W66 N220 Commerce Court ● Cedarburg, WI 53012 USA ● Phone: 262.375.4400 ● Fax: 262.375.4248 ● www.lsr.com

ENGINEERING TEST REPORT # TR 315260 A
LSR Job #: C-2343

Compliance Testing of:
940-0132 Module

Test Date(s):
November 2015

Prepared For:
Rain Bird Corporation
6691 East Southpoint Rd
Tucson, AZ 85756

This Test Report issued:
Adam Alger, Quality Systems Engineer – Test Services

Signature: Date: 3-14-16

Quality Assurance by:	**Report by:**
Peter Feilen, EMC Engineer	Adam Alger, EMC Engineer
Signature: Date: 11-20-15	Signature: Date: 11-17-15

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LS Research, LLC in Review

As an EMC Testing Laboratory, our Accreditation and Assessments are recognized through the following:

TESTING CERT #1255.01

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025: 2005 with Electrical (EMC) Scope of Accreditation
A2LA Certificate Number: 1255.01

Federal Communications Commission (FCC) – USA

Listing of 3 Meter Semi-Anechoic Chamber based on Title 47 CFR – Part 2.948
FCC Registration Number: 90756

Industrie Canada Industry Canada

Canada

Industry Canada

On file, 3 Meter Semi-Anechoic Chamber based on RSS-GEN – Issue 4
File Number: IC 3088-2
On file, 3 Meter Semi-Anechoic Chamber based on RSS-GEN – Issue 4
File Number: IC 3088-3

U. S. Conformity Assessment Body (CAB) Validation

Validated by the European Commission as a U. S. Competent Body operating under the U. S./EU, Mutual Recognition Agreement (MRA) operating under the European Union Electromagnetic Compatibility –Council Directive 2004/108/EC (formerly 89/336/EEC, Article 10.2).
Date of Validation: January 16, 2001

Validated by the European Commission as a U.S. Notified Body operating under the U.S. /EU, Mutual Recognition Agreement (MRA) operating under the European Union Telecommunication Equipment – Council Directive 99/5/EC, Annex V.
Date of Validation: November 20, 2002
Notified Body Identification Number: 1243

1.0 Summary of Test Report

In November 2015 the EUT, 940-0132 Module, as provided by Rain Bird Corporation was tested and MEETS the following requirements:

FCC Requirement	IC Requirement	Test Requirements	Measurement Procedure	Compliance (Yes/No)
15.247 (a)(2)	RSS-247 Section 5.2 (1)	6 dB Bandwidth of a Digital Modulation System	ANSI C63.10-2013 Section 11.8	Yes
15.247(b) & 1.1310	RSS-247 Section 5.4 (4)	Maximum Output Power	ANSI C63.10-2013 Section 11.9	Yes
15.247 (e)	RSS-247 Section 5.2 (2)	Power Spectral Density of a Digital Modulation System	ANSI C63.10-2013 Section 11.10	Yes
15.247(d)	RSS-247 Section 5.5	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	ANSI C63.10-2013 Section 11.11	Yes
15.247(c), 15.209 & 15.205	RSS-GEN Section 8.9, 8.10	Transmitter Radiated Emissions in Restricted Bands	ANSI C63.10-2013 Section 11.12 (6.3,6.5,6.6)	Yes
2.1055 (d)	RSS-GEN Section 6.11	Frequency Stability	ANSI C63.10-2013 Section 6.8	Yes
15.207 15.107	RSS-GEN Section 8.8	Power Line Conducted Emissions Measurements	ANSI C63.10-2013 Section 6.2	Yes
15.109	RSS-GEN Section 7	Receive Mode (Digital Device) Radiated Emissions	ANSI C63.4-2014 Section 8	Yes

2.0 Test Facilities

All testing was performed at:

LS Research, LLC
W66 N220 Commerce Court
Cedarburg, Wisconsin, 53012 USA

LS Research, LLC is accredited by A2LA (American Association for Laboratory Accreditation) to the requirements of ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.
LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted.

3.0 Client Information

Manufacturer Name:	Rain Bird Corporation
Address:	6991 E. Southpoint Road, Tucson, AZ 85756
Contact Person:	Anderson Micu

3.1 Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	940-0132 Module
Model Number:	940-0132
Serial Number:	None (Engineer Sample)
FCC ID:	2AGQP-F5500
IC:	20936-F5500

3.2 Product Information

IEEE 802.11 b/g/n (20 MHz channels only) with chip antennas (diversity)

3.3 Modifications Incorporated In the EUT for Compliance Purposes

None noted at time of test

3.4 Deviations & Exclusions from Test Specifications

None noted at time of test

3.5 Additional Information

Programmed for continuous transmit and receive on channels 1-11 (2412-2462 MHz) using special test fixture with UART to USB connection to PC running TiWi-C-W Eval Tool V1.3.0.0.
EUT fitted with temporary connection for RF Conducted measurements

4.0 Conditions of Test

Environmental:

Temperature: 20-25º C
Relative Humidity: 30-60%
Atmospheric Pressure: 86-106 kPa

Mains Voltage: 120 VAC 60 Hz (24 VAC supplied to EUT)

5.0 Test Equipment

All test equipment is calibrated by a calibration laboratory accredited by A2LA to the requirements of ISO 17025. For a complete list of test equipment and calibration dates, see Appendix A. Unless otherwise noted, resolution bandwidth of measuring instrument used during testing for given frequency range, see below.

Frequency Range	Resolution Bandwidth
9 kHz – 150 kHz	200 Hz
150 kHz – 30 MHz	9 kHz
30 MHz – 1000 MHz	120 kHz
Above 1000 MHz	1 MHz

6.0 Conformance Summary

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.247, 15.207, Industry Canada RSS-247, Issue 1 (2015), Annex 8, RSS-GEN Issue 4 (2014).

If some emissions are seen to be within 3 dB of their respective limits:
As these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

LS Research, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

Appendix A – Test Equipment

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 8-Oct-2015 Type Test : Emissions Job # : C-2343

Prepared By: Adam Alger Customer : Rain Bird Corporation Quote #: 315260

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960005	Biconical Antenna	EMCO	93110B	9601-2280	8/6/2015	8/6/2016	Active Calibration
2	AA 960163	Log Periodic Antenna	A.H. Systems, In	SAS-512-2	500	3/16/2015	3/16/2016	Active Calibration
3	AA 960158	Double Ridge Horn Antenna	ETS Lindgren	3117	109300	7/9/2015	7/9/2016	Active Calibration
4	EE 960159	0.8 - 21GHz LNA	Mini-Circuits	ZVA-213X-S+	740411007	7/9/2015	7/9/2016	Active Calibration
5	EE 960089	LISN - 15A	COM-POWER	LI-215A	191943	3/2/2015	3/2/2016	Active Calibration
6	EE 960085	N9038A MXE 26.5GHz Receiver	Agilent	N9038A	MY51210148	5/6/2015	5/6/2016	Active Calibration
7	EE 960146	Std. Gain Horn Ant. w/preamp	Adv. Micro / EM	WLA622-4 / 3160-09	123001	8/19/2015	8/19/2016	Active Calibration

Project Engineer: Adam Alger Quality Assurance:

Appendix B – Test Data
B.1 – RF Conducted Emissions

Manufacturer	Rain Bird Corporation
Test Location	LS Research, LLC
Rule Part	FCC 15.247 IC RSS-247
General Measurement Procedure	ANSI C63.10 Section 6.7
General Description of Measurement	A direct measurement of the transmitted signal was performed at the antenna port of the EUT via a cable connection to a spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings there by allowing direct measurements, without the need for any further corrections. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source.

B.1.1 – RF Conducted – Fundamental Bandwidth

Manufacturer	Rain Bird Corporation
Date	11-12-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247 (a)(2) IC RSS-247 Section 5.2(1)
Specific Measurement Procedure	ANSI C63.10-2013 Section 11.8
Additional Description of Measurement	Peak detector used
Additional Notes	Continuous transmit modulated used for this test.

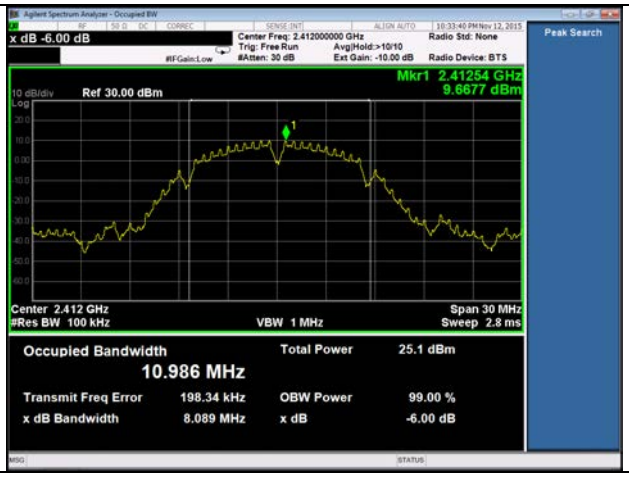
Table - Antenna 1

Mode (802.11)	Mode (Mbps)	Frequency (MHz)	6 dB DTS BW (MHz)	99 % BW (MHz)	20 dB OBW (MHz)
b	1	2412	8.09	10.96	13.17
		2437	8.08	10.95	13.18
		2462	8.08	10.74	12.90
g	6	2412	16.38	17.24	20.61
		2437	16.38	17.20	20.58
		2462	16.38	17.21	20.55
n	6.5	2412	17.63	18.28	20.97
		2437	17.62	18.26	20.92
		2462	17.64	18.19	20.99

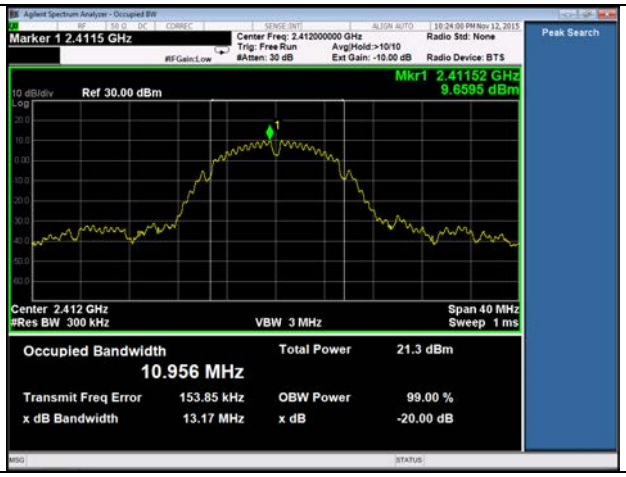
Antenna 2

Mode (802.11)	Mode (Mbps)	Frequency (MHz)	6 dB DTS BW (MHz)	99 % BW (MHz)	20 dB OBW (MHz)
b	1	2412	8.08	11.41	13.25
		2437	8.06	11.30	13.23
		2462	8.09	10.90	13.16
g	6	2412	16.42	17.23	20.58
		2437	16.41	17.24	20.57
		2462	16.40	17.22	20.49
n	6.5	2412	17.62	18.25	21.05
		2437	17.64	18.28	21.02
		2462	17.62	18.25	20.95

