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November 27, 2018

NoiseAware
2800 Routh Street STE. 215
Dallas, TX 75201

Dear Jake Umbrage,

Enclosed is the EMC Wireless test report for compliance testing of the NoiseAware, Gen 3 Collector as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), 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: (\NoiseAware\EMCA100836A-FCC247 DSS Rev. 2)

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ACCREDITED
TESTING CERT #0591.06

Electromagnetic Compatibility Criteria
Test Report

for the

NoiseAware
Gen 3 Collector

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

MET Report: EMCA100386A-FCC247 DSS Rev. 2

November 27, 2018

Prepared For:

NoiseAware
2800 Routh Street STE. 215
Dallas, TX 75201

Prepared By:
MET Laboratories, Inc.
13501 McCallen Pass
Austin, TX 78753

Electromagnetic Compatibility Criteria
Test Report

for the

NoiseAware
Gen 3 Collector

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

Giuliano Messina, 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 Part 15.247 under normal use and maintenance.

John Mason,
Director, Electromagnetic Compatibility Lab

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Report Status Sheet

Revision	Report Date	Reason for Revision
∅	November 27, 2018	Initial Issue.
1	January 26, 2019	TCB Corrections
2	January 30, 2019	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

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I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the NoiseAware Gen 3 Collector, 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 Gen 3 Collector. NoiseAware should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Gen 3 Collector, 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 NoiseAware, purchase order number 180910-1. All tests were conducted using measurement procedure ANSI C63.10-2013.

FCC Reference 47 CFR Part 15.247	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(e)	Power Density	Not Applicable
Title 47 of the CFR, Part 15 §15.247(g) & (h)	Declaration Statements for FHSS	Compliant
Title 47 of the CFR, Part 15 §15.247(i)	Maximum Permissible Exposure (MPE)	Compliant

Table 1. Executive Summary of EMC Part 15.247 Compliance Testing

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by NoiseAware to perform testing on the Gen 3 Collector, under NoiseAware's purchase order number 180910-1.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the NoiseAware, Gen 3 Collector.

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

Model(s) Tested:	Gen 3 Collector	
Model(s) Covered:	Gen 3 Collector	
EUT Specifications:	Primary Power: 120 VAC 50 Hz	
	FCC ID: 2AQIP-NA3N101	
	Type of Modulations:	DHICF
	Equipment Code:	DSS
	Peak RF Output Power:	-9.65 dBm
	EUT Frequency Ranges:	902.2-927.8 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	
Evaluated by:	Giuliano Messina	
Report Date(s):	November 27, 2018	

Table 2. EUT Summary Table

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 C63.4:2003	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 C63.10-2009	American National Standard for Testing Unlicensed Wireless Devices

Table 3. References

C. Test Site

All testing was performed at MET Laboratories, Inc., 13501 McCallen Pass, Austin, TX 78753. 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 10 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	±2.97 dB	2	95%
RF Power Radiated Emissions, <1 GHz	±2.95 dB	2	95%
RF Power Radiated Emissions, >1 GHz	±3.54 dB	2	95%

Table 4. Uncertainty Calculations Summary

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E. Description of Test Sample

The NoiseAware Gen 3 Collector, Equipment Under Test (EUT), is separated into two components:

Gen 3 Collector: The NoiseAware Indoor Noise Sensor is a WiFi-enabled noise monitoring device that mounts to most common US power outlets with an included screw. The device monitors volume levels and also acts as a gateway for the Outdoor Noise Sensor (Gen 3 Node), receiving data over Sub-1 GHz and relaying it over WiFi. It is intended to be used by professional property managers in indoor areas of short-term rental residences.

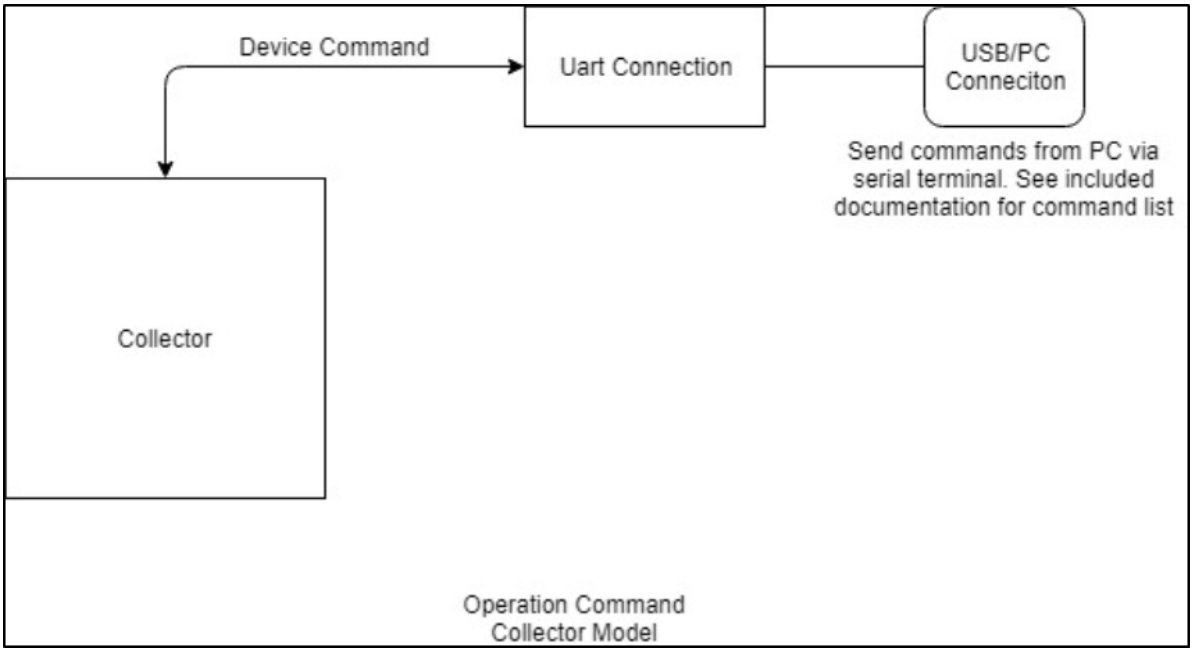

Figure 1. Block Diagram of Test Configuration

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	Revision
N/A	N/A	Gen 3 Collector "UART"	NA3N101	N/A	N/A	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
N/A	Laptop	Asus	TP200S	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. Mode of Operation

The EUT was set to transmit at the required frequency. Channel, power, and mode were controllable via UART connection to a laptop.

I. Method of Monitoring EUT Operation

The EUT transmitting frequency was monitored via EMI receiver. While the device is powered, the LED indicator at the rear of the device indicates two modes of operation: 1) During normal operation the LED is off. 2) During setup mode the LED will blink periodically to indicate it is broadcasting a discoverable AP.

J. 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.

K. Disposition of EUT

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

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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 utilizes an integrated antenna.

Test Engineer(s): Giuliano Messina

Test Date(s): September 21, 2018

Gain	Type	Model	Manufacturer
1 dBi	Ceramic (Chip)	0915AT43A0026E	Johanson Technology

Table 7. 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 Ω 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 - 0.5	66 - 56	56 - 46
0.5 - 5	56	46
5 - 30	60	50

Table 8. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Note: *Decreases with the logarithm of the frequency.

Test Procedure: The EUT was placed on a 0.8 m-high wooden table above a ground plane. 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 C63.4-2014 "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 EMI receiver. For the purpose of this testing, the transmitter was turned on.

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

Test Engineer(s): Giuliano Messina

Test Date(s): September 21, 2018

15.207(a) Conducted Emissions Test Results

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
ACLine - 900MHz	0.150	57.8	66	-8.2	Pass	38.2	56	-17.8	Pass
ACLine - 900MHz	0.194	51.6	63.869	-12.269	Pass	34.8	53.869	-19.069	Pass
ACLine - 900MHz	0.238	48.5	62.176	-13.676	Pass	34.3	52.176	-17.876	Pass
ACLine - 900MHz	0.594	41.6	56	-14.4	Pass	27.9	46	-18.1	Pass
ACLine - 900MHz	1.838	37.8	56	-18.2	Pass	27.2	46	-18.8	Pass
ACLine - 900MHz	26.082	47	60	-13	Pass	38.2	50	-11.8	Pass
ACNeutral - 900MHz	0.154	55.2	65.782	-10.582	Pass	34.9	55.782	-20.882	Pass
ACNeutral - 900MHz	0.186	52.6	64.218	-11.618	Pass	37.4	54.218	-16.818	Pass
ACNeutral - 900MHz	0.218	40.6	62.903	-22.303	Pass	25.6	52.903	-27.303	Pass
ACNeutral - 900MHz	0.650	38	56	-18	Pass	28.3	46	-17.7	Pass
ACNeutral - 900MHz	23.582	36.6	60	-23.4	Pass	25.9	50	-24.1	Pass
ACNeutral - 900MHz	26.038	49.2	60	-10.8	Pass	39.4	50	-10.6	Pass

Table 9. Conducted Emissions, 15.207(a), Test Results

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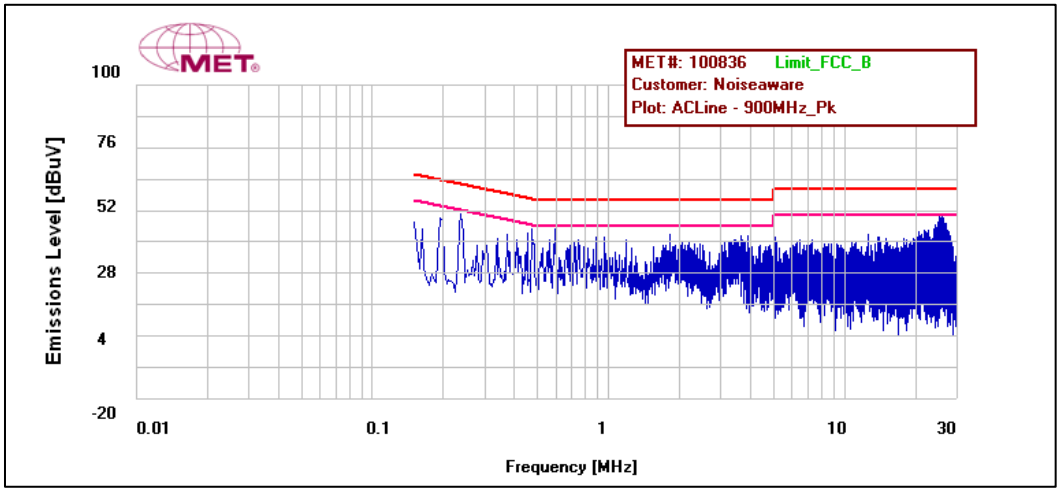
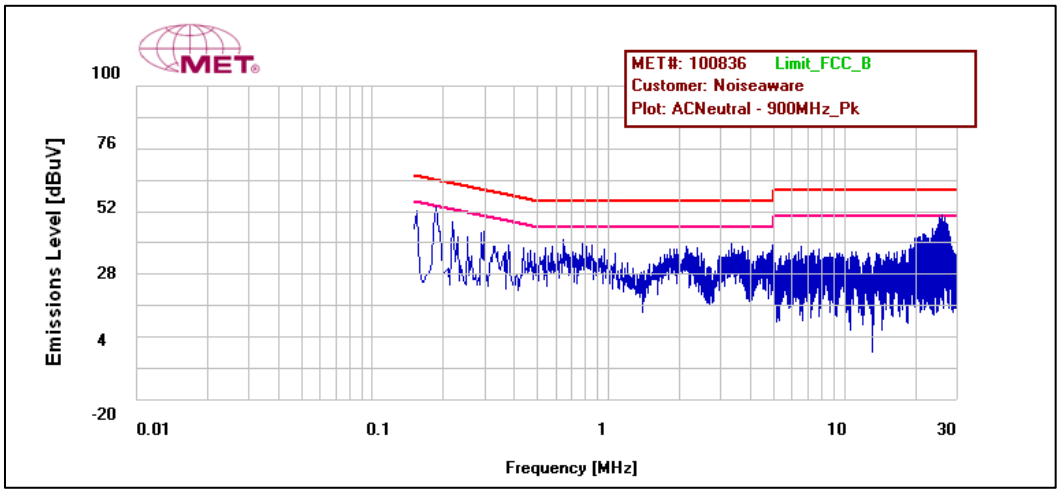


Plot 1. Conducted Emissions, 15.207(a), Phase Line



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

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.

The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

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

Test Results The EUT was compliant with § 15.247 (a)(2).

