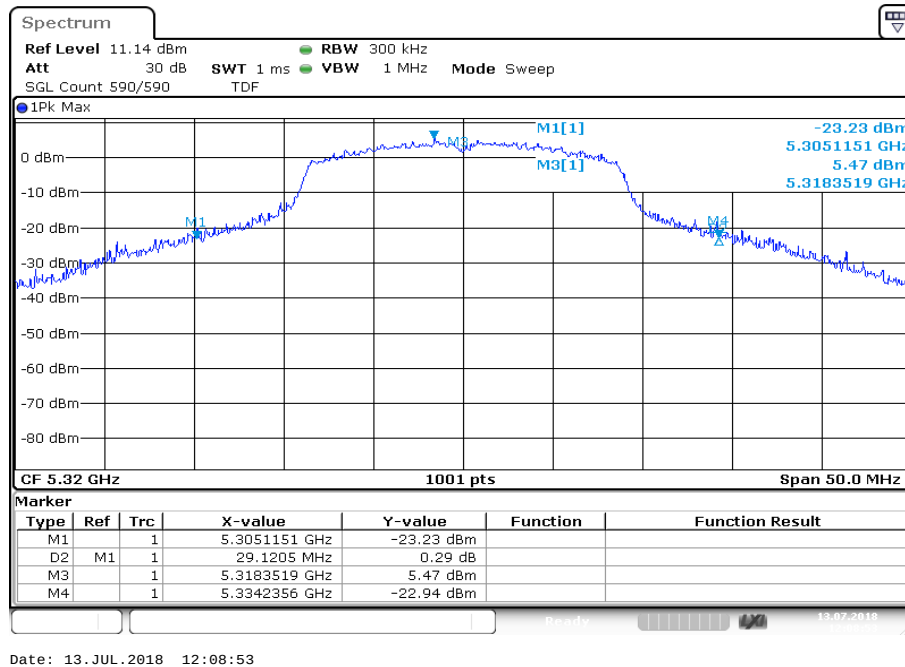
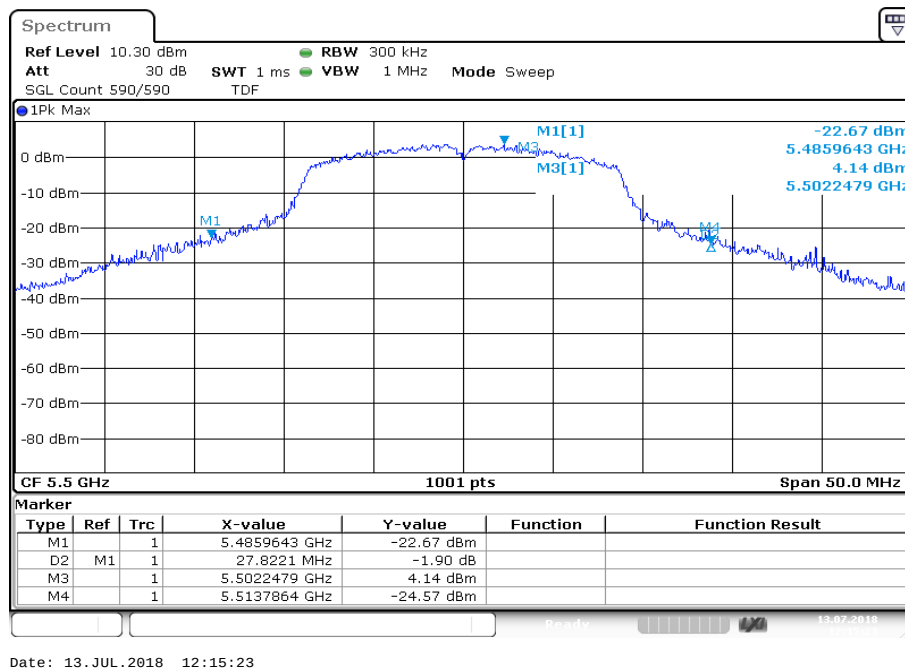
Plots: n/ac HT20 – mode

Plot 1: U-NII-2A; lowest channel

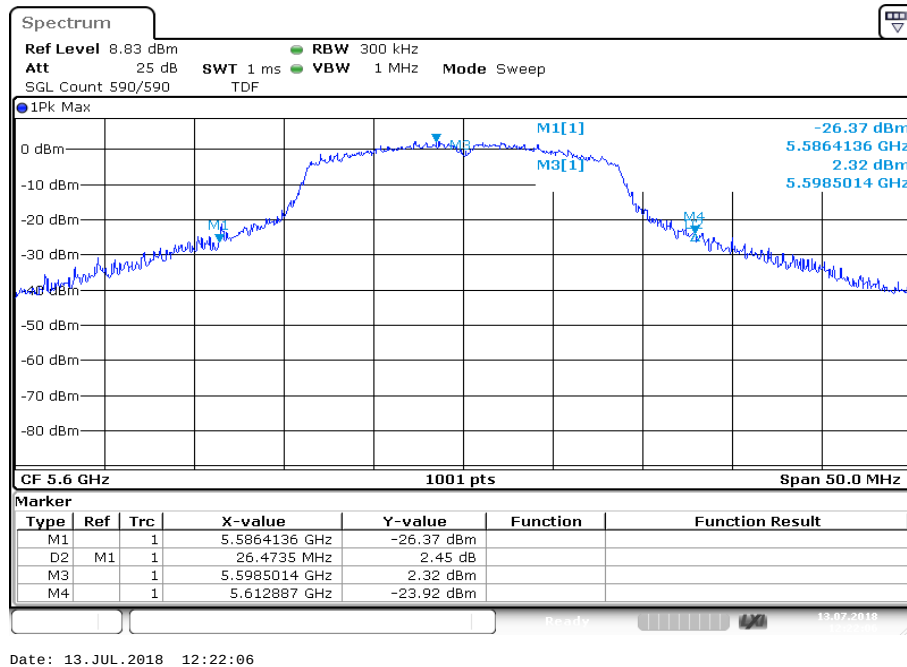


Plot 2: U-NII-2A; middle channel

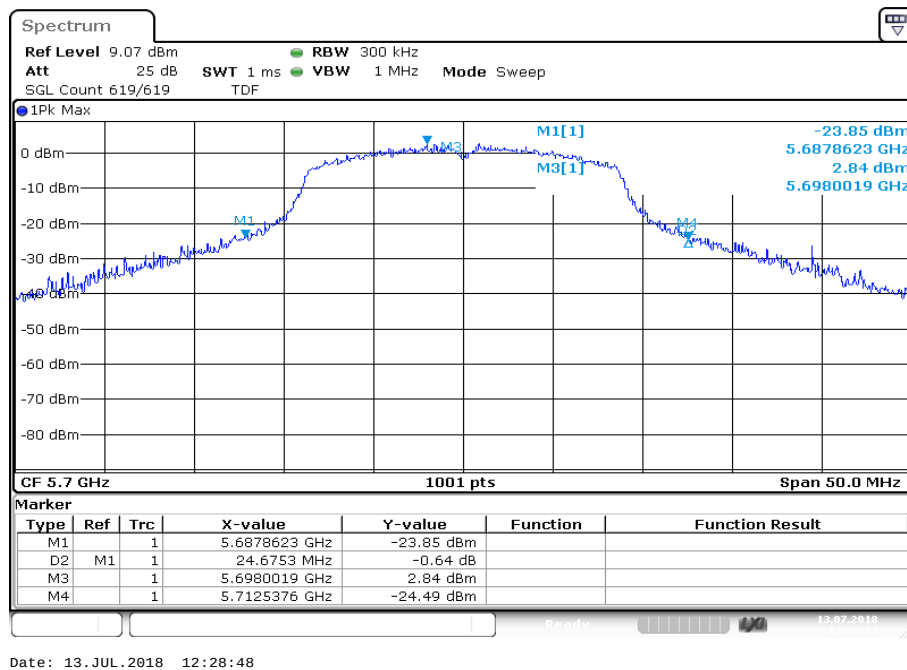


Plot 3: U-NII-2A; highest channel**Plot 4:** U-NII-2C; lowest channel

Plot 5: U-NII-2C; middle channel



Plot 6: U-NII-2C; highest channel



11.7 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:

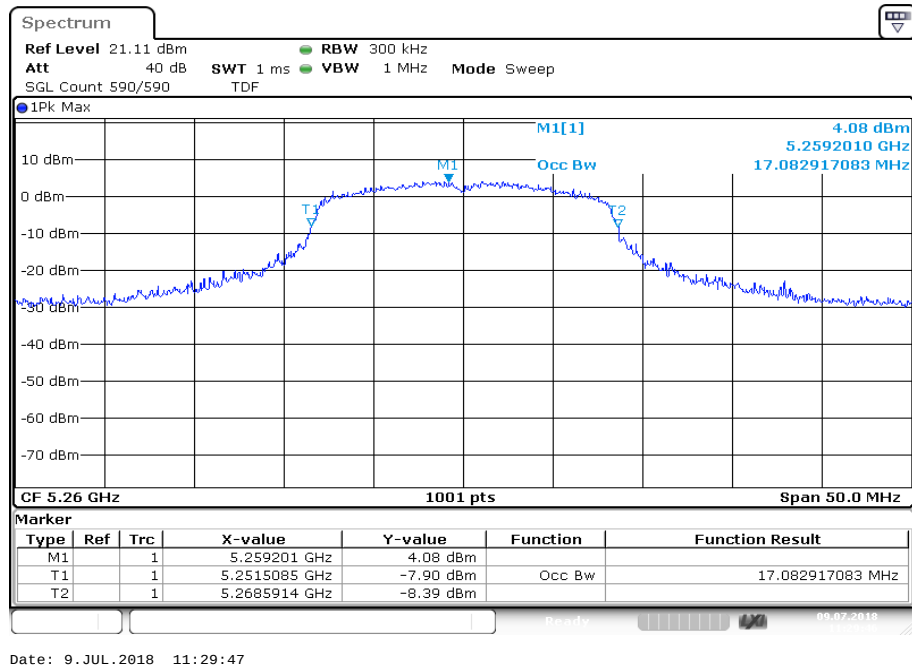
a	99% bandwidth (kHz)		
	U-NII-1 (5150 MHz to 5250 MHz)		
	Lowest channel	Middle channel	Highest channel
	-/-	-/-	-/-
	U-NII-2A (5250 MHz to 5350 MHz)		
	Lowest channel	Middle channel	Highest channel
	17083	17133	17083
	U-NII-2C (5470 MHz to 5725 MHz)		
	Lowest channel	Middle channel	Highest channel
	17033	16833	16933
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	-/-	-/-	-/-

Results:

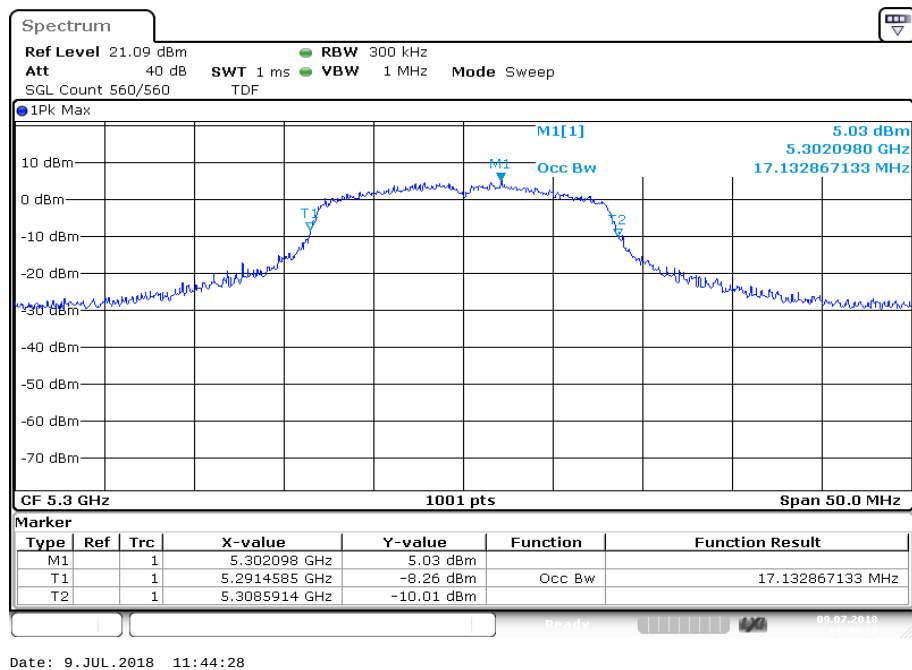
n/ac HT20	99% bandwidth (kHz)		
	U-NII-1 (5150 MHz to 5250 MHz)		
	Lowest channel	Middle channel	Highest channel
	-/-	-/-	-/-
	U-NII-2A (5250 MHz to 5350 MHz)		
	Lowest channel	Middle channel	Highest channel
	18132	18282	17083
	U-NII-2C (5470 MHz to 5725 MHz)		
	Lowest channel	Middle channel	Highest channel
	17033	16833	16933
	U-NII-3 (5725 MHz to 5850 MHz)		
	Lowest channel	Middle channel	Highest channel
	-/-	-/-	-/-

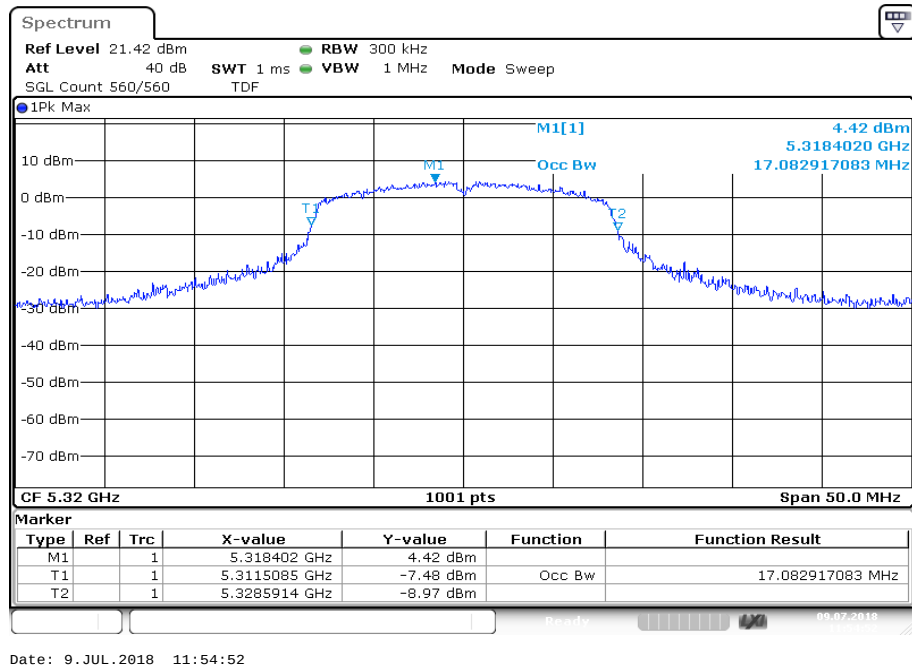
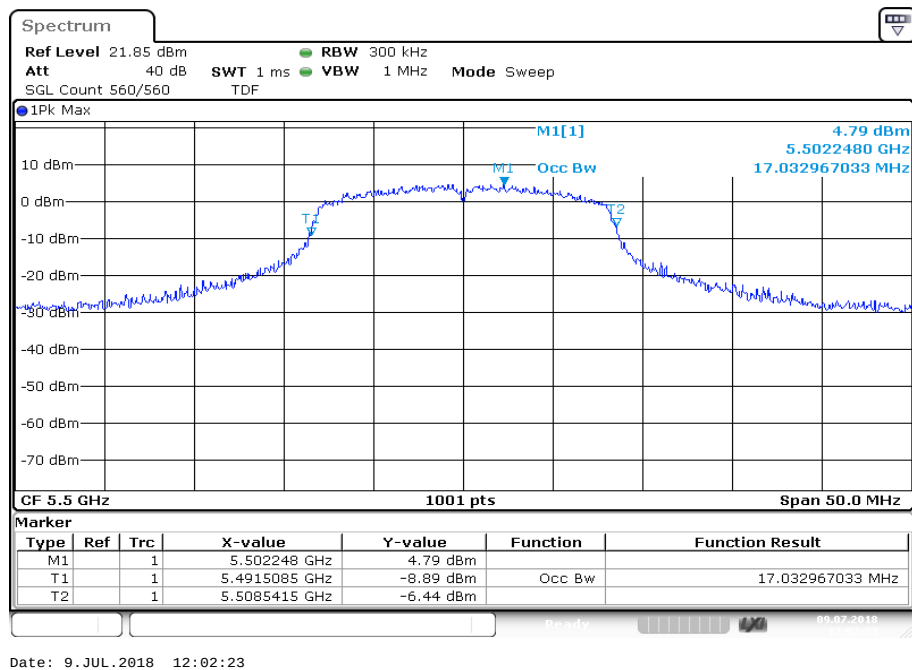
Plots: a – mode

