DEKRA Testing and Certification, S.A.U.
Parque Tecnológico de Andalucía
c/ Severo Ochoa nº 2 · 29590 Campanillas · Málaga · España
C.I.F. A29507456

ISED CABid: ES1909

Test report No:
NIE: 69535RRF.023

Partial Test Report
USA FCC Part 15.407, 15.209
CANADA RSS-247, RSS-Gen

(*) Identification of item tested	Automotive infotainment System
(*) Trademark	Mercedes-Benz
(*) Model and /or type reference	NTG7Q PREMIUM
Other identification of the product	FCC ID: T8GNTG7QPRE IC: 6434A-NTG7QPRE
(*) Features	FM/AM/DAB/DVBT USB, Bluetooth, WLAN, GNSS. HW version: D11 SW version: E329
Applicant	HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH BECKER-GOERING-STR. 16 76307 KARLSBAD GERMANY
Test method requested, standard	USA FCC Part 15.407 (10-1-21) Edition: Unlicensed National Information Infrastructure (U-NII) Devices. General technical requirements. USA FCC Part 15.209 (10-1-21) Edition: Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5 (April 2018). Guidance for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Approved by (name / position & signature)	Rafael López EMC Consumer & RF Lab. Manager 2022.09.20 14:21:58 +02'00'
Date of issue	2022-09-20
Report template No.	FDT08_24 (*) "Data provided by the client"

Index

Competences and guarantees 3
General conditions 3
Uncertainty 3
Data provided by the client 4
Usage of samples 4
Test sample description 5
Identification of the client 7
Testing period and place 7
Document history 7
Environmental conditions 7
Remarks and comments 8
Testing verdicts 9
Summary 9
Appendix A: Tests results for the U-NII-1 Band 5.15 – 5.25 GHz 11
Appendix B: Test results for the U-NII-3 Band 5.725 – 5.85 GHz 37

Competences and guarantees

DEKRA Testing and Certification is a testing laboratory accredited by the National Accreditation Body (ENAC - Entidad Nacional de Acreditación) to perform the tests indicated in the Certificate No. 51/LE 147.

DEKRA Testing and Certification is an FCC-recognized accredited testing laboratory with appropriate scope of accreditation that covers the performed tests in this report.

DEKRA Testing and Certification is an ISED-recognized accredited testing laboratory, CABid: ES1909, with the appropriate scope of accreditation that covers the performed tests in this report.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification has a calibration and maintenance program for its measurement equipment.

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

DEKRA Testing and Certification is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

IMPORTANT: No parts of this report may be reproduced or quoted out of context, in any form or by any means, except in full, without the previous written permission of DEKRA Testing and Certification.

General conditions

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

Uncertainty

Uncertainty (factor k=2) was calculated according to the DEKRA Testing and Certification internal document PODT000.

The total uncertainty of the measurement system for the radiated emissions of EUT from 30 MHz to 1 GHz is: Measurement uncertainty ≤ ±5.01 dB (with factor k = 2).

The total uncertainty of the measurement system for the radiated emissions of EUT from 1 GHz to 17 GHz is: Measurement uncertainty ≤ ±4.22 dB (with factor k = 2).

The total uncertainty of the measurement system for the radiated emissions of EUT from 17 GHz to 26 GHz is: Measurement uncertainty ≤ ±4.71 dB (with factor k = 2).

The total uncertainty of the measurement system for the radiated emissions of EUT from 26 GHz to 40 GHz is: Measurement uncertainty ≤ ±4.92 dB (with factor k = 2).

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").

2. The sample consists of an automotive head unit to be installed in cars with the following features: FM/AM/DAB/DVBT, USB, Bluetooth, WLAN and GNSS.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of result.

Usage of samples

Samples undergoing test have been selected by: The client.

Id	Control Number	Description	Model	Serial Nº	Date of Reception	Application
S/01	69535_24.1	Automotive infotainment System	NTG7Q PREMIUM	HBM657FM0N4884015	2022-06-13	Element Under Test
S/01	69535_17.1	RF Harness	--	--	2022-06-13	Element Under Test
S/01	60268_123.1	RF cable with 4 antennas	--	--	2019-09-31	Element Under Test

Notes referenced to samples during the project:

Id	Type
S/01	Test samples used for Radiated testing

Test sample description

Ports…… :	Port name and description	Cable			
		Specified max length [m]	Attached during test	Shielded	Coupled to patient(3)
	Car Connector A	>3m	[X]	[ ]	[ ]
	Car Connector B	>3m	[X]	[ ]	[ ]
	Display Connector CID/PIP / RVC	>3m	[X]	[X]	[ ]
	USB Connector	<3m	[X]	[X]	[ ]
	Eth Connector	>3m	[X]	[ ]	[ ]
	BT/WLAN-Antenna	>3m	[X]	[X]	[ ]
Supplementary information to the ports…… :	GNSS Antenna >3m				

Rated power supply .....:	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	[ ]	AC:	[ ]	[ ]	[ ]	[ ]	[ ]
	[ ]	AC:	[ ]	[ ]	[ ]	[ ]	[ ]
	[X]	DC: 12V car battery /attenuator (9,5-15,5v normal operation)					
	[ ]	DC:					
Rated Power .....:	12V						
Clock frequencies.....:	.....						
Other parameters .....:	.....						
Software version .....:	E329						
Hardware version .....:	D11						
Dimensions in cm (W x H x D) ....:	.....						
Mounting position .....:	[ ]	Table top equipment					
	[ ]	Wall/Ceiling mounted equipment					
	[ ]	Floor standing equipment					
	[ ]	Hand-held equipment					

	[X]	Other: automotive	
Modules/parts.....:	Module/parts of test item	Type	Manufacturer
	.....	.....	.....
	.....	.....	.....
	.....	.....	.....
	.....	.....	.....
Accessories (not part of the test item) .....:	Description	Type	Manufacturer
	HARMANeco (with Display or headless)	HARMANeco	HARMAN
	Cable harness	harness	HARMAN
	Display	different suppliers	different versions
	BT/WLAN-Antenna	OEM-Antenna	HIRSCHMANN
	.....	.....	.....
	.....	.....	.....
Documents as provided by the applicant.....:	Description	File name	Issue date
	Technical description	Technical Description NTG7_A20 200717 SOP2 AllVariant.pdf	A20
	Testing Guide	NTG7-TestsetupScript_191209 HU+RSU_v2.0.pdf	v2.0
	.....	.....	.....
	.....	.....	.....

(3) Only for Medical Equipment

Identification of the client

HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH
BECKER-GOERING-STR. 16
76307 KARLSBAD GERMANY

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2022-07-12
Date (finish)	2022-07-29

Document history

Report number	Date	Description
69535RRF.023	2022-09-20	First release

Environmental conditions

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

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %

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

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %

Remarks and comments

The tests have been performed by the technical personnel: Rafael Fernández and Alfonso Guitérrez.

Used instrumentation:

Control No.	Equipment	Model	Manufacturer	Next Calibration
4825	SEMIANECHOIC ABSORBER LINED CHAMBER II	FACT 3 200 STP	ETS LINDGREN	NA
4826	SHIELDED ROOM	S101	ETS LINDGREN	NA
4578	HYBRID BILOG ANTENNA 30MHz-6GHz	3142E	ETS LINDGREN	2023-04-30
6142	PRE-AMPLIFIER G>38dB 30MHz-6GHz	BLNA 0160-01N	BONN ELEKTRONIK	2023-06-16
6165	EMI TEST RECEIVER 9kHz-7GHz	ESR7	ROHDE AND SCHWARZ	2023-11-08
4611	HORN ANTENNA 1-18GHz	BBHA 9120 D	SCHWARZBECK	2022-11-18
5705	PRE-AMPLIFIER G>40dB 1-18 GHz	BLMA 0118-1M	BONN ELEKTRONIK	2023-07-21
4657	HORN ANTENNA 18-40GHz	BBHA 9170	SCHWARZBECK	2023-05-05
8856	PRE-AMPLIFIER G>30dB 18-40GHz	BLMA 1840-4A	BONN ELEKTRONIK	2022-09-08
6668	SIGNAL AND SPECTRUM ANALYZER 10Hz-40GHz	FSV40	ROHDE AND SCHWARZ	2024-05-19
7817	EMI TEST RECEIVER 2Hz-44GHz	ESW44	ROHDE AND SCHWARZ	2023-12-30
6092	DC POWER SUPPLY 30V/5A	KEYSIGHT TECHNOLOGIES	U8002A	NA
7758	DIGITAL MULTIMETER	FLUKE	175	2022-11-04
4848	SOFTWARE FOR EMC/RF TESTING	EMC32	ROHDE AND SCHWARZ	NA

Testing verdicts

Not applicable:	N/A
Pass:	P
Fail:	F
Not measured:	N/M

Summary

A. Common requirements for all bands

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		Verdict	Remark
RSS-Gen 6.6 / RSS-247 6.2.	Transmitter 99% Occupied Bandwidth	N/M	(1)
FCC 15.403 (i)	Transmitter 26 dB Emission Bandwidth (EBW)	N/M	(1)
FCC 15.35 (c) / RSS-Gen 6.10	Duty Cycle	N/M	(1)
FCC 15.407 (g) / RSS-Gen 6.11	Transmitter Frequency Stability (Temperature & Voltage Variation)	N/M	(1)
Supplementary information and remarks: (1) Test not requested			

B. U-NII-1 Band: 5.15 - 5.25 GHz

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		Verdict	Remark
FCC 15.407 (a)(1)(iv)	Transmitter Maximum conducted Output Power	N/M	(1)
RSS-247 6.2.1.1	Transmitter Maximum Equivalent Isotropically Radiated Power EIRP	N/M	(1)
FCC 15.407 (a)(1)(iv)	Transmitter Maximum Power Spectral Density	N/M	(1)
RSS-247 6.2.1.1	Transmitter EIRP Spectral Density	N/M	(1)
FCC 15.407 (b)(1)(6) / RSS-247 6.2.1.2	Transmitter Out of Band Radiated Emissions	P	
FCC 15.407 (b)(1) / RSS-247 6.2.1.2	Transmitter Band Edge Radiated Emissions	P	
FCC 15.407 (h)(1) / RSS-247 6.2.1.1	Transmitter Power Control	N/M	(1)
Supplementary information and remarks: (1) Test not requested			

C. U-NII-3 Band: 5.725 - 5.85 GHz

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		**Verdict**	**Remark**
FCC 15.407 (a)(3) / RSS-247 6.2.4.1	Transmitter Maximum conducted Output Power	N/M	(1)
FCC 15.407 (e) / RSS-247 Clause 6.2.4.1	6 dB bandwidth.	N/M	(1)
FCC 15.407 (a)(3) / RSS-247 Clause 6.2.4.1	Transmitter Maximum Power Spectral Density	N/M	(1)
FCC 15.407 (b)(4) / RSS-247 6.2.4.2	Transmitter Band Edge Radiated Emissions	P	
FCC 15.407 (b)(4)(6) / RSS-247 6.2.4.2	Transmitter Out of Band Radiated Emissions	P	
FCC 15.40 (h)(1) / RSS-247 6.2.4.1	Transmitter Power Control	N/A	
Supplementary information and remarks: (1) Test not requested			

Appendix A: Tests results for the U-NII-1 Band 5.15 – 5.25 GHz

INDEX

TEST CONDITIONS 13
FCC 15.407 (b)(1) / RSS-247 6.2.1.2. Transmitter Out of Band Radiated Emissions 17
FCC 15.407 (b)(1) / RSS-247 6.2.1.2. Transmitter Band Edge Radiated Emissions 24

TEST CONDITIONS

(*) Data provided by the Applicant

POWER SUPPLY:

Vnonimal:	12 Vdc.
Type of Power Supply (*):	DC voltage from external power supply (car battery).

ANTENNA:

Type of Antenna:	External antenna.
Maximum Declared Antenna Gain (*):	+2.5 dBi

TEST FREQUENCIES:

Technology Tested:	WLAN (IEEE 802.11 a,n,ac) / U-NII-1	
Modes:	802.11a20: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps	
	802.11n HT20: MCS0 to MCS7	
	802.11n HT40: MCS0 to MCS7	
	802.11ac VHT20: MCS0 to MCS9	
	802.11ac VHT40: MCS0 to MCS9	
	802.11ac VHT80: MCS0 to MCS9	
Setting of cores / ports:	One port.	
Beamforming:	No.	
Frequency Range:	5150 MHz to 5250 MHz	
Channel Bandwidth:	20 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Low: 36	5180
	Middle: 40	5200
	High: 48	5240
Channel Bandwidth:	40 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Low: 38	5190
	High: 46	5230
Channel Bandwidth:	80 MHz	
Transmit Channels	Middle: 42	5210

The test set-up was made in accordance with the general provisions of FCC Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017.

The EUT was tested in the following operating mode:

- Continuously transmitting with a modulated carrier at maximum power on all required channels using the supported data rates/modulations types.

The field strength at the band edges was evaluated for each mode on the lowest and highest channels at the rated power for the channel under test.

For all modes, the EUT was configured in test mode using a software application. The application was used to enable a continuous transmission and to select the test channels as required. The client supplied instructions to configure the EUT. The customer supplied a document containing the setup instructions.

The worst cases for testing were identified based on output power and spurious levels at the band edges. Preliminary testing determined the following data rates as the worst-case modes:

802.11 a20:	6 Mbps
802.11 n HT20:	MCS0
802.11 n HT40:	MCS0
802.11 ac VHT20:	MCS0
802.11 ac VHT40:	MCS0
802.11 ac VHT80:	MCS0

RADIATED MEASUREMENTS:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range from 30 MHz to 1000 MHz and 1 GHz-17 GHz Double ridge horn antenna) is situated at a distance of 3 m and a distance of 1.5m for the frequency range 17 GHz-40 GHz (18 GHz-40 GHz horn antenna).

For radiated emissions in the range 17 GHz-40 GHz performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

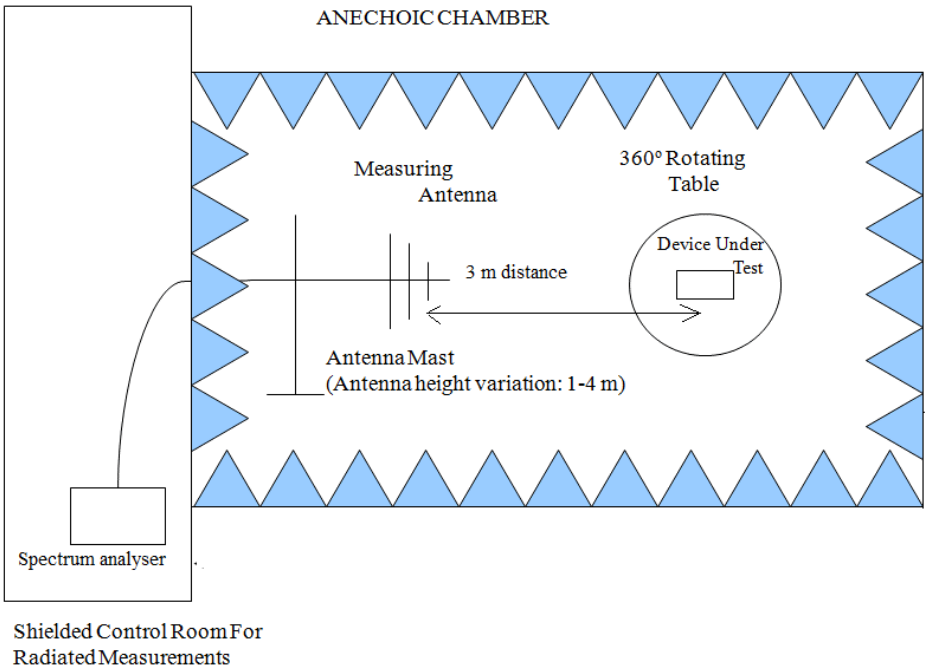
The equipment under test was set up on a non-conductive platform above the ground plane and its situation and orientation were varied to find the maximum radiated emission. It was also rotated 360º and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find the maximum radiated emission.

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

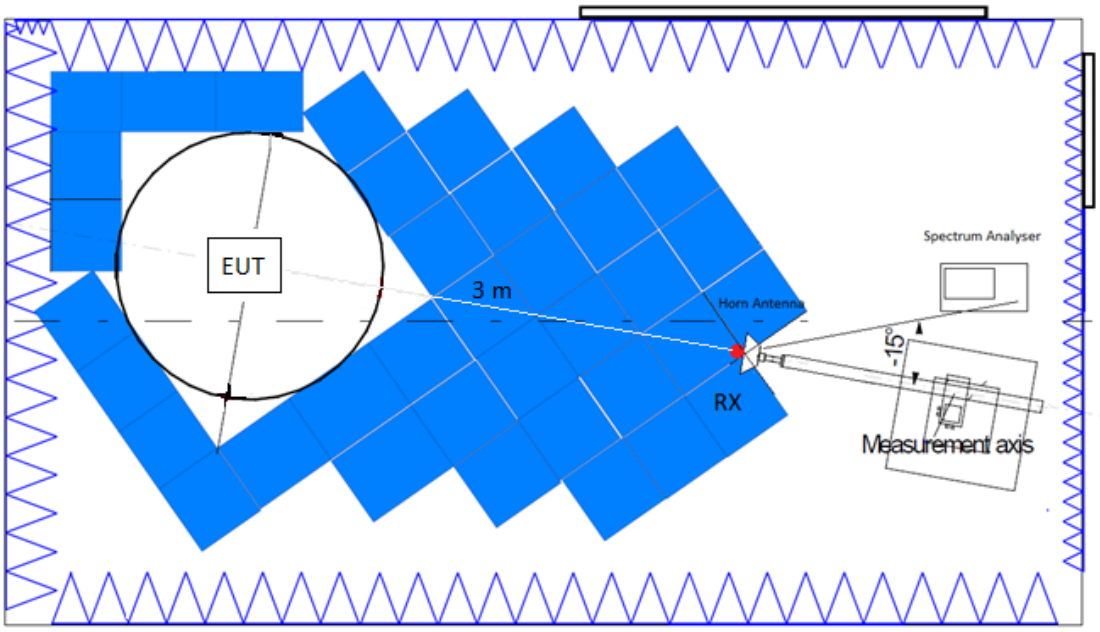
The final measured value, for the given emission, incorporates the calibrated antenna factor and cable loss.

A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

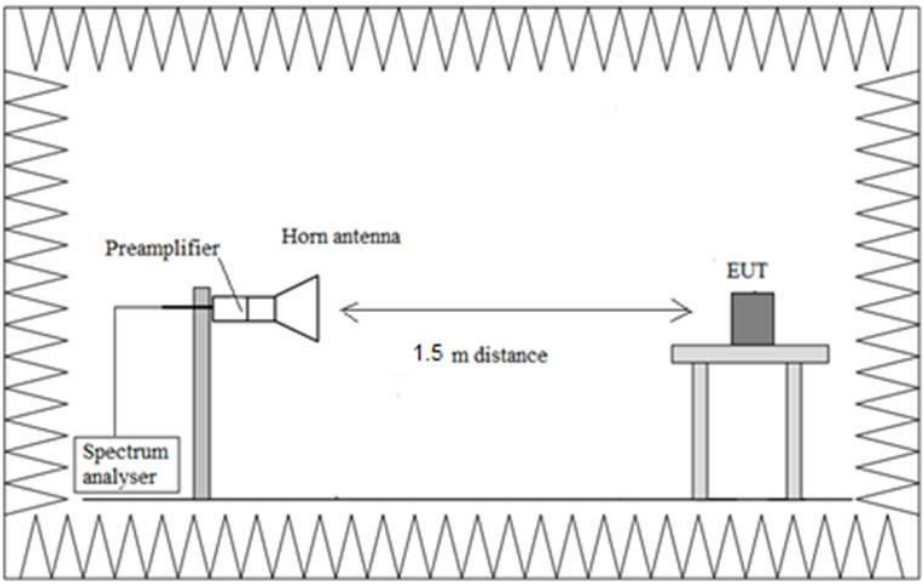
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup f > 17 GHz:



FCC 15.407 (b)(1) / RSS-247 6.2.1.2. Transmitter Out of Band Radiated Emissions

Limits

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

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)):

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

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

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

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.
Equipment certified under this standard is required to comply with the provisions in RSS-Gen with respect to emissions falling within restricted frequency bands.