Test Engineer(s): Giuliano Messina

Test Date(s): September 27, 2018

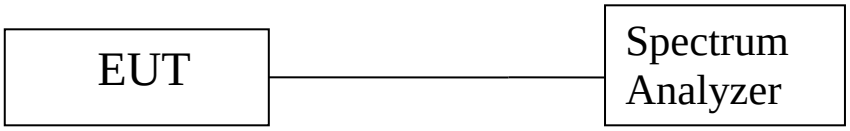
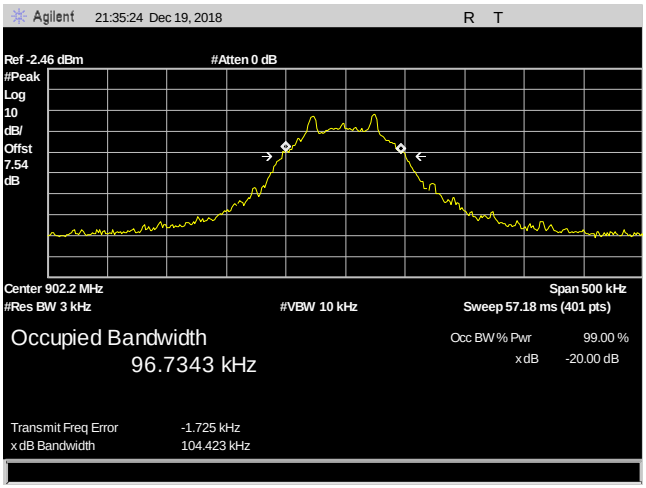
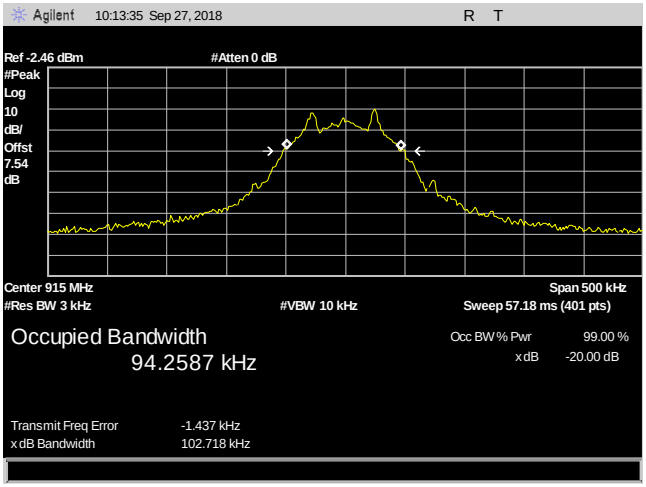


Figure 2. Block Diagram, Occupied Bandwidth Test Setup

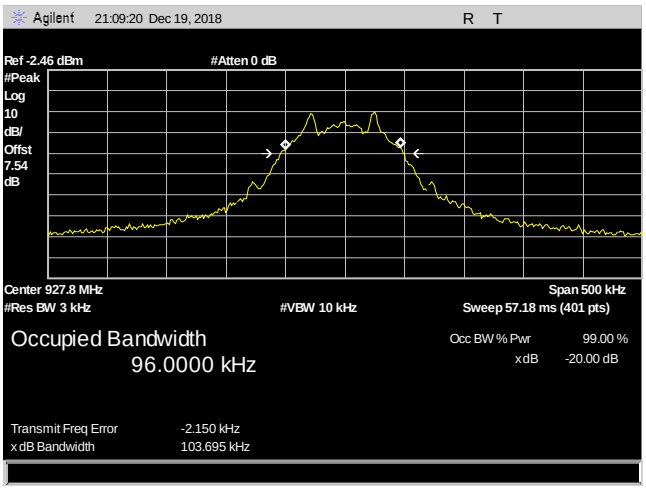
20 dB Occupied Bandwidth Test Results



Plot 3. 20 dB Occupied Bandwidth, 902.2 MHz



Plot 4. 20 dB Occupied Bandwidth, 915 MHz



Plot 5. 20 dB Occupied Bandwidth, 927.8 MHz

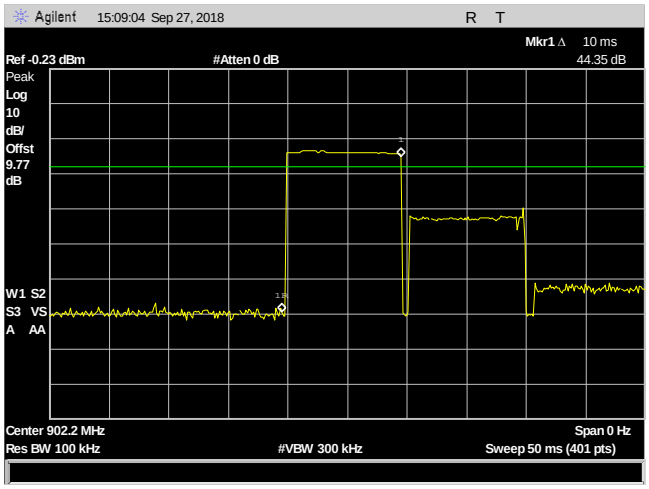
Electromagnetic Compatibility Criteria for Intentional Radiators

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

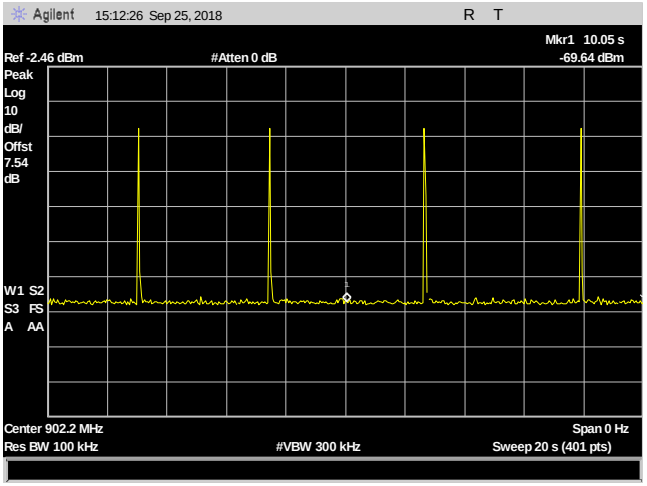
Requirements: For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Dwell Time

Test Results: The total observed dwell time in 20s is 40ms. The EUT was compliant with this requirement.



Plot 6. Dwell Time, Single Pulse, 10 ms

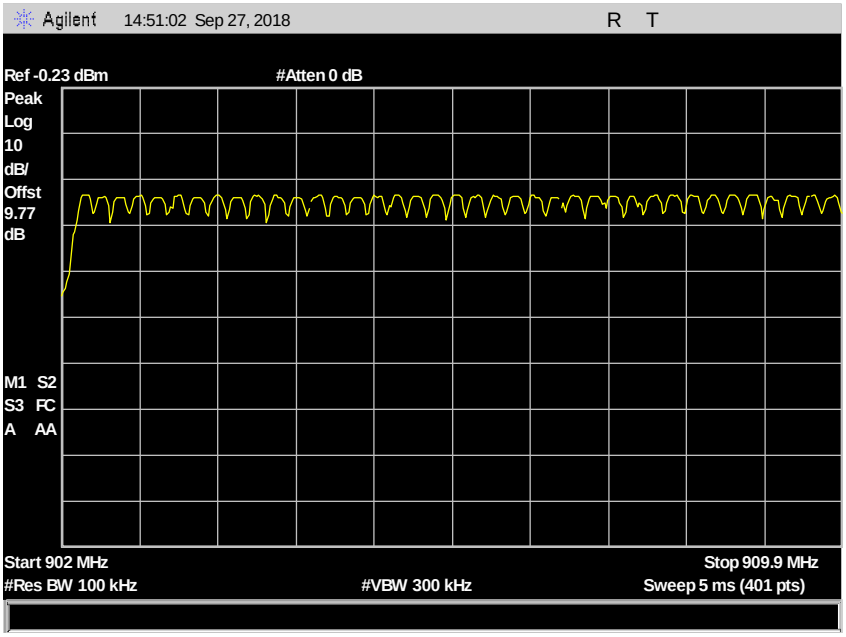


Plot 7. Dwell Time. 20s

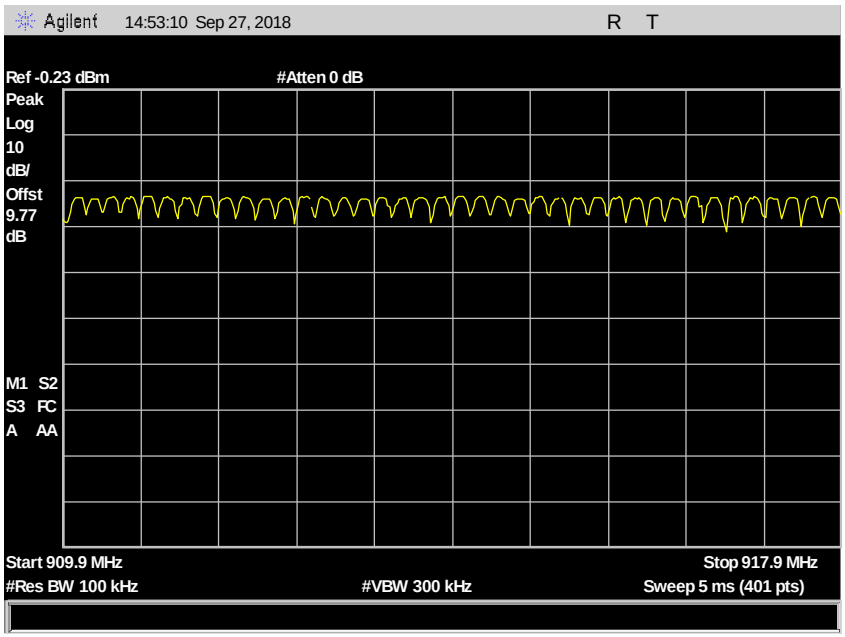
Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(1) Number of RF Channels

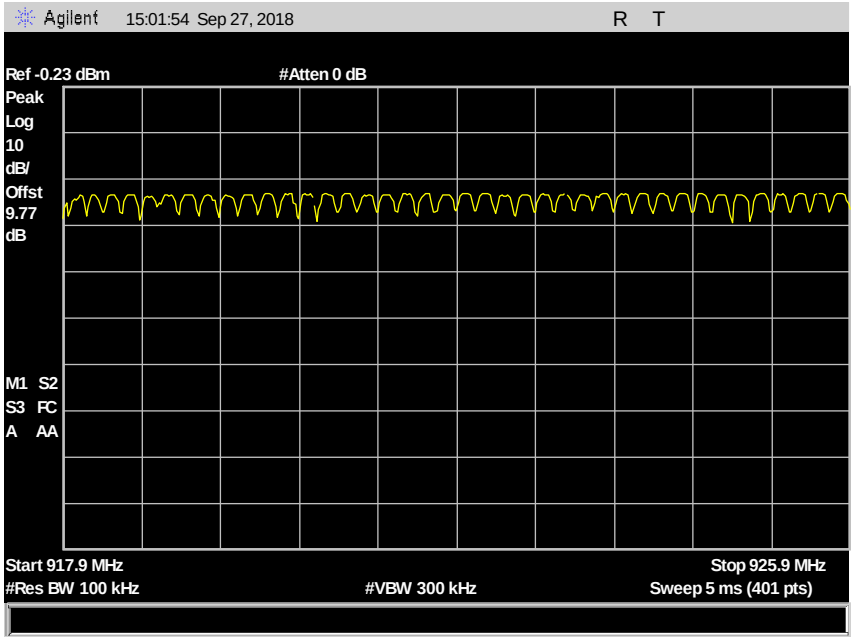
Test Results: Total hopping channels is 129. The EUT meets the specifications of Section 15.247(a) (1) (iii) for Number of Hopping Channels. The EUT was compliant with this requirement.



