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
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May 11, 2018

Audioicons
150 Meadowview Road
Athens, Georgia 30606

Dear Kevin Clark,

Enclosed is the EMC Wireless test report for compliance testing of the Audioicons, Audioicons FH1 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15, Subpart B for a Class B Digital Device, and FCC Part 15 Subpart C for Intentional Radiators.

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: (\Audioicons\EMC96018-FCC247 Rev. 2)

Electromagnetic Compatibility Criteria
Test Report

for the

Audioicons
Audioicons FH1

Tested under
the FCC Certification Rules
contained in
Title 47 of the CFR, Parts 15 Subpart B
for Class B Digital Devices

MET Report: EMC96018-FCC247 Rev. 2

May 11, 2018

Prepared For:

Audioicons
150 Meadowview Road
Athens, Georgia 30606

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

Electromagnetic Compatibility Criteria
Test Report

for the

Audioicons
Audioicons FH1

Tested under
the FCC Certification Rules
contained in
Title 47 of the CFR, Parts 15 Subpart B
for Class B Digital Devices
&
15.247 Subpart C for Intentional Radiators

Bradley Jones, 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 the FCC Rules Parts 15B and 15.247 under normal use and maintenance.

John Mason,
Director, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	April 30, 2018	Initial Issue.
1	May 1, 2018	Customer Corrections.
2	May 11, 2018	TCB Corrections.

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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
NEBS	**N**etwork **E**quipment-**B**uilding **S**ystem
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 Audioicons Audioicons FH1, with the requirements of Part 15, §15.247. 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 Audioicons FH1. Audioicons should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Audioicons FH1, 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, §15.247, in accordance with Audioicons, purchase order number AI-82817MET. All tests were conducted using measurement procedure ANSI C63.4-2003.

FCC Reference 47 CFR Part 15.247:2005	Description	Compliance
Title 47 of the CFR, Part 15 §15.203	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	Conducted Emission Limits	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)	20 dB Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)	Average Time of Occupancy (Dwell Time)	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)	Number of RF Channels	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)	RF Channel Separation	Compliant
Title 47 of the CFR, Part 15 §15.247(b)	Peak Power Output	Compliant
Title 47 of the CFR, Part 15 §15.247(d); §15.209; §15.205	Radiated Spurious Emissions	Compliant
Title 47 of the CFR, Part 15 §15.247(d)	Spurious Conducted Emissions	Compliant
Title 47 of the CFR, Part 15 §15.247(i)	SAR	Compliant

Table 1. Executive Summary of EMC Part 15.247 ComplianceTesting

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Audioicons to perform testing on the Audioicons FH1, under Audioicons's purchase order number AI-82817MET.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Audioicons, Audioicons FH1.

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

Model(s) Tested:	Audioicons FH1	
Model(s) Covered:	Audioicons FH1	
EUT Specifications:	Primary Power: 7.4 VDC	
	FCC ID: 2APKL-AIFH1	
	Type of Modulations:	GFSK, Pi/4 DQPSK, 8DPSK
	Equipment Code:	FHSS
	Peak RF Output Power:	-5.293 dBm
	EUT Frequency Ranges:	2402-2480MHz
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	
Evaluated by:	Bradley Jones	
Report Date(s):	May 11, 2018	

Table 2. EUT Summary Table

Note: All testing was conducted using GFSK modulation as this was determined to be the worst case modulation.

B. References

CFR 47, Part 15, Subpart C	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
CFR 47, Part 15, Subpart B	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
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

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. 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. Uncertainty Calculations Summary

E. Description of Test Sample

The Audioicons Audioicons FH1, Equipment Under Test (EUT), is a desktop Bluetooth audio stereo speaker system containing a Bluetooth 3.0 module (Class 2) and a 4-channel class D amplifier (2 woofers and 2 tweeters). The unit is powered by 4 Li cells at an operating voltage of 7.4V (2 in series and 2 in parallel, 2200 mAh). The battery pack incorporates a PCB to protect against damage. Charging of the batteries is accomplished by a UL-approved 12V DC charger (converted from 120V AC using a standard outlet). The manual instructs the user to avoid use during charging. All control of the FH1, other than on/off is accomplished by the connected device (typically a smart phone or tablet device). Such devices will most often be connected wirelessly by Bluetooth, but a rear panel connection is also provided for a directly wired analog connection by a commonly used 1/8" stereo jack.

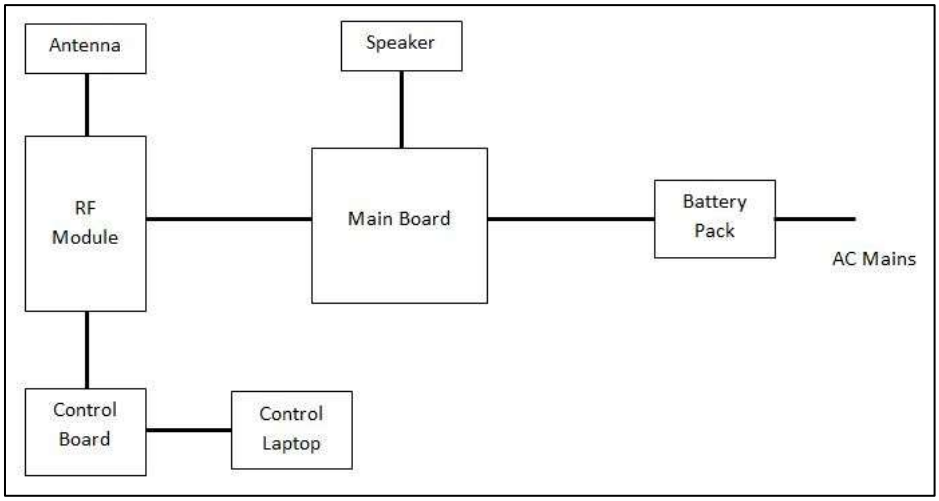


Figure 1. Block Diagram of Test Configuration

F. Equipment Configuration

The EUT was set up as outlined in Figure 1, 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	Rev. #
1	1	AudioIcons Helmet Speaker System	FH1	N/A	001, 002	N/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
1	Laptop	HP	Pro Book 430 G1	N/A
N/A	Control Board	Bosch	21.1002901.12	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)	Shielded (Y/N)	Termination Point
1	Aux	1/8" stereo cable	1	3	N/A	N

Table 7. Ports and Cabling Information

I. Mode of Operation

The FH1 can be operated either by direct connection (1/8" stereo jack) or wirelessly by standard Bluetooth connection for up to 10 hours at a moderate volume using the onboard Li battery. No other operating modes exist.

J. Method of Monitoring EUT Operation

The measurable indication that the EUT is performing correctly is that it plays and amplifies a user-selected audio file sourced from a Bluetooth-enabled laptop, smart phone, or tablet.

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 Audioicons 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. The EUT has an integral antenna.

Test Engineer(s): Surendra Shrestha

Test Date(s): October 4, 2017

Gain	Type	Model	Manufacturer
1.76 dBi	PCB Trace	BM81SPK02	Microchip/ISSC

Table 8. Antenna List

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207(a) Conducted Emissions Limits

Test Requirement(s): **§ 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 μH/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 9. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Procedure: The EUT was placed on a 0.8 m-high wooden table 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 C63.4-2003 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 μH LISN as the input transducer to an EMC/field intensity meter. For the purpose of this testing, the transmitter was turned on. Scans were performed with the transmitter on.

Test Results: The EUT was compliant with this requirement. Measured emissions were within applicable limits.

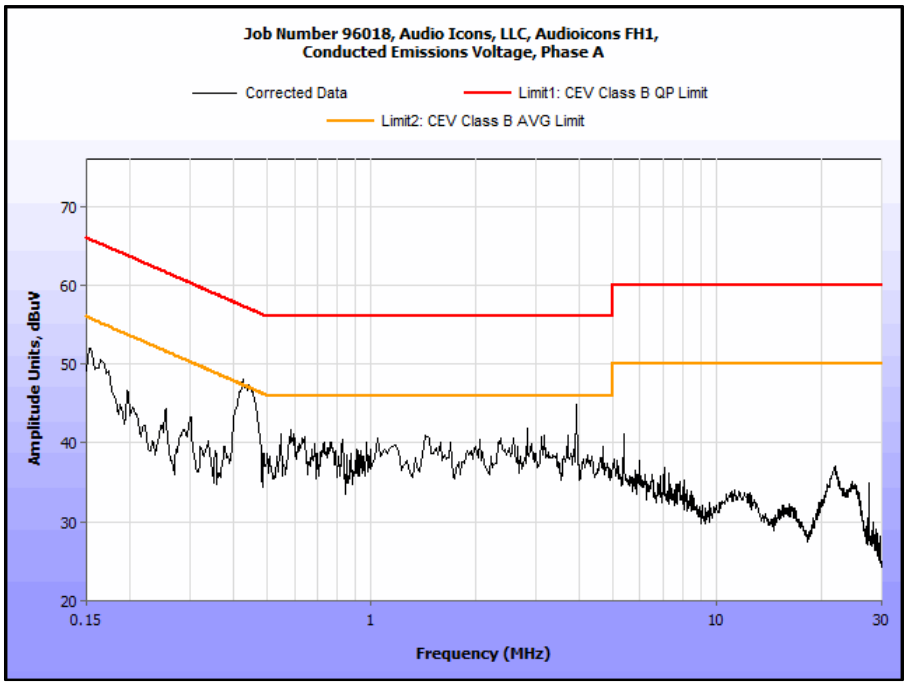
Test Engineer(s): Michael McCormick

Test Date(s): April 10, 2018

15.207(a) Conducted Emissions Test Results

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.173	45.67	0	45.67	64.82	-19.15	35.01	0	35.01	54.82	-19.81
0.4269	42.11	0	42.11	57.31	-15.2	38.79	0	38.79	47.31	-8.52
1.423	31.98	0	31.98	56	-24.02	24.51	0	24.51	46	-21.49
3.925	39.81	0	39.81	56	-16.19	23.26	0	23.26	46	-22.74
5.38	31.63	0	31.63	60	-28.37	21.89	0	21.89	50	-28.11
6.46	39.08	0	39.08	60	-20.92	19.7	0	19.7	50	-30.3

Table 10. Conducted Emissions, 15.207(a), Phase Line, Test Results

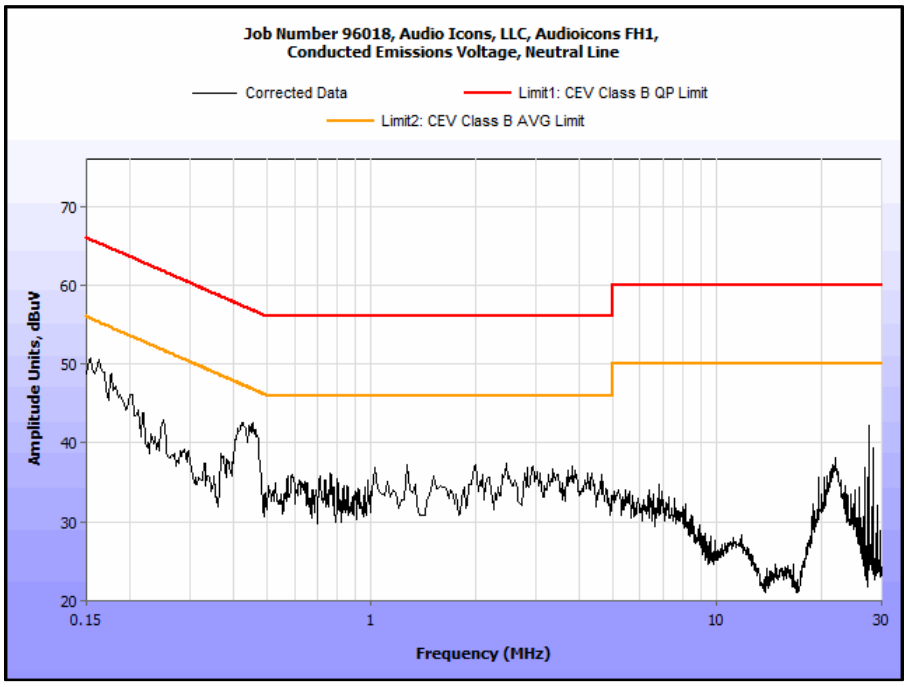


Plot 1. Conducted Emissions, 15.207(a), Phase Line

15.207(a) Conducted Emissions Test Results

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.225	33.74	0	33.74	62.63	-28.89	19.89	0	19.89	52.63	-32.74
0.434	38.86	0	38.86	57.18	-18.32	29.71	0	29.71	47.18	-17.47
4.15	30.65	0	30.65	56	-25.35	23.84	0	23.84	46	-22.16
22.06	34.14	0.11	34.25	60	-25.75	29.03	0.11	29.14	50	-20.86
27.48	39.75	0.11	39.86	60	-20.14	38.63	0.11	38.74	50	-11.26
28.26	35.1	0.12	35.22	60	-24.78	34.26	0.12	34.38	50	-15.62

Table 11. Conducted Emissions, 15.207(a), Neutral Line, Test Results



Plot 2. Conducted Emissions, 15.207(a), Neutral Line

15.207(a) Conducted Emissions Test Setup Photo

Photograph 1. Conducted Emissions, 15.207(a), Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(1) 20 dB Occupied Bandwidth

Test Requirements: **§ 15.247(a):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. For DTS, the minimum 6 dB bandwidth shall be at least 500 kHz. For frequency hopping systems, the EUT shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Test Procedure: The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately between to 1-5% of the total emission bandwidth. The 20 dB bandwidth was measured and recorded.

Test Results The EUT was compliant with § 15.247 (a)(2). No anomalies detected.

Test Engineer(s): Surendra Shrestha

Test Date(s): October 9, 2017

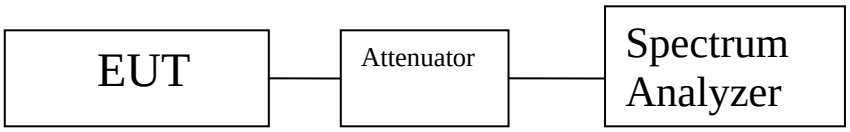
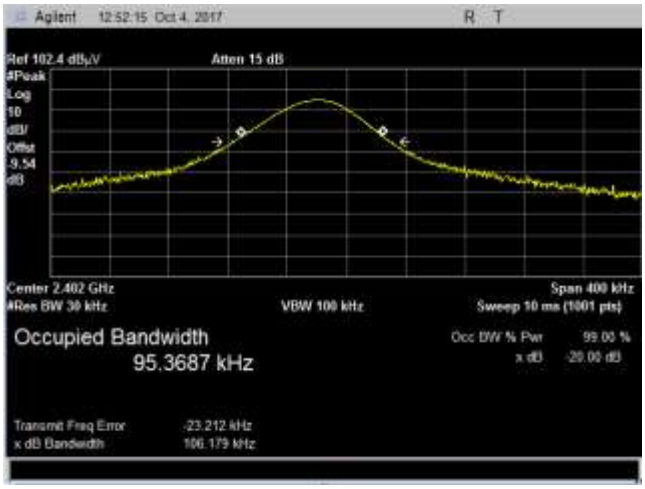
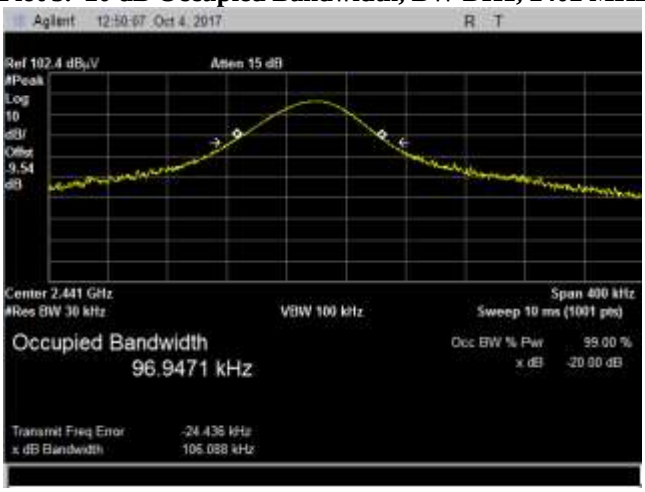


Figure 2. Block Diagram, Occupied Bandwidth Test Setup

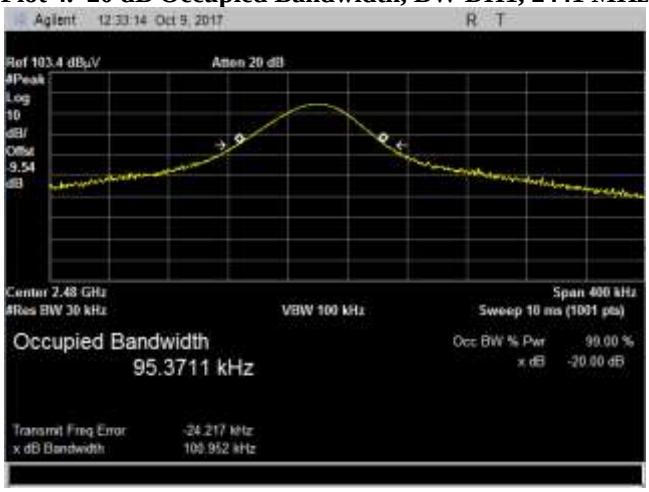
20 dB Occupied Bandwidth Test Results



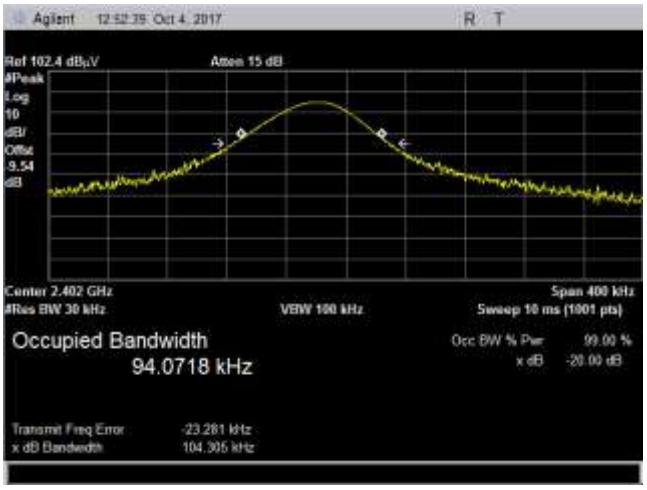
Plot 3. 20 dB Occupied Bandwidth, BW DH1, 2402 MHz



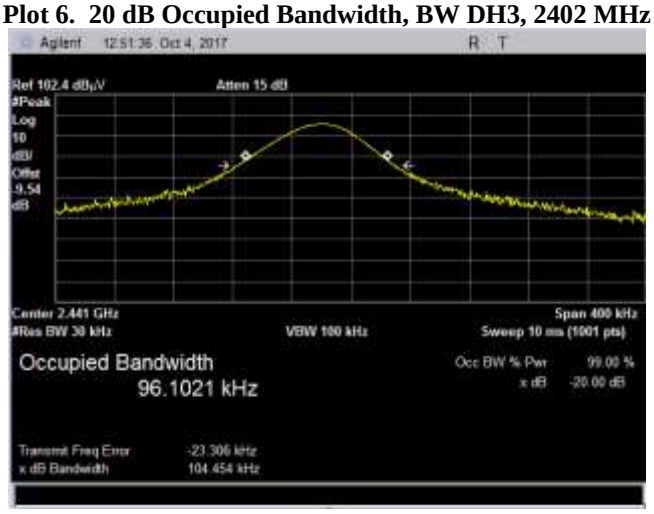
Plot 4. 20 dB Occupied Bandwidth, BW DH1, 2441 MHz



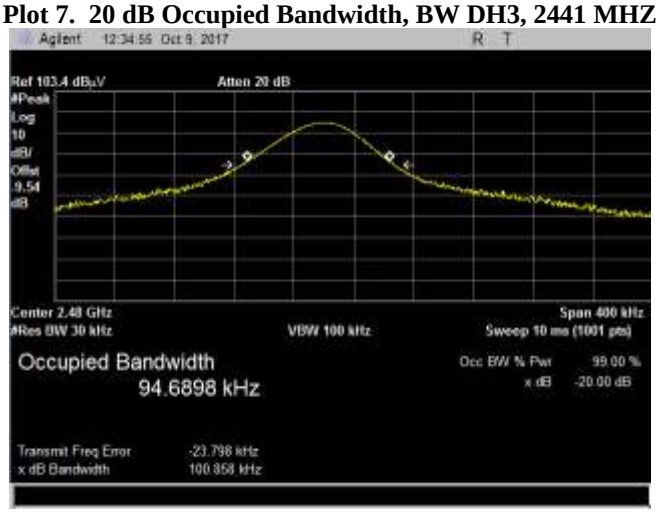
Plot 5. 20 dB Occupied Bandwidth, BW DH1, 2480 MHz



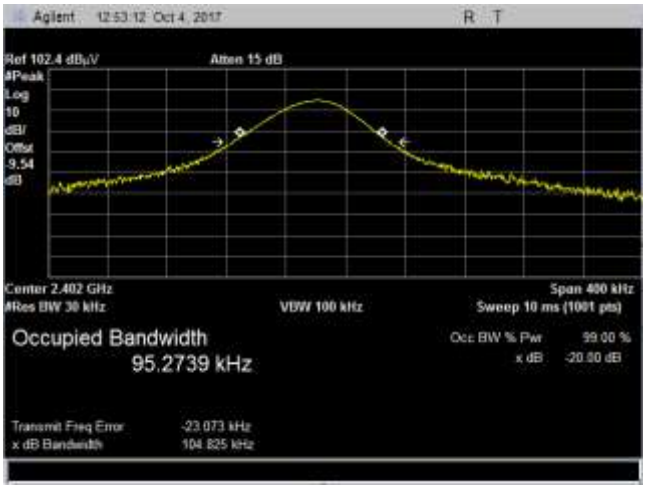
Plot 6. 20 dB Occupied Bandwidth, BW DH3, 2402 MHz



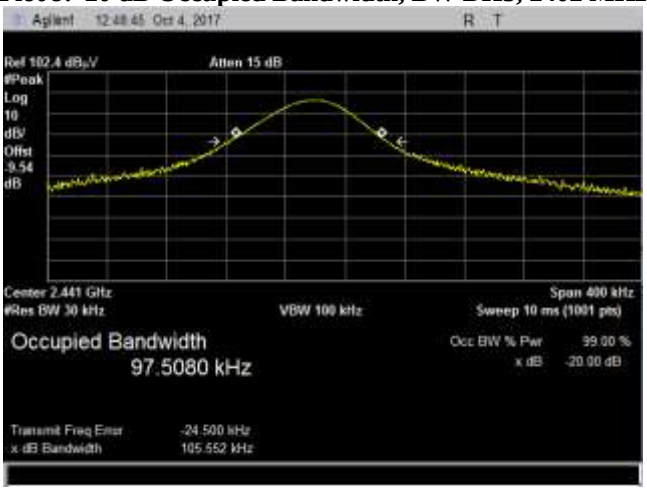
Plot 7. 20 dB Occupied Bandwidth, BW DH3, 2441 MHZ



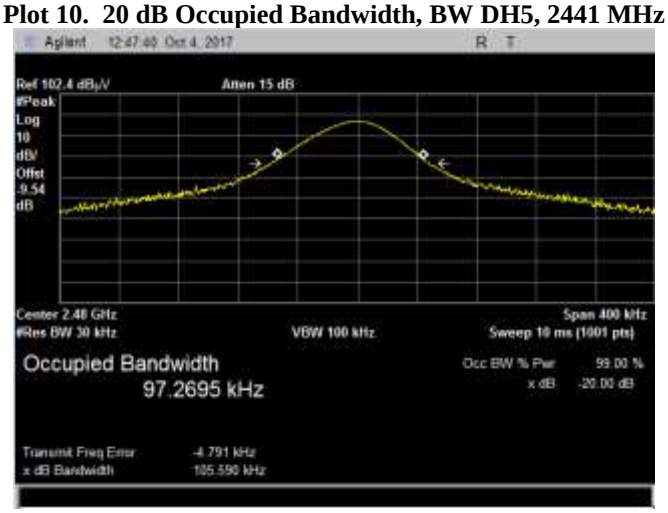
Plot 8. 20 dB Occupied Bandwidth, BW DH3, 2480 MHz



Plot 9. 20 dB Occupied Bandwidth, BW DH5, 2402 MHz



Plot 10. 20 dB Occupied Bandwidth, BW DH5, 2441 MHz



Plot 11. 20 dB Occupied Bandwidth, BW DH5, 2480 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(1) Average Time of Occupancy (Dwell Time)

Requirement: Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Procedure: EUT was set to have its hopping function enabled. Procedure 7.7.4 from ANSI C63.10 was used to capture the pulse width and entire dwell time per hopping channel.

Dwell Time Calculation;

Hopping period = Number of channel * 0.4

Number of Burst = Burst per hopping period

Burst Duration = pulse width

Dwell time = Number of Burst * Burst duration

Remarks: The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

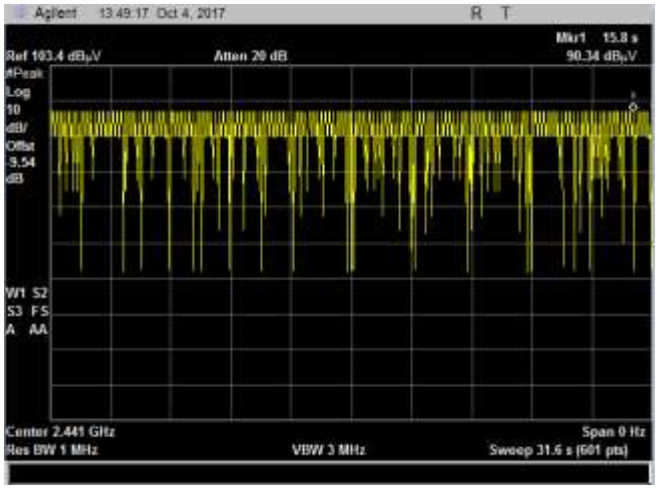
Total hopping channels is 80. The EUT meets the specifications of Section 15.247(a) (1) (iii) for Number of Hopping Channels.