Antenna 1
Plots 802.11b – 1 Mbps
Low Channel – 2412 MHz

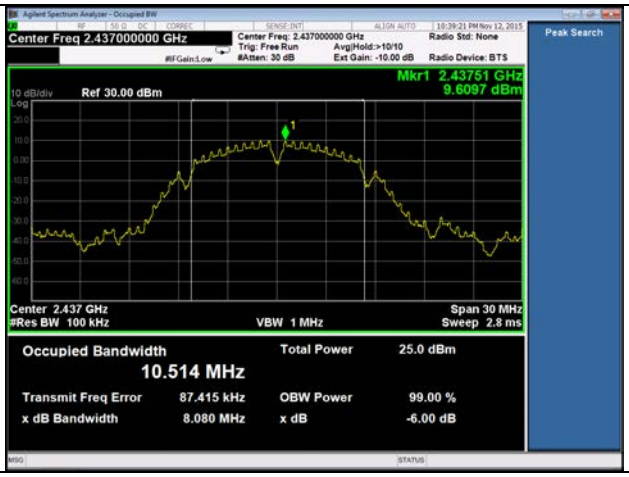


6 dB DTS BW

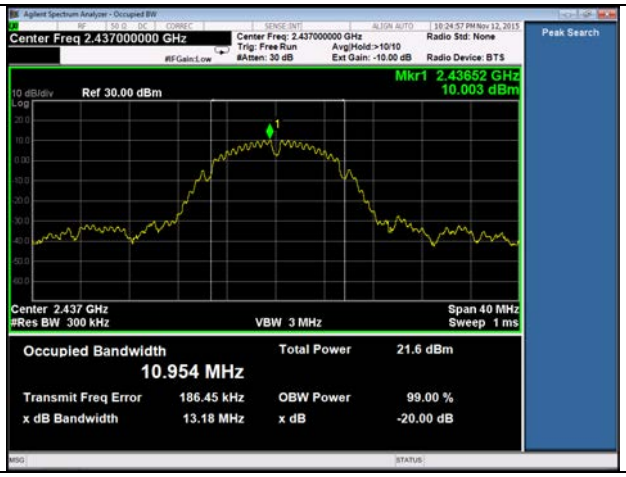


20 dB OBW + 99% BW

Mid Channel – 2437 MHz

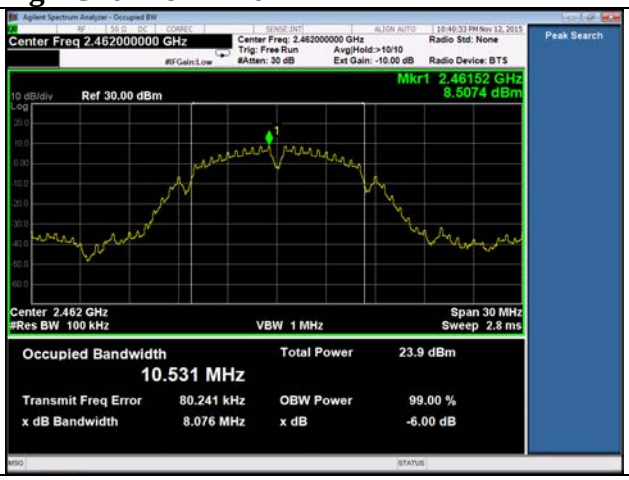


6 dB DTS BW

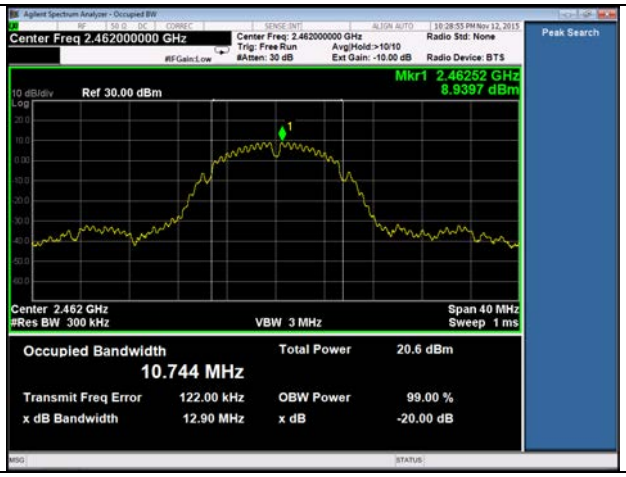


20 dB OBW + 99% BW

High Channel – 2462 MHz

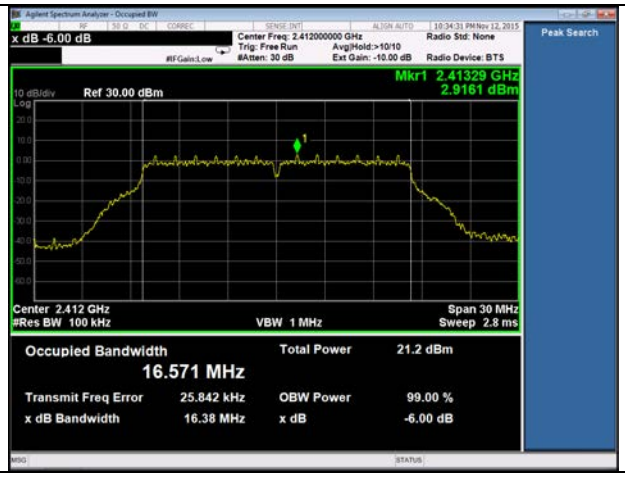


6 dB DTS BW

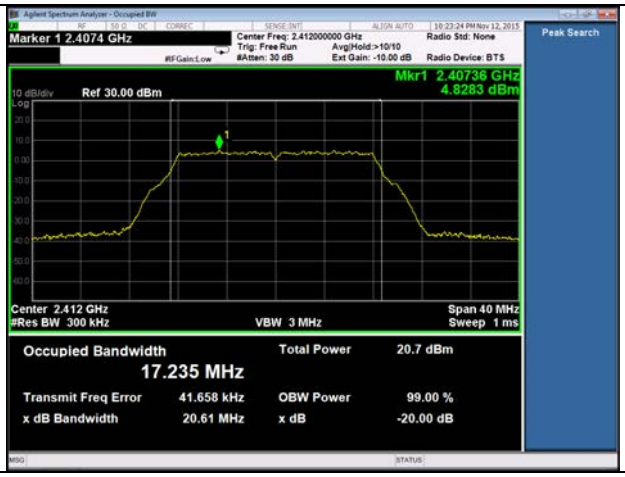


20 dB OBW + 99% BW

Antenna 1
802.11b – 6 Mbps
Low Channel – 2412 MHz

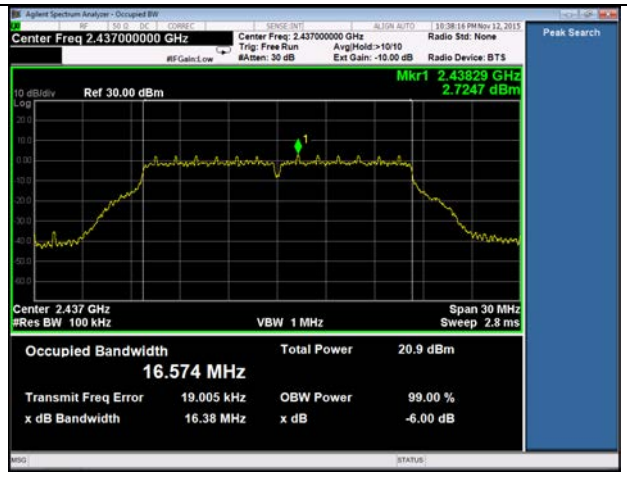


6 dB DTS BW

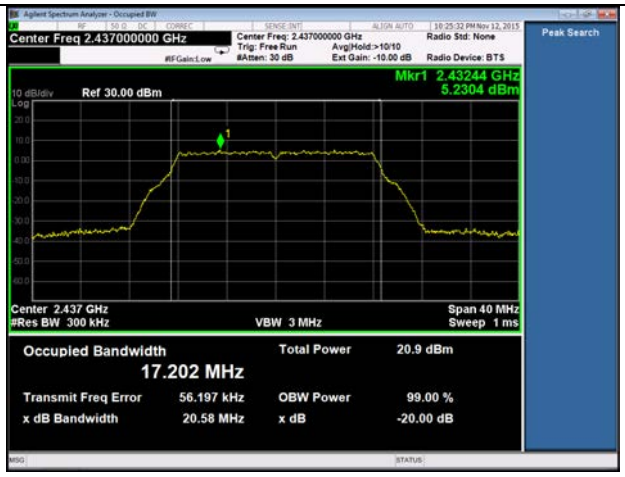


20 dB OBW + 99% BW

Mid Channel – 2437 MHz

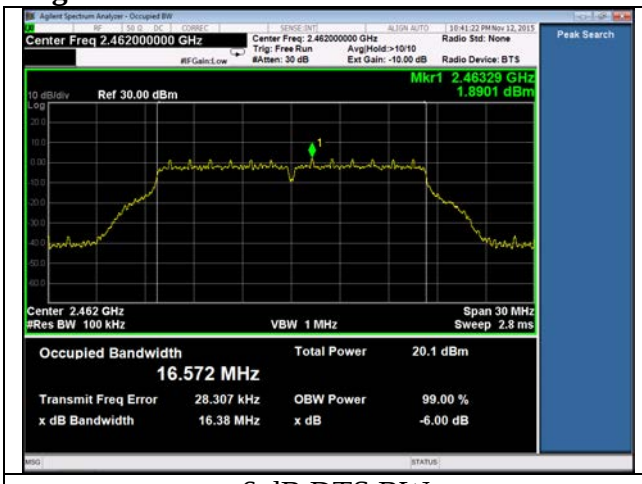


6 dB DTS BW

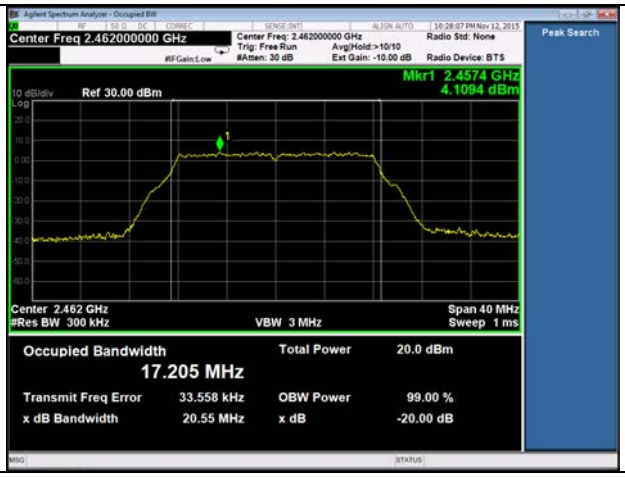


20 dB OBW + 99% BW

High Channel – 2462 MHz

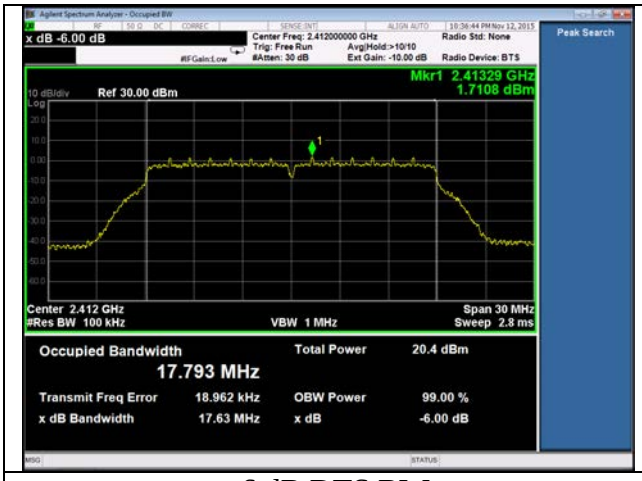


6 dB DTS BW

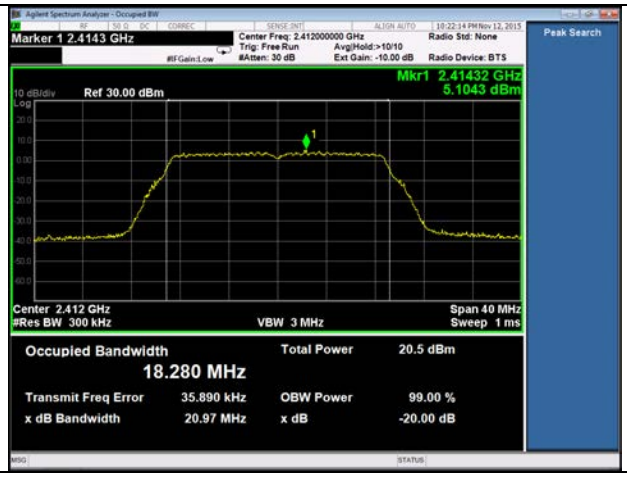


20 dB OBW + 99% BW

Antenna 1
802.11n – 6.5 Mbps
Low Channel – 2412 MHz

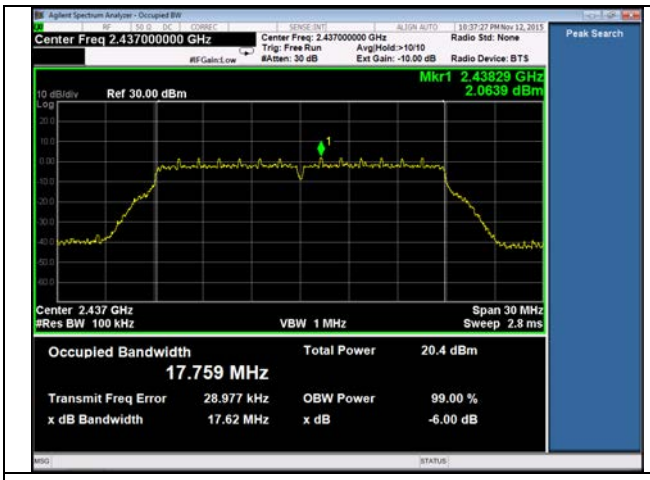


6 dB DTS BW

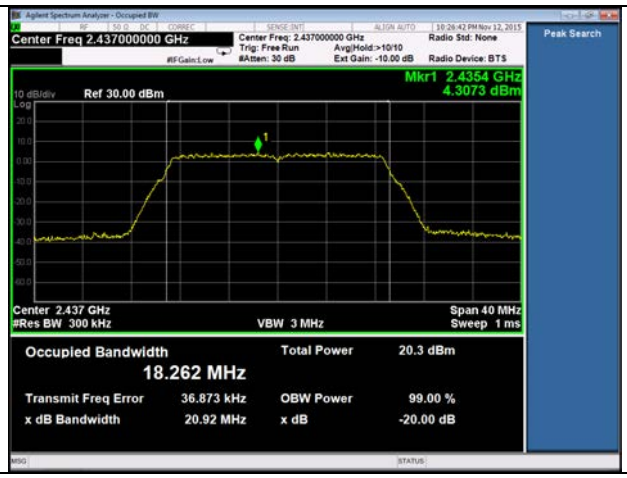


20 dB OBW + 99% BW

Mid Channel – 2437 MHz



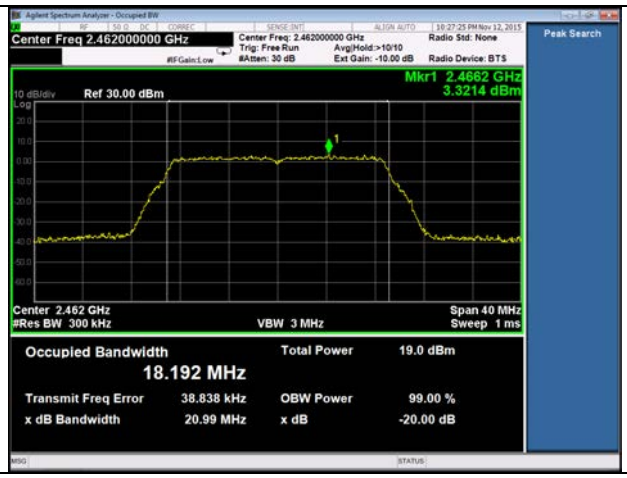
6 dB DTS BW



20 dB OBW + 99% BW

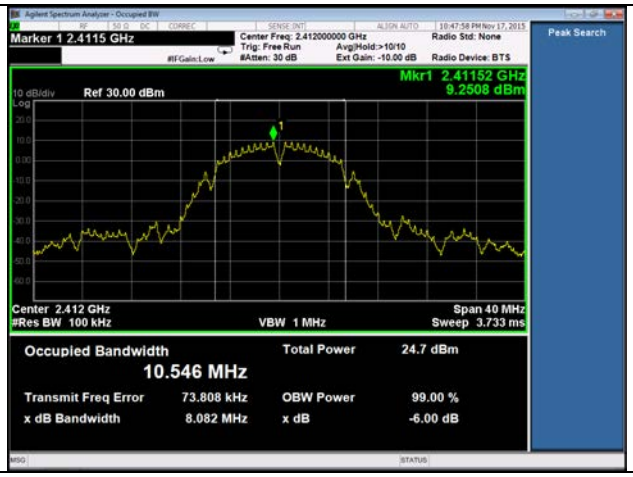
High Channel – 2462 MHz

6 dB DTS BW

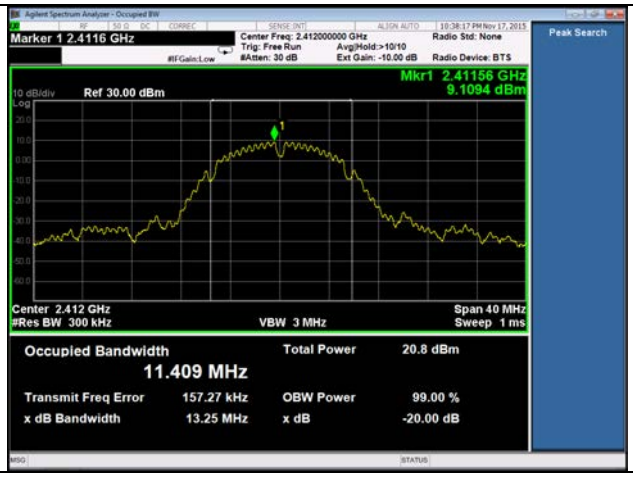


20 dB OBW + 99% BW

Antenna 2
Plots 802.11b – 1 Mbps
Low Channel – 2412 MHz

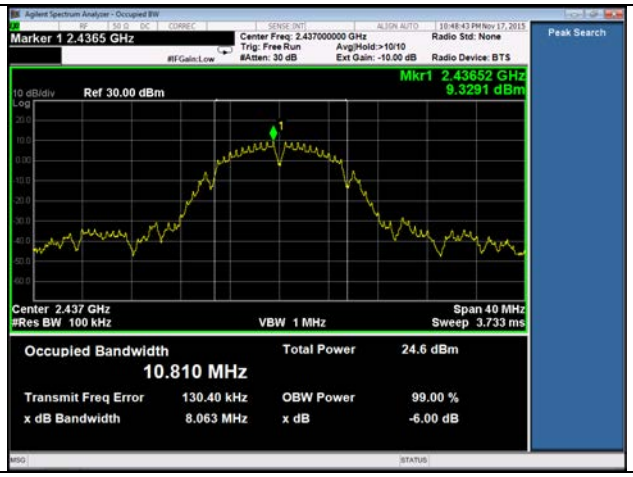


6 dB DTS BW



20 dB OBW + 99% BW

Mid Channel – 2437 MHz



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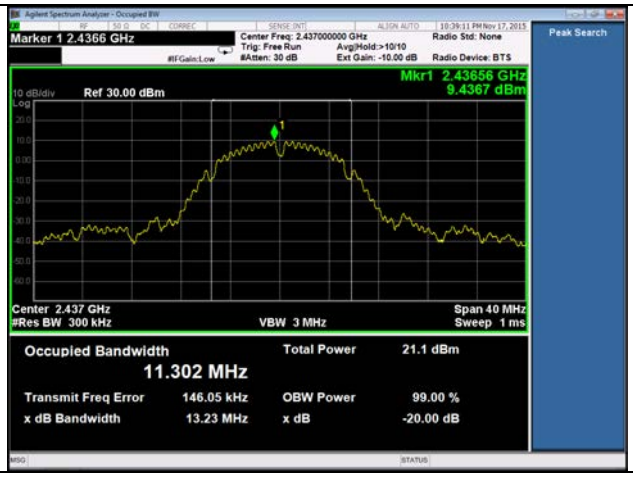
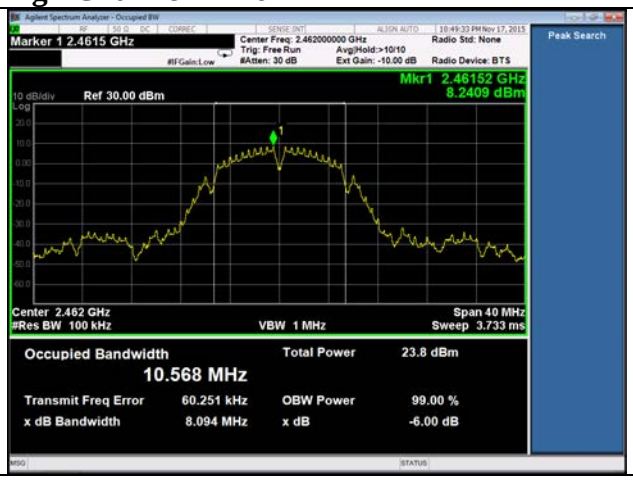
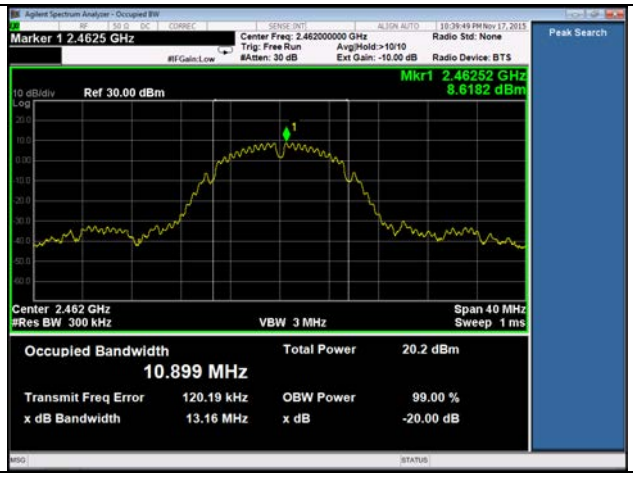


20 dB OBW + 99% BW

High Channel – 2462 MHz

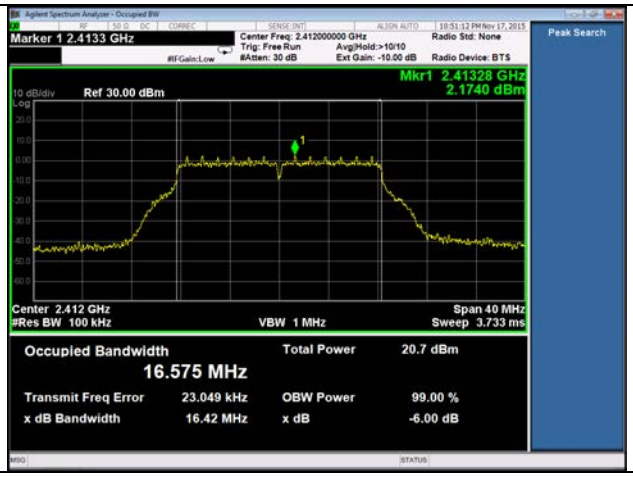


6 dB DTS BW



20 dB OBW + 99% BW

Antenna 2
802.11b – 6 Mbps
Low Channel – 2412 MHz



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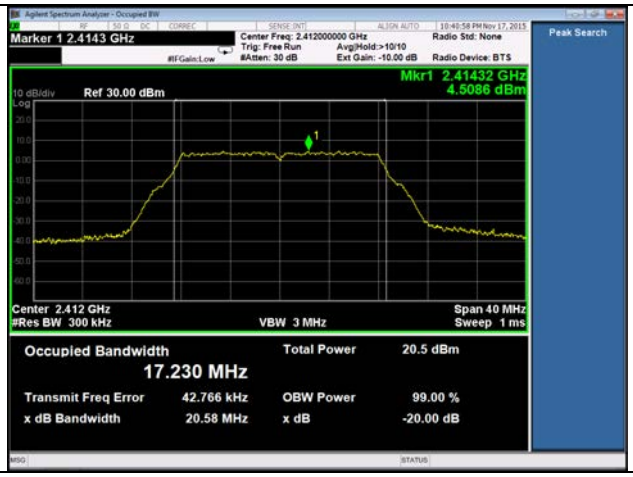
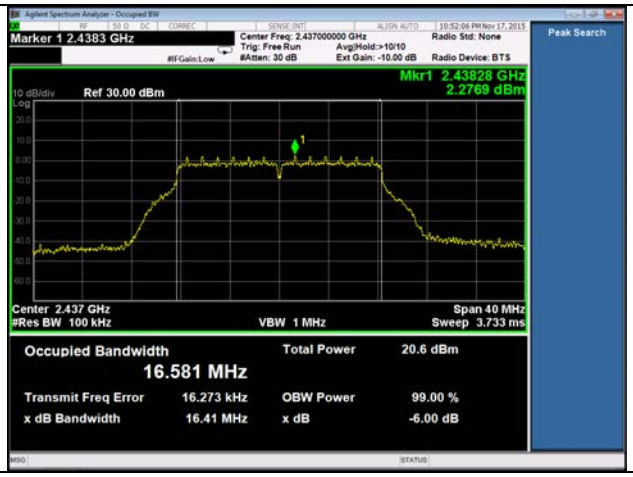
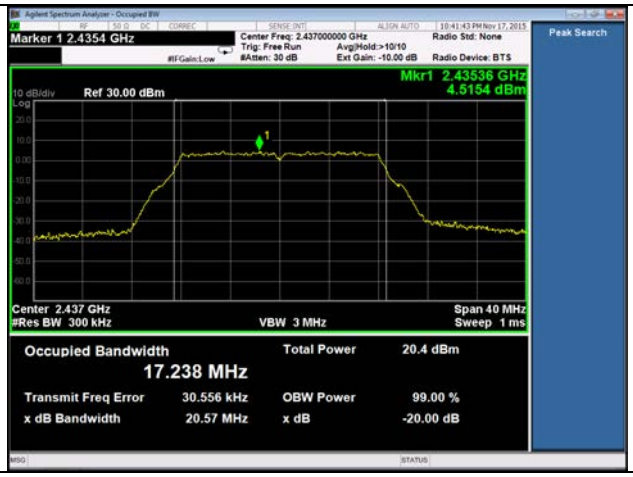