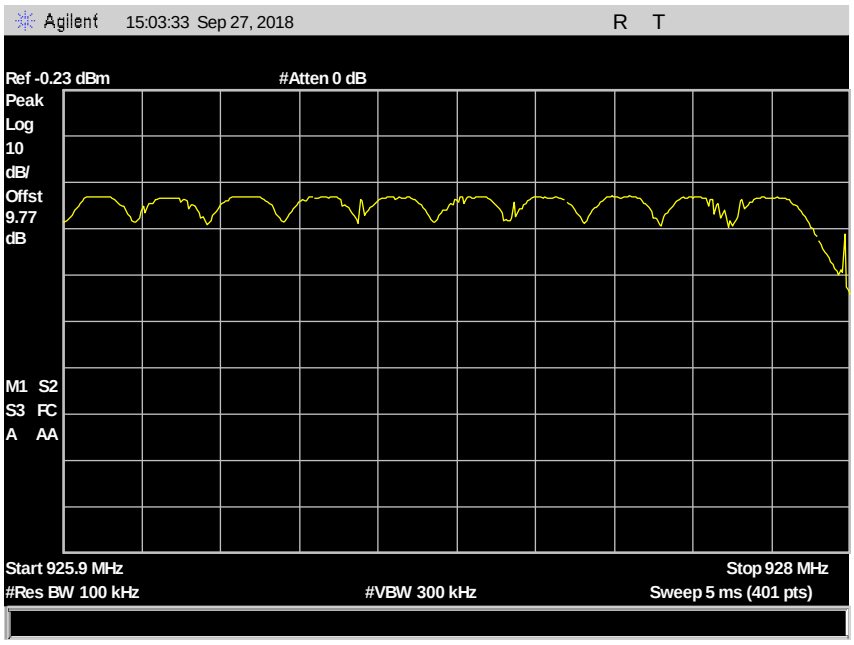
Plot 8. Number of RF Channels, 902 – 909.9 MHz, 39 channels



Plot 9. Number of RF Channels, 909.9 – 917.9 MHz, 40 channels



Plot 10. Number of RF Channels, 917.9 – 925.9 MHz, 40 channels



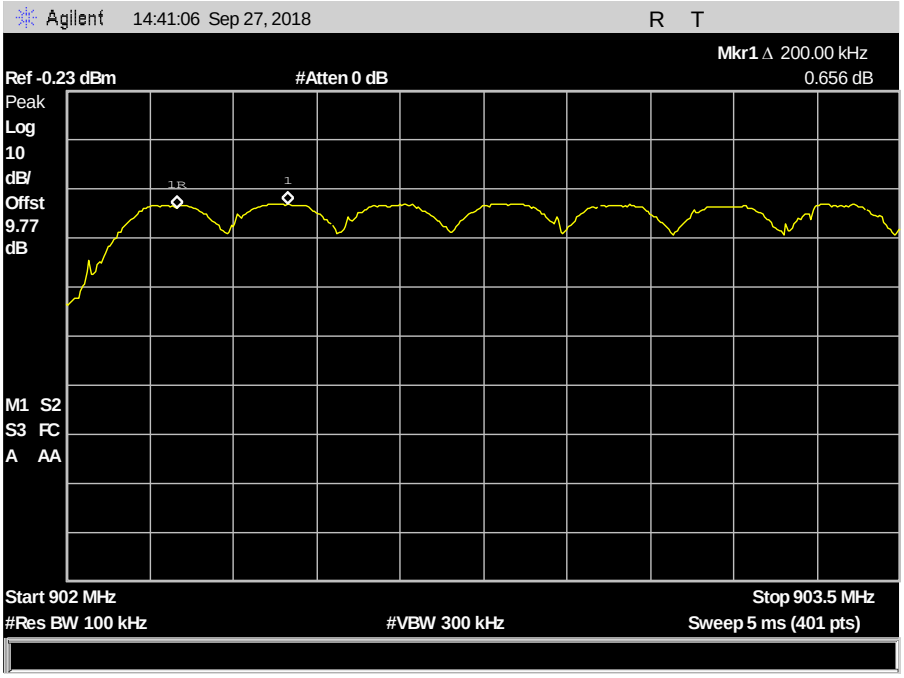
Plot 11. Number of RF Channels, 925.9 – 928 MHz, 10 channels

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.

Test Results: The measured RF channel separation is 200kHz. The EUT was compliant with this requirement.



Plot 12. Channel Separation, 200 kHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output

Test Requirements: **§15.247(b)(2):** For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

Test Procedure: The transmitter was connected to a calibrated spectrum analyzer. The EUT was measured at the low, mid and high channels of each band. The EUT was utilizes a 1dBi Antenna, so the maximum power allowed is 30dBm.

Test Results: The EUT was compliant with the Peak Power Output limits of **§15.247(b)**.

Test Engineer(s): Giuliano Messina

Test Date(s): September 25, 2018

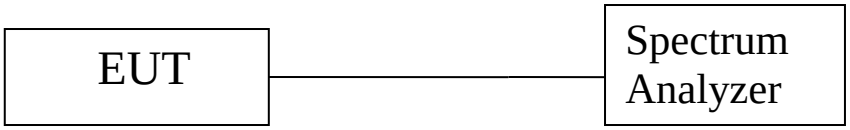


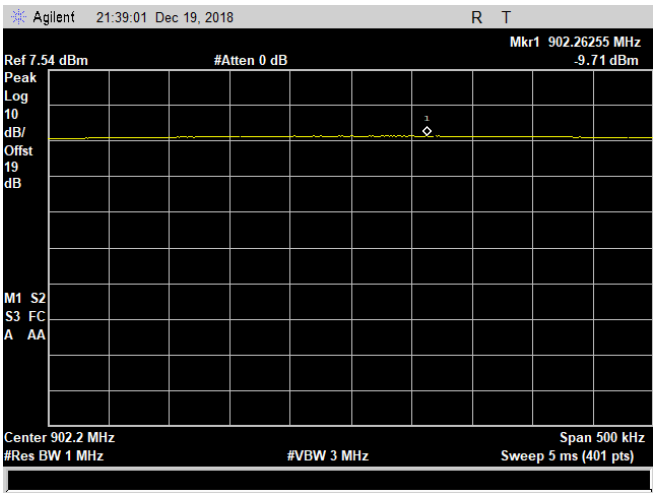
Figure 3. Peak Power Output Test Setup

Peak Power Output Test Results

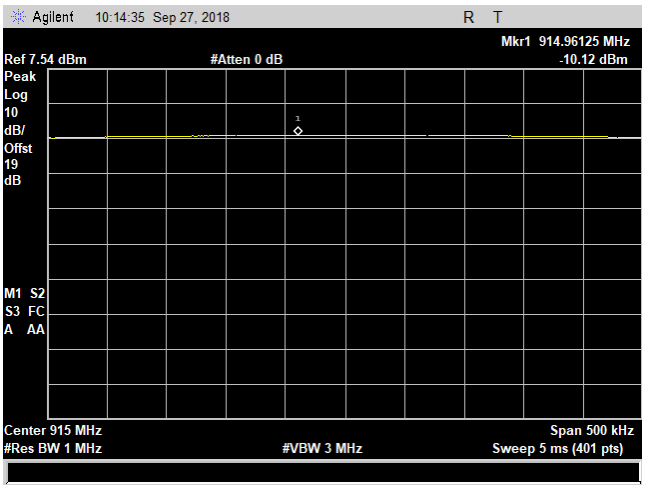
Peak Conducted Output Power		
Carrier Channel	**Frequency (MHz)**	**Measured Peak Output Power dBm**
Low	902.2	-9.71
Mid	915	-10.12
High	927.8	-9.65

Table 10. Peak Power Output, Test Results

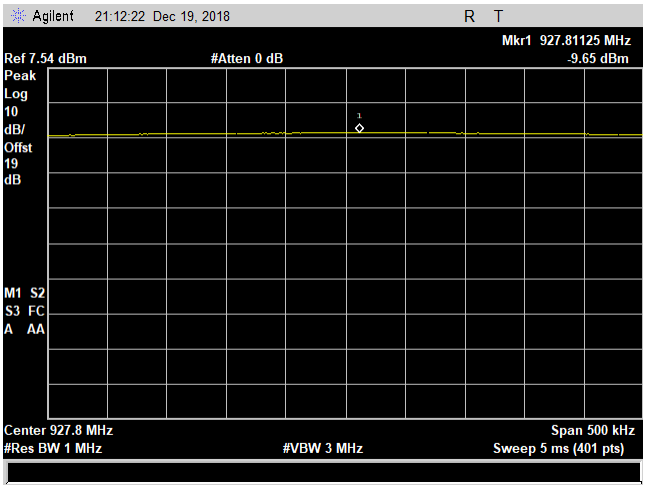
Peak Power Output Test Results



Plot 13. Peak Power Output, 902.2 MHz



Plot 14. Peak Power Output, 915 MHz



Plot 15. Peak Power Output, 927.8 MHz

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 11. 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 12.

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

Test Procedure: The transmitter was set to the low, mid, and high channels at the highest output power and placed on a 0.8 m high wooden table inside in a semi-anechoic chamber. The EUT was placed at 1.5 m high for measurements above 1 GHz. 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.

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.

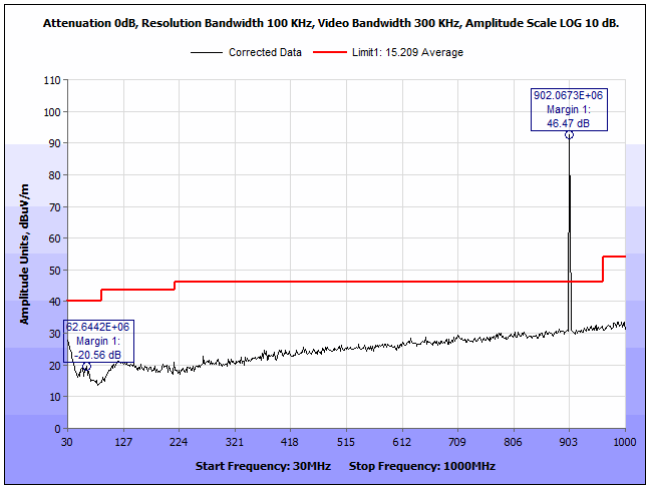
EUT Field Strength Final Amplitude = Raw Amplitude – Preamp gain + Antenna Factor + Cable Loss – Distance Correction Factor

Test Results: The EUT was compliant with the Radiated Spurious Emission limits of **§15.247(d)**. Measured emissions were within applicable limits. Any emissions over the limit were caused by an intentional transmitter and are not subject to the requirements of this section. Emissions at 2400MHz are caused by an intentional bluetooth radiator.

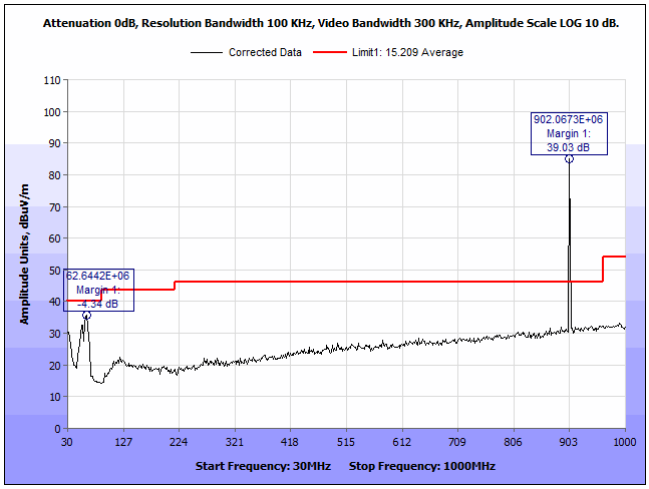
Test Engineer(s): Giuliano Messina

Test Date(s): September 27, 2018

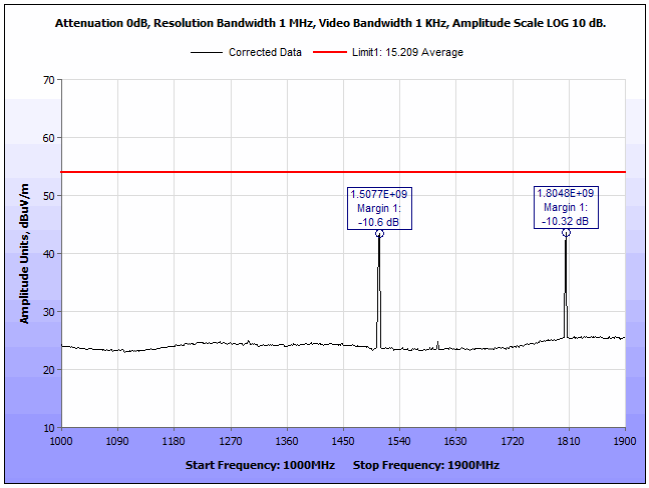
Radiated Spurious Emissions Test Results



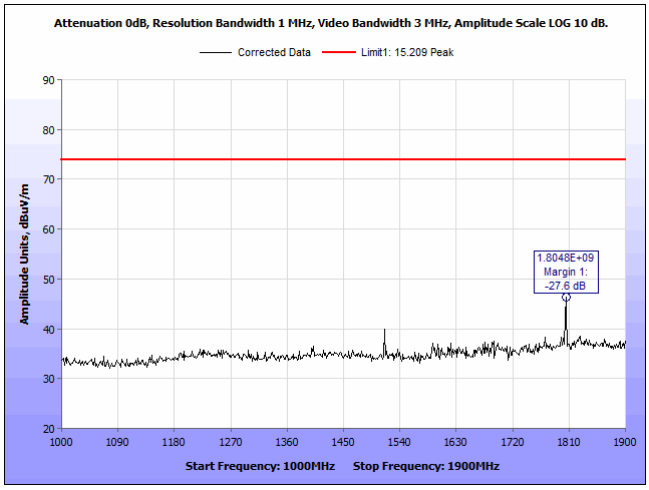
Plot 16. Radiated Spurious Emissions, 902.2 MHz, 30 MHz – 1 GHz, H