Data Rate	# of channels	hopping period (s)	# of burst per period	Burst Duration (s)	Dwell Time (s)	limit (s)	Margin
DH1	79	31.6	168	0.00041	0.06888	0.4	-0.33112
DH3	79	31.6	131	0.00167	0.21877	0.4	-0.18123
DH5	79	31.6	129	0.00288	0.37152	0.4	-0.02848

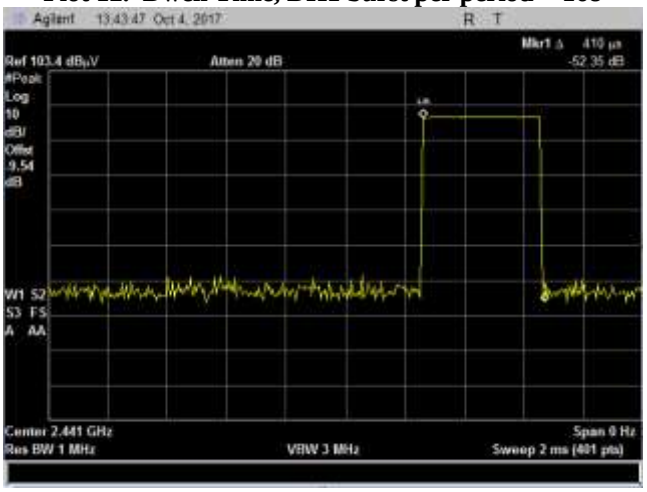
Table 12. Average Time of Occupancy

Dwell Time Calculation:
Hopping period = # of channel *0.4
# of burst = Burst per hopping period
Burst duration = time of single burst
Dwell time = # of burst * Burst Duration

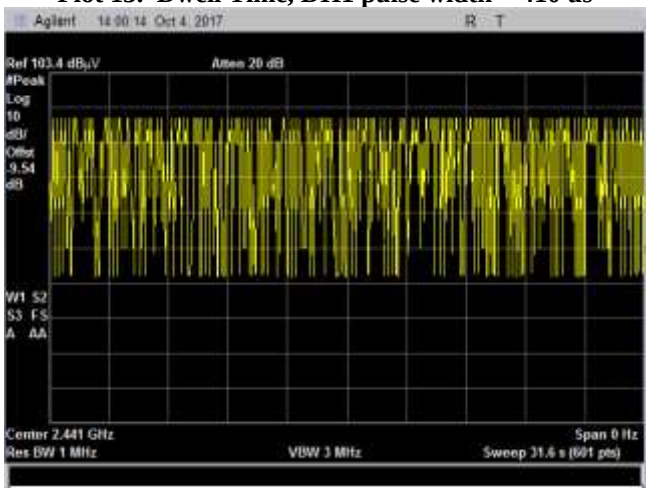
Dwell Time



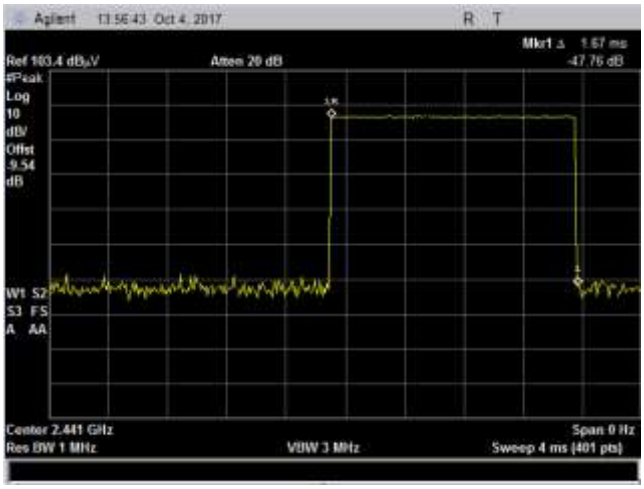
Plot 12. Dwell Time, DH1 burst per period = 168



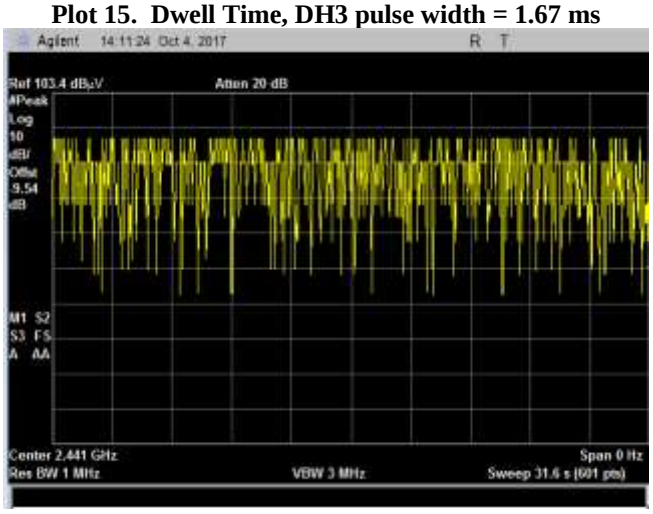
Plot 13. Dwell Time, DH1 pulse width = 410 us



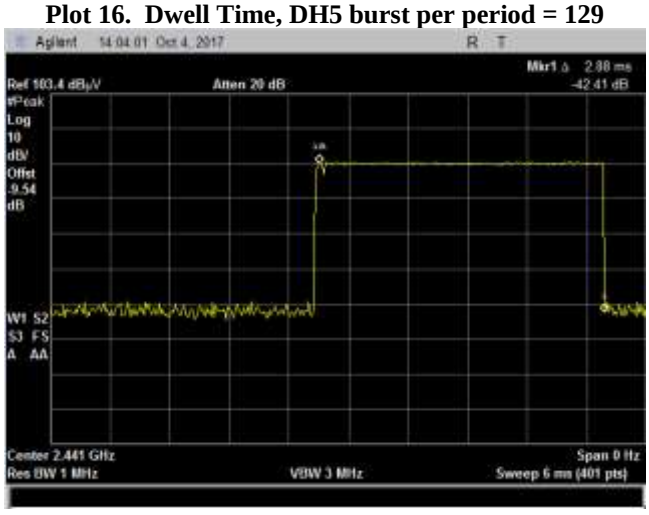
Plot 14. Dwell Time, DH3 burst per period = 131



Plot 15. Dwell Time, DH3 pulse width = 1.67 ms



Plot 16. Dwell Time, DH5 burst per period = 129

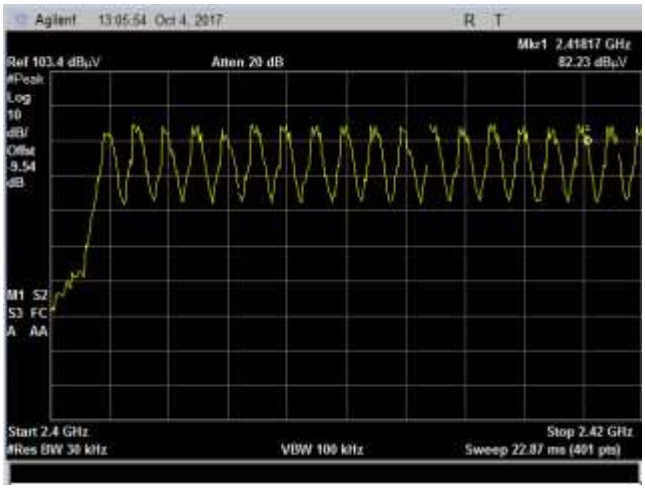


Plot 17. Dwell Time, DH5 pulse width = 2.88 ms

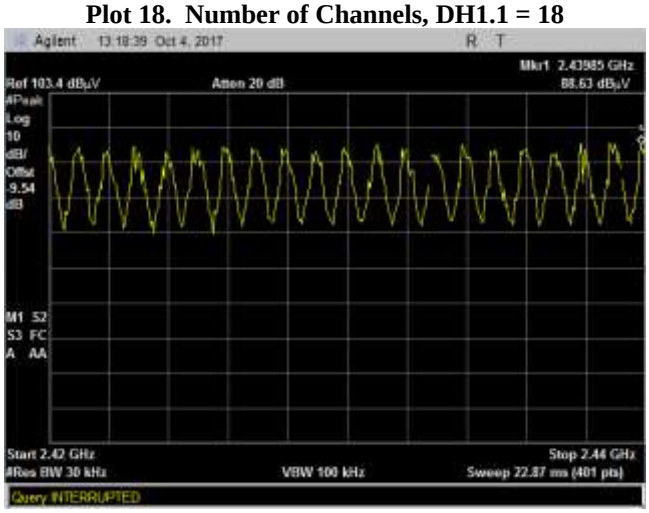
Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(1) Number of RF Channels

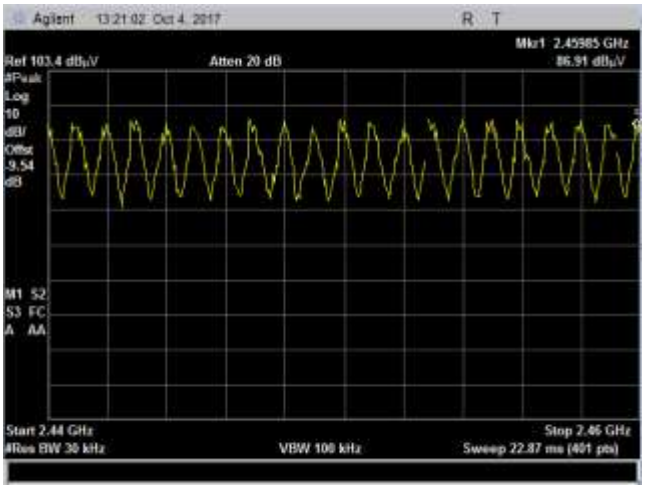
Requirement: Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.



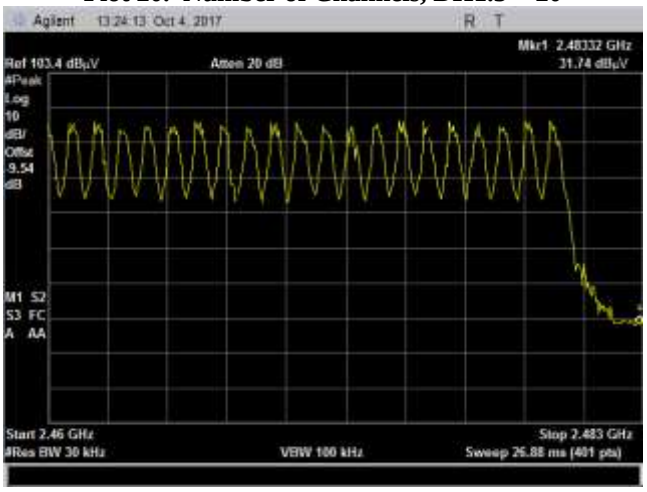
Plot 18. Number of Channels, DH1.1 = 18



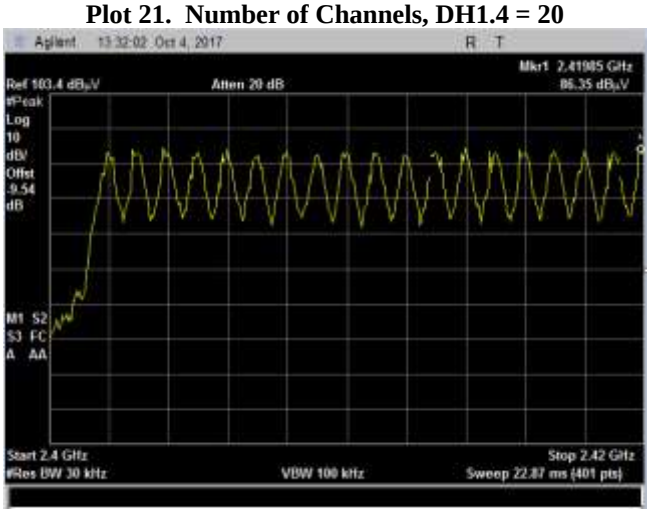
Plot 19. Number of Channels, DH1.2 = 21



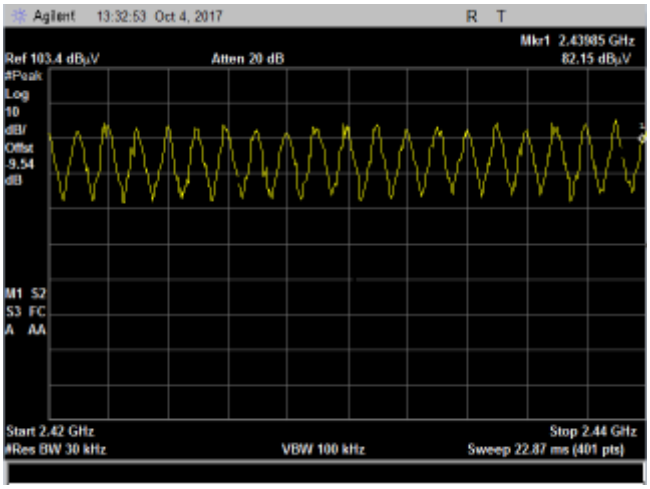
Plot 20. Number of Channels, DH1.3 = 20



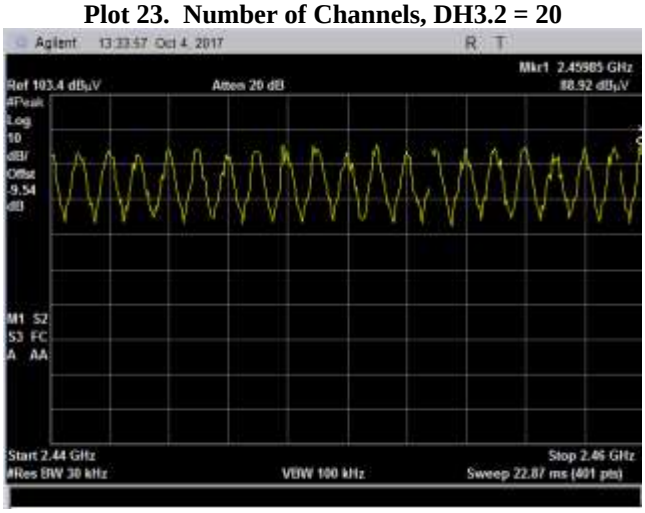
Plot 21. Number of Channels, DH1.4 = 20



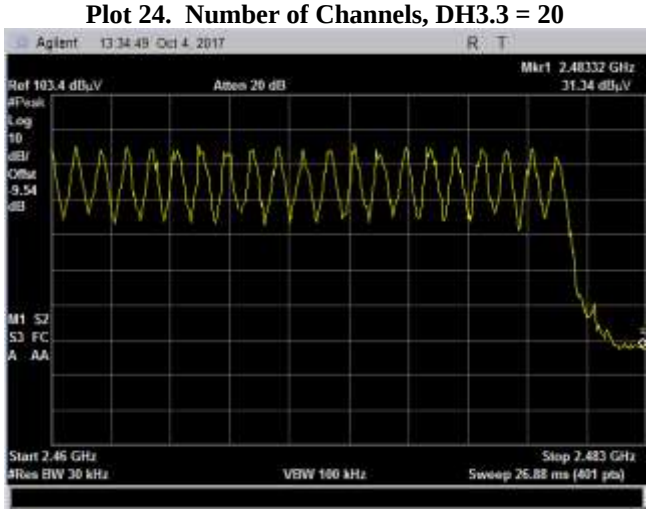
Plot 22. Number of Channels, DH3.1 = 19



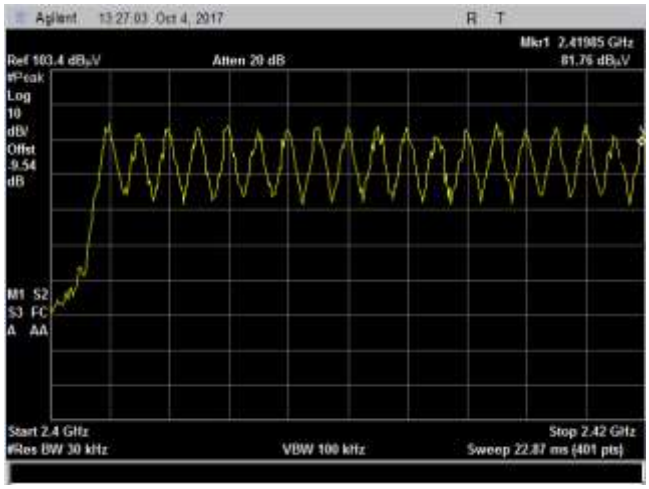
Plot 23. Number of Channels, DH3.2 = 20



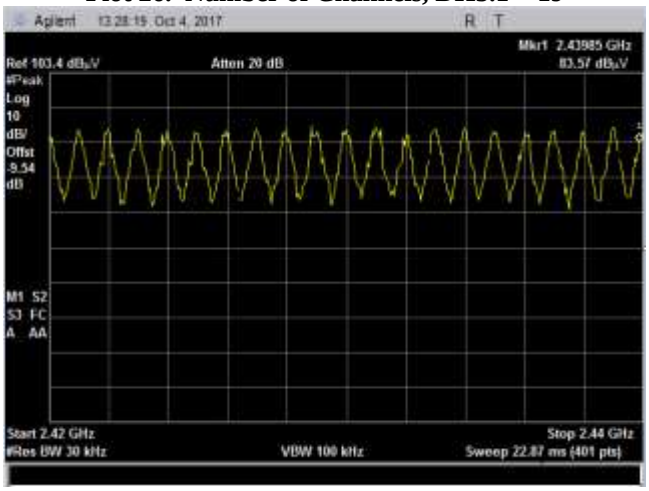
Plot 24. Number of Channels, DH3.3 = 20



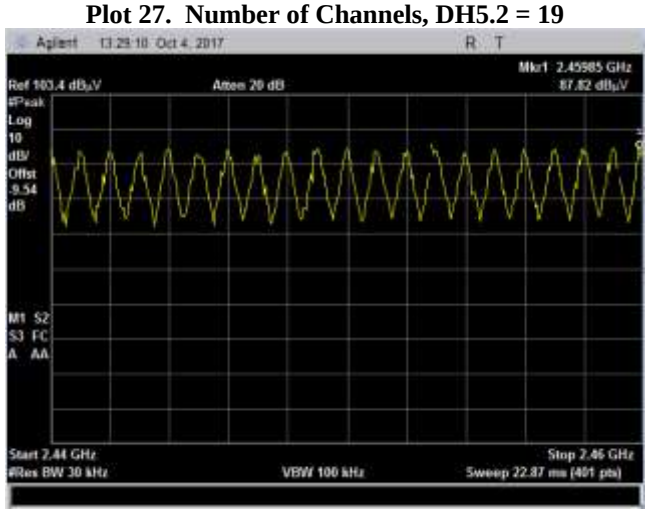
Plot 25. Number of Channels, DH3.4 = 20



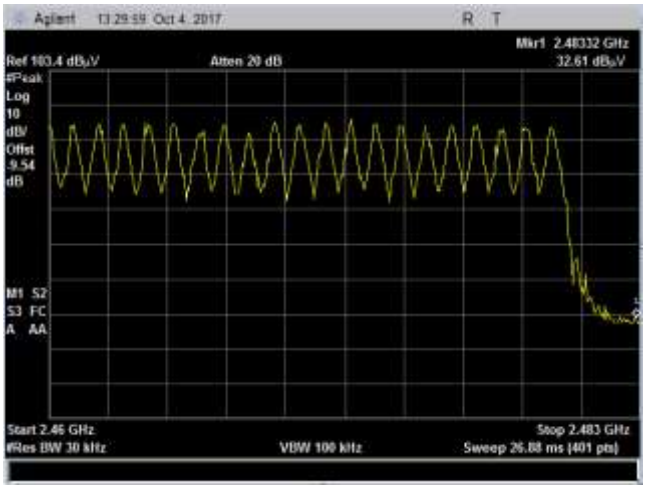
Plot 26. Number of Channels, DH5.1 = 19



Plot 27. Number of Channels, DH5.2 = 19



Plot 28. Number of Channels, DH5.3 = 21



Plot 29. Number of Channels, DH5.4 = 20

Electromagnetic Compatibility Criteria for Intentional Radiators

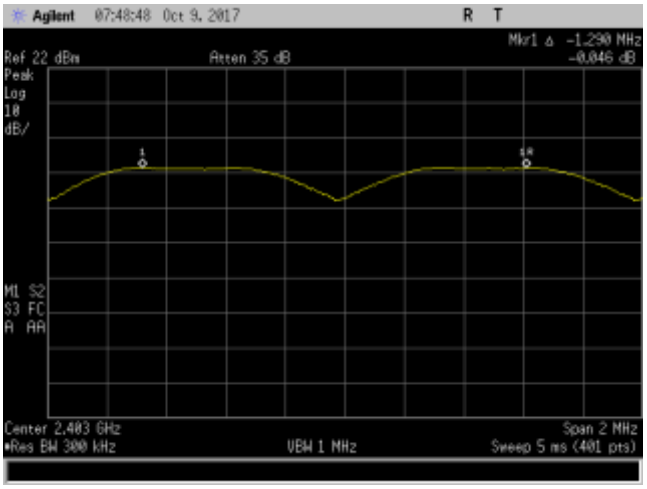
§ 15.247(a)(1) RF Channel Separation

Requirement: Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

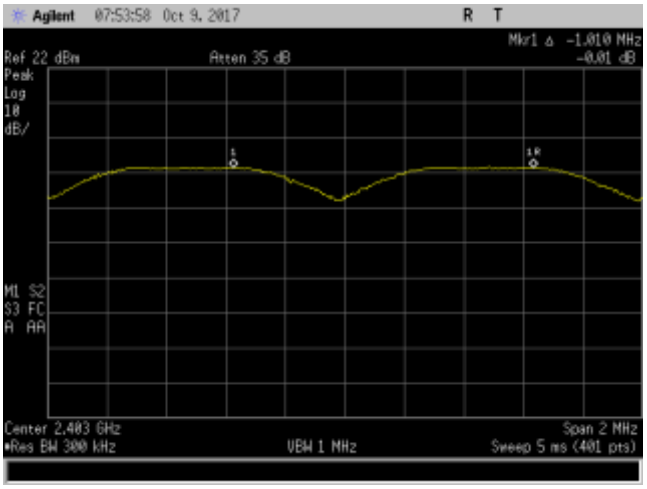
Procedure: Procedure 7.7.2 from ANSI C63.10 was used to perform the measurement. With the EUT configured to operate with its hopping function enabled, the spectrum analyzer was configured as follows: Span set to be wide enough to capture 2 adjacent channels. RBW ≥ 1% span, and VBW ≥ RBW. After allowing the trace to stabilize with max hold enabled, the marker-delta function was used to determine the separation between peaks on adjacent channels.

Remarks: EUT operates below 125mW (20dBm). Channels are separated by more than two thirds of the -20dB Bandwidth.

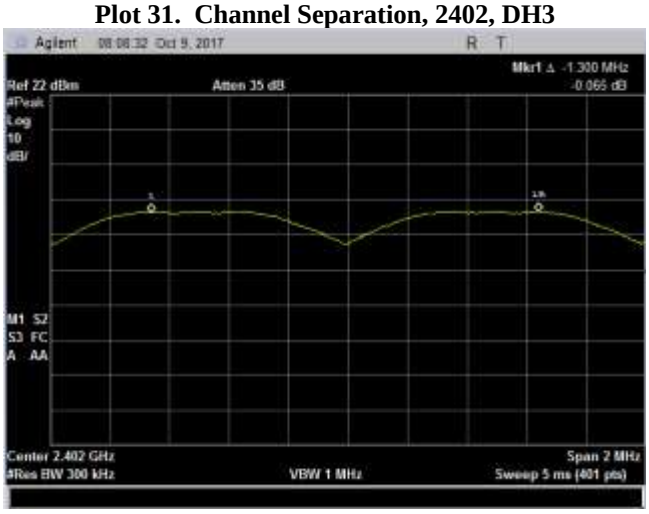
EDR – 2/3 *100.858 kHz (20dB Bandwidth) = 67.239 kHz Minimum Separation Distance



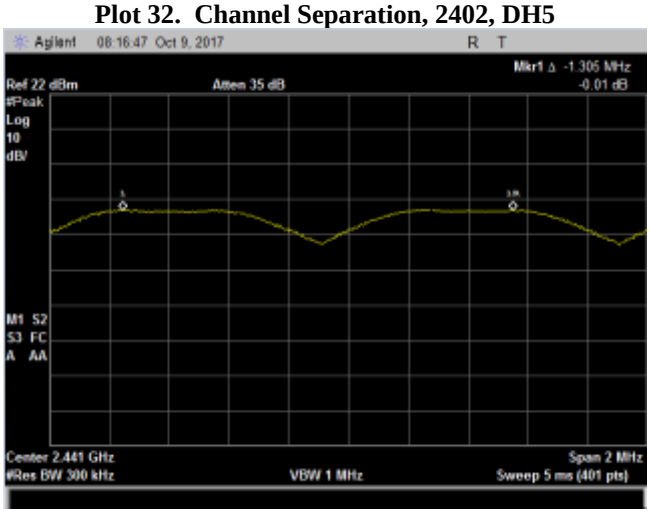
Plot 30. Channel Separation, 2402, DH1



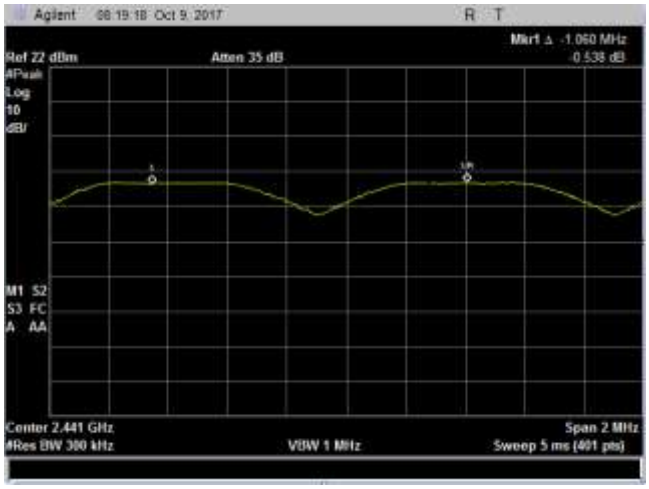
Plot 31. Channel Separation, 2402, DH3



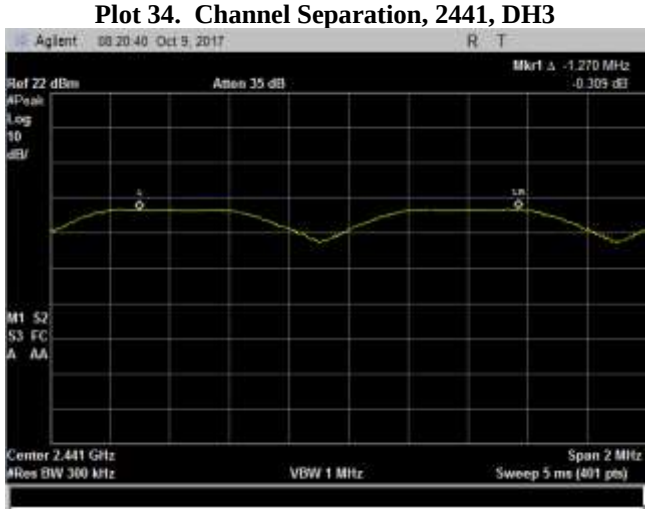
Plot 32. Channel Separation, 2402, DH5



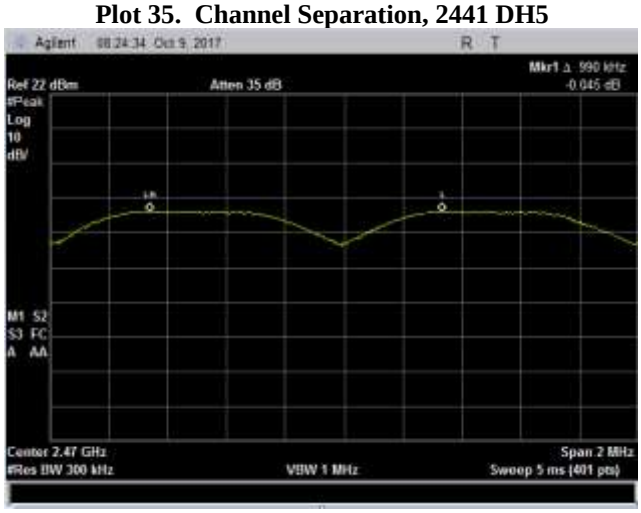
Plot 33. Channel Separation, 2441, DH1



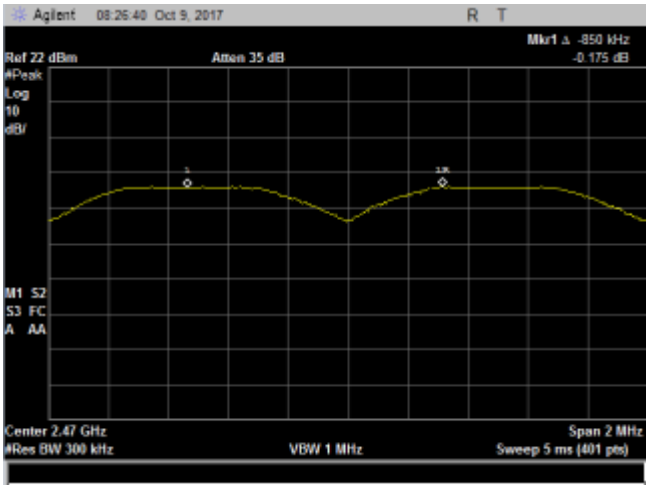
Plot 34. Channel Separation, 2441, DH3



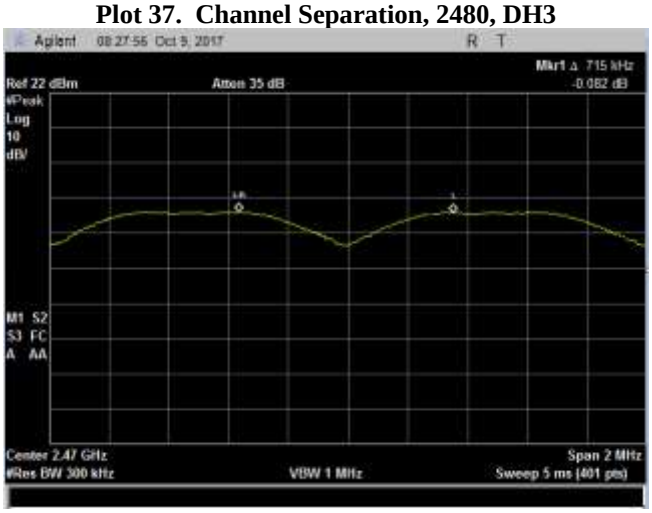
Plot 35. Channel Separation, 2441 DH5



Plot 36. Channel Separation, 2480, DH1



Plot 37. Channel Separation, 2480, DH3



Plot 38. Channel Separation, 2480, DH5

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output

Test Requirements:

§15.247(b)(1): The maximum peak output power of the intentional radiator shall not exceed 0.125 Watts for frequency hopping systems operating in the 2400-2483.5 MHz band. .

