



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

914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230 • PHONE (410) 354-3300 • FAX (410) 354-3313

33439 WESTERN AVENUE • UNION CITY, CALIFORNIA 94587 • PHONE (510) 489-6300 • FAX (510) 489-6372

3162 BELICK STREET • SANTA CLARA, CALIFORNIA 95054 • PHONE (408) 748-3585 • FAX (510) 489-6372

13501 MCCALLEN PASS • AUSTIN, TEXAS 78753 • PHONE (512) 287-2500 • FAX (512) 287-2513

October 28, 2016

Intelligent Automation, Inc.
15400 Calhoun Place Suite 400
Rockville, MD 20855

Dear Eric van Doorn,

Enclosed is the EMC Wireless test report for compliance testing of the Intelligent Automation, Inc., ARGUS 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.

Jennifer Warnell
Documentation Department

Reference: (\\Intelligent Automation, Inc.\\EMC91497-FCC249 REV 1)

Certificates and reports shall not be reproduced except in full, without the written permission of MET Laboratories, Inc.

Electromagnetic Compatibility Criteria Test Report

for the

**Intelligent Automation, Inc.
ARGUS**

Verified under
the FCC Certification Rules
contained in
Title 47 of the CFR, Part 15.249 Subpart C
for Intentional Radiators

MET Report: EMC91497-FCC249 REV 1

October 28, 2016

Prepared For:

**Intelligent Automation, Inc.
15400 Calhoun Place Suite 400
Rockville, MD 20855**

Prepared By:
MET Laboratories, Inc.
914 W. Patapsco Ave.
Baltimore, MD 21230

**Electromagnetic Compatibility Criteria
Test Report**

for the

**Intelligent Automation, Inc.
ARGUS**

Tested Under
the FCC Certification Rules
contained in
Title 47 of the CFR, Part 15.249 Subpart C
for Intentional Radiators



Deepak Giri, Project Engineer
Electromagnetic Compatibility Lab



Jennifer Warnell
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 Rule Part 15.249 under normal use and maintenance.



Asad Bajwa, Director
Electromagnetic Compatibility Lab



Intelligent Automation, Inc.
ARGUS

Electromagnetic Compatibility
Report Status
CFR Title 47, Part 15.249

Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	October 7, 2016	Initial Issue.
1	October 28, 2016	Revisions Made During TCB Review

Table of Contents

I.	Executive Summary	1
	A. Purpose of Test	2
	B. Executive Summary	2
II.	Equipment Configuration	3
	A. Overview	4
	B. References	4
	C. Test Site	5
	D. Description of Test Sample.....	5
	E. Equipment Configuration	5
	F. Support Equipment	6
	G. Ports and Cabling Information.....	6
	H. Mode of Operation.....	6
	I. Monitoring Method.....	6
	J. Modifications.....	6
	a) Modifications to EUT	6
	b) Modifications to Test Standard.....	6
	K. Disposition of EUT	6
III.	Electromagnetic Compatibility Criteria for Intentional Radiators.....	7
	§ 15.203 Antenna Requirement	8
	§ 15.207(a) Conducted Emissions Limits.....	9
	§ 15.249(a) & (b)(1) Field Strength of Fundament and Harmonics	10
	§ 15.249(a)(d) Spurious Emissions	12
	20dB Bandwidth.....	25
IV.	Duty Cycle Calculation of C/N	27
V.	Test Equipment	29
VI.	Certification & User's Manual Information	31
	A. Certification Information	32
	B. Label and User's Manual Information.....	36
VII.	ICES-003 Procedural & Labeling Requirements.....	38

List of Tables

Table 1. Executive Summary of EMC Part 15.249 Compliance Testing	2
Table 2. EUT Specifications	4
Table 3. References	4
Table 4. Equipment Configuration	5
Table 5. Support Equipment	6
Table 6. Ports and Cabling Information	6
Table 7. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)	9
Table 8. Field Strength of Fundamental, Test Results	10
Table 9. Frequencies Above Average Radiated Spurious Emissions, Above 1 GHz	22
Table 10. 20 dB Bandwidth, Test Results	25
Table 11. Duty Cycle, Test Results	27
Table 12. Test Equipment	30

List of Photographs

Photograph 1. Radiated Spurious Emissions, Test Setup, Below 30 MHz - 1 GHz	23
Photograph 2. Radiated Spurious Emissions, Test Setup, Above 1 GHz - 18 GHz	24

List of Plots

Plot 1. Radiated Field Strength of Fundamental, Low Channel	11
Plot 2. Radiated Field Strength of Fundamental, Mid Channel	11
Plot 3. Radiated Field Strength of Fundamental, High Channel	11
Plot 4. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz	13
Plot 5. Radiated Spurious Emissions, Low Channel, 1 GHz – 18 GHz, Average	13
Plot 6. Radiated Spurious Emissions, Low Channel, 1 GHz – 18 GHz, Peak	13
Plot 7. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz	14
Plot 8. Radiated Spurious Emissions, Mid Channel, 1 GHz – 18 GHz, Average	14
Plot 9. Radiated Spurious Emissions, Mid Channel, 1 GHz – 18 GHz, Peak	14
Plot 10. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz	15
Plot 11. Radiated Spurious Emissions, High Channel, 1 GHz – 18 GHz, Average	15
Plot 12. Radiated Spurious Emissions, High Channel, 1 GHz – 18 GHz, Peak	15
Plot 13. Radiated Band Edge, Low Channel	16
Plot 14. Radiated Band Edge, High Channel	16
Plot 15. Spurious Emissions, 2.4 GHz, Low 900 MHz, Mid Channel, 30 MHz – 1 GHz	17
Plot 16. Spurious Emissions, 2.4 GHz, Low 900 MHz, High Channel, 30 MHz – 1 GHz	17
Plot 17. Spurious Emissions, 2.4 GHz, Mid 900 MHz, Mid Channel, 30 MHz – 1 GHz	18
Plot 18. Spurious Emissions, 2.4 GHz, Mid 900 MHz, High Channel, 30 MHz – 1 GHz	18
Plot 19. Spurious Emissions, 2.4 GHz, Low 900 MHz, Mid Channel, 1 GHz – 18 GHz, Average	19
Plot 20. Spurious Emissions, 2.4 GHz, Low 900 MHz, Mid Channel, 1 GHz – 18 GHz, Peak	19
Plot 21. Spurious Emissions, 2.4 GHz, Low 900 MHz, High Channel, 1 GHz – 18 GHz, Average	20
Plot 22. Spurious Emissions, 2.4 GHz, Low 900 MHz, High Channel, 1 GHz – 18 GHz, Peak	20
Plot 23. Spurious Emissions, 2.4 GHz, Mid 900 MHz, Mid Channel, 1 GHz – 18 GHz, Average	20
Plot 24. Spurious Emissions, 2.4 GHz, Mid 900 MHz, Mid Channel, 1 GHz – 18 GHz, Peak	21
Plot 25. Spurious Emissions, 2.4 GHz, Mid 900 MHz, High Channel, 1 GHz – 18 GHz, Average	21
Plot 26. Spurious Emissions, 2.4 GHz, Mid 900 MHz, High Channel, 1 GHz – 18 GHz, Peak	21
Plot 27. 20 dB Bandwidth, Low Channel	26
Plot 28. 20 dB Bandwidth, Mid Channel	26
Plot 29. 20 dB Bandwidth, High Channel	26
Plot 30. Duty Cycle, Period at 10 ms Sweep Time	28

Plot 31. Duty Cycle, Period at 28.92 ms with 1 MHz Resolution Bw.....	28
Plot 32. Duty Cycle, Period_10 kHz at 28.92 ms Sweep Time	28

List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
d	Measurement Distance
dB	Decibels
dBμA	Decibels above one microamp
dBμV	Decibels above one microvolt
dBμA/m	Decibels above one microamp per meter
dBμV/m	Decibels above one microvolt per meter
DC	Direct Current
E	Electric Field
DSL	Digital Subscriber Line
ESD	Electrostatic Discharge
EUT	Equipment Under Test
f	Frequency
FCC	Federal Communications Commission
GRP	Ground Reference Plane
H	Magnetic Field
HCP	Horizontal Coupling Plane
Hz	Hertz
IEC	International Electrotechnical Commission
kHz	Kilohertz
kPa	Kilopascal
kV	Kilovolt
LISN	Line Impedance Stabilization Network
MHz	Megahertz
μH	Microhenry
μF	Microfarad
μs	Microseconds
PRF	Pulse Repetition Frequency
RF	Radio Frequency
RMS	Root-Mean-Square
TWT	Traveling Wave Tube
V/m	Volts per meter
VCP	Vertical Coupling Plane

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Intelligent Automation, Inc. ARGUS, with the requirements of Part 15, §15.249. 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 ARGUS. Intelligent Automation, Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the ARGUS, 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, §15.249, in accordance with Intelligent Automation, Inc., purchase order number 3004-16-07-20-001. All tests were conducted using measurement procedure ANSI C63.4-2014.