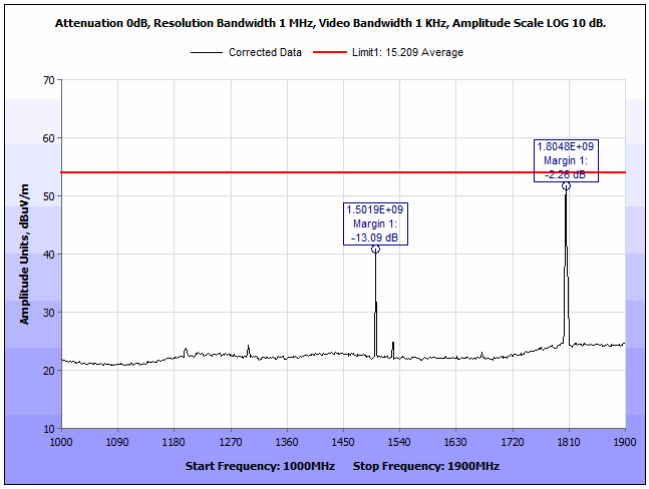
Plot 17. Radiated Spurious Emissions, 902.2 MHz, 30 MHz – 1 GHz, V



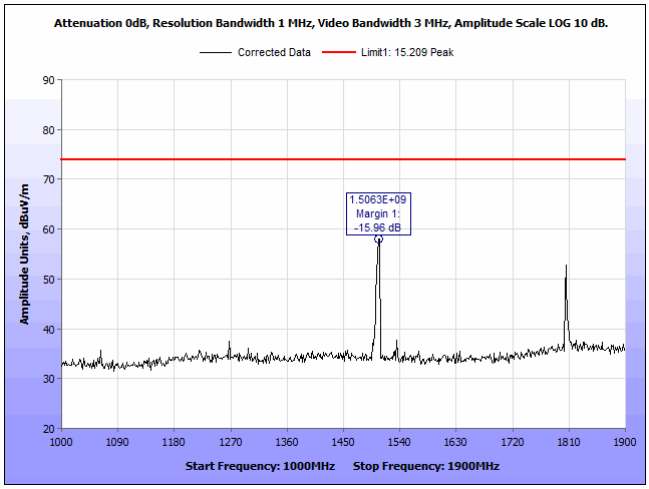
Plot 18. Radiated Spurious Emissions, 902.2 MHz, 1 – 1.9 GHz, H, Average



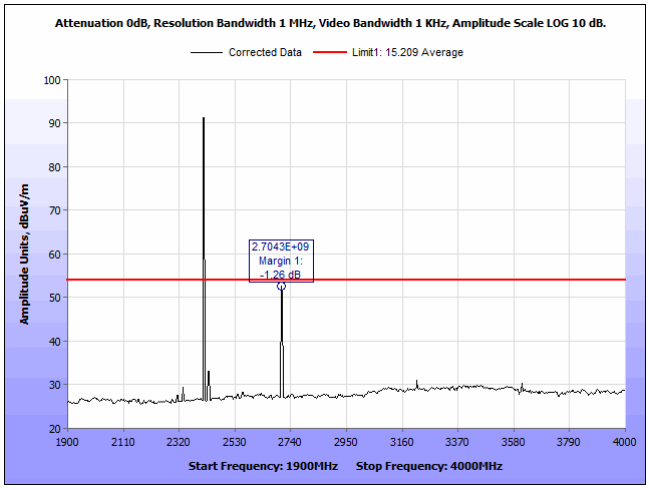
Plot 19. Radiated Spurious Emissions, 902.2 MHz, 1 – 1.9 GHz, H, Peak



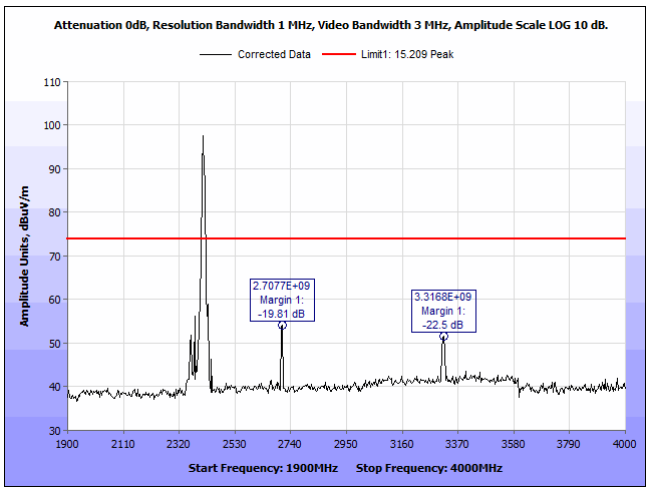
Plot 20. Radiated Spurious Emissions, 902.2 MHz, 1 – 1.9 GHz, V, Average



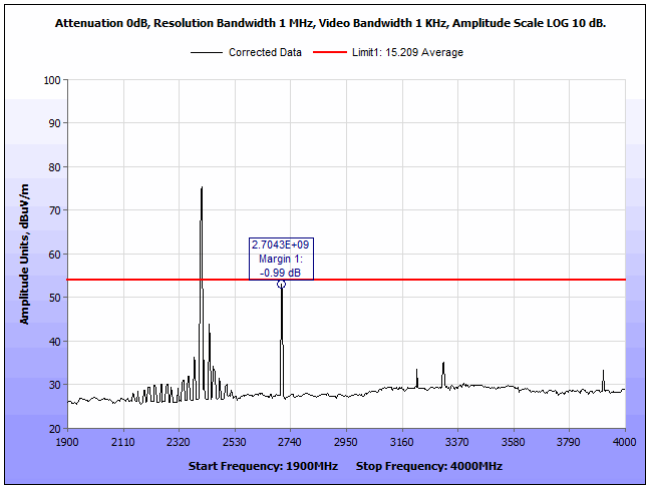
Plot 21. Radiated Spurious Emissions, 902.2 MHz, 1 – 1.9 GHz, V, Peak



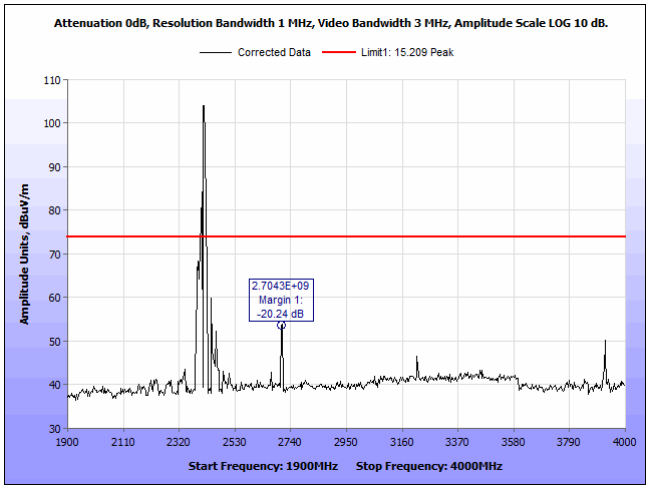
Plot 22. Radiated Spurious Emissions, 902.2 MHz, 1.9 – 4 GHz, H, Average



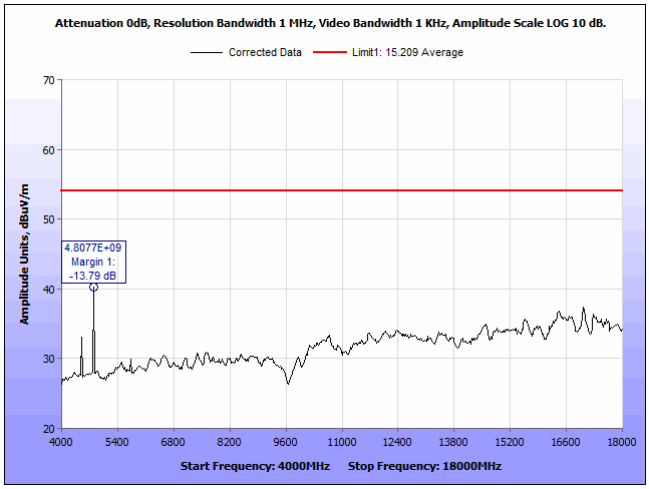
Plot 23. Radiated Spurious Emissions, 902 MHz, 1.9 – 4 GHz, H, Peak



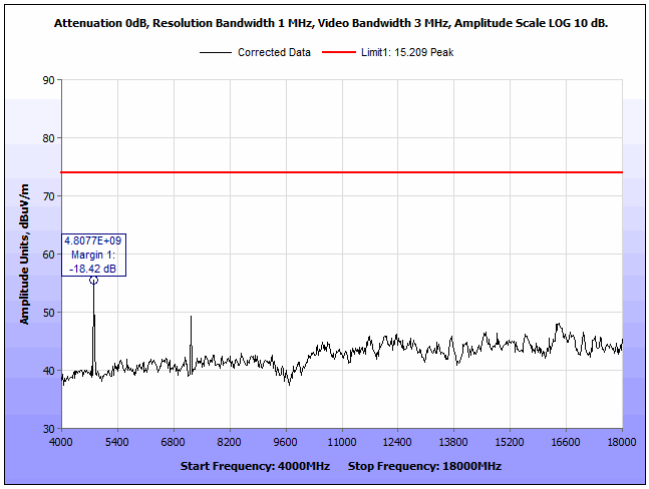
Plot 24. Radiated Spurious Emissions, 902.2 MHz, 1.9 – 4 GHz, V, Average



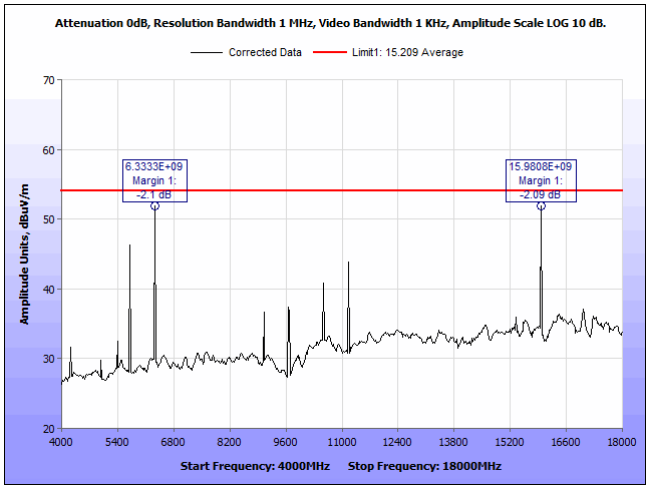
Plot 25. Radiated Spurious Emissions, 902.2 MHz, 1.9 – 4 GHz, V, Peak



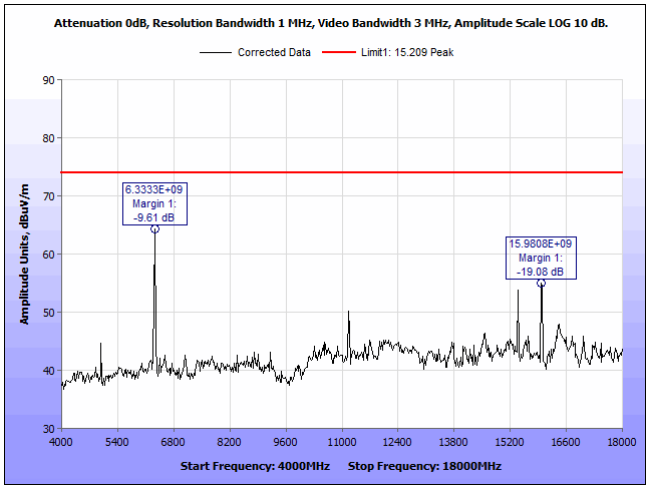
Plot 26. Radiated Spurious Emissions, 902.2 MHz, 4 – 18 GHz, H, Average



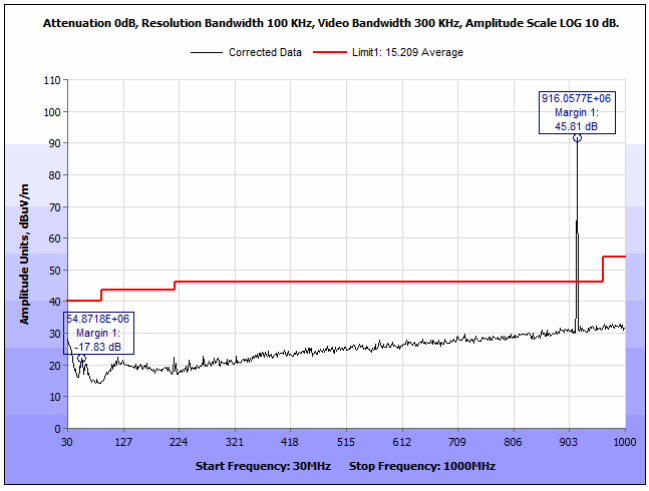
Plot 27. Radiated Spurious Emissions, 902.2 MHz, 4 – 18 GHz, H, Peak