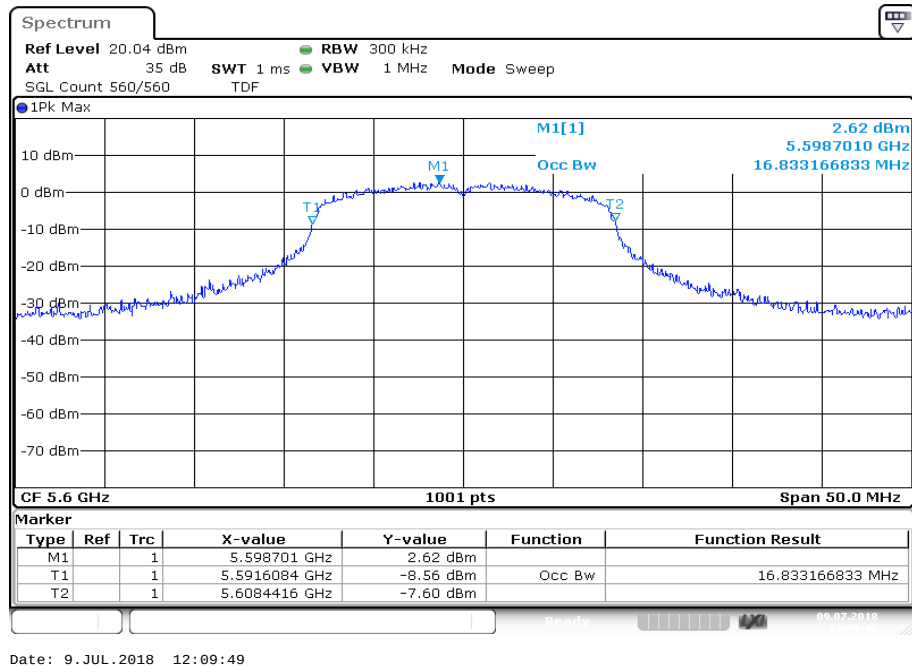
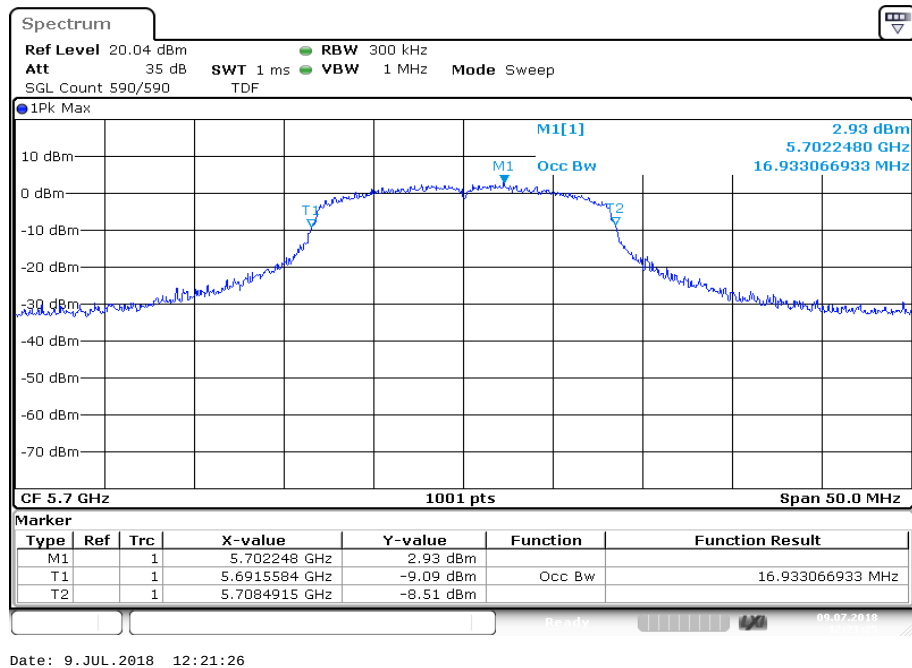
Plot 1: U-NII-2A; lowest channel



Plot 2: U-NII-2A; middle channel

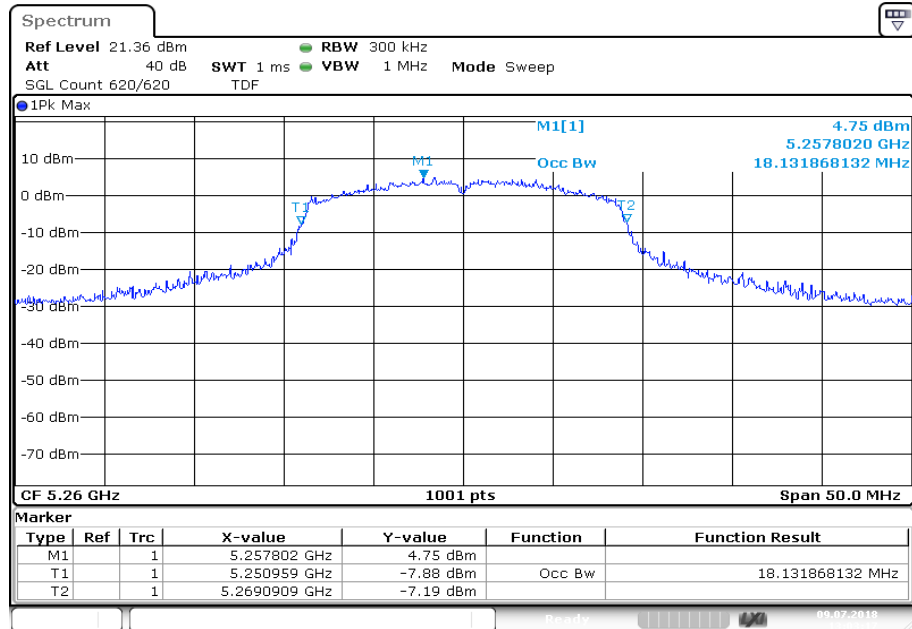


Plot 3: U-NII-2A; highest channel**Plot 4:** U-NII-2C; lowest channel

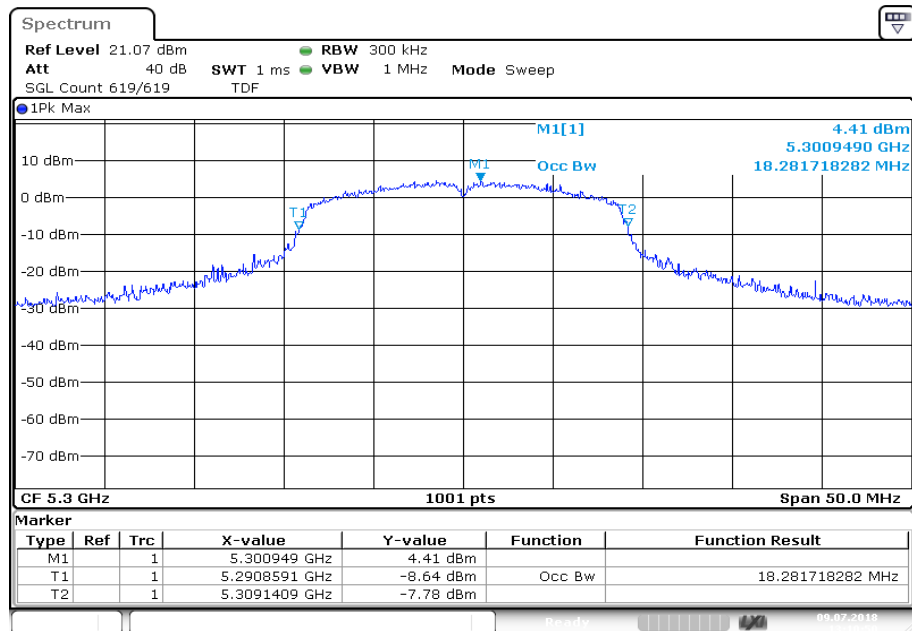
Plot 5: U-NII-2C; middle channel**Plot 6:** U-NII-2C; highest channel

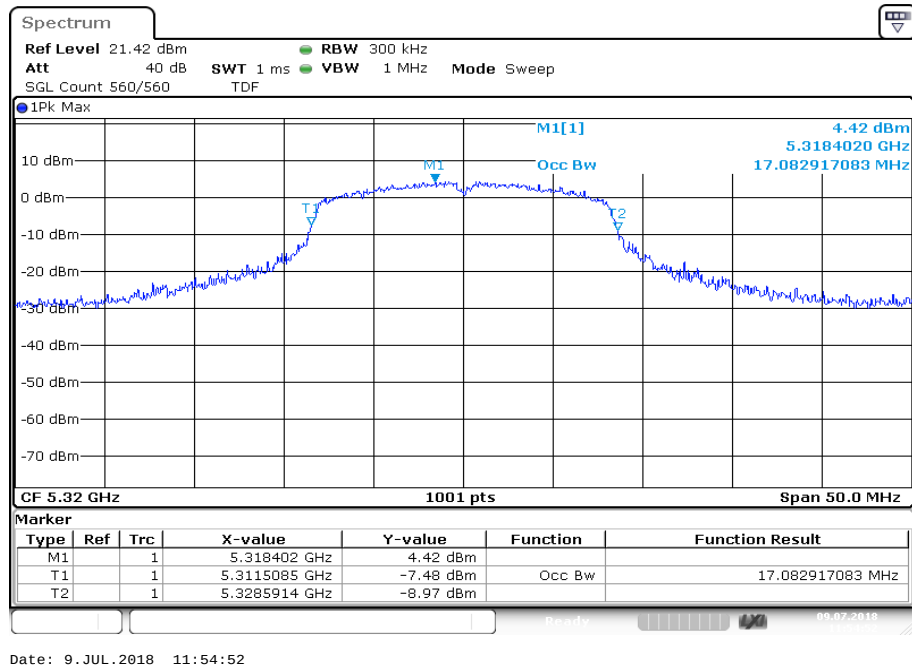
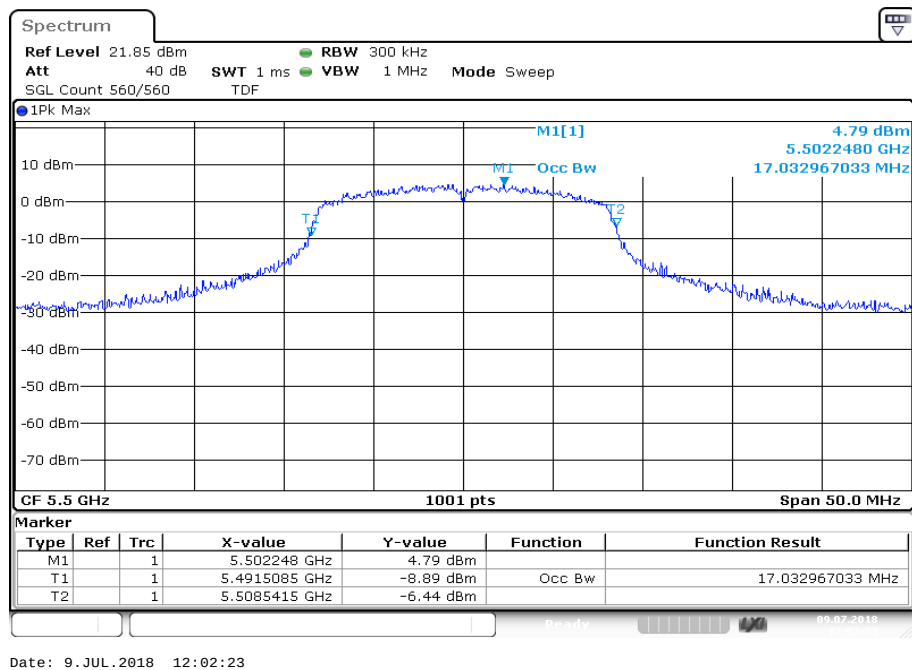
Plots: n/ac HT20 – mode

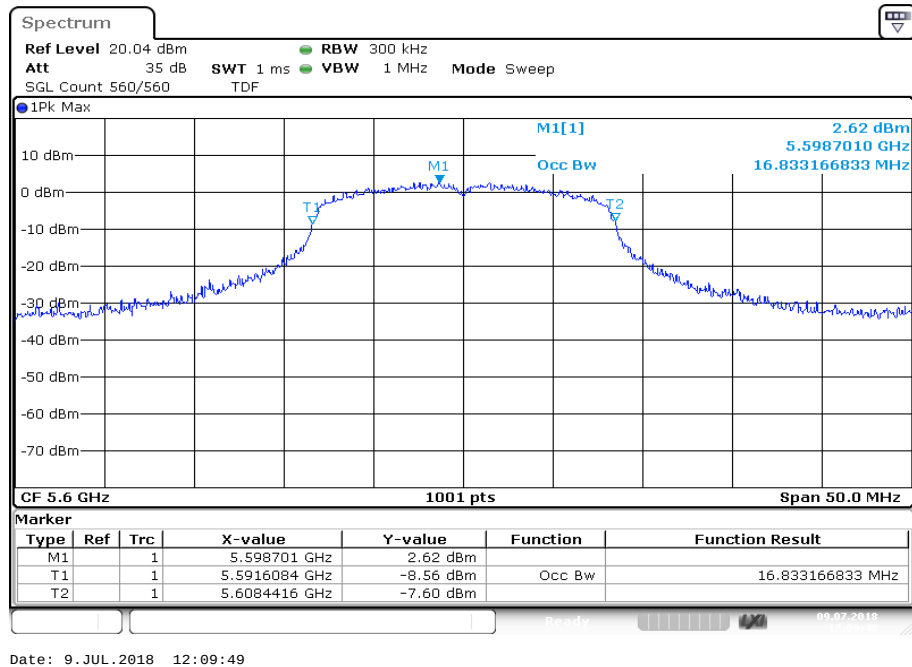
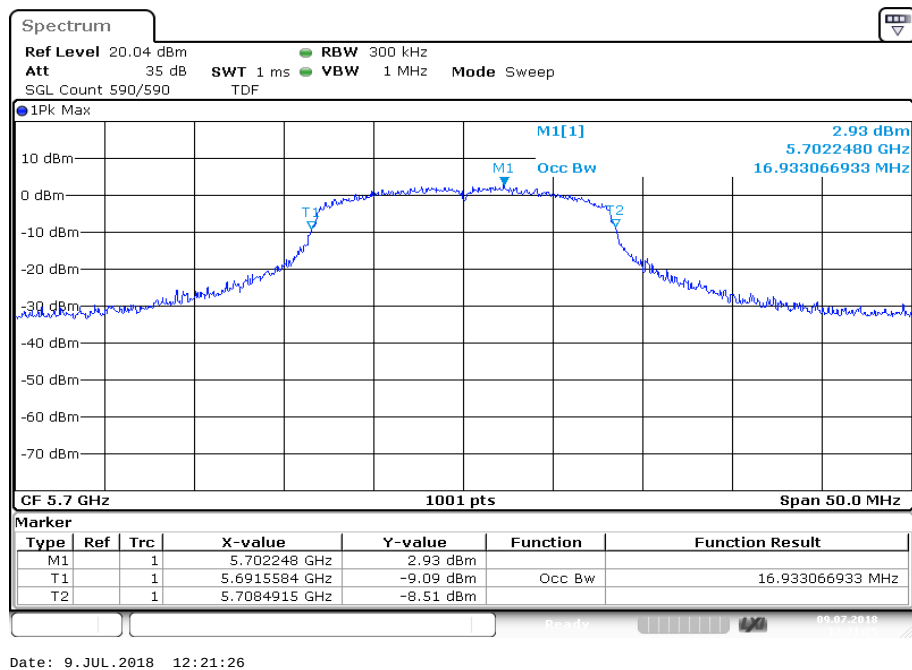
Plot 1: U-NII-2A; lowest channel



Plot 2: U-NII-2A; middle channel



Plot 3: U-NII-2A; highest channel**Plot 4:** U-NII-2C; lowest channel

Plot 5: U-NII-2C; middle channel**Plot 6:** U-NII-2C; highest channel

11.8 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:

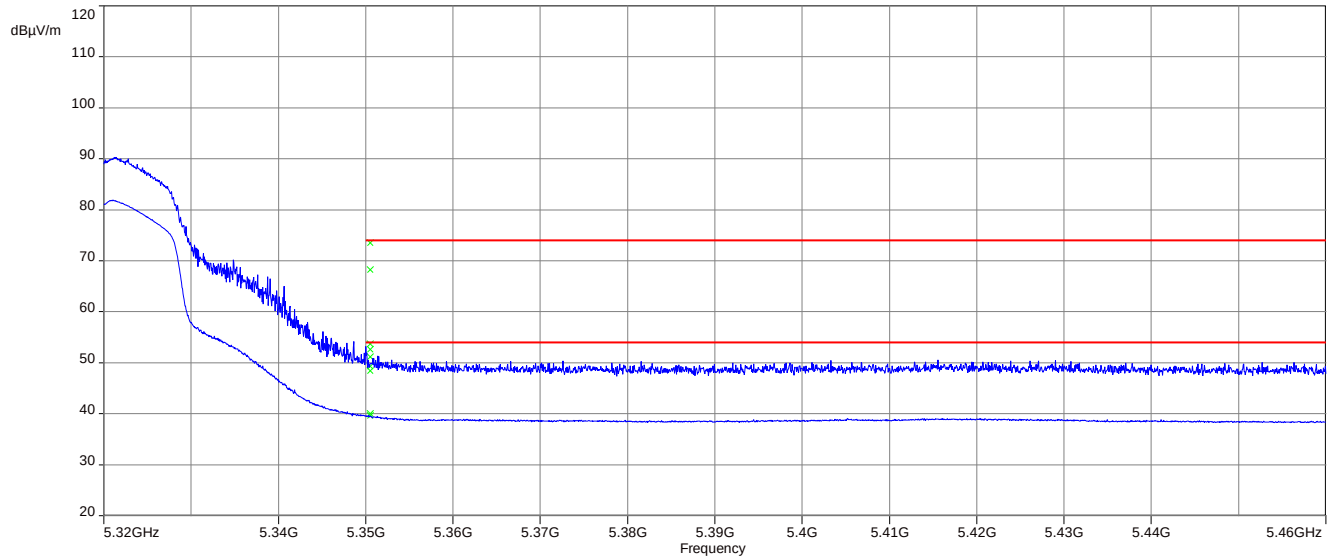
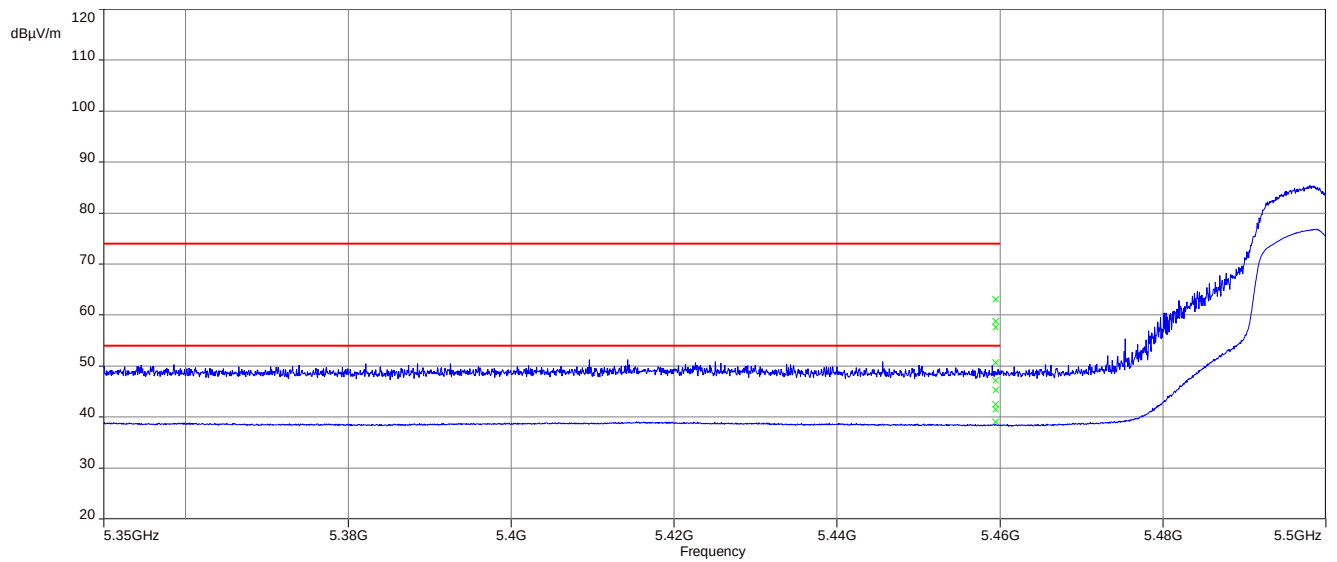
Measurement parameter	
Detector:	Peak / RMS
Sweep time:	Auto
Resolution bandwidth:	1 MHz
Video bandwidth:	$\geq 3 \times \text{RBW}$
Span:	See plots!
Trace mode:	Max Hold
Test setup:	See sub clause 6.2 – A
Measurement uncertainty:	See sub clause 8

Limits:

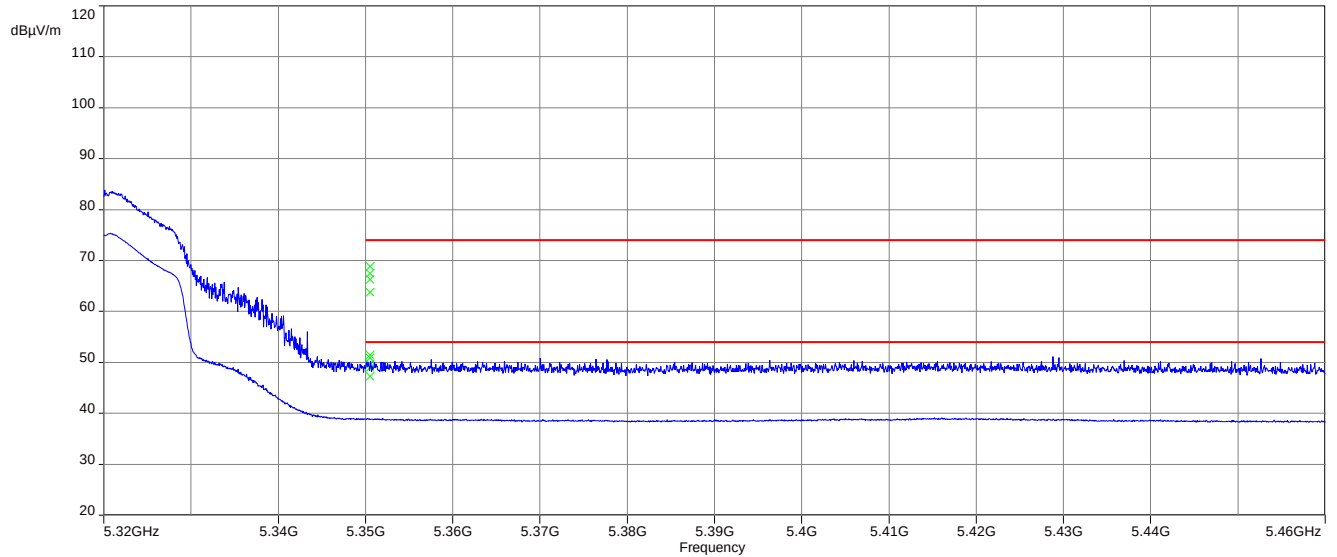
Band Edge Compliance Radiated
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within 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)

Result:

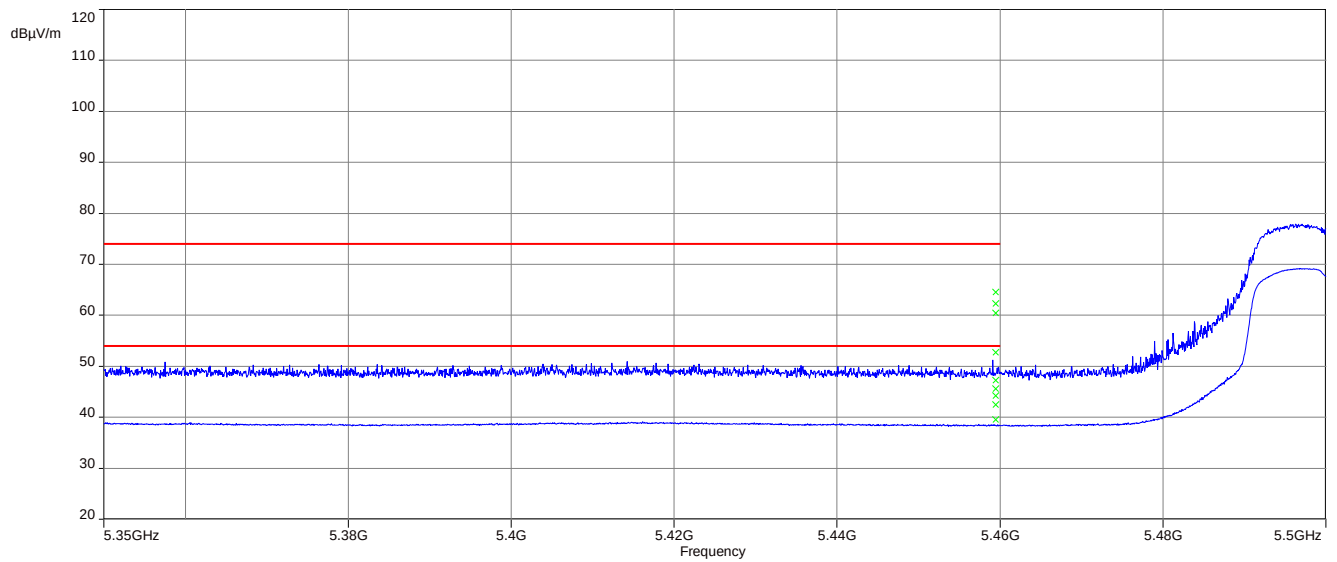
Scenario	Band Edge Compliance Radiated [dB μ V/m]
band edge	< 74 dBμV/m (peak) < 54 dBμV/m (average)

Plots:**Plot 1:** upper band edge; U-NII-2A; highest channel; 20 MHz channel bandwidth**Plot 2:** lower band edge; U-NII-2C; lowest channel; 20 MHz channel bandwidth

Plot 3: upper band edge; U-NII-2A; highest channel; 20 MHz channel bandwidth



Plot 4: lower band edge; U-NII-2C; lowest channel; 20 MHz channel bandwidth



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 recalculated 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 6.2 – B
Measurement uncertainty:	See sub clause 8

Limits:

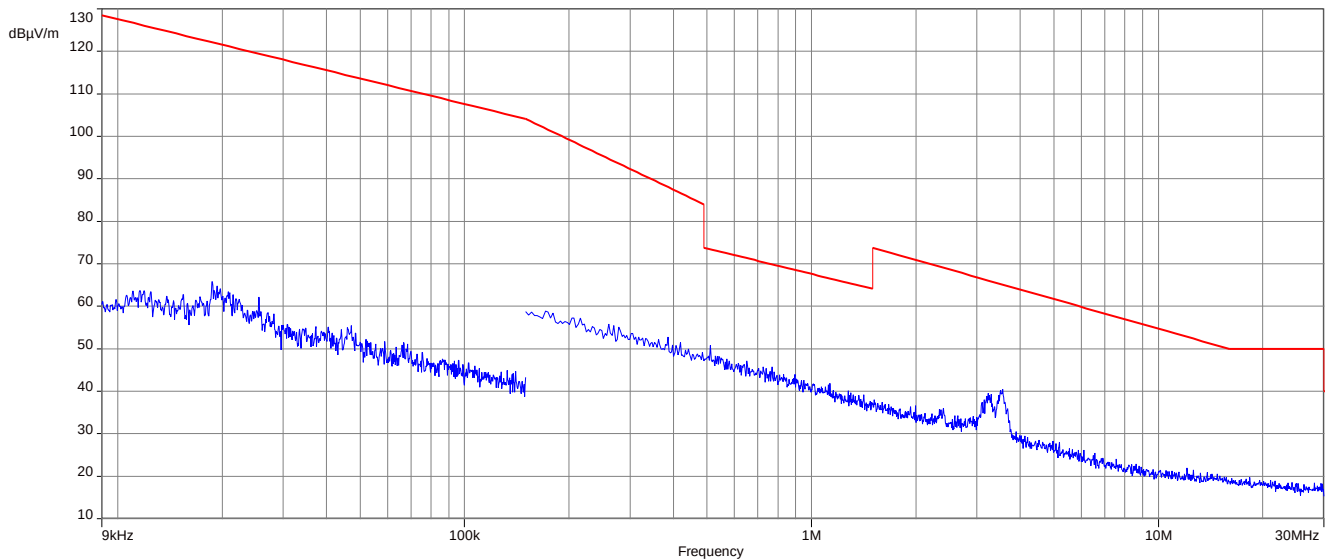
Spurious Emissions Radiated < 30 MHz		
Frequency (MHz)	Field Strength (dBμV/m)	Measurement distance
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30

Results:

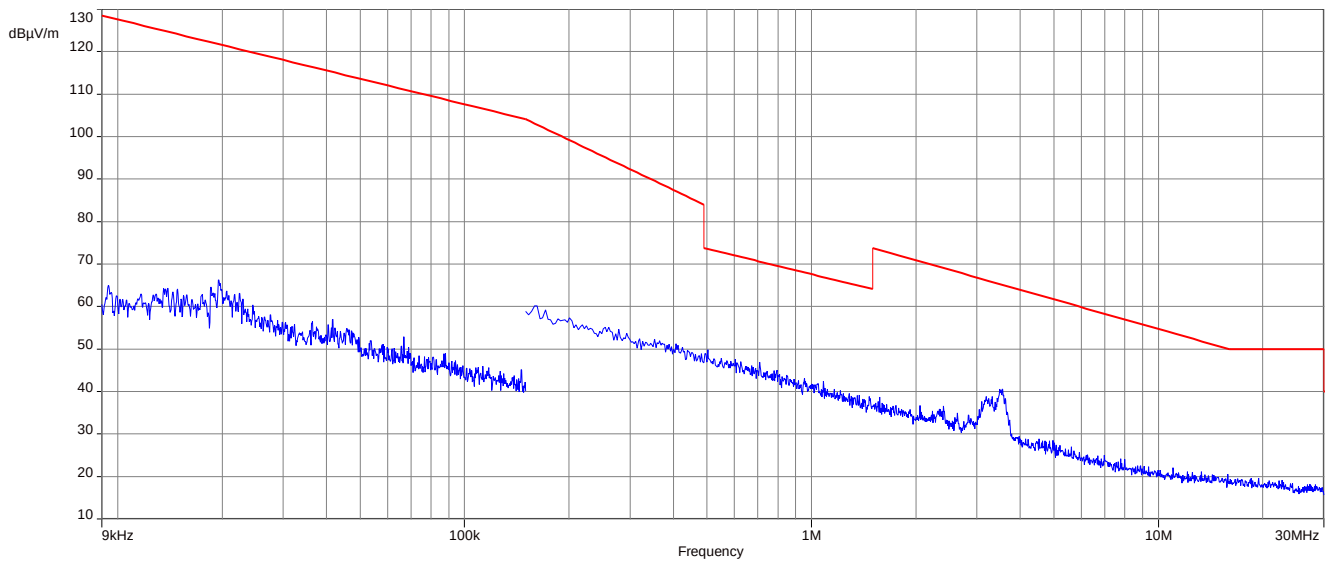
Spurious Emissions Radiated < 30 MHz [dBμV/m]		
F [MHz]	Detector	Level [dBμV/m]
All detected emissions are more than 20 dB below the limit.		