Results

The field strength is calculated by adding a correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain. For measurements above 17 GHz performed at a reduced distance, this factor also includes an inverse proportionality factor of 20 dB per decade to normalize the measured data.

Band edge emissions in the restriced band adjacent to the U-NII-1 band, i.e. 4.5-5.15 and 5.35-5.46 GHz, are reported in the next section of this test report.

Test performed on the following modulations and data rates:

802.11 a20:	6 Mbps
802.11 n HT20:	MCS0
802.11 n HT40:	MCS0
802.11 ac VHT20:	MCS0
802.11 ac VHT40:	MCS0
802.11 ac VHT80:	MCS0

OUT OF BAND EMISSIONS:

For spurious emissions outside of the U-NII-1 band, the worst-case mode was determined among all modulations after preliminary measurements of the radiated power spectral density.

The Low, Middle and High Channels were tested for the determined worst case.

Worst case: 802.11 ac VHT20 MCS0

Frequency range 30 MHz - 1 GHz

The spurious emissions below 1 GHz do not depend either on the operating channel or the modulation mode selected in the EUT.

Spurious signals detected at less than 20 dB below the limit:

Spurious Freq (MHz)	Emission Lvl (dBµV/m)	Limit (dBµV/m)	Pol	Detector
299.9898	31.44	46.00	H	PK
	29.55			QP
450.0003	30.10			PK
	26.70			QP

Frequency range 1 - 40 GHz

The results in the next tables show the maximum measured levels in the 1 - 40 GHz frequency range.

Spurious frequencies in the restricted bands with peak levels above the average limit (54 dBµV/m at 3 m) are measured with an average detector for average compliance checking.

- LOW CHANNEL 36 (5180 MHz)

  No spurious signals at less than 20 dB below the limit.

- MIDDLE CHANNEL 40 (5200 MHz)

  No spurious signals at less than 20 dB below the limit.

- HIGH CHANNEL 48 (5240 MHz)

  No spurious signals at less than 20 dB below the limit.

Verdict

Pass

Attachments

The setting for each range of frequency is indicated in the following tables:

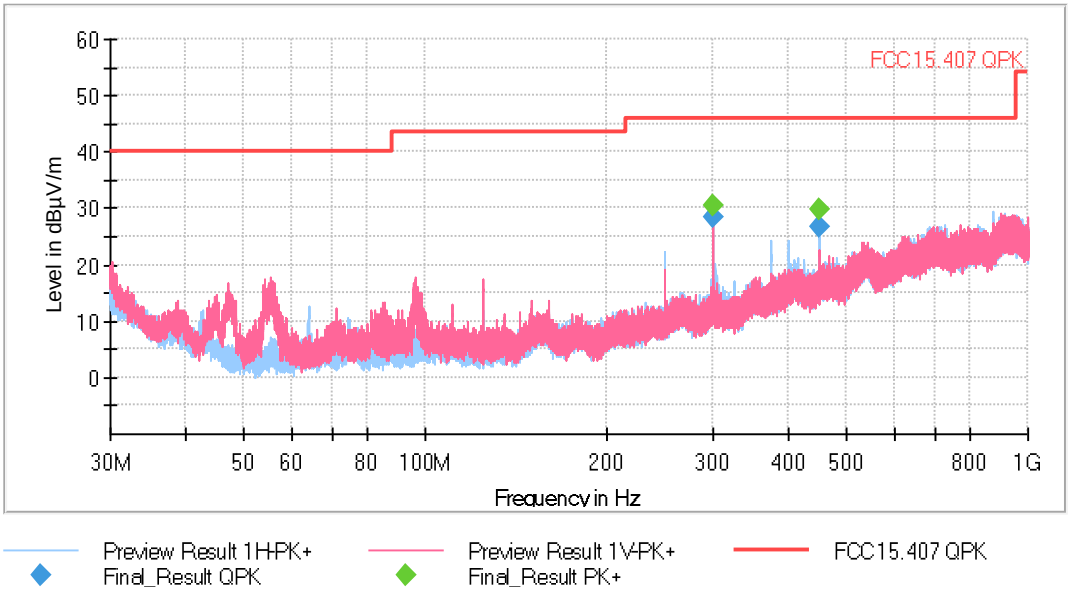
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESR 7] 30 MHz - 1 GHz	9,7 kHz	PK+	100 kHz	1 s	0 dB

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSV 40] 1 GHz - 7 GHz	187,5 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSV 40] 7 GHz - 17 GHz	312,5 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44] 17 GHz - 40 GHz	766,667 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

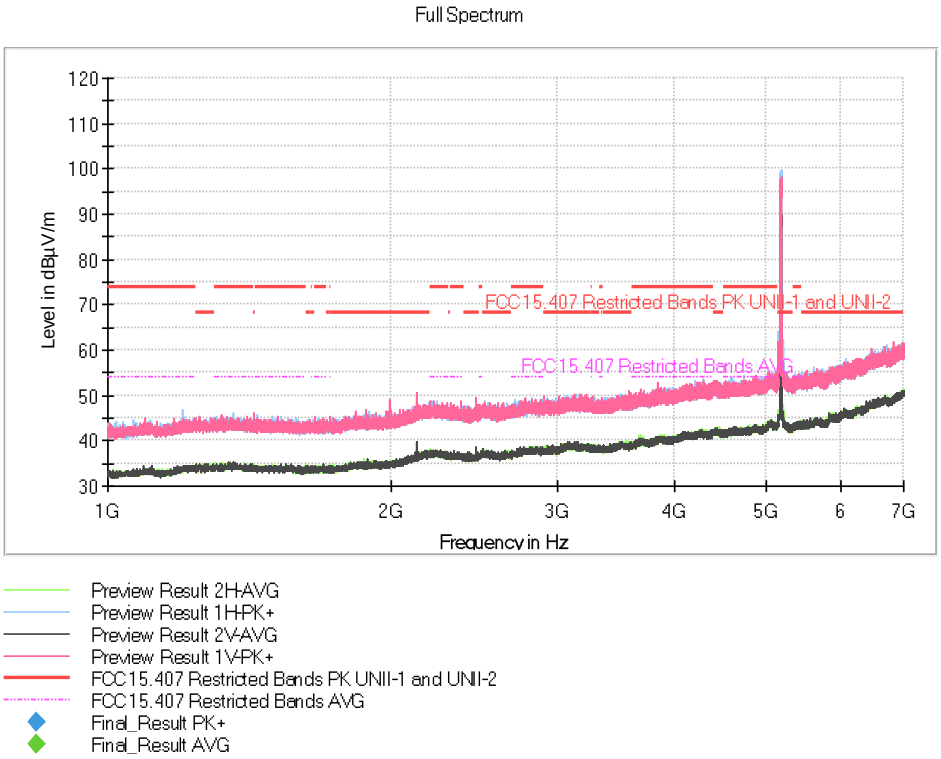
FREQUENCY RANGE 30 MHz - 1 GHz



This plot is valid for Low, Middle and High Channels and all modulations.

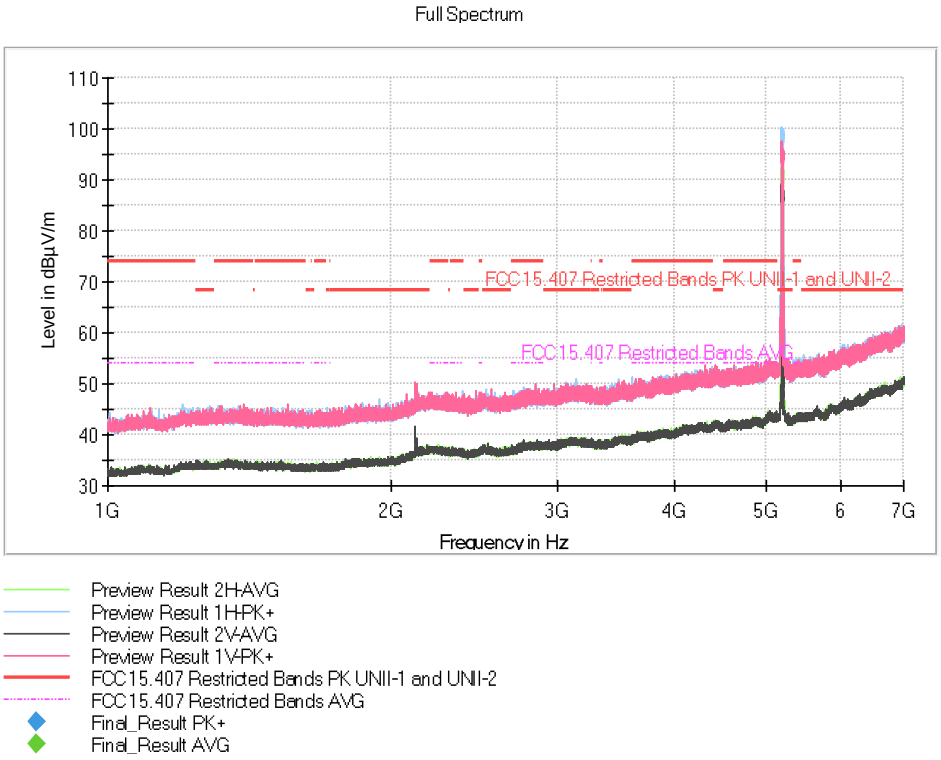
FREQUENCY RANGE 1 - 7 GHz (802.11 ac VHT20 MCS0)

- Low Channel:



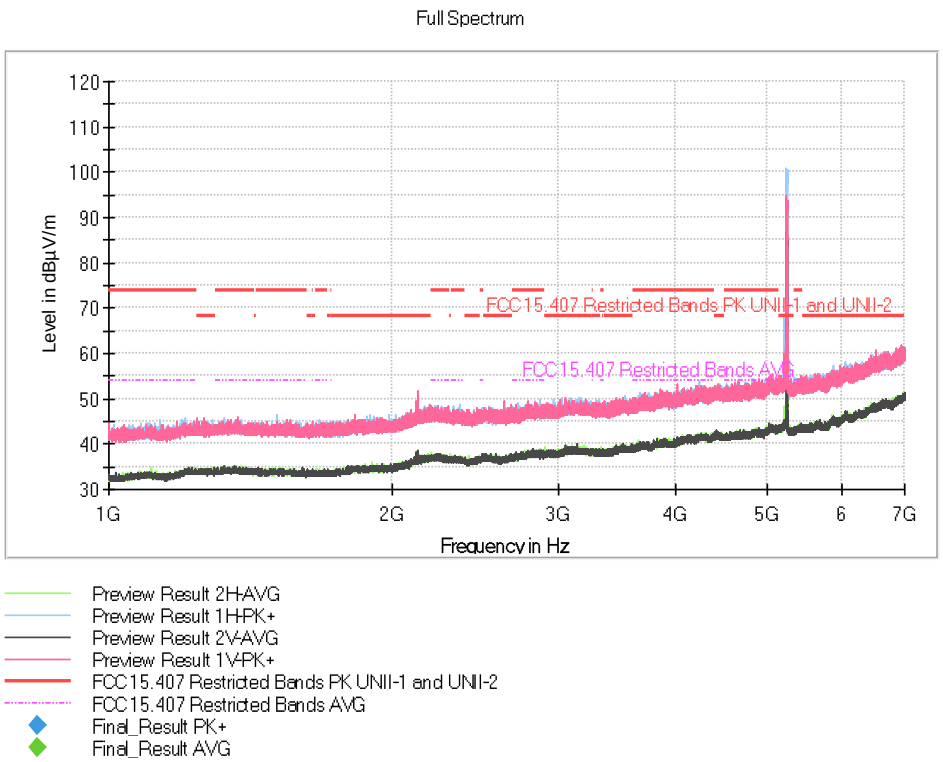
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

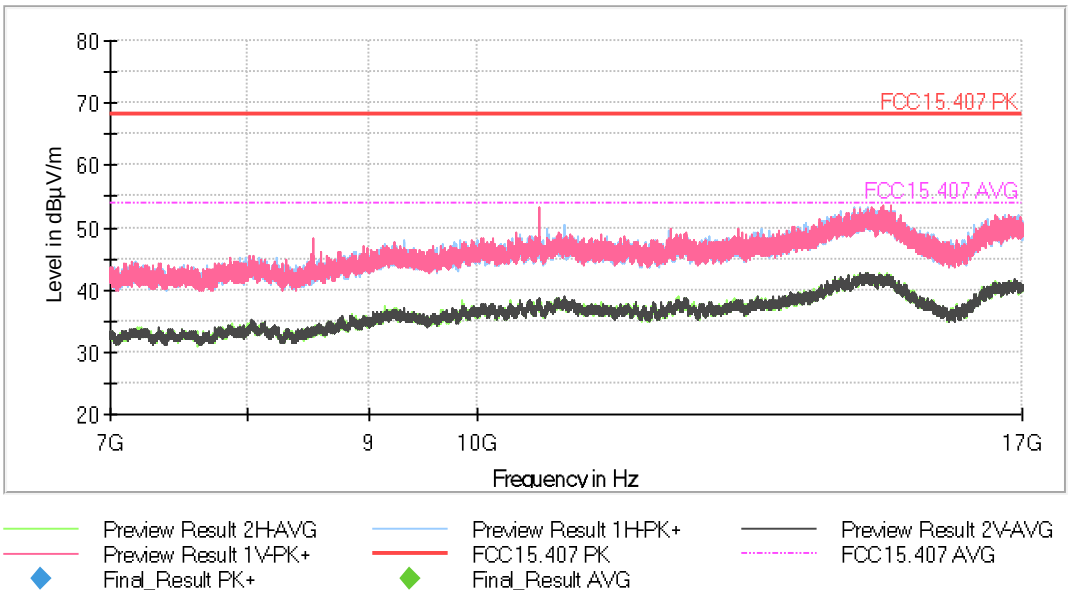
- High Channel:



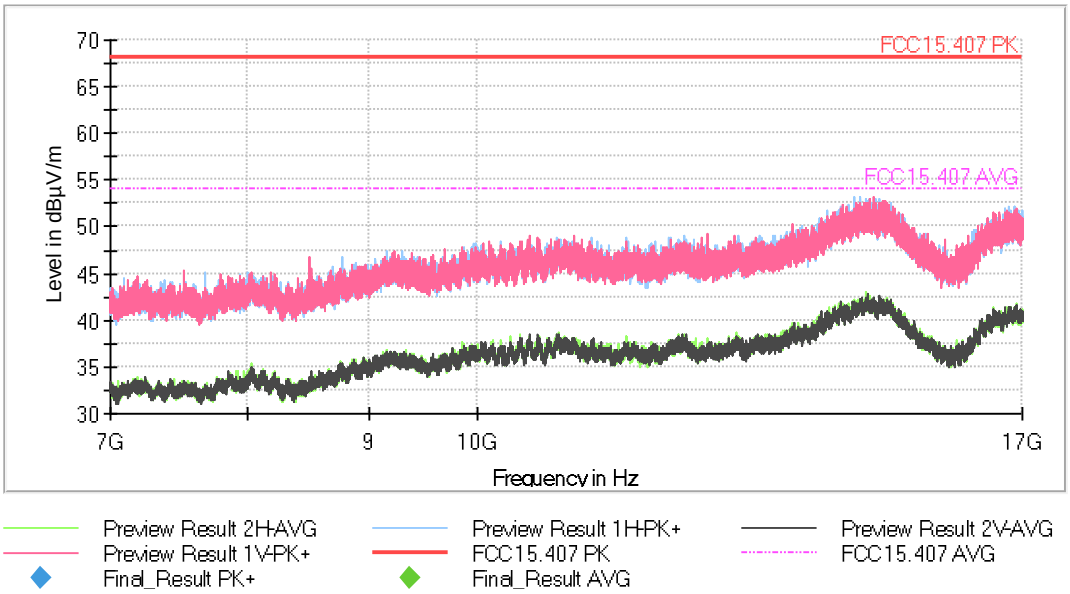
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 7 - 17 GHz (802.11 ac VHT20 MCS0)

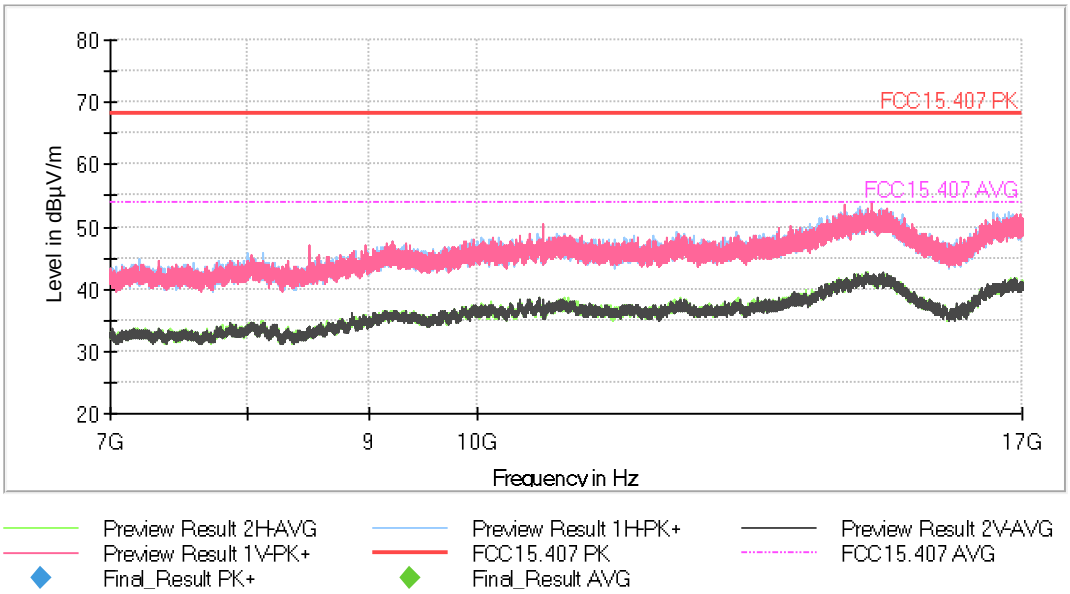
- Low Channel:



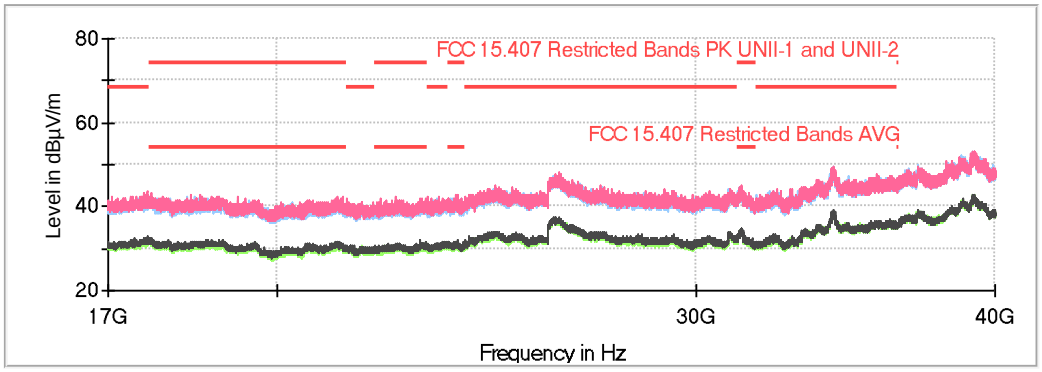
- Middle Channel:



- High Channel:



FREQUENCY RANGE 17 - 40 GHz



Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

This plot is valid for Low, Middle and High Channels and all modulations.

