MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*

914 WEST PATAPSCO AVENUE ● BALTIMORE, MARYLAND 21230-3432 ● PHONE (410) 354-3300 ● FAX (410) 354-3313
33439 WESTERN AVENUE ● UNION CITY, CALIFORNIA 94587 ● PHONE (510) 489-6300 ● FAX (510) 489-6372
3162 BELICK STREET ● SANTA CLARA, CALIFORNIA 95054 ● PHONE (408) 748-3585 ● FAX (510) 489-6372
13501 MCCALLEN PASS ● AUSTIN, TX 78753 ● PHONE (512) 287-2500 ● FAX (512) 287-2513

March 14, 2018

Caterpillar Inc.
100 NE Adams St.
Peoria, IL 61629

Dear David Mitchell,

Enclosed is the EMC Wireless test report for compliance testing of the Caterpillar Inc., PL671 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Title 47 of the CFR, Part 15.407, Subpart E (UNII 1).

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,
MET LABORATORIES, INC.

Joel Huna
Documentation Department

Reference: (\Caterpillar Inc.\ EMC95659-FCC407 UNII 1 Rev. 2)

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Electromagnetic Compatibility Criteria
Test Report

for the

Caterpillar Inc.
Model PL671

Tested under
The FCC Certification Rules
contained in
Title 47 of the CFR
15.407 Subpart E

MET Report: EMC95659-FCC407 UNII 1 Rev. 2

March 14, 2018

Prepared For:

Caterpillar Inc.
100 NE Adams St.
Peoria, IL 61629

Prepared By:
MET Laboratories, Inc.
914 West Patapsco Avenue, Baltimore, MD 21230

Electromagnetic Compatibility Criteria
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Title 47 of the CFR
15.407 Subpart E

Deepak Giri, Project Engineer
Electromagnetic Compatibility Lab

Joel Huna
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Parts 15B, 15.407, of the FCC Rules under normal use and maintenance.

John Mason,
Director, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	January 23, 2018	Initial Issue.
1	March 1, 2018	FCC ID Update.
2	March 14, 2018	TCB Corrections and Customer Name Change.

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List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci**b**els
dBµA	**D**eci**b**els above one **micro**amp
dBµV	**D**eci**b**els above one **micro**volt
dBµA/m	**D**eci**b**els above one **micro**amp **per m**eter
dBµV/m	**D**eci**b**els above one **micro**volt **per m**eter
DC	**D**irect **C**urrent
E	**E**lectric Field
DSL	**D**igital **S**ubscriber **L**ine
ESD	**E**lectro**s**tatic **D**ischarge
EUT	**E**quipment **U**nder **T**est
f	**F**requency
FCC	**F**ederal **C**ommunications **C**ommission
GRP	**G**round **R**eference **P**lane
H	Magnetic Field
HCP	**H**orizontal **C**oupling **P**lane
Hz	**H**ert**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**K**ilo**h**ert**z**
kPa	**K**ilo**pa**scal
kV	**K**ilo**v**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**Microh**enry
µ	**Microf**arad
µs	**Micros**econds
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
TWT	**T**raveling **W**ave **T**ube
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Caterpillar Inc. PL671, with the requirements of Part 15, §15.407. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the PL671. Caterpillar Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the PL671, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.407, in accordance with Caterpillar Inc., purchase order number PO9516. All tests were conducted using measurement procedure ANSI C63.4-2014.

FCC Reference	Description	Results
§15.203	Antenna Requirement	Compliant
§15.403(i)	26dB Occupied Bandwidth	Compliant
§15.407 (a)(1)	Maximum Conducted Output Power	Compliant
§15.407 (a)(1)	Maximum Power Spectral Density	Compliant
§15.407 (b)(1)& (6 - 7)	Undesirable Emissions	Compliant
§15.407(b)(6)	Conducted Emission Limits	Not Applicable
§15.407(f)	RF Exposure	Compliant

Table 1. Executive Summary of EMC Part 15.407 ComplianceTesting

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Caterpillar Inc. to perform testing on the PL671, under Caterpillar Inc.'s purchase order number PO9516.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Caterpillar Inc. PL671.

The results obtained relate only to the item(s) tested.

Model(s) Tested:	PL671	
Model(s) Covered:	PL671	
EUT Specifications:	Primary Power: 9 - 32 VDC	
	FCC ID: PQMPL671	
	Type of Modulations:	BPSK, QPSK, 16QAM
	Equipment Code:	NII
	Max. RF Output Power:	18.09 dBm
	EUT Frequency Ranges:	5180 MHz – 5240 MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35º C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Type of Filing:	Original	
Evaluated by:	Deepak Giri	
Report Date(s):	March 14, 2018	

Table 2. EUT Summary

B. References

CFR 47, Part 15, Subpart E	Unlicensed National Information Infrastructure Devices (UNII)
ANSI C63.4:2014	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
789033 D02 General UNII Test Procedures New Rules v02	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E

Table 3. References

C. Test Site

All testing was performed at MET Laboratories, Inc., 914 West Patapsco Avenue, Baltimore, MD 21230. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a 3 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

D. Description of Test Sample

The Caterpillar Inc. PL671, Equipment Under Test (EUT), is a dedicated short range communication (DSRC) device. Units are mounted on heavy machinery on both sides of the vehicle to minimize blind spots. It is intended to provide proximity information vehicle to vehicle. A dedicated radio module in the EUT is used to do provide this link. EUT can also communicate to a stationary device or device on a smaller vehicle by Wi-Fi or BT. A GNSS module inside the EUT provides positioning information to the EUT. The two EUTs communicate with each other and the vehicle using Ethernet. An audio module in the EUT can send audible warnings in case of collision possibilities.

E. Measurement Uncertainty

Test Method	Typical Expanded Uncertainty	K	Confidence Level
RF Frequencies	±4.52 Hz	2	95%
RF Power Conducted Emissions	±2.32 dB	2	95%
RF Power Conducted Spurious Emissions	±2.25 dB	2	95%
RF Power Radiated Emissions	±3.01 dB	2	95%

Table 4. Measurement Uncertainty

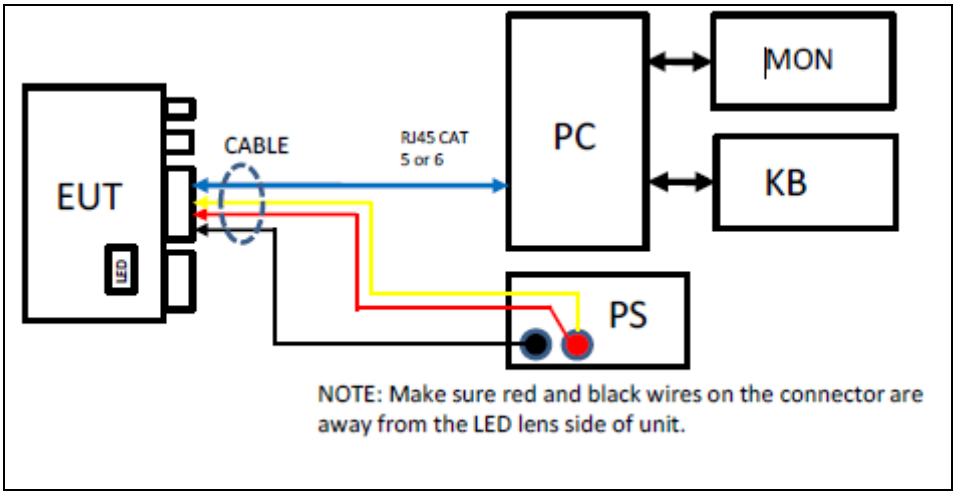
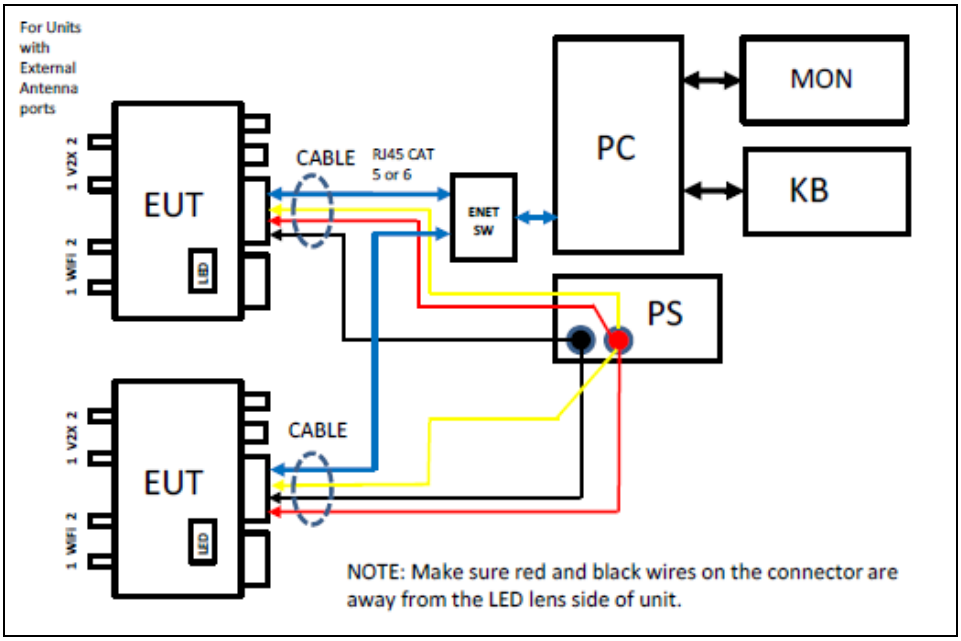


Figure 1. Block Diagram of Test Configuration 1.1



Note: EUT modified with antenna terminal only for test purposes. Otherwise, EUT will have permanent antenna.

Figure 2. Block Diagram of Test Configuration 1.2

F. Equipment Configuration

The EUT was set up as outlined in Figure 2, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Slot #	Name / Description	Model Number	Part Number	Serial Number	Revision
EUT	N/A	DSRC Radio	PL671			A

Table 5. Equipment Configuration

G. Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

Ref. ID	Name / Description	Manufacturer	Model Number	* Customer Supplied Calibration Data
PS	Power Supply	BK Precision	1697 or Equiv.	N/A
KB	Standard PC Keyboard	Dell	Any	N/A
PC	Computer	Dell	VOSTRO or Equiv.	N/A
MON	Monitor	Dell	Any	N/A
ENET SW	Ethernet Switch 10/100/1000	Linksys	EG005 or equiv.	N/A
The 'Customer Supplied Calibration Data' column will be marked as either not applicable, not available, or will contain the calibration date supplied by the customer.				

Table 6. Support Equipment

H. Ports and Cabling Information

Ref. ID	Port Name on EUT	Cable Description	Qty.	Length (m)	Max Length	Shielded (Y/N)	Termination Point
1	Data Cable	RJ45 CAT 5 or 6 on Quake Cable	2	TBD		No	12 PIN Conn.
2	Power Supply Leads	On Quake Conn. Red, Black, and Yellow		TBD		No	9-32V

Table 7. Ports and Cabling Information

I. Mode of Operation

Mode 1: The DSRC module in the EUT is put in a continuous transmit mode using the test script. It will broadcast at full power till turned off.
Mode 2: The Wi-Fi module in the EUT is put into continuous transmit mode using the test script. It will broadcast at full power till turned off.
Mode 3: The GNSS module in the EUT is activated using the test script and sends out NMEA data to the CPU. It will receive and send data till turned off. The EUT must be connected to an active antenna and have a clear sky view
Mode 4: The Ethernet is used to set up the test modes. The Ethernet is set to full duplex and set to communicate with the computer in a continuous mode.

J. Method of Monitoring EUT Operation

Mode 1: The DSRC is activated for the test menu using “d”. It will down load firmware to the DSRC module. A secondary menu will appear. Select “b” (TX with no GPS). Current will increase and a rolling script will appear in the terminal window continuously. Please refer to Quake document 1153-3011 for instructions.
Mode 2: The Wi-Fi is activated by opening another terminal. Use the test script to select “w”. Select TX mode. A continuous script will scroll in the terminal as the module transmits.
Mode 3: Open another terminal and select “g” to activate the GNSS module. The NMEA data stream from the module will scroll continuously.
Mode 4: Open another terminal and set up a ping on the ENET. Continuous acknowledgement will be sent.

K. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

L. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Caterpillar Inc. upon completion of testing.

III. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

Test Requirement: **§ 15.203:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

a.) Antenna must be permanently attached to the unit.

b.) Antenna must use a unique type of connector to attach to the EUT.

c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

Results: The EUT as tested is compliant the criteria of §15.203.

Antenna are permanently attached.

Test Engineer(s): Deepak Giri

Test Date(s): November 17, 2017

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15. 403(i) 26dB Bandwidth

Test Requirements: **§ 15.403(i):** For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 to 5.0 percent of the emission bandwidth of the device under measurement.

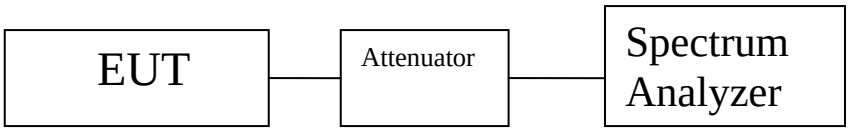
Test Procedure: The transmitter was set to low, mid, and high operating frequencies at the highest output power and connected to the spectrum analyzer through an attenuator.The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately equal to 1% - 5 % of the total emission bandwidth, VBW > RBW. The 26 dB Bandwidth was measured and recorded.

Test Results The 26 dB Bandwidth was compliant with the requirements of this section.

No anomalies detected.

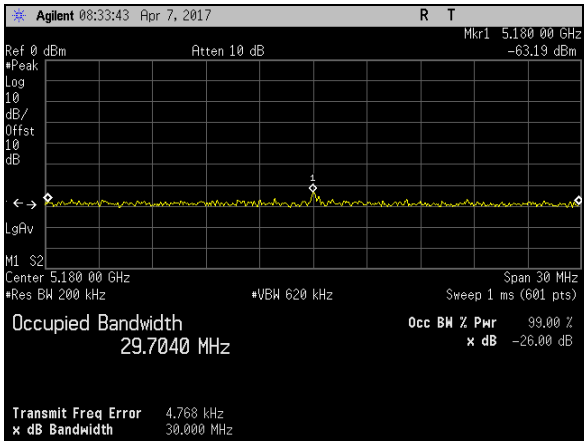
Test Engineer(s): Deepak Giri

Test Date(s): November 28, 2017

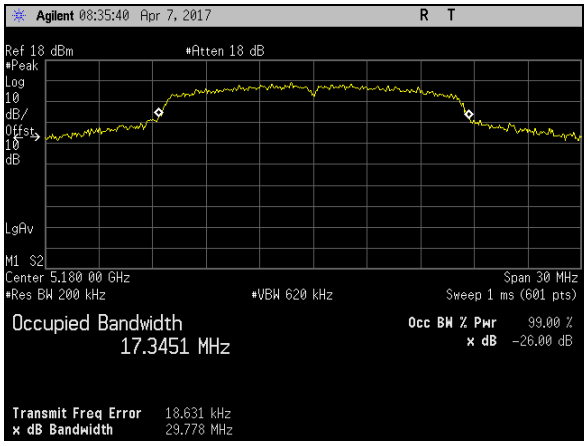


Frequency MHz	Mode	Bandwidth MHz	26 dB Bandwidth MHz port 1	26 dB Bandwidth MHz port 2
5180	a	20	29.77	30.00
5200			29.99	29.96
5240			29.66	29.74
5180	n	20	29.75	28.97
5200			29.21	29.21
5240			29.67	29.63
5190		40	46.87	48.94
5230			44.63	45.34

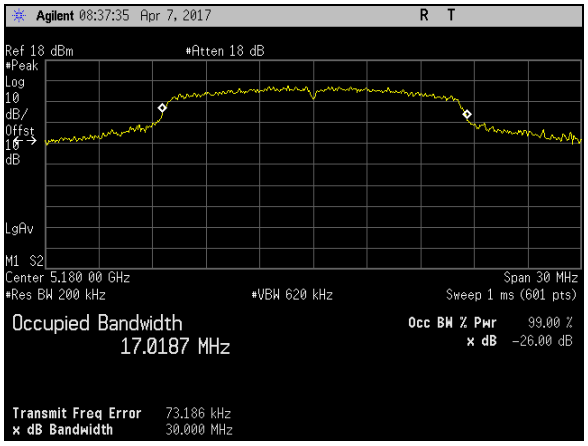
Table 8. 26 dB Occupied Bandwidth, Test Results



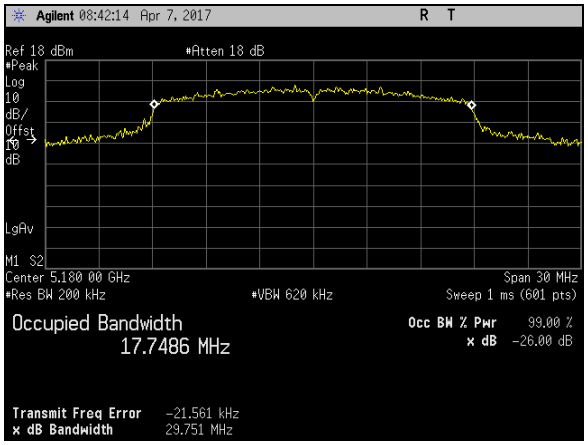
Plot 1. 26 dB Occupied Bandwidth, 26 dB, BW 20 M, Ch. 5180 MHz, A mode, Port 1, Noise Floor



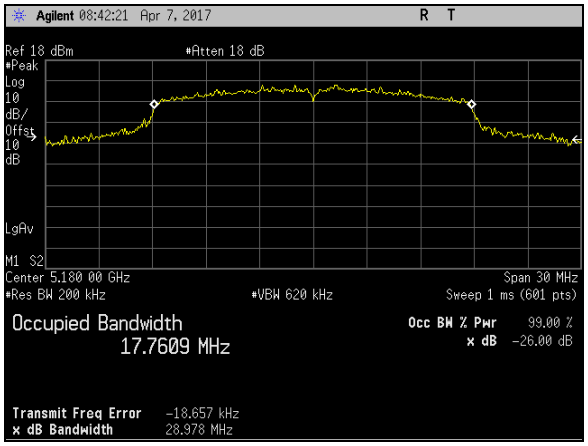
Plot 2. 26 dB Occupied Bandwidth, 26 dB, BW 20 M, Ch. 5180 MHz, A mode, Port 1



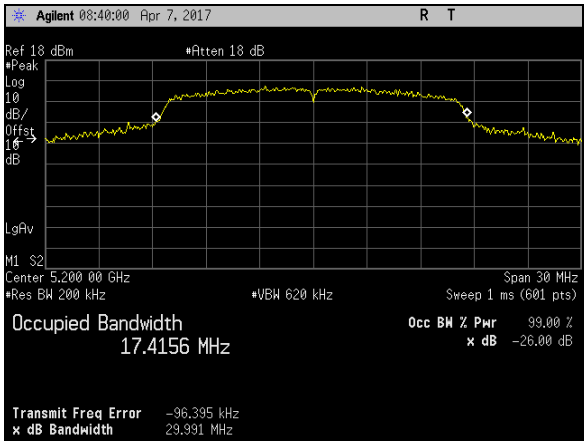
Plot 3. 26 dB Occupied Bandwidth, 26 dB, BW 20 M, Ch. 5180 MHz, A mode, Port 2



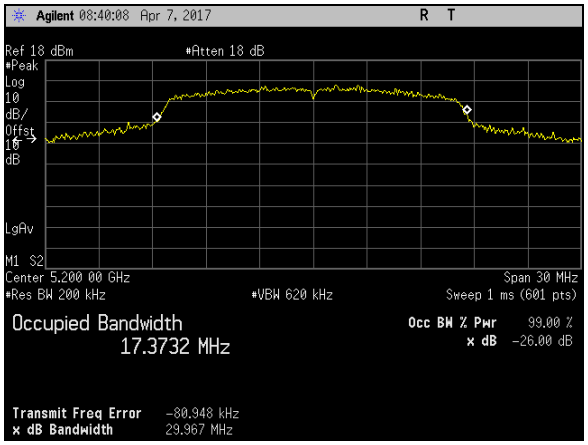
Plot 4. 26 dB Occupied Bandwidth, 26 dB, BW 20 M, Ch. 5180 MHz, N mode, Port 1



Plot 5. 26 dB Occupied Bandwidth, 26 dB, BW 20 M, Ch. 5180 MHz, N mode, Port 2

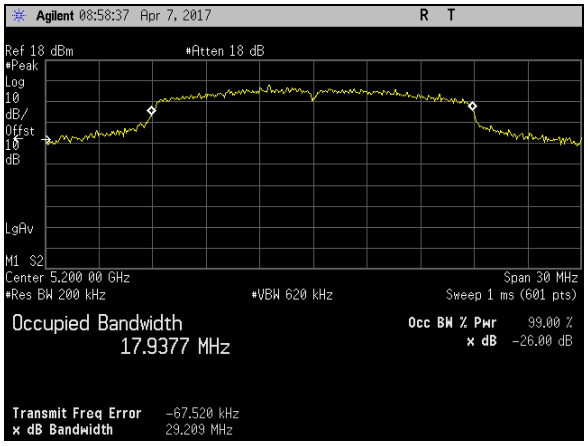


Plot 6. 26 dB Occupied Bandwidth, 26 dB, BW 20 M, Ch. 5200 MHz, A mode, Port 1

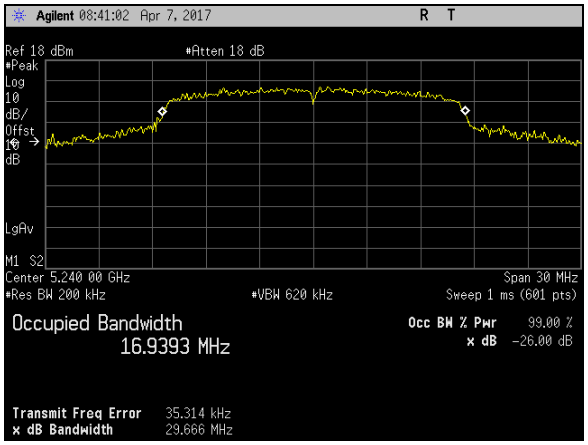


Plot 7. 26 dB Occupied Bandwidth, 26 dB, BW 20 M, Ch. 5200 MHz, A mode, Port 2

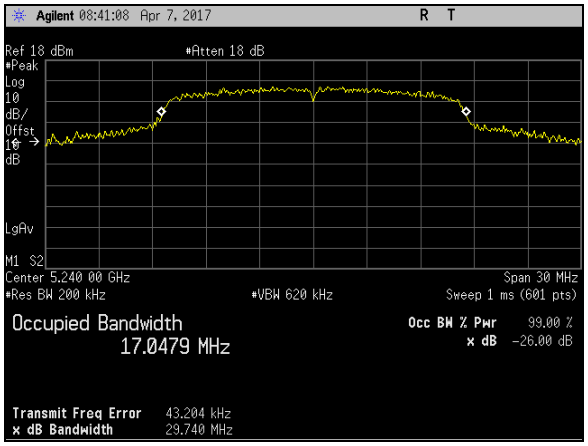
Plot 8. 26 dB Occupied Bandwidth, 26 dB, BW 20 M, Ch. 5200 MHz, N mode, Port 1



