BEC INCORPORATED

CERTIFICATION APPLICATION TEST REPORT

TEST STANDARDS:
FCC Part 15 Subpart C Intentional Radiator

ARRIS Model IP815 Set Top Box

REPORT BEC-1621-02

TEST DATES: 07/09/2015 – 07/23/2015

CUSTOMER:
ARRIS Group Incorporated
101 Tournament Drive
Horsham, PA 19044

PREPARED BY: _____
Steve Fanella, Test Engineer

REVIEWED and APPROVED BY: _____
Al Fanella, Test Director

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Testing Cert #2957.01

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Notice To Customer

This report and any recommendations it contains represent the result of BEC's testing and assessment on behalf of your company. Testing has been conducted according to accepted engineering standards and practices. This report reflects testing and assessment of product samples provided by your company and may not reflect the characteristics of other samples, especially those produced at different times. Therefore this report and its findings and recommendations, if implemented, should not be construed as an assurance or implied warranty for the continuing electromagnetic compatibility (EMC) of the product. **BEC shall not be liable for incidental or consequential damages, even if advised of the possibility thereof.**

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Revision History

Revision #	Description of Changes	Date of Changes	Date Released
0	Test Report Initial Release	N/A	07/27/2015

1.0 Administrative Information

1.1 Project Details

Project Number	BEC-1621	
Set Top Box Manufacturer	ARRIS Group Incorporated	
Set Top Box Model Number	IP815 (modified with SMA ports to RF4CE antennae)	IP815 (RF4CE antennae unmodified)
Set Top Box Serial Number	M11513TH0360	M11513TH0379
Set Top Box Sample Number	1621-04	1621-05
FCC ID	ACQ-IP815	
Frequency of Operation	2400 - 2483.5 MHz	
Test Laboratory Location	BEC Incorporated 970 East High Street Pottstown, PA 19464	
Test Performed For	ARRIS Group Incorporated 101 Tournament Drive Horsham, PA 19044	
Test Personnel	Paul Banker / Steve Fanella	
Technical Contact	Mike Welty	
Date Received	07/02/2015	
Condition Received	Suitable for test	
Sample Type	Production unit	
EUT Classification	Unlicensed Unintentional Radiator	
FCC Classification	DTS- Part 15 Digital Transmission System	
Applicable FCC Rule Part	FCC Rules Part 15.247: Operation within the bands 920-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz Direct Sequence System	

1.2 Preface

This report documents product testing conducted to verify compliance of the specified EUT with applicable standards and requirements as identified herein. EUT, test instrument configurations, test procedures, and recorded data are generally described in this report. The reader is referred to the applicable test standards for detailed procedures. The following table summarizes the test results obtained during this evaluation.

1.3 Test Result Summary Table

The ARRIS Model IP815 Set Top Box was tested and found to be compliant to the sections of the FCC Part 15 Subpart C standard listed below:

FCC Part 15, Subpart C Intentional Radiators	Test Description	Result
15.207(b)	Conducted Emissions, Power Leads, 150 kHz to 30 MHz	**PASS**
15.209(a)	Spurious Radiated Emissions, 30 MHz to 1 GHz	**PASS**
15.209, 15.205	Spurious Radiated Emissions, 1 GHz to 25 GHz	**PASS**
15.247(a)(2)	6 dB Occupied Bandwidth	**PASS**
15.247(b)(3)	Maximum Peak Power Output	**PASS**
15.247(d)	Antenna Port, Conducted Spurious Emissions	**PASS**
15.247(e)	Antenna Port, Power Spectral Density	**PASS**
15.247(d)	Band Edge Measurement	**PASS**

1.4 Measurement Uncertainty

Measurement	Measurement Distance	Frequency Range	Measurement Limit	Expanded Uncertainty
Conducted Disturbance	N/A	150 kHz – 30 MHz	FCC Section 15.207	3.58
Radiated Disturbance	3 m	30 MHz – 1 GHz	FCC Section 15.209	4.02

No adjustments to measured data presented in this report are required because all values of uncertainty are less that the CISPR 16-4-2:2003 recommendations. These uncertainties have a coverage factor of $k = 2$, which yields approximately a 95% level of confidence for the near-normal distribution typical of most measurement results.

1.5 Condition of Received Sample

An evaluation of the EUT was conducted in order to verify test subject identity and condition and to ensure suitability for testing. No evidence of physical damage was noted. The test item condition was deemed acceptable for the performance of the requested test services.

1.6 Test Equipment

All test equipment is checked to manufacturer's specifications and, when applicable, have current N.I.S.T. traceable, ISO 9002 conforming certificates of calibration. Test equipment used for the tests described herein is listed in Appendix A.

2.0 Equipment Under Test

Unless otherwise noted in the individual test results sections, testing was performed on the EUT as follows.

2.1 EUT Description

The ARRIS Model IP815 is an Advanced IP Client Video Set-Top Box with the following features and interfaces:
MoCA 2.0
Ethernet
USB 2.0
HDMI output
Composite video output
Baseband audio output
Internal IR receiver and support for external IR receiver

2.2 Receiver Classification

N/A

2.3 Product Category

FCC Part 15, Subpart C (Section 15.247)

2.4 Product Classification

RF4CE Intentional Radiator Testing Requirements for IR Signal Operation within the bands of 920-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz-Direct Sequence System

2.5 Test Configuration

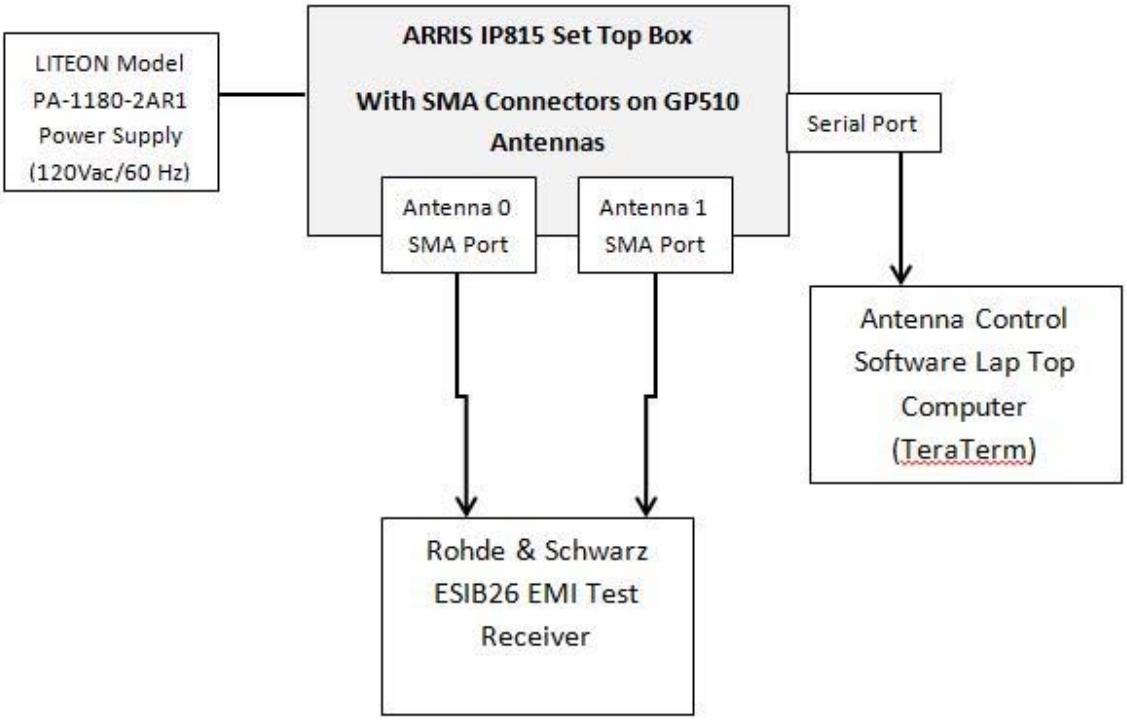
The antennas within the ARRIS IP815 set top box were controlled by software which allowed the test technician to select the specific antenna within the EUT, designate the specific Channel Frequency, control the antenna power and control the antenna modulation (on/off).

2.6 Test Configuration Rationale

The tested configuration of the EUT was required so that the test technician could view the characteristics of the antenna at specific frequencies and allow the technician to record the required measurements.

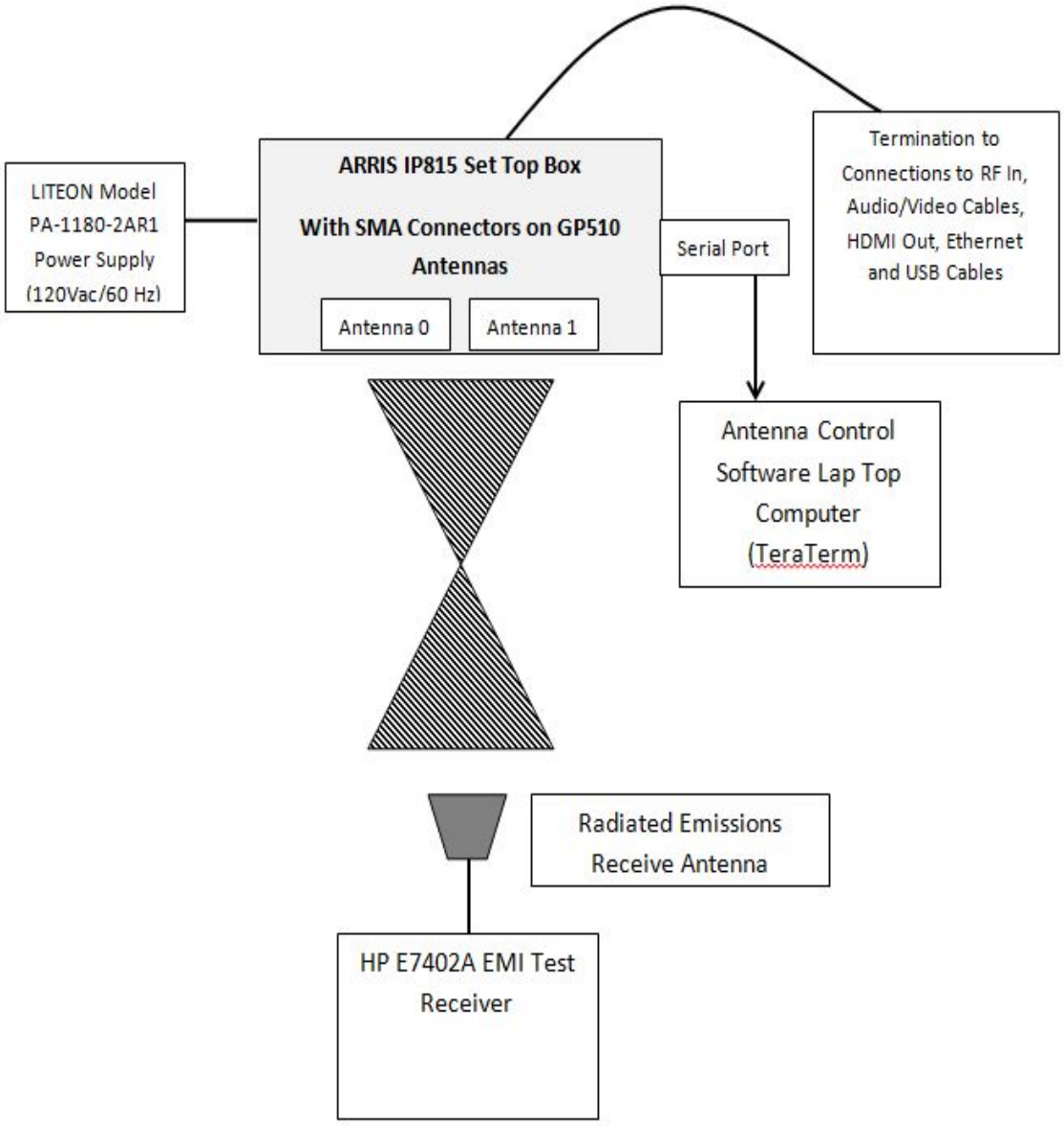
2.7 Test Configuration Diagram (Conducted Measurements)

A block diagram of the EUT configuration showing interconnection cables is illustrated below. The drawing shows the physical hardware layout used for the tests along with I/O cables and AC power distribution.



2.8 Test Configuration Diagram (Radiated Measurements)

A block diagram of the EUT configuration showing interconnection cables is illustrated below. The drawing shows the physical hardware layout used for the tests along with I/O cables and AC power distribution.



2.9 EUT Information, Interconnection Cabling and Support Equipment

EUT Hardware

Description	Manufacturer	Model	Serial Number	Sample Number
Set Top Box (Modified Antennas with SMA Connectors)	ARRIS	IP815	M11513TH0360	1621-04
Set Top Box (Unmodified Antennas)	ARRIS	IP815	M11513TH0379	1621-05
AC/DC Power Supply	Delta	ADP-18DR A	GVUD478000KY	1621-06
AC/DC Power Supply	LITEON	PA-1180-2AR1	5581240051428000 346	1621-07

Interconnection Cable List (Conducted Test Setup)

Manufacturer	Model	Type	Shielding	Length	Description
Workhorse	WHU18-3636-036	High Frequency RF Cable 1 to 40 GHz	Double Braid	1 Meter	Measurement Cable from the Antenna SMA Connector to the Rohde and Schwarz ESIB26 Receiver. Asset # BEC-814

Interconnection Cable List (Radiated Test Setup)

Type	Mfr/Part#	Shielding	Length	Description
Audio Video	Acoustic Research/PR161	95% braid w/100% aluminum Mylar foil	6 Ft	Audio & Video Out Ports
HDMI	Rocketfish	Braid over foil	1.3 m	HDMI Port
75-Ohm Coax	Belden-T 9114 Duobond	Double Braid	1 m	RF In and RF Out
Ethernet CAT5	Siemon Co. / MC5-8-T-07-20	Mylar foil	7 Ft	Ethernet Port
USB	Hannstar/E52534-D	Braid over foil	2 m	USB Port

Support Equipment

Description	Manufacturer	Model	Serial Number
Antenna Control Software Lap Top Computer	Dell	Latitude D830	CH-0HN338-48643-84F-0307

2.10 Test Signals and Test Modulation

By design this product does not have an external Modulation input connector, therefore, normal operating modulation was used for all testing reported herein. The only test where modulation was not active was during testing of the Maximum Peak Power Output FCC Section 15.247(b)(3) (Section 4.4 of this report) because the signal amplitude was higher without modulation applied when measuring.