Plots: 20 MHz channel bandwidth

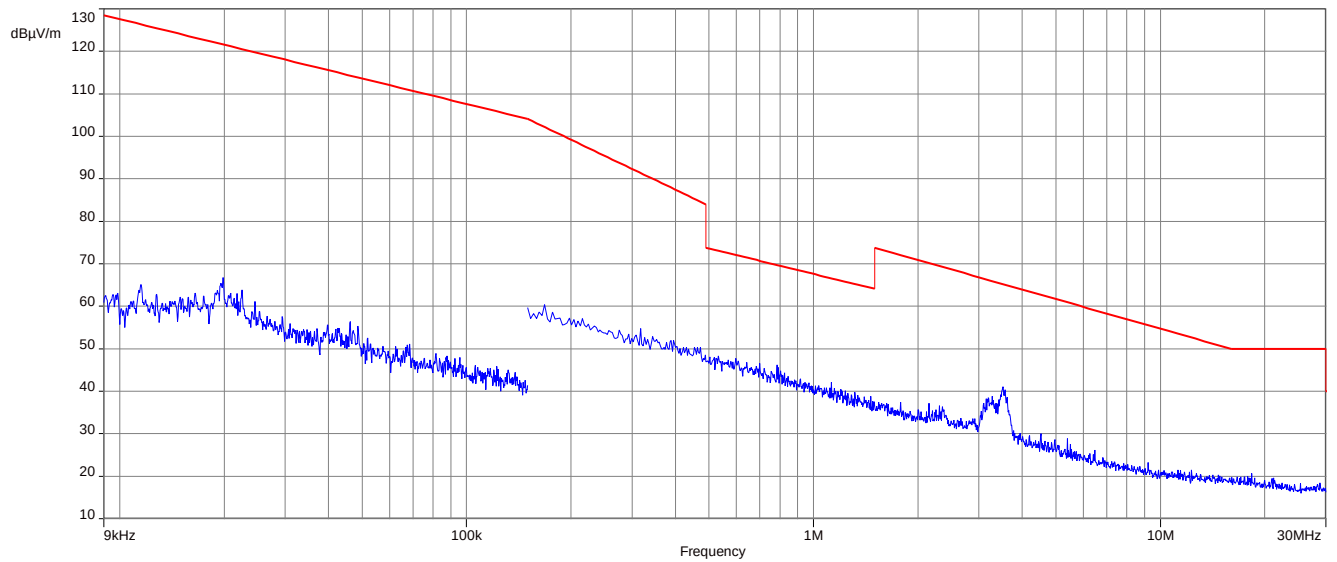
Plot 1: 9 kHz to 30 MHz, U-NII-2A; lowest channel



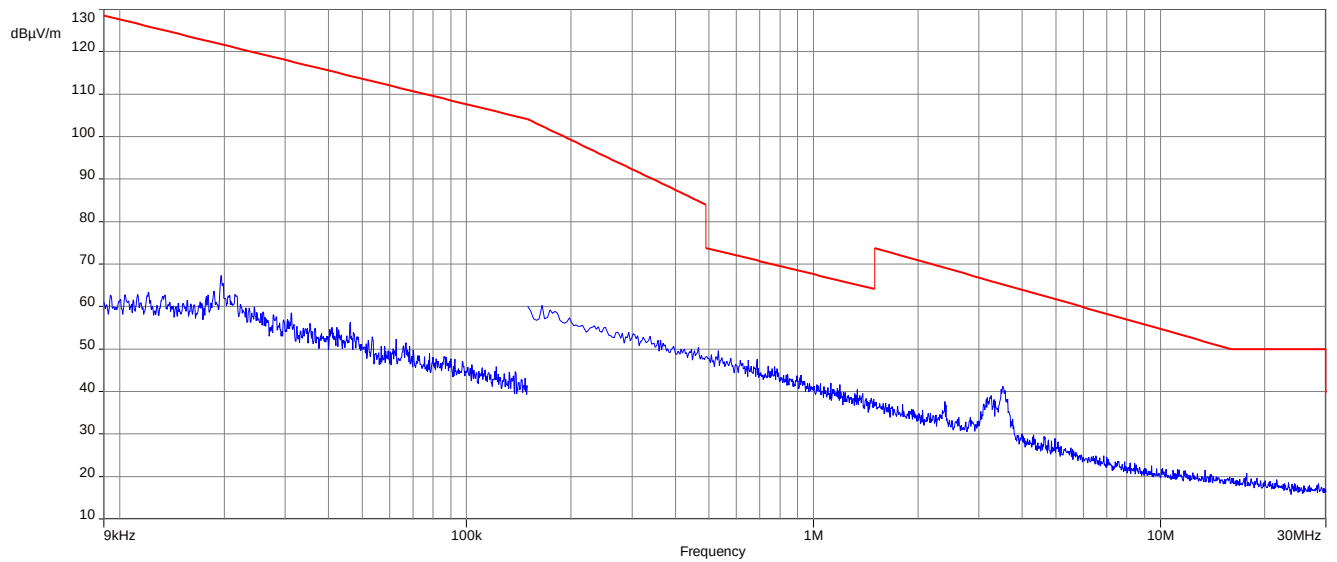
Plot 2: 9 kHz to 30 MHz, U-NII-2A; middle channel



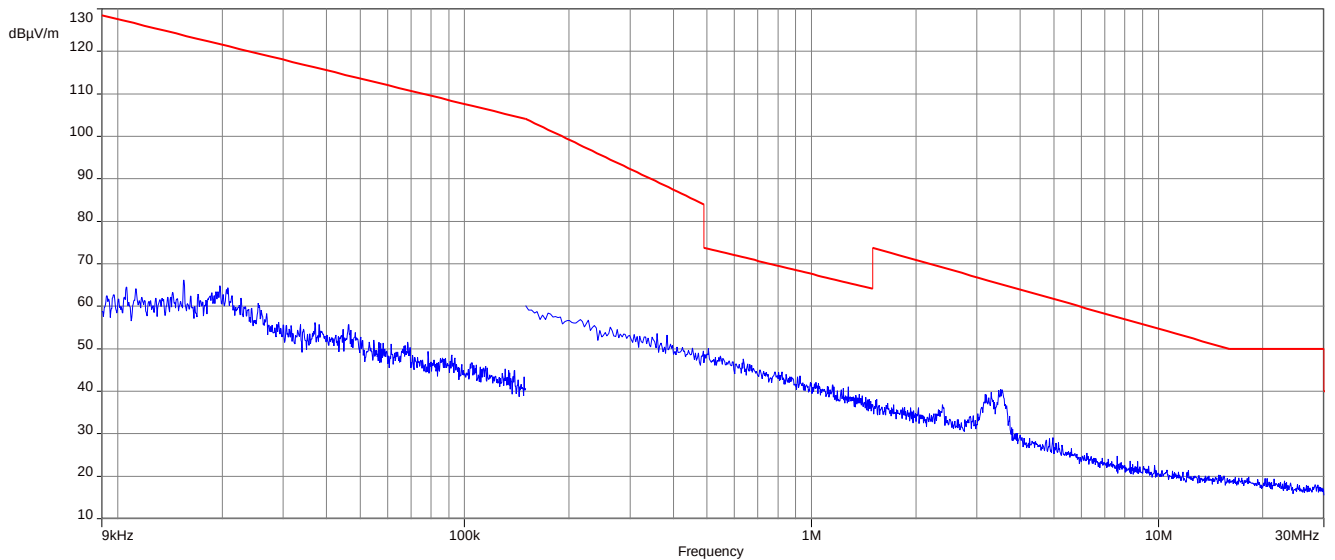
Plot 3: 9 kHz to 30 MHz, U-NII-2A; highest channel



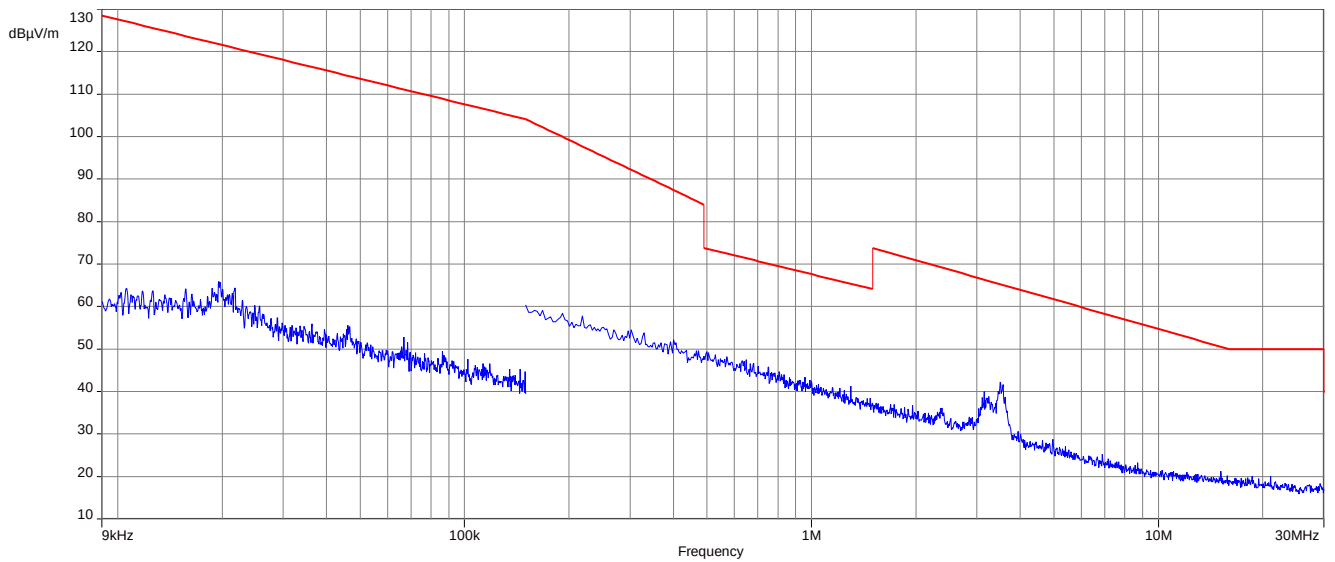
Plot 4: 9 kHz to 30 MHz, U-NII-2C; lowest channel



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



Plot 6: 9 kHz to 30 MHz, U-NII-2C; 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 sub clause 6.1 – A See sub clause 6.2 – B See sub clause 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	

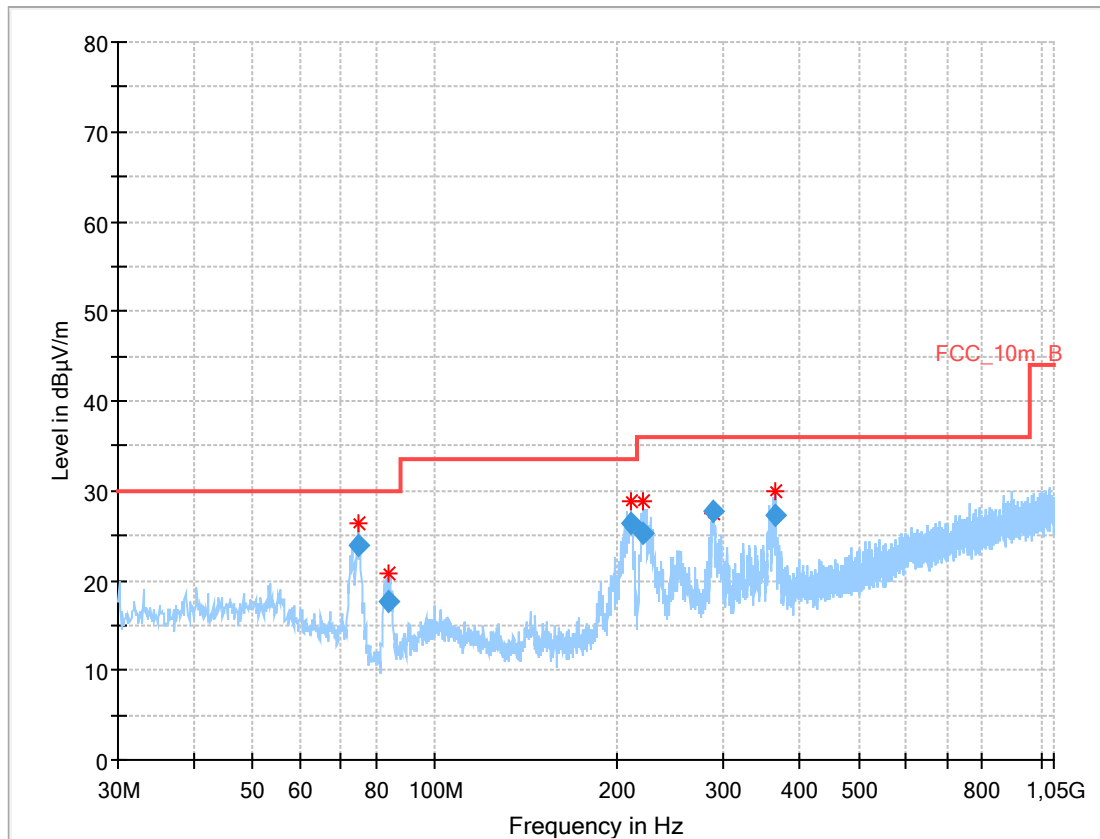
Results: 20 MHz channel bandwidth

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]
For emissions below 1 GHz please take look at the result table below plots.								
1327	Peak	36.2	-/-	Peak	-/-	10636	Peak	57.8
	AVG	24.9	-/-	AVG	-/-		AVG	45.7
-/-	Peak	-/-	-/-	Peak	-/-	-/-	Peak	-/-
	AVG	-/-		AVG	-/-		AVG	-/-
For emissions above 18 GHz please take look at the plots.								

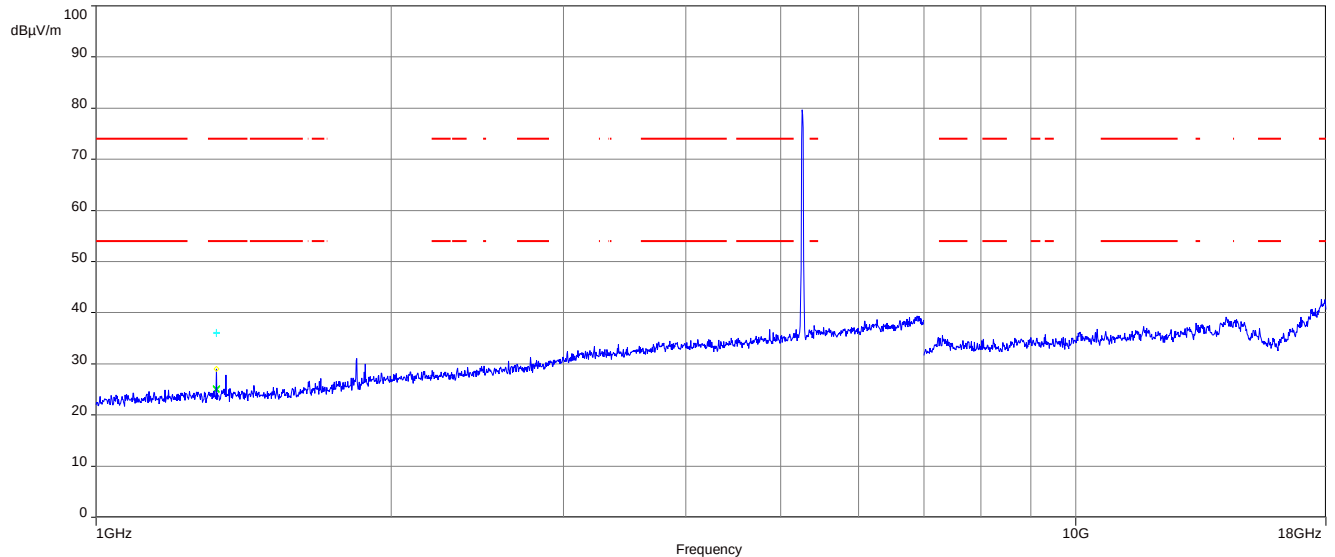
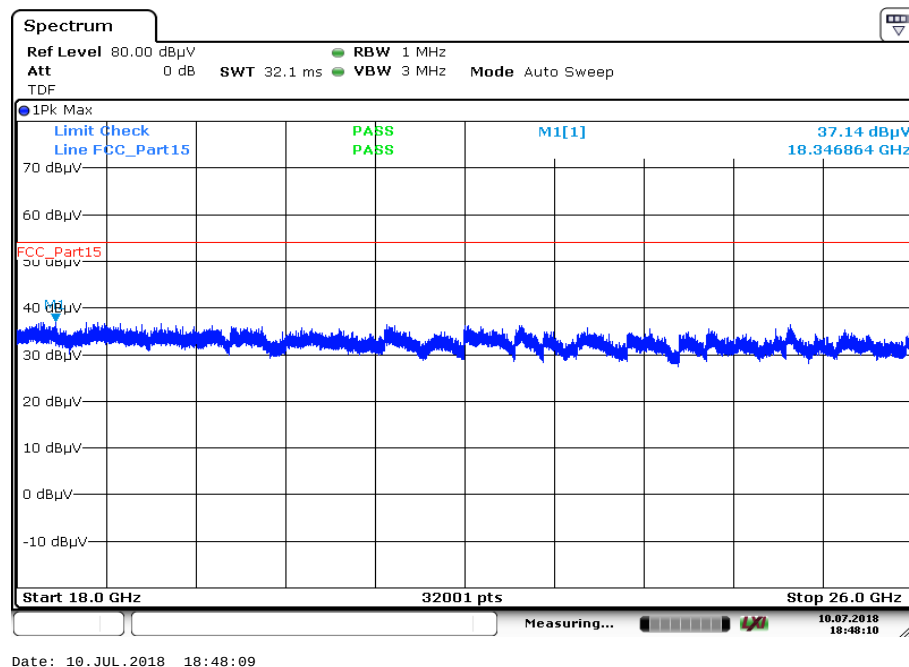
TX Spurious Emissions Radiated [dBµV/m] / dBm								
U-NII-2C (5470 MHz to 5725 MHz)								
Lowest channel			Middle channel			Highest channel		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
For emissions below 1 GHz please take look at the result table below plots.								
1847	Peak	43.6	-/-	Peak	-/-	10636	Peak	57.8
	AVG	38.4	-/-	AVG	-/-		AVG	45.7
11000	Peak	54.6	-/-	Peak	-/-	-/-	Peak	-/-
	AVG	43.0		AVG	-/-		AVG	-/-
For emissions above 18 GHz please take look at the plots.								