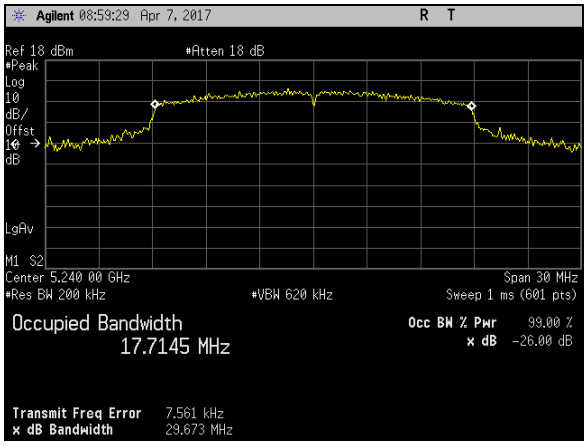
Plot 9. 26 dB Occupied Bandwidth, 26 dB, BW 20 M, Ch. 5200 MHz, N mode, Port 2



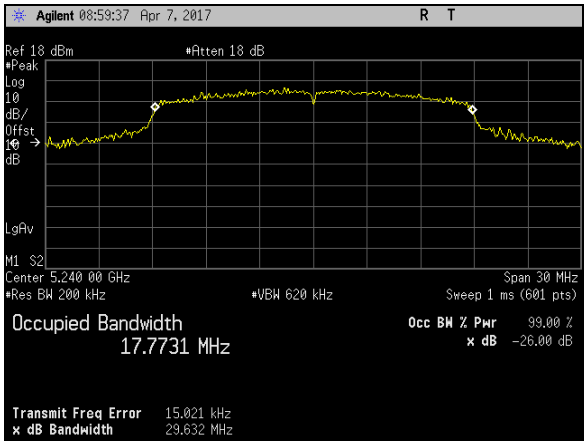
Plot 10. 26 dB Occupied Bandwidth, 26 dB, BW 20 M, Ch. 5240 MHz, A mode, Port 1



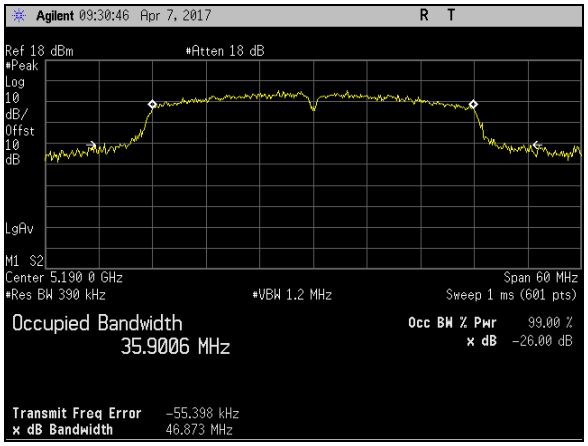
Plot 11. 26 dB Occupied Bandwidth, 26 dB, BW 20 M, Ch. 5240 MHz, A mode, Port 2



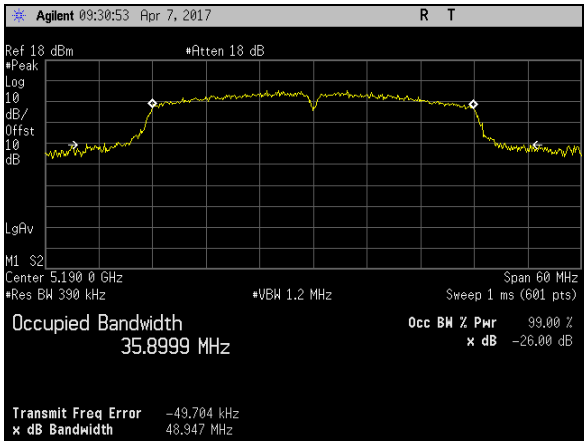
Plot 12. 26 dB Occupied Bandwidth, 26 dB, BW 20 M, Ch. 5240 MHz, N mode, Port 1



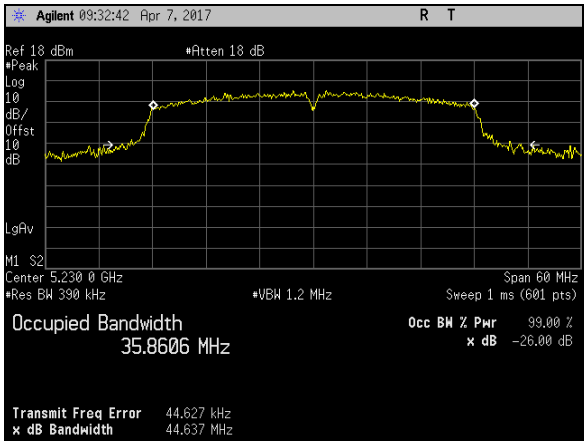
Plot 13. 26 dB Occupied Bandwidth, 26 dB, BW 20 M, Ch. 5240 MHz, N mode, Port 2



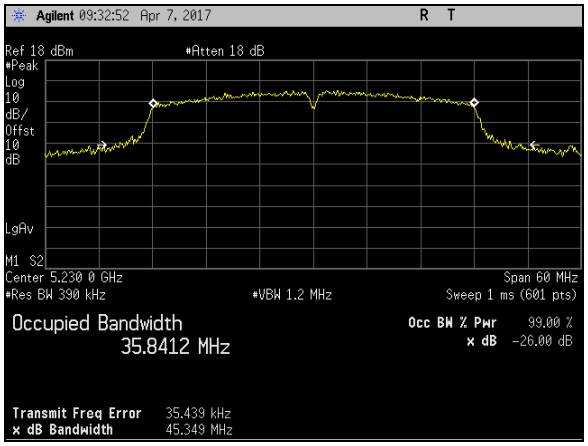
Plot 14. 26 dB Occupied Bandwidth, 26 dB, BW 40 M, Ch. 5190MHz, N mode, Port 1



Plot 15. 26 dB Occupied Bandwidth, 26 dB, BW 40 M, Ch.5190 MHz, N mode, Port 2



Plot 16. 26 dB Occupied Bandwidth, 26 dB, BW 40 M, Ch. 5230 MHz, N mode, Port 1



Plot 17. 26 dB Occupied Bandwidth, 26 dB, BW 40 M, Ch. 5230 MHz, N mode, Port 2

Electromagnetic Compatibility Criteria for Intentional Radiators

§15. 407(a)(1) Maximum Conducted Output Power

Test Requirements:

§15.407(a)(1)(i): For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi.
If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

§15.407(a)(1)(ii): For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi.
If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

§15.407(a)(1)(iii): For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.
Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi.

§15.407(a)(1)(iv): For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi.
If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

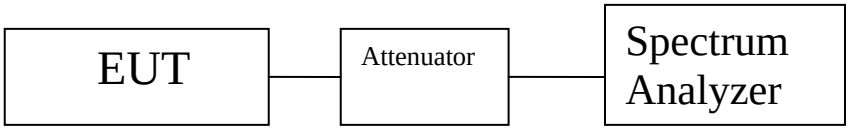
Test Procedure: The EUT was connected to a spectrum analyzer through a cable and attenuator. Measurements were taken with the EUT set to transmit on its low, mid, and high channels. Its power was measured according to measurement method SA-2, as described in 789033 D02 General UNII Test Procedures v02.

Test Results: The EUT as tested is compliant with the requirements of this section.

No anomalies detected.

Test Engineer(s): Deepak Giri

Test Date(s): November 28, 2017

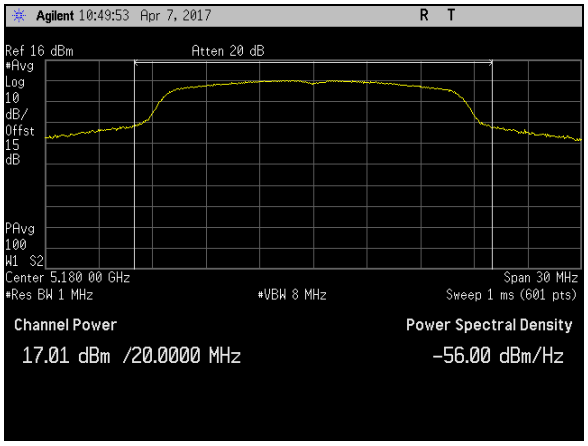


Frequency MHz	Mode	Bandwidth MHz	Conducted Power dBm port 1	Conducted Power dBm port 2	Directional Gain dBi	Conducted Limit dBm	EIRP Limit dBm
5180	a	20	17.01	15.8	4.5	30.00	36.00
5200			16.83	16.27	4.5	30.00	36.00
5240			17.25	18.09	4.5	30.00	36.00
5180	n	20	17.24	16.79	4.5	30.00	36.00
5200			17.54	16.46	4.5	30.00	36.00
5240			18.09	17.25	4.5	30.00	36.00
5190		40	14.52	14.08	4.5	30.00	36.00
5230			16.22	15.76	4.5	30.00	36.00

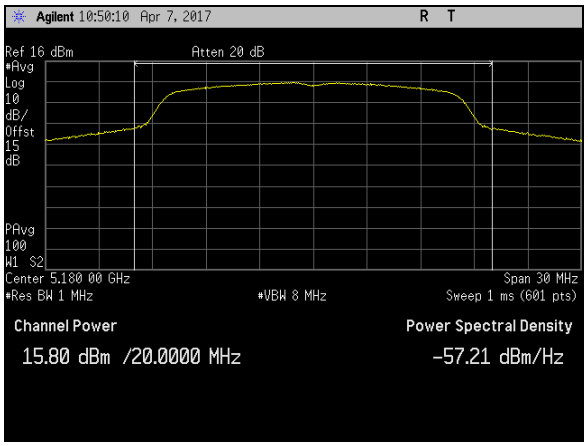
Table 9. Maximum Conducted Output Power, Test Results

Frequency MHz	Mode and Bandwidth	On Time ms	Period ms	Duty Cycle
5180	A mode 20MHz	0.4787	0.7941	0.60
5180	N mode 20 MHz	3.757	4.177	0.90
5180	N mode 40 MHz	1.833	2.231	0.82

Table 10. Duty Cycle, Test Results

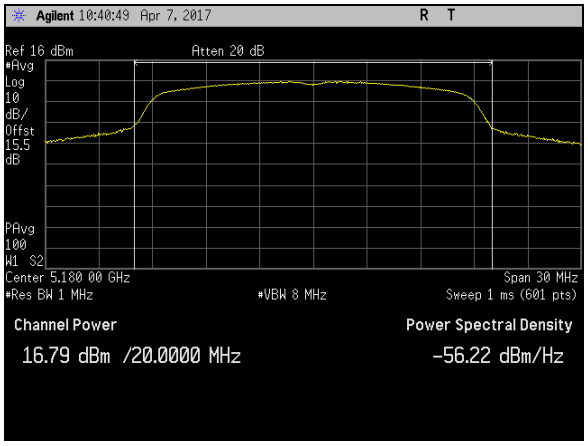


Plot 18. Conducted Output Power, BW 20M, Ch. 5180 MHz, A mode, Port 1

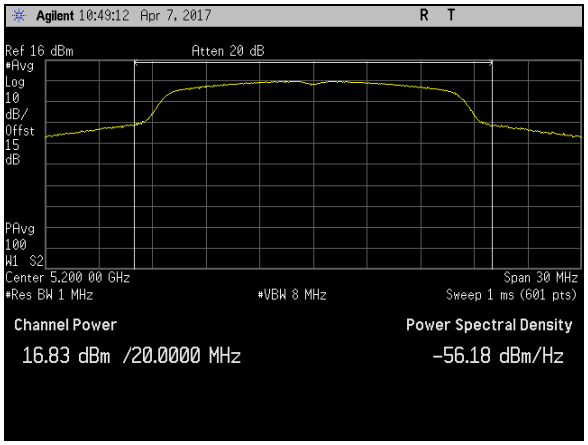


Plot 19. Conducted Output Power, BW 20M, Ch. 5180 MHz, A mode, Port 2

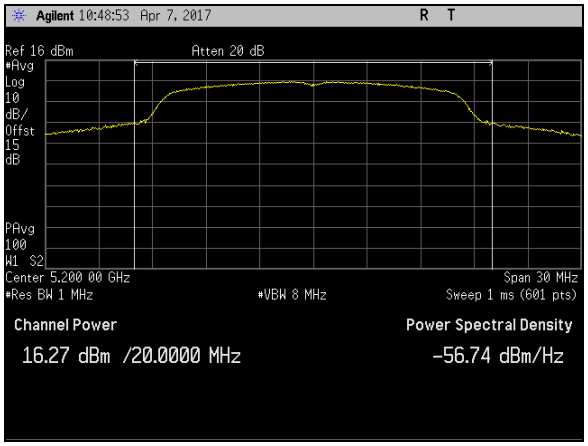
Plot 20. Conducted Output Power, BW 20M, Ch. 5180 MHz, N mode, Port 1



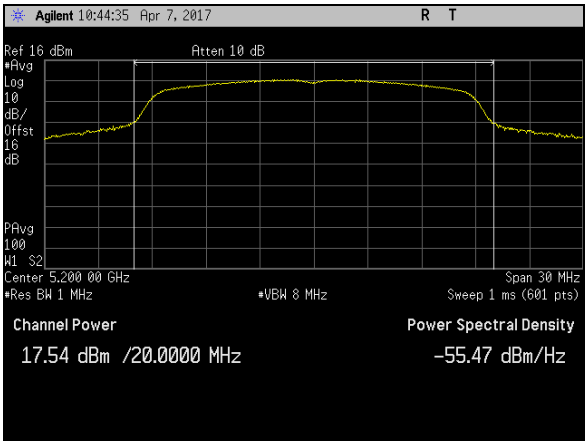
Plot 21. Conducted Output Power, BW 20M, Ch. 5180 MHz, N mode, Port 2



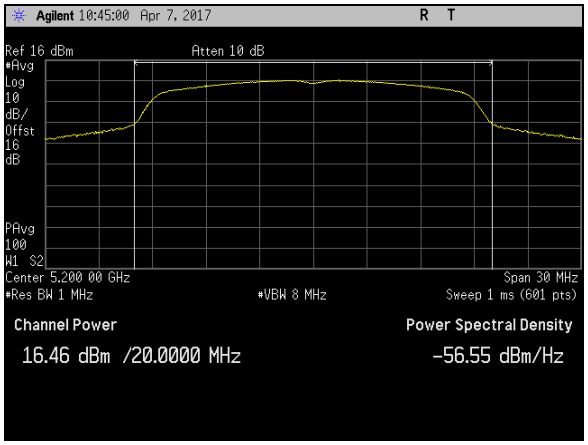
Plot 22. Conducted Output Power, BW 20M, Ch. 5200 MHz, A mode, Port 1



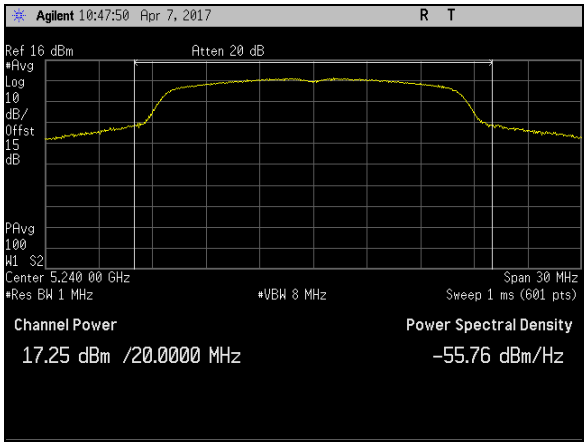
Plot 23. Conducted Output Power, BW 20M, Ch. 5200 MHz, A mode, Port 2



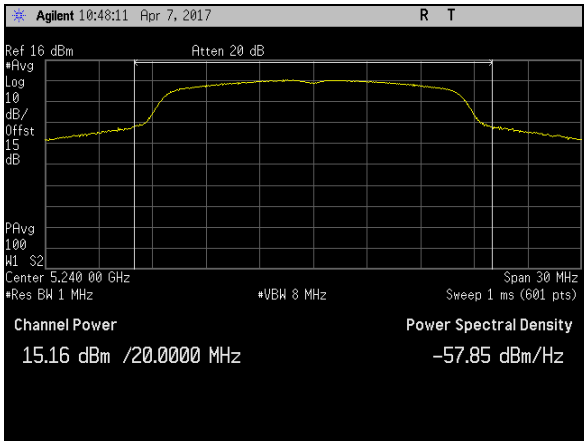
Plot 24. Conducted Output Power, BW 20M, Ch. 5200 MHz, N mode, Port 1



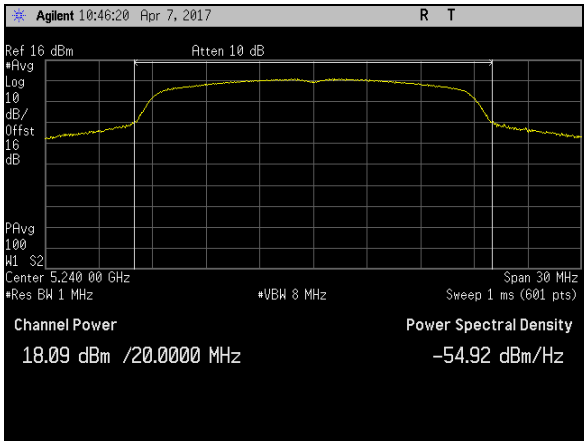
Plot 25. Conducted Output Power, BW 20M, Ch. 5200 MHz, N mode, Port 2



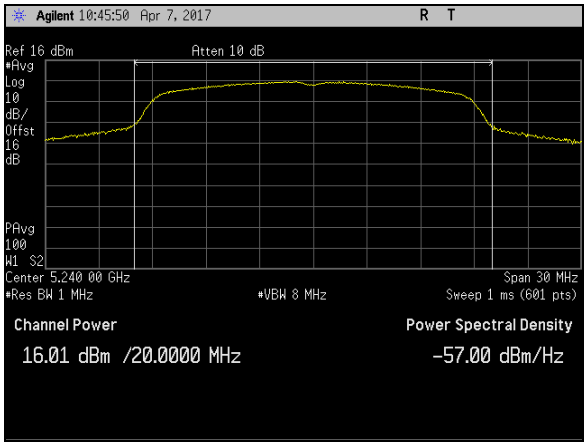
Plot 26. Conducted Output Power, BW 20M, Ch. 5240 MHz, A mode, Port 1



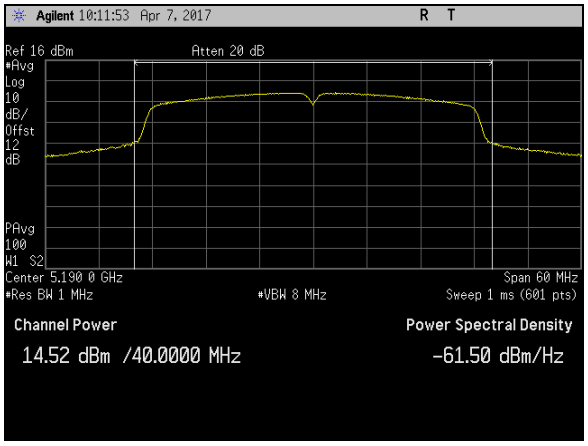
Plot 27. Conducted Output Power, BW 20M, Ch. 5240 MHz, A mode, Port 2



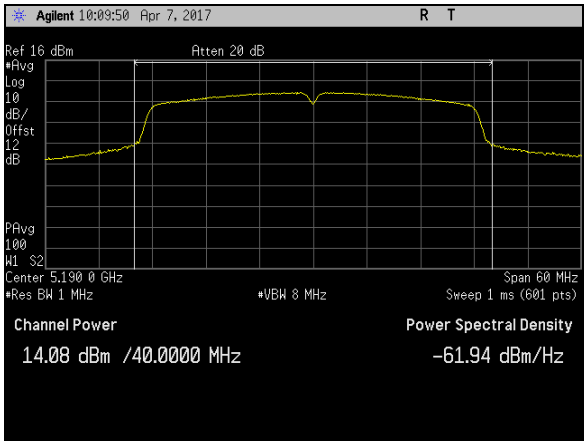
Plot 28. Conducted Output Power, BW 20M, Ch. 5240 MHz, N mode, Port 1



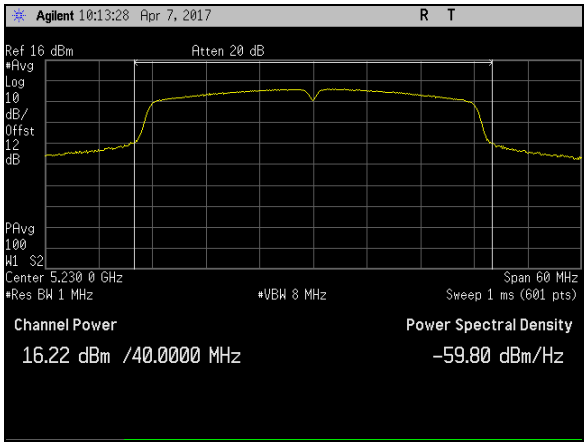
Plot 29. Conducted Output Power, BW 20M, Ch. 5240 MHz, N mode, Port 2



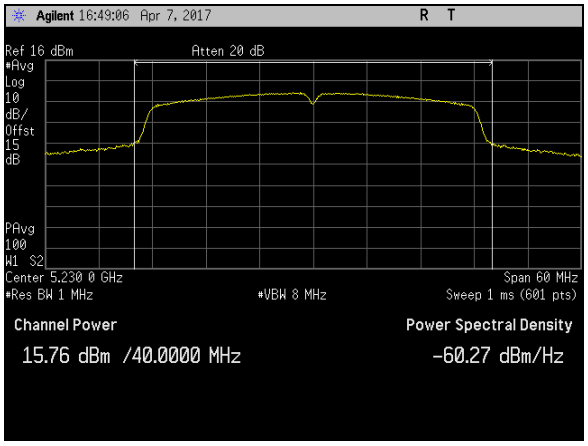
Plot 30. Conducted Output Power, BW 40M, Ch. 5190 MHz, N mode, Port 1



Plot 31. Conducted Output Power, BW 40M, Ch. 5190 MHz, N mode, Port 2



Plot 32. Conducted Output Power, BW 40M, Ch. 5230 MHz, N mode, Port 1



Plot 33. Conducted Output Power, BW 40M, Ch. 5230 MHz, N mode, Port 2

Electromagnetic Compatibility Criteria for Intentional Radiators

§15.407(a)(1) Maximum Power Spectral Density

Test Requirements:

§15.407(a)(1)(i): In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

§15.407(a)(1)(ii): In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi..

§15.407(a)(1)(iii): In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi.

§15.407(a)(1)(iv): In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

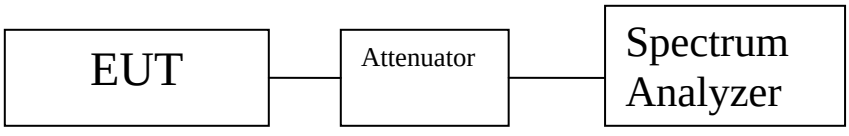
Test Procedure: The EUT was connected to a spectrum analyzer through a cable and attenuator. Measurements were taken with the EUT set to transmit on its low, mid, and high channels. Its power was measured according KDB 789033 D02 General UNII Test Procedures v02.

Test Results: The EUT as tested is compliant with the requirements of this section.

No anomalies detected.