The control unit in this product is a digital frequency transmitter. The EUT transmits to a discrete frequency on a specific channel. The RF4CE Device has 16 Channels available. The 16 Channels and frequencies that can be transmitted by the EUT are as follows:

Channel 11	2.405 GHz	Channel 19	2.445 GHz
Channel 12	2.410 GHz	Channel 20	2.450 GHz
Channel 13	2.415 GHz	Channel 21	2.455 GHz
Channel 14	2.420 GHz	Channel 22	2.460 GHz
Channel 15	2.425 GHz	Channel 23	2.465 GHz
Channel 16	2.430 GHz	Channel 24	2.470 GHz
Channel 17	2.435 GHz	Channel 25	2.475 GHz
Channel 18	2.440 GHz	Channel 26	2.480 GHz

For some of the required testing, the EUT was configured to transmit individually at low Channel 11 (2.405 GHz), middle Channel 19 (2.445 GHz) or high Channel 26 (2.480 GHz) during the measurement of the signal.

2.11 Grounding

During all testing presented in this report, earth grounding of the test sample was accomplished through the AC mains input power cord to the EUT and through the return of the DC line to the Controller.

2.12 EUT Modifications

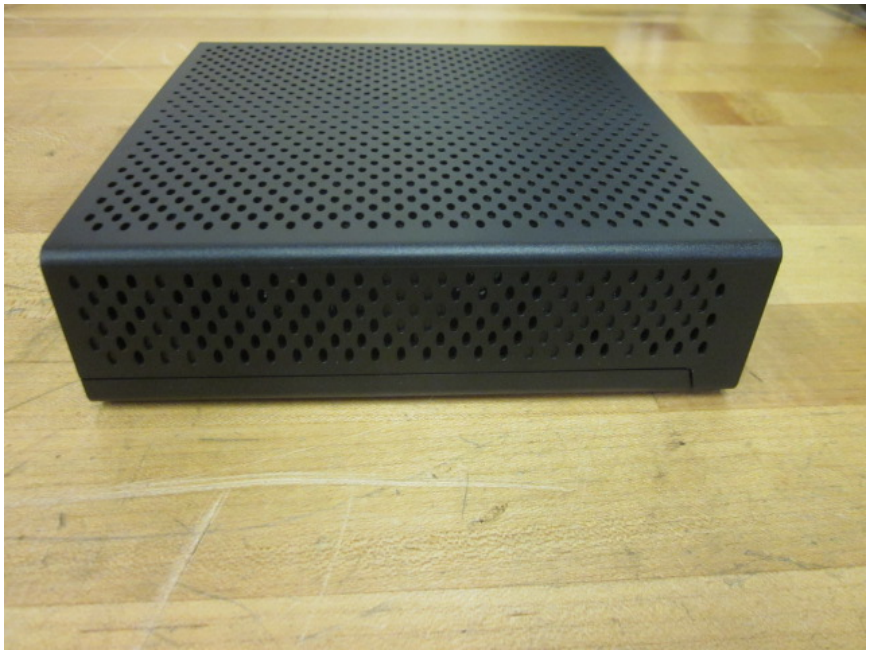
No modifications were made to the ARRIS IP815 set top box.

2.13 EUT Pictures

ARRIS IP815 SET TOP BOX FRONT

ARRIS IP815 SET TOP BOX REAR

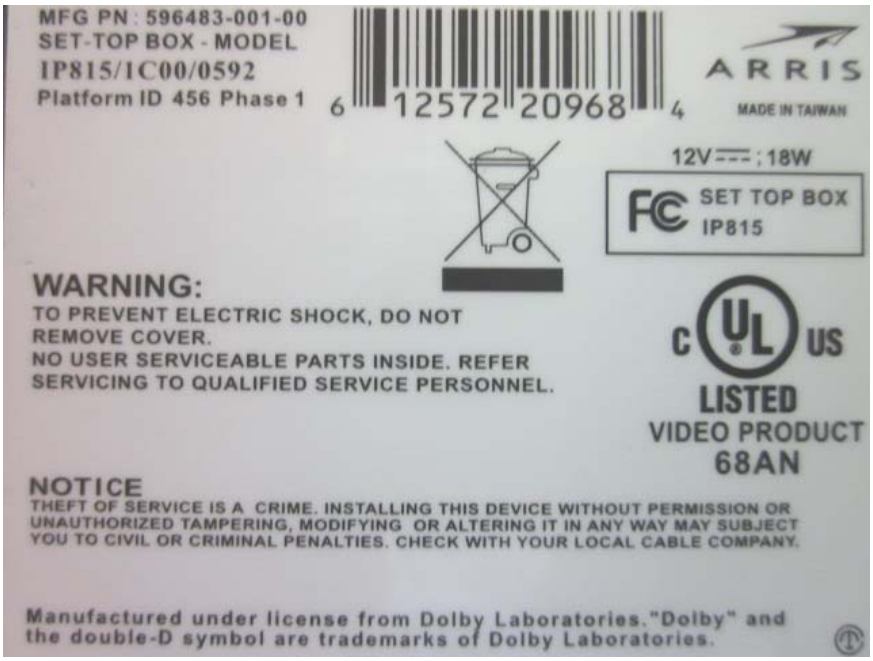
ARRIS IP815 SET TOP BOX LEFT SIDE



ARRIS IP815 SET TOP BOX RIGHT SIDE

ARRIS IP815 SET TOP BOX TOP SIDE

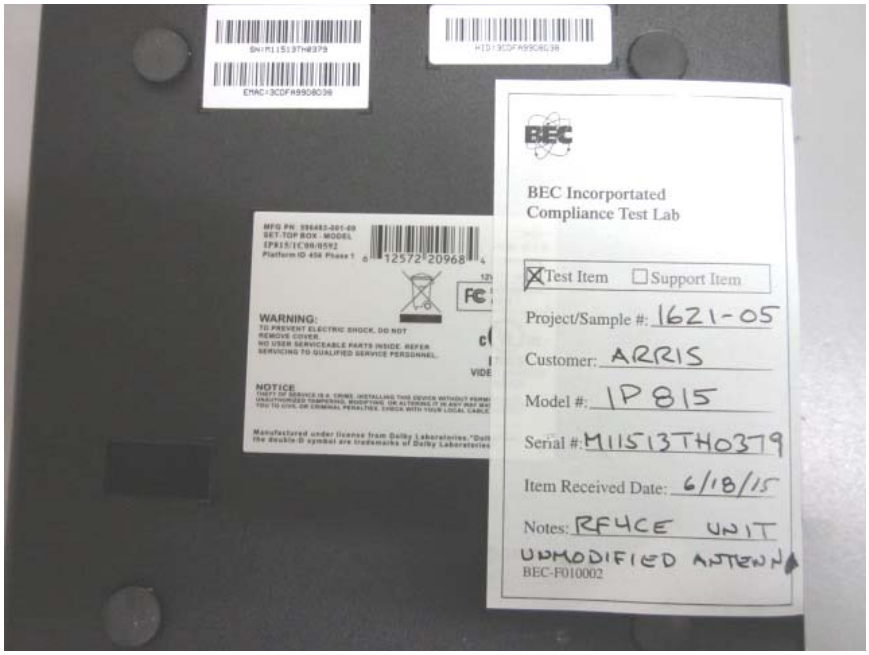
ARRIS IP815 SET TOP BOX BOTTOM LABEL



ARRIS IP815 SAMPLE 1621-04 LABEL (MODIFIED ANTENNA EUT)

ARRIS IP815 SAMPLE 1621-04 SERIAL NUMBER (MODIFIED ANTENNA EUT)

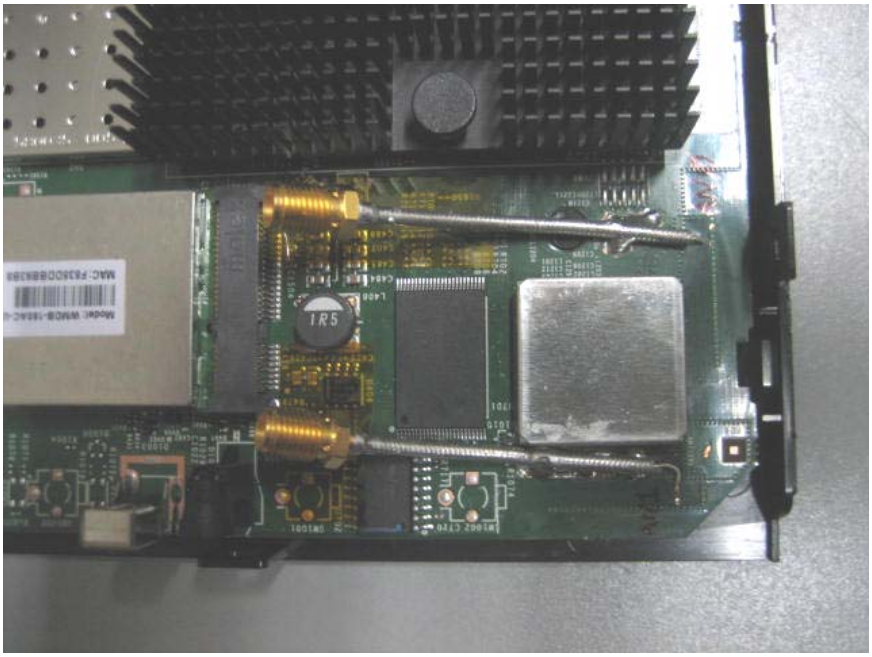
ARRIS IP815 SAMPLE 1621-05 LABEL (UNMODIFIED ANTENNA EUT)



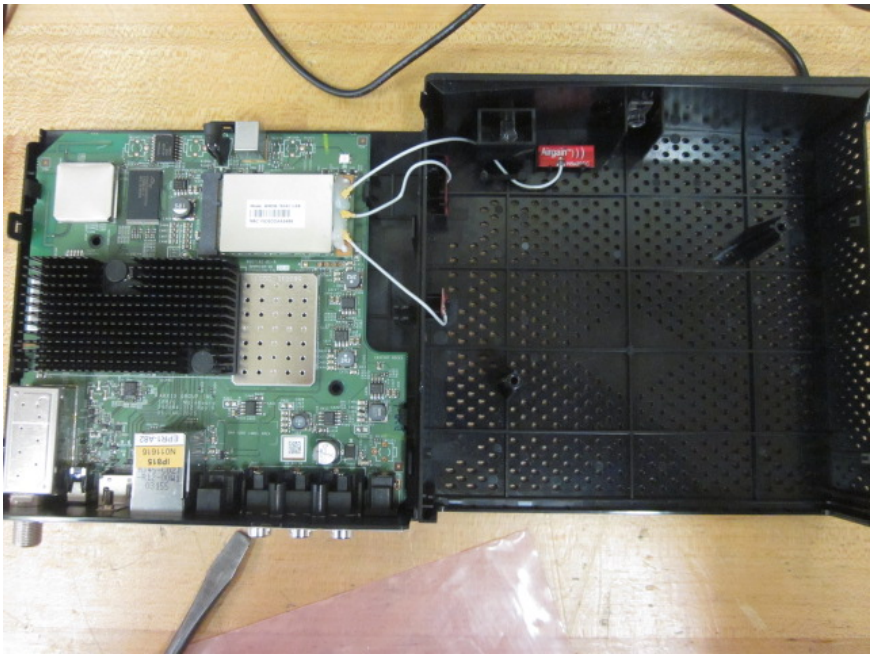
ARRIS IP815 SAMPLE 1621-05 SERIAL NUMBER (UNMODIFIED ANTENNA EUT)

ARRIS IP815 SAMPLE 1621-04 (INTERNAL SHOWING MODIFIED ANTENNAS)

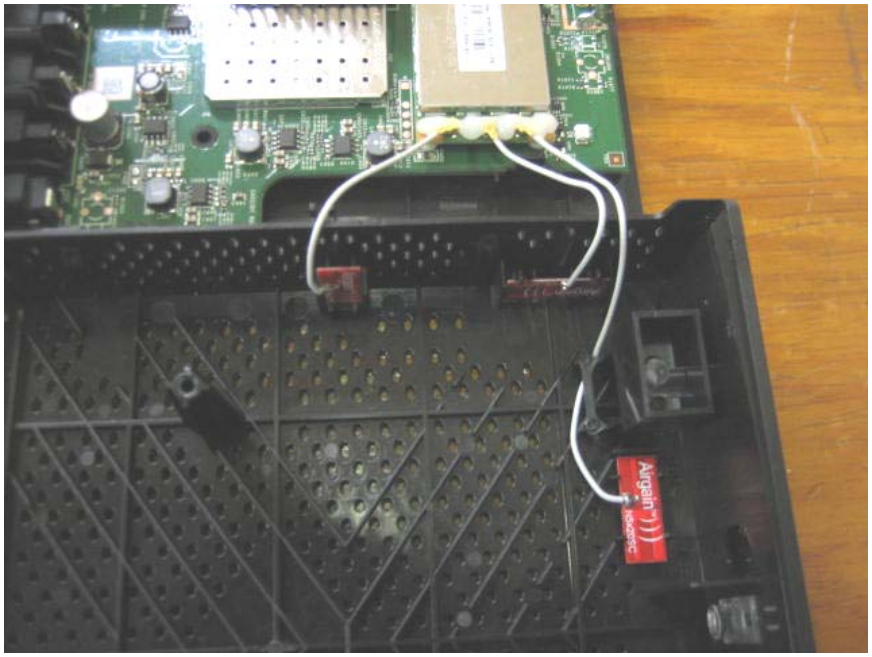
ARRIS IP815 SAMPLE 1621-04 (INTERNAL SHOWING SMA CONNECTORS)



ARRIS IP815 SAMPLE 1621-05 INSIDE TOP COVER (UNMODIFIED ANTENNAS)



ARRIS IP815 SAMPLE 1621-05 (UNMODIFIED ANTENNAS)



3.0 Applicable Requirements, Methods, and Procedures

3.1 Applicable Requirements

The results of the measurement of the radio disturbance characteristics of the EUT described herein may be applied and where appropriate, provide a presumption of compliance to one or more of the following requirements or to other requirements at the discretion of the customer, regulatory agencies, or other entities.