20 dB OBW + 99% BW

Mid Channel – 2437 MHz

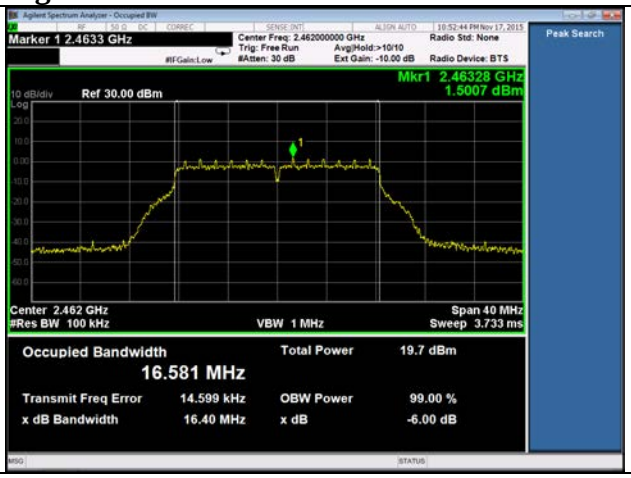


6 dB DTS BW

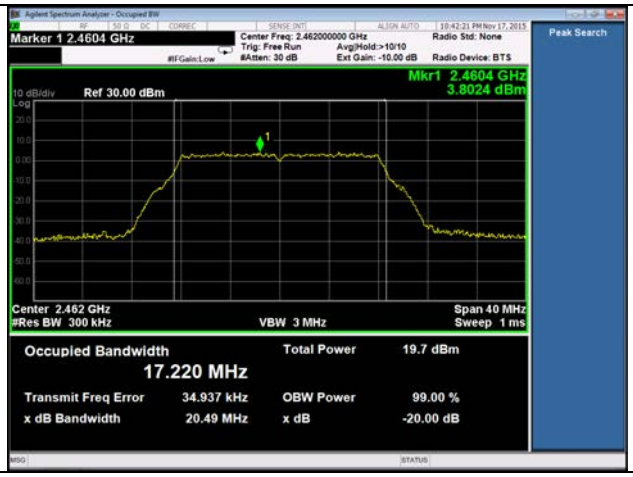


20 dB OBW + 99% BW

High Channel – 2462 MHz

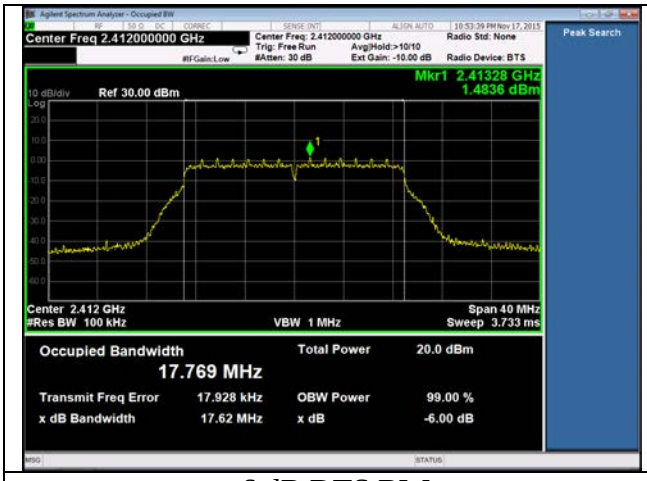


6 dB DTS BW

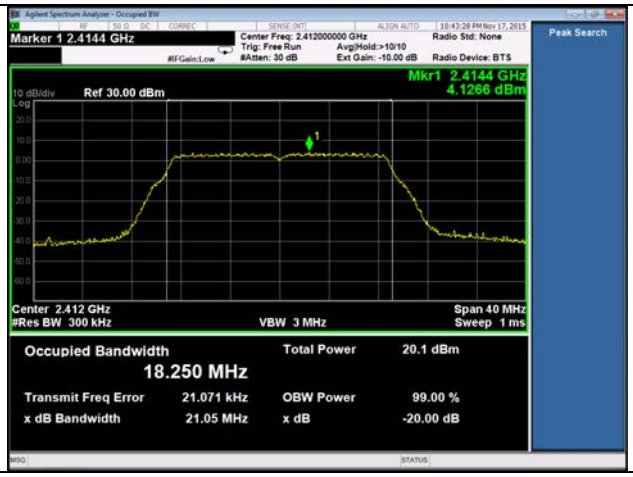


20 dB OBW + 99% BW

Antenna 2
802.11n – 6.5 Mbps
Low Channel – 2412 MHz

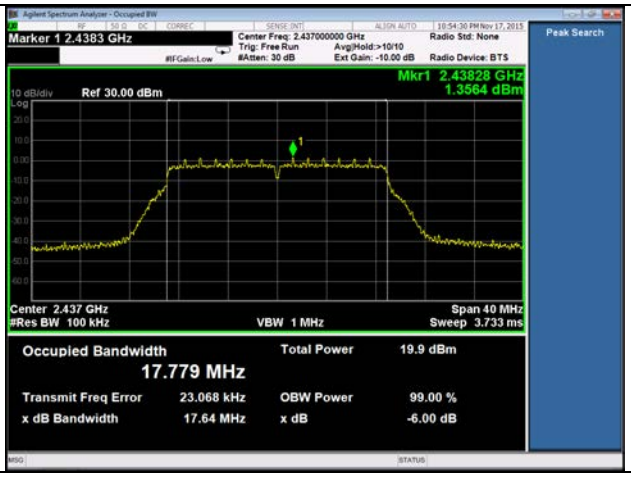


6 dB DTS BW

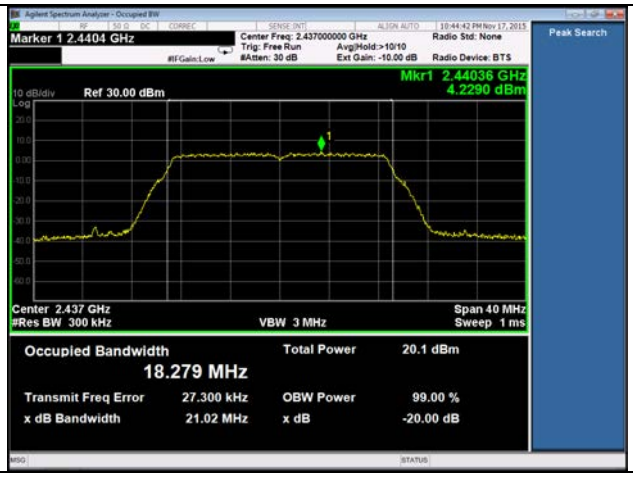


20 dB OBW + 99% BW

Mid Channel – 2437 MHz

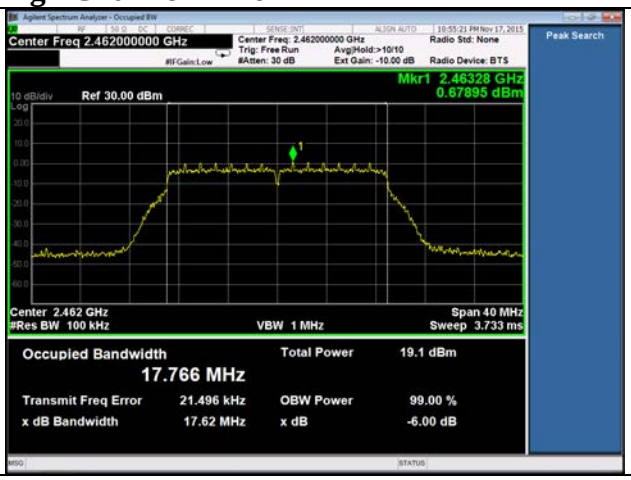


6 dB DTS BW

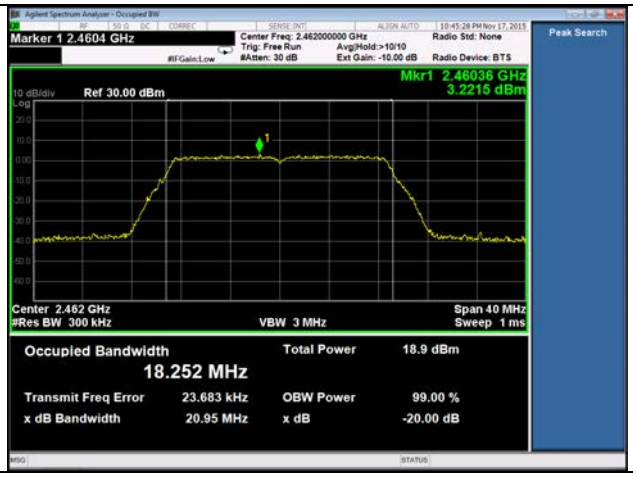


20 dB OBW + 99% BW

High Channel – 2462 MHz



6 dB DTS BW



20 dB OBW + 99% BW

B.1.2 – RF Conducted – Fundamental Power and Spectral Density

Manufacturer	Rain Bird Corporation
Date	11-12-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247 (b) & (e) IC RSS-247 Section 5.4 (4) & 5.2 (2)
Specific Measurement Procedure	ANSI C63.10-2013 Section 11.9 and 11.10
Additional Description of Measurement	100 kHz resolution bandwidth used for Power Spectral Density measurement
Additional Notes	Continuous transmit modulated used for this test. Sample Calculation: Margin (dB) = Limit – Measured level

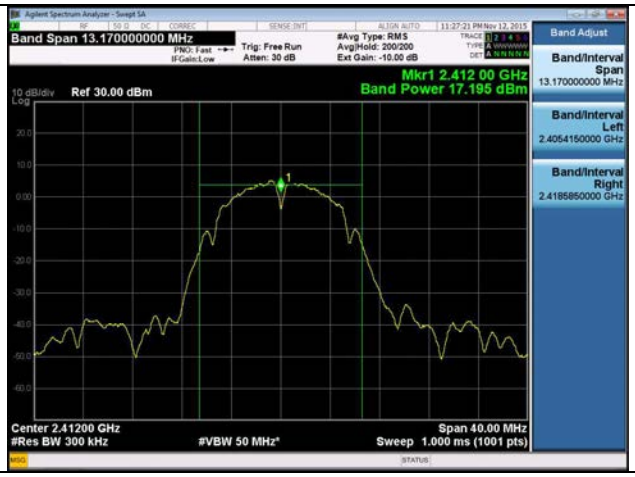
Table – Antenna 1

Mode (802.11)	Mode (Mbps)	Frequency (MHz)	6 dB DTS BW (MHz)	99 % BW (MHz)	20 dB OBW (MHz)	Meas Power (dBm)	Duty (dB)	Max Avg. Power (dBm)	Max Avg. Power Limit (dBm)	Max Avg. Power Margin (dB)	Meas PSD 100 kHz (dBm)	Duty (dB)	Max Avg. PSD 100 kHz (dBm)	Max Avg. PSD Limit (dBm / 3 kHz)	Max Avg. PSD Margin (dB)
b	1	2412	8.09	10.96	13.17	17.20	0.0	17.20	30	12.81	0.67	0.00	0.67	8	7.34
		2437	8.08	10.95	13.18	17.19	0.0	17.19		12.81	0.70	0.00	0.70		7.30
		2462	8.08	10.74	12.90	16.27	0.0	16.27		13.73	-0.40	0.00	-0.40		8.40
g	6	2412	16.38	17.24	20.61	13.32	0.1	13.42		16.58	-6.68	0.10	-6.58		14.58
		2437	16.38	17.20	20.58	13.35	0.1	13.45		16.55	-6.43	0.10	-6.33		14.33
		2462	16.38	17.21	20.55	12.65	0.1	12.75		17.25	-7.00	0.10	-6.90		14.90
n	6.5	2412	17.63	18.28	20.97	12.51	0.1	12.61		17.39	-7.56	0.10	-7.46		15.46
		2437	17.62	18.26	20.92	12.60	0.1	12.70		17.30	-8.18	0.10	-8.08		16.08
		2462	17.64	18.19	20.99	11.54	0.1	11.64		18.36	-9.12	0.10	-9.02		17.02

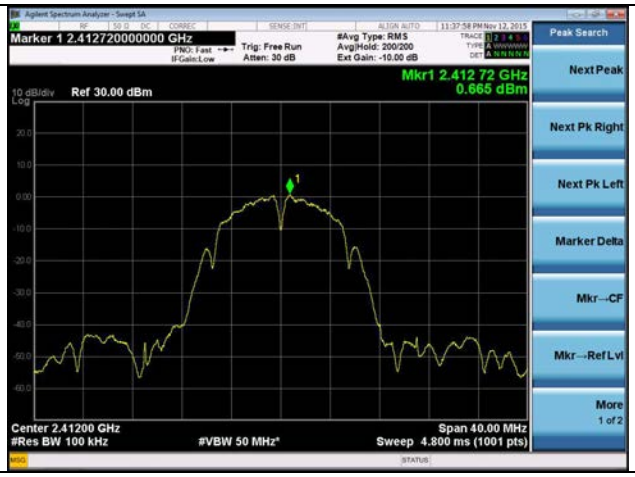
Antenna 2

Mode (802.11)	Mode (Mbps)	Frequency (MHz)	6 dB DTS BW (MHz)	99 % BW (MHz)	20 dB OBW (MHz)	Meas Power (dBm)	Duty (dB)	Max Avg. Power (dBm)	Max Avg. Power Limit (dBm)	Max Avg. Power Margin (dB)	Meas PSD 100 kHz (dBm)	Duty (dB)	Max Avg. PSD 100 kHz (dBm)	Max Avg. PSD Limit (dBm / 3 kHz)	Max Avg. PSD Margin (dB)
b	1	2412	8.08	11.41	13.25	16.88	0.0	16.88	30	13.12	0.27	0.00	0.27	8	7.73
		2437	8.06	11.30	13.23	17.01	0.0	17.01		13.00	0.72	0.00	0.72		7.28
		2462	8.09	10.90	13.16	16.02	0.0	16.02		13.98	-0.33	0.00	-0.33		8.33
g	6	2412	16.42	17.23	20.58	13.08	0.1	13.18		16.83	-7.12	0.10	-7.02		15.02
		2437	16.41	17.24	20.57	13.29	0.1	13.39		16.61	-6.85	0.10	-6.75		14.75
		2462	16.40	17.22	20.49	12.48	0.1	12.58		17.42	-7.71	0.10	-7.61		15.61
n	6.5	2412	17.62	18.25	21.05	12.19	0.1	12.29		17.72	-8.70	0.10	-8.60		16.60
		2437	17.64	18.28	21.02	12.21	0.1	12.31		17.69	-8.61	0.10	-8.51		16.51
		2462	17.62	18.25	20.95	11.36	0.1	11.46		18.55	-8.95	0.10	-8.85		16.85

