



Test report No:
 NIE: 63927RRF.002A1

Partial Test Report

USA FCC Part 15.407, 15.209

CANADA RSS-247, RSS-Gen

Unlicensed National Information Infrastructure (U-NII) Devices. General technical requirements.

Radiated emission limits; general requirements.

Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.

General Requirements and Information for the Certification of Radio Apparatus.

(*) Identification of item tested	Automotive Infotainment System
(*) Trademark	Mercedes-Benz
(*) Model and /or type reference	NTG7 PREMIUM
Other identification of the product	HW version: D5 SW version: E17.100 FCC ID: T8GNTG7PRE-US IC: 6434A-NTG7PRE-US
(*) Features	FM/AM/DAB/DVBT USB, Bluetooth, WLAN, GNSS
Applicant	HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH BECKER-GOERING-STR. 16; 76307 KARLSBAD GERMANY
Test method requested, standard	<ul style="list-style-type: none"> - USA FCC Part 15.407 (10-1-19 Edition): Unlicensed National Information Infrastructure (U-NII) Devices. General technical requirements. - USA FCC Part 15.209 (10-1-19 Edition): Radiated emission limits; general requirements. - CANADA RSS-247 Issue 2 (February 2017). - CANADA RSS-Gen Issue 5 (March 2019). - 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)	José Carlos Luque RF Lab. Supervisor <div style="font-size: small; margin-left: 20px;"> 74841983Y JOSE CARLOS LUQUE (CA29507456) </div>
Date of issue	2020-08-07
Report template No	FDT08_22
	(*) "Data provided by the client"

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Competences and guarantees

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DEKRA Testing and Certification is a FCC-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

DEKRA Testing and Certification is an ISED-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report

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

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Uncertainty

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

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 of NTG7 PREMIUM is 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.

- Sample S/01 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
60268/448	Automotive infotainment System	NTG7 PREMIUM	HBM642LS0000003	2020/04/23
60268/155	RF Harness	--	--	2019/09/30

Auxiliary elements used with the sample S/01:

Control N°	Description	Model	Serial N°	Date of reception
60268/110	SMA Adapter Cable	--	--	2019/09/30

Sample S/01 has undergone the following test(s): All Conducted tests indicated in the Appendixes A, B, C.

- Sample S/02 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
60268/448	Automotive infotainment System	NTG7 PREMIUM	HBM642LS0000003	2020/04/23
60268/308	RF Harness	--	--	2020/02/26
60268/122	RF Cable with 4 Antennas	--	--	2019/09/30

Sample S/02 has undergone the following test(s): All Radiated tests indicated in the Appendixes B, C.

Test sample description

Ports..... :	Port name and description	Cable					
		Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾		
	<i>Car Connector A</i>	>3m ^(x1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	<i>Car Connector B</i>	>3m ^(x1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	<i>Display Connector CID/PIP / RVC</i>	>3m ^(x1)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	<i>USB Connector</i>	<3m ^(x2)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	<i>Eth Connector</i>	>3m ^(x1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	<i>BT/WLAN-Antenna</i>	>3m ^(x1)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	<i>FM/AM, TV/SDARS Ant</i>	>3m ^(x1)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	<i>GNSS Antenna</i>	>3m ^(x1)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
Supplementary information to the ports..... :							
Rated power supply	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	<input type="checkbox"/>	AC:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	AC:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/>	DC: 12V Car battery / attenuator (9,5-15,5V normal operation)					
<input type="checkbox"/>	DC:						
Rated Power	9,5-15,5V normal operation						
Clock frequencies.....	see schematics						
Other parameters	See Technical Description						
Software version	E17.100						
Hardware version	D5						
Dimensions in cm (W x H x D)	182 x 78 x 160 mm						
Mounting position	<input type="checkbox"/>	Table top equipment					
	<input type="checkbox"/>	Wall/Ceiling mounted equipment					

	<input type="checkbox"/>	Floor standing equipment		
	<input type="checkbox"/>	Hand-held equipment		
	<input checked="" type="checkbox"/>	Other: automotive headunit		
Modules/parts.....:	Module/parts of test item		Type	Manufacturer
	n/a		-	
			-	
			-	
			-	
Accessories (not part of the test item)	Description		Type	Manufacturer
	Display		-	LG.
	HARMANeco RasPi / headless		-	HBAS
	Cable harness		-	HBAS
	BT/WLAN-Antenna		-	Hirschmann
Documents as provided by the applicant	Description		File name	Issue date
	Technical Description		Technical Description NTG7_A16 200324 SOP2 AllVariant.doc	

⁽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)	2020-05-22
Date (finish)	2020-06-11

Document history

Report number	Date	Description
63927RRF.002	2020-07-23	First release
63927RRF.002A1	2020-08-07	First modification due to typos. This modification test report cancels and replaces the test report 63927RRF002

Environmental conditions

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

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

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

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 35 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

Remarks and comments

The tests have been performed by the technical personnel: Javier Miguel Nadales, Verónica García, José Gabriel Pendón and Miguel Ángel Torres.

Used instrumentation:

Conducted Measurements:

	Last Calibration	Due Calibration
1. Shielded Room ETS LINDGREN S101	N.A.	N.A.
2. DC Power Supply 40V/40A Rohde & Schwarz NGPE40	2018/03	2021/03
3. Digital Multimeter, FLUKE 175	2019/10	2020/10
4. Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2019/09	2021/09

Radiated Measurements:

	Last Calibration	Due Calibration
1. Semianechoic Absorber Lined Chamber FRANKONIA SAC-3	N.A.	N.A.
2. Biconical/Log Antenna 30 MHz - 6 GHz ETS LINDGREN 3142E	2018/07	2021/07
3. RF Pre-amplifier 40 dB, 10 MHz - 6 GHz BONN ELEKTRONIK BLNA 0160-01N	N.A.	N.A.
4. EMI Test Receiver 20Hz-40GHz ROHDE AND SCHWARZ ESU40	2019/09	2021/09
5. DC Power Supply, 30V/5A KEYSIGHT TECHNOLOGIES U8002A	N.A.	N.A.
6. Digital Multimeter FLUKE 179	2019/10	2020/10
7. Shielded Room FRANKONIA	N.A.	N.A.
8. Horn Antenna 1-18GHz SCHWARZBECK MESS- ELEKTRONIK BBHA 9120 D	2018/06	2021/06
9. Broadband Horn antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2018/07	2021/07
10. RF Pre-amplifier, 30dB 500MHz-18GHz, NARDA AMF-3D-00501800-24-10P	2019/12	2020/12
11. Pre-amplifier, G>55dB 1-18GHz NARDA AMF-7D-01001800-22-10P	2020/05	2021/05
12. Pre-Amplifier G>30dB 18-40GHz BONN ELEKTRONIK BLMA 1840-3G	2019/11	2021/11

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
FCC 15.35 (c) / RSS-Gen 6.10	Duty Cycle	P	
RSS-Gen 6.7 / RSS-247 6.2.	Occupied bandwidth (or 99% emission bandwidth)	P	(1)
FCC 15.403 (i)	Transmitter 26 dB Emission Bandwidth (EBW)	N/M	
FCC 15.407 (g) / RSS-Gen 6.11	Transmitter frequency stability (Temperature & Voltage Variation)	N/M	(2)
<u>Supplementary information and remarks:</u>			
(1) Only test requested.			
(2) The manufacturer is responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user manual.			

B. 5.15 GHz – 5.25 GHz Band

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		Verdict	Remark
FCC 15.407 (a)(1)(iv)	Transmitter Maximum conducted Output Power	P	(1)
RSS-247 6.2.1.1	Transmitter Maximum Equivalent Isotropically Radiated Power EIRP	N/M	
FCC 15.407 (a)(1)(iv)	Transmitter Maximum Power Spectral Density	N/M	
RSS-247 6.2.1.1	Transmitter EIRP Spectral Density	N/M	
FCC 15.407 (b)(1)(6) / RSS-247 6.2.1.2	Transmitter Out of Band Radiated Emissions	P	(1)
FCC 15.407 (b)(1) / RSS-247 6.2.1.2	Transmitter Band Edge Radiated Emissions	P	(1)
<u>Supplementary information and remarks:</u>			
(1) Only test requested.			

C. 5.725 GHz – 5.85 GHz Band

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		Verdict	Remark
FCC 15.407 (e) / RSS-247 6.2.4.1	6 dB Bandwidth.	N/M	
FCC 15.407 (a)(3) / RSS-247 6.2.4.1	Transmitter Maximum conducted Output Power	P	(1)
FCC 15.407 (a)(3) / RSS-247 6.2.4.1	Transmitter Maximum Power Spectral Density	N/M	
FCC 15.407 (b)(4) / RSS-247 6.2.4.2	Transmitter Band Edge Radiated Emissions	P	(1)
FCC 15.407 (b)(4)(6) / RSS-247 6.2.4.2	Transmitter Out of Band Radiated Emissions	P	(1)
<u>Supplementary information and remarks:</u>			
(1) Only test requested.			

Appendix A: Test Common requirements for all bands

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FCC 15.35 (c) / RSS-Gen 6.10. Duty Cycle

SPECIFICATION:

When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

RESULTS:

The results below are for data rates with a duty cycle less than 98%. The results for all rest of modes having a value > 98%.

Tests performed on the SISO mode CORE-0_Port3 Antenna.

Sub-band	Technique	Mode	Pulse Duration (us)	Period (us)	Duty Cycle correction (dB)
U-NII-1	SISO	802.11a / 20 MHz	2046.5	2570.1	0.99
U-NII-3	SISO	802.11a / 20 MHz	2052.5	2570.1	0.98
U-NII-1	SISO	802.11n / 20 MHz	1906.4	2419.9	1.04
U-NII-3	SISO	802.11n / 20 MHz	1902.3	2419.9	1.05
U-NII-1	SISO	802.11n / 40 MHz	923.2	1438.6	1.93
U-NII-3	SISO	802.11n / 40 MHz	925.1	1444.5	1.94
U-NII-1	SISO	802.11ac / 80 MHz	452.24	969.7	3.31
U-NII-3	SISO	802.11ac / 80 MHz	451.17	964.02	3.30

RSS-Gen 6.7 / RSS-247 6.2. Occupied bandwidth (or 99% emission bandwidth)

The following modes and data rates were selected based on preliminary testing that identified those corresponding to the worst cases:

- 802.11a: 6 Mbit/s.
- 802.11n HT20: MCS0.
- 802.11n HT40: MCS0.
- 802.11ac VHT80: MCS0

Tests performed on the SISO CORE0_Port3 Antenna.

SISO CORE0_Port3 Antenna:

- **802.11 a20:**

U-NII-1 (5150-5250 MHz)

Channels	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
99% Occupied Bandwidth (MHz)	16.952	16.972	16.992
Measurement uncertainty (kHz)	<±37.01		

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
99% Occupied Bandwidth (MHz)	17.04	17.04	17.026
Measurement uncertainty (kHz)	<±42.41		

- 802.11 n20:

U-NII-1 (5150-5250 MHz)

Channels	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
99% Occupied Bandwidth (MHz)	18.124	18.1	18.116
Measurement uncertainty (kHz)	<±37.01		

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
99% Occupied Bandwidth (MHz)	18.26	18.253	18.2
Measurement uncertainty (kHz)	<±42.41		

- 802.11 n40:

U-NII-1 (5150-5250 MHz)

Channels	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
99% Occupied Bandwidth (MHz)	36.256	36.248
Measurement uncertainty (kHz)	<±62.39	

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
99% Occupied Bandwidth (MHz)	36.32	36.346
Measurement uncertainty (kHz)	<±73.18	

- **802.11 ac80:**

U-NII-1 (5150-5250 MHz)

Channel	Single Channel 42 (5210 MHz)
99% Occupied Bandwidth (MHz)	75.424
Measurement uncertainty (kHz)	<±124.73

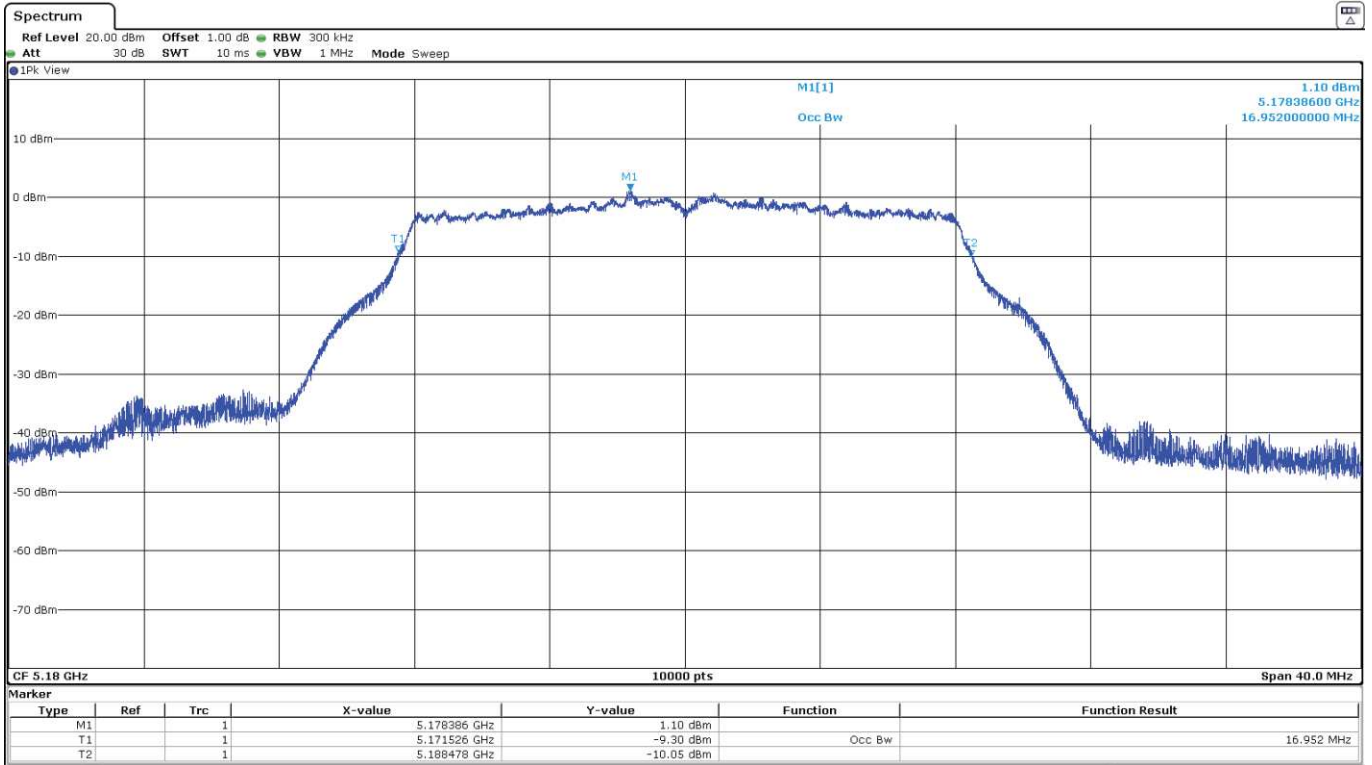
U-NII-3 (5725-5850 MHz)

Channel	Single Channel 155 (5775 MHz)
99% Occupied Bandwidth (MHz)	75.84
Measurement uncertainty (kHz)	<±146.30

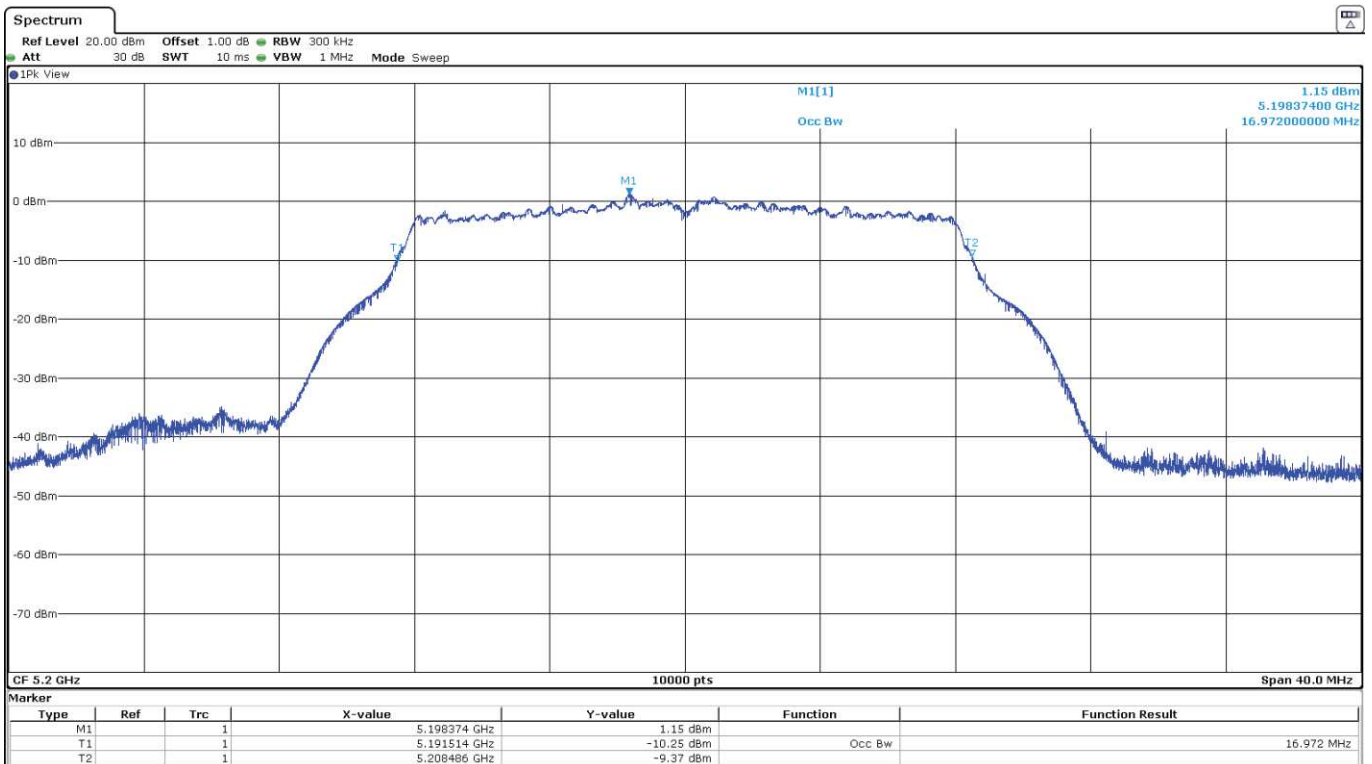
- 802.11 a20:

U-NII-1 (5150-5250 MHz)

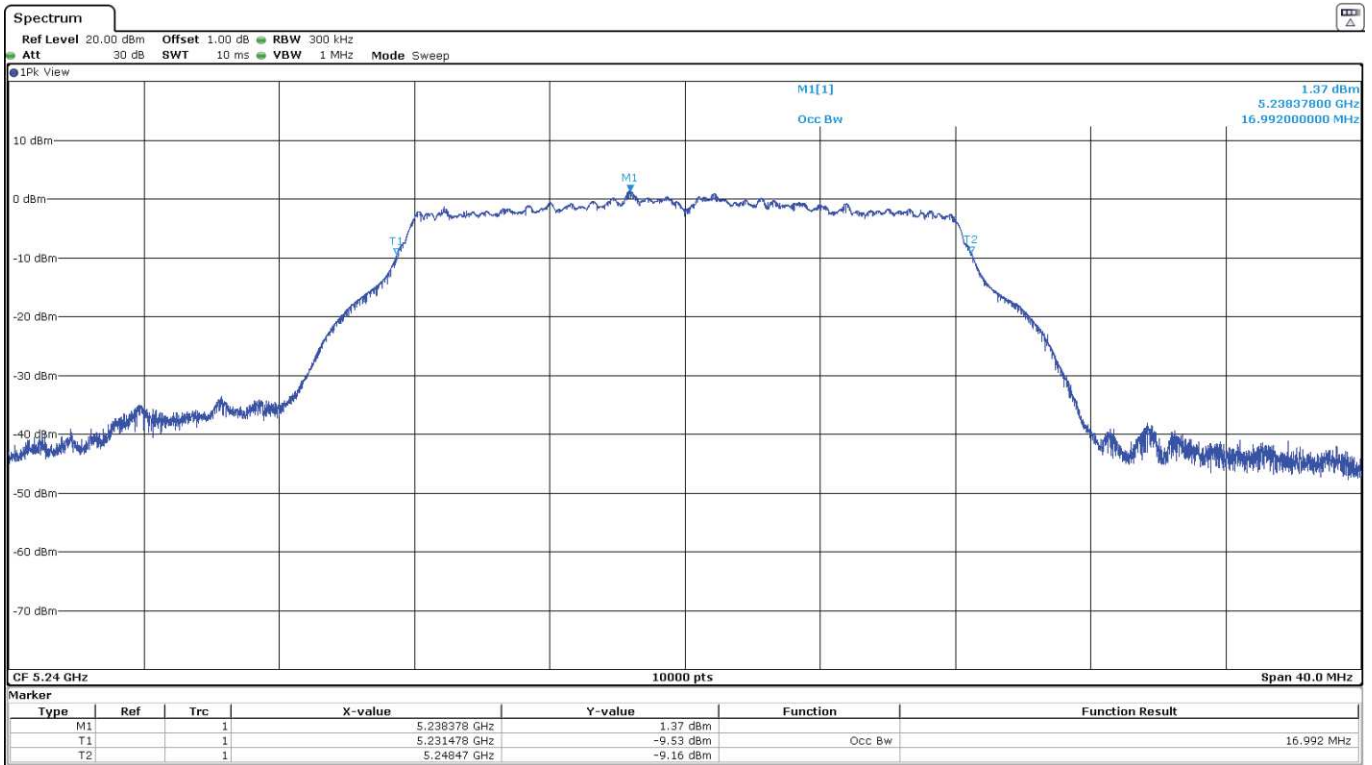
- Low Channel 36 (5180 MHz):



- Middle Channel 40 (5200 MHz):

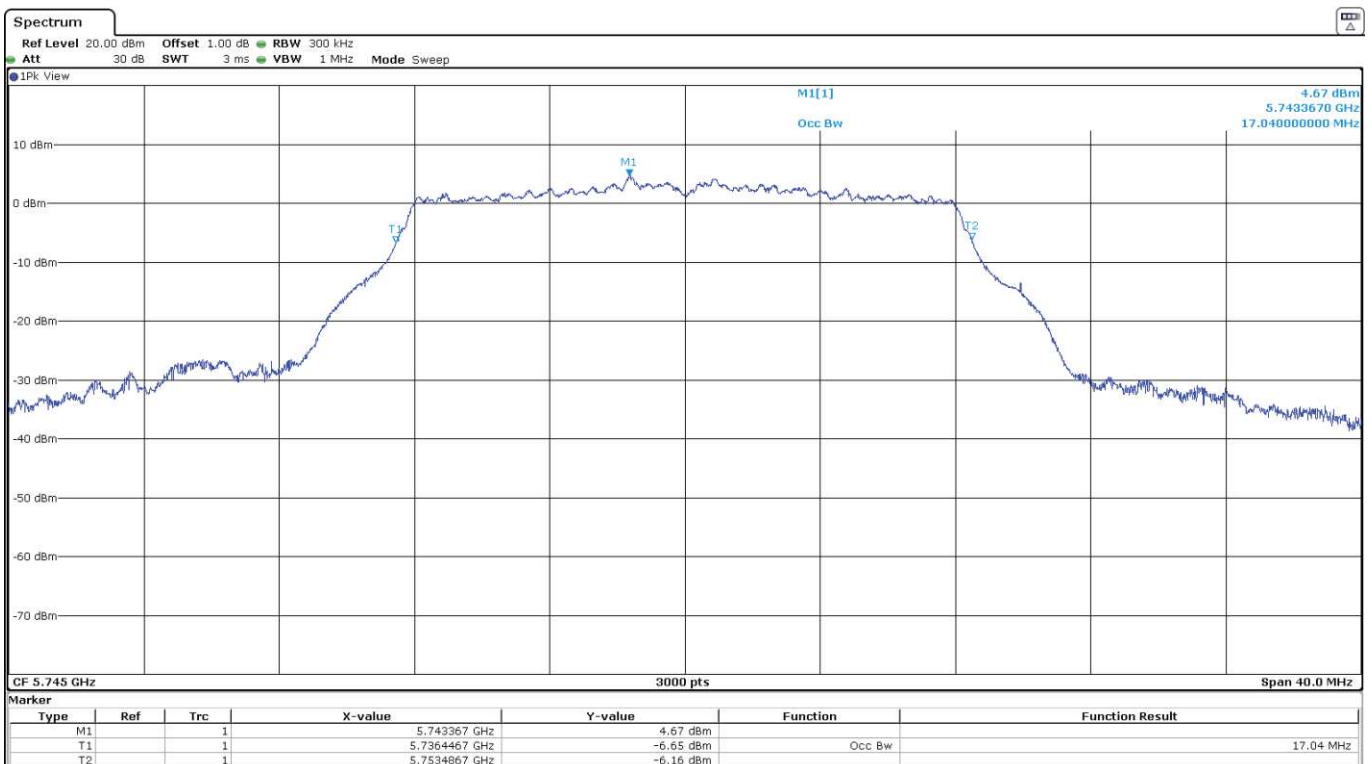


- High Channel 48 (5240 MHz):

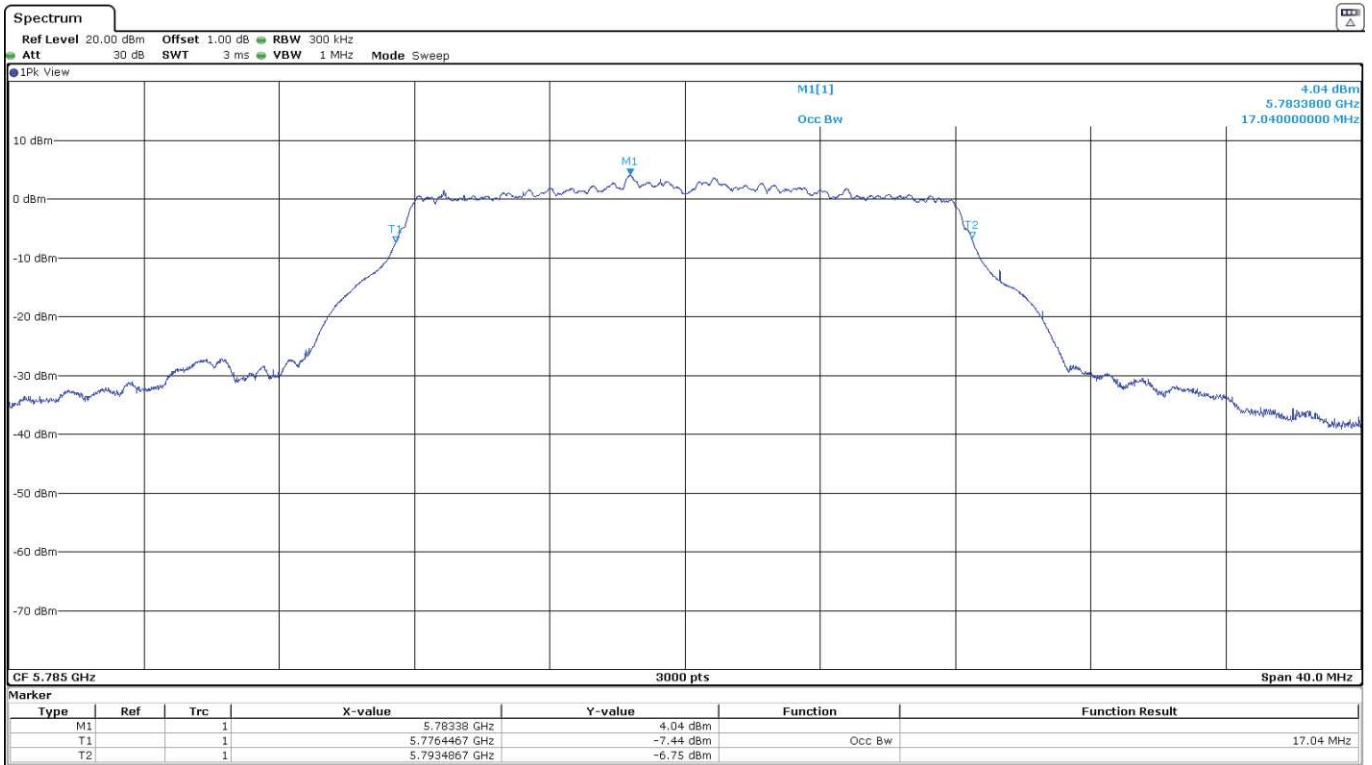


U-NII-3 (5725-5850 MHz)

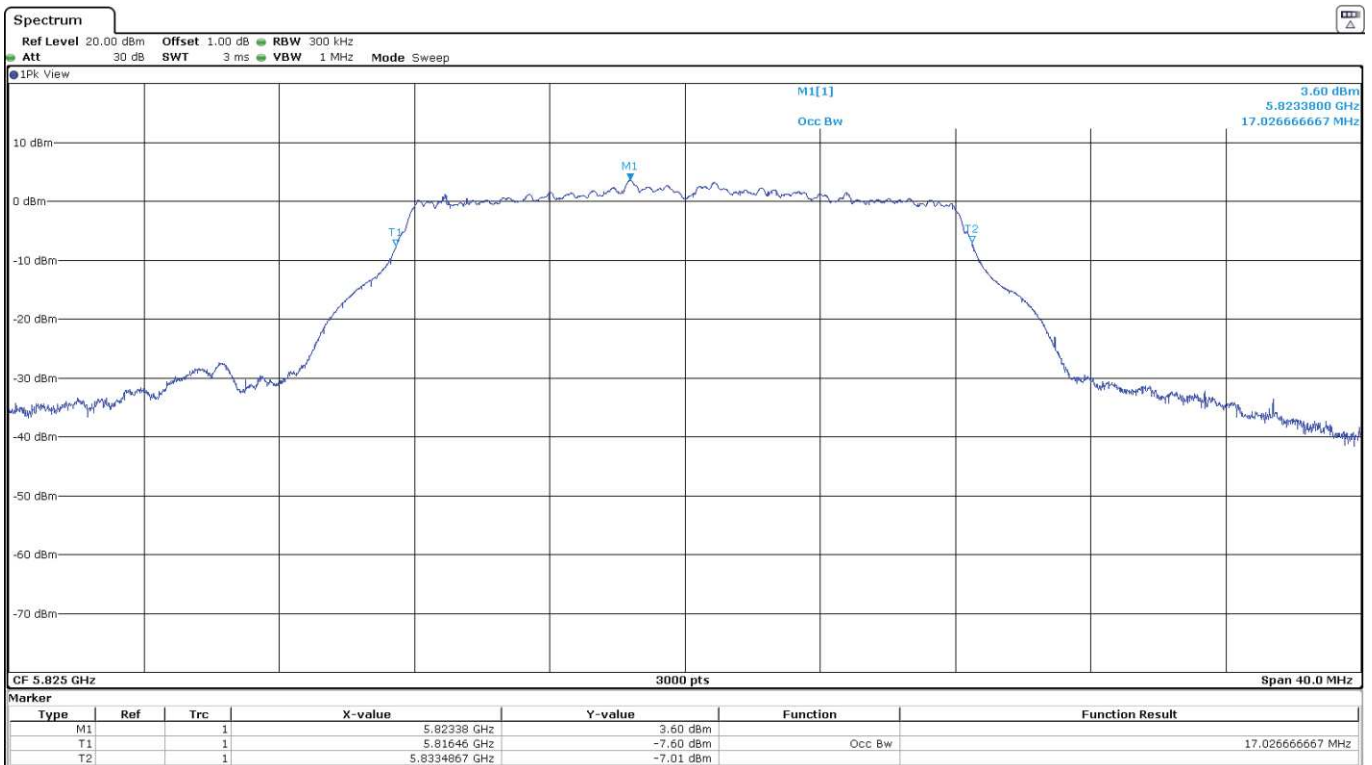
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



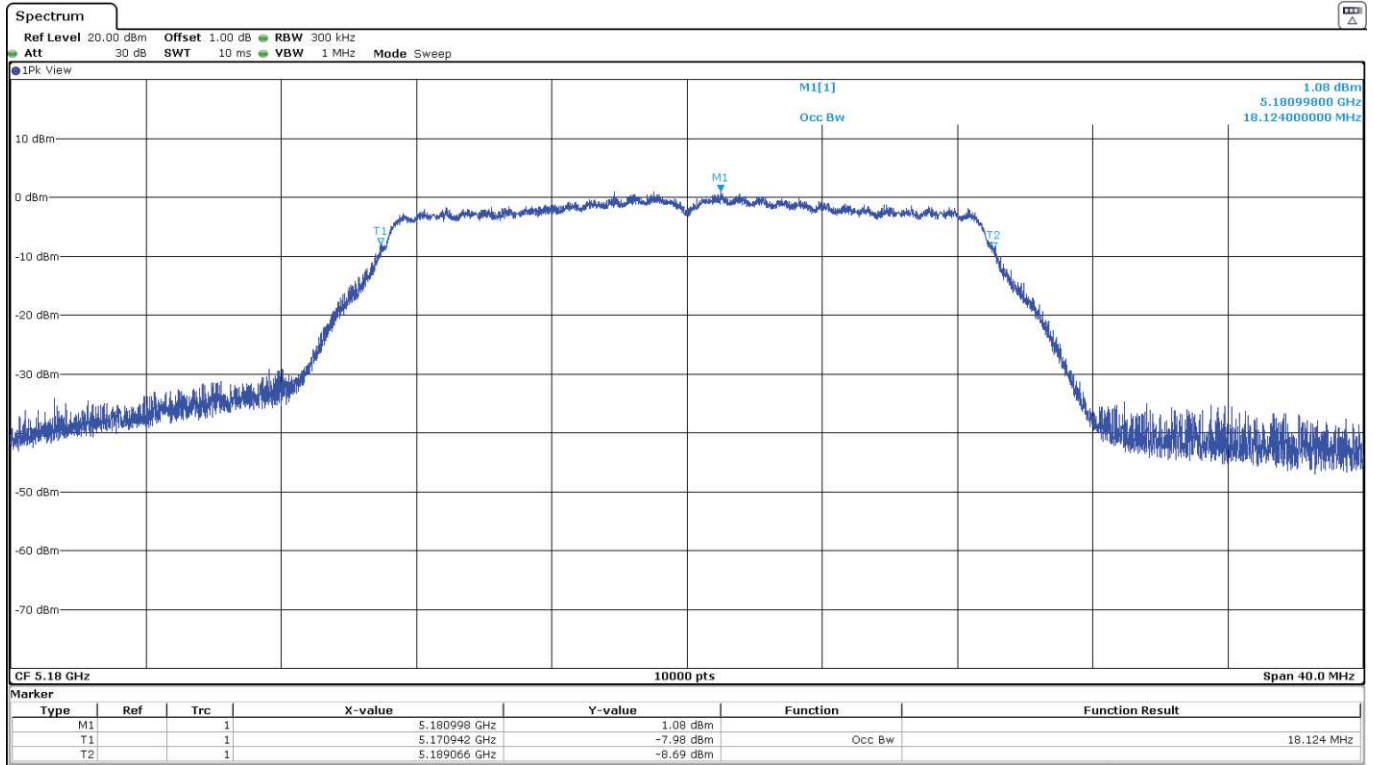
- High Channel 165 (5825 MHz):