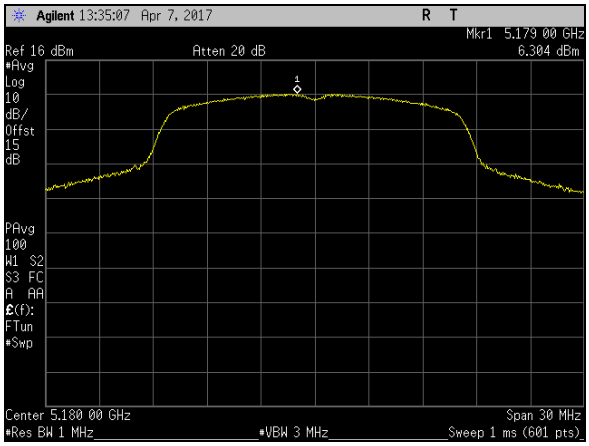
Test Engineer(s): Deepak Giri

Test Date(s): November 28, 2017

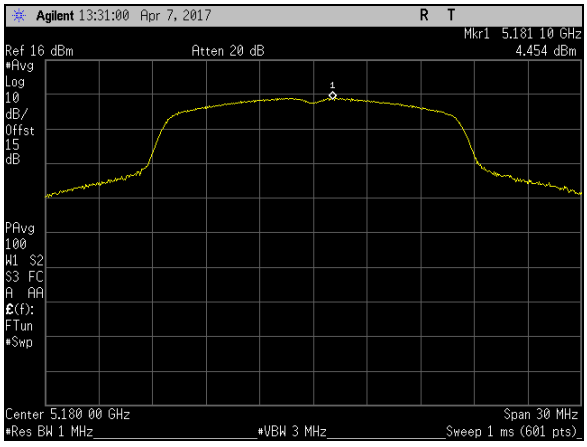


Frequency MHz	Mode	Bandwidth MHz	Power Spectral Density dBm port 1	Power Spectral Density dBm port 2	Limit dBm
5180	a	20	6.3	4.45	17.00
5200			6.09	4.74	17.00
5240			6.34	4.42	17.00
5180	n	20	5.79	4.67	17.00
5200			5.32	5.14	17.00
5240			6.2	4.06	17.00
5190		40	0.94	-0.25	17.00
5230			1.39	-0.35	17.00

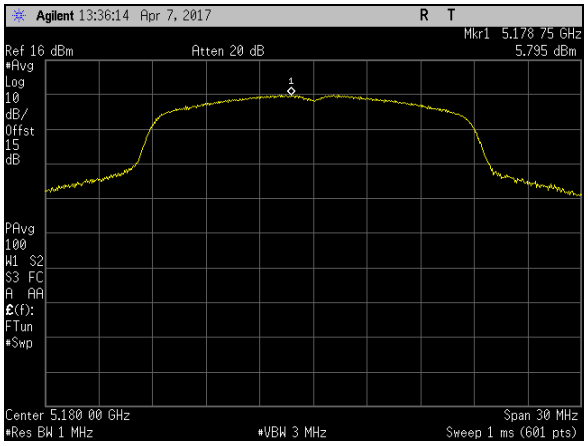
Table 11. Power Spectral Density, Test Results



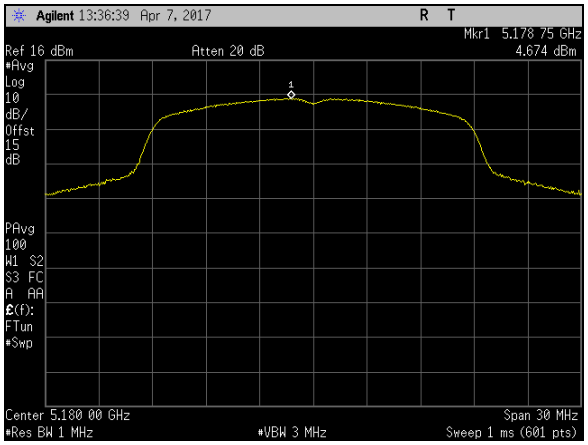
Plot 34. Power Spectral Density, BW 20 M, Ch. 5180 MHz, A mode, Port 1



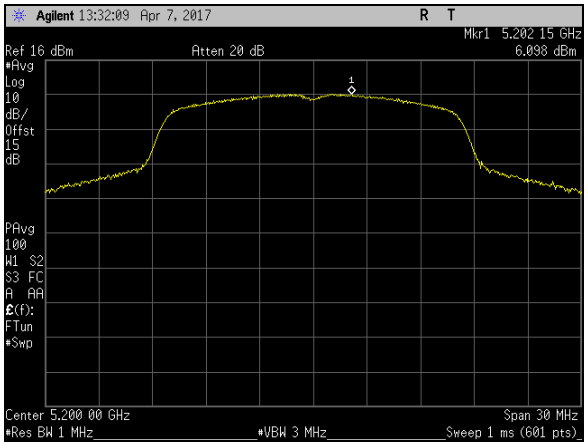
Plot 35. Power Spectral Density, BW 20 M, Ch. 5180 MHz, A mode, Port 2



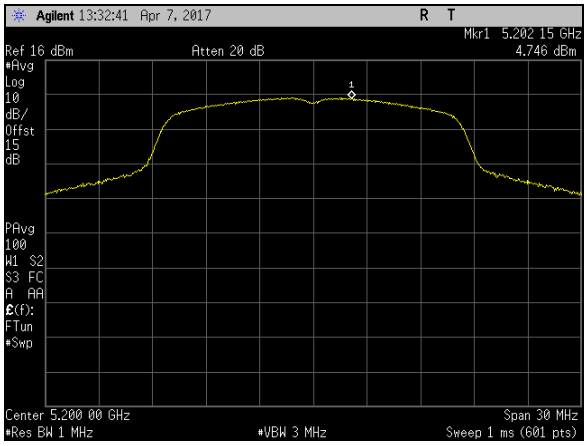
Plot 36. Power Spectral Density, BW 20 M, Ch. 5180 MHz, N mode, Port 1



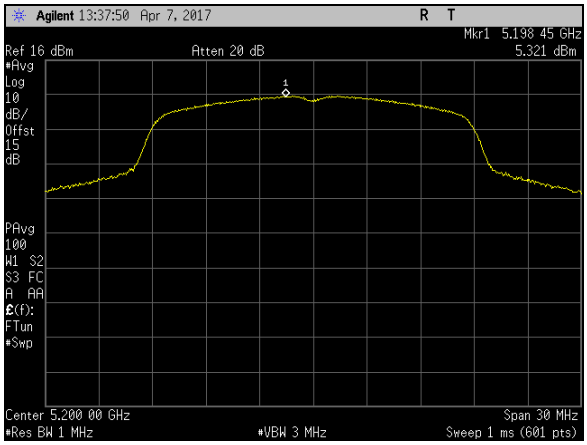
Plot 37. Power Spectral Density, BW 20 M, Ch. 5180 MHz, N mode, Port 2



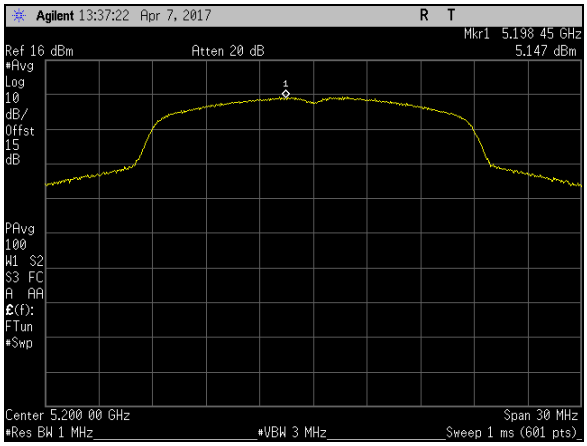
Plot 38. Power Spectral Density, BW 20 M, Ch. 5200 MHz, A mode, Port 1



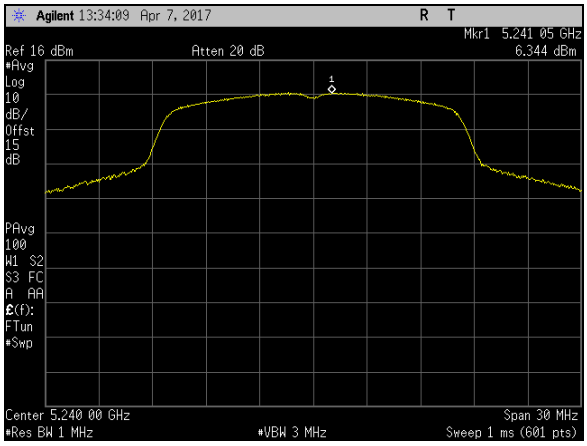
Plot 39. Power Spectral Density, BW 20 M, Ch. 5200 MHz, A mode, Port 2



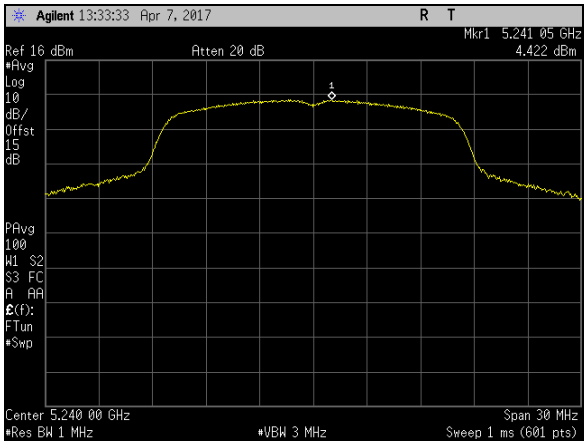
Plot 40. Power Spectral Density, BW 20 M, Ch. 5200 MHz, N mode, Port 1



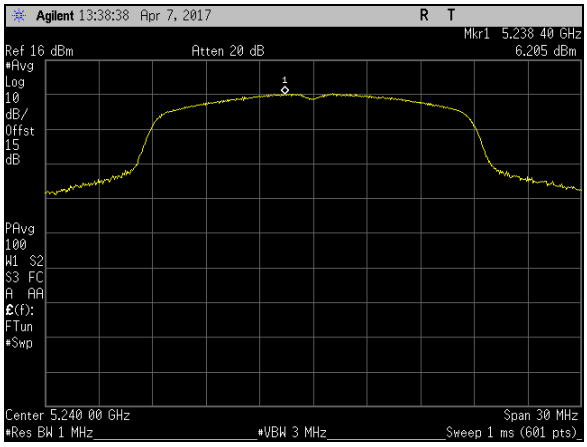
Plot 41. Power Spectral Density, BW 20 M, Ch. 5200 MHz, N mode, Port 2



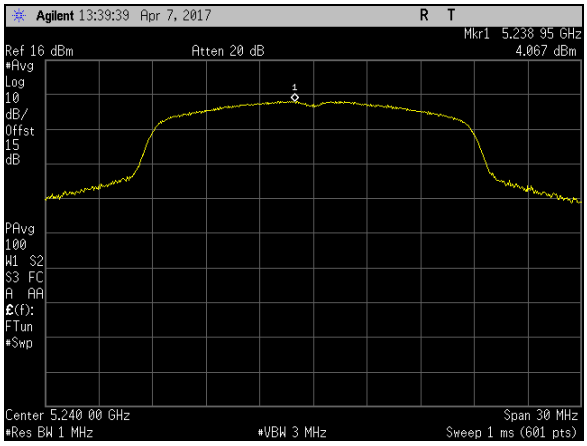
Plot 42. Power Spectral Density, BW 20 M, Ch. 5240 MHz, A mode, Port 1



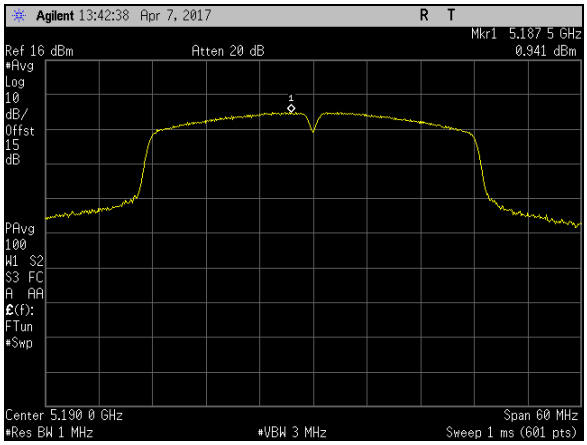
Plot 43. Power Spectral Density, BW 20 M, Ch. 5240 MHz, A mode, Port 2



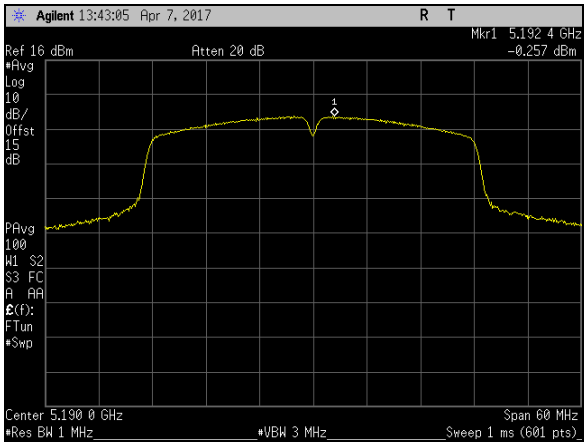
Plot 44. Power Spectral Density, BW 20 M, Ch. 5240 MHz, N mode, Port 1



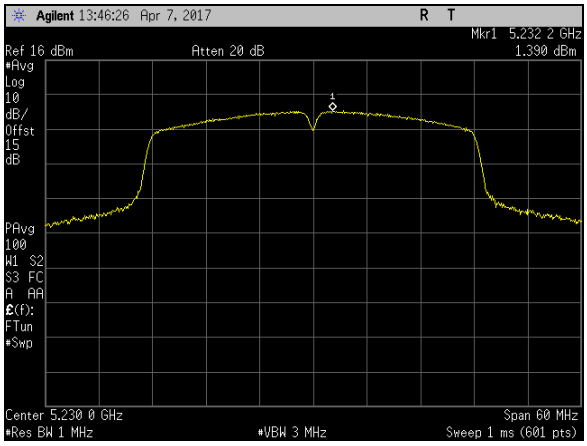
Plot 45. Power Spectral Density, BW 20 M, Ch. 5240 MHz, N mode, Port 2



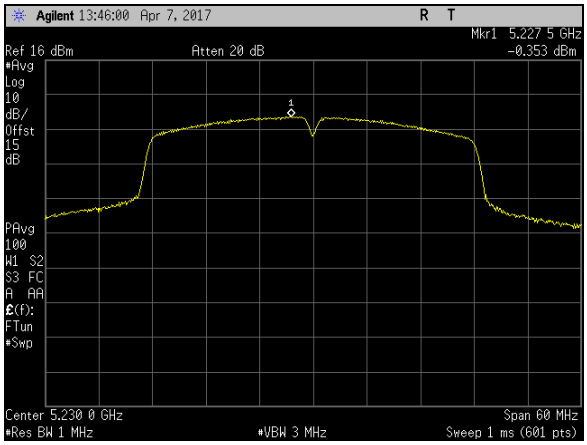
Plot 46. Power Spectral Density, BW 40 M, Ch. 5190 MHz, N mode, Port 1



Plot 47. Power Spectral Density, BW 40 M, Ch. 5190 MHz, N mode, Port 2



Plot 48. Power Spectral Density, BW 40 M, Ch. 5230 MHz, N mode, Port 1



Plot 49. Power Spectral Density, BW 40 M, Ch. 5230 MHz, N mode, Port 2

Electromagnetic Compatibility Criteria for Intentional Radiators

§15.407(b)(1) & (6 – 7) Undesirable Emissions

Test Requirements: **§ 15.407(b)(1):** 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.

§ 15.407(b)(6): Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in Section 15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in Section 15.207.

§ 15.407(b)(7): The provisions of Section 15.205 of this part apply to intentional radiators operating under this section.

Test Procedure: The EUT was placed on a non-conducting stand on a turntable in a chamber. To find the maximum emission the EUT was set to transmit on low, mid, and high channels. Additionally, the turntable was rotated 360 degrees, the EUT was oriented through its three orthogonal axes, and the receive antenna height was varied in order to maximize emissions.

For frequencies from 30 MHz to 1 GHz, measurements were first made using a peak detector with a 100 kHz resolution bandwidth. Emissions which exceeded the limits were re-measured using a quasi-peak detector with a 120 kHz resolution bandwidth.

Above 1 GHz, measurements were made pursuant the method described in FCC KDB 789033 D02 General UNII Test Procedure New Rules v02. The equation, **EIRP= E + 20 log D – 104.8** was used to convert field strength to EIRP (**E** = field strength (dBµV/m) and **D** = Reference measurement distance**).**

For emissions above 1 GHz and in restricted bands, measurements of the field strength were made with a peak detector and an average detector and compared with the limits of 15.209.

As an alternative, according to FCC KDB 789033 D02 General UNII Test Procedure New Rules v02, all emissions that comply with the peak and average limits of 15.209 satisfy the requirements of unwanted emissions in 15.407.

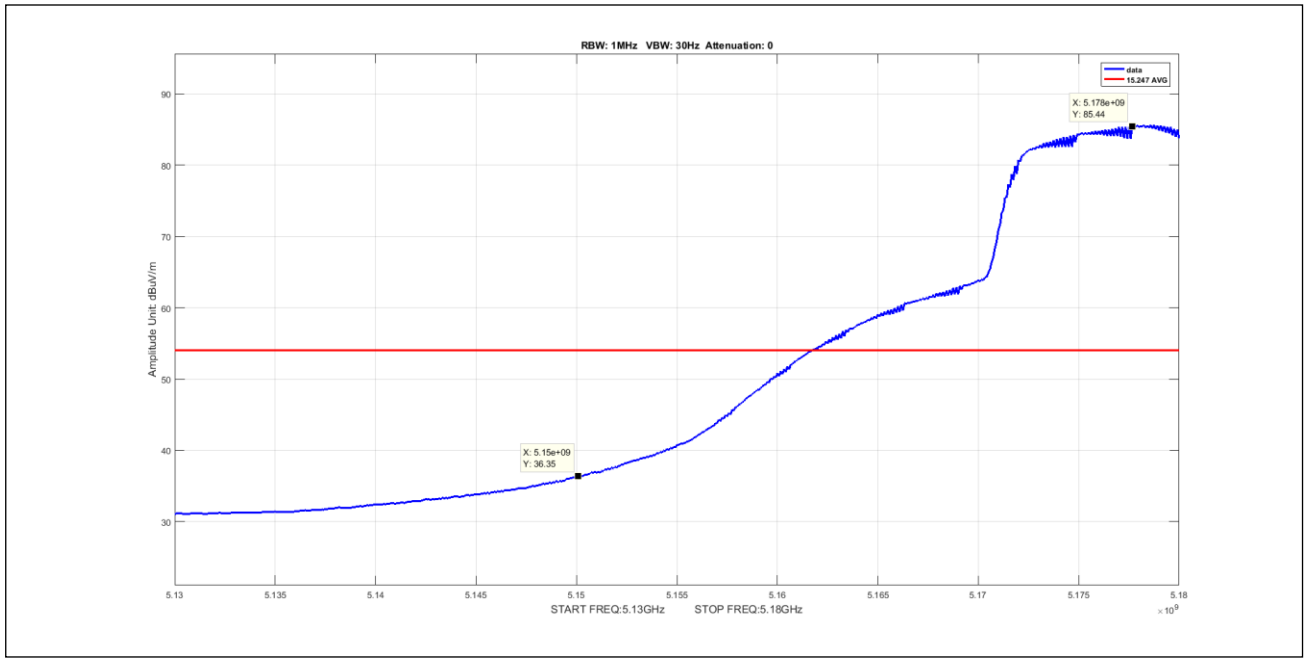
Test Results: EUT was compliant with the requirements of this section. Only noise was observed above 18 GHz and below 30 MHz. Emissions were investigated upto 10^{th} harmonics. Only worst data are presented in this report except band edges.

Measured emissions were within applicable limits.