FCC Reference	Description	Results
§15.203	Antenna Requirement	Compliant
§15.207	AC Power Line Conducted Emissions	Not Applicable
§15.249 (a)(1)	Field Strength of Fundamental	Compliant
§15.249	20 dB Bandwidth	Compliant
§15.249	RF Conducted Emissions	Compliant
§15.249	900 MHz Duty Cycle	Compliant
§15.249(a)(d), §15.209	Spurious Emissions	Compliant
§15.247(i)	Maximum Permissible Exposure	Compliant

Table 1. Executive Summary of EMC Part 15.249 Compliance Testing

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Intelligent Automation, Inc. to perform testing on the ARGUS, under Intelligent Automation, Inc.' purchase order number 3004-16-07-20-001.

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

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

Model(s) Tested:	ARGUS	
EUT Specifications:	Primary Power to Module: 3.60 V DC	
	FCC ID: 2AI6Y-ARGUSBP	
	Equipment Code:	DXX
	Highest Fundamental Field Strength:	91.57dBuV/m
	EUT Frequency Ranges:	905-925MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature (15-35° C)	
	Relative Humidity (30-60%)	
	Barometric Pressure (860-1060 mbar)	
Evaluated by:	Deepak Giri	
Report Date(s):	October 28, 2016	

Table 2. EUT Specifications

Note: Device only supports channels one at a time. Here we are using three channels for the testing .

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
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 W. Patapsco Ave., 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 semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

D. Description of Test Sample

The ARGUS is a system of unattended ground sensors used for the purpose of perimeter intrusion detection, typically in outdoor wooded or open settings surrounding a building or other high valued asset needed protection. Each individual ARGUS sensor is comprised of two radio transceivers – one 2.4GHz transceiver for the purpose of networking and communications, and one 900MHz transceiver for the purpose of sending/receiving the transmissions that are actually used to detect the intruders.

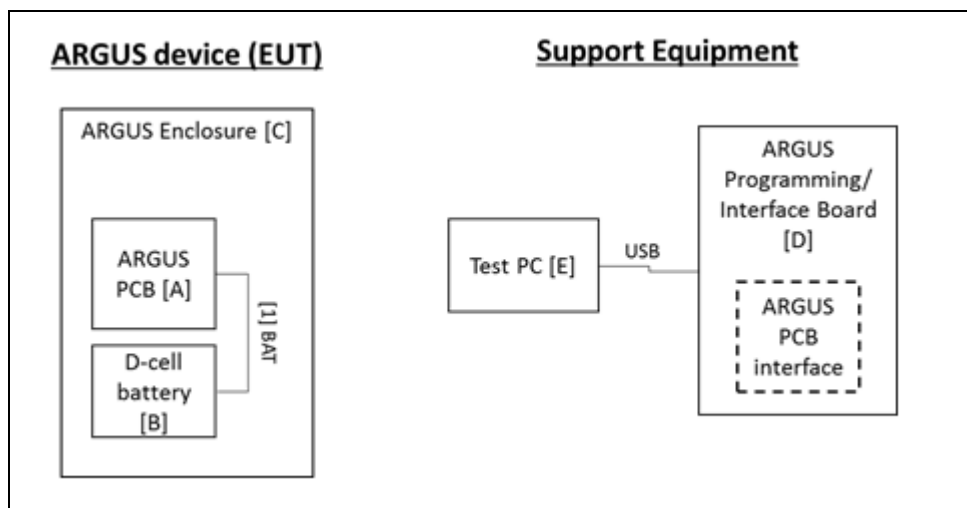


Figure 1. Block Diagram of EUT Configuration 1

E. Equipment Configuration

Ref. ID	Name / Description	Model Number	Rev. #
A	ARGUS PCB	IAI15001_ARGUSHS_X4	X4
B	D-cell battery	ER34615	--
C	ARGUS enclosure	180-001-0000	--

Table 4. Equipment Configuration

F. Support Equipment

Ref. ID	Name / Description	Manufacturer	Model Number
D	ARGUS Programming/Interface Board	Intelligent Automation, Inc.	IAI15001_DEV_X2
E	Test/Configuration PC	Panasonic	Toughbook CF-31

Table 5. Support Equipment

G. Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty.	Length as tested (m)	Shielded? (Y/N)	Termination Box ID & Port Name
1	BAT	2 conductor, 26 awg	1	0.2	No	--

Table 6. Ports and Cabling Information

H. Mode of Operation

For testing purposes, we expect to operate either/both transceivers in a continuous modulation (CM) mode on a particular channel to represent a “worst-case” configuration for the device.

I. Monitoring Method

1. The EUT will blink its onboard LED green three times indicating that it has started up. After startup, no LED indication is present.
2. If directly connected to a PC USB port (via the separate configuration interface board), the EUT will print out statements indicating the test mode being used upon startup. This would be done only to confirm a configuration, but would not be used during actual testing.
3. The 2.4GHz and/or 900MHz transmissions can be observed on a spectrum analyzer.

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 Intelligent Automation, Inc. upon completion of testing.

III. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 **Antenna Requirement**

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

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

- a.) Antenna must be permanently attached to the unit.
- b.) Antenna must use a unique type of connector to attach to the EUT.
- c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

Test Results: The EUT as tested is compliant with the criteria of §15.203. The EUT employ integral antennas.

Test Engineer(s): Deepak Giri

Test Date(s): 09/16/16

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 μ H/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 (dB μ V)	
	Quasi-Peak	Average
* 0.15- 0.45	66 - 56	56 - 46
0.45 - 0.5	56	46
0.5 - 30	60	50

Table 7. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Results: The EUT was not applicable with this requirement. The EUT is battery powered device. So conducted emission is not applicable.

Electromagnetic Compatibility Criteria for Intentional Radiators

§15.249(a) & (b)(1) Field Strength of Fundamental and Harmonics

Test Requirements: §15.249(a): Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency	Field Strength of Fundamental (millivolts/meter)	Field Strength of Harmonics (microvolts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

Test Procedure: 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. The antenna was placed 3m away from the EUT. The EUT was rotated about all three orthogonal axis. Therefore the field strength limit is based on a 3m distance.

Test Results: The EUT is compliant with the requirements of § 15.249(a) & (b)(1).

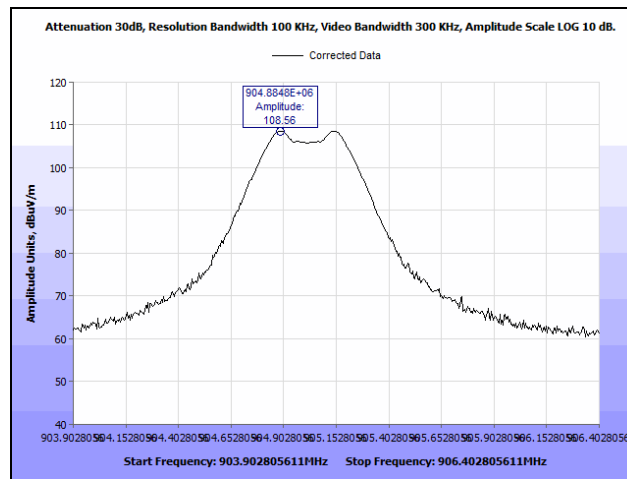
Test Engineer(s): Deepak Giri

Test Date(s): 09/16/16

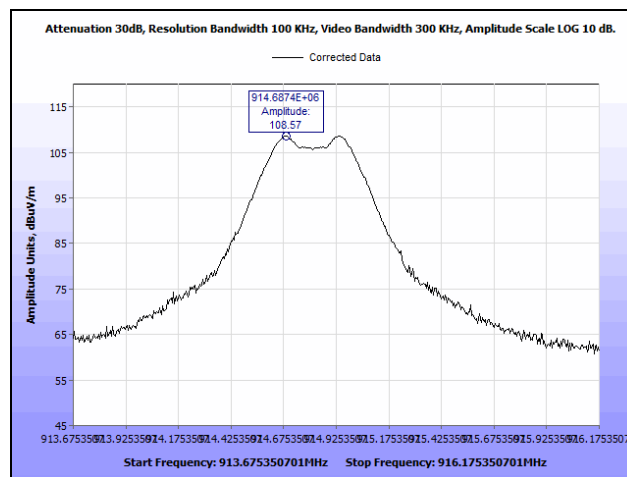
Frequency MHz	Field Strength Peak dBμV/m	Duty Cycle dB	Field Strength Average dBμV/m	Average Limit dBμV	Margin
904.88	108.56	-17	91.56	94	-2.44
914.687	108.57	-17	91.57	94	-2.43
924.93	108.43	-17	91.43	94	-2.57