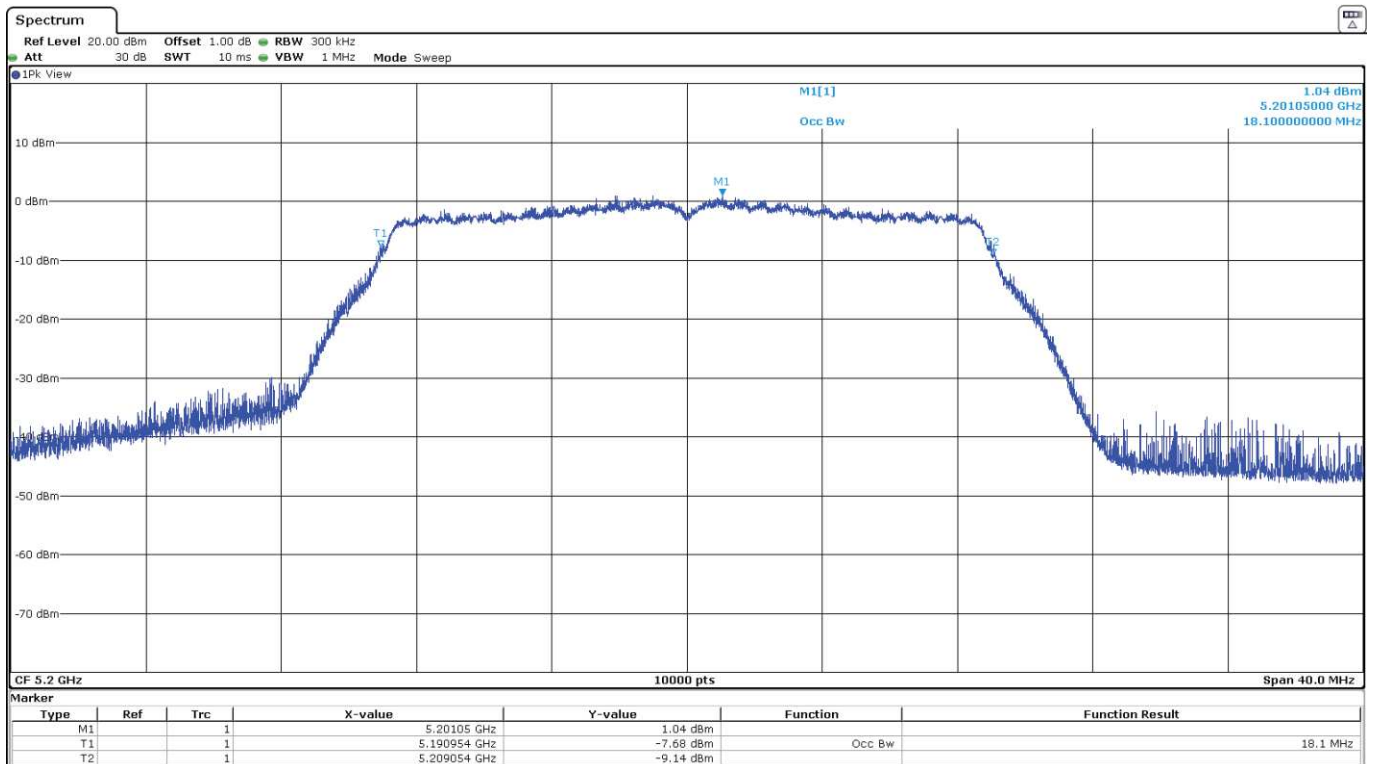
- 802.11 n20:

U-NII-1 (5150-5250 MHz)

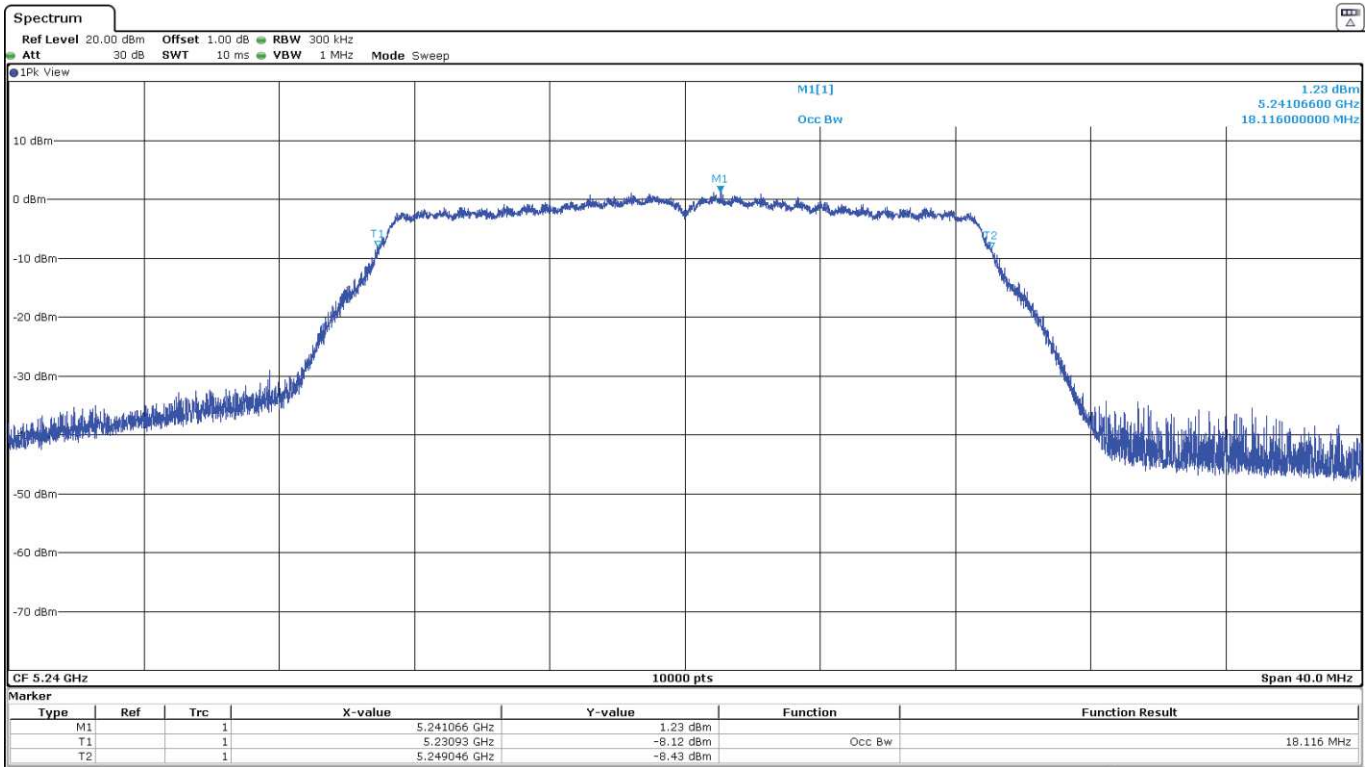
- Low Channel 36 (5180 MHz):



- Middle Channel 40 (5200 MHz):

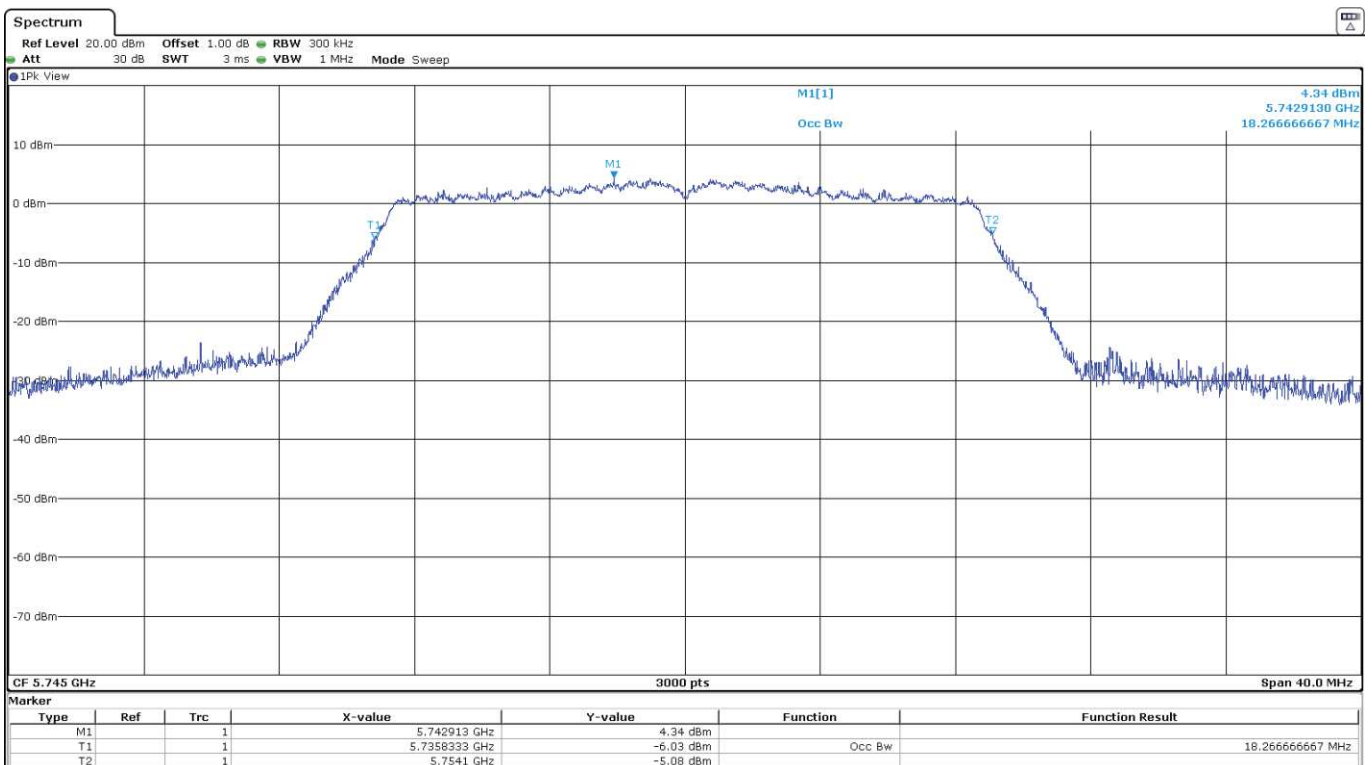


- High Channel 48 (5240 MHz):

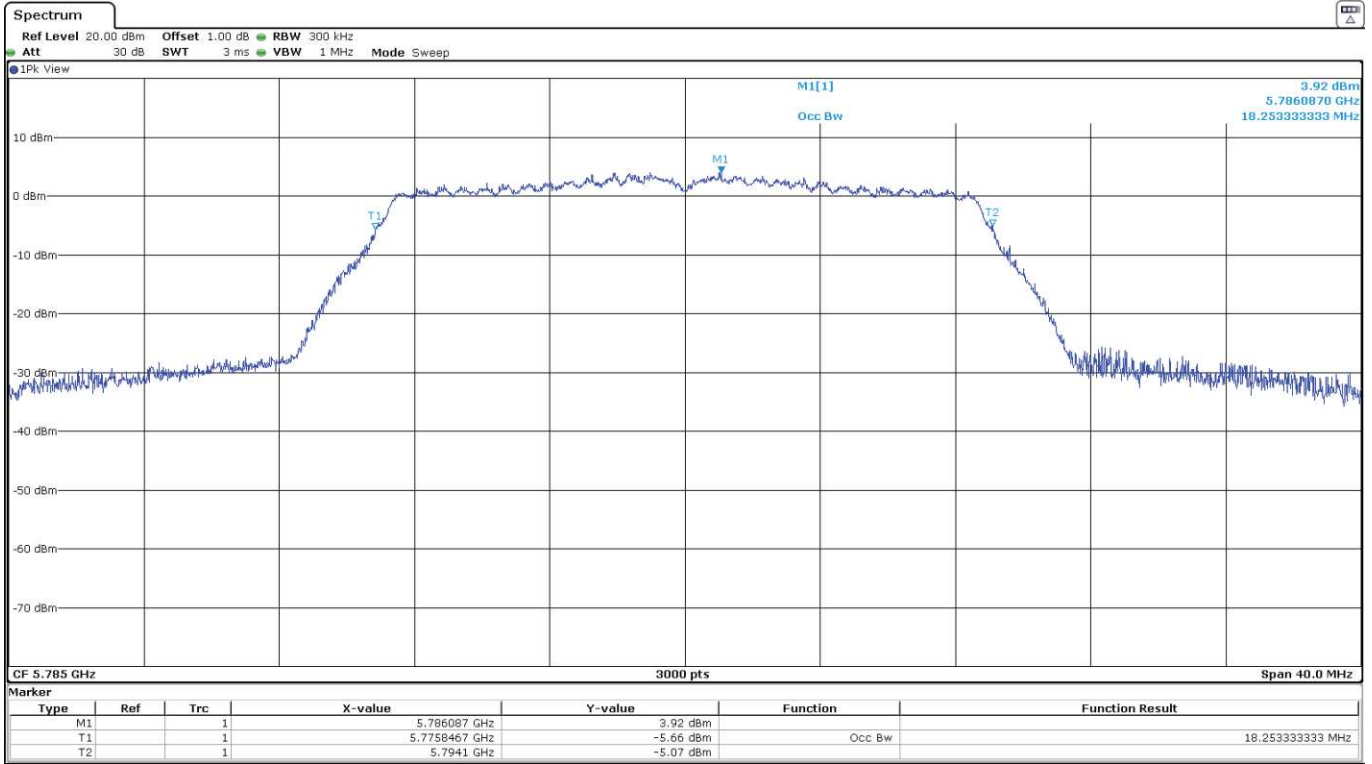


U-NII-3 (5725-5850 MHz)

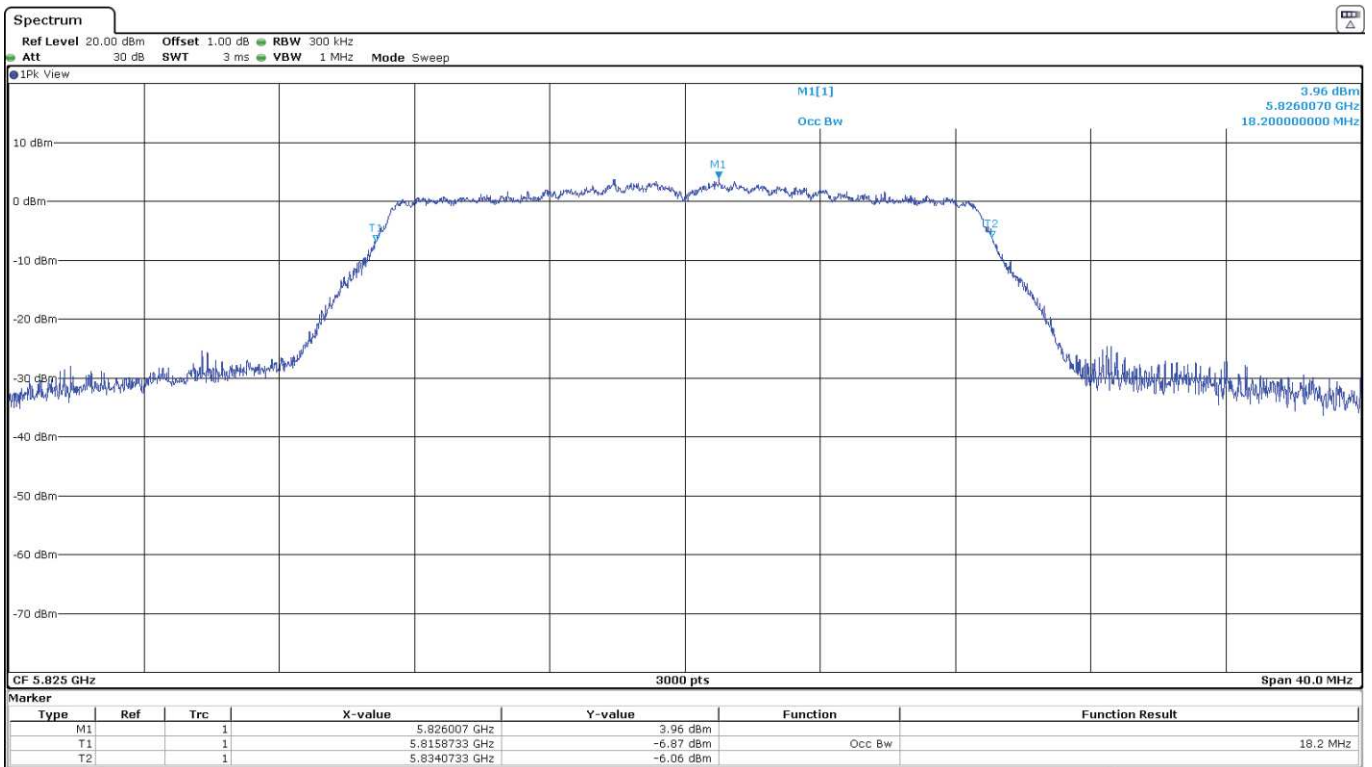
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