FCC 15.407 (b)(1) / RSS-247 6.2.1.2. Transmitter Band Edge Radiated Emissions

Limits

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)):

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

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

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

Equipment certified under this standard is required to comply with the provisions in RSS-Gen with respect to emissions falling within restricted frequency bands.

Results

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

There are restricted bands of operation below the lower band edge at 5.15 GHz (4.5-5.15 GHz) and also above the upper band edge at 5.35 GHz (5.35-5.46 GHz) therefore the provisions of FCC Part 15.205 apply.

Test performed on the following modulations and data rates:

802.11 a20:	6 Mbps
802.11 n HT20:	MCS0
802.11 n HT40:	MCS0
802.11 ac VHT20:	MCS0
802.11 ac VHT40:	MCS0
802.11 ac VHT80:	MCS0

BAND EDGE EMISSIONS:

Spurious frequencies in the restricted bands with peak levels above the average limit (54 dBµV/m at 3 m) are measured with an average detector for average compliance checking.

- **802.11 a20:**

- Lower Band Edge Channel 36 (5180 MHz). Inside the Restricted Band 4.50-5.15 GHz:

No spurious signals found.

- Upper Band Edge Channel 48 (5240 MHz). Inside the Restricted Band 5.35-5.46 GHz:

No spurious signals found.

- **802.11 n20:**

- Lower Band Edge Channel 36 (5180 MHz). Inside the Restricted Band 4.50-5.15 GHz:

No spurious signals found.

- Upper Band Edge Channel 48 (5240 MHz). Inside the Restricted Band 5.35-5.46 GHz:

No spurious signals found.

- **802.11 ac20:**

- Lower Band Edge Channel 36 (5180 MHz). Inside the Restricted Band 4.50-5.15 GHz:

No spurious signals found.

- Upper Band Edge Channel 48 (5240 MHz). Inside the Restricted Band 5.35-5.46 GHz:

No spurious signals found.

- **802.11 n40:** ** Duty cycle correction factor: 0.11 dB*

- Lower Band Edge Channel 38 (5190 MHz). Inside the Restricted Band 4.50-5.15 GHz:

Spurious signals at less than 20 dB below the limit:

Spurious Freq (MHz)	Emission Lvl (dBµV/m)	Corrected Emission Level (dBµV/m)	Pol	Detector
5149.37500	66.07	--	H	PK
	45.42	45.53		AVG
5149.75000	66.99	--		PK
	45.88	45.99		AVG

- Upper Band Edge Channel 46 (5230 MHz). Inside the Restricted Band 5.35-5.46 GHz:

No spurious signals found.

- **802.11 ac40:** ** Duty cycle correction factor: 0.13 dB*

- Lower Band Edge Channel 38 (5190 MHz). Inside the Restricted Band 4.50-5.15 GHz:

Spurious signals at less than 20 dB below the limit:

Spurious Freq (MHz)	Emission Lvl (dBµV/m)	Corrected Emission Level (dBµV/m)	Pol	Detector
5145.62500	61.04	--	H	PK
	44.24	44.37		AVG

- Upper Band Edge Channel 46 (5230 MHz). Inside the Restricted Band 5.35-5.46 GHz:

No spurious signals found.

- **802.11 ac80:** ** Duty cycle correction factor: 0.24 dB*

- Lower Band Edge Channel 42 (5210 MHz). Inside the Restricted Band 4.50-5.15 GHz:

Spurious frequencies at less than 20 dB below the limit:

Spurious Freq (MHz)	Emission Lvl (dBµV/m)	Corrected Emission Level (dBµV/m)	Pol	Detector
5116.56250	60.99	--	H	PK
	46.03	46.27		AVG
5124.43750	62.86	--		PK
	49.93	50.17		AVG
5136.25000	65.02	--		PK
	50.10	50.34		AVG
5146.9375	61.08	--		PK
	46.34	46.58		AVG

- Upper Band Edge Channel 42 (5210 MHz). Inside the Restricted Band 5.35-5.46 GHz:

No spurious signals found.

Verdict

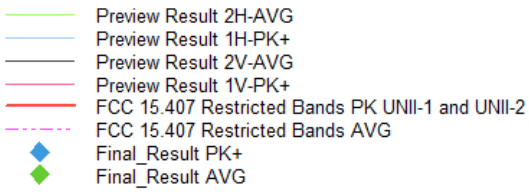
Pass

Attachments

The setting for restricted bands is indicated in the following table:

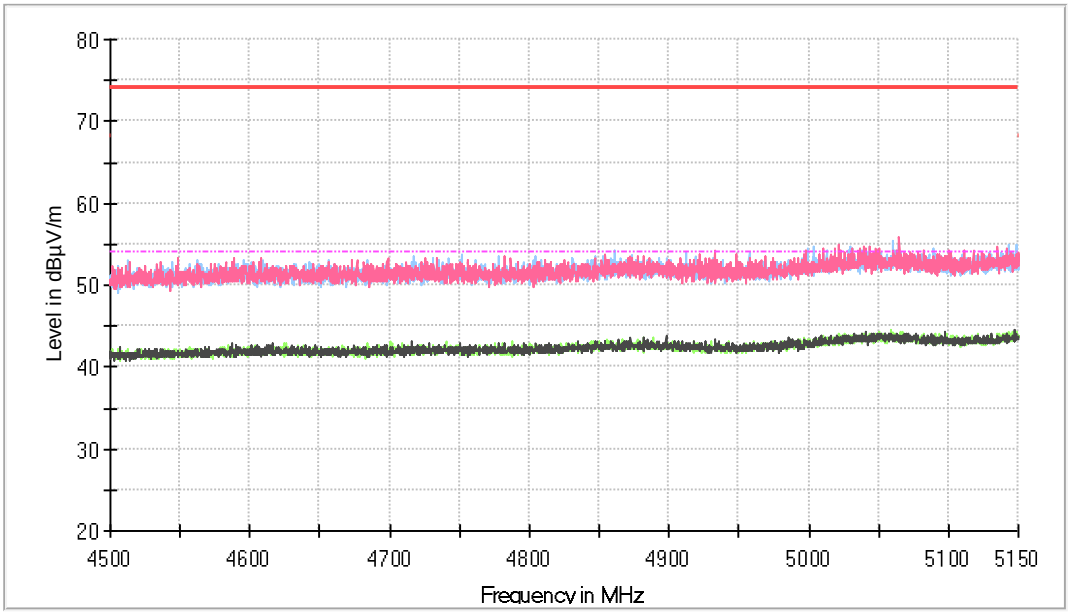
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSV 40]					
1 GHz - 7 GHz	187,5 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

The legend for the next plots is the following:

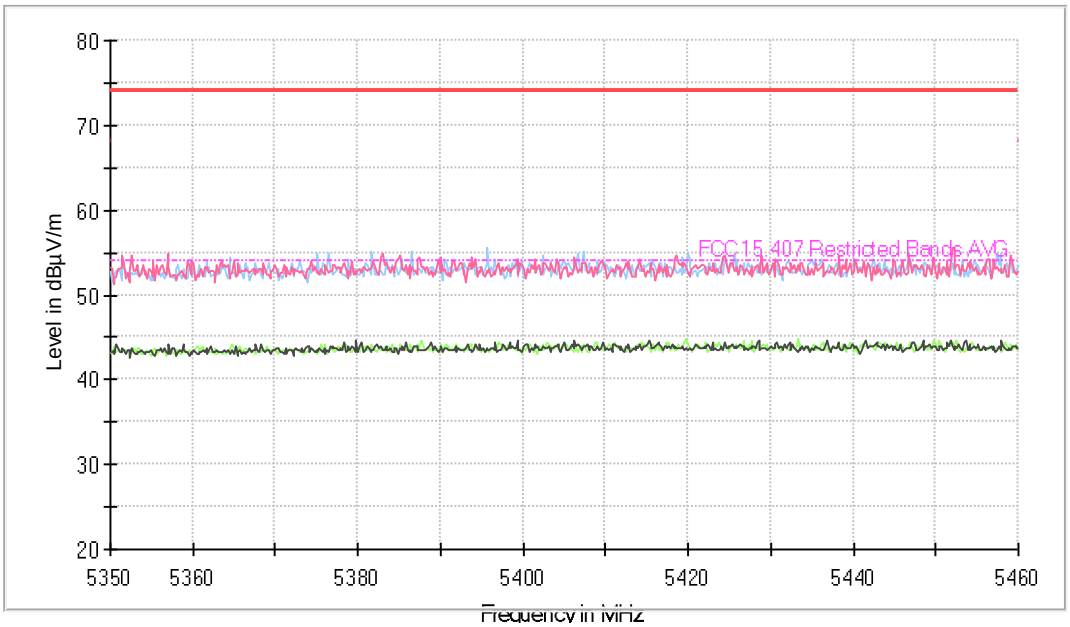


- **802.11 a20:**

  - Lower Band Edge Channel 36 (Restricted Band 4.50-5.15 GHz)

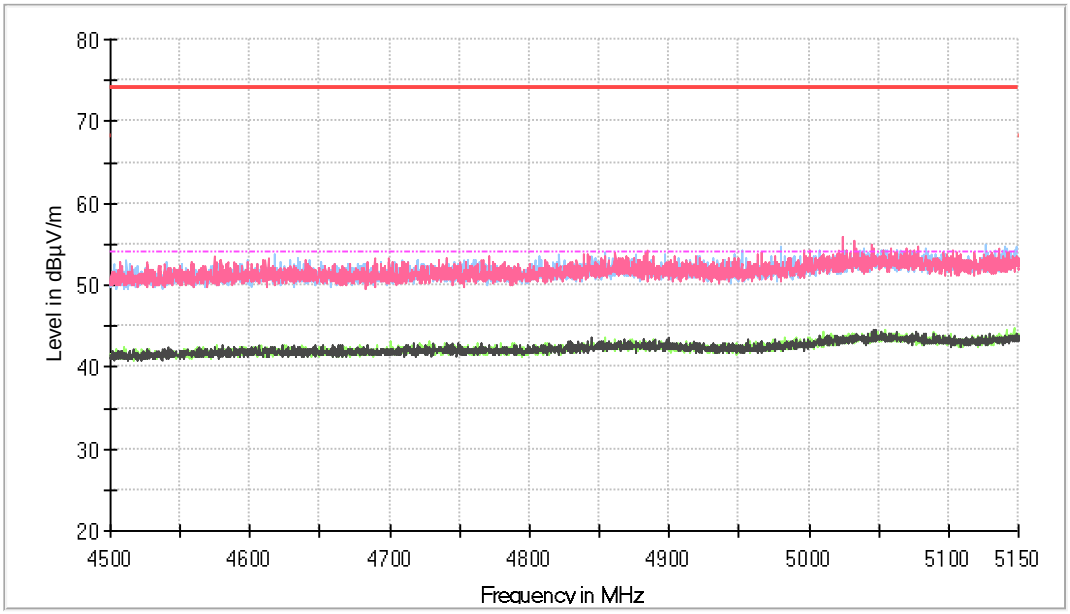


  - Upper Band Edge Channel 48 (Restricted Band 5.35-5.46 GHz)

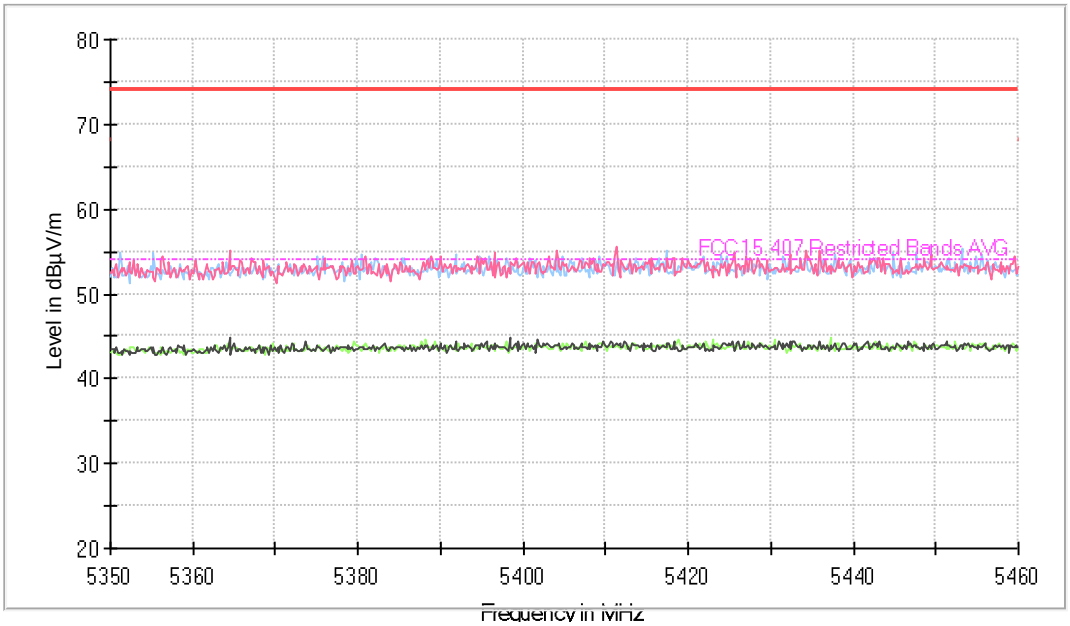


- **802.11 n20:**

  - Lower Band Edge Channel 36 (Restricted Band 4.50-5.15 GHz)

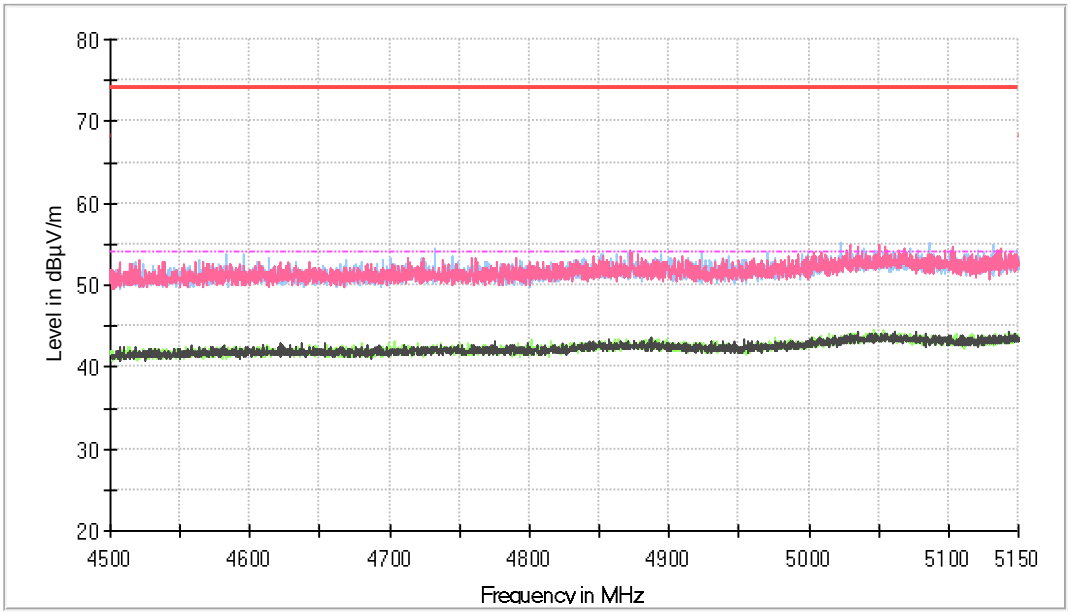


  - Upper Band Edge Channel 48 (Restricted Band 5.35-5.46 GHz)

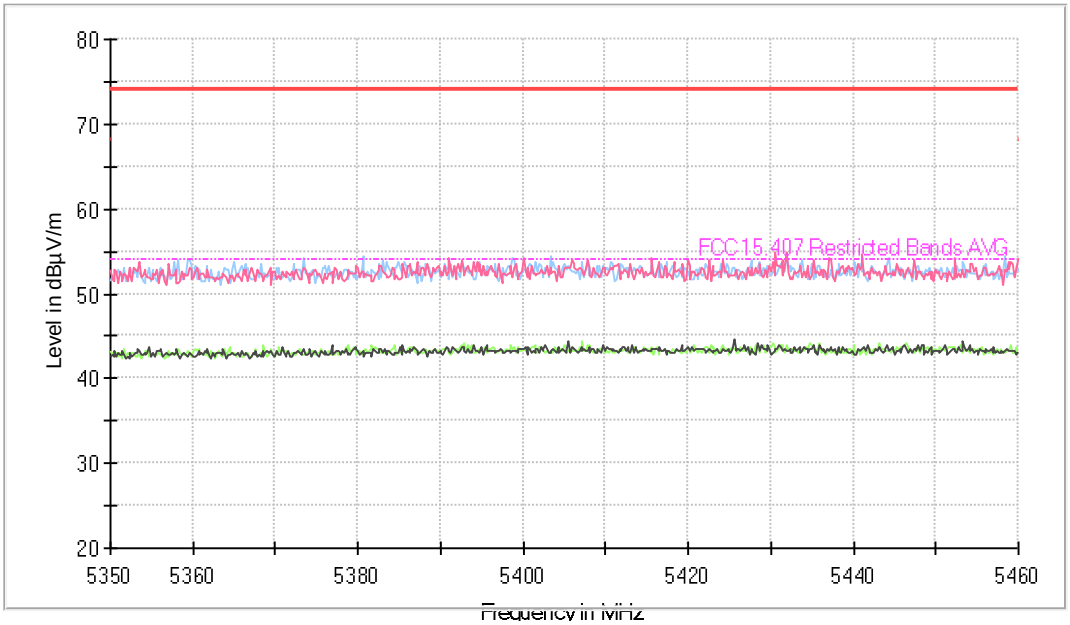


- **802.11 ac20:**

  - Lower Band Edge Channel 36 (Restricted Band 4.50-5.15 GHz)

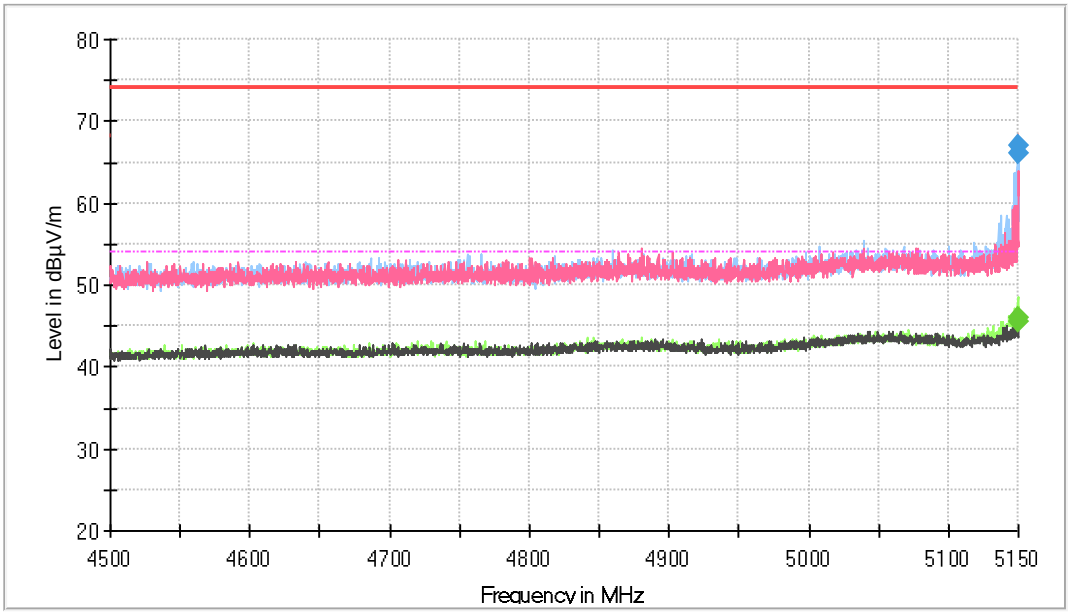


  - Upper Band Edge Channel 48 (Restricted Band 5.35-5.46 GHz)