Table 8. Field Strength of Fundamental, Test Results

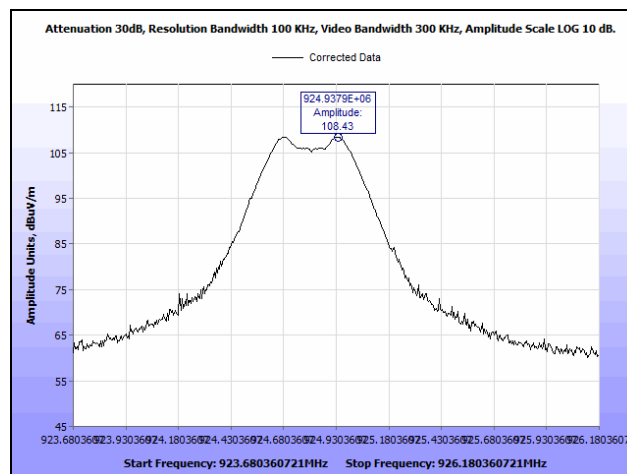
Field Strength of Fundamental



Plot 1. Radiated Field Strength of Fundamental, Low Channel



Plot 2. Radiated Field Strength of Fundamental, Mid Channel



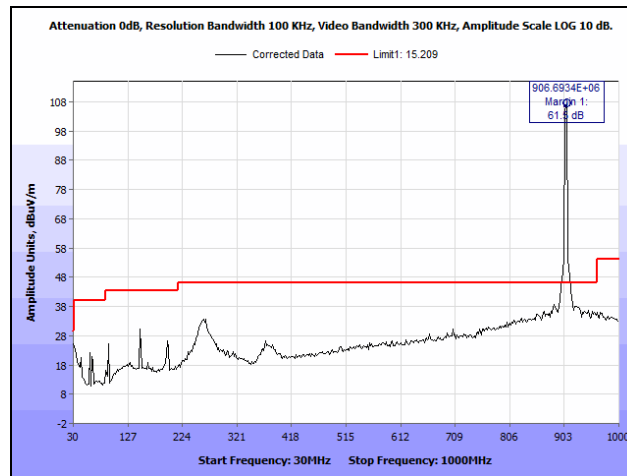
Plot 3. Radiated Field Strength of Fundamental, High Channel

Electromagnetic Compatibility Criteria for Intentional Radiators

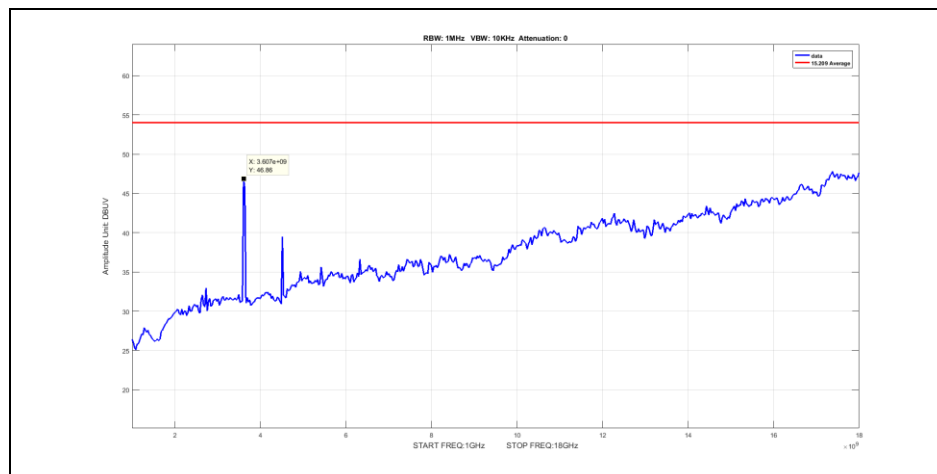
§ 15.249(a)(d) Spurious Emissions

Test Requirements:	Harmonics originating from devices that operate in the 900- 928 MHz band shall meet the 2500 microvolts/meter limit (i.e.68 dB μ V/m) with an average detector. In addition, emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.
Test Procedure:	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. Emissions below 1 GHz were performed with the antenna placed 3m away from EUT. For above 1 GHz, the measuring antenna was placed 1m away and accounted for distance correction. Measurements were performed from 30MHz to 18GHz
Test Results:	The EUT is compliant with the harmonics and Spurious Emissions Requirements of §15.249(a)(d).
Test Engineer(s):	Deepak Giri
Test Date(s):	09/19/16

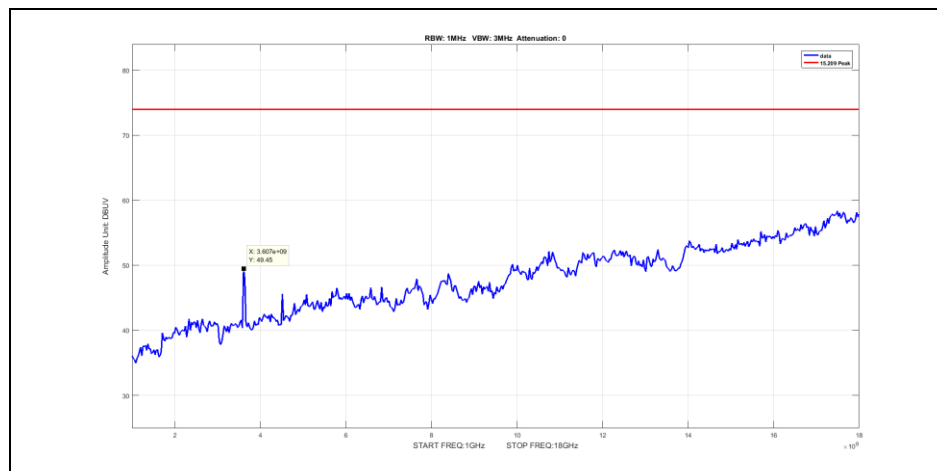
Radiated Spurious Emissions



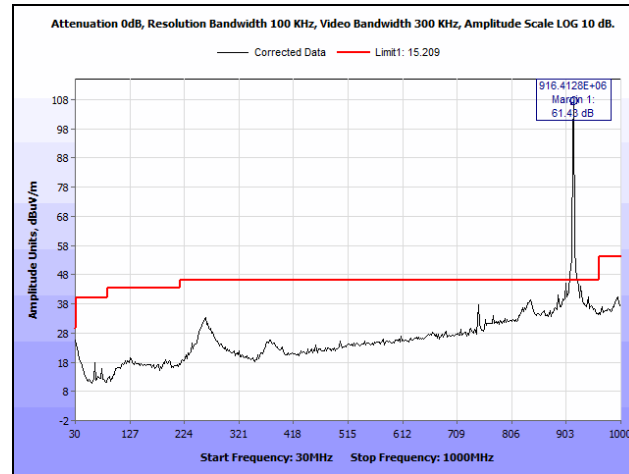
Plot 4. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz



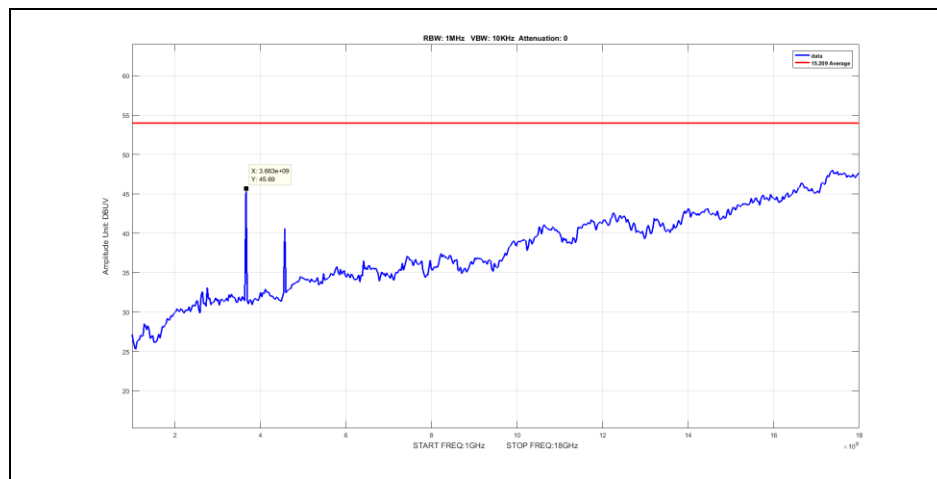
Plot 5. Radiated Spurious Emissions, Low Channel, 1 GHz – 18 GHz, Average



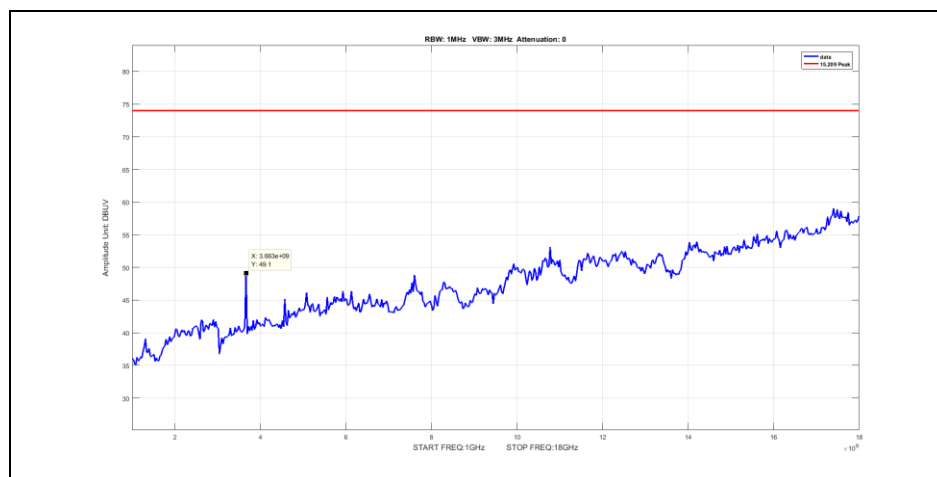
Plot 6. Radiated Spurious Emissions, Low Channel, 1 GHz – 18 GHz, Peak