3.1.1 FCC Requirements

USA

Code of Federal Regulations:

Title 47 – Telecommunication

Chapter I - Federal Communications Commission

Sub-chapter A – General

Part 15 – Radio Frequency Devices

Subpart C - Intentional Radiators

Subpart D - Unlicensed Personal Communications Service Devices

Subpart E - Unlicensed National Information Infrastructure Devices

3.1.2 Basic Test Methods and Test Procedures

ANSI C63.4, 2009, 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

3.2 Deviations or Exclusions from the Requirements

No deviations or exclusions were made.

4.0 Test Results

4.1 Conducted Emissions Power Leads, 150 kHz to 30 MHz. FCC Section 15.207(b)

4.1.1 Conducted Emissions Test Procedure

AC Power Line

Conducted emissions at the power line input of the EUT were measured with an EMI receiver set to the appropriate detector and CISPR bandwidth, which was connected to the RF output of a 50 Ω, 50 μH Line Impedance Stabilization Network (LISN) installed in each power line. Measurements were made over the frequency range of 150 kHz to 30 MHz while the EUT was operating as described in the EUT section of this report. The significant amplitudes of emissions measured on the AC power lines of the EUT were recorded as follows:

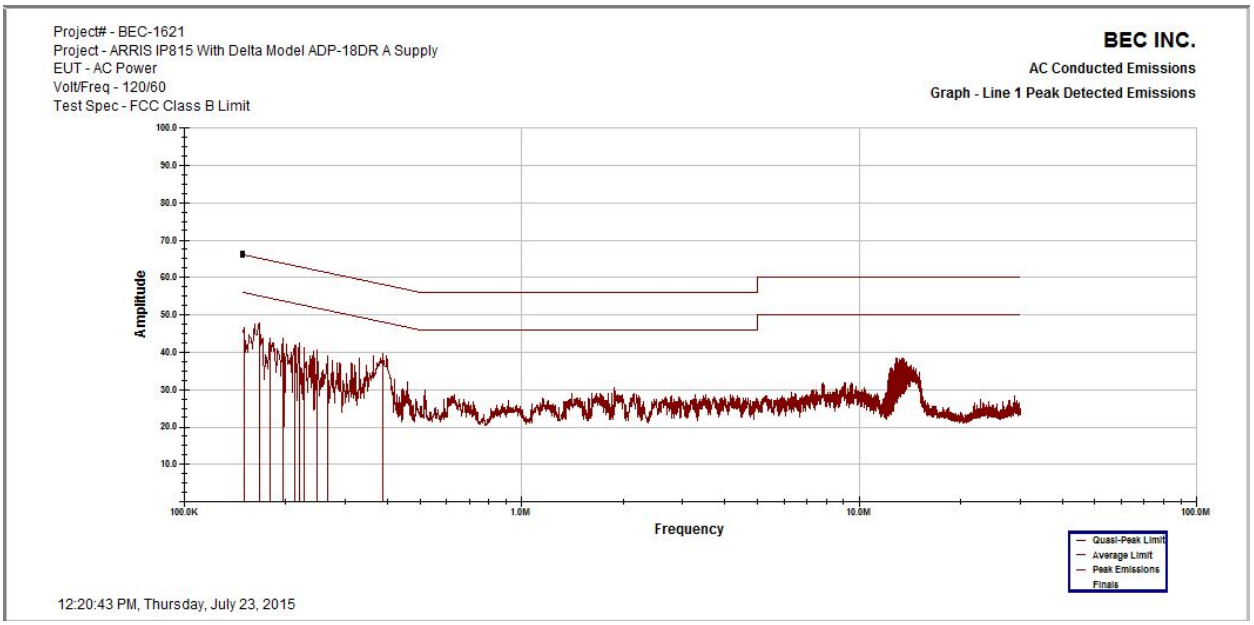
Emission (dBμV) = Meter Reading (dBμv) + Cable Loss (dB) + LISN Factor (dB) + Limiter Loss (dB)

4.1.2 Conducted Emissions Test Results Delta Model ADP-18DR A Power Supply (07/23/2015)

The following graphs and tables show the conducted emissions recorded on the AC power line of the EUT displayed against the FCC limits as outlined in Section 15.207(b). The Delta Model ADP-18DR A supply was powered at 120Vac/60 Hz.

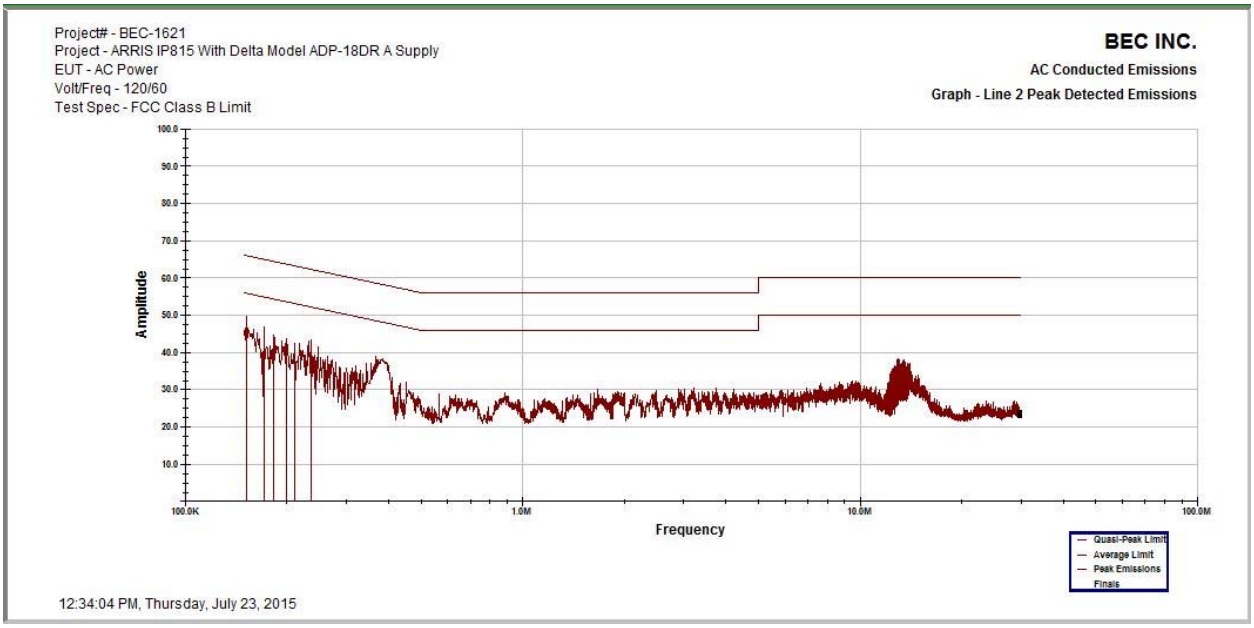
BEC INC.
Line 1 Conducted Emissions
12:26:22 PM, Thursday, July 23, 2015

	1	2	3	4	5	6	7
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor
150.686 KHz	30.88	55.98	-25.10	44.55	65.98	-21.43	0.130
166.608 KHz	32.12	55.53	-23.40	42.28	65.53	-23.25	0.130
180.166 KHz	25.31	55.14	-29.82	38.32	65.14	-26.82	0.127
196.029 KHz	26.17	54.68	-28.51	39.31	64.68	-25.37	0.121
212.148 KHz	20.36	54.22	-33.86	34.87	64.22	-29.35	0.120
217.912 KHz	18.51	54.06	-35.55	33.41	64.06	-30.65	0.120
224.070 KHz	18.46	53.88	-35.42	32.78	63.88	-31.10	0.120
249.965 KHz	14.78	53.14	-38.36	31.24	63.14	-31.90	0.120
267.060 KHz	13.01	52.66	-39.64	29.34	62.66	-33.32	0.120
387.034 KHz	31.54	49.23	-17.69	36.25	59.23	-22.98	0.130
Project# - BEC-1621							
Project - ARRIS IP815 With Delta Model ADP-18DR A Supply							
EUT - AC Power							
Volt/Freq - 120/60							
Test Spec - FCC Class B Limit							



BEC INC.
Line 2 Conducted Emissions
12:37:14 PM, Thursday, July 23, 2015

	1	2	3	4	5	6	7
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor
153.633 KHz	31.927	55.896	-23.969	42.230	65.896	-23.666	0.130
169.330 KHz	28.078	55.448	-27.370	41.010	65.448	-24.438	0.130
181.804 KHz	23.765	55.091	-31.326	37.740	65.091	-27.351	0.130
197.107 KHz	23.775	54.654	-30.879	36.520	64.654	-28.134	0.130
210.449 KHz	18.052	54.273	-36.220	34.630	64.273	-29.643	0.130
236.014 KHz	17.442	53.542	-36.100	31.090	63.542	-32.452	0.130
Project# - BEC-1621							
Project - ARRIS IP815 With Delta Model ADP-18DR A Supply							
EUT - AC Power							
Volt/Freq - 120/60							
Test Spec - FCC Class B Limit							



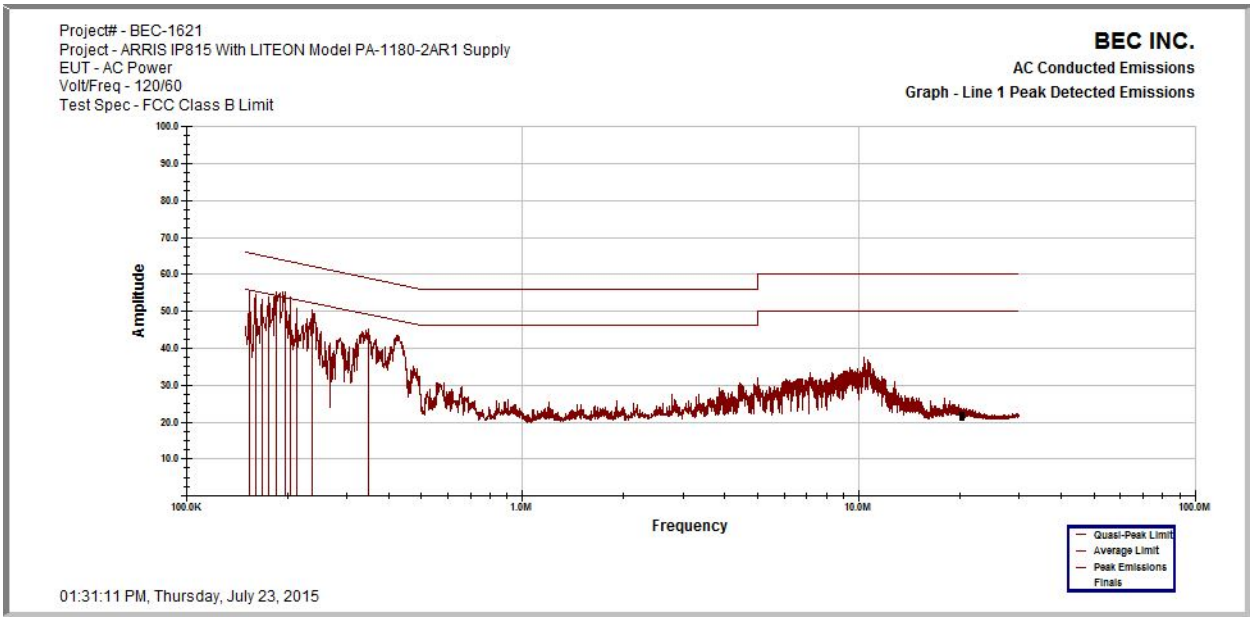
Results: All conducted emissions measured on the telecommunications port(s) of the Delta Model ADP-18DR A supply are below the limits specified in FCC Section 15.207 by a margin of at least 17.6 dB.

4.1.3 Conducted Emissions Test Results LITEON Model PA-1180-2AR1 Power Supply (07/23/2015)

The following graphs and tables show the conducted emissions recorded on the AC power line of the EUT displayed against the FCC limits as outlined in Section 15.207(b). The LITEON Model PA-1180-2AR1 supply was powered at 120Vac/60 Hz.