§15.247(c): if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400 – 2483.5 MHz band and using a point to point application may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

Fixed, point-to-point operation excludes the use of point-to-multipoint systems, omni-directional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

Test Procedure:

The spectrum analyzer was set up as follows: Span set to approximately 5 times the 20dB bandwidth, RBW > 20dB bandwidth, VBW ≥ RBW, max hold enabled. Once the trace stabilized, the peak search function was used to locate peak of the emission. The EUT was measured at the low, mid and high channels of each band. The EUT utilizes a 1dBi Antenna.
Since the EUT did not have antenna ports temporal or permanent, the test was performed on a radiated setup. The measured field strength was converted to conducted power with the following formula:

EIRP (dBm) = E (dBuV/m) + 20log(d) – 104.77 = P (dBm) + G (dBi)
P (dBm) = E (dBuV/m) + 20log(d) – 104.77 – G (dBi)

Where, P is conducted power
E is field strength
G is antenna gain.

Test Results:

The EUT was compliant with the Peak Power Output limits of **§15.247(b)**. No anomalies detected.

Test Engineer(s):

Surendra Shrestha

Test Date(s):

October 19, 2017

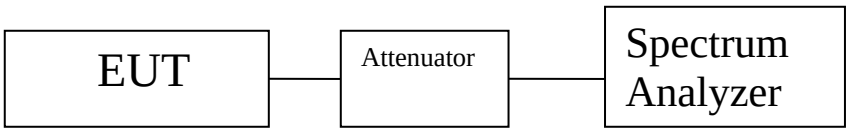


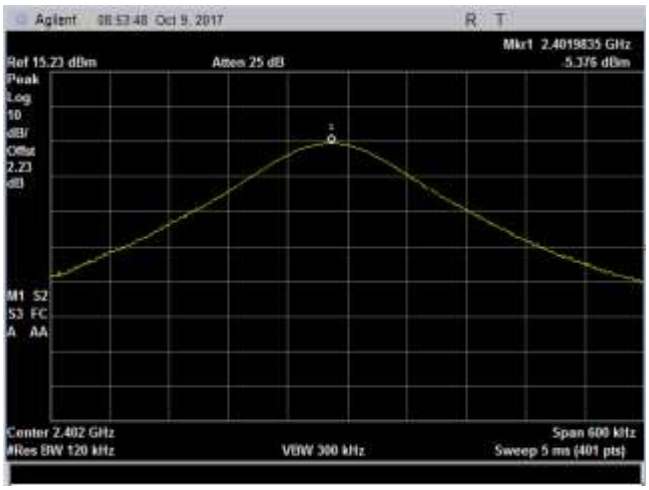
Figure 3. Peak Power Output Test Setup

Peak Power Output Test Results

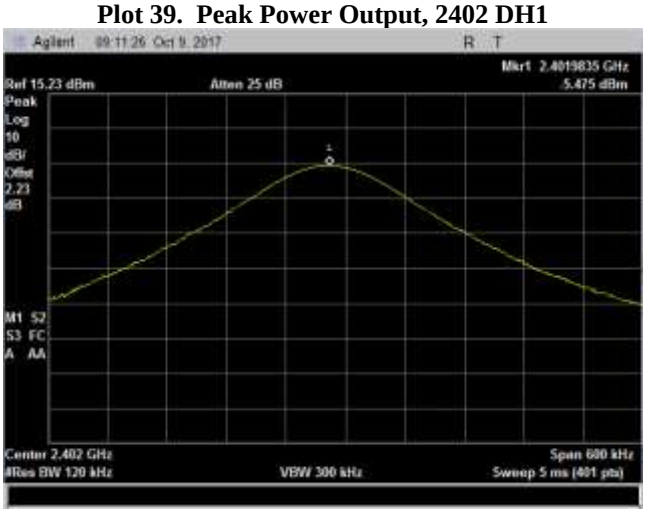
Data Rate	Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Margin (dBm)	Result
DH1	2402	-5.376	30	35.376	Pass
	2441	-5.613	30	35.613	Pass
	2480	-6.646	30	36.646	Pass
DH3	2402	-5.475	30	35.475	Pass
	2441	-5.431	30	35.431	Pass
	2480	-6.943	30	36.943	Pass
DH5	2402	-5.293	30	35.293	Pass
	2441	-5.451	30	35.451	Pass
	2480	-6.697	30	36.697	Pass

Table 13. Peak Power Output, Test Results

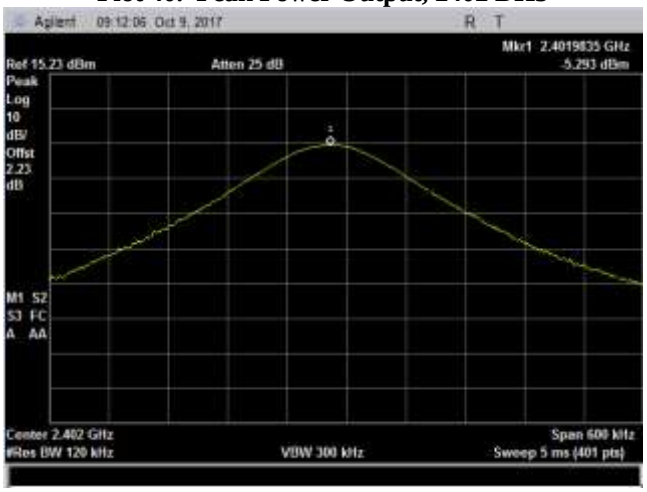
Peak Power Output Test Results



Plot 39. Peak Power Output, 2402 DH1

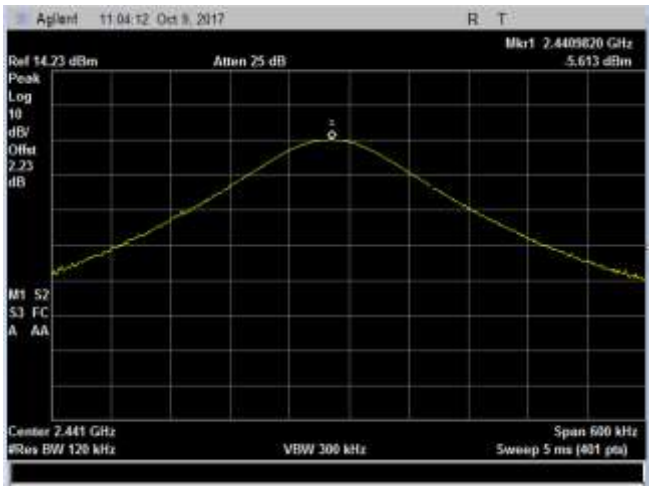


Plot 40. Peak Power Output, 2402 DH3

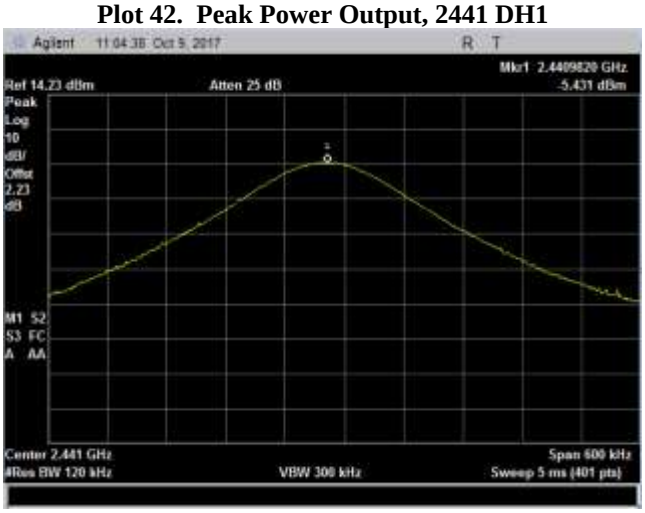


Plot 41. Peak Power Output, 2402 DH5

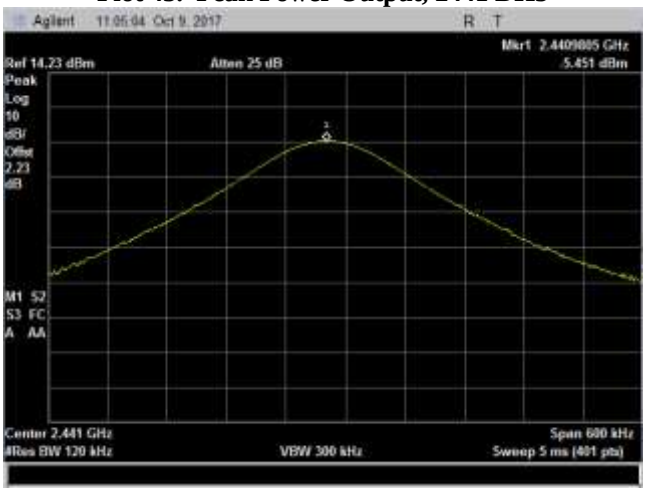
Peak Power Output Test Results



Plot 42. Peak Power Output, 2441 DH1

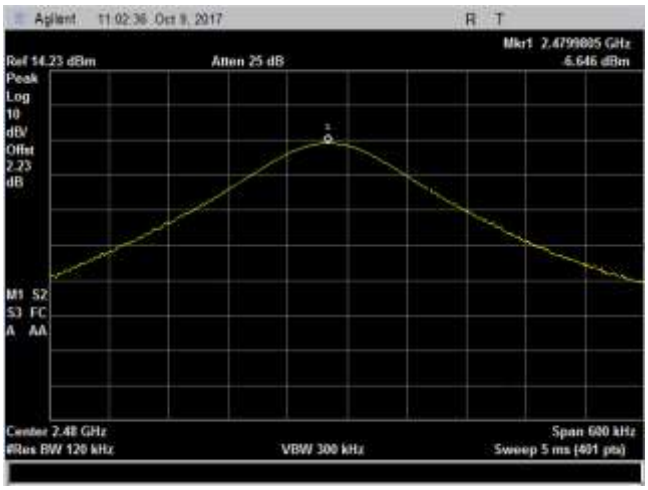


Plot 43. Peak Power Output, 2441 DH3

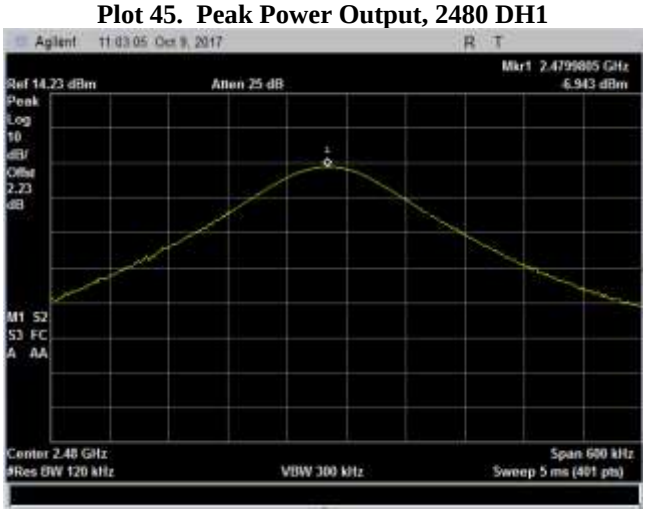


Plot 44. Peak Power Output, 2441 DH5

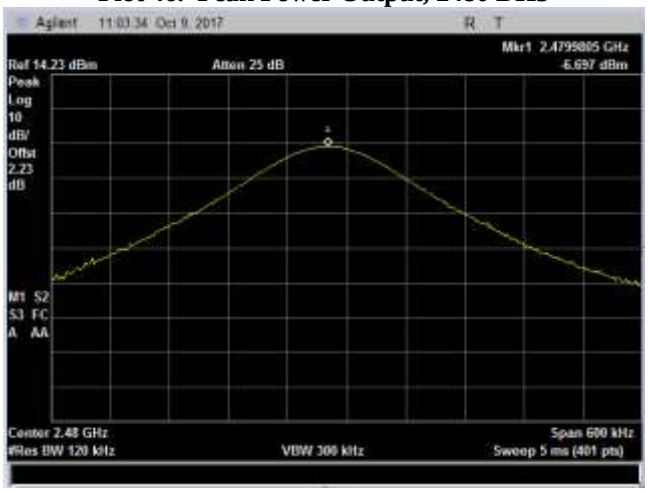
Peak Power Output Test Results



Plot 45. Peak Power Output, 2480 DH1



Plot 46. Peak Power Output, 2480 DH3



Plot 47. Peak Power Output, 2480 DH5

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Radiated Spurious Emissions Requirements and Band Edge

Test Requirements: **§15.247(d); §15.205:** Emissions outside the frequency band.

§15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, 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).

§15.205(a): Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090–0.110----------	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505----------	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905----------	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128----------	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775----------	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775----------	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218----------	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825----------	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225----------	123–138	2200–2300	14.47–14.5
8.291–8.294----------	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366----------	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675----------	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475----------	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293----------	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025----------	240–285	3345.8–3358 36.	43–36.5
12.57675–12.57725----------	322–335.4	3600–4400	([2])

Table 14. Restricted Bands of Operation

[1] Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.
[2] Above 38.6

Test Requirement(s): **§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 15.

Frequency (MHz)	§ 15.209(a),Radiated Emission Limits (dBµV) @ 3m
30 - 88	40.00
88 - 216	43.50
216 - 960	46.00
Above 960	54.00

Table 15. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

Test Procedure: The transmitter was set to the mid channel at the highest output power and placed on a 0.8 m high wooden table inside in a semi-anechoic chamber. Measurements were performed with the EUT rotated 360 degrees and varying the adjustable antenna mast with 1 m to 4 m height to determine worst case orientation for maximum emissions. Measurement were repeated the measurement at the low and highest channels.

For frequencies from 30 MHz to 1 GHz, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

In accordance with §15.35(b) the limit on the radio frequency emissions as measured using instrumentation with a peak detector function shall be 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules.

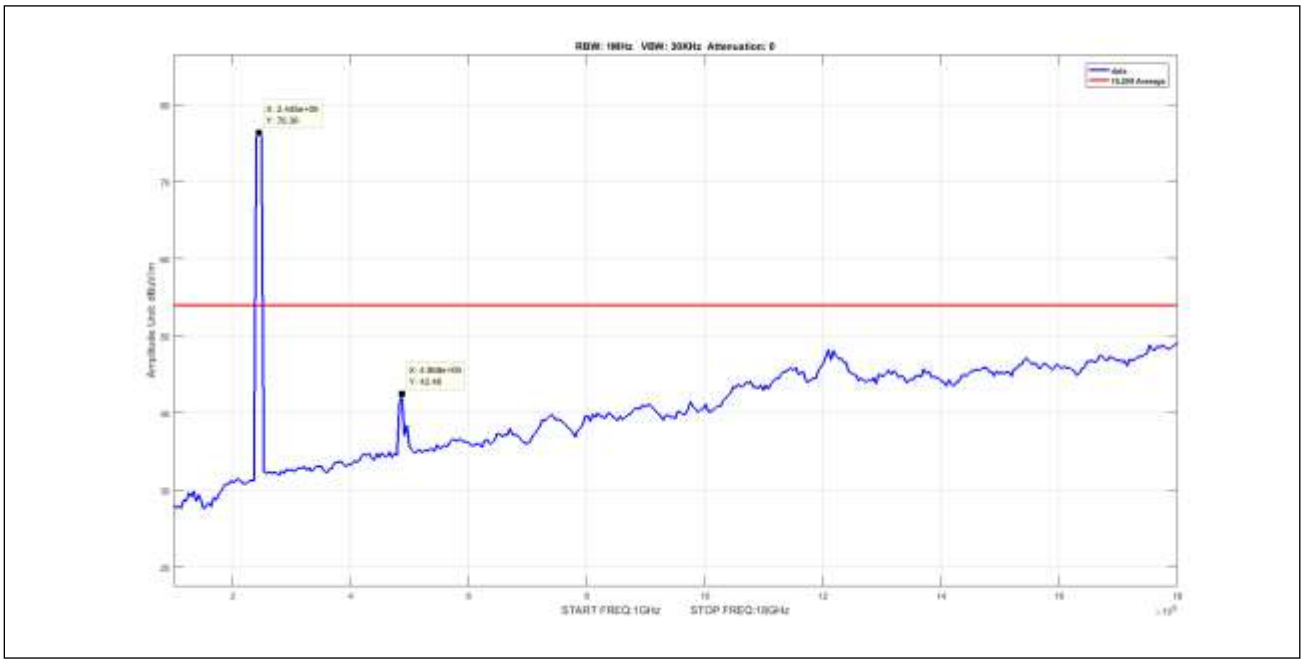
EUT Field Strength Final Amplitude = Raw Amplitude – Preamp gain + Antenna Factor + Cable Loss – Distance Correction Factor

Test Results: The EUT was compliant with the Radiated Spurious Emission limits of **§15.247(d)**. Measured emissions were within applicable limits. Above 18 GHz, only noise floor was observed on the average plots.

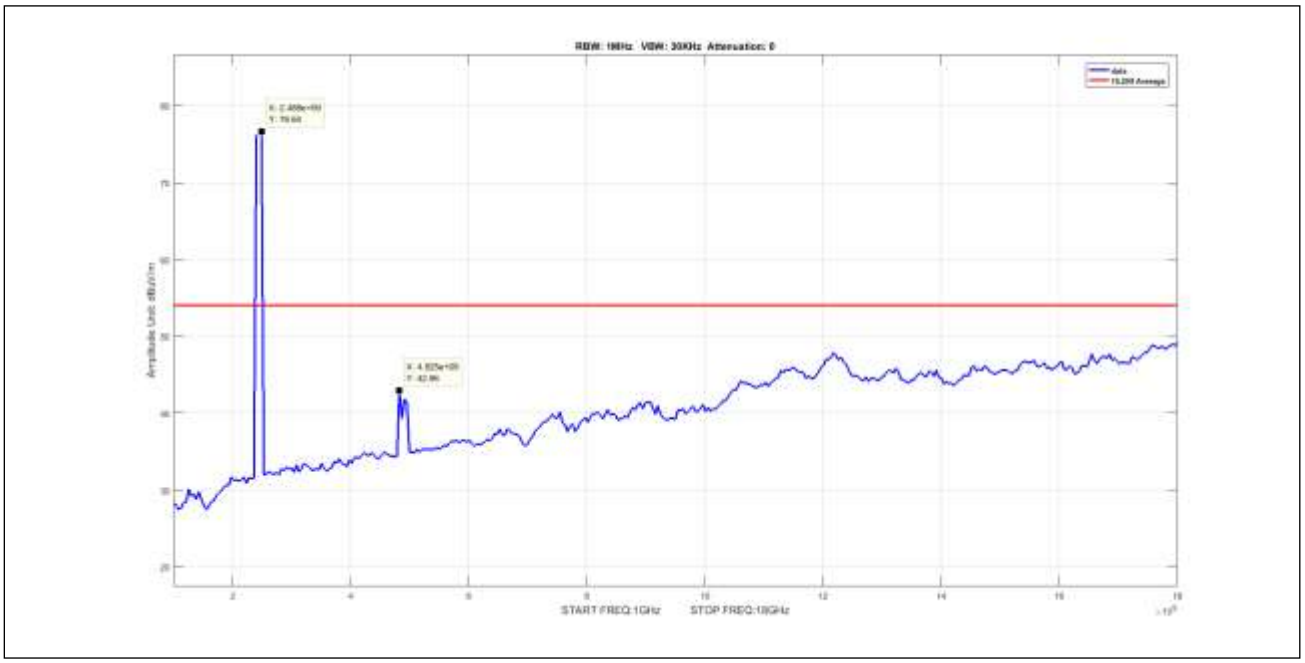
Test Engineer(s): Bradley Jones

Test Date(s): April 11, 2018

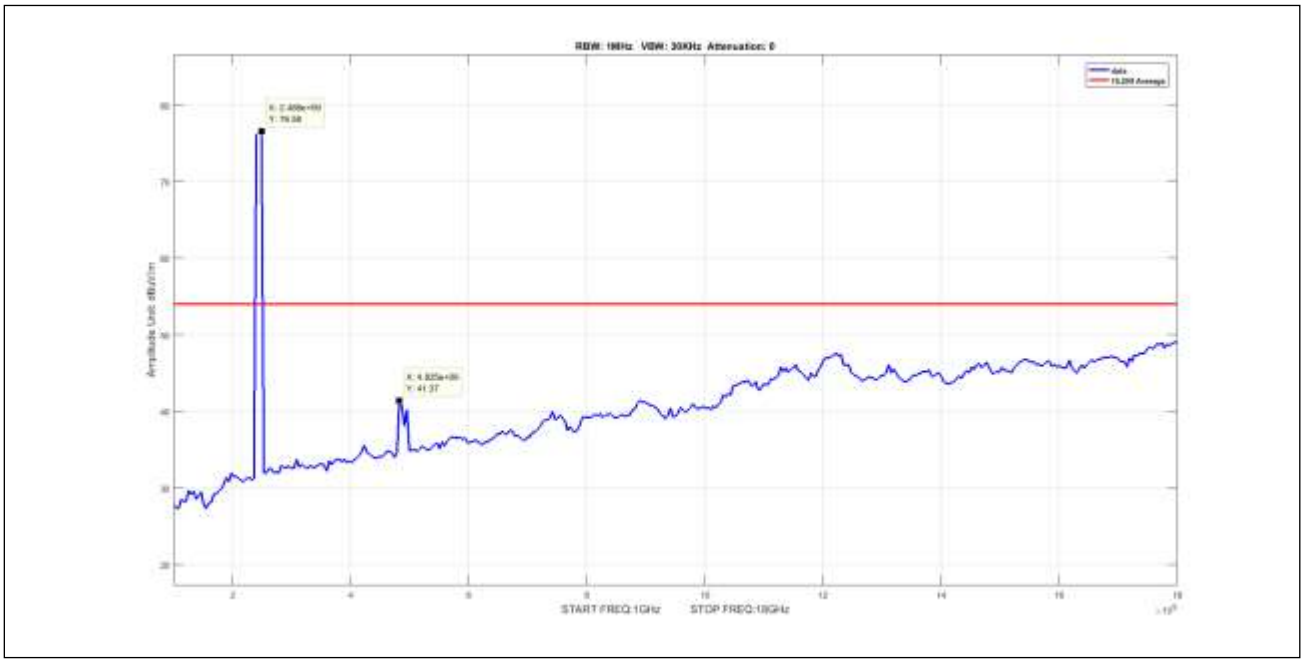
Radiated Spurious Emissions Test Results



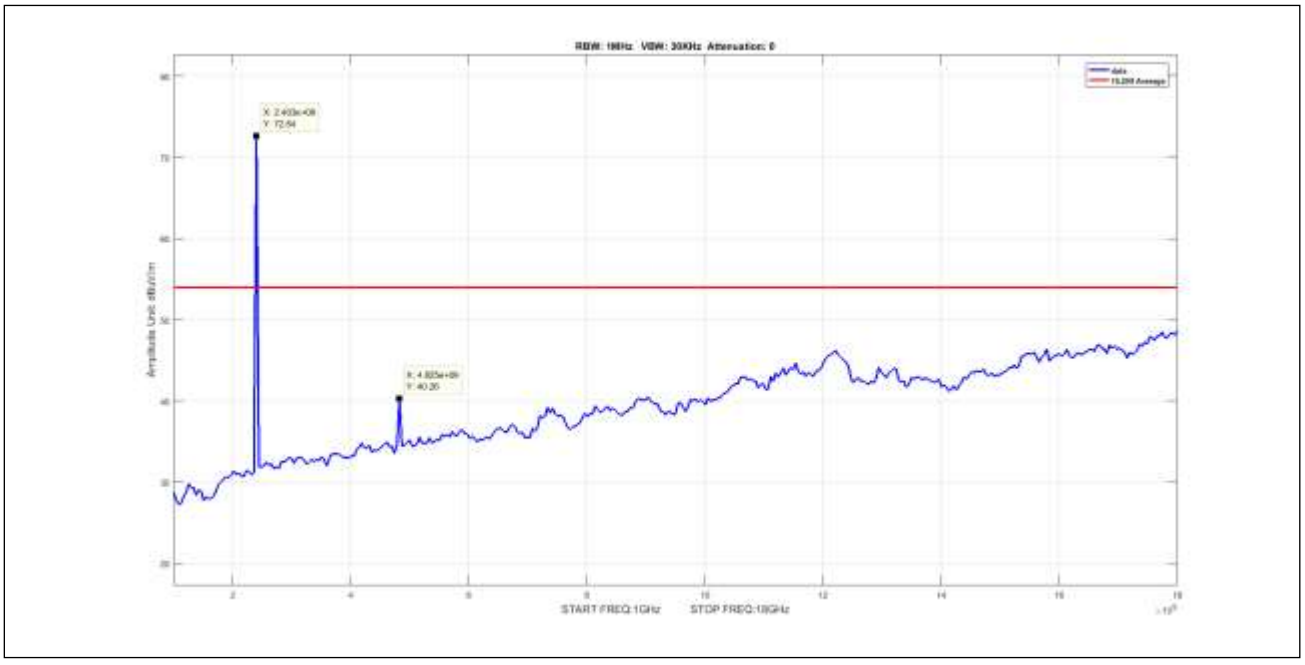
Plot 48. Radiated Emissions, average, hopping, radiated spurious, DH1



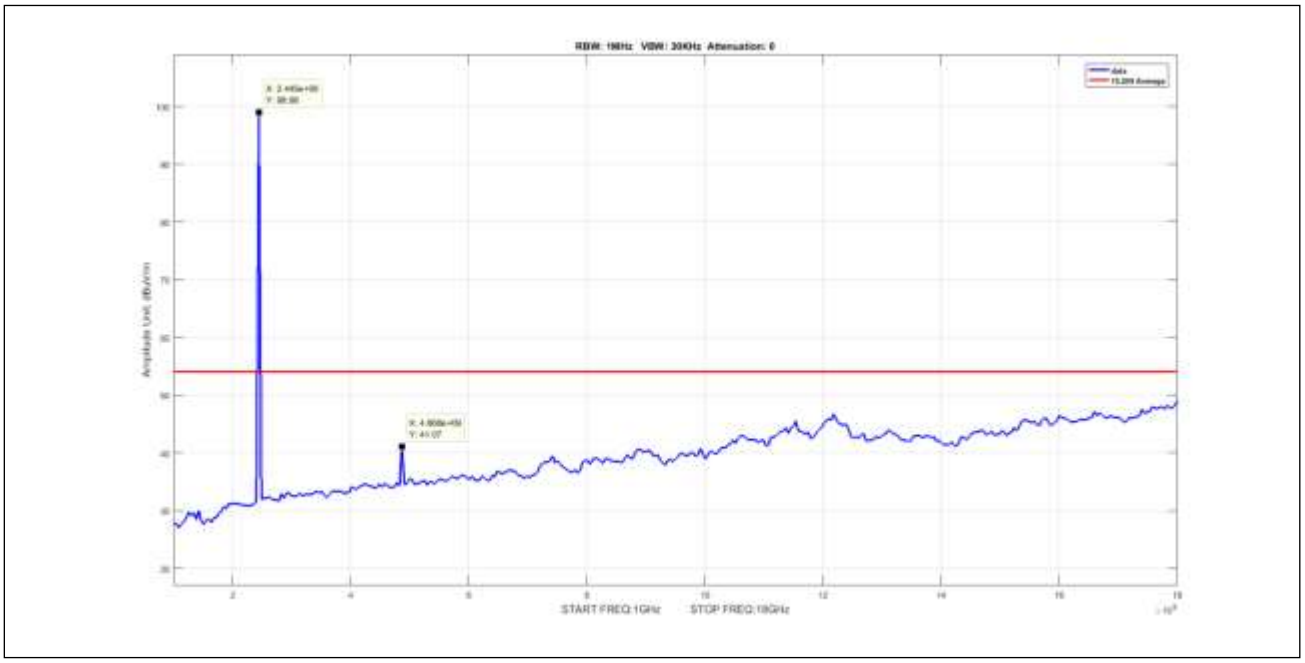
Plot 49. Radiated Emissions, average, hopping, radiated spurious, DH3