Plots: 20 MHz channel bandwidth

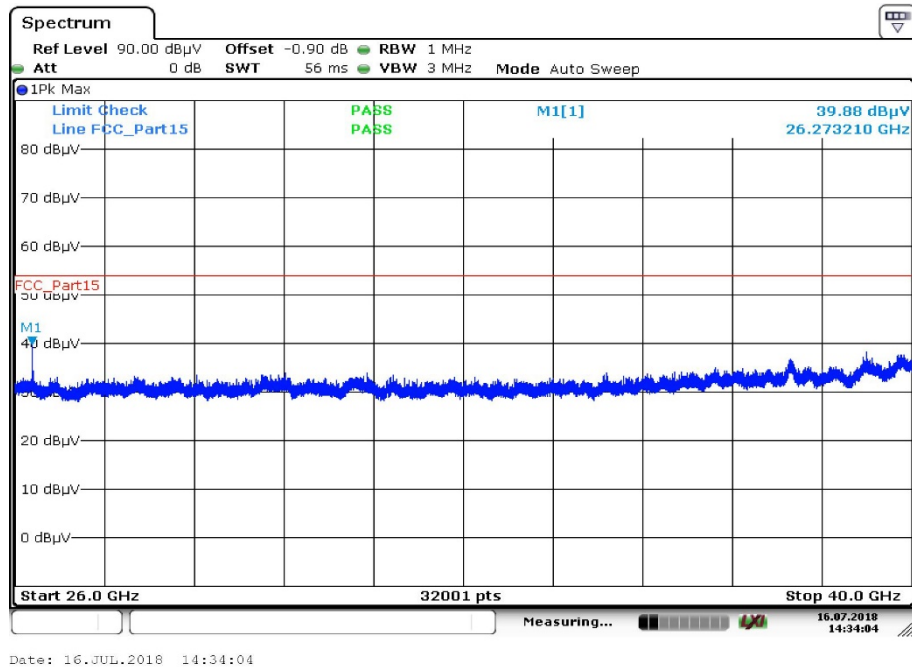
Plot 1: 30 MHz to 1 GHz; vertical & horizontal polarization; U-NII-2A; lowest channel

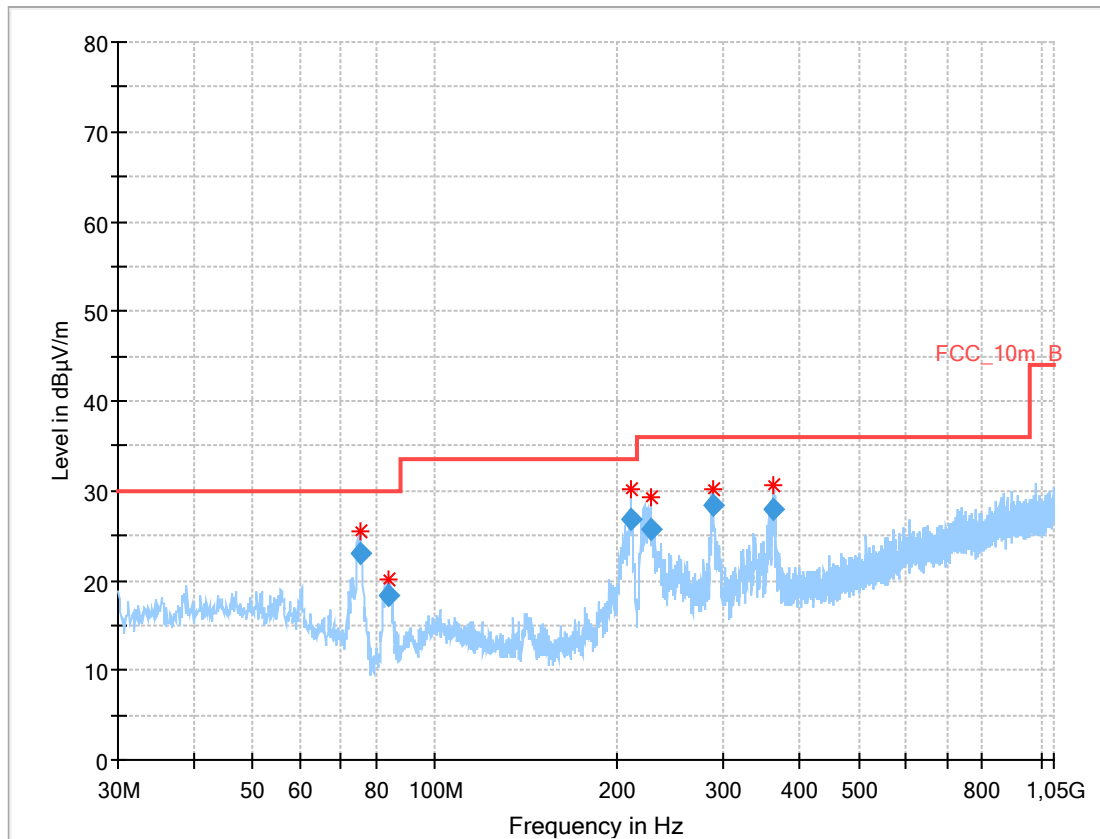


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
74.543	23.85	30.0	6.15	1000	120	170.0	V	180.0	9.0
84.092	17.75	30.0	12.25	1000	120	98.0	V	0.0	8.6
210.432	26.44	33.5	7.06	1000	120	101.0	V	90.0	12.2
220.439	25.14	36.0	10.86	1000	120	101.0	V	90.0	12.6
287.899	27.72	36.0	8.28	1000	120	170.0	H	90.0	14.2
363.312	27.16	36.0	8.84	1000	120	100.0	V	90.0	16.2

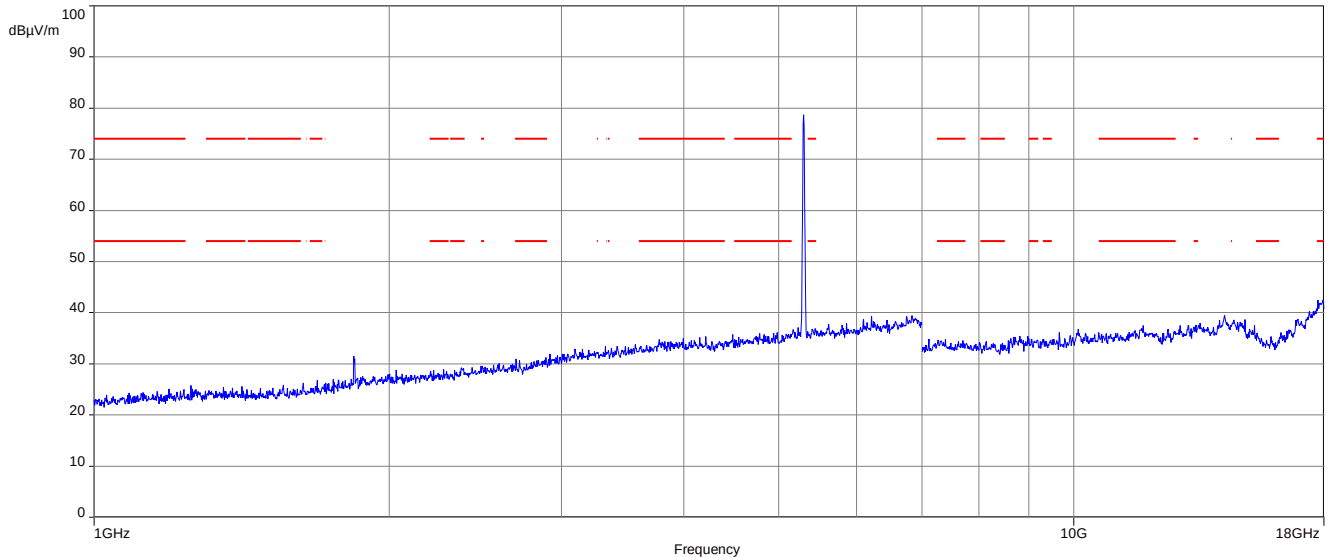
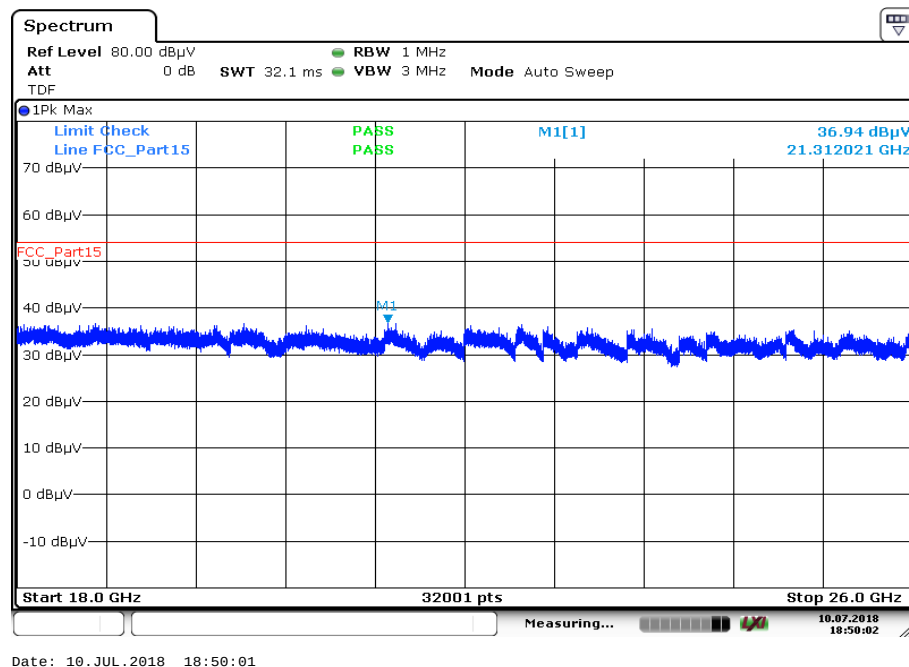
Plot 2: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2A; lowest channel**Plot 3:** 18 GHz to 26 GHz; vertical & horizontal polarization; U-NII-2A; lowest channel

Plot 4: 26 GHz to 40 GHz; vertical & horizontal polarization; U-NII-2A; lowest channel

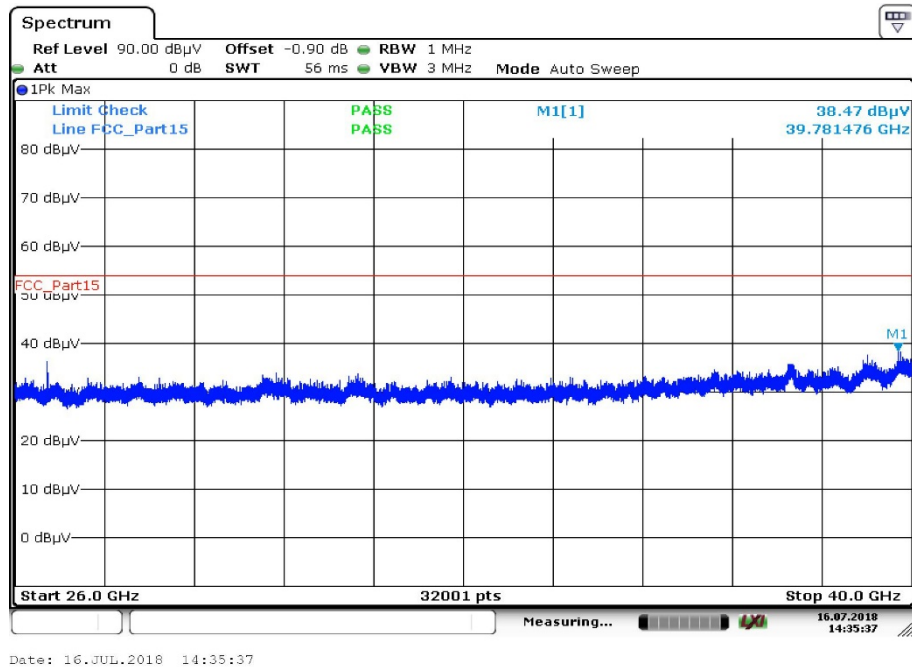


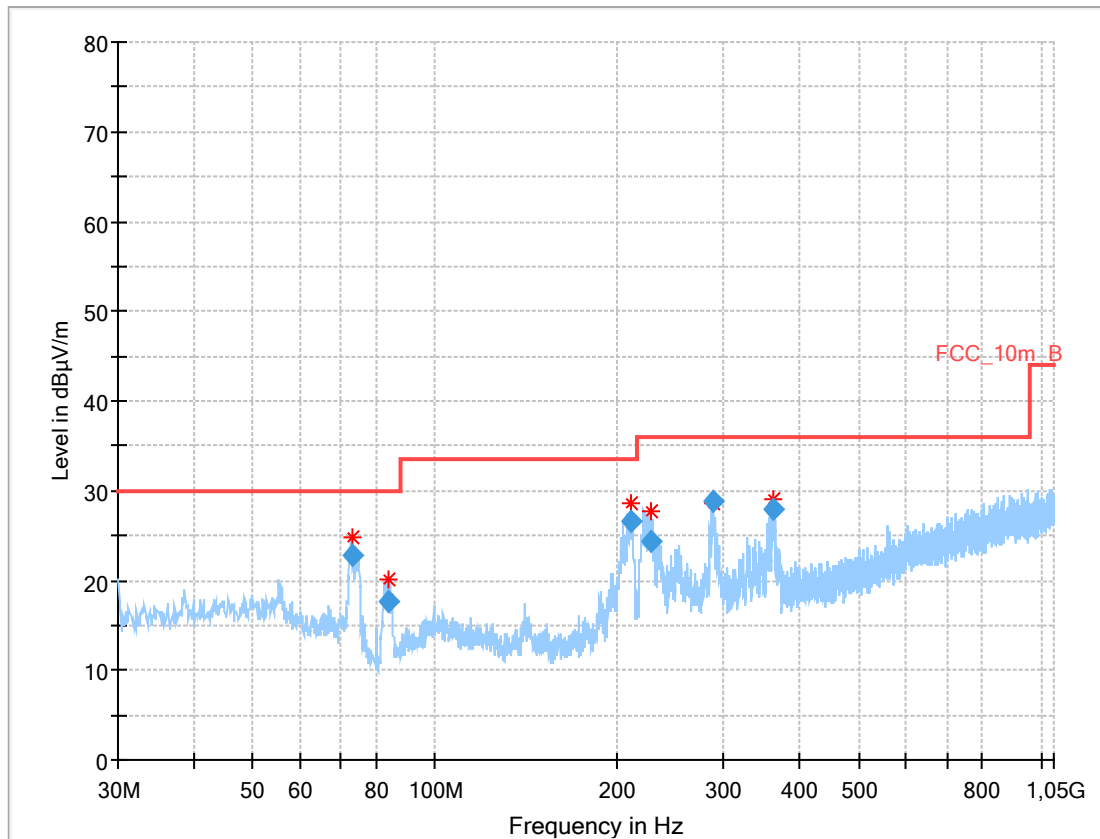
Plot 5: 30 MHz to 1 GHz; vertical & horizontal polarization; U-NII-2A; middle channel

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
75.219	23.02	30.0	6.98	1000	120	170.0	V	180.0	8.8
83.900	18.36	30.0	11.64	1000	120	101.0	V	90.0	8.6
210.236	26.87	33.5	6.63	1000	120	98.0	V	90.0	12.2
226.852	25.61	36.0	10.39	1000	120	98.0	V	90.0	12.8
286.732	28.39	36.0	7.61	1000	120	170.0	H	90.0	14.2
362.083	28.01	36.0	7.99	1000	120	98.0	V	90.0	16.2