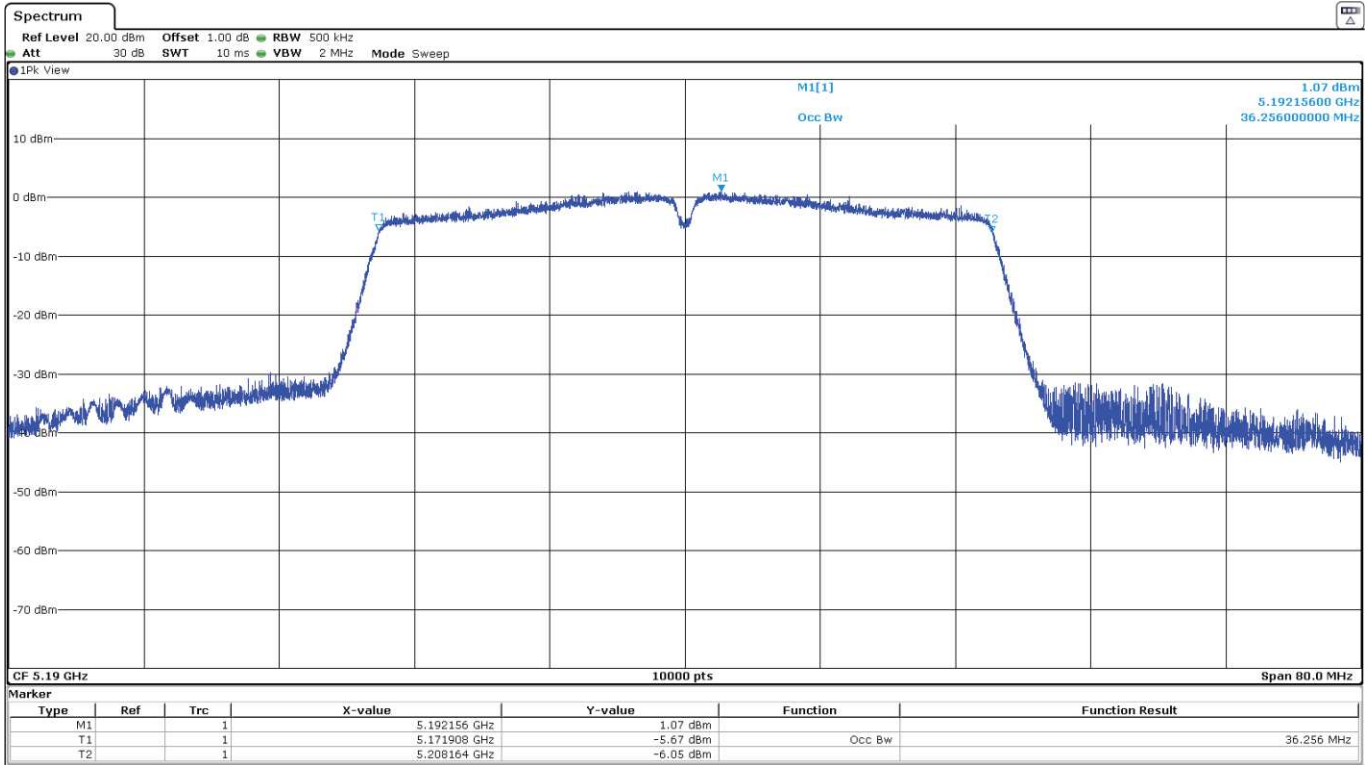
- High Channel 165 (5825 MHz):



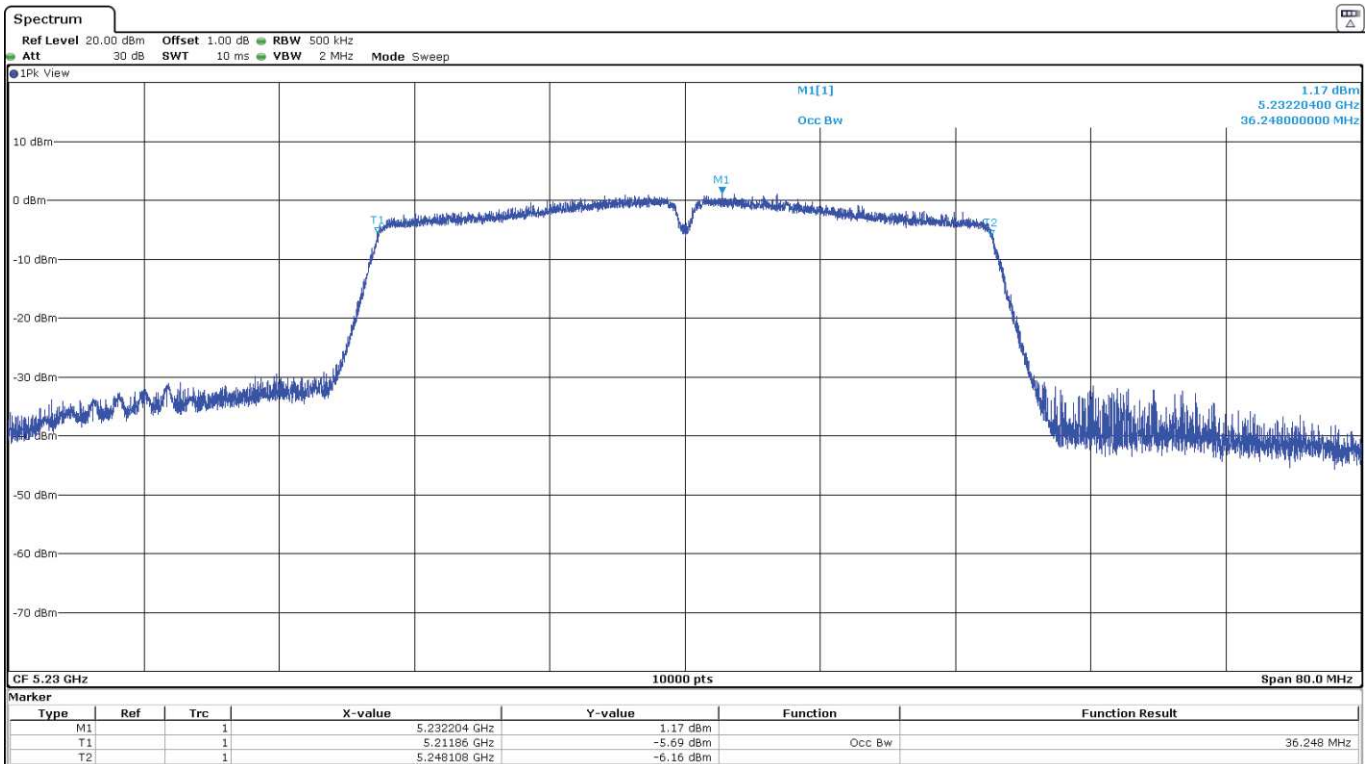
- 802.11 n40:

U-NII-1 (5150-5250 MHz)

- Low Channel 38 (5190 MHz):

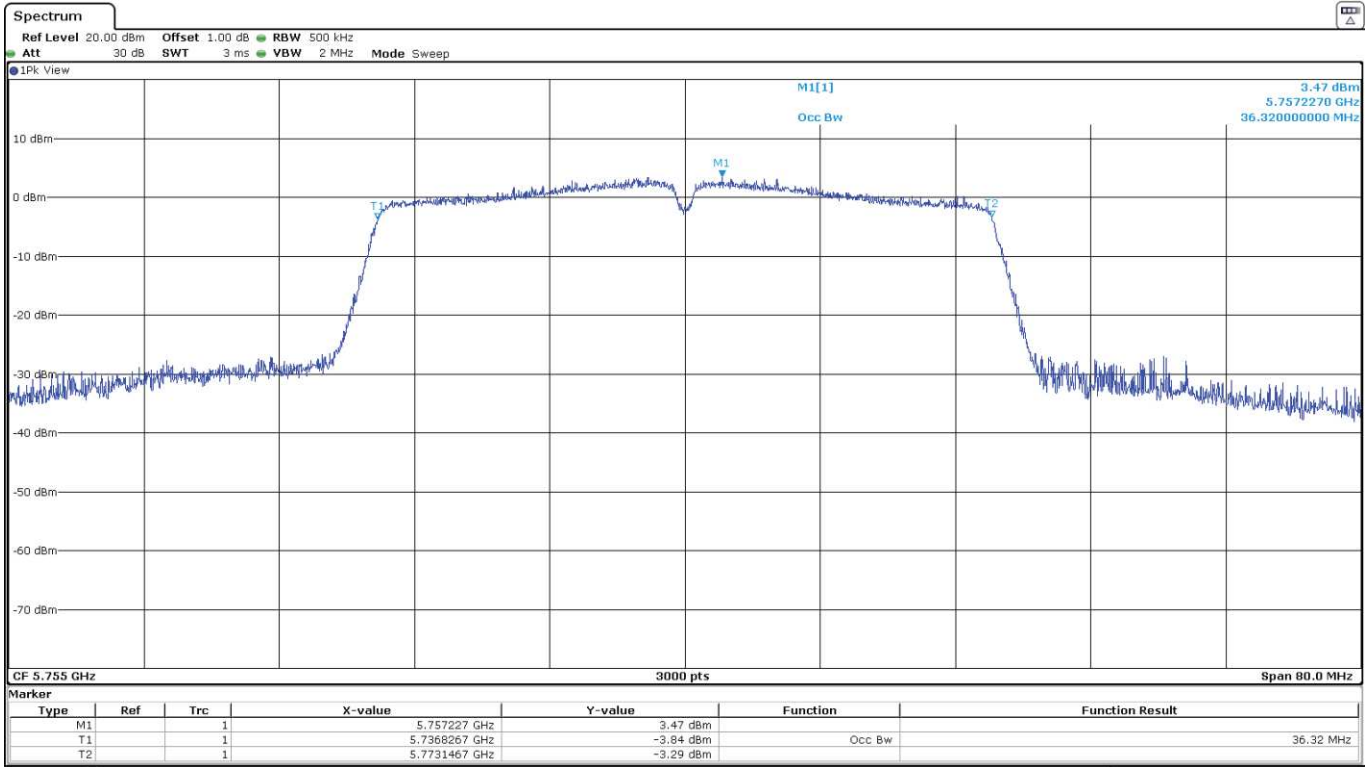


- High Channel 46 (5230 MHz):

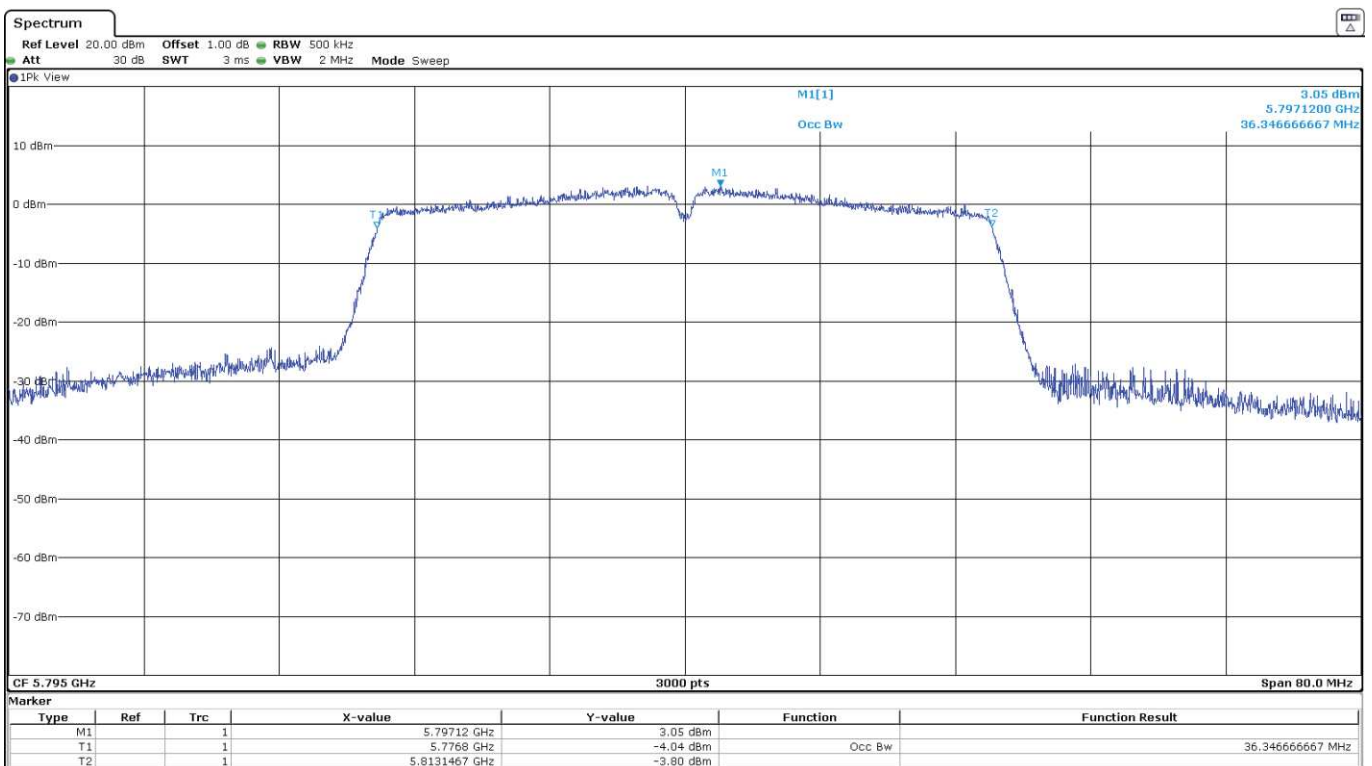


U-NII-3 (5725-5850 MHz)

- Low Channel 151 (5755 MHz):



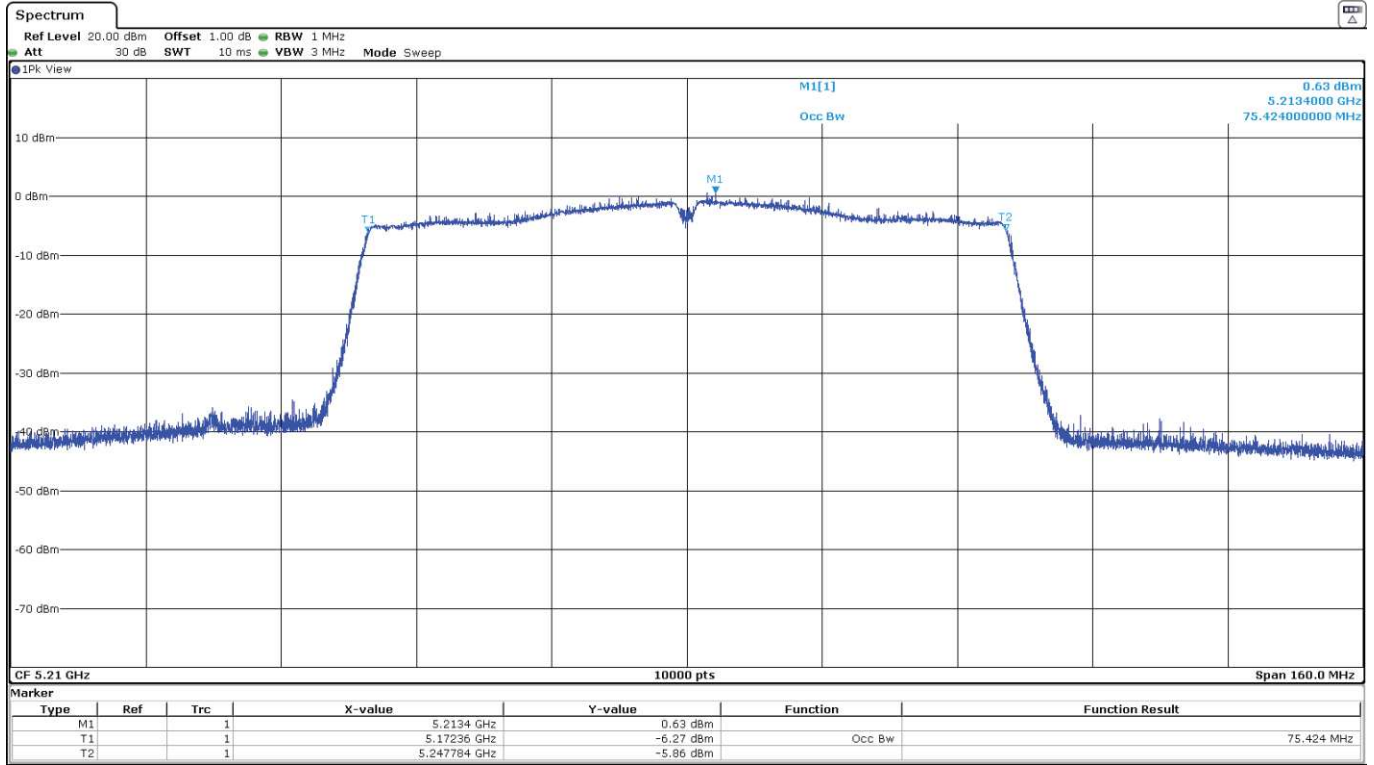
- High Channel 159 (5795 MHz):