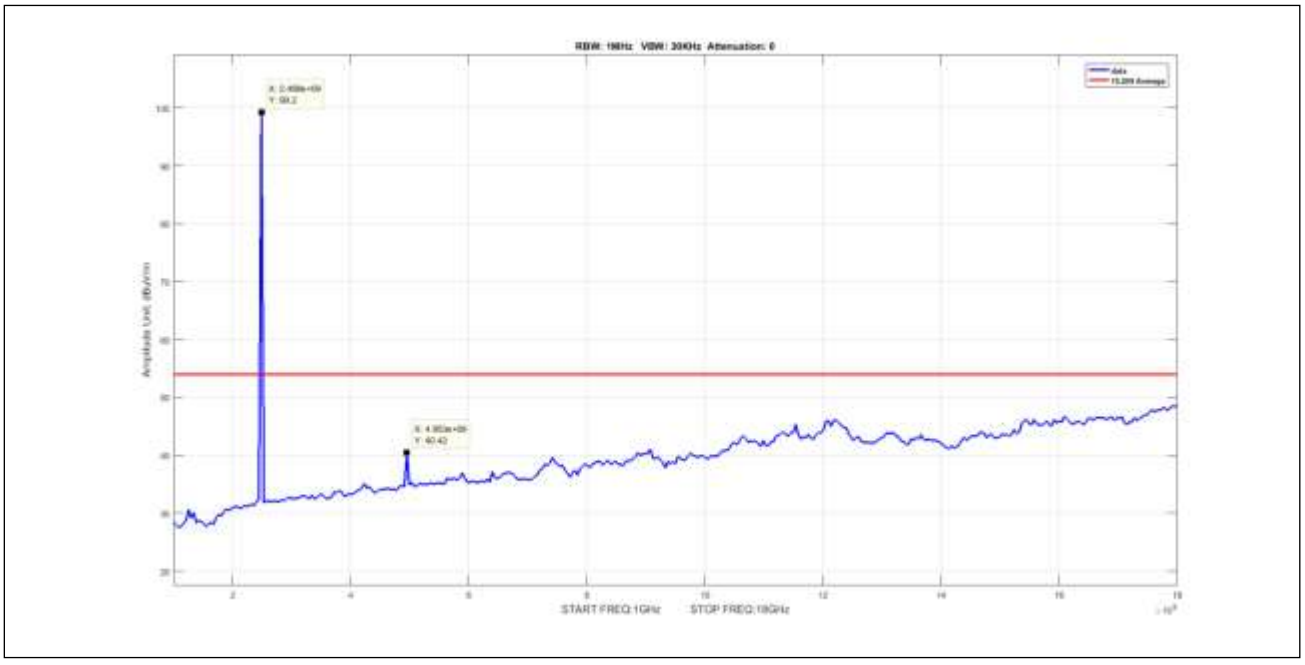
Plot 50. Radiated Emissions, average, hopping, radiated spurious, DH5



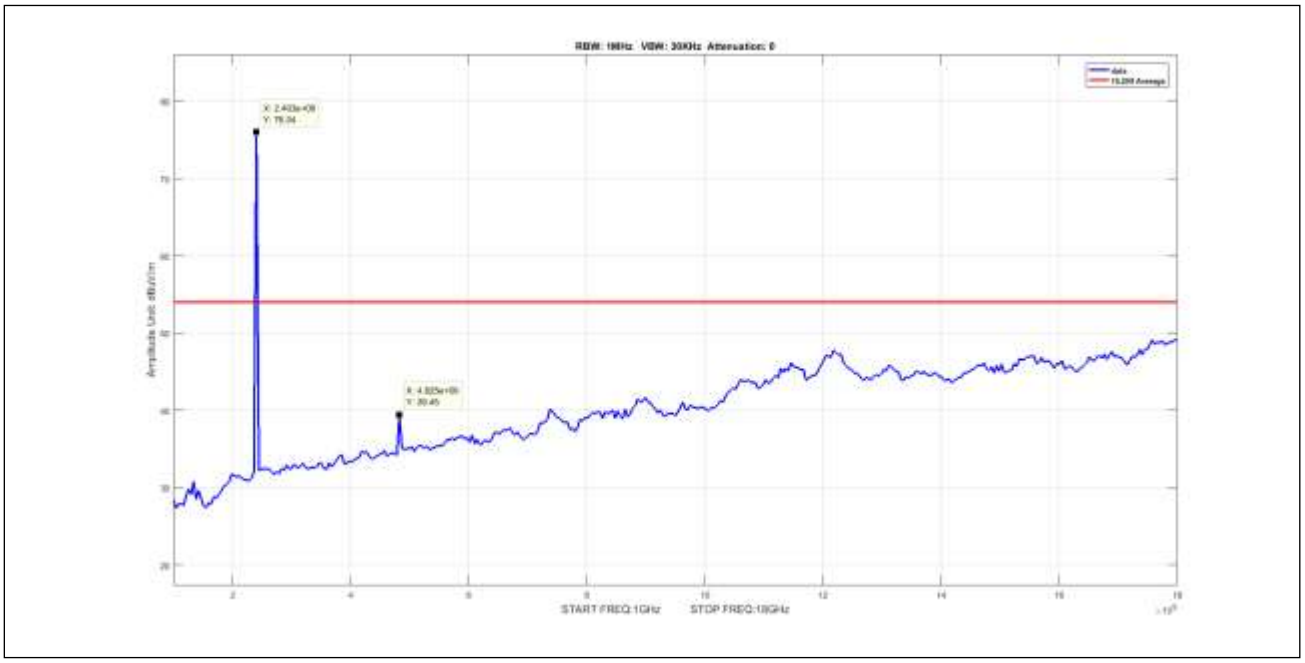
Plot 51. Radiated Emissions, average, non hopping, radiated spurious, DH1, 2402



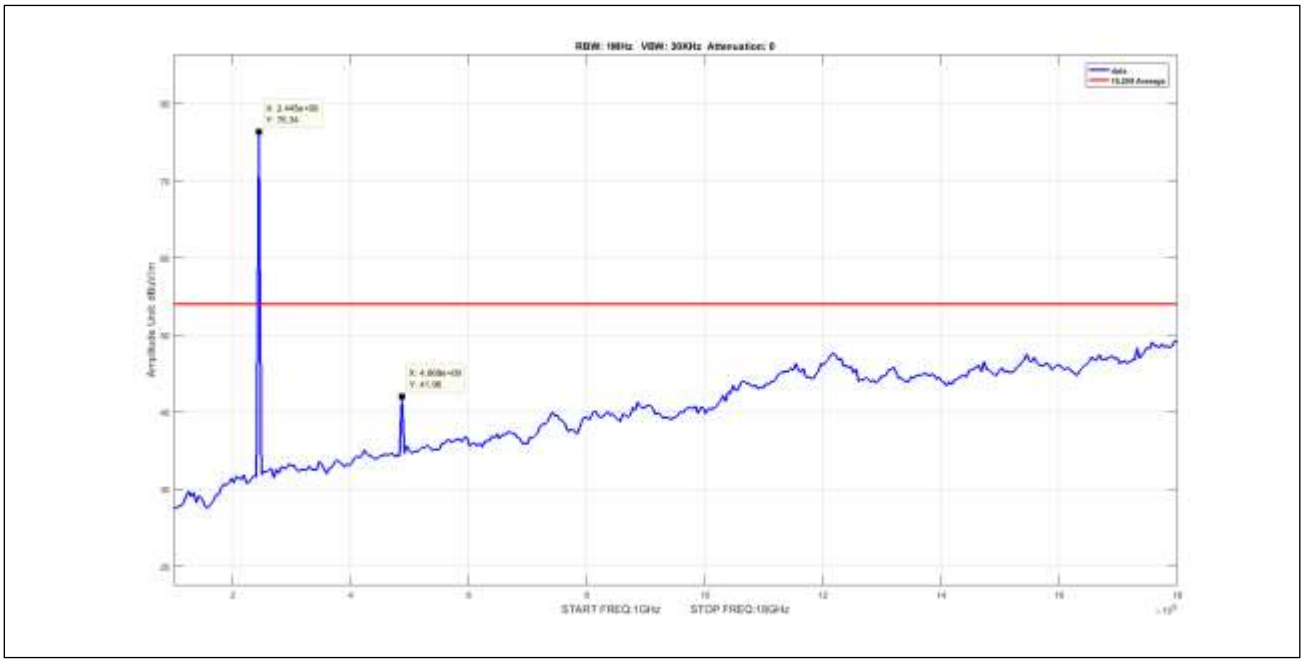
Plot 52. Radiated Emissions, average, non hopping, radiated spurious, DH1, 2441



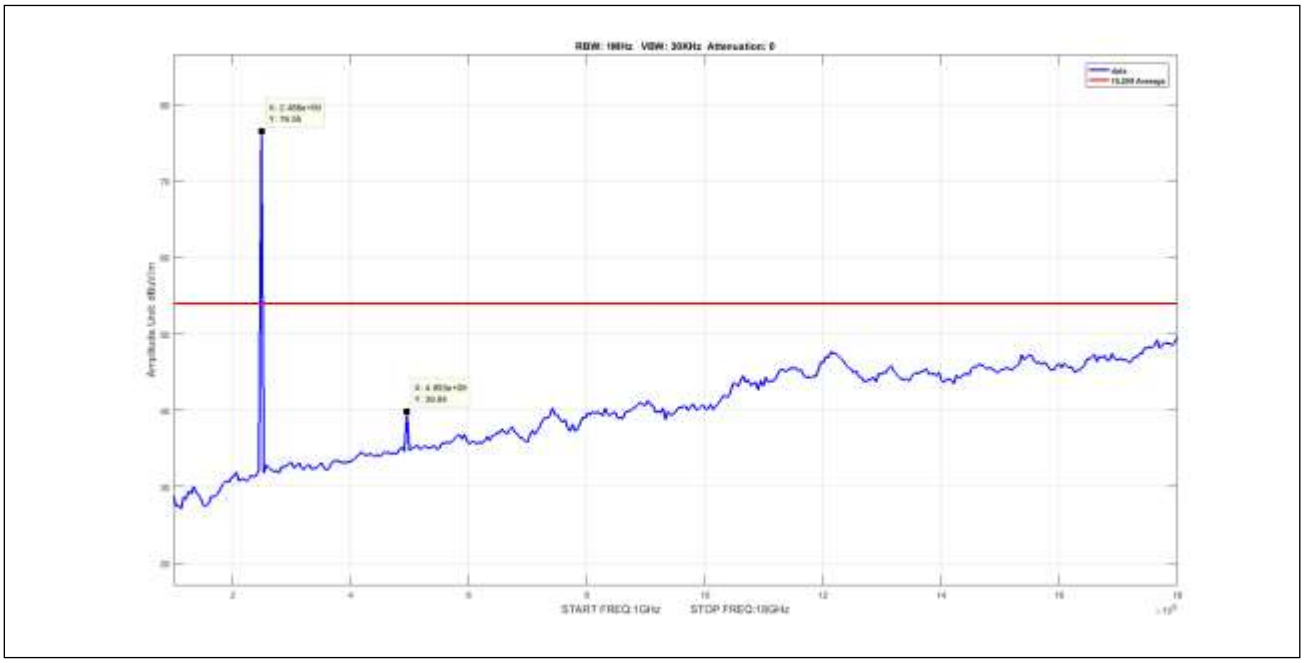
Plot 53. Radiated Emissions, average, non hopping, radiated spurious, DH1, 2480



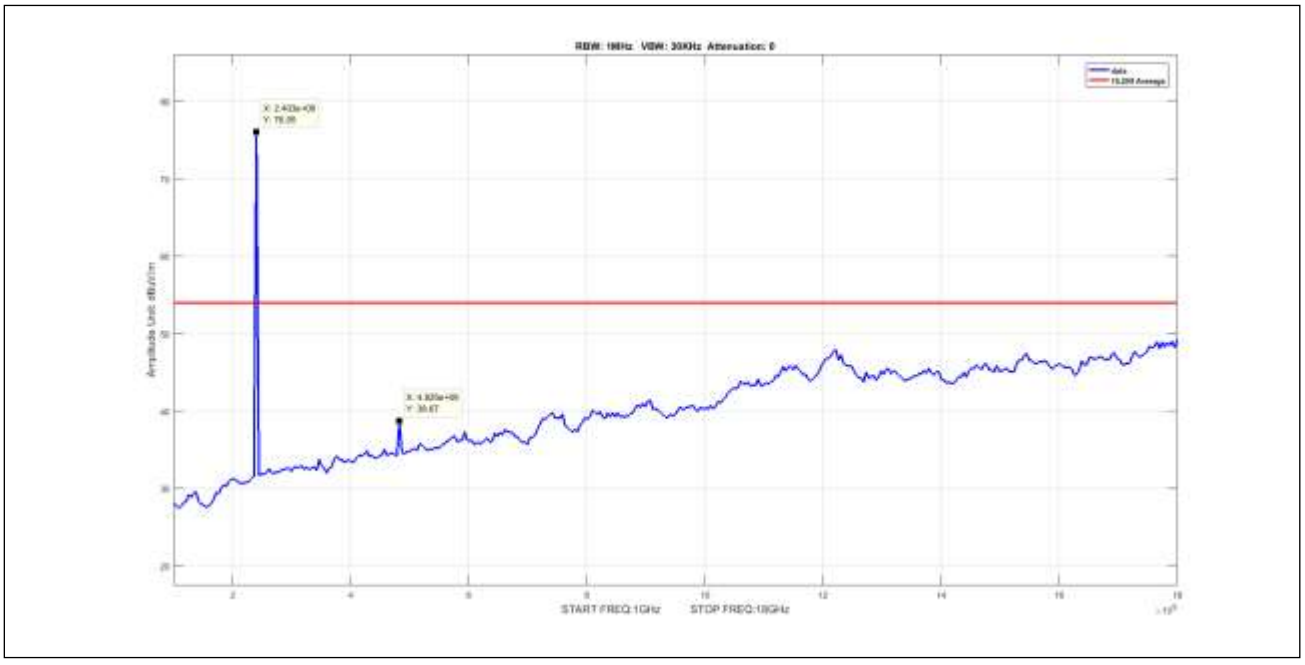
Plot 54. Radiated Emissions, average, non hopping, radiated spurious, DH3, 2402



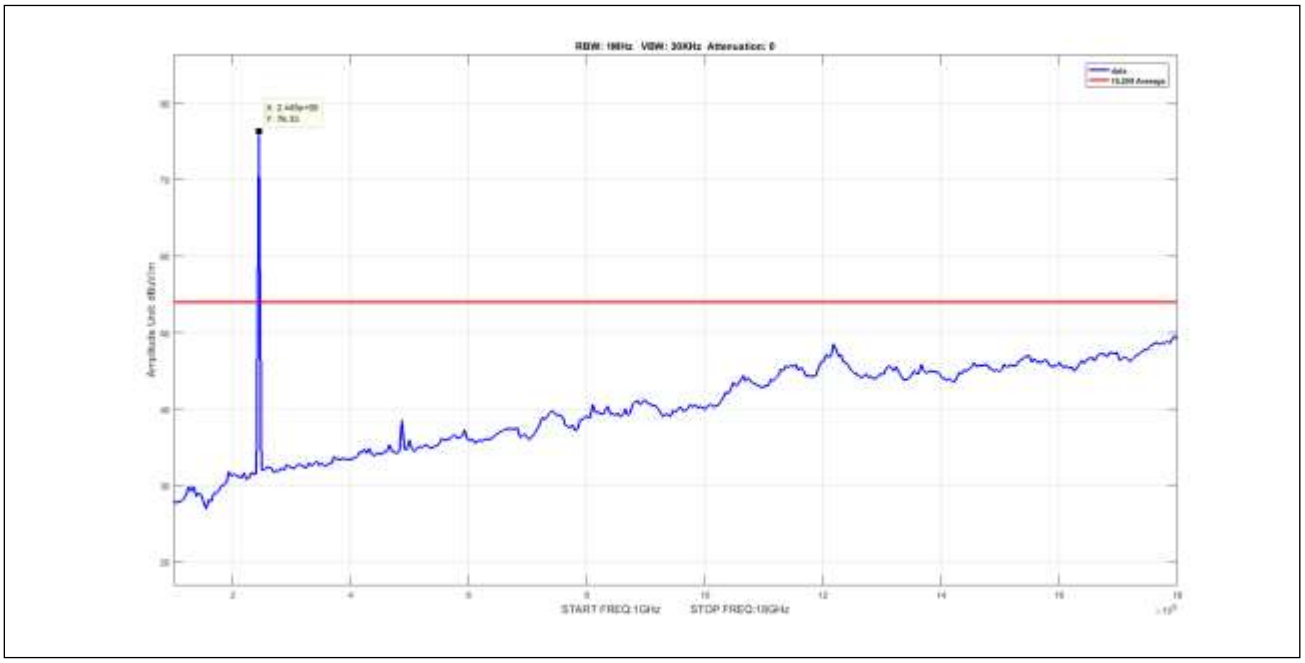
Plot 55. Radiated Emissions, average, non hopping, radiated spurious, DH3, 2441



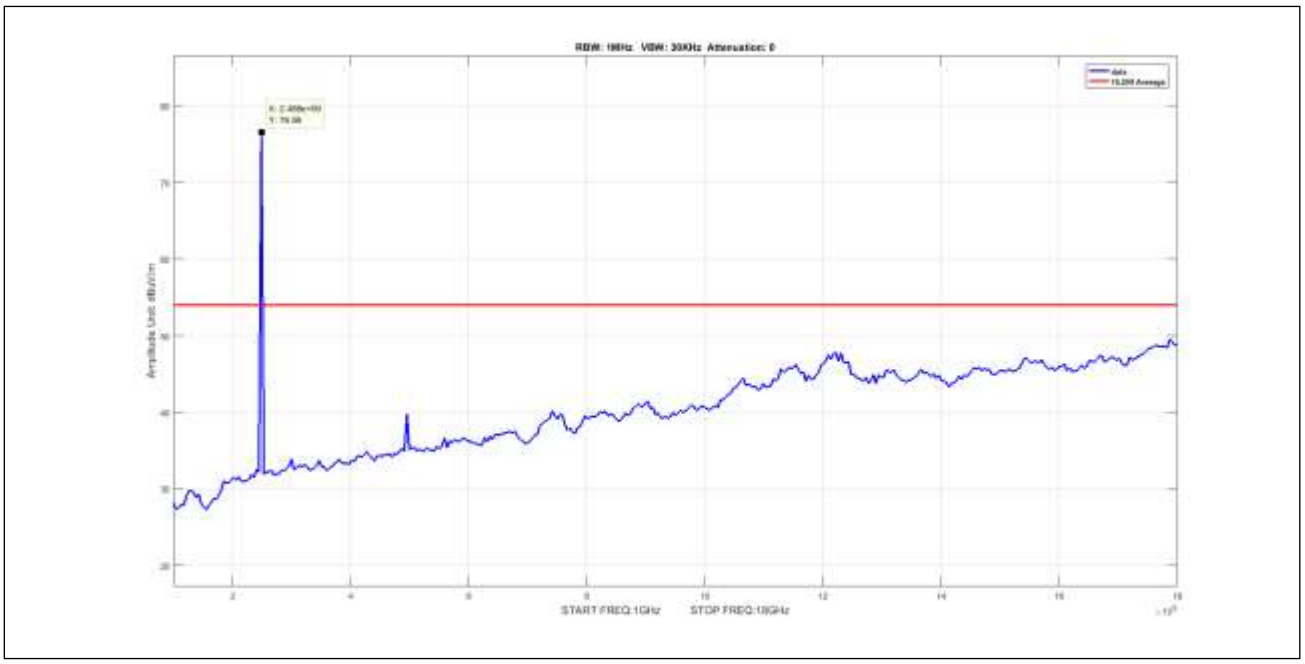
Plot 56. Radiated Emissions, average, non hopping, radiated spurious, DH3, 2480



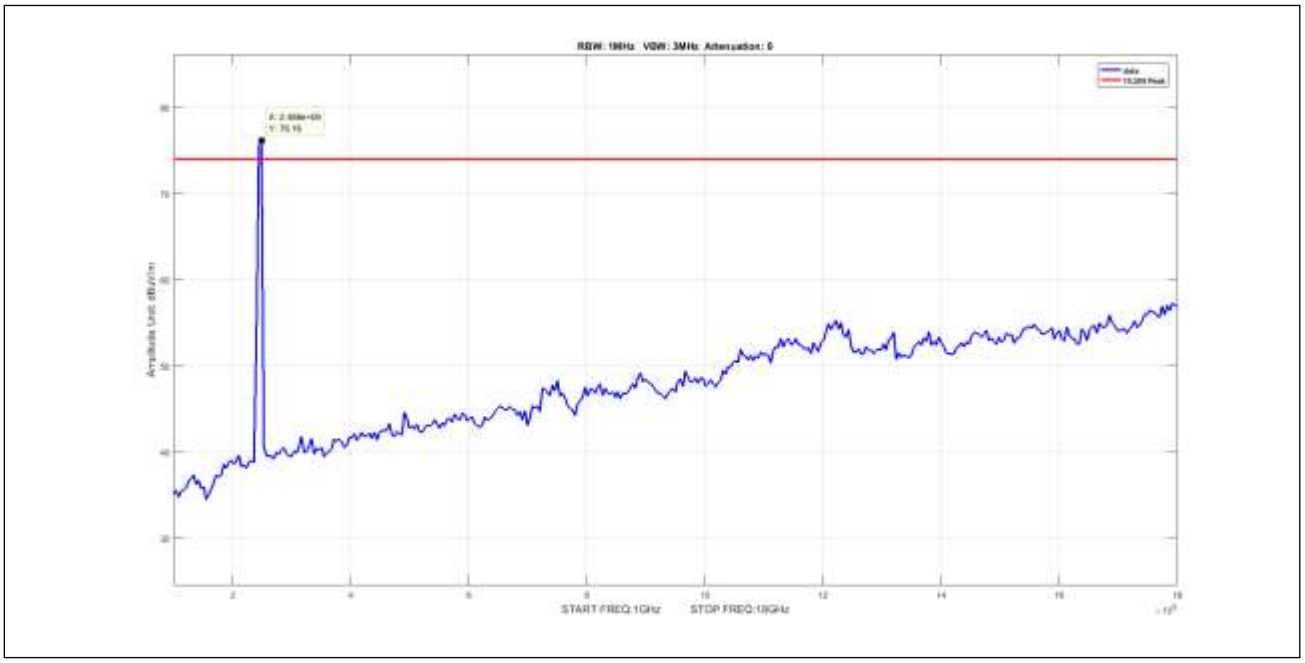
Plot 57. Radiated Emissions, average, non hopping, radiated spurious, DH5, 2402



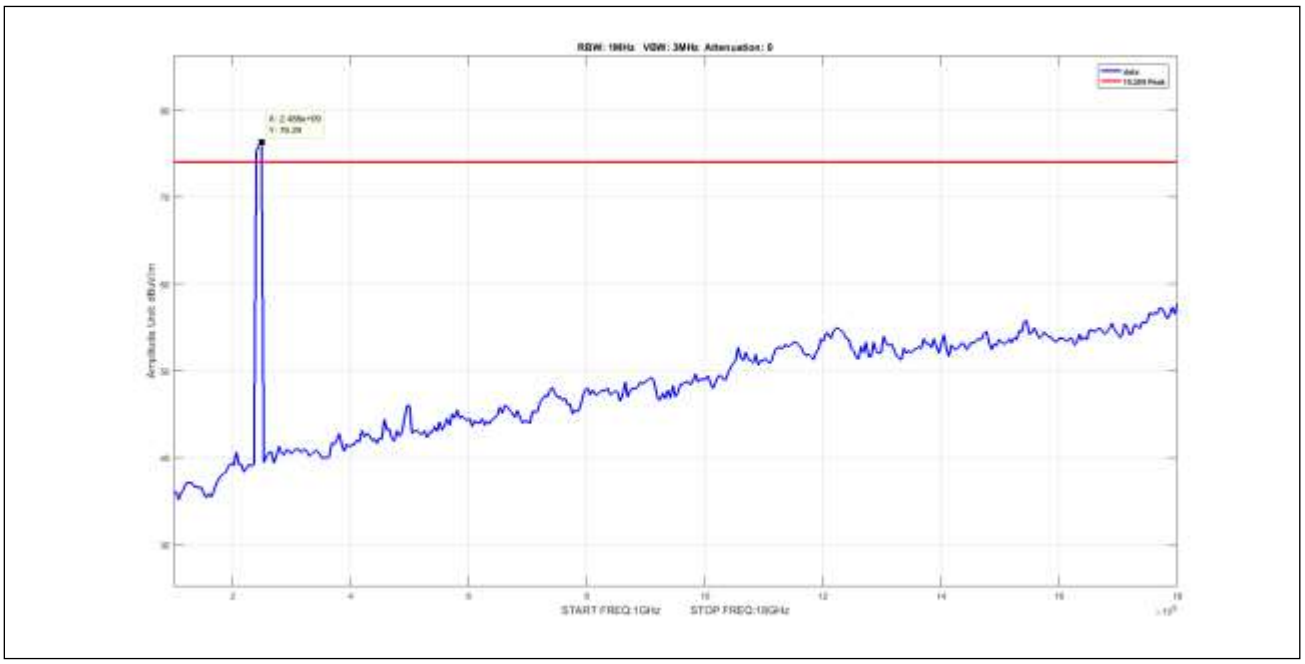
Plot 58. Radiated Emissions, average, non hopping, radiated spurious, DH5, 2441



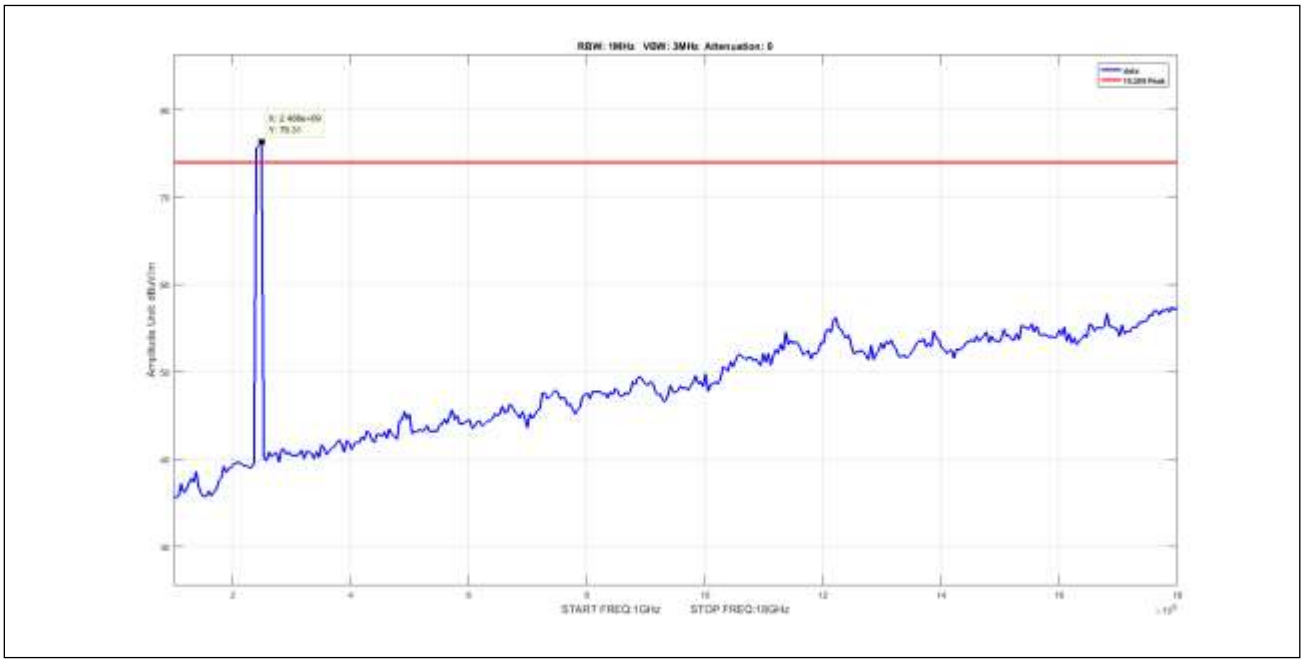
Plot 59. Radiated Emissions, average, non hopping, radiated spurious, DH5, 2480