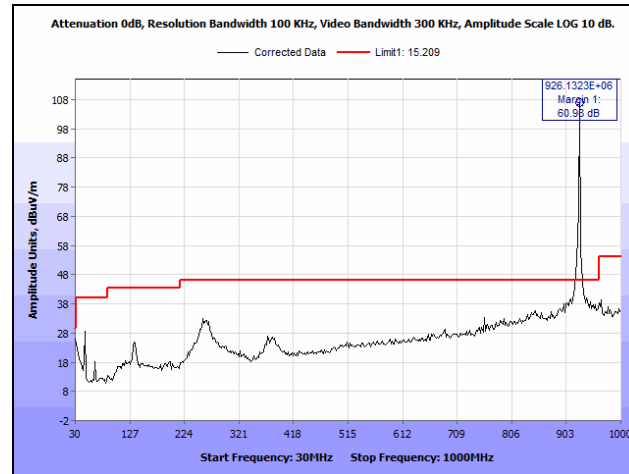
Plot 7. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz



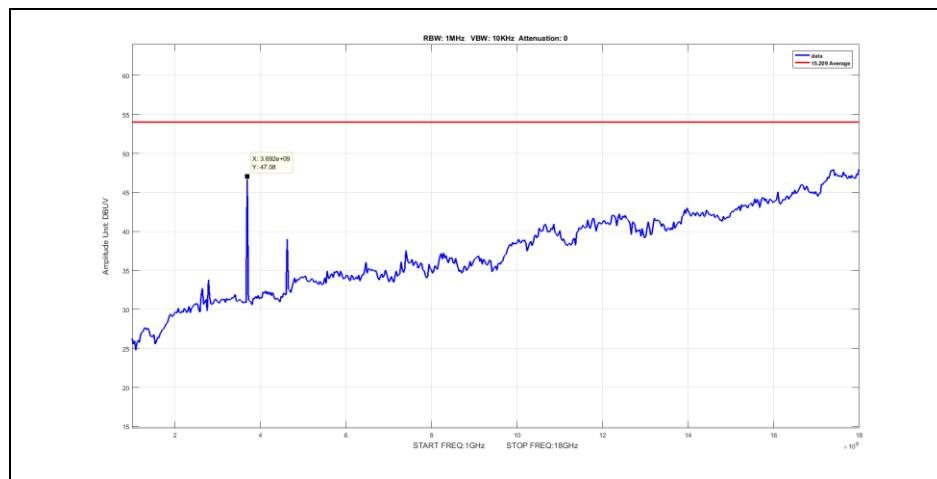
Plot 8. Radiated Spurious Emissions, Mid Channel, 1 GHz – 18 GHz, Average



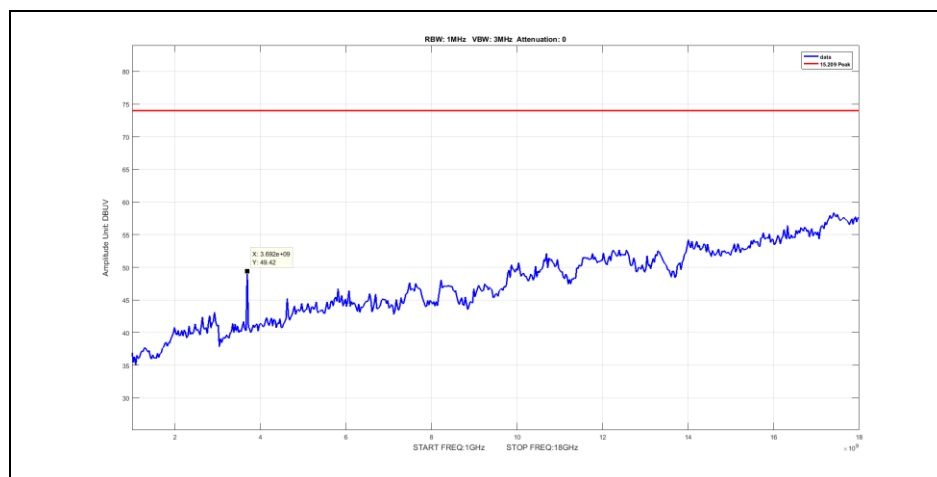
Plot 9. Radiated Spurious Emissions, Mid Channel, 1 GHz – 18 GHz, Peak



Plot 10. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz



Plot 11. Radiated Spurious Emissions, High Channel, 1 GHz – 18 GHz, Average

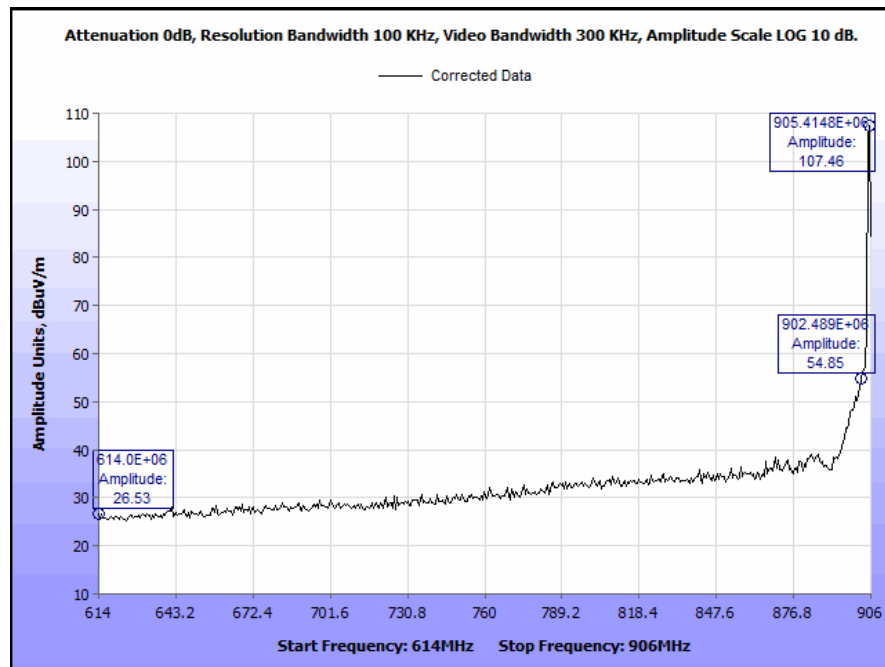


Plot 12. Radiated Spurious Emissions, High Channel, 1 GHz – 18 GHz, Peak

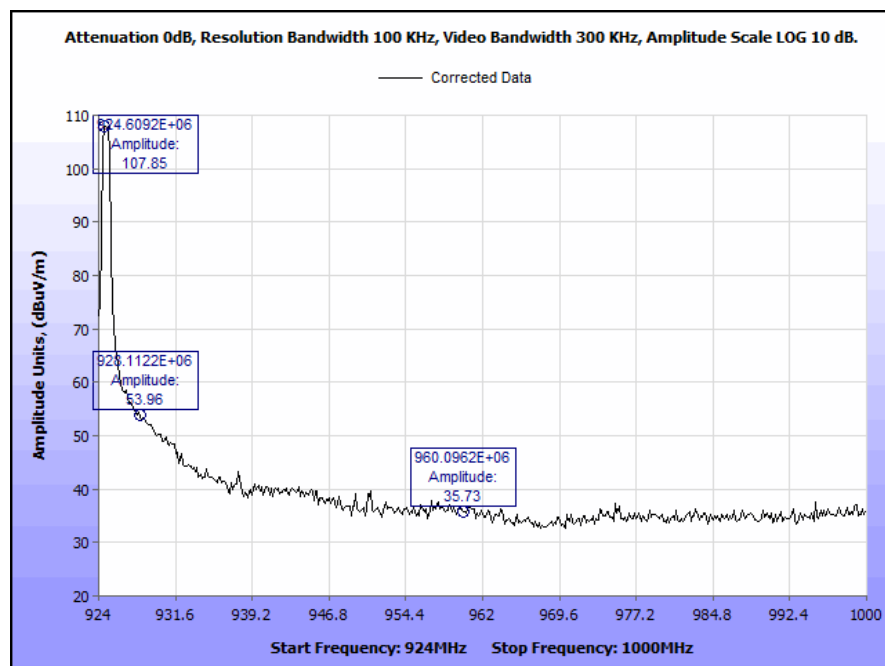
Radiated Band Edge

15.249(d): Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by 50dB below the level of the fundamental or to the general radiated emission limits of 15.209, whichever is the lesser attenuation.

Result: 15.249(d) 50dB below fundamental limit is compliant.