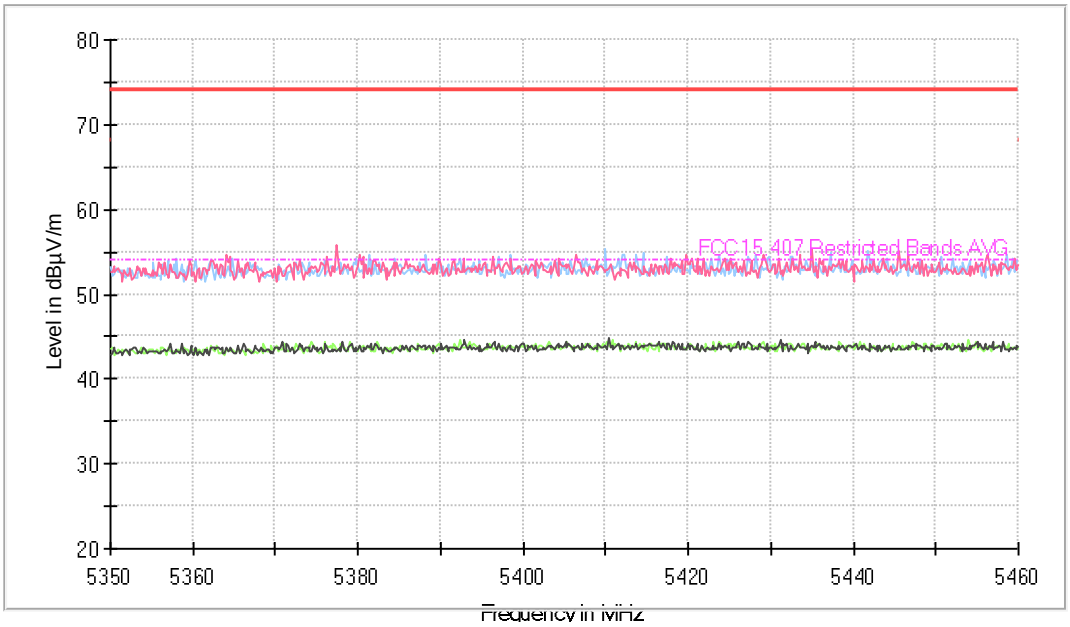


- **802.11 n40:**

  - Lower Band Edge Channel 38 (Restricted Band 4.50-5.15 GHz)

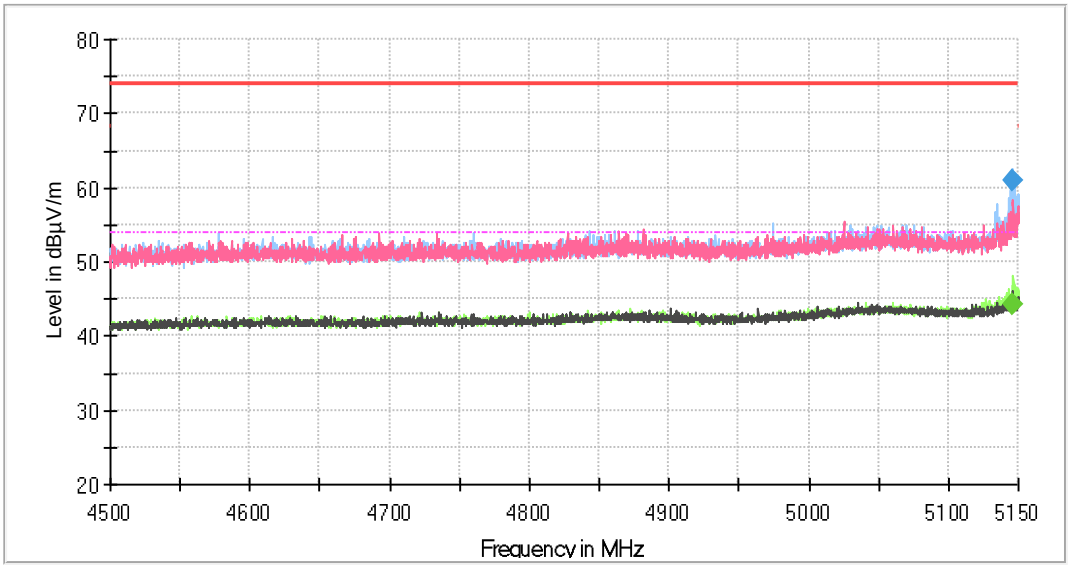


  - Upper Band Edge Channel 46 (Restricted Band 5.35-5.46 GHz)

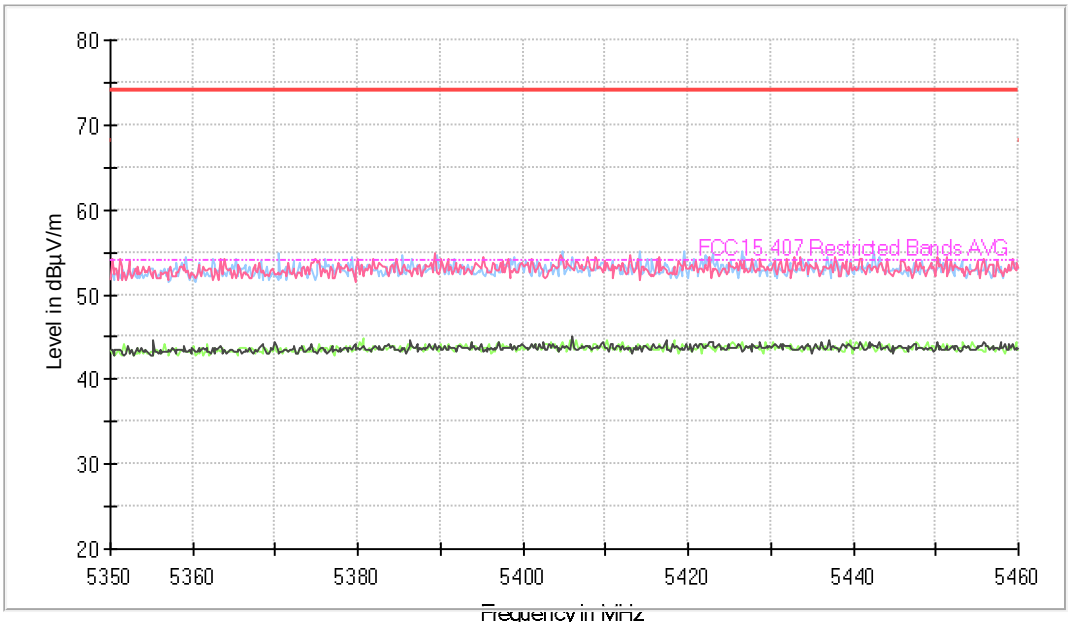


- **802.11 ac40:**

  - Lower Band Edge Channel 38 (Restricted Band 4.50-5.15 GHz)

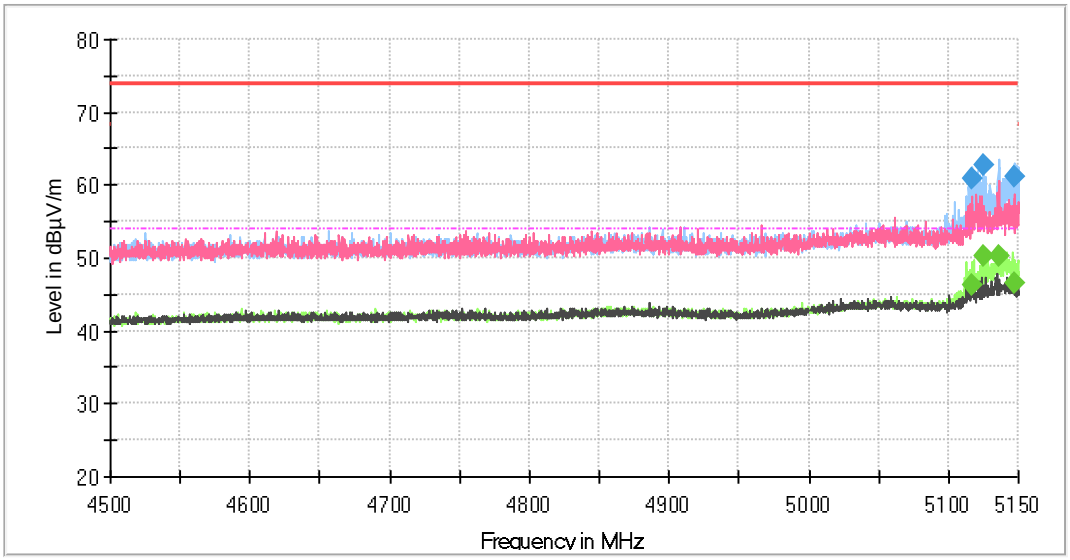


  - Upper Band Edge Channel 46 (Restricted Band 5.35-5.46 GHz)

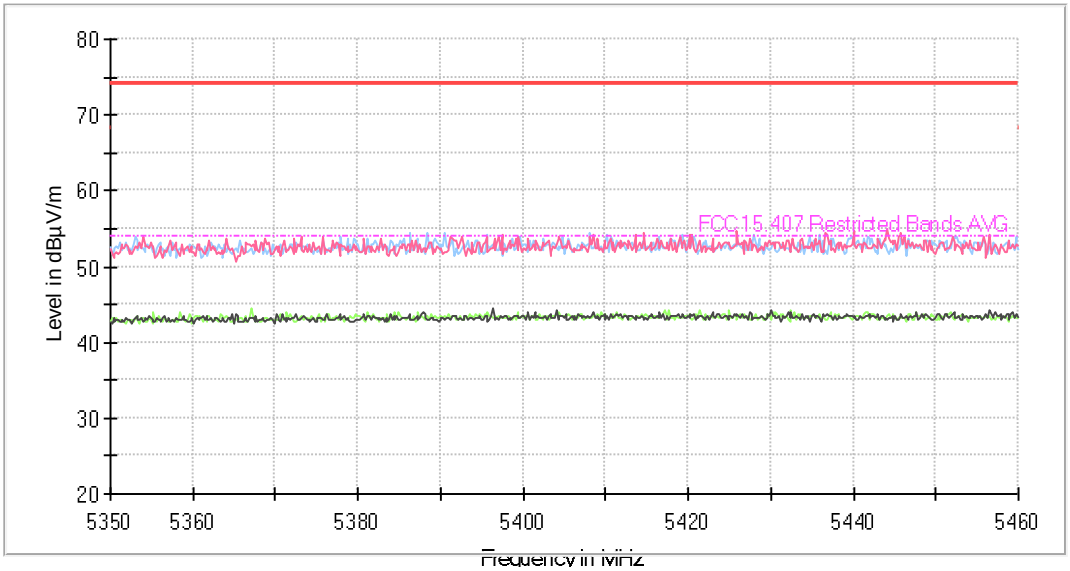


- **802.11 ac80:**

  - Lower Band Edge Channel 42 (Restricted Band 4.50-5.15 GHz)



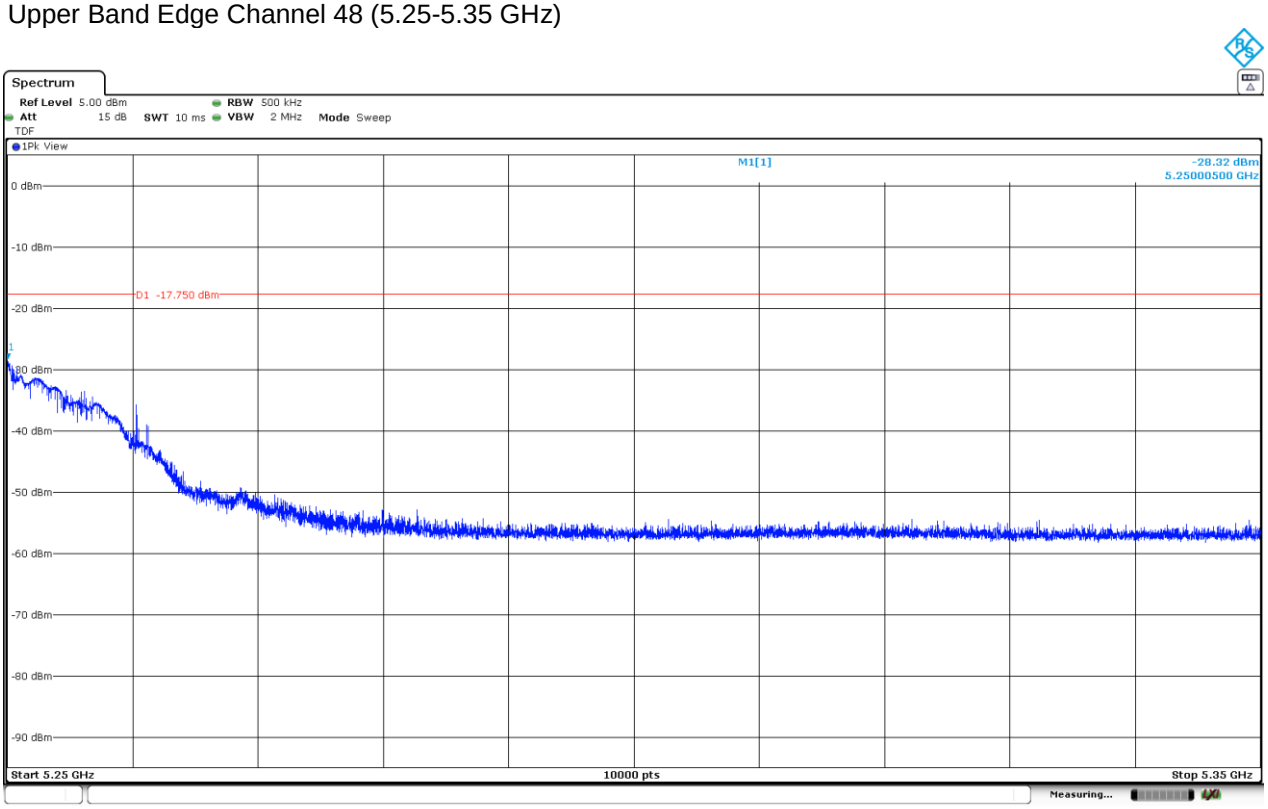
  - Upper Band Edge Channel 42 (Restricted Band 5.35-5.46 GHz)



RSS-247, RSS-Gen:

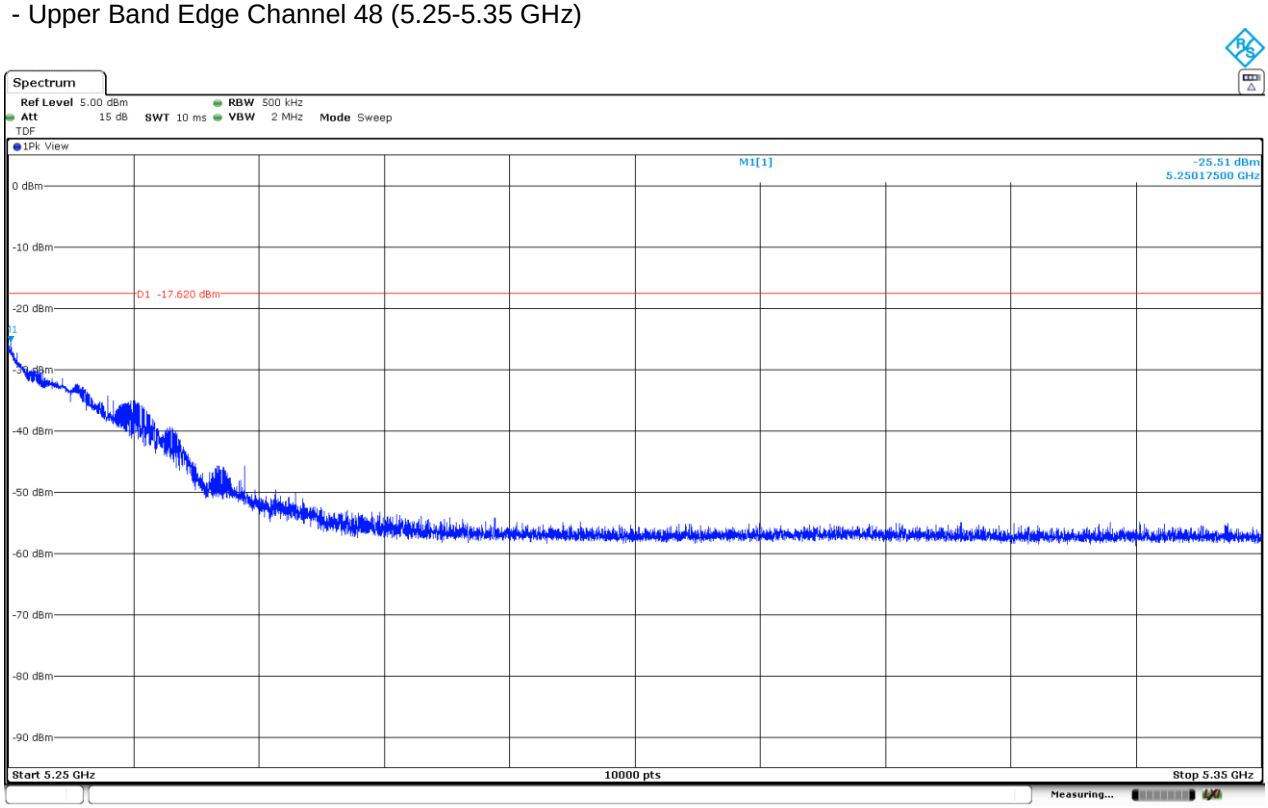
- **802.11 a20:**

  - Upper Band Edge Channel 48 (5.25-5.35 GHz)