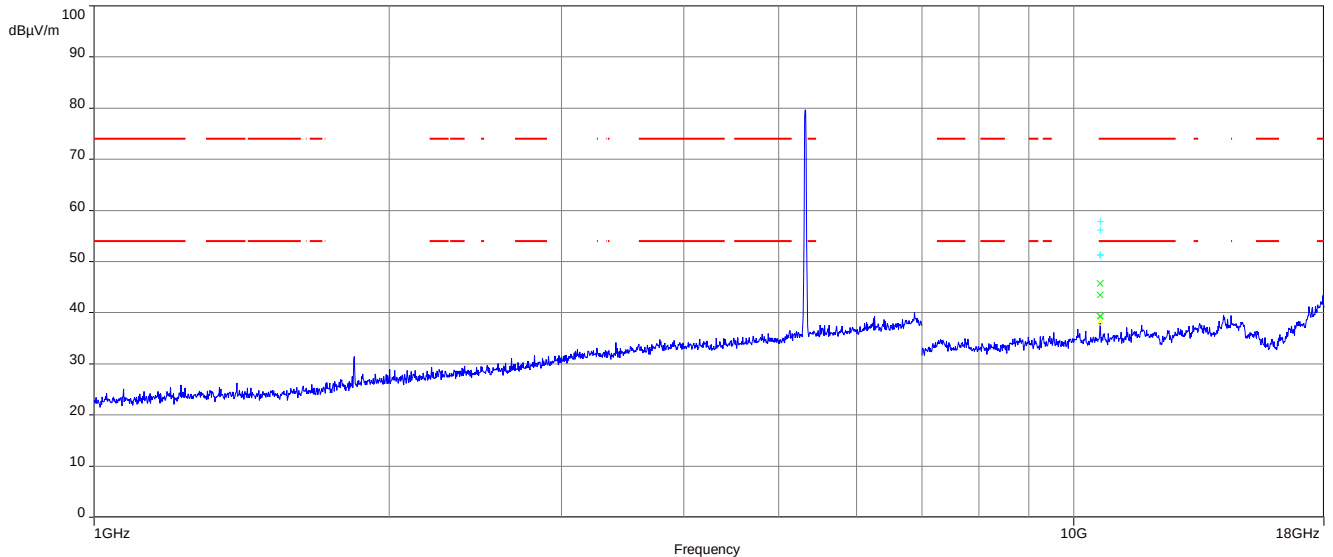
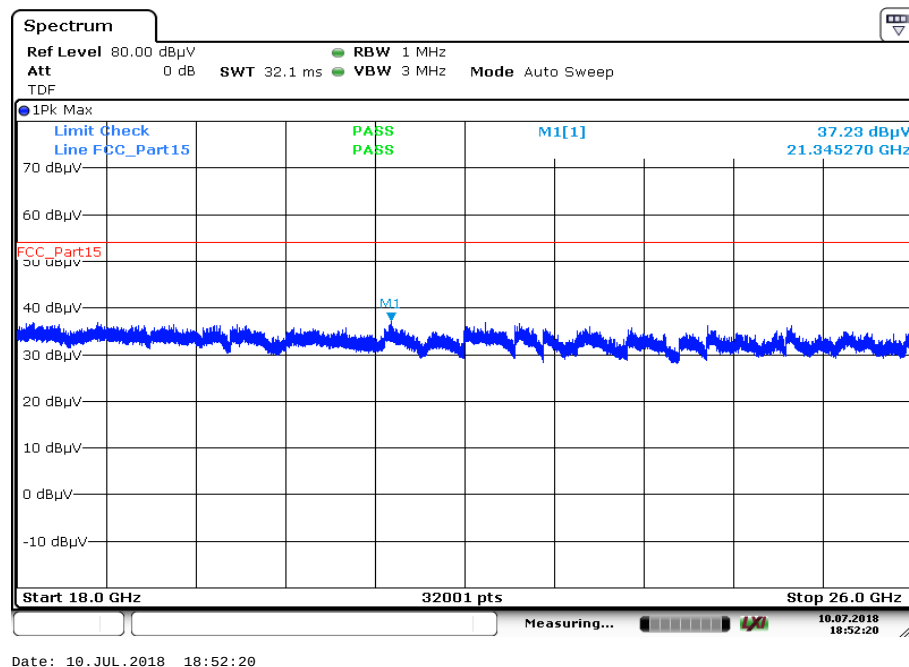
Plot 6: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2A; middle channel**Plot 7:** 18 GHz to 26 GHz; vertical & horizontal polarization; U-NII-2A; middle channel

Plot 8: 26 GHz to 40 GHz; vertical & horizontal polarization; U-NII-2A; middle channel

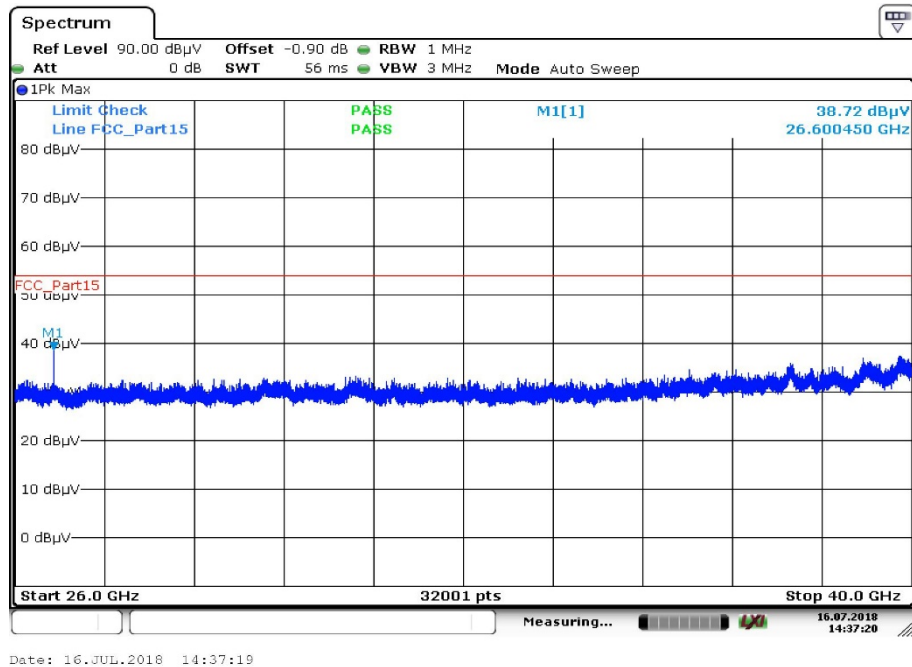


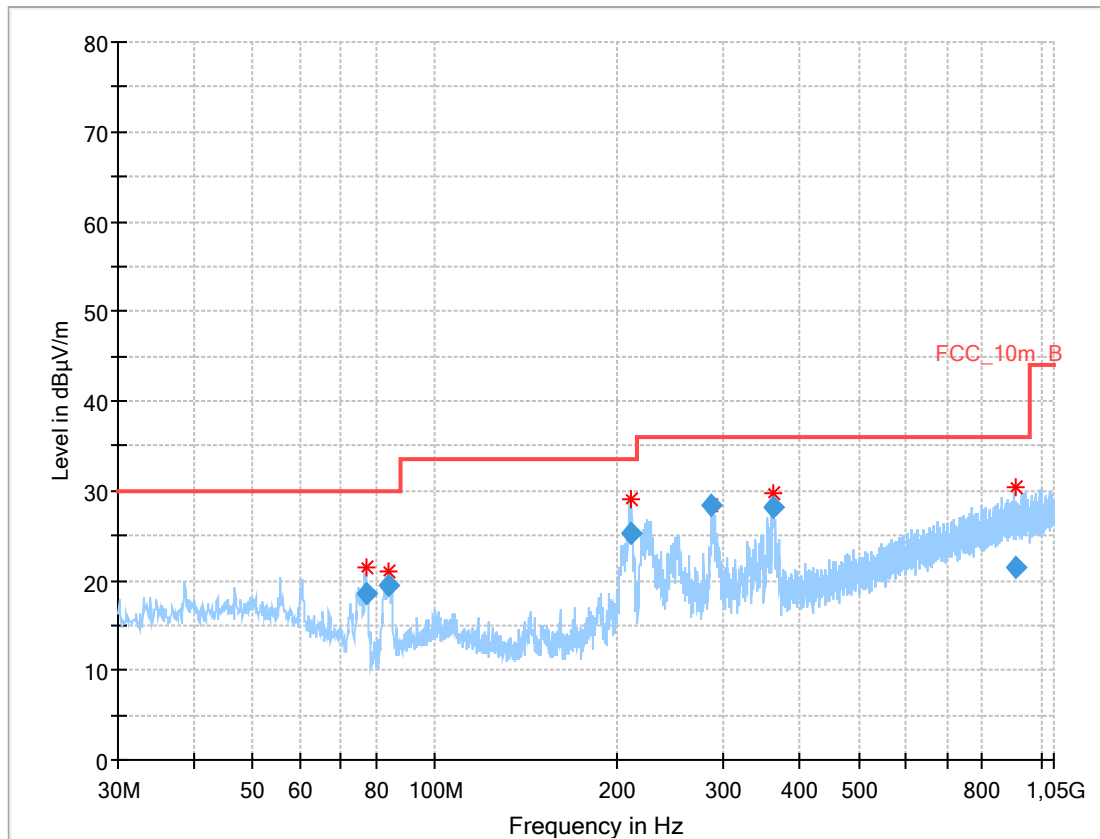
Plot 9: 30 MHz to 1 GHz; vertical & horizontal polarization; U-NII-2A; highest channel

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
73.091	22.80	30.0	7.20	1000	120	170.0	V	270.0	9.2
83.944	17.69	30.0	12.31	1000	120	98.0	V	90.0	8.6
210.872	26.64	33.5	6.86	1000	120	98.0	V	90.0	12.3
227.527	24.44	36.0	11.56	1000	120	101.0	V	90.0	12.8
286.808	28.87	36.0	7.13	1000	120	170.0	H	90.0	14.2
361.483	27.85	36.0	8.15	1000	120	98.0	V	90.0	16.2

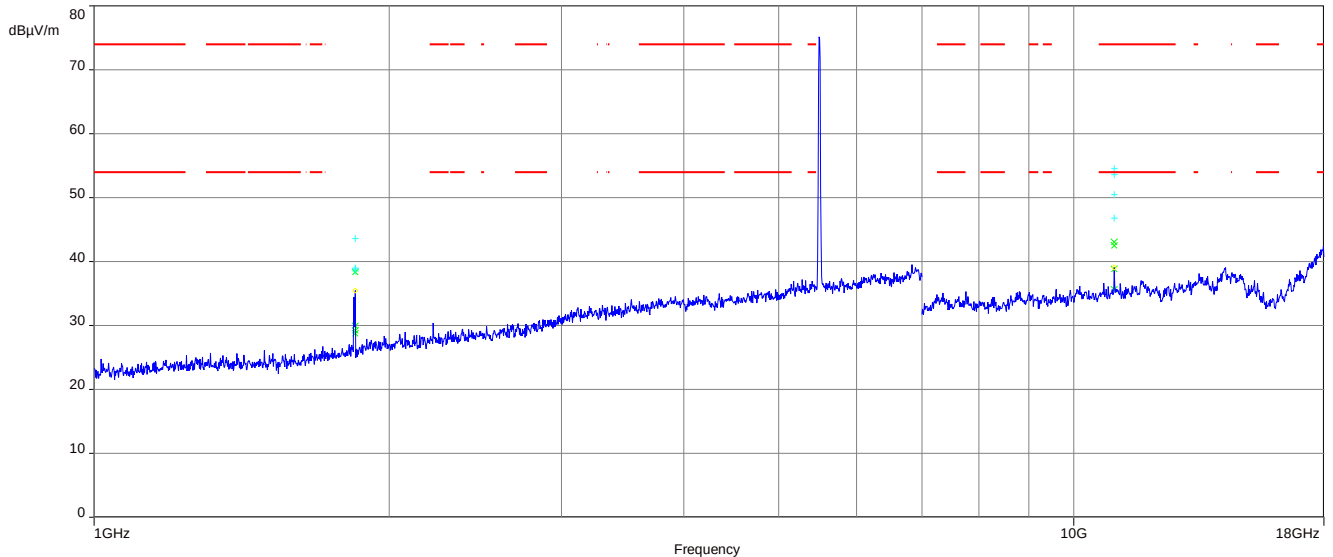
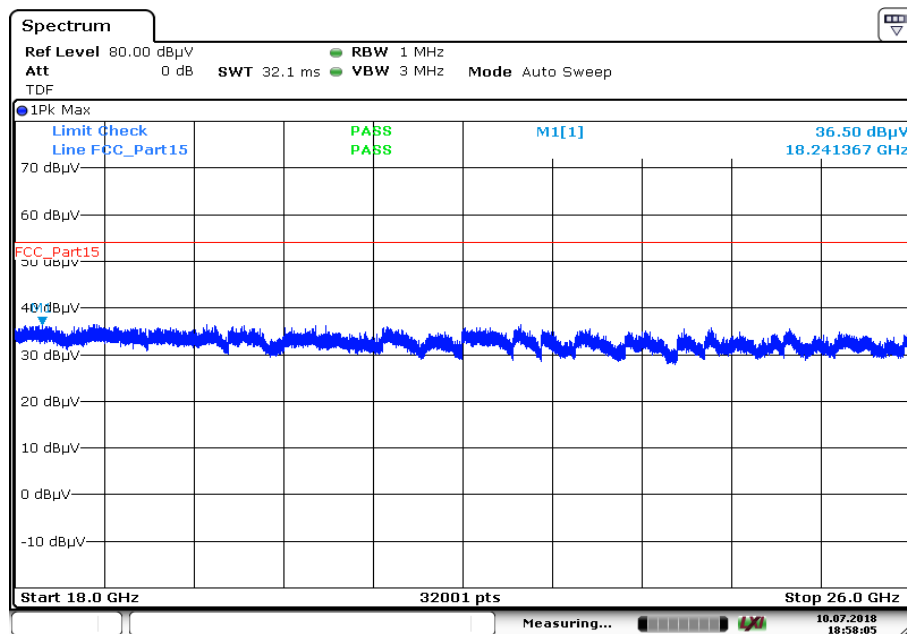
Plot 10: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2A; highest channel**Plot 11:** 18 GHz to 26 GHz; vertical & horizontal polarization; U-NII-2A; highest channel

Plot 12: 26 GHz to 40 GHz; vertical & horizontal polarization; U-NII-2A; highest channel