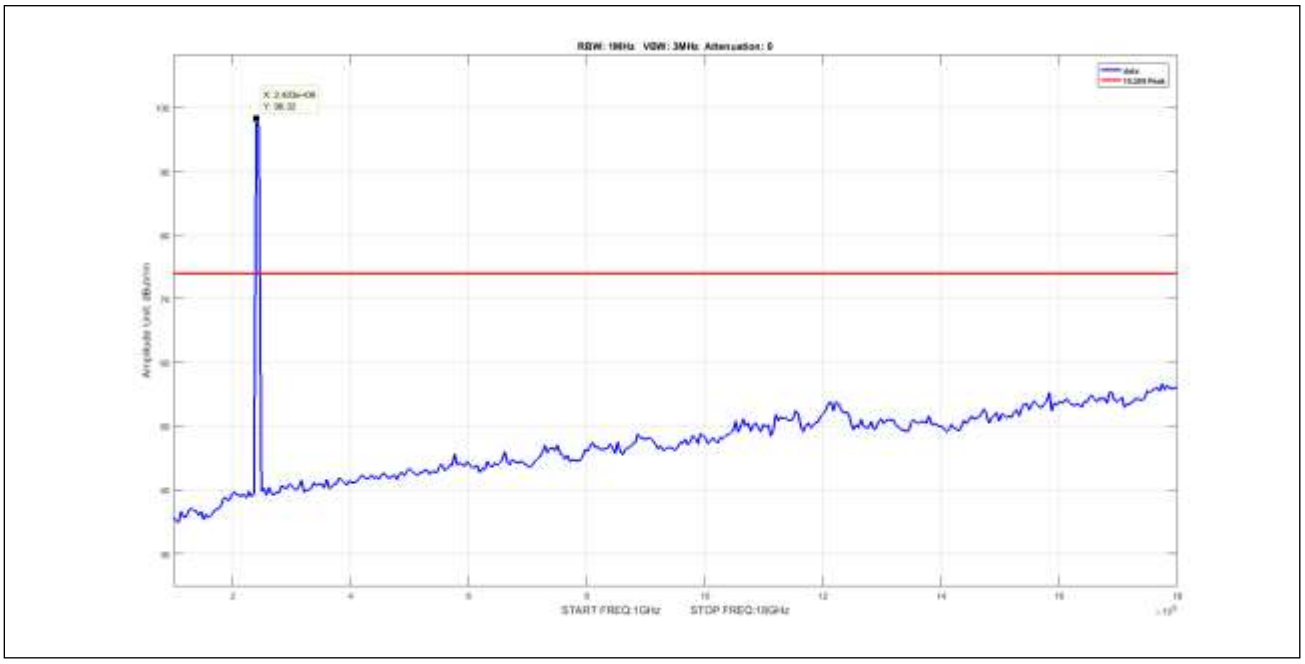
Plot 60. Radiated Emissions, peak, hopping, radiated spurious, DH1



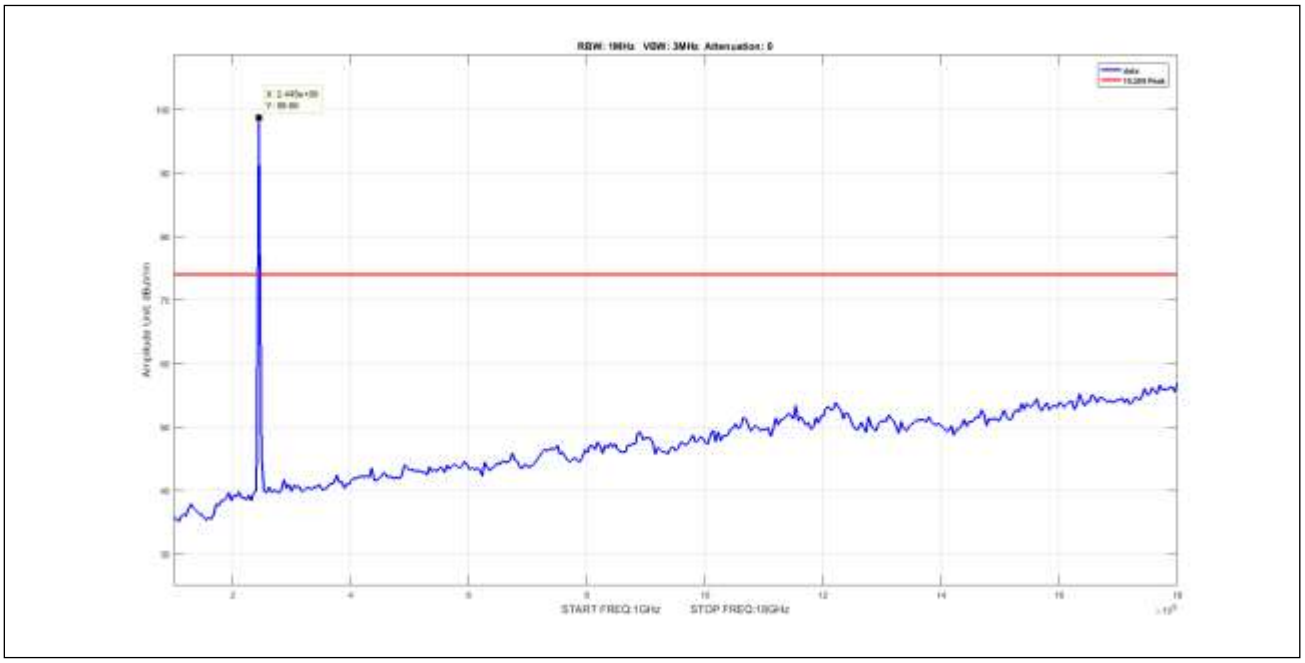
Plot 61. Radiated Emissions, peak, hopping, radiated spurious, DH3



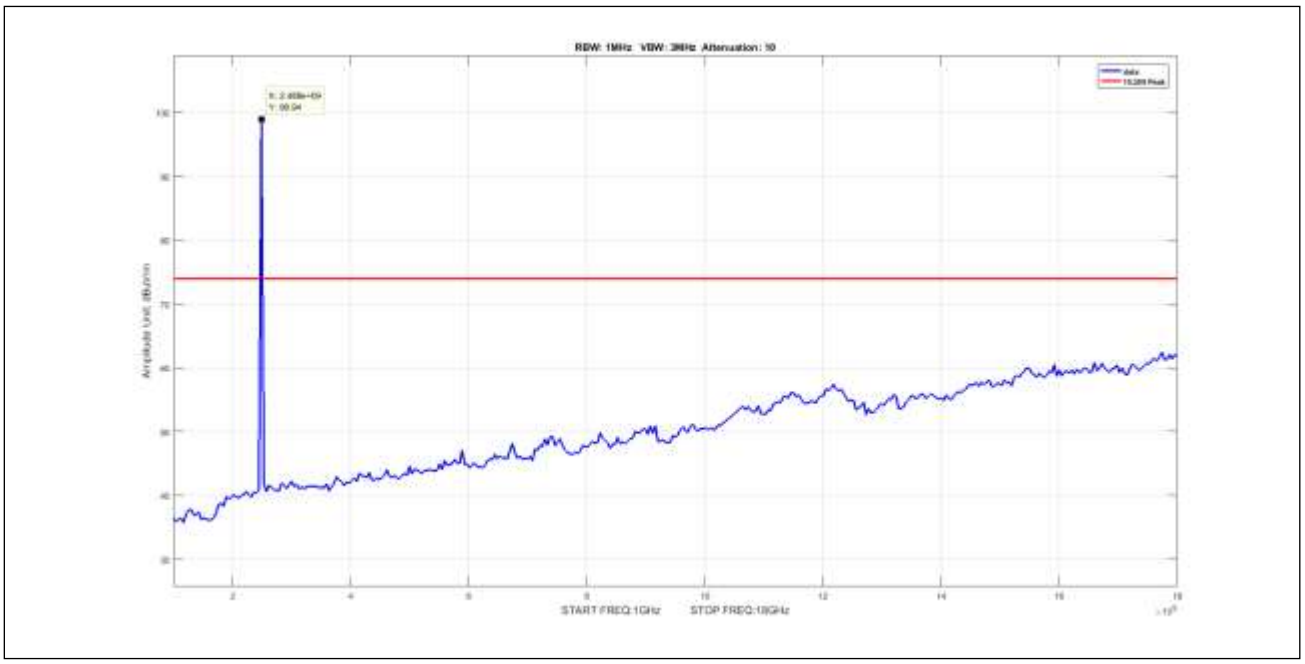
Plot 62. Radiated Emissions, peak, hopping, radiated spurious, DH5



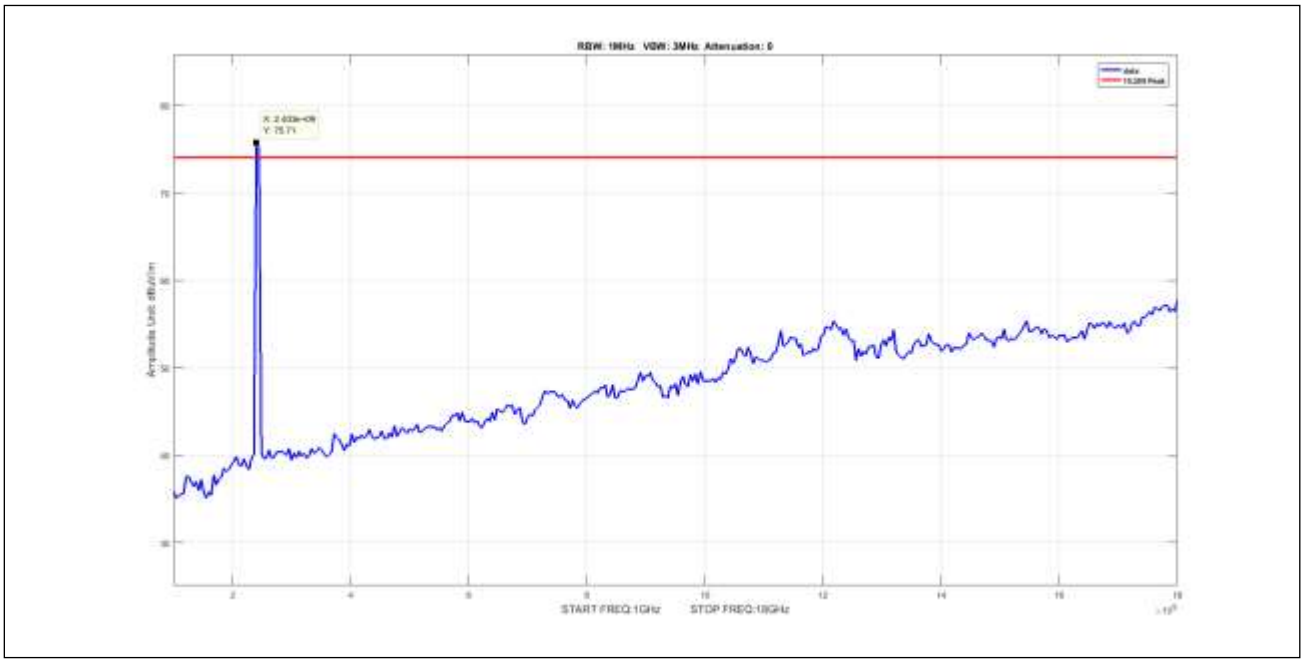
Plot 63. Radiated Emissions, peak, non hopping, radiated spurious, DH1, 2402



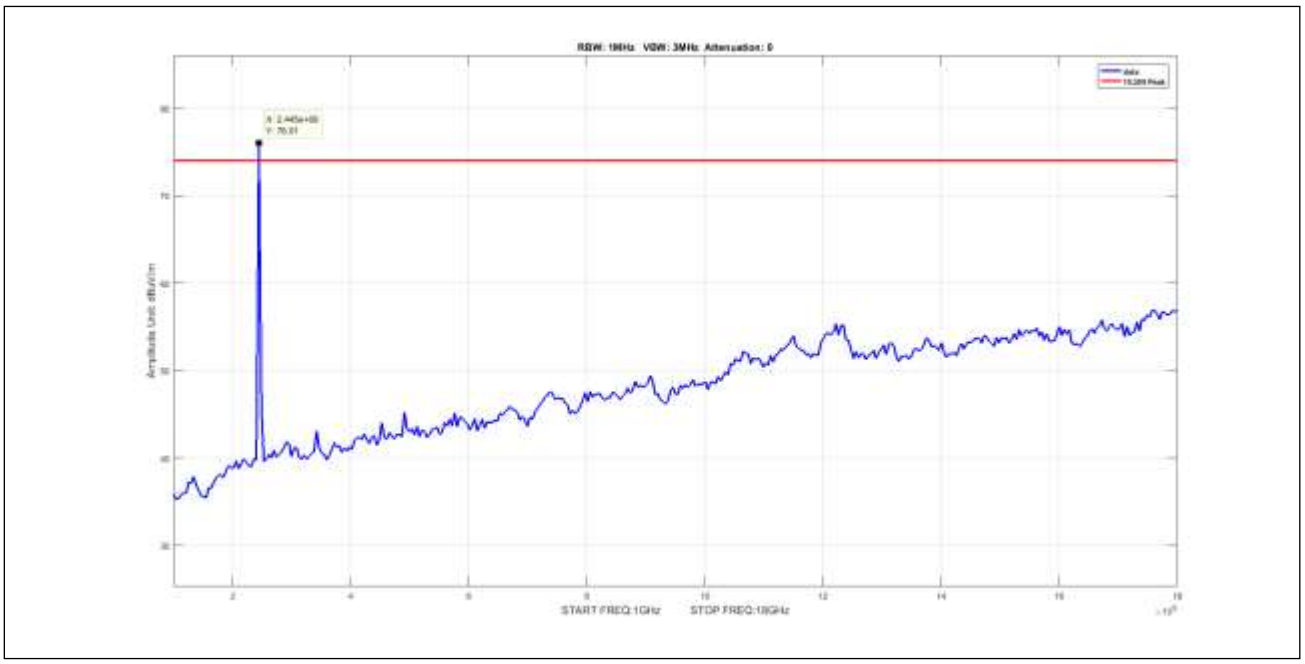
Plot 64. Radiated Emissions, peak, non hopping, radiated spurious, DH1, 2441



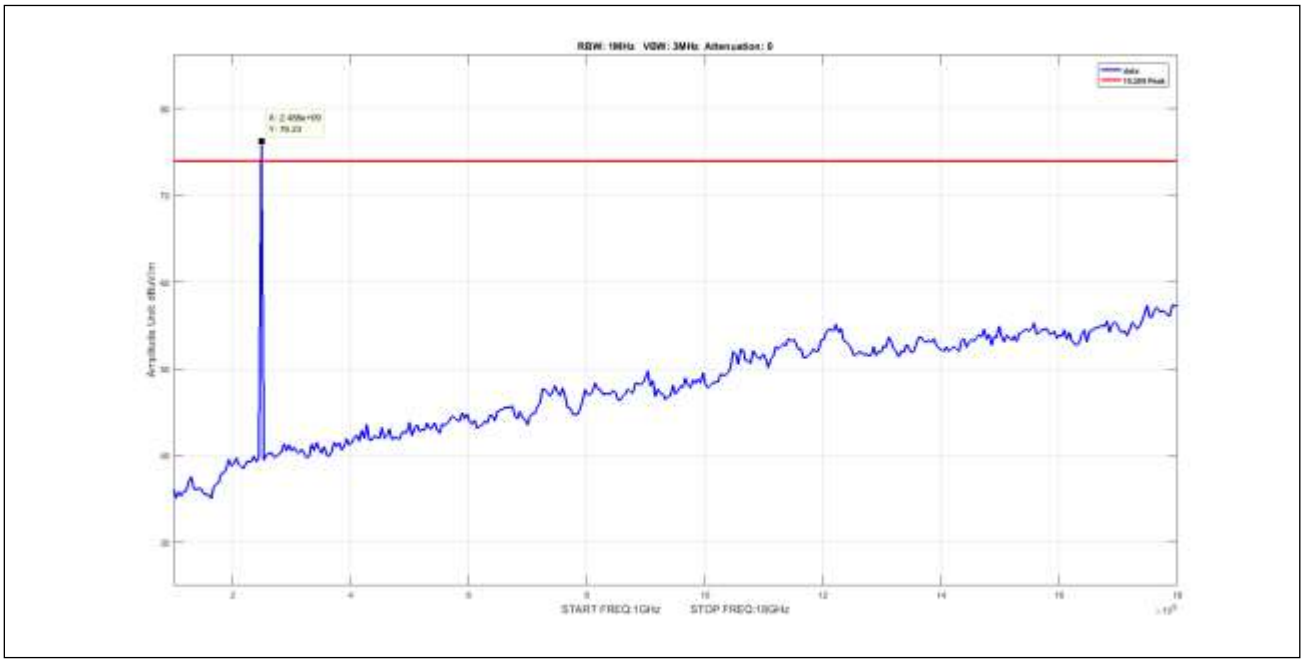
Plot 65. Radiated Emissions, peak, non hopping, radiated spurious, DH1, 2480



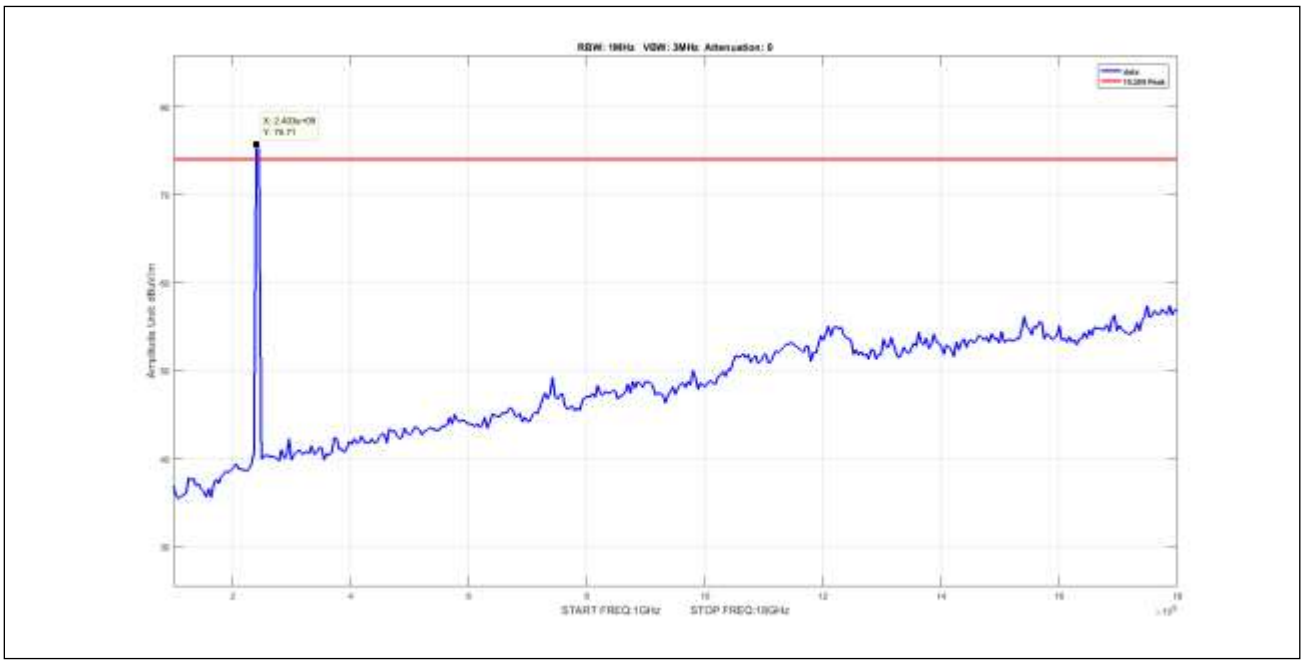
Plot 66. Radiated Emissions, peak, non hopping, radiated spurious, DH3, 2402



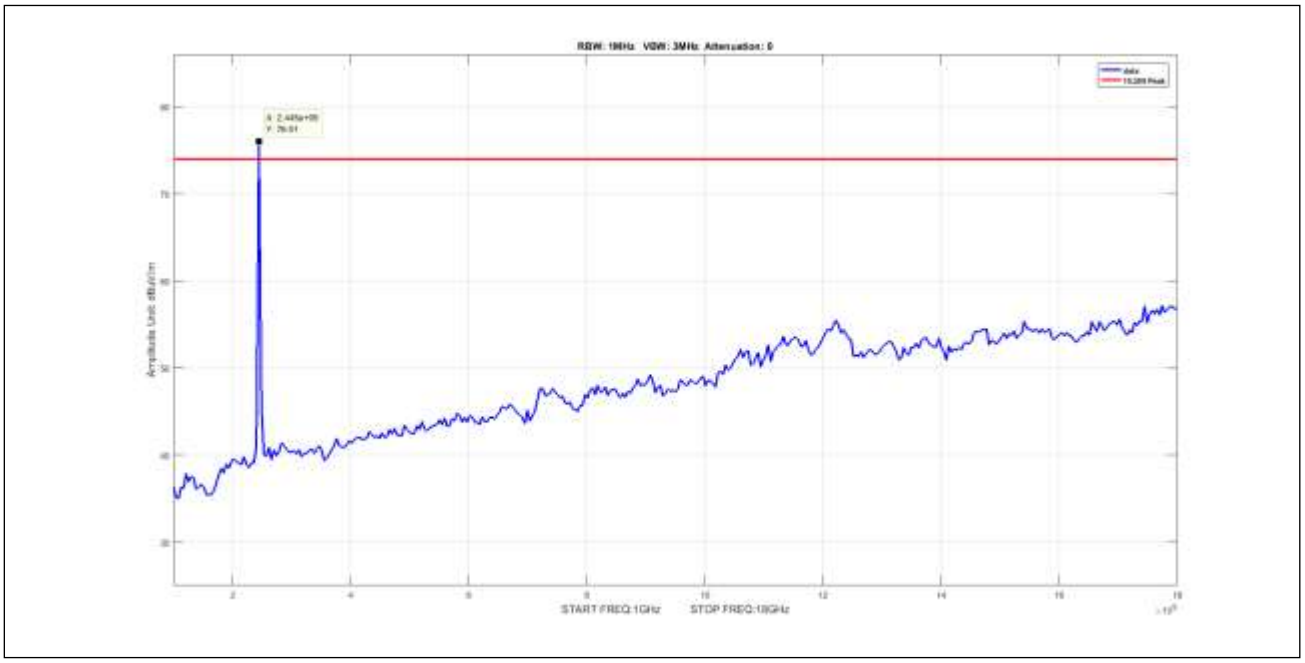
Plot 67. Radiated Emissions, peak, non hopping, radiated spurious, DH3, 2441



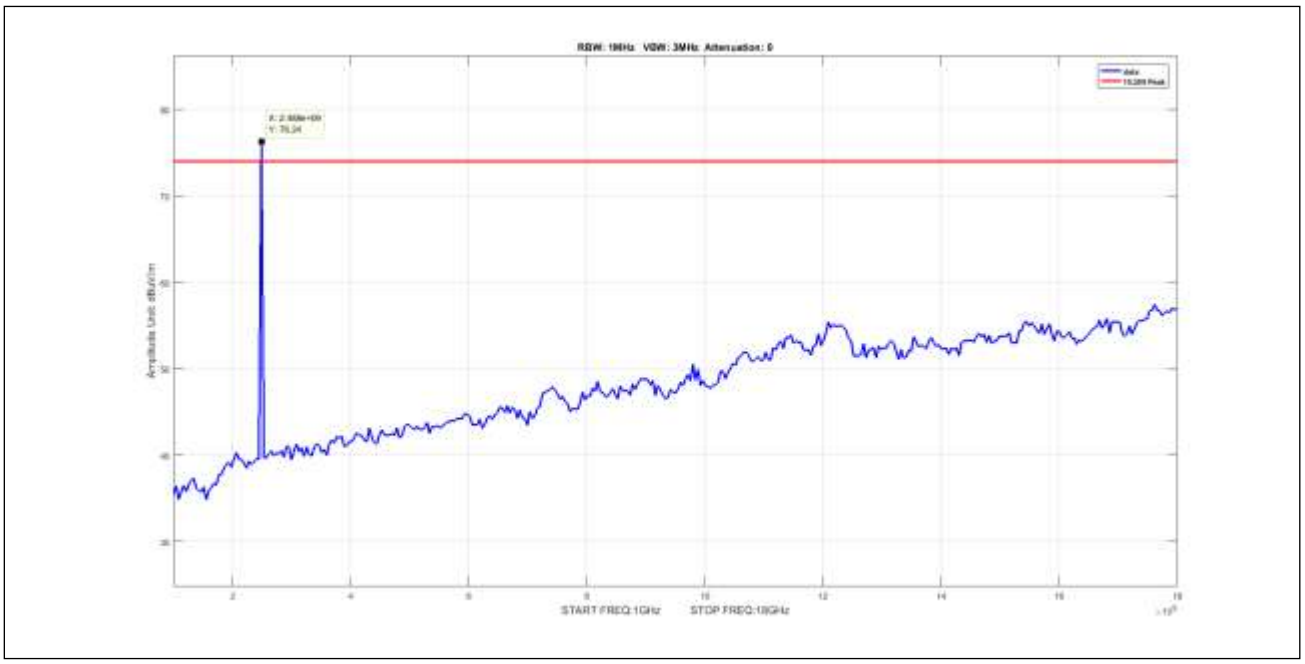
Plot 68. Radiated Emissions, peak, non hopping, radiated spurious, DH3, 2480



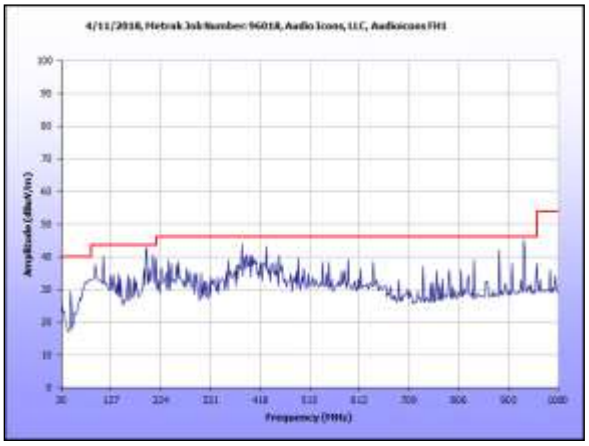
Plot 69. Radiated Emissions, peak, non hopping, radiated spurious, DH5, 2402



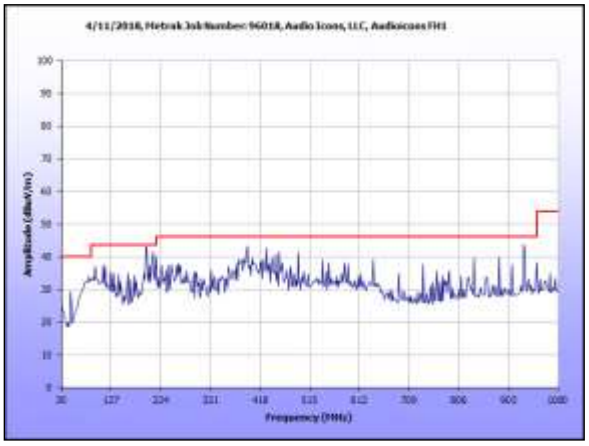
Plot 70. Radiated Emissions, peak, non hopping, radiated spurious, DH5, 2441



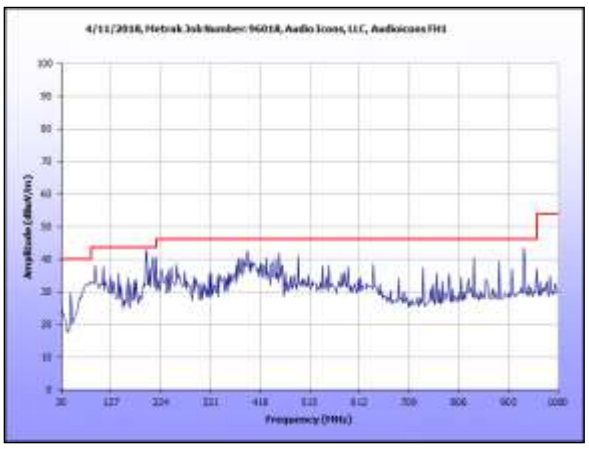
Plot 71. Radiated Emissions, peak, non hopping, radiated spurious, DH5, 2480