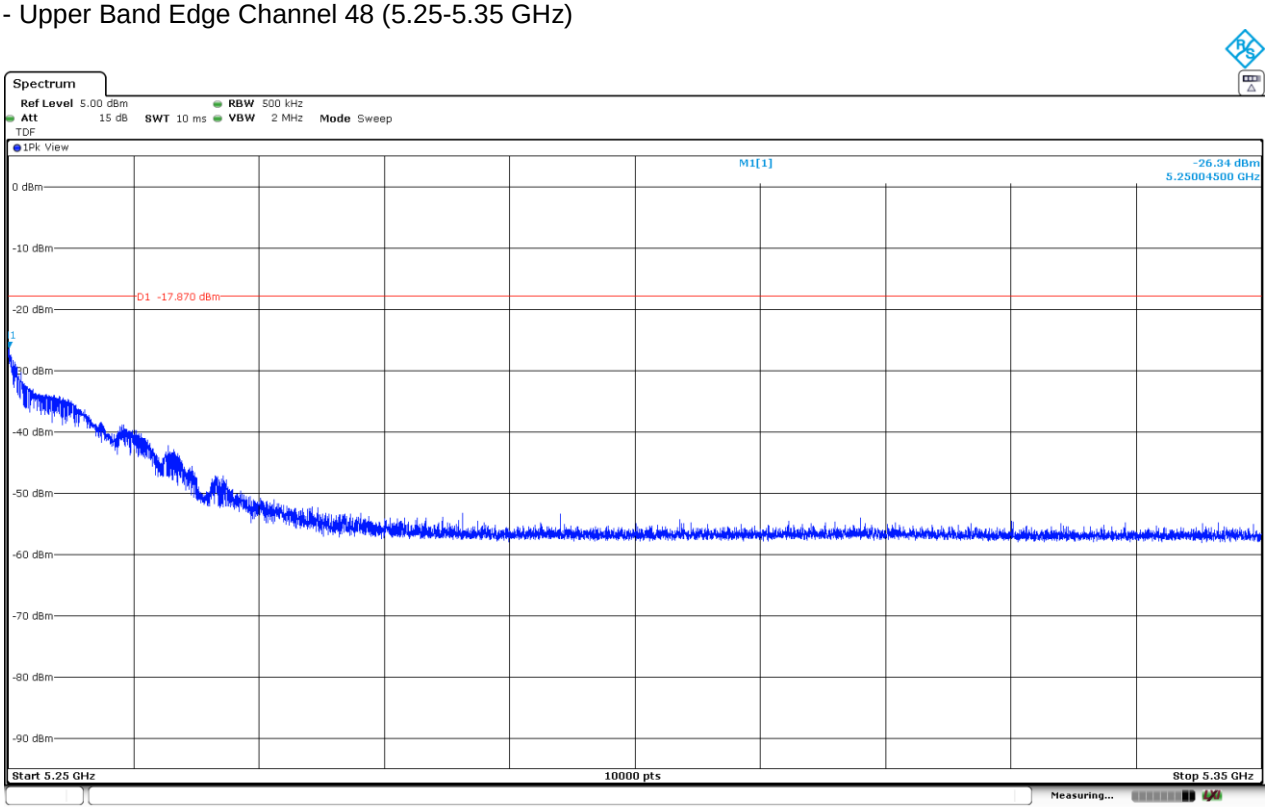
- **802.11 n20:**

  - Upper Band Edge Channel 48 (5.25-5.35 GHz)



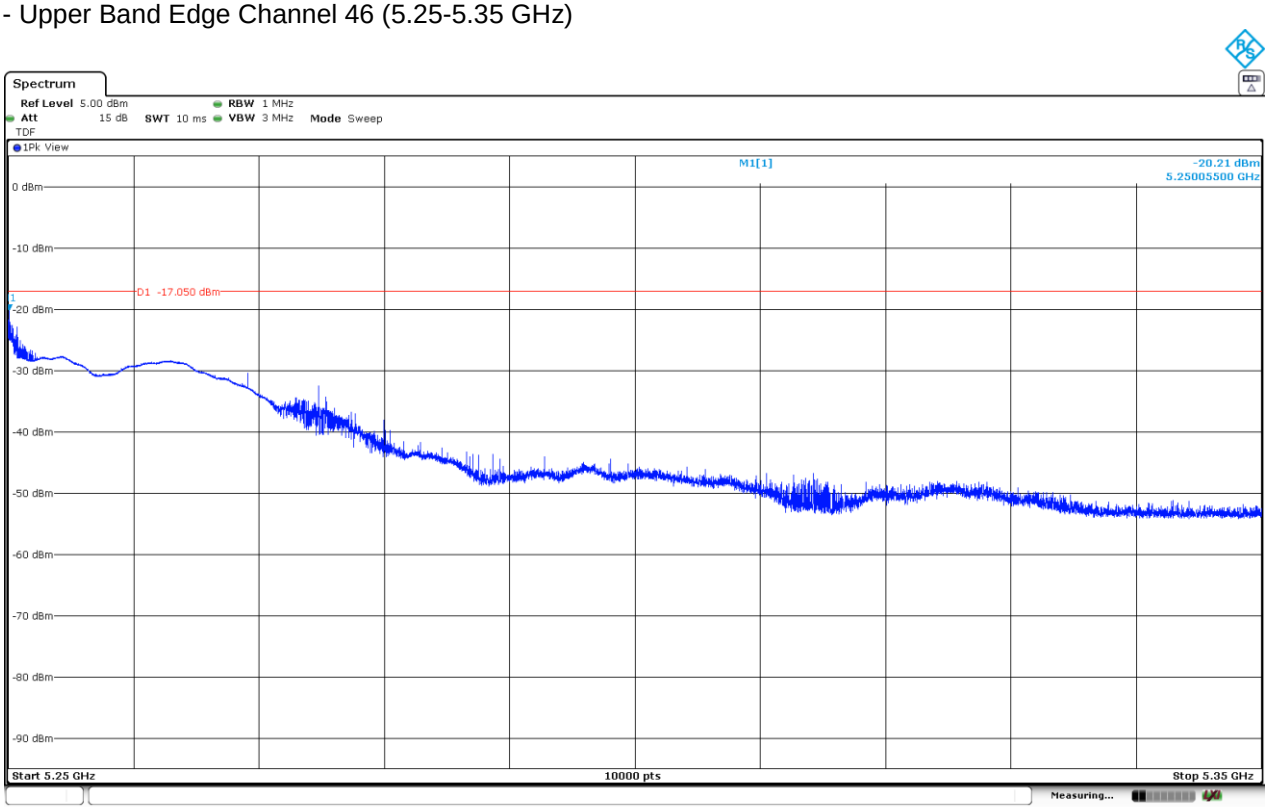
- **802.11 ac20:**

  - Upper Band Edge Channel 48 (5.25-5.35 GHz)



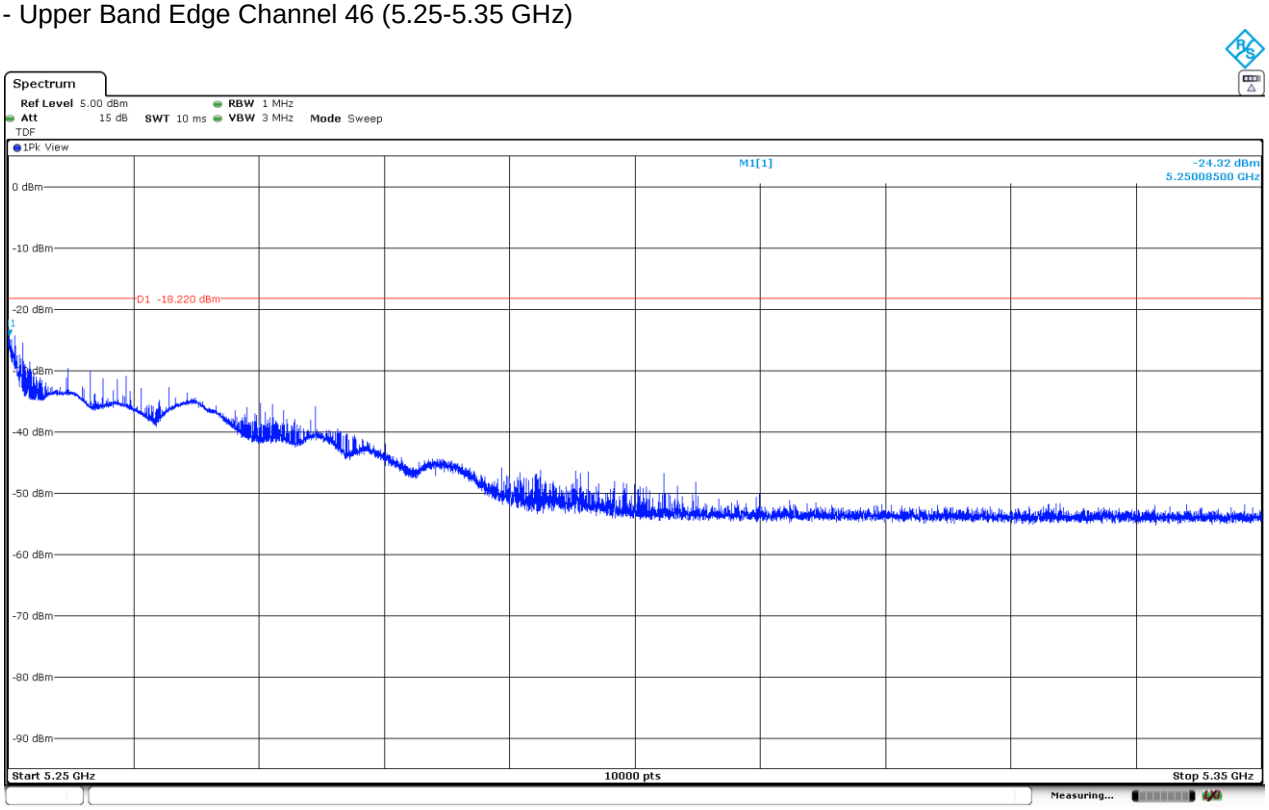
- **802.11 n40:**

  - Upper Band Edge Channel 46 (5.25-5.35 GHz)



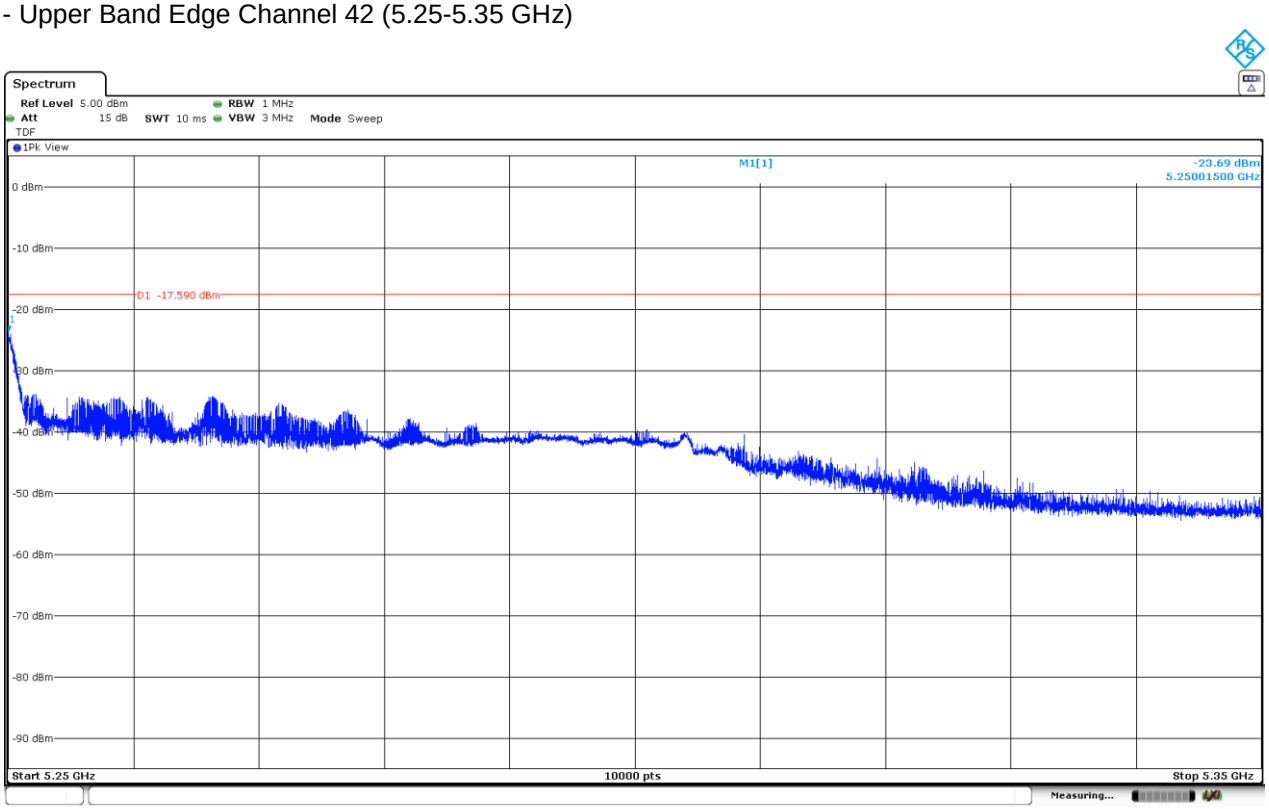
- **802.11 ac40:**

  - Upper Band Edge Channel 46 (5.25-5.35 GHz)



- **802.11 ac80:**

  - Upper Band Edge Channel 42 (5.25-5.35 GHz)



Appendix B: Test results for the U-NII-3 Band 5.725 – 5.85 GHz

INDEX

TEST CONDITIONS 39

FCC 15.407 (b)(4) / RSS-247 6.2.4.2. Transmitter Out of Band Radiated Emissions and Transmitter Band Edge Radiated Emissions 43

TEST CONDITIONS

(*) Data provided by the Applicant

POWER SUPPLY:

Vnonimal:	12 Vdc.
Type of Power Supply (*):	DC voltage from external power supply (car battery).

ANTENNA:

Type of Antenna:	External antenna.
Maximum Declared Antenna Gain (*):	+2.5 dBi

TEST FREQUENCIES:

Technology Tested:	WLAN (IEEE 802.11 a/n/ac): U-NII-3 band	
Modes:	802.11a: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps	
	802.11n HT20: MCS0 to MCS7	
	802.11n HT40: MCS0 to MCS7	
	802.11ac VHT20: MCS0 to MCS8	
	802.11ac VHT40: MCS0 to MCS9	
	802.11ac VHT80: MCS0 to MCS9	
Setting of cores / ports:	One port.	
Beamforming:	No	
Frequency Range:	5725 MHz to 5850 MHz	
Channel Bandwidth:	20 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Low: 149	5745
	Middle: 157	5785
	High: 165	5825
Channel Bandwidth:	40 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Low: 151	5755
	High: 159	5795
Channel Bandwidth:	80 MHz	
Transmit Channels	Middle: 155	5775

The test set-up was made in accordance with the general provisions of FCC Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017.

The EUT was tested in the following operating mode:

- Continuously transmitting with a modulated carrier at maximum power on all required channels using the supported data rates/modulations types.

For all modes, the EUT was configured in test mode using a software application. The application was used to enable a continuous transmission and to select the test channels as required. The client supplied instructions to configure the EUT. The customer supplied a document containing the setup instructions.

The worst cases for testing were identified based on output power and spurious levels at the band edges. Preliminary testing determined the following data rates as the worst-case modes:

802.11 a20:	6 Mbps
802.11 n HT20:	MCS0
802.11 n HT40:	MCS0
802.11 ac VHT20:	MCS0
802.11 ac VHT40:	MCS0
802.11 ac VHT80:	MCS0

RADIATED MEASUREMENTS:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range from 30 MHz to 1000 MHz and 1 GHz-17 GHz Double ridge horn antenna) is situated at a distance of 3 m and a distance of 1.5m for the frequency range 17 GHz-40 GHz (18 GHz-40 GHz horn antenna).

For radiated emissions in the range 17 GHz-40 GHz performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

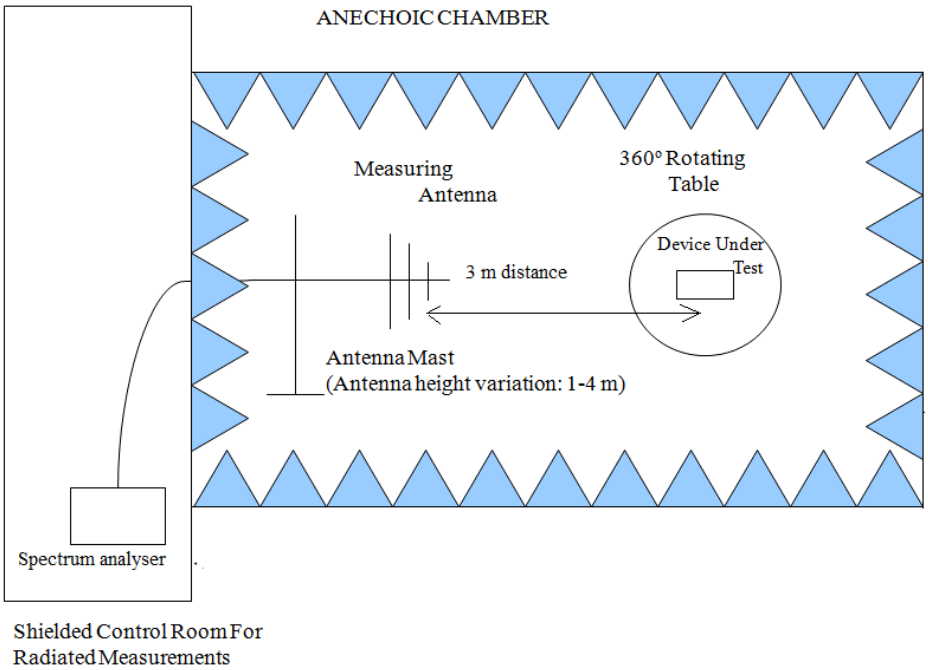
The equipment under test was set up on a non-conductive platform above the ground plane and its situation and orientation were varied to find the maximum radiated emission. It was also rotated 360º and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find the maximum radiated emission.

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

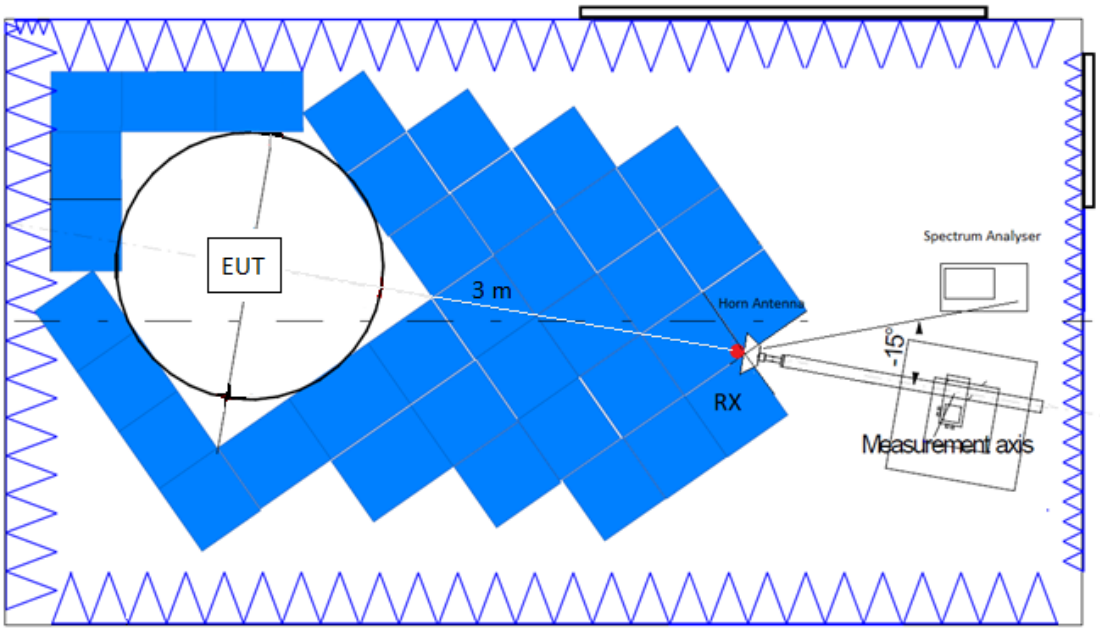
The final measured value, for the given emission, incorporates the calibrated antenna factor and cable loss.