Plot 13. Radiated Band Edge, Low Channel

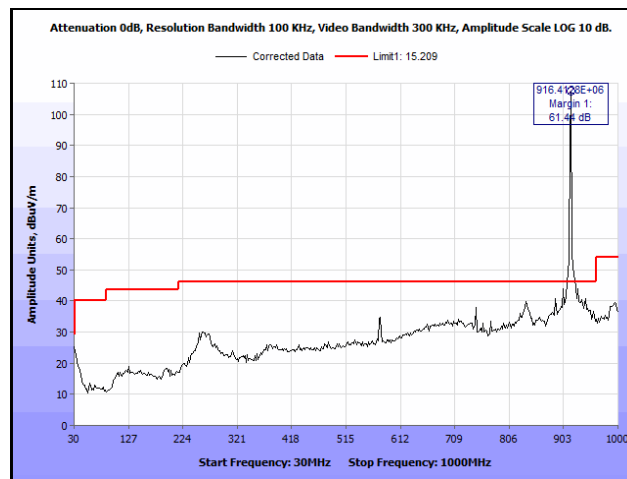


Plot 14. Radiated Band Edge, High Channel

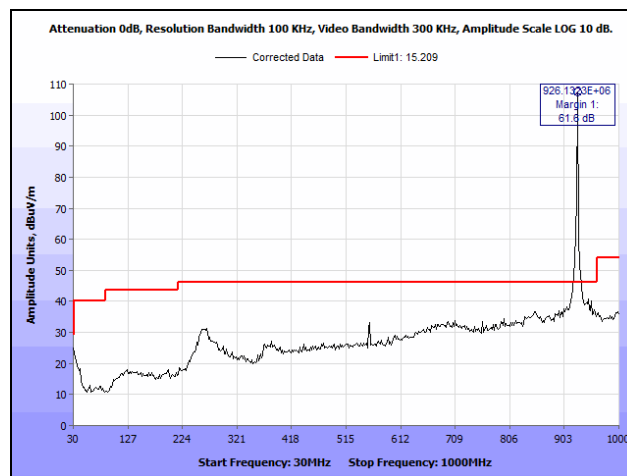
Spurious Emission for Simultaneous Operation:

This EUT has another radio operating at 2.4GHz and has its own integrated antenna, which is being tested under 15.247. 900 MHz and 2.4 GHz can operate simultaneously. Plots below show the simultaneous spurious emission from both radios. Plots shown represent worst case only.

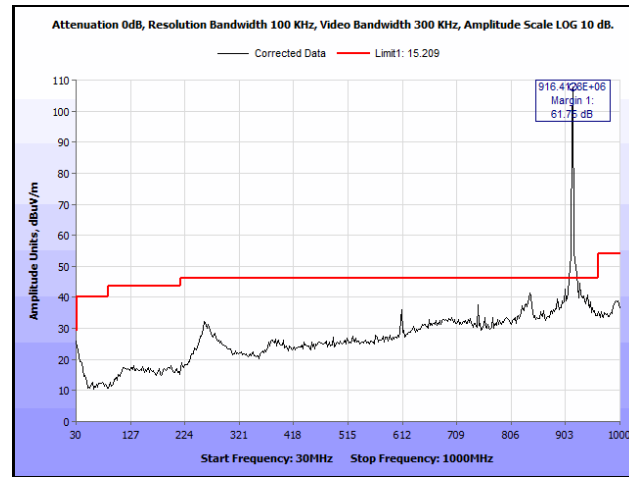
Spurious Emission for 30MHz - 1GHz:



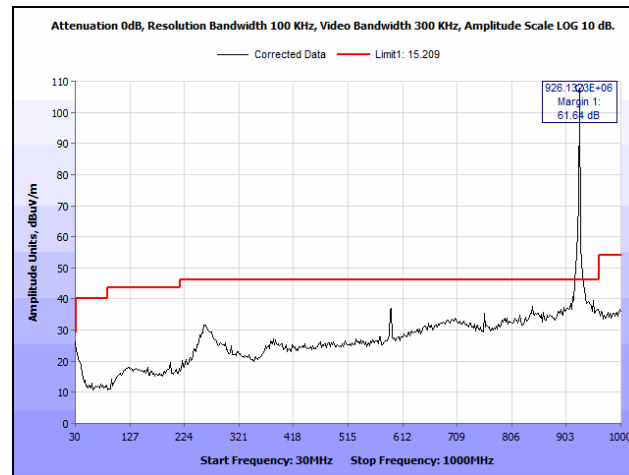
Plot 15. Spurious Emissions, 2.4 GHz, Low 900 MHz, Mid Channel, 30 MHz – 1 GHz



Plot 16. Spurious Emissions, 2.4 GHz, Low 900 MHz, High Channel, 30 MHz – 1 GHz



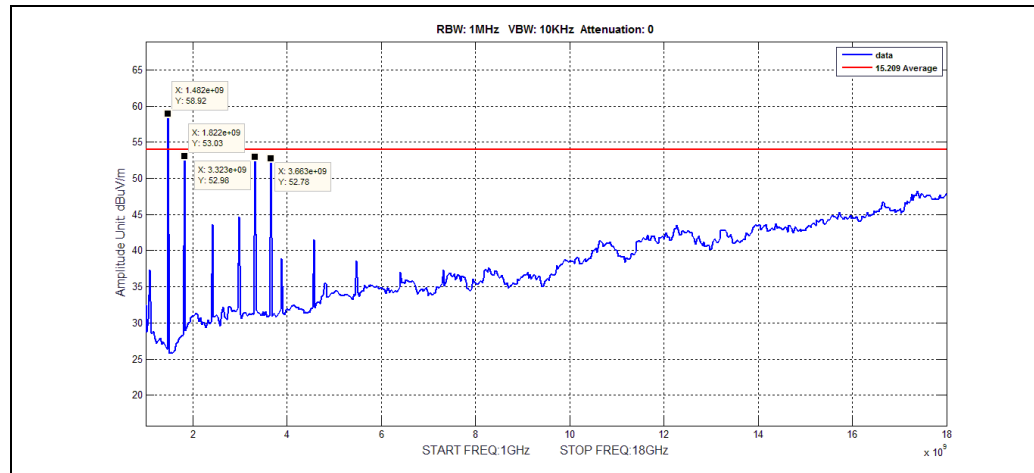
Plot 17. Spurious Emissions, 2.4 GHz, Mid 900 MHz, Mid Channel, 30 MHz – 1 GHz



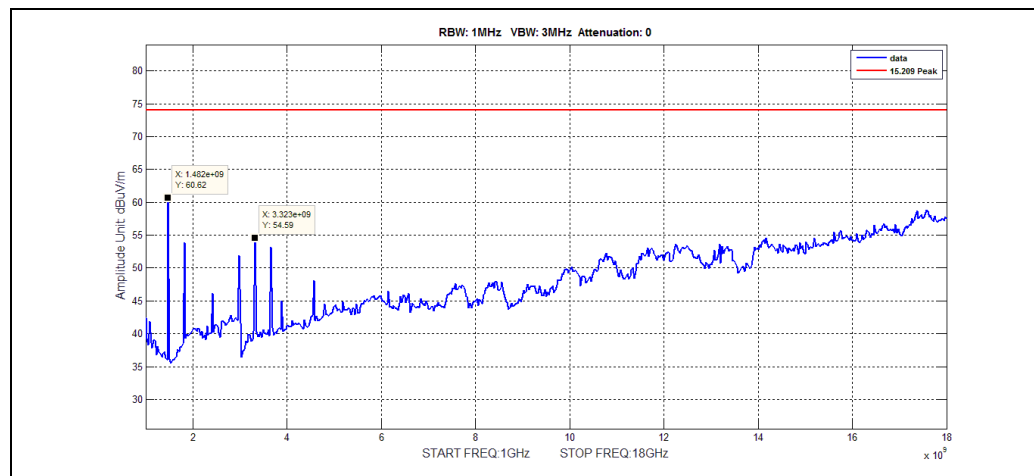
Plot 18. Spurious Emissions, 2.4 GHz, Mid 900 MHz, High Channel, 30 MHz – 1 GHz

Spurious Emission of 1GHz- 18GHz

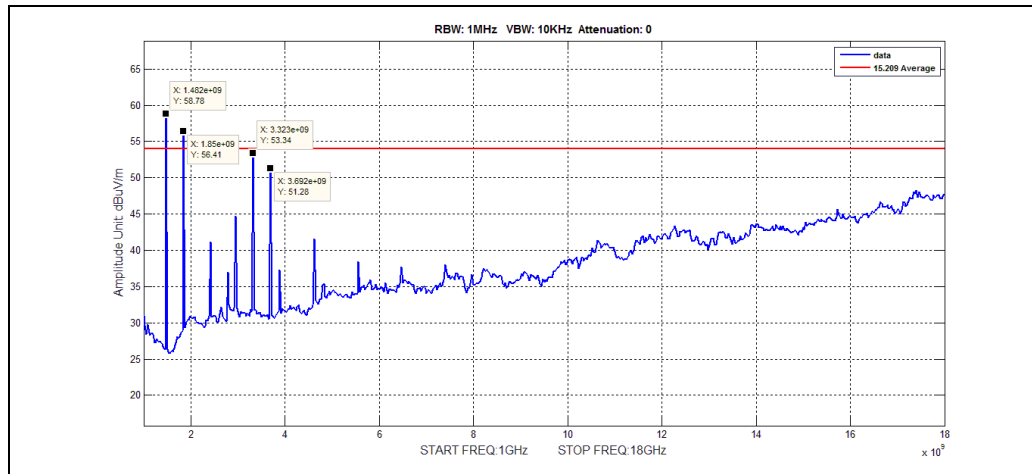
Note: Spurs above the limit are marked and identified and data is presented in the table at the end of this section. Table shows the applicable duty cycle correction to the spurs and the final measurement were recorded in the table. Plots shown represent the worst case only.