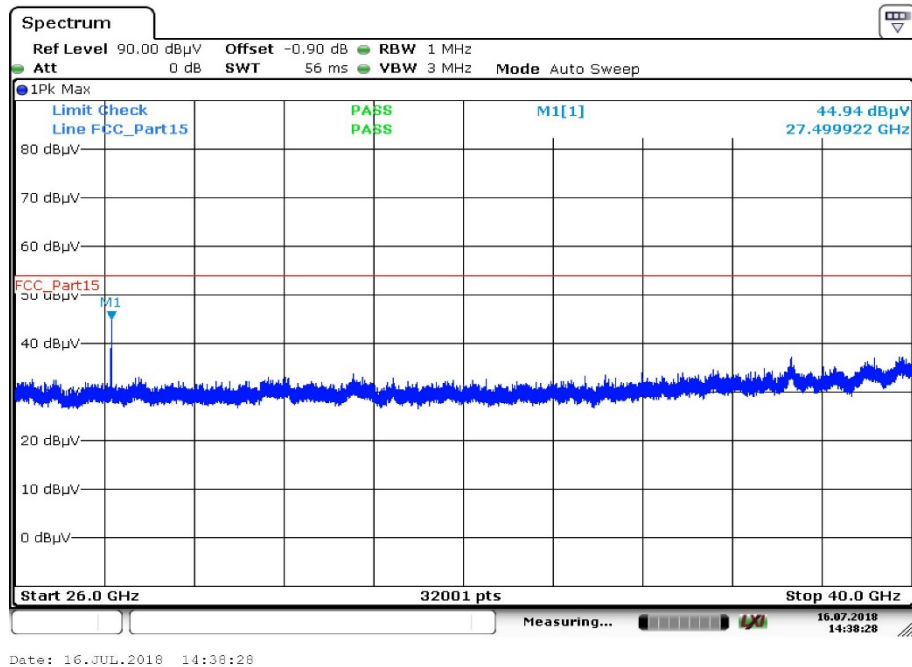


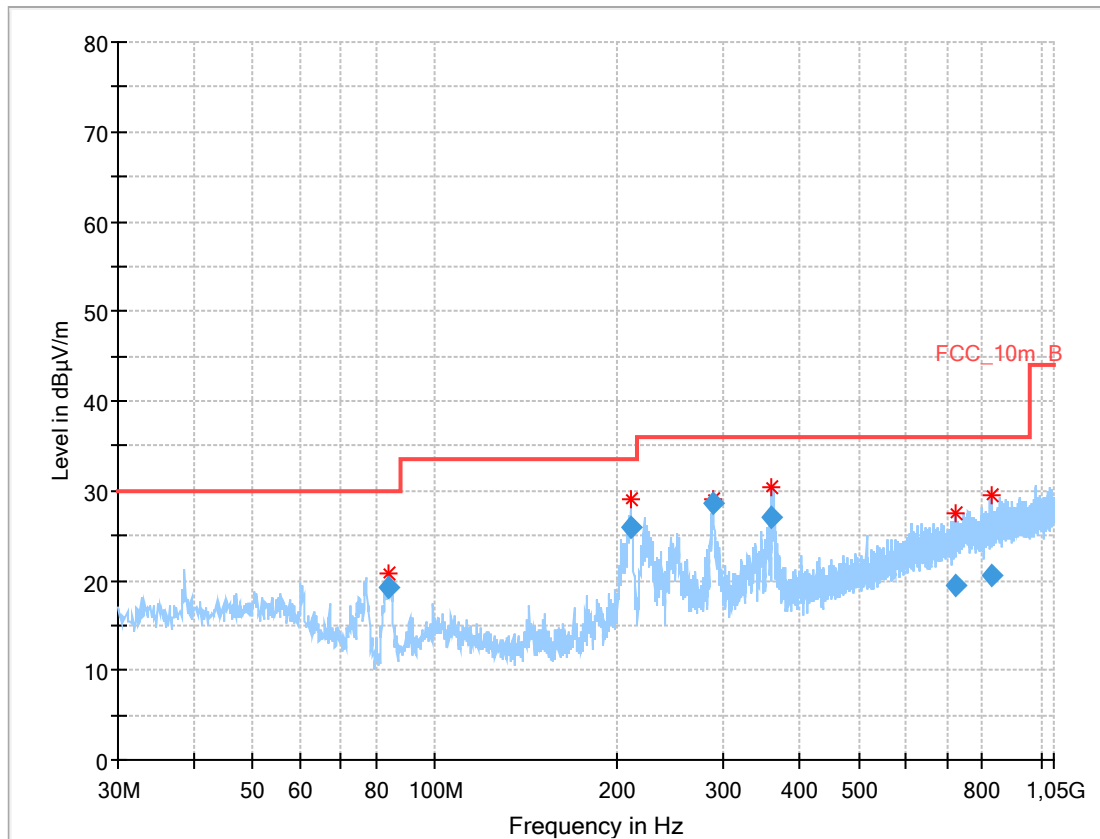
Plot 13: 30 MHz to 1 GHz; vertical & horizontal polarization; U-NII-2C; lowest channel

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
76.915	18.55	30.0	11.45	1000	120	170.0	V	270.0	8.6
83.856	19.41	30.0	10.59	1000	120	98.0	V	90.0	8.6
210.890	25.21	33.5	8.29	1000	120	101.0	V	90.0	12.3
286.382	28.44	36.0	7.56	1000	120	170.0	H	90.0	14.2
361.837	28.05	36.0	7.95	1000	120	98.0	V	90.0	16.2
905.378	21.39	36.0	14.61	1000	120	170.0	H	90.0	24.2

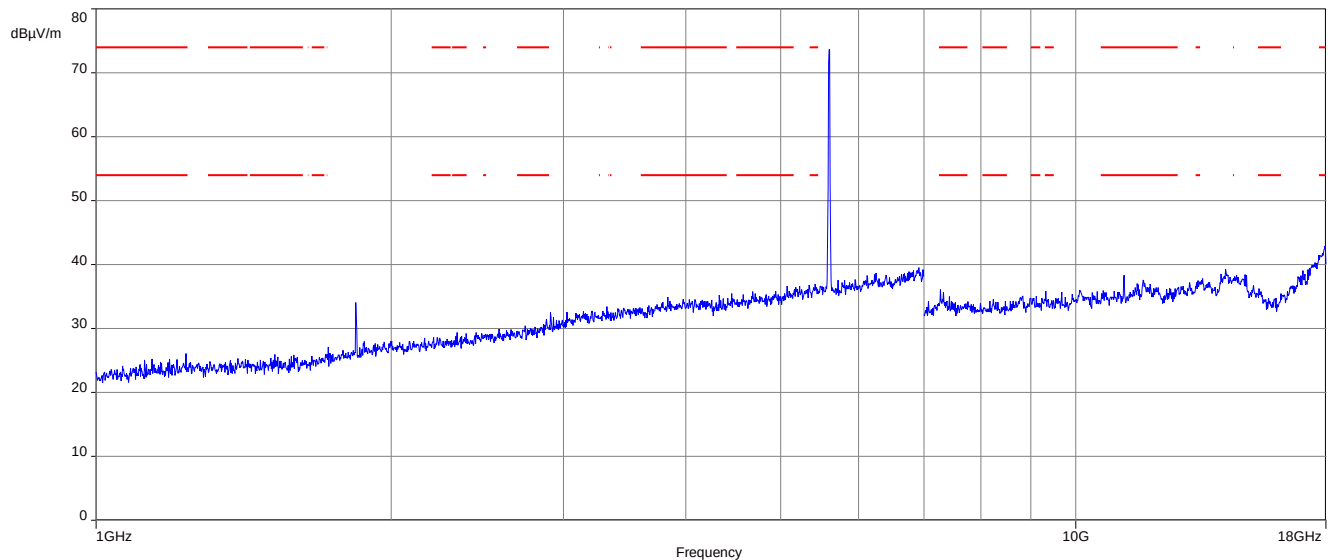
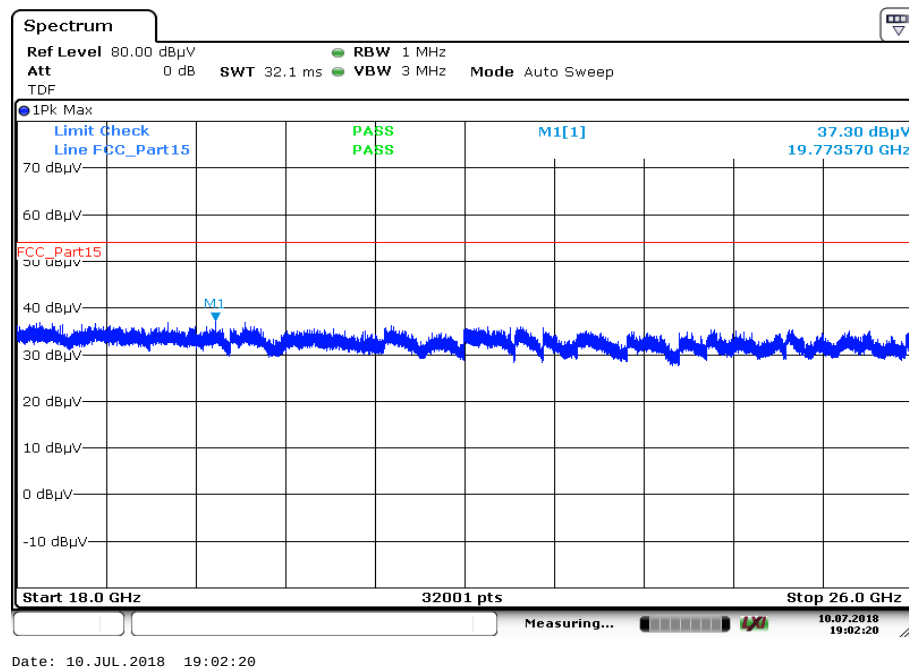
Plot 14: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2C; lowest channel**Plot 15:** 18 GHz to 26 GHz; vertical & horizontal polarization; U-NII-2C; lowest channel

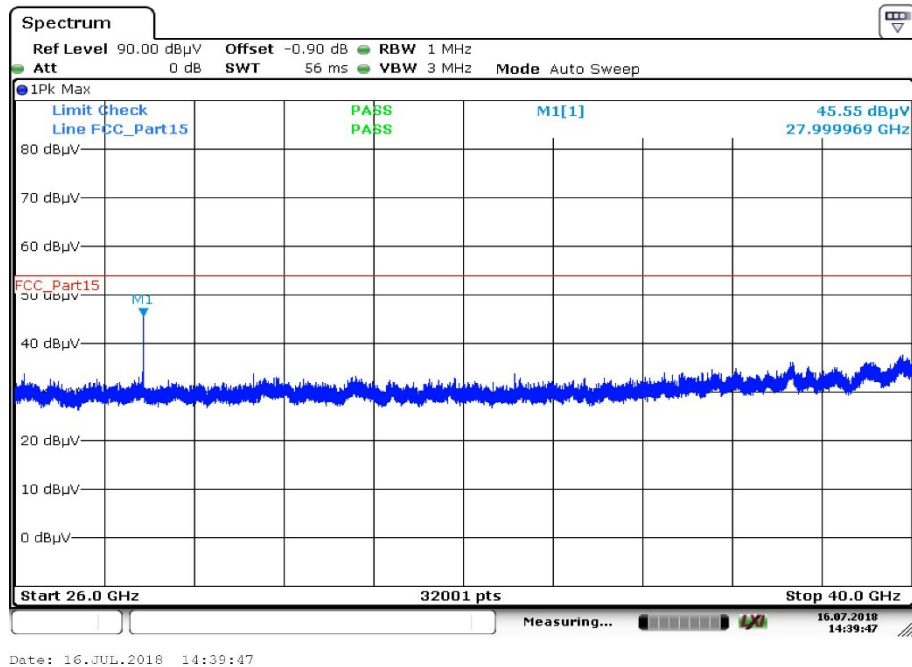
Date: 10. JUL. 2018 18:58:04

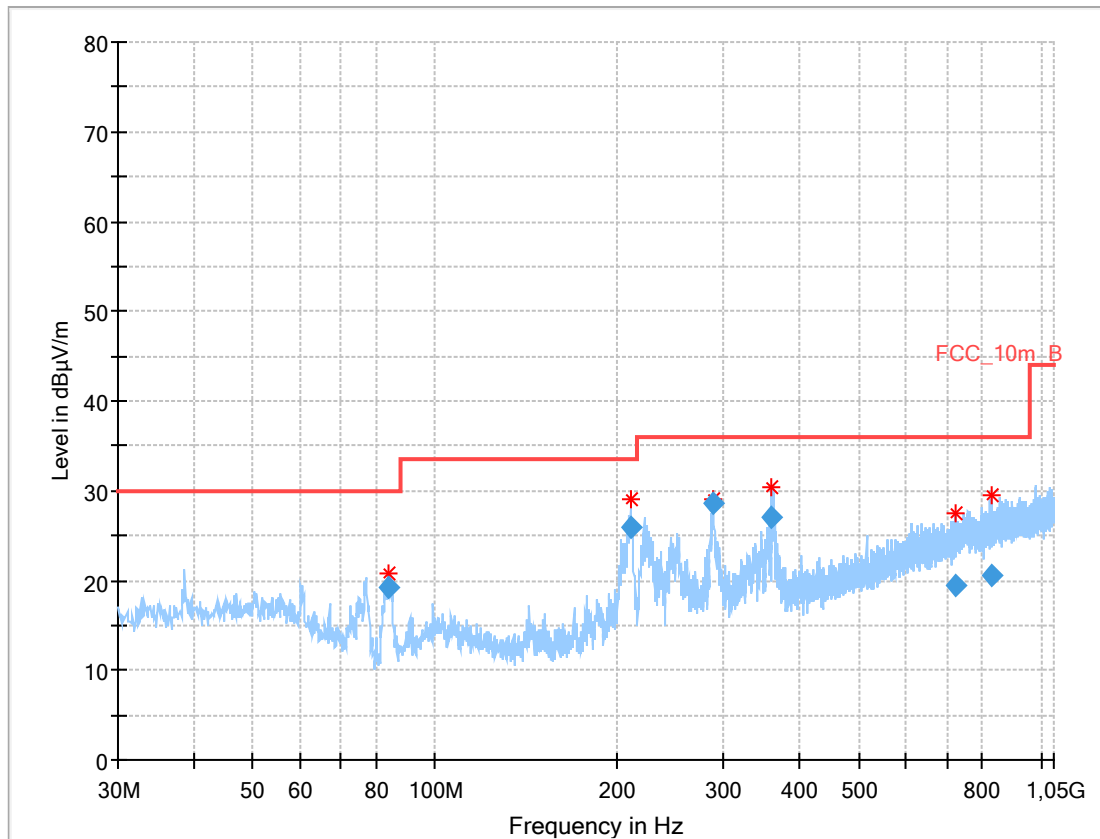
Plot 16: 26 GHz to 40 GHz; vertical & horizontal polarization; U-NII-2C; lowest channel

Plot 17: 30 MHz to 1 GHz; vertical & horizontal polarization; U-NII-2C; middle channel

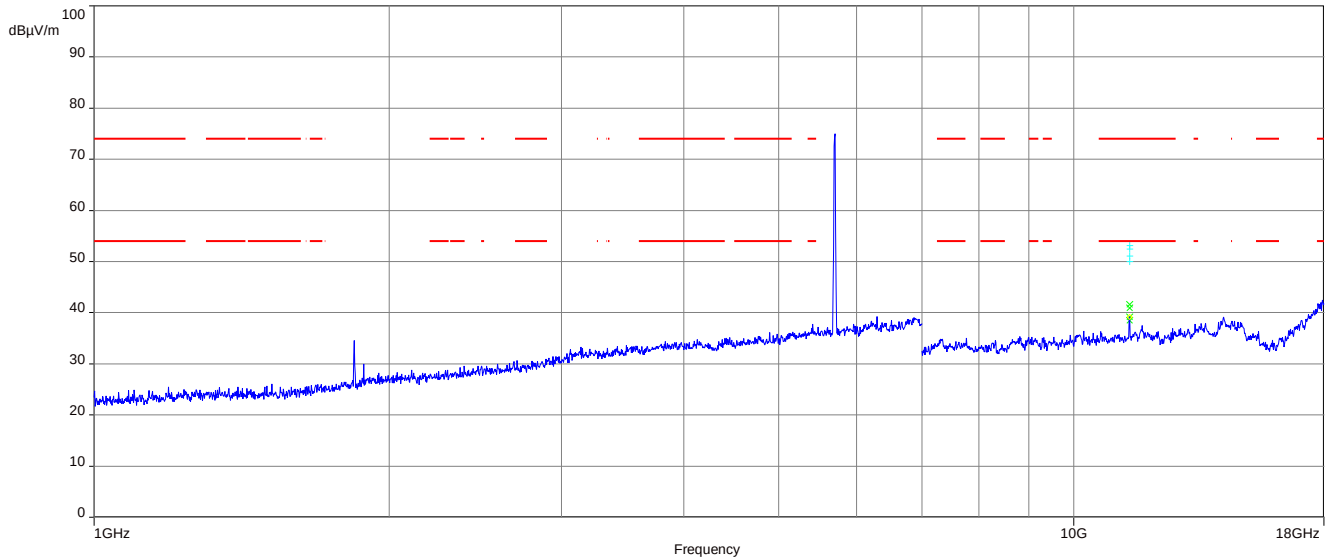
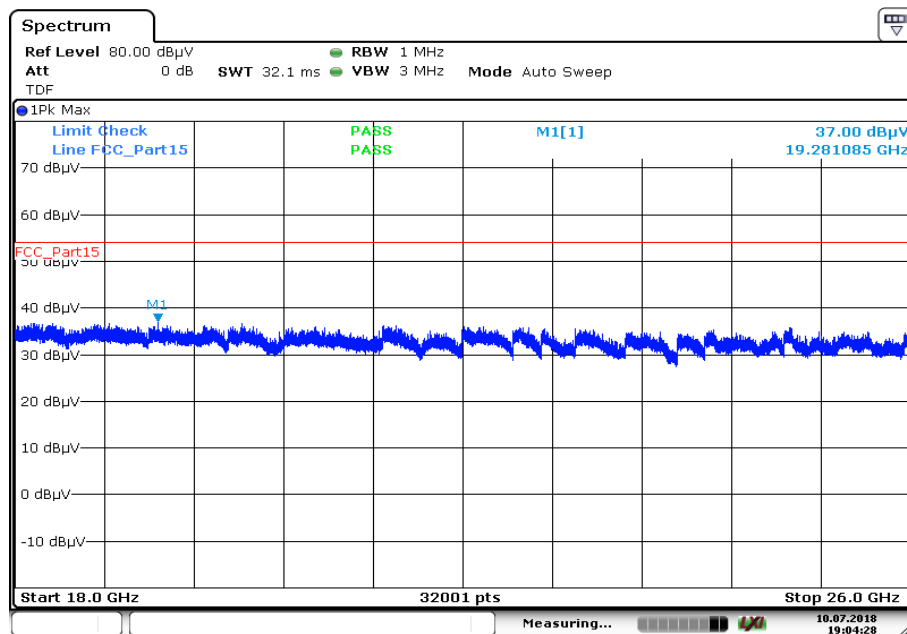
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
84.062	19.32	30.0	10.68	1000	120	98.0	V	90.0	8.6
210.359	25.84	33.5	7.66	1000	120	170.0	V	90.0	12.2
287.232	28.63	36.0	7.37	1000	120	170.0	H	90.0	14.2
360.198	27.14	36.0	8.86	1000	120	98.0	V	90.0	16.2
723.954	19.45	36.0	16.55	1000	120	98.0	H	180.0	22.1
830.420	20.59	36.0	15.41	1000	120	98.0	H	180.0	23.2