Antenna 1
Plots - 802.11b – 1 Mbps
Low Channel – 2412 MHz

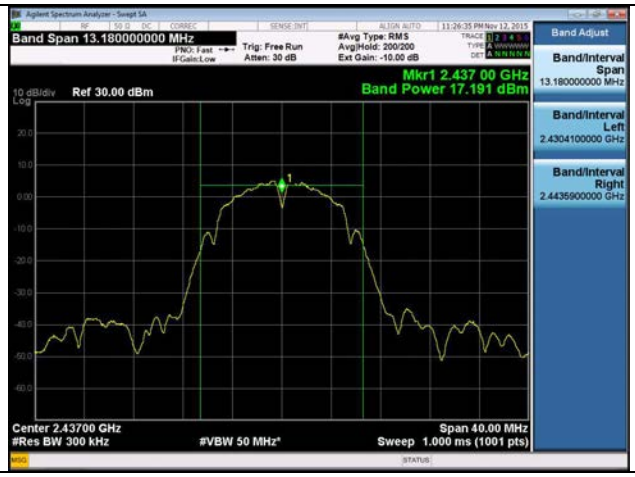


Output Power



Power Spectral Density

Mid Channel – 2437 MHz



Output Power

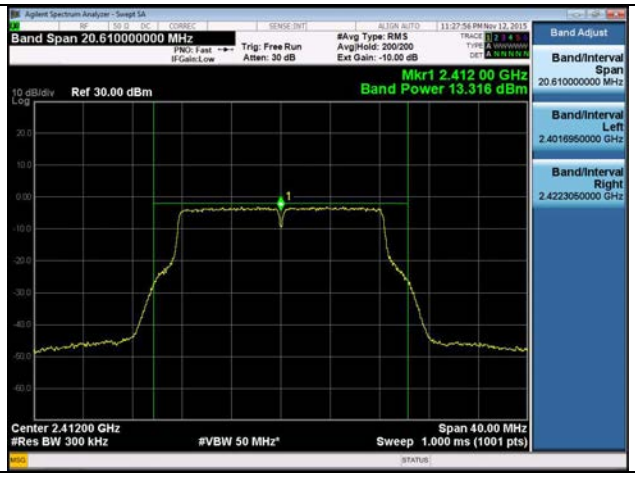
Power Spectral Density

High Channel – 2462 MHz

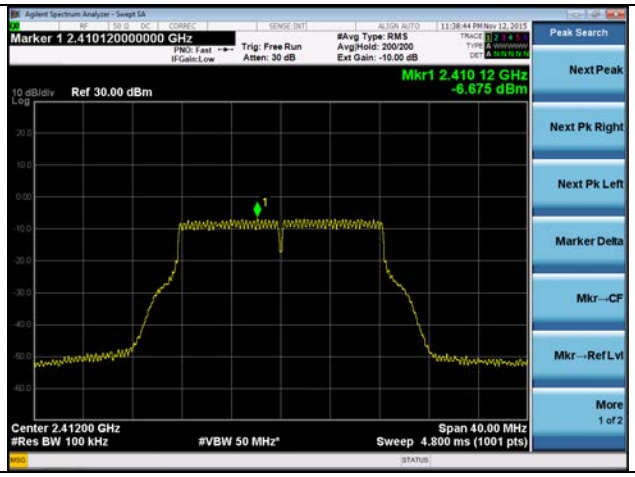
Output Power

Power Spectral Density

Antenna 1
802.11g – 6 Mbps
Low Channel – 2412 MHz

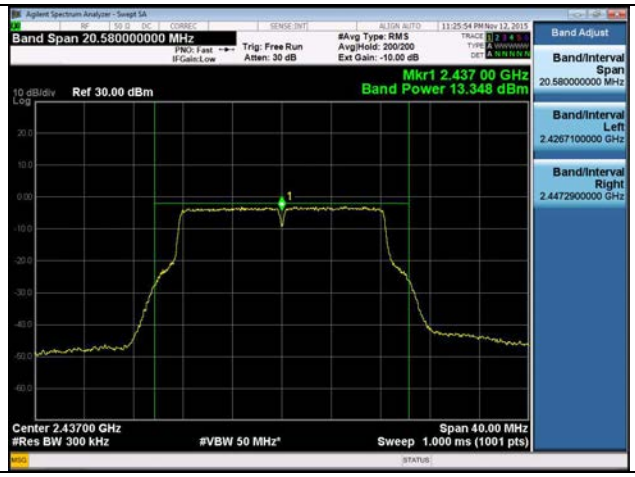


Output Power

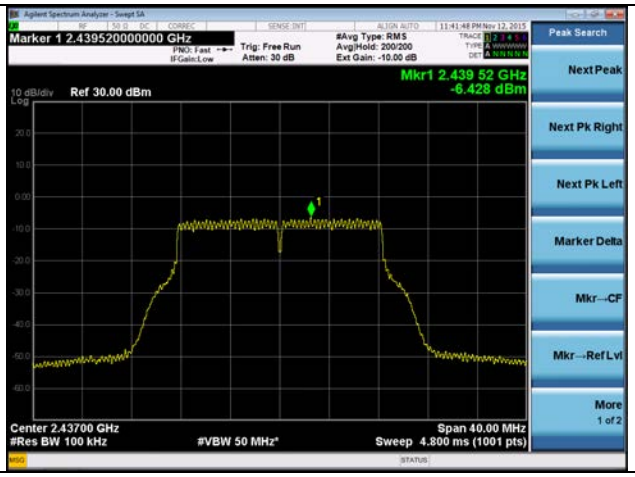


Power Spectral Density

Mid Channel – 2437 MHz

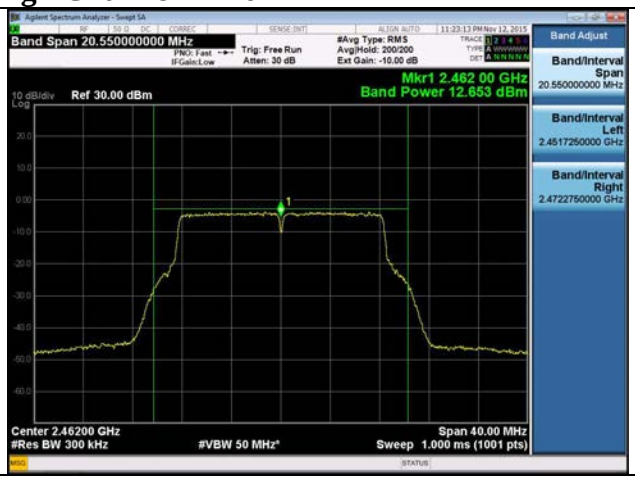


Output Power

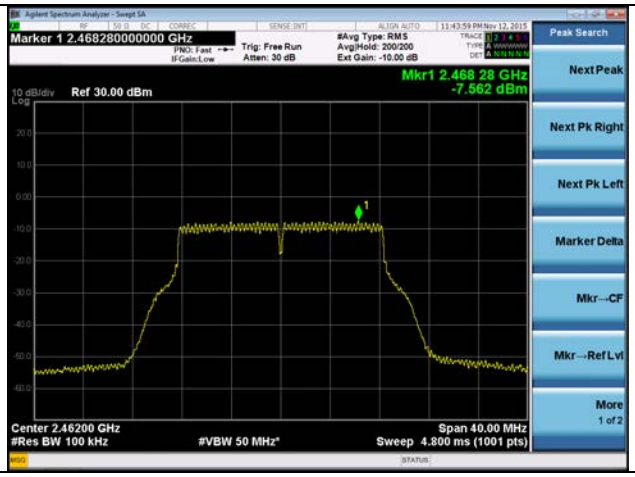


Power Spectral Density

High Channel – 2462 MHz

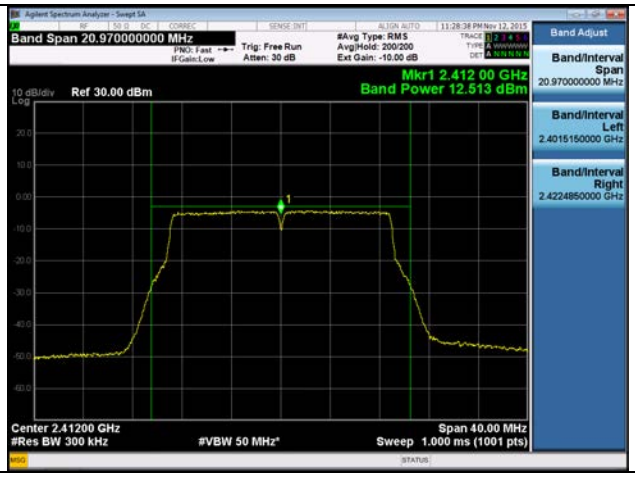


Output Power

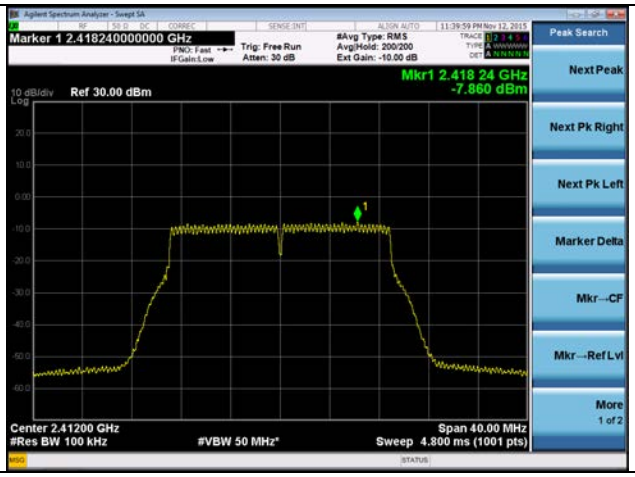


Power Spectral Density

Antenna 1
802.11n – 6.5 Mbps
Low Channel – 2412 MHz

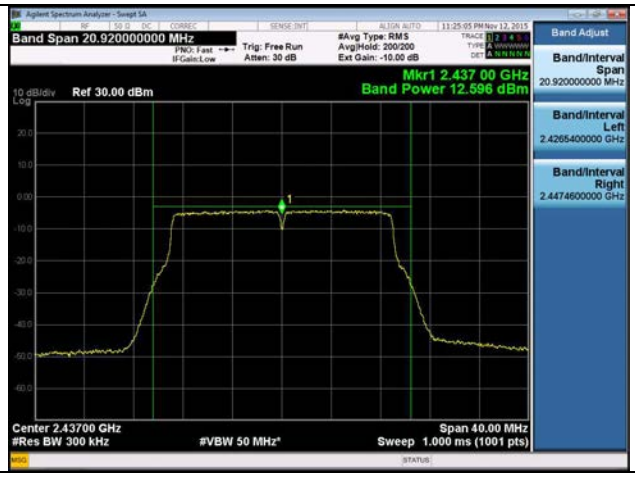


Output Power

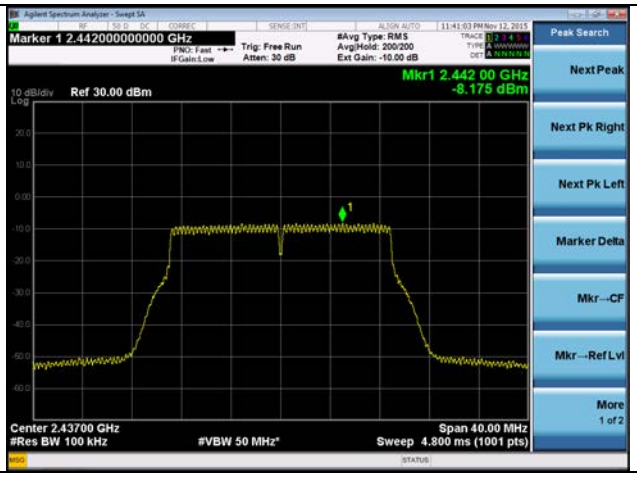


Power Spectral Density

Mid Channel – 2437 MHz

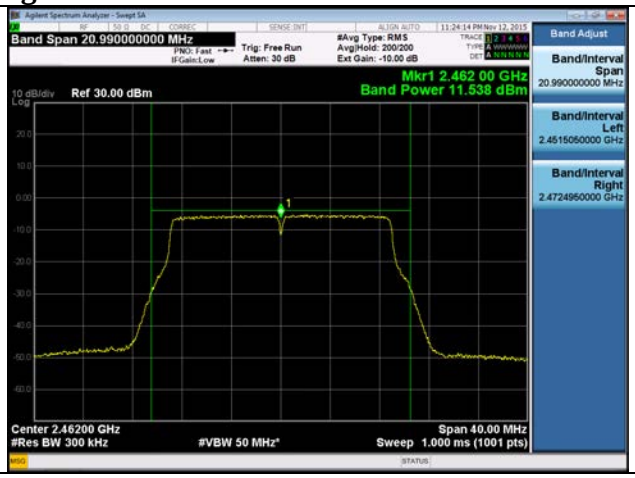


Output Power

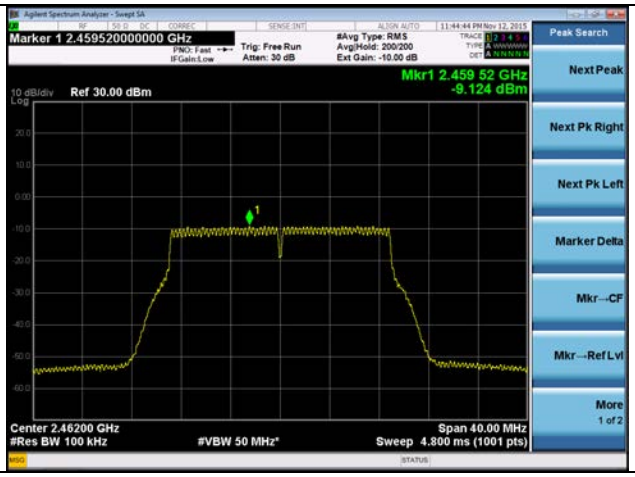


Power Spectral Density

High Channel – 2462 MHz

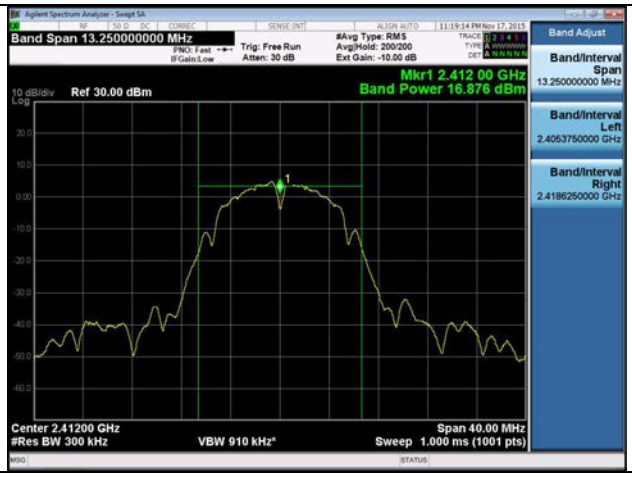


Output Power

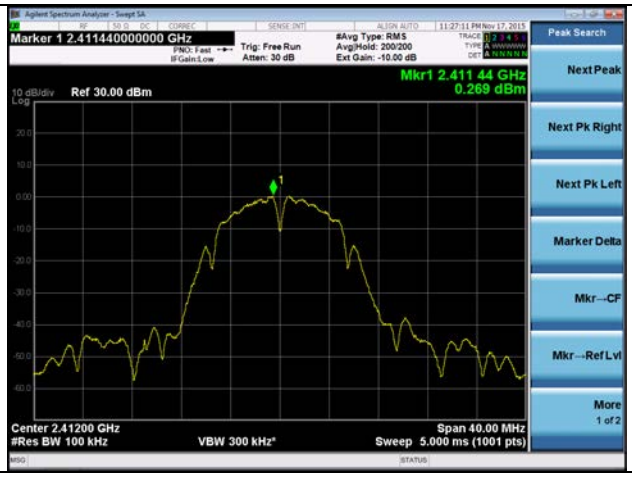


Power Spectral Density

Antenna 2
Plots - 802.11b – 1 Mbps
Low Channel – 2412 MHz

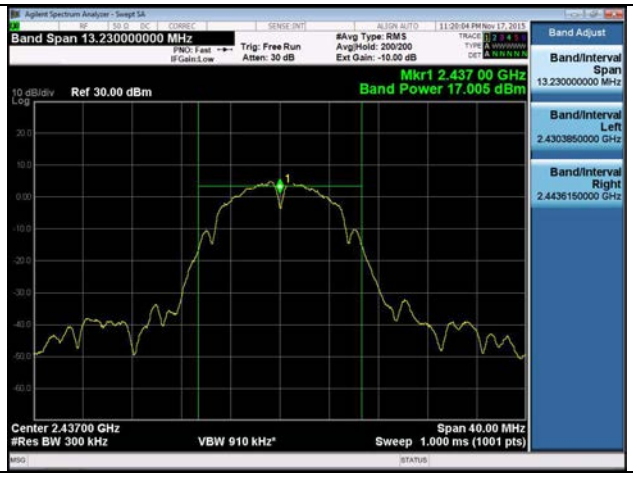


Output Power

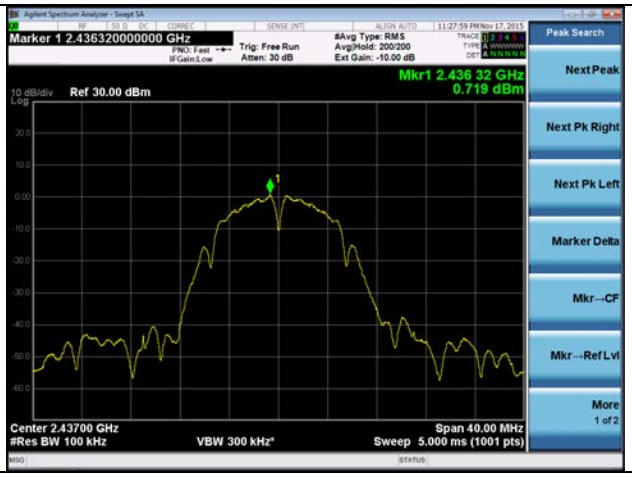


Power Spectral Density

Mid Channel – 2437 MHz



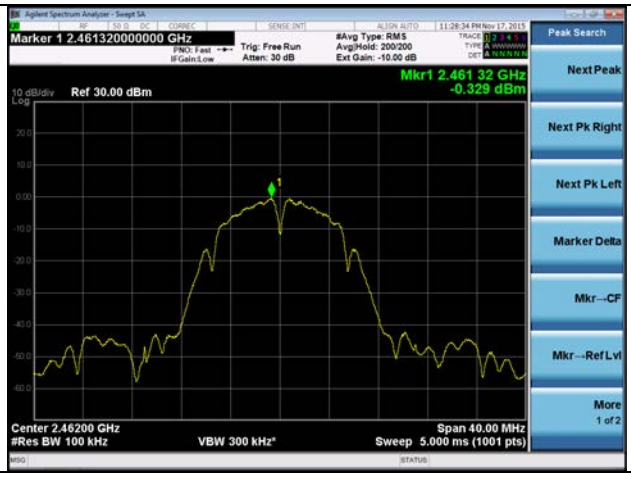
Output Power



Power Spectral Density

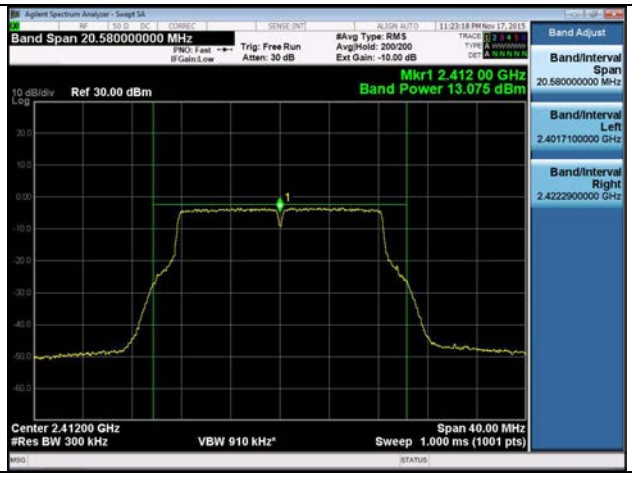
High Channel – 2462 MHz

Output Power

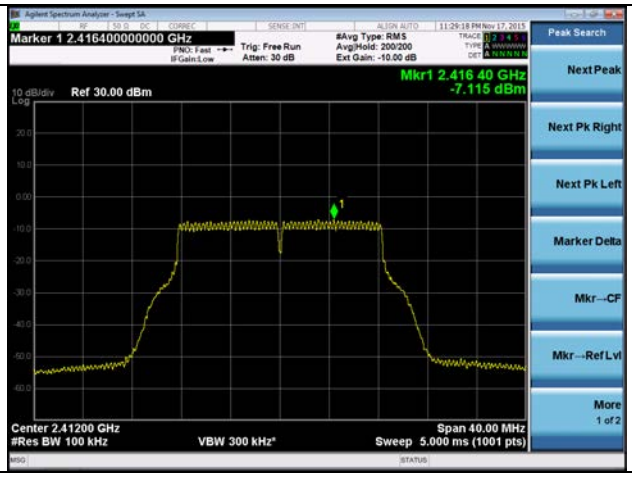


Power Spectral Density

Antenna 2
802.11g – 6 Mbps
Low Channel – 2412 MHz

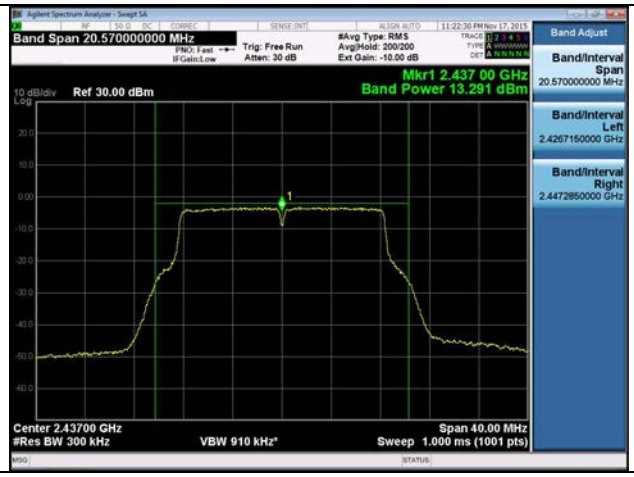


Output Power

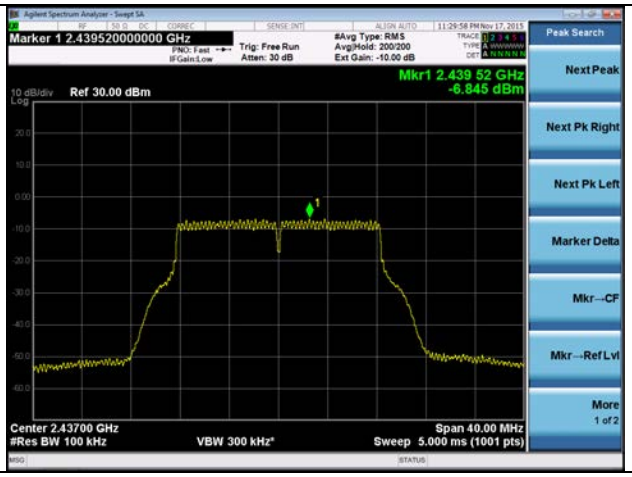


Power Spectral Density

Mid Channel – 2437 MHz

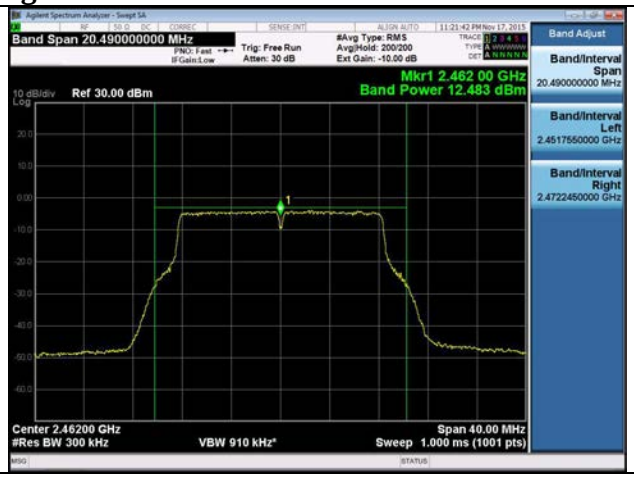


Output Power

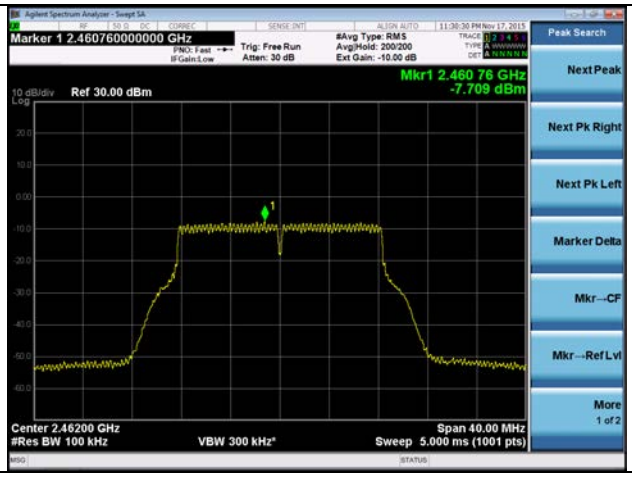


Power Spectral Density

High Channel – 2462 MHz

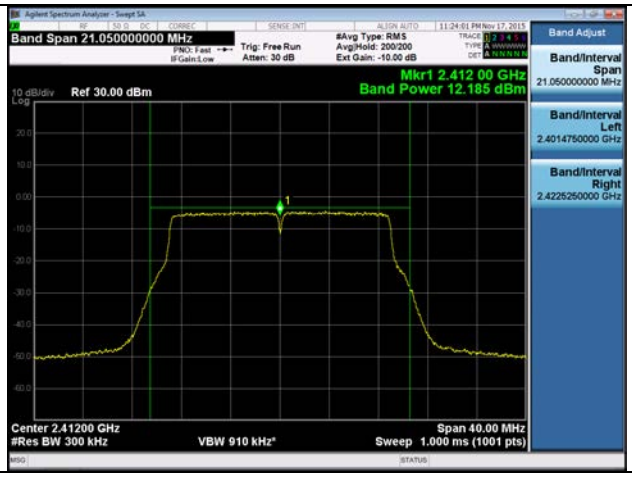


Output Power

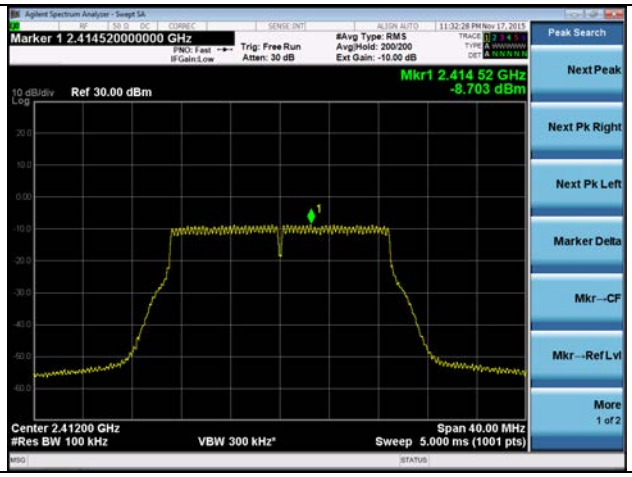


Power Spectral Density

Antenna 2
802.11n – 6.5 Mbps
Low Channel – 2412 MHz

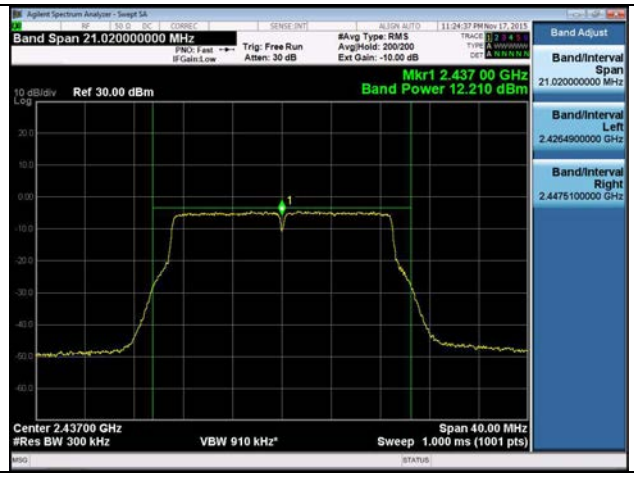


Output Power