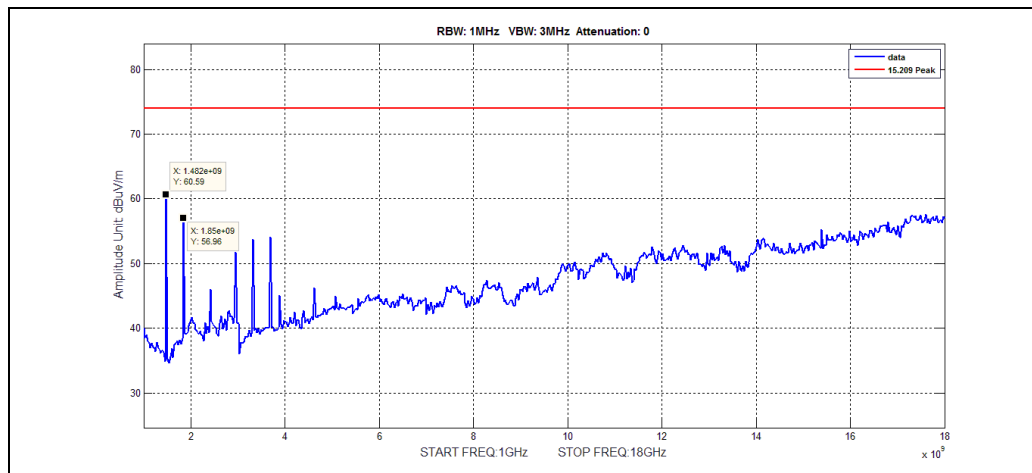
Plot 19. Spurious Emissions, 2.4 GHz, Low 900 MHz, Mid Channel, 1 GHz – 18 GHz, Average



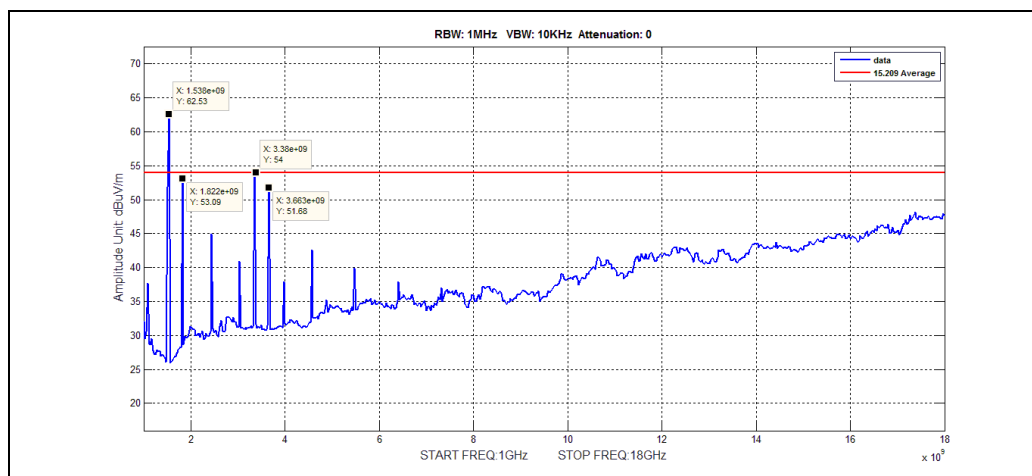
Plot 20. Spurious Emissions, 2.4 GHz, Low 900 MHz, Mid Channel, 1 GHz – 18 GHz, Peak



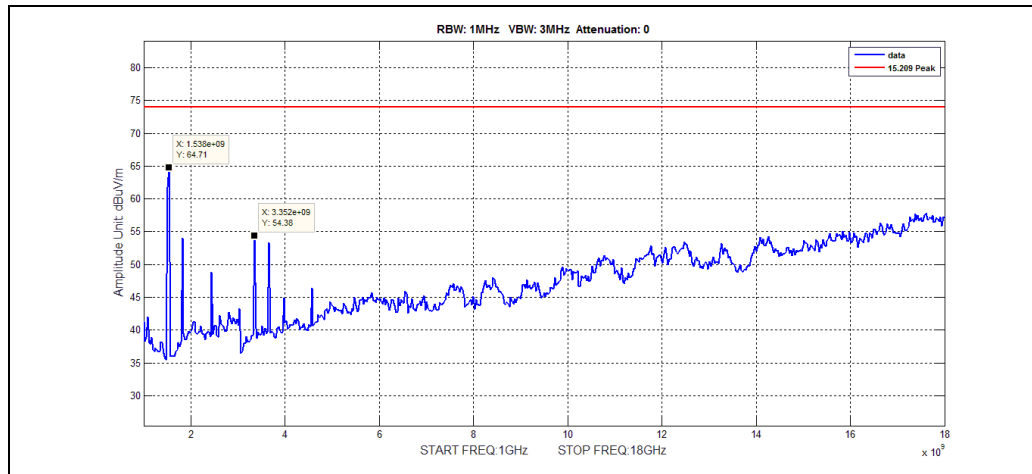
Plot 21. Spurious Emissions, 2.4 GHz, Low 900 MHz, High Channel, 1 GHz – 18 GHz, Average



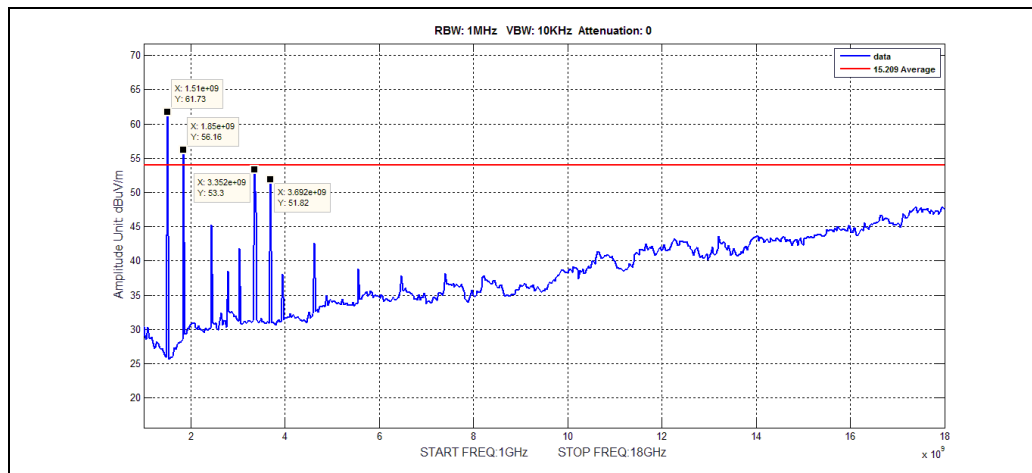
Plot 22. Spurious Emissions, 2.4 GHz, Low 900 MHz, High Channel, 1 GHz – 18 GHz, Peak



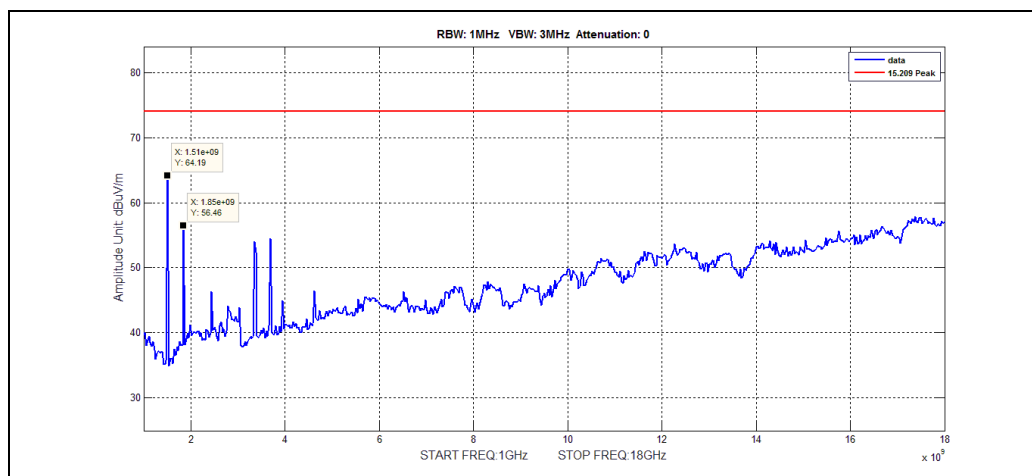
Plot 23. Spurious Emissions, 2.4 GHz, Mid 900 MHz, Mid Channel, 1 GHz – 18 GHz, Average



Plot 24. Spurious Emissions, 2.4 GHz, Mid 900 MHz, Mid Channel, 1 GHz – 18 GHz, Peak