A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

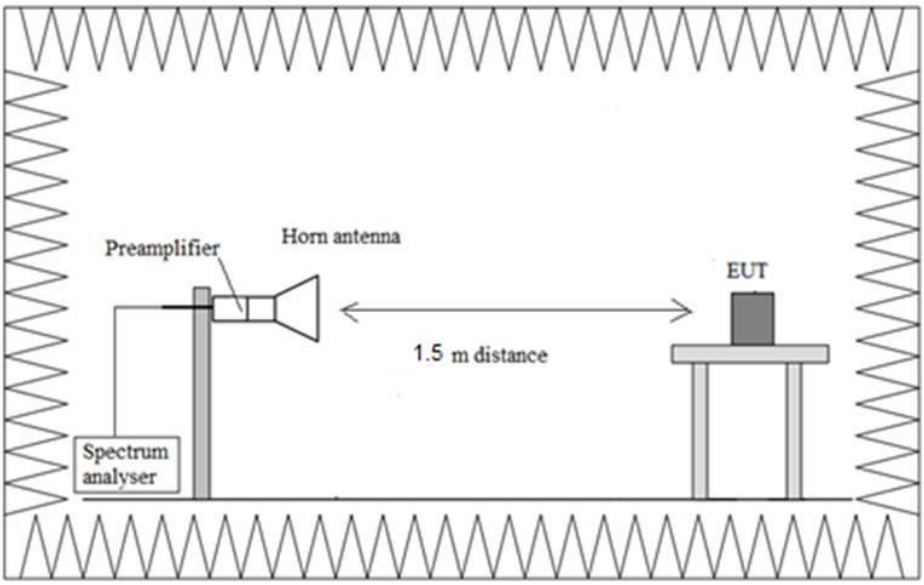
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup f > 17 GHz:



FCC 15.407 (b)(4) / RSS-247 6.2.4.2. Transmitter Out of Band Radiated Emissions and Transmitter Band Edge Radiated Emissions

Limits

For transmitters operating in the 5.725–5.85 GHz band:
All emissions shall be limited to a level of −27 dBm/MHz (68.23 dBµV/m at 3 m distance) at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)):

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

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

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

Results

The field strength is calculated by adding a correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain. For measurements above 17 GHz performed at a reduced distance, this factor also includes an inverse proportionality factor of 20 dB per decade to normalize the measured data.

Test performed on the following modulations and data rates:

802.11 a20:	6 Mbps
802.11 n HT20:	MCS0
802.11 n HT40:	MCS0
802.11 ac VHT20:	MCS0
802.11 ac VHT40:	MCS0
802.11 ac VHT80:	MCS0

OUT OF BAND EMISSIONS:

For spurious emissions outside of the U-NII-3 band-edge mask of 5.65-5.925 GHz, the worst-case mode was determined among all modulations after preliminary measurements of the radiated power spectral density.

The Low, Middle and High Channels were tested for the determined worst case.

Worst case: **802.11 a20: 6 Mbps**

Frequency range 30 MHz - 1 GHz

The spurious emissions below 1 GHz do not depend either on the operating channel or the modulation mode selected in the EUT.

Spurious signals detected at less than 20 dB below the limit:

Spurious Freq (MHz)	Emission Lvl (dBµV/m)	Limit (dBµV/m)	Pol	Detector
299.98980	28.85	46.00	H	PK
	27.02			QP
449.98090	28.47			PK
	25.88			QP

Frequency range 1 - 40 GHz

The results below show the maximum measured levels in the 1-40 GHz range except the 5.65-5.725 GHz and 5.85-5.925GHz adjacent bands. The results in the adjacent bands are reported in the next section.

Spurious frequencies in the restricted bands with peak levels above the average limit (54 dBµV/m at 3 m) are measured with an average detector for average compliance checking.

- LOW CHANNEL 149 (5745 MHz)

  No spurious signals at less than 20 dB below the limit.

- MIDDLE CHANNEL 157 (5785 MHz)

  No spurious signals at less than 20 dB below the limit.

- HIGH CHANNEL 165 (5825 MHz)

  No spurious signals at less than 20 dB below the limit.

Verdict

Pass

Attachments

The setting for each range of frequency is indicated in the following tables:

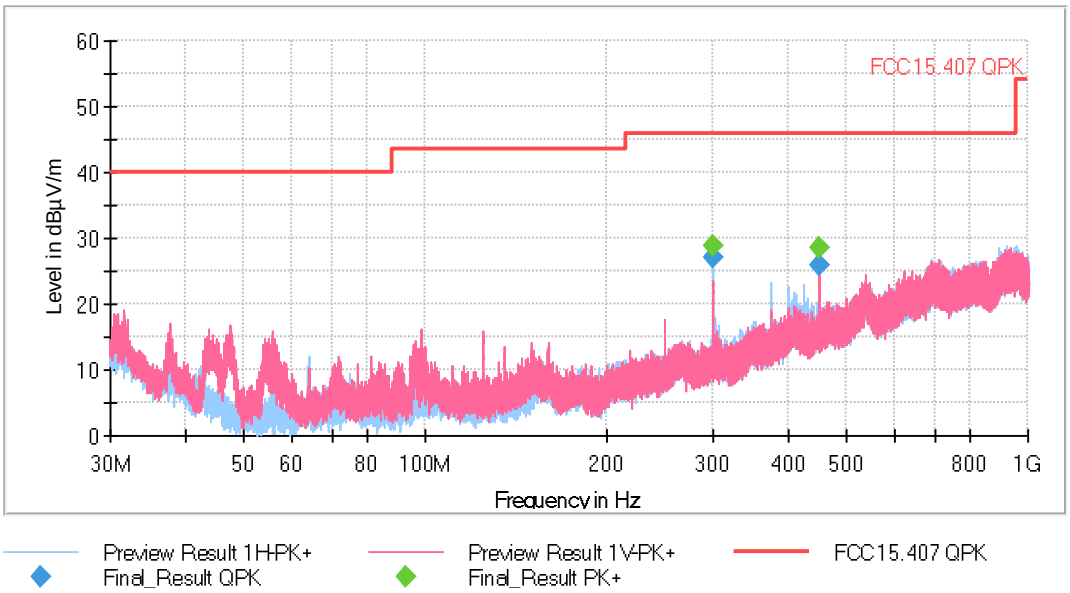
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESR 7]					
30 MHz - 1 GHz	9,7 kHz	PK+	100 kHz	1 s	0 dB

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSV 40]					
1 GHz - 7 GHz	187,5 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSV 40]					
7 GHz - 17 GHz	312,5 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44]					
17 GHz - 40 GHz	766,667 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

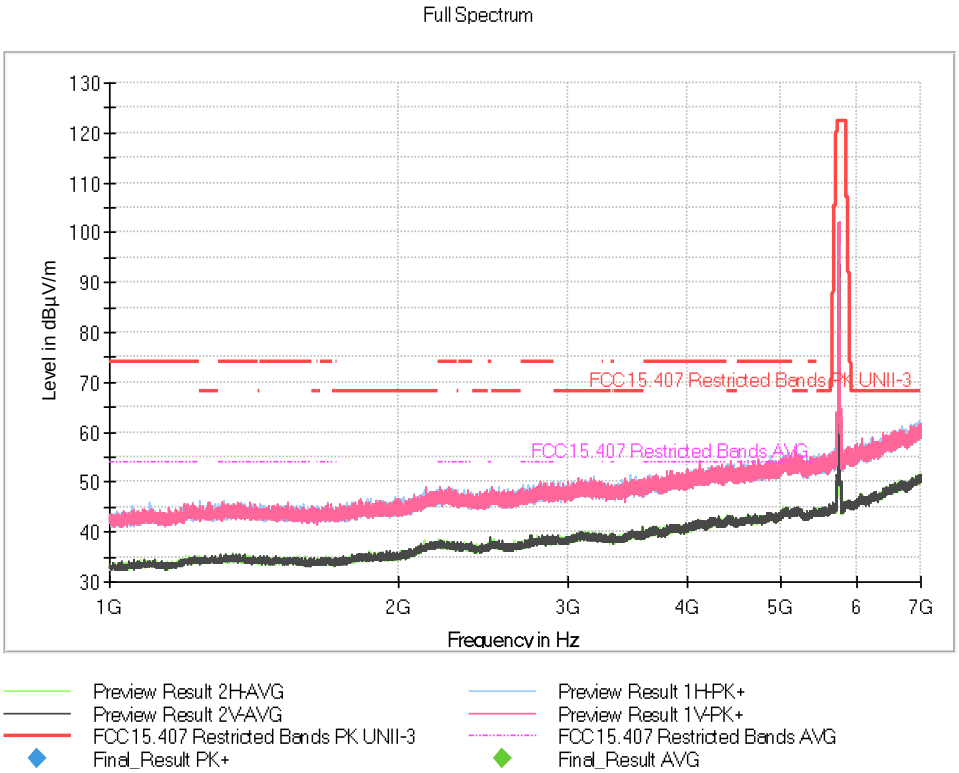
FREQUENCY RANGE 30 MHz - 1 GHz



This plot is valid for Low, Middle and High Channels and all modulations.

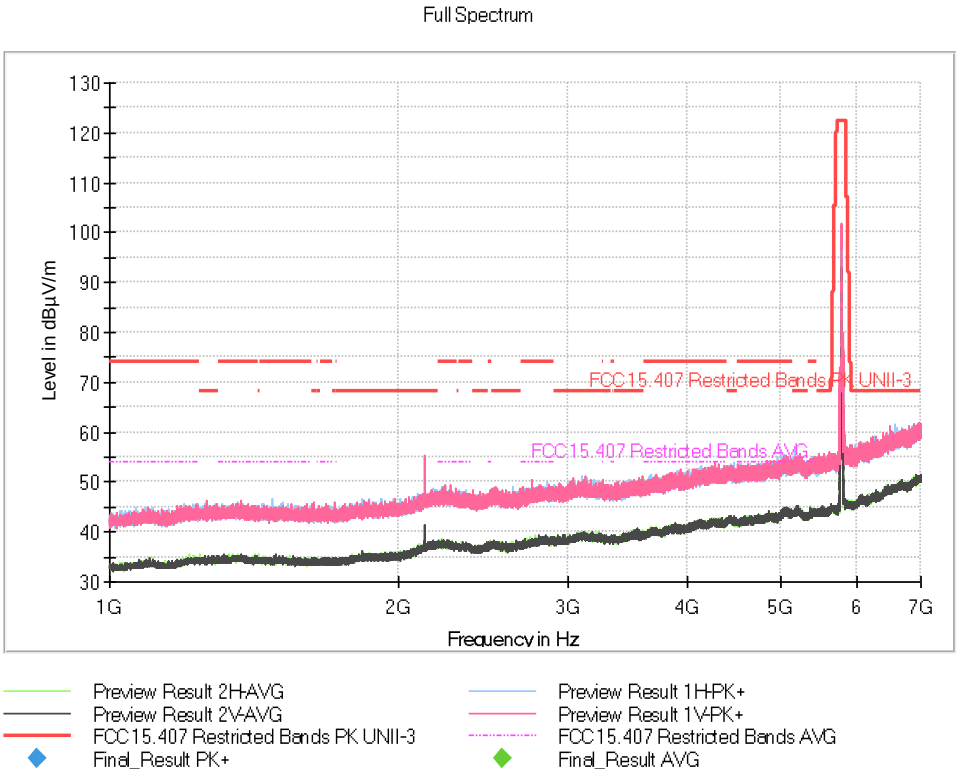
FREQUENCY RANGE 1 - 7 GHz (802.11 a20: 6 Mbps)

- Low Channel:



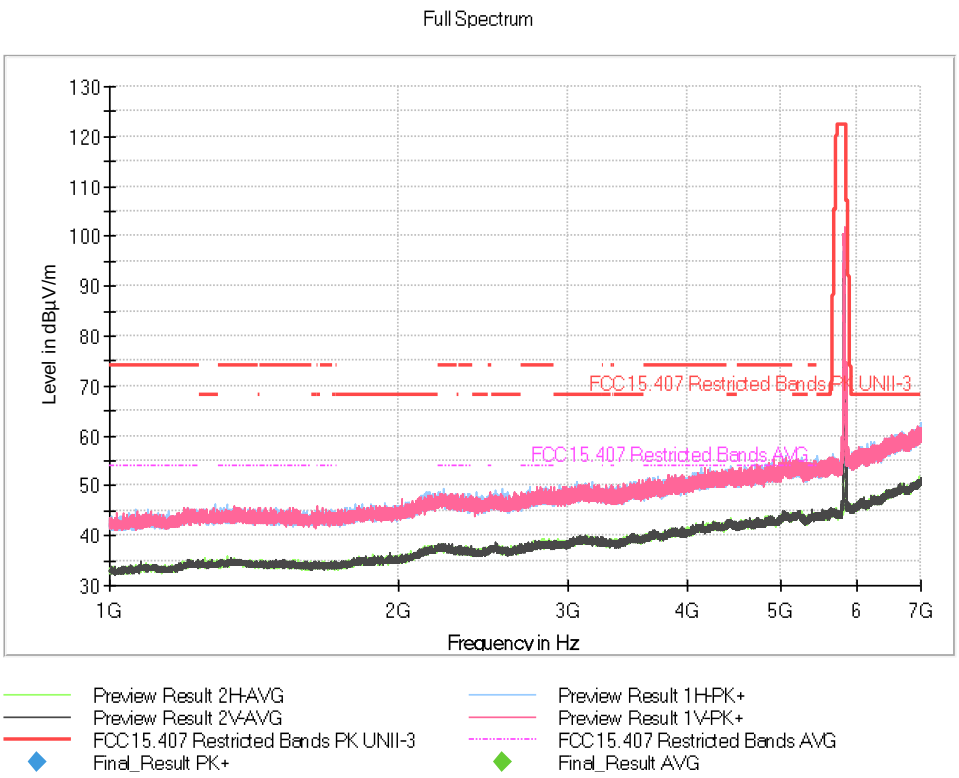
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

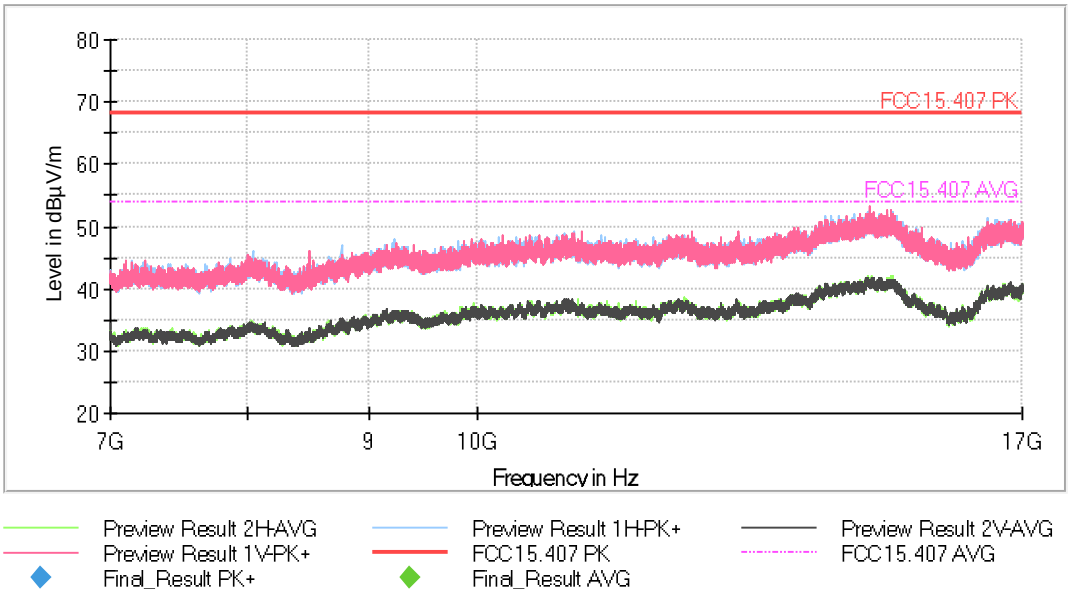
- High Channel:



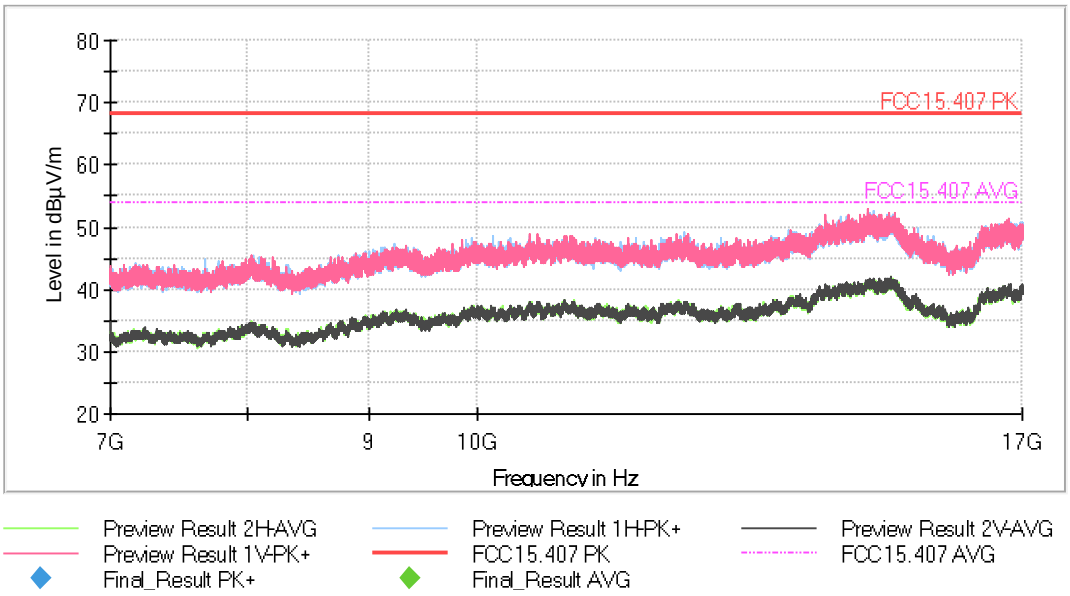
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 7 - 17 GHz (802.11 a20: 6 Mbps)

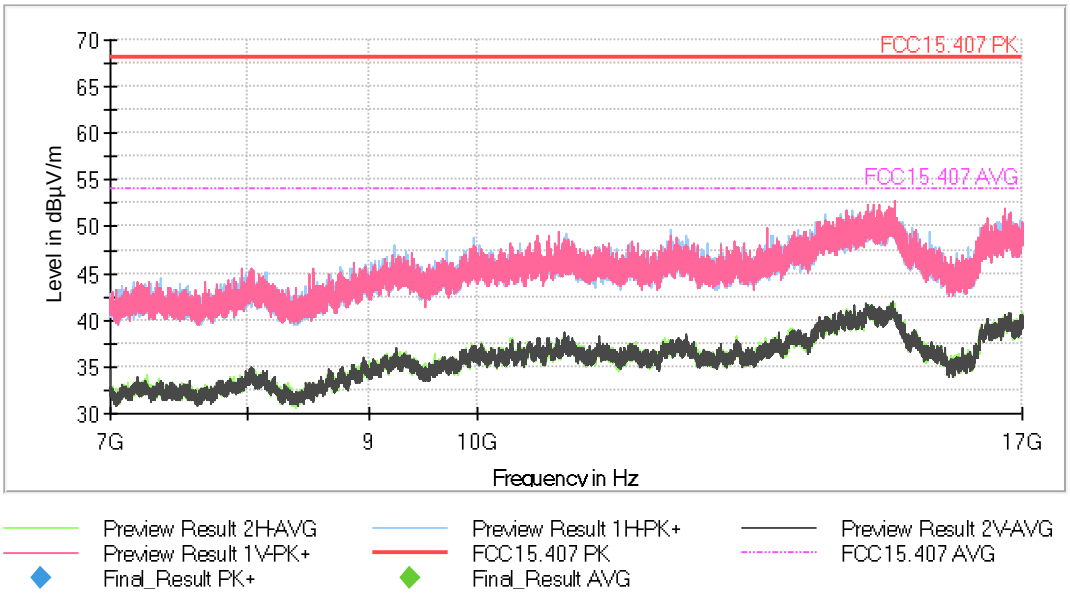
- Low Channel:



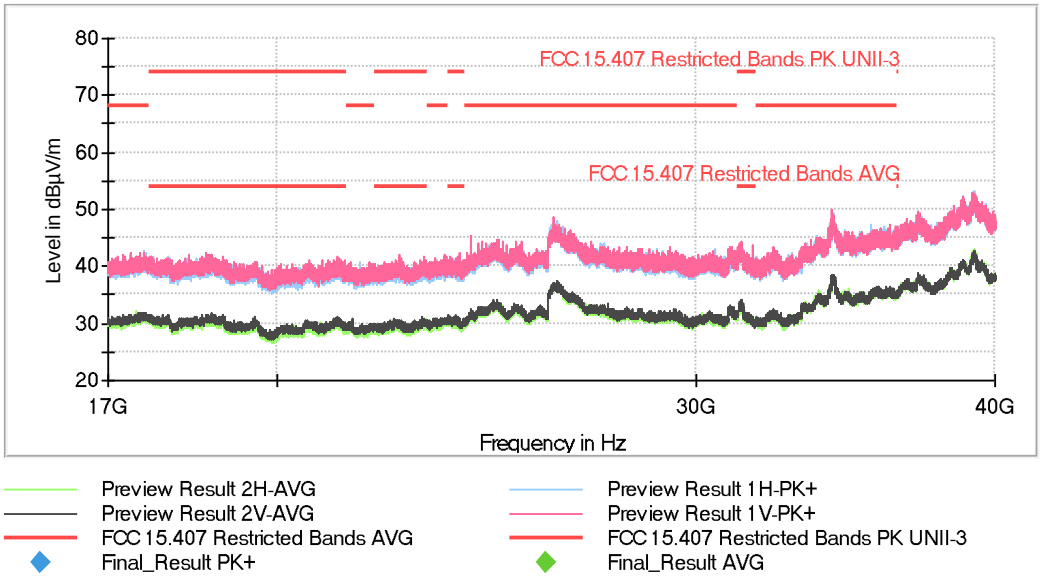
- Middle Channel:



- High Channel:



FREQUENCY RANGE 17 - 40 GHz



This plot is valid for Low, Middle and High Channels and all modulations.