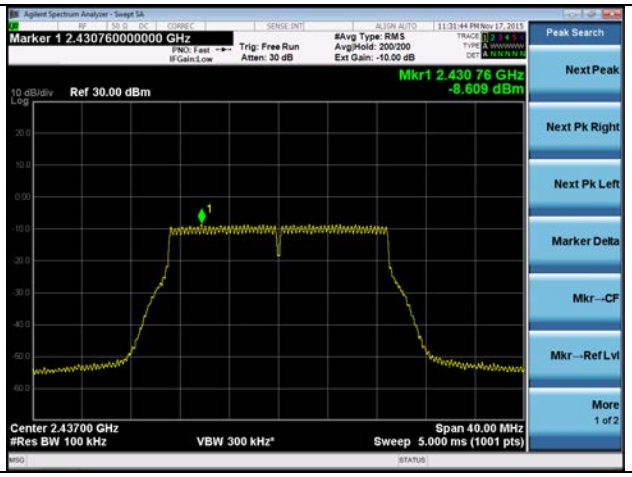


Power Spectral Density

Mid Channel – 2437 MHz

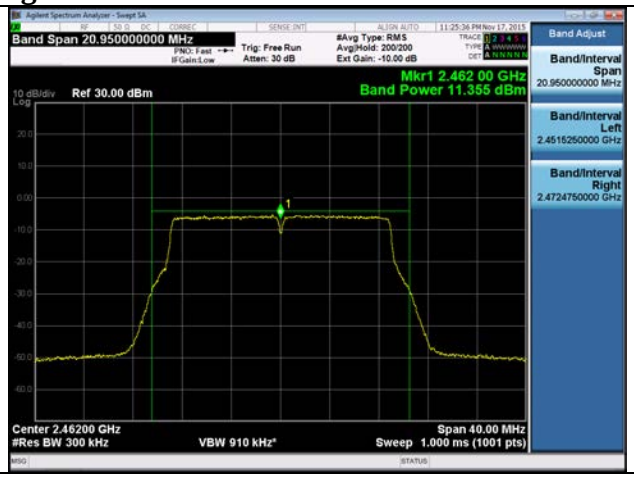


Output Power

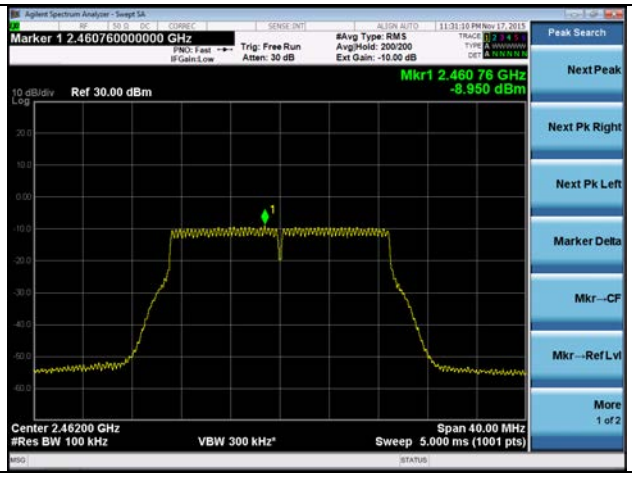


Power Spectral Density

High Channel – 2462 MHz



Output Power



Power Spectral Density

B.1.3 – RF Conducted – Transmitter Spurious Emissions

Manufacturer	Rain Bird Corporation
Date	11-12-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247 (d) IC RSS-247 Section 5.5
Specific Measurement Procedure	ANSI C63.10-2013 Section 11.11
Additional Description of Measurement	RF Conducted Measurement
Additional Notes	1. Power measurements made with average method therefore emissions attenuated 30 dB relative in band PSD level. 2. For reference level measurement see DTS BW plots. 3. Spurious non-band-edge worst case 1 Mbps.

Table
Antenna 1

Mode (802.11)	Mode (Mbps)	Frequency (MHz)	Out-of-band Level (dBm)	Limit (-30dBc) dBm	Margin (dB)
b	1	2396.5	-33.7	-20.3	13.4
		2483.5	-45.0	-20.3	24.7
g	6	2399.5	-35.6	-27.1	8.5
		2487.0	-40.6	-27.1	13.5
n	6.5	2400.0	-37.6	-27.9	9.6
		2483.6	-43.8	-27.9	15.9

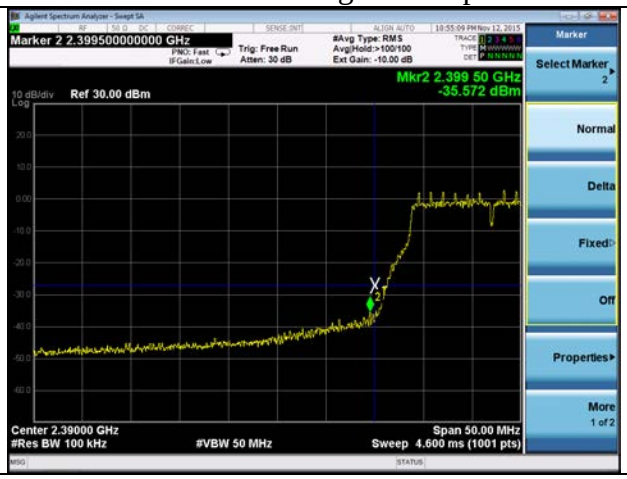
Antenna 2

Mode (802.11)	Mode (Mbps)	Frequency (MHz)	Out-of-band Level (dBm)	Limit (-30dBc) dBm	Margin (dB)
b	1	2396.6	-34.1	-20.7	13.5
		2483.5	-44.3	-20.7	23.6
g	6	2399.5	-37.7	-27.7	10.0
		2497.0	-44.9	-27.7	17.1
n	6.5	2399.9	-39.0	-28.5	10.4
		2499.5	-45.8	-28.5	17.2

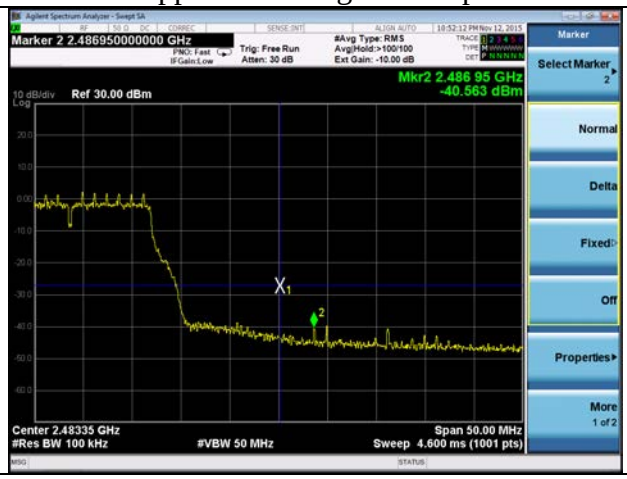
Antenna 1
Lower and Upper Band-Edge

Lower Band-Edge - 1 Mbps

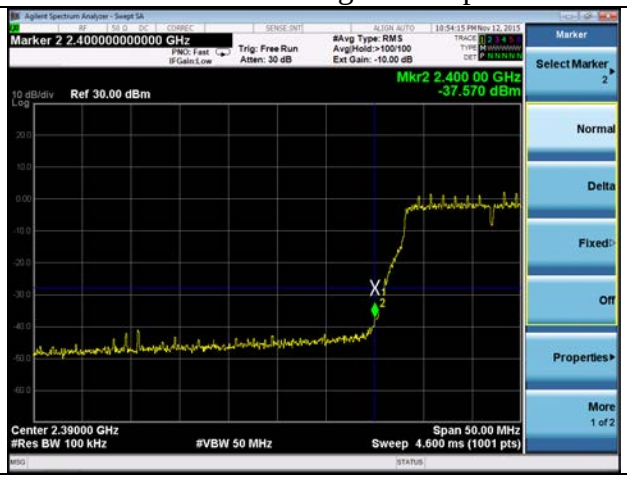
Upper Band-Edge - 1 Mbps



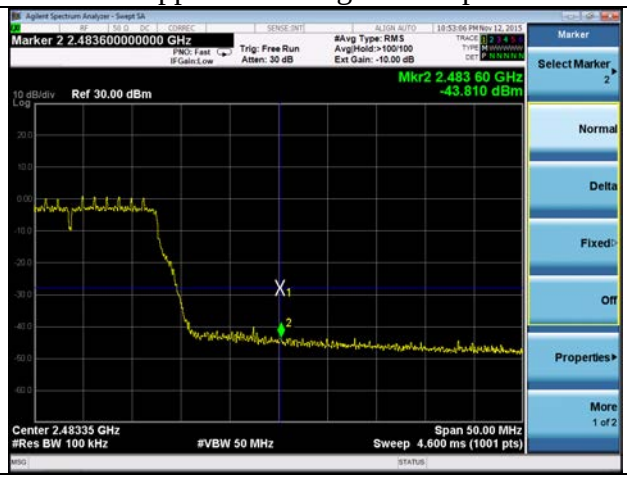
Lower Band-Edge - 6 Mbps



Upper Band-Edge - 6 Mbps

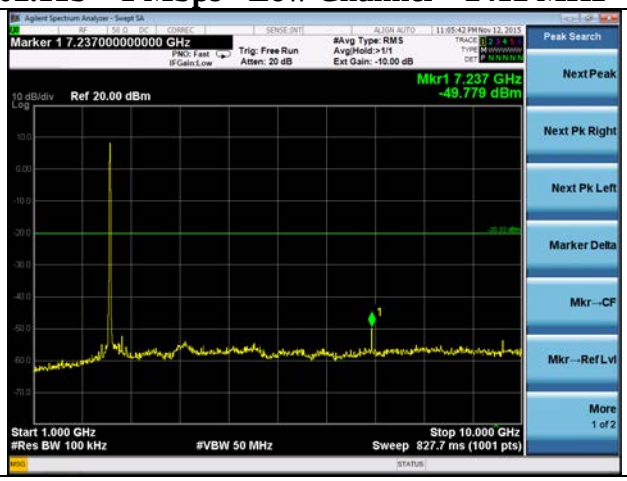


Lower Band-Edge - 6.5 Mbps



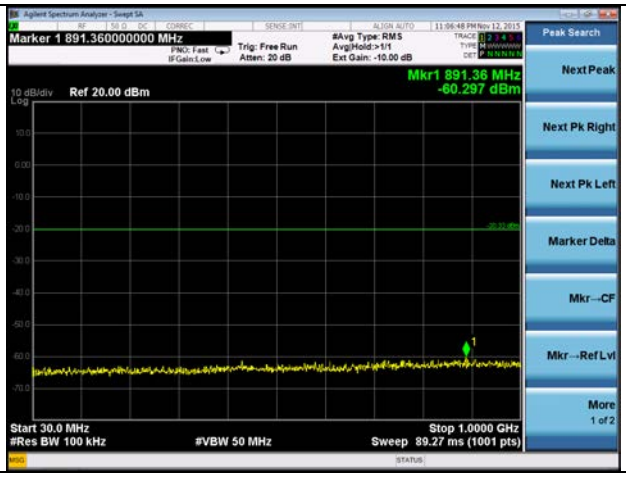
Upper Band-Edge – 6.5 Mbps

Antenna 1
802.11b – 1 Mbps - Low Channel – 2412 MHz



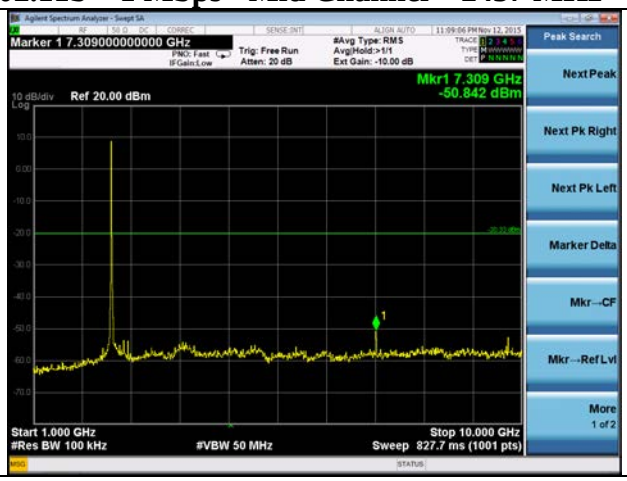
1 – 10 GHz

10-25 GHz

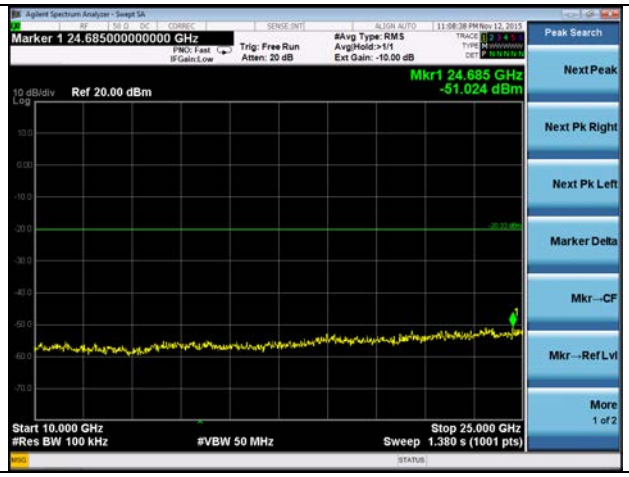


30-1000 MHz

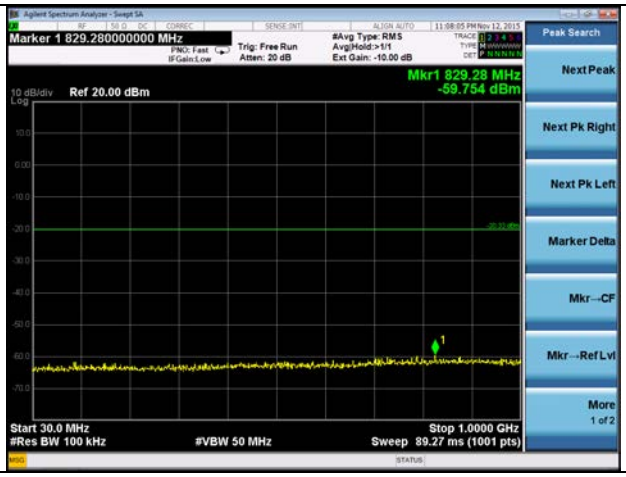
Antenna 1
802.11b – 1 Mbps - Mid Channel – 2437 MHz



1 – 10 GHz

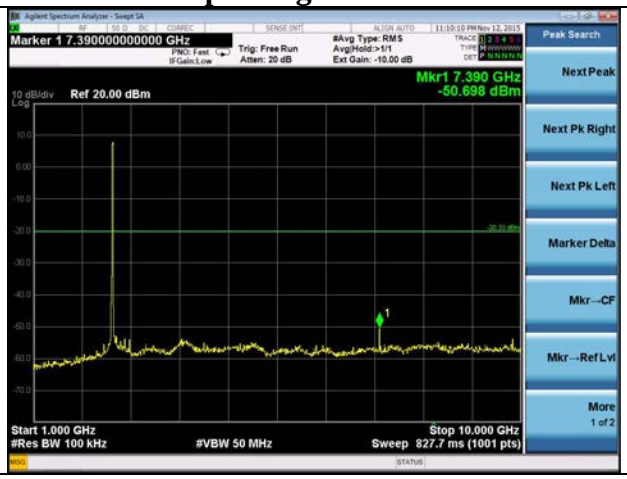


10-25 GHz

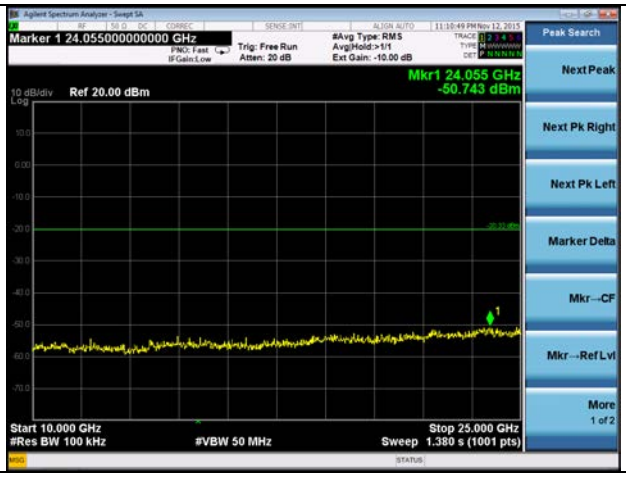


30-1000 MHz

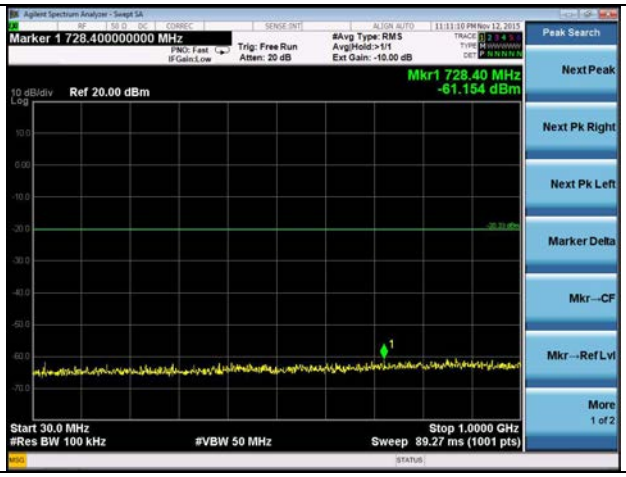
Antenna 1
802.11b – 1 Mbps - High Channel – 2462 MHz