Plot 72. Radiated Emissions, 15.209 Low Channel



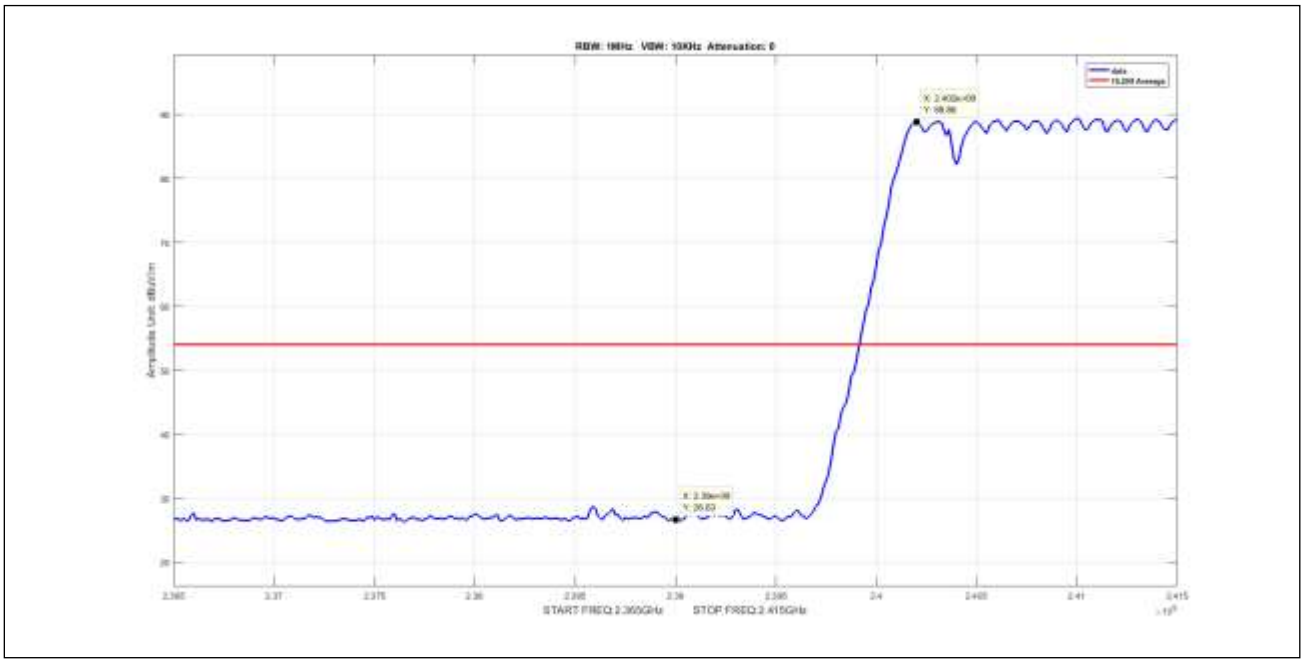
Plot 73. Radiated Emissions, 15.209 Mid Channel



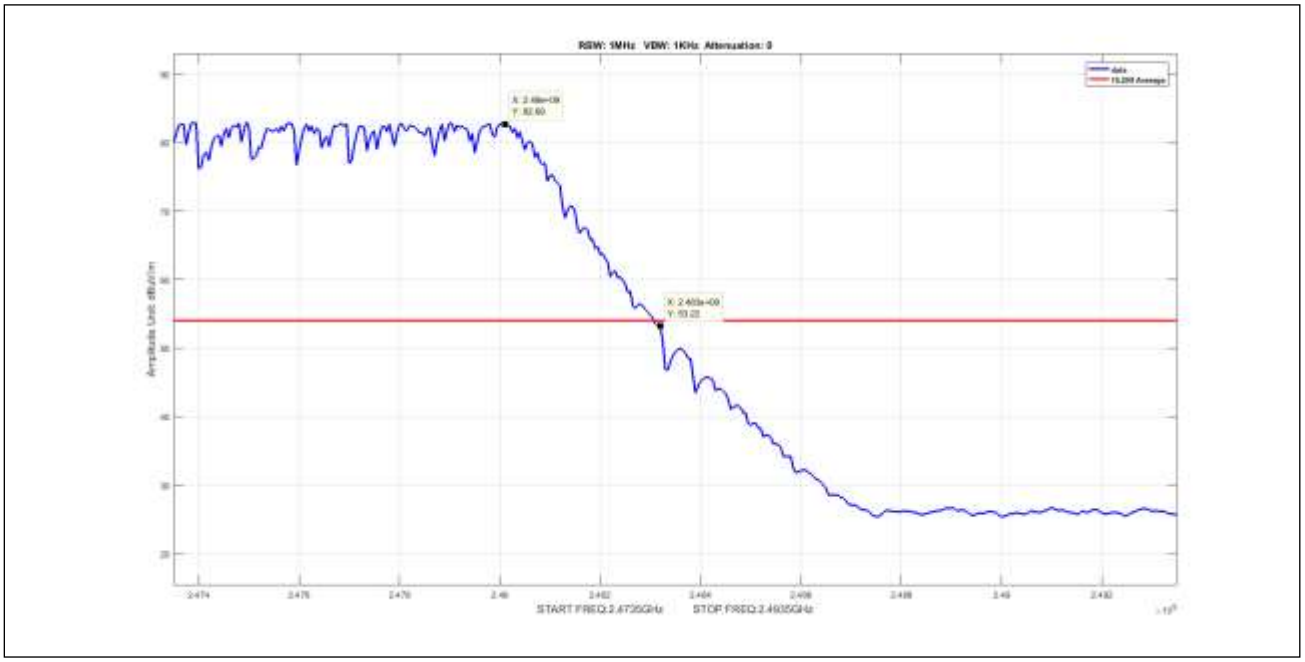
Plot 74. Radiated Emissions, 15.209 High Channel

Radiated Band Edge Measurements

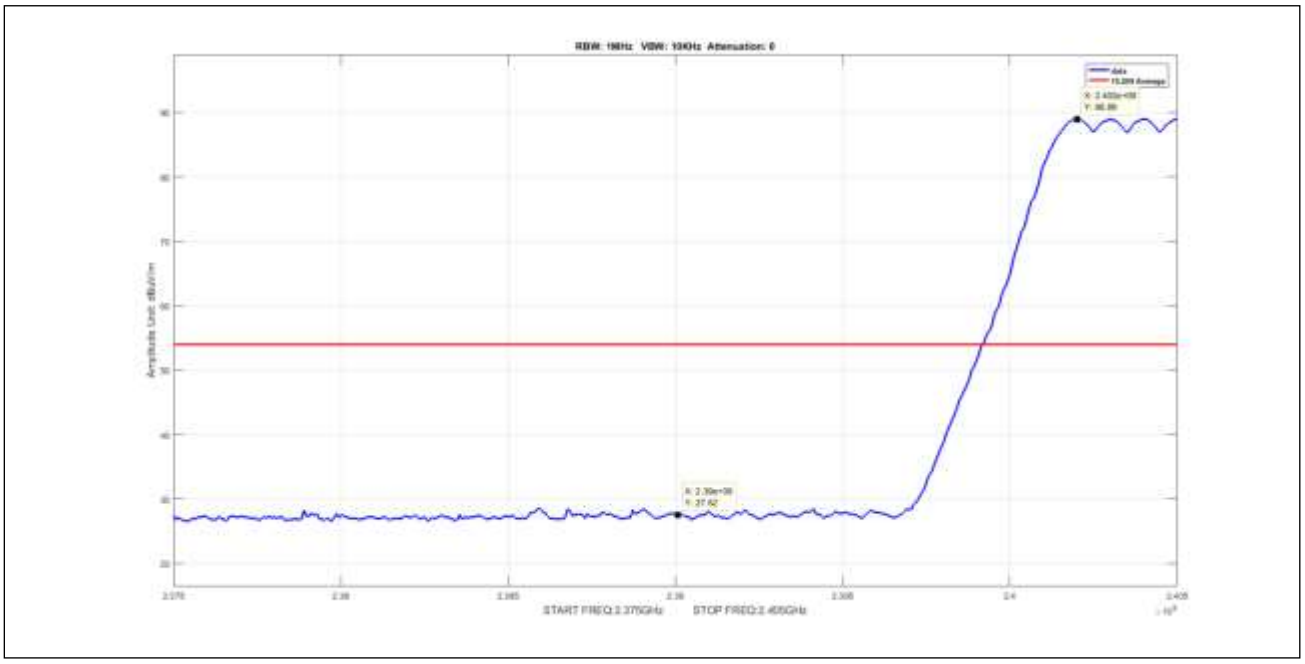
Test Procedures: The transmitter was turned. Measurements were performed of the low and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance.



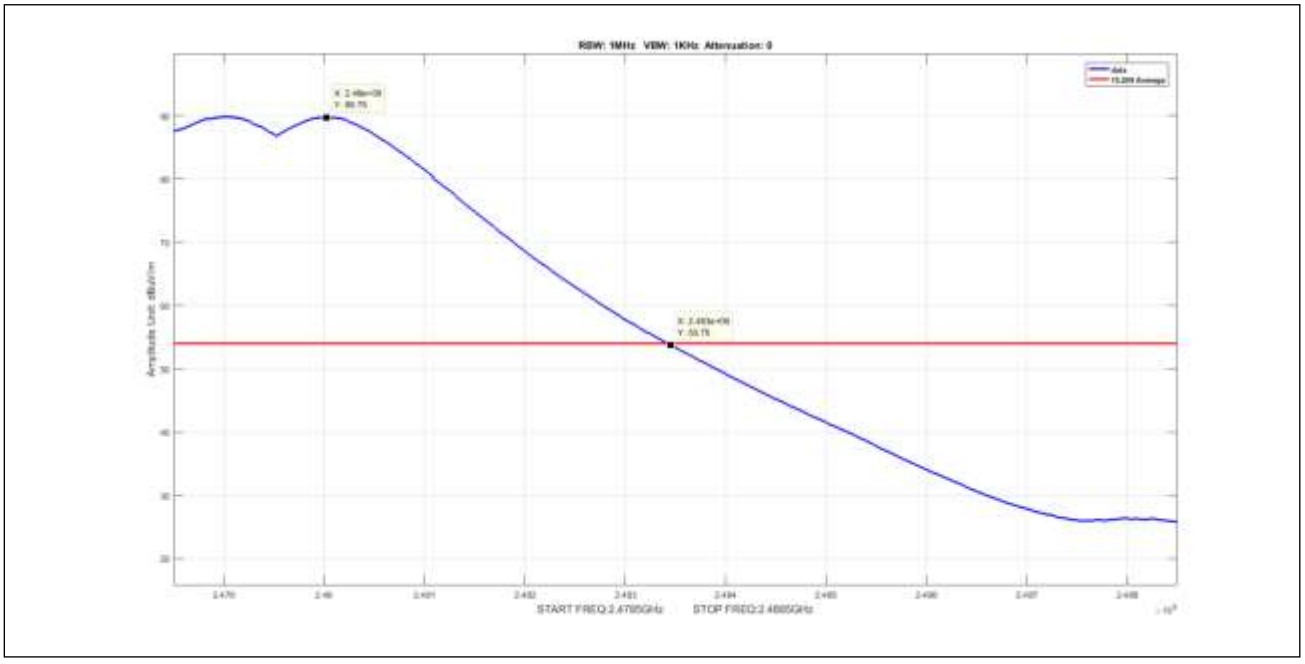
Plot 75. Radiated Emissions, average, hopping, bandedge, DH1, 2402



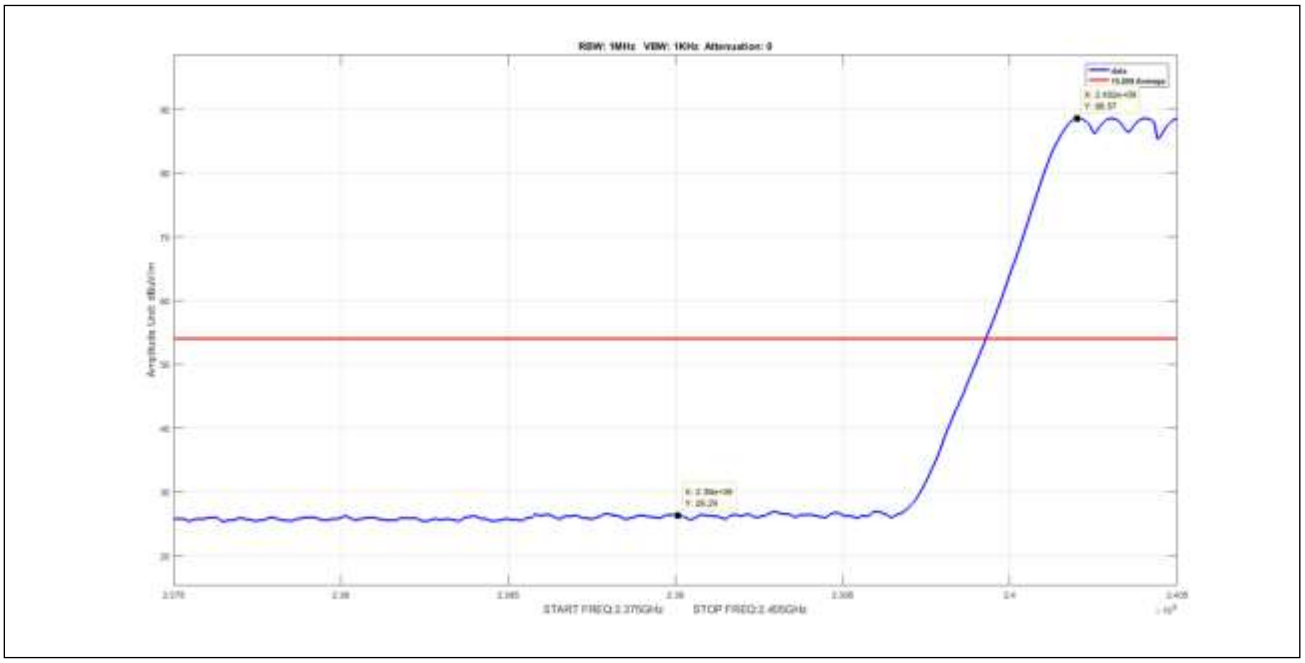
Plot 76. Radiated Emissions, average, hopping, bandedge, DH1, 2480



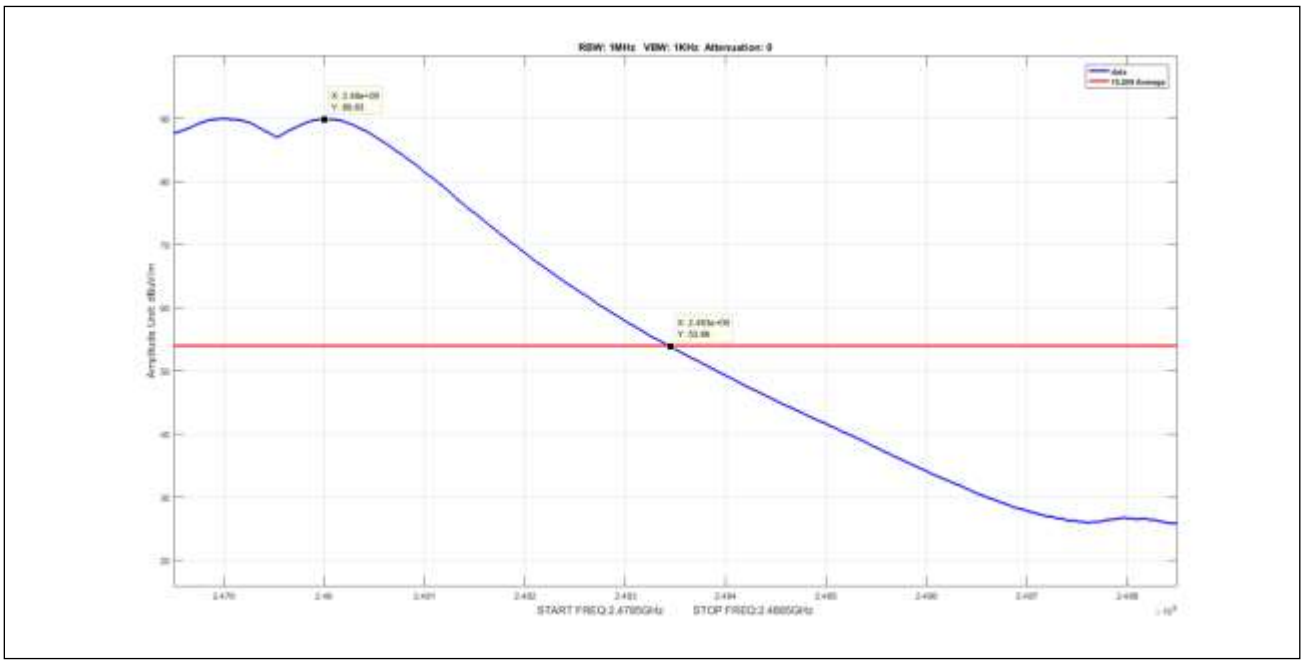
Plot 77. Radiated Emissions, average, hopping, bandedge, DH3, 2402



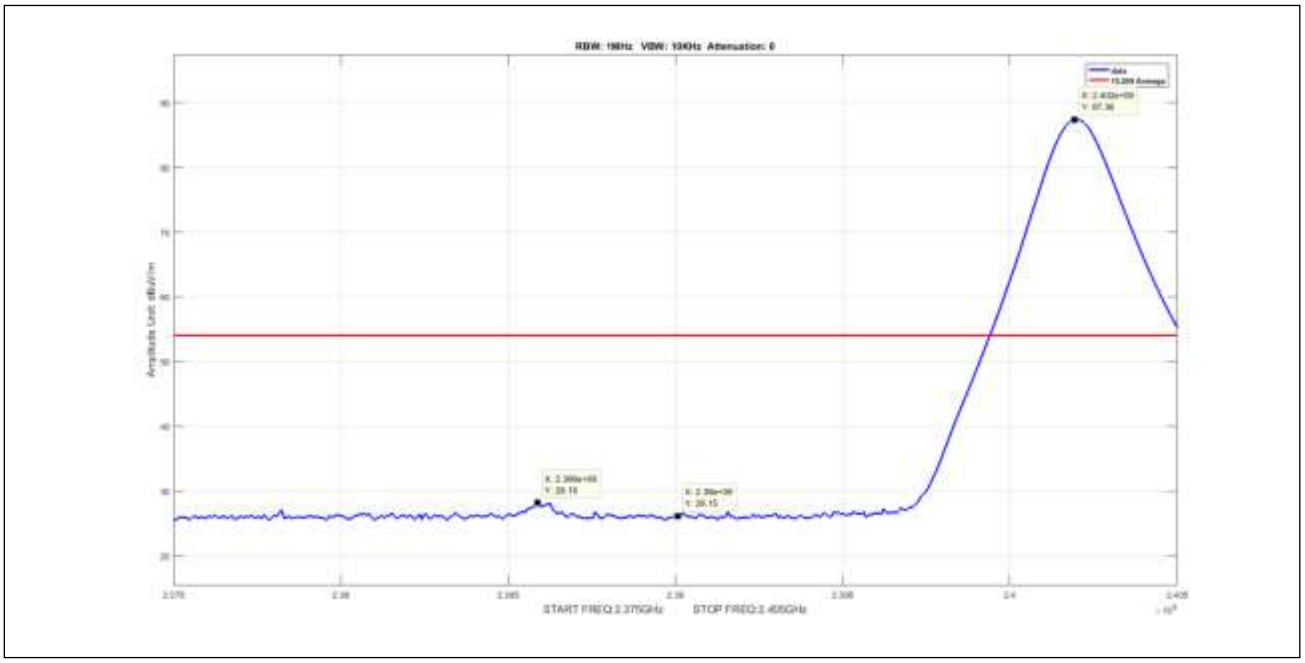
Plot 78. Radiated Emissions, average, hopping, bandedge, DH3, 2480



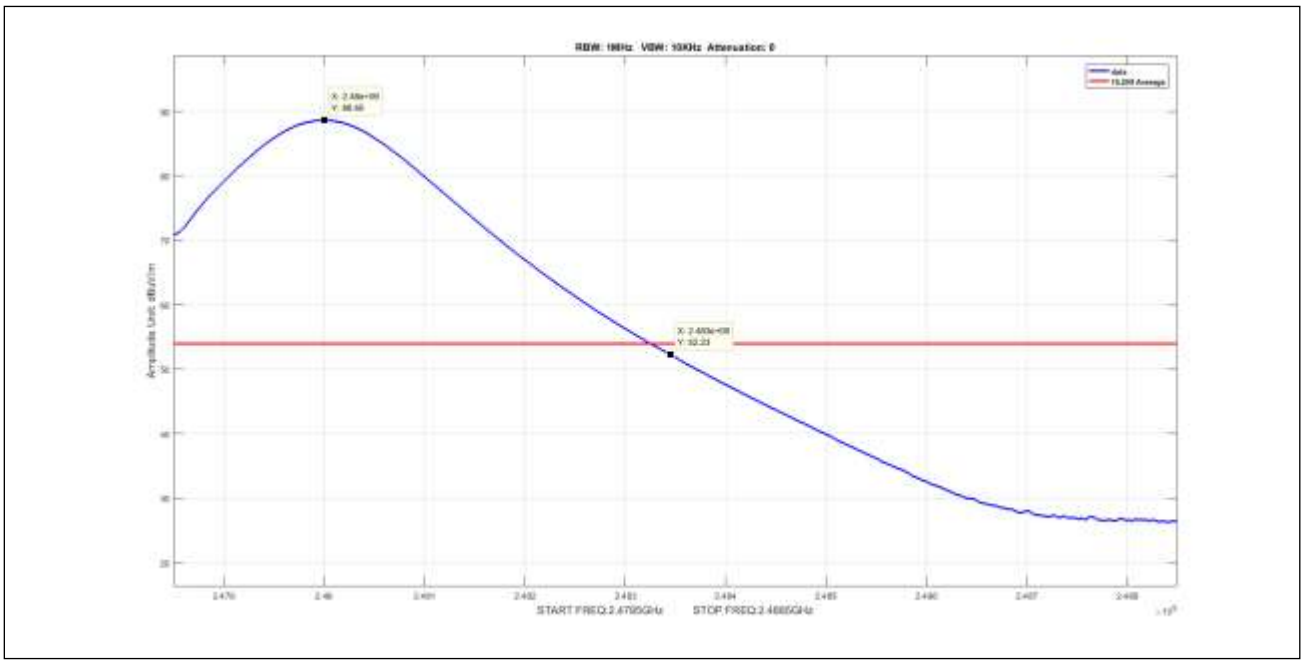
Plot 79. Radiated Emissions, average, hopping, bandedge, DH5, 2402



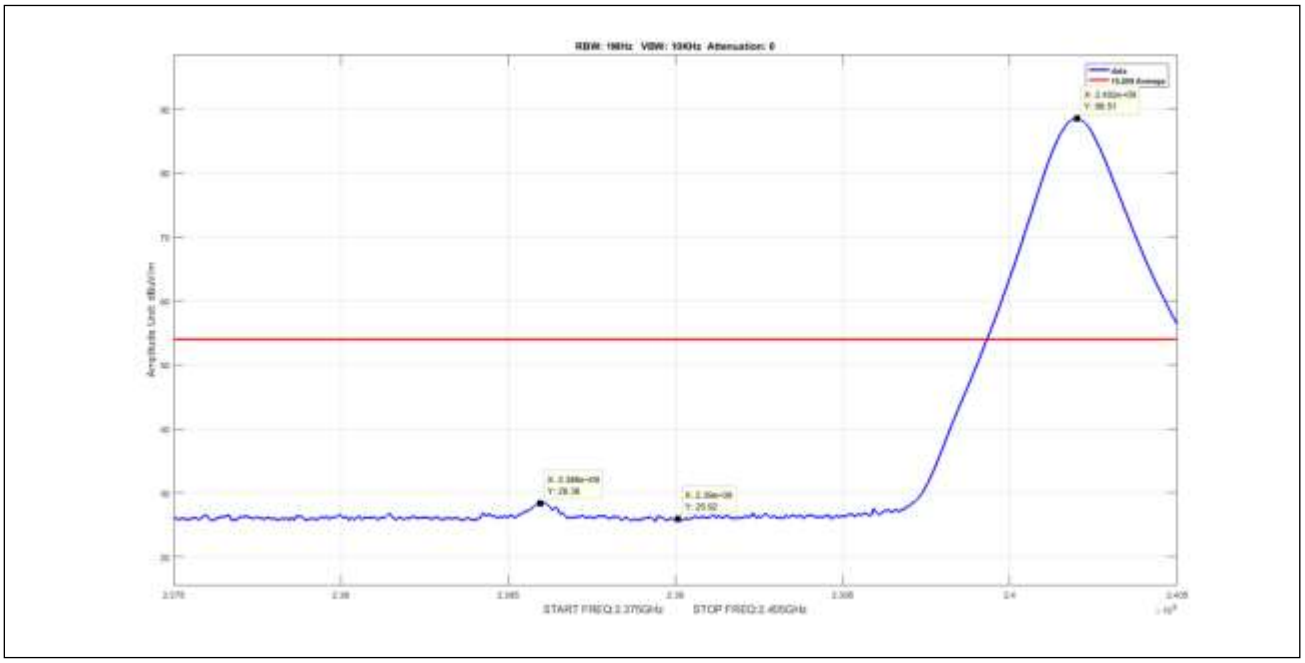
Plot 80. Radiated Emissions, average, hopping, bandedge, DH5, 2480



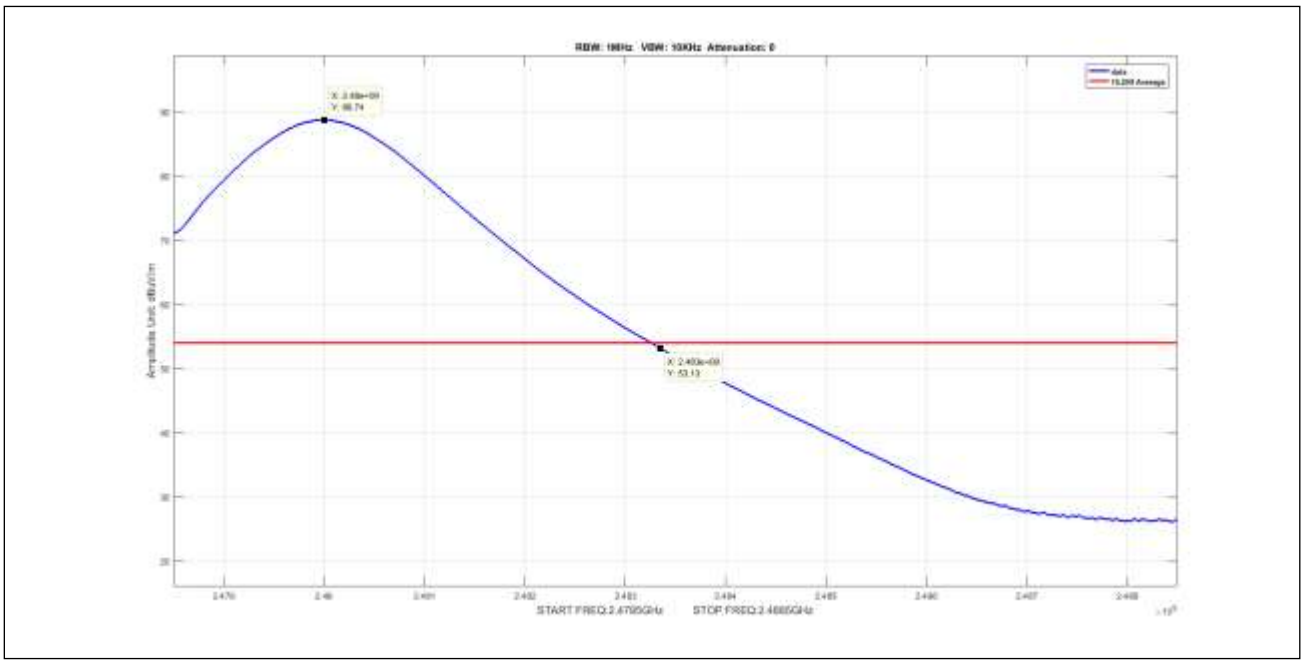
Plot 81. Radiated Emissions, average, non hopping, bandedge, DH1, 2402



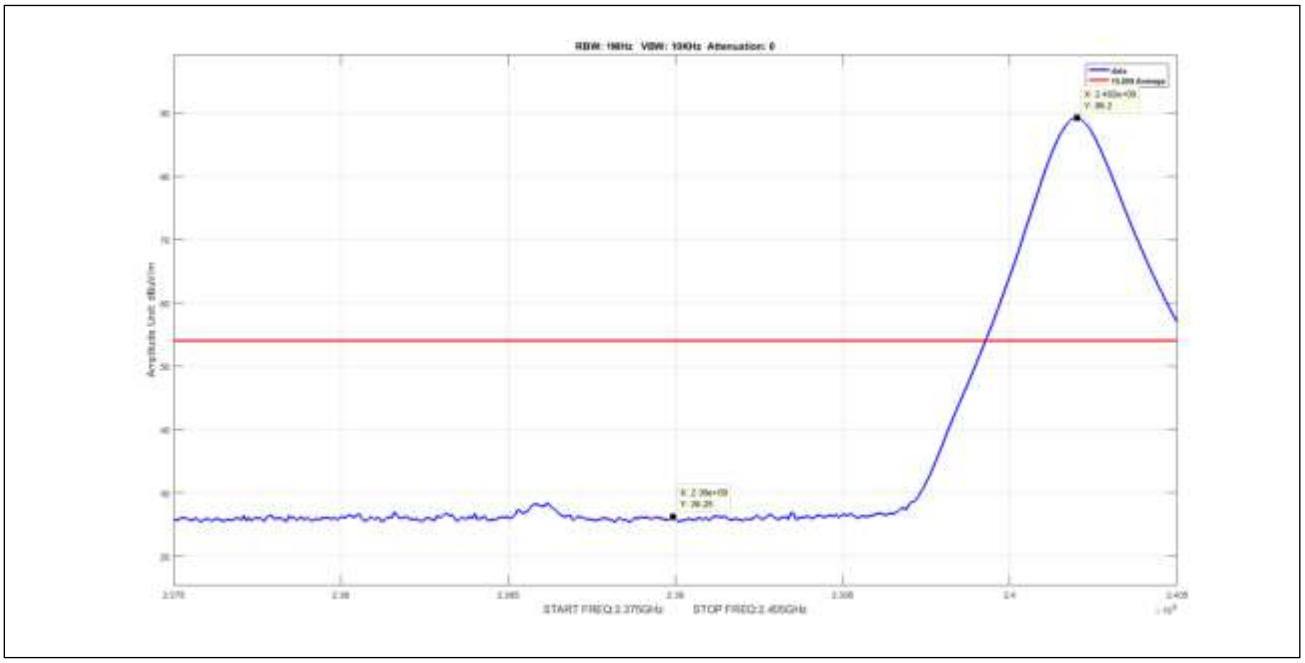
Plot 82. Radiated Emissions, average, non hopping, bandedge, DH1, 2480