BAND EDGE EMISSIONS:

- **802.11 a20. Spurious emissions inside of the mask 5.65-5.925 GHz:**

- LOW CHANNEL 149 (5745 MHz):

No spurious signals found.

- MIDDLE CHANNEL 157 (5785 MHz):

No spurious signals found.

- HIGH CHANNEL 165 (5825 MHz):

No spurious signals found.

- **802.11 n20. Spurious emissions inside of the mask 5.65-5.925 GHz:**

- LOW CHANNEL 149 (5745 MHz):

No spurious signals found.

- MIDDLE CHANNEL 157 (5785 MHz):

No spurious signals found.

- HIGH CHANNEL 165 (5825 MHz):

No spurious signals found.

- **802.11 ac20. Spurious emissions inside of the mask 5.65-5.925 GHz:**

- LOW CHANNEL 149 (5745 MHz):

No spurious signals found.

- MIDDLE CHANNEL 157 (5785 MHz):

No spurious signals found.

- HIGH CHANNEL 165 (5825 MHz):

No spurious signals found.

- **802.11 n40. Spurious emissions inside of the mask 5.65-5.925 GHz:**

- LOW CHANNEL 151 (5755 MHz):

No spurious signals found.

- HIGH CHANNEL 159 (5795 MHz):

No spurious signals found.

- **802.11 ac40. Spurious emissions inside of the mask 5.65-5.925 GHz:**

- LOW CHANNEL 151 (5755 MHz):

No spurious signals found.

- HIGH CHANNEL 159 (5795 MHz):

No spurious signals found.

- **802.11 ac80. Spurious emissions inside of the mask 5.65-5.925 GHz:**

- MIDDLE CHANNEL 155 (5775 MHz):

No spurious signals found.

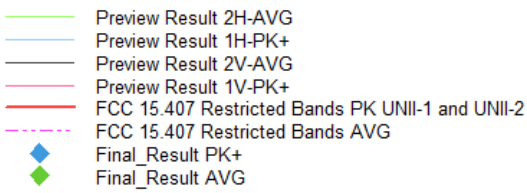
Verdict
Pass

Attachments

The setting for the mask 5.65-5.925 GHz is indicated in the following table:

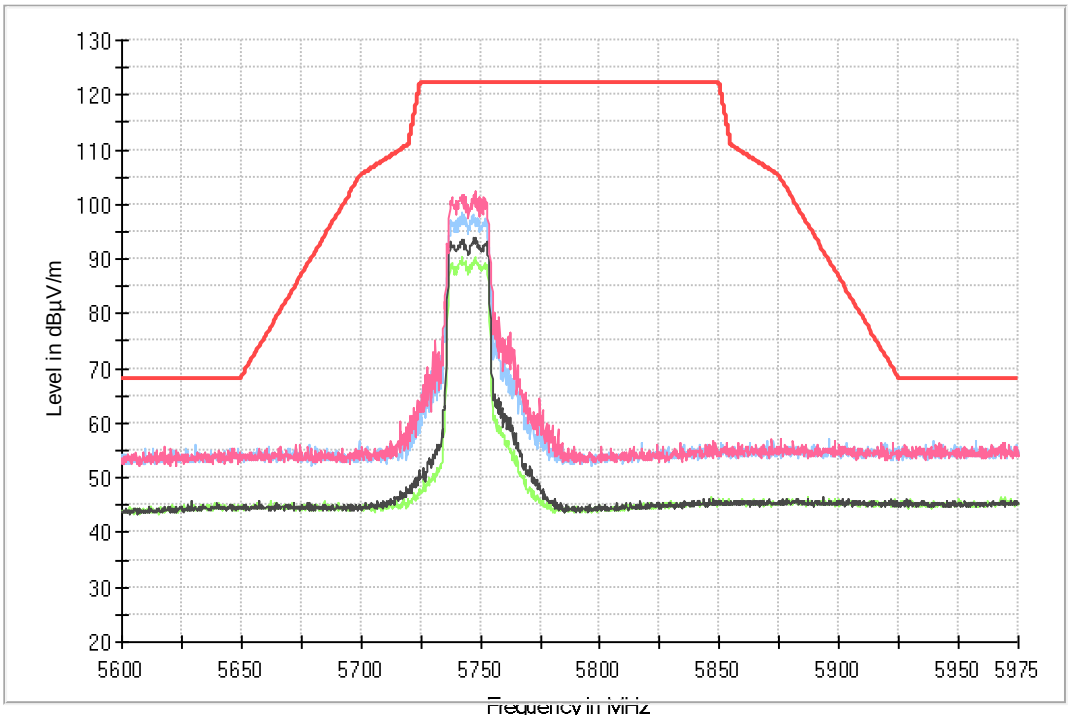
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSV 40]					
1 GHz - 7 GHz	187,5 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

The legend for the next plots is the following:

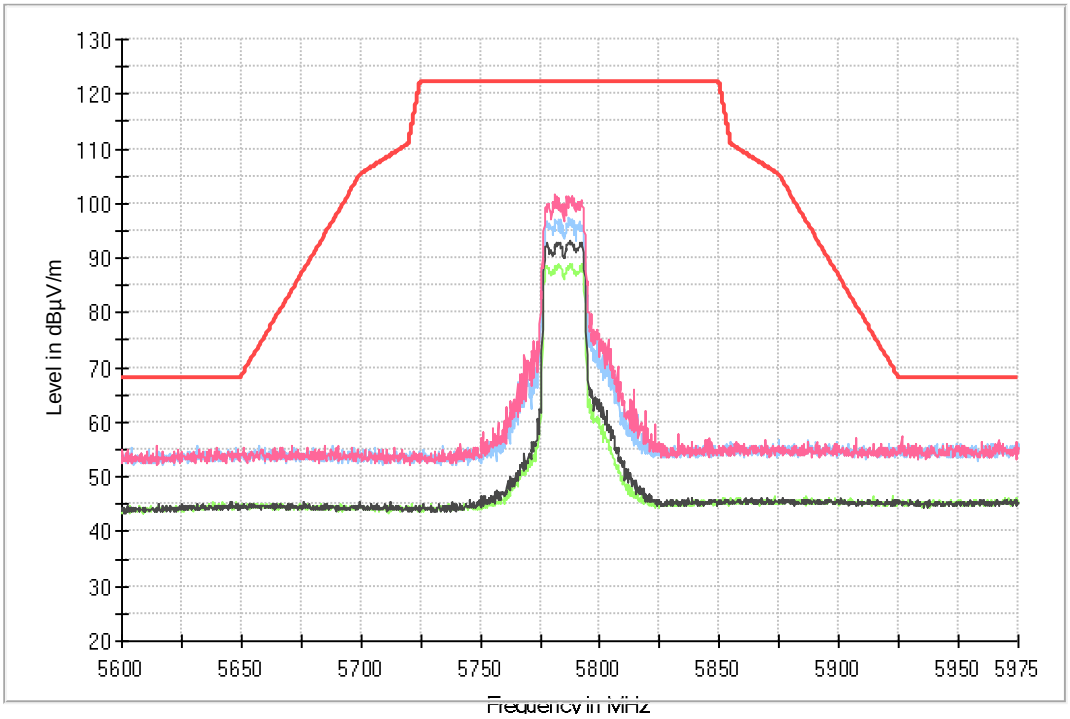


- **802.11 a20:**

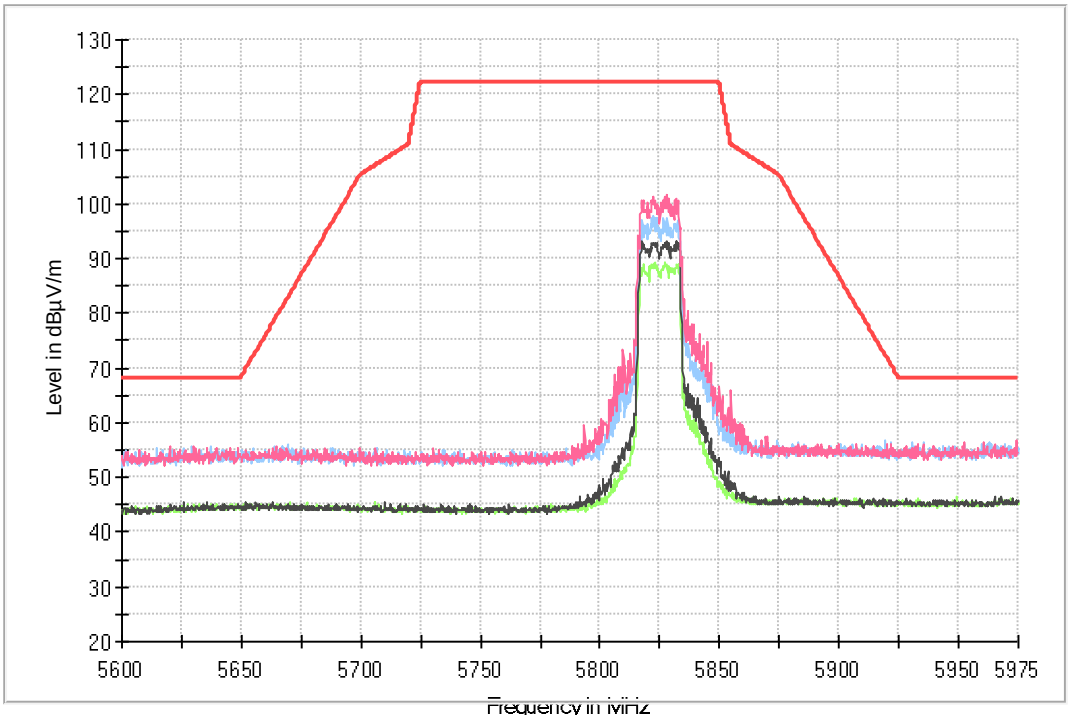
  - Low Channel 149 (5745 MHz):



  - Middle Channel 157 (5785 MHz):

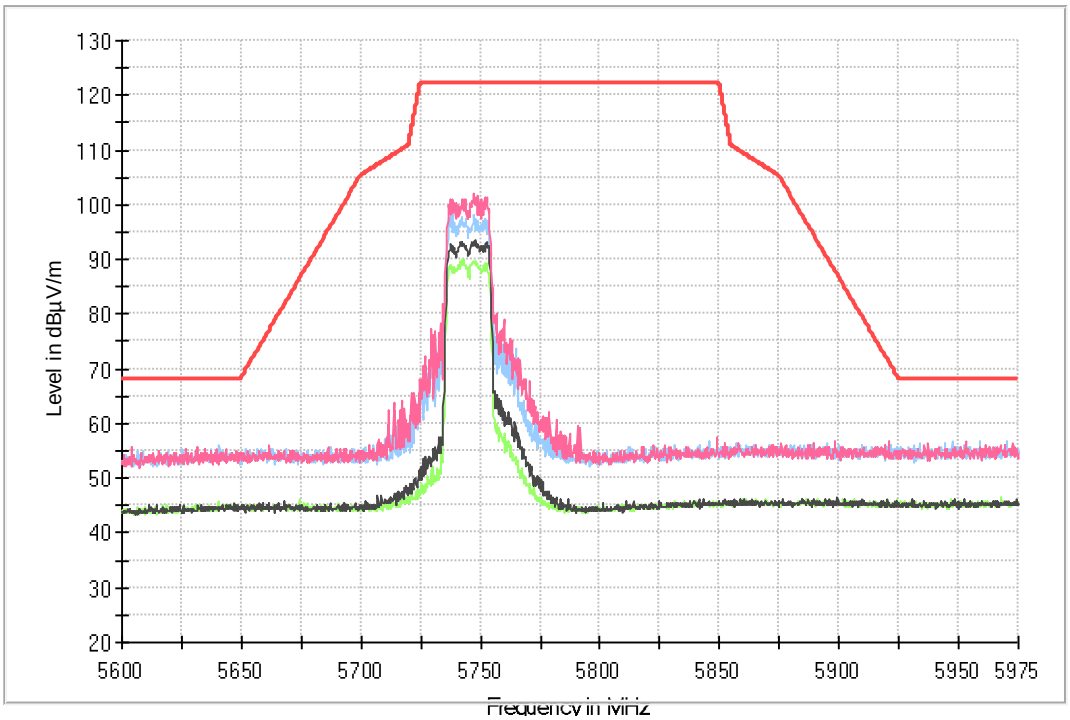


- High Channel 165 (5825 MHz):

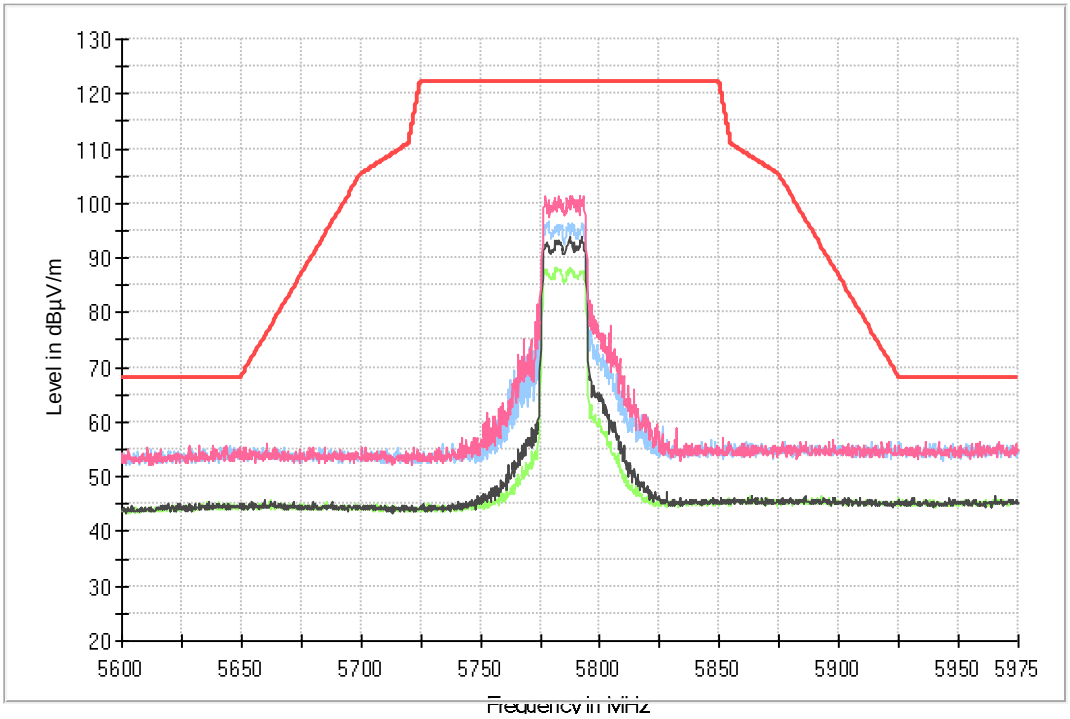


- **802.11 n20:**

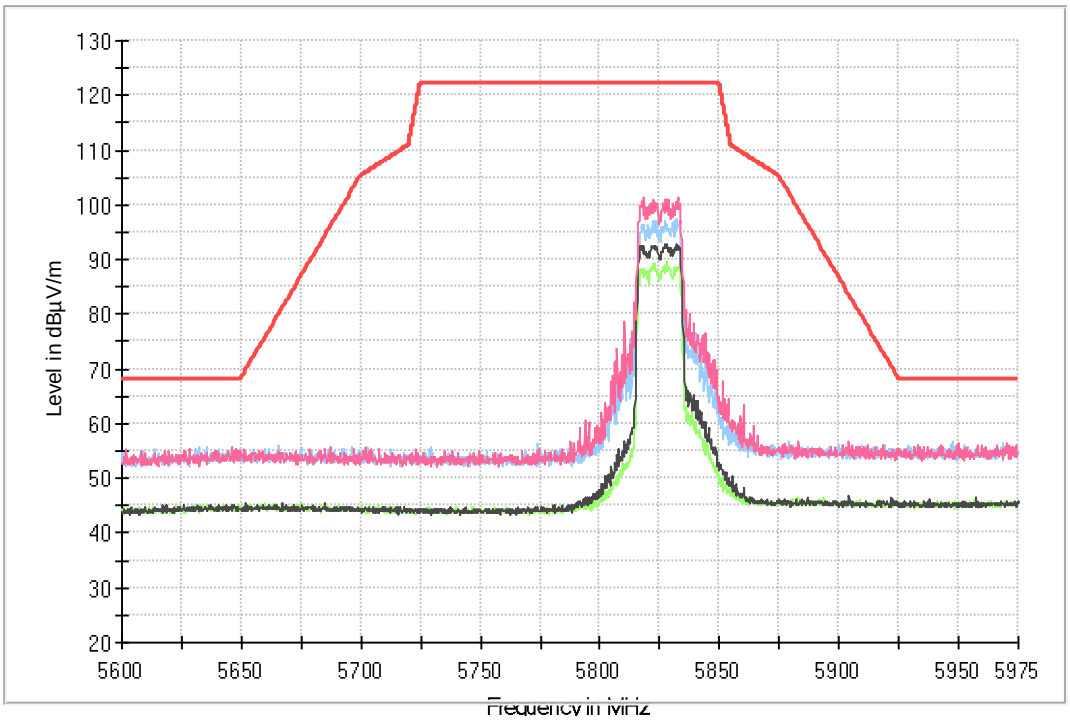
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):