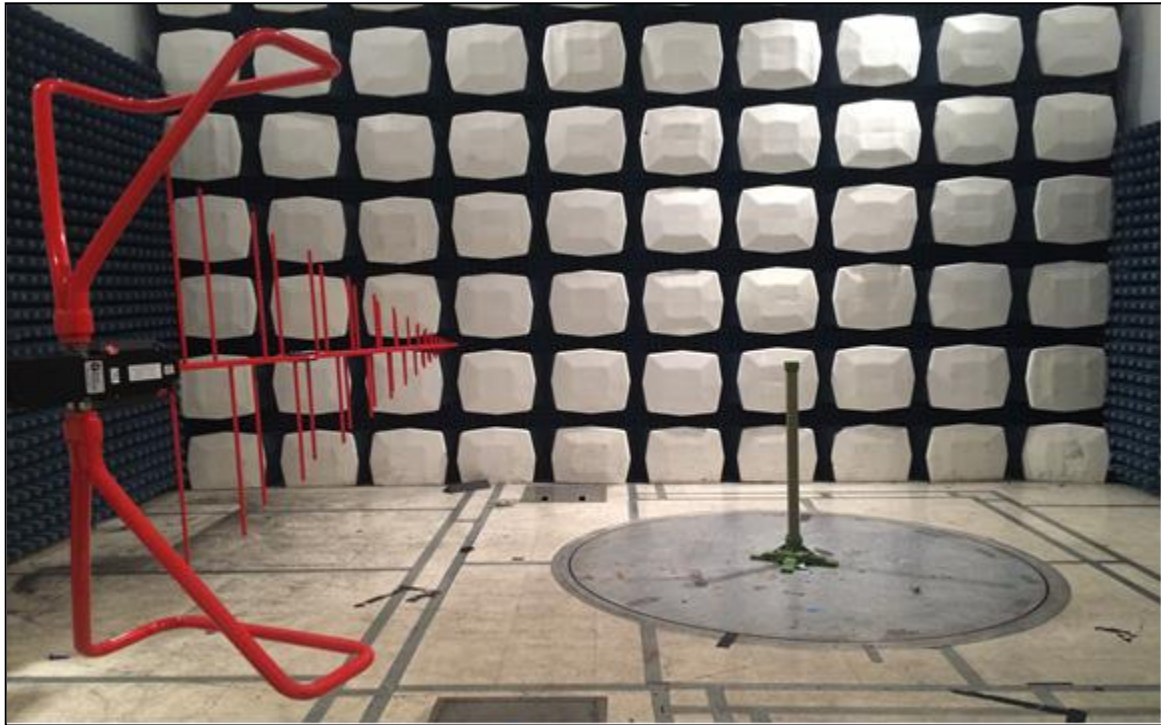
Plot 25. Spurious Emissions, 2.4 GHz, Mid 900 MHz, High Channel, 1 GHz – 18 GHz, Average



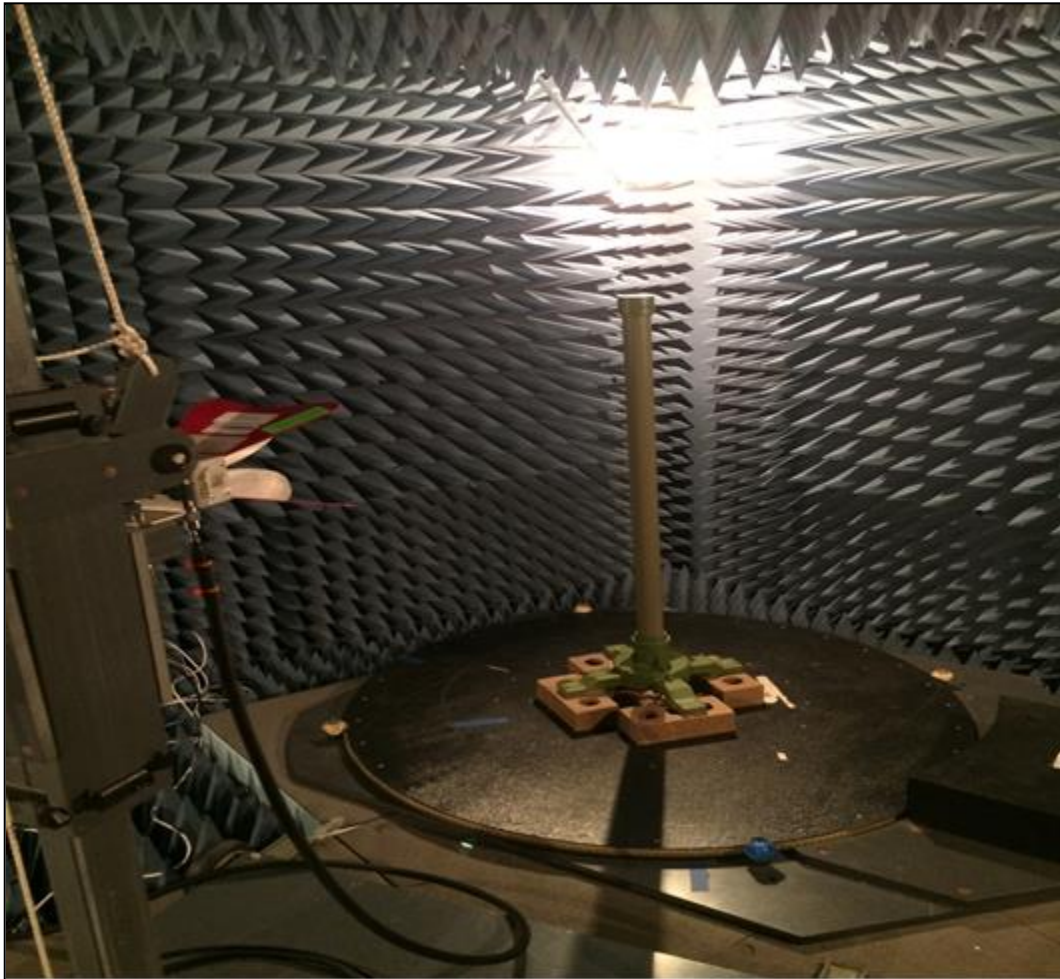
Plot 26. Spurious Emissions, 2.4 GHz, Mid 900 MHz, High Channel, 1 GHz – 18 GHz, Peak

Frequencies Above Average Rad Spurious Emission Above 1GHz							
2.4GHz Channel	900MHz Channel	Frequency	Strength dBμV/m	Duty Cycle	Final Reading dBμV/m	Limit dBμV/m	Margin
low	low	1.151GHz	61.73	17	44.73	54	-9.27
		1.85GHz	56.16	17	39.16	54	-14.84
		3.352GHz	53.3	17	36.3	54	-17.7
low	mid	1.482GHz	58.92	17	41.92	54	-12.08
		1.822GHz	53.03	17	36.03	54	-17.97
low	high	1.482GHz	58.78	17	41.78	54	-12.22
		1.85GHz	56.41	17	39.41	54	-14.59
		3.323GHz	53.34	17	36.34	54	-17.66
mid	low	1.538GHz	63.57	17	46.57	54	-7.43
		1.85GHz	54	17	37	54	-17
		3.38GHz	54	17	37	54	-17
mid	mid	1.538GHz	62.53	17	45.53	54	-8.47
		1.822GHz	53.09	17	36.09	54	-17.91
		3.38GHz	54	17	37	54	-17
mid	high	1.51GHz	61.73	17	44.73	54	-9.27
		1.85GHz	56.16	17	39.16	54	-14.84
		3.352GHz	53.3	17	36.3	54	-17.7
high	low	1.567GHz	66.24	17	49.24	54	-4.76
		1.822	54.61	17	37.61	54	-16.39
		3.607GHz	53.05	17	36.05	54	-17.95
high	mid	1.567GHz	65.36	17	48.36	54	-5.64
		1.822GHz	54	17	37	54	-17
high	high	1.538GHz	64.29	17	47.29	54	-6.71
		1.85GHz	55.57	17	38.57	54	-15.43

Table 9. Frequencies Above Average Radiated Spurious Emissions, Above 1 GHz



Photograph 1. Radiated Spurious Emissions, Test Setup, Below 30 MHz - 1 GHz



Photograph 2. Radiated Spurious Emissions, Test Setup, Above 1 GHz - 18 GHz

Electromagnetic Compatibility Criteria for Intentional Radiators

20 dB Bandwidth

Test Procedure: The transmitter was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately 1% of the total emission bandwidth, VBW > RBW. The 20 dB Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels.

Test Results The EUT was compliant with this requirement.

The 20 dB Bandwidth was determined from the plots on the following pages.