Plot 18: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2C; middle channel**Plot 19:** 18 GHz to 26 GHz; vertical & horizontal polarization; U-NII-2C; middle channel

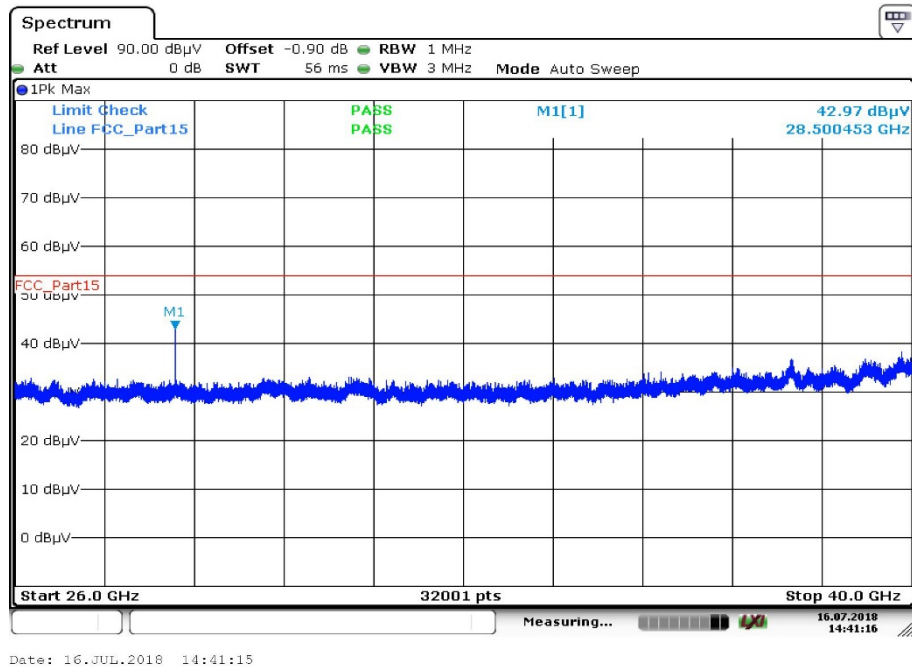
Plot 20: 26 GHz to 40 GHz; vertical & horizontal polarization; U-NII-2C; middle channel

Plot 21: 30 MHz to 1 GHz; vertical & horizontal polarization; U-NII-2C; highest channel

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
84.062	19.32	30.0	10.68	1000	120	98.0	V	90.0	8.6
210.359	25.84	33.5	7.66	1000	120	170.0	V	90.0	12.2
287.232	28.63	36.0	7.37	1000	120	170.0	H	90.0	14.2
360.198	27.14	36.0	8.86	1000	120	98.0	V	90.0	16.2
723.954	19.45	36.0	16.55	1000	120	98.0	H	180.0	22.1
830.420	20.59	36.0	15.41	1000	120	98.0	H	180.0	23.2

Plot 22: 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-2C; highest channel**Plot 23:** 18 GHz to 26 GHz; vertical & horizontal polarization; U-NII-2C; highest channel

Date: 10. JUL. 2018 19:04:28

Plot 24: 26 GHz to 40 GHz; vertical & horizontal polarization; U-NII-2C; highest channel

11.11 RX spurious emissions radiated

Description:

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

Measurement:

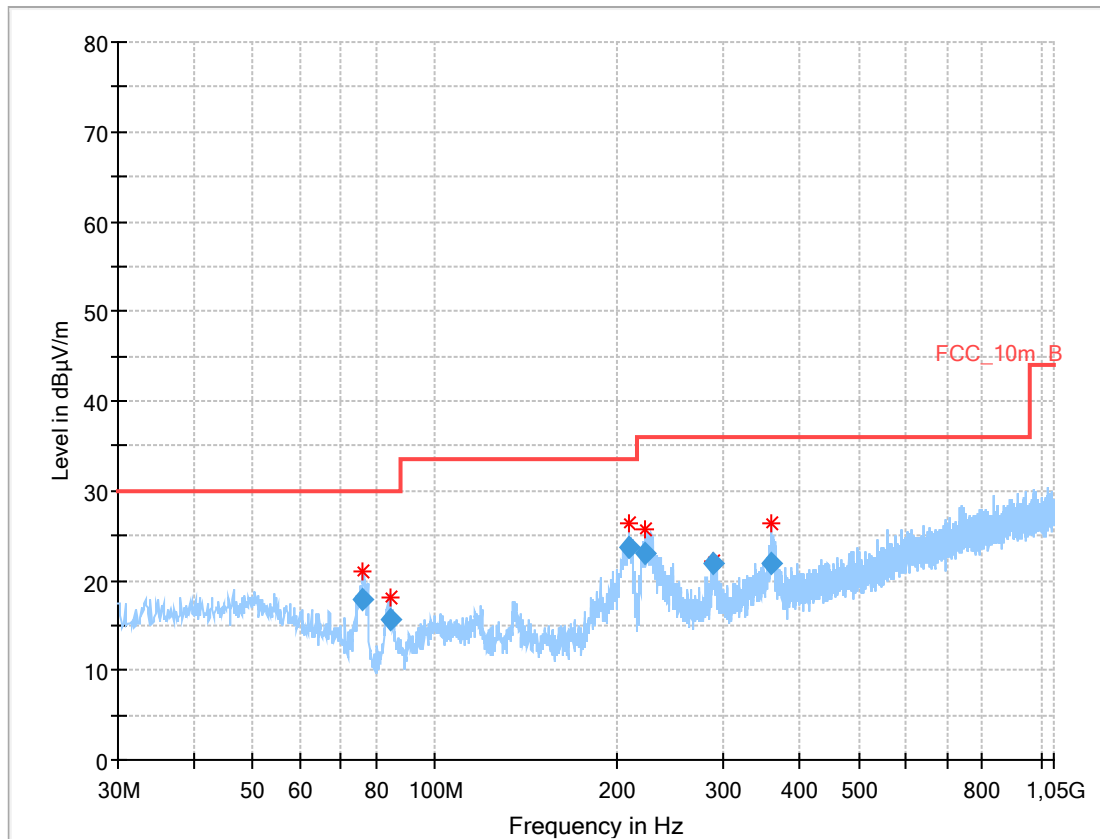
Measurement parameter	
Detector:	Quasi Peak below 1 GHz (alternative Peak) Peak above 1 GHz / RMS
Sweep time:	Auto
Resolution bandwidth:	F < 1 GHz: 100 kHz F > 1 GHz: 1 MHz
Video bandwidth:	F < 1 GHz: 100 kHz F > 1 GHz: ≥ 3 MHz
Span:	30 MHz to 40 GHz
Trace mode:	Max Hold / Average with 100 counts + 20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

Limits:

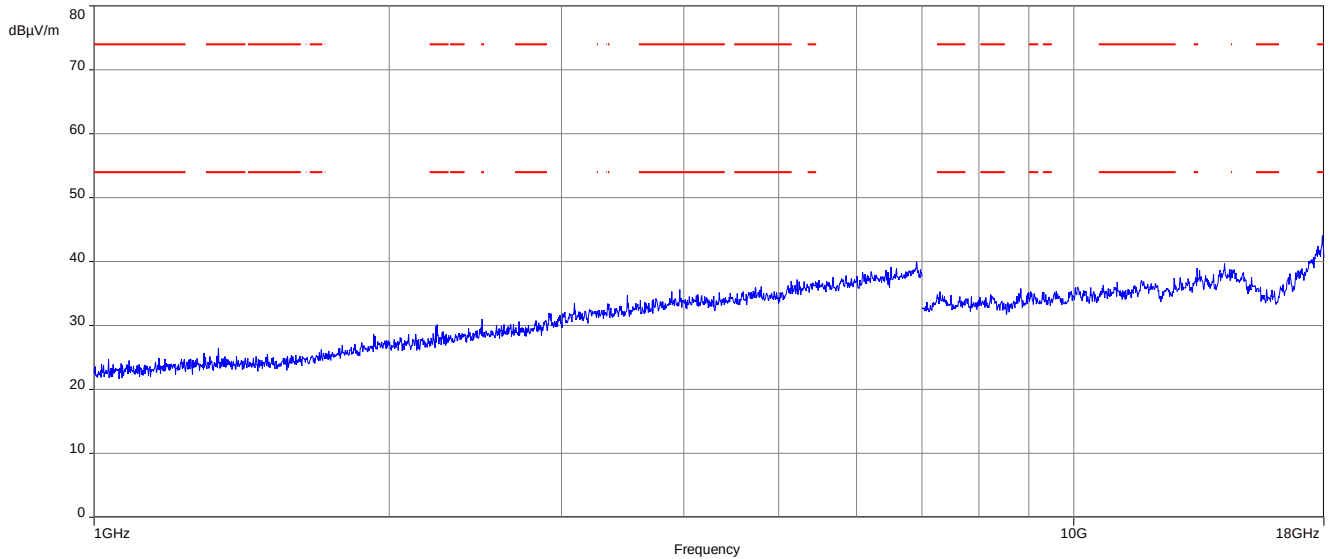
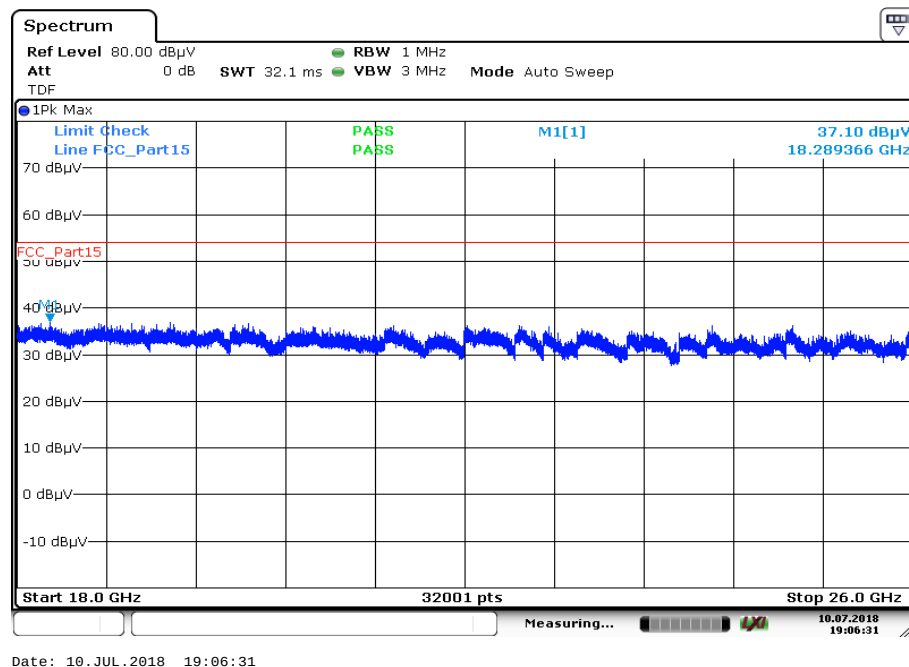
RX Spurious Emissions Radiated		
Frequency (MHz)	Field Strength (dBμV/m)	Measurement distance
30 - 88	30.0	10
88 – 216	33.5	10
216 – 960	36.0	10
Above 960	54.0	3

Results:

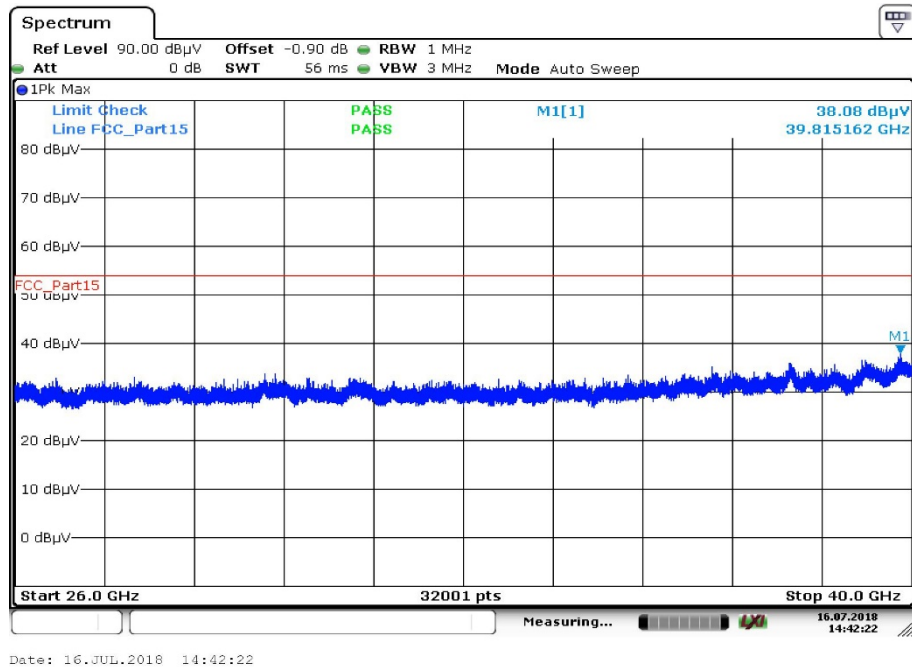
RX Spurious Emissions Radiated [dBμV/m]		
F [MHz]	Detector	Level [dBμV/m]
See result table below plots or Markers within respectively		

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)
76.165	17.96	30.0	12.04	1000	120	101.0	V	270.0	8.7
84.195	15.73	30.0	14.27	1000	120	101.0	V	90.0	8.6
209.352	23.72	33.5	9.78	1000	120	98.0	V	90.0	12.2
221.885	23.02	36.0	12.98	1000	120	98.0	V	90.0	12.6
288.732	21.90	36.0	14.10	1000	120	170.0	H	90.0	14.2
359.643	21.93	36.0	14.07	1000	120	101.0	V	90.0	16.2

Plot 2: 1 GHz to 18 GHz, vertical & horizontal polarization**Plot 3:** 18 GHz to 26 GHz, vertical & horizontal polarization

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



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
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

Annex B Document history

Version	Applied changes	Date of release
-/-	Initial release	2018-08-06
A	New FVIN added	2018-10-05

Annex C Accreditation Certificate

first page	last page
 Deutsche Akkreditierungsstelle GmbH Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition Accreditation  The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory CTC advanced GmbH Untertürkheimer Straße 6-10, 66117 Saarbrücken is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields: Telecommunication The accreditation certificate shall only apply in connection with the notice of accreditation of 02.06.2017 with the accreditation number D-PL-12076-01 and is valid until 21.04.2021. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 43 pages. Registration number of the certificate: D-PL-12076-01-03 Frankfurt, 02.06.2017  Ralf Reiter Head of Division	Deutsche Akkreditierungsstelle GmbH Office Berlin Spittelmarkt 10 10117 Berlin Office Frankfurt am Main Europa-Allee 52 60327 Frankfurt am Main Office Braunschweig Bundesallee 100 38116 Braunschweig The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkKS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf. No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkKS. The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkKS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations. The up-to-date state of membership can be retrieved from the following websites: EA: www.european-accreditation.org ILAC: www.ilac.org IAF: www.iaf.nu

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-12076-01-03e.pdf>