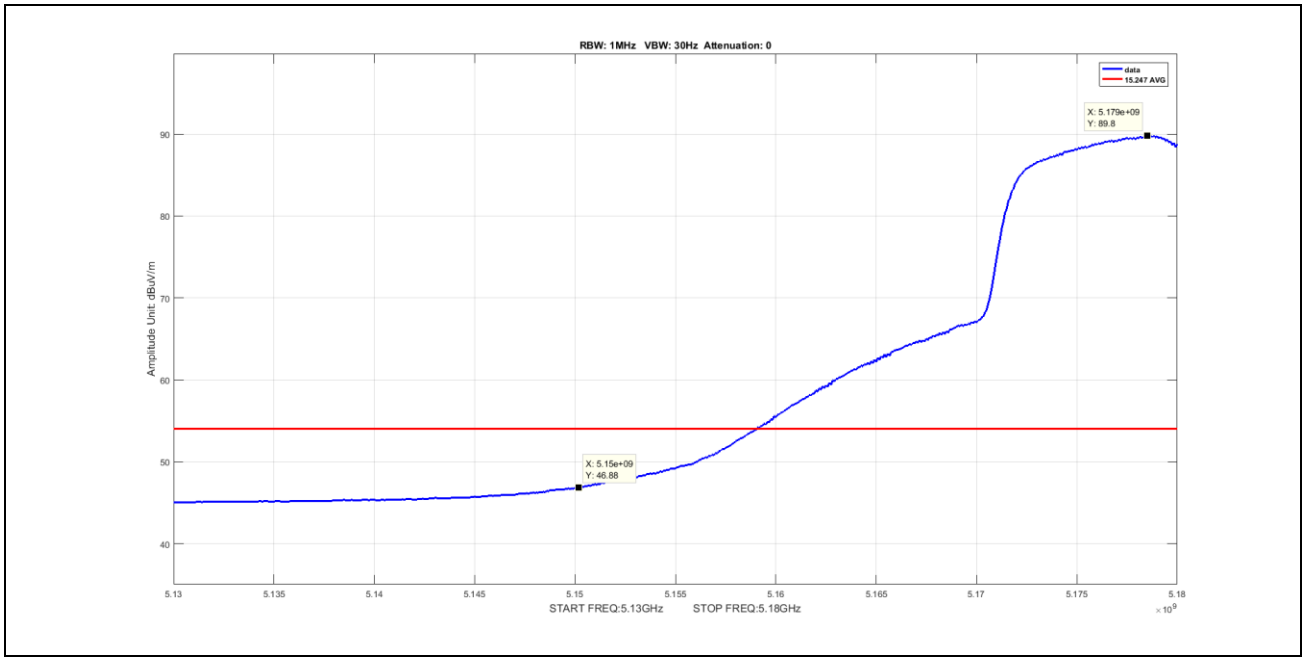
Test Engineer(s): Deepak Giri

Test Date(s): December 4, 2017

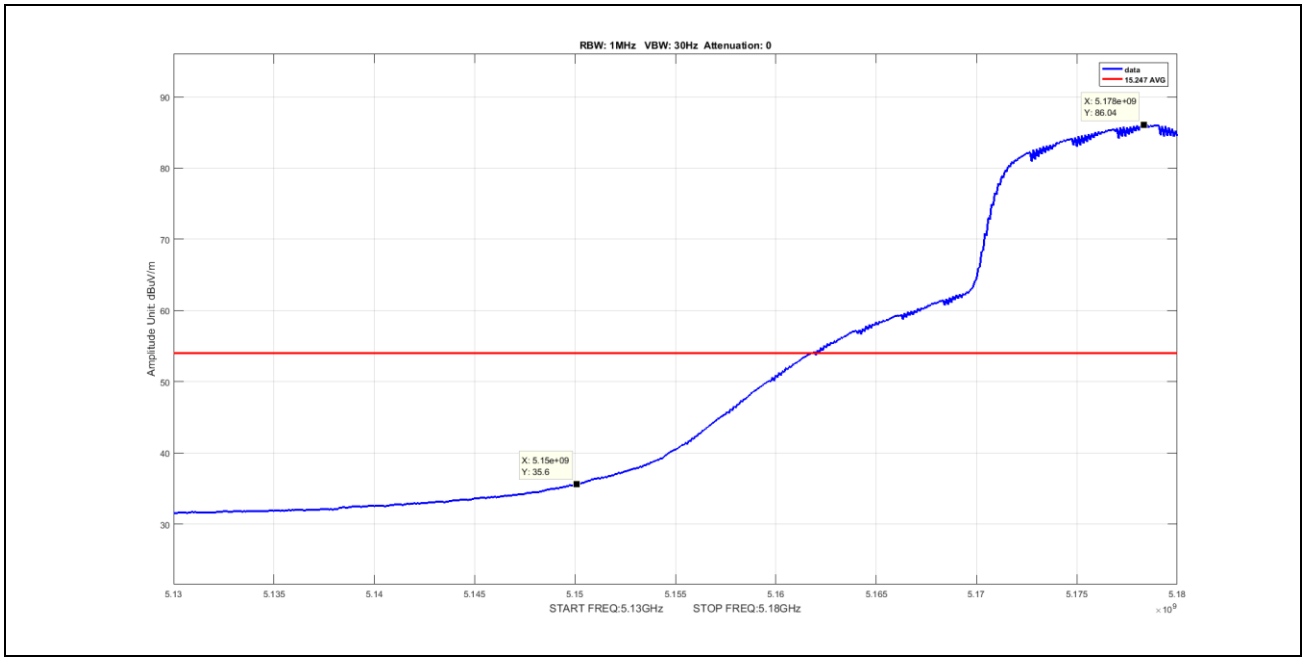
Radiated Band Edge, Test Results



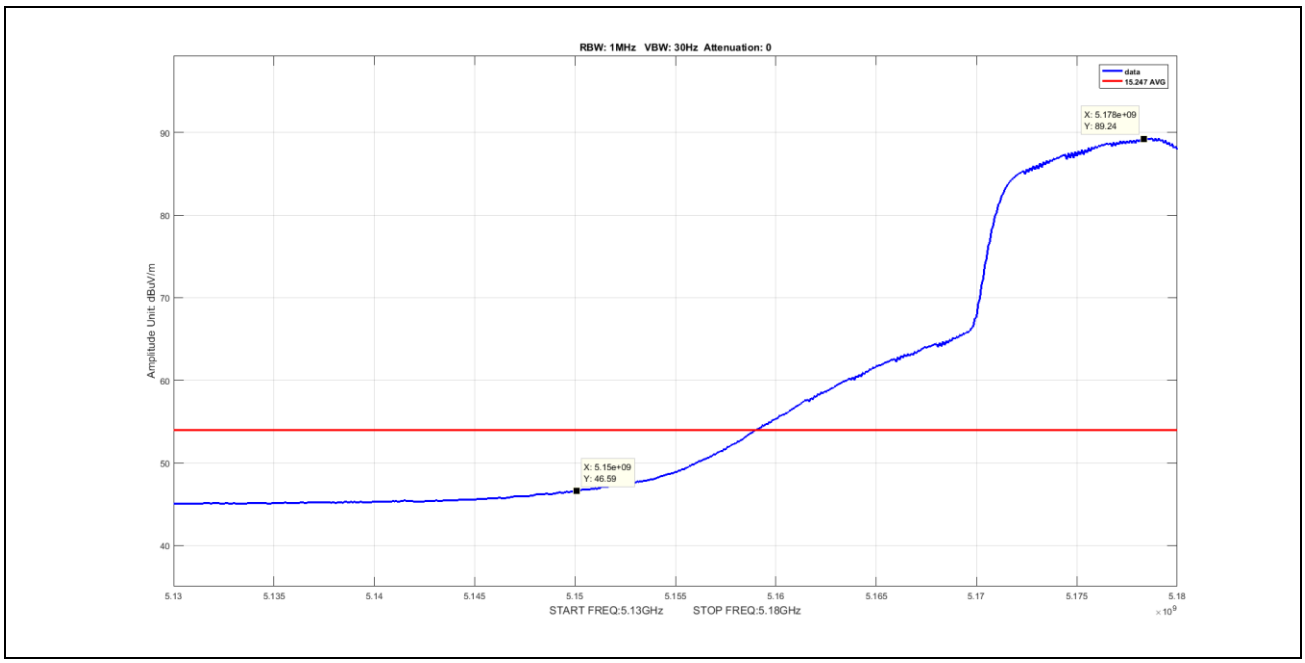
Plot 50. Undesirable Emissions, Average Band Edge Spurious, BW 20M, Ch 5180M, A Mode Port 2



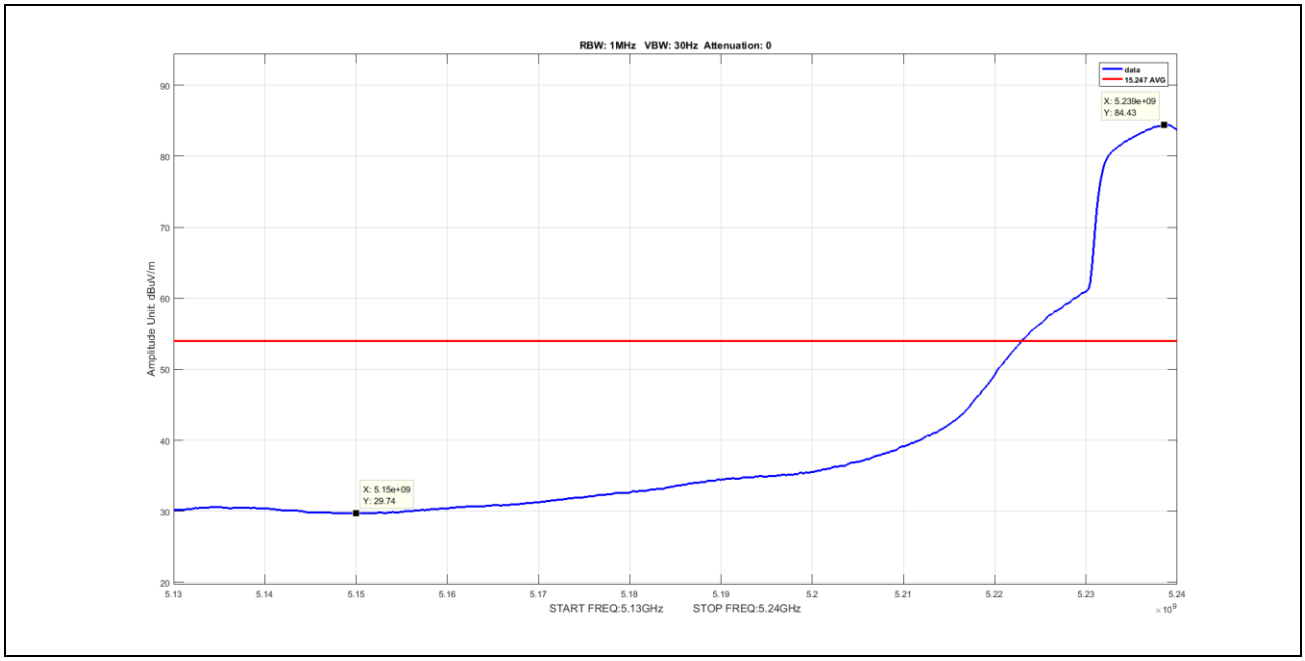
Plot 51. Undesirable Emissions, Average Band Edge Spurious, BW 20M, Ch 5180M, A Mode Port 1



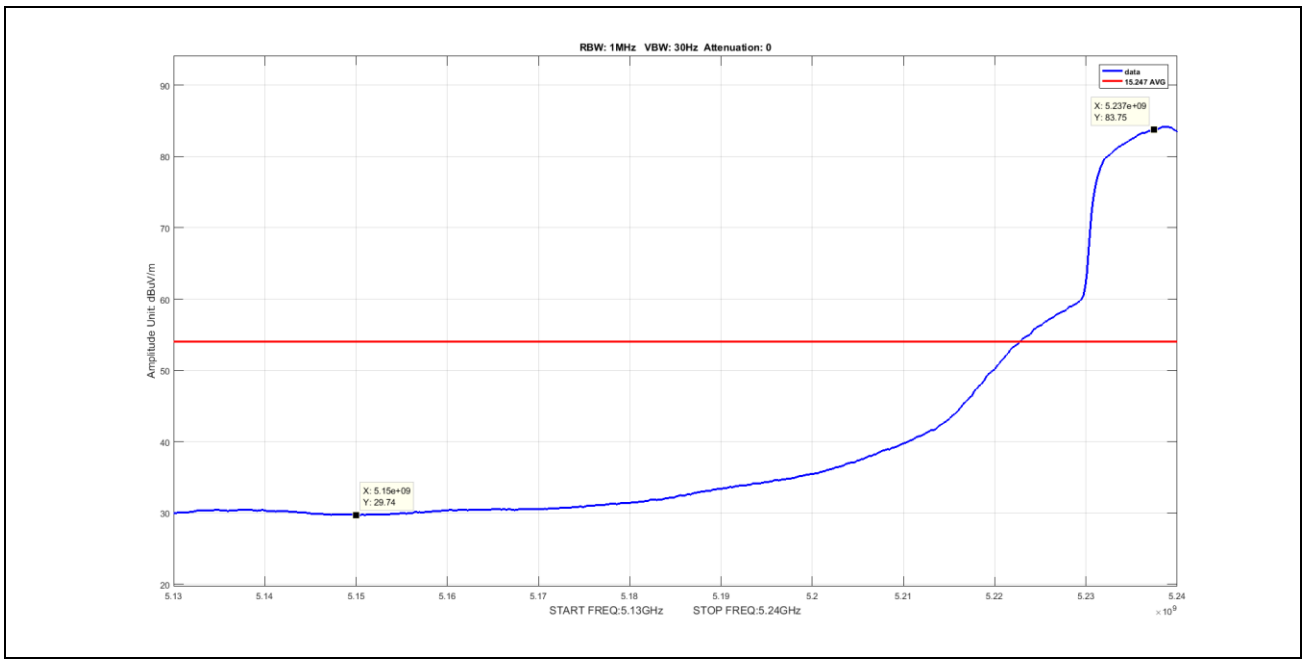
Plot 52. Undesirable Emissions, Average Band Edge Spurious, BW 20M, Ch 5180M, N Mode Port 2



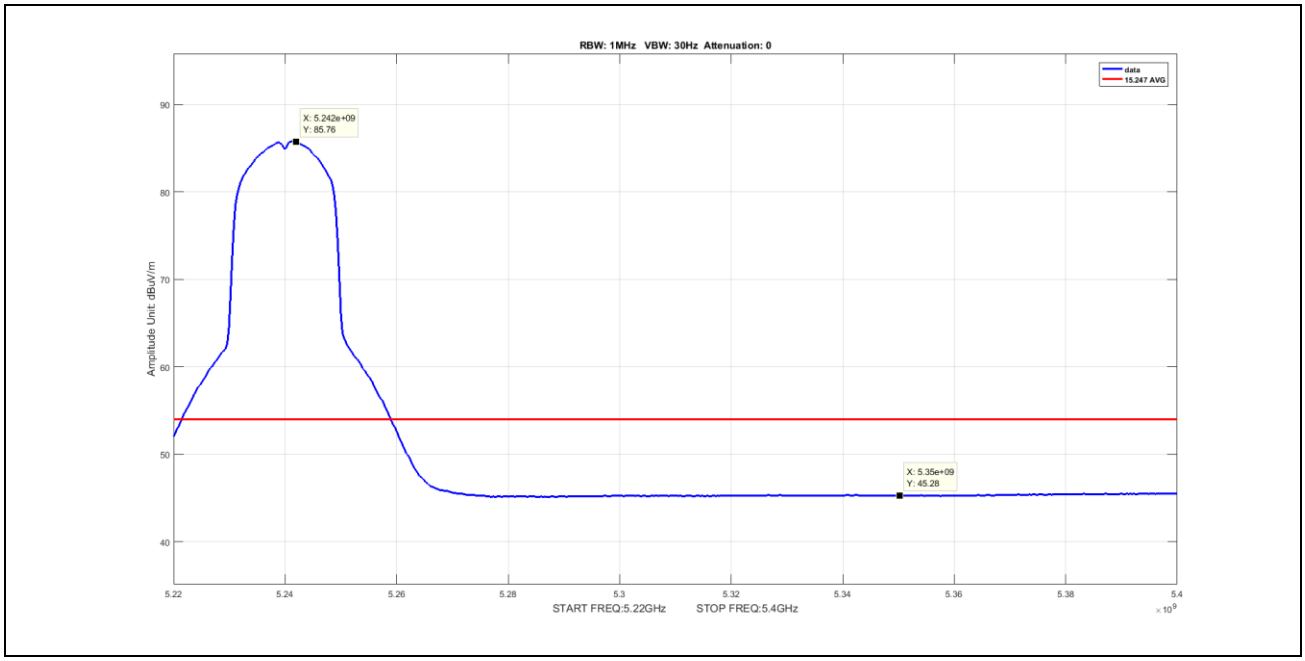
Plot 53. Undesirable Emissions, Average Band Edge Spurious, BW 20M, Ch 5180M, N Mode Port 1



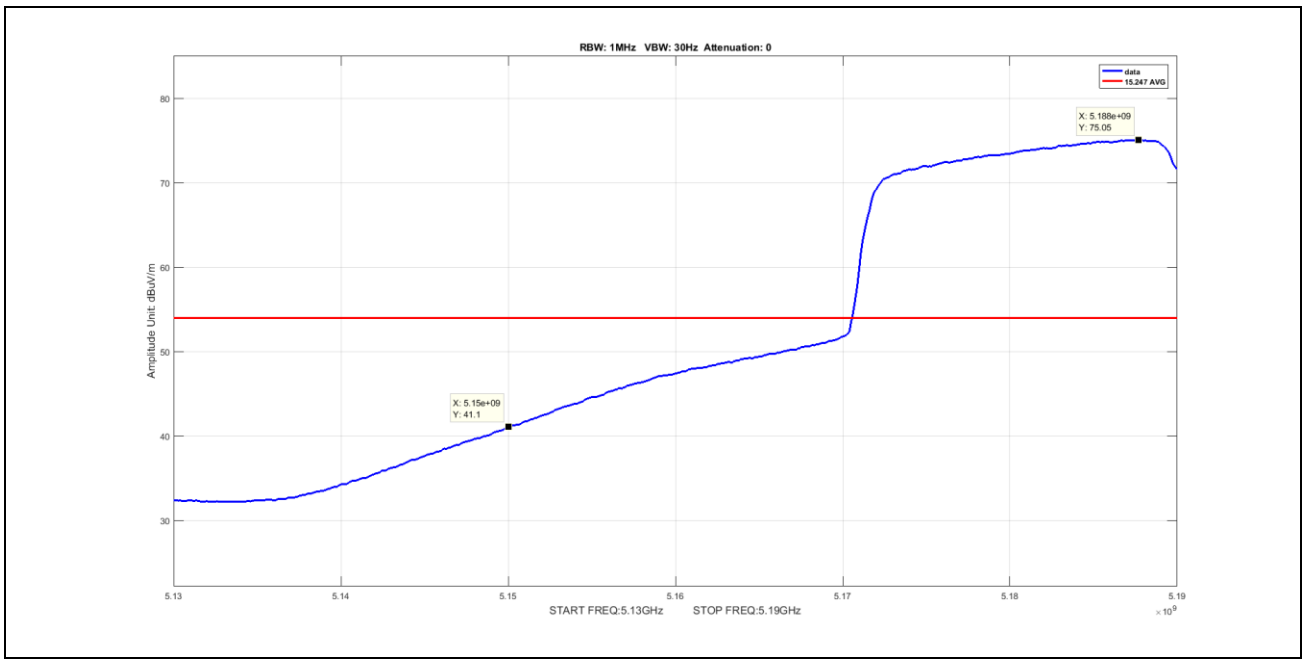
Plot 54. Undesirable Emissions, Average Band Edge Spurious, BW 20M, Ch 5240M, A Mode Port 2



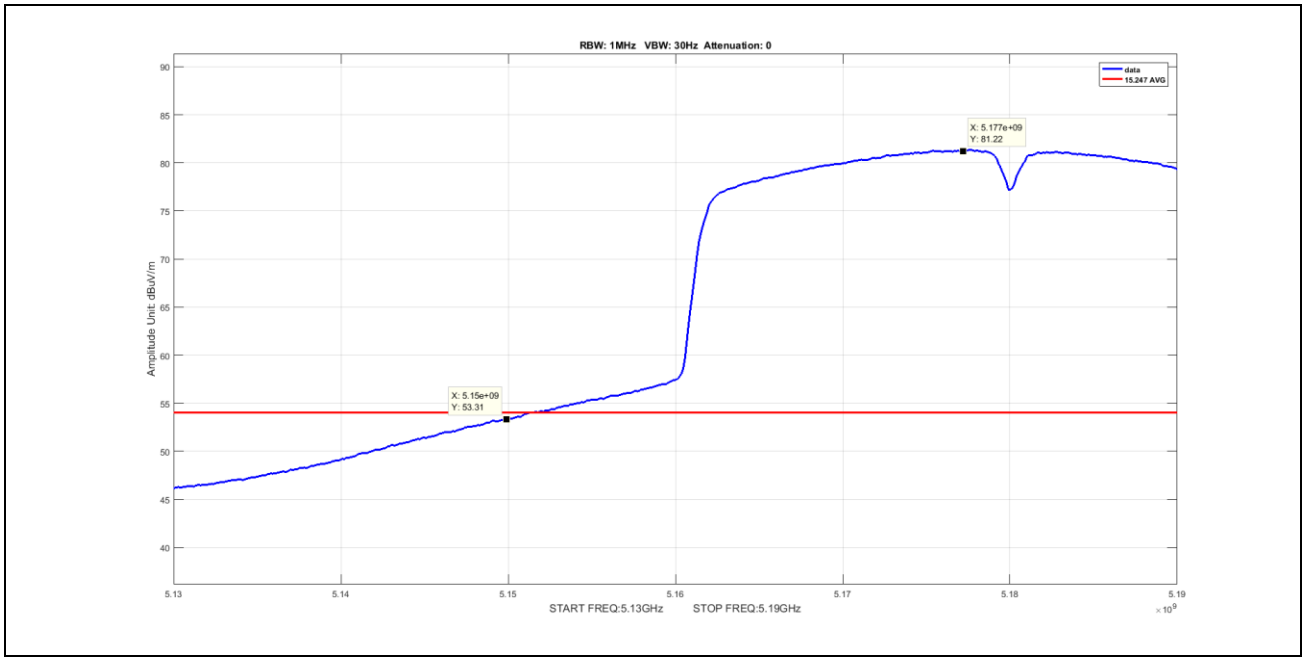
Plot 55. Undesirable Emissions, Average Band Edge Spurious, BW 20M, Ch 5240M, N Mode Port 2



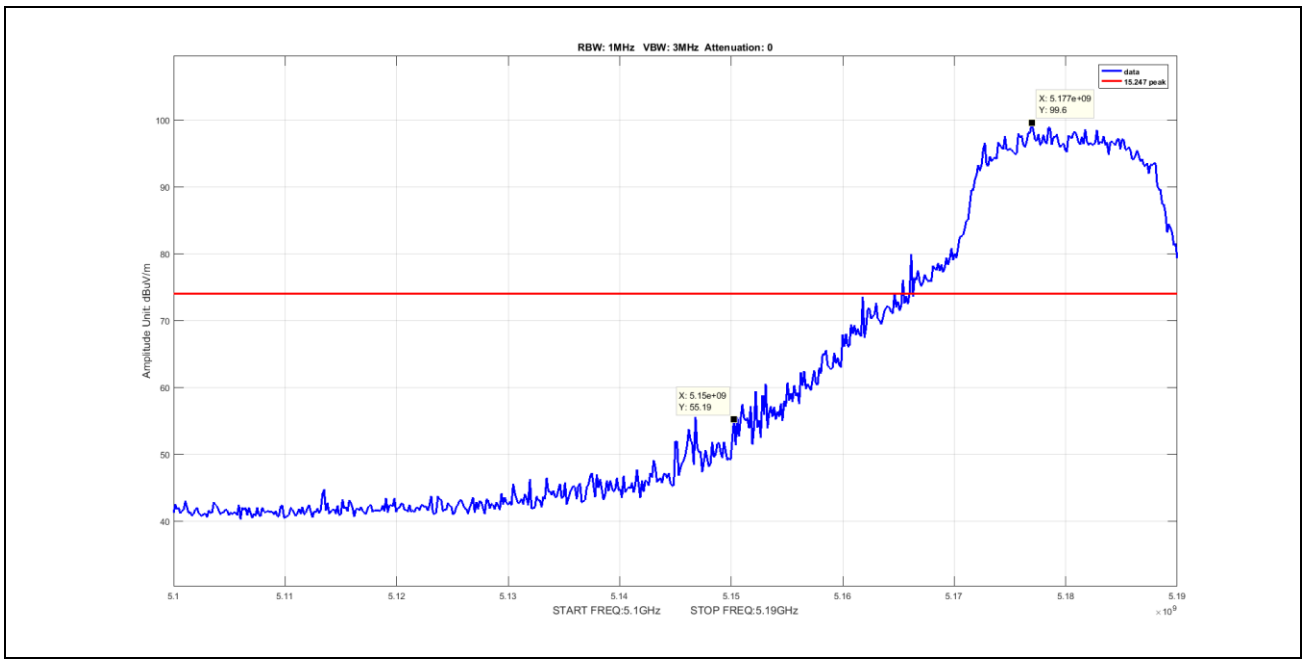
Plot 56. Undesirable Emissions, Average Band Edge Spurious, BW 20M, Ch 5240M, N Mode Port 1