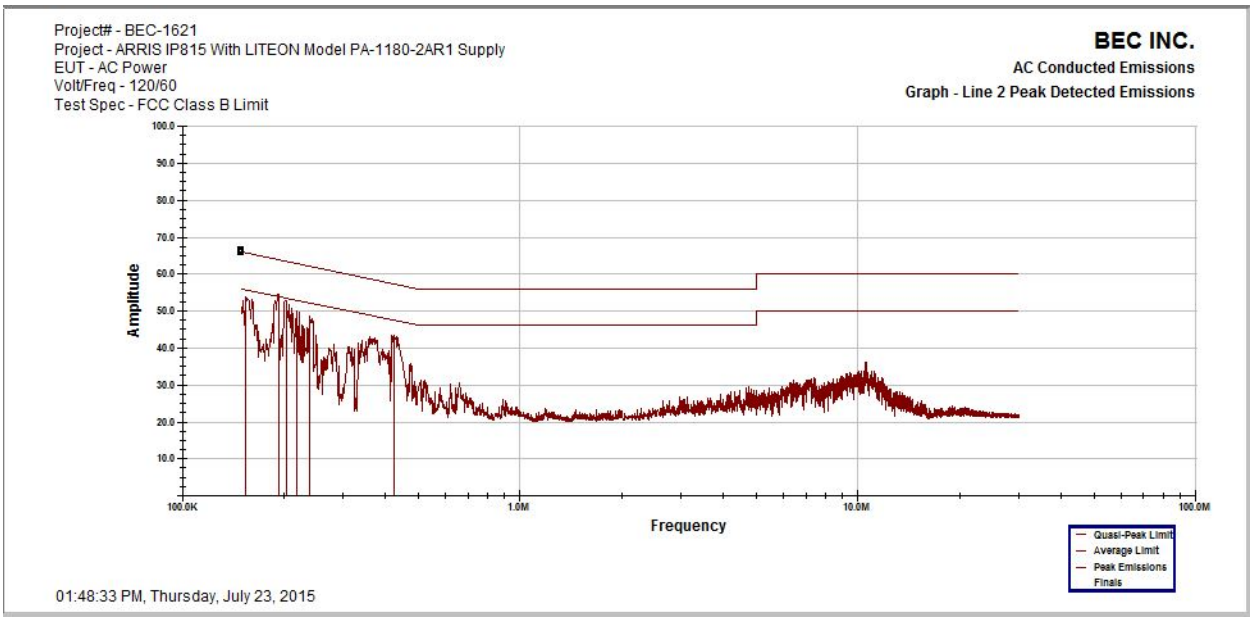
BEC INC.
Line 1 Conducted Emissions
01:36:26 PM, Thursday, July 23, 2015

	1	2	3	4	5	6	7
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor
152.368 KHz	41.72	55.93	-14.22	50.41	65.93	-15.52	0.130
158.602 KHz	35.58	55.75	-20.17	43.89	65.75	-21.86	0.130
166.940 KHz	37.87	55.52	-17.65	48.11	65.52	-17.41	0.130
175.475 KHz	31.49	55.27	-23.78	44.93	65.27	-20.34	0.128
185.326 KHz	35.19	54.99	-19.80	45.86	64.99	-19.13	0.125
198.582 KHz	33.64	54.61	-20.97	50.29	64.61	-14.32	0.120
204.167 KHz	36.99	54.45	-17.46	49.80	64.45	-14.65	0.120
210.285 KHz	33.01	54.28	-21.27	49.30	64.28	-14.98	0.120
236.078 KHz	34.54	53.54	-19.00	44.54	63.54	-19.00	0.120
343.784 KHz	32.80	50.46	-17.67	38.38	60.46	-22.08	0.129
Project# - BEC-1621							
Project - ARRIS IP815 With LITEON Model PA-1180-2AR1 Supply							
EUT - AC Power							
Volt/Freq - 120/60							
Test Spec - FCC Class B Limit							



BEC INC.
Line 2 Conducted Emissions
01:51:34 PM, Thursday, July 23, 2015

	1	2	3	4	5	6	7
Frequency	AVG	AVG	AVG	QP	QP	QP	Corr
MHz	dBuV	Limit	Margin	dBuV	Limit	Margin	Factor
155.267 KHz	44.330	55.850	-11.520	50.740	65.850	-15.110	0.130
193.236 KHz	40.792	54.765	-13.972	51.810	64.765	-12.955	0.130
203.203 KHz	37.545	54.480	-16.935	48.570	64.480	-15.910	0.130
215.918 KHz	29.007	54.117	-25.109	42.160	64.117	-21.957	0.130
235.699 KHz	34.388	53.551	-19.164	42.920	63.551	-20.631	0.130
419.388 KHz	30.104	48.303	-18.199	41.984	58.303	-16.319	0.144
Project# - BEC-1621							
Project - ARRIS IP815 With LITEON Model PA-1180-2AR1 Supply							
EUT - AC Power							
Volt/Freq - 120/60							
Test Spec - FCC Class B Limit							



Results: All conducted emissions measured on the telecommunications port(s) of the LITEON Model PA-1180-2AR1 supply are below the limits specified in FCC Section 15.207 by a margin of at least 11.5 dB.

4.2 Spurious Radiated Emissions, 1 GHz to 25 GHz. FCC Section 15.209

4.2.1 Test Facility

OATS

The Open Area Test Site (OATS) is an all-weather facility with a wooden enclosure that contains a ground level 4-foot diameter turntable capable of rotating equipment 360 degrees. The enclosure is free of reflective metallic objects and extraneous electromagnetic signals. This non-metallic enclosure and the 3 and 10 meter test range existing outside the enclosure rest upon a protective insulating material, which in turn covers a flat, metal, continuous ground plane.

Instrumentation for remote control of the antenna mast, turntable, and other equipment are controlled by personnel indoors. The EUT and support peripherals required for EUT operation were placed on a table 80 cm high for tabletop equipment or directly on the turntable surface for floor standing equipment.

The test site complies with the attenuation measurements specified in ANSI C63.4 and CISPR 22.

SR#1

The Semi-Anechoic Shielded Room (SR#1) is an ferrite and absorber lined chamber which houses a 5-foot diameter turntable capable of rotating equipment 360 degrees and antenna mast for Horizontal and Vertical polarity measurements. The enclosure is free of reflective metallic objects and extraneous electromagnetic signals. This 3 meter shielded enclosure has a raised computer floor with metal tile bottoms providing a continuous ground plane.

Instrumentation for remote control of the antenna mast, turntable, and other equipment are controlled by personnel outside the chamber. The EUT and support peripherals required for EUT operation were placed on a table 80 cm high for tabletop equipment or directly on the turntable surface for floor standing equipment.

The test site complies with the attenuation measurements specified in ANSI C63.4 and CISPR 22.

4.2.2 Spurious Radiated Emissions Test Procedure

Radiated Emissions 30 MHz – 40 GHz

The EMI receiver was set to quasi-peak mode for frequencies from 30MHz to 1GHz and the appropriate CISPR bandwidths were employed. The receiver was set to average mode for frequencies above 1GHz with the appropriate CISPR bandwidths were employed. Significant emissions found during the preliminary scans were maximized by rotating the turntable and varying the antenna height. Both horizontal and vertical antenna polarities were also investigated for suspect emissions. The signals are maximized and measured using the in house generated RADE or off the shelf TILE software. The support equipment and test item(s) were powered off in turn to determine the source of the emissions where appropriate.

Field strengths were calculated as follows:

Field Strength (dBµV/m) = Meter Reading (dBµV) + Antenna Factor (dB/m) + Cable Loss (dB) – Amplifier Gain (dB)

Because the intentional radiator has a pulse modulated amplitude signal, a "duty cycle correction factor" must be taken against the Peak Measurement of the harmonic spurious emissions when calculating the final field strengths against the required limits. The duty cycle correction factor for the GreenPeak GP711 is 20 dB (maximum allowed by the FCC).

Section 15.35 (c) mentions: "Unless otherwise specified, e.g. Section 15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds."

The maximum duty cycle of the RF4CE set top box is gated by the remote control. The maximum repeat rate of a RF4CE remote control, while continuously pressing a key, is 1 packet per 100 ms, so the set top box can confirm every 100 ms a packet with an ACK. The duration of an ACK is ~0.5 ms.

The duration of a ACK is 0.5 ms, the interval time is 100 ms. This means that the correction factor for the average spurious emission field strength is:
$20 * \log_{10}(0.5 / 100) = -46$ dB. FCC limits the max duty cycle correction factor to 20 dB.

4.2.3 Spurious Radiated Emissions 1 GHz to 25 GHz Test Results (07/13/2015)

The following table shows the highest amplitude average detected field strengths as recorded from the EUT. These measurements were performed over the frequency range of 1.0 GHz to 25 GHz at a distance of 3 meters to satisfy FCC Section 15.209 requirements. Spurious emissions from the Antenna 0 and Antenna 1 were measured when individually set to low (Channel 11), middle (Channel 19) and high (Channel 26). The signal output was maximized with modulation.

Settings: Antenna 0, Channel 11 (2.405 GHz Fundamental) Maximum Output with Modulation

Frequency	Peak Level	Calculated Average w Duty Cycle Correction Factor	Ant Pol	Azimuth	Ant. Hgt.	C/F	Avg. Limit	Avg. Margin
GHz	dBuV/m	dBuV/m		degrees	cm	dB	dBuV/m	dB
3.46	43.84	23.84	V	223	100.00	-0.76	53.98	-30.14
4.81	52.73	32.73	V	156	100.00	2.28	53.98	-21.25
4.81	56.79	36.79	H	116	100.00	2.28	53.98	-17.19
17.74	62.24	42.24	H	116	100.00	18.88	53.98	-11.74
17.97	63.15	43.15	V	075	100.00	19.51	53.98	-10.83

Settings: Antenna 0, Channel 19 (2.445 GHz Fundamental) Maximum Output with Modulation

Frequency	Peak Level	Calculated Average w Duty Cycle Correction Factor	Ant Pol	Azimuth	Ant. Hgt.	C/F	Avg. Limit	Avg. Margin
GHz	dBuV/m	dBuV/m		degrees	cm	dB	dBuV/m	dB
2.445	28.75	8.75	H	112	100	-5.32	53.98	-45.23
3.447	45.61	25.61	V	043	100	-0.79	53.98	-28.37
4.889	61.58	41.58	V	117	100	2.58	53.98	-12.40
4.890	54.61	34.61	H	114	100	2.58	53.98	-19.37
17.751	63.25	43.25	H	221	100	18.90	53.98	-10.73
17.782	61.77	41.77	V	287	100	18.99	53.98	-12.21

Settings: Antenna 0, Channel 26 (2.480 GHz Fundamental) Maximum Output with Modulation

Frequency	Peak Level	Calculated Average w Duty Cycle Correction Factor	Ant Pol	Azimuth	Ant. Hgt.	C/F	Avg. Limit	Avg. Margin
GHz	dBuV/m	dBuV/m		degrees	cm	dB	dBuV/m	dB
2.480	31.32	11.32	V	214	100	-5.18	53.98	-42.66
2.480	34.63	14.63	H	121	100	-5.18	53.98	-39.35
3.452	40.10	20.10	V	301	100	-0.77	53.98	-33.88
4.959	57.70	37.70	H	122	100	2.84	53.98	-16.28
4.961	57.71	37.71	V	154	100	2.85	53.98	-16.27
17.774	62.27	42.27	V	339	100	18.97	53.98	-11.71
17.949	61.84	41.84	H	226	100	19.46	53.98	-12.14

Settings: Antenna 1, Channel 11 (2.405 GHz Fundamental) Maximum Output with Modulation

Frequency	Peak Level	Calculated Average w Duty Cycle Correction Factor	Ant Pol	Azimuth	Ant. Hgt.	C/F	Avg. Limit	Avg. Margin
GHz	dBuV/m	dBuV/m		degrees	cm	dB	dBuV/m	dB
4.81	62.80	42.80	H	313	100.00	2.27	53.98	-11.18
3.46	39.74	19.74	V	301	100.00	-0.75	53.98	-34.24
4.81	59.40	39.40	V	096	100.00	2.30	53.98	-14.58
17.59	61.86	41.86	H	096	100.00	18.44	53.98	-12.12
17.78	64.00	44.00	V	284	100.00	18.98	53.98	-9.98

Settings: Antenna 1, Channel 19 (2.445 GHz Fundamental) Maximum Output with Modulation

Frequency	Peak Level	Calculated Average w Duty Cycle Correction Factor	Ant Pol	Azimuth	Ant. Hgt.	C/F	Avg. Limit	Avg. Margin
GHz	dBuV/m	dBuV/m		degrees	cm	dB	dBuV/m	dB
2.445	31.71	11.71	H	311	100	-5.32	53.98	-42.27
3.458	41.44	21.44	V	047	100	-0.75	53.98	-32.54
4.891	53.98	33.98	V	224	100	2.59	53.98	-20.00
4.891	62.01	42.01	H	312	100	2.59	53.98	-11.97
17.527	61.42	41.42	H	336	100	18.28	53.98	-12.56
17.781	62.80	42.80	V	000	100	18.99	53.98	-11.18

Settings: Antenna 1, Channel 26 (2.480 GHz Fundamental) Maximum Output with Modulation

Frequency	Peak Level	Calculated Average w Duty Cycle Correction Factor	Ant Pol	Azimuth	Ant. Hgt.	C/F	Avg. Limit	Avg. Margin
GHz	dBuV/m	dBuV/m		degrees	cm	dB	dBuV/m	dB
2.479	36.56	16.56	H	313	100	-5.18	53.98	-37.42
2.480	31.08	11.08	V	247	100	-5.18	53.98	-42.90
3.452	41.36	21.36	V	211	100	-0.77	53.98	-32.62
4.961	52.46	32.46	V	223	100	2.85	53.98	-21.52
4.961	62.50	42.50	H	311	100	2.85	53.98	-11.48
15.487	50.87	30.87	H	360	100	8.82	53.98	-23.11
17.781	62.80	42.80	V	068	100	18.99	53.98	-11.18

Results: All harmonic spurious radiated emissions as recorded at a distance of 3 meters from the ARRIS Model IP815 Set Top Box are below the 3 meter limit specified by FCC Section 15.209 requirements by a margin of at least 9.98 dB.