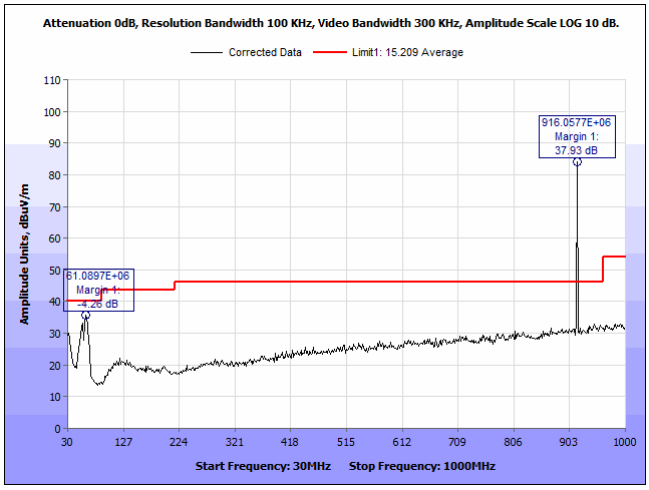
Plot 28. Radiated Spurious Emissions, 902.2 MHz, 4 – 18 GHz, V, Average



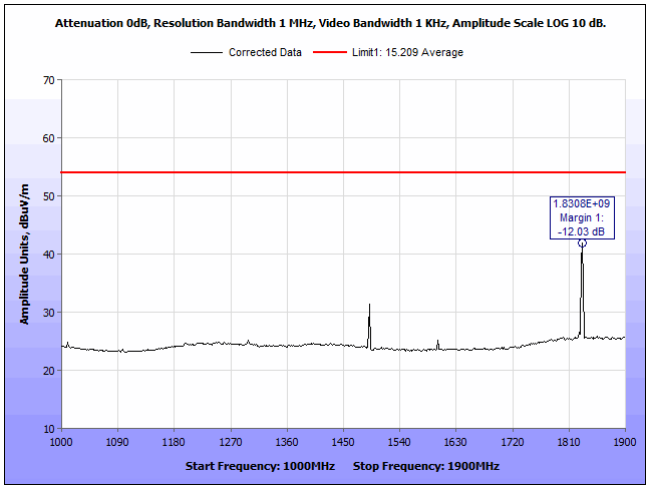
Plot 29. Radiated Spurious Emissions, 902.2 MHz, 4 – 18 GHz, V, Peak



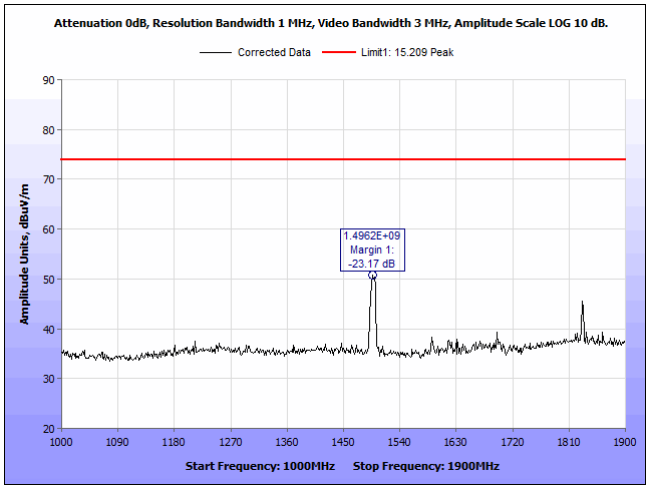
Plot 30. Radiated Spurious Emissions, 915 MHz, 30 MHz – 1 GHz, H



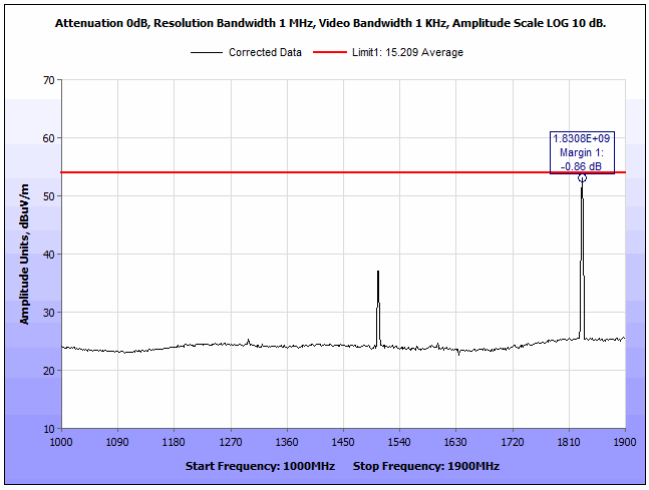
Plot 31. Radiated Spurious Emissions, 915 MHz, 30 MHz – 1 GHz, V



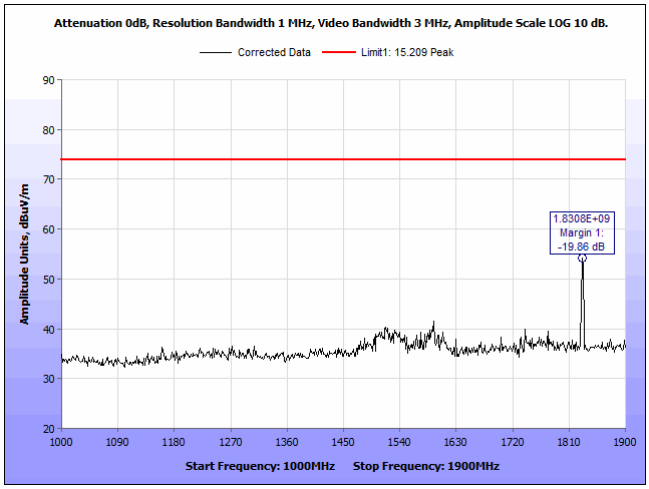
Plot 32. Radiated Spurious Emissions, 915 MHz, 1 – 1.9 GHz, H, Average



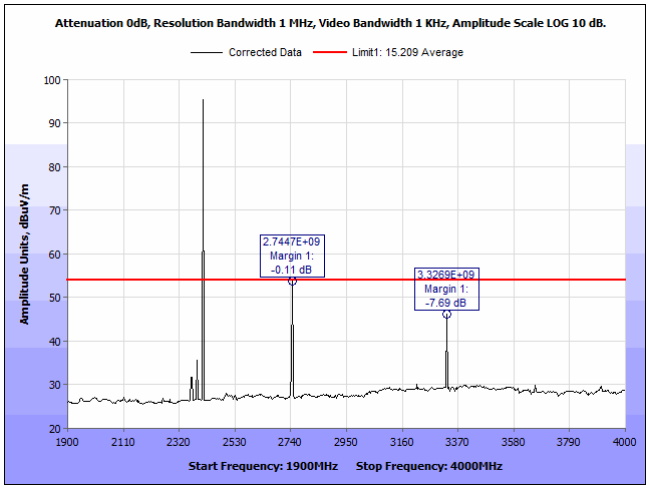
Plot 33. Radiated Spurious Emissions, 915 MHz, 1 – 1.9 GHz, H, Peak



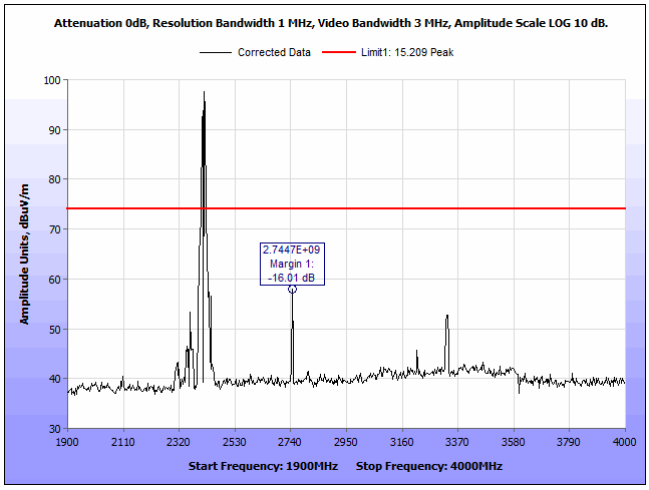
Plot 34. Radiated Spurious Emissions, 915 MHz, 1 – 1.9 GHz, V, Average



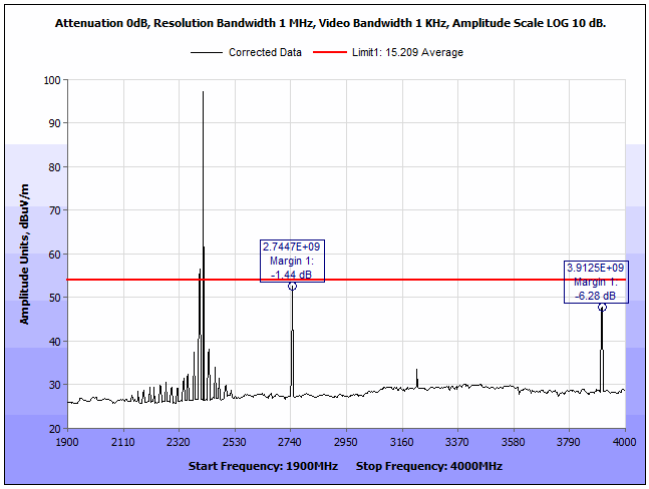
Plot 35. Radiated Spurious Emissions, 915 MHz, 1 – 1.9 GHz, V, Peak



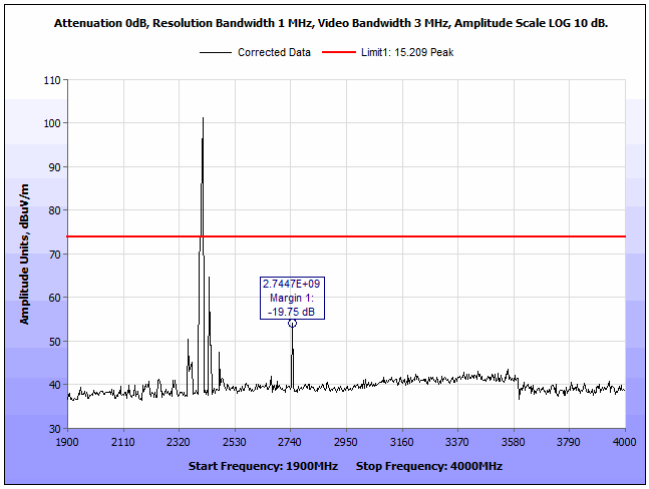
Plot 36. Radiated Spurious Emissions, 915 MHz, 1.9 – 4 GHz, H, Average



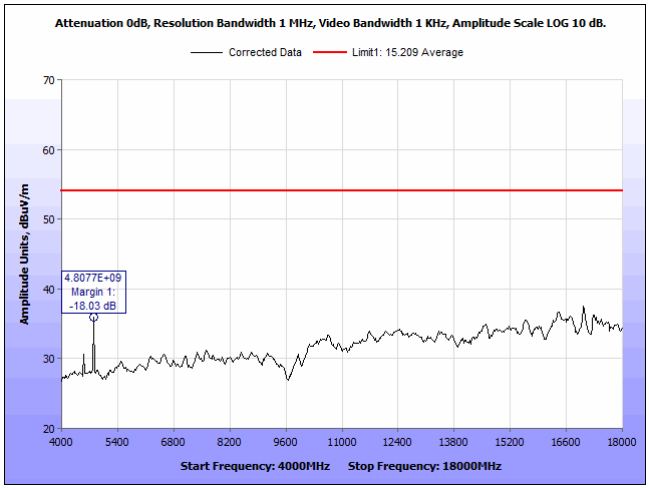
Plot 37. Radiated Spurious Emissions, 915 MHz, 1.9 – 4 GHz, H, Peak



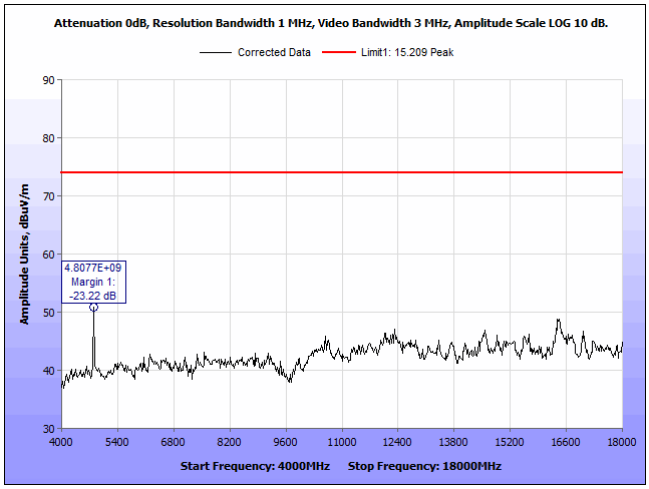
Plot 38. Radiated Spurious Emissions, 915 MHz, 1.9 – 4 GHz, V, Average