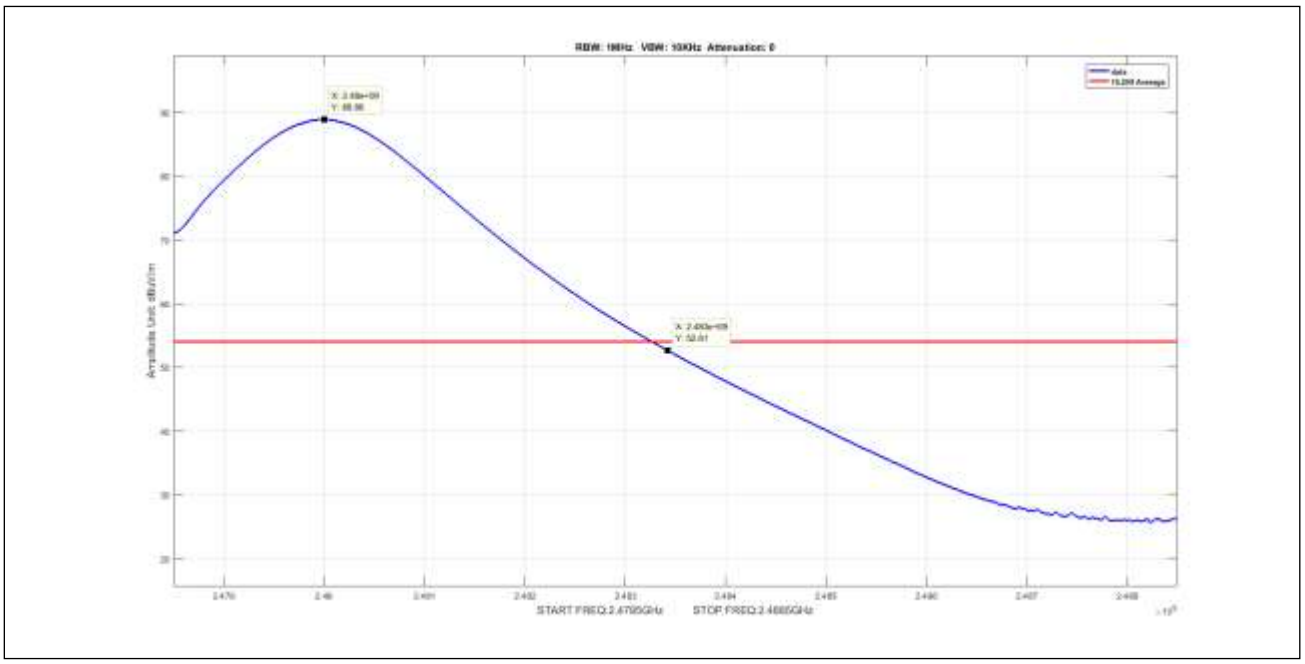
Plot 83. Radiated Emissions, average, non hopping, bandedge, DH3, 2402



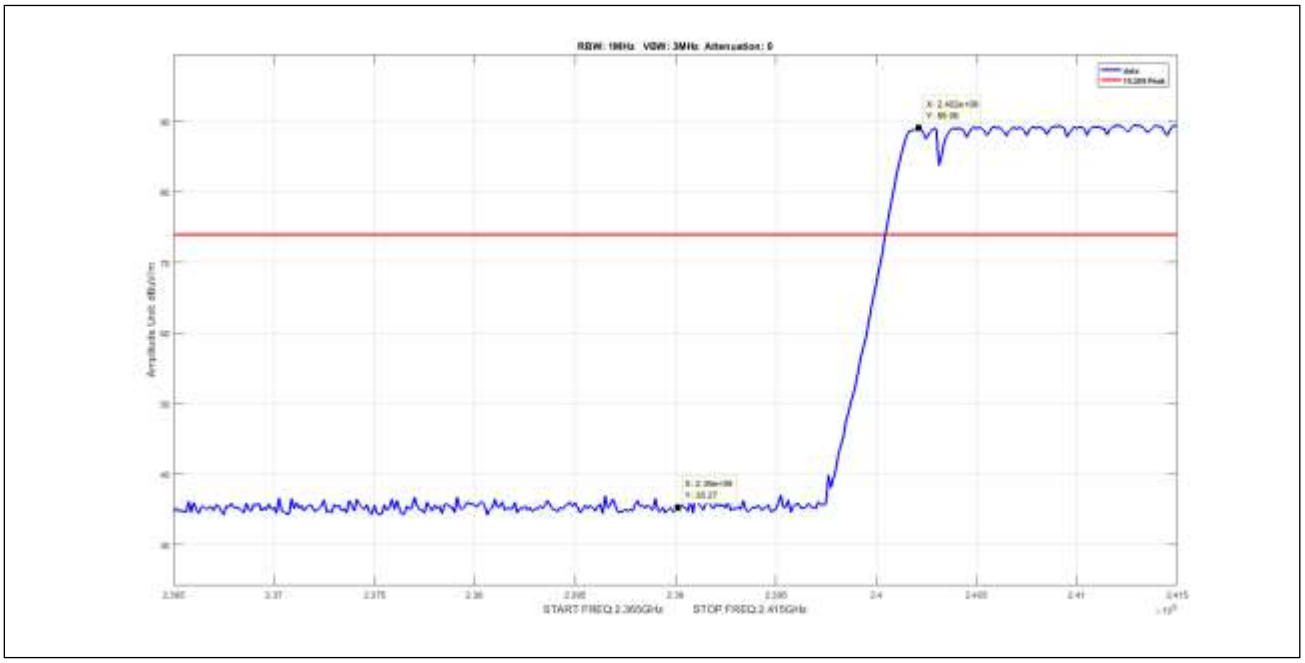
Plot 84. Radiated Emissions, average, non hopping, bandedge, DH3, 2480



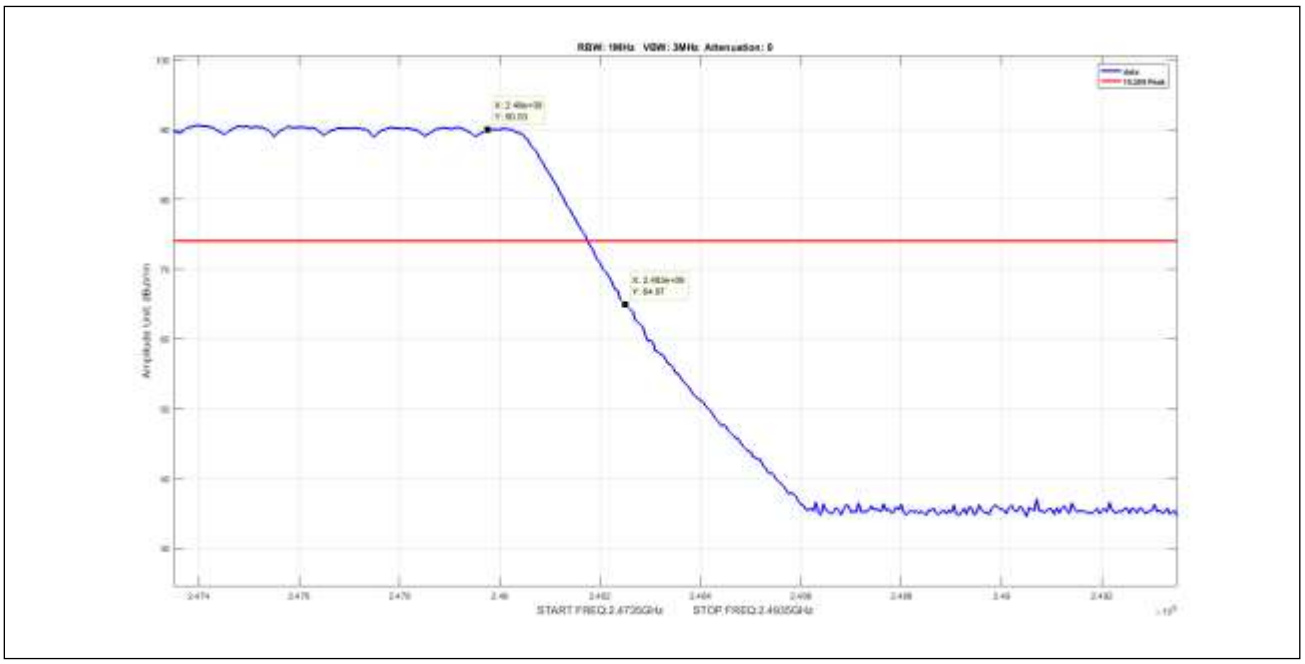
Plot 85. Radiated Emissions, average, non hopping, bandedge, DH5, 2402



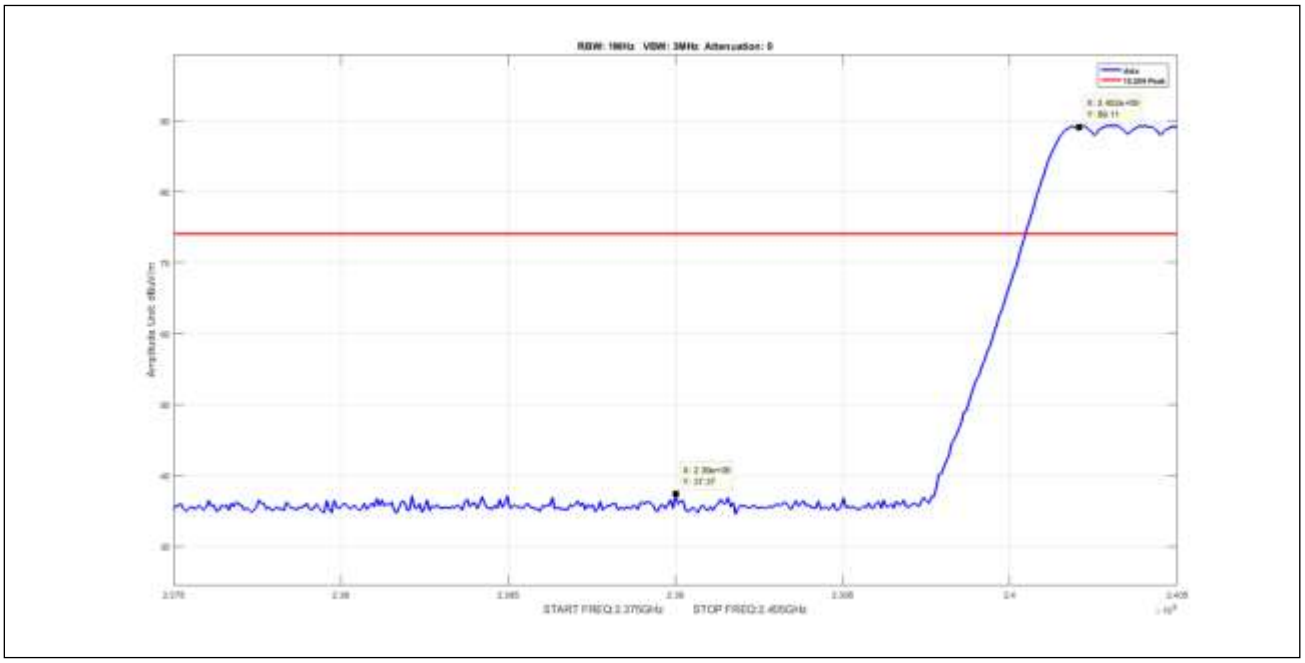
Plot 86. Radiated Emissions, average, non hopping, bandedge, DH5, 2480



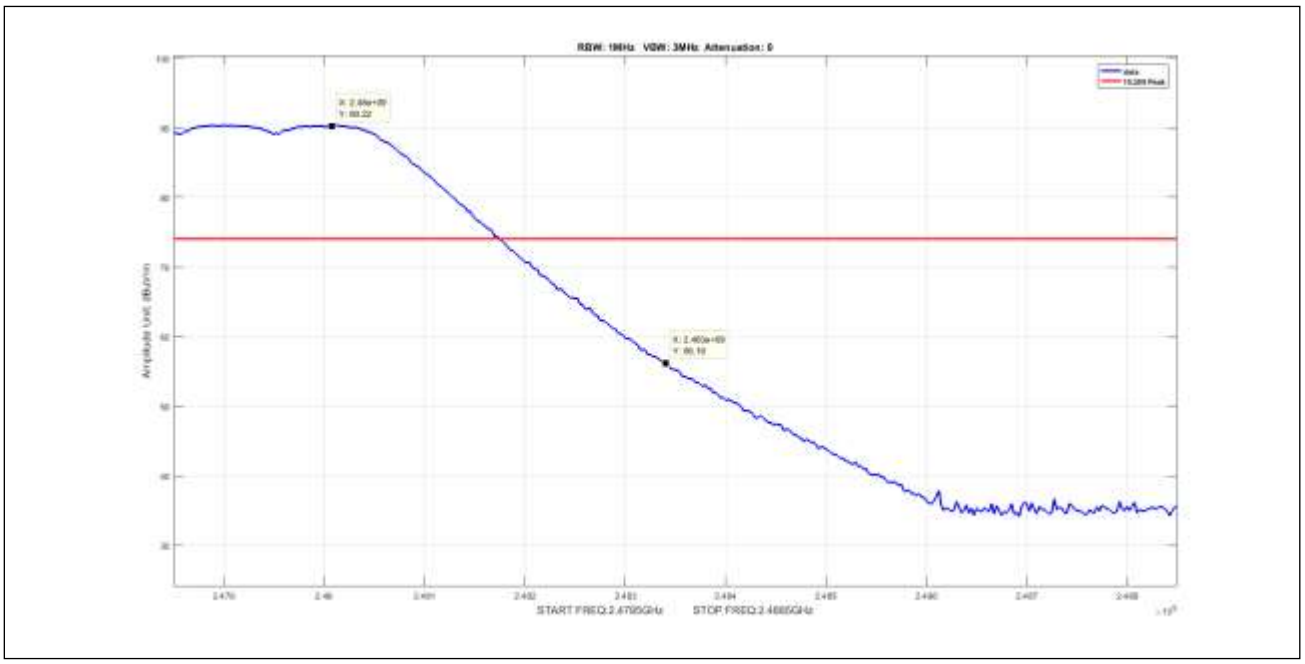
Plot 87. Radiated Emissions, peak, hopping, bandedge, DH1, 2402



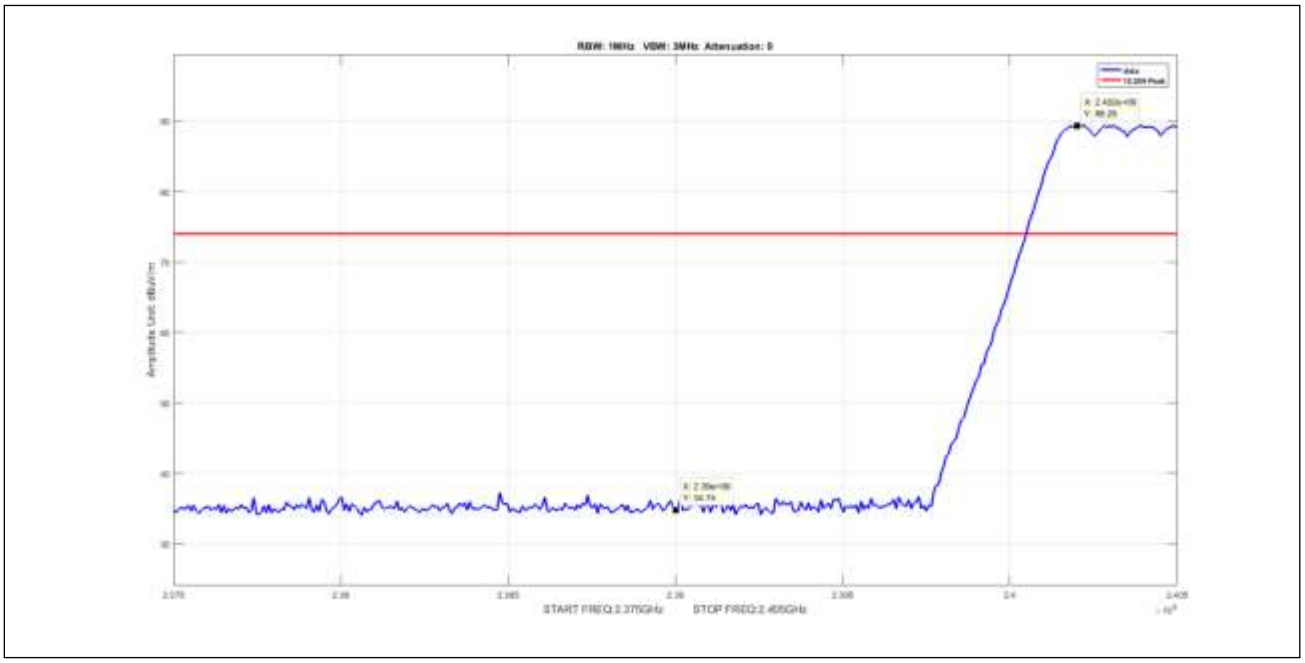
Plot 88. Radiated Emissions, peak, hopping, bandedge, DH1, 2480



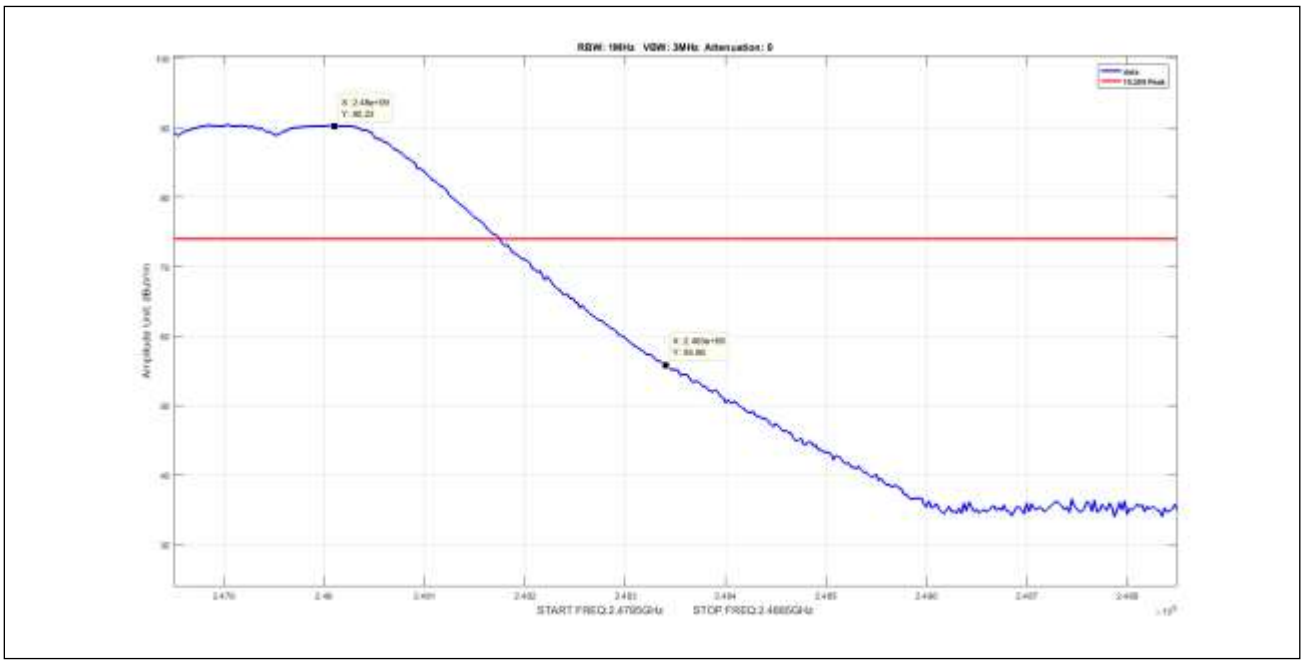
Plot 89. Radiated Emissions, peak, hopping, bandedge, DH3, 2402



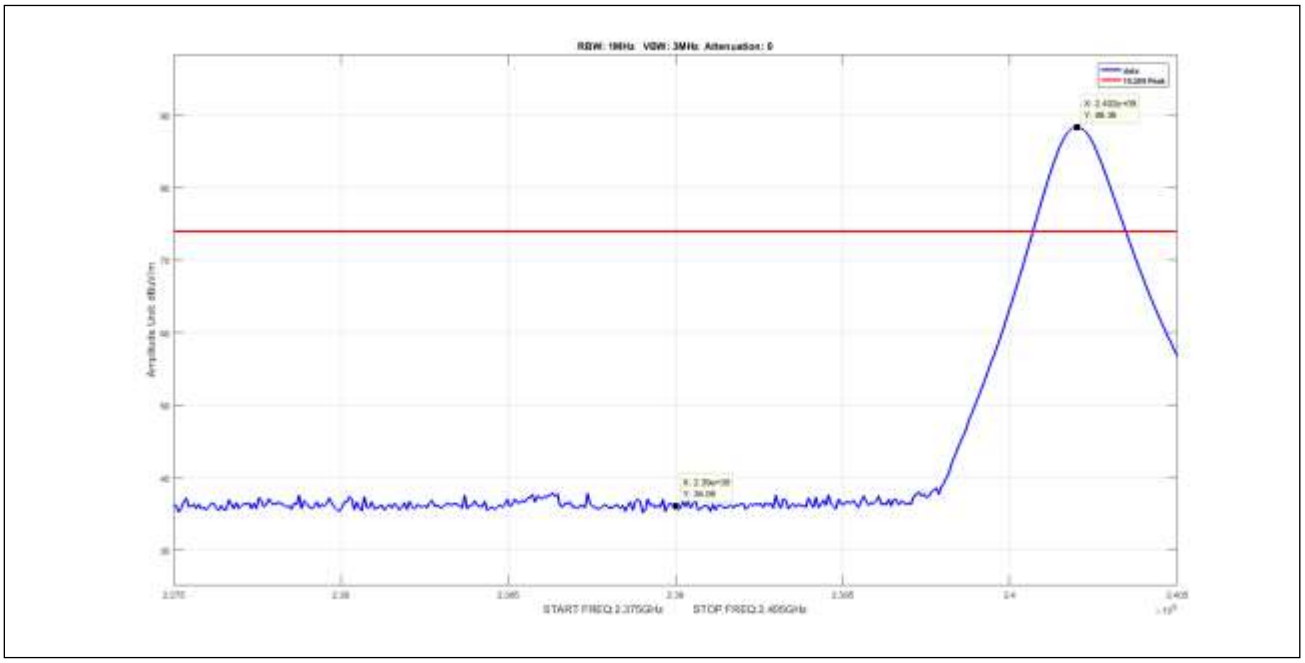
Plot 90. Radiated Emissions, peak, hopping, bandedge, DH3, 2480



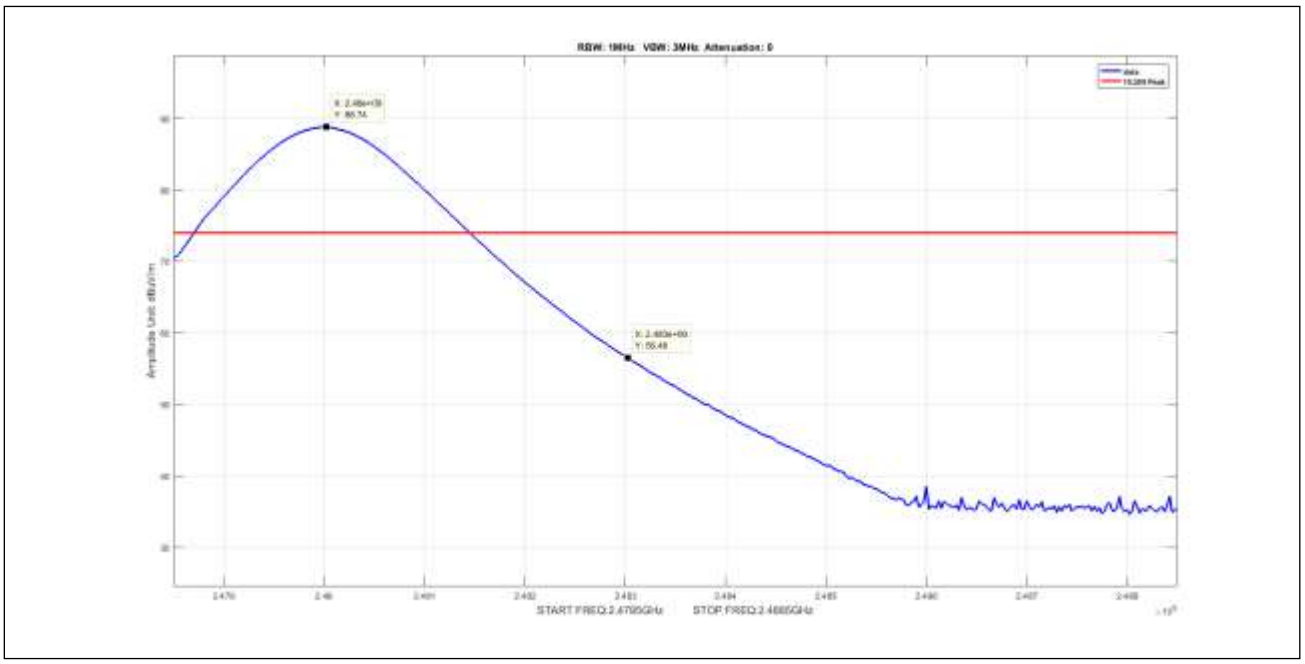
Plot 91. Radiated Emissions, peak, hopping, bandedge, DH5, 2402



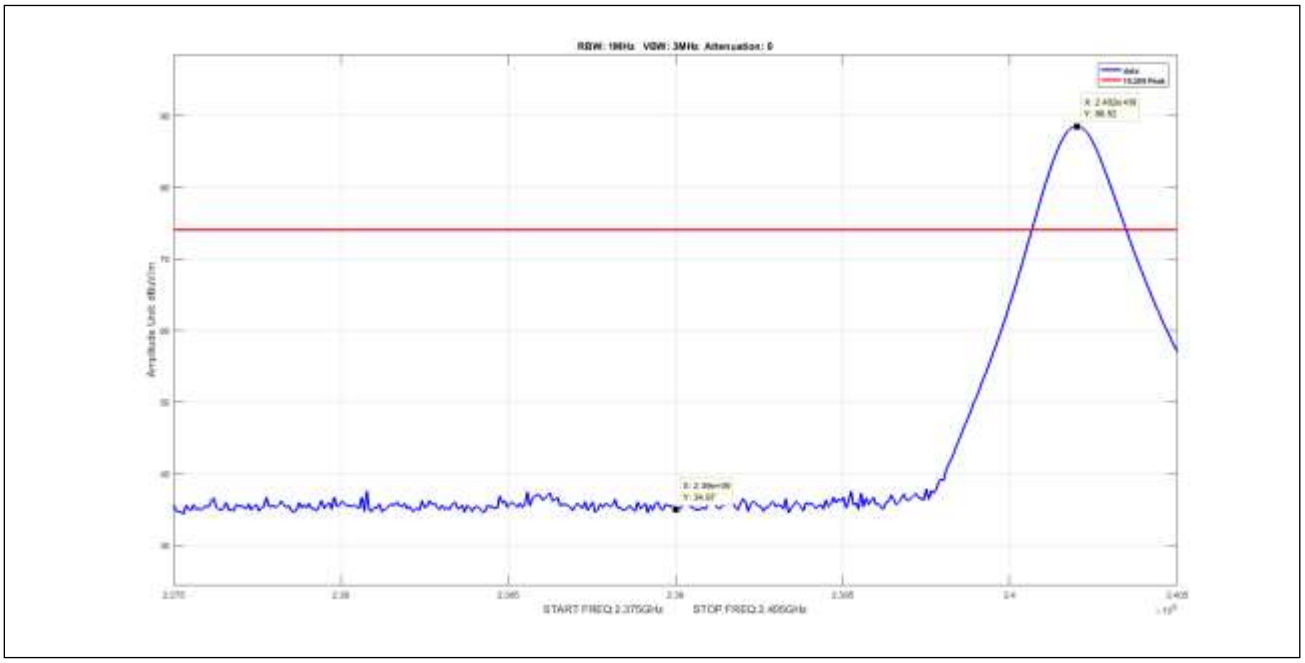
Plot 92. Radiated Emissions, peak, hopping, bandedge, DH5, 2480