1 – 10 GHz



10 – 25 GHz

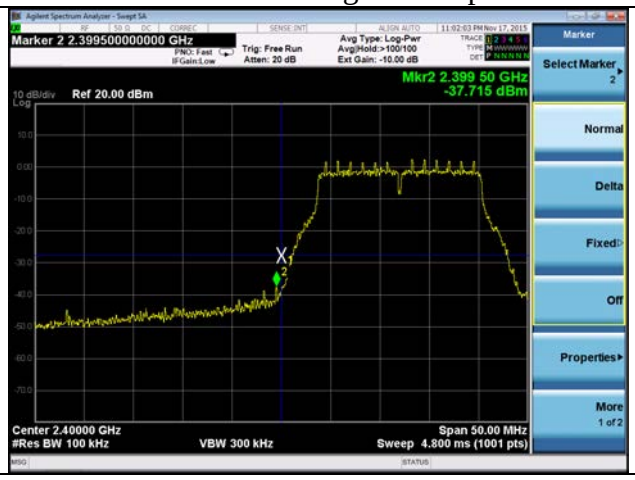


30-1000 MHz

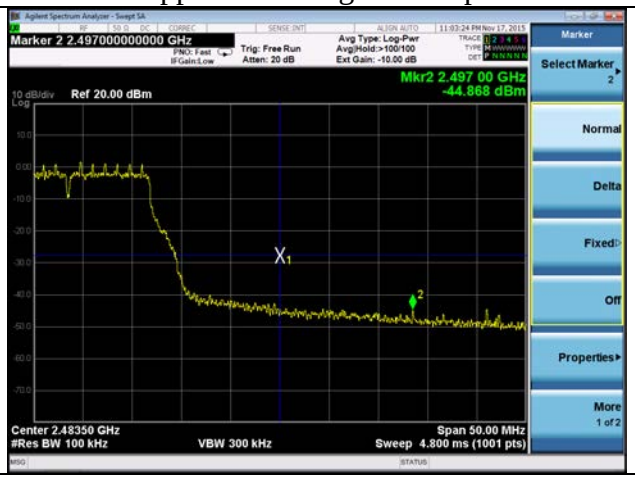
Antenna 2
Lower and Upper Band-Edge

Lower Band-Edge - 1 Mbps

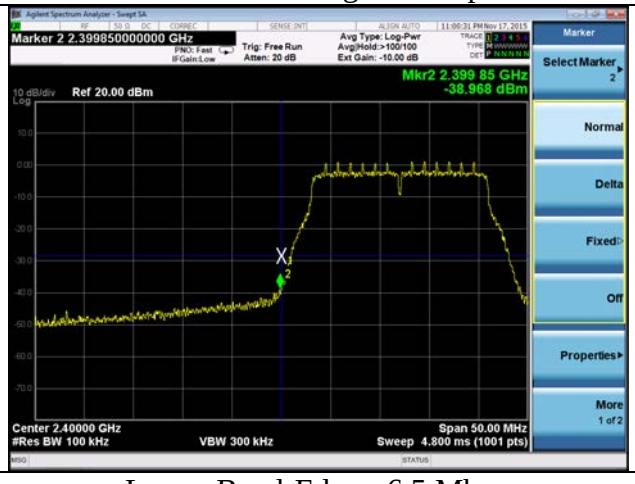
Upper Band-Edge - 1 Mbps



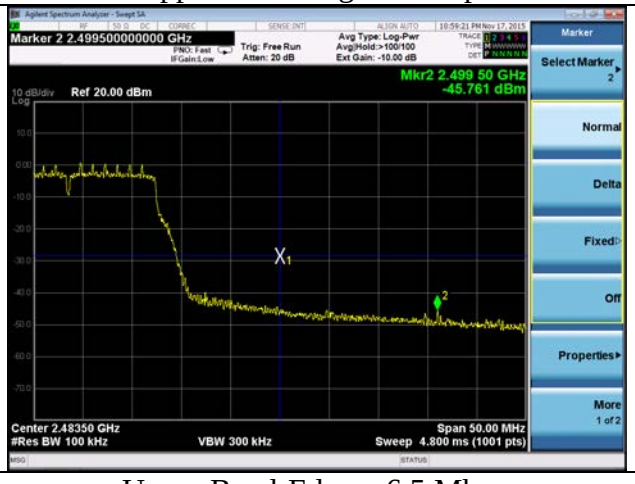
Lower Band-Edge - 6 Mbps



Upper Band-Edge - 6 Mbps

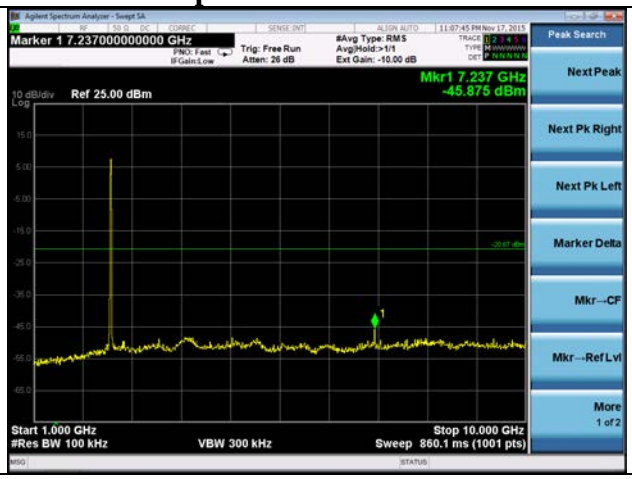


Lower Band-Edge - 6.5 Mbps



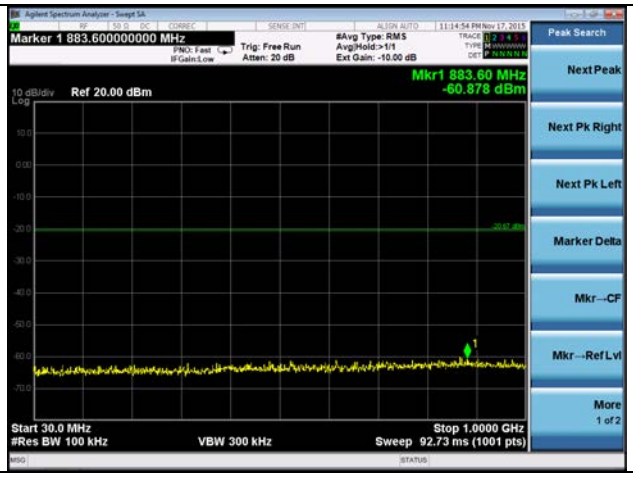
Upper Band-Edge – 6.5 Mbps

Antenna 2
802.11b – 1 Mbps - Low Channel – 2412 MHz



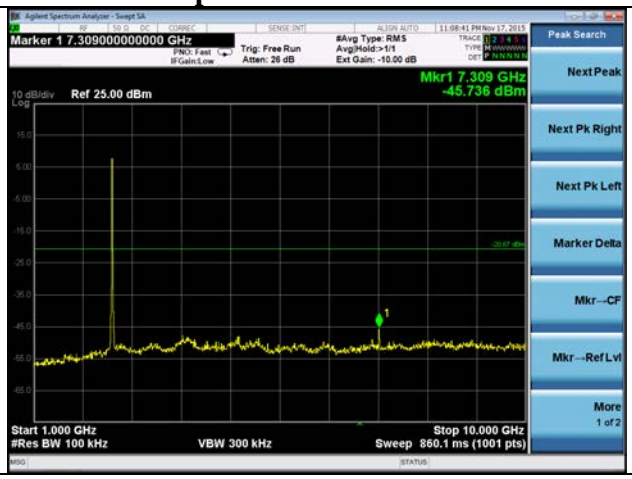
1 – 10 GHz

10-25 GHz



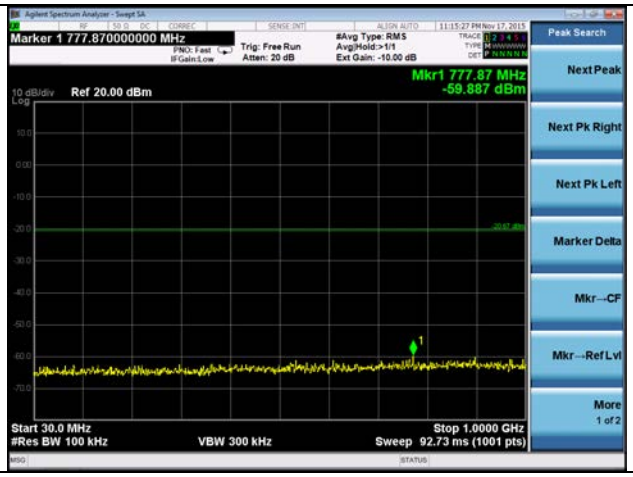
30-1000 MHz

Antenna 2
802.11b – 1 Mbps - Mid Channel – 2437 MHz



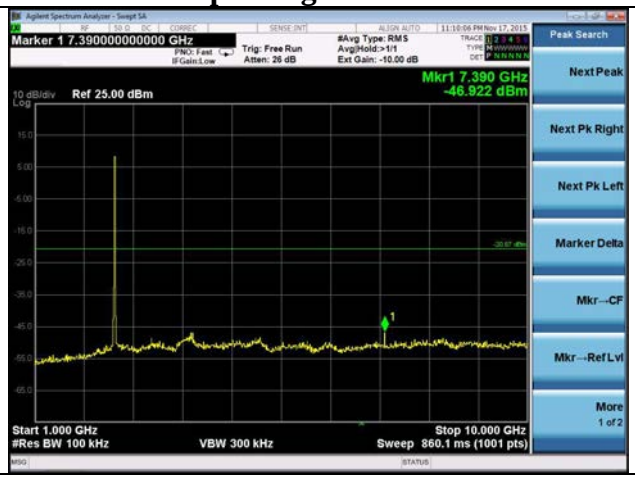
1 – 10 GHz

10-25 GHz



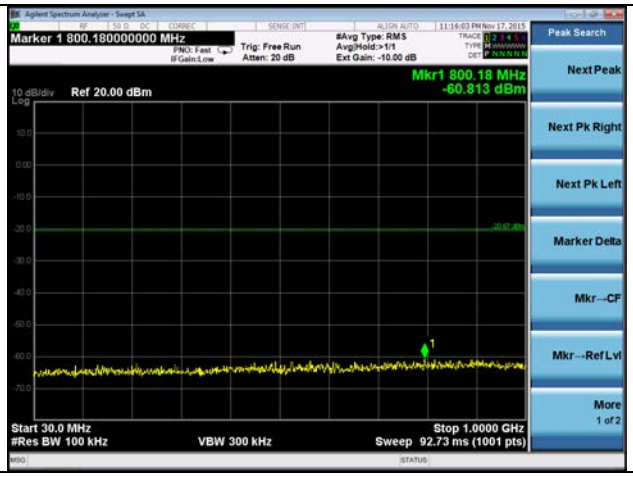
30-1000 MHz

Antenna 2
802.11b – 1 Mbps - High Channel – 2462 MHz



1 – 10 GHz

10 – 25 GHz



30-1000 MHz

B.1.4 – RF Conducted – Frequency Stability

Manufacturer	Rain Bird Corporation
Date	11-12-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 2.1055 RSS-GEN Section 6.11
Specific Measurement Procedure	ANSI C63.10-2013 Section 6.8
Additional Description of Measurement	RF Conducted Measurement
Additional Notes	The power and frequency stability of the device was examined as a function of the input voltage available to the EUT. A Spectrum Analyzer was used to measure the RF output power and frequency at the appropriate frequency markers. Power was supplied by a variable AC supply. Below is data showing stability of the fundamental frequency. Continuous transmit un-modulated used for this test. EUT operates at 24VAC from a 120 VAC 60 Hz primary voltage

Antenna 1

	102 VAC		120 VAC		138 VAC		
	POWER (dBm)	FREQUENCY (Hz)	POWER (dBm)	FREQUENCY (Hz)	POWER (dBm)	FREQUENCY (Hz)	FREQ DRIFT (Hz)
LOW CHANNEL	10.9	2411988305	10.9	2411988290	10.9	2411988540	250
MID CHANNEL	10.7	2436987660	10.7	2436987440	10.7	2436987590	220
HIGH CHANNEL	10.6	2461987250	10.6	2461987450	10.6	2461987150	300
HIGH CHANNEL	10.6	2461987250	10.6	2461987450	10.6	2461987150	300

Antenna 2

	102 VAC		120 VAC		138 VAC		
	POWER (dBm)	FREQUENCY (Hz)	POWER (dBm)	FREQUENCY (Hz)	POWER (dBm)	FREQUENCY (Hz)	FREQ DRIFT (Hz)
LOW CHANNEL	10.8	2411988310	10.8	2411988270	10.8	2411988560	290
MID CHANNEL	10.6	2436987665	10.7	2436987450	10.6	2436987540	215
HIGH CHANNEL	10.5	2461987255	10.5	2461987445	10.5	2461987170	275

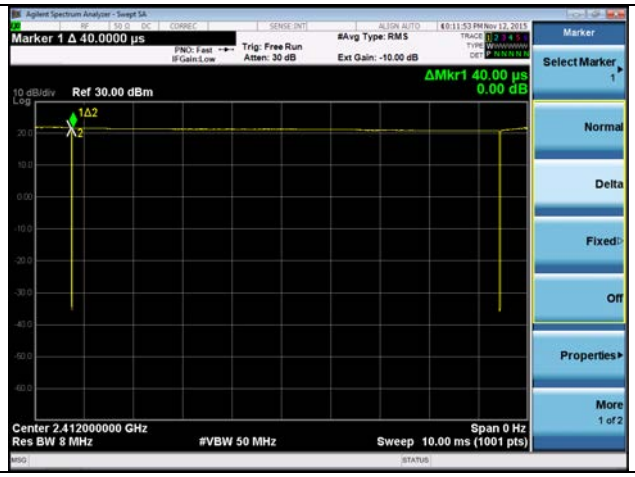
B.1.5 – RF Conducted – Duty Cycle

Manufacturer	Rain Bird Corporation
Date	11-12-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	N/A
Specific Measurement Procedure	ANSI C63.10-2013 Section 11.6
Additional Description of Measurement	RF Conducted Measurement
Additional Notes	Duty cycle used for average power and average PSD procedures

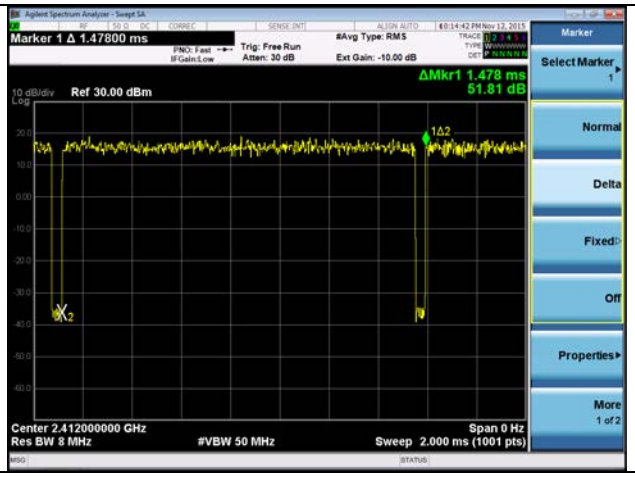
Table

Mode (802.11)	Mode (Mbps)	On-time (ms)	Total Time (ms)	Duty	*Duty Cycle correction (dB)
b	1	8.630	8.670	0.995	0.02
g	6	1.438	1.478	0.973	0.12
n	MCS0	1.344	1.384	0.971	0.13

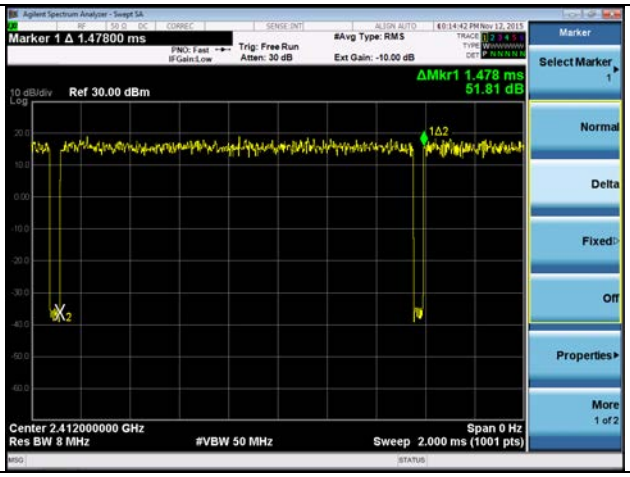
Plots



1 Mbps



6 Mbps



6.5 Mbps

B.2 – Transmitter Radiated Emissions in Restricted Bands

Rule Part(s)	FCC: 15.247 / 15.205 / 15.209 IC: RSS-GEN Section 8.9,8.10			
Measurement Procedure	ANSI C63.10 – 2013 Section 11.12 (6.3,6.5,6.6)			
Test Location	LS Research, LLC – FCC/IC Listed 3 meter Chamber			
Test Distance	See data section			
EUT Placement	Above 1 GHz: 150 cm height non-conductive table above reference ground plane covered with absorbers Below 1 GHz: 80 cm height non-conductive table above reference ground plane			
Frequency Range of Measurement	Biconical: 30-200 MHz	Log Periodic Dipole Array: 200-1000 MHz	Double-Ridged Waveguide Horn: 1-18 GHz	Standard Gain Horn: 18-26GHz
Measurement Detectors	30-1000MHz RBW: 120 kHz VBW: At least 300 kHz		1 - 40 GHz: RBW : 1MHz VBW: At least 3 MHz Peak VBW: 30 Hz Average	
Description of Measurement	1) The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are preformed. The data is gathered and reported as the corrected values. 2) The EUT is placed on a non-conductive pedestal centered on a turn-table in the test location with the antenna at the test distance from the EUT 3) Maximum radiated RF emissions are determined by rotation of azimuth and scanning the sense antenna between 1 and 4 meters in height using both horizontal and vertical antenna polarities. Maximized levels are manually noted at degree values of azimuth and at sense antenna height.			
Example Calculations	Reported Measurement data = Raw receiver measurement + Antenna Correction Factor + Cable factor (dB) - amplification factor (when applicable) + Additional factor (when applicable)			

Limits:

Frequency (MHz)	3 m Limit (µV/m)	3 m Limit (dBµV/m)	Type
30-88	100	40.0	Quasi-Peak
88-216	150	43.5	Quasi-Peak
216-960	200	46.0	Quasi-Peak
Above 960	500	54.0	Average (>1 GHz)

B.2.1 – Radiated Band-Edge Restricted Bands

Manufacturer	Rain Bird Corporation
Date	11-9-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247/ 15.205 / 15.209 IC RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.10-2013 Section 11.12
Test Distance	3 meter
EUT Placement	150 cm height non-conductive table centered on turn-table , absorbers covering ground plane
Detectors	Final Measurements: Peak / Max Hold, RBW 1 MHz, Average VBW 30Hz, Peak VBW 3 MHz
Additional Notes	1) EUT maximized in orientation, azimuth, and antenna height with maximum results reported.

Example Calculation:

Limit (dBµV/m) – Reading (dBµV/m) = Margin (dB)

Table - Antenna 1

Lower Band-edge - Average

Mode	Rate	Frequency (GHz)	Average Reading (dBµV/m)	Average Margin (dB)
b	1 Mbps	2.38728	46.93	7.1
g	6 Mbps	2.39000	48.49	5.5
n	MCS 0	2.39000	47.63	6.4

Peak

Mode	Rate	Frequency (GHz)	Peak Reading (dBµV/m)	Peak Margin (dB)
b	1 Mbps	2.38728	57.93	16.1
g	6 Mbps	2.38816	59.81	14.2
n	MCS 0	2.38944	59.13	14.9

Upper band-edge - Average

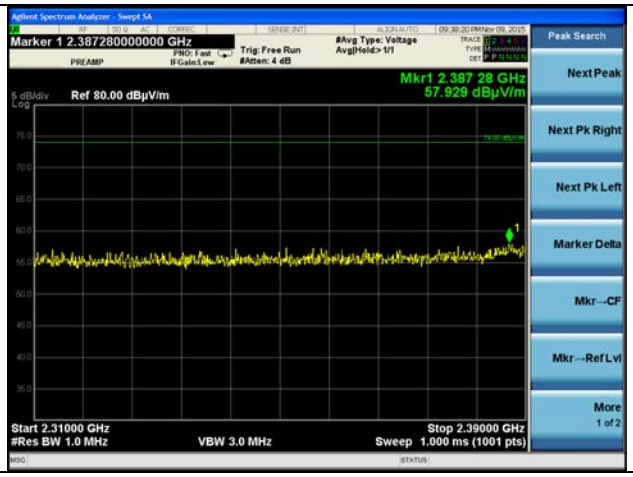
Mode	Rate	Frequency (GHz)	Average Reading (dBµV/m)	Average Margin (dB)
b	1 Mbps	2.48350	49.49	4.5
g	6 Mbps	2.48350	51.80	2.2
n	MCS 0	2.48350	51.81	2.2

Peak

Mode	Rate	Frequency (GHz)	Peak Reading (dBµV/m)	Peak Margin (dB)
b	1 Mbps	2.48451	61.33	12.7
g	6 Mbps	2.48429	64.02	10.0
n	MCS 0	2.48436	66.31	7.7