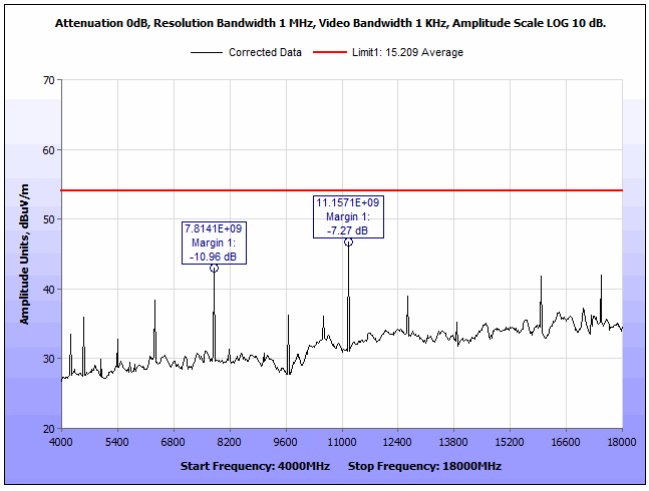
Plot 39. Radiated Spurious Emissions, 915 MHz, 1.9 – 4 GHz, V, Peak



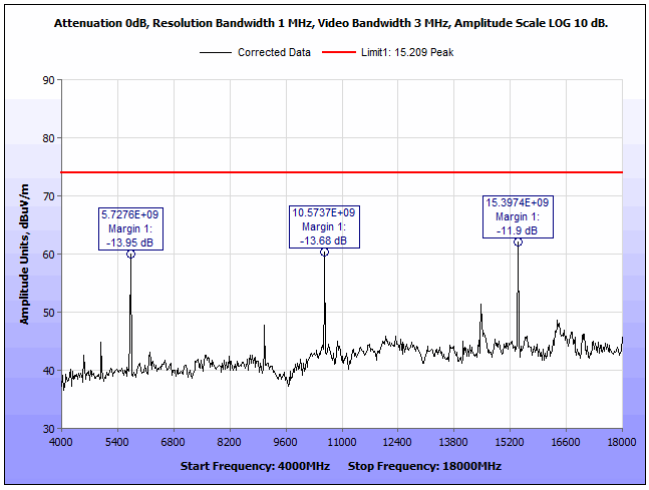
Plot 40. Radiated Spurious Emissions, 915 MHz, 4 – 18 GHz, H, Average



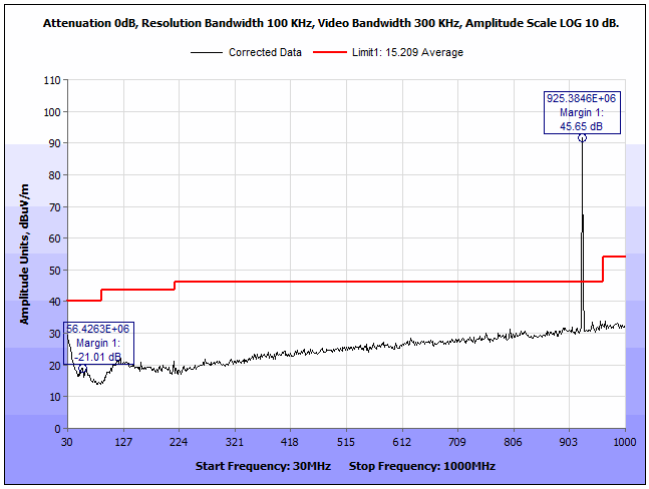
Plot 41. Radiated Spurious Emissions, 915 MHz, 4 – 18 GHz, H, Peak



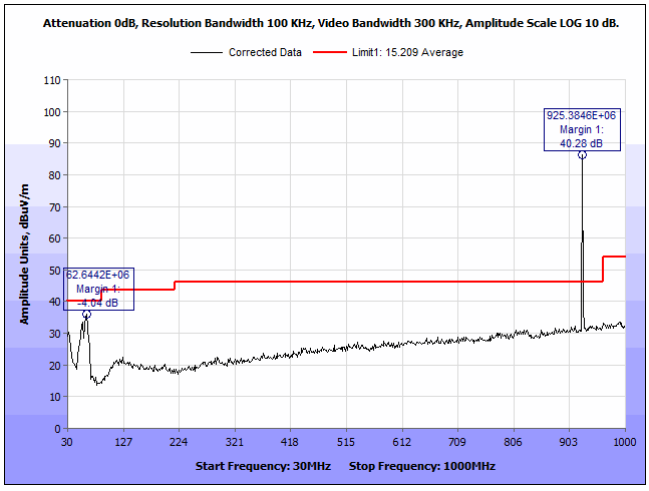
Plot 42. Radiated Spurious Emissions, 915 MHz, 4 – 18 GHz, V, Average



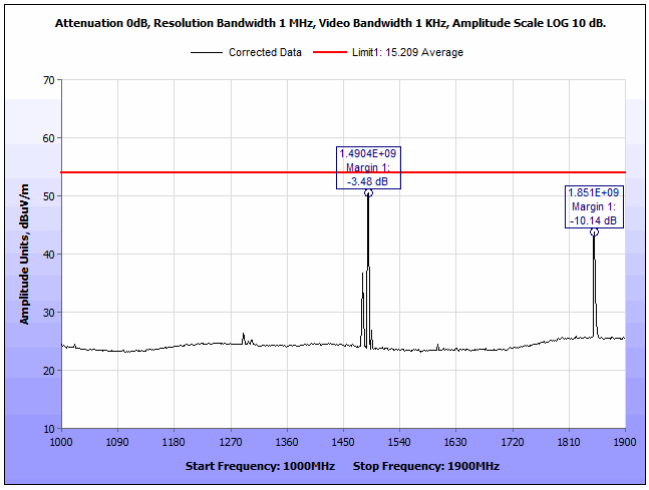
Plot 43. Radiated Spurious Emissions, 915 MHz, 4 – 18 GHz, V, Peak



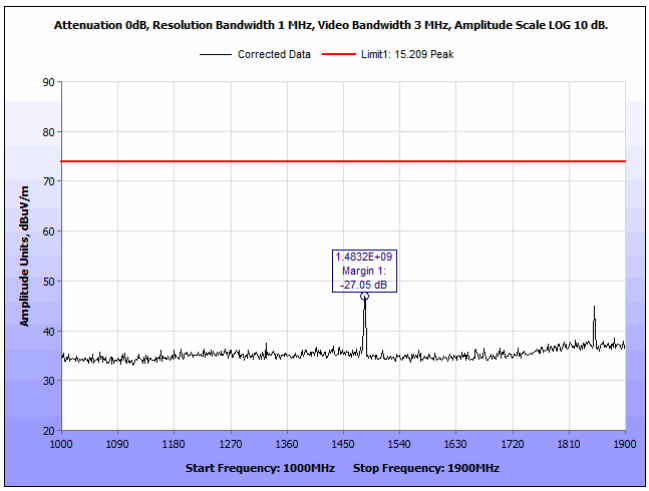
Plot 44. Radiated Spurious Emissions, 927.8 MHz, 30 MHz – 1 GHz, H



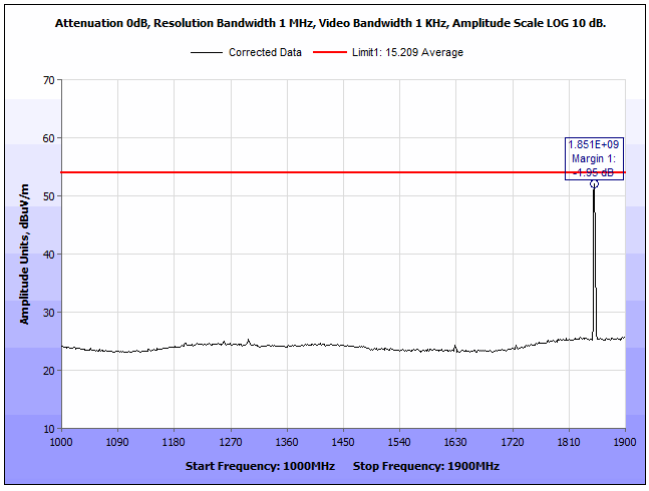
Plot 45. Radiated Spurious Emissions, 927.8 MHz, 30 MHz – 1 GHz, V



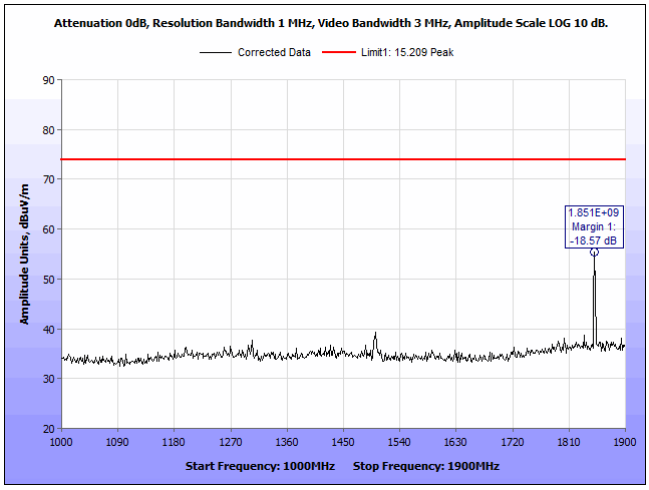
Plot 46. Radiated Spurious Emissions, 927.8 MHz, 1 – 1.9 GHz, H, Average



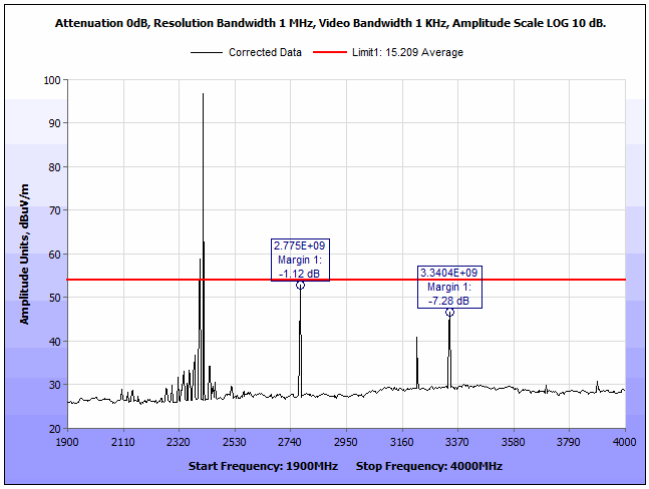
Plot 47. Radiated Spurious Emissions, 927.8 MHz, 1 – 1.9 GHz, H, Peak



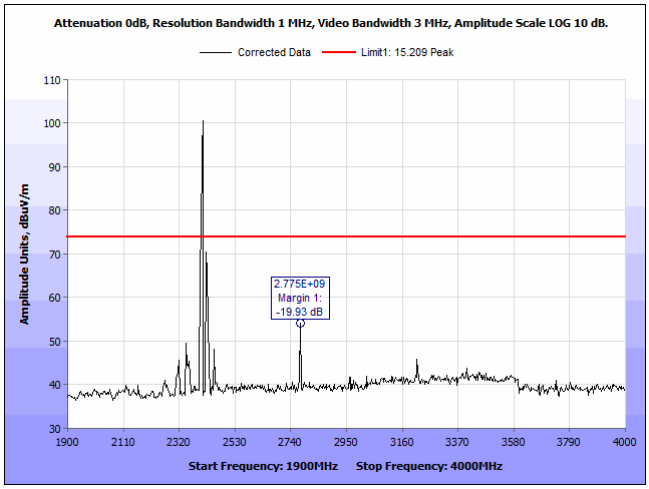
Plot 48. Radiated Spurious Emissions, 927.8 MHz, 1 – 1.9 GHz, V, Average



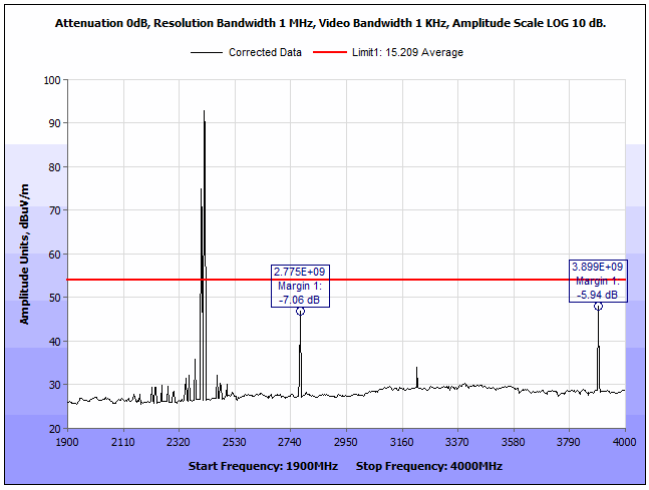
Plot 49. Radiated Spurious Emissions, 927.8 MHz, 1 – 1.9 GHz, V, Peak