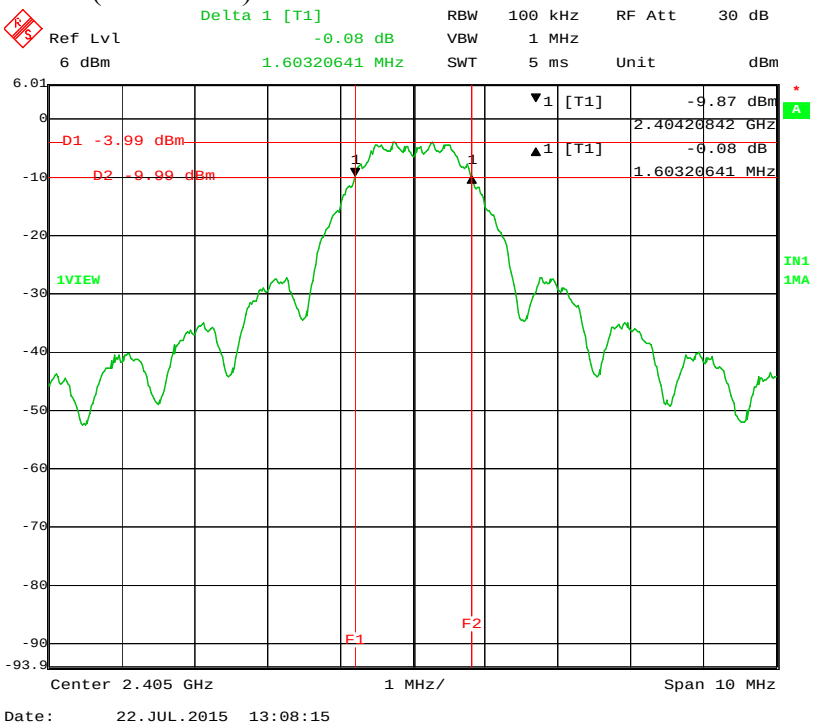
4.3 6 dB Occupied Bandwidth. FCC Section 15.247(a)(2)

4.3.1 6 dB Occupied Bandwidth – Test Procedure

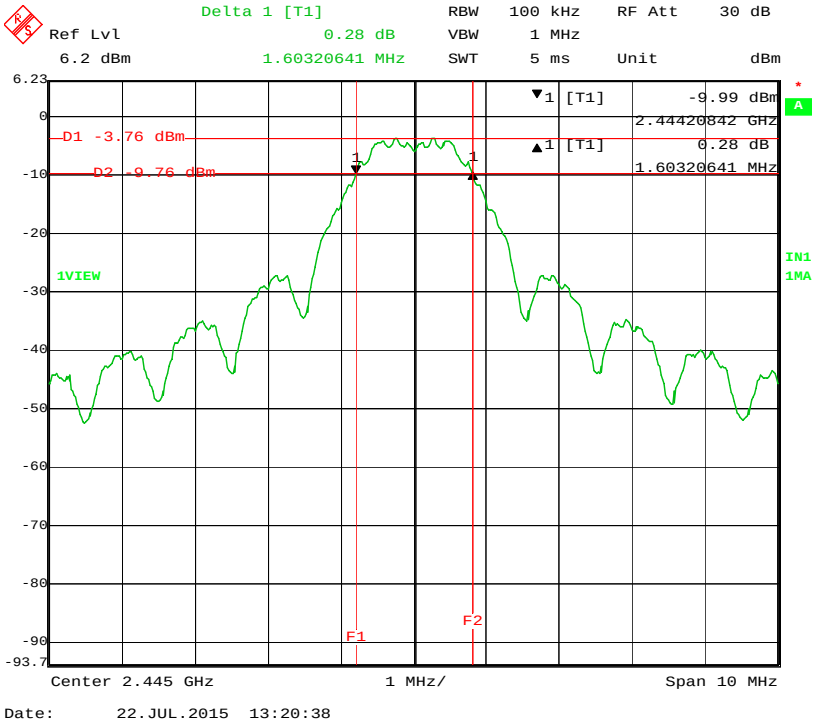
The minimum 6 dB bandwidths per FCC Section 15.247(a)(2) were measured using a 50 Ohm EMI Test Receiver with settings of 100 kHz resolution bandwidth and 300 kHz video bandwidth. The Antenna 0 and Antenna 1 were set individually to low (Channel 11), middle (Channel 19) and high (Channel 26). The signal output was maximized with modulation.

4.3.2 6 dB Occupied Bandwidth Analyzer Display Captures Antenna 0 (07/22/2015)

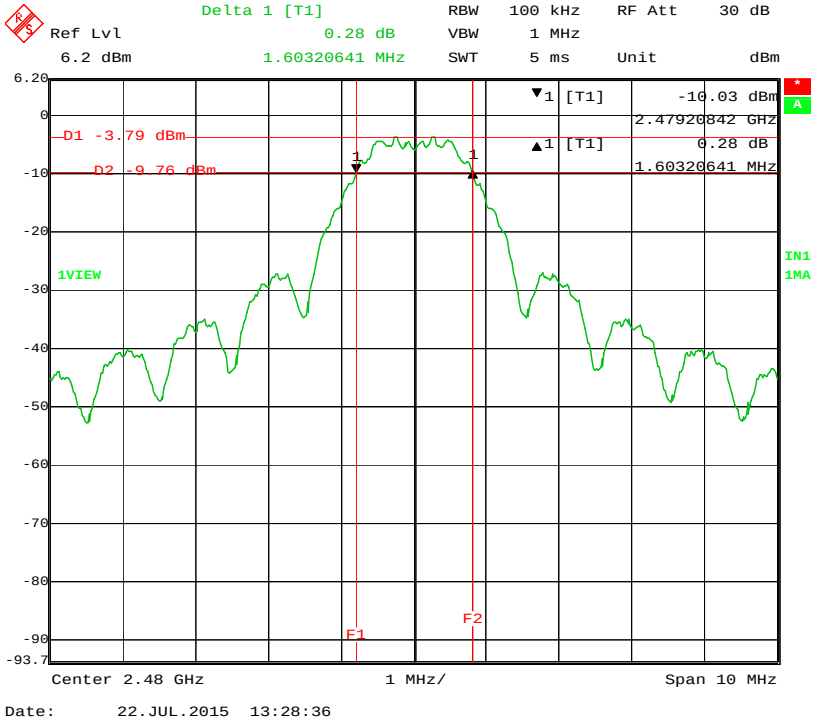
Antenna 0, Channel 11 (2.405 GHz)



Antenna 0, Channel 19 (2.445 GHz)

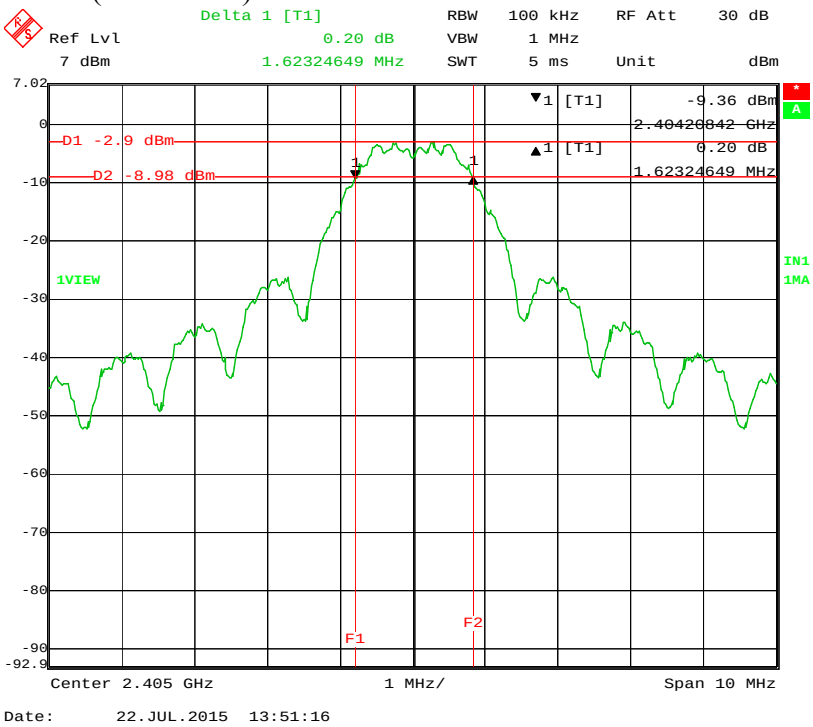


Antenna 0, Channel 26 (2.480 GHz)

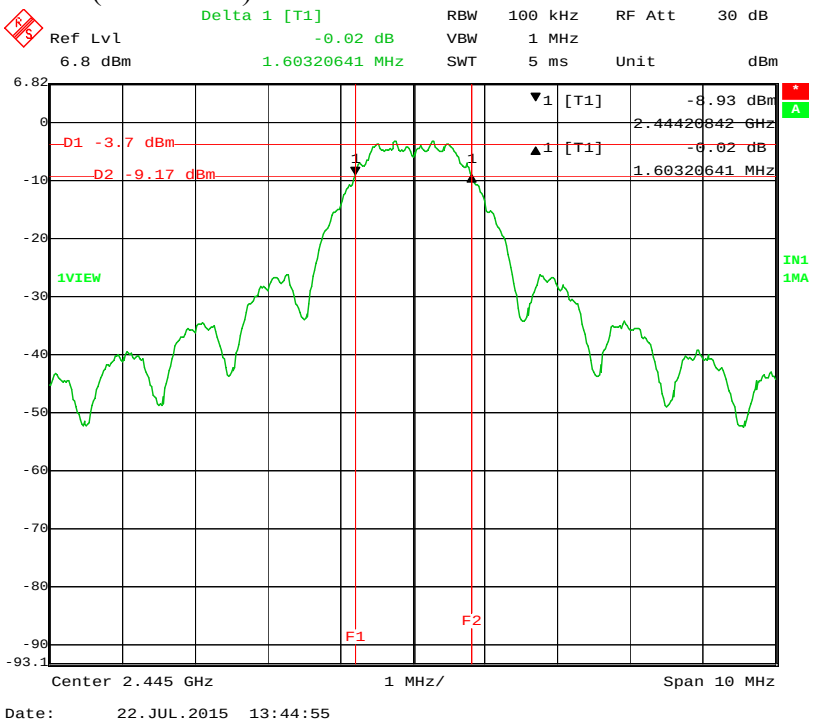


4.3.3 6 dB Occupied Bandwidth Analyzer Display Captures Antenna 1 (07/22/2015)

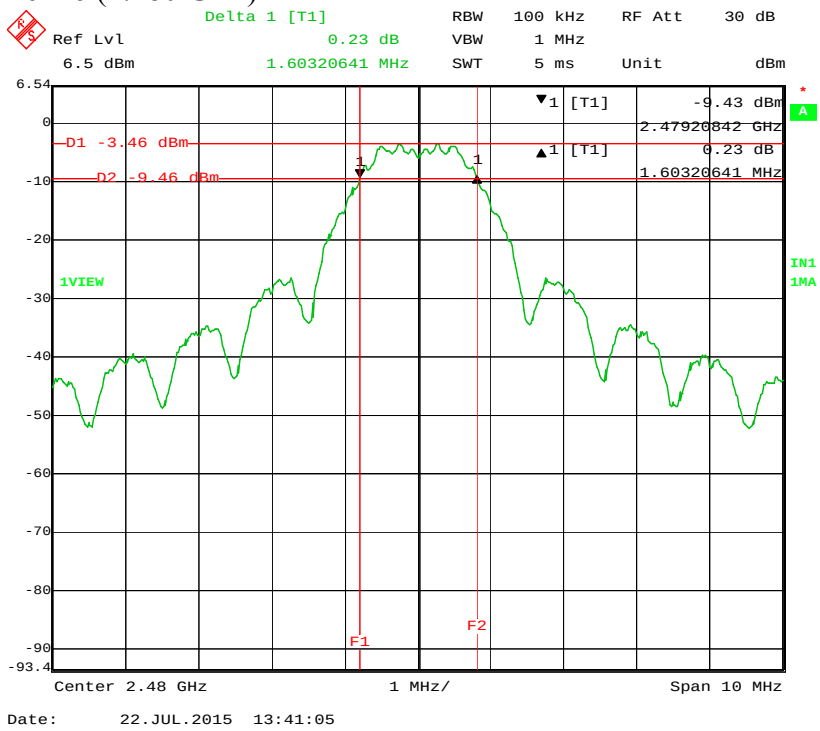
Antenna 1, Channel 11 (2.405 GHz)



Antenna 1, Channel 19 (2.445 GHz)



Antenna 1, Channel 26 (2.480 GHz)



4.3.4 6 dB Occupied Bandwidth Test Results (07/22/2015)

Antenna 0

Freq (GHz)	6 - dB Bandwidth (MHz)	Minimum Limit (MHz)	Margin (MHz)	Pass/Fail
2.4050	1.6032	0.5	-1.1032	Pass
2.4450	1.6032	0.5	-1.1032	Pass
2.4800	1.6032	0.5	-1.1032	Pass

Antenna 1

2.4050	1.6032	0.5	-1.1032	Pass
2.4450	1.6032	0.5	-1.1032	Pass
2.4800	1.6232	0.5	-1.1232	Pass

Results: The 6 dB, Occupied Bandwidth measurements for antenna 0 and antenna 1 of the ARRIS Model IP815 Set Top Box, are compliant with the limits specified in FCC Section 15.247(a)(2).