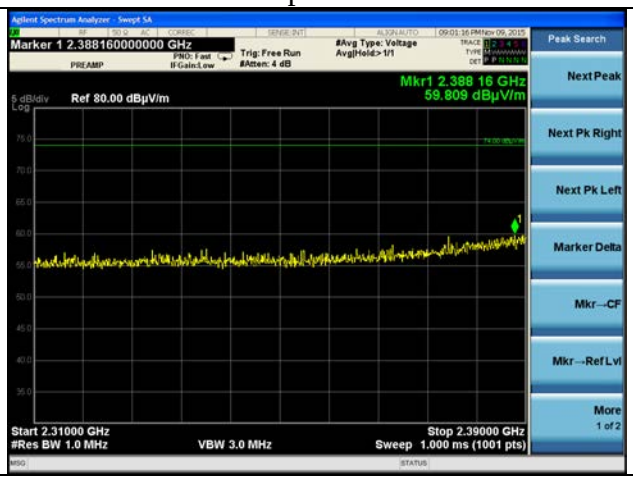
Plots - Low Channel

1 Mbps – Average



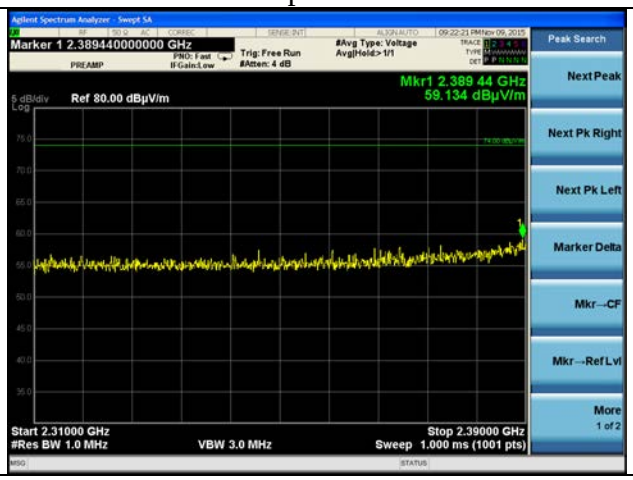
1 Mbps – Peak

6 Mbps – Average



6 Mbps – Peak

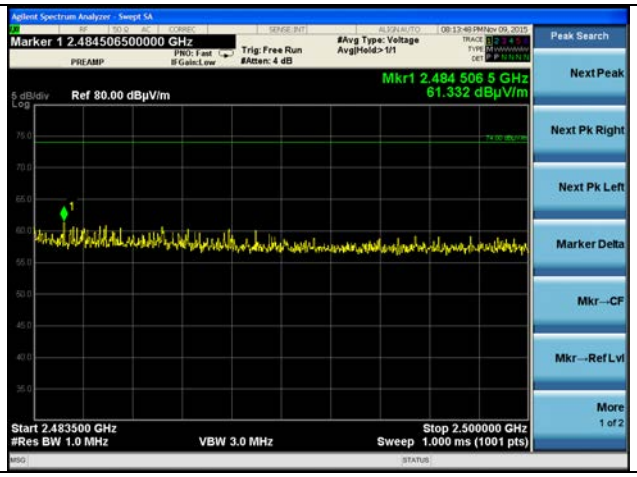
6.5 Mbps – Average



6.5 Mbps – Peak

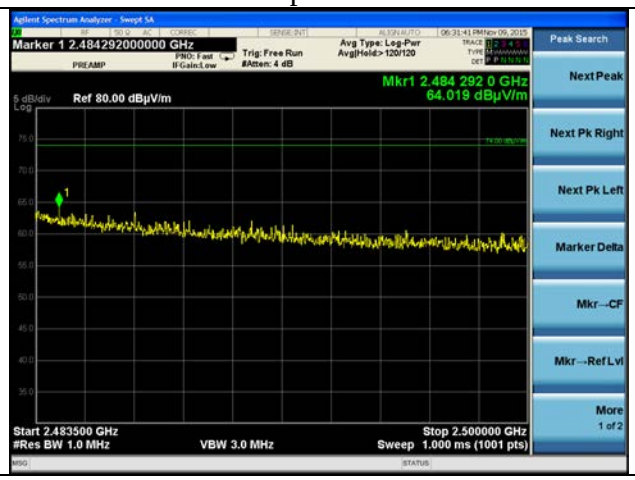
Plots - High Channel

1 Mbps – Average



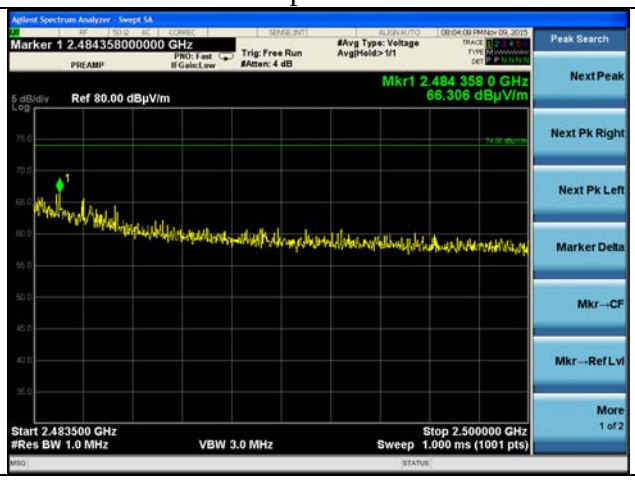
1 Mbps – Peak

6 Mbps – Average



6 Mbps – Peak

6.5 Mbps – Average



6.5 Mbps – Peak

Table – Antenna 2

Lower Band-edge – Average

Mode	Rate	Frequency (GHz)	Average Reading (dBµV/m)	Average Margin (dB)
b	1 Mbps	2.38712	46.70	7.3
g	6 Mbps	2.39000	47.78	6.2
n	MCS 0	2.39000	48.68	5.3

Peak

Mode	Rate	Frequency (GHz)	Peak Reading (dBµV/m)	Peak Margin (dB)
b	1 Mbps	2.38872	58.78	15.2
g	6 Mbps	2.38984	59.22	14.8
n	MCS 0	2.38984	61.19	12.8

Upper band-edge – Average

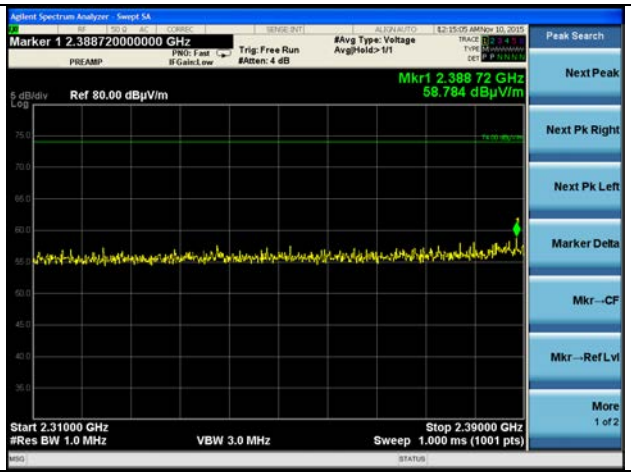
Mode	Rate	Frequency (GHz)	Average Reading (dBµV/m)	Average Margin (dB)
b	1 Mbps	2.48350	49.13	4.9
g	6 Mbps	2.48350	51.99	2.0
n	MCS 0	2.48350	51.90	2.1

Peak

Mode	Rate	Frequency (GHz)	Peak Reading (dBµV/m)	Peak Margin (dB)
b	1 Mbps	2.48357	60.01	14.0
g	6 Mbps	2.48367	64.99	9.0
n	MCS 0	2.48350	66.91	7.1

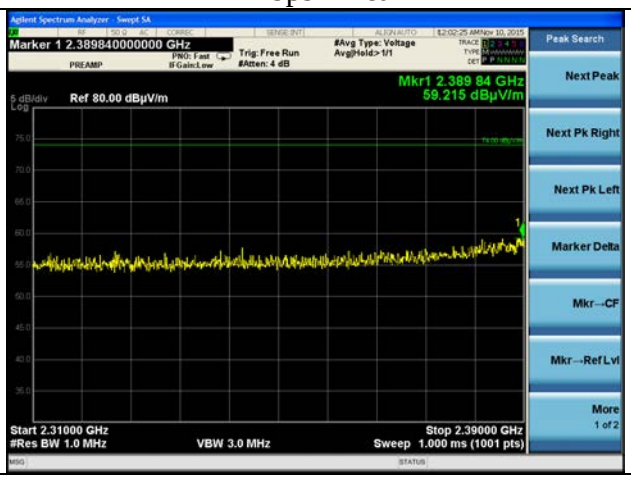
Plots - Low Channel

1 Mbps – Average



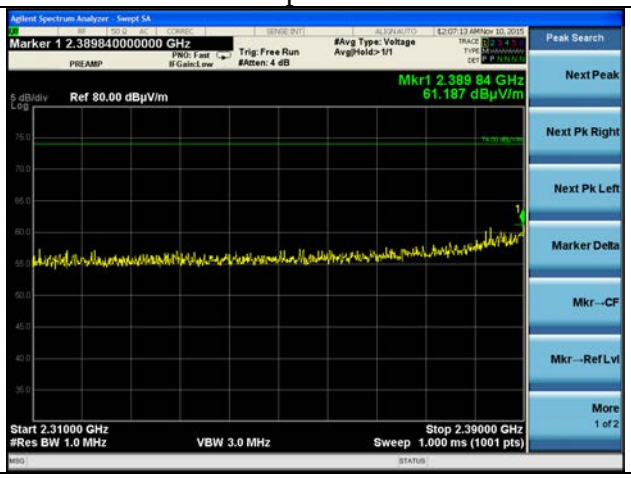
1 Mbps – Peak

6 Mbps – Average



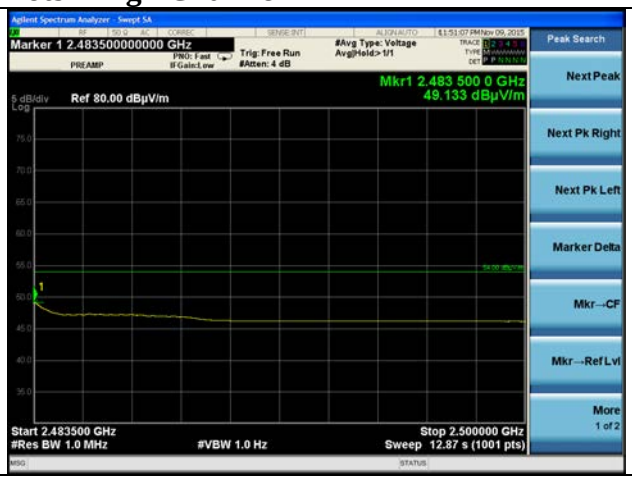
6 Mbps – Peak

6.5 Mbps – Average

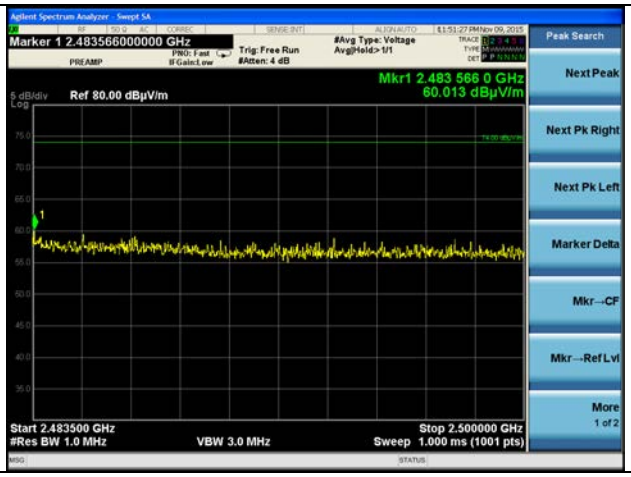


6.5 Mbps – Peak

Plots - High Channel

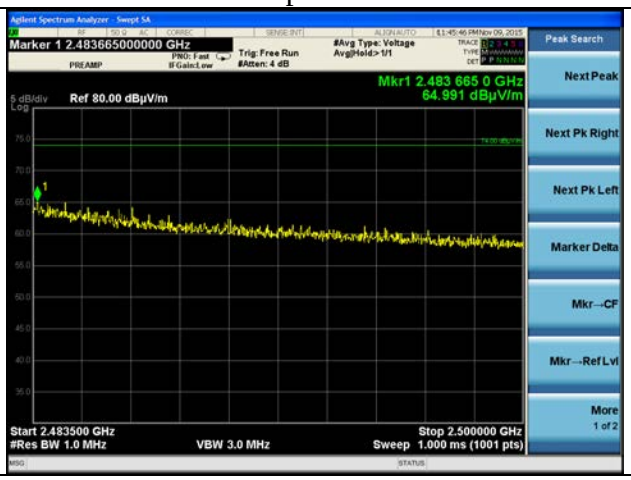


1 Mbps – Average



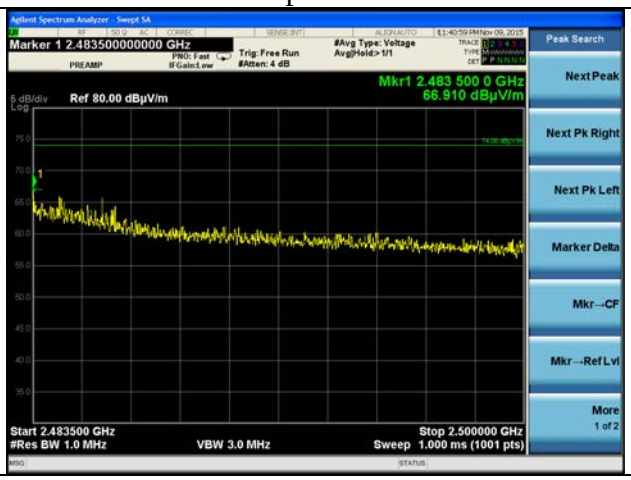
1 Mbps – Peak

6 Mbps – Average



6 Mbps – Peak

6.5 Mbps – Average



6.5 Mbps – Peak

B.2.2 – Radiated Harmonics in Restricted Bands

Manufacturer	Rain Bird Corporation
Date	11-5-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247/ 15.205 / 15.209 IC RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.10-2013 Section 11.12
Test Distance	3 meter
EUT Placement	150 cm height non-conductive table centered on turn-table , absorbers covering ground plane
Detectors	Final Measurements: Peak / Max Hold, RBW 1 MHz, Average VBW 30Hz, Peak VBW 3 MHz
Additional Notes	1) EUT maximized in orientation, azimuth, and antenna height with maximum results reported. 2) Worst case mode (1 Mbps) measured. 3) Note: Low channel third harmonic not in restricted band

Example Calculation:
Limit (dBµV/m) – Reading (dBµV/m) = Margin (dB)
Average limit = 54 (dBµV/m) at 3m
Peak limit = 74 (dBµV/m) at 3m

Table

Tx Antenna	Channel	Frequency (MHz)	EUT orientation	Antenna Polarity	Height (cm)	Azimuth (degree)	Average Reading (dBµV/m)	Peak Reading (dBµV/m)	Average Margin (dB)	Peak Margin (dB)
1	6	7311	Vertical	Horizontal	194	0	45.89	53.93	8.1	20.1
			Horizontal	Vertical	199	0	46.58	54.35	7.4	19.7
			Flat	Vertical	208	261	40.34	49.01	13.7	25.0
				Horizontal	223	34	39.55	48.62	14.5	25.4
1	11	7386	Vertical	Horizontal	231	0	45.33	53.77	8.7	20.2
			Horizontal	Vertical	210	0	45.98	53.86	8.0	20.1
2	6	7311	Vertical	Horizontal	249	7	46.95	54.78	7.1	19.2
			Horizontal	Vertical	208	0	46.95	54.89	7.1	19.1
			Flat	Vertical	149	263	40.84	49.95	13.2	24.1
				Horizontal	251	40	40.02	48.98	14.0	25.0
2	11	7386	Vertical	Horizontal	229	0	45.87	53.55	8.1	20.5
			Horizontal	Vertical	202	0	45.88	53.92	8.1	20.1

Plots

Antenna 1 – Low Channel

Antenna 2 – Low Channel

Antenna 1 – Mid Channel

Antenna 2 – Mid Channel

Antenna 1 – High Channel

Antenna 2 – High Channel

B.2.3 – Radiated Spurious Emissions Transmit Mode (1-26 GHz)

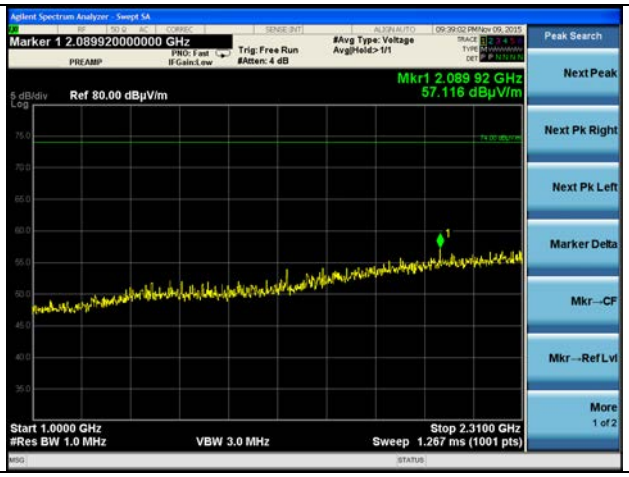
Manufacturer	Rain Bird Corporation
Date	11-9-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247/ 15.205 / 15.209 IC RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.10-2013 Section 11.12
Test Distance	3 meter 1-18 GHz 1 meter 18-26 GHz
EUT Placement	150 cm height non-conductive table centered on turn-table , absorbers covering ground plane
Detectors	Peak; RBW 1 MHz
Additional Notes	1) EUT maximized in orientation, azimuth, and antenna height with maximum results reported. 2) No Emissions found above system noise floor 3) Frequency ranges 2310-2390 MHz, 2483.5-2500 MHz, and 4-18 GHz seem in previous sections.

Example Calculation:

Limit (dBµV/m) – Reading (dBµV/m) = Margin

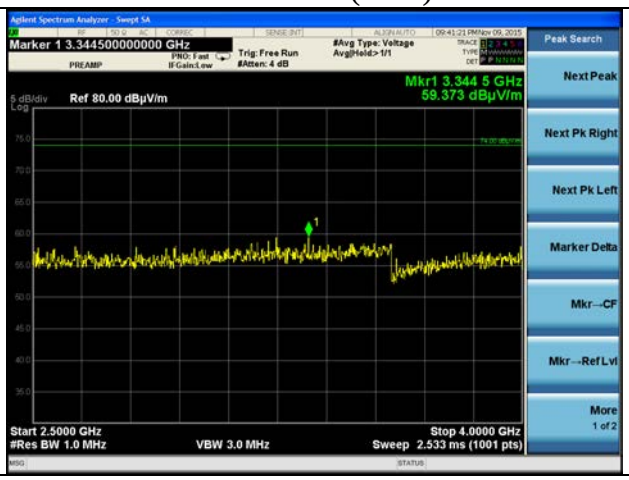
Plots

1-2.31 GHz (Reduced VBW)

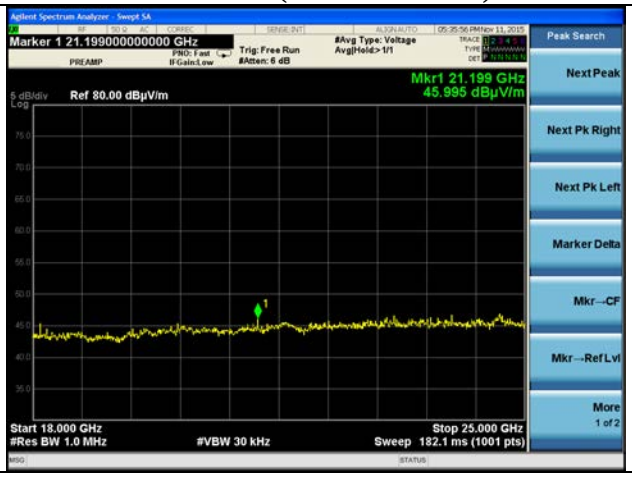


1-2.31 GHz (Peak)

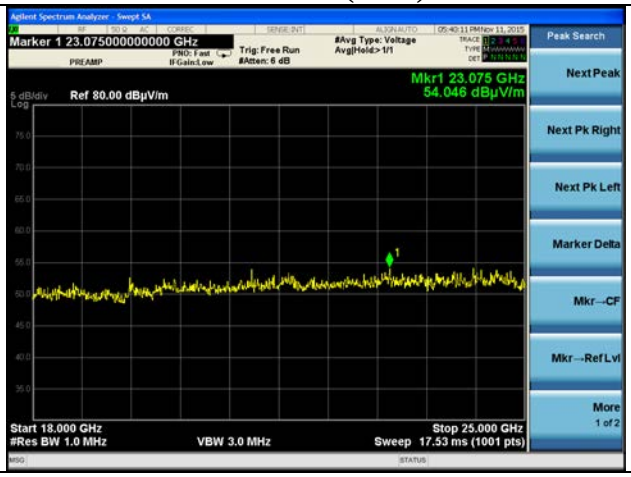
2.5-4 GHz (Reduced VBW)



2.5-4 GHz (Peak)



18-26 GHz (Reduced VBW)



18-26 GHz (Peak)

B.2.4 – Radiated Spurious Emissions Transmit Mode (30-1000 MHz)

Manufacturer	Rain Bird Corporation
Date	11-11-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247/ 15.205 / 15.209 IC RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.10-2013 Section 11.2
Test Distance	3 meter 30-1000 MHz
EUT Placement	80 cm height non-conductive table centered on turn-table (no absorbers on ground plane)
Detectors	Peak; RBW 120 kHz
Additional Notes	1) Tested in continuous transmit modulated mode with EUT in three orientations at maximum power. 2) Emissions not effected by channel or modulation.