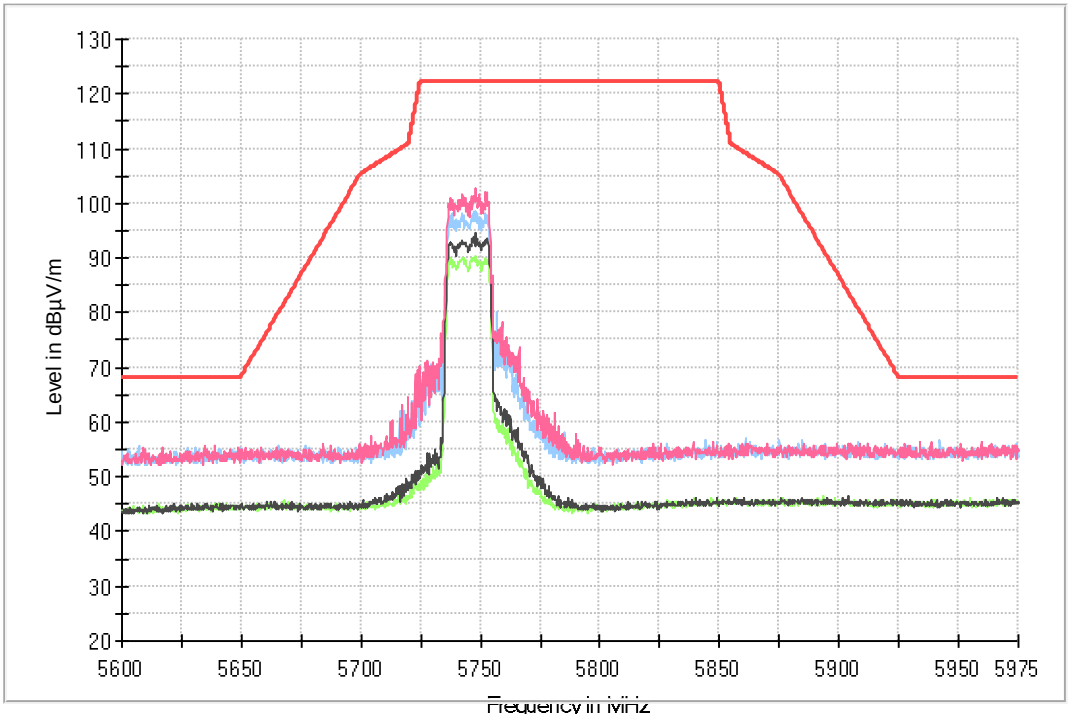


- High Channel 165 (5825 MHz):

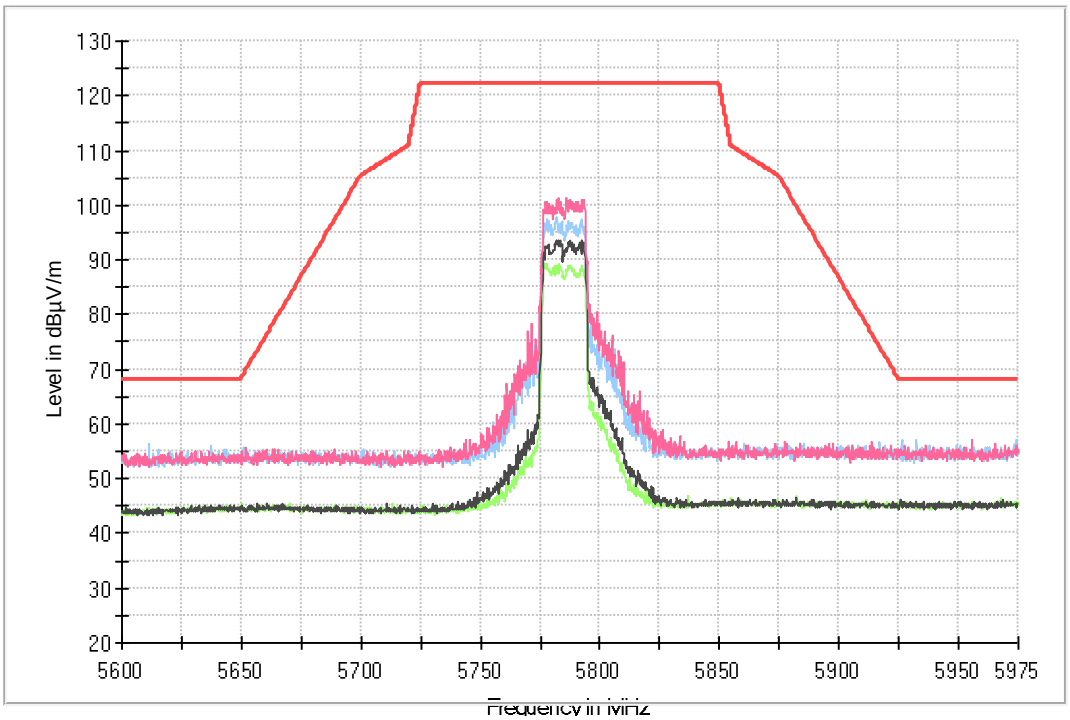


- **802.11 ac20:**

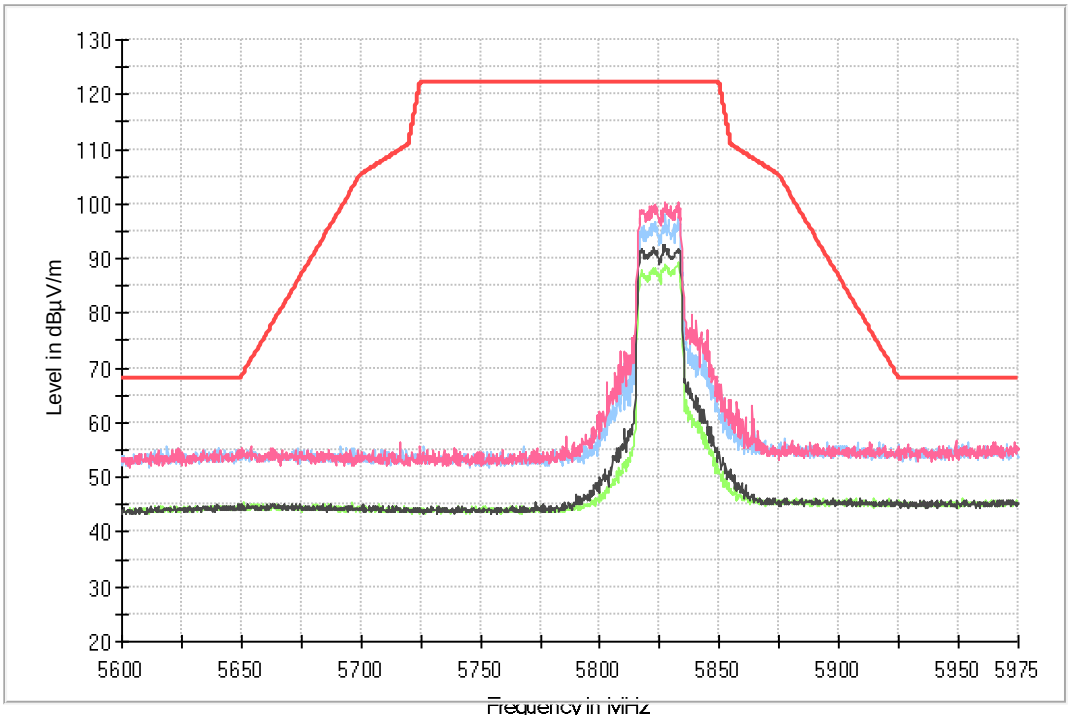
  - Low Channel 149 (5745 MHz):



  - Middle Channel 157 (5785 MHz):

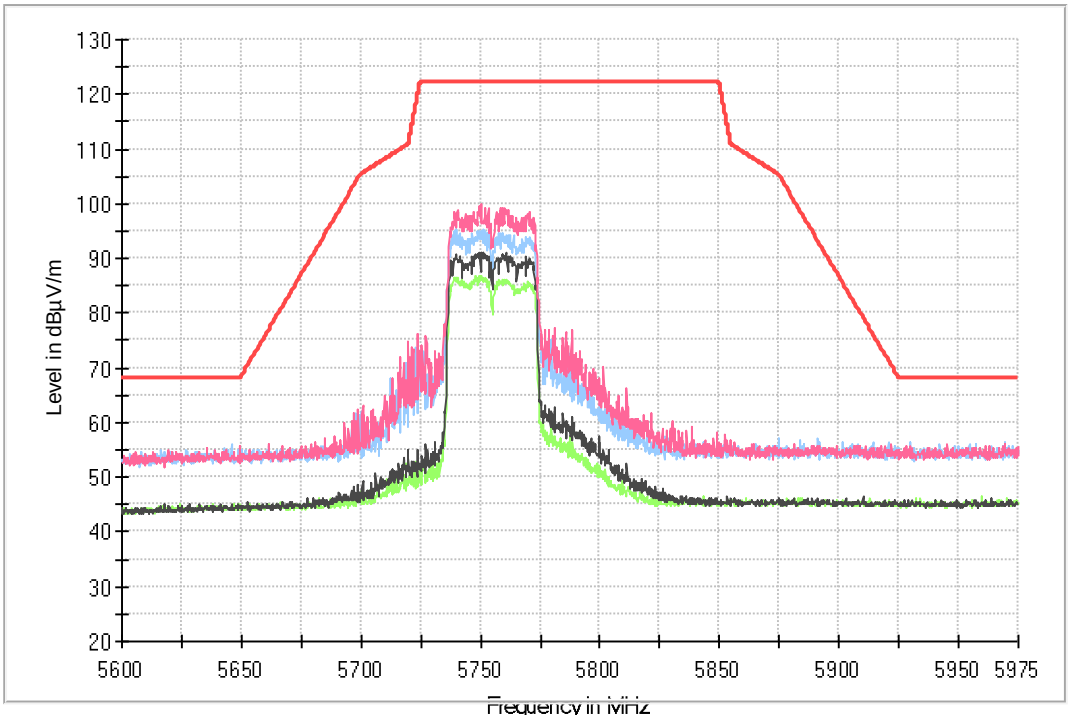


- High Channel 165 (5825 MHz):

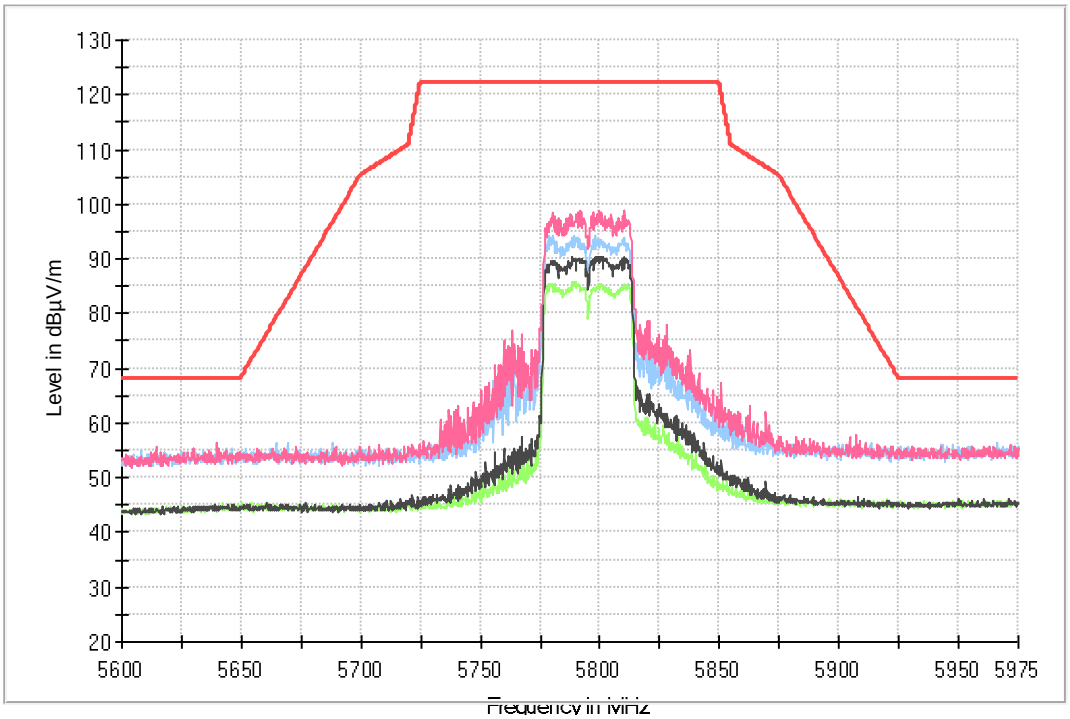


- **802.11 n40:**

- Low Channel 151 (5755 MHz):

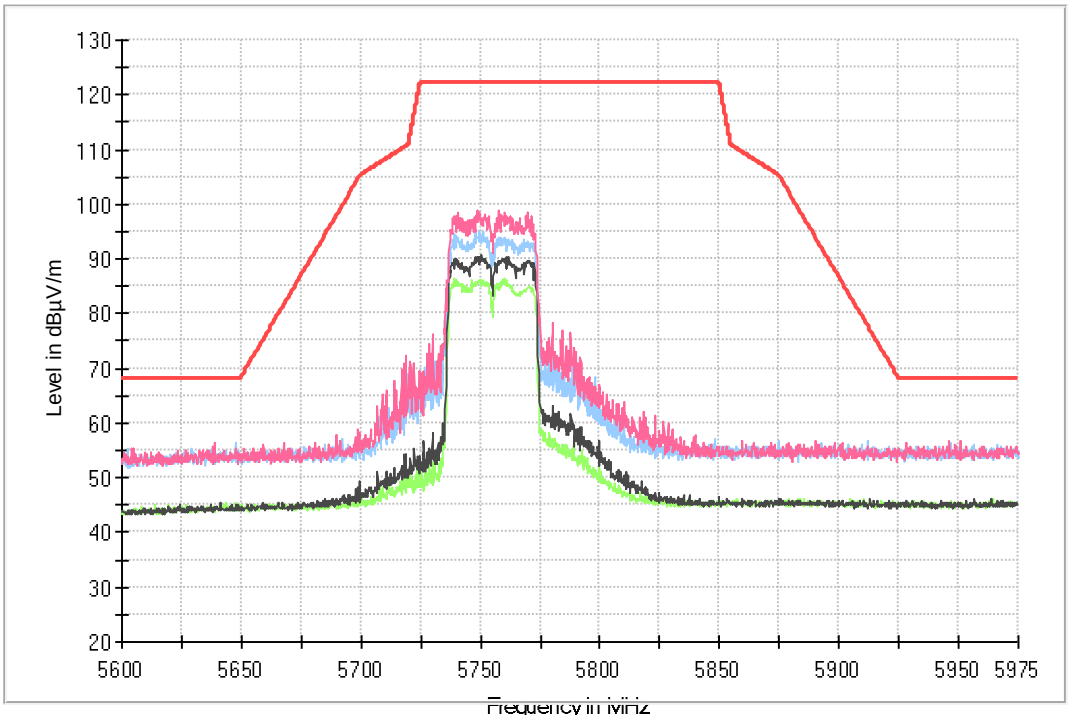


- High Channel 159 (5795 MHz):

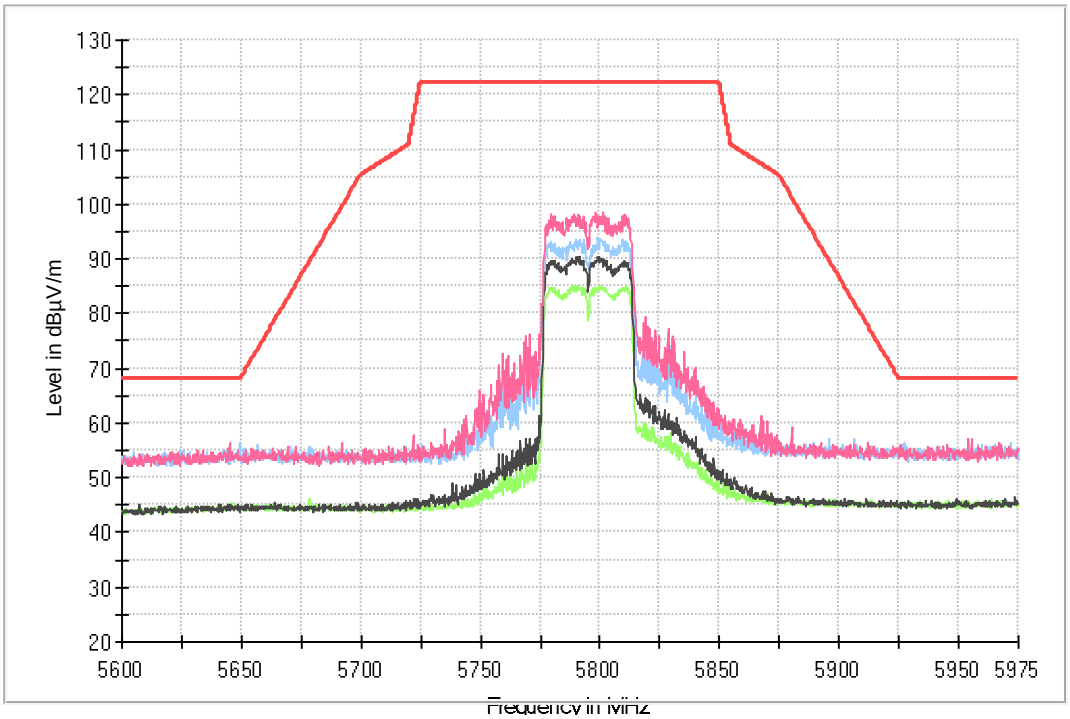


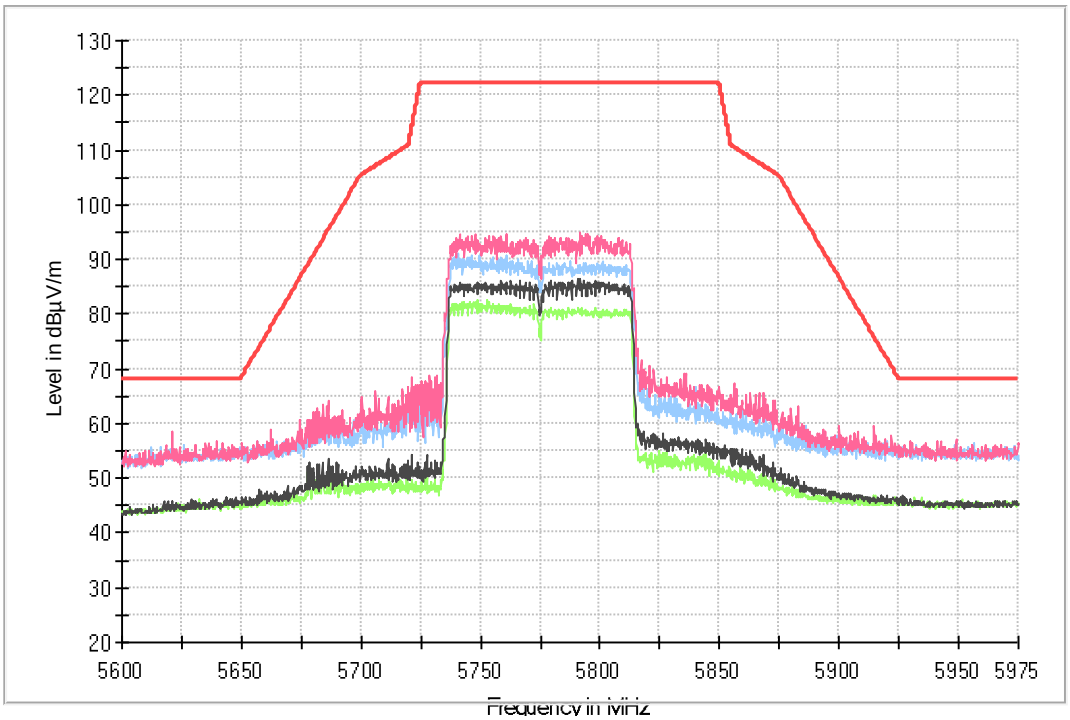
- **802.11 ac40:**

- Low Channel 149 (5755 MHz):



- High Channel 165 (5795 MHz):



- **802.11 ac80:**

- Middle Channel 155 (5775 MHz):