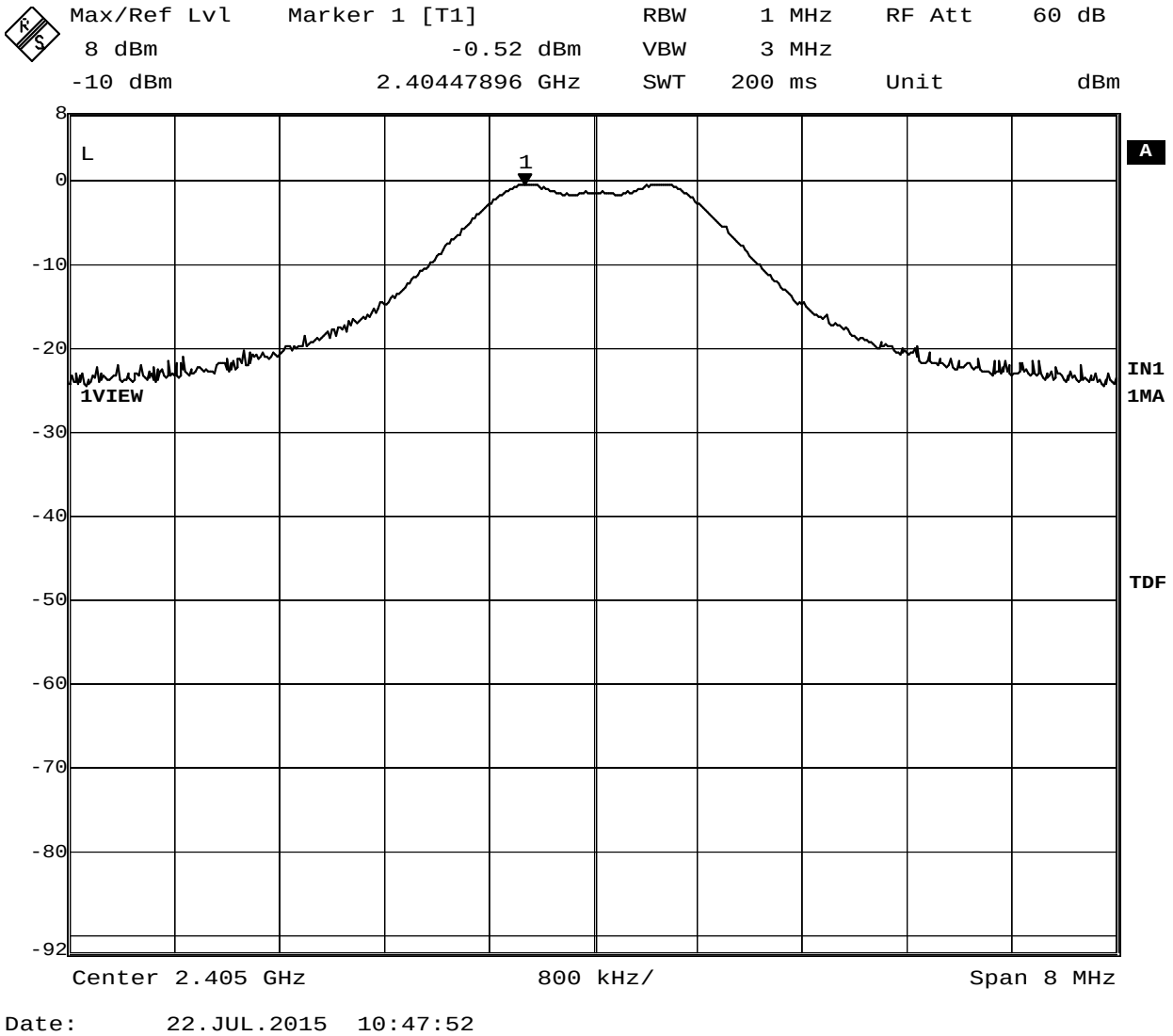
4.4 Maximum Peak Power Output FCC Section 15.247(b)(3)

4.4.1 Maximum Peak Power Output Test Procedure

A conducted power measurement of the output frequency was measured for both Antenna 0 and Antenna 1. The Antenna 0 and Antenna 1 were set individually to low (Channel 11), middle (Channel 19) and high (Channel 26). The signal output was maximized without modulation. Signal was measured with no modulation since the peak of the signal was higher when modulation was turned off.

4.4.2 Maximum Peak Power Output Analyzer Display Capture Example

Antenna 0, Channel 11 (2.405 GHz)



4.4.3 Maximum Peak Power Output Test Results (07/13/2015)

Antenna 0 w/mod

Frequency	Measured Level	Cable Loss	Total		Limit		Margin	
GHz	dBm	dB	dBm	Watts	dBm	Watts	dBm	Watts
2.405	-0.52	0.63	0.11	0.00103	30	1	-29.89	-0.99897
2.445	-1.02	0.63	-0.39	0.00091	30	1	-30.39	-0.99909
2.480	-0.67	0.63	-0.04	0.00099	30	1	-30.04	-0.99901

Antenna 1 w/mod

Frequency	Measured Level	Cable Loss	Total		Limit		Margin	
GHz	dBm	dB	dBm	Watts	dBm	Watts	dBm	Watts
2.405	0.2	0.63	0.83	0.00121	30	1	-29.17	-0.99879
2.445	-0.32	0.63	0.31	0.00107	30	1	-29.69	-0.99893
2.480	-0.14	0.63	0.49	0.00112	30	1	-29.51	-0.99888

Results: The Peak Power Output measurements for antenna 0 and antenna 1 of the ARRIS Model IP815 Set Top Box are compliant with the limits specified in FCC Section 15.247(b)(3).

4.5 Antenna Conducted Spurious Emissions FCC Section 15.247(d)

4.5.1 Antenna Conducted Spurious Emissions Test Procedure

A conducted power measurement of the output frequency was measured for both Antenna 0 and Antenna 1. The Antenna 0 and Antenna 1 were set individually to low (Channel 11), middle (Channel 19) and high (Channel 26). The signal output was maximized with modulation.

4.5.2 Antenna Conducted Spurious Emissions Test Results (07/22/2015)

Antenna 0

Channel	Freq (GHz)	Measured Level (dBm)	Cable Loss (dB)	Corrected Level (dBm)	Spurious Limit (dBm)	Margin (dB)	Pass/Fail
11	9.6092	-68.2	0.92	-67.28	-21.84	-45.44	Pass
11	12.0140	-67.93	1.92	-66.01	-21.84	-44.17	Pass
19	12.2060	-64	0.95	-63.05	-21.99	-41.06	Pass
26	9.9459	-63.43	0.95	-62.48	-23.23	-39.25	Pass
26	12.3988	-61.01	2.27	-58.74	-21.84	-36.9	Pass
	No other harmonics to 24 GHz						

Antenna 1

11	4.7996	-58.22	0.92	-57.3	-21.7	-35.6	Pass
11	12.0140	-67.26	1.06	-66.2	-21.7	-44.5	Pass
19	4.8960	-62.88	0.95	-61.93	-21.07	-40.86	Pass
19	9.7350	-57.54	1.95	-55.59	-21.07	-34.52	Pass
19	12.2060	-61.92	1.06	-60.86	-21.7	-39.16	Pass
26	4.8958	-66.56	0.95	-65.61	-21.7	-43.91	Pass
26	9.8016	-55.34	1.95	-53.39	-20.7	-32.69	Pass
26	12.2545	-58.49	1.06	-57.43	-21.7	-35.73	Pass
	No other harmonics to 24 GHz						

Results: The Antenna Conducted Spurious Emissions measurements for antenna 0 and antenna 1 of the ARRIS Model IP815 Set Top Box are compliant with the limits specified in FCC Section 15.247(d).

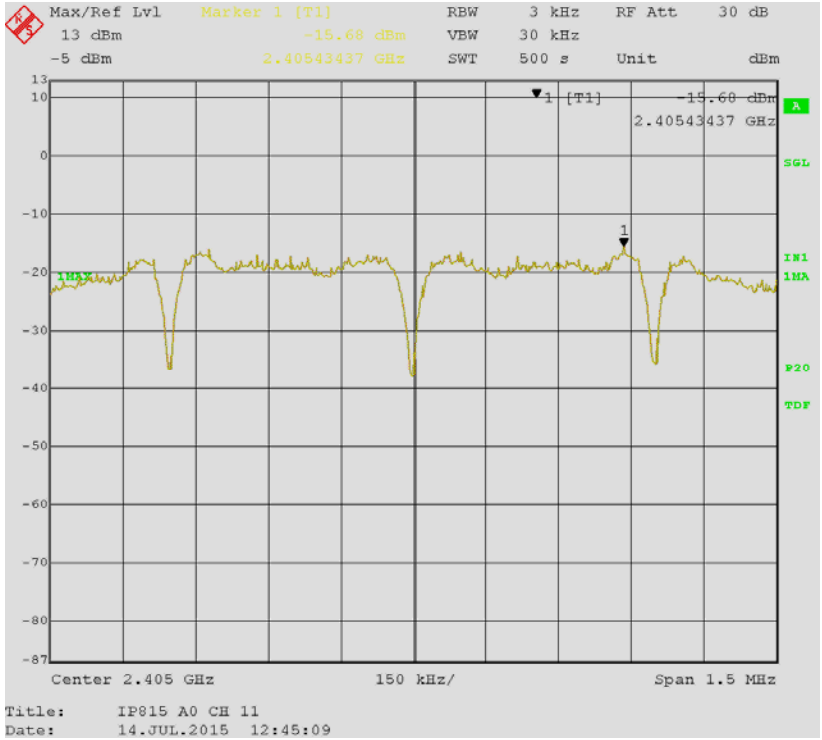
4.6 Power Spectral Density FCC Section 15.247(e)

4.6.1 Power Spectral Density Test Procedure

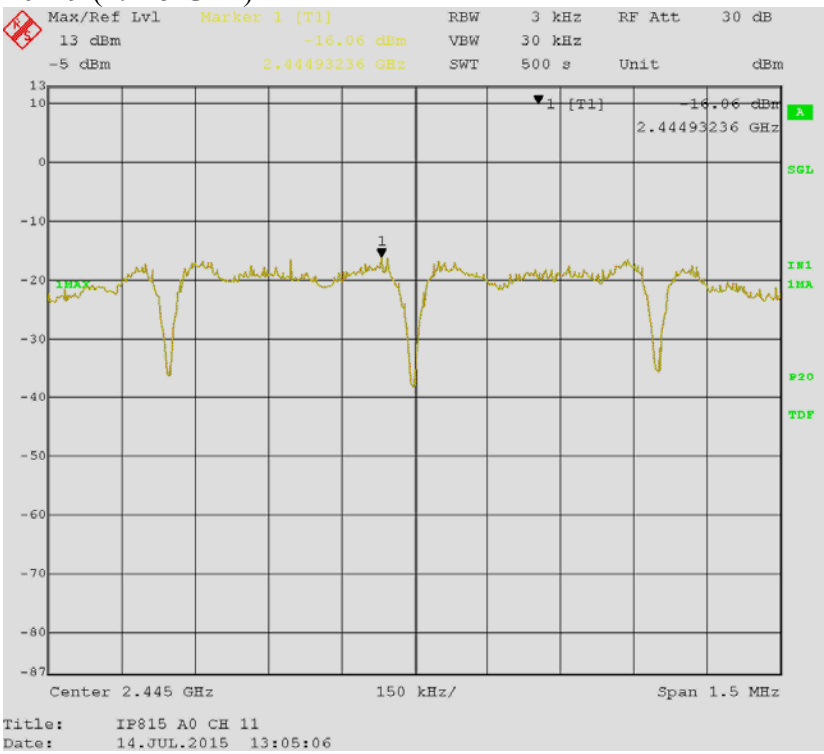
A conducted power measurement of the output frequency was measured for both Antenna 0 and Antenna 1. The Antenna 0 and Antenna 1 were set individually to low (Channel 11), middle (Channel 19) and high (Channel 26). The signal output was maximized with modulation.