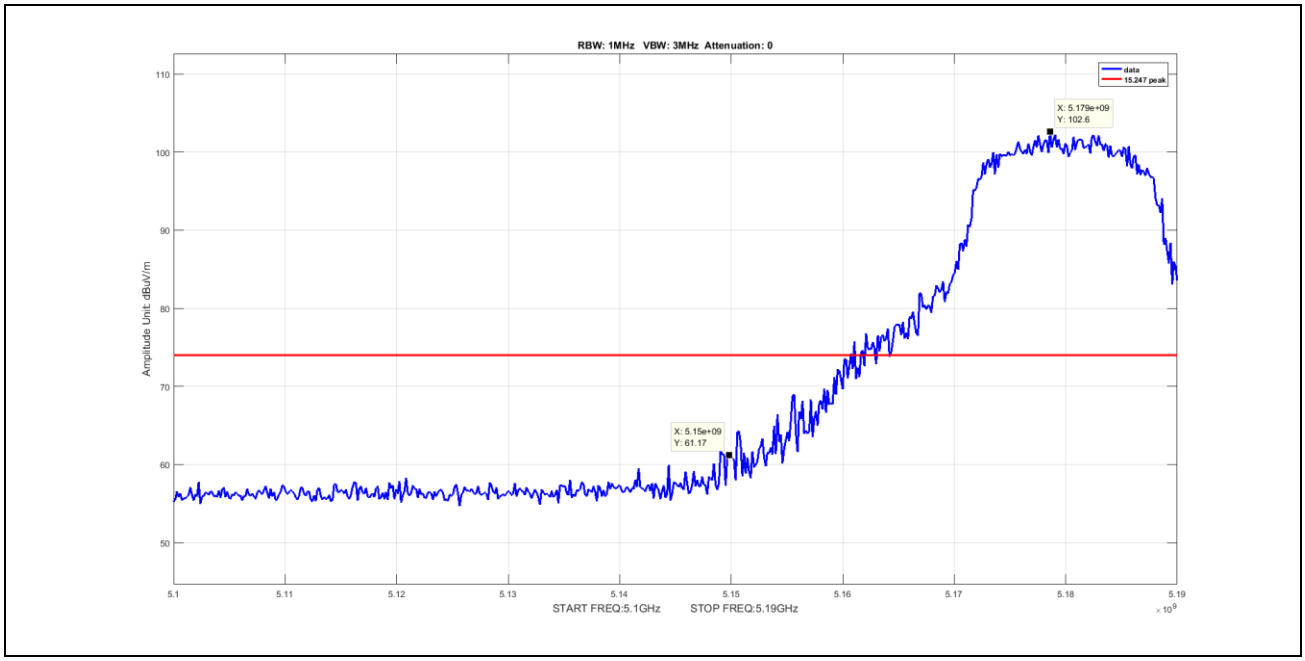
Plot 57. Undesirable Emissions, Average Band Edge Spurious, BW 40M, Ch 5190M, N Mode Port 2



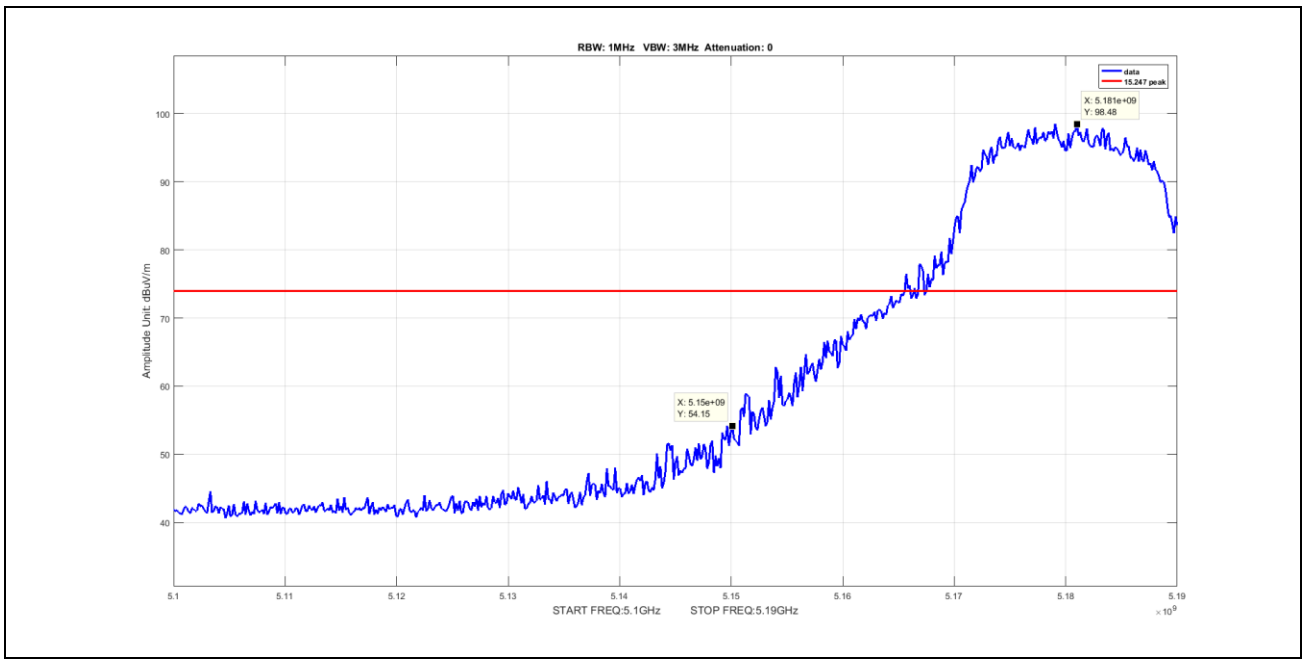
Plot 58. Undesirable Emissions, Average Band Edge Spurious, BW 40M, Ch 5190M, N Mode Port 1



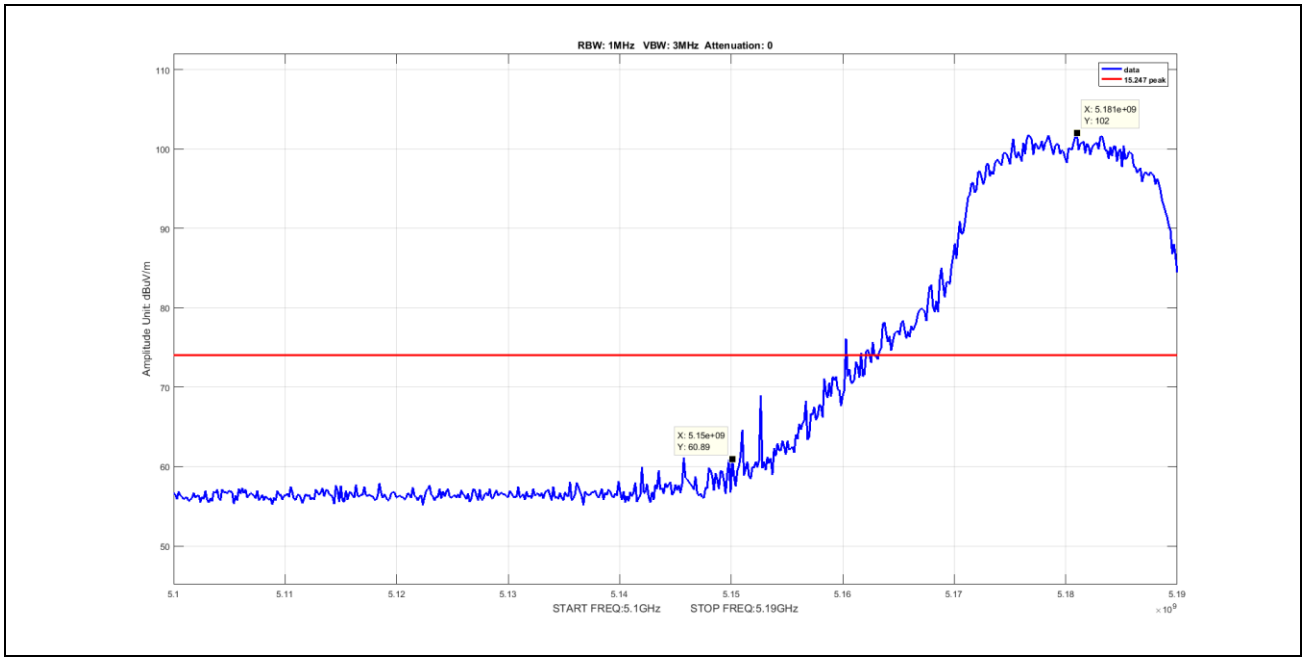
Plot 59. Undesirable Emissions, Peak Band Edge Spurious, BW 20M, Ch 5180M, A Mode Port 2



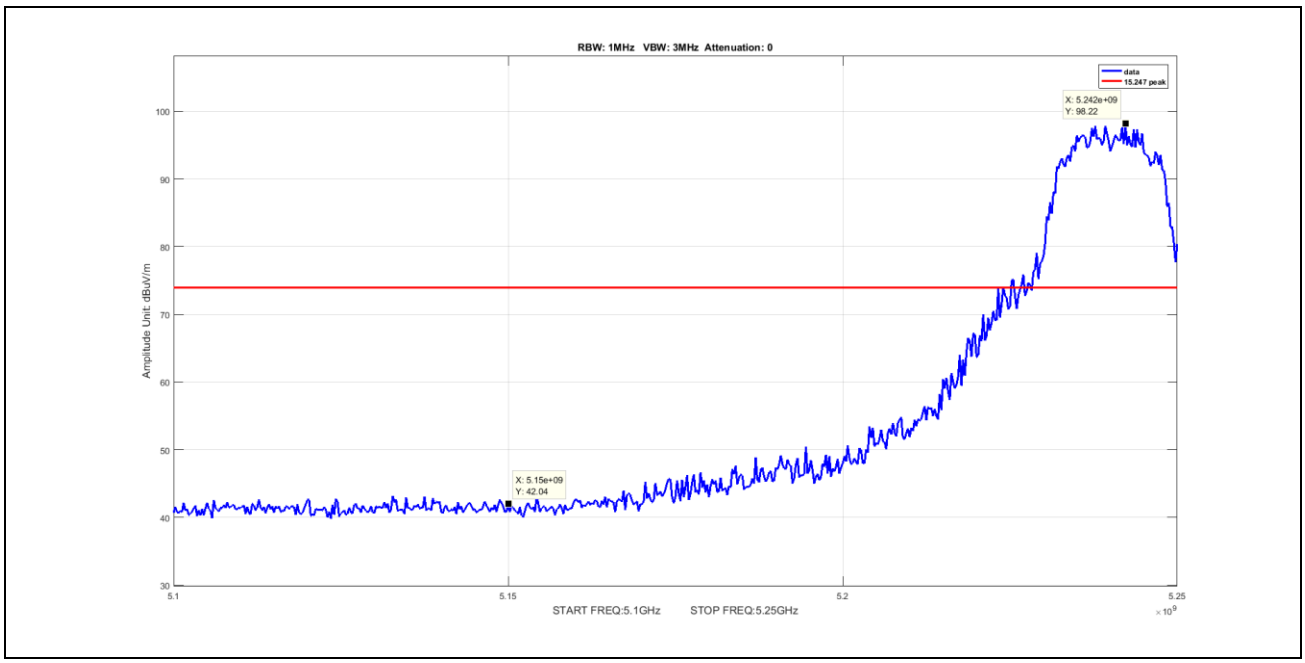
Plot 60. Undesirable Emissions, Peak Band Edge Spurious, BW 20M, Ch 5180M, A Mode Port 1



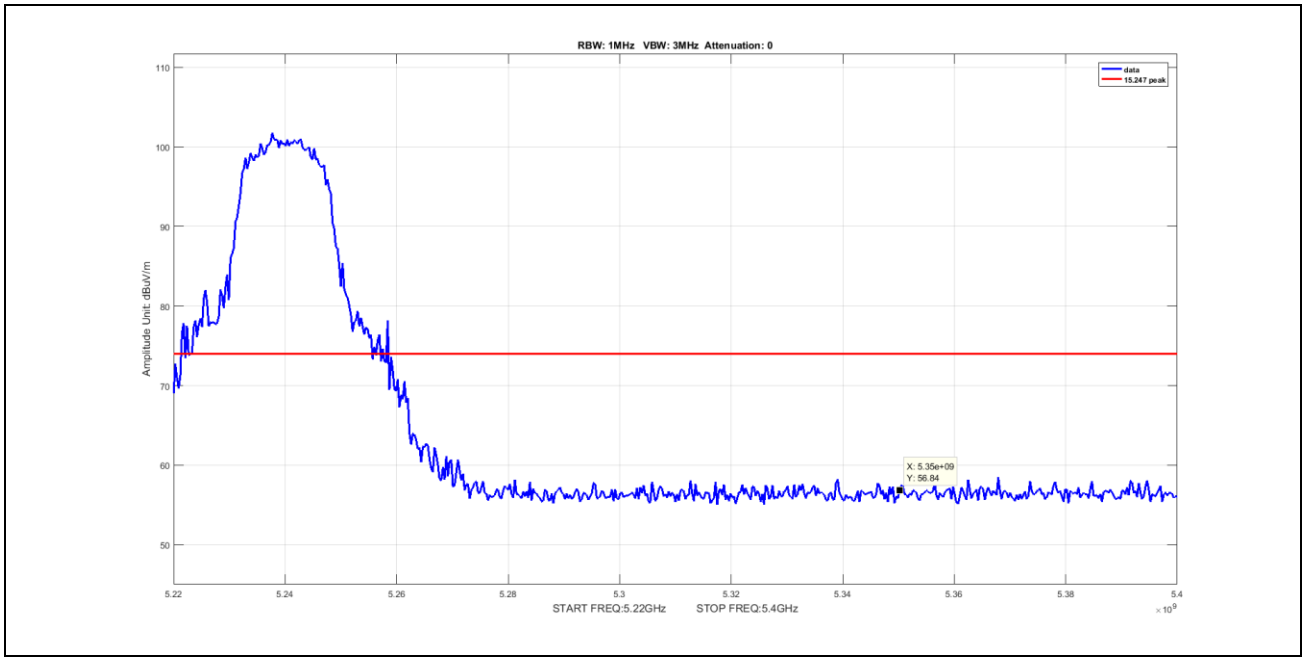
Plot 61. Undesirable Emissions, Peak Band Edge Spurious, BW 20M, Ch 5180M, N Mode Port 2



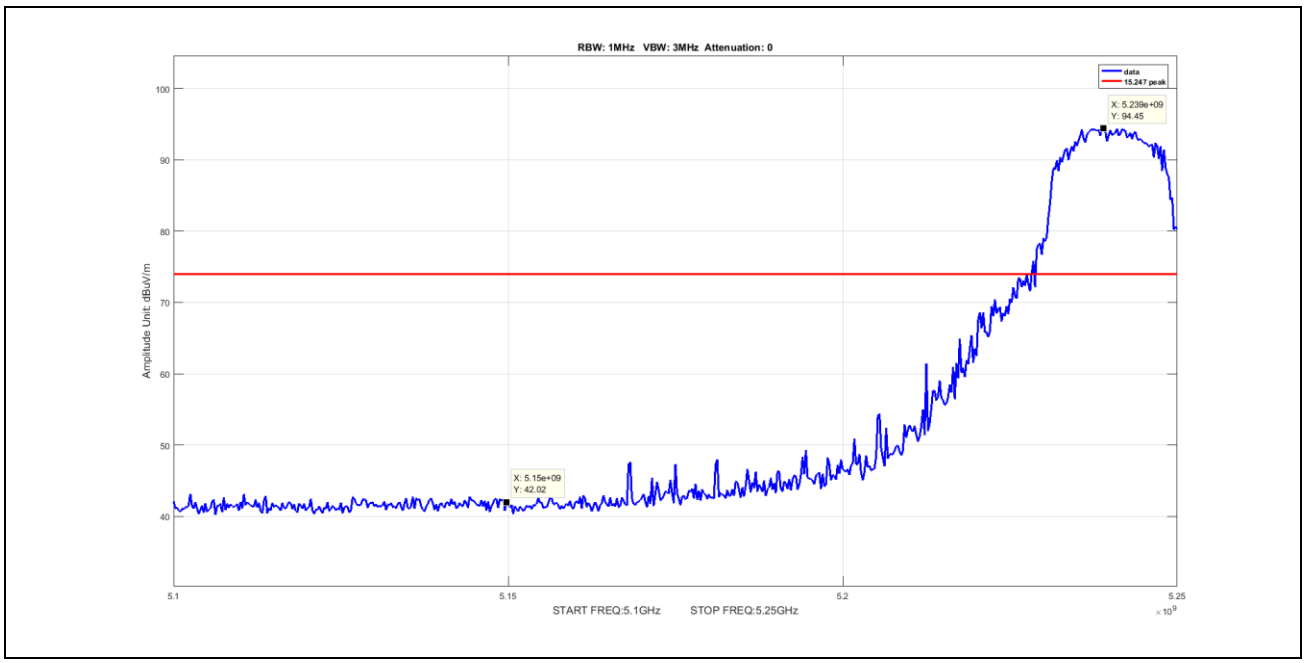
Plot 62. Undesirable Emissions, Peak Band Edge Spurious, BW 20M, Ch 5180M, N Mode Port 1



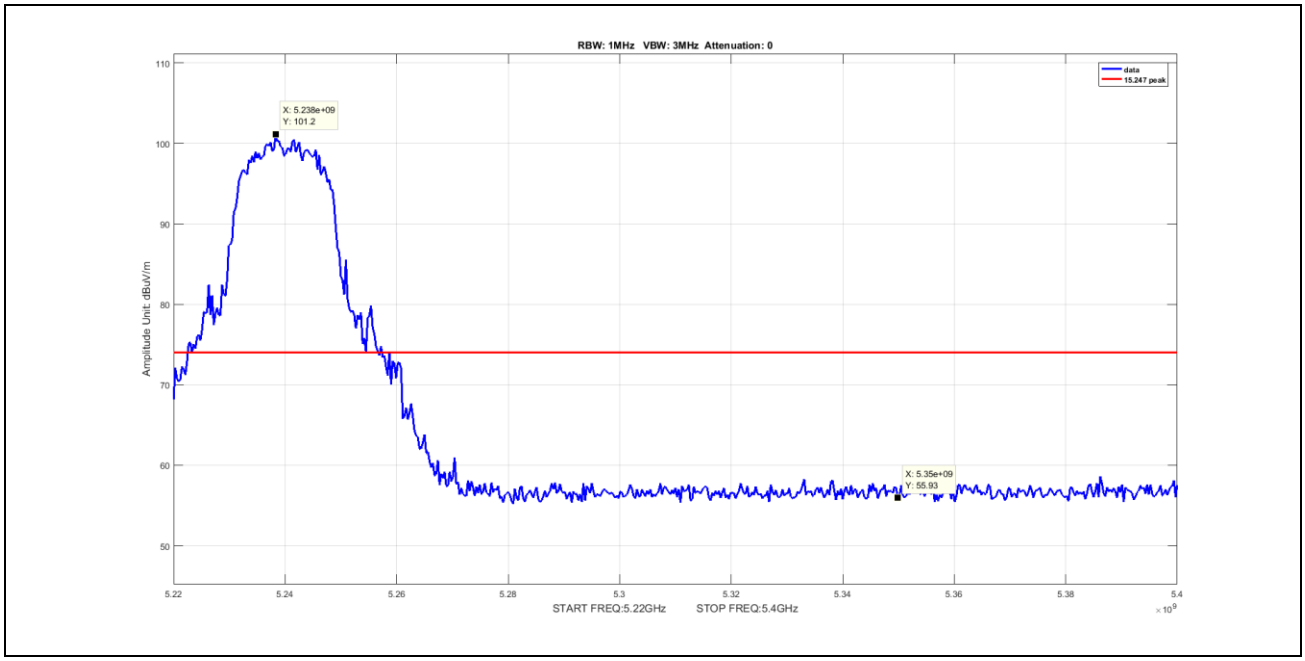
Plot 63. Undesirable Emissions, Peak Band Edge Spurious, BW 20M, Ch 5240M, A Mode Port 2



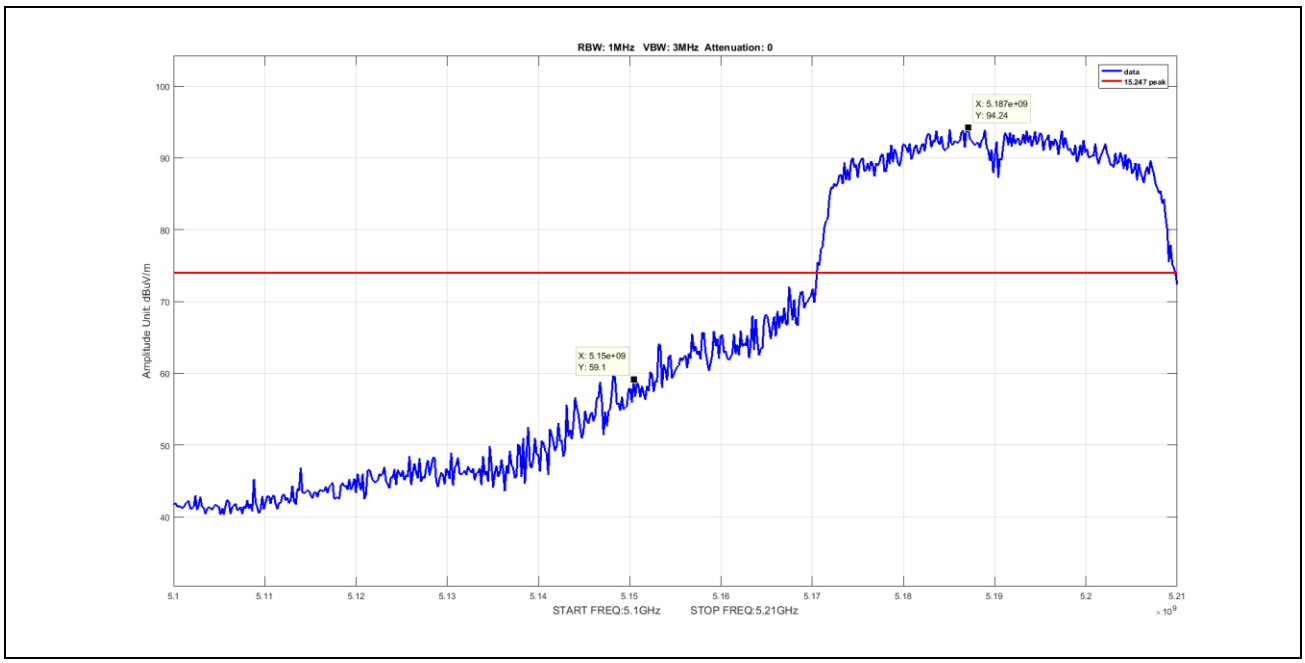
Plot 64. Undesirable Emissions, Peak Band Edge Spurious, BW 20M, Ch 5240M, A Mode Port 1



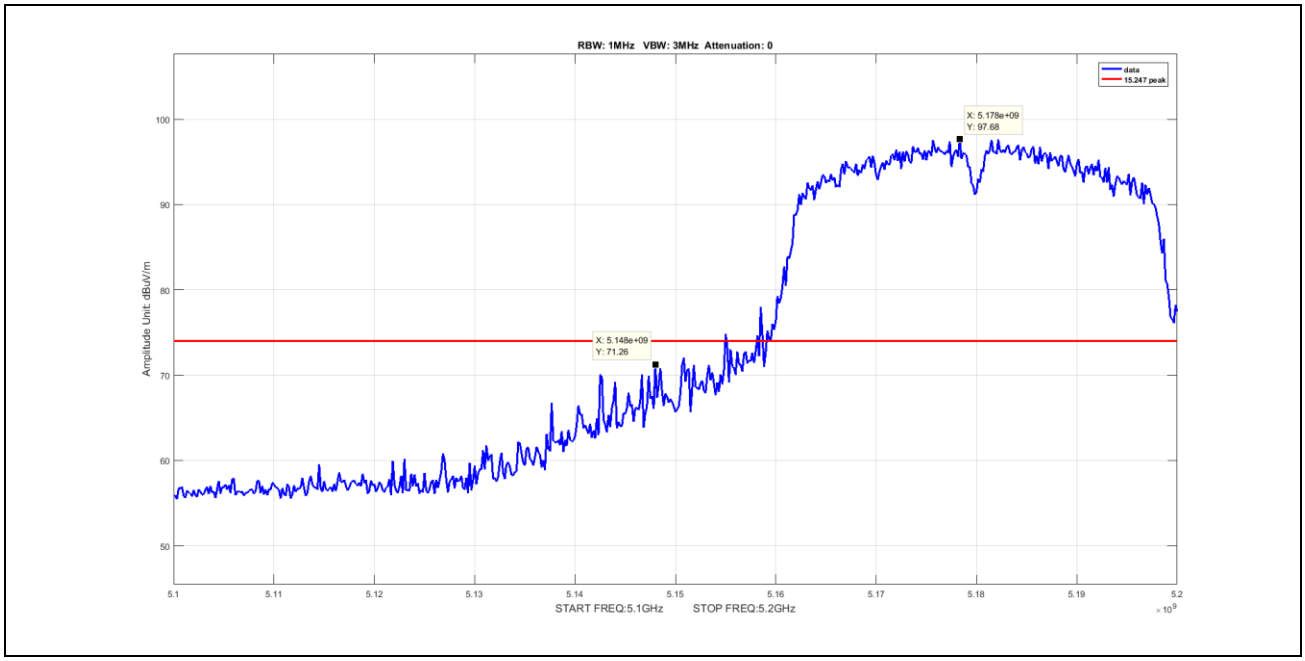
Plot 65. Undesirable Emissions, Peak Band Edge Spurious, BW 20M, Ch 5240M, N Mode Port 2