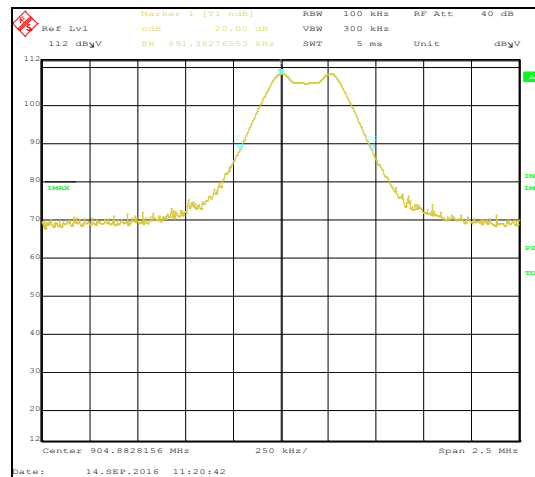
Test Engineer(s): Deepak Giri

Test Date(s): 09/19/16

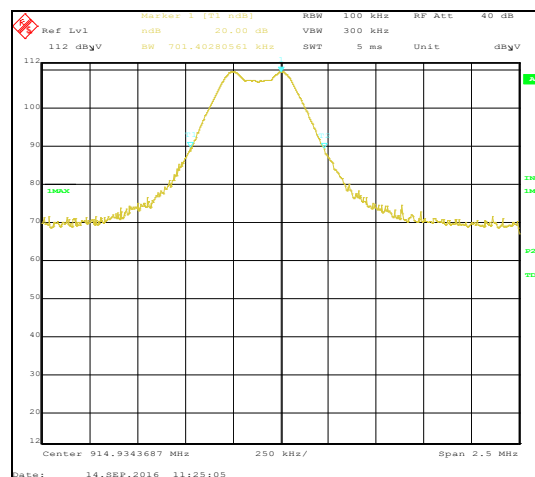
Occupied Bandwidth		
Frequency	Channel	20dB Bandwidth
904.88 MHz	Low	691.38 KHz
914.93 MHz	Mid	701.40 KHz
924.68 MHz	High	686.37 KHz

Table 10. 20 dB Bandwidth, Test Results

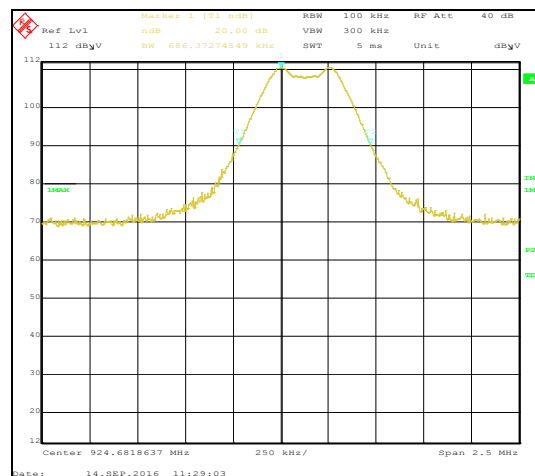
20 dB Bandwidth Test Results



Plot 27. 20 dB Bandwidth, Low Channel



Plot 28. 20 dB Bandwidth, Mid Channel



Plot 29. 20 dB Bandwidth, High Channel

Electromagnetic Compatibility Criteria for Intentional Radiators

Duty Cycle Calculation

Test Engineer(s): Deepak Giri

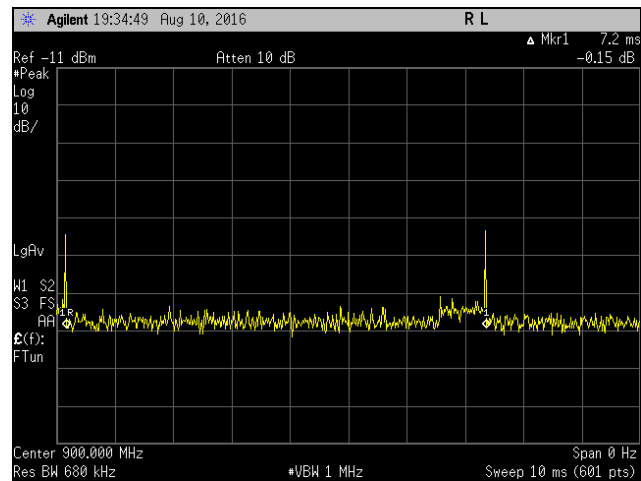
Test Date(s): 09/19/16

Frequency Band	Period mS	On Time mS	Duty Cycle
902-928 MHz	7.2	0.9676	-17.43273273

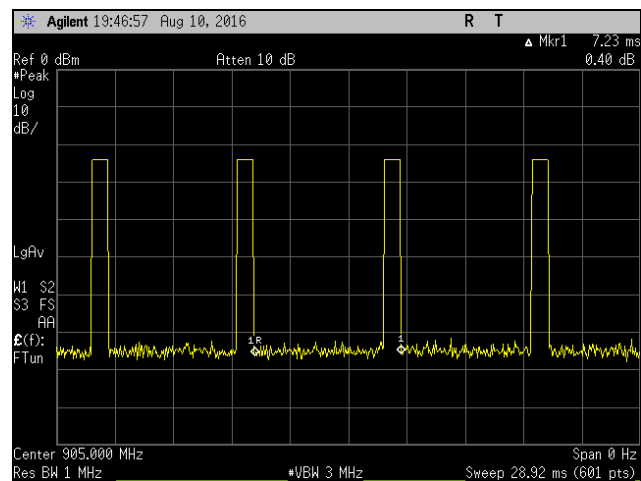
Table 11. Duty Cycle, Test Results

Note: Duty Cycle = On Time / Period
In dB = $20 \cdot \log(\text{Duty Cycle})$

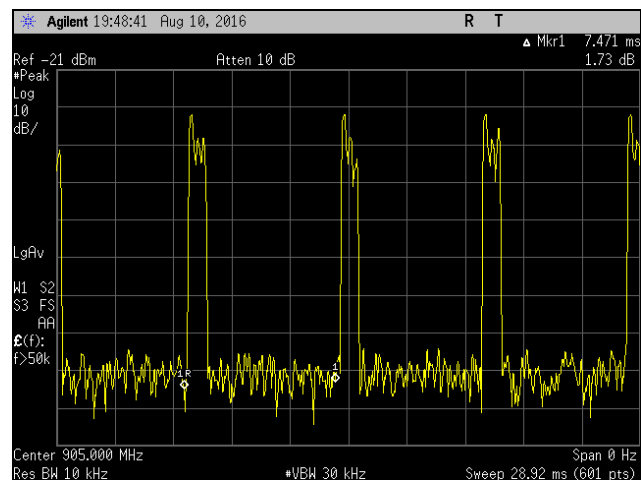
Duty Cycle



Plot 30. Duty Cycle, Period at 10 ms Sweep Time



Plot 31. Duty Cycle, Period at 28.92 ms with 1 MHz Resolution Bw



Plot 32. Duty Cycle, Period_10 kHz at 28.92 ms Sweep Time

IV. Test Equipment

Test Equipment

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

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1U0150	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB7	6/9/2016	6/9/2017
1T4751	ANTENNA - BILOG	SUNOL SCIENCES	JB6	2/26/2016	8/26/2017
1T4300	SEMI-ANECHOIC CHAMBER # 1 (NSA)	EMC TEST SYSTEMS	NONE	2/6/2015	2/6/2018
1T4859	DIGITAL BAROMETER, HYGROMETER, THERMOMETER	CONTROL COMPANY	15-078-198, FB70423, 245CD	2/10/2016	2/10/2018
1T4771	PSA SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4446A	8/10/2016	2/10/2018
1T4442	PRE-AMPLIFIER, MICROWAVE	MITEQ	AFS42- 01001800-30-10P	SEE NOTE	
1T4483	ANTENNA; HORN	ETS-LINDGREN	3117	10/8/2015	4/8/2017
1T4149	HIGH-FREQUENCY ANECHOIC CHAMBER	RAY PROOF	81	NOT REQUIRED	

Table 12. Test Equipment

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

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.



ICES-003 Procedural & Labeling Requirements

From the Industry Canada Electromagnetic Compatibility Advisory Bulletin entitled, "Implementation and Interpretation of the Interference-Causing Equipment Standard for Digital Apparatus, ICES-003" (EMCAB-3, Issue 2, July 1995):

"At present, CISPR 22: 2002 and ICES technical requirements are essentially equivalent. Therefore, if you have CISPR 22: 2002 approval by meeting CISPR Publication 22, the only additional requirements are: to attach a note to the report of the test results for compliance, indicating that these results are deemed satisfactory evidence of compliance with ICES-003 of the Canadian Interference-Causing Equipment Regulations; to maintain these records on file for the requisite five year period; and to provide the device with a notice of compliance in accordance with ICES-003."

Procedural Requirements:

According to Industry Canada's Interference Causing Equipment Standard for Digital Apparatus ICES-003 Issue 4, February 2004:

- Section 6.1: A record of the measurements and results, showing the date that the measurements were completed, shall be retained by the manufacturer or importer for a period of at least five years from the date shown in the record and made available for examination on the request of the Minister.
- Section 6.2: A written notice indicating compliance must accompany each unit of digital apparatus to the end user. The notice shall be in the form of a label that is affixed to the apparatus. Where because of insufficient space or other constraints it is not feasible to affix a label to the apparatus, the notice may be in the form of a statement in the user's manual.

Labeling Requirements:

The suggested text for the notice, in English and in French, is provided below, from the Annex of ICES-003:

This Class [²] digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe [¹] est conforme à la norme NMB-003 du Canada.

² Insert either A or B but not both as appropriate for the equipment requirements.

End of Report