4.6.2 Power Spectral Density, Antenna 0, Test Results (07/14/2015)

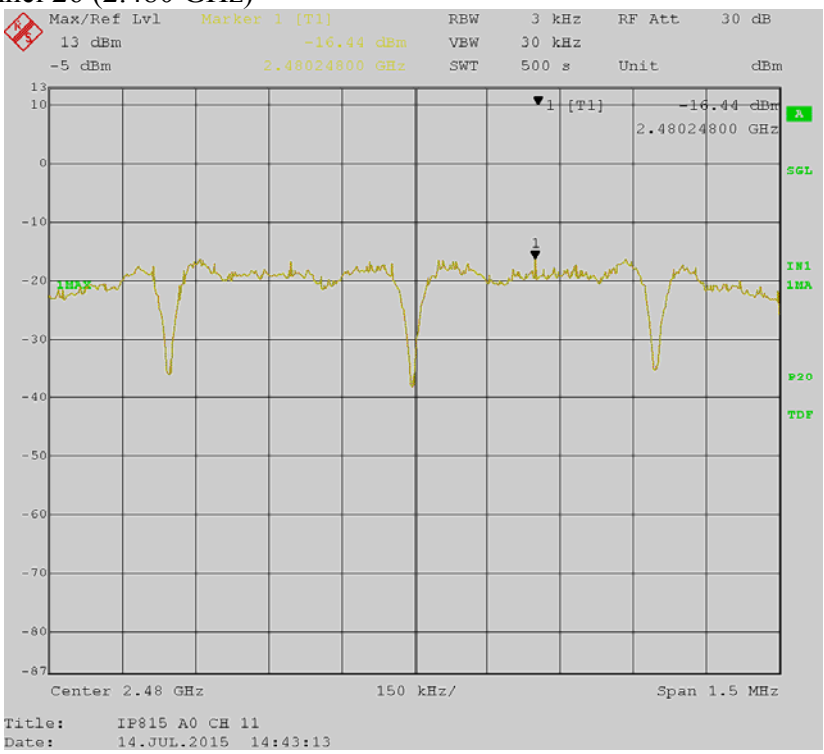
Antenna 0, Channel 11 (2.405 GHz)



Antenna 0, Channel 19 (2.445 GHz)

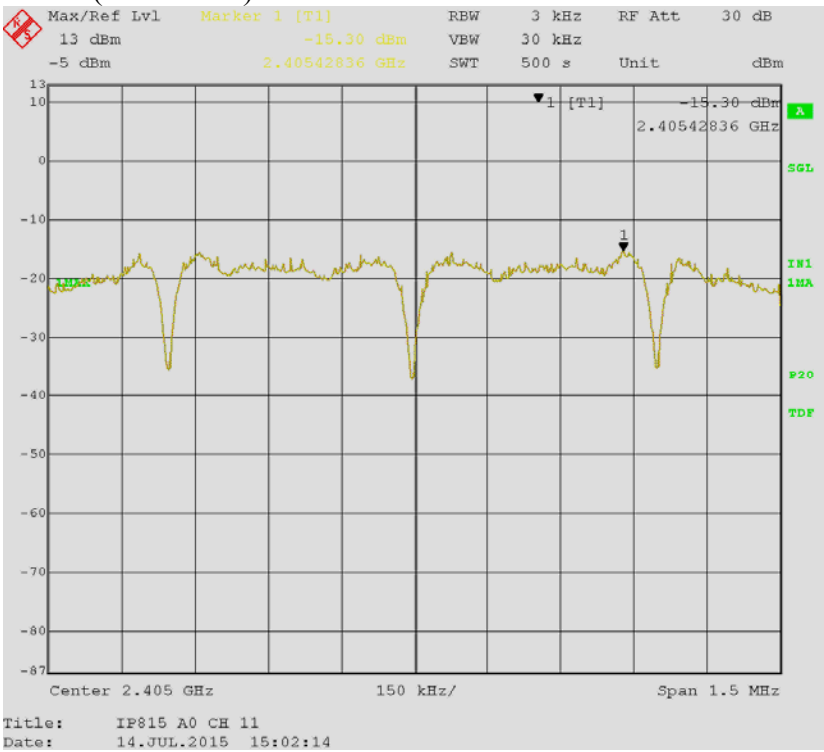


Antenna 0, Channel 26 (2.480 GHz)

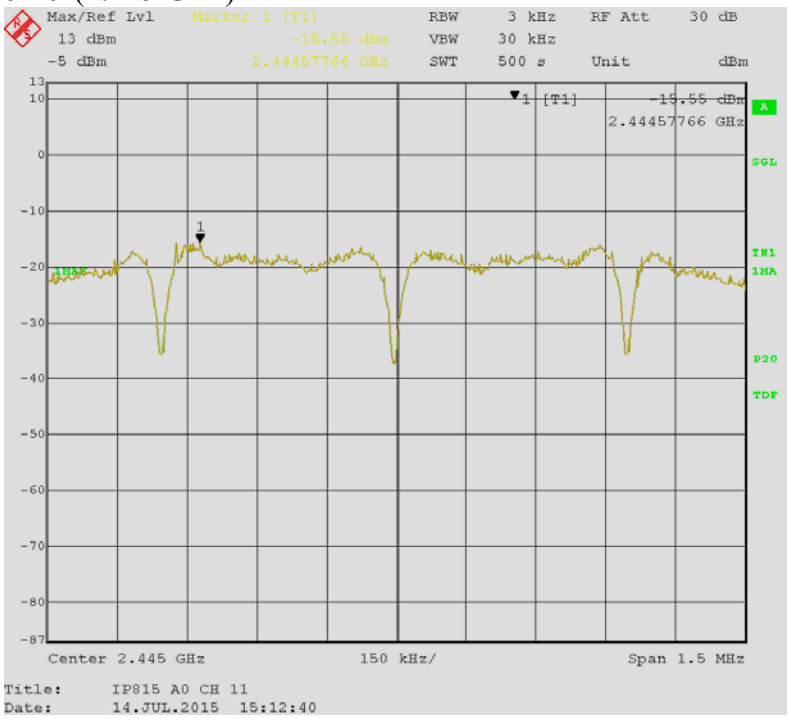


4.6.3 Power Spectral Density, Antenna 1, Test Results (07/22/2015)

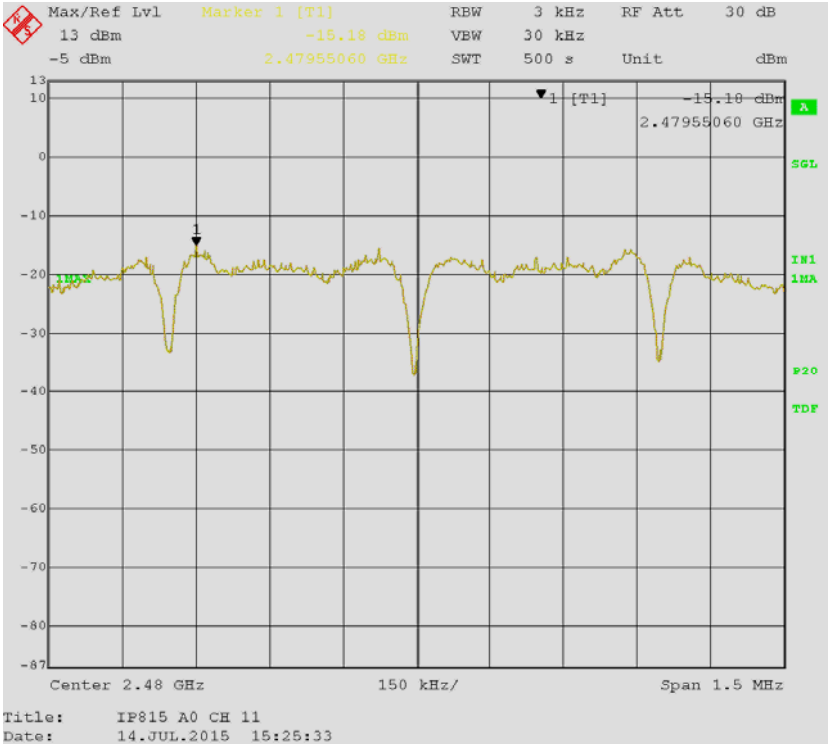
Antenna 1, Channel 11 (2.405 GHz)



Antenna 1, Channel 19 (2.445 GHz)



Antenna 1, Channel 26 (2.480 GHz)



4.6.4 Maximum Peak Power Output Test Results (07/22/2015)

Freq (GHz)	Measured Power Spectral Density (dBm)	Cable Loss (dB)	Total Power Spectral Density (dBm)	Power Spectral Density Limit (dBm)	Margin (dB)	Pass/Fail
Antenna 0						
2.4045	-15.68	0.63	-15.05	8	-23.05	Pass
2.4449	-16.06	0.63	-15.43	8	-23.43	Pass
2.4804	-16.44	0.63	-15.81	8	-23.81	Pass
Antenna 1						
2.4049	-15.30	0.63	-14.67	8	-22.67	Pass
2.4454	-15.55	0.63	-14.92	8	-22.92	Pass
2.4796	-15.10	0.63	-14.47	8	-22.47	Pass

Results: The measurement of Power Spectral Density for antenna 0 and antenna 1 of the ARRIS Model IP815 Set Top Box are compliant with the limits specified in FCC Section 15.247(e).

4.7 Band Edge Measurement FCC Section 15.247(d)

4.7.1 Band Edge Measurement Test Procedure

Band edge measurements were recorded on the EUT while operating with a modulated carrier at three frequencies (low middle and high) in the operating band of 2.4 GHz to 2.48 GHz. The measurement procedure used was the conducted output power method, where the antenna output port of the EUT was connected to the receiver input port for direct measurement.

The frequencies and associated channel numbers chosen for measurement were as follows:

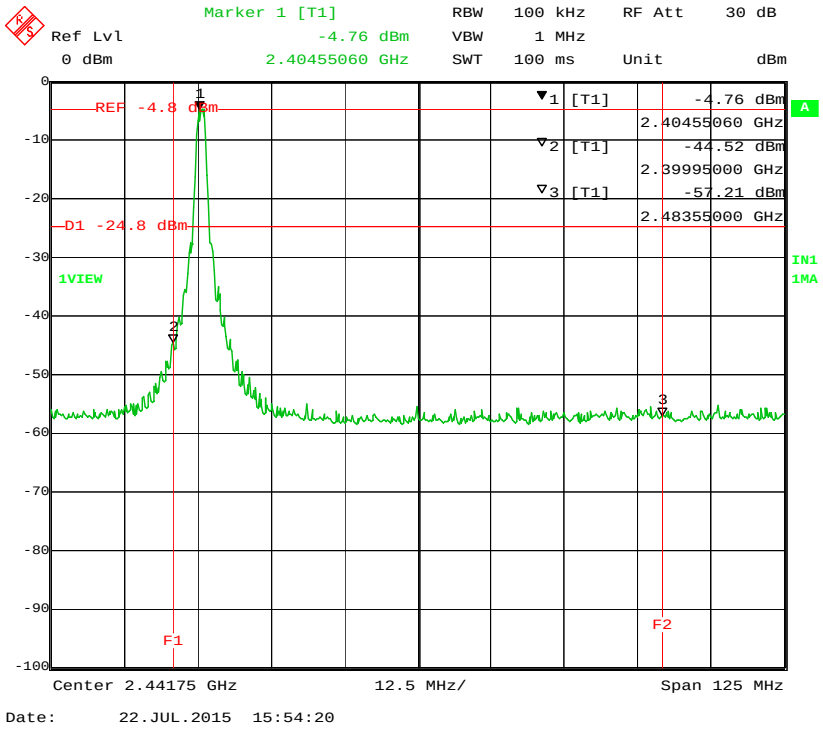
Channel	Frequency (GHz)
11	2.400
19	2.445
26	2.480

The data was recorded in three screen captures from the Spectrum Analyzer. Parameters particular to each measurement are as follows:

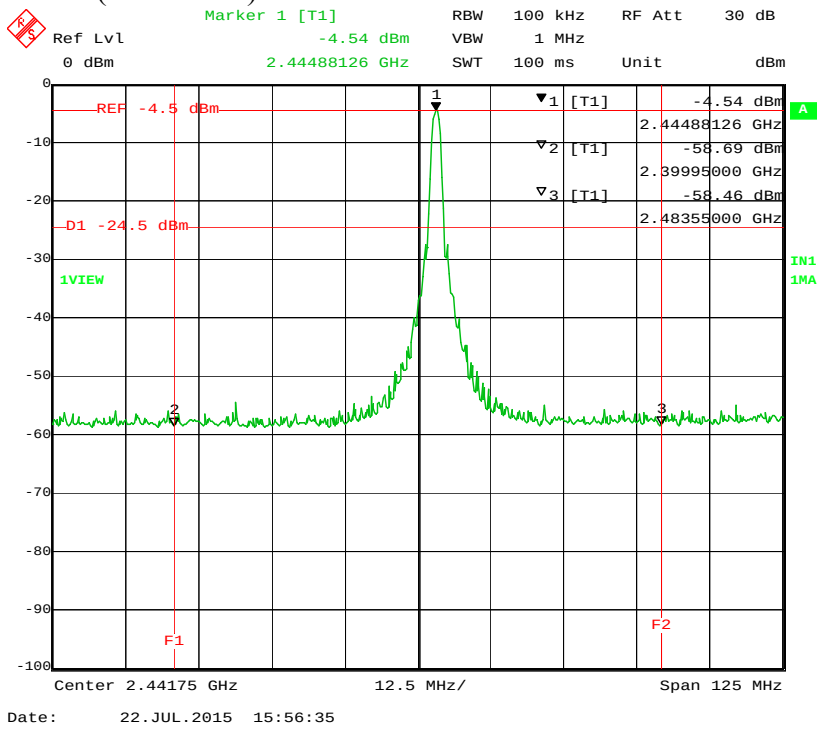
Center Frequency	
Resolution Bandwidth	100 kHz
Video Bandwidth	1 MHz
Span	125 MHz
Scale:	dBm
Reference Level:	0 dBm

4.7.2 Band Edge Measurement Analyzer Display Captures Antenna 0

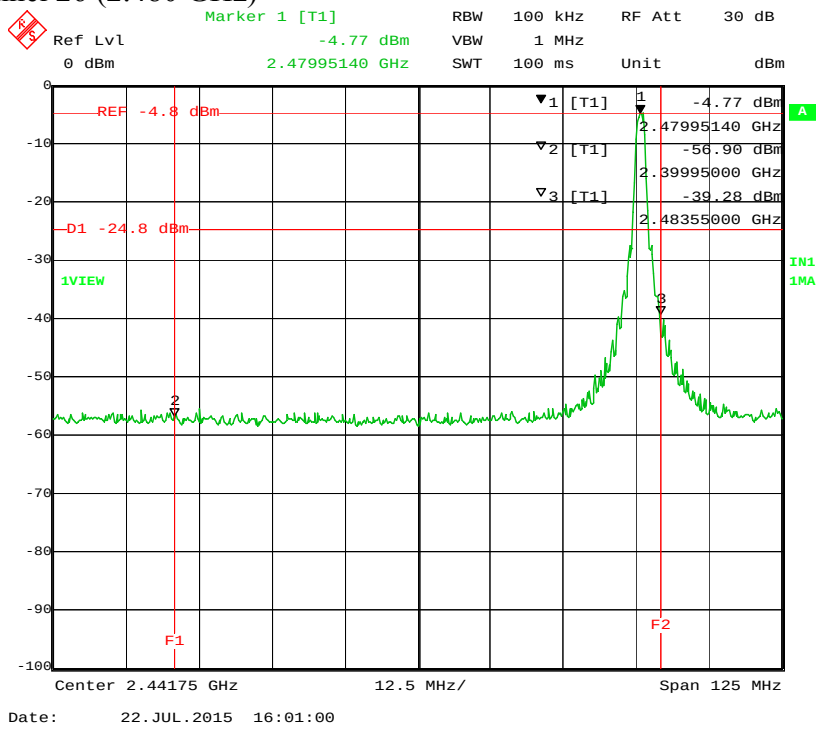
Antenna 0, Channel 11 (2.405 GHz)