Plot 66. Undesirable Emissions, Peak Band Edge Spurious, BW 20M, Ch 5240M, N Mode Port 1

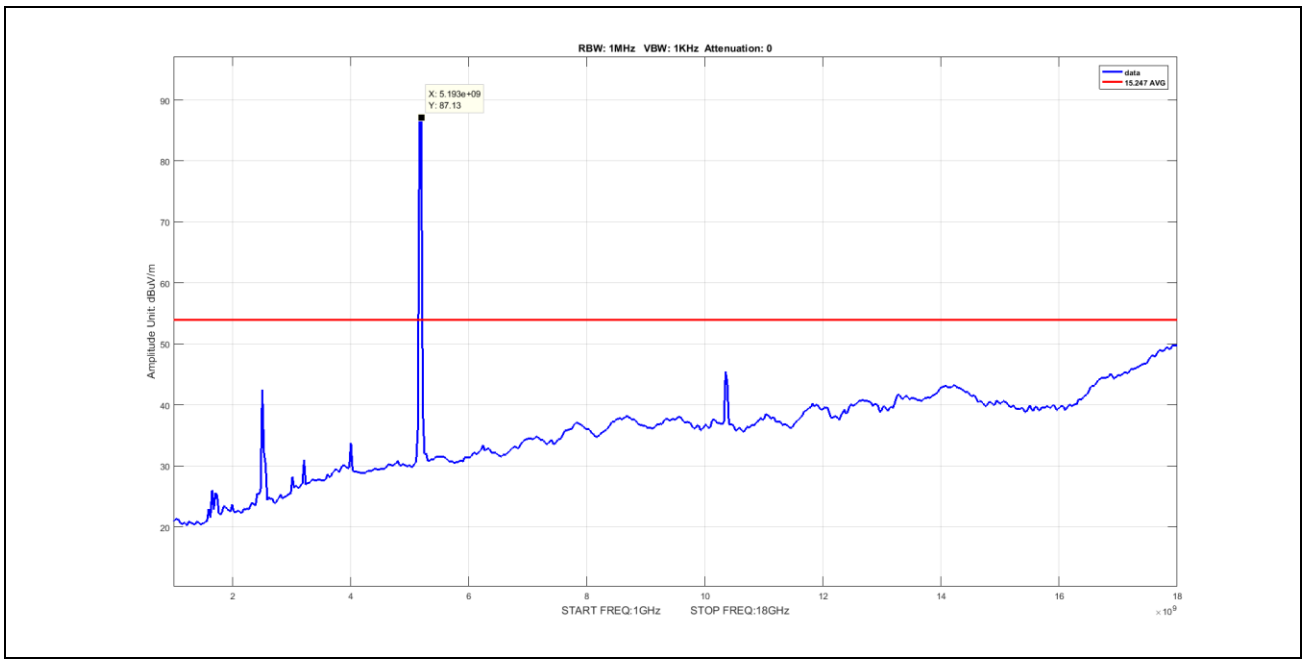


Plot 67. Undesirable Emissions, Peak Band Edge Spurious, BW 40M, Ch 5190M, N Mode Port 2

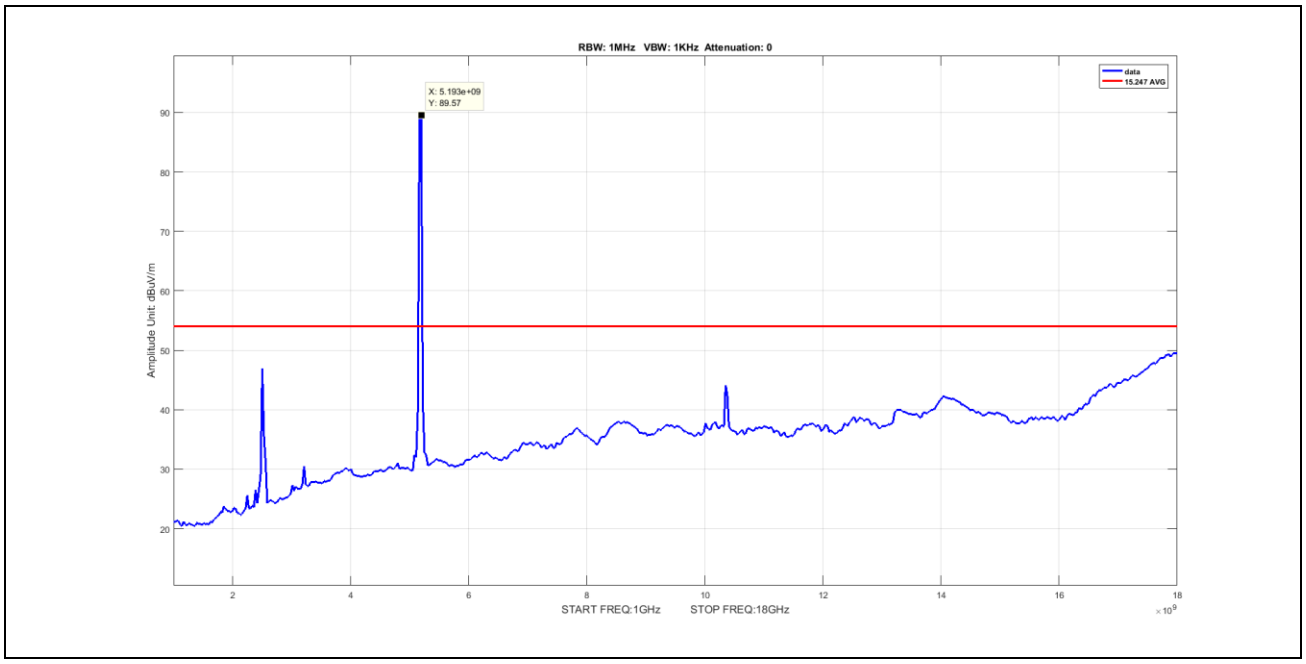


Plot 68. Undesirable Emissions, Peak Band Edge Spurious, BW 40M, Ch 5190M, N Mode Port 1

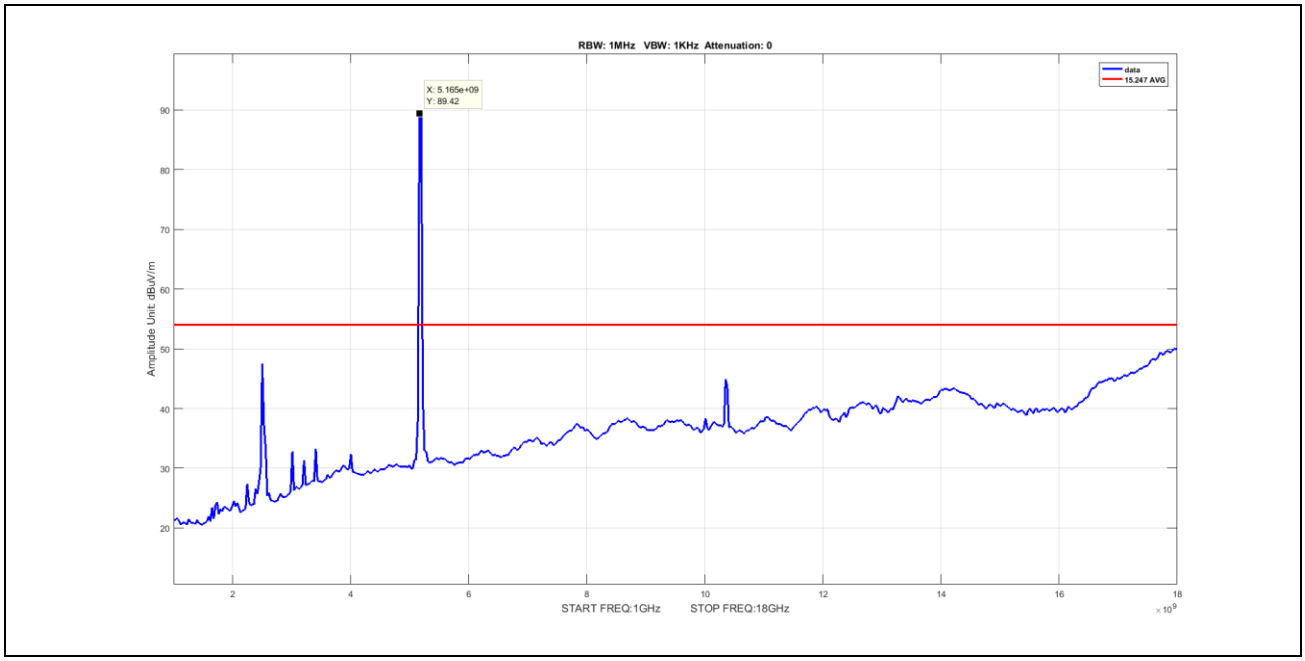
Radiated Spurious Emissions,



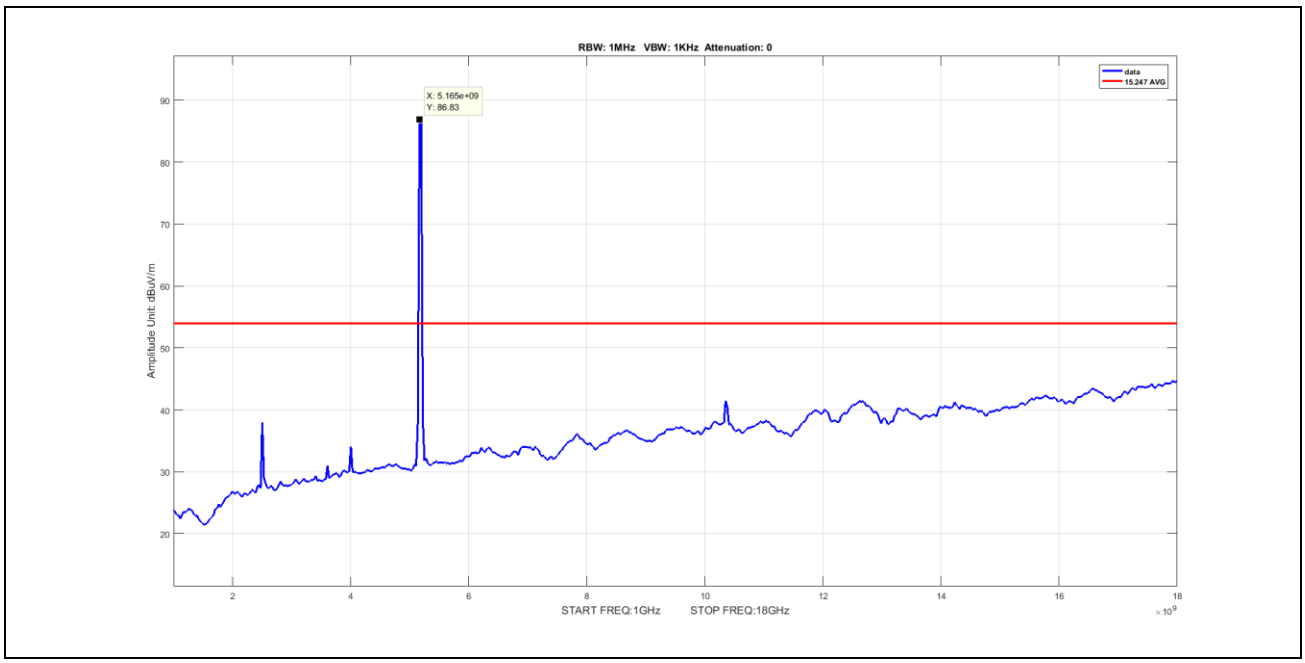
Plot 69. Undesirable Emissions, Average Spurious Emission 1-18GHz, BW 20M, Ch 5180M, A Mode Port 2



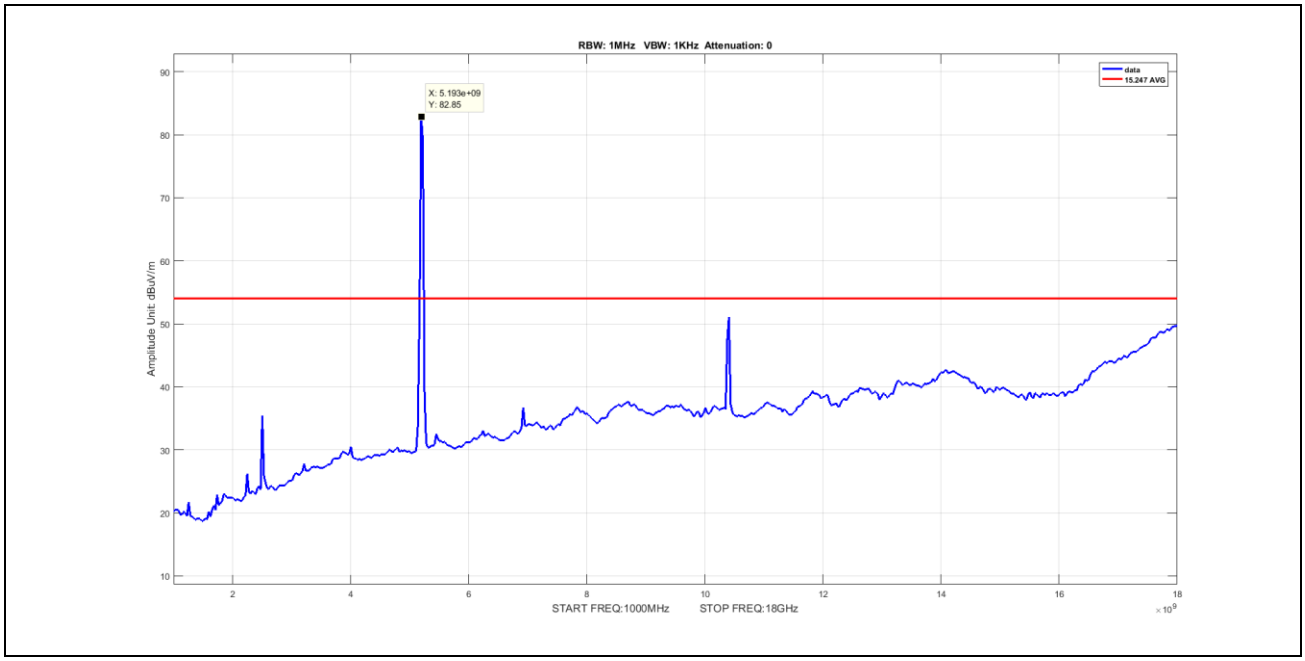
Plot 70. Undesirable Emissions, Average Spurious Emission 1-18GHz, BW 20M, Ch 5180M, A Mode Port 1



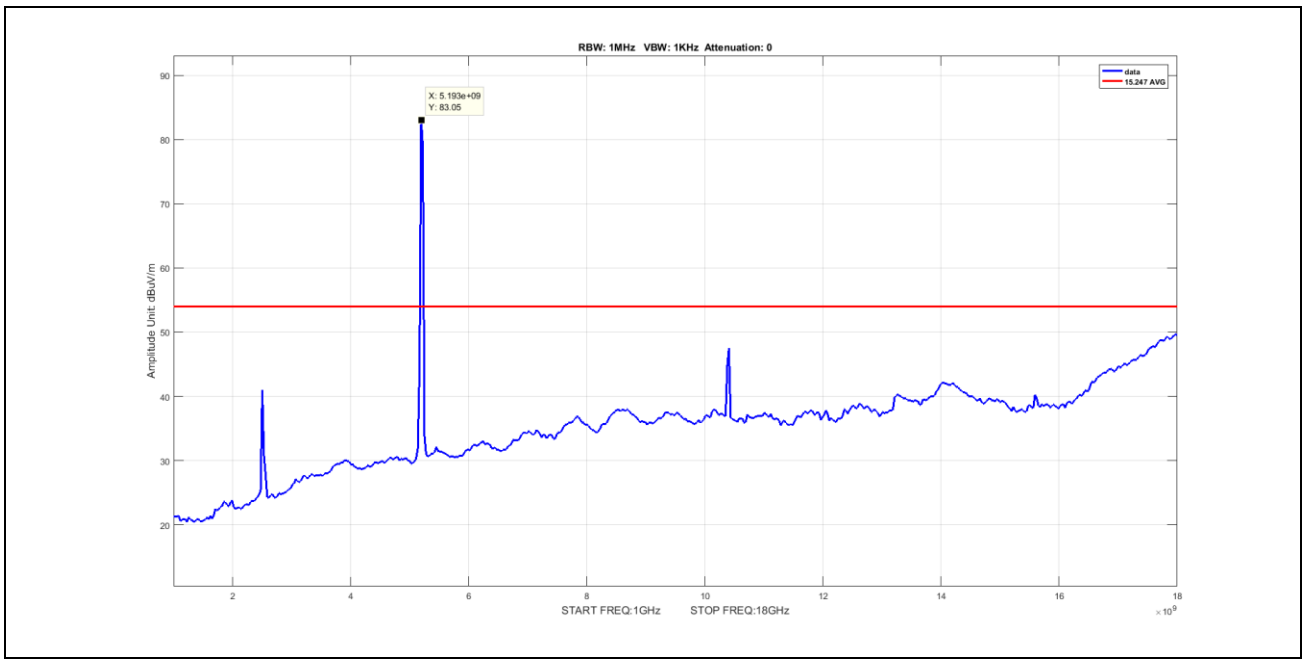
Plot 71. Undesirable Emissions, Average Spurious Emission 1-18GHz, BW 20M, Ch 5180M, N Mode Port 2



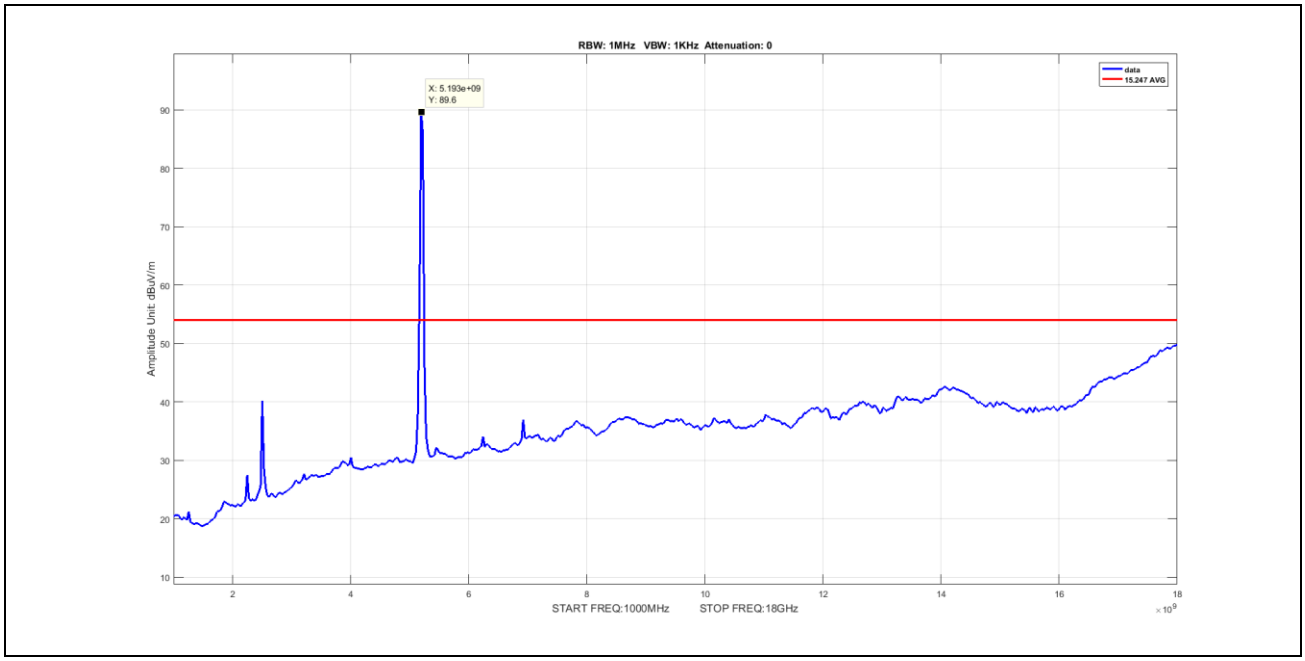
Plot 72. Undesirable Emissions, Average Spurious Emission 1-18GHz, BW 20M, Ch 5180M, N Mode Port 1



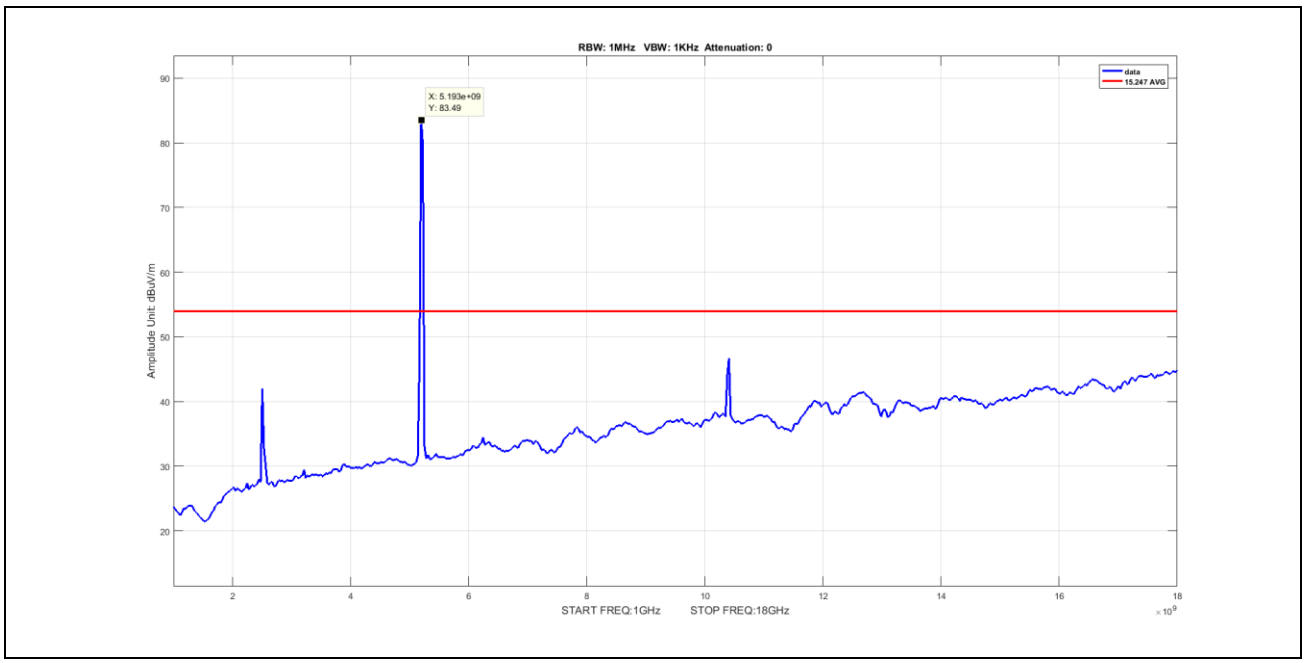
Plot 73. Undesirable Emissions, Average Spurious Emission 1-18GHz, BW 20M, Ch 5200M, A Mode Port 2