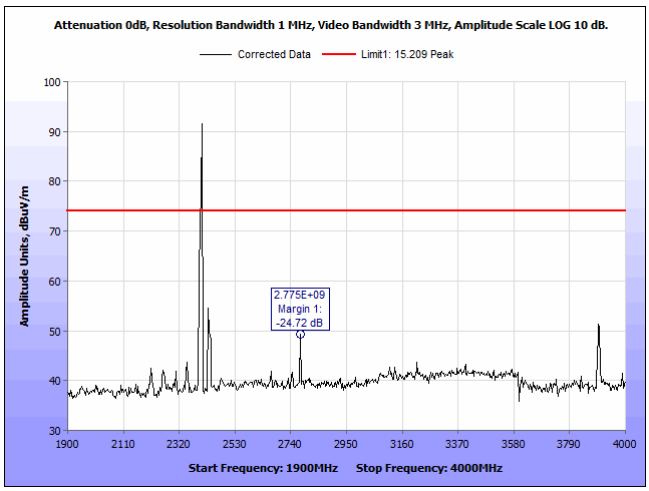
Plot 50. Radiated Spurious Emissions, 927.8 MHz, 1.9 – 4 GHz, H, Average



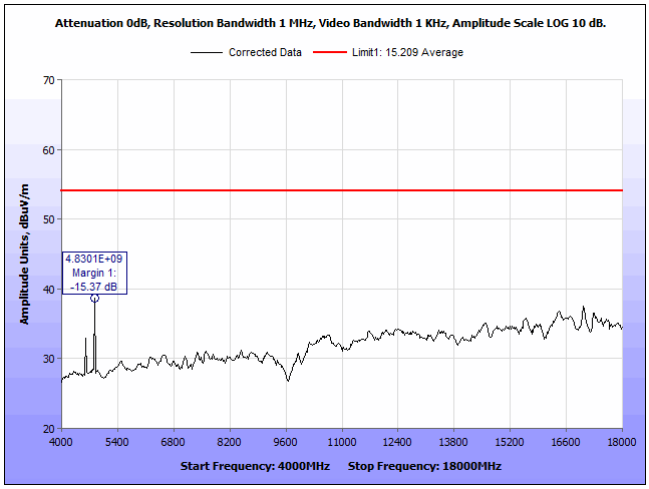
Plot 51. Radiated Spurious Emissions, 927.8 MHz, 1.9 – 4 GHz, H, Peak



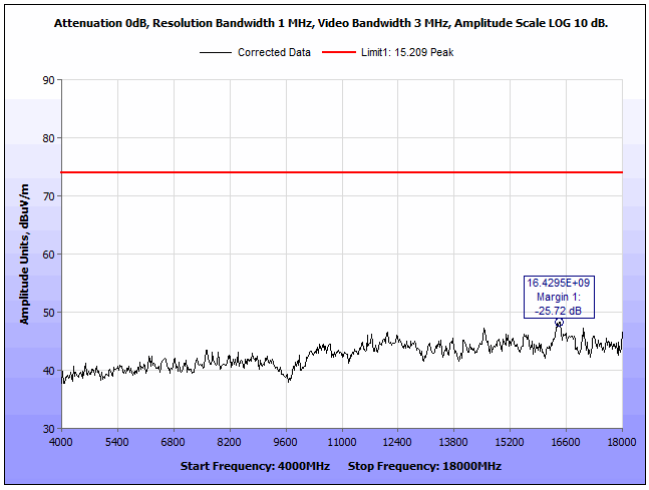
Plot 52. Radiated Spurious Emissions, 927.8 MHz, 1.9 – 4 GHz, V, Average



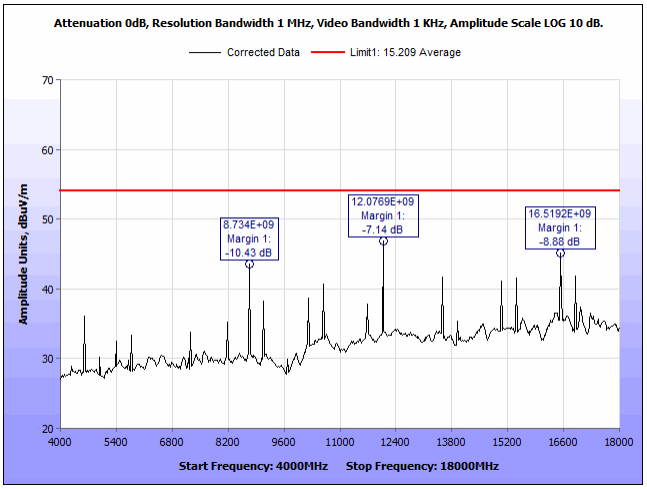
Plot 53. Radiated Spurious Emissions, 927.8 MHz, 1.9 – 4 GHz, V, Peak



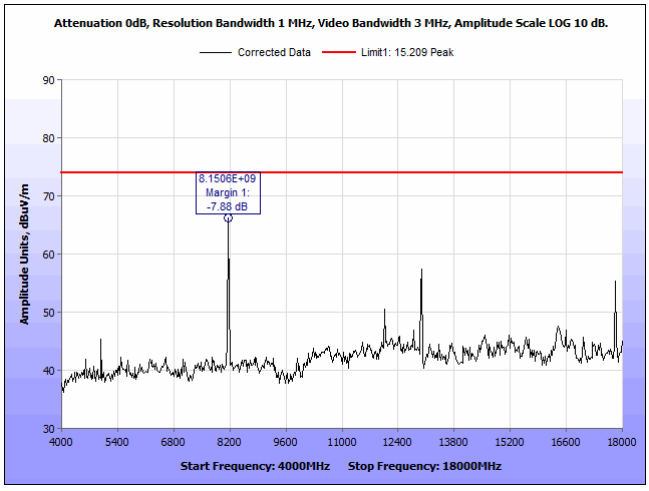
Plot 54. Radiated Spurious Emissions, 927.8 MHz, 4 – 18 GHz, H, Average



Plot 55. Radiated Spurious Emissions, 927.8 MHz, 4 – 18 GHz, H, Peak



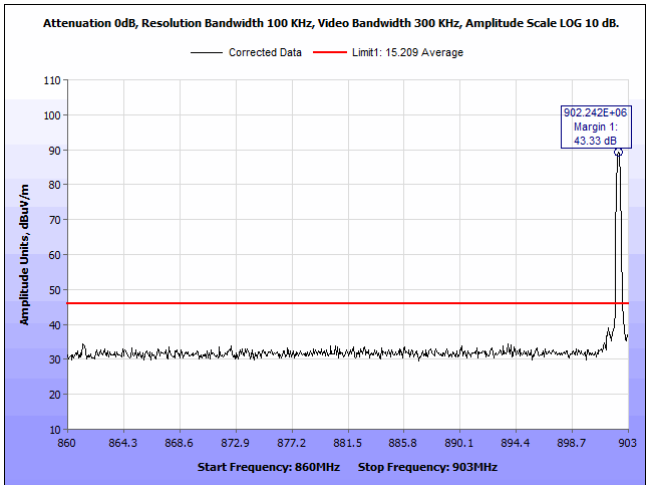
Plot 56. Radiated Spurious Emissions, 927.8 MHz, 4 – 18 GHz, V, Average



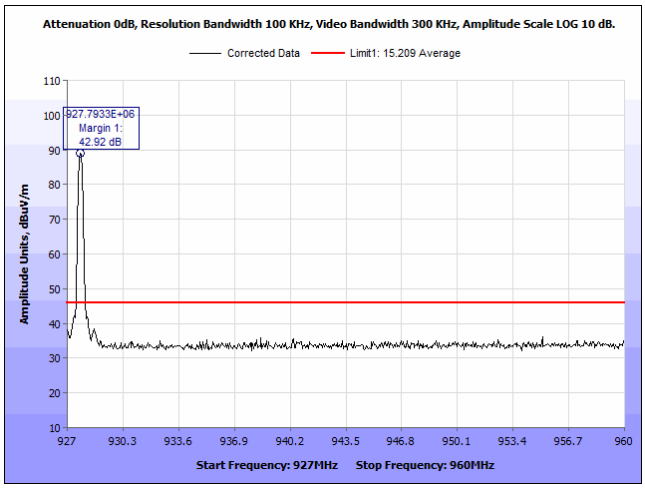
Plot 57. Radiated Spurious Emissions, 927.8 MHz, 4 – 18 GHz, V, Peak

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 58. Radiated Band Edge, 902.2 MHz, Low



Plot 59. Radiated Band Edge, 927.8 MHz, High

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.

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): Giuliano Messina

Test Date(s): September 27, 2018

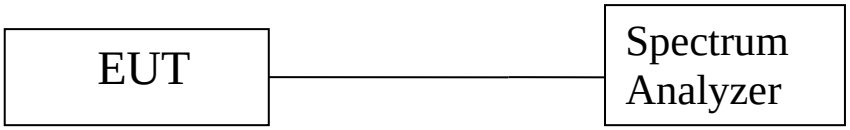
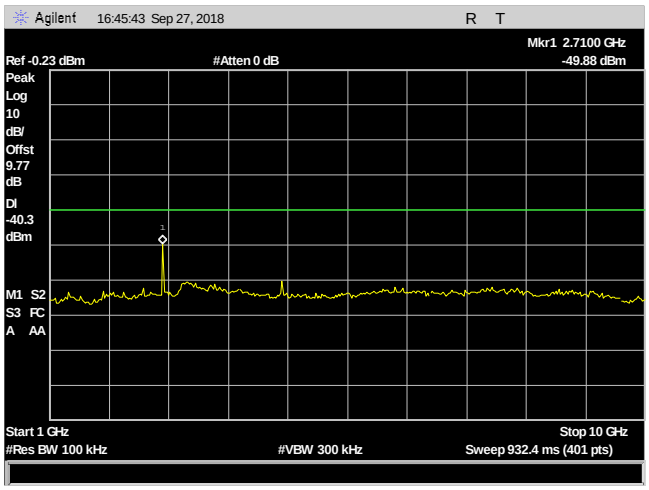
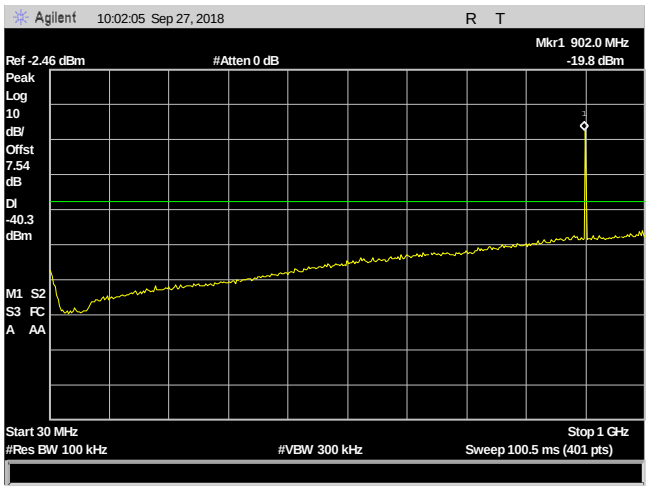


Figure 4. Block Diagram, Conducted Spurious Emissions Test Setup

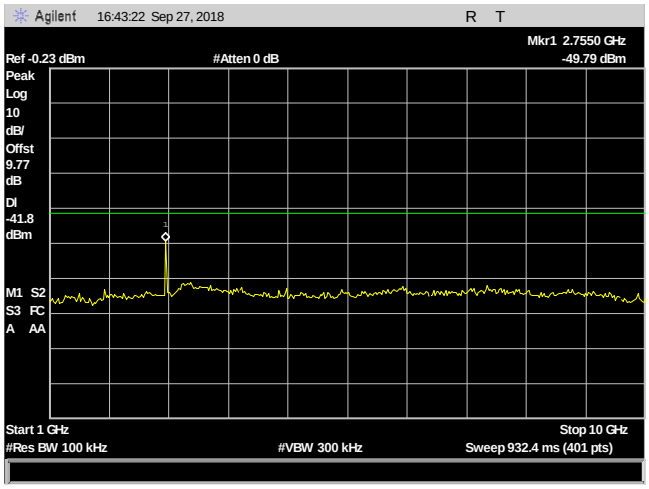
Conducted Spurious Emissions Test Results



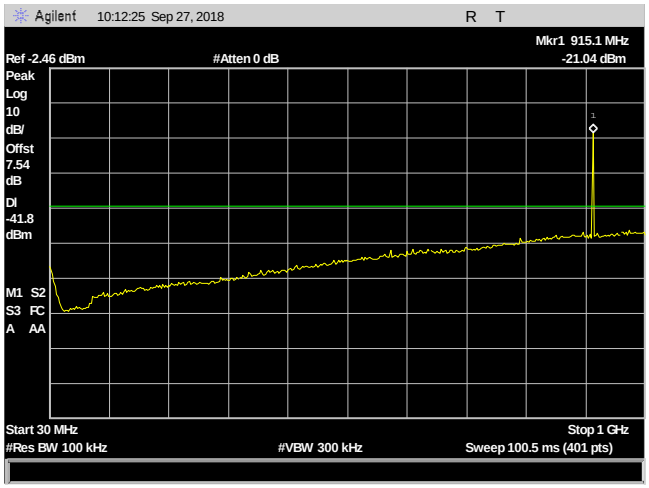
Plot 60. Conducted Spurious Emissions, 902.2 MHz, 1 – 10 GHz