- 802.11 ac80:

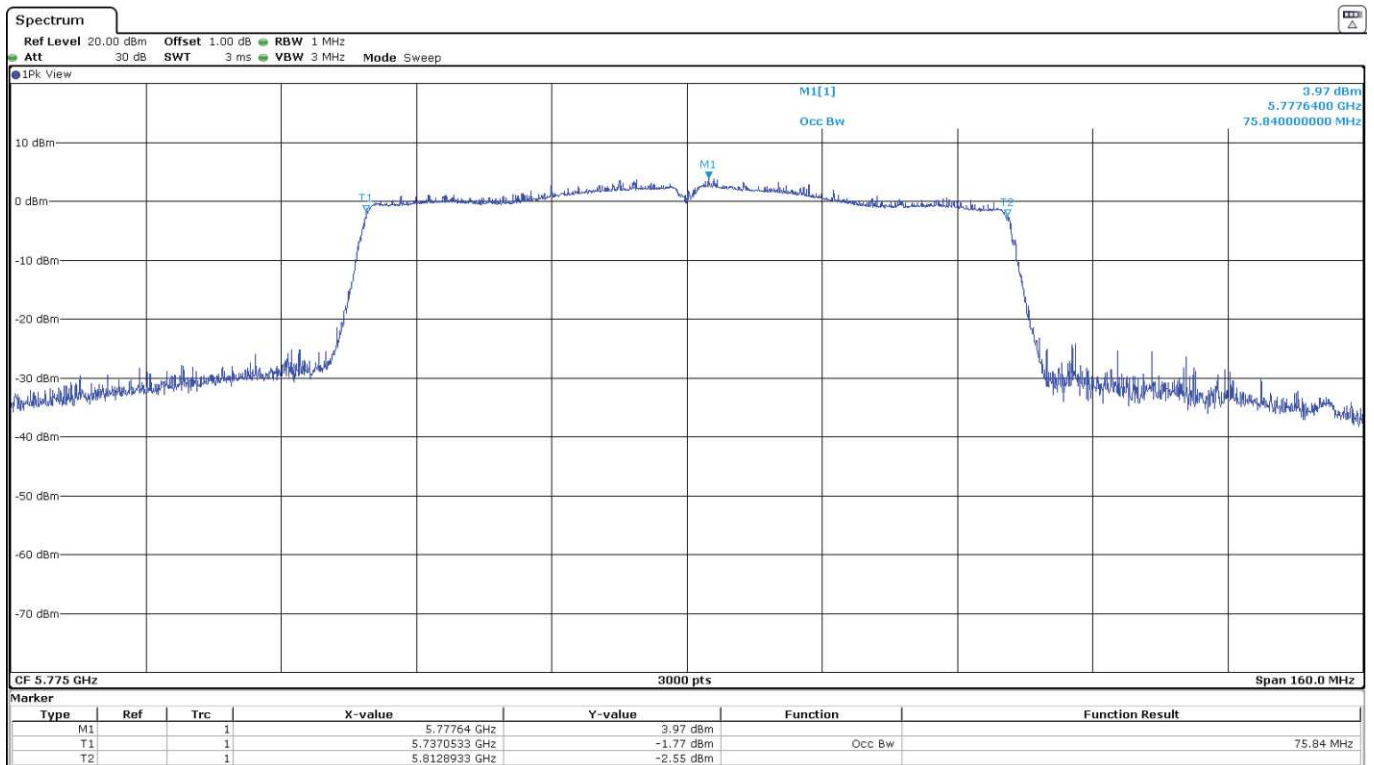
U-NII-1 (5150-5250 MHz)

- Single Channel 42 (5210 MHz):



U-NII-3 (5725-5850 MHz)

- Single Channel 155 (5775 MHz):



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

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TEST CONDITIONS

POWER SUPPLY (V):

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

ANTENNAS:

Type of Antenna: External.
 Antennas Gain:

- SISO – CORE0_Port3 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 MCS23	
	802.11n HT40: MCS0 to MCS23	
	802.11ac VHT20: MCS0 to MCS9	
	802.11ac VHT40: MCS0 to MCS9	
	802.11ac VHT80: MCS0 to MCS9	
Setting of cores / ports:	SISO CORE0_Port3.	
Beamforming:	No.	
Frequency Range:	5150 MHz to 5250 MHz	
Channel Spacing:	20 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Lowest: 36	5180
	Middle: 40	5200
	Highest: 48	5240
Channel Spacing:	40 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Lowest: 38	5190
	Highest: 46	5230
Channel Spacing:	80 MHz	
Transmit Channels	Middle: 42	5210

The test set-up was made in accordance to 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 in 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 for output power and spurious levels at the band edges which were selected based on preliminary testing that correspond to next data rates:

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

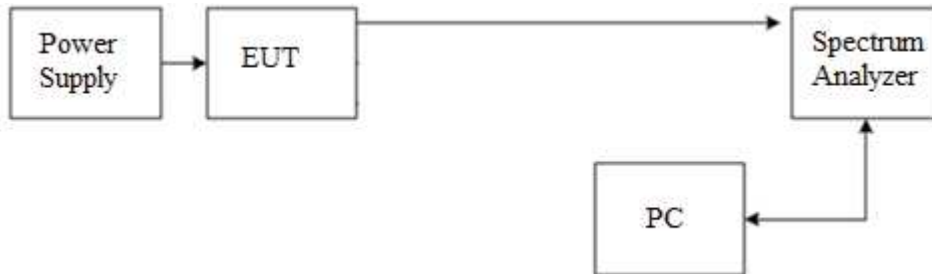
WIFI FCC:

```
tx_test.sh -a wlan0 stop
a20 - Core0
tx_test.sh -a wlan0 36 0 -d x -r 6 20 -c US
tx_test.sh -a wlan0 40 0 -d x -r 6 20 -c US
tx_test.sh -a wlan0 48 0 -d x -r 6 20 -c US
n20 - Core0
tx_test.sh -a wlan0 36 0 -d x -h 0 20 -c US
tx_test.sh -a wlan0 40 0 -d x -h 0 20 -c US
tx_test.sh -a wlan0 48 0 -d x -h 0 20 -c US
ac20 - Core0
tx_test.sh -a wlan0 36 0 -d x -v 0 20 -c US
tx_test.sh -a wlan0 40 0 -d x -v 0 20 -c US
tx_test.sh -a wlan0 48 0 -d x -v 0 20 -c US
n40 - Core0
tx_test.sh -a wlan0 40 0 -d x -h 0 40 -c US
tx_test.sh -a wlan0 48 0 -d x -h 0 40 -c US
ac40 - Core0
tx_test.sh -a wlan0 40 0 -d x -v 0 40 -c US
tx_test.sh -a wlan0 48 0 -d x -v 0 40 -c US
ac80 - Core0
tx_test.sh -a wlan0 40 0 -d x -v 0 80 -c US
```

CONDUCTED MEASUREMENTS:

The equipment under test was set up in a shielded room and connected to the spectrum analyzer using a low loss RF cable. The reading in the spectrum analyzer is corrected taking into account the internal and external RF cable loss.

For all modes:



The DC supply voltage is applied using an external power supply.

RADIATED MEASUREMENTS:

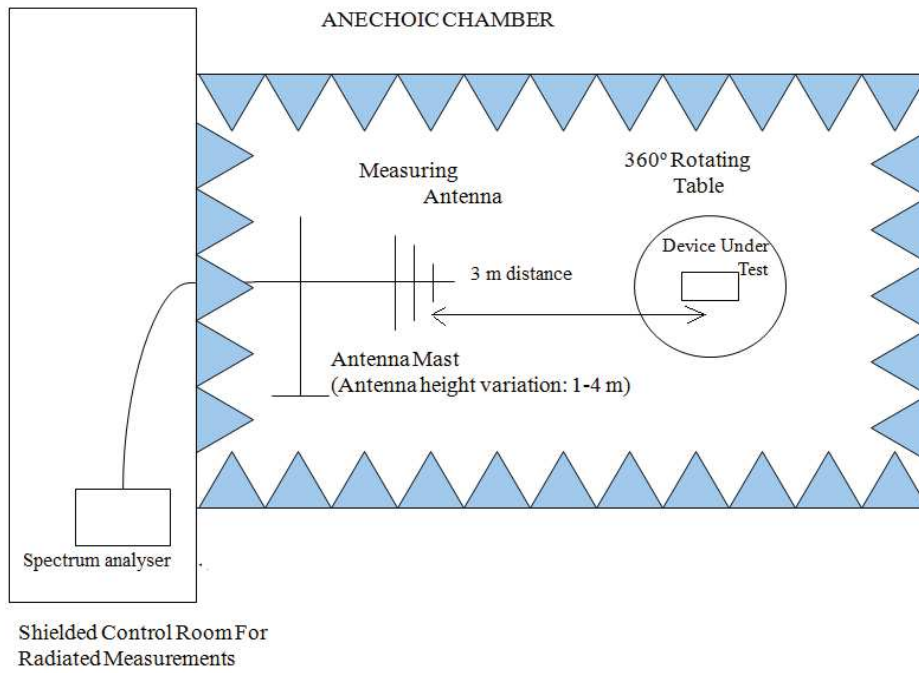
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1 GHz and 1 GHz-17 GHz Double ridge horn antenna) is situated at a distance of 3 m and at a distance of 1m for the frequency range 17 GHz-26 GHz (17 GHz-26 GHz horn antenna).

For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

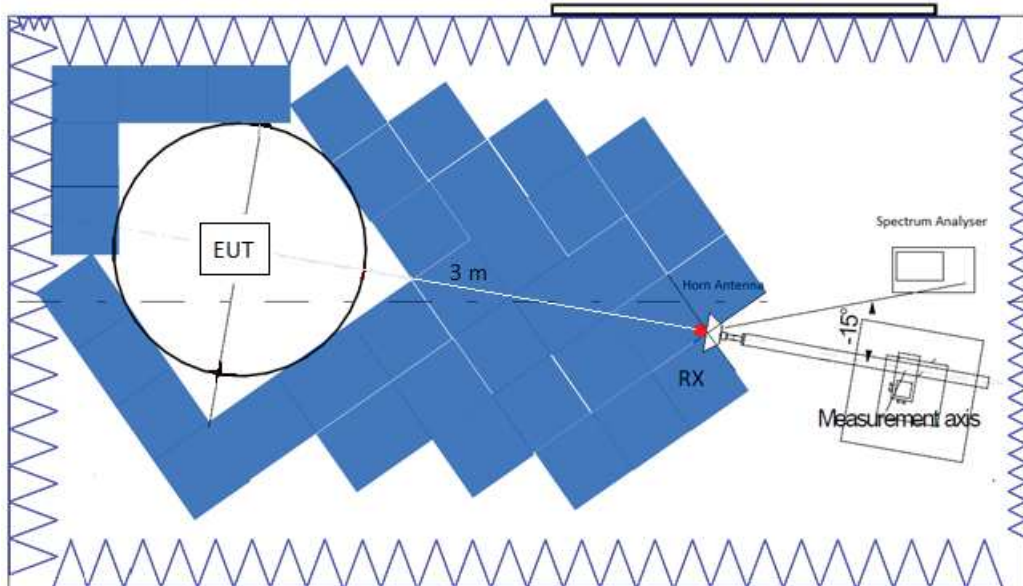
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find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

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

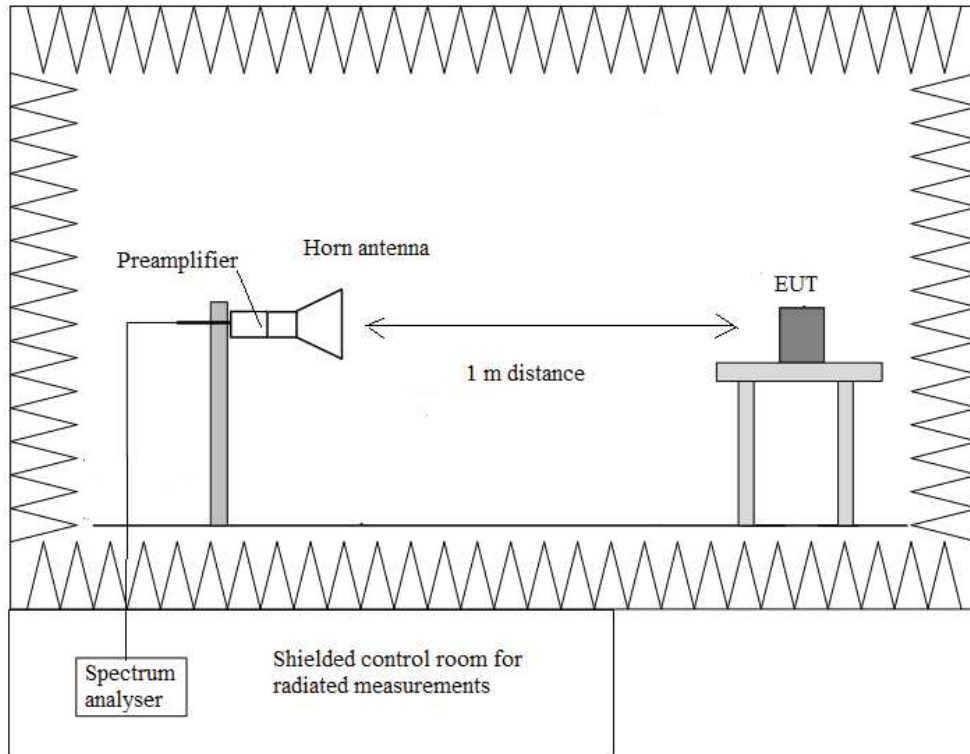
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



FCC 15.407 (a)(1)(iv) / RSS-247 6.2.1.1 Transmitter Maximum Conducted Output Power

SPECIFICATION:

FCC 15.407: For client devices in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW (24 dBm) provided the maximum antenna gain does not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS-247: The maximum e.i.r.p. shall not exceed 200 mW (23 dBm) or $10 + 10 \log_{10} B$, dBm, whichever power is less. B is the 99% emission bandwidth in MHz.

RESULTS:

The maximum conducted output power was measured using the channel power integration method according to point E) 2) b) (Method SA-1) of 789033 D02 General UNII Test Procedures New Rules v02r01 when the duty cycle is >98% and the channel power integration method according to point E) 2) d) (Method SA-2) of 789033 D02 General UNII Test Procedures New Rules v02r01 when the duty cycle is <98%.

For data rates where the EUT was transmitting at <98% duty cycle, the duty calculated in Appendix A was added to the measured power in order to calculate the total average power during the actual transmission time.

The e.i.r.p. levels are calculated by adding the declared maximum antenna gain (dBi).

- SISO – CORE0_Port3 Antenna – Maximum Declared Antenna Gain: +2.5 dBi

For all modes of operation, the antenna gain is less than 6 dBi.