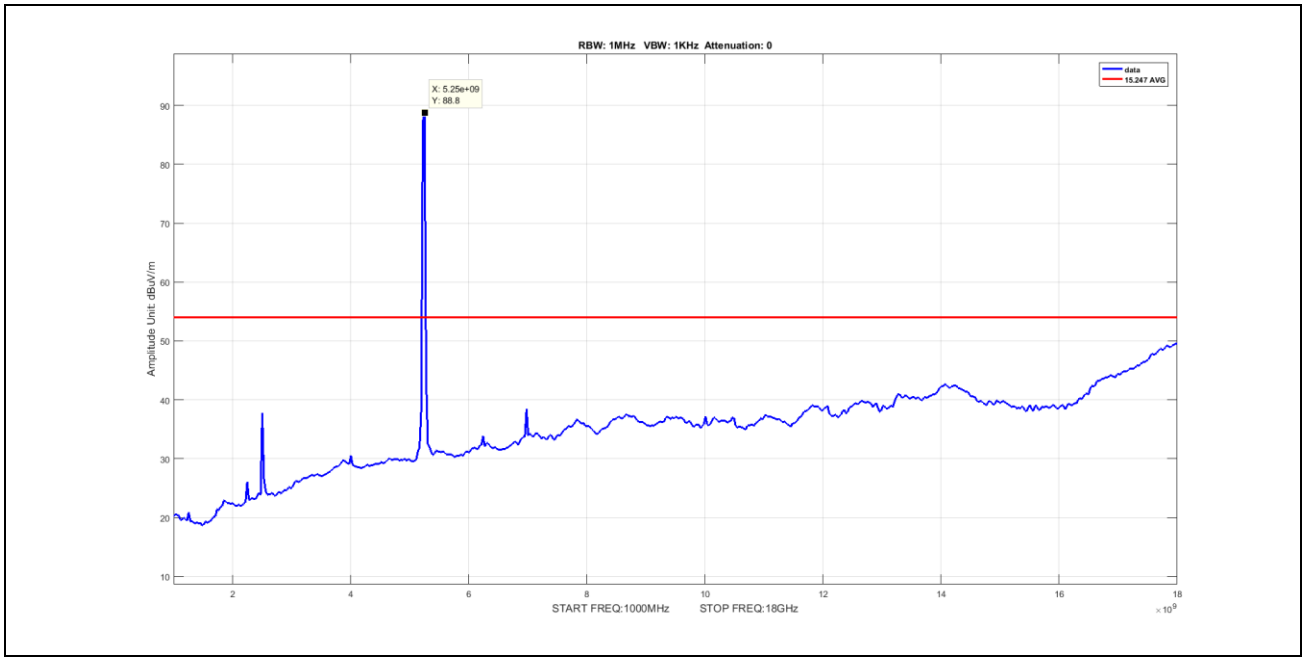
Plot 74. Undesirable Emissions, Average Spurious Emission 1-18GHz, BW 20M, Ch 5200M, A Mode Port 1



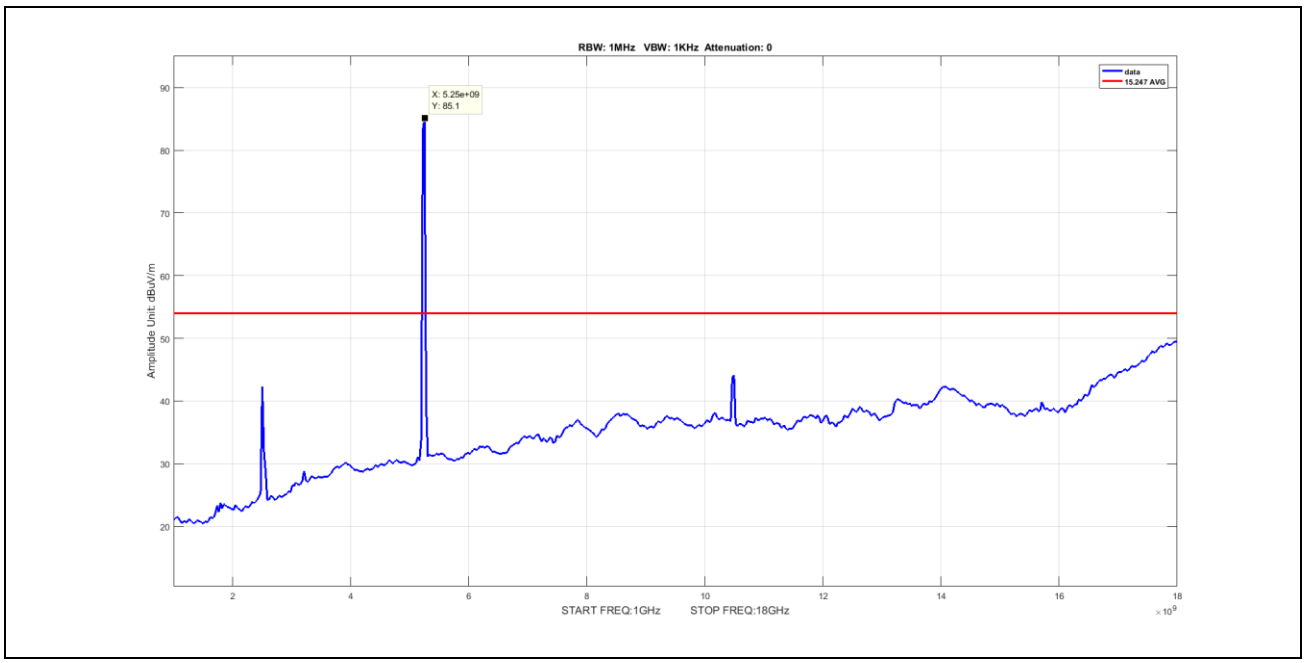
Plot 75. Undesirable Emissions, Average Spurious Emission 1-18GHz, BW 20M, Ch 5200M, N Mode Port 2



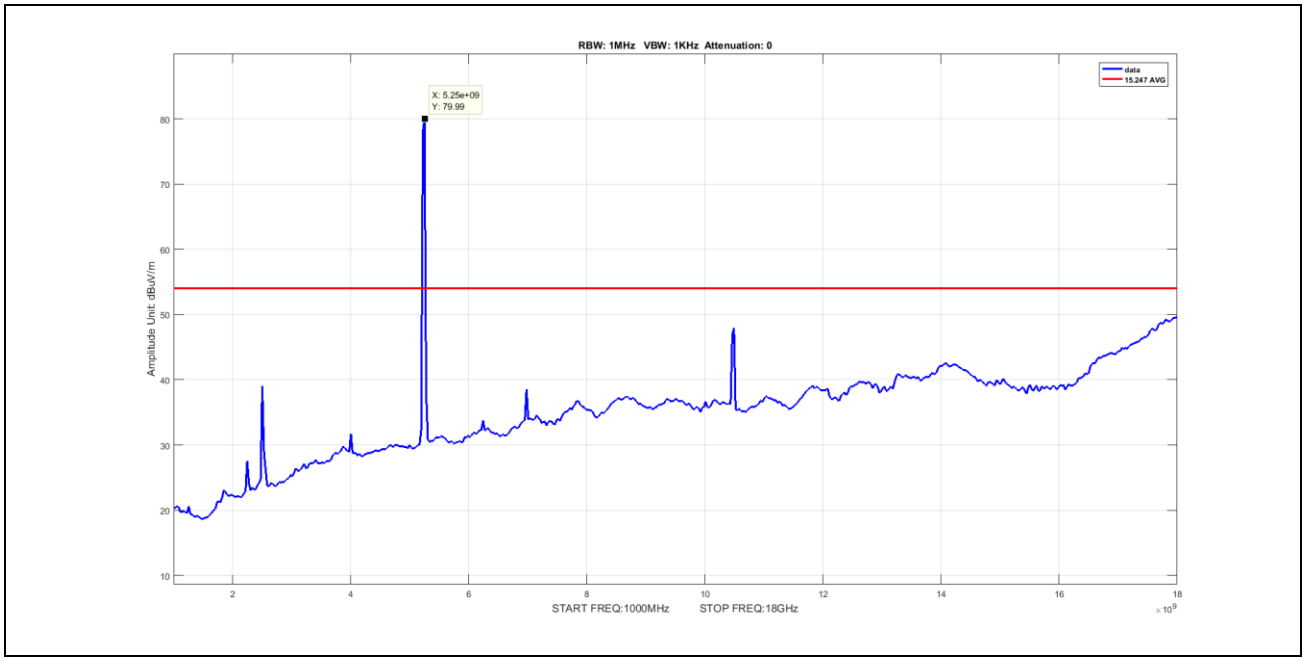
Plot 76. Undesirable Emissions, Average Spurious Emission 1-18GHz, BW 20M, Ch 5200M, N Mode Port 1



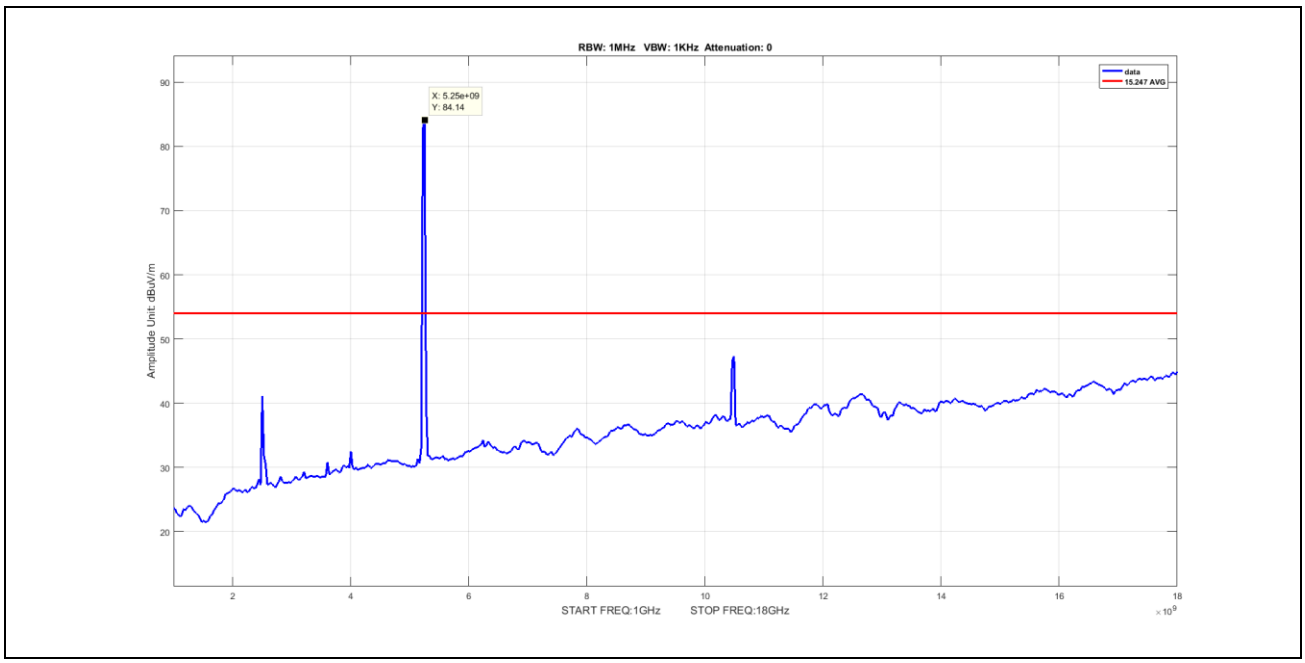
Plot 77. Undesirable Emissions, Average Spurious Emission 1-18GHz, BW 20M, Ch 5240M, A Mode Port 2



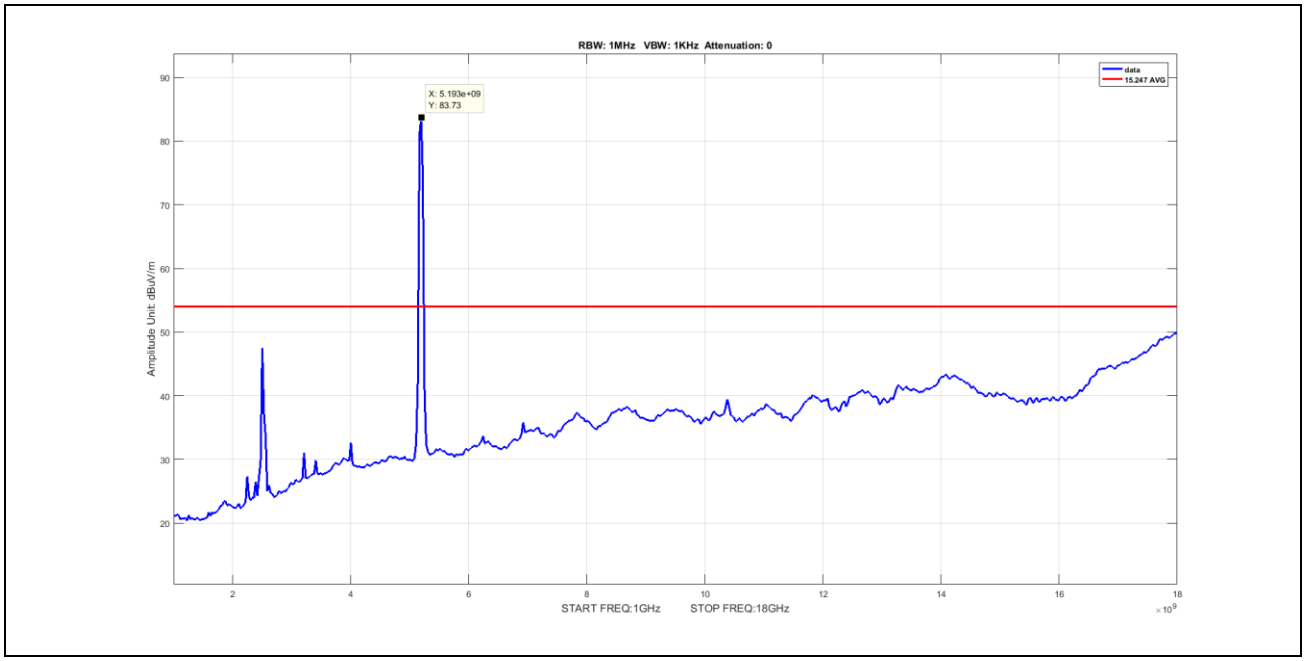
Plot 78. Undesirable Emissions, Average Spurious Emission 1-18GHz, BW 20M, Ch 5240M, A Mode Port 1



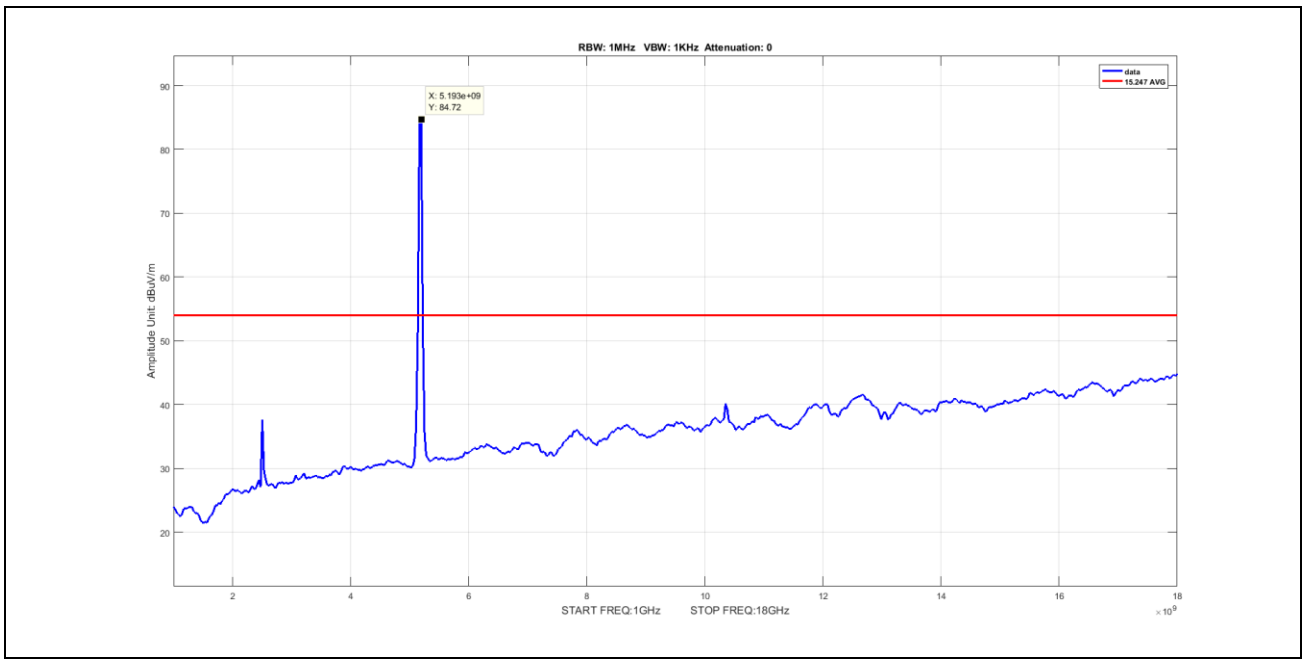
Plot 79. Undesirable Emissions, Average Spurious Emission 1-18GHz, BW 20M, Ch 5240M, N Mode Port 2



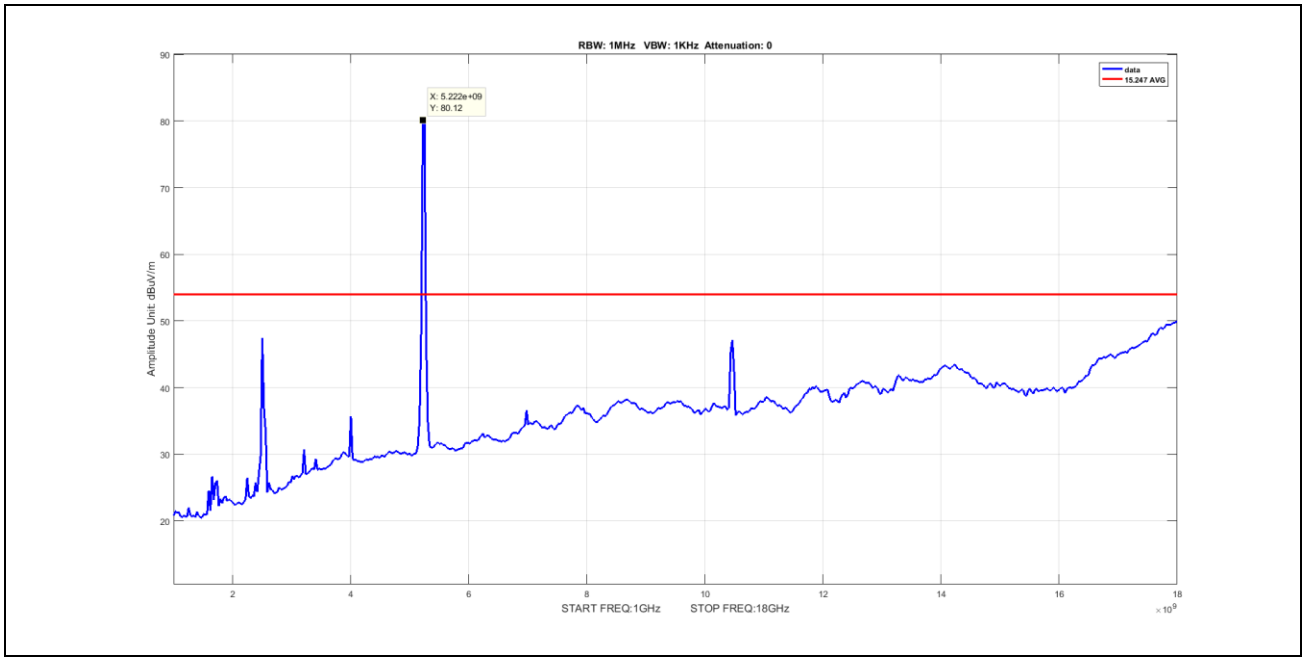
Plot 80. Undesirable Emissions, Average Spurious Emission 1-18GHz, BW 20M, Ch 5240M, N Mode Port 1



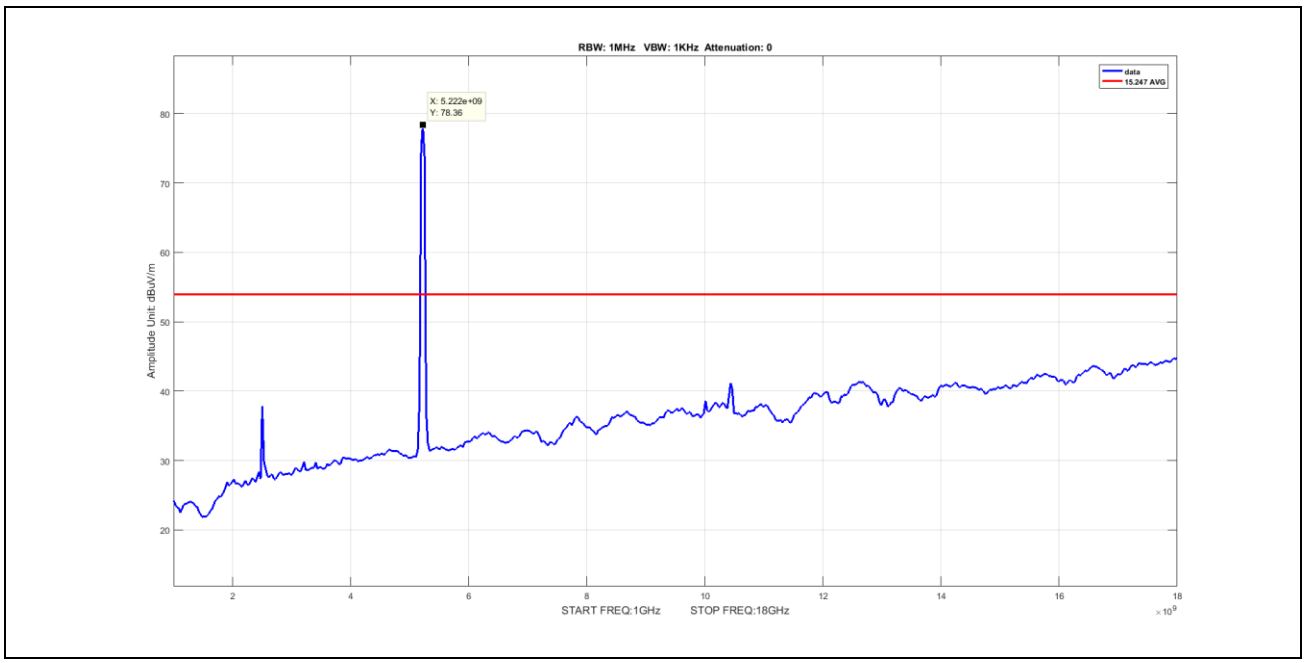
Plot 81. Undesirable Emissions, Average Spurious Emission 1-18GHz, BW 40M, Ch 5190M, N Mode Port 2