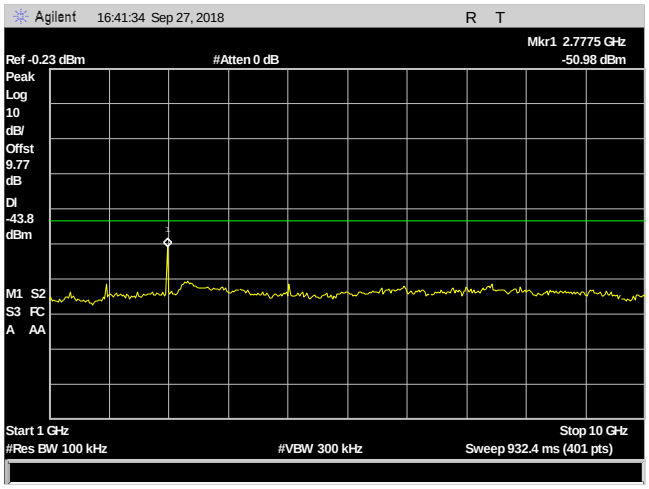
Plot 61. Conducted Spurious Emissions, 902.2 MHz, 30 MHz – 1 GHz



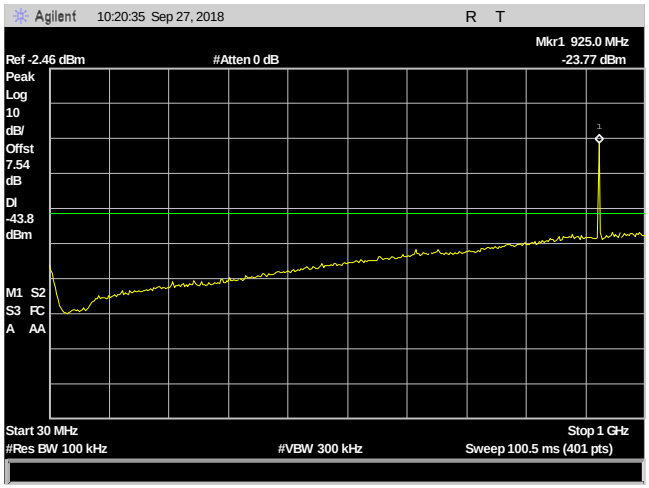
Plot 62. Conducted Spurious Emissions, 915 MHz, 1 – 10 GHz



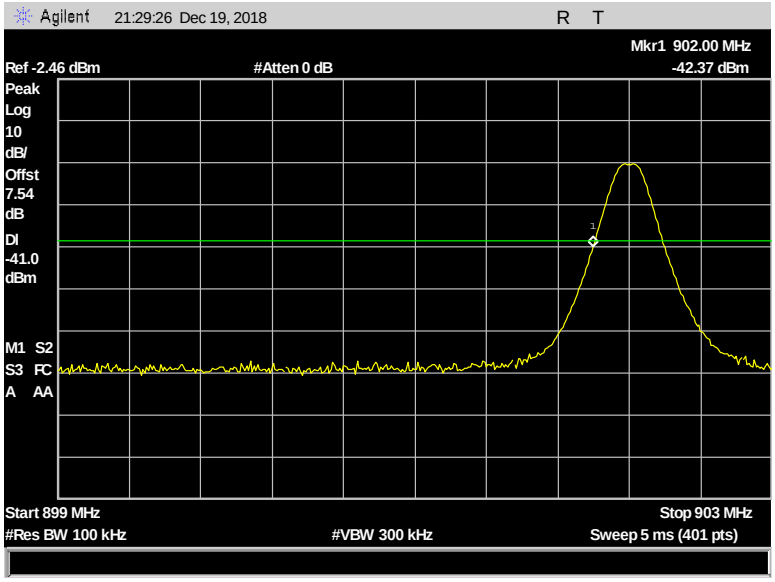
Plot 63. Conducted Spurious Emissions, 915 MHz, 30 MHz – 1 GHz



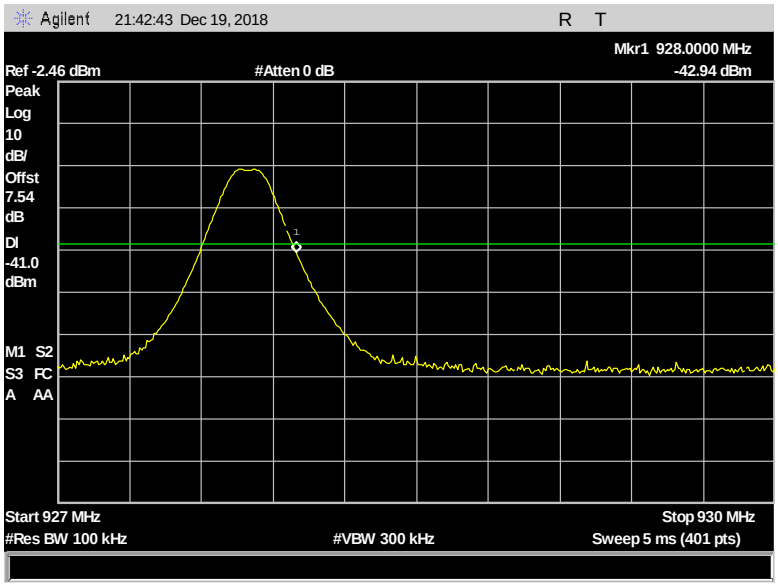
Plot 64. Conducted Spurious Emissions, 927.8 MHz, 1 – 10 GHz



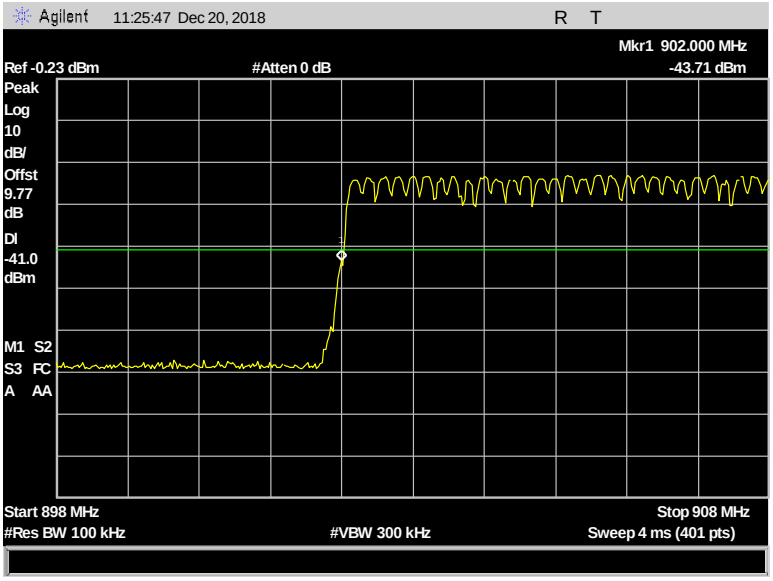
Plot 65. Conducted Spurious Emissions, 927.8 MHz, 30 MHz – 1 GHz



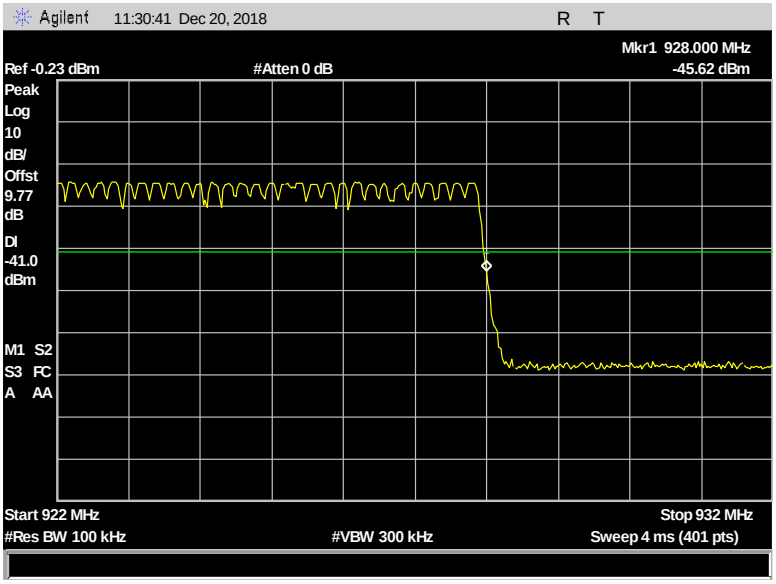
Plot 66. Conducted Spurious Emissions, Bandedge Low



Plot 67. Conducted Spurious Emissions, Bandedge High



Plot 68. Conducted Spurious Emissions, Hopping Bandedge Low



Plot 69. Conducted Spurious Emissions, Hopping Bandedge High

Electromagnetic Compatibility Criteria for Intentional Radiators
§ 15.247(g)(h) Declaration Statements for FHSS

NOISEAWARE™

NoiseAware, LLC

2800 Routh St., Ste. 215, Dallas, TX 75201 | (888) 847-5538 | info@noiseaware.io

26 Nov 2018

RE: DECLARATION STATEMENT FOR FHSS GEN 3 COLLECTOR, FCC# **2AQIP-NA3N101**

Compliance for section 15.247(g):

The 915MHz system-on-chip (SOC) within the NoiseAware Gen3 Collector device complies with the IEEE 802.15.4e standard and uses a Time Synchronized Channel Hopping (TSCH) MAC. According to this specification, the device transmits packets with a pseudorandom hopping pattern across 129 channels when presented with continuous data. Short burst transmissions from the system are also transmitted with pseudorandom frequency hopping.

Compliance for section 15.247(h):

The IEEE 802.15.4e compliant SOC does not use intelligence to adapt its hopset to avoid occupied channels, and it does not coordinate with any other FHSS systems to avoid simultaneous occupancy of individual hopping frequencies by multiple transmitters.

Please contact me if there is any information you may need.

Sincerely,

Garrett Dobbs, Head of Product

11/26/18

Figure 5. FHSS Declaration Statement

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(i) Maximum Permissible 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.

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

$S = PG / 4\pi R^2$ or $R = \sqrt{PG / 4\pi S}$

where, S = Power Density (1 mW/cm^2)
P = Power Input to antenna (41.4mW)
G = Antenna Gain (63.1 numeric)

$R = (41.4*63.1/ 4*3.14*1.0)^{1/2} = (2612.34 / 12.56)^{1/2} = 14.4$cm

Test Result:

FCC									
Frequency (MHz)	**Con. Pwr. (dBm)**	**Con. Pwr. (mW)**	**Ant. Gain (dBi)**	**Ant. Gain numeric**	**Pwr. Density (mW/cm^2)**	**Limit (mW/cm^2)**	**Margin**	**Distance (cm)**	**Result**
927.8	-9.65	0.108	1	1.259	0.00003	0.601	0.60097	20	Pass

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 #	Nomenclature	Manufacturer	Model	Last Cal Date	Cal Due Date
1A1184	Spectrum Analyzer	Agilent	E4407B	4/20/2018	4/20/2019
1A1065	EMI Receiver	Rohde & Schwarz	ESCI	3/23/2018	3/23/2019
1A1119	Test Area	Custom Made	N/A	See Note	
1A1122	LISN	Teseq	NNB 51	6/14/2018	6/14/2019
1A1149	Milliohm Meter	GW Instek	GOM-802	4/20/2018	4/20/2019
1A1079	Conducted Comb Generator	COM-Power Corp	CGC-255	See Note	
1A1087	Pulse Limiter	Rohde & Schwarz	ESH3Z2	4/4/2018	4/4/2019
1A1105	ISN	Fischer Custom	F-071115-1057-1-09	7/11/2017	1/11/2019
1A1083	EMI Test Receiver	Rohde & Schwarz	ESU40	10/12/2017	10/12/2018
1A1106	10m Chamber (FCC)	ETS	Semi-Anechoic	See Note	
1A1147	Bilog Antenna (30MHz to 1GHz)	Sunol Sciences Corp	JB3	3/9/2017	10/9/2018
1A1047	Horn Antenna	ETS	3117	2/23/2017	10/23/2018
1A1099	Generator	COM-Power Corp	CGO-51000	See Note	
1A1088	Pre-Amp	Rohde & Schwarz	TS-PR1	See Note	
1A1044	Generator	COM-Power Corp	CG-520	See Note	
1A1073	Multi Device Controller	ETS EMCO	2090	See Note	
1A1074	System Controller	Panasonic	WV-CU101	See Note	
1A1080	Multi Device Controller	ETS EMCO	2090	See Note	
1A1180	Pre-Amp	Miteq	AMF-7D-01001800-22-10P	See Note	

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

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