Antenna 0, Channel 19 (2.445 GHz)

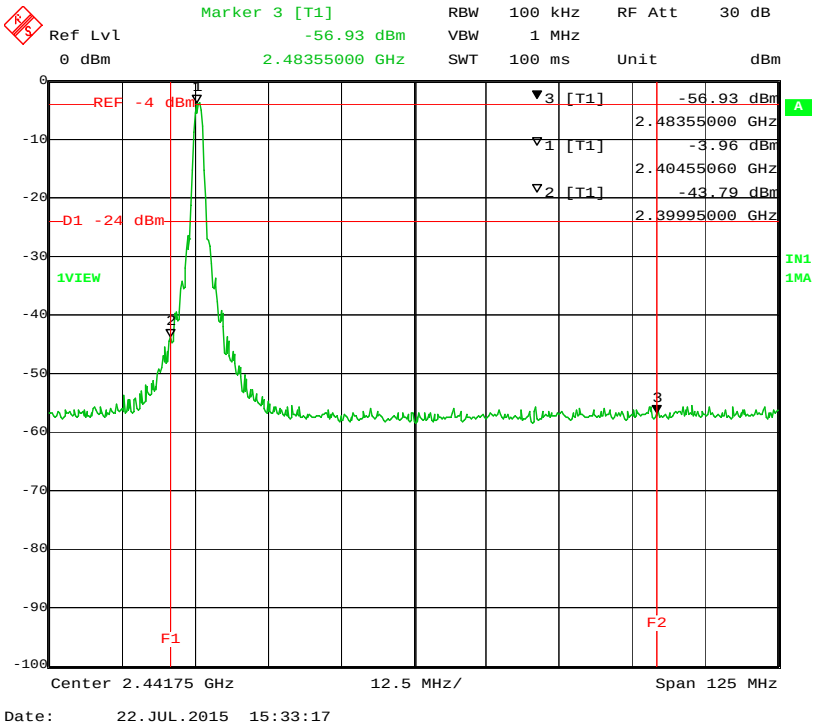


Antenna 0, Channel 26 (2.480 GHz)

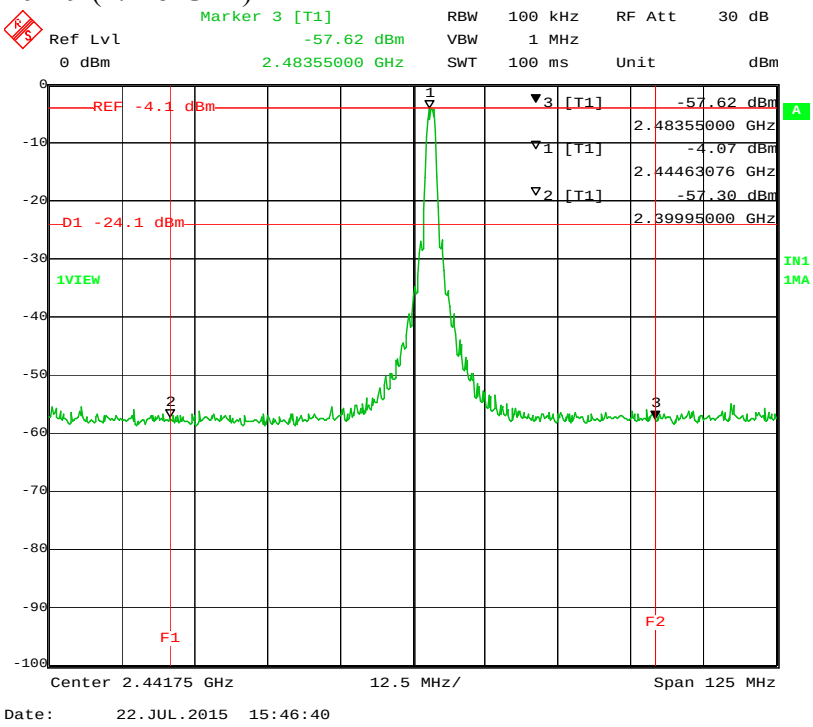


4.7.3 Band Edge Measurement Analyzer Display Captures Antenna 1

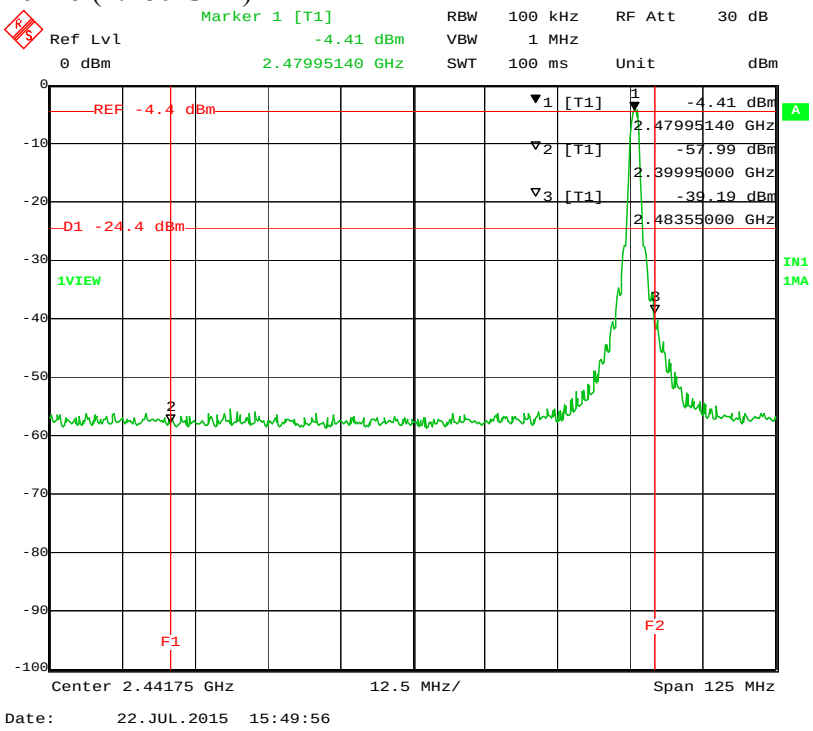
Antenna 1, Channel 11 (2.405 GHz)



Antenna 1, Channel 19 (2.445 GHz)



Antenna 0, Channel 26 (2.480 GHz)



4.7.4 Band Edge Measurement Test Data Results (07/22/2015)

Antenna 0

Channel	Measurement Frequency (GHz)	Peak Amplitude (dBm)	20 dB Limit	Lower Edge of Freq Band (GHz)	Upper Edge of Freq Band (GHz)	Lower Measured Freq (GHz)	Lower Measured Amplitude (dBm)	Upper Measured Frequency (GHz)	Upper Measured Amplitude (dBm)
11	2.4046	-4.76	-24.8	2.4	2.4835	2.39995	-44.52	2.48355	-57.21
19	2.4449	-4.54	-24.5	2.4	2.4835	2.39995	-58.69	2.48355	-58.46
26	2.48	-4.77	-24.8	2.4	2.4835	2.39995	-56.9	2.48355	-39.28

Antenna 1

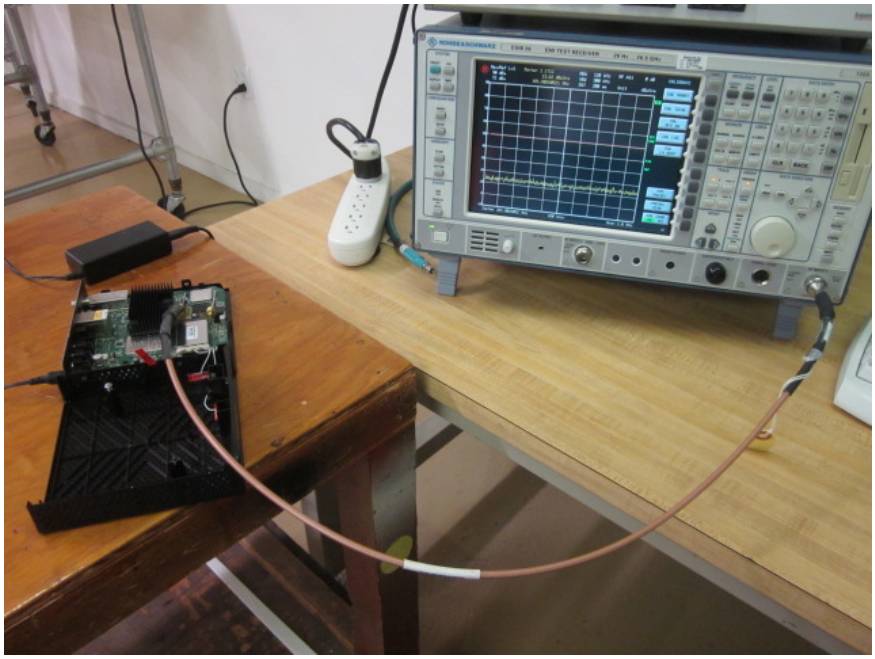
Channel	Measurement Frequency (GHz)	Peak Amplitude (dBm)	20 dB Limit	Lower Edge of Freq Band (GHz)	Upper Edge of Freq Band (GHz)	Lower Measured Freq (GHz)	Lower Measured Amplitude (dBm)	Upper Measured Frequency (GHz)	Upper Measured Amplitude (dBm)
11	2.4046	-3.96	-24	2.4	2.4835	2.39995	-43.79	2.48355	-56.93
19	2.4446	-4.07	-24.1	2.4	2.4835	2.39995	-57.3	2.48355	-57.62
26	2.48	-4.41	-24.4	2.4	2.4835	2.39995	-57.99	2.48355	-39.19

Results: The Band Edge measurements for antenna 0 and antenna 1 of the ARRIS Model IP815 Set Top Box are compliant with the limits specified in FCC Section 15.247(d).

5.0 Test Setup Pictures

5.1 Conducted Emissions Power Line Test Setup Picture

5.2 Conducted Emissions Antenna Test Setup Picture



5.3 Harmonic Radiated Emissions Test Setup Picture

Appendix A – Test Equipment

Equipment	Manufacturer	Model #	Serial #	BEC #	Calibration Date	Calibration Cycle	Calibration Due Date
Antenna (30 MHz - 6 GHz)	Sunol Sciences	JB6	A022108	712	04/25/14	2 Years	04/25/16
EMI Receiver (20 Hz – 26.5 GHz)	Rohde & Schwarz	ESIB 26	836119/006	1010	06/18/14	2 Years	06/18/16
9kHz-3GHz EMC Analyzer	Agilent	E7402A	US39440162	883	12/22/14	1 Year	12/22/15
Amplifier (.1 – 1300 MHz)	Hewlett Packard	8447F	2805A02896	1003	No Cal. Required	No Cal. Required	No Cal. Required
EMC Analyzer (9 kHz - 1.8 GHz)	Hewlett Packard	8591EM	3536A00746	821	10/14/14	2 Years	10/14/16
GTEM (30 MHz – 1 GHz)	ETS Lindgren	5317	1014	1001	No Cal. Required	No Cal. Required	No Cal. Required
Spectrum Analyzer (9 kHz - 40 GHz)	Hewlett Packard	8564E	3410A00129	769	08/07/12	3 Years	08/07/15
Amplifier System (0.5 – 50 GHz)	Hewlett Packard	83015A 83017A	3123A00360 & 3332A00219	1027	09/09/14	2 Year	09/09/16
Double Ridged Horn Antenna (1 - 18 GHz)	EMCO	3115	9705-5225	1028	10/08/14	2 Years	10/06/16
Antenna (18 - 26.5 GHz)	Hewlett Packard	84125-80008	N/A	1056	10/08/14	2 Years	10/08/16

EMI Receiver (9 kHz - 6.5 GHz)	Hewlett Packard	8546A	3325A00158	761	11/05/13	2 Years	11/05/15
Amplifier (.1 – 1300 MHz)	Hewlett Packard	8447F	3313A06658	807	No Cal. Required	No Cal. Required	No Cal. Required
Limiter	Hewlett Packard	11867A	01423	802	04/23/15	2 Years	04/23/17
LISN (9 kHz – 30 MHz)	EMCO	4825/2	9803-1047	750	04/12/15	2 Years	04/12/17
Shielded Room #1	ETS Lindgren	12-2/2-0	4078	859	12/16/13	2 Years	12/16/15
Intentional Radiator Testing High Frequency RF Test Cable	Workhorse	WHU18-3636-036	N/A	814	12/04/14	2 Years	12/04/16
OATS Site (30 MHz – 1 GHz)	BEC	N/A	N/A	705	05/07/15	1 Year	05/07/16
Temp/Humidity Meter	Control Company	4096	140055652	780	01/21/14	2 Years	01/21/16
Software (Tile Instrument Control System)	Quantum Change/EMC Systems	Version 3	N/A	N/A	No Cal. Required	No Cal. Required	No Cal. Required
Radiated Emissions Test Software	BEC	RADE	2.2	N/A	No Cal. Required	No Cal. Required	No Cal. Required