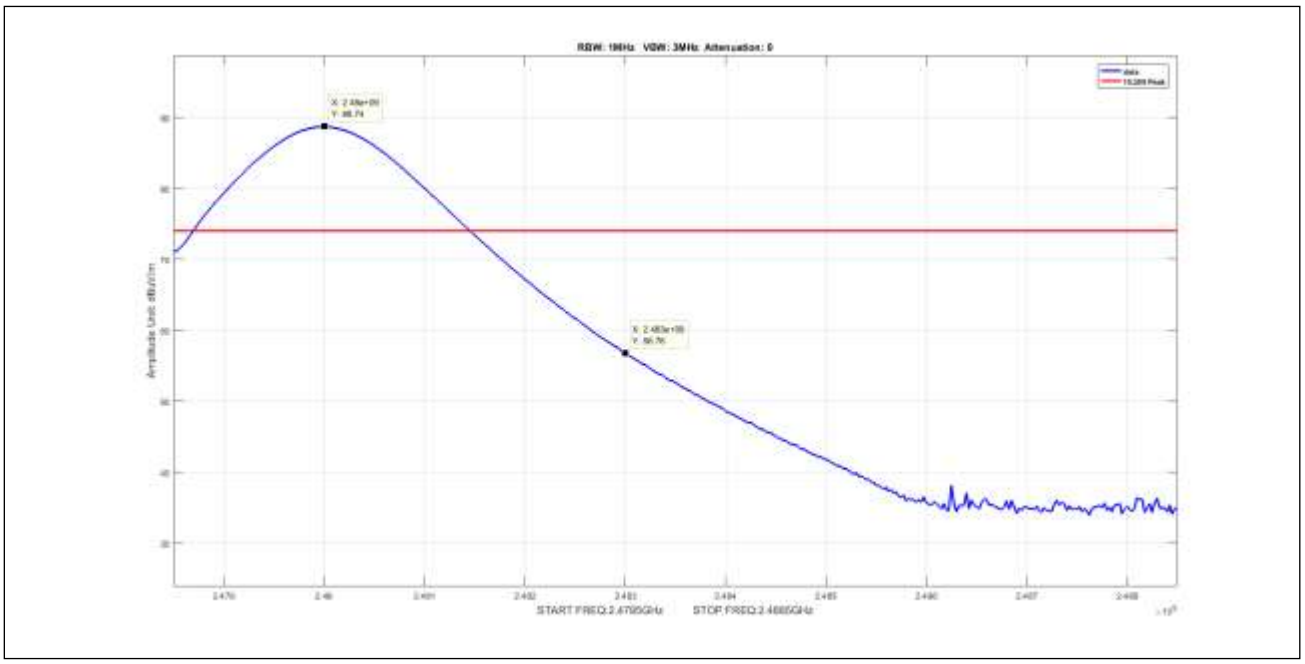
Plot 93. Radiated Emissions, peak, non hopping, bandedge, DH1, 2402



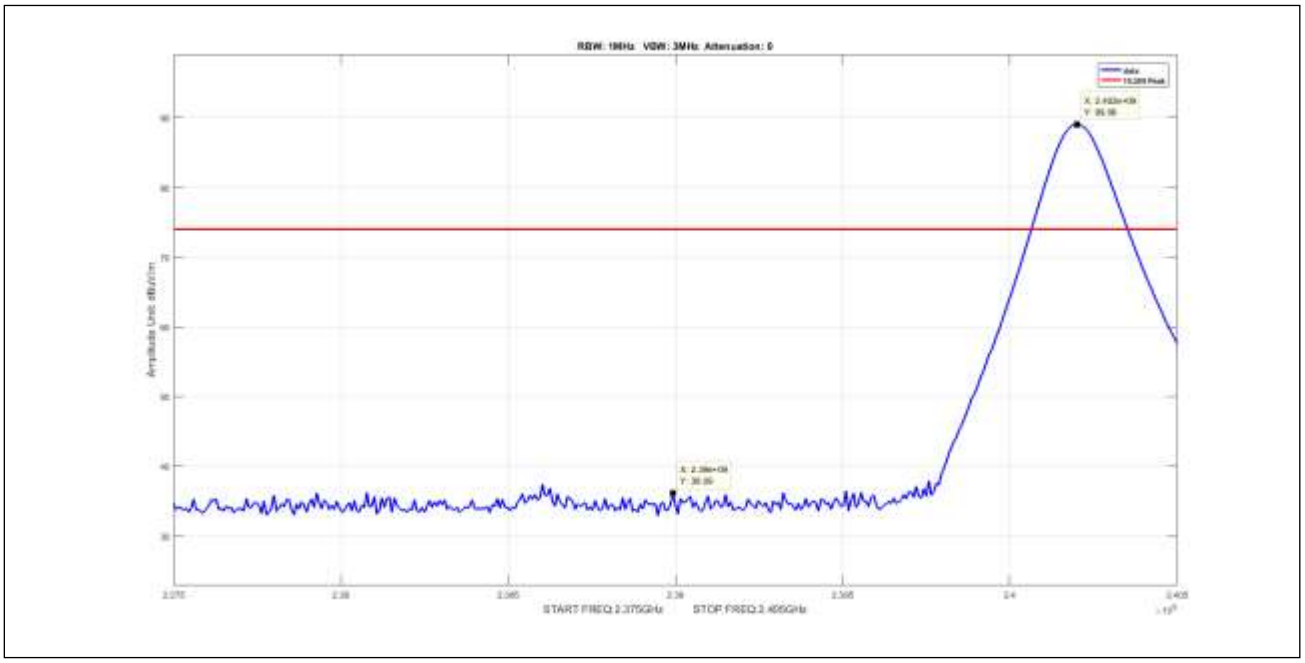
Plot 94. Radiated Emissions, peak, non hopping, bandedge, DH1, 2480



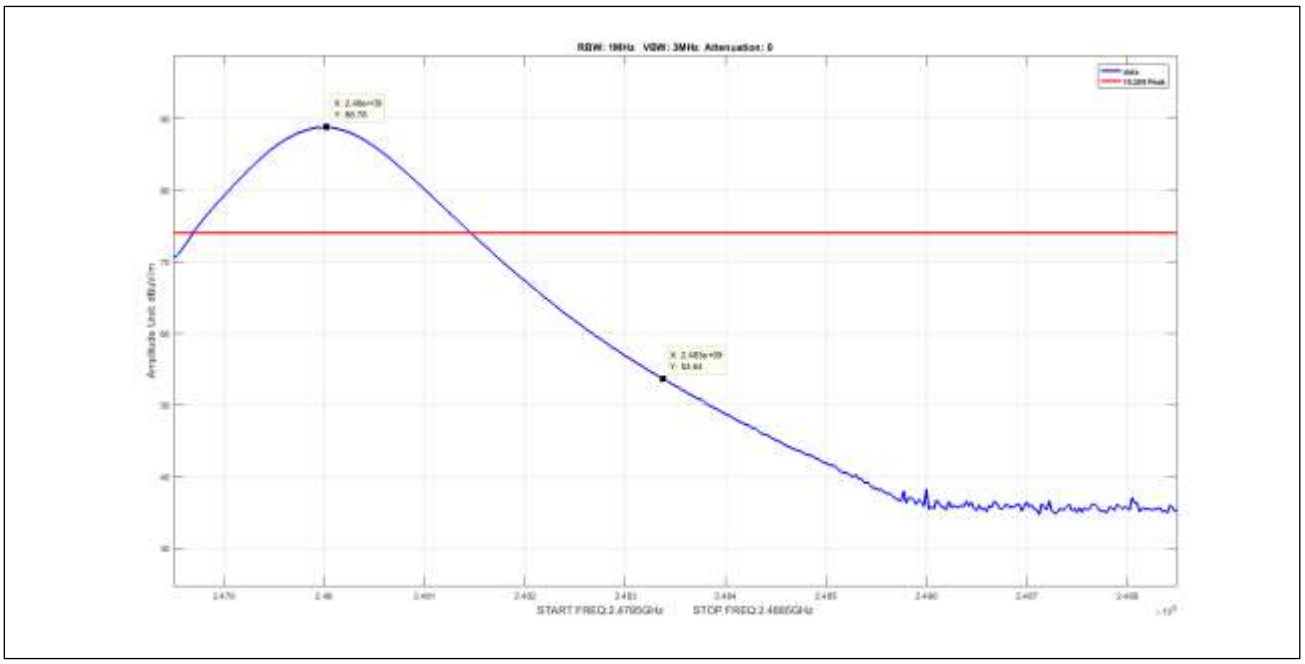
Plot 95. Radiated Emissions, peak, non hopping, bandedge, DH3, 2402



Plot 96. Radiated Emissions, peak, non hopping, bandedge, DH3, 2480

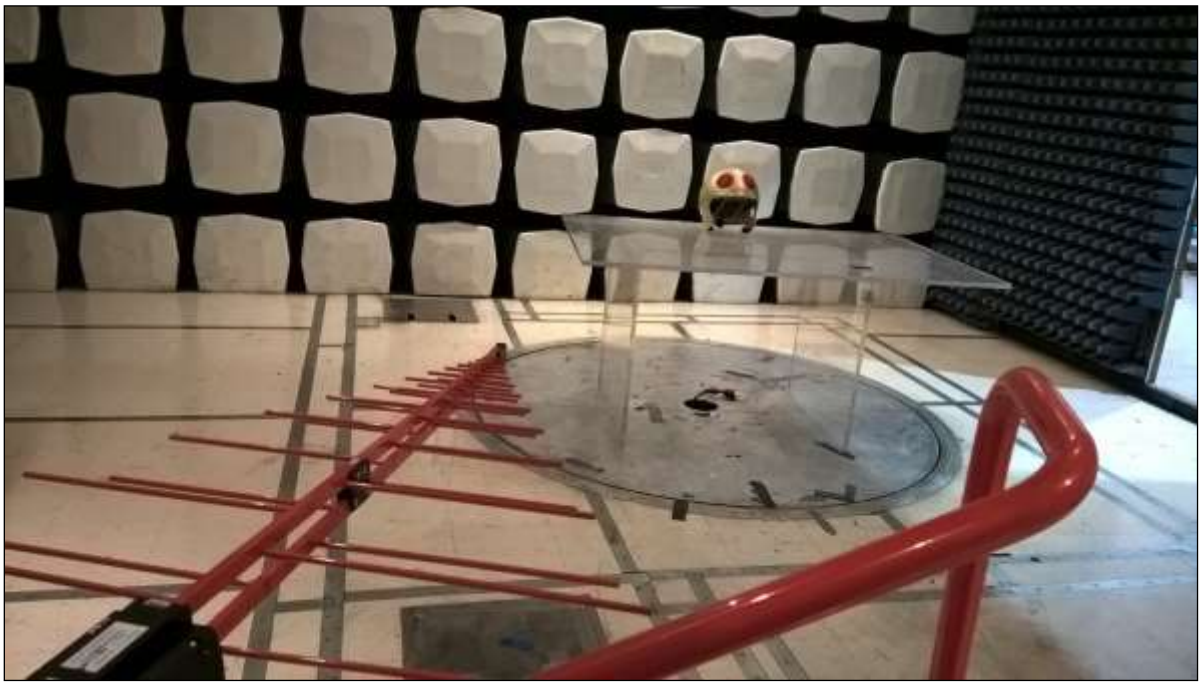


Plot 97. Radiated Emissions, peak, non hopping, bandedge, DH5, 2402

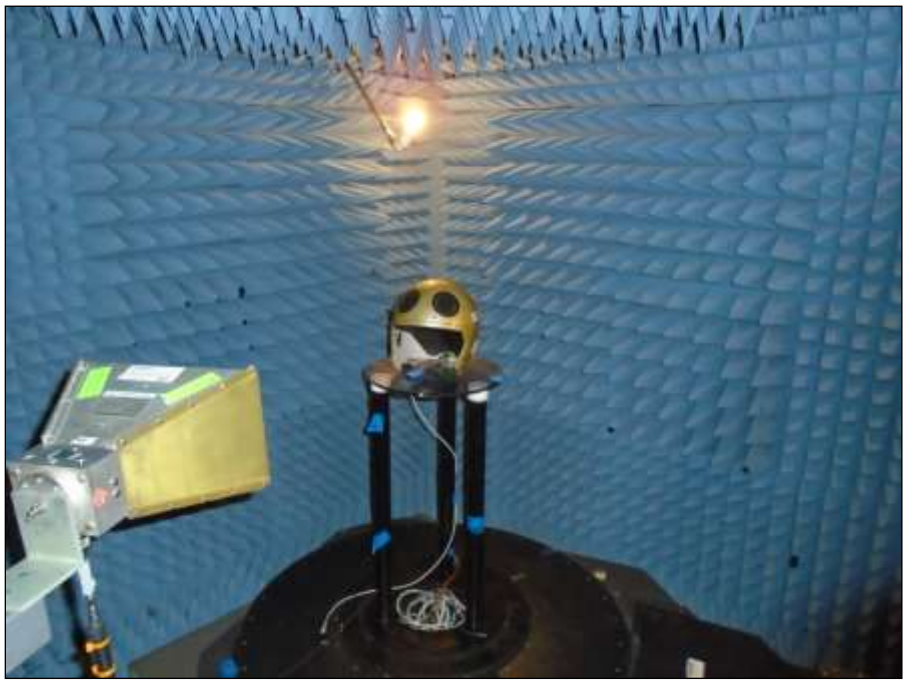


Plot 98. Radiated Emissions, peak, non hopping, bandedge, DH5, 2480

Radiated Spurious Emissions Test Setup



Plot 99. Radiated Emissions, below 1 GHz setup



Photograph 2. Radiated Emissions, above 1 GHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) RF Conducted Spurious Emissions Requirements and Band Edge

Test Requirement: **15.247(d)** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Test Procedure: For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

Since the EUT had an integral antenna, conducted measurements could not be performed. Measurements needed to be taken radiated. An antenna was located 3 m away from the EUT and plots were taken. The EUT was rotated through all three orthogonal axes. The plots were corrected for both antenna correction factor and cable lost.

See following pages for detailed test results with RF Conducted Spurious Emissions.

Test Results: The EUT was compliant with the Conducted Spurious Emission limits of **§15.247(d)**. Measured emissions were within applicable limits.

Test Engineer(s): Surendra Shrestha

Test Date(s): October 9, 2017

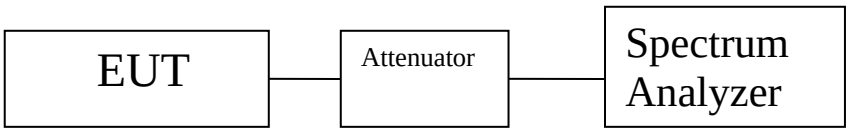
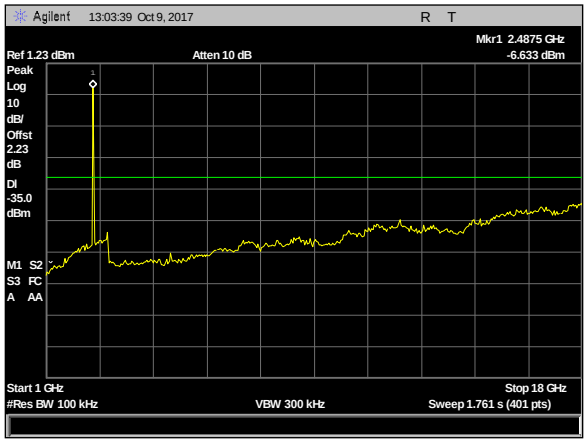
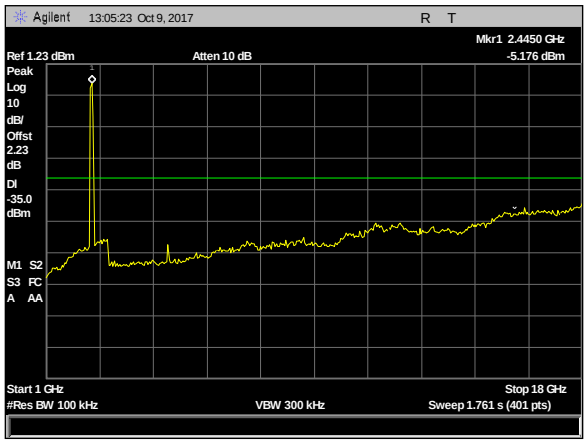


Figure 4. Block Diagram, Conducted Spurious Emissions Test Setup

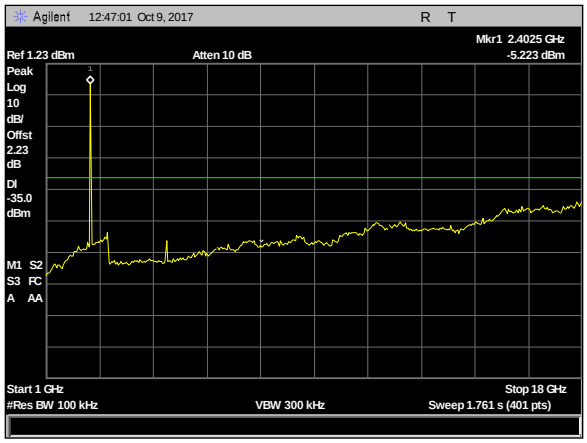
Conducted Spurious Emissions Test Results



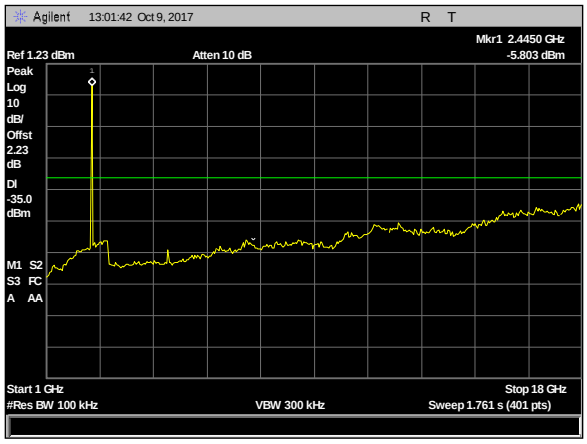
Plot 100. Conducted Spurious Emissions, DH1, high, non hopping



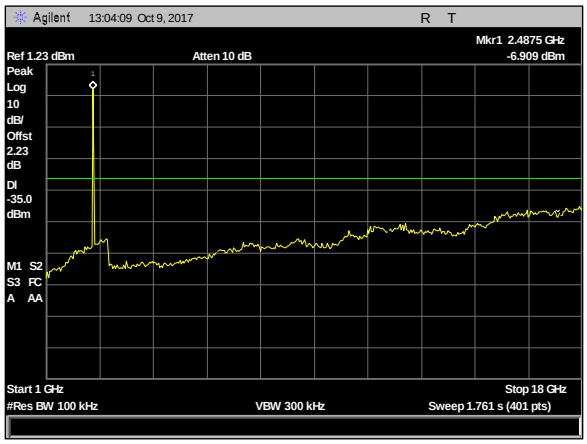
Plot 101. Conducted Spurious Emissions, DH1, hopping



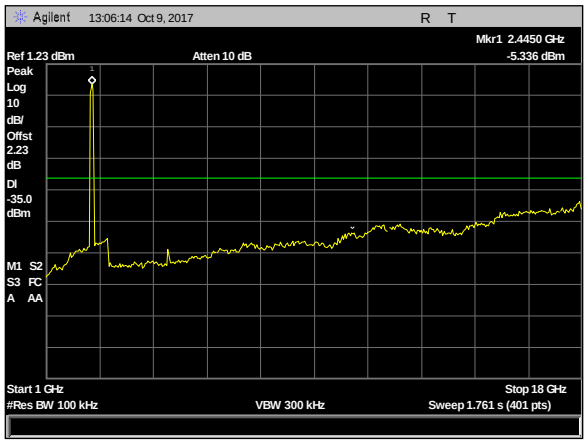
Plot 102. Conducted Spurious Emissions, DH1, low, non hopping



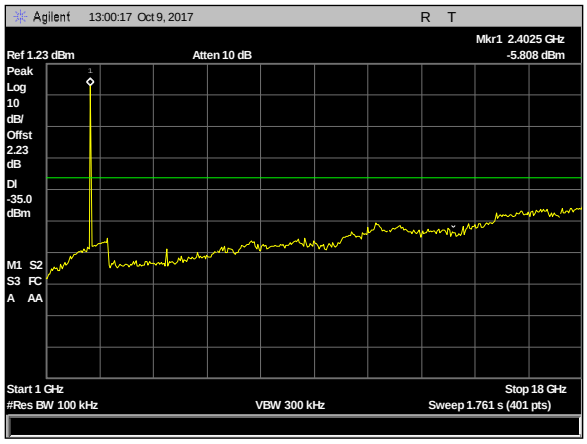
Plot 103. Conducted Spurious Emissions, DH1, mid, non hopping



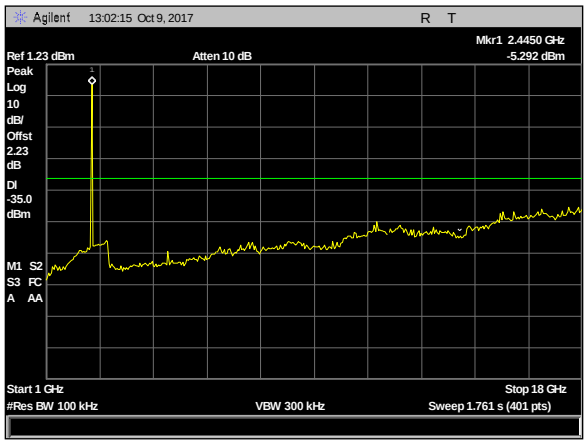
Plot 104. Conducted Spurious Emissions, DH3, high, non hopping



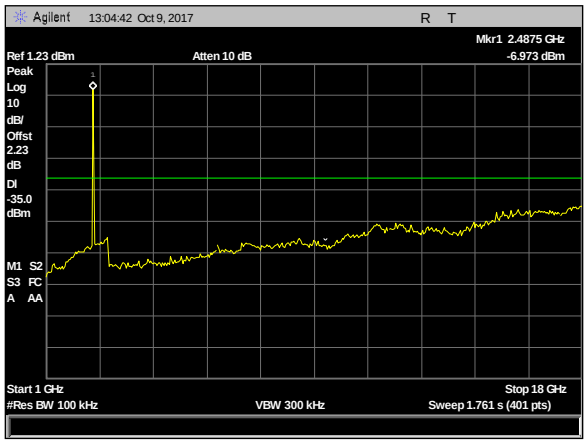
Plot 105. Conducted Spurious Emissions, DH3, hopping



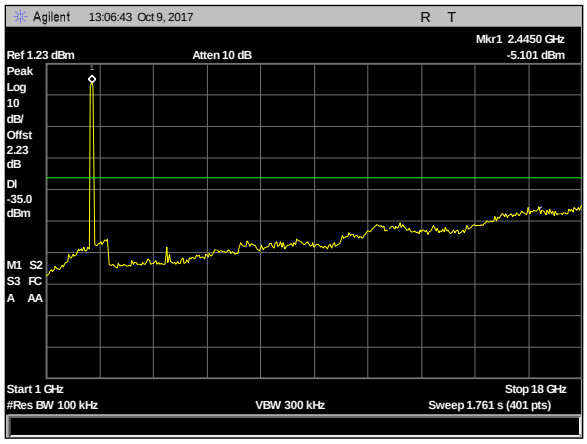
Plot 106. Conducted Spurious Emissions, DH3, low, non hopping



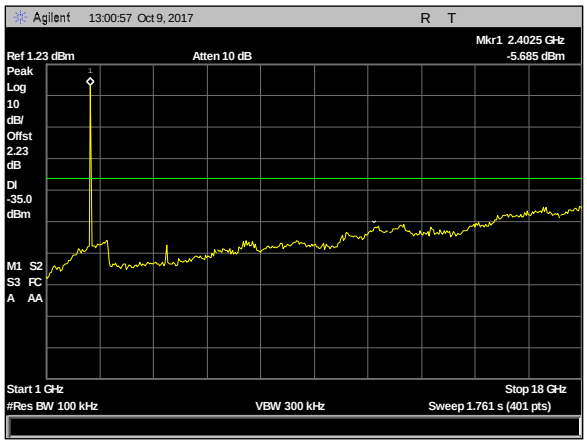
Plot 107. Conducted Spurious Emissions, DH3, mid, non hopping



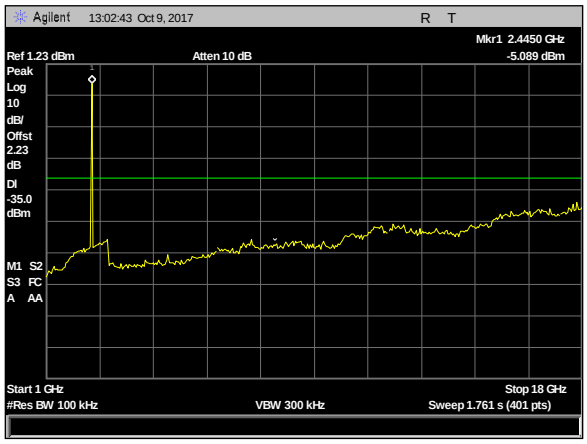
Plot 108. Conducted Spurious Emissions, DH5, high, non hopping



Plot 109. Conducted Spurious Emissions, DH5, hopping



Plot 110. Conducted Spurious Emissions, DH5, low, non hopping



Plot 111. Conducted Spurious Emissions, DH5, mid, non hopping

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(i) RF Exposure

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.

SAR Exemption Equation			
Channel	**Mode**	**Conducted Power(dBm)**	**Target Power(dBm)**
Channel 0	DH1	-5.376	8
Channel 39	DH1	-5.613	7.7
Channel 78	DH1	-6.646	7.3
Channel 0	DH3	-5.475	8
Channel 39	DH3	-5.431	7.7
Channel 78	DH3	-6.943	7.3
Channel 0	DH5	-5.293	8
Channel 39	DH5	-5.451	7.7
Channel 78	DH5	-6.697	7.3

Note 1: Antenna gain has not been added to the above values.

The highest power for 2.4 GHz is 0.296 mW. Below is the SAR exclusion equation from KDB 447498:

$$\frac{Max\ Power\ of\ Channel\ (mW)}{Test\ Separation\ Dist\ (mm)} * \sqrt{Frequency(GHz)} \leq 3.0$$

For BT Basic (1 mbps) : Target = 8 dBm + 1dBm = 9 dBm = 7.94 mW

(7.94 mW/ 9.1mm)*√2.4 = 0.563

Therefore BT channels are exempt from SAR testing.

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.

Asset	Equipment	Manufacturer	Model	Calibration Date	Calibration Due Date
1T4300A	SEMI-ANECHOIC CHAMBER # 1 (FCC)	EMC TEST SYSTEMS	NONE	01/31/2016	01/31/2019
1T4753	Antenna - Bilog	Sunol Sciences	JB6	10/24/2016	04/24/2018
1T4409	EMI Receiver	Rohde & Schwarz	ESIB7	12/07/2016	12/07/2018
1T4878	LISN	Com-Power	LI-150A	08/11/2017	08/11/2018
1T8908	LISN	Com-Power	LI-150C	03/15/2018	03/15/2019
1T2665	Antenna; Horn	EMCO	3115	06/22/2017	12/22/2018
1T4442	Pre-amplifier, Microwave	Miteq	AFS42-01001800-30-10P	Functional Verify	
1T4149	High-Frequency Anechoic Chamber	Ray Proof	81	08/23/2001	08/23/2002
1T4612	Spectrum Analyzer	Agilent Technologies	E4407B	03/30/2017	09/30/2018

Table 16. 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

A. 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

1. 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.

End of Report