SISO – CORE0_Port3 Antenna:

- **802.11 a20:**

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Max. Conducted Power (dBm)	7.17	7.48	7.46
Duty Cycle Correction Factor (dB)	0.99		
Max. Conducted Power Corrected (dBm)	8.16	8.47	8.45
Max. EIRP power Corrected (dBm)	10.66	10.97	10.95
Measurement uncertainty (dB)	<±2.57		

- **802.11 n20:**

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Max. Conducted Power (dBm)	6.89	7.19	7.28
Duty Cycle Correction Factor (dB)	1.04		
Max. Conducted Power Corrected (dBm)	7.93	8.23	8.32
Max. EIRP power Corrected (dBm)	10.43	10.73	10.82
Measurement uncertainty (dB)	<±2.57		

- **802.11 n40:**

	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
Max. Conducted Power (dBm)	6.76	7.01
Duty Cycle Correction Factor (dB)	1.93	
Max. Conducted Power Corrected (dBm)	8.69	8.94
Max. EIRP power Corrected (dBm)	11.19	11.44
Measurement uncertainty (dB)	<±2.57	

- **802.11 ac80:**

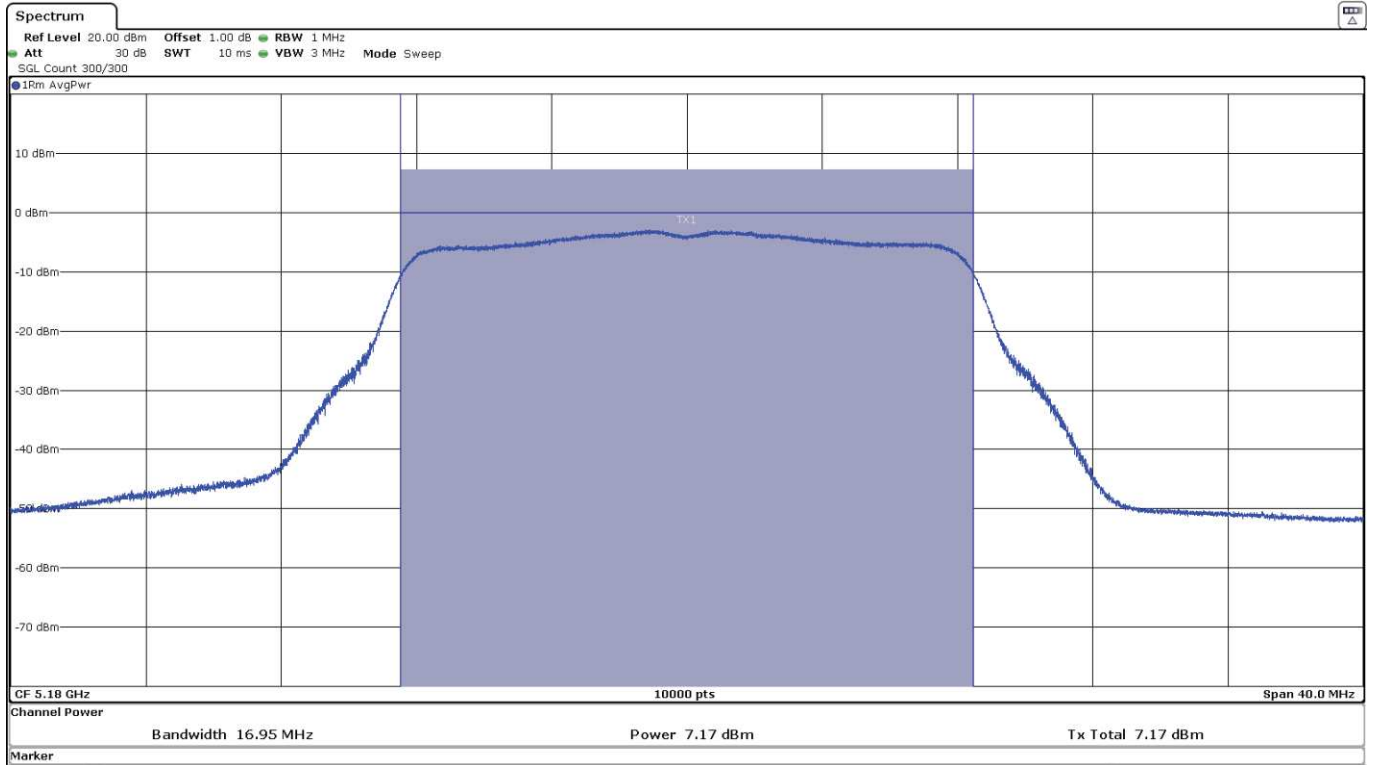
	Single Channel 42 (5210 MHz)
Max. Conducted Power (dBm)	4.31
Duty Cycle Correction Factor (dB)	3.31
Max. Conducted Power Corrected (dBm)	7.62
Max. EIRP power Corrected (dBm)	10.12
Measurement uncertainty (dB)	<±2.57

Verdict: PASS

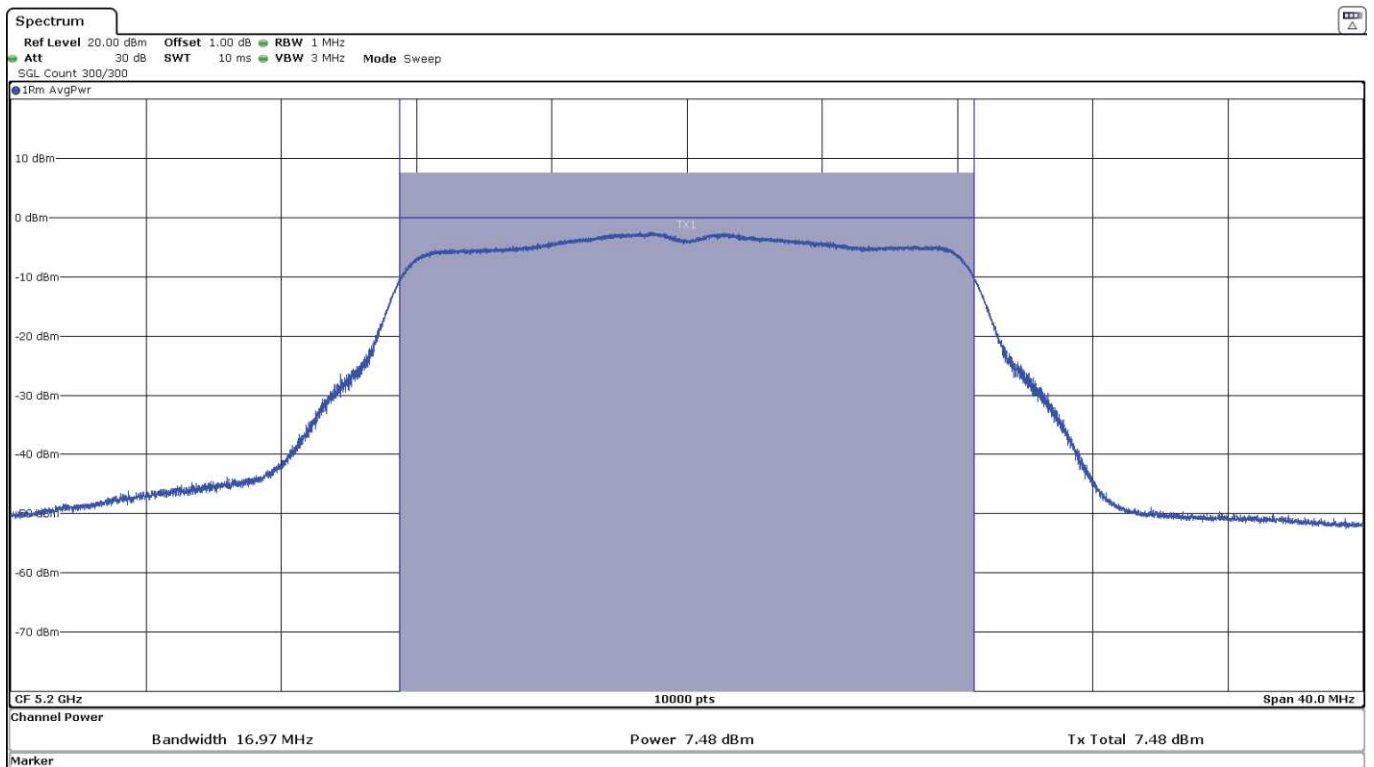
SISO – CORE0_Port3 Antenna:

- 802.11 a20:

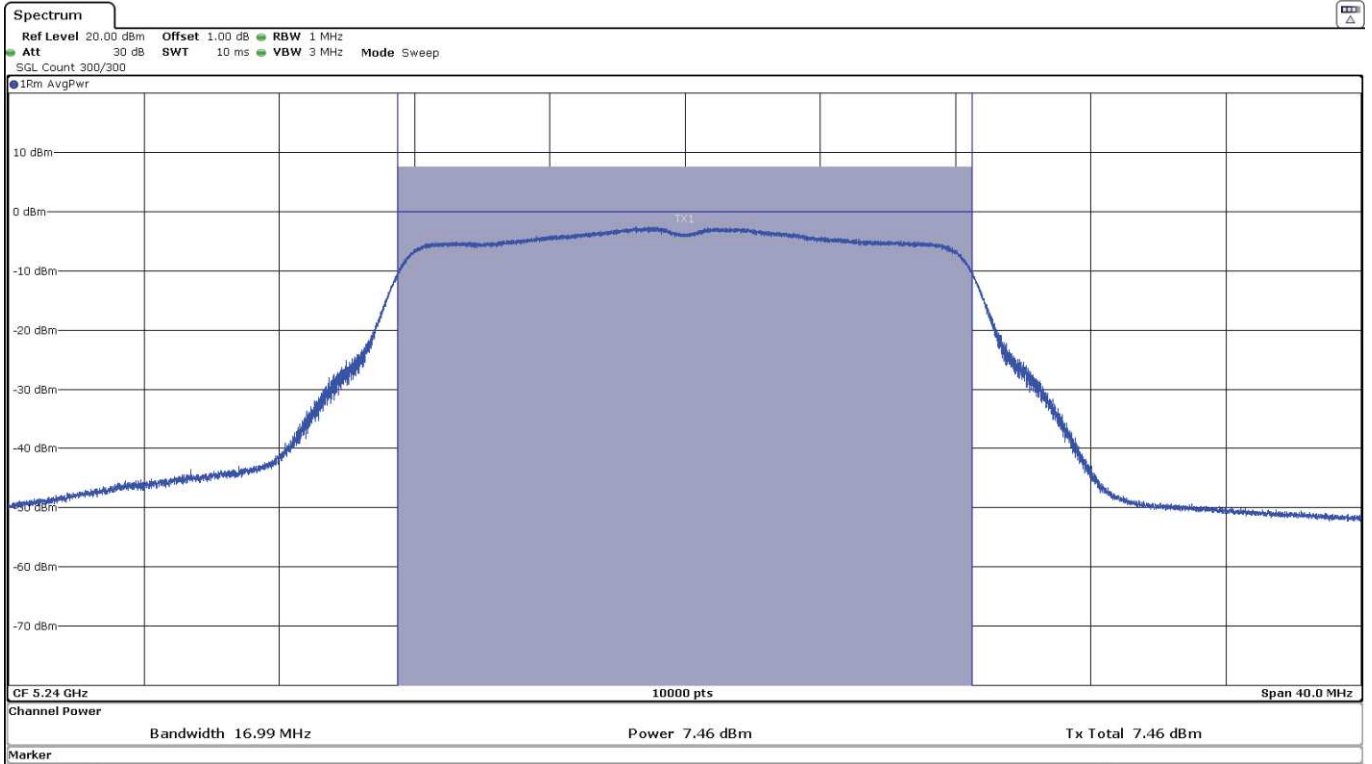
- Low Channel 36:



- Middle Channel 40:

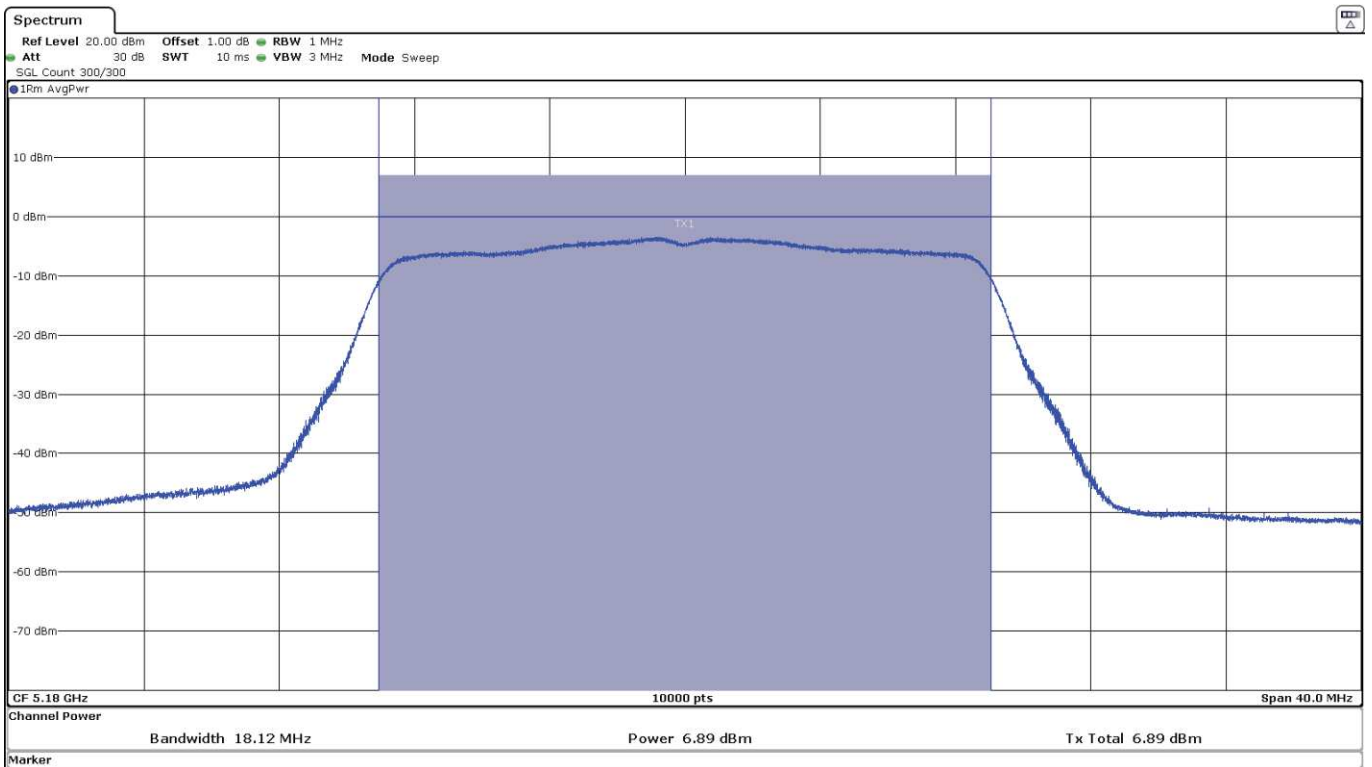


- High Channel 48:

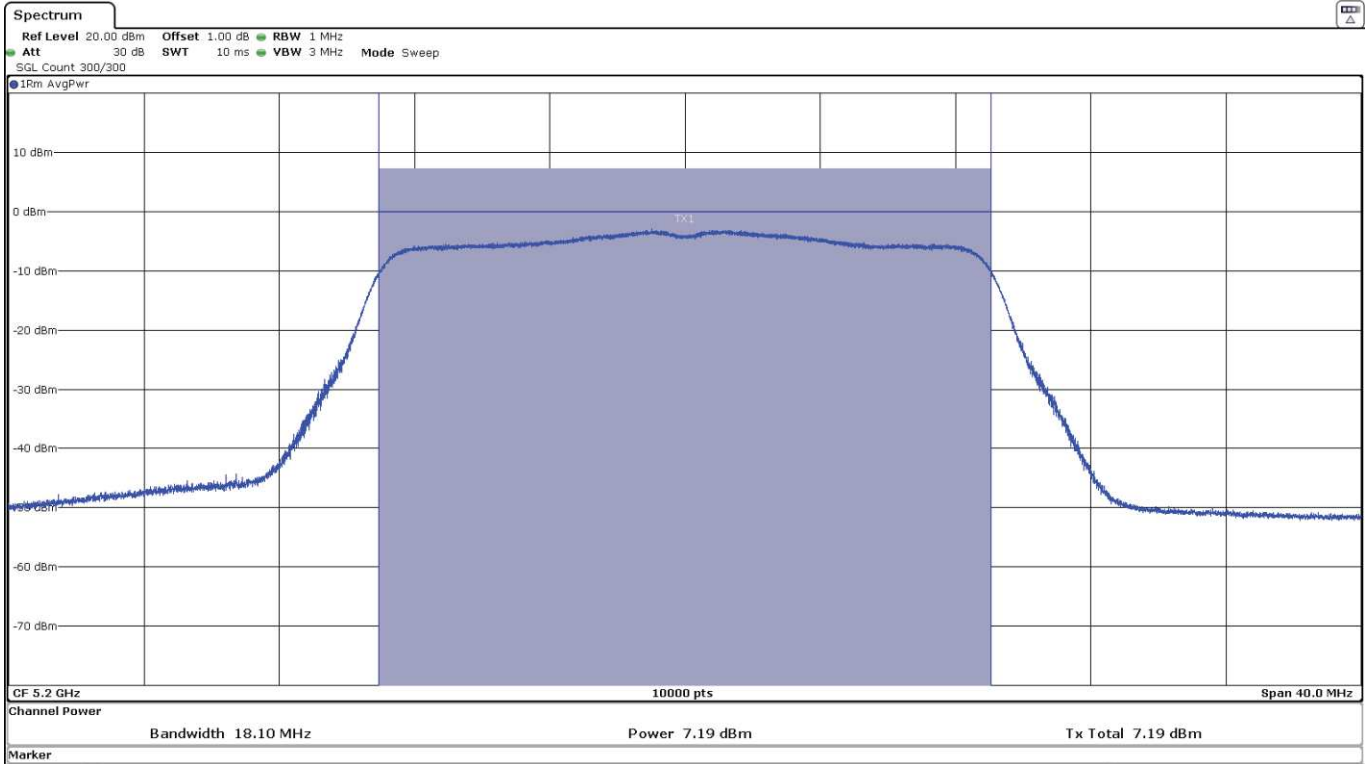


- 802.11 n20:

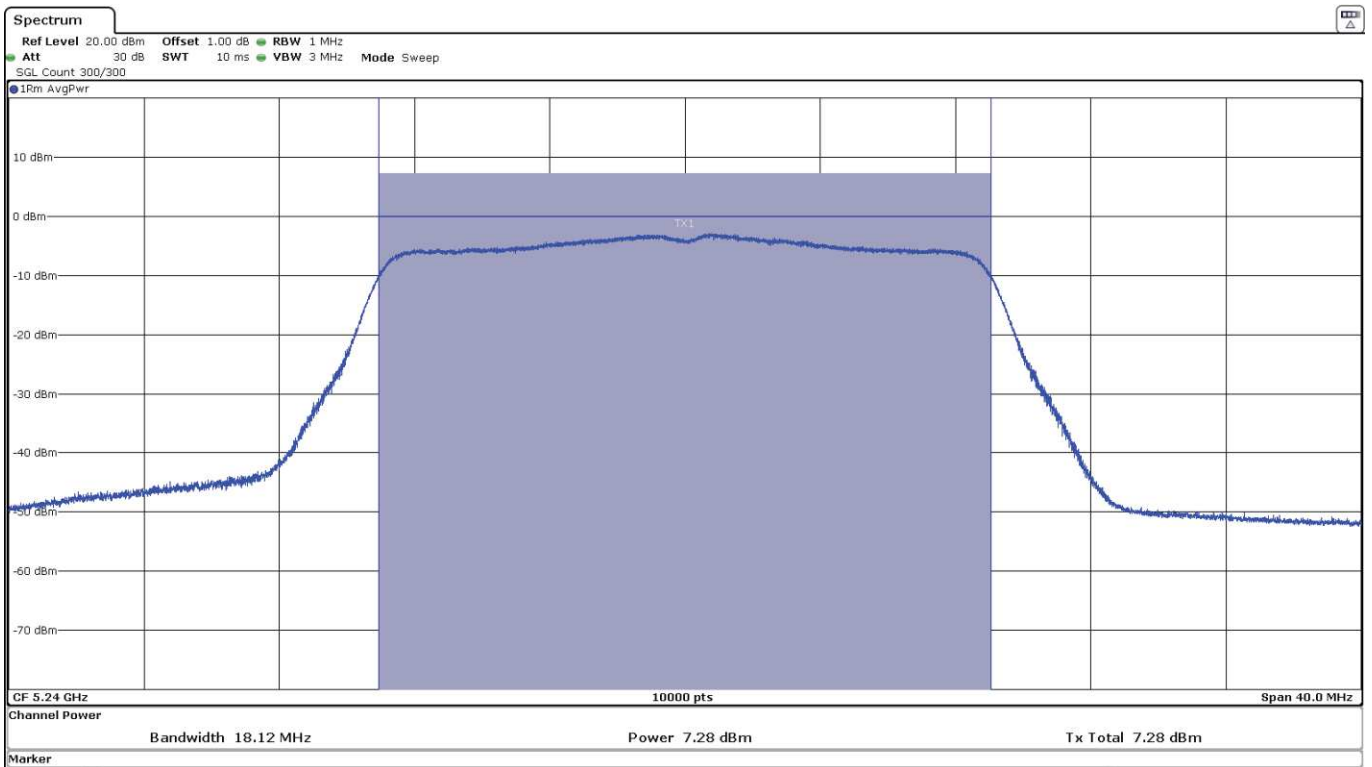
- Low Channel 36:



- Middle Channel 40:

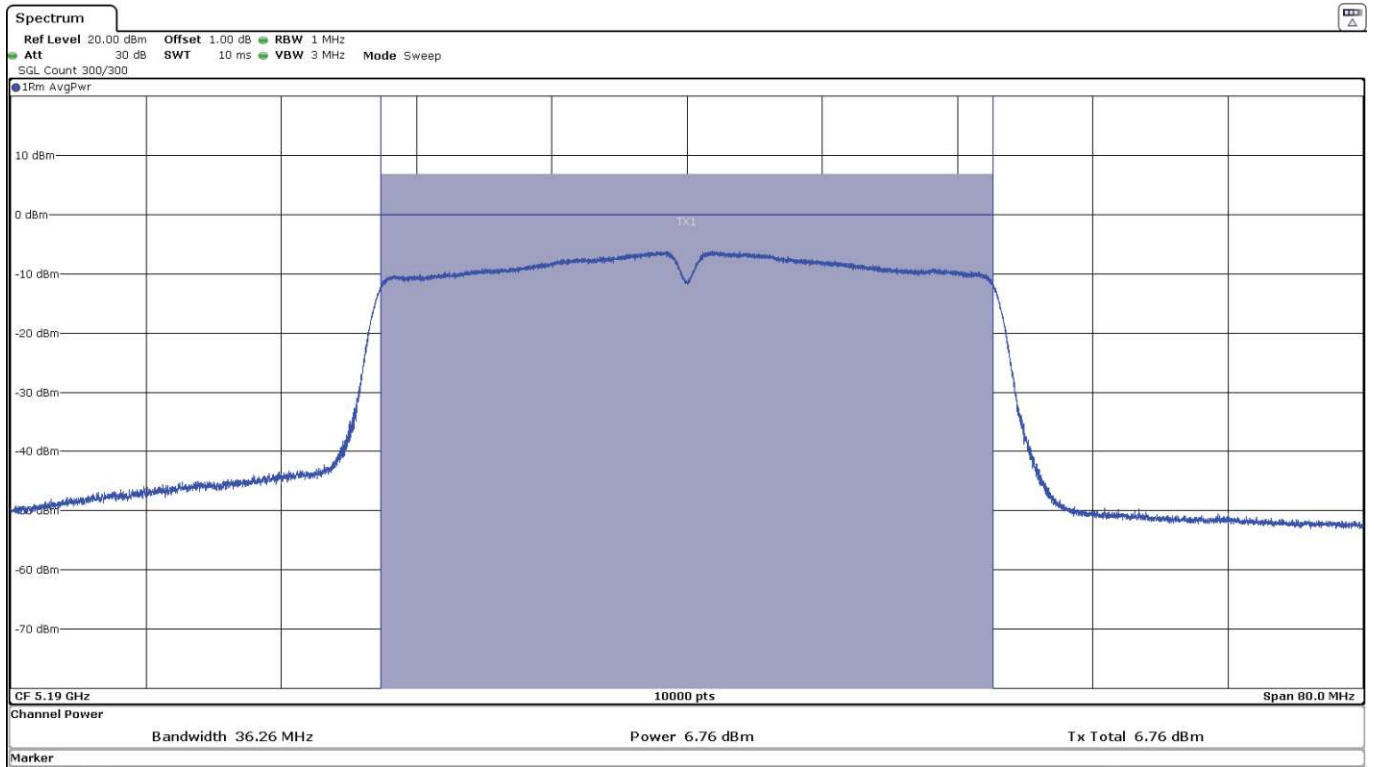


- High Channel 48:

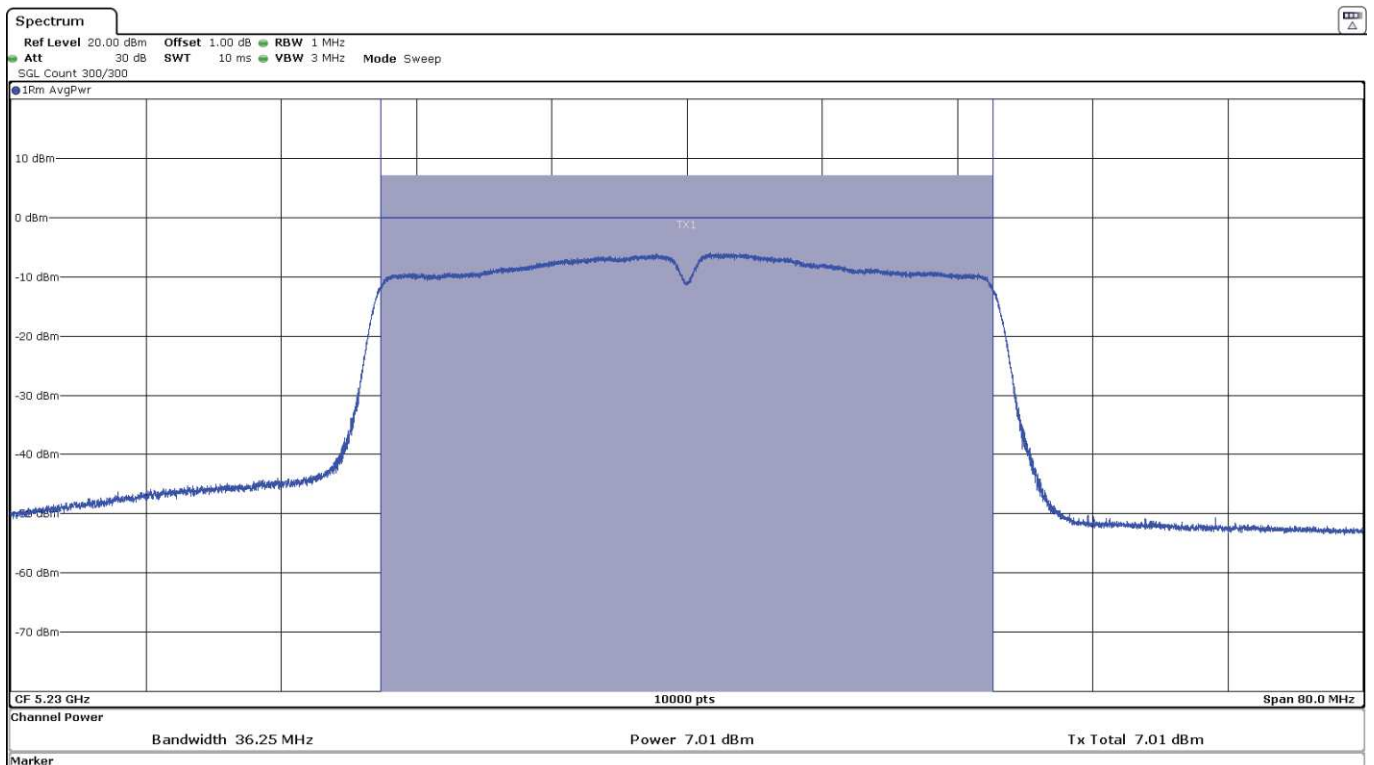


• 802.11 n40:

- Low Channel 38:

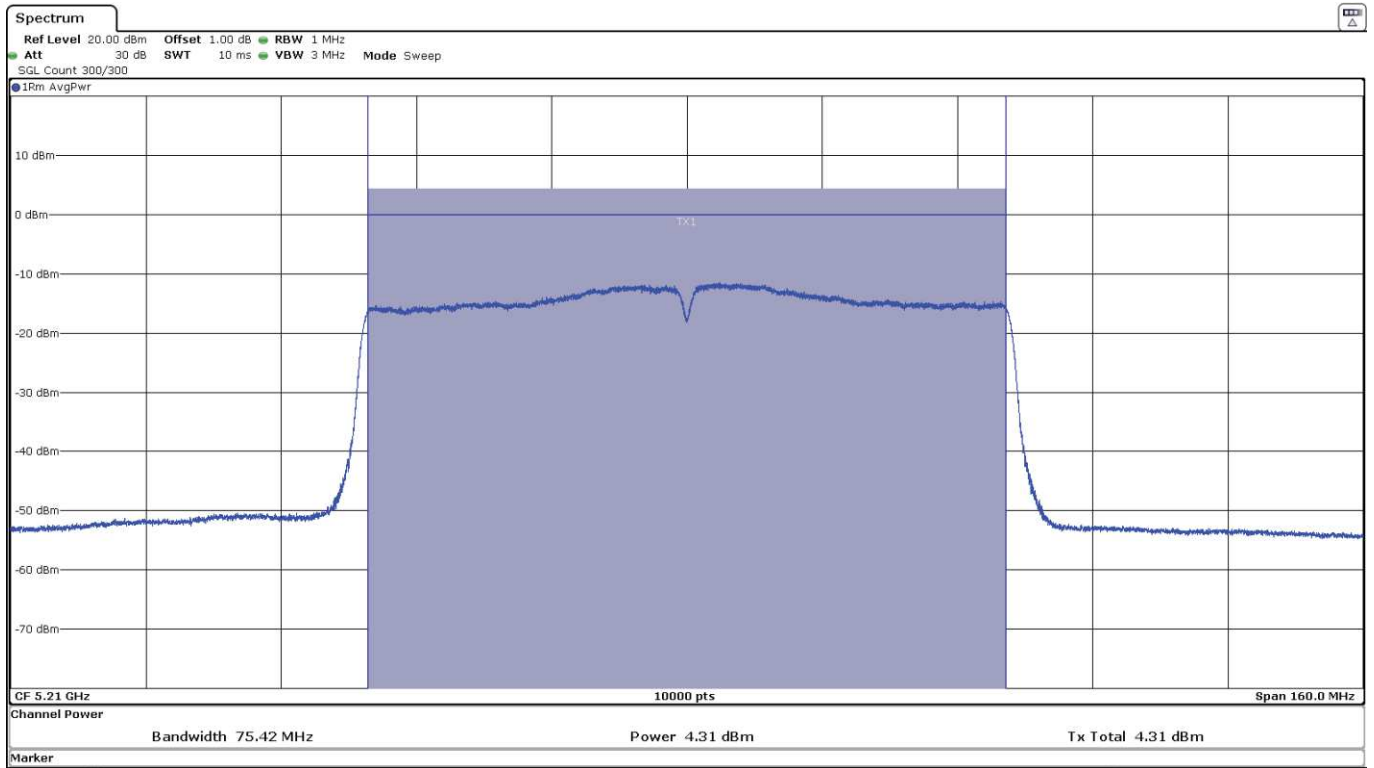


- High Channel 46:



- 802.11 ac80:

- Single Channel 42:



FCC 15.407 (b)(1)(6) / RSS-247 6.2.1.2. Out of Band Radiated Emissions

SPECIFICATION:

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
960 - 40000	500	54	3

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

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

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

All tests were performed in a semi-anechoic chamber at a distance of 1m for the frequency range 17 GHz-40 GHz and a distance of 3m for frequency range 30MHz-17GHz.

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

The worst case was determined by measuring the eirp density (radiated).

- **Test performed on the worst case: 802.11 a20**, with a bit rate of 6 Mbps.

SISO CORE0_Port3 Antenna:

Frequency range 30 MHz - 1 GHz:

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

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

Spurious frequency (MHz)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
375.029	26.86	46	V	Quasi-Peak	< \pm 5.08

Frequency range 1 - 40 GHz:

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

The Low, Middle and High Channels were measured for out-of-band emissions for the worst mode.

Spurious frequencies with peak levels above the average limit (54 dB μ V/m at 3 m) are measured with an average detector for checking compliance with the average limit.

- **802.11 a20 (worst case):**

- LOW CHANNEL. Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
10.3603	61.09	68.23	V	Peak	< \pm 5.13

- MIDDLE CHANNEL. Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
10.4023	63.29	68.23	H	Peak	< \pm 5.13

- HIGH CHANNEL. Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
10.47667	63.95	68.23	H	Peak	< \pm 5.13

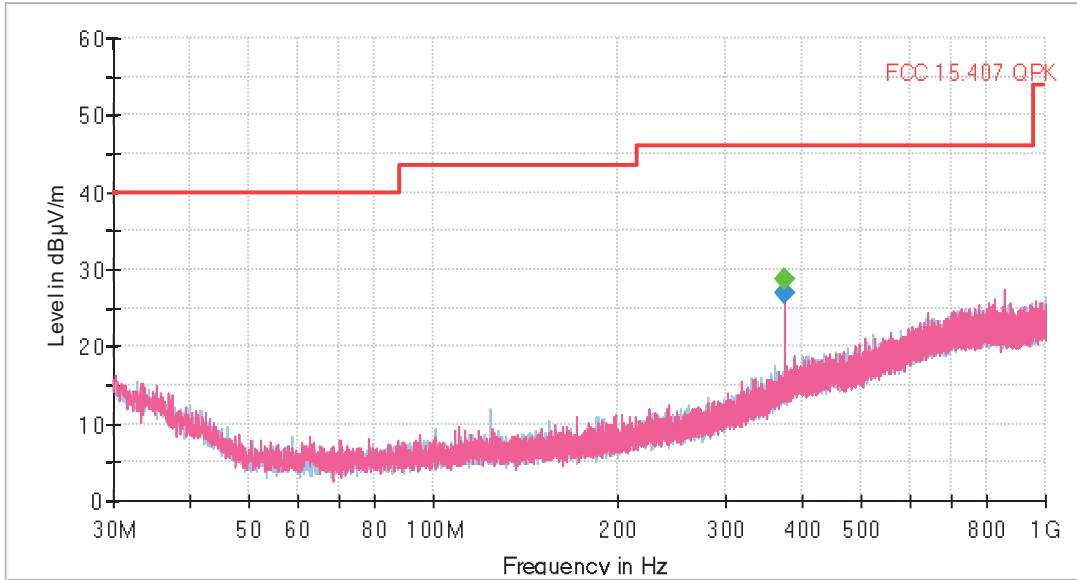
Measurement Uncertainty (dB): 1GHz-7GHz < \pm 4.11
 17GHz-26GHz < \pm 4.82
 26GHz-40GHz < \pm 4.5.14

Verdict: PASS

SISO CORE0_Port3 Antenna:

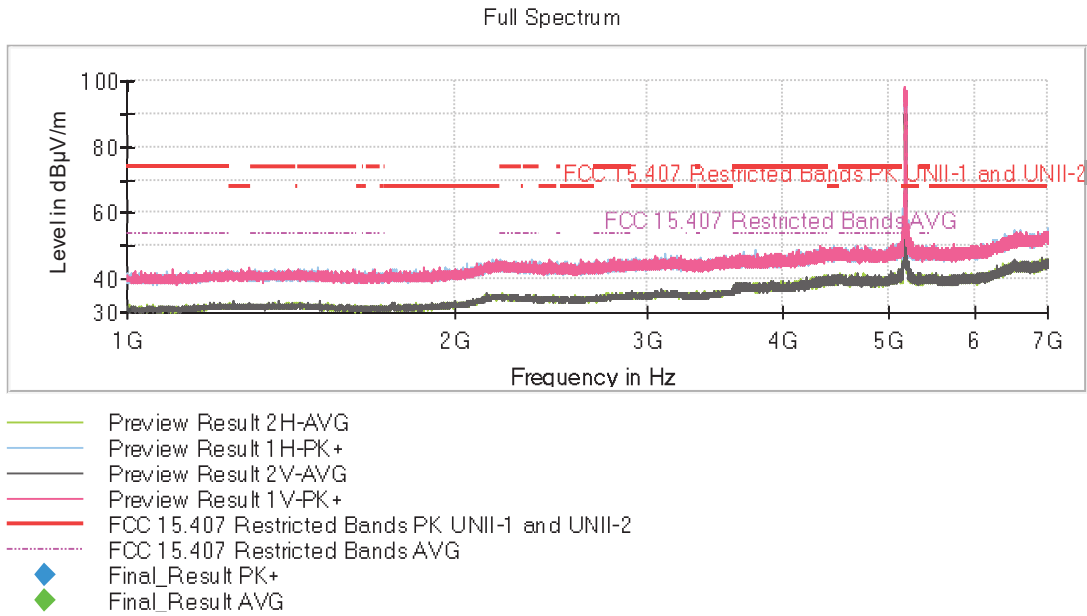
FREQUENCY RANGE 30 MHz - 1 GHz:

This plot is valid for the Low, Middle and High Channels and all the modulation modes.