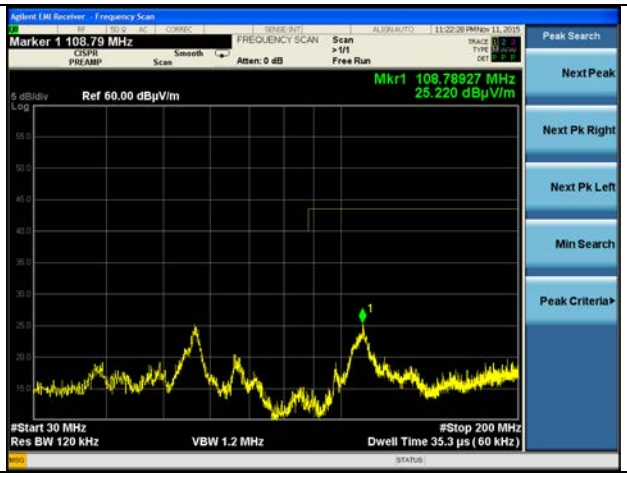
Example Calculation:

Limit (dBµV/m) – Reading (dBµV/m) = Margin

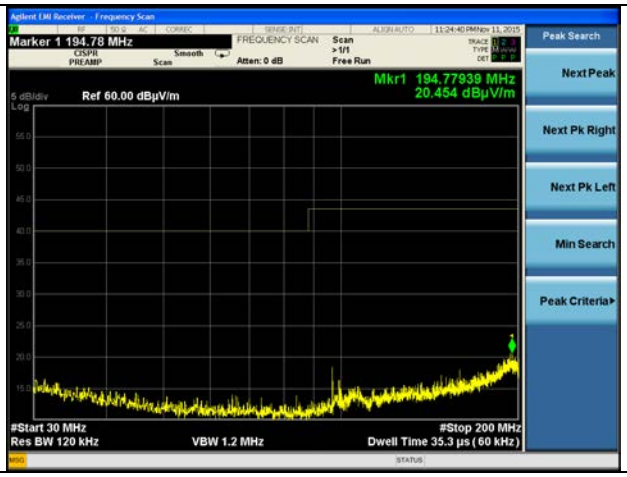
Table

Frequency (MHz)	Antenna Polarity	Azimuth (degree)	Height (cm)	Peak Reading (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Margin (dB)
320.54	Horizontal	267	100	29.20	46.0	16.8
108.8	Vertical	188	100	25.22	43.5	18.3
56.5	Vertical	188	100	25.13	40.0	14.9

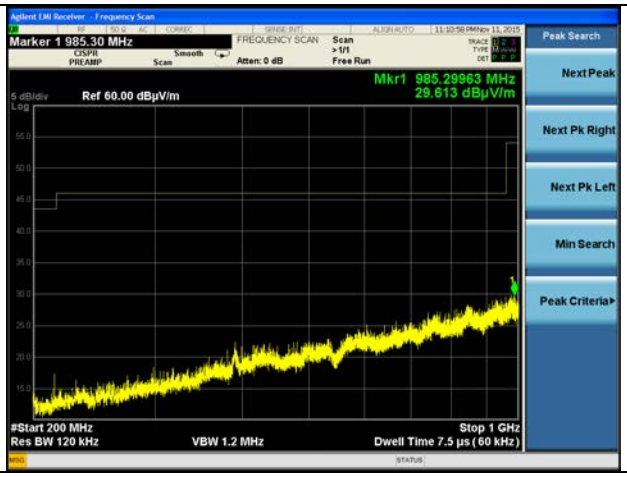
Plots



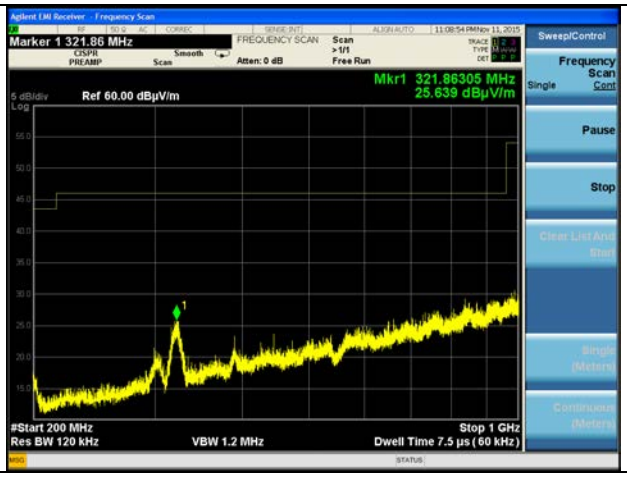
30-200 MHz Vertical



30-200 MHz Horizontal



200-1000 MHz Vertical



200-1000 MHz Horizontal

B.3 – Radiated Emissions in Receive Mode

Rule Part(s)	FCC: 15.109 IC: RSS-GEN Section 7			
Measurement Procedure	ANSI C63.4-2014 Section 8			
Test Location	LS Research, LLC – FCC/IC Listed 3 meter Chamber			
Test Distance	See data section			
EUT Placement	Above 1 GHz: 80 cm height non-conductive table above reference ground plane covered with absorbers Below 1 GHz: 80 cm height non-conductive table above reference ground plane			
Frequency Range of Measurement	Biconical: 30-300 MHz	Log Periodic Dipole Array: 300-1000 MHz	Double-Ridged Waveguide Horn: 1-18 GHz	Standard Gain Horn: 18-26GHz
Measurement Detectors	30-1000MHz RBW: 120 kHz VBW: At least 300 kHz		1 - 40 GHz: RBW : 1MHz VBW: At least 3 MHz Peak VBW: 30 Hz Average	
Description of Measurement	1) The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are preformed. The data is gathered and reported as the corrected values. 2) The EUT is placed on a non-conductive pedestal centered on a turn-table in the test location with the antenna at the test distance from the EUT 3) Maximum radiated RF emissions are determined by rotation of azimuth and scanning the sense antenna between 1 and 4 meters in height using both horizontal and vertical antenna polarities. Maximized levels are manually noted at degree values of azimuth and at sense antenna height.			
Example Calculations	Reported Measurement data = Raw receiver measurement + Antenna Correction Factor + Cable factor (dB) - amplification factor (when applicable) + Additional factor (when applicable)			

Limits:

Frequency (MHz)	3 m Limit (µV/m)	3 m Limit (dBµV/m)	Type
30-88	100	40.0	Quasi-Peak
88-216	150	43.5	Quasi-Peak
216-960	200	46.0	Quasi-Peak
Above 960	500	54.0	Average (>1 GHz)

B.3.1 – Radiated Spurious Emissions Receive Mode (30-1000 MHz)

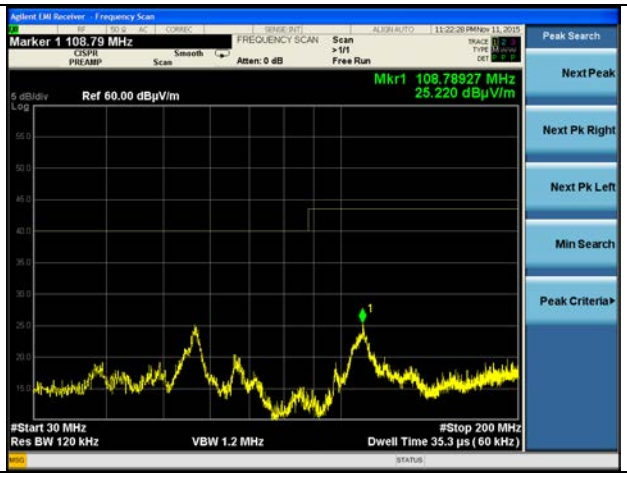
Manufacturer	Rain Bird Corporation
Date	11-11-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.109 IC RSS-GEN
Measurement Procedure	ANSI C63.4-2013 Section 8
Test Distance	3 meter 30-1000 MHz
EUT Placement	80 cm height non-conductive table centered on turn-table (no absorbers on ground plane)
Detectors	Peak; RBW 120 kHz
Additional Notes	1) Tested in continuous receive mode with EUT in three orientations 2) Emissions not effected by channel

Example Calculation:
Limit (dBµV/m) – Reading (dBµV/m) = Margin

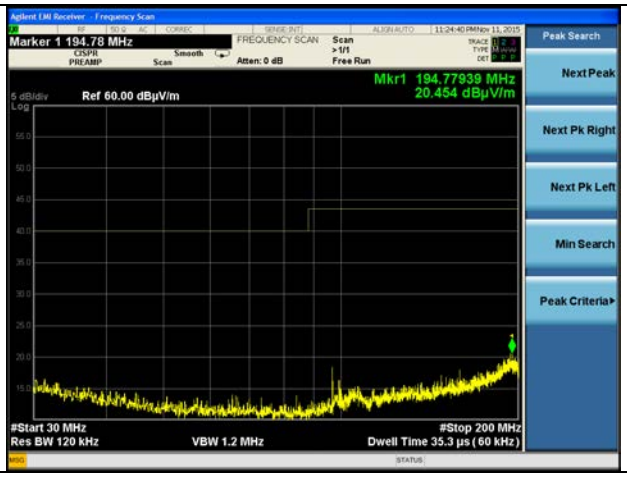
Table

Frequency (MHz)	Antenna Polarity	Azimuth (degree)	Height (cm)	Peak Reading (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Margin (dB)
320.54	Horizontal	267	100	29.20	46.0	16.8
108.8	Vertical	188	100	25.22	43.5	18.3
56.5	Vertical	188	100	25.13	40.0	14.9

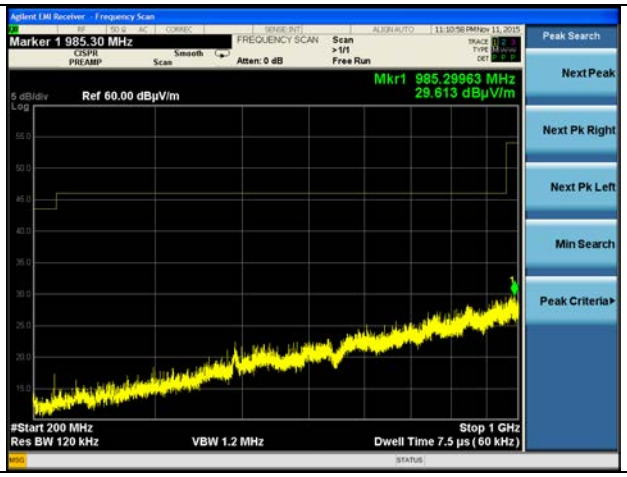
Plots



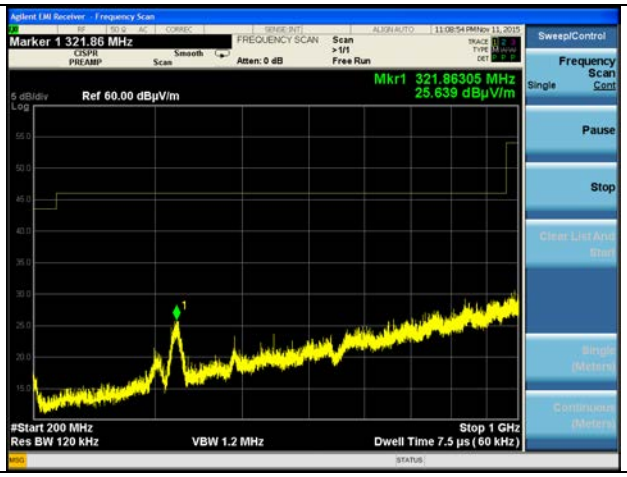
30-200 MHz Vertical



30-200 MHz Horizontal



200-1000 MHz Vertical



200-1000 MHz Horizontal

B.3.2 – Radiated Spurious Emissions Receive Mode (1-26 GHz)

Manufacturer	Rain Bird Corporation
Date	11-10, 11-11 2015
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.109 IC RSS-GEN
Measurement Procedure	ANSI C63.4-2013 Section 8
Test Distance	3 meter 1-18 GHz 1 meter 18-26 GHz
EUT Placement	80 cm height non-conductive table centered on turn-table (absorbers on ground plane)
Detectors	Peak; RBW 120 kHz
Additional Notes	1) Tested in continuous receive mode with EUT in three orientations 2) Emissions not effected by channel

Example Calculation:

Limit (dBµV/m) – Reading (dBµV/m) = Margin

No emissions found above system noise floor

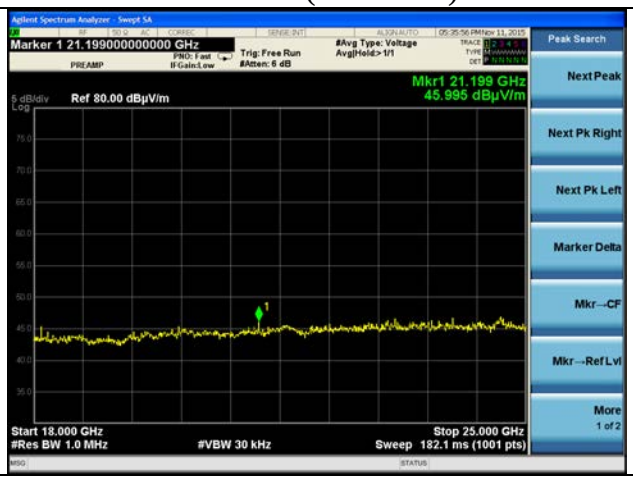
Plots

1-4 GHz (Antenna 1)

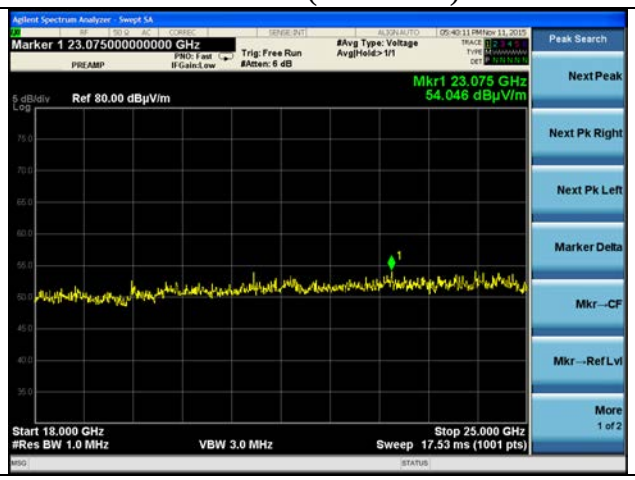
1-4 GHz (Antenna 2)

4-18 GHz (Antenna 1)

4-18 GHz (Antenna 2)



18-26 GHz (Reduced VBW)



18-26 GHz (Peak)

B.4 – AC Mains Conducted Emissions

Rule Part(s)	FCC: 15.207 / 15.107 IC: RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.4 - 2014 ANSI C63.10 – 2013
Test Location	LS Research, LLC – Conducted Emissions Area
Test Voltage	120 VAC 60 Hz
EUT Placement	80 cm height non-conductive table above reference ground plane
Frequency Range of Measurement	150 kHz – 30 MHz
Measurement Detectors	Peak, Quasi-Peak, Average RBW: 9 kHz VBW: At least 27 kHz
Description of Measurement	1) The LISN, cable, limiter, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are preformed. The data is gathered and reported as the corrected values. 2) The EUT is placed on a non-conductive pedestal at appropriate distance from ground planes and plugged into LISN. The LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral). 3) Maximum emissions are determined with peak detector and measurements at select points are made with quasi-peak and average detectors. Results are recorded and compared to limit.
Example Calculations	Reported Measurement data = Raw receiver measurement + LISN Factor + Cable factor (dB) + Additional factor (when applicable)

Limits of Conducted Emissions at the AC Mains Ports:

Frequency Range (MHz)	Class B Limits (dBµV)	
	Quasi-Peak	Average
0.150 -0.50 *	66-56	56-46
0.5 – 5.0	56	46
5.0 – 30	60	50
* The limit decreases linearly with the logarithm of the frequency in this range.		

B.4.1 – AC Mains Conducted Emissions

Manufacturer	Rainbird
Date	11-11-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	15.207 / 15.107 / RSS-GEN
Measurement Procedure	ANSI C63.4 - 2014 ANSI C63.10 - 2013 Section 6.2
Test Voltage	120 VAC 60 Hz
EUT Placement	80 cm height non-conductive table, 40 cm from vertical ground plane
Detectors	Peak; RBW 9 kHz Quasi-Peak and Average
Additional Notes	1) Tested in continuous transmit and receive with no significant difference between operating channels.

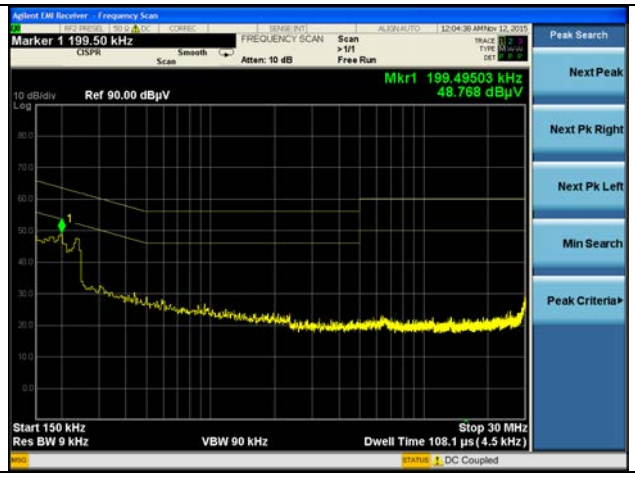
Example Calculation:

Margin (dB) = Limit (dBµV) – Reading (dBµV)

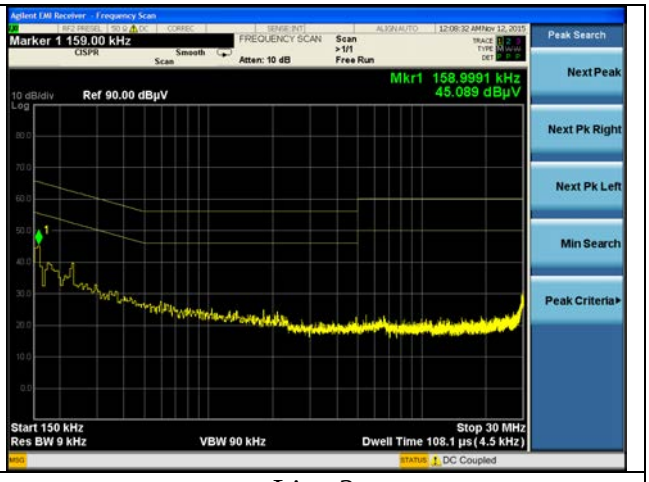
Table

Frequency (MHz)	Line	Peak Reading (dBµV)	Quasi-Peak Reading (dBµV)	Average Reading (dBµV)	Q-Peak Limit (dBµV)	Quasi-Peak Margin (dB)	Average Limit (dBµV)	Average Margin (dB)
0.199	1	47.20	41.00	30.60	63.65	22.7	53.65	23.1
0.240	1	48.40	40.00	29.50	62.10	22.1	52.10	22.6
30.000	1	27.30	22.90	16.20	60.00	37.1	50.00	33.8
0.159	2	45.50	38.80	23.00	65.52	26.7	55.52	32.5
0.244	2	43.30	32.80	20.00	61.96	29.2	51.96	32.0
30.000	2	29.70	24.20	17.40	60.00	35.8	50.00	32.6

Plots



Line 1



Line 2

Appendix C - Uncertainty Summary

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k=2.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.82 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.88 dB
Radiated Emissions	3-Meter Chamber, Horn Antenna	4.85 dB
Absolute Conducted Emissions	Agilent PSA/ESA Series	1.38 dB
AC Line Conducted Emissions	Shielded Room/EMCO LISN	3.20 dB
Radiated Immunity	3 Volts/Meter in 3-Meter Chamber	2.05 Volts/Meter
Conducted Immunity	3 Volts level	2.33 V
EFT Burst, Surge, VDI	230 VAC	54.4 V
ESD Immunity	Discharge at 15kV	3200 V
Temperature/Humidity	Thermo-hygrometer	0.64°/ 2.88 %RH

Appendix D - References

Publication	Year	Title
FCC CFR Parts 0-15	2016	Code of Federal Regulations – Telecommunications
RSS-247 Issue 1	2015	Digital Transmissions Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-GEN Issue 4	2014	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing Unlicensed Wireless Devices

END OF REPORT

Date	Version	Comments	Person
11-17-15	V0	Initial Draft Release	Adam A
11-20-15	V0	Internal Review	Peter F
03-14-16	V1	Final Release	Adam A