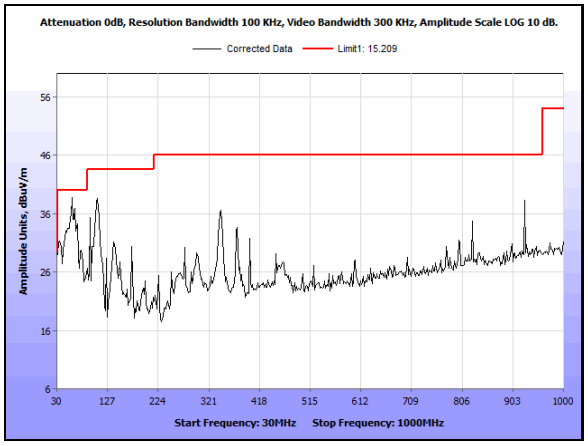
Plot 82. Undesirable Emissions, Average Spurious Emission 1-18GHz, BW 40M, Ch 5190M, N Mode Port 1



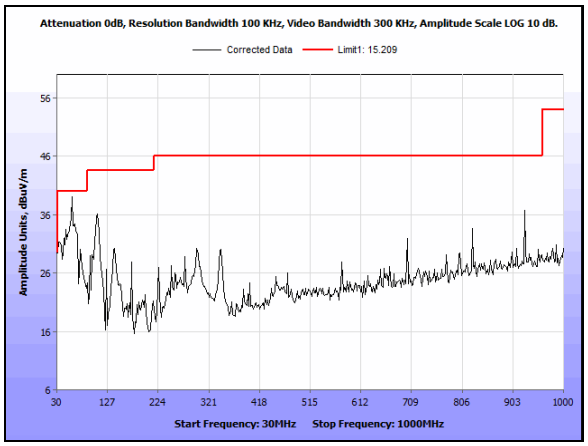
Plot 83. Undesirable Emissions, Average Spurious Emission 1-18GHz, BW 40M, Ch 5230M, N Mode Port 2



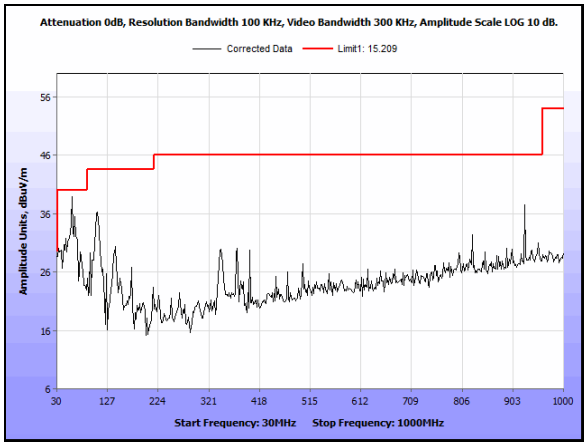
Plot 84. Undesirable Emissions, Average Spurious Emission 1-18GHz, BW 40M, Ch 5230M, N Mode Port 1



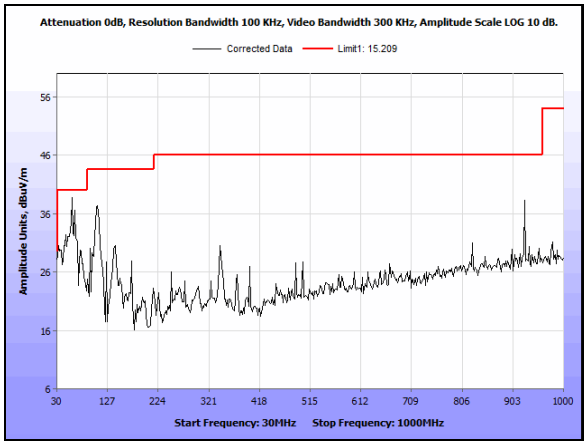
Plot 85. Undesirable Emissions, 30 MHz - 1 GHz 5180 MHz A Mode 20 MHz Port 1



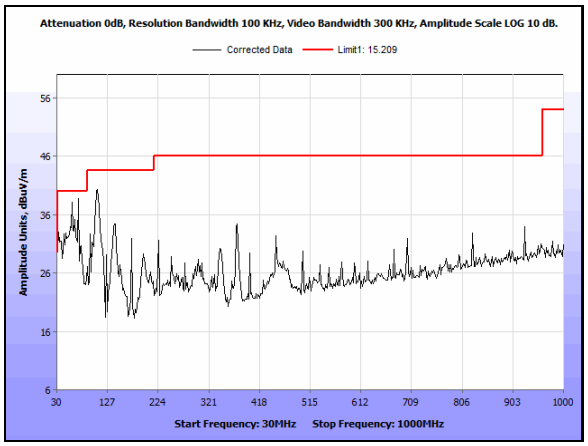
Plot 86. Undesirable Emissions, 30 MHz - 1 GHz 5180 MHz A Mode 20 MHz Port 2



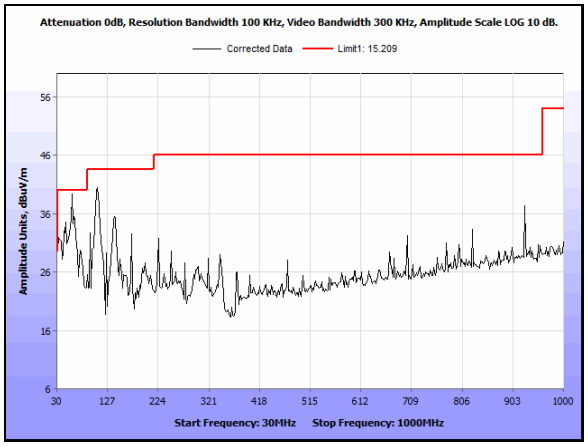
Plot 87. Undesirable Emissions, 30 MHz - 1 GHz 5180 MHz N Mode 20 MHz Port 1



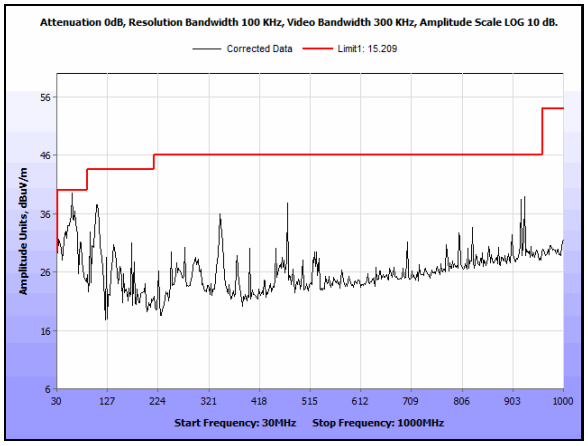
Plot 88. Undesirable Emissions, 30 MHz - 1 GHz 5180 MHz N Mode 20 MHz Port 2



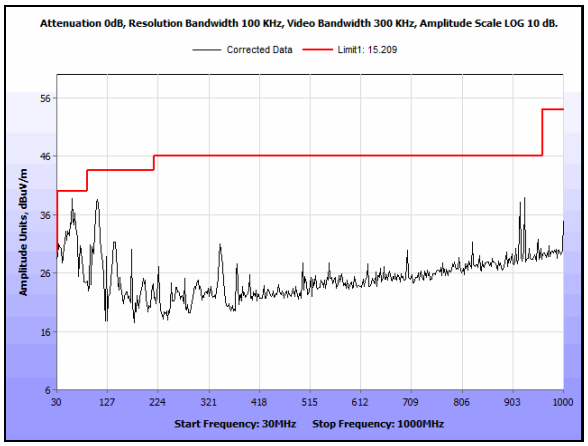
Plot 89. Undesirable Emissions, 30 MHz - 1 GHz 5190 MHz N Mode 40 MHz Port 1



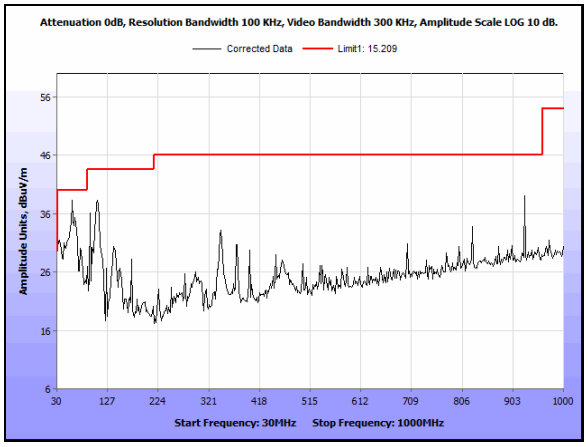
Plot 90. Undesirable Emissions, 30 MHz - 1 GHz 5190 MHz N Mode 40 MHz Port 2



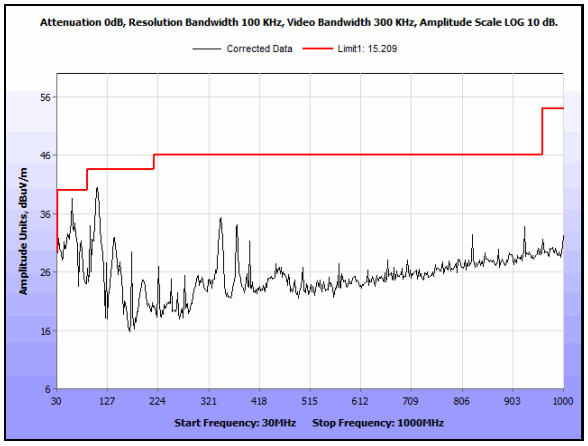
Plot 91. Undesirable Emissions, 30 MHz - 1 GHz 5200 MHz A Mode 20 MHz Port 1



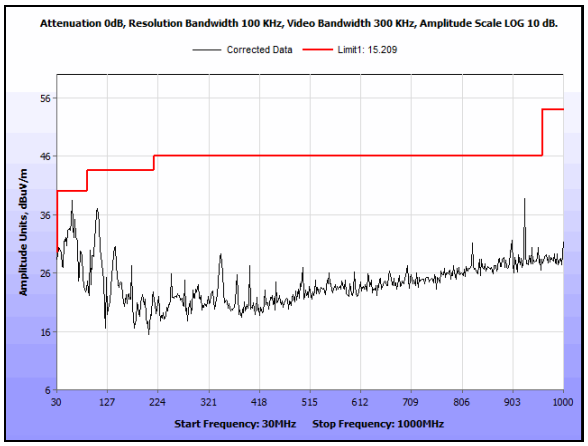
Plot 92. Undesirable Emissions, 30 MHz - 1 GHz 5200 MHz A Mode 20 MHz Port 2



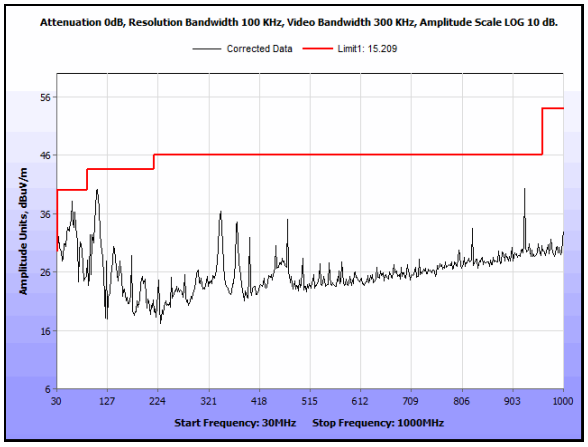
Plot 93. Undesirable Emissions, 30 MHz - 1 GHz 5200 MHz N Mode 20 MHz Port 1



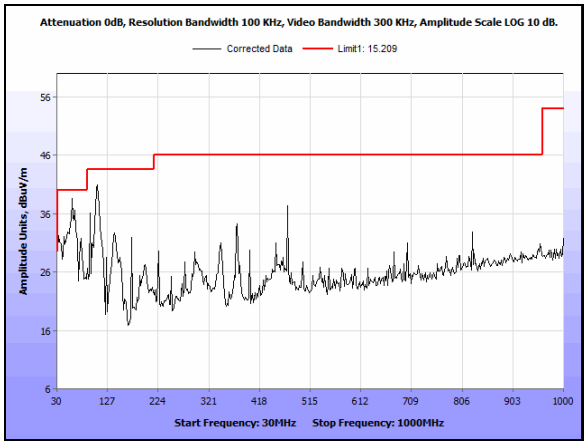
Plot 94. Undesirable Emissions, 30 MHz - 1 GHz 5200 MHz N Mode 20 MHz Port 2



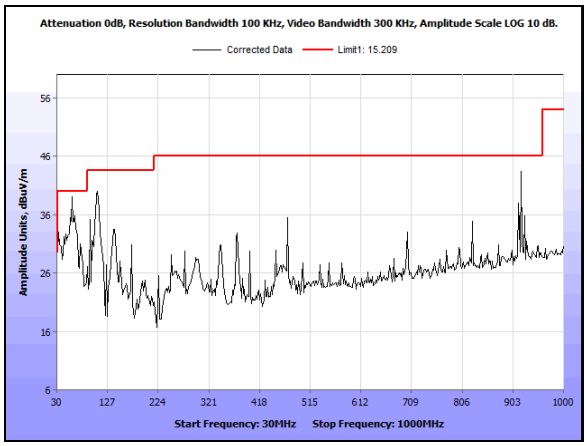
Plot 95. Undesirable Emissions, 30 MHz - 1 GHz 5240 MHz A Mode 20 MHz Port 1



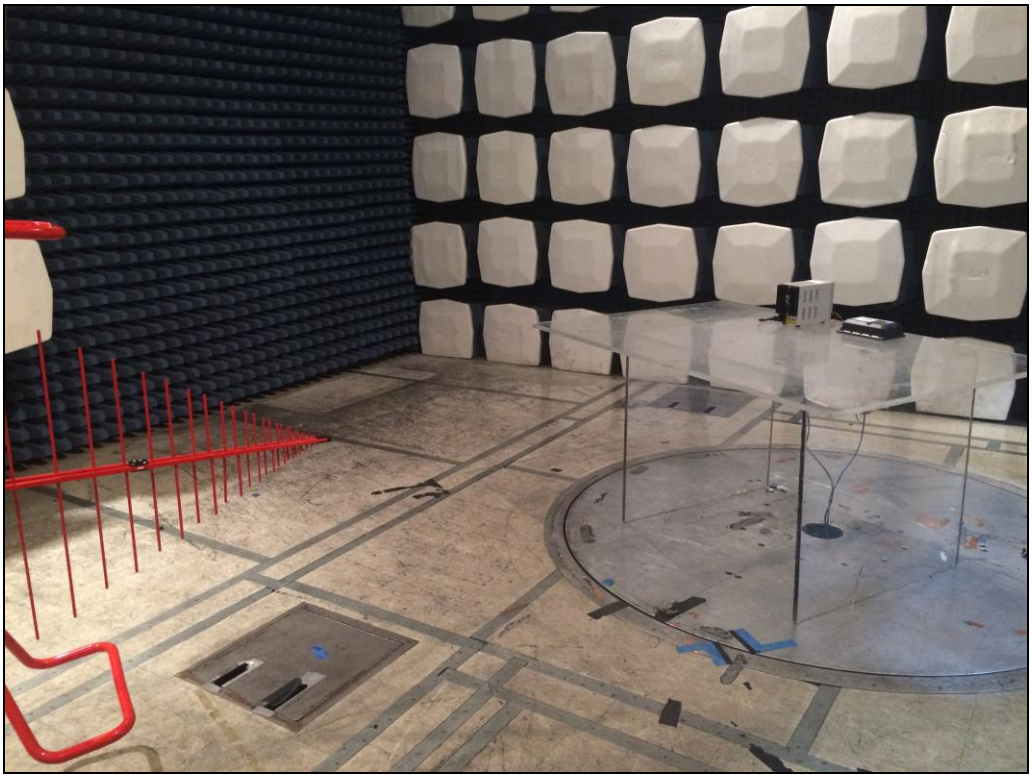
Plot 96. Undesirable Emissions, 30 MHz - 1 GHz 5240 MHz A Mode 20 MHz Port 2



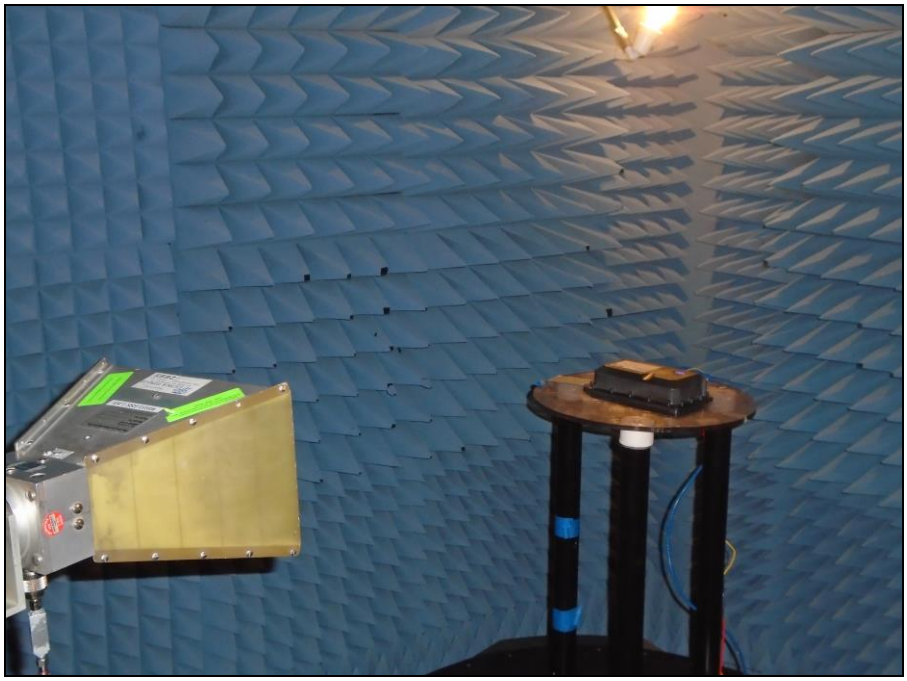
Plot 97. Undesirable Emissions, 30 MHz - 1 GHz 5240 MHz N Mode 20 MHz Port 1



Plot 98. Undesirable Emissions, 30 MHz - 1 GHz 5240 MHz N Mode 20 MHz Port 2



Photograph 1. Radiated Emission, Set up Below 1 GHz, Test Results



Photograph 2. Radiated Emissions, Above 1GHz, Test Results

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(b)(6) Conducted Emissions

Test Requirement(s): **§ 15.407 (b)(6):** Any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

§ 15.207 (a): For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30MHz, shall not exceed the limits in the following table, as measured using a 50 μΩ/50 Σ line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency range (MHz)	§ 15.207(a), Conducted Limit (dBμV)	
	Quasi-Peak	Average
* 0.15- 0.45	66 – 56	56 - 46
0.45 - 0.5	56	46
0.5 - 30	60	50

Table 12. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a non-metallic table 80 cm tall inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 μH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.10-2013 "American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices"*. Scans were performed with the transmitter on.

Test Results: The EUT was not applicable with requirements of this section.

EUT utilizes DC power supply.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(f) Maximum Permissible Exposure

Test Requirement(s): **§15.407(f):** U-NII devices are subject to the radio frequency radiation exposure requirements specified in §1.1307(b), §2.1091 and §2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a "general population/uncontrolled" environment.

RF Exposure Requirements: **§1.1307(b)(1) and §1.1307(b)(2):** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

RF Radiation Exposure Limit: **§1.1310:** As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

MPE Limit: EUT's operating frequencies @ 5150-5250 MHz; **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

Equation from page 18 of OET 65, Edition 97-01

$$S = PG / 4\pi R^2 \quad \text{or} \quad R = \sqrt{(PG / 4\pi S)}$$

where, S = Power Density (mW/cm^2)
P = Power Input to antenna (mW)
G = Antenna Gain (numeric value)
R = Distance (cm)

Test Results:

FCC									
Frequency (MHz)	**Con. Pwr. (dBm)**	**Con. Pwr. (mW)**	**Ant. Gain (dBi)**	**Ant. Gain numeric**	**Pwr. Density (mW/cm^2)**	**Limit (mW/cm^2)**	**Percentage of Margin**	**Distance (cm)**	**Result**
5240	20.7	117.49	4.5	2.818	0.06588	1	0.93412	20	Pass

The safe distance where Power Density is less than the MPE Limit listed above was found to be 20cm.

IV. Test Equipment

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2005.

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1T4612	Spectrum Analyzer	Agilent Technologies	E4407B	3/30/2017	9/30/2018
1T4771	PSA Spectrum Analyzer	Agilent Technologies	E4446A	8/10/2016	2/10/2018
1T4149	High-Frequency Anechoic Chamber	Ray Proof	81	Not Required	
1T4442	Pre-amplifier, Microwave	Miteq	AFS42-01001800-30-10P	See Note	
1T4483	Antenna; Horn	ETS-Lindgren	3117	4/19/2017	10/19/2018
1T4745	Antenna, Horn	ETS-Lindgren	3116	1/21/2017	7/21/2018
1T4752	Pre-Amplifier	Miteq	JS44-18004000-35-8P	See Note	
1T4300A	SEMI-ANECHOIC CHAMBER # 1 (FCC)	EMC TEST SYSTEMS	NONE	1/31/2016	1/31/2019
1T4753	Antenna - Bilog	Sunol Sciences	JB6	10/24/2016	4/24/2018
1T4409	EMI Receiver	Rohde & Schwarz	ESIB7	12/7/2016	12/7/2018
1T4910	Digital Barometer, Hygrometer, Thermometer	Control Company	06-662-4	1/15/2016	1/15/2018

Table 13. Test Equipment List

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

V. Certification & User's Manual Information

Certification & User's Manual Information

M. Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

§ 2.801 Radio-frequency device defined.

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

(a) The various types of radio communication transmitting devices described throughout this chapter.

(b) The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.

(c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.

(d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

§ 2.803 Marketing of radio frequency devices prior to equipment authorization.

(a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:

(1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or

(2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.

(d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.

(e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:

(i) Compliance testing;

(ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or

(v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.

(e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.

(f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

Certification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:

§ 2.901 Basis and Purpose

(a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.[1] *In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer*, be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.

(b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant.

§ 2.907 Certification.

(a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.

(b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

[1] In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.

Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

(a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.

(1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.

(i) If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.

(ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.

(2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.

Certification & User's Manual Information

Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

§ 15.19 Labeling requirements.

(a) In addition to the requirements in Part 2 of this chapter, a device subject to certification or verification shall be labeled as follows:

(1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

(2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.

(3) All other devices shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

§ 15.21 Information to user.

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Verification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

§ 15.105 Information to the user.

(a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

– Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

– Consult the dealer or an experienced radio/TV technician for help.