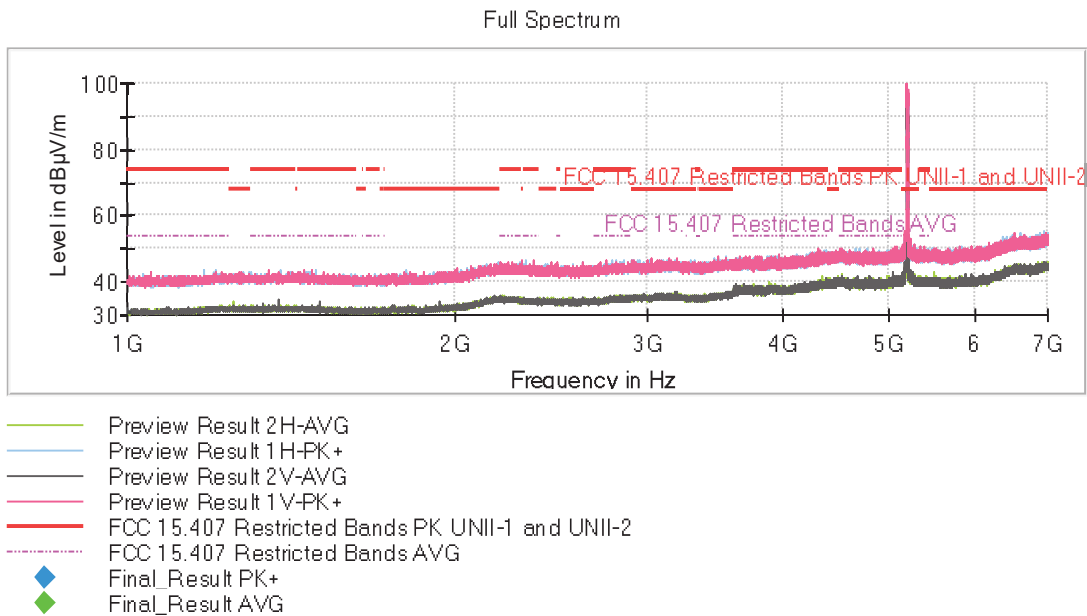
FREQUENCY RANGE 1 – 7 GHz (worst case)

- Low Channel:



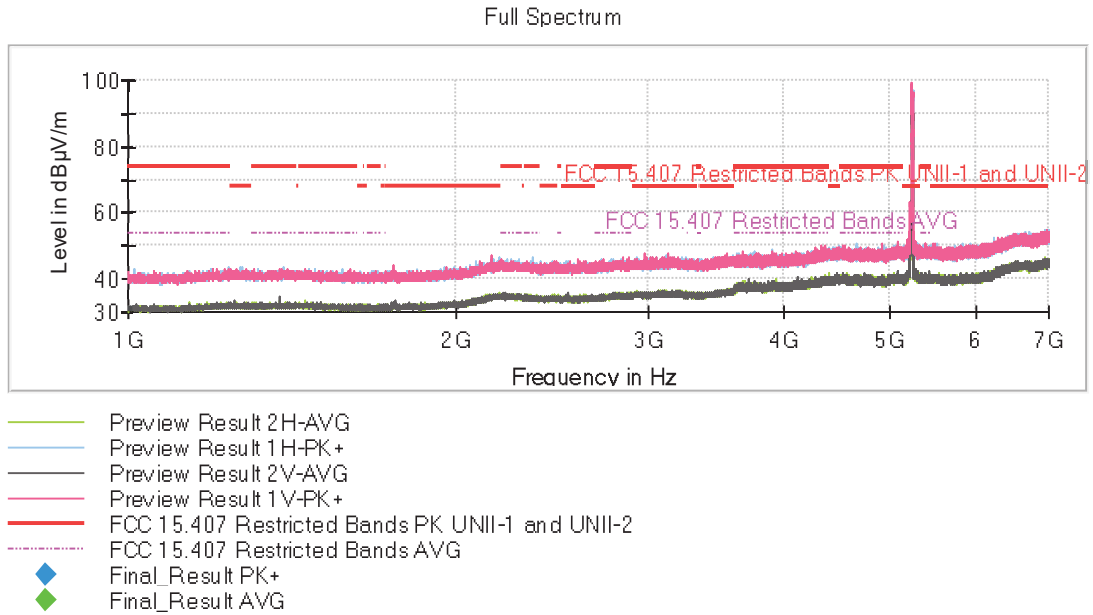
Note: The peak shown in the plot above the limit is the carrier frequency.

- Middle Channel:



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

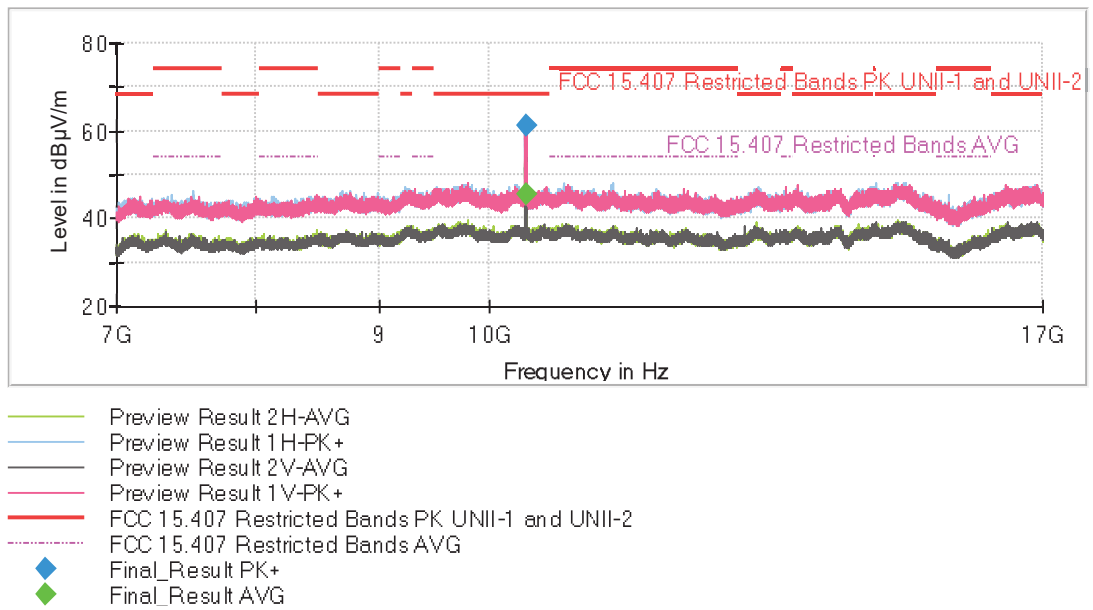
- High Channel:



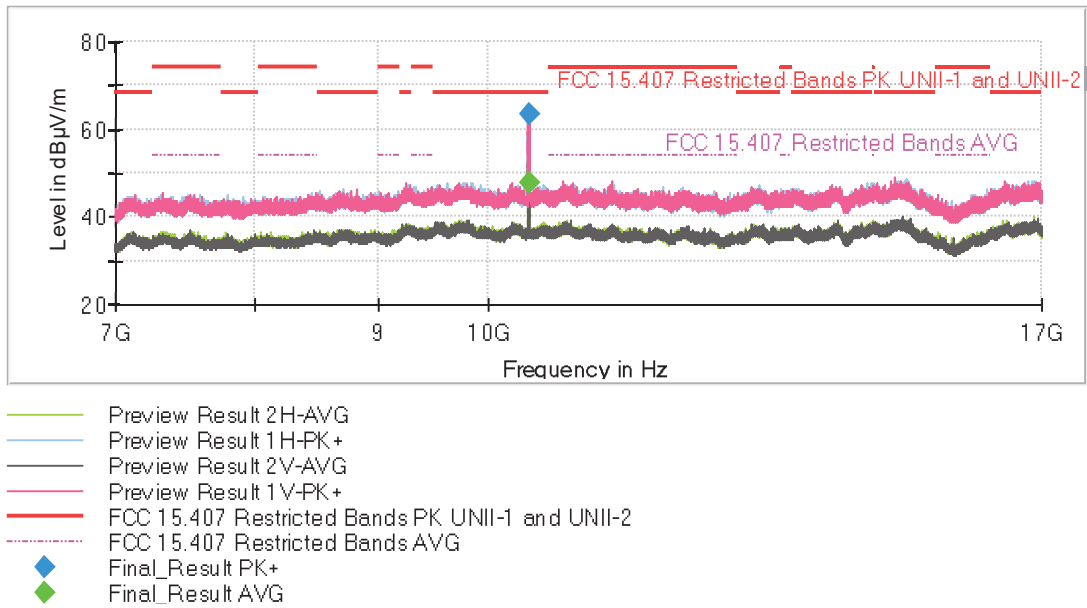
Note: The peak shown in the plot above the limit is the carrier frequency.

FREQUENCY RANGE 7 - 17 GHz. (worst case)

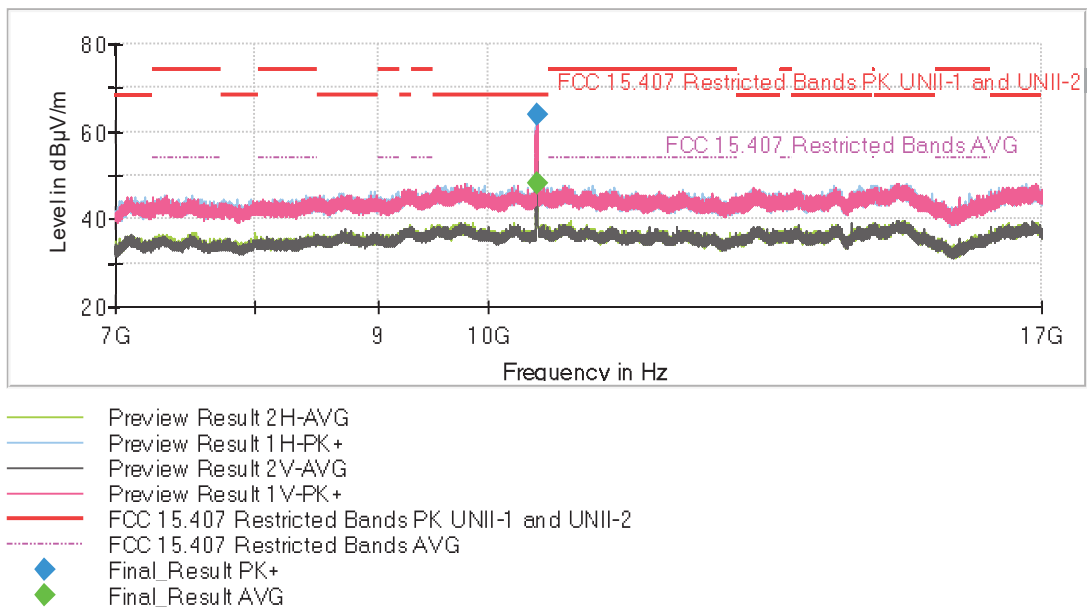
- Low Channel:



- Middle Channel:

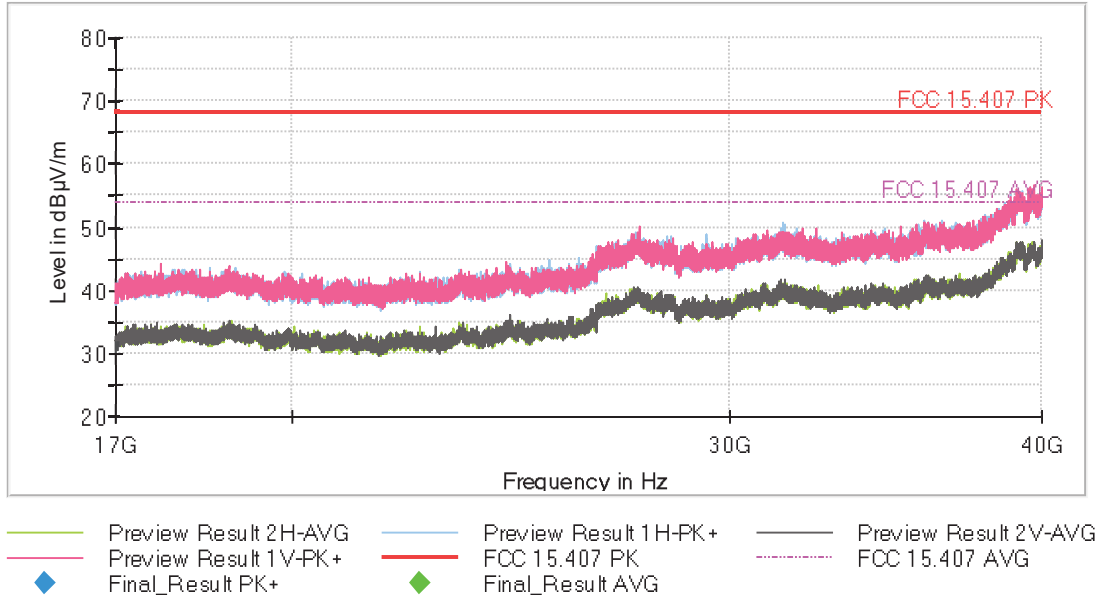


- High Channel:



FREQUENCY RANGE 17 - 40 GHz (worst case)

This plot is valid for the Low, Middle and High Channels and all the modulation modes.



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

SPECIFICATION:

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
960 - 40000	500	54	3

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

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

RESULTS:

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

All emissions outside of the 5.15-5.35GHz band shall not exceed an EIRP of -27dBm/MHz. There are restricted bands of operation below band edge at 4.5-5.15 GHz also above the upper band edge at 5.35-5.46GHz therefore the provision of FCC Part 15.205 apply.

Field strength measurements using peak and average detector performed in the restricted bands below 5.15GHz and above 5.35 GHz.

Test performed on the following worst cases modes in all relevant tests channels:

- 802.11a: 6 Mbit/s / SISO on CORE0_Port3 Antenna.
- 802.11n HT20: MCS0 / SISO on CORE0_Port3 Antenna.
- 802.11ac VHT20: MCS0 / SISO on CORE0_Port3 Antenna.
- 802.11n HT40: MCS0 / SISO on CORE0_Port3 Antenna.
- 802.11ac VHT40: MCS0 / SISO on CORE0_Port3 Antenna.
- 802.11ac VHT80: MCS0 / SISO on CORE0_Port3 Antenna.

SISO CORE0_Port3 Antenna:

- **802.11 a20:**

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

No spurious frequencies detected at less than 20 dB below the limit.

Measurement Uncertainty (dB): $<\pm 4.11$

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

No spurious frequencies detected at less than 20 dB below the limit.

Measurement Uncertainty (dB): $<\pm 4.11$

- **802.11 n20:**

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

No spurious frequencies detected at less than 20 dB below the limit.

Measurement Uncertainty (dB): $<\pm 4.11$

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

No spurious frequencies detected at less than 20 dB below the limit.

Measurement Uncertainty (dB): $<\pm 4.11$

- **802.11 ac20:**

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

No spurious frequencies detected at less than 20 dB below the limit.

Measurement Uncertainty (dB): $<\pm 4.11$

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

No spurious frequencies detected at less than 20 dB below the limit.

Measurement Uncertainty (dB): $<\pm 4.11$

• **802.11 n40:**

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

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

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5.1334	57.35	74	H	Peak	<±4.11
	38.36	54		Average	<±4.11
5.1386	59.84	74	H	Peak	<±4.11
	38.64	54		Average	<±4.11
5.1476	63.18	74	H	Peak	<±4.11
	41.55	54		Average	<±4.11
5.1488	61.22	74	H	Peak	<±4.11
	40.84	54		Average	<±4.11
5.1494	63.14	74	H	Peak	<±4.11
	41.50	54		Average	<±4.11

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

No spurious frequencies detected at less than 20 dB below the limit.

Measurement Uncertainty (dB): <±4.11

• **802.11 ac40:**

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

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

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5.1464	62.01	74	V	Peak	<±4.11
	39.97	54		Average	<±4.11
5.1488	63.02	74	H	Peak	<±4.11
	40.83	54		Average	<±4.11
5.1492	60.97	74	V	Peak	<±4.11
	39.53	54		Average	<±4.11
5.150	61.76	74	V	Peak	<±4.11
	40.04	54		Average	<±4.11

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

No spurious frequencies detected at less than 20 dB below the limit.

Measurement Uncertainty (dB): <±4.11

- **802.11 ac80:**

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

No spurious frequencies detected at less than 20 dB below the limit.

Measurement Uncertainty (dB): $<\pm 4.11$

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

No spurious frequencies detected at less than 20 dB below the limit.

Measurement Uncertainty (dB): $<\pm 4.11$

Verdict: PASS